

**Appendix  
to the  
The Recover Team's Recommendations for  
Interim Goals and Interim Targets for the  
Comprehensive Everglades Restoration Plan**



**RESTORATION COORDINATION AND  
VERIFICATION (RECOVER)**

**COMPREHENSIVE EVERGLADES  
RESTORATION PLAN**

**CENTRAL AND SOUTHERN FLORIDA PROJECT**



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## Introduction

This document presents the appendix to the technical recommendations of the Restoration Coordination and Verification (RECOVER) Team for a set of Interim Goals and Interim Targets for the implementation of the Comprehensive Everglades Restoration Plan (CERP or the Plan). This appendix provides more detailed and technical information than that provided in the main Interim Goals and Interim Targets report. As called for in the CERP Programmatic Regulations (§ 385.38) (DOD 2003), RECOVER's technical recommendations are provided to the U.S. Army Corps of Engineers, the Department of the Interior, and the South Florida Water Management District for their consideration in developing an Interim Goals Agreement. RECOVER's technical recommendations for Interim Targets are provided to the U.S. Army Corps of Engineers and the South Florida Water Management District (§385.39). The complete CERP Programmatic Regulations can be downloaded from the following web page: [http://www.evergladesplan.org/pm/progr\\_regs\\_final\\_rule.cfm](http://www.evergladesplan.org/pm/progr_regs_final_rule.cfm)

This appendix provides background and technical information for the Interim Goals and Interim Targets. The sections include a brief history and authority for the development of the Interim Goals and Targets, a brief description of the revision process, descriptions and definitions of both the Interim Goals and Interim Targets, tables summarizing the indicators for each, a discussion of the uncertainty associated with indicator predictions, responses to peer review comments, a list of acronyms used, and a list of preparers. The remainder of the appendix contains the indicator documentation sheets describing the technical aspects of each Interim Goal and Target.

## History and Authority

The Central and Southern Florida (C&SF) Project Comprehensive Review Study, known as the Restudy, was authorized by Section 309(l) of the Water Resources Development Act (WRDA) of 1992. Section 528 of WRDA 1996 provided additional direction and guidance for the Restudy.

The Restudy's purpose was to reexamine the C&SF Project to determine the feasibility of modifying the project to restore the South Florida ecosystem and provide for other water-related needs of the region, including water supply and flood protection.

Planning goals and study objectives were developed to sharpen the Restudy's intent and focus. It is these goals and objectives that guided the development of the CERP and now guide its implementation, including the development of these recommendations for Interim Goals and Interim Targets. These goals and objectives are as follows:

Goal: Enhance Ecologic Values

- Increase the total spatial extent of natural areas
- Improve habitat and functional quality
- Improve native plant and animal species abundance and diversity

Goal: Enhance Economic Values and Social Well Being

- Increase availability of fresh water (agricultural/municipal and industrial)
- Reduce flood damages (agricultural/urban)
- Provide recreational and navigation opportunities
- Protect cultural and archeological resources and values

The final feasibility report for the Restudy (USACE and SFWMD 1999) was transmitted to Congress on July 1, 1999. Through the enactment of WRDA 2000, Congress approved the CERP as a framework for structural modifications and operational changes to the C&SF Project needed to restore the South Florida ecosystem.

Section 601(h) of WRDA 2000 represents the assurances provision for CERP implementation and called for Programmatic Regulations to be developed to ensure that the goals of the CERP are achieved. The goals and purposes of the CERP are defined in the Programmatic Regulations as “the restoration, preservation, and protection of the South Florida ecosystem while providing for other water-related needs of the region, including water supply and flood protection.” Restoration is further defined as the “recovery and protection of the South Florida ecosystem so that it once again achieves and sustains those essential hydrological and biological characteristics that defined the undisturbed South Florida ecosystem.”

The Programmatic Regulations require the establishment of an Interim Goals Agreement to “facilitate interagency planning, monitoring, and assessment so as to achieve the overarching objectives of the Plan,” and that RECOVER shall recommend a set of Interim Goals for implementation of the Plan. The regulations also require that RECOVER shall recommend a set of Interim Targets for evaluating progress towards other water-related needs.

### **Description and Definition of Interim Goals**

The CERP was designed to eliminate or substantially moderate hydrologic and certain water quality stressors that have degraded the natural system (quantity, quality, timing, and distribution of water.) Significant and substantial environmental benefits are expected as a result of CERP implementation, although it was acknowledged that the predicted performance of the currently approved Plan does not equate to a totally restored South Florida ecosystem. The Interim Goals are designed to measure progress toward those environmental benefits expected through CERP implementation. Through more detailed planning and design, and the adaptive management program, it is thought that the environmental benefits expected from the CERP will increase and bring us closer to our desired restoration condition. Additionally, other factors have an effect on the ecosystem (e.g., proliferation of invasive exotic species) that the CERP was not designed to correct.

Interim Goals are defined in the Programmatic Regulations as “*a means by which the restoration success of the Plan may be evaluated throughout the implementation process.*” Interim Goals provide a means of tracking the performance of the Plan toward achieving expected environmental benefits, as well as a basis for reporting at specified intervals of time

on progress made towards restoration of the South Florida ecosystem. Furthermore, Interim Goals allow for periodic evaluation of the accuracy of predictions of system responses to the effects of the Plan.

The Interim Goals are predictions of ecosystem response to the implementation of CERP projects, and reflect incremental accomplishments towards achieving CERP goals. Evaluations of the anticipated hydrologic and water quality changes in the South Florida ecosystem brought about by CERP implementation, with the attendant ecological responses, provided the basis for the RECOVER recommendations for Interim Goals.

### **Description and Definition of Interim Targets**

Interim Targets are predictions of system response to the implementation of CERP projects, and reflect progress towards achieving CERP goals. Evaluations of the anticipated hydrologic changes in South Florida brought about by CERP implementation provided the basis for the RECOVER recommendations for Interim Targets.

Interim Targets are defined in the Programmatic Regulations as *“a means by which the success of the Plan in providing for other water-related needs of the region, including water supply and flood protection, may be evaluated throughout the implementation process.”* Interim Targets provide a means of tracking Plan performance, as well as a basis for reporting on the progress made at specified intervals of time towards providing for other water-related needs, and for periodically evaluating the accuracy of predictions of system responses to the effects of the Plan.

### **Revision Process**

As stated in the Programmatic Regulations, the agreed upon Interim Goals and Targets will be reviewed at least every five years to determine if they should be revised. Any revisions will undergo the same development and agreement process as the initial Interim Goals and Targets. Revisions will incorporate new information, improved prediction capabilities, and improved understanding of the ecosystem and its relationships, resulting in a set of goals that improve over time and a refinement of the expected benefits of the Plan. This process will also permit new Interim Goals and Targets to be incorporated as warranted. Revisions to the Interim Goals and Targets will also be made in response to changes in implementation sequencing, changes in the design and operation of the Plan, and changes resulting from adaptive management.

### **Indicators of CERP Restoration Success**

Interim Goals are designed to establish incremental milestones to evaluate progress toward the expected level of performance of the Plan. Interim Goals represent predictions of achievements in the natural system during the implementation of the CERP and are defined by

indicators that are assessed using measurable parameters with quantitative targets, or they may be assessed as trends, i.e., directions of change. The list of indicators for Interim Goals has been grouped by three general categories: hydrologic, water quality, and biological indicators. Interim Goal indicators are listed in Table A-1.

**Table A-1.** List of Recommended CERP Interim Goal Indicators

1.1 American Oysters in Northern Estuaries
1.2 Submerged Aquatic Vegetation in Northern Estuaries
2.1 Lake Okeechobee Phosphorus
2.2 Water Levels in Lake Okeechobee
2.3 Lake Okeechobee Algal Blooms
2.4 Lake Okeechobee Aquatic Vegetation
3.1 Water Volume
3.2 Sheet Flow in Natural Areas
3.3 Hydropattern
3.4 System-Wide Spatial Extent of Habitat
3.5 Everglades Wetlands Total Phosphorus
3.6 Periphyton Mat Cover, Structure, and Composition
3.7 Ridge and Slough Pattern
3.8 Everglades Tree Islands
3.9 Aquatic Fauna Regional Populations in Everglades Wetlands
3.10 American Alligator
3.11 System-wide Wading Bird Nesting Patterns
3.12 Snail Kite
4.1 Salinity Patterns in Florida and Biscayne Bays
4.2 Submerged Aquatic Vegetation in Southern Estuaries
4.3 Juvenile Shrimp Densities in Florida and Biscayne Bays
4.4 American Crocodile
4.5 Florida Bay Algal Blooms

The team selected indicators from a broad set of stressors and attributes found in the set of South Florida conceptual ecological models that are described in Appendix A of the *CERP Monitoring and Assessment Plan: Part 1 Monitoring and Supporting Research* (RECOVER 2004a). Each regional conceptual ecological model identifies the major hydrologic and chemical stressors in a landscape type within South Florida (e.g., St. Lucie Estuary, Everglades Ridge and Slough) and describes the major effects of these stressors on a set of biological attributes. Because the CERP will modify hydrology and water quality (stressors), indicators that pertain to each ecological region were included for both stressors and attributes. A primary criterion for the selection of indicators was whether that indicator is expected to be highly responsive to the CERP, that is, the indicator is a component of the natural system that the CERP is designed to influence. In addition, indicators that represent short-term,

intermediate, and long-term responses are represented as they are based on the variable response time to changes in hydrology and water quality. Physiological variables represent short-term indicators, population variables are considered intermediate indicators, and community-level variables are considered long-term indicators.

### **Evaluating Progress Towards Other Water-Related Needs of the Region**

Interim Targets are designed to establish incremental milestones to evaluate progress toward the expected level of performance of the Plan. Interim Targets represent predictions of achievements of other water-related needs of the region due to CERP implementation and are defined by indicators that are assessed using measurable parameters with quantitative criteria. The list of indicators for Interim Targets fall into three general categories: hydrologic, water supply, and flood protection. Interim Target indicators are listed in Table A-2. Together, the Interim Targets represent the expected benefits of the Plan for other water-related needs and are consistent with the goals and purposes of the CERP as described above.

**Table A-2.** List of Recommended CERP Interim Target Indicators

5.1 Water Volume
5.2 Water Supply for Lower East Coast Service Area
5.3 Water Supply for Lake Okeechobee Service Area
5.4 Protect Biscayne Aquifer from Saltwater Intrusion
5.5 Protect Southern Portion of Biscayne Aquifer from Saltwater Intrusion
5.6 Flood Control: Root Zone Groundwater Levels in South Miami-Dade Agricultural Area East of L-1N
5.7 Flood Control: Groundwater Stages for Miami-Dade, Broward, and Palm Beach Counties, and Seminole Tribe Surface Water Management Basins
5.8 Flood Control: Flood Water Removal Rate for Everglades Agricultural Area

### **Current Uncertainty Associated with Indicator Predictions**

The Interim Goals and Targets presented in this initial RECOVER report must be viewed as a preliminary set of expectations for performance by a key group of CERP indicators. These Interim Goals and Targets will be substantially revised and improved as better understandings of the relationships among hydrological conditions and ecological responses are achieved over the coming years of CERP monitoring, and as improved tools for predicting system responses are developed. It is particularly difficult during this early stage of CERP implementation for the RECOVER technical teams to estimate or predict responses by a set of key indicators in the absence of developed and tested ecological models, and while lacking an adequate representation of predictions of hydrological responses at five-year intervals during the full extent of CERP implementation.

Under these circumstances, the RECOVER teams consider it important that the users of this report understand the limitations of this initial set of Interim Goals and Targets. In striving to maintain high standards of science in supporting the CERP, the RECOVER teams have been careful to not exceed the boundaries of good science by creating predictions that are not supported by adequate understandings of ecological and biological relationships in the natural system, or that lack appropriate model outputs that can provide a temporal and spatial framework for predicting or estimating indicator responses at specific intervals during CERP implementation.

In the absence of models, the RECOVER teams have relied heavily on the best science that is currently available to the teams of experts for developing many of the Interim Goals and Targets for the initial report. The initial predictions and expectations in most cases are based on considerations of the direction of ecological and biological changes that are necessary for meeting the desired restoration endpoints called for by the CERP performance measures, and on current understandings of potential response patterns associated with improved hydrological patterns. Predictions of response patterns by the selected indicators are largely derived from the working hypotheses used to create the conceptual ecological models of the major natural system landscapes of South Florida (Appendix A of RECOVER 2004a). For those indicators where current hypotheses are weakest, and therefore do not provide for confident estimates of the rates and patterns of indicator responses, the initial Interim Goals may be more theoretical than real. These initial goals should be considered as placeholders for the refined and improved predictions of Interim Goals and Targets that will emerge as improved understandings accumulate between now and the next Interim Goal and Target reporting period.

Although the ability to develop many of the Interim Goals and Targets is limited at this time for the reasons presented above, the RECOVER team recommends the inclusion of the full set of recommended biological and ecological indicators in the initial report, as a means for focusing attention on the indicators that may be most useful for tracking progress towards the system-wide ecosystem restoration objectives of the CERP, and for identifying those attributes of the natural and human systems that should receive priority for ongoing and future monitoring, research, and modeling. The RECOVER view is that while it may not be possible in the initial report to confidently provide quantitative predictions of performance at specific intervals, all indicators should be included as a means for providing an initial perspective on the performance of the suite of indicators that collectively will show progress by the CERP, and also to show where RECOVER stands in being able to develop predictions for each of the key indicators.

Several general types of uncertainty can affect predictions of Interim Goals and Interim Targets. The sources of uncertainty discussed here are associated with 1) modeling, 2) scheduling, 3) environmental variability, and 4) geopolitical change.

## **Model Uncertainty**

Although the uncertainty of the landscape-scale models currently used for CERP Interim Goals and Targets can be large, it has been well documented (Sklar and Hunsaker 2001, Lall et al. 2002). A generalized understanding of different landscape models suggests that despite a diversity of approaches, uncertainty resides within five components of the modeling exercise. These “errors” can be traced to problems associated with 1) data collection, 2) model structure, and 3) natural variability. Reducing these uncertainties may be as simple as taking multiple environmental samples for better calibration, or as complex as running a simulation a thousand times to better understand the impacts of stochastic events such as hurricanes or fires (Sklar and Hunsaker 2001).

Every landscape model requires a map of initial conditions: a point in time and a description of the space where the model begins. However, it is rare to find a situation where a complete set of appropriately scaled landscape maps can be found for initialization. A very heterogeneous Everglades landscape represented by only a few data points are the ingredients for extreme initialization error. All models used for predicting Interim Goals and Targets have an uncertainty associated with spatial interpolation of point data, the number and distribution of point data, the complexity of the landscape, and the basic lack of understanding of ecological relationships.

Model structure also has an uncertainty such that the scale of simulated events do not always match the scale of events of the data used by the model or the information needed by the user to make predictions (Sklar et al. 1990). This mismatching of scales will most often produce uncertainties associated with model conclusions. Unfortunately, errors associated with mismatching of scales are not easy to identify. These types of uncertainties can only be avoided by careful peer review and clearly defining and bounding the model objectives.

In general, the more complex the model structure, the greater the total variation of both observational and simulated data, and the less accurate (more uncertain) the predicted Interim Goals (Costanza and Sklar 1985). The real effectiveness or explanatory power of a model is a function of both how much it attempts to explain (complexity) and how well it explains what was attempted (accuracy). There is an optimum size or complexity beyond which the “benefits” of additional complexity are outweighed by the “costs” of lowered accuracy (Costanza and Sklar 1985).

## **CERP Scheduling**

The uncertainties associated with the CERP schedule, things that can alter project start and end dates, may include unanticipated legal constraints and lawsuits, construction delays, contractual bottlenecks associated with land purchases, feasibility studies and new technologies, and the overall bureaucratic complexity associated with the management of a very large restoration program that is shared by several government agencies. Interim Goals and Targets will assume a particular sequence of CERP projects (i.e., Alternative D13R), as

well as, a construction period for each project and a specific “benefit” associated with each project. Any change in any one of these can alter the timing and effectiveness of restoration. This will, in turn, affect the five-year intervals of predicted Interim Goals and Targets. Unfortunately, it is unknown just how much an Interim Goal or Target may shift when sequencing is altered. Clearly, any schedule change to a project that is directly influencing the volume, flows, or quality of the water to the natural system, will noticeably alter any predictions associated with hydrologic and water quality Interim Goals and Targets. However, schedule shifts may also noticeably alter predictions associated with the indirect biological Interim Goals.

### **Environmental Variability**

The stochastic nature of nature is probably the largest source of any uncertainty that is associated with Interim Goals and Targets. As with CERP scheduling, Interim Goals and Targets will assume a particular weather and rainfall pattern. Since the ecosystem is affected by rainfall, runoff, hurricanes, freezing temperatures, droughts, and floods, it is very certain that our predicted Interim Goals and Targets will not exactly match reality. To account for this uncertainty, every five years we will rerun all the models used to predict the Interim Goals and Targets with the currently approved or updated CERP and all the real, updated weather and rainfall data. These “new” Interim Goals and Targets will then be compared with observations in the ecosystem to see if it is responding as expected and to make sure that restoration is proceeding in the appropriate direction.

### **Geopolitical Change**

Very few people would argue that large-scale economic and social, or geopolitical, events will not influence large-scale projects such as the CERP. The majority would agree that war, terrorists, bankruptcies, and recessions may alter resource allocations and the political will to design, construct, and complete all 50, or so, CERP projects. These realities will need to be tracked and accounted if they are found to influence our ability to schedule and complete projects, particularly those that influence predicted goals and targets. Of all the uncertainties, geopolitical change is the most unknowable. However, to produce Interim Goals and Targets we must assume geopolitical stability.

## **Responses to Peer Review Comments**

After indicators and predictive methods were selected for Interim Goals and Targets, the U.S. Army Corps of Engineers contracted Battelle Memorial Institute to facilitate an independent scientific peer review of the April 19, 2004 draft document entitled *Recommendations for Interim Goals for the Comprehensive Everglades Restoration Plan* (RECOVER 2004b). A panel of seven scientists reviewed the document and provided oral comments during a workshop on May 3, 2004, and written comments as a follow up to that meeting (Swiecichowski 2004). All review comments were compiled into a document that is available

on the CERP web page [http://www.evergladesplan.org/pm/recover/recover\\_docs/igit/122804\\_rec\\_igit\\_peer\\_report.pdf](http://www.evergladesplan.org/pm/recover/recover_docs/igit/122804_rec_igit_peer_report.pdf) The scientific peer review panel will conduct a final review of the Interim Goals and Targets in 2005 and recommendations will be incorporated during future efforts to develop and revise the Interim Goals and Targets.

The following is a summary of the peer review comments and responses:

### **Linkage between goals and targets**

#### Do not separate Interim Goals and Targets

We could not fully integrate the Interim Goals and Interim Targets because separate agreements are required by the Programmatic Regulations (33 CFR 385.38). However, with the intention of describing that CERP will provide benefits for both ecological and other water resource-related needs, we discussed indicators for Interim Goals and Interim Targets in the Foreword section of this document.

#### Describe trade-offs between Interim Goals and Targets

The Interim Goals and Targets were produced through the use of hydrologic simulations based on one plan for restoration of the South Florida ecosystem. No alternative hydrologic simulations were made to quantify potential trade-offs. Trade-off analyses were not performed as part of this effort because the CERP was purposefully designed to provide benefits for the natural system and human-related needs. Therefore, we did not include a discussion of trade-offs between Interim Goals and Interim Targets.

#### Maintain consistency between Interim Goals and Targets

The document was revised to maintain consistency between Interim Goals and Interim Targets.

### **Tell a comprehensive “story”**

#### Develop a storyline

Authors of the Interim Goals and Interim Targets document took these comments very seriously and attempted to “tell the story” by revising the document’s structure and language. This was primarily accomplished by organizing the document into regional modules that provide brief summaries of their respective regions, including information on the important indicators of restoration success and description of how regional CERP projects were likely to improve those indicators. In addition, the introduction of the document was revised to increase readability for a non-technical audience. At the same time, the document maintains a high level of scientific and technical specificity through inclusion of a scientific appendix.

#### Include project level objectives

Each regional module includes a list and brief description and list of objectives for the projects affecting that region.

Add Master Implementation Sequencing Plan (MISP) and link to individual CERP projects

We used modeling from the initial development (Restudy) of the CERP to predict Interim Goals and Interim Targets. These model results used the initial sequence of CERP projects that is described in Section 10 of the Restudy final feasibility report (USACE and SFWMD 1999) ([http://www.evergladesplan.org/docs/comp\\_plan\\_apr99/sect10.pdf](http://www.evergladesplan.org/docs/comp_plan_apr99/sect10.pdf)); therefore, the MISP (<http://www.evergladesplan.org/pm/misp.cfm>) was not used for predicting goals and targets in this document. Interim Goals and Targets will be based on the MISP after new model simulations become available.

Tie the indicators to broad classes of system functions

Generally, the regional modules describe how the major hydrologic stressors affect specific indicators and why the indicators are important. The appendix includes indicator documentation sheets that provide more specific information on the importance of each indicator and why each indicator is representative of a specific ecosystem function.

Include working hypotheses

While not always explicitly stated, working hypotheses are found in the indicator documentation sheets for each indicator.

Provide a better big picture view

We attempted to bring this “big picture” view to the document in the new Foreword and following regional module sections. These sections describe the entire South Florida ecosystem and the various ways that humans, stochastic environmental events, and water management affect the ecosystem.

Group indicators to help form a story

Each regional module was organized to describe how hydrologic changes were expected to affect each of the indicators. Effects to indicators were described together. For example, salinity-based indicators were described relative to their potential to affect oysters and seagrasses.

Include human demands and population growth as part of the story

This information was included in the water supply module of this document.

**Better define terms and concepts and reformat document**Include a summary table of the Interim Goals and Targets

A summary table for Interim Goals and Interim Targets is provided as part of the Executive Summary.

Clearly define all terms in the document

All acronyms have been clearly defined, but defining all terms was beyond the scope of the document. We attempted to minimize the use of acronyms and define confusing terminology.

Assure consistency of justification, goal statements, etc. in documentation sheets

Indicator documentation sheets have been reviewed and revised to provide as much consistency as possible between indicators.

Rewrite the document so that it can be read by a scientist or layperson

The document has been revised to be readable by a scientist or layperson.

Provide all necessary documentation within (appendix) the document

The scientific appendix includes all relevant documentation.

**Recommendations regarding indicators**Provide baseline historical data and variability for each indicator

Whenever possible, scientists provided historical baseline data and variability for indicators. For some indicators, these data were not always available. Moreover, appropriate baseline data, associated with restoration targets, were sometimes not available because significant impacts to the South Florida ecosystem occurred before thorough ecological investigations were implemented. All of the indicators used for Interim Goals and Interim Targets are discussed in the *CERP Monitoring and Assessment Plan: Part I Monitoring and Supporting Research* (RECOVER 2004a) and additional baseline data and estimates of parameter variability can be found there. In other cases, scientists did not have predictive models for use in developing Interim Goals and Interim Targets; therefore, predictions were not based on the actual indicator, but on some aspect of hydrologic suitability for the indicator.

Review and use US Environmental Protection Agency criteria for indicator selection

We did not use US Environmental Protection Agency criteria for indicator selection. Indicators for Interim Goals and Interim Targets were developed as a subset of indicators that were previously screened by other CERP planning teams for use in a predictive manner for project planning and in for assessment through the *CERP Monitoring and Assessment Plan: Part I Monitoring and Supporting Research* (RECOVER 2004a). Moreover, the scientific relevance of Interim Goals and Interim Targets indicators was previously established through the development of conceptual ecological models. These models were established using a consensus-based process with the collective knowledge and understanding of many established ecologists in South Florida. Other factors were used for selection such that the indicators should fulfill the following criteria:

- Be consistent with the goals and purposes of the CERP
- Address the physical and biological aspects of the Plan
- Be consistent with the *CERP Monitoring and Assessment Plan: Part I Monitoring and Supporting Research* (RECOVER 2004a) and the draft *CERP System-wide Performance Measures* (RECOVER 2004c)

- Be predictable and easily interpreted

In addition to these criteria, the subteam also considered other factors including the following:

- The need to maintain balance among physical stressor-based indicators and biological attribute-based indicators
- The need to have indicators from all regions of South Florida affected by the Plan
- The need to have enough indicators to adequately track representative responses for the major goals of the Plan without having so many as to be duplicative of the key goals
- The need to have indicators that represent different response times (i.e., both short-term and long-term responses to the affects of CERP implementation)

The RECOVER team considered many more indicators than have been included in these final recommendations. Some of these indicators were excluded because they were not considered to represent a broad class of ecosystem functions or because an alternative indicator was considered to be a better representative. Others were considered to be good representatives of ecosystem health generally, but were thought to be too dependent on non-CERP efforts. Still others that satisfied these tests and were considered to be good indicators of CERP success had no available prediction methods and scientists did not anticipate having these prediction methods in the near future. The Programmatic Regulations permit the Interim Goals and Targets to be reviewed at least every five years. When new prediction methods are available, some of these indicators may be added to the lists of Interim Goals and Targets.

#### Choose poster children indicators and bring them to the forefront

We did not deliberately choose “poster children” to report on at this time. Instead, we reported on all indicators while stressing Interim Goals and Interim Targets for indicators that the public would be most familiar with and likely to understand. We will work on future development of potential “poster children” indicators. For this document, we focused on telling several stories that illustrate CERP expectations in different regional areas. Thus, the readers can concentrate on reading about “their backyard” as opposed to one or two indicators found throughout South Florida.

#### Provide more documentation/justification for hydrologic indicators

Hydrologists provided additional justification for the hydrologic indicators in the indicator documentation sheets.

#### Document and sufficiently justify the importance of less obvious indicators

Each indicator documentation sheet provides substantial justification for each indicator. For brevity, and to hold the reader’s attention, little justification is provided in the main portion of the document.

Too many indicators - use a short list of indicators for developing goals

We were not able to find a more parsimonious set of indicators for this round of Interim Goals and Interim Targets predictions. Because the indicators were developed to reflect a comprehensive set of key components identified in the conceptual ecological models, they were all included.

Include socioeconomic indicators

Socioeconomic indicators other than those for water supply and flood protection are being considered for the next version of Interim Goals and Interim Targets predictions. However, routine methods for predicting system-wide effects on socioeconomic indicators have not been developed for the CERP. As these methods are developed, socioeconomic indicators will be considered if effects on them can be attributed to the CERP.

**Modeling issues and process of predicting goals**Describe natural indicator variability and the expected response relative to variability

When data for a specific indicator were available, summaries of natural variability and expected responses relative to that variability were discussed. Overall, we included an uncertainty section to manage expectations and highlight stochastic environmental processes that are certain to thwart our ability to meet all Interim Goals and Targets and confound our ability to attribute the CERP implementation to specific ecological responses.

Consider climate change when predicting goals

Hydrologic simulation modeling did not account for climate change; therefore, in most cases, it was not considered.

Discuss the cumulative uncertainty when using the South Florida Water Management Model (SFWMM) for drive secondary models

This is discussed in the uncertainty section of the document.

Use stochastic modeling simulations instead of the deterministic South Florida Water Management Model (SFWMM)

Development of an entirely new stochastic hydrologic simulation model was not possible for predicting Interim Goals and Interim Targets.

Screen models using specific model acceptability criteria

Predictive models were not screened. For this effort, we considered the process of choosing, including, and assuring sufficient monitoring plans to be the principal task. If indicator experts determined that a predictive model was useful for setting Interim Goals and Interim Targets, then the model may have been used entirely or only to guide the predictions. In most cases, all available models were run; as such, the Interim Goals and Interim Targets document represents a current disclosure of all available predictive methods with an indication of uncertainty and future needs to improve predictive power. A series of criteria for model

acceptability has not been developed for the CERP, but this process is in development. Future predictions will include these criteria to screen and accept models.

#### Use and justify best professional judgment and provide assumptions

Best professional judgment was used in the development of Interim Goals and Interim Targets. Each indicator documentation sheet includes justification for predictions based on best professional judgment and available science.

#### Discuss the Natural Systems Model (NSM)

The Natural System Model (NSM) was often used as a reference point to show how simulation models might perform before much of South Florida was impacted through development. Additional details on the NSM can be found at the following web site: <http://www.sfwmd.gov/org/pld/hsm/models/nsm/index.html>.

#### Itemize sources of uncertainty when predicting Interim Goals

In most cases it was not possible to itemize all sources of uncertainty in the development of Interim Goals and Interim Targets. Any known sources of uncertainty in predictions were outlined in the indicator documentation sheets. This appendix also includes a discussion on uncertainty and outlines several general sources of uncertainty relative to the primary simulation model, the SFWMM.

#### Use flow diagrams to explain data flow and models used for making predictions

A general flow diagram was included in the document to show how data were used to make predictions. Some indicator documentation sheets also included the logic processes for predictive models. However, it was beyond the scope of this document to include flow diagrams for all predictive models. Sufficient reference were provides such that a reader can refer to citations for additional model detail.

#### Manage expectations of long-term responses by being explicit

This was done, particularly for those indicators that are likely to respond during the late phases of CERP implementation and beyond.

#### Use reference sites for establishing targets

To the extent that the *CERP Monitoring and Assessment Plan: Part 1 Monitoring and Supporting Research* (RECOVER 2004a) utilizes reference sites, the Interim Goals and Interim Targets do as well. Specific reference sites were not established for Interim Goals and Interim Targets.

#### Do not use models to do assessments

In some cases it may be absolutely critical that models are used, in addition to real data, to perform assessments. For example, we cannot control the weather in South Florida and may need to use models to reconcile unexpected responses over short time frames (5 years) that may be due to random weather events.

Use an uncertainty classification system – red, yellow, green

All predictions for Interim Goals and Interim Targets are uncertain. The degree to which predictions are uncertain is unknown in many cases and can also be the topic of scientific debate. A method for developing a classification system was not developed because it was thought to be viewed as highly subjective and limited in value.

Keep and set Interim Goals for indicators that do not have models

In some cases, predictive models were not available to make indicator predictions, yet Interim Goals were set.

Assure that Interim Goals are quantifiable

Interim Goals were made as quantifiable as possible, but this was difficult in cases where predictive models were not available.

Human demands should be considered

Human demands are considered and Interim Targets are designed to showcase the extent to which the CERP can meet those demands throughout its implementation.

Use graphics to display goals

In most cases, graphics were used to display Interim Goals.

Achieve widespread buy-in for the predictive models

Far too many predictive models are used to achieve widespread buy-in. Indicator experts consulted with colleagues to choose the best predictive models.

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### General List of Acronyms and Abbreviations

ACI	adult component index
AFSIRS	Agricultural Field Scale Numerical Simulation
ATLSS	Across Trophic Level System Simulation
CERP	Comprehensive Everglades Restoration Plan
CESI	Cooperative Ecosystem Studies Initiative
cfs	cubic feet per second
CH3D Model	Curvilinear-Grid Hydrodynamic Three-Dimensional Model
cm	centimeter
CREW	Corkscrew Regional Ecosystem Watershed
DMSTA	Dynamic Model for Stormwater Treatment Areas
ELM	Everglades Landscape Model
ELVM	Everglades Landscape Vegetation Model
EPGM	Everglades Phosphorus Gradient Model
ft NGVD	feet National Geodetic Vertical Datum
GIS	geographic information system
GPS	Global Position System
HSPF	Hydrologic Simulation Program Fortran
ICU	Initial CERP Update
LCI	larval component index
LECSR	Lower East Coast Sub-Regional Model
LESM	Loxahatchee Estuary Salinity Management Model
LLSM	Loxahatchee Long-Term Salinity Model
LOEM	Lake Okeechobee Environmental Model
LOWQM	Lake Okeechobee Water Quality Model
LRHSM	Loxahatchee River Hydrodynamic Salinity Model
m <sup>2</sup>	square meter
mg/kg	milligrams per kilogram
MIKESHE Model	model developed by Mike She
MLR	multi-linear regression
mm	millimeter

msl	mean sea level
NSM	Natural System Model
OPTI	Reservoir Optimization Model
PAR	photosynthetically-active radiation
ppb	parts per billion
ppt	parts per thousand
RASPAT	Ridge and Slough Pattern Analysis Tool
RECOVER	Restoration Coordination and Verification
Restudy	Central and Southern Florida Project Comprehensive Review Study
RMA	model developed by Resource Management Associates
RSM	Regional Simulation Model
SESI	Spatially Explicit Suitability Index
SFWMM	South Florida Water Management Model
STA	stormwater treatment area
TMDL	total maximum daily load
VEC	valued ecosystem component
WATBAL Model	Water Balance Model
µg/L	micrograms per liter

### List of Simulation Acronyms and Abbreviations

Many different models were used to develop the Interim Goals and Interim Targets. Most models simulated pre-drainage conditions, baseline conditions, interim conditions during CERP implementation, full CERP implementation conditions, and future conditions with no CERP implementation. Different models use different abbreviations for these simulations. Below is a summary of these abbreviations

Pre-drainage conditions	NSM45 NSM45F NSM 4.5
Baseline condition in 1995	1995 Base 1995base 1995BSR 95Base 95 Base 95BSR 95R
Other baseline conditions	2003 BSR
Interim simulations	2005 2010 2015 2020 2025 2030 2035
Full CERP implementation	Alt D13R ALTD13 D13R D13R98 AD13R
Future without CERP implementation	2050 50BSR

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### **Introductory Sections**

The authors of the appendix introductory section were Agnes McLean, South Florida Water Management District, and Elizabeth Crisfield, National Park Service.

### **Northern Estuaries**

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### **Indicator Sheets**

The indicator sheets for Interim Goals and Interim Targets make up the remainder of this document.

