

## Free Executive Summary



### Progress Toward Restoring the Everglades: The Second Biennial Review, 2008

Committee on Independent Scientific Review of Everglades Restoration Progress, National Research Council

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*This book is the second biennial evaluation of progress being made in the Comprehensive Everglades Restoration Plan (CERP), a multibillion-dollar effort to restore historical water flows to the Everglades and return the ecosystem closer to its natural state. Launched in 2000 by the U.S. Army Corps of Engineers and the South Florida Water Management District, CERP is a multiorganization planning process that includes approximately 50 major projects to be completed over the next several decades. Progress Toward Restoring the Everglades: The Second Biennial Review 2008 concludes that budgeting, planning, and procedural matters are hindering a federal and state effort to restore the Florida Everglades ecosystem, which is making only scant progress toward achieving its goals. Good science has been developed to support restoration efforts, but future progress is likely to be limited by the availability of funding and current authorization mechanisms. Despite the accomplishments that lay the foundation for CERP construction, no CERP projects have been completed to date. To begin reversing decades of decline, managers should address complex planning issues and move forward with projects that have the most potential to restore the natural ecosystem.*

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## Summary

The Florida Everglades, uniquely shaped by the slow flow of water, is one of the world's treasured ecosystems. However, an extensive water control infrastructure, designed to increase regional economic productivity through improved flood control, urban water supply, and agricultural production, has changed the landscape of South Florida. The vast area of sawgrass plains, ridges, sloughs, and tree islands once supported a high diversity of plant and animal life, but remnants of the original Everglades now compete for vital water with urban and agricultural interests, and contaminated runoff from these two activities impairs their waters. The Comprehensive Everglades Restoration Plan (CERP), a joint effort led by the state and the federal government launched in 2000, seeks to reverse the general decline of the ecosystem in the midst of a changing human and environmental context. This unprecedented project envisioned the expenditure of billions of dollars in a multi-decadal effort to achieve ecological restoration by restoring the hydrologic characteristics of the Everglades, where feasible, and to create a water system that simultaneously serves the needs of the natural and the human systems of South Florida.

The Committee on Independent Scientific Review of Everglades Restoration Progress was established in 2004 in response to a request from the U.S. Army Corps of Engineers (USACE), with support from the South Florida Water Management District (SFWMD) and the U.S. Department of the Interior (DOI), based on Congress's mandate in the Water Resources Development Act of 2000 (WRDA 2000). The committee is charged to submit biennial reports that review the CERP's progress in restoring the natural system (see Chapter 1). This is the committee's second report in a series of biennial evaluations.

The committee concludes that the CERP is bogged down in budgeting, planning, and procedural matters and is making only scant progress toward achieving restoration goals. Meanwhile, the ecosystems that the CERP is intended to save are in peril, construction costs are escalating, and population growth and associated development increasingly make accomplishing

the goals of the CERP more difficult. Lack of timely restoration progress by the CERP, to date, has been largely due to the complex federal planning process and the need to resolve conflicts among agencies and stakeholders. However, future restoration progress is likely to be limited by the availability of funding and the current authorization and funding mechanisms. In periods of restricted funding and limited capability to move forward on many fronts, the ability to set priorities and implement them is critical. Much good science has been developed to support the restoration efforts, and the foundations of adaptive management have been established to support the CERP. To avert further declines, CERP planners should address major project planning and authorization hurdles and move forward expeditiously with projects that have the most potential for contributing to natural system restoration progress in the South Florida ecosystem.

### **SOUTH FLORIDA ECOSYSTEM RESTORATION**

Several South Florida restoration programs, including the CERP—the largest of the initiatives—are now under way. The CERP, led by the USACE and the SFWMD, consists primarily of projects to increase storage capacity (e.g., conventional surface-water reservoirs, aquifer storage and recovery, in-ground reservoirs), improve water quality (e.g., stormwater treatment areas [STAs]), reduce loss of water from the system (e.g., seepage management, water reuse, conservation), and reestablish pre-drainage hydrologic patterns wherever possible (e.g., removing barriers to sheet flow, rainfall-driven water management). The largest portion of the budget is devoted to water storage and conservation and to acquiring the lands needed for those projects.

The CERP builds upon other activities of the state and the federal government aimed at restoration (hereafter, non-CERP activities), many of which are essential to the success of the CERP in achieving its restoration goals. These include Modified Water Deliveries to Everglades National Park (Mod Waters) and the Kissimmee River Restoration—projects that will alter hydrologic patterns to more closely resemble pre-drainage conditions. Several non-CERP projects address water quality issues, including the Everglades Construction Project (construction of over 44,000 acres of STAs) and restoration of Lake Okeechobee. In addition, research on and management of invasive species is important to the overall restoration program. Finally, the state of Florida's Acceler8 initiative is a mix of expedited projects that were identified in the CERP and some non-CERP projects. In Chapter 2 of the report, the committee analyzes the broader context for the South Florida ecosystem restoration efforts and presents the following conclusions and recommendations:

**Population growth and associated development will make restoration more difficult.** Increasing water demands from an expanding population in Florida could create competition with ecosystem restoration when supplies are limited. Agriculture faces an uncertain future in South Florida, particularly in the Everglades Agricultural Area, which intervenes directly in the flow of water between Lake Okeechobee and Everglades National Park and influences the movement of water, sediment, and nutrients for the rest of the system. The use of “smart growth” principles that integrate the needs of environmental restoration with human demographic changes can lessen the negative impacts of population growth if cities, counties, the state, and CERP planners are all involved.

**Human-induced climate change is likely to impact the effectiveness of CERP projects, and CERP planners should assess and factor into planning and implementation the most recent projections of the impacts of climate change in South Florida.** Precipitation, evapotranspiration, and the intensity of rainfall events in South Florida are all expected to change during the current century. Impending climate change should not be an excuse for delay or inaction in the restoration but instead provides further motivation to restore the resilience of the ecosystem. The CERP Guidance Memorandum on climate change recommends consideration of sea-level rise and changes in precipitation quantity, distribution, and evapotranspiration in all CERP planning, but new analysis of impacts based on assumptions about higher sea-level rise are needed. Among those possible changes that should be assessed and factored into planning and implementation are: changes in the water budget, including increasing human demands for water; changes in the return frequency and intensity of hurricanes; the effects of climate change on the distribution of biota in the Everglades ecosystem; and impacts of projected sea-level rise on the hydro-geomorphology of the estuaries and the mangrove zone.

**Ongoing delay in South Florida ecosystem restoration not only has postponed improvements to the hydrologic condition but also has allowed ecological decline to continue.** Recent water management strategies have not produced conditions that are conducive to restoring the Cape Sable seaside sparrow and appear to be negatively impacting the snail kite. Tree islands have undergone a multi-decadal decline in both number and surface area—a trend that appears likely to continue until significant CERP and non-CERP restoration progress has been made. In the past decade, Lake Okeechobee has experienced continued water quality and habitat degradation. Meanwhile, the number and area of influence of invasive species are increasing and represent very real challenges to restoration efforts.

**In the face of these numerous challenges, Everglades restoration efforts are even more essential to improve the condition of the South Florida eco-**

**system and strengthen its resiliency as it faces additional stresses in the future.**

If ecological resilience is not restored, the possibility exists that environmental changes could precipitate rapid and deleterious state changes that might be very difficult or impossible to reverse. Unless near-term progress is achieved on major restoration initiatives, including CERP and non-CERP efforts, opportunities for restoration may close with further loss of species numbers and habitat deterioration, and the Everglades ecosystem may experience irreversible losses to its character and functioning.

**PROGRESS IN PROGRAM IMPLEMENTATION:  
BUILDING THE FOUNDATION FOR ADAPTIVE MANAGEMENT**

The initial National Research Council (NRC) biennial review of restoration progress noted that in the first 6 years after the WRDA 2000 was authorized, actual construction progress was limited, and most of the CERP accomplishments were programmatic. In 2008, most CERP accomplishments remain programmatic, including the monitoring and assessment plan, development of modeling tools, and other ways in which the foundations of adaptive management are being built in support of the restoration. Congress mandated an adaptive management approach for the CERP to facilitate restoration progress despite some scientific and engineering uncertainty, and as of 2008, nearly all of the elements needed to implement a decision-making framework using adaptive management have been produced (see Chapter 6). These elements include:

- Documents describing the adaptive management process and all aspects of performance assessment,
- Conceptual ecological models to support monitoring and assessment, and
- An information and data management system and the Interagency Modeling Center to support assessment and planning aspects of decision making.

These are significant accomplishments, and their importance should not be underestimated; however, the CERP adaptive management scheme could be improved by addressing several major issues, which are summarized in the text that follows.

**For monitoring and assessment information to adequately support CERP adaptive management, a robust program of ecological monitoring should remain a priority.** While monitoring in and of itself does not ensure restoration progress, without monitoring to understand ecosystem response to project implementation from local to whole ecosystem scales, uninformed management

decisions will be made with potentially undesirable ecosystem consequences. A well-justified and documented set of performance measures has been developed, and a scientifically robust process for updating, refining, and adding to the set of performance measures is in place. The periodic review of performance measures should consider ways to make sure that the total number of variables monitored is appropriate to their purposes for informing decisions and to the funding available for monitoring efforts. It also is important to match the frequency of monitoring with the speed of change of the variables that are monitored and to increase reliance on remotely sensed data-collection methods. Revisions of the monitoring and assessment system should be firmly grounded in the use of the data for planning and management decision making.

**The 2007 System Status Report achieved its stated objectives** to test the monitoring and assessment plan and to establish as long a baseline as possible to capture the natural variance of CERP performance measures. The first System Status Report serves as the reference that will be used to gauge system response as CERP projects are implemented, and it is extremely valuable. Insights learned during the production of the report should be incorporated into the revision of the Monitoring and Assessment Plan (MAP) and the conceptual ecological models, as needed, and for re-prioritization of the performance measures. To maximize the usefulness of System Status Reports for adaptive management, the interagency body called Restoration, Coordination, and Verification (RECOVER) should develop succinct summaries in future reports that clearly address whether the interim and longer-term goals are being met; if not, why; and what CERP operations or design changes are most likely to move ecosystem response closer to the interim goals.

**Integrated hydrologic, ecological, and water quality modeling tools are needed for science to have a fully developed role in CERP decision making and ecosystem management.** CERP planning and assessment of performance indicators are dependent on modeling tools; as model development and implementation lag, so does access to more accurate and functional tools. Models are needed for each ecological indicator (performance measures) to compare predicted and monitored indicator responses for effective adaptive management decision making. This will occur only when

- ecological modeling and data management activities are fully incorporated and funded in the CERP's Interagency Modeling Center;
- water quality and sediment transport models become routinely available and integrated with the new Regional Simulation Model; and
- these physical-chemical models can be readily linked to ecological models.

Shrinking CERP resources means that the trade-off between using staff for model development versus using them for model production runs for CERP planning favors the latter. This committee recognizes that resources are limited but notes that model development is a long-term proposition and should continue with as much support as possible so the tools required to restore and manage the ecosystem are available in the future.

### **CERP PROJECT PLANNING AND IMPLEMENTATION**

The attempt to restore an ecosystem as large and complex as the Everglades is an unprecedented challenge. Despite programmatic accomplishments and the beginning of construction for some projects identified in the CERP, natural system restoration has been delayed. The South Florida ecosystem continues to suffer as a result of a complex and sometimes contentious planning process, funding uncertainties, lack of clear restoration priorities that are central to restoration, and statutory and regulatory impediments. In Chapter 3, the committee analyzes progress in CERP planning and implementation and makes the following conclusions and recommendations:

**It is too early to evaluate the response of the ecosystem to CERP projects because none have been completed.** Construction completion for the first CERP components has not been achieved through mid-2008, and key foundational pre-CERP projects, such as Mod Waters, remain far behind schedule. If limited natural system restoration progress continues, frustration will further increase among stakeholders and agency staff, and public support for restoration is likely to diminish. Actual construction and implementation of key non-CERP and CERP projects are the only means to arrest the degradation and to assure that natural system restoration begins. State efforts to construct projects in spite of funding limitations and other serious obstacles to progress are commendable. Some partial benefits have been produced from phased construction in the Picayune Strand Restoration (wetland restoration) and Acme Basin B (stormwater treatment) projects. Additionally, several non-CERP activities are positive harbingers of future CERP programs and indicate that when project implementation does occur, bona fide ecological restoration benefits will be demonstrated. For example, the success of the Kissimmee River Restoration effort continues to be the most important piece of evidence that restoration of a natural system is possible in the Everglades region.

**The state of Florida should continue its active land acquisition efforts, accompanied by monitoring of and regular reporting on land conversion patterns in the South Florida ecosystem.** Land management for a successful CERP depends on purchasing particular sites within the project area and protecting

more general areas within the South Florida ecosystem that could help meet the broad restoration goals. The committee commends the state of Florida for its aggressive and effective financial support for acquiring important parcels, including the impressive recent announcement that the state will enter into negotiations for the potential purchase of 187,000 acres of land in the EAA from U.S. Sugar Corporation for \$1.75 billion. The acquisition of this large amount of land has the potential to alter basic CERP plans, but because of uncertainty in the timing and structure of the purchase and the possibility of numerous land exchanges made after the purchase, direct effects of the deal are impossible to predict and may not be seen for a decade or more.

**The complex project planning and approval process has been a major cause of delays for CERP projects to date.** The greatest challenge in the project planning process has been developing technically sound project plans that are acceptable to the many agencies and stakeholders involved. The process of resolving disagreements among agencies and stakeholders has led to lengthy delays in the development of some project implementation reports that can be submitted to Congress for authorization. The infrequent and unpredictable federal authorization mechanism for CERP projects has caused some additional problems and attendant delays. The committee judges that the lack of federal funding in the first eight years of the CERP is not the most serious cause of the CERP delays. Instead, the slow pace of federal funding has largely been a symptom of the problems caused by the complex and lengthy CERP planning and authorization process for each project. However, now that three CERP projects have approval for their project implementation reports and congressional authorization, funding limitations will certainly create additional constraints to CERP progress in the years ahead. Non-CERP and CERP projects will increasingly compete for limited state and federal funding, while project costs increase due to inflationary pressures and scope changes. Both state and federal partners are facing budget constraints, and dramatic state budget cuts in FY09 threaten to affect the speed of restoration progress.

**Deficiencies in CERP system-wide planning are affecting the delivery of natural system restoration benefits.** The CERP lacks a systematic approach to analyze the costs and benefits across multiple projects in support of project planning. Fundamentally, the CERP is designed as a system of related projects (i.e., components) that work together in the aggregate to produce overall restoration benefits. Without a system-wide planning process, it is not clear how system benefits can be optimized for any one project without any systematic consideration of other projects. The next added increment is a benefits evaluation method that considers benefits only from the proposed and previously authorized projects and, as currently implemented in the Everglades, it undermines system-wide

restoration planning and sequencing. The current planning process also appears to reward the least contentious projects, regardless of their potential contribution to ecosystem restoration. Without clear priorities for project planning and funding, projects with large potential restoration benefits may see lengthy restoration delays while other, less-contentious projects that address only isolated portions of the ecosystem may tie up available funding. During the 5-year review of the Programmatic Regulations, the USACE should address deficiencies and impediments in the CERP planning process that are affecting restoration progress. CERP planners should also develop mechanisms to improve system-wide planning and decision making for the CERP.

**Developing a realistic schedule and sound project sequence is a critical need for the restoration effort.** In this time of increasing fiscal pressures, it is critical that CERP planners find a means to prioritize and properly sequence restoration projects so that public funds are allocated by the degree to which the projects are essential to restoration of the South Florida ecosystem, rather than by local stakeholder support or the order of authorization. Public Web-based reporting on project progress, delays, and anticipated completion dates should be more transparent than it is currently.

**The executive and legislative branches of the federal government should consider departing from traditional project-by-project review, authorization, and yearly funding to benefit both the CERP and other multi-component ecosystem restoration projects across the nation.** It may be far more efficacious—scientifically, managerially, and economically—to design a different approach for comprehensive restoration programs that provides assured funding over a multiple-year period.

**The incremental adaptive restoration (IAR) concept proposed in the initial NRC biennial review has stimulated creative restoration approaches to Everglades restoration but has not yet been fully applied.** The prior committee's recommendation to apply IAR has been widely embraced by implementing agencies at all levels of organization as well as by various stakeholders, but an effort to apply IAR to an integrated group of Southern Everglades restoration projects was discontinued. CERP planners, however, are using the IAR concept in planning the Biscayne Bay Coastal Wetlands and C-111 Spreader Canal projects. The most effective applications of the IAR concept will probably be in the incremental execution of project components that produce significant outcomes but are of a scope and scale that can be feasibly implemented and assessed. Because most of the desired ecological changes are likely to take years or decades to respond to IAR actions, agencies should emphasize assessing variables that are leading indicators of likely long-term ecological responses as they develop IAR strategies.

**To reduce restoration delays, CERP planners should develop a stronger conceptual basis for multi-species recovery planning and management.** Although implementation of the Endangered Species Act (ESA) has increasingly become focused on single species management, the statute does provide various mechanisms that can reduce the threat of legitimate litigation and facilitate the recovery and management of multiple-listed species. However, effective multi-species management under the ESA requires a high level of integration of scientific knowledge about individual species and species interactions to understand risks and trade-offs during construction and under alternative water management regimes. It also requires strong federal leadership and a high level of trust and cooperation among the regulatory and management agencies and other stakeholders to allow for learning, compromise, and decision making under uncertainty. In addition, jeopardy determinations for endangered species and associated litigation are a significant, unresolved challenge for adaptive management and IAR. Currently, there is no scientifically credible operational plan for managing multiple species at risk in South Florida. To expedite multi-species restoration under the ESA, the DOI should immediately initiate and lead the development of a South Florida multi-species adaptive management strategy, including both science and policy dimensions, to accompany the existing South Florida Multi-species Recovery Plan.

## **CASE STUDY ANALYSES OF RESTORATION PROGRESS**

The committee evaluated two restoration efforts in detail—Mod Waters and Lake Okeechobee—to better understand the progress and challenges in the restoration of the South Florida ecosystem.

### **Modified Water Deliveries to Everglades National Park**

The history of the Mod Waters project is one of the most discouraging stories in Everglades restoration (see Chapter 4). The project, which would provide crucial first steps toward ecological restoration within Everglades National Park, has been plagued by changes in direction and scope, parochial interests, debilitating litigation, enormous cost escalation due both to inflation and to plan modifications, unanticipated engineering constraints (e.g., Tamiami Trail integrity), and lack of coordinated leadership from the responsible agencies. How the project will be funded (i.e., involving the National Park Service, USACE, Florida Department of Transportation) is a further complicating factor. While some events may have been unavoidable, the overall outcome has been the loss of support from Congress—the ultimate source of funding for the project—and the loss of

enthusiasm—or even understanding—from the public. Worst of all, the history of delay further damages Everglades National Park. Completion of Mod Waters is crucial to the success of Everglades restoration and the CERP projects that follow. If this relatively modest restoration project cannot proceed and provide some restoration benefits, the outlook for the CERP is dismal.

**Without completion of Mod Waters, central components of the CERP cannot proceed, and ecological conditions in the Everglades ecosystem will continue to deteriorate.** Nineteen years have passed since the Mod Waters project was authorized, and the restoration of water flows has not occurred, even though it is a critical foundation project for the CERP. Political leadership and the timely provision of funding are essential if progress on Mod Waters and the associated delivery of restoration benefits to Everglades National Park are going to occur.

**Strong leadership, focused on building and maintaining support among stakeholders and overcoming conflicts, is essential for Everglades restoration projects to achieve their restoration goals.** If there is insufficient political leadership to align research, planning, funding, and management with restoration goals agreed upon by the stakeholders, the CERP will be likely to result in an abbreviated series of disconnected projects that ultimately fail to meet the restoration goals. Other lessons for the CERP that can be learned from the struggles faced during the planning and implementation of the Mod Waters project include benefits of early agreement on project scope and objectives, the need for a clear project management structure, and the need to anticipate adapting project plans over time.

**The reduced scope of Mod Waters attainable with the 2008 recommended plan for modifying Tamiami Trail (alternative 3.2.2.a) provides some environmental benefits but shifts increased responsibility (and cost) to the CERP to achieve authorized Mod Waters goals.** The 2008 recommended plan represents a substantially smaller step toward restoration than was originally envisioned for Mod Waters. The recommended alternative also is less cost-effective than other alternatives when benefits are considered as habitat units per dollar spent. Although it is critical to move ahead and implement it quickly, the recommended alternative should be viewed only as a first step toward restoration. Moreover, it should be recognized that moving forward with the 2008 recommended plan increases the urgency to proceed more quickly to implement the additional necessary Tamiami Trail modifications through the CERP or some other mechanism, so that the restoration benefits for Everglades National Park outlined in the WRDA 2007 conference report can be achieved as soon as possible.

### Lake Okeechobee

Lake Okeechobee is a critical linchpin of the South Florida ecosystem. However, both high and, more recently, very low water levels, as well as poor water quality, presently plague the lake. The challenges of water quality and water quantity in the lake have two critical ramifications for the entire ecosystem: the lake supports important elements of the region's biota, and the lake has the potential to serve as a major source of water storage and water supply for downstream ecosystems, a potential that will become more critical if other planned and proposed sources of water storage do not become available. Based on an analysis of Lake Okeechobee's condition and current restoration plans (see Chapter 5), the committee presents the following conclusions and recommendations:

**An integrated, system-wide view of water quality management is essential to the achievement of restoration goals for the South Florida ecosystem.** Good data are available to understand the local dynamics of phosphorus and other contaminants, but a system-wide accounting is lacking for water and phosphorus as well as other important contaminants, such as sulfur, mercury, and nitrogen. A system-wide accounting is needed to determine the mechanisms of contaminant transport, to assess the implications of upstream changes on downstream habitats, to determine appropriate management actions, and to evaluate system-wide progress to improve water quality. It also is crucial to determine to what degree the current status of the lake represents a changed condition that will resist restoration.

**Recent water quality restoration initiatives in the Northern Everglades are not likely to achieve the stated water quality goals (40 ppb total phosphorus in the lake and 140 metric tons per year phosphorus input load) by the year 2015, and it might take decades for these goals to be met using current strategies.** Using the "no-action alternative" to manage internal phosphorus loads in the lake is likely to delay achieving in-lake concentration goals by several decades, as concluded by the SFWMD. Also, although the Northern Everglades initiative's technical plan identifies management measures to reduce phosphorus loads, the strategies probably are not adequate to reduce external phosphorus loads sufficiently. More significant remediation strategies in the lake and its watershed will probably be needed to reduce the legacy phosphorus in the system and meet the stated goal.

Although the Northern Everglades plan represents a sizable effort, it will not be easy or inexpensive to reverse the lake's decline in water quality. The lake's importance in the ecosystem, however, justifies the devotion of considerable resources to the lake.

**In the near term, restoration planners should consider the consequences of the likely failure to achieve the phosphorus goals on the South Florida ecosystem restoration and develop alternative approaches.** Alternatives may involve significant reallocation of priorities among restoration projects and/or significant changes to water quality criteria downstream. Restoration planners should consider the needs for additional STAs and should investigate methods to improve the long-term ability of STAs to remove phosphorus. In-lake treatment of phosphorus may also be needed to expedite the rehabilitation of Lake Okeechobee as external loads are reduced.

**Given concerns about the financial and technical feasibility of aquifer storage and recovery (ASR) at the large scale proposed in the CERP, additional opportunities for water storage should be investigated, and Lake Okeechobee may be an important component of those alternatives.** Several important water storage projects are under development through the CERP and Acceler8, and opportunities for upstream water storage are being considered within the Northern Everglades initiative. Nevertheless, alternative storage options should be considered as possible contingencies to ASR—the primary source of new water storage for the CERP, but for which there are concerns about financial and technical feasibility—including synergistic opportunities related to modifications of the Herbert Hoover Dike. This committee encourages CERP planners to consider a wide array of water storage alternatives and their costs and benefits.

**Short-term and long-term trade-offs will be necessary in the rehabilitation of Lake Okeechobee and northern estuaries.** Given the current altered state of the whole system, goals for the lake, the northern estuaries, and other downstream interests might not be mutually compatible in all respects. As a result, trade-offs will have to be made. Modeling and adequate, reliable data will be needed to evaluate these trade-offs.

## **OVERALL EVALUATION OF PROGRESS AND CHALLENGES**

If the sweeping vision of environmental restoration of the Everglades is to be realized, demonstrable progress needs to come soon. Even though the science and engineering that support the restoration program have been of high quality, to date, the CERP has not been effective in halting the decline of the South Florida ecosystem. Instead, the CERP is currently mired in a complex federal planning and approval process, while project costs continue to rise and development threatens to foreclose some restoration options, and funding limitations are likely to add further delays in the years ahead. To do nothing is to do harm. If the CERP continues on its present course, at its current pace, the system

will continue to lose some of its vital parts, and more importantly, the restoration effort will lose the support of the public at large. Clear funding priorities, modifications to the project planning, authorization, and funding process, and strong political leadership are needed to support system-wide restoration and to begin to reverse the decades of decline.



# PROGRESS TOWARD RESTORING THE EVERGLADES

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## Preface

In 1881 Hamilton Disston, a Philadelphia investor, began a grand project in the Everglades wilderness of Florida to drain the wetlands and convert them to an agricultural cornucopia. The Everglades once encompassed about 3 million acres, with its “River of Grass” extending southward from the area north of Lake Okeechobee to a sweeping confluence with Florida Bay at the southern end of the Florida peninsula. Disston’s project in the northern reaches of the Everglades eventually failed, but “reclamation” efforts continued. When Napoleon Bonaparte Broward became governor of Florida in 1904, he initiated a massive investment and development plan that began the wholesale modification of the Everglades for agriculture with water supply and flood control for the growing cities along the coastal margins. During this early period, environmental protectionists like Frank M. Chapman of the American Museum of Natural History worked tirelessly to protect endangered birds and their habitats. By the end of the 20th century, more than half the Everglades had disappeared, and the remainder was an ecosystem in rapid decline. In 1999, the federal and state governments combined their efforts in the Comprehensive Everglades Restoration Plan (CERP) to save the remaining Everglades along with their iconic wildlife, while at the same time providing water and flood protection for the region’s rapidly increasing human population.

The CERP is a complex, multibillion-dollar project managed by the U.S. Army Corps of Engineers (USACE) and the South Florida Water Management District (SFWMD) that was projected to require 40 years for completion. With 68 separate subprojects requiring sophisticated scientific knowledge of the ecosystem and creation of new technologies for water management, CERP represents a research, planning, implementation, and construction challenge unlike any other. In authorizing the CERP, the U.S. Congress mandated periodic independent reviews of progress restoring the natural system in the Everglades. In compliance with this requirement, the USAC, in coordination with the SFWMD and the Department of the Interior, arranged with the National Research Council

(NRC) of the National Academies the establishment of the Committee on Independent Scientific Review of Everglades Restoration Progress (CISRERP), which submits formal reports to Congress on a biennial basis.

The NRC has previously reviewed (for the South Florida Ecosystem Restoration Task Force) such specific aspects of the Everglades restoration as the management of science for decision making, general science and engineering perspectives on water storage, and the management of science for particular parts of the ecosystem such as Florida Bay. The CISRERP reviews for Congress, however, are more all encompassing, and they provide a broad picture of both science and engineering and the contributions of these endeavors to restoration. These more general reviews cannot touch upon every aspect of the overall project, so exploration of some representative examples supplements the general statements in the reports. The committee provided its first biennial report in 2006, examining the initiation of the CERP with its emphasis on planning, identifying embryonic progress in projects related to the CERP, specifying that there were no scientific impediments that should stand in the way of restoration progress, and offering a philosophic approach to managing science and restoration.

This second biennial report continues the NRC review of Everglades restoration progress. During this exacting process, I have been privileged to work with committee members who are among the nation's leading experts in their respective fields. The committee members served without compensation (except for expenses), and they have generously contributed their time and talents as their donations in service to the state and the nation. The committee includes experts in biological, hydrologic, and geographic sciences, hydrologic and systems engineering, project administration, law, and policy. The committee met seven times over the course of 18 months, with five meetings in Florida that permitted the committee to hear testimony from researchers, planners, and decision makers associated with the USACE and SFWMD, as well as from representatives of interest groups and private citizens. The report generated by this diverse committee is a consensus document.

In late June 2008, after the committee had completed its deliberations and was about to send its report for external review, the state of Florida announced its intention to enter into negotiations to acquire almost 300 square miles of the Everglades Agricultural Area from U.S. Sugar Corporation. Given the timing of the announcement late in the committee's reporting cycle, the committee was unable to assess the implications of the land purchase for the CERP in any detail in this report. The purchase of these lands could have some important implications for water quality and possibly water storage for the Everglades, and the committee does draw attention to these in appropriate places in the report, but

these issues will undoubtedly be analyzed in greater detail in future biennial reviews.

The committee could not have accomplished its task without the help of the numerous NRC staff members associated with this review, including Stephen Parker (Director of the Water Science and Technology Board). His broad vision and effective management style have been keys to our success. Three staff members in particular were our partners in this effort: Stephanie Johnson, David Policansky, and Dorothy Weir. Stephanie Johnson is a true Everglades expert whose outstanding knowledge and understanding of the science, engineering, and administrative aspects of the CERP suffuse this report. Her encyclopedic capabilities to find information, absorb its essence, analyze its implications, and write about its consequences have been a key to the committee's success. David Policansky has long been a partner of committees engaged in Everglades oversight and review, applying his extensive biological knowledge and sound scientific sense. His service with this review committee and his contributions to the reporting process exemplify his fine ability to tease out the nuances in what is one of the most complicated ecosystems and restorations that any of us has ever seen. Dorothy Weir made it possible for the committee to do its job, adroitly managing every meeting: from the preliminary planning, through the management of minute procedural details, to the concluding summary processes. Her assistance in creating the final report has been, simply, indispensable.

This report has been reviewed in draft form by individuals chosen for their diverse perspectives and technical expertise in accordance with procedures approved by the NRC's Report Review Committee. The purpose of this independent review is to provide candid and critical comments that will assist the institution in making its published report as sound as possible and to ensure that the report meets institutional standards for objectivity, evidence, and responsiveness to the study charge. The review comments and draft manuscript remain confidential to protect the integrity of the deliberative process. We wish to thank the following individuals for their review of this report: Jean M. Bahr, University of Wisconsin-Madison; Patrick L. Brezonik, University of Minnesota; Elvin R. "Vald" Heiberg III, independent consultant; Judith L. Meyer, University of Georgia; Leonard Shabman, Resources for the Future; Alan D. Steinman, Annis Water Resources Institute; Myron F. Uman, former Associate Executive Officer, National Research Council; Thomas Van Lent, The Everglades Foundation; and Jeffrey R. Walters, Virginia Polytechnic Institute and State University.

Although the reviewers listed above have provided many constructive comments and suggestions, they were not asked to endorse the conclusions or recommendations nor did they see the final draft of the report before its release. The review of this report was overseen by Frank H. Stillinger, Princeton University,

and Kenneth W. Potter, University of Wisconsin, Madison. Appointed by the NRC, they were responsible for making certain that an independent examination of this report was carried out in accordance with institutional procedures and that all review comments were carefully considered. Responsibility for the final content of this report rests entirely with the authoring committee and the institution.

Hamilton Disston, Napoleon Bonaparte Broward, and Frank M. Chapman would not recognize today's Florida. Nevertheless, many of those developers' dreams have been realized in hydrologic control systems of canals, ditches, levees, control structures, and pumps, and they would have approved of the productive agriculture and bustling cities of the region. The preservationists have succeeded in establishing sprawling refuges and a national park. Disston, Broward, and Chapman likely would be amazed that the state and the nation have committed themselves to restoring and maintaining substantial parts of the natural system while at the same time providing ecosystem services for the human population. But the three were big thinkers, and in adapting to the present-day goals of combined environmental quality and economic development, they would probably approve of the CERP: bold, challenging, and complex, but with great potential for public good. We offer this report as our contribution to the realization of that lofty goal for the Everglades.

William L. Graf  
*Chair*

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