Report
HIGHLIGHTS
September 2016

Progress Toward Restoring the Everglades

The Sixth Biennial Review—2016

Measurable ecosystem improvements are beginning to be realized from completed components of the Comprehensive Everglades Restoration Plan (CERP), and major ecosystem improvements are within reach as three non-CERP restoration projects near completion. However, new knowledge about the Everglades' pre-drainage hydrology, climate change and sea level rise, and the feasibility of storage alternatives has substantial impacts on the expected outcomes of restoration efforts. Forward-looking analysis, in conjunction with program-level adaptive management, is needed to inform decision-making and ensure that the CERP is based on the latest scientific and engineering knowledge and is robust to changing conditions.

Vegetation growth is one of the measurable improvements attributable to restoration efforts.

Considered a national treasure, the Florida Everglades is a diverse and geographically extensive wetland ecosystem reaching from Lake Okeechobee to Florida Bay. After nearly 150 years of drainage, channelization, and flood control actions, the Everglades has been dramatically altered. Now half its original size, the remnants of the Everglades compete for water with urban and agricultural interests and are impaired by contaminated runoff from these two activities.

The U.S. Congress authorized the Comprehensive Everglades Restoration Plan (CERP) in 2000 to help reverse the Everglades' decline. The $16.4 billion project was originally envisioned as a 30- to 40-year effort to reestablish the natural hydrologic characteristics in the South Florida ecosystem, where feasible, and to create a water system that serves the needs of both the natural and the human systems. The restoration program is the largest in U.S. history and is jointly administered by the U.S. Army Corps of Engineers (USACE) and the South Florida Water Management District (SFWMD) and equally funded by the federal government and the state of Florida.

This report is the sixth in a series of congressionally mandated biennial reviews by the National Academies of Sciences, Engineering, and Medicine to assess restoration progress and identify policy, scientific, or other relevant issues that may impede or diminish the overall success of the CERP.

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IMPLEMENTATION PROGRESS

Sixteen years into the CERP, several project components are completed or nearing completion and are beginning to yield measurable results, especially in terms of creating hydrologic conditions increasingly similar to pre-drainage flows. For example, portions of Picayune Strand are experiencing higher water levels even though the project is not yet complete, and vegetation is becoming more similar to reference conditions. The documented hydrologic improvements from the early CERP projects implemented involve a small proportion of the overall CERP footprint and are located on the periphery of the remnant Everglades.

However, major system-wide restoration benefits--for example, further rehydrating wetlands to improve habitat conditions—are within reach as two more CERP projects are nearing completion, four more are ongoing (see Figure 1), and three major non-CERP projects with large-scale restoration benefits—the Modified Water Deliveries (Mod Waters), C-111 South Dade, and Kissimmee River Restoration projects—are anticipated to be completed in the next 5 years. Additionally, the large-scale Central Everglades restoration project was recently authorized by Congress.

Figure 1 Locations and status of early CERP projects and CERP or CERP-related pilot projects within the South Florida ecosystem. The CERP includes 6 pilot projects, 6 plans and studies, and over 40 projects originally intended to be implemented over 30-40 years.

Non-CERP efforts to enhance the management and operations of stormwater treatment areas (STAs) continue to improve water quality in the remnant Everglades**.** In water year 2015, the average phosphorus concentration over all STA outflows was 17 ppb, the lowest achieved over 21 years of operation. Although the target annual concentrations necessary for moving new water into the Everglades through the CERP (13 ppb) have not yet been achieved, some STAs are approaching that goal. However, phosphorus concentrations in Lake Okeechobee are double what they were in the early 1990s, despite projects aimed at reducing phosphorus export from agricultural activities. Outflows from the lake continue to contribute nutrient pollution to the estuaries, as evidenced by the algal blooms of 2016, and make it more difficult to reach CERP restoration goals for those areas.

The Everglades restoration funding outlook to support project implementation has improved modestly over the past 2 years from an all-time low in 2012. Recent project authorizations and a more stable source of state funds have alleviated constraints on federal spending for the CERP caused by the state-federal cost-sharing requirements. Nonetheless, the funding pace remains slower and the project costs greater than originally envisioned, leading to the prospect that program completion will extend beyond 2060. Given that only 16 to 18 percent of the estimated total CERP cost has been funded, substantial additional investment will be needed to complete the project as envisioned.

IMPLICATIONS OF NEW KNOWLEDGE ON THE CERP

Since the CERP was developed, the scientific community has gained substantial new knowledge on pre-drainage hydrology, climate change, and sea-level rise that have important implications for the restoration plan.

Although program managers recognized from the start that the former Everglades cannot be recreated, they appropriately focused on “getting the water right” by mimicking historic hydrologic conditions as much as possible. However, recent work indicates that the Everglades ecosystem was historically much wetter than previously thought. As a result, recreating historic hydrology would have different ecological outcomes and necessitate more new water than originally envisioned in the CERP.

Sea level rise will reduce the footprint of the system, evaporative water losses are expected to increase, rainfall may become more variable, and more storage would likely be needed to accommodate future changes in the quantity and intensity of runoff.

New calculations of water storage based on design changes, new understanding of project feasibility, and changes to Lake Okeechobee's operating rules indicate that surface water storage capacity could fall short of that originally envisioned in the CERP by more than 1 million acre feet (see Figure 2). Additionally, estimated feasible underground storage has been reduced by approximately 60 percent, reducing the benefits provided by the CERP in multi-year droughts. Reduced water storage could have serious ecological consequences in both the northern estuaries and the Everglades ecosystem if this shortfall is not addressed.

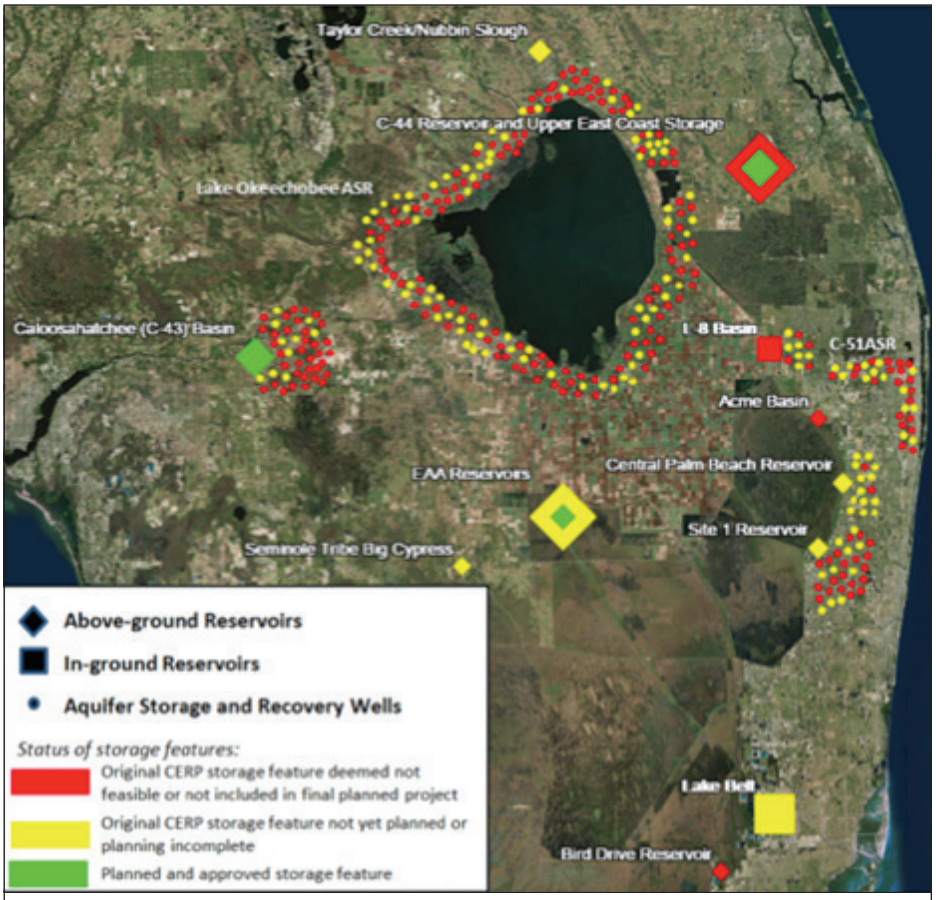

Figure 2. Water storage projects planned to date, in green, represent only 386,000 acre-feet of the 1,500,000 acre-feet of surface water storage originally envisioned in the CERP. Yellow symbols represent storage not yet planned or for which planning is incomplete, and red symbols indicate water storage that is no longer feasible or not included in the final plan.

The scientific uncertainties related to climate change and water storage should not be ignored but rather incorporated into CERP planning. A systemwide screening analysis of feasible, yet-to-be-implemented CERP storage alternatives is needed to evaluate modeled restoration outcomes with various levels of storage. Even modest changes in the Lake Okeechobee operations can have a large impact, suggesting that the lake is a central factor in future considerations of water storage. Therefore, the process to revise Lake Okeechobee operations should be initiated as soon as possible to inform near-term project planning involving water storage north and south of the lake.

RECOMMENDED FORWARD-LOOKING ACTIONS

When the CERP was launched in 2000, adaptive management was embraced as a means of incorporating new information into the plan and addressing unforeseen issues related to the plan. Since that time, a framework for CERP adaptive management has been developed, and a structure for implementation at a project-level adopted, but the original vision of adaptive management at the program level remains unfulfilled.

The CERP has made progress by developing the Program-Level Adaptive Management Plan, which identifies critical uncertainties affecting restoration progress. The plan asks highly relevant questions about CERP-related storage, design and implementation, and climate change, many of which can and should be addressed now through new research and modeling in addition to ongoing monitoring. However, no actions have been taken to carry out the plan. Doing so would require an implementation strategy to address the highest priority uncertainties and identify tasks, timelines, resources, and staffing needs.

New understanding of the Everglades historic hydrology, climate change, and sea-level rise suggests that a reexamination of the CERP restoration goals—including both ecology and hydrology—is in order, together with a realistic assessment of what can be achieved. Reaching these restoration goals necessitates quantitative restoration objectives, which reflect the inherent tradeoffs that must be made in any complex ecosystem restoration program, to support effective planning, implementation, and assessment. An effort is now needed to develop and adopt quantitative interim

goals that capture knowledge gained since the CERP was launched.

Finally, a systemwide analysis of the potential future state of the Everglades ecosystem, with and without future CERP restoration projects, particularly those with uncertain feasibility, needs to be conducted in conjunction with a CERP Update, which is long overdue. The CERP Programmatic Regulations requires a CERP Update—"an evaluation of the restoration plan using new or updated modeling that includes the latest scientific, technical, and planning information"—be conducted at least every 5 years. However these have not been routinely conducted. This analysis also should consider various scenarios for climate changes and sea-level rise and explore the ecosystem implications of various options for future CERP implementation, all of which should be help inform decision makers about the implications of near-and long-term decisions. The report states that such analyses should not slow the pace of restoration progress and that implementation of authorized projects should continue.

Challenges identified by this analysis may illuminate the need for modifications, either in future project planning or in the restoration objectives and goals themselves. Although some might consider that illuminating such issues makes complex stakeholder interaction even more difficult, failing to confront these problems in a science-based, objective manner can lead to even less desirable circumstances, including unrealistic expectations, litigation, and reduced support.

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For More Information . . . This Report Highlights was prepared by the Water Science and Technology Board and the Board on Environmental Studies and Toxicology based on the report *Progress Toward Restoring the Everglades: The Sixth Biennial Review—2016*. The study was sponsored by the Department of the Army; support was also provided by the Department of the Interior and the South Florida Water Management District. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the authoring committee and do not necessarily reflect those of the sponsor. Copies of the report are available from the National Academies Press, (800) 624-6242; **http://www.nap.edu**.

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