Progress Toward Restoring the Everglades:
The Fourth Biennial Review, 2012

Twelve years into the Comprehensive Everglades Restoration Project, little progress has been made in restoring the core of the remaining Everglades ecosystem; instead, most project construction so far has occurred along its periphery. To reverse ongoing ecosystem declines, it will be necessary to expedite restoration projects that target the central Everglades, and to improve both the quality and quantity of the water in the ecosystem. The new Central Everglades Planning Project offers an innovative approach to this challenge, although additional analyses are needed at the interface of water quality and water quantity to maximize restoration benefits within existing legal constraints.

Historically, Florida's Everglades encompassed about 3 million acres that stretched from Lake Okeechobee to Florida Bay, and its sawgrass plains, wetlands, ridges, sloughs, and tree islands supported a rich array of plant and animal life. However, over the past century the ecosystem has been greatly altered by an extensive water control infrastructure designed to provide flood control and water supply for urban and agricultural development. Today, the remnants of the original Everglades compete for vital water with urban and agricultural interests and are impaired by contaminated runoff from these two activities.

The Comprehensive Everglades Restoration Project (CERP), a joint effort led by the state of Florida and the federal government, was launched in 2000. The project was originally envisioned as a 30- to 40-year, $8-billion effort to restore the hydrologic characteristics of the Everglades and create a water system that serves the needs of both the natural and the human systems of South Florida. This report is the fourth in a series of biennial National Research Council reports that review the Comprehensive Everglades Restoration Project's progress toward restoring the natural system.

Restoration Progress

Over the past two years, notable progress has been made in launching CERP restoration projects, with eight projects now under construction. However, little progress has been made on CERP projects that would benefit the core of the Everglades ecosystem—specifically, the Water Conservation Areas and Everglades National Park (see Figure 1).

Stormwater treatment areas and the implementation of best management practices have helped reduce the loads of phosphorus flowing into the central Everglades, and the state and federal governments have recently agreed upon additional efforts to meet Everglades water

LEGEND

🔴 Project construction ongoing

🟧 Project construction not yet begun, or pilot project

1. C-43 Basin Storage Reservoir
2. Hillsboro ASR Pilot; Site 1 Impoundment
3. L-31N (L-30) Seepage Management Pilot
4. Kissimmee ASR Pilot
5. Biscayne Bay Coastal Wetlands
6. Picayune Strand Restoration
7. IRL-S C-44 Reservoir/STA
8. C-9 Impoundment
9. C-11 Impoundment
8,9. WCA 3A-3B Seepage Management
10. C-111 Spreader Canal; Design Test
11. Loxahatchee River Watershed
12. Decomp; Decomp Physical Model
13. ENP Seepage Management
14. Lake Okeechobee Watershed
15. Lakeside Ranch STA

Figure 1. CERP projects implemented so far have been located on the periphery of the remnant Everglades. Projects actively under construction are noted with a red circle, and pilot projects and projects with plans to begin construction by 2020 are marked with an orange square. © International Mapping Associates

Box 1. Challenges at the Interface of Water Quality and Water Quantity

Ecosystem problems in the Everglades stem from altered hydrology and impaired water quality. Changes in hydrology make some areas often too dry and others too wet. The slow flow of water that characterized the original Everglades ecosystem now occurs only in some areas, when sufficient water is available. Some areas of the ecosystem have become isolated (compartmentalized), limiting the water flow that is necessary to support historical landscape features.

At the same time, water quality issues resulting from runoff from agricultural and urban areas disrupt the ecosystem, raising phosphorus and nitrogen levels far above historical levels. In recognition of these impacts, a phosphorus criterion of 10 parts per billion was established for water quality in the Everglades. Increasing the volume of water flow into the Everglades, or even redistributing existing water, before water quality is improved risks introducing contaminants that could have significant impacts on the ecosystem and possibly exceed legal limits.

on water quality at the expense of water quantity, or vice versa, the report's authoring committee assessed ten ecosystem attributes of the remnant Everglades. Three stressors (total phosphorus loads, interior phosphorus concentrations, and soil phosphorus levels) were considered along with seven attributes reflecting ecosystem conditions (cattail, periphyton, fish mercury concentrations, peat, ridge and slough topography, tree islands, and snail kites; see Box 2). The committee assigned a letter grade to each attribute based on its current state relative to the pre-drainage Everglades ecosystem and described its current trend. The committee also assessed the future trajectory of each ecosystem attribute under three restoration scenarios: improved water quality, improved hydrology, and improvements to both water quality and hydrology (see Table 1). For most attributes, grades ranged from C (degraded) to D (significantly degraded), but the snail kite received a grade of F (near irreversible damage). The grades are not intended to prioritize restoration of a single attribute to the detriment of others, but to highlight the urgency of restoration actions that could benefit a wide range of ecosystem attributes and demonstrate the cost of inaction.

quality standards. However, there has been minimal progress in restoring hydrology in the remnant Everglades—that is, restoring the water flow volumes and velocities, depth, and duration that sustain the distinctive terrain of the Everglades, including ridge and slough topography, tree islands, and the peat that underlies much of the system (see Box 1).

Recent state budget cuts, combined with financial responsibilities associated with new water quality projects, threaten to slow hydrologic restoration progress even further. As a result, the federal government is likely to bear increased responsibility for maintaining the pace of CERP progress in the near term. To date, the state has vastly outspent the federal government on Everglades restoration projects and associated land acquisition. Additional Congressional authorizations will be needed to officially credit the state for much of this spending.

Assessing Ecosystem Attributes

To better understand the potential implications of the current slow pace of progress and project sequencing that focuses

Box 2. Everglades Ecosystem Attributes

- **Cattails** are plants that grow in freshwater wetland ecosystems. The extent of cattail cover in the Everglades is expanding at the expense of other native plants due to water inflows with elevated phosphorus levels.

- **Periphyton** is a mixture of algae and bacteria found in most aquatic ecosystems that serves as food for invertebrates, fish, and tadpoles. Once abundant throughout the Everglades, high phosphorus levels have reduced periphyton.

- **Fish mercury** concentrations are an indicator of mercury and sulfate contamination in Everglades waters. Mercury contamination originates from atmospheric emissions, and under elevated sulfate levels, mercury is converted to methyl mercury, which accumulates up the food chain.

- **Peat soil** is a natural feature of the Everglades, but as the landscape dries out due to overdrainage, the depth of peat is decreasing.

- **Ridge and slough topography,** with parallel sawgrass-covered ridges and sloughs that nearly always contained water under historical conditions, once covered about 1.5 million acres and helped sustain fish, alligators, and wading birds. Reduced water depths and compartmentalization that has reduced or eliminated sheet flow, have degraded the ridge and slough topography.

- **Tree islands** are small forested islands of slightly raised topography scattered irregularly throughout the ridge and slough landscape that provide habitat for a range of wildlife. Changes in hydrology and the fire regime have led to the loss of many tree islands.

- **Snail kites,** birds of prey that are endangered in South Florida, need specific hydrologic conditions to thrive. Although kites can readily move to find favorable habitat and food, recent declines in Everglade snail kite numbers demonstrate that much of their original habitat in the entire Everglades ecosystem is now significantly altered from its natural state.

Attribute	Current "Grade" of System, A-F	Current System Trend	(1) Effect of Improved Water Quality	(2) Effect of Improved Hydrology	(3) Effect of Improved Water Quality and Hydrology	Timescales of Recovery
Stressors						
Total phosphorus load	C	Stable to Improving	++	--	+	Years
Interior total phosphorus concentration	B to C	Stable to Improving	++	-	+	Decades
Soil phosphorus	C	Stabilizing	+	--	+	Decades to centuries
Ecosystem condition						
Cattail	C	Degrading, but degradation slowing in some areas	+	--	+	Decades to centuries (if actively managed)
Periphyton	C	Stable	++	--	+	Years. Recovered communities may not be the same as prior to disturbance
Peat	D	Degrading in dry areas	0	++	++	Centuries
Tree islands	D	Degrading	0	+	+	Decades to centuries: may require active restoration
Ridge and slough	D	Degrading	0	+	++	Centuries; could involve adaptive management
Snail kite	F	Degrading	0	+	+	Years to irreversible
Fish mercury	D	Stable	-	+	+	Years to decades

Table 1. In a new analysis, the report's authoring committee provided "grades" on current ecosystem conditions relative to pre-drainage conditions, and assessed current trends. Additionally, the committee compared the consequences of three restoration scenarios—(1) improved water quality with no increase in flow, (2) improved hydrology, with no additional water quality treatment, and (3) both improved hydrology and water quality. The table is, by necessity, a simplification of complex ecosystem responses.

Key: "Grades" are based on an assessment of the current level of impairment of that ecosystem attribute relative to a pre-drainage state. A: No significant degradation; B: Evidence of degradation; C: Degraded; D: Seriously degraded; F: Near irreversible degradation. The following reflect responses to the three scenarios relative to the current system trend: ++: Major improvement in trend; +: Minor to moderate improvement in trend; 0: No change; -: Minor to moderate decline in trend; - -: Major degradation in decline in trend.

Understanding Ecosystem Trajectories

The committee's analyses demonstrate that a scenario focused only on improving the quality of existing water flows would reduce the spread of cattails and enhance periphyton recovery. Peat loss, however, would continue in over-drained areas, and tree islands and ridge and slough topography would continue to decline. Most of these losses would require decades to centuries to recover, even under ideal conditions.

In contrast, if restoration projects focus only on hydrology, minor to moderate improvements could be expected for the trajectories of ridge and slough, tree islands, fish mercury, and snail kites, and major improvements for peat accumulations. However, these improvements would be accompanied by major expansions in cattails and the continued accumulation of soil phosphorus. These conditions could persist for decades to centuries, because high soil phosphorus levels will continue to impact vegetation—even if

phosphorus concentrations in inflow waters improves—until the soils are buried by less contaminated organic matter.

Improving both water quality and quantity would yield improvements in every ecosystem attribute investigated, but depending on the implementation schedule could take some time to achieve.

Support for Decision Making

Models that integrate hydrology, water quality, and ecology are essential tools to understand and evaluate the benefits and impacts of various restoration options. Progress has been made in developing linked hydrologic and ecological models, but no ecological models have been approved for use in benefits analysis for CERP. Water quality models applied to project planning should analyze a range of inflow water quality conditions, including those that exceed targeted levels. Being overly cautious with respect to water quality modeling and analysis could prevent a thorough exploration of restoration options and limit the understanding of water quality constraints on hydrologic restoration projects.

An impressive and growing body of scientific literature on the Everglades has been published in recent years, and recent science syntheses have helped advance understanding among scientists and decision makers. However, clearer acknowledgement of conflicts and tradeoffs among the restoration solutions being considered would help increase success.

To further support decision making, a comprehensive assessment of monitoring efforts is needed to ensure that short- and long-term needs of the CERP restoration program are met, and that critical gaps are addressed in the most cost-effective manner.

A Path Forward

Overall, the committee concluded that a focus on restoring the central core of the historical Everglades is needed to reverse ongoing degradation before it's too late. Avoiding costly and unproductive delays in the project planning and authorization process will be important to maintain the pace of progress. The committee is encouraged by the Central Everglades Planning Project, a new initiative that expedites the planning of the next increment of projects focused on the core of the remnant Everglades. However, key challenges remain, particularly at the interface of water quality and quantity. Rigorous analysis involving integrated models and field data is needed to clarify potential conflicts between restoration objectives and to identify interim strategies for limiting further degradation of critical ecosystem components and maximizing restoration benefits.

Read this report and locate information on related reports at

http://dels.nas.edu/wstb

Permission granted to reproduce this brief in its entirety with no additions or alterations.
Permission for images/figures must be obtained from their original source.

EXPERT
CONSENSUS
REPORT