

Review of the Everglades Aquifer Storage and Recovery Regional Study

THIS REPORT REVIEWS AN 11-YEAR REGIONAL STUDY carried out by the U.S. Army Corps of Engineers and the South Florida Water Management District to assess the regional effects of large-scale aquifer storage and recovery (ASR) in the Florida Everglades. The regional study represents a significant advancement in the understanding of large-scale implementation in South Florida; however, there are still many uncertainties that merit additional study before large-scale ASR is implemented. Phased implementation of ASR could provide incremental near-term storage benefits while also addressing the critical uncertainties that remain.

The Florida Everglades, a unique aquatic ecosystem that is home to 67 threatened and endangered species, has been greatly altered over the past century by water management to support agricultural and urban development. The Comprehensive Everglades Restoration Plan, launched in 2000, is a joint effort led by the state and federal government to reverse the decline of the ecosystem.

Increasing water storage is a critical component of the Everglades restoration, because extensive canal drainage and development over the past century greatly reduced natural water storage in the system. In addition to surface reservoirs, the restoration plan included 333 ASR wells that would store up to 1.7 billion gallons of water per day, for recovery and use during dry periods.

Aquifer storage and recovery has been used successfully in Florida since 1983, but not at the large scales proposed in the Everglades restoration program. To address uncertainties regarding the regional effects of large-scale ASR in the Everglades, the U.S. Army Corps of Engineers (USACE) and the South Florida Water Management District conducted an 11-year Regional Study that focused on the hydrogeology of the Florida aquifer system, water quality changes during aquifer storage, possible ecological risks posed by recovered water, and the regional capacity for implementing ASR.

At the request of the USACE, the National Research Council's Water Science and Technology Board convened a committee of experts to review

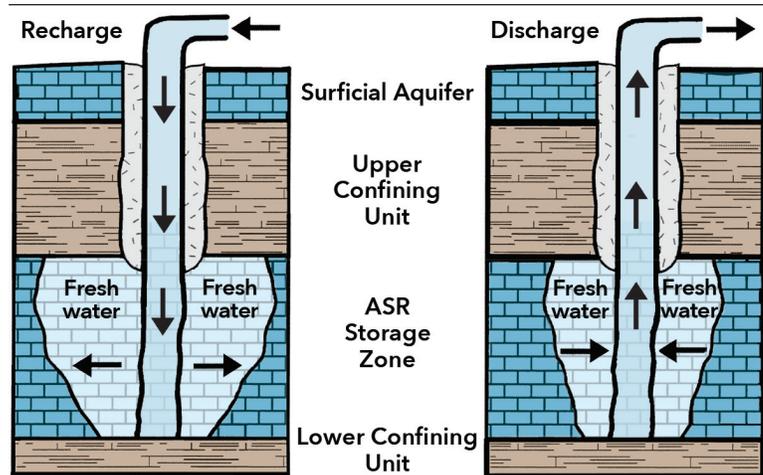


Figure 1. Recharge and discharge of water from a typical South Florida aquifer storage and recovery well. Source: National Research Council.

the Regional Study Technical Data Report and assess progress towards reducing uncertainties related to full-scale ASR implementation. The committee was not asked to provide recommendations on the appropriate role of ASR in the Everglades restoration.

WHAT THE REGIONAL STUDY FOUND

The Regional Study included literature syntheses, laboratory testing, and field scale experimentation primarily at two pilot ASR sites, and represents a significant advancement in the understanding of large-scale ASR implementation in South Florida. The study included the development of a regional groundwater model, which enabled simulations indicating that only about 131 wells can be operated without significant regional effects on well pressure and groundwater heads—far fewer than the number originally envisioned in the Everglades restoration.

ADDRESSING UNCERTAINTIES

The committee agrees with the Regional Study's finding that there are no "fatal flaws" in the use of ASR for restoration, but there are still many uncertainties that merit additional study. The committee identified five research areas as the highest priorities to inform restoration decision making:

- **Operations to Maximize Recovery and Reduce Water Quality Impacts.** More research is needed to assess improvements in recovery efficiency and recovered water quality that could result from establishing a fresh-water buffer zone. An established buffer zone could lessen the ecotoxicity of recovered water although it could also expand the zone of near-term arsenic mobilization.
- **Ecotoxicology and Ecological Risk Assessment.** Some of the largest uncertainties remaining after the ASR Regional Study are associated with the ecological risks of ASR in the Everglades. Chronic toxicity testing and regional water quality modeling suggest there could be ecological hazards associated with using recovered aquifer water in the Everglades. Further analysis is needed, for example considering factors such as longer storage times and greater recharge volumes, the use of a fresh-water buffer zone, and more ASR sites. Ecotoxicological testing should be designed to account for the fact that water from ASR operations will primarily be recovered during dry, low-flow conditions.
- **Understanding Phosphorus Reduction Potential.** Removal of phosphorus represents a key unexplored benefit of ASR, and more research is needed to examine the long-term rates and extents of subsurface phosphorus removal under various aquifer conditions.

- **Disinfection.** Disinfection permitting requirements were not uniformly achieved during the pilot studies due to high organic matter in the recharge water. Additional work is needed to develop appropriate pretreatment strategies without hindering subsurface biogeochemical processes that attenuate dissolved arsenic. Research is also needed on pathogen survival considering a wider suite of pathogens under groundwater conditions, and this information needs to be coupled with an understanding of groundwater travel times and the locations of potential human exposures to determine the level of disinfection necessary to protect human health.
- **Cost and Performance of ASR Compared to Alternatives.** Decision makers are unlikely to support continued research on ASR without clear documentation of the potential benefits, relative to other possible water storage alternatives. Thus, a comparative cost-benefit assessment for water storage alternatives, including integrated operation of ASR wells and surface storage reservoirs, is an important next step.

These high priority uncertainties can be resolved through research at a range of scales, from laboratory testing and computer modeling to expansion of the current pilot sites. Although current uncertainties are too great to justify the large-scale implementation of ASR in the Everglades, opportunities exist to target future phased implementation of ASR to provide some early restoration benefits. Until the uncertainties related to ecological effects are resolved, any new ASR wells should be sited next to large water bodies with adequate mixing zones to minimize adverse ecological impacts.

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The National Academies appointed the above committee of experts to address the specific task requested by the U.S. Army Corps of Engineers Jacksonville District. The members volunteered their time for this activity; their report is peer-reviewed and the final product signed off by both the committee members and the National Academies. This report brief was prepared by the National Research Council based on the committee's report.

For more information, contact the Water Science and Technology Board at (202) 334-3422 or visit <http://dels.nas.edu/wstb>. Copies of *Review of the Everglades Aquifer Storage and Recovery Regional Study* are available from the National Academies Press, 500 Fifth Street, NW, Washington, D.C. 20001; (800) 624-6242; www.nap.edu.

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