

Memorandum

To: Water Supply Advisory Committee members
From: Allison Ebbets and Karen Raucher, Stratus Consulting Inc.
Date: 6/1/2015
Subject: Aquifer Storage and Recovery, Lessons Learned from the Florida Everglades

1. Introduction

Just after the last WSAC meeting, the National Research Council of the National Academies of Science (NRC) released a report reviewing results from an 11 year study of aquifer storage and recovery that had been initiated as part of Everglades restoration initiative. While substantially different in scale, the NRC report makes interesting reading because of the wide-ranging topics covered and the structure of the report which emphasizes the results of the work to date and the remaining uncertainties. The technical team is providing a summary of this report for the WSAC's information.

The NRC document is being added to the WSAC website and the Water Department can provide Committee members with an electronic or printed copy of the report should anyone want one.

This memorandum summarizes the study design and results of the proposed Florida Everglades aquifer storage and recovery (ASR) project. It includes an overview of the Everglades ASR study and summarizes the following study components: study questions posed, steps taken to answer questions, and remaining uncertainties.

2. Florida Everglades ASR Evaluation

ASR is proposed as a restoration option in the Comprehensive Everglades Restoration Plan as a method for increasing water storage in the Florida Everglades. The original project proposal was to drill 333 ASR wells that would store up to an estimated 1.7 billion gallons per day.

The U.S. Army Corps of Engineers (USACE) and the South Florida Water Management District (SFWMD) conducted a \$25 million, 11-year regional study to evaluate the feasibility of implementing ASR. After the study technical report was released, the National Research Council (NRC) convened a committee to review and evaluate the study and its findings. They found that no "fatal flaws" have been discovered but the proposed project has many uncertainties that warrant additional study before large-scale ASR can be implemented (National Research Council of the National Academies, 2015). The final ASR Regional Study is expected to be released in summer 2015, and next steps for this project are not yet in place but likely involve ongoing research to address remaining uncertainties identified by the NRC (SFWMD, 2015).

Section 2.1 summarizes the questions used to frame the Florida Everglades ASR evaluation, Section 2.2 summarizes the steps taken to answer those questions, and Section 2.3 summarizes the questions and uncertainties identified at the end of this 11-year study.

2.1 Questions Used to Frame the Florida Everglades ASR Evaluation

To initiate the study, the evaluation team (USACE and SFWMD) identified seven technical issues that required investigation before ASR could move forward in the Florida Everglades:

1. Suitability of prospective source waters considering spatial and temporal variability in water quality
2. Characterization of the regional hydrogeology of the Upper Floridan aquifer
3. Understanding of the potential for rock fracturing
4. Site and regional changes in head and patterns of groundwater flow
5. Water-quality changes during movement and storage in the aquifer
6. Effects on mercury methylation and bioaccumulation in the Everglades ecosystem
7. The relationship between hydrogeologic properties and recovery and recharge volumes.

2.2 Steps Taken to Answer Evaluation Questions

To answer the above questions, researchers used a combination of modeling, literature review, and site-specific data taken from pilot studies. Five pilot study sites were planned and authorized, but only two were implemented (the other three were limited by funding and poor site conditions).

The pilot studies were designed to evaluate the following elements:

- ▶ Water quality changes
- ▶ Local hydrogeology
- ▶ Recharge and recovery performance
- ▶ Effects on hydraulic head and local groundwater flow
- ▶ Costs
- ▶ Energy use
- ▶ Cost/energy use with single and multiple monitoring wells
- ▶ Surface water and groundwater quality.

The NRC reviewed these pilot project study designs and recommended revising the study designs to include the following research questions:

- ▶ Aggregating hydraulic effects in a regional context
- ▶ Performance under long (> 1 year) recharge periods
- ▶ Subsurface geochemical changes
- ▶ Ecotoxicological effects on downstream receptors.

In response, USACE and SFWMD initiated a regional study to complement the site-specific ASR pilot studies. As part of this regional study, the project team developed a regional groundwater model of the Upper Floridan aquifer system to help assess the feasibility of the proposed 333-well ASR system.

2.3 Remaining Questions

Following 11 years of study and more than \$25 million invested, the project team found no “fatal flaws” with implementing ASR in the Florida Everglades, but the sponsors must address a number of outstanding uncertainties and questions before it could be implemented. Further, they found that ASR is feasible for only a small subset (approximately 131 wells) of the original 333-well ASR system proposed in the restoration plan.

The study team identified a wide range of uncertainties related to nearly all aspects of ASR implementation that must be resolved before ASR could be implemented. The team identified the five highest-priority uncertainties:

1. Operations to maximize recovery and reduce water quality impacts
2. Ecotoxicology and ecological risk assessment
3. Understanding phosphorous reduction potential
4. Disinfection
5. Cost and performance of ASR compared to alternative water storage methods.

The study team also identified a wide range of important uncertainties and questions related to hydrology, recharge recovery, hydraulic fracturing potential, groundwater flow and capacity, water quality (including issues about ultraviolet disinfection and with respect to specific contaminants), cost of water storage alternatives, and overall integration of the regional study topics that should be resolved before ASR is implemented.

Perhaps the most significant barrier to moving forward at this time is the question of cost performance and future funding for resolving uncertainties. The project team notes that without a comparison of ASR to other water storage options, it is unlikely to receive more funding to move forward with future uncertainty analyses.

3. Conclusion

ASR has many potential benefits but is associated with many uncertainties, especially if considered on a broad, regional scale. Determining, investigating, and answering the questions necessary to demonstrate that the technology is feasible, safe, and effective is a complex and challenging undertaking. The Florida Everglades evaluation is a good example: the project team took a systematic approach to identifying and evaluating potential issues and after 11 years and \$25 million, the team has learned a lot but is left with complex and challenging uncertainties to consider before ASR can be implemented.

References

National Research Council of the National Academies. 2015. *Review of the Everglades Aquifer Storage and Recovery Regional Study*. Prepared by the Committee to Review the Florida Aquifer Storage and Recovery Regional Study Technical Data Report Water Science and Technology Board Division on Earth and Life Studies.

SFWMD. 2015. Aquifer Storage and Recovery. South Florida Water Management District. Available: <http://www.sfwmd.gov/portal/page/portal/xweb%20-%20release%203%20water%20supply/aquifer%20storage%20and%20recovery>. Accessed May 28, 2015.