

Comprehensive Everglades Restoration Plan

AQUIFER STORAGE AND RECOVERY REGIONAL STUDY

Project Management Plan, August 2003

Executive Summary

In April 1999, the Comprehensive Everglades Restoration Plan (CERP) proposed large-scale development of Aquifer Storage and Recovery (ASR) facilities as the preferred method of providing additional freshwater storage required for overall restoration success. Six ASR components will collectively form the proposed CERP ASR System, which includes a total of 333 ASR wells and related surface facilities at the general locations in attached Figure A. All proposed ASR wells have a target capacity of 5 mgd (million gallons per day). Water treatment facilities were also included in the conceptual CERP ASR components. Total cost of the proposed CERP ASR System is approximately \$1,700,000,000. The United States Army Corps of Engineers (USACE), Jacksonville District and the South Florida Water Management District (SFWMD) are 50/50 cost sharing partners for design studies required prior to implementation of any large-scale CERP ASR facilities.

An independent scientific review of the conceptual CERP ASR System was completed in July 1999 by the ASR Issue Team, which was formed at the request of the South Florida Ecosystem Restoration Task Force's Working Group. Later the Working Group also engaged the National Academy of Sciences' Committee for the Restoration Of the Greater Everglades Ecosystem (CROGEE) to review preliminary drafts of the project management plans (PMPs) for the Lake Okeechobee and Hillsboro ASR Pilot Projects, which resulted in their report dated February 2001. The ASR Issue Team identified seven broad technical uncertainties related to ASR implementation on the unprecedented scale proposed in the CERP. These seven issues are listed in Table 1, which also identifies proposed local-scale (pilot project) and regional-scale scientific studies designed to address these issues. The CROGEE concluded that additional scientific studies are needed, including work to improve understanding of the regional hydrogeology, hydraulic properties, potential changes in water quality, and the effects, if any, of those changes on aquatic ecosystems.

Local-scale studies have been initiated in the form of three ASR Pilot Projects as recommended in the CERP. In general terms, these pilot project studies will develop site-specific data related to local water quality and hydrogeology, identify appropriate water treatment processes, and determine the feasibility

of 5 mgd capacity ASR wells at each pilot location. Figures in Appendix B of this PMP show the locations and summarize the details of the Lake Okeechobee, Hillsboro and Caloosahatchee ASR Pilot Projects. As noted above, the CROGEE ASR subcommittee previously reviewed the draft PMPs for the Lake Okeechobee and Hillsboro ASR Pilot Projects. Their report, dated February 2001, provided a technical critique of the ASR Pilot Project studies and strongly concurred with the USACE and SFWMD plan for a concurrent ASR Regional Study to address ASR issues beyond the limited geographic scope of the pilot projects.

The CERP ASR Regional Study PMP has been prepared in response to the need for additional scientific studies to address potential regional impacts related to the unprecedented large scale of the proposed CERP ASR System (333 wells). This PMP represents the collective efforts of a large interagency project delivery team (PDT) with representatives from the following local, state and federal government agencies that actively participated in its development:

Broward County Water Resources Management
Miami-Dade County Water and Sewer Department
Palm Beach County Water Utilities Department
South Florida Water Management District
Florida Department of Environmental Protection
Florida Geological Survey
Florida Department of Agricultural and Community Services
Florida Fish and Wildlife Conservation Commission
U.S. Department of Interior, Everglades Ecosystem Restoration Task Force
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
U.S. Geological Survey
U.S. Army Corps of Engineers

PDT members began PMP development by preparing the following mission statement:

“The ASR Regional Study will address issues beyond the scope of the ASR Pilot Projects. It will investigate regional, technical issues governing the feasibility of full-scale ASR implementation, as identified in the CERP, and its potential effect on water levels and water quality within the aquifer systems, and on existing water users, surface-water bodies, and the flora and fauna that inhabit them.”

Primary goals of the ASR Regional Study are to:

1. Address outstanding issues of a regional nature that cannot be adequately addressed by the authorized ASR Pilot Projects
2. Reduce uncertainties related to full-scale CERP ASR implementation by conducting scientific studies based on existing and newly acquired data and evaluate potential effects on water levels and water quality within the aquifer systems, and on existing users, surface-water bodies, and the flora and fauna that inhabit them.
3. Develop a regional groundwater model of the Floridan Aquifer System (FAS) and conduct predictive simulations to evaluate the technical feasibility of the proposed 333-well CERP ASR system, or if determined to be infeasible, identify an appropriate magnitude of ASR capacity with minimal impact to the environment and existing users of the FAS.

The PDT's plan to achieve these goals, as described in this PMP, is to identify and conduct a series of tasks that will develop scientific data to address each of the issues of concern. Many of these tasks are inter-related, and assist in addressing multiple issues. The tasks are focused on the scientific disciplines of hydrogeology, water quality, geochemistry, and ecology. A steering committee will be developed and convened as needed, ensuring the integration and refinement of these tasks to meet overall project objectives. Table 2 presents a summary of major tasks to be conducted in the ASR Regional Study, and cross-references these tasks with the issues raised by the ASR Issue Team.

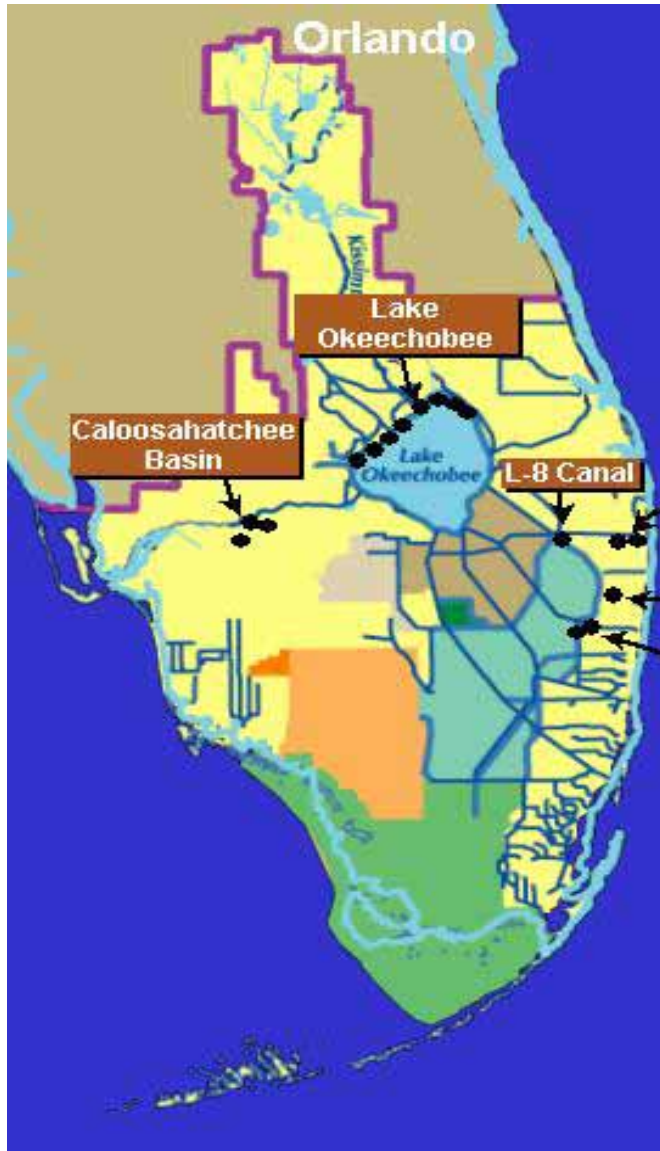
The USACE's plan formulation process will be conducted to provide the framework upon which the above-mentioned tasks are integrated. Plan formulation and evaluation criteria will be developed, followed by a preliminary evaluation of an ASR system configuration having minimal effects on the environment. This preliminary evaluation could provide a basis upon which a separate Project Implementation Report (PIR) effort to construct a "minimum number of ASR wells" is recommended. Following this, alternative ASR scenarios will be compared using regional groundwater models, with favorable scenarios further evaluated using the South Florida Water Management Model. RECOVER will evaluate each alternative for its ability to meet system-wide performance measures. If the PDT identifies a maximum CERP ASR configuration that does not meet system-wide performance needs, RECOVER will address the shortfall through the use of alternative storage technologies and/or optimized operations to be identified in a future CERP update document.

While the CERP did not directly call for an ASR Regional Study, the USACE and SFWMD agree that a coordinated central data collection and regional modeling effort is required to address large-scale ASR implementation issues.

In addition to budget amounts for the ASR Pilot Projects, the CERP April 1999 budget included a total of approximately \$128,000,000 for ASR related Planning, Engineering and Design studies for the six (6) proposed ASR components identified on Figure A. Funds for the studies outlined in this document will be provided from the established CERP ASR design budget. The ASR Regional Study described in this PMP will take roughly 9 years to complete and has a budgeted cost including contingency funds of approximately \$55,000,000. This study will conduct critical ASR related studies and develop scientific data required to help determine the scientific and engineering feasibility of large-scale ASR implementation as proposed in the CERP.

TABLE 1: Summary of ASR Issue Team Items

Issue Team Item	Pilots/Regional	Tasks
1. Characterization/Suitability of the Quality of Prospective Source Waters; Spatial and Temporal Variability	Pilot Projects	- Local Source Water Quality Characterization
	Regional Study	- Regional Water Quality Characterization
2. Characterization of the Regional Hydrogeology of the Upper Floridan Aquifer: Hydraulic Properties and Water Quality	Regional Study	- Regional Hydrogeologic Evaluation - Test/Monitor Well Drilling & Tests - Seismic Reflection Survey - Geochemistry Studies
	Pilot Projects	- ASR/Monitor Well Drilling, Background Water Quality
3. Analysis of Critical Pressure for Rock Fracturing	Regional Study	- Rock Fracturing Desk Top Analysis - Regional Groundwater Modeling
	Pilot Projects	- Laboratory Analysis of Cores
4. Analysis of Site and Regional Changes in Head and Patterns of Flow	Regional Study	- Regional Potentiometric Head (Literature Review) - Field Measurements - Regional Groundwater Modeling
	Pilot Projects	Potentiometric Head Measurements at ASR/Monitor Wells (Background and Cycle Testing)
5. Analysis of Water Quality Changes During Movement and Storage in the Aquifer	Pilot Projects	- Local Source Water Quality Characterization Program - Background Floridan Aquifer Water Quality - Cycle Testing Water Quality
	Regional Study	- Regional Groundwater Modeling - Geochemical Modeling
6. Aquifer Storage and Recovery Potential Effects on Mercury Bioaccumulation for South Florida Ecosystem Restoration Projects	Pilot Projects	- Local Source Water Quality Characterization Program - Cycle Testing Water Quality
	Regional Study	- Regional Water Quality Measurements
7. Relationship between ASR Storage Properties, Recovery Rates and Recharge Volume	Pilot Projects	- Specific Capacity Tests, Geophysical Logs, Cores - Cycle Testing Water Levels, Water Quality
	Regional Study	- Regional Groundwater Modeling - Geochemical Modeling



CERP ASR Regional Study

Purpose: To evaluate regional (program level) impacts of proposed large scale ASR implementation.

CERP ASR Sites	Wells
Lake Okeechobee	200
Caloosahatchee	44
L-8 Basin	10
C-51 Basin	34
Central PBC	15
Hillsboro	30
TOTAL	333

Note: Design Capacity for each ASR well = 5 million gallons per day (mgd).

TABLE 2: Relationship of ASR Regional Study Tasks to ASR Issues

TASK	ASR Issues Addressed						
	1	2	3	4	5	6	7
1.0 Build Inventory of Existing Data and Information. Task includes a comprehensive search for published and unpublished literature on topics related to regional geology (lithology, structure, stratigraphy, etc.), hydrogeologic framework (flow zones, leakance, transmissivity, etc.), testing results from existing ASR wells and ambient Floridan Aquifer System (FAS) water quality. Available data will be evaluated, appropriate data collected, and a database compiled.							
2.0 Evaluation of Methods. Scope includes a workshop plus expert assistance to evaluate available technologies for drilling, collection of core samples and downhole geophysical investigations.							
3.0 Define Preliminary Hydrogeologic Framework. The overall scope is the synthesis and interpretation of existing data on the geologic and hydrogeologic framework of the Floridan Aquifer System (FAS), and identification of areas needing additional data analysis. The main objective is to identify, and where possible, rectify areas of inconsistency.							
4.0 Geochemistry. Scope includes literature/data search, characterization of all components in ASR hydrogeochemical system, laboratory geochemical bench tests, geochemical reaction modeling, investigation of water/rock/microorganism interactions, comprehensive evaluation and report preparation.							
5.0 Pressure Induced Changes. Scope includes identification of engineering constraints and data gaps, model selection and development, and model runs for evaluation of potential pressure induced changes.							
6.0 Field Data Collection. Scope includes development of a data collection plan based data gaps identified in Task 3.0, drilling and testing of new wells, seismic reflection surveys, groundwater monitoring, tracer tests, testing of existing wells, and post cycle test logging and insitu dissolution experiments at 2 pilot project wells.							
7.0 Laboratory Analyses. Scope includes geotechnical testing, analyses of existing and new core samples and cuttings, geochemical analyses of rock matrix, and fracture trace analysis.							
8.0 Finalize Conceptual Hydrogeologic Framework. Task will consist of a detailed review of all findings from the field program, and evaluation and synthesis of that data with previous work to build a regional interpretation of the hydrogeologic flow system.							
9.0 Regional Groundwater Numerical Modeling. Scope includes selection of appropriate model code, development of regional and high resolution inset (subregional) hydrogeologic models, and model runs for analysis of potential site and regional changes in subsurface water pressures (heads) and patterns of flow for the conceptual CERP ASR System (333 wells) and, if needed, alternative ASR System configurations.							

<p>10.0 Surface Water Quality Data Analysis. Tasks will include identification of the study areas and relevant water quality criteria, characterization of potential ASR water supplies, compilation and evaluation of existing and new water quality data, and evaluation of potential environmental /health risk effects related to large-scale ASR implementation.</p>							
<p>11.0 Water Quality Monitoring of Source/Receiving Water Bodies. Scope includes development of a surface water quality monitoring plan plus source/receiving water data gap monitoring at five (5) ASR pilot well intake/discharge sites.</p>							
<p>12.0 Surface Water Quality Modeling. Tasks include Lake Okeechobee ecosystem modeling, ecological methylmercury modeling, pollutant fate/transport modeling, mass balance study and assessment of dissolved ions in recovered water.</p>							
<p>13.0 Ecological & Toxicological Field Studies. Scope includes screening bioassays, extended bioassay testing, biological monitoring of localized impacts (at ASR Pilot Projects), mercury methylation testing, fish/clam mesocosm studies, epidemiological study of fish consumption, and water treatment residuals management assessment.</p>							
<p>14.0 PROJECT REPORTS. Scope includes preparation of two (2) interim reports and a final report. Tentative schedule is for the first report in about three (3) years with subsequent reports on roughly the same schedule.</p>							