SPECIAL PUBLICATION SJ2012-SP7

EXPANDED EXECUTIVE SUMMARY
ORANGE COUNTY UTILITIES
AQUIFER STORAGE RECOVERY (ASR) SYSTEM

ST. JOHNS RIVER
WATER MANAGEMENT DISTRICT

Expanded Executive Summary
Orange County Utilities
Aquifer Storage Recovery (ASR) System

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Expanded Executive Summary
Orange County Utilities (OCU)
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1.0 Introduction

1.1 Purpose of Expanded Executive Summary

SJRWMD requested and authorized the preparation of an overall Expanded Executive Summary (EES) covering all phases of the Aquifer Storage Recovery System implemented in Orange County for Orange County Utilities. The EES is intended to represent the major work products and deliverables previously produced and submitted to SJRWMD and may be utilized as an example work product for future aquifer storage recovery (ASR) projects managed by the District.

1.2 Overview of District ASR Program

SJRWMD initiated the Aquifer Storage and Recovery (ASR) Construction and Testing Demonstration Program in 2002 and the first exploratory well drilling began in late 2003. The purpose of the program was to investigate the feasibility of ASR in the east central Florida region. ASR is considered a cost-effective technology for storing water that may only be available on a seasonal basis from new alternative water supply (AWS) sources. Due to potential impacts that continuous ground water withdrawals may have on natural features such as springs, lakes and wetlands; public supply utilities in the region are being required by SJRWMD to plan for and implement new AWS projects that utilize non-traditional sources, e.g. other than fresh ground water.

There were five active cooperators with whom SJRWMD proceeded with implementation of an ASR project on mutually agreed upon sites. Partnerships were formed through a Memorandum of Understanding (MOU) with each local government. SJRWMD also informally partnered with three other cooperators to investigate preliminary feasibility of ASR in their utility service areas. Two cooperators, City of Deland and Volusia County, each had two exploratory wells drilled as part of the ASR site selection effort.

The ASR program was investigated through three consultant contracts that were work-order based, utilizing Florida Forever funds. The work products prepared by these consultants included desktop studies, exploratory data collection, final design, permitting, construction, startup, training, and operational testing. Design and permitting work included engineering documents, plans, and specifications for five construction projects. The ASR program was technically challenging in the following areas:

- Approximately 50 permits of various types were required from local and state agencies, including delegated public water system permitting from the state (FDEP) to the county (Department of Health) for two projects in Volusia County.

- Design work included access roadway, pipeline, well and wellhead, instrumentation and control, water treatment, operations buildings, security features, power supply considerations, airport clearances, wetland avoidance, discharge to surface waters, storm water management, and easement acquisition.

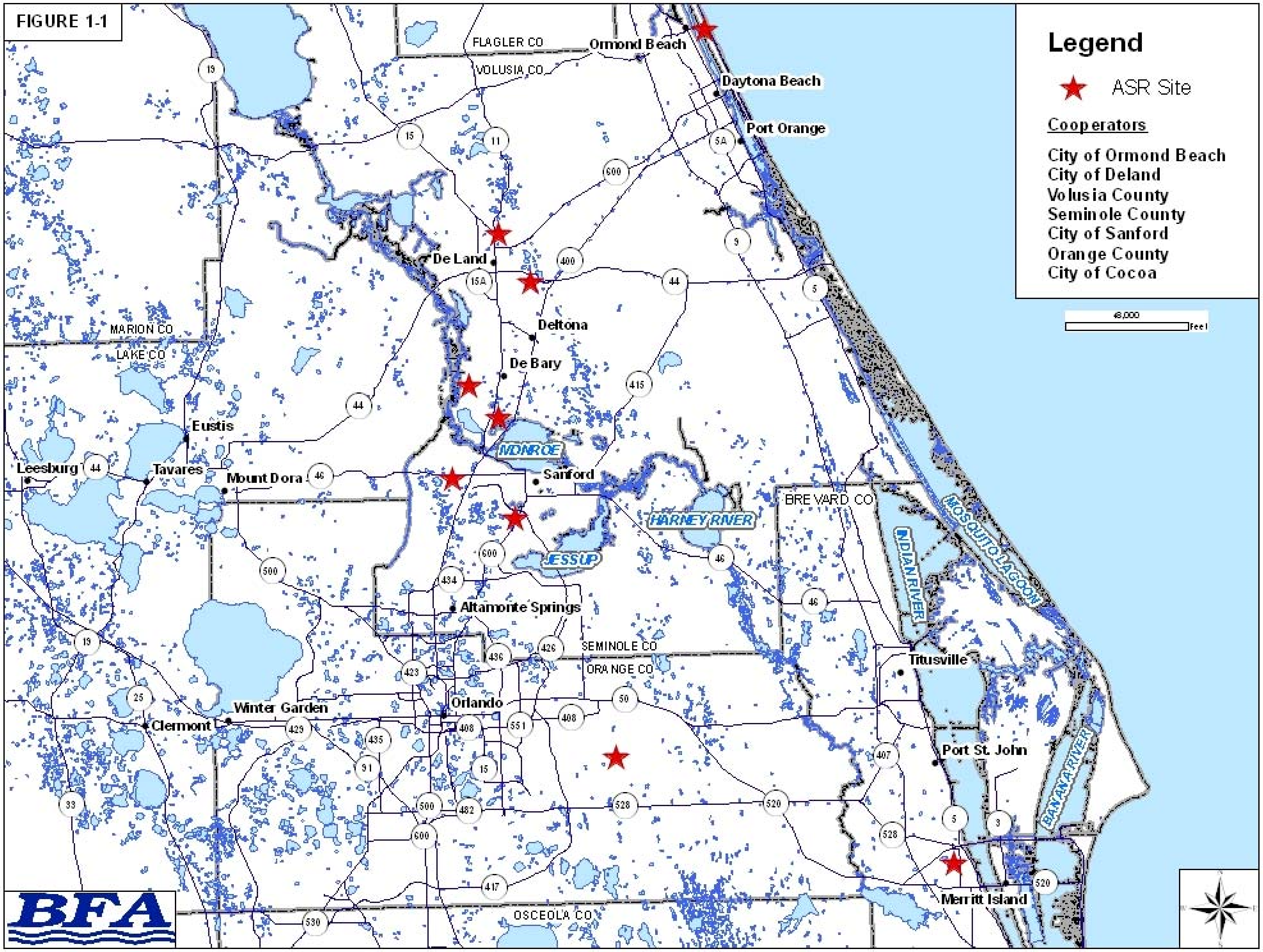
- Special accommodations related to utility master planning, roadway widening, phased construction, future water system expansion plans, and water quality considerations.

- Emerging regulatory issues, such as Administrative Orders and potentially Consent Orders from the FDEP Underground Injection Control program that address the potential for mineral leaching in the aquifer formation during operational testing.

- Detailed coordination with state agencies such as FDEP and Water Management District's, on mineral-leaching issues that have occurred in the aquifer, including assessment and monitoring of construction and O&M costs related to experimental approaches and new technologies for pre-treatment of source water.

Figure 1-1 illustrates cooperative ASR sites as part of the SJRWMD Aquifer Storage and Recovery Construction and Testing Demonstration Program.

FIGURE 1-1


Legend
★ ASR Site
Cooperators
City of Ormond Beach
City of Deland
Volusia County
Seminole County
City of Sanford
Orange County
City of Cocoa
48,000 Feet
FLAGLER CO
VOLUSIA CO
Ormond Beach
Daytona Beach
Port Orange
De Land
Deltona
De Bary
MONROE
Sanford
MARION CO
LAKE CO
Eustis
Leesburg
Tavares
Mount Dora
HARNEY RIVER
JESSUP
BREVARD CO
INDIAN RIVER
MOSQUITO LAGOON
Altamonte Springs
SEMINOLE CO
ORANGE CO
Titusville
Winter Garden
Clermont
Orlando
Port St. John
BANANA RIVER
Merritt Island
OSCEOLA CO
BFA

The Seminole County, City of Sanford, and Orange County Utilities (OCU) ASR design projects were completed in 2007, 2008, and 2009 respectively. Pretreatment was subsequently added to the Seminole County and City of Sanford projects. Cycle testing began for Sanford in February 2009 and for Seminole County and OCU in February 2010. The final design, permitting, and construction have been completed for the ASR project in the City of Deland and operational testing began in May 2010. The Volusia County project did not proceed through design and permitting but included monitor well construction and testing. The City of Ormond Beach site did not proceed with implementation due to unfavorable characteristics of the aquifer formation and the native ground water quality. The City of Titusville site did not proceed with an exploratory well due to economic constraints related to the source of water needed for testing the ASR system. The City of Cocoa will proceed with their ASR project independently from the District's demonstration program. Cycle testing by four utility cooperators, Seminole County, City of Sanford, City of Cocoa, and Orange County Utilities, has continued beyond the conclusion of the SJRWMD consultant contracts. Preliminary conclusions related to cycle testing results and long term feasibility of ASR will be briefly addressed in this Expanded Executive Summary for the Orange County project.

The Orange County Utilities ASR project was designed, implemented, and managed by Barnes, Ferland and Associates, Inc. (BFA) and its sub-consultants, CH2M HILL and ASR Systems, LLC. The BFA team provided hydrogeologic and engineering services for the planning, design, permitting, and construction activities. Diversified Drilling Corporation was selected as the project's drilling contractor and Wharton-Smith, Inc. provided general contractor services for the surface facilities. Water quality analysis was provided by Orange County Utilities Central Laboratory and PC & B Laboratory and geophysical logging services were provided by Advanced Borehole Services.

1.3 Project Timeline

The ASR program is structured in several phases/tasks that continued to advance if the assessment of each phase indicated that the project was feasible. The preparatory work for this ASR system was conducted under the Desktop Assessment and Aquifer Storage Recovery for Orange County by BFA Environmental in 2003 and submitted for review and approval. A site at OCU's Eastern Water Reclamation Facility (EWRF) was selected for further evaluation. An exploratory well was constructed and tested to determine the initial subsurface data required for eventual ASR and monitor well designs. A summary report (Aquifer Storage Recovery Exploratory Well Project Report, BFA, 2006) was prepared and peer-reviewed, and recommendations were made to further implement an ASR pilot scale system at the EWRF site. The ASR pilot scale system was constructed in 2009 and is currently in the Large Scale Cycle Testing Phase, which is scheduled for completion in early 2011. Below is a list of each phase/task as authorized by the District:

Task 1 – ASR Construction and Testing Program Plan was utilized by policy makers and the Cooperators; it included a description of evaluation criteria for the projects and a preliminary listing of regional candidate projects. The OCU Program Plan was completed and submitted in April 2002.

Task 2 – Desktop Assessment of ASR Program for OCU included a project feasibility assessment based on the approach described in SJRWMD Special Publication SJ97-SP4 titled A Tool for Assessing the Feasibility of Aquifer Storage Recovery (CH2MHILL, 1997). The assessment report was completed and submitted in 2003.

Task 3 – Cooperator Agreement established the objectives of the project and the responsibilities of SJRWMD and OCU; it is finalized by a Memorandum of Understanding (MOU) between both parties. The OCU MOU was completed and signed in May 2004.

Task 4 – Preliminary Basis of Design and Site-specific data collection served as the preliminary basis of design to guide the design team during the preparation of plans and specifications for pricing, construction and the permitting process. The site specific Preliminary Basis of Design plan was completed and submitted in September 2006.

Task 5 – ASR Pilot Project Design provided a recommended construction and testing plan for the ASR well and associated monitoring wells; one lower Floridan ASR well (ASR-LF-1), two shallow monitoring wells (SA-2 and SA-3) completed in the Surficial aquifer, one confining zone monitoring well (CZ-MW-1) completed to a total depth of 950 feet bls and two lower Floridan monitoring wells (LF-MW-1 and LF-MW-2) completed to a total depth of 1,200 feet bls. The CZ-MW-1 and LF-MW-2 will be completed as a dual zone monitor well at one location. The ASR Pilot Project Design report was completed and submitted June 2007.

Task 6 – Regulatory Permitting required adherence to all the necessary regulatory permitting requirements. The primary permitting effort was through FDEP; the first draft of the UIC permit was issued in November 2007. The FDEP issued the UIC in March 2008, The FDEP PWS permits WC48-0080780-748, WD48-0080780-749, and WC48-0080780-750 were issued in October 2007, September 2007, and October 2007 respectfully. Final clearance from FDEP was received for the PWS permits WC48-0080780-748, WD48-0080780-749, and WC48-0080780-750 on January 11, 2010, January 7, 2010, and January 13, 2010 respectively.

Task 7 – ASR Facilities Construction, Monitoring, and Testing included construction of ASR and monitor wells, and associated wellhead facilities. Well drilling activities started in March 2005 and ended in October 2009, including the shallow monitoring wells SA-2 and SA-3, the dual monitoring wells and the Lower Floridan ASR well. Construction on the surface facilities including ASR Wellhead, all above ground piping, installation of ASR vertical turbine pumps, installation of dual zone pumps, installation of instrumentation and controls, ASR Pre-fabricated building, chemical metering pumps and chemical storage tank was initiated in January 2009 with a notice to proceed issued to Wharton-Smith Construction Group. Construction was completed in December 2009 with final completion being issued in February 2010.

Task 8 – Startup and Training activities were completed during the construction and testing phase of the surface facilities. BFA/ASR Systems completed the ASR System start-up in November 2009 and conducted operational training of OCU staff on November 23 and 24 2009.

Task 9 – Large Cycle Operational Monitoring and Evaluations. On January 29 2010 FDEP approved OCU's application to begin Pre-Cycle injection for the formation of the 'Buffer Zone'. OCU has since completed Cycle I Injection/Recharge, Storage, and Recovery. OCU implemented Cycle 2 Injection on June 22, 2010 and ended on August 3, 2010. Cycle 2 Storage started on August 11, 2010 and ended on September 18, 2010 for a total of 40 days. Cycle 2 Recovery started on September 19 2010 and ended on October 14, 2010 at a rate of 1,400 gpm for a total of 30 million gallons. OCU implemented the Cycle 3 Injection from November 1, 2010 to February 21, 2011**.** Injection was at a rate of 1,700 gpm through the pump column pipe for a total injection volume of 270 million gallons over 111 days. Cycle 3 Storage started on February 22, 2011 to April 6, 2011 for 45 days. Cycle 3 Recovery started on April 7, 2011 to April 18, 2011 at a rate of 1,500 gpm. From April 19, 2011 to August 19, 2011 the Recovery rate changed to 2,500 gpm. The Recovery Cycle schedule was 11:00 am to 7:00 pm and 11:00 pm to 5:00 am daily for 14 hrs/day. OCU has submitted ASR Performance and Sampling Reports to FDEP monthly since the beginning of Cycle Testing.

Task 10 – Peer Review of ASR Consultant Team Work
This task includes the review of work products produced by ASR consultant team members by other team members as considered necessary by SJRWMD.

1.4 Section Summaries

This EES supplements the previous reports submitted for each designated Task Authorization and is structured as follows:

- Section 1 – Introduction
    - Outlines the purpose of the Expanded Executive Summary, provides a background and overview of the development of the ASR systems in the SJRWMD and summarizes the relationships, timelines and costs associated with the development of ASR Systems.

- Section 2 – Program Plan
    - Provides an outline of the SJRWMD’s ASR program goals and objectives, framework for selecting ASR construction sites and testing projects, Project funding and project implementation.
- Section 3 – Desktop Assessment of ASR for OCU
    - Evaluation of OCU’s existing water supply facilities, water demands, water storage and ASR capacity, County wide and site specific hydrogeologic conditions and hydrogeology; including ASR feasibility analysis and conceptual ASR system design.
- Section 4 – Cooperator Agreement
    - Memorandum of Understanding between SJRWMD and Orange County Florida.
- Section 5 – Preliminary Basis of Design (site-specific data collection)
    - Basic operational concepts are evaluated with reference to site specific data including the design of the ASR Well and the associated monitoring wells.
- Section 6 – Project Design
    - ASR well and monitoring well designs and drilling techniques are discussed including the testing program, geophysical logging, the fluid management program and cycle testing.
- Section 7 – Regulatory Permitting
    - All required permits are discussed including the FDEP UIC permit, SJRWMD Consumptive Use permit and drilling permits.
- Section 8 – ASR Facilities Construction, Start-up, Monitoring and Training
    - Summarizes the construction and testing process for the ASR well and monitoring wells, the surface facilities and includes the startup training, O&M training, permit clearances, and transfer of facilities to the cooperator.
- Section 9 – Large Cycle Operational Monitoring and Evaluation (Ongoing)
    - Large cycle testing is currently in progress and will be summarized in this section along with details on the water quality data and OCU current operating plan for the ASR system.

- Section 10 – Preliminary Feasibility Determination and Conclusions
    - Overall feasibility of the OCU ASR will be discussed and evaluated, including lessons learned and recommendations for future ASR projects.

2.0 Program Plan

2.1 Introduction

The St. Johns River Water Management District (SJRWMD) in its 2000 District Water Supply Plan (DWSP) identifies the need for alternative water supplies other than fresh groundwater to meet projected future demands. Current SJRWMD groundwater modeling indicates that the increased use of groundwater to meet projected demands is likely to result in the potential for unacceptable impacts to water resources and related natural systems. The model results indicate Floridan aquifer potentiometric surface declines, reduction of spring flows, lowering of wetland and lake water levels, inland movement of saline water from coastal areas, and reduction of stream flows below minimum levels required to maintain natural systems. A copy of the submitted Program Plan is included in ***Appendix A***.

2.2 ASR Construction and Testing Program Goals and Objectives

The goal of the ASR Construction and Testing Program is to examine the appropriateness of integrating ASR technology into regional water resource and water supply development programs. Accomplishing this goal requires interfacing with governmental entities or private utilities that actively participate, own, operate, or maintain a constructed facility arising out of this program. These entities are referred to as Cooperators; SJRWMD has identified several objectives that must be met:

- Determine the extent to which ASR can be applied to meet local or regional water supply needs through use of alternative water supplies.
- Establish the fundamental criteria for successful application of ASR in SJRWMD.
- Provide test sites for a variety of applications in order to identify and address the different issues (e.g., permitting/regulatory, technical, logistics, political) unique to each application.
- Identify and secure Cooperators, through executed agreements, to participate in ASR construction and testing which would result in development of a functional ASR facility to be used by the Cooperator at the conclusion of the testing period.

- Demonstrate the extent to which ASR can be safely and successfully used within SJRWMD.

2.3 ASR Construction and Testing Program and Process

2.3.1 Framework for Selecting ASR Construction and Testing Projects

Criteria for inclusion of projects in the ASR Construction and Testing Program was established based upon water use characteristics and the hydrogeology of the proposed project site. Those projects deemed by SJRWMD to be the more likely to contribute to successful achievement of regional water management goals are more likely to be selected for inclusion.

SJRWMD has established a process that allows for participation in the program by Cooperators. Participation in the program is guided by establishing the respective responsibilities for both SJRWMD and each Cooperator. SJRWMD and its consultant team screen proposed projects to ensure that the projects comply with SJRWMD's goals and objectives and make decisions concerning inclusion of the proposed project in the program.

The primary feasibility factors in the Cooperator screening process are described in SJRWMD Special Publication SJ97-SP4 titled ‘A Tool for Assessing the Feasibility of Aquifer Storage Recovery’ (CH2MHILL, 1997). SJRWMD uses these hydrogeologic and facility-planning factors as screening factors when considering potential Cooperators and proposed sites for ASR construction and testing.

2.3.2 Facility Planning Factors

The facility planning factors include the demands, supply, and storage needs associated with a Cooperator's water system service area.

- **Demand –** A Cooperator's demand consists of projected capacity and temporal water use patterns and should be large enough (>1 mgd) to justify the expense of an ASR facility in lieu of conventional storage tanks.

- **Supply –** A Cooperator's water supply consists of the groundwater and/or surface water withdrawals authorized through the consumptive use permitting process.

- **Storage Requirement** – A Cooperator's storage requirement is determined through evaluation of its historical average supply and demands.

- **Proposed Use –** A Cooperator's proposed use of ASR is to provide storage to meet its future use projections using available water supply sources, in accordance with the DWSP.

2.4 Hydrogeologic Factors

The hydrogeologic feasibility factors used to evaluate an ASR storage option include storage zone confinement, transmissivity, aquifer gradient and direction, recharge and native water quality, and interfering uses and impacts.

- **Storage Zone Confinement –** The presence and degree of vertical confinement of an aquifer proposed for an ASR storage zone is important to determinations of the degree to which an ASR system can be protected from impacts and effects of external sources of contamination or competing withdrawals above or below the storage zone.

- **Storage Zone Transmissivity –** Storage zone transmissivity should be sufficiently high so that a volume of water can be injected at reasonable wellhead pressures and the same volume of water can be recovered from the storage zone without excessive drawdown in the wells. Additionally, optimal transmissivities should be sufficiently low to allow for the creation of discrete buffer and storage zones and avoid loss of stored water due to migration away from the well or significant mixing with poor/brackish quality native water.

- **Aquifer Gradient and Direction –** The aquifer gradient of a proposed site's storage zone identifies the direction of groundwater flow and any external influence from sources (e.g., recharge areas) and sinks (e.g., operating wellfields, springs). The higher the gradient, the more likely stored water will migrate away from the well, potentially resulting in poor recovery efficiency. Optimal gradient in the storage zone should be such that the stored water stays close to the well between recharge and recovery.

- **Recharge and Native Water Quality –** Recharge water quality determines the level of treatment that may be required prior to storage. Of critical concern is the potential for storage zone plugging due to recharge water solids content, nutrient and biological content (biofouling), and carbonate geochemistry. The recharge water quality must meet applicable federal and state standards. Native water quality is an important factor in the determination of buffer and storage zone volume requirements and recovery efficiency. For example, the higher the salinity concentration of the native water, the larger the volume of recharge water required to establish the buffer zone. Additionally, native water salinity can impact the thickness of stored water in the storage zone due to the effects of density stratification within the storage zone. For example, freshwater stored in a zone with highly saline native water could result in a very thin layer of freshwater at the top of the storage zone and brackish to saline water throughout the remainder of the zone's vertical depth. This situation would, in turn, reduce recovery efficiencies.

- **Interfering Uses and Impacts –** Interfering uses result primarily from other supply wells in the vicinity of the ASR system that directly withdraw from an ASR storage zone or cause a change in the gradient that, in turn, causes migration of stored water out of the storage zone. Impacts are considered to be any current or future contamination of the aquifer storage zone. The distance to any supply or injection well in the same aquifer zone and the distance to any contamination zone influence this factor.

2.5 Project Implementation of Funding

The Program Plan identified responsibilities of the District and Cooperator in implementing the project and the anticipated available funding sources. These were later modified based on the agreements that developed between the District and Cooperator.

2.6 Project Tasks

SJRWMD has developed a detailed list of standard tasks for its ASR projects. This list of standard tasks is based upon the process utilized for successful completion of 10 operational ASR systems in Florida and 40 others throughout the United States. A brief summary is included in this document. This list will be adapted to individual needs and opportunities at each site.

Task 1 – ASR Construction and Testing Program Plan

The ASR Construction and Testing Program Plan includes a description of evaluation criteria for potential projects and a preliminary listing of regional candidate projects, and a process for implementing the ASR Program.

Task 2 – Project Evaluation and Site Selection

This task includes a desktop project feasibility assessment based on the assessment approach described in SJRWMD Special Publication SJ97-SP4 titled A Tool for Assessing the Feasibility of Aquifer Storage Recovery (CH2MHILL, 1997). If the assessment indicates that the project is feasible, the project will advance to the preparation of a Cooperator Agreement.

Task 3 – Cooperator Agreement

This is an agreement that establishes the objectives of the project and the responsibilities of SJRWMD and the Cooperator.

Task 4 – Site Specific Data Collection and Preliminary System Design

This task includes site-specific data collection and preliminary system design. The data collection plan shall address the need for initial exploratory testing as the basis of development of ASR well design criteria and whether such exploratory testing may be conducted without having to first obtain all permits for the subsequent ASR system.

Task 5 – ASR Pilot Project Design

This task includes the design of well and wellhead facilities at the selected site, including the proposed data collection and monitoring programs.

Task 6 – Regulatory Permitting

The project shall adhere to the necessary regulatory permitting requirements. The primary permitting effort is through FDEP.

Task 7 – ASR Facilities Construction, Monitoring, and Testing

Construction of ASR and monitor wells, and associated wellhead facilities. Initial hydraulic and water quality testing is conducted, in addition to geophysical logging, geochemical modeling, and evaluation of any pretreatment requirements.

Task 8 – Startup and Training

Operational training of Cooperator staff is performed to ensure a smooth transition from the test program into full operations.

Task 9 – Large Cycle Operational Monitoring and Evaluations

Operational monitoring and evaluation of ASR system performance is conducted during the first two to three years of operations, making any needed adjustments to improve system performance. The Cooperator is operating the system during this period.

Task 10 – Peer Review of ASR Consultants Team Work

This task includes the review of work products produced by ASR consultant team members by other team members as considered necessary by SJRWMD.

2.7 Project Schedule

Each ASR project has its own schedule which was established during initial planning. For typical ASR projects in Florida, the schedule requires about three years, within a range of 2 to 5 years. An anticipated typical timeline is illustrated in ***Table 2-1***.

Table 2-1: Typical Timelines and Schedule

Task	Duration (days)
ASR Construction and Testing Program Plan	45
Project Evaluation and Site Selection	69
Cooperator Agreement	67
Site-Specific Data Collection and Preliminary Design	70
ASR Pilot Project Design	53
Regulatory Permitting	93
ASR Facilities Construction, Monitoring, and Testing	140
Startup and Training	67
Large Cycle Operational Monitoring and Evaluations	262

3.0 Desktop Assessment of ASR for Orange County

3.1 Project Objectives and Scope

St. Johns River Water Management District (SJRWMD) is located in northeastern Florida. Groundwater is the primary source 97 percent of the public and domestic drinking water supplies within SJRWMD (Florence, 2002). In addition, over 73 percent of commercial/industrial and 66 percent of agricultural water needs are supplied by groundwater sources. The SJRWMD, in its *District Water Supply Plan (DWSP)*, indicates that total water demand is projected to increase by about 35 percent, to nearly 1.85 billion gallons per day in 2020. Current SJRWMD groundwater modeling suggests that the increased use of groundwater to meet projected water demands is likely to result in the potential for unacceptable impacts to water resources and related natural systems.

The DWSP identifies surface water as one of the most cost effective alternative water supply sources having sufficient capacity. Because of the seasonal variability of both quality and quantity, the use of surface water as a source requires significant storage to provide a reliable supply. The use of aquifer storage recovery (ASR) as a means of balancing sources of variable supply and demand, consists of storing water in a suitable aquifer zone through a well when water is available and recovering water from the same well for use when it is needed.

The SJRWMD has included the *Aquifer Storage Recovery Feasibility Testing Project* in its Water Resource Development Work Program. The goal of the ASR Construction and Testing Program is to examine the appropriateness of integrating ASR technology into regional water resource and water supply development projects. SJRWMD entered into an agreement (Contract #SF410RA) with the consultant team of Barnes, Ferland and Associates, Inc. (BFA), CH2M HILL, Inc. and ASR Systems, LLC to conduct the necessary project activities. The scope of work generally involves evaluating candidate projects for SJRWMD participation; designing ASR projects, including monitoring facilities; securing necessary permits; constructing ASR production and monitoring wells/facilities and performing testing services.

Orange County Utilities (OCU) was identified as a cooperative partner for this program. OCU will be responsible for providing an ASR facility site and appropriate logistical support to include facility access, a suitable source of water for testing and operations, power supply, and disposal of recovered water during initial testing and also during operational startup. The primary ASR objective for Orange County is to develop an alternative supply source that can be used to help meet the projected supply deficits through seasonal and long-term storage and recovery of water. Secondary objectives may include restoration of groundwater levels; prevention of saltwater intrusion; enhancement of well field production; reclaimed water storage for reuse; and emergency storage or strategic water reserve.

This project involves performing a desktop assessment that relies on existing data to evaluate the feasibility and options for implementation of an ASR project in eastern Orange County. Three sites were chosen by Orange County to consider for an ASR Construction and Testing Program. These sites include: Eastern Regional Water Supply Facility (ERWSF), Eastern Water Reclamation Facility (EWRF) and Moss Park (***Figure 3-1***).

Generally, this desktop assessment provides an evaluation of existing information and determination of which site is favorable for the ASR Construction and Testing Program. Key components of this task include:

- Water supply system evaluations;
- Water demand/deficit evaluations;
- Storage volume requirements;
- Hydrogeological evaluations;
- Site selection evaluations;
- Conceptual design of ASR system;
- Preliminary capital and operating cost opinions; and
- ASR testing plan and permitting issues.

3.2 Water Supply Facilities, Demand, and Capacity

The water supply for the Orange County Utilities (OCU) Eastern Service Area is currently provided by the Eastern Regional Water Supply Facility (WSF), the Bonneville WSF and the Econ WSF. These facilities are interconnected through the OCU finished water transmission/distribution facilities. The location of each of these facilities and the prospective ASR system locations being evaluated (Eastern Regional WSF, Eastern Regional EWRF and Moss Park) are shown in ***Figure 3-1***.

Orange County was issued a 20 year Consumptive Use Permit (CUP #3317) by the SJRWMD on July 11, 2000. The Eastern Service Area demand projections were developed as part of the Orange County Utilities Water and Wastewater Master Plan. Should the County’s demand projections be realized, the need for an alternative to groundwater supply will be required and the use of surface water supplies to augment groundwater supply appears to be warranted to meet these projected demand. Because of seasonal availability and water quality constraints associated with surface water supplies, use of ASR may be an effective means of large volume storage, allowing for the capture and treatment of surface waters. However, because the County’s existing CUP allocation does not appear to have sufficient excess supply above demand to provide the 3-5 mgd supply for ASR testing, a CUP allocation for testing purposes may be required.

The volume to be stored in an ASR Well Field depends upon several factors, among which are the following:

- Estimated volume required for recovery, which depends upon water supply, water demand and water quality variability.
- Storage zone thickness, hydraulic conductivity, effective porosity, dispersivity, confinement.
- Ambient groundwater quality in the storage zone.
- Hydraulic gradient in the storage zone.
- Buffer zone volume, which depends upon all of the above, typically ranging in Florida between about 50 and 150 days of recovery volume capacity.

The sum of the recovery volume and the buffer zone volume is referred to as the "Target Storage Volume," or "TSV." Storage volume required will be determined by the extent to which water production at this site requires either direct or indirect importation of water from other sources, or can produce groundwater locally. The ASR storage volume required was estimated based upon the seasonality of potential imported supplemental supplies. The County would need to import and store approximately 2.8 billion gallons per year (8 mgd) to meet the average daily flow demand projected for 2020. Assuming a surface water source of desired quality was available for 120 days per year, the required ASR Well Field capacity would be 24 mgd.

3.3 Hydrogeologic Conditions

The hydrogeology of Orange County, an area of about 1,000 square miles in east central Florida has been previously studied and described by various investigators. Using these existing sources, the project area hydrogeology was evaluated for suitability of ASR including hydraulic and groundwater quality characteristics of the Floridan Aquifer system. Site specific evaluations were also performed for each of the potential sites using available hydrogeologic data and the general suitability of various zones at the site for ASR. The results of these evaluations are discussed in Subsection 3.4.

A well inventory was also performed to identify other existing water users in the vicinity of the three potential ASR Sites and the potential for interfering with existing water uses. Records for nine sections were researched surrounding each potential ASR site. Based on pumpage density, withdrawal quantities and nearby well distances, the greatest potential for interfering water use is at the Moss Park Site, ERWSF, and the EWRF, respectively.

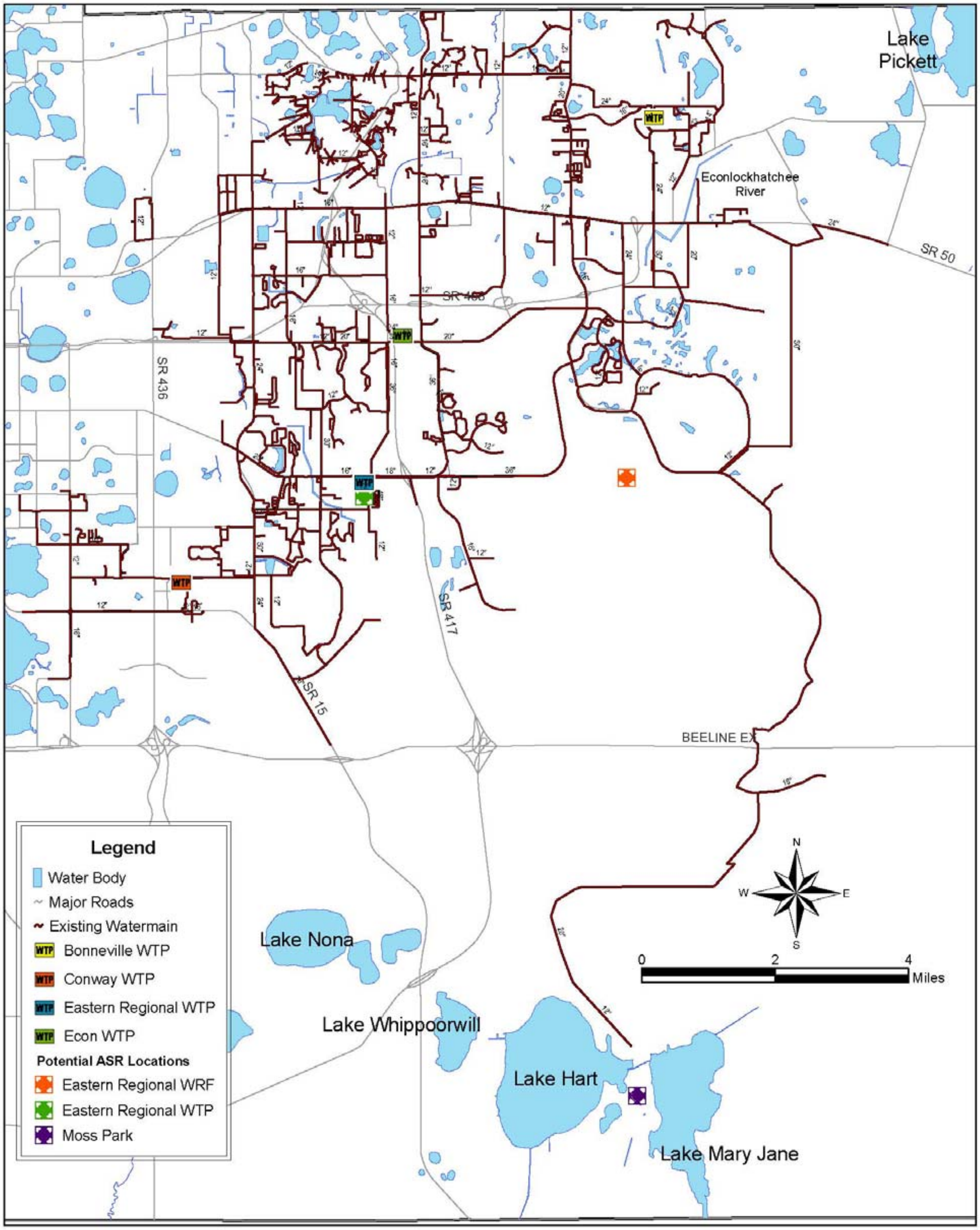


Figure 3-1
Water Supply Facilities - East Orange County

3.4 ASR Feasibility Analysis

3.4.1 Potential ASR Recharge Water Sources

The water supply used for the ASR Construction and Testing Program at each of the potential ASR sites would be drinking water from the County's Eastern Regional Water System. If an ASR facility is determined to be feasible, then a large dependable supply source of approximately 8 mgd will be required to meet the projected demands. The primary source of this alternate supply will likely be surface water that will require use of ASR. Several District sponsored Alternative Water Supply Projects are currently evaluating the feasibility of using surface water sources for future supply. Potential ASR recharge water sources in eastern Orange County include:

1. The surface-water treatment plant proposed by SJRWMD to be constructed near Lake Monroe;
2. A County constructed surface-water treatment plant for source water from the St. Johns River or Econlockhatchee River;
3. An agreement with City of Cocoa for shared use of surface water from the Taylor Creek Reservoir; and
4. Use of bank filtration systems constructed in the surficial aquifer system to induce recharge from fresh surface waters in lakes or streams.

3.4.2 Potential ASR Strategies

An ASR system can be designed and operated to meet a primary objective and one or more secondary objectives. The primary ASR objective for Orange County is to develop an alternative supply source that can be used to help meet the projected deficits through seasonal and long-term storage and recovery of water. Secondary objectives may include restoration of groundwater levels; prevention of saltwater intrusion; enhancement of well field production; reclaimed water storage for reuse; and emergency storage or strategic water reserve. Ideally, the ASR Construction and Testing Program would be located at the future ASR facility. Potential strategies for ASR at the three sites are discussed below and the advantages/disadvantages for each site are listed in ***Table 3-1***.

3.4.3 ASR Site Ranking Methodology

A numerical ranking method was used to assess the relative suitability of the three potential ASR sites. There are generally three categories of feasibility factors that have impact on site selection. ***Table 3-2*** lists these factors and criteria used in this ASR site ranking analysis. The ranking method contains three significant parts: weights, ranges, and rankings. Each of the criteria was assigned a relative weight ranging from 1 to 4. The most significant criteria have weights of 4; the least significant, a weight of 1. Generally, the factors considered to have the greatest order of importance are the hydrogeologic factors, water resource management factors and pilot testing factors, respectively.

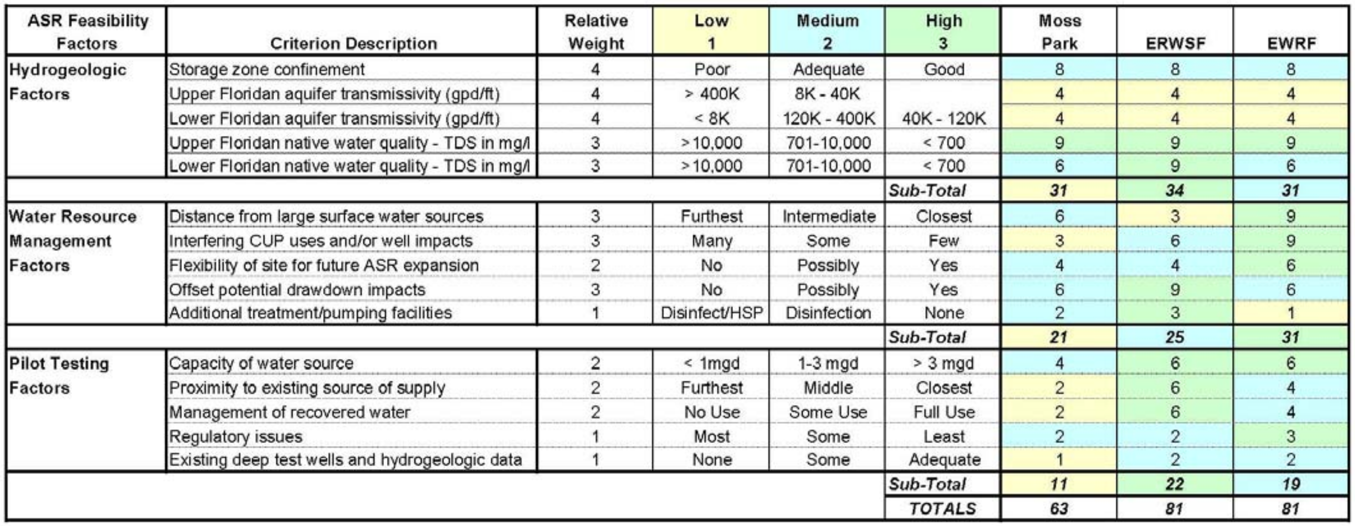
Each criterion has also been assigned a value of 1, 2, or 3 which corresponds to low, medium, and high ranges of suitability, respectively. For each potential ASR site, the relative weight and criterion value are multiplied to obtain a criteria ranking. These rankings are subsequently totaled to obtain an overall ranking for each potential ASR site. In ***Table 3-2***, the range of values and criteria ranking are shaded in yellow, blue, and green, which help to identify the low, medium, and high suitability of each criteria, respectively. Based on this ASR site ranking methodology, the ERWSF and EWRF were ranked equal and the Moss Park site was ranked significantly lower.

Table 3-1 - Advantages and Disadvantages of Potential ASR Sites in Eastern Orange County

SITE	AQUIFER	ADVANTAGE	DISADVANTAGE
ERWSF Water Plant	Upper Floridan	Potential to reduce drawdown imapcts by recovering less than 100% water stored	Active well field requires closer coordination with operators
		Close proximity to system high service pumping	
		Operation not as concerned with buffer or water quality issues since freshwater	
		Can use cycle testing water in distribution, no net water loss	
		Less expensive well and pumping costs compared to Lower Floridan	
		Seasonal water supply/source is readily available for testing	
		Site is owned/controlled by OCU- adequate site available for future expansion	
		Close proximity for O&M requirements	
ERWSF Water Plant	Lower Floridan	Potential to reduce saltwwater intrusion by recovering less than 100% water stored	Active well field requires closer coordination with operators
		Close proximity to system high service pumping	
		Operation not as concerned with buffer or water quality issues since freshwater	
		Can use cycle testing water in distribution, no net water loss	
		Seasonal water supply/source is readily available for testing	
		Site is owned/controlled by OCU- adequate site available for future expansion	
		Close proximity for O&M requirements	
EWRF Wastewater Plant	Upper Floridan	Less expensive well and pumping costs compared to Lower Floridan	ASR facility would require treatment and pumping facilities
		Site is owned/controlled by OCU- adequate site available for future expansion	
		Close proximity for O&M requirements	
		Cycle testing discharged to wastewater or wetlands	
		Seasonal water supply/source is readily available for testing	
EWRF Wastewater Plant	Lower Floridan	Potential for future reclaimed water storage	ASR facility would require treatment and pumping facilities
		Close proximity for O&M requirements	
		Site is owned/controlled by OCU- adequate site available for future expansion	
		Brackish water storage zone, could monitor recovery efficiency	
		Cycle testing discharged to wastewater or wetlands	
		Seasonal water supply/source is readily available for testing	
Moss Park	Upper Floridan	Closest proximity to proposed Orange Co. Southern Regional WSF	Site is not owned/controlled by OCU
		Less expensive well and pumping costs compared to Lower Floridan	Disposal of cycle test water to natural systems
		Lake Hart bank infiltration is a potential recharge source	Potential loss of stored water to Cocoa Well Field
			12" water main has limited capacity for testing and greater distance
			Limited by testing potable water quantity due to 12" line
			Inter-basin/District transfer of water permitting issues
			Remote distance for O&M requirements
Moss Park	Lower Floridan	Closest proximity to proposed Orange Co. Southern Regional WSF	Site is not owned/controlled by OCU
		Possible salinity barrior	Disposal of cycle test water to natural systems
		Lake Hart bank infiltration is a potential recharge source	Potential brackish water impact to Cocoa Well Field
			12" water main has limited capacity for testing and greater distance
			Limited by testing potable water quantity due to 12" line
			Inter-basin/District transfer of water permitting issues
			Remote distance for O&M requirements

Suitability Criteria: Proximity to water source, Proximity for managing recovered water, ASR expansion potential, Hydrogeologic issues, Nearby water use, Meeting long term goals

Table 3-2 Orange County Potential ASR Site Ranking Methodology



ASR Feasibility Factors	Criterion Description	Relative Weight	Low 1	Medium 2	High 3	Moss Park	ERWSF	EWRF
Hydrogeologic Factors	Storage zone confinement	4	Poor	Adequate	Good	8	8	8
	Upper Floridan aquifer transmissivity (gpd/ft)	4	> 400K	8K - 40K		4	4	4
	Lower Floridan aquifer transmissivity (gpd/ft)	4	< 8K	120K - 400K	40K - 120K	4	4	4
	Upper Floridan native water quality - TDS in mg/l	3	>10,000	701-10,000	< 700	9	9	9
	Lower Floridan native water quality - TDS in mg/l	3	>10,000	701-10,000	< 700	6	9	6
					Sub-Total	***31***	***34***	***31***
Water Resource Management Factors	Distance from large surface water sources	3	Furthest	Intermediate	Closest	6	3	9
	Interfering CUP uses and/or well impacts	3	Many	Some	Few	3	6	9
	Flexibility of site for future ASR expansion	2	No	Possibly	Yes	4	4	6
	Offset potential drawdown impacts	3	No	Possibly	Yes	6	9	6
	Additional treatment/pumping facilities	1	Disinfect/HSP	Disinfection	None	2	3	1
					Sub-Total	***21***	***25***	***31***
Pilot Testing Factors	Capacity of water source	2	< 1mgd	1-3 mgd	> 3 mgd	4	6	6
	Proximity to existing source of supply	2	Furthest	Middle	Closest	2	6	4
	Management of recovered water	2	No Use	Some Use	Full Use	2	6	4
	Regulatory issues	1	Most	Some	Least	2	2	3
	Existing deep test wells and hydrogeologic data	1	None	Some	Adequate	1	2	2
					Sub-Total	***11***	***22***	***19***
					TOTALS	***63***	***81***	***81***

NOTES: Site feasibility ranking is determined by multiplying the relative weight (1-4) by the criteria value (1-3) and summing the criteria ranking for each site at the bottom.
Transmissivity ranges are used for both the Upper and Lower Floridan

3.4.4 Recommended ASR Strategies

Based on the site ranking methodology, the ERWSF and EWRF sites are ranked equally, with the ERWSF scoring higher in the hydrogeologic and pilot testing categories and the EWRF scoring higher in the water resource management planning category. Therefore, it is recommended that conceptual designs and cost estimates for both sites be developed and the final site be determined by the Cooperator (Orange County Utilities).

Primary advantages of developing an ASR facility at the ERWSF are:

- This is an existing water supply facility and would require less treatment and pumping improvements;
- ASR system operation is much less complicated in a fresher aquifer because the user is not as concerned with developing a buffer zone and recovered water quality issues;
- By recovering less than 100% of the water stored, a large scale ASR facility at this site may offset drawdown related impacts; and
- Recovered water used during pilot testing could be treated and used in distribution with no net water loss during testing, since both the Upper and Lower Floridan aquifers contain fresh groundwater.

Primary advantages of developing an ASR facility at the EWRF are:

- Closer to alternative water supply sources;
- Closer to areas of future water demands; and
- More flexible for future ASR applications to assist Orange County Utilities to manage water resources.

3.5 EWRF Conceptual ASR System Design

This assessment has concluded that ASR could potentially meet the goals and objectives of Orange County and the SJRWMD and it is recommended that an ASR Construction and Testing Program be conducted at either the ERWSF or the EWRF. For this EES, the conceptual ASR system design for the site selected by Orange County, the EWRF site, is presented in this Section. Implementation at the EWRF site will involve completing the remaining project tasks that are described in the *ASR Construction and Testing Program Plan* and listed below:

Task 4 – Site Specific Data Collection and Preliminary System Design;

Task 5 – ASR Pilot Project Design;

Task 6 – Regulatory Permitting;

Task 7 – ASR Facilities Construction, Monitoring and Testing;

Task 8 – Startup Training; and

Task 9 – Large Cycle Operational Monitoring and Evaluations.

3.5.1 Regulatory Issues

ASR facilities are regulated by several rules of the Florida Department of Environmental Protection (FDEP) and Water Management Districts. Project Task 6 requires coordination with these agencies in regard to permitting needed for the ASR Construction and Testing Program. The following rules may apply:

62-528, FAC – Underground Injection Control (UIC)

Underground Injection Control (UIC) rules are administered by the FDEP and apply to the construction and operation of all types of injection wells. The intent of the UIC regulations is to protect underground sources of drinking water by ensuring that injected fluids remain in the target injection zone and don’t degrade the water quality of adjacent aquifer zones. ASR wells for drinking water storage are classified as Class V, Group 7 wells. The regulatory criteria and standards for Class V wells are provided in Part V of 62-528, FAC.

The UIC permitting requirements for the SJRWMD construction and testing program are not particularly burdensome since the water to be used for injection fluids meets the primary and secondary drinking water standards and has been processed by a permitted drinking water facility. Specifically, systems utilizing drinking water are excluded from water quality monitoring (62-528.615) and are not required to obtain an operating permit (62-528.640). UIC rules seem to indicate that the District construction and testing program exploratory well will require a Class V, Group 8 UIC permit (62-528.603), particularly since it is to be converted to a monitoring well. However, based on discussions between the District and FDEP Central District staff, it is understood that the program exploratory wells may not require this permit. The exploratory, monitoring and ASR wells will all need to be constructed in accordance with the construction standards outlined in 62-528.605.

40C-2- Consumptive Use Permit (CUP)

Orange County was issued a CUP by the SJRWMD on July 11, 2000 with an expiration date of July 12, 2020. The County’s current demands very closely match their CUP allocation and future demands are projected to exceed the corresponding future allocations. Therefore, a CUP for testing water supply of 3-5 MGD for a period of 6-12 months may need to be issued to the County.

3.5.2 Well Drilling and Testing Program

The overall goal of the drilling and testing program is to obtain hydrogeologic and water quality data to determine the technical and operational feasibility of ASR at the selected test site. Existing deep test monitor wells exist at the proposed ASR site; however, the major uncertainties are the nature and distribution of transmissivity in potential storage zones and vertical distribution of water quality in the Lower Floridan aquifer. The drilling and testing program will be designed to obtain detailed information on:

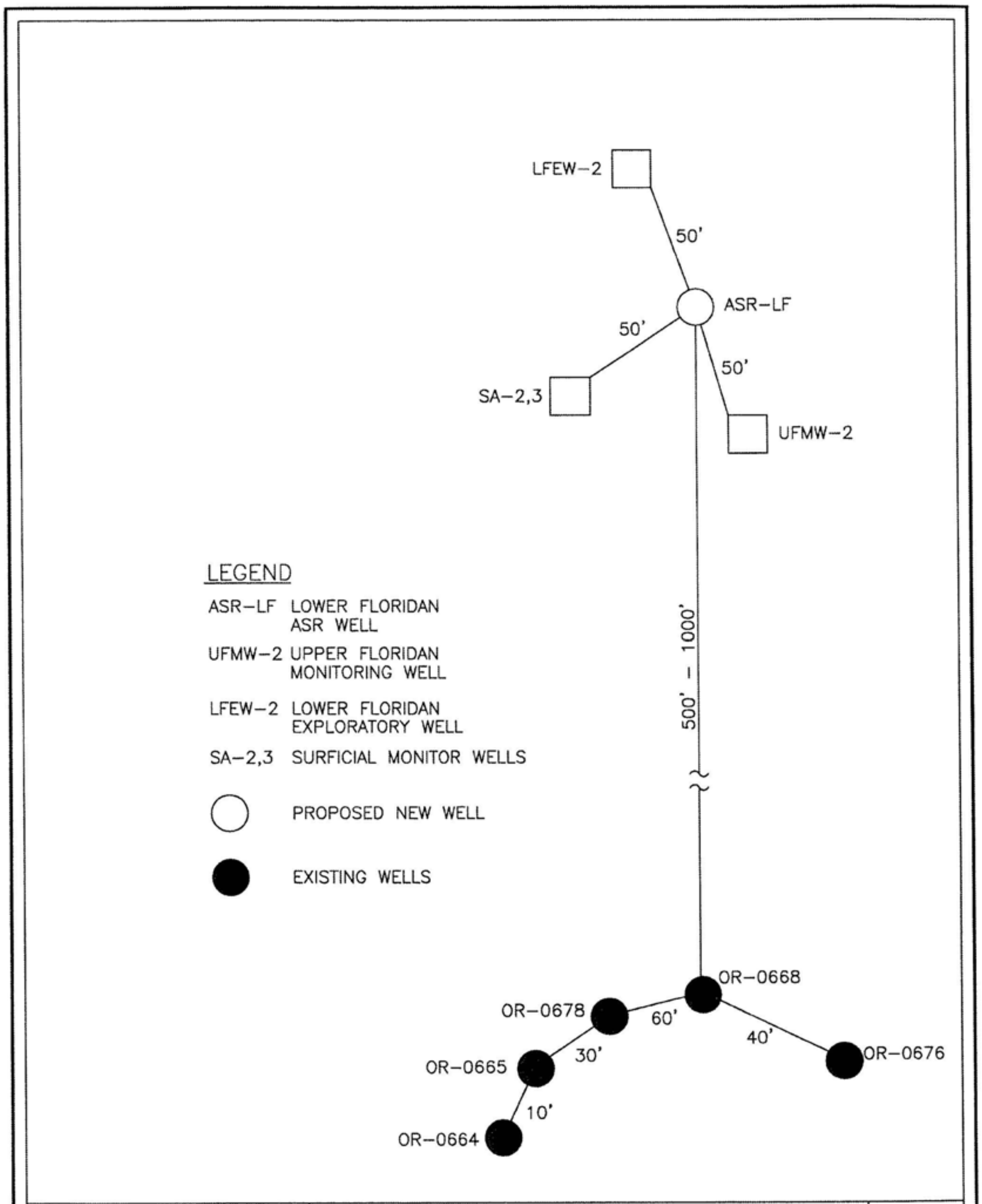
- Storage zone confinement;
- Storage zone transmissivity;
- Aquifer head gradients; and
- Native water quality with depth.

Figure 3-2 shows an aerial map of the EWRF and the proposed ASR site location. ***Figure 3-3*** shows the layout of existing and proposed new wells that may be used for testing of the Lower Floridan aquifer. A deep exploratory well and several monitor wells were completed by the SJRWMD on this property; however, additional data is needed to determine ASR system design and technical feasibility. The project will begin with construction of a Lower Floridan aquifer exploratory test/monitor well (Project Task 4). The ASR well would then be drilled to determine aquifer hydraulic parameters, followed by the remaining monitor wells.

Formation Cores and Cutting Sample Collection and Analysis

The following is a summary of the sampling and testing recommended for the site.

1. Cores will be taken of proposed Upper and Lower Floridan storage zone intervals and potential overlying and underlying confining strata.
2. The remaining intervals of the storage zone will be drilled using the reverse-air method. Cuttings will be collected every 20 feet or drilling rod change from surface to total depth and every 5 feet from the likely storage zone.
3. Cuttings will be examined for composition and texture using a stereomicroscope. Particular attention shall be paid to the presence of any potential reactive minerals (e.g., sulfides) and organic matter.
4. Thin sections will be prepared of core and cutting samples and petrographically analyzed. Selected samples shall include representatives of the various rock types.
5. Whole rock analyses will be performed on several core or cutting samples for trace elements that would be diagnostic of carbonate mineral reactions or fluid-rock interactions of concern. A radionuclide analysis sample will be taken from the part of the storage zone with the highest gamma ray log activity.
6. As leaching of arsenic and radionuclides is sometimes a concern in ASR systems, simple bench-top batch experiments may be performed. Leaching can be simulated by placing samples of cuttings in containers.



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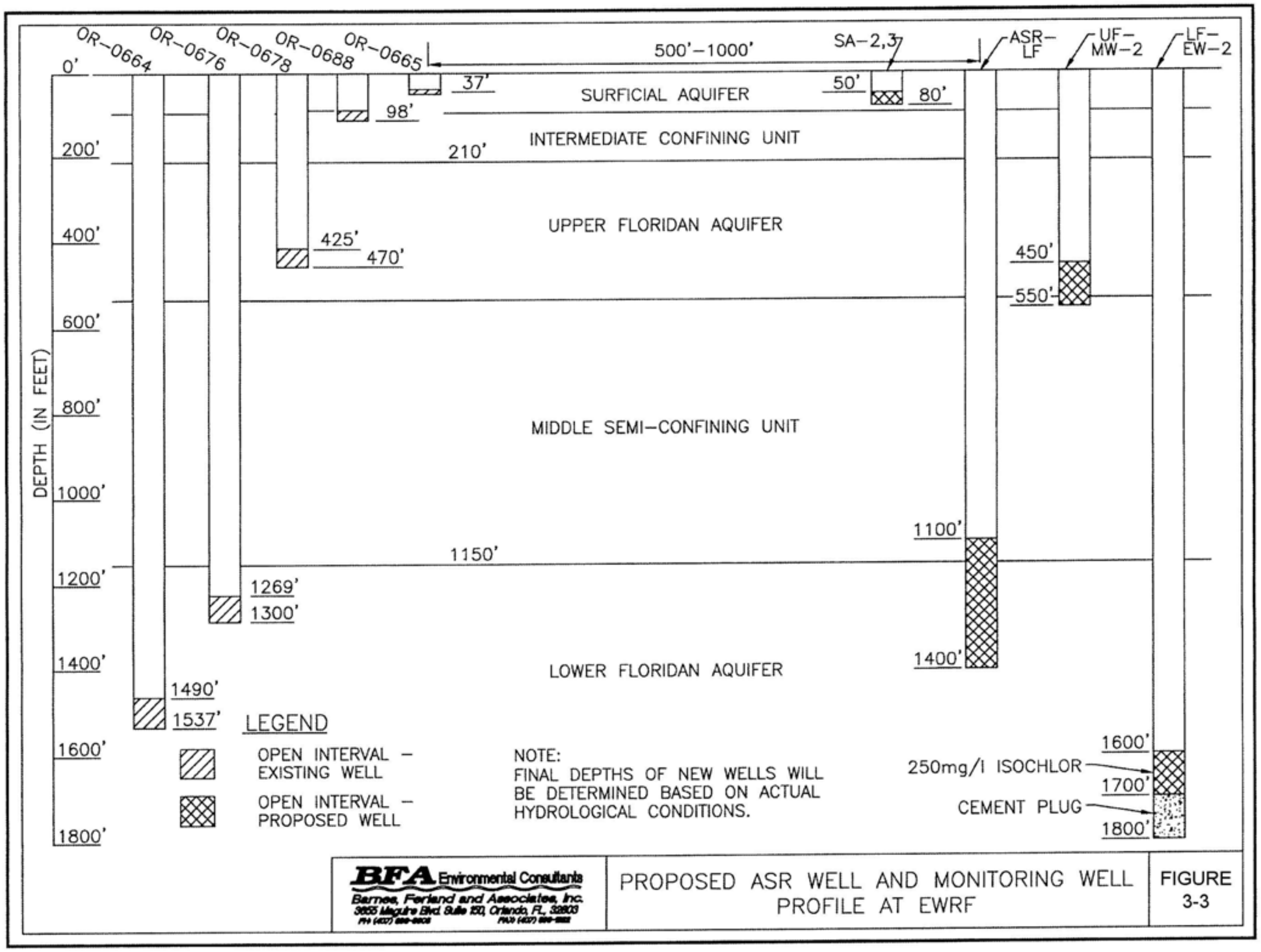
PROPOSED LAYOUT OF
ASR WELL AND MONITORING WELLS AT EWRF

FIGURE
3-2



NOTE:
FINAL DEPTHS OF NEW WELLS WILL BE DETERMINED BASED ON ACTUAL HYDROLOGICAL CONDITIONS.

PROPOSED ASR WELL AND MONITORING WELL PROFILE AT EWRF

FIGURE 3-3

Geophysical Logs

A full suite of geophysical logs will be run on the borehole in several borehole stages/intervals including:

1. Caliper;
2. Natural gamma ray;
3. Spontaneous potential;
4. Long and short-normal resistivity;
5. Pumping and static flow;
6. Pumping and static temperature;
7. Pumping and static fluid resistivity;
8. Sonic porosity; and
9. Video survey.

Pumping Tests

Pumping test will be performed to assess the hydraulic conditions of the well including:

1. During construction of the Lower Floridan aquifer test/monitor well, pumping tests will be performed over different borehole intervals within the Upper and Lower Floridan aquifer storage zones. Each test will have duration of 12 hours at rates up to 2500 gpm.
2. Step-drawdown tests will be conducted within the completed well ASR Well. The test will be conducted at various rates up to 2,500 gpm for a total duration up to 24 hours.
3. Upon completion of all monitor wells, two constant rate pumping tests will be conducted using Lower Floridan ASR Well. The test will be run using the permanent pumps and discharged into the raw water transmission main. This will require regulatory clearance of the new ASR Well. The pumping rate will be approximately 4500 gpm for ASR-LF. The test will be conducted approximately 48 hours. Actual testing time will depend on the utility system demands.

Packer Tests

Packer tests may be performed on the potential storage zone to obtain both hydraulic and water quality data. Alternatively, specific capacity pumping tests may be run on the open borehole at different depths during construction to confirm flow characteristics.

Water Quality Sampling and Testing

1. Reverse-air water quality samples shall be collected at 20 ft intervals and tested for chloride and specific conductance;
2. Depth-specific groundwater samples may be collected using a thief sampler;
3. Packer tests may be performed on the potential storage zone to obtain water quality data;
4. Samples of the storage zone water and recharge water will be analyzed for field parameters (pH, temperature, DO, Eh, specific conductance) and all major cations and anions, and other elements of concern (at a minimum Na, Ca, Mn, Fe, Mg, Sr, K, Al, Si, Cu, Zn, Cd, Se, Cl, F, HCO3, SO4, TDS, As, total and non-carbonate hardness, calcium hardness, nitrate, phosphate, ammonia, hydrogen sulfide, total organic carbon, total coliforms, trihalomethane species, gross alpha and uranium); and
5. Upon completion of ASR Well and during the step-drawdown testing, raw groundwater will be sampled and tested for all primary and secondary drinking water parameters required by FDEP (Ch. 62-550 FAC).

3.5.3 Geochemical Analysis

Essential to an ASR facility's success is recovering stored water with concentrations of chemical constituents below state or federal drinking water standards. Although the water used for recharge will meet these standards, during storage the chemistry of the water can be affected by the reactions between the recharge water and minerals in the aquifer matrix and the reactions between recharge water and native groundwater.

From the preliminary evaluation performed a conceptual understanding of the conditions in the potential ASR storage zones has been developed. Knowledge of the site geochemical conditions will be further refined during the testing program, particularly with the completion of tasks such as test well installation, native groundwater quality chemical analysis at the site and ASR cycle testing. Reasons to apply geochemical modeling are to identify potential mineral phases in equilibrium with the native groundwater, evaluate reactions caused by injecting recharge water containing elevated concentrations of dissolved oxygen (DO) and evaluate reactions that could occur during the mixing of native groundwater with recharge water.

3.5.4 Well Facilities and Utility Connections

The ASR well facilities at the EWRF site would be located as shown on ***Figure 3-2*** above. The proposed site is located adjacent to the County’s planned reclaimed water storage and booster pump facilities. Water to be used for testing will be supplied by the 36-inch potable water transmission main located on the Curry Ford. Approximately 800 feet of 16-inch water main will be constructed from Curry Ford Road to the site. It is anticipated that supply pressures will range from 50-60 psi. A conceptual layout of the wellhead facilities is shown in ***Figure 3-4***.

3.5.5 Cycle Testing

After construction and permitting of all facilities, a period of testing is necessary. An operational ASR consists of a recharge period during which water is injected until a selected storage volume is reached, followed by a storage period in the ASR zone until it is needed, and then the recovery period when the stored water is recovered for use.

If the ASR strategy used is storage of fresh water in a brackish aquifer zone, the storage zone is formed by injecting a volume of water to flush native groundwater out of the aquifer in the vicinity of the ASR well, and then water is withdrawn during the recovery period until the chloride concentration increases to some threshold.

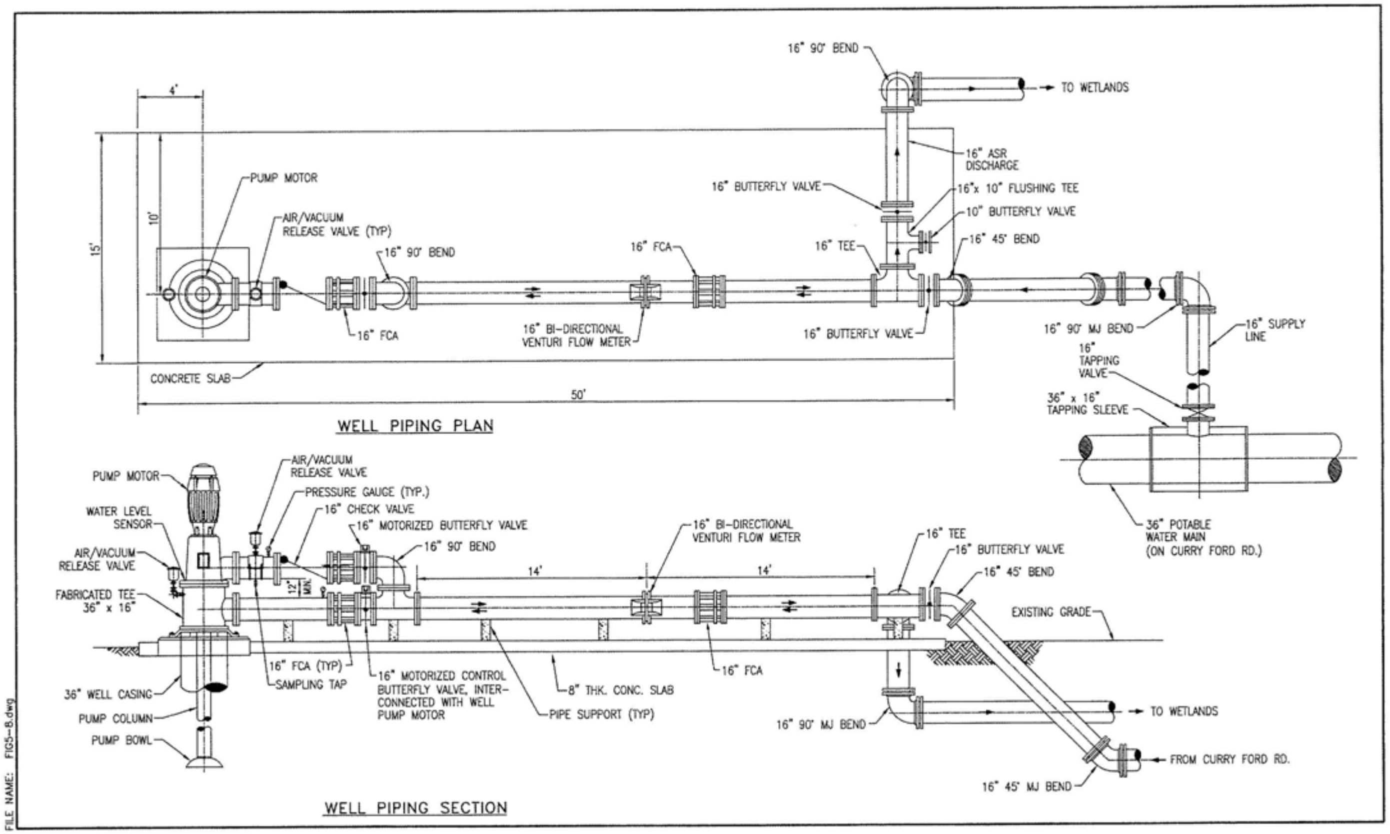


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FIGURE 3-4
ASR EWRF WELLHEAD PIPING - PLAN AND SECTION

If the ASR strategy used is storage of fresh water in a fresh aquifer zone, then cycle testing will use the addition of a tracer, such as fluoride, in the injected water to establish the recovery efficiency. Additional testing will consist of injection-recovery cycles to determine if any changes in well efficiency occur as a result of cyclic use. During these cycles, water would be injected and recovered at the proposed operational rates while hydraulic and geochemical data are monitored in the ASR zone.

3.5.6 Cost Estimate

The conceptual cost estimate for the recommended facilities at the EWRF is presented in ***Table 3-3***.

Table 3-3 – ASR Pilot Program Cost Estimate for the EWRF

PROJECT COST ITEM	Lower Floridan	Upper Floridan
WELL CONSTRUCTION AND TESTING		
Lower Floridan Exploratory/Test Well	$358,000	
Lower Floridan ASR Well	$432,000	
Upper Floridan ASR Well		$152,000
Upper Floridan Monitor Well	$26,000	
Surficial Monitor Wells	$7,000	
Sub-Total	$823,000	$152,000
ASR WELL EQUIPPING		
Pumping Equipment	$120,000	$120,000
Piping, Valves	$112,000	$112,000
Electrical	$100,000	$100,000
Sub-Total	$332,000	$332,000
OTHER CONSTRUCTION REQUIREMENTS		
Discharge Piping to Wetlands - EWRF	$76,000	$76,000
Connection to Potable Water Transmission Main	$25,000	$25,000
Sub-Total	$101,000	$101,000
WATER LABORATORY COSTS		
Packer Tests (6 samples)	$2,100	
Thief Sampler (3 samples)	$1,050	
ASR Well Clearance (1 sample)	$2,500	$2,500
Cycle Testing (21 samples)	$7,400	$7,400
Sub-Total	$13,050	$9,900
ROCK CORE LABORATORY COSTS		
Hydraulic Parameters	$4,500	
Thin Sections	$2,100	
Whole Rock Analysis	$4,500	$4,500
Bench-Top Leaching Experiments	$2,100	$2,100
Sub-Total	$13,200	$6,600
ENGINEERING COSTS		
Task 4 - Site Specific Data Collection and System Design	$121,000	
Task 5 - ASR Pilot Project Design	$209,000	
Task 6 - Regulatory Permitting	$66,000	
Task 7 - ASR Facilities Construction and Testing	$189,200	
Task 8 - Startup Training	$33,000	
Task 9 - Large Cycle Operational Monitoring and Evaluations	$85,800	
Sub-Total	$704,000	$0
Estimated Total Cost	$1,986,250	$601,500
20 % Contingency	$397,250	
EWRF Pilot Program Cost Estimate	$2,383,500	

4.0 Cooperator Agreement

4.1 Introduction

The Memorandum of Understanding (MOU) is an agreement between SJRWMD and the Cooperator, on this case Orange County Utilities (OCU), to establish the objectives of the project and define the responsibilities of both parties in implementing the project. The draft agreements were modified based on the specific requirements of OCU and SJRWMD. A presentation of the MOU was made to the Orange County Board of County Commissioners on 2009. A copy of the executed MOU is included in ***Appendix B***.

4.2 Memorandum of Understanding

The MOU between SJRWMD and OCU included a statement of work, MOU effective date and term, MOU termination requirements, funding responsibilities, liability and insurance requirements, project management roles, and identified ownership of the documents that were developed during the project. The Statement of Work, which was attached as Exhibit A to the MOU, included project definition and objectives, scope of work, task identification, project timelines, and project deliverables and responsibilities.

4.3 Overview of Project Responsibilities

The District shall prepare a preliminary design plan for the ASR system, including construction and testing of an exploratory well. Based on the results of the exploratory well, final design and permitting of the ASR system shall be conducted by the District in compliance with FDEP UIC permitting requirements. Once the design and permits are approved, the District shall construct the ASR Test Well, surface facilities, and related appurtenances. After completion of drilling and verification of project requirements, testing of the ASR Well shall be performed by the District to estimate its storage and recovery capabilities. If at any time the project is deemed infeasible, the District shall coordinate with the County the salvage of any constructed wells for monitoring or other purposes, or the District shall provide abandonment and decommissioning services, as required. Upon successful demonstration of feasibility, the completed project shall be transferred to the County for operation and ownership, including the transfer of permits.

4.4 Projects Responsibilities by Task

The following Tasks 4 through 10 are summarized from the Statement of Work. Tasks 1 through 3 were previously performed by the District.

Task 4 – Site-Specific Data Collection and Preliminary System Design

Prepare a data collection plan for the project site based on a review of existing information and coordination with FDEP. To the extent possible based, the District proposes to gather hydrogeologic information from the construction and testing of an initial exploratory well at the project site, which would then be converted to an observation well for the ASR well construction and testing program. The District will collect data per the data collection plan, evaluated the collected data, and develop a preliminary system design. The County shall provide a license agreement granting the District access to project site for exploration well drilling and data collection. If the site is deemed to be infeasible for any reason, the District and the County shall endeavor to locate an alternative site for the ASR well construction and testing program, through mutual agreement by both parties.

Task 5 – ASR Pilot Project Design

The District will design of well and wellhead facilities at the site, including supporting infrastructure such as pipelines, electrical service, and incidental site work. The County shall be provided with design documents for review, comments, and approval prior to completion of this task.

Task 6 – Regulatory Permitting

The primary permitting effort shall be through the FDEP UIC program. The District shall be responsible for site improvements with the County responsible for processing and resolving any zoning or land use issues that may arise with regard to the project. The County shall be the Owner for project related permit applications. The District shall act as the County's agent by preparing applications on behalf of the County and pay application fees.

Task 7 – ASR Facilities Construction, Monitoring, and Testing

The District shall provide for the construction of the ASR well and monitor wells, associated pipelines, electrical service, incidental site work, and wellhead facilities. Pipeline work by District shall be limited to a connection between the ASR wellhead and the nearest potable water transmission main and a discharge line from the ASR wellhead to nearby wetland or acceptable land area. The electrical work by District shall be limited to the secondary service line connecting the ASR well pump motor to the point of termination of primary power brought to the project site by the County. The District shall also conduct initial hydraulic and water quality testing, in addition to geophysical logging, geochemical modeling, and evaluation of any additional pretreatment requirements.

The District shall provide for a survey that shall stake and define the boundaries of construction within the EWRF as it is defined by EWRF boundary survey documents furnished by the County. The District shall be responsible for construction, inspection, testing, and progress reporting for the project. The County shall allow the District site access to conduct and inspect construction of the project. The County shall alert the District of any known problems and the District, when appropriate, shall require its Contractor to correct any problems or non-conforming work discovered by District inspection or the County's observation.

Task 8 – Startup and Training

The District shall provide operation and maintenance manuals and operational training of County staff.

Task 9 – Large Cycle Operational Monitoring and Evaluations

The County shall conduct operational monitoring and evaluation of ASR system performance during the first two to three years of operations, making any needed adjustments to improve system performance. The District shall conduct periodic site visits and evaluate collected data to monitor the large cycle performance and provide technical assistance to County, as necessary.

Task 10 – Peer Review of District Contractor's Work

This task includes the review by District and County of work products produced for this project by the District contractors.

4.5 Additional County Responsibilities

The County was to provide following items and "like kind services" through staff and ongoing operations:

1. Project site to be located at the County's Eastern Water Reclamation Facility (EWRF) at 1621 S. Alafaya Trail and associated access.
2. Records pertaining to the project.
3. SCADA equipment (i.e., SCADA programmed panel, antenna) to be installed by District contractor at the project site. The not-to-exceed capital cost to the County is $120,000 for the furnishing of labor, equipment, and materials to install the electrical service and provision of the SCADA equipment.
4. Water quality sampling and testing during large cycle operation phase of Project, as required during Task 9 described above, after the County assumes ownership of project. The not-to-exceed cost to the County is $100,000 for this water quality sampling and testing. Estimated testing parameters were included as an attachment to the Scope of Work.
5. Information regarding features and items that are required to comply with zoning and land development codes.
6. Testing water, permission to use recovered water discharge purposes, and appurtenant operational requirements for the Project, including necessary coordination and related services from the County's staff.
7. Accept responsibility for operation and maintenance of completed project. Agrees to assume total responsibility of ownership for continued operation, maintenance, and data collection for the ASR facilities following completion of the project but reserves the right to re-permit, modify, abandon, or decommission the Project in accordance with applicable rules and regulations.

4.6 Project Budget

District is responsible for all costs of the project with the exception of capital costs listed below and in-kind services as described in the Statement of Work. The District and the County estimated project capital costs as follows:

District Work for Task 4 – 10	$ 2,384,000
County Capital-related Cost Items:	
Task 7, Electrical Service and SCADA equipment	$ 120,000
Task 9, Water Quality Sampling and Analysis	$ 100,000
Subtotal County	$ 220,000
Total Project	$ 2,604,000

5.0 Preliminary Basis of Design

5.1 Purpose

The purpose of the Preliminary Design Report (PDR) is to define the basic concepts, design criteria, and types of equipment to be used for the design and permitting of the Aquifer Storage and Recovery (ASR) System to be built for Orange County Utilities. The ASR system will allow OCU to recharge and store water during periods of the year when excess capacity is available, and to recover stored water from the aquifer during periods of the year when additional water is needed within their system. The location and general layout of the ASR System at the EWRF is shown in ***Figure 5-1***.

The PDR serves as the preliminary basis of design to guide the design team during the preparation of plans and specifications for pricing, construction and the permitting process. A number of assumptions underlie this basis of design, as detailed below. Once these assumptions and other design issues have been reviewed, verified, and confirmed, the basis for final design of the project will be adjusted accordingly.

5.2 Basic Operational Concept

The ASR system is designed as a stand-alone facility for non-attended operation via OCU's area-wide SCADA system. Key components of the proposed system include:

- 16-inch ductile iron pipeline from the ASR System site to the 36-inch potable water main located on the west side of Curry Ford Road. The pipeline serves for both recharge water from the distribution system to the ASR well and for recovery water from the ASR well back into the distribution system.

- ASR well with 24-inch fiberglass casing rated for a 3 MGD recovery rate completed into the Lower Floridan Aquifer.

- Wellhead facilities consisting of concrete pad, wellhead fittings, 3 MGD vertical turbine pump, recharge/recovery piping, manual and automatic valves, and appurtenances.

- Instrumentation to provide flow rates and totalized flow for all modes of operation, system injection pressure and well level.
- Automatic control loop for recharge consisting of modulating control valve and PID loop flow control of the well recharge rate.
- Raising of ground elevation in the immediate vicinity of the ASR wellhead to approximately two feet above existing grade to address poor drainage observed during flooding events in the past two years.
- Discharge of recovered fresh water to waste into adjacent wetlands through a spreader distribution system.
- Disinfection facilities consisting of chlorine in the form of 12% liquid sodium hypochlorite and a storage tank for a 20-day supply.
- 480-volt, 3-phase, 60 Hz electrical system consisting of an electrical equipment/motor control system that includes metering, service entrance equipment, main breaker, adjustable frequency drive for the ASR well pump, breaker for 3-phase power panel, transformer for 208/120-volt, 3-phase, 60 Hz, load panel
- PLC-based local control panel with SCADA interface to OCU for operation of the system.
- Pre-cast concrete building for well head, chlorine feed equipment (12% liquid NaOCl), and electrical/control systems.
- Site work consisting of paved driveway and parking area and chain link fence around the ASR system wellhead to provide access to the facilities for operations personnel, system maintenance, and chemical deliveries.

During recharge, electrically-actuated valves on the recharge/recovery wellhead piping system will be positioned to allow recharge through the annular space between the pump column and inner well casing. The initial source of recharge water is via a new 16-inch connection to the 36-inch potable water main located on the west side of Curry Ford Road.

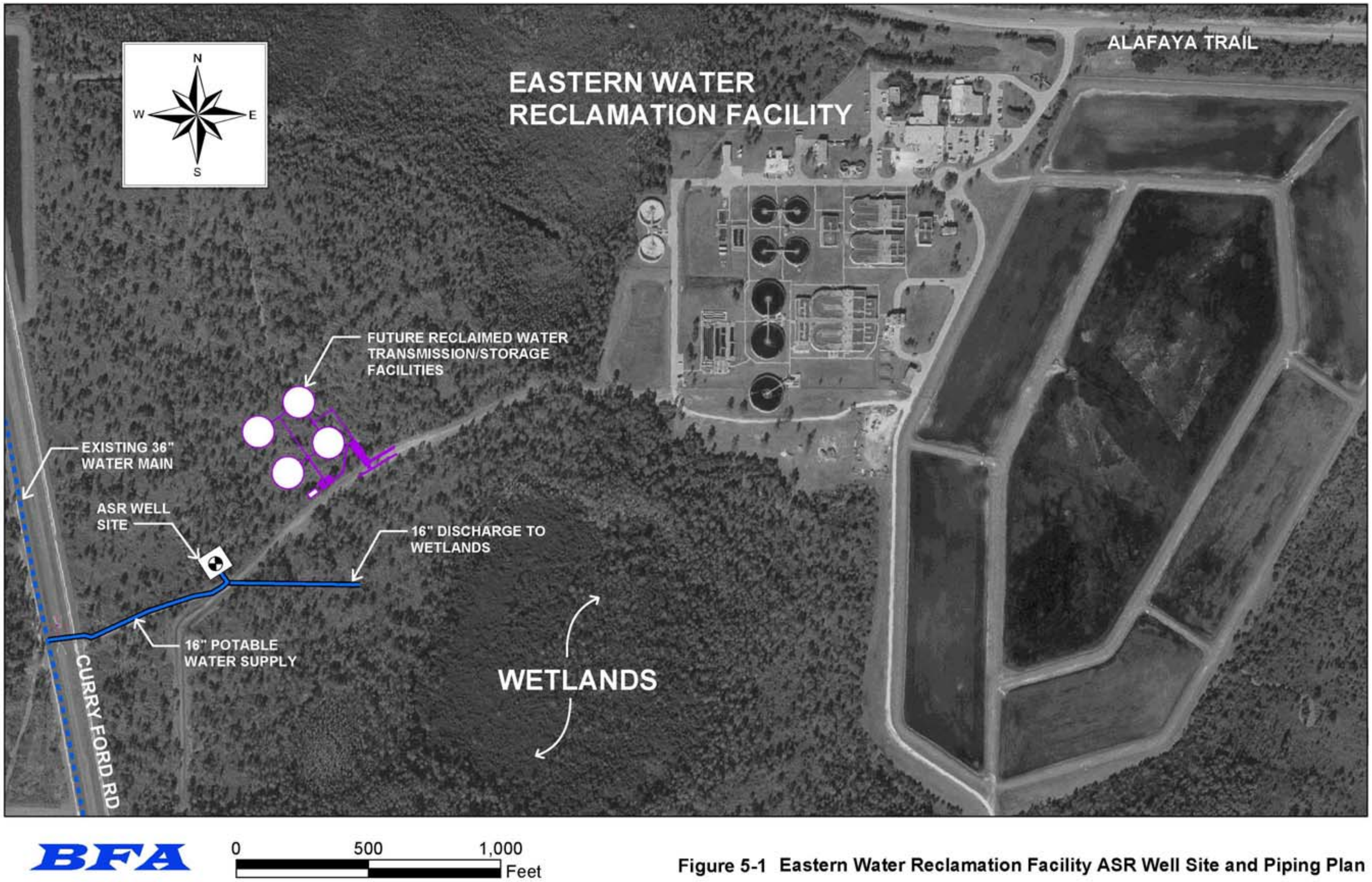


Figure 5-1 Eastern Water Reclamation Facility ASR Well Site and Piping Plan

When needed, the stored water will be recovered from the aquifer by pumping from the same ASR well, and then either discharged to the adjacent wetlands during cycle testing or, following disinfection, pumped back into the regional water transmission system during potable water operations.

During the recharge portion of the seasonal cycle OCU could store up to about 810 million gallons of finished water over a typical 9-month period from July through March, at an estimated recharge rate of 2,100 gpm (3 MGD).

The recovery portion of the cycle would consist of recovery of water from the ASR well at varying rates up to about 2,100 gallons per minute, over a three month period (April through June). Typical total recovery volume would be up to about 270 MG.

5.3 Key Subsystems

The ASR System consists of the following key components and/or subsystems:

5.3.1 ASR Well and Monitor Wells

The ASR well is sized for a maximum recovery rate of 3.0 MGD and will be completed into the top of the Lower Floridan Aquifer to a borehole depth of approximately 1200 feet below land surface (BLS). The 24-inch diameter fiberglass (FRP) casing to approximately 1100 feet BLS will be set and cemented. The production interval is fresh but is underlain by highly saline water below a very hard rock interval between 1260 and 1290 feet. Vertical confinement properties of this lower confining layer are believed to be adequate based upon packer testing conducted during exploratory well construction.

The 24-inch FRP inner casing will be cemented inside a 36-inch steel middle casing to a depth of 530 feet into the base of the Upper Floridan aquifer. The 36-inch middle casing will be cemented inside a 48-inch carbon steel outer casing set to a depth of 110 feet at the base of the surficial aquifer. The outer casing will be cemented inside a 56-inch pit casing to a depth of about 40 feet.

The static water level is anticipated to be approximately 50 feet BLS, and the specific capacity of the well is estimated to be 15 gpm/foot. This is based on the 4-hour aquifer pump test completed at the exploratory well at a pumping rate of 120 gpm. Therefore, at a 3.0 MGD recovery rate, the pumping water level in the ASR well is expected to be to approximately 190 feet BLS. During recharge the pressure in the well at land surface is expected to be about 40 psi. These assumptions will need to be verified following construction and baseline testing of the ASR well.

The recently-completed exploratory well has been converted to a monitor well in the storage zone, approximately 500 feet from the location of the proposed ASR well. The exploratory well was completed with 4.3-inch diameter PVC casing from 1100 feet up to ground surface. It is likely that FDEP will require an additional storage zone monitor well as a condition of the UIC permit, and also a monitor well in the Upper Floridan aquifer. Two monitor wells in the Surficial Aquifer are also anticipated.

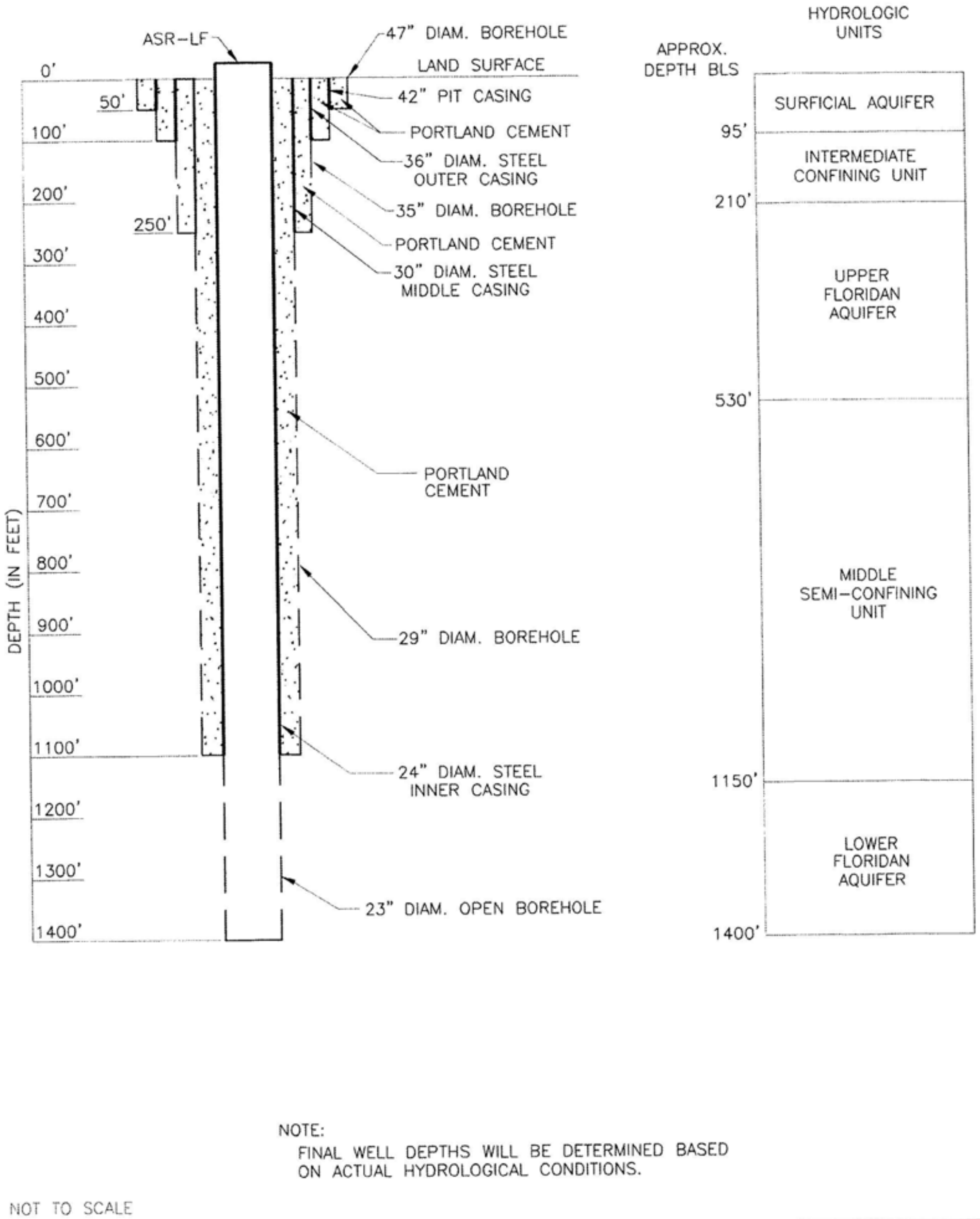
The cross sections of the preliminary ASR and monitoring wells design are shown in ***Figure 5-2***.

5.3.2 Recharge Piping Facilities and Appurtenances

The 16-inch diameter recharge/recovery piping will be connected to the existing 36-inch transmission line along Curry Ford Road. Connection of the 16-inch piping will require a jack-and-bore under the four-lanes of Curry Ford Road. The recharge/recovery wellhead piping will utilize a common bi-directional segment that will include a bi-directional magnetic flow meter and an electrically-actuated throttling valve for control of the recharge rate.

5.3.3 Recovery Pump, Piping Facilities, and Appurtenances

The recovery system will consist of a 300 horsepower[2] multi-stage vertical turbine pump, with discharge through an above ground 16-inch ductile iron recovery piping system. The above ground recovery piping will include a check valve, motorized isolation valve, air release valve, and the same bi-directional magnetic flow meter for use in monitoring the recovery flow rate. The pump and supporting electrical facilities will be sized to recover at a rate of up to approximately 2,100 gallons per minute with a total bowl head of approximately 218 feet. The preliminary design layout of the wellhead and piping are shown in ***Figure 5-3***.



NOTE:
FINAL WELL DEPTHS WILL BE DETERMINED BASED ON ACTUAL HYDROLOGICAL CONDITIONS.

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PROPOSED CONSTRUCTION DETAILS FOR LOWER FLORIDAN ASR WELL

FIGURE 5.2

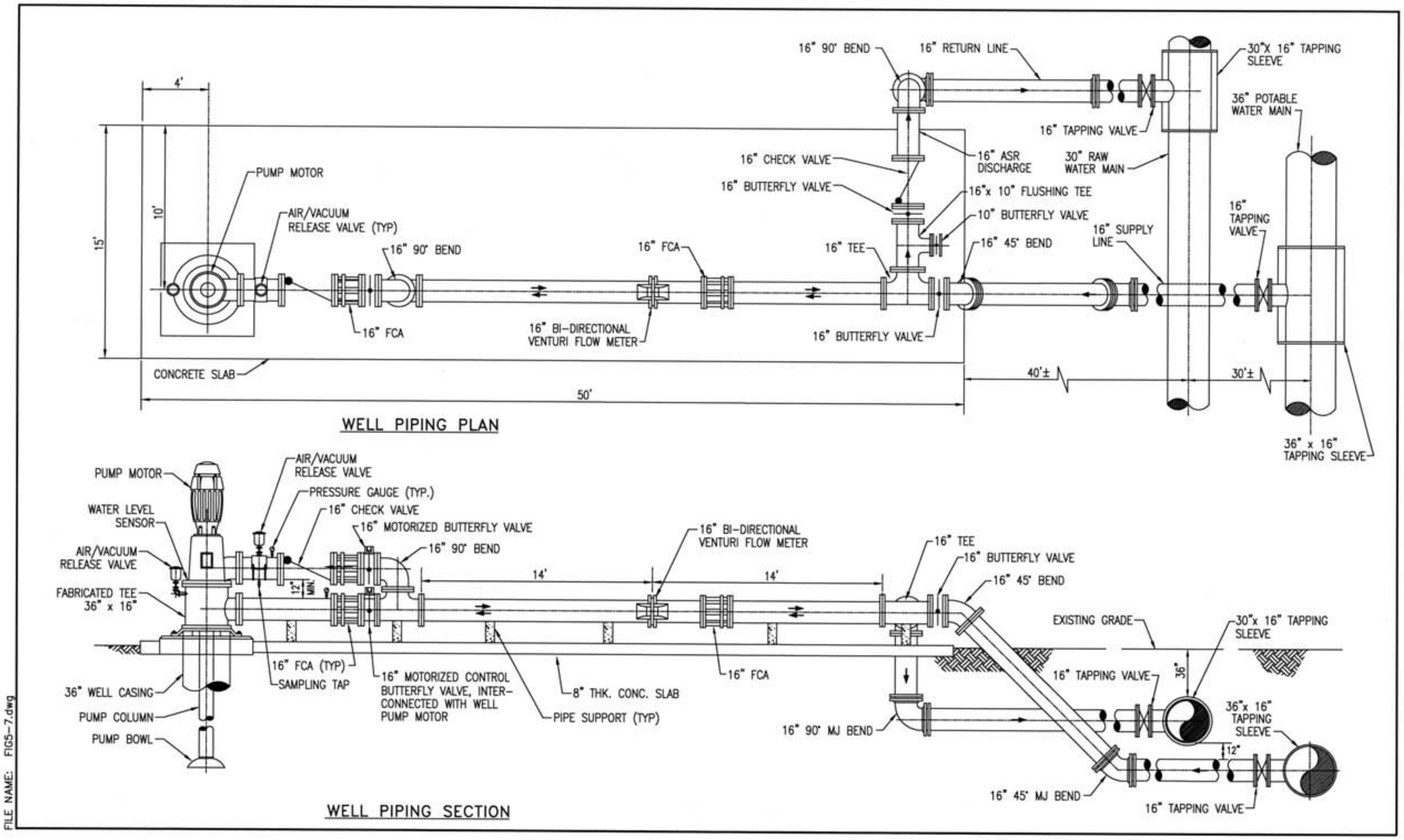


Figure 5-7
ASR ERWSF WELLHEAD PIPING - PLAN AND SECTION

Actual pump hydraulic design characteristics will be determined from a pumping test following completion of well development and prior to ordering the pump. Following selection of the ASR storage zone and prior to final design of pumping and electrical facilities, the pump design hydraulic characteristics will be reevaluated to match the potential long term operational use of this ASR facility for reclaimed water storage.

For ASR cycle testing purposes, prior to long term operation, recovery will be to the adjacent wetlands or to the water reclamation facility RIB/treatment wetland system. During recharge, the ASR wellhead will likely operate under slight positive pressure. When this occurs air within the well casing will be vented through an air and vacuum relief valve (ARV) connected to the annular space between the well casing and the pump column. Air in the pump column will be vented by a pump discharge ARV. When in the trickle flow, storage or recovery modes the water level in the well will decline and fall below land surface. When this occurs, the vacuum relief function of the ARV will allow air into the annular space. Trickle flows will be directed to below the static water level in the well through dedicated tubing attached to the pump column. Trickle flows are designed to maintain sterile conditions in the well casing and open borehole during storage periods when neither recharge nor recovery are occurring.

The wellhead will be fitted with a submersible pressure transducer through a polyethylene tubing located in the cemented annular space between the well casing and the borehole, positioned opposite the pump setting depth, so that any movement of the pump during normal operations or abrasion during installation or retrieval, will not damage the casing. The pressure transducer will be installed below the lowest water level expected in the casing during recovery and will be capable of reading the range of water levels within the well casing during recharge and recovery. A pressure gauge on the well casing will provide local indication of pressure in the casing during recharge. A separate port in the wellhead will be provided to directly measure static or pumping water level using an electric tape, in case the pressure transducer fails.

5.3.4 Well Blow-off Piping for Pumping to Wetland

The wellhead blow-off [waste] piping will consist of piping and a motorized modulating valve as a part of the above ground wellhead piping system and 14-inch ductile iron buried piping out to a wetland area located to the east of the proposed ASR system site. The modulating valve and 14-inch line size were selected to kill head from the ASR Recovery Pump that normally would pump against the higher head required to return water to the potable water distribution system. Water from the well will be wasted to the adjacent wetland or the EWRF RIB/treatment wetland system during cycle testing and back flushing operations. Discharge to the EWRF treatment wetlands will use an above ground pipeline to discharge to the EWRF ponds located adjacent to the facility.

5.3.5 Chlorine Feed System

Disinfection of the recovered water will be by contact with sodium hypochlorite to achieve an initial high-level disinfection. The ASR system will be an extension of the distribution system and will be designed to maintain residual disinfectant levels. The system will have redundant capabilities to feed at a rate of up to 3 milligrams per liter (mg/l) assuming a recovered water chlorine demand of < 2mg/l (> 1.0 mg/l chlorine residual). Should the recovered water have a higher chlorine demand, the feed pump size will be revised accordingly. The purpose of the disinfection system is to restore the chlorine residual level prior to recovery to the potable water distribution system.

For the proposed maximum recovery rate of 2,100 gpm, the maximum chlorine feed rate would be 75 pounds per day. The feed rate for each of the positive displacement pumps will be 75 gallons per day. The pumps will be selected with a capacity of up to 150 gallons per day. The chlorine feed system will be housed in the pre-manufactured concrete building and will utilize two positive-displacement feed pumps. The system will include a 2,000 gallon external double-wall storage tank for storing a 20-day supply of 12% sodium hypochlorite.

A pre-fabricated concrete building will be provided and include interior partitions to separate the chlorine room and the electrical room. The chlorine feed room will include a wall-mounted leak detector with exterior alarm to warn the operators should a chlorine leak occur. The alarm function from the leak detector will also provide remote notification through the SCADA system.

A residual chlorine analyzer will be provided to allow the operators to monitor chlorine residual during recovery operations.

5.3.6 Electrical and Control Systems

Electrical power for the 300 horsepower ASR recovery pump, motorized valves, chlorine feed systems, and other incidental loads will be obtained via a new 480-volt service. The pump motor and valves will be powered by a new 480-volt, 3-phase motor control center (MCC) to be located in the pre-fabricated concrete building as described above. The smaller 208-volt 3-phase and 120-volt single phase loads for the valve operators, chemical feed equipment, lighting, instruments, receptacles, etc. will be fed from a new power center to be provided with the new MCC equipment.

The local ASR system panel will include local monitoring and control capabilities and an interface with the County's SCADA system. The interface will be designed to conform to any existing standards that the County may have.

5.3.7 Instrumentation and Controls

The system will be designed to facilitate local control of all components and integration of the ASR recharge and recovery cycles with OCU's existing SCADA system at the Eastern Regional Water Supply Facility (ERWSF). The local control of pumps and valves will be accomplished by a control panel mounted inside the pre-fabricated building located adjacent to the ASR well system. Local indication of pump run status, valve status, wellhead pressure, flow rates and totalized flow for each mode of operation, and disinfection leak alarm status will be provided on the face of the control panel. The signals will also be extended to the County's existing SCADA system. Adjustable frequency drive (AFD) frequency will also be indicated locally and on the SCADA system.

The ASR system controls will be configured to allow the system to operate in one of five cycle modes. A pushbutton station at the control panel will allow the operator to choose from the following:

1. Recharge Cycle – The ASR well will store finished water from the County's system by diversion of a portion of the water supplied through the existing distribution facilities.
2. Waste Cycle – This cycle will be initiated at the operator's discretion prior to operating the ASR well in the Recovery Cycle mode. Water from the well will be wasted to a pre-determined location.
3. Recovery Cycle – Used to recover previously stored water from the ASR well and pump it into the distribution system. The recovered water will be disinfected with chlorine.
4. Trickle Flow/Storage Cycle – Approximately 2 to 10 gpm of treated drinking water bypasses the closed recharge valves and flows into the well to maintain a chlorine residual in the well casing and open borehole during storage periods when no recharge or recovery flow is occurring.
5. Off Cycle – The system is completely off, with all valves in the closed position, no trickle flow, and the pump off.

5.4 Design Assumptions

The ASR Project will be constructed at the Eastern Water Reclamation Facility site. The design will be based upon the following assumptions:

- ASR well construction will include a 24-inch FRP inner casing to a depth of 1100 feet BLS. The well will be completed to a depth of 1200 feet BLS resulting in an open hole interval from 1100 to 1200 feet BLS.
- Recharge and recovery of potable water will be via a 16-inch pipeline routed from the ASR well to the existing 36-inch water transmission main located on the west side of Curry Ford Road. This will allow recharge from the potable water system to the ASR well. The 16-inch pipeline may also be used during the recovery cycle to direct recovered water from the wellhead facilities to the 36-inch pipeline. The pressure in this transmission line during recharge and recovery periods is assumed to be in the range of 70 to 80 psi however this requires confirmation by OCU.

- OCU will run their hydraulic network model to determine the acceptable rate at which ASR recharge could occur, targeted to be 3 MGD, and the ability to accept 3 MGD during recovery from ASR. OCU will need to provide the design team with the pressure from their hydraulic model for a 3 MGD inflow at the connection to the 36-inch transmission main. This pressure will be used for the hydraulic design and selection of the recovery pump.

- Recharge and recovery surface facilities will consist of a vertical turbine recovery pump, piping, valves, bi-directional magnetic flow meter, recovery blow-off [waste] piping, chemical feed taps, and appurtenances. An adjustable frequency drive (AFD) will be provided for the ASR recovery pump to facilitate adjustment of ASR recovery flow rate to match changing system peak demands. The recovery rate will be adjustable over the range of approximately 50 to 100% of the design flow rate.

- The well cycle testing and back flush blow-off piping will discharge water from the pump cycle testing and from periodic brief back flushing events once the system is operational. The discharge will be to the nearby wetlands located approximately 600 feet east of the proposed ASR system position on the OCU site. The cycle testing water should be fresh water with TDS under 500 mg/l. Periodic back flushing would typically be required of the operating system at the beginning of a recovery cycle after long periods of storage and at other times during the cycle testing phases of the project. The wetlands discharge will be configured to provide low-rate, sheet-flow into the wetlands using a horizontal distribution header configured using multiple, low-velocity discharge points.

- Permitting requirements for the wetland discharge from the ASR system remain to be determined. This provision could require an ERP permit to be issued either by the SJRWMD or by FDEP.

- Disinfection systems for recovered potable water will consist of storage and feed systems that will provide recovered water with initial contact with a sodium hypochlorite solution injected into the recovery piping. Sodium hypochlorite disinfection of the recovered potable water using 12% solution. The storage tank will be a double-wall exterior tank sized for 20-days of storage. The feed pumps will be located inside of the proposed pre-manufactured concrete building.

- Pre-manufactured concrete building will consist of a nominal 12.5 ft. by 31 ft building to house the wellhead, chlorine feed equipment, the MCC, other electrical equipment, control panel, and SCADA RTU.

- Electrical power to the ASR system site will be coordinated by OCU. A transformer with 480-volt, 3-phase secondary will be required to serve the ASR facility. The ASR system design will coordinate with OCU's proposed reclaimed water ground storage tank project which will also require primary power to be brought to this area.

- Electrical system components required for the ASR System facilities will include a new electrical service entrance, metering, conduit and conductors to the new pre-manufactured concrete building, MCC mounted service disconnect, surge protection, adjustable frequency drive (AFD), power center with panel for electrically-actuated valves, chemical feed system equipment ventilation, convenience receptacles, additional site lighting, and system grounding.

- Instrumentation and control features in support of the ASR system including bi-directional rate of flow and totalized flow measurement for each mode of operation, well pressure or depth-to-water-level measurement; recharge, waste, and recovery valve operators with position indicators; pump controls; chemical system leak monitoring; residual chlorine monitoring, and phase/power failure at the MCC. Provide backup instantaneous flow measurement capability without remote monitoring or totalizing.

- A SCADA interface to the control system for the proposed ASR system will be included. OCU will provide the SCADA RTU (remote terminal unit) and software to provide control of the ASR system from the OCU water treatment plant. The design team will provide OCU with the I/O requirements and provide interconnecting capability from the ASR system control panel to the OCU-supplied SCADA interface RTU.
- Site work for the ASR system will be limited to the site at the immediate location of the well, surface facilities and pre-manufactured building.
- The exploratory well has been converted to a storage zone monitor well. The second storage zone monitor well and the Upper Floridan Aquifer and Surficial Aquifer monitor wells will be located to the east of the ASR well site, about 150 feet toward the SJRWMD well cluster. The Upper Floridan Aquifer monitor well will be open to the interval from 450 to 550 feet BLS. The Surficial Aquifer monitor well will be open to the interval from 50 to 80 feet BLS.
- OCU will provide the design team with the boundary survey for the site. The design team will prepare a topographic survey of the proposed ASR site.
- A building permit will be required from Orange County for the SCADA/ Electrical/ Disinfection building.
- OCU requires that a Safety Meeting be conducted as part of the Preconstruction Conference for Well and Wellhead Construction.
- Site access for all construction staff will be through the gate at the Alafaya Trail entrance to the plant. Access for drill rigs and heavy equipment can be through the Curry Ford Road gate by special arrangement. Badges will be provided for all construction staff.

5.5 Preliminary Drawings and Specifications

A preliminary list of drawing and specifications that are anticipated for the final design were prepared as part of the PDR. In addition, preliminary drawings including general, civil, mechanical and instrumentation drawings were also prepared and included in the PDR. These documents are included on the CD in ***Appendix G***.

5.6 Small Cycle Test Plan

5.6.1 Objectives

The objective of the cycle testing program is to establish the hydraulic and water quality characteristics of the ASR system, and to facilitate the technical, operational and regulatory requirements for a transition to operational status. This will be addressed by conducting a series of carefully controlled recharge and recovery cycles. A total of three main cycles are proposed. Key characteristics that in the testing program include:

- The general degree of mixing between stored treated drinking water and the native groundwater;
- The general volume of water required to establish a suitable buffer zone;
- Recovered water quality;
- System hydraulic performance; and
- The potential for well clogging, and the establishment of a backflushing frequency.

The first cycle will be of relatively short duration to allow some preliminary results to become immediately available and to establish confidence in the operation of the system. Specific issues to be addressed in this first cycle are:

- Verify acceptable rates of recharge and recover;
- Determine the baseline water quality response of the well due to mixing;
- Provide an initial indication of geochemical impacts and well plugging potential;
- Plant operation interface requirements;
- Initial indication of hydraulic performance;

- Estimate effect on potentiometric surface;
- Buffer zone development; and
- Recovery water quality.

5.6.2 Cycle Test Program

The initial proposed cycle test schedule is outlined in ***Table 5-1***. The estimated recharge and recovery volumes of water will be added once the recharge and recovery rates have been determined. The cycles address the need to determine hydraulic performance (sustainable rates for recharge and recovery and potential for aquifer plugging), mixing characteristics to determine recovery efficiency, and buffer zone development.

TABLE 5-1
St. Johns River Water Management District – Orange County Utilities ASR
Preliminary Cycle Testing Schedule

	Duration (days)			
Cycle	**Recharge**	**Storage**	**Recovery**	**Total**
1	14	14	7	35
2	21	21	7	49
3	28	42	14	84

Notes
Durations may be adjusted, as appropriate, based upon operational needs, wellhead or formation conditions, or results from earlier cycles.
1 Day = 24 Hours
Cycle 3 Recovery is to the Distribution System.

The following text summarizes the rationale behind the design for each cycle, and outlines the key test objectives for each cycle.

Preliminary Testing

Prior to the start of the first cycle, a series of calibration and final commissioning tests should be performed. Depending on the results of these preliminary tests, adjustments to the recharge and recovery cycles may be required.

Full Scale Cycle Tests (Cycles 1-3)

The target recharge duration for Cycle 1 is 14 days, although a slightly longer/shorter duration may be used. The prime objective of this cycle will be to begin development of the buffer zone, moving native groundwater away from the ASR well. A recovery percentage of about 50% is suggested. This water will be recovered to waste. Ongoing monitoring will provide early indications of any changes in well performance and mixing. During all cycle tests, recharge and recovery rates should be kept constant, to the extent possible, so that the specific injectivity/capacity can be determined.

Cycle 2 should use a total recharge duration of approximately 21 days, followed by 21 days of storage and 7 days of recovery to waste, to continue to build the buffer zone.

Cycle 3 will recharge for 28 days and recover to the distribution system after 14 days of recovery to waste. Recovered water will be sampled to establish compliance with state and federal water quality standards.

Monitoring

The success of the cycle testing program will be measured on the basis of data collected during the monitoring and sampling program. It is important that these data are collected so that we can gain early and continuing confirmation that the cycle testing is proceeding as predicted. Throughout the duration of the test the following items should be monitored on a frequent and regular basis:

- ASR1 groundwater level and well pressure;
- Groundwater level and well pressure at all monitor wells;
- Recharge and recovery flow rates;
- Recharge and recovery water quality in ASR1;
- Water quality in selected monitor wells; and
- Pipe work connections and valves will be monitored to check for correct operation.

Hydraulic Monitoring

Pressure transducers (gauges) should measure groundwater pressure at the ASR well and monitor wells during recharge. Flow rates during recharge and recovery should also be recorded. Manual readings from the flow meter and pressure gauges should be taken at regular intervals, twice a day initially during each recharge and recovery portion of each cycle, with once-a-day readings continuously throughout cycle testing.

Water Quality Monitoring

Water quality monitoring should include the collection of recharge water samples and recovered water samples. Water quality samples will be collected periodically at each of the wells. The analytical results will be used in conjunction with the hydraulic data to assess the mixing characteristics of the stored water with the native groundwater and geochemical reactions. The suggested analytical sampling suites and approximate number of samples to be collected are shown in ***Table 5-2***.

Recovery Efficiency

Recovery efficiency is defined as the percentage of the water volume stored that is subsequently recovered while meeting a target water quality criterion in the recovered water. It usually has little significance when the recharge water and native groundwater are both potable. The storage interval for this ASR system targets a potable water zone; therefore the native groundwater has a TDS of less than 500 mg/l. This is quite low relative to other Florida ASR well fields. However, approximately 75 percent of all ASR wells in the United States (about 72 well fields with over 300 wells) store and recover drinking water in freshwater aquifers. Storing water in an aquifer with a TDS of less than 500 mg/l maximizes recovery efficiency with a minimal investment of water to build the buffer zone between the recharge water placed into storage and the native groundwater. The highest recovery efficiencies can be expected within a relative short period of time and also during long-term operations.

TABLE 5-2
ASR Cycle Testing Water Quality Sampling and Analysis Plan
(May be Revised Based on Field Conditions)
Total of 3 Cycles

Cycle 1	# Samples	Frequency	Recharge Source Water	ASR Well Groundwater	Monitoring Wells (3)
Recharge	5	At start of cycle, before recharge begins	Complete Primary & Secondary Drinking Water Standards, Conductivity, Uranium. Field - temp, DO, eH, conductivity, pH	Complete Primary & Secondary Drinking Water Standards, Conductivity, Uranium. Field - temp, DO, eH, conductivity, pH (Plus list below)	Complete Primary & Secondary Drinking Water Standards, Conductivity, Uranium. Field - temp, DO, eH, conductivity, pH (Plus list below)
Storage	6	Two Monitoring Wells and ASR Well Sampled 2 Times Each. Storage Time approximately 2 weeks.			Lab - Alkalinity (total as CaCO3), arsenic, calcium, chloride, color, conductivity, hardness (total as CaCO3), iron, magnesium, manganese, pH, sulfate, TDS, turbidity Field - temp, DO, eH, conductivity, pH
Recovery	12	ASR Well Sampled 6 times, Two Monitoring Wells Sampled 3 Times Each. Recovery Time approximately 1 week.		Lab - Alkalinity (total as CaCO3), arsenic, calcium, chloride, color, conductivity, hardness (total as CaCO3), iron, magnesium, manganese, pH, sulfate, TDS, turbidity Field - temp, DO, eH, conductivity, pH	Lab - Alkalinity (total as CaCO3), arsenic, calcium, chloride, color, conductivity, hardness (total as CaCO3), iron, magnesium, manganese, pH, sulfate, TDS, turbidity Field - temp, DO, eH, conductivity, pH
Cycle 2	**# Samples**	**Frequency**	**Recharge Source Water**	**ASR Well Groundwater**	**Monitoring Wells (3)**
Recharge	1	At start of cycle, before recharge begins	Lab - Alkalinity (total as CaCO3), arsenic, calcium, chloride, color, conductivity, hardness (total as CaCO3), iron, magnesium, manganese, pH, sulfate, TDS, turbidity Field - temp, DO, eH, conductivity, pH		
Storage	9	Two Monitoring Wells and ASR Well Sampled 3 Times Each. Storage Time approximately 3 weeks.			Lab - Alkalinity (total as CaCO3), arsenic, calcium, chloride, color, conductivity, hardness (total as CaCO3), iron, magnesium, manganese, pH, sulfate, TDS, turbidity Field - temp, DO, eH, conductivity, pH

TABLE 5-2
ASR Cycle Testing Water Quality Sampling and Analysis Plan
(May be Revised Based on Field Conditions)
Total of 3 Cycles

Cycle 2	**# Samples**	**Frequency**	**Recharge Source Water**	**ASR Well Groundwater**	**Monitoring Wells (3)**
Recovery	12	ASR Well Sampled 6 times, Two Monitoring Wells Sampled 3 Times Each. Recovery Time approximately 1 week.		Lab - Alkalinity (total as CaCO3), arsenic, calcium, chloride, color, conductivity, hardness (total as CaCO3), iron, magnesium, manganese, pH, sulfate, TDS, turbidity Field - temp, DO, eH, conductivity, pH	Lab - Alkalinity (total as CaCO3), arsenic, calcium, chloride, color, conductivity, hardness (total as CaCO3), iron, magnesium, manganese, pH, sulfate, TDS, turbidity Field - temp, DO, eH, conductivity, pH

Cycle 3	**# Samples**	**Frequency**	**Recharge Source Water**	**ASR Well Groundwater**	**Monitoring Wells (3)**
Recharge	1	At start of cycle, before recharge begins	Lab - Alkalinity (total as CaCO3), arsenic, calcium, chloride, color, conductivity, hardness (total as CaCO3), iron, magnesium, manganese, pH, sulfate, TDS, turbidity Field - temp, DO, eH, conductivity, pH		
Storage	12	Two Monitoring Wells and ASR Well Sampled 4 Times Each. Storage Time approximately 6 weeks.		Lab - Alkalinity (total as CaCO3), arsenic, calcium, chloride, color, conductivity, hardness (total as CaCO3), iron, magnesium, manganese, pH, sulfate, TDS, turbidity Field - temp, DO, eH, conductivity, pH	Lab - Alkalinity (total as CaCO3), arsenic, calcium, chloride, color, conductivity, hardness (total as CaCO3), iron, magnesium, manganese, pH, sulfate, TDS, turbidity Field - temp, DO, eH, conductivity, pH
Recovery	14	ASR Well Sampled 6 times, Two Monitoring Wells Sampled 4 Times Each. Recovery Time approximately 4 weeks.		Lab - Alkalinity (total as CaCO3), arsenic, calcium, chloride, color, conductivity, hardness (total as CaCO3), iron, magnesium, manganese, pH, sulfate, TDS, turbidity Field - temp, DO, eH, conductivity, pH	Lab - Alkalinity (total as CaCO3), arsenic, calcium, chloride, color, conductivity, hardness (total as CaCO3), iron, magnesium, manganese, pH, sulfate, TDS, turbidity Field - temp, DO, eH, conductivity, pH
Recovery	3	ASR Well Sampled 1 Time, Two Monitoring Wells Sampled 1 Time Each.		Complete Primary & Secondary Drinking Water Standards, Conductivity, Uranium. Field - temp, DO, eH, conductivity, pH	Complete Primary & Secondary Drinking Water Standards, Conductivity, Uranium. Field - temp, DO, eH, conductivity, pH

Water Quality Tracers during Cycle Testing

Water quality parameters that could potentially be used as an indicator of percent recovery are listed in the PDR, as wells as, water quality data from a sample of the OCU finished/recharge water that would be used for cycle testing, the native groundwater from Packer Test 6 open to 1120 to 1210 feet, and the native groundwater from the completed exploratory well.

Fluoride may be the best indicator for tracking stored water during recovery, with manganese and total dissolved solids providing some additional information to estimate the percent recovery.

5.7 Construction and Testing of Exploratory Well

The construction and testing of the exploratory well on was included in Task 4 – Site-Specific Data Collection and Preliminary System Design and results were presented in a separate report, *ASR Exploratory Well Project Report for EWRF Orange County Florida* completed in September 2006. The results of the exploratory well testing were required to evaluate the hydrogeologic character and are the basis of development for ASR well design criteria. The evaluation considered factors related to ASR and provides recommendations regarding the suitability of the site and selection of the most favorable subsurface interval for the application of ASR.

5.7.1 Exploratory Well Construction and Testing

The exploratory well at the EWRF was drilled by Diversified Drilling Corporation of Tampa between March 14, 2005 and April 17, 2005. The well was located approximately 500 feet from the proposed ASR Well and completed to a depth of 1,700 feet. Continuous wireline rock coring was performed by Boart-Longyear between the depths of 600 to 1,700 feet. Data collected included rock cuttings and cores, groundwater samples, geophysical and video logs, packer/specific capacity testing. The borehole interval, from 1,350 feet to about 1,415 feet, was extremely dense and highly fractured. The exploratory well was completed as a storage zone monitor well (LFMW-2) with casings set respectively: diameters 24/18/12/4 inches and depths 118/220/600/1,100 feet BLS. The zone from a depth of 1,100 to 1,205 feet was left as the open-interval.

5.7.2 Hydrogeologic Setting and Testing Results

The principal hydrogeologic units encountered at the EWRF well site are:

- Surficial Aquifer System near land surface to 110 feet BLS.
- Intermediate Confining Unit between 110 to 200 feet BLS.
- Upper Floridan Aquifer between 200 to 520 feet BLS.
- Middle Semi-Confining Unit between 520 to 1,085feet.
- Lower Floridan Aquifer from 1,085 feet to greater than 1,700 feet BLS

The recommended storage zone, between 1,100 to 1,200 feet BLS, primarily consists of dolomite and dolomitic wackestones of the Avon Park Formation. The formation is very hard, highly fractured and transmissive from 1,335 to 1,415 feet. A soft limestone, encountered from 1,590 to 1,700 feet, acts as a deeper semi-confining layer. Rock core analysis and leaching studies were conducted by Mineralogy, Inc. and the Florida Geological Survey and presented under a separate document, *Bench-Scale Geochemical Assessment of Water-Rock Interactions*, completed in April 22, 2008.

The transmissivity of the storage zone was not specifically determined, due to the well casing diameter limitations. Storage zone transmissivity will be determined once the ASR Well is completed and tested. However, the graph of water level measurements during Packer Test No. 6 (1,120 to 1,210 feet) shows a quick recovery response suggesting that a high yield is likely. Also, the pumping flow log indicates that significant amounts of flow entered the borehole at about 1,195 and 1,160 feet within the target storage zone. Very fresh groundwater extends to depths of at least 1,100 feet, and the 250 isochlor occurs at about 1,270 feet in the upper part of the Lower Floridan aquifer. By a depth of 1350 feet, the groundwater quality is mineralized (brackish). Groundwater samples were collected from the completed monitor well after approximately 8 hours of development. All Florida Drinking Water Standards (F.A.C. 62-550) were tested and found to be below the Maximum Contaminant Levels (MCL), except odor, which likely results from elevated hydrogen sulfide levels. Groundwater samples collected within the recommended storage zone had a TDS of 270 mg/l and chlorides of 37 mg/l.

5.7.3 Preliminary ASR System Design and Operation

Section 7 of the *ASR Exploratory Well Project Report for EWRF Orange County Florida* includes a general description of the proposed ASR system. However, more comprehensive descriptions of the basic operational concepts, well configuration and features, chemical feed systems, building configuration, electrical system and controls are included in the *Preliminary Basis of Design for an Aquifer Storage Recovery System at the OCU Eastern Water Reclamation Facility* which is summarized above in Sections 5.1 to 5.6.

5.7.4 Reclaimed Water ASR

In addition to potable water, reclaimed water can also be stored in an ASR well and several reclaimed water projects are currently being investigated in Florida. Discharge of public access quality reclaimed water can be stored in Class G-II aquifers with groundwater greater than 3,000 mg/l of total dissolved solids (TDS) without additional treatment required. The depth where the 3000 mg/l TDS is exceeded occurs at about 1340 feet at EWRF where the formation becomes highly fractured/transmissive and groundwater becomes increasingly brackish. A relatively thin storage zone with good confinement is not apparent from this drilling data, therefore, storage of reclaimed water is not considered feasible below this depth. Though the selected storage zone has a TDS concentration less than 3,000 mg/l, storage of reclaimed water in this zone may be permittable. However, additional high-level treatment of the reclaimed water to Full Treatment Standards in Chapter 62-610.563 (3) would be required.

This project will be designed, permitted and built for potable water ASR. After transfer of the completed ASR test well, the county has the separate option to prepare and submit a Major Permit Modification to FDEP for the Underground Injection Control (UIC) Permit to utilize a non-potable source (e.g.: either reclaimed water or partially treated surface water) of injection water.

5.7.5 Recommendations

Site investigations indicate favorable conditions exist for ASR at the EWRF. The recommended ASR target storage zone is in a fresh water interval between about 1,100 to 1,200 feet BLS. A primary value of this ASR system is in providing storage of seasonally available water in the Lower Floridan aquifer that is not usable in this area due to the proximity of brackish water below and its potential upward and lateral migration under a typical extraction scenario. Cyclic recharge and recovery will potentially allow use of this previously unavailable source without inland movement of brackish water. It is recommended to proceed with the design, permitting and construction of the ASR system at the EWRF.

5.8 FGS Leaching Study

5.8.1 Introduction

Rock core samples from within the Avon Park Formation of the Exploratory Well at the Eastern Water Reclamation Facility (EWRF) were provided to the Florida Geological Survey to perform rock core analysis and leaching studies. The purpose of the study was to characterize the geochemistry, bench-scale leachability and sources of soluble metals in storage zone carbonate rocks from the Orange County ASR. The scope of the study includes three main parts: 1) lithologic, geochemical and mineralogical characterization of aquifer rocks from the ASR well storage zone; 2) bench-scale leaching of ASR core samples in response to variable redox conditions; and 3) sequential extraction analyses of storage zone rocks. The *Bench-Scale Geochemical Assessment of Water-Rock Interactions: Orange County Aquifer Storage and Recovery Facility* Final Report was completed in April 2008 and is included on the CD in ***Appendix G***.

The bench-scale component of the study was designed to isolate and characterize mobilization of metals under varying dissolved oxygen (DO) conditions within a source water leachate collected from the Orange County potable water system at the fire hydrant on Curry Ford Road at the EWRF. The bench-scale study is “reaction-kinetic” limited and is only an approximation of potential aquifer conditions during ASR activities, at least until ASR cycle-test data becomes available for comparison.

Additional factors that constrain the application of bench-scale studies are groundwater mixing, effects of scale (i.e., study area size), water-rock ratios, physical and chemical aquifer heterogeneities (e.g., dual porosity), pressure-temperature differences, and microbial activity. While the bench-scale results may not have reached equilibrium conditions for all potential reactions, and are not expected to provide a direct comparison with water-quality changes observed during cycle testing at the Orange County ASR facility, prediction of relative degrees and perhaps magnitudes of metals mobilization may be realized. This information may prove to be predictive tool in the design, testing, and operation of an ASR well.

5.8.2 Study Conclusions

Hydrogeochemical implications inferred from bench-scale leaching tests are intended to provide a cost-efficient approximation of what may be observed at the field scale. Specifically, the bench scale results presented herein will hopefully provide information on relative mobility of metals and the potential order-of-magnitude changes in ASR storage zone water quality. In laboratory conditions, mobilization of metals (and metalloids) is clearly indicated; some metals are strongly desorbed from the aquifer matrix, some are apparently immobile, others sorb, and some metals exhibit dynamic behaviors that are highly responsive to changes in redox and solute compositions.

Noteworthy caveats exist with regard to interpretation of these results. Issues of volume and scale, physical aquifer characteristics, reaction kinetics during fluid flow and storage, etc. preclude direct transfer of the bench-study results to the field. While the study hopefully brackets the range of many hydrochemical processes during ASR, complicating variables include, but are not limited to temperature, pressure, redox conditions, water-rock surface area ratio, core sample atmospheric oxidation, variability in source-water composition, source-water – groundwater mixing, effects of dual porosity, and artificial enhancement of trace-mineral exposure to the leachate solution (i.e., use of core chips rather than a flow-through core may have exposed pyrites to the leachate that would otherwise have been isolated from the matrix permeability). While beyond scope of the present study, the importance of geochemical modeling as a potential predictive tool cannot be overstated.

At the proposed Orange County ASR site, leaching of metals from the dolostone aquifer matrix is indicated by bench-scale studies. The source of the potentially mobilized Arsenic (As) and other metals is predominantly pyrite; however, the As may also be associated with natural organic material. Oxidation-reduction potential (ORP) (and DO) appear to be the dominant factors regarding desorption/sorption of As. The As cycle may move between difference phases (i.e., pyrite and hydrous ferric oxides) depending on the ORP. If the Orange County ASR system can be designed to maintain ORP of the source water in reduced conditions, mobilization of As and other metals may be minimized. Molybdenum, apparently being more water soluble, may desorb from the aquifer matrix more liberally as it appears less sensitive to ORP at the bench scale. However, if previous bench studies are any indication, the Mo will attenuate with successive cycle testing as long as the same zone of aquifer matrix is exposed to the recharged source water.

5.9 Expansion Plan

5.9.1 Background and Purpose

Orange County Utilities (OCU) and St Johns River Water Management District (SJRWMD) are working together on an Aquifer Storage and Recovery (ASR Program to examine the appropriateness of integrating ASR technology into regional water supply development projects. The primary ASR objective for the County is to develop a water management technique that can be used to help meet projected deficits through seasonal and long-term storage and recovery of water. An exploration well was constructed and testing at OCU’s Eastern Water Reclamation Facility (EWRF) resulting in favorable conditions to further implement an ASR pilot system. The ASR test and monitoring wells are currently under construction and cycle testing is targeted to begin during 2009.

Assuming that the planned ASR pilot system at the EWRF is deemed a success, OCU may expand the facilities from one ASR well to an ASR wellfield, storing treated drinking water imported from a new surface water source, such at the St Johns River/Taylor Creek Reservoir and /or the County’s existing potable water transmission system.

This summary taken from the Technical Memorandum (TM) prepared for Orange County Utilities under the title {Orange County Utilities Aquifer Storage and Recovery (ASR) Demonstration Program Preliminary Expansion Plan for ASR Wellfield at Eastern Water Reclamation Facility by ASR Systems, LLC and BFA, Inc.}. The TM is intended to provide a conceptual layout of such a wellfield and to address some of the issues that would need to be addressed for its development. ***Figure 5-4*** shows the conceptual ASR Wellfield layout at the EWRF.

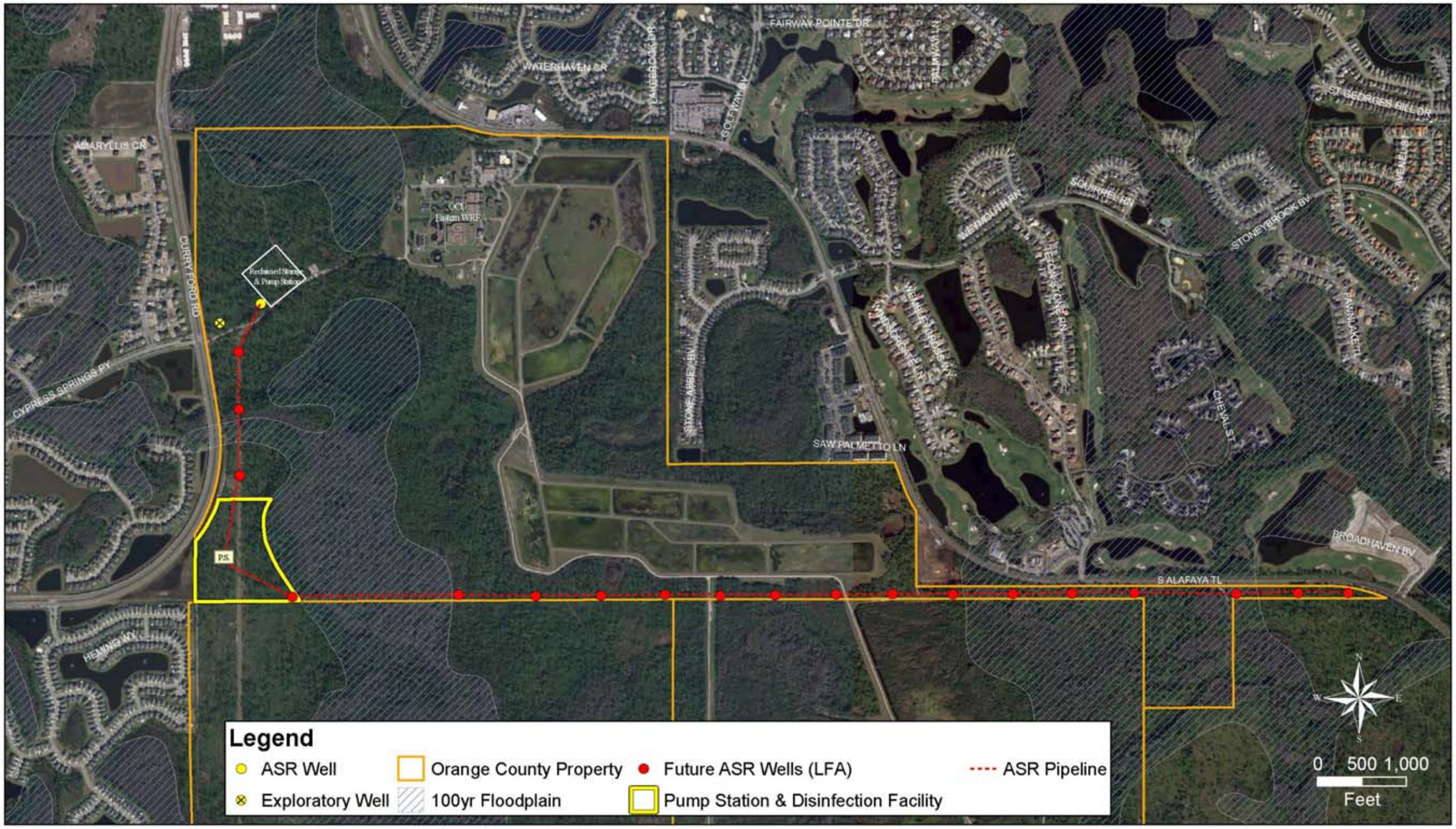
The expansion project will be designed, permitted and built for potable ASR and was the focus of the TM expansion plan. In addition to potable water, non-potable water sources (such as reclaimed or stormwater) may be considered if high level (membrane) treatment to full treatment standards are applied (Chapter 62-610.563(3)). The County has a separate option to prepare and submit a Major Permit Modification to FDEP for Underground Injection Control (UIC) Permit to utilize a non-potable source of injection water.

5.9.2 Basis of Design

The basis of design for the ASR wellfield expansion will largely depending on the following estimated needs and quantities:

- Future 2030 OCU services area water needs of 49.6 mgd;
- Floridan Aquifer system ASR constraints/limitations at EWRF (>50mgd); and
- Quantities of potable water from potential alternative surface water sources:
    - SJR/TCR Water Supply Project (40 mgd);
    - SJR near SR 50 Water Supply Project (10 mgd);
    - SJR near SR 46 Water Supplu Project (63.13 mgd);
    - SJR near Yankee Lake Water Supply Project (86.33mgd); and
    - Lake Hart and Mary Jane Water Supply Project (7 mgd).

Sources: SJRWMD Water Supply Projections by Richard Dotty – May 13, 2008 Third Addendum of the District Water Supply Plan (Tech. Pub. SJ2006-2C).



BFA

ST JOHNS RIVER WATER MANAGEMENT DISTRICT & ORANGE COUNTY UTILITIES
AQUIFER STORAGE AND RECOVERY SYSTEM FUTURE WELLFIELD LOCATION MAP

FIGURE 5-4

ASR wellfield expansion would likely be conducted in several phases. For purposes of the TM, an ultimate capacity up to 50 mgd is envisioned to be available for OCU from a combination of the above alternative surface water sources. This would be the planned recovery rate. Recharge is assumed to occur at rates up to 30 mgd, from the above potential sources. ASR wellfield design capacity would be the greater of either the recharge capacity or the recovery capacity. Potential ultimate capacity from these sources to meet regional water supply needs is not yet known nor is the share of that capacity that may be stored at an ASR wellfield at the OCU site. It should be noted that flows could come from any of the sources listed above and it is possible that ASR storage may be distributed to multiple sites, of which the EWRF site would be one.

Water is assumed to be stored during typically several months per year. The stored water would be recovered to help meet peak water demands during droughts of up to four months duration. Annual average storage and recovery volumes for ASR wellfields may be in the range of 5 to 6 billion gallons (BG). Cumulative stored water volumes may be significantly larger for regional water banking operation since successive wet years and successive drought years will cause greater variability in stored water volumes.

During wet years recharge may continue for possibly up to ten months. During drought years, recharge may occur for a much shorter period, possibly as short as about three months. The ASR wellfield would therefore operate as a water banking operation, storing more water in wet years and recovering more water in drought years.

Water quality of the recharge water is assumed to meet all drinking water standards. The ambient groundwater is fresh; however, it has elevated concentrations of hydrogen sulfide. Concern also exists that arsenic may be present in the storage aquifer and may, under certain conditions, be found in the water recovered from the ASR wells. Based upon extensive Florida ASR experience since 1983, both of these concerns are believed to be easily and cost-effectively addressed through appropriate development and operation of ASR wellfield.

Conveyance of these flows is assumed to occur via pipeline from the above listed surface water sources to the EWRF site. This is not the only conveyance option since the aquifer could also be used to convey these flows for a considerable portion of the distance, providing additional storage volume and also salinity intrusion control. However current plans envision pipeline and pumping stations conveyance for the full distance.

These assumed flow rates, storage volumes and water quality assumptions comprise the fundamental basis of design for the expanded ASR wellfield. At such time as the ASR Cycle Testing Program is approaching completion, presumably 2010, it would be appropriate to prepare an ASR Wellfield Expansion Plan, updating the TM. The basis of design assumes that experience with flow rates, well spacing, water quality and other issues during early phases of the ASR expansion will be incorporated into the successful design and operation of the subsequent phases.

6.0 Project Design

6.1 ASR and Monitoring Well Drilling and Testing Plan

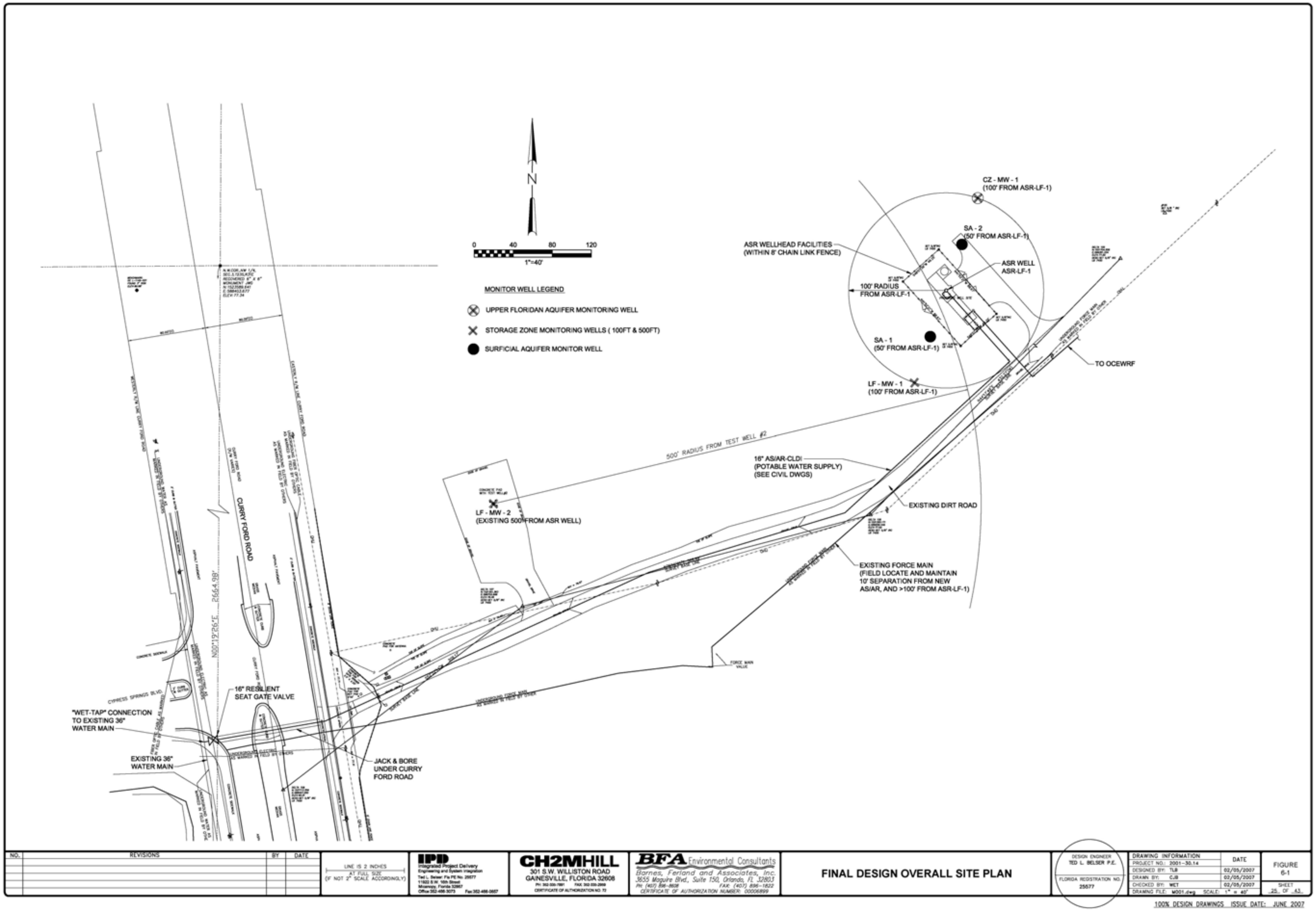
The proposed Orange County ASR system at the EWRF includes the following wells:

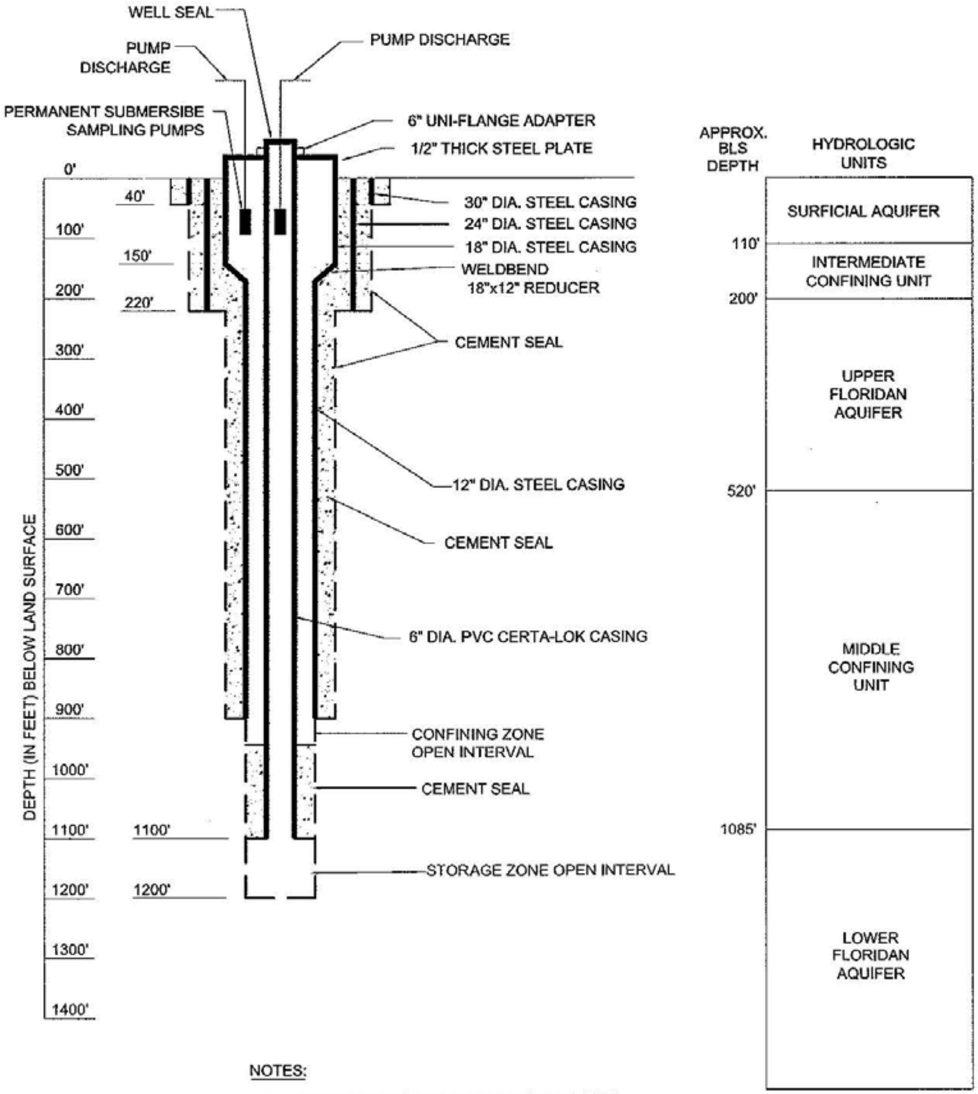
- One Lower Floridan ASR Well (ASR-LF-1) completed to a depth of 1,200 feet.
- Two shallow monitoring wells (SA-2 and SA-3) completed in the surficial aquifer.
- One confining zone monitoring well (CZMW-1) completed to a depth of 950 feet.
- Two Lower Floridan monitoring wells (LFMW-1 and LFMW-2) completed to a depth of 1,200 feet within the ASR storage zone.

CZMW-1 and LFMW-2 will be completed as a dual zone monitor well at one location. LFMW-2 will be recently completed as an exploratory well to evaluate the feasibility for an ASR system at the EWRF site. The locations of proposed wells and existing exploratory well are shown in ***Figure 6-1***. A summary of the recommended construction and testing plan for the ASR well and associated monitoring wells (SA-2, SA-3, and LFMW-1/CZMW-1) is presented below. Well construction details for the ASR and monitoring wells are provided in ***Figures 6-2a*** and ***6-2b***. Actual casing lengths and final depths of all wells depended on site-specific hydrogeologic conditions.

6.1.1 Shallow Monitoring Wells SA-2 and SA-3

Shallow monitoring wells SA-2 and SA-3 will be installed to a total depth of 15 feet BLS and constructed of 5 feet of 2-inch-diameter Schedule 40 PVC well casing and 10 feet of 10-slot PVC well screen. Both wells will be installed in a 6-inch diameter borehole. Completion procedures consists of filling the annular space between the borehole and the well screen with sand from the bottom of the well to approximately 2 feet above the top of the well screen. Approximately 1 feet of hydrated bentonite will be placed above the filter sand. The remaining annular space will be filled with a Type I cement grout mixture to surface grade.


N
0 40 80 120
1"=40'
MONITOR WELL LEGEND
UPPER FLORIDAN AQUIFER MONITORING WELL
STORAGE ZONE MONITORING WELLS (100FT & 500FT)
SURFICIAL AQUIFER MONITOR WELL
CZ - MW - 1
(100' FROM ASR-LF-1)
SA - 2
(50' FROM ASR-LF-1)
ASR WELLHEAD FACILITIES
(WITHIN 8' CHAIN LINK FENCE)
ASR WELL
ASR-LF-1
100' RADIUS
FROM ASR-LF-1
SA - 1
(50' FROM ASR-LF-1)
LF - MW - 1
(100' FROM ASR-LF-1)
TO OCEWRF
500' RADIUS FROM TEST WELL #2
16" AS/AR-CLDI
(POTABLE WATER SUPPLY)
(SEE CIVIL DWGS)
EXISTING DIRT ROAD
LF - MW - 2
(EXISTING 500' FROM ASR WELL)
EXISTING FORCE MAIN
(FIELD LOCATE AND MAINTAIN
10' SEPARATION FROM NEW
AS/AR, AND >100' FROM ASR-LF-1)
FORCE MAIN VALVE
CURRY FORD ROAD
N00°19'26"E 2664.98'
CYPRESS SPRINGS BLVD.
"WET-TAP" CONNECTION
TO EXISTING 36"
WATER MAIN
16" RESILIENT
SEAT GATE VALVE
EXISTING 36"
WATER MAIN
JACK & BORE
UNDER CURRY
FORD ROAD
NO.
REVISIONS
BY
DATE
LINE IS 2 INCHES
AT FULL SIZE
(IF NOT 2" SCALE ACCORDINGLY)
IPD
Integrated Project Delivery
Engineering and System Integration
CH2MHILL
301 S.W. WILLISTON ROAD
GAINESVILLE, FLORIDA 32608
CERTIFICATE OF AUTHORIZATION NO. 72
BFA Environmental Consultants
Barnes, Ferland and Associates, Inc.
3655 Maguire Blvd., Suite 150, Orlando, FL 32803
PH: (407) 896-8608 FAX: (407) 896-1822
CERTIFICATE OF AUTHORIZATION NUMBER: 00006899
FINAL DESIGN OVERALL SITE PLAN
DESIGN ENGINEER
TED L. BELSER P.E.
FLORIDA REGISTRATION NO.
25577
DRAWING INFORMATION
DATE
PROJECT NO.: 2001-30.14
DESIGNED BY: TLB 02/05/2007
DRAWN BY: CJB 02/05/2007
CHECKED BY: WCT 02/05/2007
DRAWING FILE: M001.dwg SCALE: 1" = 40'
FIGURE
6-1
SHEET
25 OF 43
100% DESIGN DRAWINGS ISSUE DATE: JUNE 2007



NOTES:

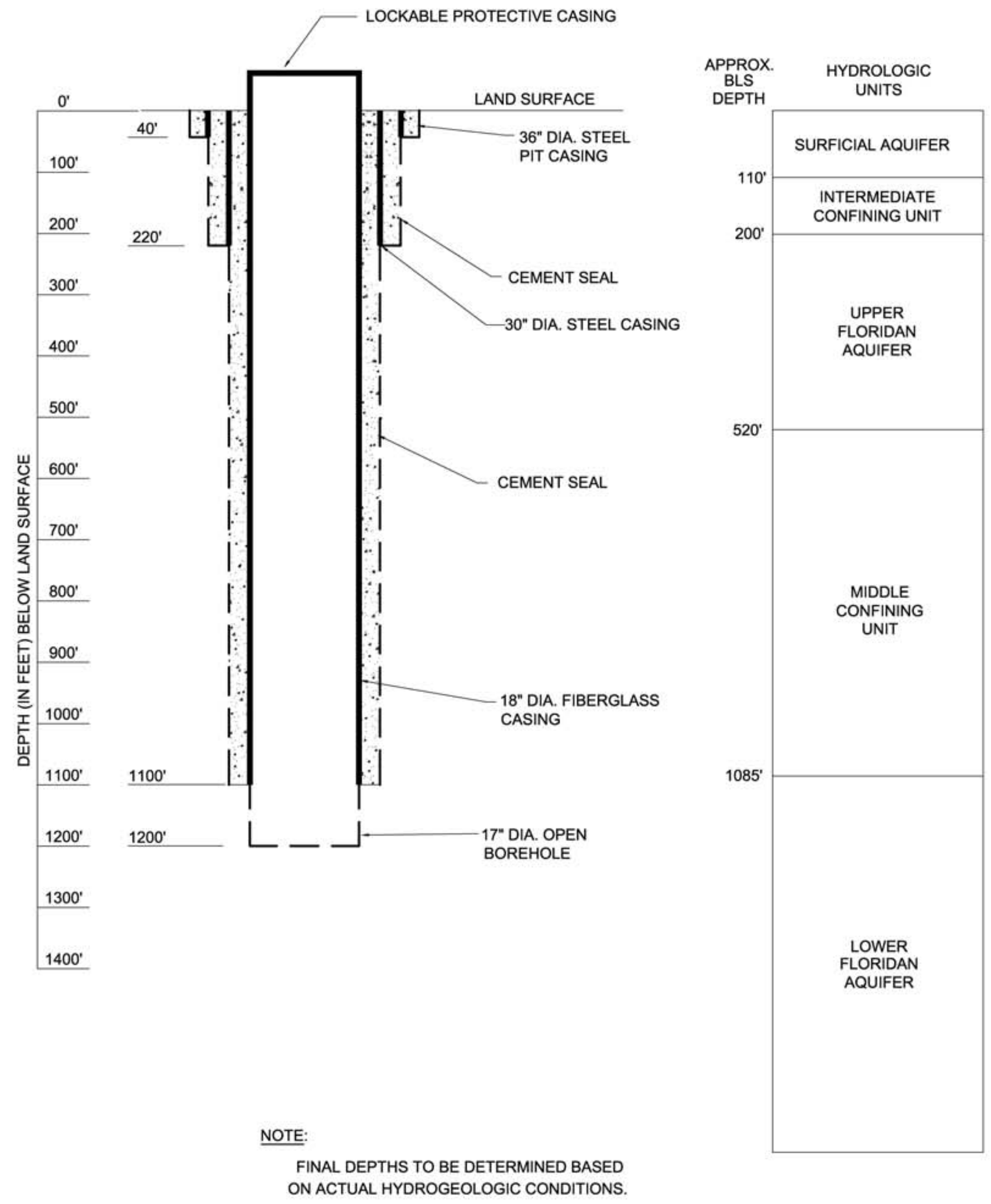
1) FINAL DEPTHS TO BE DETERMINED BASED ON ACTUAL HYDROGEOLOGIC CONDITIONS.
2) BOWSPRING CENTRALIZERS EVERY 30' FOR 6" DIA. CASING, FROM 950-1100' DEPTH

CONSTRUCTION DETAILS FOR DUAL ZONE MONITOR WELLS LF-MW-1 AND CZ-MW-1

BFA

FINAL DESIGN WELL SECTIONS

FIGURE 6-2 A



NOTE:

FINAL DEPTHS TO BE DETERMINED BASED ON ACTUAL HYDROGEOLOGIC CONDITIONS.

CONSTRUCTION DETAILS FOR
PROPOSED LOWER FLORIDAN ASR WELL

BFA	**FINAL DESIGN WELL SECTIONS**	FIGURE 6-2 B

6.1.2 Dual Zone Monitoring Well (CZMW-1 and LFMW-1)

The dual zone monitoring well serves to monitor both the confining zone (CZ) and the lower Floridan storage zone (LF) at the same location.

- Set up fluid containment system for mud rotary and reverse air drilling.
- Drill a nominal 8-inch-diameter pilot hole from ground surface to a depth of 40 feet.
- Collect drill cuttings at 5-foot intervals from the surface to depth of 1,200 feet.
- Ream a nominal 36–inch-diameter borehole and install a 30-inch-diameter steel surface casing to a depth of approximately 40 feet. Grout the 30-inch steel casing using ASTM Type II Portland Cement.
- Drill a nominal 8-inch pilot hole from 40 feet to 250 feet BLS.
- Ream a nominal 29 inch-diameter borehole and install a 24-inch-diameter casing to a depth of 220 feet BLS. Grout the 24-inch casing using ASTM Type II Portland Cement.
- Drill a nominal 17-inch borehole from 220 feet to 900 feet BLS.
- Perform a caliper log to 900 feet.
- Install an 18-inch diameter steel casing to 150 feet with a WELDBEND Reducer welded to a 12-inch-diameter steel casing to a depth of approximately 900 feet BLS. Use approved centralizers on 12-inch casing at depths of approximately 880, 500, 250, 150 and 20 feet BLS. Grout 18/12-inch casings using ASTM Type II Portland cement.
- Drill a nominal 11-inch-diameter open borehole section from 900 feet to 1,050 feet BLS.
- Set up test pumping equipment (up to 2000 gpm) and discharge line.
- Develop well until the groundwater is free of sand and suspended solids, and the maximum capacity of the well is achieved.
- Conduct a step drawdown test and 24-hour constant-rate pumping test as described below under Aquifer Performance Testing.
- Drill a nominal 11-inch-diameter borehole section from 1,050 feet to approximately 1,200 feet BLS.
- Set up test pumping equipment (up to 2000 gpm).

- Develop well until the groundwater is free of sand and suspended solids, and the maximum capacity of the well is achieved.
- Conduct a step drawdown test and 48-hour constant-rate pumping test.
- Measure turbidity during the variable-rate and constant-rate pumping tests.
- Conduct a full suite of geophysical logs on the open-section of the well, from 1,050 to 1,200 feet BLS as described below under Geophysical Logging.
- After testing is completed, install a 6-inch-diameter Certa-Lok PVC casing inside the existing 12-inch casing from ground surface to a depth of 1,100 feet BLS. Use centralizers on 6-inch casing at depths of approximately 1090, 1,060, 1030, 1000, 970, 960, 895, 700, 500, 300 and 160 feet BLS. Carefully grout 6-inch casing from 950 feet BLS to 1100 feet BLS using ASTM Type II Portland Cement.
- Develop both wells and perform caliper and video logs to 1,200 feet BLS to verify grout did not migrate into open hole sections.

6.1.3 ASR Well ASR-LF-1

The general sequence of events for the construction of ASR Well is summarized below:

- Set up fluid containment system for mud rotary and reverse air drilling.
- Drill a nominal 8-inch pilot hole from ground surface to a depth of 40 feet BLS.
- Drill cuttings were collected and described at 5-foot intervals from the surface to total depth.
- Ream a nominal 42-inch-diameter hole and install a 36-inch-diameter steel surface casing from surface to a depth of about 40 feet BLS. Grout 36-inch casing using ASTM Type II Portland cement.
- Drill a nominal 8-inch pilot hole from 40 to 250 feet BLS.
- Ream a nominal 35-inch-diameter hole and install a 30-inch-diameter steel casing from ground surface to a depth of about 220 feet BLS. Grout 30-inch casing using ASTM Type II Portland Cement.
- Drill a nominal 8-inch pilot hole from 220 to 1,100 feet BLS.

- Ream a nominal 29-inch-diameter hole and perform a caliper log to 1,100 feet BLS.
- Perform a caliper log to 1,100 feet BLS.
- Install an 18-inch-diameter FRP casing to a depth of about 1,100 feet BLS. Use centralizers on 18-inch casing at depths of approximately 1,090, 1,080, 1,000, 800, 600, 400, 200 and 20 feet BLS. Grout 18-inch casing using ASTM Type II Portland Cement.
- Drill a nominal 18-inch-diameter diameter open borehole section from 1,100 feet to approximately 1,200 feet BLS.
- Set up test pumping equipment (up to 2500 gpm) and discharge line.
- Develop well until the groundwater is free of sand and suspended solids, and the maximum capacity of the well is achieved.
- Conduct a step drawdown test and 24-hour constant-rate pumping test as described below under Aquifer Performance Testing.
- Measure turbidity during the variable-rate and constant-rate pumping tests.
- Collect water quality samples at the conclusion of the variable-rate and constant-rate pumping tests as described in Water Quality Testing.
- Conduct full suite of geophysical logs as described below under Geophysical Logging.

  Conduct an integrity test consisting of packer testing of the entire length of the ASR well casing by pressurizing the well. Casing to be pressurized to 60 pounds per square inch (psi) for a 2-hour period. Successful testing of the well will require that the casing pressure variation to be less than 5% (variation maximum 3 psi) at the completion of the mechanical integrity test.

- The well will be cleaned of foreign substances after it is constructed and tested using a chlorine solution with strength and volume to produce an available chlorine concentration of at least 50 parts per million at the entire water depth in the well.

6.1.4 Drilling Techniques

The new ASR and monitoring wells will be drilled using direct circulation rotary or reverse circulation techniques. The surface-casing sections will be completed by the mud-rotary method and the open-hole sections of the wells will be completed by the reverse air circulation method.

6.1.5 Cement and Backplugging Operations

All casing intervals will be grouted from the bottom of casing to land surface. All final casing will be grouted with a minimum thickness between borehole and casing as required by regulations. Pressure grouting will be performed by pumping through a tremie pipe placed inside the casing and within 10 feet of the bottom of the casing. If additional stages are required, the remaining stages will be placed through the tremie pipe inside the annular space placed within 5 feet of the top of the previous stage. No drilling operations will be permitted for a minimum of 48 hours and until the final stage of grout has cured.

6.2 Aquifer Testing Plan

The aquifer testing plan will include two variable-rate pumping tests, two constant-rate pumping tests, turbidity sampling, geophysical logging, and water quality testing.

6.2.1 Variable-Rate Pumping Tests

Variable-rate pumping tests will be conducted on wells LF-MW-1 and ASR-LF-1 as detailed below:

- Discharge water from the well will be directed towards a nearby wetland area. Approximately 1000 feet of temporary piping will be used to direct water from the well area to existing piping that discharged groundwater to the wetland area.

- Three discharge rates representing 50%, 75%, and 110% of the recharge and recovery design capacity (approximately 2,100 gpm) will be used. The discharge line will be equipped with a calibrated flow meter to measure pumping rates. Pumping rates will be controlled by a throttling valve on the discharge side of the pump. Pumping continued while discharge rates will be increased between each step.

- The duration of each step will be approximately 120 minutes (total test duration of 8 hours).
- Water levels will be measured in the pumped well with an electronic data logger and backed up with manual measurements.
- Water levels will be allowed to recovery to within 95 percent of the pre-pumping conditions.
- Water level measurements will be used to calculate the specific capacities of the wells.

6.2.2 Constant-Rate Pumping Tests

The first constant-rate pumping test will be conducted after LFMW-1 has been constructed. LFMW-1 will be pumped to nearby wetlands and water levels will be monitored in the existing storage zone monitoring well (LFMW-2) located approximately 520 feet from LFMW-1.

A second constant-rate pumping test will be conducted after the installation of the new ASR Well. The ASR Well will be pumped to nearby wetlands, and water level monitoring will be conducted in the storage zone monitoring wells (LFMW-1 and LFMW- 2), confining zone monitoring well (CZMW-1), the two shallow monitoring wells (SA- 1 and SA-2) and the pumped well.

Details of both constant rate tests are as follows:

- Water levels in the pumped well and monitoring wells will be measured and recorded with pressure transducers connected to a data logger.
- Background water levels will be measured and recorded for a minimum of 24 hours prior to the test. Data logger will be programmed to take readings logarithmically to a maximum of every 15 minutes.
- The discharge line will be equipped with a calibrated flow meter so that the pumping rate can be measured and controlled to achieve a flow rate as constant as possible.
- The selected discharge rates for each test will be determined based on results of the variable-rate pumping tests.

- Anticipated pumping test duration for the ASR well is 24 hours and for the monitor well LF-MW-1 is 48 hours. This duration may have been revised based on results of the variable-rate test.
- If drawdowns were not observed in the monitoring wells after 24 hours, a longer duration will be completed.
- Water level recovery measurements will be recorded following shutdown of the constant-rate tests until the static water level is within 5% of the pre-test measurement, or for a maximum of 24 hours.

6.2.3 Geophysical Logging

Geophysical logging equipment cable of continuous recording and acquiring accurate data will be used to log the entire length of the completed well. Static and dynamic logs listed will be completed on the open hole portion only. Geophysical logging will be completed on LFMW-1 and the ASR Well.

6.2.4 Water Quality Testing

Water quality testing will be conducted in accordance with SJRWMD requirements described in the Geochemical Sampling Protocol of the Aquifer Storage Recovery Construction and Testing Program. Native groundwater samples will be collected from the ASR well at the end of the variable-rate and constant-rate pumping test and analyzed for primary and secondary drinking water standards and the parameters listed in ***Table 6-1*** and ***Table 6-2.*** A sample of the recharge water from the County's Eastern Water System will be also collected and analyzed for parameter listed in ***Table 6-2***.

TABLE 6-1
ASR and Monitoring Well Construction and Testing Program
OCU/SJRWMD – EWRF ASR System

Parameter	Number of Native Groundwater Samples	Number of Recharge Samples
Primary and Secondary Standards	2	1
Calcium	2	1
Potassium	2	1
Phosphate	2	1

Total/Non Carbonate/Calcium Hardness	2	1
Total Organic Carbon	2	1
Bicarbonate – total Alkalinity if pH is 6.9 or lower	2	1
Magnesium	2	1
Silica	2	1
Ammonia	2	1
Hydrogen Sulfide	2	1
UV-254	2	1
Specific Conductance	2	1
Dissolved Oxygen	2	1
pH	2	1
Temperature	2	1
Oxidation Reduction Potential	12	1

TABLE 6-2
ASR and Monitoring Well Construction and Testing Program
OCU/SJRWMD – ER WRF ASR System

Field Parameter	**Number of Samples**
Temperature	2
Dissolved Oxygen	2
Chloride	2
Specific Conductance	2
Eh	2
pH	2

6.3 Fluid Management

The Drilling and Testing Fluid Management Plan was prepared to assist with the ASR and monitoring wells construction and testing fluid management. The main sources of fluid include drilling mud and cuttings during construction, pump test disposal water and cycle test water.

6.3.1 Drilling Fluid

The drilling contractor will be responsible for disposal of all cuttings in accordance with Federal, State and Local regulations. The Contractor will monitor and control the flow of fluids from the well at all times. During periods of inactivity, the well will be shut in by the Contractor.

Settling of Drilling Fluid and Cuttings

During well drilling, the contractor will retain all drilling mud and cuttings that will be generated during mud rotary drilling in steel mud tubs. All cuttings, removed during reverse air drilling operations, will be stock piled at an on-site location designated by the Owner. The cuttings and drilling mud will be disposed of at an off-site location in an acceptable manner required by Federal, State, and Local regulations.

The Contractor will remove turbidity through settling and convey the fluid away from the well. An above ground storage tank will be used so that maximum time for settling of cuttings and fines is achieved. The Contractor will ensure that the discharge water meets turbidity requirements before being disposed of in approved location.

Disposal Locations

All reverse-air drilling fluids and development water will be transported to an approved location. A discharge line of sufficient length will be provided by the contactor to convey the water to the Owner approved disposal location, estimated to be within 200 feet of the wellhead. Any fluids and settled materials not approved for this disposal location will be hauled off-site to the county landfill for disposal. The Contractor will be responsible for meeting turbidity requirements prior to discharge water entering any stormwater collection system or receiving waters.

Protection of Water Quality

The Contractor will take all necessary precautions in order to prevent contaminated water, hydraulic oil, gasoline, and other hazardous substance from entering the well.

6.3.2 Pump Test Disposal Water

Discharge Practice

Wells will be developed until the water has a turbidity of less than 1 NTU prior to all pumping tests. Pumping tests will be completed at wells CZMW-1 and LFMW-1 (the Dual Zone Monitor Well) and ASR Well. The Contractor will provide temporary discharge piping, approximately 200 feet, to convey pumped water to the designated disposal area. A control valve on the pump discharge suitable for throttling the flow will be installed to ensure that the discharge will not cause turbid water to result or scouring.

The Contractor will dispose of the water into the adjacent non-wetlands to allow sheet flowed overland into the wetlands. The discharge water will be disposed of in accordance with the Federal, State, and Local regulations.

Discharge Volume

The volume of water discharged to the adjacent non-wetlands during pump testing is estimated to be 15.36 million gallons. The two step-drawdown tests will be performed on the Dual Zone Monitor Well with a flow rate of 2,000 gpm for 8 hours each. A constant rate pumping test will be performed on the Dual Zone Monitor Well with a flow rate of 2,000 gpm. The ASR Well pumping tests will include a 2500 gpm 8 hour step drawdown test and a 2500 gpm 24 hour constant rate test.

Cycle Test Water

Cycle testing water will be sent to the OCU reclaimed water system as a groundwater supplemental water supply. The test water from the well will be sent to the reclaimed water system only during the initial cycle testing phase and to purge the well at the beginning of each recovery phase during normal operations.

Initial cycle testing water will be pumped via a temporary pipeline to the EWRF effluent pump station for the first and second cycle testing events. The amount of water pumped to the reuse system will be approximately 3 MGD for 10 days during Cycle 1 and 3 MGD for 14 days during Cycle 2. The total volume of water pumped to the reuse system is 72 million gallons during the cycle testing.

The purge water from the well will be pumped to the reclaimed water ground storage tank adjacent to the ASR well site. The ASR well purging occurs at the beginning of the recovery cycle based on seasonal demands. The purge water volume is approximately 30,000 gallons per event. Assuming four separate recovery periods per year, approximately 120,000 gallons will be purged to the reclaimed water system.

6.4 Conceptual Cycle Testing Plan

6.4.1 Objectives

The objective of the cycle testing program is to establish the hydraulic and water quality characteristics of the ASR system, and to facilitate the technical, operational, and regulatory requirements for a transition to operational status. This will be addressed by conducting a series of carefully controlled recharge and recovery cycles. A total of four main cycles are scheduled to be completed.

Key characteristics that will be defined in the testing program include:

- The general degree of mixing between stored treated drinking water and the native groundwater;
- The general volume of water required to establish a suitable buffer zone;
- Recovered water quality;
- System hydraulic performance; and
- The potential for well clogging, and the establishment of a backflushing frequency.

The first cycle will be of relatively short duration to allow some preliminary results to become immediately available and to establish confidence in the operation of the system. Specific issues to be addressed in this first cycle are:

- Verify acceptable rates of recharge and recover;
- Determine the baseline water quality response of the well due to mixing;
- Provide an initial indication of geochemical impacts and well plugging potential;
- Plant operation interface requirements;
- Initial indication of hydraulic performance;
- Estimation of effect on potentiometric surface;
- Buffer zone development; and
- Recovery water quality.

6.4.2 Cycle Test Plan

The initial proposed cycle test schedule is outlined in ***Table 6-3***. The estimated recharge and recovery volumes of water will be added once the recharge and recovery rates have been determined. Four main cycles are proposed. These cycles address the need to determine hydraulic performance (sustainable rates for recharge and recovery and potential for aquifer plugging), mixing characteristics to determine recovery efficiency, and buffer zone development.

TABLE 6-3
St. Johns River Water Management District – Orange County Utilities ASR
Preliminary Cycle Testing Schedule

	Duration (days)			
Cycle	**Recharge**	**Storage**	**Recovery**	**Total**
1	10	-	10	20
2	10	14	10	34
3	28	42	14	84
4	90	45	90	225

It is anticipated that the durations may be adjusted based upon operational needs, wellhead or formation conditions, or results from earlier cycles. Cycles 3 and 4 recovered water is proposed to be to the distribution system if water quality results from previous cycle tests meet primary and secondary drinking water standards. The actual schedule may be changed dependent on the early cycle test results, the availability of recharge water and the commencement date of the testing. During all cycle tests, recharge and recovery rates should be kept constant, to the extent possible, so that the specific injectivity/capacity can be determined. The following text summarizes the rationale behind the design for each cycle, and outlines the key test objectives for each cycle.

Preliminary Testing

Prior to the start of the first cycle, a series of calibration and final commissioning tests should be performed. Depending on the results of these preliminary tests, adjustments to the recharge and recovery cycles may be required. The preliminary tests should include calibration of the pressure transducer installed in the ASR well, calibration of the flow meter on the ASR recharge and discharge pipe, and measurement of the static water level in each of the wells. This testing also includes a short (approximately 30 minutes) recharge period and a short (approximately 60 minutes) recovery period to confirm proper system operation.

Monitoring

The success of the cycle testing program will be measured on the basis of data collected during the monitoring and sampling program. Throughout the duration of the test the following items should be monitored on a frequent and regular basis:

- ASR Well groundwater level and well pressure;
- Groundwater level and well pressure at all monitor wells;
- Recharge and recovery flow rates;
- Recharge and recovery water quality in ASR1;
- Water quality in selected monitor wells; and
- Pipe work connections and valves will be monitored to check for correct operation.

Hydraulic Monitoring

Pressure transducers (gauges) will measure groundwater pressure at the ASR well and the monitor wells during recharge. Flow rates during recharge and recovery should also be recorded. Manual readings from the flow meter and pressure gauges should be taken at regular intervals, twice a day initially during each recharge and recovery portion of each cycle, with once-a-day readings continuously throughout cycle testing.

Water Quality Monitoring

Water quality monitoring will include the collection of recharge, storage and recovered water samples. Water quality samples will be collected periodically at each of the wells. The analytical results will be used in conjunction with the hydraulic data to assess the mixing characteristics of the stored water with the native groundwater and geochemical reactions. The suggested analytical sampling suites and approximate number of samples to be collected are shown in ***Table 6-4***. In each case where multiple samples are collected during a recharge or recovery period, the general pattern is to collect samples more frequently during the early portions of the period, and less frequently in the latter portions of the period.

TABLE 6-4
Preliminary ASR Cycle Test Operational Monitoring and Evaluation

Cycle Phase	# Samples	Frequency	Recharge Source Water	ASR Well Recovered Water	Monitoring Wells (3)
Recharge	5	At start of phase, before recharge begins	Complete Primary & Secondary Drinking Water Standards, Conductivity, Uranium. Field – temp, DO, eH, conductivity, pH	Complete Primary & Secondary Drinking Water Standards, Conductivity, Uranium. Field – temp, DO, eH, conductivity, pH	Complete Primary & Secondary Drinking Water Standards, Conductivity, Uranium. Field – temp, DO, eH, conductivity, pH
	40	Recharge source water and monitoring wells groundwater – Daily for 1st 10 Days.	Lab - Alkalinity (total as CaCO3), arsenic, calcium, chloride, color, conductivity, hardness (total as CaCO3), iron, magnesium, manganese, pH, sulfate, TDS, turbidity Field – temp, DO, eH, conductivity, pH		Lab – Alkalinity (total as CaCO3), arsenic, calcium, chloride, color, conductivity, hardness (total as CaCO3), iron, magnesium, manganese, pH, sulfate, TDS, turbidity, Field – temp, DO, eH, conductivity, pH
	5 x number of weeks in recharge cycle phase	Weekly	TTHMs, Eh, Arsenic	TTHMs, Eh, Arsenic	Eh, TTHMs, Arsenic
	3	At the end of the recharge period			Complete Primary & Secondary Drinking Water Standards, Conductivity, Uranium. Field – temp, DO, eH, conductivity, pH

Storage	1	Midpoint of storage		Primary & Secondary Drinking Water Standards, temp,D.O., Eh, Specific Conductance, Ca, Mg, K, Si, HCO3, Total/non-carbonate/ calcium hardness, Phosphate, Ammonia, H2S, TOC, U.	
	4 x number of weeks in storage cycle phase	Weekly	Cl, F, SO4, TDS,pH, Temp., D.O., Eh, Specific Conductance, Arsenic		Gross Alpha, Cl, F, SO4, TDS, pH, Temp., D.O., Eh, Specific Conductance, Arsenic

Recovery	4	At start of phase, before recovery begins		Primary & Secondary Drinking Water Standards, pH, temp,D.O., Eh, Specific Conductance, Ca, Mg, K, Si, HCO3, Total/non-carbonate/calcium hardness, Phosphate, Ammonia, H2S, TOC, U, Gross Alpha.	Cl, F, SO4, TDS,pH, Temp., D.O., Eh, Specific Conductance
	40	Recharge source water and ASR groundwater- Daily for 1st 10 Days.		Cl, F, SO4, TDS,pH, Temp., D.O., Eh, Specific Conductance	Cl, F, SO4, TDS,pH, Temp., D.O., Eh, Specific Conductance
	5 times the number of weeks in recovery cycle phase	Weekly	THM Species, Eh, Arsenic, gross alpha	THM Species, Eh, Arsenic, gross alpha	Cl, F, SO4, TDS,pH, Temp., D.O., Eh, Specific Conductance, gross alpha, TTHM Species, Arsenic
	1	At end of phase		Gross Alpha.	

Water Quality Tracer during Cycle Testing

Below is a preliminary list of water quality parameters that could potentially be used as an indicator of percent recovery. Water quality data from a sample of the recharge water from the OCU Eastern Water System that would be used for cycle testing, the native groundwater from Packer Test 6 open to 1,1200 to 1,210 feet, and the native groundwater from the completed exploratory well is provided for these parameters in ***Table 6-5***.

TABLE 6-5
Operational Monitoring Program
OCU/SJRWMD – ER WRF ASR System

Parameter	units	ERWSF Finished (1) 3/14/2006 Results	Packer Test #6 (2) 2/7/2006 Results	Completed SZMW (3) 4/9/2006
Arsenic	mg/L	0.0002U	0.0008U	ND
Chloride	mg/L	18.6	52.8	37
Conductivity	µmhos/cm	331	437	ND
Fluoride	mg/L	0.902	0.17	0.22
Iron	mg/L	0.017	0.095	0.03
Manganese	mg/L	0.0011	0.0031	0.003
Mercury	µg/L	0.000024U	0.000024	0.2U
Nitrate	mg/L as N	0.06	0.02	0.007U
pH	SU	7.71	7.96	8.38
Sulfate	mg/L	5.14	7.7	14
Total Dissolved Solids	mg/L	190	240	270

Fluoride may be the best indicator for tracking stored water during recovery, with manganese and total dissolved solids providing some additional information to estimate the percent recovery. None of these parameters are considered ideal for the measurement of percent recovery using a water quality indicator.

6.5 Development of Construction Contract Documents

The ASR System construction was divided into to two contracts: 1) drilling and testing of the ASR and monitoring wells and 2) construction and startup of the ASR Surface Facilities. The project construction was divided to allow collection and analysis of the hydrogeologic test data for the ASR and monitoring wells prior to entering into a contract for construction of surface facilities. This will allow a feasibly check of the project before proceeding to the next step.

All construction documents included reviews by BFA and its subconsultant team, CH2Mhill and ASR Systems Inc., and both OCU and SJRWMD at the 60%, 90%, and 100% design completion levels. All comments were resolved at each submittal level. The final design construction documents are included on the CD in ***Appendix G.***

6.5.1 Final Construction Plans

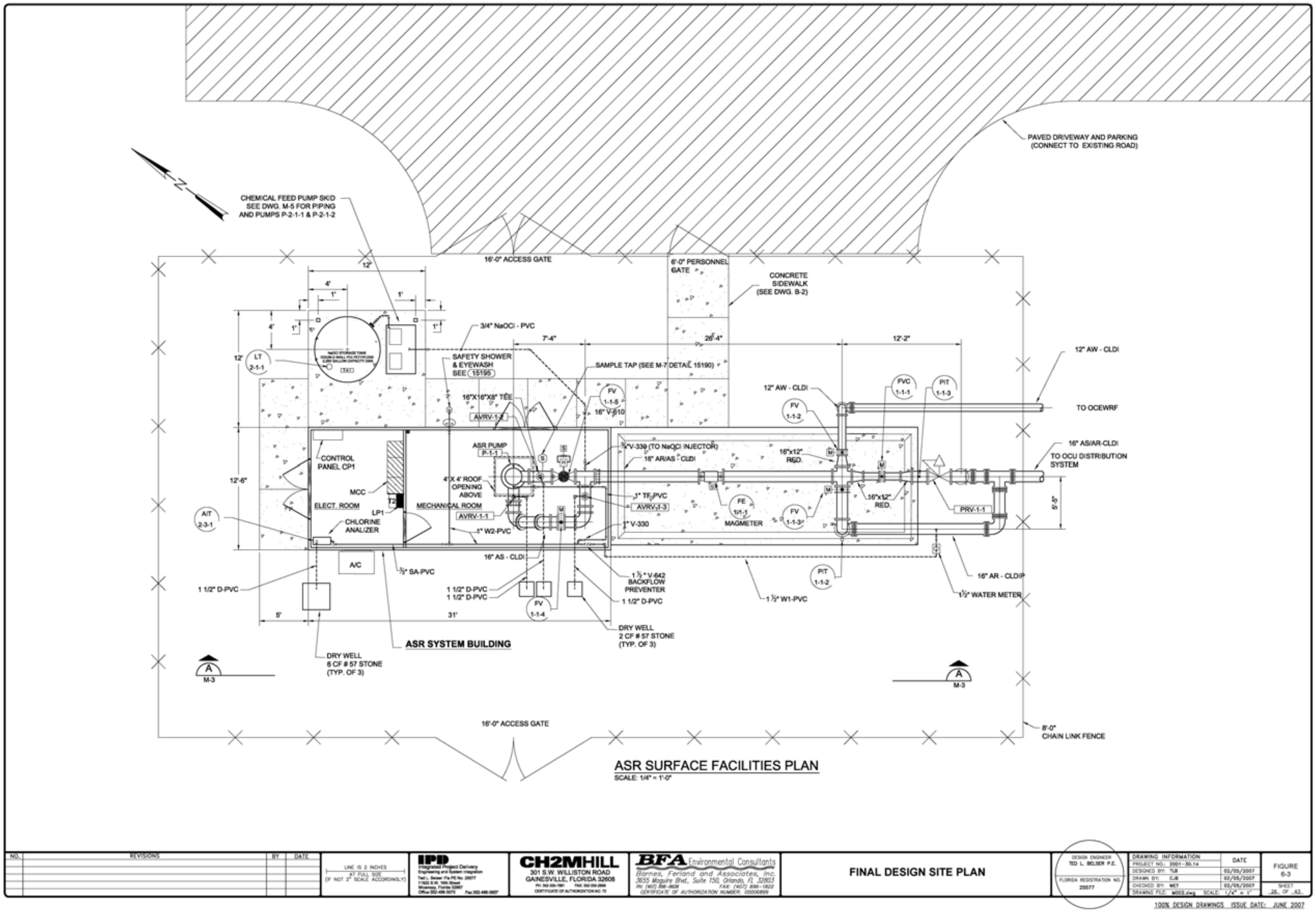
The final construction plans included both the ASR/monitoring wells and the ASR System Surface Facilities. The plans included 43 drawings consisting of general, civil/pipeline, water system details, wells, building, mechanical, electrical and instrumentation/control sheets. Only the applicable sheets were included with each construction contract. Final site design and layout is shown in ***Figure 6-3***

6.5.2 Well Construction Specifications and Driller's Contract

The well construction specifications included the drilling, development, geophysical logging, and testing of the ASR Well; the Lower Floridan storage zone monitoring well and the confining zone monitoring well, LFMW-1 and CZMW-1 respectively, as a single dual zone well; and the two shallow monitoring wells. The dual zone monitoring well will be test and completed prior to the ASR Well to allow time for evaluation and analysis of the test data before proceeding with the ASR Well. The well driller contract included general contract conditions, well construction specifications, applicable well drawings, and unit price bid schedule.

6.5.3 ASR System Surface Facilities Specifications

The specifications for the ASR System Surface Facilities included outfitting the ASR well, a prefabricated building for well pump and electrical systems, well head piping for recovery and recharge, re-disinfection system with storage and feed system, water main to the existing County distribution system for recharge and recovery, and pipeline for discharge to the EWRF during cycle testing.


PAVED DRIVEWAY AND PARKING
(CONNECT TO EXISTING ROAD)
N
CHEMICAL FEED PUMP SKID
SEE DWG. M-5 FOR PIPING
AND PUMPS P-2-1-1 & P-2-1-2
16'-0" ACCESS GATE
6'-0" PERSONNEL GATE
CONCRETE SIDEWALK (SEE DWG. B-2)
12'
4'
1'
LT 2-1-1
3/4" NaOCl - PVC
SAFETY SHOWER & EYEWASH SEE 15195
7'-4"
26'-4"
12'-2"
SAMPLE TAP (SEE M-7 DETAIL 15190)
12" AW - CLDI
TO OCEWRF
FVC 1-1-1
PIT 1-1-3
FV 1-1-2
16"X16"X8" TEE
AVRV-1-2
FV 1-1-5
16" V-610
ASR PUMP P-1-1
¾"V-330 (TO NaOCl INJECTOR)
16" AR/AS - CLDI
16"x12" RED.
16" AS/AR-CLDI
TO OCU DISTRIBUTION SYSTEM
CONTROL PANEL CP1
4' X 4' ROOF OPENING ABOVE
MCC
ELECT. ROOM
MECHANICAL ROOM
LP1
T2
AVRV-1-1
CHLORINE ANALIZER
1" TF-PVC
AVRV-1-3
1" V-330
FE 1/1-1 MAGMETER
FV 1-1-3
PRV-1-1
5'-5"
12'-6"
A/T 2-3-1
1" W2-PVC
16" AS - CLDI
A/C
½" SA-PVC
1 1/2" D-PVC
1 ½ " V-642 BACKFLOW PREVENTER
PIT 1-1-2
16" AR - CLDIP
1½" WATER METER
1 ½" W1-PVC
FV 1-1-4
5'
31'
DRY WELL 2 CF # 57 STONE (TYP. OF 3)
ASR SYSTEM BUILDING
DRY WELL 6 CF # 57 STONE (TYP. OF 3)
A M-3
A M-3
16'-0" ACCESS GATE
8'-0" CHAIN LINK FENCE
ASR SURFACE FACILITIES PLAN
SCALE: 1/4" = 1'-0"
NO.
REVISIONS
BY
DATE
LINE IS 2 INCHES AT FULL SIZE (IF NOT 2" SCALE ACCORDINGLY)
IPD Integrated Project Delivery
Engineering and System Integration
Ted L. Belser: Fla PE No. 25577
Micanopy, Florida
CH2MHILL
301 S.W. WILLISTON ROAD
GAINESVILLE, FLORIDA 32608
CERTIFICATE OF AUTHORIZATION NO. 72
BFA Environmental Consultants
Barnes, Ferland and Associates, Inc.
3655 Maguire Blvd., Suite 150, Orlando, FL 32803
PH: (407) 896-8608 FAX: (407) 896-1822
CERTIFICATE OF AUTHORIZATION NUMBER: 00006899
FINAL DESIGN SITE PLAN
DESIGN ENGINEER
TED L. BELSER P.E.
FLORIDA REGISTRATION NO. 25577
DRAWING INFORMATION
DATE
PROJECT NO.: 2001-30.14
DESIGNED BY: TLB 02/05/2007
DRAWN BY: CJB 02/05/2007
CHECKED BY: WET 02/05/2007
DRAWING FILE: M002.dwg SCALE: 1/4" = 1'
FIGURE 6-3
SHEET 26 OF 43
100% DESIGN DRAWINGS ISSUE DATE: JUNE 2007

7.0 Regulatory Permitting

The project included extensive permitting through state and local agencies. The permits obtained prior to construction activities at the ASR site are summarized below. A copy the FDEP UIC permit and Administrative Order are included in ***Appendix D***. Digital copies of all permits are included on the CD in ***Appendix G***.

7.1 Permits

7.1.1 FDEP UIC Permit No. 48-0272819-001

Pursuant to Section(s) 403.087, Florida Statues, was issued to construct a Class V, Group Seven, ASR injection well system with two storage zone monitoring wells (LFMW-1 and LFMW-2) and one confining zone monitoring well (CZMW-1). This permit includes the cycle testing and monitoring of the entire ASR system. The basic ASR well design will consist of an 18-inch diameter well to a depth of approximately 1,200 feet and cased to approximately 1,100 feet BLS. The ASR system will have a storage capacity of approximately 540 million gallons (MG). The overall objective of the ASR system is to store, in the Floridan aquifer, potable water from the OCU potable water distribution system and retrieve the stored potable water for use. The permit was issued March 4, 2008 and expires on March 3, 2013. A Permit Modification was requested and granted by FDEP. The purpose of the permit modification is to allow for the issuance of Administrative Order (AO) Number AO-09-0001 and to modify cycle testing and monitoring plans.

7.1.2 Consumptive Use Permit (CUP) – SJRWMD CUP # 3317

Source water for cycle testing will come from the County's potable water system, which is described in SJRWMD Consumptive Use Permit (CUP) #3317. Specific Condition 18 of this permit states that a maximum of 900 million gallons of potable water from the potable water system over and above the allocation required by the County to meet its other demands is authorized for ASR testing. The permit also states that the ASR testing will occur during a three year period commencing on January 1, 2009, or alternate date as determined by the County and established with District notification, but that the allocation for ASR testing water will terminate no later than January 1, 2012.

7.1.3 Well Drilling Permits issued by SJRWMD

7.1.3.1 Permit No. 96911-1 was issued for the drilling and construction of the ASR Exploratory Test Well, at the Eastern Water Reclamation Facility.

7.1.3.2 Permit 118439-1 was issued for the drilling and construction of the ASR Well at the Eastern Water Reclamation Facility.

7.1.3.3 Permit No. 115529-1 was issued for the drilling and construction of the Dual Zone Monitoring Well, at the Eastern Water Reclamation Facility.

7.1.4 FDEP PWS Permits

7.1.4.1 Permit No. WC48-0080780-748 was acquired for construction of the well, well pump, wellhead piping and to fill the ASR well with water from distribution system during times of low demand and pump the water to the distribution system during times of high demand. The permit was issued October 25, 2007 and expires October 24, 2012.

7.1.4.2 Permit No. WC48-0080780-749 allows the extension of OCU's distribution system by the construction of approximately 1,000 feet of 16-inch water main from the ASR Well to the existing 36-inch water main on Curry Ford Road. The permit was issued on September 20, 2007 and expires on January 29, 2012.

7.1.4.3 Permit No. WC48-0080780-750 was acquired for construction of the sodium hypochlorite storage and feed system to disinfect water from the ASR well prior to discharge to OCU's water distribution system. The permit was issued October 25, 2007 and expires October 24, 2012.

7.1.5 FDEP Permit No. FL0038849-006-DW1

The permit was revised to authorize the inclusion of groundwater as a supplemental water supply for the OCU Eastern Reclaimed Water Distribution System. This permit revision allows the water recovered during cycle testing and the purge/flush water at the start of each recovery phase to be sent to the EWRF reclaimed water pumping station. The permit revision was issued on May 2, 2007.

7.1.6 Orange County Building Permits

7.1.6.1 **Building Permit No. B08903622** was issued for the construction of the ASR Well Building on May 19, 2009.

7.1.6.2 **Building Permit No. B08903623** was issued for the construction of the ASR Well Chemical Feed System on May 19, 2009.

7.1.6.3 **Building Permit No. B08903624** was issued for the construction of the ASR Well Pump and Piping on May 19, 2009.

7.1.7 Generic Permit for Discharge of Produced Ground Water

Generic Permit Document (62-621.300(2)) was utilized during construction of the wells, aquifer performance tests and constant rate pump test performed on the monitoring wells and the ASR well; test water was discharged to uplands about 500 feet away from the well - the test water should remain on the County’s property.

8.0 ASR Facilities Construction, Startup, Monitoring and Training

8.1 Well Construction and Testing

This section summarizes the construction and testing of the ASR well and the Dual Zone Monitor Well (CZMW-1 and LFMW-1) and the further evaluation of the storage interval including hydraulic characteristics and potential for upconing brackish groundwater. The completed work was previously documented in the *Well Construction and Testing Report for the Orange County Utilities Eastern Water Reclamation Facility AST Test Well and Monitor Well Construction* dated May 2009. That report was used to meet the Underground Injection Control (UIC) permit-reporting requirements by the Florida Department of Environmental Protection (FDEP).

8.1.1 Hydrogeologic Framework

Overview of Aquifers and Confining Units

The ground-water flow system beneath Orange County consists of lithostratigraphic units that form a multilayered sequence of aquifers and confining units. Aquifers are permeable water bearing layers of sediment/rock that yield significant quantities of water to wells and confining beds have very low permeability that restricts the movement of water either into or out of adjacent aquifers.

The principal water-bearing units in Orange County are the surficial and Floridan aquifer systems. The surficial aquifer system is underlain by and separated from the Floridan aquifer system by the intermediate confining unit, which restricts the movement of water between the two aquifers. The Floridan aquifer system is composed of two major water-bearing units, the Upper and Lower Floridan aquifers, separated by a less permeable zone called the middle semi-confining unit. Underlying the Floridan aquifer system are low permeability limestone and dolomite containing considerable gypsum and anhydrite that define the bottom of the Floridan aquifer system.

Hydrogeologic Setting at the EWRF ASR Site

Three Lower Floridan aquifer wells have been constructed and tested at the EWRF ASR site. Based on interpretations of formation cuttings, rock cores and geophysical logs collected at the EWRF ASR site from these wells, the principal hydrogeologic units and depths encountered are listed below:

• Surficial Aquifer System	near land surface to 110 feet below land surface (bls)
• Intermediate Confining Unit	110' to 200 ft. bls
• Upper Floridan Aquifer	200' to 520 ft.bls
• Middle Semi-Confining Unit	520' to 1,000 ft. bls
• Lower Floridan Aquifer	1,000' to > 2,000 ft. bls

Note: All depths are referenced to land surface datum at the site, which is approximately 80 feet NGVD

The top of the surficial aquifer system occurs from the water table, near land surface, and its base is the intermediate confining unit at a depth of about 110 feet. The upper 25 to 30 feet are composed of fine to medium grained sand, and the remaining thickness is composed of varying amounts of finer grained materials and shell fragments.

The intermediate confining unit is present from about 110 to 200 feet. It is composed largely of sediments of the Hawthorn Group. Clays predominate in the upper part of this interval, grading downward to clayey sands with increasing amounts of shell material. These clayey materials generally function to restrict the movement of groundwater and thus act to confine the Upper Floridan aquifer; however, these materials may be discontinuous or breached, as was the case at the first DZMW well site.

The Upper Floridan aquifer (UFA) is present from about 200 to 520 feet. It is composed of the softer Ocala Limestone (200 to 370 feet) and dolomitic limestones (370 to 400 feet) with hard dolomite (400 to 520 feet) of the Avon Park Formation. A number of prominent cavities are apparent throughout most of this Upper Floridan section and it likely would yield moderately large quantities of water.

The middle semi-confining unit occurs from about 520 to 1,000 feet and is composed of alternating dolomites and limestones of the Avon Park Formation. Though some zones within the middle semi confining unit are capable of yielding relatively large quantities of water, the section penetrated by the DZMW appears to be relatively tight. However, the interval from about 600 to 690 appears to be relatively soft and the TV log indicates some solution features.

The top of Lower Floridan aquifer (LFA) occurs at about 1,000 feet and its base, according to O'Reilly and others (2002), is approximately 2,000 feet. Dolomites and dolomitic limestones predominate in the section between 1,000 to 1,590 feet. The selected ASR storage interval is between 1,045 to 1,190 feet and consists of dolostone with intervening limestone within the Avon Park Formation. Moldic porosity, beginning at about 1,000 feet and increasing downward, becomes more evident in the intervals between relatively small cavities. These features persist to about 1,185 feet, below which the borehole walls appear less permeable to a depth of 1,200 feet. Below 1,270 feet the transmissivity increases with progressively more prominent fractures; and from about 1,335 to 1,415 feet, intersecting fractures probably indicate the most transmissive interval penetrated by the deepest test/monitor well LFMW-2. The interval 1,590 to 1,700 is the tightest section of borehole. The sub-Floridan confining unit was not penetrated during the drilling program, as the deepest well (LFMW-2) was drilled to 1,700 feet.

Groundwater samples were obtained during construction of the Lower Floridan ASR and monitor wells. The chloride curve suggests that significant confinement exists below the storage interval as shown by the sharp increase in chlorides concentrations over a relatively short vertical distance. This quality profile indicates that very fresh water extends to depths of at least 1,100 feet, and the 250 mg/L isochlor occurs at about 1,270 feet in the upper part of the Lower Floridan aquifer.   Higher salinities coupled with the higher transmissivity at depth precluded consideration of deeper ASR test intervals. The interval between 1,335 to 1,415 feet contains groundwater with chloride concentrations above 4,100 mg/L.

8.1.2 Well Construction Summary

The ASR Well, a Dual Zone Monitor Well (DZMW) and two shallow surficial aquifer wells were constructed during a 10 month period from April, 2008 to January, 2009 by Diversified Drilling Corporation (DDC). Well construction and testing field activities were observed by Barnes, Ferland and Associates (BFA) and were conducted in accordance with plans and specifications titled *Orange County Aquifer Storage Recovery and Monitoring Wells,* the SJRWMD's well regulations (Chapter 40C-3) and the construction permits.

DZMW Construction

The first attempt at drilling the DZMW was abandoned because mud circulation was lost within a significant void at a depth of 185 feet, causing the 12-inch diameter pilot hole to collapse. The 24-inch diameter surface casing dropped about 15 to 20 feet downhole and a 12 foot diameter depression formed around the well. Approximately 105 cubic yards of clean sand fill was quickly washed down the borehole and the drill rig was moved off the well site. The unconsolidated deposits were found to be quite different at this location compared to the previously drilled exploratory well (LFMW-2) 500 feet southwest. At well LFMW-2, a thick clayey layer was present between depths of 110 feet to the top of the Upper Floridan aquifer. The geology at this first DZMW location consisted of silty fine sand to 50 feet then sand and shell to 180 feet, where the large void was encountered.

The DZMW location was moved about 100 feet northwest and a smaller rotary rig was used to drill an 8-inch diameter pilot hole into the top of the Upper Floridan aquifer. The clayey layer was present at this location between 98 and 185 feet where a void occurred again and mud circulation was lost. DDC used the drive and wash method to install 189 feet of temporary 6-inch diameter steel casing to penetrate the void and find competent limestone to set casing into the top of the Upper Floridan aquifer. The presence of these voids at 185 feet depth precluded the use of mud rotary drilling in unconsolidated deposits at this site. It was decided to use the dual rotary drilling method to install the 24-inch diameter casings into the Upper Floridan for the DZMW and ASR wells; this generally involves simultaneously drilling and installing casings.

The construction details for the DZMW are also shown in Section 6. The 24-inch diameter outer steel casing was installed to 220 feet into competent limestone within the top of the Upper Floridan aquifer using a ‘Foremost 24’ dual rotary drill rig. This work was performed by Royall Pump and Well Company of Powhatan Virginia and support was provided by DDC. The casings were installed in 20 foot lengths and dry bentonite was shoveled into the annulus at surface to form a seal as the casing was advanced.

Construction of the DZMW includes two open intervals 900 to 945 feet (CZMW-1) and 1,045 to 1,200 feet (LFMW-1). A 6-inch diameter PVC Certa-Lok inner casing was installed to a depth of 1,045 feet with two cement baskets attached to the bottom. The upper monitoring zone is accessible through the annular space between the 6-inch and 12-inch casings. Water levels were measured in the upper monitor interval while pumping the lower interval at 100 gpm. The response was insignificant indicating a good annulus seal exists between the open/monitor zones. Caliper and video logs were performed within the lower interval well (LFMW-1) to confirm construction as specified.

The approximate pumping capacity was determined for each monitor well. The lower interval monitor well (LFMW-1) is more productive and will produce about 100 gpm with the submersible pump set at 100 feet. The upper interval monitor well (CZMW-1) is within the base of the middle confining unit and will produce about 50 gpm with the submersible pump set at 130 feet.

ASR Well Construction

The construction details for the ASR Well are also shown in Section 6. The 24-inch diameter outer steel casing was installed to 220 feet into competent limestone within the top of the Upper Floridan aquifer using the ‘Foremost 24’ dual rotary drill rig. This work was performed by Royall Pump and Well and support was provided by DDC. The casings were installed in 20 foot lengths and dry bentonite was shoveled into the annulus at surface to form a seal as the casing was advanced. The bottom five feet of casing was seated into cement to provide a seal.

Once the 24-inch outer casing was installed, DDC mobilized a rotary drill rig and the reverse air drilling method was used to complete the ASR Well. A 12-inch diameter pilot hole and 23-inch diameter borehole were drilled to 1,050 feet. A caliper log was performed to develop a grouting plan and the 18-inch diameter steel casing was installed to a depth of 1,045 feet. The casing was pressure-grouted through a tremmie pipe.

A pressure test was performed on the 18-inch diameter inner steel casing to verify casing integrity. Pressure testing was performed by installing a pressure tight temporary wellhead on the top of the casing. The bottom 15 feet of the casing was sealed by the cement plug. Successful testing was demonstrated by maintaining pressure of 60 psi for a period of 120 minutes with not more than ±5 percent deviation in pressure. Following testing, the cement plug was drilled from the casing and the ASR well construction proceeded.

A 17-inch pilot hole was then advanced through the storage interval from 1,045 to 1,190 feet and the well was developed. Well development involved pumping and surging the well for a 24 hour period at up to 3,500 gpm. A step drawdown test and 48-hour constant rate test were performed to determine the hydraulic characteristics and water quality changes within the ASR storage interval. A full suite of geophysical logs was performed to a total depth of 1,190 feet to confirm construction and storage zone characteristics.

8.1.3 Well Testing and Evaluation

The following section provides a summary of the evaluation of the data collected during construction and testing of the DZMW and the ASR wells. These data include subsurface lithology, aquifer testing and groundwater quality. These data were obtained in order to: 1) finalize the depth of the storage interval and ASR well design; 2) further evaluate the storage zone hydraulics (potential well yield and transmissivity); 3) address the earlier concern of saltwater upconing of brackish water from below the storage zone; 4) determine the storage interval ambient water quality and 5) satisfy the UIC permit condition requirements. Testing data collection and analyses included:

- Drill cuttings from the pilot hole of the DZMW and ASR wells
- Geophysical logs
- Step-drawdown tests

- Constant rate tests
- Water sample analyses of reverse air discharge and completed wells.

Drill Cuttings Lithologic Analysis

During reverse air drilling, formation cuttings were collected from the 12-inch pilot hole to a depth of about 1,200 feet below surface in both the DZMW and the ASR wells. The ASR storage zone (1,045-1,190 feet) is comprised of largely of dolomitic limestone with moldic type porosity. At 1,190 feet, a softer and less porous limestone is present and appears to provide confinement below the ASR storage zone.

Geophysical Logging

The geophysical logs were performed by Advanced Borehole Services and observed by BFA. Geophysical logging was designed to collect information on the hydrogeology of the strata penetrated, data on borehole geometry that would assist in the setting and cementing of casing strings and identifying and evaluating the ASR storage zone and confining strata.

A full suite of borehole geophysical logs were obtained for the DZMW on August 29, 2008. At the time of logging, the DZMW borehole was finished with 12-inch diameter steel casing to 900 feet and then drilled with nominal 11-inch diameter bit to total depth of 1,200 feet. Logging emphasis was on the open-hole interval, 900-1,200 feet, to evaluate the potential ASR storage interval and to finalize the ASR well design.

A full suite of borehole geophysical logs were obtained for the ASR Well on January 12, 2009. At the time of logging, the ASR well was finished with an 18-inch diameter steel casing to 1,045 feet and then drilled with a 17-inch diameter bit to total depth of 1,190 feet. Logging emphasis was on the open-hole interval, 1,045-1,190 feet, which is the ASR storage zone within the top of the Lower Floridan aquifer.

Results of the lithologic and geophysical/video logging indicate that the ASR storage zone (1,045 to 1,190 feet) consists of dolostone with intervening limestone within the Avon Park Formation. Significant flows enter the borehole near 1,136 and 1,160 feet, and most of the total flow has entered by depth 1,120 feet. The more prominent cavities below 1,180 feet yield very little water but contribute significantly to the TDS concentrations in pumpage from the ASR storage zone. The combination of moldic porosity and small cavity zones above 1,180 feet provides substantial yield.

8.1.4 Aquifer Performance Testing

Aquifer performance tests included step-drawdown and constant rate pumping tests. Step-drawdown tests are used to determine well specific capacity, to confirm and compare the relative yield of wells and/or formation intervals and for selecting pump size and depth setting. Three step-drawdown tests were conducted by pumping the wells up to four incrementally higher flow rates, for a period of two hours. Following evaluation of step-drawdown data, three constant rate pumping tests were also conducted up to a 48-hour period, primarily to determine the storage zone transmissivity and the effectiveness of the underlying confining bed (below 1,190 feet) to retard upward invasion from the brackish zones below.

The DZMW and ASR wells were pumped using an engine driven vertical turbine pump with a capacity up to approximately 3,500 gpm. A temporary 12-inch diameter PVC pipeline was used to convey groundwater produced from the wells to a point about 500 feet northeast of the well site which flowed into low lying areas within the pine flatwoods. A Generic Permit for Discharge of Groundwater was obtained from the FDEP.

Results of the ASR storage zone aquifer testing indicate that the potential ASR zones are adequately productive for an ASR system. The ASR well step drawdown test consisted of four steps of 120 minutes each. The ASR well was pumped at rates of 1,455, 2,139, 2,859 and 3,518 gallons per minute (gpm) resulting in specific capacity values of 265, 210, 170 and 140 gpm/ft, respectively. The best estimate of transmisssivity for the ASR storage zone is about 136,000 ft^2/d, which should constitute a favorable zone for storage and recovery of relatively high volumes of water.

The presence and degree of vertical confinement of an aquifer proposed for an ASR storage zone is important to determinations of the degree to which an ASR system can be protected from impacts and effects of external sources of contamination or competing withdrawals above or below the storage zone. Aquifer testing, water quality, and geophysical logging results indicate that water level changes during recharge and recovery cycles should not cause significant adverse effects upon other wells, ecosystems or brackish water upconing due to the confining nature above and below the selected storage zone.

8.1.5 Groundwater Quality Analysis

The focus of groundwater quality analysis was to determine native/background water quality of the ASR storage zone and to determine the effectiveness of the underlying confining bed to retard upward invasion from the brackish zones below. During the drilling and testing of the DZMW and ASR wells, water quality samples were collected from reverse air discharge and during aquifer testing. Field determinations were made by BFA including temperature, pH, specific conductance, chloride, turbidity, dissolved oxygen, and ORP/Eh. The OCU laboratory performed analysis of major ions and TDS during aquifer testing of the DZMW and ASR wells. Samples were collected from the ASR well storage zone near the end of the 48-hour constant rate test and analyzed for Florida Drinking Water Standards. Copies of laboratory reports are provided on the CD in ***Appendix G***. These water quality results indicate occurrence of fresh groundwater throughout the interval tested (900-1200 feet) as discussed below.

Results of the native groundwater quality analysis appear favorable for ASR development from the selected storage zone. Freshwater with low concentrations of chloride (77.4 mg/L); TDS (302 mg/L); and sulfate (18.6 mg/L) were reported upon sampling and testing at the end of the 48-hour aquifer test at an average rate of 2,143 gpm. All Florida Drinking Water Standards (*F.A.C.* 62-550) were tested and found to be below maximum contaminant levels, except odor (16 threshold odor number-TON), which likely results from elevated hydrogen sulfide levels. Cycle testing is planned to document that leaching of metals at this site can be effectively controlled through initial formation and maintenance of a buffer zone, based on review of operating performance at several other Florida ASR well fields.

8.2 Surface Facilities Construction

This section summarizes the construction activities for the ASR Surface Facilities. Wharton-Smith, Inc. provided general contractor services for the surface facilities with BFA providing engineering construction administration and inspection. The Notice to Proceed was issued to Wharton Smith on January 8, 2009 with Final Completion issued on February 4, 2010. The permits issued for the project were previously discussed in Section 7. ***Figures 8-1*** through ***8-4*** show construction photographs from various aspects of the surface facilities process.

8.2.1 Pipelines

Recharge/Recovery Pipeline

The recharge/recovery pipeline consists of 1,050 feet of 16-inch DIP from the ASR site to the 36-inch water main in the OCU water distribution system located on the west side of Curry Ford Road. Installation of this pipeline consisted of the following activities:

- Jack & bore across Curry Ford Road which required maintenance of traffic (MOT) along Curry Ford Road, dewatering and excavation of installation pit for equipment, 30-inch steel casing pipe, 16-inch DIP carrier pipe and site restoration.
- Wet tap of the 36-inch DIP water main required coordination with OCU operations staff for locating and connecting to the distribution system.
- The 16-inch DIP pipe was installed by open cut construction at 30 inches of cover from Curry Ford Road to the ASR well site along the existing gravel access road.
- Testing and clearance of the pipeline consisted of pressure testing, disinfection, and bacteriological sampling and testing in accordance with FDEP regulations.

Figure 8-1

16" Pipe and Fittings Assembly

16" DIP Water Main Installation

Figure 8-2

Concrete Pad Foundation and Form Work

Pre-Fabricated Concrete Building Placement

Figure 8-3

Jack and Bore Across Curry Ford Road

Column Pipe Installation

Figure 8-4

Chemical Metering Pumps

Finished ASR Site

Flush Pipeline

The flush pipeline consists of 720 feet of 8-inch DR18 PVC pipe from the ASR well discharge piping to the ground storage tank at the OCU Eastern Reclaimed Water Storage and Re-pump Facility located adjacent to the ASR well site. The pipe changes to DIP before it extends up the outside of the storage tank and discharges through the tank roof. This pipeline was installed by open cut construction at 30 inches of cover. The pipeline passed a 150 psi pressure test and bacteriological sampling. The 8-inch flush pipeline is the permanent line to be used before each recovery cycle mode.

Temporary Recovery Discharge Pipeline

The temporary recovery discharge pipeline consists of 2,000 feet of 12-inch fusion-welded SDR17 DIP-size HDPE pipe. This pipe is located on grade and anchored by 4”x 4” pressure treated wood to control lateral movement. The recovery discharge pipeline is located along the gravel access road from the ASR site to the EWRF effluent pump station. The pipeline discharges through the top of the effluent pump station structure. The pipeline passed a 60 psi pressure test. This pipeline is a temporary pipeline for use during cycle testing for recovery water discharge until the quality of the recovery water is confirmed to consistently meet drinking water standards. OCU will be responsible for the operation, maintenance, and eventual disposal of the temporary recovery discharge pipeline.

8.2.2 Well Pump Building

The ASR well pump building is a pre-fabricated concrete building with separate rooms for the well pump and eletrical/control systems. The building is designed and constructed to meet the Orange County Building Code requirements, including hurricane wind load standards. The building was designed with wall and floor blockouts for electrical, instrumentation, piping, wellhead and A/C unit, and a 4’ x 4’ removable skylight for accessing the ASR well and well pump. Attached to the building is a steel canopy to cover the sodium hypochlorite storage tank.

8.2.3 Well Pump and Wellhead Piping

The wellhead facilities consist of vertical turbine well pump, wellhead fittings, discharge pump fittings, and wellhead recharge/recovery piping. The design of the ASR well pump was revised during the shop drawing review process to reflect the aquifer conditions that were determined from the aquifer performance testing conducted during well drilling. The well pump horsepower was reduced to 150 hp with the final pump design conditions of 2,100 gpm @ 218 feet TDH. The wellhead fittings, pump discharge head and motor stand materials were changed from stainless steel to epoxy-coated steel, consistent with the previous change in well casing material from fiberglass reinforced plastic (FRP) to steel. These changes are reflected in the record drawings. The wellhead recharge/recovery piping includes the above grade 16-inch DIP piping, fittings and control valves between the ASR Well Pump and the 16 inch water main constructed along the access road. The wellhead piping passed a 150 psi pressure test. The well and wellhead piping were disinfested and passed the bacterlogical testing.

8.2.4 Chlorination System

The chlorination system consists of a 2,000 gallon storage tank, a duplex feed pump skid for 12% sodium hypochlorite solution, safety shower/eyewash station and controls. This system disinfects the recovered water and maintains residual chlorine levels before the recovered water is sent to the OCU distribution system. The location of the tank and feed pumps were adjusted slightly during the shop drawing review process to accommodate clearance requirements for maintenance and panel access. The chemical feed pumps are designed to operate at a rate of 75 gpd and no less than 150 gpd at 70 psi. The pumps are positive displacement diaphragm type with simplex pumping head and totally enclosed in a pump skid housing. The sodium hypochlorite HDPE storage tank is double-walled for spill containment. The storage tank is anchored to the concrete slab to resist overturn when empty and exposed to 120 mph winds. A safety shower and eyewash station meeting OSHA standards was installed near the chlorination system.

8.2.5 Electrical, Instrumentation, and Controls

The electrical system consists of 480-volt, 3-phase, and 60 Hz equipment including metering, service entrance equipment, main breaker, adjustable frequency drive for well pump, breaker for 3-phase power panel, and transformer for the 208/120-volt, 3-phase, 60 Hz load panel. OCU coordinated with Progress Energy to provide a new power supply to the ASR site from Curry Ford Road. Electrical conduits were installed and inspected with other small piping in the compacted soil foundation prior to pouring the concrete pad for the building. Electrical conduits were also installed to the dual zone monitoring well to provide power to the sampling pumps.

Instrumentation was provided for flow rates and totalized flow for all modes of operation, system injection pressure and well level. Automatic controls for recharge consist of modulating control valve and PID feedback flow control of the well recharge rate. A PLC based local control panel was installed to provide a local control interface for the system and also with OCU SCADA for remote operation. System integration and programming was coordinated with OCU. OCU furnished a programmed router and UPS for installation by the contractor.

8.2.6 Monitoring Well Pumps

The ASR System includes the following monitoring wells:

- Lower Floridan Monitoring Well No. 1 (LFMW-1) located in the dual zone monitoring well 100 feet from the ASR well.
- Confining Zone Monitoring Well No. 1 (CZMW-1) located in the dual zone monitoring well 100 feet from the ASR well.
- Lower Floridan Monitoring Well No. 2 (LFMW-2) located 500 feet from the ASR well.
- Surficial Aquifer Wells No. 1 and No. 2 (SA-1 and SA-2, respectively), each located 50 feet from the ASR well.

LFMW-1 and CZMW-1 were constructed in the dual zone well located 100 feet from the ASR well. Surface completion of the dual zone well consists of a reinforced concrete maintenance pad constructed around the outer well casing. The LFMW-1 Sample Pump was installed in the 6-inch PVC inner well casing at 100 feet bls. The CZMW-1 Sample Pump was installed in the annular space between the 6-inch inner well casing and the 18-inch steel outer well upper casing at 130 feet bls. An on-off disconnect switch is provided at the dual zone well field for each sample pump. The sample pump design conditions are as follows:

- LFMW-1 Pump – Design Point: 100 gpm @ 100 ft. TDH; Column Pipe Length: 100 feet; Column Pipe Diameter: 3 inches. Column Pipe Materials: Steel
- CZMW-1 Pump – Design Point: 50 gpm @ 133 ft TDH; Column Pipe Length: 130 feet; Column Pipe Diameter: 2 inches. Column Pipe Materials: Steel

LFMW-2 was originally constructed as an exploratory well in 2006. This well was modified to serve as one of the required storage zone monitoring wells for the ASR system and is located 500 feet from the ASR well. OCU will use a portable sampling pump to collect samples from this well.

8.3 Startup Activities

8.3.1 Start-up and Testing

Following completion of the ASR surface facilities construction, BFA/Wharton Smith implemented a facility startup and performance demonstration plan which included a manufacturer equipment test for each piece of equipment. An ASR system functional and performance test was conducted on October 29, 2009. Approval was granted by FDEP to perform short term calibration cycle testing through the three modes of operation to test the ASR system: 1) recharge/injection, 2) storage, and 3) recovery. Calibration was performed for a few hours for each mode of operation. These cycles were used to confirm proper operation, with emphasis on mechanical equipment, instrumentation, and control components.

On November 24, 2009 a 24-hour ASR System Start-up and Calibration Test was performed to evaluate the constructed facility for confirmation of proper operation and to verify integration with OCU's remote operation of the facilities. The 24-hour ASR System test provided additional opportunity to test the recharge/recovery pipeline, wellhead piping, flush pipeline and temporary recovery discharge pipeline. The water pumped from the ASR well during the testing was discharged to the EWRF effluent pump station through the temporary recovery discharge pipeline. Although the 24-hour test was successful, the following changes were made based on the findings of the 24-hour test:

1. OCU requested the ability to monitor the water quality by measurement of chlorine residual during the flushing mode. A water sampling line was installed and connected to the chlorine analyzer to monitor chlorine residual during both recovery and flush modes of operation.
2. The ASR system was designed to recharge the aquifer using the column pipe and annular space between the column pipe and well casing. Initially, recharge would be down the column pipe until the water level in the annular space mounded to the surface. The control system would open the valve to the annular and continue recharging the aquifer through both the column pipe and annular space. During testing it was observed that the maximum flow down the column pipe was 1,700 gpm with a wellhead pressure of 48 psi and that there was minimal mounding in the aquifer. When recharge flow was directed down the annular between the pump column and well casing it was observed that maximum flows were in excess of 6,500 gpm and water levels in the annulus increased steadily until a back-pressure reading were observed at the wellhead of 4 psi. Based on theses findings and discussions with OCU, two modes of recharge were programmed into the control system: Mode A through the pipe column and Mode B through the annular space between the column pipe and well casing.

8.3.2 Operation and Maintenance

8.3.2.1 O&M Manuals

The Operation and Maintenance (O&M) Manual consists of two parts. A comprehensive description of the operational strategies, control capabilities, and the monitoring and permit requirements was prepared by ASR Systems, LLC in conjunction with IPD and BFA; and the O&M equipment manuals provided by the equipment suppliers and the I&C subcontractor, Curry Controls. The O&M Manual includes process objectives, descriptions of facilities and equipment, suggested operating procedures, process control information, photos and drawings of system components and general maintenance information of the ASR system and components. The manual also provides general safety requirements and safety procedures to follow when operating or performing maintenance on the ASR system.

The draft O&M Manual was submitted for OCU review prior to the operator training and used during the training program. The O&M Manual was updated and finalized based on changes suggested during the final phases of construction and based on comments and/or questions raised during the operator training.

8.3.2.2 Training

Classroom and hands-on operator training of OCU staff was conducted on November 24, 2009 by ASR Systems, LLC in conjunction with IPD and BFA. The training sessions began with classroom presentation and discussions using the O&M Manual as a guide. This was followed by a field visit and hand-on training at the ASR facility.

8.4 Permit Clearances

8.4.1 FDEP PWS Permits

The three (3) FDEP PWS permits required submittal of Requests for Letter of Clearance to Place a Public Drinking Water Facility in to Service, FDEP Form 62-555.900(9), to the FDEP Central District Office and supporting documents.

- FDEP Permit # WC48-0080780-748 for construction of the well, well pump, wellhead piping and to fill the ASR well with water from distribution system during times of low demand and pump the water to the distribution system during times of high demand. The clearance documents were submitted to FDEP on November 24, 2009 and included a 20-sample bacteriological well survey and ASR well water quality. FDEP requested additional information on December 11, 2009, which was provided to FDEP on December 16, 2009. FDEP provided a clearance letter on January 11, 2010. A copy the complete submittal and clearance letter is included in ***Appendix G***.
- FDEP Permit # WD48-0080780-749 for the extension of OCU's distribution system by the construction of approximately 1,000 feet of 16-inch water main from the ASR Well to the existing 36-inch water main on Curry Ford Road. The clearance documents were submitted to FDEP on November 24, 2009 and included bacteriological sample analysis of the pipeline and sample point location map. FDEP provided a clearance letter on January 7, 2010. A copy the complete submittal and clearance letter is included in ***Appendix G***.
- FDEP Permit # WC48-0080780-750 for the construction of the sodium hypochlorite storage and feed system to disinfect water from the ASR well prior to discharge to OCU's water distribution system. The clearance documents were submitted to FDEP on November 24, 2009. FDEP requested additional information on December 9, 2009, which was provided to FDEP on December 17, 2009. FDEP provided a clearance letter on January 7, 2010. A copy the complete submittal and clearance letter is included in ***Appendix G***.

8.4.2 Orange County Building Permits

The three (3) Orange County Building Permits obtained for the project required intermediate and final inspections before use of the facilities. The permits obtained and final inspections dates are listed below.

- Orange County Building Permit No. B08903622 was issued for the construction of the ASR Well Building on May 19, 2009. The Final Inspection Date was November 18, 2009.
- Orange County Building Permit No. B08903623 was issued for the construction of the ASR Chemical Feed System on May 19, 2009. The Final Inspection Date was November 18, 2009.
- Orange County Building Permit No. B08903624 was issued for the construction of the ASR Well Pump and Piping on May 19, 2009. The Final Inspection Date was November 18, 2009.

8.4.3 FDEP Underground Injection Control Permit

The FDEP Underground Injection Control Permit (Permit # 48-0272819-001-UIC) is for construction for the ASR system and monitoring wells and cycle testing. This permit will remain a construction permit until cycle testing is favorably completed and FDEP has approved an Operational Permit. The authorization request package to begin cycle testing for this permit was submitted on February 5, 2010 and included the following documents:

1. Draft copies of the operation and maintenance manual.
2. Surface equipment completion certifications.
    - FDEP Permit No. WC48-0080780-748
    - FDEP Permit No. WD48-0080780-749
    - FDEP Permit No. WC48-0080780-750
3. Signed and sealed as-built engineering drawings of ASR surface facilities.
4. Source Water Analysis
    - Point of Entry Water Quality Data
    - Background Water Quality Data for ASR well and monitoring wells
5. Draft plugging and abandonment plan.

The following items were previously submitted at the completion of the well drilling:

1. Lithologic and geophysical logs with interpretations.
2. Completion report for the ASR well and storage zone monitoring wells.
3. Updated inventory of all wells within a 1.0 mile radius of the ASR test well.
4. Consumptive use permit and Generic Discharge Permit
    - SJRWMD Consumptive Use Permit (CUP) #3317 - Specific Condition 18
    - Generic NPDES Discharge Permit for uncontaminated ground water

FDEP provided an email on January 29, 2010 granting authorization to initiate cycle testing. A copy of the submittal package and FDEP e-mail granting authorization to initiate cycle testing is included on the CD in ***Appendix G***.

8.5 Transfer of Facilities to Cooperator

In accordance with the Memorandum of Understanding (MOU) signed by SJRWMD and OCU the Wells and Surface Facilities constructed ended on December 11, 2009 and the warrantee period started. The transfer of facilities and substantial completion agreement was signed by Wharton Smith, OCU, and BFA (on behalf of the SJRWMD) on February 5, 2010.

9.0 Large Cycle Operational Monitoring and Evaluation

9.1 Cycle Testing

9.1.1 Current Status

On January 29, 2010, FDEP granted authorization to initiate cycle testing consistent with the approved UIC Permit Cycle Test Plan. The approved schedule and volumes for recharge, storage, and recovery are shown in Table 9-1.

Table 9-1

Cycle Test Schedule and Volumes

Cycle	**Recharge**		**Storage**		**Recovery**	
	Days	Volume	Days	Volume	Days	Volume
Pre-Cycle Injection	60	180	0	180	0	0
1	10	30	14	210	10	30
2	35	105	40	285	10	30
3	90	270	45	420	90	270

Note: Volume in million gallons

The water source for the cycle testing was from OCU's potable water distribution system. The recovered water was discharged into the effluent pump station of OCU's Eastern WRF and ultimately to the reclaimed water/reuse system. The following summarizes the cycle testing performed on the Orange County ASR.

Pre-cycle Injection

OCU began pre-cycle injection on February 1, 2010 for establishment of a buffer zone in the ASR storage zone. The creation of the buffer zone was to assist with arsenic mobilization and attenuation. Due to demands in their distribution system, OCU initially injected at the higher rate of 5,500 gpm through the annular space in two 8-hour batches on weekdays starting at 10:00 AM and again at 10:00 PM. Shorter injection periods were used during weekends at times of higher distribution system demand.

On March 8, 2010 OCU changed the pre-cycle injection rate to a lower flow constant rate of 1,700 gpm down the pump column pipe. All water was injected under pressure from the distribution system. On March 25, 2010 OCU completed the pre-cycle injection having injected 180 million gallons over 55 days.

Cycle 1

The Cycle 1 Injection began on March 26, 2010 at a rate of 1,700 gpm through the pump column pipe. The Cycle 1 Injection ended on April 7, 2010 with 31.8 million gallons injected into the storage zone. The ASR System was placed in storage mode for 14 days until April 21, 2010.

Cycle 1 Recovery started on April 21, 2010, however only 1-1/2 days of recovery was completed prior to equipment failure at the EWRF. Although the equipment failure was not directly related to the ASR recovery water discharge at the EWRF effluent pump station, the equipment failure limited the County’s effluent discharge to only a portion the disposal system and capacity was not available for the recovery water. FDEP was notified of the equipment failure and subsequent delay and approved an extended Cycle 1 Storage until OCU could complete the necessary repairs. The ASR System remained in extended storage mode for 46 days from April 24, 2010 through June 8, 2010.

On June 8, 2010 FDEP was notified that the repairs were completed at the EWRF and FDEP approved reinitiating the Cycle 1 Recovery. Cycle 1 Recovery was completed on June 21, 2010 with 30.5 million gallons recovered from the ASR System.

Cycle 2

OCU implemented the Cycle 2 Injection from June 28, 2010 to August 10, 2010. Injection was at a rate of 1,700 gpm through the pump column pipe over 43 days for a total injection of 105 million gallons. Cycle 2 Injection was completed on August 10, 2010 and held in storage for a total of 40 days until September 18, 2010. Cycle 2 Recovery started on September 19 2010 and ended on October 14, 2010 at a rate of 1,400 gpm for a total of 30 million gallons.

Cycle 3

OCU implemented the Cycle 3 Injection from November 1, 2010 to February 21, 2011**.** Injection was at a rate of 1,700 gpm through the pump column pipe over 111 days for a total injection volume of 270 million gallons. Cycle 3 Storage started on February 22, 2011 to April 6, 2011 for 45 days. Cycle 3 Recovery started on April 7, 2011 to April 18, 2011 at a rate of 1,500 gpm. From April 19, 2011 to August 19, 2011 the Recovery rate changed to 2,500 gpm. The Recovery Cycle schedule was 11:00 AM to 7:00 PM and 11:00 PM to 5:00 AM daily for 14 hours per day.

The actual flows and dates for the completed cycle testing through Cycle 3 are presented in ***Figure 9-1***.

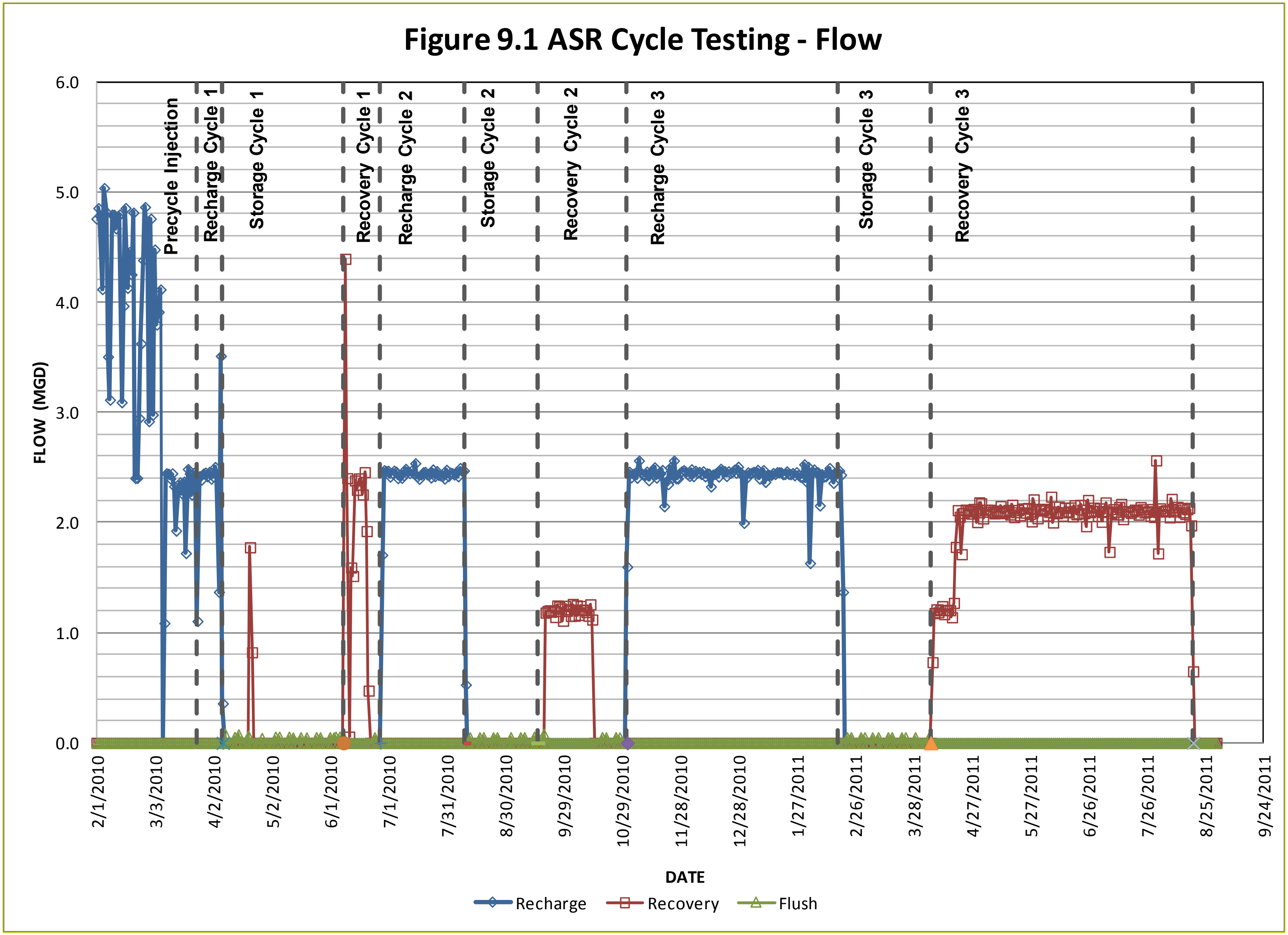


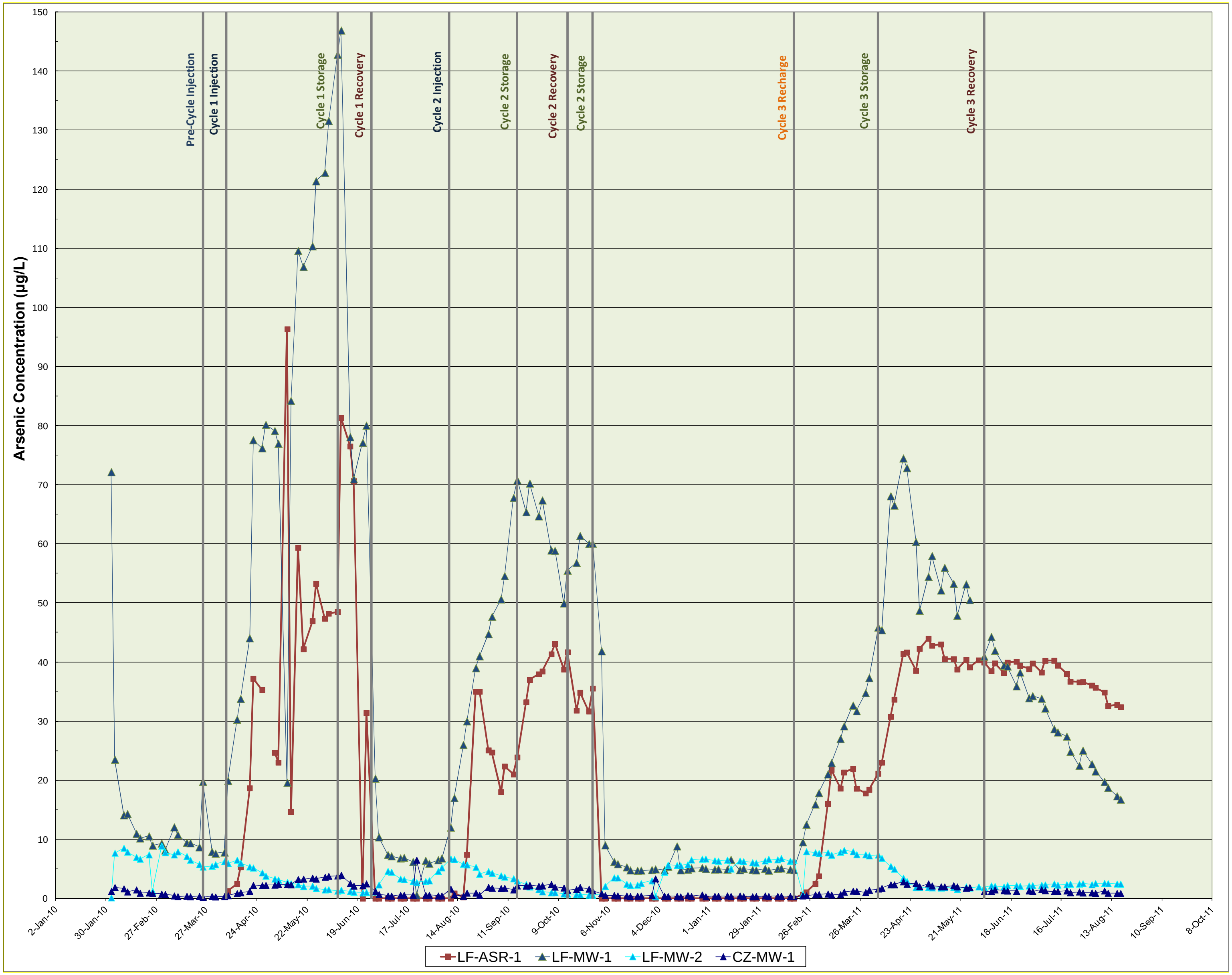
Figure 9.1 ASR Cycle Testing - Flow
FLOW (MGD)
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Precycle Injection
Recharge Cycle 1
Storage Cycle 1
Recovery Cycle 1
Recharge Cycle 2
Storage Cycle 2
Recovery Cycle 2
Recharge Cycle 3
Storage Cycle 3
Recovery Cycle 3
2/1/2010
3/3/2010
4/2/2010
5/2/2010
6/1/2010
7/1/2010
7/31/2010
8/30/2010
9/29/2010
10/29/2010
11/28/2010
12/28/2010
1/27/2011
2/26/2011
3/28/2011
4/27/2011
5/27/2011
6/26/2011
7/26/2011
8/25/2011
9/24/2011
DATE
Recharge
Recovery
Flush

Water Quality Monitoring

OCU implemented the water quality monitoring of the stored and recovered water consistent with the UIC permit cycle testing monitoring plan. Samples were collected twice per week for Arsenic and once per week for additional metals, chloride, sulfate, and total dissolved solids as well as field measurements for DO, ORP, pH, conductivity, and temperature. OCU submitted monthly reports of the laboratory results to FDEP from February 2, 2010 through August 19, 2011. The *August 2011 Cycle Testing Report* submitted to FDEP on September 23, 2011 is included in ***Appendix F***. The *August 2011 Cycle Testing Report* includes all data for all samples collected through the end of Cycle 3 Recovery. A summary of the Arsenic data is presented in ***Figure 9-2***. Additional graphs of the Arsenic data at the monitoring wells and ASR well are included in ***Appendix E.***

Figure 9-2

Summary of Arsenic Data



9.1.2 Work Scheduled for this Fiscal Year

Orange County has indicated plans to continue cycle testing intended to demonstrate more realistic operating conditions. OCU and their consultant, Parsons Brinckerhoff, are currently preparing testing plans towards this goal. The additional cycle testing plan is anticipated to be submitted to FDEP this fall.

10.0 Feasibility Determination and Conclusion

10.1 Feasibility of ASR at this Site

At the completion of each task of the investigations and evaluations of ASR at the EWRF site, it was determined that the site met the goals for continuing forward with the project. The initial desktop assessment has been supported by the site specific data and studies of the hydrogeologic conditions at the site. In addition, the site benefits based on the coordinated operation of the potable water system and ASR system have remained consistent.

The key benefits of the site are summarized below:

- Accessible to existing water supplies, as well as, being located in the County’s service area expected to receive alternative water supplies requiring seasonal water storage.
- Large site allows for significant buffer and potential for expansion.
- Centrally located within the County’s Eastern Service Area allowing for good institutional control and reduced potential for interference with existing users.
- Evaluations of the site hydrogeologic conditions indicate a large storage zone with good storage zone confinement and expected good recovery efficiency.

There are still critical questions to be answer on the feasibility and future implementation of ASR at the EWRF site. The primary issue centers on whether the arsenic levels will attenuate over time or remain at elevated levels within the storage zone and recovered water with continued use. The FGS Leaching Study inferred elevated arsenic levels, but the effects of the project scale, physical aquifer characteristics, reactions during flow and storage, etc. preclude direct comparison to the field. As the cycle testing has progressed there has been a downward trend of the Arsenic levels in the stored and recovered water. This issue remains to be further evaluated during the additional cycle tests that currently proposed by OCU.

10.2 Summary of Project Costs

ASR Project Capital Cost

Table 10-1 provides a summary of the capital costs for the implementation of the ASR Project at the EWRF. These costs do not include costs incurred by Orange County for staff project management; SCADA, electrical work and other miscellaneous work for the surface facilities construction: and laboratory and operating costs during the cycle testing.

Table 10-1 Orange County ASR Project Capital Cost

Task	Description	Capital Cost
1, 2 ,3 &4	Desktop Assessment. PDR and Exploratory Well	$928,000
5 and 6	Final Design and Permitting	$282,000
7	ASR Well and Monitoring Well Construction	$1,808,000
7	Surface Facilities Construction	$1,683,000
8	Startup/Training	$25,000
9	Monitor Cycle Test	$74,000
	Total	**$4,800,000**

10.3 Compare Original Schedule to Final Schedule

The original ASR Project schedule had the following milestone delivery dates:

Task	Original Date	Actual Date
Task 1 – ASR Construction and Testing Plan	02/2002	04/2002
Task 2 – Desktop Assessment of ASR for OCU	03/2003	03/2003
Task 3 – Cooperator Agreement	03/2003	05/2004
Task 4 – Preliminary Basis of Design	03/2005	09/2006
Task 5 – ASR Final Design	03/2007	06/2007
Task 6 – Regulatory Permitting	04/2007	02/2009
Task 7 – ASR Facilities Const/Start-up/Monit/Train	05/2008	11/2009
Task 8 – Large Cycle Operational/Monitor/Evaluate	01/2008	08/2011
Task 9 – Preliminary Feasibility & Conclusion		

10.3.1 Detailed Description of Task Schedule

Task 1 ASR Construction and Testing Program Plan

The schedule for this task was base on a defined scope of services in coordination with the District and OCU as one of the cooperators. This task was completed in six (6) months from October 2001 to February 2002. The final report for this task was approved and published by the District in April 2002.

Task 2 Desktop Assessment of ASR for OCU

The original conceptual schedule developed in the Task 1 ASR Program Plan report shows Task 2 completed in 69 days. The actual task was completed in six (6) months (from September 2002 to March 2003) which is consistent with the defined scope of services for this task. The actual duration of this task was longer than the conceptual schedule because it did not account for the extensive evaluation and decision process required by the multiple entities involved including the District, FDEP, and OCU.

Task 3 Cooperator Agreement

The original conceptual schedule developed in the ASR Program Plan report shows Task 3 completed in 67 days. The actual duration of this task was significantly longer. Assistance and coordination services involved the District, OCU and other cooperators under multiple work orders and lasted one (1) year and two (2) months from March 2003 to final signature in May 2005. The agreement went through several draft versions that were necessary to finalize the Memorandum of Understanding (MOU) between the District and Orange County Utilities. The MOU states that specific timeframe for subsequent tasks could be established only after the District and the Orange County signed the MOU. The specific schedules were then developed during the Preliminary Design Task 4.

Task 4 Preliminary Design

The schedule for this task was based on multiple defined scopes of services in coordination with the District and OCU. The original schedule was for duration of five (5) months from November 2004 to March 2005 which included drilling and PDR preparation. This task was extended to September 2006 due to multiple factors. Drilling did not begin until March 2005 (a five month delay) due to the 2004 hurricane season and subsequent disaster recovery.

Other delays occurred during the drilling process which included dense subsurface formations, alternative drilling methods, subsurface obstructions, and unsafe weather conditions (flooding, lightning, etc.). The final PDR established detailed schedule for subsequent Tasks 5 through 8.

Task 5 Final Design

The schedule for this task was developed in the PDR and was included in the scope of services in conjunction with Task 6 Permitting. The schedule provided for a six (6) month duration from October 2006 to March 2007. The PDR was actually completed in nine (9) months in June 2007. Minor delays to the schedule include a longer review period by OCU and the addition of a well enclosure building and well sampling pumps. This additional equipment and structures required modifications to the design drawings and specifications.

Task 6 Regulatory Permitting

This task encompassed the entire FDEP permitting process as outlined in Section 7 of this document although the UIC permit was the only one that caused schedule delays. The original schedule for this task was seven (7) months duration from October 2006 to April 2007. However, the first UIC permit was obtained in March 2008 and a major modification was received in February 2009. Major delays occurred during this time which included changes in FDEP requirements and Arsenic rule implementation. The original schedule accounted for one RAI and a 30-day review period. There were 2 RAIs and multiple coordination meetings with FDEP and cooperators over a 2-year period. FDEP and the District developed the Administrative Order (AO) and evaluated ASR feasibility during this time. FDEP required a permit modification to include the new AO. OCU and the District also used this opportunity to modify the cycle testing plan to better fit OCU's unique project conditions.

Task 7 ASR Facilities Construction

The issuance of the notice to proceed for this task was delayed because the District and FDEP were evaluating the new arsenic rule implementation and assessing ASR feasibility and effectiveness of pretreatment. The District also decided to split drilling and surface facility construction into two separate work orders.

This task experienced minor delays throughout the construction process; however, there were two (2) major delays: 1) the first attempt at drilling the DZMW was abandoned because mud circulation was lost causing the 12-inch diameter pilot hole to collapse. The 24-inch diameter surface casing dropped about 15 to 20 feet downhole and a 12 foot diameter depression formed around the well. The DZMW location was moved about 100 feet northwest and a smaller rotary rig was used to drill an 8-inch diameter pilot hole into the top of the Upper Floridan aquifer. 2) Surface Facilities construction started in February 2009 and experienced a major delay due to the delayed delivery and installation of the ASR vertical turbine pump. However, the coordination and teamwork provided by the entire project team allowed the remaining aspects of the construction to flow seamlessly and minimize the overall delay of the project. All construction ended in late October 2009 including all change order items. BFA and ASR System conducted the operation and maintenance training in late November 2009. Wharton Smith Construction was issued substantial completion on December 11, 2009 and the ASR System was transferred to OCU on February 5, 2010. The Certification of Substantial Completion document is included in ***Appendix E***.

Task 8 Large Cycle Operational Monitoring and Evaluation

This Task began on February 1, 2010 with the pre-cycle injection for the formation of the Buffer Zone. Original scheduling had Cycle Testing starting in October 2009 and finishing in March 2011. However, with the delays experienced throughout the other Tasks and with an additional delay experienced at the beginning of Cycle 1 Recovery due to equipment failure at the EWRF affecting the recovered water discharge, Cycle Testing was not completed until August 19, 2011.

10.4 Lessons Learned and Recommendations for Future ASR Projects

The ASR Project at the Orange County EWRF site has provided valuable understanding and experience for the design and implementation of ASR projects. Several lessons learned should be considered for the planning and design of future ASR projects. In some cases, the understandings of the benefit to the project were not determined until later in the process. For this ASR Project, additional consideration to size of property, institutional controls, water availably and cycle test fluid management have benefitted implementation of the project. Adjustments to the scoring weight for certain criteria in the site assessment process may be the means to address these benefits. A few of the lessons learned from this ASR project are summarized below.

Size of Property

ASR facilities can be located on small parcels as easily as large parcels; however, some advantages to having larger property sites may include:

- Property control should arsenic or other potential contaminants mobilize in the ASR storage zone. By having sufficient property buffer around the storage zone, offsite contaminant migration is minimized.
- Discharge of recovered water can be significantly limited with smaller sites unless adjacent stormwater ponds or wetlands area are available. A larger site may allow for several alternate pond or wetland discharge sites. This can be more critical should elevated arsenic level be present in the recovered water.
- For larger water systems, the ability to expand the ASR System onto the surrounding property may be a significant consideration towards use of ASR.
- Available land for pretreatment of recharge water or post treatment of recovered water, if needed.

Institutional Controls

Institutional controls such as control of the surrounding utility service area can benefit the project by limiting the potential for interference with existing non-utility owned wells and reducing concerns with well contamination should arsenic or other metals mobilize into the storage aquifer.

Water for Cycle Testing

As identified early in the project, having a large volume of water available for cycle testing can significantly affect the feasibility of an ASR project. The cost to bring the needed quantities of water to a potential ASR may impact the decision to consider ASR as a storage option. This can be especially critical for a larger ASR projects.

Cycle Test Fluid Management

If elevated arsenic levels are present in the recovered water, the options for cycle test fluid management originally planned in a project may not be available. Planning for alternate sites or methods of disposal or reuse could prevent significant project delay.

APPENDICES

APPENDIX A
Program Plan

St. Johns River Water Management District
Aquifer Storage Recovery
Construction and Testing
Program Plan — FY 2002

St. Johns River Water Management District
and
Aquifer Storage Recovery Consultant Team:
Barnes Ferland & Associates, Inc.
Camp Dresser & McKee, Inc.
Water Resource Solutions, Inc.

Palatka, Florida
April 2002

St. Johns River Water Management District
Aquifer Storage Recovery
Construction and Testing Program Plan

1.0 Background

1.1 Introduction

The St. Johns River Water Management District (SJRWMD) in its 2000 District Water Supply Plan (DWSP) identifies the need for alternative water supplies other than fresh groundwater to meet projected future demands. Current SJRWMD groundwater modeling indicates that the increased use of groundwater to meet projected demands is likely to result in the potential for unacceptable impacts to water resources and related natural systems. The model results indicate Floridan aquifer potentiometric surface declines, reduction of spring flows, lowering of wetland and lake water levels, inland movement of saline water from coastal areas, and reduction of stream flows below minimum levels required to maintain natural systems.

The DWSP identifies surface water as one of the most cost-effective alternative water supply sources having significant capacity. Because of the seasonal variability of both quality and quantity, the use of surface water as a source of supply requires significant storage to provide a reliable supply. Other alternative sources such as seawater desalination could be developed to supplement existing freshwater supplies where needed — however, at higher cost. The use of reclaimed water or storm water for non-essential uses, such as lawn irrigation or agricultural irrigation, could also reduce the demand on limited fresh groundwater supplies.

The use of aquifer storage recovery (ASR) technology can be a cost-effective method of storing water. ASR provides a means of balancing the sources of water available for supply with the temporal aspects of water supply, water demand, and water quality. Successful ASR development generally requires that it be implemented as a component of an overall aquifer management plan. Water is stored during times when it is available, such as wet months when supply exceeds demand or when water quality is best, and is recovered during times when it is needed, such as dry months, emergencies, or when quality of water from other sources is poor. Water is stored and recovered through the same wells which, in Florida, usually penetrate the limestones of the Upper Floridan aquifer.

After appropriate development of the storage zone around an ASR well, approximately the same volume of water stored is typically recovered, without significant changes in water quality between the water recharged and recovered. The potential storage volume in the aquifer is essentially unlimited; however, care has to be taken to ensure that water level changes during recharge and recovery do not cause any significant adverse effects upon other wells or ecosystems. It is noteworthy that ASR can be developed close to the area of demand or in a more remote area for regional distribution.

The principal driving force behind ASR implementation has been its cost-effectiveness relative to other water storage alternatives, such as tanks and reservoirs, and water supply alternatives, such as demineralization/desalination of saline groundwater or surface water. The cost of meeting increasing peak demands with ASR is usually less than half the cost of meeting those demands with other water supply alternatives. An important secondary factor for ASR implementation has been its acceptance as an environmentally beneficial water management alternative. Some of the environmental benefits include reducing or eliminating the need for dams and surface storage reservoirs, reducing diversions from surface waters during low-flow periods, maintaining minimum flows and levels at lower cost, and reducing excess surface water discharge to coastal waters during wet weather periods.

ASR wellfields have been operating in the United States since the 1960s and in Florida since 1983, when the first system became operational in Manatee County. Ten ASR wellfields are now operating in Florida and about 30 more systems are in various stages of development. Within SJRWMD, the City of Cocoa ASR wellfield has been operational since 1987 and is now completing its third system expansion to 10 wells. Also, the Town of Palm Bay has a single ASR well that has been operational since 1989. Nationwide, about 50 ASR wellfields are operational, with at least 100 more in development. The largest ASR wellfield is in Las Vegas, Nevada, with a recovery capacity of about 100 million gallons per day (mgd). For the Everglades Restoration Plan in South Florida, an ASR capacity of about 1.7 billion gallons per day is planned.

For the SJRWMD ASR Construction and Testing Program, no regulatory changes are required to support proposed applications for construction and testing projects. Early coordination will be conducted with the Florida Department of Environmental Protection (FDEP) for permitting requirements. Water stored will comply with current federal and state regulations.

1.2 SJRWMD ASR Construction and Testing Program Goals and Objectives

The goal of the ASR Construction and Testing Program is to examine the appropriateness of integrating ASR technology into regional water resource and water supply development projects. Accomplishing this goal will require interfacing with governmental entities or private utilities that may actively participate, own, operate, or maintain a constructed facility arising out of this program. These entities are referred to as Cooperators. It is estimated that effective ASR could make economically feasible the use of multiple surface water or groundwater sources that may yield up to 350 mgd of additional resource. To achieve this goal, SJRWMD has identified several objectives that must be met:

- Determine the extent to which ASR can be applied to meet local or regional water supply needs through use of alternative water supplies (i.e., surface waters, reclaimed waters) in addition to limited groundwater supplies.
- Establish the fundamental criteria for successful application of ASR in SJRWMD.
- Provide test sites for a variety of applications in order to identify and address the different issues (e.g., permitting/regulatory, technical, logistics, political) unique to each application.

- Identify and secure Cooperators, through executed agreements, to participate in ASR construction and testing which would result in development of a functional ASR facility to be used by the Cooperator at the conclusion of the testing period.
- Demonstrate the extent to which ASR can be safely and successfully used within SJRWMD.

The desire of SJRWMD is to examine a broad range of ASR applications and alternative water sources. Possible ASR applications include such things as providing storage to meet seasonal supply and demand variations; supplementing water supplies for coastal communities; providing salinity intrusion control; maintaining minimum flows and levels in surface waters, wetlands, and other natural systems; impact avoidance; and agricultural irrigation. All of these ASR applications are currently in use at various locations in Florida or elsewhere in the United States.

Subject to regulatory requirements, such as treatment to meet water quality criteria, sources may include, for instance, drinking water from fresh water sources, drinking water from desalinated brackish or seawater sources, surface water from lakes and rivers, reclaimed water, groundwater from overlying or underlying aquifers, and groundwater from the same aquifer at distant locations where the water is fresh.

2.0 ASR Construction and Testing Program and Process

2.1 Framework for Selecting ASR Construction and Testing Projects

Criteria for inclusion of projects in the ASR Construction and Testing Program have been established based upon water use characteristics and the hydrogeology of the proposed project site. Those projects deemed by SJRWMD to be the more likely to contribute to successful achievement of regional water management goals are more likely to be selected for inclusion.

SJRWMD has established a process that allows for participation in the program by Cooperators. Participation in the program is guided by establishing the respective responsibilities for both SJRWMD and each Cooperator. SJRWMD may solicit participation by certain Cooperators whose participation is deemed essential to accomplishment of the program's goals and objectives. Others interested in participating in the program are encouraged to apply for consideration by submitting a letter of interest to SJRWMD. SJRWMD and its consultant team will screen proposed projects to ensure that the projects comply with SJRWMD's goals and objectives and will make decisions concerning inclusion of the proposed project in the program.

The primary feasibility factors in the Cooperator screening process are described in SJRWMD Special Publication SJ97-SP4 titled *A Tool for Assessing the Feasibility of Aquifer Storage Recovery* (CH2MHILL, 1997). These factors are highlighted in Sections 2.2 and 2.3 of this document.

2.2 Facility Planning Factors

The facility planning factors include the demands, supply, and storage needs associated with a Cooperator's water system service area.

- **Demand** — A Cooperator's demand consists of projected capacity and temporal water use patterns. A Cooperator's demand should be large enough (>1 mgd) to justify the expense of an ASR facility in lieu of conventional storage tanks.

- **Supply** — A Cooperator's water supply consists of the groundwater and/or surface water withdrawals authorized by allocations established through the SJRWMD consumptive use permitting process.

- **Storage Requirement** — A Cooperator's storage requirement is determined through evaluation of its historical average supply and demands. A Cooperator's storage requirement can be long-term storage, in which a Cooperator wishes to store excess water which is withdrawn in the future to offset the need for infrastructure expansion, or seasonal storage, in which a Cooperator wishes to store water during wet seasons and withdraw water during dry seasons.

- **Proposed Use** — A Cooperator's proposed use of ASR, as demonstrated by inclusion in a master plan or other similar document, is to provide storage to meet its future use projections using available water supply sources, in accordance with the DWSP.

2.3 Hydrogeologic Factors

The hydrogeologic feasibility factors used to evaluate an ASR storage option include storage zone confinement, transmissivity, aquifer gradient and direction, recharge and native water quality, and interfering uses and impacts.

- **Storage Zone Confinement** — The presence and degree of vertical confinement of an aquifer proposed for an ASR storage zone is important to determinations of the degree to which an ASR system can be protected from impacts and effects of external sources of contamination or competing withdrawals above or below the storage zone.

- **Storage Zone Transmissivity** — Transmissivity is a measure of water flow rate through the aquifer media. Storage zone transmissivity should be sufficiently high so that a volume of water can be injected at reasonable wellhead pressures and the same volume of water can be recovered from the storage zone without excessive drawdown in the wells. Additionally, optimal transmissivities should be sufficiently low to allow for the creation of discrete buffer and storage zones and avoid loss of stored water due to migration away from the well or significant mixing with poor/brackish quality native water.

- **Aquifer Gradient and Direction** — The aquifer gradient of a proposed site's storage zone identifies the direction of groundwater flow and any external influence from sources (e.g., recharge areas) and sinks (e.g., operating wellfields, springs). Additionally, the higher the gradient, the more likely stored water will migrate away from the well, potentially resulting in a poor recovery efficiency if the storage zone is in a brackish aquifer. Optimal gradient in the storage zone should be such that the stored water stays close to the well between recharge and recovery.

- **Recharge and Native Water Quality** — Recharge water quality determines the level of treatment that may be required prior to storage. Of critical concern is the potential for storage zone plugging due to recharge water solids content, nutrient and biological content (biofouling), and carbonate geochemistry. For SJRWMD's program, the recharge water quality must meet applicable federal and state standards.

  Native water quality is an important factor in the determination of buffer and storage zone volume requirements and recovery efficiency. For example, the higher the salinity concentration of the native water, the larger the volume of recharge water required to establish the buffer zone. Additionally, native water salinity can impact the thickness of stored water in the storage zone due to the effects of density stratification within the storage zone. For example, freshwater stored in a zone with highly saline native water could result in a very thin layer of freshwater at the top of the storage zone and brackish to saline water throughout the remainder of the zone's vertical depth. This situation would, in turn, reduce recovery efficiencies.

- **Interfering Uses and Impacts** — Interfering uses result primarily from other supply wells in the vicinity of the ASR system that directly withdraw from an ASR storage zone or cause a change in the gradient that, in turn, causes migration of stored water out of the storage zone.

  Impacts are considered to be any current or future contamination of the aquifer storage zone. The distance to any supply or injection well in the same aquifer zone and the distance to any contamination zone influence this factor.

SJRWMD will use these hydrogeologic and facility-planning factors as screening factors when considering potential Cooperators and proposed sites for ASR construction and testing.

2.4 Candidate Projects

SJRWMD and its consultant team have identified the following initial potential candidate projects for the ASR Construction and Testing Program:

> **Volusia County ASR Project** — This project is proposed in association with SJRWMD's St. Johns River Water Supply Project. Successful development of water supplies from the St. Johns River is likely to depend largely on the feasibility of utilizing ASR as the primary storage technique.

Seminole County ASR Project — This project is associated with SJRWMD's St. Johns River Water Supply Project. Successful development of water supplies from the St. Johns River is likely to depend largely on the feasibility of utilizing ASR as the primary storage technique.

City of Cocoa Reclaimed Water ASR Project — This project is proposed to examine the feasibility of ASR as an effective means of storing reclaimed water during periods of excess supply for recovery and use during periods of short supply.

This document will be revised to add additional candidate projects as those projects are identified.

3.0 Project Funding

SJRWMD has developed a budget of $11.82 million for ASR construction and testing for the fiscal year 2002–2006 period. Projects are proposed to be accomplished with SJRWMD ad valorem and Florida Forever funds as well as Cooperator funding in the form of in-kind services and/or cash contributions currently estimated at approximately $7.90 million, for a total program budget of $19.72 million (Table 1).

Current legislation restricts the use of Florida Forever funds to construction components of the project. Planning and design costs must be funded using ad valorem and Cooperator funds. It is SJRWMD's intent to leverage the Florida Forever funds as much as possible by favoring proposed Cooperators who are willing to provide in-kind services and direct financial contributions for projects that are deemed by SJRWMD to contribute toward achieving the goals of the program. Additionally, those potential Cooperators who apply earlier are more likely to achieve funding than those who apply later. It is estimated that the current total program funding should be sufficient to provide for at least nine ASR investigations and possibly more, depending on the extent to which Cooperators are willing to share the cost.

Table 1. SJRWMD ASR Construction and Testing Program proposed funding for fiscal years 2001 to 2006 (in dollars)

	Total for Period	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
Sources ($ million)							
SJRWMD ad valorem	0.350	0.000	0.350	0.000	0.000	0.000	0.000
Florida Forever	11.471	2.375	1.596	2.500	2.500	2.500	0.000
Cooperators	7.898	1.834	1.064	1.667	1.667	1.667	0.000
Total	**19.719**	4.209	3.009	4.167	4.167	4.167	0.000
Disbursements ($ million)	**19.719**	0.000	6.219	4.167	4.167	4.167	1.000

4.0 Project Implementation

4.1 Responsibilities of SJRWMD

SJRWMD will be responsible for selecting those projects to be included in the ASR Construction and Testing Program and for funding a portion of each project. SJRWMD will also be responsible for coordination between governmental agencies and other entities that may be involved in the ASR Construction and Testing Program. As part of this coordination, SJRWMD will take the lead in the negotiation of complex regulatory issues that may arise pertaining to ASR implementation at each site.

Additional SJRWMD responsibilities will depend upon the agreement to be developed between SJRWMD and each Cooperator. It is anticipated that SJRWMD will provide funding for planning, design, permitting (including permit fees), construction, testing, startup, and initial operations of ASR facilities (including operator staff training and transferring operation of the facilities to the Cooperator after the test program and initial startup are completed). Alternatively, SJRWMD may provide funding to the Cooperator, who would then complete ASR project development with review and approval of progress at selected checkpoints during the term of the project.

The assigned roles of SJRWMD and the Cooperator will be established in advance for each site as conditions of the Cooperator agreement. SJRWMD's consideration of a Cooperator's proposal to participate in the program will be influenced by the extent to which the Cooperator demonstrates a willingness to provide direct financial contributions or in-kind services and a commitment to the long-term operation of the ASR facilities.

4.2 Responsibilities of the Cooperator

The Cooperator will be responsible for providing an ASR facility site and appropriate logistical support to include, at least, facility access, a suitable source of water for testing and operations, power supply, and disposal of recovered water during initial testing and also during operational startup. In general, water supply sufficient to conduct the ASR investigations requires the ability to store at least 50 million gallons of water during a typical recharge season.

Support could also include direct financial contribution toward project costs, particularly to the extent that the Cooperator wishes to assume responsibility for directing activities at its site. Support may also include in-kind services such as assistance during sampling, monitoring, and other testing and operational activities, which could vary from minor assistance during initial portions of the testing program to primary responsibility during later portions of the testing program.

Upon completion of the ASR project, the Cooperator will be responsible for continued operation of the ASR facilities, assuming that their operational success has been demonstrated during the test program. The assistance of the Cooperator in helping to resolve regulatory issues would also be expected, including preparation for and participation in agency meetings.

4.3 Project Tasks

SJRWMD has developed a detailed list of standard tasks for its ASR projects. This list of standard tasks is based upon the process utilized for successful completion of 10 operational ASR systems in Florida and 40 others throughout the United States. A brief summary is included in this document as a guide to potential Cooperators and others who may be interested. A full copy of the task list is included as Exhibit A. This list will be adapted to individual needs and opportunities at each site. It should be noted that some tasks may require greater emphasis and some will require less. Additionally, it is possible that individual needs at selected potential ASR sites may require additional tasks not identified on this list.

Each project will include project coordination, management, and other meetings.

Task 1 — ASR Construction and Testing Program Plan

The ASR Construction and Testing Program Plan is intended to be suitable for distribution to policy makers, potential Cooperators, interest groups, and the technical community. It includes a description of evaluation criteria for potential projects and a preliminary listing of regional candidate projects. This plan will be revised as necessary.

Task 2 — Project Evaluation and Site Selection

This task includes a desktop project feasibility assessment based on the assessment approach described in SJRWMD Special Publication SJ97-SP4 titled *A Tool for Assessing the Feasibility of Aquifer Storage Recovery* (CH2MHILL, 1997). If the assessment indicates that the project is feasible, the project will advance to the preparation of a Cooperator Agreement. If the project is deemed to be not feasible, it will not be further considered.

Task 3 — Cooperator Agreement

An agreement that establishes the objectives of the project and the responsibilities of SJRWMD and the Cooperator will be developed. This task also includes preparation and presentation of project information to Cooperator decision makers.

Task 4 — Site-Specific Data Collection and Preliminary System Design

This task includes site-specific data collection and preliminary system design. A data collection plan for each site will be prepared based on a review of existing information and coordination with FDEP. In particular, the plan shall address the need for initial exploratory testing as the basis of development of ASR well design criteria and whether such exploratory testing may be conducted without having to first obtain all permits for the subsequent ASR system. To the extent possible based on FDEP guidelines, SJRWMD proposes to gather hydrogeologic information from the construction and testing of an initial test well at each site, which would then be converted to an observation well for the ASR construction and testing program. The data collection plan will be implemented, the data will be evaluated, and a preliminary system design will be developed.

Task 5 — ASR Pilot Project Design

This task includes the design of well and wellhead facilities at the selected site, including the proposed data collection and monitoring programs.

Task 6 — Regulatory Permitting
SJRWMD, and its cooperators and consultants, will adhere to the necessary regulatory permitting requirements, including preparation of permit applications, and responses to requests for information from regulatory agencies. The primary permitting effort will be through FDEP.

Task 7 — ASR Facilities Construction, Monitoring, and Testing
This task includes construction of ASR and monitor wells, and associated wellhead facilities. Initial hydraulic and water quality testing would be conducted, in addition to geophysical logging, geochemical modeling, and evaluation of any additional pretreatment requirements. A series of ASR test cycles would then be conducted to address technical and other issues pertaining to each site.

Task 8 — Startup and Training
SJRWMD's consultant will provide operational training of Cooperator staff to ensure a smooth transition from the test program into full operations.

Task 9 — Large Cycle Operational Monitoring and Evaluations
Operational monitoring and evaluation of ASR system performance will be conducted during the first two to three years of operations, making any needed adjustments to improve system performance. The Cooperator will be operating the system during this period.

Task 10 — Peer Review of ASR Consultant Team Work
This task includes the review of work products produced by ASR consultant team members by other team members as considered necessary by SJRWMD.

4.4 Project Schedule

Each project will have its own schedule, to be established during initial planning. For typical ASR projects in Florida, the schedule requires about three years, within a range of 2 to 5 years. Upon completion, the ASR facility is fully operational and fully permitted. A typical timeline is illustrated in Table 2.

Initial planning and feasibility assessment typically requires about 3 to 6 months, although shorter periods are reasonable in situations where existing ASR facilities are already in operation nearby.

Agreements with Cooperators and the completion of preliminary design efforts can be accomplished in 3 to 6 months.

Facilities final design typically requires about 2 to 6 months, during which time permit applications may be submitted.

Final permit approval for ASR systems complying with current water quality standards may require from 4 to 12 months from initial submittal, depending upon the number and scope of requests for information (RFIs) made by the permitting agencies. If there exists any public opposition, the permit issuance may be delayed until the public opposition issues are sufficiently addressed.

Bidding requires approximately 2 to 4 months and construction typically requires 4 to 8 months, depending upon the complexity of the facilities, the number of bid packages, and the project delivery method.

ASR testing duration will depend upon the conditions at each site, and will vary between sites. However, a typical duration for ASR testing is about 6 to 12 months, followed by operational startup. Experience has demonstrated the wisdom of providing close monitoring of operational performance during at least the first year of full operations.

Table 2. Aquifer Storage Recovery (ASR) project schedule

Task	Duration (days)
ASR Construction and Testing Program Plan	1
Project Evaluation and Site Selection	69
Cooperator Agreement	67
Site-Specific Data Collection and Preliminary Design	70
ASR Pilot Project Design	53
Regulatory Permitting	93
ASR Facilities Construction, Monitoring, and Testing	140
Startup and Training	67
Large Cycle Operational Monitoring and Evaluations	262

EXHIBIT "A" – SCOPE OF SERVICES

The St. Johns River Water Management District (DISTRICT) is implementing the District Water Supply Plan (DWSP). Successful development and implementation of Aquifer Storage Recovery (ASR) as a component of that plan is critical. In order to successfully evaluate and account for hydrogeologic variations and source water quality, it is important to establish a comprehensive, yet flexible, approach to consistent analysis of different projects, locations, and uses. Tasks may include interface with governmental entities or private utilities that may actively participate, own, operate, or maintain a constructed facility arising out of this project. These entities are referred to as co-operators. The task list provided herein provides an outline for consistent analysis and feasibility assessment at various sites through a full-scale ASR Construction and Testing Program. The site characteristics and conditions for each potential project will dictate the specific scope of work necessary to fully investigate the feasibility of ASR at a project location.

The following tasks A and B, and their subtasks are generic project tasks for routine meetings and other tasks not specifically associated with ASR but required by DISTRICT during the course of any Water Supply or Water Resource Development Project.

Task A. <u>Project Coordination, Management, and Meetings</u>

The purpose of this task is to provide for project management and coordination, including meetings of concerned parties. Also included in this task is the development of, and participation in, workshops designed to communicate the purpose and progress of the ASR Construction and Testing Project to the public, as well as to provide document production support to DISTRICT as needed.

The District's Office of Communications must approve all outreach tasks. Coordination must occur with the Office of Communications in a timely manner to provide opportunities for appropriate review. All media calls must be referred to the District's Office of Communications.

Task A.1 Project Progress Meetings

CONTRACTOR shall prepare for, attend, and participate in project coordination and progress meetings, as scheduled by DISTRICT, related to the work performed pursuant to this AGREEMENT. This will include preparation of monthly progress reports describing recent developments along with updates of the project schedule. The primary purpose of these meetings is to provide project coordination, scheduling, and needed information exchange among the ASR project work efforts. A total of two quarterly progress meetings and two quarterly progress teleconference meetings are anticipated each year of the contract. This task represents the face-to-face meetings portion of the task.

Task A.2 Teleconference Meetings

CONTRACTOR shall prepare for and participate in periodic teleconference meetings as needed for the purpose of reporting progress and exchange of information among the interrelated ASR Construction and Testing work efforts. A total of two face-to-face quarterly progress meetings and two quarterly progress teleconference meetings are anticipated each year of the contract. This task represents the teleconference meetings portion of the task.

Task A.3 Recurring Program Meetings

CONTRACTOR shall prepare for, attend, and participate in program progress meetings as scheduled by DISTRICT for the purpose of reporting progress and exchange of information among all parities involved in water supply planning and implementation within the DISTRICT. The primary purpose of these meetings is to provide project coordination, scheduling and needed information exchange among the many related DISTRICT water supply initiatives. This will include currently ongoing initiatives as well as initiatives begun during the course of the ASR Construction and Testing Contracts. The DISTRICT may schedule up to three such meetings each year.

Task A.4 Public Workshops

CONTRACTOR shall prepare for and participate in up to a total of three (3) public workshops per project, as scheduled by DISTRICT, designed to inform interested parties in the DISTRICT regarding the purpose and progress of the ASR Construction and Testing project. Coordination is required with the District's Office of Communications as addressed in Task A.

Task A.5 Other Meetings

CONTRACTOR shall prepare for and participate in other meetings, as may be needed, as determined by and assigned by DISTRICT's Project Manager for reporting the purpose, and or progress, of the ASR Construction and Testing project to interested individuals or groups. Coordination is required with the DISTRICT's Office of Communications as addressed in Task A.

Task A.6 Document Production Assistance

CONTRACTOR shall prepare fact sheets, brochures, presentations, or other documents, as may be needed, for the purpose of providing project information in support of DISTRICT public outreach programs, or other related report preparation activities, as authorized by DISTRICT Project Manager. Coordination is required with the District's Office of Communications as addressed in Task A. Materials, as required, shall be converted to web-compatible format and transmitted electronically to DISTRICT staff for inclusion in a DISTRICT-maintained web site.

Task B. **Water Supply Program and Technical Assistance**

The ASR Construction and Testing project activities may interface with many other ongoing DISTRICT water supply program activities including, but not limited to the following:

- Groundwater hydrologic modeling
- St. Johns River minimum flows and levels (MFL's) determination
- Facilitated decision making process
- ASR Construction and Testing (by others)
- St. Johns River Water Supply Project

It is likely that issues related to the many ongoing DISTRICT water supply program initiatives will arise during the course of the ASR Construction and Testing project. This task provides for addressing these issues as they may arise. Upon receipt of written instruction, referred to as DISTRICT Supplemental Instructions (DSI), from DISTRICT's Project Manager, CONTRACTOR shall assist DISTRICT in the evaluation of water supply program issues or strategies, and shall prepare documentation in conformance with guidelines provided by the DISTRICT's Project Manager. The schedule for completion of each document shall be included in the DSI.

Task 1 - ASR Work Plan

1.1 Develop ASR work plan describing ASR program suitable for distribution to policy makers, interest groups, and technical community. Work Plan shall include:

1.1.1 Executive summary

1.1.2 Program goals and objectives

1.1.3 Funding and participation requirements

1.1.4 Project selection process

1.1.5 DISTRICT and cooperator responsibilities

1.2 Develop evaluation criteria for potential projects that are compatible with DISTRICT goals.

1.3 Provide in plan a list by region of the candidate areas from which ASR projects of specific types will likely be chosen.

1.4 Deliverables:

Draft and Final ASR work plan document as described in section 1.1.

1.5 Decision Process:

Work plan shall be evaluated by DISTRICT staff for sufficiency and modified as necessary by CONTRACTOR before publication by DISTRICT. The DISTRICT will assign regional candidate sites or potential utility cooperator(s) to the CONTRACTOR for proceeding with the next task.

Task 2 - Desktop project/site feasibility and selection assessment.

2.1 Perform desktop assessment of assigned candidate ASR project(s). Sites will be assessed using criteria developed in Task 1.2. The assessments will include evaluation of the following:

2.1.1 Project objectives (i.e., natural systems impact mitigation, seasonal storage and recovery, long term aquifer recharge, saltwater intrusion barrier, etc.).

2.1.2 Water supply availability for ASR testing and long-term operation:

2.1.2.1 Pipe size and delivery pressure

2.1.2.2 Seasonal availability

2.1.2.3 Water supply trends

2.1.3 Water demands, including variability and demand center location relative to supply source, ASR well site, and treatment/distribution facilities.

2.1.4 Quality of source water (including seasonal variability) and treatment requirements of both recharged and recovered water.

2.1.5 Hydrogeology of proposed ASR system (including water quality, well inventory and potential hydrologic impacts such as interference effects).

2.1.6 Required ASR system capacity and storage volume requirements to achieve project objectives.

2.1.7 Conceptual design of ASR system (including cycle testing and monitoring requirements) at a level sufficient to identify site logistics (i.e., piping, electrical service provision, pumping, etc.).

2.1.8 Preliminary cost estimate (capital and operating). The cost estimate shall include a percentage-based allowance for final design, construction engineering, and inspection.

2.1.9 Preliminary appraisal of other non-technical issues (regulatory, environmental, community, land acquisition, and political support/opposition).

2.2 Prepare preliminary plans for site-specific hydrogeologic testing program (test well) with a construction cost estimate.

2.3 Deliverables:

Draft and final Technical Memorandum evaluating the technical and regulatory feasibility of assigned potential ASR project, a cost estimate (including the cost to cooperator) and an evaluation of the degree to which the project meets the construction and testing ASR program goals of the DISTRICT. The draft will be peer reviewed by the other DISTRICT CONTRACTORs and the DISTRICT.

2.4 Decision Process:

Pending the results of the collaborative CONTRACTOR peer review, a recommendation of the project feasibility and appropriateness of combining subsequent tasks will be determined. A decision by DISTRICT whether or not to proceed to next task will be made and subsequent task cost negotiated.

Task 3 - Cooperator Agreement

3.1 Submit Technical Memorandum (Task 2) to proposed Cooperator and meet to discuss ASR system objectives, conceptual design, testing program, DISTRICT-specific data collection and costs. The Technical Memorandum shall establish Cooperator goals and success criteria.

3.2 Prepare draft agreement with proposed Cooperator and submit to DISTRICT for review and comment. After DISTRICT approval, present draft agreement to Cooperator and assist DISTRICT in negotiations.

3.3 Present project before city/county commission/council/Cooperator to support staff in obtaining project agreement approval.

3.4 Deliverables:

Draft agreement between DISTRICT and Cooperator.
Attendance at meetings/presentations.

3.5 Decision Process

Pending the successful execution of a cooperative agreement between the DISTRICT and cooperator, the CONTRACTOR will be authorized to proceed to the next task.

Task 4 - Site-specific data collection and preliminary system design.

The approach outlined in Tasks 4 and 5 reflects the desire of the DISTRICT to coordinate with the Florida Department of Environmental Protection (FDEP) in the early stages of the test program development. The exact scope of work activities will vary dependent on specific site characteristics and conditions. The DISTRICT may authorize the CONTRACTOR to combine Task 4 and Task 5 in order to reduce costs, if the likelihood of successful permitting is sufficient to warrant the additional expenditure.

4.1 Develop and/or coordinate regulatory strategy for intended ASR permit application.

4.2 Identify agency and permit requirements applicable to site and intended use. Develop checklist of requirements.

4.2.1 Obtain FDEP – Exploratory Well Construction and Testing Permit if required. This would become one of the required monitor wells for operation. If required to enter the Underground Injection Control (UIC) permit program, then the CONTRACTOR will submit an application for the Exploratory Well Construction and Testing Permit with the appropriate information required. Such information will include, but may not be limited to, (1) a conceptual plan of the project, (2) a preliminary area of review study, (3) proposed other uses of exploratory well, (4) drilling and testing plan for the exploratory well, and (5) an abandonment plan, if needed. If it is determined that sufficient information exists at the site to omit Task 4, then the scope will follow the tasks outlined in Task 5 – ASR Pilot Project Design.

4.3 Construct test well and obtain site-specific hydrogeologic data. The DISTRICT may elect to self-perform this sub-task. The obtained data shall include:

4.3.1 Analysis of well cuttings.

4.3.2 Geophysical logging

4.3.3 Water quality

4.3.4 Cores and/or packer tests

4.3.5 Step drawdown test

4.4 Perform compatibility analysis that includes core analysis, geochemical compatibility analysis and modeling, and analysis that considers both the test water and alternative source waters.

4.5 Perform analyses to establish pre-treatment requirements of potential sources of recharge water.

4.6 Revised impact analysis (2.1.5), which may include preliminary hydraulic modeling.

4.7 Deliverables:

Draft and final Technical memorandum including the results of the testing program, a revised feasibility analysis (based on site-specific data), preliminary ASR system design, and revised cost estimate. The draft will be peer reviewed by other DISTRICT CONTRACTORs, the DISTRICT, and the cooperator.

4.8 Decision Process

Determination and recommendation by CONTRACTOR, peer reviewed by other teams, on whether project should proceed based on test results.

Pending the results of the collaborative CONTRACTOR peer review, a recommendation of the project feasibility and the appropriateness of continuing the project will be determined. A decision by DISTRICT whether or not to proceed to next task will be made and subsequent task costs may be negotiated.

Task 5 - ASR Pilot Project Design

5.1 Develop ASR and monitor well drilling and testing program (including all coring, packer testing, logging, laboratory analyses, special procedures etc.).

5.2 Finalize siting issues and design ASR and monitor wells (allowing for variations in geologic conditions).

5.3 Develop drilling and testing fluid management program.

5.4 Design surface facilities for pumping, pretreatment, post recovery treatment etc.

5.5 Develop cyclical testing and operational program.

5.6 Develop monitoring program.

5.7 Deliverables:

Well construction and testing program for the monitor/exploration well(s) and ASR well; designs for surface facilities; and operational and monitoring program. This information may be used in the permitting documents.)

5.8 Decision Process

Upon delivery by CONTRACTOR of program documents, review and comment will be conducted by FDEP and it will be peer reviewed by other DISTRICT CONTRACTOR teams.

Upon completion of a monitoring program that is satisfactory to FDEP, the DISTRICT will make a decision on whether to proceed with regulatory permitting.

Task 6 - Regulatory Permitting

6.1 Prepare permit applications with appropriate supporting documentation. Respond to requests for information.

6.2 Coordinate with appropriate agencies and gain approval for disposal of pumped water used in testing, and supply other information as required.

6.3 Deliverables

Permit applications.
Responses to request for additional information.
Permits.

6.4 Decision Process:

Pending successful issuance of FDEP UIC permit and the ability to move the project forward in a timely manner, a decision by DISTRICT whether or not to proceed to next task will be made and subsequent task cost may be negotiated.

Task 7 - ASR Facilities Construction, Monitoring and Testing

7.1 Construct ASR well and monitoring wells, and/or provides resident observation and construction services, depending upon the project delivery approach selected for each site. The DISTRICT may elect to self-perform the well construction portion of this sub-task.

7.2 Construct surface facilities, and/or provide resident observation and construction services, depending upon the project delivery approach selected for each site.

7.3 Prepare well completion report.

7.4 Implement monitoring plan, including sampling and laboratory analysis in accordance with FDEP-approved Comprehensive Quality Assurance Plan.

7.5 Perform field activities including geophysical logging, packer tests, coring and core analysis, specific capacity tests, well acidization, step pumping and step injection tests, and aquifer performance test as applicable on ASR and monitoring wells during well construction. The DISTRICT may elect to self-perform this sub-task.

7.6 Perform short-term "calibration cycle" recharge, storage, and recovery testing on ASR system. Provide start-up of operations, troubleshooting, and verification of treatment equipment operation, injected water quality. Evaluate well performance and potential needs for system adjustments.

7.7 Confirm/evaluate geochemical compatibility of proposed source water with native water and geologic formation.

7.7.1 Geochemical compatibility analysis should include core analysis, geochemical analysis and modeling in conjunction with alternative source waters.

7.8 Evaluate treatment requirements of recharged water and recovered water after withdrawal from ASR well and make adjustments as necessary.

7.9 Evaluate well performance with respect to recovery from first cycle and compare to earlier predictions. Calibrate ASR performance model to predict performance of future cycles.

7.10 Prepare final report on hydrology, geology, well performance, cycle testing and impacts in conformance with federal, state, and local permits.

7.11 Prepare operations and maintenance manual, and record drawings for well and wellhead construction.

7.12 Deliverables:

7.12.1 Constructed facilities.
7.12.2 Well completion report.
7.12.3 Monthly Progress Reports for testing and monitoring results.
7.12.4 Final report describing: Monitoring and facility test results (monitoring and testing data provided as appendices).
7.12.5 Long-term monitoring requirements.

7.13 Decision Process:

Pending successful construction and demonstration that the test ASR facilities are functional and capable of enhancing cooperator's operations, and any outstanding permitting issues have been addressed to the appropriate commenting agencies, the DISTRICT will make a decision whether to proceed with Task 8.

Task 8 - Start-up and Training

8.1 Provide start-up services to assist with initial operations, monitoring, data reporting, and operational adjustments, as needed.

8.2 Provide training to Cooperator staff responsible for future operation.

8.3 Deliverables:

Training programs for Cooperator staff.

8.4 Decision Process

Pending the CONTRACTOR's recommendation as to whether or not the cooperator is capable of operating and monitoring the test ASR facility in order perform the large cycle testing, a decision by DISTRICT whether or not to cooperate in large-cycle operational monitoring and evaluations will be made.

Task 9 - Large Cycle Operational Monitoring and Evaluations

9.1 Oversee operation and monitoring of operational cycles as needed (preferably 2 years or 3 large cycles). Operational monitoring should encompass a minimum of 2 large cycles. Large cycle is defined as one design cycle.

9.2 Prepare performance report for each cycle with analysis of well behavior and outline any issues that could jeopardize or improve injection process.

9.3 Address significant differences between predicted and actual recovery and make appropriate calibrations to the operational performance model. Indicate actions that might be taken to improve the system operation and performance.

9.4 Deliverables:

Assessment report on system performance.

9.5 Decision Process

Deliverables only.

Task 10 - Peer review of other ASR CONTRACTOR teamwork as determined by DISTRICT.

10.1 As directed by DISTRICT, CONTRACTOR shall review work product of other ASR CONTRACTOR teams and provide comments to DISTRICT.

10.2 Deliverables:

Review comments in letter format.

10.3 Decision Process:

None – Deliverables only.

APPENDIX B
MOU

APPROVED
ORANGE COUNTY BOARD
COUNTY COMMISSIONERS
Y 0 4 2004 AA BS

Contract #SH307AA

MEMORANDUM OF UNDERSTANDING BETWEEN THE ST. JOHNS RIVER WATER MANAGEMENT DISTRICT AND ORANGE COUNTY, FLORIDA FOR AQUIFER STORAGE AND RECOVERY CONSTRUCTION AND TESTING

THIS MEMORANDUM OF UNDERSTANDING ("MOU") is made and entered into by and between the St. Johns River Water Management District (the "District"), whose mailing address is Post Office Box 1429, Palatka, Florida 32178-1429, and ORANGE COUNTY, FLORIDA, (the "County"), whose address is 201 South Rosalind Avenue, Orlando, Florida 32802.

WITNESSETH:

WHEREAS, the parties to this MOU desire to design, permit, and construct an Aquifer Storage and Recovery ("ASR") system ("Project");

WHEREAS, the District and the County each have programmatic authority and established funding sources to cost-share this project;

WHEREAS, a goal of the Project is to demonstrate that ASR is a feasible technology for utilities in the east-Central Florida region; and

WHEREAS, the District and the County agree the District shall serve as the lead agency for the design, permitting, construction, and testing of the ASR project.

NOW THEREFORE, in consideration of the foregoing premises, which are made a part of this Memorandum of Understanding, the District and the County hereby agree to the following:

SANDRA L. BERTRAM, CLERK OF THE ST. JOHNS RIVER WATER MANAGEMENT DISTRICT, HEREBY CERTIFIES THIS TO BE A TRUE AND CORRECT COPY OF THE DOCUMENT NOW OF RECORD IN THIS OFFICE. WITNESS MY HAND AND SEAL THIS 24th DAY OF MAY, 2004

BY Sandra L Bertram

CLERK/~~ASSISTANT DISTRICT CLERK~~

I. AUTHORITY:

This Memorandum of Understanding is entered into by the parties under the following authority:

A. The District enters into this Memorandum of Understanding under the authority of Section 373.083, Florida Statutes, which authorizes the Governing Board to enter into agreements with other public agencies to accomplish the directives and goals of Chapter 373.

B. The County enters into this Memorandum of Understanding under the authority of Sections 125.01(1)(k)1, and 125.01(1)(p), Florida Statutes, which authorize the County to enter into agreements with other public agencies to accomplish goals for providing water to its customers.

II. STATEMENT OF WORK:

All work shall be performed in accordance with Exhibit "A", Statement of Work. All work shall be performed by the District's Contractor under District Contract #SF410RA.

III. EFFECTIVE DATE, TERM, AMENDMENTS, TERMINATION:

A. This MOU shall commence on the date of full execution as evidenced by the last date this MOU is signed, and shall remain in effect for five (5) years, in accordance with this MOU.

B. This MOU shall be reviewed annually by the parties and may be amended upon mutual agreement of the parties. Amendments shall be in writing and approved by all parties.

C. This MOU may be terminated by either party at any time upon thirty (30) days written notice to the other party, provided however, that such termination shall not relieve either party of its obligation to pay, through the date of notice of termination, its respective cost-share amount for ongoing projects or programs for which it has advanced or committed funds. The County's obligation to pay is subject to the approval of the County's annual budget. The District's obligation to pay is subject to the approval of Florida Forever funding and the annual budget by the District's Governing Board.

IV. FUNDING OF THE AQUIFER STORAGE AND RECOVERY COST-SHARE PROGRAM:

A. The District agrees to fund the ASR Project as set forth in Exhibit "A," Statement of Work. The District's contribution is contingent upon and subject to annual budget approval by the District's Governing Board.

B. The County agrees to contribute to the Aquifer Storage and Recovery project in the manner and the amount described in Exhibit "A," Statement of Work. The County's contribution is contingent upon and subject to annual appropriation by the County's Board of County Commissioners.

V. LIABILITY AND INSURANCE:

Both the District and the County:

A. Are responsible for all personal injury and property damage attributable to the negligent acts or omissions of that party and the officers and employees acting within the scope of their employment. In addition, each party is subject to the provisions of Section 768.28, Florida Statutes. Neither this provision nor any other in this MOU shall be construed as a waiver of sovereign immunity by either party.

B. Both the District and the County shall acquire and maintain throughout the term of this MOU such general liability insurance, automobile insurance, and workers' compensation insurance as required by their current rules and regulations.

C. District agrees that all contracts and subcontracts for any construction work described in the Statement of Work shall include hold harmless and indemnification provisions to protect the County and the District in a form acceptable to the County and the District. The District contractor or subcontractor shall provide the County with evidence of said hold harmless and indemnity prior to commencement of work and access to County property.

VI. PROJECT MANAGEMENT:

A. Project Managers - Each party hereby designates the employee set forth below as its respective Project Manager. Project Managers shall assist with project coordination and shall be the party's primary contact person. Notices or reports shall be sent to the attention of the parties' Project Manager by U.S. Mail, postage prepaid, to the parties' addresses as follows:

For the District:
Douglas Munch, P.G.
4049 Reid Street
Palatka, FL 32177
Tel: (386) 329-4173

For the County:
Robert Teegarden, P.E.
Orange County Utilities Engineering
109 East Church Street, 3rd Floor
Orlando, FL 32802
Tel: (407) 836-7240

B. Either party may designate a new Project Manager at its discretion. Written notification of the new Project Manager and effective date shall be provided to the other party.

C. At a minimum, the District's Project Manager shall consult with the County's Project Manager prior to initiating each task. The District's Project Manager shall provide County's Project Manager a report as to the status of each task on a monthly basis. The District's Project Manager shall notify County's Project Manager of the completion of each task within 30 calendar days of the completion of each task.

VII. OWNERSHIP OF DOCUMENTS:

A. Ownership and copyright to all reports and all accompanying data (in all formats) produced pursuant to work done under this MOU shall be vested in both parties to this MOU. Any source documents or any other documents or materials developed, secured or used in the performance of this MOU shall be considered property of the District and the County.

B. All permits shall be in the name of the District. The District shall provide a copy of all permits, as well as design and construction plans, to the County's Project Manager. At the expiration or termination of the project, at the request of the County, the District shall transfer to the County all permits.

Remainder of page intentionally left blank

IN WITNESS WHEREOF, the following authorized representative of the ST. JOHNS RIVER WATER MANAGEMENT DISTRICT and ORANGE COUNTY have executed this Memorandum of Understanding on the date signed by each party.

ST. JOHNS RIVER WATER
MANAGEMENT DISTRICT

By:
Kirby B. Green, III
Executive Director

Date: 24 May 04

ORANGE COUNTY
By: Board of County Commissioners

By:
for Richard T. Crotty
County Chairman

Date: 5. 4. 2004

ATTEST: Martha O. Haynie, County Comptroller
As Clerk of the Board of County Commissioners

By:
Deputy Clerk

APPROVED BY THE OFFICE OF GENERAL COUNSEL

Stanley J. Niego, Sr. Assistant General Counsel

EXHIBIT A

ST JOHNS RIVER WATER MANAGEMENT District / ORANGE COUNTY AQUIFER STORAGE AND RECOVERY CONSTRUCTION AND TESTING DEMONSTRATION PROGRAM

STATEMENT OF WORK

INTRODUCTION/BACKGROUND

Project Definition - The St. Johns River Water Management District (the "District") and Orange County (the "County") shall jointly endeavor to design, permit, and construct a Floridan Aquifer Storage and Recovery ("ASR") system, consisting of an exploratory well, monitoring wells, ASR test well, site work, and related pipelines and appurtenances, all defined to be part of the Project.

Project Need – Determine the feasibility of ASR for storing and recovering seasonally available large volumes of alternative water supplies to offset the use of potable groundwater in east Central Florida.

Memorandum of Understanding's Goals – Demonstrate the feasibility of ASR technology for utilities in the east Central Florida region. The District seeks to complete this cooperative project with the County and shall require the District's contractor, Barnes, Ferland and Associates, Inc., to prepare the design of the Project in accordance with the requirements of regulatory agencies, the County, and the District and to permit and construct the system in accordance with such design.

Consistency With District's Mission And Goals – This project is included in the Water Resource Development Work Program, dated November 7, 2002, as required by Section 373.536(6)(a) 4, Florida Statutes. The design shall be consistent with the District's report entitled "Desktop Assessment of Aquifer Storage Recovery for Orange County, Florida", prepared by Barnes, Ferland and Associates, Inc, and dated March, 2003.

Location Of The Work – The Project shall be located at the County's Eastern Water Reclamation Facility (EWRF) on 1621 S. Alafaya Trail in Orange County, Florida, or a different site if mutually agreed upon by both parties.

OBJECTIVES

Statements Of The Results To Be Achieved – The Project shall be implemented with design features approved by the District and the County, in sequential order to provide for maximum benefit of expended funds. Sequential progress shall be based on exploration, permitting, and construction. The ASR test well shall be drilled in accordance with Florida Department of Environmental Protection ("FDEP") Underground Injection Control ("UIC") requirements, and successfully cycle-tested with potable water, to demonstrate feasibility for water storage and recovery.

SCOPE OF WORK

Outline Of Work

Note: Tasks 1 and 2 are included herein as reference only, as these tasks have been completed prior to the issuance of this Agreement. Task 3 will be completed with execution of this Memorandum of Understanding.

Task 1	Report titled "District Aquifer Storage and Recovery Construction and Testing P Program Plan- FY2002", April 2002, prepared by Barnes Ferland & Associates, Inc.
Task 2	Report titled "Desktop Assessment of Aquifer Storage Recovery for Orange County, Florida, Contract #SF410RA", March 2003, prepared by Barnes Ferland & Associates, Inc.
Task 3	Preparation and approval of a County Memorandum of Understanding (MOU) and Statement of Work ("SOW")
Task 4	Site-Specific Data Collection and Preliminary System Design
Task 5	ASR Pilot Project Design
Task 6	Regulatory Permitting
Task 7	ASR Facilities Construction, Monitoring, and Testing
Task 8	Startup and Training
Task 9	Large Cycle Operational Monitoring and Evaluations
Task 10	Peer Review

Overview Of The Steps Of Project

The District shall prepare a preliminary design plan for the ASR system, including an exploratory well. Based on the results of the exploratory well, final design of the ASR system shall be conducted in compliance with FDEP UIC permitting requirements. Once the design and permit are approved, the District shall begin construction of the ASR Test Well and related appurtenances. After completion of drilling and verification of project requirements, cycle testing shall be performed by the District to measure storage and recovery. If at any time the project is deemed infeasible, the District shall coordinate with the County the salvage of any constructed wells for monitoring or other purposes, or the District shall provide abandonment and decommissioning services, as required. Upon successful demonstration of feasibility, as mutually agreed on by District and County, the completed project shall be transferred to the County for operation and ownership, including any transfer of the existing UIC permit that may be required, at no cost to the County.

Description Of The Methodology To Be Used

The District shall utilize methodologies accepted in the professional practices of engineering and geology. Methodologies shall incorporate FDEP UIC permitting requirements and provide sufficient milestones for review, comment, and approval by the District and the County. Construction methods shall be in accordance with the General Conditions provided for in District Contract #SF410RA, incorporated herein by reference (Attachment "B"), including compliance with County local codes and requirements.

Location Of Work - The project shall be located at the County's EWRF located at 1621 S. Alafaya Trail in Orange County, Florida. The exact project location at the EWRF site shall be determined based on preliminary design and coordinated with the location of potable source water and discharge facilities. The proposed potable water supply is the County's 36" water transmission main located in the Curry Ford Road right-of-way. The proposed recovered water discharge is to wetlands located on the EWRF site. The ASR system shall accommodate elements of existing and planned improvements at the EWRF.

TASK IDENTIFICATION

The following Tasks 4 through 10 are summarized from the District's ASR Construction and Testing Demonstration Program Plan. These tasks shall be performed under separate agreements, authorized and approved by work-orders issued by District to its contractor prior to beginning each individual task, or group of tasks.

Task 4 — Site-Specific Data Collection and Preliminary System Design

Prepare a data collection plan for the project site based on a review of existing information and coordination with FDEP. In particular, the plan shall address the need for initial exploratory testing as the basis of development of ASR well design.

To the extent possible based on FDEP guidelines, the District proposes to gather hydrogeologic information from the construction and testing of an initial exploratory well at the project site, which would then be converted to an observation well for the ASR well construction and testing program. The data collection plan shall be implemented, the data shall be evaluated, and a preliminary system design shall be developed. The County shall provide a license agreement granting the District access to project site for exploration well drilling and data collection. If the site is deemed to be infeasible for any reason, the District and the County shall endeavor to locate an alternative site for the ASR well construction and testing program, through mutual agreement by both parties.

Task 5 — ASR Pilot Project Design

This task includes the design of well and wellhead facilities at the selected site, including supporting infrastructure such as pipelines, electrical service, and incidental site work. The design shall also specify the proposed data collection and monitoring programs. The County shall be provided with design documents for review, comments and approval prior to completion of this task.

Task 6 — Regulatory Permitting

The District and the County shall adhere to regulatory permitting requirements, including submittal of permit applications, and responses to requests for information from regulatory agencies. The primary permitting effort shall be through the FDEP UIC program. District shall provide services to support the cost of preparation of: a) Well Construction permit applications, b) local government permit applications, as required, c) FDEP UIC permit application, d) District Consumptive Use Permit application for testing water, e) FDEP Drinking Water System extension permit application, f) NPDES storm water discharge permit application if required, f) other FDEP water system permits, if required, and g) project reports.

The District shall be responsible for site improvements when required for the project, which shall be mutually agreed upon by the parties. The County shall be responsible for processing and resolving any zoning or land use issues that may arise with regard to the Project. The County shall be the Owner for well construction, FDEP UIC, FDEP water main extension construction and any other project-related permit applications. The District shall act as the County's agent, by preparing applications on behalf of the County, for any permit-related issues and pay application fees.

Task 7 — ASR Facilities Construction, Monitoring, and Testing

The District shall provide for the construction of an ASR well and monitor wells, associated pipelines, electrical service, incidental site work, and wellhead facilities. Pipeline work by District shall be limited to 1) a connection between the ASR wellhead and the nearest potable water transmission main and 2) a discharge line from the ASR wellhead to nearby wetland or acceptable land area at the project site. The electrical work by District shall be limited to the secondary service line connecting the ASR well pump motor to the point of termination of primary power brought to the project site by the County. The District shall also conduct initial hydraulic and water quality testing, in addition to geophysical logging, geochemical modeling, and evaluation of any additional pretreatment requirements. A series of ASR "small cycle" test cycles shall be conducted to evaluate the project site.

The District shall provide for a survey that shall stake and define the boundaries of construction within the EWRF as it is defined by EWRF boundary survey documents furnished by the County. The District shall be responsible for construction, inspection, testing, and progress reporting for the Project. The County shall allow the District and/or its agents full Project site access to conduct and inspect construction of the Project. The County shall alert the District of any known problems and the District, when appropriate, shall require its Contractor to correct any problems or non-conforming work discovered by District inspection or the County's observation.

Task 8 — Startup and Training

The District shall provide operational training of County staff to ensure a smooth transition from the ASR test program into full ASR operations. The final training plan shall be developed subsequent to analysis of the small cycle testing program results.

Task 9 — Large Cycle Operational Monitoring and Evaluations

Conduct operational monitoring and evaluation of ASR system performance during the first two to three years of operations, making any needed adjustments to improve system performance. The County shall operate the system during this period. The District shall conduct periodic site visits and evaluate collected data to monitor large cycle performance and provide technical assistance to County, as necessary. A preliminary plan outline of County responsibilities for conducting large cycle operation and monitoring is provided in Attachment 1. This plan outline shall be developed further, when permit conditions are known, and Task 9 is implemented, for review and approval by the County and the District.

Special note is made for potential interference with monitoring requirements associated with Orange County's Consumptive Use Permit. The County and District do not believe that the five existing monitor wells (OR-664, OR-665, OR-668, OR-676, AND OR-678) on the EWRF site will be partially or fully interfered with by the operation of the proposed ASR pilot well approximately two (2) miles away. However, in the event of partial or full interference with monitored conditions at these five monitor wells on the EWRF, the County and District shall agree to jointly work, within the scope of this MOU, to resolve any interference with the monitor wells.

Task 10 — Peer Review of District Contractor's Work

This task includes the review of work products, produced for this project by the District contractors and the County.

TIMEFRAMES AND DELIVERABLES

Timeframe For Completion Of Entire Project

Successive task completion without major disruption shall require a minimum of three (3) years, and up to five (5) years for final completion. Specific timeframes shall be established after the District and the County have signed the Memorandum of Understanding (MOU).

District Deliverables and Responsibilities

Deliverables associated with the tasks outlined below shall be furnished by both hard copy and electronic versions. All deliverables shall be provided to the District and the County Project Managers and shall generally include the following items, by task. Other elements of the project may be added as mutually agreed upon by both parties in writing.

Task 4, Site-Specific Data Collection and Preliminary System Design: As defined in the work(s) order, to include the following.

- Data Collection Plan
- Preliminary Design Report
    - Exploratory Well Construction Plan
    - Exploratory Well Construction Specifications
    - Exploratory Well Contractor's Safety Plan
    - Exploratory Well Construction Schedule
    - Exploratory Well Sampling and Testing Plan
- Exploratory Well Construction Permit Application
- Well Salvage Plans for Monitoring, or Abandonment if Site is Infeasible
- Completed Exploratory Well
- Water Quality Sampling and Testing
- Exploratory Well Project Report
- Construction security plan, including access provisions, work hours and construction site security facilities. Plan must be approved by the County prior to any construction activities commencing.
- Project Schedule

Task 5, ASR Pilot Project Design: As defined in the work order(s), to include the following.

- ASR System Construction Plans
- ASR System Construction Specifications
- ASR System Construction Cost Estimate
- ASR System Construction Phase Services Plan
- ASR System Contractor's Safety Plan
- ASR System Construction Schedule
- ASR System Final Project Report

Task 6, Regulatory Permitting: District to pay for all permit application fees. One or more of the following deliverables shall apply to the project, as required:

- Well Construction Permit Application(s)
- Local Government Permit Application(s)
- FDEP Underground Injection Control (UIC) Permit Application
- Consumptive Use Permit (CUP) Application For Testing Water
- FDEP Drinking Water System Extension Permit Application
- NPDES Storm Water Discharge Permit Application
- Other FDEP Water System Permit(s)
- Permitting Condition Progress Report(s)
- Permitting Condition Sampling And Testing Report(s)

Task 7, ASR Facilities Construction, Monitoring, and Testing: As defined in the work order(s), to include the following.

- Payment and Performance Bond
- Construction Survey Layout and Control
- Shop Drawings
- Updated ASR System Contractor's Safety Plan
- Updated ASR System Construction Schedule
- Monthly ASR System Project Progress Reports
- Laboratory Reports
- Well Testing Discharge Plan
- Initial (start-up) cycle testing
- Construction Inspection and Testing Records
- Completed ASR System
- Site Restoration
- Construction Record Drawings
- Certifications of Completion
- Releases for Final Payment
- Final Construction Report
- Startup and Training Plan

Task 8, Startup and Training: As defined in the work order(s), to include the following.

- Operation and Maintenance Manuals
- Training Instruction
- Operating Guidelines
- Large Cycle Operation and Monitoring Plan
  (Preliminary plan provided as Attachment A)

Task 9, Large Cycle Operational Monitoring and Evaluations: Large Cycle Evaluation Reports as defined in the work order(s). The District shall provide technical oversight and assistance as required during this task.

Task 10, Peer Review: As defined in the work order(s).

COUNTY Deliverables and Responsibilities

The County shall deliver the following items and "like kind services" through staff and ongoing operations, according to the time they are needed as jointly determined by the County and the District during the course of the work:

1. Provide project site and associated access for the Project. As necessary, provide evidence of ownership or easements providing access and control of facilities expected to be installed on the property.
2. Timely review and provide comments on District submittals.
3. Execution of permit applications, as property owner.
4. Provide relevant records pertaining to, or affecting, the Project which may consist of, but not be limited to, survey data and legal descriptions, easement documents, soils data, water facilities record drawings, site plans, right of way use requirements, and other technical information pertaining to the planning, design, and construction of the ASR facility at the proposed Project site.
5. Unique construction requirements not covered under local permits or codes, such as site lighting requirements, site access constraints, other, and any limitations on construction activities.
6. Electrical power service to the site, as required during Task 7 described above, including offsite extensions, material purchases, new equipment, lighting, metering, and individual well service connections, in accordance with local power company requirements. Shall also provide SCADA equipment (i.e., SCADA programmed panel, antenna) to be installed by District at Project site. The not-to-exceed capital cost to the County is $120,000 for the furnishing of labor, equipment, and materials to install the electrical service and provision of the SCADA equipment.

7. Water quality sampling and testing during large cycle operation phase of Project, as required during Task 9 described above, after the County assumes ownership of project. The not-to-exceed cost to the County is $100,000 for this water quality sampling and testing. This analytical work shall be consistent with regulatory agency permitting and monitoring requirements. For estimated testing parameters, see Table 1 ASR Large Cycle Water Quality Testing Plan in Attachment 1.
8. Information regarding features and items that are required to comply with zoning and land development codes.
9. Necessary testing water, permission to use recovered water discharge purposes, and appurtenant operational requirements for the Project, including necessary coordination and related services from the County's staff. If the County does not have an adequate allocation of water under existing consumptive use permits for the cycle testing, then the District shall be responsible for preparing the permit application necessary for the District review and approval of a separate (or additional) allocation of water sufficient for this purpose.
10. Accept responsibility for operation and maintenance of completed project. Agrees to assume total responsibility of ownership for continued operation, maintenance, and data collection for the ASR facilities following completion of the project, in perpetuity, but reserves the right to re-permit, modify, abandon, or decommission the Project in accordance with applicable rules and regulations.

Comment And Review Time

Major milestone submittals defined in the work orders shall generally include four (4) weeks for review and comment by the District and the County. Review and comment for lesser submittals may be reduced to three (3) weeks, as mutually agreed.

Construction-phase data that must be reviewed and approved in a shorter timeframe to facilitate construction activities shall be specified in the work order or determined by the District's Project Manager, and agreed to by the County.

District shall compile all review comments for mutual resolution and action within the Scope of Work.

CONTRACT BUDGET

The District shall be responsible for all costs of the Project with the exception of capital costs listed below and in-kind services as described in this Statement of Work. The estimated cost for the District's Contractor to implement the Project is within the cost range estimated in District report entitled "Desktop Assessment of Aquifer Storage Recovery for Orange County, Florida", prepared by Barnes, Ferland and Associates, Inc., and dated March, 2003.

The County shall be responsible for its portion of the costs for the Project, as defined in the County Deliverables and Responsibilities section of this Statement of Work.

The District and the County estimated project capital costs are as follows:

District Work for Task 4 - 10 Using Current Florida Forever Funding	$ 2,384,000
County Capital-related Cost Items:	
Task 7, Electrical Service and SCADA equipment	$ 120,000
Task 9, Water Quality Sampling and Analysis	$ 100,000
Sub Total County	$ 220,000
TOTAL DISTRICT AND COUNTY	$ 2,604,000

ATTACHMENT 1

District / ORANGE COUNTY
AQUIFER STORAGE AND RECOVERY
CONSTRUCTION AND TESTING DEMONSTRATION PROGRAM

PRELIMINARY OUTLINE FOR LARGE CYCLE TESTING PLAN

BASIS OF PLAN:

ASR Well:	1 to 5MGD Capacity
Monitoring Wells:	1 Background, 2 Down Gradient
Cycle:	90 Days Storage 90 Days Dormant 90 Days Recovery 2 Cycles to be tested (270 Days/ Cycle)

COUNTY OPERATIONAL REQUIREMENTS:

1. During well operation (Storage & Recovery Phases):

   a. Daily inspections and routine maintenance of mechanical equipment and instrumentation.

   b. Daily Recording of:

      - Well Head Pressure *
      - Water Level at ASR and Monitoring Wells *
      - Flow (Storage or Recovery)*
      - Operation of Valves and Well Pump as necessary for storage or recovery

        *These functions may be performed with continuous read instrumentation.

2. Flow meter annual calibration

3. Instrument calibration, as required (i.e. water level monitors, pressure monitors, etc)

4. Collection and analysis of water quality samples, See Table 1.

CYCLE OPERATIONAL PLAN:

1. Storage

   a. Open ASR well inlet valve to allow 1-5 MG volume into aquifer over 16-24-hour period.

   b. Shut / throttle inlet valve as required during distribution system peak demand periods.

   c. Record flow, pressure and water levels on daily basis (or continuously, if equipped with instrumentation) for ASR and monitoring wells

   d. Collect water quality samples from storage source water, ASR well, and monitoring wells in accordance with frequency and chemical parameters shown in Table 1.

   e. Back flush ASR well to waste, as necessary, based on storage rate and well head pressure.

2. Dormant Phase

   a. Collect water quality samples and water levels from ASR well and monitoring wells – See Table 1 for frequency and chemical Parameters.

   b. Periodic inspection of well equipment.

3. Recovery

   a. Open ASR discharge valve; Operate pump to discharge 1- 5MGD on daily basis.

   b. Record flow, pressure and water levels from ASR and monitoring wells.

   c. Collect water quality samples from ASR well and monitoring wells – See Table 1.

   d. Close ASR well on daily basis when target recovery volumes achieved.

Table 1. ASR Large Cycle Water Quality Testing Plan

Cycle Phase	No. of Samples	Frequency	Parameters for Storage Source Water	Parameters for ASR Well Ground Water	Monitoring Wells (3)
Storage	2	At start of phase, before storage begins	Primary & Secondary Drinking Water Standards, pH, temp,D.O., Eh, Specific Conductance, Ca, Mg, K, Si, HCO_3, Total/non-carbonate/calcium hardness, Phosphate, Ammonia, H_2S, TOC, U.	Primary & Secondary Drinking Water Standards, pH, temp,D.O., Eh, Specific Conductance, Ca, Mg, K, Si, HCO_3, Total/non-carbonate/calcium hardness, Phosphate, Ammonia, H_2S, TOC, U.	
	60	Storage source water and ASR ground water-Daily for 1st 30 Days.	Cl, F, SO4, TDS,pH, Temp., D.O., Eh, Specific Conductance	Cl, F, SO4, TDS,pH, Temp., D.O., Eh, Specific Conductance	
	20	Every 3 Days for Days 31-60			
	8	Weekly for Days 61-90			
	4	Monthly	Na, Ca, Mn, Fe, Mg, Sr, K, Al, Si, Cu, Zn, Cd, Se, As, HCO3, Total/non-carbonate/calcium hardness, Phosphate, Ammonia, H2S, TOC, THM Species.	Na, Ca, Mn, Fe, Mg, Sr, K, Al, Si, Cu, Zn, Cd, Se, As, HCO3, Total/non-carbonate/calcium hardness, Phosphate, Ammonia, H2S, TOC, THM Species.	
	39	Weekly			Cl, F, SO4, TDS,pH, Temp., D.O., Eh, Specific Conductance
Dormant	1	At Day 45 of Dormant Phase		Primary & Secondary Drinking Water Standards, temp,D.O., Eh, Specific Conductance, Ca, Mg, K, Si, HCO3, Total/non-carbonate/calcium hardness, Phosphate, Ammonia, H2S, TOC, U.	
	2	Monthly		Cl, F, SO4, TDS,pH, Temp., D.O., Eh, Specific Conductance	
	6	Monthly			Cl, F, SO4, TDS,pH, Temp., D.O., Eh, Specific Conductance

Cycle Phase	No. of Samples	Frequency	Parameters for Storage Source Water	Parameters for ASR Well Ground Water	Monitoring Wells (3)
Recovery	1	At start of phase, before recovery begins		Primary & Secondary Drinking Water Standards, pH, temp,D.O., Eh, Specific Conductance, Ca, Mg, K, Si, HCO_3, Total/non-carbonate/calcium hardness, Phosphate, Ammonia, H_2S, TOC, U.	Cl, F, SO4, TDS,pH, Temp., D.O., Eh, Specific Conductance
	30	ASR ground water- Daily for 1st 30 Days.		Cl, F, SO4, TDS,pH, Temp., D.O., Eh, Specific Conductance	
	10	Every 3 Days for Days 31-60			
	4	Weekly for Days 61-90			
	2	Monthly		Na, Ca, Mn, Fe, Mg, Sr, K, Al, Si, Cu, Zn, Cd, Se, As, HCO3, Total/non-carbonate/calcium hardness, Phosphate, Ammonia, H2S, TOC, THM Species.	
	39	Weekly			Cl, F, SO4, TDS,pH, Temp., D.O., Eh, Specific Conductance

ORANGE COUNTY GOVERNMENT
FLORIDA

Interoffice Memorandum

APPROVED
BY ORANGE COUNTY BOARD
OF COUNTY COMMISSIONERS
MAY 0 4 2004 A4/BS

April 19, 2004

TO: Richard T. Crotty, Chairman
and
Board of County Commissioners

FROM: Michael L. Chandler, Director MLC
Utilities Department

SUBJECT: BCC Agenda Item – Consent Agenda
May 4, 2004, BCC Meeting
Approval of Memorandum of Understanding Between the St. Johns River Water Management District and Orange County, Florida for Aquifer Storage and Recovery Construction and Testing
Contact: Rob Teegarden, P. E., Chief Engineer
Engineering Division
(407) 386-7240

Orange County Utilities Department and the St. Johns River Water Management District (SJRWMD) propose to jointly fund a project to investigate the feasibility of an aquifer storage recovery (ASR) well for potable water storage in eastern Orange County. The Eastern Regional Water Reclamation Facility is the proposed project location. ASR wells are used in many other areas of Florida to provide low cost, reliable potable water storage.

The total cost of the project is \$2.6 million. The SJRWMD portion of the cost is \$2,348,000 for planning, permitting, design and construction of the well. The Utilities Department share of the cost is \$220,000 for power and water quality sampling/analysis. The Utilities Department is also responsible for providing the project site and access for project personnel. At the conclusion of the project, the Utilities Department will own the ASR well. The work will be completed in approximately three to five years.

Orange County Attorney's Office staff has reviewed and approved the attached memorandum of understanding as to form. Utilities Department staff has reviewed the agreement and recommends approval.

Action Requested: **Approval of the Memorandum of Understanding between the St. Johns River Water Management District and Orange County, Florida, for Aquifer Storage and Recovery Construction and Testing.**

District 4.

APPENDIX C
Conceptual Expansion Plan

Technical Memorandum

Orange County Utilities Aquifer Storage Recovery (ASR) Demonstration Program Preliminary Expansion Plan for ASR Wellfield at Eastern Water Reclamation Facility

Prepared by ASR Systems LLC and Barnes, Ferland and Associates, Inc.

Background and Purpose

Orange County Utilities (OCU) and the St. Johns River Water Management District (SJRWMD) are working together on as Aquifer Storage and Recovery (ASR) Program to examine the appropriateness of integrating ASR technology into regional water resource and water supply development projects. The primary ASR objective for the County is to develop a water management technique that can be used to help meet projected deficits through seasonal and long-term storage and recovery of water. An exploratory well was constructed and tested at OCU's Eastern Water Reclamation Facility (EWRF) resulting in favorable conditions to further implement an ASR pilot system. The ASR test and monitor wells are currently under construction and cycle testing is targeted to begin during 2009.

Assuming that the planned ASR pilot system at the EWRF is deemed a success, OCU may expand the facilities from one ASR well to an ASR wellfield, storing treated drinking water imported from a new surface water source, such as the St Johns River / Taylor Creek Reservoir and/or the County's existing potable water transmission system. This technical memorandum (TM) is intended to provide a conceptual layout of such a wellfield and to address some of the issues that would need to be addressed for its development. The expansion plan should be updated periodically to reflect evolving regional water supply needs, opportunities and constraints.

This project will be designed, permitted and built for potable ASR and is the focus of this TM expansion plan. In addition to potable water, non potable water sources (such as reclaimed or stormwater) may be considered if high level (membrane) treatment to full treatment standards is applied (Chapter 62-610.563(3). The County has a separate option to prepare and submit a Major Permit Modification to FDEP for the Underground Injection Control (UIC) Permit to utilize a non-potable source of injection water.

Basis of Design

The basis of design for the ASR wellfield expansion will largely depend on the following *estimated* needs and quantities:

- Future 2030 OCU service area water needs (49.6 mgd);
- Floridan aquifer system ASR constraints/limitations at EWRF (>50 mgd);
- Quantities of potable water from potential alternative surface water sources;
    - -SJR/TCR Water Supply Project (40 mgd)
    - -SJR near SR 50 Water Supply Project (10 mgd)
    - -SJR near SR 46 Water Supply Project (63.13 mgd)
    - -SJR near Yankee Lake Water Supply Project (86.33 mgd)
    - - Lake Hart and Mary Jane Water Supply Project (7 mgd)

SOURCES: SJRWMD Water Supply Projections by Richard Dotty
May 13, 2008 Third Addendum of the District Water Supply Plan (Tech. Pub. SJ2006-2C).

ASR wellfield expansion would likely be conducted in several phases. For purposes of this TM, an ultimate capacity up to 50 mgd is envisioned to be available for OCU from a combination of the above alternative surface water sources. This would be the planned recovery rate. Recharge is assumed to occur at rates up to 30 mgd, from the above potential sources. ASR wellfield design capacity would be the greater of either the recharge capacity or the recovery capacity. Potential ultimate capacity from these sources to meet regional water supply needs is not yet known, or the share of that capacity that may be stored at an ASR wellfield at the OCU site. It should be noted that flows could come from any of the sources listed above and it is possible that ASR storage may be distributed at multiple sites, of which the EWRF site would be one.

Water is assumed to be stored during typically several months per year. The stored water would be recovered to help meet peak water demands during droughts of up to four months' duration. Annual average storage and recovery volumes for the ASR wellfield may be in the range of 5 to 6 billion gallons (BG). Cumulative stored water volumes may be significantly larger for a regional water banking operation since successive wet years and successive drought years will cause greater variability in stored water volumes.

During wet years recharge may continue for possibly up to about ten months. During drought years, recharge may occur for a much shorter period, possibly as short as about three months. The ASR wellfield would therefore operate as a water banking operation, storing more water in wet years and recovering more water in drought years.

Water quality of the recharge water is assumed to meet all drinking water standards. The ambient groundwater is fresh, however it has elevated concentrations of hydrogen sulfide. Concern also exists that arsenic may be present in the storage aquifer and may, under certain conditions, be found in the water recovered from the ASR wells. Based upon extensive Florida ASR experience since 1983, both of these concerns are believed to be easily and cost-effectively addressed through appropriate development and operation of the ASR wellfield.

Conveyance of these flows is assumed to occur via a pipeline from the above listed surface water sources to the EWRF site. This is not the only conveyance option since the aquifer could also be used to convey these flows for a considerable portion of the distance, providing additional storage volume and also salinity intrusion control. However current plans envision pipeline and pumping station conveyance for the full distance.

These assumed flow rates, storage volumes and water quality assumptions comprise the fundamental basis of design for the expanded ASR wellfield. At such time as the ASR Cycle Testing Program is approaching completion, presumably about 2010, it would be appropriate to prepare an ASR Wellfield Expansion Plan, updating this document. The Basis of Design assumes that experience with flow rates, well spacing, water quality and other issues during early phases of ASR expansion will be incorporated into the successful design and operation of subsequent phases.

Existing and Proposed Non-ASR Improvements in the Wellfield Vicinity

OCU is planning to construct a reclaimed water booster station, ground storage reservoirs and associated 30 inch reclaimed water transmission pipeline along the south access road next to the ASR test well, extending to Curry Ford Road. The City of Orlando is planning to construct a 36 inch reclaimed water main along the same general alignment. Location of ASR wellfield facilities so that they do not interfere with either construction or operation of these reclaimed water facilities would be prudent. Ample space exists for the ASR wellfield at the 2,090 acre EWRF site.

Well Design

An exploratory well was drilled and tested to a depth of 1,700 feet at the EWRF. The principal hydrogeologic units encountered are:

Surficial Aquifer System	near land surface to 110'
Intermediate Confining Unit	110' to 200'
Upper Floridan Aquifer	200' to 520'
Middle Semi-Confining Unit	520' to 1,085'
Lower Floridan Aquifer	1,085' to > 1,700'

The selected ASR interval to be tested is between 1,100 to 1,200 feet, and consists of dolomite of the Avon Park formation. Below this test interval the formation materials become very hard and highly fractured. The groundwater quality profile indicates that very fresh water extends to depths of at least 1,100 feet, and the 250 isochlor occurs at about 1,270 feet in the upper part of the Lower Floridan aquifer. Data from water samples while drilling indicate that chloride concentrations exceed 5,000 mg/L by 1,400 feet. Higher salinities coupled with the higher transmissivies at depth precluded consideration of deeper ASR test intervals. The current ASR test well has been designed for water storage in an interval of the Lower Floridan aquifer between 1,100 and 1,200 feet, providing substantial hydraulic separation from the upper Floridan aquifer and also, hopefully, from underlying brackish water found at depths below 1,300 feet.

Additional ASR zones below 1,200 feet are not suitable for consideration; but the entire Upper Floridan aquifer (200-570 feet) may be suitable for freshwater ASR. A favorable combination of transmissivity and porosity may occur in the relatively softer limestone noted in the upper interval, 200 to 370 feet depth. Verification of additional ASR potential at EWRF would require additional drilling and testing of the Upper Floridan aquifer. At the Lake Okeechobee/Paradise Run Site, the South Florida Water Management District is considering a "stacked" well system, with one ASR storage zone completed into the Upper Floridan aquifer and a second storage zone into the middle Floridan aquifer that would produce a higher capacity ASR system. This stacked well field scenario may be considered further in future EWRF expansion plan updates once the viability of ASR at this site has been demonstrated. This approach may substantially reduce the areal extent and cost of the ASR wellfield and may also ease the potential for upconing of brackish water during extended ASR recovery periods.

A confining layer that generally exists between 110 and 200 feet separates the Upper Floridan aquifer from the surficial aquifer. Initial testing of upper Floridan aquifer ASR wells would indicate whether any adverse impact occurs in adjacent wetlands due to ASR recovery operations. If unacceptable adverse impacts are noted, recovery flow rates from the upper Floridan aquifer may be reduced accordingly.

Well Spacing and Arrangement

At this time it is assumed that the ASR well storage zone would only be within the Lower Floridan aquifer at depths of approximately 1,100 to 1,200 feet. Well spacing should be sufficiently close so that the stored water bubble surrounding each of the wells will coalesce, forming an envelope surrounding the entire wellfield. A small buffer zone will need to be formed and maintained so that hydrogen sulfide does not occur in the recovered water. A preliminary estimate of the buffer zone volume is 50 days of recovery at the design recovery rate for each well. Assuming individual well recovery rates ranging between 3 and 5 MGD, the buffer zone volume would be 75 to 125 MG for each well. This is in addition to the volume required for recovery, which is assumed to be sufficient to support recovery for up to 120 days. The associated volume would be 180 to 300 MG. Target Storage Volume (TSV) is the sum of the stored water volume plus the buffer zone volume. TSV for each of the ASR wells would therefore be approximately 255 to 425 MG, depending upon well yield. The TSV is usually measured in days; in this case it is estimated at about 85 days. The stored water volume would be banked for annual recovery, more in dry years and less in wet years.

The buffer zone would be formed initially and then maintained. The buffer zone would not be recovered without incurring the risk of having to retreat the recovered water, other than disinfection. Operational and regulatory constraints will be needed to ensure that the buffer zone volume is not recovered. Alternatively OCU would need to provide standby treatment facilities to retreat the water in the event that the buffer zone is recovered, at which point recovered water quality would tend to approach ambient groundwater quality with elevated concentrations of hydrogen sulfide and possibly elevated concentrations of arsenic.

Further work will be required to establish optimal well spacing, including aquifer modeling. Typically such work is conducted after the initial ASR well has been tested to confirm local aquifer hydraulic characteristics. Based upon typical experience in the central Florida area, a well spacing of 750 feet is recommended as a placeholder. Wells would be most cost-effectively arrayed along a straight line, adjacent to the transmission pipeline (Figure 1).

Until such time as well yields are confirmed, a conservative assessment is that each well will yield 3 MGD. A higher yield of 5 MGD may also be possible, thereby reducing the required number of wells and wellsites. Providing firm recovery capacity of 50 MGD would require construction of 19 wells, allowing for 15% to be out of service during design drought conditions such as due to lightning strikes, mechanical failure or other operational reasons. Total length of the wellfield alignment would be 13,500 feet (2.5 miles).

Distance from County's Public Supply Wells

The closest public supply wells are the OCU Eastern Regional Wellfield which is located 3 to 4 miles to the west within the Upper Floridan aquifer. Regional aquifer modeling will be needed to evaluate the impact of ASR operations upon this wellfield and others at greater distance in East Central Florida. Net impact is expected to be zero since, in the long run, recharge will balance recovery. Also the middle confining unit acts to limit pumping effects between the Upper and Lower Floridan aquifers. However during recharge periods the potentiometric surface will rise and the location of the salt water interface will tend to retreat eastward. To the extent that the Lower Floridan aquifer below a depth of 1,300 feet may be in hydraulic communication with the ASR storage zone, some loss of water may occur to the underlying aquifer however the depth to the top of brackish water will probably remain about the same. During ASR recovery periods the reverse would be true. The regional potentiometric surface will fall; the salt water interface will tend to move westward and, if any hydraulic communication exists with the brackish water portion of the lower Floridan aquifer, upconing may occur.

Under normal conditions a substantial volume of water will be stored in the Floridan aquifer. This may manifest as a slight rise in the regional potentiometric surface and also potentially as a slight eastward and downward movement of the saltwater interface, or at least a reduction of the rate for any westerly movement that may be occurring.

Construction Access

An existing dirt road extends north-south along the west side of the OCU property, connecting to the EWRF and also to Curry Ford Road (Figure 1). Approximately 0.6 miles of this trail would become part of the transmission pipeline corridor and associated construction access. The area along this trail is currently undeveloped. The main portion of the transmission pipeline corridor and ASR wellfield would extend due east along the south boundary of the EWRF property to South Alafaya Trail, as shown on Figure 1. Construction access is probably available from many directions along unpaved trails and also from paved roads such as Curry Ford Road and South Alafaya Trail.

Construction Phasing

ASR wellfield expansion should occur in stages, with each phase being adjusted to reflect evolving needs, constraints and opportunities, plus the operating experience of earlier ASR wells at this site. It is assumed that the initial stage would be close to the planned ASR test well south of the treatment plant since that location will initially provide the only readily available source of water for recharge and also a place to discharge the water during recovery.

First phase expansion would fully develop existing and planned near-term hydraulic capacity at this location. This is presumed to be defined, at least in part, by the capacity of the 36 inch potable water transmission pipeline along Curry Ford Road, conveyance capacity of which is assumed to be about 28 MGD. For planning purposes it is assumed that recharge could occur at rates up to 10 MGD from this pipeline during wet months, without adversely impacting its level of service to local customers. Recovery at rates up to 15 MGD is assumed to be viable during peak demand periods. Further investigations using hydraulic network modeling will be required to update this preliminary planning assumption.

The first phase would include up to five ASR wells providing 15% firm capacity in the event that one well is out of operation during peak demand periods. Four well sites in a line extending due south from the ASR Test Well along the existing trail would appear to achieve this objective. Wellhead facilities would be as already designed for the ASR Test Well, including a building for each well. During Phase One, impact of ASR operations at a 15 MGD scale upon upconing of brackish water from the Lower Floridan aquifer, and upon nearby wetlands, would be more clearly established, providing a firm basis for further expansion to fully develop the storage potential and individual well maximum recharge and recovery rates for the Lower Floridan aquifers.

Second phase expansion is assumed to achieve an additional 35 MGD of firm recovery capacity, raising total wellfield recovery capacity to 50 MGD. This would require importation of water from an alternative surface water source such as Taylor Creek Reservoir and/or the St Johns River. Up to about 14 additional ASR wells would be constructed. These would be located generally to the south and east of the Phase 1 wells (Figure 1). Total wellfield length would be approximately 2.5 miles.

Hydraulics of Existing and Proposed Pipelines

We understand that no work has been performed to estimate new pipeline diameters; flows available from the existing transmission system during recharge; flows that can be accepted by the transmission system at reasonable pressures during recovery; recharge water levels and pumping water levels during recovery, accounting for interference between ASR wells. This is a substantial body of engineering work that will need to be performed. While it could be performed now with considerable benefit, more accurate results would follow after the ASR test well has been constructed and initially tested to determine aquifer hydraulics and initial water quality and hydraulic response to ASR cycle testing operations.

Regulatory Issues

The ASR regulatory framework in Florida is in a high state of flux, with at least 14 Underground Injection Control (UIC) permits on hold pending resolution by FDEP regarding how best to handle their current concerns about the potential or known occurrence of arsenic at elevated levels in the recovered water from some ASR wells. The real problem is: 1) localized, typically within 200 feet of an ASR well, and 2) transitional, diminishing with successive operating cycles or with formation of an adequate buffer zone. The technical solution requires formation and maintenance of a buffer zone. However, the regulatory solution is apparently complex and will likely require some time and effort to work out.

A meeting was held between the District and County, to discuss FDEP's option for the UIC permitee to have an Administrative Order (AO) to address the potential for mineral leaching during cycle testing (rather than a consent order after it has occurred). The County has agreed with District on the FDEP's proposed use of an AO on this ASR project, as a no-penalties, "protective" tool to facilitate the regulated community's transition into new rule requirements (e.g. Arsenic MCL at 10 ppb), or to allow for potential time that may be needed to come into compliance (e.g. through continued cycle testing during the construction permit). BFA plans to prepare the request letter, which will initiate a major modification process for the UIC permit to include a revised cycle test plan to promote a large "Target Storage Volume" approach to the cycle test program.

Easement Requirements

Assuming that all initial ASR wellfield facilities are constructed on lands already owned by Orange County (2,090 acres), then no easements would be required. However for the ASR wellfield expansion it may be necessary to acquire title or easements to lands extending further east along South Alafaya Trail from the OCU property.

Alternatively, a working agreement with Orlando Utilities Commission may be sought for use of the transmission powerline right of way between the St Johns River and the Stanton Power Plant, or a strip of land already owned by Orange County that is contiguous to this right of way.

Other Conceptual Design Criteria, Issues and Assumptions

ASR Cycle Testing Program

It would be wise to assume that elevated arsenic concentrations may occur during the cycle testing program. If the intention is to conduct initial geochemical test cycles to investigate the potential maximum occurrence of arsenic, one cycle is probably sufficient if it is properly designed and implemented. Results of this cycle will probably also show recovery of hydrogen sulfide at the end of recovery. On the other hand, if the intention is to develop a viable, arsenic-free and hydrogen sulfide-free ASR program, then a revised cycle testing program is needed. With the revised program, one or two initial, small geochemical cycles would be conducted. Following this, the TSV would be formed. Subsequent cycles should show neither arsenic nor hydrogen sulfide in either the recovered water or nearby monitor wells.

Considering the substantial funds invested in this ASR project, it seems prudent to design the cycle testing program to achieve success. The high arsenic concentrations during ASR recovery only occur when the buffer zone is pulled too close to the ASR well. If the buffer zone is formed and maintained, arsenic sorbed onto the aquifer matrix and ferric hydroxide floc remains very close to the well, probably within a few tens of feet, and is not mobilized during recovery. The goal of the cycle testing program is to demonstrate to FDEP that the potential arsenic problem goes away with time, with distance and with successive, roughly equal volume cycles, and also with initial formation of a buffer zone.

Regional Water Supply Plan

A placeholder assumption is that a regional ASR wellfield at the OCU location would supply up to 50 MGD during peak demand periods and would be recharged at a rate of up to 30 MGD during months when flow is available from the St Johns River or other sources. This assumption should be updated to reflect current regional plans for development of alternative surface water sources. These plans are being prepared by the SJRWMD and several local governmental entities, including OCU.

Discharge of Water During Pump Testing and Cycle Testing

The need for protracted cycle testing will diminish with successive stages of wellfield expansion. Usually in later stages a single baseline cycle is conducted at each new well, followed by routine operations. Nevertheless it is important to provide for disposal of recovered water during well construction, pump testing, cycle testing and periodic backflushing of water to waste. With the large number of wells and potentially high flow rates, it will be important to address disposal of water to waste in a satisfactory manner. Facilities for disposal to waste should be provided at least at each ASR wellsite, independent of the operation of the remainder of the ASR wellfield. Provision of a parallel pipeline to collect this water during pump testing, cycle testing, backflushing and other such events would enable conveyance of this water to the reclaimed water system where it could be beneficially utilized, instead of being discharged to waste.

Recovered Water Disinfection

Centralized disinfection of the recovered water will be more efficient and cost-effective compared to providing disinfection facilities at each well site. Disinfection practices are evolving in the United States. Adapting to evolving regulatory requirements is more easily achieved with a centralized system.

Providing a Terminal Ground Storage Reservoir, Pumping Station and Disinfection Facility may enhance operational control and flexibility for the ultimate ASR wellfield, as opposed to pumping from up to 19 separate wells. This option should be evaluated further. If found favorable, the ASR wellfield expansion plan should provide a suitable location for this facility, probably near Curry Ford Road.

Power Supply

Power needs for a single ASR Test Well are relatively small. However for up to 19 ASR wells and a 50 MGD ASR wellfield, recovering water to pressures consistent with the regional transmission and distribution system during peak demand periods, a substantial power supply will be needed. Planning for this should start well ahead of when the power supply will be needed.

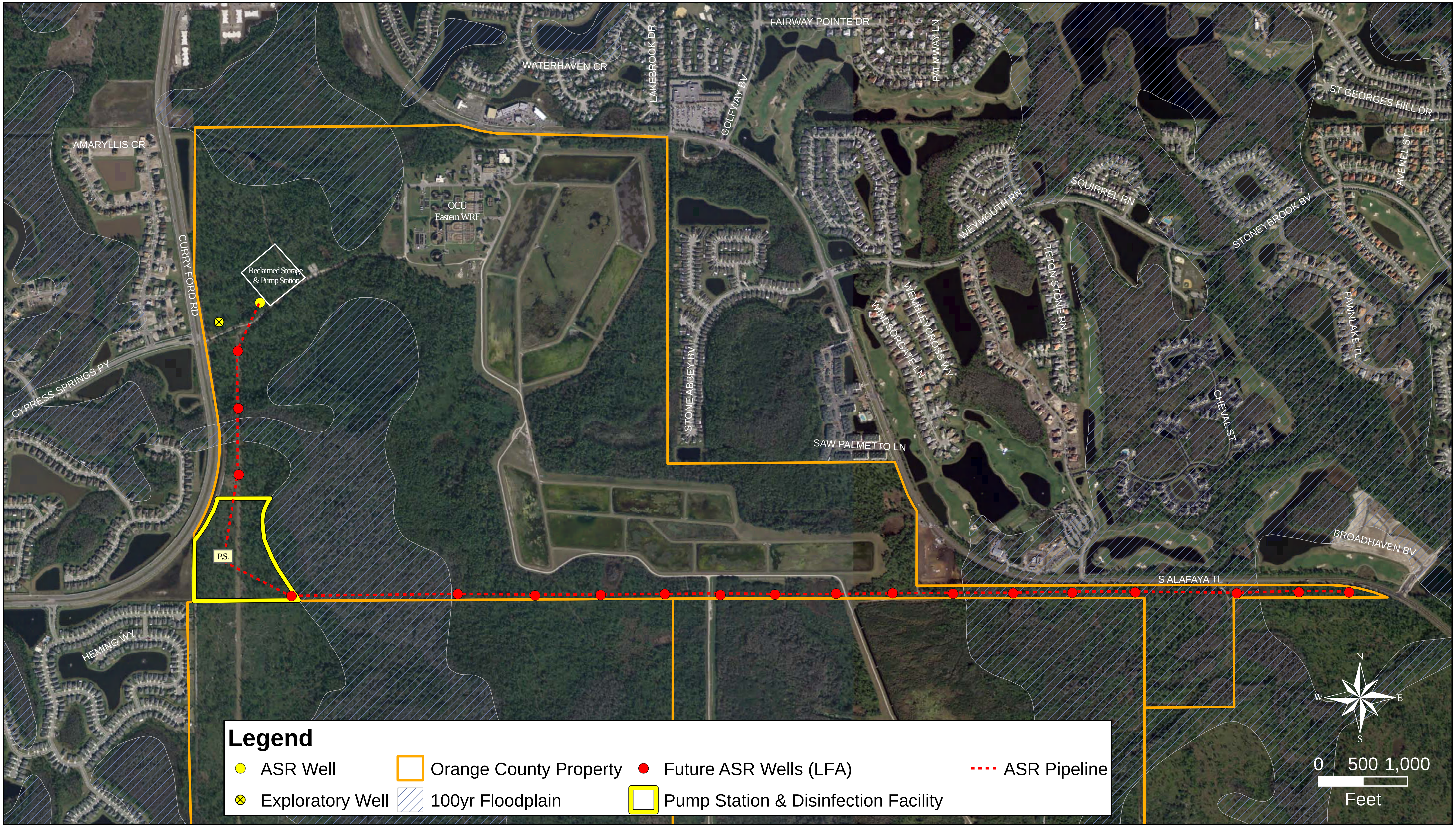
ASR Pretreatment

Degasification and dechlorination technology is not recommended for this facility, as a means of pretreatment of injected water, to reduce the chance that mineral leaching that may occur during ASR cycle testing. The County EWRF project, due to its size (3 mgd) and easier disposal options (discharge to RW system), is not a likely candidate for pretreatment funding. Cost of pretreatment facilities is estimated to add to the capital cost about $0.40 per gallon per day of recovery capacity. For a 3 to 5 MGD ASR well this would amount to $1.2 M to $2 M. It is possible that these facilities will only be needed until such time as the TSV has been formed, after which their continued operation may prove to be unnecessary. A better option would be to work with FDEP to get a cycle testing program that demonstrates the arsenic problem goes away with time, with distance and with successive, roughly equal volume cycles, and also with initial formation of a buffer zone.

Mixing of Surface Water and Groundwater in the Water Distribution System

This ASR program has the potential for storing and recovering seasonally available large volumes of alternative water supplies to offset the use of potable groundwater in east Central Florida. The existing drinking water supplies for the central Florida area are all from groundwater. Proposed future supplemental supplies will be from seasonally available surface water. Even though both sources may be treated to meet all drinking water standards, differences in taste and odor will be evident to consumers. Seasonal variability in water quality often generate customer complaints. Several water utilities in the United States have implemented ASR to avoid or minimize the customer complaints associated with seasonal variability in water taste and odor, and the associated public perception of variable water quality. While this may not be a public health issue it is certainly a public perception and aesthetics issue to be avoided if possible. For this reason it will likely be important for future regional water supply plans to address this issue.

One solution would be to build into the plan the need for ASR storage of all the treated surface water so that only recovered water from ASR wells would be added to the water distribution system. Another approach would be to build into the plan the need for conveyance of the stored water through the aquifer from a line of ASR wells primarily utilized for aquifer recharge, to distant (or nearby) production wells. This would achieve the same objectives for providing ASR storage but would also reduce pipeline and pumping costs.



BFA

ST JOHNS RIVER WATER MANAGEMENT DISTRICT & ORANGE COUNTY UTILITIES
AQUIFER STORAGE AND RECOVERY SYSTEM FUTURE WELLFIELD LOCATION MAP

FIGURE 1

Bench-Scale Geochemical Assessment of Water-Rock Interactions: Orange County Aquifer Storage and Recovery Facility

FINAL REPORT

Submitted to
Barnes, Ferland and Associates, Inc.
Environmental Consultants

by

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Florida Department of Environmental Protection, Florida Geological Survey
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April 22, 2008

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ABBREVIATIONS AND ACRONYMS

Ag	Silver
Al	Aluminum
Al_2O_3	Aluminum oxide
As	Arsenic
ASR	Aquifer Storage and Recovery
Au	Gold
Ba	Barium
b.d.	below detection
Be	Beryllium
Bi	Bismuth
BLS	Below land surface
Br	Bromine
BSE	Backscatter electron
C	Carbon
Ca	Calcium
Cd	Cadmium
Ce	Cerium
CERP	Comprehensive Everglades Restoration Plan
cm	Centimeters
Co	Cobalt
CO_2	Carbon dioxide
CO_3	Carbonate
Cr	Chromium
Cs	Cesium
Cu	Copper
DDI	Distilled de-ionized water
DO	Dissolved oxygen
Dy	Dysporium
EC	Electrical conductance
EDS	Energy-dispersive X-ray
Eh	Oxidation-reduction potential
Er	Erbium
Eu	Europium
EPMA	Electron probe microanalysis
FAS	Floridan aquifer system
Fe	Iron
Fe_2O_3	Ferric oxide
FeS_2	Pyrite or ferrous sulfide

ABBREVIATIONS AND ACRONYMS (continued)

FDEP/FGS	Florida Department of Environmental Protection/Florida Geological Survey
FIU – FCEAM	Florida International University - Florida Center for Analytical Electron Microscopy
FSU	Florida State University
g	grams
Ga	Gallium
Ge	Germanium
HCO_3	Bicarbonate
HDO	High dissolved oxygen
Hf	Hafnium
HFO	Hydrous ferric oxides
Hg	Mercury
HNO_3	Nitric Acid
Ho	Holmium
H_2S	Hydrogen sulfide (gas)
I	Iodine
ICP-MS	Inductively coupled plasma mass spectrometer
ICP-OES	Inductively coupled plasma optical emission spectrometer
INAA	Instrumental neutron activation analysis
In	Indium
K	Potassium
kV	Kilovolts
La	Lanthanum
LDO	Low dissolved oxygen
Li	Lithium
Lu	Lutetium
Mg	Magnesium
MgO	Magnesium oxide
µS	MicroSiemens
ml	milliliters
Mn	Manganese
Mo	Molybdenum
N_2	Nitrogen (gas)
n.a.	Not applicable
Na	Sodium
nA	Nano angstroms
NOM	Natural organic material
Nb	Niobium
n.d.	Not determined

ABBREVIATIONS AND ACRONYMS (continued)

Nd	Neodymium
Ni	Nickel
NO_3	Nitrate
O_2	Oxygen
ORP	Oxidation-reduction potential
Os	Osmium
Pb	Lead
Pd	Palladium
pH	negative log of the hydrogen ion concentration
ppb	parts per billion or ug/L
ppm	parts per million or mg/L
Pr	Praseodymium
Pt	Platinum
Rb	Rubidium
Re	Rhenium
REE	Rare earth elements
Ru	Rubidium
S	Sulfur
S_2	Sulfide
Sc	Scandium
Se	Selenium
SEM	Scanning electron microscope
SO_4	Sulfate
Sb	Antimony
SiO_2	Silica dioxide
Sm	Samarium
Sn	Tin
Sr	Strontium
Ta	Tantalum
Tb	Terbium
TDS	Total dissolved solids
Te	Tellurium
Th	Thorium
Ti	Titanium
Tm	Thulium
U	Uranium
V	Vanadium
W	Tungsten
WDS	Wavelength dispersive energy

ABBREVIATIONS AND ACRONYMS (continued)

XRF	X-ray fluorescence
Y	Yttrium
Zn	Zinc
Zr	Zirconium

Bench-Scale Geochemical Assessment of Water-Rock Interactions: Orange County Aquifer Storage and Recovery Facility

Jonathan D. Arthur, P.G. 1149, Cindy Fischler, P.G. 2512, and Adel A. Dabous

INTRODUCTION

The purpose of this study is to characterize the geochemistry, bench-scale leachability and sources of soluble metals in storage zone carbonate rocks from the Orange County ASR (latitude 28° 31' 08"; longitude 81° 11' 24"). The scope of this study includes three main parts: 1) lithologic, geochemical and mineralogical characterization of aquifer rocks from the ASR well storage zone, 2) bench-scale leaching of ASR core samples in response to variable redox conditions, and 3) sequential extraction analyses of storage zone rocks.

Simulated cycle tests employed in previous geochemical studies (e.g., Arthur and others, 2005) identified mobilization of trace metals and metalloids (hereafter referred to as "metals") from core material when exposed to high-DO conditions. Other researchers have identified the significance of DO with regard to metals mobilization during aquifer recharge (e.g., de Ruiter and Stuyfzand, 1998; Arthur and others, 2002; Pichler and others, 2004; Arthur and others, 2005). The bench-scale component of the present study is designed to isolate and characterize mobilization of metals under varying DO conditions within a source water leachate collected from the fire hydrant on Curry Ford Road at the Eastern Water Reclamation Facility.

The bench-scale study is "reaction-kinetic" limited and is only an approximation of potential aquifer conditions during ASR activities, at least until ASR cycle-test data becomes available for comparison. Additional factors that constrain the application of bench-scale studies are ground-water mixing, effects of scale (i.e., study area size), water-rock ratios, physical and chemical aquifer heterogeneities (e.g., dual porosity), pressure-temperature differences, and microbial activity. While the bench-scale results may not have reached equilibrium conditions for all potential reactions, and are not expected to provide a direct comparison with water-quality changes observed during cycle testing at the Orange County ASR facility, prediction of relative degrees and perhaps magnitudes of metals mobilization may be realized. This information may prove to be a powerful predictive tool in the design, testing, and operation of an ASR well.

METHODS

Sample Preparation

Ideally, each sample was of sufficient volume to complete all types of analyses in this study. Bulk (whole rock) geochemistry required up to 100 grams of powdered material. Thin section and microprobe analysis required one tab 1.1 x 1.8 (27 X 46 mm). Bench-scale leaching required 300 grams of crushed sample. A duplicate sample was selected at random, thus a minimum of at least 600 grams of crushed sample was targeted. Based on the above requirements, which includes random duplicate analyses, the optimal sample volume is 1000 grams. In terms of core length, each sample was comprised of approximately 12 inches. (30.48 cm) of 2.5 inches (6.35 cm) diameter core.

Core exteriors were removed using a new water-cooled trim saw. To minimize contamination, the trim saw was used solely for bench-scale leaching projects. Moreover, sample trimming was intended to remove drilling mud impregnated along the core exterior, post-drilling oxidized zones and precipitates (e.g., gypsum formed during core storage), as well as any possible anthropogenic contaminants. After trimming, each sample was rinsed with de-ionized (DI) water. Samples were then air-dried in a contamination-free environment.

Splitting and Powdering

Rock powders were required for lithogeochemical analyses in this study. Pulverization was completed Activation Laboratories Ltd. (ActLabs; analysis code RX2). **Appendix 1** provides more detail on the pulverization procedure. Upon receipt of rock chips (for bench-scale leaching) at the FDEP/FGS Hydrogeochemistry Laboratory, samples were further split using a Fritsch Rotary Cone Divider (**Figure 1**). The Fritsch unit was cleaned with a nylon brush, rinsed with DI, then 2-propanol and jetted with compressed air.

Figure 1. Fritsch rotary cone divider at FDEP/FGS Hydrogeochemistry Laboratory. This unit is accurate to within 0.42%, which is significantly better than the standard “cone and quarter” technique.

Scanning Electron Microscopy and Microprobe Analyses

Trace mineralogical analyses were completed using reflected light microscopy, scanning electron microscopy (SEM), secondary electron backscatter imaging (BSE) and energy-dispersive x-ray (EDS) and wavelength dispersive (WDS) electron probe microanalysis (EPMA). Polished thin sections (27 X 46 mm) were made at Spectrum Petrographics, Inc. Experimentation was completed to identify an impregnating/embedding resin for use in friable samples that did not contain measurable quantities of As and other trace metals. 3M Scotchcast #3 ™ was selected as an embedding material. Prior to image analyses, all thin sections were sputter-coated with carbon at the FDEP/FGS Microanalysis Laboratory.

Microanalyses at the FDEP/FGS were completed using a JOEL JXA 840A electron probe microanalyzer. The unit consists of a main console which incorporates the electron optical column, secondary electron detector, Robinson backscatter electron detector (BSE), and EDS detector manufactured by X-ray Optics (**Figure 2**). 4pi Revolution software was utilized for microanalysis and imaging, including element maps and energy spectra. Energy-dispersive analyses had a 100-second acquire time, with a dead time between 20 and 25%. The working distance was 39 mm and the stage was set to zero tilt. Electron probe current ranged from 8 and 10 nannoamps (nA) and the SEM operating voltage was 20 kV. Secondary electron (topographic) imagery is useful to identify textures, while BSE images enhance contrast between different minerals or mineral compositions based on the average atomic number; the brighter the mineral the higher its average atomic number.

Figure 2. FDEP/FGS microanalysis laboratory (left) and the electron probe microanalysis laboratory at the FIU-FCEAM facility (right).

Quantitative electron probe microanalyses (EPMA) were completed on-site (and remotely via the Internet) at the Florida Center for Analytical Electron Microscopy (FCAEM) at Florida International University (http://www.fiu.edu/~emlab/inst_EPMA.html) using a JEOL 8900R Superprobe with five 2-crystal detectors (Figure 2). Quantitative analyses of minerals in polished, carbon-coated thin sections were completed using a 20 nA probe current. Each analysis included 15 elements (see **Table 1** for element conditions). According to the lab, analytical detection limits for all metals analyses and element maps was approximately 200 parts per million (ppm).

Calibration and validation of As analyses was assessed through analysis of non-certified reference material from the US Geological Survey (USGS). The reference material is a basalt glass, which was spiked with As at concentrations of 500 ppm, 2000 ppm and 5000 ppm. The glasses were mounted and polished at FCAEM. Based on the calibration curve, a more conservative As detection limit of 300 ppm was applied for EPMA quantitative results in this study due to analytical uncertainty. Arsenic values in dolomites are not reported due to energy peak interference between As and Mg.

Geochemical Procedures

This section not only describes the analytical methods for rock and water chemical analyses, but also methods designed and employed for bench-scale and sequential extraction analyses of aquifer matrix samples. Electron microprobe analytical procedures are described in the prior section. Addressing significant figures in this report was a challenge due to limitations of data-management software and inconsistencies in laboratory reporting. For consistency herein, the number of decimal places in analytical detection limits (DL) was applied and ½ of the DL was used for calculation of descriptive statistics, ratios and a majority of plotted data. Tables and appendices in this report denote concentrations less than the DL for a particular analyte as ½ the DL (non-bold font).

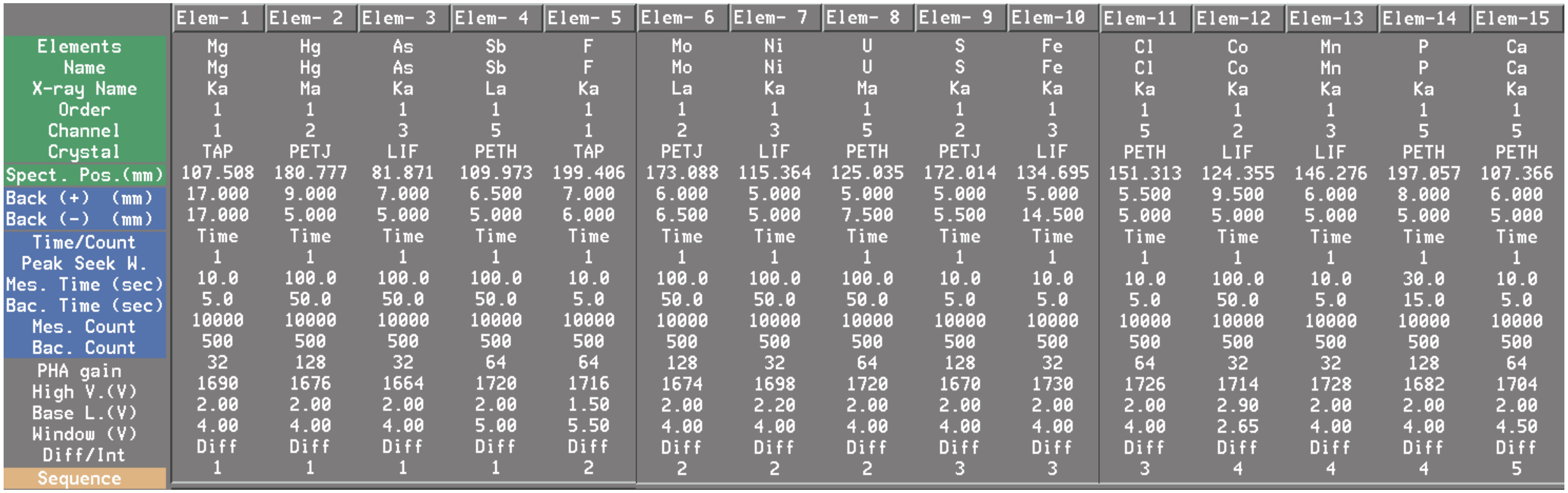
For lithogeochemical and hydrogeochemical analyses (e.g., bench-scale studies and sequential extraction), analytical precision was monitored by duplicate analyses and accuracy was monitored by using international standard reference materials. Detection limits, total analytical accuracy (Chi-square test of independence) and total analytical precision (Fischer [F]-test of variance) for each element has been calculated at alpha = 0.05 (95% level of significance). P-values at this alpha are also calculated, thus p-values > 0.05 are significant at 95%. The p-values generally reflect the relation between "critical" and calculated values for the Chi-squared (X^2) test and F-test. For example, where a calculated F-test value < F critical (at alpha=0.05), the variances are equal at a 95% level of significance. In the same manner, where the calculated $X^2 < X^2$ critical at alpha = 0.05, the overall observed and expected values are equal at a 95% level of significance. In the appendices, p-values ≤ 0.05 are shaded to denote lower levels of significance; however, nearly all of the p-values are > 0.05 indicating significance of at least 95% for both accuracy and precision.

The present study had the benefit of being completed during the Comprehensive Everglades Restoration Plan (CERP) ASR geochemical study, through which period, accuracy and precision analyses of more than 50 samples was completed. These comprehensive quality assurance analyses are presented in a following section per the techniques described above.

Hydrogeochemistry

Water-sample compositions from bench-scale leaching and sequential extraction studies were determined at ActLabs (analytical Code 6) using ICP/MS and ICP/OES (if "over-range" was required). Accuracy was monitored by analysis of water standards. Detection limits, total analytical accuracy (X^2-test of independence) and total analytical precision (F-test of variance) for each element is shown in **Appendix 2.** Accuracy and precision are based on an average of at least 70 geochemical standard analyses or duplicate analyses, respectively. All p-values exceed a

Table 1. Example of electron probe microanalyses (EPMA) element conditions for geochemical standard and unknown analyses.



	Elem- 1	Elem- 2	Elem- 3	Elem- 4	Elem- 5	Elem- 6	Elem- 7	Elem- 8	Elem- 9	Elem-10	Elem-11	Elem-12	Elem-13	Elem-14	Elem-15
Elements	Mg	Hg	As	Sb	F	Mo	Ni	U	S	Fe	Cl	Co	Mn	P	Ca
Name	Mg	Hg	As	Sb	F	Mo	Ni	U	S	Fe	Cl	Co	Mn	P	Ca
X-ray Name	Ka	Ma	Ka	La	Ka	La	Ka	Ma	Ka	Ka	Ka	Ka	Ka	Ka	Ka
Order	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Channel	1	2	3	5	1	2	3	5	2	3	5	2	3	5	5
Crystal	TAP	PETJ	LIF	PETH	TAP	PETJ	LIF	PETH	PETJ	LIF	PETH	LIF	LIF	PETH	PETH
Spect. Pos.(mm)	107.508	180.777	81.871	109.973	199.406	173.088	115.364	125.035	172.014	134.695	151.313	124.355	146.276	197.057	107.366
Back (+) (mm)	17.000	9.000	7.000	6.500	7.000	6.000	5.000	5.000	5.000	5.000	5.500	9.500	6.000	8.000	6.000
Back (-) (mm)	17.000	5.000	5.000	5.000	6.000	6.500	5.000	7.500	5.500	14.500	5.000	5.000	5.000	5.000	5.000
Time/Count	Time	Time	Time	Time	Time	Time	Time	Time	Time	Time	Time	Time	Time	Time	Time
Peak Seek W.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Mes. Time (sec)	10.0	100.0	100.0	100.0	10.0	100.0	100.0	100.0	10.0	10.0	10.0	100.0	10.0	30.0	10.0
Bac. Time (sec)	5.0	50.0	50.0	50.0	5.0	50.0	50.0	50.0	5.0	5.0	5.0	50.0	5.0	15.0	5.0
Mes. Count	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000
Bac. Count	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500
PHA gain	32	128	32	64	64	128	32	64	128	32	64	32	32	128	64
High V.(V)	1690	1676	1664	1720	1716	1674	1698	1720	1670	1730	1726	1714	1728	1682	1704
Base L.(V)	2.00	2.00	2.00	2.00	1.50	2.00	2.20	2.00	2.00	2.00	2.00	2.90	2.00	2.00	2.00
Window (V)	4.00	4.00	4.00	5.00	5.50	4.00	4.00	4.00	4.00	4.00	4.00	2.65	4.00	4.00	4.50
Diff/Int	Diff	Diff	Diff	Diff	Diff	Diff	Diff	Diff	Diff	Diff	Diff	Diff	Diff	Diff	Diff
Sequence	1	1	1	1	2	2	2	2	3	3	3	4	4	4	5

95% level of significance, with the following exceptions. For low concentrations of Na, Mg, Si, K and Ca, accuracy was less than 95% significant using ICP/MS; however, unknown concentrations in this study usually exceeded the upper range for ICP/MS. These "over-range" samples were analyzed by ICP/OES. Accuracy for ICP/OES analyses exceeded a 95% level of significance (i.e., observed and expected values are the same at $\alpha = 0.05$). Only one metal, Y, did not meet the p-value threshold for analytical precision.

Cation analyses for water samples (e.g., source and groundwater analyses, leachability and sequential extraction samples) were completed using ActLabs "Code 6 – ICP/MS" (Appendix 1). Anions for water (leachate) samples, including the water-soluble step in the sequential extraction procedure were analyzed by ion chromatography using EPA reference method 300.0.

Bench-scale leaching

Bench-scale leaching followed protocols that varied according to the results of prior bench studies, including those of Arthur and Dabous (2008) and Arthur and others (2008a, 2008b). The samples were analyzed (**Table 2**) using source water as the "leachate." Source water was collected from the fire hydrant on Curry Ford Road at the Eastern Water Reclamation Facility. This is the source water expected to be used for ASR activities.

Table 2. Samples and water utilized in bench-scale leaching study; "Ft BLS" - feet below land surface, "*" = geochemical control samples (blank).

Reaction vessel number	Leachate sample number	Sample depth (feet BLS)	Water type	Comments
15	L1S	1099-1100	Source, Curry Ford Rd.	core chips
16	L2S	1117.8-1118.6	Source, Curry Ford Rd.	core chips
17	L3S	1130.4-1131.3	Source, Curry Ford Rd.	core chips
18	L4S	1155-1156	Source, Curry Ford Rd.	core chips
19	L4aS	1155-1156	Source, Curry Ford Rd.	core chips (duplicate)
20	L5S	1182-1183	Source, Curry Ford Rd.	core chips
21	L6S	1209-1210	Source, Curry Ford Rd.	core chips
22*	LBS	N/A	Source, Curry Ford Rd.	leachate blank

Source Water Collection

The containers were filled, rinsed and drained of source water several times before a sample was collected. Aeration was kept to a minimum during sampling. Samples were immediately transported to the FDEP/FGS Hydrogeochemistry Laboratory and refrigerated. In both cases, there was an effort to minimize UV/sunlight exposure after collection.

Bench-Scale Analysis Protocols

The protocols/procedures employed in the present study are intended to address specific hypotheses related to ASR water-rock chemical reactions. These bench studies are not intended to determine distribution coefficients (Kds). This work is in support of an ASR system designed to evaluate water-rock hydrogeochemical processes at the bench scale to characterize what may be encountered in field during cycle testing.

The ratio of core chips to leachate used in the bench-scale leaching experiments was qualitatively derived from measured As in ASR cycle-test field data (using 20 ug/L As) and a "high average" As concentration in the aquifer matrix (5 ppm). This combination yields 0.4% leaching of total As in the rock. With this amount of leaching, 300 g of rock with 5 ppm As would yield concentrations in the leachate above the As detection limit and within the range of observed As in ASR recovered water.

The procedure for the bench-scale study (**Table 3)** includes five phases. During phase 1a, 300 g of crushed core samples (maximum chip size is 10 mm) were added to the reaction vessels (**Figure 3**) using a paper funnel to avoid sample loss and to guide sample on to chemically pure/inert mesh inside the vessel. One liter of DDI was slowly added, taking care not to scatter the rock sample. Upon DDI addition to the vessel, the 1L level was marked on the vessel. After all reaction vessels were filled, a vacuum was applied to pull fluid into the rock pore space. A second water-level mark was made for reference. After addition of the DDI, conductivity was measured for each vessel. This parameter was required by ActLabs to process anion concentrations. Water samples were then collected: 18 mL for ICP-MS and ICP-OES (for over-range analyses), and 2 mL for anions. The 18 mL sample was preserved with HNO_3 (diluted 1:1) and centrifuged at ~3,800 rpm for five minutes. No preservative was needed for the 2 mL anion sample; however, during collection, the anion samples were micro-filtered (Figure 3).

The leachate change to source water (SW) was required in preparation for the next experimental phase (1b; Table 3). Water was siphoned out of each reaction vessel into a Millipore filter (Millipore Omnipore membrane 1.0 μm) funnel. The water was pulled through the filter by low vacuum and as much water as possible was removed from the reaction vessels. A sample was collected from the source water to be used as a geochemical leachate reference. Prior to adding the source water, suspended material caught in the filter was washed into the vessel. If multiple filters were needed due to clogging, all filters were washed into the reaction vessel. Source water was added using a peristaltic pump. The conditions for Phase 1b were high dissolved oxygen (HDO), which was accomplished by air sparging the source water before filling the vessels. A vacuum was applied, and then each vessel was gently filled to the 1L mark.

All vessels were measured for physical parameters (temperature, DO, ORP, pH, and conductivity). Per the schedule outlined in the protocol, all vessels were sampled for cation and anion analyses (2.0 mL for anions and 18 mL for cations). After measuring physical parameters

Table 3. Protocol for the bench-scale leaching study.

Project phase	**1a**	**1b**	**2**	**3**	**4**	**5**
Cumulative timeline (number of weeks at end of phase)	<1	2	5	25	26	42
Chart label	HDO1	HDO1	LDO1	HDO2	LDO2	HDO3
Phase duration	3 hours	2 weeks	3 weeks	~20 weeks	1 week	~12 weeks
Type of leachate	DDI	Oxygenated source water	Source Water (same as Phase II)	Source Water (same as Phase II)	Source Water (same as Phase II)	Source Water (same as Phase II)
Reaction vessel head space	Air (2)	Air (2)	N2 (gas)	Air (2)	95% N2 and 5% H2S initial followed by hungate with N2	Air (2)
Processes to address	Pre-leach conditioning to minimize potential WQ effects of metals mobilization via dissolution of pyrite oxidation products (e.g., Fe(III)-hydroxysulfate, Fe-oxides, FeOOH)	Stabilize DO, ORP, obtain background analyses; assess oxidation of As	Assess potential effects of reductive dissolution	Assess effects of reintroduced O2	Assess potential effects of reductive dissolution	Assess effects of reintroduced O2
Sampling frequency for hydrogeochemistry	1x	3x/week	3x/week	3x/week	Varied	Varied
Sampling frequency for physical parameters	Once	Daily first week, then 3x/week	Daily first week, then 3x/week	Daily first week	Varied	Varied
Phase-specific comments	Add core chips; see footnote (1), (5)	Replace DDI with air-sparged source water	(6)	Bring up DO with air-sparge	Last sample collected during morning of 2/1/07	Bring up DO with air-sparge; first sample collected of 2/2/07; last sample on 5/1/07

Overall comments:	Each sampling event is replaced with an equal volume of original leachate water
	Analyses will include standard multi-metal, multi-method hydrogeochemistry package plus anions, DO, T, ORP, pH, EC
	Geochemical blank and duplicate with core-chip split (4) will be sampled and analyzed
	Modified hungate technique will be employed during sampling of low-DO leachate
	Core chips from a split of selected samples will undergo SEM/EDS microprobe analyses before and after leaching

Footnotes (x):

(1) Exposure of core chips to distilled-deionized water for 3 hours to remove pyrite oxidation products

(2) Sparge with air recognizing that CO2 in air reduces pH, which although buffered at field scale, is not efficiently buffered at bench scale.

(3) Leachate samples for cation analyses are cetrifuged; anion samples are microfiltered (0.2 um)

(4) Spinning riffling splitter (Fritsch, Inc.) will be used; accurate to within 0.42%, which is significantly better than the cone and quarter method

(5) Pull vacuum on all vessels to maximize infiltration leachate water into rock matrix

(6) Induce N2 (gas) head space to reduce and maintain low DO.

(7) Sequence continuous from phase HDO1 through HDO2; reaction vessels remained undisturbed for ~3 months before start of LDO2 phase. Samples colelcted during HDO3 spanned ~3 months.

Figure 3. Sealed reaction vessels (mesocosms) with N_2 (gas) lines (left) and filtered sampling for anions analyses (right).

and sampling, the volume of water removed for analysis was replaced by adding 20 mL of SW to the vessels.

Per Table 3, phase 2 was initiated using N_2 (gas) to induce low-DO (LDO) conditions. Sampling and parameter measurements were completed as previously described. Phase 3 was again an HDO condition, with similar frequency of sampling. This was the original bench-scale protocol; however, the experiment was extended to incorporate another LDO (phase 4) and HDO (phase 5) cycle. This final LDO cycle employed a mixture of 95% N_2 (gas) plus 5% H_2S (gas) in the head space of the reaction vessel to reduce the oxidation-reduction potential (ORP). All precautionary/safety measures were taken, including the need to inform the local city gas department when the gas was utilized under the fume hood. The experiment was successful and the ORP dropped below -300 mV. Results are discussed in a later section of this report.

For purposes of labeling charts in this report, the sequence of HDO and LDO (i.e., HDO1, LDO1, HDO2, etc.) phases is indicated. These symbols are listed in the "Chart label" row of Table 3.

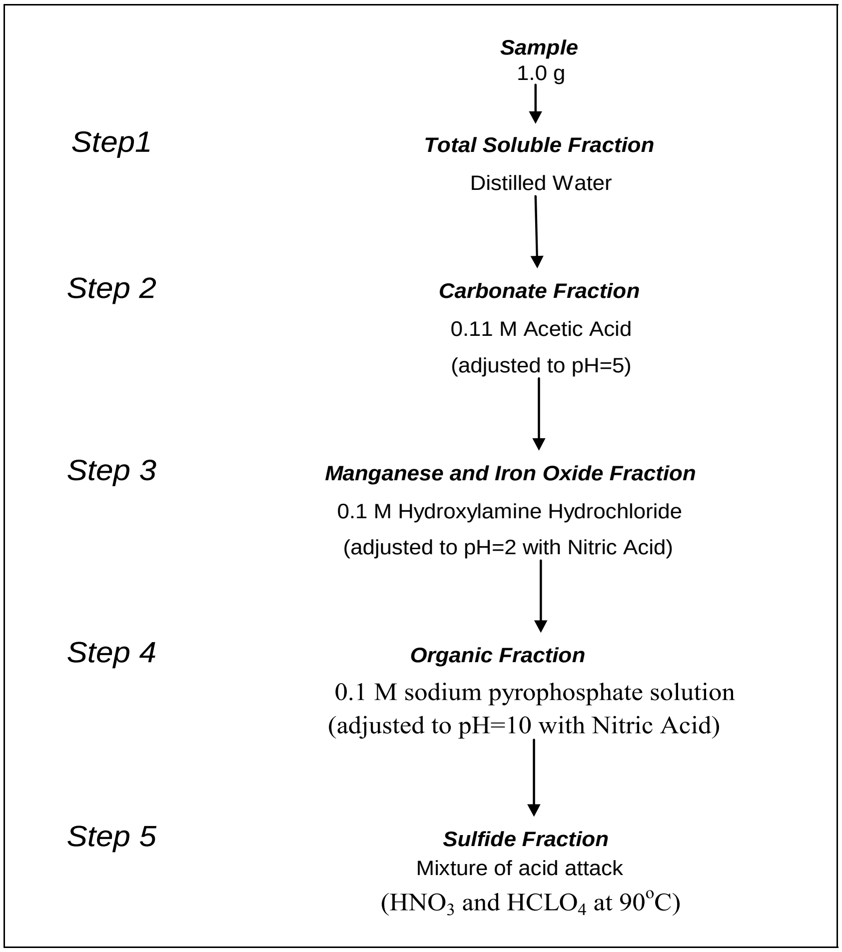
Sequential Extraction

Sequential extraction (leaching) methods have been used to determine the mineralogical distribution of trace elements in rocks and sediments. In the present study, a five-step sequential extraction procedure was developed based on procedures described in Bascomb (1968), Chunguo and others (1988), Dhoum and Evans (1998), Dold (2003), Hall and others (1996), Ito (2001), Moore and others (1988), Thomas and others (1994), Perez del Villar and others (2002) and Quevauviller and others (1997). Results of these analyses provide information regarding the association of metals to mineral bond-relationships or other phases (i.e., natural organic material [NOM]).

For the purpose of whole-rock geochemistry, the collected core samples from drilled wells were trimmed, rinsed with distilled water and sent to the Actlabs in Canada for analyses of major, trace and rare earth elements. At the Actlabs, all the samples were pulverized using Code RX2. In addition to the rock samples, a pure pyrite sample was ground in an agate mortar to 200 mesh size. An aliquot of 4.0 g was sent to the ActLabs for the whole-rock geochemical analyses, the results of which were used for methodology validation.

For the purpose of the sequential extraction procedure, pulverized core samples (received from the ActLabs and analyzed previously for the whole rock geochemistry) were further split at the FDEP/FGS Hydrogeochemistry Lab using a Fritsch Rotary Cone Divider. All the samples were dried in the oven at 60^{o} C in 1- mm depth for 1/2 hour. Duplicate analyses from prior sequential extraction analyses (Arthur and others, 2008b) utilizing this same procedure and the same commercial laboratory to complete the hydrogeochemical analyses indicates a high and acceptable degree of reproducibility with this method. A blank sample (i.e. no rock sample, only leaching solutions) was run with every three batches of extractions. The sequential extraction procedure is summarized in **Table 4** and described in detail in Appendix 1. Data management and calculations involved in this procedure are included in Appendix 1 as well.

Table 4. Sequential extraction procedure.



Published research on which the sequential extraction protocol was based utilized rocks and sediments other than carbonates. Upon receiving results of the analyses of samples for this study, it became obvious that the acetic acid used in the carbonate step (2) was overwhelmed and completely buffered by the carbonate minerals. As a result, not all of the carbonate minerals dissolved in step 2; these minerals also dissolved in subsequent steps, especially the sulfides (step 5). A comparison of Ca/Mg ratios suggests that step 2 preferentially leached calcite relative to dolomite, thus subsequent carbonate-mineral leaching reflected greater amounts of dolomite when present. While results of this part of the study yielded important information, it must be recognized that data from the sulfide step (and possibly other steps) reflect an overprint of carbonate dissolution. Aspects of this carbonate overprint are described in **Results – Sequential Extraction**.

Lithogeochemistry

Major, trace, and rare earth element geochemical analyses were completed at a commercial laboratory (Activation Laboratories, Ltd. [ActLabs], Anacaster, Ontario, Canada) for 9 rock samples. The multi-method analytical package (4E-Research) included use of these analytical methods: 1) inductively coupled plasma - optical emission spectrometer (ICP-OES), 2) trace element fusion inductively coupled plasma - mass spectrometer (ICP/MS), 3) instrumental neutron activation analysis (INAA), and 4) x-ray fluorescence spectrometer (XRF). Carbon and S were analyzed using an automated LECO CS-344 analyzer and a solid-state infra-red detector to yield CO_2, total C, graphitic C, organic C, S and SO_4. A Perkin Elmer Flow Injection Mercury System (FIMS) 100 cold vapor Hg analyzer was used for all samples.

As described previously, numerous samples (one from this study and more than 50 from the CERP study) were analyzed in duplicate for precision analysis. Analyses of geochemical standards as unknowns (observed versus expected) were also completed to assess analytical accuracy. Eleven of the metals, including Pb and "non-essential" trace metals (e.g., V, Rb, Zr) had p-values < 0.05 indicating accuracy at less than a 95% level of significance (**Appendix 3**). On the other hand, all major and trace elements of critical importance to this study (e.g., As, Cr, Mo, Sb, Se, and U) exceeded the accuracy standard of 95% significance. Accuracy was also assessed by analyzing two USGS geochemical standards as unknowns (carbonate standards were not available, thus two shales [SCo-1 and SGR-1] were purchased and analyzed; **Appendix 4**). With regard to precision, all but three constituents (CO_2, Co, Ni) exceeded the 95% level of confidence as described above.

ActLabs utilizes a lithium metaborate/tetraborate fusion process, followed by acid digestion to ensure total metal recovery, particularly for rare-earth elements (REEs) in resistate phases. This method is employed because standard acid digestions of refractory minerals (e.g., zircon, sphene, etc.) may be incomplete. The trace element package by ICP/MS on the fusion solution provides research quality data whether using standard or research detection limits. The "Code 4E Research" analytical package combines ICP, INAA, ICP/MS and XRF technologies to completely characterize geological samples using the optimum method for individual constituents. The package provides lower (research-grade) detection limits that are among the best of those commercially available. These detection limits are suitable for geochemical modeling needs. More detailed description of these analytical procedures are included in Appendix 1.

RESULTS

Lithologic and hydrogeological properties

All samples of the Orange County ASR core (W-18722) were collected from within the Avon Park Formation. In the study area, this lithostratigraphic unit is predominately a dolostone with intervening limestone. Finely disseminated NOM is observed throughout the section. Grain sizes are generally microcrystalline to fine and induration is good. Cements include dolomite, calcilutite and sparry calcite. A detailed description of the samples subjected to whole-rock chemical analyses and leaching is provided in **Appendix 5**.

Hydrogeological data from the Sanford ASR storage zone may reflect general conditions in the Orange County core. In the Sanford core, the median value for vertical hydraulic conductivity analyses is $8.62E^{-05}$ ft/day ($3.04E^{-08}$ cm/sec; average = $3.87E^{-02}$ ft/day or $1.37E^{-05}$ cm/sec) and the horizontal hydraulic conductivity median value is $1.78E^{-03}$ ft/day ($6.27E^{-07}$ cm/sec; average = $5.13E^{-02}$ ft/day or 1.81^{-05} cm/sec). Average total porosity of the storage zone samples equals 18.6 percent, with a standard deviation of 11.4 percent.

Mineralogy and mineral chemistry

Mineralogy of samples for which lithogeochemistry was completed is relatively simple. The dolostones are comprised of dolomite, calcite, with trace amounts of clay, pyrite and NOM. Pyrites occur as framboids and euhedral crystals in the Orange county ASR core (**Figures 4 - 9**). Figure 4 is a BSE image of a typical pyrite framboid. Figure 5 is a BSE image of an unaltered, euhedral pyrite crystal with accompanying element map (Figure 6) showing indications of trace concentrations of Ni and As. This element map has been filtered for edge enhancement and median values to improve contrast in the concentration map. Figure 7 is an EDS spectrum of the pyrite framboid in Figure 4; note the Ni peaks. The BSE image of the pyrite crystal in Figure 8 is the same crystal analyzed in the Figure 9 EDS element map. Iron and S have distinct patterns reflecting pyrite while the Mg and Ca reflect the surrounding dolomite. Also note the faint pattern of Ni, U and possibly Mo in association with the pyrite. **Appendix 6** provides a compilation of additional SEM images and element maps (both EDS and wavelength dispersive [WDS] X-ray microprobe).

Quantitative EPMA utilizing WDS was completed for pyrites observed in two thin sections. The analytical detection limit is 300 ppm (0.03%), anything below which is listed as below detection limit (BDL) in **Table 5**. Trace metal associations with pyrites, based on these analyses, include As and Mo. The maximum observed As concentrations in the Orange County dolostones equals 0.25 %, or 2500 ppm. Although not observed in these samples, U and Sb occur in other Avon Park Formation dolostones (Arthur and others, 2008b). An unidentified Fe-sulfide (?) occurs as a non-opaque, light green mineral.

Table 5. Electron probe microanalyses data for pyrites; BDL – below detection limit (DL = 300 ppm, 0.03%).

	Weight percent													
Lab ID	**Mg**	**As**	**Sb**	**Mo**	**Ni**	**U**	**S**	**Fe**	**Cl**	**Co**	**Mn**	**Ca**	**Total**	**Comments**
Pyrite														
W-18722-1155-6	BDL	0.14	BDL	0.61	0.08	BDL	52.50	43.64	BDL	BDL	BDL	0.24	97.24	reflected light - lt. green
W-18722-1155-7	0.08	BDL	BDL	0.56	BDL	BDL	52.47	44.08	BDL	BDL	BDL	0.60	97.84	reflected light - lt. green
W-18722-1155-11	BDL	0.21	BDL	0.60	BDL	BDL	51.99	42.32	BDL	BDL	BDL	0.22	95.35	
W-18722-1155-12	0.04	0.15	BDL	0.60	BDL	BDL	52.47	44.99	BDL	BDL	0.03	0.53	98.83	
W-18722-1182-py1a	BDL	0.09	BDL	0.61	BDL	BDL	52.72	43.54	BDL	BDL	BDL	0.31	97.30	
W-18722-1182-py1b	BDL	0.11	BDL	0.60	BDL	BDL	52.08	43.80	BDL	BDL	BDL	0.28	96.89	same crystal as "py1a"
W-18722-1182-py3	0.04	0.08	BDL	0.60	BDL	BDL	52.76	44.01	BDL	BDL	BDL	0.61	98.10	reflected light - lt. green
W-18722-1182-py_x	0.11	0.25	BDL	0.73	0.13	BDL	50.60	41.94	BDL	BDL	0.08	0.60	94.45	

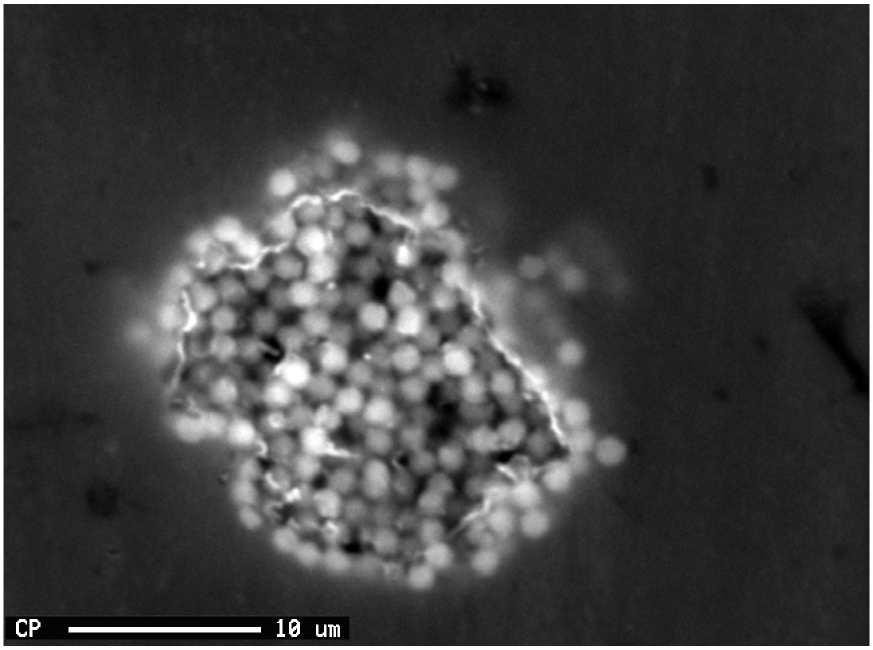


Figure 4. Backscatter electron image of pyrite framboid at 1155 ft. BLS. Diameter of pyrite framboid (light spotted area) is approximately 10 um.

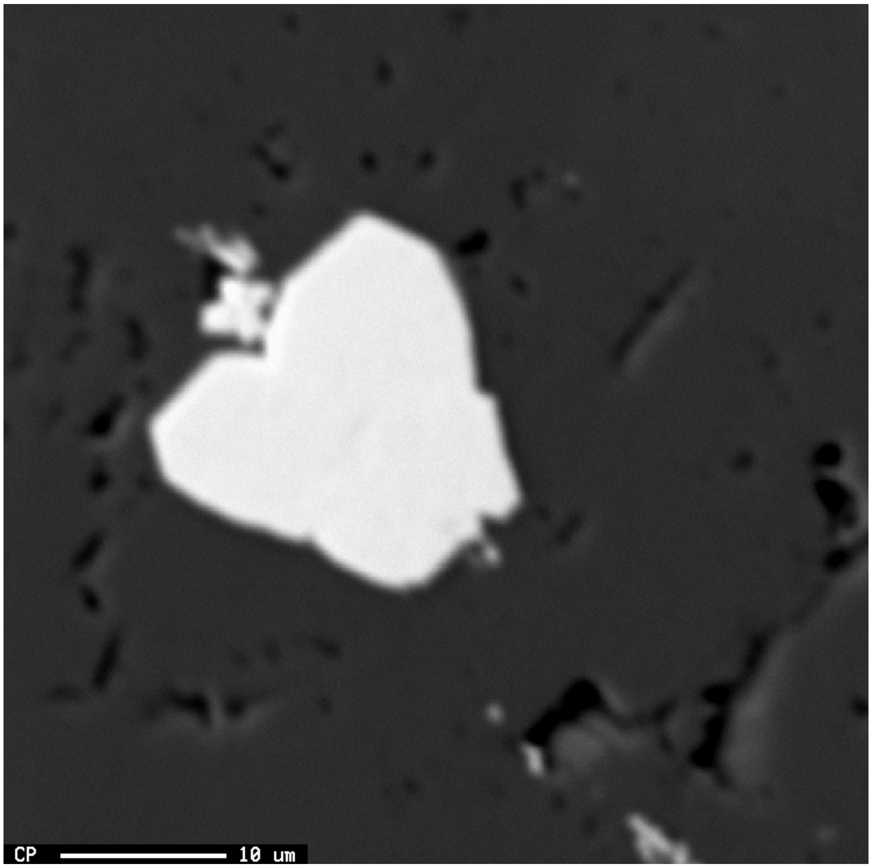


Figure 5. Backscatter electron image of pyrite at 1182 ft. BLS.

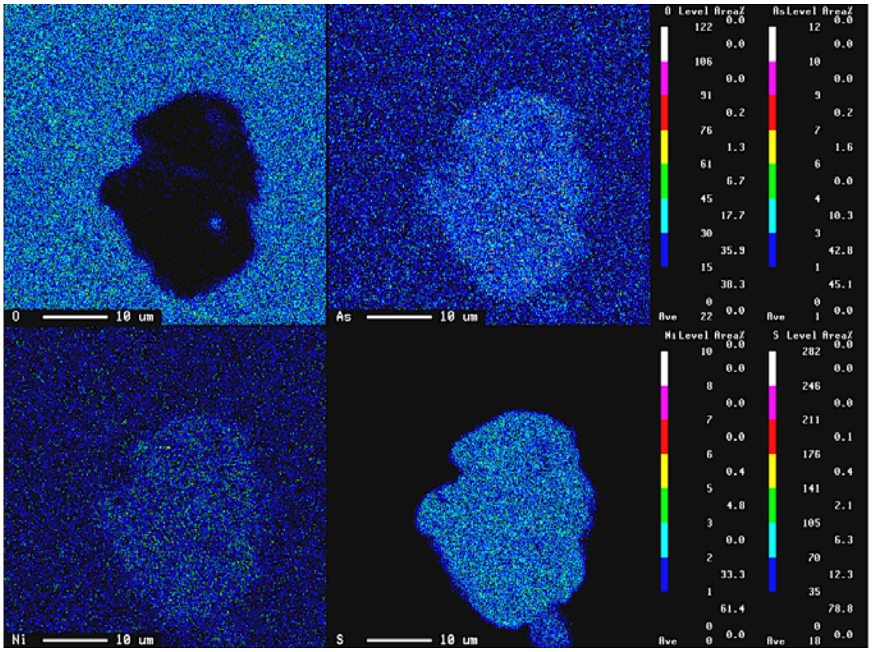
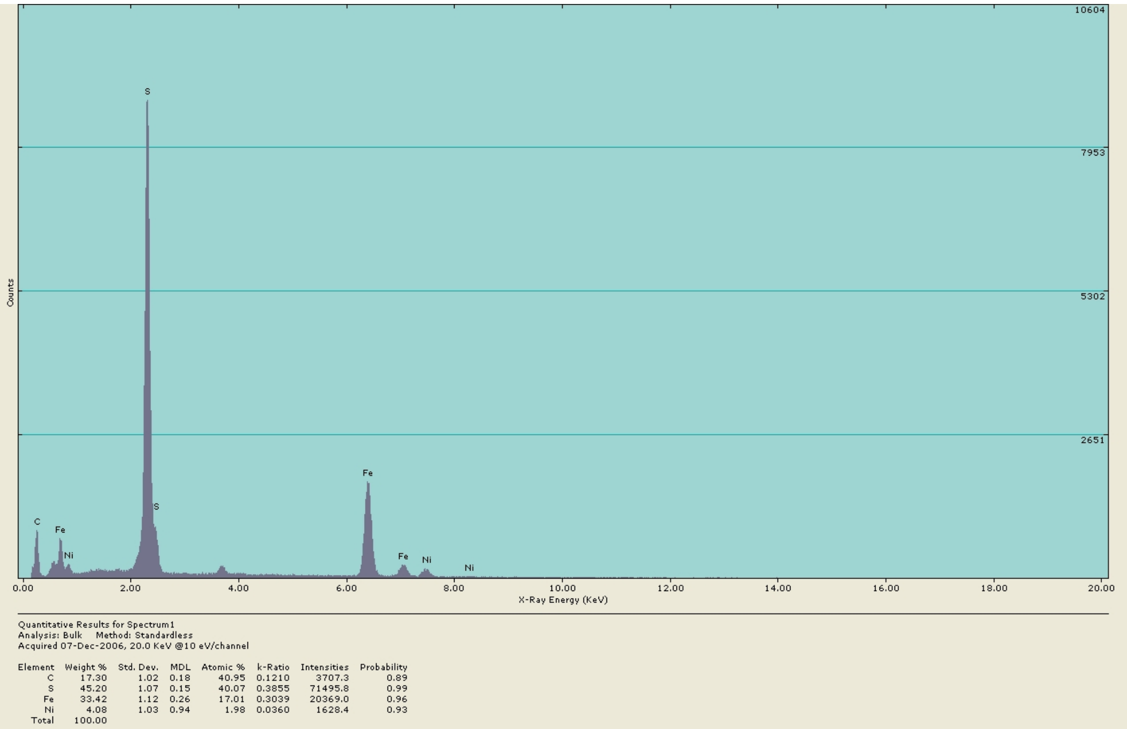


Figure 6. Element map (WDS) of pyrite at 1155 ft. BLS. Arsenic and Ni are observed as trace metals in the crystal. See also accompanying XRD spectra (Figure 7).



```
Quantitative Results for Spectrum1
Analysis: Bulk     Method: Standardless
Acquired 07-Dec-2006, 20.0 KeV @10 eV/channel

Element   Weight %   Std. Dev.   MDL   Atomic %   k-Ratio   Intensities   Probability
      C      17.30        1.02  0.18      40.95    0.1210        3707.3          0.89
      S      45.20        1.07  0.15      40.07    0.3855       71495.8          0.99
     Fe      33.42        1.12  0.26      17.01    0.3039       20369.0          0.96
     Ni       4.08        1.03  0.94       1.98    0.0360        1628.4          0.93
  Total     100.00
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Figure 7. Energy dispersive X-ray spectrum indicating Ni in pyrite (See also Figure 6).

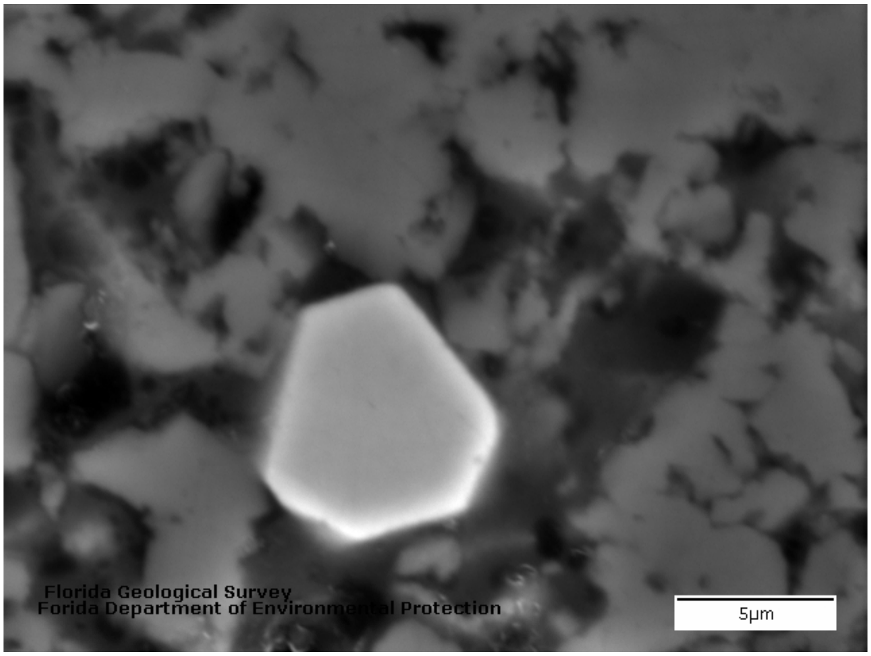

Figure 8. Euhedral pyrite at 1209 ft. BLS; see also Figure 9.

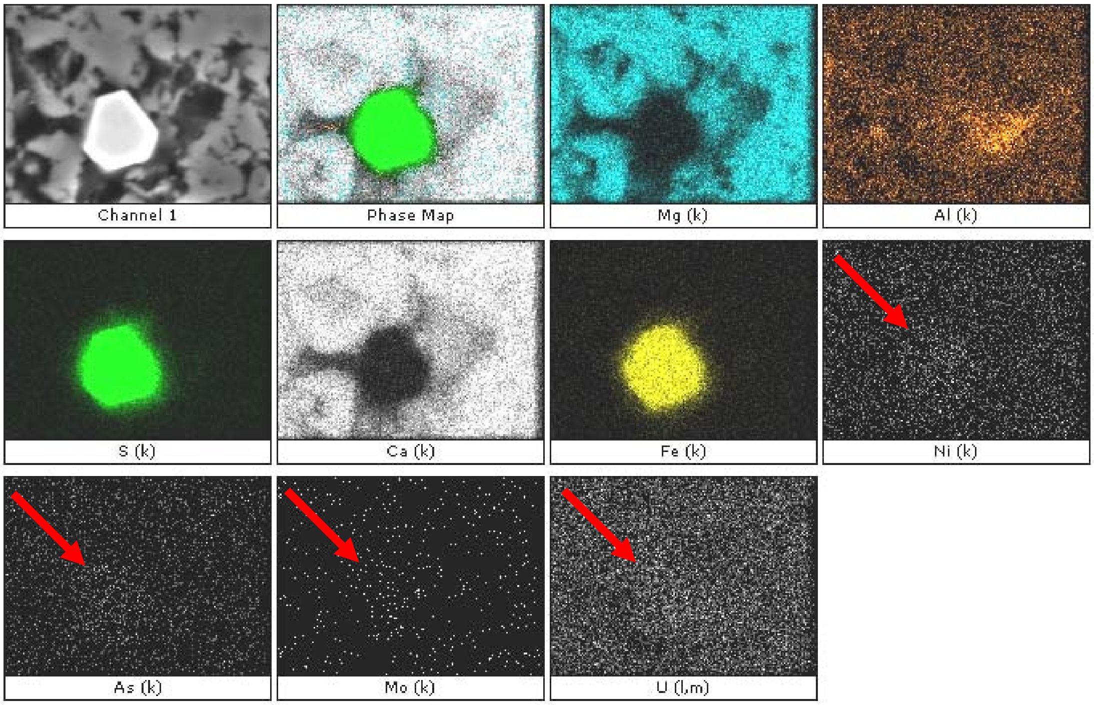

Figure 9. Element map of pyrite in Figure 8; 1209 ft. BLS. Visual and analytical detection limit is on the order of 1-2 weight percent. While Fe and S are highly visible as expected, only trace amounts (ppm level) of As, Ni and U are likely present in this crystal, therefore the visual pattern is at best very faint (see higher density "cloud" at tip of red arrow corresponding to location of pyrite crystal in other frames).

Matrix geochemistry

Whole-rock geochemical analyses are tabulated in **Appendix 7**. A correlation matrix (**Appendix 8**) was calculated for the whole-rock geochemical data set. Correlation coefficients > 0.666 denote a 95% level of significance. Numerous statistically significant correlations exist, such as 1) Fe_2O_3(T)[1] vs. SiO_2 (**Figure 10**), Al_2O_3, Sc, Cr, Ba, and Ce, 2) As vs. Sr(?) and Mo (**Figure 11**), 3) SiO_2 vs. Al_2O_3, Fe_2O_3, K_2O, Sc, Cr, and many rare-earth elements (REEs), 4) Th vs. SiO_2, Al_2O_3, K_2O, Sc, Cr and rare earth elements (REE), and 5) Ni vs. MgO (negative correlation). **Table 6** contains a subset of the data in Appendix 7 to facilitate comparison of rock chemistry to trends in leachate chemistry as presented in charts later in this section.

A dendogram of Avon Park dolostone lithogeochemical analyses (**Figure 12**) in the present study illustrates the relatively strong correlations between As and Mo, as well as cations associated with clay minerals (e.g., Si, Al, Sc, Cr and REEs). Correlations observed in Avon Park Formation samples in the CERP project (Arthur and others, 2008b) reveal a strong relation between Sr and SO_4, suggesting the presence of celestite. Moreover, in the CERP samples, As and Sb are strongly correlated. It is unknown whether these relationships simply do not occur in Orange County Avon Park Formation samples or if the dataset is too limited in number to discern the patterns.

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[1] Fe_2O_3(T) reflects total iron represented as Fe^{3+}

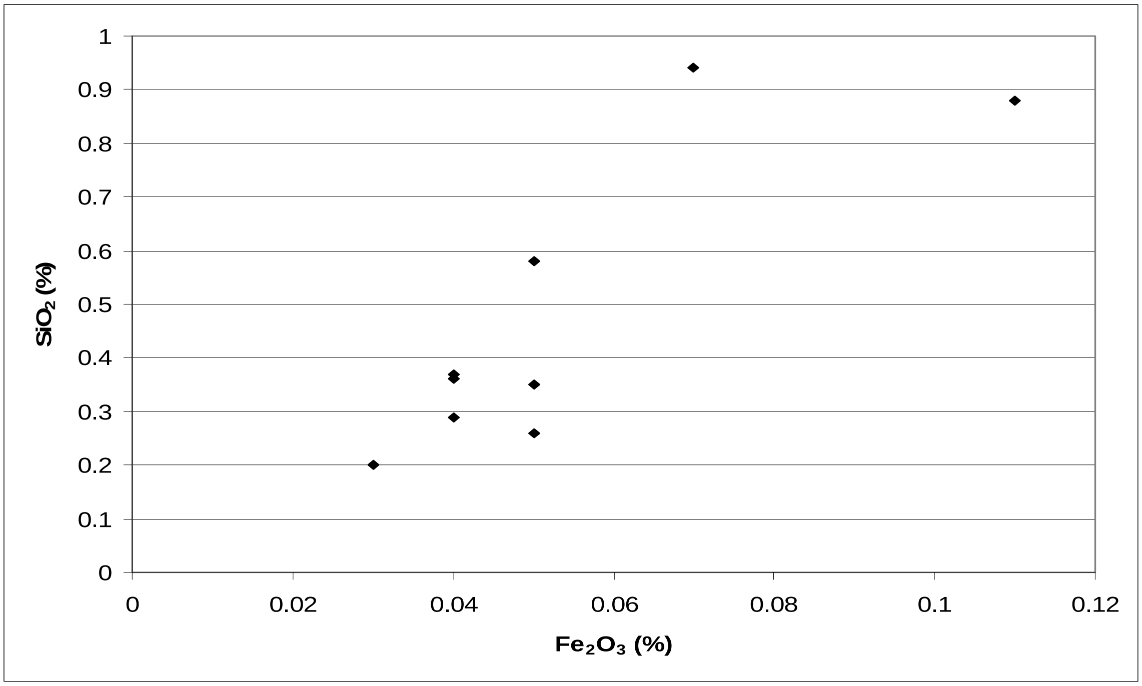

Figure 10. Whole rock concentrations: Fe_2O_3 versus SiO_2 (weight percent).

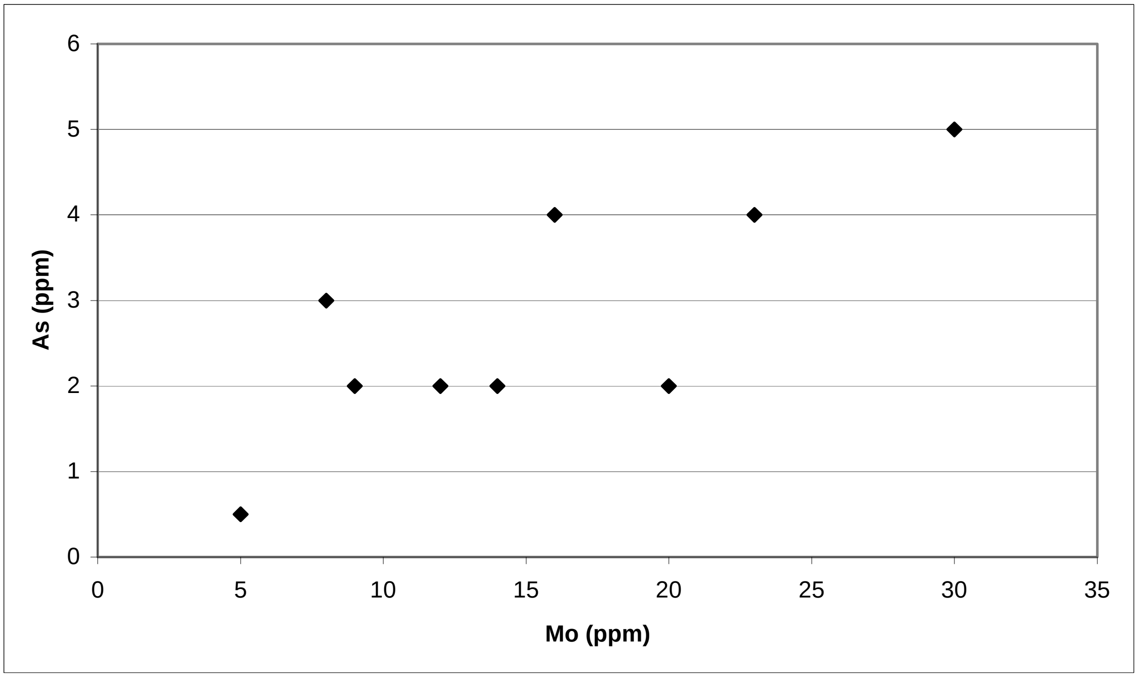

Figure 11. Whole rock concentrations: Mo versus As.

Table 6. Selected lithogeochemical analyses of Avon Park Formation dolostones.

Reaction Vessel Number		SiO2 %	Al2O3 %	Fe2O3(T) %	MgO %	CaO %	C-Organic %	S %	As ppm	Mo ppm	Ni ppm	Sb ppm	U ppm
	Detection Limit	0.01	0.01	0.01	0.01	0.01	0.05	0.01	1	2	1	0.1	0.01
	Depth (feet BLS)												
n/a	1097-1098	0.35	0.11	0.05	20.97	29.88	0.69	0.09	2	14	2	0.2	2.93
L1S	1099-1100	0.20	0.07	0.03	21.09	30.09	0.22	0.04	1	5	2	0.1	1.89
n/a	1103-1104	0.29	0.09	0.04	21.09	29.84	0.27	0.06	4	16	3	0.3	2.60
n/a	1111-1112	0.37	0.10	0.04	21.19	29.94	0.49	0.09	2	20	5	0.2	3.56
L2S	1117.8-1118.6	0.26	0.08	0.05	21.19	30.43	0.05	0.04	5	30	2	0.2	2.27
L3S	1130.4-1131.3	0.88	0.30	0.11	20.94	30.15	0.42	0.06	3	8	3	0.2	2.55
L4S, L4aS	1155-1156	0.58	0.20	0.05	20.63	30.05	0.19	0.05	4	23	9	0.5	3.18
L5S	1182-1183	0.36	0.11	0.04	21.14	30.52	0.23	0.05	2	12	3	0.2	3.81
L6S	1209-1210	0.94	0.30	0.07	20.99	29.69	0.22	0.08	2	9	4	0.1	2.98

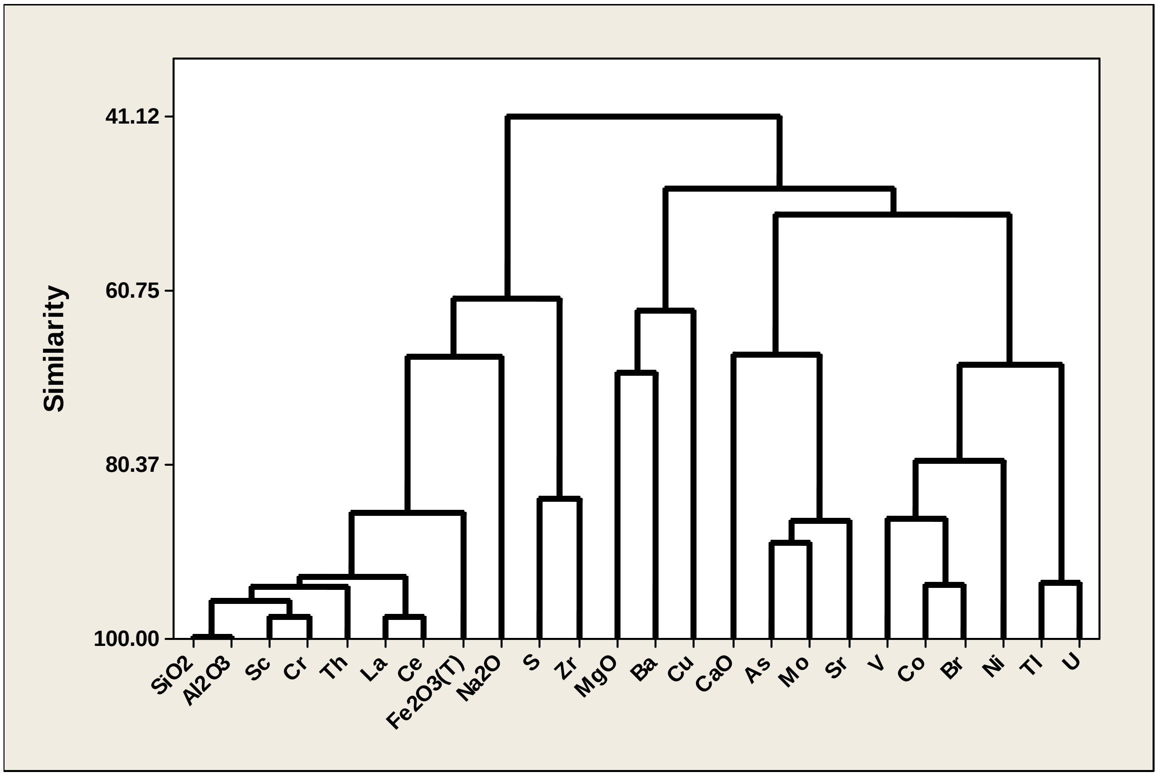

Figure 12. Dendogram of lithogeochemical analyses for selected metals and oxides.

Bench-scale Leaching

Of particular interest in this study is the mobilization of As due to water-rock interactions during simulated ASR conditions in the laboratory. Research indicates that pyrite oxidation is a primary mechanism responsible for the mobilization of As into recharged and recovered water during ASR (e.g., de Ruiter and Stuyfzand, 1998; Pichler and others, 2004; Arthur and others, 2005). During recovery, however, other As desorbing processes may occur. Water-quality changes observed during simulated (bench-scale) "cycle tests" employed prior ASR geochemical studies (e.g., Arthur and Dabous, 2008; Arthur and others, 2008a, 2008b) clearly defined mobilization of As and other trace metals from core material when exposed to high-DO conditions (i.e., DO > 7 mg/L).

The goal of the bench-scale study experimental design (Table 3) was to establish initial anoxic conditions (i.e., LDO; generally < 0.3 mg/L) in which oxidation of As-bearing phases (e.g. pyrite or NOM) would not occur upon the addition of source water (SW). Phase 1a comprised an initial "shock" of high-DO DDI in an attempt to remove highly soluble metals. For example, had pyrite oxidized to Fe-sulfate in the cores during storage, phase 1a was an opportunity to leach highly soluble metals. The DDI was replaced by SW at the start of phase 1b. Phase 2 began as the air head space was replaced by N_2 (gas), inducing LDO conditions. Purposeful oxidation via air sparging (phase 3) was expected to intensify desorption or oxidative dissolution of certain metals and perhaps allow assessment of HDO precipitates. If sufficient dissolved Fe and appropriate ORP conditions exist in the leachate during phase 3, precipitation of hydrous ferric oxides (e.g., Fe-oxyhydroxide, ferrihydrite or ferric hydroxide hereafter referred to as HFO) may occur.

To further isolate As mobilization processes, a new experimental design was employed in the present study. After completion of the original protocol for the bench study, the research was extended to include another LDO – HDO "cycle." This final cycle differs in that the agent to remove DO is a mixture of 5% H_2S (gas) and 95% N_2 (gas), rather than pure N_2 (gas). Further details on this procedure are outlined in **Methods**.

For discussion purposes, the hydrochemical results based on the initial protocol are presented first and include **Figures 13 - 23**. In context of experimental phases, (Table 3) the time span includes phases 1a, 1b, 2 and the first week of phase 3 (ending on 9/1/06). Note that the geochemical "blank" sample (i.e., no rock, only SW) is sample "LBS" in the charts. The duplicate rock sample, which was split into two reaction vessels, is labeled "L4S" and L4aS."

The extended dataset began on 9/1/06, thereby extending the duration of phase 3. Hydrogeochemical sampling during the extended period did not begin until the morning of 1/29/07, ending the "HDO2" period (Table 3). Replacement of the air head space in the reaction vessels with the H_2S (gas) mixture occurred mid-day on 1/29/07, marking the beginning of phase 4 ("LDO2"). A sample was collected from each reaction vessel during the afternoon of 1/29/07; thus two samples are shown for that day on the time-series charts reflecting the extended dataset (**Figures 24-28**). Phase 5 ("HDO3" on the charts) began on 2/2/07 and extended until 5/1/07. This phase was included to assess potential As re-sorption due to presence or precipitation of HFOs, or As desorption due to further pyrite oxidation, or a combination of the two processes.

In the time-series charts that include only the HDO1-LDO1-HDO2 sequence (Figures 13-21) the effects of changing DO from ~7.4 mg/L (HDO conditions) to 0.3 mg/L (LDO conditions) were minimal. The most notable change was in the leachate pH (Figure 13) where exposure to CO_2 (gas) in the air contributed to lowering the pH. Geochemical reactions discussed below also influenced pH to some degree.

Maximum As concentrations in the leachates occur in sample L2S, which corresponds to the rock sample with the highest As (Table 6). This relationship, however, is not always observed in leaching studies (Arthur and others, 2008b). Molybdenum and Sb (Figures 16 and 17) tend to follow the As pattern, with no response to changing DO concentrations. On the other hand, Ni and U (Figures 15 and 18, respectively) exhibit a slight decline in leachate concentrations upon the onset of LDO conditions. Overall, the metals As, Mo, Ni, Sb, and U are strongly desorbed

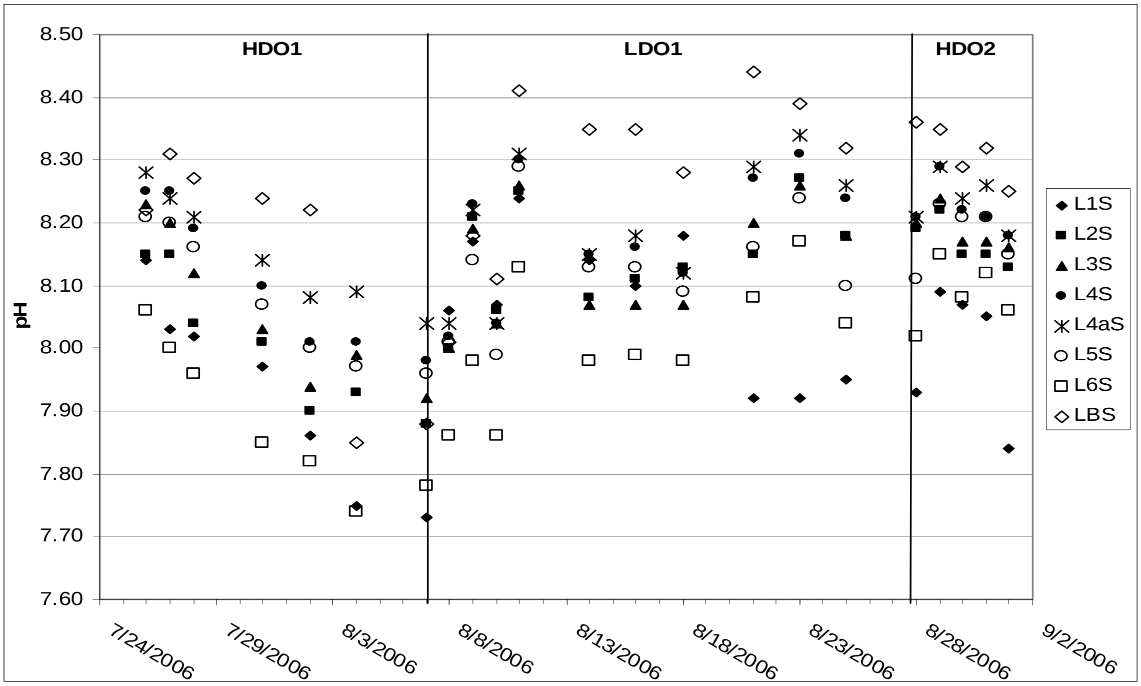

Figure 13. Bench-scale leachate pH values; initial dataset.

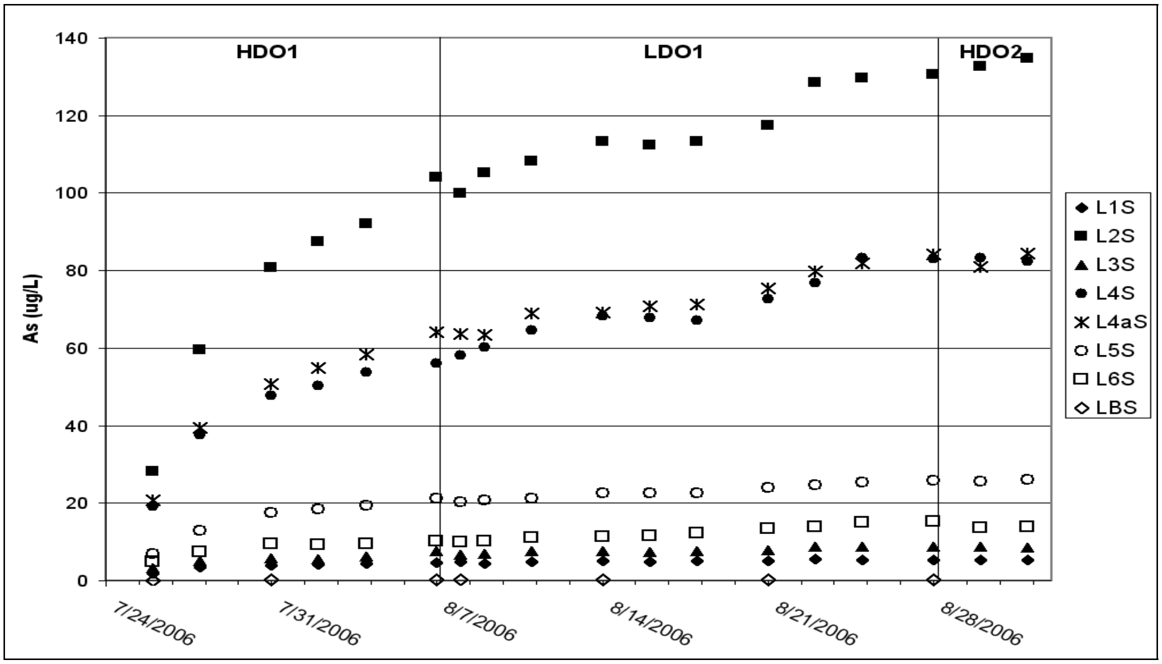

Figure 14. Arsenic concentrations in leachates; initial dataset.

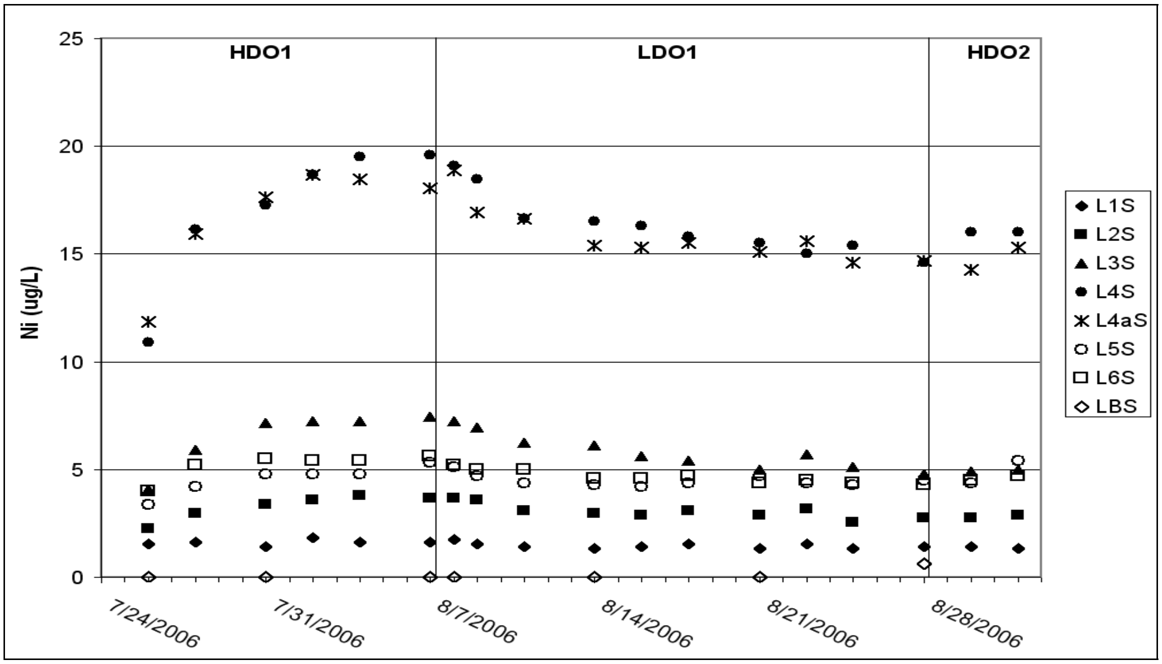

Figure 15. Nickel concentrations in leachates; initial dataset.

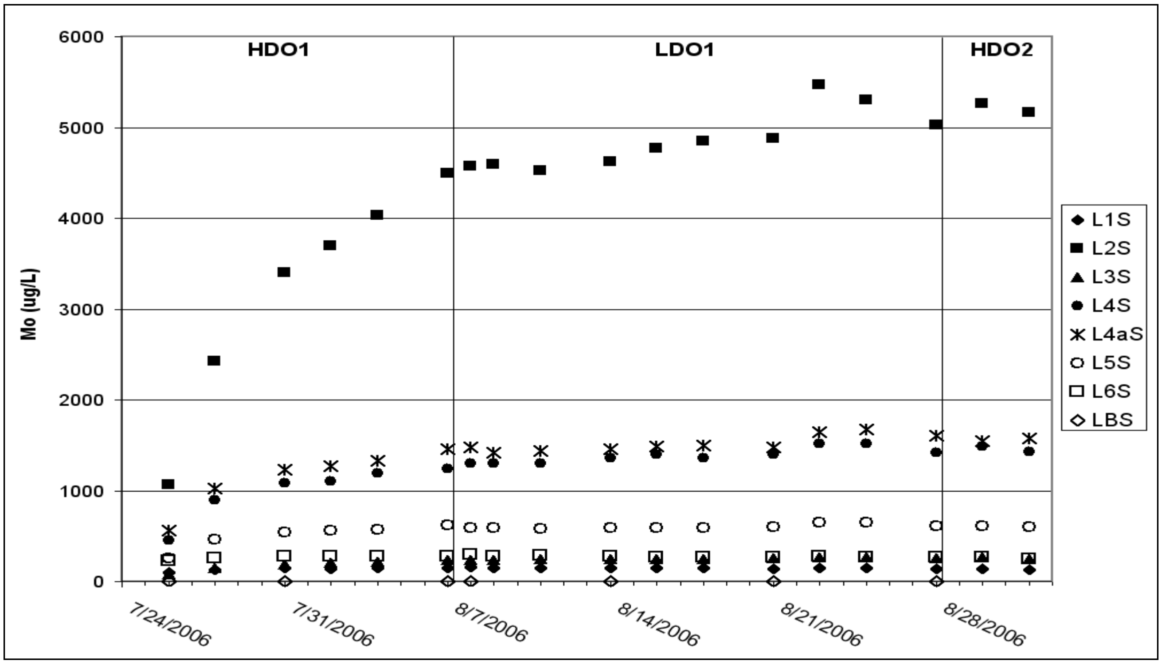

Figure 16. Molybdenum concentrations in leachates; initial dataset.

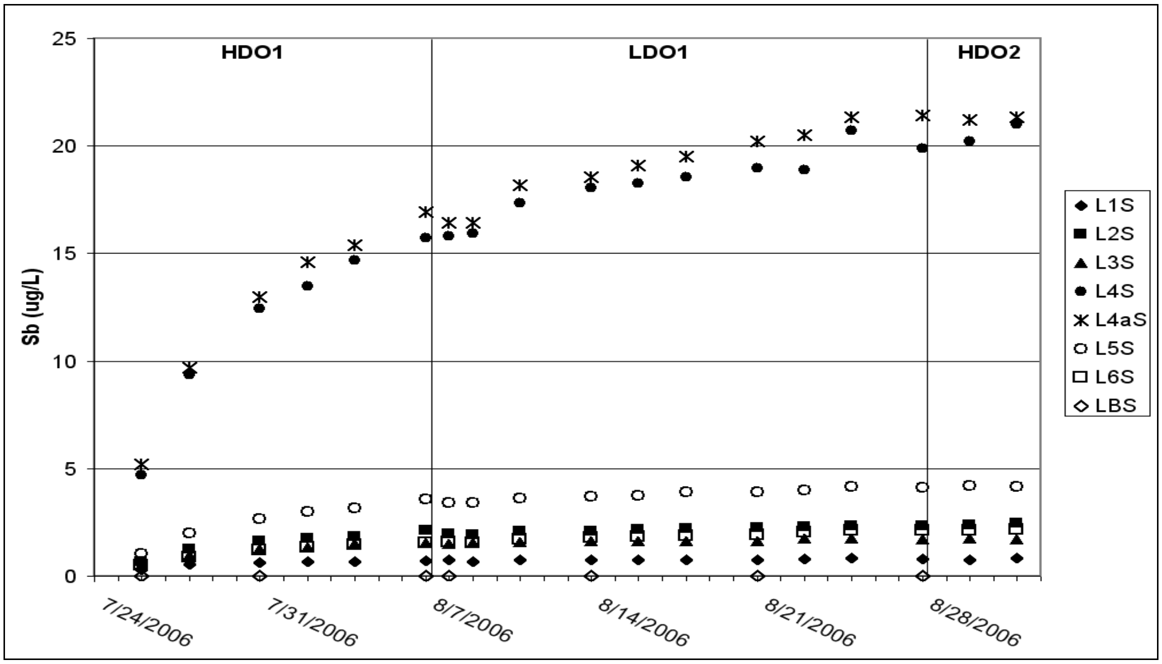

Figure 17. Antimony concentrations in leachates; initial dataset.

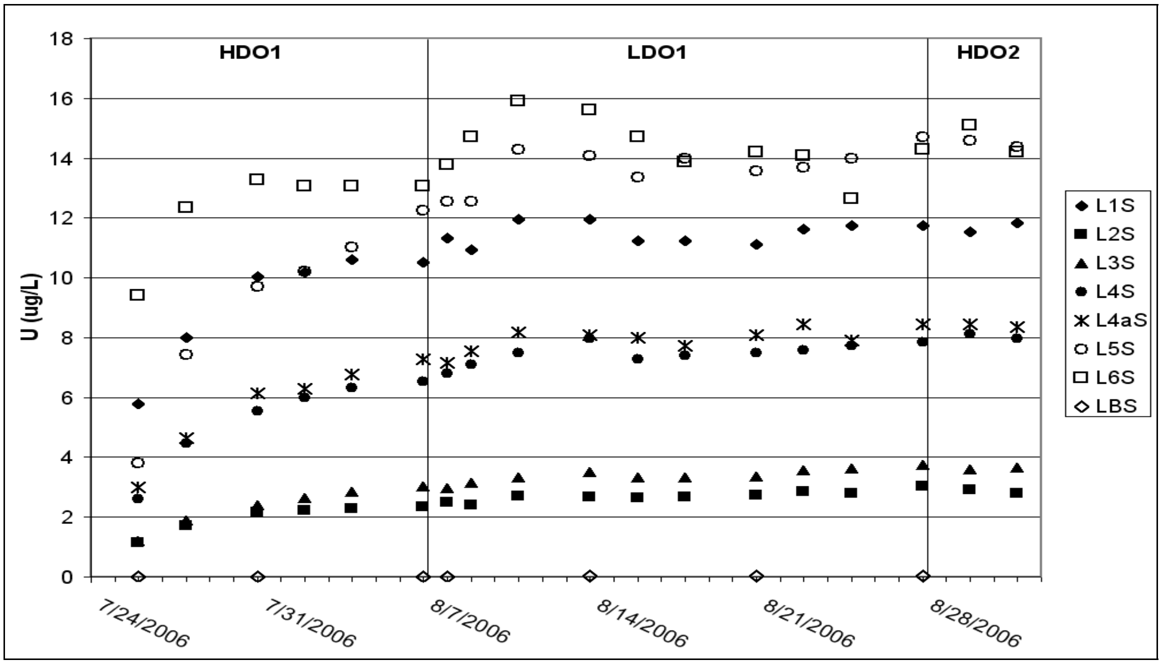

Figure 18. Uranium concentrations in leachates; initial dataset.

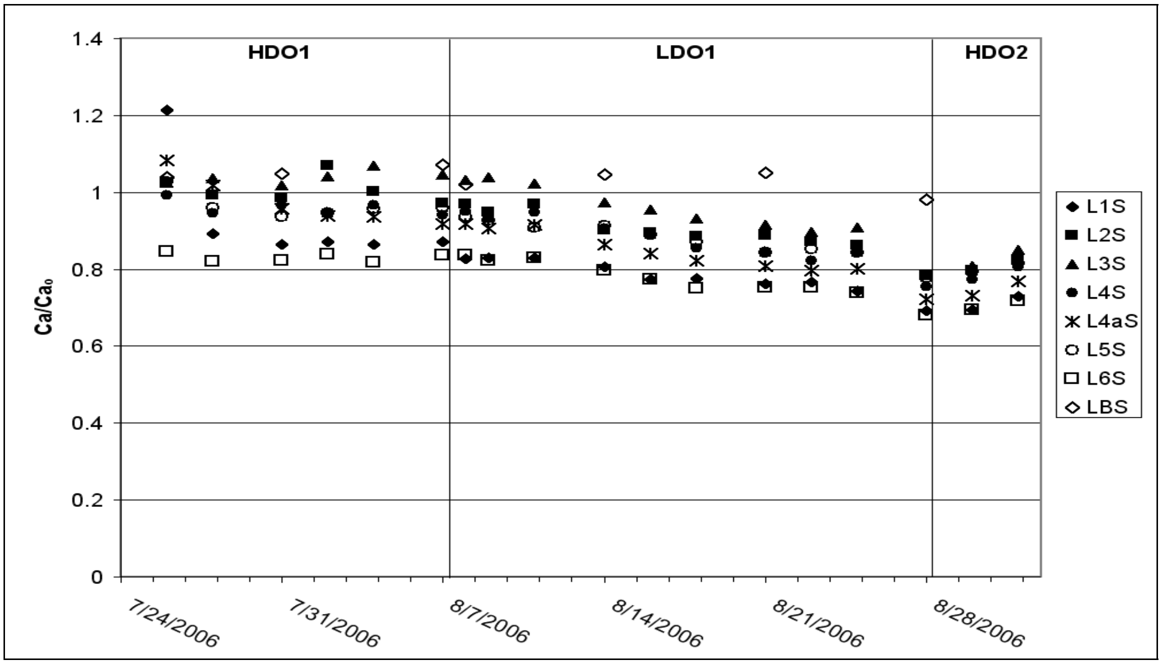

Figure 19. Normalized Ca concentrations in leachates; initial dataset; C/Co = leachate/original (source water) composition.

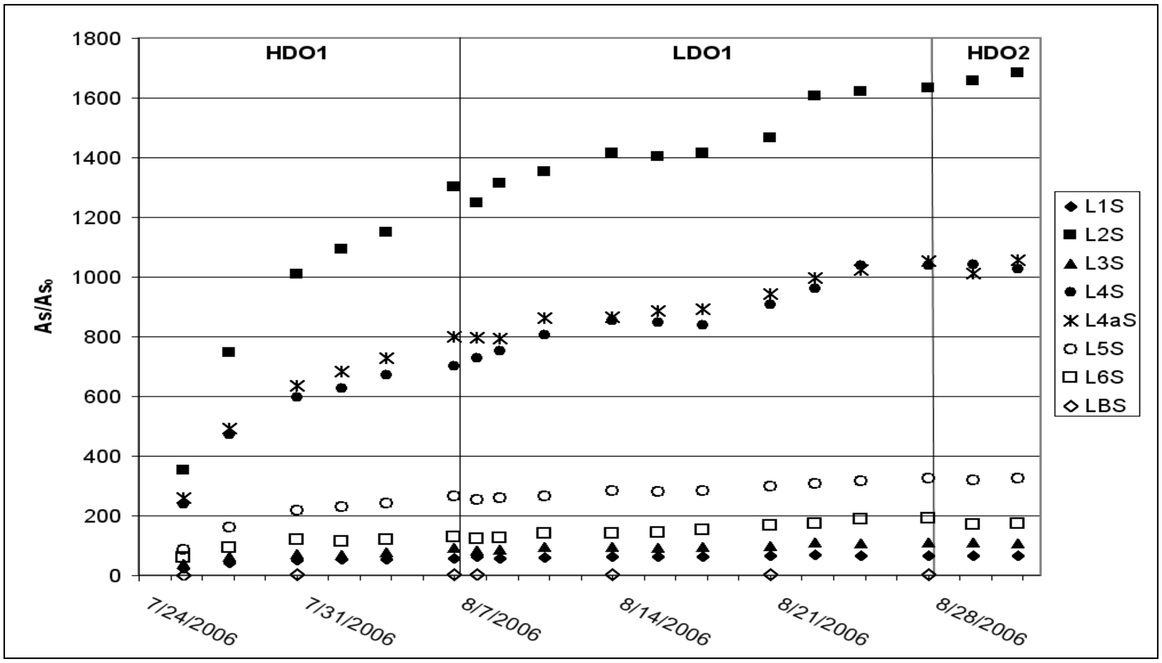

Figure 20. Normalized As concentrations in leachates; initial dataset; C/Co = leachate/original (source water) composition.

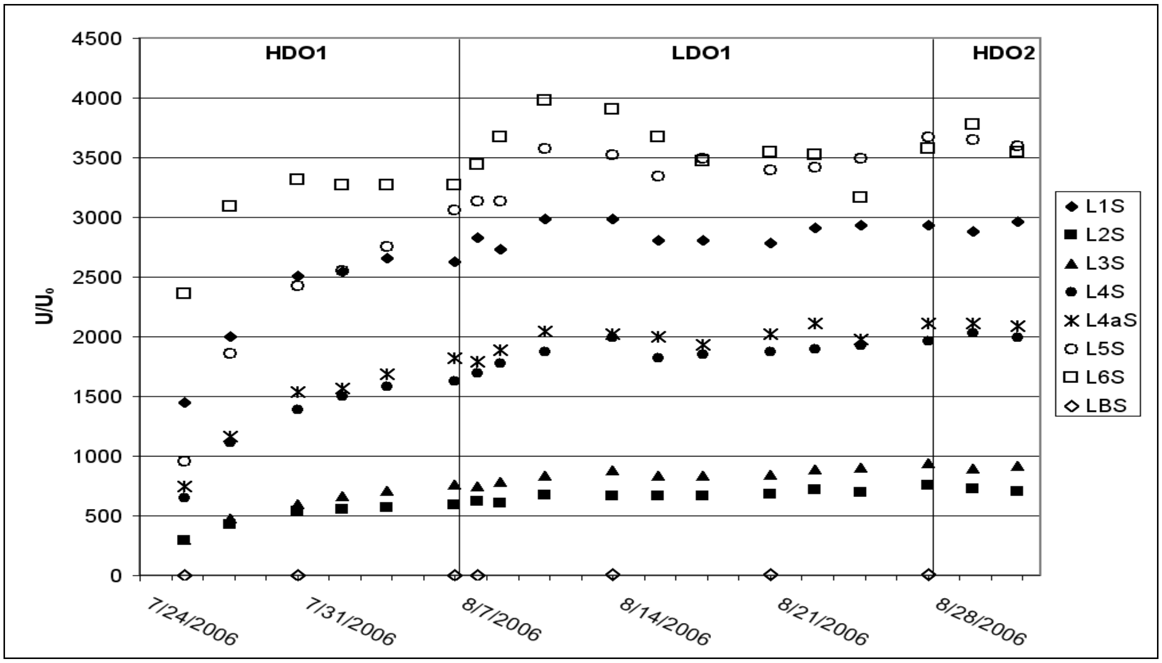

Figure 21. Normalized U concentrations in leachates; initial dataset; C/Co = leachate/original (source water) composition.

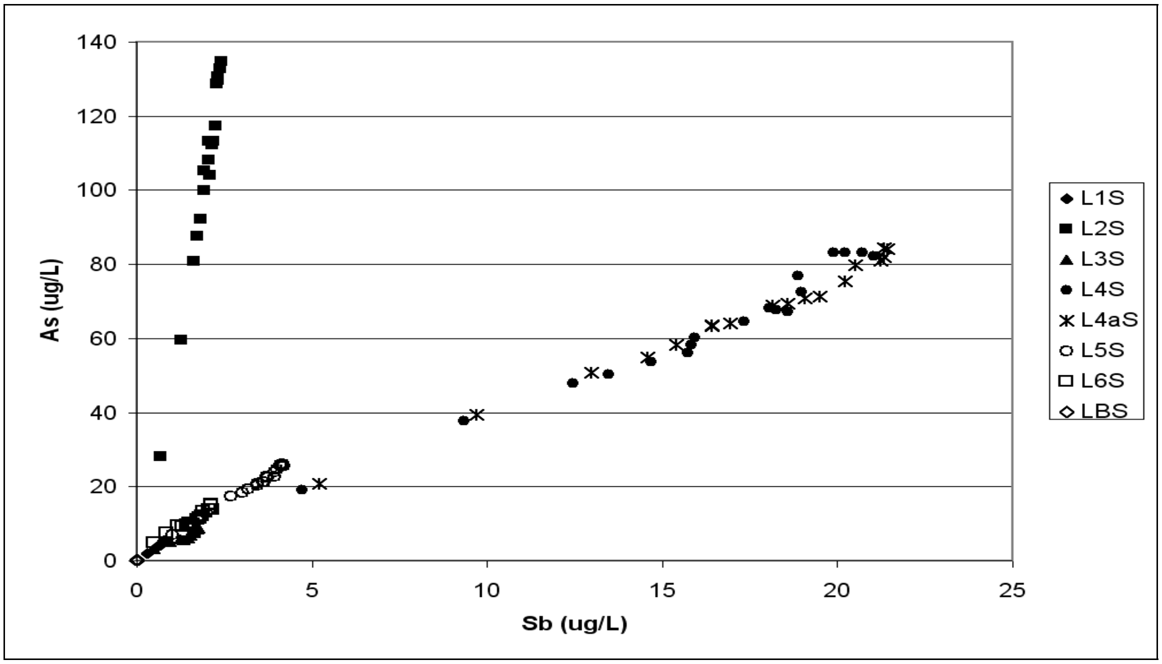

Figure 22. Bivariate relation between Sb and As in leachate samples.

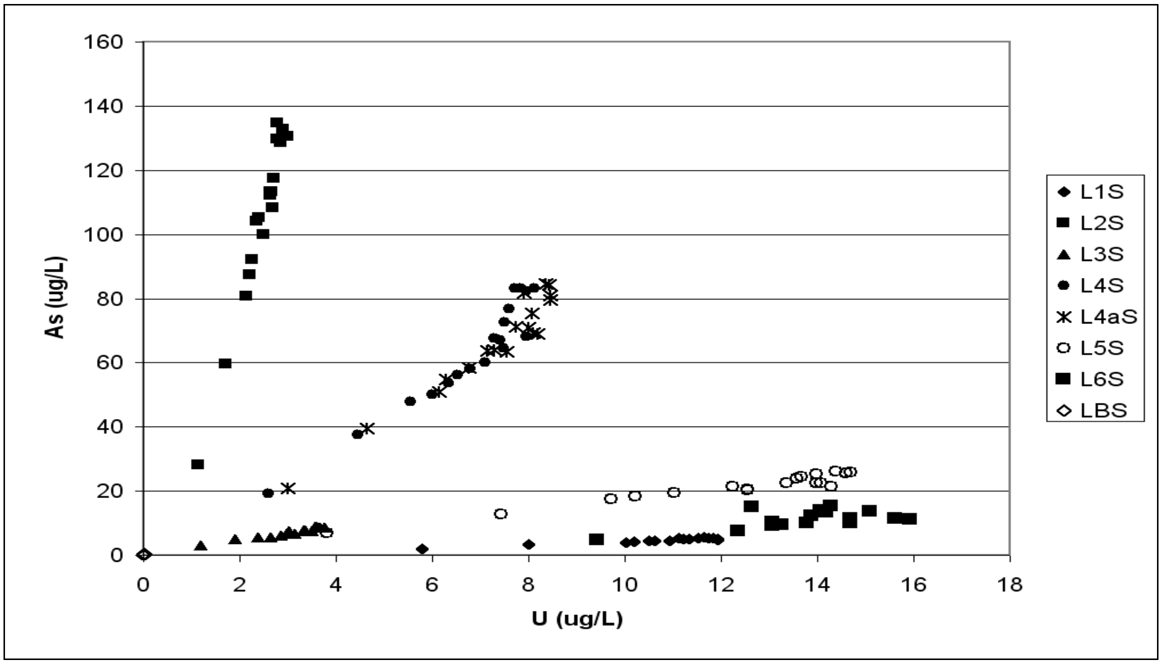

Figure 23. Bivariate relation between U and As in leachate samples.

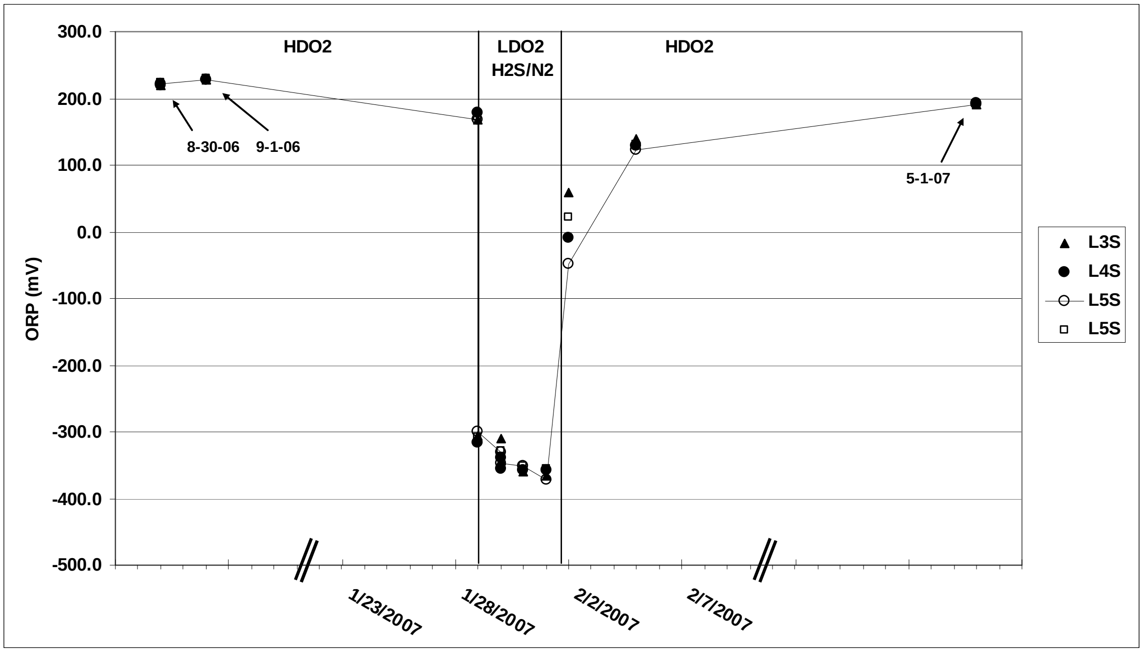

Figure 24. Oxidation-reduction potential (ORP) in leachate samples; extended H_2S dataset.

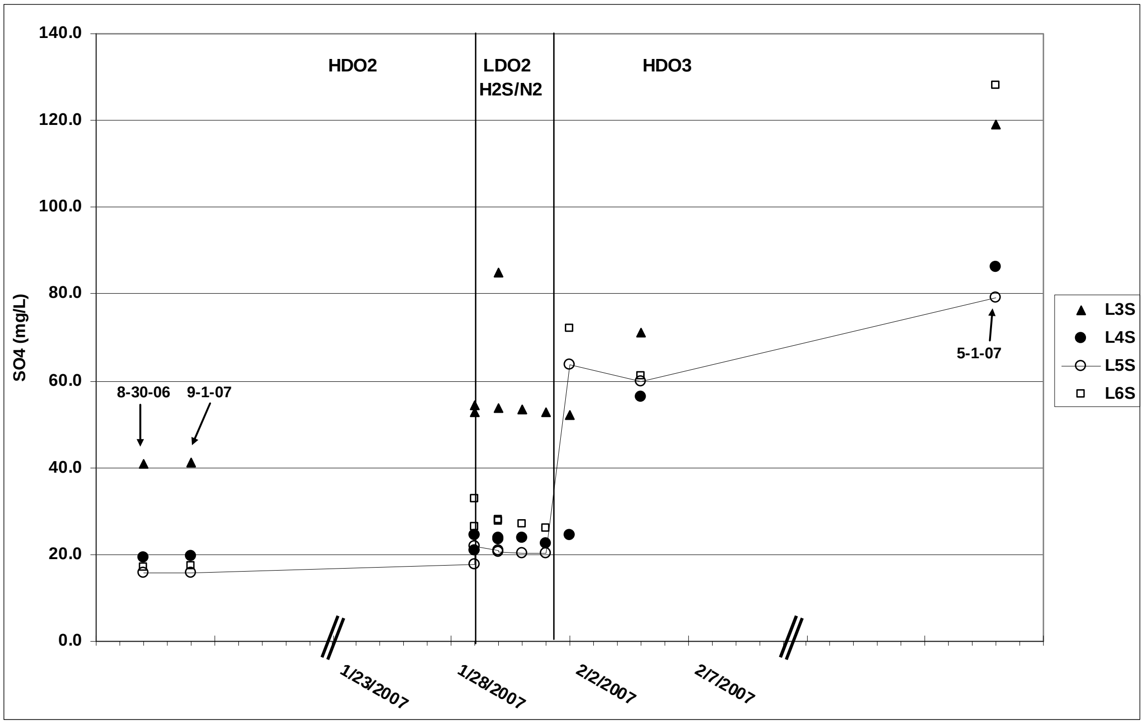

Figure 25. Sulfate concentrations in leachate samples; extended H_2S dataset.

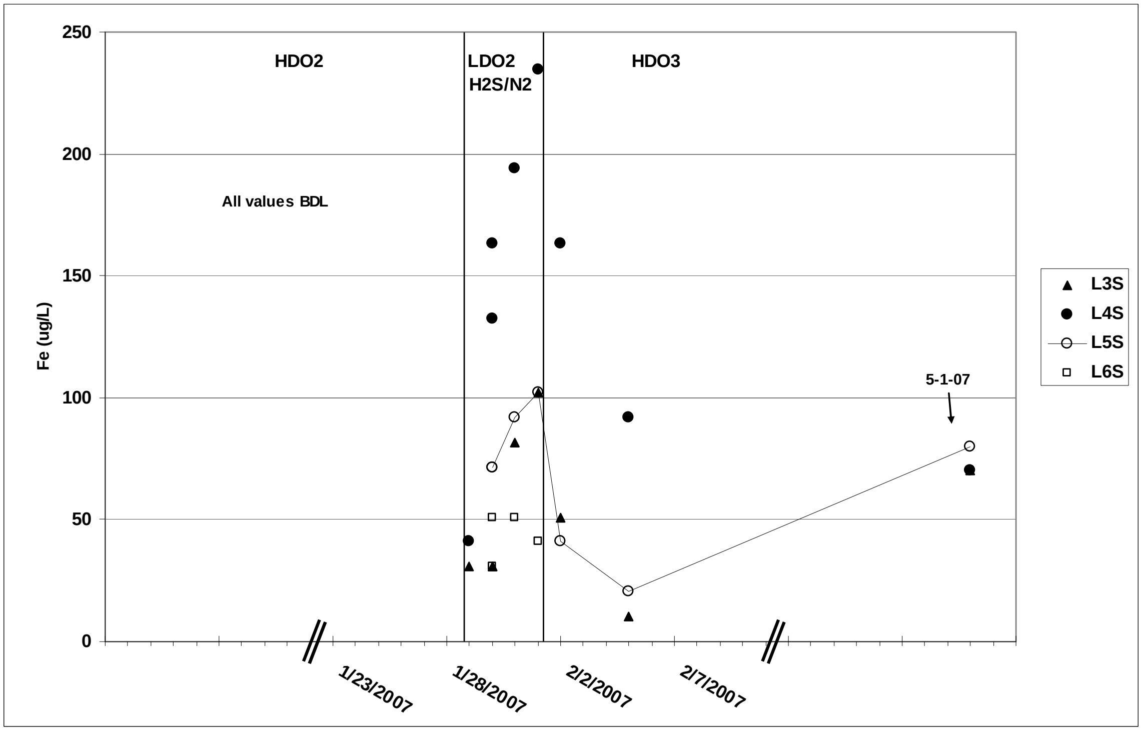

Figure 26. Iron concentrations in leachate samples; extended H_2S dataset.

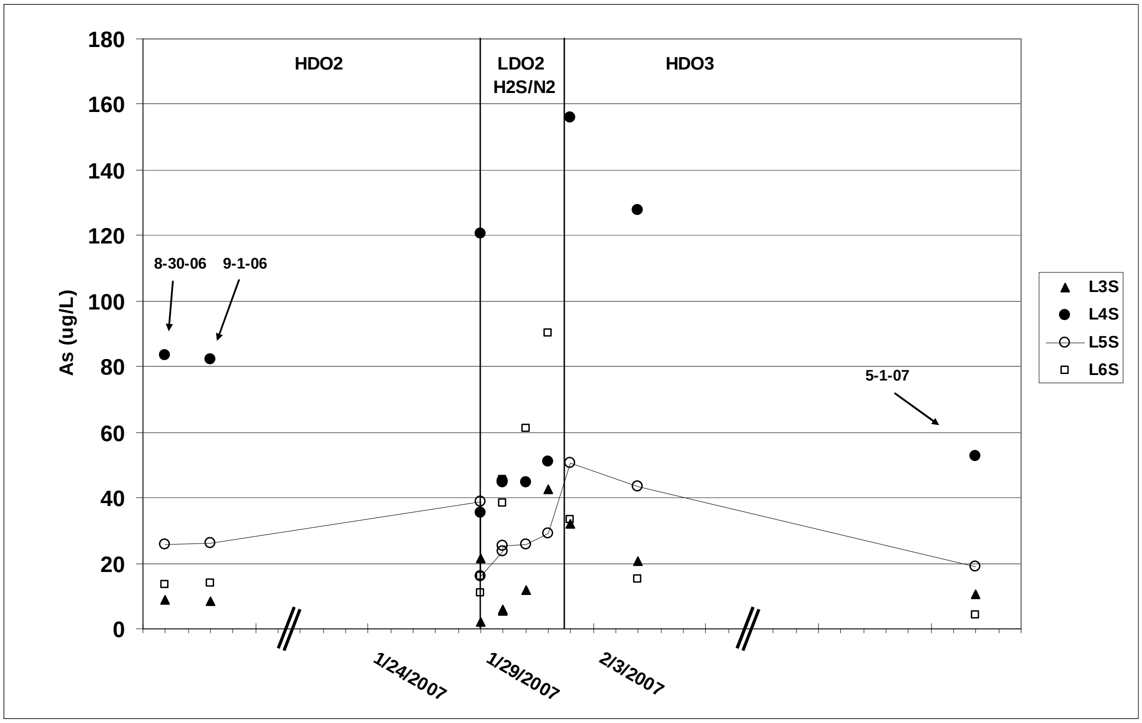

Figure 27. Arsenic concentrations in leachate samples; extended H_2S dataset.

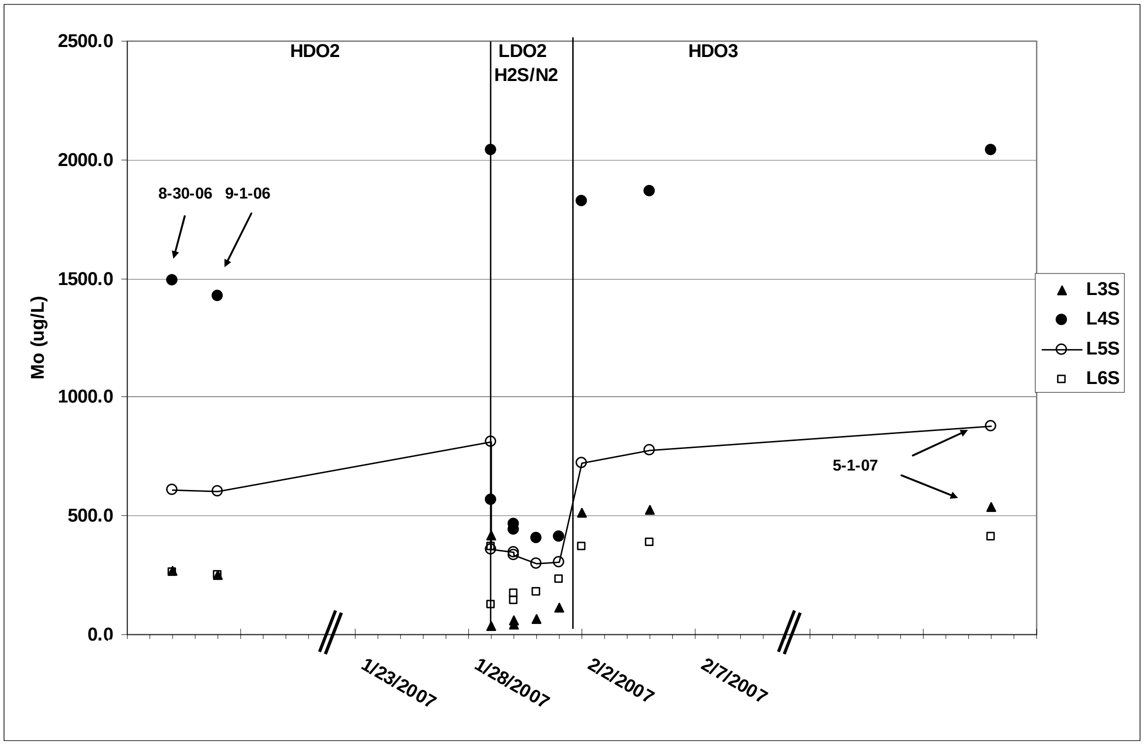

Figure 28. Molybdenum concentrations in leachate samples; extended H_2S dataset.

from the aquifer matrix as denoted by the increasing concentrations in the leachate. A review of **Appendix 9** indicates that this observation applies to numerous cations.

Normalized concentrations (C/Co) for Ca (Figure 19) suggest approximately 20% undersaturation (i.e., sorption or precipitation from the leachate solution). Due to low or BDL concentrations in the SW, patterns for normalized As and U (Figures 20 and 21) mirror that of Figures 14 and 18 (As and U, non-normalized).

Strong positive correlations between As and Sb (Figure 22) and U (Figure 23) are observed in the leahcate. Note, however, that the ratio differs between samples, especially with respect to As:U. Although the geochemical affinity between As and Sb is widely known, the differing slopes and the As-U relation warrant further study.

Four samples (L3S, L4S, L5S, and L6S) were selected for continued analysis under the extended bench-scale protocol that included phases LDO2 and HDO3. Selected parameters in the extended dataset are summarized in time-series charts (**Figures 24-28**). In each chart, a line is drawn across one representative sample dataset to emphasis the overall pattern. During the period prior to LDO2, the ORP generally remained at levels exceeding +100 mV (Appendix 9). Upon initiating LDO2 conditions utilizing 5% H_2S (gas) the ORP rapidly declined to below -300 mV (Figure 24). This drop occurred within a period of 4 hours (recall that the last HDO2 sample and the first LDO2 sample were collected on the same day). Sulfate concentrations exhibit a slight to sharp increase across the transition from HDO2 to LDO2 (Figure 25). Upon re-oxidation of the leachate, dissolved sulfate increases, most notably in sample L6S. During HDO2, Fe is below detection; however, the leachate increases in Fe concentration during LDO2 (Figure 26). Iron decreases during phase 5 (HDO3). A rapid reaction rate is also observed in As and Mo (Figures 27 and 28), where both cations drastically decrease in leachate concentration at the onset of LDO2 conditions, but sharply increase upon re-oxidation of the leachate. Arsenic and Mo differ during HDO3, however, in that Mo remains relatively constant and As exhibits a decrease in leachate concentration. During LDO2, the only consistent pattern in the charts is an increase in As and Fe leachate concentrations.

Sequential Extraction

Sequential extraction (SE) involves subjecting rock samples (powdered) to a series of solutions designed to selectively leach constituents from the rock according to their association with mineral phases and organic material. Step 1 involves exposure of the sample to DDI water and analyzing the leachate, similar to that of the bench-scale study; the difference being that SE involves hours rather than days/weeks of exposure to water. Step 2 characterizes metals that are bound to carbonate minerals. In dolostone, for example, one would expect most of the Mg and Ca to be leached into solution. Extracts from step 3 reflect elements bound to Fe- and Mn-oxide minerals. Step 4 identifies elements associated with organics and step 5 identifies elements associated with sulfide minerals. Details of this procedure are described in Methods. Hydrogeochemical analyses of SE samples are tabulated in **Appendix 10,** separated by extraction step. Anions were analyzed for step 1 extractants to assess presence of highly soluble pyrite oxidation products.

In Appendix 10, hydrogeochemical analyses of the extractants have been corrected for both volume and mass, and are expressed as % for the major elements and as ppm for the trace elements. This conversion allows direct comparison with whole-rock lithogeochemistry. Due to matrix effects, detection limits vary with each SE step; these detection limits have also been corrected for mass and volume.

For each SE step, hydrochemical patterns within extractant data and relative soluble proportions facilitate identification of metal-mineral relationships. Before identifying and interpreting these patterns, two important aspects of the SE results warrant discussion. First, the water-soluble step is clearly requisite for interpreting results from the subsequent steps. However, while step 1 results are discussed to some degree, the bench-scale leaching studies provide much more comprehensive detail regarding solubility of rock constituents. Step 1 utilized DDI water high in DO and low in initial ionic strength. As such, results are to be interpreted accordingly.

The second aspect pertains to the SE protocol selected for this study, which was validated by analyzing pure pyrite. The results of this test were excellent; however, the SE procedure was based on techniques employed for siliciclastic rocks. While the method worked well for pure sulfide minerals, high-carbonate rocks yield different results. None of the methods on which our protocol was based used pure carbonate rocks, which, resulted in the carbonate mineral volume overwhelming extraction step 2 (carbonate-bound metals). The amount of Ca extracted during step 2 ranged up to ~24%. Upon completion of all steps, however, approximately 90% of Ca in the rock was recovered during SE. Results of step 2 are meaningful, yet because carbonate dissolution was incomplete, any interpretations should recognize that calcite was preferentially leached relative to dolomite, as indicated by assessment of Ca:Mg ratio. Carbonate minerals remaining after step 2 were dissolved primarily during steps 3 and 5, therefore any interpretations of the data must take this overprint into account. Based on assessment of Ca percent recovery, results of step 4 are minimally affected.

Dendograms reflecting correlations within each extraction step (**Figures 29 – 33**) allows for identifying metal associations with respect to solubility and bond-type. For the most part, the dendograms include only those elements for which three or more analyses were above the detection limit. As a result, some elements are not shown for different steps in the procedure.

Correlations in the extractant data for the water-soluble step (step 1; Figure 29) exist between Ca, Sr and SO_4, suggesting the presence (and dissolution of) of gypsum and celestite. Although As concentrations in this fraction are very low, and comprise less than 3% of the total extracted As (**Appendix 11**), statistically significant correlations between As and other elements detected in this fraction exist (e.g. As-Mo, As-Sb, As-Tl). Given that Fe was BDL in this step, there is no evidence of dissolution of $FeSO_4$, which would have perhaps reflected pyrite oxidation products. On the other hand, absence of Fe in the extractant may be due to HFO precipitation. The most water-soluble element is Mo (**Figure 34**), which comprises more than 50% of the total extractible Mo (Appendix 11). The Mo concentrations released in this step, however, average 6.3 ppm.

Dominant elements extracted during step 2 (carbonate fraction) include Mg, Ca, V, Ni, Sr, Mo, Ba, and U (Appendix 11). Significant correlations between As and several other extracted elements occur (e.g. Mo, Sb, U, V). In the cluster analysis (i.e., dendogram, Figure 30), four metal associations exist: 1) Mg, Ca, Sr and Na, 2) V, As, Mo and Sb, 3) K and Al, and 4) Co and Ni. These relationships, especially in group 2 warrant further study in the context of As occurrence in carbonate minerals.

Elements released during step 3 (oxide fraction) indicate minimal association with or presence of oxides in the analyzed samples. The most notable constituents released during this step are U and

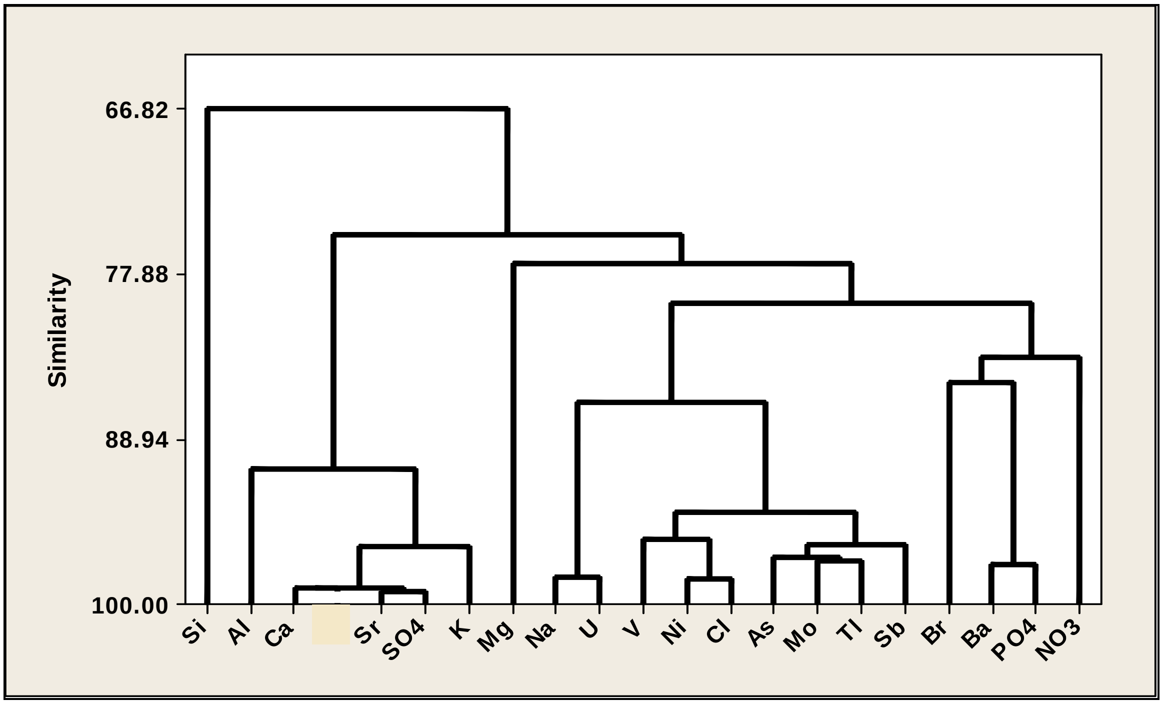

Figure 29. Dendogram showing the relationships among species extracted from the Orange County core samples in step 1 (Water Soluble).

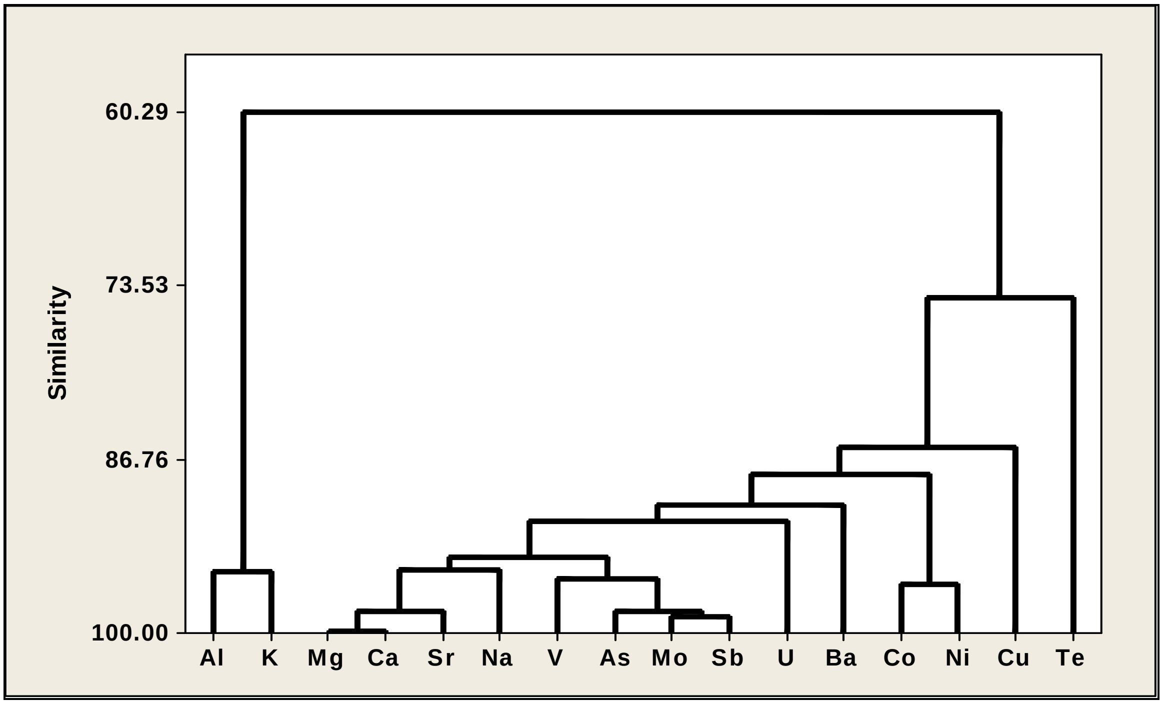

Figure 30. Dendogram showing the relationships among species extracted from the Orange County core samples in step 2 (Carbonates).

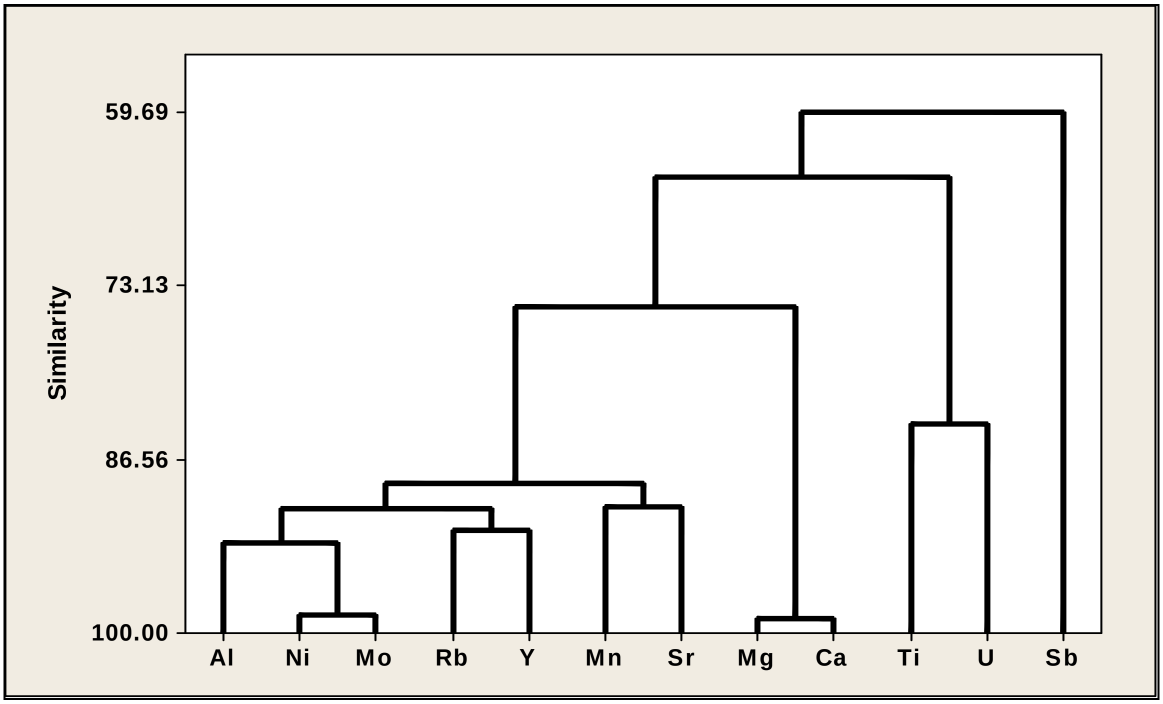

Figure 31. Dendogram showing the relationships among species extracted from the Orange County core samples in step 3 (Oxides).

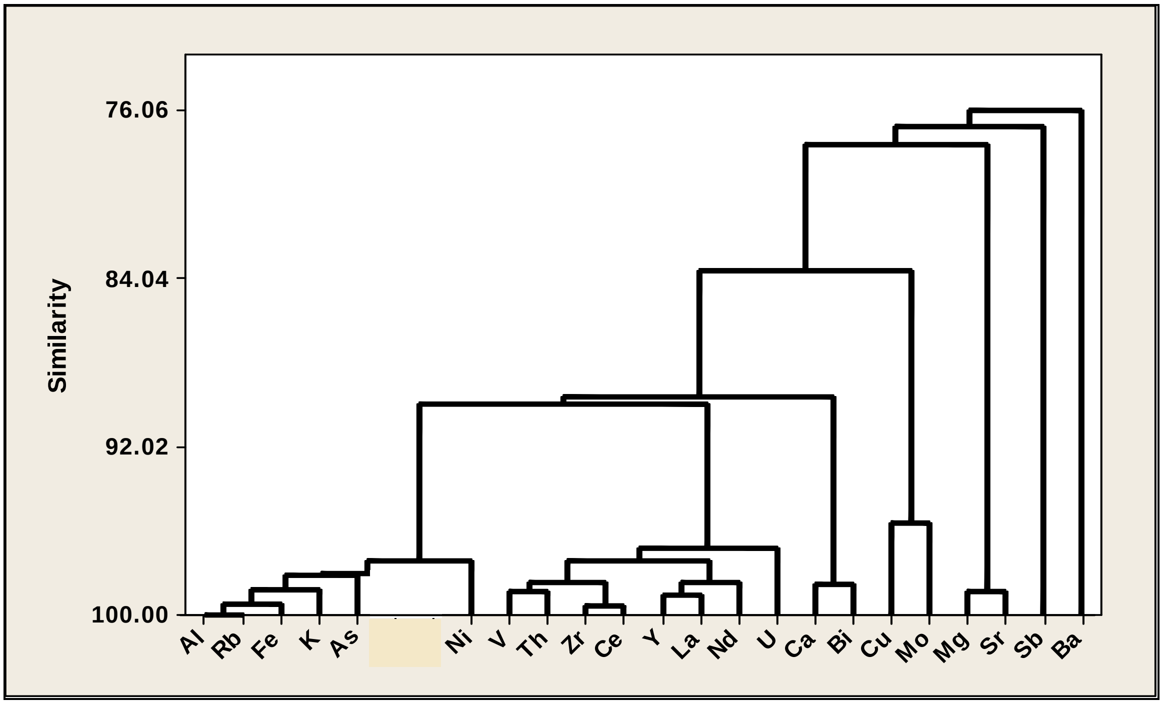

Figure 32. Dendogram showing the relationships among species extracted from the Orange County core samples in step 4 (Organics).

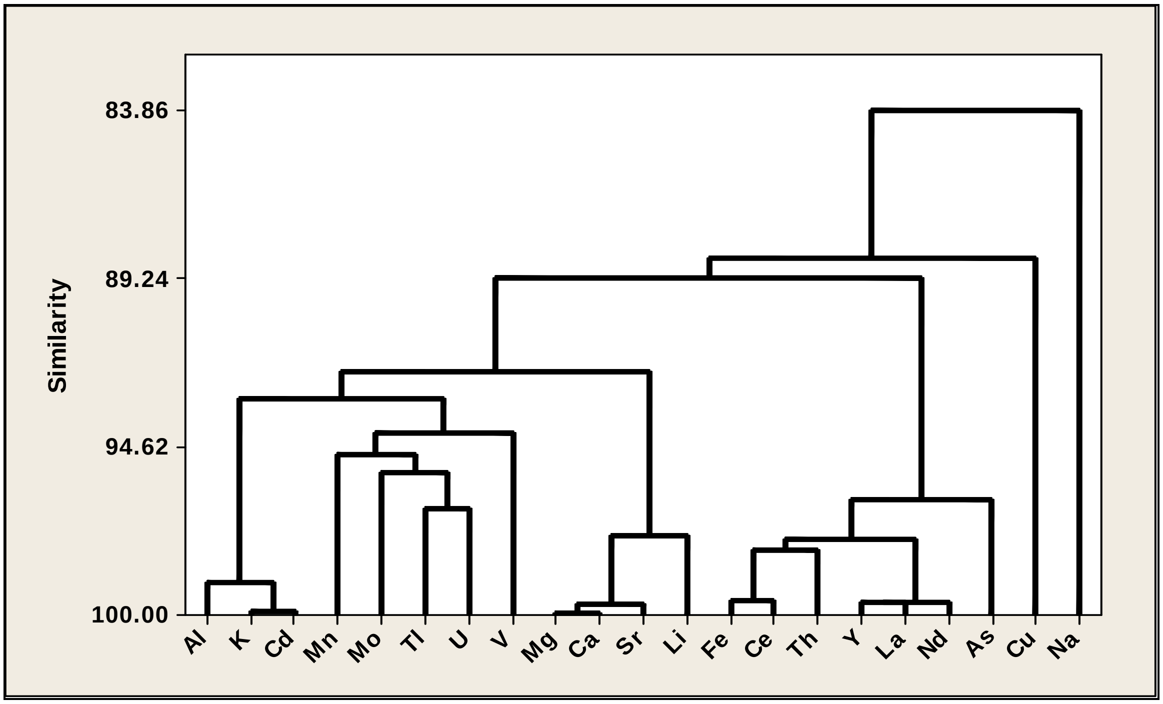

Figure 33. Dendogram showing the relationships among species extracted from the Orange County core samples in step 5 (Sulfides).

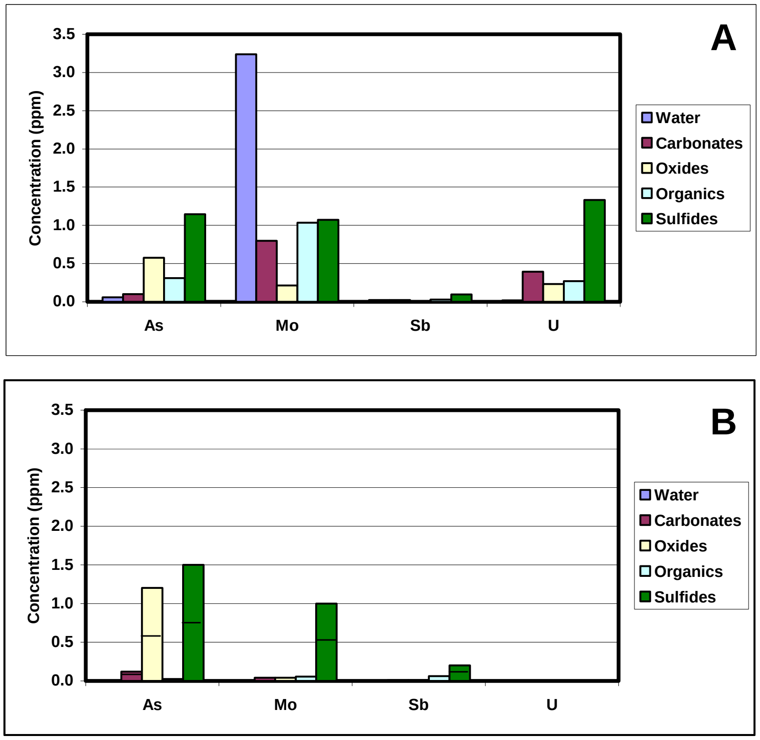

Figure 34. (A) Concentrations of selected elements extracted during each step of the sequential extraction procedure. (B) Detection limits and ½ detection limits (horizontal bars) for elements in (A).

Tl; however, this may reflect the carbonate overprint, which also includes release of Ca, Mg, Sr, Mo, and Ni. A strong correlation between Ca and Mg also documents the carbonate effect (Figure 31). Several additional correlations exist between, yet the patterns are not readily explained (e.g., Rb-Y and U-Ti). The dendogram does not include Fe and As because many of the extractants were below detection for these elements, thus a correlation coefficient was not valid.

Elements extracted in the organic step include Fe, Mg, Ca, K, V, Ni, Cu, As, Sr, Zr, Mo, Ba, Ta, Th, U and REEs. The dendogram (Figure 32) reveals several clusters. Perhaps the most notable are Al-Rb-Fe-K (and As - Ni to a lesser extent) and V-Th-Zr-Ce-Y-La-Nd-U. The first cluster likely reflects dissolution of clay minerals, which occurs dominantly in this step (e.g., Bates and others, 1978). The latter cluster reflects transition metals and REEs associated with NOM.

In the sulfide extraction step (step 5), a majority of the elements, including As, Fe and REEs occur in greatest proportion relative to the other steps. The dendogram (Figure 33) indicates strong correlations between Mg-Ca-Sr indicative of the carbonate overprint. This dendogram shows four main clusters: 1) Al, K and Cd, 2) Mg, Ca, Sr and Li, 3) Mn, Mo, Tl, U and V, and 4) Fe, Ce, Th, Y, La, Nd and As. The latter cluster probably reflects pyrite control.

Figure 34 illustrates concentrations for selected elements associated with each extract. As these data are considered, additional factors should be taken into account. As noted above, detection limits for each metal within each step differ because of matrix effects. In addition, the data and detection limits have been recalculated to allow direct comparison with rock chemistry. In the event that the extract analyses are below detection, ½ of the calculated detection limit is used for plotting and descriptive statistics. Validation of employing ½ detection limits is supported by improved mass balance with rock chemistry (i.e., a better agreement between total amount of a given element in the rock with total extracted amount). Figure 34 depicts averages of values that include these ½ detection limits. As a result, some of the reported averages fall below the detection limit even though individual samples may fall above. The most noteworthy information in Figure 34 includes the relationship between Mo and all fractions, the As association in the organic step and the U partition toward the sulfide step, which is supported by EPMA data in other ASR geochemistry studies (Arthur and others, 2008b).

DISCUSSION

Based on the dynamic redox setting within ASR storage zones, a working hypothesis has emerged with regard to As fate and transport (Mirecki, 2006; Stuyfzand, 2006 [personal communication]; Arthur and others, 2007; Vanderzalm and others, 2007): 1) as recharged/injected oxic SW permeates the aquifer matrix, initial mobilization of As occurs via oxidative dissolution of pyrite and to a lesser extent, oxidation of NOM; 2) if sufficient dissolved Fe is present, hydrous ferric oxide (HFO) precipitation occurs, on which As may sorb depending on competing ion concentrations (e.g., HCO_3^-, PO_4^{3-}); 3) during recovery, HFOs experience As desorption (or As release during HFO reductive dissolution) as reducing, de-oxygenated SW and/or an increasing proportion of reducing NGW migrates toward the ASR well. Gotkowitz and others (2004) report an analogous As-mobilization scenario for pumping wells in a confined aquifer.

Pyrite is unstable at positive ORP values and high DO concentrations. In the bench-scale leaching study, DO generally exceeds 7.2 mg/L in HDO conditions and is generally less than 0.3 mg/L in LDO conditions. Despite conditions during LDO1, there was apparently sufficient DO to oxidize pyrite via:

(1) $FeS_2 + 7/2\ O_2 + H_2O \rightarrow Fe^{2+} + 2SO_4{}^{2-} + 2H^+$.

Increased concentrations of As and other metals in the leachate during this experimental phase may also have been related to the presence of secondary As-bearing soluble minerals. For example, during core retrieval, transport and storage pyrite oxidation products may have formed on the pyrite surfaces. Todd and others (2003) report that pyrite oxidation in air may yield ferric oxyhydroxides or ferric hydroxysulfates, depending on pH and moisture content[2].

During phases HDO1-LDO1-HDO2, metals mobilization generally continued until reducing conditions were achieved through addition of an H_2S gas mixture to the reaction vessels. If pyrite oxidation occurred during ORP-positive phases (HDO1, LDO1 and HDO2), an increase in products of reaction (1) might be expected in the leachate. With the exception of data from L3S during HDO1, $SO_4{}^{2-}$ concentrations were generally consistent throughout the bench study until the beginning of LDO2 (Appendix 9). It is likely that leachate $SO_4{}^{2-}$ was buffered by other processes, or that SW $SO_4{}^{2-}$ concentrations were sufficiently high to mask subtle ug/L trends resulting from oxidation of trace amounts of pyrite.

One may also expect Fe(II) to increase in the leachate as a result of reaction (1). On the other hand, Fe(II) may have oxidized to Fe(III) and precipitated as HFO, represented here as $Fe(OH)_3$:

(2) $Fe^{2+} + 1/4O_2 + 5/2H_2O \rightarrow Fe(OH)_3 + 2H^+$

Iron was below detection during HDO1 and HDO2; however, leachates during LDO1 averaged ~85 ug/L Fe. This suggests that HFOs indeed may have formed during HDO phases, synchronous with pyrite oxidation:

(3) $FeS_2 + 15/4\ O_2 + 7/2H_2O \rightarrow 2SO_4{}^{2-} + 4H^+ + Fe(OH)_3$

For reasons explained above, a significant increase in $SO_4{}^{2-}$ is not observed in the leachate as a result of reaction (3); however, during HDO1 a steady decline in pH occurred (Appendix 9). Results from a field-scale ASR trial in Bolivar, South Australia, suggest reaction (3) may explain below-detection Fe concentrations during pyrite oxidation; however, they also recognize the potential role of carbonate equilibrium reactions as ankerite was observed in the aquifer matrix (Vanderzalm and others, 2007). In the present study, sorption of As in oxic conditions during HDO3 may have involved precipitation of colloidal HFO, which is a known As-scavenging phase (e.g., Nickson and others, 2000; Lu and others, 2005).

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[2] Plans are underway to initiate “minimum oxygen exposure” protocols for core samples intended for batch or column studies. For example, upon retrieval from the core barrel, samples will be extruded into PVC tubing then sealed in a N_2 (gas) atmosphere. After sample collection and trimming to remove exposed surfaces, the samples will be stored in light shielded vacuum desiccators (i.e., oxygen and moisture free).

It is noteworthy that indications of reaction (3) are not ubiquitous in the bench-study results. During LDO1, pyrite oxidation [reaction (1)] unaccompanied by HFO formation [reaction (2) or (3)] most likely accounts for the Fe in LDO1 leachates.

In the CERP study (Arthur and others, 2008b), the average As:Fe atomic ratio in pyrite = 0.0022. This value differs significantly from that of the range of mobilized As and Fe in the Orange County bench study leachates (As:Fe ranges from 0.06 to 1.3). Arsenic concentrations are orders of magnitude greater than expected if bulk dissolution of pyrite is the only operative geochemical process. Several factors may account for this discrepancy, including: 1) selective leaching of As from pyrite, 2) desorption of As from NOM or mineral/phases other than pyrite, and 3) upon pyrite oxidation, rapid re-sorption of Fe as a different phase [e.g., reaction (2) or (3)]. With regard to the latter factor, Stüben and others (2003) attribute a poor Fe-As correlation to resorption of As on freshly exposed HFOs, thereby changing the Fe:As ratio.

Experimental work by Kim and others (2000) suggests that HCO_3^- in the presence of pyrite dissolution is effective in increasing soluble As concentrations. Results of modeling by Appelo and others (2002) suggest that through competitive ion exchange, HCO_3^- displaces As sorbed to HFOs within an aerobic environment, and further increases in As (i.e., in the leachate) occur due to dissolution of HFOs in a strongly reducing environment (e.g., presence of dissolved NOM). Appelo and others (2002) also describe the effects of As sorption/desorption capacities in response to changes in CO_2 pressure and the presence of dissolved Fe and PO_4^{3-} underscoring the dynamic nature of the system with respect to As and HFOs.

Pederson and others (2006) further clarify the relation between HFOs and As, reporting that arsenic (as arsenate) is adsorbed onto the HFO surface rather than becoming incorporated in the lattice. Based on their results, incongruent release of As and Fe is expected during reductive dissolution of HFOs, due in part to the change in HFO surface area as well as the kinetics of Fe reduction. They also found that more than half of the Fe in HFOs must be reduced before significant arsenate desorption will occur. These dynamics may explain why As and Fe do not always “follow” in the leachate concentration patterns due to preferential leaching/desorption of As.

Preliminary assessment of leachate analyses in the present study supports this observation. During LDO2, strongly reducing conditions were induced in the reaction vessels using a gas mixture of 5% H_2S and 95% N_2. In response, leachate Fe concentrations rapidly increased by more than 100% (Figure 26), yet As and Mo exhibits sorption/precipitation (Figure 27 and 28). With continued strongly negative ORP conditions, As and Mo then follow Fe for some samples as they exhibit desorption. Arsenic sorption during LDO2 has important implications with regard to understanding water-rock interactions during ASR and warrants further study.

During HDO3, Fe begins to drop out of solution (HFO precipitation?) but with increased time, the pattern may also reflect pyrite oxidation as indicated by the “flattening” and increasing Fe concentrations (Figure 26). Arsenic, on the other hand, exhibits a continual decrease in leachate concentrations suggesting sorption/precipitation without overprinting of other processes (?).

Figures 35 and 36 provide a different perspective on the extended dataset. Not only is the transition between positive and negative ORP is readily observed, text labels (A through N) are included on the charts to allow assessment of “composite reaction paths” during the HDO2-LDO2-HDO3 phases. To emphasize the reaction paths, data from only two of the four reaction vessels are plotted. **Table 7** provides cross reference between chart labels (A through N) and sample parameters (e.g., date, leachate temperature, EC).

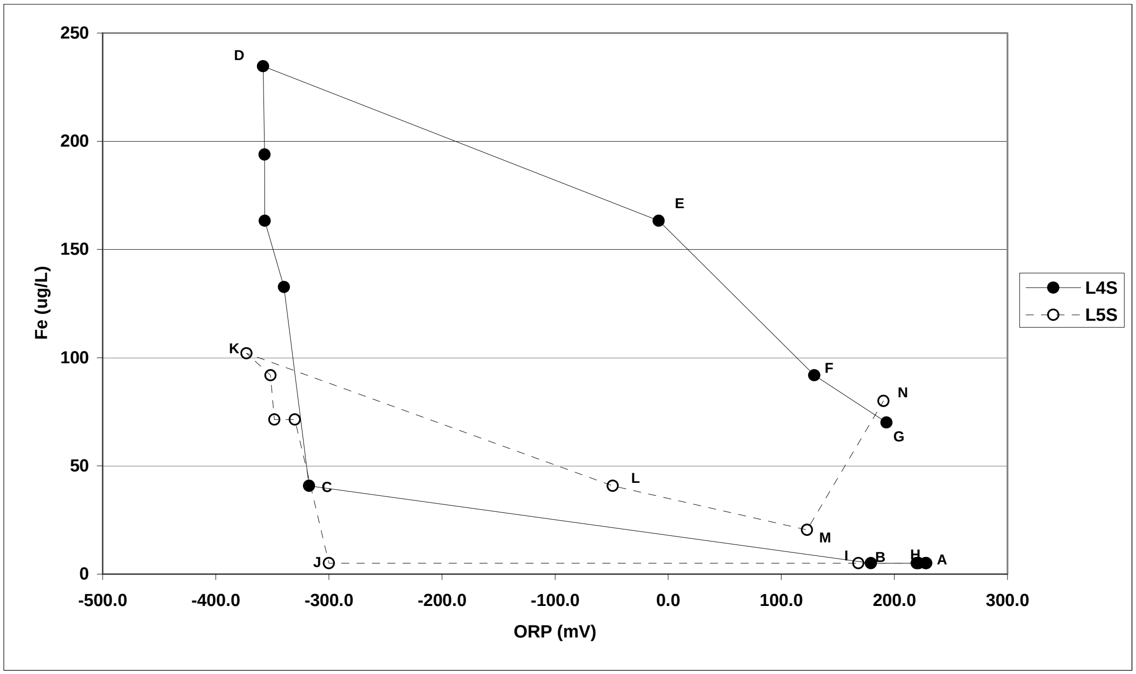

Figure 35. Bivariate relation between ORP and Fe; extended H_2S dataset. Sample labels (letters) denote various periods during the protocol (Table 3). See Table 7 for explanation of sample labels and relevant physical parameters.

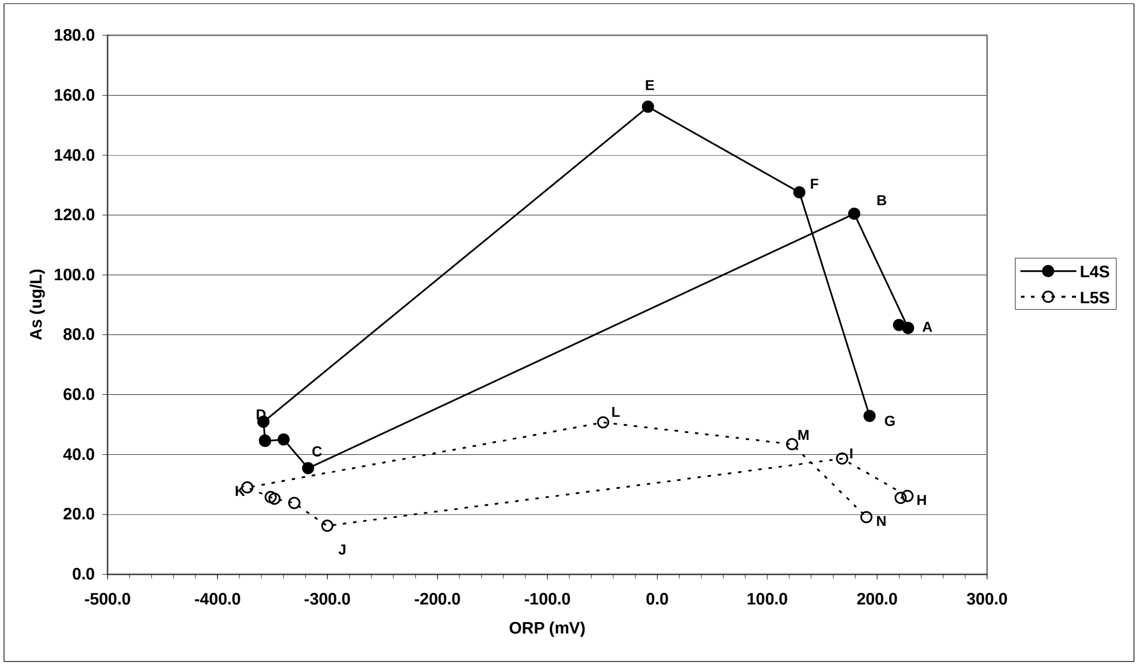

Figure 36. Bivariate relation between ORP and As; extended H_2S dataset. Sample labels (letters) denote various periods during the protocol (Table 3). See Table 7 for explanation of sample labels and relevant physical parameters.

In the ORP – Fe chart (Figure 35), labels A, B, H and I reflect Fe concentrations at ½ detection limits because the reported values were below detection. As the samples reflect the trend through LDO2 (C-D and J-K), Fe desorption is observed within these strongly reduced (~-325 mV) conditions, suggesting reductive dissolution of HFOs. During this period, the leachate became discolored (faint reddish-brown) and one vessel contained visible precipitate (composition unknown). Air sparging, which occurred minutes after points D and K, brought the ORP toward positive values. Approximately 15 hours later, samples E and L were collected. Interestingly during this oxic period, Fe rapidly sorbs or precipitates; however, in two of the four reaction vessels, As continued to desorb. During HDO3 as the ORP became positive (paths E-F and L-M), Fe continued to be removed from the leachate. During the ~3 months reflected by path F-G and M-N, Fe desorbs in three reaction vessels (L3S, L5S and L6S; data from L3S and L6S in Appendix 9) and continues to sorb in vessel L4S (see M-N, Figure 35).

In contrast to Fe, As desorption occurs during HDO2 (A-B and H-I), followed by sorption at the onset of LDO2 (samples C and J; Figure 36). Between C-D and J-K as LDO2 progresses, a slight As mobilization is observed reflecting As desorption. The mechanism for As sorption may be related to sulfide precipitation, whereas subsequent As mobilization (C-D and J-K) may reflect desorption from or dissolution of HFOs. Dissolved-oxygen saturated conditions (HDO3) were resumed minutes after collection of samples D and K. As noted above, Fe responded with rapid sorption (D-E and K-L); however, As lagged in two of the four reaction vessels, continuing to desorb until samples E and L. The As path then follows Fe (E-F and L-M, Figure 36) as it sorbs onto aquifer media or colloidal HFOs.[3] Incongruent behavior between As and Fe also occurs in three of the four reaction vessels at the end of the reaction path, where As continues to sorb/precipitate in all samples while Fe desorbs in 3 samples (e.g., M-N, Figure 35).

The reaction paths for As and Fe in Figures 35 and 36 broadly support the working hypothesis outlined above regarding As mobilization during ASR recharge and recovery. The hypothesis, however, does meet with some contradiction. For example, geochemical modeling using mixtures of SW and NGW in southwest Florida do not indicate HFO stability (Jones and Pichler, 2007). Their work is based on a specific conceptual model that employed the sulfate/sulfide redox pair to reflect redox conditions in recharge water, native ground water and mixtures thereof. A stability field for colloidal HFOs exists in their plot of log activity of the sulfate/sulfide ratio, but at high-positive values (see Figures 3A, 4A and 5A in Jones and Pichler [2007]). Equilibrium of the redox couple during water mixing was not assumed as explained in their paper. It would be interesting to see the diagrams if equilibrium had been assumed during mixing, or if a different redox pair could have been utilized. Moreover, the modeling effort did not consider the chemical interaction of aquifer media, such as its continued buffering capacity or the consumption of oxygen and liberation of Fe during pyrite oxidation. Haque and Johannesson (2006), in a study of arsenic along the groundwater flowpath in southwest Florida, suggest that HFOs, governed in part by microbial activity, play an important role in arsenic distribution along the flowpath. Certainly many variables and unknowns exist with respect to the working hypothesis, including effects of pressure, temperature, microbial activity, dissolved organic carbon, variable SW and NGW compositions, aquifer matrix chemistry/mineralogy, reaction kinetics and hydraulics of a likely dual-porosity system.

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[3] It should be noted that during this extended part of the study temperature varied significantly due to HVAC issues in the laboratory; however, assessment of temperature in Table 7 suggests that the results of the experiment were not adversely affected.

The behavior of As in the ASR hydrogeochemical setting is not the only potential concern. Other metals (e.g., Mn, Ni, V and U) have been observed in concentrations above background NGW during ASR recovery (Arthur et al., 2005). Analyses of water samples collected during cycle-tests at some Florida ASR sites reveals that Mo, Sb and gross alpha are locally of concern. These observations, variables and uncertainties, underscore the importance of geochemical characterization of the aquifer matrix, as well as consideration of NGW and SW compositions in relation to water-rock interactions.

Table 7. Cross reference of chart labels and physical parameters; see Figures 35 – 37.

Sample ID	Label	Date	Phase	pH	Temp ^{o}C	Electrical Conductivity mV
L4S	A	8/30/2006	HDO2	8.22	25.2	337.0
L4S		9/1/2006	HDO2	8.18	25.1	339.0
L4S	B	1/29/2007	HDO2	7.39	19.6	528
L4S	C	1/29/2007	LDO2	6.67	15.0	572
L4S		1/30/2007	LDO2	7.31	10.7	592
L4S		1/30/2007	LDO2	7.34	16.1	523
L4S		1/31/2007	LDO2	7.76	13.8	519
L4S	D	2/1/2007	LDO2	7.81	16.3	506
L4S	E	2/2/2007	HDO3	7.64	18.2	488
L4S	F	2/5/2007	HDO3	7.13	13.1	494
L4S	G	5/1/2007	HDO3	7.03	23.1	603
L5S	H	8/30/2006	HDO2	8.21	25.2	336.0
L5S		9/1/2006	HDO2	8.15	25.1	334.0
L5S	I	1/29/2007	HDO2	7.43	19.7	513
L5S	J	1/29/2007	LDO2	6.70	15.1	542
L5S		1/30/2007	LDO2	7.34	10.7	583
L5S		1/30/2007	LDO2	7.33	16.3	507
L5S		1/31/2007	LDO2	7.77	13.7	503
L5S	K	2/1/2007	LDO2	7.85	16.3	490
L5S	L	2/2/2007	HDO3	7.82	18.1	469
L5S	M	2/5/2007	HDO3	7.14	13.2	486
L5S	N	5/1/2007	HDO3	7.08	23.0	575

CONCLUSIONS

Hydrogeochemical implications inferred from bench-scale leaching tests are intended to provide a cost-efficient approximation of what may be observed at the field scale. Specifically, the bench-scale results presented herein will hopefully provide information on relative mobility of metals and the potential order-of-magnitude changes in ASR storage zone water quality. In laboratory conditions, mobilization of metals (and metalloids) is clearly indicated; some metals are strongly desorbed from the aquifer matrix, some are apparently immobile, others sorb, and some metals exhibit dynamic behaviors that are highly responsive to changes in redox and solute compositions.

Noteworthy caveats exist with regard to interpretation of these results. Issues of volume and scale, physical aquifer characteristics, reaction kinetics during fluid flow and storage, etc. preclude direct transfer of the bench-study results to the field. While the study hopefully brackets the range of many hydrochemical processes during ASR, complicating variables include, but are not limited to temperature, pressure, redox conditions, water-rock surface area ratio, core sample atmospheric oxidation, variability in source-water composition, source-water – ground-water mixing, effects of dual porosity, and artificial enhancement of trace-mineral exposure to the leachate solution (i.e., use of core chips rather than a flow-through core may have exposed pyrites to the leachate that would otherwise have been isolated from the matrix permeability). While beyond scope of the present study, the importance of geochemical modeling as a potential predictive tool cannot be overstated.

At the proposed Orange County ASR site, leaching of metals from the dolostone aquifer matrix is indicated by bench-scale studies. The source of the potentially mobilized As and other metals is predominantly pyrite; however, the As may also be associated with NOM. Oxidation-reduction potential (and DO) appear to be the dominant factors regarding desorption/sorption of As. The As cycle may move between difference phases (i.e., pyrite, and HFOs) depending on the ORP (for details, see introduction to **Discussion**). If the Orange County ASR system can be designed to maintain ORP of the SW in reduced conditions (<-200mV?), mobilization of As and other metals may be minimized. Molybdenum, apparently being more water soluble, may desorb from the aquifer matrix more liberally as it appears less sensitive to ORP at the bench scale. However, if previous bench studies are any indication, the Mo will attenuate with successive cycle testing as long as the same zone of aquifer matrix is exposed to the recharged SW.

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APPENDIX D
FDEP UIC Permit and AO

Florida Department of Environmental Protection

Central District
3319 Maguire Boulevard, Suite 232
Orlando, Florida 32803-3767
Phone: (407) 894-7555

BEFORE THE STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Responsible Authority:

Michael Chandler, Director
Orange County Utilities
9150 Curry Ford Road
Orlando, FL 32825-0000

DEP Permit No. 48-0272819-001-UC
Order No. AO-09-0001
Orange County Utilities Potable Water ASR Project

DRAFT ADMINSTRATIVE ORDER

I. STATUTORY AUTHORITY

The Department of Environmental Protection (Department) issues this Administrative Order under the authority of Section 403.088(2)(f) of the Florida Statutes (F.S.). The Secretary of the Department has delegated this authority to the Director of the Central District, who issues this Order and makes the following findings of fact.

II. FINDINGS OF FACT

1. The Permittee, Michael Chandler, is a person under Section 403.031, F. S.

2. The Facility is located at the Orange County Eastern Regional Water Reclamation Facility (ERWRF), Orange County, Florida. This aquifer storage and recovery (ASR) operation is subject to the requirements contained in Rules 62-4, 62-520, 62-528 and 62-550 of the Florida Administrative Code (F.A.C.), which includes underground injection control, permitting and ground water monitoring requirements.

3. The Facility applied for a permit on January 19, 2007, under Section 403 .0876, F.S., to construct an aquifer storage and recovery (ASR) system. Permit No. 48-0272819-001-UC (Permit) constitutes Department approval for the construction of the approved ASR Facility. Operational (cycle) testing approval will require Department authorization per Specific Condition 5.a of Permit No. 48-0272819-001-UC.

4. The Department acknowledges that the site at which this Facility operates has never been used

for ASR activities that may potentially affect ground water quality.

5. The availability of ground water monitoring data in the ASR aquifer is limited or does not exist for this facility.

6. The Facility has provided reasonable assurance that the water injected will meet all primary drinking water standards prior to injection.

7. The Facility has not provided reasonable assurance that the ASR activity will result in arsenic concentrations that will meet the 10 µg/L standard in the ground water. Most ASR facilities in Florida have experienced exceedances of the 10 µg/L standard either in the recovered water or the storage zone monitor wells, or both, although the injectate meets the standard. The Facility can not provide data to demonstrate this ASR project will result in compliance with the arsenic standard.

III. ORDER

Based on the foregoing findings of fact, IT IS ORDERED,

8. The Facility shall comply with all conditions of Permit No. 48-0272819-001-UC and applicable water quality standards, except as otherwise authorized under this Administrative Order.

9. If arsenic levels during operational (cycle) testing conducted under Permit No. 48-0272819-001-UC or subsequent permit modifications or renewals, or future construction permits for ASR wells, or monitor wells not covered under Permit No. 48-0272819-001-UC, are found to exceed 10 µg/L in the recovered water or any associated monitor well, the permittee shall submit a report addressing the operational (cycle) testing results of the collected ground water monitoring data including a determination after every two cycles if there is an indication that arsenic levels are decreasing. The report shall be submitted to the Department no later than 90 days following the end of the recovery period for the second cycle. The report shall include a discussion of the changes in water quality parameters exceeding maximum contaminant levels, including arsenic, during the injection, storage, and recovery periods. The discussion of the arsenic results shall address the possibility that continued cycles may allow the facility to come into compliance without pretreatment and shall include a projected time until compliance will be achieved.

10. If the arsenic standard is exceeded in recovered water or ground water as a result of ASR operations, any future ASR permits for this facility can only be issued with an associated Consent Order.

11. In addition, the Department may require certain enhancements to the ASR facility, which may include, but not be limited to, additional monitoring parameters; a greater monitoring frequency; additional monitoring wells particularly if ground water not meeting the arsenic standard may be migrating off Facility property; and a pretreatment program to reduce arsenic leaching in the storage zone.

12. If monitoring indicates the potential that arsenic exceeding 10 µg/L is occurring off-site because of the ASR activity, the Department may require the following within the area of review which includes the lateral extent into which the injected fluids are calculated to migrate plus a 50

percent buffer zone; or a one-mile radius, whichever is larger:

a) A field-verified inventory of all wells used to withdraw water from the ASR storage zone or any zone into which the stored water may migrate; or

b) Institutional controls that prohibit the construction of new wells and use of existing wells for drinking water supply which withdraw from the storage zone aquifer or any zone into which the injected fluid may migrate.

13. Reports or other information required by this Administrative Order shall be sent to the Department of Environmental Protection, Underground Injection Control Program, Central District, 3319 Maguire Boulevard, Suite 232, Orlando, Florida 32803-3767, and to the Department of Environmental Protection, Underground Injection Control Program, 2600 Blair Stone Road, MS 3530, Tallahassee, Florida 32399-2400.

14. This Administrative Order does not operate as a permit under Section 403.088 of the Florida Statutes. This Administrative Order shall be incorporated by reference into Permit No. 48-0272819-001-UC.

15. Failure to comply with the requirements of this Administrative Order shall constitute a violation of this Administrative Order and Permit No. 48-0272819-001-UC, and may subject the Facility to penalties as provided in Section 403.161, F.S.

16. If any event, excluding administrative or judicial challenges by third parties unrelated to the Facility, occurs which causes delay or the reasonable likelihood of delay, in complying with the requirements of this Administrative Order, the Facility shall have the burden of demonstrating that the delay was or will be caused by circumstances beyond the reasonable control of the Facility and could not have been or cannot be overcome by the Facility’s due diligence. Economic circumstances shall not be considered circumstances beyond the reasonable control of Facility, nor shall the failure of a contractor, subcontractor, materialman or other agent (collectively referred to as “contractor”) to whom responsibility for performance is delegated to meet contractually imposed deadlines be a cause beyond the control of Facility, unless the cause of the contractor’s late performance was also beyond the contractor’s control. Upon occurrence of an event causing delay, or upon becoming aware of a potential for delay, the Facility shall notify the Central District of the Department orally at (407) 894-7555 within 24 hours or by the next working day and shall, within seven calendar days of oral notification to the Department, notify the Department in writing at: Department of Environmental Protection, Underground Injection Control Program, Central District, 3319 Maguire Boulevard, Suite 232, Orlando, Florida 32803-3767 of the anticipated length and cause of the delay, the measures taken or to be taken to prevent or minimize the delay and the timetable by which Facility intends to implement these measures. If the parties can agree that the delay or anticipated delay has been or will be caused by circumstances beyond the reasonable control of the Facility, the time for performance hereunder shall be extended for a period equal to the agreed delay resulting from such circumstances.

IV. NOTICE OF RIGHTS

17. A person whose substantial interests are affected by this Order may petition for an administrative proceeding (hearing) under Sections 120.569 and 120.57, Florida Statutes. The petition must contain the information set forth below and must be filed (received by the clerk) in

the Office of General Counsel of the Department at 3900 Commonwealth Boulevard, Mail Station 35, Tallahassee, Florida 32399-3000.

Under Rule 62-110.106(4), Florida Administrative Code, a person may request enlargement of the time for filing a petition for an administrative hearing. The request must be filed (received by the clerk) in the Office of General Counsel before the end of the time period for filing a petition for an administrative hearing.

Petitions by the applicant or any of the persons listed below must be filed within fourteen days of receipt of this written notice. Petitions filed by any persons other than those entitled to written notice under Section 120.60(3), Florida Statutes, must be filed within fourteen days of publication of the notice or within fourteen days of receipt of the written notice, whichever occurs first. Under Section 120.60(3), Florida Statutes, however, any person who has asked the Department for notice of agency action may file a petition within fourteen days of receipt of such notice, regardless of the date of publication.

The petitioner shall mail a copy of the petition to the applicant at the address indicated above at the time of filing. The failure of any person to file a petition within fourteen days of receipt of notice shall constitute a waiver of that person's right to request an administrative determination (hearing) under Sections 120.569 and 120.57, Florida Statutes. Any subsequent intervention (in a proceeding initiated by another party) will be only at the discretion of the presiding officer upon the filing of a motion in compliance with Rule 28-106.205, Florida Administrative Code.

A petition that disputes the material facts on which the Department's action is based must contain the following information:

(a) The name, address, and telephone number of each petitioner; the name, address, and telephone number of the petitioner's representative, if any; the Department permit identification number and the county in which the subject matter or activity is located;
(b) A statement of how and when each petitioner received notice of the Department action;
(c) A statement of how each petitioner's substantial interests are affected by the Department action;
(d) A statement of all disputed issues of material fact. If there are none, the petition must so indicate;
(e) A statement of facts that the petitioner contends warrant reversal or modification of the Department action;
(f) A concise statement of the ultimate facts alleged, as well as the rules and statutes which entitle the petitioner to relief and
(g) A statement of the relief sought by the petitioner, stating precisely the action that the petitioner wants the Department to take.

Because the administrative hearing process is designed to formulate final agency action, the filing of a petition means that the Department's final action may be different from the position taken by it in this notice. Persons whose substantial interests will be affected by any such final decision of the Department have the right to petition to become a party to the proceeding, in accordance with the requirements set forth above.

Mediation under Section 120.573, Florida Statutes, is not available for this proceeding.

This Order is final and effective on the date filed with the clerk of the Department unless a petition is filed in accordance with the above. Upon the timely filing of a petition this Order will not be effective until further order of the Department.

Any party to the permit has the right to seek judicial review of the Order under Section 120.68, Florida Statutes, by the filing of a notice of appeal under Rules 9.110 and 9.190, Florida Rules of Appellate Procedure, with the clerk of the Department in the Office of General Counsel, Mail Station 35**,** 3900 Commonwealth Boulevard, Tallahassee, Florida, 32399-3000; and by filing a copy of the notice of appeal accompanied by the applicable filing fees with the appropriate district court of appeal. The notice of appeal must be filed within 30 days from the date when this Order is filed with the clerk of the Department.

DONE AND ORDERED on this _____ day of _______ 2009 in Orlando, Florida.

STATE OF FLORIDA DEPARTMENT
OF ENVIRONMENTAL PROTECTION

DRAFT

____
Vivian F. Garfein
Director, Central District

FILED AND ACKNOWLEDGED on this date, under Section 120.52(11) of the Florida Statutes, with the designated Department Clerk, receipt of which is acknowledged.

Clerk _____________________________________ Date ______________________

St. Johns River
Water Management District
Kirby B Green III Executive Director • David W Fisk, Assistant Executive Director

4049 Reid Street • PO Box 1429 • Palatka, FL 32178 1429 • (386) 329-4500
On the Internet at *www sjrwmd com*

October 13, 2008

Orange County Utilities
9150 Curry Ford Road
Orlando, FL 32825

SUBJECT Water Well Construction Permit 118439 located in Orange County

Dear Sirs/Madam

Please find enclosed the permit for the above referenced project Permit issuance does not relieve you from the responsibility of obtaining permits from any federal, state, and/or local agencies asserting concurrent jurisdiction for this work

In the event you sell your property, the permit will be transferred to the new owner if we are notified by you within thirty (30) days of the recording of the sale Please assist us in this matter so as to maintain a valid permit for the new property owner

The permit enclosed is a legal document Please read the permit carefully since you are responsible for compliance with any conditions which is a part of this permit Compliance is a legal requirement and your assistance in this matter will be greatly appreciated

If you have any questions concerning your permit, please do not hesitate to contact this office at (386) 329-4401

Thank you for your interest in our water resources

Sincerely,

Rosie Parker

Rosie Parker
Regulatory Info Mgmt Spec III
Division of Regulatory Information Management

Cc District Permit File
Contractor
James Frazee Jr

STATE OF FLORIDA PERMIT APPLICATION TO CONSTRUCT, REPAIR, MODIFY, OR ABANDON A WELL

☐ Southwest
☐ Northwest
☒ St Johns River
☐ South Florida
☐ Suwannee River

CHECK BOX FOR APPROPRIATE DISTRICT ADDRESS ON BACK OF PERMIT FORM

THIS FORM MUST BE FILLED OUT COMPLETELY

The water well contractor is responsible for completing this form and forwarding the permit to the appropriate delegated county where applicable

Permit No 118439-1
Florida Unique I D AAE1513
Permit Stipulations Required (See attached)
62-524 well ☐
CUP/WUP Application No n/a

ABOVE THIS LINE FOR OFFICIAL USE ONLY

1 Orange County Utilities — 9150 Curryford Rd — Orlando — 32825 — 407-254-9900
Owner Legal Name of Entity if Corporation — Address — City — Zip — Telephone Number

2 1621 South Alafaya Trail, Orlando, FL 32828 Eastern Water Reclamation Facility
Well Location - Address Road Name or Number City

3 Charles William Musselwhite — 11191 — (407)654-6970
Well Drilling Contractor — License No — Telephone No

1031 Crown Park Circle
Address

Winter Garden — FL — 34787
City — State — Zip

4 SW 1/4 of NW 1/4 of Section 3

5 Township 23S Range 31E

6 Orange — 02-23-31-0000-00-002
County — Subdivision Name — Lot — Block — Unit

7 Number of Proposed Wells 1 Check the use of well Aquifer Storage and Recovery

Distance from septic system 100+ ft Description of facility Eastern Water Reclamation Estimated start of construction date 10/2008

8 Application for New Construction Reason for Abandonment ______

Date Stamp
9/12/2008

9 Estimated Well Depth 1200 Casing Depth 1100 Screen Interval from — to —

Casing Material Black Steel
Casing Diameter 18 Seal Material Cement

10 If applicable Proposed Grouting Interval From 0 To 1100 Seal Material Neat Cement
From ____ To ____ Seal Material ____
From ____ To ____ Seal Material ____

11 Telescope Casing ____ or Liner ____(check one) Diameter n/a

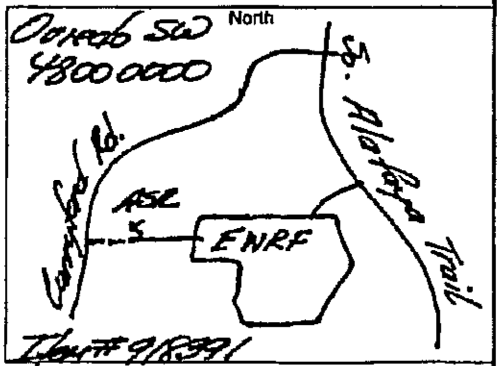
12 Method of Construction Rotary

ASR Test well, DZMW at this location

13 Indicate total No of wells on site 2x List no of unused wells on site 01

14 Is this well or any other well or water withdrawal on the owner's contiguous property covered under a Consumptive/Water Use Permit (CUP/WUP) or CUP/WUP Application? [✓ No] Yes
(If yes, complete the following) CUP/WUP No not assigned to CUP
District well I D No 242698
Latitude 28°31'09.918" Longitude 81°12'32.576"
Data obtained from GPS ✓ or map__ or survey__ *(map datum NAD27__ NAD83* ✓

Draw a map of well location and indicate well site with an X Identify known roads and landmarks, provide distances between well and landmarks



15 I herby certify that I will comply with the applicable rules of Title 40 Florida Administrative Code and that a water use permit or artifical recharge permit, if needed has been or will be obtained prior to commencement of well construction I further certify that all information provided on this applications is accurate and that I will obtain necessary approval from other federal state or local governments if applicable I agree to provide a well completion report to the District within 30 days after drilling or the permit expiration whichever occurs first

I certify that I am the owner of the property that the information provided is accurate and that I am aware of my responsibilities under Chapter 373 Florida Statutes to maintain or properly abandon this well or I certify that I am the agent for the owner that the information provided is accurate and that I have informed the owner of his responsibilities as stated above Owner consents to personnel of the WMD or a representative access to the well site

Charles William Musselwhite — 11191 — Charles William Musselwhite — 180687
Contractor Name — License No — Owner or Agent — Confirmation No

DO NOT WRITE BELOW THIS LINE — FOR OFFICIAL USE ONLY

Approval Granted By ______ Issue Date 10/13/08 Hydrologist Approval ______ Initials

Owner Number ASR PW-1 Fee Received $ 120.00 Receipt No. 44684 Check No. on-line

THIS PERMIT NOT VALID UNTIL PROPERLY SIGNED BY AN AUTHORIZED OFFICER OR REPRESENTATIVE OF THE WMD IT SHALL BE AVAILABLE AT THE WELL SITE DURING ALL DRILLING OPERATIONS ***This permit is valid for 90 days from date of issue***

SRWMD FORM 408 3 1 REV 12/95

WHITE ORIGINAL FILE
YELLOW DRILLING CONTRACTOR
PINK OWNER

"EXHIBIT A"
CONDITIONS FOR ISSUANCE OF PERMIT NUMBER 118439
ORANGE COUNTY UTILITIES
DATED OCTOBER 13, 2008

SPECIAL CONDITIONS
Zone C-UIC-ASR-NXC
40C-3, F A C , Standard Areas

1 The well contractor shall notify the District no less than 24 hours prior to any construction or grouting operations A final inspection shall be scheduled by the well contractor within 60 days of slab, pump, and system component installation

District representative Jim Frazee/Charles Shirley
Office Altamonte Springs Service Center
Telephone (fax) 407-659-4842/4866(4805)
jfrazee@sjrwmd com / cshirley@sjrwmd com

2 The well contractor shall submit a well completion report within 30 days of well completion and prior to a final inspection

3 The well contractor shall construct the well as described in the application specifications submitted on September 12, 2008 District staff must approve any changes prior to construction The well owner is required to maintain a spacing of 100 feet from any property boundary to meet the Chapter 62-555, F A C requirement for community wells

4 The well contractor shall pump this well clean using the permanent pump and disinfected in accordance with Chapters 62-555 and 62-532, F A C The discharge water shall be clear and free of particulate material as determined using an Imhoff Cone test

5 This well contractor shall install all system components a minimum of 12 inches above the slab and 18 inches above the ground surface as required in Chapters 62-555 and 62-532, F A C The sample tap shall be unthreaded and turned downward The tap will not be directed towards or discharge water towards any electrical boxes or connections

6 The well contractor shall install a 6X6 feet concrete slab centered on the well The casing shall be at least 12 inches above the slab Grouting approval by the District shall occur prior to the installation of the slab

7 The well contractor shall add the latitude and longitude coordinates of this well (**283109 913 / 811232 576**) to the list of information required to be inscribed, stamped or printed on the metallic well tag

8 The well owner shall obtain quality and system clearance from the Florida Department of Environmental Protection prior to use of this well

9 The well contractor shall post a copy of this permit at the well site during all phases of well construction

10 The well contractor must collect drill cutting samples in order to identify casing seat geology during construction The District reserves the right to require pump removal to check construction and formation information if the well does not produce water that passes the Imhoff Cone test

11 The well contractor shall provide to the District all geophysical or video logs of this well done during or post construction   Geophysical logs shall be submitted in hard copy and LAS electronic format, depth-corrected for the position of the sensor on the logging tool, and labeled with the well name and latitude/longitude position   Video logs shall be provided in a format compatible with Windows Media Player

STATE OF FLORIDA PERMIT APPLICATION TO CONSTRUCT, REPAIR, MODIFY, OR ABANDON A WELL

☐ Southwest
☐ Northwest
☑ St. Johns River
☐ South Florida
☐ Suwannee River

CHECK BOX FOR APPROPRIATE DISTRICT, ADDRESS ON BACK OF PERMIT FORM.

THIS FORM MUST BE FILLED OUT COMPLETELY.

The water well contractor is responsible for completing this form and forwarding the permit to the appropriate delegated county where applicable.

Permit No. 115529-1
Florida Unique I.D. AAL5927
Permit Stipulations Required (See attached)

62-524 well ☐
CUP/WUP Application No. 50035

ABOVE THIS LINE FOR DISTRICT USE

1. Orange County Utilities 9150 Curryford Rd. Orlando, FL 32825 407-254-9900
~~Diversified Drilling Corp.~~ ~~1031 Crown Park Circle~~ ~~Winter Garden~~ ~~34787~~ ~~(407)654-6970~~
Owner, Legal Name of Entity if Corporation   Address   City   Zip   Telephone Number

2. 1621 South Alafaya Trail, Orlando, Florida 32828 @ Eastern Water Reclamation Facility
Well Location - Address, Road Name or Number, City

3. William Musselwhite   11191   (407)654-6970
Well Drilling Contractor   License No.   Telephone No.

1031 Crown Park Cir
Address

Winter Garden   FL   34787
City   State   Zip

4. NW/SW 1/4 of NW 1/4 of Section 3

5. Township 23S   Range 31E

6. Orange   02-23-31-0000-00-002
County   Subdivision Name   Lot   Block   Unit

7. Number of Proposed Wells 1   Check the use of well: Other

Distance from septic system 100+ ft.   Description of facility Eastern Water Reclamation   Estimated start of construction date 4/2008

8. Application for: New Construction   Reason for Abandonment

Date Stamp
3/17/2008

9. Estimated Well Depth: 1200   Casing Depth: 900/1100   Screen Interval from — to —

Casing Material: Black Steel (12"); PVC 6" (1100-1200)   Monitor Zones 900-950, 1100-1200
Casing Diameter 12   Seal Material Cement

10. If applicable: Proposed Grouting Interval
From 0 To 40 Seal Material Cement
From 0 To 220 Seal Material Cement neat
From 0 To 900 Seal Material Cement
900 1100 ACI

11. Telescope Casing ___ or Liner ___ (check one)   Diameter 6in
PVC

12. Method of Construction: Rotary

ASR TW 96911-4

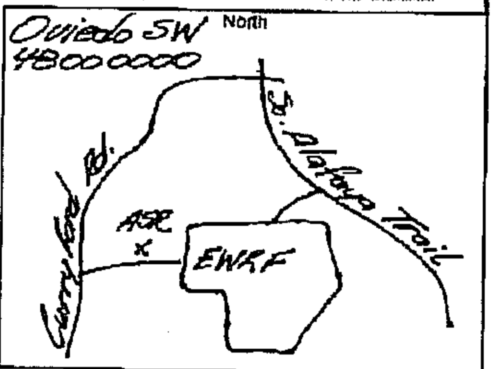
13. Indicate total No. of wells on site 61   List no. of unused wells on site: 8

14. Is this well or any other well or water withdrawal on the owner's contiguous property covered under a Consumptive/Water Use Permit (CUP/WUP) or CUP/WUP Application? X No   Yes

(If yes, complete the following)   CUP/WUP No. 50035 - not listed on CUP table
District well I.D. No. 228475
Latitude 28°31' 09.202"   Longitude 81°12'31.802"

Data obtained from GPS ✓ or map X or survey __ (map datum NAD27 __ NAD83 ✓)

Draw a map of well location and indicate well site with an 'X'. Identify known roads and landmarks; provide distances between well and landmarks.



15. I hereby certify that I will comply with the applicable rules of Title 40, Florida Administrative Code, and that a water use permit or artificial recharge permit, if needed has been or will be obtained prior to commencement of well construction. I further certify that all information provided on this application is accurate and that I will obtain necessary approval from other federal, state, or local governments, if applicable. I agree to provide a well completion report to the District within 30 days after drilling or the permit expiration, whichever occurs first.

I certify that I am the owner of the property, that the information provided is accurate, and that I am aware of my responsibilities under Chapter 373, Florida Statutes, to maintain or properly abandon this well; or, I certify that I am the agent for the owner, that the information provided is accurate, and that I have informed the owner of his responsibilities as stated above. Owner consents to personnel of the WMD or a representative access to the well site.

Authorized by John Nelson, Barnes, Ferland and Assoc, Inc.

William Musselwhite   11191
Contractor Name   License No.

William Musselwhite   16656R
Owner or Agent   Confirmation No.

DO NOT WRITE BELOW THIS LINE — FOR OFFICIAL USE ONLY

Approval Granted By: Carlton Crufer   Issue Date: 04/15/08   Hydrologist Approval   Initials

Owner Number: DZ-MW-ASR   Fee Received: $ 120.00 250.00 Rec'd.   Receipt No.: 42929   Check No.: On-line

THIS PERMIT NOT VALID UNTIL PROPERLY SIGNED BY AN AUTHORIZED OFFICER OR REPRESENTATIVE OF THE WMD. IT SHALL BE AVAILABLE AT THE WELL SITE DURING ALL DRILLING OPERATIONS. *This permit is valid for 90 days from date of issue.*

SRWMD FORM 400-3-1 REV. 12/95

WHITE:	ORIGINAL FILE
YELLOW:	DRILLING CONTRACTOR
PINK:	OWNER

SPECIAL CONDITIONS
Permit 115529-1, Orange County ASR Site
DZ-MW-ASR

Wells to be constructed as ASR monitor wells are required to meet special conditions as listed below unless modified by field determinations. **Testing was completed to determine the feasibility of an ASR injection program. The current activity will complete the ASR production and monitoring facility. The project is in cooperation with the District's Division of Water Supply Management.**

1. The proposed well will be located in a manner that meets all applicable spacing standards from sanitary hazards as addressed in chapters 62-532, 62-555 and 40C-3, F.A.C. **A copy of this permit will be forwarded to the FDEP/Central District office as is required for all injection/drainage sites.**

2. The well construction design or design alternatives will be followed unless site conditions require a change. Two zones at 900 and 1100 feet will be monitored using multiple casing strings. The District will approve any changes prior to work starting.

3. The completed well terminus will be a minimum of 12 inches above the ground surface. All system components will meet the 12-inch requirement.

4. The well will be purged of disinfectant residuals and developed until clear water discharge occurs. All development, disinfection, and testing activities will be completed prior to any sampling.

5. Grouting approval by the District must occur prior to the installation of any structural enclosures around and above the well terminus. **See condition 7 for notification requirement.**

6. Latitude and longitude coordinates will be added to the list of information required by chapter 40C-3, F.A.C., to be inscribed, stamped or printed on the required metallic tag. The latitude and longitude for this well is: **283109.202 / 811231.802**

7. The well contractor must notify a District field representative 24 hours prior to initiating construction or grouting operations. A final inspection will be scheduled after the system components are installed and are ready for testing. **Completion reports, well head completion and sample submittal to the District are required within 30 days of well completion unless notice is given to the District staff listed below.**

District Representatives: Jim Frazee/**Charles Shirley**
Office: Altamonte Springs Service Center
Telephone (fax): **407-659-4800/4842/4866**(4805)

8. Well drill cuttings must be taken at 10 feet intervals and at formation changes when required. The well contractor must notify the District one week in advance of work commencing so bags can be provided. Any change in sample intervals must be approved in advance by the District. **Samples should be taken and stored on site for inspection by the District. Sample splits with the Division of Ground Water Programs and assigned consultants can be coordinated on site to reduce well contractor labor. The District will provide sample bags if requested.**

9. **A copy of this permit must be on site during all phases of well construction. This well is a designated monitor well.** Construction as documented will meet all Chapter 62-555, 40C-3 and 62-532, F.A.C., standards.

FLORIDA DEPARTMENT OF
HEALTH

STATE OF FLORIDA
DEPARTMENT OF HEALTH
Orange County Health Department
300 N. Mercy Dr., Suite 1 Orlando, FL 32808
Phone 407 - 521-2630

XXXXXXXX
160399

Permit # **080210** Fee **$80.00**
Date Issued **3/19/2008**
WellLocation **1621 S Alafaya Trl**
S **3** T **23** R **31** **Orlando**

Permit for: **New Well Construction**
Primary Use: Monitoring
Issued to

Diversified Drilling C Lic # 11191
Charles Musselwhite
1031 Crown Park Cr
Winter Garden FL 34787

Construction Specifics

Drilling Meth:
Annular Mat: **Grout**
Casing joined by **Coupling**
Grout:
Pump Type:
Tank Type:
Delineated: **N**

Type Well: **Shallow**
Casing Mat: **PVC**
Well Diameter **8** in
Casing depth **5** ft
Exceed 75psi **No**
Electric **No**

Well must meet all required setbacks
Authority Chapter 36-A Orange County Well Code

Florida Department of
Environmental Protection
Central District
3319 Maguire Boulevard, Suite 232
Orlando, Florida 32803-3767

Charlie Crist
Governor

Jeff Kottkamp
Lt. Governor

Michael W. Sole
Secretary

BY ELECTRONIC MAIL:

Jason Herrick, P.E.
Manager, Engineering Division
Orange County Utilities
9150 Curry Ford Road
Orlando, FL 32825-0000
Jason.Herrick@ocfl.net

Attention: Jason Herrick, P.E.
Manager, Engineering Division

Orange County - UIC
Potable Water ASR Program
Construction Permit 48-0272819-001-UC
Application No. 48-0272819-003-UC
Modification of Conditions

Dear Mr. Herrick:

The Department is in receipt of your Application No. 48-0272819-003-UC to modify the conditions of the injection well operation permit referenced above. The conditions are changed as follows:

1. The following language is added to Specific Condition No. 6.b. of the permit:

   The new dual zone well (LFMW-1/CZMW-1) shall be constructed as follows:

   CZMW-1 – The monitor interval shall be moved up from 900 – 950 feet to 900 – 940 feet.
   LFMW-1 – The monitor interval shall be moved up from 1,100 – 1,200 to 1,040 – 1,200 feet.
   Cement 100 feet of annulus between the 6-inch diameter casing and borehole well from 940-1,040 feet.

   The new ASR well (ASR-LF-1) shall be constructed as follows:

   The 36-inch steel pit casing landed to 40 feet depth is eliminated.
   220 feet of 24-inch steel casing (not 30-inch casing) will be installed into the top of rock.
   The inner fiberglass ASR casing will be changed to 0.5 inch thick black carbon steel casing.
   The ASR storage interval will be moved up from 1,100 – 1,200 feet to 1,045 – 1,185 feet.

2. Fact Sheet condition 2.E. is changed to indicate that the well LFMW-1 uses six inch PVC casing.

This letter must be attached to Injection Well Operation Permit No. 48-0272819-001-UC and becomes a part of and subject to all conditions of that permit.

The Department’s proposed agency action shall become final unless a timely petition for an administrative hearing is filed under Sections 120.569 and 120.57 of the Florida Statutes before the deadline for filing a petition. The procedures for petitioning for a hearing are set forth below.

A person whose substantial interests are affected by the Department’s proposed permitting decision may petition for an administrative proceeding (hearing) under Sections 120.569 and 120.57 of the Florida Statutes. The petition must contain the information set forth below and must be filed (received by the clerk) in the Office of General Counsel of the Department at 3900 Commonwealth Boulevard, Mail Station 35, Tallahassee, Florida 32399-3000.

Petitions by the applicant or any of the parties listed below must be filed within fourteen days of receipt of this written notice. Petitions filed by any persons other than those entitled to written notice under Section 120.60(3) of the Florida Statutes must be filed within fourteen days of publication of the notice or within fourteen days of receipt of the written notice, whichever occurs first.

Under Section 120.60(3) of the Florida Statutes, however, any person who has asked the Department for notice of agency action may file a petition within fourteen days of receipt of such notice, regardless of the date of publication.

The petitioner shall mail a copy of the petition to the applicant at the address indicated above at the time of filing. The failure of any person to file a petition within the appropriate time period shall constitute a waiver of that person’s right to request an administrative determination (hearing) under Sections 120.569 and 120.57 of the Florida Statutes. Any subsequent intervention (in a proceeding initiated by another party) will be only at the discretion of the presiding officer upon the filing of a motion in compliance with Rule 28-106.205 of the Florida Administrative Code.

A petition that disputes the material facts on which the Department’s action is based must contain the following information:

(a) The name, address, and telephone number of each petitioner; the name, address, and telephone number of the petitioner’s representative, if any; the Department permit identification number and the county in which the subject matter or activity is located;
(b) A statement of how and when each petitioner received notice of the Department action;
(c) A statement of how each petitioner's substantial interests are affected by the Department action;
(d) A statement of all disputed issues of material fact. If there are none, the petition must so indicate;
(e) A statement of facts that the petitioner contends warrant reversal or modification of the Department action;
(f) A concise statement of the ultimate facts alleged, as well as the rules and statutes which entitle the petitioner to relief; and
(g) A statement of the relief sought by the petitioner, stating precisely the action that the petitioner wants the Department to take.

A petition that does not dispute the material facts on which the Department’s action is based shall state that no such facts are in dispute and otherwise shall contain the same information as set forth above, as required by Rule 28-106.301.

Because the administrative hearing process is designed to formulate final agency action, the filing of a petition means that the Department’s final action may be different from the position taken by it in this notice. Persons whose substantial interests will be affected by any such final decision of the Department have the right to petition to become a party to the proceeding, in accordance with the requirements set forth above.

Mediation under Section 120.573 of the Florida Statutes is not available for this proceeding.

This action is final and effective on the date filed with the Clerk of the Department unless a petition is filed in accordance with the above. Upon the timely filing of a petition this order will not be effective until further order of the Department.

Any party to the order has the right to seek judicial review of the order under Section 120.68 of the Florida Statutes, by the filing of a Notice Of Appeal under Rule 9.110 of the Florida Rules of Appellate Procedure with the Clerk of the Department in the Office of General Counsel, Mail Station 35, 3900 Commonwealth Boulevard, Tallahassee, Florida, 32399-3000; and by filing a copy of the Notice Of Appeal accompanied by the applicable filing fees with the appropriate district court of appeal. The Notice of Appeal must be filed within 30 days from the date when the final order is filed with the Clerk of the Department.

Executed in Orlando, Florida.

STATE OF FLORIDA DEPARTMENT
OF ENVIRONMENTAL PROTECTION

Christianne C. Ferraro

Christianne C. Ferraro, P.E.
Program Administrator
Water Resource Management
3319 Maguire Boulevard
Suite 232
Orlando, Florida 32803-3767
(407) 894-7555

Date: September 19, 2008

FILING AND ACKNOWLEDGMENT

FILED, on this date, pursuant to Section 120.52, F.S., with the designated Department Clerk, receipt of which is hereby acknowledged.

Clerk	September 19, 2008 Date

CCF/AKD/dw

cc: George Heuler, PG, UIC, Tallahassee

CERTIFICATE OF SERVICE

This is to certify that this MODIFICATION OF CONDITIONS and all copies were e-mailed before the close of business on September 20, 2008 to the listed persons by Duane Watroba.

Florida Department of
Environmental Protection
Central District
3319 Maguire Boulevard, Suite 232
Orlando, Florida 32803-3767

Charlie Crist
Governor

Jeff Kottkamp
Lt. Governor

Michael W. Sole
Secretary

BY ELECTRONIC MAIL:

Jason Herrick, P.E.
Manager, Engineering Division
Orange County Utilities
9150 Curry Ford Road
Orlando, FL 32825-0000
Jason.Herrick@ocfl.net

Attention: Jason Herrick, P.E.
Manager, Engineering Division

Orange County - UIC
Potable Water ASR Program
Construction Permit 48-0272819-001-UC
Application No. 48-0272819-002-UC
Modification of Conditions

Dear Mr. Herrick:

The Department is in receipt of your Application No. 48-0272819-002-UC to modify the conditions of the injection well operation permit referenced above. The conditions are changed as follows:

1. The following language is added to Specific Condition No. 6.b. of the permit:

   The new dual zone well (LFMW-1/CZMW-1) shall be constructed as follows:

   24 inch steel casing to 220 feet
   18 inch steel to 150 feet
   18 inch x 12 inch weldbend reducer
   12 inch steel casing to 900 feet
   Open hole interval 900 feet to 950 feet
   6 inch PVC certa-lok casing to 1,100 feet
   Open hole interval 1,100 feet to 1,200 feet

   The new dual zone well is to be located approximately 100 feet north west of the original location on the 100 foot radius of the ASR well (ASR-LF-1).

2. Fact Sheet condition 2.E. is changed to indicate that the well LFMW-1 uses six inch PVC casing.

This letter must be attached to Injection Well Operation Permit No. 48-0272819-001-UC and becomes a part of and subject to all conditions of that permit.

The Department's proposed agency action shall become final unless a timely petition for an administrative hearing is filed under Sections 120.569 and 120.57 of the Florida Statutes before the deadline for filing a petition. The procedures for petitioning for a hearing are set forth below.

A person whose substantial interests are affected by the Department's proposed permitting decision may petition for an administrative proceeding (hearing) under Sections 120.569 and 120.57 of the Florida Statutes. The petition must contain the information set forth below and must be filed (received by the clerk) in the Office of General Counsel of the Department at 3900 Commonwealth Boulevard, Mail Station 35, Tallahassee, Florida 32399-3000.

Petitions by the applicant or any of the parties listed below must be filed within fourteen days of receipt of this written notice. Petitions filed by any persons other than those entitled to written notice under Section 120.60(3) of the Florida Statutes must be filed within fourteen days of publication of the notice or within fourteen days of receipt of the written notice, whichever occurs first.

Under Section 120.60(3) of the Florida Statutes, however, any person who has asked the Department for notice of agency action may file a petition within fourteen days of receipt of such notice, regardless of the date of publication.

The petitioner shall mail a copy of the petition to the applicant at the address indicated above at the time of filing. The failure of any person to file a petition within the appropriate time period shall constitute a waiver of that person's right to request an administrative determination (hearing) under Sections 120.569 and 120.57 of the Florida Statutes. Any subsequent intervention (in a proceeding initiated by another party) will be only at the discretion of the presiding officer upon the filing of a motion in compliance with Rule 28-106.205 of the Florida Administrative Code.

A petition that disputes the material facts on which the Department's action is based must contain the following information:

(a) The name, address, and telephone number of each petitioner; the name, address, and telephone number of the petitioner's representative, if any; the Department permit identification number and the county in which the subject matter or activity is located;
(b) A statement of how and when each petitioner received notice of the Department action;
(c) A statement of how each petitioner's substantial interests are affected by the Department action;
(d) A statement of all disputed issues of material fact. If there are none, the petition must so indicate;
(e) A statement of facts that the petitioner contends warrant reversal or modification of the Department action;
(f) A concise statement of the ultimate facts alleged, as well as the rules and statutes which entitle the petitioner to relief; and
(g) A statement of the relief sought by the petitioner, stating precisely the action that the petitioner wants the Department to take.

A petition that does not dispute the material facts on which the Department's action is based shall state that no such facts are in dispute and otherwise shall contain the same information as set forth above, as required by Rule 28-106.301.

Because the administrative hearing process is designed to formulate final agency action, the filing of a petition means that the Department's final action may be different from the position taken by it in this notice. Persons whose substantial interests will be affected by any such final decision of the Department have the right to petition to become a party to the proceeding, in accordance with the requirements set forth above.

Mediation under Section 120.573 of the Florida Statutes is not available for this proceeding.

Florida Department of Environmental Protection

Central District
3319 Maguire Boulevard, Suite 232
Orlando, Florida 32803-3767

Charlie Crist
Governor

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Lt. Governor

Michael W. Sole
Secretary

BY ELECTRONIC MAIL: Jason.Herrick@ocfl.net

PERMIT

PERMITTEE:
Jason Herrick, P.E.
Orange County Utilities
9150 Curry Ford Road
Orlando, Florida 32825-0000
Jason.Herrick@ocfl.net

Orange County – UIC
Permit File Number: 48-0272819-001-UC
Date of Issue: March 4, 2008
Expiration Date: March 3, 2013
County: Orange
Latitude: 28° 31' 08" N
Longitude: 81° 12' 36" W
Orange County Utilities Potable Water ASR
Project Class V ASR Injection Well

This permit is issued under the provisions of Chapter 403 of the Florida Statutes (F.S.) and Rules 62-4, 62-520, 62-528 and 62-550 of the Florida Administrative Code. The above named permittee is hereby authorized to perform the work or operate the facility shown on the application and approved drawing(s), plans, and other documents, attached hereto or on file with the Department and made a part hereof and specifically described as follows:

Construct one Class V Group Seven Aquifer Storage and Recovery (ASR-LF-1) injection well system with two storage zone monitoring wells (LF-MW-1 and LF-MW-2) and one confining zone monitoring well (CZ-MW-1). The basic ASR well design will consist of an 18-inch diameter injection well to a proposed total depth of approximately 1,200 feet and cased to approximately 1,100 feet below land surface (bls). The ASR system will have a maximum storage capacity of approximately 540 MG. The overall objective of this ASR well is to store, in the Floridan aquifer, potable water from the Orange County potable water distribution system and retrieve the stored potable water for use. Initially, the ASR well will be cycle tested by injecting, storing and recovering potable water for a period of approximately 5 years.

The Application to Construct V Injection well System, DEP Form 62-528.900(1), was received January 19, 2007, with supporting documents and additional information last received October 17, 2007. The location for this project is the Orange County Eastern Regional Water Reclamation Facility (ERWRF), Alafaya Trail, directly south of the intersection of Alafaya Trail and Curry Ford Road, Orange County, Florida.

Subject to Specific Conditions 1-7 and General Conditions 1-4.

1. General Criteria:

a. This permit approval is based upon evaluation of the data contained in the application, plans and specifications submitted in support of the application. Any changes, except as provided elsewhere in this permit, must be approved by the Department before implementation.

b. No drilling operations shall begin without an approved disposal site for drill cuttings, fluids or waste. It shall be the Water Well Contractor's responsibility to obtain any necessary Department and local agency approval for disposal prior to the start of construction. It is anticipated that wastes will be disposed of on site using a fluid containment system. In this event, permits shall be obtained accordingly.

c. No fluid shall be injected without written authorization from the Department. The issuance of this construction permit does not obligate the Department to permit its operation, unless the well, monitoring system and surface appurtenances qualify for an operation permit.

d. Those conditions imposed by the St. Johns River Water Management District in this project's Water Use Permit(s) regarding the testing of the ASR system remain in effect.

e. No underground injection is allowed that causes or allows movement of fluid into an underground source of drinking water if such fluid movement may cause a violation of any primary drinking water standard or may otherwise adversely affect the health of persons.

f. If historical or archaeological artifacts, such as Indian canoes, are discovered at any time within the project site, the permittee shall notify the FDEP Orlando Central District office and the Bureau of Historic Preservation, Division of Archives, History and Records Management, R. A. Gray Building, Tallahassee, Florida 32301, telephone number (850) 487-2073.

g. Signatories and Certification Requirements

(1) All reports and other submittals required to comply with this permit shall be signed by a person authorized under Rules 62-528.340(1) or (2), F.A.C.

(2) In accordance with Rule 62-528.340(4), F.A.C., all reports shall contain the following certification:

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based upon my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

h. Plugging/abandonment and Alternate use plans – Permittees who are unable to operate the ASR well to meet its intended purpose shall within 180 days of FDEP notification:

(1) Submit a plugging and abandonment permit application in accordance with Rules 62-528.625 and 62-528.645, F.A.C., or

(2) Submit an alternate use plan for the well. Alternate use may commence after the plan has been approved by the Department, including any necessary permit or permit modifications as required by the Department or any other agency.

i. Prior to operational testing under this permit, the permittee shall obtain from the Department, a Water Quality Criteria Exemption (pursuant to Rule 62-520.500, F.A.C.) for sodium or any secondary standards that may be exceeded, where applicable.

j. The permittee shall be aware of and operate under General Conditions F.A.C. Rule 62-528.307(1)(a) through (x) and Rule 62-528.307(2). General Conditions are binding upon the permittee and enforceable pursuant to Chapter 403 of the Florida Statutes (see attachment I).

k. The permittee shall refer to Rule 62-602, F.A.C., in its entirety, to ensure compliance with all requirements for ASR wells.

2. Quality Assurance/Quality Control

a. The permittee shall ensure that the construction of this facility shall be as described in the application and supporting documents. Any proposed modifications to this permit shall be submitted in writing to the Underground Injection Control program manager for review and clearance prior to implementation. Changes of negligible impact to the environment and staff time will be reviewed by the program manager, cleared when appropriate, and incorporated into this permit. Changes or modifications other than those described above will require submission of completed application and appropriate processing fees as per Rule 62-4.050, F.A.C.

b. A Florida registered professional engineer, pursuant to Chapter 471, Florida Statutes (F.S.), shall be retained throughout the construction period and operational testing to be responsible for the construction operation and to certify the application, specifications and completion report and other related documents, pursuant to Rule 62-528.440(5), F.A.C. A professional engineer or professional geologist shall provide monitoring of the drilling and testing operation. The Department shall be notified immediately of any change of the Engineer of Record.

c. All water quality samples required in this permit shall be collected and analyzed in accordance with Department Standard Operating Procedures (SOP), pursuant to the FDEP Quality Assurance, Chapter 62-160, F.A.C. The various components of the collection of the FDEP SOPs are found in DEP-SOP-001/01 (Field Procedures) and DEP-SOP-002/01 (Laboratory Procedures).

d. The permittee shall calibrate all pressure gauge(s), flow meter(s), chart recorder(s), and other related equipment associated with the injection well system on a semi-annual basis. The permittee shall maintain all monitoring equipment and shall ensure that the monitoring equipment is calibrated and in proper operating condition at all times. Laboratory equipment, methods, and quality control will follow EPA guidelines as expressed in Standard Methods for the Examination of Water and Wastewater. The pressure gauge(s), flow meter(s), and chart recorder(s) shall be calibrated using standard engineering methods.

e. Continuous on-site supervision by qualified personnel (engineer and/or geologist, as appropriate) is required during all testing and geophysical logging operations.

f. Proper operation and maintenance includes effective performance, adequate funding, adequate operator staffing and training, and adequate laboratory and process controls, including appropriate quality assurance procedures.

g. Hurricane Preparedness - Upon the issuance of a "Hurricane Watch" by the National Weather Service, the preparations to be made include, but are not necessarily limited to, the following:

(1) Secure all on-site salt and other stockpiled additive materials to prevent surface and/or ground water contamination.

(2) Properly secure drilling equipment and rig(s) to prevent damage to well(s) and on-site treatment process equipment.

3. Source Water Fluid Analysis

a. Potable Water – a single event to occur within the 60 days prior to beginning cycle testing

(1) Prior to injection, the potable water analyses shall include:

(a) Primary and Secondary drinking water standards established in Chapter 62-550, Part III, F.A.C., (excluding asbestos, acrylamide, epichlorohydrin, and dioxin);

(b) Giardia lamblia and Cryptosporidium (count and viability testing where applicable) dissolved oxygen, E. coli and enteroccoci (a single event test for characterizing the background water quality);

(c) Fecal and total coliform.

4. Construction, Testing and Reporting

a. Prior to the commencement of any work, the name of the Florida-registered driller(s) supervising the drilling operations and the driller's registration number shall be submitted to the Department. The permittee or the engineer of record shall provide the Department with copies of all required federal, state or local permits prior to the commencement of drilling the wells.

b. If any problem develops that may seriously hinder compliance with this permit, construction progress or good construction practice, the Department shall be notified immediately. The Department may require a detailed written report describing what problems have occurred, the remedial measures applied to assure compliance and the measures taken to prevent recurrence of the problem.

c. During the construction period allowed by this permit, daily progress reports shall be submitted to the Department and the Technical Advisory Committee each week. The reporting period shall run for seven (7) days and reports shall be mailed or e-mailed within 48 hours of the last day of the reporting period. The report shall include, but is not limited to, the following:

(1) A cover letter summarizing each week's activities and a projection of activities for the next reporting period;

(2) Description of daily footage drilled by diameter of bit or size of hole opener or reamer being used;

(3) Description of work during installation and cementing of casing, including amounts of casing and cement used;

(4) Lithologic log with cuttings description, formation, and depth encountered;

(5) Collection of drilling cuttings at least every 5 feet and at every formation change;

(6) Water quality analyses;

(7) Description of work and type of testing accomplished including geophysical logging, video logs, and pumping tests;

(8) Description of any construction problems that developed during the reporting period and current status;

(9) Copies of the driller's log are to be submitted with the weekly summary;

(10) Description of any deviation survey conducted;

(11) Details of any packer tests, pump tests and core analyses; and

(12) Details of the additions of salt or other materials to suppress well flow (if applicable), and include the date, depth and amount of material used.

d. Upon completion of construction of the injection well and all monitor wells, detailed in this permit, a complete set of as-built engineering drawings (Florida registered P.E. signed and sealed) shall be submitted to the Department's district office and Tallahassee UIC Program.

e. Background ground-water quality samples shall be obtained from the ASR test well and all monitor wells for the specific water quality criteria listed for potable water in Specific Condition No. 3. "Background" means the condition of waters in the absence of the activity or discharge under consideration, based on the best scientific information available to the Department [Rule 62-520.200(3), F.A.C.]. The samples shall be taken after final completion and clearance of drilling fluids from each well, and prior to the initiation of any pump tests.

f. Within 30 days of well completion of the ASR test well and monitor wells, the permittee or the authorized representative shall submit to the Department for each well the following information:

(1) Certification of Class V Well Construction Completion, DEP Form 62-528.900(4);

(2) A copy of the St. Johns River Water Management District permit to construct a well;

(3) A copy of the Water Management District's Well Completion Report; and

(4) A copy of the Water Management District's Consumptive Use /Water Use Permit.

g. This project shall be monitored by the Department with the assistance of the U.S. Environmental Protection Agency (EPA) - Region 4 and the Technical Advisory Committee (TAC), which consists of representatives of the following agencies:

Department of Environmental Protection – Orlando
Department of Environmental Protection – Tallahassee
Department of Environmental Protection/Florida Geologic Survey - Tallahassee
St. Johns River Water Management District – Palm Bay
US Environmental Protection Agency (EPA), Region 4 – Atlanta (Note - EPA is not a TAC member, however, does provide oversight)

h. Permitee shall provide copies of all correspondence relative to this permit to each member of the TAC. Such correspondence includes but is not limited to reports, schedules, analyses and geophysical logs required by the Department under the terms of this permit. The permittee is not required to provide specific correspondence to any TAC member who submits to the permittee a written request to be omitted as a recipient of specific correspondence.

i. After completion of construction and testing, a final engineering report shall be submitted to the Department, the EPA and the TAC. The report shall include, but not be limited to, all information and data collected under Rules 62-528.605, 62-528.615, and 62-528.635, F.A.C., with appropriate interpretations. Mill certificates for the casings shall be included in the report. To the extent possible, the transmissivity and storativity of the injection zone and the maximum capacity within safe pressure limits shall be estimated. This report shall also be signed and sealed by a Florida licensed professional engineer and professional geologist.

j. After completion of construction and testing, the following items shall be submitted to the State Geologist at the Florida Geological Survey, 903 West Tennessee Street, Tallahassee, Florida 32304-7707:

(1) Cuttings obtained during well construction;

(2) Any cores obtained during well construction when no longer needed by the permittee;

(3) Any geophysical logs run during well construction; and

(4) A copy of the final report described in Condition 4.i. above.

k. A written, detailed evaluation of the ASR system performance shall be included with the permit renewal or operation permit application.

l. The specifications for a temporary containment structure around the borehole during the drilling of the ASR well shall be submitted to and approved by the Department prior to the ASR well construction.

5. Cycle Testing Requirements Using Potable Water

To address the potential for mineral leaching in the aquifer that may result from aquifer storage and recovery cycle testing, the potable water which may have higher dissolved-oxygen levels and higher oxidation-reduction potential than native ground water will be pre-treated before injection and storage in the lower Floridan Aquifer. Pretreatment shall include degasification and dechlorination. The permittee will install and operate portable dechlorination equipment and Membrana Liqui-Cel® membrane contactors in order to pre-treat the potable water in-line, prior to injection and storage in the ASR well. Equipment components will be sized to operate at the design injection rate of 2,000 gallons per minute.

The Drinking Water Permit will be amended by incorporating the proposed treatment components.

a. After authorization by the Department, the permittee shall conduct cycle testing of the ASR well system using potable water to demonstrate that the ASR well(s) can maintain water quality standards and assimilate the design daily flows prior to receiving approval for full operation using potable water. Cycle testing using potable water shall not commence until issuance of authorization from the Department. Prior to Department authorization of operational cycle testing:

(1) The permittee shall submit at a minimum the following information to each member of the Technical Advisory Committee for review:

(a) Draft operation and maintenance manual;

(b) Lithologic and geophysical logs with interpretations;

(c) Results of pressure tests (if conducted) on the final casing for the ASR well;

(d) Surface equipment completion certification or certification of interim completion for the purposes of testing;

(e) Signed and sealed as-built engineering drawings of all wellheads and subsurface well components;

(f) A consumptive use permit and all other applicable permits; and

(g) Submittal of a plugging and abandonment plan.

(h) Completion report for the storage zone monitoring wells (LF-MW-1 and LF-MW-2) located in the vicinity of well ASR-LF-1.

(2) Before authorizing operational testing, the Department shall conduct an inspection of the facility to determine if the conditions of this permit have been met.

(3) The permittee shall provide an updated well inventory and physically verify all wells that are within a 1.0-mile radius of the ASR test well. Operational status, existing use, depth of final casing, and total depth of the wells shall be determined and submitted with the above-mentioned information.

(4) Prior to approval to inject into Class G-II ground water, the permittee shall meet the applicable criteria in Rule 62-610.466, F.A.C. Compliance with public and utility notifications in Rule 62-610.574(4), F.A.C., is also required.

b. A cycle testing schedule is attached to this permit (see Table 1). In the event arsenic concentrations are observed that exceed 10 µg/L in any monitoring well or in the ASR well, the permittee shall contact the Department with this finding and cease injection until such time a Consent Order has been issued by the Department that addresses the arsenic exceedance. In any event, cycle testing shall cease after the third cycle in order to allow for Department review of the water quality sampling results for the ASR and monitoring wells. Cycle testing shall not resume until authorized by the Department.

c. The Florida Geological Survey (FGS) is currently investigating the effects of ASR systems on storage zones. The Department requests that the permittee contact the Hydrogeology Program at the FGS (850-488-9380) at least 30 days prior to operational testing to allow the Survey to coordinate a sampling schedule during the operational testing phase of this project.

d. A set back distance for the ASR well(s), in accordance with Chapter 62-521.200(7), F.A.C., has been established to be at least 500 feet from potable water supply wells.

6. Post Cycle Testing Operational Conditions Using Potable Water

a. A qualified representative of the Engineer of Record must be present for the start-up operations and the Department must be notified in writing of the date operational testing began for the subject well.

b. Proposed Class V ASR Test Well:

Well Name	Casing Diameter [OD] / Depth*	Injection Interval	Aquifer
ASR-LF-1	18" Fiberglass / 1,100'	1,100 – 1,200'	Floridan

* below land surface; approximate depths.

Monitor Well System

Well Name	Casing Diameter / Depth*	Monitored Interval	Aquifer
LF-MW-1	6.6" STL / 1,100'	1,100 – 1,200'	Floridan
LF-MW-2	4.7" STL / 1,100'	1,100 – 1,200'	Floridan
CZ-MW-1	12" STL / 900'	900 - 950'	Floridan
SA-1	2" PVC / 15'	5 - 15'	Surficial
SA-2	2" PVC / 15'	5 - 15'	Surficial

* below land surface; approximate depths.
(LF-MW – Storage Zone Monitoring Well, CZ-MW – Confining Zone Monitoring Well, SA – Shallow Aquifer Monitoring Well) (Note – LF-MW-2 is completed as an existing exploratory well)

c. Prior to operational use of the ASR, the authorization referenced in Specific 5.a. above shall have been obtained and a monitoring plan shall have been approved using the newly installed monitoring wells (both LF-MWs). Results of the water quality analyses of the potable water and background water quality pursuant to Specific Conditions 3. and 4.e. of this permit shall have been submitted. Aquifer test data, analysis and evaluation shall have been submitted and a monitoring program plan that includes construction diagrams, well specifications, well locations, construction specifications and drilling and testing plans shall have been submitted, approved by the Department and the new wells shall have been installed.

The ASR test well shall be monitored in accordance with the approved monitoring plan referenced above. The Department anticipates that the standard monitoring parameters and frequency listed below (and attached as Table 1) will apply during each recharge and recovery period. The monitor wells shall be sampled and analyzed in accordance with the schedule listed below and on the attached Table 1 based on the approved monitoring plan. Once the monitoring plan and parameters are approved, the permittee will be submitting a summary of the monthly monitoring data developed from the injection well instrumentation. The report shall include the following data:

Parameter	**Units**	**Recording Frequency**	**Frequency of Analysis**	
			ASR	**Monitoring Wells**
Flow Rate, max.	Mgd	continuous	D/M	
Flow Rate, min.	Mgd	continuous	D/M	
Flow Rate, avg.	Mgd	continuous	D/M	
Total Volume Recharged	Mg	daily	D/M	
Total Volume Recovered	Mg	daily	D/M	
Net Storage Volume	Mg	daily	M*	
Injection Pressure, max.	Psi	continuous	D/M	
Injection Pressure, min.	Psi	continuous	D/M	
Injection Pressure, avg.	Psi	continuous	D/M	

* - Monthly net storage volume per ASR well and total ASR wellfield.

D/M - daily and monthly; M - monthly.

Note: During extended storage periods (greater than 30 days), the physical parameters listed above may be monitored monthly.

e. The permittee shall submit monthly results of all injection well and monitoring well data required by this permit, and monthly progress reports which include both the current status of operational testing and a summary of all monthly activities, no later than the 28th day of the month immediately following the month of record. The results and progress reports shall be sent to the Department of Environmental Protection, 3319 Maguire Boulevard, Suite 232, Orlando, FL 32803-3767. A copy of the results and reports shall also be sent to the Department of Environmental Protection, Underground Injection Control Program, Mail Station 3530, 2600 Blair Stone Road, Tallahassee, FL 32399-2400.

f. A final engineering report shall be submitted to the Department, the FGS and each TAC member and include the following information:

(1) A detailed analysis of all cycle testing;

(2) An operation and maintenance section;

(3) Record drawings sealed by the Engineer of Record;

(4) Summary of all water quality and water level data collected, conclusions and recommendations; and

(5) Estimated ASR well capacity.

7. Abnormal Events

a. In the event the permittee is temporarily unable to comply with any conditions of this permit due to breakdown of equipment, power outages, destruction by hazard of fire, wind or by other cause, the permittee shall notify the Department. Notification shall be made in person, by telephone or by electronic mail within 24 hours of breakdown or malfunction to the UIC program staff, Orlando Central District, (407) 893-3308.

b. A written report of any noncompliance referenced in Condition 7.a. above shall be submitted to the Orlando Central District office within five days after discovery of the occurrence. The report shall describe the nature and cause of the breakdown or malfunction, the steps being taken or planned to be taken to correct the problem and prevent its reoccurrence, emergency procedures in use pending correction of the problem, and the time when the facility will again be operating in accordance with permit conditions.

Issued this 5th day of March, 2008.

STATE OF FLORIDA DEPARTMENT
OF ENVIRONMENTAL PROTECTION

Vivian F. Garfein

Vivian F. Garfein
Director, Central District

PERMITTEE:

Permit/Certification No: 48-0272819-001
Date of Issue: March 4, 2008
Date of Expiration: March 3, 2013

Jason Herrick, P.E.

VFG/CCF/AKD/dw

CHAPTER 62-528 Florida Administrative Code

62-528.307 Underground Injection Control: General Conditions for Permits.

The following general conditions shall be included in each of the respective types of underground injection control permits.

(1) All UIC Permits.

- (a) The terms, conditions, requirements, limitations and restrictions set forth in this permit are "permit conditions" and are binding and enforceable pursuant to section 403.141, F.S.
- (b) This permit is valid only for the specific processes and operations applied for and indicated in the approved drawings or exhibits. Any unauthorized deviation from the approved drawings, exhibits, specifications, or conditions of this permit may constitute grounds for revocation and enforcement action.
- (c) As provided in subsection 403.087(7), F.S., the issuance of this permit does not convey any vested rights or exclusive privileges. Neither does it authorize any injury to public or private property or any invasion of personal rights, nor infringement of federal, state, or local laws or regulations. This permit is not a waiver of or approval of any other Department permit that may be required for other aspects of the total project which are not addressed in this permit.
- (d) This permit conveys no title to land, water, does not constitute State recognition or acknowledgment of title, and does not constitute authority for the use of submerged lands unless herein provided and the necessary title or leasehold interests have been obtained from the State. Only the Trustees of the Internal Improvement Trust Fund may express State opinion as to title.
- (e) This permit does not relieve the permittee from liability for harm to human health or welfare, animal, or plant life, or property caused by the construction or operation of this permitted source, or from penalties therefrom; nor does it allow the permittee to cause pollution in contravention of Florida Statutes and Department rules, unless specifically authorized by an order from the Department.
- (f) The permittee shall properly operate and maintain the facility and systems of treatment and control (and related appurtenances) that are installed and used by the permittee to achieve compliance with the conditions of this permit, or are required by Department rules. This provision includes the operation of backup or auxiliary facilities or similar systems when necessary to achieve compliance with the conditions of the permit and when required by Department rules.
- (g) The permittee, by accepting this permit, specifically agrees to allow authorized Department personnel, upon presentation of credentials or other documents as may be required by law and at reasonable times, access to the premises where the permitted activity is located or conducted to:
  1. Have access to and copy any records that must be kept under conditions of this permit;
  2. Inspect the facility, equipment, practices, or operations regulated or required under this permit; and
  3. Sample or monitor any substances or parameters at any location reasonably necessary to assure compliance with this permit or Department rules.

  Reasonable time will depend on the nature of the concern being investigated.
- (h) If, for any reason, the permittee does not comply with or will be unable to comply with any condition or limitation specified in this permit, the permittee shall immediately provide the Department with the following information:
  1. A description of and cause of noncompliance; and
  2. The period of noncompliance, including dates and times; or, if not corrected the anticipated time the noncompliance is expected to continue, and steps being taken to reduce, eliminate, and prevent the recurrence of the noncompliance. The permittee shall be responsible for any and all damages which may result and may be subject to enforcement action by the Department for penalties or for revocation of this permit.
- (i) In accepting this permit, the permittee understands and agrees that all records, notes, monitoring data and other information relating to the construction or operation of this permitted source which are submitted to the Department may be used by the Department as evidence in any enforcement case involving the permitted source arising under the Florida Statutes or Department rules, except where such use is proscribed by sections 403.111 and 403.73, F.S. Such evidence shall only be used to the extent it is consistent with the Florida Rules of Civil Procedure and appropriate evidentiary rules.
- (j) The permittee agrees to comply with changes in Department rules and Florida Statutes after a reasonable time for compliance; provided, however, the permittee does not waive any other rights granted by Florida Statutes or Department rules.
- (k) This permit is transferable only upon Department approval in accordance with rules 62-4.120 and 62-528.350, F.A.C. The permittee shall be liable for any non-compliance of the permitted activity until the transfer is approved by the Department.
- (l) This permit or a copy thereof shall be kept at the work site of the permitted activity.
- (m) The permittee shall comply with the following:
  1. Upon request, the permittee shall furnish all records and plans required under Department rules. During enforcement actions, the retention period for all records shall be extended automatically unless the Department determines that the records are no longer required.

2. The permittee shall hold at the facility or other location designated by this permit records of all monitoring information (including calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation) required by the permit, copies of all reports required by this permit, and records of all data used to complete the application for this permit. These materials shall be retained at least three years from the date of the sample, measurement, report, or application unless otherwise specified by Department rule.
3. Records of monitoring information shall include:
    a. the date, exact place, and time of sampling or measurements;
    b. the person responsible for performing the sampling or measurements;
    c. the dates analyses were performed;
    d. the person responsible for performing the analyses;
    e. the analytical techniques or methods used;
    f. the results of such analyses.
4. The permittee shall furnish to the Department, within the time requested in writing, any information which the Department requests to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit, or to determine compliance with this permit.
5. If the permittee becomes aware that relevant facts were not submitted or were incorrect in the permit application or in any report to the Department, such facts or information shall be corrected promptly.

(n) All applications, reports, or information required by the Department shall be certified as being true, accurate, and complete.

(o) Reports of compliance or noncompliance with, or any progress reports on, requirements contained in any compliance schedule of this permit shall be submitted no later than 14 days following each scheduled date.

(p) Any permit noncompliance constitutes a violation of the Safe Drinking Water Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or for denial of a permit renewal application.

(q) It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

(r) The permittee shall take all reasonable steps to minimize or correct any adverse impact on the environment resulting from noncompliance with this permit.

(s) This permit may be modified, revoked and reissued, or terminated for cause, as provided in 40 C.F.R. sections 144.39(a), 144.40(a), and 144.41 (1998). The filing of a request by the permittee for a permit modification, revocation or reissuance, or termination, or a notification of planned changes or anticipated noncompliance, does not stay any permit condition.

(t) The permittee shall retain all records of all monitoring information concerning the nature and composition of injected fluid until five years after completion of any plugging and abandonment procedures specified under rule 62-528.435, F.A.C. The permittee shall deliver the records to the Department office that issued the permit at the conclusion of the retention period unless the permittee elects to continue retention of the records.

(u) All reports and other submittals required to comply with this permit shall be signed by a person authorized under rules 62-528.340(1) or (2), F.A.C. All reports shall contain the certification required in rule 62-528.340(4), F.A.C.

(v) The permittee shall notify the Department as soon as possible of any planned physical alterations or additions to the permitted facility. In addition, prior approval is required for activities described in rule 62-528.410(1)(h).

(w) The permittee shall give advance notice to the Department of any planned changes in the permitted facility or injection activity which may result in noncompliance with permit requirements.

(x) The permittee shall report any noncompliance which may endanger health or the environment including:
1. Any monitoring or other information which indicates that any contaminant may cause an endangerment to an underground source of drinking water; or
2. Any noncompliance with a permit condition or malfunction of the injection system which may cause fluid migration into or between underground sources of drinking water.

Any information shall be provided orally within 24 hours from the time the permittee becomes aware of the circumstances. A written submission shall also be provided within 5 days of the time the permittee becomes aware of the circumstances. The written submission shall contain a description of the noncompliance and its cause, the period of noncompliance, including exact dates and times, and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and the steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance.

(2) All UIC Construction Permits.

(a) If injection is to continue beyond the expiration date of this permit the permittee shall apply for, and obtain an operation permit. If necessary to complete the operational testing period, the permittee shall apply for renewal of the construction permit at least 60 days prior to the expiration date of this permit.

(b) Proper operation and maintenance includes effective performance, adequate funding, adequate operator staffing and training, and adequate laboratory and process controls, including appropriate quality assurance procedures.

(c) The injection system shall be monitored in accordance with rules 62-528.425(1)(g) and 62-528.430(2), F.A.C. Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity.

(d) The permittee shall submit monthly to the Department the results of all injection well and monitor well data required by this permit no later than the last day of the month immediately following the month of record. The results shall be sent to the Department of Environmental Protection, [Name]District Office, [Address]. A copy of this report shall also be sent to the Department of Environmental Protection, Underground Injection Control Program, MS 3530, 2600 Blair Stone Road, Tallahassee, Florida 32399-2400.

(e) Operational testing. Prior to operational testing, the permittee shall comply with the requirements of rule 62-528.450(3)(a),(b), and (c), F.A.C.

(f) Mechanical Integrity.

1. Injection is prohibited until the permittee affirmatively demonstrates that the well has mechanical integrity. Prior to operational testing the permittee shall establish, and thereafter maintain the mechanical integrity of the well at all times.
2. If the Department determines that the injection well lacks mechanical integrity, written notice shall be given to the permittee.
3. Within 48 hours of receiving written notice that the well lacks mechanical integrity, unless the Department requires immediate cessation of injection, the permittee shall cease injection into the well unless the Department allows continued injection pursuant to subparagraph 4 below.
4. The Department shall allow the permittee to continue operation of a well that lacks mechanical integrity if the permittee has made a satisfactory demonstration that fluid movement into or between underground sources of drinking water is not occurring.

(3) All UIC Operation Permits.

(a) In accordance with rules 62-4.090(1) and 62-528.455(3)(a), F.A.C., the permittee shall submit an application for permit renewal at least 60 days prior to expiration of this permit.

(b) Proper operation and maintenance includes effective performance, adequate funding, adequate operator staffing and training, and adequate laboratory and process controls, including appropriate quality assurance procedures.

(c) The injection system shall be monitored in accordance with rules 62-528.425(1)(g) and 62-528.430(2), F.A.C. Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity.

(d) The permittee shall submit monthly to the Department the results of all injection well and monitor well data required by this permit no later than the last day of the month immediately following the month of record. The results shall be sent to the Department of Environmental Protection, [Name] District Office, [Address]. A copy of this report shall also be sent to the Department of Environmental Protection, Underground Injection Control Program, MS 3530, 2600 Blair Stone Road, Tallahassee, Florida 32399-2400.

(e) Mechanical Integrity.

1. The permittee shall maintain the mechanical integrity of the well at all times.
2. If the Department determines that the injection well lacks mechanical integrity, written notice shall be given to the permittee.
3. Within 48 hours of receiving written notice that the well lacks mechanical integrity, unless the Department requires immediate cessation of injection, the permittee shall cease injection into the well unless the Department allows continued injection pursuant to subparagraph 4 below.
4. The Department shall allow the permittee to continue operation of a well that lacks mechanical integrity if the permittee has made a satisfactory demonstration that fluid movement into or between underground sources of drinking water is not occurring.

(4) All UIC Plugging and Abandonment Permits.

(a) The well shall be plugged and abandoned in a manner that will not allow fluid movement into or between underground sources of drinking water.

(b) In accordance with rule 62-528.435(11), F.A.C., the permittee shall submit to the Department a plugging and abandonment report within 90 days of completion of plugging and abandonment.

Specific Authority 403.061, 403.087, 403.088 FS. Law Implemented 403.061, 403.087, 403.088 FS. History-- New 7-15-99.

r

WELL COMPLETION REPORT (Please complete in black ink or type.)

PERMIT # 118439 1 CUP/WUP # 50035 DID # 228475

If permit is for multiple wells indicate the number of wells drilled ______.

Indicate remaining wells to be cancelled ______.

WATER WELL CONTRACTOR'S SIGNATURE ______ License # 11191

I certify that the information provided in this report is accurate and true.

Grout	No. of Bags	From (Ft.)	To (Ft.)
Neat Cement:	2,277	0 500'	450' 1045'
Lime rock	23 YDS	450'	500'

WELL LOCATION: County ORANGE

NW/SW 1/4 of NW 1/4 of Section 3 Twp: 23S Rge: 31E

Latitude 28° 31' 09.918" Longitude 81° 12' 32.576"

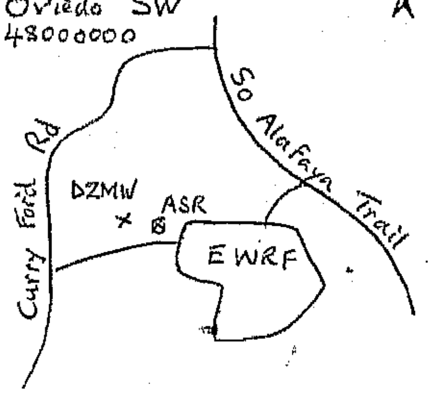
DATE STAMP

Official Use Only

Sketch of well location on property

Oviedo SW

48000000



Give distances from septic tank and house or other reference points

CHEMICAL ANALYSIS WHEN REQUIRED

Iron: ____ ppm Sulfate: ____ ppm

Chloride: ____ ppm

☐ Lab Test ☐ Field Test Kit

Pump Type

☐ Centrifugal ☐ Jet ☐ Submersible ☐ Turbine

Horsepower 250 Capacity 3500 G.P.M. 2150

Pump Depth 150 Ft. Intake Depth 152 Ft.

Form 408-3-3 Rev. 12/95

OWNER'S NAME Orange County Utilities

COMPLETION DATE 1/8/09 Florida Unique I.D. AAK 1513

WELL USE: DEP/Public ____ Irrigation ____ Domestic ____ Monitor ____

HRS Limited ____ 62-524 ____ Other ASR

DRILL METHOD ☑ Rotary ☐ Cable Tool ☐ Combination

☐ Jet ☐ Auger Other ______

Measured Static Water Level 45.10' Measured Pumping Water Level 55.28'

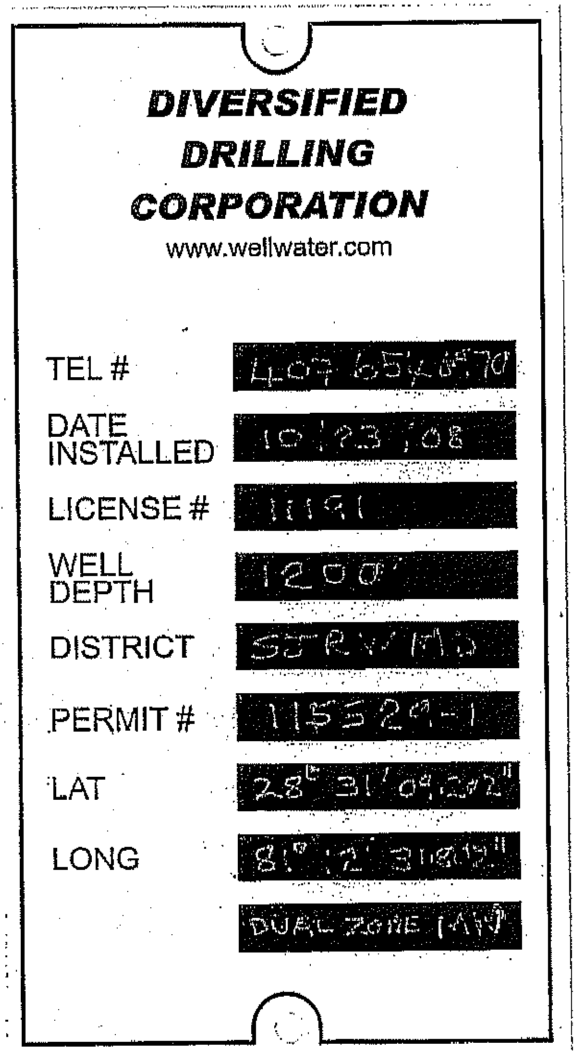
After 48 Hours at 2150 G.P.M. Measuring Pt. (Describe): TOP CASING

Which is 3 Ft. ☑ Above ☐ Below Land Surface

Casing: ☑ Black Steel ☐ Galv. ☐ PVC Other ______

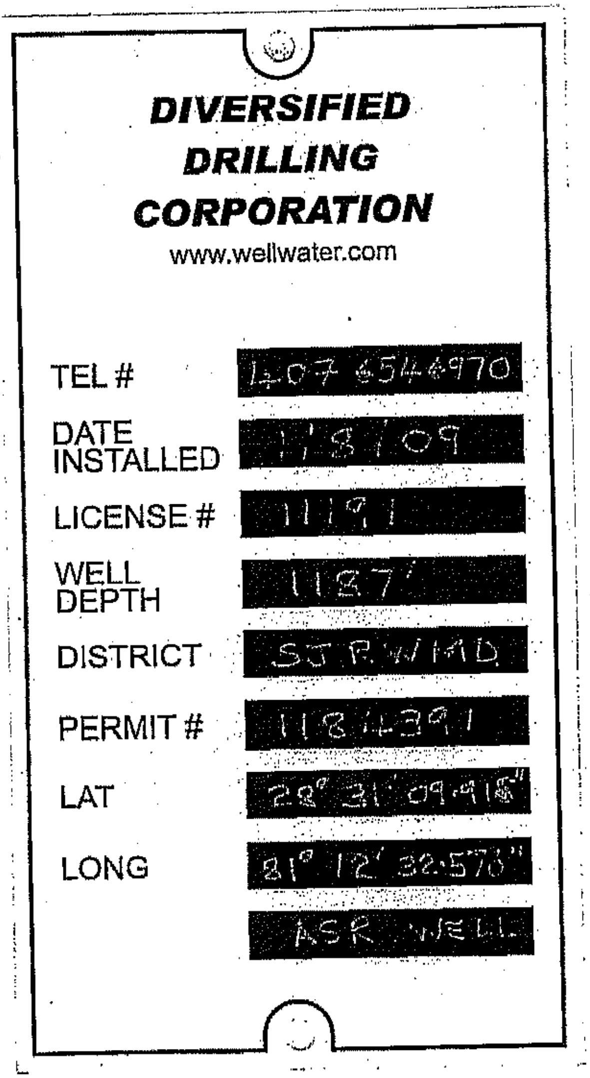
☐ Open Hole ☐ Screen Casing Diameter & Depth (Ft.)	Depth (Ft.) From	To	DRILL CUTTINGS LOG Examine cuttings every 20 ft. or at formation changes. Note cavities, depth to producing zones. *Color | Grain Size | Type of Material*
Diameter 24" From 0 To 221			See Attached Cuttings Log 24" x .375" CASING 24" Installed Dual Rotary with Benseal bottom 5' cemented 20sac
Diameter 18" From +3' To 1045'			18" x 1/2" CASING
Liner ☐ or Casing ☐ Diameter ____ From ____ To ____			OPEN HOLE TO 1187'

Driller's Name: (print or type) Dave Adkins



DIVERSIFIED
DRILLING
CORPORATION
www.wellwater.com

TEL #	407 654 6970
DATE INSTALLED	10/23/08
LICENSE #	11191
WELL DEPTH	1200'
DISTRICT	SJRWMD
PERMIT #	115529-1
LAT	28° 31' 09.202"
LONG	81° 12' 31.802"
	DUAL ZONE (AW)



DIVERSIFIED
DRILLING
CORPORATION
www.wellwater.com

TEL #	407 654 6970
DATE INSTALLED	11/8/09
LICENSE #	11191
WELL DEPTH	1187'
DISTRICT	SJRWMD
PERMIT #	1184391
LAT	28° 31' 09.918"
LONG	81° 12' 32.578"
	ASR WELL

ORANGE COUNTY ASR, DUAL ZONE MONITOR WELL

UPPER OPEN HOLE ZONE 900′ – 945′ (Annulus)
LOWER OPEN HOLE ZONE 1045′ – 1200′ (6″ PVC)

WELL COMPLETION REPORT (Please complete in black ink or type.)

PERMIT # 115529-1 CUP/WUP # 50035 DID # 228475

If permit is for multiple wells indicate the number of wells drilled ________.

Indicate remaining wells to be cancelled ________

WATER WELL CONTRACTOR'S SIGNATURE ________ License # 11191

I certify that the information provided in this report is accurate and true.

Grout	No. of Bags	From (Ft.)	To (Ft.)
Neat Cement:	18″x12″ 1338	0	900′ *
Neat Cement	6″ PVC 9 sacks neat 39 sacks 5%	945 959	959 1045

WELL LOCATION: County Orange

NW/SW 1/4 of NW 1/4 of Section 3 Twp: 23S Rge: 31E

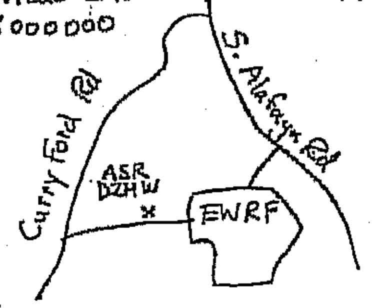
Latitude 28° 31′ 09.202″ Longitude 81° 12′ 31.802″

DATE STAMP

Official Use Only

Sketch of well location on property

Oviedo SW
48000000



Give distances from septic tank and house or other reference points

CHEMICAL ANALYSIS WHEN REQUIRED

Iron: ____ ppm Sulfate: ____ ppm

Chloride: ____ ppm

[ ] Lab Test [ ] Field Test Kit

Pump Type

[ ] Centrifugal [ ] Jet [✓] Submersible [ ] Turbine

Horsepower U 5 HP L 30 HP Capacity U 75 L 300 G.P.M. U 20 GPM L 325 GPM

Pump Depth U 86′ L 95′ Ft. Intake Depth U 86′ L 98′ Ft.

Form 408-3-3 Rev. 12/85

OWNER'S NAME Orange County Utilities

COMPLETION DATE 10/23/08 Florida Unique I.D. AAL 5927

WELL USE: DEP/Public ____ Irrigation ____ Domestic ____ Monitor ✓ Dual

HRS Limited ____ 62-524 ____ Other ____

DRILL METHOD [✓] Rotary [ ] Cable Tool [ ] Combination

[ ] Jet [ ] Auger Other ____

Measured Static Water Level UPPER 44.35 LOWER 43.0 Measured Pumping Water Level UPPER 58 LOWER 81.43

After 2 Hours at U 20 GPM L 325 G.P.M. Measuring Pt. (Describe): Top of 24″ casing

Which Is 3 Ft. [✓] Above [ ] Below Land Surface

Casing: [✓] Black Steel [ ] Galv. [✓] PVC Other ____

[ ] Open Hole [ ] Screen	Depth (Ft.)		DRILL CUTTINGS LOG Examine cuttings every 20 ft. or at formation changes. Note cavities, depth to producing zones.
Casing Diameter & Depth (Ft.)	From	To	Color | Grain Size | Type of Material
Diameter 24″ From 0 To 220′			Drill Cuttings Log Attached TD 1200′
Diameter 18″x12″ From 0 To 900′			18″ x 12″ Casing with 150′ 18″ Casing, 18″x12″ weld reducer and 750′ of 12″ casing to 900′
Liner [ ] or Casing [ ] " Diameter 6 From +4′ To 1045′			6″ PVC Certa Lok Casing OD 6.625″ ID 5.728″ (SDR17) Cement basket 1044

Driller's Name: (print or type) David Adkins

* 18″x12″ Casing Cavities rocked up 2.5 YDS 630′ – 649′

Orange County Dual Zone Monitor Well

Description	Depth (Ft.) From	To
Sand	11	35
Gray sand stone, sand	35	45
Shell and sand	45	52
Blue clay and shell	52	65
Shell and silty clay	65	68
Silty clay	75	105
Silty clay, minor limestone	105	135
Shell and tan lime	135	191
Tan limestone	191	196
White limestone	196	230
Dolomite	230	450
Tan limestone	450	510
Hard brown limestone	510	1050
Dolomite	1050	1125
	1125	1200

BFA Environmental Consultants
Barnes, Ferland and Associates, Inc.

September 13, 2007 BFA #01-30.14

Ali Kazi
Florida Department of Environmental Services
3319 Maguire Boulevard, Suite 232
Orlando, FL 32803-3767

Subject: Generic Permit for Discharge of Produced Ground Water
Orange County Aquifer Storage and Recovery (ASR) Facilities – Orange County Utilities (OCU)

Dear Mr. Kazi:

The purpose of this letter is to submit supporting documentation for a Generic Permit for the discharge of produced groundwater from non-contaminated site activity under 62-621.300 (2); F.A.C.

General Project Description

The St. Johns River Water Management District (SJRWMD) and Orange County Utilities (OCU) are working together on a copperative Aquifer Storage and Recovery (ASR) program that may be used to help meet OCU's projected deficits through seasonal and long-term storage and recovery of water. This will involve the construction and testing of one ASR Well and one Dual Zone Monitoring Well. Groundwater discharges will need to occur from these wells during construction and testing.

General information on the facility and permittee is listed below.

Permittee
Orange County Utilities (PWS 3484132)
Jason Herrick,P.E., Chief Engineer
9150 Curry Ford Road, Orlando FL 32825
Phone: 407-254-9700; Fax: 407-254-9999

Facility
Name: Orange County Aquifer Storage Recovery Facility
Location: On the OCU Eastern Water Reclamation Facility Property (FL0038849)
Tim Madhanagopal, P.E.
1621 Alafaya Trail, Orlando FL, 32825
Phone: 407-249-6248
Lat & Long: 28° 31′ 10″ N, 81° 12′ 31″

The permitee Orange County Utilities is also the water supplier and will own the project after it is put into operation.

3655 Maguire Boulevard • Suite 150 • Orlando, Florida 32803
Office (407) 896-8608 • Fax (407) 896-1822

Water Quality

The planned wells will be located within 500 feet of the existing exploratory well and open within the same storage zone interval/dept h 1100 to 1200 feet below surface. The water quality analysis from this exploratory well is considered representative of the water quality from the planned wells. Exploratory well MW-2 (1100′-1200′) water samples were taken on April 6, 2006 and analyzed for all primary and secondary drinking water parameters except dioxin and asbestoes. These laboratory results are included as an attachment to this letter and compared below to the freshwater discharge screening values listed in 62-621.300 (2); F.A.C.

Discharge Parameter	**Fresh Waters Discharge Screening Values**	**MW-2 Results 4-26-06**
Total Organic Carbon (TOC) - mg/l	10.0	N/A
pH, standard units	6.0-8.5	8.38
Total Recoverable Mercury - µg/l	0.012	0.2 U
Total Recoverable Cadmium - µg/l	9.3	0.5 U
Total Recoverable Copper - µg/l	2.9	1.0 U
Total Recoverable Lead - mg/l	0.03	0.004 I
Total Recoverable Zinc - µg/l	86.0	45.0
Total Recoverable Chromium (Hex.) - µg/l	11.0	1.0 U
Benzene - µg/l	1.0	0.5 U
Naphthalene - µg/l	100.0	N/A

Ground Water Discharge

During construction of the wells, variable rate and constant rate pump testing will be performed on the monitoring wells and the ASR well. The test water will be discharged to uplands about 500 feet away from the well. Some water will pond and percolate in the uplands area and some will overland flow to wetlands on the site located about 700 feet away. The test water should remain on the County's property. Details about discharge methods and volume are included in the Drilling and Testing Fluid Management Plan under section "Pump Test Disposal Water". This plan is included as an attachment to this letter.

Also, the attached figure shows the overall site plan with the existing and proposed wells, discharge location, Orange County's property lines and the receiving wetlands.

I trust the information provided in this letter and attachments meets the Department's requirements. Should you require additional information or clarification, please don't hesitate to contact me.

Sincerely,

Barnes, Ferland, and Associates, Inc.

Ronald P. Ferland, P.E.
Project Manager

cc: Anil Desai, DEP
Chuck Digerlando, P.E., Orange County Utilities
Glenn Forrest, P.E., SJRWMD
Bryan McDonald, P.G., CH2MHILL

Attachment 1 - Exploratory Well Water Quality
Attachment 2 - Drilling and Testing Fluid Management Plan
Attachment 3 - Overall Site Plan (Figure)

Drilling and Testing Fluid Management Plan

Introduction

This document has been prepared to describe fluid management during the planned construction and testing of the ASR Well and Dual Zone Monitor Well at the Orange County Eastern Water Reclamation Facility. The main fluid sources include:

- Bentonite mud and unconsolidated cuttings during mud rotary drilling
- Groundwater discharge during reverse air drilling
- Groundwater discharge during well development
- Groundwater discharge during variable rate and constant rate testing
- Disposal of recovered water during cycle testing

Drilling Fluid and Development Water

The Contractor shall take all necessary precautions in order to prevent contaminated water, hydraulic oil, gasoline, and other hazardous substance from entering the well and/or receiving waters. Surficial aquifer monitor wells SA-1 and SA-2 will be sampled and tested prior to and upon completion of ASR well construction.

The Contractor will be responsible for disposal of all drilling fluids, well discharges and cuttings in a manner that is acceptable to Orange County and the in accordance with Federal, State and Local regulations. The contractor shall monitor and control the flow of fluids from the well at all times.

During mud rotary drilling, the Contractor shall retain all bentonite mud and cuttings that are generated in a fluid containment system including steel mud tubs/bins. The Contractor shall not make use of any un-lined or plastic-lined pits. Drilling mud and sediments/cuttings shall be disposed of at an offsite location in an acceptable manner.

Reverse air discharge water will require settling to reduce turbidity prior to disposal using a fluid containment system and conveyed to a location approved by Orange County. All limerock cuttings, removed during reverse air drilling operations, shall be stock piled or spread out at an on-site location designated by the Orange County.

Well development water will require settling prior to disposal using a fluid containment system and conveyed to a location approved by Orange County in an environmentally safe manner. The Contractor is responsible for meeting turbidity requirements prior to discharge development water entering any stormwater collection system or receiving waters.

Pump Test Disposal Water

Wells will be developed approximately 8 to 24 hours and until the water has a turbidity of less than 1 NTU, prior to all pumping tests. Variable rate and constant rate pumping tests will be completed at wells CZ/LF-MW-1 (Dual Zone Monitor Well) and ASR-LF-1 (ASR Well). A control valve and flow meter on the discharge line will be used to control and measure flows.

The Contractor shall provide temporary discharge piping, approximately 500 feet, to convey pumped water to the designated disposal area shown in Figure 1. The Contractor shall dispose the water at adjacent uplands and the water will overland sheet flow to the wetlands. The discharge water shall be disposed of in accordance with the Generic Permit for the discharge of produced groundwater from non-contaminated site activity under Chapter 62-621.300 (2); F.A.C.

Table 1 – Pumping Test Discharge Volumes.

Well Name	Open Interval	Pumping Test	Discharge Rate -	Period Hours	Volume Gallons	Volume Acre-Feet
Dual Zone	900'-1050'	Step Test 1	1000	2	180,000	0.37
			1500	2	180,000	0.55
			2100	2	252,000	0.77
		Constant 1	2100	24	3,024,000	9.28
Sub-Totals					**3,576,000**	**11**
Dual Zone	900'-1200'	Step Test 2	1000	2	120,000	0.37
			1500	2	180,000	0.55
			2100	2	252,000	0.77
		Constant 2	2100	48	6,048,000	18.56
Sub-Totals					**6,600,000**	**20**
ASR Well	1100'-1200'	Step Test 3	1000	2	120,000	0.37
			1500	2	180,000	0.55
			2000	2	240,000	0.74
			2500	2	300,000	0.92
	1100'-1200'	Constant 3	2100	24	3,024,000	9.28
Sub-Totals					**3,864,000**	**12**
Totals					***14,040,000***	***43***

The total volume of water discharged to the adjacent uplands during pump testing shall amount to approximately 14 million gallons over several pumping periods. Two 8-hour step-drawdown tests shall be performed on the Dual Zone

Monitor Well with a flow rate up to 2,100 gallons per minute. Two constant rate pumping tests shall be performed on the Dual Zone Monitor Well with a flow rate of 2,100 gpm for periods of 24 and 48 hours. One 8-hour step-drawdown test shall be performed on the ASR Well with a flow rate up to 2500 gpm. One constant rate pumping test shall be performed on the ASR Well with a flow rate of 2,500 gpm for a 24 hour period.

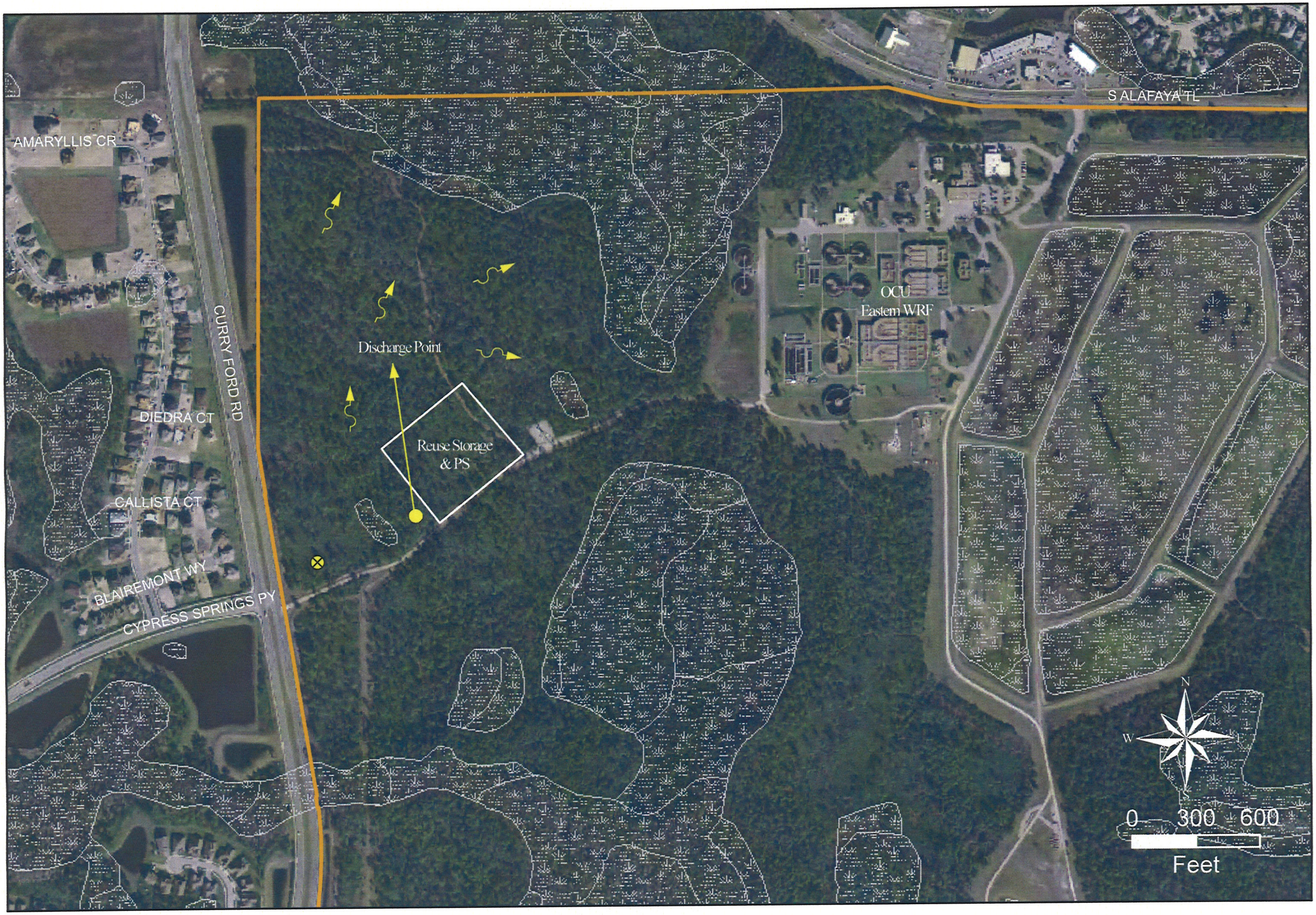
Cycle Test Water

Cycle testing water will be sent to the OCU reclaimed water system as a groundwater supplemental water supply. The test water from the well will be sent to the reclaimed water system only during the initial cycle testing phase and to purge the well at the beginning of each recovery phase during normal operations.

Initial cycle testing water will be pumped via a temporary pipeline to the effluent pump station for the first and maybe second cycle testing events. The amount of water pumped to the reuse system is approximately 3 MGD for 10 days during Cycle 1 and during Cycle 2.

The purge water from the well will be pumped to the reuse ground storage tank adjacent to the proposed ASR well site. The ASR well purging will occur at the beginning of every recovery cycle maybe 3 to 4 times a year based on seasonal demands. The purge water volume is approximately 30,000 gallons per event.

The total volume of water pumped to the reuse system is 60 million gallons during the cycle testing and approximately 120,000 gallons per year prior to every recovery phase during normal operation of the ASR Well.



BFA

Legend

- ● ASR Well
- ⊗ Exploratory Well
- ☐ Orange County Property
- ▨ Wetlands
- ⤳ Flow Arrow

Groundwater Discharge Location
SJRWMD/OCU ASR WELL FACILITY

PC&B Environmental Laboratories, Inc.
210 Park Road, Oviedo, Florida 32765
Phone: 407-359-7194 Fax: 407-359-7197

MAY 0 1 2006

04-26-2006

Murdock Munroe
Barnes, Ferland & Associates, Inc.
3655 Maguire Blvd., Suite 150
Orlando, FL 32803-

Dear Murdock Munroe:

Enclosed are the results of the analysis of your samples received 04/06/2006.

Our laboratory is NELAP certified by the Florida DOH (Lab #E83239) and operates under an NELAP approved Quality Assurance Plan. Unless otherwise noted, all results are reported as received. All data were determined in accordance with published procedures (EPA-600/4-79-020), Methods for Chemical Analysis of Water and Wastes, Revised March 1983, or later and/or Standard Methods for the examination of Water and Wastewater, 20th Edition 1999, or later and/or Test Methods for Evaluating Solid Waste (EPA-SW-846, Revised January 1995, or later), unless stated otherwise in our ComQapp under method modifications.

Test results meet all of the requirements of the NELAC Standards.

If you have any questions, please do not hesitate to give me a call.

Sincerely,

W. Judson Rogers

W. Judson Rogers III
Quality Assurance Officer

PC&B Environmental Laboratories, Inc.
210 Park Road, Oviedo, Florida 32765
Phone: 407-359-7194 Fax: 407-359-7197

Client : Barnes, Ferland & Associates, Inc.
3655 Maguire Blvd., Suite 150
Orlando, FL 32803-

Contact : Murdock Munroe
Phone : (407) 896-8608

Laboratory Reference Number : 206040049

Project Name : Orange Co ASR
Project Number :
Chain of Custody :
Sample temperature at time of receipt: 3 degrees C

Laboratory ID	Matrix	Client ID	Status	Date/Time Sampled
206040049-1	DW	OCU 1100-1205	RUN	04/06/2006 13:00

Number	Parameter	Description
1	Group Test	Full Regulated List (w/o diox., asbest.)
1	EPA 900.0	Gross Alpha
1	EERF Ra-05	Radium-228

PC&B Environmental Laboratories, Inc.
210 Park Road
Oviedo, FL 32765-8801
PHONE: 407-359-7194

Report of Analysis

CLIENT NAME: Barnes, Ferland & Associates, Inc.
PROJECT NAME: Orange Co ASR
PROJECT NUMBER:
DATE RECEIVED: 04/06/2006

Lab Reference Number			206040049-1	
Client Sample ID			OCU 1100-1205	
Date/Time Sampled			04/06/2006 13:00	
Sample Matrix (as Received)			DW	
EPA 110.2	Color	PCU	10	
EPA 140.1	Odor	TON	20	
EPA 150.1	pH	Unit	8.38	
EPA 300.0	Chloride	mg/l	37	
EPA 335.3	Cyanide	mg/l	0.002	U
EPA 300.0	Fluoride	mg/l	0.22	
SM5540C	MBAS as LAS(MW 318)	mg/l	0.06	
EPA 353.3	Nitrate/Nitrite	mg/l	0.007	U
EPA 300.0	Nitrate	mg/l	0.007	U
EPA 300.0	Nitrite	mg/l	0.008	U
EPA 160.1	Residue, Filterable (TDS)	mg/l	270	
EPA 6010/200.7	Sodium, Total	mg/l	17.2	
EPA 300.0	Sulfate	mg/l	14	
EPA 900.0	Gross Alpha	pCi/l	1.9	
EERF Ra-05	Radium 228	pCi/l	3.0	U
EPA 6010/200.7	Aluminum, Total	ug/l	100	
EPA 200.9	Antimony, Total	ug/l	5	U
EPA 6010/200.7	Arsenic, Total	ug/l	5.0	U
EPA 6010/200.7	Barium, Total	ug/l	72.0	
EPA 6010/200.7	Beryllium, Total	ug/l	9	U
EPA 6010/200.7	Cadmium, Total	ug/l	0.5	U
EPA 6010/200.7	Chromium, Total	ug/l	1	U
EPA 6010/200.7	Copper, Total	ug/l	1.0	U
EPA 549.2	Diquat	ug/l	1	U
EPA 548.1	Endothall	ug/l	10	U
EPA 547	Glyphosate	ug/l	10	
EPA 6010/200.7	Iron, Total	ug/l	30	
EPA 200.9	Lead, Total	ug/l	4	I
EPA 6010/200.7	Manganese, Total	ug/l	3	U
EPA 245.1	Mercury, Total	ug/l	0.2	U
EPA 6010/200.7	Nickel, Total	ug/l	5	U
EPA 200.9	Selenium, Total	ug/l	5	U
EPA 6010/200.7	Silver, Total	ug/l	1	U
EPA 200.9	Thallium, Total	ug/l	1.0	U
EPA 6010/200.7	Zinc, Total	ug/l	45	

U = Undetected. The value preceeding the 'U' is the RDL for the analyte. Results reported on a Wet Weight basis.

NELAP- FDOH Certification # E83239

Reviewed by : ____________________

PC&B Environmental Laboratories, Inc.
210 Park Road
Oviedo, FL 32765-8801
PHONE: 407-359-7194
FAX: 407-359-7197

Report of Analysis
Chlorinated Pesticides/PCBs

CLIENT NAME: Barnes, Ferland & Associates, Inc.
PROJECT NAME: Orange Co ASR
PROJECT NUMBER:
DATE RECEIVED: 04/06/2006
ANALYTICAL PROTOCOL: EPA 508

Lab Reference Number	206040049-1
Client Sample ID	OCU 1100-1205
Date/Time Sampled	04/06/2006 13:00
Date/Time Extracted	04/07/2006
Date/Time Analyzed	04/07/2006 17:09
Sample Matrix (as Received)	DW
Analysis Confirmed	No
Dilution Factor	1
Result Units	ug/l
Gamma_BHC (Lindane)	0.02 U
Endrin	0.02 U
Heptachlor	0.02 U
Heptachlor Epoxide	0.02 U
Hexachlorobenzene	0.02 U
Methoxychlor	0.02 U
Toxaphene	1.0 U
Chlordane(technical)	0.8 U
Total PCBs	0.25 U

U = Undetected. The value preceeding the 'U' is the RDL for the analyte, based on dilution. Results reported on a Wet Weight basis.

NELAP- FDOH Certification # E83239

Reviewed by : ____________________

PC&B Environmental Laboratories, Inc.
210 Park Road
Oviedo, FL 32765-8801
PHONE: 407-359-7194
FAX: 407-359-7197

Report of Analysis
EDB/DBCP

CLIENT NAME: Barnes, Ferland & Associates, Inc.
PROJECT NAME: Orange Co ASR
PROJECT NUMBER:
DATE RECEIVED: 04/06/2006
ANALYTICAL PROTOCOL: EPA 504/504.1

Lab Reference Number	206040049-1
Client Sample ID	OCU 1100-1205
Date/Time Sampled	04/06/2006 13:00
Date/Time Extracted	04/10/2006
Date/Time Analyzed	04/10/2006 12:14
Sample Matrix (as Received)	DW
Analysis Confirmed	No
Dilution Factor	1
Result Units	ug/l
Ethylene dibromide (EDB)	0.01 U
1,2-Dibromo-3-chloropropane	0.02 U
(Surr) BFB (%)	96

U = Undetected. The value preceeding the 'U' is the RDL for the analyte, based on dilution. Results reported on a Wet Weight basis.

NELAP- FDOH Certification # E83239

Reviewed by : ______________

PC&B Environmental Laboratories, Inc.
210 Park Road
Oviedo, FL 32765-8801
PHONE: 407-359-7194
FAX: 407-359-7197

Report of Analysis
Regulated Carbamate Pesticides

CLIENT NAME: Barnes, Ferland & Associates, Inc.
PROJECT NAME: Orange Co ASR
PROJECT NUMBER:
DATE RECEIVED: 04/06/2006
ANALYTICAL PROTOCOL: EPA 531.1

Lab Reference Number	206040049-1
Client Sample ID	OCU 1100-1205
Date/Time Sampled	04/06/2006 13:00
Date/Time Extracted	04/11/2006 03:37
Date/Time Analyzed	04/11/2006 03:37
Sample Matrix (as Received)	DW
Analysis Confirmed	No
Dilution Factor	1
Result Units	ug/l
Carbofuran	0.5
Oxamyl	0.5

U = Undetected. The value preceeding the 'U' is the RDL for the analyte, based on dilution. Results reported on a Wet Weight basis.

NELAP- FDOH Certification # E83239

Reviewed by : ____________________

PC&B Environmental Laboratories, Inc.
210 Park Road
Oviedo, FL 32765-8801
PHONE: 407-359-7194
FAX: 407-359-7197

Report of Analysis
Regulated Herbicides

CLIENT NAME: Barnes, Ferland & Associates, Inc.
PROJECT NAME: Orange Co ASR
PROJECT NUMBER:
DATE RECEIVED: 04/06/2006
ANALYTICAL PROTOCOL: EPA 515.1

Lab Reference Number	206040049-1
Client Sample ID	OCU 1100-1205
Date/Time Sampled	04/06/2006 13:00
Date/Time Extracted	04/10/2006
Date/Time Analyzed	04/11/2006 10:37
Sample Matrix (as Received)	DW
Analysis Confirmed	No
Dilution Factor	1
Result Units	ug/l
2,4-D	0.05 U
Dalapon	0.05 U
Dinoseb	0.05 U
Picloram	0.05 U
2,4,5-TP (silvex)	0.05 U
PCP	0.05 U

U = Undetected. The value preceeding the 'U' is the RDL for the analyte, based on dilution. Results reported on a Wet Weight basis.

NELAP- FDOH Certification # E83239

Reviewed by :

PC&B Environmental Laboratories, Inc.
210 Park Road
Oviedo, FL 32765-8801
PHONE: 407-359-7194
FAX: 407-359-7197

Report of Analysis
Regulated Semivolatile Organic

CLIENT NAME: Barnes, Ferland & Associates, Inc.
PROJECT NAME: Orange Co ASR
PROJECT NUMBER:
DATE RECEIVED: 04/06/2006
ANALYTICAL PROTOCOL: EPA 525.2

Lab Reference Number	206040049-1
Client Sample ID	OCU 1100-1205
Date/Time Sampled	04/06/2006 13:00
Date/Time Extracted	04/10/2006 12:00
Date/Time Analyzed	04/10/2006 18:23
Sample Matrix (as Received)	DW
Analysis Confirmed	GCMS
Dilution Factor	1
Result Units	ug/l
Atrazine	1.0 U
Benzo(a)pyrene	0.1 U
bis(2-ethylhexyl)phthalate	1.0 U
bis(2-ethylhexyl)adipate	1.0 U
Hexachlorocyclopentadiene	1.0 U
Pentachlorophenol	0.4 U
Simazine	1.0 U
Alachlor	1.0 U

U = Undetected. The value preceeding the 'U' is the RDL for the analyte, based on dilution. Results reported on a Wet Weight basis.

NELAP- FDOH Certification # E83239

Reviewed by : ____________________

PC&B Environmental Laboratories, Inc.
210 Park Road
Oviedo, FL 32765-8801
PHONE: 407-359-7194
FAX: 407-359-7197

Report of Analysis
Regulated Volatile Organics

CLIENT NAME: Barnes, Ferland & Associates, Inc.
PROJECT NAME: Orange Co ASR
PROJECT NUMBER:
DATE RECEIVED: 04/06/2006
ANALYTICAL PROTOCOL: EPA 524.2

Lab Reference Number	206040049-1
Client Sample ID	OCU 1100-1205
Date/Time Sampled	04/06/2006 13:00
Date/Time Extracted	04/10/2006
Date/Time Analyzed	04/10/2006 11:47
Sample Matrix (as Received)	DW
Analysis Confirmed	GCMS
Dilution Factor	1
Result Units	ug/l
Benzene	0.5 U
Carbon tetrachloride	0.5 U
Chlorobenzene	0.5 U
1,2-Dichorobenzene	0.5 U
1,4-Dichlorobenzene	0.5 U
1,2-Dichloroethane	0.5 U
1,1-Dichloroethene	0.5 U
cis-1,2-Dichloroethene	0.5 U
trans-1,2-Dichloroethene	0.5 U
1,2-Dichloropropane	0.5 U
Ethylbenzene	0.5 U
Methylene chloride	0.5 U
Styrene	0.5 U
Tetrachloroethene	0.5 U
Toluene	0.5 U
1,2,4-Trichlorobenzene	0.5 U
1,1,1-Trichloroethane	0.5 U
1,1,2-Trichloroethane	0.5 U
Trichloroethene	0.5 U
Vinyl chloride	0.5 U
Xylenes, total	0.5 U

U = Undetected. The value preceeding the 'U' is the RDL for the analyte, based on dilution. Results reported on a Wet Weight basis.

NELAP- FDOH Certification # E83239

Reviewed by : ____________________

Quality Control Report for LCS Analysis

EDB/DBCP

Matrix: Water
Lab Sample ID: LCS
QC Batch ID: 200604EDB002
LCS Units: ug/l

Analysis Date: 04/10/2006
Preparation Date: 04/10/2006
Method: EPA 504
Analyst: RM

Analyte	LCS Conc	LCS Result	Percent Recovery	Lower Control Limit	Upper Control Limit
(Surr) BFB	100.0	100.0	100	**80**	**120**
Ethylene dibromide (EDB)	0.25	0.27	108	**48**	**141**
1,2-Dibromo-3-chloropropane	0.3	0.3	108	**43**	**142**

Quality Control Report for LCS Analysis

Chlorinated Pesticides/PCBs

Matrix: Water
Lab Sample ID: LCS
QC Batch ID: 200604PEST027
LCS Units: ug/l

Analysis Date: 04/07/2006
Preparation Date: 04/07/2006
Method: EPA 508
Analyst: RM

Analyte	LCS Conc	LCS Result	Percent Recovery	Lower Control Limit	Upper Control Limit
Gamma_BHC (Lindane)	0.100	0.109	110	**50**	**120**
Heptachlor	0.100	0.114	114	**50**	**120**
Heptachlor Epoxide	0.100	0.112	112	**50**	**120**
Methoxychlor	0.100	0.070	70	**50**	**120**

Quality Control Report for LCS Analysis

Regulated Herbicides

Matrix: Water
Lab Sample ID: LCS
QC Batch ID: 200604HERB039
LCS Units: ug/l

Analysis Date: 04/11/2006
Preparation Date: 04/10/2006
Method: EPA 515.1
Analyst: RM

Analyte	LCS Conc	LCS Result	Percent Recovery	Lower Control Limit	Upper Control Limit
2,4-D	0.2	0.2	95	**75**	**120**
Dalapon	2.0	2.4	120	**75**	**120**
Dinoseb	2.0	2.4	120	**75**	**120**
Picloram	2.0	2.3	115	**75**	**120**
2,4,5-TP (silvex)	0.1	0.1	110	**75**	**120**

Quality Control Report for LCS Analysis

Regulated Volatile Organics

Matrix: Water
Lab Sample ID: LCS
QC Batch ID: 200604MS2016
LCS Units: ug/l

Analysis Date: 04/10/2006
Preparation Date: 04/10/2006
Method: EPA 524.2
Analyst: KN

Analyte	LCS Conc	LCS Result	Percent Recovery	Lower Control Limit	Upper Control Limit
cis-1,2-Dichloroethene	10.0	9.6	96	**70**	**130**
trans-1,2-Dichloroethene	10.0	10.4	104	**70**	**130**
1,2-Dichloropropane	10.0	9.4	94	**70**	**130**
Ethylbenzene	10.0	9.7	97	**70**	**130**
Methylene chloride	10.0	10.4	104	**70**	**130**
Styrene	10.0	9.7	97	**70**	**130**
Tetrachloroethene	10.0	10.0	100	**70**	**130**
Toluene	10.0	9.8	98	**70**	**130**
1,2,4-Trichlorobenzene	10.0	9.9	99	**70**	**130**
1,1,1-Trichloroethane	10.0	9.8	98	**70**	**130**
1,1,2-Trichloroethane	10.0	9.9	99	**70**	**130**
Trichloroethene	10.0	9.9	99	**70**	**130**
Vinyl chloride	10.0	10.3	103	**70**	**130**
Xylenes, total	30.0	30.4	101	**70**	**130**
Benzene	10.0	9.7	97	**70**	**130**
Carbon tetrachloride	10.0	9.9	99	**70**	**130**
Chlorobenzene	10.0	10.1	101	**70**	**130**
1,2-Dichorobenzene	10.0	10.0	100	**70**	**130**
1,4-Dichlorobenzene	10.0	9.9	99	**70**	**130**
1,2-Dichloroethane	10.0	10.0	100	**70**	**130**
1,1-Dichloroethene	10.0	10.3	103	**70**	**130**

Quality Control Report for LCS Analysis

Regulated Semivolatile Organics

Matrix: Water
Lab Sample ID: LCS
QC Batch ID: 200604DWI025
LCS Units: ug/l

Analysis Date: 04/10/2006
Preparation Date: 04/10/2006
Method: EPA 525.2
Analyst: DN

Analyte	LCS Conc	LCS Result	Percent Recovery	Lower Control Limit	Upper Control Limit
Benzo(a)pyrene	10.0	10.9	109	**35**	**135**

Quality Control Report for LCS Analysis

INORGANICS

Analyte		LCS Conc		LCS Result	Percent Recovery	Lower Control Limit	Upper Control Limit
Method: EPA 548.1 Endothall	QC Batch: 200604ENDO038	Sample ID: LCS 100 ug/l	Date Prep: 04/11/2006 0	Date Anal: 04/11/2006 90	90	Analyst: DN 41	130
Method: EPA 549 Diquat	QC Batch: 200604DIQ037	Sample ID: LCS 5.0 ug/l	Date Prep: 04/10/2006 0.0	Date Anal: 04/10/2006 0.9	17 *	Analyst: RM 21	155
Method: EPA 325.3/300.0 Chloride	QC Batch: 200604ICS029	Sample ID: LCS 4.0 mg/l	Date Prep: 04/06/2006 0.0	Date Anal: 04/06/2006 4.4	110 *	Analyst: SH 90	105
Method: EPA 300.0/340.2 Fluoride	QC Batch: 200604ICS029	Sample ID: LCS 2.0 mg/l	Date Prep: 04/06/2006 0.0	Date Anal: 04/06/2006 2.1	107 *	Analyst: SH 92	106
Method: EPA 6010/200.7 Aluminum, Total	QC Batch: 200604RC037	Sample ID: LCS 200 ug/l	Date Prep: 04/07/2006 0	Date Anal: 04/07/2006 188	94	Analyst: GG 73	123
Method: EPA 6010/200.7 Arsenic, Total	QC Batch: 200604RC037	Sample ID: LCS 200 ug/l	Date Prep: 04/07/2006 0	Date Anal: 04/07/2006 210	105	Analyst: GG 82	111
Method: EPA 6010/200.7 Barium, Total	QC Batch: 200604RC037	Sample ID: LCS 500 ug/l	Date Prep: 04/07/2006 0	Date Anal: 04/07/2006 511	102	Analyst: GG 85	113
Method: EPA 6010/200.7 Beryllium, Total	QC Batch: 200604RC037	Sample ID: LCS 100 ug/l	Date Prep: 04/07/2006 0	Date Anal: 04/07/2006 104	104	Analyst: GG 82	111
Method: EPA 6010/200.7 Cadmium, Total	QC Batch: 200604RC037	Sample ID: LCS 100 ug/l	Date Prep: 04/07/2006 0	Date Anal: 04/07/2006 97	97	Analyst: GG 84	111
Method: EPA 6010/200.7 Chromium, Total	QC Batch: 200604RC037	Sample ID: LCS 100 ug/l	Date Prep: 04/07/2006 0	Date Anal: 04/07/2006 99	99	Analyst: GG 82	112
Method: EPA 6010/200.7 Copper, Total	QC Batch: 200604RC037	Sample ID: LCS 100 ug/l	Date Prep: 04/07/2006 0	Date Anal: 04/07/2006 99	99	Analyst: GG 85	114
Method: EPA 6010/200.7 Iron, Total	QC Batch: 200604RC037	Sample ID: LCS 200 ug/l	Date Prep: 04/07/2006 0	Date Anal: 04/07/2006 192	96	Analyst: GG 77	123
Method: EPA 6010/200.7 Manganese, Total	QC Batch: 200604RC037	Sample ID: LCS 100 ug/l	Date Prep: 04/07/2006 0	Date Anal: 04/07/2006 106	106	Analyst: GG 83	117
Method: EPA 6010/200.7 Nickel, Total	QC Batch: 200604RC037	Sample ID: LCS 100 ug/l	Date Prep: 04/07/2006 0	Date Anal: 04/07/2006 102	102	Analyst: GG 82	115
Method: EPA 6010/200.7 Sodium, Total	QC Batch: 200604RC037	Sample ID: LCS 5 mg/l	Date Prep: 04/07/2006 0	Date Anal: 04/07/2006 5	98	Analyst: GG 81	104
Method: EPA 6010/200.7 Zinc, Total	QC Batch: 200604RC037	Sample ID: LCS 200 ug/l	Date Prep: 04/07/2006 0	Date Anal: 04/07/2006 197	99	Analyst: GG 88	119
Method: EPA 425.1 MBAS as LAS(MW 318)	QC Batch: 200604MBAS030	Sample ID: LCS 0.500 mg/l	Date Prep: 04/07/2006 0.000	Date Anal: 04/07/2006 0.570	114	Analyst: GIG 80	115
Method: EPA 300.0/354.1 Nitrite	QC Batch: 200604ICS029	Sample ID: LCS 2.0 mg/l	Date Prep: 04/06/2006 0.0	Date Anal: 04/06/2006 2.1	103	Analyst: SH 96	106
Method: EPA 300.0/353.3 Nitrate/Nitrite	QC Batch: 200604ICS029	Sample ID: LCS 4.0 mg/l	Date Prep: 04/06/2006 0.0	Date Anal: 04/06/2006 4.1	101	Analyst: SH 88	111
Method: EPA 200.9 Antimony, Total	QC Batch: 200604RC057	Sample ID: LCS 50 ug/l	Date Prep: 04/11/2006 0	Date Anal: 04/11/2006 49	99	Analyst: GG 79	128
Method: EPA 200.9 Lead, Total	QC Batch: 200604RC057	Sample ID: LCS 50.0 ug/l	Date Prep: 04/11/2006 0.0	Date Anal: 04/11/2006 48.7	97	Analyst: GG 79	123
Method: EPA 245.1 Mercury, Total	QC Batch: 200604HG54	Sample ID: LCS 2.0 ug/l	Date Prep: 04/11/2006 0.0	Date Anal: 04/11/2006 2.0	98	Analyst: YP 75	130
Method: EPA 200.9 Selenium, Total	QC Batch: 200604RC057	Sample ID: LCS 50 ug/l	Date Prep: 04/11/2006 0	Date Anal: 04/11/2006 50	99	Analyst: GG 76	121
Method: EPA 200.9 Thallium, Total	QC Batch: 200604RC057	Sample ID: LCS 50 ug/l	Date Prep: 04/11/2006 0	Date Anal: 04/11/2006 50	99	Analyst: GG 72	131

PC&E Environmental
210 Park Road, Oviedo, FL 32765
407-359-7194 (FAX) 407-359-7197

Chain of Custody

Work Order: 2D6L-0049
Date: 4/6/06 Page ____ of ____

COMPANY: BPA
ADDRESS: 3655 Maguire Blvd #150
Orlando, FL 32803
SAMPLED BY: MURDOCK MUNROE SIGN: Murdock Munroe
PHONE: 407-896-8608 FAX: 407-896-1822

#	SAMPLE ID	DATE/TIME	MATRIX AIR	WATER	SLUDGE	SOIL/SOLID	ORG. LIQUID	ANALYSIS REQUESTED Kit Rep #9828															Number of Containers
								PRESERVATION															
1	OOW 1100-1205	4/6/06 1:00		X				X															
2																							
3																							
4																							
5																							
6																							
7																							
8																							
9																							
10																							
11																							
12																							
13																							

RELINQUISHED BY	DATE/TIME	RECEIVED BY	DATE/TIME
1:	4/5/06 1503	1: Murdock Munroe	4/5/06 1503
2: Murdock Munroe	4/6/06	2: N. Hong	4-6-06
3:		3:	

PROJECT INFORMATION
PROJECT NAME: Orange Co ASR
PROJECT #:
SITE ADDRESS:
PROJECT MANAGER: Murdock Munroe

SAMPLE RECEIPT
Total # of Containers
Chain of Custody Seals
Recv'd in Good Condition
PO #:

SPECIAL INSTRUCTIONS/COMMENTS:
No Asbestos or Dioxin

INVOICE TO:
(IF DIFFERENT FROM ABOVE)

QUOTE/CONTRACT #:

WHITE: Project File YELLOW: Laboratory . PINK: Sampler

STATE OF FLORIDA

DEPARTMENT OF ENVIRONMENTAL PROTECTION

GENERIC PERMIT

FOR THE

DISCHARGE OF PRODUCED GROUND WATER

FROM ANY NON-CONTAMINATED SITE ACTIVITY

Document number 62-621.300(2)
Effective Date: February 14, 2000

Generic Permit for the Discharge of Produced Ground Water from any Non-Contaminated Site Activity

(1) The facility is authorized to discharge produced ground water from any non-contaminated site activity which discharges by a point source to surface waters of the State, as defined in Chapter 62-620, F.A.C., only if the reported values for the parameters listed in Table 1 do not exceed any of the listed screening values. Before discharge of produced ground water can occur from such sites, analytical tests on samples of the proposed untreated discharge water shall be performed to determine if contamination exists.

(2) Minimum reporting requirements for all produced ground water dischargers. The effluent shall be sampled before the commencement of discharge, again within thirty (30) days after commencement of discharge, and then once every six (6) months for the life of the project to maintain continued coverage under this generic permit. Samples taken in compliance with the provisions of this permit shall be taken prior to actual discharge or mixing with the receiving waters. The effluent shall be sampled for the parameters listed in Table 1.

Table 1

	Screening Values for Discharges into:	
Parameter	Fresh Waters	Coastal Waters
Total Organic Carbon (TOC)	10.0 mg/l	10.0 mg/l
pH, standard units	6.0-8.5	6.5-8.5
Total Recoverable Mercury	0.012 μg/l	0.025 μg/l
Total Recoverable Cadmium	9.3 μg/l	9.3 μg/l
Total Recoverable Copper	2.9 μg/l	2.9 μg/l
Total Recoverable Lead	0.03 mg/l	5.6 μg/l
Total Recoverable Zinc	86.0 μg/l	86.0 μg/l
Total Recoverable Chromium (Hex.)	11.0 μg/l	50.0 μg/l
Benzene	1.0 μg/l	1.0 μg/l
Naphthalene	100.0 μg/l	100.0 μg/l

(3) If any of the analytical test results exceed the screening values listed in Table 1, except TOC, the discharge is not authorized by this permit.

(a) For initial TOC values that exceed the screening values listed in Table 1, which may be caused by naturally-occurring, high molecular weight organic compounds, the permittee may request to be exempted from the TOC requirement. To request this exemption, the permittee shall submit additional information with a Notice of Intent (NOI), described below, which describes the method used to determine that these compounds are naturally occurring. The Department shall grant the exemption if the permittee affirmatively demonstrates that the TOC values are caused by naturally-occurring, high molecular weight organic compounds.

(b) The NOI shall be submitted to the appropriate Department district office thirty (30) days prior to discharge, and contain the following information:

1. the name and address of the person that the permit coverage will be issued to;
2. the name and address of the facility, including county location;
3. any applicable individual wastewater permit number(s);
4. a map showing the facility and discharge location (including latitude and longitude);
5. the name of the receiving water; and
6. the additional information required by paragraph (3)(a) of this permit.

(c) Discharge shall not commence until notification of coverage is received from the Department.

(4) For fresh waters and coastal waters, the pH of the effluent shall not be lowered to less than 6.0 units for fresh waters, or less than 6.5 units for coastal waters, or raised above 8.5 units, unless the permittee submits natural background data confirming a natural background pH outside of this range. If natural background of the receiving water is determined to be less than 6.0 units for fresh waters, or less than 6.5 units in coastal waters, the pH shall not vary below natural background or vary more than one (1) unit above natural background for fresh and coastal waters. If natural background of the receiving water is determined to be higher than 8.5 units, the pH shall not vary above natural background or vary more than one (1) unit below natural background of fresh and coastal waters. The permittee shall include the natural background pH of the receiving waters with the results of the analyses required under paragraph (2) of this permit. For purposes of this section only, fresh waters are those having a chloride concentration of less than 1500 mg/l, and coastal waters are those having a chloride concentration equal to or greater than 1500 mg/l.

(5) In accordance with Rule 62-302.500(1)(a-c), F.A.C., the discharge shall at all times be free from floating solids, visible foam, turbidity, or visible oil in such amounts as to form nuisances on surface waters.

(6) If contamination exists, as indicated by the results of the analytical tests required by paragraph (2), the discharge cannot be covered by this generic permit. The facility shall apply for an individual wastewater permit at least ninety (90) days prior to the date discharge to surface waters of the State is expected, or, if applicable, the facility may seek coverage under any other applicable Department generic permit. No discharge is permissible without an effective permit.

(7) If the analytical tests required by paragraph (2) reveal that no contamination exists from any source, the facility can begin discharge immediately and is covered by this permit without having to submit an NOI request for coverage to the Department. A short summary of the proposed activity and copy of the analytical tests shall be sent to the applicable Department district office within one (1) week after discharge begins. These analytical tests shall be kept on site during discharge and made available to the Department if requested. Additionally, no Discharge Monitoring Report forms are required to be submitted to the Department.

(8) All of the general conditions listed in Rule 62-621.250, F.A.C., are applicable to this generic permit.

(9) There are no annual fees associated with the use of this generic permit.

September 13, 2007 BFA #01-30.14

Ali Kazi
Florida Department of Environmental Services
3319 Maguire Boulevard, Suite 232
Orlando, FL 32803-3767

Subject: Generic Permit for Discharge of Produced Ground Water
Orange County Aquifer Storage and Recovery (ASR) Facilities – Orange County Utilities (OCU)

Dear Mr. Kazi:

The purpose of this letter is to submit supporting documentation for a Generic Permit for the discharge of produced groundwater from non-contaminated site activity under 62-621.300 (2); F.A.C.

General Project Description

The St. Johns River Water Management District (SJRWMD) and Orange County Utilities (OCU) are working together on a copperative Aquifer Storage and Recovery (ASR) program that may be used to help meet OCU's projected deficits through seasonal and long-term storage and recovery of water. This will involve the construction and testing of one ASR Well and one Dual Zone Monitoring Well. Groundwater discharges will need to occur from these wells during construction and testing.

General information on the facility and permittee is listed below.

Permittee
Orange County Utilities (PWS 3484132)
Jason Herrick,P.E., Chief Engineer
9150 Curry Ford Road, Orlando FL 32825
Phone: 407-254-9700; Fax: 407-254-9999

Facility
Name: Orange County Aquifer Storage Recovery Facility
Location: On the OCU Eastern Water Reclamation Facility Property (FL0038849)
Tim Madhanagopal, P.E.
1621 Alafaya Trail, Orlando FL, 32825
Phone: 407-249-6248
Lat & Long: 28° 31′ 10″ N, 81° 12′ 31″

The permitee Orange County Utilities is also the water supplier and will own the project after it is put into operation.

Water Quality

The planned wells will be located within 500 feet of the existing exploratory well and open within the same storage zone interval/dept h 1100 to 1200 feet below surface. The water quality analysis from this exploratory well is considered representative of the water quality from the planned wells. Exploratory well MW-2 (1100′-1200′) water samples were taken on April 6, 2006 and analyzed for all primary and secondary drinking water parameters except dioxin and asbestoes. These laboratory results are included as an attachment to this letter and compared below to the freshwater discharge screening values listed in 62-621.300 (2); F.A.C.

Discharge Parameter	**Fresh Waters Discharge Screening Values**	**MW-2 Results 4-26-06**
Total Organic Carbon (TOC) - mg/l	10.0	N/A
pH, standard units	6.0-8.5	8.38
Total Recoverable Mercury - µg/l	0.012	0.2 U
Total Recoverable Cadmium - µg/l	9.3	0.5 U
Total Recoverable Copper - µg/l	2.9	1.0 U
Total Recoverable Lead - mg/l	0.03	0.004 I
Total Recoverable Zinc - µg/l	86.0	45.0
Total Recoverable Chromium (Hex.) - µg/l	11.0	1.0 U
Benzene - µg/l	1.0	0.5 U
Naphthalene - µg/l	100.0	N/A

Ground Water Discharge

During construction of the wells, variable rate and constant rate pump testing will be performed on the monitoring wells and the ASR well. The test water will be discharged to uplands about 500 feet away from the well. Some water will pond and percolate in the uplands area and some will overland flow to wetlands on the site located about 700 feet away. The test water should remain on the County's property. Details about discharge methods and volume are included in the Drilling and Testing Fluid Management Plan under section "Pump Test Disposal Water". This plan is included as an attachment to this letter.

Also, the attached figure shows the overall site plan with the existing and proposed wells, discharge location, Orange County's property lines and the receiving wetlands.

I trust the information provided in this letter and attachments meets the Department's requirements. Should you require additional information or clarification, please don't hesitate to contact me.

Sincerely,

Barnes, Ferland, and Associates, Inc.

Ronald P. Ferland, P.E.
Project Manager

cc: Anil Desai, DEP
Chuck Digerlando, P.E., Orange County Utilities
Glenn Forrest, P.E., SJRWMD
Bryan McDonald, P.G., CH2MHILL

Attachment 1 – Exploratory Well Water Quality
Attachment 2 – Drilling and Testing Fluid Management Plan
Attachment 3 – Overall Site Plan (Figure)

Drilling and Testing Fluid Management Plan

Introduction

This document has been prepared to describe fluid management during the planned construction and testing of the ASR Well and Dual Zone Monitor Well at the Orange County Eastern Water Reclamation Facility. The main fluid sources include:

- Bentonite mud and unconsolidated cuttings during mud rotary drilling
- Groundwater discharge during reverse air drilling
- Groundwater discharge during well development
- Groundwater discharge during variable rate and constant rate testing
- Disposal of recovered water during cycle testing

Drilling Fluid and Development Water

The Contractor shall take all necessary precautions in order to prevent contaminated water, hydraulic oil, gasoline, and other hazardous substance from entering the well and/or receiving waters. Surficial aquifer monitor wells SA-1 and SA-2 will be sampled and tested prior to and upon completion of ASR well construction.

The Contractor will be responsible for disposal of all drilling fluids, well discharges and cuttings in a manner that is acceptable to Orange County and the in accordance with Federal, State and Local regulations. The contractor shall monitor and control the flow of fluids from the well at all times.

During mud rotary drilling, the Contractor shall retain all bentonite mud and cuttings that are generated in a fluid containment system including steel mud tubs/bins. The Contractor shall not make use of any un-lined or plastic-lined pits. Drilling mud and sediments/cuttings shall be disposed of at an offsite location in an acceptable manner.

Reverse air discharge water will require settling to reduce turbidity prior to disposal using a fluid containment system and conveyed to a location approved by Orange County. All limerock cuttings, removed during reverse air drilling operations, shall be stock piled or spread out at an on-site location designated by the Orange County.

Well development water will require settling prior to disposal using a fluid containment system and conveyed to a location approved by Orange County in an environmentally safe manner. The Contractor is responsible for meeting turbidity requirements prior to discharge development water entering any stormwater collection system or receiving waters.

Pump Test Disposal Water

Wells will be developed approximately 8 to 24 hours and until the water has a turbidity of less than 1 NTU, prior to all pumping tests. Variable rate and constant rate pumping tests will be completed at wells CZ/LF-MW-1 (Dual Zone Monitor Well) and ASR-LF-1 (ASR Well). A control valve and flow meter on the discharge line will be used to control and measure flows.

The Contractor shall provide temporary discharge piping, approximately 500 feet, to convey pumped water to the designated disposal area shown in Figure 1. The Contractor shall dispose the water at adjacent uplands and the water will overland sheet flow to the wetlands. The discharge water shall be disposed of in accordance with the Generic Permit for the discharge of produced groundwater from non-contaminated site activity under Chapter 62-621.300 (2); F.A.C.

Table 1 – Pumping Test Discharge Volumes.

Well Name	Open Interval	Pumping Test	Discharge Rate -	Period Hours	Volume Gallons	Volume Acre-Feet
Dual Zone	900'-1050'	Step Test 1	1000	2	180,000	0.37
			1500	2	180,000	0.55
			2100	2	252,000	0.77
		Constant 1	2100	24	3,024,000	9.28
Sub-Totals					**3,576,000**	**11**
Dual Zone	900'-1200'	Step Test 2	1000	2	120,000	0.37
			1500	2	180,000	0.55
			2100	2	252,000	0.77
		Constant 2	2100	48	6,048,000	18.56
Sub-Totals					**6,600,000**	**20**
ASR Well	1100'-1200'	Step Test 3	1000	2	120,000	0.37
			1500	2	180,000	0.55
			2000	2	240,000	0.74
			2500	2	300,000	0.92
	1100'-1200'	Constant 3	2100	24	3,024,000	9.28
Sub-Totals					**3,864,000**	**12**
Totals					***14,040,000***	***43***

The total volume of water discharged to the adjacent uplands during pump testing shall amount to approximately 14 million gallons over several pumping periods. Two 8-hour step-drawdown tests shall be performed on the Dual Zone

Monitor Well with a flow rate up to 2,100 gallons per minute. Two constant rate pumping tests shall be performed on the Dual Zone Monitor Well with a flow rate of 2,100 gpm for periods of 24 and 48 hours. One 8-hour step-drawdown test shall be performed on the ASR Well with a flow rate up to 2500 gpm. One constant rate pumping test shall be performed on the ASR Well with a flow rate of 2,500 gpm for a 24 hour period.

Cycle Test Water

Cycle testing water will be sent to the OCU reclaimed water system as a groundwater supplemental water supply. The test water from the well will be sent to the reclaimed water system only during the initial cycle testing phase and to purge the well at the beginning of each recovery phase during normal operations.

Initial cycle testing water will be pumped via a temporary pipeline to the effluent pump station for the first and maybe second cycle testing events. The amount of water pumped to the reuse system is approximately 3 MGD for 10 days during Cycle 1 and during Cycle 2.

The purge water from the well will be pumped to the reuse ground storage tank adjacent to the proposed ASR well site. The ASR well purging will occur at the beginning of every recovery cycle maybe 3 to 4 times a year based on seasonal demands. The purge water volume is approximately 30,000 gallons per event.

The total volume of water pumped to the reuse system is 60 million gallons during the cycle testing and approximately 120,000 gallons per year prior to every recovery phase during normal operation of the ASR Well.

ORANGE COUNTY GOVERNMENT
FLORIDA

Division of Building Safety
20 South Rosalind Avenue, 1st Floor
Reply to: Post Office Box 2687
Orlando, Florida 32802-2687
Telephone (407) 836-5550

08/17/09

OFFICIAL RECEIPT
BOARD OF COUNTY COMMISSIONERS
DIVISION OF BUILDING SAFETY

PERMIT NBR: B08-903622

RECEIVED OF: WHARTON -SMITH

FOR: MISCELLANEOUS 103.00

DESCRIPTION: PRE-POWER
PAY BY CK 066

```
VALIDATION Building and Zoning
PAID 2009/08/17 10:09:48     $103.00
002-437877:KOTASKA -00003003
0300 Misc. Receipt        B08903622
0230  Miscellaneous       $    103.00
                          ------------
       TOTAL              $    103.00

9001  Check               $    103.00
```

103.00

This document becomes your receipt when properly validated
White Copy - Owner   Canary Copy - Office
R20090817-022 PRINTED BY FWBDCF1 08/17/09 10:08

"NOTICE In addition to the requirements of this permit, there may be additional restrictions applicable to this property that [illegible]e found in the public records of this county, and there may be additional permits required from other governmental entities such as water management districts, state agencies, or federal agencies." The issuance of this permit does not grant permission to violate any applicable Orange County and/or State of Florida codes and/or ordinances.

ORANGE COUNTY GOVERNMENT
FLORIDA

ORANGE COUNTY DIVISION OF BUILDING SAFETY
201 SO[illegible] ROSALIND AVE.
ORLAN[illegible], FLORIDA 32802-2687
PHONE 407-836-5550

PERMIT

BUILDING

PERMIT NUMBER DUPLICATE
JOB NUMBER B08903624

SEPARATE PERMITS ARE REQUIRED FOR SIGNS, ELECTRICAL, PLUMBING AND MECHANICAL SERVICES. THIS PERMIT BECOMES VOID IF THE WORK AUTHORIZED IS NOT COMMENCED WITHIN 6 MONTHS, OR IS SUSPENDED OR ABANDONED FOR A PERIOD OF 6 MONTHS AFTER COMMENCEMENT. WORK SHALL BE CONSIDERED SUSPENDED IF AN APPROVED INSPECTION HAS NOT BEEN MADE WITHIN A 6 MONTH PERIOD.

PERMISSION IS GRANTED TO DO THE FOLLOWING WORK ACCORDING TO THE CONDITIONS HEREON AND THE APPROVED PLANS AND SPECIFICATIONS, SUBJECT TO COMPLIANCE WITH THE ORDINANCES OF ORANGE COUNTY, FLORIDA.

CONTRACTOR CGC1511243
WHARTON SMITH INC
P.O. BOX 471028
LAKE MONROE FL 32747-1028

OWNERSHIP IS PUBLIC
PARCEL NO. 02-23-31-0000-00002

OWNER PHONE 407-254-9900
ORANGE COUNTY UTILITES
9150 CURRY FORD RD
ORLANDO FL 32828

JOB ADDRESS PHONE 407-321-8410
1621 S ALAFAYA TL
ORLANDO FL 32828

ALTER TYPE VB PUBLIC WORK & UTILITIES
TENANT / OCCUPANT

PAYER / ADDRESS

PERMIT FEE 4,679.00

NATURE OF WORK / SPECIAL CONSIDERATIONS
N/C WELL PUMP & PIPING
ACR WELL PUMP AND PIPING

DATE OF APPLICATION 12/18/2008
DATE ISSUED 05/19/2009

BLDG. DIV. VALUE 760,821

INSPECTOR JMS / PURDET1

B U I L D I N G F E A T U R E S

SQ.FT. AREA .00 --- OTHER INFO ---

SQ.FT./FLOOR	.00	OCC. GROUP S	
NO.OF UNITS			
MAX OCC/FLR		PERMITS REQ	
HGT. LIMIT		E -	
# STORIES	.0	COP	
EL.LOW FLR	.0	SEER	
EL.FLD.PLAIN	.0		
MAX.FL.LOAD			
ZONE CLASS			
OWN.EST.VAL.	760,821		
WATER SYSTEM OC		PLANS - R	
NO.OF BLDGS.	0		

----------IMPACT FEES---------- D/T-----ZONES---

LAW ENFORCE.	.00	SECTOR
FIRE	.00	AREA
TRAFFIC	.00	ZONE
LTTR CRD RD	.00	
LTTR CRD PRK	.00	
RAD & RBI	.00	
SCHOOL	.00	
PARKS	.00	
LTTR CRD SCH	.00	

BUILDING FEES

BLD&CS	3,825.00	PLN	.00
ENV	.00	PUB	.00
ZON	64.00	HEA	.00
FIR	790.00	ENG	.00

VALIDATION Building and Zoning
PAID 2009/05/19 15:38:50 $4679.00
002-430599:KOTASKA -00002940 MULTI
0201 Building Permit B08903624

B001	Zoning Dept. Fee	$	64.00
B003	Fire Dept. Fee	$	790.00
B008	Build/Const. Sup Fee	$	3825.00
	TOTAL	$	4679.00

THIS DOCUMENT BECOMES YOUR PERMIT WHEN PROPERLY VALIDATED.

P
20090519-166 PRINTED BY PUBDLT3 **APPLICANT'S COPY**

"NOTICE In addition to the requirements of this permit, th[illegible]ay be additional restrictions applicable to this property that [illegible] be found in the public records of this county, and there may be additional permits required from other governmental entities such as water management districts, state agencies, or federal agencies." The issuance of this permit does not grant permission to violate any applicable Orange County and/or State of Florida codes and/or ordinances.

ORANGE COUNTY
GOVERNMENT
FLORIDA

ORANG[illegible] COUNTY DIVISION OF BUILDING SAFETY
201 S[illegible] ROSALIND AVE.
ORLANDO, FLORIDA 32802-2687
PHONE 407-836-5550

PERMIT

BUILDING

PERMIT NUMBER DUPLICATE
JOB NUMBER B08903623

SEPARATE PERMITS ARE REQUIRED FOR SIGNS, ELECTRICAL, PLUMBING AND MECHANICAL SERVICES. THIS PERMIT BECOMES VOID IF THE WORK AUTHORIZED IS NOT COMMENCED WITHIN 6 MONTHS, OR IS SUSPENDED OR ABANDONED FOR A PERIOD OF 6 MONTHS AFTER COMMENCEMENT. WORK SHALL BE CONSIDERED SUSPENDED IF AN APPROVED INSPECTION HAS NOT BEEN MADE WITHIN A 6 MONTH PERIOD.

PERMISSION IS GRANTED TO DO THE FOLLOWING WORK ACCORDING TO THE CONDITIONS HEREON AND THE APPROVED PLANS AND SPECIFICATIONS, SUBJECT TO COMPLIANCE WITH THE ORDINANCES OF ORANGE COUNTY, FLORIDA.

CONTRACTOR CGC1511243

WHARTON SMITH INC
P.O. BOX 471028
LAKE MONROE FL 32747-1028

OWNERSHIP IS PUBLIC
PARCEL NO. 02-23-31-0000-00002

OWNER PHONE 407-254-9900
ORANGE COUNTY UTILITES
9150 CURRY FORD RD
ORLANDO FL 32820

JOB ADDRESS PHONE 407-321-8410
1621 S ALAFAYA TL
ORLANDO FL 32828

TENANT / OCCUPANT ALTER TYPE VB PUBLIC WORK & UTILITIES

PAYER / ADDRESS

PERMIT FEE 293.00

NATURE OF WORK / SPECIAL CONSIDERATIONS
N/C CHEMICAL FEED SYSTEM
N/C WELL CHEMICAL FEED SYSTEM

DATE OF APPLICATION 12/18/2008
DATE ISSUED 05/19/2009

BLDG. DIV. VALUE 29,320

INSPECTOR JMS / PURDET1

BUILDING FEATURES

SQ.FT. AREA	.00	OTHER INFO	
SQ.FT./FLOOR	.00	OCC. GROUP	S
NO.OF UNITS			
MAX OCC/FLR		PERMITS REQ	
HGT. LIMIT		E	
# STORIES	.0	EGP	
EL.LOW FLR	.0	SEER	
EL.FLD.PLAIN	.0		
MAX FL LOAD			
ZONE CLASS			
OWN,EST,VAL.	29,320		
WATER SYSTEM OC		PLANS	R
NO.OF BLDGS.	.0		
IMPACT FEES		D/T ZONES	
LAW ENFORCE.	.00	SECTOR	
FIRE	.00	AREA	
TRAFFIC	.00	ZONE	
LTTR CRD RD	.00		
LTTR CRD PRK	.00		
RAD & RDI	.00		
SCHOOL	.00		
PARKS	.00		
LTTR CRD SCH	.00		
BUILDING FEES			
BLD&CS	170.00	PLN	.00
ENV	.00	PUB	.00
ZON	64.00	HEA	.00
FIR	59.00	ENG	.00

VALIDATION Building and Zoning
PAID 2009/05/19 15:38:38 $293.00
002-430598:KOTASKA -00002940 MULTI
0201 Building Permit B08903623

B001	Zoning Dept. Fee	$	64.00
B003	Fire Dept. Fee	$	59.00
B008	Build/Const. Sup Fee	$	170.00
	TOTAL	$	293.00

THIS DOCUMENT BECOMES YOUR PERMIT WHEN PROPERLY VALIDATED.

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20090519-164 PRINTED BY PUBDLT3 **APPLICANT'S COPY** B08903623

"NOTICE In addition to the requirements of this permit, th[illegible]ay be additional restrictions applicable to this property that [illegible] be found in the public records of this county, and there may be additional permits required from other governmental entities such as water management districts, state agencies, or federal agencies." The issuance of this permit does not grant permission to violate any applicable Orange County and/or State of Florida codes and/or ordinances.

ORANGE COUNTY GOVERNMENT
FLORIDA

ORANG[illegible] COUNTY DIVISION OF BUILDING SAFETY
201 S[illegible]H ROSALIND AVE.
ORLANDO, FLORIDA 32802-2687
PHONE 407-836-5550

PERMIT

BUILDING

PERMIT NUMBER DUPLICATE
JOB NUMBER B08903622

SEPARATE PERMITS ARE REQUIRED FOR SIGNS, ELECTRICAL, PLUMBING AND MECHANICAL SERVICES. THIS PERMIT BECOMES VOID IF THE WORK AUTHORIZED IS NOT COMMENCED WITHIN 6 MONTHS, OR IS SUSPENDED OR ABANDONED FOR A PERIOD OF 6 MONTHS AFTER COMMENCEMENT. WORK SHALL BE CONSIDERED SUSPENDED IF AN APPROVED INSPECTION HAS NOT BEEN MADE WITHIN A 6 MONTH PERIOD.

PERMISSION IS GRANTED TO DO THE FOLLOWING WORK ACCORDING TO THE CONDITIONS HEREON AND THE APPROVED PLANS AND SPECIFICATIONS, SUBJECT TO COMPLIANCE WITH THE ORDINANCES OF ORANGE COUNTY, FLORIDA.

CONTRACTOR CGC1511243

WHARTON SMITH INC
P.O. BOX 471028
LAKE MONROE FL 32747-1028

OWNERSHIP IS PUBLIC
PARCEL NO. 02-23-31-0000-00002

OWNER PHONE 407-254-9900
ORANGE COUNTY UTILITES
9150 CURRY FORD RD
ORLANDO FL 32028

JOB ADDRESS PHONE 407-321-8410
1621 S ALAFAYA TL
ORLANDO FL 32828

ERECT TYPE IIB PUBLIC WORK & UTILITIES

TENANT / OCCUPANT

PAYER / ADDRESS

PERMIT FEE 3,248.88

NATURE OF WORK / SPECIAL CONSIDERATIONS
N/C AGR WELL BLDG
N/C AGR WELL BLDG

DATE OF APPLICATION 12/18/2008
DATE ISSUED 05/19/2009

BLDG. DIV. VALUE 229,300

INSPECTOR JMS / PURDET1

BUILDING FEATURES

SQ FT AREA 388.00 -- OTHER INFO --

SQ.FT./FLOOR	388.00	OCC. GROUP S	
NO.OF UNITS			
MAX OCC/FLR		PERMITS REQ	
HGT. LIMIT		E	
# STORIES	.0	COP	
EL.LOW FLR	.0	SEER	
EL.FLD.PLAIN	.0		
MAX.FL.LOAD	1		
ZONE CLASS			
OWN.EST.VAL.	229,300		
WATER SYSTEM OC		PLANS - R	
NO.OF BLDGS.	1		
----------IMPACT FEES----------		D/T-----ZONES--	
LAW ENFORCE.	.00	SECTOR	
FIRE	.00	AREA	
TRAFFIC	.00	ZONE	
LTTR CRD RD	.00		
LTTR CRD PRK	.00		
RAD & RBI	3.88		
SCHOOL	.00		
PARKS	.00		
LTTR CRD SCH	.00		
BUILDING FEES			
BLD&CS	1,170.00	PLN	.00
ENV	3.00	PUB	.00
ZON	200.00	HEA	50.00
FIR	259.00	ENG	1,563.00

VALIDATION Building and Zoning
PAID 2009/05/19 15:39:03 $3248.88
002-430600:KOTASKA -00002940 MULTI
0201 Building Permit B08903622

B001	Zoning Dept. Fee	$	200.00
B002	Engineering Dept Fee	$	1563.00
B003	Fire Dept. Fee	$	259.00
B005	Env. Prot. Dept. Fee	$	3.00
B007	Health Dept. Fee	$	50.00
B008	Build/Const. Sup Fee	$	1170.00
B400	Radon Fee	$	3.88
	TOTAL	$	3248.88
9001	Check	$	8632.88

THIS DOCUMENT BECOMES YOUR PERMIT WHEN PROPERLY VALIDATED.

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20090519-143 PRINTED BY PUBDLT3 **APPLICANT'S COPY**

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INP136C/MS3N              DISPLAY PROJECT FEE TOTALS
CATEGORY:  NEW   COMM     STOP WORK

STREET NBR:   1621 DIR: S  STREET NAME: ALAFAYA           TYPE: TL SUFF:
PROJECT NAME: ORANGE COUNTY UTILITES                 VRS AMOUNT: $
PROJECT NBR:  B08903622                              VRS DATE   :       000000
TY==DESCRIPTION==========AMOUNT DUE=====AMOUNT PAID====AMOUNT OWE=
A PLAN SUBM FEE      $      412.00 $           .00 $      412.00
0 REG PERMIT FEE     $     8217.00 $           .00 $     8217.00
1 IMPACT-LAW         $         .00 $           .00 $         .00
2 IMPACT-FIRE        $         .00 $           .00 $         .00
3 IMPACT-ROAD-SFR    $         .00 $           .00 $         .00
4 RADON-CHARGE       $        3.88 $           .00 $        3.88
5 IMPACT-SCHOOL      $         .00 $           .00 $         .00
6 IMPACT-PARKS       $         .00 $           .00 $         .00
7 VIOLATION FEE      $         .00 $           .00 $         .00
8 EXTENSION FEE      $         .00 $           .00 $         .00
9 REINSPECTION FEE   $         .00 $           .00 $         .00
A LTTR CRD SCHOOL    $         .00 $           .00 $         .00
B LTTR CRD ROAD      $         .00 $           .00 $         .00
C LTTR CRD PARKS     $         .00 $           .00 $         .00
         TOTAL FEES  $     8632.88 $           .00 $     8632.88
                                         PF5=FIND                 PF12=EXIT
```

ORANGE COUNTY GOVERNMENT
FLORIDA

Division of Building Safety
201 South Rosalind Avenue, 1st Floor
Reply to: Post Office Box 2687
Orlando, Florida 32802-2687
Telephone (407) 836-5550

05/19/09

OFFICIAL RECEIPT
BOARD OF COUNTY COMMISSIONERS
DIVISION OF BUILDING SAFETY

PERMIT NBR: B08-903622

RECEIVED OF: WHARTON SMITH INC

FOR: PLAN SUBMISSION 412.0

VALIDATION Building and Zoning
PAID 2009/05/19 15:38:30 $412.00
002-430597:KOTASKA -00002940 MULTI
0303 Plan Submission Fee B08903622
BA00 Plan Submission Fee $ 412.00

TOTAL $ 412.00

DESCRIPTION: PLANS SUMBITTAL FEE
CK # 262903

412.0

This document becomes your receipt when properly validated
White Copy - Owner Canary Copy - Office

R20090519-078 PRINTED BY PWBDMF1 05/19/09 15:37

Wharton-Smith, Inc. 0180044 5-19-09 262903

INVOICE NUMBER	INV DATE	GROSS AMT	RETAINAGE	DISCOUNT	NET AMOUNT
051909CKRQ	5-19-09	8632.88	.00	.00	8632.88
ORANGE COUNTY BUILDING DEPT		8632.88	.00	.00	8632.88

PLEASE DETACH AND RETAIN FOR YOUR RECORDS

Division of Building Safety
201 S Rosalind Avenue, 1st Floor
Reply to: Post Office Box 2687
Orlando, Florida 32802-2687
Telephone (407) 836-5550

05/19/09

OFFICIAL RECEIPT
BOARD OF COUNTY COMMISSIONERS
DIVISION OF BUILDING SAFETY

PERMIT NBR: B08-903622

RECEIVED OF: WHARTON SMITH INC

FOR: PLAN SUBMISSION 412.00

DESCRIPTION: PLANS SUMBITTAL FEE
CK # 262903

VALIDATION Building and Zoning
PAID 2009/05/19 15:38:30 $412.00
002-430597:KOTASKA -00002940 MULTI
0303 Plan Submission Fee B08903622
BA00 Plan Submission Fee $ 412.00

TOTAL $ 412.00

412.00

This document becomes your receipt when properly validated
White Copy - Owner Canary Copy - Office
R20090519-078 PRINTED BY PWBDMF1 05/19/09 15:37

Florida Department of
Environmental Protection
Central District
3319 Maguire Boulevard, Suite 232
Orlando, Florida 32803-3767

Charlie Crist
Governor

Jeff Kottkamp
Lt. Governor

Michael W. Sole
Secretary

Sent via e-mail: jason.herrick@ocfl.net

ORANGE COUNTY UTILITIES DEPARTMENT
8100 PRESIDENTS DRIVE, SUITE A
ORLANDO, FL 32809-7679

ATTENTION JASON D HERRICK PE
MANAGER OF ENGINEERING UTILITIES

Orange County - DW
OCUD/Eastern WRF
File No. FL0038849-006-DW1
Permit Revision for ASR Reclaimed Water Augmentation

Dear Mr. Herrick:

The Department is in receipt of your request to revise the conditions of the permit referenced above. The permit is hereby revised to include the following:

1. Authorization to include groundwater as a supplemental water supply for the OCUD Eastern reclaimed water distribution system. The groundwater will come from the OCUD ASR well located on the Eastern Water Reclamation Facility property. The water from the well will be sent to the reclaimed water system only during the initial cycle testing phase and to purge the well at the beginning of each recovery phase.

2. Monitoring of the groundwater supply shall be conducted quarterly for fecal coliforms. At the end of the first year of operation, monitoring of the groundwater shall be reduced if the applicant provides an affirmative demonstration that the groundwater supply meets high-level disinfection criteria for fecal coliforms and that public health will be protected [62-610.472(4) (a) 3, F.A.C.]. The samples will be taken at Monitoring Site numbers OTH-1 that is defined as sample point for ASR supplemental reclaimed water supply. Attached is a revised page 11 of the facilities DMRs that includes the required fecal monitoring.

3. Prior to placing the new facilities into operation or any individual unit processes into operation, for any purpose other than testing for leaks and equipment operation, the permittee shall complete and submit to the Department DEP Form 62-620.910(12), Notification of Completion of Construction for Domestic Wastewater Facilities. [62-620.630(2)]

4. Within six months after a facility is placed in operation, the permittee shall provide written certification to the Department on Form 62-620.910(13) that record drawings pursuant to Chapter 62-600, F.A.C., and that an operation and maintenance manual pursuant to Chapters 62-600 and 62-610, F.A.C., as applicable, are available at the location specified on the form. [62-620.630(7)]

5. This permit does not cover any of the structural engineering aspects of this project.

This letter must be attached to Wastewater Permit No. FL0038849 and becomes a part of and subject to all conditions of that permit.

The Department's proposed agency action shall become final unless a timely petition for an administrative hearing is filed under sections 120.569 and 120.57 of the Florida Statutes before the deadline for filing a petition. The procedures for petitioning for a hearing are set forth below.

A person whose substantial interests are affected by the Department's proposed permitting decision may petition for an administrative proceeding (hearing) under sections 120.569 and 120.57 of the Florida Statutes. The petition must contain the information set forth below and must be filed (received by the clerk) in the Office of General Counsel of the Department at 3900 Commonwealth Boulevard, Mail Station 35, Tallahassee, Florida 32399-3000.

Petitions by the applicant or any of the parties listed below must be filed within fourteen days of receipt of this written notice. Petitions filed by any persons other than those entitled to written notice under section 120.60(3) of the Florida Statutes must be filed within fourteen days of publication of the notice or within fourteen days of receipt of the written notice, whichever occurs first.

Under section 120.60(3) of the Florida Statutes, however, any person who has asked the Department for notice of agency action may file a petition within fourteen days of receipt of such notice, regardless of the date of publication.

The petitioner shall mail a copy of the petition to the applicant at the address indicated above at the time of filing. The failure of any person to file a petition within the appropriate time period shall constitute a waiver of that person's right to request an administrative determination (hearing) under sections 120.569 and 120.57 of the Florida Statutes. Any subsequent intervention (in a proceeding initiated by another party) will be only at the discretion of the presiding officer upon the filing of a motion in compliance with rule 28-106.205 of the Florida Administrative Code.

A petition that disputes the material facts on which the Department's action is based must contain the following information:

(a) The name, address, and telephone number of each petitioner; the name, address, and telephone number of the petitioner's representative, if any; the Department permit identification number and the county in which the subject matter or activity is located;
(b) A statement of how and when each petitioner received notice of the Department action;
(c) A statement of how each petitioner's substantial interests are affected by the Department action;
(d) A statement of all disputed issues of material fact. If there are none, the petition must so indicate;
(e) A statement of facts that the petitioner contends warrant reversal or modification of the Department action;
(f) A concise statement of the ultimate facts alleged, as well as the rules and statutes which entitle the petitioner to relief; and
(g) A statement of the relief sought by the petitioner, stating precisely the action that the petitioner wants the Department to take.

A petition that does not dispute the material facts on which the Department's action is based shall state that no such facts are in dispute and otherwise shall contain the same information as set forth above, as required by rule 28-106.301.

Because the administrative hearing process is designed to formulate final agency action, the filing of a petition means that the Department's final action may be different from the position taken by it in this notice. Persons whose substantial interests will be affected by any such final decision of the Department have the right to petition to become a party to the proceeding, in accordance with the requirements set forth above.

Mediation under section 120.573 of the Florida Statutes is not available for this proceeding.

This action is final and effective on the date filed with the Clerk of the Department unless a petition is filed in accordance with the above. Upon the timely filing of a petition this order will not be effective until further order of the Department.

Any party to the order has the right to seek judicial review of the order under section 120.68 of the Florida Statutes, by the filing of a notice of appeal under rule 9.110 of the Florida Rules of Appellate Procedure with the Clerk of the Department in the Office of General Counsel, Mail Station 35, 3900 Commonwealth Boulevard, Tallahassee, Florida, 32399-3000; and by filing a copy of the notice of appeal accompanied by the applicable filing fees with the appropriate district court of appeal. The notice of appeal must be filed within 30 days from the date when the final order is filed with the Clerk of the Department.

Executed in Orlando, Florida.

STATE OF FLORIDA DEPARTMENT
OF ENVIRONMENTAL PROTECTION

Christianne C. Ferraro

Christianne C. Ferraro, P.E.
Program Administrator
Water Facilities
3319 Maguire Boulevard, Suite 232
Orlando, FL 32803-3767
Phone: (407)894-7555

Date: May 2, 2007

FILING AND ACKNOWLEDGMENT

Filed, on this date, pursuant to Section 120.52, F.S., with the designated Department Clerk, receipt of which is hereby acknowledged.

Tricia L. Young
Clerk

May 3, 2007
Date

CCF/trw/cs/ply

Enclosure: Revised page of DMR

cc: Ron Ferland (via e-mail: rferland@bfaenvironmental.com)

CERTIFICATE OF SERVICE

This is to certify that this PERMIT REVISION and all copies were mailed before the close of business on May 3, 2007 to the listed persons by Tricia L. Young.

Florida Department of
Environmental Protection
Central District
3319 Maguire Boulevard, Suite 232
Orlando, Florida 32803-3767

Charlie Crist
Governor

Jeff Kottkamp
Lt. Governor

Michael W. Sole
Secretary

NOTICE OF PERMIT ISSUANCE

SENT BY E-MAIL
Jason Herrick, Chief Engineer
Orange County Utilities
9150 Curry Ford Road
Orlando, FL 32825

Orange County – PW
Orange County Aquifer Storage Recovery (ASR) Facility
Orange County Aquifer Storage and Recovery Well
PWS ID No. 3484132

Dear Mr. Herrick:

Enclosed is Permit Number WC48-0080780-748 to fill the aquifer storage and recovery well (ASR) with water from the distribution system during times of low demand and pump the water to the distribution system during times of high demand, issued pursuant to Section 403.861(9), *Florida Statutes*.

The Department's proposed agency action shall become final unless a timely petition for an administrative hearing is filed under Sections 120.569 and 120.57 of the *Florida Statutes* before the deadline for filing a petition. The procedures for petitioning for a hearing are set forth below.

A person whose substantial interests are affected by the Department's proposed permitting decision may petition for an administrative proceeding (hearing) under Sections 120.569 and 120.57 of the *Florida Statutes*. The petition must contain the information set forth below and must be filed (received by the clerk) with:

Clerk of the Department of Environmental Protection
Office of General Counsel
3900 Commonwealth Boulevard, Mail Station 35
Tallahassee, Florida 32399-3000.

Petitions by the applicant or any of the parties listed below must be filed within fourteen days of receipt of this written notice. Petitions filed by any persons other than those entitled to written notice under Section 120.60(3) of the *Florida Statutes* must be filed within fourteen days of publication of the notice or within fourteen days of receipt of the written notice, whichever occurs first.

Under Section 120.60(3) of the *Florida Statutes*, however, any person who has asked the Department for notice of agency action may file a petition within fourteen days of receipt of such notice, regardless of the date of publication.

The petitioner shall mail a copy of the petition to the applicant at the address indicated above at the time of filing. The failure of any person to file a petition within the appropriate time period shall constitute a waiver of that person's right to request an administrative determination (hearing) under Sections 120.569 and 120.57 of the *Florida Statutes*. Any subsequent intervention (in a proceeding initiated by another party) will be only at the discretion of the presiding officer upon the filing of a motion in compliance with Rule 28-106.205 of the *Florida Administrative Code*.

A petition that disputes the material facts on which the Department's action is based must contain the following information:

(a) The name, address, and telephone number of each petitioner; the name, address, and telephone number of the petitioner's representative, if any; the Department permit identification number and the county in which the subject matter or activity is located;
(b) A statement of how and when each petitioner received notice of the Department action;
(c) A statement of how each petitioner's substantial interests are affected by the Department action;
(d) A statement of all disputed issues of material fact. If there are none, the petition must so indicate;
(e) A statement of facts that the petitioner contends warrant reversal or modification of the Department action;
(f) A concise statement of the ultimate facts alleged, as well as the rules and statutes which entitle the petitioner to relief; and
(g) A statement of the relief sought by the petitioner, stating precisely the action that the petitioner wants the Department to take.

A petition that does not dispute the material facts on which the Department's action is based shall state that no such facts are in dispute and otherwise shall contain the same information as set forth above, as required by Rule 28-106.301, *Florida Statutes.*

Because the administrative hearing process is designed to formulate final agency action, the filing of a petition means that the Department's final action may be different from the position taken by it in this notice. Persons whose substantial interests will be affected by any such final decision of the Department have the right to petition to become a party to the proceeding, in accordance with the requirements set forth above.

Mediation under Section 120.573 of the *Florida Statutes* is not available for this proceeding.

This action is final and effective on the date filed with the Clerk of the Department unless a petition is filed in accordance with the above. Upon the timely filing of a petition this order will not be effective until further order of the Department.

Any party to the order has the right to seek judicial review of the order under Section 120.68 of the *Florida Statutes*, by the filing of a notice of appeal under Rule 9.110 of the Florida Rules of Appellate Procedure with:

Clerk of the Department of Environmental Protection
Office of General Counsel
Mail Station 35,
3900 Commonwealth Boulevard
Tallahassee, Florida, 32399-3000

and by filing a copy of the notice of appeal accompanied by the applicable filing fees with the appropriate district court of appeal. The notice of appeal must be filed within 30 days from the date when the final order is filed with the Clerk of the Department.

Florida Department of
Environmental Protection
Central District
3319 Maguire Boulevard, Suite 232
Orlando, Florida 32803-3767

Charlie Crist
Governor

Jeff Kottkamp
Lt. Governor

Michael W. Sole
Secretary

This permit is issued under the provisions of Chapter 403, *Florida Statutes*, and Rule 62-555, *Florida Administrative Code*, (F.A.C.). The above named permittee is hereby authorized to perform the work shown on the application and approved drawing, plans, and other documents attached hereto or on file with the Department and made a part hereof and specifically described as follows:

The project is located at along an access road off Curry Ford Road near the intersection of Cypress Springs Boulevard in Orange County, Florida. This facility is associated with the Orange County Utilities Water Reclamation. This permit concerns the connection of the well to the water distribution system.

The project consists of the following components or approved equivalents:

- ASR well consisting of a 24-inch FRP inner casing to a depth of approximately 1100 feet bls and a total depth of 1200 feet bls. The 24-inch casing will be set inside a 36-inch steel casing to a depth of approximately 550 feet bls. The complete well assembly will be set inside a 48-inch steel casing to a depth of approximately 110 feet bls. Pit casing with a diameter for 56-inch will also be set to a depth of approximately 40 feet bls. The estimated recovery is a maximum of 3 mgd.
- 300 HP Goulds 14RJHC, 5-stage vertical turbine recovery pump (2,100 gpm) @ 370 TDH;
- Bi-directional magnetic flow meter.
- 480-volt, 3-phase motor control center;
- 16-inch pipeline from the ASR well to an existing 36-inch water main along Curry Ford Road to allow for water to and from the distribution system.

The well cycle test and backflush water will be discharged to the Orange County Eastern Water Reclamation Facility (EWRF) reclaimed water system. It is left to the discretion of the utility to determine the operator coverage, the number of visits, and the duration of each visit.

This permit expires five years after the date of issuance. It does not pertain to any wastewater, stormwater or dredge and fill aspects of the project.

GENERAL CONDITIONS:

1. The terms, conditions, requirements, limitations and restrictions set forth in this permit, are "permit conditions" and are binding and enforceable pursuant to Sections 403.141, 403.727, or 403.859 through 403.861, F.S. The permittee is placed on notice that the Department will review this permit periodically and may initiate enforcement action for any violations of these conditions.

2. This permit is valid only for the specific processes and operations applied for and indicated in the approved drawings or exhibits. Any unauthorized deviation from the approved drawings, exhibits, specifications, or conditions of this permit may constitute grounds for revocation and enforcement action by the Department.

3. As provided in subsections 403.087(6) and 403.722(5), F.S., the issuance of this permit does not convey any vested rights or any exclusive privileges. Neither does it authorize any injury to public or private property or any invasion of personal rights, nor any infringement of federal, state, or local laws or regulations. This permit is not a waiver of or approval of any other Department permit that may be required for other aspects of the total project which are not addressed in this permit.

4. This permit conveys no title to land or water, does not constitute State recognition or acknowledgment of title, and does not constitute authority for the use of submerged lands unless herein provided and the necessary title or leasehold interests have been obtained from the State. Only the Trustees of the Internal Improvement Trust Fund may express State opinion as to title.

5. This permit does not relieve the permittee from liability for harm or injury to human health or welfare, animal, or plant life, or property caused by the construction or operation of this permitted source, or from penalties therefore; nor does it allow the permittee to cause pollution in contravention of Florida Statutes and Department rules, unless specifically authorized by an order from the Department.

6. The permittee shall properly operate and maintain the facility and systems of treatment and control(and related appurtenances) that are installed and used by the permittee to achieve compliance with the conditions of this permit, as required by Department rules. This provision includes the operation of backup or auxiliary facilities or similar systems when necessary to achieve compliance with the conditions of the permit and when required by Department rules.

7. The permittee, by accepting this permit, specifically agrees to allow authorized Department personnel, upon presentation of credentials or other documents as may be required by law and at reasonable times, access to the premises where the permitted activity is located or conducted to:

   (a) Have access to and copy any records that must be kept under conditions of the permit;
   (b) Inspect the facility, equipment, practices, or operations regulated or required under this permit; and
   (c) Sample or monitor any substances or parameters at any location reasonably necessary to assure compliance with this permit or Department rules.

   Reasonable time may depend on the nature of the concern being investigated.

8. If, for any reason, the permittee does not comply with or will be unable to comply with any conditions or limitation specified in this permit, the permittee shall immediately provide the Department with the following information:

   (a) A description of and cause of noncompliance; and
   (b) The period of noncompliance, including dates and times; or, if not corrected, the anticipated time the noncompliance is expected to continue, and steps being taken to reduce, eliminate, and prevent recurrence of the noncompliance.

   The permittee shall be responsible for any and all damages which may result and may be subject to enforcement action by the Department for penalties or for revocation of this permit.

9. In accepting this permit, the permittee understands and agrees that all records, notes, monitoring data and other information relating to the construction or operation of this permitted source which are submitted to the Department may be used by the Department as evidence in any enforcement case involving the permitted source arising under the Florida Statutes or Department rules, except where such use is prescribed by Section 403.111 and 403.73, F.S. Such evidence shall only be used to the extent it is consistent with the Florida Rules of Civil Procedure and appropriate evidentiary rules.

10. The permittee agrees to comply with changes in Department rules and Florida Statutes after a reasonable time for compliance; provided, however, the permittee does not waive any other rights granted by Florida Statutes or Department rules.

11. This permit is transferable only upon Department approval in accordance with Rule 62-4.120 and 62-30.300, F.A.C., as applicable. The permittee shall be liable for any non-compliance of the permitted activity until the transfer is approved by the Department.

12. This permit or a copy thereof shall be kept at the work site of the permitted activity.

~~13. This permit also constitutes:~~

~~( ) Determination of Best Available Control Technology (BACT)~~
~~( ) Determination of Prevention of Significant Deterioration (PSD)~~
~~( ) Certification of compliance with state Water Quality Standards (Section 401, PL 92-500)~~
~~( ) Compliance with New Source Performance Standards~~

14. The permittee shall comply with the following:

(a) Upon request, the permittee shall furnish all records and plans required under Department rules. During enforcement actions, the retention period for all records will be extended automatically unless otherwise stipulated by the Department.

(b) The permittee shall hold at the facility or other location designated by this permit records of all monitoring information (including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation) required by the permit, copies of all reports required by this permit, and records of all data used to complete the application for this permit. These materials shall be retained at least three years from the date the sample, measurement, report, or application unless otherwise specified by Department rule.

(c) Records of monitoring information shall include:

1. the date, exact place, and time of sampling or measurements;
2. the person responsible for performing the sampling or measurements;
3. the dates analyses were performed;
4. the person responsible for performing the analyses;
5. the analytical techniques or methods used;
6. the results of such analyses.

15. When requested by the Department, the permittee shall within a reasonable time furnish any information required by law which is needed to determine compliance with the permit. If the permittee becomes aware the relevant facts were not submitted or were incorrect in the permit application or in any report to the Department, such facts or information shall be corrected promptly.

SPECIFIC CONDITIONS:

Clearance of the Project

1. ***A Clearance Letter must be issued by the DEP Central District Potable Water program before placement of this project into service. Failure to do so will result in enforcement action against the permittee.***

To obtain clearance letter, the engineer of record must submit the following:

(1) completion of the enclosed "Request for Letter of Release to Place Water Supply System into Service" [DEP Form 62-555.900(9), F.A.C.]; and
(2) a copy of this permit; and
(3) a copy of satisfactory bacteriological sample results taken on two consecutive days from the point of entry to the distribution system.
(4) The permittee shall contact Ms. Echo Goodner or Mr. Paul Morrison at 407.894.7555 ext. 3988 regarding changes to monitoring in the Lead/Copper and bacteriological plans and other required monitoring programs.
(5) 20-sample Bacteriological well survey must be done in accordance with Rule 62-555.315(6)(b), F.A.C. Samples must be taken on consecutive days (weekends and holidays may be excluded) with no more than two (2) samples taken per day, at least 6 hours apart.
(6) The permittee shall contact Mr. Kyle Kubanek at 407.894.7555 ext. 2262 to set up a date and time to conduct a sanitary survey of the facility.

(7) A copy of the well permit and well construction log.

(8) Provide one (1) copy of the chemical analysis from the production (not a "test" or "monitoring") well and performed by a Certified Laboratory with results submitted on the Standard Format for all water analysis per 62-550 F.A.C.:

- Primary Inorganics;
- Turbidity (If >1.0 NTU, well not adequately developed);
- Synthetic Organic Contaminants (SOCs);
- Volatile Organic Compounds (VOCs);
- Gross Alpha Radioactivity & Radium 228;
- Secondary contaminants;
- Total Sulfide, alkalinity, dissolved iron, & dissolved oxygen.

Clearance Required before Service

2. ***NOTE TO THE UTILITY: Pursuant to Rule 403.859(6), Florida Statutes, do not provide water service to this project (other than flushing/testing) until the Department of Environmental Protection has issued a letter of clearance or the utility, shall be subject to enforcement action.***

Sale or Transfer of Facility

3. The permittee will promptly notify the Department upon sale or legal transfer of the permitted facility. In accordance with General Condition #11 of this permit, this permit is transferable only upon Department approval. ***The new owner must apply, by letter, for a transfer of permit within 30 days following sale or transaction.***

Professional Engineer in Charge of Construction

4. The permittee shall retain a Florida-licensed professional engineer in accordance with subsection 62-555.530(3), F.A.C. to take responsible charge of inspecting construction of the project for the purpose of determining in general if the construction proceeds in compliance with the permit, including the approved preliminary design report or drawings and specifications, for the project.

Record Drawings

5. The permittee shall have complete record drawings produced for the project in accordance with Rule 62-555.530(4), F.A.C.

Permittee to Provide O&M Manual

6. The permittee shall provide an operation & maintenance manual for the new or altered treatment facilities to fulfill the requirements under Rule 62-555.350(13), F.A.C.

Permittee to Provide Records

7. The permitte shall keep:
    A. Records documenting that their finished-drinking-water storage tanks, including conventional hydro-pneumatic tanks with an access manhole have been cleaned and inspected during the past five years in accordance with subsection 62-555.350(2), F.A.C.

B. Records documenting that their isolation valves are being exercised, and their water mains conveying finished drinking water are being flushed, in accordance with subsection 62-555.350(2), F.A.C.

Permittee to Provide Water Distribution System Map

8. The permittee shall keep an up-to-date map of the drinking water system and where appropriate, water distribution system. Such a map shall show the location and size of water mains if known; the location of valves and fire hydrants; and the location of any pressure zone boundaries, pumping facilities, storage tanks, and interconnections with other public water systems.

Permittee to Provide Emergency Preparedness/Response Plan

9. The permittee shall keep a written emergency preparedness/response plan in accordance with *Emergency Planning for Water Utilities*, AWWA Manual M19, as adopted in Rule 62-555.335, F.A.C., by no later than December 31, 2004, and shall update and implement the plan as necessary thereafter. Said suppliers of water shall coordinate with their Local Emergency Planning Committee and their Florida Department of Law Enforcement Regional Security Task Force when developing their emergency plan.

Submittal of Monthly Operating Reports

10. The system shall submit MORs in accordance with Chapter 62-555 and 62-550, Florida Administrative Code.

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Christianne C. Ferraro

Christianne C. Ferraro, P.E.
Administrator, Water Resource Management
Date of Issuance: October 25, 2007 Date of Expiration: October 24, 2012

Copies furnished to: Kim Dodson; Kyle Kubanek; Echo Goodner; Paul Morrison; Jason.herrick@ocfl.net; rferland@bfaenvironmental.com`

CERTIFICATE OF SERVICE

The undersigned duly designated deputy agency clerk hereby certified that this NOTICE OF PERMIT ISSUANCE and all copies were sent by E-Mail before the close of business on October 26, 2007 to the listed persons.

FILING AND ACKNOWLEDGMENT

FILED, on this date, under Section 120.52(7), *Florida Statutes*, with the designated Department Clerk, receipt of which is hereby acknowledged.

Tricia L. Young October 25, 2007
Clerk Date

Florida Department of
Environmental Protection
Central District
3319 Maguire Boulevard, Suite 232
Orlando, Florida 32803-3767

Charlie Crist
Governor

Jeff Kottkamp
Lt. Governor

Michael W. Sole
Secretary

NOTICE OF PERMIT ISSUANCE

SENT BY E-MAIL

Orange County Utilities
9150 CurryFord Road
Orlando, FL 32825

Attention: Jason Herrick, Chief Engineer

Orange County - PW
OCUD-Eastern
ASR New Charge/Withdrawal Main

Dear Mr. Herrick:

Enclosed is Permit Number to construct a water distribution system extension issued pursuant to Section 403.861(9), *Florida Statutes*.

The Department's proposed agency action shall become final unless a timely petition for an administrative hearing is filed under Sections 120.569 and 120.57 of the *Florida Statutes* before the deadline for filing a petition. The procedures for petitioning for a hearing are set forth below.

A person whose substantial interests are affected by the Department's proposed permitting decision may petition for an administrative proceeding (hearing) under Sections 120.569 and 120.57 of the *Florida Statutes*. The petition must contain the information set forth below and must be filed (received by the clerk) with:

Clerk of the Department of Environmental Protection
Office of General Counsel
3900 Commonwealth Boulevard, Mail Station 35
Tallahassee, Florida 32399-3000.

Petitions by the applicant or any of the parties listed below must be filed within fourteen days of receipt of this written notice. Petitions filed by any persons other than those entitled to written notice under Section 120.60(3) of the *Florida Statutes* must be filed within fourteen days of publication of the notice or within fourteen days of receipt of the written notice, whichever occurs first.

Under Section 120.60(3) of the *Florida Statutes*, however, any person who has asked the Department for notice of agency action may file a petition within fourteen days of receipt of such notice, regardless of the date of publication.

The petitioner shall mail a copy of the petition to the applicant at the address indicated above at the time of filing. The failure of any person to file a petition within the appropriate time period shall constitute a waiver of that person's right to request an administrative determination (hearing) under Sections 120.569 and 120.57 of the *Florida Statutes*. Any subsequent intervention (in a proceeding initiated by another party) will be only at the discretion of the presiding officer upon the filing of a motion in compliance with Rule 28-106.205 of the *Florida Administrative Code*.

A petition that disputes the material facts on which the Department's action is based must contain the following information:

(a) The name, address, and telephone number of each petitioner; the name, address, and telephone number of the petitioner's representative, if any; the Department permit identification number and the county in which the subject matter or activity is located;

(b) A statement of how and when each petitioner received notice of the Department action;

(c) A statement of how each petitioner's substantial interests are affected by the Department action;

(d) A statement of all disputed issues of material fact. If there are none, the petition must so indicate;

(e) A statement of facts that the petitioner contends warrant reversal or modification of the Department action;

(f) A concise statement of the ultimate facts alleged, as well as the rules and statutes which entitle the petitioner to relief; and

(g) A statement of the relief sought by the petitioner, stating precisely the action that the petitioner wants the Department to take.

A petition that does not dispute the material facts on which the Department's action is based shall state that no such facts are in dispute and otherwise shall contain the same information as set forth above, as required by Rule 28-106.301, *Florida Statutes.*

Because the administrative hearing process is designed to formulate final agency action, the filing of a petition means that the Department's final action may be different from the position taken by it in this notice. Persons whose substantial interests will be affected by any such final decision of the Department have the right to petition to become a party to the proceeding, in accordance with the requirements set forth above.

Mediation under Section 120.573 of the *Florida Statutes* is not available for this proceeding.

This action is final and effective on the date filed with the Clerk of the Department unless a petition is filed in accordance with the above. Upon the timely filing of a petition this order will not be effective until further order of the Department.

Any party to the order has the right to seek judicial review of the order under Section 120.68 of the *Florida Statutes*, by the filing of a notice of appeal under Rule 9.110 of the Florida Rules of Appellate Procedure with:

Clerk of the Department of Environmental Protection
Office of General Counsel
Mail Station 35,
3900 Commonwealth Boulevard
Tallahassee, Florida, 32399-3000

and by filing a copy of the notice of appeal accompanied by the applicable filing fees with the appropriate district court of appeal. The notice of appeal must be filed within 30 days from the date when the final order is filed with the Clerk of the Department.

Florida Department of
Environmental Protection
Central District
3319 Maguire Boulevard, Suite 232
Orlando, Florida 32803-3767

Charlie Crist
Governor

Jeff Kottkamp
Lt. Governor

Michael W. Sole
Secretary

Permittee:
Orange County Utilities
9150 CurryFord Road
Orlando, FL 32825

Attention: Jason Herrick, Chief Engineer

Permit Number: WD48-0080780-749
Expiration Date: January 29, 2012
County: Orange
Utility: OCUD-Eastern
Project: ASR New Change/Withdrawal Main

This permit is issued under the provisions of Chapter 403, *Florida Statutes*, and Rule 62-555, *Florida Administrative Code*, (F.A.C.). The above named permittee is hereby authorized to perform the work shown on the application and approved drawing, plans, and other documents attached hereto or on file with the Department and made a part hereof and specifically described as follows:

Extension of the OCUD-Eastern water distribution system by the construction of approximately 1000 ft of 16-inch main from the proposed ASR Well location to connect to the existing 36-inch main on Curry Ford Road.

This permit does not pertain to any wastewater, stormwater or dredge and fill aspects of the project. This permit expires 5 years after the date of issuance.

GENERAL CONDITIONS

1. The terms, conditions, requirements, limitations and restrictions set forth in this permit, are "permit conditions" and are binding and enforceable pursuant to Sections 403.141, 403.727, or 403.859 through 403.861, F.S. The permittee is placed on notice that the Department will review this permit periodically and may initiate enforcement action for any violations of these conditions.

2. This permit is valid only for the specific processes and operations applied for and indicated in the approved drawings or exhibits. Any unauthorized deviation from the approved drawings, exhibits, specifications, or conditions of this permit may constitute grounds for revocation and enforcement action by the Department.

3. As provided in subsections 403.087(6) and 403.722(5), F.S., the issuance of this permit does not convey any vested rights or any exclusive privileges. Neither does it authorize any injury to public or private property or any invasion of personal rights, nor any infringement of federal, state, or local laws or regulations. This permit is not a waiver of or approval of any other Department permit that may be required for other aspects of the total project which are not addressed in this permit.

4. This permit conveys no title to land or water, does not constitute State recognition or acknowledgment of title, and does not constitute authority for the use of submerged lands unless herein provided and the necessary title or leasehold interests have been obtained from the State. Only the Trustees of the Internal Improvement Trust Fund may express State opinion as to title.

5. This permit does not relieve the permittee from liability for harm or injury to human health or welfare, animal, or plant life, or property caused by the construction or operation of this permitted source, or from penalties therefore; nor does it allow the permittee to cause pollution in contravention of Florida Statutes and Department rules, unless specifically authorized by an order from the Department.

6. The permittee shall properly operate and maintain the facility and systems of treatment and control(and related appurtenances) that are installed and used by the permittee to achieve compliance with the conditions of this permit, as required by Department rules. This provision includes the operation of backup or auxiliary facilities or similar systems when necessary to achieve compliance with the conditions of the permit and when required by Department rules.

7. The permittee, by accepting this permit, specifically agrees to allow authorized Department personnel, upon presentation of credentials or other documents as may be required by law and at reasonable times, access to the premises where the permitted activity is located or conducted to:

   (a) Have access to and copy any records that must be kept under conditions of the permit;
   (b) Inspect the facility, equipment, practices, or operations regulated or required under this permit; and
   (c) Sample or monitor any substances or parameters at any location reasonably necessary to assure compliance with this permit or Department rules.

   Reasonable time may depend on the nature of the concern being investigated.

8. If, for any reason, the permittee does not comply with or will be unable to comply with any conditions or limitation specified in this permit, the permittee shall immediately provide the Department with the following information:

   (a) A description of and cause of noncompliance; and
   (b) The period of noncompliance, including dates and times; or, if not corrected, the anticipated time the noncompliance is expected to continue, and steps being taken to reduce, eliminate, and prevent recurrence of the noncompliance.

   The permittee shall be responsible for any and all damages which may result and may be subject to enforcement action by the Department for penalties or for revocation of this permit.

9. In accepting this permit, the permittee understands and agrees that all records, notes, monitoring data and other information relating to the construction or operation of this permitted source which are submitted to the Department may be used by the Department as evidence in any enforcement case involving the permitted source arising under the Florida Statutes or Department rules, except where such use is prescribed by Section 403.111 and 403.73, F.S. Such evidence shall only be used to the extent it is consistent with the Florida Rules of Civil Procedure and appropriate evidentiary rules.

GENERAL CONDITIONS

10. The permittee agrees to comply with changes in Department rules and Florida Statutes after a reasonable time for compliance; provided, however, the permittee does not waive any other rights granted by Florida Statutes or Department rules.

11. This permit is transferable only upon Department approval in accordance with Rule 62-4.120 and 62-30.300, F.A.C., as applicable. The permittee shall be liable for any non-compliance of the permitted activity until the transfer is approved by the Department.

12. This permit or a copy thereof shall be kept at the work site of the permitted activity.

~~13. This permit also constitutes:~~

~~( ) Determination of Best Available Control Technology (BACT)~~
~~( ) Determination of Prevention of Significant Deterioration (PSD)~~
~~( ) Certification of compliance with state Water Quality Standards (Section 401, PL 92-500)~~
~~( ) Compliance with New Source Performance Standards~~

14. The permittee shall comply with the following:

    (a) Upon request, the permittee shall furnish all records and plans required under Department rules. During enforcement actions, the retention period for all records will be extended automatically unless otherwise stipulated by the Department.
    (b) The permittee shall hold at the facility or other location designated by this permit records of all monitoring information (including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation) required by the permit, copies of all reports required by this permit, and records of all data used to complete the application for this permit. These materials shall be retained at least three years from the date the sample, measurement, report, or application unless otherwise specified by Department rule.
    (c) Records of monitoring information shall include:

        1. the date, exact place, and time of sampling or measurements;
        2. the person responsible for performing the sampling or measurements;
        3. the dates analyses were performed;
        4. the person responsible for performing the analyses;
        5. the analytical techniques or methods used;
        6. the results of such analyses.

15. When requested by the Department, the permittee shall within a reasonable time furnish any information required by law which is needed to determine compliance with the permit. If the permittee becomes aware the relevant facts were not submitted or were incorrect in the permit application or in any report to the Department, such facts or information shall be corrected promptly.

Permit Number: WD48-0080780-749
Expiration Date: January 29, 2012
County: Orange
Utility: OCUD-Eastern
Project: ASR New Change/Withdrawal Main

Permittee:
Orange County Utilities
9150 CurryFord Road
Orlando, FL 32825

Attention: Jason Herrick, Chief Engineer

SPECIFIC CONDITIONS:

Clearance of the Project

1. A Clearance Letter must be issued by the DEP Central District Potable Water program before placement of any public water system components constructed or altered under this permit into operation for any purpose other than disinfection, testing for leaks, or testing equipment operation. Failure to do so will result in enforcement action against the permittee. This does not prohibit the permittee from cutting into existing water mains and returning the water mains to operation in accordance with Rule 62-555.340(5), F.A.C. without the Department's approval. To obtain clearance letter, the engineer of record must submit the following:
   (1) completion of the enclosed "Request for Letter of Release to Place Water Supply System into Service" [DEP Form 62-555.900(9), F.A.C.];
   (2) a copy of this permit; and
   (3) A copy of satisfactory bacteriological sample results taken on two consecutive days from the proposed main at its beginning and end.
   (4) Evidence of clearance; the permitted 16-inch main shall not be cleared by the DEP for placement into service unless and until the ASR well is cleared for service by the agency; the two permits may be certified complete simultaneously.
2. ***NOTE TO THE UTILITY: Pursuant to Rule 403.859(6), Florida Statutes, do not provide water service to this project (other than flushing/testing) until the Department of Environmental Protection has issued a letter of clearance or the utility, shall be subject to enforcement action.***

Permit Transfer

3. The permittee will promptly notify the Department upon sale or legal transfer of the permitted facility. In accordance with General Condition #11 of this permit, this permit is transferable only upon Department approval. The new owner must apply, by letter, for a transfer of permit within 30 days.
4. The permittee shall retain a Florida-licensed professional engineer in accordance with subsection 62-555.530(3),F.A.C. to take responsible charge of inspecting construction of the project for the purpose of determining in general if the construction proceeds in compliance with the permit, including the approved preliminary design report or drawings and specifications, for the project.
5. The permittee shall have complete record drawings produced for the project in accordance with Rule 62-555530(4), F.A.C.

SPECIFIC CONDITIONS:

6. The permittee shall provide an operational maintenance manual for the new or altered treatment facilities to fulfill the requirements under Rule 62-555.350(13), F.A.C.

STATE OF FLORIDA DEPARTMENT
OF ENVIRONMENTAL PROTECTION

Richard S. Lott

Richard S. Lott, P.G., P.E.
Program Manager, Drinking Water

ISSUED September 20, 2007

RSL: ohm: mn

Copies furnished to:
jason.herrick@ocfl.net; rferland@bfaenvironmental.com;

CERTIFICATE OF SERVICE

The undersigned duly designated deputy agency clerk hereby certified that this NOTICE OF PERMIT ISSUANCE and all copies were sent by E-Mail before the close of business on September 21, 2007 to the listed persons.

FILING AND ACKNOWLEDGMENT

FILED, on this date, pursuant to Section 120.52, *Florida Statutes*, with the designated Department Clerk, receipt of which is hereby acknowledged.

Tricia L. Young — September 21, 2007
Clerk — Date

Florida Department of
Environmental Protection

Central District
3319 Maguire Boulevard, Suite 232
Orlando, Florida 32803-3767

Charlie Crist
Governor

Jeff Kottkamp
Lt. Governor

Michael W. Sole
Secretary

NOTICE OF PERMIT ISSUANCE

SENT BY E-MAIL
Jason Herrick, Chief Engineer
Orange County Utilities
9150 Curry Ford Road
Orlando, FL 32825

Orange County – PW
Orange County Aquifer Storage Recovery (ASR) Facility
Orange County Aquifer Storage and Recovery Well
PWS ID No. 3484132

Dear Mr. Herrick:

Enclosed is Permit Number WC48-0080780-750 to disinfect water from the aquifer storage and recovery well (ASR) prior to discharge to the distribution system, issued pursuant to Section 403.861(9), *Florida Statutes*.

The Department's proposed agency action shall become final unless a timely petition for an administrative hearing is filed under Sections 120.569 and 120.57 of the *Florida Statutes* before the deadline for filing a petition. The procedures for petitioning for a hearing are set forth below.

A person whose substantial interests are affected by the Department's proposed permitting decision may petition for an administrative proceeding (hearing) under Sections 120.569 and 120.57 of the *Florida Statutes*. The petition must contain the information set forth below and must be filed (received by the clerk) with:

Clerk of the Department of Environmental Protection
Office of General Counsel
3900 Commonwealth Boulevard, Mail Station 35
Tallahassee, Florida 32399-3000.

Petitions by the applicant or any of the parties listed below must be filed within fourteen days of receipt of this written notice. Petitions filed by any persons other than those entitled to written notice under Section 120.60(3) of the *Florida Statutes* must be filed within fourteen days of publication of the notice or within fourteen days of receipt of the written notice, whichever occurs first.

Under Section 120.60(3) of the *Florida Statutes*, however, any person who has asked the Department for notice of agency action may file a petition within fourteen days of receipt of such notice, regardless of the date of publication.

The petitioner shall mail a copy of the petition to the applicant at the address indicated above at the time of filing. The failure of any person to file a petition within the appropriate time period shall constitute a waiver of that person's right to request an administrative determination (hearing) under Sections 120.569 and 120.57 of the *Florida Statutes*. Any subsequent intervention (in a proceeding initiated by another party) will be only at the discretion of the presiding officer upon the filing of a motion in compliance with Rule 28-106.205 of the *Florida Administrative Code*.

A petition that disputes the material facts on which the Department's action is based must contain the following information:

(a) The name, address, and telephone number of each petitioner; the name, address, and telephone number of the petitioner's representative, if any; the Department permit identification number and the county in which the subject matter or activity is located;
(b) A statement of how and when each petitioner received notice of the Department action;
(c) A statement of how each petitioner's substantial interests are affected by the Department action;
(d) A statement of all disputed issues of material fact. If there are none, the petition must so indicate;
(e) A statement of facts that the petitioner contends warrant reversal or modification of the Department action;
(f) A concise statement of the ultimate facts alleged, as well as the rules and statutes which entitle the petitioner to relief; and
(g) A statement of the relief sought by the petitioner, stating precisely the action that the petitioner wants the Department to take.

A petition that does not dispute the material facts on which the Department's action is based shall state that no such facts are in dispute and otherwise shall contain the same information as set forth above, as required by Rule 28-106.301, *Florida Statutes.*

Because the administrative hearing process is designed to formulate final agency action, the filing of a petition means that the Department's final action may be different from the position taken by it in this notice. Persons whose substantial interests will be affected by any such final decision of the Department have the right to petition to become a party to the proceeding, in accordance with the requirements set forth above.

Mediation under Section 120.573 of the *Florida Statutes* is not available for this proceeding. This action is final and effective on the date filed with the Clerk of the Department unless a petition is filed in accordance with the above. Upon the timely filing of a petition this order will not be effective until further order of the Department.

Any party to the order has the right to seek judicial review of the order under Section 120.68 of the *Florida Statutes*, by the filing of a notice of appeal under Rule 9.110 of the Florida Rules of Appellate Procedure with:

Clerk of the Department of Environmental Protection
Office of General Counsel
Mail Station 35,
3900 Commonwealth Boulevard
Tallahassee, Florida, 32399-3000

and by filing a copy of the notice of appeal accompanied by the applicable filing fees with the appropriate district court of appeal. The notice of appeal must be filed within 30 days from the date when the final order is filed with the Clerk of the Department.

Florida Department of
Environmental Protection
Central District
3319 Maguire Boulevard, Suite 232
Orlando, Florida 32803-3767

Charlie Crist
Governor

Jeff Kottkamp
Lt. Governor

Michael W. Sole
Secretary

This permit is issued under the provisions of Chapter 403, *Florida Statutes*, and Rule 62-555, *Florida Administrative Code*, (F.A.C.). The above named permittee is hereby authorized to perform the work shown on the application and approved drawing, plans, and other documents attached hereto or on file with the Department and made a part hereof and specifically described as follows:

The project is located at along an access road off Curry Ford Road near the intersection of Cypress Springs Boulevard in Orange County, Florida. This facility is associated with the Orange County Utilities Water Reclamation. This permit is for disinfection of the water being drawn from the well prior to entering the distribution system. Permit 48-0080780-748 was issued for connection of the well and concomitant pipe to the distribution system.

The project consists of the following components or approved equivalents:

- Residual chlorine analyzer;
- 480-volt, 3-phase motor control center;
- Sodium hypochlorite feed system in a concrete business consisting of:
  - Two (2) Skid mounted chemical metering pumps;
  - Double walled 1500 gallon storage tank for a 20-day supply of liquid sodium hypochlorite.

The well cycle test and backflush water will be discharged to the Orange County Eastern Water Reclamation Facility (EWRF) reclaimed water system. It is left to the discretion of the utility to determine the operator coverage, the number of visits, and the duration of each visit.

This permit expires five years after the date of issuance. It does not pertain to any wastewater, stormwater or dredge and fill aspects of the project.

GENERAL CONDITIONS:

1. The terms, conditions, requirements, limitations and restrictions set forth in this permit, are "permit conditions" and are binding and enforceable pursuant to Sections 403.141, 403.727, or 403.859 through 403.861, F.S. The permittee is placed on notice that the Department will review this permit periodically and may initiate enforcement action for any violations of these conditions.

2. This permit is valid only for the specific processes and operations applied for and indicated in the approved drawings or exhibits. Any unauthorized deviation from the approved drawings, exhibits, specifications, or conditions of this permit may constitute grounds for revocation and enforcement action by the Department.

3. As provided in subsections 403.087(6) and 403.722(5), F.S., the issuance of this permit does not convey any vested rights or any exclusive privileges. Neither does it authorize any injury to public or private property or any invasion of personal rights, nor any infringement of federal, state, or local laws or regulations. This permit is not a waiver of or approval of any other Department permit that may be required for other aspects of the total project which are not addressed in this permit.

4. This permit conveys no title to land or water, does not constitute State recognition or acknowledgment of title, and does not constitute authority for the use of submerged lands unless herein provided and the necessary title or leasehold interests have been obtained from the State. Only the Trustees of the Internal Improvement Trust Fund may express State opinion as to title.

5. This permit does not relieve the permittee from liability for harm or injury to human health or welfare, animal, or plant life, or property caused by the construction or operation of this permitted source, or from penalties therefore; nor does it allow the permittee to cause pollution in contravention of Florida Statutes and Department rules, unless specifically authorized by an order from the Department.

6. The permittee shall properly operate and maintain the facility and systems of treatment and control(and related appurtenances) that are installed and used by the permittee to achieve compliance with the conditions of this permit, as required by Department rules. This provision includes the operation of backup or auxiliary facilities or similar systems when necessary to achieve compliance with the conditions of the permit and when required by Department rules.

7. The permittee, by accepting this permit, specifically agrees to allow authorized Department personnel, upon presentation of credentials or other documents as may be required by law and at reasonable times, access to the premises where the permitted activity is located or conducted to:

   (a) Have access to and copy any records that must be kept under conditions of the permit;
   (b) Inspect the facility, equipment, practices, or operations regulated or required under this permit; and
   (c) Sample or monitor any substances or parameters at any location reasonably necessary to assure compliance with this permit or Department rules.

   Reasonable time may depend on the nature of the concern being investigated.

8. If, for any reason, the permittee does not comply with or will be unable to comply with any conditions or limitation specified in this permit, the permittee shall immediately provide the Department with the following information:

   (a) A description of and cause of noncompliance; and
   (b) The period of noncompliance, including dates and times; or, if not corrected, the anticipated time the noncompliance is expected to continue, and steps being taken to reduce, eliminate, and prevent recurrence of the noncompliance.

   The permittee shall be responsible for any and all damages which may result and may be subject to enforcement action by the Department for penalties or for revocation of this permit.

9. In accepting this permit, the permittee understands and agrees that all records, notes, monitoring data and other information relating to the construction or operation of this permitted source which are submitted to the Department may be used by the Department as evidence in any enforcement case involving the permitted source arising under the Florida Statutes or Department rules, except where such use is prescribed by Section 403.111 and 403.73, F.S. Such evidence shall only be used to the extent it is consistent with the Florida Rules of Civil Procedure and appropriate evidentiary rules.

10. The permittee agrees to comply with changes in Department rules and Florida Statutes after a reasonable time for compliance; provided, however, the permittee does not waive any other rights granted by Florida Statutes or Department rules.

11. This permit is transferable only upon Department approval in accordance with Rule 62-4.120 and 62-30.300, F.A.C., as applicable. The permittee shall be liable for any non-compliance of the permitted activity until the transfer is approved by the Department.

12. This permit or a copy thereof shall be kept at the work site of the permitted activity.

~~13. This permit also constitutes:~~

~~( ) Determination of Best Available Control Technology (BACT)~~
~~( ) Determination of Prevention of Significant Deterioration (PSD)~~
~~( ) Certification of compliance with state Water Quality Standards (Section 401, PL 92-500)~~
~~( ) Compliance with New Source Performance Standards~~

14. The permittee shall comply with the following:

(a) Upon request, the permittee shall furnish all records and plans required under Department rules. During enforcement actions, the retention period for all records will be extended automatically unless otherwise stipulated by the Department.

(b) The permittee shall hold at the facility or other location designated by this permit records of all monitoring information (including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation) required by the permit, copies of all reports required by this permit, and records of all data used to complete the application for this permit. These materials shall be retained at least three years from the date the sample, measurement, report, or application unless otherwise specified by Department rule.

(c) Records of monitoring information shall include:

1. the date, exact place, and time of sampling or measurements;
2. the person responsible for performing the sampling or measurements;
3. the dates analyses were performed;
4. the person responsible for performing the analyses;
5. the analytical techniques or methods used;
6. the results of such analyses.

15. When requested by the Department, the permittee shall within a reasonable time furnish any information required by law which is needed to determine compliance with the permit. If the permittee becomes aware the relevant facts were not submitted or were incorrect in the permit application or in any report to the Department, such facts or information shall be corrected promptly.

SPECIFIC CONDITIONS:

Clearance of the Project

1. ***A Clearance Letter must be issued by the DEP Central District Potable Water program before placement of this project into service. Failure to do so will result in enforcement action against the permittee.***

To obtain clearance letter, the engineer of record must submit the following:

(1) completion of the enclosed "Request for Letter of Release to Place Water Supply System into Service" [DEP Form 62-555.900(9), F.A.C.]; and
(2) a copy of this permit; and
(3) The permittee shall contact Ms. Echo Goodner or Mr. Paul Morrison at 407.894.7555 ext. 3988 regarding changes to monitoring in the Lead/Copper and bacteriological plans and other required monitoring programs.
(4) The permittee shall contact Mr. Kyle Kubanek at 407.894.7555 ext. 2262 to set up a date and time to conduct a sanitary survey of the facility.
(5) Certification from the engineer that all safety equipment for this application was provided in accordance with Table 15.5 of *Water Treatment Plant Design*.
(6) Certification that the sodium hypochlorite is approved by NSF.
(7) Certification from the engineer that hypochlorination facilities were constructed in accordance with Rule 62-555.320(13)(b)(1 through 13), Florida Administrative Code.

Clearance Required before Service

2. ***NOTE TO THE UTILITY: Pursuant to Rule 403.859(6), Florida Statutes, do not provide water service to this project (other than flushing/testing) until the Department of Environmental Protection has issued a letter of clearance or the utility, shall be subject to enforcement action.***

Sale or Transfer of Facility

3. The permittee will promptly notify the Department upon sale or legal transfer of the permitted facility. In accordance with General Condition #11 of this permit, this permit is transferable only upon Department approval. ***The new owner must apply, by letter, for a transfer of permit within 30 days following sale or transaction.***

Professional Engineer in Charge of Construction

4. The permittee shall retain a Florida-licensed professional engineer in accordance with subsection 62-555.530(3), F.A.C. to take responsible charge of inspecting construction of the project for the purpose of determining in general if the construction proceeds in compliance with the permit, including the approved preliminary design report or drawings and specifications, for the project.

Record Drawings

5. The permittee shall have complete record drawings produced for the project in accordance with Rule 62-555.530(4), F.A.C.

Permittee to Provide O&M Manual

6. The permittee shall provide an operation & maintenance manual for the new or altered treatment facilities to fulfill the requirements under Rule 62-555.350(13), F.A.C.

Permittee to Provide Records

7. The permitte shall keep:
    A. Records documenting that their finished-drinking-water storage tanks, including conventional hydro-pneumatic tanks with an access manhole have been cleaned and inspected during the past five years in accordance with subsection 62-555.350(2), F.A.C.
    B. Records documenting that their isolation valves are being exercised, and their water mains conveying finished drinking water are being flushed, in accordance with subsection 62-555.350(2), F.A.C.

Permittee to Provide Water Distribution System Map

8. The permittee shall keep an up-to-date map of the drinking water system and where appropriate, water distribution system. Such a map shall show the location and size of water mains if known; the location of valves and fire hydrants; and the location of any pressure zone boundaries, pumping facilities, storage tanks, and interconnections with other public water systems.

Permittee to Provide Emergency Preparedness/Response Plan

9. The permittee shall keep a written emergency preparedness/response plan in accordance with *Emergency Planning for Water Utilities*, AWWA Manual M19, as adopted in Rule 62-555.335, F.A.C., by no later than December 31, 2004, and shall update and implement the plan as necessary thereafter. Said suppliers of water shall coordinate with their Local Emergency Planning Committee and their Florida Department of Law Enforcement Regional Security Task Force when developing their emergency plan.

Submittal of Monthly Operating Reports

10. The system shall submit MORs in accordance with Chapter 62-555 and 62-550, Florida Administrative Code.

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Christianne C. Ferraro

Christianne C. Ferraro, P.E.
Administrator, Water Resource Management
Date of Issuance: October 25, 2007 Date of Expiration: October 24, 2012

Copies furnished to:
Kim Dodson; Kyle Kubanek; Echo Goodner; Paul Morrison;
Jason.herrick@ocfl.net; rferland@bfaenvironmental.com`

CERTIFICATE OF SERVICE

The undersigned duly designated deputy agency clerk hereby certified that this NOTICE OF PERMIT ISSUANCE and all copies were sent by E-Mail before the close of business on October 26, 2007 to the listed persons.

FILING AND ACKNOWLEDGMENT

FILED, on this date, under Section 120.52(7), *Florida Statutes*, with the designated Department Clerk, receipt of which is hereby acknowledged.

Tricia L. Young October 25, 2007
Clerk Date

Florida Department of
Environmental Protection
Central District
3319 Maguire Boulevard, Suite 232
Orlando, Florida 32803-3767

Charlie Crist
Governor

Jeff Kottkamp
Lt. Governor

Michael W. Sole
Secretary

BY ELECTRONIC MAIL: Jason.Herrick@ocfl.net

In the Matter of an
Application for Permit by:

Jason Herrick, P.E.
Manager, Engineering Division
Orange County Utilities
9150 Curry Ford Road
Orlando, FL 32825-0000
Jason.Herrick@ocfl.net

Orange County – UIC
FDEP File No. 48-0272819-001-UC
Potable Water ASR Program
Class V ASR Injection Well

NOTICE OF PERMIT ISSUANCE

Enclosed is Permit Number 48-0272819-001 to construct one Class V, Group Seven, Aquifer Storage and Recovery (ASR) injection well system, issued pursuant to Section(s) 403.087, Florida Statutes.

The purpose of the ASR well is to store and recover potable water in the Floridan aquifer in order to meet potable water demands, provided that injection testing is successful.

Any party to this Order (permit) has the right to seek judicial review of the permit pursuant to Section 120.68, Florida Statutes, by the filing of a Notice of Appeal pursuant to Rule 9.110, Florida Rules of Appellate Procedure, with the Clerk of the Department in the Office of General Counsel, 3900 Commonwealth Boulevard, Mail Station 35, Tallahassee, Florida 32399-3000; and by filing a copy of the Notice of appeal accompanied by the applicable filing fees with the appropriate District Court of Appeal. The Notice of Appeal must be filed within 30 days from the date this Notice is filed with the Clerk of the Department.

Executed in Orlando, Florida.

STATE OF FLORIDA DEPARTMENT
OF ENVIRONMENTAL PROTECTION

Vivian F. Garfein

Vivian F. Garfein
Director, Central District

CERTIFICATE OF SERVICE

The undersigned duly designated deputy clerk hereby certifies that this PERMIT and all copies were mailed before the close of business on March 5, 2008 to the listed persons.

Clerk Stamp

FILING AND ACKNOWLEDGMENT

FILED, on this date, pursuant to Section.120.52, Florida Statutes, with the designated Department Clerk, receipt of which is hereby acknowledged.

Tricia L. Young	March 5, 2008
Clerk	Date

VFG/CCF/AKD/dw/ply
Enclosures
Copies furnished to:

Technical Advisory Committee

Florida Department of
Environmental Protection
Central District
3319 Maguire Boulevard, Suite 232
Orlando, Florida 32803-3767

Charlie Crist
Governor

Jeff Kottkamp
Lt. Governor

Michael W. Sole
Secretary

BY ELECTRONIC MAIL: Jason.Herrick@ocfl.net

PERMIT

PERMITTEE:
Jason Herrick, P.E.
Orange County Utilities
9150 Curry Ford Road
Orlando, Florida 32825-0000
Jason.Herrick@ocfl.net

Orange County – UIC
Permit File Number: 48-0272819-001-UC
Date of Issue: March 4, 2008
Expiration Date: March 3, 2013
County: Orange
Latitude: 28° 31’ 08” N
Longitude: 81° 12’ 36” W
Orange County Utilities Potable Water ASR
Project Class V ASR Injection Well

This permit is issued under the provisions of Chapter 403 of the Florida Statutes (F.S.) and Rules 62-4, 62-520, 62-528 and 62-550 of the Florida Administrative Code. The above named permittee is hereby authorized to perform the work or operate the facility shown on the application and approved drawing(s), plans, and other documents, attached hereto or on file with the Department and made a part hereof and specifically described as follows:

Construct one Class V Group Seven Aquifer Storage and Recovery (ASR-LF-1) injection well system with two storage zone monitoring wells (LF-MW-1 and LF-MW-2) and one confining zone monitoring well (CZ-MW-1). The basic ASR well design will consist of an 18-inch diameter injection well to a proposed total depth of approximately 1,200 feet and cased to approximately 1,100 feet below land surface (bls). The ASR system will have a maximum storage capacity of approximately 540 MG. The overall objective of this ASR well is to store, in the Floridan aquifer, potable water from the Orange County potable water distribution system and retrieve the stored potable water for use. Initially, the ASR well will be cycle tested by injecting, storing and recovering potable water for a period of approximately 5 years.

The Application to Construct V Injection well System, DEP Form 62-528.900(1), was received January 19, 2007, with supporting documents and additional information last received October 17, 2007. The location for this project is the Orange County Eastern Regional Water Reclamation Facility (ERWRF), Alafaya Trail, directly south of the intersection of Alafaya Trail and Curry Ford Road, Orange County, Florida.

Subject to Specific Conditions 1-7 and General Conditions 1-4.

1. General Criteria:

   a. This permit approval is based upon evaluation of the data contained in the application, plans and specifications submitted in support of the application. Any changes, except as provided elsewhere in this permit, must be approved by the Department before implementation.

   b. No drilling operations shall begin without an approved disposal site for drill cuttings, fluids or waste. It shall be the Water Well Contractor's responsibility to obtain any necessary Department and local agency approval for disposal prior to the start of construction. It is anticipated that wastes will be disposed of on site using a fluid containment system. In this event, permits shall be obtained accordingly.

   c. No fluid shall be injected without written authorization from the Department. The issuance of this construction permit does not obligate the Department to permit its operation, unless the well, monitoring system and surface appurtenances qualify for an operation permit.

   d. Those conditions imposed by the St. Johns River Water Management District in this project's Water Use Permit(s) regarding the testing of the ASR system remain in effect.

   e. No underground injection is allowed that causes or allows movement of fluid into an underground source of drinking water if such fluid movement may cause a violation of any primary drinking water standard or may otherwise adversely affect the health of persons.

   f. If historical or archaeological artifacts, such as Indian canoes, are discovered at any time within the project site, the permittee shall notify the FDEP Orlando Central District office and the Bureau of Historic Preservation, Division of Archives, History and Records Management, R. A. Gray Building, Tallahassee, Florida 32301, telephone number (850) 487-2073.

   g. Signatories and Certification Requirements

      (1) All reports and other submittals required to comply with this permit shall be signed by a person authorized under Rules 62-528.340(1) or (2), F.A.C.

      (2) In accordance with Rule 62-528.340(4), F.A.C., all reports shall contain the following certification:

      "I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based upon my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

   h. Plugging/abandonment and Alternate use plans – Permittees who are unable to operate the ASR well to meet its intended purpose shall within 180 days of FDEP notification:

      (1) Submit a plugging and abandonment permit application in accordance with Rules 62-528.625 and 62-528.645, F.A.C., or

      (2) Submit an alternate use plan for the well. Alternate use may commence after the plan has been approved by the Department, including any necessary permit or permit modifications as required by the Department or any other agency.

i. Prior to operational testing under this permit, the permittee shall obtain from the Department, a Water Quality Criteria Exemption (pursuant to Rule 62-520.500, F.A.C.) for sodium or any secondary standards that may be exceeded, where applicable.

j. The permittee shall be aware of and operate under General Conditions F.A.C. Rule 62-528.307(1)(a) through (x) and Rule 62-528.307(2). General Conditions are binding upon the permittee and enforceable pursuant to Chapter 403 of the Florida Statutes (see attachment I).

k. The permittee shall refer to Rule 62-602, F.A.C., in its entirety, to ensure compliance with all requirements for ASR wells.

2. Quality Assurance/Quality Control

   a. The permittee shall ensure that the construction of this facility shall be as described in the application and supporting documents. Any proposed modifications to this permit shall be submitted in writing to the Underground Injection Control program manager for review and clearance prior to implementation. Changes of negligible impact to the environment and staff time will be reviewed by the program manager, cleared when appropriate, and incorporated into this permit. Changes or modifications other than those described above will require submission of completed application and appropriate processing fees as per Rule 62-4.050, F.A.C.

   b. A Florida registered professional engineer, pursuant to Chapter 471, Florida Statutes (F.S.), shall be retained throughout the construction period and operational testing to be responsible for the construction operation and to certify the application, specifications and completion report and other related documents, pursuant to Rule 62-528.440(5), F.A.C. A professional engineer or professional geologist shall provide monitoring of the drilling and testing operation. The Department shall be notified immediately of any change of the Engineer of Record.

   c. All water quality samples required in this permit shall be collected and analyzed in accordance with Department Standard Operating Procedures (SOP), pursuant to the FDEP Quality Assurance, Chapter 62-160, F.A.C. The various components of the collection of the FDEP SOPs are found in DEP-SOP-001/01 (Field Procedures) and DEP-SOP-002/01 (Laboratory Procedures).

   d. The permittee shall calibrate all pressure gauge(s), flow meter(s), chart recorder(s), and other related equipment associated with the injection well system on a semi-annual basis. The permittee shall maintain all monitoring equipment and shall ensure that the monitoring equipment is calibrated and in proper operating condition at all times. Laboratory equipment, methods, and quality control will follow EPA guidelines as expressed in Standard Methods for the Examination of Water and Wastewater. The pressure gauge(s), flow meter(s), and chart recorder(s) shall be calibrated using standard engineering methods.

   e. Continuous on-site supervision by qualified personnel (engineer and/or geologist, as appropriate) is required during all testing and geophysical logging operations.

   f. Proper operation and maintenance includes effective performance, adequate funding, adequate operator staffing and training, and adequate laboratory and process controls, including appropriate quality assurance procedures.

   g. Hurricane Preparedness - Upon the issuance of a "Hurricane Watch" by the National Weather Service, the preparations to be made include, but are not necessarily limited to, the following:

      (1) Secure all on-site salt and other stockpiled additive materials to prevent surface and/or ground water contamination.

(2) Properly secure drilling equipment and rig(s) to prevent damage to well(s) and on-site treatment process equipment.

3. Source Water Fluid Analysis

a. Potable Water – a single event to occur within the 60 days prior to beginning cycle testing

(1) Prior to injection, the potable water analyses shall include:

(a) Primary and Secondary drinking water standards established in Chapter 62-550, Part III, F.A.C., (excluding asbestos, acrylamide, epichlorohydrin, and dioxin);

(b) Giardia lamblia and Cryptosporidium (count and viability testing where applicable) dissolved oxygen, E. coli and enteroccoci (a single event test for characterizing the background water quality);

(c) Fecal and total coliform.

4. Construction, Testing and Reporting

a. Prior to the commencement of any work, the name of the Florida-registered driller(s) supervising the drilling operations and the driller's registration number shall be submitted to the Department. The permittee or the engineer of record shall provide the Department with copies of all required federal, state or local permits prior to the commencement of drilling the wells.

b. If any problem develops that may seriously hinder compliance with this permit, construction progress or good construction practice, the Department shall be notified immediately. The Department may require a detailed written report describing what problems have occurred, the remedial measures applied to assure compliance and the measures taken to prevent recurrence of the problem.

c. During the construction period allowed by this permit, daily progress reports shall be submitted to the Department and the Technical Advisory Committee each week. The reporting period shall run for seven (7) days and reports shall be mailed or e-mailed within 48 hours of the last day of the reporting period. The report shall include, but is not limited to, the following:

(1) A cover letter summarizing each week’s activities and a projection of activities for the next reporting period;

(2) Description of daily footage drilled by diameter of bit or size of hole opener or reamer being used;

(3) Description of work during installation and cementing of casing, including amounts of casing and cement used;

(4) Lithologic log with cuttings description, formation, and depth encountered;

(5) Collection of drilling cuttings at least every 5 feet and at every formation change;

(6) Water quality analyses;

(7) Description of work and type of testing accomplished including geophysical logging, video logs, and pumping tests;

(8) Description of any construction problems that developed during the reporting period and current status;

(9) Copies of the driller's log are to be submitted with the weekly summary;

(10) Description of any deviation survey conducted;

(11) Details of any packer tests, pump tests and core analyses; and

(12) Details of the additions of salt or other materials to suppress well flow (if applicable), and include the date, depth and amount of material used.

d. Upon completion of construction of the injection well and all monitor wells, detailed in this permit, a complete set of as-built engineering drawings (Florida registered P.E. signed and sealed) shall be submitted to the Department’s district office and Tallahassee UIC Program.

e. Background ground-water quality samples shall be obtained from the ASR test well and all monitor wells for the specific water quality criteria listed for potable water in Specific Condition No. 3. “Background” means the condition of waters in the absence of the activity or discharge under consideration, based on the best scientific information available to the Department [Rule 62-520.200(3), F.A.C.]. The samples shall be taken after final completion and clearance of drilling fluids from each well, and prior to the initiation of any pump tests.

f. Within 30 days of well completion of the ASR test well and monitor wells, the permittee or the authorized representative shall submit to the Department for each well the following information:

(1) Certification of Class V Well Construction Completion, DEP Form 62-528.900(4);

(2) A copy of the St. Johns River Water Management District permit to construct a well;

(3) A copy of the Water Management District’s Well Completion Report; and

(4) A copy of the Water Management District’s Consumptive Use /Water Use Permit.

g. This project shall be monitored by the Department with the assistance of the U.S. Environmental Protection Agency (EPA) - Region 4 and the Technical Advisory Committee (TAC), which consists of representatives of the following agencies:

Department of Environmental Protection – Orlando
Department of Environmental Protection – Tallahassee
Department of Environmental Protection/Florida Geologic Survey - Tallahassee
St. Johns River Water Management District – Palm Bay
US Environmental Protection Agency (EPA), Region 4 – Atlanta (Note - EPA is not a TAC member, however, does provide oversight)

h. Permitee shall provide copies of all correspondence relative to this permit to each member of the TAC. Such correspondence includes but is not limited to reports, schedules, analyses and geophysical logs required by the Department under the terms of this permit. The permittee is not required to provide specific correspondence to any TAC member who submits to the permittee a written request to be omitted as a recipient of specific correspondence.

i. After completion of construction and testing, a final engineering report shall be submitted to the Department, the EPA and the TAC. The report shall include, but not be limited to, all information and data collected under Rules 62-528.605, 62-528.615, and 62-528.635, F.A.C., with appropriate interpretations. Mill certificates for the casings shall be included in the report. To the extent possible, the transmissivity and storativity of the injection zone and the maximum capacity within safe pressure limits shall be estimated. This report shall also be signed and sealed by a Florida licensed professional engineer and professional geologist.

j. After completion of construction and testing, the following items shall be submitted to the State Geologist at the Florida Geological Survey, 903 West Tennessee Street, Tallahassee, Florida 32304-7707:

(1) Cuttings obtained during well construction;

(2) Any cores obtained during well construction when no longer needed by the permittee;

(3) Any geophysical logs run during well construction; and

(4) A copy of the final report described in Condition 4.i. above.

k. A written, detailed evaluation of the ASR system performance shall be included with the permit renewal or operation permit application.

l. The specifications for a temporary containment structure around the borehole during the drilling of the ASR well shall be submitted to and approved by the Department prior to the ASR well construction.

5. <u>Cycle Testing Requirements Using Potable Water</u>

To address the potential for mineral leaching in the aquifer that may result from aquifer storage and recovery cycle testing, the potable water which may have higher dissolved-oxygen levels and higher oxidation-reduction potential than native ground water will be pre-treated before injection and storage in the lower Floridan Aquifer. Pretreatment shall include degasification and dechlorination. The permittee will install and operate portable dechlorination equipment and Membrana Liqui-Cel® membrane contactors in order to pre-treat the potable water in-line, prior to injection and storage in the ASR well. Equipment components will be sized to operate at the design injection rate of 2,000 gallons per minute.

The Drinking Water Permit will be amended by incorporating the proposed treatment components.

a. After authorization by the Department, the permittee shall conduct cycle testing of the ASR well system using potable water to demonstrate that the ASR well(s) can maintain water quality standards and assimilate the design daily flows prior to receiving approval for full operation using potable water. Cycle testing using potable water shall not commence until issuance of authorization from the Department. Prior to Department authorization of operational cycle testing:

(1) The permittee shall submit at a minimum the following information to each member of the Technical Advisory Committee for review:

(a) Draft operation and maintenance manual;

(b) Lithologic and geophysical logs with interpretations;

(c) Results of pressure tests (if conducted) on the final casing for the ASR well;

(d) Surface equipment completion certification or certification of interim completion for the purposes of testing;

(e) Signed and sealed as-built engineering drawings of all wellheads and subsurface well components;

(f) A consumptive use permit and all other applicable permits; and

(g) Submittal of a plugging and abandonment plan.

(h) Completion report for the storage zone monitoring wells (LF-MW-1 and LF-MW-2) located in the vicinity of well ASR-LF-1.

(2) Before authorizing operational testing, the Department shall conduct an inspection of the facility to determine if the conditions of this permit have been met.

(3) The permittee shall provide an updated well inventory and physically verify all wells that are within a 1.0-mile radius of the ASR test well. Operational status, existing use, depth of final casing, and total depth of the wells shall be determined and submitted with the above-mentioned information.

(4) Prior to approval to inject into Class G-II ground water, the permittee shall meet the applicable criteria in Rule 62-610.466, F.A.C. Compliance with public and utility notifications in Rule 62-610.574(4), F.A.C., is also required.

b. A cycle testing schedule is attached to this permit (see Table 1). In the event arsenic concentrations are observed that exceed 10 µg/L in any monitoring well or in the ASR well, the permittee shall contact the Department with this finding and cease injection until such time a Consent Order has been issued by the Department that addresses the arsenic exceedance. In any event, cycle testing shall cease after the third cycle in order to allow for Department review of the water quality sampling results for the ASR and monitoring wells. Cycle testing shall not resume until authorized by the Department.

c. The Florida Geological Survey (FGS) is currently investigating the effects of ASR systems on storage zones. The Department requests that the permittee contact the Hydrogeology Program at the FGS (850-488-9380) at least 30 days prior to operational testing to allow the Survey to coordinate a sampling schedule during the operational testing phase of this project.

d. A set back distance for the ASR well(s), in accordance with Chapter 62-521.200(7), F.A.C., has been established to be at least 500 feet from potable water supply wells.

6. <u>Post Cycle Testing Operational Conditions Using Potable Water</u>

a. A qualified representative of the Engineer of Record must be present for the start-up operations and the Department must be notified in writing of the date operational testing began for the subject well.

b. Proposed Class V ASR Test Well:

Well Name	Casing Diameter [OD] / Depth*	Injection Interval	Aquifer
ASR-LF-1	18" Fiberglass / 1,100'	1,100 – 1,200’	Floridan

* below land surface; approximate depths.

Monitor Well System

Well Name	Casing Diameter / Depth*	Monitored Interval	Aquifer
LF-MW-1	6.6" STL / 1,100'	1,100 – 1,200'	Floridan
LF-MW-2	4.7" STL / 1,100'	1,100 – 1,200'	Floridan
CZ-MW-1	12" STL / 900'	900 - 950'	Floridan
SA-1	2" PVC / 15'	5 - 15'	Surficial
SA-2	2" PVC / 15'	5 - 15'	Surficial

* below land surface; approximate depths.
(LF-MW – Storage Zone Monitoring Well, CZ-MW – Confining Zone Monitoring Well, SA – Shallow Aquifer Monitoring Well) (Note – LF-MW-2 is completed as an existing exploratory well)

c. Prior to operational use of the ASR, the authorization referenced in Specific 5.a. above shall have been obtained and a monitoring plan shall have been approved using the newly installed monitoring wells (both LF-MWs). Results of the water quality analyses of the potable water and background water quality pursuant to Specific Conditions 3. and 4.e. of this permit shall have been submitted. Aquifer test data, analysis and evaluation shall have been submitted and a monitoring program plan that includes construction diagrams, well specifications, well locations, construction specifications and drilling and testing plans shall have been submitted, approved by the Department and the new wells shall have been installed.

The ASR test well shall be monitored in accordance with the approved monitoring plan referenced above. The Department anticipates that the standard monitoring parameters and frequency listed below (and attached as Table 1) will apply during each recharge and recovery period. The monitor wells shall be sampled and analyzed in accordance with the schedule listed below and on the attached Table 1 based on the approved monitoring plan. Once the monitoring plan and parameters are approved, the permittee will be submitting a summary of the monthly monitoring data developed from the injection well instrumentation. The report shall include the following data:

Parameter	**Units**	**Recording Frequency**	**Frequency of Analysis**	
			ASR	**Monitoring Wells**
Flow Rate, max.	Mgd	continuous	D/M	
Flow Rate, min.	Mgd	continuous	D/M	
Flow Rate, avg.	Mgd	continuous	D/M	
Total Volume Recharged	Mg	daily	D/M	
Total Volume Recovered	Mg	daily	D/M	
Net Storage Volume	Mg	daily	M*	
Injection Pressure, max.	Psi	continuous	D/M	
Injection Pressure, min.	Psi	continuous	D/M	
Injection Pressure, avg.	Psi	continuous	D/M	

* - Monthly net storage volume per ASR well and total ASR wellfield.

D/M - daily and monthly; M - monthly.

Note: During extended storage periods (greater than 30 days), the physical parameters listed above may be monitored monthly.

e. The permittee shall submit monthly results of all injection well and monitoring well data required by this permit, and monthly progress reports which include both the current status of operational testing and a summary of all monthly activities, no later than the 28th day of the month immediately following the month of record. The results and progress reports shall be sent to the Department of Environmental Protection, 3319 Maguire Boulevard, Suite 232, Orlando, FL 32803-3767. A copy of the results and reports shall also be sent to the Department of Environmental Protection, Underground Injection Control Program, Mail Station 3530, 2600 Blair Stone Road, Tallahassee, FL 32399-2400.

f. A final engineering report shall be submitted to the Department, the FGS and each TAC member and include the following information:

   (1) A detailed analysis of all cycle testing;

   (2) An operation and maintenance section;

   (3) Record drawings sealed by the Engineer of Record;

   (4) Summary of all water quality and water level data collected, conclusions and recommendations; and

   (5) Estimated ASR well capacity.

7. <u>Abnormal Events</u>

a. In the event the permittee is temporarily unable to comply with any conditions of this permit due to breakdown of equipment, power outages, destruction by hazard of fire, wind or by other cause, the permittee shall notify the Department. Notification shall be made in person, by telephone or by electronic mail within 24 hours of breakdown or malfunction to the UIC program staff, Orlando Central District, (407) 893-3308.

b. A written report of any noncompliance referenced in Condition 7.a. above shall be submitted to the Orlando Central District office within five days after discovery of the occurrence. The report shall describe the nature and cause of the breakdown or malfunction, the steps being taken or planned to be taken to correct the problem and prevent its reoccurrence, emergency procedures in use pending correction of the problem, and the time when the facility will again be operating in accordance with permit conditions.

Issued this 5th day of March, 2008.

STATE OF FLORIDA DEPARTMENT
OF ENVIRONMENTAL PROTECTION

Vivian F. Garfein

Vivian F. Garfein
Director, Central District

Jason Herrick, P.E.

VFG/CCF/AKD/dw

Florida Department of
Environmental Protection
Central District
3319 Maguire Boulevard, Suite 232
Orlando, Florida 32803-3767

Charlie Crist
Governor

Jeff Kottkamp
Lt. Governor

Michael W. Sole
Secretary

BY ELECTRONIC MAIL:

Michael Chandler
Director
Orange County Utilities
9150 Curry Ford Road
Orlando, FL 32825-0000
Michael.Chandler@ocfl.net

Attention: Michael Chandler
Director

Orange County - UIC
Potable Water ASR Program
Construction Permit 48-0272819-001-UC
Application No. 48-0272819-004-UC
Modification of Conditions

Dear Mr. Chandler:

The Department is in receipt of your Application No. 48-0272819-004-UC to modify the conditions of the injection well operation permit referenced above. The conditions are changed as follows:

1. The following language is added to page one of nine of the permit:

   This Permit is issued in conjunction with Administrative Order Number AO-09-0001 (attached to this permit modification). Cycle testing plans are modified in accordance with attachments 1 and 2 of this permit.

This letter must be attached to Injection Well Operation Permit No. 48-0272819-001-UC and becomes a part of and subject to all conditions of that permit.

The Department's proposed agency action shall become final unless a timely petition for an administrative hearing is filed under Sections 120.569 and 120.57 of the Florida Statutes before the deadline for filing a petition. The procedures for petitioning for a hearing are set forth below.

A person whose substantial interests are affected by the Department's proposed permitting decision may petition for an administrative proceeding (hearing) under Sections 120.569 and 120.57 of the Florida Statutes. The petition must contain the information set forth below and must be filed (received by the clerk) in the Office of General Counsel of the Department at 3900 Commonwealth Boulevard, Mail Station 35, Tallahassee, Florida 32399-3000.

Petitions by the applicant or any of the parties listed below must be filed within fourteen days of receipt of this written notice. Petitions filed by any persons other than those entitled to written notice under Section 120.60(3) of the Florida Statutes must be filed within fourteen days of publication of the notice or within fourteen days of receipt of the written notice, whichever occurs first.

Under Section 120.60(3) of the Florida Statutes, however, any person who has asked the Department for notice of agency action may file a petition within fourteen days of receipt of such notice, regardless of the date of publication.

The petitioner shall mail a copy of the petition to the applicant at the address indicated above at the time of filing. The failure of any person to file a petition within the appropriate time period shall constitute a waiver of that person's right to request an administrative determination (hearing) under Sections 120.569 and 120.57 of the Florida Statutes. Any subsequent intervention (in a proceeding initiated by another party) will be only at the discretion of the presiding officer upon the filing of a motion in compliance with Rule 28-106.205 of the Florida Administrative Code.

A petition that disputes the material facts on which the Department's action is based must contain the following information:

(a) The name, address, and telephone number of each petitioner; the name, address, and telephone number of the petitioner's representative, if any; the Department permit identification number and the county in which the subject matter or activity is located;
(b) A statement of how and when each petitioner received notice of the Department action;
(c) A statement of how each petitioner's substantial interests are affected by the Department action;
(d) A statement of all disputed issues of material fact. If there are none, the petition must so indicate;
(e) A statement of facts that the petitioner contends warrant reversal or modification of the Department action;
(f) A concise statement of the ultimate facts alleged, as well as the rules and statutes which entitle the petitioner to relief; and
(g) A statement of the relief sought by the petitioner, stating precisely the action that the petitioner wants the Department to take.

A petition that does not dispute the material facts on which the Department's action is based shall state that no such facts are in dispute and otherwise shall contain the same information as set forth above, as required by Rule 28-106.301.

Because the administrative hearing process is designed to formulate final agency action, the filing of a petition means that the Department's final action may be different from the position taken by it in this notice. Persons whose substantial interests will be affected by any such final decision of the Department have the right to petition to become a party to the proceeding, in accordance with the requirements set forth above.

Mediation under Section 120.573 of the Florida Statutes is not available for this proceeding.

This action is final and effective on the date filed with the Clerk of the Department unless a petition is filed in accordance with the above. Upon the timely filing of a petition this order will not be effective until further order of the Department.

Any party to the order has the right to seek judicial review of the order under Section 120.68 of the Florida Statutes, by the filing of a Notice Of Appeal under Rule 9.110 of the Florida Rules of Appellate Procedure with the Clerk of the Department in the Office of General Counsel, Mail Station 35, 3900 Commonwealth Boulevard, Tallahassee, Florida, 32399-3000; and by filing a copy of the Notice Of Appeal accompanied by the applicable filing fees with the appropriate district court of appeal. The

Notice Of Appeal must be filed within 30 days from the date when the final order is filed with the Clerk of the Department.

Executed in Orlando, Florida.

STATE OF FLORIDA DEPARTMENT
OF ENVIRONMENTAL PROTECTION

____
Vivian F. Garfein
Director, Central District
3319 Maguire Boulevard
Suite 232
Orlando, Florida 32803-3767
(407) 894-7555

Date: ______________________

FILING AND ACKNOWLEDGMENT

FILED, on this date, pursuant to Section 120.52, F.S., with the designated Department Clerk, receipt of which is hereby acknowledged.

____________________ ________________
Clerk Date

VFG/CCF/AKD/dw

cc: George Heuler, PG, UIC, Tallahassee

CERTIFICATE OF SERVICE

This is to certify that this MODIFICATION OF CONDITIONS and all copies were e-mailed before the close of business on __________ to the listed persons by Duane Watroba.

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL PROTECTION

In the Matter of an
Application for Permit by:

Orange County Utilities
9150 Curry Ford Road
Orlando, FL 32825-0000

Attention: Michael Chandler
Director

Orange County - UIC
Orange County Utilities Potable Water ASR
Class V Injection Well Project
DEP File No.: 48-0272819-004-UC

NOTICE OF DRAFT PERMIT MODIFICATION

The Central District Office of the Department of Environmental Protection hereby gives notice that a draft permit modification has been developed for the proposed project as detailed in the application specified above. The Central District has developed a draft permit modification for the reasons stated below.

The applicant, Michael Chandler, Director, Orange County Utilities applied on November 10, 2008 to the Department of Environmental Protection for a permit modification of an existing construction permit (construction permit 40-0272819-001-UC) to allow for the issuance of Administrative Order (AO) Number AO-09-0001 and to modify both cycle testing and monitoring plans.

Under this permit modification the maximum storage capacity of the ASR is approximately 540 MG. Injection is into the Floridan aquifer at a depth of between 1,100 and 1,200 feet below land surface (BLS). Flow rates and volumes in and out of the system will be determined based on cycle testing.

The Department has permitting jurisdiction under Section 403 Florida Statutes (F.S.) and Chapter 62-4, 62-520, 62-521, 62-528, 62-550 and 62-610, Florida Administrative Code (F.A.C.). The project is not exempt from permitting procedures. The Department has determined that a construction permit modification is required for the proposed work.

Pursuant to Section 403.815, F.S. and Rule 62-103.150, F.A.C., you (the applicant) are required to publish at your own expense the enclosed Notice of Draft Permit Modification. The Notice must be published one time only within thirty (30) days, in the legal ad section of a newspaper of general circulation in the area affected. For the purpose of this rule, "publication in a newspaper of general circulation in the area affected" means publication in a newspaper meeting the requirements of Sections 50.011 and 50.031 of the F.S., in the county where the activity is to take place. The applicant shall provide proof of publication to the Central District Office of the Department within seven (7) days of publication. Failure to publish the Notice and provide proof of publication within the allotted time may result in the denial of the permit.

The Department will accept public comment concerning this proposed permit action for a minimum of 30 days following publication of this Notice. A public meeting must be held in the area of the well no less than 30 days after publication of this Notice for the purpose of receiving verbal and written comment concerning this project. The Department in formulating a final decision concerning this project will consider comments received within the 30-day period and during the public meeting. A location, date and time for the public meeting must be arranged prior to publication of this Notice. Please contact Duane Watroba at (407) 894-7555 to arrange for the public meeting.

Executed in Orlando, Florida.

STATE OF FLORIDA DEPARTMENT
OF ENVIRONMENTAL PROTECTION

Christianne C. Ferraro

for Vivian F. Garfein
Director, Central District
3319 Maguire Boulevard
Suite 232
Orlando, Florida 32803-3767
(407) 894-7555

Date: February 5, 2009

FILING AND ACKNOWLEDGMENT FILED, on this date, pursuant to §120.52, Florida Statutes, with the designated Department Clerk, receipt of which is hereby acknowledged.

Clerk February 5, 2009
Date

CCF/AKD/dw

Enclosures: Draft Permit

Copies furnished to:
T.A.C. Members

CERTIFICATE OF SERVICE

This hereby certifies that this NOTICE OF INTENT TO ISSUE PERMIT and all copies were e-mailed before the close of business on February 6, 2009 to the listed persons by Duane Watroba.

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL PROTECTION

NOTICE OF DRAFT PERMIT MODIFICATION

The Department of Environmental Protection gives notice that a Draft Permit Modification (Construction Permit No. 48-0272819-001) has been prepared for Michael Chandler, Director, Orange County Utilities, 9150 Curry Ford Road, Orlando, Florida 32825-0000. This Permit Modification will allow for the issuance of Administrative Order (AO) Number AO-09-0001 and to modify both cycle testing and monitoring plans.

The purpose of the project is to store and recover potable water in the Floridan aquifer in order to meet water supply demands.

The Department has permitting jurisdiction under Chapter 403 of the Florida Statutes, and Chapters 62-4, 62-520, 62-521, 62-528, 62-550 and 62-660 of the Florida Administrative Code. The project is not exempt from permitting procedures. The Department has determined that a construction permit modification is required for the proposed work.

All persons interested in the foregoing permitting decision are invited to attend a public meeting that will be held at ______________, Florida on ________, 2009 at _________, and may submit written comments to the Department of Environmental Protection, 3319 Maguire Boulevard, Suite 232, Orlando, Florida 32803-3767 up until the close of the public meeting. All comments received will be considered in formulation of the Department's final decision regarding permit issuance.

The application, draft permit, and fact sheet are available for public inspection during normal business hours, 8:00 a.m. to 5:00 p.m., Monday through Friday, except legal holidays, at Department of Environmental Protection, Central District, 3319 Maguire Boulevard, Suite 232, Orlando, Florida 32803-3767. Additional information concerning this project may be obtained by contacting Duane Watroba at (407) 894-7555.

St. Johns River
Water Management District
Kirby B. Green III, Executive Director • David W. Fisk, Assistant Executive Director

4049 Reid Street • P.O. Box 1429 • Palatka, FL 32178-1429 • (386) 329-4500
On the Internet at *www.sjrwmd.com.*

FEB 08 2005

February 1, 2005

Orange County Public Utilities
109 E Church St
Orlando, FL 32801

SUBJECT: Water Well Construction Permit 96911 located in Orange County

Dear Sirs/Madam:

Please find enclosed the permit for the above referenced project. Permit issuance does not relieve you from the responsibility of obtaining permits from any federal, state, and/or local agencies asserting concurrent jurisdiction for this work.

In the event you sell your property, the permit will be transferred to the new owner if we are notified by you within thirty (30) days of the recording of the sale. Please assist us in this matter so as to maintain a valid permit for the new property owner.

The permit enclosed is a legal document. Please read the permit carefully since you are responsible for compliance with any conditions which is a part of this permit. Compliance is a legal requirement and your assistance in this matter will be greatly appreciated.

If you have any questions concerning your permit, please do not hesitate to contact this office at (904) 329-4401.

Thank you for your interest in our water resources.

Sincerely,

Sarah Viera

Sarah Viera
Data Management Specialist II
Division of Permit Data Services

Cc: District Permit File
Contractor
James Frazee Jr.

STATE OF FLORIDA PERMIT APPLICATION TO CONSTRUCT, REPAIR, MODIFY, OR ABANDON A WELL

☐ Southwest
☐ Northwest
☒ St. Johns River
☐ South Florida
☐ Suwannee River

CHECK BOX FOR APPROPRIATE DISTRICT. ADDRESS ON BACK ON PERMIT FORM

THIS FORM *MUST* BE FILLED OUT COMPLETELY.

The water well contractor is responsible for completing this form and forwarding the permit to the appropriate delegated county where applicable.

Permit No. 96911-1
Florida Unique I.D. AAI5710
Permit Stipulations Required (See attached)
62-524 well ☐
cup/wup Application No. 50035 (not attached)

ABOVE THIS LINE FOR OFFICIAL USE ONLY

1. Orange County Utilities 109 E. Church St. Orlando 32801 (407) 836-7221
Owner. Legal Name of Entity if Corporation / Address / City / Zip / Telephone Number

2. Eastern Water Reclamation Facility 1621 South Alafaya Trail Orlando, FL 32828
Well Location – Address. Road Name or Number. City

3. Diversified Drilling Corporation (813) 988-1132
Well Drilling Contractor / License No. / Telephone No.

8801 Maislin Drive
Address

Tampa FL 33637
City / State / Zip

4. SW (SW) 1/4 of NW 1/4 of Section 3
(smallest) (biggest)

NW NE
(Indicate Well on Chart) x 3
SW SE

5. Township 23S Range 31E

6. Orange / Orange County Eastern Water Reclamation Facility
County / Subdivision Name / Lot / Block / Unit

7. **Number of proposed wells** 1 **Check the use of well:** (See back of permit for additional choices) ______ Domestic Monitor (type) ASR

______ Irrigation (type) (See Back) Public Water Supply (type) ______ (See Back) List Other Exploratory Well

Distance from septic system +200 ft. **Description of facility** Water Reclamation **Estimated start of construction date** [illegible]n 05

8. **Application for:** X New Construction ____ Repair/Modify ____ Abandonment ______ (Reason for Abandonment)

RECEIVED
Date Stamp
DEC 27 2004
PDS
ALTAMONTE SVC. CTR.

Estimated: Well Depth 1700/1400 Casing Depth 1300 Screen Interval from — to —
Casing Material [✓ Blk-Steel] / Gal [✓ PVC] Casing Diameter 12/ 4" or 6" Seal Material neat cement
24, 18, 12" 6" or 4"

10. **If applicable: Proposed Grouting Interval**
From 100 to 1300 Seal Material Grout (NC) 4" or 6"
From 0 to 200 Seal Material 18" surface casing NC.
From 0 to 70 Seal Material 24" pit casing NC

11. **Telescope Casing** X **or Liner** ____ (check one) Diameter 4" or 6"
Blk-Steel / Galvanized [✓ PVC] Other (specify): 100 - 1300'

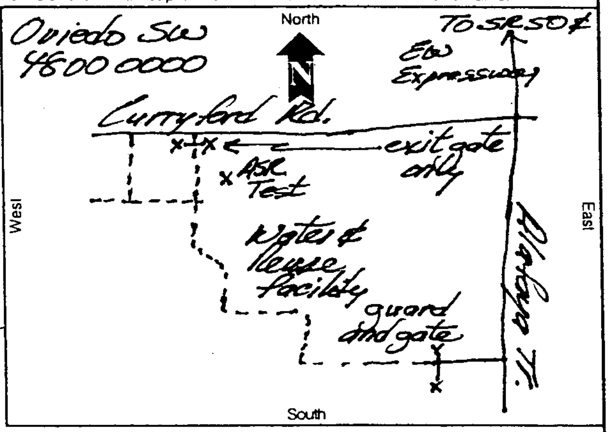
12. **Method of Construction:** X Rotary ____ Cable Tool ____ Combination
____ Auger ____ Other (specify:) ______

13. **Indicate total No. of wells on site** 0 **List number of unused wells on site** 0

14. **Is this well or any other well or water withdrawal on the owner's contiguous properly covered under a Consumptive/Water Use Permit (CUP/WUP) or CUP/WUP Application?** ___ No X Yes

(If yes. complete the following) CUP/WUP No. 50035
District well I.D. No. IT 38520 This ASR well not attached to CUP
Latitude 28°31'08.094" Longitude 81°12'36.624"
Data obtained from GPS X or map ____ or survey ____ (*map datum NAD 27* ____ *NAD 83* ✓)

Draw a map of well location and indicate well site with and "X". Identify known roads and landmarks: provide distances between well and landmarks.



15. I hereby certify that I will comply with the applicable rules of Title 40. Florida Administrative Code and that a water use permit or artificial recharge permit, if needed, has been or will be obtained prior to commencement of well construction. I further certify that all information provided on this application is accurate and that I will obtain necessary approval from other federal, state, or local governments, if applicable. I agree to provide a well completion report to the District within 30 days after drilling or the permit expiration, whichever occurs first.

Signature of Contractor

11191
License No

I certify that I am the owner of the property, that the information provided is accurate, and that I am aware of my responsibilities under Chapter 373, Florida Statutes, to maintain or properly abandon this well; or, I certify that I am the agent for the owner, that the information provided is accurate, and that I have informed the owner of his responsibilities as stated above. Owner consents to personnel of the WMD or a representative access to the well site.

X
Owner's or Agent's Signature

1/27/05
Date

DO NOT WRITE BELOW THIS LINE – FOR OFFICIAL USE ONLY

Approval Granted By: ______ Issue Date: 02/01/05 27625 Hydrologist Approval ______ Initials

Owner Number: ASR Exploratory well #1 Fee Received: $ 120.00 Receipt No. A027732 Check No.: 015838

THIS PERMIT NOT VALID UNTIL PROPERLY SIGNED BY AN AUTHORIZED OFFICER OR REPRESENTATIVE OF THE WMD. IT SHALL BE AVAILABLE AT THE WELL SITE DURING ALL DRILLING OPERATIONS. *This permit is valid for 90 days from date of issue.*

SPECIAL CONDITIONS

Permit #96911-1, Orange County Utilities, ASR Test Well
Eastern Water Reclamation Facility

Wells constructed within areas where a marker bed is used to determine casing and open hole depths are required to meet special conditions as listed below unless modified by field determinations. **This is a test site to determine the feasibility of an ASR injection program. The project is in cooperation with the District's Division of Water Supply Management.**

1. The proposed well will be located in a manner that meets all applicable spacing standards from sanitary hazards as addressed in chapters 62-532, 62-555 and 40C-3, F.A.C. **A copy of this permit will be forwarded to the FDEP/Central District office as required for all injection/drainage permitted well sites.**

2. The well construction design or design alternatives will be followed unless site conditions require a change. Any changes will be approved by a District representative working with the project staff prior to work commencing. **The surface casing in this area must be installed to clay sealing all caving materials above the limestone to prevent surface collapse when the borehole contacts the first limestone.**

3. The well design includes an 24 inch pit casing to approximately 70 feet. The 18 inch surface casing will be seated in limestone at approximately 200 feet. An intermediate 12 inch casing will then be installed and grouted to the Middle Floridan Confining Unit at approximately 600 feet. **Caution should be taken to case off any weathered limestone at the top of the Ocala. This layer tends to wash out during development and construction activities.** The borehole will then be drilled to 1700 feet. After testing the hole will be back plugged to 1400 feet. A 6 or 4 inch PVC test casing will be grouted in this borehole at approximately 1300 feet. **The District approves the process as described in the construction specifications including reaming to depth, packer testing, coring operations, logging, and testing.**

4. Grouting approval by the District must occur prior to the installation of any structural enclosures around and above the well terminus. If the well head and system structures cannot be completed for final inspection within 30 days of well completion, the owner/agent should contact the District in writing to set a final inspection schedule. **See condition 6 for notification requirement.**

5. Latitude and longitude coordinates will be added to the list of information required by chapter 40C-3, F.A.C., to be inscribed, stamped or printed on the required metallic tag. The latitude and longitude for this well is: 283108.094 / 811236.624

6. The well contractor must notify a District field representative 24 hours prior to initiating construction or grouting operations. The District will allow grouting to proceed after notification if a staff member is not on site at the scheduled time. A final inspection will be scheduled after the pad, and system components are installed and are ready for testing.

   District Representatives: Jim Frazee/Charles Shirley
   Office: Altamonte Springs Service Center
   Telephone(fax): **407-659**-4800/4842/**4866**(4805)

7. Well drill cuttings must be taken at 10 feet intervals and at formation changes when required. The well contractor must notify the District one week in advance of work commencing so bags can be provided. Any change in sample intervals must be approved in advance by the District. **Total samples are required on this site. Sample splits with the Division of Ground Water Programs and assigned consultants can be coordinated on site to reduce well contractor labor. Cutting samples will be inspected on site as necessary by a District representative.**

8. Completion reports are required for the any monitor wells planned for the Surficial aquifer system and the ASR Test well. All reports are due to the District within 30 days of well completion.

9. All Discharges from the well site must be turbidity free.

10. A copy of this permit must be on site during all phases of well construction.

APPENDIX E
Substantial Completion Certificate

CERTIFICATE OF SUBSTANTIAL COMPLETION

PROJECT Orange County Aquifer Storage and Recovery (ASR) Project at Eastern Regional Water Reclamation Facility.

DATE OF ISSUANCE

February 5th 2010

OWNER: St. Johns River Water Management District (SJRWMD) (ownership to be transferred to Orange County Utilities upon completion of startup and training)

OWNER's Contract No.: SJRWMD SF410RA (and Orange County MOU SH307AA)

Barnes Ferland & Associates (BFA) Project No.: 2001-30

CONTRACTOR / ENGINEER: Barnes Ferland & Associates Inc.

CONSTRUCTION SUB-CONTRACTOR: Wharton Smith Inc.

This Certificate of Substantial Completion applies to all Work under the Contract Documents or to the following specified parts thereof:

Task 7 – Construction of ASR Surface Facilities and appurtenant work, in accordance with approved Plans and Specifications dated June 2007.

To: St. Johns River Water Management District and Orange County Utilities Department
OWNER

And To Barnes Ferland & Associates, Inc.
CONTRACTOR / ENGINEER

The Work to which this Certificate applies has been inspected by authorized representatives of OWNER, CONTRACTOR / ENGINEER, and CONSTRUCTOIN SUBCONTRACTOR and that Work is hereby declared to be substantially complete in accordance with the Contract Documents on

February 5th 2010
DATE OF SUBSTANTIAL COMPLETION

A tentative list of items to be completed or corrected is attached hereto. This list may not be all-inclusive, and the failure to include an item in it does not alter the responsibility of CONTRACTOR / ENGINEER and CONSTRUCTION SUBCONTRACTOR to complete all the Work in accordance with Contract Documents.

From the date of Substantial Completion, the responsibilities between OWNER, CONTRACTOR / ENGINEER, and CONSTRUCTION SUBCONTRACTOR for security, operation, safety, maintenance, heat, utilities, insurance and warranties and guarantees for the completed ASR Surface Facilities shall be as follows:

RESPONSIBILITIES:

OWNER: Orange County Utilities: security, operation, safety, maintenance, utilities, insurance.

CONTRACTOR / ENGINEER and CONSTRUCTION SUB-CONTRACTOR: Complete punch

CERTIFICATE OF SUBSTANTIAL COMPLETION

lists and provide warranties and guarantees per contract.

The following documents are attached to and made a part of this Certificate:

Punch-list dated __February 4th 2010___________.

[For items to be attached see definition of Substantial Completion as supplemented and other specifically noted conditions precedent to achieving Substantial Completion as required by Contract Documents.]

This certificate does not constitute an acceptance of Work not in accordance with the Contract Documents nor is it a release of CONTRACTOR / ENGINEER's obligation to complete the Work in accordance with the Contract Documents.

Executed by CONTRACTOR / ENGINEER on 2/5, 2010

Barnes Ferland & Associates Inc.

CONTRACTOR / ENGINEER

By: ________________________

(Authorized Signature)

Accepted by CONSTRUCTION SUB-CONTRACTOR on 2/5, 2010

Wharton Smith Inc.

CONSTRUCTION SUB-CONTRACTOR

By: ________________________

(Authorized Signature)

OWNER accepts this Certificate of Substantial Completion on _________________, 2010

St. John's River Water Management District

OWNER

By: ________________________

(Authorized Signature)

Orange County Utilities

OWNER

By: ________________________

(Authorized Signature)

Note: Execution by Contractor / Engineer and acceptance by Owner includes previously completed work by Contractor / Engineer and its drilling construction subcontractor Diversified Drilling Corporation, for ASR well and two monitor wells (DZMW-1 and EW-1).

Note: The Substantial Completion between Wharton-Smith, Inc and Barnes, Ferland, and Associates, Owner(s) occurred on 12/11/2009. This date constitutes the start of the Warranty work for work performed by Wharton-Smith, Inc.

Barnes, Ferland and Associates
ASR Project - Surface Facilities Construction
Punch List

Project No.:	2001-30.22	Project Engineer:	Sam Roberts, BFA
Description:	ASR Surface Facilities Construction	Resident Engineer:	Sam Roberts, BFA
Contractor:	Wharton-Smith	Wharton Smith Construction Group:	Erik Anderson

Final QA/QC Inspection of ASR Project - Surface Facilities Construction

Date	Item #	Punch List Item Description	Responsibility	Requested By Reinspected 2/4/2010 by Carlos Torres	Re-Inspection Reinspected by Carlos Torres
02/04/2010	1	Install Electrical Conduit between Chlorine Analyser and acuator valve	WS	OCU	
02/04/2010	2	Install Pipe supports on water supply line to Chlorine Analyser outside of building	WS	OCU	
02/04/2010	3	Provide new calibration sheet with re-installed flow meter	WS	OCU	
02/04/2010	4	Install Well Head Info. Tag on Well Head	WS	OCU	
02/04/2010	5	Install and remove elcetrical control panel extra covers in electrical room	WS	OCU	

APPENDIX F
Cycle Testing Reports

ORANGE COUNTY UTILITIES WATER PRODUCTION
9100 E. Curry Ford Road ▪ Orlando, Florida 32825
407-254-9500 ▪ Fax 407-254-9510
http://www.orangecountyfl.net

September 23, 2011

Mr. Anil Desai, P.E.
Florida Department of Environmental Protection
3319 Maguire Blvd., Suite 232
Orlando, FL 32083-3767

RE: Orange County- UIC
Potable Water ASR Program
Construction Permit 48-0272819-001-UC
Orange County Utilities Potable Water ASR Well at EWRF Site
August 2011 Cycle Testing Report (End of Cycle 3)

Dear Mr. Desai:

Attached please find the monthly report for the above referenced cycle testing being conducted by Orange County Utilities. In summary, the project is proceeding as follows:

- Pre-cycle injection was completed on March 25, 2010 for a total of 179.791 Million Gallons.
- Cycle 1 injection of potable water from Orange County Utilities (OCU) Eastern water system began on March 26, 2010 and was completed on April 7, 2010 for a total of 209.364 Million gallons injected through April 7, 2010. Cycle 1 recovery began on April 21, 2010. The recovery was interrupted on April 22, 2010 due to maintenance issues at the EWRF which did not allow them to accept the flow from the ASR project. Cycle 1 recovery resumed on June 1, 2010 and continued through June 21, 2010.
- Cycle 2 recharge began on June 28, 2010 and continued through August 10, 2010. Cycle 2 storage began on August 10, 2010 and continued until September 19, 2010. Cycle 2 recovery began on September 19, 2010 and continued through October 14, 2010. All data associated with Cycle 2 is contained on this report.
- Cycle 3 recharge began on November 1, 2010 and was completed on February 20, 2011 for a total of 270.097 MG. Cycle 3 storage began on February 20 and was completed on April 6, 2011. Cycle 3 recovery began on April 7, 2011 and was completed on August 19, 2011. Arsenic levels in recovery were between 20 and 45 ug/L for the ASR well.

This report includes all data for samples collected through the end of cycle 3 recovery. Samples were collected according to the UIC permit cycle testing monitoring plan twice per week for Arsenic at each monitoring well and once per week for additional metals, chloride, sulfate, and total dissolved solids as well as field measurements for DO, ORP, pH, Conductivity and temperature.

We look forward to meeting with you in early November to discuss these results and our plan for additional cycles.

"To produce and provide water of the highest quality that meets or exceeds all local, state and federal regulations in a safe, effective and efficient manner in a friendly and team atmosphere"

Please call me if you have any questions or concerns at 407-254-9555.

Sincerely,

KA Kunihiro

Kimberly A. Kunihiro,
Water Quality Manager and Acting Water Production Section Manager
Orange County Utilities

C: Daniel Allen, BFA Environmental Consultants
Glenn Forrest, St. Johns River Water Management District
Chris Rader, Orange County Utilities
Rob Denis, Liquid Solutions Group

Attachments

ORANGE COUNTY UTILITIES ASR MONTHLY FLOWS

February 2010	Well Recharge (1000 gallons)	Daily (Million Gallons)			Well Recovery	Daily			Well Flush	Daily			Water Level (ft)	Daily Level
Start	638			start	0			Start	0			Start	47.2	
1	5396	4.758		1	0	0.000		1	0	0.000		1	47.2	0.0
2	10250	4.854		2	0	0.000		2	0	0.000		2	47.2	0.0
3	15030	4.780		3	0	0.000		3	0	0.000		3	47.2	0.0
4	19148	4.118		4	0	0.000		4	0	0.000		4	47.2	0.0
5	24184	5.036		5	0	0.000		5	0	0.000		5	47.2	0.0
6	29002	4.818		6	0	0.000		6	0	0.000		6	47.1	-0.1
7	32507	3.505		7	0	0.000		7	0	0.000		7	47.1	0.0
8	35621	3.114		8	0	0.000		8	0	0.000		8	47.1	0.0
9	40416	4.795		9	0	0.000		9	0	0.000		9	47.2	0.1
10	45209	4.793		10	0	0.000		10	0	0.000		10	47.1	-0.1
11	49879	4.670		11	0	0.000		11	0	0.000		11	47.1	0.0
12	54662	4.783		12	0	0.000		12	0	0.000		12	47.1	0.0
13	59458	4.796		13	0	0.000		13	0	0.000		13	47.0	-0.1
14	62549	3.091		14	0	0.000		14	0	0.000		14	47.2	0.2
15	66515	3.966		15	0	0.000		15	0	0.000		15	47.1	-0.1
16	71370	4.855		16	0	0.000		16	0	0.000		16	47.1	0.0
17	75499	4.129		17	0	0.000		17	0	0.000		17	47.0	-0.1
18	79955	4.456		18	0	0.000		18	0	0.000		18	47.1	0.1
19	84206	4.251		19	0	0.000		19	0	0.000		19	47.0	-0.1
20	89019	4.813		20	0	0.000		20	0	0.000		20	47.0	0.0
21	91422	2.403		21	0	0.000		21	0	0.000		21	47.0	0.0
22	93826	2.404		22	0	0.000		22	0	0.000		22	46.6	-0.4
23	96774	2.948		23	0	0.000		23	0	0.000		23	47.0	0.4
24	100399	3.625		24	0	0.000		24	0	0.000		24	47.1	0.1
25	104782	4.383		25	0	0.000		25	0	0.000		25	47.1	0.0
26	109646	4.864		26	0	0.000		26	0	0.000		26	47.1	0.0
27	114254	4.608		27	0	0.000		27	0	0.000		27	46.1	-1.0
28	117173	2.919		28	0	0.000		28	0	0.000		28	46.7	0.6
		116.535				0.000				0.000				

March	Well Recharge (1000 gallons)	Daily (Million Gallons)			Well Recovery	Daily			Well Flush	Daily			Water Level (ft)	Daily Level
Start	117173			start	0			Start	0			Start	46.7	
1	121931	4.758		1	0	0.000		1	0	0.000		1	46.6	-0.1
2	124910	2.979		2	0	0.000		2	0	0.000		2	46.7	0.1
3	129388	4.478		3	0	0.000		3	0	0.000		3	46.7	0.0
4	133184	3.796		4	0	0.000		4	0	0.000		4	46.7	0.0
5	137096	3.912		5	0	0.000		5	0	0.000		5	46.7	0.0
6	141211	4.115		6	0	0.000		6	0	0.000		6	47.0	0.3
7	141211	0.000		7	0	0.000		7	0	0.000		7	47.0	0.0
8	142298	1.087		8	0	0.000		8	0	0.000		8	37.7	-9.3
9	144745	2.447		9	0	0.000		9	0	0.000		9	38.1	0.4
10	147187	2.442		10	0	0.000		10	0	0.000		10	38.3	0.2
11	149586	2.399		11	0	0.000		11	0	0.000		11	37.5	-0.8
12	152032	2.446		12	0	0.000		12	0	0.000		12	37.6	0.1
13	154360	2.328		13	0	0.000		13	0	0.000		13	40.4	2.8
14	156286	1.926		14	0	0.000		14	0	0.000		14	41.0	0.6
15	158596	2.310		15	0	0.000		15	0	0.000		15	38.2	-2.8
16	160960	2.364		16	0	0.000		16	0	0.000		16	38.0	-0.2
17	163223	2.263		17	0	0.000		17	0	0.000		17	38.6	0.6
18	165594	2.371		18	0	0.000		18	0	0.000		18	38.4	-0.2
19	167316	1.722		19	0	0.000		19	0	0.000		19	39.1	0.7
20	169801	2.485		20	0	0.000		20	0	0.000		20	39.4	0.3
21	172246	2.445		21	0	0.000		21	0	0.000		21	39.9	0.5
22	174499	2.253		22	0	0.000		22	0	0.000		22	39.4	-0.5
23	176950	2.451		23	0	0.000		23	0	0.000		23	39.7	0.3
24	179324	2.374		24	0	0.000		24	0	0.000		24	39.1	-0.6
25	180429	1.105		25	0	0.000		25	0	0.000		25	48.3	9.2
26	182850	2.421		26	0	0.000		26	0	0.000		26	39.4	-8.9
27	185239	2.389		27	0	0.000		27	0	0.000		27	39.4	0.0
28	187683	2.444		28	0	0.000		28	0	0.000		28	39.4	0.0
29	190136	2.453		29	0	0.000		29	0	0.000		29	39.4	0.0
30	192555	2.419		30	0	0.000		30	0	0.000		30	39.4	0.0
31	195014	2.459		31	0	0.000		31	0	0.000		31	39.5	0.1
		77.841				0.000				0.000				

April	Well Recharge	Daily		Well Recovery	Daily		Well Flush	Daily		Well Level (ft)	Daily Level
Start	195014		Start	0		Start	0		Start	39.5	
1	197411	2.397	1	0	0.000	1	0	0.000	1	39.0	-0.5
2	199829	2.418	2	0	0.000	2	0	0.000	2	39.4	0.4
3	202333	2.504	3	0	0.000	3	0	0.000	3	39.1	-0.3
4	204762	2.429	4	0	0.000	4	0	0.000	4	39.2	0.1
5	206132	1.370	5	0	0.000	5	0	0.000	5	39.1	-0.1
6	209644	3.512	6	0	0.000	6	0	0.000	6	39.2	0.1
7	210002	0.358	7	0	0.000	7	0	0.000	7	48.3	9.1
8	210002	0.000	8	0	0.000	8	85	0.085	8	48.4	0.1
9	210002	0.000	9	0	0.000	9	85	0.000	9	48.5	0.1
10	210002	0.000	10	0	0.000	10	85	0.000	10	48.8	0.3
11	210002	0.000	11	0	0.000	11	85	0.000	11	48.8	0.0
12	210002	0.000	12	0	0.000	12	85	0.000	12	48.8	0.0
13	210002	0.000	13	0	0.000	13	138	0.053	13	48.9	0.1
14	210002	0.000	14	0	0.000	14	138	0.000	14	49.0	0.1
15	210002	0.000	15	0	0.000	15	215	0.077	15	49.0	0.0
16	210002	0.000	16	0	0.000	16	229	0.014	16	49.0	0.0
17	210002	0.000	17	0	0.000	17	229	0.000	17	49.0	0.0
18	210002	0.000	18	0	0.000	18	229	0.000	18	49.0	0.0
19	210002	0.000	19	0	0.000	19	229	0.000	19	49.0	0.0
20	210002	0.000	20	0	0.000	20	294	0.065	20	49.0	0.0
21	210002	0.000	21	1775	1.775	21	1775	0.000	21	49.0	0.0
22	210002	0.000	22	2597	0.822	22	2597	0.000	22	49.0	0.0
23	210002	0.000	23	2597	0.000	23	2597	0.000	23	49.0	0.0
24	210002	0.000	24	2597	0.000	24	2597	0.000	24	49.0	0.0
25	210002	0.000	25	2597	0.000	25	2597	0.000	25	49.0	0.0
26	210002	0.000	26	2597	0.000	26	2597	0.000	26	48.8	-0.2
27	210002	0.000	27	2597	0.000	27	2597	0.045	27	48.9	0.1
28	210002	0.000	28	2597	0.000	28	2597	0.000	28	49.0	0.1
29	210002	0.000	29	2597	0.000	29	2597	0.000	29	49.0	0.0
30	210002	0.000	30	2597	0.000	30	2597	0.000	30	49.0	0.0
		14.988			**2.597**			**0.339**			

Precycle 11 am (total volume MG)	179.791
Start of cycle 1 recharge at 00:01 Total vo	29.573
Total Recharge Volume (MG)	209.364
Total Recovery Volume (MG)	2.597
Total Flush Volume (MG)	0.339

May	Well Recharge	Daily		Well Recovery	Daily		Well Flush	Daily		Well Level (ft)	Daily Level
Start	210002		END	0		END	2597		END	49	
1	210002	0.000	1	0	0.000	1	2597	0.000	1	49.0	0.0
2	210002	0.000	2	0	0.000	2	2597	0.000	2	49.2	0.2
3	210002	0.000	3	0	0.000	3	2597	0.000	3	49.2	0.0
4	210002	0.000	4	0	0.000	4	2597	0.056	4	49.1	-0.1
5	210002	0.000	5	0	0.000	5	2597	0.000	5	49.2	0.1
6	210002	0.000	6	0	0.000	6	2597	0.056	6	49.2	0.0
7	210002	0.000	7	0	0.000	7	2597	0.000	7	49.2	0.0
8	210002	0.000	8	0	0.000	8	2597	0.000	8	49.3	0.1
9	210002	0.000	9	0	0.000	9	2597	0.000	9	49.6	0.3
10	210002	0.000	10	0	0.000	10	2597	0.000	10	49.6	0.0
11	210002	0.000	11	0	0.000	11	2597	0.056	11	49.6	0.0
12	210002	0.000	12	0	0.000	12	2597	0.000	12	49.8	0.2
13	210002	0.000	13	0	0.000	13	2597	0.049	13	50.0	0.2
14	210002	0.000	14	0	0.000	14	2597	0.000	14	50.0	0.0
15	210002	0.000	15	0	0.000	15	2597	0.000	15	50.1	0.1
16	210002	0.000	16	0	0.000	16	2597	0.000	16	50.2	0.1
17	210002	0.000	17	0	0.000	17	2648	0.051	17	50.0	-0.2
18	210002	0.000	18	0	0.000	18	2648	0.000	18	49.9	-0.1
19	210002	0.000	19	0	0.000	19	2648	0.000	19	49.9	0.0
20	210002	0.000	20	0	0.000	20	2698	0.050	20	50.0	0.1
21	210002	0.000	21	0	0.000	21	2698	0.000	21	50.0	0.0
22	210002	0.000	22	0	0.000	22	2698	0.000	22	50.2	0.2
23	210002	0.000	23	0	0.000	23	2698	0.000	23	50.3	0.1
24	210002	0.000	24	0	0.000	24	2698	0.000	24	50.3	0.0
25	210002	0.000	25	0	0.000	25	2749	0.051	25	50.3	0.0
26	210002	0.000	26	0	0.000	26	2749	0.000	26	50.2	-0.1
27	210002	0.000	27	0	0.000	27	2799	0.050	27	50.5	0.3
28	210002	0.000	28	0	0.000	28	2799	0.000	28	50.3	-0.2
29	210002	0.000	29	0	0.000	29	2799	0.000	29	50.3	0.0
30	210002	0.000	30	0	0.000	30	2799	0.000	30	50.5	0.2
31	210002	0.000	31	0	0.000	31	2799	0.000	31	50.3	-0.2
		0.000			**0.000**			**0.419**			

Precycle (total volume MG)	179.791
Cycle 1 recharge volume (MG)	29.573
Total Recharge Volume (MG)	209.364
Total Recovery Volume (MG)	2.597
Total Flush Volume (MG)	0.758

June	Well Recharge	Daily		Well Recovery	Daily		Well Flush	Daily		Well Level (ft)	Daily Level
Start	210002		END	0		END	2799		END	50.3	
1	210002	0.000	1	0	0.000	1	2850	0.051	1	50.0	-0.3
2	210002	0.000	2	0	0.000	2	2850	0.000	2	50.2	0.2
3	210002	0.000	3	0	0.000	3	2900	0.050	3	50.2	0.0
4	210002	0.000	4	0	0.000	4	2900	0.056	4	50.0	-0.2
5	210002	0.000	5	0	0.000	5	2900	0.000	5	50.0	0.0
6	210002	0.000	6	0	0.000	6	2900	0.056	6	50.0	0.0
7	210002	0.000	7	0	0.000	7	2900	0.000	7	49.9	-0.1
8	210002	0.000	8	0	0.000	8	2950	0.050	8	50.0	0.1
9	210002	0.000	9	4393	4.393	9	4393	0.000	9	71.2	21.2
10	210002	0.000	10	6795	2.402	10	6795	0.000	10	69.6	-1.6
11	210002	0.000	11	9278	0.056	11	9278	0.000	11	69.6	0.0
12	210002	0.000	12	10869	1.591	12	10869	0.000	12	69.6	0.0
13	210002	0.000	13	13200	1.514	13	13200	0.000	13	69.9	0.3
14	210002	0.000	14	15581	2.381	14	15581	0.000	14	68.7	-1.2
15	210002	0.000	15	17877	2.296	15	17877	0.000	15	69.7	1.0
16	210002	0.000	16	20277	2.400	16	20277	0.000	16	70.9	1.2
17	210002	0.000	17	22677	2.400	17	22677	0.000	17	70.9	0.0
18	210002	0.000	18	24931	2.254	18	24931	0.000	18	70.7	-0.2
19	210002	0.000	19	27388	2.457	19	27388	0.000	19	70.2	-0.5
20	210002	0.000	20	29310	1.922	20	29310	0.000	20	71.1	0.9
21	210002	0.000	21	29784	0.474	21	29784	0.000	21	50.0	-21.1
22	210002	0.000	22	0	0.000	22	29784	0.000	22	50.0	0.0
23	210002	0.000	23	0	0.000	23	29784	0.000	23	50.0	0.0
24	210002	0.000	24	0	0.000	24	29835	0.051	24	50.2	0.2
25	210002	0.000	25	0	0.000	25	29835	0.000	25	50.0	-0.2
26	210002	0.000	26	0	0.000	26	29835	0.000	26	50.1	0.1
27	210002	0.000	27	0	0.000	27	29835	0.000	27	50.3	0.2
28	211708	1.706	28	0	0.000	28	29835	0.000	28	42.7	-7.6
29	214183	2.475	29	0	0.000	29	29835	0.000	29	42.8	0.1
30	216650	2.467	30	0	0.000	30	29835	0.000	30	42.6	-0.2
		6.648			**26.540**			**0.314**			

Precycle (total volume MG)	179.791
Cycle 1 recharge volume (MG)	29.573
Total Recharge Volume (MG)	216.012
Total Recovery Volume (MG)	29.137
Total Flush Volume (MG)	1.072

July	Well Recharge	Daily		Well Recovery	Daily		Well Flush	Daily		Well Level (ft)	Daily Level
END	216650		END	0		END	29835		END	42.6	
1	219120	2.470	1	0	0.000	1	29835	0.000	1	43.1	0.5
2	221536	2.416	2	0	0.000	2	29835	0.000	2	42.7	-0.4
3	223986	2.450	3	0	0.000	3	29835	0.000	3	42.6	-0.1
4	226457	2.471	4	0	0.000	4	29835	0.000	4	42.9	0.3
5	228919	2.462	5	0	0.000	5	29835	0.000	5	41.8	-1.1
6	231321	2.402	6	0	0.000	6	29835	0.000	6	42.2	0.4
7	233755	2.434	7	0	0.000	7	29835	0.000	7	42.9	0.7
8	236159	2.404	8	0	0.000	8	29835	0.000	8	42.4	-0.5
9	238586	2.427	9	0	0.000	9	29835	0.000	9	42.0	-0.4
10	241073	2.487	10	0	0.000	10	29835	0.000	10	42.0	0.0
11	243535	2.462	11	0	0.000	11	29835	0.000	11	41.8	-0.2
12	245983	2.448	12	0	0.000	12	29835	0.000	12	42.4	0.6
13	248453	2.470	13	0	0.000	13	29835	0.000	13	41.8	-0.6
14	250899	2.446	14	0	0.000	14	29835	0.000	14	42.1	0.3
15	253437	2.538	15	0	0.000	15	29835	0.000	15	42.1	0.0
16	255855	2.418	16	0	0.000	16	29835	0.000	16	42.2	0.1
17	258251	2.396	17	0	0.000	17	29835	0.000	17	42.4	0.2
18	260687	2.436	18	0	0.000	18	29835	0.000	18	42.0	-0.4
19	263143	2.456	19	0	0.000	19	29835	0.000	19	42.7	0.7
20	265603	2.460	20	0	0.000	20	29835	0.000	20	42.0	-0.7
21	268040	2.437	21	0	0.000	21	29835	0.000	21	42.5	0.5
22	270475	2.435	22	0	0.000	22	29835	0.000	22	42.7	0.2
23	272883	2.408	23	0	0.000	23	29835	0.000	23	42.4	-0.3
24	275364	2.481	24	0	0.000	24	29835	0.000	24	42.6	0.2
25	277784	2.420	25	0	0.000	25	29835	0.000	25	42.4	-0.2
26	280251	2.467	26	0	0.000	26	29835	0.000	26	42.8	0.4
27	282682	2.431	27	0	0.000	27	29835	0.000	27	42.8	0.0
28	285109	2.427	28	0	0.000	28	29835	0.000	28	43.0	0.2
29	287531	2.422	29	0	0.000	29	29835	0.000	29	42.7	-0.3
30	289929	2.398	30	0	0.000	30	29835	0.000	30	42.4	-0.3
31	292407	2.478	31	0	0.000	31	29835	0.000	31	42.8	0.4
		75.757			**0.000**			**0.000**			

Precycle (total volume MG)	179.791
Cycle 1 recharge volume (MG)	29.573
Cycle 2 recharge volume (MG)	82.405
Total Recharge Volume (MG)	291.769
Total Recovery Volume (MG)	29.137
Total Flush Volume (MG)	1.072

August	Well Recharge	Daily		Well Recovery	Daily		Well Flush	Daily		Well Level (ft)	Daily Level
END	292407		END	0		END	29835		END	42.8	
1	294828	2.421	1	0	0.000	1	29835	0.000	1	43.0	0.2
2	297281	2.453	2	0	0.000	2	29835	0.000	2	42.7	-0.3
3	299729	2.448	3	0	0.000	3	29835	0.000	3	42.8	0.1
4	302164	2.435	4	0	0.000	4	29835	0.000	4	42.4	-0.4
5	304623	2.459	5	0	0.000	5	29835	0.000	5	42.4	0.0
6	307042	2.419	6	0	0.000	6	29835	0.000	6	42.7	0.3
7	309537	2.495	7	0	0.000	7	29835	0.000	7	42.1	-0.6
8	312003	2.466	8	0	0.000	8	29835	0.000	8	42.4	0.3
9	314474	2.471	9	0	0.000	9	29835	0.000	9	42.4	0.0
10	315002	0.528	10	0	0.000	10	29835	0.000	10	50.3	7.9
11	315002	0.000	11	0	0.000	11	29835	0.000	11	50.3	0.0
12	315002	0.000	12	0	0.000	12	29885	0.050	12	50.2	-0.1
13	315002	0.000	13	0	0.000	13	29885	0.000	13	50.3	0.1
14	315002	0.000	14	0	0.000	14	29885	0.000	14	50.2	-0.1
15	315002	0.000	15	0	0.000	15	29885	0.000	15	50.2	0.0
16	315002	0.000	16	0	0.000	16	29885	0.000	16	50.1	-0.1
17	315002	0.000	17	0	0.000	17	29935	0.050	17	50.2	0.1
18	315002	0.000	18	0	0.000	18	29935	0.000	18	50.3	0.1
19	315002	0.000	19	0	0.000	19	29986	0.051	19	50.3	0.0
20	315002	0.000	20	0	0.000	20	29986	0.000	20	50.2	-0.1
21	315002	0.000	21	0	0.000	21	29986	0.000	21	50.2	0.0
22	315002	0.000	22	0	0.000	22	29986	0.000	22	50.0	-0.2
23	315002	0.000	23	0	0.000	23	29986	0.000	23	50.0	0.0
24	315002	0.000	24	0	0.000	24	30036	0.050	24	50.0	0.0
25	315002	0.000	25	0	0.000	25	30036	0.000	25	49.9	-0.1
26	315002	0.000	26	0	0.000	26	30087	0.051	26	50.0	0.1
27	315002	0.000	27	0	0.000	27	30087	0.000	27	49.9	-0.1
28	315002	0.000	28	0	0.000	28	30087	0.000	28	49.9	0.0
29	315002	0.000	29	0	0.000	29	30087	0.000	29	49.9	0.0
30	315002	0.000	30	0	0.000	30	30087	0.000	30	49.8	-0.1
31	315002	0.000	31	0	0.000	31	30137	0.050	31	49.9	0.1
		22.595			**0.000**			**0.302**			

Precycle (total volume MG)	179.791
Cycle 1 recharge volume (MG)	29.573
Cycle 2 recharge volume (MG)	105.000
Total Recharge Volume (MG)	314.364
Total Recovery Volume (MG)	29.137
Total Flush Volume (MG)	1.374

September	Well Recharge	Daily		Well Recovery	Daily		Well Flush	Daily		Well Level (ft)	Daily Level
END	315002		END	0		END	30137		END	49.9	
1	315002	0.000	1	0	0.000	1	30137	0.000	1	49.9	0.0
2	315002	0.000	2	0	0.000	2	30188	0.051	2	49.9	0.0
3	315002	0.000	3	0	0.000	3	30188	0.000	3	49.9	0.0
4	315002	0.000	4	0	0.000	4	30188	0.000	4	50.0	0.1
5	315002	0.000	5	0	0.000	5	30188	0.000	5	50.0	0.0
6	315002	0.000	6	0	0.000	6	30188	0.000	6	50.0	0.0
7	315002	0.000	7	0	0.000	7	30238	0.050	7	50.0	0.0
8	315002	0.000	8	0	0.000	8	30238	0.000	8	49.9	-0.1
9	315002	0.000	9	0	0.000	9	30289	0.051	9	49.6	-0.3
10	315002	0.000	10	0	0.000	10	30289	0.000	10	49.6	0.0
11	315002	0.000	11	0	0.000	11	30289	0.000	11	49.6	0.0
12	315002	0.000	12	0	0.000	12	30289	0.000	12	49.6	0.0
13	315002	0.000	13	0	0.000	13	30289	0.000	13	49.6	0.0
14	315002	0.000	14	0	0.000	14	30344	0.055	14	49.6	0.0
15	315002	0.000	15	0	0.000	15	30344	0.000	15	49.6	0.0
16	315002	0.000	16	0	0.000	16	30394	0.050	16	49.8	0.2
17	315002	0.000	17	0	0.000	17	30394	0.000	17	49.6	-0.2
18	315002	0.000	18	0	0.000	18	30394	0.000	18	49.6	0.0
19	315002	0.000	19	30477	0.000	19	30477	0.083	19	49.6	0.0
20	315002	0.000	20	31659	1.182	20	30477	0.000	20	47.5	-2.1
21	315002	0.000	21	32856	1.197	21	30477	0.000	21	48.9	1.4
22	315002	0.000	22	34059	1.203	22	30477	0.000	22	49.3	0.4
23	315002	0.000	23	35250	1.191	23	30477	0.000	23	49.3	0.0
24	315002	0.000	24	36444	1.194	24	30477	0.000	24	49.0	-0.3
25	315002	0.000	25	37586	1.142	25	30477	0.000	25	49.8	0.8
26	315002	0.000	26	38832	1.246	26	30477	0.000	26	47.4	-2.4
27	315002	0.000	27	40068	1.236	27	30477	0.000	27	49.6	2.2
28	315002	0.000	28	41287	1.219	28	30477	0.000	28	50.3	0.7
29	315002	0.000	29	42395	1.108	29	30477	0.000	29	52.7	2.4
30	315002	0.000	30	43639	1.244	30	30477	0.000	30	49.9	-2.8
		0.000			**13.162**			**0.340**			

Precycle (total volume MG)	179.791
Cycle 1 recharge volume (MG)	29.573
Cycle 2 recharge volume (MG)	105.000
Total Recharge Volume (MG)	314.364
Total Recovery Volume (MG)	42.299
Total Flush Volume (MG)	1.714

October	Well Recharge	Daily		Well Recovery	Daily		Well Flush	Daily		Well Level (ft)	Daily Level
END	315002		END	43639	0	END	43639		END	49.9	
1	315002	0.000	1	44837	1.198	1	43639	0.000	1	48.0	-1.9
2	315002	0.000	2	46049	1.212	2	43639	0.000	2	48.4	0.4
3	315002	0.000	3	47200	1.151	3	43639	0.000	3	48.5	0.1
4	315002	0.000	4	48460	1.260	4	43639	0.000	4	50.2	1.7
5	315002	0.000	5	49614	1.154	5	43639	0.000	5	52.3	2.1
6	315002	0.000	6	50862	1.248	6	43639	0.000	6	48.9	-3.4
7	315002	0.000	7	52023	1.161	7	43639	0.000	7	51.9	3.0
8	315002	0.000	8	53265	1.242	8	43639	0.000	8	48.5	-3.4
9	315002	0.000	9	54475	1.210	9	43639	0.000	9	48.0	-0.5
10	315002	0.000	10	55679	1.204	10	43639	0.000	10	48.9	0.9
11	315002	0.000	11	56865	1.186	11	43639	0.000	11	49.0	0.1
12	315002	0.000	12	58019	1.154	12	43639	0.000	12	48.9	-0.1
13	315002	0.000	13	59276	1.257	13	43639	0.000	13	49.2	0.3
14	315002	0.000	14	60395	1.119	14	43639	0.000	14	50.3	1.1
15	315002	0.000	15	60395	0.000	15	60395	0.000	15	50.5	0.2
16	315002	0.000	16	60395	0.000	16	60395	0.000	16	50.6	0.1
17	315002	0.000	17	60395	0.000	17	60395	0.000	17	50.3	-0.3
18	315002	0.000	18	60395	0.000	18	60395	0.000	18	50.7	0.4
19	315002	0.000	19	60395	0.000	19	60446	0.051	19	50.6	-0.1
20	315002	0.000	20	60395	0.000	20	60446	0.000	20	50.8	0.2
21	315002	0.000	21	60395	0.000	21	60496	0.050	21	50.9	0.1
22	315002	0.000	22	60395	0.000	22	60496	0.000	22	51.0	0.1
23	315002	0.000	23	60395	0.000	23	60496	0.000	23	51.2	0.2
24	315002	0.000	24	60395	0.000	24	60496	0.000	24	51.4	0.2
25	315002	0.000	25	60395	0.000	25	60496	0.000	25	51.0	-0.4
26	315002	0.000	26	60395	0.000	26	60547	0.051	26	51.0	0.0
27	315002	0.000	27	60395	0.000	27	60547	0.000	27	51.2	0.2
28	315002	0.000	28	60395	0.000	28	60597	0.050	28	51.4	0.2
29	315002	0.000	29	60395	0.000	29	60597	0.000	29	51.4	0.0
30	315002	0.000	30	60395	0.000	30	60597	0.000	30	51.4	0.0
31	315002	0.000	31	60395	0.000	31	60597	0.000	31	51.6	0.2
		0.000			**16.756**			**0.202**			

Precycle (total volume MG)	179.791
Cycle 1 recharge volume (MG)	29.573
Cycle 2 recharge volume (MG)	105.000
Total Recharge Volume (MG)	314.364
Total Recovery Volume (MG)	59.055
Total Flush Volume (MG)	1.916

November	Well Recharge	Daily		Well Recovery	Daily		Well Flush	Daily		Well Level (ft)	Daily Level
END	315002		31	0		31	60597		30	51.6	
1	316600	1.598	1	0	0.000	1	60597	0.000	1	43.6	-8.0
2	319061	2.461	2	0	0.000	2	60597	0.000	2	44.0	0.4
3	321471	2.410	3	0	0.000	3	60597	0.000	3	43.9	-0.1
4	323912	2.441	4	0	0.000	4	60597	0.000	4	43.6	-0.3
5	326362	2.450	5	0	0.000	5	60597	0.000	5	43.1	-0.5
6	328768	2.406	6	0	0.000	6	60597	0.000	6	43.8	0.7
7	331330	2.562	7	0	0.000	7	60597	0.000	7	44.0	0.2
8	333781	2.451	8	0	0.000	8	60597	0.000	8	44.0	0.0
9	336216	2.435	9	0	0.000	9	60597	0.000	9	43.0	-1.0
10	338647	2.431	10	0	0.000	10	60597	0.000	10	43.5	0.5
11	341109	2.462	11	0	0.000	11	60597	0.000	11	43.9	0.4
12	343492	2.383	12	0	0.000	12	60597	0.000	12	44.0	0.1
13	345952	2.460	13	0	0.000	13	60597	0.000	13	43.9	-0.1
14	348389	2.437	14	0	0.000	14	60597	0.000	14	44.2	0.3
15	350890	2.501	15	0	0.000	15	60597	0.000	15	43.6	-0.6
16	353297	2.407	16	0	0.000	16	60597	0.000	16	43.5	-0.1
17	355742	2.445	17	0	0.000	17	60597	0.000	17	43.7	0.2
18	358188	2.446	18	0	0.000	18	60597	0.000	18	43.6	-0.1
19	360665	2.477	19	0	0.000	19	60597	0.000	19	43.7	0.1
20	362812	2.147	20	0	0.000	20	60597	0.000	20	51.7	8.0
21	365186	2.374	21	0	0.000	21	60597	0.000	21	43.9	-7.8
22	367533	2.347	22	0	0.000	22	60597	0.000	22	44.4	0.5
23	370032	2.499	23	0	0.000	23	60597	0.000	23	44.3	-0.1
24	372438	2.406	24	0	0.000	24	60597	0.000	24	43.9	-0.4
25	375000	2.562	25	0	0.000	25	60597	0.000	25	43.9	0.0
26	377400	2.400	26	0	0.000	26	60597	0.000	26	43.8	-0.1
27	379799	2.399	27	0	0.000	27	60597	0.000	27	43.9	0.1
28	382250	2.451	28	0	0.000	28	60597	0.000	28	43.9	0.0
29	384715	2.465	29	0	0.000	29	60597	0.000	29	43.6	-0.3
30	387190	2.475	30	0	0.000	30	60597	0.000	30	42.8	-0.8
		72.188			**0.000**			**0.000**			

Precycle (total volume MG)	179.791
Cycle 1 recharge volume (MG)	29.573
Cycle 2 recharge volume (MG)	105.000
Cycle 3 recharge volume (MG)	72.188
Total Recharge Volume (MG)	386.552
Total Recovery Volume (MG)	59.055
Total Flush Volume (MG)	1.916

December	Well Recharge	Daily		Well Recovery	Daily		Well Flush	Daily		Well Level (ft)	Daily Level
END	387190		30	0		30	60597		30	42.8	
1	389651	2.461	1	0	0.000	1	60597	0.000	1	43.8	1.0
2	392087	2.436	2	0	0.000	2	60597	0.000	2	43.9	0.1
3	394509	2.422	3	0	0.000	3	60597	0.000	3	43.9	0.0
4	396992	2.483	4	0	0.000	4	60597	0.000	4	44.2	0.3
5	399412	2.420	5	0	0.000	5	60597	0.000	5	43.7	-0.5
6	401882	2.470	6	0	0.000	6	60597	0.000	6	44.0	0.3
7	404334	2.452	7	0	0.000	7	60597	0.000	7	44.2	0.2
8	406793	2.459	8	0	0.000	8	60597	0.000	8	43.8	-0.4
9	409232	2.439	9	0	0.000	9	60597	0.000	9	43.9	0.1
10	411697	2.465	10	0	0.000	10	60597	0.000	10	43.9	0.0
11	414116	2.419	11	0	0.000	11	60597	0.000	11	43.8	-0.1
12	416563	2.447	12	0	0.000	12	60597	0.000	12	43.6	-0.2
13	419005	2.442	13	0	0.000	13	60597	0.000	13	43.6	0.0
14	421332	2.327	14	0	0.000	14	60597	0.000	14	44.2	0.6
15	423767	2.435	15	0	0.000	15	60597	0.000	15	44.5	0.3
16	426208	2.441	16	0	0.000	16	60597	0.000	16	43.9	-0.6
17	428661	2.453	17	0	0.000	17	60597	0.000	17	44.4	0.5
18	431077	2.416	18	0	0.000	18	60597	0.000	18	44.0	-0.4
19	433565	2.488	19	0	0.000	19	60597	0.000	19	44.2	0.2
20	436037	2.472	20	0	0.000	20	60597	0.000	20	44.5	0.3
21	438503	2.466	21	0	0.000	21	60597	0.000	21	44.2	-0.3
22	440925	2.422	22	0	0.000	22	60597	0.000	22	44.0	-0.2
23	443390	2.465	23	0	0.000	23	60597	0.000	23	44.2	0.2
24	445839	2.449	24	0	0.000	24	60597	0.000	24	44.2	0.0
25	448300	2.461	25	0	0.000	25	60597	0.000	25	43.6	-0.6
26	450779	2.479	26	0	0.000	26	60597	0.000	26	44.6	1.0
27	453230	2.451	27	0	0.000	27	60597	0.000	27	44.4	-0.2
28	455736	2.506	28	0	0.000	28	60597	0.000	28	44.5	0.1
29	458194	2.458	29	0	0.000	29	60597	0.000	29	43.7	-0.8
30	460624	2.430	30	0	0.000	30	60597	0.000	30	44.2	0.5
31	462620	1.996	31	0	0.000	31	60597	0.000	31	44.5	0.3
		75.430			**0.000**			**0.000**			

Precycle (total volume MG)	179.791
Cycle 1 recharge volume (MG)	29.573
Cycle 2 recharge volume (MG)	105.000
Cycle 3 recharge volume (MG)	147.618
Total Recharge Volume (MG)	461.982
Total Recovery Volume (MG)	59.055
Total Flush Volume (MG)	1.916

January 2011	Well Recharge	Daily		Well Recovery	Daily		Well Flush	Daily		Well Level (ft)	Daily Level
END	462670		END	0		END	60597		END	44.5	
1	465069	2.399	1	0	0.000	1	60597	0.000	1	45.1	0.6
2	467524	2.455	2	0	0.000	2	60597	0.000	2	44.6	-0.5
3	469970	2.446	3	0	0.000	3	60597	0.000	3	44.4	-0.2
4	472422	2.452	4	0	0.000	4	60597	0.000	4	44.4	0.0
5	474882	2.460	5	0	0.000	5	60597	0.000	5	43.6	-0.8
6	477337	2.455	6	0	0.000	6	60597	0.000	6	43.7	0.1
7	479815	2.478	7	0	0.000	7	60597	0.000	7	43.6	-0.1
8	482213	2.398	8	0	0.000	8	60597	0.000	8	44.3	0.7
9	484672	2.459	9	0	0.000	9	60597	0.000	9	44.9	0.6
10	487148	2.476	10	0	0.000	10	60597	0.000	10	43.8	-1.1
11	489516	2.368	11	0	0.000	11	60597	0.000	11	43.8	0.0
12	491948	2.432	12	0	0.000	12	60597	0.000	12	44.7	0.9
13	494378	2.430	13	0	0.000	13	60597	0.000	13	44.6	-0.1
14	496808	2.430	14	0	0.000	14	60597	0.000	14	44.7	0.1
15	499257	2.449	15	0	0.000	15	60597	0.000	15	44.3	-0.4
16	501696	2.439	16	0	0.000	16	60597	0.000	16	44.2	-0.1
17	504153	2.457	17	0	0.000	17	60597	0.000	17	43.9	-0.3
18	506609	2.456	18	0	0.000	18	60597	0.000	18	43.7	-0.2
19	509064	2.455	19	0	0.000	19	60597	0.000	19	44.0	0.3
20	511502	2.438	20	0	0.000	20	60597	0.000	20	43.4	-0.6
21	513941	2.439	21	0	0.000	21	60597	0.000	21	43.4	0.0
22	516405	2.464	22	0	0.000	22	60597	0.000	22	44.0	0.6
23	518845	2.440	23	0	0.000	23	60597	0.000	23	44.0	0.0
24	521283	2.438	24	0	0.000	24	60597	0.000	24	43.6	-0.4
25	523732	2.449	25	0	0.000	25	60597	0.000	25	43.6	0.0
26	526160	2.428	26	0	0.000	26	60597	0.000	26	43.6	0.0
27	528617	2.457	27	0	0.000	27	60597	0.000	27	43.4	-0.2
28	531048	2.431	28	0	0.000	28	60597	0.000	28	44.0	0.6
29	533462	2.414	29	0	0.000	29	60597	0.000	29	43.4	-0.6
30	535874	2.412	30	0	0.000	30	60597	0.000	30	43.6	0.2
31	538402	2.528	31	0	0.000	31	60597	0.000	31	43.4	-0.2
		75.732			**0.000**			**0.000**			

Precycle (total volume MG)	179.791
Cycle 1 recharge volume (MG)	29.573
Cycle 2 recharge volume (MG)	105.000
Cycle 3 recharge volume (MG)	223.350
Total Recharge Volume (MG)	537.714
Total Recovery Volume (MG)	59.055
Total Flush Volume (MG)	1.916

February 2011	Well Recharge	Daily		Well Recovery	Daily		Well Flush	Daily		Well Level (ft)	Daily Level
END	538402		END	0		END	60597		END	43.4	
1	540774	2.372	1	0	0.000	1	60597	0.000	1	43.3	-0.1
2	543279	2.505	2	0	0.000	2	60597	0.000	2	43.1	-0.2
3	544910	1.631	3	0	0.000	3	60597	0.000	3	43.4	0.3
4	547361	2.451	4	0	0.000	4	60597	0.000	4	43.4	0.0
5	549843	2.482	5	0	0.000	5	60597	0.000	5	43.4	0.0
6	552299	2.456	6	0	0.000	6	60597	0.000	6	43.5	0.1
7	554754	2.455	7	0	0.000	7	60597	0.000	7	43.6	0.1
8	556908	2.154	8	0	0.000	8	60597	0.000	8	44.3	0.7
9	559347	2.439	9	0	0.000	9	60597	0.000	9	43.0	-1.3
10	561763	2.416	10	0	0.000	10	60597	0.000	10	43.1	0.1
11	564182	2.419	11	0	0.000	11	60597	0.000	11	43.6	0.5
12	566641	2.459	12	0	0.000	12	60597	0.000	12	43.5	-0.1
13	569136	2.495	13	0	0.000	13	60597	0.000	13	42.7	-0.8
14	571570	2.434	14	0	0.000	14	60597	0.000	14	43.4	0.7
15	573929	2.359	15	0	0.000	15	60597	0.000	15	43.1	-0.3
16	576364	2.435	16	0	0.000	16	60597	0.000	16	42.8	-0.3
17	578826	2.462	17	0	0.000	17	60597	0.000	17	42.7	-0.1
18	581297	2.471	18	0	0.000	18	60597	0.000	18	43.1	0.4
19	583730	2.433	19	0	0.000	19	60597	0.000	19	42.8	-0.3
20	585099	1.369	20	0	0.000	20	60597	0.000	20	51.8	9.0
21	585099	0.000	21	0	0.000	21	60597	0.000	21	51.7	-0.1
22	585099	0.000	22	0	0.000	22	60647	0.050	22	51.8	0.1
23	585099	0.000	23	0	0.000	23	60647	0.000	23	52.0	0.2
24	585099	0.000	24	0	0.000	24	60698	0.051	24	51.9	-0.1
25	585099	0.000	25	0	0.000	25	60698	0.000	25	52.0	0.1
26	585099	0.000	26	0	0.000	26	60698	0.000	26	52.3	0.3
27	585099	0.000	27	0	0.000	27	60698	0.000	27	52.3	0.0
28	585099	0.000	28	0	0.000	28	60698	0.000	28	52.3	0.0
		46.697			**0.000**			**0.101**			

Precycle (total volume MG)	179.791
Cycle 1 recharge volume (MG)	29.573
Cycle 2 recharge volume (MG)	105.000
Cycle 3 recharge volume (MG)	270.047
Total Recharge Volume (MG)	584.411
Total Recovery Volume (MG)	59.055
Total Flush Volume (MG)	2.017

March 2011	Well Recharge	Daily		Well Recovery	Daily		Well Flush	Daily		Well Level (ft)	Daily Level
END	585099		END	0		END	60698		END	52.3	
1	585099	0.000	1	0	0.000	1	60748	0.050	1	52.3	0.0
2	585099	0.000	2	0	0.000	2	60748	0.000	2	52.9	0.6
3	585099	0.000	3	0	0.000	3	60799	0.051	3	52.3	-0.6
4	585099	0.000	4	0	0.000	4	60799	0.000	4	52.3	0.0
5	585099	0.000	5	0	0.000	5	60799	0.000	5	52.3	0.0
6	585099	0.000	6	0	0.000	6	60799	0.000	6	52.5	0.2
7	585099	0.000	7	0	0.000	7	60849	0.050	7	52.3	-0.2
8	585099	0.000	8	0	0.000	8	60849	0.000	8	52.4	0.1
9	585099	0.000	9	0	0.000	9	60849	0.000	9	52.5	0.1
10	585099	0.000	10	0	0.000	10	60900	0.051	10	52.3	-0.2
11	585099	0.000	11	0	0.000	11	60900	0.000	11	52.4	0.1
12	585099	0.000	12	0	0.000	12	60900	0.000	12	52.5	0.1
13	585099	0.000	13	0	0.000	13	60900	0.000	13	52.5	0.0
14	585099	0.000	14	0	0.000	14	60900	0.000	14	52.5	0.0
15	585099	0.000	15	0	0.000	15	60950	0.050	15	52.5	0.0
16	585099	0.000	16	0	0.000	16	60950	0.000	16	52.5	0.0
17	585099	0.000	17	0	0.000	17	61001	0.051	17	52.7	0.2
18	585099	0.000	18	0	0.000	18	61001	0.000	18	52.7	0.0
19	585099	0.000	19	0	0.000	19	61001	0.000	19	52.8	0.1
20	585099	0.000	20	0	0.000	20	61001	0.000	20	52.9	0.1
21	585099	0.000	21	0	0.000	21	61001	0.000	21	52.8	-0.1
22	585099	0.000	22	0	0.000	22	61051	0.050	22	52.7	-0.1
23	585099	0.000	23	0	0.000	23	61051	0.000	23	52.8	0.1
24	585099	0.000	24	0	0.000	24	61102	0.051	24	52.8	0.0
25	585099	0.000	25	0	0.000	25	61102	0.000	25	53.0	0.2
26	585099	0.000	26	0	0.000	26	61102	0.000	26	53.2	0.2
27	585099	0.000	27	0	0.000	27	61102	0.000	27	53.2	0.0
28	585099	0.000	28	0	0.000	28	61102	0.000	28	53.2	0.0
29	585099	0.000	29	0	0.000	29	61152	0.050	29	52.9	-0.3
30	585099	0.000	30	0	0.000	30	61152	0.000	30	52.7	-0.2
31	585099	0.000	31	0	0.000	31	61203	0.051	31	52.5	-0.2
		0.000			**0.000**			**0.505**			

Precycle (total volume MG)	179.791
Cycle 1 recharge volume (MG)	29.573
Cycle 2 recharge volume (MG)	105.000
Cycle 3 recharge volume (MG)	270.047
Total Recharge Volume (MG)	584.411
Total Recovery Volume (MG)	59.055
Total Flush Volume (MG)	2.522

April 2011	Well Recharge	Daily		Well Recovery	Daily		Well Flush	Daily		Well Level (ft)	Daily Level
END	585099		END	61203		END	61203		END	52.5	
1	585099	0.000	1	61203	0.000	1	61203	0.000	1	52.5	0.0
2	585099	0.000	2	61203	0.000	2	61203	0.000	2	52.5	0.0
3	585099	0.000	3	61203	0.000	3	61203	0.000	3	52.5	0.0
4	585099	0.000	4	61203	0.000	4	61203	0.000	4	52.1	-0.4
5	585099	0.000	5	61253	0.000	5	61253	0.050	5	52.1	0.0
6	585099	0.000	6	61253	0.000	6	61253	0.000	6	52.3	0.2
7	585099	0.000	7	61985	0.732	7	61253	0.000	7	47.3	-5.0
8	585099	0.000	8	63163	1.178	8	61253	0.000	8	49.1	1.8
9	585099	0.000	9	64375	1.212	9	61253	0.000	9	47.8	-1.3
10	585099	0.000	10	65560	1.185	10	61253	0.000	10	48.5	0.7
11	585099	0.000	11	66764	1.204	11	61253	0.000	11	49.0	0.5
12	585099	0.000	12	68005	1.241	12	61253	0.000	12	46.0	-3.0
13	585099	0.000	13	69173	1.168	13	61253	0.000	13	49.0	3.0
14	585099	0.000	14	70377	1.204	14	61253	0.000	14	49.3	0.3
15	585099	0.000	15	71584	1.207	15	61253	0.000	15	47.3	-2.0
16	585099	0.000	16	72787	1.203	16	61253	0.000	16	46.2	-1.1
17	585099	0.000	17	73927	1.140	17	61253	0.000	17	52.8	6.6
18	585099	0.000	18	75197	1.270	18	61253	0.000	18	48.7	-4.1
19	585099	0.000	19	76975	1.778	19	61253	0.000	19	68.0	19.3
20	585099	0.000	20	79087	2.112	20	61253	0.000	20	68.2	0.2
21	585099	0.000	21	81139	2.052	21	61253	0.000	21	45.3	-22.9
22	585099	0.000	22	82851	1.712	22	61253	0.000	22	67.0	21.7
23	585099	0.000	23	84937	2.086	23	61253	0.000	23	68.2	1.2
24	585099	0.000	24	87054	2.117	24	61253	0.000	24	68.8	0.6
25	585099	0.000	25	89167	2.113	25	61253	0.000	25	68.7	-0.1
26	585099	0.000	26	91267	2.100	26	61253	0.000	26	68.7	0.0
27	585099	0.000	27	93347	2.080	27	61253	0.000	27	67.0	-1.7
28	585099	0.000	28	95470	2.123	28	61253	0.000	28	70.0	3.0
29	585099	0.000	29	97577	2.107	29	61253	0.000	29	67.8	-2.2
30	585099	0.000	30	99580	2.003	30	61253	0.000	30	58.0	-9.8
		0.000			**38.327**			**0.050**			

Precycle (total volume MG)	179.791
Cycle 1 recharge volume (MG)	29.573
Cycle 2 recharge volume (MG)	105.000
Cycle 3 recharge volume (MG)	270.047
Total Recharge Volume (MG)	584.411
Total Recovery Volume (MG)	97.382
Total Flush Volume (MG)	2.572

May 2011	Well Recharge	Daily		Well Recovery	Daily		Well Flush	Daily		Well Level (ft)	Daily Level
END	585099		END	99580		END	99580		END	58.0	
1	585099	0.000	1	101763	2.183	1	99580	0.000	1	69.8	11.8
2	585099	0.000	2	103937	2.174	2	99580	0.000	2	71.6	1.8
3	585099	0.000	3	105974	2.037	3	99580	0.000	3	69.9	-1.7
4	585099	0.000	4	108088	2.114	4	99580	0.000	4	69.8	-0.1
5	585099	0.000	5	110205	2.117	5	99580	0.000	5	70.0	0.2
6	585099	0.000	6	112303	2.098	6	99580	0.000	6	68.7	-1.3
7	585099	0.000	7	114419	2.116	7	99580	0.000	7	68.7	0.0
8	585099	0.000	8	116511	2.092	8	99580	0.000	8	68.7	0.0
9	585099	0.000	9	118593	2.082	9	99580	0.000	9	67.8	-0.9
10	585099	0.000	10	120701	2.108	10	99580	0.000	10	71.2	3.4
11	585099	0.000	11	122800	2.099	11	99580	0.000	11	69.5	-1.7
12	585099	0.000	12	124949	2.149	12	99580	0.000	12	72.7	3.2
13	585099	0.000	13	127033	2.084	13	99580	0.000	13	70.0	-2.7
14	585099	0.000	14	129123	2.090	14	99580	0.000	14	73.4	3.4
15	585099	0.000	15	131225	2.102	15	99580	0.000	15	68.7	-4.7
16	585099	0.000	16	133339	2.114	16	99580	0.000	16	69.4	0.7
17	585099	0.000	17	135412	2.073	17	99580	0.000	17	69.1	-0.3
18	585099	0.000	18	137573	2.161	18	99580	0.000	18	70.9	1.8
19	585099	0.000	19	139622	2.049	19	99580	0.000	19	72.3	1.4
20	585099	0.000	20	141715	2.093	20	99580	0.000	20	71.0	-1.3
21	585099	0.000	21	143828	2.113	21	99580	0.000	21	71.5	0.5
22	585099	0.000	22	145893	2.065	22	99580	0.000	22	73.3	1.8
23	585099	0.000	23	148020	2.127	23	99580	0.000	23	73.4	0.1
24	585099	0.000	24	150146	2.126	24	99580	0.000	24	70.0	-3.4
25	585099	0.000	25	152235	2.089	25	99580	0.000	25	73.4	3.4
26	585099	0.000	26	154367	2.132	26	99580	0.000	26	72.0	-1.4
27	585099	0.000	27	156444	2.077	27	99580	0.000	27	72.1	0.1
28	585099	0.000	28	158454	2.010	28	99580	0.000	28	51.8	-20.3
29	585099	0.000	29	160664	2.210	29	99580	0.000	29	50.1	-1.7
30	585099	0.000	30	162787	2.123	30	99580	0.000	30	73.6	23.5
31	585099	0.000	31	164825	2.038	31	99580	0.000	31	71.2	-2.4
		0.000			**65.245**			**0.000**			

Precycle (total volume MG)	179.791
Cycle 1 recharge volume (MG)	29.573
Cycle 2 recharge volume (MG)	105.000
Cycle 3 recharge volume (MG)	270.047
Total Recharge Volume (MG)	584.411
Total Recovery Volume (MG)	162.627
Total Flush Volume (MG)	2.572

June 2011	Well Recharge	Daily		Well Recovery	Daily		Well Flush	Daily		Well Level (ft)	Daily Level
END	585099		END	164825		END	99580	0.000	END	71.2	
1	585099	0.000	1	166949	2.124	1	99580	0.000	1	71.2	0.0
2	585099	0.000	2	169057	2.108	2	99580	0.000	2	73.4	2.2
3	585099	0.000	3	171170	2.113	3	99580	0.000	3	72.2	-1.2
4	585099	0.000	4	173294	2.124	4	99580	0.000	4	72.0	-0.2
5	585099	0.000	5	175357	2.063	5	99580	0.000	5	71.5	-0.5
6	585099	0.000	6	177454	2.097	6	99580	0.000	6	73.7	2.2
7	585099	0.000	7	179688	2.234	7	99580	0.000	7	72.3	-1.4
8	585099	0.000	8	181688	2.000	8	99580	0.000	8	73.7	1.4
9	585099	0.000	9	183787	2.099	9	99580	0.000	9	73.4	-0.3
10	585099	0.000	10	185870	2.083	10	99580	0.000	10	73.7	0.3
11	585099	0.000	11	188015	2.145	11	99580	0.000	11	73.1	-0.6
12	585099	0.000	12	190109	2.094	12	99580	0.000	12	73.6	0.5
13	585099	0.000	13	192170	2.061	13	99580	0.000	13	70.7	-2.9
14	585099	0.000	14	194303	2.133	14	99580	0.000	14	72.1	1.4
15	585099	0.000	15	196395	2.092	15	99580	0.000	15	72.7	0.6
16	585099	0.000	16	198495	2.100	16	99580	0.000	16	73.7	1.0
17	585099	0.000	17	200631	2.136	17	99580	0.000	17	73.4	-0.3
18	585099	0.000	18	202686	2.055	18	99580	0.000	18	73.3	-0.1
19	585099	0.000	19	204842	2.156	19	99580	0.000	19	72.1	-1.2
20	585099	0.000	20	206917	2.075	20	99580	0.000	20	73.0	0.9
21	585099	0.000	21	209000	2.083	21	99580	0.000	21	70.5	-2.5
22	585099	0.000	22	211160	2.160	22	99580	0.000	22	73.6	3.1
23	585099	0.000	23	213277	2.117	23	99580	0.000	23	73.6	0.0
24	585099	0.000	24	215362	2.085	24	99580	0.000	24	73.7	0.1
25	585099	0.000	25	217328	1.966	25	99580	0.000	25	73.6	-0.1
26	585099	0.000	26	219532	2.204	26	99580	0.000	26	71.6	-2.0
27	585099	0.000	27	221625	2.093	27	99580	0.000	27	72.3	0.7
28	585099	0.000	28	223729	2.104	28	99580	0.000	28	71.2	-1.1
29	585099	0.000	29	225864	2.135	29	99580	0.000	29	73.7	2.5
30	585099	0.000	30	227971	2.107	30	99580	0.000	30	72.5	-1.2
		0.000			**63.146**			**0.000**			

Precycle (total volume MG)	179.791
Cycle 1 recharge volume (MG)	29.573
Cycle 2 recharge volume (MG)	105.000
Cycle 3 recharge volume (MG)	270.047
Total Recharge Volume (MG)	584.411
Total Recovery Volume (MG)	225.773
Total Flush Volume (MG)	2.572

July 2011	Well Recharge	Daily		Well Recovery	Daily		Well Flush	Daily		Well Level (ft)	Daily Level
END	585099		END	227971		END	99580		END	72.5	
1	585099	0.000	1	230030	2.059	1	99580	0.000	1	73.7	1.2
2	585099	0.000	2	232158	2.128	2	99580	0.000	2	70.4	-3.3
3	585099	0.000	3	234164	2.006	3	99580	0.000	3	72.0	1.6
4	585099	0.000	4	236267	2.103	4	99580	0.000	4	72.4	0.4
5	585099	0.000	5	238449	2.182	5	99580	0.000	5	71.2	-1.2
6	585099	0.000	6	240552	2.103	6	99580	0.000	6	68.7	-2.5
7	585099	0.000	7	242285	1.733	7	99580	0.000	7	71.2	2.5
8	585099	0.000	8	244370	2.085	8	99580	0.000	8	69.0	-2.2
9	585099	0.000	9	246491	2.121	9	99580	0.000	9	68.6	-0.4
10	585099	0.000	10	248589	2.098	10	99580	0.000	10	69.0	0.4
11	585099	0.000	11	250662	2.073	11	99580	0.000	11	71.2	2.2
12	585099	0.000	12	252802	2.140	12	99580	0.000	12	72.0	0.8
13	585099	0.000	13	254971	2.169	13	99580	0.000	13	70.2	-1.8
14	585099	0.000	14	257001	2.030	14	99580	0.000	14	67.8	-2.4
15	585099	0.000	15	259103	2.102	15	99580	0.000	15	72.1	4.3
16	585099	0.000	16	261203	2.100	16	99580	0.000	16	69.9	-2.2
17	585099	0.000	17	263305	2.102	17	99580	0.000	17	69.8	-0.1
18	585099	0.000	18	265392	2.087	18	99580	0.000	18	69.4	-0.4
19	585099	0.000	19	267493	2.101	19	99580	0.000	19	67.8	-1.6
20	585099	0.000	20	269610	2.117	20	99580	0.000	20	68.7	0.9
21	585099	0.000	21	271721	2.111	21	99580	0.000	21	65.3	-3.4
22	585099	0.000	22	273793	2.072	22	99580	0.000	22	71.8	6.5
23	585099	0.000	23	275932	2.139	23	99580	0.000	23	70.9	-0.9
24	585099	0.000	24	278052	2.120	24	99580	0.000	24	68.1	-2.8
25	585099	0.000	25	280143	2.091	25	99580	0.000	25	68.4	0.3
26	585099	0.000	26	282240	2.097	26	99580	0.000	26	69.9	1.5
27	585099	0.000	27	284343	2.103	27	99580	0.000	27	70.2	0.3
28	585099	0.000	28	286404	2.061	28	99580	0.000	28	70.7	0.5
29	585099	0.000	29	288526	2.122	29	99580	0.000	29	68.7	-2.0
30	585099	0.000	30	290576	2.050	30	99580	0.000	30	54.2	-14.5
31	585099	0.000	31	293140	2.564	31	99580	0.000	31	69.2	15.0
		0.000			**65.169**			**0.000**			

Precycle (total volume MG)	179.791
Cycle 1 recharge volume (MG)	29.573
Cycle 2 recharge volume (MG)	105.000
Cycle 3 recharge volume (MG)	270.047
Total Recharge Volume (MG)	584.411
Total Recovery Volume (MG)	290.942
Total Flush Volume (MG)	2.572

August 2011	Well Recharge	Daily		Well Recovery	Daily		Well Flush	Daily		Well Level (ft)	Daily Level
END	585099		END	293140		END	99580		END	69.2	
1	585099	0.000	1	294859	1.719	1	99580	0.000	1	70.7	1.5
2	585099	0.000	2	296987	2.128	2	99580	0.000	2	67.8	-2.9
3	585099	0.000	3	299087	2.100	3	99580	0.000	3	68.7	0.9
4	585099	0.000	4	301192	2.105	4	99580	0.000	4	67.8	-0.9
5	585099	0.000	5	303303	2.111	5	99580	0.000	5	66.2	-1.6
6	585099	0.000	6	305409	2.106	6	99580	0.000	6	68.2	2.0
7	585099	0.000	7	307456	2.047	7	99580	0.000	7	68.0	-0.2
8	585099	0.000	8	309670	2.214	8	99580	0.000	8	71.5	3.5
9	585099	0.000	9	311770	2.100	9	99580	0.000	9	71.0	-0.5
10	585099	0.000	10	313885	2.115	10	99580	0.000	10	68.7	-2.3
11	585099	0.000	11	316027	2.142	11	99580	0.000	11	68.0	-0.7
12	585099	0.000	12	318077	2.050	12	99580	0.000	12	70.0	2.0
13	585099	0.000	13	320209	2.132	13	99580	0.000	13	69.9	-0.1
14	585099	0.000	14	322301	2.092	14	99580	0.000	14	70.9	1.0
15	585099	0.000	15	324378	2.077	15	99580	0.000	15	70.0	-0.9
16	585099	0.000	16	326498	2.120	16	99580	0.000	16	70.0	0.0
17	585099	0.000	17	328631	2.133	17	99580	0.000	17	70.8	0.8
18	585099	0.000	18	330605	1.974	18	99580	0.000	18	70.0	-0.8
19	585099	0.000	19	331254	0.649	19	99580	0.000	19	54.5	-15.5
20	585099	0.000	20	331254	0.000	20	99580	0.000	20	53.5	-1.0
21	585099	0.000	21	331254	0.000	21	99580	0.000	21	53.5	0.0
22	585099	0.000	22	331254	0.000	22	99580	0.000	22	53.4	-0.1
23	585099	0.000	23	331254	0.000	23	99580	0.000	23	53.4	0.0
24	585099	0.000	24	331254	0.000	24	99580	0.000	24	53.2	-0.2
25	585099	0.000	25	331254	0.000	25	99580	0.000	25	53.2	0.0
26	585099	0.000	26	331254	0.000	26	99580	0.000	26	53.2	0.0
27	585099	0.000	27	331254	0.000	27	99580	0.000	27	53.2	0.0
28	585099	0.000	28	331254	0.000	28	99580	0.000	28	53.2	0.0
29	585099	0.000	29	331254	0.000	29	99580	0.000	29	53.4	0.2
30	585099	0.000	30	331254	0.000	30	99580	0.000	30	53.4	0.0
31	585099	0.000	31	331254	0.000	31	99580	0.000	31	53.4	0.0
		0.000			**38.114**			**0.000**			

Precycle (total volume MG)	179.791
Cycle 1 recharge volume (MG)	29.573
Cycle 2 recharge volume (MG)	105.000
Cycle 3 recharge volume (MG)	270.047
Total Recharge Volume (MG)	584.411
Total Recovery Volume (MG)	329.056
Total Flush Volume (MG)	2.572

Cycle Testing Laboratory Results
UIC Permit No. 59-0259876-001-UC

LF-ASR-1				Parameter:	ORP (field)	Total Alkalinity	TTHM	Gross Alpha	Uranium	Ammonia	Calcium	Color	HCO_3	Hydrogen Sulfide	Phosphate	Silica	Total Organic Carbon	Turbidity	Molybdenum	Fluoride
				Units:	mV	mg/L as $CaCO_3$	ug/L	pCi/L	pCi/L	mg/L	mg/L	Std. Color Units	mg/L	mg/L	mg/L	mg/L as Si	mg/L	NTU	mg/L	mg/L
				MCL:	NA	NA	80	15	20											
Date	**Days**	**Volume MG**	**Cycle**	**Stage**	**value**	**value**	**value**	**value**	**value**	**value**	**value**	**value**	**value**	**value**	**value**	**value**	**value**	**value**	**value**	**value**
7/28/2009			Background		40.1	97	0.14U	1.4U	0.9U	0.14	28	15	118	0.1U	0.028	1.47	10.4	0.78	0.00518	0.00518
11/11/2009			Background									5						0.15		
11/16/2009			Background PWS			124	28.08	1.7	1.05U	0.02U	40	1U	151	0.1U	0.054	11.8	1.53	1.86	0.00088	0.00088
Not Sampled	53	179.791	Pre-Cycle Injection	Recharge																
TOTAL	53	179.791	Pre-Cycle Injection	**Cumulative Recharge**																
Not Sampled	6	29.573	Cycle 1	Recharge																
4/8/2010	14		Cycle 1	Storage	30.2													1.4		
4/13/2010			Cycle 1	Storage	4.5	124	79.05	1.6+/-1.1	0.4U	0.02U	44	10	151	0.1U	0.057	5.1	2.2	2		
4/15/2010			Cycle 1	Storage	28.1													4.1		
4/20/2010			Cycle 1	Storage	17.9	125				0.02U	43	18	152	0.1U	0.054	5.3	2.21	3		
4/22/2010	2	2.597	Cycle 1	Recovery	57.7	132	70.75	5.0+/-1.9	0.8+/-0.6	0.02U	47	15	161	0.1U	0.062	5.5	1.99	0.75		
4/27/2010	39		Cycle 1	Storage	9	124	64.33	1.6U	0.7U	0.02U	48	30	151	0.2	0.156	6.1	2.23	5.2		
5/4/2010			Cycle 1	Storage	-1.5	126	63.9	1.7U	0.5U	0.02U	46	8	153.7	0.3	0.1	5.7	2.01	5.4		
5/6/2010			Cycle 1	Storage	26.7													4.7		
5/11/2010			Cycle 1	Storage	12.5	130	55.13	2.0U	0.5U	0.13	48	5	159	0.3	0.076	4.9	1.81	3.8		
5/13/2010			Cycle 1	Storage	-17.5													3.6		
5/17/2010			Cycle 1	Storage	-8.1	142	46.36	2.3+/-1.2	0.7+/-0.6	0.2	54	10	173	1	0.163	5.8	1.9	4.3		
5/20/2010			Cycle 1	Storage	-9.3													1.6		
5/25/2010			Cycle 1	Storage	-24.8	141	24.37	2.8U	0.6U	0.15	51	12	172	0.5	0.094	5.8	2.31			
5/27/2010			Cycle 1	Storage	-20.5													0.9		
6/1/2010	8		Cycle 1	Storage	-7	136	12.88	2.8U	0.6U	0.03	49	8	165.9	0.9	0.189	5.1	2.32	1.6		
6/3/2010			Cycle 1	Storage	-0.5													1.3		
6/8/2010			Cycle 1	Storage	-2.3	137	14.67	2.5U	0.6U	0.16	47	8	167	1	0.064	5.2	2.09	1.4		
6/10/2010	13	26.540	Cycle 1	Recovery	2.4													0.2		
6/15/2010			Cycle 1	Recovery	7	134	1.16	2.0+/-1.5	0.6U	0.1	47	8	163	0.1U	0.049	5.6	1.61	0.25		
6/17/2010			Cycle 1	Recovery	15.6													0.1		
6/24/2010	6		Cycle 1	Storage	23													0.55		0.394
TOTAL	88	209.364	Cycle 1	**Cumulative Recharge**																
		29.137	Cycle 1	**Cumulative Recovered**																
		179.155	Cycle 1	**Net Storage**																
Not sampled	44	105.000	Cycle 2	Recharge																
			Cycle 2	Recharge																
			Cycle 2	Recharge																
			Cycle 2	Recharge																
			Cycle 2	Recharge																
			Cycle 2	Recharge																
			Cycle 2	Recharge																
			Cycle 2	Recharge																
			Cycle 2	Recharge																
8/12/2010	35		Cycle 2	Storage	31.3													2.4		0.814
8/17/2010			Cycle 2	Storage	10.4	131	118.28	2.5U	0.6U	0.02	47	15	160	0.1U	0.04	5.4	2.41	0.65		0.792
8/19/2010			Cycle 2	Storage	11													0.95		0.796
8/24/2010			Cycle 2	Storage	30.9	127	97.65	2.1U	0.6U	0.02	49	35	155	0.1	0.067	5.8	2.71	0.9		0.793
8/26/2010			Cycle 2	Storage	5.1													2.7		0.777
8/31/2010			Cycle 2	Storage	4.9	135	74.38	2.0+/-1.3	0.5U	0.04	51	30	165	0.3	0.117	5.6	2.84	1.1		0.789
9/2/2010			Cycle 2	Storage	-7.6													0.9		0.793
9/7/2010			Cycle 2	Storage	-18.8	135	48.63	2.1U	0.5U	0.01U	47	30	165	0.7	0.041	5.2	2.48	1.9		0.812
9/9/2010			Cycle 2	Storage	-2.2													0.9		0.801
9/14/2010			Cycle 2	Storage	-24.7	136	22.79	2.2U	0.4U	0.03	48	18	166	0.2	0.035	5.2	2.4	0.95		0.779
9/16/2010			Cycle 2	Storage	13													0.85		0.774
9/21/2010	28	29.918	Cycle 2	Recovery	-14.9	138	18.81	2.2U	0.5	0.18	48	10	168	0.1U	0.035	5	1.91	0.2		0.727
9/23/2010			Cycle 2	Recovery	32.2													0.25		0.711
9/28/2010			Cycle 2	Recovery	-69.2	136	4.67	3.9+/-1.6	0.5U	0.04	47	10	166	0.1U	0.039	5.4	1.73	0.15		0.667
9/30/2010			Cycle 2	Recovery	26.7													0.2		0.652
10/5/2010			Cycle 2	Recovery	-18.1	134	0.5	1.9+/-2.0	1.5	0.06	47	8	163	0.1U	0.038	5.3	1.65	0.23		0.605
10/7/2010			Cycle 2	Recovery	-37													0.2		0.599
10/12/2010			Cycle 2	Recovery	-85.4	136	0.5U	2.6+/-1.8	0.6U	0.05	44	8	166	0.1U	0.037	5.2	1.6	0.1		0.53
10/14/2010			Cycle 2	Recovery	-83.3													1.9		0.535
10/19/2010	16		Cycle 2	Storage	57.9	132	12.8	1.5+/-1.1	0.6U	0.02	47	8	158	0.1U	0.035	5.5	1.63	0.45		0.61
10/21/2010			Cycle 2	Storage	146.9													0.6		0.578
10/26/2010			Cycle 2	Storage	-98.9	131	12.56	3.2+/-2.0	0.6U	0.09	48	12	157	0.1U	0.042	5.4	1.75	0.7		0.619
10/28/2010			Cycle 2	Storage	-82.2													0.65		0.6
TOTAL	107	314.364	Cycle 2	**Cumulative Recharge**																
		59.055	Cycle 2	**Cumulative Recovered**																
		255.309	Cycle 2	**Net Storage**																

Cycle Testing Laboratory Results
UIC Permit No. 59-0259876-001-UC

LF-ASR-1				Parameter:	ORP (field)	Total Alkalinity	TTHM	Gross Alpha	Uranium	Ammonia	Calcium	Color	HCO_3	Hydrogen Sulfide	Phosphate	Silica	Total Organic Carbon	Turbidity	Molybdenum	Fluoride
				Units:	mV	mg/L as $CaCO_3$	ug/L	pCi/L	pCi/L	mg/L	mg/L	Std. Color Units	mg/L	mg/L	mg/L	mg/L as Si	mg/L	NTU	mg/L	mg/L
				MCL:	NA	NA	80	15	20											
Date	**Days**	**Volume MG**	**Cycle**	**Stage**	**value**	**value**	**value**	**value**	**value**	**value**	**value**	**value**	**value**	**value**	**value**	**value**	**value**	**value**	**value**	**value**
Not sampled	112	270.047	Cycle 3	Recharge																
			Cycle 3	Recharge																
			Cycle 3	Recharge																
			Cycle 3	Recharge																
			Cycle 3	Recharge																
			Cycle 3	Recharge																
			Cycle 3	Recharge																
			Cycle 3	Recharge																
			Cycle 3	Recharge																
2/22/2011	45		Cycle 3	Storage	-10.2	122	79.33	1.9U	0.5U	0.02	40	5	149	0.1U	0.041	5	2.06	1.9		0.809
2/24/2011			Cycle 3	Storage	-9.4													1.4		0.821
3/1/2011			Cycle 3	Storage	22.4	127	115.59	1.8+/-1.4	0.4U	0.02	48	18	155	0.1U	0.067	6	2.5	1		0.77
3/3/2011			Cycle 3	Storage	-74.4													0.65		0.839
3/8/2011			Cycle 3	Storage	-137.5	128	84.15	3.1+/-1.7	0.6U	0.07	59	30	156	0.2	0.039	6.4	2.78	1.1		0.727
3/10/2011			Cycle 3	Storage	-108.8													2.1		0.813
3/15/2011			Cycle 3	Storage	-100.8	136	67.88	3.3+/-1.7	0.5U	0.05	58	18	166	1.3	0.164	6.1	2.89	0.7		0.759
3/17/2011			Cycle 3	Storage	-161.1													1		0.789
3/22/2011			Cycle 3	Storage	-228.5	140	48.71	2.4+/-1.0	0.4U	0.02	58	10	171	2.7	0.136	5.3	2.93	0.95		0.716
3/24/2011			Cycle 3	Storage	-189.8													1.5		0.739
3/29/2011			Cycle 3	Storage	-183.5	139	18.8	2.8+/-1.6	0.5U	0.04	60	12	170	2.6	0.091	6.1	2.83	1.4		0.709
3/31/2011			Cycle 3	Storage	-195.8													1.2		0.706
4/5/2011			Cycle 3	Storage	-205.5	149	10.78	1.9U	0.6U	0.04	52	8	182	0.1	0.085	5.4	2.46	2.7		0.739
4/7/2011	134	270.001	Cycle 3	Recovery	-128.7													0.5		0.778
4/12/2011			Cycle 3	Recovery	-164.3	136	8.97	3.0+/-1.5	0.7U	0.02	51	8	166	0.1	0.059	5.2	1.71	0.2		0.73
4/14/2011			Cycle 3	Recovery	-105.8													0.15		0.738
4/19/2011			Cycle 3	Recovery	-108.8	140	2.68	2.6+/-1.5	0.5U	0.03	49	10	171	0.1U	0.04	5.2	1.59	0.4	0.51	0.424
4/21/2011			Cycle 3	Recovery	-104.6													0.15		0.653
4/26/2011			Cycle 3	Recovery	-65.3	132	0.87	2.0+/-1.5	0.6+/-0.5	0.04	44	5	161	0.1U	0.042	4.9	1.7	0.25		0.627
4/28/2011			Cycle 3	Recovery	-98.7													0.1		0.623
5/3/2011			Cycle 3	Recovery	-33	132	0.35	4.1+/-2.1	1.1+/-0.6	0.04	46	5	161	0.1U	0.042	5.8	1.87	0.15		0.566
5/5/2011			Cycle 3	Recovery	-52.1													0.35		0.499
5/10/2011			Cycle 3	Recovery	-92.1	131	0.05U	2.5+/-1.7	0.6U	0.1	48	8	160	0.1U	0.026	4.2	1.79	0.15		0.473
5/12/2011			Cycle 3	Recovery	-58.6													0.75		0.491
5/17/2011			Cycle 3	Recovery	-48.2	131	0.19	1.6U	0.6U	0.08	44	8	160	0.1U	0.042	5.3	1.56	0.1		0.499
5/19/2011			Cycle 3	Recovery	-64.3													1.6		0.487
5/24/2011			Cycle 3	Recovery	-77.9	132	0.33	1.5U	0.5U	0.08	44	8	161	0.1U	0.045	5.6	1.86	1.2		0.483
5/26/2011			Cycle 3	Recovery	-98.5													0.2		0.472
5/31/2011			Cycle 3	Recovery	-112.2	133	0.3	3.1+/-1.5	0.5U	0.08	45	2	162	0.1U	0.041	5.3	1.75	0.25		0.448
6/3/2011			Cycle 3	Recovery	-114.7													0.1U		0.437
6/7/2011			Cycle 3	Recovery	-130.6	133	0.47	2.8+/-1.6	0.7U	0.1	46	2	162	0.1U	0.043	5.6	1.76	0.15		0.447
6/9/2011			Cycle 3	Recovery	-111.4													0.85		0.419
6/14/2011			Cycle 3	Recovery	-179.1	134	0.61	3.5+/-1.9	0.6U	0.09	47	2	163	0.1U	0.049	5.7	1.73	0.1U		0.423
6/16/2011			Cycle 3	Recovery	-123.1													0.2		0.417
6/21/2011			Cycle 3	Recovery	-132.7	134	0.57	3.1+/-1.7	0.5U	0.11	47	2	163	0.1	0.054	5.6	1.75	0.15		0.444
6/23/2011			Cycle 3	Recovery	-125.4													0.25		0.383
6/28/2011			Cycle 3	Recovery	-126.7	132	0.47	4.2+/-2.2	1.7+/-0.8	0.1	46	2	161	0.1	0.048	5.6	1.69	0.1		0.36
6/30/2011			Cycle 3	Recovery	-143.9													0.15		0.366
7/5/2011			Cycle 3	Recovery	-136	133	0.29	3.2+/-2.0	0.5U	0.09	46	5	162	0.1	0.047	5.9	1.6	0.2		0.364
7/7/2011			Cycle 3	Recovery	-146.7													0.5		0.349
7/12/2011			Cycle 3	Recovery	-149.4	132	0.19	1.7U	0.5U	0.15	45	2	161	0.1U	0.046	5.8	1.67	0.15		0.356
7/14/2011			Cycle 3	Recovery	-147.1													0.2		0.294
7/19/2011			Cycle 3	Recovery	-179.8	132	0.15	3.6+/-2.4	0.6U	0.11	46	5	161	0.1U	0.038	5.9		0.1		0.224
7/21/2011			Cycle 3	Recovery	-131.5													0.1U		0.287
7/26/2011			Cycle 3	Recovery	-154.1	132	0.18	1.9+/-0.8	0.5U	0.15	44	2	161	0.1	0.049	5.9	1.64	0.15		0.307
7/28/2011			Cycle 3	Recovery	-142.4													0.15		0.29
8/2/2011			Cycle 3	Recovery	-155	131	0.11	2.3U	0.6U	0.17	47	5	160	0.1U	0.053	6.1	1.38	0.65		0.253
8/4/2011			Cycle 3	Recovery	-149.8													2.7		0.345
8/9/2011			Cycle 3	Recovery	-167	130	0.25	2.1+/-0.9	0.6U	0.21	47	5	159	0.1U	0.062	5.8	1.28	0.4		0.333
8/11/2011			Cycle 3	Recovery	-192.5													0.1		0.334
8/16/2011			Cycle 3	Recovery	-217.5	134	0.21	2.2U	0.6U	0.19	42	5	163	0.1U	0.079	5.1	1.61	0.15		0.343
8/18/2011			Cycle 3	Recovery	-133.5													0.1		0.284
TOTAL	291	584.411	Cycle 3	**Cumulative Recharge**																
		329.056	Cycle 3	**Cumulative Recovered**																
		255.355	Cycle 3	**Net Storage**																
Total Days	539																			

Cycle Testing Laboratory Results
UIC Permit No. 59-0250382-001-UC

CZ-MW-1				Parameter:	Arsenic	Chloride	DO (field)	Iron, Total	Sodium	pH (field)	Cond (field)	Sulfate	Temp (field)	TDS	ORP (field)	Bicarbonate Alkalinity	Magnesium	Manganese
				Units:	mg/L	mg/L	mg/L	mg/L	mg/L	std units	umhos/cm	mg/L	°C	mg/L	mV	mg/L as $CaCO_3$	mg/L	mg/L
				MCL:	0.010	250	NA	0.3	160	NA	NA	250	NA	500	NA	NA	NA	0.05
Date	Days	Volume	Cycle	Stage	value	value	value	value	value	value	value	value	value	value	value	value	value	value
6/29/2010	44	105.000	Cycle 2	Recharge	0.0012	14.5	1.37	0.45	12	8.2	312	3.73	25.4	172	1.2	142	10	0.016
7/1/2010			Cycle 2	Recharge	0.000674	13.7	3.85	0.21	12	8.06	335	8.07	24.7	190	-25.4			
7/6/2010			Cycle 2	Recharge	0.00045	13.7	1.2	0.18	12	8.05	347	8.62	25.4	181	-6.4	146	10	0.0086
7/8/2010			Cycle 2	Recharge	0.000414	13.7	1.06	0.3	12	8.17	332	5.29	25.2	181	-25.2			
7/13/2010			Cycle 2	Recharge	0.00056U	13.3	2.07	0.39	12	8.11	315	4.46	25.4	178	-0.9	138	10	0.013
7/15/2010			Cycle 2	Recharge	0.00056U	13.2	1.38	0.18	12	7.89	345	15.3	25.4	200	-19.3			
7/20/2010			Cycle 2	Recharge	0.00056U	13.3	1.6	0.65	12	8.08	330	6.7	26.2	180	1.8	140	10	0.011
7/22/2010			Cycle 2	Recharge	0.0065	13.7	4.61	0.45	20	7.68	348	6.52	25.4	200	1.8			
7/27/2010			Cycle 2	Recharge	0.00056U	14	2.34	0.46	11	8.02	314	4.36	24.8	178	7.9	139	9.8	0.013
7/29/2010			Cycle 2	Recharge	0.00056U	13.3	2.08	0.27	11	7.6	333	6.49	25.3	183	-4.4			
8/3/2010			Cycle 2	Recharge	0.00045	13.7	1.2	0.39	11	7.87	315	4.3	25.1	183	-9.6	137	9	0.011
8/5/2010			Cycle 2	Recharge	0.00044	13.2	1.13	0.22	11	8	332	6.64	25.3	185	-21.2			
8/10/2010	35		Cycle 2	Storage	0.0016	17.3	1.46	1.6	14	8.09	324	4	25.1	194	13.6	139	9.9	0.031
8/12/2010			Cycle 2	Storage	0.00062	13.1	0.96	0.67	12	8.26	324	5.02	25.9	175	12			
8/17/2010			Cycle 2	Storage	0.00039	13.1	1.61	0.64	12	8.25	308	1.63	25	173	8.2	136	10	0.02
8/19/2010			Cycle 2	Storage	0.00093	13.1	2.45	0.27	12	7.91	334	5.47	24.8	179	-3.1			
8/24/2010			Cycle 2	Storage	0.00093	13.2	1.67	0.81	12	7.94	315	1.21	24	171	18.6	137	10	0.027
8/26/2010			Cycle 2	Storage	0.00056U	13.1	2.04	0.57	13	8.35	305	1.55	24.8	169	9.2			
8/31/2010			Cycle 2	Storage	0.00189	13.1	1.69	0.73	13	8.2	298	1.23	25.2	168	3.3	136	11	0.024
9/2/2010			Cycle 2	Storage	0.001751	13.1	2.45	0.23	12	8.13	319	7.13	25.6	183	-45.4			
9/7/2010			Cycle 2	Storage	0.001695	13.1	1.33	0.53	12	8.24	311	1.31	25.1	175	23.1	139	9.9	0.022
9/9/2010			Cycle 2	Storage	0.001743	13.2	3	0.16	12	8.07	315	7.9	26	193	-7			
9/14/2010			Cycle 2	Storage	0.001464	13.3	3.62	0.58	12	8.4	310	1.81	25.1	177	-7.2	135	10	0.021
9/16/2010			Cycle 2	Storage	0.002128	13.3	1.31	0.22	12	7.58	331	5.23	26.2	194	10.9			
9/21/2010	28	29.918	Cycle 2	Recovery	0.002121	13.3	1.2	0.31	13	7.76	324	4.93	24.9	191	-25.4	141	10	0.014
9/23/2010			Cycle 2	Recovery	0.002244	13.4	1.12	0.21	13	8.28	334	6.5	25.3	193	-94.6			
9/28/2010			Cycle 2	Recovery	0.002091	13.2	1.46	0.21	12	7.97	324	5.32	25.4	185	-186.9	138	11	0.011
9/30/2010			Cycle 2	Recovery	0.002144	13.6	1.29	0.22	12	8.31	333	7.72	24.7	184	-150.5			
10/5/2010			Cycle 2	Recovery	0.002376	13.8	1.39	0.54	13	8.27	314	1.52	25.2	176	-158.3	137	11	0.023
10/7/2010			Cycle 2	Recovery	0.00193	13.6	1.24	0.27	12	7.98	332	5.55	26	189	-178.01			
10/12/2010			Cycle 2	Recovery	0.00179	13.4	1.34	0.47	12	8.19	312	1.82	25	179	-92.2	139	9.5	0.019
10/14/2010			Cycle 2	Recovery	0.00141	13.8	0.89	0.24	12	8.2	330	4.64	24.4	196	-173.9			
10/19/2010	16		Cycle 2	Storage	0.00153	13.8	1.24	0.24	13	7.97	327	5.38	24.7	186	-181.8	142	10	0.012
10/21/2010			Cycle 2	Storage	0.00190	13.8	1.13	0.26	14	8.28	330	4.94	25.3	191	-184.8			
10/26/2010			Cycle 2	Storage	0.00160	13.2	1.85	0.2	12	8.2	327	5.82	25.1	187	-188	139	10	0.011
10/28/2010			Cycle 2	Storage	0.00130	13.7	2.64	0.23	12	8.27	332	5.34	25	184	-170.6			
			Cycle 2	Storage														
TOTAL	107	314.364	Cycle 2	**Cumlative Recharge**														
		59.055	Cycle 2	**Cumlative Recovered**														
		255.309	Cycle 2	**Net Storage**														
11/2/2010	112	270.047	Cycle 3	Recharge	0.000822	13.2	1.61	0.2	12	7.99	328	6.49	24.8	192	-182.2	145	9.9	0.0097
11/4/2010			Cycle 3	Recharge	0.000506	13.1	1.32	0.18	12	8.01	336	7.75	24.9	188	-195.4			
11/9/2010			Cycle 3	Recharge	0.000527	13.1	1.37	0.42	12	8.05	319	4.62	24.6	191	-183.8	140	9.9	0.013
11/11/2010			Cycle 3	Recharge	0.000451	13	1.61	0.28	12	8.00	331	8.84	24.7	199	-215.8			
11/16/2010			Cycle 3	Recharge	0.000438	12.8	1.37	0.35	11	8.07	320	4.83	24.6	217	-211.7	131	9.5	0.015
11/18/2010			Cycle 3	Recharge	0.00033	13	1.16	0.24	11	8.00	336	11.2	24.9	201	-85.7			
11/22/2010			Cycle 3	Recharge	0.000404	13.1	1.48	0.48	11	8.04	317	3.07	24.7	184	14.2	142	9	0.018
11/24/2010			Cycle 3	Recharge	0.000427	13.4	0.82	0.27	12	7.97	333	7.07	24.8	182	-73.7			
11/30/2010			Cycle 3	Recharge	0.000519	13.3	1.5	0.48	10	8.11	308	3.03	24.9	171	-13.4	134	8.5	0.016
12/2/2010			Cycle 3	Recharge	0.003327	13.7	1.52	0.059	19	7.97	336	7.79	23.8	178	-73.8			
12/7/2010			Cycle 3	Recharge	0.000409	14.9	0.81	0.47	10	8.31	317	4	24.2	178	-66.4	138	8.5	0.017
12/9/2010			Cycle 3	Recharge	0.000359	13.9	1.75	0.22	12	8.05	331	8.74	24.4	183	-78			
12/14/2010			Cycle 3	Recharge	0.000378	13.7	1.48	0.33	10	8.02	323	7.05	23.5	131	-64	142	8.9	0.013
12/16/2010			Cycle 3	Recharge	0.000298	13.7	1.65	0.27	12	8.04	331	5.58	22.9	202	-48.6			
12/20/2010			Cycle 3	Recharge	0.000519	13.8	1.28	0.57	11	8.23	319	3.54	24	192	-34.4	142	9.2	0.02
12/22/2010			Cycle 3	Recharge	0.000356	12.7	1.5	0.19	11	8.03	332	9.67	24.7	184	-86			
12/28/2010			Cycle 3	Recharge	0.000608	13.5	2.74	0.82	13	8.27	319	2.02	20.5	176	-75	139	10	0.024
12/30/2010			Cycle 3	Recharge	0.000323	13.4	1.53	0.25	11	7.95	329	7.24	24.6	186	-129.6			

Cycle Testing Laboratory Results
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CZ-MW-1				Parameter:	Arsenic	Chloride	DO (field)	Iron, Total	Sodium	pH (field)	Cond (field)	Sulfate	Temp (field)	TDS	ORP (field)	Bicarbonate Alkalinity	Magnesium	Manganese
				Units:	mg/L	mg/L	mg/L	mg/L	mg/L	std units	umhos/cm	mg/L	°C	mg/L	mV	mg/L as $CaCO_3$	mg/L	mg/L
				MCL:	0.010	250	NA	0.3	160	NA	NA	250	NA	500	NA	NA	NA	0.05
Date	Days	Volume	Cycle	Stage	value	value	value	value	value	value	value	value	value	value	value	value	value	value
1/4/2011			Cycle 3	Recharge	0.000377	12.9	1.58	0.48	11	8.12	314	3.66	24.6	165	-105	138	9.3	0.017
1/6/2011			Cycle 3	Recharge	0.000377	13.1	1.53	0.24	11	8.17	331	5.56	24.6	192	-177.1			
1/11/2011			Cycle 3	Recharge	0.000435	13.2	1.67	0.49	12	8.19	314	3.65	23.8	182	-137.1	142	10	0.017
1/13/2011			Cycle 3	Recharge	0.000349	13.9	1.35	0.27	11	8	330	5.87	22.9	192	-105.3			
1/18/2011			Cycle 3	Recharge	0.000435	13.1	1.6	0.43	12	8.11	316	4.44	24.5	172	-153.1	142	10	0.016
1/20/2011			Cycle 3	Recharge	0.000325	13.7	1.78	0.17	12	7.95	334	12	24.7	187	-189.3			
1/25/2011			Cycle 3	Recharge	0.000309	13.8	1.57	0.28	11	8.01	318	6.68	24.6	175	-204.4	138	9.5	0.013
1/27/2011			Cycle 3	Recharge	0.000337	14.7	2.06	0.27	12	8.09	329	7.93	24.2	190	-177.3			
2/1/2011			Cycle 3	Recharge	0.000442	14.5	1.65	0.42	13	8.03	314	4.28	24.6	181	-177.3	138	11	0.017
2/3/2011			Cycle 3	Recharge	0.000365	14.8	2.21	0.25	10	8.07	329	6.52	23.9	1U	-158.2			
2/8/2011			Cycle 3	Recharge	0.000374	13.3	1.06	0.36	11	8.21	314	3.9	24.1	164	-137.2	134	9.6	0.015
2/10/2011			Cycle 3	Recharge	0.000371	13.4	1.92	0.3	12	8.06	329	8.3	24.2	181	-178.5			
2/15/2011			Cycle 3	Recharge	0.000345	13.5	1.99	0.36	12	8.03	323	7.74	23	179	-142.6	141	9.7	0.012
2/17/2011			Cycle 3	Recharge	0.000331	13.1	1.9	0.26	11	8.03	334	6.42	24	192	-152.6			
2/22/2011	45		Cycle 3	Storage	0.000442	13	1.65	0.32	12	8.06	321	4.88	24.8	195	-101.7	140	10	0.013
2/24/2011			Cycle 3	Storage	0.000479	13.3	1.54	0.17	11	7.89	348	8.73	24.3	200	-190.5			
3/1/2011			Cycle 3	Storage	0.000617	12.7	1.8	0.26	12	8.03	333	5.24	23.9	182	-193.7	137	10	0.012
3/3/2011			Cycle 3	Storage	0.000686	13.6	1.8	0.2	12	8.11	330	6	24.2	182	-174.3			
3/8/2011			Cycle 3	Storage	0.00077	12.9	0.96	0.2	13	7.91	347	11.9	24.4	186	-210.8	139	11	0.01
3/10/2011			Cycle 3	Storage	0.00059	14	0.49	0.29	12	8.07	332	6.84	23.4	192	-151.6			
3/15/2011			Cycle 3	Storage	0.00065	13.9	1.5	0.46	11	8.11	316	2.77	24	181	-87.8	136	9.9	0.023
3/17/2011			Cycle 3	Storage	0.00110	14.3	1.52	0.21	12	8.06	335	5.92	24.6	191	-151.9			
3/22/2011			Cycle 3	Storage	0.00125	13	1.33	0.45	12	8.15	321	1.57	24.5	170	-187.8	138	11	0.021
3/24/2011			Cycle 3	Storage	0.0012	13.4	1.38	0.21	12	8.11	333	6.21	24.7	188	-185.3			
3/29/2011			Cycle 3	Storage	0.00102	13.2	1.29	0.41	12	8.24	321	2.8	24.3	173	-120.2	138	11	0.022
3/31/2011			Cycle 3	Storage	0.00141	13.2	1.3	0.15	12	7.81	343	7.83	24.4	194	-202.2			
4/5/2011			Cycle 3	Storage	0.001613	13	1.16	0.14	12	7.94	347	12.9	23.5	206	-203.8	153	10	0.008
4/7/2011	134	270.001	Cycle 3	Recovery	0.001732	15.2	2.71	0.2	12	8.18	330	7.75	24.7	199	-247.3			
4/12/2011			Cycle 3	Recovery	0.002326	13.2	1.39	0.19	12	8	328	5.56	24.8	197	-224.7	140	11	0.011
4/14/2011			Cycle 3	Recovery	0.002336	13.3	3.23	0.14	11	8	343	7.74	24.8	203	-186.2			
4/19/2011			Cycle 3	Recovery	0.002831	28.8	1.56	0.36	12	8.16	320	17	25.8	190	-219	139	11	0.017
4/21/2011			Cycle 3	Recovery	0.002402	13.3	1.7	0.16	12	8	340	6.78	24.8	191	-209			
4/26/2011			Cycle 3	Recovery	0.002572	13.3	0.78	0.28	12	8.22	320	3.71	25.1	179	-205.9	133	10	0.015
4/28/2011			Cycle 3	Recovery	0.002009	13.5	1.48	0.16	12	7.97	337	7.01	24.9	198	-227.5			
5/3/2011			Cycle 3	Recovery	0.002481	13.2	1.69	0.32	13	8.04	325	3.84	24.9	182	-95.9	137	10	0.016
5/5/2011			Cycle 3	Recovery	0.002128	13.8	2.35	0.18	12	8.15	342	7.96	25.1	185	-180.9			
5/10/2011			Cycle 3	Recovery	0.001992	13.8	1.34	0.17	11	7.99	342	5.68	25	188	-217.8	138	9.7	0.011
5/12/2011			Cycle 3	Recovery	0.00198	14.4	2.38	0.17	12	8.18	340	5.83	25.4	185	-181.1			
5/17/2011			Cycle 3	Recovery	0.002184	14	1.87	0.32	11	8.12	322	1.63	24.8	183	-198.8	134	9.5	0.018
5/19/2011			Cycle 3	Recovery	0.001987	14.5	2.43	0.16	11	8.17	340	5.74	25.3	194	-185.5			
5/24/2011			Cycle 3	Recovery	0.001744	14.2	0.58	0.16	12	8.06	339	5.67	25.9	185	-276.5	138	10	0.01
5/26/2011			Cycle 3	Recovery	0.001861	14.2	0.8	0.14	11	8.06	343	9.14	25	207	-244.1			
6/3/2011			Cycle 3	Recovery	0.001166	13.6	3.49	0.6	12	8.19	324	0.76	25.1	167	-129.3	135	10	0.027
6/7/2011			Cycle 3	Recovery	0.001209	14.3	1.22	0.44	12	8.24	308	0.15	25.8	166	-200.6	130	10	0.022
6/9/2011			Cycle 3	Recovery	0.001467	14.6	2.47	0.35	12	8.24	317	0.46	25	172	-148.8			
6/14/2011			Cycle 3	Recovery	0.001327	14.7	1.63	0.46	13	8.09	307	0.15	24.7	176	-210.7	133	11	0.024
6/16/2011			Cycle 3	Recovery	0.001275	15	2.38	0.39	12	8.25	313	0.16	23.6	180	-147			
6/21/2011			Cycle 3	Recovery	0.001231	15	1.84	0.46	12	8.14	310	0.26	25.8	167	-172.7	151	10	0.024
6/23/2011			Cycle 3	Recovery		14.6	1.2	0.28	12	7.83	340	0.28	25.9	286	-174.1			
6/28/2011			Cycle 3	Recovery	0.001294	14.4	0.73	0.49	12	8.21	319	0.29	24.1	179	-188.4	135	10	0.023
6/30/2011			Cycle 3	Recovery	0.001164	14.8	1.65	0.14	12	8.04	352	0.69	24.8	196	-207.2			
7/5/2011			Cycle 3	Recovery	0.001504	13.9	1.03	0.31	13	8.15	326	1.32	25.1	182	-167.4	138	10	0.021
7/7/2011			Cycle 3	Recovery	0.001324	14.9	2.65	0.22	12	7.85	329	1.75	25.7	326	-164.9			
7/12/2011			Cycle 3	Recovery	0.001178	15.1	1.86	0.38	12	7.99	318	0.54	24.9	190	-193.3	136	10	0.023
7/14/2011			Cycle 3	Recovery	0.001203	15.4	2.2	0.17	12	8.03	337	0.68	24.7	192	-182.3			
7/19/2011			Cycle 3	Recovery	0.001291	15.6	2.52	0.32	13	8.26	332	1.8	24.9	190	-139.4	138	10	0.019
7/21/2011			Cycle 3	Recovery	0.000984	15.8	1.42	0.16	12	8	349	5.37	25	204	-178.9			
7/26/2011			Cycle 3	Recovery	0.001109	15.7	1.46	0.25	12	8.15	333	2.01	25	193	-161	139	9.6	0.017
7/28/2011			Cycle 3	Recovery	0.000939	15.5	1.64	0.15	12	8.03	351	5.2	24.9	203	-179.7			
8/2/2011			Cycle 3	Recovery	0.000973	15.4	1.74	0.22	12	8.17	334	1.9	25.7	185	-117.4	136	9.8	0.018
8/4/2011			Cycle 3	Recovery	0.000885	16	2.31	0.14	12	8.16	351	5.45	25.2	201	-175.7			
8/9/2011			Cycle 3	Recovery	0.00128	16.3	1.68	0.21	11	8	337	3.67	24	191	-136.6	143	14	0.001
8/11/2011			Cycle 3	Recovery	0.000898	16.2	2.02	0.29	13	8.05	326	1.74	25.1	186	-154.4			
8/16/2011			Cycle 3	Recovery	0.000873	16.9	2.26	0.24	12	8.06	331	2.29	25.2	180	-188.5	140	9.2	0.017
8/18/2011			Cycle 3	Recovery	0.000847	16.3	1.66	0.12	12	8.01	352	6.27	25.1	196	-205.2			
TOTAL	291	584.411	Cycle 3	**Cumulative Recharge**														
		329.056	Cycle 3	**Cumulative Recovered**														
		255.355	Cycle 3	**Net Storage**														
Total Days	539																	

Cycle Testing Laboratory Results
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CZ-MW-1				Parameter:	Total Alkalinity	TTHM	Gross Alpha	Uranium	Ammonia	Calcium	Color	HCO_3	Hydrogen Sulfide	Phosphate	Silica	Total Organic Carbon	Turbidity	Molybdenum	Fluoride
				Units:	mg/L as $CaCO_3$	ug/L	pCi/L	pCi/L	mg/L	mg/L	Std. Color Units	mg/L	mg/L	mg/L	mg/L as Si	mg/L	NTU	ug/L	mg/L
				MCL:	NA	80	15	20											
Date	**Days**	**Volume**	**Cycle**	**Stage**	**value**	**value**	**value**	**value**	**value**	**value**	**value**	**value**	**value**	**value**	**value**	**value**	**value**	**value**	**value**
7/28/2009			Background		50	0.14U	0.9U	1.05U	0.14	9.8	25	61	0.1U	0.027	1.42	1.57	2.8	0.027	0.027
10/14/2009			Background																
2/2/2010	28	116.535	Pre-Cycle Injection	Recharge	NOT SAMPLED												1.1		
2/4/2010			Pre-Cycle Injection	Recharge													0.65		
2/9/2010			Pre-Cycle Injection	Recharge													0.8		
2/11/2010			Pre-Cycle Injection	Recharge													0.7		
2/16/2010			Pre-Cycle Injection	Recharge													2.2		
2/18/2010			Pre-Cycle Injection	Recharge													0.7		
2/23/2010			Pre-Cycle Injection	Recharge													1.5		
2/25/2010			Pre-Cycle Injection	Recharge															
3/2/2010	25	63.256	Pre-Cycle Injection	Recharge													1.02		
3/4/2010			Pre-Cycle Injection	Recharge													0.76		
3/9/2010			Pre-Cycle Injection	Recharge													0.64		
3/11/2010			Pre-Cycle Injection	Recharge													0.64		
3/16/2010			Pre-Cycle Injection	Recharge													1.41		
3/18/2010			Pre-Cycle Injection	Recharge													0.74		
3/23/2010			Pre-Cycle Injection	Recharge													1.2		
3/25/2010			Pre-Cycle Injection	Recharge													0.26		
TOTAL	53	179.791	Pre-Cycle Injection	**Cumulative Recharge**															
			Pre-Cycle Injection																
			Pre-Cycle Injection																
3/30/2010	6	29.573	Cycle 1	Recharge	NOT SAMPLED												0.75		
4/1/2010			Cycle 1	Recharge													0.55		
4/6/2010			Cycle 1	Recharge													0.7		
4/8/2010	14		Cycle 1	Storage													0.5		
4/13/2010			Cycle 1	Storage	145	2.05	3.3+/-1.6	3.0+/-1.3	0.26	48	18	177	2	0.007U	6.2	1.65	0.7		
4/15/2010			Cycle 1	Storage													0.55		
4/20/2010			Cycle 1	Storage	143				0.24	44		174	1.4	0.007U	6		0.35		
4/22/2010	2	2.597	Cycle 1	Recovery	147	1.92	1.9+/-1.3	0.6U	0.27	51	8	179	1.2	0.007U	7.4	1.59	2.3		
4/27/2010	39		Cycle 1	Storage	145	1.92	1.4U	0.5U	0.26	47	8	177	1.7	0.007U	6.8	1.62	0.3		
4/30/2010			Cycle 1	Storage													2.9		
5/4/2010			Cycle 1	Storage	141	1.87	2.7+/-1.7	0.5U	0.24	46	8	172	1.6	0.007U	6.4	1.67	0.35		
5/6/2010			Cycle 1	Storage													0.45		
5/11/2010			Cycle 1	Storage	140	1.44	1.9+/-1.4	0.5+/-0.5	0.28	46	8	171	0.7	0.007U	5.6	1.49	0.4		
5/13/2010			Cycle 1	Storage													0.2		
5/17/2010			Cycle 1	Storage	139	1.13	2.1+/-1.7	0.5U	0.38	43	8	167	1.4	0.03	6.4	1.52	0.6		
5/20/2010			Cycle 1	Storage													0.6		
5/25/2010			Cycle 1	Storage	140	0.71	1.7U	0.5U	0.26	42	5	170	0.2	0.023	6.5	1.56	0.25		
5/27/2010			Cycle 1	Storage													0.2		
6/1/2010	8		Cycle 1	Storage	140	0.07U	2.4+/-1.3	0.6U	0.26	43	5	171	1.6	1.18	6.2	1.62	0.2		
6/3/2010			Cycle 1	Storage													0.3		
6/8/2010			Cycle 1	Storage	137	0.07U	1.6U	0.6U	0.37	41	5	166	1.4	0.007U	6.1	1.49	0.45		
6/10/2010	13	26.54	Cycle 1	Recovery													0.3		
6/15/2010			Cycle 1	Recovery	139	0.07U	2.6+/-1.6	0.6U	0.29	45	5	170	1.4	0.007U	6.6	1.52	0.2		
6/17/2010			Cycle 1	Recovery													0.25		
6/22/2010	6		Cycle 1	Storage	142	0.07U	1.8+/-1.1	0.5U	0.36	45	5	173	2	0.007U	6.8	1.7	0.6		
6/24/2010			Cycle 1	Storage													0.3		0.179
TOTAL	88	209.364	Cycle 1	**Cumlative Recharge**															
		29.137	Cycle 1	**Cumlative Recovered**															
		186.875	Cycle 1	**Net Storage**															

Cycle Testing Laboratory Results
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CZ-MW-1				Parameter:	Total Alkalinity	TTHM	Gross Alpha	Uranium	Ammonia	Calcium	Color	HCO_3	Hydrogen Sulfide	Phosphate	Silica	Total Organic Carbon	Turbidity	Molybdenum	Fluoride
				Units:	mg/L as $CaCO_3$	ug/L	pCi/L	pCi/L	mg/L	mg/L	Std. Color Units	mg/L	mg/L	mg/L	mg/L as Si	mg/L	NTU	ug/L	mg/L
				MCL:	NA	80	15	20											
Date	**Days**	**Volume**	**Cycle**	**Stage**	**value**	**value**	**value**	**value**	**value**	**value**	**value**	**value**	**value**	**value**	**value**	**value**	**value**	**value**	**value**
6/29/2010			Cycle 2	Recharge	142	0.07U	1.8U	0.4+/-0.4	0.27	42	20	173	1.3	0.007U	6.5	1.72	0.8		0.178
7/1/2010	44	105.000	Cycle 2	Recharge													0.75		0.186
7/6/2010			Cycle 2	Recharge	146	1.9	1.3+/-1.1	0.6U	0.28	49	8	178	1.4	0.007U	6.5	1.81	0.85		0.201
7/8/2010			Cycle 2	Recharge													0.85		0.199
7/13/2010			Cycle 2	Recharge	138	2.42	1.4U	0.6U	0.27	43	5	168	1.1	0.007U	6.4	1.62	1		0.203
7/15/2010			Cycle 2	Recharge													0.3		0.199
7/20/2010			Cycle 2	Recharge	140	11.68	1.5U	0.6U	0.27	47	2	170	1.8	0.07	6.4	1.77	1.6		0.203
7/22/2010			Cycle 2	Recharge													0.2		0.204
7/27/2010			Cycle 2	Recharge	139	2.13	1.6+/-1.1	0.6U	0.27	42	2	169	0.5	0.007U	6.3	1.59	1.3		0.224
7/29/2010			Cycle 2	Recharge													0.65		0.198
8/3/2010			Cycle 2	Recharge	137	2.88	1.1+/-0.7	0.5U	0.25	42	5	167	0.5	0.007U	5.8	1.65	1.2		0.219
8/5/2010			Cycle 2	Recharge													0.55		0.202
8/10/2010	35		Cycle 2	Storage	139	5.42	1.4+/-1.0	0.6U	0.18	42	2	170	0.1	0.007U	5.8	1.6	13		0.374
8/12/2010			Cycle 2	Storage													3.9		0.202
8/17/2010			Cycle 2	Storage	141	2.13	3.6+/-1.7	0.6U	0.29	41	5	172	0.2	0.007U	6.1	1.5	1.4		0.192
8/19/2010			Cycle 2	Storage													0.45		0.194
8/24/2010			Cycle 2	Storage	141	1.45	2.3+/-1.3	0.5U	0.28	42	2	172	0.2	0.007U	6.2	1.51	1.7		0.189
8/26/2010			Cycle 2	Storage													1.6		0.191
8/31/2010			Cycle 2	Storage	139	1.25	1.4U	0.6U	0.27	44	5	170	0.1	0.007U	6.7	1.6	0.9		0.197
9/2/2010			Cycle 2	Storage													0.45		0.2
9/7/2010			Cycle 2	Storage	141	0.81	3.7+/-2.0	0.8	0.29	41	12	172	0.1	0.007U	6.1	1.56	0.45		0.193
9/9/2010			Cycle 2	Storage													0.4		0.2
9/14/2010			Cycle 2	Storage	138	0.07U	2.0U	0.4U	0.26	43	15	168	0.3	0.006U	6.5	1.58	0.45		0.183
9/16/2010			Cycle 2	Storage													0.3		0.189
9/21/2010	28	29.918	Cycle 2	Recovery	141	0.07U	1.4+/-1.1	0.5U	0.32	45	8	172	1.4	0.006U	6.7	1.63	0.35		0.193
9/23/2010			Cycle 2	Recovery													0.3		0.194
9/28/2010			Cycle 2	Recovery	142	0.07U	2.8+/-1.6	0.6U	0.3	45	12	173	1.5	0.006U	7	1.67	0.25		0.189
9/30/2010			Cycle 2	Recovery													0.25		0.19
10/5/2010			Cycle 2	Recovery	137	0.05U	2.2+/-1.3	0.5U	0.27	43	15	167	0.2	0.006U	6.4	1.58	0.35		0.187
10/7/2010			Cycle 2	Recovery													0.5		0.184
10/12/2010			Cycle 2	Recovery	139	0.05U	2.3+/-1.3	0.5U	0.28	39	15	170	0.3	0.006U	6.3	1.57	0.4		0.176
10/14/2010			Cycle 2	Recovery													0.2		0.181
10/19/2010	16		Cycle 2	Storage	142	0.05U	1.4U	0.4U	0.33	45	5	170	1.2	0.006U	6.5	1.62	0.2		0.183
10/21/2010			Cycle 2	Storage													0.5		0.182
10/26/2010			Cycle 2	Storage	140	0.05U	1.7U	0.6U	0.32	45	8	167	2.2	0.006U	6.8	1.66	0.45		0.181
10/28/2010			Cycle 2	Storage													0.4		0.185
			Cycle 2	Storage															
TOTAL	107	314.364	Cycle 2	**Cumlative Recharge**															
		59.055	Cycle 2	**Cumlative Recovered**															
		255.309	Cycle 2	**Net Storage**															
11/2/2010	112	270.047	Cycle 3	Recharge	145	0.8	1.6U	0.5U	0.27	46	15	177	1.4	0.006U	6.7	1.65	0.3		0.199
11/4/2010			Cycle 3	Recharge													0.25		0.197
11/9/2010			Cycle 3	Recharge	140	1.75	2.9+/-1.4	0.5+/-0.5	0.28	42	15	171	1	0.006U	6.5	1.62	0.8		0.206
11/11/2010			Cycle 3	Recharge													0.6		0.195
11/16/2010			Cycle 3	Recharge	142	1.85	1.7U	0.6U	0.27	43	8	173	0.9	0.006U	6.3	1.66	1		0.203
11/18/2010			Cycle 3	Recharge													0.35		0.19
11/22/2010			Cycle 3	Recharge	143	1.83	1.7+/-1.2	0.6U	0.27	40	20	174	0.3	0.006U	6.5	1.58	1.2		0.202
11/24/2010			Cycle 3	Recharge													1.5		0.219
11/30/2010			Cycle 3	Recharge	137	2.97	1.7+/-0.9	0.5U	0.24	36	8	164	0.2	0.006U	5.9	1.58	1.6		0.215
12/2/2010			Cycle 3	Recharge													0.45		0.233
12/7/2010			Cycle 3	Recharge	141	3.51	1.4U	0.7U	0.26	35	8	172	0.3	0.03	5.4	1.58	2		0.238
12/9/2010			Cycle 3	Recharge													0.65		0.212
12/14/2010			Cycle 3	Recharge	142	2.84	1.8+/-1.2	0.5U	0.21	40	15	173	0.8	0.006U	5.8	1.62	5.1		0.214
12/16/2010			Cycle 3	Recharge													0.75		0.208
12/20/2010			Cycle 3	Recharge	144	3.59	1.0U	0.6U	0.22	41	18	175	0.2	0.006U	6	1.6	2.2		0.226
12/22/2010			Cycle 3	Recharge													0.5		0.191
12/28/2010			Cycle 3	Recharge	139	5.06	1.5U	0.5U	0.21	41	5	170	0.2	0.006U	5.8	1.55	1.6		0.231
12/30/2010			Cycle 3	Recharge													0.75		0.196

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CZ-MW-1				Parameter:	Total Alkalinity	TTHM	Gross Alpha	Uranium	Ammonia	Calcium	Color	HCO_3	Hydrogen Sulfide	Phosphate	Silica	Total Organic Carbon	Turbidity	Molybdenum	Fluoride
				Units:	mg/L as $CaCO_3$	ug/L	pCi/L	pCi/L	mg/L	mg/L	Std. Color Units	mg/L	mg/L	mg/L	mg/L as Si	mg/L	NTU	ug/L	mg/L
				MCL:	NA	80	15	20											
Date	Days	Volume	Cycle	Stage	value	value	value	value	value	value	value	value	value	value	value	value	value	value	value
1/4/2011			Cycle 3	Recharge	139	2.37	2.0U	0.4U	0.26	40	5	170	0.3	0.006	5.4	1.66	1.5		0.116
1/6/2011			Cycle 3	Recharge													0.5		0.197
1/11/2011			Cycle 3	Recharge	144	3.71	1.5+/-0.8	0.5U	0.24	44	15	176	0.4	0.006U	6.6	1.67	2		0.202
1/13/2011			Cycle 3	Recharge													0.95		0.218
1/18/2011			Cycle 3	Recharge	142	3.26	2.8+/-1.6	0.6U	0.26	43	15	173	0.5	0.006U	6.4	2.37	1.4		0.163
1/20/2011			Cycle 3	Recharge													0.5		0.151
1/25/2011			Cycle 3	Recharge	138	2.12	2.8+/-1.5	0.5U	0.25	40	8	168	0.7	0.07	6.7	3.26	1.4		0.216
1/27/2011			Cycle 3	Recharge													0.85		0.208
2/1/2011			Cycle 3	Recharge	138	3.67	2.8+/-1.6	0.6U	0.24	45	20	168	0.3	0.037	5.9	1.56	1.5		0.221
2/3/2011			Cycle 3	Recharge													0.7		0.224
2/8/2011			Cycle 3	Recharge	136	2.84	2.3U	0.5U	0.28	41	15	166	0.9	0.021	6.4	1.63	1.3		0.208
2/10/2011			Cycle 3	Recharge													24		0.199
2/15/2011			Cycle 3	Recharge	141	2.91	1.7U	0.5U	0.28	42	8	172	0.5	0.006U	6.2	1.61	1.1		0.203
2/17/2011			Cycle 3	Recharge													0.95		0.186
2/22/2011	45		Cycle 3	Storage	140	2.84	2.8+/-1.8	0.5+/-0.5	0.26	45	12	171	0.7	0.012	5.5	1.6	0.85		0.2
2/24/2011			Cycle 3	Storage													0.3		0.188
3/1/2011			Cycle 3	Storage	139	1.99	2.4+/-1.6	0.5+/-0.5	0.26	45	5	170	1.3	0.034	6.6	1.62	0.5		0.187
3/3/2011			Cycle 3	Storage													0.4		0.199
3/8/2011			Cycle 3	Storage	139	1.86	3.2+/-2.1	0.6U	0.26	52	8	170	1.4	0.006U	7	1.65	12		0.171
3/10/2011			Cycle 3	Storage													1		0.194
3/15/2011			Cycle 3	Storage	139	0.84	2.2+/-1.6	0.6U	0.27	41	8	170	0.1	0.004U	6.2	1.61	24		0.186
3/17/2011			Cycle 3	Storage													0.35		0.188
3/22/2011			Cycle 3	Storage	140	0.93	1.6U	0.5U	0.26	43	5	171	0.2	0.024	6	1.63	0.85		0.178
3/24/2011			Cycle 3	Storage													0.3		0.184
3/29/2011			Cycle 3	Storage	140	0.84	2.5+/-1.3	0.5U	0.27	47	2	171	0.2	0.004U	6.7	1.69	1.1		0.172
3/31/2011			Cycle 3	Storage													0.3		0.172
4/5/2011			Cycle 3	Storage	153	0.78	2.8+/-1.5	0.6U	0.27	49	5	187	0.2	0.004U	6.6	1.58	0.3		0.196
4/7/2011	134	270.001	Cycle 3	Recovery													0.3		0.159
4/12/2011			Cycle 3	Recovery	140	0.05U	2.5+/-1.3	0.6U	0.26	47	5	171	0.2	0.03	6.8	1.51	0.25		0.187
4/14/2011			Cycle 3	Recovery													0.2		0.2
4/19/2011			Cycle 3	Recovery	140	0.05U	2.2U	0.6U	0.26	45	5	170	0.3	0.042	6.5	1.47	0.45	0.03	0.184
4/21/2011			Cycle 3	Recovery													0.15		0.181
4/26/2011			Cycle 3	Recovery	133	0.05U	1.5U	0.5U	0.27	43	2	162	0.1	0.021	6.1	1.66	0.2		0.192
4/28/2011			Cycle 3	Recovery													0.15		0.196
5/3/2011			Cycle 3	Recovery	137	0.05U	1.8U	0.5U	0.26	42	5	167	0.2	0.021	2.4	1.83	0.55		0.178
5/5/2011			Cycle 3	Recovery													0.3		0.154
5/10/2011			Cycle 3	Recovery	138	0.05U	2.5+/-1.3	0.6U	0.29	43	5	168	1.5	0.004U	5.2	1.77	0.35		0.154
5/12/2011			Cycle 3	Recovery													0.15		0.169
5/17/2011			Cycle 3	Recovery	136	0.05U	1.6U	0.5U	0.29	39	8	166	0.3	0.004U	6.1	1.5	0.45		0.164
5/19/2011			Cycle 3	Recovery													0.2		0.17
5/24/2011			Cycle 3	Recovery	138	0.05U	1.9U	0.6U	0.27	45	12	168	2.2	0.004U	6.5	1.97	0.25		0.172
5/26/2011			Cycle 3	Recovery													0.25		0.177
6/3/2011			Cycle 3	Recovery	135	0.2	1.6U	0.5U	0.27	40	2	165	0.3	0.004U	6.3	1.71	1.5		0.168
6/7/2011			Cycle 3	Recovery	132	0.23	2.3+/-1.3	0.5U	0.3	39	2	161	0.3	0.004U	5.9	1.69	0.75		0.164
6/9/2011			Cycle 3	Recovery													0.5		0.163
6/14/2011			Cycle 3	Recovery	134	0.25	1.5+/-1.1	0.6U	0.26	39	2	163	0.1	0.004U	6	1.63	0.85		0.161
6/16/2011			Cycle 3	Recovery													0.5		0.175
6/21/2011			Cycle 3	Recovery	131	0.26	1.8U	0.6U	0.26	40	2	160	0.4	0.004U	6	1.69	0.55		0.174
6/23/2011			Cycle 3	Recovery													0.2		0.156
6/28/2011			Cycle 3	Recovery	137	0.23	1.6U	0.8+/-0.6	0.25	39	2	167	0.1	0.004U	5.8	1.59	0.95		0.154
6/30/2011			Cycle 3	Recovery													0.3		0.164
7/5/2011			Cycle 3	Recovery	140	0.05U	2.4U	0.5U	0.21	42	5	171	0.3	0.004U	6.6	1.54	0.35		0.158
7/7/2011			Cycle 3	Recovery													0.15		0.164
7/12/2011			Cycle 3	Recovery	136	0.05U	2.2U	0.7U	0.22	38	5	166	0.1U	0.004U	6.2	1.64	0.45		0.162
7/14/2011			Cycle 3	Recovery													0.25		0.137
7/19/2011			Cycle 3	Recovery	139	0.05U	1.6+/-1.1	0.6U	0.24	41	2	170	0.1	0.004U	6.4	1.54	0.35		0.196
7/21/2011			Cycle 3	Recovery													0.25		0.152
7/26/2011			Cycle 3	Recovery	139	0.05U	1.5U	0.5U	0.02U	41	5	170	0.1U	0.004U	6.5	1.66	0.35		0.129
7/28/2011			Cycle 3	Recovery													0.25		0.149
8/2/2011			Cycle 3	Recovery	140	0.05U	1.4U	0.5U	0.26	41	2	171	0.1	0.004U	6.5	1.86	0.3		0.145
8/4/2011			Cycle 3	Recovery													0.3		0.173
8/9/2011			Cycle 3	Recovery	143	0.05U	1.6U	0.5U	0.29	48	2	174	0.1U	0.004U	5.9	1.9	1.8		0.17
8/11/2011			Cycle 3	Recovery													0.3		0.17
8/16/2011			Cycle 3	Recovery	140	0.05U	1.7U	0.6U	0.26	37	5	171	0.1U	0.004U	5.6	1.54	0.3		0.19
8/18/2011			Cycle 3	Recovery													0.2		0.172
TOTAL	291	584.411	Cycle 3	**Cumulative Recharge**															
		329.056	Cycle 3	**Cumulative Recovered**															
		255.355	Cycle 3	**Net Storage**															
Total Days	539																		

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LF-MW-1				Parameter:	Arsenic	Chloride	DO (field)	Iron, Total	Sodium	pH (field)	Cond (field)	Sulfate	Temp (field)	TDS	ORP (field)	Bicarbonate Alkalinity	Magnesium	Manganese
				Units:	mg/L	mg/L	mg/L	mg/L	mg/L	std units	umhos/cm	mg/L	°C	mg/L	mV	mg/L as $CaCO_3$	mg/L	mg/L
				MCL:	0.010	250	NA	0.3	160	NA	NA	250	NA	500	NA	NA	NA	0.05
Date	Days	Volume	Cycle	Stage	value	value	value	value	value	value	value	value	value	value	value	value	value	value
7/28/2009			Background		0.033	50	0.83	0.076	33	8.51	397	14.7	24.2	239		105	9.6	0.008
10/14/2009			Background		0.004U			0.049		7.90								
2/2/2010	28	116.535	Pre-Cycle Injection	Recharge	0.07218	31.5	2.41	0.012	22	7.66	386	15.4	25.2	215				
2/4/2010			Pre-Cycle Injection	Recharge	0.02351		3.05			7.6	364		25.1					
2/9/2010			Pre-Cycle Injection	Recharge	0.01411	30.9	3.7	0.0099	19	7.73	361	12.3	24.7	189	-6.9			
2/11/2010			Pre-Cycle Injection	Recharge	0.0143		4.59			7.73	359		24.7		-1.6			
2/16/2010			Pre-Cycle Injection	Recharge	0.01095	26.5	3.6	0.007U	18	7.77	354	9.35	23.9	190	2.6			
2/18/2010			Pre-Cycle Injection	Recharge	0.01018		6.43			7.73	349		25		14.7			
2/23/2010			Pre-Cycle Injection	Recharge	0.01053	28.2	4.26	0.007U	20	7.69	357	9.36	24.8	178	-1.7			
2/25/2010			Pre-Cycle Injection	Recharge	0.00896		4.11			7.69	362		23.9		17.4			
3/2/2010	25	63.256	Pre-Cycle Injection	Recharge	0.009311	26.8	4.05	0.054	19	7.85	355	8.69	23.8	178	7.6			
3/4/2010			Pre-Cycle Injection	Recharge	0.008144		5.12			7.64	353		24.7		11.9			
3/9/2010			Pre-Cycle Injection	Recharge	0.01207	26.5	3.7	0.057	18	7.75	362	9.96	24.2	211	-16.6			
3/11/2010			Pre-Cycle Injection	Recharge	0.01077		4.17			7.78	359		24.2		-16.6			
3/16/2010			Pre-Cycle Injection	Recharge	0.009429	27.8	4.27	0.04	21	7.68	352	7.96	24.6	201	10.9			
3/18/2010			Pre-Cycle Injection	Recharge	0.009369		3.65			7.66	352		24.5		1.6			
3/23/2010			Pre-Cycle Injection	Recharge	0.008688	28.5	5.24	0.057	22	7.02	347	8.58	24.5	196	13.7			
3/25/2010			Pre-Cycle Injection	Recharge	0.01976		3.57			7.62	352		24.8		5.0			
TOTAL	53	179.791	Pre-Cycle Injection	Cumlative Recharge														
			Pre-Cycle Injection															
			Pre-Cycle Injection															
3/30/2010	6	29.573	Cycle 1	Recharge	0.007892	28.8	3.35	0.035	21	7.75	367	8.3	24.1	200	12.2			
4/1/2010			Cycle 1	Recharge	0.007604		4.55			7.6	363		24.9		5.9			
4/6/2010			Cycle 1	Recharge	0.007796	26.9	3.33	0.042	20	7.74	353	7.27	24.7	184	23.4			
4/8/2010	14		Cycle 1	Storage	0.0199		2.64			7.57	361		25		65.5			
4/13/2010			Cycle 1	Storage	0.03027	27.7	1.23	0.05	20	7.59	383	15.9	24.8	224	-44.9	130	10	0.003
4/15/2010			Cycle 1	Storage	0.03378		1.63			7.6	386		24.6		4.8			
4/20/2010			Cycle 1	Storage	0.04405	27.7	1.44	0.05	20	7.6	395	18	24.9	221	-4.4	133	11	0.0049
4/22/2010	2	2.597	Cycle 1	Recovery	0.07759	28	1.27	0.047	21	7.88	398	16.7	24.5	206	-0.8	134	11	0.0036
4/27/2010	39		Cycle 1	Storage	0.07621	28.5	1.82	0.036	21	7.56	410	17.7	25.5	232	1.2	133	11	0.0044
4/30/2010			Cycle 1	Storage	0.08017	28.9	2.22	0.052	21	7.74	403	18.3	24.6	212	41			
5/4/2010			Cycle 1	Storage	0.079130	28.2	1.81	0.063	22	7.53	399	18.2	25.2	218	12.3	138	12	0.0045
5/6/2010			Cycle 1	Storage	0.076960	28.5	2.58	0.065	21	7.64	406	18.3	25.2	220	7			
5/11/2010			Cycle 1	Storage	0.019590	28.7	1.65	0.3	20	7.69	399	18.1	25.5	219	4.4	139	12	0.017
5/13/2010			Cycle 1	Storage	0.084210	28.6	1.7	0.084	22	7.63	402	18.7	25.2	219	-8.4			
5/17/2010			Cycle 1	Storage	0.109600	29.1	1.88	0.09	21	7.54	400	18.1	24.9	231	40.3	139	12	0.0036
5/20/2010			Cycle 1	Storage	0.106900	28.2	1.73	0.086	21	7.4	403	17.5	24.9	224	13.3			
5/25/2010			Cycle 1	Storage	0.110400	28.4	1.55	0.08	22	7.62	402	17.5	25.1	228	-7.5	140	12	0.003
5/27/2010			Cycle 1	Storage	0.121400	28.7	1.76	0.081	23	7	407	17.7	24.9	228	6.7			
6/1/2010	8		Cycle 1	Storage	0.122800	29.2	1.67	0.079	22	7.48	403	17.8	25.7	233	12.8	140	12	0.0028
6/3/2010			Cycle 1	Storage	0.131600	28.9	1.7	0.11	22	7.72	407	17.6	24.7	242	27.8			
6/8/2010			Cycle 1	Storage	0.142800	29.7	1.05	0.1	22	7.7	408	18	26	226	-10.8	137	11	0.0032
6/10/2010	13	26.54	Cycle 1	Recovery	0.146900	31	1.47	0.094	22	7.87	402	18.1	25.3	220	15.1			
6/15/2010			Cycle 1	Recovery	0.078080	35	1.66	0.12	25	7.63	411	16.7	26.6	230	-0.8	134	12	0.0023
6/17/2010			Cycle 1	Recovery	0.070960	37	2.63	0.12	28	7.76	422	16.9	25.8	229	14.4			
6/22/2010	6		Cycle 1	Storage	0.077120	39.6	2.19	0.13	28	7.63	435	16.7	25.9	254	27.4	134	12	0.0028
6/24/2010			Cycle 1	Storage	0.080040	40	1.61	0.12	27	7.38	436	16.9	25.7	233	-27.3			
TOTAL	88	209.364	Cycle 1	Cumlative Recharge														
		29.137	Cycle 1	Cumlative Recovered														
		186.875	Cycle 1	Net Storage														
6/29/2010	44	105.000	Cycle 2	Recharge	0.0203	30.1	2.67	0.056	22	7.55	371	13.7	25.7	198	41	119	10	0.0028
7/1/2010			Cycle 2	Recharge	0.01038	29.7	3.96	0.027	21	7.65	363	11.3	25.1	200	-18.7			
7/6/2010			Cycle 2	Recharge	0.007382	27	3.8	0.035	20	7.97	359	10.3	24.8	201	19.2	125	9.4	0.0014
7/8/2010			Cycle 2	Recharge	0.007151	28.9	4.01	0.039	21	7.63	360	9.84	26.5	200	-15.3			
7/13/2010			Cycle 2	Recharge	0.0068	26.3	4.13	0.053	20	7.59	345	8.27	26.4	196	9.5	124	9.3	0.0015
7/15/2010			Cycle 2	Recharge	0.0069	28.1	3.87	0.054	21	7.62	354	8.4	25.7	200	-0.9			
7/20/2010			Cycle 2	Recharge	0.0062	25.9	4.6	0.053	20	7.86	346	8.08	25.8	186	12.1	122	9.2	0.0012
7/22/2010			Cycle 2	Recharge	0.00056U	27.3	1.46	0.36	12	8.21	333	8.63	25.1	193	10.3			
7/27/2010			Cycle 2	Recharge	0.0064	26.7	5.85	0.032	19	7.57	348	9.25	25.4	191	32.9	130	9.1	0.001U
7/29/2010			Cycle 2	Recharge	0.0059	26.5	4.83	0.056	19	7.6	352	8.69	25.9	192	6.5			
8/3/2010			Cycle 2	Recharge	0.0065	27.2	4.2	0.035	20	7.45	353	8.4	25.7	197	9.6	125	8.7	0.001U
8/5/2010			Cycle 2	Recharge	0.0068	26.9	4.7	0.034	19	7.61	356	8.16	26	191	7.7			

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LF-MW-1				Parameter:	Arsenic	Chloride	DO (field)	Iron, Total	Sodium	pH (field)	Cond (field)	Sulfate	Temp (field)	TDS	ORP (field)	Bicarbonate Alkalinity	Magnesium	Manganese
				Units:	mg/L	mg/L	mg/L	mg/L	mg/L	std units	umhos/cm	mg/L	°C	mg/L	mV	mg/L as $CaCO_3$	mg/L	mg/L
				MCL:	0.010	250	NA	0.3	160	NA	NA	250	NA	500	NA	NA	NA	0.05
Date	Days	Volume	Cycle	Stage	value	value	value	value	value	value	value	value	value	value	value	value	value	value
8/10/2010	35		Cycle 2	Storage	0.012	28.3	5.36	0.038	21	7.89	354	9.65	25.7	213	28.3	127	9.1	0.001U
8/12/2010			Cycle 2	Storage	0.017	27.2	2.68	0.04	21	7.76	364	11.9	26	199	-1.6			
8/17/2010			Cycle 2	Storage	0.026	27.5	2.5	0.05	25	7.56	381	15.4	25.7	216	19.9	134	12	0.0026
8/19/2010			Cycle 2	Storage	0.03	27.7	2.19	0.039	22	7.5	387	16.2	25.8	223	-12.8			
8/24/2010			Cycle 2	Storage	0.039	27.9	1.85	0.043	20	7.44	397	17.5	24.2	218	29.8	136	10	0.005
8/26/2010			Cycle 2	Storage	0.041	27.9	2.53	0.045	22	7.75	394	17.6	25.1	228	28.6			
8/31/2010			Cycle 2	Storage	0.04476	28.1	2.03	0.041	23	7.55	385	18.4	26.1	218	-1.1	136	12	0.0062
9/2/2010			Cycle 2	Storage	0.04767	28.4	4.9	0.049	22	7.85	389	18.6	26.1	222	45.4			
9/7/2010			Cycle 2	Storage	0.05064	27.9	1.07	0.055	22	7.72	401	18.5	25.4	229	24.6	138	11	0.0057
9/9/2010			Cycle 2	Storage	0.05457	28.6	3.02	0.053	21	7.59	387	19	26.3	227	29.7			
9/14/2010			Cycle 2	Storage	0.0678	29.1	2.47	0.071	22	7.72	405	18.9	26	226	-22.1	139	12	0.0055
9/16/2010			Cycle 2	Storage	0.07079	28.9	1.82	0.069	22	5.47	397	18.8	25.1	239	23.9			
9/21/2010	28		Cycle 2	Recovery	0.0654	29.2	1.87	0.075	22	7.2	404	18.3	25.5	245	1.5	137	12	0.004
9/23/2010			Cycle 2	Recovery	0.07025	29.5	1.35	0.08	22	7.84	399	17.7	25.8	224	-1.1			
9/28/2010			Cycle 2	Recovery	0.0647	30.8	1.38	0.042	23	7.52	399	16.8	26	227	-79.2	136	12	0.0025
9/30/2010			Cycle 2	Recovery	0.06739	32.7	3	0.094	24	7.9	405	17.7	24.9	231	256			
10/5/2010			Cycle 2	Recovery	0.05893	34.4	1.21	0.087	29	7.72	409	17.2	25.9	228	-90.3	134	13	0.0029
10/7/2010			Cycle 2	Recovery	0.05885	35.5	3.34	0.076	27	7.81	421	17.2	24	236	-50.5			
10/12/2010			Cycle 2	Recovery	0.04996	36	1.38	0.085	26	7.64	417	16.4	25.6	237	-181.7	135	11	0.001U
10/14/2010			Cycle 2	Recovery	0.05549	38.4	1.37	0.084	28	7.78	420	17.1	26.1	255	-101.1			
10/19/2010	16		Cycle 2	Storage	0.05681	39.8	1.42	0.089	29	7.77	429	17.2	25.2	244	-80.8	134	12	0.0029
10/21/2010			Cycle 2	Storage	0.06137	40.1	1.28	0.092	31	7.82	427	17.2	25.1	250	-120.2			
10/26/2010			Cycle 2	Storage	0.06001	38.9	2.02	0.12	31	7.87	433	17	25.1	241	67.4	135	13	0.0044
10/28/2010			Cycle 2	Storage	0.06007	40.8	3.83	0.099	28	7.9	434	17.7	25.3	249	-94.8			
			Cycle 2	Storage														
TOTAL	107	314.364	Cycle 2	**Cumlative Recharge**														
		59.055	Cycle 2	**Cumlative Recovered**														
		255.309	Cycle 2	**Net Storage**														
11/2/2010	112	72.188	Cycle 3	Recharge	0.04186	27.4	2.7	0.043	21	7.68	366	13.1	25.2	210	-32.5	128	10	0.0021
11/4/2010			Cycle 3	Recharge	0.009024	25.8	3.5	0.098	20	7.65	354	10.7	25.2	192	-16.9			
11/9/2010			Cycle 3	Recharge	0.006214	23.6	4.51	0.072	20	7.58	342	9.18	25.1	201	19.8	128	10	0.0012
11/11/2010			Cycle 3	Recharge	0.005827	24.8	4.88	0.029	19	7.64	351	9.2	24.6	204	21.6			
11/16/2010			Cycle 3	Recharge	0.005299	23.6	4.21	0.073	19	7.75	347	8.92	25.3	194	15.9	121	9.2	0.0016
11/18/2010			Cycle 3	Recharge	0.004766	26.3	4.07	0.055	18	7.58	348	9.12	25.1	202	-12.6			
11/22/2010			Cycle 3	Recharge	0.004718	24	4.44	0.062	18	7.65	343	8.59	24.8	195	10.9	127	8.6	0.001U
11/24/2010			Cycle 3	Recharge	0.00474	24.6	3.78	0.036	19	7.53	348	9.15	25	189	-11.3			
11/30/2010			Cycle 3	Recharge	0.004836	24.5	4.16	0.008U	17	7.64	346	8.85	25.2	195	0.7	125	8	0.001U
12/2/2010			Cycle 3	Recharge	0.004952	25.6	4.81	0.038	18	7.79	353	8.59	22.4	190	94.3			
12/7/2010			Cycle 3	Recharge	0.004806	26.6	4.61	0.058	16	7.68	344	10.1	24.8	201	2.2	127	7.9	0.0014
12/9/2010			Cycle 3	Recharge	0.005406	25.8	4.7	0.042	17	7.7	344	8.87	23.8	191	-36.2			
12/14/2010			Cycle 3	Recharge	0.008823	24.2	5.08	0.046	15	7.58	344	8.9	23.5	191	-27.1	127	7.6	0.001U
12/16/2010			Cycle 3	Recharge	0.004788	25	4.13	0.063	19	7.66	341	7.64	22.2	196	45			
12/20/2010			Cycle 3	Recharge	0.004877	23.7	4.76	0.059	16	7.76	344	8.51	23.4	198	67.2	124	7.8	0.001U
12/22/2010			Cycle 3	Recharge	0.005118	23.7	5	0.048	19	7.51	345	8.3	24.8	195	-16.8			
12/28/2010			Cycle 3	Recharge	0.005186	23.3	5.76	0.067	19	7.73	347	8.14	20.7	198	-29.6	127	9.1	0.001U
12/30/2010			Cycle 3	Recharge	0.005004	25.2	4.73	0.065	19	7.43	345	8.56	24.8	195	-0.6			
1/4/2011			Cycle 3	Recharge	0.004915	25.3	4.33	0.064	17	7.7	342	17	24.8	190	-33.8	125	8.4	0.001U
1/6/2011			Cycle 3	Recharge	0.004953	25.1	4.84	0.054	19	7.68	347	7.85	24.7	200	21.1			
1/11/2011			Cycle 3	Recharge	0.0049	25.2	4.69	0.064	19	7.86	340	8.05	22.9	152	94	126	9.2	0.001U
1/13/2011			Cycle 3	Recharge	0.006559	25.9	4.75	0.066	18	7.75	343	8.15	23.6	199	-39			
1/18/2011			Cycle 3	Recharge	0.004807	24.3	4.21	0.066	19	7.76	340	8	24.4	189	-16.4	129	9	0.001U

Cycle Testing Laboratory Results
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LF-MW-1				Parameter:	Arsenic	Chloride	DO (field)	Iron, Total	Sodium	pH (field)	Cond (field)	Sulfate	Temp (field)	TDS	ORP (field)	Bicarbonate Alkalinity	Magnesium	Manganese
				Units:	mg/L	mg/L	mg/L	mg/L	mg/L	std units	umhos/cm	mg/L	°C	mg/L	mV	mg/L as $CaCO_3$	mg/L	mg/L
				MCL:	0.010	250	NA	0.3	160	NA	NA	250	NA	500	NA	NA	NA	0.05
Date	Days	Volume	Cycle	Stage	value	value	value	value	value	value	value	value	value	value	value	value	value	value
1/20/2011			Cycle 3	Recharge	0.005029	25.6	4.98	0.068	20	7.67	340	7.91	24.9	185	82.9			
1/25/2011			Cycle 3	Recharge	0.00485	24.6	4.28	0.037	18	7.65	339	8	24.6	181	54.6	125	8.7	0.001U
1/27/2011			Cycle 3	Recharge	0.004782	27.6	4.9	0.067	20	7.7	346	8.9	0.6	207	11.7			
2/1/2011			Cycle 3	Recharge	0.005039	25.8	4.92	0.061	18	7.59	337	8.03	24.7	190	70.3	126	8.7	0.0021
2/3/2011			Cycle 3	Recharge	0.004739	27.2	5.54	0.036	15	7.73	340	8.29	23.3	186	266.8			
2/8/2011			Cycle 3	Recharge	0.005024	24.7	4.24	0.068	18	7.66	345	7.73	22.9	182	295.9	123	8.7	0.001
2/10/2011			Cycle 3	Recharge	0.005103	25.7	4.99	0.076	20	7.64	344	8.01	23.6	192	67.7			
2/15/2011			Cycle 3	Recharge	0.004894	26.2	5.21	0.061	20	7.81	351	8.31	23.6	192	92.4	160	9	0.001U
2/17/2011			Cycle 3	Recharge	0.004837	26	5.34	0.053	20	7.73	355	8.15	24	199	262.8			
2/22/2011	45		Cycle 3	Storage	0.009531	25.9	3.39	0.059	20	7.69	357	9.56	25.3	212	28.7	126	9.7	0.0018
2/24/2011			Cycle 3	Storage	0.01251	26.8	3.44	0.057	19	7.83	375	11.6	24.5	216	3.5			
3/1/2011			Cycle 3	Storage	0.01593	25.9	2.46	0.058	20	7.58	387	13.7	24.1	213	220.6	132	10	0.0032
3/3/2011			Cycle 3	Storage	0.01786	27.5	2.04	0.066	21	7.67	383	15.2	24.4	208	-18			
3/8/2011			Cycle 3	Storage	0.02102	26.4	4.52	0.048	21	7.83	396	16	24.7	215	-77.7	133	11	0.0053
3/10/2011			Cycle 3	Storage	0.02293	28.6	0.63	0.064	20	7.58	389	18.1	24.2	222	93.7			
3/15/2011			Cycle 3	Storage	0.02701	28.4	2.92	0.041	21	7.73	396	18.7	24.7	231	139.8	138	12	0.0079
3/17/2011			Cycle 3	Storage	0.02916	28.7	1.5	0.074	20	7.66	397	19	25	239	77.6			
3/22/2011			Cycle 3	Storage	0.03267	27	1.43	0.069	22	7.78	399	18.2	25.2	218	124.1	136	12	0.0083
3/24/2011			Cycle 3	Storage	0.0317	27.3	2.53	0.072	20	7.74	399	18.3	24.2	222	272.3			
3/29/2011			Cycle 3	Storage	0.03477	27.2	1.01	0.068	22	7.73	400	18.4	25	220	10.3	137	12	0.0095
3/31/2011			Cycle 3	Storage	0.03732	26.9	1.28	0.07	21	7.6	401	18.2	24.1	222	10.5			
4/5/2011			Cycle 3	Storage	0.04587	26.9	2.63	0.078	22	7.65	404	18.1	23.9	240	187.7	145	13	0.0085
4/7/2011	134	270.001	Cycle 3	Recovery	0.04542	27.1	2.3	0.097	21	7.71	470	18.3	25.4	243	164.7			
4/12/2011			Cycle 3	Recovery	0.06809	26.9	1.28	0.093	21	7.66	398	17.5	24.9	240	16.7	138	12	0.0063
4/14/2011			Cycle 3	Recovery	0.06651	27.7	2.78	0.097	21	7.75	398	17.4	25	230	8			
4/19/2011			Cycle 3	Recovery	0.07449	28.9	1.35	0.084	22	7.65	397	16.9	25.7	236	-69.5	136	12	0.0046
4/21/2011			Cycle 3	Recovery	0.07286	29.3	1.31	0.094	21	7.72	397	16.5	25.1	227	-51.3			
4/26/2011			Cycle 3	Recovery	0.06034	31.2	2.55	0.1	23	7.85	400	16.1	25.3	228	-55.2	134	12	0.0035
4/28/2011			Cycle 3	Recovery	0.04871	31.8	1.51	0.12	24	7.71	404	16.1	25.1	238	-120.9			
5/3/2011			Cycle 3	Recovery	0.05443	34.1	1.69	0.11	26	7.77	424	15.6	25.2	239	-127.9	129	12	0.0031
5/5/2011			Cycle 3	Recovery	0.05796	36.7	2.53	0.13	25	7.81	422	16.1	25.4	229	-70.2			
5/10/2011			Cycle 3	Recovery	0.05215	38.5	1.4	0.11	22	7.75	428	15.9	25.5	240	-117.5	132	12	0.003
5/12/2011			Cycle 3	Recovery	0.05598	41.7	2.65	0.12	27	7.87	437	17	25.7	243	-80.5			
5/17/2011			Cycle 3	Recovery	0.05326	42.6	2.3	0.14	28	7.64	449	15.5	25.3	258	25.7	133	12	0.0025
5/19/2011			Cycle 3	Recovery	0.04786	44.6	2.54	0.17	30	7.88	448	16	25.7	257	-988			
5/24/2011			Cycle 3	Recovery	0.05317	47	1.18	0.18	31	7.66	481	16.1	25.8	262	-97.9	133	12	0.002
5/26/2011			Cycle 3	Recovery	0.05051	47.9	1.38	0.19	30	7.84	466	16.4	25.8	274	-59.6			
6/3/2011			Cycle 3	Recovery	0.04095	50.5	2.21	0.23	33	7.82	468	16.4	25.7	259	-171.4	130	12	0.0018
6/7/2011			Cycle 3	Recovery	0.04427	53	1.53	0.25	35	7.79	479	16.7	25.6	261	-167.8	132	13	0.0019
6/9/2011			Cycle 3	Recovery	0.04195	53.3	2.56	0.24	32	7.9	488	16.5	25.1	280	-151.6			
6/14/2011			Cycle 3	Recovery	0.03942	57.4	2.01	0.27	37	7.84	491	17	25.3	270	-191.4	134	13	0.0017
6/16/2011			Cycle 3	Recovery	0.03928	58.5	1.83	0.27	37	7.86	497	17	24.9	287	-155.3			
6/21/2011			Cycle 3	Recovery	0.03594	63	1.93	0.28	39	7.85	508	17.7	26.3	284	-154	133	12	0.0014
6/23/2011			Cycle 3	Recovery	0.03825	43.5	1.78	0.28	39	7.8	513	16.6	25.9	275	-118			
6/28/2011			Cycle 3	Recovery	0.03392	65.4	1.19	0.27	40	7.92	529	17.6	24.5	302	-173.3	138	13	0.0016
6/30/2011			Cycle 3	Recovery	0.03427	66.7	0.78	0.23	40	7.85	532	17.5	25.1	301	-184.9			
7/5/2011			Cycle 3	Recovery	0.03383	67.4	0.96	0.22	44	7.68	542	17	25.8	311	-182.2	133	13	0.001U
7/7/2011			Cycle 3	Recovery	0.03217	68.5	1.05	0.22	43	7.82	543	17.3	25.3	319	-189.1			
7/12/2011			Cycle 3	Recovery	0.02866	75.4	1.49	0.22	47	7.78	554	18.3	25.3	321	-185	135	14	0.001U
7/14/2011			Cycle 3	Recovery	0.02812	76.3	1.37	0.21	46	7.76	562	18.3	25	330	-181.3			
7/19/2011			Cycle 3	Recovery	0.0274	70.3	1.6	0.2	47	7.84	565	19.2	25.4	308	-172.3	133	13	0.001U
7/21/2011			Cycle 3	Recovery	0.02483	80.2	1.75	0.19	47	7.82	572	19	25.4	344	-160.9			
7/26/2011			Cycle 3	Recovery	0.02246	81.6	1.3	0.17	47	7.82	583	18.9	25.5	341	-158.7	134	13	0.001U
7/28/2011			Cycle 3	Recovery	0.02504	82.7	1.49	0.18	49	7.72	588	19.1	25.2	335	-174.8			
8/2/2011			Cycle 3	Recovery	0.02274	85.9	1.7	0.15	53	7.85	612	19.4	25.6	336	-156.2	133	14	0.001U
8/4/2011			Cycle 3	Recovery	0.02151	88	1.72	0.15	53	7.8	612	19.8	25.4	351	-189			
8/9/2011			Cycle 3	Recovery	0.01972	90.9	1.97	0.16	55	7.76	612	20.2	25.1	340	-187.6	135	14	0.001U
8/11/2011			Cycle 3	Recovery	0.01873	90.3	1.86	0.13	47	7.84	610	23	25.7	353	-196.1			
8/16/2011			Cycle 3	Recovery	0.01731	95.8	2.29	0.12	50	7.81	619	24.2	25.9	346	-232.2	134	13	0.001U
8/18/2011			Cycle 3	Recovery	0.01674	94.3	2.56	0.11	48	7.81	625	24	25.8	356	-208.2			
TOTAL	291	584.411	Cycle 3	**Cumlative Recharge**														
		329.056	Cycle 3	**Cumlative Recovered**														
		255.355	Cycle 3	**Net Storage**														
Total Days	539																	

Cycle Testing Laboratory Results
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LF-MW-1				Parameter:	Total Alkalinity	TTHM	Gross Alpha	Uranium	Ammonia	Calcium	Color	HCO$_3$	Hydrogen Sulfide	Phosphate	Silica	Total Organic Carbon	Turbidity	Molybdenum	Fluoride
				Units:	mg/L as CaCO$_3$	ug/L	pCi/L	pCi/L	mg/L	mg/L	Std. Color Units	mg/L	mg/L	mg/L	mg/L as Si	mg/L	NTU	ug/L	mg/L
				MCL:	NA	80	15	20											
Date	Days	Volume	Cycle	Stage	value	value	value	value	value	value	value	value	value	value	value	value	value	value	value
7/28/2009			Background		105	0.14U	2.1	1.05U	0.23	34	8	128	0.8	0.068	16.2	1.65	0.35	0.136	0.136
10/14/2009			Background																
2/2/2010	28	116.535	Pre-Cycle Injection	Recharge													0.2		
2/4/2010			Pre-Cycle Injection	Recharge													0.3		
2/9/2010			Pre-Cycle Injection	Recharge													0.4		
2/11/2010			Pre-Cycle Injection	Recharge													0.3		
2/16/2010			Pre-Cycle Injection	Recharge													0.3		
2/18/2010			Pre-Cycle Injection	Recharge													0.25		
2/23/2010			Pre-Cycle Injection	Recharge													0.3		
2/25/2010			Pre-Cycle Injection	Recharge															
3/2/2010	25	63.256	Pre-Cycle Injection	Recharge													0.36		
3/4/2010			Pre-Cycle Injection	Recharge													0.40		
3/9/2010			Pre-Cycle Injection	Recharge													0.17		
3/11/2010			Pre-Cycle Injection	Recharge													0.35		
3/16/2010			Pre-Cycle Injection	Recharge													0.17		
3/18/2010			Pre-Cycle Injection	Recharge													0.17		
3/23/2010			Pre-Cycle Injection	Recharge													0.25		
3/25/2010			Pre-Cycle Injection	Recharge													0.31		
TOTAL	53	179.791	Pre-Cycle Injection	Cumlative Recharge															
			Pre-Cycle Injection																
			Pre-Cycle Injection																
3/30/2010	6	29.573	Cycle 1	Recharge													0.25		
4/1/2010			Cycle 1	Recharge													0.3		
4/6/2010			Cycle 1	Recharge													0.2		
4/8/2010	14		Cycle 1	Storage													0.1		
4/13/2010			Cycle 1	Storage	130	62.46	2.6+/-1.3	1.5+/-1.0	0.02U	45	8	159	0.1U	0.051	4.9	1.88	0.1		
4/15/2010			Cycle 1	Storage													0.15		
4/20/2010			Cycle 1	Storage	133				0.02U	45		162	0.1U	0.044	4.9		0.15		
4/22/2010	2	2.597	Cycle 1	Recovery	134	59.33	2.2U	0.5U	0.02U	47	8	163	0.1U	0.042	5.6	1.66	0.1		
4/27/2010	39		Cycle 1	Storage	133	54.7	1.7+/-1.3	0.5U	0.02U	48	5	162	0.1U	0.044	5.4	1.73	0.1		
4/30/2010			Cycle 1	Storage													0.1		
5/4/2010			Cycle 1	Storage	138	55.96	3.7+/-2.1	0.7U	0.02U	47	8	168	0.1U	0.038	5	1.86	0.15		
5/6/2010			Cycle 1	Storage													0.15		
5/11/2010			Cycle 1	Storage	139	40.88	1.9U	0.6U	0.02	49	8	170	0.1U	0.038	5.9	1.62	0.15		
5/13/2010			Cycle 1	Storage													0.1		
5/17/2010			Cycle 1	Storage	139	31.81	1.9U	0.6U	0.03	47	8	170	0.1U	0.032	5.1	1.65	0.4		
5/20/2010			Cycle 1	Storage													0.2		
5/25/2010			Cycle 1	Storage	140	19.21	3.2+/-1.8	0.5U	0.02U	48	5	171	0.1U	0.04	5.2	1.69	0.1U		
5/27/2010			Cycle 1	Storage													0.15		
6/1/2010	8		Cycle 1	Storage	140	7.2	2.6+/-1.8	0.7U	0.02U	47	5	171	0.1U	0.045	4.8	1.8	0.2		
6/3/2010			Cycle 1	Storage													0.2		
6/8/2010			Cycle 1	Storage	137	2.24	1.6U	0.7U	0.02U	45	8	167	0.1U	0.05	4.9	1.61	0.15		
6/10/2010	13	26.54	Cycle 1	Recovery													0.15		
6/15/2010			Cycle 1	Recovery	134	0.43	3.7+/-1.7	0.6U	0.12	45	5	163	0.1U	0.044	5.6	1.57	0.2		
6/17/2010			Cycle 1	Recovery													0.15		
6/22/2010	6		Cycle 1	Storage	134	0.3	3.2+/-1.8	0.6U	0.14	44	5	163	0.1U	0.043	5.4	1.66	0.35		
6/24/2010			Cycle 1	Storage													0.1U		0.379
TOTAL	88	209.364	Cycle 1	Cumlative Recharge															
		29.137	Cycle 1	Cumlative Recovered															
		186.875	Cycle 1	Net Storage															
6/29/2010	44	105.000	Cycle 2	Recharge	126	30.36	1.5+/-1.3	1.2+/-0.7	0.04	42	8	154	0.1U	0.034	5	1.91	0.3		0.298
7/1/2010			Cycle 2	Recharge													0.3		0.485
7/6/2010			Cycle 2	Recharge	125	53.36	1.8U	0.5U	0.03	43	2	150	0.1U	0.042	5.4	1.83	0.1		0.69
7/8/2010			Cycle 2	Recharge													0.15		0.749
7/13/2010			Cycle 2	Recharge	124	55.18	1.7U	0.5+/-0.5	0.01U	42	2	149	0.1U	0.043	5.5	1.82	0.1		0.783
7/15/2010			Cycle 2	Recharge													0.15		0.816
7/20/2010			Cycle 2	Recharge	122	54.61	2.1+/-1.4	0.5U	0.01U	43	2	146	0.1U	0.048	5.3	1.92	0.35		0.786
7/22/2010			Cycle 2	Recharge													0.65		0.825
7/27/2010			Cycle 2	Recharge	130	58.02	1.4U	0.6U	0.01	42	2	156	0.1U	0.052	5.4	1.77	0.2		0.822
7/29/2010			Cycle 2	Recharge													0.2		0.793
8/3/2010			Cycle 2	Recharge	125	54.11	1.8U	0.5U	0.01U	44	2	150	0.1U	0.051	5.2	1.8	0.15		0.811
8/5/2010			Cycle 2	Recharge													0.15		0.812

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LF-MW-1				Parameter:	Total Alkalinity	TTHM	Gross Alpha	Uranium	Ammonia	Calcium	Color	HCO₃	Hydrogen Sulfide	Phosphate	Silica	Total Organic Carbon	Turbidity	Molybdenum	Fluoride
				Units:	mg/L as CaCO₃	ug/L	pCi/L	pCi/L	mg/L	mg/L	Std. Color Units	mg/L	mg/L	mg/L	mg/L as Si	mg/L	NTU	ug/L	mg/L
				MCL:	NA	80	15	20											
Date	Days	Volume	Cycle	Stage	value	value	value	value	value	value	value	value	value	value	value	value	value	value	value
8/10/2010			Cycle 2	Storage	127	57.61	2.6+/-1.4	0.6U	0.01U	42	2	152	0.1U	0.052	5.5	1.8	0.25		0.844
8/12/2010	35		Cycle 2	Storage													0.25		0.776
8/17/2010			Cycle 2	Storage	134	58.86	2.0U	0.6U	0.01U	53	5	161	0.1U	0.044	5.3	1.74	0.2		0.756
8/19/2010			Cycle 2	Storage													0.2		0.751
8/24/2010			Cycle 2	Storage	136	49.63	4.5+/-1.8	0.7U	0.01	47	2	166	0.1U	0.043	5.3	1.71	0.15		0.737
8/26/2010			Cycle 2	Storage													0.2		0.741
8/31/2010			Cycle 2	Storage	136	37.48	1.6U	0.6U	0.01	50	5	166	0.1U	0.042	5.2	1.78	0.15		0.737
9/2/2010			Cycle 2	Storage													0.15		0.742
9/7/2010			Cycle 2	Storage	138	25.75	3.5+/-1.6	0.7	0.01	47	5	168	0.1U	0.041	5.2	1.74	0.15		0.709
9/9/2010			Cycle 2	Storage													0.4		0.741
9/14/2010			Cycle 2	Storage	139	17.08	2.4+/-1.6	0.5U	0.02	50	5	170	0.1U	0.035	5.4	1.77	0.15		0.698
9/16/2010			Cycle 2	Storage													0.25		0.705
9/21/2010	28		Cycle 2	Recovery	137	5.99	3.2+/-1.4	0.5U	0.04	46	5	167	0.1U	0.035	5.3	1.75	0.15		0.669
9/23/2010			Cycle 2	Recovery													0.2		0.638
9/28/2010			Cycle 2	Recovery	136	0.07U	6.1+/-2.1	0.9	0.05	46	5	166	0.1U	0.039	5.6	1.7	0.1U		0.57
9/30/2010			Cycle 2	Recovery													0.2		0.574
10/5/2010			Cycle 2	Recovery	134	0.05U	6.0+/-2.0	0.8	0.07	50	5	163	0.1U	0.035	5.7	1.64	0.1		0.511
10/7/2010			Cycle 2	Recovery													0.35		0.499
10/12/2010			Cycle 2	Recovery	135	0.05U	2.8+/-1.4	0.5U	0.07	44	5	165	0.1U	0.036	5.3	1.58	0.15		0.448
10/14/2010			Cycle 2	Recovery													0.15		0.459
10/19/2010	16		Cycle 2	Storage	134	0.05U	1.3+/-0.8	0.6U	0.08	47	5	161	0.1U	0.037	6	1.6	0.1		0.465
10/21/2010			Cycle 2	Storage													0.15		0.456
10/26/2010			Cycle 2	Storage	135	38.95	1.9+/-1.4	0.4	0.18	48	5	165	0.1U	0.042	5.6	1.62	0.2		0.461
10/28/2010			Cycle 2	Storage													0.2		0.467
			Cycle 2	Storage															
TOTAL	107	314.364	Cycle 2	**Cumlative Recharge**															
		59.055	Cycle 2	**Cumlative Recovered**															
		255.309	Cycle 2	**Net Storage**															
11/2/2010	112	72.188	Cycle 3	Recharge	128	27.36	1.5U	0.7U	0.03	42	5	156	1.3	0.034	5.6	1.81	0.2		0.706
11/4/2010			Cycle 3	Recharge													0.15		0.763
11/9/2010			Cycle 3	Recharge	128	54.14	1.5U	0.7U	0.01U	46	2	156	0.1U	0.044	6	1.74	0.2		0.794
11/11/2010			Cycle 3	Recharge													0.15		0.79
11/16/2010			Cycle 3	Recharge	128	59.39	1.5U	0.6U	0.01	43	2	148	0.1U	0.043	5.7	1.67	0.2		0.782
11/18/2010			Cycle 3	Recharge													0.25		0.822
11/22/2010			Cycle 3	Recharge	127	61.67	2.8+/-1.7	0.5U	0.01U	42	1U	155	0.1U	0.047	5.2	1.71	0.3		0.796
11/24/2010			Cycle 3	Recharge													0.2		0.811
11/30/2010			Cycle 3	Recharge	125	54.75	3.4+/-1.4	0.7+/-0.6	0.01U	43	5	152	0.1U	0.035	5.6	1.71	0.8		0.825
12/2/2010			Cycle 3	Recharge													0.25		0.83
12/7/2010			Cycle 3	Recharge	127	61.84	1.4+/-1.1	0.4U	0.01U	41	2	155	0.1U	0.06	5.6	1.78	0.15		0.892
12/9/2010			Cycle 3	Recharge													0.25		0.886
12/14/2010			Cycle 3	Recharge	127	61.75	1.5U	0.5U	0.01U	36	2	155	0.1U	0.051	5.6	1.73	0.2		0.811
12/16/2010			Cycle 3	Recharge													0.2		0.834
12/20/2010			Cycle 3	Recharge	124	57.3	1.5+/-0.7	0.5U	0.01U	38	8	151	0.1U	0.06	4.9	1.73	0.15		0.815
12/22/2010			Cycle 3	Recharge													0.2		0.756
12/28/2010			Cycle 3	Recharge	127	58.5	2.0U	0.4U	0.01U	41	2	155	0.1U	0.006U	5.5	7.26	0.25		0.752
12/30/2010			Cycle 3	Recharge													0.2		0.784
1/4/2011			Cycle 3	Recharge	125	53.9	1.5U	0.6U	0.01U	39	2	152	0.1U	0.04	5.4	1.85	0.15		0.43
1/6/2011			Cycle 3	Recharge													0.25		0.802
1/11/2011			Cycle 3	Recharge	126	64.67	1.0+/-0.8	0.6U	0.01U	43	2	154	0.1U	0.006U	5.8	1.85	0.4		0.767
1/13/2011			Cycle 3	Recharge													0.2		0.868
1/18/2011			Cycle 3	Recharge	129	61.14	1.6U	0.5U	0.04	42	2	157	0.1U	0.006U	5.2	1.88	0.2		0.264

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LF-MW-1				Parameter:	Total Alkalinity	TTHM	Gross Alpha	Uranium	Ammonia	Calcium	Color	HCO_3	Hydrogen Sulfide	Phosphate	Silica	Total Organic Carbon	Turbidity	Molybdenum	Fluoride
				Units:	mg/L as $CaCO_3$	ug/L	pCi/L	pCi/L	mg/L	mg/L	Std. Color Units	mg/L	mg/L	mg/L	mg/L as Si	mg/L	NTU	ug/L	mg/L
				MCL:	NA	80	15	20											
Date	**Days**	**Volume**	**Cycle**	**Stage**	**value**	**value**	**value**	**value**	**value**	**value**	**value**	**value**	**value**	**value**	**value**	**value**	**value**	**value**	**value**
1/20/2011			Cycle 3	Recharge													0.25		0.762
1/25/2011			Cycle 3	Recharge	125	55.98	1.6+/-1.2	0.7U	0.02	39	2	152	0.1U	0.087	5.5	1.69	0.25		0.839
1/27/2011			Cycle 3	Recharge													0.6		0.889
2/1/2011			Cycle 3	Recharge	126	65.52	1.7+/-1.3	0.5U	0.01U	40	10	154	0.1U	0.065	5.3	1.71	0.15		0.902
2/3/2011			Cycle 3	Recharge													0.2		0.931
2/8/2011			Cycle 3	Recharge	123	59.94	1.9+/-1.5	0.5U	0.03	40	2	150	0.1U	0.044	5.5	1.82	0.25		0.812
2/10/2011			Cycle 3	Recharge													0.15		0.799
2/15/2011			Cycle 3	Recharge	126	48.35	2.1U	0.4+/-0.4	0.03	41	2	154	0.1U	0.033	5.4	1.79	0.2		0.826
2/17/2011			Cycle 3	Recharge													0.25		0.673
2/22/2011	45		Cycle 3	Storage	126	54.22	2.2+/-1.4	0.6U	0.02U	44	2	154	0.1U	0.039	0.99	1.83	0.2		0.787
2/24/2011			Cycle 3	Storage													0.2		0.79
3/1/2011			Cycle 3	Storage	132	56.76	2.2+/-1.5	0.6+/-0.6	0.02U	46	5	161	0.1U	0.062	5.2	1.89	0.45		0.753
3/3/2011			Cycle 3	Storage													0.1		0.789
3/8/2011			Cycle 3	Storage	133	42.4	2.5+/-1.7	0.5U	0.02U	49	8	162	0.1U	0.032	5.8	1.83	0.3		0.7
3/10/2011			Cycle 3	Storage													0.2		0.78
3/15/2011			Cycle 3	Storage	138	38.7	2.0+/-1.4	0.5U	0.02U	50	5	168	0.1U	0.046	5.4	1.88	0.15		0.76
3/17/2011			Cycle 3	Storage													0.25		0.77
3/22/2011			Cycle 3	Storage	136	32.23	2.0U	0.5U	0.05	50	5	166	0.1U	0.045	5.2	1.95	0.2		0.7
3/24/2011			Cycle 3	Storage													0.25		0.709
3/29/2011			Cycle 3	Storage	137	26.24	4.0+/-1.9	0.5U	0.02	54	5	167	0.1U	0.046	5.7	1.94	0.25		0.686
3/31/2011			Cycle 3	Storage													0.2		0.715
4/5/2011			Cycle 3	Storage	145	0.09	2.9+/-1.6	0.5U	0.02	50	5	177	0.1U	0.054	5.4	1.77	0.3		0.72
4/7/2011	134	270.001	Cycle 3	Recovery													0.2		0.717
4/12/2011			Cycle 3	Recovery	138	2.11	1.9U	0.4U	0.02	50	5	168	0.1U	0.052	5.6	1.57	0.3		0.688
4/14/2011			Cycle 3	Recovery													0.15		0.674
4/19/2011			Cycle 3	Recovery	136	0.05U	3.5+/-2.0	0.5+/-0.5	0.03	48	8	166	0.1U	0.046	5.2	1.52	0.1	0.6	0.681
4/21/2011			Cycle 3	Recovery													0.1		0.6
4/26/2011			Cycle 3	Recovery	134	0.17	1.8+/-1.5	0.4+/-0.4	0.09	45	5	163	0.1U	0.042	5.2	1.59	0.2		0.554
4/28/2011			Cycle 3	Recovery													0.1U		0.537
5/3/2011			Cycle 3	Recovery	129	0.19	3.0+/-1.7	0.9+/-0.4	0.09	44	2	157	0.1	0.042	5.9	1.88	0.2		0.464
5/5/2011			Cycle 3	Recovery													0.1		0.416
5/10/2011			Cycle 3	Recovery	132	0.05U	1.9+/-1.5	0.6U	0.11	38	8	161	0.1U	0.027	4	1.8	0.15		0.385
5/12/2011			Cycle 3	Recovery													0.1		0.443
5/17/2011			Cycle 3	Recovery	133	0.05U	2.0U	0.5U	0.1	44	5	162	0.1U	0.048	5.5	1.6	0.1		0.421
5/19/2011			Cycle 3	Recovery													0.1		0.403
5/24/2011			Cycle 3	Recovery	133	0.05U	2.4+/-1.4	0.6U	0.14	44	8	162	0.1	0.053	5.6	1.88	0.35		0.408
5/26/2011			Cycle 3	Recovery													0.15		0.395
6/3/2011			Cycle 3	Recovery	130	0.31	2.7+/-1.5	0.5U	0.14	45	2	159	0.1	0.049	5.4	1.76	0.1U		0.368
6/7/2011			Cycle 3	Recovery	132	0.3	2.1+/-1.4	0.6U	0.14	47	2	161	0.2	0.05	5.8	1.83	0.15		0.374
6/9/2011			Cycle 3	Recovery													0.2		0.366
6/14/2011			Cycle 3	Recovery	134	0.32	2.0+/-1.6	0.6U	0.13	46	2	163	0.2	0.056	6	1.72	0.2		0.344
6/16/2011			Cycle 3	Recovery													0.2		0.344
6/21/2011			Cycle 3	Recovery	133	0.32	2.2U	0.7U	0.15	48	2	162	0.5	0.062	5.4	1.77	0.2		0.361
6/23/2011			Cycle 3	Recovery													0.3		0.251
6/28/2011			Cycle 3	Recovery	138	0.31	2.6+/-1.9	1.8+-/0.8	0.15	46	2	168	0.1	0.053	5.7	1.63	0.1		0.331
6/30/2011			Cycle 3	Recovery													0.1		0.314
7/5/2011			Cycle 3	Recovery	133	0.05U	3.2+/-2.0	0.6U	0.13	46	5	162	0.5	0.053	6.3	1.64	0.4		0.289
7/7/2011			Cycle 3	Recovery													0.15		0.264
7/12/2011			Cycle 3	Recovery	135	0.05U	2.0+/-1.0	0.5U	0.14	47	2	165	0.2	0.05	6.1	1.71	0.1		0.29
7/14/2011			Cycle 3	Recovery													0.15		0.239
7/19/2011			Cycle 3	Recovery	133	0.05U	2.2U	0.4U	0.16	47	2	162	0.3	0.04	6.1	1.69	0.15		0.334
7/21/2011			Cycle 3	Recovery													0.2		0.245
7/26/2011			Cycle 3	Recovery	134	0.05U	2.4+/-1.2	0.4U	0.26	47	2	163	0.2	0.049	6.1	1.59	0.15		0.254
7/28/2011			Cycle 3	Recovery													0.2		0.244
8/2/2011			Cycle 3	Recovery	133	0.05U	3.0+/-2.0	0.5+/-0.5	0.19	49	5	162	0.1	0.058	6.2	1.29	0.15		0.248
8/4/2011			Cycle 3	Recovery													0.15		0.294
8/9/2011			Cycle 3	Recovery	135	0.05U	2.4+/-0.8	0.5U	0.2	49	2	165	0.1	0.043	5.2	1.25	0.3		0.285
8/11/2011			Cycle 3	Recovery													0.15		0.277
8/16/2011			Cycle 3	Recovery	134	0.05U	2.3U	0.5U	0.2	44	2	163	0.1U	0.062	5.2	1.6	0.2		0.28
8/18/2011			Cycle 3	Recovery													0.1		0.278
TOTAL	291	584.411	Cycle 3	**Cumlative Recharge**															
		329.056	Cycle 3	**Cumlative Recovered**															
		255.355	Cycle 3	**Net Storage**															
Total Days	539																		

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LF-MW-2				Parameter:	Total Alkalinity	TTHM	Gross Alpha	Uranium	Ammonia	Calcium	Color	HCO_3	Hydrogen Sulfide	Phosphate	Silica	Total Organic Carbon	Turbidity	Molybdenum	Fluoride
				Units:	mg/L as $CaCO_3$	ug/L	pCi/L	pCi/L	mg/L	mg/L	Std. Color Units	mg/L	mg/L	mg/L	mg/L as Si	mg/L	NTU	mg/L	mg/L
				MCL:	NA	80	15	20											
Date	Days	Volume	Cycle	Stage	value	value	value	value	value	value	value	value	value	value	value	value	value	value	value
7/28/2009			Background		105	0.14U	1.5U	0.9U	0.22	36	8	128	0.1U	0.03	9.4	1.6	0.15	0.081	0.081
10/14/2009			Background																
2/2/2010	28	116.535	Pre-Cycle Injection	Recharge													0.1		
2/4/2010			Pre-Cycle Injection	Recharge													0.15		
2/9/2010			Pre-Cycle Injection	Recharge													0.1U		
2/11/2010			Pre-Cycle Injection	Recharge													0.1		
2/16/2010			Pre-Cycle Injection	Recharge													0.1		
2/18/2010			Pre-Cycle Injection	Recharge													0.1		
2/23/2010			Pre-Cycle Injection	Recharge													0.15		
2/25/2010			Pre-Cycle Injection	Recharge															
3/2/2010	25	63.256	Pre-Cycle Injection	Recharge													0.15		
3/4/2010			Pre-Cycle Injection	Recharge													0.13		
3/9/2010			Pre-Cycle Injection	Recharge													0.11		
3/11/2010			Pre-Cycle Injection	Recharge													0.09		
3/16/2010			Pre-Cycle Injection	Recharge													0.12		
3/18/2010			Pre-Cycle Injection	Recharge													0.14		
3/23/2010			Pre-Cycle Injection	Recharge													0.1		
3/25/2010			Pre-Cycle Injection	Recharge													0.1		
TOTAL	53	179.791	Pre-Cycle Injection	Cumulative Recharge															
			Pre-Cycle Injection																
			Pre-Cycle Injection																
3/30/2010	6	29.573	Cycle 1	Recharge													0.1		
4/1/2010			Cycle 1	Recharge													0.15		
4/6/2010			Cycle 1	Recharge													0.1U		
4/8/2010	14		Cycle 1	Storage													0.1U		
4/13/2010			Cycle 1	Storage	131	12.44	2.2U	2.0+/-0.9	0.1	43	5	160	0.2	0.044	5.1	1.6	0.1		
4/15/2010			Cycle 1	Storage													0.1U		
4/20/2010			Cycle 1	Storage	131				0.11	41		160	0.2	0.038	5.1		0.1		
4/22/2010	2	2.597	Cycle 1	Recovery	134	1.58	3.5+/-1.6	0.6U	0.14	46	2	163	0.2	0.042	6.1	1.6	0.1		
4/27/2010	39		Cycle 1	Storage	131	0.07U	1.5U	0.5U	0.16	46	5	160	0.4	0.042	6	1.62	0.1		
4/30/2010			Cycle 1	Storage													0.1U		
5/4/2010			Cycle 1	Storage	132	0.07U	3.5+/-2.2	0.5U	0.12	44	2	161	0.3	0.057	5.6	1.6	0.1U		
5/6/2010			Cycle 1	Storage													0.15		
5/11/2010			Cycle 1	Storage	129	0.16	1.8U	0.4U	0.18	46	5	157	0.4	0.05	5.4	1.48	0.1		
5/13/2010			Cycle 1	Storage													0.1		
5/17/2010			Cycle 1	Storage	132	0.07U	1.6U	0.5U	0.15	46	5	161	0.3	0.007U	5.9	1.52	0.25		
5/20/2010			Cycle 1	Storage													0.1U		
5/25/2010			Cycle 1	Storage	133	0.07U	2.3+/-1.6	0.7U	0.15	44	2	162	0.3	0.036	5.7	1.54	0.1U		
5/27/2010			Cycle 1	Storage													0.1		
6/1/2010	8		Cycle 1	Storage	131	0.07U	2.0+/-1.6	0.5U	0.16	43	2	160	1	0.202	5.5	1.58	0.1U		
6/3/2010			Cycle 1	Storage													0.1		
6/8/2010			Cycle 1	Storage	130	0.07U	1.6U	0.5U	0.18	43	2	159	1	0.045	5.7	1.5	0.15		
6/10/2010	13	26.54	Cycle 1	Recovery													0.15		
6/15/2010			Cycle 1	Recovery	136	0.07U	1.9+/-1.4	0.5U	0.23	47	2	166	1.1	0.044	5.7	1.66	0.1		
6/17/2010			Cycle 1	Recovery													0.1		
6/22/2010	6		Cycle 1	Storage	134	0.07U	1.8U	0.6U	0.23	44	2	163	1	0.036	5.9	1.63	0.45		
6/24/2010			Cycle 1	Storage													0.1		0.238
TOTAL	88	209.364	Cycle 1	Cumlative Recharge															
		29.573	Cycle 1	Cumlative Recovered															
		186.875	Cycle 1	Net Storage															
6/29/2010	44	105.000	Cycle 2	Recharge	136	0.07U	2.1U	0.6U	0.28	47	8	166	0.9	0.039	6	1.85	0.1		0.247
7/1/2010			Cycle 2	Recharge													0.1		0.266
7/6/2010			Cycle 2	Recharge	134	6.61	2.1U	0.5U	0.2	47	5	161	0.4	0.039	5.8	1.74	0.2		0.292
7/8/2010			Cycle 2	Recharge													0.1		0.325
7/13/2010			Cycle 2	Recharge	135	14.9	1.9+/-1.3	0.5U	0.14	45	2	165	1	0.034	5.6	1.65	0.15		0.379
7/15/2010			Cycle 2	Recharge													0.2		0.426
7/20/2010			Cycle 2	Recharge	129	2.26	1.4U	0.6U	0.13	47	5	155	0.5	0.036	5.6	1.89	0.25		0.426
7/22/2010			Cycle 2	Recharge													0.75		0.479
7/27/2010			Cycle 2	Recharge	142	3.02	1.8+/-1.3	0.7U	0.12	44	2	170	0.4	0.039	5.4	1.61	0.15		0.504
7/29/2010			Cycle 2	Recharge													0.25		0.48
8/3/2010			Cycle 2	Recharge	135	0.52	1.3U	0.6U	0.11	46	2	165	0.3	0.038	5.1	1.69	0.15		0.505

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LF-MW-2				Parameter:	Total Alkalinity	TTHM	Gross Alpha	Uranium	Ammonia	Calcium	Color	HCO_3	Hydrogen Sulfide	Phosphate	Silica	Total Organic Carbon	Turbidity	Molybdenum	Fluoride
				Units:	mg/L as $CaCO_3$	ug/L	pCi/L	pCi/L	mg/L	mg/L	Std. Color Units	mg/L	mg/L	mg/L	mg/L as Si	mg/L	NTU	mg/L	mg/L
				MCL:	NA	80	15	20											
Date	Days	Volume	Cycle	Stage	value	value	value	value	value	value	value	value	value	value	value	value	value	value	value
8/5/2010			Cycle 2	Recharge													0.1		0.506
8/10/2010	35		Cycle 2	Storage	135	0.39	1.7+/-1.3	0.6U	0.11	46	2	165	0.2	0.038	5.6	1.69	0.2		0.526
8/12/2010			Cycle 2	Storage													0.3		0.475
8/17/2010			Cycle 2	Storage	134	0.07U	3.7+/-2.0	0.6U	0.13	45	2	161	0.2	0.036	5.5	1.54	0.1		0.46
8/19/2010			Cycle 2	Storage													0.1		0.46
8/24/2010			Cycle 2	Storage	133	0.07U	4.0+/-1.7	0.7U	0.15	45	2	162	0.4	0.037	5.7	1.54	0.1		0.441
8/26/2010			Cycle 2	Storage													0.15		0.439
8/31/2010			Cycle 2	Storage	133	0.07U	1.7+/-1.1	0.6U	0.14	47	1U	162	0.3	0.037	5.3	1.6	0.1		0.432
9/2/2010			Cycle 2	Storage													0.2		0.007U
9/7/2010			Cycle 2	Storage	133	0.07U	1.6+/-1.3	0.5U	0.13	42	2	162	0.3	0.038	5.2	1.62	0.15		0.42
9/9/2010			Cycle 2	Storage													0.15		0.422
9/14/2010			Cycle 2	Storage	133	0.07U	2.0+/-1.6	0.4U	0.17	47	2	162	0.4	0.064	5.9	1.59	0.15		0.398
9/16/2010			Cycle 2	Storage													0.1		0.397
9/21/2010	28	29.918	Cycle 2	Recovery	136	0.07U	2.7+/-1.6	0.6U	0.19	42	2	166	0.5	0.033	5.4	1.6	0.1U		0.386
9/23/2010			Cycle 2	Recovery													0.4		0.371
9/28/2010			Cycle 2	Recovery	137	0.07U	1.9+/-1.8	0.5	0.19	47	2	167	0.8	0.044	6.1	1.63	0.15		0.351
9/30/2010			Cycle 2	Recovery													0.2		0.344
10/5/2010			Cycle 2	Recovery	132	0.05U	1.7+/-1.4	0.5U	0.2	45	2	161	1	0.037	5.7	1.6	0.1		0.334
10/7/2010			Cycle 2	Recovery													0.3		0.32
10/12/2010			Cycle 2	Recovery	135	0.05U	4.1+/-1.7	0.5U	0.19	46	2	165	1.2	0.035	5.7	1.59	0.1		0.297
10/14/2010			Cycle 2	Recovery													0.15		0.294
10/19/2010	16		Cycle 2	Storage	134	0.05U	1.4U	0.6U	0.21	48	2	161	1.3	0.041	6	1.52	0.15		0.304
10/21/2010			Cycle 2	Storage													0.25		0.294
10/26/2010			Cycle 2	Storage	132	0.05U	1.6U	0.6U	0.2	48	2	158	2.4	0.041	6	1.57	0.15		0.294
10/28/2010			Cycle 2	Storage													0.15		0.303
			Cycle 2	Storage															
TOTAL	107	314.364	Cycle 2	**Cumlative Recharge**															
		59.055	Cycle 2	**Cumlative Recovered**															
		255.309	Cycle 2	**Net Storage**															
11/2/2010	112	270.047	Cycle 3	Recharge	140	0.05U	1.8U	0.5U	0.19	44	5	171	0.1U	0.038	5.7	1.62	0.1		0.31
11/4/2010			Cycle 3	Recharge													0.1		0.322
11/9/2010			Cycle 3	Recharge	138	5.81	2.0+/-1.3	0.6U	0.17	46	2	168	0.8	0.037	5.9	1.62	0.15		0.391
11/11/2010			Cycle 3	Recharge													0.2		0.419
11/16/2010			Cycle 3	Recharge	134	19.81	2.9+/-1.8	0.6U	0.13	46	2	163	0.6	0.032	5.7	1.54	0.3		0.453
11/18/2010			Cycle 3	Recharge													0.2		0.469
11/22/2010			Cycle 3	Recharge	136	19.77	1.8U	0.6U	0.12	46	5	166	0.4	0.033	5.6	1.55	0.25		0.476
11/24/2010			Cycle 3	Recharge													0.2		0.501
11/30/2010			Cycle 3	Recharge	134	11.09	2.0+/-1.2	0.5U	0.11	42	2	163	0.3	0.064	5.3	1.53	0.15		0.505
12/2/2010			Cycle 3	Recharge													0.3		0.516
12/7/2010			Cycle 3	Recharge	135	7.25	3.1+/-1.6	0.5U	0.1	34	5	165	0.5	0.1	4.1	1.61	0.35		0.566
12/9/2010			Cycle 3	Recharge													0.25		0.57
12/14/2010			Cycle 3	Recharge	135	3.7	2.3+/-1.4	0.5U	0.08	45	2	165	0.3	0.039	5.2	1.57	0.15		0.531
12/16/2010			Cycle 3	Recharge													0.25		0.551
12/20/2010			Cycle 3	Recharge	135	2.15	2.7+/-1.2	0.6U	0.07	42	5	165	0.4	0.047	5	1.62	0.15		0.538
12/22/2010			Cycle 3	Recharge													0.15		0.501
12/28/2010			Cycle 3	Recharge	137	2.2	2.3U	0.5U	0.06	44	2	167	0.6	0.006U	5.2	1.61	0.15		0.508
12/30/2010			Cycle 3	Recharge													0.15		0.524
1/4/2011			Cycle 3	Recharge	136	2.12	2.8+/-1.6	0.5U	0.1	43	0	166	0.3	0.025	5	1.71	0.2		0.782
1/6/2011			Cycle 3	Recharge													0.25		0.543
1/11/2011			Cycle 3	Recharge	139	4.47	1.7+/-1.0	0.6U	0.07	46	5	170	0.3	0.006U	5.7	1.65	0.3		0.518
1/13/2011			Cycle 3	Recharge													0.15		0.575
1/18/2011			Cycle 3	Recharge	138	4.48	4.2+/-1.8	0.6U	0.08	45	12	168	0.3	0.006U	5.4	1.68	0.2		0.514
1/20/2011			Cycle 3	Recharge													0.2		0.42
1/25/2011			Cycle 3	Recharge	131	5.77	1.8U	0.6U	0.07	39	2	160	0.3	0.071	5.5	1.64	0.2		0.485

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LF-MW-2				Parameter:	Total Alkalinity	TTHM	Gross Alpha	Uranium	Ammonia	Calcium	Color	HCO_3	Hydrogen Sulfide	Phosphate	Silica	Total Organic Carbon	Turbidity	Molybdenum	Fluoride
				Units:	mg/L as $CaCO_3$	ug/L	pCi/L	pCi/L	mg/L	mg/L	Std. Color Units	mg/L	mg/L	mg/L	mg/L as Si	mg/L	NTU	mg/L	mg/L
				MCL:	NA	80	15	20											
Date	Days	Volume	Cycle	Stage	value	value	value	value	value	value	value	value	value	value	value	value	value	value	value
1/27/2011			Cycle 3	Recharge													0.2		0.518
2/1/2011			Cycle 3	Recharge	133	8.27	2.4U	0.7U	0.14	44	12	162	0.1	0.052	5.2	1.59	0.15		0.565
2/3/2011			Cycle 3	Recharge													0.1		0.597
2/8/2011			Cycle 3	Recharge	131	9.74	1.8+/-1.5	0.7U	0.12	44	2	160	0.5	0.035	5.4	1.65	0.3		0.555
2/10/2011			Cycle 3	Recharge													0.15		0.561
2/15/2011			Cycle 3	Recharge	134	11.01	1.8U	0.6U	0.13	46	2	163	0.2	0.016	5.5	1.62	0.15		0.546
2/17/2011			Cycle 3	Recharge													0.2		0.549
2/22/2011			Cycle 3	Storage	133	1.77	2.1+/-1.4	0.5U	0.1	46	2	162	0.3	0.027	5.5	1.64	0.15		0.543
2/24/2011			Cycle 3	Storage													0.15		0.536
3/1/2011			Cycle 3	Storage	134	0.33	2.0U	0.6U	0.09	46	5	163	0.2	0.05	5.6	1.57	0.25		0.508
3/3/2011			Cycle 3	Storage													0.2		0.522
3/8/2011			Cycle 3	Storage	131	0.15	1.5+/-1.2	0.7U	0.1	51	5	160	0.3	0.023	5.8	1.56	0.25		0.461
3/10/2011			Cycle 3	Storage													0.15		0.511
3/15/2011	45		Cycle 3	Storage	134	0.05U	2.4U	0.6U	0.1	45	5	163	0.2	0.046	5.3	1.57	0.15		0.502
3/17/2011			Cycle 3	Storage													0.25		0.507
3/22/2011			Cycle 3	Storage	132	0.05U	1.7U	0.6U	0.11	46	3	161	0.2	0.039	5.4	1.91	0.15		0.451
3/24/2011			Cycle 3	Storage													0.2		0.47
3/29/2011			Cycle 3	Storage	134	0.05U	2.4+/-1.6	0.5U	0.12	48	2	163	0.3	0.039	5.7	1.63	0.15		0.44
3/31/2011			Cycle 3	Storage													0.2		0.432
4/5/2011			Cycle 3	Storage	141	0.05U	2.1U	0.7U	0.11	47	2	172	0.1U	0.046	5.8	1.46	0.2		0.462
4/7/2011			Cycle 3	Recovery													0.15		0.469
4/12/2011			Cycle 3	Recovery	141	0.05U	1.8+/-1.3	0.4U	0.11	48	2	172	0.1U	0.048	5.9	1.45	0.15		0.446
4/14/2011			Cycle 3	Recovery													0.15		0.465
4/19/2011			Cycle 3	Recovery	132	0.05U	1.7I	0.6U	0.12	50	2	161	0.2	0.023	5.7	1.46	0.1	0.19	0.639
4/21/2011			Cycle 3	Recovery													0.1		0.419
4/26/2011			Cycle 3	Recovery	136	0.05U	2.0U	1.1+/-0.6	0.17	46	2	166	0.1U	0.038	5.5	1.63	0.15		0.39
4/28/2011			Cycle 3	Recovery													0.1		0.388
5/3/2011			Cycle 3	Recovery	133	0.05U	2.4+/-1.3	0.6U	0.17	46	2	162	1.3	0.037	6.1	1.73	0.15		0.352
5/5/2011			Cycle 3	Recovery													0.15		0.294
5/10/2011			Cycle 3	Recovery	131	0.05U	1.5+/-1.2	0.4U	0.2	43	2	160	2.2	0.022	4.2	1.78	0.15		0.304
5/12/2011			Cycle 3	Recovery													0.1		0.31
5/17/2011			Cycle 3	Recovery	131	0.05U	2.4+/-1.7	0.6U	0.2	46	2	160	1.8	0.039	5.6	1.52	0.1		0.304
5/19/2011			Cycle 3	Recovery													0.15		0.302
5/24/2011			Cycle 3	Recovery	131	0.05U	2.3+/-1.2	0.6U	0.21	44	5	160	1.4	0.036	5.9	1.99	0.35		0.296
5/26/2011			Cycle 3	Recovery													0.3		0.302
5/31/2011			Cycle 3	Recovery	131	0.05U	2.3+/-1.5	0.7U	0.18	43	2	160	2.2	0.035	5.6	1.78	0.25		0.284
6/3/2011			Cycle 3	Recovery													0.1		0.29
6/7/2011			Cycle 3	Recovery	131	0.27	2.9+/-1.6	0.7U	0.21	44	2	160	2.8	0.035	5.7	1.69	0.1		0.281
6/9/2011			Cycle 3	Recovery													0.15		0.266
6/14/2011	134	270.001	Cycle 3	Recovery	133	0.29	2.3+/-1.5	0.5U	0.22	46	2	162	2.1	0.041	6	1.68	0.1		0.274
6/16/2011			Cycle 3	Recovery													0.25		0.285
6/21/2011			Cycle 3	Recovery	134	0.29	3.2+/-1.7	0.6U	0.2	45	1U	163	2.3	0.043	5.5	1.71	0.15		0.281
6/23/2011			Cycle 3	Recovery													0.25		0.254
6/28/2011			Cycle 3	Recovery	132	0.26	2.7+/-1.9	1.2+/-0.7	0.2	45	2	161	0.4	0.036	5.8	1.65	0.1		0.245
6/30/2011			Cycle 3	Recovery													0.1		0.252
7/5/2011			Cycle 3	Recovery	131	0.05U	2.2+/-1.6	0.6U	0.18	45	2	160	2.3	0.035	6.2	1.59	0.2		0.23
7/7/2011			Cycle 3	Recovery													0.15		0.222
7/12/2011			Cycle 3	Recovery	135	0.05U	1.9+/-1.2	0.5U	0.21	44	2	165	0.6	0.033	6	1.66	0.1		0.252
7/14/2011			Cycle 3	Recovery													0.15		0.208
7/19/2011			Cycle 3	Recovery	132	0.05U	2.2U	0.4U	0.18	45	2	161	0.4	0.038	5.9	1.64	0.18		0.224
7/21/2011			Cycle 3	Recovery													0.15		0.218
7/26/2011			Cycle 3	Recovery	131	0.05U	2.0+/-1.6	0.5U	0.23	44	2	160	0.5	0.035	6	1.61	0.15		0.215
7/28/2011			Cycle 3	Recovery													0.2		0.217
8/2/2011			Cycle 3	Recovery	133	0.05U	1.7U	0.5U	0.21	43	2	162	0.3	0.043	6.1	1.61	0.1		0.204
8/4/2011			Cycle 3	Recovery													0.15		0.256
8/9/2011			Cycle 3	Recovery	134	0.05U	3.2+/-2.0	0.5U	0.28	48	1U	163	0.1U	0.062	6	1.62	0.3		0.258
8/11/2011			Cycle 3	Recovery													0.15		0.254
8/16/2011			Cycle 3	Recovery	136	0.05U	2.5+/-1.4	0.5U	0.21	41	5	166	0.1U	0.043	5.2	1.68	0.15		0.255
8/18/2011			Cycle 3	Recovery													0.1		0.258
TOTAL	291	584.411	Cycle 3	**Cumlative Recharge**															
		329.056	Cycle 3	**Cumlative Recovered**															
		255.355	Cycle 3	**Net Storage**															
Total Days	539																		

APPENDIX G
CD (Attached)