SPECIAL PUBLICATION SJ2012-SP5

CITY OF DELAND AIRPORT AQUIFER STORAGE AND RECOVERY WELL SYSTEM

EXPANDED EXECUTIVE SUMMARY

ST. JOHNS RIVER WATER MANAGEMENT DISTRICT

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City of DeLand
Airport Aquifer Storage and Recovery Well System

Expanded Executive Summary

September 2011

Project Number : 11437200.00

Prepared by

Cardno ENTRIX
Shaping the Future

Prepared for

City of DeLand Public Services
1102 South Garfield Avenue
DeLand, Florida 32724

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Expanded Executive Summary
City of DeLand ASR Site at Municipal Airport
Aquifer Storage Recovery (ASR) System

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2. Construction & Testing of Exploratory Well EX-1 Airport Site, City of DeLand, Florida, Prepared for: St. Johns River Water Management District. September 2005.
3. Construction & Testing of Exploratory Well EX-2 Delfa Site, City of DeLand, Florida, Prepared for: St. Johns River Water Management District, Contract No. SF408RA. September 2006.
4. Results of Leaching Tests, Compatibility Analyses, and Basis of Design Report for Deland ASR Facilities at the Airport Site, WRS and Boyle Engineering Corp., Prepared for: St. Johns River Water Management District and City of DeLand, Contract No. SF408RA. August 2006.
5. Construction and Testing Permit Application, Class V Pilot ASR System, DeLand Municipal Airport, SJRWMD Contract No. SF408RA, Work Order No. 17. November 2006.
6. FDEP / UIC Permit No. 64-0272120-001, Notice of Completion, May 29, 2007; UIC Permit No. 64-0272120-001; and UIC Permit Modification 64-0272120-002.
7. Administrative Order for FDEP / UIC Permit No. 64-0272120-001
8. Technical Specification for Exploratory Well Drilling, City of Deland Airport Project Site, Prepared for: City of DeLand and St. Johns River Water Management District. May 2008.
9. Technical Specification for Well Drilling, City of Deland Airport Project Site, Prepared for: City of DeLand and St. Johns River Water Management District. May 2008.
10. A. Volume I: ASR Well and Monitor Wells Construction and Testing Report, City of DeLand Aquifer Storage and Recovery Well System, Prepared for: St. Johns River Water Management District ASR Demonstration Project. April 2009.
    B. Volume II: Appendices
11. City of DeLand Airport Site, Aquifer Storage and Recovery Project, Construction Plans Prepared for DeLand and SJRWMD. Prepared by: AECOM in association with WRS ENTRIX, Inc. July 2007. 100% Submittal.
12. Deoxygenation-Pretreatment System Addition Using Sodium Hydrosulfide for the City of DeLand Municipal Airport ASR Project, Construction Plans Prepared for DeLand and

SJRWMD. Prepared by: AECOM in association with WRS ENTRIX, Inc. October 2009. 100% Submittal.

13. Report of Subsurface Exploration and Geotechnical Engineering Evaluation, Nodarse & Associates, Inc. June 26, 2007.
14. Deoxygenation-Pretreatment System Addition Using Sodium Hydrosulfide for the City of DeLand Municipal Airport ASR Project, Construction Plans Prepared for DeLand and SJRWMD. Prepared by: AECOM in association with WRS ENTRIX, Inc. November 2009. Conformed Documents Dec 2009 (including Addenda 1 and 2).
15. Technical Memorandum- City of DeLand Airport ASR Program, Small-Scale Pilot Test of Catalytic Deoxygenation. Prepared for: SJRWMD. March 2009.
16. Technical Memorandum- City of DeLand ASR Program, Mini-Scale Pilot Test of Deoxygenation Using Sulfide. Prepared for: SJRWMD. May 2009.
17. City of DeLand Airport Site ASR Project, Deoxygenation System Addition (Using Membrana™), Construction Plans Prepared for DeLand and SJRWMD. Prepared by: AECOM in association with ENTRIX, Inc. September 2009. Not for Construction – Draft 100% Submittal.
18. Final Clearance for 8-inch & 12-inch supply & return water mains for ASR Well, Volusia County Health Department, Prepared for: Rasesh R. Shah, P.E., AECOM-USA, Inc., Permit No. 0128184-185-DSGP. December 2009.
19. Permit to Construct ASR System and Chemical Bldg Bin #7, City of DeLand, Florida. June 2009.
20. Landscape/Paving, Grading and Drainage Plan for City of DeLand Airport Site ASR Project, WRS and Boyle Engineering Corp, June 2007.
21. Certificate of Occupancy for Construction of ASR System and Chemical Bldg Bin #7, City of DeLand, Florida, City of DeLand Building Department. May 2010.
22. Field Reports, Installation Certifications and Line Test Results, Cornell Balancing Company, Inc., Prepared for: Southeast Pump. January 2010.
23. City of DeLand Airport Site ASR Project, Record Drawings (Surface Facilities), May 21, 2010, prepared by: ENTRIX in association with AECOM-USA, Inc.
24. Draft ASR Well System Operation and Maintenance Manual, Attachment 8 of "Operational Testing Request, April 2010)", ENTRIX, April 2010.
25. As-Built Survey, Echezabal & Associates, Inc., January 2010.
26. Record Drawings, Deoxygenation Pretreatment System Addition Using Sodium-Hydrosulfide, City of DeLand Municipal Airport ASR Project, AECOM, May 2010.
27. Request for Operational Testing Approval, ENTRIX, April 2010
28. Sketch of As-Built Survey of ASR Facilities – DeLand Airport, Exacta Land Surveyors, Inc. January 2010.
29. PWS ASR System Clearance, Volusia County Health Department, Permit Nos. 0128184-184-WC//17 and 128184-219-WC/M1. May 27, 2010.
30. Equip and Connect Permit, Volusia County Health Department, August 29, 2007. PWS I.D. No. 3640286.
31. Technical Memo, Mini-cycle 5 and Pre-Test Cycle Results, ENTRIX, August 23, 2010
32. Technical Memo, Cycle Test # 1 Results, ENTRIX, December 14, 2010
33. Technical Memo, Cycle Test # 2 Results, ENTRIX, April 25, 2011

Section 1 Introduction

1.1 Purpose of Expanded Executive Summary

The preparation of this Expanded Executive Summary (EES) was authorized by St. Johns River Water Management District (SJRWMD) in order to document the development process, cooperative procedures, work products and results of the SJRWMD Regional Aquifer Storage and Recovery (ASR) Demonstration Project implemented in cooperation with the City of DeLand, Florida. This EES provides background materials, work products and a generalized summary of the activities necessary for a cooperative assessment of ASR feasibility in east-central Florida. This summary may be utilized as a template for the development of future ASR projects in the region.

1.2 Overview of District ASR Program

SJRWMD initiated the 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 and/or alternative water supply (AWS) sources. Due to potential impacts that continuing groundwater withdrawals may have on natural features (such as springs, lakes, and wetlands), public water-supply utilities in the region are being required by SJRWMD to plan for and implement new AWS projects that utilize non-traditional sources (other than fresh ground water).

There were 5 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 5 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 of Florida Department of Environmental Protection (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;

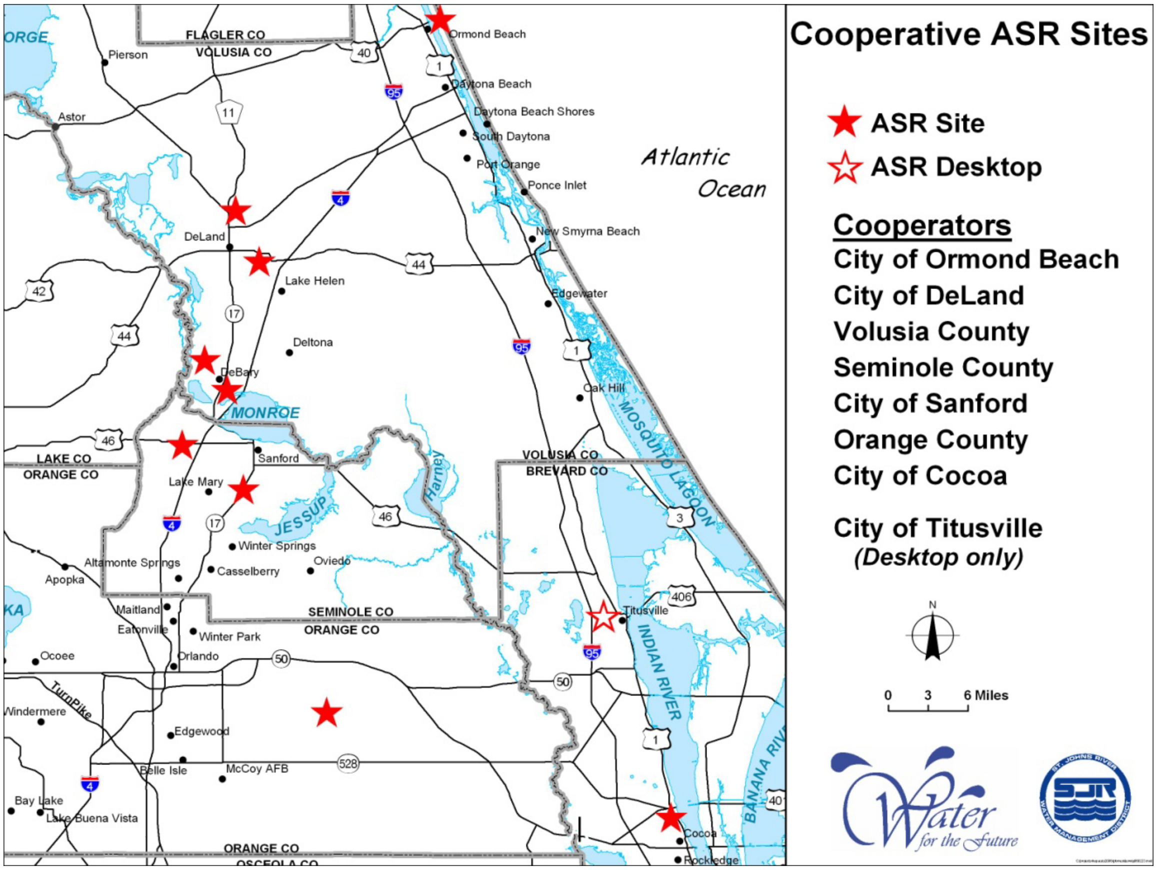
- Special accommodations related to utility master planning, roadway widening, phased construction, future water system expansion plans, and water quality considerations;

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

- Detailed coordination with state agencies such as FDEP and state water management districts, on mineral-leaching issues that have occurred in the aquifer, including assessment and monitoring of construction and Operation and Maintenance (O&M) costs related to experimental approaches and new technologies for pre-treatment of source water.

The map below illustrates cooperative ASR sites as part of the SJRWMD ASR Construction and Testing Demonstration Program.

FIGURE 1-1



The Seminole County and City of Sanford ASR projects were completed in 2007 and 2008, respectively. Pretreatment was subsequently added to both projects and cycle testing began for Sanford in February 2009 and for Seminole County in February 2010. The final design, permitting, and construction has been completed for the ASR projects for Orange County Utilities (OCU), and the City of DeLand; with operational testing begun in January 2010 for OCU and in May 2010 for DeLand. The Volusia County project did not proceed through design and permitting but included monitor well construction and testing. Cycle testing by four utility cooperators 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 for the Deland Airport ASR site in this document.

Anticipated funding for the ASR demonstration program was based on available Florida Forever Act funds, Cooperator participation and SJRWMD operational budgets at the time of the development of the plan for the program:

TABLE 1-1 ANTICIPATED FUNDING

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

Volusia County did not proceed with final design or construction of an ASR well system due to economic constraints. 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 planned to proceed with their ASR project independently from the District's demonstration program.

1.3 Project Timeline

The ASR Construction and Testing Project, conducted in cooperation with the City of DeLand, was structured to occur in discrete phases (or Tasks) which included the preparation of feasibility assessments and recommendations between phases prior to authorization of a subsequent project task. The work phases do not correspond to the authorized Work Order numbers because each work order was active for no more than one fiscal year (October 1 to September 30). In some cases, concurrent Work Orders were issued for tasks that were related to primary phases, but that otherwise did not require preparation of a separate feasibility assessment or recommendation.

The timeline for each individual project was estimated based on implementation of no more than one exploratory well and included about 8.5 months of operational (cycle) testing:

TABLE 1-2 ASR PROJECT SCHEDULE (ASR PROGRAM PLAN)

TASK DESCRIPTION	**NO. OF 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
Total Days	**822**

1.3.1 Task 1 - ASR Work Plan

The ASR work plan was intended to be suitable for distribution to policy makers, interest groups and the technical community and includes a description of evaluation criteria for potential projects and a preliminary listing of regional ASR candidate projects. The ASR Project Work Plan, or Program Plan, was completed in 2002 by Barnes, Ferland & Associates, Inc., and is included as Appendix A.

1.3.2 Task 2 - Project / Site Evaluation and Selection

This task included a desktop project feasibility assessment, providing an assessment of project objectives; variability in water supply, water demand and water quality at the proposed site; hydrogeology; required ASR system capacity and storage volume requirements; conceptual facilities design, including proposed hydrogeologic testing program and associated preliminary cost estimate; and a preliminary appraisal of other pertinent issues such as regulatory, environmental, political support and/or opposition, institutional constraints, etc. The “Desktop Assessment of Aquifer Storage and Recovery for the City of Deland” was completed in September 2003.

1.3.3 Task 3 - Cooperator Agreement

This task was undertaken by SJRWMD concurrently with the above-referenced feasibility assessment, and consisted of the development of a Cooperator Agreement that established the mutual objectives of the project and the associated responsibilities of the District and the Cooperator (City of DeLand). This task also included preparation of presentation materials and making presentations to Cooperator decision makers. A copy of the MOU is included as Appendix B.

1.3.4 Task 4- Site-specific Data Collection and Preliminary System Design

This task includes site specific data collection and preliminary system design. In particular, it was intended to determine whether initial exploratory testing at the site was necessary for 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. In this case, exploratory testing was considered necessary and was performed at two potential ASR well sites. The intent was to gather hydrogeologic information from the construction and testing of an initial test well, which would then be converted to an observation well for the ASR test program.

Section 5 of this document addresses the data collection performed to compile the information needed to select a suitable ASR site. Two sites were considered as potential ASR test locations: the Delfa Water Treatment Plant and the DeLand Airport. The Deland Airport site, off of Pistol Range Road (now Industrial Drive) was selected as the most promising location for a Floridan Aquifer ASR Test Well. Construction of Exploratory Well (EX) EX-1 began in late August 2004 and was completed in January 2005. The results of that exploratory well program indicated that the brackish portion of the Floridan Aquifer (between 950 and 1,100 feet below land surface [bls]) was not suitable for ASR development at that location. The Delfa site was then tested by the construction and testing of Exploratory Well EX-2 to a total depth of 1,302 feet bls. Again, the brackish portion of the Floridan Aquifer was in a very narrow depth interval with relatively low transmissivity.

The reports for both Exploratory Well sites are included in Appendix F (on the enclosed CD).

After the exploration program ended, WRS (now Cardno ENTRIX) recommended that brackish water ASR not be pursued, because the two project locations independently demonstrated that brackish water ASR would likely be problematic in the vicinity, if not the immediate region. The decision to utilize the freshwater portion of the Floridan Aquifer then was recommended as an alternative; and the memorandum included as Appendix C provides the applicable recommendation to explore the use of the fresh portion of the Upper Floridan Aquifer at the Deland Airport location.

Cardno ENTRIX retained Boyle Engineering Corporation as the engineering design subconsultant for the project. Preliminary design documents relating to the ASR well system and proposed surface facilities are included on the enclosed CD in Appendix F:

- Results of Leaching Tests, Compatibility Analyses, and Basis of Design Report for Deland ASR Facilities at the Airport Site, WRS and Boyle Engineering Corp., Prepared for: St. Johns River Water Management District and City of DeLand, Contract No. SF408RA. August 2006.

- Construction & Testing of Exploratory Well EX-1 Airport Site, City of DeLand, Florida, Prepared for: St. Johns River Water Management District. September 2005.
- Construction & Testing of Exploratory Well EX-2 Delfa Site, City of DeLand, Florida, Prepared for: St. Johns River Water Management District, Contract No. SF408RA. September 2006.

Some of the more important considerations during initial design discussions were the City's public-works building architectural standards, SJRWMD desire to construct an expandable ASR system, regulatory compliance with surface-water discharge standards for recovered water and the protection of nearby wetlands from potential impacts of groundwater withdrawal during recovery phases of large-scale cycle testing. For the ASR testing program, the recovery of water to the City's distribution system would be postponed until the ASR Test Well system was proven to operate effectively and contingent upon the City's needs. A spreader swale discharge impoundment was designed to sheet flow to the nearby wetland. Preliminary design had included piping the recovered water to Bass Lake, an alternative Class III surface water with identical discharge limitations.

1.3.5 ASR Pilot Project Design

This task included design of the ASR Test Well, the Storage-Zone Monitor Wells (SZMWs) and associated wellhead facilities at the selected site, including the proposed data collection and monitoring programs. Much of the exploratory wells' hydrogeologic information was useful in providing supporting information for the Underground Injection Control (UIC) permit application. This design task was included in the above-referenced Basis of Design Report submitted to the City of DeLand and SJRWMD in early September 2006 (Appendix E). The design of the ASR well system was formally defined in the FDEP UIC Section permit application prepared for the ASR Test Well and monitor wells. The ASR well system design is presented in more detail in the UIC application included in Appendix F (Construction and Testing Permit Application, Class V Pilot ASR System, DeLand Municipal Airport, SJRWMD Contract No. SF408RA, Work Order No. 17. November 2006). The development of the preliminary surface facility designs is addressed in Section 6 and the final record drawing and completion information is provided in Section 8.

1.3.6 Regulatory Permitting

Regulatory permitting, including preparation of permit applications, and responses to requests for information from regulatory agencies was an ongoing task following the completion of the exploratory / test wells in June 2006. Permitting efforts are outlined in more detail in Section 7 of this Summary. Site specific permits and clearances included:

- Consumptive use permit modification for ASR (by City) from SJRWMD
- Class V, Group 7 well under Florida Administrative Code (FAC) Chapter 62-528 (FDEP).

- Federal Aviation Administration (FAA) Temporary Structure Permit (FAA/Orlando)
- Generic National Pollutant Discharge Elimination System (NPDES) Permit (FDEP Industrial Wastewater)
- Environmental Resource Permit (ERP) Determination (SJRWMD)
- ASR Test Well and Monitor Well Permits (SJRWMD)
- ASR test Well Bacteriological Clearance (Volusia County Health Department)
- Building Permits (City of Deland)
- Public Water Supply Permit (Volusia County Health Department)
- Equip and Connect Permit Clearance (Volusia County Health Department)

1.3.7 ASR Facilities Construction, Monitoring and Testing

This task includes construction of ASR and monitor wells. Initial hydraulic (aquifer performance) and water quality testing was conducted, in addition to the geophysical logging, geochemical modeling, and proactive evaluation of any additional pretreatment requirements. Following an evaluation of the aquifer performance testing, the construction of the Surface Facilities for the ASR and monitor wells was authorized by SJRWMD. The primary facility was a remotely operated water treatment plant for post-treatment of the recovered water from the ASR well. The SJRWMD also authorized design and construction of a temporary structure and facilities for pretreatment of the City’s potable water to test the effect (on subsurface leaching of metals) of reducing dissolved oxygen concentration in the City’s potable water prior to recharge. After completion of the Surface Facilities, a series of ASR test cycles was planned to address technical and other issues pertaining to the functional efficiency of the system. Preliminary design information is provided in Section 6, and final design details are presented in Section 8.

1.3.8 Start-up and Training

The “Startup and Training” task of the project included the operational training of Cooperator staff to ensure a smooth transition from the test program to full-scale operation. In this project, no “Startup and Training” work order was authorized by SJRWMD, and training was limited to two (2) onsite training sessions by the SCADA system supplier with concurrent functional testing. The reason for this diversion from the Work Order authorizations requested at the other sites was that City had installed DFS, Inc. SCADA systems at all their other water and wastewater treatment facilities, and was familiar with remote, web-based polling and operation. The subcontractor for the treatment building installation provided the final DFS, Inc., installation on March

18, 2010. DFS software modifications were completed on May 14 and May 15, 2010. Additional adjustments were required on the software, and for that reason, the first mini-cycle testing began on June 2, 2010, with the recharge performed using the ASR system in a manual operation mode.

1.3.9 Large Cycle Operational Monitoring and Evaluations

Large-scale cycle testing involved 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. In general, the City of DeLand (Cooperator) operated the system during this period with assistance from Cardno ENTRIX. At the Deland Airport ASR facility, this operational testing began on June 2, 2010 and concluded in September 2011.

1.3.10 Peer Review of Other ASR Consultant Team Work as Determined By the District

This task included review of work product produced by other ASR consultant teams and was authorized on a task basis under scope-specific District Supplemental Instructions (DSIs).

1.4 Section Summaries

1.4.1 Introduction

The *Introduction* provided an overview of the purpose and background for this Expanded Executive Summary (ESS) and summarized the stakeholder relationships, timelines and development status of the ASR systems funded under the SJRWMD ASR Demonstration Program.

1.4.2 Program Plan

The program plan provided a generalized outline of ASR program challenges, program goals and SJRWMD objectives for the selection of ASR sites and projects, including a review of the basis for funding and project implementation.

Section 2 Program Plan

2.1 Program Plan

As provided in Appendix A, the work began with the preparation of a Program Plan. This overarching Plan, prepared by others, included the general description of the evaluation criteria for potential ASR sites and a listing of prospective projects in the SJRWMD.

The ASR Construction and Testing Program Plan was 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. A copy of the Plan is included as Appendix A. Tasks identified in the Program plan included those listed in Section 1.3 above.

Section 3 Desktop Assessment of ASR

3.1 Project Objectives and Site Selection

In order to evaluate the application of ASR in DeLand, SJRWMD wished to conduct a multiphase pilot program. The initial phase of this work involved a desktop feasibility study to evaluate alternative locations and select a site for conducting a pilot program. The sites were selected based on the City of DeLand's needs, hydrogeologic conditions, and logistical factors. Figure 3-1 illustrates the ASR sites considered for selection.

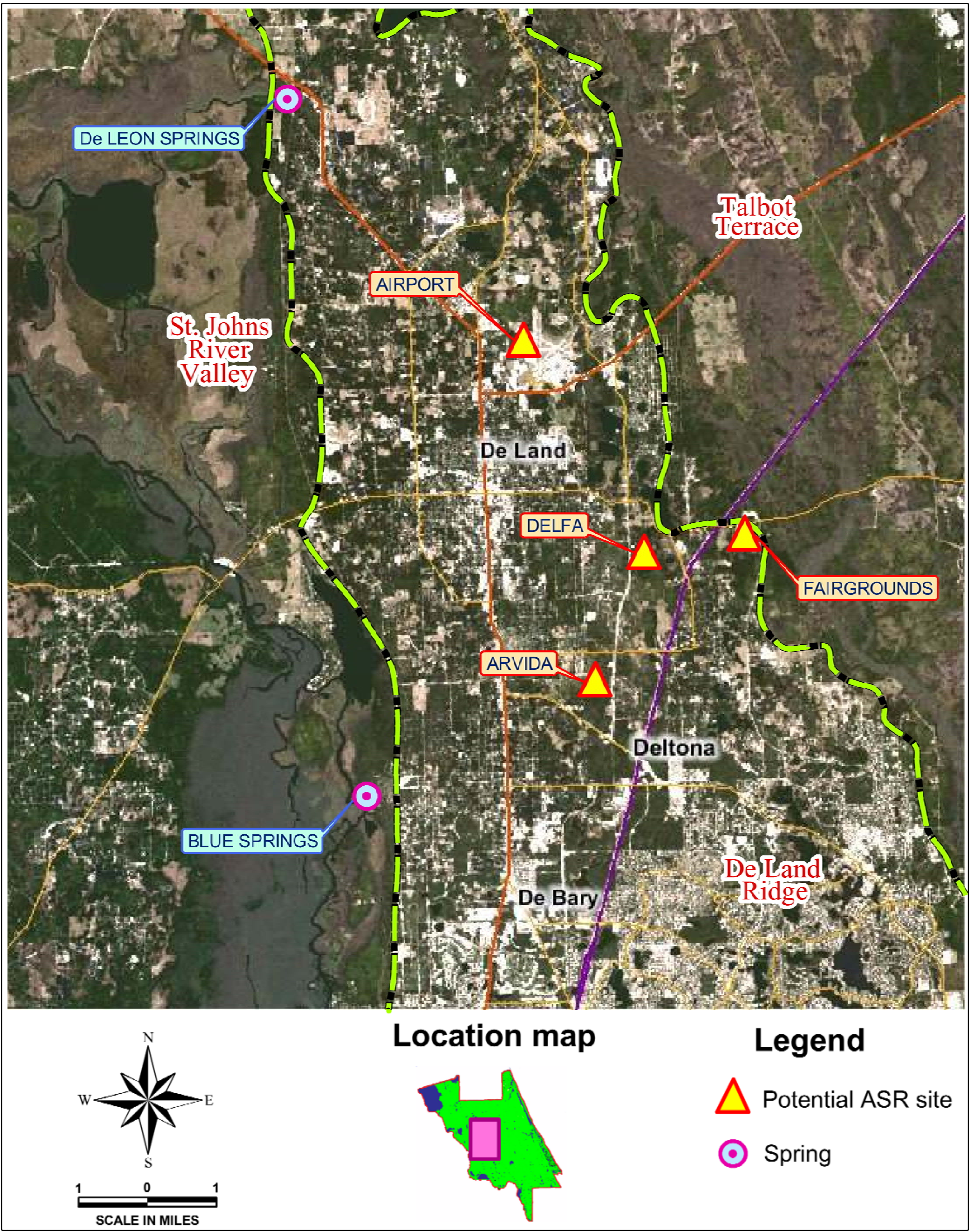
Several criteria influence the feasibility of ASR. The criteria are broken down into two categories of facility planning factors and site-specific criteria. The planning factors deal mostly with demand, supply, storage requirements, and proposed use. The site-specific criteria deal with hydrogeologic factors. The facility planning factors include:

- Demand
- Supply
- Storage Requirement
- Proposed Use

The hydrogeologic factors used to evaluate ASR include:

- Storage Zone Confinement
- Storage Zone Transmissivity
- Aquifer Gradient and Direction
- Recharge and Native Water Quality
- Interfering Uses and Impacts

Beyond the general criteria that make ASR more or less feasible on a regional basis, the individual site locations under consideration had to be evaluated on a relative basis. At least the four (4) sites listed below were considered for exploratory drilling and testing. The sites had specific advantages and disadvantages in relation to their suitability for long-term ASR operation. Table 3-1 provides some of the relevant information for each site:



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DATE: 08/11/11

FIGURE 3-1. ASR SITES SELECTED FOR CONSIDERATION BY CITY OF DELAND.

TABLE 3-1 ADVANTAGES AND DISADVANTAGES OF POTENTIAL ASR SITES

SITE	Water Supply Availability	Land Ownership	Residual Main-Line Pressure	Water Management Features for Discharge
Deland Airport	Adequate with CUP Modification	City	Booster Pump needed for 3-Well System	Onsite Wetlands and nearby Lake (Bass)
Delfa WTP	Adequate with CUP Modification	City	Booster Pump needed for 3-Well System	Lake nearby (2000')
Arvida Site	Adequate with CUP Modification	Arvida Corp.	Adequate w/o Booster Pump	None
Fairgrounds Site	Adequate with CUP Modification	Volusia County	Adequate w/o Booster Pump	Wetlands nearby (1000')

Next, a weighted-criteria alternatives analysis was developed to determine the highest ranked site of the four (4) sites screened for the ASR project. Note that the four (4) sites were scored based on a relative ranking from 1 through 4, multiplied by a weighting factor for each criterion; thus, the lowest ranking score was the preferred alternative (City of DeLand Airport Site).

TABLE 3-2 SITE RANKING METHODOLOGY

	SITES	**Arvida Site**	**Volusia County Fairgrounds**	**Delfa Site**	**DeLand Airport**
	Weighting Factor	**Site Ranking**			
Criteria					
1. Proximity to water source for testing	***1***	1	1	1	1
2. Proximity to an appropriate facility for accepting and managing recovered water	***1***	4	3	2	1
3. Availability of neighboring property for expansion of the ASR system	***1***	3	1	3	1
4. Hydrogeologic issues	***2***	4	1	1	1
5. Nearby water use	***2***	4	1	1	1
6. Suitability for meeting long-term program goals	***2***	2	2	2	1
7. Suitability of site for managing drilling fluids	***1***	4	2	1	1
Relative Ranking Scores		**32**	**16**	**15**	**10**

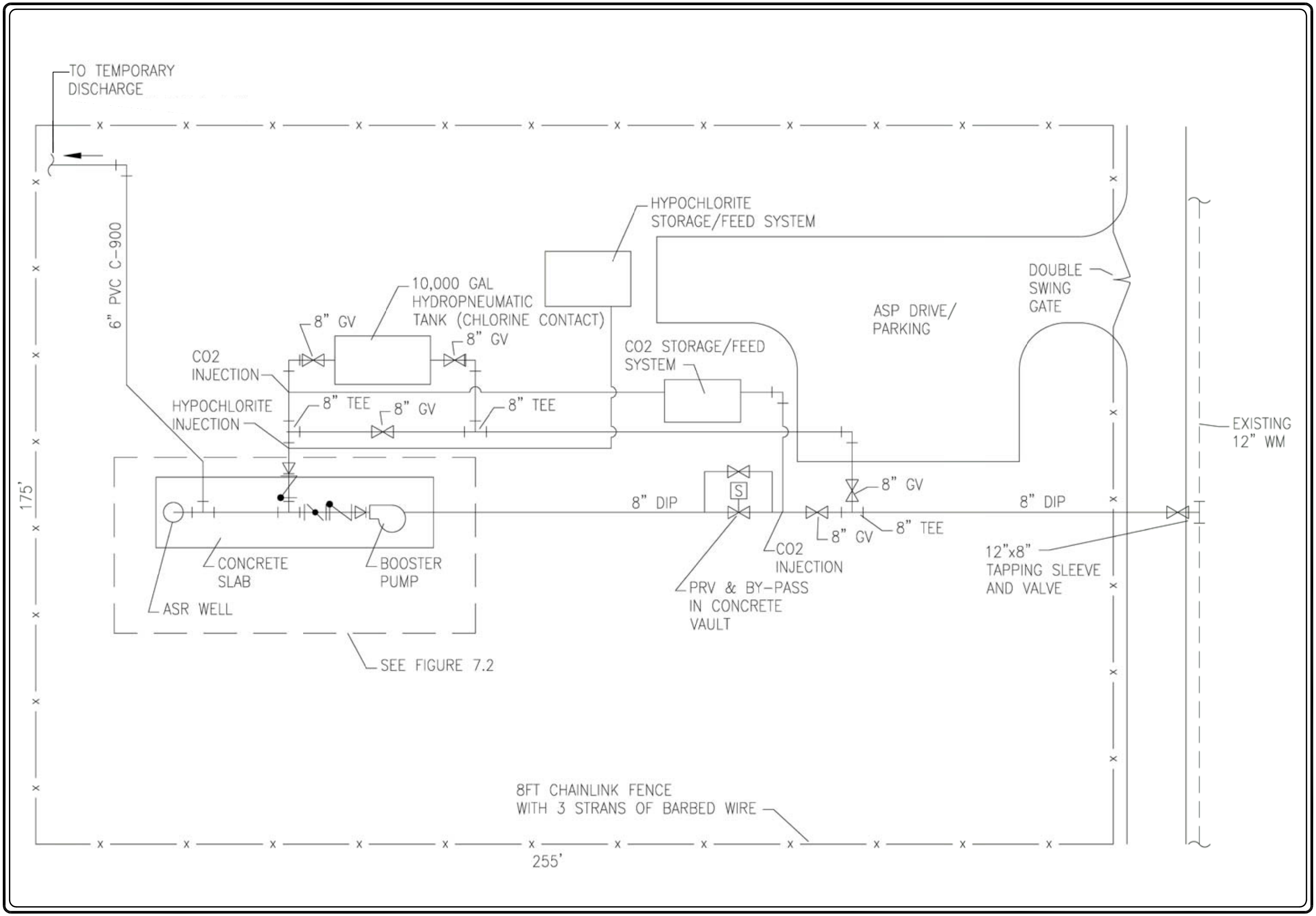
3.2 Water Supply Availability

The City of Deland consumptive use permit (CUP) contains an allocation of 2,485.65 million gallons per year (MGY), or an average of 6.81 million gallons per day (MGD). In addition, General Condition # 8 (“Other Conditions”), provides for an additional allocation of 450 MG (total), or 0.41 MGD, for the purpose of ASR Well System testing. As addressed in the initial feasibility document, actual water supply demand has significantly changed since the most recent assessment described in the report included in Appendix F (Desktop Assessment of Aquifer Storage and Recovery for the City of DeLand , prepared for: St. Johns River Water Management District and City of DeLand, Contract No. SF408RA. July 2003. pp. 5-18).

Since 2007, a significant economic downturn has reduced the projected capacity demands in the area of Deland. Therefore, it is unlikely that the water-supply availability and demand projections developed for the above-referenced document are reliable. Current water demand varies seasonally in the City, but is significantly less than the 6.81 MGD allocated.

3.3 Preliminary Layouts

Figure 3-2 presents a preliminary layout for the potential site and generalized water supply, recovered-water discharge and water-treatment components anticipated for an ASR system at the candidate sites.



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DWG. NUMBER: 11437200mw1
DATE: 08/12/11

FIGURE 3-2. PROPOSED SITE PLAN/LAYOUT WITH YARD PIPING FOR ALTERNATIVE SITES.

3.4 Hydrogeologic Testing Program

The testing plan included in the Desktop Assessment (July 2003) included pilot-hole lithologic analysis, geophysical logging, water quality sampling, drill stem packer-testing and collection and analysis of cores from select zones during an Exploratory Well Construction and Testing Program. The exploration well program was developed to address the major issues that are important for implementing an ASR project. A summary of the elements that made up the exploration program included:

- Development of regulatory strategy and permitting
- Exploratory well design
- Test program design
- Well construction and hydrogeologic services
- Stored water and native water compatibility analyses, core analyses, and trace metal analyses
- Hydrogeologic evaluations and preliminary engineering

As part of the regulatory program, a meeting was conducted with FDEP to address the issue of permitting under the UIC rules. Because of the uncertainty regarding the feasibility of ASR at an untested location, the decision was made to construct an exploratory well prior to proceeding with permitting of a potential ASR well. The SJRWMD elected to not undertake permitting for the exploratory well under the UIC program. In cooperation with the FDEP, it was agreed that the exploratory well would not be used for injection of fluids and any future use of the exploratory well as a monitoring well under the UIC program would involve permitting of the well and evaluation of its construction according to UIC standards.

The original intent of the ASR project was to select a target ASR storage interval within the mid-Floridan Aquifer containing brackish water quality with total dissolved solids concentrations between approximately 3,000 and 6,000 milligrams per liter (mg/L).

The location that was recommended in the desktop study for the first exploratory well was a site located on the western side of the DeLand Municipal Airport. The exploratory well was located in the right-of-way near the intersection of Pistol Range Road and Industrial Drive. Typical well designs developed during the exploratory well design program are presented below.

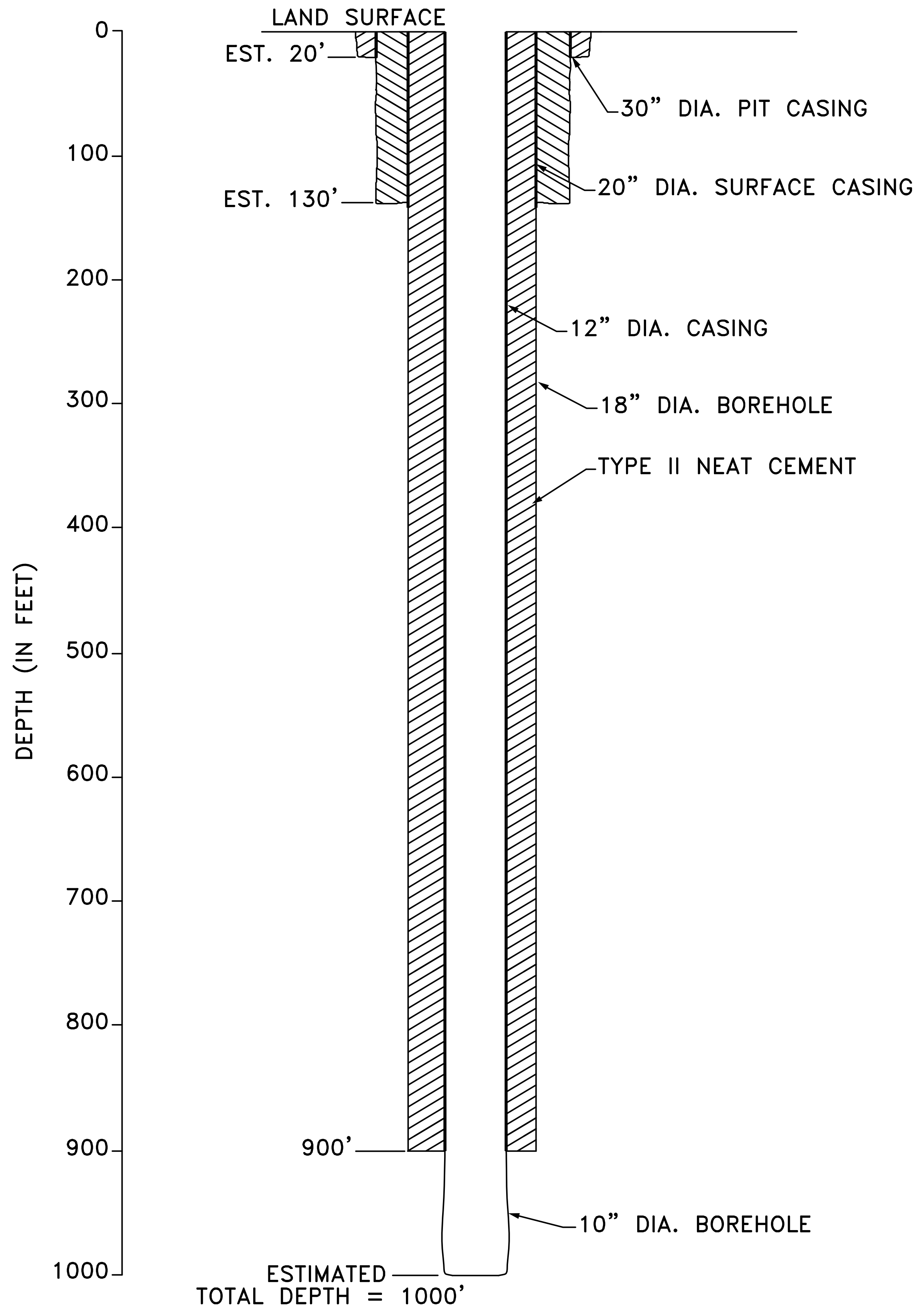

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FIGURE 3-3. PROPOSED SECTION OF TYPICAL ASR WELL.

Section 4 Cooperator Agreement

4.1 Memorandum of Understanding

A copy of the MOU is included as Appendix B.

Section 5 Preliminary Basis of Design (site-specific data collection)

The preliminary design of the ASR system was based on the site-specific data collected during the exploratory program and then was modified after the site selection was decided upon. However, until after the completion of the exploratory well drilling and testing program, “typical” design criteria and drawings were used to describe the proposed ASR system. The Preliminary Design – Overall Site Plan presented as Figure 5-1 is taken from Section 6 of the Desktop Assessment Report (July 2003, Conceptual Design and Preliminary Costs Opinion). Cost opinions for both the Delfa and Airport sites were estimated in that 2003 report. After the construction and testing of exploratory wells at each site, the decision to install an ASR system at the Airport site was made by SJRWMD. The applicable recommendations for that decision are found in memoranda dated December 28, 2004 and February 3, 2005, included in Appendix C.

5.1 City of DeLand Municipal Airport Facility

The original basis of design for the City of DeLand ASR site at the municipal airport was not significantly different from that proposed for the Delfa site (Figure 3-2). Section 6 below includes the general design data, design-criteria descriptions, preliminary site layout, well designs and water treatment facility designs.

5.1.1 Basic Operational Concept

The basic operational concept is to recharge potable water from the City of DeLand supply for either an extended period of time, or during low demand periods of the day (storing the water in the aquifer when not needed), and recovering the water to the distribution system on an as-needed basis. Operational considerations that were critical to the City of Deland were addressed later in the design process, including remote operation without staffing, chemical-feed system flexibility and consistency with City of DeLand architectural standards.

5.1.2 Key Subsystems

Key subsystems required for the City of Deland site included a bi-directional water line extension from water main on Industrial Drive to the ASR Test Well, a purge line for flushing either potable water or initial recovery from the ASR well, and remotely operated water treatment facility. The preliminary design phase during the desktop assessment task and following the exploratory well program design included only dechlorination and hydrochloric acid addition as pretreatment systems, and re-treatment of the recovered water prior to distribution in the water main was not yet addressed. The City of Deland assisted in the development of the design criteria that originated with SJRWMD. An example was the development of the design to provide electrical and instrumentation systems that would provide for remote operation without a full-time operator.

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FIGURE 5–1. PRELIMINARY DESIGN – OVERALL SITE PLAN.

Later developments included water re-treatment chemical-feed systems including phosphate, chlorine, and fluoride (fluorosilic acid). A chemical feed bay was added to include pretreatment with hydrochloric acid in the event that the storage interval was subject to formation plugging. These refinements can be seen in the AECOM Surface Facilities Plans included in Appendix F (on the enclosed CD).

5.1.3 Design Assumptions

Certain design assumptions were made to provide consistency in the design process:

- Each ASR well would be limited to more or less than a daily recharge and recovery rate of one MGD;
- The source water was to be the City's potable supply for the purpose of operationally testing the feasibility of the ASR system;
- The recovered water would be piped directly back to the City's water main, with a pre-flush of the ASR well to a permitted discharge point or feature;
- The system would be expandable, with enough room on site for additional ASR wells and a jockey-pump assembly if needed;
- The system design would meet City requirements and all state, federal and local regulations.

5.1.4 Preliminary List of Drawings and Specifications

A preliminary list of drawings and specifications for the exploratory well program was not compiled or found.

5.1.5 Construction and Testing of Exploratory Well EX-1

Based on hydrogeologic, logistic, and facility-related recommendations, the desktop feasibility study recommendations included a pilot ASR well project at a site adjacent to the northwestern edge of the DeLand Municipal Airport. The study also indicated that there was insufficient existing data for the region with respect to deeper aquifers (and the application of ASR technology). A recommendation of the feasibility study was the construction of an exploratory well in the vicinity of the proposed pilot project site to better evaluate the local hydrogeologic conditions.

A meeting was then conducted with FDEP to address the issue of permitting a pilot project under the UIC rules (Chapter 62-528 of the Florida Administrative Code [FAC]). Because of the uncertainty regarding the feasibility of ASR at an untested location, the decision was made to construct an exploratory well prior to proceeding with permitting of a potential ASR well. SJRWMD elected to not undertake permitting for the exploratory well under the UIC program. In cooperation with the FDEP, it was agreed that the exploratory well would not be used for injection of fluids and any future use of the exploratory well as a monitoring well under the UIC program would include permitting of the monitor well and evaluation of its construction.

Exploratory well EX-1 was constructed just north of the intersection of Industrial Drive and Pistol Range Road, just west of the DeLand Municipal Airport (Figure 1.1). Drilling of the well was initiated on August 26, 2004 and completed on January 19, 2005. The well was drilled to a total depth of 1,400 feet below land surface (bls). Tests performed on the EX-1 well for potential ASR zones showed that brackish water of suitable quality for the construction of an ASR system existed between approximately 1,000 and 1,090 feet bls, but no zones with sufficiently high transmissivity and suitable flow characteristics were found. Flow zones that appeared appropriate for ASR, however, were noted in the upper, freshwater portions of the aquifer. A memorandum (dated December 28, 2004) was prepared by Cardno ENTRIX (then Water Resource Solutions) with recommendations regarding the future direction of the exploratory program (Appendix C). A second memorandum (dated February 3, 2005) confirms the decision to proceed with a second exploratory well installation at the Delfa site.

Following the construction of EX-2, ENTRIX prepared a technical memorandum (dated May 19, 2006) that addressed conducting ASR within the freshwater portions of the Floridan aquifer and comparing the Delfa (EX-2) and Airport (EX-1) locations with regard to suitability for ASR (Appendix C). It was decided to proceed with construction of an ASR system to utilize the freshwater portion of the Floridan aquifer at the DeLand Municipal Airport site. The freshwater portion of the upper Floridan aquifer, although low in chloride, has high dissolved iron concentrations, and for this reason, is deemed unsuitable as a potable water source. A flow zone had previously been identified within this freshwater portion of the upper Floridan Aquifer between about 200 feet and 210 feet bls, with characteristics suitable to the development of an ASR well. The decision was made to install an ASR test well to target this zone. In addition to the ASR test well, plans were made to install two storage-zone monitor wells, Storage Zone Monitor Well No. 1 (SZMW-1) and Storage Zone Monitor Well No. 2 (SZMW-2). The locations chosen for the ASR test well and SZMW-1 are just north of Well EX-1 (renamed to “LFA” Well). The location chosen for SZMW-2 was just north of Pistol Range Road, approximately 435 feet west of EX-1/LFA Well. (Note Figure 3-3, 3-4 and 5-2).

5.1.6 Exploratory Well EX-1 Project Report

Completed in September 2005, the report of construction and testing for the EX-1 exploratory well contains the detailed hydrogeologic testing methodologies and results that formed the basis of the decision process described above. The report contains the as-built drawing for the completed well. A completed copy of the report is included in Appendix F on the enclosed CD.

5.2 City of DeLand Delfa Site

The testing of the exploratory well at the Airport site showed that the site was not ideally suitable for the application of a conventional ASR system, with storage in a brackish water interval. Brackish water intervals identified at the site were not sufficiently productive to allow construction of an ASR well with a suitably large capacity. The installation of an ASR well that utilized a freshwater interval for storage was considered, because high iron and hydrogen-sulfide concentrations in the UFA at the Airport site made it unsuitable for potable supply, but this option was not immediately pursued.

A decision was made to construct a second exploratory well in the City of DeLand at the site rated second highest in the initial feasibility study. This site, the Delfa site, is located along Kepler Road approximately 0.8 miles south of State Road 44. This exploratory well, EX-2, was constructed to a depth of 1,302 feet. Testing conducted during construction included coring, geophysical logging, pumping tests, and water-quality analyses.

5.2.1 Construction and Testing of Exploratory Well EX-2

Construction and testing of the exploration well began on August 25, 2005 and abandonment was completed on June 13, 2006 under Work Order #5 for SJRWMD Contract Number SF408RA. The work was permitted under Well Construction Permit Number 97731 issued by the SJRWMD.

The exploratory well was constructed by Diversified Drilling Corporation (DDC) of Winter Garden, Florida. The mud-rotary method was used until the 14-inch casing was installed. Drilling continued using the reverse air drilling method. Water from a hydrant was added to the borehole until a quantity of water sufficient to allow reverse-air drilling was encountered at a depth of 228 feet. The well was drilled using a 12.25-inch diameter drill bit to a depth of 598 feet bls. A different drilling rig was then mobilized to the site and continuous HQ sized core (2.5 inch diameter) was collected from 598 feet to 1,302 feet bls. During coring, the drill pipe became stuck in the borehole. Efforts made to free the stuck pipe included drilling alongside the pipe with an 8-inch drill bit and pulling on the pipe with a vibratory hammer. Overdrilling the core pipe with a second, larger core bit and pipe was ultimately successful. Because of this issue, it was not possible to perform certain testing planned for the borehole after coring, including straddle packer testing and geophysical logging. After backplugging of the cored interval, the well was reamed using a 12.25-inch diameter drill bit to a depth of 1,202 feet bls. This drilling was conducted in two phases, with additional testing, including packer testing and geophysical logging, occurring after the borehole had been drilled to depths of 1,033 and 1,202 feet.

Fresh water was found throughout the surficial aquifer, Upper Floridan aquifer, and MSCU at the site of the exploratory well. Water quality in the upper part of the Lower Floridan aquifer was also found to be fresh. Fresh water with a specific conductance of 385 uS/cm and chlorides of 30 mg/l was encountered during the packer test performed on the interval between 1,004 and 1,033 feet bls. Saline water was produced during the second packer test, which covered the interval from 1,004 to 1,202 feet. After four hours of pumping, water with a total dissolved solids concentration of 4,030 mg/l and chlorides of 1,870 mg/l was produced. Water quality was steadily becoming worse during the packer test, and a longer period of pumpage would have resulted in water with significantly higher levels of dissolved solids. A water sample collected from the interval between 1,257 and 1,302 feet bls collected at the completion of the coring showed a specific conductance of 28,400 uS/cm, which would be expected to correspond to a total dissolved solids concentration in excess of 15,000 mg/l. This sample was taken prior to complete stabilization of water quality during a test where water quality was declining as pumpage continued.

During the drilling of the exploratory well several testing and evaluation methods were used in order to evaluate the test site, including geophysical logging, vertical-head monitoring, packer and pumping tests, core samples, and lithologic cutting descriptions Some testing planned for the well, including straddle packer testing and some of the proposed geophysical logging, could not be performed due to drilling difficulties encountered while collecting the continuous core. Other testing planned for the project, including detailed mineralogical testing and leaching tests, was not completed because those tasks were contingent upon finding a suitable storage interval.

5.2.2 ASR Zone Selection, Impact Analysis, and Preliminary Design

Based on the results of testing, it was evident that a suitable storage interval containing brackish water of an acceptable quality was not present at the site.

The potential for installation of an ASR well at the Delfa site that utilized a freshwater storage zone was considered, but several factors, including water quality, site location, and location of nearby wells, made the Delfa site less attractive for this purpose than the original test site at the DeLand Airport. Because no suitable alternative use for the well, such as regional monitoring or future supply, was present, the exploratory well at the Delfa site was plugged and abandoned. However, the data from this project yielded valuable information about the Floridan aquifer that was previously unavailable for this region. Future investigations focused on the application of ASR at the original, DeLand Airport site utilizing a freshwater storage zone.

A memorandum of ASR feasibility for the Delfa site is included in Appendix C (Memorandum dated May 19, 2006).

5.2.3 Exploratory Well EX-2 Project Report

Completed in September 2006, the report of construction and testing for the EX-2 exploratory well contains the detailed hydrogeologic testing methodologies and results that formed the basis of the decision process described above. The report contains the as-built drawing for the plugged and abandoned well. A completed copy of the report is included in Appendix F on the enclosed C.

Section 6 Project Design

The preliminary basis of design was presented in the report entitled: "Results of Leaching Tests, Compatibility Analyses, and Basis of Design Report for Deland ASR Facilities at the Airport Site, WRS and Boyle Engineering Corp., Prepared for: St. Johns River Water Management District and City of DeLand, Contract No. SF408RA. August 2006" (Appendix F). However, the design and drilling and testing program for the Deland Airport ASR Test Well and Storage-Zone Monitor Wells was modified for the UIC Permit application for the Class V, ASR Well System, as referenced in Section 8.

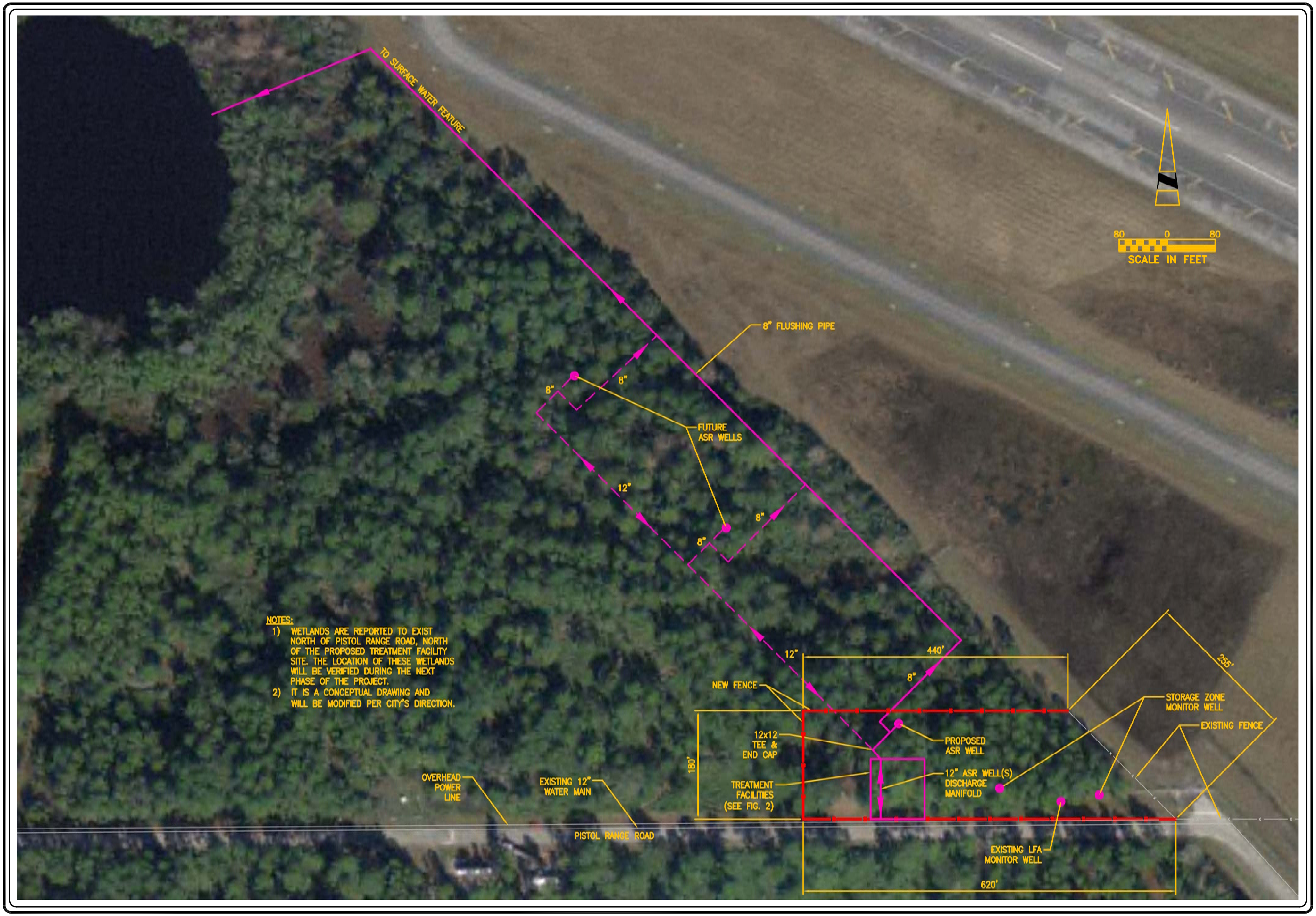
6.1 ASR and Monitoring Well Drilling and Testing Program

Proposed well construction procedures and specifications are detailed in the document entitled: "Technical Specification for Well Drilling, City of Deland Airport Project Site, Prepared for: City of DeLand and St. Johns River Water Management District. May 2008", and included in Appendix F (in the enclosed CD). In that document, typical ASR Test Well and Storage-Zone Monitor Well construction details are presented as Figures 3 and 4, respectively.

Originally, the ASR wells at the DeLand Airport site were proposed for a wooded area west of the DeLand Airport (Figure 5-1) as shown on the Proposed Overall Site Plan as Figure 6-1. However, due to nearby SJRWMD-designated wetlands, the site location was moved eastward to a narrow elevated area immediately west of the Airport. The well sites and facility footprint were moved to the east, as shown on Figure 6-2.

6.2 Conceptual Cycle Testing Plan

At the time that the Class V well permitting was in progress, FDEP's UIC Section was actively revising the cycle testing requirements for new, Class V ASR well permits. Primary revisions included requirements for multiple, short (low-volume) cycle testing designed to establish the extent and degree of subsurface leaching of arsenic from wells completed in the Floridan Aquifer. In addition, increased sampling frequencies and additional analytical parameters were being established for new ASR permits that would significantly increase the costs of operational testing. The cycle testing plan was based on these changing requirements, but included notations to provide for future flexibility in the number and duration of cycle tests required by the permit-approved testing sampling schedule. The FDEP-approved cycle testing plan is presented as Table 6-1 (Cycle Test Plan).



NOTES:
1) WETLANDS ARE REPORTED TO EXIST NORTH OF PISTOL RANGE ROAD, NORTH OF THE PROPOSED TREATMENT FACILITY SITE. THE LOCATION OF THESE WETLANDS WILL BE VERIFIED DURING THE NEXT PHASE OF THE PROJECT.
2) IT IS A CONCEPTUAL DRAWING AND WILL BE MODIFIED PER CITY'S DIRECTION.

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AECOM

FIGURE 6–1. PROPOSED OVERALL SITE PLAN.

TABLE 6-1 CYCLE TEST PLAN

Cycle No.	Injection Duration (Days)	Injection Volume (MG)	Storage Duration (Days)	Recovery Duration	Anticipated Recovery Percent	Limiting Water-Quality Criteria [Fe] (mg/L)
Pre-Test	10	10	0	</= 10	7	0.30
1	10	10	3	</= 10	5	0.30
2	60	60	30	</= 10	20	0.30
3*	100	100	45	</= 75	35	0.30
4*	100	100	60	</= 90	75	0.30
5*	100	100	90	</= 100	90	0.30

"Fe" – denotes total iron concentration of recovered water in units of milligrams per liter (mg/L)
"MG" – denotes gallons in millions
Cycle #1 primarily tests pumping and monitoring equipment
Cycle #2 primarily tests long-term effects of storage on water quality of recovered water
"*" – denotes that Cycles #3, #4, and #5 are intended to intended to closely approximate operating conditions
"**" – estimated using SWIFT™ model results from a similar exploratory well (ENTRIX report dated September 2006)

6.3 Operational Monitoring Program

During operational testing, permit conditions applicable to monitoring the physical and chemical characteristics of injected and recovered fluids and aquifer-storage zone (ASZ) monitor well (MW) fluids, as well as monitoring of the operational performance of the ASR well, must be satisfied to provide information to submit an operating permit application for the Pilot ASR well system. The general conditions specific to the DeLand ASR site are included in the UIC Permit included in Appendix D.

6.3.1 Potable Water Analysis

An analytical laboratory analysis for primary and secondary drinking water standards (62-550 F.A.C.) and (municipal) minimum-criteria parameters must be submitted within 45 days after the start of operational testing and annually (sampled in February and submitted in April). For the permitting of the Class V ASR System wells under the UIC Permit, background water quality was collected from the City's potable supply. The results of the background water-quality sampling are included as Attachment 7 of the April 5, 2010 letter request: "Request for Operational Testing Approval, City of DeLand ASR System", included in Appendix F.

Sampling of chemical characteristics of the injected, stored, and recovered water was required by permit on a periodic basis, as presented in Table 6-2 (Proposed Cycle Testing Schedule).

Table 6-2. Proposed Monitoring Schedule for City of DeLand ASR System

Parameter	Units	Injection & Recovery Frequency		Pre-Cycle Testing # of Samples			Pre-Test # of Samples						Cycle 1 # of Samples						Cycle 2					
				365 days	Background Sampling[2]		Injection (10 days)		Storage (0 days)		Recovery (7-10 days)		Injection (10 days)		Storage (5 days)		Recovery (5-10 days)		Injection (20 days)		Storage (14 days)		Recovery (5-20 days)	
		ASR	MWs	Source Water[1]	ASR	MWs	ASR	MWs	ASR	MWs	ASR	MWs	ASR	MWs	ASR	MWs	ASR	MWs	ASR	MWs	ASR	MWs	ASR	MWs
Arsenic	µg/L	W2	W2	---	---	---	---	3	1	1	3	3	---	3	1	1	3	3	---	6	2	2	3	3
Chloride	mg/L	W	W	---	---	---	---	1	1	1	1	1	---	1	1	1	1	1	---	2	1	1	1	2
Dissolved Oxygen (field)	mg/L	W	W	---	---	---	1*	1	1	1	1	1	1*	1	1	1	1	1	1*	2	1	1	1	2
Iron, total	mg/L	W	W	---	---	---	---	1	1	1	1	1	---	1	1	1	1	1	---	2	1	1	1	2
Sodium	mg/L	W	W	---	---	---	---	1	1	1	1	1	---	1	1	1	1	1	---	2	1	1	1	2
pH	std. units	W	W	---	---	---	---	1	1	1	1	1	---	1	1	1	1	1	---	2	1	1	1	2
Specific Conductance (field)	µmhos/cm	W	W	---	---	---	---	1	1	1	1	1	---	1	1	1	1	1	---	2	1	1	1	2
Sulfate	mg/L	W	W	---	---	---	---	1	1	1	1	1	---	1	1	1	1	1	---	2	1	1	1	2
Temperature (field)	°C	W	W	---	---	---	---	1	1	1	1	1	---	1	1	1	1	1	---	2	1	1	1	2
Total Dissolved Solids	mg/L	W	W	---	---	---	---	1	1	1	1	1	---	1	1	1	1	1	---	2	1	1	1	2
Bicarbonate	mg/L	W		---	---	---	---	---	1	1	1	1	---	---	1	1	1	1	---	2	1	1	1	2
Magnesium	mg/L	W		---	---	---	---	---	1	1	1	1	---	---	1	1	1	1	---	2	1	1	1	2
Manganese	mg/L	W		---	---	---	---	---	1	1	1	1	---	---	1	1	1	1	---	2	1	1	1	2
ORP (field)	mV	W		---	---	---	---	---	1	1	1	1	---	---	1	1	1	1	---	2	1	1	1	2
Potassium	mg/L	W		---	---	---	---	---	1	1	1	1	---	---	1	1	1	1	---	2	1	1	1	2
Total Alkalinity	mg/L	W		---	---	---	---	---	1	1	1	1	---	---	1	1	1	1	---	2	1	1	1	2
Total Trihalomethanes	ug/L	W		---	---	---	1*	---	1	1	1	1	1*	---	1	1	1	1	1*	2	1	1	1	2
Total Coliform	#/100 ml	W		---	---	---	---	---	1	1	1	1	---	---	1	1	1	1	---	2	1	1	1	2
Fecal Coliform	#/100/ml	W		---	---	---	---	---	1	1	1	1	---	---	1	1	1	1	---	2	1	1	1	2
Gross Alpha	pCi/L			---	---	---	---	---	---	---	1	1	---	---	---	---	1	1	---	2	---	---	1	2
Uranium	pCi/L			---	---	---	---	---	---	---	1	1	---	---	---	---	1	1	---	2	---	---	1	2
^{226}Ra / ^{228}Ra	pCi/L	O	---	---	---	---	---	---	---	---	2	---	---	---	---	---	2	---	---	---	---	---	2	---
[1]Selected Primary and Secondary DW Parameters		A	---	4	1	1	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

Parameter	Units	Injection & Recovery Frequency		Cycle 3 # of Samples						Cycle 4 # of Samples					
				Injection (30 days)		Storage (20 days)		Recovery (20-30 days		Injection (90 days)		Storage (30 days)		Recovery (45-90 days	
		ASR	MWs	ASR	MWs	ASR	MWs	ASR	MWs	ASR	MWs	ASR	MWs	ASR	MWs
Arsenic	µg/L	W2	W2	---	8	2	2	6	6	---	24	2	2	12	12
Chloride	mg/L	W	W	---	2	2	2	2	2	---	12	2	2	6	6
Dissolved Oxygen (field)	mg/L	W	W	2*	2	2	2	2	2	12*	12	2	2	6	6
Iron, total	mg/L	W	W	---	2	2	2	2	2	---	12	2	2	6	6
Sodium	mg/L	W	W	---	2	2	2	2	2	---	12	2	2	6	6
pH	std. units	W	W	---	2	2	2	2	2	---	12	2	2	6	6
Specific Conductance (field)	µmhos/cm	W	W	---	2	2	2	2	2	---	12	2	2	6	6
Sulfate	mg/L	W	W	---	2	2	2	2	2	---	12	2	2	6	6
Temperature (field)	°C	W	W	---	2	2	2	2	2	---	12	2	2	6	6
Total Dissolved Solids	mg/L	W	W	---	2	2	2	2	2	---	12	2	2	6	6
Bicarbonate	mg/L	W		---	2	2	2	2	2	---	12	2	2	6	6
Magnesium	mg/L	W		---	2	2	2	2	2	---	12	2	2	6	6
Manganese	mg/L	W		---	2	2	2	2	2	---	12	2	2	6	6
ORP (field)	mV	W		---	2	2	2	2	2	---	12	2	2	6	6
Potassium	mg/L	W		---	2	2	2	2	2	---	12	2	2	6	6
Total Alkalinity	mg/L	W		---	2	2	2	2	2	---	12	2	2	6	6
Total Trihalomethanes	ug/L	W		2*	2	2	2	2	2	12*	12	2	2	6	6
Total Coliform	#/100 ml	W		---	2	2	2	2	2	---	12	2	2	6	6
Fecal Coliform	#/100/ml	W		---	2	2	2	2	2	---	12	2	2	6	6
Gross Alpha	pCi/L			---	2	2	2	2	2	---	12	2	2	6	6
Uranium	pCi/L			---	1	1	1	1	1	---	12	1	1	6	6
^{226}Ra / ^{228}Ra	pCi/L	O	---	---	---	---	---	2	---	---	---	---	---	2	---
[1]Selected Primary and Secondary DW Parameters		A	---	---	---	---	---	---	---	---	---	---	---	1	1

MWs - Monitor Wells MW-1, MW-2

W – Weekly

W2 – Twice/week

O – Only required when gross alpha exceeds 5 pCi/L, sampled beginning and end of recovery cycle.

A – Annually

[1] Source/potable water: Sampled in aaccordance with the FDEP UIC Permit (up to four times) prior to starting cycle testing (for Primary and Secondary Drinking Water Parameters established in 62-550, Part III) & during testing for dissolved oxygen and TTHMs. excluding asbestos and dioxin, and including giardia lamblia, cryptosporidium, dissolved oxygen, E.coli, enteroccoci, and fecal and total coliform.

[2] Completed prior to any pump tests.

[2] Background sampling period to be followed by PRE-CYCLE TEST of 10 days of injection followed by 10 days of recovery (no storage), with sampling per "Cycle 1" requirements.

* - denotes sampling of injection fluids.

Recovery periods are **estimated**, and limits will be based on actual recovered water quality and permission to end cycle from FDEP if less than the injection period (based on volume injected) and/or stated recovery period.

In the event that the "Cycle 2" recovery period extends for more than 14 days, a minimum of three (3) samples will be collected from the Aquifer Storage Zone Monitor Wells.

For the Pre-Test and Cycle 1, one sample will be collected prior to recovery, per FDEP NPDES permit, and the results will be reviewed to ensure that NPDES permit requirements are met (these analytical results will be ordered on a rush basis, and results will be provided as quickly as teh analytical lab can perform the analyses).

Storage times for the Pre-test and Cycle 1 may be modified slightly to allow for turnaround time on analytical laboratory task orders (and data review, per pending FDEP NPDES permitting requirements).

6.3.2 ASR-Well Performance

The ASR system has not been permitted for operation, but has been tested under the conditions of the FDEP UIC Section construction permit. The permitted ASR wellhead pressure monitoring/reporting may include the following in pounds per square inch-gauge (psig):

1) injection pressure, daily average (psig)
2) sustained (15 minutes) injection pressure, daily max. (psig)
3) sustained (15 minutes) injection pressure, daily min. (psig)
4) injection pressure, monthly average (psig)
5) sustained (15 minutes) injection pressure, monthly max. (psig)
6) sustained (15 minutes) injection pressure, monthly min. (psig)
7) monthly wellhead pressure with no flow(shut in) (psig)
8) quarterly specific injectivity test results (gpm/change in psi)

Injection volume monitoring/reporting includes the following in millions of gallons (MG):

1) monthly average daily flow volume (MG)
2) monthly maximum of daily flow volume (MG)
3) monthly minimum of daily flow volume (MG)
4) total monthly flow volume to injection well (MG)
5) total monthly flow volume to injection well (MG) from the reverse-osmosis reject concentrate water stream
6) total daily flow volume to injection well (MG)

Injection rate monitoring/recording may include the following in MG per day (MGD):

1) average daily flow rate to injection well (MGD)
2) maximum daily sustained (15 min.) flow rate to injection well (MGD)
3) minimum daily sustained (15 min.) flow rate to injection well (MGD)
4) monthly average daily flow rate to injection well (MGD)
5) monthly maximum daily sustained (15 min.) flow rate to injection well (MGD)
6) monthly maximum peak hour flow (MGD)
7) monthly minimum daily sustained flow rate to injection well (MGD)

6.3.3 Monitor-Well Water Sampling and Analysis

The monitoring/reporting includes the physical characteristics of ASR Storage-Zone Monitor Well SZMW-1 and SZMW-2 water, including the potentiometric surface heights relative to NGVD (feet of head) or pressure (psig) referenced to NGVD:

1) daily maximum sustained pressure (ft. NAVD or psig)
2) daily minimum sustained pressure (ft. NAVD or psig)
3) daily average pressure (ft. NAVD or psig)
4) monthly maximum sustained pressure (ft. NAVD or psig)

5) monthly minimum sustained pressure (ft. NGVD or psig)
6) monthly average pressure (ft. NGVD or psig)

The monitoring/reporting during the operational testing phase included the chemical characteristics of the two (2) monitor wells' water, including parameters which may require periodic analysis under an operational permit, as presented on Table 6-2 (Proposed Cycle Testing Schedule).

Quality-assurance procedures included requirements that: Three (3) well storage volumes of fluid shall be evacuated from the monitor system prior to sampling for the chemical parameters listed in Table 6-2.

6.4 Development of Plans and Specifications

The basis of design for the Surface Facilities at the project site grew out of the results of the exploratory and ASR well construction programs, SJRWMD design assumptions and the City of Deland preferences defined in preliminary design meetings that occurred before and during the completion of the ASR Test Well and monitor wells.

6.4.1 ASR and Monitoring Wells

The ASR test well and two storage-zone monitor wells (SZMW-1 and SZMW-2) were installed on and near the western edge of the DeLand Municipal Airport, at 2091 Industrial Drive. Each well was drilled to approximately 225 feet bls and cased to approximately 190 feet bls. The target storage zone in the ASR test well was acidized prior to a 72-hour aquifer performance test (APT). Step-rate pumping tests and the APT of the ASR test well indicate that conditions suitable for aquifer storage and recovery exist at the DeLand Airport ASR test well site. A memorandum of results from the APT with a recommendation regarding ASR feasibility for the DeLand Airport site is included as Appendix E. Well completion diagrams are presented in Section 8. The final, proposed layout for the ASR Test Well and two monitor wells is presented as Figure 6-2.

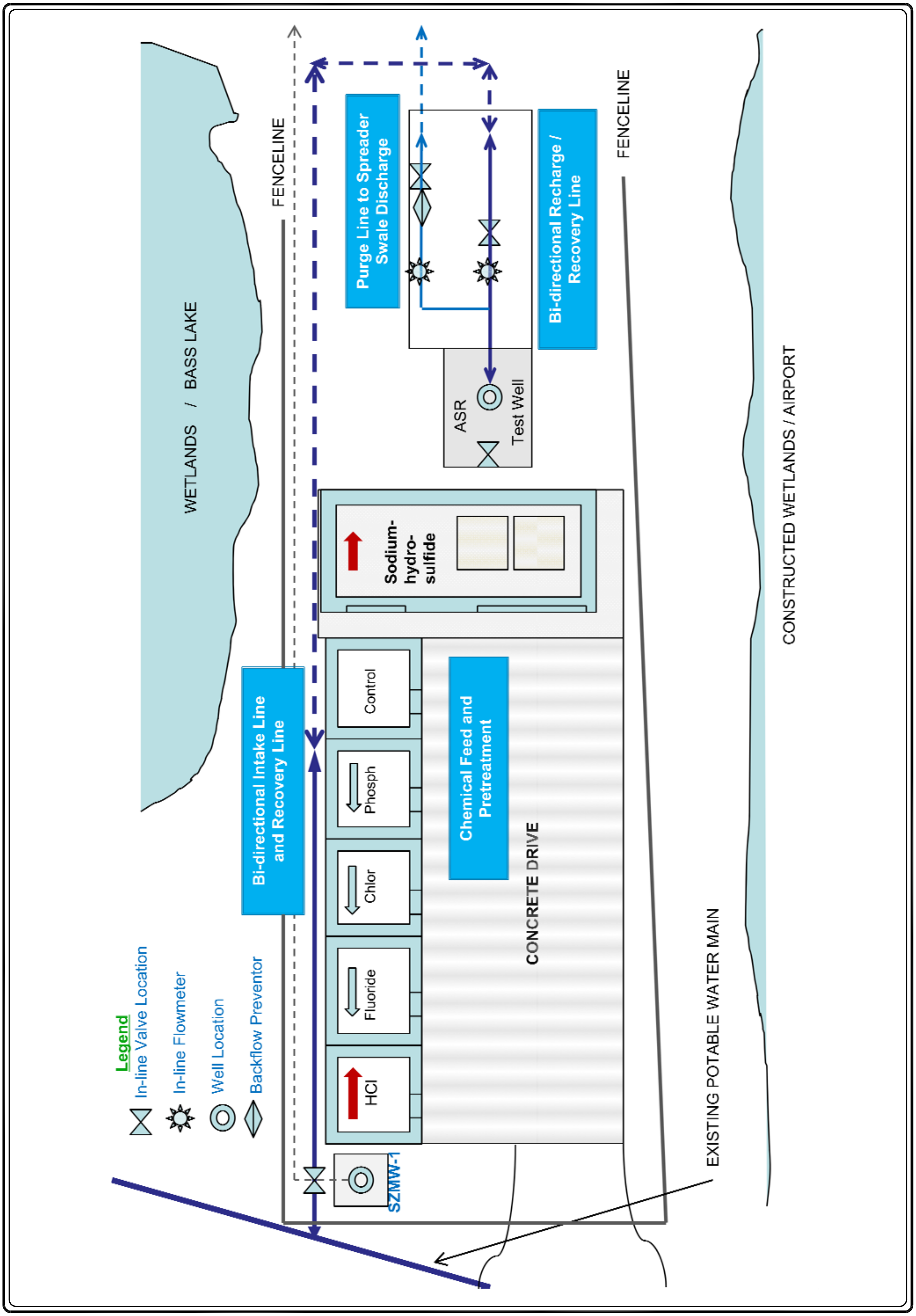
6.4.2 ASR Surface Facilities

Prior to the initiation of the well drilling program, the Surface Facilities design process was nearly completed. The bulk of the design process for the chemical treatment and SCADA control building took place in 2006 and 2007. Some changes were required to the Building Permit submittal after the 2007 Florida Building Code revisions became effective in March 2009. The final permitting and design revisions were conducted concurrent with the design of pretreatment systems for the ASR facility, as detailed in the following subsection. Design documents were prepared by AECOM and are included in Appendix F. A process flow schematic for the ASR chemical feed building and ASR pretreatment system is presented as Figure 6-3. The design drawing for the primary chemical feed building is presented as Figure 6-4. A design drawing of the proposed pretreatment system is presented as Figure 6-5.

Cardno ENTRIX

PROJECT NAME: SJRWMD
PROJECT NUMBER: 11437200.00
DWG. NUMBER: 1143714mw1
DATE: 08/12/11

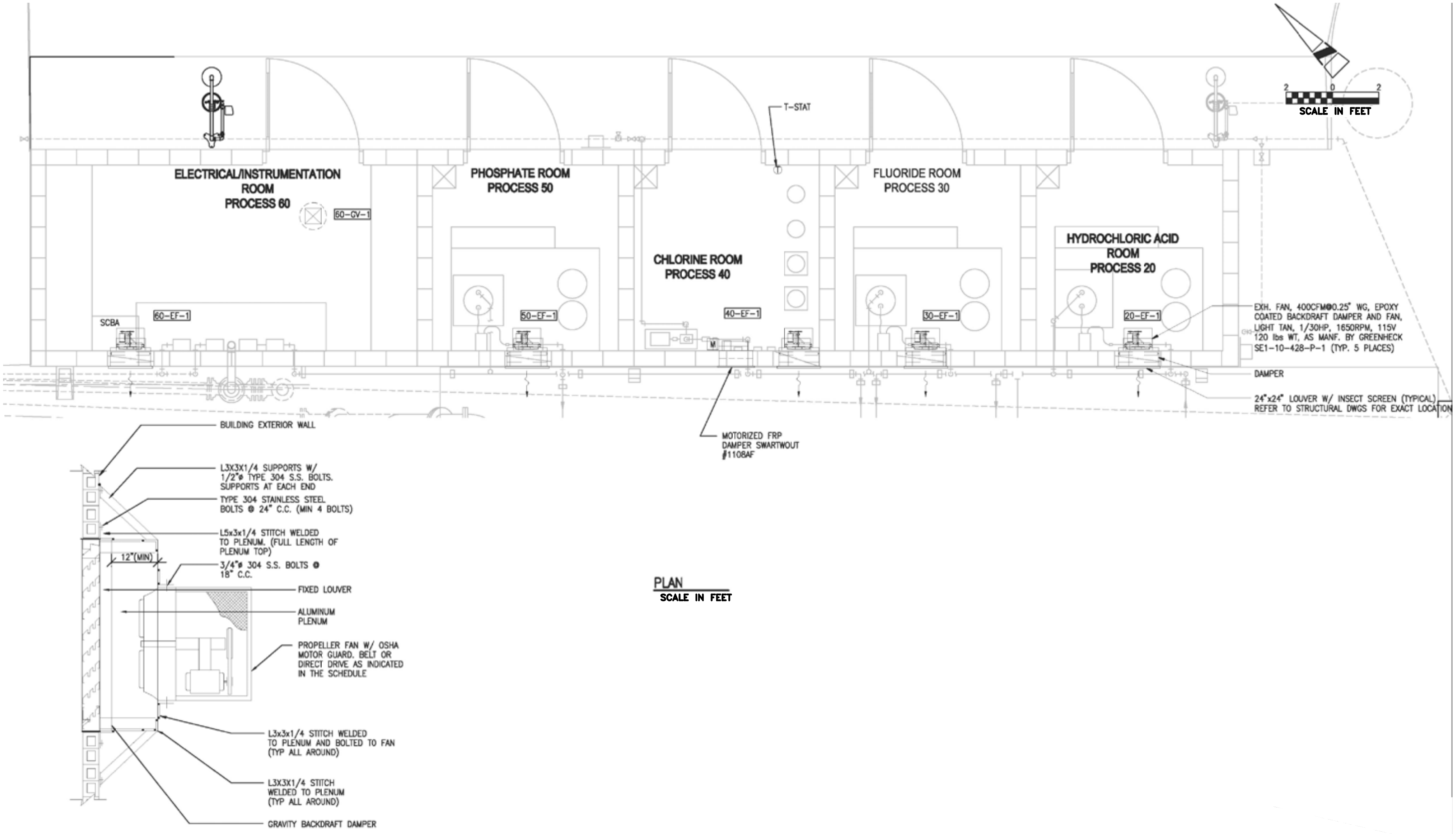
FIGURE 6–2. PROPOSED LAYOUT FOR ASR TEST WELL AND STORAGE–ZONE MONITOR WELLS.



Cardno ENTRIX

PROJECT NAME: SJRWMD
PROJECT NUMBER: 11437200.00
DWG. NUMBER: 11437200mw1
DATE: 08/11/11

FIGURE 6–3. PROCESS FLOW SCHEMATIC.



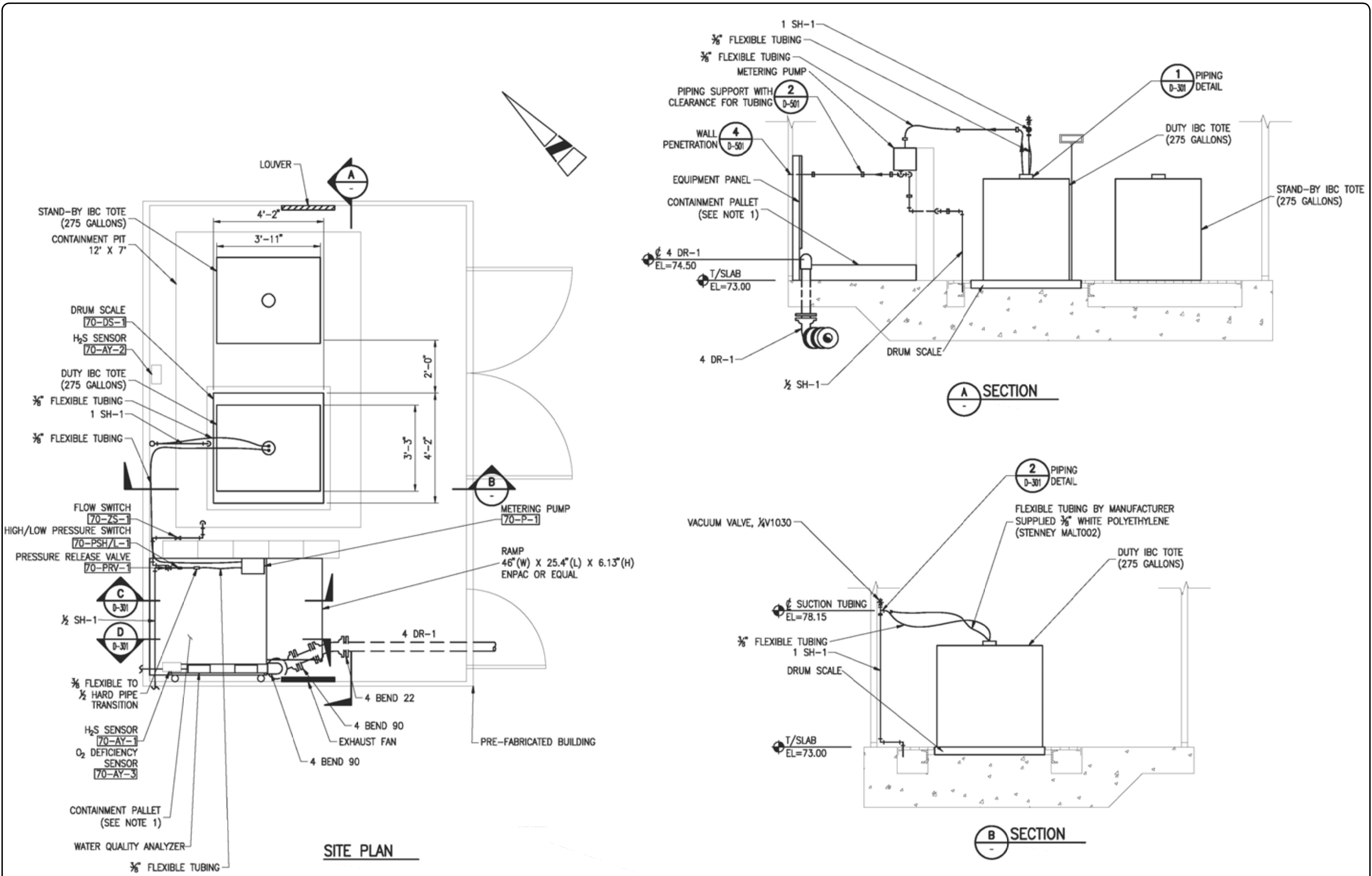
RECORD DRAWING

The record drawing applies only to those facilities constructed under the contract identified in the title block and has been prepared, in part, on the basis of information compiled and furnished by others. The Engineer will not be responsible for any errors or omissions which have been incorporated into this drawing as a result of the work by others.

Cardno ENTRIX

PROJECT NAME: SJRWMD
PROJECT NUMBER: 11437200.00
DWG. NUMBER: 11437200mw1
DATE: 08/11/11

FIGURE 6–4. PROPOSED DESIGN PLAN OF BUILDING AND PIPING.



NOTES:

1. THE WATER LEAKAGE/SPILL CONTAINMENT PALLET SHALL BE MADE OF POLYETHYLENE. IT SHALL HAVE LOAD BEARING CAPACITY OF AT LEAST 6,000 LBS AND SHALL BE ENPAC 4-DRUM WORK STATION (52.5"(L) X 53"(W) X 6"(H) OR EQUAL.
2. IBC = INTERMEDIATE BULK CONTAINER. CONTAINER DIMENSIONS ARE 47"(L) X 39"(W) X 45.7"(H). SCHUTZ ECOBULK MX1000 OR EQUAL.

Cardno ENTRIX

PROJECT NAME: SJRWMD
PROJECT NUMBER: 11437200.00
DWG. NUMBER: 11437200mw1
DATE: 08/11/11

AECOM

FIGURE 6–5. PROPOSED DESIGN OF PRETREATMENT SYSTEMS.

The chemical feed and storage systems are capable of treating from 600 to 900 gpm of water flow. Each chemical system is housed in a separate room of a concrete block (CMU) remote water-plant chemical building. This building has a total of five (5) rooms. Four (4) rooms house chemical feed and storage systems and the fifth room houses electrical equipment and the SCADA system. Each chemical feed room has internal dimensions of 8 feet by 8 feet and will have one exhaust fan (w/vent) for ventilation.

Chemicals will be injected into the above-ground portion of the 12-inch diameter ductile iron supply/recovery piping, which is located adjacent to the chemical building. Hydrochloric acid (HCl) was planned for use as a pretreatment to prevent or mitigate formation plugging, to be injected into the static mixer when water was recharged into the aquifer. During cycle testing, it was determined that HCl use was not necessary. Chlorine, Fluoride, and Phosphate were to be injected upstream of the static mixer during ground water recovery operation of the ASR well.

The maximum pressure in the potable water distribution system piping was assumed to be 80 psi. This pressure was used to size and select chemical feed pumps and booster pumps. Feed system details are listed below.

<u>Chlorine Feed and Storage System</u>

- Chemical – Chlorine Gas
- Average Chlorine Dose – 3.0 mg/L Chlorine
- Average Chlorine Feed Rate – 1.05 lbs per hour
- Dose Range – 0 to 4.0 lbs per hour (up to 9.0 mg/L Chlorine dose @ 900 gpm)
- Minimum Chlorine Residual – 1.0 mg/L Chlorine
- Storage Volume Requirements for 30 Days Supply – 757 lbs
- Number of Cylinders Required for 30 Days – 5 (each 150 lbs)
- Two sets of scales will be provided.
- A chlorine gas alarm will be provided.
- Feed System Operation - The online measurement of chlorine will occur downstream of chlorine injection point. The chlorine injection feed rate will be manually set (using a manual rate adjustment valve) based on the water flow rate and the measured chlorine residual concentration.
- A horizontal regenerative turbine booster pump and ejector will inject the chlorine solution into the 12-inch supply and recovery pipe. The booster pump will be capable of pumping at maximum injection pipe (12-inch supply and return main) pressure of 80 psi.
- The chlorinator equipment will be capable of dosing up to 100 ppd chlorine into recovered water.
- The exhaust fan is installed at the floor level.
- The booster pump, chlorine cylinders and scales are installed on the floor of the chlorine room. The remainder of the equipment will be mounted on the wall.
- The injection pipe shall be a solvent welded Schedule 80 PVC pipe.

- A Self Contained Breathing Apparatus (SCBA) will be maintained in the control room of the chemical building.

Hydrochloric Acid Feed and Storage System

- Chemical – 20% Hydrochloric Acid
- Desired pH Change - 0.5 to 1.0 units
- HCL Average Dose - 120 mL of 20% HCL per 1,000 gallons of water
- HCL Average Dose – 1.33 gph
- HCL Dose Range - 50 to 500 mL of 20% HCL per 1,000 gallons of water
- HCL Feed Rate Range - 0.5 to 7.13 gph
- Storage Volume Requirements for 30 Days Supply – 958 gallons
- Number of Drums Required for 30 Days – 17 (55 gallons each)
- One scale will be provided
- A pallet spill containment system is provided
- Feed System Operation - The feed rate will be manually set based on water flow rate in the pipe and the desired pH change. Injection water pH and pressure will be monitored.
- The metering pump is installed on the wall inside the hydrochloric acid room.

Fluoride Feed and Storage System

- Chemical – 23% Hydrofluosilicic Acid
- Fluoride Average Dose – 0.87 mg/L (calculated dose for City supplied 40 lbs/day chemical usage)
- Fluoride Dose Range – 0.7 to 1.3 mg/L (per the FDEP)
- Fluoride Feed Rate Range - 0.12 to 0.33 gph
- Storage Volume Requirements for 30 Days Supply – 121 gallons
- Number of Drums Required for 30 Days – 3.0 (each 55 gallons)
- One scale is provided
- A pallet spill containment system will be provided
- Feed System Operation - The feed rate will be manually set based on water flow rate in the pipe and the desired Fluoride levels. The peristaltic chemical metering pump will be sized to deliver 0 to 0.33 gph. The metering pump is a Stenner model with #2 tubing.
- The metering pump is installed on the wall inside the Fluoride room.

Phosphate Blend Feed and Storage System

- The City of DeLand uses 36% Phosphate Blend liquid from Calciquest (acquired by Carus Phosphates, Inc.) for corrosion inhibition.
- 2.0 gpd of this chemical is required to treat 1.0 mgd of water with 1.0 mg/L phosphate.
- Dose and Daily Chemical Consumption:

PER VENDOR	DOSE (MG/L)	CONSUMPTION (GPD)	CONSUMPTION (LBS/DAY)
Minimum	1.0	2.0	23
Average	2.15	4.3	50
Maximum	9.0	18.0	209

- Chemical – 36% Phosphate Blend Liquid
- Phosphate Average Dose – 2.15 mg/L (calculated dose for City supplied 50 lbs/day chemical usage)
- Phosphate Dose Range – 1.0 to 9.0 mg/L (10.0 mg/L is max in drinking water)
- Phosphate Feed Rate Range - 0 to 0.75 gph
- Storage Volume Requirements for 30 Days Supply – 129 gallons
- One 55-gal. drum holds about 638 lbs of this chemical. Therefore, one drum will last for 12 days at the average consumption rate.
- Number of Drums Required for 30 Days – 3.0 (each 55 gallons)
- One scale is provided
- A pallet spill containment system is provided
- System Operation - The feed rate will be manually set based on water flow rate in the pipe. Using the average dose, the chemical flow rate is 0.18 gph. The peristaltic metering pumps will be sized to deliver 0 to 0.75 gph.

6.4.2.1 System Operation

The system can be operated remotely via the City’s SCADA system.

- The mode of operation will be operator initiated from the City’s central control facility or via local override.
- Valves are motor-operated gate valves except check valves, which are swing type.
- A flow control valve (FCV) is used to control the rate of flow into the well during recharge.
- Water injection and recovery cannot occur simultaneously.

When surplus water is available, the water injection sequence will be turned ON by the operator. Injection of the water into the well will involve:

- Well pump OFF and in MANUAL mode (on screen).
- The Flow Control Valve (FCV) in the well, will regulate the flow.
- Acid feed pump will be turned ON, as needed, after injection begins. The timing of this operation can be controlled manually, or with a time delay.
- Respective motor operated valves will be closed to isolate the ASR well discharge pipe and the purge pipe.

When water demand is high, the water recovery sequence will be turned ON by the operator. It will involve:

- Well Pump ON.
- Respective motor operated valves will be closed to isolate ASR well injection pipe.
- Respective valves will be operated for a set time for water purge. Purge water turbidity will be monitored to validate water quality.
- Chlorine, Fluoride and Phosphate Blend feed systems will be ON. Feed pumps will be electrically interlinked with well pump motor for simultaneous ON/OFF operation. Pumps will still be set manually to the desired feed rate.

The distribution system pressure is monitored. If the distribution pressure drops below a pre-selected minimum value and if water injection into ASR well sequence is ON, then injection of water into the aquifer is automatically terminated. Operator initiated water recovery can be implemented to increase the distribution system pressure by supplying water from the ASR well.

6.4.2.2 NaHS Pretreatment System Design Criteria

The sodium hydrosulfide (NaHS) chemical feed and storage is housed in a separate pre-engineered metal building northwest of the existing concrete masonry unit (CMU) chemical building. The pre-engineered building designed by Steel and Post (DeLand, FL) has inside dimensions of 11'-6" by 18'-2" and outside dimensions of 12'-2" by 18'-4". The building contains the NaHS chemical feed and storage systems, water-quality analyzers, and grated chemical containment sump. An 8-foot wide, 8-foot tall fiberglass-reinforced plastic (FRP) double door and a 3-foot wide FRP man door allow access to the building. An exhaust fan and louver are provided for ventilation. An air-conditioner and heater are provided for cooling and heating. A combination emergency shower and eyewash is installed just outside the room.

The NaHS is stored in two (2), 275-gallon intermediate bulk containers (IBCs). NaHS is pumped via a peristaltic metering pump to an above ground chemical injection station retrofitted to the 12-inch diameter ductile-iron supply/recovery piping. This piping runs behind the existing chemical building. Specifics of the system components are presented below.

<u>37% NaHS Solution Information</u>

- Common synonyms: NaHS (NaSH), sodium bisulfide, sodium sulfhydrate, sodium hydrogen sulfide, sodium mercaptan
- Produced by reacting H_2S with NaOH
- pH of 11.5
- Solution freezing point: 40°F
- Specific gravity: 1.26
- Density: 10.51 lb/gal
- Odor: rotten egg
- CAS No.: 16721-80-5

- The chemical does not meet the OSHA listing criteria for Process Safety Management (PSM) or Risk Management Plan (RMP)
- UN No.: 2922
- DOT Hazard Class: 8 (6.1), due to its corrosiveness and toxicity

Safety Design Considerations

- NaHS will produce large amounts of hydrogen sulfide gas (H_2S) when it reacts with an acid or is exposed to high heat
- "Olfactory fatigue," a loss of the sense of smell and subsequently not realizing that H_2S is present, must be considered when designing the NaHS safety systems
- NaHS incidents typically follow three elements:
  - Inadvertent spill, leak or mixing with an acidic solution to produce H_2S
  - Inadequate ventilation or H_2S detection devices
  - Inappropriate emergency response by workers
- Acid and NaHS waste streams should be separated or designed to handle mixing so as to prevent an uncontrolled or otherwise hazardous release of H_2S
- Ventilation systems and H_2S detectors and alarms at locations where hazardous concentrations may occur (e.g., storage areas and off-loading terminals) shall be installed
- Design transfer connections and procedures to prevent inadvertent mixing. Limit access to these connections to trained and authorized personnel through reliable and effective controls, which should include procedures and physical barriers
- Process system components shall be constructed from materials capable of withstanding corrosivity and temperatures associated with NaHS solutions. NaHS manufacturers recommend the following materials:
  - Storage tanks and steam coils: 304 stainless steel
  - Pumps: 304L or 316L stainless steel
  - Piping: 316 stainless steel, insulated and heat-traced in locations where freezing may occur
  - Gaskets: Spiral-wound 316L stainless steel or a PTFE ring
  - Valves: lubricated or made with a PTFE sleeve and seal
- Copper, zinc, brass, bronze, aluminum and galvanized metals should be avoided due to corrosion
- Alarm and detection:
  - Two (2) H_2S detectors with low and high alarms (set at 10 ppm and 15 ppm, respectively)
  - Located in containment area, 2 ft above ground level
  - Located near the metering pump, 2 ft above ground level
  - Oxygen (O_2) deficiency monitor located outside of containment area at ground level and set to 20.0% caution and 19.5% danger per OSHA standards
  - Visual alarms are installed outside of building
  - Alarms are be connected to the SCADA system
- An emergency eyewash/shower was installed outside of the building

Emergency responders shall be called if H_2S gas alarm is triggered. Emergency responders shall be equipped with NIOSH-approved, full-facepiece SCBA in pressure demand mode, and protective outer garments. The City may want to contract with environmental spill clean-up companies to handle emergency if there is an alarm event.

The following are the general guidelines during an event:

- For small fires, use dry chemicals, CO_2, or water spray
- For large fires, use dry chemicals, CO_2, alcohol-resistant foam, or water spray
- For spill response, contain the spill and recover spilled material on adsorbents and place in covered containers for reclamation or disposal

SCBA will be provided but shall only be used for small spills by the OSHA trained operators at less than H2S gas alarm concentrations
SCBA systems provided shall be same make and model as those owned by City of DeLand fire department
SCBA systems are kept inside the instrumentation room in the CMU building

NaHS Feed and Storage System Description

- Chemical – 37% NaHS solution
- Average NaHS dose – 5 mg/L
- Dose Range – 0 to 10 mg/L
- Average NaHS Feed Rate – 20.3 gallons per day (gpd)
- NaHS Feed Rate Range – 0 to 40 gpd
- Normal Minimum Storage Volume Requirements for 14 Days Supply – 284 gallons
- Total Storage Volume – 550 gallons, each tote provides 275 gallons of storage
- The intent is to run the chemical inventory to near zero at the end of the ASR injection season

One (1) 50-inch-by-50-inch scale was provided for use for monitoring of the duty tote. Two (2) hydrogen sulfide (H_2S) gas and one (1) oxygen deficiency (O_2) sensors and alarms were provided for the chemical room. Chemical containment for the NaHS was provided by a grated sump underneath the IBC storage. The minimum available containment volume for the structure should be 413 gallons (55.3 ft^3), which is equal to 150% of one tote storage volume. This containment volume is greater than the required 110% of one tote volume and provides chemical storage expansion to two (2) 375-gallon totes in future. A total future chemical storage volume can be 750 gallons. Grating meets ADA spacing requirements. Other equipment included:

- A variable speed peristaltic metering pump rated at 40 gpd @ 100 psi to pump the solution to the injection point.
- The exhaust fan installed at the floor level on the west wall of the room.
- The louver installed at eye level on the east wall of the room.
- The NaHS solution pipe is dual-contained outside the building and is 3/8-inch diameter styrene tubing.

- The chemical supplier will fill the IBCs at 100°F to allow enough volume for vapors. The supplier recommended not providing any vents but instead provided a vacuum breaker on the tote to let air in when the solution level decreases due to pumping. Thus, the totes will not be vented to outside air.
- Materials coming in contact with potable water have NSF 61 certification.

Concrete containment slab design (Performance Specifications)

- Minimum available below grade sump containment volume: 413 gallons (55.3 ft^3) using 150% of one 275-gallon tote volume. Preliminary containment size for providing at least 413 gallons volume = 12'L X 7'W X 1'D
- Minimum walkway width to and from doorway: 3'-6"
- Minimum grating width surrounding each IBC tote: 6"
- IBC tote (Schutz Ecobulk MX) to be provided by chemical manufacturer (TDC, LLC):
    - Number of totes: Two (2)
    - Volume: 275 gallons (ea.)
    - Footprint: 48"Lx 40"W (ea.). The long side shall be placed parallel the room width.
    - Weight of tote (empty): 141 lb (ea.)
    - Weight of tote (full): 2,946 lb (ea.)
- To allow movement of approximately 3,000 lbs of combined weight of pallet jack and a full tote, the flat surface needed to be designed from the tote unloading area outside the room to the tote final installation location. The grating shall be flush-mounted with the concrete slab and top of the scale
- Safety factor for loads: 1.5
- Grating: ADA approved (McNichols Wheels 'n Heels, or equal), 316 stainless steel
- 1'-6" x 1'-6" of grating to be removable to use temporary sump pump.
- Slope containment to 1'-6" x 1'-6" sump with elevation 6-inches lower than bottom of containment
- Design shall allow for installation of IBC scale under one (1) duty IBC 50-inch by 50-inch Force Flow Electronic Low Profile Chem-Scale with Wizard 4000 Indicator for IBC Tote Bins; Scale height: 3.5-inches, Stainless Steel
- Top of pipe elevation for 6-DR-1 concrete encasement under building is: 70.72'

The location of the building and slab allows for a minimum of 3'-0" between the building and the well pump equipment pad for a walkway access to chemical injection diffuser and for minimum of 10'-0" between the building and the fence line to permit vehicular access to spreader swale and well pump.

Pre-engineered fabricated metal building design (by Steel & Post, Inc.)

- 8-foot wide by 8-foot high double Chem-Pruf™ door
- 3-foot Chem-Pruf™ man door shall provide normal access to chemical building.

Ventilation:

- Exhaust fan installed on west wall of the building near grade.
- Louver installed on east side of building at eye level.
- Air handler shall be suspended from building above chemical pumping area. The air handler will have another opening on the building wall to let fresh air in the room

Structural criteria:

- Florida Building Code: FBC 2007 with 2009 amendments
- ASCE 7-05, Minimum design loads for buildings and other structures
- AISC Manual of steel construction, thirteenth edition
- ACI 318-05, Building code requirements for structural concrete
- ACI 350-06, Code requirements for environmental engineering concrete structures
- ACI 530-05, Building code requirements for masonry structures

Wind loading criteria:

Design wind velocity	140 MPH
Building exposure	C
Building Category	III
Importance Factor	1.15

Excavation and earthwork criteria:

- Geotechnical report recommendations prepared by Nodarse and Associates, dated June 26, 2007 for the site excavation, fill and backfill implemented.

Electrical System Description

Electrical power for the new chemical building will be provided from the existing facility electrical system. The chemical pumps, HVAC system, scale, fan, lighting and receptacles will all be powered from existing Panel ‘LP-1’ (120/208V., 3-phase system). As part of the original design, adequate space is being provided in the existing control panel.

Instrumentation and Controls Description

The feed pump will automatically be turned ON with the initiation of the water injection cycle to the ASR well. The feed pump speed is manually changed based on the injection water flow rate into the ASR well using the touchscreen HMI.

Necessary water quality analyzers, chemical consumption (by weight scale), alarms and pump status will be monitored via SCADA.

- One (1) meter monitors the dissolved oxygen content of the water downstream of the NaHS injection point during injection into the well.
- One (1) ORP meter (for injection and recovery).
- One (1) Cl_2 meter located downstream of NaHS injection is used during injection.

Heading, Ventilation and Air Conditioning (HVAC) Description

The A/C system consists of an outdoor condenser, an indoor air handler and a small vent. Air conditioning and heater is set to avoid chemical freezing in the winter and chemical off-gassing in the summer. The A/C system provides ventilation during normal operation of the system. During normal operation, the floor-mounted exhaust fan will remain off and the eye-level louver will remain closed. “Seacoast” construction shall be specified. While hydrogen sulfide releases are not anticipated, the seacoast construction will help resist corrosion.

In the event of a high level H_2S alarm, the louver will open and the exhaust fan will turn ON to vent the room.

Construction of the above surface facilities began in June 2009 and ended in February 2010.

6.4.3 ASR Pretreatment

In late 2008 (FY 2009), SJRWMD authorized pilot testing of a catalytic-media process patented by Severn Trent Water Services (STWS) at the Deland Airport location to deoxygenate potable water from the City main line. During the same time period, design of a membrane-based deoxygenation system was in progress under another SJRWMD work order authorization. Although the pilot test was unsuccessful with the catalytic deoxygenation system, the results indicated that the probable cause of the failure was related to deposits in the selected palladium media. A report of the results of the pilot testing is included in Appendix F (enclosed CD).

On February 6, 2009, Lloyd Horvath, P. E., of ENTRIX, Inc.(now Cardno ENTRIX), contacted the SJRWMD-assigned project manager to recommend a new process developed by ENTRIX, Inc., for deoxygenation of water without the use of membranes, nitrogen gas or media contact chambers. On April 6, 2009, SJRWMD authorized a pilot (mini-scale) test of the chemical addition process that uses sodium bisulfide. Pilot testing was conducted by ENTRIX on site from April 8 to April 24, 2009. On May 12, 2009, a memorandum of results was submitted to SJRWMD (Appendix F, enclosed CD).

On June 10, 2009, SJRWMD authorized the full-scale design and construction of a sodium-bisulfide pretreatment facility for the ASR project site (under Work Order # 30). Again, AECOM was retained for the engineering design, but on a design/build basis. The SCADA system modifications to the DFS, Inc., software integration package were designed and installed under W.O. #33 (a continuation of W. O. # 29) using funds from a contingency budget item and the initial subcontractor. The conformed building plans were submitted to the Deland Building Department on December 22, 2010. The building and monitoring system construction was completed in February 2010. A generalized Process Flow Schematic is presented as Figure 6-3 and the proposed design for the pretreatment facility is presented as Figure 6-5.

Section 7 Regulatory Permitting

7.1 Permits

Regulatory permitting, including preparation of permit applications, and responses to requests for information from regulatory agencies was an ongoing task following the completion of the exploratory / test wells in June 2006. Site specific permits and clearances included:

- Consumptive Use Permit modification for ASR (by City) from SJRWMD
- Class V, Group 7 well under Florida Administrative Code (FAC) Chapter 62-528 (FDEP)
- Federal Aviation Administration Temporary Structure Permit (FAA/Orlando)
- Generic NPDES Permit (FDEP Industrial Wastewater)
- Environmental Resource Permit (ERP) Determination (SJRWMD)
- ASR Test Well and Monitor Well Permits (SJRWMD)
- ASR test Well Bacteriological Clearance (Volusia County Health Department)
- Building Permits (City of Deland)
- Public Water Supply (Water Main) Permit (Volusia County Health Department)
- Equip and Connect Permit Clearance (Volusia County Health Department)

7.2 FDEP UIC Permit

This permit is obtained by application to the Orlando (Central District) UIC Section office of FDEP. The permit allows for construction of the ASR Test Well and the two Storage-Zone Monitor Wells under Chapter 62-529 FAC regulations and also provides for operational testing of the completed ASR well system under general conditions specified in the permit. A copy of the UIC permit is included in Appendix D.

In addition, FDEP asked that the cooperator execute an Administrative Order (AO) before the construction of the ASR system. The AO provide for specific actions required by the City in the event that either storage-zone monitor well samples or recovered water from the ASR Test Well contained arsenic concentrations that exceeded 10 micrograms per liter (the Florida maximum contaminant level and Primary Drinking Water Standard concentration). A copy of the AO also is included in Appendix D.

7.3 Federal Aviation Administration Permit

A FAA temporary-structure permit was obtained from the Orlando office of the FAA. The FAA permit provided regulatory clearance for the use of a drilling rig mast on the Airport property at the ASR Test well and nearby SZMW-1 locations. Special rig mast lighting conditions were stipulated and followed during the drilling operations on the Airport property. A copy of the permit was included in the report: "ASR Well and Monitor Wells Construction and Testing Report, City of DeLand Aquifer Storage and Recovery Well System, Prepared for: St. Johns River Water Management District ASR Demonstration Project. April 2009."

7.4 CUP Condition for Water Supply

The City of Deland CUP provide for 2,485.65 million gallon**s** per year (MGY), or an average of 6.81 million gallons per day (MGD) in allocated raw water supply; but also includes General Condition # 8 ("Other Conditions"), providing an additional allocation of 450 MG (total), or 0.41 MGD, for the purpose of ASR Well System testing.

7.5 Well Drilling Permits from SJRWMD

The selected water well Contractor (DDC) coordinated the application for well drilling permits for the Deland Airport ASR system. SJRWMD permitting specialist Jim Frazee managed and expedited those permits for the Contractor. Copies of the well permits are included in Appendix F (enclosed CD).

Note that SJRWMD issued a letter determination that an Environmental Resource Permit was not required for the project.

7.6 FDEP Potable Water System Permits

The PWS clearance for the 12-inch diameter water main extension and 8-inch diameter discharge piping was issued by the Volusia County Health Department on December 2, 2009 (Appendix F). The clearance for the PWS was issued by the Volusia County Health Department on May 27, 2010 (Appendix F).

7.7 FDEP Permit Modification for Existing Facility, if Applicable

In order to maintain a contingency for the operational testing phase of the UIC construction permit, FDEP asked that the cooperator execute an Administrative Order (AO) before the construction of the ASR system. The AO provide for specific actions required by the City in the event that either storage-zone monitor well samples or recovered water from the ASR Test Well contained arsenic concentrations that exceeded 10 micrograms per liter (the Florida maximum contaminant level and Primary Drinking Water Standard concentration). A copy of the AO also is included in Appendix D.

7.8 Building Permits

A Master Building Permit was obtained by the general subcontractor for the construction of the main water treatment plant (WTP)/chemical-feed building and related facilities (Florida Design Contractors, North Palm Beach, FL). Another permit was issued to the subcontractor retained for the construction of the temporary sodium-hydrosulfide storage building (Minuteman Constructors). Building permits are included in Appendix F (enclosed CD).

7.9 NPDES Permit for Discharge of Recovered Water during Operational Testing and Pipe Flushes

FDEP Industrial Wastewater Section issued a Notice of Coverage for the ASR Well under Rule 62-621.300(2), FAC on August 1, 2007. The Generic permit for produced groundwater discharge covers the maximum allowable screening values for those parameters listed under the National Pollutant Discharge Elimination System (NPDES) rule. For generic permits, FDEP administers the federal NPDES enforcement program in Florida under Florida Administrative Code rules. The discharges to the spreader swale following recharge periods were sampled for the relevant parameters and the results were reported to FDEP in Orlando.

No letters or notices of non-compliance were received for this site during the permitting, design, construction or operational testing periods.

Section 8 ASR Facilities Construction, Start-up, Monitoring and Training

The ASR test well and two Storage-Zone monitor wells (SZMW-1 and SZMW-2) were installed on and near the western edge of the DeLand Municipal Airport, at 2091 Industrial Drive. Each well was drilled to approximately 225 feet bls and cased to approximately 190 feet bls. The target storage zone in the ASR test well was acidized prior to a 72-hour aquifer performance test (APT). Step-rate pumping tests and the APT of the ASR test well indicate that conditions suitable for aquifer storage and recovery exist at the DeLand Airport ASR test well site. Furthermore, the results of the construction and testing program indicate that the ASR test well, as built, is capable of maintaining the proposed pumping rate of approximately 700 gpm.

A memorandum of results from the APT with a recommendation regarding ASR feasibility for the DeLand Airport site is included as Appendix E.

8.1 Construction and Testing of the ASR Well and Monitor Wells

The ASR facility at the City of DeLand Municipal Airport consists of one (1) ASR test well, designed to accept a flow rate of about 1.0 MGD, equivalent to about 700 gpm and two (2) storage-zone monitor wells (SZMWs) , completed in the same interval as the ASR Test Well. The construction and testing of a single, freshwater ASR test well and two storage zone monitor wells (SZMW-1 and SZMW-2) were completed at the project location along the northwestern edge of the DeLand Municipal Airport, at 2091 Industrial Drive, DeLand, Florida. The ASR test well is located at 29^0 04’ 05” N Latitude and 81^0 17’ 22” W Longitude, SZMW-1 is located at 29^0 04’ 06” N Latitude and 81^0 17’ 22” W Longitude, and SZMW-2 is located at 29^0 04’ 05” N Latitude and 81^0 17’ 26” W Longitude. Construction and testing of the pilot project wells began on June 12, 2008 and was completed on January 27, 2009.

The City of DeLand ASR test well was designed to store treated potable water from the City of DeLand Water Treatment System supply, originating from the distribution main in the right-of-way immediately south of the project site. Treated potable water is injected into and recovered from a zone of suitable transmissivity in the upper Floridan aquifer. In the vicinity of the ASR test well site, the upper Floridan aquifer is low in dissolved chloride concentrations, but generally is high in dissolved iron and hydrogen sulfide, and is not utilized by the City for potable supply for that reason. The intent of an ASR well in the upper Floridan aquifer at DeLand is to flush the undesirable water from the storage zone and then operate to store and recover treated water that could be used with little additional (or re-) treatment.

8.1.1 Hydrogeologic Framework

The hydrogeologic conditions underlying the site play a key role in determining the viability of an ASR well system. The primary elements of hydrogeology that affect the success of an ASR well system include vertical confinement, thickness of the storage interval, transmissivity and ambient water quality. The appendices and detailed figures and tables for this discussion are found in Appendix F on the enclosed CD, as part of the previously submitted document: ASR Well and Monitor Wells Construction and Testing Report, City of DeLand Aquifer Storage and Recovery Well System, Prepared for: St. Johns River Water Management District ASR Demonstration Project. April 2009.

The City of DeLand and the DeLand ASR test well site lie on the DeLand Ridge, a remnant of the Penholoway Terrace (see Wyrick, 1960; Rutledge, 1985). This terrace represents the remains of an ancient shoreline formed during the Sangamonian Stage (Sangamon Interglacial, ~ 128,000 - 115,000 years ago) when sea level was up to 100 feet above the current level (Williams, 2006). The DeLand Ridge has been highly modified by abundant sinkholes and the development of karst topography. There is little channelized flow off the Penholoway Terrace, and nearly all precipitation either enters the groundwater or is evaporated (Wyrick, 1960). The upper strata on the DeLand Ridge are dominated by siliciclastics and comprise the surficial aquifer and intermediate confining unit. These strata are underlain by the carbonate-dominated strata of the Floridan Aquifer System. The hydrostratigraphic terminology used to describe the hydrologic system is consistent with that applied in a recent SJRWMD report (Williams 2006).

8.1.1.2 Hydrostratigraphy of the Site

The geologic strata exhibit varying levels of permeability that form a hydrogeologic system with more permeable strata functioning as aquifers and less permeable strata serving as confining intervals. In the vicinity of the ASR test well site, the hydrogeologic sequence of concern consists of three primary hydrogeologic units: the surficial aquifer system, the intermediate confining unit, and the upper part of the Floridan aquifer.

The surficial aquifer system is a generally unconfined aquifer system composed primarily of undifferentiated, unconsolidated sands with relatively minor amounts of clay and shell. It generally occurs under unconfined conditions between the fluctuating water table and the less permeable strata present below. At the site, the surficial aquifer extends from the water table to a depth of approximately 30 feet.

The fine-grained sediments that separate the surficial and Floridan aquifer systems are referred to as the intermediate-confining unit (ICU). The ICU at the ASR test well site is composed predominantly of olive-gray, plastic clay with abundant quartz sand and minor amounts of heavy minerals and mica. The top of the ICU, in the vicinity of the ASR test well site, ranges from about 23 to 33 feet bls and thickens, from west to east, from about 20 feet thick to 35 feet thick. Reports from previous geologic investigations in the region indicate that this confining unit is regionally discontinuous due to local geologic heterogeneity (Knochenmus and Beard 1971; Kimrey 1990). Phelps (1991) noted that, in Volusia County, the ICU is leaky but serves to confine water in the underlying Floridan aquifer system under artesian pressure. The issue of local confinement was investigated further as part of a 72-hour aquifer performance test conducted at the DeLand ASR test well site and this testing indicated that the ICU effectively served to provide confinement between the surficial aquifer system and the upper Floridan aquifer.

The upper Floridan aquifer underlies the intermediate confining unit. At the ASR test well site, a 33 to 39-foot thick unconsolidated shell bed composed largely of small bivalve shells makes up the upper part of the upper Floridan aquifer. Minor amounts of clayey sand are locally encountered in this shell bed, but for the most part, there appears to be little or no matrix and the unit appears to have good to excellent intergranular porosity.

The shell bed is underlain by limestone at 91 feet bls with fair to good fine vuggy and moldic porosity. This limestone extends down to approximately 140 feet bls. A thin (less than 4 feet thick) clay unit was noted in wells SZMW-2 and the ASR test well at a depth of about 125 feet bls, but was not identified in SZMW-1.

From 140 feet bls to the total depth drilled for the ASR test well system (224.5 feet bls), dolomitic limestones, calcitic dolostones, and dolostones become the primary lithologies. These dolomitic units tend to have good moldic and fine vuggy porosities. The ASR zone is located within the dolostones in the lower part of the ASR test well. Although there do not appear to be obvious confining units, other than the thin clay layer between the ASR zone and the shell bed underlying the intermediate confining unit, hydraulic connection between the two appears to be limited. It seems unlikely that the thin and apparently discontinuous clay at about 125 feet bls serves significantly to impede the vertical movement of groundwater in the upper Florida aquifer at the ASR test well site. The limestone in the upper part of the upper Floridan aquifer apparently has lower permeability than the underlying dolostones based on the observed porosities of the limestone strata as well as the need to continually supply potable water to the hole during the reverse-air drilling of the hole. The interpretation of limited hydraulic connection between the ASR zone and the overlying limestones and shell bed is supported by the muted response of the intermediate monitor well during the aquifer performance tests at the site.

8.1.1.3 Description of Aquifer Systems

Surficial Aquifer System

The productivity of the surficial aquifer is generally low in Volusia County, and its use is normally restricted to meeting domestic and other limited needs (Rutledge 1985; Toth 1993).

Floridan Aquifer System

The Floridan aquifer system in Volusia County is divided vertically into the upper and lower Floridan aquifers. These two major sequences of limestone and dolostone have good overall water-yielding characteristics (Miller 1986) and are separated by intervening carbonate units of generally lower permeability. The Upper Floridan aquifer (UFA) is the portion of the Floridan aquifer system of interest at the project site. It extends from the base of the overlying intermediate confining unit through approximately the upper one-third of the Avon Park Formation. Flow logs obtained during the construction of the Exploratory Well (EX-1) indicated a flow zone from 200-210 feet bls, and this interval is the target zone for the ASR system at DeLand.

8.1.1.4 Site Lithostratigraphy

Drill cuttings were collected continuously and bagged at intervals of 5 feet throughout construction of the ASR test well and the two storage zone monitor wells. The lithologic units encountered during the construction of the ASR test well and the two storage zone monitor wells are described below. Lithologic descriptions of these cuttings are included as Geologic Logs for each well in Appendix B of the above-referenced report dated April 2009.

Undifferentiated Surficial Sands

At the project site, the sediments between land surface and approximately 30 feet bls are composed primarily of poorly consolidated yellowish brown to moderate brown quartz sands that include rare to common heavy mineral grains. Generally minor amounts of clay and shell may also be present. No age diagnostic fossils were noted in these strata, but it is likely that these sediments were primarily deposited during the formation of the Penholoway Terrace during the Sangamonian Stage (approximately 128,000 to 115,000 years ago) of the Pleistocene Epoch.

Pleistocene Lagoonal Clays

Underlying the undifferentiated surficial sands, from approximately 30 to 55 feet bls, are olive-gray clay-rich sands to sandy clays. Quartz sand remains a major component, particularly in the upper part, but clay tends to be the dominant component in the lower part. Heavy minerals are common in the sandy clays, and colorless mica (muscovite?) is also a noticeable component. No diagnostic fossils were observed in the clayey sands at the ASR test well site. Previous authors (e.g. Knochenmus and Beard 1971; Kimrey 1990) have stated that the poorly consolidated sands, clays, and shell beds that overlie the consolidated limestones are of Pleistocene to Miocene age. Scott (1990, Fig. 26.2) however, indicates that Miocene age Hawthorn Group strata are not known from the DeLand area, nor for most of Volusia County. Florida Assistant State Geologist, Dr. Thomas Scott, was of the opinion that the clays probably represent Pleistocene lagoonal deposits, which are seen frequently in northern and central Florida (Scott, T. M., 2009, pers. comm., 20 February).

Nashua Formation

Underlying the olive-gray sandy clays is an unconsolidated to poorly consolidated bed composed primarily of the aragonitic shells of mollusks. Bivalves are the dominant components but gastropods are common as well and most specimens are relatively small. Foraminifera are abundant in much of the unit. Thin sand stringers or lenses are occasionally encountered within the shell bed. These strata extend downward from approximately 55 to 91 feet bls, and are assigned to the late Pliocene to early Pleistocene age Nashua Formation.

Avon Park Formation

At a depth of about 91 feet bls, a thin (2 - 3 foot), hard (well indurated) limestone is encountered. It is underlain by generally softer, more friable limestones to a depth of approximately 140 feet bls. These limestones are dominated by packstones, but range from wackestone to grainstone and generally have fair to good fine vuggy and moldic porosity. Thin yellowish gray clay layers, however, are interbedded with the limestone between 124 and 139 feet bls. Fossils are locally abundant and are dominated by foraminifera including: *Dictyoconus cookei*, *Archaias* sp., *Lituonella floridana,* and miliolids (*Triloculina*? sp.). Bivalves, gastropods, bryozoans and the small echinoid *Neolaganum* are locally abundant below 120 feet bls. The fossil content is consistent with that typically encountered in the Middle Eocene Avon Park Formation.

From approximately 140 feet bls to the total depth of 224.5 feet bls, the section is dominated by moderately to well indurated dolomitic limestones, calcitic dolostones, and dolostones. These strata commonly show good moldic and fine vuggy porosity, but minimal development of fractures. The fossil content is much like that of the limestone-dominated interval from 90 - 140 feet bls. Lithologic and faunal content of these strata support assignment to the Avon Park Formation.

Davis, et al. (2001) recognized three commonly present lithozones of the Avon Park Formation in the SJRWMD (upper, middle, lower) in which dolostone is the main lithology, while limestone is more common in the intervening units. The interval from approximately 140 feet bls to the total depth drilled for the ASR test well and storage zone monitor wells can be assigned to the upper dolostone lithozone.

8.1.1.5 Water Quality Profile

Freshwater, with respect to dissolved chlorides, was found throughout both the surficial aquifer and upper Floridan aquifer at the site of the DeLand ASR test well.

8.1.2 Well Construction Summary

The selected well site can accommodate a total of three (3) ASR wells in the future. The ASR test well was constructed with a fully-cemented, nominal 17.4-inch outside diameter (OD), 1.024-inch wall, PVC, longstring casing for the storage and recovery of potable water. Construction and testing of the well was performed in accordance with Chapter 62-528, FAC, the recommendations of the Technical Advisory Committee (TAC), and the provisions of FDEP Construction Class V ASR Well Permit No. 64-0272120-001-UC.

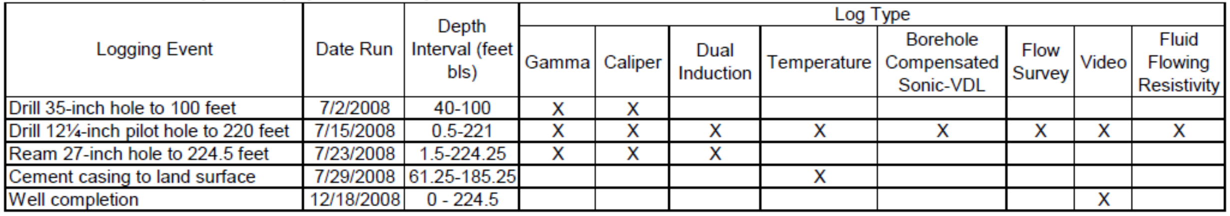
The ASR test well and SZMWs were constructed following the Technical Specifications prepared by ENTRIX dated May 2008. A detailed well construction and testing program was developed with technical review and recommendations provided by SJRWMD. The work was permitted under UIC Well Construction Permit Number 64-0272120-001, issued by the FDEP on March 25, 2008. A copy of the UIC Permit #64-0272120-001 is included in Appendix D.

The program included detailed testing and analysis, including drilled cuttings evaluation, geophysical logging (Table 8-1), aquifer performance testing, water-quality analyses and related interpretation. Construction and testing of the pilot project wells began on June 12, 2008 and was completed on January 27, 2009 under Work Order Number 27 for SJRWMD Contract Number SF408RA. Record drawings of the ASR Test Well, SZMW-1 and SZMW-2 are presented below as Figure 8-1, 8-2 and 8-3, respectively.

A summary of the geophysical surveys on the three ASR system wells is provided below.

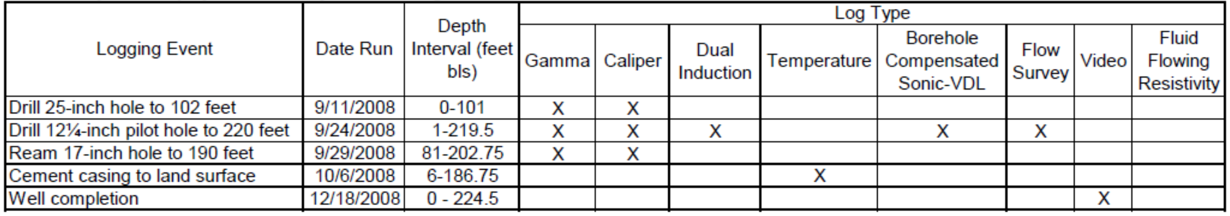
TABLE 8-1 SUMMARY OF GEOPHYSICAL SURVEYS

Table 8-1. Summary of Geophysical Surveys for the ASR Test Well



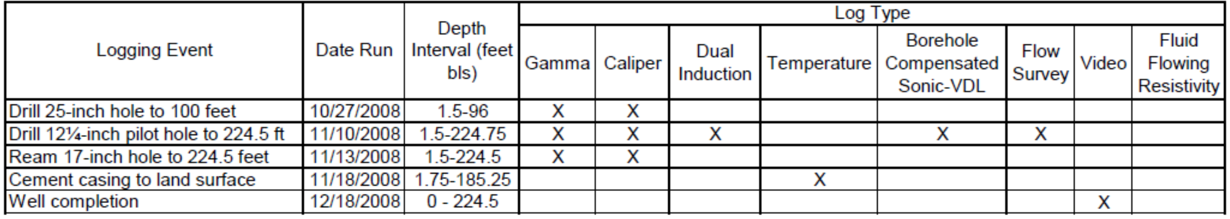
Logging Event	Date Run	Depth Interval (feet bls)	Log Type							
			Gamma	Caliper	Dual Induction	Temperature	Borehole Compensated Sonic-VDL	Flow Survey	Video	Fluid Flowing Resistivity
Drill 35-inch hole to 100 feet	7/2/2008	40-100	X	X						
Drill 12¼-inch pilot hole to 220 feet	7/15/2008	0.5-221	X	X	X	X	X	X	X	X
Ream 27-inch hole to 224.5 feet	7/23/2008	1.5-224.25	X	X	X					
Cement casing to land surface	7/29/2008	61.25-185.25				X				
Well completion	12/18/2008	0 - 224.5							X	

Summary of Geophysical Surveys for Storage Zone Monitor Well SZMW-1

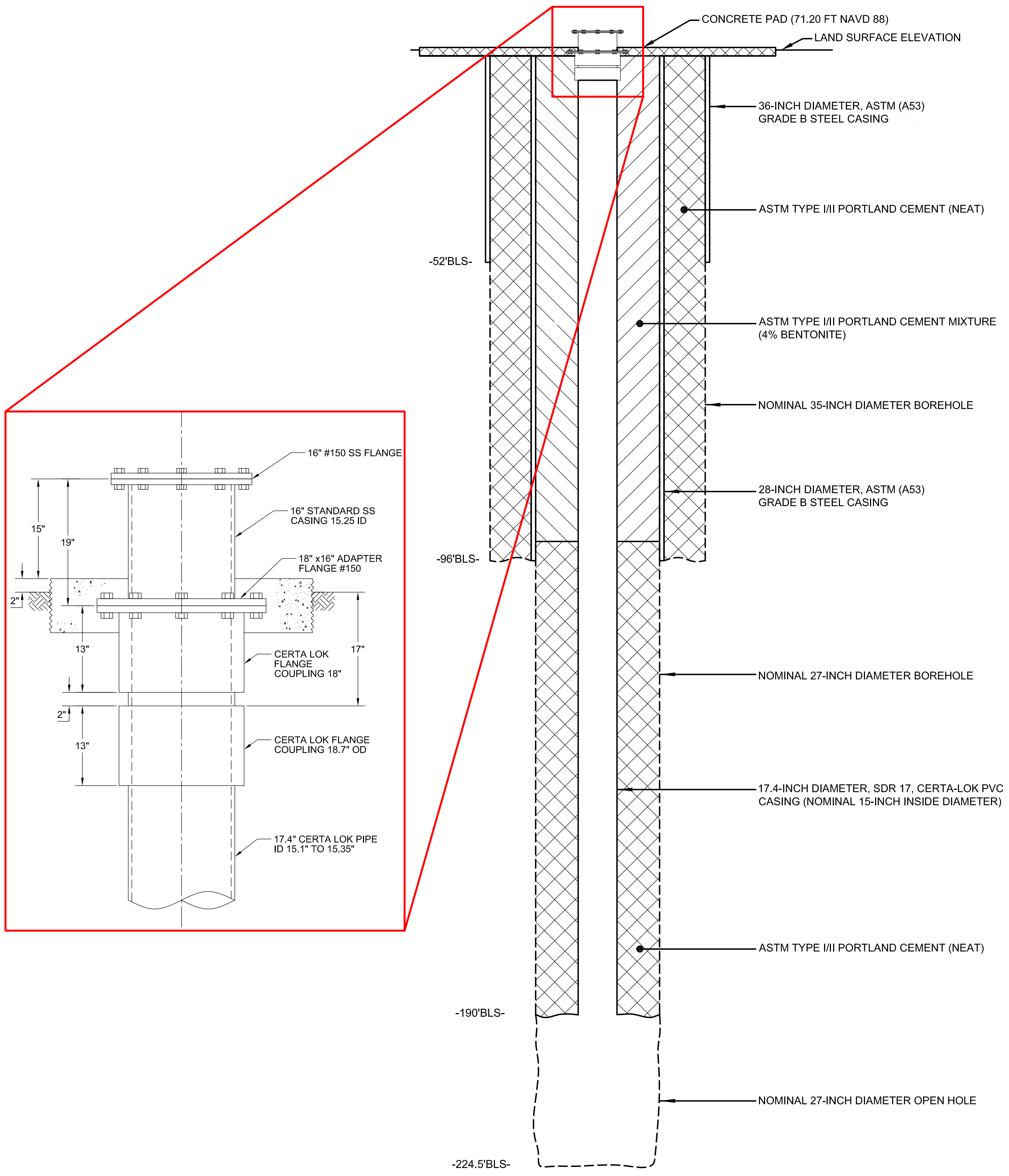


Logging Event	Date Run	Depth Interval (feet bls)	Log Type							
			Gamma	Caliper	Dual Induction	Temperature	Borehole Compensated Sonic-VDL	Flow Survey	Video	Fluid Flowing Resistivity
Drill 25-inch hole to 102 feet	9/11/2008	0-101	X	X						
Drill 12¼-inch pilot hole to 220 feet	9/24/2008	1-219.5	X	X	X		X	X		
Ream 17-inch hole to 190 feet	9/29/2008	81-202.75	X	X						
Cement casing to land surface	10/6/2008	6-186.75				X				
Well completion	12/18/2008	0 - 224.5							X	

Summary of Geophysical Surveys for Storage Zone Monitor Well SZMW-2



Logging Event	Date Run	Depth Interval (feet bls)	Log Type							
			Gamma	Caliper	Dual Induction	Temperature	Borehole Compensated Sonic-VDL	Flow Survey	Video	Fluid Flowing Resistivity
Drill 25-inch hole to 100 feet	10/27/2008	1.5-96	X	X						
Drill 12¼-inch pilot hole to 224.5 ft	11/10/2008	1.5-224.75	X	X	X		X	X		
Ream 17-inch hole to 224.5 feet	11/13/2008	1.5-224.5	X	X						
Cement casing to land surface	11/18/2008	1.75-185.25				X				
Well completion	12/18/2008	0 - 224.5							X	

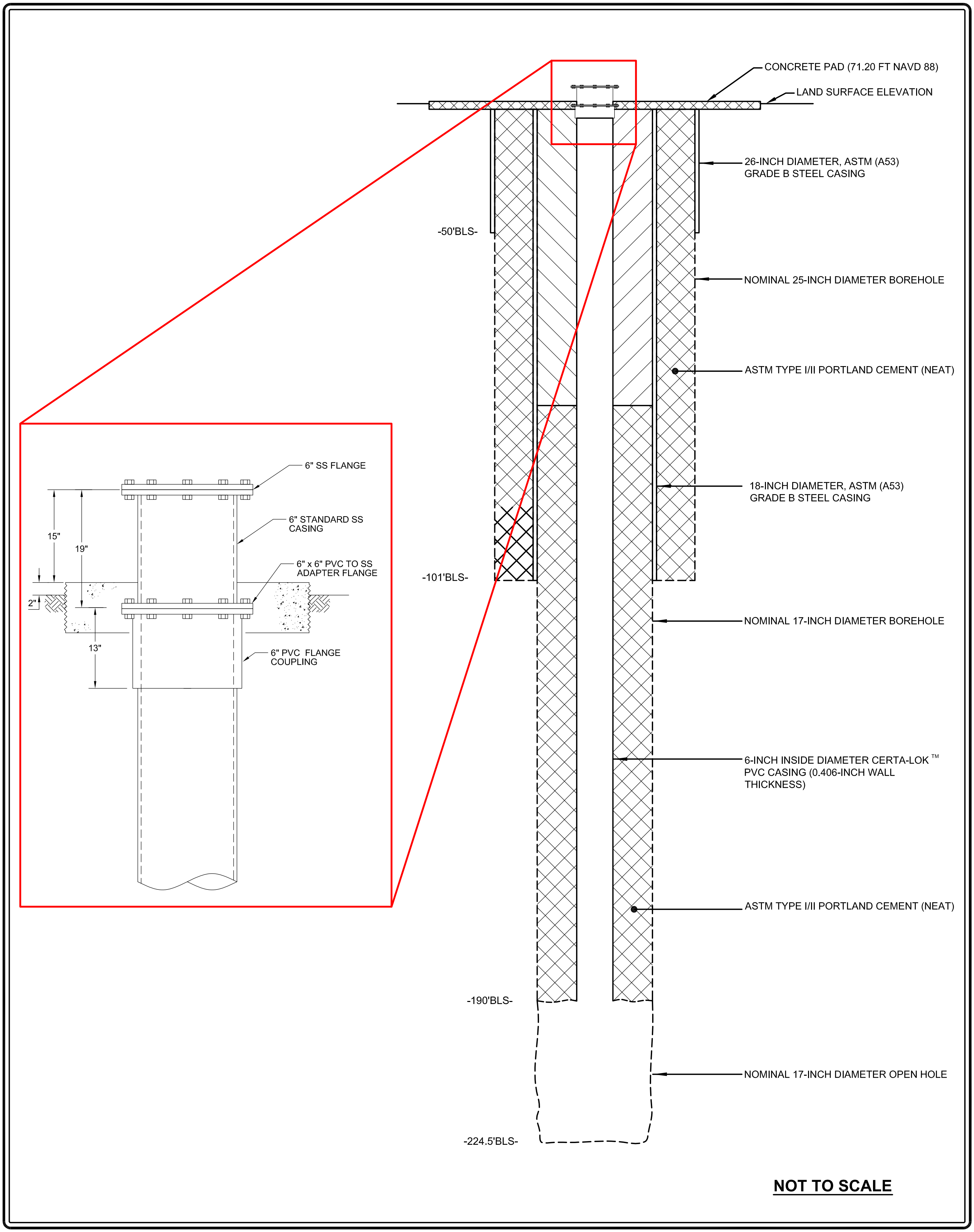


NOT TO SCALE

Cardno ENTRIX

	PROJECT NAME: SJRWMD	DWG. NUMBER: 1143717mw1
	PROJECT NUMBER: 11437200.00	DATE: 08/12/10

FIGURE 8-1. RECORD DRAWINGS OF ASR TEST WELL.



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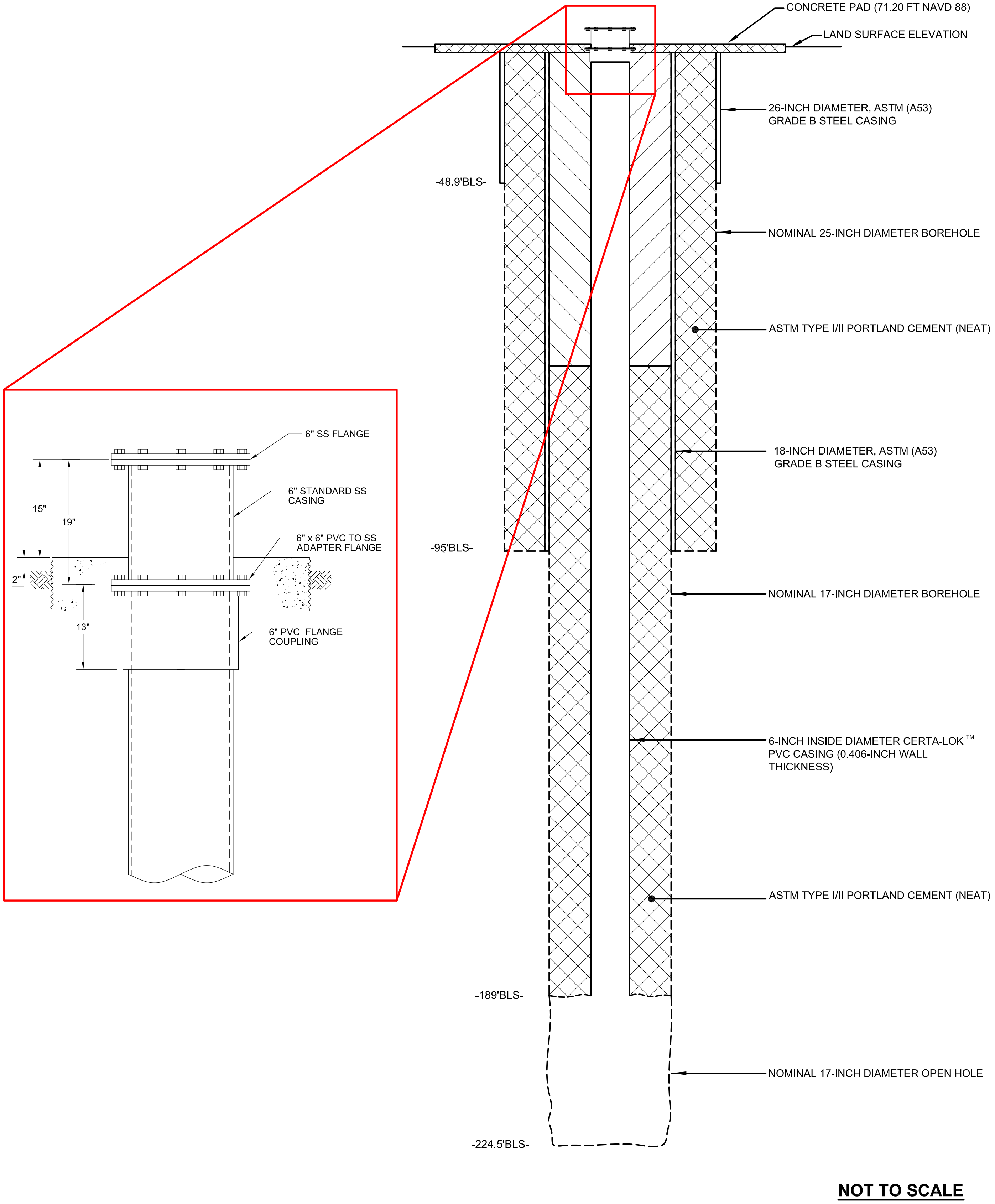
PROJECT NAME: SJRWMD
PROJECT NUMBER: 11437200.00
DWG. NUMBER: 1143717mw1
DATE: 08/12/10

FIGURE 8-2. RECORD DRAWINGS OF STORAGE-ZONE MONITOR WELL SZMW-1.



PROJECT NAME: SJRWMD
PROJECT NUMBER: 11437200.00
DWG. NUMBER: 1143717mw1
DATE: 08/12/10

FIGURE 8–3. RECORD DRAWINGS OF STORAGE–ZONE MONITOR WELL SZMW–2.

Quality assurance and quality control (QA/QC) were maintained throughout the project. Drilling and testing of the new wells followed the requirements outlines in the Technical Specifications and the FDEP/UIC construction permit (May 2008). The water quality analyses were performed by a Florida Department of Health National Environmental Laboratory Accreditation Program (NELAP) certified analytical laboratory. Important field decisions were discussed and agreed upon by the staff of ENTRIX, the SJRWMD, and the City of DeLand throughout the project.

Based on the information collected prior to and during the installation of the City of DeLand Airport ASR test and monitor wells, the following conclusions can be made:

- In the vicinity of the ASR test well site, the upper Floridan aquifer is low in dissolved chloride concentrations, but generally is high in dissolved iron and hydrogen sulfide, and is not utilized by the City for potable supply for that reason. The intent of an ASR well in the upper Floridan aquifer at DeLand was to flush the undesirable water from the storage zone and then operate to store and recover treated water that could be used with little additional (or re-) treatment.

- The ASR test well and two Storage-Zone Monitor Wells (SZMW-1 and SZMW-2) were installed on and near the western edge of the DeLand Municipal Airport, just northwest of the intersection of Industrial Drive and Pistol Range Road. Each well was drilled to approximately 224.5 feet bls and cased to approximately 190 feet bls within the upper part of the upper Floridan aquifer.

- From approximately 140 feet bls to the total depth of 224.5 feet bls, the section is dominated by moderately to well-indurated dolomitic limestones, calcitic dolostones, and dolostones. These strata commonly show good moldic and fine vuggy porosity, but minimal development of fractures. The fossil content is much like that of the limestone-dominated interval from 90 - 140 feet bls. The ASR zone is located within the dolostones in the lower part of the ASR test well. Lithologic and faunal content of these strata support assignment to the Avon Park Formation.

- The limestone in the upper part of the upper Floridan aquifer has lower apparent permeability than the underlying dolostones based on the observed porosities of the limestone strata (Appendix C). The interpretation of limited hydraulic connection between the ASR zone and the overlying limestones and shell bed is supported by the muted response of the intermediate monitor well during the aquifer performance tests at the site.

8.1.3 Well Testing and Evaluation

The program included detailed testing and analysis, including drilled cuttings evaluation, geophysical logging, aquifer performance testing, water-quality analyses and related interpretation.

8.1.4 ASR Storage Zone Characteristics

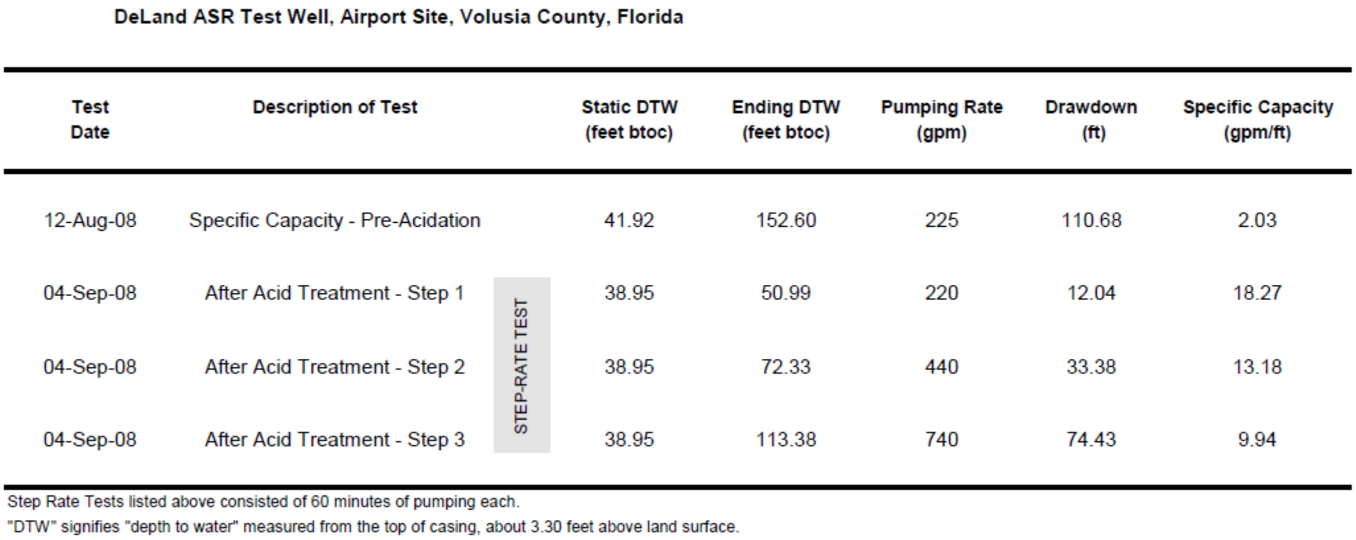
Evaluation of the collected data indicated that:

- Step-drawdown pumping tests, summarized in Table 8-2, and two Aquifer Performance Tests (APTs) of the ASR test well indicated that conditions suitable for aquifer storage and recovery exist at the DeLand Airport ASR test well site. Furthermore, the results of the construction and testing program indicate that the ASR test well, as built, is capable of maintaining a design pumping rate of approximately 700 gpm.

- The APT data was used to estimate the transmissivity, storage and leakance coefficients of the aquifer using the Hantush-Jacob Type Curve Solution (1955) and the Horner Method. Results from the late drawdown data indicate that the transmissivity of the aquifer is about 4,600 ft^2/d; the storage of the aquifer is about 3.5 E-6; and the leakance is approximately 9.3 E-7 day^{-1}. Results from the early drawdown data indicate that the transmissivity of the aquifer is about 2300 ft^2/d; the storage of the aquifer is about 1.8 E-5; and the leakance is approximately 3.4 E-4 day^{-1}. Under normal and long term pumping conditions the hydraulic coefficients derived using the later drawdown data (APT 1) are more representative of the aquifer system.

- In order to test for the presence of a hydraulic connection between the upper Floridan aquifer and the shallower aquifers, these aquifers were monitored during APT 1. Data gathered during the tests indicate that the water level in the Surficial aquifer was not impacted by the UFA pumpage. Data also indicate a minor hydraulic connection between the Intermediate confining unit and the UFA.

TABLE 8-2 SUMMARY OF STEP-DRAWDOWN TESTS



DeLand ASR Test Well, Airport Site, Volusia County, Florida

Test Date	Description of Test		Static DTW (feet btoc)	Ending DTW (feet btoc)	Pumping Rate (gpm)	Drawdown (ft)	Specific Capacity (gpm/ft)
12-Aug-08	Specific Capacity - Pre-Acidation		41.92	152.60	225	110.68	2.03
04-Sep-08	After Acid Treatment - Step 1	STEP-RATE TEST	38.95	50.99	220	12.04	18.27
04-Sep-08	After Acid Treatment - Step 2		38.95	72.33	440	33.38	13.18
04-Sep-08	After Acid Treatment - Step 3		38.95	113.38	740	74.43	9.94

Step Rate Tests listed above consisted of 60 minutes of pumping each.
"DTW" signifies "depth to water" measured from the top of casing, about 3.30 feet above land surface.

DeLand ASR Storage Zone Monitor Well 1 (MW-1), Airport Site, Volusia County, Florida

Test Date	Description of Test		Static Water Level (ft. btoc)	Pumping Water Level (ft. btoc)	Discharge Rate (gpm)	Drawdown (ft.)	Specific Capacity (gpm/ft.)
20-Oct-08	Step 1	STEP-RATE TEST	38.20	47.51	100	9.31	10.74
20-Oct-08	Step 2		38.20	52.68	150	14.48	10.36
20-Oct-08	Step 3		38.20	58.68	200	20.48	9.77
20-Oct-08	Step 4		38.20	66.08	250	27.88	8.97

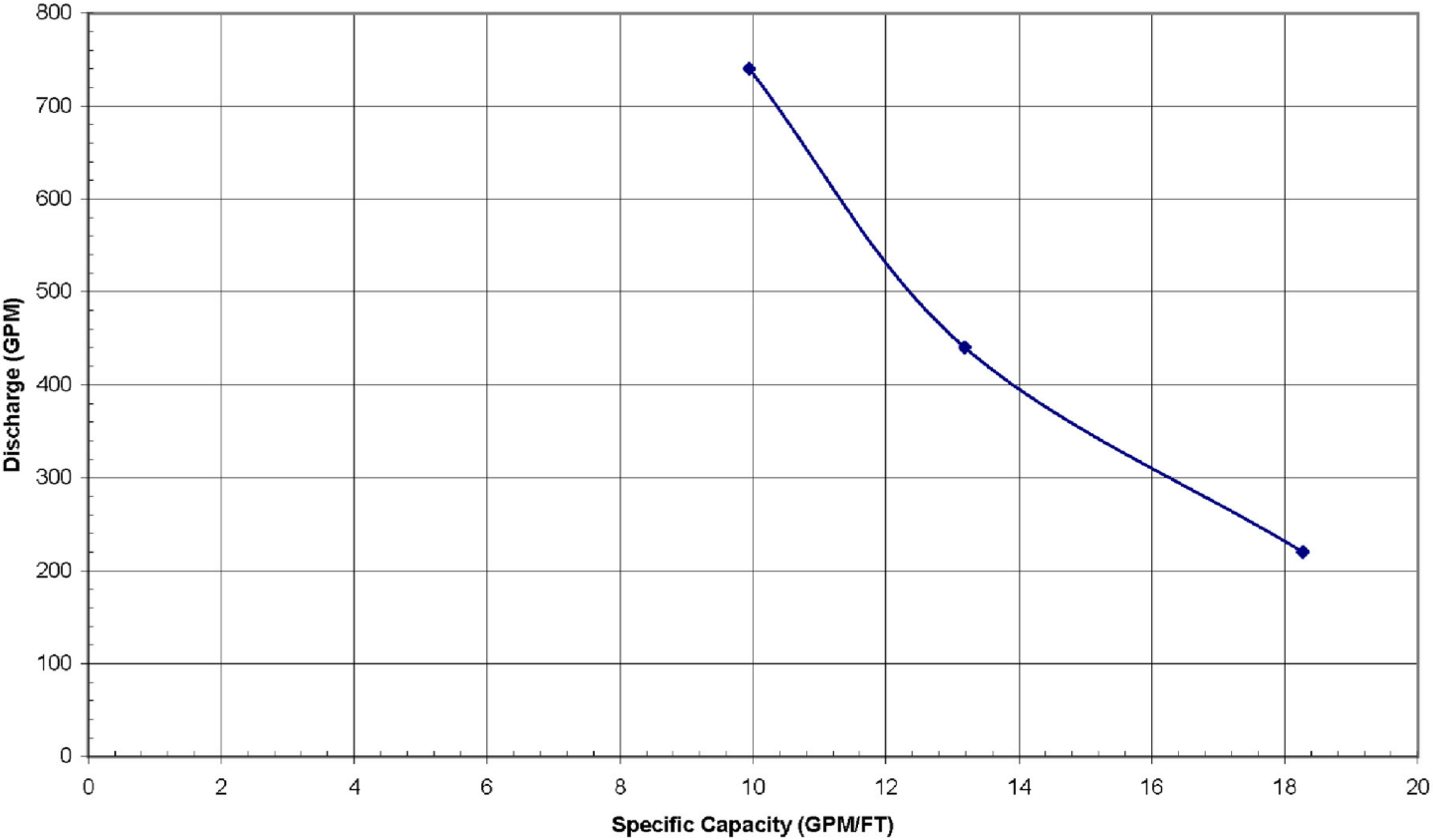
Step Rate Tests listed above consisted of 60 minutes of pumping each.

DeLand ASR Storage Zone Monitor Well 2 (MW-2), Airport Site, Volusia County, Florida

Test Date	Description of Test		Static Water Level (ft. btoc)	Pumping Water Level (ft. btoc)	Discharge Rate (gpm)	Drawdown (ft.)	Specific Capacity (gpm/ft.)
21-Nov-08	Step 1	STEP-RATE TEST	39.80	53.72	100	13.92	7.18
21-Nov-08	Step 2		39.80	62.78	150	22.98	6.53
21-Nov-08	Step 3		39.80	70.30	200	30.50	6.56
21-Nov-08	Step 4		39.80	76.85	250	37.05	6.75

Step Rate Tests listed above consisted of 60 minutes of pumping each.

Step-test drawdown results for the ASR Test Well are presented as Figure 8-4.



Cardno ENTRIX

PROJECT NAME: SJRWMD
PROJECT NUMBER: 11437200.00

DWG. NUMBER: 11437200mw1
DATE: 08/11/11

FIGURE 8–4. ASR TEST WELL STEP–DRAWDOWN TEST RESULTS.

The APT report, included as Appendix E, defined the general ASR zone characteristics:

TABLE 8-3

	Hantush and Jacob Method (1955)				**Horner Method (1966)**		
	APT-1		**APT-2**		**APT-1**	**Average**	
	MW-1	**MW-2**	**MW-1**	**MW-2**	**PW-1**	**APT1**	**APT 2***
Transmissivity (ft^2/d)	4,336	4,897	1,460	3,247	4,829	4,687	2,354
Storage	2.26E-09	7.09E-06	1.21E-05	2.50E-05		3.55E-06	1.86E-05
Leakance (day $^{-1}$)	5.64E-10	1.87E-06	4.69E-04	2.15E-04		9.33E-07	3.42E-04

*APT-2 shows influence of partial penetration. Leakance computed by APT-2 is influenced by zones below the production zone of the pumped well.

The estimated transmissivity values were within the range considered suitable for ASR well development. One of the other objectives of this study was to determine the degree of hydraulic connectivity between the Upper Floridan Aquifer (UFA) and the shallower aquifers (Intermediate and Surficial aquifers). Water levels were measured in 2 monitoring wells, one well tapping the Intermediate aquifer (designated as V-1154) and one well tapping the Surficial aquifer (designated as V-1155).

Test results at the project site suggested that under long-term pumping conditions, the late data transmissivity value of about 4,600 ft^2/d governed potentiometric head response, and a leakance coefficient of 9.33 E-7 day^{-1} governed leakage from above into the zone tested within the UFA. A storage value of 3.55 E-6 is considered the most reasonable value for the project site. Note that the leakance coefficient calculated using the short-term APT (APT 2) represents leakage from lower portions of the Floridan Aquifer System due to partial penetration of the wells while the leakance coefficient calculated using this long-term APT (APT 1) represents leakage from the Intermediate aquifer system. The steady decline observed in the Intermediate aquifer during APT 1 suggests that the unit that separates the UFA and the Intermediate Aquifer system is semi-confined or leaky. It is relevant to note that the “drawdown” observed in the Intermediate aquifer was about 2.3 feet compared to about 70 feet of drawdown observed in pumping well PW-1 which taps the upper portion of the UFA. This suggests that the hydraulic connection between the UFA and the Intermediate Aquifer is relatively minimal. The water level observed in well V-1155 which taps the Surficial aquifer did not show any measurable drawdown during the test. The water level fluctuations observed in this well suggest that the Surficial aquifer acts independently from the UFA. This is also supported by the fact that the water level in the Surficial aquifer is consistently more than 30 feet higher than that of the UFA. The APT report also provided a recommendation to proceed with the Surface Facilities Construction task as previously anticipated, based on favorable hydrogeologic conditions at the Airport ASR Test Well location.

8.2 Surface Facilities Construction

Surface facilities at the Airport ASR location consisted of a 12-inch diameter, bi-direction pipeline to connect the City's potable water main to the ASR Test Well, a chemical treatment building with chemical feed pumps and remote operation capabilities, well pump and wellhead installations, a spreader swale structure to route discharged water to an offsite wetland, a RTU and related instrumentation components to provide for remote operation of the treatment plant, ASR monitor well pumps and discharge piping to the spreader swale, and a sodium-bisulfide pretreatment unit with chemical feed pump and a secondary containment sump.

8.2.1 Pipeline

The 12-inch diameter, DIP piping is a bi-directional pipe to both transmit water from the potable water main on Industrial Drive to the ASR Test Well, but back to the main when the system is in routine operation for recovery of recharged water. Chemical fee pumps from the WTP building connect to the pipe along an aboveground section located just west of the WTP building.

8.2.2 Chemical Treatment Building

The WTP building is a Concrete Block Structure (CBS) with 5 separate bays and includes: 1) an electrical / control room, 2) a phosphate chemical storage and feed pump room, 3) a chlorine gas and chemical feed room, 4) a fluorosilic acid storage and chemical feed room, and; 5) a hydrochloric acid chemical feed room. An important feature of the chemical feed supply system from the City's perspective is that the individual feed pumps must be manually started on the SCADA / HMI touchscreen display panel and then feed rates must then be manually entered on the Stenner™ pumps in the feed rooms for phosphate and fluoride treatment and at the Chlorine gas supply meter.

8.2.3 Well Pump and Wellhead Piping

A 75-horsepower (Crane Deming 4770) motor and lineshaft vertical-turbine pump was installed on 8-inch diameter, flanged column pipe with the intake at a depth of 160 feet below land surface. The pump motor is a single-speed, maximum 1,770 revolutions per second, seven-stage pump with open-lineshaft lubrication and a mechanical split seal at the wellhead.

In addition, a downhole, flow control valve was installed in the column pipe section approximately 15 feet above the pump bowls (consisting of a hydraulically-operated sleeve) to allow flow into the well through the column pipe. A foot valve maintains water in the column pipe when the pump is turned off, and the flow valve can be opened to provide for flow into the well during recharge without an air gap that would otherwise entrain air in the recharge water. The flow control valve is manufactured 3R™ Valve, Oregon. Typically, such valves are not necessary in ASR wells in which the water well is artesian (flows at land surface).

8.2.4 Spreader Swale Discharge Structure

The spreader swale impoundment was constructed to accept water from the potable water line; storage-zone monitor wells and ASR well and allow water to gradually spread into the wetland located to the west of the project site under a generic NPDES permit from FDEP. A copy of the permit correspondence is included in Appendix F (in the enclosed CD). The specific site uses for the swale are for:

- Monitor well purge water discharged prior to compliance sampling;

- Pre-flush water from the ASR well prior to recovery and during all recovery for operational testing;

- Pre-flush of the potable water line prior to recharge operations.

8.2.5 Electrical, Instrumentation and Controls

The electrical system and site instrumentation are designed to provide safety systems, alarms and automatic/default shut-down of the ASR system in the event that some aspect or component of the ASR system requires the operator's attention.

The system will be operated remotely via the City's SCADA system:

- The mode of operation will be operator initiated from the City's central control facility or via local override.
- Valves will be motor-operated butterfly valves except check valves, which will be swing type.
- A downhole flow control valve (FCV) 3R™ was installed to control the rate of flow into the well during recharge.
- Water injection and recovery cannot occur simultaneously.

When surplus water is available, the water injection sequence will be turned ON by the operator. Injection of water into the well involves:

- Well pump OFF
- FCV will regulate the flow.
- Acid feed pump will be turned ON after injection begins. The timing of this operation can be controlled manually, or with a time delay.
- Respective motor operated valves will be closed to isolate the ASR well discharge pipe and the purge pipe.

When water demand is high, the water recovery sequence will be turned ON by the operator. Recovery of recharged water involves:

- Well Pump ON.

- Respective motor operated valves will be closed to isolate ASR well injection pipe.
- Respective valves will be operated for a set time for water purge. Purge water turbidity will be monitored to validate water quality.
- Chlorine, Fluoride and Phosphate Blend feed systems will be ON. Feed pumps will be electrically interlinked with well pump motor for simultaneous ON/OFF operation.
- The distribution system pressure will be monitored. If the distribution pressure drops below a pre-selected minimum value and if water injection into ASR well sequence is ON, then injection of water into the aquifer will be automatically terminated. Operator initiated water recovery can be implemented to increase the distribution system pressure by supplying water from the ASR well.

8.2.6 Monitoring Well Pumps and Piping

Both SZMW-1 and SZMW-2 were installed with 4-inch diameter, Grundfos submersible pumps and 2-inch diameter, PVC discharge piping routed to the onsite spreader swale. The pumps were selected based on the approximated head conditions during pumping at the monitor locations and are capable of pumping 20 gpm to the discharge swale. The pumps are activated by a master switch installed at each well site and were pumped of approximately 5 well volumes prior to each sampling event.

8.2.7 Pretreatment System

On June 10, 2009, SJRWMD authorized the full-scale design and construction of a sodium-bisulfide pretreatment facility for the ASR project site (under Work Order # 30). Again, AECOM was retained for the engineering design on a design/build timeframe. The SCADA system modifications to the DFS, Inc., software integration package were designed and installed under W.O. #33 (a continuation of W. O. # 29) using funds from a contingency budget item and the initial subcontractor. The conformed building plans were submitted to the Deland Building Department on December 22, 2010.

Construction of the pretreatment building began on December 23, 2009 using a second subcontractor (Minuteman Constructors, Inc.), and was completed by January 30, 2010. The DFS, Inc., final component installation and physical-system integration to the water treatment facility were completed on March 18, 2010.

8.3 Start-up Activities

8.3.1 Start-up, functional tests, and equipment training (include discussion of pretreatment, procedures to reduce oxygen entrainment)

There are several issues that arose during functional testing of the ASR system. The prevalent challenges related to the programming of the remote monitoring system. In addition, there were functional considerations to allow testing of the facility without pumping recovered water back to the distribution system, and some of those considerations were not made part of the original programming specifications for performance.

As referenced in Section 1, no “Startup and Training” work order was authorized by SJRWMD, and training was limited to two (2) onsite training sessions by the SCADA system supplier with concurrent functional testing. The reason for this diversion from the Work Order authorizations requested at the other sites was that City had installed DFS, Inc., SCADA systems at all their other water and wastewater treatment facilities, and was familiar with remote, web-based polling and operation. DFS was the City of Deland’s preferred contractor for the SCADA system software design and installation and were selected for that reason. The general subcontractor for the treatment building installation provided the final DFS, Inc., installation on March 18, 2010. DFS software modifications were completed on May 14 and May 15, 2010. Additional adjustments were required on the software, and for that reason, the first mini-cycle testing began on June 2, 2010, with the recharge performed using the ASR system in a manual operation mode. Although functional demonstration testing occurred on May 14 and 15, 2010, that testing did not complete the software modifications necessary to interrupt automated recovery of recovered water into the distribution system, and both a “Recovery-Purge Only” (purge to the swale) feature and a Test Interrupt/override” were later built into the DFS software.

8.3.2 Operation and Maintenance

Because the system has been operating under warranty since completion in June 2010, much of the maintenance associated with the facility has been conducted on an as-needed basis to date. Instrumentation replacement schedules for individual instruments are provided in an Operation and Maintenance (O&M) Manual which is kept on the site. An O&M Manual for remote operation of the ASR System and for the ASR well system components is included in Appendix F as Attachment 8 of the Operational Testing Request letter (ENTRIX correspondence dated April 5, 2010), also included in Appendix F. Depending on the future use of the facility, a consolidated O&M schedule may be of required for maintaining operational efficiency. However, the City has not yet concluded that the operation of the ASR facility is economically viable for potable water storage and recovery. It should be kept in mind that individual components typically need to be maintained in a non-operational state for long periods of time, due to the cyclical nature of ASR recharge, storage and recovery phases.

8.3.2.1 O&M Manual

A four (4) volume O&M Manual was prepared for the remote WTP facility at the City of Deland Airport ASR Site. The volumes consist of:

I. City of DeLand Airport Aquifer Storage and Recovery Well System
Volume I - RTU400 (401)

II. City of DeLand Airport Aquifer Storage and Recovery Well System
Volume II - Water Treatment Building and Transmission System

III. City of DeLand Airport Aquifer Storage and Recovery Well System
Volume III - Water Treatment Building and Transmission System

IV. City of DeLand Airport Aquifer Storage and Recovery Well System
Volume IV - Pretreatment-Deoxygenation System

8.3.3 Training

A training task work order was not issued by the District; however, the remote WTP facility is constructed in close conformity with and using the same SCADA subcontractor that the City staff already has in operation at their other water and wastewater monitoring facilities. For this reason, training for City staff was limited to preliminary and startup meetings to demonstrate the operation of the ASR facility.

8.4 Permit and Clearances

As described in Section 7 above, the applicable permits and clearances previously discussed were obtained and the City has maintained compliance with the approved permits.

8.5 Transfer of Facilities to Cooperator

8.5.1 Wells and Surface Facilities, including Pretreatment

Cardno ENTRIX was not involved in the transfer of facilities from SJRWMD to the City of DeLand and does not have supporting documentation of that transfer.

8.5.2 Substantial Completion and Warranties

Substantial completion documents were submitted to the City and SJRWMD in the Memorandum of Substantial Completion Documentation included in Appendix C.

Section 9 Large-Cycle Operational Monitoring and Evaluations

Construction of the pretreatment building began on December 23, 2009 using a second subcontractor (Minuteman Constructors, Inc.), and was completed by January 30, 2010. The DFS, Inc., final component installation and physical-system integration to the water treatment facility were completed on March 18, 2010. Hardware and software adjustments and training occurred in May 2010, and on June 2, 2010, the ASR system began cycle testing under the FDEP UIC Section Permit.

The planned cycle testing program (Table 6-1), as initially defined in the UIC Permit (Appendix D) was later modified as cycle testing results indicated that shorter cycles would prove the effectiveness of the ASR pretreatment process more rapidly by increasing the amount of data that could be obtained in the available time for testing. Some flexibility was anticipated in the original UIC permit application and testing and the test schedules were modified after Cycle 1 and 2.

TABLE 9-1 MODIFIED CYCLE TEST PLAN

Cycle No.	Injection Duration (Days)	Injection Volume (MG)	Storage Duration (Days)	Recovery Volume (MG)	Limiting Water-Quality Criteria [As] (ug/L)
Pre-Test	5	5	0	3-5	10
1	20	20	5-10	8-20	10
2	20	20	5-10	8-20	10
3	20	20	5-10	8-20	10
4	60	60	10-20	40-60	10

"As" – denotes total arsenic concentration of recovered water in units of micrograms per liter (ug/L)
"MG" – denotes gallons in millions
Pre-Test cycle primarily tests pumping and monitoring equipment

9.1 Cycle Testing

Initial mini-cycle testing was conducted without sodium-bisulfide pretreatment to determine whether arsenic would be produced even from very limited recharge and recovery of the city's potable water. Two (2) short cycles were conducted without any pretreatment additive, as control data (Control Mini-Cycles). The updated Cycle Test Plan is presented as Table 9-1. An updated Monitoring Schedule is presented as Table 9-2.

Next, four (4) additional mini-cycles were performed with addition of sodium bisulfide at varying concentrations up to 12 parts per million (ppm, as sulfide ion). Then a single Pre-Test of longer duration was conducted as a "shakedown test" using the fully automated mode of operation and involving the recharge and recovery of approximately 750,000 gallons. The additional mini-cycle tests are shown on Table 9-3.

Formal Cycle Testing began with Cycle Test #1 (CT-1) and the FDEP-approved sampling and monitoring schedule was used to track the sampling for the cycle testing program. Dissolved oxygen levels of the potable supply water used for the recharge events were measured at approximately 5.5 to 6.5 parts per million in the field.

Table 9-2 Cycle Test Schedule

Proposed Monitoring Schedule for City of DeLand ASR System

Parameter	Units	Injection & Recovery Frequency		Pre-Cycle Testing # of Samples			Pre-Test # of Samples						Cycle 1 # of Samples					
				1 Year Ongoing	Background Sampling		Injection (5 days^3 or 5 MG)		Storage (0 days)		Recovery (3-5 days)^3		Injection (20 days^3 or 20 MG)		Storage (5 to 10 days)		Recovery (8 to 20 days)^3	
		ASR	MWs	Source Water^1	ASR	MWs	ASR*	MWs	ASR	MWs	ASR	MWs	ASR*	MWs	ASR	MWs	ASR	MWs
Arsenic	μg/L	W2	**W2**	---	---	---	**2**	**2**	---	**1**	**2**	**2**	**6**	**6**	---	**1**	**6**	**6**
Chloride	mg/L	W	W	---	---	---	1	1	---	1	1	1	1	1	---	1	1	1
Dissolved Oxygen (field)	mg/L	W	W	---	---	---	1	1	---	1	1	1	1	1	---	1	1	1
Iron, total	mg/L	W	W	---	---	---	1	1	---	1	1	1	1	1	---	1	1	1
Sodium	mg/L	W	W	---	---	---	1	1	---	1	1	1	1	1	---	1	1	1
pH	std. units	W	W	---	---	---	1	1	---	1	1	1	1	1	---	1	1	1
Specific Conductance (field)	μmhos/cm	W	W	---	---	---	1	1	---	1	1	1	1	1	---	1	1	1
Sulfate	mg/L	W	W	---	---	---	1	1	---	1	1	1	1	1	---	1	1	1
Temperature (field)	°C	W	W	---	---	---	1	1	---	1	1	1	1	1	---	1	1	1
Total Dissolved Solids	mg/L	W	W	---	---	---	1	1	---	1	1	1	1	1	---	1	1	1
Bicarbonate	mg/L	W	W	---	---	---	1	1	---	1	1	1	1	1	---	1	1	1
Magnesium	mg/L	W	W	---	---	---	1	1	---	1	1	1	1	1	---	1	1	1
Manganese	mg/L	W	W	---	---	---	1	1	---	1	1	1	1	1	---	1	1	1
ORP (field)	mV	W	W	---	---	---	1	1	---	1	1	1	1	1	---	1	1	1
Potassium	mg/L	W	W	---	---	---	1	1	---	1	1	1	1	1	---	1	1	1
Total Sulfides	mg/L	W	W	---	---	---	1	1	---	1	1	1	1	1	---	1	1	1
Total Alkalinity	mg/L	W	W	---	---	---	1	1	---	1	1	1	1	1	---	1	1	1
Total Trihalomethanes	ug/L	W	W	---	---	---	1	1	---	1	1	1	1	1	---	1	1	1
Total Coliform	#/100 ml	W	W	---	---	---	1	1	---	1	1	1	1	1	---	1	1	1
Fecal Coliform	#/100/ml	W	W	---	---	---	1	1	---	1	1	1	1	1	---	1	1	1
Gross Alpha	pCi/L			---	---	---	1	1	---	---	1	1	1	1	---	---	1	1
Uranium	pCi/L			---	---	---	1	1	---	---	1	1	1	1	---	---	1	1
^{226}Ra / ^{228}Ra	pCi/L	O	---	---	---	---	1	1	---	---	1	1	1	1	---	---	1	1
[1]Selected Primary and Secondary DW Parameters		A	---	4	1	1	---	---	---	---	---	---	---	---	---	---	---	---

Parameter	Units	Injection & Recovery Frequency		Cycle 2 # of Samples						Cycle 3 # of Samples						Cycle 4 # of Samples					
				Injection (20 days^3 or 20 MG)		Storage (5 to 10 days		Recovery (8 to 20 days)^3		Injection (20 days^3 or 20 MG)		Storage (5 to 10 days)		Recovery (8 to 20 days)^3		Injection (60 days^3 or 60 MG)		Storage (10 to 20 days)		Recovery (40 to 60 days)^3	
		ASR	MWs	ASR*	MWs	ASR	MWs	ASR	MWs	ASR*	MWs	ASR	MWs	ASR	MWs	ASR*	MWs	ASR	MWs	ASR	MWs
Arsenic	μg/L	W2	**W2**	**6**	**6**	---	**1**	**6**	**6**	**6**	**6**	---	**1**	**6**	**6**	**16**	**16**	---	**2**	**16**	**16**
Chloride	mg/L	W	W	1	1	---	1	1	1	1	1	---	1	1	1	8	8	---	1	8	8
Dissolved Oxygen (field)	mg/L	W	W	1	1	---	1	1	1	1	1	---	1	1	1	8	8	---	1	8	8
Iron, total	mg/L	W	W	1	1	---	1	1	1	1	1	---	1	1	1	8	8	---	1	8	8
Sodium	mg/L	W	W	1	1	---	1	1	1	1	1	---	1	1	1	8	8	---	1	8	8
pH	std. units	W	W	1	1	---	1	1	1	1	1	---	1	1	1	8	8	---	1	8	8
Specific Conductance (field)	μmhos/cm	W	W	1	1	---	1	1	1	1	1	---	1	1	1	8	8	---	1	8	8
Sulfate	mg/L	W	W	1	1	---	1	1	1	1	1	---	1	1	1	8	8	---	1	8	8
Temperature (field)	°C	W	W	1	1	---	1	1	1	1	1	---	1	1	1	8	8	---	1	8	8
Total Dissolved Solids	mg/L	W	W	1	1	---	1	1	1	1	1	---	1	1	1	8	8	---	1	8	8
Bicarbonate	mg/L	W	W	1	1	---	1	1	1	1	1	---	1	1	1	8	8	---	1	8	8
Magnesium	mg/L	W	W	1	1	---	1	1	1	1	1	---	1	1	1	8	8	---	1	8	8
Manganese	mg/L	W	W	1	1	---	1	1	1	1	1	---	1	1	1	8	8	---	1	8	8
ORP (field)	mV	W	W	1	1	---	1	1	1	1	1	---	1	1	1	8	8	---	1	8	8
Potassium	mg/L	W	W	1	1	---	1	1	1	1	1	---	1	1	1	8	8	---	1	8	8
Total Sulfides	mg/L	W	W	1	1	---	1	1	1	1	1	---	1	1	1	8	8	---	1	8	8
Total Alkalinity	mg/L	W	W	1	1	---	1	1	1	1	1	---	1	1	1	8	8	---	1	8	8
Total Trihalomethanes	ug/L	W	W	1	1	---	1	1	1	1	1	---	1	1	1	8	8	---	1	8	8
Total Coliform	#/100 ml	W	W	1	1	---	1	1	1	1	1	---	1	1	1	4	4	---	1	4	4
Fecal Coliform	#/100/ml	W	W	1	1	---	1	1	1	1	1	---	1	1	1	4	4	---	1	4	4
Gross Alpha	pCi/L			1	1	---	---	1	1	1	1	---	---	1	1	4	4	---	---	4	4
Uranium	pCi/L			1	1	---	---	1	1	1	1	---	---	1	1	4	4	---	---	4	4
^{226}Ra / ^{228}Ra	pCi/L	O	---	1	1	---	---	1	1	1	1	---	---	1	1	2	2	---	---	2	2
[1]Selected Primary and Secondary DW Parameters		A	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

MWs - Monitor Wells MW-1, MW-2
W – Weekly
W2 – Twice/week
O – Only required when gross alpha exceeds 5 pCi/L, sampled beginning and if above 5 pCi/L, at end of recovery cycle.
A – Annually

[1] Source/potable water: Sampled in accordance with the FDEP UIC Permit prior to starting cycle testing (for Primary and Secondary Drinking Water Parameters established in 62-550, Part III) & during testing for dissolved oxygen and TTHMs, excluding asbestos and dioxin, and including giardia lamblia, cryptosporidium, dissolved oxygen, E.coli, enteroccoci, and fecal and total coliform.

[2] Completed prior to any installed facility pump tests. Background sampling period to be followed by PRE-CYCLE TEST of 1 days of injection followed by 1+ days of recovery (no storage), with sampling requirements as shown.

[3] Injection periods are based on assumption that the injection and recovery rates are both one million gallons per day (MGD), such that 5 days is equivalent to 5 million gallons (MG).

* - denotes sampling of injection fluids; injected fluids will be sampled before injection and then as injection continues, as indicated above.

A reduction in ASR well injected-fluids (potable-water) sampling frequencies will be requested by the Permittee after Cycle Test #2.

Recovery periods are **estimated**, and limits will be based on actual recovered water quality and permission to end cycle from FDEP if less than the injection period (based on volume injected) and/or stated recovery period.

For the Pre-Test and Cycle 1, one sample will be collected prior to recovery, per FDEP NPDES permit, and the results will be reviewed to ensure that NPDES permit requirements are met; (these analytical results will be ordered on a rush basis, and results will be provided as quickly as the analytical lab can perform the analyses).

Storage times for Pre-Test and Cycle 1 may be modified through coordination and agreement between the City, District and FDEP, to allow for turnaround on laboratory task orders (and data review, per pending FDEP NPDES permitting requirements).

Pre-Test may, or may not include the dechlorination and /or de-oxygenation of finished source water; subsequent cycle testing use of de-oxygenation is dependent upon recovered water-quality results.

In an effort to maximize the success of large scale injection, up to ten (10) "Pre-Test" mini-cycles may be required to establish the levels of dechlorination and/or deoxygenation required for the finished source water, based on the dissipation of sodium hydrosulfide in the subsurface and the levels of hydrosulfide in the recovered water. These short cycle tests (5 to 10 total days each) will be used to help establish the relationship between the chemical treatment and dosage requirements and the observed variations in recovered water quality, and specifically in order to adjust sulfide-ion injection rates such that arsenic leaching is minimized or eliminated and recovery of excess sulfide does not occur during subsequent cycle tests. Longer cycle tests and treatment requirements using de-oxygenation will be dependent upon recovered water-quality results obtained from the pre-tests.

The results of cycle testing were reported through the completion of CT-2 in technical memoranda that are included in Appendix F.

TABLE 9-3 CYCLE TESTING RESULTS SUMMARY

Mini-Cycle or Cycle-Test Designation	**Dates**		**Recharge Volume (MG)**	**Recovery Volume (MG)**	**Sodium-Bisulfide Pretreatment Conc. in [S^{2-}] (mg/L)**	**Highest Arsenic Concentration in Recovered Water (ug/L)**
Control Mini-Cycle 1	5/26/10	5/27/10	0.214	0.278	0.0	8.4
Control Mini-Cycle 2	5/27/10	5/28/10	0.2200	0.231	0.0	7.3
Mini-Cycle 1	6/1/10	6/2/10	0.337	0.819	2.0	6.0
Mini-Cycle 2	6/3/10	6/4/10	0.336	0.840	2.0	4.5
Mini-Cycle 3	6/8/10	6/9/10	0.336	0.959	6.0	3.2
Mini-Cycle 4	6/22/10	6/23/10	0.104	0.119	6.0	2.0
Mini-Cycle 5	7/12/10	7/12/10	0.750	0.750	4.2 – 4.3	1.3
Pre-Test (5 MG)	7/20/10	8/3/10	5.237	5.240	3.9 – 4.2	0.8
Cycle-Test 1 (20 MG)	9/9/10	11/9/10	20.541	20.540	3.0 – 3.5	1.3
Cycle-Test 2 (20 MG)	1/25/11	3/29/11	19.187	21.819	3.0 – 3.25	3.2
Cycle-Test 3 (20 MG)	5/31/11	9/2/11	15.478	In Progress	2.75 – 3.0	1.7

"NST" – denotes that no storage time elapsed between the end of the recharge and beginning of the recovery phase
"MG" – denotes volume in units of millions of gallons
"mg/L" – denotes concentration of sulfide ion in milligrams per liter
"ug//L" – denotes arsenic concentration in micrograms per liter
"ST: 20 DY" – denotes the days in Storage phase

The results of cycle testing were reported through the completion of CT-2 in technical memoranda that are included in Appendix F. In general, the application of the sodium-bisulfide pretreatment appears to have mitigated the tendency for arsenic to be leached from the formation during recharge and then released from the aquifer upon recovery, as indicated by the results of the two (2) "Control" mini-cycle tests compared to subsequent cycle tests. Storage periods appear to increase the release of residual arsenic produced during the original "Control" mini-cycles; this effect of sulfides on iron oxyhydroxides is now fairly well known.

9.1.1 Current Status

Cycle Test #3 has recently been completed, with 15.5 million gallons recharged and that approximate amount planned for recovery.

9.1.2 Work Scheduled for Fiscal Year 2011

The remaining month of FY 2011 will include the return of chemical totes and recycling of used, biodegradable oil from the ASR facility and reporting of the final Cycle Test # 3 results. Additional activities or extension of the contract for work under SJRWMD contract is not anticipated.

9.1.3 Work Planned for Fiscal Year 2012 by Cooperator

The City of Deland is solely responsible for the disposition of the Airport ASR facility as of September 30, 2011. The City does not contemplate using the ASR System for potable water ASR, based on the cost of pretreatment and post-recovery (re-) treatment. A decision has not been made regarding other possible use(s) of the ASR Test Well and monitor wells at the site.

9.1.4 Unique Features of Project and Related Lessons

The initial selection of the Deland Airport ASR site was in part because the high iron content in the freshwater portion of the Floridan Aquifer at the site was not suitable for potable water wells. In addition, the high iron was considered a suitable ASR tracer for recovered water. However, the SJRWMD later decided that proactive pretreatment of the potable water (for 3 of 4 installed ASR Cooperator sites) was a priority of the ASR Demonstration Program. However, the addition of arsenic pretreatment using sulfide addition made the reduction of iron concentrations during recharge more challenging, in that, oxidation of the iron in the formation water would be limited. Iron removal proved to be a challenge during recovery operations and is related to the high native iron concentrations.

Addition of sodium hydroxide was included in Cycle Test #3 in order to adjust the pH of recharged water, but all the results have not yet become available. The primary source of recovered iron appears to be iron sulfide, and pH adjustment should reduce the solubility of iron compounds in the recovered water.

A storage-tank facility could provide for pre-injection detention time to allow the deoxidation process to be partially completed prior to injection. Post-treatment storage would allow for the City to test water and provide assurance of its quality prior to recovery to the water line; and also would provide for an aeration basin for iron precipitation at the surface. Additional operational recommendations are presented in Section 10.

9.2 Predicted and Actual Performance

The predicted versus actual performance evaluation is a task deferred to the Cooperator.

Section 10Preliminary Feasibility Determination and Conclusion

10.1 Feasibility of ASR at Airport ASR Site

The economics of potable water ASR was considered by the City of Deland, but the project's intent was testing for feasibility of ASR for a future surface water source. At this time, the re-treatment of potable water adds costs to the utility operations without a compensating incentive. Because the SJRWMD ASR Demonstration Program's long-term plan included the implementation of a surface water source project, the ability to shift the ASR system use later would enhance the economic viability of ASR for the City. As referenced in Section 3 above, a significant economic downturn has reduced the projected potable-water demands in the area since 2007. Because the City's current water demand is significantly less than the permit allocation, the potential to provide additional potable water to customers using an ASR system during the dry season has limited benefits. Additionally, due to funding and other constraints, no surface water source project was implemented by SJRWMD during the ASR Demonstration Project.

The control of subsurface arsenic leaching achieved at this ASR project (Section 9) provides valuable information for future ASR programs in the region. Although native iron concentrations at this location were not significantly reduced by the arsenic immobilization process employed at the site, standard iron treatment procedures could be employed on recovered water.

10.2 Summary of Project Costs

TABLE 10-1 FINAL CAPITAL COSTS

TASK	Approximate Itemized Cost ($M)	Approximate Cumulative Costs ($M)
Exploratory Well EX-1	0.560	0.560
Exploratory Well EX-1	0.395	0.955
ASR and Storage-Zone Monitor Wells – Construction and Testing	0.676	1.631
Design and Permitting of Surface Facilities	0.255	1.886
Construction of Surface Facilities	1.641	3.527
Pretreatment Design/Build	0.335	3.862

10.3 Original Schedule to Final Schedule Comparison

The original schedule of 822 days did not take into consideration more than one exploratory well program or the full effect of implementing a phased approach to the ASR feasibility project. Pilot project design was estimated at less than 90 days, and did not take into consideration the effect of adding pretreatment to the design contract. Decision points between work order authorizations often required technical review by SJRWMD staff and were based on preliminary recommendations by Cardno ENTRIX. Actual program tasks were authorized between 2003 and 2011, or more than 7.5 years in total.

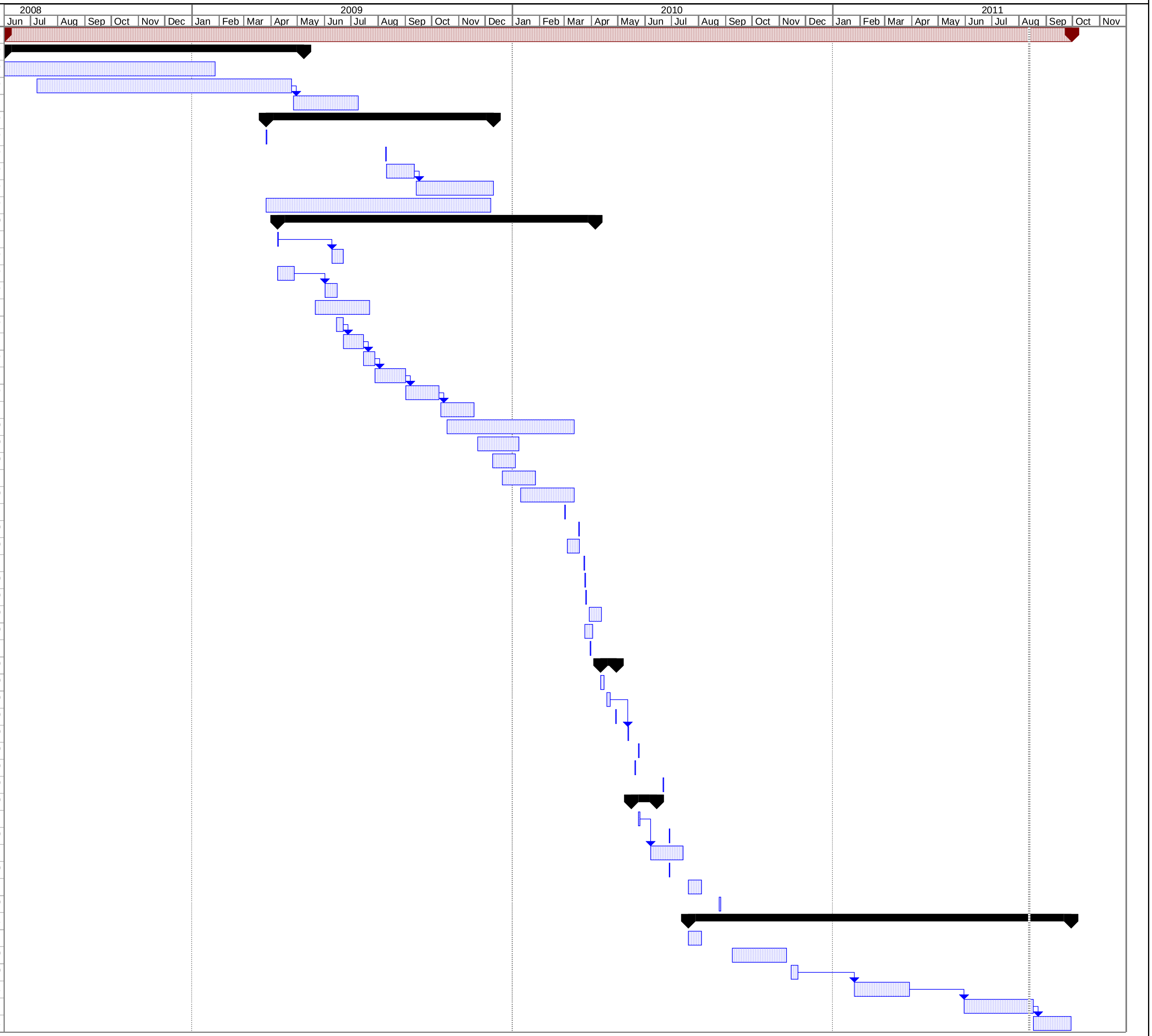
A roll-up schedule showing activities from Surface Facilities design and construction to the end of Cycle Test 3 is presented as Figure 10-1.

August 2011

Figure 10-1

CITY OF DELAND/SJRWMD
DELAND AIRPORT ASR SITE
PROJECT TIMELINE
SURFACE FACILITIES TO CYCLE TESTING

ID	Task Name	Duration	Start	Finish
1	**CITY OF DELAND/SJRWMD ASR PROGRAM**	870 days	Mon 6/2/08	Fri 9/30/11
2	**SURFACE FACILITIES CONSTRUCTION/TESTING PHASE**	245 days	Mon 6/2/08	Fri 5/8/09
3	ASR Test Well System Construction	172 days	Mon 6/2/08	Tue 1/27/09
4	Mini-scale Pilot Test Development, Authorization and Completion (Hydrosulfide)	208 days	Wed 7/9/08	Fri 4/24/09
5	Technical Evaluation, Recommendations (Tech. Memo) and District Review	54 days	Mon 4/27/09	Thu 7/9/09
6	FULL-SCALE PRETREATMENT DE-OX SYSTEM - DESIGN AND PERMIT	185 days	Fri 3/27/09	Thu 12/10/09
7	Submit Major UIC Permit Mod. Request to FDEP for Administrative Order	1 day	Fri 3/27/09	Fri 3/27/09
8	District Authorizes Work Order #30 for Implementing Pretreatment-DeOx System	1 day	Mon 8/10/09	Mon 8/10/09
9	60% Preliminary Design Report	24 days	Tue 8/11/09	Fri 9/11/09
10	100% Design Documents Prepared and Submitted	64 days	Mon 9/14/09	Thu 12/10/09
11	FDEP UIC Permit Modification and Administrative Order	182 days	Fri 3/27/09	Mon 12/7/09
12	SURFACE EQUIPMENT CONSTRUCTION	258 days	Thu 4/9/09	Mon 4/5/10
13	Contract Start Date April 9, 2009	1 day	Thu 4/9/09	Thu 4/9/09
14	P & P Bonds Approved and Notice to Proceed	9 days	Wed 6/10/09	Mon 6/22/09
15	Conformed Documents for Building Permit & Site Layout and Staking	13 days	Thu 4/9/09	Mon 4/27/09
16	Building Permit Approval	10 days	Tue 6/2/09	Mon 6/15/09
17	Submittals and Purchasing	44 days	Fri 5/22/09	Wed 7/22/09
18	Site Mobilization, Fencing, Barriers & Survey Corners	6 days	Mon 6/15/09	Mon 6/22/09
19	Underground Piping and Utility Tie-Ins	17 days	Tue 6/23/09	Wed 7/15/09
20	Complete Foundations/Footers	9 days	Thu 7/16/09	Tue 7/28/09
21	Vertical: Block and Wall Frames	25 days	Wed 7/29/09	Tue 9/1/09
22	Outfit Building for Utility/Service Lines & Install Trusses w/ Tie Downs	28 days	Wed 9/2/09	Fri 10/9/09
23	Outfit Wellheads and Complete Building Structure	28 days	Mon 10/12/09	Wed 11/18/09
24	Electrical System Pulls to Termination	105 days	Mon 10/19/09	Fri 3/12/10
25	Coordinate with and Retain Data Flow Systems for NaSH Component	35 days	Mon 11/23/09	Fri 1/8/10
26	Install and Calibrate Metering Pumps	18 days	Thu 12/10/09	Mon 1/4/10
27	Install and Pressure Test Feed from NaSH Building to 12" Diameter Water Line	28 days	Mon 12/21/09	Wed 1/27/10
28	DFS Programming (Offsite)	45 days	Mon 1/11/10	Fri 3/12/10
29	Draft Asbuilts Submitted for Record Drawings	1 day	Tue 3/2/10	Tue 3/2/10
30	Sodium-Bisulfide (NaSH) Building Complete	1 day	Thu 3/18/10	Thu 3/18/10
31	DFS Install, Vert.-Turbine ASR Pump Test	10 days	Fri 3/5/10	Thu 3/18/10
32	Functional Acceptance Testing	1 day	Wed 3/24/10	Wed 3/24/10
33	Progress Meeting #10	1 day	Thu 3/25/10	Thu 3/25/10
34	Wet Tap to Add Recovery Water Discharge Point on 12"	1 day	Fri 3/26/10	Fri 3/26/10
35	Restart and Perform Bacteriological Testing of ASR Well	10 days	Tue 3/30/10	Mon 4/12/10
36	Additional Pump Testing and Pump Perfomance Checks	7 days	Thu 3/25/10	Fri 4/2/10
37	Sodium Bisulfide Delivery (2 Totes)	1 day	Wed 3/31/10	Wed 3/31/10
38	Preliminary Testing and Functional Testing	14 days	Mon 4/12/10	Thu 4/29/10
39	Prepare for revision of mechanical seal configuration	4 days	Mon 4/12/10	Thu 4/15/10
40	Revise configuration of mechanical seal	4 days	Mon 4/19/10	Thu 4/22/10
41	Retest ASR Well Controls and RTU/SCADA Interface	1 day	Thu 4/29/10	Thu 4/29/10
42	Functional Demonstration Testing and Training (including DFS download to WTP)	1 day	Thu 5/13/10	Thu 5/13/10
43	Substantial Completion Walkthrough and Punchlist Issuance	1 day	Tue 5/25/10	Tue 5/25/10
44	Record Drawings Submittal	1 day	Fri 5/21/10	Fri 5/21/10
45	O&M Manuals - Preparation and Submittal (not including DFS Operations Manual)	1 day	Tue 6/22/10	Tue 6/22/10
46	SYSTEM CERTIFICATION, STARTUP AND PRELIMINARY SAMPLING	21 days	Mon 5/17/10	Mon 6/14/10
47	HD Inspection (a.m.) and FDEP/UIC Approval and Inspection (p.m.)	2 days	Tue 5/25/10	Wed 5/26/10
48	DFS O&M Manual Submittal (Estimated)	1 day	Tue 6/29/10	Tue 6/29/10
49	Mini-Cycle Tests (3 to 10 tests in a period of up to 4 weeks)	27 days	Tue 6/8/10	Wed 7/14/10
50	Final Completion Review	1 day	Tue 6/29/10	Tue 6/29/10
51	ASR System Training and/or Training/Mini-Cycle Review by ENTRIX	11 days	Wed 7/21/10	Wed 8/4/10
52	Adjustment to SCADA System to Meet Automation Specifications	2 days	Wed 8/25/10	Thu 8/26/10
53	OPERATIONAL TESTING	312 days	Wed 7/21/10	Thu 9/29/11
54	Pre-Test/Shakedown* (5 MG: 5 INJ / 3 - 5 REC)	11 days	Wed 7/21/10	Wed 8/4/10
55	Cycle 1 (20 MG: 20 INJ / 5-10 ST / 8 - 20 REC)	44 days	Thu 9/9/10	Tue 11/9/10
56	FDEP Review of Proposed Testing Schedule Modifications	6 days	Mon 11/15/10	Mon 11/22/10
57	Cycle 2 (20 MG: 20 INJ / 5-10 ST / 8 - 20 REC)	45 days	Wed 1/26/11	Tue 3/29/11
58	Cycle 3 (20 MG: 20 INJ / 5-10 ST / 8 - 20 REC)	57 days	Tue 5/31/11	Wed 8/17/11
59	Final Reporting	31 days	Thu 8/18/11	Thu 9/29/11



5-Schedule_General_Rev 11 v1_Sept 2010 Fri 8/12/11

10.4 Recommendations

At the DeLand Airport ASR site, long-term implementation may need to include methods for concurrent control and/or mitigation of arsenic leaching and high native-iron concentrations for economically viable use of the system. The most feasible ASR alternatives include:

- The use of the ASR well for potable water ASR in the future, with the intent to add pre-recharge and post-recovery treatment using a mixing/aerating storage tank and pump system;
- The use of the ASR well for raw groundwater ASR with the intent to add post-recovery treatment using an aerating storage tank and pump system;
- The use of the ASR well for partially-pretreated surface water with the intent to add post-recovery treatment using an aerating storage tank and pump system;
- The use of the ASR well, after deepening, to store reclaimed water from the City supply. Successful implementation would depend on location of a suitable target interval with total dissolved solids concentration between 1,000 mg/L and 3,000 mg/L and meeting the requirements of Chapter 62-610.466(9), FAC, with an expected recovery efficiency of about 45% of recharge water. Recovery efficiency may be enhanced by blending of recovered water with reclaimed water at the distribution line.

Appendix A

Program Plan

Appendix A

Program Plan

Construction and Testing Program Plan
St Johns River Water Management District
and Aquifer Storage Recovery Consultant Team
Palatka, Florida
April 2002

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. Project Coordination, Management, and Meetings

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. **<u>Water Supply Program and Technical Assistance</u>**

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

Memorandum of Understanding

Appendix B

Memorandum of Understanding

Exhibit A

SJRWMD/City of DeLand

Aquifer Storage and Recovery

Construction and Testing Demonstration Program

Statement of Work

EXHIBIT A

SJRWMD / THE CITY OF DELAND
AQUIFER STORAGE AND RECOVERY
CONSTRUCTION AND TESTING DEMONSTRATION PROGRAM

STATEMENT OF WORK

INTRODUCTION/BACKGROUND

Project Definition - The St. Johns River Water Management ("SJRWMD") and the City of DeLand ("COOPERATOR") 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. References to SJRWMD herein shall refer to SJRWMD and its employees and agents. **Project Need –** Determine the feasibility of aquifer storage and recovery (ASR) for storing seasonally available large volumes of alternative water supplies to offset the use of potable groundwater in east Central Florida.

Contract's Goals – Demonstrate the feasibility of ASR technology for utilities in the east Central Florida region. SJRWMD seeks to complete this cooperative project with and the City of DeLand and shall require its Contractor, under SJRWMD Contract SF408RA, to prepare the design of the Project in accordance with the requirements of regulatory agencies, the COOPERATOR, and SJRWMD and to permit and construct the system in accordance with such design.

Consistency With SJRWMD's Mission And Goals – This project is included in the Water Resource Development Work Program, dated September 2003, as required by Section 373.536(6)(a) 4, Florida Statutes. The design shall be consistent with SJRWMD report entitled "Desktop Assessment of Aquifer Storage and Recovery for the City of DeLand", prepared by Water Resource Solutions, Inc. and dated September 2003.

Location Of The Work – The project will be located on City property adjacent to the DeLand Municipal Airport, or a different site if mutually agreed upon by both parties.

OBJECTIVES

Statements Of The Results To Be Achieved – The project will be implemented with design features approved by SJRWMD and COOPERATOR, in sequential order to provide for maximum benefit of expended funds. Sequential progress will be based on exploration, permitting, and construction. The ASR Test Well will 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 Extent Of Work

Although Tasks 1, 2 and 3 are complete, they are included in this Scope of Work as reference only.

Task 1 - Report titled "SJRWMD Aquifer Storage and Recovery Construction and Testing Program Plan- FY2002", April, 2002 prepared by Barnes Ferland & Associates.

Task 2 - Report titled "Desktop Assessment of Aquifer Storage and Recovery for the City of DeLand", dated September 2003 prepared by Water Resource Solutions, Inc.

Task 3 - Preparation and approval of a COOPERATOR 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

SJRWMD will 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 will be conducted and coordinated with FDEP UIC permitting requirements. Once the design and permit are approved, SJRWMD will begin construction of the ASR Test Well and related appurtenances. After completion of drilling and verification of project requirements, cycle testing will be performed by SJRWMD to measure storage and recovery. If at any time the project is deemed infeasible, SJRWMD will coordinate with the COOPERATOR the salvage of any constructed wells for monitoring or other purposes, or SJRWMD will provide abandonment and decommissioning services, as required. Upon successful demonstration of feasibility, as mutually agreed on by SJRWMD and COOPERATOR, the completed project will be transferred to the COOPERATOR for operation and ownership, including any transfer of the existing UIC permit that may be required, at no cost to the COOPERATOR.

Description Of The Methodology To Be Used

SJRWMD will 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 SJRWMD and the COOPERATOR. Construction methods shall be in accordance with the General Conditions provided for in SJRWMD Contract #SF408RA, incorporated herein by reference, including conformance with COOPERATOR local codes and requirements.

Description Of Location Of Work - The project will be located at the on City property adjacent to the DeLand Municipal Airport. The exact site of the facilities will be determined based on preliminary design and coordinated with the location of the potable source water and discharge facilities. The proposed water supply is from the potable water main line adjacent to the property. The proposed recovered water discharge is expected to be either to an appropriate surface water body nearby or to the wastewater collection system. This issue will be determined as part of the preliminary design.

TASK IDENTIFICATION

The following Tasks 4 through 10 are summarized from SJRWMD Contract #SF408RA. These tasks will be performed on a work-order basis as each individual task is successfully completed.

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, SJRWMD 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 construction and testing program. The data collection plan will be implemented, the data will be evaluated, and a preliminary system design will be developed. COOPERATOR will provide an agreement granting SJRWMD access to project site for exploration well drilling and data collection. If the site is deemed to be infeasible for any reason, SJRWMD and the COOPERATOR shall endeavor to locate an alternative site for the ASR 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. COOPERATOR will be provided with design documents for review, comments and approval.

Task 6 — Regulatory Permitting

SJRWMD, COOPERATOR, and the SJRWMD Contractor 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 the FDEP Underground Injection Control (UIC) program, although other ancillary permits may be required from local government. SJRWMD will provide services to support the cost of preparation of a) Well Construction permit applications, b) local government permit applications, as required, c) Florida Department of Environmental Protection (FDEP) Underground Injection Control (UIC) permit application, d) SJRWMD Consumptive Use Permit (CUP) application for testing water, e) FDEP Drinking Water System extension permit application, f) NPDES storm water discharge permit application if required, g) other FDEP water system permits, if required, and g) project reports.

The SJRWMD's Agreement or contract work order with its third-party Contractor shall include site improvements required by the project and mutually agreed upon by the parties. COOPERATOR will be responsible for processing and resolving any zoning or land use issues that may arise with regard to the Project. COOPERATOR will be the Owner for well construction, FDEP UIC, FDEP water main extension construction and any other project related permit applications. SJRWMD or SJRWMD's Contractor will act as applicant and pay application fees.

Task 7 — ASR Facilities Construction, Monitoring, and Testing

Construct ASR well and monitor wells, associated pipelines, electrical service, incidental site work, and wellhead facilities. 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 will be conducted to evaluate the project site.

SJRWMD will stake and define the legal boundaries of construction within the designated site, based on property documents furnished by COOPERATOR. SJRWMD shall be responsible for construction, inspection, testing, and progress reporting for the Project. COOPERATOR shall allow the SJRWMD full site access to conduct and inspect construction of the project. COOPERATOR shall alert SJRWMD of any problems it knows of and SJRWMD, when appropriate, shall require its Contractor to correct any problems or non-conforming work discovered by SJRWMD inspection or COOPERATOR's observation.

Task 8 — Startup and Training

SJRWMD's Contractor will provide operational training of COOPERATOR staff to ensure a smooth transition from the test program into full operations. The final training plan will 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 COOPERATOR will operate the system during this period. SJRWMD will conduct periodic site visits and evaluate collected data to monitor large cycle performance and provide technical assistance to COOPERATOR, as necessary. A preliminary plan outline of COOPERATOR responsibilities for conducting Large Cycle operation and monitoring is provided in Exhibit B. This plan outline will be developed further when permit conditions are known and Task 9 is implemented, for review and approval by COOPERATOR and SJRWMD.

Task 10 — Peer Review of SJRWMD Contractor's Work

This task includes the review of work products produced by the SJRWMD Contractor, by other SJRWMD ASR team members and COOPERATOR.

TIMEFRAMES AND DELIVERABLES

Timeframe For Completion Of Entire Project

Successive task completion without major disruption will require a minimum of three (3) years, and up to five (5) years for final completion, in accordance with the Memorandum of Understanding.. Specific timeframes will be established after SJRWMD and COOPERATOR have signed a Memorandum of Understanding (MOU).

SJRWMD Contractor Deliverables and Responsibilities

Contractor deliverables defined in the work orders shall be governed by SJRWMD Contract #SF408RA and shall include both hard copy and electronic versions. All deliverables shall be provided to SJRWMD and the COOPERATOR Project Manager and shall generally include the following items, by task. Other elements of the project may be added as mutually agreed upon by both parties.

Task 4, Site-Specific Data Collection and Preliminary System Design: As defined in the work 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 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 COOPERATOR prior to any construction activities commencing.
- Project Schedule

Task 5, ASR Pilot Project Design: As defined in the work order, 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: SJRWMD to pay for all permit application fees. One or more of the following deliverables will 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
- Other FDEP Water System Permit(s)
- NPDES Storm Water Discharge 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, 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, 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. SJRWMD shall provide technical oversight and assistance as required during this task.

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

COOPERATOR Deliverables and Responsibilities

The COOPERATOR 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 COOPERATOR and SJRWMD during the course of the work:

1. COOPERATOR to provide project site and associated access for the project. COOPERATOR shall provide evidence of ownership or easements providing access and control of facilities expected to be installed on the property.
2. Timely review comments on Contractor submittals.
3. Execution of permit applications, as project owner.
4. 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 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. The estimated capital cost to the COOPERATOR is $50,000 for the furnishing of labor, equipment, and materials to install the electrical service.
7. Water quality sampling and testing during large cycle operation phase of project, as required during Task 9 described above, after COOPERATOR assumes

ownership of project. The estimated cost to the COOPERATOR is $45,000 for this water quality sampling and testing per large cycle or approximately $90,000 in total. 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 Exhibit B.

8. Information regarding features and items that are required to comply with zoning and land development codes.
9. Necessary testing water, permission to use or discharge recovered water, and appurtenant operational requirements for the Project, including necessary coordination and related services from COOPERATOR's staff. COOPERATOR does not have an adequate allocation of water under existing consumptive use permits for the entire period of cycle testing. The SJRWMD Contractor will be responsible for preparing the permit application necessary for SJRWMD review and approval of a separate (or additional) allocation of water sufficient for the purpose of ASR cycle testing.
10. COOPERATOR will accept responsibility for operation and maintenance of completed project. COOPERATOR 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 SJRWMD and COOPERATOR. 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 Contractor's activities shall be specified in the work order or determined by the SJRWMD Project Manager, and agreed to by the COOPERATOR.

SJRWMD will compile review comments from SJRWMD staff and COOPERATOR project representatives into one document for transmittal to the SJRWMD Contractor. COOPERATOR shall be available for explanation, discussion, and resolution of review comments.

CONTRACT BUDGET

SJRWMD will 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 SJRWMD Contractor to implement the project is within the cost range estimated in SJRWMD report entitled "Desktop Assessment of Aquifer Storage and Recovery for the City of DeLand", prepared by Water Resource Solutions, Inc. and dated September 2003. The COOPERATOR will be responsible for the costs for the project, as defined in the COOPERATOR Deliverables and Responsibilities section of this Statement of Work.

SJRWMD and COOPERATOR estimated project capital costs are as follows:

SJRWMD Work by Contractor Using Current Florida Forever Funding	$ 1,647,940
COOPERATOR Capital-related Cost Items:	
Task 7, Electrical Service	$ 50,000
Task 9, Water Quality Sampling and Analysis[1]	$ 90,000
Sub Total COOPERATOR	$ 140,000
TOTAL	$ 1,787,940

[1] Laboratory and sampling costs are for two large cycles

End of Exhibit A Statement of Work.

EXHIBIT B

SJRWMD / THE CITY OF DELAND
AQUIFER STORAGE AND RECOVERY
CONSTRUCTION AND TESTING DEMONSTRATION PROGRAM

PRELIMINARY OUTLINE for LARGE CYCLE TESTING PLAN

BASIS OF PLAN:

ASR Well:	Approximately 1 MGD Capacity
Monitoring Wells:	1 well in storage zone, 1 well in upper interval
ASR Cycle Testing:	90 to 120 Days recharge 90 Days dormant 50 to 80 Days recovery depending on cycle 2 Cycles to be tested (230 to 290 Days/ Cycle)

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. Recharge

    a. Open ASR well inlet valve to allow approximately 1 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. Adjust system as necessary to maintain desired flow rate. This period might require limited treatment to address potential plugging issues that may occur.

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

    f. 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 Tables 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. Shut in ASR well as appropriate depending on recovered water quality or when target recovery volumes achieved.

TABLE 1. ANTICIPATED ASR SYSTEM MONITORING PLAN DURING POTABLE WATER INJECTION

Class V ASR Test Well

The ASR test well is anticipated to be monitored in accordance with the parameters and frequency listed below during each recharge and recovery cycle. The monitoring report is expected to include the following data:

Parameters	Recording Frequency	Reporting Frequency
Injection Pressure (p.si.)	Continuously	
Maximum Injection Pressure		Daily/Monthly
Minimum Injection Pressure		Daily/Monthly
Average Injection Pressure		Monthly
Flow Rate (m.g.d.)	Continuously	
Maximum Flow Rate		Daily/Monthly
Minimum Flow Rate		Daily/Monthly
Average Flow Rate		Monthly
Total Volume recharged (Gals.)	Daily	Daily/Monthly
Total Volume recovered (Gals.)	Daily	Daily/Monthly
	Water Quality	
*Gross Alpha (pCi/L)	Monthly	Monthly
Total Coliform (cts/100ml)	Monthly+	Monthly+
Fecal Coliform (cts/100ml)	Monthly+	Monthly+
Arsenic (µg/L)	Weekly	Weekly
Chloride (mg/L)	Weekly	Weekly
Color (color units)	Weekly	Weekly
Dissolved Oxygen (mg/L)	Weekly	Weekly
pH (std. units)	Weekly	Weekly

Specific Conductivity (umhos/cm)	Weekly	Weekly
Sulfate (mg/L)	Weekly	Weekly
Temperature (°C)	Weekly	Weekly
Total Alkalinity (mg/L)	Weekly	Weekly
Total Dissolved Solids (mg/L)	Weekly	Weekly
Total Iron (mg/L)	Weekly	Weekly
Total Trihalomethanes (mg/L)	Weekly	Weekly
Primary and Secondary DWS	++	++

* Beginning of recharge cycle; beginning and end of each recovery cycle.

\+ Only conducted during recovery.

++ Once during Cycle 1 recovery and once during Cycle 2 recovery.

Monitoring Well System

During all recharge, storage and recovery cycles of the injection/production well, and report is expected to include the following data:

Parameters	Recording Frequency	Reporting Frequency
Water Level (N.G.V.D. / psi)	Continuously	
Maximum Water Level/Pressure		Daily/Monthly
Minimum Water Level/Pressure		Daily/Monthly
Average Water Level/Pressure		Monthly
	Water Quality	
Gross Alpha (pCi/L)	Monthly	Monthly
Arsenic (µg/L)	Weekly	Weekly
Chloride (mg/L)	Weekly	Weekly
Color (color units)	Weekly	Weekly
Dissolved Oxygen (mg/L)	Weekly	Weekly
pH (std. units)	Weekly	Weekly
Specific Conductivity (umhos/cm)	Weekly	Weekly
Sulfate (mg/L)	Weekly	Weekly

Temperature (°C)	Weekly	Weekly
Total Alkalinity (mg/L)	Weekly	Weekly
Total Dissolved Solids (mg/L)	Weekly	Weekly
Total Iron (mg/L)	Weekly	Weekly
Total Trihalomethanes (mg/L)	Weekly	Weekly
Turbidity (NTU)	Weekly	Weekly

NOTE: During extended storage periods (greater than 30 days), the water quality parameters listed above may be sampled and analyzed monthly; water level readings to remain weekly.

End of Exhibit B.

Appendix C

Memoranda

Appendix C

Memoranda

C.1 DeLand – Results of Recent Testing of Exploration Well. Dec. 28, 2004

C.2 Outcome of Discussions regarding the DeLand Tesing Program to Evaluate Aquifer Storage and Recovery (ASR) at the Airport Site and Follow up Testing. February 3, 2005

C.3 City of DeLand
Comparison of Sites for Development of ASR to store water within a Fresh Storage Zone. May 19, 2006

C.4 City of DeLand Airport ASR, Construction and Testing: Task 7 – Surface Facilities, Documentation for Substantial Completion. June 21, 2010

Water Resource Solutions
428 Pine Island Road SW, Cape Coral, Florida 239 574 1919 Fax 239 574 8106

Memorandum

To: Glenn Forrest, P.E.

From: Lloyd Horvath, P.E. Water Resource Solutions

Date: December 28, 2004

RE: DeLand - Results of Resent Testing of Exploratory Well

Background on the Modified Testing Program to Evaluate Alternative ASR Intervals

After drilling to 1400 feet and performing appropriate testing and geophysical logs it was determined that the lowermost intervals would not be appropriate for ASR due to the high TDS of the water. The combination of zones below about 1020 feet produced water having a TDS of over 5000 mg/. The water from the intervals below 1200 feet was estimated to contain TDS in the range of 7000 to 8000 mg/l TDS. The general guideline that we were using for a native water quality is a maximum TDS of about 6000 mg/l. Also important was that the flow from the more significant zone (from 1,220 to 1,250 feet bls) appeared to be fracture flow rather than the matrix type flow, which is preferred for application of ASR.

However, the induction log indicated an interval between the depth of 1020 and 1050 feet could potentially contain an appropriate quality and the flowmeter log showed that the zone was somewhat productive. It was not possible to determine from the logs if the flow would be sufficient to meet our estimated capacity target of about 1 MGD. Therefore, it was decided to conduct additional testing before it should be considered for use it as an ASR zone and complete the well as a monitor well.

The plan for testing the interval was to backplug the lower portion of the well with cement to a depth of approximately 1,080 feet. While backplugging, the packer would be left in the borehole. After the cementing, a pump would be installed in the packer string and a pumping test would be performed to evaluate the transmissivity of the targeted zone and determine its water quality. Depending on the well performance, an attempt may be made to increase production capacity through acidization. This would indicate the likelihood of an ASR well meeting our capacity target.

Results of Testing

Water Quality

The results of the additional testing showed that the water quality of the interval tested meets our target criteria. The TDS of the water produce became continually lower with pumping and is estimated to be below 1000 mg/l based on the last sample obtained.

Flow

The flow capacity testing did not show favorable results. The pumping test indicated low yield, and the transmissivity of the formation appears to be below our target range. During the pumping test, at 180 gpm the drawdown was approximately 110 feet. Analysis of the recovery data indicated the transmissivity of the interval tested falls within a range of about 3000 to 12,000 gpd/ft. It is not possible to estimate the actual transmissivity with better accuracy using the existing data.

If the transmissivity of the zone tested is at the low end of the estimated range, then a conservative estimate of the maximum capacity of a single ASR well would be in the range of 250 gpm. It was hoped that an ASR well for this project would have a capacity of approximately 1 MGD. Using the low end of the estimated transmissivity range, it does not appear that the interval tested can meet the flow criteria under routine operating pressures. If the transmissivity of the formation is at the high end of the range, then it might be possible to develop an ASR well to operate in the range of 400 to 600 gpm.

Options

Before considering further testing to evaluate using acid treatment to stimulate the flow from the potential ASR interval between 1020 and 1080 feet bls, it is be important to reevaluate the issue of ASR well capacity. . We believe that the chances are not great that a well capacity in excess of about 300 gpm would be obtained. If it would be considered acceptable to develop an ASR system of 250 to 300 gallons per minute capacity, then we would recommend conducting acid treatment to stimulate flow. Higher flow rates might be possible, but it is risky to anticipate such an outcome.

One alternative that might be considered for ASR within the tested zone at this site is the use of multiple wells of smaller capacity. It may be possible to construct wells spaced at a distance of about 100 feet, and connect them to a manifold system. The cost of such a project would likely increase by $500,000 to $600,000 if a full scale project were to be constructed.

If we decide to do no further testing of the current interval and proceed to backplug the well, then the only option that should be considered for ASR at this site would be the use of one of the upper intervals between about 200 and 400 feet. These intervals contain native water that is fresh, but they also contain high levels of iron and hydrogen sulfide. The City previously tested water from these zones near this site and the utility was not satisfied with the water quality due to its chemistry and therefore production wells were not constructed. If ASR were to be accomplished in these shallower intervals, it would be intended to flush the undesirable water from the storage zone and then operate to store and recover treated water that can be used with little or no additional treatment.

Currently the interval that is the most likely candidate for ASR to operate at a flow rate of 1 MGD is within the depth range between 300 and 350 feet below land surface. This zone is the only other alternative for ASR at this site.

If the District and the City of DeLand wish to construct an ASR system to store water within a brackish zone and operate at a capacity of near 1 MGD using single well, then it is recommended to consider test drilling at an alternative location. Based on the results of the" desktop study", the Delfa site was the second option.

Water Resource Solutions
428 Pine Island Road SW, Cape Coral, Florida 239 574 1919 Fax 239 574 8106

Glenn E. Forrest P.E., Inc.
7200 Aloma Ave, Suite A
Winter Park, Florida 32792

February 3, 2005

RE: Outcome of discussions regarding the DeLand Testing Program to Evaluate Aquifer Storage and Recovery (ASR) at the Airport Site and follow-up testing

Dear Glenn:

This letter describes the outcome of our teleconference of January 3, 2005 regarding the results of the ASR exploration program at the airport site, and activities for the program to move forward.

After drilling to 1400 feet and performing the testing program at the airport site it was determined that the lowermost intervals would not be appropriate for ASR due to the high TDS of the water. The combination of zones below about 1020 feet produced water having a TDS of over 5000 mg/l. The water from the intervals below 1200 feet was estimated to contain TDS in the range of 7000 to 8000 mg/l TDS. The general guideline that we were using for a native water quality is a maximum TDS of about 6000 mg/l. Also important was that the flow from the more significant zone appeared to be fracture flow rather than the matrix type flow. Matrix flow is preferred for application of ASR.

However, one of the geophysical logs (induction log) indicated an interval between the depth of 1020 and 1050 feet could potentially contain an appropriate quality and the flowmeter log showed that this zone was somewhat productive. It was not possible to determine from the logs if the flow would be sufficient to meet our estimated capacity target. Therefore, it was decided to conduct additional testing before it should be considered for use as an ASR zone.

The result of the additional testing showed that the water quality of the interval tested met our target criteria and was below 1000 mg/l TDS. Unfortunately, the flow capacity testing did not show favorable results. The pumping test indicated low yield, and the transmissivity of the formation was below our target range. A conservative estimate of the maximum capacity of a single ASR well would be in the range of 250 gpm. It was hoped that an ASR well for this project would have a capacity of approximately 700 gpm.

After considering all other alternatives, and the associated costs and uncertainties, it was decided that constructing an ASR system at the airport site would not be appropriate. The decision was made to convert the exploration well into a Floridan Aquifer monitor well, as part of the District's regional monitoring network, to be finished in a manner that would be compatible with the future development plans for the properties in the immediate vicinity of the well site. The well would be completed in an appropriate manner for long term monitoring by the SJRWMD, and all such work would be coordinated with the City of DeLand. Associated with this well, the SJRWMD would also be expected to add a second well to monitor a shallower portion of the Floridan Aquifer. Such well would be installed at a later date after coordinating with the City. The location of the exploratory well EX-1, which will now be converted to a long term monitoring well, is shown in Figure 1. The pad monitoring wells shown on the figure are for the surficial aquifer during construction and will not be part of the District's monitoring system. The District's future upper Floridan Aquifer monitor well would likely be installed very near to EX-1 but is not shown on the figure.

The discussion then commenced regarding alternative locations for siting an ASR well and facilities. The Memorandum of Understanding between SJRWMD and the City had included provisions for building the project at a different site if mutually agreed upon by both parties. Based on the results of the "Desktop Assessment", the Delfa site was the second option. In the days prior to the teleconference WRS had done a site visit, researched the records and reviewed other issues of the Delfa site. This work showed that the property size and other logistical issues appear to be appropriate for conducting an ASR exploration program and if favorable conditions were encountered, the site would be appropriate for installation of a pilot ASR system.

Subsequent evaluations indicate that the operational issues related to power requirements, pipeline pressures and water quality are approximately the same at the Delfa site as those for the airport site. A minor difference from the conditions shown in the Desktop Assessment is that the discharge for excess water and for early cycle testing would more likely go toward Lake Diamond (northeast), which would reduce the length of pipeline required. The likely route for the discharge pipeline is shown in Figure 2 along with the potential well locations.

WRS was given preliminary authorization to develop a testing plan and to begin planning for mobilizing to the Delfa site for test drilling. Pending approval of all parties, it is anticipated that the drilling and testing would begin about the middle of February. The time anticipated for drilling and testing would be about 3 months from start and if favorable conditions are encountered, the completion of preliminary design and analyses should be about September 2005.

Assuming that all parties are in agreement with proceeding with the testing at the Delfa site, the existing agreement with SJRWMD for the airport site would apply to all related activities at the Delfa site as well.

If you have any additional questions or suggestions please call or email me.

Sincerely,

Lloyd E Horvath

Lloyd E. Horvath
President

Water Resource Solutions
428 Pine Island Road SW, Cape Coral, Florida 239 574 1919 Fax 239 574 8106

Memorandum

To: Doug Munch, P. G., Glenn Forrest, P. E.

From: Lloyd Horvath, Water Resource Solutions

Date: May 19, 2006

RE: City of DeLand ASR Demonstration Program
Comparison of Sites for Development of ASR to Store Water within a Fresh Storage Zone

Water Resource Solutions, Inc completed a report titled “Desktop Assessment of Aquifer Storage and Recovery for the City of DeLand” in September 2003. This report assessed the feasibility of developing an ASR facility at four potential sites in the City of DeLand. Exploratory wells have since been completed at the two highest rated sites (the DeLand Municipal Airport site and the Delfa site), and neither was found to be ideal for the application of ASR utilizing a brackish storage zone. Storage in a brackish zone was the District’s initial preference since the injected water can be more easily tracked to measure recovery efficiency. Additionally, a brackish zone would not typically be developed for public water supply, thereby significantly reducing concerns about potential impacts to the aquifer during ASR recovery.

At each of the exploratory well locations, the productivity of the aquifer zones containing moderately saline water was insufficient to allow the construction of an ASR well capable of meeting the project goal of 0.5 to 1.0 million gallons per day (mgd) of capacity. Additionally, in some instances, there was a rapid transition in native water quality from fresh to brackish, which can be problematic in ASR systems. Development of an appropriately sized ASR facility to store fresh water in an aquifer zone that contains fresh water, however, remains an option at each of the two sites.

The following sections discuss the issues that would affect the favorability of one site over the other.

During the initial desktop assessment, each potential site was ranked based on its relative suitability in seven separate factors:

1. Proximity to the water source for testing and system operation

   This criterion relates to how close an appropriately sized city potable water main is to the project site. The existing water main should have hydraulic capacity to provide 2 to 3 mgd at acceptable velocities for the ASR test well. There should also be capacity to additionally supply two more ASR Wells, if the first ASR well is successful and the system is expanded.

2. Proximity to an appropriate facility for accepting and managing the recovered water

3. Availability of site and neighboring property for potential expansion of the ASR facility

   This criterion relates to the expandability of the site for more (at least two) ASR wells, if the first one is successful. Expandability must consider the city's future land use for the site, wellhead setbacks, spacing between ASR wells (400' minimum), positioning of monitor wells, and piping configurations.

4. Hydrogeologic issues (double weighting)

   This criterion relates to storage zone depth; underground formation and confinement characteristics; ground water quality, gradient and direction; aquifer transmissivity and productivity; ground water flow or connectivity to environmental features such as springs, lakes, and wetlands; and other data related to subsurface conditions.

5. Nearby water use concerns (double weighting)

   This criterion relates to potential interference with existing legal users of the aquifer and potential use of the target aquifer zone for future public water supply.

6. Suitability for meeting long term program goals (double weighting)

   This criterion relates to local government planning and implementation of future alternative water supply sources. Future water supplies from surface water sources in this region have been identified in the District Water Supply Plan, 2005 (St. Johns River near DeLand and St. Johns River near Lake George).

7. Suitability of the site for managing drilling fluids

   This criterion relates to fluid management during construction, and whether the site has any severe environmental or topographical constraints for fluid discharge.

A relative rank was given to each site for each of the seven factors. A weighting factor of two was used to give greater weight to the criteria considered most important to the successful development of an ASR facility (hydrogeologic issues, nearby water use concerns, and suitability for meeting long term program goals).

In the desktop assessment, the Airport site was ranked highest, and the Delfa site was ranked second. Therefore the first exploratory well was drilled at the Airport site. The Airport site was ranked higher than the Delfa site in three factors (proximity to a facility for accepting and managing the recovered water, availability of property for expansion of the ASR system, and suitability for meeting long term goals) and was ranked equal to the Delfa site in the remaining four factors.

With the focus changing to the possible construction of an ASR facility that utilizes a fresh water storage zone, the factors listed above are still applicable. The Airport site and the Delfa site have been re-ranked using the same factors and ranking system, applying the knowledge gained from the exploratory well completed at each site, and the results are shown in Table 1.

Some additional factors that could affect the decision regarding which site is most feasible have developed or changed since the completion of the desktop assessment. These include long term program goals, native water quality, utility system modifications, regulatory limitations, and tracking injected water.

Long Term Program Goals – Since the inception of the ASR demonstration program with the city of DeLand, the District Water Supply Plan has been updated (DWSP, 2005). The DWSP lists two potential long-range surface water development projects (St. Johns River near DeLand and St. Johns River near Lake George). However, there are no utility sponsors for these projects, and no funding or implementation timelines have been developed. While the Airport and DeLand sites are both suitable for implementation of ASR relative to long term regional plans, it appears that the interim use of ASR by the city for demand management purposes would be for a long period of time if surface water development does not move forward in the near future.

Native Water Quality - One factor that tends to favor the Airport site is the poor quality of the native water encountered in the area. According to representatives of the City of Deland, a previous study of the area for locating municipal wells identified elevated concentrations of iron and hydrogen sulfide in the upper Floridan aquifer on the airport property, which caused the City to look elsewhere for potable ground water supplies. Elevated iron concentrations (1.53 mg/l) and a hydrogen sulfide concentration of 0.4 mg/l were also observed in the upper Floridan aquifer during the testing of the ASR exploratory well at the Airport site. However, these analyses were done on aerated samples and therefore the results may not accurately reflect the actual groundwater conditions and the concentrations reported could be higher. Since the site is was not considered by the City as desirable for potable supply wells, its feasibility for ASR is enhanced because water that would be recharged and stored in that area (based on new water available to the city from development of a future alternative water supply source) would make more water available for recovery to meet dry season demands.

Utility System Modifications - A new factor is that the City is planning to construct a reclaimed water booster pumping station at the Delfa site, which would also include a ground storage tank. This issue might cause space constraints on the relatively small site. A review with the city of any modifications to their Utility Master Plan (Quentin Hampton & Associates, 2003) did not indicate any other modifications of significance to the ASR project.

Regulatory Limitations - A further issue regarding the Delfa site that could affect development of ASR within the fresh portion of the aquifer system, is future regulatory limitations on water production that are being imposed related to existing natural systems, e.g. Blue Springs, Lake Colby, and Big Lake. This issue has recently affected the City's plans to develop new water supply wells in an area that is just a few thousand feet south of the Delfa site, and it also influences the city's operations of some of its existing public supply wells.

Tracking Injected Water - A final criterion for consideration in comparing sites is the ability to track the water injected in comparison to the native water. One potential advantage of the DeLand Municipal Airport site is that the native water and the injected water differ in terms of iron content and sulfides. By utilization of these two parameters for tracking, it is possible to develop a relationship between the water injected and the water recovered. This type of tracking is being done at other sites in southwest Florida. The simple methodology of tracking odor (natural hydrogen sulfide) as a parameter has also been shown to be useful in this effort and this type of tracking should not add significant cost to the program.

Table 1 is presented below for re-ranking the two sites in consideration of recent drilling experience and other factors listed above. A simple two point ranking system is used, whereby a rank of 1 would be the preferred site with regard to each parameter. The site having the lower score would be recommended.

Table 1. Ranking of Airport and Delfa Sites for ASR Demonstration Project in the city of DeLand.

Ranking Criteria	Delfa Site	Airport Site
Proximity to the water source for testing	1	2
Proximity to an appropriate facility for accepting and managing the recovered water	2	1
Availability of neighboring property for expansion of the ASR facility	2	1
Hydrogeologic issues	1	1
Nearby water use concerns	1	1
Suitability for meeting long term program goals	1	1

Suitability of the site for managing drilling fluids	1	1
Ability to track the stored water	2	1
Total Score	11	9

Based on the ranking criteria, the Airport site is recommended for development of an ASR pilot project. In consideration of the city's long term planning for economic development of this site, attached is a layout plan showing the existing exploratory well and proposed locations for the ASR Test Well, (3) monitor wells, and potential future ASR wells if the ASR system is expanded in the future.

From a project cost standpoint, the District's programmed cost in early 2004 was $1,647,940. Since April 2004, when the Memorandum of Understanding (MOU) between the District and the city was first executed (for 4-year duration), costs have increased. The estimated cost for the District to implement the project at the Airport site, with ASR in a fresh water zone, is now $1,610,927 This cost does not include the cost of the exploratory well projects. Since the exploratory well at the Airport site was converted to a regional monitoring well for the District's ground water monitoring network, it cannot be used as an ASR monitoring well. The increase in the District's project cost, somewhat mitigated by the shallower storage zone depths, is attributed to the FDEP requirement for an additional monitoring well and general inflationary trends in the construction marketplace.

The City's cost responsibilities in the MOU were estimated to be $50,000 for electrical service and $90,000 for water quality sampling and testing. The revised estimated cost for electrical service, equipment and control is $90,000 which is due to increase construction costs that have been seen in recent similar projects. For water quality sampling and testing the estimate is $100,000. due to increased monitoring requirements being imposed by FDEP on all ASR projects throughout the state.

The preliminary estimate to develop the ASR system on site is shown on the following Table 1.

Figure 1 shows the proposed layout of the ASR facilities on site. There is considerable possibility for adjustment of the site plan at this time to suit any plans that the City may have for the property.

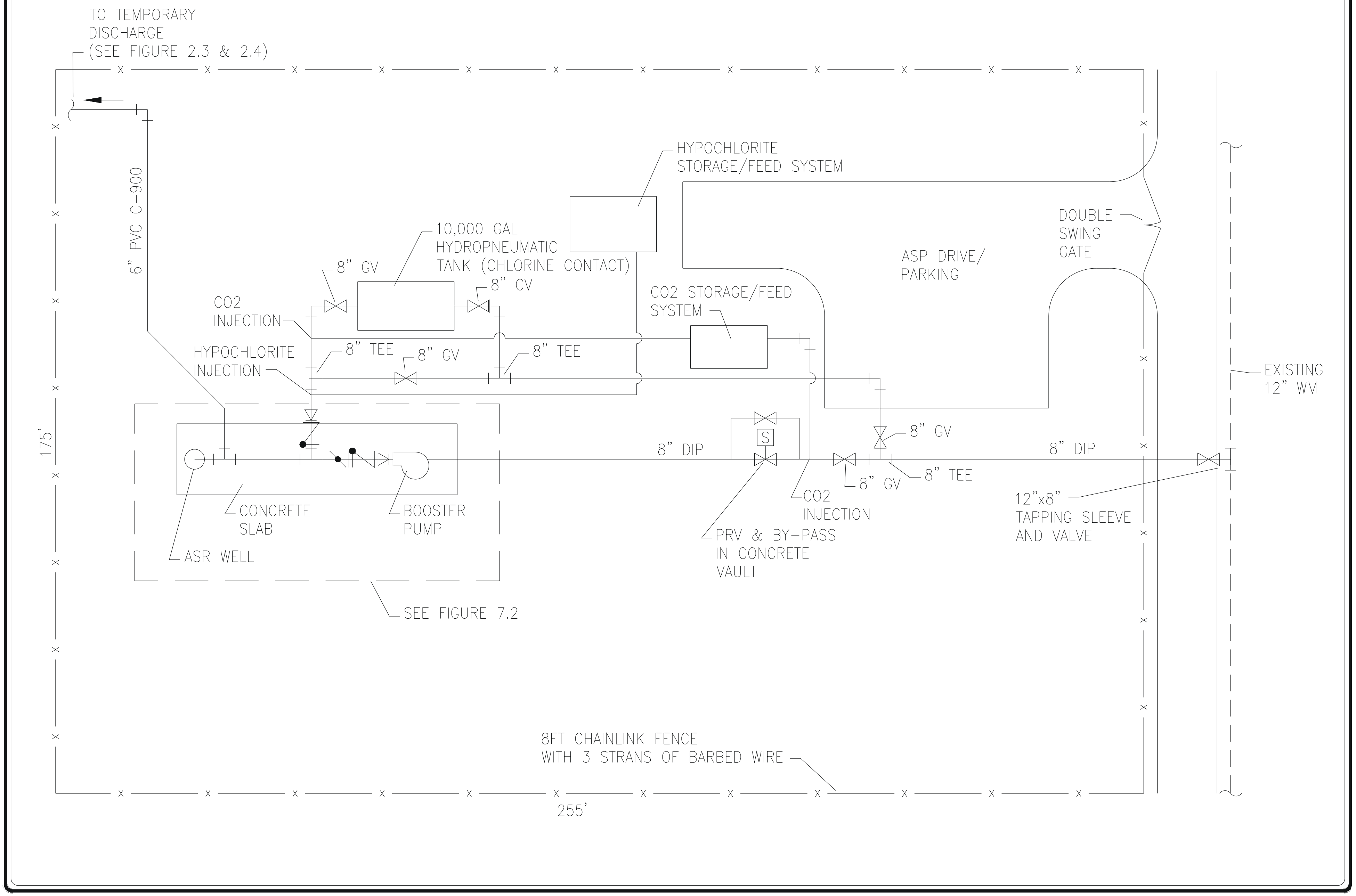
The preliminary design for the facility is the same as was used in the Desktop Assessment. The attached Figure 6-1 shows the piping and facility schematic.

CITY OF DELAND
ASR SYSTEM
Table 1. PRELIMINARY OPINION OF PROBABLE PROJECT COST

AIRPORT SITE

Item No.	Item Description	Units	Quantity	Unit Cost ($)	Total Cost ($)
1	Mobilization/Demobilization	LS	1	$22,000	$22,000
2	Clearing, and Earthwork and Grading Fencing	LS	1	$60,500	$60,500
3	ASR Well	LS	1	$275,000	$275,000
4	ASR Well Pump and Wellhead Equipment	LS	1	$66,000	$66,000
5	Monitor Well 1	LS	1	$66,000	$66,000
6	Monitor Well 2	LS	1	$66,000	$66,000
7	Monitor Well Pumps w Equipment and Gages	EA	2	$8,250	$16,500
8	Connection to Existing 12" WM	LS	1	$17,600	$17,600
9	8" DIP & Fittings	LS	1	$17,710	$17,710
10	8" Gates Valve & Boxes	EA	6	$2,750	$16,500
11	Pressure Sustaining Valve	LS	1	$6,050	$6,050
12	Booster Pump	LS	1	$18,700	$18,700
13	Conc Equip/Piping Slabs	LS	1	$27,500	$27,500
14	Flanged DIP and Fittings	LS	1	$12,100	$12,100
15	6" Butterfly Valves	EA	7	$726	$5,082
16	Motor Actuators for 6" BV's	EA	5	$3,850	$19,250
17	6" Check Valves	EA	3	$2,090	$6,270
18	Flow Meter	EA	2	$7,150	$14,300
19	Misc. Valves, Gages, etc.	LS	1	$2,200	$2,200
20	10,000 Gal Hydro Tank	LS	1	$27,500	$27,500
21	Sodium Hypochlorite System	LS	1	$60,500	$60,500
22	CO2 System	LS	1	$24,200	$24,200
23	6-inch PVC (on-site)	LF	100	$28	$2,800
24	pH adjustment system (CO2)	LS	1	$110,000	$110,000
25	6-inch PVC (off-site)	LF	1,800	$28	$50,400
26	Electrical and Controls System	LS	1	$90,000	$90,000
27	**Sub-Total**				**$1,100,662**
28	Contingency				$220,132
29	Engineering and Hydrogeologic Oversight and Reporting				$220,132
30	Permitting, Planning, Zoning, Agency Coord.				$70,000
31	**Total Estimated Cost**				**$1,610,927**

Figure 1. Potential Layout of ASR Facilities on Site



Water Resource Solutions	**BOYLE** ENGINEERING CORPORATION	PROJECT NAME: CITY OF DELAND DATE: 07/23/03

FIGURE 6-1. SITE PLAN WITH YARD PIPING SCHEMATIC FOR ALL ALTERNATIVE SITES.

ENTRIX
Down to Earth. Down to Business.™

ENTRIX, Inc.
3460 Fairlane Farms Road, Suite 8
Wellington, Florida 33414
(561) 791-6912 | Fax (561) 791-6915
www.entrix.com

Memorandum

Date:	June 21, 2010		
To:	Glenn E. Forrest, P.E.	**Project No.:**	MOU #23403 [SH334AA]
cc:	Keith Riger, P.E.	**Project Name:**	City of DeLand Airport ASR Construction and Testing: Task 7 - Surface Facilities
From:	Michael J. Waldron, P.G.	**RE:**	**Documentation for Substantial Completion**

Background

As the Contractor for the St. Johns River Water Management District (District) on the above-referenced City of DeLand Aquifer Storage and Recovery (ASR) project, ENTRIX is requesting support for a substantial-completion status for the project pursuant to your review of the attached documents. In order for the City to authorize substantial-completion, a number of outstanding construction-related documents were to be submitted and several tasks were to be completed, including:

- Substantial completion forms (enclosed);
- Operation and Maintenance (O&M) Manual – Volumes 2-4 (enclosed);
- A review of the ASR Test Well pump's performance in the field (Attachment 1), relative to the pump's factory-tested pump curve results, and a certification of acceptance by the Engineer of Record (EOR) for the ENTRIX Project Team, if applicable;
- Final punch list (Attachment 2);
- A completed certificate of occupancy for the ASR water treatment facility (Attachment 3);
- Documentation of FDEP & Health Department permit approvals (Attachment 4);
- Revised schedule for FDEP-accepted cycle tests (Attachment 5);
- ENTRIX Letter of Commitment for the ASR wellhead seal replacement (Attachment 6).

Documentation

Regarding the schedule for the completion of these submittals and tasks, the requested documentation is attached, with the exception of the Data Flow Systems (DFS) operational procedures section (Volume 1) for the O&M Manual. The pending DFS submittal will outline the procedures for local and remote operation of the onsite equipment as identified in the specifications, subject to review and revision the ENTRIX Project-Team EOR. The final DFS programming and training session is scheduled for June 22, 2010. Subsequent to that date, DFS will provide to ENTRIX the operational-procedures section necessary to complete Volume 1 of the 4-volume O&M Manual for the RTU/SCADA system and WTP facility equipment and appurtenances.

The required information is attached in the following numerical order with this Memorandum.

1. Technical Memorandum of ASR Well Pump Acceptance (prepared by: AECOM USA, Inc.)
2. Final Punch List
3. Certificate of Occupancy
4. Environmental-Permit Correspondence
   a) Potable Water System Permit Acceptance, Volusia County Health Department
   b) Generic NPDES Permit Conditions and Acceptance Letter
   c) Underground Injection Control Permit and Approval for Operational Testing
5. Revised Schedule
6. ENTRIX Letter of Commitment for warranty work on the ASR wellhead seal
   [Notes: Operation and Maintenance Manual - Volumes 2 through 4 (enclosed) and Record Drawings previously were submitted in hard copy and in electronic format]

ASR Test Well Pump Performance

A technical memorandum prepared by AECOM USA, Inc., providing a comparison of the ASR well pump's performance in the field, relative to the pump's factory-tested pump-curve results, is presented as Attachment 1. Based on the initial field testing, the pump's total-dynamic head at pumping rates above 400 gallons per minute (gpm) appeared to be less than indicated on the certified, factory pump curve. Following this, several field conditions were reviewed to determine whether adjustments to the factory curve were justified, and verify whether the pump and/or installed design were acceptable. After review of project documents, the primary cause of the additional friction losses were shown to be the restriction at the downhole (3R™) ASR valve. Other column pipe friction losses and the losses at the foot valve contributed to an underestimation of head loss. These conditions have now been addressed in the attached memo.

An additional concern during initial testing was cavitation in the pump impellers due to the installed location of the foot-valve and strainer as indicated by air bubbles in the discharge to the spreader swale. However, later verification of the pumping water levels, the absence of air bubbles at the point of discharge from the pump assembly, along with verification from the EOR, indicates that the air bubbles noted in the spreader swale while pumping are not from the ASR well. It is apparent that the purge-line's valve configuration causes air to be retained, which causes an extended period of discharge of entrained air when pumping to the swale.

In summary, after review of the pump's operating conditions (over longer-duration pumping periods) and the results of the entrained air evaluation, we conclude that the pump is acceptable. The pump's performance meets or exceeds the requirements for the project and will provide one million gallons per day into the water line at the anticipated pressures during normal operations for recovering water.

Wellhead Modification Review

A review and summary of the status of the wellhead modification has been requested by the District. The Potable Water System (PWS) permit has been accepted by the Volusia County Health Department. The annulus of the well was sealed as was originally designed – using a welded seal between the casing and the pump base plate (Plan Drawings D-101 and D-502, enclosed). The well seal was accomplished by fabricating a 2-inch wide section of mild steel casing, which was welded between the mild-steel base plate of the pump and the top of the stainless-steel well casing. In any application of a welded seal, at least one weld between unlike metals is necessary. ENTRIX believes the “modified” wellhead construction is “equal to” that intended by the original design.

The wellhead modification required that the gasket and sealant between the sole/base plate and the pump’s discharge head be removed, so that the sole plate could be connected to the well casing. As referenced in the PWS application, the cement used as a sealant to seat the gasket between the base plate and discharge head was not NSF 61 certified. ENTRIX has performed 5 mini-cycle tests at recharge rates up to 800 gpm with no leakage from the modified wellhead and/or cemented-gasket, pump-assembly seal. The operation of the ASR Test Well at recharge rates above 700 gallons per minute is not necessary, but such flows can cause Storage-Zone Monitor Well No. 1 (SZMW-1) to flow from its wellhead vent. ENTRIX agrees with the City’s recommendation to add a ball valve on the vent pipe. We believe that the monitor well will not flow under design-rate recharge (700 gpm), but the installation of a valve at the vent is prudent. The well discharge line should also remain open to the discharge swale to relieve a buildup of pressure at the wellhead.

ENTRIX has attached a commitment letter for the wellhead seal (Attachment 6). ENTRIX recommends the continued use of the wellhead in its current configuration until the feasibility of the ASR Test Well is established, or the use of the well for ASR is determined to be unfeasible. ENTRIX understands that the wellhead seal is considered a warranty issue, and ENTRIX will modify the wellhead sealant to an NSF 61 certified alternative in the event of a failure, or at the City’s request after the feasibility of the well is established and before the well is placed into routine operation for demand management. This alternative can be performed during the one-year warranty period.

If the routine operation of the ASR system is not advantageous to the City of DeLand, we believe it may be in the City’s best interest to re-utilize the ASR Well pump at an alternate, supply well location. In that event, it will be necessary to remove the pump and take apart the existing pump-head assembly.

Substantial Completion Request

The Substantial Completion certificates are enclosed with this Memorandum on the following pages. We understand that a few items remain outstanding, and that the above-referenced well construction issues require further discussions. For these reasons, the form has been post-dated to June 25th, 2010, and can be further modified upon request.

Enclosures:
Certificate of Substantial Completion (2)
April 2009 Plans (2): Drawing D-101 and D-502
O&M Manual Volumes II, III and IV

Attachments:
1. AECOM Technical Memorandum
2. Final Punch List
3. Certificate of Occupancy
4. Environmental Permit Correspondence
5. Revised Schedule
6. ENTRIX Letter of Commitment

CERTIFICATE OF SUBSTANTIAL COMPLETION

PROJECT: City of DeLand Aquifer Storage and Recovery (ASR) Project at City of DeLand Municipal Airport Site.

DATE OF ISSUANCE

June 25th 2010

OWNER: St. John's River Water Management District (SJRWMD) (ownership to be transferred to City of DeLand Utilities Department upon completion of startup and training)

OWNER's Contract No: SJRWMD SF408RA (and City of DeLand MOU SH307AA)

ENTRIX, INC. Project No: 11437160.00

CONTRACTOR / ENGINEER: ENTRIX, INC.

CONSTRUCTION SUB-CONTRACTOR: Florida Design Contractors, 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 Specification dated April 2009.

To: St. Johns River Water Management District and the City of DeLand
OWNER

And To: ENTRIX, INC.
CONTRACTOR / ENGINEER

The work to which this Certificate applies has been inspected by authorized representatives of OWNER, CONTRACTOR / ENGINEER, and CONSTRUCTION SUBCONTRACTOR and that Work is hereby declared to be substantially complete in accordance with Contract Documents.

June 25th 2010
DATE OF SUBSTANTIAL COMPLETION

A tentative list of items to be completed or correlated 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 for security, operation, safety, maintenance, heat, utilities, insurance and warranties and guarantees for the completed ASR Surface Facilities shall be as follows:

RESPONSIBILITIES:

OWNER: City of DeLand: security, operation, safety, maintenance, utilities, insurance.

CONTRACTOR / ENGINEER and CONTRUCTION SUB-CONTRACTOR: Complete punch lists and provide warranties and guarantees per contract.

CERTIFICATE OF SUBSTANTIAL COMPLETION

The following documents are attached to and make a part of this Certificate:

Punch-list dated June 2nd, 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 ___________ , 2010

ENTRIX, INC.
CONTRACTOR / ENGINEER

By: ____
(Authorized Signature)

Accepted by CONTRUCTION SUB-CONTRACTOR on JUNE 18, 2010

Florida Design Contractors, 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)

City of DeLand
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, Inc. for ASR well and two monitoring wells.

Note: The Substantial Completion between Florida Design Contractors, Inc. and ENTRIX, INC. occurred on June 25th, 2010. This date constitutes the start of the Warranty work performed by Florida Design Contractors, Inc.

CERTIFICATE OF SUBSTANTIAL COMPLETION

PROJECT: City of DeLand Aquifer Storage and Recovery (ASR) Project at City of DeLand Municipal Airport Site.

DATE OF ISSUANCE

June 25th, 2010

OWNER: St. John's River Water Management District (SJRWMD) (ownership to be transferred to City of DeLand Utilities Department upon completion of startup and training)

OWNER's Contract No: SJRWMD SF408RA (and City of DeLand MOU #23403 [SH334AA])

ENTRIX, INC. Project No: 11437170.00

CONTRACTOR / ENGINEER: ENTRIX, INC.

CONSTRUCTION SUB-CONTRACTOR: Minuteman Consructors, 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 Specification dated April 2009.

To: St. Johns River Water Management District and the City of DeLand
OWNER

And To: ENTRIX, INC.
CONTRACTOR / ENGINEER

The work to which this Certificate applies has been inspected by authorized representatives of OWNER, CONTRACTOR / ENGINEER, and CONSTRUCTION SUBCONTRACTOR and that Work is hereby declared to be substantially complete in accordance with Contract Documents.

June 25th, 2010
DATE OF SUBSTANTIAL COMPLETION

A tentative list of items to be completed or correlated 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 for security, operation, safety, maintenance, heat, utilities, insurance and warranties and guarantees for the completed ASR Surface Facilities shall be as follows:

RESPONSIBILITIES:

OWNER: City of DeLand: security, operation, safety, maintenance, utilities, insurance.

CONTRACTOR / ENGINEER and CONTRUCTION SUB-CONTRACTOR: Complete punch lists and provide warranties and guarantees per contract.

CERTIFICATE OF SUBSTANTIAL COMPLETION

The following documents are attached to and make a part of this Certificate:

Punch-list dated June 2nd, 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 June 14, 2010

ENTRIX, INC.
CONTRACTOR / ENGINEER

By: ______________________
(Authorized Signature)

Accepted by CONTRUCTION SUB-CONTRACTOR on April 30th, 2010

Minuteman Constructors, Inc.
CONSTRUCTION SUB-CONTRACTOR

By: ______________________
(Authorized Signature)

OWNER accepts this Certificate of Substantial Completion on ______________________, 2010

St. John's River Water Management District
OWNER

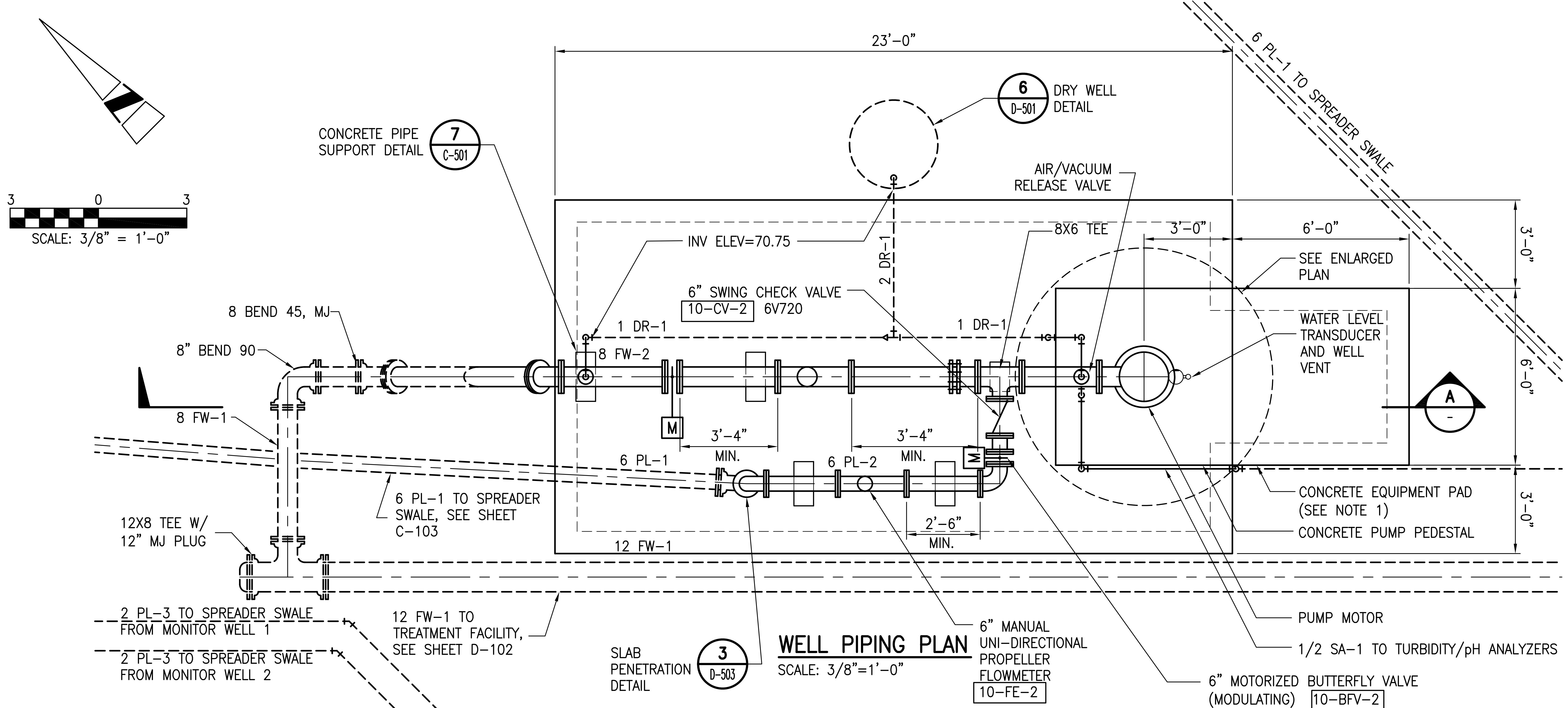
By: ______________________
(Authorized Signature)

City of DeLand
OWNER

By: ______________________
(Authorized Signature)

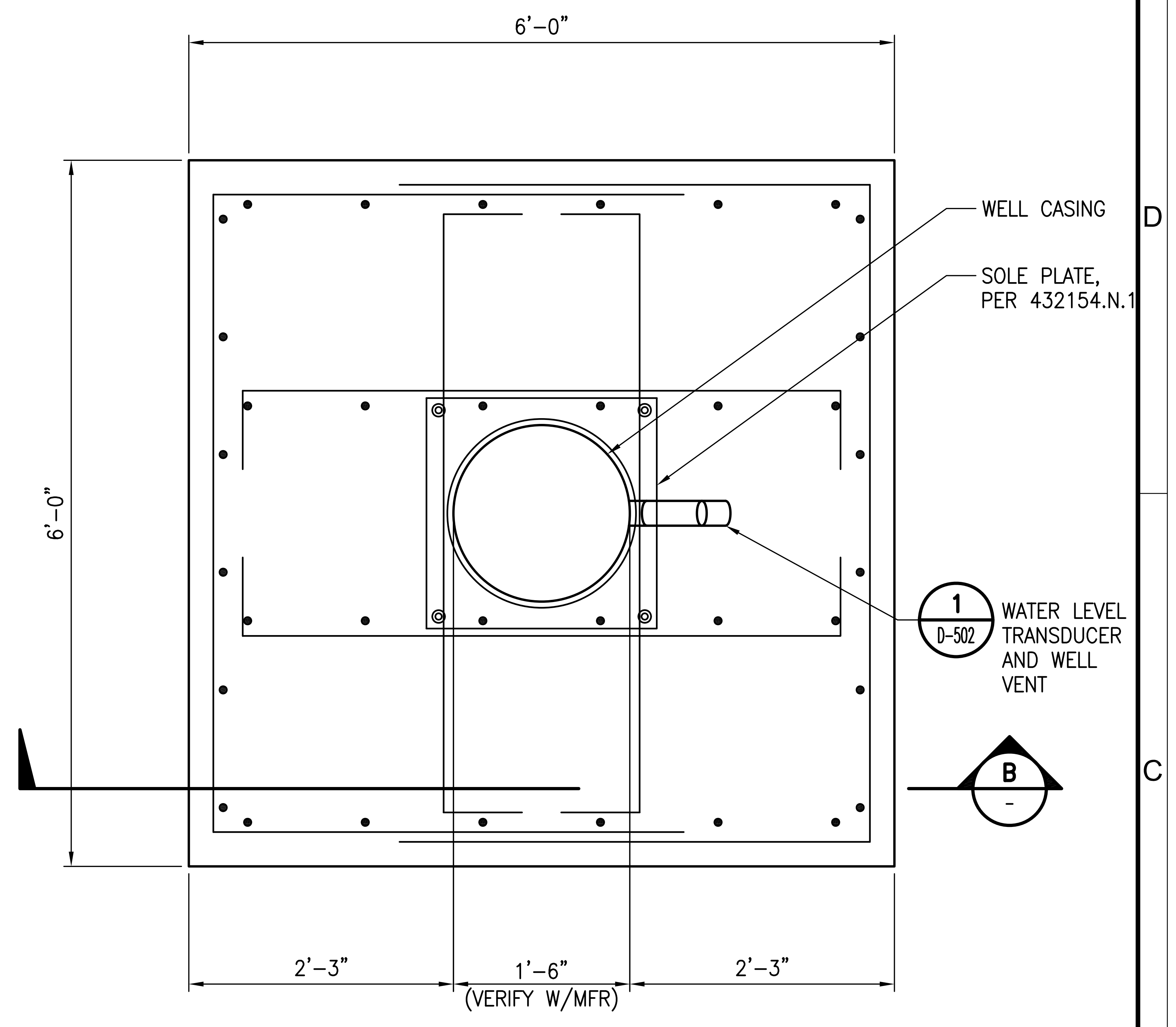
Note: Execution by Contractor / Engineer and acceptance by Owner includes previously completed work by Contractor / Engineer and its drilling construction subcontractor Diversified Drilling Corporation, Inc. for ASR well and two monitoring wells.

Note: The Substantial Completion between Minuteman Constructors, Inc. and ENTRIX, INC. occurred on February 23rd, 2010. This date constitutes the start of the Warranty work performed by Minuteman Constructors, Inc.



WELL PIPING PLAN

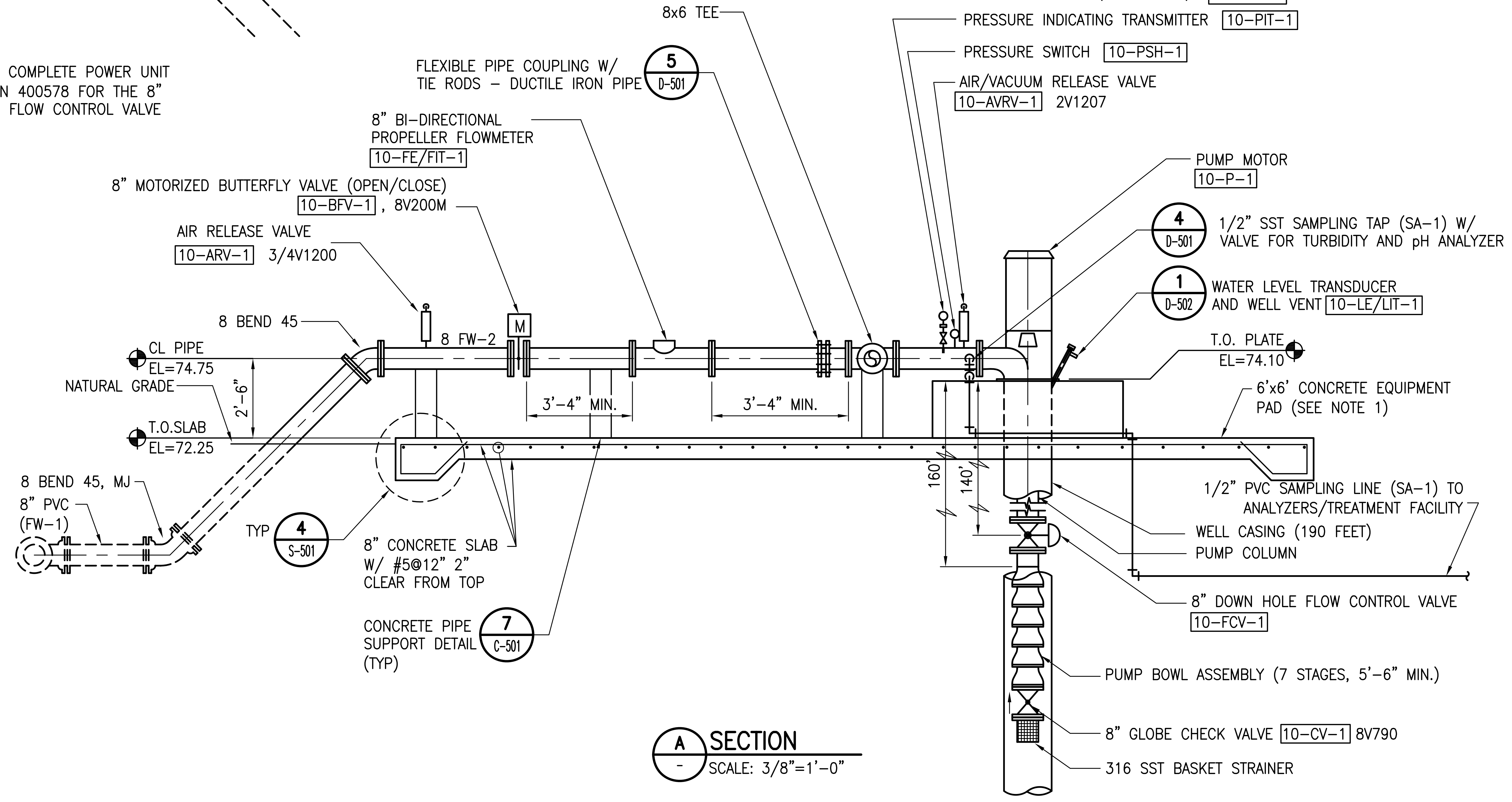
SCALE: 3/8"=1'-0"



ENLARGED PLAN

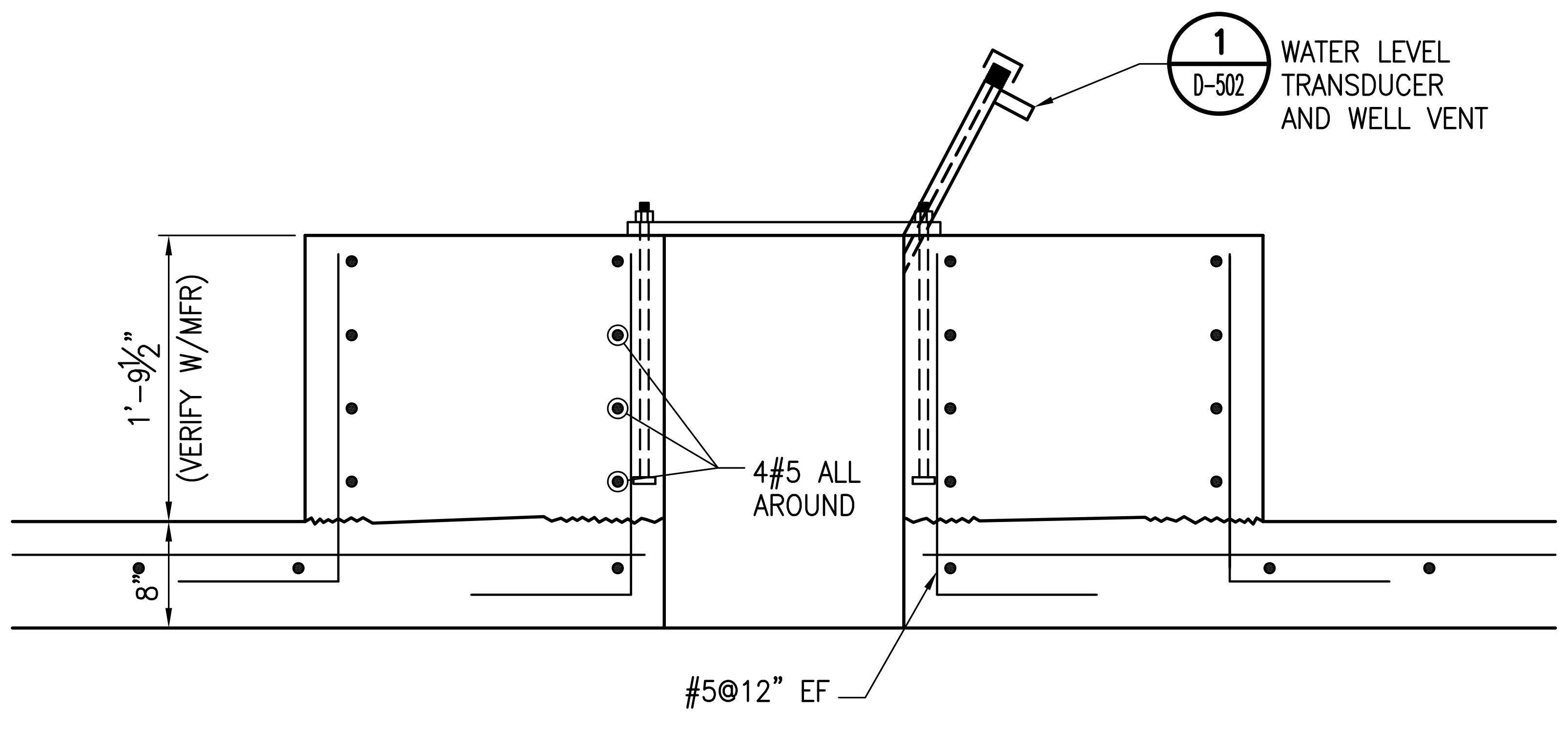
SCALE: 1"=1'-0"

NOTE:
1. INSTALL COMPLETE POWER UNIT PER SECTION 400578 FOR THE 8" DOWN HOLE FLOW CONTROL VALVE



A SECTION

SCALE: 3/8"=1'-0"



B SECTION

SCALE: 1"=1'-0"

REV	DATE	DESCRIPTION	APPR
1			
2			
3			
4			
5			
6			

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

DESIGNED BY RRS
DRAWN BY BLA
CHECKED BY KCR
DATE JULY 2007
PROJECT ENGINEER KEITH C. RICE, PE
REG NUMBER 28552
EXP DATE 02/28/09
PROJECT NUMBER 22147.03
CADD STANDARDS BOYLE

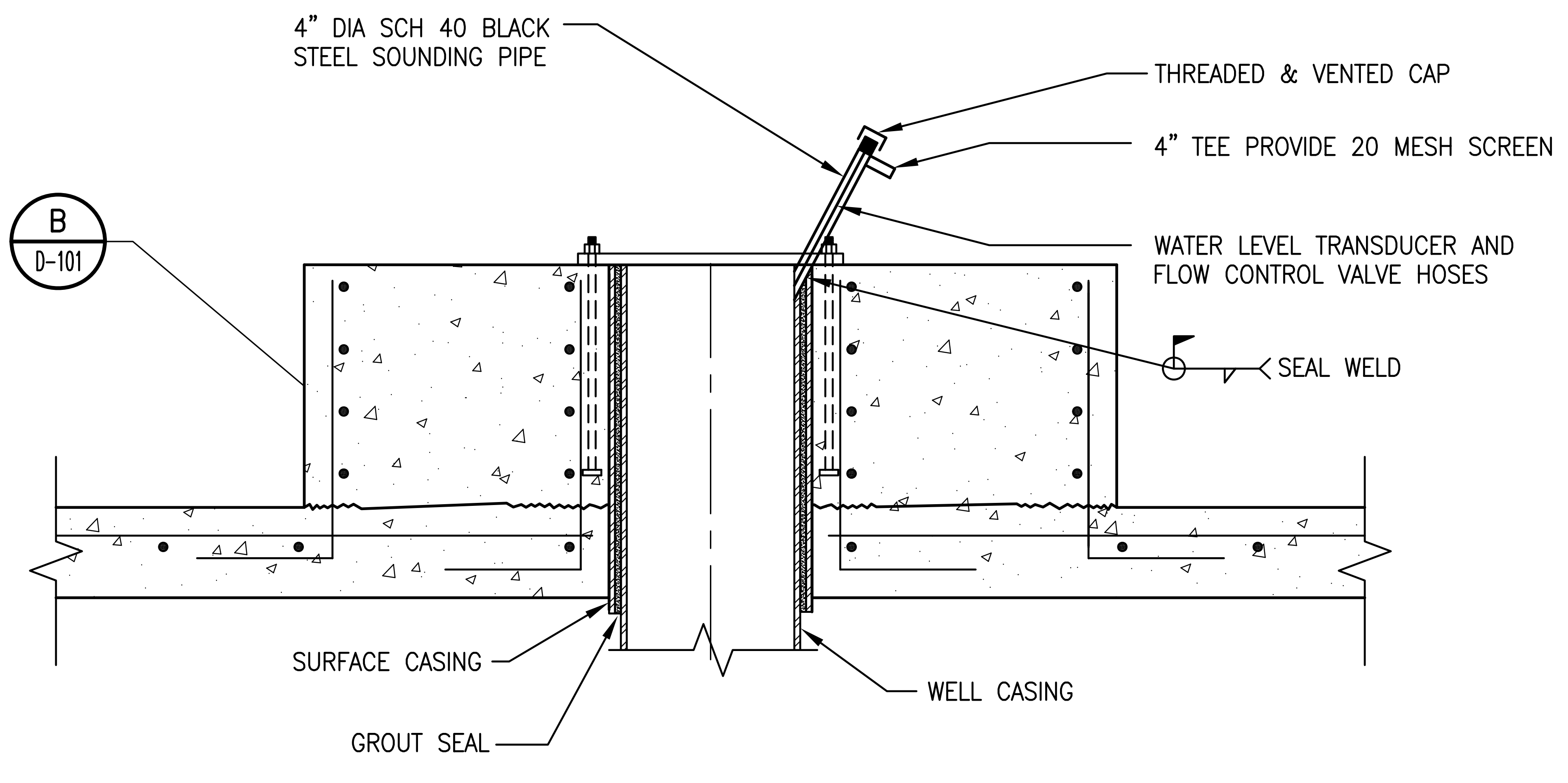
BOYLE ENGINEERING CORPORATION
320 East South Street Orlando, FL 32801
FL. ENGINEERING BUS. NO. 2005
407-425-1100

Water Resource Solutions
A Division of ENTRIX
ENVIRONMENTAL CONSULTANTS
1388 Colonial Blvd. Fort Myers, FL 33907

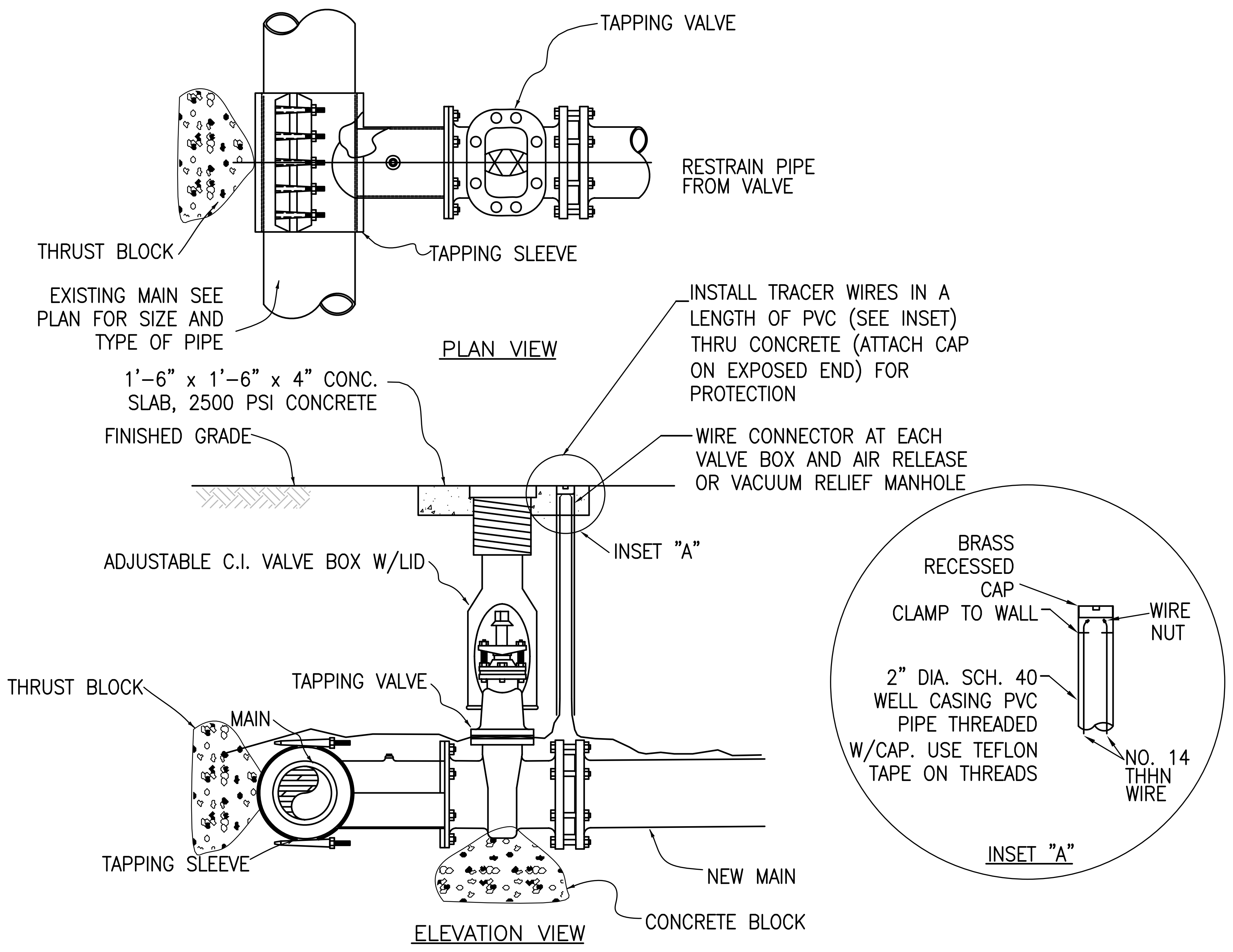
CITY OF DELAND AIRPORT SITE
AQUIFER STORAGE AND RECOVERY PROJECT
WELL PUMP
PLAN AND SECTION

DRAWING D-101
SHEET 14
OF 43 SHEETS

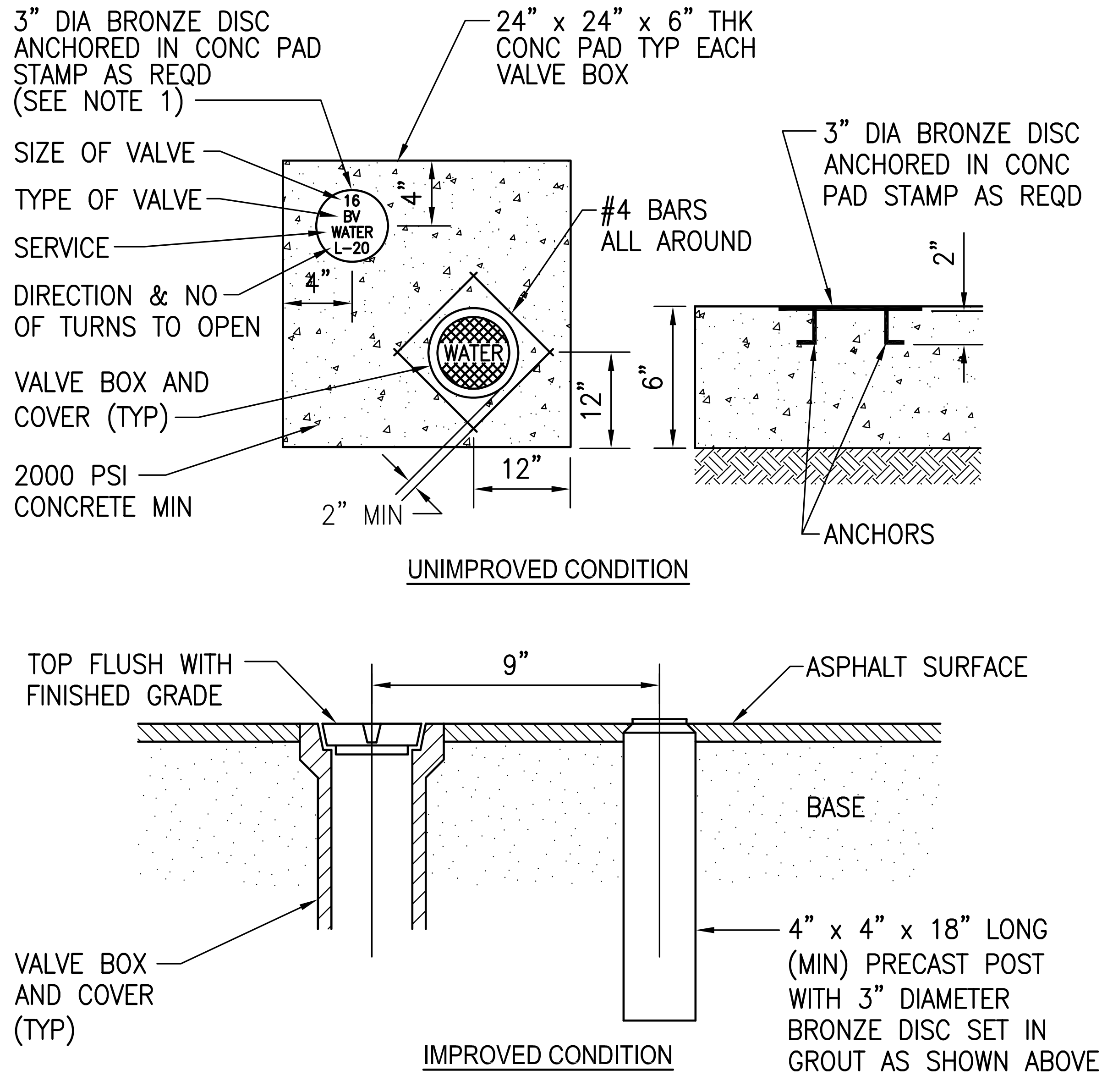
DWG: B:\Orlando\Orlando - Projects\WRS\ASR Design DeLand\CAD\PLANSET\D-502.dwg USER: baikens
DATE: Jul 12, 2007 10:38am XREFS: WR-702-BD IMAGES: WRSLOGO.TIF



1 WATER LEVEL TRANSDUCER AND WELL VENT DETAIL
D-502
SCALE: NONE

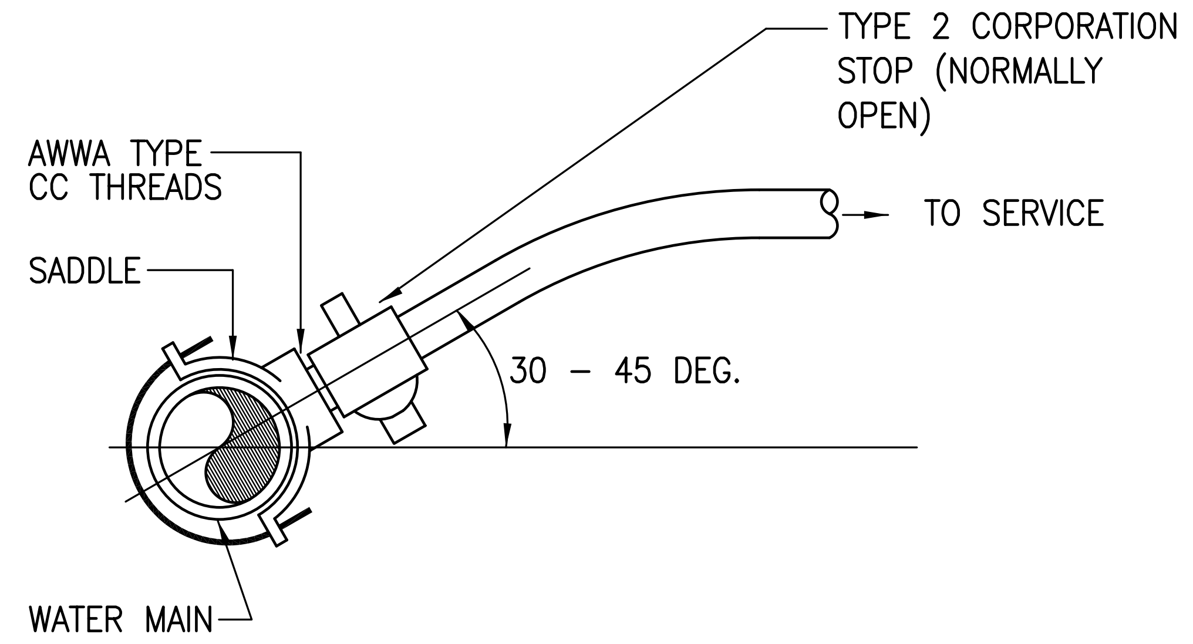


2 TAPPING SLEEVE
D-502
SCALE: NONE



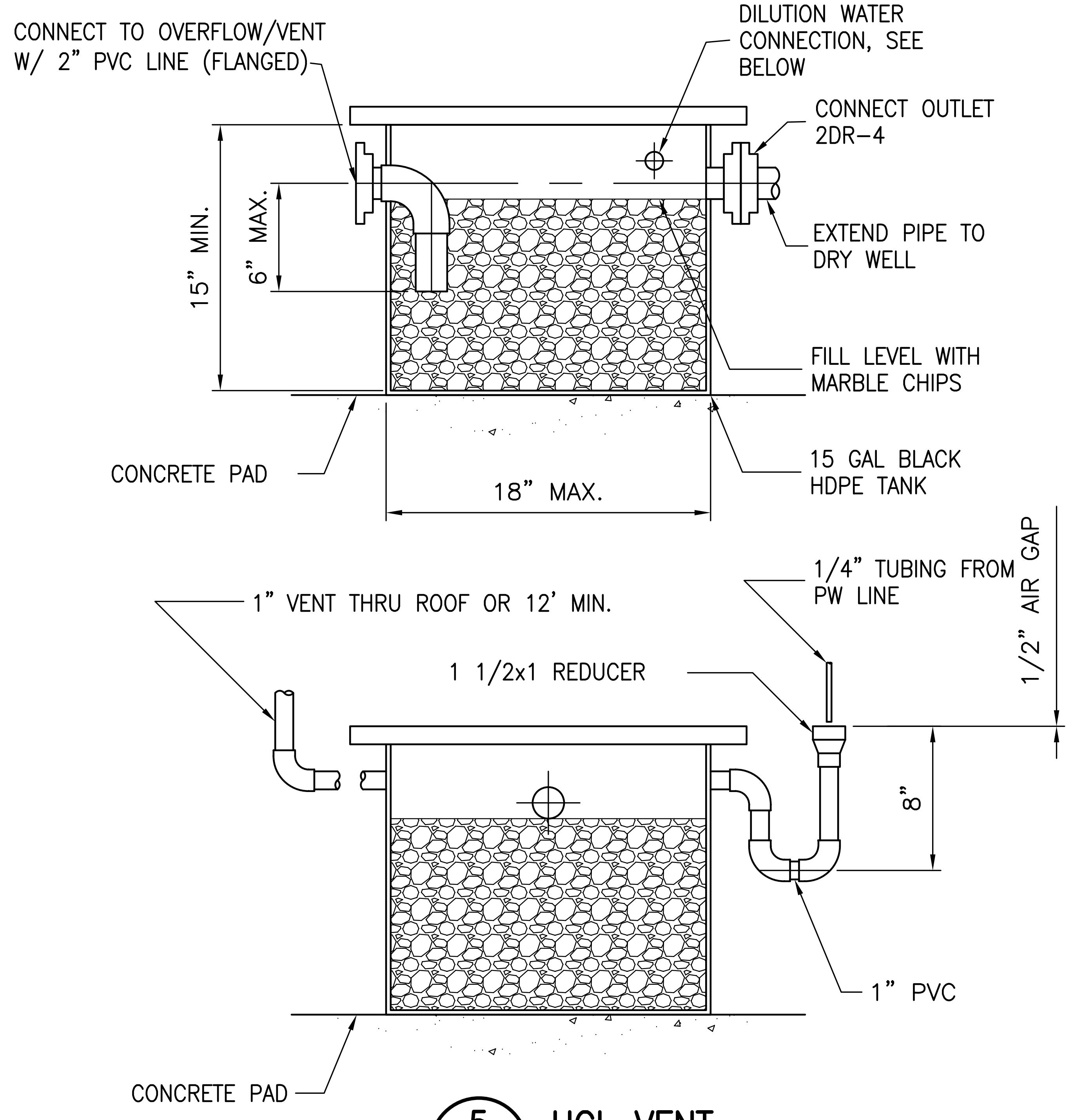
NOTE:
1. BRONZE IDENTIFICATION DISC SHALL BE REQUIRED FOR ALL VALVES.

3 VALVE COLLAR DETAIL
D-502
SCALE: NONE



NOTE:
1. ALL FITTINGS SHALL BE BRASS WITH COMPRESSION/PACK JOINT TYPE CONNECTIONS.

4 WATER SERVICE CONNECTION DETAIL
D-502
~~SCALE~~: NONE



5 HCL VENT
D-502
SCALE: NONE

REV	DATE	DESCRIPTION	APPR
1			
2			
3			
4			
5			
6			

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

DESIGNED BY RRS
DRAWN BY BLA
CHECKED BY KCR
DATE JULY 2007

PROJECT ENGINEER KEITH C. RICE, PE
REG NUMBER 28552
EXP DATE 02/28/09
PROJECT NUMBER 22147.03
CADD STANDARDS BOYLE

BOYLE
ENGINEERING CORPORATION
320 East South Street Orlando, FL 32801
FL. ENGINEERING BUS. NO. 2005
407-425-1100

Water Resource Solutions
A Division of ENTRIX
ENVIRONMENTAL CONSULTANTS
1388 Colonial Blvd. Fort Myers, FL 33907

CITY OF DELAND AIRPORT SITE
AQUIFER STORAGE AND RECOVERY PROJECT

PROCESS DETAILS

DRAWING D-502
SHEET 22
OF 43 SHEETS

Attachment 1

Memorandum – Recommendation of Pump Acceptance, Prepared by AECOM USA, Inc.

AECOM
320 East South Street
Orlando, FL 32801
www.aecom.com

407 425 1100 tel
407 246 7002 fax

Memorandum

To	Michael Waldron, PG	Page	1
Subject	City of Deland Airport Site ASR Well Surface Facilities Installation Project - Well Pump Acceptance Recommendation		
From	Rasesh Shah, P.E. Derek Bieber, E.I.		
Date	June 10, 2010		

Based on our analysis of the performance of the well pump (10-P-1), it is recommended that the pump be accepted.

The certified factory pump curves (Contractor submittal 432154-065), **Appendix A**, were accepted on 9/23/2009. The curves tested performance of the pump bowls and discharge head. Not included in the factory performance test were:

- Foot check valve friction losses
- 3R downhole control valve friction losses
- Column pipe friction losses

Field data was collected during three events (**Appendix B**):

- First wire-to-water test (3/17/2010)
- Second wire-to-water test (4/5/2010)
- Field observations following functional demonstration test (4/29/2010)

In order to compare the performance curve and test data, adjustment of the factory test performance curve to include the headloss from the three appurtenances is necessary, which wasn't done in prior discussions on the subject, which lead to the doubts about the pump performance. The certified performance curve was adjusted using manufacturer adjustments for head losses. The individual losses are explained below and shown in **Table 1**:

- Foot check valve friction losses were subtracted based on the Head Loss Chart for Full Flow Foot Valves (8-inch valve, **Appendix C**).
- 3R Valve friction losses were subtracted based on the manufacturer's calculations based on 8-inch column and 1-1/4-inch shaft (**Appendix D**).
- Column friction losses were subtracted based on the manufacturer's Column Friction Loss Charts (**Appendix E**).

Table 1: Certified Pump Curve Adjustments

Test Data		Adjustments				
Flow	Original Discharge Pressure	Foot Valve Head Loss	Head Loss through 3R Valve	Column Friction Losses	Sum of Losses	Adjusted Discharge Pressure
(gpm)	(TDH)	(ft)	(ft)	(ft)	(ft)	(TDH)
0	426.35	0.00	0.00	0.00	0.00	426
201	401.03	1.17	4.93	1.00	7.10	394
402	348.07	1.31	9.42	1.99	12.72	335
600	301.67	1.54	15.20	4.18	20.92	281
802	253.14	1.86	22.48	7.23	31.57	222
1000	158.15	2.27	30.97	10.62	43.85	114

The resulting adjusted curve was compared to the test data (**Appendix F**). The chart also includes error bars to account for inaccuracies in the instrumentation equipment (well level transducer, flow meter and pressure transducer). The three sets of test data appear to be within the range of error allowed for the system.

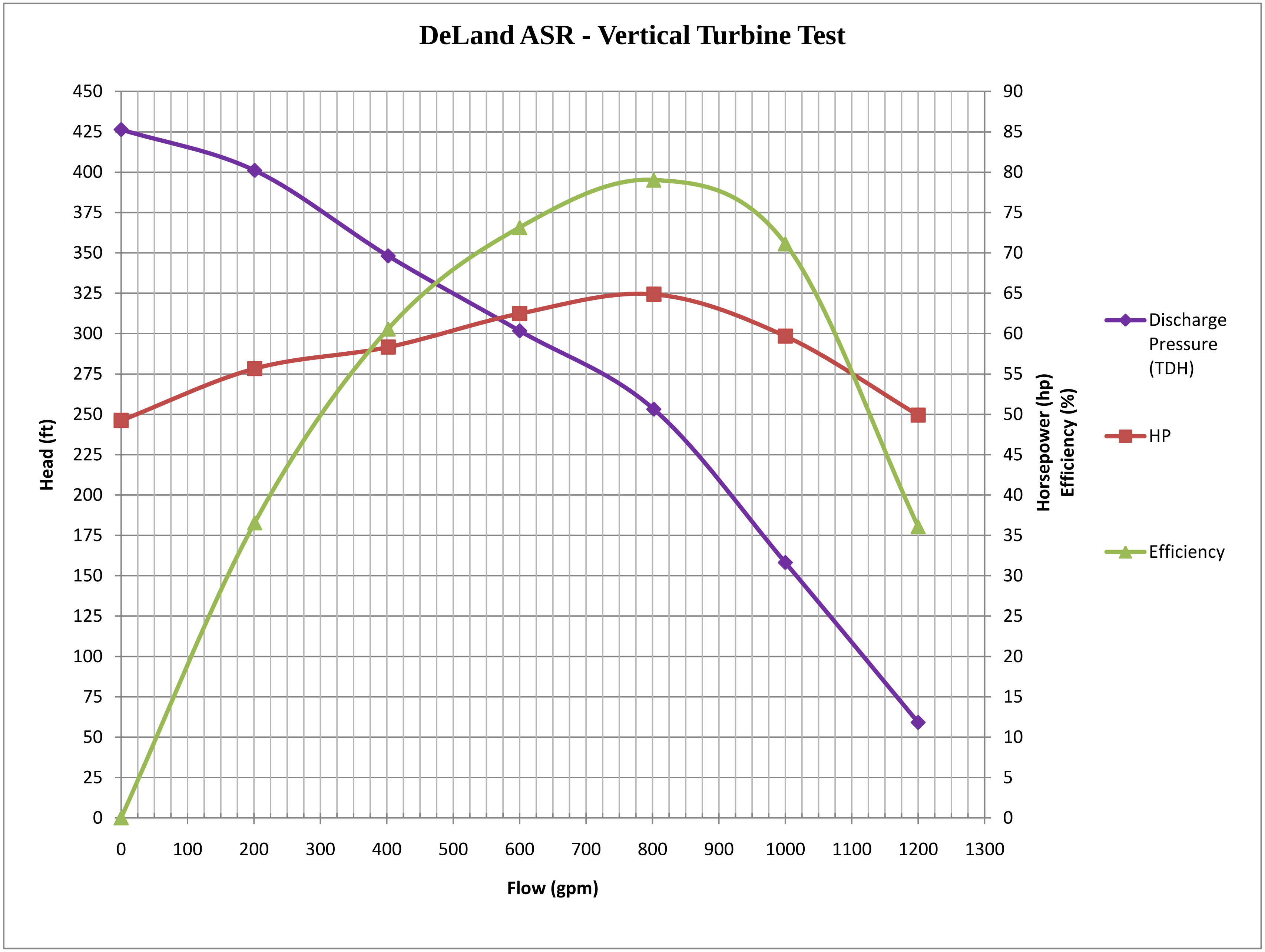
Additionally, the Wire-to-Water (WTW) efficiency data recorded on April 5, 2010 (**Appendix G**) supports acceptance of the pump by showing a close relationship between the calculated WTW efficiency and the expected WTW efficiency.

The above ground pipe at well head is the high point in the purge line. When the well pump turns off, due to the momentum of the water, the purge pipe drains to the swale leaving the above ground purge pipe (high point) empty. The air enters this empty pipe thru ARVs or pipe joints or RPZ back flow preventer. Therefore, when the pump turns on again, this trapped air gradually comes out in the swale via bubbles. It won’t hinder the purging operation but installing an ARV on the purge pipe high point after the RPZ back flow preventer can help address the issue. If the bubbles are forming in the pump they would collapse in the column pipe due to high pressure and won’t reach up to the swale.

In summary, the field curve is tracking close to the specified curve and the pump delivers 690 gpm @ 65 psi (highest potable water distribution system pressure near the site). In other words, the pump will be able to pump 1 mgd into the distribution system and is acceptable.

Appendix A

Certified Factory Pump Curves


DeLand ASR - Vertical Turbine Test
Head (ft)
450
425
400
375
350
325
300
275
250
225
200
175
150
125
100
75
50
25
0
Horsepower (hp)
Efficiency (%)
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
Flow (gpm)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
Discharge Pressure (TDH)
HP
Efficiency

Appendix B

Collected Field Data

Average system pressures:
Low: 50 psi = 116 ft
Max: 65 psi = 150 ft
Avg: 58 psi = 134 ft

Inputs
Output

First WTW Test Field Data
TDH (ft) = static head + gauge pressure

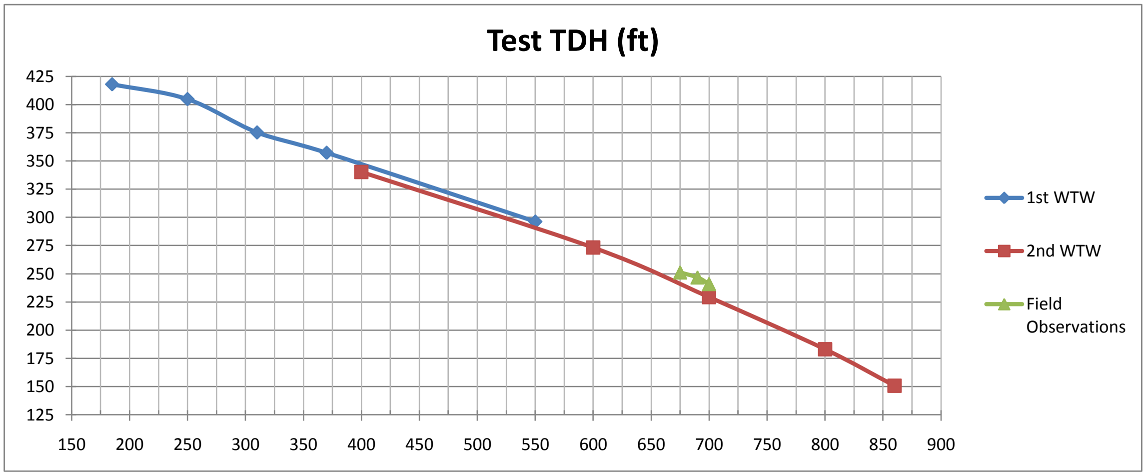
Flow	Length of Transducer	Water above Transducer	Water above Transducer	Static Lift	Gauge Pressure	Discharge Pressure	TDH
(gpm)	(ft)	(psi)	(ft)	(ft)	(psi)	(ft)	(ft)
185	130	26.3	61	69	151	349	418
250	130	25.0	58	72	144	333	405
310	130	23.8	55	75	130	300	375
370	130	22.6	52	78	121	280	357
550	130	19.0	44	86	91	210	296

Second WTW Test Field Data
TDH (ft) = static head + gauge pressure

Flow	Length of Transducer	Water above Transducer	Water above Transducer	Static Lift	Gauge Pressure	Discharge Pressure	TDH
(gpm)	(ft)	(psi)	(ft)	(ft)	(psi)	(ft)	(ft)
400	130	22	51	79	113	261	340
600	130	18	42	88	80	185	273
700	130	13	30	100	56	129	229
800	130	8	18	112	31	72	183
860	130	3	7	123	12	28	151

Field Observations from Rasesh
TDH (ft) = static head + gauge pressure

Flow	Static Lift	Gauge Pressure	Discharge Pressure	TDH
(gpm)	(ft)	(psi)	(ft)	(ft)
675	87	71	164	251
690	97	65	150	247
700	91	65	150	241

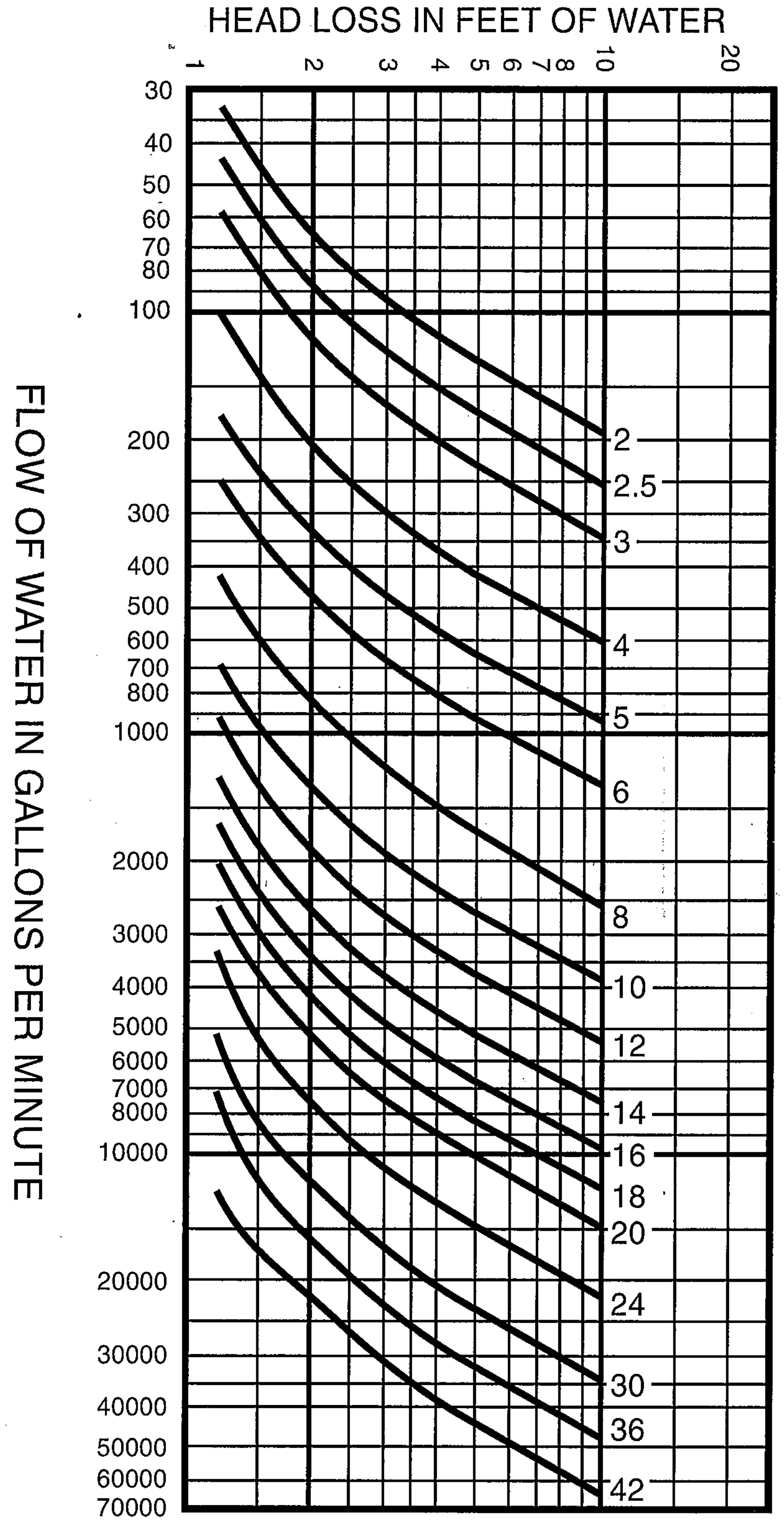


Appendix C

Head Loss Chart for Full Flow Foot Valves

Appendix C

SIZE	2	2.5	3	4	5	6	8	10	12	14	16	18	20	24	30	36	42
CV	75	100	140	240	380	550	1,000	1,600	2,200	3,100	3,800	5,000	6,000	8,500	14,000	19,000	26,000



Revised 6-30-09

HEAD LOSS CHART FOR FULL FLOW FOOT VALVES

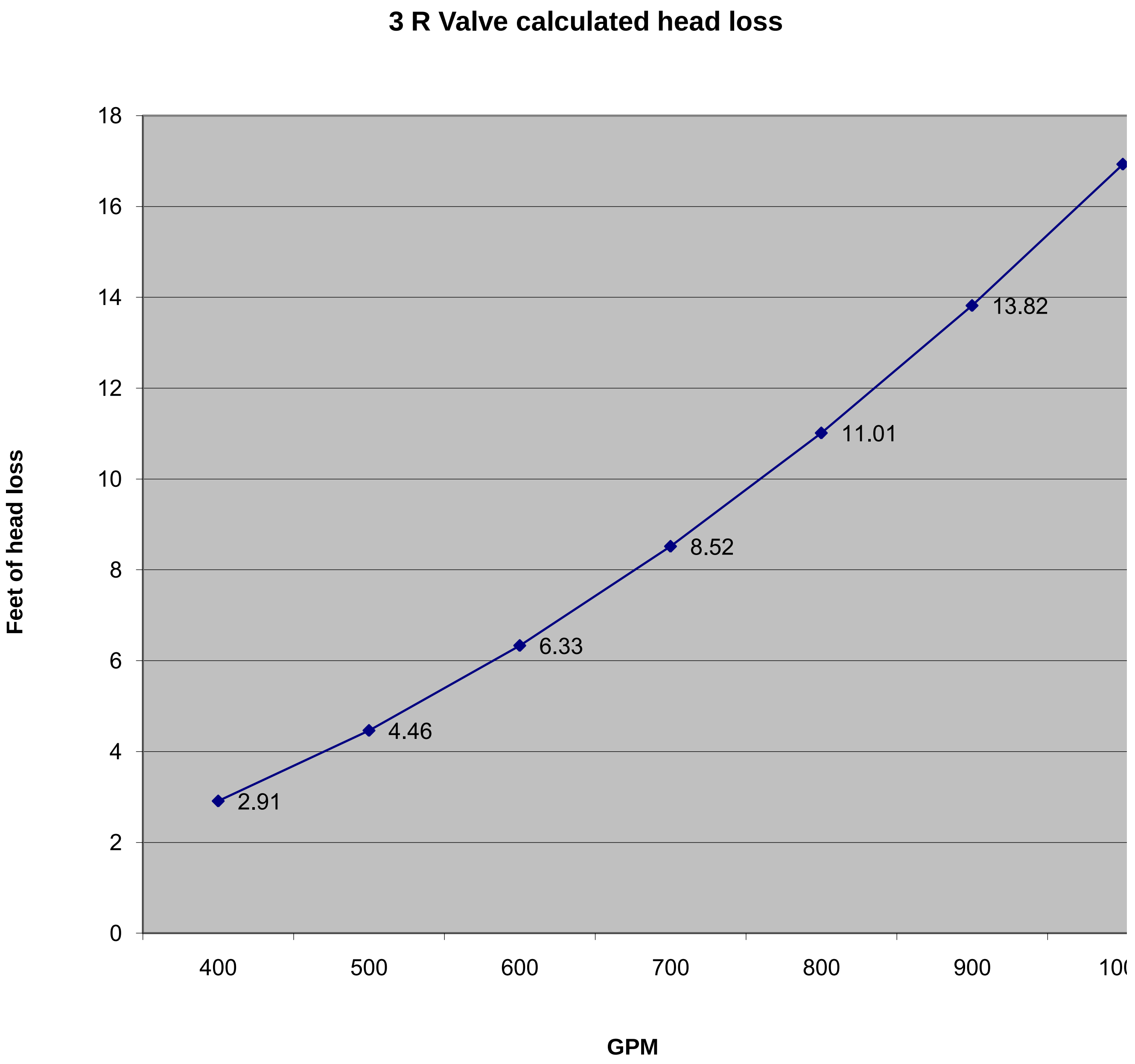
DATE 10-29-91

VAL-MATIC® VALVE AND MANUFACTURING CORP.

DRWG. NO. SS-914

Appendix D

3R Valve Calculated Head Loss


3 R Valve calculated head loss
Feet of head loss
GPM
0
2
4
6
8
10
12
14
16
18
400
500
600
700
800
900
10
2.91
4.46
6.33
8.52
11.01
13.82

Appendix E

Pump Column Friction Loss Chart

Appendix E

Lubricated

Column Friction Loss Charts

Friction loss in excess of 5.0 feet per 100 feet of column pipe should be avoided, if possible.

Column & Open Lineshaft Size	Column & Enclosed Lineshaft Size	FRICTION LOSS IN FEET PER 100 FEET OF SETTING																							
		GALLONS PER MINUTE																							
		20	25	30	35	40	50	60	75	85	100	115	125	150	160	175	200	225	250	275	300	325	350	375	400
3 x 3/4	~	1.0	1.4	1.9	2.5	3.1	4.4	6.0	8.8	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
3 x 1	~	1.4	2.0	2.6	3.4	4.2	6.1	8.4	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
4 x 3/4	~	~	~	~	~	~	.6	.9	1.3	1.6	2.2	2.7	3.2	4.4	5.0	5.7	7.3	~	~	~	~	~	~	~	~
4 x 1	4 x 1 1/2	~	~	~	.7	.8	.9	1.2	1.8	2.2	2.9	3.6	4.3	5.7	6.4	7.5	~	~	~	~	~	~	~	~	~
4 x 1 1/4	4 x 2	~	.6	.7	.9	1.1	1.7	2.2	3.3	4.0	5.3	6.7	7.8	~	~	~	~	~	~	~	~	~	~	~	~
5 x 1	5 x 1 1/2	~	~	~	~	~	~	~	~	~	~	~	~	1.3	1.5	1.8	2.2	2.7	3.3	3.9	4.5	5.2	5.9	6.7	7.5
5 x 1 1/4	5 x 2	~	~	~	~	~	~	~	~	~	~	~	1.4	1.9	2.1	2.5	3.2	3.9	4.7	5.5	6.4	7.6	~	~	~
5 x 1 1/2	5 x 2 1/2	~	~	~	~	~	~	~	~	~	~	~	1.9	2.6	3.0	3.5	4.3	5.3	6.4	7.6	~	~	~	~	~
5 x 1 11/16	5 x 2 1/2	~	~	~	~	~	~	~	~	~	~	~	1.9	2.6	3.0	3.5	4.3	5.3	6.4	7.6	~	~	~	~	~

Column & Open Lineshaft Size	Column & Enclosed Lineshaft Size	FRICTION LOSS IN FEET PER 100 FEET OF SETTING																			
		GALLONS PER MINUTE																			
		200	300	400	500	600	700	800	900	1000	1200	1400	1600	1800	2000	2200	2400	2600	2800	3000	3200
6 x 1	6 x 1 1/2	.73	1.6	2.7	3.8	5.2	7.0	8.9	11.5	~	~	~	~	~	~	~	~	~	~	~	~
6 x 1 1/4	6 x 2	.95	2.0	3.4	4.9	7.0	9.0	12.0	14.5	~	~	~	~	~	~	~	~	~	~	~	~
6 x 1 1/2	6 x 2 1/2	1.4	2.9	4.7	6.9	9.5	12.5	16.2	~	~	~	~	~	~	~	~	~	~	~	~	~
6 x 1 11/16	6 x 2 1/2	1.4	2.9	4.7	6.9	9.5	12.5	16.2	~	~	~	~	~	~	~	~	~	~	~	~	~
6 x 1 15/16	6 x 3	2.2	4.5	7.6	11.8	17.1	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~
8 x 1	8 x 1 1/2	~	~	~	~	~	.96	1.3	1.6	1.9	2.6	3.5	4.5	5.5	6.7	7.9	9.4	11.0	12.8	14.7	16.7
8 x 1 1/4	8 x 2	~	~	.61	.91	1.3	1.8	2.2	2.8	3.3	4.5	5.95	7.55	9.4	12.5	15.1	~	~	~	~	~
8 x 1 1/2	8 x 2 1/2	~	~	.74	1.1	1.55	2.1	2.7	3.2	3.9	5.5	7.2	9.2	14.0	~	~	~	~	~	~	~
8 x 1 11/16	8 x 2 1/2	~	~	.74	1.1	1.55	2.1	2.7	3.2	3.9	5.5	7.2	9.2	14.0	~	~	~	~	~	~	~
8 x 1 15/16	8 x 3	~		1.05	1.55	2.2	2.9	3.7	4.7	5.4	7.5	9.98	13.0	16.4	~	~	~	~	~	~	~
8 x 2 3/16	8 x 3	~		1.05	1.55	2.2	2.9	3.7	4.7	5.4	7.5	9.98	13.0	16.4	~	~	~	~	~	~	~

Column & Open Lineshaft Size	Column & Enclosed Lineshaft Size	FRICTION LOSS IN FEET PER 100 FEET OF SETTING																							
		GALLONS PER MINUTE																							
		700	800	900	1000	1200	1400	1600	1800	2000	2200	2400	2600	2800	3000	3200	3400	3600	3800	4000	4200	4400	4600	4800	5000
10 x 1	10 x 1 1/2	~	~	~	~	1.06	1.4	1.79	2.2	2.69	3.2	3.75	4.33	5.0	5.65	6.35	7.05	7.85	8.7	9.6	10.6	11.6	12.7	13.8	15.0
10 x 1 1/4	10 x 2	~	.58	.72	.89	1.2	1.59	2.02	2.5	3.02	3.6	4.2	4.9	5.6	6.4	7.15	8.0	8.9	9.8	12.0	14.5	~	~	~	~
10 x 1 1/2	10 x 2 1/2	.5	.67	.83	1.0	1.38	1.81	2.30	2.88	3.5	4.1	4.8	5.6	6.4	7.25	8.2	9.1	10.5	12.5	13.5	14.9	~	~	~	~
10 x 1 11/16	10 x 2 1/2	.5	.67	.83	1.0	1.38	1.81	2.30	2.88	3.5	4.1	4.8	5.6	6.4	7.25	8.2	9.1	10.5	12.5	13.5	14.9	~	~	~	~
10 x 1 15/16	10 x 3	.62	.8	1.0	1.17	1.65	2.16	2.78	3.5	4.25	5.05	5.95	6.9	7.9	8.95	9.99	12.0	13.5	14.5	~	~	~	~	~	~
10 x 2 3/16	10 x 3	.62	.8	1.0	1.17	1.65	2.16	2.78	3.5	4.25	5.05	5.95	6.9	7.9	8.95	9.99	12.0	13.5	14.5	~	~	~	~	~	~

Column & Open Lineshaft Size	Column & Enclosed Lineshaft Size	FRICTION LOSS IN FEET PER 100 FEET OF SETTING																							
		GALLONS PER MINUTE																							
		1600	1800	2000	2200	2400	2600	2800	3000	3200	3400	3600	3800	4000	4200	4400	4600	4800	5000	5500	6000	6500	7000	7500	8000
12 x 1 1/4	12 x 2	~	.99	1.2	1.42	1.68	1.92	2.2	2.5	2.8	3.15	3.5	3.85	4.27	4.67	5.1	5.5	5.9	6.4	7.6	9.0	10.6	12.3	14.1	16.0
12 x 1 1/2	12 x 2 1/2	.9	1.11	1.36	1.6	1.89	2.18	2.5	2.87	3.2	3.6	4.0	4.4	4.8	5.25	5.8	6.3	6.8	7.3	8.7	10.4	12.2	14.1	16.2	~
12 x 1 11/16	12 x 2 1/2	.9	1.11	1.36	1.6	1.89	2.18	2.5	2.87	3.2	3.6	4.0	4.4	4.8	5.25	5.8	6.3	6.8	7.3	8.7	10.4	12.2	14.1	16.2	~

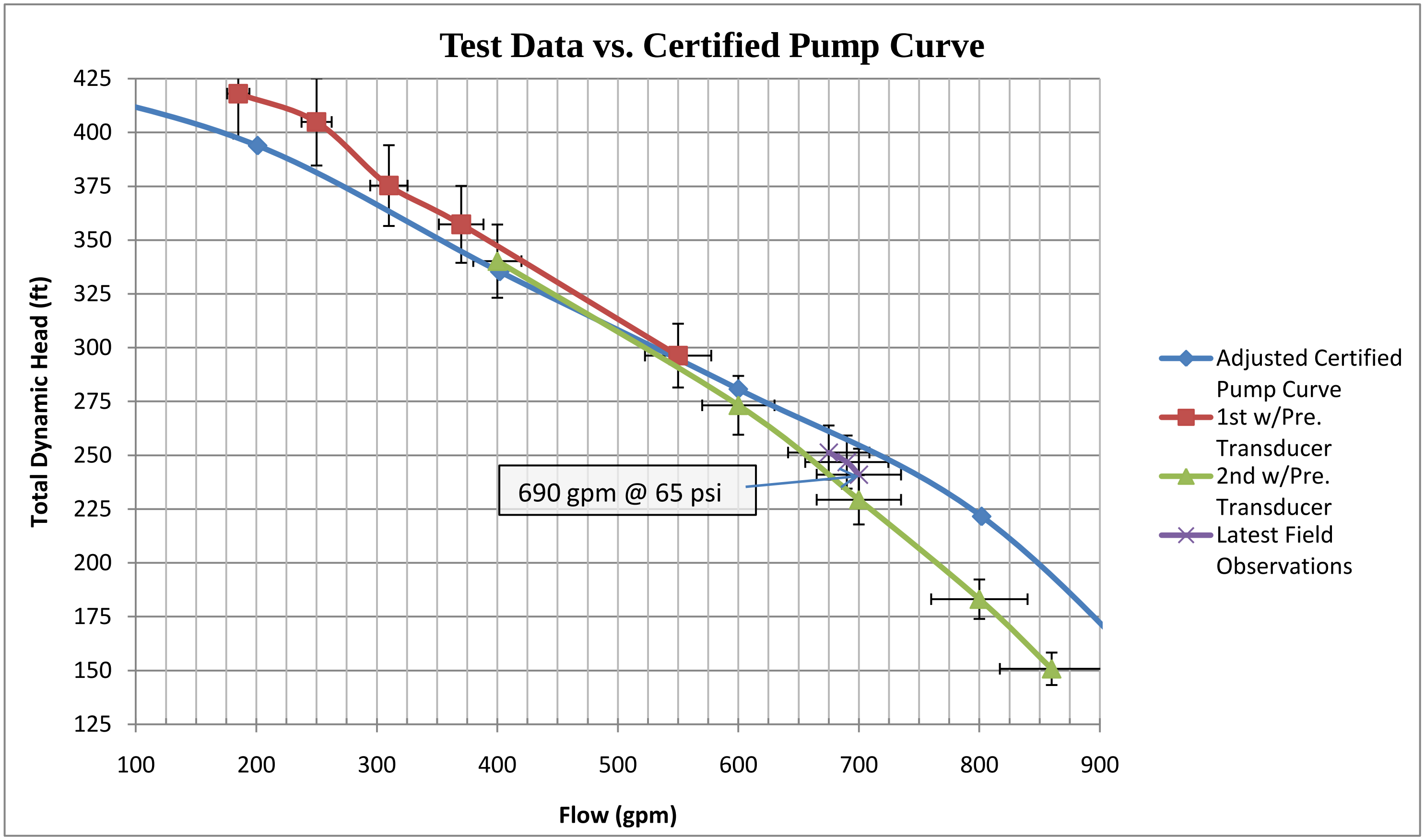
Column & Open Lineshaft Size	Column & Enclosed Lineshaft Size	FRICTION LOSS IN FEET PER 100 FEET OF SETTING																							
		GALLONS PER MINUTE																							
		1400	1600	1800	2000	2200	2400	2600	2800	3000	3200	3400	3600	3800	4000	4200	4400	4600	4800	5000	5500	6000	6500	7000	7500
12 x 1 15/16	12 x 3	~	1.04	1.29	1.57	1.85	2.18	2.5	2.9	3.3	3.72	4.15	4.6	5.15	5.65	6.15	6.7	7.25	7.9	8.55	10.3	12.3	14.4	16.8	~
12 x 2 3/16	12 x 3	~	1.04	1.29	1.57	1.85	2.18	2.5	2.9	3.3	3.72	4.15	4.6	5.15	5.65	6.15	6.7	7.25	7.9	8.55	10.3	12.3	14.4	16.8	~
12 x 2 7/16	12 x 3 1/2	1.02	1.3	1.65	1.95	2.35	2.76	3.23	3.69	4.2	4.73	5.28	5.9	5.55	7.25	7.85	8.6	9.3	10.1	11.1	13.3	15.8	~	~	~

Up to 12" - threaded column. 14" and up - flanged only.

Appendix F

Adjusted Certified Pump Curve vs. Test Data Comparison

City of DeLand ASR
Well Pump Summary - 6/1/2010



Certified factory test pump has been adjusted to include the following:

- Foot valve and strainer, which were not installed at the time of the pump test.
- 3R Valve, which was not installed at the time of the pump test.
- Column friction losses, which were not included in the factory pump test.

Appendix G

Wire-to-Water Efficiency Calculations

Wire-to-Water Efficiency is calculated for the second test (4-5-2010)

Output			**Input**					**Wire-to-Water**			
Flow (gpm)	**Total Dynamic Head (ft)**	**Power (hp)**	**Load (A)**	**Average Load (A)**	**Electrical Potential (V)**	**Average Electrical Potential (V)**	**Power (hp)**	**Wire-to-Water Efficiency (%)**	**Specified Efficiencies (%)**	**Motor Efficiency (%)**	**Expected WWE Values (%)**
400	341	34.5	67	66.47	494	493	59.1	58%			
			66.9		492						
			65.5		493						
600	275	41.6	69.3	68.20	494	493	60.6	**69%**	76.5%	89.5%	**68.5%**
			68.3		492						
			67		493						
700	231	40.9	67.7	67.07	494	493	59.6	**69%**	79.0%	89.5%	**70.7%**
			67.5		492						
			66		493						
800	186	37.5	64.8	64.53	494	493	57.4	65%			
			65		492						
			63.8		493						
860	154	33.5	62.2	61.73	494	493	54.9	**61%**	72.0%	89.5%	**64.4%**
			62.5		492						
			60.5		493						

Attachment 2

Final Punch List

PUNCH LIST
FLORIDA DESIGN CONTRACTORS

City of DeLand Airport Site Aquifer Storage and Recovery Project
Deficiency List for Substantial Completion

Site Visit: 5/25/2010

Worked Completed 6/11/2010

Description	Completed	Verified by FDC	Verified by SJRWMD / City / ENTRIX / AECOM	Comments
Replace broken strap on exterior light conduit.	X	TC		
Restore grass near well-head to remove vehicle track ruts.	X	TC		
Relocate emergency eyewash flow switch tag 40-FS-1 to be near flow switch.	X	TC		
Provide equipment tags for monitoring well #2 pump, 10-P-3, and level indicator, 10-LE/LIT-3.	X	TC		
Chemical Rooms (general)				
Connect intake vent pipe to drum using nipple and flexible hose. Connection must be sealed.	X	TC		
Hydrochloric				
Remove all dirt & debris from containment pallets.	X	TC		
Secure Stenner pump to PVC plate.	X	TC		
Tighten sump electrical receptacle.	X	TC		
Troubleshoot and fix chemical injector, which seems clogged or repair check valve, which is malfunctioning. The PRV limits flow to the high pressure bucket.	X	TC		
Hydrofluosilicic				
Clean containment pallet of debris & dirt.	X	TC		
Secure Stenner pump to PVC plate.	X	TC		
Tighten sump electrical receptacle.	X	TC		
Chlorine Room				
Exhaust fan does not operate from room thermostat (thermostat should control exhaust fan during normal operation).	X	TC		
Provide valve tags for 40-V-1A, 1B and 1C.	X	TC		
Phosphate Room				
Clean containment pallet of debris & dirt.	X	TC		
Secure Stenner pump to PVC plate.	X	TC		

PUNCH LIST
FLORIDA DESIGN CONTRACTORS

Description	Completed	Verified by FDC	Verified by SJRWMD / City / ENTRIX / AECOM	Comments
Hydrosulfide Room				
Clean up excess foam sealant from southwest exterior near A/C condenser.	X	MW		
Install tags on equipment in building	X	MW		
Install missing A/C AHU exhaust vent fins on exterior.	X	MW		Vent fins restrict air flow - screen added
Confirm H_2S sensors are set to the following concentrations: medium – 5 ppm; high – 10 ppm; high-high – 15 ppm.	X	MW		Confirmed
Confirm O_2 deficiency sensor set to the following concentrations: Caution – 20.0%; Danger – 19.5%.	X	MW		Alarm 1: 19% Alarm 2: 18% Alarm 3: 22%
Electrical/I&C Room				
Provide labels for the following: LP-1, MTS-1, 10-SSSS-1, PLC-1, TX-1, 10-SV-1, 10-SV-2 and 40-SV-1.	X	TC		
HMI/SCADA to include totalized flow for injection and recovery; high and low water level interrupts and NaHS pump simple-loop algorithm to adjust NaHS rate with flow rate.	X	TC		
Well Area				
Provide label for level transmitter 10-LIT-1.	X	TC		
Provide correct label for flow meter, 10-FE/FIT-1.	X	TC		
Remove corrosion from yellow OSHA guard on well pump.	X	TC		
Repair broken electrical line at SZMW-1	X	TC		
Verify bi-directional flow meter operates in both directions with anti-reverse functioning correctly.	X	TC		
Piping				
Underground main line valve may not be closing 100%please bleed to check, or pressure test.	X	TC		

Notes: FDC to submit preliminary I&C O&M.

Attachment 3

Certificate of Occupancy – City of DeLand Building Department

5/13/2010

CERTIFICATE OF OCCUPANCY

CITY OF DELAND FLORIDA
120 S. FLORIDA AVE. DELAND, FL 32720
(386) 626-7009

This Certificate issued pursuant to the requirements of the Florida Building Code certifying that at the time of issuance this structure was in compliance with the various ordinances of the jurisdiction regulating building construction or use.

CUSTOMER #: 0005650

PROJECT ADDRESS: 2051 Industrial Dr

PERMIT #: 000000508520

PROPOSED USE: Construct ASR System and Chemical Bldg Bin # 7 2091 Industrial

OCCUPANCY TYPE: COMM **CONSTRUCTION TYPE:** NEW

PROPERTY OWNER: City of DeLand

ADDRESS: 120 S FLORIDA AVE
AIRPORT

1882

CITY: DELAND

STATE: FL **ZIP:** 32720-5422

PARCEL NUMBER: 341[illegible]30-00-00-0020

COMPLETION DATE: 03/30/2010

Approved by Building Official Matt Adair

____/____/____
Date

Attachment 4

Permit Correspondence

FLORIDA DEPARTMENT OF
HEALTH

Charlie Crist
Governor

Ana M. Viamonte Ros, M.D., M.P.H.
State Surgeon General

Sent by E-Mail
rasesh.shah@aecom.com
rigerk@deland.org

May 27, 2010

Rasesh R. Shah, P.E.
Aecom USA, Inc.
320 East South Street
Orlando, Florida 32801

PWS ID No. 3640286
Final Clearance for City of Deland ASR Well – Complete Facility
Permit Nos.: 0128184-184-WC/17 and 0128184-219-WC/M1

Dear Mr. Shah:

This acknowledges receipt of your engineering certification that the above subject ASR Well and associated pretreatment / recovery chemical feed systems have been completed in accordance with the approved plans and related materials as permitted by this Department on Permit Number 0128184-184-WC/17 dated August 29, 2007 and Permit Number 0128184-219-WC/M1 dated December 29, 2009 that the system meets all applicable AWWA Standards.

Based on your certification and the satisfactory sampling results from the well, we are clearing the ASR well and treatment facility for operation.

The responsibility for the quality of the water at the time it ultimately reaches the consumer's meter remains entirely with the utility and/or the owner/operator of the system. This letter of clearance does not preclude the need for obtaining acceptance by other entities as may be required.

Your cooperation in the drinking water program is appreciated. Please call me at (386) 736-5158 if you have any questions.

Sincerely,

Ronald E Freeman

Ronald E. Freeman, P.E.
Professional Engineer Administrator

CC: File P8184184 & P8184219
J. Lee Faircloth, Eng. IV, VCHD

Volusia County Health Department • Environmental Health Engineering
1845 Holsonback Drive. • Daytona Beach, FL 32117-5114

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 BY E-MAIL TO:
rigerk@deland.org

City of Deland Utilities
1102 S. Garfield Ave
Deland, FL 32724

OCD-IW-09-199

Attention: Keith Riger, P.E.
City Engineer and Public Services Director

Volusia County - IW
City of Deland Airport Site Aquifer Storage and Recovery Project
Produced Groundwater Discharge under 62-621.300(2)
Notice of Continued Coverage

Dear Mr. Riger:

The Department of Environmental Protection received your submittal dated November 13, 2009. The Department has reviewed the current submittal along with the previously submitted Notice of Intent (NOI) dated July 19, 2007. Engineering and technical staffs performed a preliminary review of the material submitted in support of the permit for the proposed project. Based on the information submitted the project is still covered under 62-621.300(2). The sampling and analysis shall conform to screening values listed in Table 1 of Rule 62-621.300(2). In addition, the facility must analyze Residual Chlorine, which shall be less than 0.001 mg/L (Rule 62-302.530(18)), Arsenic, which shall be less than 50 ug/L (Rule 62-302.530(5a)). The Department requires that sampling must be conducted on every discharge, which would be daily samples if the discharge last less than one week, and weekly if the discharge lasts more than one week. This letter shall be attached to OCD-IW-07-180.

If you have any questions, please contact Ali Kazi, P.E.at telephone number 407-893-3317, FAX number 407-893-5633 or e-mail ali.kazi@dep.state.fl.us.

Sincerely,

Christianne C. Ferraro

Christianne C. Ferraro, P.E.
Program Administrator
Water Facilities
Date: December 2, 2009

AK/rc

cc: Gabor Matrai/Volusia County Environmental Management Department/gmatrai@co.volusia.fl.us
Gary Miller / DEP / Orlando
Rasesh Shah, PE/ AECOM/ rasesh.shah@aecom.com
Richard Lott, P.E. / DEP/ Orlando

"More Protection, Less Process"

From: Watroba, Duane [Duane.Watroba@dep.state.fl.us]
Sent: Monday, May 17, 2010 4:38 PM
To: Mike Waldron
Subject: Deland Airport ASR

Mike:

For the record, as far as DEP is concerned, cycle testing may commence at the above referenced facility. Let us know when you start and what happens.

Duane

From: Kazi, Ali [Ali.Kazi@dep.state.fl.us]
Sent: Tuesday, January 19, 2010 12:29 PM
To: Shah, Rasesh
Cc: Mike Waldron; Ferraro, Chris
Subject: RE: DeLand Potable Water ASR NPDES Coverage

Dear Rasesh: We believe that the discharge will be continuous. We revisited our letter. We request that the sampling should be on weekly basis for the first month when the discharge commences. If all the result are at less than 50% of the screening value, continue sampling on a quarterly basis thereafter as long as the result remain at or below 50% of the screening values. If the results are at the screening values then sampling should be on a monthly basis. This is based on our standard practice of requiring a monthly sampling for permits. This is slightly different from our discussion this morning. Please attach this e mail to the letter 09-199 that was issued December 2, 2009. Please call me at 407-893-3317 if you have any question.

From: Shah, Rasesh [mailto:Rasesh.Shah@aecom.com]
Sent: Tuesday, January 19, 2010 11:24 AM
To: Kazi, Ali
Cc: Mike Waldron
Subject: FW: DeLand Potable Water ASR NPDES Coverage

I am sending this email to summarize our phone conversation today. Following is the schedule we will follow for the DeLand Airport Site ASR Project:
After we get the operational clearance to inject potable water into the ASR well , we will initiate the 1st monthly sampling including arsenic, residual chlorine and all table 1 parameters. We will send this results to FDEP for review. We will continue doing monthly sampling for 2 more months and forward results to FDEP. If water quality is in compliance with the surface water discharge requirements, FDEP will let us do quarterly sampling during the course of cycle testing.

Please let me know, if you have edits to this schedule.
Thanks,
Rasesh Shah, P.E.
Project Manager, Water
D 407.513.8279 C 321.663.2993
rasesh.shah@aecom.com

AECOM
320 E. South Street
Orlando, FL 32801
T 407.425.1100 F 407.422.3866
www.aecom.com

From: Shah, Rasesh
Sent: Monday, January 11, 2010 1:07 PM
To: 'ali.kazi@dep.state.fl.us'
Subject: DeLand Potable Water ASR NPDES Coverage
Hi,
This is Rasesh. We spoke a few weeks back. We have another issue that we need your feedback on. It relates to the frequency of sampling.
Attached is the latest permit copy and the reference document (600-621.300) with screening parameters (table 1) for your quick access.
My interpretation of the permit is to sample arsenic, residual chlorine, and all table 1

parameters during recovery of water from the potable water ASR well as follows:
Daily – If discharge lasts less than a week
Weekly – if discharge last more than a week
If above information is true, it will be very expensive. Also, once we go through first couple of sampling cycles, we will get good idea about water quality.
The reference document (600-621.300) with table 1 seems less stringent than the permit coverage document itself. Could we follow the "minimum reporting requirement" as detailed in the 600-621.300(2)?
Thanks,
Rasesh Shah
407-513-8279

<<62-621 300_2_table_1.pdf>> <<09-199-64- City of Deland ASR.pdf>>

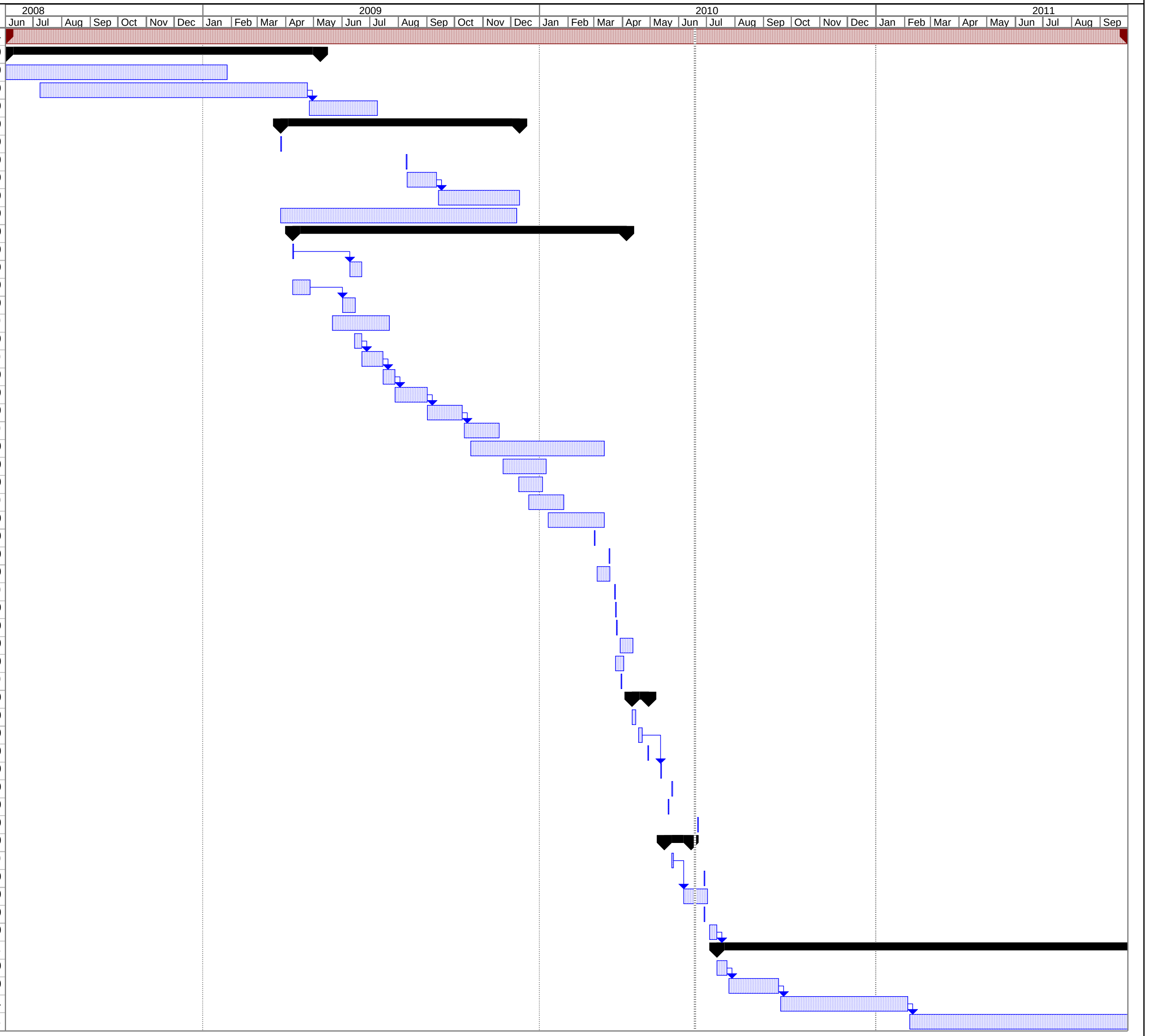
Attachment 5

Revised Schedule of Cycle Testing

CITY OF DELAND/SJRWMD ASR
DELAND MUNICIPAL AIRPORT SITE
PROJECT SCHEDULE

June 2010

ID	Task Name	Duration	Start	Finish
1	**CITY OF DELAND/SJRWMD ASR PROGRAM**	870 days	Mon 6/2/08	Fri 9/30/11
2	**SURFACE FACILITIES CONSTRUCTION/TESTING PHASE**	245 days	Mon 6/2/08	Fri 5/8/09
3	ASR Test Well System Construction	172 days	Mon 6/2/08	Tue 1/27/09
4	Mini-scale Pilot Test Development, Authorization and Completion (Hydrosulfide)	208 days	Wed 7/9/08	Fri 4/24/09
5	Technical Evaluation, Recommendations (Tech. Memo) and District Review	54 days	Mon 4/27/09	Thu 7/9/09
6	FULL-SCALE PRETREATMENT DE-OX SYSTEM - DESIGN AND PERMIT	185 days	Fri 3/27/09	Thu 12/10/09
7	Submit Major UIC Permit Mod. Request to FDEP for Administrative Order	1 day	Fri 3/27/09	Fri 3/27/09
8	District Authorizes Work Order #30 for Implementing Pretreatment-DeOx System	1 day	Mon 8/10/09	Mon 8/10/09
9	60% Preliminary Design Report	24 days	Tue 8/11/09	Fri 9/11/09
10	100% Design Documents Prepared and Submitted	64 days	Mon 9/14/09	Thu 12/10/09
11	FDEP UIC Permit Modification and Administrative Order	182 days	Fri 3/27/09	Mon 12/7/09
12	SURFACE EQUIPMENT CONSTRUCTION	258 days	Thu 4/9/09	Mon 4/5/10
13	Contract Start Date April 9, 2009	1 day	Thu 4/9/09	Thu 4/9/09
14	P & P Bonds Approved and Notice to Proceed	9 days	Wed 6/10/09	Mon 6/22/09
15	Conformed Documents for Building Permit & Site Layout and Staking	13 days	Thu 4/9/09	Mon 4/27/09
16	Building Permit Approval	10 days	Tue 6/2/09	Mon 6/15/09
17	Submittals and Purchasing	44 days	Fri 5/22/09	Wed 7/22/09
18	Site Mobilization, Fencing, Barriers & Survey Corners	6 days	Mon 6/15/09	Mon 6/22/09
19	Underground Piping and Utility Tie-Ins	17 days	Tue 6/23/09	Wed 7/15/09
20	Complete Foundations/Footers	9 days	Thu 7/16/09	Tue 7/28/09
21	Vertical: Block and Wall Frames	25 days	Wed 7/29/09	Tue 9/1/09
22	Outfit Building for Utility/Service Lines & Install Trusses w/ Tie Downs	28 days	Wed 9/2/09	Fri 10/9/09
23	Outfit Wellheads and Complete Building Structure	28 days	Mon 10/12/09	Wed 11/18/09
24	Electrical System Pulls to Termination	105 days	Mon 10/19/09	Fri 3/12/10
25	Coordinate with and Retain Data Flow Systems for NaSH Component	35 days	Mon 11/23/09	Fri 1/8/10
26	Install and Calibrate Metering Pumps	18 days	Thu 12/10/09	Mon 1/4/10
27	Install and Pressure Test Feed from NaSH Building to 12" Diameter Water Line	28 days	Mon 12/21/09	Wed 1/27/10
28	DFS Programming (Offsite)	45 days	Mon 1/11/10	Fri 3/12/10
29	Draft Asbuilts Submitted for Record Drawings	1 day	Tue 3/2/10	Tue 3/2/10
30	Sodium-Bisulfide (NaSH) Building Complete	1 day	Thu 3/18/10	Thu 3/18/10
31	DFS Install, Vert.-Turbine ASR Pump Test	10 days	Fri 3/5/10	Thu 3/18/10
32	Functional Acceptance Testing	1 day	Wed 3/24/10	Wed 3/24/10
33	Progress Meeting #10	1 day	Thu 3/25/10	Thu 3/25/10
34	Wet Tap to Add Recovery Water Discharge Point on 12"	1 day	Fri 3/26/10	Fri 3/26/10
35	Restart and Perform Bacteriological Testing of ASR Well	10 days	Tue 3/30/10	Mon 4/12/10
36	Additional Pump Testing and Pump Perfomance Checks	7 days	Thu 3/25/10	Fri 4/2/10
37	Sodium Bisulfide Delivery (2 Totes)	1 day	Wed 3/31/10	Wed 3/31/10
38	Preliminary Testing and Functional Testing	14 days	Mon 4/12/10	Thu 4/29/10
39	Prepare for revision of mechanical seal configuration	4 days	Mon 4/12/10	Thu 4/15/10
40	Revise configuration of mechanical seal	4 days	Mon 4/19/10	Thu 4/22/10
41	Retest ASR Well Controls and RTU/SCADA Interface	1 day	Thu 4/29/10	Thu 4/29/10
42	Functional Demonstration Testing and Training (including DFS download to WTP)	1 day	Thu 5/13/10	Thu 5/13/10
43	Substantial Completion Walkthrough and Punchlist Issuance	1 day	Tue 5/25/10	Tue 5/25/10
44	Record Drawings Submittal	1 day	Fri 5/21/10	Fri 5/21/10
45	O&M Manuals - Preparation and Submittal (not including DFS Operations Manual)	1 day	Tue 6/22/10	Tue 6/22/10
46	SYSTEM CERTIFICATION, STARTUP AND PRELIMINARY SAMPLING	21 days	Mon 5/17/10	Mon 6/14/10
47	HD Inspection (a.m.) and FDEP/UIC Approval and Inspection (p.m.)	2 days	Tue 5/25/10	Wed 5/26/10
48	DFS O&M Manual Submittal (Estimated)	1 day	Tue 6/29/10	Tue 6/29/10
49	Mini-Cycle Tests (3 to 10 tests in a period of up to 4 weeks)	20 days	Mon 6/7/10	Fri 7/2/10
50	Final Completion Review	1 day	Tue 6/29/10	Tue 6/29/10
51	ASR System Training and/or Training/Mini-Cycle Review by ENTRIX	6 days	Mon 7/5/10	Mon 7/12/10
52	OPERATIONAL TESTING	342 days	Tue 7/13/10	Wed 11/2/11
53	Pre-Test/Shakedown* (10 MG: 5 INJ / 3 - 5 REC)	9 days	Tue 7/13/10	Fri 7/23/10
54	Cycle 1 (20 MG: 20 INJ / 5-10 ST / 8 - 20 REC)	40 days	Mon 7/26/10	Fri 9/17/10
55	Cycle 2 (60 MG: 60 INJ / 10 - 20 ST / 40 - 60 REC)	100 days	Mon 9/20/10	Fri 2/4/11
56	Cycle 3 (90 MG: 90 INJ / 90 ST / 60 - 90 REC)	193 days	Mon 2/7/11	Wed 11/2/11



Attachment 6

ENTRIX Letter of Commitment

ENTRIX
Down to Earth. Down to Business.™

June 21, 2010

Keith Riger, P. E.
Director of Public Services
City of DeLand
1102 South Garfield Avenue
DeLand, Florida 32724

Project Title: City of DeLand Airport ASR System
Project Reference: SF408RA, Work Order No. 29 / 33
Location: 2091 Industrial **D**rive, DeLand, Florida
Owner: St. Johns River Water Management District
Contractor: ENTRIX, Inc.

Dear Mr. Riger:

This letter serves as a commitment by ENTRIX, Inc., to provide wellhead seal replacement as set forth in the Memorandum dated June 21, 2010 to which this letter is attached, as warranty services, upon written request by the City of DeLand. The work performed by ENTRIX under contract to the St. Johns River Water Management District (SJRWMD) included a welded-seal connection between the 16-inch diameter, stainless-steel casing riser and the soleplate of the vertical-turbine pump motor for the ASR Test Well. During the work to install the welded-seal connection, the gasket between the pump-discharge assembly and the sole plate was damaged and the two pieces were re-seated with a neoprene gasket and a marine sealant. It was later determined that the sealant material was not NSF 61 certified. The non-certification of the sealant was pointed out to the Health Department; however, because the sealant was placed on the outer portion of the gasket (not in direct contact with the flow stream) it was accepted by the Health Department and the associated permit was issued.

Although the completed connection is in conformity to the contract documents, in the event of a failure of either the wellhead seal or the pump-assembly seal (the above-referenced sealant), ENTRIX, Inc., commits to the repair and replacement of the wellhead to its existing condition (but with an NSF 61 certified sealant). After a pending demonstration of remote operation of the ASR system using the SCADA integration software, the project will be substantially complete and ready for functional testing. Ownership of the ASR facility can be transferred from SJRWMD to the City upon execution of the Certificates of Substantial Completion.

Sincerely,

Michael J. Waldron, P.G.
Senior Consultant

File: 11437160.00/Closeout Files/Substantial_Completion_Memo/ENTRIX Letter of Commitment_062110

3460 Fairlane Farms Road • Suite 8 • Wellington, FL 33414 • MAIN 561.791.6912 • FAX 561.791.6915 • 1.800.368.7511 •
entrix.com

Appendix D

UIC Permit / Admin. Order

Appendix D

UIC Permit / Administrative Order

D.1 Administrative Order, Florida Department of Environmental Protection, No. 64-0272120-001-UC
Order No. A0-09-0004
DeLand Airport Aquifer Storage and Recovery Facility, Volusia County

D.2 Underground Injection Control Section Permit and Notice, Permit File No. 64-0272120-001-UC
DeLand Airport Potable Water ASR Project
Class V ASR Injection Well

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:

Keith D. Riger, P.E., City Engineer
City of DeLand
1102 South Garfield Avenue
DeLand, FL 32782

DEP Permit No. 64-0272120-001-UC
Order No. AO-09-0004
DeLand Airport Aquifer Storage and Recovery Facility, Volusia County

ADMINISTRATIVE 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, Keith D. Riger, P.E., is a person under Section 403.031, F. S.

2. The Facility is located at the City of DeLand Municipal Airport, Pistol Range Road, DeLand, Volusia 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, reclaimed water management, and ground water monitoring requirements.

3. The Facility applied for a permit on December 21, 2006, under Section 403 .0876, F.S., to construct an aquifer storage and recovery (ASR) system. Permit No. 64-0272120-001-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. 64-0272120-001-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 exceedences 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 cannot 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. 64-0272120-001-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. 64-0272120-001-UC or subsequent permit modifications or renewals, or future construction permits for ASR wells, or monitor wells not covered under Permit No. 64-0272120-001-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 that arsenic exceeding 10 µg/L is occurring off-site because of the ASR activity, the Department shall require the following:

    (a) An estimate of the vertical and lateral extent of arsenic concentration exceeding 10 µg/L
    (b) A field-verified inventory of all water wells within the area determined by best professional judgment to include the area potentially affected by the discharge plus a safety factor of 50%, or a one-mile radius, whichever is larger (area of review)
    (c) Provisions for alternate water supplies for water wells within the area of review
    (d) Measures that will be taken to remove off-site contamination or risk-based corrective actions the facility will conduct under Chapter 62-780, F.A.C., including Department-approved institutional controls in accordance with the Division of Waste Management's Institutional Controls Procedures Guidance, November 2004, to prevent the construction and use of new water wells within areas of off-site contamination. The Department shall accept a local government's ordinance as an institutional control if that ordinance prohibits the construction or use of water wells within areas of off-site contamination.
    (e) The facility may be required to sample off-site wells identified within the area of review that withdrawal from the storage zone

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. 64-0272120-001-UC.

15. Failure to comply with the requirements of this Administrative Order shall constitute a violation of this Administrative Order and Permit No. 64-0272120-001-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, material man 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 16th day of December, 2009 in Orlando, Florida.

STATE OF FLORIDA DEPARTMENT
OF ENVIRONMENTAL PROTECTION

Vivian F. Garfein

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 Stephanie Lalonde Date December 16, 2009

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:

Keith D. Riger, P.E.
City Engineer
City of DeLand
1102 South Garfield Avenue
Deland, FL 32782
rigerk@deland.org

Attention: Keith D. Riger, P.E.
City Engineer

Volusia County - UIC
DeLand Airport Potable Water ASR Program
Construction Permit 64-0272120-001-UC
Application No. 64-0272120-002-UC
Modification of Conditions

Dear Mr. Riger:

The Department is in receipt of your Application No. 64-0272120-002-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 page one of nine of the permit:

   This Permit is issued in conjunction with Administrative Order Number AO-09-0004 (attached to this permit modification). Cycle testing and monitoring plans are modified in accordance with the attachments (1 and 2) to this permit. Under this permit modification, the maximum storage capacity of the ASR is approximately 360 MG over a two year injection period.

This letter must be attached to Injection Well Construction Permit No. 64-0272120-001-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 28-106.205.

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 120.57 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

Vivian F. Garfein
Director, Central District
3319 Maguire Boulevard
Suite 232
Orlando, Florida 32803-3767
(407) 894-7555

Date: December 16, 2009

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.

December 16, 2009
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 December 16, 2009 to the listed persons by Duane Watroba.

FACT SHEET

Deland Airport Potable Water Aquifer Storage and Recovery well (ASR)
Permit No.0272120-002-UC
September 23, 2009

A Major Modification is requested that will include monitoring revisions to the construction permit for the ASR system at Deland.

1. General Information

A. Statutory Basis for Requiring/Issuing Permit

The Department has permitting jurisdiction under Chapter 403 Florida Statues (F.S.), and 62-4 and 62-528, Florida Administrative Code (F.A.C.). The project is not exempt from permitting procedures. The Department has determined that a major modification of the existing construction permit is required.

B. Name and Address of Applicant

Keith Riger, P.E.
Public Services Director
1102 S. Garfield Avenue
Deland, Florida 32782

C. Description of Applicant's Proposed Operation

The City of Deland Utilities Department has requested a major modification to modify the Underground Injection Control (UIC) Permit No. 0272120-002-UC. Cycle testing and monitoring plans will be modified in accordance with Attachments 1 and 2 of the permit. Under this permit modification, the maximum storage capacity of the ASR is approximately 360 MG over a two year injection period.

D. Permitting History of this Facility

March 25, 2008 – UIC Permit and Administrative Order No. 64-0272120-001-UC

E. Documents Used in Permitting Decision

1) Construction Permit Application, Class V Pilot Aquifer Storage and Recovery Well System, Deland Municipal Airport, SJRWMD Contract # SF408RA; prepared by Water Resource Solutions, Inc.

2) Underground Injection Control (UIC) permit for the Deland Airport ASR, August 2007.

3) July 22, 2009 – Response Letter to Request for Further Information (RFI), ENTRIX, Inc. received August 4, 2009 via email.

4) September 9, 2009 – Response Letter to August 13, 2009 RFI, ENTRIX, Inc. received via email.

5) DEP Notice of Draft Permit Modification

2. Reasons Permit was Issued; Derivation of Conditions

A. Mechanical Integrity Demonstration

Not required by Chapter 62-528, F.A.C., for Class V wells.

B. Confinement (Rule 62-528.405(2), F.A.C.)

The storage zone is overlain by units consisting of shell and sands from land surface to a depth of approximately 90 feet bls. These sediments are underlain by semi-confining limestone layers which occur to the depth of the storage zone, which will extend between approximately 190’ and 220’ bls. (See Document 1, Part 1 for details).

C. Injection Zone (Rule 62-528.405(3), F.A.C.)

The storage zone at this facility is present between approximately 190-220 feet bls, in the Avon Park Limestone. This formation composes the top of the Upper Floridan aquifer, which consists of dolomite and less common limestone. The water quality of the storage zone is expected less than 1,500 mg/L total dissolved solids (TDS). See Document 1 for details.

D. Underground Source of Drinking Water (Rule 62-528.605, F.A.C.)

The Underground Source of Drinking Water (USDW), which contains water with TDS less than 10,000 mg/L, has been documented at several UIC Class I facilities in the region, and the USDW at this site is expected to extend to a depth greater than 1,400 feet bls. This project will take place entirely within the USDW.

E. Well Construction:

ASR
17.4" SDR 17, Certa-Lok PVC casing, set to 190' bls
Injection interval 190-220’ bls
SZMW-1 & SZMW-2
6" Schedule 40 PVC casing, set to 190' bls
Open hole from190-220’ bls

F. Monitor Plan (Rule 62-528.615, F.A.C.)

The monitoring plan includes two storage zone monitor wells, SZMW-1 and SZMW-2, designed to measure the injected water as it mixes with the native ground water which vary due to mixing times that will be different based on the distance to the ASR well and the volume of water recharged during a given cycle test. The chemical and physical parameters to be monitored and the monitoring schedule are included on the revised Table 1 of the draft permit. The ASR well will be monitored for injection pressure, flow, and water quality of injected and recovered water.

G. Financial Responsibility

Not required by Chapter 62-528, F.A.C. for Class V wells.

H. Emergency Disposal

Not required by Chapter 62-528, F.A.C. for Class V wells.

3. Agency Action

The UIC Program staff recommends approval of the modification to the construction permit.

4. Public Rights (Rules 62-528.310, .315, and .326, F.A.C.)

The Department accepted public comment concerning this proposed permit action for a minimum of 30 days following publication of the Notice of Draft Permit. A public meeting was held in the area of the injection project no less than 30 days after publication of this Notice for the purpose of receiving verbal and written comment concerning this project. Comments received within the 30-day period and during the public meeting were considered by the Department in formulating a final decision concerning this project. The public meeting was held at City of Deland City Hall, 120 South Florida Ave., Deland, Florida on November 4, 2009 at 2:00 PM.

After the conclusion of the public comment period and public meeting described above the Department considered all comments received during the public comment period in making a final decision concerning this permit action. When the Department has made a decision concerning the permit modification, the applicant will publish notice of the proposed agency action. A person whose substantial interests are affected by the Department's proposed permitting decision may petition for an administrative proceeding (hearing). Accordingly, the Department's final action may be different from the position taken by it in the Notice. Persons whose substantial interests will be affected by any decision of the Department with regard to the application have the right to petition to become a party to the proceeding. The petition must conform to the requirements specified in the Notice and be filed (received) within 14 days of publication of this Notice in the Office of General Counsel at the address of the Department. Failure to petition within the allowed time period constitutes a waiver of any right such person has to request a hearing under Sections 120.569 and l20.57, F.S., and participate as a party to this proceeding. Any subsequent intervention will only be at the approval of the presiding officer upon motion filed pursuant to Rule 28-5.207, Florida Administrative Code.

The application and draft permit 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 Office, 3319 Maguire Boulevard, Suite 232, Orlando, Florida 32803-3767. Please contact Duane Watroba at (407) 894-7555 for additional information concerning this project.

5. Agency Contact

Duane Watroba, Technical Advisory Committee
Florida Department of Environmental Protection
3319 Maguire Boulevard, Suite 232
Orlando, Florida 32803-3767
(407) 894-7555

Table 1. Proposed Monitoring Schedule for City of DeLand ASR System

Parameter	Units	Injection & Recovery Frequency		Pre-Cycle Testing # of Samples			Pre-Test # of Samples						Cycle 1 # of Samples					
				1 Year Ongoing	Background Sampling[2]		Injection (5 days[3] or 5 MG)		Storage (0 days)		Recovery (3-5 days)[3]		Injection (20 days[3] or 20 MG)		Storage (5 to 10 days)		Recovery (8 to 20 days)[3]	
		ASR	MWs	Source Water[1]	ASR	MWs	ASR*	MWs	ASR	MWs	ASR	MWs	ASR*	MWs	ASR	MWs	ASR	MWs
Arsenic	µg/L	W2	**W2**	---	---	---	**2**	**2**	---	**1**	**2**	**2**	**6**	**6**	---	**1**	**6**	**6**
Chloride	mg/L	W	W	---	---	---	1	1	---	1	1	1	1	1	---	1	1	1
Dissolved Oxygen (field)	mg/L	W	W	---	---	---	1	1	---	1	1	1	1	1	---	1	1	1
Iron, total	mg/L	W	W	---	---	---	1	1	---	1	1	1	1	1	---	1	1	1
Sodium	mg/L	W	W	---	---	---	1	1	---	1	1	1	1	1	---	1	1	1
pH	std. units	W	W	---	---	---	1	1	---	1	1	1	1	1	---	1	1	1
Specific Conductance (field)	µmhos/cm	W	W	---	---	---	1	1	---	1	1	1	1	1	---	1	1	1
Sulfate	mg/L	W	W	---	---	---	1	1	---	1	1	1	1	1	---	1	1	1
Temperature (field)	°C	W	W	---	---	---	1	1	---	1	1	1	1	1	---	1	1	1
Total Dissolved Solids	mg/L	W	W	---	---	---	1	1	---	1	1	1	1	1	---	1	1	1
Bicarbonate	mg/L	W	W	---	---	---	1	1	---	1	1	1	1	1	---	1	1	1
Magnesium	mg/L	W	W	---	---	---	1	1	---	1	1	1	1	1	---	1	1	1
Manganese	mg/L	W	W	---	---	---	1	1	---	1	1	1	1	1	---	1	1	1
ORP (field)	mV	W	W	---	---	---	1	1	---	1	1	1	1	1	---	1	1	1
Potassium	mg/L	W	W	---	---	---	1	1	---	1	1	1	1	1	---	1	1	1
Total Sulfides	mg/L	W	W	---	---	---	1	1	---	1	1	1	1	1	---	1	1	1
Total Alkalinity	mg/L	W	W	---	---	---	1	1	---	1	1	1	1	1	---	1	1	1
Total Trihalomethanes	ug/L	W	W	---	---	---	1	1	---	1	1	1	1	1	---	1	1	1
Total Coliform	#/100 ml	W	W	---	---	---	1	1	---	1	1	1	1	1	---	1	1	1
Fecal Coliform	#/100/ml	W	W	---	---	---	1	1	---	1	1	1	1	1	---	1	1	1
Gross Alpha	pCi/L			---	---	---	1	1	---	---	1	1	1	1	---	---	1	1
Uranium	pCi/L			---	---	---	1	1	---	---	1	1	1	1	---	---	1	1
^{226}Ra / ^{228}Ra	pCi/L	O	---	---	---	---	1	1	---	---	1	1	1	1	---	---	1	1
[1]Selected Primary and Secondary DW Parameters		A	---	4	1	1	---	---	---	---	---	---	---	---	---	---	---	---

Parameter	Units	Injection & Recovery Frequency		Cycle 2 # of Samples						Cycle 3 # of Samples					
				Injection (60 days[3] or 60 MG)		Storage (10 to 20 days)		Recovery (40 to 60 days)[3]		Injection (90 days[3] or 90 MG)		Storage (90 days)		Recovery (60 to 90 days)[3]	
		ASR	MWs	ASR*	MWs	ASR	MWs	ASR	MWs	ASR*	MWs	ASR	MWs	ASR	MWs
Arsenic	µg/L	W2	**W2**	**16**	**16**	---	**2**	**16**	**16**	**24**	**24**	---	**2**	**24**	**24**
Chloride	mg/L	W	W	8	8	---	1	8	8	12	12	---	2	12	12
Dissolved Oxygen (field)	mg/L	W	W	8	8	---	1	8	8	12	12	---	2	12	12
Iron, total	mg/L	W	W	8	8	---	1	8	8	12	12	---	2	12	12
Sodium	mg/L	W	W	8	8	---	1	8	8	12	12	---	2	12	12
pH	std. units	W	W	8	8	---	1	8	8	12	12	---	2	12	12
Specific Conductance (field)	µmhos/cm	W	W	8	8	---	1	8	8	12	12	---	2	12	12
Sulfate	mg/L	W	W	8	8	---	1	8	8	12	12	---	2	12	12
Temperature (field)	°C	W	W	8	8	---	1	8	8	12	12	---	2	12	12
Total Dissolved Solids	mg/L	W	W	8	8	---	1	8	8	12	12	---	2	12	12
Bicarbonate	mg/L	W	W	8	8	---	1	8	8	12	12	---	2	12	12
Magnesium	mg/L	W	W	8	8	---	1	8	8	12	12	---	2	12	12
Manganese	mg/L	W	W	8	8	---	1	8	8	12	12	---	2	12	12
ORP (field)	mV	W	W	8	8	---	1	8	8	12	12	---	2	12	12
Potassium	mg/L	W	W	8	8	---	1	8	8	12	12	---	2	12	12
Total Sulfides	mg/L	W	W	8	8	---	1	8	8	12	12	---	2	12	12
Total Alkalinity	mg/L	W	W	8	8	---	1	8	8	12	12	---	2	12	12
Total Trihalomethanes	ug/L	W	W	8	8	---	1	8	8	12	12	---	2	12	12
Total Coliform	#/100 ml	W	W	4	4	---	1	4	4	6	6	---	2	6	6
Fecal Coliform	#/100/ml	W	W	4	4	---	1	4	4	6	6	---	2	6	6
Gross Alpha	pCi/L			4	4	---	---	4	4	6	6	---	2	6	6
Uranium	pCi/L			4	4	---	---	4	4	6	6	---	1	6	6
^{226}Ra / ^{228}Ra	pCi/L	O	---	2	2	---	---	2	2	4	4	---	---	4	4
[1]Selected Primary and Secondary DW Parameters		A	---	---	---	---	---	---	---	---	---	---	---	---	---

MWs - Monitor Wells MW-1, MW-2
W – Weekly
W2 – Twice/week
O – Only required when gross alpha exceeds 5 pCi/L, sampled beginning and if above 5 pCi/L, at end of recovery cycle.
A – Annually

[1] Source/potable water: Sampled in accordance with the FDEP UIC Permit prior to starting cycle testing (for Primary and Secondary Drinking Water Parameters established in 62-550, Part III) & during testing for dissolved oxygen and TTHMs, excluding asbestos and dioxin, and including giardia lamblia, cryptosporidium, dissolved oxygen, E.coli, enteroccoci, and fecal and total coliform.

[2] Completed prior to any installed facility pump tests. Background sampling period to be followed by PRE-CYCLE TEST of 1 days of injection followed by 1+ days of recovery (no storage), with sampling requirements as shown.

[3] Injection periods are based on assumption that the injection and recovery rates are both one million gallons per day (MGD), such that 5 days is equivalent to 5 million gallons (MG).

* - denotes sampling of injection fluids; injected fluids will be sampled before injection and then as injection continues, as indicated above.

A reduction in ASR well injected-fluids (potable-water) sampling frequencies will be requested by the Permittee after Cycle Test #2.

Recovery periods are **estimated**, and limits will be based on actual recovered water quality and permission to end cycle from FDEP if less than the injection period (based on volume injected) and/or stated recovery period.

For the Pre-Test and Cycle 1, one sample will be collected prior to recovery, per FDEP NPDES permit, and the results will be reviewed to ensure that NPDES permit requirements are met; (these analytical results will be ordered on a rush basis, and results will be provided as quickly as the analytical lab can perform the analyses).

Storage times for Pre-Test and Cycle 1 may be modified through coordination and agreement between the City, District and FDEP, to allow for turnaround on laboratory task orders (and data review, per pending FDEP NPDES permitting requirements).

Pre-Test may, or may not include the dechlorination and /or de-oxygenation of finished source water; subsequent cycle testing use of de-oxygenation is dependent upon recovered water-quality results.

In an effort to maximize the success of large scale injection, up to ten (10) "Pre-Test" mini-cycles may be required to establish the levels of dechlorination and/or deoxygenation required for the finished source water, based on the dissipation of sodium hydrosulfide in the subsurface and the levels of hydrosulfide in the recovered water. These short cycle tests (5 to 10 total days each) will be used to help establish the relationship between the chemical treatment and dosage requirements and the observed variations in recovered water quality, and specifically in order to adjust sulfide-ion injection rates such that arsenic leaching is minimized or eliminated and recovery of excess sulfide does not occur during subsequent cycle tests. Longer cycle tests and treatment requirements using de-oxygenation will be dependent upon recovered water-quality results obtained from the pre-tests.

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: RigerK@Deland.org

In the Matter of an
Application for Permit by:

Keith D. Riger, P.E.
Public Services Director
City of Deland
336 West Michigan Avenue
Deland, FL 32720-0000
RigerK@Deland.org

Volusia County – UIC
FDEP File No. 64-0272120-001-UC
Potable Water ASR Program
Class V ASR Injection Well

NOTICE OF PERMIT ISSUANCE

Enclosed is Permit Number 64-0272120-001 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 26, 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.

Stephanie Lalonde
Clerk

3/26/2008
Date

VFG/CCF/AKD/dw
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: RigerK@Deland.org

PERMIT

PERMITTEE:
Keith D. Riger, P.E.
Public Services Director
336 West Michigan Avenue
Deland, Florida 32720-0000
RigerK@Deland.org

Volusia County – UIC
Permit File Number: 64-0272120-001-UC
Date of Issue: March 25, 2008
Expiration Date: March 24, 2013
County: Volusia
Latitude: 29° 04’ 05” N
Longitude: 81° 17’ 24” W
Deland Airport 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, 62-550 and 62-600, 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) injection well system with two storage zone monitoring wells (SZMW-1 and SZMW-2). The basic ASR well design will consist of a 17.4-inch diameter injection well (inner diameter 15 inches) to a proposed total depth of approximately 220 feet and cased to approximately 190 feet below land surface (bls). The ASR system will have a maximum storage capacity of approximately 90 MG. The overall objective of this ASR well is to store, in the Floridan aquifer, potable water from City of Deland potable water distribution system and retrieve the stored potable water for use in a priority water resource caution area. Initially, the ASR well will be cycle tested by injecting, storing and recovering potable water for a period of approximately 5 years. Provided that the testing is successful, the ASR will be put in use.

The Application to Construct V Injection well System, DEP Form 62-528.900(1), was received December 21, 2006, with supporting documents and additional information last received April 20, 2007. The location for this project is the City of Deland Municipal Airport, Pistol Range Road, Deland, Volusia County, Florida.

Subject to Specific Conditions 1-8 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 closed loop 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). 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 62-610.466, 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 Friday through Thursday and reports shall be mailed on Friday of each week. 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 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, Region 4 - Atlanta

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.

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 upper 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 700 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 on the final casing for the ASR well and the storage zone monitor wells;

    (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 (SZMW-1 and SZMW-2) located in the vicinity of well ASR-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 during recovery, the permittee shall contact the Department within 24 hours of this finding. Cycle testing shall resume under the attached Administrative Order No. AO-07-0004.

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	16" PVC / 220'	190 – 220’	Upper Floridan

* Below land surface; approximate depths.

Monitor Well System

Well Name	Casing Diameter / Depth*	Monitored Interval	Aquifer
SZMW-1	6.9" PVC / 220'	190 – 220'	Upper Floridan
SZMW-2	6.9" PVC / 220'	190 – 220'	Upper Floridan

* Below land surface; approximate depths.
(SZMW – Storage Zone Monitoring 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 SZMWs). 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 2) 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 2 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, EPA 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 26th day of March, 2008.

STATE OF FLORIDA DEPARTMENT
OF ENVIRONMENTAL PROTECTION

Vivian F. Garfein

Vivian F. Garfein
Director, Central District

VFG/CCF/dw

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.

FACT SHEET

Deland Airport Ground Water Aquifer Storage and Recovery well (ASR)
Permit No.0272120-001-UC
Latitude/Longitude: 29°04'05" North, 81°17'24" West
August 13, 2007

A construction permit is requested for a Class V Group 7 Aquifer Storage and Recovery well (ASR) and two storage zone monitor wells (SZMW-1 and SZMW-2) at the Deland Airport.

1. General Information

A. Statutory Basis for Requiring/Issuing Permit

The Department has permitting jurisdiction under Chapter 403 Florida Statues (F.S.), and 62-4 and 62-528, Florida Administrative Code (F.A.C.). The project is not exempt from permitting procedures. The Department has determined that a construction permit is required.

B. Name and Address of Applicant

Keith Riger, P.E.
Public Services Director
336 West Michigan Avenue
Deland, Florida 32720-0000

C. Description of Applicant's Proposed Operation

The City of Deland Utilities Department is requesting a permit for construction of one ASR well and two storage zone monitor wells (SZMW-1 & -2). This ASR facility is located in Volusia County on the Pistol Range Road at the Deland Municipal Airport. The target storage zone of this ASR is expected to be between approximately 190 and 220 feet below land surface (bls) in the Floridan Aquifer. Potable water from the City of Deland water distribution system will be used at this priority water resource caution area.

D. Permitting History of this Facility

This is the first FDEP UIC permit for the City of Deland.

E. Documents Used in Permitting Decision

1) Construction Permit Application, Class V Pilot Aquifer Storage and Recovery Well System, Deland Municipal Airport, SJRWMD Contract # SF408RA; prepared by Water Resource Solutions, Inc.

2) City of Deland Report: EX-1 Exploratory well, Water Resource Solutions

3) Draft Underground Injection Control (UIC) permit for the Deland Airport ASR, August 2007.

4) Responses to Request for Additional Information from Water Resource Solutions, includes responses dated:

   a. March 13 , 2007
   b. May 18, 2007.

2. Reasons Permit was Issued; Derivation of Conditions

A. Mechanical Integrity Demonstration

Not required by Chapter 62-528, F.A.C., for Class V wells.

B. Confinement (Rule 62-528.405(2), F.A.C.)

The storage zone is overlain by units consisting of shell and sands to a depth of approximately 90 feet bls. These sediments are overlain by semi-confining limestone layers which occur to the depth of the storage zone, which will extend between approximately 190’ and 220’ bls. (See Document 1, Part 1 for details).

C. Injection Zone (Rule 62-528.405(3), F.A.C.)

The storage zone at this facility is present between approximately 190-220 feet bls, in the Avon Park Limestone. This formation composes the top of the Upper Floridan aquifer, which consists of dolomite and less common limestone. The water quality of the storage zone is expected less than 1,500 mg/L total dissolved solids (TDS). See Document 1 for details.

D. Underground Source of Drinking Water (Rule 62-528.605, F.A.C.)

The Underground Source of Drinking Water (USDW), which contains water with TDS less than 10,000 mg/L, has been documented at several UIC Class I facilities in the region, and the USDW at this site is expected to extend to a depth greater than 1,400 feet bls. This project will take place entirely within the USDW.

E. Well Construction:

ASR
17.4" (15-inch inner diameter) PVC casing, set to 190' bls
Injection interval 190-220’ bls
SZMW-1 & SZMW-2
6" Schedule 40 PVC casing, set to 190' bls
Open hole from190-220’ bls
Exploratory Well SZMW-1
4" Schedule 40 PVC casing, set to 800' bls
Open hole from 800-900’ bls

F. Monitor Plan (Rule 62-528.615, F.A.C.)

The current monitoring plan includes two storage zone monitor wells, SZMW-1 and SZMW-2, designed to measure the injected water as it mixes with the native ground water, and the time period required for this mixing interface to reach the SZMWs. The mixing times are expected to be different based on the distance to the ASR well and the volume of water recharged during a given cycle test. The chemical and physical parameters to be monitored, and the monitoring schedule are included on Table 1 of the permit. The ASR well will be monitored for injection pressure, flow, and water quality of injected and recovered water.

G. Financial Responsibility

Not required by Chapter 62-528, F.A.C. for Class V wells.

H. Emergency Disposal

Not required by Chapter 62-528, F.A.C. for Class V wells.

3. Agency Action

The UIC Program staff recommends approval of the construction permit.

4. Public Rights (Rules 62-528.310, .315, and .326, F.A.C.)

The Department accepted public comment concerning this proposed permit action for a minimum of 30 days following publication of the Notice of Draft Permit. A public meeting was held in the area of the injection project no less than 30 days after publication of this Notice for the purpose of receiving verbal and written comment concerning this project. Comments received within the 30-day period and during the public meeting were considered by the Department in formulating a final decision concerning this project. The public meeting was held at City of Deland City Hall, 120 South Florida Avenue, Deland, Florida on December 18, 2007 at 5:30 PM.

After the conclusion of the public comment period and public meeting described above the Department considered all comments received during the public comment period in making a final decision concerning this permit action. When the Department has made a decision concerning the permit modification, the applicant will publish notice of the proposed agency action. A person whose substantial interests are affected by the Department's proposed permitting decision may petition for an administrative proceeding (hearing). Accordingly, the Department's final action may be different from the position taken by it in the Notice. Persons whose substantial interests will be affected by any decision of the Department with regard to the application have the right to petition to become a party to the proceeding. The petition must conform to the requirements specified in the Notice and be filed (received) within 14 days of publication of this Notice in the Office of General Counsel at the address of the Department. Failure to petition within the allowed time frame constitutes a waiver of any right such person has to request a hearing under Section l20.57, F.S., and to participate as a party to this proceeding. Any subsequent intervention will only be at the approval of the presiding officer upon motion filed pursuant to Rule 28-5.207, Florida Administrative Code.

The application and draft permit 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 Office, 3319 Maguire Boulevard, Suite 232, Orlando, Florida 32803-3767. Please contact Duane Watroba at (407) 894-7555 for additional information concerning this project.

5. Agency Contact

Duane Watroba, Technical Advisory Committee
Florida Department of Environmental Protection
3319 Maguire Boulevard, Suite 232
Orlando, Florida 32803-3767
(407) 894-7555

TAC LIST

Duane Watroba
Department of Environmental Protection
3319 Maguire Boulevard
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Email – duane.watroba@dep.state.fl.us

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David King
SJRWMD Palm Bay Service Center
525 Community College Parkway, SE
Palm Bay, FL 32909
Email – dking@sjrwmd.com

EPA Contact
Nancy Marsh
UIC
EPA Region 4
Atlanta Federal Center
61 Forsyth Street
Atlanta, Georgia 30303-8960

Table 1. Proposed Monitoring Schedule for City of DeLand ASR System

		Injection & Recovery Frequency		Pre-Cycle Testing # of Samples			Pre-Test # of Samples						Cycle 1 # of Samples						Cycle 2					
				365 days	Background Sampling[2]		Injection (10 days)		Storage (0 days)		Recovery (7-10 days)		Injection (10 days)		Storage (5 days)		Recovery (5-10 days)		Injection (20 days)		Storage (14 days)		Recovery (5-20 days)	
Parameter	Units	ASR	MWs	Source Water[1]	ASR	MWs	ASR	MWs	ASR	MWs	ASR	MWs	ASR	MWs	ASR	MWs	ASR	MWs	ASR	MWs	ASR	MWs	ASR	MWs
Arsenic	μg/L	W2	**W2**	---	---	---	---	**3**	1	**1**	3	**3**	---	**3**	1	**1**	3	**3**	---	**6**	**2**	**2**	**3**	**3**
Chloride	mg/L	W	W	---	---	---	---	1	1	1	1	1	---	1	1	1	1	1	---	2	1	1	1	2
Dissolved Oxygen (field)	mg/L	W	W	---	---	---	1*	1	1	1	1	1	1*	1	1	1	1	1	1*	2	1	1	1	2
Iron, total	mg/L	W	W	---	---	---	---	1	1	1	1	1	---	1	1	1	1	1	---	2	1	1	1	2
Sodium	mg/L	W	W	---	---	---	---	1	1	1	1	1	---	1	1	1	1	1	---	2	1	1	1	2
pH	std. units	W	W	---	---	---	---	1	1	1	1	1	---	1	1	1	1	1	---	2	1	1	1	2
Specific Conductance (field)	μmhos/cm	W	W	---	---	---	---	1	1	1	1	1	---	1	1	1	1	1	---	2	1	1	1	2
Sulfate	mg/L	W	W	---	---	---	---	1	1	1	1	1	---	1	1	1	1	1	---	2	1	1	1	2
Temperature (field)	°C	W	W	---	---	---	---	1	1	1	1	1	---	1	1	1	1	1	---	2	1	1	1	2
Total Dissolved Solids	mg/L	W	W	---	---	---	---	1	1	1	1	1	---	1	1	1	1	1	---	2	1	1	1	2
Bicarbonate	mg/L	W		---	---	---	---	---	1	1	1	1	---	---	1	1	1	1	---	2	1	1	1	2
Magnesium	mg/L	W		---	---	---	---	---	1	1	1	1	---	---	1	1	1	1	---	2	1	1	1	2
Manganese	mg/L	W		---	---	---	---	---	1	1	1	1	---	---	1	1	1	1	---	2	1	1	1	2
ORP (field)	mV	W		---	---	---	---	---	1	1	1	1	---	---	1	1	1	1	---	2	1	1	1	2
Potassium	mg/L	W		---	---	---	---	---	1	1	1	1	---	---	1	1	1	1	---	2	1	1	1	2
Total Alkalinity	mg/L	W		---	---	---	---	---	1	1	1	1	---	---	1	1	1	1	---	2	1	1	1	2
Total Trihalomethanes	ug/L	W		---	---	---	1*	---	1	1	1	1	1*	---	1	1	1	1	1*	2	1	1	1	2
Total Coliform	#/100 ml	W		---	---	---	---	---	1	1	1	1	---	---	1	1	1	1	---	2	1	1	1	2
Fecal Coliform	#/100/ml	W		---	---	---	---	---	1	1	1	1	---	---	1	1	1	1	---	2	1	1	1	2
Gross Alpha	pCi/L			---	---	---	---	---	---	---	1	1	---	---	---	---	1	1	---	2	---	---	1	2
Uranium	pCi/L			---	---	---	---	---	---	---	1	1	---	---	---	---	1	1	---	2	---	---	1	2
^{226}Ra / ^{228}Ra	pCi/L	O	---	---	---	---	---	---	---	---	2	---	---	---	---	---	2	---	---	---	---	---	2	---
[1]Selected Primary and Secondary DW Parameters		A	---	2	1	1	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

		Injection & Recovery Frequency		Cycle 3 # of Samples						Cycle 4 # of Samples					
				Injection (30 days)		Storage (20 days)		Recovery (20-30 days)		Injection (90 days)		Storage (30 days)		Recovery (45-90 days)	
Parameter	Units	ASR	MWs	ASR	MWs	ASR	MWs	ASR	MWs	ASR	MWs	ASR	MWs	ASR	MWs
Arsenic	μg/L	W2	**W2**	---	**8**	2	**2**	6	**6**	---	**24**	2	**2**	12	**12**
Chloride	mg/L	W	W	---	2	2	2	2	2	---	12	2	2	6	6
Dissolved Oxygen (field)	mg/L	W	W	2*	2	2	2	2	2	12*	12	2	2	6	6
Iron, total	mg/L	W	W	---	2	2	2	2	2	---	12	2	2	6	6
Sodium	mg/L	W	W	---	2	2	2	2	2	---	12	2	2	6	6
pH	std. units	W	W	---	2	2	2	2	2	---	12	2	2	6	6
Specific Conductance (field)	μmhos/cm	W	W	---	2	2	2	2	2	---	12	2	2	6	6
Sulfate	mg/L	W	W	---	2	2	2	2	2	---	12	2	2	6	6
Temperature (field)	°C	W	W	---	2	2	2	2	2	---	12	2	2	6	6
Total Dissolved Solids	mg/L	W	W	---	2	2	2	2	2	---	12	2	2	6	6
Bicarbonate	mg/L	W		---	2	2	2	2	2	---	12	2	2	6	6
Magnesium	mg/L	W		---	2	2	2	2	2	---	12	2	2	6	6
Manganese	mg/L	W		---	2	2	2	2	2	---	12	2	2	6	6
ORP (field)	mV	W		---	2	2	2	2	2	---	12	2	2	6	6
Potassium	mg/L	W		---	2	2	2	2	2	---	12	2	2	6	6
Total Alkalinity	mg/L	W		---	2	2	2	2	2	---	12	2	2	6	6
Total Trihalomethanes	ug/L	W		2*	2	2	2	2	2	12*	12	2	2	6	6
Total Coliform	#/100 ml	W		---	2	2	2	2	2	---	12	2	2	6	6
Fecal Coliform	#/100/ml	W		---	2	2	2	2	2	---	12	2	2	6	6
Gross Alpha	pCi/L			---	2	2	2	2	2	---	12	2	2	6	6
Uranium	pCi/L			---	1	1	1	1	1	---	12	1	1	6	6
^{226}Ra / ^{228}Ra	pCi/L	O	---	---	---	---	---	2	---	---	---	---	---	2	---
[1]Selected Primary and Secondary DW Parameters		A	---	---	---	---	---	---	---	---	---	---	---	1	1

MWs - Monitor Wells MW-1, MW-2
W – Weekly
W2 – Twice/week
O – Only required when gross alpha exceeds 5 pCi/L, sampled beginning and end of recovery cycle.
A – Annually

[1] Source/potable water: Sampled in accordance with the FDEP UIC Permit prior to starting cycle testing (for Primary and Secondary Drinking Water Parameters established in 62-550, Part III) & during testing for dissolved oxygen and TTHMs. excluding asbestos and dioxin, and including giardia lamblia, cryptosporidium, dissolved oxygen, E.coli, enteroccoci, and fecal and total coliform.

[2] Completed prior to any pump tests.

[2] Background sampling period to be followed by PRE-CYCLE TEST of 10 days of injection followed by 10 days of recovery (no storage), with sampling per "Cycle 1" requirements.

* - denotes sampling of injection fluids.

Recovery periods are **estimated**, and limits will be based on actual recovered water quality and permission to end cycle from FDEP if less than the injection period (based on volume injected) and/or stated recovery period.

In the event that the "Cycle 2" recovery period extends for more than 14 days, a minimum of three (3) samples will be collected from the Aquifer Storage Zone Monitor Wells.

For the Pre-Test and Cycle 1, one sample will be collected prior to recovery, per FDEP NPDES permit, and the results will be reviewed to ensure that NPDES permit requirements are met (these analytical results will be ordered on a rush basis, and results will be provided as quickly as the analytical lab can perform the analyses).

Storage times for the Pre-test and Cycle 1 may be modified slightly to allow for turnaround time on analytical laboratory task orders (and data review, per pending FDEP NPDES permitting requirements).

Appendix E

Aquifer Performance Test (APT) Results

Appendix E

Aquifer Performance Test (APT) Results

Technical Memorandum (Draft), City of DeLand Airport ASR Test Well, Aquifer Performance Test, St. Johns River Water Management District ASR Demonstration Project, January 2009.

DRAFT

TECHNICAL MEMORANDUM

CITY OF DELAND AIRPORT ASR TEST WELL AQUIFER PREFORMANCE TEST ST. JOHNS RIVER WATER MANAGEMENT DISTRICT ASR DEMONSTRATION PROJECT

Prepared for:

ST. JOHNS RIVER WATER MANAGEMENT DISTRICT

Prepared by:

Entrix Water Solutions
January 2009

Rahul John
Hydrogeologist

Lloyd E. Horvath, P.E.
Technical Director

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1.0 INTRODUCTION

This report presents the procedures and results of two aquifer performance tests (APTs) conducted in the City of DeLand, Volusia County, Florida. The project site is located north of the intersection of Pistol Range Road and Industrial Drive in Section 34, Township 16 South and Range 30 East. The regional location of the project site is provided on Figure 1.

There are two main objectives to this study. The first objective is to determine the hydraulic coefficients of the upper part of the Upper Floridan Aquifer (UFA) in the area of the project site, in order to understand the aquifer storage and recovery (ASR) potential of this zone and the second objective is to determine if the UFA is hydraulically connected to the Surficial and/or Intermediate aquifers. The hydraulic coefficients of the aquifer were determined by performing two APTs (herein referred to as APT 1 and APT 2). APT 1 was a 72-hour constant discharge drawdown test. APT 2 was a shorter duration test performed for confirmation of drawdown curves, especially the early portion of the APT. Water levels in the Surficial and Intermediate aquifers were monitored during the APTs to determine if the UFA in the area of the project site is hydraulically connected to these aquifers.

The well network designed for the APT consists of three wells completed in the upper portion of the UFA. The APT layout is shown on Figure 2. The locations of Surficial and Intermediate aquifer monitoring wells are also shown on Figure 2. Summary of construction and location details of the wells are provided in Tables 1 and 2.

2.0 AQUIFER PERFORMANCE TESTS: ANALYSES AND RESULTS

2.1 APT CONFIGURATION

A 72-hour constant rate aquifer performance test (APT 1) and a two-hour constant rate aquifer performance test (APT 2) were conducted during this investigation. The potentiometric changes in the pumping well (designated as PW-1) and the two observation wells (designated as MW-1 and MW-2) were measured using “vented” pressure transducers (trolls) before, during and after the tests. Vented transducers compensate for the influences of barometric or atmospheric pressure at the point of measurement and, therefore, measure the “pressure-corrected” height of the water column. The pressure transducers used in this project were manufactured by In-Situ Inc.

APT 1 was initiated at 1:15 p.m. on December 2, 2008 and terminated at 1:20 p.m. on December 5, 2008. APT 2 was conducted between 12.00 p.m. and 2:00 pm on December 16, 2008. The tests were accomplished by pumping PW-1 using a vertical turbine pump at a constant rate of 745 gpm for APT 1 and 775 gpm for APT 2. Water pumped from PW-1 was discharged away from the APT “area of influence” to allow for an accurate assessment of impacts on the Surficial aquifer (without artificial recharge) during pumping. Discharge rates were measured using a calibrated in-line flow meter. The pump operated continuously throughout the test with no difficulties.

ENTRIX also collected background water level data in the three wells (PW-1, MW-1 and MW-2) that tapped the upper portion of the UFA. A pressure transducer was installed in Well PW-1 on November 26, 2008. Pressure transducers were installed in wells MW-1 and MW-2 on November 25 and November 24 of 2008, respectively. The background water levels were recorded at 15-minute intervals for MW-1 and 10 minute intervals for PW-1 and MW-2. Water level data were downloaded and reviewed by ENTRIX personnel during the APTs. Water level data collection in the Intermediate and Surficial aquifers are described in Section 3.0.

2.2 METHODOLOGY

The data that were utilized in this study to estimate the aquifer hydraulic coefficients are measured water level changes (or drawdown) as observed in wells MW-1 and MW-2 during the pumping of well PW-1 and recovery water level data in PW-1.

The transmissivity, storage, and leakance values of the upper portion of the UFA were calculated using the Hantush-Jacob Type Curve Solution (1955) and the Horner Method (1966) for the analysis of recovery. The Hantush-Jacob Type Curve Solution utilizes drawdown data in observation wells during pumping and the Horner method utilizes recovery water level data.

2.3 RESULTS

The summary of results generated using the two aforementioned methods are tabulated in Table 3 and graphically presented on Figures 3 to 7.

Data presented in Figures 3 to 6 suggest that the drawdown observed during the first two hours of the tests is a reflection of partial penetration effects induced by the pumping well PW-1. This is indicated by the relatively high leakance coefficient (and low transmissivity) calculated based on the first two hours of drawdown data (APT 2). Because the automated computer curve matching performed on APT 1 data was heavily weighed on late drawdown data, the partial penetration effects are less significant for APT 1.

Results from the APT 1 analysis indicate that the average transmissivity of the aquifer is about 36,000 gpd/ft (4,600 ft^2/d); the average storage of the aquifer is about 3.55 E-6, and the average leakance of the aquifer is about 9.33 E-7 day^{-1}.

Results from the APT 2 analysis indicate that the average transmissivity of the aquifer is about 17,000 gpd/ft (2,300 ft^2/d); the average storage of the aquifer is about 1.86 E-5, and the average leakance of the aquifer is about 3.42 E-4 day^{-1}.

Test results at the project site suggest that under long term pumping conditions, the late data transmissivity value of about 4,600 ft^2/d will govern potentiometric head response, and a leakance coefficient of 9.33 E-7 day^{-1} will govern leakage from above into the zone tested within the UFA. A storage value of 3.55 E-6 is considered the most reasonable value for the project site. Note that the leakance coefficient calculated using the short-term APT (APT 2) represents leakage from lower portions of the Floridan Aquifer System due to partial penetration of the wells while the leakance coefficient calculated using this long-term APT (APT 1) represents leakage from the Intermediate aquifer system.

The electronic version of water level data recorded for the APTs is provided in the attached CD (Exhibit A).

3.0 LEAKANCE INTO THE FLORIDAN AQUIFER SYSTEM FROM SHALLOWER AQUIFERS.

One of the objectives of this study is to determine the degree of hydraulic connectivity between the Upper Floridan Aquifer and the shallower aquifers (Intermediate and Surficial aquifers). Water levels were measured in 2 monitoring wells, one well tapping the Intermediate aquifer (designated as V-1154) and one well tapping the Surficial aquifer (designated as V-1155). Refer to Figure 2 for locations of the monitoring sites and Table 1 for construction details.

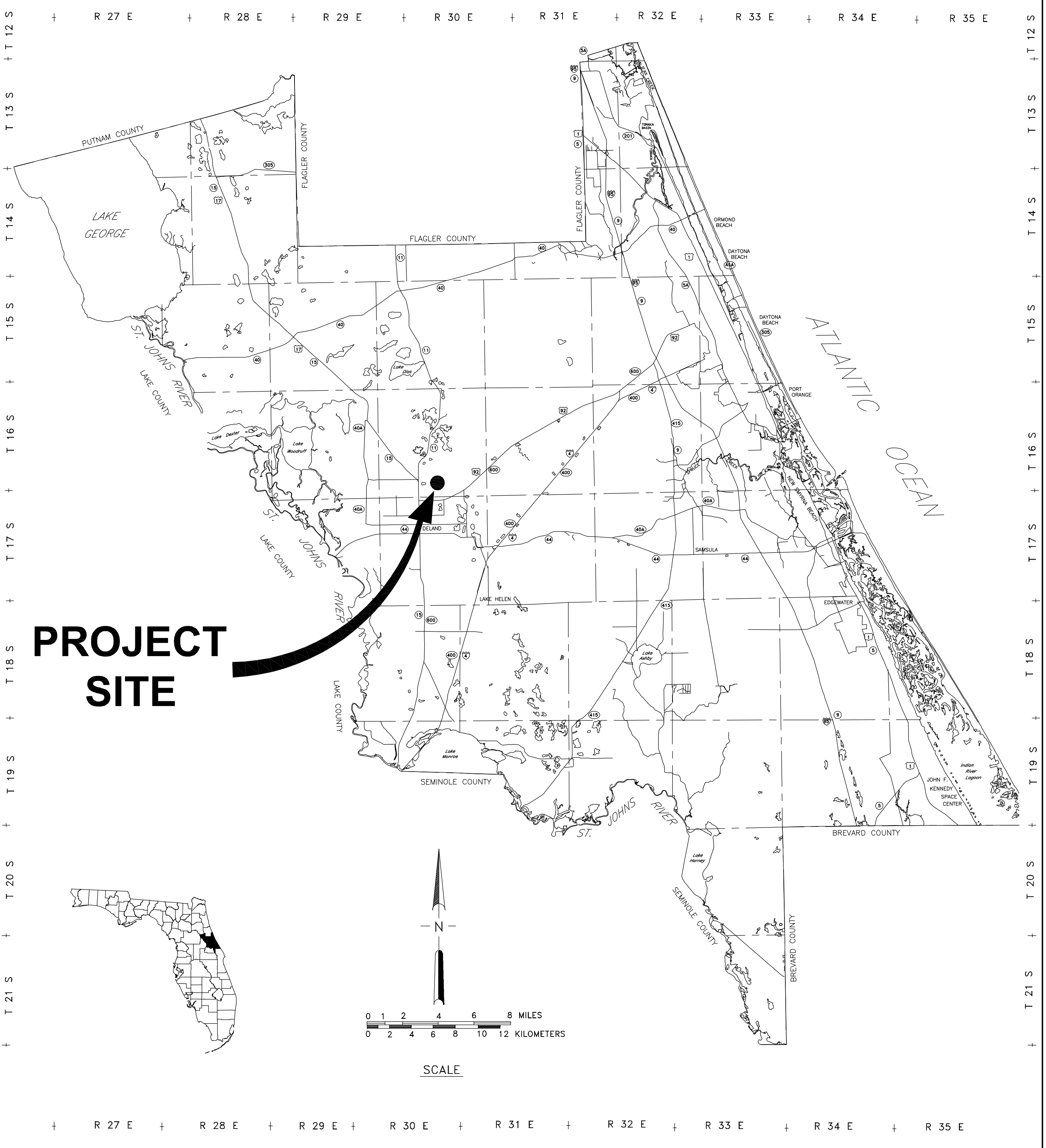
Figure 8 shows the hydrographs of all monitoring wells before, during and after APT 1. Monitoring well V-1154, which taps the Intermediate aquifer showed a quick rise in water level of about 0.3 feet (when the pump in PW-1 was turned on) and a steady decline of about 2.3 feet during APT 1. The sudden rise may be attributed to the “Noordbergum” effect, caused due to transfer of horizontal strain of aquifer(s) to less permeable layers via shear. The steady decline observed in the Intermediate aquifer during APT 1 suggests that the unit that separates the Upper Floridan Aquifer and the Intermediate Aquifer system is semi-confined or leaky. It is relevant to note that the “drawdown” observed in the Intermediate aquifer is about 2.3 feet compared to about 70 feet of drawdown observed in pumping well PW-1 which taps the upper portion of the UFA. This suggests that the hydraulic connection between the UFA and the Intermediate Aquifer is relatively minimal. The water level observed in well V-1155 which taps the Surficial aquifer did not show any measurable drawdown during the test. The water level fluctuations observed in this well suggest that the Surficial aquifer acts independently from the Upper Floridan Aquifer. This is also supported by the fact that the water level in the Surficial aquifer is consistently more than 30 feet higher than that of the UFA.

4.0 SUMMARY AND CONCLUSIONS

In summary, analysis of the data collected during this investigation yield the following conclusions:

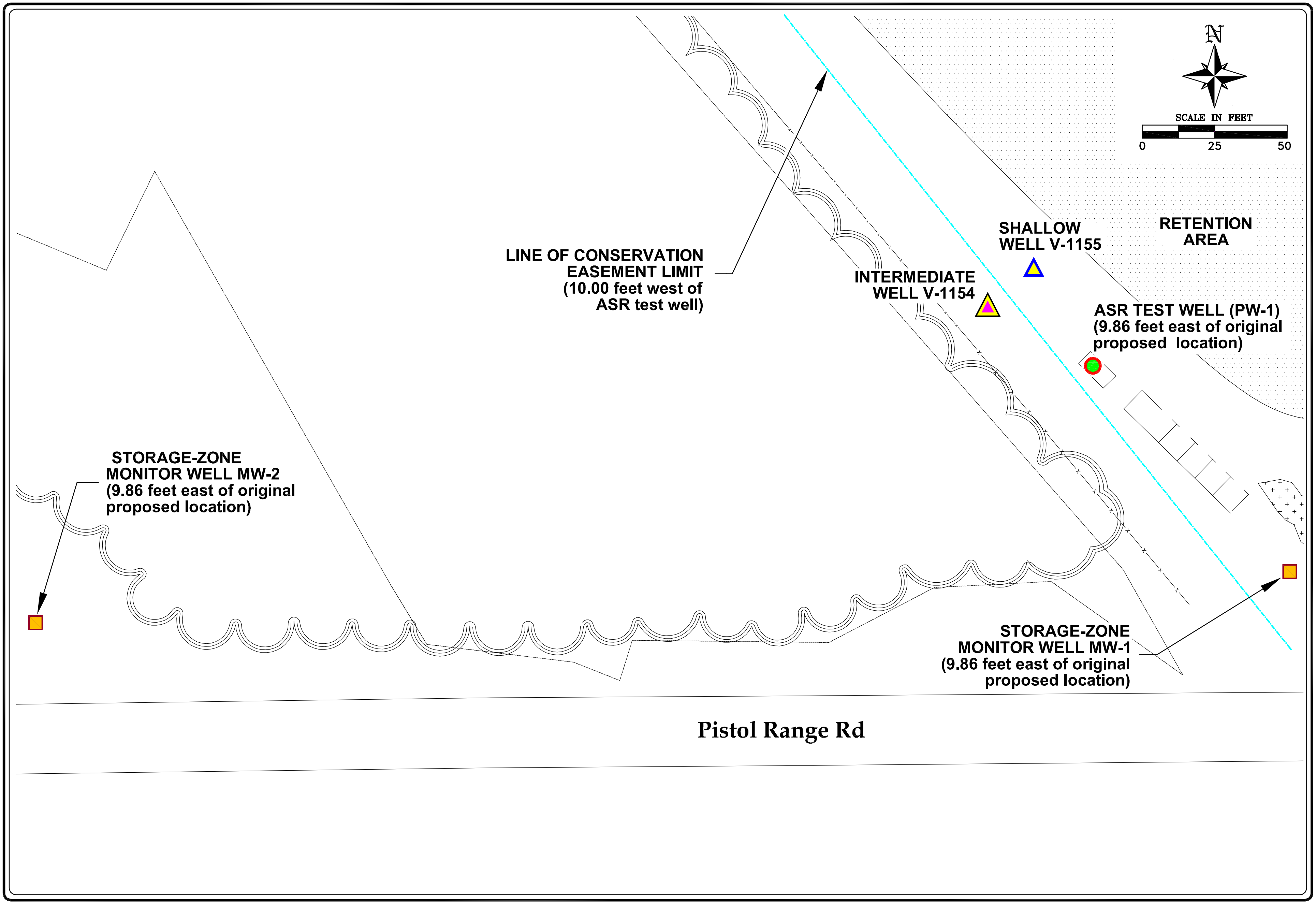
- The APT data was used to estimate the transmissivity, storage and leakance coefficients of the aquifer using the Hantush-Jacob Type Curve Solution (1955) and the Horner Method. Results from the late drawdown data indicate that the transmissivity of the aquifer is about 4,600 ft^2/d; the storage of the aquifer is about 3.55 E-6; and the leakance is approximately 9.33 E-7 day^{-1}. Results from the early drawdown data indicate that the transmissivity of the aquifer is about 2300 ft^2/d; the storage of the aquifer is about 1.86 E-5; and the leakance is approximately 3.42 E-4 day^{-1}. Under normal and long term pumping conditions the hydraulic coefficients derived using the later drawdown data (APT 1) are more representative of the aquifer system.

- In order to test for the presence of a hydraulic connection between the Upper Floridan Aquifer and the shallower aquifers, these aquifers were monitored during APT 1. Data gathered during the tests indicate that the water level in the Surficial aquifer is not impacted by the Upper Floridan Aquifer pumpage. Data also indicate a minor hydraulic connection between the Intermediate Aquifer and the Upper Floridan Aquifer.



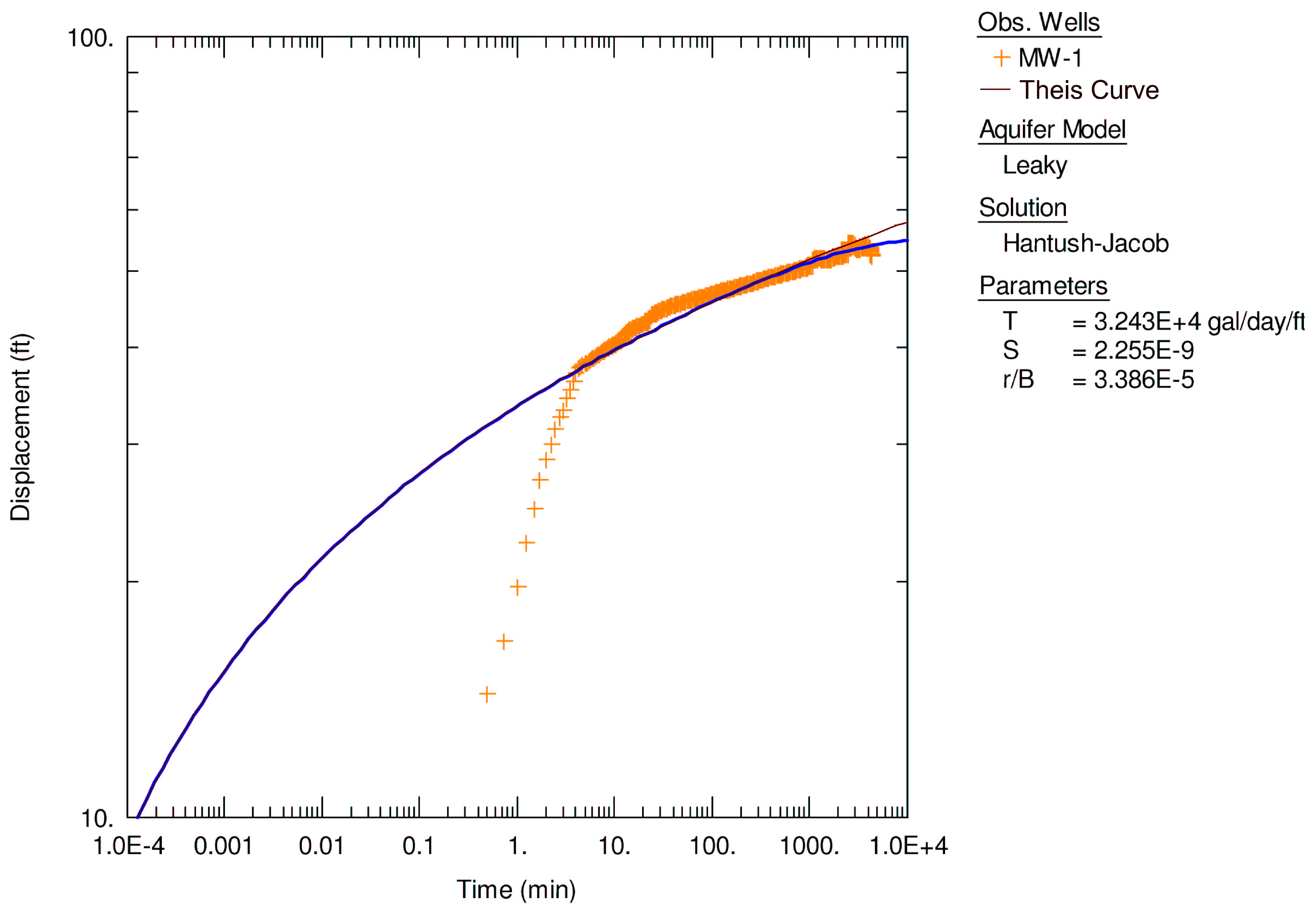
ENTRIX WATER SOLUTIONS	PROJECT NAME: DELAND ASR DESIGN	DWG. NUMBER: 1143713mw1
	PROJECT NUMBER: 1143713	DATE: 01/05/09

FIGURE 1. REGIONAL LOCATION MAP.



ENTRIX WATER SOLUTIONS	PROJECT NAME: DELAND ASR DESIGN	DWG. NUMBER: 1143713mw1
	PROJECT NUMBER: 1143713	DATE: 01/05/09

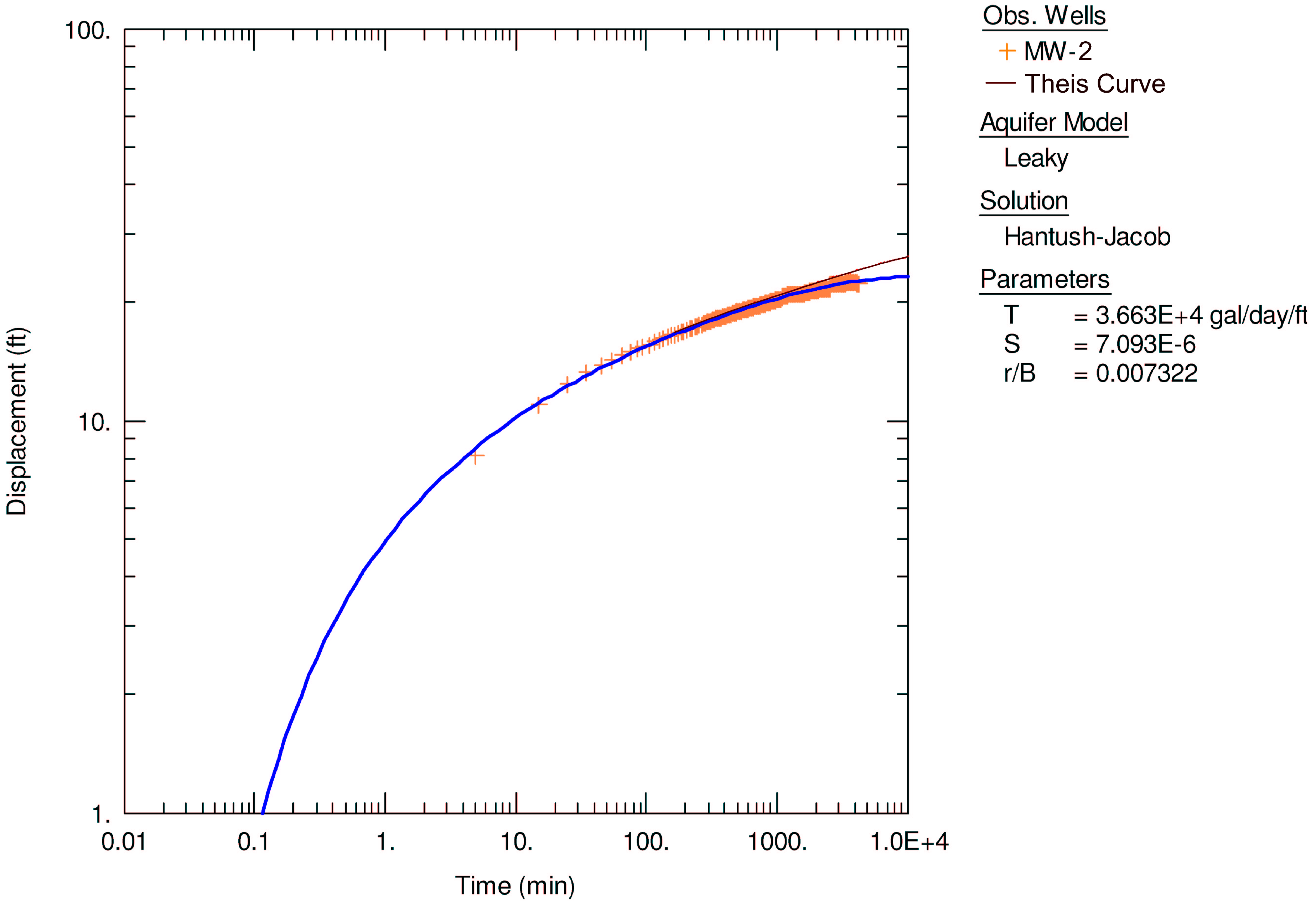
FIGURE 2. MAP SHOWING APT LAYOUT.



ENTRIX WATER SOLUTIONS

PROJECT NAME: DELAND ASR DESIGN
PROJECT NUMBER: 1143713
DWG. NUMBER: 1143712tt1
DATE: 01/05/09

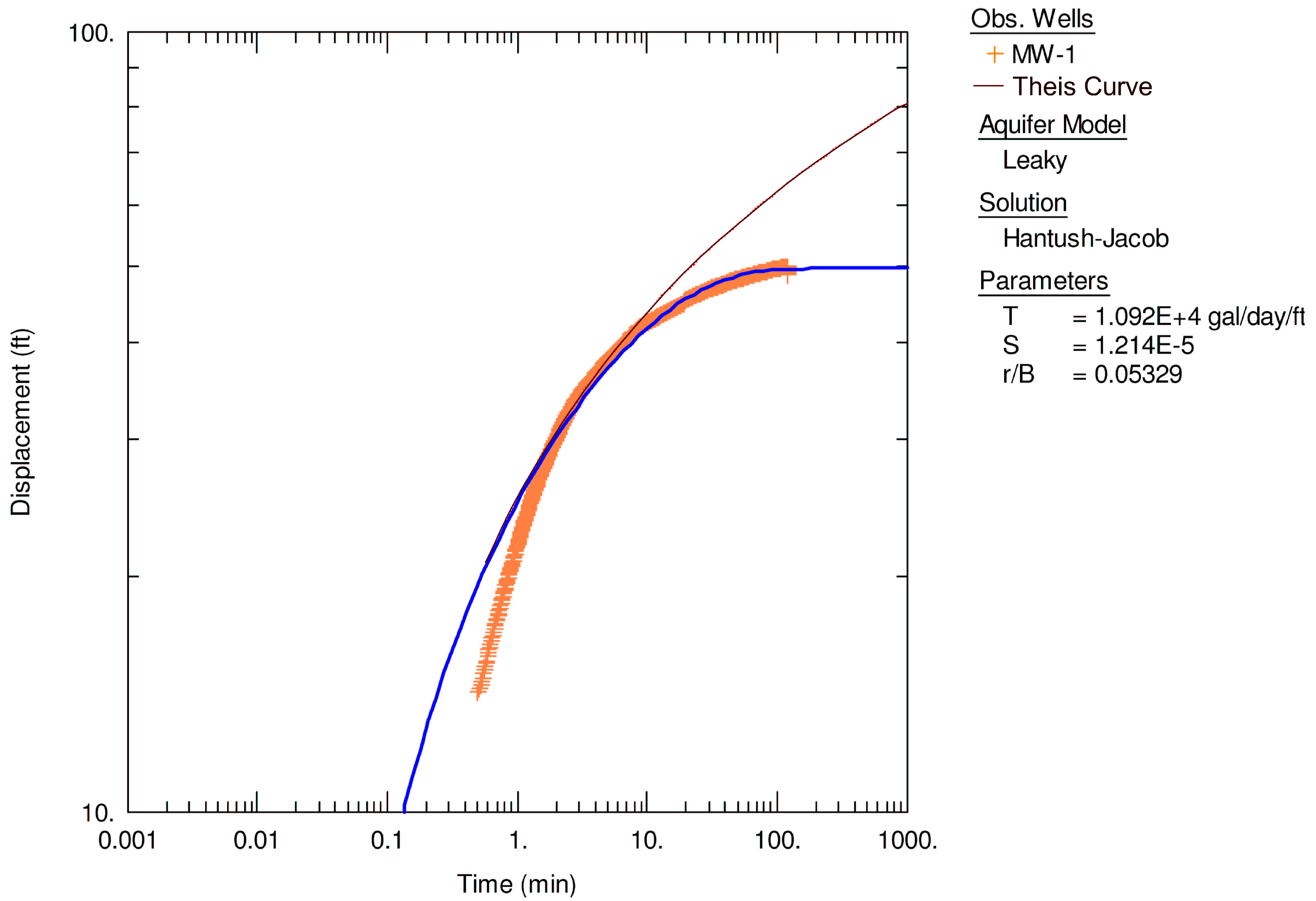
FIGURE 3. CURVE MATCHING RESULTS BASED ON DRAWDOWN OBSERVED AT MONITORING WELL MW−1 DURING APT 1.



ENTRIX WATER SOLUTIONS

PROJECT NAME: DELAND ASR DESIGN
PROJECT NUMBER: 1143713
DWG. NUMBER: 1143712#1
DATE: 01/05/09

FIGURE 4. CURVE MATCHING RESULTS BASED ON DRAWDOWN OBSERVED AT MONITORING WELL MW–2 DURING APT 1.

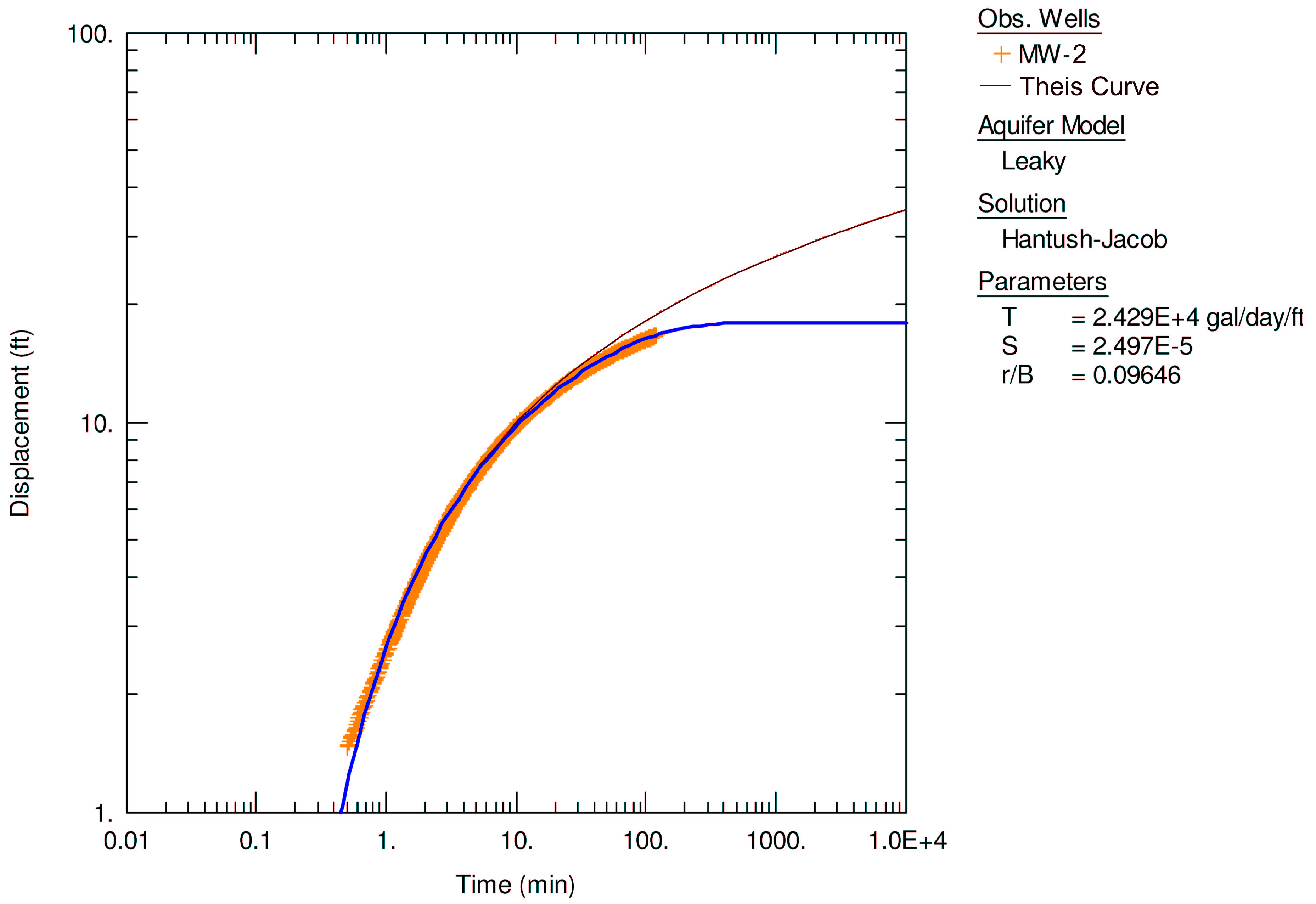


ENTRIX WATER SOLUTIONS

PROJECT NAME: DELAND ASR DESIGN
PROJECT NUMBER: 1143713

DWG. NUMBER: 1143712tt1
DATE: 01/05/09

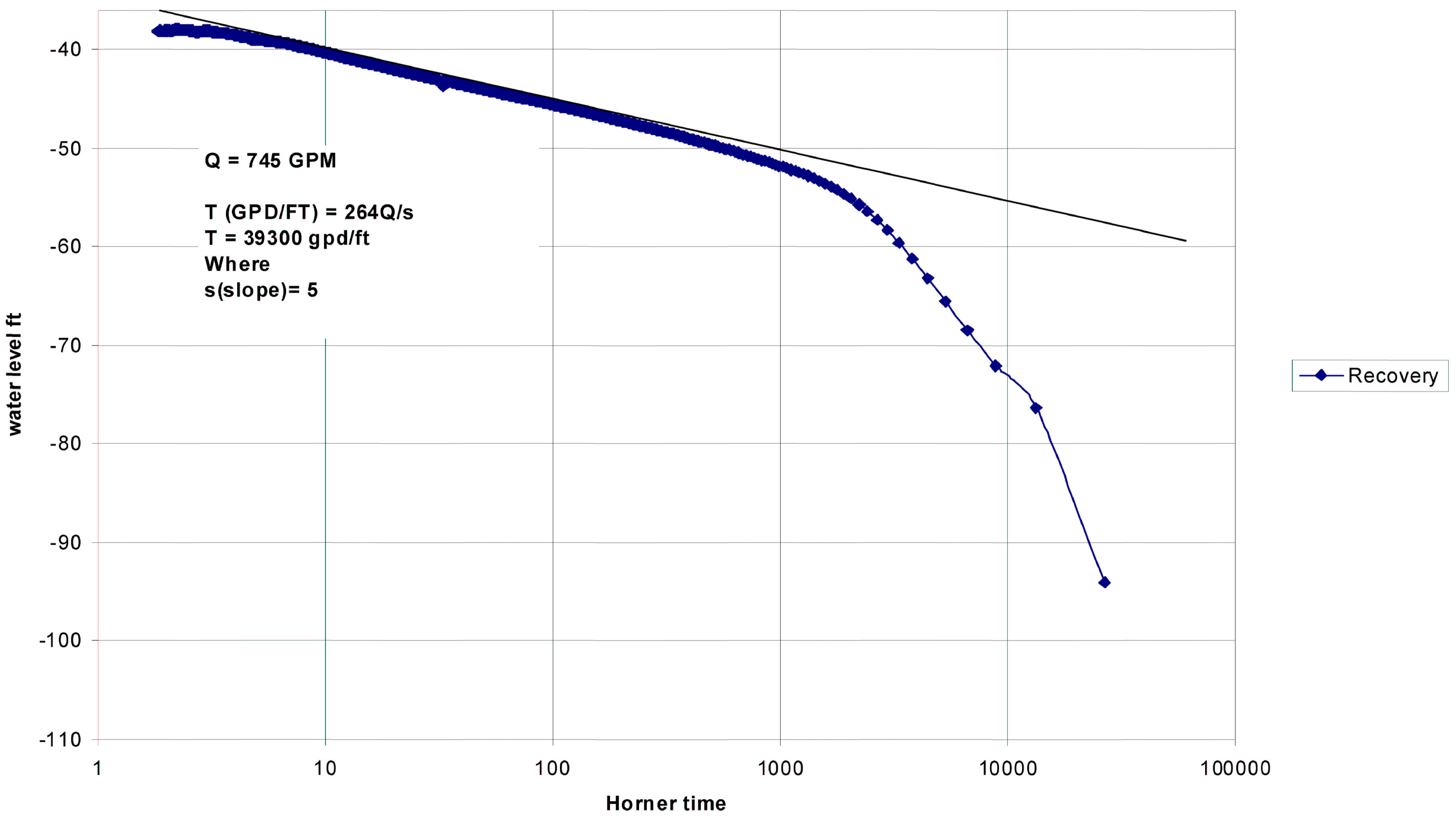
FIGURE 5. CURVE MATCHING RESULTS BASED ON DRAWDOWN OBSERVED AT MONITORING WELL MW–1 DURING APT 2.



ENTRIX WATER SOLUTIONS

PROJECT NAME: DELAND ASR DESIGN
PROJECT NUMBER: 1143713
DWG. NUMBER: 1143712tt1
DATE: 01/05/09

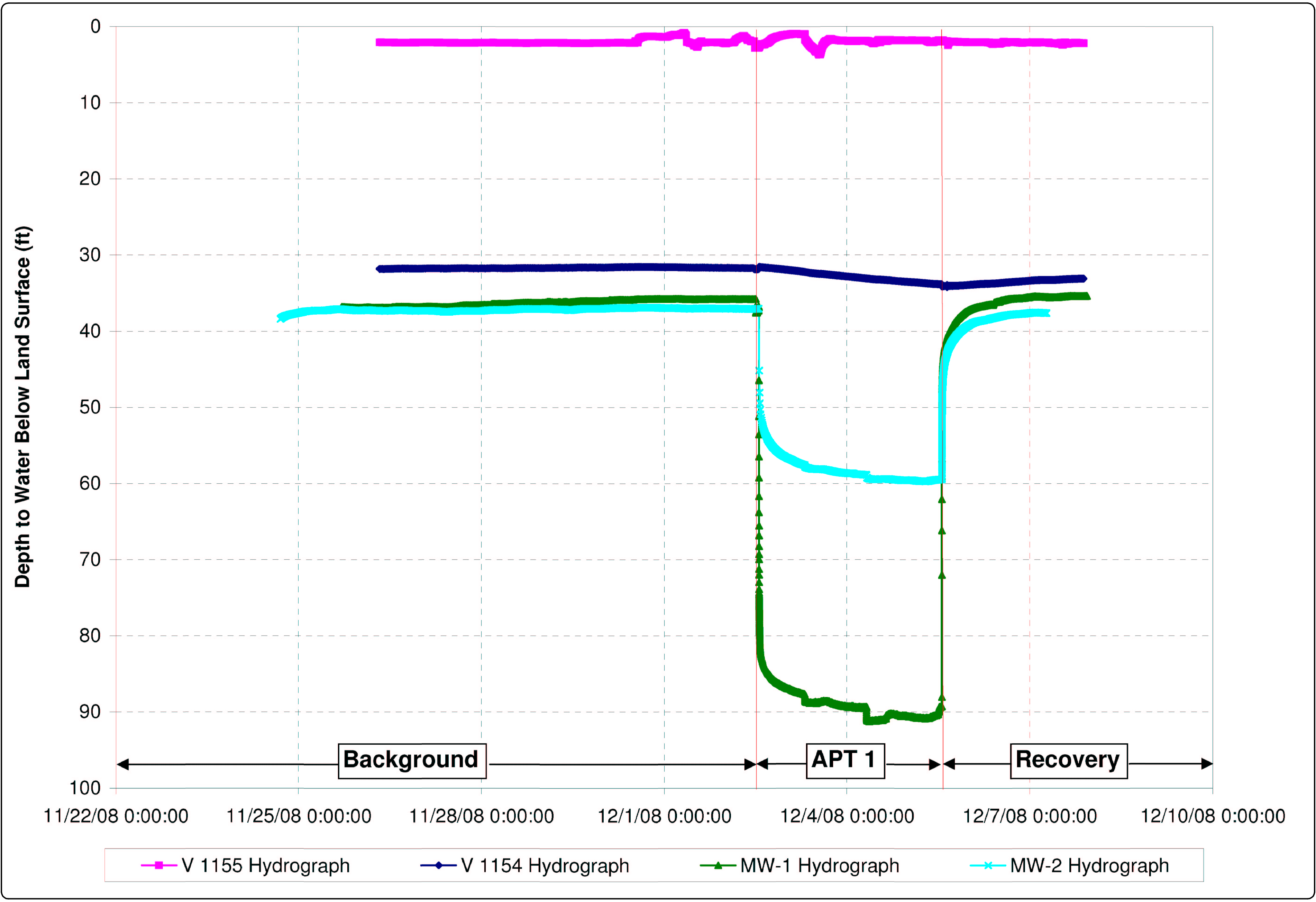
FIGURE 6. CURVE MATCHING RESULTS BASED ON DRAWDOWN OBSERVED AT MONITORING WELL MW–2 DURING APT 2.



ENTRIX WATER SOLUTIONS

PROJECT NAME: DELAND ASR DESIGN
PROJECT NUMBER: 1143713
DWG. NUMBER: 1143712tt1
DATE: 01/05/09

FIGURE 7. PLOT OF WATER LEVEL DURING RECOVERY (FOR PW–1) VERSUS REDUCED TIME.



ENTRIX
WATER SOLUTIONS

PROJECT NAME: DELAND ASR DESIGN
PROJECT NUMBER: 1143713

DWG. NUMBER: 1143712tt1
DATE: 01/05/09

FIGURE 8. HYDROGRAPHS OF MONITORING WELLS BEFORE, DURING AND AFTER APT 1.

Table 1. Well Construction Details, DeLand Airport ASR Test Well Program

Well Designation	Casing Depth (feet bls)	Total Depth (feet bls)	Approximate Distance from Pumping Well PW-1 (feet)	Aquifer
PW-1 (ASR Test Well)	190	224.5	NA	Upper Floridan
MW-1	190	224.5	94	Upper Floridan
MW-2	189	224.5	375	Upper Floridan
V-1154	61	66	39	Intermediate
V-1155	11	26	40	Surficial

Table 2. Summary of Revisions to Latitude & Longitude for DeLand Airport ASR Well Locations, DeLand ASR Test Well Program

Well Designations	Lat. / Long. Original ALP Map	True Lat. / Long. from Original ALP Plots (Surveyor Points)	Offset Lat. / Long. Relocates using 9.86-foot East Offsets
PW-1 (ASR Test Well)	29^{0} 04’ 6.09” 81^{0} 17’ 22.62”	29^{0} 04’ 5.8” 81^{0} 17’ 22.4”	29^{0} 04’ 5.9” 81^{0} 17’ 22.3”
MW-1 (SE)	29^{0} 04’ 5.23” 81^{0} 17’ 21.51”	29^{0} 04’ 5.3” 81^{0} 17’ 21.7”	29^{0} 04’ 5.3” 81^{0} 17’ 21.6”
MW-2 (West)	29^{0} 04’ 4.76” 81^{0} 17’ 26.23”	29^{0} 04’ 5.3” 81^{0} 17’ 26.6”	29^{0} 04’ 5.2” 81^{0} 17’ 26.4”

Table 3. Summary of APT Analysis Results, DeLand Airport ASR Test Well Program

	Hantush and Jacob Method (1955)				Horner Method (1966)		
	APT-1		**APT-2**		**APT-1**	**Average**	
	MW-1	**MW-2**	**MW-1**	**MW-2**	**PW-1**	**APT1**	**APT 2***
Transmissivity (ft^2/d)	4,336	4,897	1,460	3,247	4,829	4,687	2,354
Storage	2.26E-09	7.09E-06	1.21E-05	2.50E-05		3.55E-06	1.86E-05
Leakance (day $^{-1}$)	5.64E-10	1.87E-06	4.69E-04	2.15E-04		9.33E-07	3.42E-04

* APT-2 shows influence of partial penetration. Leakance computed by APT-2 is influenced by zones below the production zone of the pumped well.

Appendix F

Historical Documents

Appendix F

Historical Documents

FY 2002 – FY 2011

ENTRIX Contract No. SF408RA