ENGINEERING REPORT for the

CONSTRUCTION AND TESTING
of the
CITY OF ST. CLOUD
SOUTHSIDE WASTEWATER TREATMENT FACILITY
CLASS V INJECTION WELL SYSTEM

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION
CLASS V GROUP 9 EXPLORATORY WELL
PERMIT No. 0327299-001-UC5X

PREPARED FOR

CITY OF ST. CLOUD UTILITIES

PREPARED BY

ASR US, LLC

In Association With

JONES EDMUNDS

TAMPA, FL

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List of Acronyms and Abbreviations

AADF	Annual Average Daily Flow
ADF	Average Daily Flow
APPZ	Avon Park Permeable Zone
ASR	Aquifer Storage And Recovery
BCS	Borehole Compensated Sonic
bls	Below Land Surface
CY	Cubic Yards
DIL	Dual Induction Log
DWS	Drinking Water Standards
^{o}F	Degrees Fahrenheit
FAC	Florida Administrative Code
FAS	Floridan Aquifer System
FDEP	Florida Department of Environmental Protection
FGS	Florida Geological Survey
FDD	Florida Design Drilling
ft	Feet
API	American Petroleum Institute
gpm	Gallons Per Minute
gpm/ft	Gallons per minute per foot of drawdown (or rise)
HDPE	High-density polyethylene
ICU	Intermediate Confining Unit
ID	Inside Diameter
ID	Identification
LFA	Lower Floridan Aquifer
MCI	Middle Confining Unit I
MCII	Middle Confining Unit II
MCL	Maximum Contaminant Level
MG	Million Gallons
mg/L	Milligrams Per Liter
MGD	Million Gallons Per Day
NGVD	National Geodetic Vertical Datum of 1929

List of Acronyms and Abbreviations (continued)

OD	Outside Diameter
PCU	Color Units
pCi/L	Pico Curies per liter
psi	Pounds per square inch
PT	Packer Test
PVC	Polyvinyl Chloride
Q/s	Specific Capacity (gpm/foot of drawdown)
SFWMD	South Florida Water Management District
SMW-1	Shallow Monitoring Well-1
SP	Spontaneous Potential
SSWWTF	Southside Wastewater Treatment Facility
SWAF	Storm Water Augmentation Facility
SZMW-1	Storage Zone Monitoring Well-1
TDS	Total Dissolved Solids
TON	Threshold Odor Number
UFA	Upper Floridan Aquifer
UIC	Underground Injection Control
USDW	Underground Source of Drinking Water
USGS	United States Geological Survey
VDL	Variable Density Log
µg/L	Micrograms per Liter
µS/cm	MicroSiemens per centimeter

Professional Geologists

The geological evaluation and interpretations pertaining to the *Engineering Report for the Construction and Testing of the City of St. Cloud Southside Wastewater Treatment Facility ASR Well System,* prepared December 2016, on behalf of the City of St. Cloud, Florida, were prepared by, and reviewed by, a Licensed Professional Geologist in the State of Florida. 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 on 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.

Martin J. Clasen, P.G.

12/28/16

Date

00027

Mark B. McNeal, P.G.

12/28/16

Date

01231

1.0 Introduction

1.1. Project Background

The City of St. Cloud (City) owns and operates the Southside Wastewater Treatment Facility (SSWWTF), which is permitted for an annual average daily flow (AADF) of 6.0 million gallons per day (MGD). The facility has one 89-MG public-access reclaimed water wet-weather storage pond and two on-site reject water ponds (7 million gallons [MG] and 29 MG). Between May through November 2013, the SSWWTF received monthly average daily flows (ADF) between 3 and 4 MGD. The facility is designed and permitted for 100 percent unrestricted public-access reuse in accordance with Chapter 62-610, Florida Administrative Code (FAC), with no alternative permitted means of effluent disposal. The unrestricted public-access reuse system (R-001) is permitted for 8.50 MGD AADF. In addition, the City has the ability to augment the supply of reclaimed water from two stormwater ponds at the Lakeshore Storm Water Augmentation Facility (SWAF), with a permitted capacity of 2.0 MGD Annual Average Daily Flow (AADF).

During dry weather, the City has sufficient pond storage and reuse demand to use or store all treated effluent that the SSWWTF produces. However, over the past 3 years discharges to surface water have occurred from the reclaimed ponds during extreme wet weather events and/or wet weather months via an emergency overflow structure on the west side of the 7 MG reject water pond.

The City entered into a Consent Order agreement with the Florida Department of Environmental Protection (FDEP) due to the wet weather discharge events. The Consent Order includes the investigation of reclaimed water Aquifer Storage and Recovery (ASR) as a cost-effective wet weather storage alternative. Reclaimed water ASR will provide subsurface storage of surplus reclaimed water typically accumulated during wet weather periods. The stored reclaimed water would be recovered during periods of decreased supply and/or increased demand during the dry season. This stored reclaimed water can be applied to future uses, which may otherwise represent additional groundwater or potable demands.

The well was originally permitted as a Class V Group 3 ASR system. Due to a highly permeable storage zone encountered during drilling the site was deemed not conducive to a successful ASR system. The ASR well was re-permitted as a Class V injection well. Supplemental reuse water could still be recovered from this location although it may prove more viable from a shallower recovery well rather than directly from the injection zone. Data presented in later sections of this report support this re-permitting effort.

The Class V injection well site is located in Section 24, Township 26 South, and Range 30 East. Average land surface elevation varies across the site from 75 to 80 feet above the National Geodetic Vertical Datum (NGVD). The general location of the SSWWTF is shown on **Figure 1-1**. A site aerial is shown on **Figure 1-2.**

Design and permitting of the Class V injection well and associated monitoring wells was initiated by the City in 2014 with the assistance of Jones Edmunds & Associates, Inc., the Engineer of Record, and ASRus, LLC, providing hydrogeological and permitting services. On October 27, 2014, the FDEP issued the well construction permit (FDEP Permit No. 0327299-001-UC5X) to the City. A copy of the FDEP well construction permit is presented in **Appendix A**.

Four shallow water table monitoring wells (NE, NW, SW and SE) were installed before the construction of the ASR well and were used to monitor the Surficial Aquifer during well construction activities.

Technical specifications and contract documents were prepared and released for bid by the City (Bid No. 2014-124) on October 5, 2014, and opened on October 28, 2014. Florida Design Drilling (FDD) of Fort Lauderdale, Florida was selected as the lowest responsible bidder for the construction and testing of an exploratory well (ASR-1), a storage zone monitoring well (SZMW-1) and a shallow monitoring well (SMW-1). Following verification of the bid submittal and execution of the contract documents, a notice-to-proceed was issued by the City to FDD on January 5, 2015. Drilling equipment was mobilized to the site beginning in January 2015. ASRus provided inspection services during construction and testing activities of ASR-1, SZMW-1 and SMW-1.

1.2. Site Description

The test well system is located at the SSWWTF in north central Osceola County, Florida (see **Figure 1-1**). The SSWWTF is located at 5701 Michigan Ave, St. Cloud, Florida. The well site is bordered on the north by a golf course, on the east by a storm water pond, on the south and west by plant facilities.

The well site is located in the northeast corner of the SSWWTF at the approximate latitude of 28° 12′ 26″ North and longitude 81° 16′ and 27″ West (see **Figure 1-2**). The shallow water table monitor wells ASR-NE, ASR-NW, ASR-SW and ASR-SE are located outside the four corners of the concrete temporary containment pad.

1.3. Purpose and Scope

The purpose of this report is to present a description of the well construction activities and the hydrogeologic testing program completed during construction of the exploratory well ASR-1 and two monitoring wells, SZMW-1 and SMW-1. A summary of the findings and appropriate recommendations are presented at the end of this report. The report is prepared in compliance with FDEP requirements contained in Chapter 62-528, FAC, and the FDEP well construction permit No. 0327299-001-UC5X.

Well construction information provided in this report includes a description of drilling procedures, the type and quantity of materials used to complete the exploratory well and two monitor wells, and the chronology of major construction and testing events. A chronology of critical decisions made requiring FDEP concurrence is also provided. Unless otherwise specified, all depths given in this report refer to feet below land surface (bls).

Hydrogeologic testing data presented in this report include the results of formation sampling and coring, drilling and packer test water quality analyses, geophysical logging, and packer hydraulic tests conducted during the construction of ASR-1, SZMW-1 and SMW-1.

1.4. Acknowledgements

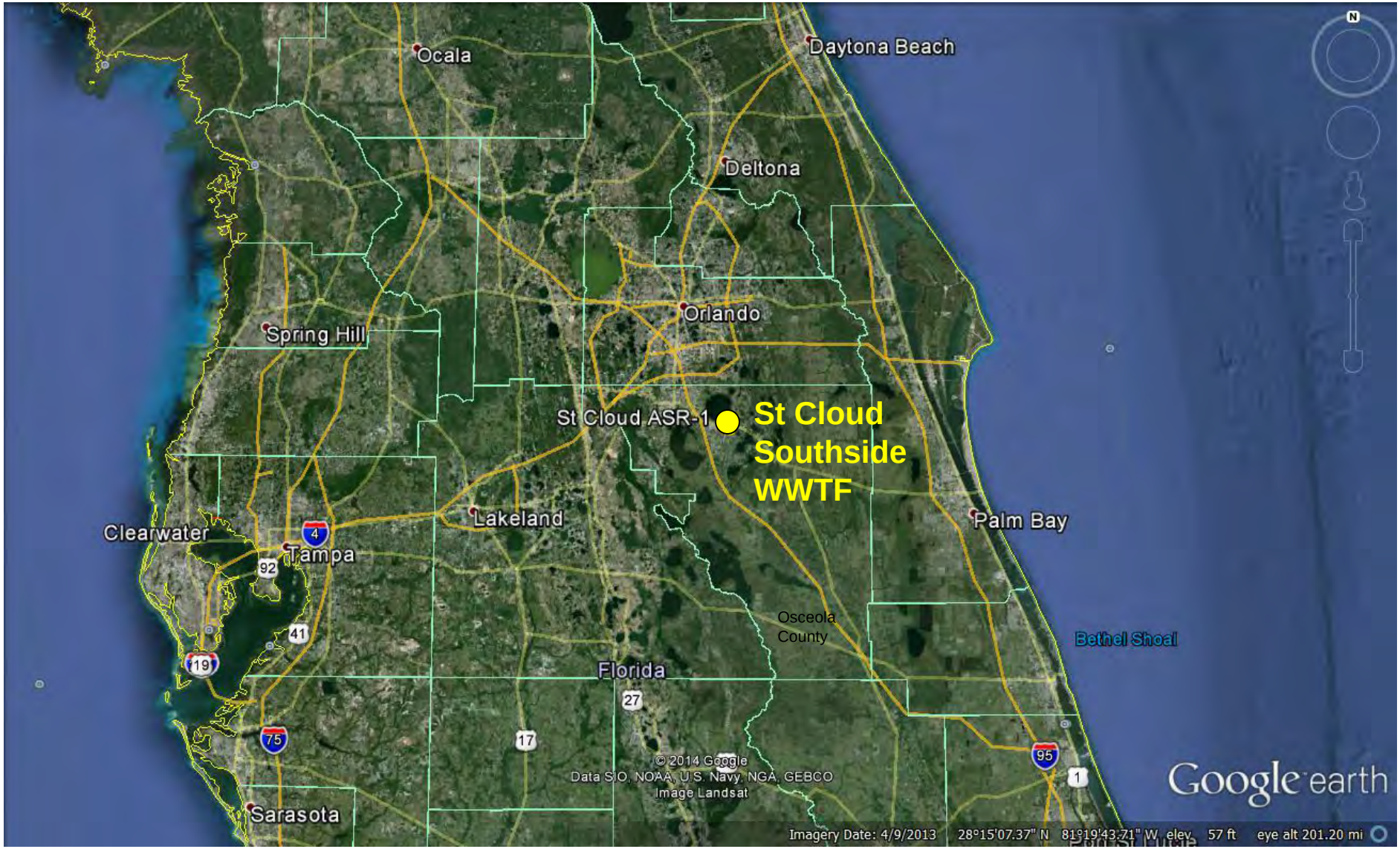
The successful completion of the City of St. Cloud SSWWTF ASR well project was the result of close cooperation by numerous agencies and individuals. The Engineer of Record, Jones Edmunds & Associates, and the hydrogeologic consultant, ASRus, designed the ASR system and provided construction oversight. The FDEP Underground Injection Control (UIC) Program provided valuable agency support and technical assistance throughout the project. Key individuals include:

Mr. Joe Haberfeld, P.G., FDEP/Tallahassee
Mr. George Hueler, P.G., FDEP/Tallahassee
Mr. Doug Thornton, P.G., FDEP/Tallahassee
Ms. Caroline Shine, FDEP/Orlando
Mr. Anil Dasai, FDEP/Orlando

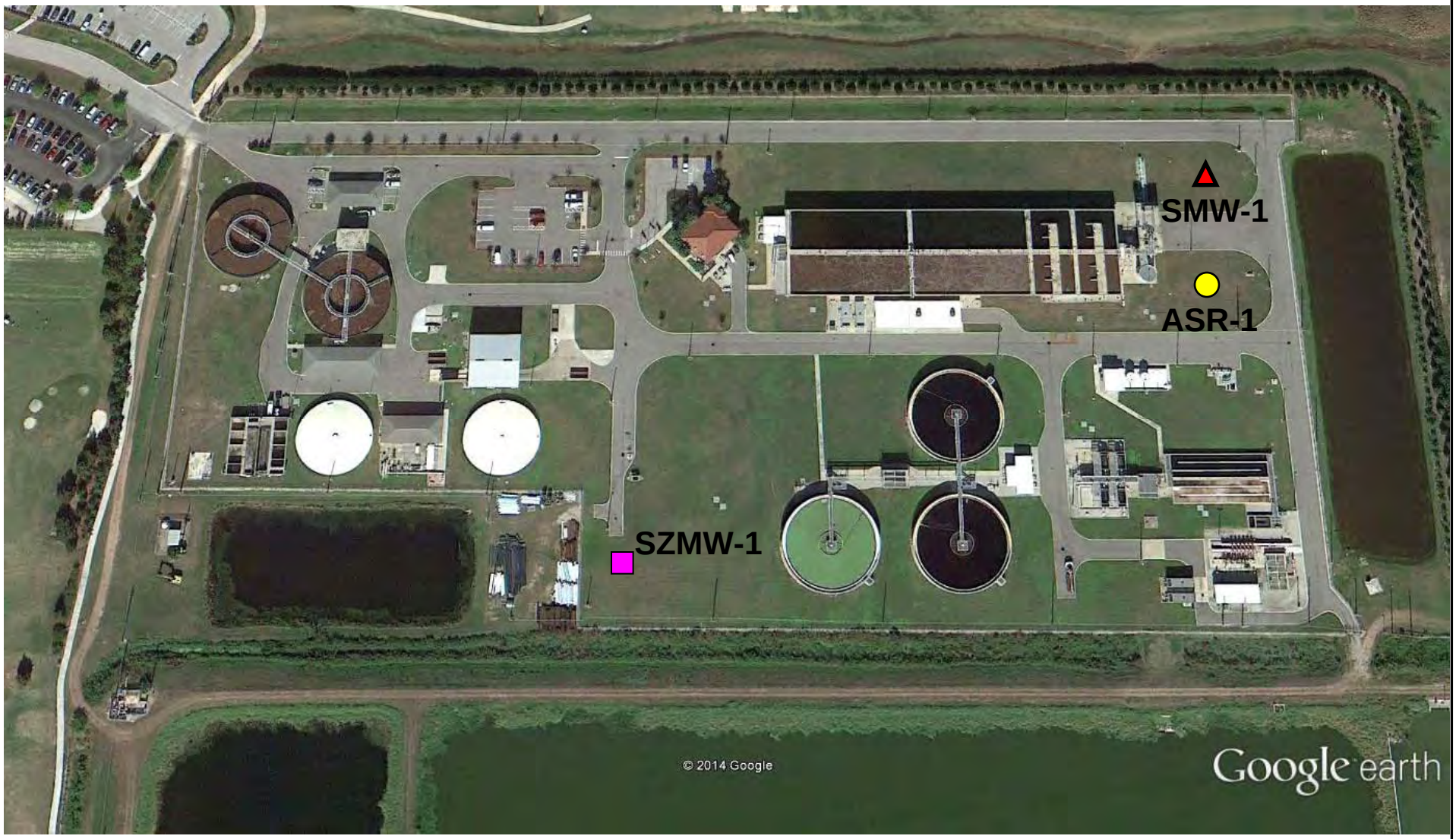
City of St Cloud personnel were also helpful in providing guidance and logistical support towards the successful completion of the project. Key City of St. Cloud individuals supporting this project include:

Mr. Chris Fasnacht
Mr. Kevin Felblinger
Ms. Ada Levy

Mr. Howard Miller
Mr. Ricky Brown



City of St. Cloud **Class V Injection Well System**	JONES EDMUNDS ASR US LLC	Southside WWTF Location Map	DATE 10/30/16 **FIGURE 1-1**



- Class V Injection Well
- Storage Zone Monitoring Well
- Shallow Monitoring Well

Distances from ASR-1 to:

- SZMW-1 ~ 730 ft
- SMW-1 ~ 130 ft

City of St. Cloud **Class V Injection Well System**	JONES EDMUNDS ASR US LLC	ASR Site Plan for the Southside Wastewater Treatment Facility (SSWWTF)	DATE 10/30/16 **FIGURE 1-2**

2.0 Well Construction

This section describes the construction and testing history of the shallow pad monitoring wells and the three Class V injection system wells, ASR-1, SZMW-1 and SMW-1, at the City of St. Cloud SSWWTF site. For each of these wells, a detailed description is provided for the well drilling methodology used, casing installation and cementing procedures and the quantity of materials used in the wells. Hydrogeological data collected during the construction of the exploratory well and two monitor wells are presented and discussed in **Section 3.0** of this report.

During well construction activities, FDEP was provided weekly summary reports. The weekly construction summary reports, including daily construction activity logs are included in **Appendix B.** Well completion reports generated during the course of this project are included in **Appendix C**.

2.1. Drilling Operation Methodology

The four pad monitor wells for ASR-1 and SZMW-1 and two pad monitoring wells for SMW-1 were drilled with a truck-mounted auger drilling rig **(Figure 2-1)**. The drilling rig incorporated a top-head drive rotary system with a drill floor located approximately 3.5 feet above the top of the land surface. The augers were approximately 5 feet in length with a 9-inch outside diameter.

One trailer-mounted rotary drilling rig and a large electric rotary rig were utilized in the construction of wells ASR-1, SZMW-1, and SMW-1 **(Figures 2-2 and 2-3)**. The smaller trailer-mounted rig was used for wells SMW-1 and SZMW-1. The electric rig was used for well ASR-1. The drill rods utilized were 30 feet in length. Various drill bit sizes were used during well construction for wells ASR-1, SZMW-1, and SMW-1 ranging in diameter from 9.5 inches to 34 inches.

The drilling operations for all three wells consisted initially of mud rotary drilling techniques until an approximate depth of 300 feet was obtained followed by reverse-air drilling methods. The mud drilling technique was primarily used to drill through sand and unconsolidated or poorly consolidated deposits that generally are unstable and produce little water. These deposits have a tendency to collapse into the borehole. The drilling mud stabilizes the hole and removes the drill cuttings during drilling operations. Reverse-air drilling techniques are used primarily to drill in competent, generally water-bearing, rock. Water produced by the formation serves as the drilling fluid. Reverse-air drilling techniques allow for the collection of formation water samples during drilling operations.

Both drilling techniques were used at the site under a closed circulation system (no discharge). The water in the lower Floridan aquifer encountered during drilling of the exploratory well and SZMW-1 is brackish to saline water and would contaminate the water table aquifer at the site if discharged to land surface. In addition, the FDEP construction permit 0308156-001-UC5X states that disposal of drilling fluids and formation water must be in a sound environmental manner that avoids violation of surface water and groundwater quality standards.

2.1.1. Mud Drilling Method

The mud drilling operations at the site used bentonite-drilling mud with approved additives as the drilling fluid. The drilling mud was mixed in an approximately 4,000 gallon mud slurry tank. This fluid was pumped through an 8-inch inside diameter (ID) PVC mud line to the drill rig and ultimately down the drill rods, exiting out the drilling bit. The viscous drilling fluid suspends the cuttings and circulates back up the borehole to land surface where the drilling fluid was routed through a 10-inch ID PVC return line back to the mud tank onto a vibrating screen, known as a "shale shaker," suspended over the mud tank (**Figure 2-4)**. The screen separates the cuttings from the drilling fluid, allowing the fluid to drop into the slurry tank for re-circulation and the cuttings into a 20 CY sealed steel storage tank. Cuttings were removed from the storage tank with a track hoe and disposed of at the abandoned orange grove south of the site as approved by FDEP.

2.1.2. Reverse-Air Drilling Method

The reverse-air drilling method utilizes groundwater as the drilling fluid. Steel tubing is suspended down inside the 4.5-inch ID drill rod assembly and connected to a high capacity diesel-powered air compressor. The bottom of the 1.25-inch Outside Diameter (OD) PVC airline was generally set to a depth between 60 and 90 feet above the drilling bit. Compressed air is piped down the tubing that aerates the water inside the drill pipe above the end of the tubing. This aeration causes a pressure differential, which in turn causes upward flow of the water inside the drill pipe. The drill rod in effect becomes an airlift pump. Water and cuttings at the bottom of the borehole and at the drill bit face are drawn into the drilling bit and conveyed up the drill rod to the surface. The water and cuttings from the drill rod are then routed to the storage tank system and the cuttings settle out of suspension. The water flows into the storage tank where it is returned back into the well through a port on the wellhead.

During the construction of the exploratory well, artesian conditions in the well were not encountered. The well was located within a High-Density Polyethylene (HDPE) lined containment pad with two-foot walls in the event that artesian conditions were encountered, thus allowing time for a wellhead assembly and backflow preventer to be

installed. In addition, the supplies required to create a mud wafer solution were also stored on-site in the event that water levels needed to be suppressed.

2.2. Pad Monitor Well Construction

The four pad monitor wells NE, NW, SW, and SE were installed around the perimeter of the drilling pad before the construction of the deep exploratory well in January 2015 (**Figure 2-1**). The shallow wells were used to monitor the water quality of the Surficial Aquifer during drilling operations of ASR-1. Weekly water quality samples collected from the shallow monitor wells were analyzed for pH, specific conductance, temperature, and chloride in the field by site personnel. **Appendix D** contains the water quality data for the pad monitor wells. The sampling results are discussed in **Section 3**.

CenterLine Drilling, Inc. from Fort Lauderdale, Florida was contracted to drill the pad monitor wells using a small truck mounted auger drilling rig. All of the monitor wells were installed by auger drilling techniques using a nominal 9-inch diameter hollow-stem auger bit. The wells were drilled to a total depth of 15 or 20 feet; after which, 10 feet of a 2-inch OD Schedule 40 PVC casing with a 10-foot PVC screen (0.01-inch slot size) were installed to the total depth. The annulus was backfilled with 20/30 graded silica sand to a depth of approximately two feet above the top of the screen and then was topped with approximately one foot of bentonite pellets. The remainder of the annulus was filled with Type II neat cement grout to land surface. Each completed well was developed in preparation for water quality sampling prior to and during well construction activities and equipped with an expandable locking cap. Completion reports for all the permitted wells are contained in **Appendix C**. Four separate pad monitoring wells were constructed for well SZMW-1 and are labeled SZNE, SZNW, SZSW, and SZSE. For monitoring well SMW-1, FDEP authorized the construction of two additional pad monitoring wells NE and SE to monitor this shallower well.

2.3. ASR-1 Well Construction

Construction of ASR-1 commenced on January 28, 2015, and was completed on June 22, 2016, when the injection test at the well was performed. A chronology of the significant well construction and testing activities is presented in **Table 2-1**.

The pilot hole for the well was drilled to a total depth of approximately 3,060 feet with the final open-hole interval completed between approximately 1,650 feet and 3,060 feet. Casing diameters of the well varied and included the following: a nominal 36-inch diameter steel pit casing, a 32-inch diameter steel surface casing, a 20-inch diameter steel intermediate casing, and a 12-inch steel final casing. A mill certificate is a steel industry document that is used to certify the manufacturing standards of the steel

casing produced by the mill. Copies of the mill certificates for the steel casings used in the construction of ASR-1 are presented in **Appendix E**.

2.3.1. ASR-1 Drilling and Casing Installation

2.3.1.1. ASR-1 Pit Casing

Prior to the initiation of drilling operations, the pit casing for ASR-1 was installed using an auger rig and bentonite mud. Consisting of a 36-inch diameter, 0.375-inch wall steel casing, the pit casing was installed to a depth of approximately 48 feet into competent rock and cemented to surface with neat cement grout. The primary function of the pit casing was to stabilize the top of the borehole in the unconsolidated sediments, allowing for pilot-hole drilling and reaming operations facilitating the installation of the surface casing.

2.3.1.2. ASR-1 Surface Casing (28-Inch)

A nominal 12.25-inch diameter mud-rotary drilled borehole was advanced to an approximate depth of 320 feet on March 5, 2015. The pilot hole was then reamed with a 34-inch diameter reamer bit to a depth of 316 feet on March 11, 2015, in preparation for installation of the 28-inch diameter surface casing. A geophysical logging suite consisting of gamma ray and caliper logs was conducted prior to casing installation to verify borehole dimensions and estimate cement quantities. A theoretical cement volume of 623 sacks was calculated from the caliper log to fill the annulus between the surface casing and borehole.

The surface casing of ASR-1 consisted of nominal 40-foot sections of 0.375-inch wall, 28-inch diameter steel casing that were butt-welded together as the casing was installed (**Figure 2-5**). The casing was installed to a total depth of approximately 313 feet on March 12, 2015, without encountering any obstructions.

The contractor cemented the 28-inch diameter surface casing with one pressure grout stage completed on March 12 and one tremie grout stage completed on March 13, 2015. The pressure grout stage consisted of pumping 395 sacks of Portland Type II cement. The tremie grout stage consisted of 262 sacks of Type II neat cement. A total volume of 657 sacks of cement were pumped, which was greater than the theoretical fill volume of 623. Cement quantities from all of the grouting stages during construction of ASR-1 are presented in **Table 2-2**.

2.3.1.3. ASR-1 Intermediate Casing (20-Inch)

A nominal 9.5-inch diameter reverse-air drilled borehole was advanced to an approximate depth of 1,405 feet on April 6, 2015. The pilot hole was then reamed with a 26-inch diameter reamer bit to a depth of 1,383 feet on June 19, 2015, in preparation for installation of the 20-inch diameter intermediate casing. A geophysical logging suite consisting of gamma ray and caliper logs was conducted prior to casing installation to verify borehole dimensions and estimate cement quantities. A theoretical cement volume of 2,650 sacks was calculated from the caliper log to fill the annulus between the intermediate casing and borehole to land surface.

The intermediate casing of ASR-1 consisted of nominal 40-foot sections of 0.375-inch wall, 20-inch diameter steel casing that were butt-welded together as the casing was installed (**Figure 2-6**). The casing was installed to a total depth of approximately 1,380 feet on June 24, 2015 without encountering any obstructions.

The contractor cemented the 20-inch diameter intermediate casing with nine tremie grout stages completed between June 24, 2015, and July 7, 2015. The cement stages consisted of three stages of neat cement, four stages of 6% bentonite cement, and two stages of 12% bentonite cement. Additionally, two stages of gravel were installed over the intervals from 628 to 602 feet and 583 to 520 feet. A total volume of 5,050 sacks of cement and 37.2 cubic yards of gravel were installed, which was greater than the theoretical fill volume of 2,650 sacks. Cement quantities from all of the grouting stages during construction of ASR-1 are presented in **Table 2-2**.

2.3.1.4. ASR-1 Final Casing (12-Inch/14-Inch)

On September 3, 2015, FDD completed pilot-hole drilling to a depth of 3,060 feet bls. The pilot hole was then reamed with an 18.75-inch diameter reamer bit to a depth of 1,650 feet on November 18, 2015, in preparation for installation of the 12-inch diameter final casing. A geophysical logging suite consisting of gamma ray and caliper logs was conducted prior to casing installation to verify borehole dimensions and estimate cement quantities. A theoretical cement volume of 1,613 sacks was calculated from the caliper log to fill the annulus between the final casing and borehole to land surface.

The final casing of ASR-1 consisted of nominal 40-foot sections of 0.5-inch wall, 12-inch diameter steel casing that were butt-welded together as the casing was installed. The casing was installed to a total depth of approximately 1,650 feet on November 23, 2015, without encountering any obstructions. In order to allow additional space for a larger pump, the top 200 feet of casing was upsized to 14-inch diameter steel with 0.50 inch wall thickness. A transition piece was fabricated between the 12-inch and 14-inch casing. The final well construction diagram for well ASR-1 is shown in **Figure 2-7**.

The contractor cemented the 12-inch/14-inch diameter final casing with ten tremie grout stages completed between November 24, 2015, and December 9, 2015. The cement stages consisted of ten stages of neat cement. A total volume of 5,192 sacks of cement were installed. Cement quantities from all of the grouting stages during construction of ASR-1 are presented in **Table 2-2**.

The deviation surveys, which are summarized in **Table 2-3**, were collected in the pilot hole and in the reamed borehole of the exploratory well at 90-foot intervals. The maximum allowable borehole deviation is 1.0 degree. All of the deviation surveys were within the allowable limit of 1.0 degree or less deviation over the tested interval.

2.3.1.5 ASR-1 Casing Pressure Test

The 12-inch/14-inch final casing of ASR-1 was pressure tested as a condition of the FDEP well construction permit 0327299-003-UC/M5. The pressure test of the final 12/14-inch casing was conducted on December 21, 2015, utilizing a single packer installed at the bottom of the 12/14-inch diameter casing from approximately 1,645 to 1,650 feet. The top of the 12/14-inch casing was sealed with a temporary header assembly and the test was conducted by pressurizing the inside of the 12/14-inch casing to 112.5 pounds per square inch (psi) for 60 minutes (**Table 2-4)**. After 60 minutes, the pressure had decreased to 112 psi. The 0.5-psi decrease represents a 0.4 percent pressure change, which is within the five percent allowable pressure change during the test. The casing pressure test and thus the internal mechanical integrity demonstration of the Class V injection well final casing were successful.

2.4. SZMW-1 Well Construction

Construction of SZMW-1 commenced on September 8, 2015, and was completed on July 7, 2016, when the final geophysical logs were conducted. A chronology of the significant well construction and testing activities is presented in **Table 2-1**.

The pilot hole for the well was drilled to a total depth of approximately 1,680 feet with the final open-hole interval completed between approximately 1,650 feet and 1,680 feet. Casing diameters of the well varied and included the following: a nominal 30-inch steel pit casing, a 20-inch steel surface casing, a 12-inch steel intermediate casing, and a 6-inch steel final casing. Copies of the mill certificates for the steel casings used in the construction of SZMW-1 are presented in **Appendix E**.

2.4.1. SZMW-1 Drilling and Casing Installation

2.4.1.1. SZMW-1 Pit Casing

Prior to the initiation of drilling operations, the pit casing for SZMW-1 was installed via mud-rotary auger drilling. Consisting of a 30-inch diameter, 0.375-inch wall steel casing, the pit casing was installed to a depth of approximately 50 feet into clay and was cemented to surface. The primary function of the pit casing was to stabilize the top of the borehole allowing for pilot-hole drilling and reaming operations facilitating the installation of the surface casing.

2.4.1.2. SZMW-1 Surface Casing (20-Inch)

A nominal 26-inch diameter mud-rotary drilled borehole was advanced to an approximate depth of 305 feet on September 18, 2015. The surface casing of SZMW-1 consisted of nominal 40-foot sections of 0.375-inch wall, 20-inch diameter steel casing that were butt-welded together as the casing was installed. The casing was installed to a total depth of approximately 300 feet on September 22, 2015, without encountering any obstructions.

The contractor cemented the 20-inch diameter surface casing with two tremie grout stages completed on September 22 and 23, 2015. The first grout stage consisted of 571 sacks of Type II neat cement using the pressure tremie method. The second tremie grout stage consisted of 67 sacks of Type II neat cement, which resulted in a visible cement return at land surface. A total volume of 638 sacks of cement was pumped. Cement quantities from all of the grouting stages during construction of SZMW-1 are presented in **Table 2-5**.

2.4.1.3. SZMW-1 Intermediate Casing (12-Inch)

A nominal 12-inch diameter reverse-air drilled pilot-hole was advanced to an approximate depth of 1,155 feet on October 19, 2015. The pilot hole was then reamed with an 18-inch diameter bit to a depth of 1,147 feet on November 11, 2015. A geophysical logging suite consisting of gamma ray and caliper logs was conducted prior to casing installation to verify borehole dimensions and estimate cement quantities. A theoretical cement volume of 1,228 sacks was calculated from the caliper log to fill the annulus between the intermediate casing and borehole to land surface.

The intermediate casing of SZMW-1 consisted of nominal 40-foot sections of 0.375-inch wall, 12-inch diameter steel casing that were butt-welded together as the casing was installed. The casing was installed to a total depth of approximately 1,140 feet on November 17, 2015, without encountering any obstructions.

The contractor cemented the 12-inch diameter intermediate casing with four tremie grout stages completed between November 17, 2015, and November 19, 2015. The cementing of this casing consisted of three stages of neat cement and one stage of 6% bentonite cement. A total volume of 971 sacks of neat cement and 389 sacks of 6% bentonite cement was installed. Cement quantities from all of the grouting stages during construction of SZMW-1 are presented in **Table 2-5**.

2.4.1.4. SZMW-1 Final Casing (6-Inch)

On January 19, 2016, FDD completed 11.875-inch diameter pilot-hole drilling to a depth of 1,680 feet bls. A geophysical logging suite consisting of gamma ray, caliper, spontaneous potential, dual induction, fluid conductivity, temperature, flow meter, and borehole compensated sonic logs was conducted prior to casing installation to verify borehole dimensions and estimate cement quantities.

The final casing of SZMW-1 consisted of nominal 41-foot sections of 0.28-inch wall, 6.625-inch diameter steel casing that were butt-welded together as the casing was installed. The casing was installed to a total depth of approximately 1,649 feet on January 28, 2016 without encountering any obstructions.

The contractor cemented the 6-inch diameter final casing with 22 tremie grout stages completed between January 28, 2016, and February 15, 2016. Approximately two feet of pea gravel was placed on top of the cement baskets before cementing began. A total volume of 2,293 sacks of neat cement grout and 2,263 sacks of 6% bentonite grout were installed. Cement quantities from all of the grouting stages during construction of SZMW-1 are presented in **Table 2-5**. The final well construction diagram for SZMW-1 is shown in **Figure 2-7**.

2.5. SMW-1 Well Construction

Construction of SMW-1 commenced on February 19, 2016 and was completed on July 7, 2016, when final geophysical logging was completed on the well. A chronology of the significant well construction and testing activities is presented in **Table 2-1**.

The pilot hole for the well was drilled to a total depth of approximately 1,520 feet with the final open-hole interval completed between approximately 1,480 feet and 1,520 feet. Casing diameters of the well varied and included the following: a nominal 30-inch steel pit casing, a 20-inch steel surface casing, and a 12-inch steel final casing. Copies of the mill certificates for the steel casings used in the construction of SMW-1 are presented in **Appendix E**.

2.5.1. SMW-1 Drilling and Casing Installation

2.5.1.1. SMW-1 Pit Casing

Prior to the initiation of drilling operations, the pit casing for the SMW-1 was installed via mud-rotary auger drilling. Consisting of a 30-inch diameter, 0.375-inch wall steel casing, the pit casing was installed to a depth of approximately 50 feet into the top of clay and was cemented to surface. The primary function of the pit casing was to stabilize the top of the borehole allowing for pilot-hole drilling and reaming operations facilitating the installation of the surface casing.

2.5.1.2. SMW-1 Surface Casing (20-Inch)

A nominal 26-inch diameter mud-rotary drilled borehole was advanced to an approximate depth of 320 feet on March 1, 2016. The surface casing of SMW-1 consisted of nominal 40-foot sections of 0.375-inch wall, 20-inch diameter steel casing that were butt-welded together as the casing was installed. The casing was installed to a total depth of approximately 320 feet on March 3, 2016, without encountering any obstructions.

The contractor cemented the 20-inch diameter surface casing with two tremie grout stages completed on March 3 and 4, 2016. The first tremie grout stage consisted of 476 sacks of Type II neat cement grout. The second stage consisted of 72 sacks of Type II neat cement grout, which resulted in a visible cement return at land surface. A total volume of 548 sacks of cement was pumped. On March 7, 2016, FDD physically tagged the top of cement in the annulus at 3.5 feet bls. FDD mixed an additional five sacks of neat cement grout on site and poured it into the annulus to bring the top of cement to near land surface. Cement quantities from all of the grouting stages during construction of SMW-1 are presented in **Table 2-6**.

2.5.1.3. SMW-1 Final Casing (12-Inch)

On April 13, 2016, FDD completed 11.875-inch diameter pilot-hole drilling to a depth of 1,490 feet bls. A geophysical logging suite consisting of gamma ray, caliper, spontaneous potential, dual induction, and borehole compensated sonic logs was conducted to verify borehole characteristics. The borehole was reamed to a nominal 18-inches in diameter and a caliper log was run to estimate cement quantities.

The final casing of SMW-1 consisted of nominal 42-foot sections of 0.5-inch wall, 12.75-inch diameter steel casing that were butt-welded together as the casing was installed. The casing was installed to a total depth of approximately 1,480 feet on May 5, 2016 without encountering any obstructions.

The contractor cemented the 12-inch diameter final casing with one pressure grout stage and sixteen tremie grout stages completed between May 5, 2016, and May 17, 2016. A total volume of 5,480 sacks of cement grout was installed. Gravel was installed in fracture intervals from 1,431 feet to 1,395 feet bls and from 669 feet to 578 feet bls. Cement quantities from all of the grouting stages during construction of SMW-1 are presented in **Table 2-6**. The final well construction diagram for SMW-1 is shown in **Figure 2-7**.

TABLE 2-1 Chronology of Significant Construction and Testing Activities

DATE	ASR-1 ACTIVITY
01/05/15	The Notice to Proceed was issued to Florida Design Drilling by the City of St Cloud.
01/15/15	Four shallow water table monitoring wells were installed around the drill rig pad to monitor the surficial aquifer water quality.
01/21/15	Sampled four shallow pad monitoing wells for background water quality.
01/28/15	Installed 36-inch diameter steel pit casing to a depth of 48 feet bls using an auger rig, cemented to surface.
03/05/15	Drilled 12.25-inch diameter pilot-hole to a depth of 320 feet bls using mud-rotary drilling techniques.
03/05/15	Geophysical logging was conducted including gamma ray, x-y caliper, dual induction, and SP.
03/11/15	Completed reaming of the pilot-hole to a diameter of 34-inches to a depth of 316 feet bls.
03/11/15	Geophysical logging was conducted on the reamed borehole including gamma ray and x-y caliper.
03/12/15	Installed 28-inch diameter steel surface casing to a depth of 313 feet bls.
03/13/15	Completed cementing the 28-inch diameter surface casing to land surface with a total of 657 sacks of neat cement grout.
04/06/15	Drilled 9.5-inch diameter pilot-hole to a depth of 1,405 feet bls using reverse-air drilling techniques.
04/07/15	Geophysical logging was conducted including gamma ray, x-y caliper, dual induction, sonic, fluid conductivity, flow meter, and temperature.
04/08/15	Completed PT-1 from 1,064 feet to 1,405 feet bls, specific capacity is 18.9 gpm/ft, TDS is 386 mg/L.
04/09/15	Completed PT-2 from 872 feet to 1,405 feet bls, specific capacity is 22.1 gpm/ft, TDS is 352 mg/L.
04/10/15	Completed PT-3 from 706 feet to 1,405 feet bls, specific capacity is 27.2 gpm/ft, TDS is 380 mg/L.
06/19/15	Completed reaming pilot hole to a diameter of 26-inches to a depth of 1,383 feet bls.
06/23/15	Geophysical logging was conducted on the reamed borehole including gamma ray and x-y caliper.
06/24/15	Installed 20-inch diameter steel intermediate casing to a depth of 1,380 feet bls.
07/08/15	Completed cementing the 20-inch diameter intermediate casing to land surface with a total of 5,183 sacks of cement grout.
09/03/15	Completed pilot hole drilling to 3,060 feet bls, conducted geophysical logging on the pilot hole from 1,380 feet to 2,000 feet bls.
10/15/15	Reamed pilot hole to 15-inches to 2,000 feet bls, conducted DIL geophysical logging on the pilot hole from 1,380 feet to 3,045 feet bls.
10/22/15	Completed PT-4 from 1,616 feet to 1,652 feet bls, specific capacity is 7 gpm/ft, TDS is 2,660 mg/L.
10/26/15	Completed PT-5 from 1,591 feet to 1,627 feet bls, specific capacity is 15 gpm/ft, TDS is 2,860 mg/L.
10/27/15	Completed PT-6 from 1,510 feet to 1,546 feet bls, specific capacity is 12 gpm/ft, TDS is 2,410 mg/L.
10/29/15	Completed PT-7 from 1,475 feet to 1,511 feet bls, specific capacity is 10.8 gpm/ft, TDS is 1,620 mg/L.
11/02/15	Completed PT-8 from 1,405 feet to 1,441 feet bls, specific capacity is 13.6 gpm/ft, TDS is 1,050 mg/L.
11/18/15	FDEP approved final casing setting depth of 1,650 feet bls.
11/18/15	Completed reaming pilot hole to a diameter of 18.75-inches to a depth of 1,650 feet bls.
11/20/15	Geophysical logging was conducted on the reamed borehole including gamma ray and x-y caliper.
11/23/15	Installed 12-inch diameter steel final casing to a depth of 1,650 feet bls (top 200 feet is 14-inch steel casing).
12/09/15	Completed cementing the 12-inch diameter final casing to land surface with a total of 5,192 sacks of cement grout.
12/16/15	Drilled 10.875-inch diameter pilot-hole to a depth of 3,060 feet bls using reverse-air drilling techniques.
12/18/15	Developed well and ran specific capacity test 500 gpm with 0.77 ft of drawdown, SC = 649 gpm/ft.
12/18/15	Conducted final suite of geophysical logs including video survey and dynamic flow meter.
12/21/15	Successfully completed pressure test on 12-inch final casing, 112 psi for 1-hour only 0.5 psi loss.
06/21/16	Collected background water quality sample for primary and secondary standards.
06/21/16	Completed short-term pumping test at 490 gpm with drawdown of 1.32 feet.
06/22/16	Completed short-term specific injectivity test pumping at 1,600 gpm with well head pressure increase of 4.16 psi.
07/15/16	Completed Well Head and Site Restoration.
DATE	**SMW-1 ACTIVITY**
01/05/15	The Notice to Proceed was issued to Florida Design Drilling by the City of St Cloud.
01/15/15	Two shallow water table monitoring wells were installed around SMW-1 pad to monitor the surficial aquifer water quality.
01/21/15	Sampled two shallow pad monitoing wells for background water quality.
01/29/15	Installed 30-inch diameter steel pit casing to a depth of 50 feet bls using auger rig, cemented to surface.
02/19/16	Begin pilot hole drilling using mud-rotary drilling techniques.
02/23/16	Drilled 11.875-inch diameter pilot-hole to a depth of 320 feet bls using mud-rotary drilling techniques.
02/24/16	Geophysical logging was conducted including gamma ray, x-y caliper, dual induction, and SP.
03/03/16	Installed 20-inch diameter steel surface casing to a depth of 320 feet bls.
03/04/16	Completed cementing the 20-inch diameter surface casing to land surface with a total of 549 sacks of neat cement grout.
04/13/16	Drilled 11.875-inch diameter pilot-hole to a depth of 1,490 feet bls using reverse-air drilling techniques.
04/14/16	Geophysical logging was conducted including gamma ray, x-y caliper, dual induction, sonic, fluid conductivity, and temperature.
05/05/16	Installed 12-inch diameter steel final casing to a depth of 1,480 feet bls.
05/17/16	Completed cementing the 12-inch diameter final casing to land surface with a total of 5,480 sacks of cement grout.
06/22/16	Completed well development and background water quality sampling.
07/07/16	Completed final geophysical logging including caliper, gamma ray, dual induction, fluid conductivity, temperature.
07/15/16	Completed Well Head and Site Restoration.

TABLE 2-1 Chronology of Significant Construction and Testing Activities

DATE	SZMW-1 ACTIVITY
01/05/15	The Notice to Proceed was issued to Florida Design Drilling by the City of St Cloud.
01/15/15	Four shallow water table monitoring wells were installed around the drill rig pad to monitor the surficial aquifer water quality.
01/21/15	Sampled four shallow pad monitoing wells for background water quality.
02/02/15	Installed 30-inch diameter steel pit casing to a depth of 50 feet bls using auger rig, cemented to surface.
09/08/15	Begin pilot hole drilling using mud-rotary drilling techniques.
09/18/15	Drilled 26-inch diameter hole to a depth of 305 feet bls using mud-rotary drilling techniques.
09/22/15	Installed 20-inch diameter steel surface casing to a depth of 300 feet bls.
09/23/15	Completed cementing the 20-inch diameter surface casing to land surface with a total of 657 sacks of neat cement grout.
10/19/15	Drilled 12-inch diameter pilot-hole to a depth of 1,155 feet bls using reverse-air drilling techniques.
10/20/15	Geophysical logging was conducted including gamma ray, x-y caliper, dual induction, sonic, fluid conductivity, and temperature.
11/12/15	Completed reaming pilot hole to a diameter of 18.75-inches to a depth of 1,147 feet bls.
11/13/15	Geophysical logging was conducted on the reamed borehole including gamma ray and x-y caliper.
11/17/15	Installed 12-inch diameter steel intermediate casing to a depth of 1,140 feet bls.
11/19/15	Completed cementing the 12-inch diameter intermediate casing to land surface with a total of 1,360 sacks of cement grout.
12/30/15	Successfully collected 1-foot core sample from 1,432 feet to 1,433 feet bls in dolostone.
01/19/16	Completed 11.875-inch pilot hole drilling to 1,680 feet bls.
01/22/16	Geophysical logging was conducted including gamma ray, x-y caliper, dual induction, sonic, fluid conductivity, flow meter, and temperature.
01/25/16	Completed off-bottom packer test over the interval from 1,650 - 1,680 feet.
01/28/16	Installed 6-inch diameter steel final casing to a depth of 1,650 feet bls.
02/15/16	Completed cementing the 6-inch diameter final csing to land surface with a total of 2,293 sacks of neat cement grout and 2,263 sacks of 6%.
06/23/16	Completed well development and background water quality sampling.
07/07/16	Completed final geophysical logging including caliper, gamma ray, dual induction, sonic, SP, fluid conductivity, temperature.
07/15/16	Completed Well Head and Site Restoration.

TABLE 2-2
Exploratory Well ASR-1
Summary of Casing Setting Depths and Cement Quantities

Casing	Casing Material	Outside Diameter (inches)	Inside Diameter (inches)	Casing Thickness (inches)	Casing Depth (feet bpl)	Date	Cement Stage	Type of Cement	Quantity of Cement (sacks)	Base of the Cemented Interval (feet bpl)	Theoretical Fill (feet)	Actual Fill (feet)	Percent Fill	Remarks
Pit Casing	Steel	36.00	35.25	0.375	48	1/28/2015	NA	neat	50	NA	NA	NA	NA	Installed with auger rig
Surface Casing	Steel	28.00	27.25	0.375	313	3/12/2015	#1	neat	395	313	213	178	84%	Pressure grout from bottom of casing
						3/13/2015	#2	neat	262	135	135	135	100%	Tremied from 121 feet bls
Intermediate Casing	Steel	20.00	19.25	0.375	1,380	6/24/2015	#1	neat	495	1,380	350	92	26%	Tremied from 1,370 feet bls
						6/26/2015	#2	neat	600	1,288	378	98	26%	Tremied from 1,250 feet bls
						6/29/2015	#3	6%	542	1,190	490	8	2%	Tremied from 1170 feet bls
						6/30/2015	#4	6%	568	1,182	519	191	37%	Tremied from 1160 feet bls
						6/30/2015	#5	6%	601	991	421	288	68%	Tremied from 960 feet bls
						7/1/2015	#6	12%	529	703	333	75	23%	Tremied from 690 feet bls
						7/6/2015	#7	pea gravel	NA	628	26	26	100%	Pea gravel added with water
						7/6/2015	#8	12%	642	602	492	19	4%	Tremied from 600 feet bls
						7/6/2015	#9	pea gravel	NA	583	63	63	100%	Pea gravel added with water
						7/7/2015	#10	6%	512	520	330	191	58%	Tremied from 500 feet bls
						7/7/2015	#11	neat	561	329	329	318	97%	Tremied from 300 feet bls
Final Casing	Steel	12.75 and 14.00	11.75 and 13	0.500	1,650	11/24/2015	#1	neat	95	1,650	90	14	16%	Tremied from top of the cement basket at 1,648 feet bls.
						11/25/2015	#2	neat	48	1,636	41	25	61%	Tremied from 1,630 feet bls
						11/30/2015	#3	neat	661	1,611	655	40	6%	Tremied from 1,605 feet bls
						12/1/2015	#4	neat	661	1,571	671	123	18%	Tremied from 1,565 feet bls
						12/2/2015	#5	neat	699	1,497	662	0	0%	Tremied from 1,490 feet bls
						12/3/2015	#6	gravel	NA	1,497	NA	8	NA	Tremied from 1,490 feet bls
						12/3/2015	#7	neat	695	1,489	704	10	1%	Tremied from 1,480 feet bls
						12/4/2015	#8	neat	709	1,479	719	57	8%	Tremied from 1,470 feet bls
						12/7/2015	#9	neat	771	1,422	792	642	81%	Tremied from 1,410 feet bls
						12/8/2015	#10	neat	771	780	780	697	89%	Tremied from 770 feet bls
						12/9/2015	#11	neat	81	83	83	83	100%	Tremied from 70 feet bls
								Total Neat	**7,554**					
								Total 4% and 6%	**2,223**					
								Total 12%	**529**					
								Total	**10,306**					

bls = below land surface

Table 2-3
City of St. Cloud SSWWTF Well ASR-1
ASR-1 Borehole Deviation Survey Record (7.0 degree disk)

Pilot Hole Drilling				Pilot Hole Reaming			
Date	Depth (ft)	Deviation (°)	Comments	Date	Depth (ft)	Deviation (°)	Comments
3/3/2015	90	< 1		3/6/2015	90	<1	
3/4/2015	180	< 1		3/9/2015	180	<1	
3/4/2015	270	< 1		3/10/2015	270	<1	
3/19/2015	360	< 1		4/14/2015	360	0	
3/20/2015	450	< 1		4/15/2015	450	<1	
3/23/2015	540	1		4/24/2015	540	<1	
3/24/2015	630	<1			630		
3/27/2015	720	0			720		
3/29/2015	810	0		5/29/2015	820	<1	
3/29/2015	900	1		6/1/2015	910	<1	
3/30/2015	990	<1		6/5/2015	1000	0	
3/31/2015	1080	<1		6/8/2015	1090	<1	
4/1/2015	1170	<1			1180	<1	
4/2/2015	1260	<1		6/16/2015	1270	<1	
4/6/2015	1350	<1		6/18/2015	1350	<1	
7/10/2015	1440	<1					
7/14/2015	1530	1					
7/15/2015	1620	<1					
7/20/2015	1710	0					
7/20/2015	1800	0					
7/23/2015	1890	1					
7/29/2015	1980	0					
7/31/2015	2070	1					
8/5/2015	2160	1					
8/11/2015	2250	1					
8/7/2015	2340	1					
8/11/2015	2430	<1					
8/14/2015	2520	0					
8/21/2015	2610	<1					
8/21/2015	2700	1					

TABLE 2-4

CASING PRESSURE TEST

Project: City of St. Cloud Southside WWTF

Well No. and Casing: Well ASR-1 12/14-inch Steel **Casing Depth:** 1,650 feet bls

Date: Monday December 21, 2015

Time	Total Minutes	Header Pressure (PSIG)	Comments
08:15	0	112.5	Start test, 5% is 5.625 psi
08:20	5	112.5	0 psi change
08:25	10	112.5	0 psi change
08:30	15	112.25	0.25 psi loss
08:35	20	112.25	0.25 psi loss
08:40	25	112.25	0.25 psi loss
08:45	30	112.25	0.25 psi loss
08:50	35	112.25	0.25 psi loss
08:55	40	112	0.5 psi loss
09:00	45	112	0.5 psi loss
09:05	50	112	0.5 psi loss
09:10	55	112	0.5 psi loss
09:15	60	112	0.5 psi loss, after one hour
			Test Passed

ASRus Witness:

Martin J. Clasen

_____

TABLE 2-5

Monitoring Well SZMW-1

Summary of Casing Setting Depths and Cement Quantities

Casing	Casing Material	Outside Diameter (inches)	Inside Diameter (inches)	Casing Thickness (inches)	Casing Depth (feet bpl)	Date	Cement Stage	Type of Cement	Quantity of Cement (sacks)	Base of the Cemented Interval (feet bpl)	Theoretical Fill (feet)	Actual Fill (feet)	Percent Fill	Remarks
Pit Casing	Steel	30.00	29.25	0.375	50	2/2/2015	NA	neat	NA	NA	NA	NA	NA	Installed with auger rig
Surface Casing	Steel	20.00	19.25	0.375	300	9/22/2015	#1	neat	571	300	300	271	90%	Pressure grout from 270 feet bls
						9/23/2015	#2	neat	67	29	29	29	100%	Tremied from 20 feet bls
								Total	638					
Intermediate Casing	Steel	12.75	12.00	0.375	1,140	11/17/2015	#1	neat	381	1,140	380	451	119%	Pressure grout from 1,130 feet bls
						11/18/2015	#2	6%	389	689	504	474	94%	Tremied from 680 feet bls
						11/18/2015	#3	neat	476	215	215	92	43%	Tremied from 200 feet bls
						11/19/2015	#4	neat	114	123	123	123	100%	Tremied from 120 feet bls
								Total	1360					971 sacks neat, 389 sacks 6%
Final Casing	Steel	6.625	6.07	0.280	1,650	1/28/2015	#1	Neat	5	1,650	10	0	0	Tremied from 1,640 feet bls
						1/29/2015	#2	Neat	5	1,650	40,383	2	0	Tremied from 1,640 feet bls
						2/1/2016	#3	Neat	10	1,648	18	8	44	Tremied from 1,640 feet bls
						2/3/2016	#4	Neat	50	1,640	110	32	29	Tremied from 1,630 feet bls
						2/4/2016	#5	Neat	157	1,608	308	29	9	Tremied from 1,600 feet bls
						2/4/2016	#6	Neat	157	1,579	309	3	1	Tremied from 1,570 feet bls
						2/5/2016	#7	Neat	162	1,576	320	4	1	Tremied from 1,570 feet bls
						2/5/2016	#8	6% bentonite	162	1,572	316	1	0	Tremied from 1,560 feet bls
						2/8/2016	#9	gravel	NA	1,571	NA	9	NA	Added from surface
						2/8/2016	#10	6% bentonite	155	1,562	342	4	1	Tremied from 1,550 feet bls
						2/9/2016	#11	6% bentonite w/ N-SEAL	155	1,558	328	38	12	Tremied from 1,550 feet bls
						2/9/2016	#12	6% bentonite w/ N-SEAL	155	1,520	330	9	3	Tremied from 1,490 feet bls
						2/10/2016	#13	6% bentonite w/ N-SEAL	155	1,511	341	1	0	Tremied from 1,490 feet bls
						2/10/2016	#14	gravel	NA	1,511	NA	33	NA	Added from surface
						2/10/2016	#15	6% bentonite w/ N-SEAL	155	1,478	338	1	0	Tremied from 1,470 feet bls
						2/11/2016	#16	gravel	NA	1,477	NA	22	NA	Added from surface
						2/11/2016	#17	6% bentonite w/ N-SEAL	155	1,455	345	76	22	Tremied from 1,440 feet bls
						2/11/2016	#18	6% bentonite w/ N-SEAL	155	1,379	349	80	23	Tremied from 1,350 feet bls
						2/12/2016	#19	6% bentonite w/ N-SEAL	155	1,299	350	20	6	Tremied from 1,290 feet bls
						2/12/2016	#20	6% bentonite w/ N-SEAL	87	1,279	350	17	5	Tremied from 1,260 feet bls
						2/15/2016	#21	6% bentonite w/ N-SEAL	145	1,262	362	118	33	Tremied from 1,250 feet bls
						2/15/2016	#22	240 sks 6%, 138 sks neat	378	1,144	1,144	1144	100	Tremied from 1,1350 feet bls
								Total	2558					684 sks neat, 1,874 sks 6%
								Total Neat	**2,293**					
								Total 6%	**2,263**					
								Total	**4,556**					

bls = below land surface

TABLE 2-6

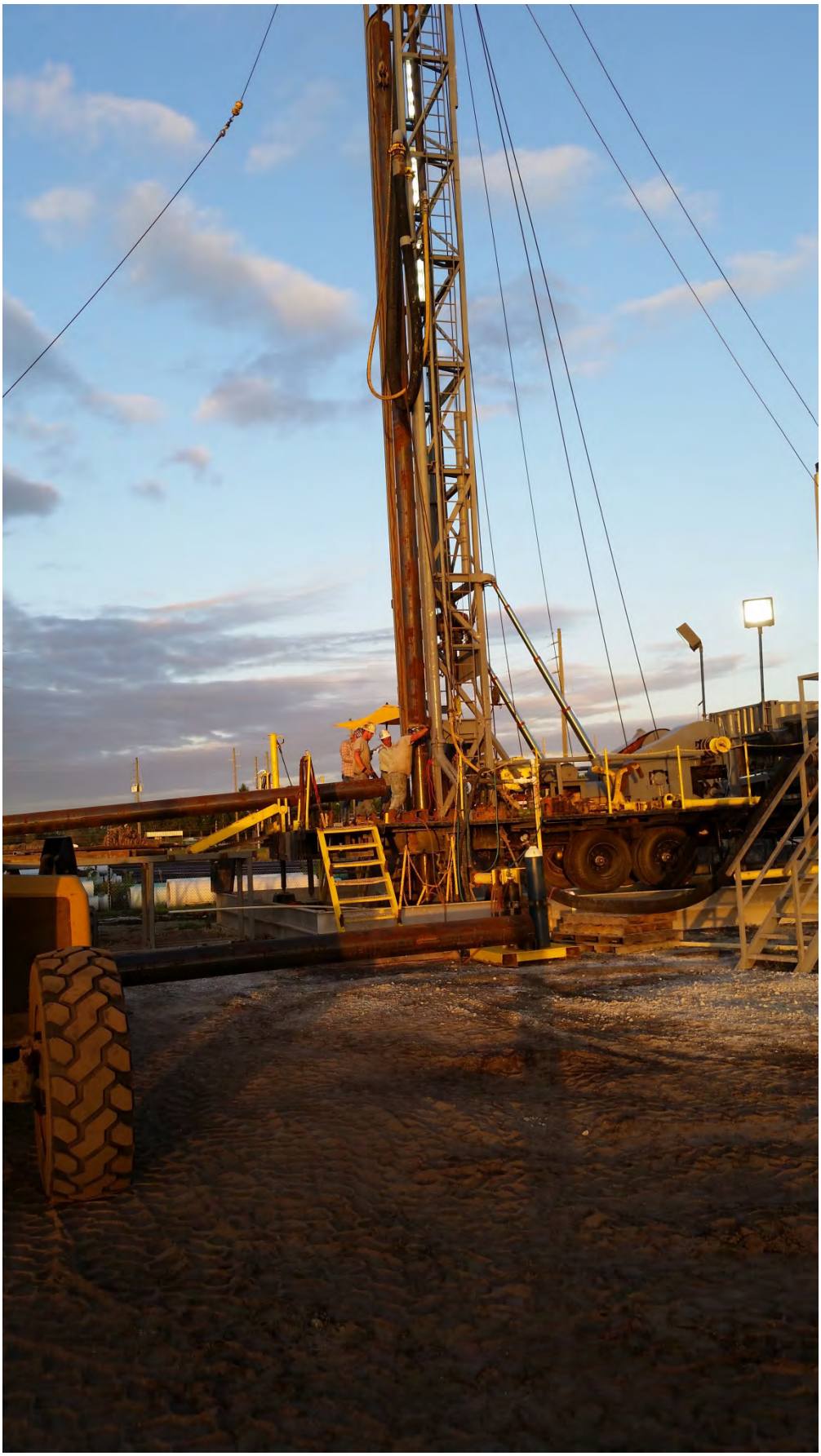
Monitoring Well SMW-1

Summary of Casing Setting Depths and Cement Quantities

Casing	Casing Material	Outside Diameter (inches)	Inside Diameter (inches)	Casing Thickness (inches)	Casing Depth (feet bpl)	Date	Cement Stage	Type of Cement	Quantity of Cement (sacks)	Base of the Cemented Interval (feet bpl)	Theoretical Fill (feet)	Actual Fill (feet)	Percent Fill	Remarks
Pit Casing	Steel	30.00	29.25	0.375	50	1/19/2015	NA	NA	NA	NA	NA	NA	NA	Installed with auger rig
Surface Casing	Steel	20.00	19.25	0.375	320	3/3/2016	#1	neat	476	320	270	283	105%	Tremied from 290 feet bls
						3/4/2016	#2	neat	72	37	37	37	100%	Tremied from 20 feet bls
								Total	548					
Final Casing	Steel	12.75	11.75	0.50	1,480	5/5/2016	#1	neat	528	1,480	518	21	4%	Pressure grout
						5/6/2016	#2	neat	714	1,459	729	20.0	3%	Tremied from 1450 feet bls
						5/9/2016	#3	neat	571	1,439	559	5	1%	Tremied from 1430 feet bls
						5/9/2016	#4	neat	200	1,434	209	3	1%	Tremied from 1424 feet bls
						5/10/2016	#5	neat	290	1,431	311	0	0%	Tremied from 1421 feet bls
						5/10/2016	#6	gravel	NA	1,431	36	36	100%	Pea gravel added
						5/10/2016	#7	neat	309	1,395	325	16	5%	Tremied from 1385 feet bls
						5/11/2016	#8	6%	342	1,379	479	52	11%	Tremied from 1369 feet bls
						5/11/2016	#9	6%	349	1,327	477	115	24%	Tremied from 1317 feet bls
						5/12/2016	#10	6%	359	1,212	482	229	48%	Tremied from 1200 feet bls
						5/12/2016	#11	6%	346	983	448	286	64%	Tremied from 970 feet bls
						5/13/2016	#12	12%	522	697	687	28	4%	Tremied from 685 feet bls
						5/16/2016	#13	gravel	NA	669	91	91	100%	Pea gravel added
						5/16/2016	#14	6%	309	578	363	73	20%	Tremied from 565 feet bls
						5/17/2016	#15	6%	346	505	455	251	55%	Tremied from 495 feet bls
						5/17/2016	#16	neat	295	254	254	254	100%	Tremied from 240 feet bls, to surface
								Total Neat	**3,455**					
								Total 6%	**2,051**					
								Total 12%	**522**					
								Total	**6,028**					

bls = below land surface

City of St. Cloud **Class V Injection Well System**	JONES EDMUNDS ASR US LLC	Pad Monitoring Well Auger Rig	DATE 10/30/16 **FIGURE 2-1**



City of St. Cloud **Class V Injection Well System**	JONES EDMUNDS ASR US, LLC	Trailer-mounted Drilling Rig	DATE 10/30/16 Figure 2-2

City of St. Cloud **Class V Injection Well System**	JONES EDMUNDS ASR US LLC	Electric Drilling Rig	DATE 10/30/16 **FIGURE 2-3**

City of St. Cloud **Class V Injection Well System**	JONES EDMUNDS ASR US LLC	Shale Shaker and Mud System	DATE 10/30/16 **FIGURE 2-4**

City of St. Cloud **Class V Injection Well System**	JONES EDMUNDS ASR US LLC	28-inch Surface Casing Installation	DATE 10/30/16 **FIGURE 2-5**

City of St. Cloud **Class V Injection Well System**	JONES EDMUNDS ASR US LLC	ASR-1 20-inch Intermediate Casing Installation	DATE 10/30/16 **FIGURE 2-6**

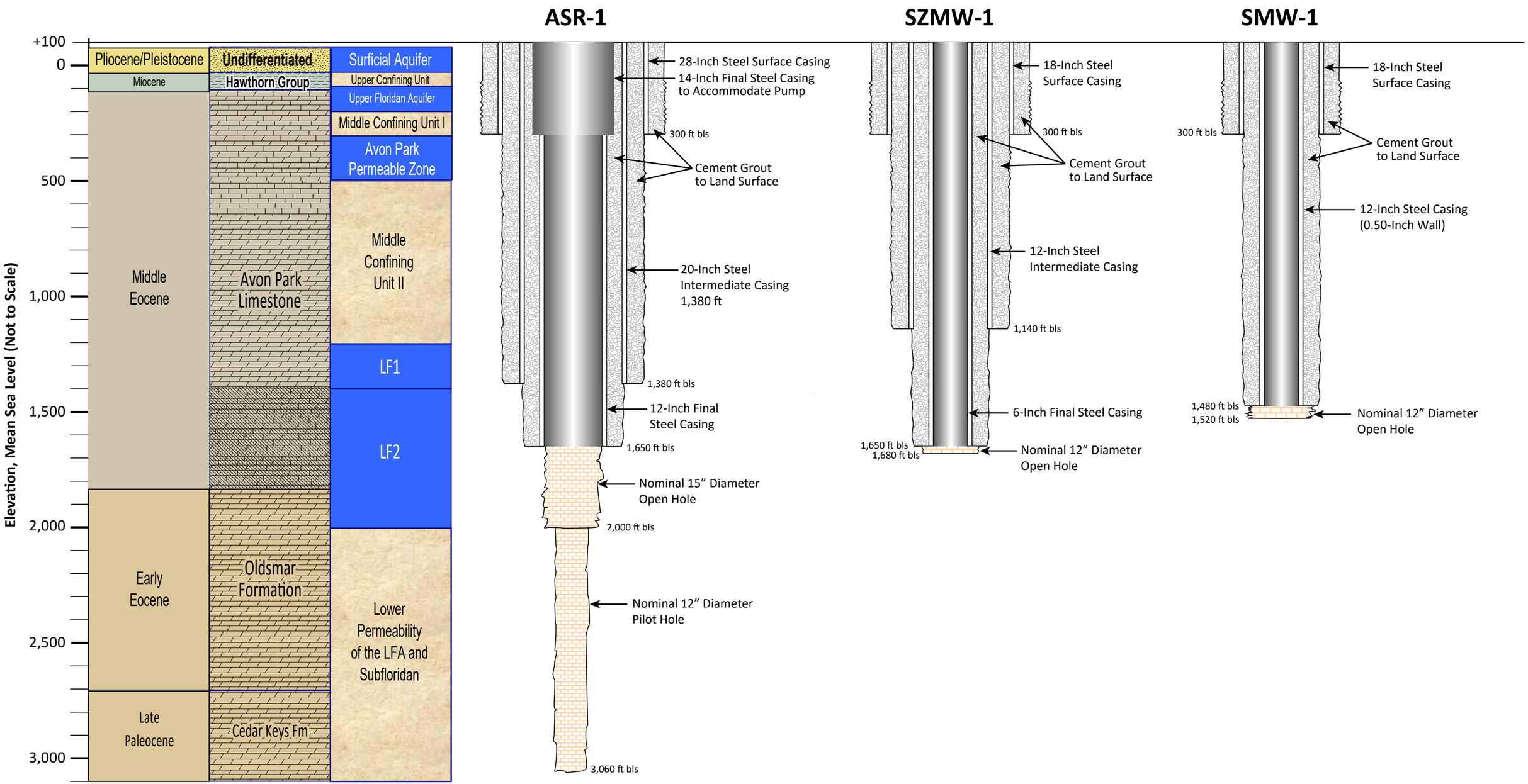


FIGURE 2-7
Geologic Profile and Well Construction Details at the City of St. Cloud Southside WWTF ASR System

3.0 Hydrogeologic Data and Analysis

An extensive hydrogeologic data collection program was undertaken during construction of the exploratory well with the objective of obtaining the hydrogeologic information necessary to identify an acceptable ASR zone and to assist in a feasibility assessment of an ASR system in the area of interest. The hydrogeologic data consisted of the following: formation (lithologic) sampling, water quality sampling, hydraulic testing (packer tests), rock coring and geophysical logging. Regional and site-specific data are presented in the sections below.

3.1. Geologic and Hydrogeologic Framework

The City of St. Cloud Southside Wastewater Treatment Facility (SSWWTF) is located in the center of the Penholoway Terrace geomorphic province of central Osceola County (**Figure 3-1**). The major landforms in Osceola County evolved during Pleistocene time and consist of marine terraces. Terraces are steplike, extensive flatlands, bordered by scarps and ridges formed by ancient seas that stood at different levels. The shape of the land surface has not been modified much since Pleistocene times (Shiner, 1993). The Penholoway Terrace is a low, irregular terrace produced by the erosion of soluble sediments. Elevations of the Penholoway Terrace that lie within Osceola County range from 40 to about 85 feet above the National Geodetic Vertical Datum of 1929 (NGVD). The site lies in the Kissimmee River drainage basin and is between two large lakes, Lake Tohopekaliga and East Lake Tohopekaliga. Elevations in the area of the SSWWTF are approximately 70 to 80 feet above NGVD.

3.1.1. Site Stratigraphy

Osceola County is underlain by a thick sequence of sedimentary rocks. These sediments are predominantly of shallow-water marine origin and are composed of limestone, dolostone, evaporite, clay, and sand that range in age from Late Cretaceous to Holocene. The major stratigraphic units of interest in Osceola County, from oldest to youngest, are: the Cedar Keys Formation of late Paleocene age, the Oldsmar Formation of early Eocene age, the Avon Park Formation of middle Eocene age, the Ocala Limestone of late Eocene age, the Hawthorn Group of late Oligocene to Miocene age, and the undifferentiated surficial deposits of Pliocene to Holocene ages (Schiner, 1993). The regional stratigraphy and hydrostratigraphy is shown on **Figure 3-2** (O'Reilly and Spechler, 2002).

The basal Tertiary unit within Osceola County is the Cedar Keys Formation of late Paleocene age (**Figure 3-2**). The Cedar Keys Formation generally has extremely low permeability, and thus, functions as the sub-Floridan confining unit at the base of the

Floridan aquifer system. A site specific cross section is included as **Figure 3-3**. The top elevation of the Cedar Keys Formation at the site is estimated to occur at approximately -2,500 feet NGVD (Miller, 1986). Conformably overlying the Cedar Keys Formation is the Oldsmar Formation of early Eocene age. It is composed mostly of limestone and dolostone that in places contains inclusions of gypsum and anhydrite. These evaporites were deposited in shallow, restricted marine basins on emergent areas of the Florida Platform during lower sea-level stands. The elevation of the top of the Oldsmar Formation near the SSWWTF is estimated to occur at approximately -1,863 feet NGVD based on a gamma ray peak from well ASR-1.

The Avon Park Formation, a thick sequence of marine limestone and dolostone, overlies the Oldsmar Formation and is characterized by alternating layers of soft to well-indurated, fossiliferous, tan to light-brown limestone and brown, crystalline dolostone. The upper portion of the Avon Park Formation typically is highly fractured and cavernous. Inclusions of gypsum and anhydrite nodules also occur within the lower part of the Avon Park Formation. The top of the Avon Park Formation was evident at approximately -262 feet NGVD based on the first occurrence of the foraminifera Dictyoconus americanus.

In some parts of Osceola County the Ocala Limestone overlies the Avon Park Formation. The Ocala Limestone was identified at the SSWWTF from -222 feet NGVD to -262 feet NGVD based on the foraminifera Lepidocyclina.

Unconformably overlying the Ocala Limestone is the Hawthorn Group of late Oligocene to Miocene age. In southern peninsular Florida, the Hawthorn Group includes, in ascending order, the Arcadia and Peace River Formations (Scott, 1988). The Arcadia Formation is composed of limestone and dolostone containing varying amounts of quartz sand, clay, and phosphate grains. Thin beds of quartz sand and clay are scattered throughout the section and generally are calcareous or dolomitic and phosphatic. The Peace River Formation is composed of interbedded quartz sand, clay, and carbonates, with variable amounts of phosphate. Siliciclastics, however, are the predominant lithology, comprising more than two-thirds of the formation (Scott, 1988). The thickness of the Hawthorn Group at the SSWWTF is approximately 260 feet and occurs from 38 feet NGVD to -222 feet NGVD. The Hawthorn Group is composed of unconsolidated shell beds, soft non-indurated clay, silt, and quartz phosphatic sand units.

Overlying the Hawthorn Group are the undifferentiated clastic (surficial) deposits of Pliocene to Holocene age. The undifferentiated surficial deposits consist primarily of unconsolidated quartz sands and varying amounts of shell, limestone, and clay. At the SSWWTF, at well ASR-1, the undifferentiated clastics occur from 78 feet NGVD to 38 feet NGVD and are about 40 feet thick.

3.1.2. Site Hydrogeology

In the area of the SSWWTF, the uppermost water-bearing unit is the surficial aquifer, which is approximately 40 feet thick. The surficial aquifer is underlain by and separated from the Floridan Aquifer System (FAS) by the Intermediate Confining Unit (ICU). The intermediate confining unit consists of Hawthorn Group confining sediments that restrict the movement of water between the overlying and underlying aquifers. The lowermost water-bearing unit is the FAS. The aquifer systems are discussed below.

3.1.2.1. Surficial Aquifer

The surficial aquifer is unconfined and consists of unconsolidated clastic deposits that range in age from Pliocene to Holocene. The surficial aquifer is recharged primarily by infiltration of rainfall. Much of the rainfall drains into streams or is lost to evapotranspiration. The remaining rainfall percolates into the unsaturated surficial deposits and recharges the surficial aquifer. Most of the water in the surficial aquifer flows vertically to recharge the Upper Floridan aquifer (UFA), although there is a lateral component of flow. The lateral direction of groundwater flow is typically governed by topography, flowing from areas of higher elevation to lower areas such as streams, lakes, or wetlands (Spechler and Kroening, 2007). Thickness of the surficial aquifer in the area of the SSWWTF near well ASR-1 averages approximately 40 feet.

3.1.2.2. Intermediate Confining Unit and Intermediate Aquifer System

The ICU consists of confining units extending from the base of the surficial aquifer to the top of the UFA. The Intermediate Aquifer System (IAS) consists of unconsolidated shell beds, soft non-indurated clay, silt, and quartz phosphatic sand units. The confining units are highly variable both spatially and vertically. As a whole, the entire system restricts vertical movement of groundwater between the overlying surficial aquifer and underlying Floridan aquifer. The approximate thickness of the ICU at the St. Cloud test site is approximately 260 feet based on well ASR-1.

3.1.2.3. Floridan Aquifer System

The FAS underlies all of Florida and parts of Alabama, Georgia, and South Carolina. The FAS, as defined by Miller (1986), is a vertically continuous sequence of carbonate rocks of generally high permeability that are mostly of Tertiary age. The rocks are hydraulically connected in varying degrees, and their permeability generally is one order to several orders of magnitude greater than that of the units bounding the system above and below. The FAS is divided into two aquifers of relatively high permeability—the UFA and the Lower Floridan aquifer (LFA).

3.1.2.3.1. Upper Floridan Aquifer

Below the ICU are water-bearing units of the UFA. The UFA is the principal source of groundwater in Osceola County. The surface of the UFA is the remnant of an ancient karst plain, and generally exhibits considerable irregularity throughout Osceola County. The top of the UFA at the SSWWTF is approximately 222 feet below NGVD based on the first occurrence of the Ocala Limestone. Recharge areas for the UFA cover much of Osceola County, and include wetlands, swamps, closed basins and sinkholes. The UFA is recharged by downward movement of water through the surficial and intermediate aquifer systems (Spechler and Kroening, 2007).

The lowermost permeable zone of the UFA was previously defined as occurring in the hard, fractured dolostone within the Avon Park Formation. The permeability of the Upper Avon Park Formation is due primarily to fractures and interconnecting solution cavities. This permeable zone has been recently identified by Reese and Richardson (2007) as the Avon Park permeable zone. The Avon Park permeable zone usually lies between the UFA and LFA and within the middle confining unit. This sub-aquifer is present over most of southern peninsular Florida and characteristically consists of thick units of dolostone and interbedded limestone, and limestone in its upper part. Permeability is primarily associated with fracturing. The elevation of the Avon Park permeable zone at the SSWWTF occurs from approximately -452 feet to -602 feet NGVD based on lithologic samples and geophysical logs from well ASR-1.

3.1.2.3.2. Middle Confining Unit

The middle confining unit of the Floridan aquifer system underlies the UFA, and in most of the study area, is divided into upper (MCI) and lower (MCII) parts that are separated by the Avon Park permeable zone (discussed above). Despite the name, in most of the study area the middle confining unit is semi-confining or leaky in nature and generally consists of micritic limestone (wackstone to mudstone), dolomitic limestone, and dolomite or dolostone. The upper boundary of middle confining unit I (MCI) is placed at or near the upper contact of the Ocala Limestone in west central Florida. The top of MCI in the area of the SSWWTF is approximately -272 feet NGVD and extends to approximately -452 feet NGVD. Middle confining unit II (MCII) generally corresponds to the lower part of the Avon Park Formation and is typically considerably less permeable than the overlying MCI. The top of middle confining unit II at the SSWWTF is at approximately -602 feet NGVD and extends to approximately -1,162 feet NGVD.

3.1.3. Lower Floridan Aquifer

The LFA is present throughout Osceola County and underlies the middle confining unit. Because the water within the LFA is thought to be highly mineralized throughout much of the county, and sufficient amounts of water can be obtained from the UFA, few wells have been drilled into the LFA. Consequently, less is known of the hydrologic properties or the chemical quality of water of the LFA within Osceola County.

The LFA generally is present within the lower part of the Avon Park Formation, the Oldsmar Formation, and the upper part of the Cedar Keys Formation (**Figure 3-2**). The elevation of the top of the LFA at the SSWWTF is approximately -1,162 feet NGVD (**Figure 3-3**), and the estimated thickness is approximately 740 feet at well ASR-1. The top of the Oldsmar Formation at well ASR-1 was noted at 1,863 feet below NGVD by the presence of a gamma ray high.

The LFA at the SSWWTF consisted of a permeable zone (LF-1) from -1,162 feet to -1,522 feet NGVD, a semi-confining unit from -1,522 feet to -1,587 feet NGVD, and a permeable zone (LF-2) from -1,587 feet to -1,902 feet NGVD.

LF-2 is a tremendously high producing zone and was logged in the LFA from a 26-foot cavern beginning at 1,587 feet below NGVD to 1,902 feet below NGVD. The 315-foot thick zone consists of highly fractured dolostone and is similar to the so called "Boulder Zone" in south Florida.

3.1.3.1. Sub-Floridan Confining Unit

Underlying the LFA are low-permeability dolostone and limestone containing abundant evaporite minerals that form the sub-Floridan confining unit. The top of this unit is defined as the uppermost stratigraphic occurrence of persistent evaporite deposits in the upper part of the Cedar Keys Formation. The depth of the sub-Floridan confining unit in the area of the SSWWTF is approximately -2,452 feet NGVD. The exploratory pilot hole at the SSWWTF was drilled to the top of the sub-Floridan confining unit so that all LFA units were identified and characterized. Very poor quality water containing greater than 121,000 mg/L TDS was encountered at a depth of approximately -2,982 feet NGVD.

3.1.3.2. Groundwater Flow

Groundwater flow on a regional scale for the LFA is mapped by the U.S. Geological Survey (USGS). A portion of the potentiometric surface map for September 1998 (O'Reilly and Spechler, 2002) is included as **Figure 3-4**, and shows that UFA groundwater flow in the vicinity of the SSWWTF is from southwest to northeast.

3.2. Formation Sampling

Formation (lithologic) samples were obtained during the drilling operations of the exploratory well. These samples were collected at ten-foot intervals throughout the total depth of the exploratory well. The formation samples were collected from the discharge line during mud rotary and reverse-air drilling. FDD provided one set of formation samples to the engineer and stored a second set of samples on-site for the FDEP, which were shipped to the Florida Geological Survey (FGS) upon well completion.

Formation samples were described on the basis of composition, color, texture, visible porosity, fossil content and structure. Analyses of the formation samples were used to prepare a lithologic log of the wells at the site. A copy of the complete lithology log for the exploratory well is presented in **Appendix F**.

Estimates of geologic formation and aquifer unit contacts were made from the lithologic logs and geophysical logging data collected from the exploratory well pilot hole. The Hawthorn Group extends from a depth of 40 feet to 300 feet. During the utilization of the mud rotary drilling techniques during the initial 300 feet of the well pilot-hole construction, water quality samples are not collected due to the presence of mud within the samples.

3.3. Rock Cores

Three rock core samples were attempted from the confining unit (MCUII) above the proposed injection zone while drilling well ASR-1. No usable core sections were recovered due to the highly fractured nature of the rock. One rock core was successfully collected while drilling well SZMW-1 from 1,432 feet to1,440 feet bls. The rock core was collected by advancing the pilot hole to the targeted coring depth, tripping out the drill bit, tripping in the core barrel and cutting the core sample with a diamond core bit.

A representative section of the core interval was submitted to the Ardaman and Associates, Inc. Geotechnical Laboratory in Orlando, Florida for analysis of selected physical and hydraulic parameters including specific horizontal and vertical permeability, total porosity, specific gravity, Young's modulus/elastic formation factor, Archie's cementation exponent and coefficient, and rock compressibility. Results are shown in **Table 3-1**. Laboratory reports are included in **Appendix L**. Laboratory results show a vertical permeability of 1.4×10^{-6} cm/sec.

3.4. Hydraulic Testing

Hydraulic testing performed during the exploratory well construction project consisted of thirteen packer tests on well ASR-1, a short-term pump out test, and a short-term specific injectivity test. Discharge water generated during the packer tests was pumped to two 50,000 gallon portable bladder tanks for temporary storage and subsequently pumped back down the injection well. Both single off-bottom packer tests and straddle packer tests were conducted and generally consisted of pumping the testing interval until water quality stabilized followed by at least three hours of recovery.

3.4.1. ASR-1 Packer Tests

Thirteen packer tests were completed in the exploratory well (ASR-1). A packer is used to isolate intervals within a borehole so that data can be obtained from a discrete zone. The packer is inserted into the borehole and hydraulically inflated, creating a seal against the borehole wall. The tubing from which the packer is attached is open through the center of the packer allowing for water to be removed from the isolated zone. Single packer or off-bottom packer tests were used to test the interval from the center of the packer to the bottom of the borehole. Three off-bottom packer tests (PT-1, PT-2, and PT-3) were conducted. The off-bottom packer tests were used to define the specific capacity and water quality of the open borehole from the bottom of the hole at 1,405 feet bls (at the time of packer testing) up to 706 feet bls. Straddle packer tests were also conducted. Straddle packer tests use two packers separated by perforated pipe. Pumping inside the drill pipe measured the specific capacity of the zone between the two packers. Additionally, five annulus packer tests (PT-4A, PT-5A, PT-6A, PT-7A, and PT-8A) were conducted to define the characteristics of the open borehole above the top packer to the bottom of the intermediate casing set at a depth of 1,380 feet bls.

For the annular packer tests, the zone above the packer was tested by installing a submersible pump in the annulus between the 20-inch intermediate casing and the drill pipe the packer was installed on. Nine-inch diameter Baski packers (expandable to 17-inches) were used for the packer testing along with an InSitu data logger with a transducer inside the drill pipe to measure drawdown and recovery of water levels and a second transducer in the annulus to check for any apparent packer leaks (and measure drawdown in the annulus tests). A summary of the packer testing results is shown in **Table 3-2**. Specific capacity estimates are based on water level recovery data when possible, which is more representative of the water quality and water levels in the aquifer. Packer test data are included in **Appendix G**.

3.4.1.1. ASR-1 PT-1 1,064 feet to 1,405 feet

The first packer was set at 1,064 feet bls when the pilot hole had been drilled to 1,405 feet bls. The tested zone was a 341-foot interval from 1,064 feet to 1,405 feet bls. The

test was conducted to determine the specific capacity and water quality of the LF-1 permeable zone. The interval was pumped for six hours at a pumping rate of approximately 116 gpm. Water level drawdown was recorded at 6.15 feet and the specific capacity was calculated at 18.9 gpm/ft (116 gpm/6.15 feet). The water quality stabilized during pumping with a field specific conductance value of 609 microSiemens per centimeter (µS/cm).

3.4.1.2. ASR-1 PT-2 872 feet to 1,405 feet

The second packer test was conducted with a single off-bottom packer set at a depth of 872 feet. The tested zone was a 533-foot interval from 872 feet to 1,405 feet bls. The test was conducted to test the semi-confining unit below LF-1. The interval was pumped for four hours at a pumping rate of approximately 116 gpm. Water level drawdown was recorded at 5.25 feet. The specific capacity of the zone was 22.1 gpm/ft, suggesting the interval from 872 feet to 1,064 feet produces water with a an approximate capacity of 3.2 gpm/ft (22.1 gpm/ft – 18.9 gpm/ft from PT-1). The water quality stabilized during pumping with a field specific conductance value of 610 µS/cm.

3.4.1.3. ASR-1 PT-3 706 feet to 1,405 feet

The third packer test was conducted with a single off-bottom packer set at a depth of 706 feet bls. The tested zone was a 699-foot interval from 706 feet to 1,405 feet bls. The test was conducted to test the semi-confining unit above LF-1. The interval was pumped for three hours at a pumping rate of approximately 126 gpm. Water level drawdown was recorded at 4.64 feet. The specific capacity of the zone was 27.2 gpm/ft, suggesting the interval from 706 feet to 872 feet produces water with a an approximate capacity of 5.1 gpm/ft (27.2 gpm/ft – 22.1 gpm/ft). The pumping test was run until water quality began to stabilize. The water quality stabilized during pumping with a field specific conductance of approximately 612 µS/cm.

3.4.1.4. ASR-1 PT-4 1,616 feet to 1,652 feet

The fourth packer test was conducted with a straddle packer testing the interval between 1,616 feet and 1,652 feet bls. The test was conducted to determine the specific capacity of the zone between the packers and estimate potential confinement. The interval was pumped for five hours at a pumping rate of approximately 84.6 gpm. Water level drawdown was recorded at 14.34 feet. The specific capacity of the zone was estimated at 5.9 gpm/ft, suggesting the interval from 1,616 feet to 1,652 is not a significant confining unit. The pumping test was run until water quality began to stabilize. The water quality stabilized during pumping with a field specific conductance of approximately 4,250 µS/cm. Laboratory TDS was reported as 2,660 mg/L.

3.4.1.5. ASR-1 PT-4A 1,380 to 1,616 feet

The first annulus packer test (PT-4A) was conducted to test the interval above the upper packer. The upper packer was set at a depth of 1,616 feet bls. The intermediate casing was installed to a depth of 1,380 feet bls; therefore, PT-4A tested the interval from 1,380 feet to 1,616 feet bls. The interval was pumped for 5 hours at a pumping rate of approximately 131 gpm. Water level recovery was recorded at 0.08 feet. The specific capacity of the zone was estimated at approximately 1,600 gpm/ft. The pumping test was run until water quality began to stabilize. The water quality stabilized during pumping with a field specific conductance of approximately 2,475 µS/cm. Laboratory Total Dissolved Solids (TDS) was reported as 1,570 mg/L.

3.4.1.6. ASR-1 PT-5 1,591 to 1,627 feet

The fifth packer test was conducted with a straddle packer testing the interval between 1,591 feet and 1,627 feet bls. The test was conducted to determine the specific capacity and water quality of the zone between the packers and estimate potential for an ASR recharge zone. The interval was pumped for five hours at a pumping rate of approximately 131.5 gpm. Water level drawdown was recorded at 11.14 feet. The specific capacity of the zone was estimated at 11.8 gpm/ft, suggesting the zone could potentially be used for ASR. The pumping test was run until water quality began to stabilize. The water quality stabilized during pumping with a field specific conductance of approximately 4,113 µS/cm. Laboratory TDS was reported as 2,860 mg/L.

3.4.1.7. ASR-1 PT-5A 1,380 to 1,591 feet

The second annulus packer test (PT-5A) was conducted to test the interval above the upper packer. The upper packer was set at a depth of 1,591 feet bls. The intermediate casing was installed to a depth of 1,380 feet bls; therefore, PT-5A tested the interval from 1,380 feet to 1,591 feet bls. The interval was pumped for 5 hours at a pumping rate of approximately 89.5 gpm. Water level recovery was recorded at 0.03 feet. The specific capacity of the zone was estimated at approximately 3,000 gpm/ft. The pumping test was run until water quality began to stabilize. The water quality stabilized during pumping with a field specific conductance of approximately 2,440 µS/cm. Laboratory TDS was reported as 1,590 mg/L.

3.4.1.8. ASR-1 PT-6 1,510 feet to 1,546 feet

The sixth packer test was conducted with a straddle packer testing the interval between 1,510 feet and 1,546 feet bls. The test was conducted to determine the specific capacity of the zone between the packers and estimate potential confinement. The interval was pumped for four hours at a pumping rate of approximately 88.6 gpm. Water level

drawdown was recorded at 9.11 feet. The specific capacity of the zone was estimated at 9.7 gpm/ft, suggesting the interval from 1,510 feet to 1,546 is not a significant confining unit. The pumping test was run until water quality began to stabilize. The water quality stabilized during pumping with a field specific conductance of approximately 4,030 µS/cm. Laboratory TDS was reported as 2,620 mg/L.

3.4.1.9. ASR-1 PT-6A 1,380 to 1,510 feet

The third annulus packer test (PT-6A) was conducted to test the interval above the upper packer. The upper packer was set at a depth of 1,510 feet bls. The intermediate casing was installed to a depth of 1,380 feet bls; therefore, PT-6A tested the interval from 1,380 feet to 1,510 feet bls. The interval was pumped for 4.7 hours at a pumping rate of approximately 131 gpm. Water level recovery was recorded at 0.02 feet. The specific capacity of the zone was estimated at approximately 6,500 gpm/ft. The pumping test was run until water quality began to stabilize. The water quality stabilized during pumping with a field specific conductance of approximately 2,320 µS/cm. Laboratory TDS was reported as 1,510 mg/L.

3.4.1.10. ASR-1 PT-7 1,475 to 1,511 feet

The fifth packer test was conducted with a straddle packer testing the interval between 1,475 feet and 1,511 feet bls. The test was conducted to determine the specific capacity and water quality of the zone between the packers and estimate potential for an ASR recharge zone or a Class V injection zone. The interval was pumped for 4.25 hours at a pumping rate of approximately 128 gpm. Water level drawdown was recorded at 11.8 feet. The specific capacity of the zone was estimated at 10.8 gpm/ft, suggesting the zone could potentially be used for ASR. The pumping test was run until water quality began to stabilize. The water quality stabilized during pumping with a field specific conductance of approximately 2,790 µS/cm. Laboratory TDS was reported as 1,810 mg/L.

3.4.1.11. ASR-1 PT-7A 1,380 to 1,475 feet

The fourth annulus packer test (PT-7A) was conducted to test the interval above the upper packer. The upper packer was set at a depth of 1,475 feet bls. The intermediate casing was installed to a depth of 1,380 feet bls; therefore, PT-7A tested the interval from 1,380 feet to 1,475 feet bls. The interval was pumped for 5.7 hours at a pumping rate of approximately 95.7 gpm. Water level recovery was recorded at 0.027 feet. The specific capacity of the zone was estimated at approximately 3,500 gpm/ft. The pumping test was run until water quality began to stabilize. The water quality stabilized during pumping with a field specific conductance of approximately 2,330 µS/cm. Laboratory TDS was reported as 1,510 mg/L.

3.4.1.12. ASR-1 PT-8 1,405 feet to 1,441 feet

The eighth packer test was conducted with a straddle packer testing the interval between 1,405 feet and 1,441 feet bls. The test was conducted to determine the specific capacity of the zone between the packers and estimate potential confinement. The interval was pumped for five hours at a pumping rate of approximately 88.6 gpm. Water level drawdown was recorded at 6.51 feet. The specific capacity of the zone was estimated at 13.6 gpm/ft, suggesting the interval from 1,405 feet to 1,441 is not a significant confining unit. The pumping test was run until water quality began to stabilize. The water quality stabilized during pumping with a field specific conductance of approximately 1,670 µS/cm. Laboratory TDS was reported as 1,090 mg/L.

3.4.1.13. ASR-1 PT-8A 1,380 to 1,405 feet

The fifth annulus packer test (PT-8A) was conducted to test the interval above the upper packer. The upper packer was set at a depth of 1,405 feet bls. The intermediate casing was installed to a depth of 1,380 feet bls; therefore, PT-8A tested the interval from 1,380 feet to 1,405 feet bls. The interval was pumped for 6.25 hours at a pumping rate of approximately 91.5 gpm. Water level recovery was recorded at 6.72 feet. The specific capacity of the zone was estimated at approximately 13.6 gpm/ft. The pumping test was run until water quality began to stabilize. The water quality stabilized during pumping with a field specific conductance of approximately 650 µS/cm. Laboratory TDS was reported as 420 mg/L.

3.4.1.14. ASR-1 Packer Test Summary

The packer testing successfully delineated the producing intervals of the borehole and helped to confirm the water quality in the pilot hole. The following summarizes some of the key findings from the packer testing performed:

- Two primary producing intervals were identified to occur in the upper fracture between 1,475 and 1,511 feet, and the lower fracture between 1,591 feet and 1,627 feet bls. The upper fracture has a TDS of approximately 1,810 mg/L and the lower fracture has a TDS of approximately 2,860 mg/L. Either of these zones have sufficient specific capacity values (10.8 gpm/ft for the upper fracture and 11.8 gpm/ft for the lower fracture) for completing a recharge well.

- Packer tests PT-4, PT-6, and PT-8 were designed to prove confinement below and between the fractures, however, these packer tests showed specific capacity values ranging from 5.9 gpm/ft to 13.6 gpm/ft, which shows that minimal confinement exists throughout these intervals.

- Packer test results suggest that the site is more conducive for a recharge well than an ASR well. These results were used to support re-purposing of this well to a Class V disposal well.

3.4.2. Short-Term Pumping Test

In preparation for final background sampling at ASR-1, a short-term pumping test was conducted to estimate the specific capacity of the completed ASR well to a depth of 3,060 feet bls. The water was discharged to one 21,000 gallon frac tank and two 50,000 gallon on site storage bladder tanks and later re-circulated back down the well. The well was pumped at an average rate of 490 gpm and the drawdown after 200 minutes was approximately 1.32 feet. The specific capacity was estimated at approximately 371 gpm/ft (490 gpm/1.32 feet).

3.4.3. Short-Term Specific Injectivity Test

ASRus conducted a short-term specific injectivity test at well ASR-1 to estimate the well head injection pressure at an injection rate of approximately two MGD. The available water for the test was approximately 21,000 gallons from the onsite frac tank. An in-line flow meter was used to monitor the injection rate and a downhole transducer was used to monitor the increase in pressure. The maximum flow rate during the short-term injection test was approximately 1,600 gpm. The increase in wellhead pressure was 4.16 psi based on the downhole pressure transducer. Manual water level readings were also recorded and the maximum rise in water level was 8.99 feet or 3.89 psi (8.99 feet/2.31 ft/psi). The specific injectivity was estimated at 385 gpm/psi (1,600 gpm/4.16 psi). The injection well, therefore, can safely be operated at an injection rate of 2 MGD or more with a minimal increase in wellhead pressure. At 1,400 gpm, the projected pressure increase is 3.6 psi at the wellhead.

3.5. Water Quality Sampling

The water quality sampling program implemented during the exploratory well construction project consisted of four main sampling types: surficial aquifer pad monitoring well sampling, reverse-air drilling sampling, packer test sampling, and final background sampling. The Surficial Aquifer was monitored during construction of ASR-1 by sampling four shallow water table monitor wells (NE, NW, SW, and SE) located near the drilling pad. Four additional Surficial Aquifer monitoring wells were sampled during construction of SZMW-1 (wells SZNE, SZNW, SZSW, and SZSE). During construction of SMW-1, two pad monitoring wells NW and SE were monitored. During reverse-air drilling operations, airlift water samples were collected in order to monitor potential changes in ground water quality during drilling. Water quality

samples were also collected from isolated intervals during the performance of the packer tests. Final background water quality samples were collected following drilling and development of ASR-1, SZMW-1, and SMW-1.

3.5.1. Surficial Aquifer Water Quality

The ten Surficial Aquifer monitoring wells (NE, NW, SW, SE, SZNE, SZNW, SZSW, SZSE, SMNW, and SMSE) located around the drilling pads for the three wells were sampled weekly to monitor for any potential water quality changes resulting from the drilling operation. The pad wells were installed and initially sampled prior to any deep drilling activities in order to establish ambient groundwater conditions.

ASRus personnel collected and analyzed weekly water levels and water quality samples. Each well was purged and sampled using a small submersible pump. Discharge water was collected after a minimum of three well volumes had been purged. The water samples were analyzed in the field for the following parameters: chloride, specific conductance, pH, and temperature (**Tables 3-3, 3-4, and 3-5)**. **Figures 3-5, 3-6, and 3-7** graphically present the results of the water quality analyses for the ASR-1 area, SZMW-1 area, and the SMW-1 area, respectively. Based on the monitoring results, it was determined that the Surficial Aquifer had not been affected by drilling operations.

3.5.2. ASR-1 Airlift Water Quality

During the reverse-air drilling phase of ASR-1, water samples were collected at approximately every 90 feet for field and laboratory analysis (**Table 3-6)**. These samples were collected to provide indicators of water quality changes at depth during drilling activities and to estimate the water quality in the proposed recharge zone. The samples were collected by the contractor in two, 1-liter bottles and labeled with the well ID, depth, date, and collection time. Samples were submitted to ASRus personnel for field testing of specific conductance, temperature and pH with field instruments. The laboratory samples were submitted to Flowers Chemical Laboratories, Inc. in Altamonte Springs, Florida for analysis of chloride, specific conductance, sulfate and total dissolved solids. Copies of the laboratory reports for the airlift groundwater quality analyses are included in **Appendix H**.

Due to the drilling technique of re-circulating discharge water back to the well and due to the contiguous open-hole section of the pilot hole, airlift water quality results at specific depths are not considered very accurate; however, relative changes in water quality with depth were used in evaluating changes in formation hydraulic capacity and groundwater quality. Airlift water quality results were obtained from ASR-1 below an approximate depth of 1,466 feet after installing the intermediate casing at a depth of 1,380 feet to seal off the UFA. Reverse-air samples showed a significant increase in specific conductance below 1,933 feet. The laboratory TDS concentration at a depth of

1,933 feet was reported as 7,370 mg/L and at a depth of 2,026 feet was 21,200 mg/L, indicating that the base of the lowermost Underground Source of Drinking Water (USDW), where a TDS of 10,000 mg/L first occurs, is between 1,933 feet and 2,026 feet bls.

The TDS to conductivity ratio shown in **Table 3-6** indicates a ratio ranging from 0.55 to 0.69 which is typical of groundwater influenced by relict seawater. The sample from the bottom of the borehole at a depth of 3,060 feet bls showed a TDS value of 121,000 mg/L, indicating relict connate groundwater that has not been recharged by fresh water.

3.5.3. ASR-1 Packer Test Water Quality

The water quality results determined during the packer tests are deemed more reliable than the estimated water quality measurements conducted during the airlift water quality sampling events. They are not, however, entirely representative due to flooding of the fresher UFA water into the deeper permeable intervals during borehole advancement. Water samples collected from packer tests completed on well ASR-1 were submitted to ASRus personnel for field testing in conjunction with duplicate samples submitted by the Contractor to Flowers Chemical Laboratories, Inc. for analysis of specific conductance, chloride, sulfate, and TDS. **Table 3-7** summarizes the laboratory water quality analysis results from the ASR-1 packer tests. Copies of the laboratory reports for the ASR-1 packer tests are included in **Appendix I**.

3.5.4. Background Water Quality Conditions

3.5.4.1 ASR-1 Water Quality

Following installation of the final casing at the ASR well, background water quality conditions were established. The open-borehole interval was pumped as part of well testing until the discharge water was clear and free of sediment and a minimum of three well volumes had been removed from the well. A submersible pump was utilized by FDD personnel in order to draw representative discharge water samples from the well. The representative water samples were collected in labeled sample bottles and transported to Flowers Chemical Laboratories, Inc. for analyses. Well ASR-1 was sampled on June 21, 2016, to determine native water quality.

The background water samples were analyzed for the parameters that have established Primary and Secondary Drinking Water Standards in accordance with Chapter 62.550, FAC, in addition to the municipal wastewater indicator parameters for groundwater. **Table 3-8** presents the laboratory results for the background water samples with any exceedances of the maximum contaminant limits (MCLs) highlighted.

The only primary drinking water standards that exceeded an MCL were Radium-226 with a measured concentration of 5.5 picocuries per liter (pCi/L) and sodium with a measured concentration of 715 mg/L. The Radium-226 value only slightly exceeds the MCL of 5 pCi/L for combined Radium -226 and Radium -228. Radium-226 is commonly detected in brackish groundwater. The sodium exceedance is a common occurrence in brackish groundwater.

Secondary standard exceedances were detected for iron, chloride, sulfate and total dissolved solids (TDS). Iron was detected at a concentration of 0.377 mg/L which is only slightly above the MCL of 0.3 mg/L. Chloride, sulfate and TDS are naturally occurring and reflect the brackish ambient groundwater. All of the chemical analyses are included in the laboratory reports contained within **Appendix J**.

3.5.4.2 SMW-1 Water Quality

Following installation of the final casing at well SMW-1, background water quality conditions were established. The open-borehole interval was pumped as part of well testing until the discharge water was clear and free of sediment and a minimum of three well volumes had been removed from the well. Immediately following the completion of the well development procedures, a submersible pump was utilized by ASRus personnel in order to draw representative discharge water samples from the well. The representative water samples were collected in labeled sample bottles and transported to Flowers Chemical Laboratories, Inc. for analyses. Well SMW-1 was sampled on June 22, 2016 to determine native water quality.

The background water sample was analyzed for the parameters that have established Primary and Secondary Drinking Water Standards in accordance with Chapter 62.550, F.A.C. in addition to the municipal wastewater indicator parameters for groundwater. **Table 3-9** presents a comparison of the background water samples with the maximum contaminant limits (MCLs) of the drinking water standards.

Primary drinking water standards that exceeded an MCL in shallow monitoring well SMW-1 included sodium with a measured concentration of 401 mg/L, beryllium with a concentration of 0.006 mg/L, uranium with a concentration of 1,000 pCi/L, and Radium-226 with a concentration of 10.5 pCi/L. Sodium is common occurrence in brackish groundwater. Beryllium only slightly exceeded the MCL of 0.004 mg/L. Uranium and Radium-226 are commonly detected in central Florida..

Secondary standard exceedances were detected for iron, chloride, and TDS. Iron was detected at a concentration of 0.762 mg/L, which is above the MCL of 0.3 mg/L. Chloride and TDS are commonly found in brackish groundwater.

3.5.4.3 SZMW-1 Water Quality

Following installation of the final casing at well SZMW-1, background water quality conditions were established. The open-borehole interval was pumped as part of well testing until the discharge water was clear and free of sediment and a minimum of three well volumes had been removed from the well. Immediately following the completion of the well development procedures, a submersible pump was utilized by ASRus personnel in order to draw representative discharge water samples from the well. The representative water samples were collected in labeled sample bottles and transported to Flowers Chemical Laboratories, Inc. for analyses. Well SZMW-1 was sampled on June 23, 2016 to determine native water quality.

The background water sample was analyzed for the parameters that have established Primary and Secondary Drinking Water Standards in accordance with Chapter 62.550, FAC, in addition to the municipal wastewater indicator parameters for groundwater. **Table 3-10** presents the laboratory results for the background water samples with any exceedances of the MCLs highlighted.

Three primary drinking water standards were exceeded in well SZMW-1 including sodium, uranium, and Radium-226. Sodium was reported as 794 mg/L with an MCL of 160 mg/L. Uranium was reported as 900 pCi/L with an MCL of 30 µg/L. Radium-226 was reported as 10.8 pCi/L with an MCL of 5 pCi/L for combined radium-226 and radium-228. Five secondary drinking water standards were exceeded, including TDS, chloride, sulfate, iron, and color. TDS was reported as 3,090 mg/L with an MCL of 500 mg/L. Chloride was reported as 1,440 mg/L with an MCL of 250 mg/L. Sulfate was reported as 379 mg/L with an MCL of 250 mg/L and iron was reported as 1.1 mg/L with an MCL of 0.3 mg/L. Color was reported as 20 color units (PCU) with an MCL of 15 PCU.

3.6. ASR-1 Geophysical Logging Runs

A geophysical logging program was conducted throughout the construction of the three wells. The logging program included collection of geophysical data for use in the interpretation of the hydrogeologic conditions beneath the site, identifying the depth to the base of the lowermost USDW, and to aid in the estimation and verification of the construction details of the wells. MV Geophysical provided all geophysical logging services during construction activities.

The geophysical logging series conducted on ASR-1 consisted of nine individual logging events that were performed during the course of the exploratory well construction. Geophysical logging was completed on all pilot and reamed portions of the borehole in addition to selected stages of well construction. Logging operations in the 10.625-inch to 12.25-inch diameter pilot hole were conducted primarily to verify

hydrogeologic conditions and to determine casing setting depths and the packer test intervals. Logs conducted in the reamed portion of the borehole were primarily run to verify the diameter of the borehole and estimate cement quantities. A summary of all geophysical logging of ASR-1 is presented in **Table 3-11**. Copies of individual logs for ASR-1 are included in **Appendix K**.

Various geophysical logging tools were utilized during the construction of the well. The caliper log provides a continuous record of average borehole diameter in addition to being utilized to identify fractures and possible water-bearing flow zones. Gamma ray logs record the natural-gamma radiation emitted from rocks penetrated by the borehole, which is utilized to identify lithologic units. Fluid temperature logs record the vertical water temperature variations in the borehole and are generally utilized to identify water-producing and water-receiving zones. Temperature logs are also utilized to delineate the cement top depths following casing grouting procedures. Electromagnetic-induction (dual induction) logs record the electrical conductivity or resistivity of the formation and the water within the borehole and are affected by the porosity, permeability and clay content of the formation and by the dissolved solids concentration of the water within the formation. The borehole compensated sonic (BCS) log measures the transit time of an elastic wave created by an acoustic signal after passing through the formation. The sonic log is used to delineate lithology and to estimate the intergranular porosity of a rock formation.

ASR-1 Run 1 included X-Y caliper, gamma ray, spontaneous potential (SP), and dual induction logs (DILs) run inside the 12.25-inch diameter mudded pilot-hole to a depth of 320 feet to verify the geologic characteristics of the formation exposed within the borehole and determine possible casing setting depths. The results of the caliper log delineated a borehole diameter range from approximately 12.25 inches to the maximum caliper arm extension of 33 inches just below the 36-inch diameter pit casing set at a depth of 48 feet bls. The borehole diameter varied from approximately 13 inches to 14 inches from 68 feet to 304 feet bls. From 304 feet to the bottom of the borehole at 322 feet, the diameter was near the bit size of 12.25-inches, indicating the 28-inch casing could be installed at 313 feet bls. The gamma ray log showed gamma ray values, which ranged from 10 to 105 American Petroleum Institute (API) gamma ray units. Gamma ray values ranged from approximately 10 to 30 GAPI from 0 to 240 feet bls. Gamma ray peaks were noted at depths of 248 feet, 278 feet, 287 feet, and 300 feet bls. The peak at 300 feet bls correlates with clayey limestone at this depth. The dual induction log indicates resistivities ranging from approximately 50 to 70 ohm-meters. No resistivity anomalies were noted. The SP log did not show any anomalies through the logged interval from 0 to 322 feet bls.

ASR-1 Run 2 included gamma ray and X-Y caliper logs run on the 34-inch diameter reamed hole to confirm the casing setting depth and calculate the cement quantities for the installation of the 28-inch diameter casing. The borehole diameter varied from bit size (34 inches) to 40.75 inches below the pit casing at 50 feet. The borehole was near bit

size from 240 feet to the bottom of the hole, indicating the 28-inch diameter casing could be successfully installed at a depth of 313 feet bls.

ASR-1 Run 3 was conducted on the 9.5-inch pilot hole to 1,404 feet in order to verify the pilot-hole geology, determine hydrogeologic characteristics and determine the appropriate setting depth for the intermediate casing. The geophysical logs included X-Y caliper, gamma ray, DIL, SP, BCS, temperature, fluid conductivity, and flow meter.

X-Y Caliper Log

The caliper log showed that the borehole diameter ranged from the bit size of 9.5-inches to a maximum of approximately 32 inches at a depth of 318 feet bls in a washed out section of the Ocala Limestone just below the surface casing. The most notable feature of the caliper log is the distinctive Avon Park Permeable Zone (APPZ) from approximately 546 feet bls to 662 feet bls where several large fracture zones are evident. This correlates well with the lithologic log where dolostone was noted from 520 feet to 690 feet bls. Smaller fractures are noted at depths of 955 feet, 1,088 feet, 1,254 feet, 1,308 feet, and 1,350 feet bls within LF-1.***Gamma Ray Log***

The gamma ray log generally shows values ranging from 10 to 20 API units. A significant feature on the gamma ray log is a peak of 70 API units at a depth of 1,316 feet bls, which may correlate to a lignite layer described in the lithologic sample from this depth.

Dual Induction

The dual induction log shows semi-confining characteristics from approximately 350 feet to 530 feet bls. The APPZ is first noted at a depth of 530 feet bls and extends to approximately 700 feet bls, correlating well with the interpretations from the caliper log and lithologic log. The log suggests that semi-confining materials occur from approximately 930 feet bls to 1,060 feet bls. From 1,060 feet to 1,380 feet bls minor permeability characteristics are shown on the log.

SP Log

The SP log does not indicate any obvious deflections or anomalies that correlate with any other geophysical logs or lithology.

BCS Log

The borehole compensated sonic porosity (BCS) log shows similar features as the dual induction log. Confining characteristics are exhibited from depths of approximately 350 feet bls to 530 feet bls. The APPZ is evident from approximately 530 feet bls to 690 feet bls, correlating with the caliper log, dual induction log and lithologic log. This increased permeability is particularly evident on the Variable Density Log (VDL). The

log suggests semi-confining units extend from approximately 940 feet to 1,060 feet bls and permeable units extend from 1,060 feet to 1,380 feet bls.

Fluid Conductivity, Temperature and Flow Meter Logs

The fluid conductivity log shows that the groundwater is very fresh in the borehole with specific conductance ranging from approximately 579 µS/cm to 644 µS/cm, showing a slight gradual increase with depth. The temperature log shows a slightly increasing temperature gradient from 77.8 degrees Fahrenheit (° F) to 80.6 ° F from 330 feet bls to 1,400 feet bls. A temperature deflection is noted at a depth of 540 feet bls correlating with the top of the APPZ. The static flow meter log suggested flow entering the borehole at a depth of 1,276 feet bls and exiting the borehole at a depth of 630 feet bls. Static flow measurements were recorded at depths of 627 feet, 645 feet, 675 feet, 1,095 feet, 1,265 feet, and 1,285 feet bls and indicated no measurable borehole flow in the bottom 50 feet of the borehole.

ASR-1 Run 4 was a gamma ray and X-Y caliper log run on the 26-inch diameter reamed hole to confirm the casing setting depth and calculate the cement quantities for the installation of the 20-inch diameter intermediate casing. The borehole diameter varied from bit size (26 inches) to greater than 47-inches (maximum extension of caliper arms). The borehole was slightly larger than bit size from 1,040 feet bls to the bottom of the hole. The logging confirmed that the 20-inch diameter intermediate casing could be safely installed to a depth of 1,380 feet bls.

ASR-1 Run 5 included X-Y caliper, gamma ray, static fluid conductivity, and static temperature geophysical logs on the pilot hole. An attempt was made to log the 3,060 foot pilot hole on September 3, 2015, however, due to the highly fractured nature of the borehole, the logging tools could only reach a depth of 1,779 feet bls. A video log conducted on September 3, 2015 showed a highly fractured dolostone similar to the so called "Boulder Zone" in south Florida from the cavern encountered at 1,670 feet to the total depth of the video of 1,779 feet bls. The borehole was reamed to a larger diameter of 10.875-inches and the geophysical logging was attempted again on September 16, 2015. This time the caliper tool was able to reach a depth of 1,933 feet bls but the borehole remained too unstable to reach the total depth of the well.

X-Y Caliper Log

The caliper log showed that the borehole diameter ranged from the bit size of 10.875 inches to greater than the maximum arm diameter of approximately 33 inches. The borehole is washed out to approximately 27-inches in diameter below the 20-inch casing depth of 1,378 feet bls. A 26-inch diameter fracture is evident at a depth of 1,394 feet bls. The borehole is near bit size from approximately 1,395 feet to 1,492 feet bls. A large fracture of approximately 31 inches in diameter occurs at a depth of 1,493 feet bls. The borehole is near bit size from 1,494 feet to 1,600 feet bls. A large fracture of

approximately 31 inches in diameter occurs at a depth of 1,603 feet bls. A large cavern with a diameter greater than 33 inches in diameter is logged from approximately 1,666 feet to 1,690 feet bls. A zone of fractures greater than 33 inches in diameter is noted from 1,690 feet to 1,760 feet bls. The borehole has numerous fractures greater than 20 inches in diameter from 1,760 feet to 1,930 feet, the approximate maximum depth reached by the logging tools.

Gamma Ray Log

The gamma ray log generally shows values ranging from 10 to 20 API units. An elevated gamma count of 32 API units is noted at a depth of approximately 1,762 feet bls. From approximately 1,392 feet to approximately 1,834 feet the gamma counts are consistently below 10 API units.

Fluid Conductivity and Temperature Logs

The static fluid conductivity log shows that the groundwater gradually increases from approximately 500 µS/cm near the base of the casing to approximately 5,000 µS/cm at approximately 1,670 feet bls, at the top of the large cavern. Entering the cavern, the groundwater fluid conductivity quickly increases to a value of approximately 12,000 µS/cm. From a depth of 1,670 feet to 1,880 feet bls, the groundwater conductivity is stable at 12,000 µS/cm. From 1,880 feet to approximately 2,000 feet bls the groundwater conductivity increases from 12,000 µS/cm to approximately 48,000 µS/cm and remains at approximately 48,000 µS/cm to the total depth of the log at approximately 2,010 feet bls. The log suggests that downhole flow may be occurring from the cavern to approximately 1,900 feet bls. The temperature log also shows a very slight increasing temperature gradient from approximately 80.7 °F to approximately 82.9 °F from the base of the casing to approximately 1,670 feet bls (in the cavern). The temperature remains stable from approximately 1,670 feet to 1900 feet bls. The relatively stable temperature is further indication that water is moving downhole from the cavern to 1,900 feet bls under static conditions. Most of this water appears to be re-entering the borehole above 2,000 feet bls.

ASR-1 Run 6 was conducted on October 15, 2015. The borehole had been reamed to a diameter of 15-inches to 2,000 feet in order to have a better chance of reaching the bottom of the borehole with the logging tools. Two of the longer and heavier tools, the dual induction and the borehole compensated sonic porosity tools, made it to the bottom of the borehole at a depth of approximately 3,040 feet bls. The other logging tools could only reach approximately 1,900 feet. The purpose of this logging was to characterize the wellbore completed to date and to assist with packer setting depths and determine the appropriate setting depth for the final casing. A full suite of geophysical logs were run including X-Y caliper, gamma ray, dual induction, SP, BCS, temperature, fluid conductivity, flow meter, and TDS compilation log.

X-Y Caliper Log

The caliper log showed that the borehole diameter was close to the bit size of 15 inches from the intermediate casing depth of 1,380 feet to approximately 1,490 feet bls. A large fracture up to 38-inches in diameter was noted at a depth of 1,495 feet bls. Another large fracture up to 22 inches in diameter was noted at a depth of 1,606 feet bls. A large cavern is apparent from 1,670 feet to 1,698 feet bls where the driller noted a bit drop during pilot hole drilling. The borehole is highly fractured from 1,670 feet to 1,974 feet bls, similar to the so called "Boulder Zone" of south Florida.

Gamma Ray Log

The gamma ray log generally shows values ranging from 5 to 15 API units. No gamma ray anomalies are distinguished on the log.

Dual Induction

The dual induction log shows the large cavern from 1,670 feet to 1,694 feet bls, correlating well with the caliper log. Higher resistivities are noted from below the casing to 1,890 feet bls, correlating with the highly permeable dolostone unit. A shift to the left, indicating lower resistivities occurs at 1,975 feet bls, which may correlate with higher salinity groundwater at this depth. The dual induction log shows a notable shift to the left at approximately 2,000 feet bls, which may be due to the change in borehole diameter from 15-inches to 12-inches. Lower resistivities are noted from 2,000 feet to 2,530 feet bls which may correlate with lower permeability zones. The resistivity increases from 2,530 feet to 2,850 feet bls which may correlate to higher percentages of evaporite deposits logged through this portion of the well. From 2,850 feet to the total depth logged of 3,045 feet bls, resistivity values increase again which may be correlated to persistent evaporites logged (up to 90%) in this portion of the well.

SP Log

The spontaneous potential (SP) log does not indicate any obvious deflections or anomalies that correlate with any other geophysical logs or lithology.

BCS Log

The BCS porosity log shows similar features as the dual induction log. The log suggests high porosity is present from the base of the casing to approximately total depth of the log at 3,045 feet bls. The lowest porosity values occur from 2,870 feet to total depth, correlating well with the lithologic log describing approximately 90 percent evaporites through this interval.

Fluid Conductivity and Temperature Logs

The static fluid conductivity log shows that the groundwater gradually increases from approximately 500 µS/cm near the base of the casing to approximately 5,000 µS/cm at approximately 1,670 feet bls, at the top of the large cavern. Entering the cavern, the groundwater fluid conductivity quickly increases to a value of approximately 12,000 µS/cm. From a depth of 1,670 feet to 1,880 feet bls, the groundwater conductivity is stable at 12,000 µS/cm. From 1,880 feet to 2,000 feet bls the groundwater conductivity increases from 12,000 µS/cm to approximately 48,000 µS/cm and remains at 48,000 µS/cm to the total depth of the log at approximately 2,010 feet bls. The log suggests that downhole flow may be occurring from the cavern to approximately 1,900 feet bls. The temperature log also shows a very slight increasing temperature gradient from approximately 80.7 °F to approximately 82.9 °F from the base of the casing to approximately 1,670 feet bls (in the cavern). The temperature remains stable from 1,670 feet to 1,900 feet bls. The relatively stable temperature is further indication that water is moving downhole from the cavern to 1,900 feet bls under static conditions. Most of this water appears to be re-entering the borehole above 2,000 feet bls.

TDS Compilation Log

The TDS compilation log is derived from the dual induction and borehole compensated sonic log. This log typically provides a good estimation of where the base of the lowermost USDW occurs and is intended to interpret formation fluids rather than borehole fluids. However, due to the highly fractured nature of the borehole and large diameter of the borehole, the TDS compilation log was not useful in this well and could not be interpreted accurately.

Flow Meter Log

The flow meter logging was inconclusive due the extremely high permeability of the cavern. At the maximum pumping rate available of 470 gpm, the well was not stressed below the cavern. During pumping for the logging a specific capacity test was conducted. The results showed a specific capacity of 940 gpm/ft (470 gpm/0.5 ft of drawdown). A water quality sample collected at the end of pumping had a field conductivity value of 5,500 µS/cm, which is estimated at 3,575 mg/L TDS.

ASR-1 Run 7 included gamma ray and X-Y caliper logs run on the 19-inch diameter reamed hole to confirm the casing setting depth and calculate the cement quantities for the installation of the 12-inch diameter final casing. The borehole diameter varied from bit size (19 inches) to 32 inches. A large fracture up to 32 inches was noted at a depth of 1,495 feet bls. Another large fracture up to 31 inches was noted at a depth of 1,607 feet bls. The borehole was slightly larger than bit size from 1,634 feet bls to the bottom of the hole, indicating the 12-inch diameter casing could be successfully installed at this

depth. The gamma ray log showed values ranging from zero to 20 API units. No gamma ray anomalies were noted.

ASR-1 Run 8 consisted of a series of temperature logs that were conducted following each major cement stage during the grouting of the 12-inch diameter final casing to a depth of 1,650 feet. A total of ten cement stages were conducted during the grouting process and a total of six temperature logs were conducted since the first two stages were small shots of neat cement and the final two stages were inside the intermediate casing and brought the cement to land surface. The results of the individual temperature logs are included in **Appendix K**.

The temperature log (a) completed after the third cementing stage delineated the top of the cement at a depth of 1,564 feet. The physical tag of the cement top was at 1,571 feet. The temperature log (b) completed after the fourth cementing stage indicated that the top of the cement was located at approximately 1,501 feet, which was confirmed with a physical tag at 1,497 feet. The temperature log (c) completed after the fifth cementing stage indicated a cement top at 1,498 feet and the physical tag indicated a cement top depth of 1,497 feet. The temperature log (d) completed after the sixth cementing stage indicated an approximate cement top depth of 1,497 feet, and the physical tag indicated a cement top at 1,444 feet, which may have been an erroneous tag. The temperature log (e) completed after the seventh cementing stage indicated an approximate cement top depth of 1,403 feet, and the physical tag indicated a cement top of 1,422 feet. The temperature log (f) completed after the eighth cementing stage indicated an approximate cement top depth of 781 feet, which was confirmed with a physical tag at 780 feet. The remainder of the final casing was grouted to land surface in cementing stages 9 and 10. In general, there was a strong correlation between the cement top depth determined via the temperature logs and the physical tags.

ASR-1 Run 9 was conducted on the final completed ASR well. A suite of geophysical logs were run on the 15-inch pilot hole to 2,000 feet including X-Y caliper, gamma ray, dual induction, SP, fluid conductivity, temperature, flow meter, and a video survey.

X-Y Caliper Log

The caliper log showed that the borehole diameter ranged from the bit size of 15 inches to the maximum arm extension of approximately 41 inches. A large cavern greater than the maximum arm extension of 41 inches extends from 1,668 feet to 1,698 feet bls. From 1,700 to 1,800 feet bls, several large fractures are noted, greater than 41 inches in diameter. From 1,900 to 2,000 feet, fractures up to 40 inches in diameter are noted. The borehole is highly fractured from 1,700 to 1,975 feet bls, similar to the so called "Boulder Zone" of south Florida.

Gamma Ray Log

The gamma ray log generally shows values ranging from 10 to 20 API units. No gamma ray anomalies were apparent.

Dual Induction

The dual induction log shows the cavern from approximately 1,670 feet to 1,690 feet bls. From 1,700 to 1,890 feet bls the log indicates fractured dolostone. The log indicates a decrease in resistivity, which may correlate with an increase in formation water TDS, occurs at a depth from approximately 1,890 feet to 1,950 feet bls.

SP Log

The SP log does not indicate any obvious deflections or anomalies that correlate with any other geophysical logs or lithology.

Fluid Conductivity, Temperature and Flow Meter Logs

The static fluid conductivity log shows fresh water in the casing to the cavern at a depth of 1,670 feet bls. Fresh water was circulated in the casing the week before logging during the casing pressure test to cool the casing. From below the cavern at a depth of 1,700 feet bls to the bottom of the logged interval at 2,000 feet bls, the groundwater specific conductance increases from 2,651 µS/cm to 3,148 µS/cm. The dynamic fluid conductivity log shows an increasing specific conductance from 3,000 µS/cm in the cavern to 8,744 µS/cm at 2,000 feet bls. The well was pumped at a rate of 500 gpm.

The static temperature log shows an increase in temperature from 74.2 °F above the cavern to 79 °F in the cavern, indicating the fresh water may be exiting the borehole in the cavern. The dynamic temperature log shows temperatures increasing from 78.6 °F at a depth of 1,650 feet to 80.8 °F at 2,000 feet bls.

The interpreted flow meter log is based on pumping the well at a rate of 500 gpm. No flow was produced below 1,678 feet at the pumping rate of 500 gpm. The majority of the flow is produced from just below the casing at a depth of 1,654 feet bls at a pumping rate of 500 gpm.

Video Survey

A video survey was conducted on the pilot hole on September 16, 2015, from land surface to 1,980 feet bls, where the geophysical logger stopped because of poor visibility. A final video survey was conducted on the completed well on December 18, 2015, from land surface to 1,790 feet bls, where the geophysical logger stopped because of poor visibility. The 12-inch diameter casing is installed to a depth of 1,652 feet bls. Casing joints were visible from 260 feet to 1,635 feet bls and were intact. A summary of

the two video logs is included in **Table 3-14**. Screen shots from the video logs showing the cavern and several zones within the "Boulder Zone" are included in **Figures 3-8, 3-9, 3-10, and 3-11**.

3.7. SMW-1 Geophysical Logging Runs

The geophysical logging series conducted on well SMW-1 consisted of three individual logging events that were performed during the course of the monitoring well construction. Geophysical logging was completed on selected pilot and reamed portions of the borehole. **Table 3-12** presents a summary of geophysical logging events for well SMW-1.

SMW-1 Run 1 included X-Y caliper, gamma ray, SP, and DIL logs run inside the 11.875-inch diameter mudded pilot hole to a depth of 320 feet to verify the geologic characteristics of the formation exposed within the borehole and determine possible casing setting depths. The results of the caliper log delineated a borehole diameter range from approximately 12 inches (bit size) from approximately 220 feet to 320 feet bls to approximately 17 inches at a depth of 52 feet bls, just below the pit casing. The caliper log indicated the surface casing could be safely set near 320 feet bls. The gamma ray log showed a wide range of gamma ray values from 10 to 90 API units. High gamma ray values were logged from 50 feet to 270 feet corresponding with clayey Hawthorn Group sediments. The DIL log showed competent limestone from 270 feet to 320 feet bls.

SMW-1 Run 2 included gamma ray and X-Y caliper logs run on the 25-inch diameter reamed hole to confirm the casing setting depth and calculate the cement quantities for the installation of the 20-inch diameter casing. The borehole diameter varied from bit size (25 inches) to 35 inches below the pit casing at 50 feet. The borehole was near bit size from 290 feet to 298, indicating the 20-inch diameter casing could be successfully installed at a depth of 320 feet bls.

SMW-1 Run 3 was conducted on the 11.875-inch pilot hole to a depth of 1,490 feet bls in order to verify the pilot-hole geology, determine hydrogeologic characteristics and determine the appropriate setting depth for the final casing. The geophysical logs conducted included X-Y caliper, gamma ray, DIL, SP, and BCS.

X-Y Caliper Log

The caliper log showed that the borehole diameter ranged from the bit size of 11.875 inches to a maximum of approximately 28 inches at a depth of 320 feet bls within a washout just below the surface casing. The borehole is near-bit sized from 1,478 feet to 1,490 feet bls, indicating the final casing can be set at the proposed depth of 1,480 feet bls.

Gamma Ray Log

The gamma ray log generally shows values ranging from 10 to 20 API units. A minor peak is noted at a depth of 1,321 feet bls (35 API units).

DIL

The dual induction log generally shows highly resistive fractured dolostone typical of the Avon Park formation in this area. The APPZ is evident from 630 feet to 710 feet bls. Confining beds are indicated from approximately 850 feet to 1,070 feet bls. Higher resistivities are noted from 1,300 feet to approximately 1,480 feet bls, correlating with the permeable dolostone unit.

SP Log

The SP log does not indicate any obvious deflections or anomalies that correlate with any other geophysical logs or lithology.

BCS Log

The BCS porosity log suggests the APPZ occurs from 630 feet to 710 feet bls. The highest porosity values occur from approximately 1,320 feet to 1,470 feet, which may be related to a highly fractured dolostone unit. The VDL indicates confining properties from approximately 960 feet to 1,088 feet bls.

SMW-1 Run 4 included gamma ray and X-Y caliper logs run on the 18-inch diameter reamed hole to confirm the casing setting depth and calculate the cement quantities for the installation of the 12-inch diameter final casing. The borehole diameter varied from bit size (18 inches) to 32 inches. A large washout up to 32 inches was noted at a depth of 315 feet bls, just below the surface casing. Another large fracture up to 28.5 inches was noted at a depth of 595 feet bls within the APPZ. The borehole was slightly larger than bit size from 1,460 feet bls to the bottom of the hole, indicating the 12-inch diameter casing could be successfully installed at this depth. The gamma ray log showed values ranging from zero to 20 API units. No gamma ray anomalies were noted.

SMW-1 Run 5 was conducted on the final completed shallow monitoring well to verify the casing setting depth and the hydrogeologic characteristics of the open-hole interval. The logs were run on the 11.5-inch diameter pilot hole from 1,480 feet to 1,520 feet bls. A suite of geophysical logs was run including X-Y caliper, gamma ray, DIL, temperature, fluid conductivity, and flow meter. The caliper log indicates that fractures occur at depths of 1,482 feet and 1,510 feet bls. The gamma ray log shows background values of 5 to 22 API units over the open-hole interval. The dual induction log indicates a possible permeable zone occurs at a depth of 1,480 to 1,490 feet bls. No obvious flow zones were noted on the static temperature and flow meter logs. The fluid conductivity log indicated a water quality of 2,789 µS/cm at the bottom of the borehole which

correlated very well with the water quality sampling during background sampling of 2,800 µS/cm.

3.8. SZMW-1 Geophysical Logging Runs

The geophysical logging series conducted on well SZMW-1 consisted of seven individual logging events that were performed during the course of the monitoring well construction. Geophysical logging was completed on selected pilot and reamed portions of the borehole. **Table 3-13** presents a summary of geophysical logging events for monitoring well SZMW-1.

SZMW-1 Run 1 included X-Y caliper, gamma ray, and DIL logs run inside the 12-inch diameter mudded pilot hole to a depth of 312 feet to verify the geologic characteristics of the formation exposed within the borehole and determine possible surface casing setting depths. The results of the caliper log delineated a borehole diameter range from approximately 12 inches (bit size) from approximately 270 feet to 300 feet bls to greater than 31 inches at a depth of 50 feet bls, just below the pit casing. The caliper log indicated the surface casing could be safely set near 300 feet bls. The gamma ray log showed a wide range of gamma ray values from 10 to 130 API units. High gamma ray values were logged from 50 feet to 270 feet corresponding with clayey Hawthorn Group sediments. The DIL log showed competent limestone from 290 feet to 300 feet bls.

SZMW-1 Run 2 included gamma ray and X-Y caliper logs run on the 26-inch diameter reamed hole to confirm the casing setting depth and calculate the cement quantities for the installation of the 18-inch diameter casing. The borehole diameter varied from bit size (26 inches) to 35 inches below the pit casing at 50 feet. The borehole was near bit size from 290 feet to 298, indicating the 18-inch diameter casing could be successfully installed at a depth of 300 feet bls.

SZMW-1 Run 3 included X-Y caliper, gamma ray, SP, DIL, and BCS logs run inside the 11.875-inch diameter pilot hole to a depth of 1,154 feet to verify the geologic characteristics of the formation exposed within the borehole and determine possible intermediate casing setting depths.

X-Y Caliper Log

The caliper log showed that the borehole diameter ranged from the bit size of 11.875 inches to a maximum of approximately 29.5 inches at a depth of 302 feet bls in a washed out section of the Ocala Limestone just below the surface casing. The APPZ is not clearly defined on the caliper log. Some fracturing occurs from approximately 590 feet bls to 620 feet bls. A washed out area occurs from approximately 710 feet to 750 feet bls.

Gamma Ray Log

The gamma ray log generally shows values ranging from 10 to 20 API units. A gamma ray high of 30 API units occurs at approximately 300 feet bls, which may correlate to calcareous clay logged from 290 to 300 feet bls.

DIL

The dual induction log shows semi-confining characteristics from approximately 350 feet to 550 feet bls. The APPZ is first noted at a depth of 620 feet bls and extends to approximately 690 feet bls, correlating well with the interpretations from the lithologic log. The log suggests that semi-confining materials occur from approximately 700 feet bls to 1,154 feet bls, the total depth of the borehole.

SP Log

The spontaneous potential log does not indicate any obvious deflections or anomalies that correlate with any other geophysical logs or lithology.

BCS Log

The borehole compensated sonic porosity log shows similar features as the dual induction log. Confining semi-characteristics are exhibited from a depth of approximately 350 feet bls to 550 feet bls. The APPZ is evident from approximately 620 feet bls to 690 feet bls, correlating with the dual induction log and lithologic log. This increased permeability is particularly evident on the VDL. The log suggests semi-confining units extend from approximately 700 feet to 1,154 feet bls, the total depth of the borehole.

SZMW-1 Run 4 was a gamma ray and X-Y caliper log run on the 17-inch diameter reamed hole to confirm the casing setting depth and calculate the cement quantities for the installation of the 12-inch diameter intermediate casing. The borehole diameter varied from bit size (17-inches) to 29-inches in a washout just below the surface casing at approximately 303 feet bls. The borehole was slightly larger than bit size from 1,100 feet bls to the bottom of the hole, indicating the 12-inch casing could be safely installed at this depth. The logging confirmed that the 12-inch diameter intermediate casing could be safely installed to a depth of 1,140 feet bls.

SZMW-1 Run 5 was a gamma ray and X-Y caliper log run on the 11.875-inch diameter pilot hole to confirm the proposed packer setting depth of 1,480 feet bls. The borehole diameter varied from bit size (11.875 inches) to 15.75 inches in a fracture at approximately 1,456 feet bls. The logging confirmed that the 9.5-inch diameter packer could be safely set at a depth of 1,480 feet bls.

SZMW-1 Run 6 was conducted on the 11.875-inch pilot hole to a depth of 1,680 feet bls in order to verify the pilot-hole geology, determine hydrogeologic characteristics and determine the appropriate setting depth for the final casing. The geophysical logs conducted included X-Y caliper, gamma ray, DIL, SP, BCS, temperature, fluid conductivity, and flow meter.

X-Y Caliper Log

The caliper log showed that the borehole diameter ranged from the bit size of 11.875 inches to a maximum of approximately 16.5 inches at a depth of 1,673 feet bls within the Avon Park Formation. The caliper log shows a near-bit sized borehole from below the 12-inch diameter casing at 1,140 feet to approximately 1,250 feet bls. From approximately 1,250 feet to 1,520 feet, the borehole shows minor fracturing indicative of Avon Park Formation dolostones. The borehole is near-bit sized from 1,636 feet to 1,670 feet bls, indicating the final casing could be safely set at the proposed depth of 1,650 feet bls.

Gamma Ray Log

The gamma ray log generally shows values ranging from 10 to 20 API units. Two minor peaks are noted at depths of 1,332 feet bls (30 API units) and 1,360 feet bls (22.5 API units).

DIL

The dual induction log generally shows highly resistive fractured dolostone typical of the Avon Park Formation in this area. Higher resistivities are noted from below the casing to approximately 1,400 feet bls, correlating with the permeable dolostone unit. A shift to the left is observed, indicating lower resistivities occur at 1,620 feet bls.

SP Log

The SP log does not indicate any obvious deflections or anomalies that correlate with any other geophysical logs or lithology.

BCS Log

The BCS log suggests relatively low porosity is present from the base of the casing to approximately the total depth of the log at 1,680 feet bls. The highest porosity values occur from approximately 1,410 feet to 1,450 feet, which may be related to a highly fractured dolostone unit. A porosity high also occurs at 1,650 feet. This should not affect the casing seat since the caliper log shows a near gauged borehole for the casing to be seated with two cement baskets which will reach 1,649 feet bls.

Fluid Conductivity, Temperature and Flow Meter Logs

The static fluid conductivity log shows that the groundwater gradually increases from approximately 1,185 µS/cm near the base of the casing to approximately 4,808 µS/cm at the bottom of the open hole at approximately 1,680 feet bls. The log suggests flow may be entering the borehole at depths of 1,455 feet and 1,660 feet bls. The temperature log also shows a very slight increasing temperature gradient from approximately 79.8 °F to approximately 83.8 °F from the base of the casing to approximately 1,680 feet bls (total depth of the borehole). The temperature log suggests flow may be entering the borehole at depths of 1,468 feet and 1,666 feet bls.

The static flow meter logging did not indicate any obvious flow zones within the open-hole interval from 1,140 feet to 1,680 feet bls.

SZMW-1 Run 7 was conducted on the final completed storage zone monitoring well to verify the casing setting depth and the hydrogeologic characteristics of the open-hole interval. The logs were run on the 11.875-inch diameter pilot hole from 1,650 feet to 1,680 feet bls. A suite of geophysical logs was run including X-Y caliper, gamma ray, DIL, temperature, fluid conductivity, and flow meter.

X-Y Caliper Log

The X-Y caliper log showed the borehole diameter is generally near the bit size of 11.875 inches from the casing at 1,650 feet bls to 1,672 feet bls where a 17.7-inch diameter fracture occurs.

Gamma Ray Log

The gamma ray log generally shows values ranging from 7 to 15 API units and averaging 10 API units.

DIL

The dual induction log shows higher, irregular resistivities from just below the casing to a depth of 1,680 feet bls, indicating some permeability.

Fluid Conductivity, Temperature, and Flow Meter Logs

The static fluid conductivity log shows that the groundwater is fairly consistent over the logged interval. The fluid conductivity at the bottom of the open-hole interval is 4,892 µS/cm, which correlates well with the background water quality sample which was measured at 4,450 µS/cm. No obvious flow zones are apparent from the fluid conductivity or temperature logs. The static flow meter log showed no obvious flow zones over the logged interval.

TABLE 3-1 Core Data Summary

Core Sample Depth (feet bls)	Description	Total Porosity (%)	Vertical K (cm/sec)	Horizontal K (cm/sec)
SZMW-1 (1,433 ft)	Dolomitic Limestone	0.139 (V) 0.103 (H)	1.4×10^{-6}	9.0×10^{-7}

TABLE 3-2 Packer Test Hydraulic Data Summary

Packer Test Interval (feet bls)	Pumping Rate (gpm)	Drawdown (feet)	Specific Capacity (gpm/ft)	Additional SC (gpm/ft)
PT-1 (1,064 -1,405)	116	6.15	18.9	NA
PT-2 (872-1,405)	116	5.25	22.1	3.2
PT-3 (706-1,405)	126	4.64	27.2	5.1
PT-4 (1616-1652)	84.6	14.34	5.9	NA
PT-4A (1380-1616)	131	0.08	1638	NA
PT-5 (1591-1627)	131.5	11.14	11.8	NA
PT-5A (1380-1591)	89.5	0.03	2983	NA
PT-6 (1510-1546)	88.6	9.11	9.7	NA
PT-6A (1380-1510)	131	0.02	6550	NA
PT-7 (1475-1511)	128	11.8	10.8	NA
PT-7A (1380-1475)	95.7	0.027	3544	NA
PT-8 (1405-1441)	88.6	6.51	13.6	NA
PT-8A (1380-1405)	91.5	6.72	13.6	NA

Table 3-3

ASR-1 Pad Monitoring Wells Water Quality Data

	Pad Monitoring Well Northeast					Pad Monitoring Well Northwest					Pad Monitoring Well Southwest					Pad Monitoring Well Southeast				
	WL	Specific Conductance	TDS	Temp	Chloride	WL	Specific Conductance	TDS	Temp	Chloride	WL	Specific Conductance	TDS	Temp	Chloride	WL	Specific Conductance	TDS	Temp	Chloride
Date	(Elev)	(µS/cm)	(mg/L)	(°C)	(mg/L)	(Elev)	(µS/cm)	(mg/L)	(°C)	(mg/L)	(Elev)	(µS/cm)	(mg/L)	(°C)	(mg/L)	(Elev)	(µS/cm)	(mg/L)	(°C)	(mg/L)
1/21/2015	73.53	490	286	25.0	120	75.96	600	352	24.0	132	75.36	590	334	24.2	148	75.17	590	352	24.9	140
3/4/2015	73.68	525	280	25.1	124	76.31	629	358	25.5	148	75.70	735	416	23.9	190	75.52	720	450	25.0	140
3/11/2015	73.37	506	284	24.5	120	75.93	603	344	24.2	136	75.27	699	420	23.7	180	75.36	769	552	23.2	184
3/18/2015	73.36	504	264	24.1	120	75.88	593	346	24.1	140	75.23	631	378	23.7	156	75.32	460	290	24.9	100
3/25/2015	73.25	511		23.8	124	75.68	610		23.9	140	75.01	635		23.7	156	75.26	532		23.6	120
4/1/2015	73.17	528		23.8	120	75.65	608		23.6	146	74.99	587		23.4	144	75.24	524		23.9	120
4/8/2015	73.11	533		24.7	132	75.59	615		24.7	144	74.89	576		24.4	140	75.17	538		25.1	128
4/15/2015	74.16	498		24.6	120	76.78	600		24.3	140	75.96	656		25.0	168	76.24	520		24.9	120
4/22/2015	73.51	533		24.2	124	76.14	601		24.2	140	75.46	725		24.7	168	75.62	516		25.1	124
4/28/2015	73.33	539		24.0	124	75.88	607		24.0	136	75.21	686		24.4	176	75.38	503		25.0	120
5/5/2015	73.17	532		24.6	124	75.68	614		24.4	140	74.97	685		25.2	164	75.23	476		25.4	116
5/12/2015	73.12	540		25.6	124	75.58	615		24.9	148	74.87	626		26.6	156	75.16	501		26.6	120
5/19/2015	73.08	534		25.0	128	75.58	624		24.7	150	74.90	610		25.8	150	75.13	480		26.1	116
5/26/2015	73.00	530		25.9	116	75.40	620		25.0	146	74.68	579		26.2	144	75.04	487		26.6	108
6/2/2015	72.72	520		24.9	122	75.03	645		25.4	140	74.60	535		26.1	132	74.78	443		26.1	97
6/9/2015	72.93	514		25.7	114	75.17	643		26.4	148	74.77	527		26.7	116	75.04	443		26.1	97
6/16/2015	73.32	518		26.5	118	75.98	609		26.2	140	75.47	710		26.7	184	75.35	493		27.1	78
6/24/2015	73.24	506		27.1	112	75.89	631		26.6	150	75.09	690		28.1	176	75.16	512		27.9	102
7/1/2015	73.13	654		26.7	104	75.53	673		25.9	160	74.93	631		26.3	155	75.33	500		27.7	112
7/8/2015	74.10	564		25.9	114	76.81	646		25.6	156	75.79	648		27.0	148	76.19	467		27.6	76
7/14/2015	73.42	516		26.1	120	76.05	643		25.9	150	75.48	796		28.0	180	75.43	507		27.5	120
7/21/2015	73.68	507		26.3	116	76.25	652		26.0	156	75.54	778		28.4	172	75.75	471		27.7	108
7/28/2015	73.31	501		26.2	108	75.83	663		26.1	156	75.13	647		27.6	152	75.33	463		27.6	104
8/4/2015	73.71	491		26.3	108	76.31	677		25.8	160	75.60	793		27.6	176	75.79	441		27.6	100
8/11/2015	73.43	465		26.4	100	75.98	658		26.6	168	75.33	660		28.3	164	75.49	460		28.2	112
8/18/2015	73.65	476		26.8	104	76.31	672		26.4	164	75.48	720		28.2	176	75.81	452		28.3	100
8/25/2015	73.51	470		26.8	104	76.05	673		26.4	164	75.36	680		28.1	168	75.58	466		28.2	100
8/31/2015	74.76	475		27.7	108	77.12	683		26.0	160	76.38	719		28.1	168	76.86	400		27.9	80
9/9/2015	73.66	480		27.0	112	76.23	683		26.9	174	75.57	815		28.3	180	75.76	448		28.6	100
9/15/2015	73.72	480		26.9	108	76.33	680		26.7	160	75.67	827		27.8	180	75.81	443		28.5	100
9/22/2015	73.57	497		27.0	110	76.03	678		27.0	170	75.38	703		29.0	170	75.67	487		28.3	100
9/30/2015	73.87	501		26.5	116	76.58	696		25.6	170	75.88	650		27.0	150	75.94	435		28.4	100
10/6/2015	73.38	500		27.1	112	76.01	675		26.9	170	75.33	555		28.5	136	75.47	437		28.4	100
10/13/2015	73.32	493		26.2	120	75.89	682		26.4	174	75.17	566		27.4	140	75.35	437		27.6	108
10/19/2015	73.21	481		26.5	116	75.73	713		26.0	176	74.98	590		27.4	136	75.34	438		27.6	104
10/27/2015	73.13	476		26.1	114	75.72	683		26.9	174	74.95	594		27.3	136	75.28	433		27.4	100
11/2/2015	73.13	492		27.0	108	75.63	700		26.8	176	74.91	552		27.6	130	75.24	419		27.7	84
11/10/2015	73.12	499		26.3	108	75.56	700		26.7	184	74.83	600		26.8	156	75.24	455		27.0	96
11/18/2015	73.03	482		26.8	104	75.44	681		26.4	180	74.67	574		27.5	152	75.13	435		27.5	96
11/24/2015	73.26	473		26.5	116	75.68	688		26.0	184	75.02	606		27.1	160	75.33	407		27.2	100
12/1/2015	73.19	484		26.1	116	75.62	675		25.5	180	74.91	572		26.4	148	75.32	418		26.8	96
12/9/2015	73.22	484		24.7	112	75.63	703		25.3	150	74.91	640		25.3	150	75.45	423		26.0	98
12/14/2015	73.20	481		26.5	108	75.76	683		26.1	172	74.95	580		26.7	140	75.36	425		26.8	100
12/21/2015	73.18	472		26.6	100	75.57	668		26.3	172	74.92	560		26.5	136	75.31	422		26.7	96
12/29/2015	73.11	465		26.4	96	75.48	676		26.1	172	74.80	548		26.4	120	75.24	436		26.5	104
1/5/2016	73.09	465		25.8	96	75.45	682		25.6	180	74.78	640		26.1	160	75.21	423		26.0	100
1/12/2016	73.05	464		24.5	100	75.43	694		23.2	170	74.76	635		24.3	150	75.21	412		24.3	96
1/20/2016	73.41	451		23.9	100	75.90	600		23.1	160	75.24	599		23.9	150	75.53	400		24.2	92
1/26/2016	73.30	467		24.5	96	75.77	667		24.1	170	75.11	619		23.3	150	75.48	419		24.1	96
2/1/2016	73.61	460		25.0	96	76.21	532		24.8	140	75.52	608		24.0	150	75.73	386		24.6	84
2/8/2016	73.51	455		23.5	96	76.09	600		22.8	160	75.42	529		23.0	136	75.65	400		23.1	92
2/15/2016	73.42	462		23.9	96	75.90	637		24.1	148	75.18	509		22.9	132	75.54	404		23.6	92
2/23/2016	73.57	471		24.6	100	76.13	438		23.8	110	75.47	616		23.5	140	75.70	408		24.6	105
3/2/2016	73.43	477		27.5	110	75.94	562		27.2	118	75.23	640		23.8	144	75.57	549		22.8	120
3/9/2016	73.36	460		25.0	104	75.83	573		24.7	124	75.13	699		23.6	142	75.51	389		24.5	104
3/14/2016	73.25	495		24.6	108	75.70	668		24.6	170	75.02	562		23.3	140	75.37	417		24.2	96
3/22/2016	73.09	497		23.5	108	75.49	690		22.9	184	74.76	552		23.0	130	75.21	405		24.5	92

Table 3-4
SZMW-1-1 Pad Monitoring Wells Water Quality Data

	Pad Monitoring Well Northeast					Pad Monitoring Well Northwest					Pad Monitoring Well Southwest					Pad Monitoring Well Southeast				
Date	WL (Elev)	Specific Conductance (µS/cm)	TDS (mg/L)	Temp (°C)	Chloride (mg/L)	WL (Elev)	Specific Conductance (µS/cm)	TDS (mg/L)	Temp (°C)	Chloride (mg/L)	WL (Elev)	Specific Conductance (µS/cm)	TDS (mg/L)	Temp (°C)	Chloride (mg/L)	WL (Elev)	Specific Conductance (µS/cm)	TDS (mg/L)	Temp (°C)	Chlc (mg
1/21/2015	77.18	680	424	23.1	148	77.42	800	504	23.3	196	77.60	640	358	23.8	152	76.88	580	380	22.7	1
9/9/2015	75.03	575	436	28.1	120	75.62	1045	612	28.7	210	75.89	706	706	28.4	172	74.91	653	384	28.1	1
9/15/2015	75.04	570	416	27.9	120	75.57	1000	656	28.1	204	75.87	630	630	28.6	160	74.91	578	342	28.2	1
9/23/2015	74.82	622	438	26.2	160	75.37	735	486	26.8	180	75.66	640	414	27.5	168	74.70	600	390	26.4	1
9/30/2015	75.58	595		27.1	150	75.80	850		28.1	180	76.05	645		28.3	172	75.08	582		27.9	1
10/7/2015	74.67	622		26.7	148	75.25	647		27.1	150	75.66	692		27.4	164	74.64	577		26.7	1
10/13/2015	74.63	610		26.5	150	75.20	631		27.7	160	75.58	620		27.8	160	74.59	562		26.6	1
10/20/2015	74.51	634		25.3	156	75.05	648		25.8	160	75.46	638		26.6	160	74.49	557		25.5	1
10/27/2015	74.46	630		26.2	152	75.03	638		27.1	160	75.42	635		27.5	164	74.43	568		26.3	1
11/2/2015	74.44	655		26.4	148	74.97	710		27.1	164	75.36	644		27.5	172	74.37	572		26.5	1
11/10/2015	74.40	631		26.3	144	75.04	755		27.2	200	75.38	634		27.4	175	74.37	560		26.3	1
11/18/2015	74.15	588		26.2	140	74.82	839		26.7	210	75.19	630		26.9	176	74.15	544		26.3	1
11/24/2015	74.36	566		25.0	140	74.99	1002		26.2	212	75.34	628		26.8	172	74.31	555		25.5	1
12/1/2015	74.39	623		25.8	144	75.03	863		26.8	204	75.38	644		27.1	172	74.36	557		27.1	1
12/9/2015	74.49	620		24.4	140	75.07	838		25.9	200	75.46	641		25.5	172	74.48	555		24.7	1
12/14/2015	74.58	584		25.7	140	75.17	780		26.2	192	75.58	640		26.3	172	74.57	550		25.8	1
12/21/2015	74.61	566		24.7	136	75.19	755		25.8	192	75.65	637		25.9	160	74.61	537		24.7	1
12/29/2015	74.48	605		24.6	136	75.07	655		25.6	164	75.55	634		25.7	164	74.50	530		24.3	1
1/5/2016	74.51	507		22.3	124	75.07	631		25.2	160	75.58	706		23.5	180	74.55	471		22.4	1
1/12/2016	74.45	610		21.8	150	75.23	635		21.9	160	75.54	643		22.8	172	74.54	504		21.8	1
1/20/2016	74.75	605		22.2	150	75.32	727		22.4	164	75.73	638		22.8	172	74.73	510		21.0	1
1/26/2016	74.56	636		21.8	148	75.25	655		22.3	164	75.61	660		22.1	172	74.66	514		22.1	1
2/1/2016	75.01	653		23.5	148	75.55	806		23.6	192	75.88	606		23.8	164	74.94	523		23.1	1
2/8/2016	74.94	600		22.3	136	75.43	769		22.8	192	75.84	613		23.0	164	74.85	503		23.1	1
2/15/2016	74.76	597		22.4	136	75.35	695		22.8	164	75.72	633		23.1	168	74.74	510		22.8	1
2/23/2016	74.94	644		22.8	160	75.54	760		22.8	180	75.87	611		23.1	145	74.86	526		22.6	1
3/2/2016	74.91	586		22.4	130	75.47	809		24.0	160	75.85	640		23.8	144	74.84	549		22.8	1
3/9/2016	74.75	601		25.0	130	75.32	716		24.7	164	75.70	616		23.6	149	74.71	503		22.4	1
3/14/2016	74.63	623		22.3	144	75.18	680		23.1	160	75.60	671		23.6	172	74.60	542		22.4	1
3/22/2016	74.44	595		22.3	140	75.04	661		23.4	164	75.46	675		23.6	172	74.45	572		23.0	1

Table 3-5

SMW-1 Pad Monitoring Wells Water Quality Data

	SMW-1 Pad Monitoring Well Southeast					SMW-1 Pad Monitoring Well Northwest				
Date	WL (Elevation)	Specific Conductance (µS/cm)	TDS (mg/L)	Temp (°C)	Chloride (mg/L)	WL (Elevation)	Specific Conductance (µS/cm)	TDS (mg/L)	Temp (°C)	Chloride (mg/L)
1/21/2015	75.92	720	390	23.4	176	75.75	580	356	24.3	132
2/23/2016	75.48	748	646	23.3	165	75.85	621	314	23.8	140
3/2/2016	75.26	1002	582	28.2	190	75.65	652	346	27.5	130
3/9/2016	75.29	1015	544	21.9	194	75.51	638	330	23.8	135
3/14/2016	75.13	980		22.9	186	75.42	631		23.2	134
3/22/2016	74.98	892		22.5	180	75.24	643		23.5	136
3/30/2016	75.79	697		22.7	176	76.29	573		22.6	120
4/6/2016	75.33	690		23.1	176	75.77	603		23.7	140
4/13/2016	75.22	900		22.2	196	75.61	647		24.0	148
4/20/2016	75.27	941		22.4	196	75.67	645		24.4	148
4/27/2016	75.14	1005		23.3	200	75.50	660		24.7	152
5/2/2016	75.09	1163		23.7	300	75.40	692		25.0	160
5/9/2016	75.30	1192		23.5	300	75.73	642		25.2	148
5/16/2016	75.21	1477		24.0	420	75.58	638		24.9	135
6/23/2016	75.36	364		28.6	132	75.90	413		28.6	160

Table 3-6
Pilot Hole Reverse-air Circulation Water Quality Data

	Field				Lab				
Depth	Specific Conductance (*u* S/cm)	Temp. (oC)	Salinity (ppt)	pH (StUn)	Specific Conductance (*u* S/cm)	Chloride (mg/L)	Sulfate (mg/L)	TDS (mg/L)	TDS/ Cond ratio
1,466	1,865	27.6	0.9	10.5	1920	426	169	1,090	0.57
1,560	2,800	26.6	1.4	8.57	2920	690	237	1,680	0.58
1,651	3,860	28.5	2.0	8.2	4160	992	312	2,550	0.61
1,745	5,250	28.0	2.8	8.02	5,420	1,330	407	3,000	0.55
1,837	5,300	28.0	2.9	8.25	4,910	1,540	443	3,400	0.69
1,933	11,740	27.4	6.7	7.93	10,900	3,400	818	7,370	0.68
2,026	31,570	27.9	19.7	7.73	33,000	7,280	2,190	21,200	0.64
2,118	48,700	26.7	31.8	7.88	52,000	13,300	2,870	34,100	0.66
2,214	48,600	27.3	31.6	7.65	50,900	14,600	2,750	34,800	0.68
2,306	49,200	-	32.1	7.62	51500	13,400	2,740	34,700	0.67
2,337	49,000	27.6	31.9	7.68	51,900	16,000	2,800	34,700	0.67
2,431	49,100	28.4	31.8	7.66	50,300	17,500	2,720	34,300	0.68
2,522	48,800	27.4	31.8	7.67	50,900	17,800	2,800	34,200	0.67
2,610	48,800	28.7	31.8	7.74	49,700	19,100	2,710	34,500	0.69
2,710	50,000	26.9	32.6	5.12	52,600	19,300	2,720	34,100	0.65
2,804	49,900	28.0	32.6	7.77	52,500	17,200	3,090	36,100	0.69
2,897	51,200	27.3	33.3	7.76	54,700	19,600	3,020	34,000	0.62
2,989	51,900	27.1	34.2	7.96	58,700	17,300	3,240	38,000	0.65
3,060	139,700	26.9	OVER	7.94	142,000	31,200	4,400	121,000	0.85

Table 3-7
St. Cloud ASR-1 Packer Test Water Quality Data

	Field			Lab				
Packer Test Interval	Specific Conductance (*u* S/cm)	Temp. (°C)	pH (StUn)	Specific Conductance (*u* S/cm)	Chloride (mg/L)	Sulfate (mg/L)	TDS (mg/L)	TDS/ Cond ratio
PT-1 1,064-1,405 ft	605	27.2	8.12	591	86	36.9	386	0.65
PT-2 872-1405 ft	615	27.2	8.2	616	94.6	29.2	352	0.57
PT-3 706-1405	615	22.3	8.11	616	92.1	31	380	0.62
PT-4 1616-1652 ft	4,250	27.6	7.91	4,260	1,160	333	2,660	0.62
PT-4a 1380-1616 ft	2,475	27.0	7.77	2,500	653	171	1,570	0.63
PT-5 1591-1627 ft	4,113	28.4	8.26	4380	1,070	449	2,860	0.65
PT-5a 1380-1591 ft	2,440	27.1	8.15	2,470	606	206	1,410	0.57
PT-6 1510-1546 ft	4,030	27.3	7.96	4,120	1,110	245	2,410	0.58
PT-6a 1380-1510 ft	2,320	26.9	7.93	2,480	586	208	1,440	0.58
PT-7 1475-1511 ft	2,770	27.1	7.92	2,970	716	208	1,620	0.55
PT-7a 1380-1475 ft	2,320	27.1	8.28	2,410	638	167	1,370	0.57
PT-8 1405-1441 ft	1,670	27.4	8.21	1,770	423	117	1,050	0.59
PT-8a 1380-1405 ft	650	27.6	8.24	668	105	40	378	0.57

TABLE 3-8
ASR-1 Background Laboratory Data

Primary Drinking Water Standards: Inorganic Contaminants			
Parameter	**MCL[1]**	**Units**	**6/21/16**
Nitrate (as N)	10.0	mg/l	<0.200
Nitrite (as N)	1.0	mg/l	<0.200
Arsenic	0.01	mg/l	<0.00100
Barium	2	mg/l	0.0323
Cadmium	0.005	mg/l	<0.00100
Chromium	0.10	mg/l	<0.00100
Cyanide	0.20	mg/l	<0.00500
Fluoride	4.0	mg/l	0.369 I
Lead	0.015	mg/l	<0.00100
Mercury	0.002	mg/l	<0.0000200
Nickel	0.1	mg/l	0.00170 I
Selenium	0.05	mg/l	<0.0200
Sodium	160	mg/l	715
Antimony	0.006	mg/l	<0.00100
Beryllium	0.004	mg/l	<0.000500
Thallium	0.002	mg/l	<0.00100
Primary Drinking Water Standards: Volatile Organics			
Parameter	**MCL[1]**	**Units**	**6/21/16**
1,2,4-Trichloro-benzene	0.07	mg/l	<0.000500
cis-1,2-Dichloroethene	0.07	mg/l	<0.000200
Xylenes (Total)	10	mg/l	<0.000500
Dichloromethane (Methylene Chloride)	0.005	mg/l	<0.000500
o-Dichlorobenzene(1,2-Dichlorobenzene)	0.6	mg/l	<0.000500
p-Dichlorobenzene(1,4-Dichlorobenzene)	0.075	mg/l	<0.000500
Vinyl Chloride	0.001	mg/l	<0.000500
1,1-Dichloroethene	0.007	mg/l	<0.000500
Trans-1,2-Dichloroethene	0.1	mg/l	<0.000500
1,2-Dichloroethane	0.003	mg/l	<0.000500
1,1,1-Trichloroethane	0.2	mg/l	<0.000500
Carbon Tetrachloride	0.003	mg/l	<0.000500
1,2-Dichloropropane	0.005	mg/l	<0.000500
Trichloroethene	0.003	mg/l	<0.000500
1,1,2-Trichloro-ethane	0.005	mg/l	<0.000500
Tetrachloroethene	0.003	mg/l	<0.000500
Chlorobenzene	0.1	mg/l	<0.000500
Benzene	0.001	mg/l	<0.000500
Toluene	1	mg/l	<0.000500
Ethylbenzene	0.7	mg/l	<0.000500
Styrene	0.1	mg/l	<0.000500
Primary Drinking Water Standards: Synthetic Organics			
Parameter	**MCL[1]**	**Units**	**6/21/16**
Endrin	0.002	mg/l	<0.0000100
Lindane	0.0002	mg/l	<0.0000100
Methoxychlor	0.04	mg/l	<0.0000500
Toxaphene	0.003	mg/l	<0.000500
Dalapon	0.2	mg/l	<0.00100
Diquat	0.02	mg/l	<0.000400

Endothall	0.1	mg/l	<0.00900
Glyphosate (Roundup)	0.7	mg/l	<0.00600
Di(2-ethylhexyl)adipate	0.4	mg/l	<0.00600
Oxamyl (Vydate)	0.2	mg/l	<0.00200
Simazine	0.004	mg/l	<0.0000700
Di(2-ethylhexyl)phthalate	0.006	mg/l	<0.000600
Picloram	0.5	mg/l	<0.000100
Dinoseb	0.007	mg/l	<0.000200
Hexachlorocyclo-pentadiene	0.05	mg/l	<0.000100
Carbofuran	0.04	mg/l	<0.000900
Atrazine	0.003	mg/l	<0.000100
Alachlor	0.002	mg/l	<0.000200
Heptachlor	0.0004	mg/l	<0.0000100
Heptachlor Epoxide	0.0002	mg/l	<0.0000100
2,4-D	0.07	mg/l	<0.000100
2,4,5-TP (Silvex)	0.05	mg/l	<0.000200
Hexachlorobenzene	0.001	mg/l	<0.000100
Benzo(a)pyrene	0.0002	mg/l	<0.0000200
Pentachlorophenol	0.001	mg/l	<0.0000400
Polychlorinated Biphenyl (PCB)	0.0005	mg/l	<0.000100
1,2-Dibromo-3-Chloropropoane	0.0002	mg/l	0.00002
Ethylene Dibromide (EDB)	0.00002	mg/l	<0.0000100
Chlordane	0.002	mg/l	<0.0000100
Primary Drinking Water Standards: Disinfection Byproducts			
Total Trihalomethanes (THMs)	0.08	mg/l	<0.000500
Haloacetic Acids (HAA5)	0.06	mg/l	<0.000500

Primary Drinking Water Standards: Radionuclides			
Parameter	**MCL[1]**	**Units**	**10/3/16**
Uranium	30	ug/l	1.6±0.6
Radium 226	5	pCi/l	5.3±0.7
Radium 228		pCi/l	1.3±0.5
Gross Alpha	15	pCi/l	6.4±0.8
Primary Drinking Water Standards: Microbiological			
Parameter	**MCL[1]**	**Units**	**6/21/16**
Total Coliform	4 [2]		NA
Fecal Coliform	absence[2]		NA
Secondary Drinking Water Standards			
Parameter	**MCL[1]**	**Units**	**6/21/16**
Aluminum	0.2	mg/l	<0.0200
Chloride	250	mg/l	1420
Copper	1.0	mg/l	0.0037
Fluoride	2.0	mg/l	0.369 I
Iron	0.3	mg/l	0.377
Manganese	0.05	mg/l	0.0111 I
Silver	0.1	mg/l	<0.000500
Sulfate	250	mg/l	381
Zinc	5	mg/l	0.0309
Color	15	PCU	< 5.00
Odor	3	TON	< 1.00
pH	6.5 - 8.5	Std units	8.02

Total Dissolved Solids (TDS)	500	mg/l	3060
Foaming Agents	0.5	mg/l	0.235 I

Municipal Wastewater Indicator Parameters for Groundwater Monitoring

Parameter	MCL[1]	Units	6/21/16
Inorganics			
Ammonia	None	mg/L	0.0390
Nitrogen (organic)	None	mg/L	0.526
Total Kjeldahl Nitrogen (TKN)	None	mg/L	0.506
Total Phosphorus (phosphate)	None	mg/L	0.0527 I
Volatile Organics			
Chloroethane	None	mg/L	NA
Chloroform	None	mg/L	<0.000500
para-Dichlorobenzene (1,4 Dichlorobenzene)	None	mg/L	<0.000500
1,2-Dichloroethylene (cis or trans)	0.07	mg/L	<0.000500
Base/Neutral Organics			
Anthracene	None	mg/L	<0.00200
Butylbenzylphthallate	None	mg/L	<0.00300
Dimethylphthallate	None	mg/L	<0.00300
Naphthalene	None	mg/L	<0.00200
Phenanthrene	None	mg/L	<0.00200
Pesticides and PCBs			
Aldrin	None	mg/L	<0.0000100
Dieldrin	None	mg/L	<0.0000100
Acid Extractables			
2-chlorophenol	None	mg/L	<0.00200
2,4,6-trichlorophenol	None	mg/L	<0.00200
Other			
Conductivity	None	µmhos/cm	4600
Biochemical Oxygen Demand	None	mg/L	<2.00
Chemical Oxygen Demand	None	mg/L	49.9
Temperature	None	°C	NA
Calcium	None	mg/L	146
Magnesium	None	mg/L	92
Total Alkalinity	None	mg/L	95.1
Total Hardness	None	mg/L	669
Non-carbonate Hardness	None	mg/L	NA
Total Nitrogen	None	mg/L	0.526
Ammonia Nitrogen	None	mg/L	0.0390

Notes

1. Maximum Contaminant Level (MCL) per Rules 62-550.310 and 62-550.320, FAC.
2. Sodium is a state (non-federal) drinking water standard.
3. Temperature from field development

Abbreviations

None : No MCL Available

1420	Value exceeds MCL
NA	Sample not collected
(I)	laboratory method detection limit
	detection limit and reporting limit

PCU: Color Units
TON: Threshhold Odor Number
pCi/l: Picocurries/liter

Table 3-9
SMW-1 Background Laboratory Data

Primary Drinking Water Standards: Inorganic Contaminants			
Parameter	**MCL[1]**	**Units**	**6/22/16**
Nitrate (as N)	10.0	mg/l	<0.200
Nitrite (as N)	1.0	mg/l	<0.200
Arsenic	0.01	mg/l	0.0055
Barium	2	mg/l	0.0514
Cadmium	0.005	mg/l	<0.00100
Chromium	0.10	mg/l	<0.00100
Cyanide	0.20	mg/l	<0.00500
Fluoride	4.0	mg/l	0.333 I
Lead	0.015	mg/l	<0.00100
Mercury	0.002	mg/l	<0.0000200
Nickel	0.1	mg/l	0.00130 I
Selenium	0.05	mg/l	<0.00200
Sodium	160	mg/l	401
Antimony	0.006	mg/l	<0.00100
Beryllium	0.004	mg/l	0.006
Thallium	0.002	mg/l	<0.00100

Primary Drinking Water Standards: Volatile Organics			
Parameter	**MCL[1]**	**Units**	**6/22/16**
1,2,4-Trichloro-benzene	0.07	mg/l	<0.000500
cis-1,2-Dichloroethene	0.07	mg/l	<0.000200
Xylenes (Total)	10	mg/l	<0.000500
Dichloromethane (Methylene Chloride)	0.005	mg/l	<0.000500
o-Dichlorobenzene(1,2-Dichlorobenzene)	0.6	mg/l	<0.000500
p-Dichlorobenzene(1,4-Dichlorobenzene)	0.075	mg/l	<0.000500
Vinyl Chloride	0.001	mg/l	<0.000500
1,1-Dichloroethene	0.007	mg/l	<0.000500
Trans-1,2-Dichloroethene	0.1	mg/l	<0.000500
1,2-Dichloroethane	0.003	mg/l	<0.000500
1,1,1-Trichloroethane	0.2	mg/l	<0.000500
Carbon Tetrachloride	0.003	mg/l	<0.000500
1,2-Dichloropropane	0.005	mg/l	<0.000500
Trichloroethene	0.003	mg/l	<0.000500
1,1,2-Trichloro-ethane	0.005	mg/l	<0.000500
Tetrachloroethene	0.003	mg/l	<0.000500
Chlorobenzene	0.1	mg/l	<0.000500
Benzene	0.001	mg/l	<0.000500
Toluene	1	mg/l	<0.000500
Ethylbenzene	0.7	mg/l	<0.000500
Styrene	0.1	mg/l	<0.000500

Primary Drinking Water Standards: Synthetic Organics			
Parameter	**MCL[1]**	**Units**	**6/22/16**
Endrin	0.002	mg/l	<0.0000100
Lindane	0.0002	mg/l	<0.0000100
Methoxychlor	0.04	mg/l	<0.0000500
Toxaphene	0.003	mg/l	<0.000500
Dalapon	0.2	mg/l	<0.000100
Diquat	0.02	mg/l	<0.000400

Endothall	0.1	mg/l	<0.00900
Glyphosate (Roundup)	0.7	mg/l	<0.00600
Di(2-ethylhexyl)adipate	0.4	mg/l	<0.000600
Oxamyl (Vydate)	0.2	mg/l	<0.00200
Simazine	0.004	mg/l	<0.0000700
Di(2-ethylhexyl)phthalate	0.006	mg/l	<0.000600
Picloram	0.5	mg/l	<0.000100
Dinoseb	0.007	mg/l	<0.000200
Hexachlorocyclo-pentadiene	0.05	mg/l	<0.000100
Carbofuran	0.04	mg/l	<0.000900
Atrazine	0.003	mg/l	<0.000100
Alachlor	0.002	mg/l	<0.000200
Heptachlor	0.0004	mg/l	<0.0000100
Heptachlor Epoxide	0.0002	mg/l	<0.0000100
2,4-D	0.07	mg/l	<0.000100
2,4,5-TP (Silvex)	0.05	mg/l	<0.000200
Hexachlorobenzene	0.001	mg/l	<0.000100
Benzo(a)pyrene	0.0002	mg/l	<0.0000200
Pentachlorophenol	0.001	mg/l	<0.0000400
Polychlorinated Biphenyl (PCB)	0.0005	mg/l	<0.000100
1,2-Dibromo-3-Chloropropoane	0.0002	mg/l	<0.00002
Ethylene Dibromide (EDB)	0.00002	mg/l	<0.0000100
Chlordane	0.002	mg/l	<0.0000100
Primary Drinking Water Standards: Disinfection Byproducts			
Parameter	**MCL[1]**	**Units**	**6/22/16**
Total Trihalomethanes (THMs)	0.08	mg/l	<0.000500
Haloacetic Acids (HAA5)	0.06	mg/l	<0.000500

Primary Drinking Water Standards: Radionuclides			
Parameter	**MCL[1]**	**Units**	**10/3/16**
Uranium	30	µg/l	1.0±0.5
Radium 226	5	pCi/l	10.5±0.9
Radium 228		pCi/l	2.7±0.6
Gross Alpha	15	pCi/l	17.8±1.3
Secondary Drinking Water Standards			
Parameter	**MCL[1]**	**Units**	**6/22/16**
Aluminum	0.2	mg/l	<0.0200
Chloride	250	mg/l	793
Copper	1.0	mg/l	<0.00100
Fluoride	2.0	mg/l	0.333 I
Iron	0.3	mg/l	0.762
Manganese	0.05	mg/l	0.0215
Silver	0.1	mg/l	<0.000500
Sulfate	250	mg/l	221
Zinc	5	mg/l	<0.0100
Color	15	PCU	< 5.00
Odor	3	TON	< 1.00
pH	6.5 - 8.5	Std units	7.70
Total Dissolved Solids (TDS)	500	mg/l	1820
Foaming Agents	0.5	mg/l	<0.200
Municipal Wastewater Indicator Parameters for Groundwater Monitoring			

Parameter	MCL[1]	Units	6/22/16
Inorganics			
Ammonia	None	mg/L	0.0799
Nitrogen (organic)	None	mg/L	<0.0200
Total Kjeldahl Nitrogen (TKN)	None	mg/L	0.307 I
Total Phosphorus (phosphate)	None	mg/L	<0.0400
Volatile Organics			
Chloroethane	None	mg/L	NA
Chloroform	None	mg/L	<0.000500
para-Dichlorobenzene (1,4 Dichlorobenzene)	None	mg/L	<0.000500
1,2-Dichloroethylene (cis or trans)	0.07	mg/L	<0.000500
Base/Neutral Organics			
Anthracene	None	mg/L	<0.00200
Butylbenzylphthallate	None	mg/L	<0.00300
Dimethylphthallate	None	mg/L	<0.00300
Naphthalene	None	mg/L	<0.00200
Phenanthrene	None	mg/L	<0.00200
Pesticides and PCBs			
Aldrin	None	mg/L	<0.0000100
Dieldrin	None	mg/L	<0.0000100
Acid Extractables			
2-chlorophenol	None	mg/L	<0.00200
2,4,6-trichlorophenol	None	mg/L	<0.00200
Other			
Conductivity	None	µmhos/cm	2710
Biochemical Oxygen Demand	None	mg/L	<2.00
Chemical Oxygen Demand	None	mg/L	29.3 I
Temperature	None	°C	NA
Calcium	None	mg/L	103
Magnesium	None	mg/L	49.0
Total Alkalinity	None	mg/L	94.7
Total Hardness	None	mg/L	459
Non-carbonate Hardness	None	mg/L	NA
Total Nitrogen	None	mg/L	0.327
Ammonia Nitrogen	None	mg/L	0.0799

Notes

1. Maximum Contaminant Level (MCL) per Rules 62-550.310 and 62-550.320, FAC.
2. Sodium is a state (non-federal) drinking water standard.
3. Temperature from field development

Abbreviations

None : No MCL Available

550	Value exceeds MCL
NA	Sample not collected
(I)	laboratory method detection limit
	detection limit and reporting limit

PCU: Color Units
TON: Threshhold Odor Number
pCi/l: Picocurries/liter

TABLE 3-10
SZMW-1 Background Laboratory Data

Primary Drinking Water Standards: Inorganic Contaminants			
Parameter	**MCL[1]**	**Units**	**6/23/16**
Nitrate (as N)	10.0	mg/l	<0.0100
Nitrite (as N)	1.0	mg/l	<0.0200
Arsenic	0.01	mg/l	<0.00100
Barium	2	mg/l	0.0325
Cadmium	0.005	mg/l	<0.00100
Chromium	0.10	mg/l	<0.00100
Cyanide	0.20	mg/l	<0.00500
Fluoride	4.0	mg/l	<0.200
Lead	0.015	mg/l	<0.00100
Mercury	0.002	mg/l	<0.0000200
Nickel	0.1	mg/l	0.00130 I
Selenium	0.05	mg/l	<0.00200
Sodium	160	mg/l	794
Antimony	0.006	mg/l	<0.00100
Beryllium	0.004	mg/l	<0.000500
Thallium	0.002	mg/l	<0.00100
Primary Drinking Water Standards: Volatile Organics			
Parameter	**MCL[1]**	**Units**	**6/23/16**
1,2,4-Trichloro-benzene	0.07	mg/l	<0.000500
cis-1,2-Dichloroethene	0.07	mg/l	<0.000200
Xylenes (Total)	10	mg/l	<0.000500
Dichloromethane (Methylene Chloride)	0.005	mg/l	<0.000500
o-Dichlorobenzene(1,2-Dichlorobenzene)	0.6	mg/l	<0.000500
p-Dichlorobenzene(1,4-Dichlorobenzene)	0.075	mg/l	<0.000500
Vinyl Chloride	0.001	mg/l	<0.000500
1,1-Dichloroethene	0.007	mg/l	<0.000500
Trans-1,2-Dichloroethene	0.1	mg/l	<0.000500
1,2-Dichloroethane	0.003	mg/l	<0.000500
1,1,1-Trichloroethane	0.2	mg/l	<0.000500
Carbon Tetrachloride	0.003	mg/l	<0.000500
1,2-Dichloropropane	0.005	mg/l	<0.000500
Trichloroethene	0.003	mg/l	<0.000500
1,1,2-Trichloro-ethane	0.005	mg/l	<0.000500
Tetrachloroethene	0.003	mg/l	<0.000500
Chlorobenzene	0.1	mg/l	<0.000500
Benzene	0.001	mg/l	<0.000500
Toluene	1	mg/l	<0.000500
Ethylbenzene	0.7	mg/l	<0.000500
Styrene	0.1	mg/l	<0.000500
Primary Drinking Water Standards: Synthetic Organics			
Parameter	**MCL[1]**	**Units**	**6/23/16**
Endrin	0.002	mg/l	<0.0000100
Lindane	0.0002	mg/l	<0.0000100
Methoxychlor	0.04	mg/l	<0.0000500
Toxaphene	0.003	mg/l	<0.000500
Dalapon	0.2	mg/l	<0.000100

Diquat	0.02	mg/l	<0.000400
Endothall	0.1	mg/l	<0.00900
Glyphosate (Roundup)	0.7	mg/l	<0.00600
Di(2-ethylhexyl)adipate	0.4	mg/l	<0.00600
Oxamyl (Vydate)	0.2	mg/l	<0.00200
Simazine	0.004	mg/l	<0.0000700
Di(2-ethylhexyl)phthalate	0.006	mg/l	<0.000600
Picloram	0.5	mg/l	<0.000100
Dinoseb	0.007	mg/l	<0.000200
Hexachlorocyclo-pentadiene	0.05	mg/l	<0.000100
Carbofuran	0.04	mg/l	<0.000900
Atrazine	0.003	mg/l	<0.000100
Alachlor	0.002	mg/l	<0.000200
Heptachlor	0.0004	mg/l	<0.0000100
Heptachlor Epoxide	0.0002	mg/l	<0.0000100
2,4-D	0.07	mg/l	<0.000100
2,4,5-TP (Silvex)	0.05	mg/l	<0.000200
Hexachlorobenzene	0.001	mg/l	<0.000100
Benzo(a)pyrene	0.0002	mg/l	<0.0000200
Pentachlorophenol	0.001	mg/l	<0.0000400
Polychlorinated Biphenyl (PCB)	0.0005	mg/l	<0.000100
1,2-Dibromo-3-Chloropropoane	0.0002	mg/l	0.0000200
Ethylene Dibromide (EDB)	0.00002	mg/l	<0.0000100
Chlordane	0.002	mg/l	<0.0000100
Primary Drinking Water Standards: Disinfection Byproducts			
Total Trihalomethanes (THMs)	0.08	mg/l	<0.000500
Haloacetic Acids (HAA5)	0.06	mg/l	<0.000500
Primary Drinking Water Standards: Radionuclides			
Parameter	**MCL[1]**	**Units**	**10/3/16**
Uranium	30	µg/l	0.9±0.5
Radium 226	5	pCi/l	10.8±1.0
Radium 228		pCi/l	1.9±0.6
Gross Alpha	15	pCi/l	13.2±1.1
Primary Drinking Water Standards: Microbiological			
Parameter	**MCL[1]**	**Units**	**6/23/16**
Total Coliform	4[2]		NA
Fecal Coliform	absence[2]		NA
Secondary Drinking Water Standards			
Parameter	**MCL[1]**	**Units**	**6/23/16**
Aluminum	0.2	mg/l	<0.0200
Chloride	250	mg/l	1440
Copper	1.0	mg/l	<0.00100
Fluoride	2.0	mg/l	<0.200
Iron	0.3	mg/l	1.11
Manganese	0.05	mg/l	0.0102 I
Silver	0.1	mg/l	<0.000500
Sulfate	250	mg/l	379
Zinc	5	mg/l	<0.0100
Color	15	PCU	20.0
Odor	3	TON	< 1.00

pH	6.5 - 8.5	Std units	7.70
Total Dissolved Solids (TDS)	500	mg/l	3090
Foaming Agents	0.5	mg/l	<0.200

Municipal Wastewater Indicator Parameters for Groundwater Monitoring

Parameter	MCL[1]	Units	6/23/16
Inorganics			
Ammonia	None	mg/L	0.0641
Nitrogen (organic)	None	mg/L	0.232
Total Kjeldahl Nitrogen (TKN)	None	mg/L	0.212 I
Total Phosphorus (phosphate)	None	mg/L	0.0710 I
Volatile Organics			
Chloroethane	None	mg/L	NA
Chloroform	None	mg/L	<0.000500
para-Dichlorobenzene (1,4 Dichlorobenzene)	None	mg/L	<0.000500
1,2-Dichloroethylene (cis or trans)	0.07	mg/L	<0.000500
Base/Neutral Organics			
Anthracene	None	mg/L	<0.00200
Butylbenzylphthallate	None	mg/L	<0.00300
Dimethylphthallate	None	mg/L	<0.00300
Naphthalene	None	mg/L	<0.00200
Phenanthrene	None	mg/L	<0.00200
Pesticides and PCBs			
Aldrin	None	mg/L	<0.0000100
Dieldrin	None	mg/L	<0.0000100
Acid Extractables			
2-chlorophenol	None	mg/L	<0.00200
2,4,6-trichlorophenol	None	mg/L	<0.00200
Other			
Conductivity	None	µmhos/cm	4990
Biochemical Oxygen Demand	None	mg/L	<2.00
Chemical Oxygen Demand	None	mg/L	54.9
Temperature	None	°C	NA
Calcium	None	mg/L	146
Magnesium	None	mg/L	100
Total Alkalinity	None	mg/L	95.3
Total Hardness	None	mg/L	776
Non-carbonate Hardness	None	mg/L	NA
Total Nitrogen	None	mg/L	0.232
Ammonia Nitrogen	None	mg/L	0.0641

Notes

1. Maximum Contaminant Level (MCL) per Rules 62-550.310 and 62-550.320, FAC.
2. Sodium is a state (non-federal) drinking water standard.
3. Temperature from field development

Abbreviations

None : No MCL Available

1440	Value exceeds MCL
NA	Sample not collected
(I)	laboratory method detection limit
	detection limit and reporting limit

PCU: Color Units
TON: Threshhold Odor Number
pCi/l: Picocurries/liter

TABLE 3-11
ASR-1 Summary of Geophysical Logs

DATE	3/5/15	3/11/15	4/7/15	6/23/15	9/16/15	10/15/15	11/20/15	12/8/15	12/18/15
LOGGING RUNS	**RUN-1**	**RUN-2**	**RUN-3**	**RUN-4**	**RUN-5**	**RUN-6**	**RUN-7**	**RUN-8**	**RUN-9**
BOREHOLE	12.25-inch pilot	34-inch reamed	9.5-inch pilot	26-inch reamed	10.875-inch pilot	15-inch pilot hole to 2,000	19-inch reamed	12/14-inch final casing	15-inch pilot
TOP INTERVAL LOGGED (FT BLS)	0	0	0	0	1,380	1,380	0	0	1,650
BOTTOM INTERVAL (FT BLS)	322	321	1,404	1,384	1,933	3,045	1,650	1,650	2,000
GEOPHYSICAL LOGS RUN									
X-Y CALIPER	X	X	X	X	X	X	X		X
GAMMA RAY	X	X	X	X	X	X	X		X
DUAL INDUCTION	X		X			X			X
SPONTANEOUS POTENTIAL	X		X						
TEMPERATURE			X		X	X		X	X
FLUID CONDUCTIVITY			X		X	X			X
FLOW METER			X			X			X
BHC SONIC			X			X			
LOG DERIVED TDS						X			
VIDEO									X
COMMENTS	Geologic confirmation Indication of Casing Placement	Confirmation of Surface Casing Placement	Geologic confirmation Intermediate Casing Placement	Confirmation of Casing Placement	Geologic confirmation/Indication of Casing Placement	Geologic confirmation/Indication of Casing Placement	Confirmation of Casing Placement	Cement Top Temperature Logs	Final Open Hole and Casing Inspection

TABLE 3-12
SMW-1 Summary of Geophysical Logs

DATE	2/24/16	3/3/16	4/14/16	5/2/16	7/7/16
LOGGING RUNS	RUN-1	RUN-2	RUN-3	RUN-4	RUN-5
BOREHOLE	11.875-inch pilot	25-inch reamed hole	11.875-inch pilot	18-inch reamed hole	Final Open Hole Interval
TOP INTERVAL LOGGED (FT BLS)	0	0	195	0	1,480
BOTTOM INTERVAL (FT BLS)	320	320	1,490	1,480	1,520
GEOPHYSICAL LOGS RUN					
X-Y CALIPER	X	X	X	X	X
GAMMA RAY	X	X	X	X	X
DUAL INDUCTION	X		X		X
TEMPERATURE					X
FLUID CONDUCTIVITY					X
FLOW METER					X
BHC SONIC			X		
LOG DERIVED TDS					
VIDEO					
COMMENTS	Geologic confirmation /Indication of Casing Placement	Confirm Casing Placement	Geologic Information /Confirmation of Casing Placement	Confirm Casing Placement	Final Open Hole Interval

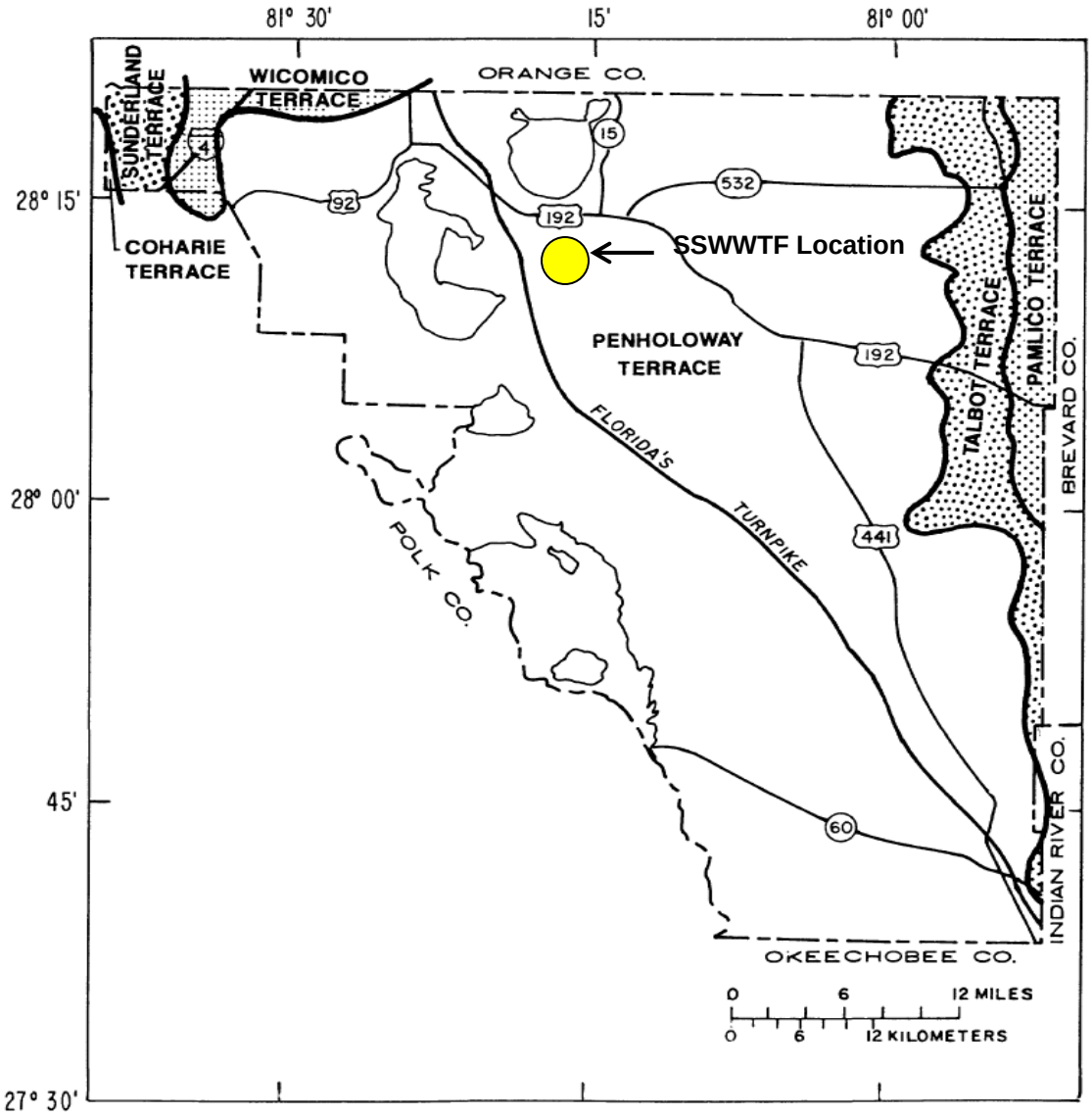
TABLE 3-13
SZMW-1 Summary of Geophysical Logs

DATE	9/14/15	9/21/15	10/20/15	11/13/15	1/8/16	1/22/16	7/7/16
LOGGING RUNS	RUN-1	RUN-2	RUN-3	RUN-4	RUN-5	RUN-6	RUN-7
BOREHOLE	11.875-inch pilot	26-inch reamed hole	11.875-inch pilot	17-inch reamed hole	11.875-inch pilot	6-inch final casing	Final Open Hole
TOP INTERVAL LOGGED (FT BLS)	0	0	0	0	1,050	1,040	0
BOTTOM INTERVAL (FT BLS)	312	306	1,154	1,152	1,523	1,680	1,680
GEOPHYSICAL LOGS RUN							
X-Y CALIPER	X	X	X	X	X	X	X
GAMMA RAY	X	X	X	X	X	X	X
DUAL INDUCTION	X		X			X	X
TEMPERATURE						X	X
FLUID CONDUCTIVITY						X	X
FLOW METER						X	X
BOREHOLE COMPENSATED SONIC			X			X	
COMMENTS	Geologic confirmation Indication of Casing Placement	Confirmation of Surface Casing Placement	Geologic Information Confirmation of Casing Placement	Confirmation of Intermediate Casing Placement	Confirmation of Packer Setting Depth	Geologic Information Confirmation of Casing Placement	Final Open Hole

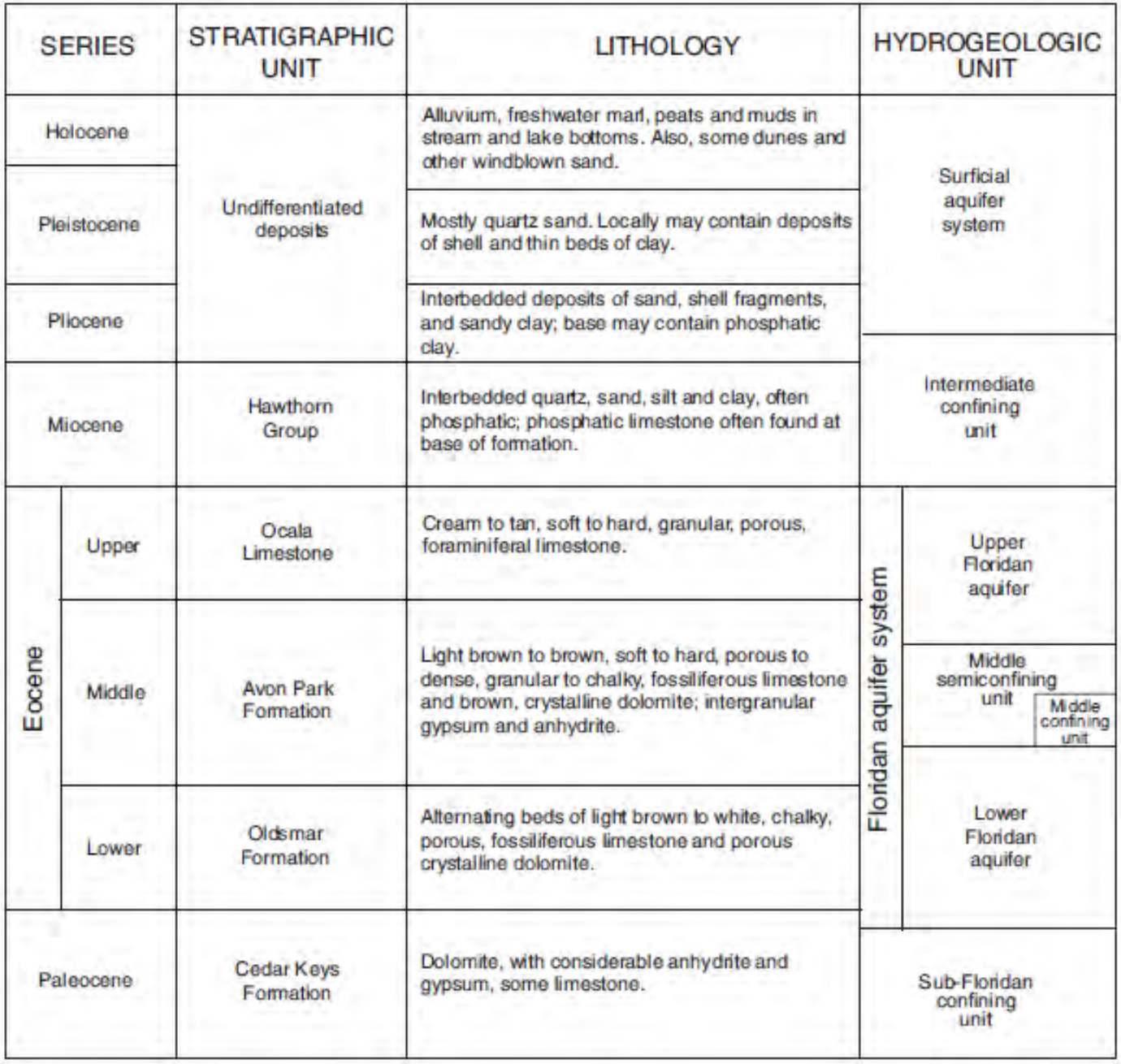
TABLE 3-14 ASR-1 Video Log

Owner: City of St. Cloud
Well: Exploratory Well ASR-1
Video Dates: 9/16/2015 and 12/18/2015
Witnessed by: Marty Clasen
Log Prepared by: Marty Clasen

Depth (feet BLS)		
From	**To**	**Description**
1650	1650	bottom of 12-inch casing 1650 ft
1668	1668	Top of cavern
1689	1689	Bottom of cavern
1700	1700	"Boulder Zone" no apparent round borehole, broken rock, ledges
1735	1735	Wedge in rock, difficult to pass with camera
1814	1814	"Boulder Zone" as above
1825	1825	Apparent downhole flow
1850	1850	"Boulder Zone" as above
1870	1870	"Boulder Zone" as above
1947	1947	"Boulder Zone" as above
1980	1980	Cloudy, no visibility, end of video
		Note: well was drilled to 3,060 feet



City of St. Cloud **Class V Injection Well System**	JONES EDMUNDS ASR US, LLC	Pleistocene Terraces from (Schiner, 1993)	DATE 10/30/16 FIGURE 3-1



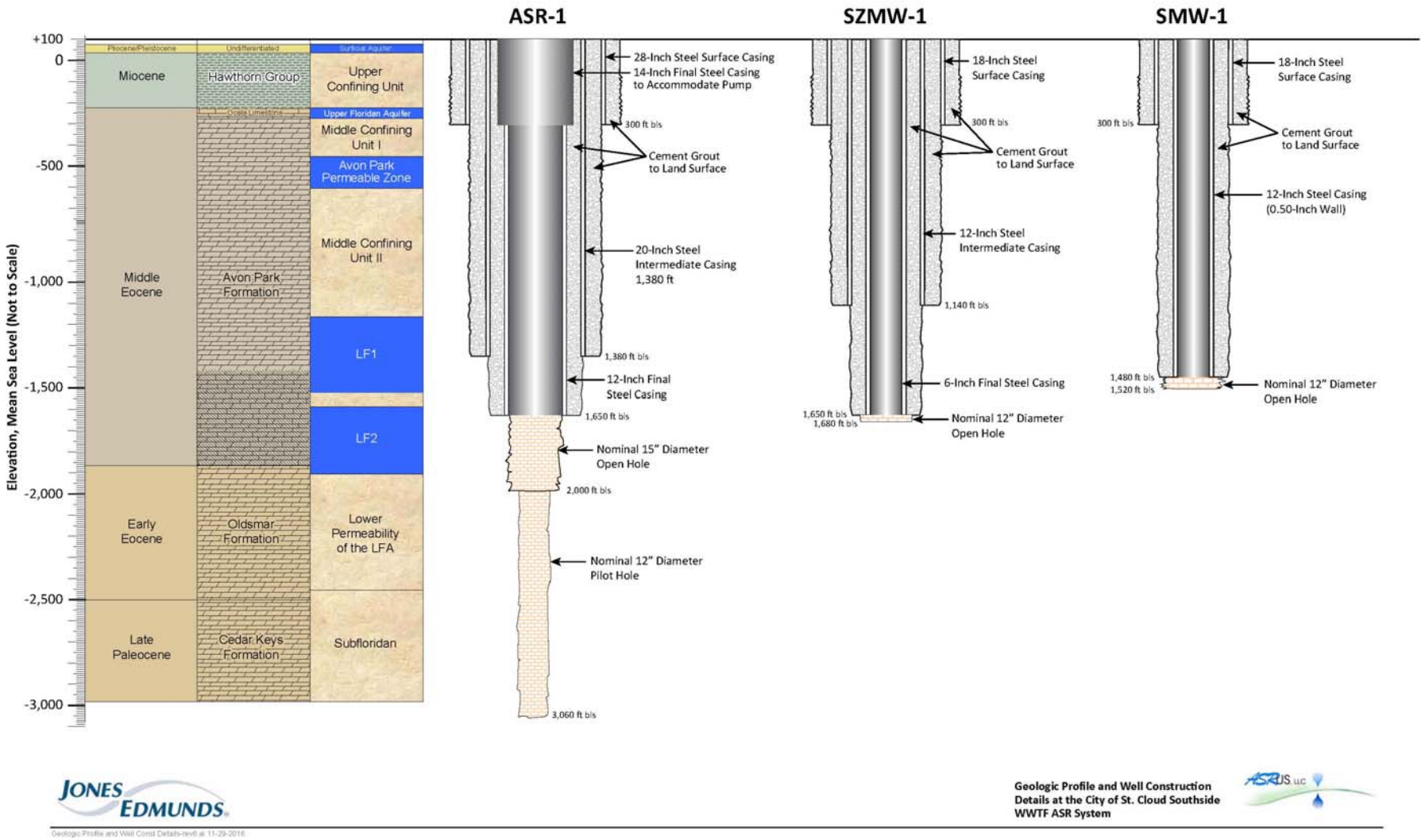
City of St. Cloud
Class V Injection Well System

JONES EDMUNDS
ASR US, LLC

General Geology and Hydrogeology
From (O'Reilly and Spechler, 2002)

DATE 10/30/16

FIGURE 3-2



JONES EDMUNDS

Geologic Profile and Well Construction Details at the City of St. Cloud Southside WWTF ASR System

ASR US, LLC

Geologic Profile and Well Const Details-rev6 at 11-29-2016

City of St. Cloud **Class V Injection Well System**	JONES EDMUNDS ASR US, LLC	Site Stratigraphy	DATE 10/30/16 FIGURE 3-3

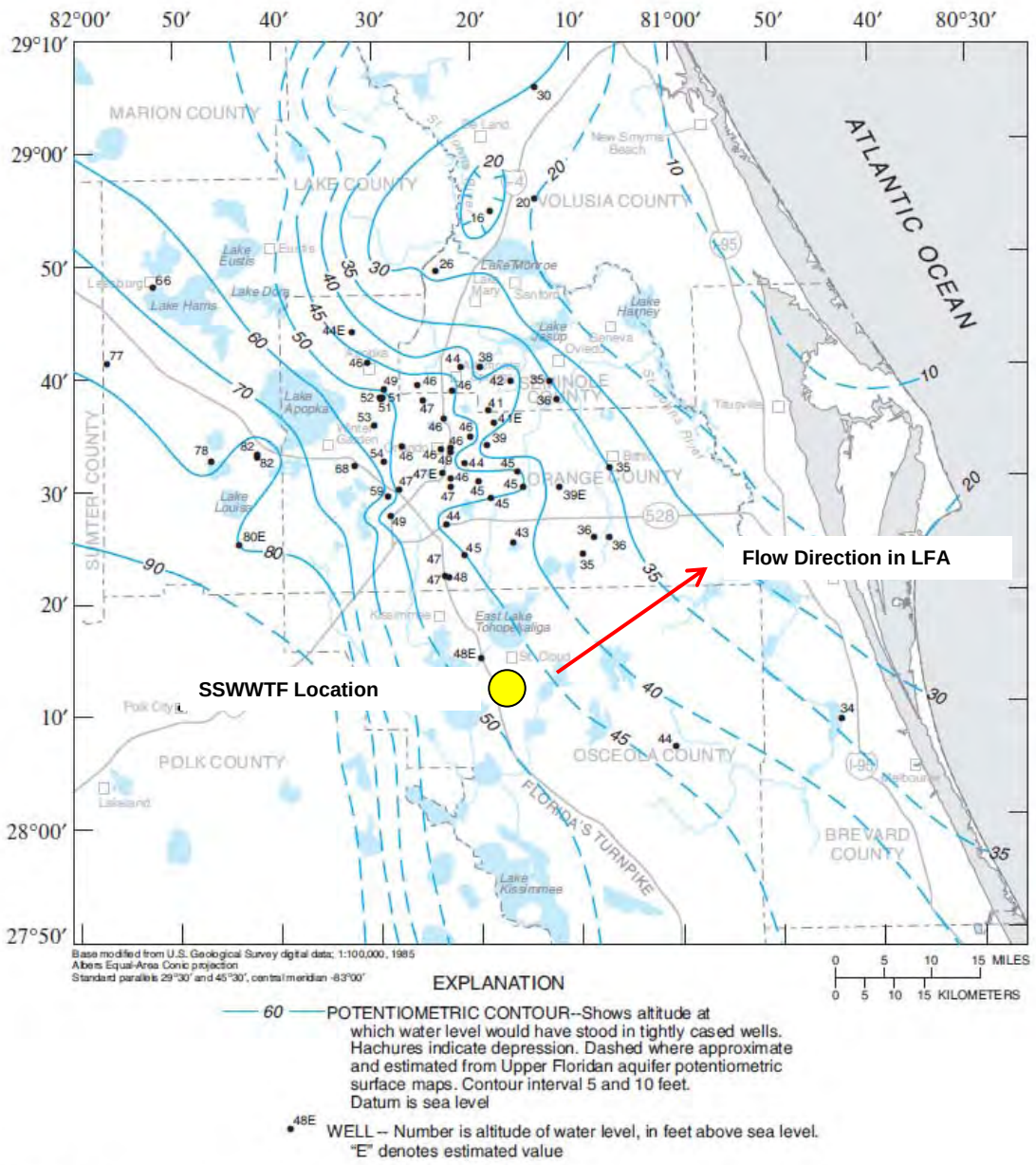
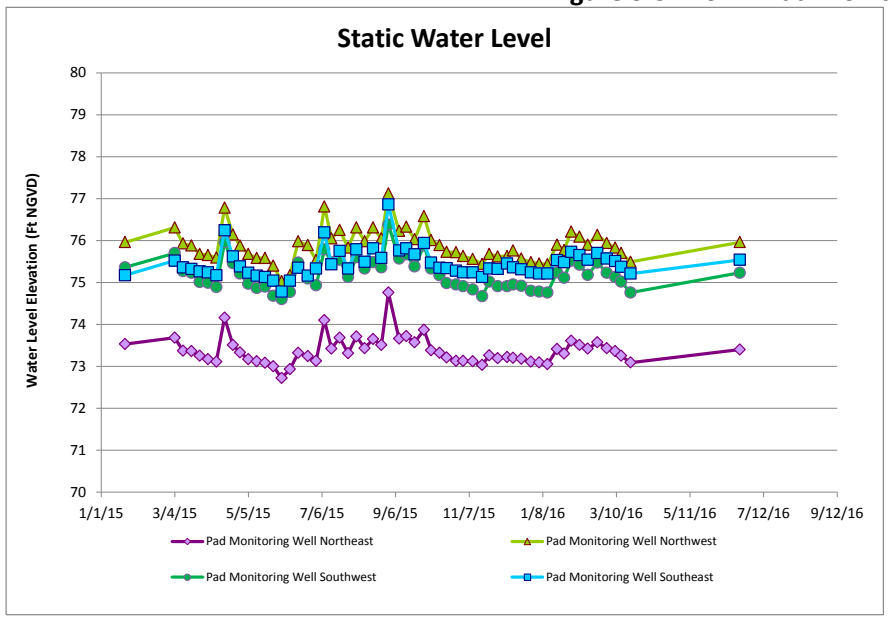
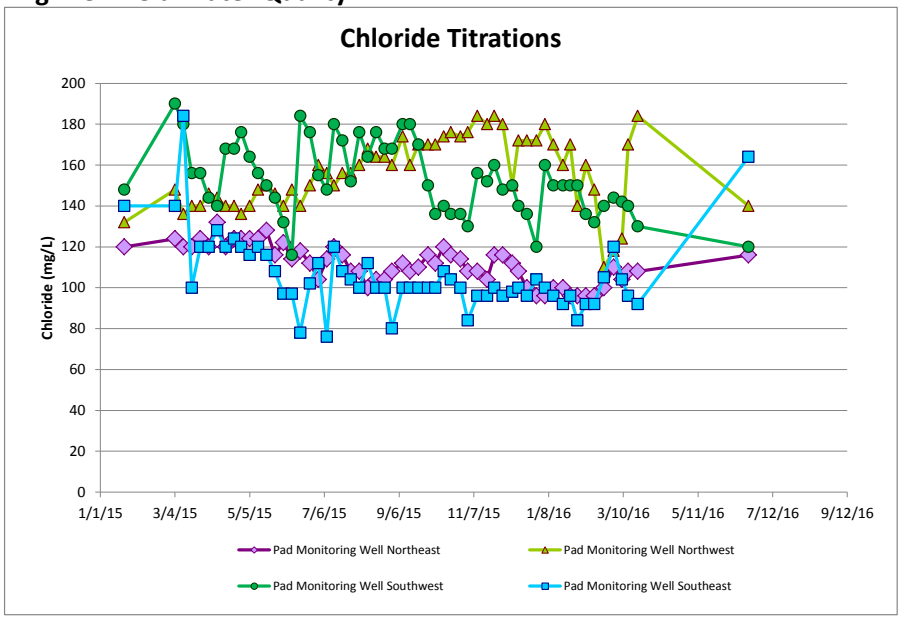


Figure 17. Generalized potentiometric surface of the Lower Floridan aquifer, September 1998.

City of St. Cloud **Class V Injection Well System**	JONES EDMUNDS ASR US, LLC	September 1998 Potentiometric Map (from O'Reilly and Spechler, 2002)	DATE 10/30/16 FIGURE 3-4

Figure 3-5 ASR-1 Pad Monitoring Well Field Water Quality





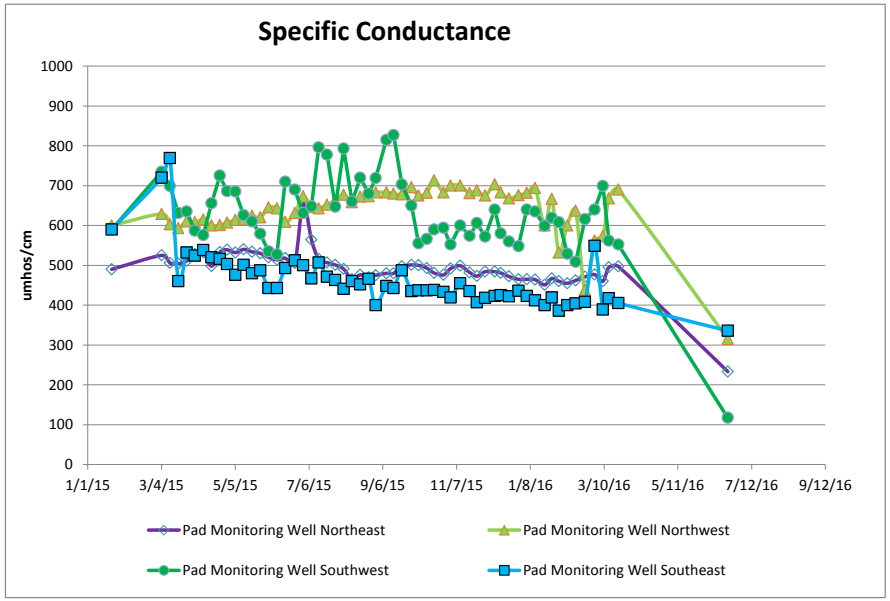
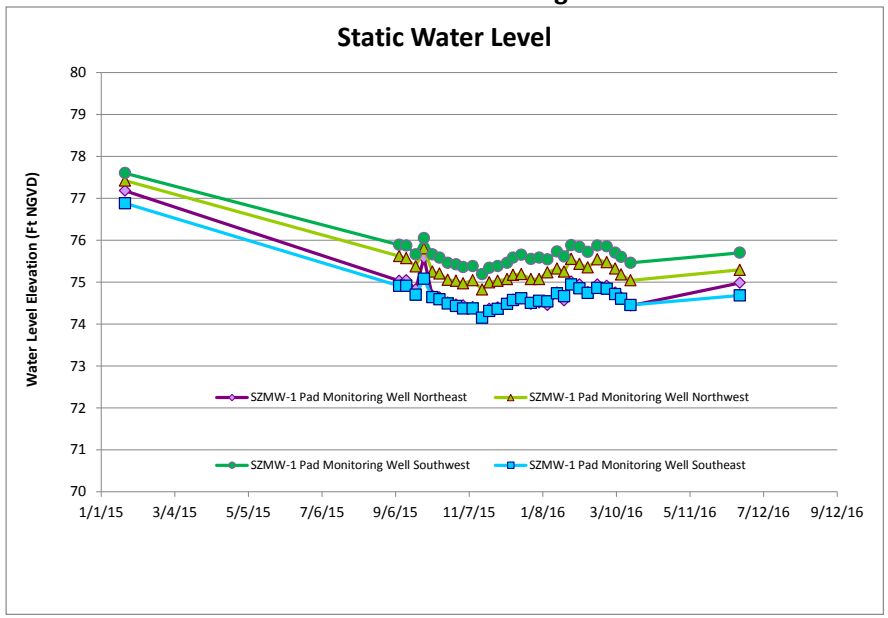
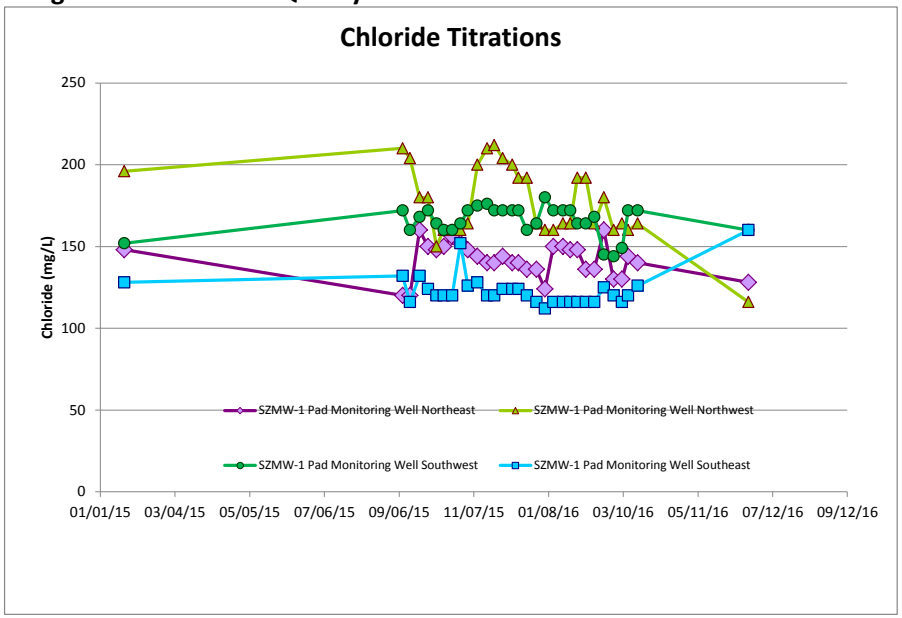


Figure 3-6 SZMW-1 Pad Monitoring Well Field Water Quality





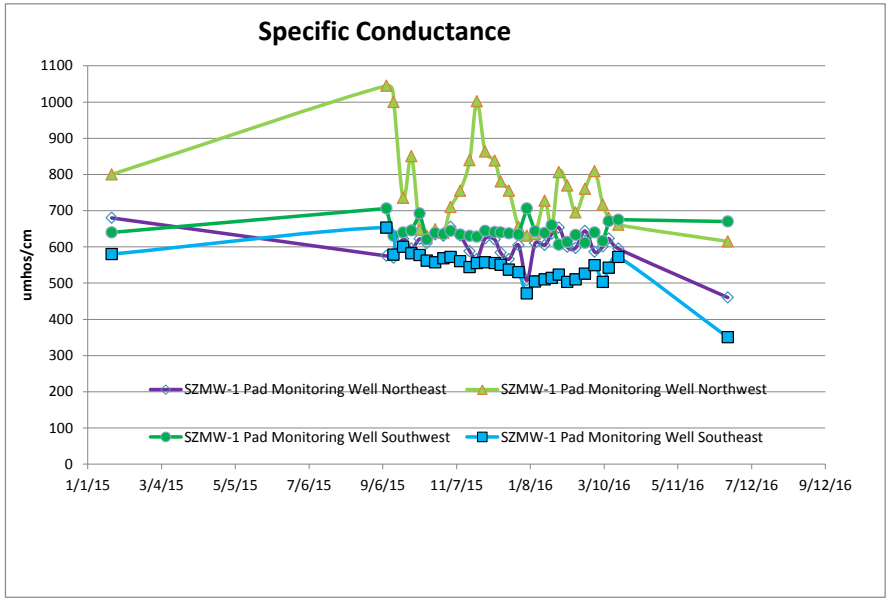
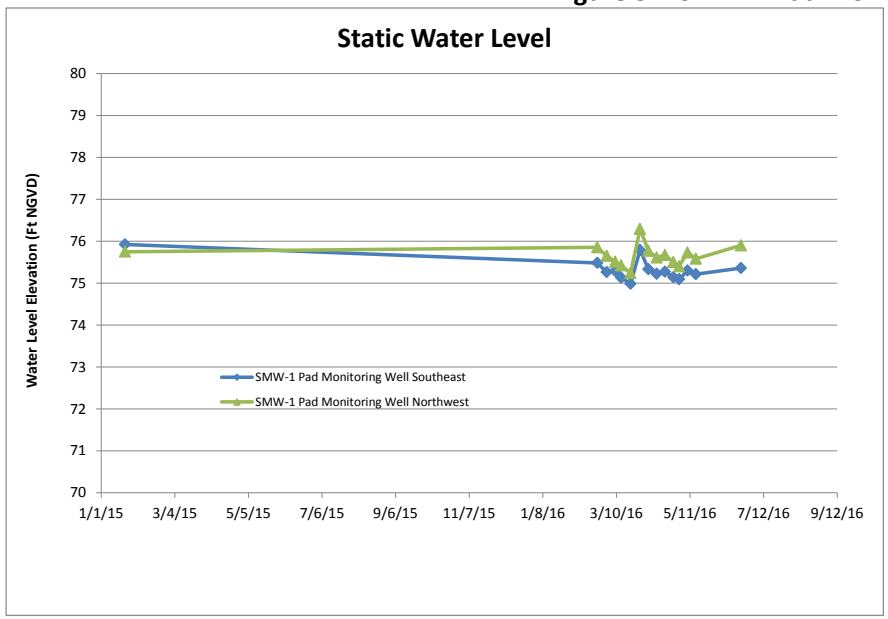
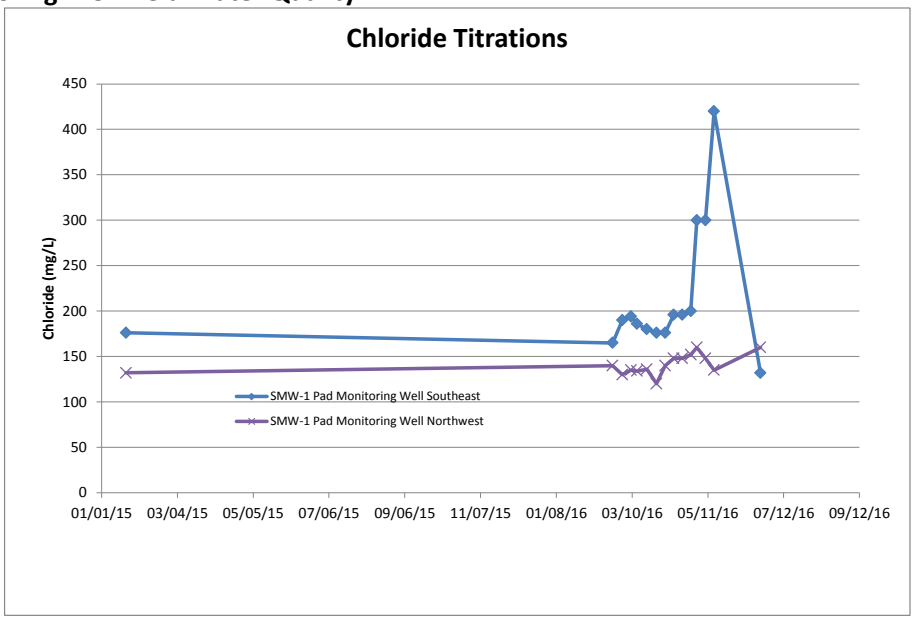
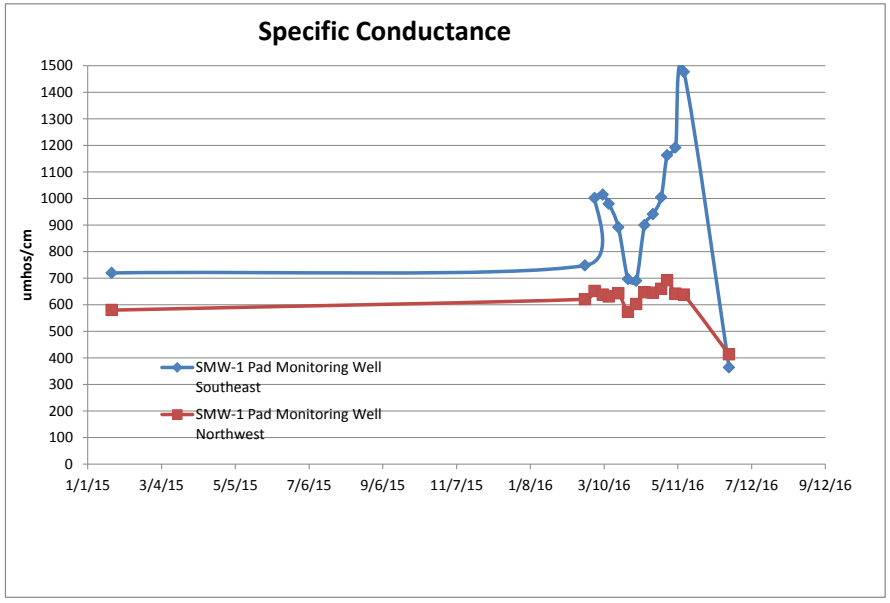


Figure 3-7 SMW-1 Pad Monitoring Well Field Water Quality







City of St. Cloud **Class V Injection Well System**	JONES EDMUNDS ASR US LLC	Video Survey Top of Cavern at 1,669 feet bls	DATE 10/30/16 FIGURE 3-8

City of St. Cloud **Class V Injection Well System**	JONES EDMUNDS ASR US LLC	Video Survey of “Boulder Zone” at 1,702 feet bls	DATE 10/30/16 FIGURE 3-9

City of St. Cloud **Class V Injection Well System**	JONES EDMUNDS ASR US LLC	Video Survey of "Boulder Zone" at 1,870 feet bls	DATE 10/30/16 FIGURE 3-10

City of St. Cloud **Class V Injection Well System**	JONES EDMUNDS ASR US LLC	Video Survey of "Boulder Zone" at 1,947 feet bls	DATE 10/30/16 FIGURE 3-11

4.0 Summary and Recommendations

4.1. Summary

A Class V injection well and two monitoring wells were successfully constructed and tested at the SSWWTF site in St. Cloud. The Class V well was initially permitted as an ASR well but later repurposed as a Class V disposal well due to the increased permeability observed in the proposed storage zone. Well ASR-1 was completed with a 12/14-inch diameter steel casing to an approximate depth of 1,650 feet with an open-hole section extending to an approximate depth of 3,060 feet. Four shallow water table monitoring wells were installed around the ASR-1 well to monitor the Surficial Aquifer water quality during construction activities. Shallow monitoring well SMW-1 was constructed 145 feet north of ASR-1 and was completed with a 12-inch diameter carbon steel casing to an approximate depth of 1,480 feet bls with an open-hole extending to 1,520 feet bls. Two additional shallow water table monitoring wells were installed around SMW-1. Storage zone monitoring well SZMW-1 was constructed approximately 700 feet west-southwest of ASR-1 and was completed with a 6-inch diameter carbon steel casing to an approximate depth of 1,650 feet bls with an open-hole extending to 1,680 feet bls. Four additional shallow water table monitoring wells were installed around SZMW-1. All drilling operations were conducted under the construction permit issued by the FDEP. ASRus, as a subconsultant to Jones Edmunds, provided oversight services by a Professional Geologist licensed in the state of Florida. Florida Design Drilling, Inc. was hired as the drilling contractor to complete all well drilling and testing activities.

A hydrogeologic testing program was approved by the FDEP and stipulated as part of the Class V well construction permit. The testing program was performed on wells ASR-1, SMW-1, and SZMW-1 during construction activities and included the following: formation sampling, rock coring, open-hole packer hydraulic testing, water quality sampling and geophysical logging.

Data collected from the hydrogeologic testing program were used to define the hydrogeologic framework beneath the SSWWTF site and aid in developing the proposed injection interval and the proposed final construction details for the monitor wells. Formation sampling and geophysical logging were used to verify the geology of the site. Geophysical logging and water quality sampling (airlift and packer test) were used to determine the occurrence of the base of the USDW, which was identified at approximately 1,980 feet. The proposed injection zone at the site is a limestone and dolostone sequence located within the LFA from a depth of 1,650 feet to 3,060 feet bls. Less permeable evaporites are interbedded with the carbonate strata throughout the storage interval selected.

Water quality samples also allowed a characterization of the background water quality conditions within the proposed reclaimed water storage zone. Packer tests and rock core tests were used to estimate the hydraulic characteristics of confining units overlying the proposed injection zone. The packer tests indicated specific capacity values of approximately 6 to 14 gpm/ft for the semi-confining units. The specific capacity testing of the proposed injection zone yielded approximately 371 gpm/ft at a pumping rate of 490 gpm.

4.2. Recommendations

The data collected during the construction and testing of wells ASR-1, SMW-1, and SZMW-1 indicate that permitting of a Class V injection well is feasible at the SSWWTF site. The following recommendations are proposed:

- Complete the piping and wellheads and, following FDEP approval, begin injection testing with reclaimed water. Preliminary testing indicates an injection rate of 2 MGD or more is feasible.
- Following FDEP approval to begin operational testing, begin injection testing in accordance with the approved sampling program contained in the permit.
- Continue to coordinate closely with FDEP during operational testing to collect sufficient data to support the ultimate issuance of a Class V Operation Permit for the completed recharge system at this facility.

5.0 References

ASRus and Jones Edmunds, June 2014. City of St. Cloud Southside Wastewater Treatment Facility FDEP Class V Well Construction Permit Application. Prepared for the City of St. Cloud, St. Cloud, FL.

Miller, J.A., 1986, Hydrogeologic framework of the Floridan aquifer system in Florida and in parts of Georgia, South Carolina, and Alabama: U.S. Geological Survey Professional Paper 1403-B, 91 p., 33 plate

O'Reilly, A. and Spechler, R., 2002, Hydrogeology and Water-Quality Characteristics of the Lower Floridan Aquifer in East-Central Florida, U.S. Geological Survey Water Resources Investigations Report 02-4193, 60 p.

Schiner, George R., 1993, Geohydrology of Osceola County, Florida: U.S. Geological Survey Water Resources Investigation Report 92-4076, 68 p.

Scott, Thomas M. (1988), The Lithostratigraphy of the Hawthorn Group (Miocene) of Florida, Bulletin No. 59.

Spechler, R. M., and Kroening, S. E., 2007, Hydrology of Polk County, Florida: U.S. Geological Survey Scientific Investigations Report 2006-5320, 114 p.

Reese, R. and Richardson, Emily, 2007, Synthesis of the Hydrogeologic Framework of the Floridan Aquifer System and Delineation of a Major Avon Park Permeable Zone in Central and Southern Florida, U.S. Geological Survey Scientific Investigations Report 2007-5207. Prepared in cooperation with the SFWMD.

APPENDIX A

Well Construction Permits

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

BOB MARTINEZ CENTER
2600 BLAIR STONE ROAD
TALLAHASSEE, FLORIDA 32399-2400

RICK SCOTT
GOVERNOR

CARLOS LOPEZ-CANTERA
LT. GOVERNOR

HERSCHEL T. VINYARD JR.
SECRETARY

SENT VIA ELECTRONIC MAIL:

In the Matter of an Application for Permit by:

October 27, 2014

Veronica Miller, Assistant City Manager
City of St. Cloud Utilities
1300 Ninth Street
St. Cloud, Florida 34769
vmiller@stcloud.org

Osceola County UIC

UIC Permit Number 0327299-001-UC/5X & 0327299-002-UC/5X

WACS ID 101938
Class V ASR Well System
Construction and Testing Permit

NOTICE OF PERMIT

Enclosed is Permit Number 0327299-001-UC/5X & 0327299-002-UC/5X to construct and operationally test: a Class V, Group 3, Aquifer Storage and Recovery (ASR) wells system. Two ASR injection wells (ASR-1 & ASR-2) will store and recover excess reclaimed water in the Oldsmar and Cedar Keys formations. The reclaimed water will be supplied from the St. Cloud Southside Wastewater Treatment Facility (WWTF). The approximate total volume of recharged water per injection well will be 2 MGD. Rates may be increased with Department authorization if technical justification is provided to the Department. There are a total of three monitor wells to determine water quality and level fluctuations in the Floridian aquifer system. The ASR wells (ASR-1 & ASR-2) will consist of 12-inch final casings landed at 2,200 feet below land surface (bls) with open hole intervals extending from 2,200 to 2,800 feet bls. The ASR wells will be drilled to a total depth of 3100 feet bls and plugged back to 2800 feet bls.

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 Rules 9.110 and 9.190, 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, agency_cleck@dep.state.fl.us; 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 Leon County, Florida.

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL
PROTECTION

Joseph Haberfeld

Joseph Haberfeld, P.G.
Aquifer Protection Program Administrator

CERTIFICATE OF SERVICE

The undersigned designated clerk hereby certifies that this **NOTICE OF PERMIT** and all copies were mailed before the close of business on Monday, October 27, 2014 to the listed persons.

FILING AND ACKNOWLEDGMENT

FILED, on this date, pursuant to Section 120.52, Florida Statutes, with the designated Department Clerk, receipt of which is hereby acknowledged.

Mary Parker
Clerk

October 27, 2014
Date

Copies Furnished To:

Joseph Haberfeld, FDEP/TLH	*joe.haberfeld@dep.state.fl.us*
Douglas Thornton, FDEP/TLH	*douglas.thornton@dep.state.fl.us*
Cathleen McCarthy, FDEP/TLH	*cathleen.mccarty@dep.state.fl.us*
George Heuler, FDEP/TLH	*george.heuler@dep.state.fl.us*
Caroline Shine, FDEP/ORL	*caroline.shine@dep.state.fl.us*
Anil Desai, FDEP/ORL	*anil.desai@dep.state.fl.us*
Bartt Booz, JEA	*bbooz@jonesedmunds.com*
James Tully, P.E., JEA	*jtully@jonesedmunds.com*
Mark McNeal, ASRus/Tampa	*mmcneal@asrus.net*
Leandro Garcia, FDEP/TLH	*leandro.garcia@dep.state.fl.us*
Mary Genung, FDEP/TLH	*mary.genung@dep.state.fl.us*
Nancy Marsh, USEPA/ATL	*marsh.nancy@epa.gov*

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION
BOB MARTINEZ CENTER
2600 BLAIR STONE ROAD
TALLAHASSEE, FLORIDA 32399-2400

RICK SCOTT
GOVERNOR

CARLOS LOPEZ-CANTERA.
LT. GOVERNOR

HERSCHEL T. VINYARD JR.
SECRETARY

Underground Injection Control
Class V, Group 3 Aquifer and Storage Recovery (ASR) Well System
Construction and Testing Permit

Permittee:
Veronica Miller, Assistant City Manager
City of St. Cloud Utilities
1300 Ninth Street
St. Cloud, Florida 34769
vmiller@stcloud.org

Facility
St. Cloud Southside WTF
5701 Michigan Avenue
St. Cloud, Florida 34769

Permit/Certification	
Permit Number:	0327299-001-UC/5X & 0327299-002-UC/5X
WACS ID:	101938
Date of Issuance:	October 27, 2014
Date of Expiration:	October 26, 2019
Permit Processor:	Douglas Thornton
Location	
County:	Osceola County UIC
Latitude:	28° 12' 26" N
Longitude:	81° 16' 27" W
Section/Township/Range:	Sec 24/ T26S / R30E

Project: Class V ASR Well System ASR-1, ASR-2.

This permit is issued under the provisions of Chapter 403, Florida Statutes, and the rules adopted thereunder. 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.

TO CONSTRUCT AND OPERATIONALLY TEST: A Class V, Group 3, Aquifer Storage and Recovery (ASR) wells system. Two ASR injection wells (ASR-1 & ASR-2) will store and recover excess reclaimed water in the Oldsmar and Cedar Keys formations. The reclaimed water will be supplied from the St. Cloud Southside Wastewater Treatment Facility (WWTF). The approximate total volume of recharged water per injection well will be 2 MGD. Rates may be increased with Department authorization if technical justification is provided to the Department. There are a total of three monitor wells to determine water quality and level fluctuations in the Floridian aquifer system. The ASR wells (ASR-1 & ASR-2) will consist of 12-inch final casings landed at 2,200 feet below land surface (bls) with open hole intervals extending from 2,200 to 2,800 feet bls. The ASR wells will be drilled to a total depth of 3100 feet bls and plugged back to 2800 feet bls.

IN ACCORDANCE WITH The Application to Construct DEP Form No. 62-528.900(1) received, June 23, 2014, response to the Department's July 11, 2014, request for additional information, and supporting information submitted to this agency.

LOCATION: St. Cloud Southside Wastewater Treatment Facility, 5701 Michigan Avenue, St. Cloud, Florida 34769, in the county of Osceola.

The injection and monitoring wells at this facility are designated as follows:

Injection Wells:

Well Name	*WACS Effluent Testsite ID*	*Total Well Depth **	*Casing Diameter (inches)*	*Casing or Tubing Type*	*Casing or Interval**
ASR-1 0327299-001-UC/5X	13997	3100	28	Steel	300
			20	Steel	1400
			12	Steel	2200
			Open hole		From 2200 to 2800
ASR-2 0327299-002-UC/5X	13998	3100	28	Steel	300
			20	Steel	1400
			12	Steel	2200
			Open hole		From 2200 to 2800

*Feet Below Land Surface
Total depth 3100 feet bls, plugged back to 2800 feet bls
12-inch casing connected to 14-inch casing at approximately 200 feet bls

Monitoring Wells:

Well Name	*WACS Monitoring Well Testsite ID*	*Monitoring Zone*	*Casing Diameter (OD)*	*Casing Type*	*Casing Depth**	*Monitoring Depth**
SMW-1	29323A		18	Steel	300	
			12	Steel	700	
			6	Steel	1300	
		Upper Zone				From 1300 to 1400
SMW-2	29324A		18	Steel	300	
			12	Steel	700	
			6	Steel	1300	
		Upper Zone				From 1300 to 1400
SZMW-1	29325A		18		300	
			12		1400	
			6		2200	
		Lower Zone				From 2200 to 2400

*Feet Below Land Surface

SUBJECT TO: Specific Conditions I-VII and General Conditions 1-24.

Specific Conditions

I. GENERAL REQUIREMENTS

1. This permit is for the City of St. Cloud Utilities to construct and operationally test a Class V, Group 3, Aquifer Storage and Recovery (ASR) well system. Two ASR injection wells (ASR-1 & ASR-2) will store and recover excess reclaimed water in the Oldsmar and Cedar Keys formations. The reclaimed water will be supplied from the St. Cloud Southside Wastewater Treatment Facility (WTF). This permit does not authorize the construction or operational testing of any other well or wells. *[62-528.440(2)(a)]*

2. In the event a well must be plugged or abandoned, the permittee shall obtain a permit from the Department as required by Chapter 62-528, Florida Administrative Code. When no longer used for their intended purpose, these wells shall be properly plugged and abandoned. Within 180 days of well abandonment, the permittee shall submit to the Department the proposed plugging method, pursuant to Rule 62-528.460, F.A.C. *[62-528.460(1) and 62-528.435(6)]*

3. 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. *[62-528.307(2)(a)]*

II. SITE REQUIREMENTS

1. A drilling pad shall be provided to collect spillage of contaminants and to support the heaviest load that will be encountered during drilling. Spillage during construction activities, and any fluids spilled during maintenance, testing or repairs to the system(s) shall be contained on the pad(s) and directed to a means of treatment or proper disposal. The specifications for a temporary containment structure around the borehole during the drilling of the ASR well and storage zone monitoring wells shall be submitted to and approved by the Department prior to those wells being constructed. *[62-528.410(9)(b)]*

2. No drilling operations shall begin without an approved disposal site for drilling fluids, cuttings, or waste. It shall be the permittee's responsibility to obtain the necessary approval(s) for disposal prior to the start of construction. A detailed disposal plan shall be submitted to the Department prior to the commencement of drilling activities for the ASR and monitoring wells. *[62-528.410(9)(a)]*

3. Two surficial aquifer monitoring wells, identified as Pad Monitoring Wells (PMWs), shall be located near the corners of the pads to be constructed for SMW-1 and SMW-2, and four surficial aquifer monitoring wells shall be located near the corners of the pads to be constructed for ASR-1, ASR-2, & SZMW-1, and shall be identified by location number and pad location, i.e. NW, SE. If located in a traffic area the well head(s) must be protected by traffic bearing enclosure(s) and cover(s). Each cover must lock and be

specifically marked to identify the well and its purpose. The PMWs shall be sampled as follows:

a. During the construction and associated testing phases, the PMWs shall be sampled weekly for chlorides (mg/L), specific conductance (µmho/cm or µS/cm), temperature, and water level relative to the North American Vertical Datum of 1988 (NAVD 88). Initial PMW analyses shall be submitted prior to the onset of drilling activities.
b. The PMWs shall also be sampled for total dissolved solids (mg/L) during the first four weeks of PMW sampling and at all times when specifically requested by the Department.
c. The results of the PMW analyses shall be submitted to the Department in the weekly progress report. The PMWs shall be retained in service throughout the construction phase of the project. Upon completion of construction, the permittee may submit a request to the Department for cessation of sampling followed by capping, or plugging and abandonment of these wells.

[62-528.410(9)(b)]

4. Specific drilling pad dimensions and design drawings for Department record shall be provided prior to commencing construction and shortly after selection of the drilling contractor. *[62-528.410(9)(b)]*

5. Hurricane Preparedness: Preparations to be made by permittee upon issuance of a "Hurricane Watch" by the National Weather Service include, but are not limited to:
   a. Secure all onsite salt and other stockpiled additive materials to prevent surface and/or ground water contamination.
   b. Properly secure equipment to prevent damage to well(s) and onsite treatment process equipment.

   [62-528.307(1)(f)]

III. CONSTRUCTION AND TESTING REQUIREMENTS

A. General

1. Any construction, modification, repair, or abandonment of a well shall be performed by a Florida licensed water well contractor, licensed under Chapter 62-532, F.A.C., to engage in the business of construction, modification, repair or abandonment of a well. *[62-532.200]*

2. Well construction shall follow the requirements of Rule 62-532.500 for Water Well Construction Standards. *[62-532.500]*

3. The measurement points for drilling and logging operations shall be surveyed and referenced to the North American Vertical Datum of 1988 (NAVD 88) prior to the onset of drilling activities for the ASR well(s) and associated monitoring well system. *[62-160.240(2)]*

4. Blow-out preventers or comparable flow control devices shall be installed on the wells prior to penetration of the Floridan aquifer system. *[62-528.410(9)(c)]*

5. The Department shall be notified 7 days prior to the mobilization of drilling operations to the site. *[62-528.307(1)(g)]*

6. If additives that were not approved in the permit application are used during grouting, for lost circulation or for any other reason, information on their properties shall be submitted to FDEP prior to their use for Department review and approval. *[62-528.410(5)(c)]*

B. Evaluation and Testing

1. The construction, geophysical logging program and packer testing program shall be implemented in accordance with this permit and as proposed in the following submittals:
   - June 23, 2014, "Well Construction Application";
   - July 29, 2014, Response to RAI;
   - Other approved submittals received by the Department.

   [62-528.307(1)(b)]

2. Exact depths of casing seats and monitoring intervals will be determined based on field conditions and the results obtained during the construction and testing program, and are subject to the conditions of this permit. *[62-528.410(4)(c)]*

3. Department approval is required prior to the following stages of construction and testing:
   a. Contract documents and spud date
   b. Intermediate (20-inch) casing seat in each injection well
   c. Final (12-inch) casing seat in each injection well
   d. Intermediate (12-inch) casing seat in monitoring well SZMW-1
   e. Final (6-inch O.D.) casing seat in each monitoring well
   f. Monitoring zone selection
   g. Operational testing

   [62-528.410(4)(c) and 62-528.420(4)(c)]

4. The data and analysis supporting the selection of the monitoring intervals shall be submitted to the Department after the collection, interpretation and analysis of all pertinent cores, geophysical logs, packer tests and analysis of fluid samples. The Department shall approve the final selection of the specific monitoring intervals. *[62-528.420(3)(c)]*

5. Confinement shall be demonstrated using at a minimum, directly measured lithologic properties, geophysical evidence, and tests performed while pumping the formation. *[62-528.405(2)(c)]*

C. Surface Equipment

1. The integrity of the monitoring zone sampling systems shall be maintained at all times. Sampling lines shall be clearly and unambiguously identified by monitoring zone at the point at which samples are drawn. All reasonable and prudent precautions shall be taken to ensure that samples are properly identified by monitoring zone and that samples obtained are representative of those zones. Sampling lines and equipment shall be kept free of contamination with independent discharges and no interconnections with any other lines. *[62-528.307(1)(f) and 62-528.307(3)(b)]*

2. The surface equipment and piping for the ASR and monitoring wells shall be kept free of corrosion at all times. *[62-528.307(1)(f) and 62-528.307(3)(b)]*

3. The ASR well pads shall be maintained and retained in service for the life of the ASR wells. The ASR well pads are not, unless specific approval is obtained from the Department, to be used for storage of any material or equipment at any time. *[62-528.307(1)(f) and 62-528.307(3)(b)]*

IV. QUALITY ASSURANCE/QUALITY CONTROL

1. The permittee shall ensure that the construction and operational testing of this ASR well system shall be as described in the application and supporting documents. Any proposed modifications to the permit shall be submitted in writing to the Underground Injection Control Program 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 a completed application and appropriate processing fee as per Rule 62-4.050, F.A.C. *[62-528.100, 62-4.050]*
2. Proper operation and maintenance include effective performance and appropriate quality assurance procedures; adequate operator staffing and training; and adequate laboratory and process controls. *[62-528.307(2)(b)]*
3. All water quality samples required by this permit shall be collected in accordance with the appropriate Department Standard Operation Procedures (SOP), pursuant to Chapter 62-160, F.A.C., Field Procedures. A certified laboratory shall conduct the analytical work, as provided by Chapter 62-160, F.A.C., Laboratory Certification. Department approved test methods shall be utilized, unless otherwise stated in this permit. All calibration procedures for field testing and laboratory equipment shall follow manufacturer's instrumentation manuals and satisfy the requirements of the Department SOPs. A listing of the SOPs pertaining to field and laboratory activities is available at the FDEP website at: http://www.dep.state.fl.us/water/sas/sop/sops.htm. *[62-4.246, 62-160]*

4. All indicating, recording and totalizing devices associated with the ASR well system shall be maintained in good operating condition and calibrated annually at a minimum. The pressure gauges, flow meter, and chart records shall be calibrated using standard engineering methods. *[62-528.307(2)(b)]*

5. All reports submitted to satisfy the requirements of this permit shall be signed by a person authorized under Rule 62-528.340(1), F.A.C., or a duly authorized representative of that person under Rule 62-528.340(2), F.A.C. All reports required by this permit which are submitted to the Department shall contain the following certification as required by Rule 62-528.340(4), F.A.C.:

   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 on 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.
   [62-528.340(1), (2), and (4)]

6. Analyses shall be conducted on unfiltered samples, unless filtered samples have been approved by the Central District as being more representative of ground water conditions. *[62-520.310(5)]*

7. A professional engineer registered pursuant to Chapter 471, F.S., shall be retained throughout the construction period to be responsible for the construction operation and to certify the application, specifications, completion report and other related documents. The Department shall be notified immediately of any change of engineer. *[62-528.440(5)(b)]*

8. Continuous on-site supervision by qualified personnel (engineer and/or geologist, as applicable) is required during all testing and geophysical logging operations. *[62-528.440(5)(b)]*

V. REPORTING REQUIREMENTS

1. The drilling and construction schedule, site layout of drilling pad and pad monitoring well locations shall be submitted to the Department during site preparation but prior to drilling operation commencement for the ASR well system. *[62-528.430(2)(a)]*

2. Weekly progress reports shall be submitted to the Department's Tallahassee and Central District offices throughout the construction period for each well. These reports, which may be submitted by electronic mail, shall be submitted within 48 hours of the end of the period of record and shall include at a minimum the following information:
   a. A cover letter summary of the daily engineer report, driller's log and a projection for activities in the next reporting period
   b. Daily engineers reports and driller's/work logs with detailed descriptions of all drilling progress, cementing, testing, logging, and casing installation activities.
   c. Description of daily footage drilled by diameter of bit or size of hole opener or reamer being used.
   d. Collection of drilling cuttings every 10 feet and at every formation change;

e. Description of work during installation and cementing of casing, including amounts of casing and cement used. Details of cementing operations shall include the number of cementing stages, and the following information for each stage of cementing: the volume of cement pumped, the theoretical fill depth, and the actual tag depth. From both the physical tag and the geophysical logs, a percent fill shall be calculated. An explanation of any deviation between actual versus theoretical fill shall be provided
f. Details of the additions of salt or other materials to suppress well flow, including the date, depth and amount of material used.
g. Description of testing accomplished including (but not limited to) pumping and packer tests
h. Lithologic logs and core descriptions with cuttings description, formation and depth encountered
i. Geophysical logs, video logs, and deviation survey results.
j. Water quality analyses, including but not limited to the weekly water quality analysis and water levels for the PMWs.
k. Well development records
l. Description of any construction problems that developed during the reporting period and current status
m. Interpretations included with all test results and logs submitted.
n. Documentation of disposal of drilling fluids, cuttings, formation water, or waste as per specific condition II.2.
o. Description of any construction problems that developed during the reporting period and current status;
p. Copies of the driller's log are to be submitted with the weekly summary;
q. Description of any deviation survey conducted;

[62-528.430(1) and 62-528.410(9)(a)]

3. Upon completion of the construction of the ASR well(s) detailed in this permit, a complete set of as-built engineering drawings (Florida licensed P.E. signed and sealed) shall be submitted to the Department. *[62-528.450(2)]*

4. Natural background ground water quality samples shall be obtained from the ASR zone and each monitoring zone for primary and secondary standards (Chapter 62-550.310 and 320, F.A.C.), excluding asbestos, dioxin, butachlor, acrylamide, and epichlorohydrin. The analysis shall also include dissolved oxygen, total iron, fecal coliform, *Cryptosporidium,* and *Giardia lamblia* (count and viability testing, where applicable). "Natural Background" means the condition of waters in the absence of man-induced alterations based on the best scientific information available to the Department [Rule 62-520.200(12), 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 injection. *[62-528.600(5)(a)]*

5. The final selection of specific injection and monitoring intervals must be approved by the Department. In order to obtain an approval, the permittee shall submit a written request to the Department. All casing seat requests for the ASR well(s) and the monitoring well(s)

shall be accompanied by technical justification. To the extent possible, each casing seat request should address the following items:

a. Lithologic and geophysical logs with interpretations, as the interpretations relate to the casing seat.
b. Water quality data (including but not necessarily limited to TDS concentrations)
c. Identification of confining units, including hydrogeologic data and interpretations
d. Identification of monitoring zones
e. Casing depth evaluation (mechanically secure formation, potential for grout seal)
f. Lithologic drilling rate and weight on bit data, with interpretations (related to the casing seat)
g. Identification of the base of the USDW using water quality, RWA plots, and geophysical log interpretations
h. An evaluation of all logging and test results, submitted with test data.
i. Transmissivity or specific capacity of proposed monitoring zone
j. Packer test drawdown curves and interpretation

[62-528.410(4)(c), 62-528.420(4)(c) and 62-528.605(2)]

6. Upon completion of analysis of cores and sample cuttings recovered during the construction of wells covered by this permit (when no longer needed by the well owner), the permittee shall contact the Geological & Geotechnical Data Acquisition Program of the Florida Geological Survey (FGS) to arrange for the transfer of the cores and cuttings. The FGS shall also be contacted to arrange for the collection of 100 ml water samples, with nitric acid preservative for metal analysis, at the end of each packer test (where sufficient water is available) and aquifer background sample collection events. *[62-528.400(5)]*

7. All cores, cuttings, and water samples for FGS shall be shipped to the Florida Geological Survey, Geological & Geotechnical Data Acquisition Program, 3915 Commonwealth Boulevard, Tallahassee, Florida 32399. All cores and samples shall clearly identify the site name, well name/number, depths of samples/cores, and the latitude/longitude location of the well(s) using the form in this permit. *[62-528.400(5)]*

8. A final report of the construction and testing of the ASR well(s) and monitoring well(s), shall be submitted no later than 120 days after commencement of operational testing, pursuant to Rule 62-528.430(1)(e), F.A.C. In addition, a copy of the cover letter for the report shall be sent to the U. S. Environmental Protection Agency, Region 4, UIC program, 61 Forsyth St. SW, Atlanta, GA 30303-8909. This report shall include as a minimum, definitions of the injection interval, all relevant confining units, the depth of the base of the USDW and all monitoring zones, including all relevant data and interpretations. *[62-528.400(5)]*

PERMITTEE: Veronica Miller, Assistant City Manager
City of St. Cloud Utilities
St. Cloud Southside WTF

Permit Number: 0327299-001-UC/5X &
0327299-002-UC/5X
WACS ID: 101938

VI. OPERATIONAL TESTING AND MONITORING REQUIREMENTS

A. Operational Testing

1. The permittee shall conduct operational testing of the ASR well system prior to submittal of an operating permit application to demonstrate that the system will operate consistently with Department rules. *[62-528.450(3)(a)]*

2. Prior to operational testing, the permittee shall comply with the requirements of rule 62-528.450(3) (a), (b) and (c), F.A.C. *[62-528.307(2)(e)]*

3. The operational testing of the ASR well system under this permit shall not commence without written authorization from the Department. *[62-528.450(3)(b)]*

4. Prior to operational testing approval, the following items must be submitted (with the request for operational testing approval) for Department review and approval:

   a. Lithologic and geophysical logs with interpretations.
   b. Certification of mechanical integrity and interpreted test data.
   c. A description of the actual injection procedure including the anticipated maximum pressure and flow rate at which the well will be operated under normal and emergency conditions.
   d. Certification of completion of well construction by the Engineer of Record.
   e. Surface equipment completion (including piping, pressure gauges and flow meters, and all appurtenances) certified by the Engineer of Record.
   f. Calibration certificates for pressure gauges and flow meters.
   g. Signed and sealed record "as-built" engineering drawings of the ASR well system including all well construction, subsurface and surface piping and equipment, and appurtenances.
   h. The demonstration of confinement, and defining the injection and confining sequences utilizing data collected during the drilling, logging and testing of the ASR and monitoring wells. The confinement demonstration shall include the results of hydraulic testing (permeability, porosity, etc.) on the cores. This submittal shall be prepared, signed, and sealed by a Florida Registered Professional Geologist or appropriately qualified Florida Registered Professional Engineer.
   i. Background water quality data from the monitoring and injection zones (specific condition V.4.).
   j. Other data obtained during well construction needed by the Department to evaluate whether the well will operate in compliance with Department Rules.

   [62-528.450(3)(a), 62-528.455(1)(c)6. and 62-528.450(3)(a)3.i]

5. Pressure gauges and flow meters shall be installed on the ASR well prior to initiating injection activities at the site. *[62-528.450(3)(a)]*

6. Prior to the authorization of operational testing by the Department, the permittee shall contact the Central District office to arrange a site inspection. The inspection will determine if the conditions of the permit have been met and to verify that the ASR well system is operational. During the inspection, emergency procedures and reporting requirements shall be reviewed. *[62-528.450(3)(c)]*

7. The Engineer of Record or designated qualified representative must be present for the start-up operations and the Department must be notified in writing of the date operational testing commenced for the subject well. *[62-528.440(5)(b)]*

8. Cycle Testing Plan

Proposed Cycle Program at the St. Cloud Southside WTF:

Cycle	Recharge Duration (Days)	Recharge Rate (mgd)	Recharge Volume (MG)	Storage Duration (Days)	Recovery Duration (Days	Recovery Rate (mgd)	Recovery Volume (MG)	Cumulative Storage Volume (MG)
1	100	2	200	30-60	30	1	30	170
2	100	2	200	30-60	40	1	40	330
3	90	2	180	30-90	40	1.5	60	450
4	90	2	180	30-90	60	1	60	570
5	90	2	180	30-90	60	1	60	690

The cycle testing program may be altered with a written request and written approval by the Department.

B. Monitoring

1. The ASR system shall be monitored in accordance with Rules 62-528.425(l)(g) and 62-528.430(2), F.A.C. The following ASR well performance data and monitor zone data shall be recorded and reported in the Monthly Operating Report (MOR) as indicated below. Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity. The monitoring frequency or parameters may be changed upon justification provided to the Department and written approval provided by the Department. *[62-528.307(2)(d), 528.430(2) and 62-528.450(3)(b)5.]*

PARAMETER	UNIT	RECORDING FREQUENCY	FREQUENCY OF ANALYSES				
			ASR-1 13997	**ASR-2 13998**	**SMW-1 29323A**	**SMW-2 29324A**	**SZMW-1 29325A**
Flow Rate, max.	gpm	continuous	[a]	[a]			
Flow Rate, min.	gpm	continuous	[a]	[a]			
Flow Rate, avg.	gpm	continuous	[a]	[a]			
Total Volume Recharged	mg	daily/monthly	D/M	D/M			
Total Volume Recovered	mg	daily/monthly	D/M	D/M			
Net Storage, each ASR well	MG	monthly	M	M			
Net Storage, wellfield	MG	monthly	M	M			
ASR Well Pressure, max.	psi	continuous	[a]	[a]			
ASR Well Pressure, min.	psi	continuous	[a]	[a]			
ASR Well Pressure, avg.	psi	continuous	[a]	[a]			
Water Level or Pressure, max.	feet (NAVD) or psi	continuous			[a]	[a]	[a]
Water Level or Pressure, min.	feet (NAVD) or psi	continuous			[a]	[a]	[a]
Water Level or Pressure, avg.	feet (NAVD) or psi	continuous			[a]	[a]	[a]
Dissolved Oxygen [b]	mg/L		W	W	M	M	W
Oxidation-Reduction Potential [b]	mV		W	W	M	M	W
pH [b]	std. units		W	W	M	M	W
Specific Conductance [b]	µmhos/cm		W	W	M	M	W
Temperature [b]	°C		W	W	M	M	W
Arsenic	µg/L		W	W	M	M	W
Chloride	mg/L		W	W	M	M	W
Sulfate	mg/L		W	W	M	M	W
Fecal Coliform	#/100 ml		W	W	M	M	W
Total Coliform	#/100 ml		W	W	M	M	W
Total Dissolved Solids	mg/L		W	W	M	M	W
Total Iron	mg/L		W	W	M	M	W
Total Haloacetic Acids	mg/L		W	W	M	M	W
Total Alkalinity	mg/L		W	W	M	M	W
Color	PCU		W	W	M	M	W
Odor	TON		W	W	M	M	W
Turbidity	NTU		W	W	M	M	W
Total Trihalomethanes	mg/L		W	W	M	M	W
Primary / Secondary DWS's			A*				

See ASR well and monitoring well tables at beginning of permit for more information. No sampling of the ASR wells during storage; during months with only storage all monitor well parameters may be sampled monthly. Injected water sampled at chlorine contact chamber; recovered water sampled from each ASR well.
W – Weekly; M - Monthly; * - Injectate only
[a] - Operational data reporting for flows, pressures and water levels: daily max, min and average from continuous reporting; monthly max, min and average (calculated from daily averages).
[b] - Field samples

2. The permittee shall submit monthly to the Department the results of all ASR well and monitoring well data required by this permit no later than the last day of the month immediately following the month of record. The report shall include:
   a. A cover page summarizing the current status of all monthly activities, including the certification and signature required in condition II.5.;
   b. Operational and water quality data in a tabular format. The following identifying information must be included on each data sheet:
      i. Facility Name
      ii. Well Name
      iii. UIC Permit Number
      iv. WACS Facility ID
      v. WACS Testsite ID (on appropriate data sheet) as provided on the Injection Well and Monitoring Well tables on page 2 of this permit.
   c. Laboratory pages and supporting documentation.

   [62-528.307(3)(d)]

3. The report may be sent via electronic mail in Adobe™ (.pdf) format to the following Program e-mail addresses:

Central District	CD_UIC@dep.state.fl.us
Tallahassee - UIC Program	TAL_UIC@dep.state.fl.us

   If a paper copy of the report is submitted, it should be sent to Department staff at the following addresses:

Central District	3319 Maguire Boulevard, Suite 232 Orlando, Florida 32803-3767
Tallahassee - UIC Program	2600 Blair Stone Road, MS 3530 Tallahassee, Florida, 32399-2400

   [62-528.307(3)(d)]

4. Pertaining to the evacuation (purging) of the monitoring wells, which is required prior to the collection of samples for the Monthly Operating Reports (MORs), the facility may elect to follow either one of the following two purging protocols:

   a. The protocol stated below:
   A minimum of three well volumes of fluid shall be evacuated from the monitoring systems prior to sampling for the chemical parameters listed above. Sufficient purging shall have occurred when either of the following has occurred:

      1) pH, specific conductance and temperature when sampled, upon purging the third or subsequent well volume, each vary less than 5% from that sampled upon purging the previous well volume; or
      2) Upon purging the fifth well volume.

b. The following protocol taken from DEP-SOP-001/01(Field Procedures):
   1) Purge until the water level has stabilized (well recovery rate equals the purge rate), then purge a minimum of one well volume, and then collect the first set of stabilization parameters, namely pH, specific conductance and temperature;
   2) Thereafter, collect stabilization parameters ≥ every ¼ well volume;
   3) Purging shall be complete when either of the following have occurred:
      a) 3 consecutive readings of the parameters listed below are within the following ranges[1]:
         - pH ± 0.2 Standard Units
         - Specific Conductance ± 5.0% of reading
         - Temperature ± 0.2°C
      b) Upon purging the fifth well volume.

[62-160.210(1) and 62-528.430(2)]

5. The flow from the monitoring zones during well evacuation and sampling shall not be discharged to surface waters or aquifers containing an Underground Source of Drinking Water (USDW). Waters purged from monitoring wells in preparation for sampling shall be diverted to the ASR well head via the pad drainage system, wet well, or treatment plant. *[62-4.030, 62-620.320]*

VII. ABNORMAL EVENTS

1. In the event the permittee is temporarily unable to comply with any of the conditions of a permit due to breakdown of equipment, power outages or destruction by hazard of fire, wind, or by other cause, the permittee of the facility shall notify the Central District office. *[62-528.415(4)(a)]*

2. Notification shall be made in person, by telephone, or by electronic mail (e-mail) within 24 hours of breakdown or malfunction to the Central District office. *[62-528.307(1)(x)]*

3. A written report of any noncompliance referenced in Specific Condition (1) above shall be submitted to the Central District office and the Tallahassee office within five days after its 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. *[62-528.415(4)(b)]*

[1] Provided dissolved oxygen in the groundwater of the zone being monitored is ≤ 20% of saturation for the measured temperature and turbidity is ≤ 20 NTUs. This assumption holds true for groundwater in most zones of the Floridan aquifer.

General Conditions

1. The terms, conditions, requirements, limitations and restrictions set forth in this permit are "permit conditions" and are binding and enforceable pursuant to section 403.141, F.S. *[62-528.307(1)(a)]*
2. This permit is valid only for the specific processes and operations applied for and indicated in the approved drawings or exhibits. Any unauthorized deviation from the approved drawings, exhibits, specifications, or conditions of this permit may constitute grounds for revocation and enforcement action. *[62-528.307(1)(b)]*
3. 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. *[62-528.307(1)(c)]*
4. 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. *[62-528.307(1)(d)]*
5. 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 there from; 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. *[62-528.307(1)(e)]*
6. The permittee shall properly operate and maintain the facility and systems of treatment and control (and related appurtenances) that are installed and used by the permittee to achieve compliance with the conditions of this permit, 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. *[62-528.307(1)(f)]*
7. The permittee, by accepting this permit, specifically agrees to allow authorized Department personnel, upon presentation of credentials or other documents as may be required by law and at reasonable times, access to the premises where the permitted activity is located or conducted to:
   a. Have access to and copy any records that must be kept under conditions of this permit;
   b. Inspect the facility, equipment, practices, or operations regulated or required under this permit; and
   c. Sample or monitor any substances or parameters at any location reasonably necessary to assure compliance with this permit or Department rules.
   d. Reasonable time will depend on the nature of the concern being investigated.

[62-528.307(1)(g)]

8. 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:
   a. A description of and cause of noncompliance; and
   b. The period of noncompliance, including dates and times; or, if not corrected the anticipated time the noncompliance is expected to continue, and steps being taken to reduce, eliminate, and prevent 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.

   [62-528.307(1)(h)]

9. In accepting this permit, the permittee understands and agrees that all records, notes, monitoring data and other information relating to the construction or operation of this permitted source which are submitted to the Department may be used by the Department as evidence in any enforcement case involving the permitted source arising under the Florida Statutes or Department rules, except where such use is 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. *[62-528.307(1)(i)]*

10. The permittee agrees to comply with changes in Department rules and Florida Statutes after a reasonable time for compliance; provided, however, the permittee does not waive any other rights granted by Florida Statutes or Department rules. *[62-528.307(1)(j)]*

11. 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. *[62-528.307(1)(k)]*

12. This permit or a copy thereof shall be kept at the work site of the permitted activity. *[62-528.307(1)(l)]*

13. The permittee shall comply with the following:
    a. Upon request, the permittee shall furnish all records and plans required under Department rules. During enforcement actions, the retention period for all records shall be extended automatically unless the Department determines that the records are no longer required.
    b. 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.
    c. Records of monitoring information shall include:
        i. the date, exact place, and time of sampling or measurements;
        ii. the person responsible for performing the sampling or measurements;

iii. the dates analyses were performed;
iv. the person responsible for performing the analyses;
v. the analytical techniques or methods used;
vi. the results of such analyses.

d. 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.

e. 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.

[62-528.307(1)(m)]

14. All applications, reports, or information required by the Department shall be certified as being true, accurate, and complete. *[62-528.307(1)(n)]*

15. 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. *62-528.307(1)(o)]*

16. 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. *[62-528.307(1)(p)]*

17. 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. *[62-528.307(1)(q)]*

18. The permittee shall take all reasonable steps to minimize or correct any adverse impact on the environment resulting from noncompliance with this permit. *[62-528.307(1)(r)]*

19. 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. *[62-528.307(1)(s)]*

20. 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. *[62-528.307(1)(t)]*

21. 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. *[62-528.307(1)(u)]*

22. 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). *[62-528.307(1)(v)]*

23. 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. *[62-528.307(1)(w)]*

24. The permittee shall report any noncompliance which may endanger health or the environment including:
    a. Any monitoring or other information which indicates that any contaminant may cause an endangerment to an underground source of drinking water; or
    b. 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.
    [62-528.307(1)(x)]

Issued this 27th day of October 2014

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL
PROTECTION

Joseph Haberfeld

Joseph Haberfeld, P.G.
Aquifer Protection Program Administrator
Division of Water Resource Management

FDEP Underground Injection Control Program Sample Form

(Cores/Cuttings/Formation Water)

Well Name:	
Well Type (circle one) Class I Class V Exploratory Monitoring	
Date Collected:	Date sent to FGS:
Sample type (circle one) Core Cuttings Formation Water	
Preservative used — if formation water sample — (circle one) Nitric n/a Other (describe)	
Datum and elevation:	Sample Interval:
Elevation method (circle one) Survey USGS Quadrangle Other (describe)	
Sample Interval Drilling Method (circle one) Reverse Air Mud Rotary Sonic/Acoustic Other (describe)	
Well Coordinates ____ ° ____ ' _____ " N / ____ ° ____ ' _____ " W	
Method (circle one) AGPS (hand held) DGPS (GPS survey) Map Derived	
FDEP Permit Number:	
Facility Name:	
Permittee (owner):	
Facility Address:	
Drilling Company:	Lead Driller:
Project Geologist:	Consulting Company:

APPENDIX B

Weekly FDEP Construction Reports

APPENDIX C

Well Completion Reports

Florida Department of Environmental Protection

Twin Towers Office Bldg., 2600 Blair Stone Road,
Tallahassee, Florida 32399-2400

DEP Form No: 62-528.900(4)
Form Title: Certification of Class V Well construction Completion
Effective Date:
DEP Application No.: (Filled in by DEP)

CERTIFICATION OF CLASS V WELL CONSTRUCTION COMPLETION

INSTRUCTIONS: Submit this certification to the Department along with a signed copy of the Well Completion Report from the appropriate Water Managemant District.

DEP Construction Permit No. 0327299 , issued on 10/27/14 (Date) . County Osceola

Owner's Name Christopher Fasnacht, Deputy Director

Owner's Address 5701 Michigan Avenue

City St. Cloud State FL Zip -347690000-

Well Contractor's Name Dan Ringdahl, Florida Design Drilling Corporation

Title President State License No. 11148

Well Contractor's Address 7733 Hooper Road

City West Palm Beach State FL Zip 33411

Well Location 28 12' 26" N 81 16' 27" W

Deviations from the application and plans approved by the Department:

28" casing to 313 ft (application 300 ft), 20" casing to 1,380 ft (application 1,400 ft)

12.75" casing to 1,650 ft (application 2,200 ft) top 200 ft is 14", total depth is 3,060'

Actual Dimensions:

Diameter 12.75 inches

Well depth 3,060 feet

Casing depth 1,650 feet

This is to certify that, with the exception of the deviations noted above, the construction of this well has been completed in accordance with the plans authorized by Construction Permit No. 0327299-001-UC/5X , dated 10/27/14 .

Date: 7/12/2016

(Contractor's Signature)

Florida Department of Environmental Protection

Twin Towers Office Bldg., 2600 Blair Stone Road,
Tallahassee, Florida 32399-2400

DEP Form No:	62-528.900(10)
Form Title:	Certification of Monitor Well Completion
Effective Date:	
DEP Application No.:	(Filled in by DEP)

CERTIFICATION OF MONITOR WELL COMPLETION

Facility Name: City of St. Cloud Southside Wastewater Treatment Facility

Owners Name: Christopher Fasnacht, Deputy Director

Address: 5701 Michigan Avenue

City: St. Cloud State: FL Zip: 34769-0000

Well Contractor's Name: Dan Ringdahl, Florida Design Drilling

Title: President State License No.: 11148

Address: 7733 Hooper Road

City: West Palm Beach State: FL Zip: 33411-0000

Well Location: 775 ft SW of ASR-1

UIC Construction Permit Number: 0327299-001-UC/5X Date Issued: 10/27/14

Monitor Well Purpose: (fill in all that are applicable)

SZMW1 On-site monitor well associated with Injection Well No(s). ASR-1

X Single Zone _____ Multizone

_____ Regional monitor well

_____ Other monitor well (specify) _____

Monitor Well Location:

Latitude/Longitude:

Location Relative to Injection Well(s):

Please indicate distance (in feet) and direction from each injection well for which the monitor well is associated. For regional monitor wells please indicate approximate distance and direction from a specified point at the injection facility and the address where the well is located.

775 feet SW of ASR-1

Actual Dimensions:

Diameter 6 inches Monitoring Interval(s) 1

Well Depth 1,680 feet Casing depth 1,650 feet

DEP Form No:	62-528.900(10)
Form Title:	Certification of Monitor Well Completion
Effective Date:	
DEP Application No.:	(Filled in by DEP)

Deviations from the application and plans approved by the Department:

20" casing to 300 ft (application 18" casing to 300 ft)

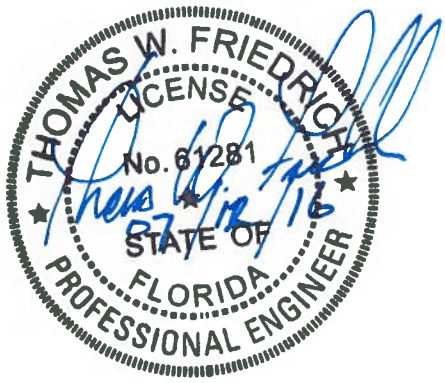
12" casing to 1,140 ft (application 12" casing to 1,400 ft)

6" casing to 1,650 ft (application 6" casing to 2,200 ft)

total depth 1,680 ft (application total depth 2,400 ft)

Certification by Professional Engineer

I certify that the monitor well has been completed substantially in accordance with the approved plans and specifications, or that deviations will not prevent the monitor well from functioning in compliance with the requirements of Chapter 62-528, F.A.C., when properly operated and maintained. These determinations have been based upon on-site observation of well construction, scheduled or conducted by me or by a project representative under my direct supervision, for the purpose of determining if work proceeded in compliance with plans and specifications and application materials.



(Affix Seal)

Thomas W. Friedrich, P.E.
Name (please type)

61281
Florida Registration Number

Jones Edmunds & Associates
Company Name

324 S. Hyde Park Ave Suite 250
Company Address

Tampa	FL	33606-0000
City	State	Zip

Telephone No. 813 258-0703, Ext. 176

Florida Department of Environmental Protection

Twin Towers Office Bldg., 2600 Blair Stone Road,
Tallahassee, Florida 32399-2400

DEP Form No:	62-528.900(10)
Form Title:	Certification of Monitor Well Completion
Effective Date:	
DEP Application No.:	(Filled in by DEP)

CERTIFICATION OF MONITOR WELL COMPLETION

Facility Name: St. Cloud Southside Wastewater Treatment Facility

Owners Name: Christopher Fasnacht, Deputy Director

Address: 5701 Michigan Avenue

City: St. Cloud State: FL Zip: 34769-0000

Well Contractor's Name: Dan Ringdahl, FLorida Design Drilling Corporation

Title: President State License No.: 11148

Address: 7733 HOOPER Road

City: West Palm Beach State: FL Zip: 33411-0000

Well Location: 150 feet North of ASR-1

UIC Construction Permit Number: 0327299-001-UC/5x Date Issued: 10/27/14

Monitor Well Purpose: (fill in all that are applicable)

SMW-1 On-site monitor well associated with Injection Well No(s). ASR-1

X Single Zone _____ Multizone

_____ Regional monitor well

_____ Other monitor well (specify) _____

Monitor Well Location:

Latitude/Longitude:

Location Relative to Injection Well(s):

Please indicate distance (in feet) and direction from each injection well for which the monitor well is associated. For regional monitor wells please indicate approximate distance and direction from a specified point at the injection facility and the address where the well is located.

150 feet North of ASR-1

Actual Dimensions:

Diameter 12 inches Monitoring Interval(s) 1

Well Depth 1,520 feet Casing depth 1,480 feet

DEP Form No:	62-528.900(10)
Form Title:	Certification of Monitor Well Completion
Effective Date:	
DEP Application No.:	(Filled in by DEP)

Deviations from the application and plans approved by the Department:

20" casing to 315 feet (application 18" to 300 feet)

12" casing to 1,480 feet (application 12" to 700 feet)no 6" casing installed

total depth 1,520 feet (application total depth 1,400 feet with 6" casing to 1,300 ft)

Certification by Professional Engineer

I certify that the monitor well has been completed substantially in accordance with the approved plans and specifications, or that deviations will not prevent the monitor well from functioning in compliance with the requirements of Chapter 62-528, F.A.C., when properly operated and maintained. These determinations have been based upon on-site observation of well construction, scheduled or conducted by me or by a project representative under my direct supervision, for the purpose of determining if work proceeded in compliance with plans and specifications and application materials.

THOMAS W. FRIEDRICH LICENSE No. 61281 STATE OF FLORIDA PROFESSIONAL ENGINEER

07/12/16

(Affix Seal)

Thomas W. Friedrich, P.E.
Name (please type)

61281
Florida Registration Number

Jones Edmunds & Associates
Company Name

324 S. Hyde Park Ave Suite 250
Company Address

Tampa | FL | 33606-0000
City | State | Zip

Telephone No. (813) 258-0703 ext. 1761

APPENDIX D

Pad Monitoring Well Water Quality

APPENDIX E

Casing Mill Certificates

APPENDIX F
Lithologic Logs

Well Name:	ASR-1
Location:	City of St. Cloud Southside WWTF
Contractor:	Florida Design Drilling
Drilling Method	Mud-Rotary/Reverse-Air
Bit-Size:	12 1/4" and 9 1/2" tricone bits
Total Depth:	3,060 feet bls
Casing Depth:	36" casing to 48 ft bls, 28" casing to 313 ft bls, 20" casing to 1,380 ft bls
Resident Observer:	Marty Clasen/Pete Larkin

From:	To:	ASR-1 Lithologic Description
0	10	SILTY SAND, very dark brown (2/2), sandy loam, fill
10	20	SAND, grayish brown (5/2), very fine grained quartz, well rounded, well sorted
20	30	SAND, as above
30	40	SAND, as above
40	50	CLAYEY SAND AND CLAY, olive gray (5Y 3/2), clayey sand, 40-47 feet, very fine subrounded quartz sand, soft green clay 47-50 feet
50	60	CLAYEY SAND, olive gray (10Y 4/2), very fine subrounded quartz sand, with soft green clay and some shell
60	70	SHELL and CLAY, olive gray (10Y 4/2), 50% small 0.5-inch diameter mollusk shells with green clay matrix, trace black organics
70	80	SAND/SHELL, pale olive (10Y 6/2), 50% quartz sand, medium grained subangular, 50% mollusk shells
80	90	SAND/SHELL, as above with 5% black lignite
90	100	SAND/SHELL, as above with 5% black lignite
100	110	SAND/SHELL, as above with 5% black lignite
110	120	SAND, light olive gray (5Y 5/2), quartz sand, medium grained, subangular, 10% mollusk shell, trace black lignite
120	130	SAND, light olive gray (5Y 5/2), quartz sand, medium grained, subangular, trace mollusk shell, trace phosphate
130	140	SAND, light olive gray (5Y 5/2), quartz sand, medium grained, subangular, trace mollusk shell, trace phosphate
140	150	SAND, as above
150	160	SAND with SHELL, light olive gray (5Y 5/2), quartz sand, medium grained, subangular, 25% mollusk shell, trace phosphate
160	170	SAND with SHELL, light olive gray (5Y 5/2), quartz sand, medium grained, subangular, 30% mollusk shell, trace phosphate
170	180	SAND with SHELL, light olive gray (5Y 5/2), quartz sand, medium grained, subangular, 30% mollusk shell, trace phosphate
180	190	SAND AND SHELL, light olive gray (5Y 5/2), quartz sand, medium grained, subangular, 50% mollusk shell, trace phosphate
190	200	CLAYEY SAND WITH SHELL, olive gray (5Y 3/2), fine grained quartz sand with some green soft clay, 25% mollusk shell
200	210	SAND, light olive gray (5Y 5/2), quartz sand, medium grained, subangular, 5% mollusk shell, trace phosphate
210	220	SAND with SHELL, light olive gray (5Y 5/2), quartz sand, medium grained, subangular, 30% mollusk shell, trace phosphate
220	230	SAND, light olive gray (5Y 5/2), quartz sand, medium grained, subangular, 5% mollusk shell, trace phosphate
230	240	SAND, light olive gray (5Y 5/2), quartz sand, medium grained, subangular, 5% mollusk shell, trace phosphate
240	250	SAND with SHELL, light olive gray (5Y 5/2), quartz sand, medium grained, subangular, 25% mollusk shell, trace phosphate
250	260	SAND, light olive gray (5Y 5/2), quartz sand, medium grained, subangular, trace phosphate
260	270	SAND, light olive gray (5Y 5/2), quartz sand, medium grained, subangular, trace phosphate
270	280	SAND with SHELL, light olive gray (5Y 5/2), quartz sand, medium grained, subangular, 25% mollusk shell, trace phosphate, driller noticed drilling at 275 feet
280	290	SAND with SHELL, light olive gray (5Y 5/2), quartz sand, medium grained, subangular, 25% mollusk shell, trace phosphate
290	300	SAND with SHELL, light olive gray (5Y 5/2), quartz sand, medium grained, subangular, 25% mollusk shell, trace phosphate
300	310	LIMESTONE, very pale orange (10YR 8/2), sucrosic, soft, some chert, black, some phosphate, trace shell
310	320	LIMESTONE, very pale orange (10YR 8/2), sucrosic, soft, fossiliferous, benthic foraminifera, Lepidocyclina, Nummulites, typical of Ocala Limestone

From:	To:	ASR-1 Lithologic Description
320	330	LIMESTONE, very pale orange (10YR 8/2), sucrosic, soft, fossiliferous, benthic foraminifera, Nummulites vanderstoki, typical of Ocala Limestone
330	340	LIMESTONE, very pale orange (10YR 8/2), sucrosic, soft, fossiliferous
340	350	LIMESTONE, very pale orange (10YR 8/2), sucrosic, fossiliferous, echinoderms, benthic foraminifera, Dictyoconus americanus, typical of the Avon Park Formation
350	360	LIMESTONE, very pale orange (10YR 8/2), sucrosic, fossiliferous, benthic foraminifera, Dictyoconus americanus, typical of the Avon Park Formation
360	370	LIMESTONE, very pale orange (10YR 8/2), sucrosic, fossiliferous, benthic foraminifera, Dictyoconus americanus, typical of the Avon Park Formation
370	380	LIMESTONE, very pale orange (10YR 8/2), sucrosic, fossiliferous, benthic foraminifera, Dictyoconus americanus, typical of the Avon Park Formation
380	390	LIMESTONE, as above
390	400	LIMESTONE, as above
400	410	CALCAREOUS CLAY, grayish green (5G 5/2), soft, rollable clay, driller says clay was 6-inches thick, plugged off bit
410	420	LIMESTONE, very pale orange (10YR 8/2), sucrosic, fossiliferous, benthic foraminifera, Dictyoconus americanus, typical of the Avon Park Formation
420	430	LIMESTONE, very pale orange (10YR 8/2), sucrosic, fossiliferous, benthic foraminifera, Dictyoconus americanus, typical of the Avon Park Formation
430	440	LIMESTONE, very pale orange (10YR 8/2), sucrosic, fossiliferous, benthic foraminifera, calcite
440	450	LIMESTONE, very pale orange (10YR 8/2), sucrosic, fossiliferous, benthic foraminifera, Dictyoconus americanus
450	460	LIMESTONE, very pale orange (10YR 8/2), sucrosic, fossiliferous, benthic foraminifera, calcite
460	470	LIMESTONE, very pale orange (10YR 8/2), sucrosic, fossiliferous, benthic foraminifera, Dictyoconus americanus
470	480	LIMESTONE, as above
480	490	LIMESTONE, very pale orange (10YR 8/2), sucrosic, fossiliferous, benthic foraminifera, echinoderms
490	500	LIMESTONE, very pale orange (10YR 8/2), some moderate yellowish brown (10YR 5/4) dolomitic limestone, sucrosic, fossiliferous, benthic foraminifera, echinoderms
500	510	LIMESTONE, very pale orange (10YR 8/2), sucrosic, fossiliferous, benthic foraminifera, Dictyoconus americanus
510	520	LIMESTONE, very pale orange (10YR 8/2), sucrosic, fossiliferous, benthic foraminifera, Dictyoconus americanus
520	530	DOLOSTONE, pale yellowish brown (10YR 6/2), hard, micritic, fine grained, slow drilling
530	540	DOLOSTONE, pale yellowish brown (10YR 6/2), hard, micritic, fine grained, slow drilling
540	550	DOLOSTONE, light brown (5YR 6/4), hard, fine grained, some gravel sized fragments.
550	560	DOLOSTONE, light brown (5YR 6/4) to pale brown (5YR 5/2), hard, fine grained, some gravel sized fragments.
560	570	LIMESTONE, pale yellowish brown (10YR 6/2), moderately soft.
570	580	LIMESTONE, as above.
580	590	DOLOSTONE, light brown (5YR 6/4) to pale brown (5YR 5/2), hard, fine grained, some gravel sized fragments.
590	600	DOLOSTONE, pale brown (5YR 5/2), hard, re-crystalized, some gravel sized fragments.
600	610	DOLOSTONE, as above.
610	620	DOLOSTONE, pale brown (5YR 5/2) to dusky brown (5YR 2/2), hard, re-crystalized, angular gravel sized fragments.
620	630	DOLOSTONE, dark yellowish brown (10YR 4/2), hard, re-crystalized, angular gravel sized fragments.
630	640	DOLOSTONE, as above.
640	650	DOLOSTONE, as above.
650	660	DOLOSTONE, as above.
660	670	DOLOSTONE, as above.
670	680	DOLOSTONE, dusky yellowish brown (10YR 2/2), very hard, micritic, microcrystalline, large angular fragments
680	690	DOLOSTONE, as above, somewhat softer with smaller fragments, 20% LIMESTONE, very pale orange (10YR 8/2), soft, micritic
690	700	DOLOMITIC LIMESTONE, grayish orange (10YR 7/4), moderately hard, micritic, very fine grained
700	710	DOLOMITIC LIMESTONE, grayish orange (10YR 7/4), moderately hard, micritic, very fine grained
710	720	DOLOMITIC LIMESTONE, grayish orange (10YR 7/4), moderately hard, micritic, very fine grained

From:	To:	ASR-1 Lithologic Description
720	730	DOLOMITIC LIMESTONE, as above
730	740	DOLOMITIC LIMESTONE, as above
740	750	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2), moderately hard, very fine grained, micritic
750	760	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2), moderately hard, very fine grained, micritic
760	770	DOLOMITIC LIMESTONE, as above
770	780	DOLOMITIC LIMESTONE, as above
780	790	DOLOMITIC LIMESTONE, as above, some pin-hole vugs
790	800	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2), moderately hard, very fine grained, micritic
800	810	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2), moderately hard, very fine grained, micritic
810	820	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2), moderately hard, very fine grained, micritic
820	830	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2), moderately hard, very fine grained, micritic
830	840	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2), moderately hard, very fine grained, micritic
840	850	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2), moderately hard, very fine grained, micritic
850	860	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2), moderately hard, very fine grained, micritic
860	870	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2), moderately hard, very fine grained, micritic
870	880	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2), moderately hard, very fine grained, micritic, trace pin-hole vugs
880	890	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2), moderately hard, very fine grained, micritic
890	900	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2), moderately hard, very fine grained, micritic
900	910	DOLOMITIC LIMESTONE, as above
910	920	DOLOMITIC LIMESTONE, as above
920	930	DOLOMITIC LIMESTONE, as above
930	940	DOLOMITIC LIMESTONE, as above
940	950	DOLOMITIC LIMESTONE, as above
950	960	DOLOMITIC LIMESTONE, as above
960	970	DOLOMITIC LIMESTONE, as above
970	980	DOLOMITIC LIMESTONE, as above
980	990	DOLOMITIC LIMESTONE, as above
990	1000	DOLOMITIC LIMESTONE, as above
1000	1010	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2), soft, very fine grained, micritic
1010	1020	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2), soft, very fine grained, micritic
1020	1030	DOLOMITIC LIMESTONE, as above, trace lignite
1030	1040	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2), soft, very fine grained, micritic
1040	1050	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2), soft, very fine grained, micritic
1050	1060	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2), soft, very fine grained, micritic
1060	1070	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2), soft, very fine grained, micritic
1070	1080	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2), soft, very fine grained, micritic
1080	1090	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2), soft, very fine grained, micritic
1090	1100	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2), soft, very fine grained, micritic
1100	1110	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2), soft, very fine grained, micritic
1110	1120	DOLOMITIC LIMESTONE, as above
1120	1130	DOLOMITIC LIMESTONE, as above
1130	1140	DOLOMITIC LIMESTONE, very pale orange (10YR 8/2), very fine grained, micrite, very hard, slow drilling
1140	1150	DOLOMITIC LIMESTONE, grayish orange (10YR 7/4), moderately hard, micritic, very fine grained
1150	1160	DOLOMITIC LIMESTONE, as above
1160	1170	DOLOMITIC LIMESTONE, as above

From:	To:	ASR-1 Lithologic Description
1170	1180	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2), very hard, very fine grained, micritic, trace lignite, trace pin hole vugs
1180	1190	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2), very hard, very fine grained, micritic, trace pin hole vugs
1190	1200	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2), very hard, very fine grained, micritic, trace pin hole vugs
1200	1210	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2), very hard, very fine grained, micritic, trace lignite
1210	1220	DOLOMITIC LIMESTONE, light gray (N7), soft, fine grained, micritic
1220	1230	DOLOMITIC LIMESTONE, very pale orange (10YR 8/2), very fine grained, micrite, very hard, slow drilling
1230	1240	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2), very hard, very fine grained, micritic, trace lignite
1240	1250	DOLOSTONE, moderate yellowish brown (10YR 5/4), very hard, micritic, recrystallized, angular fragments, slow drilling
1250	1260	DOLOSTONE, moderate yellowish brown (10YR 5/4), very hard, micritic, recrystallized, angular fragments, slow drilling
1260	1270	DOLOSTONE, pale yellowish brown (10YR 6/2), very hard, micritic, recrystallized, angular fragments, slow drilling, trace dolomitic limestone from above
1270	1280	DOLOSTONE, grayish orange (10YR 7/4), very hard, micritic, recrystallized, angular fragments, slow drilling
1280	1290	DOLOSTONE, pale brown (5YR 5/2), hard, micritic, recrystallized, angular fragments, slow drilling
1290	1300	DOLOSTONE, pale brown (5YR 5/2), hard, recrystallized, angular fragments, some vuggyness noted in larger fragments - possible porosity,slow drilling.
1300	1310	DOLOSTONE, moderate brown (5YR 3/4), hard, recrystallized, angular fragments, ssome vuggyness noted in larger fragments - possible porosity,slow drilling.
1310	1320	DOLOSTONE, dusky brown (5YR 2/2), hard, recrystallized, angular fragments, some vuggyness noted in larger fragments - possible porosity, some lignite, slow drilling.
1320	1330	DOLOSTONE, moderate brown (5YR 3/4), hard, recrystallized, angular fragments, some vuggyness noted in larger fragments - possible porosity,slow drilling.
1330	1340	DOLOSTONE, same as above, smaller fragments.
1340	1350	DOLOSTONE, pale brown, 5YR 5/2, hard, recrysitallized, angular fragments.
1350	1360	DOLOSTONE, light brown, 5YR 6/4, moderately hard, sand sized fragments.
1360	1370	DOLOSTONE, as above
1370	1380	DOLOSTONE, pale brown, 5YR 5/2, hard, recrysitallized, large gravel sized angular fragments.
1380	1390	DOLOSTONE, as above
1390	1400	DOLOSTONE, light brown, 5YR 6/4, moderately hard, sand sized fragments.
1400	1410	DOLOSTONE, moderate yellowish brown (5YR 5/4), hard, recrystallized, angular fragments, some pinhole vuggyness noted in larger fragments - possible porosity,slow drilling.
1410	1420	DOLOSTONE, as above, some cement from casing in sample
1420	1430	DOLOSTONE, moderate yellowish brown (5YR 5/4), hard, recrystallized, angular fragments, some pinhole vuggyness noted in larger fragments - possible porosity,slow drilling.
1430	1440	DOLOSTONE, dark yellowish brown (10YR 4/2), hard, re-crystalized, angular gravel sized fragments.
1440	1450	DOLOSTONE, dark yellowish brown (10YR 4/2), hard, re-crystalized, angular gravel sized fragments.
1450	1460	DOLOSTONE, dark yellowish brown (10YR 4/2), hard, re-crystalized, angular gravel sized fragments.
1460	1470	DOLOSTONE, as above, 5% medium dark gray, trace evaporites (gypsum)
1470	1480	DOLOSTONE, as above, 5% medium dark gray, trace evaporites (gypsum)
1480	1490	DOLOSTONE, medium dark gray (N4), very hard, crystalline, some dark yellowish brown dolostone, as above
1490	1500	DOLOSTONE, 10% medium dark gray (N4), hard, crystalline, 90% light olive gray (5Y 6/1), soft, sandy, vuggy
1500	1510	DOLOSTONE, as above
1510	1520	DOLOSTONE, medium light gray (N6), medium hard, crystalline, sucrosic, vuggy
1520	1530	DOLOSTONE, as above
1530	1540	DOLOSTONE, as above
1540	1550	DOLOSTONE, light gray (N7), softer, drilling faster, sucrosic, grinds up to sand sized grains

From:	To:	ASR-1 Lithologic Description
1550	1560	DOLOSTONE, medium light gray (N6), medium hard, crystalline, sucrosic, vuggy
1560	1570	DOLOSTONE, medium light gray (N6), medium hard, crystalline, sucrosic, vuggy
1570	1580	DOLOSTONE, as above
1580	1590	DOLOSTONE, as above
1590	1600	DOLOSTONE, medium light gray (N6), medium hard, crystalline, sucrosic, vuggy
1600	1610	LIMESTONE, moderate yellowish brown (10YR 5/4), soft, sandy, sucrosic, trace gray dolostone from above
1610	1620	LIMESTONE, very pale orange (10YR 8/2), soft, sandy, sucrosic, trace gray dolostone from above
1620	1630	LIMESTONE, as above
1630	1640	DOLOMITIC LIMESTONE, moderate yellowish brown (10YR 5/4), 50% moderately hard, crystalline, 50% soft sandy, sucrosic
1640	1650	DOLOMITIC LIMESTONE, moderate yellowish brown (10YR 5/4), 50% moderately hard, crystalline, 50% soft sandy, sucrosic
1650	1660	LIMESTONE, very pale orange (10YR 8/2), soft, sandy, sucrosic, trace gray dolostone from above
1660	1670	LIMESTONE, very pale orange (10YR 8/2), micritic, very fine grained lime mud, thin layer of CHERT approximately 1,666 feet bls, very hard, medium light gray (N6), conchoidal fractures, sharp edges
1670	1680	VOID - no sample, cavern from 1,670 feet to 1,696 feet bls
1680	1690	VOID - no sample, cavern from 1,670 feet to 1,696 feet bls
1690	1700	60% LIMESTONE, very pale orange (10YR 8/2), micritic, very fine grained lime mud, 40% DOLOMITIC LIMESTONE, moderate yellowish brown (10YR 5/4), hard, fine grained, trace chert from above
1700	1710	50% LIMESTONE, very pale orange (10YR 8/2), micritic, very fine grained lime mud, 50% DOLOMITIC LIMESTONE, moderate yellowish brown (10YR 5/4), hard, fine grained, trace chert from above
1710	1720	DOLOSTONE, moderate yellowish brown (5YR 5/4), hard, recrystallized
1720	1730	DOLOSTONE, moderate yellowish brown (5YR 5/4), hard, recrystallized, trace pin-hole vugs, trace evaporites (anhydrite)
1730	1740	DOLOSTONE, moderate yellowish brown (5YR 5/4), hard, recrystallized, trace pin-hole vugs, 5-10% evaporites (anhydrite)
1740	1750	DOLOMITIC LIMESTONE, moderate yellowish brown (10YR 5/4), sandy, sucrosic
1750	1760	DOLOMITIC LIMESTONE, moderate yellowish brown (10YR 5/4), 50% moderately hard, crystalline, 50% soft sandy, sucrosic
1760	1770	LIMESTONE, yellowish grey (5YR 8/1), 50% moderately hard subangular fragments, 50% sandy, sucrosic.
1770	1780	LIMESTONE, medium light grey (N6), hard, large angular fragments.
1780	1790	LIMESTONE, medium light grey (N6), hard, angular fragments, Dolostone 50%, hard, moderate yellowish brown (10YR 5/4), moderately hard, possibly from up hole.
1790	1800	LIMESTONE, very pale orange (10YR 8/2), micritic, very fine grained lime mud, 20% DOLOMITIC LIMESTONE, moderate yellowish brown (10YR 5/4), hard, fine grained
1800	1810	LIMESTONE, medium light grey (N6), moderately soft, small to sand sized fragments, Dolostone 30%, hard, moderate yellowish brown (10YR 5/4), possibly from up hole.
1810	1820	LIMESTONE, medium light grey (N6), hard, angular fragments, some light colored banding in larger fragments possible evaporite inclusions.
1820	1830	LIMESTONE, very pale orange (10YR 8/2), soft, sandy, sucrosic
1830	1840	LIMESTONE, very pale orange (10YR 8/2), soft, sandy, sucrosic

From:	To:	ASR-1 Lithologic Description
1840	1850	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2), hard, micritic, fine grained, trace evaporites
1850	1860	DOLOSTONE, dark yellowish brown (10YR 4/2), hard, micritic, fine grained
1860	1870	DOLOSTONE, dark yellowish brown (10YR 4/2), hard, micritic, fine grained
1870	1880	DOLOSTONE, dark yellowish brown (10YR 4/2), hard, micritic, fine grained, large fragments, angular
1880	1890	DOLOSTONE, dark yellowish brown (10YR 4/2), and medium light gray (N6), hard, micritic, fine grained, large fragments, angular
1890	1900	DOLOSTONE, dusky brown (5YR 2/2), hard, micritic, fine grained, large fragments, angular, trace pinhole vugs
1900	1910	DOLOSTONE, dusky brown (5YR 2/2), hard, micritic, fine grained, large fragments, angular, trace pinhole vugs
1910	1920	DOLOSTONE, dark yellowish brown (10YR 4/2), hard, micritic, fine grained, large fragments, angular
1920	1930	DOLOSTONE, as above.
1930	1940	DOLOSTONE, as above.
1940	1950	DOLOSTONE, as above, large gravel to sand sized fragments.
1950	1960	DOLOSTONE, pale yellowish brown (10YR 6/2), hard, micritic, fine grained, large fragments, angular
1960	1970	DOLOSTONE, dark yellowish brown (10YR 4/2), hard, micritic, fine grained, large fragments, angular, trace pinhole vugs
1970	1980	DOLOSTONE, 50% grayish orange (10YR 7/4), soft, sucrosic, pin hole vugs; 50% dark yellowish brown (10YR 4/2), hard, crystalline, micritic
1980	1990	DOLOSTONE, 80% pale yellowish brown (10YR 6/2), soft, sandy, sucrosic, bit grinds to sand sized particles; 20% dusky yellowish brown (10YR 2/2), hard, crystalline, micritic
1990	2000	DOLOSTONE, 50% pale yellowish brown (10YR 6/2), soft, sandy, sucrosic, bit grinds to sand sized particles; 50% dusky yellowish brown (10YR 2/2), hard, crystalline, micritic
2000	2010	DOLOSTONE, 80% pale yellowish brown (10YR 6/2), soft, sandy, sucrosic, bit grinds to sand sized particles; 20% dusky yellowish brown (10YR 2/2), hard, crystalline, micritic
2010	2020	DOLOSTONE, 50% pale yellowish brown (10YR 6/2), very hard, micritic, choncoidal fractures; 50% dusky yellowish brown (10YR 2/2), hard, crystalline, micritic
2020	2030	DOLOSTONE, pale brown (5YR 5/2), very hard, micritic, crystalline.
2030	2040	DOLOSTONE, pale yellowish brown (10YR 6/2), very hard, micritic, crystalline, bit grinds to sand sized particles and small angular chip fragments.
2040	2050	DOLOSTONE, 70% dark yellowish brown (10YR 4/2), very hard, micritic, crystalline, small angular chip fragments; 30% pale brown (5YR 5/2), hard micritic, crystalline, small angular chip fragments.
2050	2060	DOLOSTONE, pale brown (5YR 5/2), very hard, micritic, crystalline, small to medium sized angular chip fragments.
2060	2070	DOLOSTONE, pale yellowish brown (10YR 6/2), very hard, micritic, crystalline, bit grinds to sand sized particles and small angular chip fragments.
2070	2080	DOLOSTONE, pale brown (5YR 5/2), very hard, micritic, crystalline, medium to large sized angular fragments.
2080	2090	DOLOSTONE, 40% pale yellowish brown (10YR 6/2), very hard, micritic, crystalline, small angular fragments; 40% dark yellowish brown (10YR 4/2), very hard, micritic, crystalline, bit grinds to sand sized particles and small angular fragments; 20% dusky yellowish brown (10 YR 2/2) very hard, micritic, crystalline, bit grinds to sand sized particles and small angular fragments;
2090	2100	DOLOSTONE, 80% pale yellowish brown (10YR 6/2), very hard, micritic, crystalline, small angular fragments; 20% dark yellowish brown (10YR 4/2), very hard, micritic, crystalline, bit grinds to sand sized particles and small angular fragments;
2100	2110	DOLOSTONE, 80% pale yellowish brown (10YR 6/2), very hard, micritic, crystalline, small angular fragments; 20% dusky yellowish brown (10 YR 2/2) very hard, micritic, crystalline, small angular fragments.
2110	2120	DOLOSTONE dusky yellowish brown (10 YR 2/2) very hard, micritic, crystalline, small angular fragments.
2120	2130	DOLOSTONE, medium dark gray (N4),moderately hard, crystalline, micritic, bit is grinding to sand sized particles
2130	2140	DOLOSTONE, light gray (N7),moderately hard, crystalline, micritic, bit is grinding to sand sized particles
2140	2150	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2), soft, sucrosic, small fragments
2150	2160	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2), soft, sucrosic, small fragments
2160	2170	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2), soft, sucrosic, small fragments

From:	To:	ASR-1 Lithologic Description
2170	2180	DOLOMITIC LIMESTONE, medium light gray (N6), soft, sucrosic, small fragments
2180	2190	DOLOSTONE, pale yellowish brown (10YR 6/2), medium hard, micritic, trace black lignite
2190	2200	DOLOSTONE, pale yellowish brown (10YR 6/2), medium hard, micritic, bit grinds most of sample to small fragments
2200	2210	DOLOMITIC LIMESTONE, very pale orange (10YR 8/2), soft, sucrosic, small fragments
2210	2220	DOLOSTONE, light gray (N7),moderately hard, crystalline, micritic, trace pinhole vugs
2220	2230	DOLOSTONE, light olive gray (5Y 6/1),moderately hard, crystalline, micritic
2230	2240	DOLOSTONE, as above
2240	2250	DOLOSTONE, medium gray (N5),moderately hard, crystalline, micritic, trace gypsum
2250	2260	DOLOSTONE, medium gray (N5),moderately soft, crystalline, micritic, subrounded to subangular fragments.
2260	2270	DOLOSTONE, as above
2270	2280	DOLOSTONE, pale brown (5YR 5/2), moderately hard to moderately soft, crystalline, micritic, subrounded to subangular fragments; trace gypsum
2280	2290	DOLOSTONE, pale brown (5YR 5/2) and medium gray (N5), moderately hard to moderately soft, crystalline, micritic, subrounded to subangular fragments; trace gypsum
2290	2300	LIMESTONE, mudstone, medium gray (N5), moderately soft, micritic, subrounded chips and sand sized fragments.
2300	2310	LIMESTONE, mudstone, medium light gray (N6), moderately soft, micritic, subrounded chips and sand sized fragments.
2310	2320	LIMESTONE, mudstone, clayey, light gray (N7), moderately soft, micritic, subrounded chips and sand sized fragments.
2320	2330	LIMESTONE, mudstone, medium light gray (N6), moderately soft, micritic, subrounded to subangular and sand sized fragments.
2330	2340	LIMESTONE, mudstone, light brownish gray (5YR 6/1), moderately soft, micritic, subrounded to subangular and sand sized fragments.
2340	2350	LIMESTONE, as above.
2350	2360	LIMESTONE, mudstone, medium gray (N5), moderately soft, micritic, subrounded fragments and sand sized fragments.
2360	2370	LIMESTONE, mudstone, medium gray (N5), moderately soft, micritic, rounded gravel sized fragments.
2370	2380	LIMESTONE, mudstone, medium gray (N5), moderately soft, micritic, subrounded fragments and sand sized fragments.
2380	2390	DOLOSTONE, brownish gray (5YR 4/1), hard to moderately hard, mictritic, angular chip fragments; trace gypsum.
2390	2400	LIMESTONE, light brownish gray (5YR 6/1) moderately soft, AND DOLOSTONE olive gray (5Y 4/1), moderately hard to moderately soft, mictritic, subrounded to subangulart fragments.
2400	2410	DOLOSTONE, brownish gray (5YR 4/1), hard to moderately hard, mictritic, angular chip fragments; trace gypsum.
2410	2420	DOLOSTONE, brownish gray (5YR 4/1), hard to moderately hard, mictritic, angular chip fragments and sand sized fragments; trace gypsum.
2420	2430	LIMESTONE, mudstone, medium light gray (N6), soft, micritic, subrounded fragments and sand sized fragments.
2430	2440	LIMESTONE, as above, 1% gypsum
2440	2450	DOLOSTONE, light olive gray (5Y 6/1), moderately hard, mictritic, angular chip fragments and sand sized fragments; 3-5% gypsum.
2450	2460	DOLOSTONE, light olive gray (5Y 6/1), moderately hard, mictritic, angular chip fragments and sand sized fragments; 1% gypsum.
2460	2470	DOLOSTONE, as above
2470	2480	DOLOSTONE, as above, trace gypsum
2480	2490	DOLOSTONE, light olive gray (5Y 6/1), moderately soft, mictritic, rounded chip fragments and sand sized fragments.
2490	2500	DOLOSTONE, light olive gray (5Y 6/1), moderately hard, mictritic, angular chip fragments and sand sized fragments; 3-5% gypsum.

From:	To:	ASR-1 Lithologic Description
2500	2510	DOLOSTONE, as above
2510	2520	DOLOSTONE, very light gray (N8), hard, micritic, rounded chip fragments and sand sized fragments, trace gypsum
2520	2530	DOLOSTONE, very light gray (N8), hard, micritic, rounded chip fragments and sand sized fragments, trace gypsum
2530	2540	DOLOSTONE, light gray (N7), hard, micritic, rounded chip fragments and sand sized fragments, 25% evaporites (gypsum and anhydrite)
2540	2550	DOLOSTONE, light gray (N7), hard, micritic, rounded chip fragments and sand sized fragments, 25% evaporites (gypsum and anhydrite)
2550	2560	DOLOSTONE, light gray (N7), hard, micritic, rounded chip fragments and sand sized fragments, 50% evaporites (gypsum and anhydrite)
2560	2570	DOLOSTONE, light gray (N7), hard, micritic, rounded chip fragments and sand sized fragments, trace gypsum
2570	2580	DOLOSTONE, light gray (N7), hard, micritic, rounded chip fragments and sand sized fragments, 50% evaporites (gypsum and anhydrite)
2580	2590	DOLOSTONE, light gray (N7), hard, micritic, rounded chip fragments and sand sized fragments, trace gypsum
2590	2600	EVAPORITES, gypsum (white) and anhydrite (translucent), 25% DOLOSTONE, light gray (N7), hard, micritic, rounded chip fragments and sand sized fragments
2600	2610	EVAPORITES, gypsum (white) and anhydrite (translucent), 25% DOLOSTONE, light gray (N7), hard, micritic, rounded chip fragments and sand sized fragments
2610	2620	EVAPORITES, gypsum (white) and anhydrite (translucent), 25% DOLOSTONE, light gray (N7), hard, micritic, rounded chip fragments and sand sized fragments
2620	2630	DOLOSTONE, light gray (N7), hard, micritic, rounded chip fragments and sand sized fragments, 50% evaporites (gypsum and anhydrite)
2630	2640	DOLOSTONE, light gray (N7), hard, micritic, rounded chip fragments and sand sized fragments, 50% evaporites (gypsum and anhydrite), trace lignite
2640	2650	DOLOSTONE, very pale orange (10YR 8/2), hard, micritic, trace evaporites (gypsum and anhydrite)
2650	2660	DOLOSTONE, light gray (N7), hard, micritic, rounded chip fragments and sand sized fragments, 10% evaporites (gypsum and anhydrite), >40% calcite
2660	2670	DOLOSTONE, light gray (N7), hard, micritic, rounded chip fragments and sand sized fragments, trace gypsum
2670	2680	DOLOSTONE, medium light gray (N6), medium hard, micritic, rounded, trace gypsum
2680	2690	DOLOSTONE, very pale orange (10YR 8/2), hard, micritic, 25% evaporites (gypsum and anhydrite)
2690	2700	DOLOSTONE, very pale orange (10YR 8/2), hard, micritic, 25% evaporites (gypsum and anhydrite)
2700	2710	DOLOMITIC LIMESTONE, moderate yellowish brown (10YR 5/4), sandy, sucrosic
2710	2720	DOLOMITIC LIMESTONE, light gray (N7), sandy, sucrosic
2720	2730	DOLOSTONE, very pale orange (10YR 8/2), hard, micritic, 15% evaporites (gypsum and anhydrite)
2730	2740	DOLOMITIC LIMESTONE, very pale orange (10YR 8/2), sandy, sucrosic, 5% gypsum
2740	2750	DOLOSTONE, light gray (N7), hard, micritic, rounded chip fragments, 30% evaporites
2750	2760	DOLOSTONE, light gray (N7), hard, micritic, rounded chip fragments, 40% evaporites
2760	2770	DOLOSTONE, light gray (N7), hard, micritic, rounded chip fragments, 30% evaporites
2770	2780	LIMESTONE, very pale orange (10YR 8/2), soft, sucrosic, 40% evaporites
2780	2790	LIMESTONE/EVAPORITES, 50% LIMESTONE, very pale orange (10YR 8/2), soft, sucrosic, 50% evaporites
2790	2800	DOLOMITIC LIMESTONE, very pale orange (10YR 8/2), sandy, sucrosic, 15% gypsum
2800	2810	DOLOSTONE, very pale orange (10YR 8/2), and light gray (N7), hard, micritic, trace evaporites (gypsum and anhydrite)
2810	2820	DOLOSTONE, very pale orange (10YR 8/2), and light gray (N7), hard, micritic, 20% evaporites (gypsum and anhydrite)
2820	2830	DOLOMITIC LIMESTONE, very pale orange (10YR 8/2), sandy, sucrosic, 50% gypsum
2830	2840	DOLOMITIC LIMESTONE, very pale orange (10YR 8/2), sandy, sucrosic, 50% evaporites
2840	2850	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2), sandy, sucrosic, 50% evaporites
2850	2860	EVAPORITES, > 90% gypsum (white) and anhydrite (translucent), some DOLOMITIC LIMESTONE, light gray (N7), soft, sucrosic

From:	To:	ASR-1 Lithologic Description
2860	2870	LIMESTONE/EVAPORITES, 50% LIMESTONE, very pale orange (10YR 8/2), soft, sucrosic, 50% evaporites
2870	2880	EVAPORITES, > 90% gypsum (white) and anhydrite (translucent), trace black lignite
2880	2890	EVAPORITES, > 90% gypsum (white) and anhydrite (translucent), some DOLOMITIC LIMESTONE, light gray (N7), soft, sucrosic
2890	2900	EVAPORITES, > 90% gypsum (white) and anhydrite (translucent), trace DOLOSTONE, light gray (N7), soft, sucrosic
2900	2910	EVAPORITES, > 90% gypsum (white) and anhydrite (translucent), some DOLOMITIC LIMESTONE, very pale orange (10YR 8/2), soft, sucrosic
2910	2920	EVAPORITES, > 90% gypsum (white) and anhydrite (translucent), some DOLOMITIC LIMESTONE, very pale orange (10YR 8/2), soft, sucrosic
2920	2930	EVAPORITES, > 90% gypsum (white) and anhydrite (translucent), some DOLOMITIC LIMESTONE, very pale orange (10YR 8/2), soft, sucrosic
2930	2940	EVAPORITES, > 90% gypsum (white) and anhydrite (translucent), some DOLOMITIC LIMESTONE, very pale orange (10YR 8/2), soft, sucrosic
2940	2950	EVAPORITES, > 90% gypsum (white) and anhydrite (translucent), some DOLOMITIC LIMESTONE, very pale orange (10YR 8/2), soft, sucrosic
2950	2960	EVAPORITES, > 90% gypsum (white) and anhydrite (translucent), some DOLOMITIC LIMESTONE, very pale orange (10YR 8/2), soft, sucrosic
2960	2970	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2), sandy, sucrosic, 50% evaporites
2970	2980	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2) and medium light gray (N6), sandy, sucrosic, 50% evaporites
2980	2990	EVAPORITES, > 90% gypsum (white) and anhydrite (translucent), some DOLOMITIC LIMESTONE, very pale orange (10YR 8/2), soft, sucrosic
2990	3000	EVAPORITES, > 90% gypsum (white) and anhydrite (translucent), some DOLOSTONE, dark yellowish brown (10YR 4/2), hard, micritic
3000	3010	EVAPORITES, > 90% gypsum (white) and anhydrite (translucent), some DOLOSTONE, dark yellowish brown (10YR 4/2), hard, micritic
3010	3020	EVAPORITES, > 90% gypsum (white) and anhydrite (translucent), some DOLOSTONE, dark yellowish brown (10YR 4/2), hard, micritic
3020	3030	EVAPORITES/DOLOSTONE 50/50, dark gray (N3) and very pale orange (10YR 8/2) hard micritic, banded
3030	3040	EVAPORITES/DOLOSTONE 50/50, dark gray (N3) and very pale orange (10YR 8/2) hard micritic, banded
3040	3050	EVAPORITES/DOLOSTONE 50/50, dark gray (N3) and very pale orange (10YR 8/2) hard micritic, banded, some dolomitic limestone
3050	3060	EVAPORITES/DOLOSTONE 50/50, dark gray (N3) and very pale orange (10YR 8/2) hard micritic, banded, some dolomitic limestone, total depth of hole

Well Name: SZMW-1
Location: City of St. Cloud Southside WWTF
Contractor: Florida Design Drilling
Drilling Method Mud-Rotary/Reverse-Air
Bit-Size: 12 1/4" tricone bit
Total Depth: TBD
Casing Depth: 30" casing to 50 ft bls, 20" csg to 300 ft bls, 12" casing to 1,140 ft bls, 6" casing to 1,650 ft
Resident Observer: Marty Clasen, Hunter Clasen

From:	To:	SZMW-1 Lithologic Description
0	10	SILTY SAND, very dark brown (2/2), sandy loam, fill and SAND, grayish brown (5/2), very fine grained qtz, well rounded, well sorted
10	20	SAND, grayish brown (5/2), very fine grained quartz, well rounded, well sorted
20	30	SAND, as above
30	40	SAND, as above
40	50	CLAYEY SAND AND CLAY, olive gray (5Y 3/2), clayey sand, 40-47 feet, very fine subrounded quartz sand, soft green clay 47-50 feet
50	60	CLAYEY SAND, olive gray (10Y 4/2), very fine subrounded quartz sand, with soft green clay and some shell
60	70	CLAYEY SAND, olive gray (10Y 4/2), very fine subrounded quartz sand, with soft green clay and some shell
70	80	SAND, olive gray (10Y 4/2), very fine subrounded quartz sand, with some shell
80	90	SAND, olive gray (10Y 4/2), very fine subrounded quartz sand, with some shell
90	100	SAND, olive gray (10Y 4/2), very fine subrounded quartz sand, with some shell
100	110	SAND, olive gray (10Y 4/2), very fine subrounded quartz sand, with some shell
110	120	SAND, light olive gray (5Y 5/2), quartz sand, medium grained, subangular, 10% mollusk shell, trace black lignite
120	130	SAND, light olive gray (5Y 5/2), quartz sand, medium grained, subangular, trace mollusk shell, trace phosphate
130	140	SILTY SAND, light olive gray (5Y 5/2), quartz sand, medium grained, subangular, trace mollusk shell, trace phosphate
140	150	SILTY SAND, light olive gray (5Y 5/2), quartz sand, medium grained, subangular, trace mollusk shell, trace phosphate
150	160	SAND, light olive gray (5Y 5/2), quartz sand, medium grained, subangular, trace black phosphate
160	170	SAND, light olive gray (5Y 5/2), quartz sand, medium grained, subangular, trace black phosphate
170	180	SAND, light olive gray (5Y 5/2), quartz sand, medium grained, subangular, trace black phosphate
180	190	SAND with SHELL, light olive gray (5Y 5/2), quartz sand, medium grained, subangular, 15% mollusk shell, trace phosphate
190	200	SILTY SAND, light olive gray (5Y 5/2), quartz sand, medium grained, subangular, trace mollusk shell, trace phosphate
200	210	SAND, light olive gray (5Y 5/2), quartz sand, medium grained, subangular, 15% mollusk shell, trace phosphate
210	220	SAND, light olive gray (5Y 5/2), quartz sand, medium grained, subangular, 15% mollusk shell, trace phosphate
220	230	SAND, light olive gray (5Y 5/2), quartz sand, medium grained, subangular, 15% mollusk shell, trace phosphate
230	240	SAND, light olive gray (5Y 5/2), quartz sand, medium grained, subangular, 15% mollusk shell, trace phosphate
240	250	SAND, light olive gray (5Y 5/2), quartz sand, medium grained, subangular, 15% mollusk shell, trace phosphate
250	260	SAND, light olive gray (5Y 5/2), quartz sand, medium grained, subangular, 15% mollusk shell, trace phosphate
260	270	SAND, light olive gray (5Y 5/2), quartz sand, medium grained, subangular, 15% mollusk shell, trace phosphate
270	280	LIMESTONE, very pale orange (10YR 8/2), sucrosic, soft, some chert, black, some phosphate, trace shell, fossiliferous, Nummulites, typical of Ocala Limestone formation
280	290	70% CALCAREOUS CLAY, greenish grey (5GY 6/1), soft, somewhat silty; 30% LIMESTONE, very pale orange (10YR 8/2), sucrosic, soft
290	300	70% CALCAREOUS CLAY, greenish grey (5GY 6/1), soft, somewhat silty; 30% LIMESTONE, very pale orange (10YR 8/2), sucrosic, soft
300	310	LIMESTONE, very pale orange (10YR 8/2), sucrosic, soft,
310	320	LIMESTONE, very pale orange (10YR 8/2), sucrosic, soft,
320	330	LIMESTONE, very pale orange (10YR 8/2), sucrosic, soft,
330	340	LIMESTONE, very pale orange (10YR 8/2), sucrosic, soft,
340	350	LIMESTONE, very pale orange (10YR 8/2), sucrosic, fossiliferous, benthic foraminifera, Dictyoconus americanus
350	360	LIMESTONE, very pale orange (10YR 8/2), sucrosic, fossiliferous, benthic foraminifera, Dictyoconus americanus
360	370	LIMESTONE, very pale orange (10YR 8/2), sucrosic, fossiliferous, benthic foraminifera, Dictyoconus americanus
370	380	LIMESTONE, very pale orange (10YR 8/2), sucrosic, fossiliferous, benthic foraminifera, Dictyoconus americanus, somewhat harder
380	390	LIMESTONE, very pale orange (10YR 8/2), sucrosic, fossiliferous, benthic foraminifera, Dictyoconus americanus, somewhat harder, larger fragments
390	400	LIMESTONE, very pale orange (10YR 8/2), sucrosic, fossiliferous, benthic foraminifera, Dictyoconus americanus
400	410	LIMESTONE, very pale orange (10YR 8/2), sucrosic, fossiliferous, benthic foraminifera, Dictyoconus americanus
410	420	LIMESTONE, very pale orange (10YR 8/2), sucrosic, fossiliferous, benthic foraminifera, Dictyoconus americanus
420	430	LIMESTONE, very pale orange (10YR 8/2), sucrosic, fossiliferous, benthic foraminifera, Dictyoconus americanus

430	440	DOLOMITIC LIMESTONE, very pale orange (10YR 8/2), hard, micritic, trace pin-hole vugs
440	450	LIMESTONE, very pale orange (10YR 8/2), sucrosic, fossiliferous, benthic foraminifera, Dictyoconus americanus, echinoderms
450	460	LIMESTONE, very pale orange (10YR 8/2), sucrosic, fossiliferous, benthic foraminifera, Dictyoconus americanus
460	470	LIMESTONE, very pale orange (10YR 8/2), sucrosic, fossiliferous, benthic foraminifera, Dictyoconus americanus
470	480	LIMESTONE, very pale orange (10YR 8/2), soft, sucrosic, fossiliferous, benthic foraminifera, echinoderms
480	490	LIMESTONE, very pale orange (10YR 8/2), soft, sucrosic, fossiliferous, benthic foraminifera, echinoderms
490	500	LIMESTONE, very pale orange (10YR 8/2), soft, sucrosic, fossiliferous, benthic foraminifera
500	510	LIMESTONE, very pale orange (10YR 8/2), soft, sucrosic, fossiliferous, benthic foraminifera
510	520	LIMESTONE, very pale orange (10YR 8/2), soft, sucrosic, fossiliferous, benthic foraminifera, 30% calcareous clay
520	530	LIMESTONE, very pale orange (10YR 8/2), soft, sucrosic, fossiliferous, benthic foraminifera
530	540	DOLOMITIC LIMESTONE, very pale orange (10YR 8/2), hard, micritic, trace pin-hole vugs
540	550	LIMESTONE, very pale orange (10YR 8/2), soft, sucrosic, fossiliferous, benthic foraminifera
550	560	DOLOSTONE, moderate yellowish brown (10YR 5/4), hard, micritic, fine grained, trace pin-holoe vugs, slow drilling
560	570	LIMESTONE, very pale orange (10YR 8/2), soft, sucrosic, fossiliferous, benthic foraminifera
570	580	LIMESTONE, very pale orange (10YR 8/2), soft, sucrosic, fossiliferous, benthic foraminifera
580	590	LIMESTONE, very pale orange (10YR 8/2), soft, sucrosic, fossiliferous, benthic foraminifera
590	600	DOLOSTONE, dark yellowish brown (10YR 4/2), hard, micritic, typical of the Avon Park Permeable Zone (APPZ), some limestone from above
600	610	DOLOSTONE, moderate brown (5YR 3/4), hard, micritic, typical of the APPZ
610	620	DOLOSTONE, moderate brown (5YR 3/4), hard, micritic, typical of the APPZ
620	630	DOLOSTONE, moderate yellowish brown (5YR 5/4), hard, micritic, typical of the APPZ
630	640	DOLOSTONE, moderate yellowish brown (5YR 5/4), hard, micritic, typical of the APPZ
640	650	DOLOSTONE, moderate yellowish brown (5YR 5/4), hard, micritic, typical of the APPZ, finer grained cuttings
650	660	DOLOSTONE, moderate yellowish brown (5YR 5/4), hard, micritic, typical of the APPZ, finer grained cuttings, trace LIMESTONE, very pale orange (10YR 8/2)
660	670	DOLOSTONE/DOLOMITIC LIMESTONE, moderate yellowish brown (10YR 5/4) and very pale orange (10YR 8/2), hard, micritic
670	680	DOLOSTONE/DOLOMITIC LIMESTONE, moderate yellowish brown (10YR 5/4) and very pale orange (10YR 8/2), fine grained cuttings, softer, greater percentage of limestone
680	690	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2), moderately hard, very fine grained, micritic, some pin-hole vugs
690	700	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2), moderately hard, very fine grained, micritic, some pin-hole vugs
700	710	DOLOMITIC LIMESTONE, very pale orange (10YR 8/2), moderately hard, very fine grained, micritic, some pin-hole vugs
710	720	DOLOMITIC LIMESTONE, very pale orange (10YR 8/2), moderately hard, very fine grained, micritic
720	730	DOLOMITIC LIMESTONE, very pale orange (10YR 8/2), moderately hard, very fine grained, micritic
730	740	DOLOMITIC LIMESTONE, very pale orange (10YR 8/2), moderately hard, very fine grained, micritic
740	750	DOLOMITIC LIMESTONE, very pale orange (10YR 8/2), moderately hard, very fine grained, micritic
750	760	DOLOMITIC LIMESTONE, very pale orange (10YR 8/2), moderately hard, very fine grained, micritic, some pin-hole vugs
760	770	DOLOMITIC LIMESTONE, very pale orange (10YR 8/2), moderately hard, very fine grained, micritic
770	780	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2), moderately hard, very fine grained, micritic
780	790	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2), moderately hard, very fine grained, micritic
790	800	DOLOMITIC LIMESTONE, grayish orange (10YR 7/4), moderately hard, very fine grained, micritic, trace pin hole vugs
800	810	DOLOMITIC LIMESTONE, grayish orange (10YR 7/4), moderately hard, very fine grained, micritic
810	820	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2), moderately hard, very fine grained, micritic
820	830	DOLOMITIC LIMESTONE, very pale orange (10YR 8/2), moderately hard, very fine grained, micritic
830	840	DOLOMITIC LIMESTONE, very pale orange (10YR 8/2), moderately hard, very fine grained, micritic
840	850	DOLOMITIC LIMESTONE, very pale orange (10YR 8/2), moderately hard, very fine grained, micritic
850	860	DOLOMITIC LIMESTONE, very pale orange (10YR 8/2), moderately hard, very fine grained, micritic
860	870	DOLOMITIC LIMESTONE, very pale orange (10YR 8/2), moderately hard, very fine grained, micritic, trace pin hole vugs
870	880	DOLOMITIC LIMESTONE, grayish orange (10YR 7/4), moderately hard, very fine grained, micritic
880	890	DOLOMITIC LIMESTONE, as above
890	900	DOLOMITIC LIMESTONE, as above
900	910	DOLOMITIC LIMESTONE, as above

910	920	DOLOMITIC LIMESTONE, as above
920	930	DOLOMITIC LIMESTONE, as above
930	940	DOLOMITIC LIMESTONE, as above
940	950	DOLOMITIC LIMESTONE, as above
950	960	DOLOMITIC LIMESTONE, as above
960	970	CORE RUN 967-982 feet, recovered 3.5 feet approximately 978.5-982 feet
970	980	DOLOSTONE/DOLOMITIC LIMESTONE, very pale orange (10YR 8/2), moderately soft, micritic, 979 ft very fined grained silty, low apparent permeability, 979-981 ft, softer, sample is broken into small fragments, small pin-hole vugs, some filled with calcite, 981 ft, possible testable piece, hard micritic dolostone, 982 ft very fine grained, silty
980	990	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2), moderately hard, very fine grained, micritic
990	1000	DOLOMITIC LIMESTONE, grayish orange (10YR 7/4), moderately hard, very fine grained, micritic
1000	1010	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2), soft, very fine grained, micritic
1010	1020	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2), soft, very fine grained, micritic
1020	1030	DOLOMITIC LIMESTONE, as above
1030	1040	DOLOMITIC LIMESTONE, as above
1040	1050	DOLOMITIC LIMESTONE, as above
1050	1060	DOLOMITIC LIMESTONE, as above
1060	1070	DOLOMITIC LIMESTONE, as above
1070	1080	DOLOMITIC LIMESTONE, as above
1080	1090	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2), moderately hard, very fine grained, micritic, 0.25-inch diameter fragments
1090	1100	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2), soft, fine grained, micritic
1100	1110	DOLOMITIC LIMESTONE, grayish orange (10YR 7/4), moderately hard, fine grained, micritic, 1-inch diameter fragments
1110	1120	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2), moderately hard, very fine grained, micritic, 0.25-inch diameter fragments
1120	1130	DOLOMITIC LIMESTONE, as above, trace pin hole vugs
1130	1140	DOLOMITIC LIMESTONE, as above, trace pin hole vugs
1140	1150	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2), very soft, very fine grained, micritic
1150	1160	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2) (wet sample), moderately hard, fine grained, micritic,trace pin hole vugs, 0.25-inch diameter fragments
1160	1170	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2) (wet sample), moderately hard, fine grained, trace pin hole vugs, angular fragments
1170	1180	DOLOMITIC LIMESTONE, as above, trace pin hole vugs
1180	1190	DOLOMITIC LIMESTONE, moderate yellowish brown (10YR 5/4), cuttings ground to sand with some larger, hard fragments.
1190	1200	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2), very hard, fine grained with pin hole vugs.
1200	1210	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2), very hard, large boulder sized fragments with pin hole vugs, trace lignite.
1210	1220	LIMESTONE, very pale orange (10YR 8/2), limemud, moderately soft.
1220	1230	DOLOMITIC LIMESTONE, very light grey (N8) and white (N9), with some pale yellowish brown (10YR 6/2), very hard, large sized fragments, micritic.
1230	1240	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2) with some medium light grey (N6), very hard, large sized angluar fragments, micritic.
1240	1250	DOLOSTONE, moderate yellowish brown (10YR 5/4) very hard, micritic, and Dolomitic Limestone, light grey (N7), very hard, micritic.
1250	1260	DOLOSTONE, moderate yellowish brown (10YR 5/4), very hard, recyristallized.
1260	1270	DOLOSTONE, very pale orange (10YR 8/2), hard, micritic, recrystallized, trace pin-hole vugs
1270	1280	DOLOSTONE, moderate yellowish brown (10YR 5/4), hard, micritic, recrystallized, trace pin-hole vugs

1280	1290	DOLOSTONE, very pale orange (10YR 8/2), moderately hard, micritic, some sucrosic, recrystallized
1290	1300	DOLOSTONE, moderate yellowish brown (10YR 5/4), moderately hard, micritic, some sucrosic, recrystallized, some pin-hole vugs
1300	1310	DOLOSTONE, very pale orange (10YR 8/2), moderately hard, micritic, some sucrosic, trace pin-hole vugs
1310	1320	DOLOSTONE, moderate yellowish brown (10YR 5/4), moderately hard, micritic, some sucrosic, trace pin-hole vugs
1320	1330	DOLOSTONE, very dark brown (10YR 2/2) with some moderate yellowish brown (10YR 5/4), hard, micritic, trace pin-hole vugs
1330	1340	DOLOSTONE, moderate yellowish brown (10YR 5/4), moderately hard, micritic, some sucrosic, trace pin-hole vugs
1340	1350	DOLOSTONE, as above, more sucrosic
1350	1360	DOLOSTONE, pale yellowish brown (10YR 6/2), moderately hard, micritic, some sucrosic, trace pin-hole vugs
1360	1370	DOLOSTONE, pale yellowish brown (10YR 6/2), very hard, up to 2-inch fragments, micritic, some sucrosic, trace pin-hole vugs
1370	1380	DOLOSTONE, moderate yellowish brown (10YR 5/4), moderately hard, micritic, some sucrosic, trace pin-hole vugs
1380	1390	DOLOSTONE, as above, more sucrosic
1390	1400	DOLOSTONE, moderate yellowish brown (10YR 5/4), very hard, micritic, microcrystalline, some sucrosic, trace pin-hole vugs
1400	1410	DOLOSTONE, pale yellowish brown (10YR 6/2), very hard, up to 2-inch fragments, micritic, some sucrosic, trace pin-hole vugs
1410	1420	DOLOSTONE, moderate yellowish brown (10YR 5/4), very hard, micritic, microcrystalline, some sucrosic, trace pin-hole vugs
1420	1430	DOLOSTONE, moderate yellowish brown (10YR 5/4), very hard, micritic, microcrystalline, some sucrosic, trace pin-hole vugs
1430	1440	CORE RUN 1,432-1,433 feet, recovered 1 foot, DOLOSTONE, moderate yellowish brown (10YR 5/4), hard, micritic,some sucrosic, some pin hole vugs
1440	1450	DOLOSTONE, moderate yellowish brown (10YR 5/4), very hard, micritic, microcrystalline, up to 2-inch diameter fragments
1450	1460	DOLOSTONE, moderate yellowish brown (10YR 5/4), very hard, micritic, microcrystalline, up to 1-inch diameter fragments
1460	1470	DOLOSTONE, as above, trace limestone from above
1470	1480	DOLOSTONE, dark yellowish brown (10YR 4/2), very hard, micritic, microcrystalline, up to 1-inch diameter fragments
1480	1490	DOLOSTONE, moderate yellowish brown (10YR 5/4), very hard, micritic, microcrystalline, some sucrosic, trace pin-hole vugs
1490	1500	DOLOSTONE, as above, trace dusky yellowish brown (10YR 2/2)
1500	1510	DOLOSTONE, pale yellowish brown (10YR 6/2), very hard, up to 2-inch fragments, micritic, trace pin-hole vugs
1510	1520	DOLOSTONE, as above
1520	1530	DOLOSTONE, yellowish gray (5YR 8/1), soft, sucrosic
1530	1540	DOLOSTONE, as above
1540	1550	DOLOSTONE, pale yellowish brown (10YR 6/2), very hard, up to 2-inch fragments, micritic, microcrystalline
1550	1560	DOLOSTONE, as above
1560	1570	DOLOSTONE, very pale orange (10YR 8/2), hard, micritic, recrystallized
1570	1580	DOLOSTONE, yellowish gray (5YR 8/1), soft, sucrosic
1580	1590	DOLOSTONE, as above
1590	1600	DOLOSTONE, as above
1600	1610	DOLOSTONE, medium light gray (N6), very hard, micritic, microcrystalline
1610	1620	DOLOSTONE, as above
1620	1630	LIMESTONE, very pale orange (10YR 8/2), soft, crumbly, sucrosic
1630	1640	DOLOSTONE, pale yellowish brown (10YR 6/2), very hard, micritic, microcrystalline
1640	1650	DOLOSTONE, as above
1650	1660	DOLOSTONE, as above
1660	1670	DOLOSTONE, as above
1670	1680	DOLOSTONE, pale yellowish brown (10YR 6/2), very hard, micritic, microcrystalline

Well Name:	SMW-1
Location:	City of St. Cloud Southside WWTF
Contractor:	Florida Design Drilling
Drilling Method	Mud-Rotary/Reverse-Air
Bit-Size:	11 7/8" tricone bit
Total Depth:	TBD
Casing Depth:	30" casing to 50 ft bls, 20" casing to 315 ft bls, 12" casing to 1,480 feet bls
Resident Observer:	Marty Clasen

From:	To:	SMW-1 Lithologic Description
0	10	SAND, grayish brown (5/2), very fine quartz, well rounded, well sorted
10	20	SAND, as above
20	30	SAND, as above
30	40	SAND, as above, trace black organics
40	50	CLAYEY SAND AND CLAY, olive gray (5Y 3/2), clayey sand, 40-47 feet, very fine subrounded quartz sand, soft green clay 47-50 feet
50	60	SAND, light olive gray (5Y 5/2), quartz sand, medium grained, subangular, 10% mollusk shell, trace black lignite
60	70	SAND/SHELL, pale olive (10Y 6/2), 50% quartz sand, medium grained subangular, 50% mollusk shells
70	80	SAND/SHELL, as above with 5% black lignite
80	90	SAND/SHELL, as above with 5% black lignite
90	100	SAND/SHELL, as above with 5% black lignite
100	110	SAND, light olive gray (5Y 5/2), quartz sand, medium grained, subangular, 20% mollusk shell, trace black lignite
110	120	SAND, light olive gray (5Y 5/2), quartz sand, medium grained, subangular, 20% mollusk shell, trace black lignite
120	130	SAND, light olive gray (5Y 5/2), quartz sand, medium grained, subangular, 20% mollusk shell, trace black lignite
130	140	SAND/SHELL, pale olive (10Y 6/2), 50% quartz sand, medium grained subangular, 50% mollusk shells
140	150	SAND, light olive gray (5Y 5/2), quartz sand, medium grained, subangular, 20% mollusk shell, trace black lignite
150	160	SAND with SHELL, light olive gray (5Y 5/2), quartz sand, medium grained, subangular, 10% mollusk shell, trace phosphate
160	170	SAND with SHELL, light olive gray (5Y 5/2), quartz sand, medium grained, subangular, 10% mollusk shell, trace phosphate
170	180	SAND with SHELL, light olive gray (5Y 5/2), quartz sand, medium grained, subangular, 30% mollusk shell, trace phosphate
180	190	SAND with SHELL, light olive gray (5Y 5/2), quartz sand, medium grained, subangular, 10% mollusk shell, trace phosphate
190	200	CLAYEY SAND WITH SHELL, olive gray (5Y 3/2), fine grained quartz sand with some green soft clay, 25% mollusk shell
200	210	CLAYEY SAND WITH SHELL, olive gray (5Y 3/2), fine grained quartz sand with some green soft clay, 25% mollusk shell
210	220	SAND with SHELL, light olive gray (5Y 5/2), quartz sand, medium grained, subangular, 25% mollusk shell, trace phosphate
220	230	SAND, light olive gray (5Y 5/2), quartz sand, medium grained, subangular, 5% mollusk shell, trace phosphate
230	240	SAND, light olive gray (5Y 5/2), quartz sand, medium grained, subangular, 5% mollusk shell, trace phosphate
240	250	SAND, light olive gray (5Y 5/2), quartz sand, medium grained, subangular, 5% mollusk shell, trace phosphate
250	260	SAND, as above, some foraminifera
260	270	SAND, as above, some foraminifera
270	280	LIMESTONE, very pale orange (10YR 8/2), sucrosic, soft, fossiliferous, benthic foraminifera, Lepidocyclina, Nummulites, typical of Ocala Limestone
280	290	LIMESTONE, very pale orange (10YR 8/2), sucrosic, soft, fossiliferous, benthic foraminifera, Lepidocyclina, Nummulites, typical of Ocala Limestone
290	300	LIMESTONE, very pale orange (10YR 8/2), sucrosic, soft, fossiliferous
300	310	LIMESTONE, very pale orange (10YR 8/2), sucrosic, soft, fossiliferous

310	320	LIMESTONE, very pale orange (10YR 8/2), sucrosic, soft, fossiliferous
320	330	LIMESTONE, very pale orange (10YR 8/2), sucrosic, fossiliferous, echinoderms, benthic foraminifera, Dictyoconus americanus, typical of the Avon Park Formation
330	340	LIMESTONE, very pale orange (10YR 8/2), sucrosic, fossiliferous, echinoderms, benthic foraminifera, Dictyoconus americanus, typical of the Avon Park Formation
340	350	LIMESTONE, very pale orange (10YR 8/2), soft, sucrosic, fossiliferous, benthic foraminifera, calcite
350	360	LIMESTONE, as above
360	370	LIMESTONE, as above
370	380	LIMESTONE, as above
380	390	LIMESTONE, as above
390	400	LIMESTONE, as above
400	410	LIMESTONE, as above
410	420	LIMESTONE, as above, very soft
420	430	LIMESTONE, as above, hard
430	440	LIMESTONE, as above
440	450	LIMESTONE, as above
450	460	LIMESTONE, as above
460	470	LIMESTONE, as above
470	480	LIMESTONE, as above
480	490	LIMESTONE, as above
490	500	LIMESTONE, as above
500	510	LIMESTONE, as above, very fine grained, calcilutite, hard
510	520	LIMESTONE, as above
520	530	LIMESTONE, as above
530	540	LIMESTONE, as above
540	550	LIMESTONE, as above
550	560	LIMESTONE, as above
560	570	LIMESTONE, as above
570	580	LIMESTONE, as above
580	590	DOLOSTONE, dark yellowish brown (10YR 4/2), very hard, micritic, microcrystalline, large angular fragments
590	600	DOLOSTONE, moderate yellowish brown (10YR 5/4), very hard, micritic, microcrystalline, large angular fragments
600	610	DOLOSTONE, moderate yellowish brown (10YR 5/4), very hard, micritic, microcrystalline, large angular fragments
610	620	LIMESTONE, very pale orange (10YR 8/2), soft, sucrosic, fossiliferous, benthic foraminifera, calcite
620	630	DOLOSTONE, dark yellowish brown (10YR 4/2), very hard, micritic, microcrystalline, large angular fragments
630	640	DOLOSTONE, moderate yellowish brown (10YR 5/4), very hard, micritic, microcrystalline, large angular fragments
640	650	DOLOSTONE, moderate yellowish brown (10YR 5/4), very hard, micritic, microcrystalline, large angular fragments
650	660	DOLOSTONE, as above
660	670	DOLOSTONE, as above
670	680	DOLOSTONE, grayish orange (10YR 7/4), very hard, micritic, microcrystalline
680	690	DOLOSTONE, as above
690	700	DOLOSTONE, as above
700	710	DOLOMITIC LIMESTONE, grayish orange (10YR 7/4), moderately hard, micritic, very fine grained
710	720	DOLOMITIC LIMESTONE, as above
720	730	DOLOMITIC LIMESTONE, as above

730	740	DOLOMITIC LIMESTONE, as above
740	750	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2), moderately hard, very fine grained, micritic
750	760	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2), moderately hard, very fine grained, micritic
760	770	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2), moderately hard, very fine grained, micritic
770	780	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2), moderately hard, very fine grained, micritic
780	790	DOLOSTONE, moderate yellowish brown (10YR 5/4), very hard, micritic, microcrystalline
790	800	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2) and moderate yellowish brown (10YR 5/4) moderately hard, very fine grained, micritic
800	810	DOLOMITIC LIMESTONE, grayish orange (10YR 7/4), moderately hard, micritic, very fine grained, up to 1-inch fragments
810	820	DOLOMITIC LIMESTONE, grayish orange (10YR 7/4), moderately hard, micritic, very fine grained, up to 1-inch fragments
820	830	DOLOMITIC LIMESTONE, grayish orange (10YR 7/4), moderately hard, micritic, very fine grained, up to 1-inch fragments
830	840	DOLOMITIC LIMESTONE, grayish orange (10YR 7/4), moderately hard, micritic, very fine grained, up to 1-inch fragments
840	850	DOLOMITIC LIMESTONE, grayish orange (10YR 7/4), moderately hard, micritic, very fine grained, up to 1-inch fragments
850	860	DOLOMITIC LIMESTONE, grayish orange (10YR 7/4), soft, micritic, very fine grained
860	870	DOLOMITIC LIMESTONE, grayish orange (10YR 7/4), soft, micritic, very fine grained
870	880	DOLOMITIC LIMESTONE, grayish orange (10YR 7/4), soft, micritic, very fine grained
880	890	DOLOMITIC LIMESTONE, grayish orange (10YR 7/4), moderately hard, micritic, very fine grained, up to 1/2-inch fragments
890	900	DOLOMITIC LIMESTONE, grayish orange (10YR 7/4), moderately hard, micritic, very fine grained, up to 1/2-inch fragments
900	910	DOLOMITIC LIMESTONE, grayish orange (10YR 7/4), moderately soft, micritic, very fine grained, up to 1/2-inch fragments
910	920	DOLOMITIC LIMESTONE, as above
920	930	DOLOMITIC LIMESTONE, as above
930	940	DOLOMITIC LIMESTONE, as above
940	950	DOLOMITIC LIMESTONE, as above
950	960	DOLOMITIC LIMESTONE, as above
960	970	DOLOMITIC LIMESTONE, as above
970	980	DOLOMITIC LIMESTONE, grayish orange (10YR 7/4), soft, micritic, very fine grained
980	990	DOLOMITIC LIMESTONE, grayish orange (10YR 7/4), soft, micritic, very fine grained
990	1000	DOLOMITIC LIMESTONE, grayish orange (10YR 7/4), moderately soft, micritic, very fine grained, up to 1/2-inch fragments
1000	1010	DOLOMITIC LIMESTONE, grayish orange (10YR 7/4), moderately soft, micritic, very fine grained, up to 1/2-inch fragments
1010	1020	DOLOMITIC LIMESTONE, grayish orange (10YR 7/4), moderately soft, micritic, very fine grained, up to 1/2-inch fragments
1020	1030	DOLOMITIC LIMESTONE, as above
1030	1040	DOLOMITIC LIMESTONE, as above
1040	1050	DOLOMITIC LIMESTONE, as above
1050	1060	DOLOMITIC LIMESTONE, as above
1060	1070	DOLOMITIC LIMESTONE, as above
1070	1080	DOLOMITIC LIMESTONE, as above
1080	1090	DOLOMITIC LIMESTONE, as above
1090	1100	DOLOMITIC LIMESTONE, very pale orange (10YR 8/2), moderately hard, micritic, very fine grained, less than 1-inch fragments

1100	1110	DOLOMITIC LIMESTONE, as above
1110	1120	DOLOMITIC LIMESTONE, as above
1120	1130	DOLOMITIC LIMESTONE, as above
1130	1140	DOLOMITIC LIMESTONE, as above
1140	1150	DOLOMITIC LIMESTONE, as above
1150	1160	DOLOMITIC LIMESTONE, as above
1160	1170	DOLOMITIC LIMESTONE, as above
1170	1180	DOLOMITIC LIMESTONE, as above
1180	1190	DOLOMITIC LIMESTONE, as above
1190	1200	DOLOMITIC LIMESTONE, as above
1200	1210	DOLOMITIC LIMESTONE, very pale orange (10YR 8/2), moderately hard, micritic, very fine grained, less than 1-inch fragments, some LIMESTONE
1210	1220	DOLOMITIC LIMESTONE, very pale orange (10YR 8/2), moderately hard, micritic, very fine grained, less than 1-inch fragments
1220	1230	DOLOMITIC LIMESTONE, very pale orange (10YR 8/2), moderately hard, micritic, very fine grained, less than 1-inch fragments
1230	1240	DOLOMITIC LIMESTONE, grayish orange (10YR 8/2), hard, micritic, very fine grained, less than 1/2-inch fragments
1240	1250	DOLOMITIC LIMESTONE, grayish orange (10YR 8/2), hard, micritic, very fine grained, less than 1/2-inch fragments
1250	1260	DOLOMITIC LIMESTONE, very pale orange (10YR 8/2), moderately hard, micritic, very fine grained, less than 1-inch fragments, some LIMESTONE
1260	1270	DOLOMITIC LIMESTONE, as above
1270	1280	DOLOMITIC LIMESTONE, as above
1280	1290	DOLOMITIC LIMESTONE, medium light gray (N6), hard, micritic, very fine grained, less than 1/2-inch fragments
1290	1300	DOLOMITIC LIMESTONE, very pale orange (10YR 8/2), moderately hard, micritic, very fine grained, less than 1-inch fragments, some LIMESTONE
1300	1310	DOLOMITIC LIMESTONE, pale yellowish brown (10YR 6/2), moderately hard, very fine grained, micritic
1310	1320	DOLOSTONE, moderate brown (5YR 3/4), hard, recrystallized, angular fragments, some vuggyness noted in larger fragments - possible porosity,slow drilling.
1320	1330	DOLOSTONE, dusky brown (5YR 2/2), hard, recrystallized, angular fragments, some vuggyness noted in larger fragments - possible porosity, some lignite, slow drilling.
1330	1340	DOLOSTONE, moderate yellowish brown (5YR 5/4), hard, recrystallized, angular fragments, some vuggyness noted in larger fragments - possible porosity,slow drilling.
1340	1350	DOLOSTONE, moderate yellowish brown (5YR 5/4), hard, recrystallized, angular fragments, slow drilling.
1350	1360	DOLOSTONE, light brown, 5YR 6/4, moderately hard, sand sized fragments.
1360	1370	DOLOSTONE, as above
1370	1380	DOLOSTONE, pale brown, 5YR 5/2, hard, recrysitallized, large gravel sized angular fragments.
1380	1390	DOLOSTONE, as above
1390	1400	DOLOSTONE, light brown, 5YR 6/4, moderately hard, sand sized fragments.
1400	1410	DOLOSTONE, moderate yellowish brown (5YR 5/4), hard, recrystallized, angular fragments, some pinhole vuggyness noted in larger fragments - possible porosity,slow drilling.
1410	1420	DOLOSTONE, moderate yellowish brown (5YR 5/4), hard, recrystallized, angular fragments, some pinhole vuggyness noted in larger fragments - possible porosity,slow drilling.
1420	1430	DOLOSTONE, as above
1430	1440	DOLOSTONE, as above
1440	1450	DOLOSTONE, as above

1450	1460	DOLOSTONE, as above
1460	1470	DOLOSTONE, as above
1470	1480	DOLOSTONE, as above
1480	1490	DOLOSTONE, medium dark gray (N4), very hard, crystalline, some dark yellowish brown dolostone, as above
1490	1500	DOLOSTONE, as above
1500	1510	DOLOSTONE, medium dark gray (N4), moderately hard, crystalline
1510	1520	DOLOSTONE, as above

APPENDIX G

Packer Test Data

APPENDIX H

Airlift Water Quality Laboratory Reports

APPENDIX I

Packer Test Water Quality Laboratory Reports

FLOWERS CHEMICAL LABORATORIES INC.
P.O. Box 150597, Altamonte Springs, FL 32715-0597 Phone: 407-339-5984 E83018 (Main Lab)
571 NW Mercantile Pl, Suite 111, Port St. Lucie, FL 34986 Phone: 772-343-8006 E86562 (South Lab)
812 SW Harvey Green Dr, Madison, FL 32340 Phone: 850-973-6878 E82405 (North Lab)
3980 Overseas Hwy, Suite 103, Marathon, FL 33050 Phone: 305-743-8598 E35834 (Keys Lab)

Florida Design Drilling Corp
7733 Hooper Rd.
West Palm Bay,FL 33411

PO #: n/a
Client Project #: St. Cloud ASR Well
Date Sampled: Apr 8, 2015
Apr 14, 2015; Invoice: 263351

Report Summary

Date Received: Apr 9, 2015 FCL Project Manager: Robert J. Carpenter

Laboratory #	Sample Description	Analysis	Chemist	Location	SampleMatrix
263351GW1	PT-1 1,064'	EPA120.1	CCP	Main Lab	Ground Water
		EPA300.0	YGS	Main Lab	
		SM2540 C	PLB	Main Lab	
		SM4500-Cl E	VLB	Main Lab	
		SM4500-H B	CCP	Main Lab	

Certificate of Results
Sample integrity was certified prior to analysis. Test results meet all requirements of the NELAC Standards except as noted in the Quality Control Report. Uncertainties for these data are available on request. This report may not be reproduced in part; results relate only to items tested.

Jefferson S. Flowers, Ph.D.
President/Technical Director

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Florida Design Drilling Corp
7733 Hooper Rd.
West Palm Bay,FL 33411

PO #: n/a
Client Project #: St. Cloud ASR Well
Date Sampled: Apr 8, 2015
Apr 14, 2015; Invoice: 263351

Analysis Report

Lab #: 263351GW1 **Sampled:** 04/08/15 11:15 PM **Desc:** PT-1 1,064'

Parameter	Result	Units	DF	MDL	PQL	QC Batch	Method	CAS #	Analyzed	
Specific_Conductance	591	umhos/cm	1.00	1.00	2.00	10278766	EPA120.1	10-34-4	04/09/15	
Lab pH (units)	8.12 Q	pH	1.00	0.0100	0.0200	10278772	SM4500-H B	39-38-4	04/09/15	08:35 AM
Sulfate	36.9	mg/L	1.00	1.00	2.00	10278929	EPA300.0	14808-79-8	04/10/15	
TDS	386	mg/L	1.00	2.50	5.00	10279025	SM2540 C	10-33-3	04/10/15	
Chloride	86.0	mg/L	2.00	8.00	16.0	10279040	SM4500-Cl E	16887-00-6	04/11/15	

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Florida Design Drilling Corp
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West Palm Bay,FL 33411

PO #: n/a
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Quality Report

Quality Control Batch: 10278766 **Analyst:** CCP

Blank	**Result**	**Units**
Specific_Conductance	1.00U	umhos/cm

Quality Control Batch: 10278929 **Analyst:** YGS

Blank	**Result**	**Units**
Sulfate	1.00U	mg/L

Laboratory Control Sample	**Result**	**Units**	**Spike**	**%REC**	**%REC Lim**
Sulfate	2.17	mg/L	2.00	108.30	90.00-110.00

Matrix Spike	**Result**	**Units**	**Spike**	**%REC**	**%REC Lim**	**Sample**
Sulfate	2.58	mg/L	2.00	128.79	80.00-120.00	1.00U

Matrix Spike Duplicate	**Result**	**Units**	**Spike**	**%REC**	**%REC Lim**	**Sample**	**RPD**	**RPD Lim**
Sulfate	2.57	mg/L	2.00	128.29	80.00-120.00	1.00U	0.39	24.79

Quality Control Batch: 10279025 **Analyst:** PLB

Blank	**Result**	**Units**
TDS	2.50U	mg/L

Laboratory Control Sample	**Result**	**Units**	**Spike**	**%REC**	**%REC Lim**
TDS	1490	mg/L	1500	99.20	91.15-105.70

Quality Control Batch: 10279040 **Analyst:** VLB

Blank	**Result**	**Units**

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3980 Overseas Hwy, Suite 103, Marathon, FL 33050 Phone: 305-743-8598 E35834 (Keys Lab)

Florida Design Drilling Corp
7733 Hooper Rd.
West Palm Bay,FL 33411

PO #: n/a
Client Project #: St. Cloud ASR Well
Date Sampled: Apr 8, 2015
Apr 14, 2015; Invoice: 263351

Quality Control Batch: 10279040 **Analyst:** VLB

Blank	**Result**	**Units**
Chloride	4.00U	mg/L

Laboratory Control Sample	**Result**	**Units**	**Spike**	**%REC**	**%REC Lim**
Chloride	81.0	mg/L	80.0	101.20	90.00-110.00

Matrix Spike	**Result**	**Units**	**Spike**	**%REC**	**%REC Lim**	**Sample**
Chloride	66.0	mg/L	50.0	90.96	80.00-120.00	20.5

Matrix Spike Duplicate	**Result**	**Units**	**Spike**	**%REC**	**%REC Lim**	**Sample**	**RPD**	**RPD Lim**
Chloride	65.8	mg/L	50.0	90.42	80.00-120.00	20.5	0.41	20.00

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Florida Design Drilling Corp
7733 Hooper Rd.
West Palm Bay,FL 33411

PO #: n/a
Client Project #: St. Cloud ASR Well
Date Sampled: Apr 8, 2015
Apr 14, 2015; Invoice: 263351

Narrative Report

Sample Handling
Sample handling and holding time criteria were met for all samples. Samples collected by submitter. No unusual events occurred during analysis. Results are reported on a wet weight basis for aqueous matrices and on a dry weight basis for sludge and soil matrices unless otherwise noted. Sample results reported as dissolved were field filtered.

Quality Control
Enclosed analyses met method or FCL criteria, unless otherwise denoted on the sample results. Applied data qualifiers are defined below.

Attachments
Chain of Custody

Qualifier	Meaning
U	Compound was analyzed for but not detected.
J	Estimated value; one or more QC components associated with this data value exceed current QC limits.
Q	Sample held beyond the accepted holding time.
L	Off-scale high; reported concentration exceeds the highest standard.
V	Analyte was detected in both the sample and the associated method blank.
W	The dissolved oxygen blank was above 0.2 mg/L but less than the MDL.
Z	Too numerous to count colonies on plate.
A	Absent
P	Present
T	Value reported is less than the statistical method detection limit. Reported for informational purposes only.
M	Value reported is greater than the statistical method detection limit, but less than the reported MDL.
G	The greatest of the dilutions performed did not yield sufficient oxygen depletion for valid data.
S	The least of the dilutions performed did not yield sufficient oxygen residual for valid data.
O	Result is greater than (over) the specified value.
I	Reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.
B	Results based upon colony plate count outside ideal range.
Y	The laboratory analysis was from an improperly preserved sample. The data may not be accurate.

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7733 Hooper Rd.
West Palm Bay,FL 33411

PO #: n/a
Client Project #: St. Cloud ASR Well
Date Sampled: Apr 9, 2015
Apr 21, 2015; Invoice: 263658

Report Summary

Date Received: Apr 13, 2015 FCL Project Manager: Robert J. Carpenter

Laboratory #	Sample Description	Analysis	Chemist	Location	SampleMatrix
263658GW1	PT-2 872'	EPA120.1	CCP	Main Lab	Ground Water
		EPA375.2	PCW	Main Lab	
		SM2540 C	PLB	Main Lab	
		SM4500-Cl E	VLB	Main Lab	
		SM4500-H B	CCP	Main Lab	

Certificate of Results
Sample integrity was certified prior to analysis. Test results meet all requirements of the NELAC Standards except as noted in the Quality Control Report. Uncertainties for these data are available on request. This report may not be reproduced in part; results relate only to items tested.

Jefferson S. Flowers, Ph.D.
President/Technical Director

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7733 Hooper Rd.
West Palm Bay,FL 33411

PO #: n/a
Client Project #: St. Cloud ASR Well
Date Sampled: Apr 9, 2015
Apr 21, 2015; Invoice: 263658

Analysis Report

Lab #: 263658GW1 **Sampled:** 04/09/15 05:30 PM **Desc:** PT-2 872'

Parameter	Result	Units	DF	MDL	PQL	QC Batch	Method	CAS #	Analyzed	
Specific_Conductance	616	umhos/cm	1.00	1.00	2.00	10279135	EPA120.1	10-34-4	04/14/15	
Lab pH (units)	8.20 Q	pH	1.00	0.0100	0.0200	10279157	SM4500-H B	39-38-4	04/14/15	09:10 AM
TDS	352	mg/L	1.00	2.50	5.00	10279273	SM2540 C	10-33-3	04/14/15	
Sulfate	29.2	mg/L	1.00	5.00	10.0	10279440	EPA375.2	14808-79-8	04/17/15	
Chloride	94.6	mg/L	1.00	4.00	8.00	10279680	SM4500-Cl E	16887-00-6	04/18/15	

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Florida Design Drilling Corp
7733 Hooper Rd.
West Palm Bay,FL 33411

PO #: n/a
Client Project #: St. Cloud ASR Well
Date Sampled: Apr 9, 2015
Apr 21, 2015; Invoice: 263658

Quality Report

Quality Control Batch: 10279135 **Analyst:** CCP

Blank	Result	Units
Specific_Conductance	1.00U	umhos/cm

Quality Control Batch: 10279273 **Analyst:** PLB

Blank	Result	Units
TDS	2.50U	mg/L

Laboratory Control Sample	Result	Units	Spike	%REC	%REC Lim
TDS	1530	mg/L	1500	101.87	91.15-105.70

Quality Control Batch: 10279440 **Analyst:** PCW

Blank	Result	Units
Sulfate	5.00U	mg/L

Laboratory Control Sample	Result	Units	Spike	%REC	%REC Lim
Sulfate	60.3	mg/L	60.0	100.50	90.00-110.00

Matrix Spike	Result	Units	Spike	%REC	%REC Lim	Sample
Sulfate	131	mg/L	100	105.00	80.00-120.00	26.0

Matrix Spike Duplicate	Result	Units	Spike	%REC	%REC Lim	Sample	RPD	RPD Lim
Sulfate	132	mg/L	100	106.00	80.00-120.00	26.0	0.76	7.80

Quality Control Batch: 10279680 **Analyst:** VLB

Blank	Result	Units

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PO #: n/a
Client Project #: St. Cloud ASR Well
Date Sampled: Apr 9, 2015
Apr 21, 2015; Invoice: 263658

Quality Control Batch: 10279680 **Analyst:** VLB

Blank	**Result**	**Units**
Chloride	4.00U	mg/L

Laboratory Control Sample	**Result**	**Units**	**Spike**	**%REC**	**%REC Lim**
Chloride	51.2	mg/L	50.0	102.32	90.00-110.00

Matrix Spike	**Result**	**Units**	**Spike**	**%REC**	**%REC Lim**	**Sample**
Chloride	83.9	mg/L	50.0	100.66	80.00-120.00	33.5

Matrix Spike Duplicate	**Result**	**Units**	**Spike**	**%REC**	**%REC Lim**	**Sample**	**RPD**	**RPD Lim**
Chloride	82.6	mg/L	50.0	98.08	80.00-120.00	33.5	1.55	20.00

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Florida Design Drilling Corp
7733 Hooper Rd.
West Palm Bay,FL 33411

PO #: n/a
Client Project #: St. Cloud ASR Well
Date Sampled: Apr 9, 2015
Apr 21, 2015; Invoice: 263658

Narrative Report

Sample Handling
Sample handling and holding time criteria were met for all samples. Samples collected by submitter. No unusual events occurred during analysis. Results are reported on a wet weight basis for aqueous matrices and on a dry weight basis for sludge and soil matrices unless otherwise noted. Sample results reported as dissolved were field filtered.

Quality Control
Enclosed analyses met method or FCL criteria, unless otherwise denoted on the sample results. Applied data qualifiers are defined below.

Attachments
Chain of Custody

Qualifier	Meaning
U	Compound was analyzed for but not detected.
J	Estimated value; one or more QC components associated with this data value exceed current QC limits.
Q	Sample held beyond the accepted holding time.
L	Off-scale high; reported concentration exceeds the highest standard.
V	Analyte was detected in both the sample and the associated method blank.
W	The dissolved oxygen blank was above 0.2 mg/L but less than the MDL.
Z	Too numerous to count colonies on plate.
A	Absent
P	Present
T	Value reported is less than the statistical method detection limit. Reported for informational purposes only.
M	Value reported is greater than the statistical method detection limit, but less than the reported MDL.
G	The greatest of the dilutions performed did not yield sufficient oxygen depletion for valid data.
S	The least of the dilutions performed did not yield sufficient oxygen residual for valid data.
O	Result is greater than (over) the specified value.
I	Reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.
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West Palm Bay,FL 33411

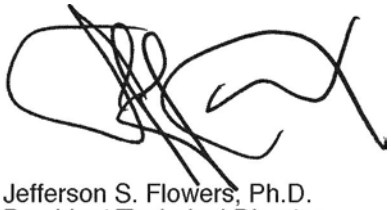
PO #: n/a
Client Project #: ST. Cloud ASR Well
Date Sampled: Apr 10, 2015
Apr 21, 2015; Invoice: 263659

Report Summary

Date Received: Apr 13, 2015 FCL Project Manager: Robert J. Carpenter

Laboratory #	Sample Description	Analysis	Chemist	Location	SampleMatrix
263659GW1	PT-3 706'	EPA120.1	CCP	Main Lab	Ground Water
		EPA375.2	PCW	Main Lab	
		SM2540 C	PLB	Main Lab	
		SM4500-Cl E	VLB	Main Lab	
		SM4500-H B	CCP	Main Lab	

Certificate of Results
Sample integrity was certified prior to analysis. Test results meet all requirements of the NELAC Standards except as noted in the Quality Control Report. Uncertainties for these data are available on request. This report may not be reproduced in part; results relate only to items tested.



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Florida Design Drilling Corp
7733 Hooper Rd.
West Palm Bay,FL 33411

PO #: n/a
Client Project #: ST. Cloud ASR Well
Date Sampled: Apr 10, 2015
Apr 21, 2015; Invoice: 263659

Analysis Report

Lab #: 263659GW1 **Sampled:** 04/10/15 10:15 AM **Desc:** PT-3 706'

Parameter	Result	Units	DF	MDL	PQL	QC Batch	Method	CAS #	Analyzed	
Specific_Conductance	616	umhos/cm	1.00	1.00	2.00	10279135	EPA120.1	10-34-4	04/14/15	
Lab pH (units)	8.11 Q	pH	1.00	0.0100	0.0200	10279157	SM4500-H B	39-38-4	04/14/15	09:10 AM
TDS	380	mg/L	1.00	2.50	5.00	10279273	SM2540 C	10-33-3	04/14/15	
Sulfate	31.0	mg/L	1.00	5.00	10.0	10279440	EPA375.2	14808-79-8	04/17/15	
Chloride	92.1	mg/L	1.00	4.00	8.00	10279680	SM4500-Cl E	16887-00-6	04/18/15	

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West Palm Bay,FL 33411

PO #: n/a
Client Project #: ST. Cloud ASR Well
Date Sampled: Apr 10, 2015
Apr 21, 2015; Invoice: 263659

Quality Report

Quality Control Batch: 10279135 **Analyst:** CCP

Blank	Result	Units
Specific_Conductance	1.00U	umhos/cm

Quality Control Batch: 10279273 **Analyst:** PLB

Blank	Result	Units
TDS	2.50U	mg/L

Laboratory Control Sample	Result	Units	Spike	%REC	%REC Lim
TDS	1530	mg/L	1500	101.87	91.15-105.70

Quality Control Batch: 10279440 **Analyst:** PCW

Blank	Result	Units
Sulfate	5.00U	mg/L

Laboratory Control Sample	Result	Units	Spike	%REC	%REC Lim
Sulfate	60.3	mg/L	60.0	100.50	90.00-110.00

Matrix Spike	Result	Units	Spike	%REC	%REC Lim	Sample
Sulfate	131	mg/L	100	105.00	80.00-120.00	26.0

Matrix Spike Duplicate	Result	Units	Spike	%REC	%REC Lim	Sample	RPD	RPD Lim
Sulfate	132	mg/L	100	106.00	80.00-120.00	26.0	0.76	7.80

Quality Control Batch: 10279680 **Analyst:** VLB

Blank	Result	Units

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7733 Hooper Rd.
West Palm Bay,FL 33411

PO #: n/a
Client Project #: ST. Cloud ASR Well
Date Sampled: Apr 10, 2015
Apr 21, 2015; Invoice: 263659

Quality Control Batch: 10279680 **Analyst:** VLB

Blank	**Result**	**Units**
Chloride	4.00U	mg/L

Laboratory Control Sample	**Result**	**Units**	**Spike**	**%REC**	**%REC Lim**
Chloride	51.2	mg/L	50.0	102.32	90.00-110.00

Matrix Spike	**Result**	**Units**	**Spike**	**%REC**	**%REC Lim**	**Sample**
Chloride	83.9	mg/L	50.0	100.66	80.00-120.00	33.5

Matrix Spike Duplicate	**Result**	**Units**	**Spike**	**%REC**	**%REC Lim**	**Sample**	**RPD**	**RPD Lim**
Chloride	82.6	mg/L	50.0	98.08	80.00-120.00	33.5	1.55	20.00

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West Palm Bay,FL 33411

PO #: n/a
Client Project #: ST. Cloud ASR Well
Date Sampled: Apr 10, 2015
Apr 21, 2015; Invoice: 263659

Narrative Report

Sample Handling
Sample handling and holding time criteria were met for all samples. Samples collected by submitter. No unusual events occurred during analysis. Results are reported on a wet weight basis for aqueous matrices and on a dry weight basis for sludge and soil matrices unless otherwise noted. Sample results reported as dissolved were field filtered.

Quality Control
Enclosed analyses met method or FCL criteria, unless otherwise denoted on the sample results. Applied data qualifiers are defined below.

Attachments
Chain of Custody

Qualifier	Meaning
U	Compound was analyzed for but not detected.
J	Estimated value; one or more QC components associated with this data value exceed current QC limits.
Q	Sample held beyond the accepted holding time.
L	Off-scale high; reported concentration exceeds the highest standard.
V	Analyte was detected in both the sample and the associated method blank.
W	The dissolved oxygen blank was above 0.2 mg/L but less than the MDL.
Z	Too numerous to count colonies on plate.
A	Absent
P	Present
T	Value reported is less than the statistical method detection limit. Reported for informational purposes only.
M	Value reported is greater than the statistical method detection limit, but less than the reported MDL.
G	The greatest of the dilutions performed did not yield sufficient oxygen depletion for valid data.
S	The least of the dilutions performed did not yield sufficient oxygen residual for valid data.
O	Result is greater than (over) the specified value.
I	Reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.
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PO #: n/a
Client Project #: St. Cloud ASR Well
Date Sampled: Oct 22, 2015
Oct 30, 2015; Invoice: 280564

Report Summary

Date Received: Oct 23, 2015 FCL Project Manager: Robert J. Carpenter

Laboratory #	Sample Description	Analysis	Chemist	Location	SampleMatrix
280564GW1	PT-4	EPA120.1	CCP	Main Lab	Ground Water
		EPA300.0	YGS	Main Lab	
		SM2540 C	PLB	Main Lab	
		SM4500-Cl E	VLB	Main Lab	
		SM4500-H B	CCP	Main Lab	
280564GW2	PT-4a	EPA120.1	CCP	Main Lab	Ground Water
		EPA300.0	YGS	Main Lab	
		SM2540 C	PLB	Main Lab	
		SM4500-Cl E	VLB	Main Lab	
		SM4500-H B	CCP	Main Lab	

Certificate of Results
Sample integrity was certified prior to analysis. Test results meet all requirements of the NELAC Standards except as noted in the Quality Control Report. Uncertainties for these data are available on request. This report may not be reproduced in part; results relate only to items tested.

Jefferson S. Flowers, Ph.D.
President/Technical Director

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Florida Design Drilling Corp
7733 Hooper Rd.
West Palm Bay,FL 33411

PO #: n/a
Client Project #: St. Cloud ASR Well
Date Sampled: Oct 22, 2015
Oct 30, 2015; Invoice: 280564

Analysis Report

Lab #: 280564GW1 **Sampled:** 10/22/15 04:00 PM **Desc:** PT-4

Parameter	Result	Units	DF	MDL	PQL	QC Batch	Method	CAS #	Analyzed	
Specific_Conductance	4260	umhos/cm	1.00	1.00	2.00	10294579	EPA120.1	10-34-4	10/23/15	
Lab pH (units)	7.91 Q	pH	1.00	0.0100	0.0200	10294580	SM4500-H B	39-38-4	10/23/15	09:36 AM
Chloride	1160	mg/L	20.0	80.0	160	10294615	SM4500-Cl E	16887-00-6	10/24/15	
Sulfate	333	mg/L	1.00	1.00	2.00	10294851	EPA300.0	14808-79-8	10/27/15	
TDS	2660	mg/L	1.00	2.50	5.00	10295047	SM2540 C	10-33-3	10/28/15	

Lab #: 280564GW2 **Sampled:** 10/22/15 11:30 PM **Desc:** PT-4a

Parameter	Result	Units	DF	MDL	PQL	QC Batch	Method	CAS #	Analyzed	
Specific_Conductance	2500	umhos/cm	1.00	1.00	2.00	10294579	EPA120.1	10-34-4	10/23/15	
Lab pH (units)	7.77 Q	pH	1.00	0.0100	0.0200	10294580	SM4500-H B	39-38-4	10/23/15	09:36 AM
Chloride	653	mg/L	10.0	40.0	80.0	10294615	SM4500-Cl E	16887-00-6	10/24/15	
Sulfate	171	mg/L	1.00	1.00	2.00	10294851	EPA300.0	14808-79-8	10/27/15	
TDS	1570	mg/L	1.00	2.50	5.00	10295047	SM2540 C	10-33-3	10/28/15	

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Florida Design Drilling Corp
7733 Hooper Rd.
West Palm Bay,FL 33411

PO #: n/a
Client Project #: St. Cloud ASR Well
Date Sampled: Oct 22, 2015
Oct 30, 2015; Invoice: 280564

Quality Report

Quality Control Batch: 10294579 **Analyst:** CCP

Blank	**Result**	**Units**
Specific_Conductance	1.00U	umhos/cm

Quality Control Batch: 10294615 **Analyst:** VLB

Blank	**Result**	**Units**
Chloride	4.00U	mg/L

Laboratory Control Sample	**Result**	**Units**	**Spike**	**%REC**	**%REC Lim**
Chloride	50.8	mg/L	50.0	101.56	85.00-115.00

Matrix Spike	**Result**	**Units**	**Spike**	**%REC**	**%REC Lim**	**Sample**
Chloride	107	mg/L	50.0	93.96	85.00-115.00	59.9

Matrix Spike Duplicate	**Result**	**Units**	**Spike**	**%REC**	**%REC Lim**	**Sample**	**RPD**	**RPD Lim**
Chloride	106	mg/L	50.0	92.40	85.00-115.00	59.9	0.73	20.00

Quality Control Batch: 10294851 **Analyst:** YGS

Blank	**Result**	**Units**
Sulfate	1.00U	mg/L

Laboratory Control Sample	**Result**	**Units**	**Spike**	**%REC**	**%REC Lim**
Sulfate	2.09	mg/L	2.00	104.47	90.00-110.00

Matrix Spike	**Result**	**Units**	**Spike**	**%REC**	**%REC Lim**	**Sample**
Sulfate	2.04	mg/L	2.00	101.90	90.00-110.00	1.00U

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PO #: n/a
Client Project #: St. Cloud ASR Well
Date Sampled: Oct 22, 2015
Oct 30, 2015; Invoice: 280564

Matrix Spike Duplicate	Result	Units	Spike	%REC	%REC Lim	Sample	RPD	RPD Lim
Sulfate	2.03	mg/L	2.00	101.72	90.00-110.00	1.00U	0.18	20.00

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PO #: n/a
Client Project #: St. Cloud ASR Well
Date Sampled: Oct 22, 2015
Oct 30, 2015; Invoice: 280564

Narrative Report

Sample Handling
Sample handling and holding time criteria were met for all samples. Samples collected by submitter. No unusual events occurred during analysis. Results are reported on a wet weight basis for aqueous matrices and on a dry weight basis for sludge and soil matrices unless otherwise noted. Sample results reported as dissolved were field filtered.

Quality Control
Enclosed analyses met method or FCL criteria, unless otherwise denoted on the sample results. Applied data qualifiers are defined below.

Attachments
Chain of Custody

Qualifier	Meaning
U	Compound was analyzed for but not detected.
J	Estimated value; one or more QC components associated with this data value exceed current QC limits.
Q	Sample held beyond the accepted holding time.
L	Off-scale high; reported concentration exceeds the highest standard.
V	Analyte was detected in both the sample and the associated method blank.
W	The dissolved oxygen blank was above 0.2 mg/L but less than the MDL.
Z	Too numerous to count colonies on plate.
A	Absent
P	Present
T	Value reported is less than the statistical method detection limit. Reported for informational purposes only.
M	Value reported is greater than the statistical method detection limit, but less than the reported MDL.
G	The greatest of the dilutions performed did not yield sufficient oxygen depletion for valid data.
S	The least of the dilutions performed did not yield sufficient oxygen residual for valid data.
O	Result is greater than (over) the specified value.
I	Reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.
B	Results based upon colony plate count outside ideal range.
Y	The laboratory analysis was from an improperly preserved sample. The data may not be accurate.

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Florida Design Drilling Corp
7733 Hooper Rd.
West Palm Bay,FL 33411

PO #: n/a
Client Project #: St. Cloud ASR Well
Date Sampled: Oct 26, 2015
Nov 1, 2015; Invoice: 280656

Report Summary

Date Received: Oct 26, 2015 FCL Project Manager: Robert J. Carpenter

Laboratory #	Sample Description	Analysis	Chemist	Location	SampleMatrix
280656GW1	ASR-1 PT5	EPA120.1	CCP	Main Lab	Ground Water
		EPA375.2	PCW	Main Lab	
		SM2540 C	PLB	Main Lab	
		SM4500-Cl E	VLB	Main Lab	
		SM4500-H B	CCP	Main Lab	

Certificate of Results
Sample integrity was certified prior to analysis. Test results meet all requirements of the NELAC Standards except as noted in the Quality Control Report. Uncertainties for these data are available on request. This report may not be reproduced in part; results relate only to items tested.

Jefferson S. Flowers, Ph.D.
President/Technical Director

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Florida Design Drilling Corp
7733 Hooper Rd.
West Palm Bay,FL 33411

PO #: n/a
Client Project #: St. Cloud ASR Well
Date Sampled: Oct 26, 2015
Nov 1, 2015; Invoice: 280656

Analysis Report

Lab #: 280656GW1 **Sampled:** 10/26/15 12:00 AM **Desc:** ASR-1 PT5

Parameter	Result	Units	DF	MDL	PQL	QC Batch	Method	CAS #	Analyzed	
Sulfate	449	mg/L	10.0	50.0	100	10294756	EPA375.2	14808-79-8	10/26/15	
Specific_Conductance	4380	umhos/cm	1.00	1.00	2.00	10294803	EPA120.1	10-34-4	10/27/15	
Lab pH (units)	8.26 Q	pH	1.00	0.0100	0.0200	10294804	SM4500-H B	39-38-4	10/27/15	11:09 AM
TDS	2860	mg/L	1.00	2.50	5.00	10295048	SM2540 C	10-33-3	10/28/15	
Chloride	1070	mg/L	20.0	80.0	160	10295172	SM4500-Cl E	16887-00-6	10/31/15	

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PO #: n/a
Client Project #: St. Cloud ASR Well
Date Sampled: Oct 26, 2015
Nov 1, 2015; Invoice: 280656

Quality Report

Quality Control Batch: 10294803 **Analyst:** CCP

Blank	Result	Units
Specific_Conductance	1.00U	umhos/cm

Quality Control Batch: 10295048 **Analyst:** PLB

Blank	Result	Units
TDS	2.50U	mg/L

Laboratory Control Sample	Result	Units	Spike	%REC	%REC Lim
TDS	1480	mg/L	1500	98.53	50.00-150.00

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West Palm Bay,FL 33411

PO #: n/a
Client Project #: St. Cloud ASR Well
Date Sampled: Oct 26, 2015
Nov 1, 2015; Invoice: 280656

Narrative Report

Sample Handling
Sample handling and holding time criteria were met for all samples. Samples collected by submitter. No unusual events occurred during analysis. Results are reported on a wet weight basis for aqueous matrices and on a dry weight basis for sludge and soil matrices unless otherwise noted. Sample results reported as dissolved were field filtered.

Quality Control
Enclosed analyses met method or FCL criteria, unless otherwise denoted on the sample results. Applied data qualifiers are defined below.

Attachments
Chain of Custody

Qualifier	Meaning
U	Compound was analyzed for but not detected.
J	Estimated value; one or more QC components associated with this data value exceed current QC limits.
Q	Sample held beyond the accepted holding time.
L	Off-scale high; reported concentration exceeds the highest standard.
V	Analyte was detected in both the sample and the associated method blank.
W	The dissolved oxygen blank was above 0.2 mg/L but less than the MDL.
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PO #: n/a
Client Project #: St. Cloud ASR Well
Date Sampled: Oct 26, 2015
Nov 6, 2015; Invoice: 280852

Report Summary

Date Received: Oct 27, 2015 FCL Project Manager: Robert J. Carpenter

Laboratory #	Sample Description	Analysis	Chemist	Location	SampleMatrix
280852GW1	ASR-1 PT-a	EPA120.1	CCP	Main Lab	Ground Water
		EPA375.2	PCW	Main Lab	
		SM2540 C	PLB	Main Lab	
		SM4500-Cl E	VLB	Main Lab	
		SM4500-H B	CCP	Main Lab	

Certificate of Results
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7733 Hooper Rd.
West Palm Bay,FL 33411

PO #: n/a
Client Project #: St. Cloud ASR Well
Date Sampled: Oct 26, 2015
Nov 6, 2015; Invoice: 280852

Analysis Report

Lab #: 280852GW1 **Sampled:** 10/26/15 09:15 PM **Desc:** ASR-1 PT-a

Parameter	Result	Units	DF	MDL	PQL	QC Batch	Method	CAS #	Analyzed	
Specific_Conductance	2470	umhos/cm	1.00	1.00	2.00	10294950	EPA120.1	10-34-4	10/28/15	
Lab pH (units)	8.15 Q	pH	1.00	0.0100	0.0200	10294951	SM4500-H B	39-38-4	10/28/15	10:03 AM
TDS	1410	mg/L	1.00	2.50	5.00	10295056	SM2540 C	10-33-3	10/28/15	
Chloride	606	mg/L	10.0	40.0	80.0	10295174	SM4500-Cl E	16887-00-6	10/31/15	
Sulfate	206	mg/L	5.00	25.0	50.0	10295716	EPA375.2	14808-79-8	11/06/15	

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Florida Design Drilling Corp
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PO #: n/a
Client Project #: St. Cloud ASR Well
Date Sampled: Oct 26, 2015
Nov 6, 2015; Invoice: 280852

Quality Report

Quality Control Batch: 10294950 **Analyst:** CCP

Blank	Result	Units
Specific_Conductance	1.00U	umhos/cm

Quality Control Batch: 10295056 **Analyst:** PLB

Blank	Result	Units
TDS	2.50U	mg/L

Laboratory Control Sample	Result	Units	Spike	%REC	%REC Lim
TDS	1470	mg/L	1500	98.13	50.00-150.00

Quality Control Batch: 10295716 **Analyst:** PCW

Blank	Result	Units
Sulfate	5.00U	mg/L

Laboratory Control Sample	Result	Units	Spike	%REC	%REC Lim
Sulfate	59.6	mg/L	60.0	99.33	85.00-115.00

Matrix Spike	Result	Units	Spike	%REC	%REC Lim	Sample
Sulfate	125	mg/L	50.0	109.60	85.00-115.00	70.2

Matrix Spike Duplicate	Result	Units	Spike	%REC	%REC Lim	Sample	RPD	RPD Lim
Sulfate	123	mg/L	50.0	105.60	85.00-115.00	70.2	1.61	20.00

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PO #: n/a
Client Project #: St. Cloud ASR Well
Date Sampled: Oct 26, 2015
Nov 6, 2015; Invoice: 280852

Narrative Report

Sample Handling
Sample handling and holding time criteria were met for all samples. Samples collected by submitter. No unusual events occurred during analysis. Results are reported on a wet weight basis for aqueous matrices and on a dry weight basis for sludge and soil matrices unless otherwise noted. Sample results reported as dissolved were field filtered.

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7733 Hooper Rd.
West Palm Bay,FL 33411

PO #: n/a
Client Project #: St. Cloud ASR Well
Date Sampled: Oct 27, 2015
Nov 6, 2015; Invoice: 280965

Report Summary

Date Received: Oct 28, 2015 FCL Project Manager: Robert J. Carpenter

Laboratory #	Sample Description	Analysis	Chemist	Location	SampleMatrix
280965GW1	ASR-1 PT-6	EPA120.1	CCP	Main Lab	Ground Water
		EPA375.2	PCW	Main Lab	
		SM2540 C	PLB	Main Lab	
		SM4500-Cl E	VLB	Main Lab	
		SM4500-H B	CCP	Main Lab	

Certificate of Results
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7733 Hooper Rd.
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PO #: n/a
Client Project #: St. Cloud ASR Well
Date Sampled: Oct 27, 2015
Nov 6, 2015; Invoice: 280965

Analysis Report

Lab #: 280965GW1 **Sampled:** 10/27/15 07:30 PM **Desc:** ASR-1 PT-6

Parameter	Result	Units	DF	MDL	PQL	QC Batch	Method	CAS #	Analyzed	
Specific_Conductance	4120	umhos/cm	1.00	1.00	2.00	10295150	EPA120.1	10-34-4	10/29/15	
Lab pH (units)	7.96 Q	pH	1.00	0.0100	0.0200	10295151	SM4500-H B	39-38-4	10/29/15	10:05 AM
Chloride	1110	mg/L	20.0	80.0	160	10295175	SM4500-Cl E	16887-00-6	10/31/15	
TDS	2410	mg/L	1.00	2.50	5.00	10295192	SM2540 C	10-33-3	10/29/15	
Sulfate	245	mg/L	5.00	25.0	50.0	10295716	EPA375.2	14808-79-8	11/06/15	

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PO #: n/a
Client Project #: St. Cloud ASR Well
Date Sampled: Oct 27, 2015
Nov 6, 2015; Invoice: 280965

Quality Report

Quality Control Batch: 10295150 **Analyst:** CCP

Blank	**Result**	**Units**
Specific_Conductance	1.00U	umhos/cm

Quality Control Batch: 10295175 **Analyst:** VLB

Blank	**Result**	**Units**
Chloride	4.00U	mg/L

Laboratory Control Sample	**Result**	**Units**	**Spike**	**%REC**	**%REC Lim**
Chloride	50.8	mg/L	50.0	101.66	85.00-115.00

Matrix Spike	**Result**	**Units**	**Spike**	**%REC**	**%REC Lim**	**Sample**
Chloride	59.4	mg/L	50.0	96.98	85.00-115.00	10.9

Matrix Spike Duplicate	**Result**	**Units**	**Spike**	**%REC**	**%REC Lim**	**Sample**	**RPD**	**RPD Lim**
Chloride	59.8	mg/L	50.0	97.74	85.00-115.00	10.9	0.64	20.00

Quality Control Batch: 10295192 **Analyst:** PLB

Blank	**Result**	**Units**
TDS	2.50U	mg/L

Laboratory Control Sample	**Result**	**Units**	**Spike**	**%REC**	**%REC Lim**
TDS	1470	mg/L	1500	97.87	50.00-150.00

Quality Control Batch: 10295716 **Analyst:** PCW

Blank	**Result**	**Units**

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PO #: n/a
Client Project #: St. Cloud ASR Well
Date Sampled: Oct 27, 2015
Nov 6, 2015; Invoice: 280965

Quality Control Batch: 10295716 **Analyst:** PCW

Blank	**Result**	**Units**
Sulfate	5.00U	mg/L

Laboratory Control Sample	**Result**	**Units**	**Spike**	**%REC**	**%REC Lim**
Sulfate	59.6	mg/L	60.0	99.33	85.00-115.00

Matrix Spike	**Result**	**Units**	**Spike**	**%REC**	**%REC Lim**	**Sample**
Sulfate	125	mg/L	50.0	109.60	85.00-115.00	70.2

Matrix Spike Duplicate	**Result**	**Units**	**Spike**	**%REC**	**%REC Lim**	**Sample**	**RPD**	**RPD Lim**
Sulfate	123	mg/L	50.0	105.60	85.00-115.00	70.2	1.61	20.00

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PO #: n/a
Client Project #: St. Cloud ASR Well
Date Sampled: Oct 27, 2015
Nov 6, 2015; Invoice: 280965

Narrative Report

Sample Handling
Sample handling and holding time criteria were met for all samples. Samples collected by submitter. No unusual events occurred during analysis. Results are reported on a wet weight basis for aqueous matrices and on a dry weight basis for sludge and soil matrices unless otherwise noted. Sample results reported as dissolved were field filtered.

Quality Control
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Attachments
Chain of Custody

Qualifier	Meaning
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J	Estimated value; one or more QC components associated with this data value exceed current QC limits.
Q	Sample held beyond the accepted holding time.
L	Off-scale high; reported concentration exceeds the highest standard.
V	Analyte was detected in both the sample and the associated method blank.
W	The dissolved oxygen blank was above 0.2 mg/L but less than the MDL.
Z	Too numerous to count colonies on plate.
A	Absent
P	Present
T	Value reported is less than the statistical method detection limit. Reported for informational purposes only.
M	Value reported is greater than the statistical method detection limit, but less than the reported MDL.
G	The greatest of the dilutions performed did not yield sufficient oxygen depletion for valid data.
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O	Result is greater than (over) the specified value.
I	Reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.
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Florida Design Drilling Corp
7733 Hooper Rd.
West Palm Bay,FL 33411

PO #: n/a
Client Project #: St. Cloud ASR Well
Date Sampled: Oct 28, 2015
Nov 6, 2015; Invoice: 281120

Report Summary

Date Received: Oct 29, 2015 FCL Project Manager: Robert J. Carpenter

Laboratory #	Sample Description	Analysis	Chemist	Location	SampleMatrix
281120GW1	PT6A	EPA120.1	CCP	Main Lab	Ground Water
		EPA375.2	PCW	Main Lab	
		SM2540 C	PLB	Main Lab	
		SM4500-Cl E	VLB	Main Lab	
		SM4500-H B	CCP	Main Lab	

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Jefferson S. Flowers, Ph.D.
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7733 Hooper Rd.
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PO #: n/a
Client Project #: St. Cloud ASR Well
Date Sampled: Oct 28, 2015
Nov 6, 2015; Invoice: 281120

Analysis Report

Lab #: 281120GW1 **Sampled:** 10/28/15 01:05 PM **Desc:** PT6A

Parameter	Result	Units	DF	MDL	PQL	QC Batch	Method	CAS #	Analyzed	
Chloride	586	mg/L	8.00	32.0	64.0	10295173	SM4500-Cl E	16887-00-6	10/31/15	
TDS	1440	mg/L	1.00	2.50	5.00	10295303	SM2540 C	10-33-3	10/30/15	
Lab pH (units)	7.93 Q	pH	1.00	0.0100	0.0200	10295329	SM4500-H B	39-38-4	10/30/15	10:51 AM
Specific_Conductance	2480	umhos/cm	1.00	1.00	2.00	10295394	EPA120.1	10-34-4	10/30/15	
Sulfate	208	mg/L	5.00	25.0	50.0	10295716	EPA375.2	14808-79-8	11/06/15	

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PO #: n/a
Client Project #: St. Cloud ASR Well
Date Sampled: Oct 28, 2015
Nov 6, 2015; Invoice: 281120

Quality Report

Quality Control Batch: 10295394 **Analyst:** CCP

Blank	**Result**	**Units**
Specific_Conductance	1.00U	umhos/cm

Quality Control Batch: 10295716 **Analyst:** PCW

Blank	**Result**	**Units**
Sulfate	5.00U	mg/L

Laboratory Control Sample	**Result**	**Units**	**Spike**	**%REC**	**%REC Lim**
Sulfate	59.6	mg/L	60.0	99.33	85.00-115.00

Matrix Spike	**Result**	**Units**	**Spike**	**%REC**	**%REC Lim**	**Sample**
Sulfate	125	mg/L	50.0	109.60	85.00-115.00	70.2

Matrix Spike Duplicate	**Result**	**Units**	**Spike**	**%REC**	**%REC Lim**	**Sample**	**RPD**	**RPD Lim**
Sulfate	123	mg/L	50.0	105.60	85.00-115.00	70.2	1.61	20.00

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PO #: n/a
Client Project #: St. Cloud ASR Well
Date Sampled: Oct 28, 2015
Nov 6, 2015; Invoice: 281120

Narrative Report

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Florida Design Drilling Corp
7733 Hooper Rd.
West Palm Bay,FL 33411

PO #: n/a
Client Project #: St. Cloud ASR Well
Date Sampled: Oct 29, 2015
Nov 6, 2015; Invoice: 281206

Report Summary

Date Received: Oct 30, 2015 FCL Project Manager: Robert J. Carpenter

Laboratory #	Sample Description	Analysis	Chemist	Location	SampleMatrix
281206GW1	ASR-1 PT 7	EPA120.1	CCP	Main Lab	Ground Water
		EPA375.2	PCW	Main Lab	
		SM2540 C	PLB	Main Lab	
		SM4500-Cl E	VLB	Main Lab	
		SM4500-H B	CCP	Main Lab	

Certificate of Results
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Florida Design Drilling Corp
7733 Hooper Rd.
West Palm Bay,FL 33411

PO #: n/a
Client Project #: St. Cloud ASR Well
Date Sampled: Oct 29, 2015
Nov 6, 2015; Invoice: 281206

Analysis Report

Lab #: 281206GW1 **Sampled:** 10/29/15 03:00 PM **Desc:** ASR-1 PT 7

Parameter	Result	Units	DF	MDL	PQL	QC Batch	Method	CAS #	Analyzed	
Chloride	716	mg/L	10.0	40.0	80.0	10295310	SM4500-Cl E	16887-00-6	10/31/15	
Lab pH (units)	7.92 Q	pH	1.00	0.0100	0.0200	10295329	SM4500-H B	39-38-4	10/30/15	10:51 AM
TDS	1620	mg/L	1.00	2.50	5.00	10295349	SM2540 C	10-33-3	10/31/15	
Specific_Conductance	2970	umhos/cm	1.00	1.00	2.00	10295394	EPA120.1	10-34-4	10/30/15	
Sulfate	208	mg/L	5.00	25.0	50.0	10295738	EPA375.2	14808-79-8	11/06/15	

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West Palm Bay,FL 33411

PO #: n/a
Client Project #: St. Cloud ASR Well
Date Sampled: Oct 29, 2015
Nov 6, 2015; Invoice: 281206

Quality Report

Quality Control Batch: 10295310 **Analyst:** VLB

Blank	**Result**	**Units**
Chloride	4.00U	mg/L

Laboratory Control Sample	**Result**	**Units**	**Spike**	**%REC**	**%REC Lim**
Chloride	76.3	mg/L	80.0	95.31	85.00-115.00

Matrix Spike	**Result**	**Units**	**Spike**	**%REC**	**%REC Lim**	**Sample**
Chloride	54.8	mg/L	50.0	97.30	85.00-115.00	6.13

Matrix Spike Duplicate	**Result**	**Units**	**Spike**	**%REC**	**%REC Lim**	**Sample**	**RPD**	**RPD Lim**
Chloride	53.3	mg/L	50.0	94.40	85.00-115.00	6.13	2.68	20.00

Quality Control Batch: 10295349 **Analyst:** PLB

Blank	**Result**	**Units**
TDS	2.50U	mg/L

Laboratory Control Sample	**Result**	**Units**	**Spike**	**%REC**	**%REC Lim**
TDS	1470	mg/L	1500	97.73	50.00-150.00

Quality Control Batch: 10295394 **Analyst:** CCP

Blank	**Result**	**Units**
Specific_Conductance	1.00U	umhos/cm

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West Palm Bay,FL 33411

PO #: n/a
Client Project #: St. Cloud ASR Well
Date Sampled: Oct 29, 2015
Nov 6, 2015; Invoice: 281206

Narrative Report

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Florida Design Drilling Corp
7733 Hooper Rd.
West Palm Bay,FL 33411

PO #: n/a
Client Project #: St. Cloud ASR Well
Date Sampled: Oct 30, 2015
Nov 7, 2015; Invoice: 281237

Report Summary

Date Received: Oct 30, 2015 FCL Project Manager: Robert J. Carpenter

Laboratory #	Sample Description	Analysis	Chemist	Location	SampleMatrix
281237GW1	ASR-1 PT-7A	EPA120.1	CCP	Main Lab	Ground Water
		EPA300.0	YGS	Main Lab	
		SM2540 C	PLB	Main Lab	
		SM4500-Cl E	VLB	Main Lab	
		SM4500-H B	CCP	Main Lab	

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Florida Design Drilling Corp
7733 Hooper Rd.
West Palm Bay,FL 33411

PO #: n/a
Client Project #: St. Cloud ASR Well
Date Sampled: Oct 30, 2015
Nov 7, 2015; Invoice: 281237

Analysis Report

Lab #: 281237GW1 **Sampled:** 10/30/15 12:00 PM **Desc:** ASR-1 PT-7A

Parameter	Result	Units	DF	MDL	PQL	QC Batch	Method	CAS #	Analyzed	
Specific_Conductance	2410	umhos/cm	1.00	1.00	2.00	10295328	EPA120.1	10-34-4	11/02/15	
Lab pH (units)	8.28 Q	pH	1.00	0.0100	0.0200	10295330	SM4500-H B	39-38-4	11/02/15	10:17 AM
Sulfate	167	mg/L	1.00	1.00	2.00	10295492	EPA300.0	14808-79-8	11/03/15	
TDS	1370	mg/L	1.00	2.50	5.00	10295672	SM2540 C	10-33-3	11/04/15	
Chloride	638	mg/L	10.0	40.0	80.0	10295791	SM4500-Cl E	16887-00-6	11/07/15	

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PO #: n/a
Client Project #: St. Cloud ASR Well
Date Sampled: Oct 30, 2015
Nov 7, 2015; Invoice: 281237

Quality Report

Quality Control Batch: 10295328 **Analyst:** CCP

Blank	Result	Units
Specific_Conductance	1.00U	umhos/cm

Quality Control Batch: 10295791 **Analyst:** VLB

Blank	Result	Units
Chloride	4.00U	mg/L

Laboratory Control Sample	Result	Units	Spike	%REC	%REC Lim
Chloride	51.2	mg/L	50.0	102.30	85.00-115.00

Matrix Spike	Result	Units	Spike	%REC	%REC Lim	Sample
Chloride	73.3	mg/L	50.0	96.30	85.00-115.00	25.2

Matrix Spike Duplicate	Result	Units	Spike	%REC	%REC Lim	Sample	RPD	RPD Lim
Chloride	73.8	mg/L	50.0	97.24	85.00-115.00	25.2	0.64	20.00

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PO #: n/a
Client Project #: St. Cloud ASR Well
Date Sampled: Oct 30, 2015
Nov 7, 2015; Invoice: 281237

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Florida Design Drilling Corp
7733 Hooper Rd.
West Palm Bay,FL 33411

PO #: n/a
Client Project #: St. Cloud ASR Well
Date Sampled: Nov 2, 2015
Nov 11, 2015; Invoice: 281555

Report Summary

Date Received: Nov 3, 2015 FCL Project Manager: Robert J. Carpenter

Laboratory #	Sample Description	Analysis	Chemist	Location	SampleMatrix
281555GW1	ASR-1 PT-8	EPA120.1	CCP	Main Lab	Ground Water
		EPA300.0	YGS	Main Lab	
		SM2540 C	PLB	Main Lab	
		SM4500-Cl E	VLB	Main Lab	
		SM4500-H B	CCP	Main Lab	

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West Palm Bay,FL 33411

PO #: n/a
Client Project #: St. Cloud ASR Well
Date Sampled: Nov 2, 2015
Nov 11, 2015; Invoice: 281555

Analysis Report

Lab #: 281555GW1 **Sampled:** 11/02/15 12:00 AM **Desc:** ASR-1 PT-8

Parameter	Result	Units	DF	MDL	PQL	QC Batch	Method	CAS #	Analyzed	
Specific_Conductance	1770	umhos/cm	1.00	1.00	2.00	10295609	EPA120.1	10-34-4	11/04/15	
Lab pH (units)	8.21 Q	pH	1.00	0.0100	0.0200	10295610	SM4500-H B	39-38-4	11/04/15	09:52 AM
TDS	1050	mg/L	1.00	2.50	5.00	10295673	SM2540 C	10-33-3	11/04/15	
Chloride	423	mg/L	5.00	20.0	40.0	10295788	SM4500-Cl E	16887-00-6	11/07/15	
Sulfate	117	mg/L	1.00	1.00	2.00	10296027	EPA300.0	14808-79-8	11/10/15	

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PO #: n/a
Client Project #: St. Cloud ASR Well
Date Sampled: Nov 2, 2015
Nov 11, 2015; Invoice: 281555

Quality Report

Quality Control Batch: 10295609 **Analyst:** CCP

Blank	**Result**	**Units**
Specific_Conductance	1.00U	umhos/cm

Quality Control Batch: 10295673 **Analyst:** PLB

Blank	**Result**	**Units**
TDS	2.50U	mg/L

Laboratory Control Sample	**Result**	**Units**	**Spike**	**%REC**	**%REC Lim**
TDS	1450	mg/L	1500	96.40	50.00-150.00

Quality Control Batch: 10295788 **Analyst:** VLB

Blank	**Result**	**Units**
Chloride	4.00U	mg/L

Laboratory Control Sample	**Result**	**Units**	**Spike**	**%REC**	**%REC Lim**
Chloride	80.3	mg/L	80.0	100.39	85.00-115.00

Matrix Spike	**Result**	**Units**	**Spike**	**%REC**	**%REC Lim**	**Sample**
Chloride	50.8	mg/L	50.0	99.08	85.00-115.00	1.27

Matrix Spike Duplicate	**Result**	**Units**	**Spike**	**%REC**	**%REC Lim**	**Sample**	**RPD**	**RPD Lim**
Chloride	50.1	mg/L	50.0	97.58	85.00-115.00	1.27	1.49	20.00

Quality Control Batch: 10296027 **Analyst:** YGS

Blank	**Result**	**Units**

FLOWERS CHEMICAL LABORATORIES INC.
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812 SW Harvey Green Dr, Madison, FL 32340 Phone: 850-973-6878 E82405 (North Lab)
3980 Overseas Hwy, Suite 103, Marathon, FL 33050 Phone: 305-743-8598 E35834 (Keys Lab)

Florida Design Drilling Corp
7733 Hooper Rd.
West Palm Bay,FL 33411

PO #: n/a
Client Project #: St. Cloud ASR Well
Date Sampled: Nov 2, 2015
Nov 11, 2015; Invoice: 281555

Quality Control Batch: 10296027 **Analyst:** YGS

Blank	**Result**	**Units**
Sulfate	1.00U	mg/L

Laboratory Control Sample	**Result**	**Units**	**Spike**	**%REC**	**%REC Lim**
Sulfate	2.13	mg/L	2.00	106.74	90.00-110.00

Matrix Spike	**Result**	**Units**	**Spike**	**%REC**	**%REC Lim**	**Sample**
Sulfate	2.19	mg/L	2.00	109.33	90.00-110.00	1.00U

Matrix Spike Duplicate	**Result**	**Units**	**Spike**	**%REC**	**%REC Lim**	**Sample**	**RPD**	**RPD Lim**
Sulfate	2.18	mg/L	2.00	109.03	90.00-110.00	1.00U	0.27	20.00

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Florida Design Drilling Corp
7733 Hooper Rd.
West Palm Bay,FL 33411

PO #: n/a
Client Project #: St. Cloud ASR Well
Date Sampled: Nov 2, 2015
Nov 11, 2015; Invoice: 281555

Narrative Report

Sample Handling
Sample handling and holding time criteria were met for all samples. Samples collected by submitter. No unusual events occurred during analysis. Results are reported on a wet weight basis for aqueous matrices and on a dry weight basis for sludge and soil matrices unless otherwise noted. Sample results reported as dissolved were field filtered.

Quality Control
Enclosed analyses met method or FCL criteria, unless otherwise denoted on the sample results. Applied data qualifiers are defined below.

Attachments
Chain of Custody

Qualifier	Meaning
U	Compound was analyzed for but not detected.
J	Estimated value; one or more QC components associated with this data value exceed current QC limits.
Q	Sample held beyond the accepted holding time.
L	Off-scale high; reported concentration exceeds the highest standard.
V	Analyte was detected in both the sample and the associated method blank.
W	The dissolved oxygen blank was above 0.2 mg/L but less than the MDL.
Z	Too numerous to count colonies on plate.
A	Absent
P	Present
T	Value reported is less than the statistical method detection limit. Reported for informational purposes only.
M	Value reported is greater than the statistical method detection limit, but less than the reported MDL.
G	The greatest of the dilutions performed did not yield sufficient oxygen depletion for valid data.
S	The least of the dilutions performed did not yield sufficient oxygen residual for valid data.
O	Result is greater than (over) the specified value.
I	Reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.
B	Results based upon colony plate count outside ideal range.
Y	The laboratory analysis was from an improperly preserved sample. The data may not be accurate.

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Florida Design Drilling Corp
7733 Hooper Rd.
West Palm Bay,FL 33411

PO #: n/a
Client Project #: St. Cloud ASR Well
Date Sampled: Nov 3, 2015
Nov 11, 2015; Invoice: 281752

Report Summary

Date Received: Nov 4, 2015 FCL Project Manager: Robert J. Carpenter

Laboratory #	Sample Description	Analysis	Chemist	Location	SampleMatrix
281752GW1	ASR-1 PT-8a	EPA120.1	CCP	Main Lab	Ground Water
		EPA300.0	YGS	Main Lab	
		SM2540 C	PLB	Main Lab	
		SM4500-Cl E	VLB	Main Lab	
		SM4500-H B	CCP	Main Lab	

Certificate of Results
Sample integrity was certified prior to analysis. Test results meet all requirements of the NELAC Standards except as noted in the Quality Control Report. Uncertainties for these data are available on request. This report may not be reproduced in part; results relate only to items tested.

Jefferson S. Flowers, Ph.D.
President/Technical Director

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Florida Design Drilling Corp
7733 Hooper Rd.
West Palm Bay,FL 33411

PO #: n/a
Client Project #: St. Cloud ASR Well
Date Sampled: Nov 3, 2015
Nov 11, 2015; Invoice: 281752

Analysis Report

Lab #: 281752GW1 **Sampled:** 11/03/15 04:15 PM **Desc:** ASR-1 PT-8a

Parameter	Result	Units	DF	MDL	PQL	QC Batch	Method	CAS #	Analyzed	
Specific_Conductance	668	umhos/cm	1.00	1.00	2.00	10295736	EPA120.1	10-34-4	11/05/15	
Lab pH (units)	8.24 Q	pH	1.00	0.0100	0.0200	10295737	SM4500-H B	39-38-4	11/05/15	10:08 AM
TDS	378	mg/L	1.00	2.50	5.00	10295775	SM2540 C	10-33-3	11/05/15	
Chloride	105	mg/L	2.00	8.00	16.0	10295789	SM4500-Cl E	16887-00-6	11/07/15	
Sulfate	39.6	mg/L	1.00	1.00	2.00	10296027	EPA300.0	14808-79-8	11/10/15	

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West Palm Bay,FL 33411

PO #: n/a
Client Project #: St. Cloud ASR Well
Date Sampled: Nov 3, 2015
Nov 11, 2015; Invoice: 281752

Quality Report

Quality Control Batch: 10295736 **Analyst:** CCP

Blank	**Result**	**Units**
Specific_Conductance	1.00U	umhos/cm

Quality Control Batch: 10295775 **Analyst:** PLB

Blank	**Result**	**Units**
TDS	2.50U	mg/L

Laboratory Control Sample	**Result**	**Units**	**Spike**	**%REC**	**%REC Lim**
TDS	1470	mg/L	1500	98.13	50.00-150.00

Quality Control Batch: 10295789 **Analyst:** VLB

Blank	**Result**	**Units**
Chloride	4.00U	mg/L

Laboratory Control Sample	**Result**	**Units**	**Spike**	**%REC**	**%REC Lim**
Chloride	79.5	mg/L	80.0	99.39	85.00-115.00

Matrix Spike	**Result**	**Units**	**Spike**	**%REC**	**%REC Lim**	**Sample**
Chloride	52.0	mg/L	50.0	94.62	85.00-115.00	4.67

Matrix Spike Duplicate	**Result**	**Units**	**Spike**	**%REC**	**%REC Lim**	**Sample**	**RPD**	**RPD Lim**
Chloride	50.9	mg/L	50.0	92.48	85.00-115.00	4.67	2.08	20.00

Quality Control Batch: 10296027 **Analyst:** YGS

Blank	**Result**	**Units**

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PO #: n/a
Client Project #: St. Cloud ASR Well
Date Sampled: Nov 3, 2015
Nov 11, 2015; Invoice: 281752

Quality Control Batch: 10296027 **Analyst:** YGS

Blank	**Result**	**Units**
Sulfate	1.00U	mg/L

Laboratory Control Sample	**Result**	**Units**	**Spike**	**%REC**	**%REC Lim**
Sulfate	2.13	mg/L	2.00	106.74	90.00-110.00

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Sulfate	2.19	mg/L	2.00	109.33	90.00-110.00	1.00U

Matrix Spike Duplicate	**Result**	**Units**	**Spike**	**%REC**	**%REC Lim**	**Sample**	**RPD**	**RPD Lim**
Sulfate	2.18	mg/L	2.00	109.03	90.00-110.00	1.00U	0.27	20.00

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Florida Design Drilling Corp
7733 Hooper Rd.
West Palm Bay,FL 33411

PO #: n/a
Client Project #: St. Cloud ASR Well
Date Sampled: Nov 3, 2015
Nov 11, 2015; Invoice: 281752

Narrative Report

Sample Handling
Sample handling and holding time criteria were met for all samples. Samples collected by submitter. No unusual events occurred during analysis. Results are reported on a wet weight basis for aqueous matrices and on a dry weight basis for sludge and soil matrices unless otherwise noted. Sample results reported as dissolved were field filtered.

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Attachments
Chain of Custody

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L	Off-scale high; reported concentration exceeds the highest standard.
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I	Reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.
B	Results based upon colony plate count outside ideal range.
Y	The laboratory analysis was from an improperly preserved sample. The data may not be accurate.

☑ **Flowers Chemical Laboratories, Inc.**
481 Newburyport Ave.
Altamonte Springs, FL 32701
Bus: 407-339-5984
Fax: 407-260-6110

☐ **Flowers Chemical Labs-South**
West Park Industrial Plaza
571 N.W. Mercantile Pl., Suite 111
Port St. Lucie, FL 34986
Bus: 772-343-8006
Fax: 772-343-8089

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812 S.W. Harvey Greene Dr.
Madison, FL 32340
Bus: 850-973-6878
Fax: 850-973-6878

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FLOWERS CHEMICAL LABORATORIES INCORPORATED

Client: FLORIDA DESIGN DRILLING Co.
Address: 7733 HOOPER ROAD
WEST PALM BEACH, FL 33411
Phone: BRETT ANDRES
Sampled By (PRINT):
Sampler Signature:
Date Sampled: 10/3 10/4

Project Name: ST. CLOUD ASR
Contact: JEFF HOIST
FCL Lab Coordinator: ROBERT
Requested Due Date:
P.O. #

GW - ground water DW - drinking water WW - wastewater
SW - surface water S - Soil/solid SL - sludge A - Air

ITEM NO.	SAMPLE DESCRIPTION	DATE	TIME	MATRIX	LAB NO.	PRESERVATIVES: NONE	H_2SO_4	HNO_3	HCl	$Na_2S_2O_3$	ANALYSES REQUEST: RADIUM 226	RADIUM 228	GROSS ALPHA	URANIUM	HAA				1.9.1	Total #
1	SITE ASR-1	10/3	16:40		311661 GW1						X	X	X	X	X					4
2	SITE SZMW-1	10/3	16:40		2						X	X	X	X	X					4
3	SITE SMW-1	10/4	10:30		3						X	X	X	X	X					4
4																				4
5																				
6																				
7																				
8																				
9																				
10																				

Relinquished By / Affiliation	Date	Time	Accepted By / Affiliation	Date	Time	Relinquished By / Affiliation	Date	Time	Accepted By / Affiliation	Date	Time
BRETT ANDRES	10-4	1301		10-4	1301		10/4	1412			
										10/4/16	1415

• WHITE - Original - To Be Returned • YELLOW - Duplicate

KNL ENVIRONMENTAL TESTING

DOH Certification #E84025
DEP COMPQAP # 870251

Report Date: October 19, 2016

Flowers Chemical Laboratory
P.O. Box 150-597
Altamonte Springs, FL 32715-0597

Field Custody: Client
Client/Field ID: 311661GW1
Sample Collection: 10-3-16/1640

Lab ID No: 16.10999
Lab Custody Date: 10-11-16/1100
Sample description: GW

CERTIFICATE OF ANALYSIS

Parameter	Units	Results			Analysis Date/Time	Method	Detection Limit
Gross Alpha	pCi/l	6.4	±	0.8	10-14-16/1634	EPA 00-02	0.6
Radium-226	pCi/l	5.3	±	0.7	10-17-16/1240	EPA 903.0	0.3
Radium-228	pCi/l	1.3	±	0.5	10-18-16/0930	EPA Ra-05	0.7
Uranium	pCi/l	1.1	±	0.4	10-16-16/1022	EPA 908.0	0.6
Uranium	ppb	1.6	±	0.6	Calc	Calc	Calc

Alpha Standard: Th-230

James W. Hayes
Laboratory Manager

Test results meet all requirements of the NELAC standards. Test results refer only to sample(s) listed. Contact person: Jim Hayes (813)229-2879

KNL ENVIRONMENTAL TESTING

DOH Certification #E84025
DEP COMPQAP # 870251

Report Date: October 19, 2016

Flowers Chemical Laboratory
P.O. Box 150-597
Altamonte Springs, FL 32715-0597

Field Custody: Client
Client/Field ID: 311661GW2
Sample Collection: 10-3-16/1640

Lab ID No: 16.11000
Lab Custody Date: 10-11-16/1100
Sample description: GW

CERTIFICATE OF ANALYSIS

Parameter	Units	Results			Analysis Date/Time	Method	Detection Limit
Gross Alpha	pCi/l	13.2	±	1.1	10-14-16/1634	EPA 00-02	0.6
Radium-226	pCi/l	10.8	±	1.0	10-17-16/1240	EPA 903.0	0.3
Radium-228	pCi/l	1.9	±	0.6	10-18-16/0930	EPA Ra-05	0.7
Uranium	pCi/l	0.6	±	0.3	10-16-16/1022	EPA 908.0	0.5
Uranium	ppb	0.9	±	0.5	Calc	Calc	Calc

Alpha Standard: Th-230

James W Hayes

James W. Hayes
Laboratory Manager

Test results meet all requirements of the NELAC standards. Test results refer only to sample(s) listed. Contact person: Jim Hayes (813)229-2879

KNL ENVIRONMENTAL TESTING

DOH Certification #E84025
DEP COMPQAP # 870251

Report Date: October 19, 2016

Flowers Chemical Laboratory
P.O. Box 150-597
Altamonte Springs, FL 32715-0597

Field Custody: Client
Client/Field ID: 311661GW3
Sample Collection: 10-3-16/1030

Lab ID No: 16.11001
Lab Custody Date: 10-11-16/1100
Sample description: GW

CERTIFICATE OF ANALYSIS

Parameter	Units	Results			Analysis Date/Time	Method	Detection Limit
Gross Alpha	pCi/l	17.8	±	1.3	10-14-16/1634	EPA 00-02	0.6
Radium-226	pCi/l	10.5	±	0.9	10-17-16/1240	EPA 903.0	0.3
Radium-228	pCi/l	2.7	±	0.6	10-18-16/0930	EPA Ra-05	0.7
Uranium	pCi/l	0.7	±	0.3	10-16-16/1022	EPA 908.0	0.6
Uranium	ppb	1.0	±	0.5	Calc	Calc	Calc

Alpha Standard: Th-230

James W Hayes

James W. Hayes
Laboratory Manager

Test results meet all requirements of the NELAC standards. Test results refer only to sample(s) listed. Contact person: Jim Hayes (813)229-2879

Check Box That Applies To Your Location

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☐ **Flowers Chemical Labs-Keys**
3980 Overseas Highway, Ste. 103
Marathon, FL 33050
Bus: 305-743-8598
Fax: 305-743-8598

FLOWERS CHEMICAL LABORATORIES INCORPORATED

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Client: KNL Labs
Address:
Phone:
Sampled By (PRINT):
Sampler Signature:
Date Sampled:

Project Name:
Client Contact:
FCL Project Manager:
Requested Due Date / 10 Day Standard OR MM DD YY
P.O. #:
FAX:
E-MAIL:
Rush Charges May Apply
Pick-Up Fee $
Vehicle Surcharge $
Sampling Fee $

GW - ground water DW - drinking water WW - wastewater
SW - surface water SO - soil/solid SL - sludge HW - waste

ITEM NO.	SAMPLE ID	DATE	TIME	MATRIX	(LAB USE ONLY) LAB NO.	PRESERVATIVES: NONE	H_2SO_4	HNO_3	HCl	$Na_2S_2O_3$	ANALYSES REQUEST: Gross Alpha	Ra 226	Ra 228	Uranium	COMMENTS	Total # Containers
1	311344DW1	9/29	13:30	DW	10997			✓			✓	✓	✓			2
2	311350DW1	9/29	10:45	DW	98			✓			✓	✓	✓			2
3	311661GW1	10/3	16:40	GW	99			✓			✓	✓	✓	✓	10997-11005	
4	311661GW2	10/3	16:40	"	11000			✓			✓	✓	✓	✓		
5	311661GW3	10/4	10:30	"	11001			✓			✓	✓	✓	✓		
6	311693DW1	10/4	08:10	DW	11002			✓			✓	✓	✓			2
7	311720WW1	10/4	08:00	WW	11003			✓			*				3,865	1
8	311720GW1	10/4	09:19	GW	11004						✓				786	
9	311720GW2	10/4	10:24	GW	11005						✓				578	
10							pH 10-20-16									

Relinquished By / Affiliation	Date	Time	Accepted By / Affiliation	Date	Time	Relinquished By / Affiliation	Date	Time	Accepted By / Affiliation	Date	Time
							10/10/16	1500			
										10-11-16	1100

* - high solids method cond.

FINANCE CHARGES APPLIED TO PAST DUE INVOICES

• **WHITE** - Lab Copy - To Be Scanned • **YELLOW** - Client Copy

Rev 04-08

Florida Department of Environmental Protection

Safe Drinking Water Program Laboratory Reporting Format

PUBLIC WATER SYSTEM INFORMATION (to be completed by sampler - please type or print legibly)

System Name: _____ PWS I.D. # ☐☐☐☐☐☐☐

System Type (check one): ☐ Community ☐ Nontransient Noncommunity ☐ Transient Noncommunity

Address: _____

City: _____ ZIP Code: _____

Phone #: _____ Fax #: _____ E-Mail Address: _____

SAMPLE INFORMATION (to be completed by sampler)

Sample Number: 311661GW1 Sample Date: _____ Sample Time: _____ AM PM (Circle One)

Sample Location (be specific): _____ Location Code: Site ASR-1

Disinfectant Residual (required when reporting trihalomethanes and haloacetic acids): _____ mg/L Field pH: _____

Sample Type (Check Only One)

☐ Distribution
☐ Entry Point (to Distribution)
☐ Plant Tap (not for compliance with 62-550)
☐ Raw (at well or intake)
☐ Max Residence Time
☐ Avg Residence Time
☐ Near First Customer

Reason(s) for Sample (Check all that apply)

☐ Routine Compliance (with 62-550)
☐ Confirmation of MCL Exceedance*
☐ Composite of Multiple Sites **
☐ Other: _____
☐ Sampling Procedure Used or Other Comments:

☐ Replacement (of Invalidated Sample)
☐ Special (not for compliance with 62-550)
☐ Clearance (permitting)

_____

* See 62-550.500(6) for requirements and restrictions And 62-550.512(3) for nitrate or nitrite exceedances.

** See 62-550.550(4) for requirements and attach a results page for each site.

SAMPLER CERTIFICATION

I, _____ (Print Name) , _____ (Print Title), do HEREBY CERTIFY that the above public water system and collection information is complete and correct.

Signature: _____ Date: _____

Certified Operator #: _____ Phone #: _____ Sampler's Fax: _____

Sampler's E-Mail: _____

Florida Department of Environmental Protection

Safe Drinking Water Program Laboratory Reporting Format

LABORATORY CERTIFICATION INFORMATION (to be completed by lab - please type or print legibly)

Lab Name: Flowers Chemical Laboratories, Inc. Florida DOH Certification #: E83018 Certification Expiration Date: 6/30/2017

ATTACH CURRENT DOH ANALYTE SHEET*

Address: P. O. Box 150597, Altamonte Springs, FL 32715-0597 Phone #: 407-339-5984

Were any analyses subcontracted? ☐ Yes ☒ No If yes, please provide DOH certification number(s): _____

ATTACH DOH ANALYTE SHEET FOR EACH SUBCONTRACTED LAB*

ANALYSIS INFORMATION (to be completed by lab) Date Sample(s) Received: 10/04/16

PWS ID (From Page 1): _____ Sample Number (From Page 1): 311661GW1 Lab Assigned Report # or Job ID: 311661

Group(s) analyzed and results attached for compliance with Chapter 62-550, F.A.C. (check all that apply)

Inorganics	Synthetic Organics	Volatile Organics	Disinfection Byproducts	Radionuclides	Secondaries
☐ All Except Asbestos	☐ All 30	☐ All 21	☐ Trihalomethanes	☐ Single Sample	☐ All 14
☐ Partial	☐ All Except Dioxin	☐ Partial	☒ Haloacetic Acids	☐ Qtrly Composite**	☐ Partial
☐ Nitrate	☐ Partial		☐ Chlorite		
☐ Nitrite	☐ Dioxin Only		☐ Bromate		
☐ Asbestos					

LAB CERTIFICATION

I, Jefferson S. Flowers, Technical Director, do HEREBY CERTIFY that all attached analytical data are correct and unless noted meet all requirements of the National Environmental Laboratory Accreditation Conference (NELAC).

Signature:  Date: 10/22/16

* Failure to provide a valid and current Florida DOH certification number and a current Analyte Sheet for the attached analysis results will result in rejection of the report and possible enforcement against the public water system for failure to sample, and may result in notification of the DOH Bureau of Laboratory Services.

** Please provide radiological sample dates & locations for each quarter.

CONFIRMATION AND NOTIFICATION IS REQUIRED WITHIN 24 HRS FOR NITRATE MCL EXCEEDANCES

NON-DETECTS ARE TO BE REPORTED AS THE MDL WITH A "U" QUALIFIER. (Non-detects reported as "BDL" or with a "<" are not acceptable.)

Compliance Determination (to be completed by DEP or DOH - attach notes as necessary)

Sample Collection & Analysis Satisfactory ☐ Yes ☐ No _____ Replacement Sample or Report Requested (circle or highlight group(s) above)

Person Notified: _____ Date Notified: _____ DEP/DOH Reviewing Official: _____

Florida Department of Environmental Protection

Safe Drinking Water Program Laboratory Reporting Format

DISINFECTION BYPRODUCTS
62-550.310(3)

Report Number / Job ID: 311661GW1
Disinfectant Residual (mg/L):
PWS ID (From Page 1): St. Cloud ASR

Contam ID	Contam Name	MCL	Units	Analysis Result	Qualifier*	Analytical Method	Lab MDL	Regulatory MRL**	Analysis Date	Analysis Time	DOH Lab Cert #
2450	Monochloroacetic Acid	N/A	ug/L	2.00	U	EPA552.3	2.00	2.0	10/05/16		E83018
2451	Dichloroacetic Acid	N/A	ug/L	1.00	U	EPA552.3	1.00	1.0	10/05/16		E83018
2452	Trichloroacetic Acid	N/A	ug/L	0.500	U	EPA552.3	0.500	1.0	10/05/16		E83018
2453	Monobromoacetic Acid	N/A	ug/L	1.00	U	EPA552.3	1.00	1.0	10/05/16		E83018
2454	Dibromoacetic Acid	N/A	ug/L	0.500	U	EPA552.3	0.500	1.0	10/05/16		E83018
2456	Total Haloacetic Acids (HAA5)	60	ug/L	0.500	U	EPA552.3	0.500	---	10/05/16		E83018

** Laboratories are required to adhere to the minimum reporting level (MRL) requirements of 40 CFR 141.131(b)(2)(iv)
*** Applicable to monitoring as prescribed in 40 CFR 141.132(b)(2)(i)(B) and (b)(2)(ii)
**** Laboratories that use EPA methods 317.0 Revision 2.0, 326.0 or 321.8 must meet a 1.0 ug/L MRL for bromate.

NOTE: Do not round values. Report results to the accuracy, precision, and sensitivity of the analytical method used.

Florida Department of Environmental Protection

Safe Drinking Water Program Laboratory Reporting Format

PUBLIC WATER SYSTEM INFORMATION (to be completed by sampler - please type or print legibly)

System Name: _____ PWS I.D. # ☐☐☐☐☐☐☐

System Type (check one): ☐ Community ☐ Nontransient Noncommunity ☐ Transient Noncommunity

Address: _____

City: _____ ZIP Code: _____

Phone #: _____ Fax #: _____ E-Mail Address: _____

SAMPLE INFORMATION (to be completed by sampler)

Sample Number: 311661GW2 Sample Date: _____ Sample Time: _____ AM PM (Circle One)

Sample Location (be specific): _____ Location Code: Site SZMW-1

Disinfectant Residual (required when reporting trihalomethanes and haloacetic acids): _____ mg/L Field pH: _____

Sample Type (Check Only One)

- ☐ Distribution
- ☐ Entry Point (to Distribution)
- ☐ Plant Tap (not for compliance with 62-550)
- ☐ Raw (at well or intake)
- ☐ Max Residence Time
- ☐ Avg Residence Time
- ☐ Near First Customer

Reason(s) for Sample (Check all that apply)

- ☐ Routine Compliance (with 62-550)
- ☐ Confirmation of MCL Exceedance*
- ☐ Composite of Multiple Sites **
- ☐ Other: _____
- ☐ Sampling Procedure Used or Other Comments:

_____

- ☐ Replacement (of Invalidated Sample)
- ☐ Special (not for compliance with 62-550)
- ☐ Clearance (permitting)

* See 62-550.500(6) for requirements and restrictions And 62-550.512(3) for nitrate or nitrite exceedances.

** See 62-550.550(4) for requirements and attach a results page for each site.

SAMPLER CERTIFICATION

I, _____ (Print Name), _____ (Print Title), do HEREBY CERTIFY that the above public water system and collection information is complete and correct.

Signature: _____ Date: _____

Certified Operator #: _____ Phone #: _____ Sampler's Fax: _____

Sampler's E-Mail: _____

Florida Department of Environmental Protection

Safe Drinking Water Program Laboratory Reporting Format

LABORATORY CERTIFICATION INFORMATION (to be completed by lab - please type or print legibly)

Lab Name: Flowers Chemical Laboratories, Inc. Florida DOH Certification #: E83018 Certification Expiration Date: 6/30/2017

ATTACH CURRENT DOH ANALYTE SHEET*

Address: P. O. Box 150597, Altamonte Springs, FL 32715-0597 Phone #: 407-339-5984

Were any analyses subcontracted? ☐ Yes ☒ No If yes, please provide DOH certification number(s): _____

ATTACH DOH ANALYTE SHEET FOR EACH SUBCONTRACTED LAB*

ANALYSIS INFORMATION (to be completed by lab) Date Sample(s) Received: 10/04/16

PWS ID (From Page 1): _____ Sample Number (From Page 1): 311661GW2 Lab Assigned Report # or Job ID: 311661

Group(s) analyzed and results attached for compliance with Chapter 62-550, F.A.C. (check all that apply)

Inorganics	Synthetic Organics	Volatile Organics	Disinfection Byproducts	Radionuclides	Secondaries
☐ All Except Asbestos	☐ All 30	☐ All 21	☐ Trihalomethanes	☐ Single Sample	☐ All 14
☐ Partial	☐ All Except Dioxin	☐ Partial	☒ Haloacetic Acids	☐ Qtrly Composite**	☐ Partial
☐ Nitrate	☐ Partial		☐ Chlorite		
☐ Nitrite	☐ Dioxin Only		☐ Bromate		
☐ Asbestos					

LAB CERTIFICATION

I, Jefferson S. Flowers, Technical Director, do HEREBY CERTIFY that all attached analytical data are correct and unless noted meet all requirements of the National Environmental Laboratory Accreditation Conference (NELAC).

Signature:  Date: 10/22/16

* Failure to provide a valid and current Florida DOH certification number and a current Analyte Sheet for the attached analysis results will result in rejection of the report and possible enforcement against the public water system for failure to sample, and may result in notification of the DOH Bureau of Laboratory Services.

** Please provide radiological sample dates & locations for each quarter.

CONFIRMATION AND NOTIFICATION IS REQUIRED WITHIN 24 HRS FOR NITRATE MCL EXCEEDANCES

NON-DETECTS ARE TO BE REPORTED AS THE MDL WITH A "U" QUALIFIER. (Non-detects reported as "BDL" or with a "<" are not acceptable.)

Compliance Determination (to be completed by DEP or DOH - attach notes as necessary)

Sample Collection & Analysis Satisfactory ☐ Yes ☐ No _____ Replacement Sample or Report Requested (circle or highlight group(s) above)

Person Notified: _____ Date Notified: _____ DEP/DOH Reviewing Official: _____

Florida Department of Environmental Protection

Safe Drinking Water Program Laboratory Reporting Format

DISINFECTION BYPRODUCTS
62-550.310(3)

Report Number / Job ID: 311661GW2
Disinfectant Residual (mg/L):
PWS ID (From Page 1): St. Cloud ASR

Contam ID	Contam Name	MCL	Units	Analysis Result	Qualifier*	Analytical Method	Lab MDL	Regulatory MRL**	Analysis Date	Analysis Time	DOH Lab Cert #
2450	Monochloroacetic Acid	N/A	ug/L	2.00	U	EPA552.3	2.00	2.0	10/05/16		E83018
2451	Dichloroacetic Acid	N/A	ug/L	1.00	U	EPA552.3	1.00	1.0	10/05/16		E83018
2452	Trichloroacetic Acid	N/A	ug/L	0.500	U	EPA552.3	0.500	1.0	10/05/16		E83018
2453	Monobromoacetic Acid	N/A	ug/L	1.00	U	EPA552.3	1.00	1.0	10/05/16		E83018
2454	Dibromoacetic Acid	N/A	ug/L	0.500	U	EPA552.3	0.500	1.0	10/05/16		E83018
2456	Total Haloacetic Acids (HAA5)	60	ug/L	0.500	U	EPA552.3	0.500	---	10/05/16		E83018

** Laboratories are required to adhere to the minimum reporting level (MRL) requirements of 40 CFR 141.131(b)(2)(iv)
*** Applicable to monitoring as prescribed in 40 CFR 141.132(b)(2)(i)(B) and (b)(2)(ii)
**** Laboratories that use EPA methods 317.0 Revision 2.0, 326.0 or 321.8 must meet a 1.0 ug/L MRL for bromate.

NOTE: Do not round values. Report results to the accuracy, precision, and sensitivity of the analytical method used.

Florida Department of Environmental Protection

Safe Drinking Water Program Laboratory Reporting Format

PUBLIC WATER SYSTEM INFORMATION (to be completed by sampler - please type or print legibly)

System Name: _____ PWS I.D. # ☐☐☐☐☐☐☐

System Type (check one): ☐ Community ☐ Nontransient Noncommunity ☐ Transient Noncommunity

Address: _____

City: _____ ZIP Code: _____

Phone #: _____ Fax #: _____ E-Mail Address: _____

SAMPLE INFORMATION (to be completed by sampler)

Sample Number: 311661GW3 Sample Date: _____ Sample Time: _____ AM PM (Circle One)

Sample Location (be specific): _____ Location Code: Site SMW-1

Disinfectant Residual (required when reporting trihalomethanes and haloacetic acids): _____ mg/L Field pH: _____

Sample Type (Check Only One)

- ☐ Distribution
- ☐ Entry Point (to Distribution)
- ☐ Plant Tap (not for compliance with 62-550)
- ☐ Raw (at well or intake)
- ☐ Max Residence Time
- ☐ Avg Residence Time
- ☐ Near First Customer

Reason(s) for Sample (Check all that apply)

- ☐ Routine Compliance (with 62-550)
- ☐ Confirmation of MCL Exceedance*
- ☐ Composite of Multiple Sites **
- ☐ Other: _____
- ☐ Sampling Procedure Used or Other Comments:

_____

- ☐ Replacement (of Invalidated Sample)
- ☐ Special (not for compliance with 62-550)
- ☐ Clearance (permitting)

* See 62-550.500(6) for requirements and restrictions And 62-550.512(3) for nitrate or nitrite exceedances.

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Address: P. O. Box 150597, Altamonte Springs, FL 32715-0597 Phone #: 407-339-5984

Were any analyses subcontracted? ☐ Yes ☒ No If yes, please provide DOH certification number(s): _____

ATTACH DOH ANALYTE SHEET FOR EACH SUBCONTRACTED LAB*

ANALYSIS INFORMATION (to be completed by lab) Date Sample(s) Received: 10/04/16

PWS ID (From Page 1): _____ Sample Number (From Page 1): 311661GW3 Lab Assigned Report # or Job ID: 311661

Group(s) analyzed and results attached for compliance with Chapter 62-550, F.A.C. (check all that apply)

Inorganics	Synthetic Organics	Volatile Organics	Disinfection Byproducts	Radionuclides	Secondaries
☐ All Except Asbestos	☐ All 30	☐ All 21	☐ Trihalomethanes	☐ Single Sample	☐ All 14
☐ Partial	☐ All Except Dioxin	☐ Partial	☒ Haloacetic Acids	☐ Qtrly Composite**	☐ Partial
☐ Nitrate	☐ Partial		☐ Chlorite		
☐ Nitrite	☐ Dioxin Only		☐ Bromate		
☐ Asbestos					

LAB CERTIFICATION

I, Jefferson S. Flowers, Technical Director, do HEREBY CERTIFY that all attached analytical data are correct and unless noted meet all requirements of the National Environmental Laboratory Accreditation Conference (NELAC).

Signature:  Date: 10/22/16

* Failure to provide a valid and current Florida DOH certification number and a current Analyte Sheet for the attached analysis results will result in rejection of the report and possible enforcement against the public water system for failure to sample, and may result in notification of the DOH Bureau of Laboratory Services.

** Please provide radiological sample dates & locations for each quarter.

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Sample Collection & Analysis Satisfactory ☐ Yes ☐ No _____ Replacement Sample or Report Requested (circle or highlight group(s) above)

Person Notified: _____ Date Notified: _____ DEP/DOH Reviewing Official: _____

Florida Department of Environmental Protection

Safe Drinking Water Program Laboratory Reporting Format

DISINFECTION BYPRODUCTS
62-550.310(3)

Report Number / Job ID: 311661GW3
Disinfectant Residual (mg/L):
PWS ID (From Page 1): St. Cloud ASR

Contam ID	Contam Name	MCL	Units	Analysis Result	Qualifier*	Analytical Method	Lab MDL	Regulatory MRL**	Analysis Date	Analysis Time	DOH Lab Cert #
2450	Monochloroacetic Acid	N/A	ug/L	2.00	U	EPA552.3	2.00	2.0	10/05/16		E83018
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2452	Trichloroacetic Acid	N/A	ug/L	0.500	U	EPA552.3	0.500	1.0	10/05/16		E83018
2453	Monobromoacetic Acid	N/A	ug/L	1.00	U	EPA552.3	1.00	1.0	10/05/16		E83018
2454	Dibromoacetic Acid	N/A	ug/L	0.500	U	EPA552.3	0.500	1.0	10/05/16		E83018
2456	Total Haloacetic Acids (HAA5)	60	ug/L	0.500	U	EPA552.3	0.500	---	10/05/16		E83018

** Laboratories are required to adhere to the minimum reporting level (MRL) requirements of 40 CFR 141.131(b)(2)(iv)
*** Applicable to monitoring as prescribed in 40 CFR 141.132(b)(2)(i)(B) and (b)(2)(ii)
**** Laboratories that use EPA methods 317.0 Revision 2.0, 326.0 or 321.8 must meet a 1.0 ug/L MRL for bromate.

NOTE: Do not round values. Report results to the accuracy, precision, and sensitivity of the analytical method used.

APPENDIX J

Background Water Quality Laboratory Reports

APPENDIX K
Geophysical Logs

APPENDIX L

Rock Core Laboratory Data

Ardaman & Associates, Inc.

Geotechnical, Environmental and
Materials Consultants

July 20, 2016
File Number 16-13-0015

Florida Design Drilling Corporation
7733 Hooper Road
West Palm Beach, Florida 33411

Attention: Mr. Daniel Ringdahl

Subject: Rock Core Testing, ASRus, LLC SZMW-1

Gentlemen:

As requested, vertical and horizontal permeability, unconfined compression and specific gravity tests have been completed on one rock core provided for testing by your firm. The core was received on January 18, 2016 and was designated as follows:

Core	Depth (feet)
SZMW-1	1,433

Photographs of the as-received core are attached. Two short sections of core were provided for testing. The longer section was used for permeability testing. The shorter section was used for the unconfined compression test.

Permeability Tests

Permeability tests were performed in general accordance with ASTM Standard D5084 "Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter" using the constant head (Method A) test method. The core sample was tested for vertical hydraulic conductivity and then cross-cored for measurement of horizontal hydraulic conductivity on the vertical permeability test specimen. The permeability test results are presented on the attached hydraulic conductivity test reports

Unconfined Compression Test

The unconfined compression test was performed in general accordance with ASTM Standard D7012 "Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures" using Method C Uniaxial Compressive Strength of Intact Rock Core Specimens. The results of the unconfined compression test are presented on the attached unconfined compression test report. The test specimen was cored to a diameter of 1.3 inches in order to maintain the height to diameter ratio in the required range of 2.0 to 2.5 for the available sample length. This diameter is less than the specified minimum test diameter of 1.85 inches, but was necessary because of the length of the sample.

Specific Gravity Tests

The specific gravity test was performed in general accordance with ASTM Standard D854 "Specific Gravity of Soil Solids by Water Pycnometer" using a 90 gram specimen ground to pass

the U.S. Standard No. 40 sieve. The measured mineral specific gravity is presented on the attached test reports.

Total Porosity

The total porosity, n, of each permeability test specimen was back-calculated from dry density, γ_d, and measured mineral specific gravity, G_s, using the relationship: $n= [\gamma_d/(G_s\gamma_w)]-1$ where γ_w is the unit weight of water. The total porosities of the permeability test specimens are reported on the hydraulic conductivity test reports.

The test samples were reported to be from the client-specified designations herein. The test results are indicative of only the specimens that were actually tested. The test results presented are based upon accepted industry practice as well as test method(s) listed. Ardaman & Associates, Inc. neither accepts responsibility for, nor makes claims to the final use and purpose of the test results.

Please contact us if you have any questions about the test results or require additional information.

Very truly yours,
ARDAMAN & ASSOCIATES, INC.
Certificate of Authorization No. 5950

Thomas S. Ingra, P.E.
Laboratory Director
Florida License No. 31987

S:\Projects\2016\16-13-0015 Florida Design Drilling\REPORT 1 072016.docx

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
ROCK CORE HYDRAULIC CONDUCTIVITY TEST REPORT

CLIENT: Florida Design Drilling Corporation

PROJECT: ASRus, LLC SZMW-1

FILE NO.: 16-13-0015

DATE SAMPLE RECEIVED: 01/18/16 SET UP: 01/26/16

DATE REPORTED: 07/20/16

INCOMING SAMPLE NO.: **SZMW-1 1433'**

LABORATORY IDENTIFICATION NO.: 160015/1433

SAMPLE DESCRIPTION: Dark brown dolomitic limestone

ASTM D5084 TEST METHOD:

- ☒ A - Constant Head
- ☐ B - Falling Head; Constant Tailwater
- ☐ C - Falling Head; Rising Tailwater
- ☐ D - Constant Rate of Flow

B-FACTOR: 97%

- ☐ Beginning of Test;
- ☒ End of Test

$\Delta\sigma_c$ (lb/in^2): 6.2

SPECIMEN DATA:

As-Received Diameter (inch): 4 Diameter Trimmed: ☐ Yes ☒ No

As-Received Length (inch): 4.5/3.5* Length Trimmed: ☒ Yes ☐ No

TEST SPECIMEN ORIENTATION: ☒ **Vertical** ☐ Horizontal

SPECIFIC GRAVITY, G_s: 2.84 ☐ Assumed ☒ Measured (ASTM D854)

PERMEANT: ☒ Deaired Tap Water ☐ Other

Initial Conditions							Test Conditions					Final Conditions			Hydraulic Conductivity
H (cm)	D (cm)	V (cm^3)	w_c (%)	γ_d (lb/ft^3)	n	S (%)	σ'_c (lb/in^2)	u_b (lb/in^2)	i_{avg}	Q (cm^3)	t (days)	WDS (gram)	w_c (%)	S (%)	k_{20} (cm/sec)
8.636	9.978	675.35	4.0	152.5	0.139	71	30	160	19.5	20.9	4	1,650.83	4.2	74	**1.4x10-06**

COMMENTS: (1) Core sample was cut to length, air-dried, deaired under vacuum for a minimum of 24 hours, and then saturated with deaired tap water from the bottom up while maintaining the vacuum. (2) WDS from measured air dry mass.
*First length is total sample length. Second length is useable length at full core diameter.

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Where: H = Specimen height; D = Specimen diameter; V = Volume; WDS = Dry mass; w_c = Water content (ASTM D2216); γ_d = Dry density; S = Saturation; σ'_c = Isotropic effective confining stress; u_b = Back-pressure; i_{avg} = Average hydraulic gradient; Q = Flow volume; t = Test duration; k_{20} = Saturated hydraulic conductivity at 20°C; n = Total porosity; and G_s = Specific gravity.

Checked By: TM Date: 07/20/16

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
ROCK CORE HYDRAULIC CONDUCTIVITY TEST REPORT

CLIENT: Florida Design Drilling Corporation

PROJECT: ASRus, LLC SZMW-1

FILE NO.: 16-13-0015

DATE SAMPLE RECEIVED: 01/18/16 SET UP: 02/29/16

DATE REPORTED: 07/20/16

INCOMING SAMPLE NO.: **SZMW-1 1433'**

LABORATORY IDENTIFICATION NO.: 160015/1433

SAMPLE DESCRIPTION: Dark brown dolomitic limestone

ASTM D5084 TEST METHOD:

- ☒ A - Constant Head
- ☐ B - Falling Head; Constant Tailwater
- ☐ C - Falling Head; Rising Tailwater
- ☐ D - Constant Rate of Flow

B-FACTOR: 89% [stable] ☐ Beginning of Test; ☒ End of Test

$\Delta\sigma_c$ (lb/in^2): 6.4; 12.4; 17.7

SPECIMEN DATA:

As-Received Diameter (inch): 4 Diameter Trimmed: ☐ Yes ☒ No

As-Received Length (inch): 4.5/3.5* Length Trimmed: ☒ Yes ☐ No

TEST SPECIMEN ORIENTATION: ☐ **Vertical** ☒ Horizontal

SPECIFIC GRAVITY, G_s: 2.84 ☐ Assumed ☒ Measured (ASTM D854)

PERMEANT: ☒ Deaired Tap Water ☐ Other

Initial Conditions							Test Conditions					Final Conditions			Hydraulic Conductivity
H (cm)	D (cm)	V (cm^3)	w_c (%)	γ_d (lb/ft^3)	n	S (%)	σ'_c (lb/in^2)	u_b (lb/in^2)	i_{avg}	Q (cm^3)	t (days)	WDS (gram)	w_c (%)	S (%)	k_{20} (cm/sec)
6.821	4.989	133.33	3.7	158.9	0.103	90	30	160	25.7	21.2	2	339.57	3.8	94	**9.0x10-07**

COMMENTS: (1) Horizontal permeability test specimen was cross-cored from the corresponding vertical test specimen.
*First length is total sample length. Second length is useable length at full core diameter.

Where: H = Specimen height; D = Specimen diameter; V = Volume; WDS = Dry mass; w_c = Water content (ASTM D2216); γ_d = Dry density; S = Saturation; σ'_c = Isotropic effective confining stress; u_b = Back-pressure; i_{avg} = Average hydraulic gradient; Q = Flow volume; t = Test duration; k_{20} = Saturated hydraulic conductivity at 20°C; n = Total porosity; and G_s = Specific gravity.

Checked By: DM Date: 07/20/16

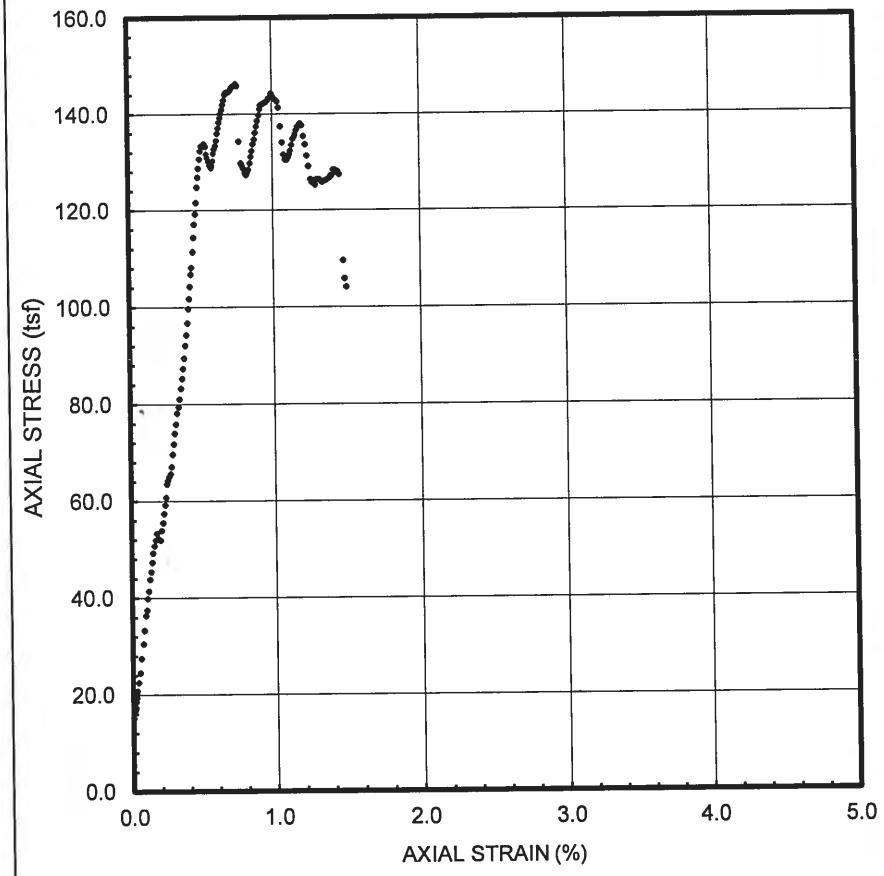
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
INTACT ROCK CORE UNCONFINED COMPRESSION TEST REPORT

CLIENT: Florida Design Drilling Corporation
PROJECT: ASRus, LLC SZMW-1
FILE NO.: 16-13-0015

DATE SAMPLE RECEIVED: 01/18/16
DATE TEST SET-UP: 02/05/16
DATE REPORTED: 07/20/16

INCOMING SAMPLE NO.: SZMW-1
BORING: --- SAMPLE: ---
DEPTH: 1433 ☒ feet; ☐ meters
LABORATORY IDENTIFICATION NO.:
SAMPLE DESCRIPTION: Dark brown dolomitic limestone

Specimen Dimensions			Initial Conditions			Rate of Loading		Time to Failure (minutes)	Strain at Failure (%)	Unconfined Compressive Strength, σ_a(ult) (lb/in^2)	Young's Tangent Modulus, E_{50} (lb/in^2)	Modulus Ratio [E_{50} / σ_a(ult)]
H (cm)	D (cm)	H/D	w_c (%)	γ_d (lb/ft^3)	S (%)	$\dot{\varepsilon}$ (cm/minute)	$\dot{\varepsilon}$ (%/minute)					
6.951	3.298	2.1	3.0	142.0	35	0.0061	0.088	8.5	0.75	**2,030**	2.84E05	140



TEST PROCEDURES

ASTM Standard D7012 [Method C] and D4543 for specimen preparation

Air Temperature (°C): 22.0

Capping Material: ☐ None ☒ Lab-Stone

Comments: Cored to 1.3" diameter specimen because of sample length to provide satisfactory H/D.

Average Loading Rate (lb/in^2/sec): 4.0

SPECIMEN PREPARATION

Original Core Diameter (inch): 4.0

Specimen Sub-Cored for Testing:
☒ Yes
☐ No

Specimen Side Straightness (Procedure S1)
☒ Satisfies Criterion of ≤ 0.020 inches
☐ Does Not Satisfy Criterion: _____

Specimen Side Parallelism (Procedure P2)
☐ Satisfies Criterion of ≤ 0.43%
☒ Does Not Satisfy Criterion: 1.75%

Specimen End Flatness (Procedure FP2)
☒ Specimen Capped – Not Applicable
☐ Satisfies Criterion of ≤ 0.001 inches
☐ Does Not Satisfy Criterion

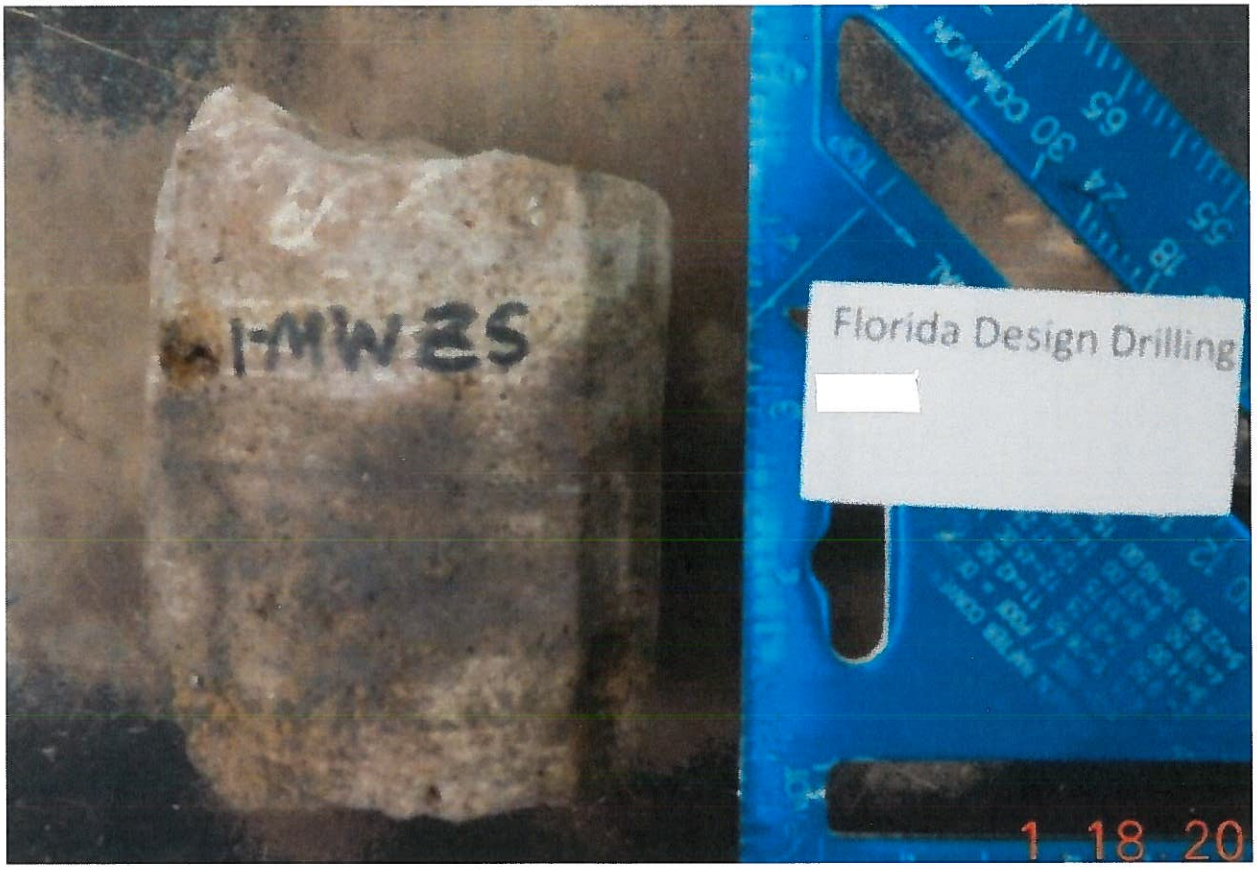
G_s: 2.84 ☐ Assumed ☒ Measured

FAILURE SKETCH

Where: H = Specimen height; D = Specimen diameter; w_c = Water content (ASTM D2216); γ_d = Dry density; S = Saturation; $\dot{\varepsilon}$ = Vertical displacement rate; G_s = Specific gravity; and E_{50} = Young's tangent modulus at 50%of unconfined compressive strength unless indicated otherwise.

Checked By: TM Date: 07/20/16

Florida Design Drilling Corporation
File Number 16-13-0015



Florida Design Drilling Corporation
File Number 16-13-0015