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CITY OF SUNRISE FLORIDA

CONSTRUCTION AND TESTING SUMMARY REPORT

Floridan Aquifer Test Wells SGF-1 and SGF-2

Sawgrass Utility Complex

September 2013

Construction and Testing Summary Report

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City of Sunrise, Sawgrass Utility Complex

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Table of Contents

Table of Contents

1. Introduction

The City of Sunrise (City) retained Malcolm Pirnie/ARCADIS (Engineer) to provide engineering and hydrogeologic consulting services for the construction and testing of two test wells to be constructed into the Floridan Aquifer near the City's Sawgrass Utility Complex. The Sawgrass Utility Complex includes both a water treatment plant (WTP) which currently treats raw Biscayne Aquifer water and a wastewater treatment facility (WWTF) that includes three Class I municipal injection wells. A fourth Class I injection well is included within the WTP for disposal of reverse-osmosis concentrate. The two wells are designated as SGF-1 and SGF-2. A location map showing the location of the wells and the Sawgrass Utility Complex is provided as **Figure 1**.

The two wells were designed as test production wells, so that relevant data could be obtained during construction and then the wells could have future potential use as water supply production wells for the City's planned reverse-osmosis water treatment system. Well construction and testing procedures were performed in accordance with the October 2011 contract and specifications entitled "Sawgrass Floridan Well Construction and Aquifer Performance Test (APT)" prepared by MWH. The Contractor selected for the construction and testing of SGF-1 and SGF-2 was Florida Design Drilling, Inc.; a Florida state licensed water well contractor.

2. Design and Test Objectives

The City of Sunrise (CITY) has secured a Water Use Permit (WUP) with South Florida Water Management District. Pertinent information from the WUP is as follows:

- The total annual allocation is 40.7 million gallons per day (MGD) with a 45.9 MGD max month allocation from the Biscayne and Floridan Aquifers.
- The baseline allocation from the Biscayne Aquifer from the City's wellfields (Springtree, Sawgrass, Flamingo and Southwest) is 29.09 MGD (reduced on May 13, 2013 from 31.39 MDG)
- The current allocation for the Floridan Aquifer is 4.76 MGD in 2013. The allocation is permitted to increase with increasing demand to the allocated amount of 10.98 MGD by 2028

The City's primary aim with this project was to 1) evaluate the Floridan Aquifer in the Sawgrass area to determine the expected yield as a preliminary step towards development of a Floridan Aquifer Alternative water supply source and 2) establish the optimal design and placement for future Floridan Aquifer wells. The initial design of the Floridan Aquifer test wells was completed by MWH with consultation from Malcolm Pirnie/ARCADIS. Several components were considered for the design of the Floridan Aquifer Test Wells which include:

- The diameter of the final casing shall be adequate to accommodate appropriately sized pumps. It was determined that an inside diameter (I.D.) of 16 inches is sufficiently sized for a conservative pumping design flow of 2 MGD.

- The final casing shall consist of a material appropriate for resistance to corrosion of brackish Floridan Aquifer waters and shall be certified by the National Sanitation Foundation (NSF) to be acceptable for water supply.

- The open-hole interval within the Floridan Aquifer shall intersect competent and permeable strata with acceptable water quality.

- The Surficial Aquifer System, the Hawthorn Group and the Floridan Aquifer shall be isolated from each other by setting and cementing casings concentrically near the base of the Surficial Aquifer and near the base of the Hawthorn Group.

- The casings shall be appropriately cemented in place. Regulations require a minimum thickness of 2 inches for the cement sheath.

- Construction and testing shall satisfy Florida Department of Environmental Protection (FDEP) Underground Injection Control (UIC) regulatory requirements for Class V aquifer storage and recovery (ASR) wells in order to provide the City the option to convert the test wells to ASR wells in the future.

3. Regional Hydrogeological Setting

The regional stratigraphy and hydrogeological setting of the area surrounding the test well site is summarized in **Appendix A**: Generalized Regional Geology and Hydrogeology. The figure summarizes the stratigraphic units, lithologic descriptions and corresponding hydrogeologic units. Two distinctly different aquifer units are present at this location; the Surficial Aquifer and the Floridan Aquifer, separated by a sequence of clays and other sediments belonging to the Hawthorn Group.

The Surficial Aquifer is the uppermost water-bearing unit and generally consists of unconsolidated sands with varying amounts of shell and clay. This aquifer contains the water table, and water within it is under mainly unconfined conditions and in the low lying wetland areas is very close to, or at the surface. These sediments, which were deposited during the Pliocene to Holocene periods, lie between land surface and a depth of approximately 200 feet.

The lower limit of the Surficial Aquifer coincides with the top of laterally extensive and vertically persistent beds of lower permeability. These beds, which belong to the Hawthorn Group, consist of interbedded, phosphatic clays, silt, sand, limestone and dolomite. These sediments are collectively referred to as the

"Intermediate Confining Unit" and restrict vertical movement of groundwater between the Surficial Aquifer and the underlying Floridan Aquifer. At the base of the intermediate confining units there are more permeable zones of sandy limestone and dolomite which are generally attributed to the Arcadia Formation (basal Hawthorn Group). The Floridan Aquifer system underlies all of Florida and southern Georgia. The aquifer consists primarily of Eocene-age Ocala Limestone, Avon Park Formation and Oldsmar Formation. The aquifer system has been mapped with two permeable zones; the Upper and Lower Floridan Aquifers. The Upper Florida Aquifer lies within the Ocala Limestone and the upper portion of the Avon Park Formation. The Lower Floridan Aquifer was not encountered during drilling.

4. Findings

The results of the construction and testing of SGF-1 and SGF-2 led to the following findings noted below. A summary of the hydrogeological units intersected in the test wells is presented in **Figures 2 and 3**.

- The base of the Biscayne Aquifer and the top of the Upper Confining Unit (top of the Hawthorn Group) are located in SGF-1 and SGF-2 at a depth of approximately 190 and 200 feet below ground level (bgl), respectively.

- The base of the upper confining unit and the top of the Upper Floridan Aquifer are located in SGF-1 and SGF-2 at depths of approximately 995 and 999 feet bgl, respectively.

- Pilot holes were completed in SGF-1 and SGF-2 to the total depths of 1,800 feet bgl and 1,863 feet bgl, respectively.

- Good correlation exists between the strata intercepted by SGF-1 and SGF-2 boreholes with vertical offsets within the Floridan Aquifer of approximately 14 feet (SGF-2 strata encountered 14 feet deeper than SGF-1 strata).

- Groundwater quality profiles obtained from drill-stem water quality samples, discrete packer testing water quality sampling and static and dynamic geophysical fluid logging confirm that the water quality profiles are complex. Two discrete zones of less brackish groundwater are identified (referred to as "Freshwater Zones" in this report):

    - An upper "freshwater" zone located within the top of the Upper Floridan Aquifer lies between approximately 1,000 feet and 1,155 feet bgl, with an average salinity (based on packer test results), as measured by conductivity and TDS, of 9,200 micro Siemens per centimeter (μS/cm) and 5,850 milligrams per liter (mg/L), respectively.

  - A lower "freshwater" zone located within the base of the Upper Floridan Aquifer lies between approximately 1,705 feet and 1,800 feet bgl, with an average salinity (based on packer test results, as measured by conductivity and TDS, of 8,650 μS/cm and 5,300 mg/L, respectively.

  - Between these two "fresh water" or less brackish groundwater intervals, increasing trends in salinity, as measured by conductivity, chloride and total dissolved solids (TDS) are observed. Formation with the highest salinity was observed between approximately 1,450 and 1,580 feet bgl, with a conductivity up to 19,190 μS/cm measured in a pilot hole drill stem sample of SGF-2.

- The lowermost base of the underground source of drinking water (USDW) defined as formation waters containing TDS concentrations at or below 10,000 milligrams per liter (mg/L), was not intercepted by the SGF-1 and SGF-2 pilot holes. The extension of the SGF-2 pilot hole from 1,800 feet to 1,863 feet bgl intercepted groundwater within a USDW and with lower TDS concentrations (4,330 mg/L) compared to concentrations found at shallower depths in the Floridan Aquifer. However, the formation permeability was considered too low to be part of a viable production interval. During construction of the injection well systems located within the Sawgrass Utility Complex (constructed by others), the lowermost USDW base was encountered at depths of approximately 1,920 feet bgl. Good correlation of the strata encountered in these injection wells with SGF-1 and SGF-2 was obtained with an approximate vertical offset of 20 feet, therefore based on this correlation it is interpreted that the USDW will likely lie at a depth of approximately 1,940 feet bgl in SGF-1 and approximately 1,950 feet bgl in SGF-2. This interpretation is made on the assumption that the change in salinity is primarily controlled by changes in formation lithology, that is groundwater flow is primarily horizontal along bedding planes and restricted from flowing vertically due to low permeability layers. It should be noted that while this assumption is often correct, it is not always true, therefore this interpretation is provisional only and only by drilling to these depths can the actual depth of the lowermost USDW be determined.

- The open hole production interval in both SGF-1 and SGF-2 are located within the upper "freshwater" zones after it was determined that the upper zone was more permeable and is bounded by only one saline front. In SGF-1 the open hole production interval is between 1,006 and 1,127 feet bgl, and in SGF-2 it is between 1,014 and 1,150 feet bgl.

- The approximate transmissivities of the open holes in SGF-1 and SGF-2 are 43,500 gallons per day per foot (gpd/ft) and 42,000 gpd/ft, respectively. These permeabilities are approximately half of what was originally expected, based on hydraulic parameters used for groundwater modeling that was used to determine the well separation between SGF-1 and 2.

5. Construction and Testing

The Contractor was given notice to commence work on March 30, 2012. After mobilizing to the SGF-1 site, construction of SGF-1 began in May 2012. The construction and testing of SGF-1 was complete by January 2013 (with the exception of combined aquifer performance testing of both wells). The Contractor mobilized a second drilling rig at SGF-2 and the construction of the wells partially overlapped. The construction of SGF-2 began in August 2012 and construction and testing was completed by May 2013.

During well construction, data were collected and interpreted to determine the geologic and hydrogeologic characteristics of the strata intercepted by the borehole. These data were used to determine the optimal subsurface design. Data also were collected to ensure both wells were being constructed in accordance with the technical specifications. Data-collection methods and results are described below. Summaries of the construction and testing activities for SGF-1 and SGF-2 are presented as **Table 1A** and **Table 1B**, respectively.

Both SGF-1 and SGF-2 were completed with the following casings and tubings:

- 48-inch outside diameter (O.D.), 0.375-inch wall thickness, welded steel Pit casing. Casing was installed and cemented to facilitate drilling within the Surficial Aquifer.
- 36-inch O.D., 0.375-inch wall thickness, welded steel Surface casing. Casing was installed and cemented to isolate the Surficial Aquifer
- 28-inch O.D., 0.375-inch wall thickness, welded steel Intermediate casing. Casing was installed and cemented to isolate the Hawthorn Group.
- 16-inch inside diameter (I.D.) with maximum O.D. of 20 inches at couplings, 0.500-inch wall thickness, threaded and coupled fiberglass reinforced plastic (FRP) tubing manufactured by Burgess Well Company, Inc. Tubing was installed and cemented to serve as a Final casing which is resistant to corrosion from the brackish groundwater.

5.1 Construction above the Floridan Aquifer

<u>48-inch O.D. Pit Casing</u>:

At both the SGF-1 and SGF-2 sites the Contractor drilled a borehole using the auger drilling method to facilitate the installation and cementing of a 48-inch O.D. steel pit casing. During drilling drill cuttings were collected at 10-foot depth intervals, described by the onsite geologist and summarized in geologic logs. Lithologic summaries for SGF-1 and SGF-2 are provided in **Appendix A**. The base of the pit casings were

set in SGF-1 and SGF-2 at 41 feet and 48 feet bgl, respectively. Construction details of SGF-1 are provided in **Figure 2** and construction details of SGF-2 are provided in **Figure 3**.

36-inch O.D. Surface Casing:

Following installation of the 48-inch O.D. pit casing, the Contractor drilled a pilot hole by the mud-rotary drilling method. The pilot hole was extended to 225 feet bgl in SGF-1 and to 228 feet bgl in SGF-2. During drilling, cutting samples were collected as described above. Inclination surveys were performed by the Contractor in the pilot hole (and all subsequent borehole drilling operations) of SGF-1 and SGF-2 at approximately 90-foot intervals. The maximum allowable inclination from vertical at any portion of a hole was 1.0 degree. The maximum allowable difference between any two successive survey points was 0.5 degree. During drilling operations, all inclination surveys met the above criteria. Summaries of inclination survey results for SGF-1 and SGF-2 are presented in **Tables 2A and 2B**, respectively.

Following pilot-hole drilling, geophysical logging was performed. Based on the drill cuttings and geophysical logging, the base of the Surficial Aquifer (Biscayne Aquifer) and the top of the Hawthorn Group was identified at 190 feet bgl in SGF-1 and at 200 feet bgl in SGF-2. Geophysical logging is discussed in Section 4.2.3 of this report. The pilot holes were then reamed to a nominal 48-inch diameter in SGF-1 and SGF-2 to depths of 217 feet and 228 feet bgl, respectively. X-Y caliper and gamma-ray logging was then performed and 36-inch O.D. steel surface casing was installed and cemented to surface in stages. The base of the surface casing was set at 215 feet bgl in SGF-1 and at 225 feet bgl in SGF-2. Summaries of cementing stages for SGF-1 and SGF-2 are provided in **Table 3**.

28-inch O.D. Intermediate Casing

After the 36-inch O.D. casing was set and cemented for each well, the Contractor drilled a pilot hole by the mud-rotary drilling method below the base of the 36-inch O.D. casing. The pilot hole in SGF-1 was extended to 1,020 feet bgl; approximately 25 feet below the base of the lowermost competent clay layer observed in the Hawthorn Group (observed between 960 and 995 feet bgl). Further descriptions of geological units intercepted are discussed in Section 4.3 below. The pilot hole in SGF-2 was terminated at 980 feet bgl. During pilot-hole drilling in SGF-2, development of the completed SGF-1 well was occurring. It was decided to terminate the pilot hole in SGF-2 prior to penetrating the lowermost clay layer in order to eliminate the risk of drilling fluids in SGF-2 migrating towards SGF-1 and adversely affecting the production interval.

Geophysical logging was then performed in the pilot holes. Based on the drill cuttings and geophysical logging, the base of the Hawthorn Group clays and the top of the Upper Floridan Aquifer in SGF-1 was identified at 995 feet bgl. The base of the Hawthorn Group clays in SGF-2 was identified at 999 feet bgl (based on cuttings collected and logging performed in the reamed hole described below). The pilot holes

were then reamed to a nominal 36 inch diameter borehole in SGF-1 and SGF-2 to depths of 1,004 feet and 1,010 feet bgl, respectively. X-Y caliper and gamma-ray logging was then performed and 28-inch O.D. steel casing was installed and cemented to surface in stages. The base of the 28-inch O.D. casing was set at 1,000 feet bgl in SGF-1 and at 1,006 feet bgl in SGF-2.

5.2 Pilot Hole Drilling and Testing within the Floridan Aquifer

During pilot hole drilling and testing within the Floridan Aquifer, the general sequence of work performed is outlined below. Pertinent construction and testing procedures are described further in the subsequent report sections.

1. Drill pilot holes to total depth and perform geophysical logging; during drilling collect drill cutting samples (every 10 feet), collect drill stem water quality samples (approximately every 30 feet), perform inclination surveys (approximately every 90 feet) and perform specific capacity testing (approximately every 30 feet).

2. Perform packer testing and collect packer test water quality samples for laboratory analysis. It should be noted that the pilot hole in SGF-2 was extended an additional 63 feet after performing geophysical logging and performing one packer test. A second packer test was performed in SGF-2 after extending the pilot hole.

5.2.1 Lithology

During pilot hole drilling of both SGF-1 and SGF-2, drill cuttings were collected in the Floridan Aquifer at 10-foot depth intervals, described by an onsite (ARCADIS) geologist and summarized in geologic logs. Lithologic summaries for SGF-1 and SGF-2 are provided in **Appendix A**. A description of the formations encountered during pilot-hole drilling is included in Section 5.3 below and summarized in **Figures 2 and 3**.

5.2.2 Pilot Hole Water Quality Sampling and Specific Capacity Testing

The Contractor performed pilot-hole drilling in the Floridan Aquifer using the open-circulation reverse-air drilling method. During drilling the annulus between the drill stem and the open hole was allowed to flow under artesian conditions. Formation waters were diverted to a settling tank and then discharged to the wet well at the Sawgrass Utility Complex through temporary discharge piping. Fluids from the wet well were then injected into the Class I injection wells located at the Sawgrass complex. At each drill rod connection (approximately 30-foot intervals), the Contractor continued to circulate the borehole for approximately 15 minutes to remove cuttings. Just prior to terminating circulation, a sample of the discharge fluids (referred to in this report as a “drill stem” sample) was collected for field analysis of conductivity, temperature, chloride, hydrogen sulfide, sulfate (SGF-1 and SGF-2) and pH (SGF-2 only).

The reverse-air circulation was then terminated and the annulus was shut in (valving on the annulus flow line was closed). A manometer tube consisting of clear plastic tubing was connected to the annulus and extended up the mast of the drill rig. After approximately 15 to 20 minutes, the Contractor climbed up the rig mast and measured the artesian head of the annulus from ground level. The annulus valve was then opened until the water level in the manometer tube lowered to several feet above ground level. The flow from the annulus was continued for a sufficient period of time to allow flow rates and water levels in the manometer tube to generally approach stabilization. The flow rate and water-level drawdown were measured and specific capacities were calculated. At the start of each work day, after allowing water levels to recover overnight, the Contractor also recorded the static water level in the manometer tube prior to resuming drilling operations. A linear trend between corrected water levels each day was then assumed and a "corrected static water level" measurement derived so that specific capacities performed throughout the day could be calculated.

Just prior to terminating the specific capacity test, a sample from the annulus was collected for field analysis of the parameters noted above. The annulus samples are considered a representative sample of the entire open borehole compared to the drill stem sample that preferentially is taken from the base of the pilot hole at the time the sample was collected. As pilot-hole drilling progresses, each annulus sample represents a greater depth interval. For example, the annulus sample in SGF-1 collected at a pilot hole depth of 1,248 feet bgl represents a mixture of formation water quality in the pilot hole interval between 1,000 feet (base of 28-inch casing) and 1,248 feet bgl (a depth interval of 248 feet). It should be noted that a greater percentage of each sample will be comprised of formation waters from highly transmissive intervals compared to formation intervals with more confining properties.

Summaries of pilot-hole water quality and specific capacity testing results are included in **Appendix B**. Further descriptions of water quality trends observed are provided in Section 5.3 below. Figures B-1 and B-2 in Appendix B show conductivity and chloride concentrations with depth of pilot-hole drill stem samples for both SGF-1 and SGF-2. Analyzing conductivity and chloride parameters serve to provide an indication of salinity trends in the Floridan Aquifer intersected by the pilot hole. For both wells, trends for chloride closely match the trends observed in conductivity. Figures B-3 and B-4 in Appendix B show conductivity and chloride concentrations from samples taken from the annulus for both SGF-1 and SGF-2.

Figure B-5 in Appendix B shows results from specific capacity testing in both SGF-1 and SGF-2. Figure B-6 shows the stabilized flow rates for each specific capacity test performed. As anticipated, specific capacity results generally increase as the pilot-hole interval increases and an ever greater portion of the artesian Floridan Aquifer is intersected. The tests performed between approximately 1,050 and 1,330 feet bgl show that specific capacity in SGF-1 appears to be slightly greater than SGF-2. Below 1,330 feet bgl, specific capacity results in SGF-1 and SGF-2 appear to be approximately the same.

5.2.3 Geophysical Logging

Geophysical logging was performed in the pilot-hole intervals of both SGF-1 and SGF-2 to achieve multiple objectives including: correlating drill cuttings collected during drilling; identifying formation boundaries; correlating vertical geological offsets between SGF-1 and SGF-2; and obtaining specific geologic and hydrogeologic data. These data were used to determine packer-testing intervals, identify transmissive and confining intervals and assist in selecting optimum production zones. Reamed-hole caliper logs were performed prior to casing installation to confirm appropriate casing setting depths and provide data for use in calculating theoretical casing-cementing volumes.

A summary of the geophysical logs performed in SGF-1 and SGF-2 is provided in **Table 4**. Hardcopies of the geophysical logs are provided with this report under separate cover. Video surveys performed are on DVDs included with the hardcopy logs (separate cover). Interpretations of the geophysical logs performed in the pilot holes within the Floridan Aquifer (approximately between 1,000 and 1,800 feet bgl) are provided in Section 5.3 below. Additional summary plots of the geophysical logs are provided as figures in **Appendix C** to assist in the interpretation of the logs and are as follows:

Figure C-1: SGF-1 log plots between ground level and 1,020 feet bgl

Figure C-2: SGF-1 static log plots between 1,000 and 1,800 feet bgl

Figure C-3: SGF-1 dynamic log plots between 1,000 and 1,800 feet bgl

Figure C-4: SGF-2 log plots between ground level and 980 feet bgl

Figure C-5: SGF-2 static log plots between 1,000 and 1,800 feet bgl

Figure C-6: SGF-2 dynamic log plots between 1,000 and 1,800

Figure C-7: Comparison of SGF-1 and SGF-2 log plots between ground level and 980 feet bgl (gamma-ray and dual induction)

Figure C-8: Comparison of SGF-1 and SGF-2 log plots between 1,000 and 1,800 feet bgl (gamma-ray and dual induction)

Figure C-9: Comparison of percent flow between 1,000 and 1,800 feet bgl (based on flowmeter logging)

5.2.4 Packer Testing

Four packer tests were conducted in SGF-1 and two packer tests were conducted in SGF-2. The tests were performed to determine the water quality and hydrologic properties of the test intervals. Excluding packer tests 3A and 3B in SGF-1, the packer tests utilized a single-packer assembly. Packer test intervals were carefully selected based on the drilling results, geophysical logs and video logs to ensure that the most appropriate intervals were tested and that the packer elements are seated on competent strata (reducing the chance of waters leaking around the packer element). A brief description of each packer test, including the primary test objectives, is included below. A summary of the water-sample analytical results and performance data from packer testing is presented as **Table 5**. Packer test water-quality summaries, charts and analytical reports are included in **Appendix D.**

SGF-1 Packer Test (PT) #1: Following geophysical logging in the pilot hole of SGF-1, the Contractor installed a single inflatable packer on drill pipe to 1,603 feet bgl (centerline of the packer element). After inflating the packer, the Contractor installed a submersible pump in the drill pipe. Water level transducers were installed in the drill pipe (above the pump) to measure water level changes in the test interval 1,603 to 1,800 feet bgl (below the packer) and the annulus outside the drill pipe so that water levels above the test interval could be measured to determine if any vertical formation leakance or leakage around the packer was occurring. The primary objective of this test was to determine the water quality and aquifer permeability so that the suitability of this lower “freshwater” zone as a production interval could be determined.

The Contractor began developing the interval between the packer and the total depth of the pilot hole (between 1,603 and 1,800 feet bgl) to remove suspended sediment and establish an appropriate pumping rate for the test. After developing for over 2 hours, the pump was turned off and water levels were allowed to recover to near static conditions. Following the recovery of the water level after development, the pump was turned back on, and the pumping portion of the test began at a pumping rate of 221 gpm. A totalizer was used to measure total flow volume and flowrate. During testing, water levels were measured in the drill pipe and annulus using the water level transducers and recorded on a data logger. Water quality samples were collected throughout the pumping test and field analyzed for temperature, conductivity and chloride. Just prior to terminating the pumping portion of the test, a final water sample was collected for laboratory analysis. The recovery portion of the test began when the pump was shut off. Water levels were measured during the recovery portion of the test to observe water levels returning to near static conditions.

SGF-1 Packer Test #2: The procedure for PT #2 was similar to PT #1 with the exception that the annulus located above the packer element was tested. For PT #2, the inflatable packer was set with a packer element centerline at 1,155 feet bgl and the interval between the base of the 28-inch O.D. casing (set at 1,000 feet bgl) and 1,155 feet bgl was tested. The primary objective of this test was to determine the water quality and aquifer permeability so that the suitability of this upper “freshwater” zone as a production interval

could be determined. During testing, the annulus was allowed to flow (under artesian conditions) at a rate of 479 gpm.

SGF-1 Packer Tests 3A and 3B: After completing PT #2, the Contractor removed the single packer from the well and installed a straddle packer assembly. The top packer was set at 1,528 feet bgl and the bottom packer was set at 1,569 feet bgl. The packers were connected with perforated drill pipe to facilitate the testing of the interval between the packers. A submersible pump and transducers were installed similar to PT #1. An additional transducer also was attached to the base of the bottom packer to record water level changes in the interval between the bottom packer and the base of the pilot hole (1,800 feet bgl) so that potential leakance from below the lower packer (due to packer bleed or formation leakance) could be measured. It should be noted that this transducer could not be vented to the atmosphere and therefore recorded absolute pressure. The primary objective of Packer Test 3A was to isolate the interval suspected to contain the most saline groundwater and determine the water quality within this zone. The primary objectives of Packer Test 3B, by testing the zone above this interval while monitoring pressure heads between the straddle packers, was to determine the potential for up-coning of the poor water quality by measuring vertical hydraulic connection, and to quantify the potential water quality and yield if the upper "freshwater" zone was extended to a greater depth to include some of the poorer quality groundwater.

For both PT #3A and PT #3B, testing was conducted without performing development of the tested interval. For PT #3A, the pump inside the drill pipe was turned on and the testing between 1,528 and 1,569 feet bgl was performed at a rate of 203 gpm. After completing testing, water levels in the drill pipe and annulus were allowed to recover for approximately 30 hours. Following recovery, the annulus outside the drill pipe (between 1,000 and 1,528 feet bgl) was allowed to flow under artesian conditions at a flow rate of 920 gpm.

SGF-2 Packer Test #1: For PT #1 in SGF-2, a single packer was installed to 1,628 feet bgl, and the interval between 1,628 and 1,800 feet bgl was tested to quantify the water quality and aquifer permeability so that the suitability of this lower "freshwater" zone as a production interval could be determined. . This test was performed similar to PT #1 performed in SGF-1, and was performed at a pumping rate of 190 gpm. It should be noted that this test was performed in SGF-2 prior to the Contractor extending the total depth of the pilot hole from 1,800 feet to 1,863 feet bgl.

SGF-2 Packer Test #2: After performing PT #1 in SGF-2, the Contractor removed the single packer from the well and extended the pilot an additional 63 feet to 1,863 feet bgl. The Contractor then reinserted the single packer to 1,801 feet bgl, and the interval between 1,801 and 1,863 feet bgl was tested. The primary objective of this test was to determine if this deeper interval would yield sufficient groundwater of suitable water quality that would support extending the lower "freshwater" zone to increase the viability of this zone as a lower production interval. This test was performed similar to PT #1 performed in SGF-1. The test pumping rate was 166 gpm.

Water-level data were used to estimate the horizontal hydraulic conductivity and transmissivity of each test interval. The horizontal hydraulic conductivity and transmissivity estimates assisted in determining the hydraulic performance of the tested strata. Analytical results from the water quality samples assisted in determining whether waters within the tested interval are of suitable quality to be included in the production interval of the completed wells. Results from the packer test are further described in Section 5 below.

5.3 Hydrogeological Setting

Based on the results obtained from drilling and testing described above, the hydrogeological setting surrounding the SGF-1 and SGF-2 well sites is summarized below.

Test Well SGF-1:

Ground level to 190 feet bgl: This interval incorporates the Surficial Aquifer System (Biscayne Aquifer) and primarily consists of interbedded layers of permeable limestone and sandstone with silty sands. Gamma-ray activity increases at approximately 50 feet bgl and again at 140 feet bgl.

190 to 480 feet bgl: This interval includes the top of the Hawthorn Group and primarily consists of fine unconsolidated silt with a small amount of clay, limestone and shell. Based on the dual induction log, formation waters within this interval become increasingly saline.

480 to 960 feet bgl: A formation change is observed near 480 feet from silt to interbedded layers of poorly consolidated limestone and calcareous clay of low plasticity. This transition also is observed with a spike in gamma-ray readings and a minor (but distinct) increase in the dual-induction log plot. As observed in the cuttings and spikes in the gamma-ray log plot, an interval of phosphatic clays is present between approximately 810 and 870 feet bgl.

960 to 995 feet bgl: More cohesive olive gray clay with higher plasticity is present within this interval. The upper transition to this clay is seen with a spike of gamma-ray readings at approximately 955 feet bgl. This interval is considered the lowermost confining interval above the Upper Floridan Aquifer.

995 to 1,120 feet bgl: Below 995 to 1,020 feet, a transition from clay to limestone is present and incorporates the base of the Hawthorn Group and the top of the Floridan Aquifer. From 1,020 to approximately 1,100 070 feet bgl, limestone with numerous phosphate grains are present as seen in the cuttings and as indicated with high gamma-ray activity. A highly transmissive fracture is present between 1,100 and 1,106 feet bgl as seen in the XY caliper, flowmeter and video log. Between 1,110 and 1,120 feet bgl, a quartz grainstone layer is present; a spike in gamma-ray counts and dual induction readings are seen in this interval. Based on flowmeter logging, this interval provides approximately 30% of the total flow from the pilot hole. Collection of pilot-hole water quality samples began at a depth of 1,033 feet bgl. Between

1,033 and 1,123 feet bgl, conductivity concentrations range between 8,960 and 9,560 μS/cm. Packer testing between 1,000 and 1,155 feet bgl (PT #2) show conductivity and TDS results of 9,200 μS/cm and 5,850 mg/L, respectively.

1,120 to 1,580 feet bgl: The interval between 1,120 and 1,580 feet bgl primarily consists of a poorly cemented limestone. A more competent limestone interval is present between 1,175 and 1,180 feet bgl which is observed in the cuttings, XY caliper, dual induction and sonic porosity log. A fracture is observed between approximately 1,240 and 1,245 feet bgl. Below this fracture a distinct decrease in percent flow (based on flowmeter logging) is observed (between 5% and 10%). Within this interval, down to 1,500 feet bgl, drill stem water quality shows an increasing salinity trend as indicated by conductivity and chloride results. The greatest salinity was observed at 1,465 feet bgl with conductivity readings up to 16,630 μS/cm. Packer testing between 1,528 and 1,569 feet bgl (PT #3A) shows conductivity and TDS results of 14,300 μS/cm and 9,070 mg/L, respectively. It should be noted that the waters within this test interval nearly exceeds the TDS limit (10,000 mg/L) of what is considered a potential USDW. Based on flowmeter logging, the interval between 1,120 and 1,580 feet bgl provides approximately 50% of the total flow from the pilot hole.

1,580 to 1,685 feet bgl: This interval is primarily identified as a transition to less saline formation waters as seen by the elevated readings seen on the dual induction log plot. Pilot hole water quality shows a decrease in conductivity from 14,040 μS/cm (at 1,588 feet bgl) to 5,970 μS/cm. Sonic porosity shows greater variation in this interval compared to the interval above. Based on the flowmeter log, this interval contributes approximately 15% of the total flow from the pilot hole. This interval primarily consists of a poorly cemented limestone.

1,685 to 1,800 feet bgl: This interval provides formation waters with the lowest salinity of the Upper Floridan Aquifer but shows low transmissivity compared to the intervals above. Conductivity from drill stem samples range between 5,970 μS/cm (at 1,682 feet bgl) and 6,080 μS/cm (at 1,800 feet bgl). Packer testing between 1,603 and 1,800 feet bgl (PT #1) shows conductivity and TDS results of 8,650 μS/cm and 5,300 mg/L, respectively. Based on the flowmeter log, this interval contributes approximately 10% of the total flow from the pilot hole. Although the pilot hole in SGF-1 was terminated at 1,800 feet bgl, construction and testing of Class I injection well systems at the Sawgrass Utility Complex (located less than 0.5 mile east of the SGF-1 site) intersected the base of the lowermost USDW at a depth of approximately 1,920 feet bgl. This interval consists primarily of a poorly cemented limestone.

Test Well SGF-2:

Ground level to 200 feet bgl: This interval incorporates the Surficial Aquifer System (Biscayne Aquifer) and primarily consists of interbedded layers of permeable limestone and silty sands. Less consolidated cemented sands (sandstone) were encountered in SGF-2 compared to SGF-1. Similar gamma-ray activity

was observed (at similar depths) as observed in SGF-1. The base of the Surficial Aquifer and the top of the Hawthorn Group were observed at 200 feet bgl (approximately 10 feet deeper than SGF-1).

200 to 490 feet bgl: This interval includes the top of the Hawthorn Group and primarily consists of a clayey silt with a small amount of limestone and shell. Based on the dual induction log, formation waters within this interval become increasingly saline. A 10-foot offset of formation features (with SGF-2 being deeper) is maintained in this interval.

490 to 978 feet bgl: A formation change is observed near 490 feet bgl from clayey silt to interbedded layers of poorly consolidated limestone and calcareous clay of low plasticity. This transition also is observed with a spike in gamma-ray readings and a minor spike in dual induction. As observed with the spikes in the gamma-ray log plot, an interval of phosphatic clays is present between approximately 820 and 870 feet bgl.

978 to 999 feet bgl: More cohesive olive gray clay with higher plasticity is present within this interval. The upper transition to this clay is seen with a spike of gamma-ray readings at approximately 970 feet bgl. This interval is considered the lowermost confining interval above the Upper Floridan Aquifer. The thickness of the confining layer in SGF-2 is 21 feet less than the confining layer observed in SGF-1, and the base of the confining layer in SGF-2 is 4 feet deeper than seen in the SGF-1.

999 to 1,140 feet bgl: Below 999 feet to 1,010 feet bgl a transition from clay to limestone is present and incorporates the base of the Hawthorn Group and the top of the Upper Floridan Aquifer System. From 1,020 to 1,080 feet, limestone with numerous phosphate grains is present as seen in the cuttings and as indicated with high gamma-ray activity. A highly transmissive fracture is present centered at 1,120 feet bgl (15 to 20 feet deeper than the fracture observed in SGF-1). Based on flowmeter logging, this interval provides approximately 30% of the total flow from the pilot hole. Between 1,083 and 1,150 feet bgl, drill stem conductivity concentrations range between 9,790 and 10,239 μS/cm; these results closely match the results seen in SGF-1.

1,140 to 1,610 feet bgl: The interval between 1,140 and 1,610 feet bgl primarily consists of a poorly to moderately cemented limestone. A small fracture is in the XY caliper log centered at 1,265 feet bgl. Below the fracture a distinct decrease in flow of 10% is observed. Between 1,140 and 1,426 feet bgl, drill stem water quality shows an increasing salinity trend with conductivity and chloride results similar to the trend observed in SGF-1. Conductivity concentrations increase from 10,239 μS/cm (at 1,150 feet bgl) to 15,854 μS/cm. Below 1,518 feet bgl, conductivity concentrations are elevated compared to concentrations in SGF-1. The highest concentration observed in SGF-2 was 19,190 μS/cm at a depth of 1,548 feet bgl. Although packer testing was not performed (and TDS concentrations were not analyzed) within the interval where the highest salinity is observed in the drill stem samples (between approximately 1,456 and 1,580 feet bgl), it is reasonable to assume that formation waters exceed USDW standards for TDS concentrations. A freshening trend is observed in the drill stem water quality below 1,548 feet to a depth of 1,674 feet bgl. Based on

flowmeter logging, the interval between 1,140 and 1,610 feet bgl provides approximately 35% of the total flow from the pilot hole.

1,610 to 1,705 feet bgl: This interval is identified as a transition to less saline formation waters to a depth of approximately 1,680 feet bgl as seen by the elevated readings seen on the dual induction log plot. Pilot hole water quality shows a decrease in conductivity from 16,645 μS/cm (at 1,611 feet bgl) to 10,465 μS/cm (at 1,674 feet bgl). It's important to note that although a freshening trend is observed, formation waters appear to be more saline in this interval compared to SGF-1. Between 1,680 and 1,705 feet bgl, a permeable zone with higher saline waters are present. This saline interval is observed in the lower readings of the dual induction log and in the drill stem water quality samples with conductivity concentrations spiking to 16,270 μS/cm (at 1,705 feet bgl). Based on the flowmeter log, this interval contributes approximately 25% of the total flow from the pilot hole. Packer testing was performed in SGF-2 between 1,628 and 1,800 feet bgl showing elevated readings in conductivity and TDS concentrations compared to packer testing in SGF-1 at a similar depth interval (between 1,603 and 1,800 feet bgl). This interval consists primarily of a poorly cemented limestone.

1,705 to 1,863 feet bgl: Below 1,705 feet bgl, a freshening trend occurs with drill stem water quality showing conductivity concentrations decreasing from 16,270 μS/cm (at 1,705 feet bgl) to 7,110 μS/cm (at 1,863 feet bgl). Packer testing between 1,800 and 1,863 feet bgl shows conductivity and TDS results of 6,970 μS/cm and 4,330 mg/L, respectively. Based on the flowmeter log, the interval below 1,705 feet bgl only contributes approximately 10% of the total flow from the pilot hole.

5.4 Final Design and Testing

The original design for both wells included an approximate setting for the FRP tubing at 1,600 feet bgl and an open-hole interval between 1,600 and 1,750 feet bgl. As noted in Section 2 above, a primary design objective is to complete the wells in permeable strata with acceptable water quality. It was later agreed by the City, MWH and Malcolm Pirnie/ARCADIS that the primary guideline for determining acceptable water quality would be formation waters with TDS concentrations no greater than 6,000 mg/L.

Based on packer testing in SGF-1, two separate formation intervals meet the TDS criteria. The interval between 1,000 and 1,155 feet bgl (Upper "Freshwater" Zone) has an average TDS concentration of 5,850 mg/L, and the interval between 1,603 and 1,800 feet bgl (Lower "Freshwater" Zone) shows a slightly lower TDS with an average concentration of 5,300 mg/L. Both the Upper and Lower Freshwater Zones in SGF-1 show similar salinity concentrations, but the Upper Freshwater Zone contributes 30% of the total flow from the pilot hole compared to the Lower Freshwater Zone that contributes approximately 20% of the total flow. Also, the Lower Freshwater Zone is a relatively narrow lens of less saline groundwater with brackish groundwater with salinities greater than a TDS of 10,000 mg/L water located above and below. Completing the production interval within the Lower Freshwater Zone would increase the risk of vertical migration (either

upwards, downwards or both) of brackish water contaminating production interval. For these reasons, it was jointly determined that the production interval in SGF-1 would be completed in the Upper Freshwater Zone. The production interval in SGF-1 was completed between 1,006 feet bgl (base of FRP tubing) and 1,127 feet bgl.

Data obtained in the pilot hole of SGF-2 showed similar results to the data obtained in SGF-1. An Upper Freshwater Zone is identified between approximately 1,000 and 1,150 feet bgl primarily based on drill stem water quality samples. The Lower Freshwater Zone is not as clearly identified in SGF-2 compared to SGF-1. Based on drill stem water quality samples and dual induction logging, the Lower Freshwater Zone occurs below 1,620 feet bgl with a discreet lens of brackish water near 1,700 feet bgl. The original pilot hole at SGF-2 was extended to 1,800 feet bgl. As seen in the drill stem water quality samples and the flowmeter log, a clear freshening trend with low permeability was observed between 1,705 and 1,800 feet bgl. Based on this trend, it was decided to extend the pilot hole approximately 60 feet (actual depth to 1,863 feet bgl) in an attempt to locate a permeable freshwater zone. A packer test was then performed between 1,801 and 1,863 feet bgl, providing the freshest water quality observed in either the SGF-1 or SGF-2 pilot holes with a conductivity concentration of 6,970 μS/cm and a TDS concentration of 4,330 mg/L. However, the permeability of the Lower Freshwater Zone in SGF-2 was too low to be an effective production interval, and it was jointly decided that the production interval in SGF-2 would be completed in the Upper Freshwater Zone. The production interval in SGF-2 was completed between 1,014 feet bgl (base of FRP tubing) and 1,150 feet bgl.

After the final design for each well was determined the general sequence of work performed is outlined below and pertinent construction and testing procedures are described further in subsequent report sections.

1. Plug back the pilot hole to approximately the base of the open-hole production zone.

2. Ream the pilot hole to the base of the open hole production interval and perform geophysical logging

3. Install FRP tubing to the selected setting depth and fill the reamed hole with gravel to the base of the FRP tubing.

4. Cement the FRP tubing to surface.

5. Perform plumbness and alignment testing, remove gravel from open hole and acidize the production interval

6. Perform airlift and pump development of the production interval

7. Perform aquifer performance testing including step testing and 72-hour constant rate pump testing. Collect water quality sample for analysis of primary and secondary drinking water standards at the end of the constant rate pump test.

8. Perform final video survey and cement bond logging

5.4.1 Final Tubing Installation

After performing packer testing in the pilot holes and the final design of the wells were determined, the Contractor performed backplugging of the pilot holes. Between 1,587 and 1,800 feet bgl, the pilot hole in SGF-1 was filled with gravel, and between 1,121 and 1,587 feet bgl, the pilot hole was filled with cement. The purpose of filling the interval between 1,587 and 1,800 with gravel was to provide an opportunity to complete the well within a deeper production interval if deemed necessary. In SGF-2, the entire pilot hole between 1,155 and 1,863 feet bgl was filled with cement. Based on additional testing in SGF-1 and SGF-2 after the pilot hole in SGF-1 was backplugged with gravel and cement, it was determined that the production interval in SGF-2 would not be completed within the deeper interval. Therefore the pilot hole in SGF-2 was backplugged with cement.

The remaining open-hole portion of each pilot hole was then reamed to a nominal 28-inch diameter borehole to a depth of 1,127 feet bgl in SGF-1 and to a depth of 1,150 feet bgl in SGF-2. X-Y caliper and gamma-ray logging was then performed in each well. Following geophysical logging, 16-inch I.D. FRP tubing was installed to 1,006 feet bgl in SGF-1 and to 1,014 feet bgl in SGF-2. Gravel was then installed into the reamed hole (through the FRP tubing) to the base of the tubing. After installing the gravel, the Contractor installed steel cement tubing in the annulus between the 28-inch O.D. steel casing and the FRP tubing and began cementing the FRP tubing in stages. After the first cement stage in SGF-1 was performed (top of cement at 982 feet bgl), the Contractor performed background cement-bond logging. After the second cement stage in SGF-2 (top of cement at 890 feet bgl), the Contractor performed background cement-bond logging. Further discussion on cement-bond logging is included Section 5.4.6 of this report. Following background cement-bond logging in each well, the Contractor continued cementing the FRP tubing to ground level in stages.

After cementing the FRP to surface, the Contractor performed plumbness and alignment testing of the tubing to ensure the wells are round, plumb and true to line. The plumbness and alignment testing was performed in accordance with the specifications and American Water Works Association (AWWA) Standard 100 for Water Wells, and the results from testing met standard requirements.

5.4.2 Acidization

After performing plumbness and alignment testing, the Contractor installed a drill bit inside the FRP tubing and began removing the gravel from inside the tubing and the open hole. After removing the gravel in SGF-1 to a depth of 1,127 feet bgl, the Contractor performed a specific capacity test of the production interval resulting in a specific capacity of 13.4 gpm/ft. In an effort to improve the performance of the production interval, acidization of the open hole was performed as outlined below:

1. An inflatable packer was installed on drill pipe and set near the base of the FRP tubing

2. Steel tubing (acid line) was then installed inside the drill pipe to 1,035 feet bgl; immediately above the uppermost permeable interval (determination based on XY caliper and flowmeter logging).

3. Freshwater was then pumped through the drill pipe for approximately 15 minutes. A 31.5% hydrochloric acid solution then was pumped through the acid line while continuing to pump freshwater through the drill pipe at an approximate ratio of 1 to 1 (acid to freshwater). During acid pumping, wellhead pressures were continuously monitored.

4. After injecting approximately 2,500 gallons of acid, the acid line was flushed with freshwater, and the well was then shut in for 1 hour.

5. After shutting in the well for 1 hour, freshwater flow was reestablished in the drill pipe, and acid was again injected through the acid line at a 1 to 1 ratio. Another 2,500 gallons of acid was injected for a total acid volume of 5,000 gallons.

6. The acid line was again flushed with freshwater and the well was shut in overnight. Wellhead pressures were monitored for several hours after shutting in the well.

7. The following day, the Contractor removed the spent acid from the well. The spent acid was neutralized to a pH of 7 prior to discharge.

After removing gravel inside the FRP tubing and open hole in SGF-2, the Contractor performed several hours of airlift development. Following development, a specific capacity test was performed resulting in a specific capacity of 32 gpm/ft. Although the specific capacity was considerably greater in SGF-2 compared to SGF-1 (13.4 gpm/ft), the City requested that acidization be performed in an effort to achieve the highest performance possible in the production interval. The same acid procedure was performed in SGF-2 as was performed in SGF-1. The acid line in SGF-2 was installed to 1,064 feet bgl.

5.4.3 Development

After acidization, the Contractor developed the production interval of both wells. Initial development consisted of airlifting. Airlift development was performed in both wells for approximately two days. Following airlifting, the Contractor installed a submersible pump and resumed developing by pump surging. During pump development, sand content was measured on multiple occasions each day using a Rossum sand tester. Pump development was considered complete when sand content was at or below 1 part per million (ppm) at the approximate design rate (approximately 1,400 gpm). Pump surging was performed in SGF-1 for approximately 13 days and in SGF-2 for approximately 2 days.

5.4.4 Step Rate Pump Testing

After development was considered complete, a step rate pump test was performed for each well. The step-rate test in SGF-1 was performed on November 20, 2012, and the step-rate test in SGF-2 was performed on March 18, 2013. Summary tables and charts of data collected during step rate testing in both wells are provided in **Appendix E**.

SGF-1 Step Rate Test

The step rate test in SGF-1 consisted of 4 steps of increased pumping at average rates of 845 gpm (61% of design rate), 1,114 gpm (80%), 1,399 (101%) and 1,725 (124%). Each step was pumped at a nearly constant rate for more than 1 hour. Prior to performing the test, the Contractor installed a transducer in the well to monitor water levels. During testing, sand content was continuously monitored. With the exception of the highest pumping rate (1,710 gpm), sand content remained below the specified limit of 1 ppm. Near the end of each step, a water quality sample was collected for field analysis of conductivity, temperature, pH, hydrogen sulfide, chloride and turbidity.

Silt density index (SDI) testing also was performed at the end of each step. SDI is a measure for the fouling capacity of water in reverse osmosis systems. The test measures the rate at which a 0.45-micrometre filter is plugged when subjected to a constant water pressure of 30 psi. Specifications require that SDI shall not exceed a value of 3 any time after 20-minutes of pumping. The maximum SDI was observed at the highest flow rate with a value of 1.6. At the end of the test, pumping was terminated and the recovery portion of the test began. During recovery water levels were measured to observe water levels returning to near static conditions.

SGF-2 Step Rate Test

Step rate testing in SGF-2 was performed using the same procedures as the test performed in SGF-1. The average pumping rates for the SGF-2 test were: 852 gpm (61% of design rate), 1,095 gpm (79%), 1,440

(104%) and 1,742 gpm (126%). Sand content remained below 1 ppm with the greatest sand content observed at the highest pump rate (1,742 gpm) at 0.95 ppm. SDI results show a downward trend as the pumping rates increased from a value of 5.5 to a value of 1.9. Decreasing SDI values with increasing pumping rates and increasing sand content is counterintuitive. Nevertheless, because SDI values were below specified limits at the pumping rates above the design rate of 2 MGD (1,388 gpm), the test was deemed successful.

5.4.5 Constant Rate Pump Testing

Constant rate pump testing was completed with several broad objectives; to determine the hydraulic performance of each well; to determine the combined well interference effects so that combined pumping rates and pump setting depths could be recommended; to determine local aquifer parameters that could in the future be used to determine the viability and design of a Floridan Aquifer well field with multiple production wells.

Three tests were completed and are summarized below. Constant rate tests with just one well pumping were initially performed for each well. These tests were performed following step rate testing. Water levels were monitored for several days following step rate testing to allow the water levels to recover before performing the constant rate tests for approximately 72 hours in SGF-1 and SGF-2. The pump test for SGF-1 was conducted between November 26, 2012 and November 29, 2012, and in SGF-2 between March 25, 2013 and March 28, 2013. After performing the constant rate test in SGF-2, water levels again were allowed to recover. A third pump test was then performed by simultaneously pumping both SGF-1 and SGF-2. The combined constant rate test was conducted between April 2, 2013 and April 5, 2013. Summary tables and charts of data collected during constant rate pump testing are provided in **Appendix E**.

<u>SGF-1 Constant Rate Test</u>

The constant rate pump test in SGF-1 was performed for approximately 73 hours at an average rate of 1,450 gpm. Water levels in SGF-1 (pumped well) and SGF-2 (observation well) were measured using a water level transducer in each well. It should be noted that the Contractor was performing pilot hole drilling in SGF-2 prior to performing step rate and constant rate pump testing in SGF-1. The Contractor extended the pilot hole in SGF-2 to 1,150 feet bgl by November 19, 2012. The drill bit was then removed from the well and water levels were monitored during the entire background, pumping and recovery portions of both the step rate test and constant rate test performed in SGF-1.

The static depth to water at SGF-1 and SGF-2 at the start of the test was 40.8 and 43.3 feet above ground level (agl), respectively. The maximum depth to water in SGF-1, measured at the end of the test, was 17.5 feet bgl (drawdown of 58.3 feet); in SGF-2, the maximum depth to water was measured at 25.8 feet agl (drawdown of 17.5 feet). It should be noted that water levels did not stabilize in SGF-1 or SGF-2 during the

entire duration of pumping. Just prior to shutting down the pump and beginning the recovery portion of the test, the Contractor collected a water quality sample for analysis of primary and secondary drinking water standards. After pumping, the water level in SGF-1 had recovered to nearly 1 foot of the original pre-test static level after approximately 4 days of recovery. The water level in SGF-2 recovered to approximately 1.5 feet of the original pre-test static level after approximately 4 days of recovery.

The overall specific capacity in SGF-1 was determined to be 24.9 gpm/ft (1,450 gpm/58.3 feet of drawdown). The transmissivity value can be estimated at 39,900 gpd/ft of drawdown using a method developed by Jacob (1946b). This is considered an apparent transmissivity near the well bore. Recovery test data were used for the calculation. The use of the recovery data is generally preferable because those data are less impacted by radial and convergent flow into the pumped well and by well inefficiencies. Using a method developed by Turcan (1963) for estimating the specific capacity of a partially penetrating well, transmissivity was estimated at 43,500 gpd/ft. This value may be more representative of the full aquifer thickness.

SGF-2 Constant Rate Test

The constant rate pump test in SGF-2 was performed for approximately 72 hours at an average rate of 1,450 gpm. Water levels in SGF-2 (pumped well) and SGF-1 (observation well) were measured using a water level transducer in each well. It should be noted that at the time of testing in SGF-2, SGF-1 was completed with an open hole between 1,006 and 1,127 feet bgl. It should also be noted that another well completed within the Floridan Aquifer was also monitored during the SGF-2 constant rate test and during the SGF-1 and SGF-2 combined pump test (discussed below). The well is referred to in this report as the "Melalueca Well". The Melalueca Well is located approximately 1.8 miles southeast of SGF-1 and 2.25 miles southeast of SGF-2. Water levels monitored in the Melalueca well during pump testing is included in Appendix E, Figure E-9.

The static depth to water at SGF-2 and SGF-1 at the start of the test was 40.2 and 37.6 feet agl, respectively. The maximum depth to water in SGF-2, measured at the end of the test, was 20.5 feet bgl (drawdown of 60.5 feet); in SGF-1, the maximum depth to water was measured at 20.5 feet agl (drawdown of 17.1 feet). As with the test performed in SGF-1, water levels did not stabilize in either well during the entire duration of pumping. Just prior to shutting down the pump and beginning the recovery portion of the test, the Contractor collected a water quality sample for analysis of primary and secondary drinking water standards. After pumping, the water level in SGF-2 had recovered to nearly 1 foot of the original pre-test static level after approximately 4.5 days of recovery. The water level in SGF-1 also recovered to approximately 1 foot of the original pre-test static level after approximately 4.5 days of recovery.

The overall specific capacity in SGF-2 was determined to be 24.0 gpm/ft (1,450 gpm/60.5 feet of drawdown). The transmissivity value can be estimated at 43,000 gpd/ft of drawdown using the Jacob method (1946b).

Recovery test data were used for the calculation. Using the Turcan method (1963), transmissivity was estimated at 42,000 gpd/ft.

SGF-1 and SGF-2 Combined Pump Test

Prior to step rate and constant rate testing in SGF-2, a submersible was installed in SGF-1. Following recovery from the SGF-2 constant rate test, the Contractor began pumping from both SGF-1 and SGF-2. The combined constant rate test was performed for approximately 77 hours. It should be noted that the test was extended an additional 5 hours (beyond the typical 72 hour period) due to a temporary shut down of both pumps on April 3, 2013 for approximately 2.5 hours. The average pumping rate in SGF-1 was 1,418 gpm with fluctuations in rates ranging between 1,345 gpm and 1,537 gpm. The average pumping rate in SGF-2 was 1,436 gpm with fluctuations in rates ranging between 1,415 gpm and 1,479 gpm. The variable pump rates were primarily caused by the fluctuating head pressures in the discharge piping. The discharge from SGF-1 was combined with the discharge from SGF-2 several feet downstream of SGF-1.

The static depth to water at SGF-1 and SGF-2 at the start of the test was 36.7 and 39.2 feet agl, respectively. The maximum depth to water in SGF-1, measured at the end of the test, was 33.6 feet bgl (drawdown of 70.4 feet); in SGF-2, the maximum depth to water was measured at 31.4 feet bgl (drawdown of 70.4 feet). The overall specific capacity in SGF-1 was determined to be 20.2 gpm/ft (1,418 gpm/70.4 feet of drawdown). The overall specific capacity in SGF-2 was determined to be 20.4 gpm/ft (1,436 gpm/70.4 feet of drawdown). In general specific capacities of the wells show a decrease of approximately 4 gpm/ft when pumping both wells compared to pumping only one well at similar pump rates.

A projected pumping water level has been predicted for both SGF-1 and SGF-2. Because wells typically decrease in efficiency over time and pumping water levels did not stabilize during the constant rate tests, a 20% decline in the calculated specific capacity (based on the combined constant rate test) with both wells operating at the design rate of 2 MGD has been assumed (from 20.2 gpm/ft to 16.2 gpm/ft). Water level recovery data collected after each constant rate test show that several days of non-pumping conditions are required for water levels to recover to near static levels. Because of the slow recovery after pumping, an additional 5 feet of water level drawdown is assumed (noted below as local interference). We also assumed that water levels may drop due to seasonal decline, but it was considered unlikely the water level will drop by more than 3 feet. Based on assumptions noted above and using a static water level of 40 feet above ground level (approximate static water level in SGF-1 prior to the SGF-1 constant rate test), the pumping water level in SGF-1 and SGF-2 at the design pump rate of 2 MGD can be predicted as:

- Static depth to water: 40 feet agl
- Specific Capacity (assuming 20% decline): 16.2 gpm/ft

- Stabilized Drawdown (based on a specific capacity of 16.2 gpm/ft): 86 feet
- Local Interference: 5 feet
- Seasonal Decline: 3 feet
- Total depth to water: 54 feet bgl

5.4.6 Cement Bond Logging

During the early stages of construction at SGF-1 (approximately June 2012), the City requested for the Engineer to investigate the feasibility of converting the test wells to ASR wells in the future. ASR wells are classified as Class V injection wells and are regulated under FDEP UIC. FDEP was contacted to determine what testing would be required during construction beyond what was already specified. FDEP required that cement bond logging (CBL) be performed in the final FRP tubing to provide further evidence that the wells possess mechanical integrity.

As briefly discussed in Section 5.4.1 above, background CBLs in SGF-1 and SGF-2 were performed prior to cementing the FRP tubing to ground level. The purpose of the background CBLs is to calibrate the CBL tool to the free pipe signal of the un-cemented tubing. The background CBL was performed in SGF-1 on September 27, 2012 and in SGF-2 on January 24, 2013. The final CBL of the cemented FRP was performed in SGF-1 on December 3, 2012 and in SGF-2 on April 17, 2013. CBLs typically are performed in steel casing to demonstrate the presence of cement behind the casing and that the bond between the casing and cement and between the cement and formation are established. Due to the large diameter (16-inch I.D.) and makeup (fiberglass reinforced plastic), it is very difficult to determine the quality of the cement bond around the tubing. However, the signal amplitudes in the un-cemented CBL logs for both wells are consistently higher the amplitudes observed in the post-cement CBL logs. This demonstrates that cement is present around the FRP tubing. Hardcopies of the CBLs are provided with this report under separate cover.

5.4.7 Final Video Survey

The final video inspection in SGF-1 was performed on December 3, 2012. The video showed the FRP tubing in good condition and the base of the tubing was observed at 1,006 feet bgl. The video also showed that the open hole section was filled with sediment up to 1,106 feet bgl. The Contractor was instructed to clean out the bottom of the borehole to the original open hole depth of 1,127 feet bgl.

The final video inspection in SGF-2 was performed on April 11, 2013. The video showed the FRP tubing in good condition and the base of the tubing was observed at 1,014 feet bgl. The video also showed that the

open hole section was filled to 1,136 feet bgl. The Contractor was instructed to clean out the bottom of the borehole to the original open hole depth of 1,150 feet bgl.

6. Summary

Two Floridan Aquifer test wells, SGF-1 and SGF-2 were successfully constructed and tested for the City of Sunrise near the Sawgrass Utility Complex. The Surficial Aquifer and Hawthorn Group formation are isolated from the Upper Floridan Aquifer production with 36-inch O.D. casing (installed to the base of Surficial Aquifer) and 28-inch O.D. casing (installed near the base of the Hawthorn Group).

Groundwaters within the Upper Floridan Aquifer between approximately 1,000 feet and 1,863 feet bgl can be separated into three general intervals based on salinity. Between approximately 1,000 feet and 1,155 feet bgl, the formation observed in both wells appear to possess groundwaters with acceptable TDS concentrations (under 6,000 mg/L). This interval is referred to as the Upper "Freshwater" Zone in this report. Below 1,155 feet bgl, the salinity of the formation waters increase rapidly, with salinities as measured by TDS exceeding 10,000 mg/L between approximately 1,450 feet and 1,580 feet bgl, beyond the TDS concentrations within USDW limits (10,000 mgl). Below approximately 1,580 feet bgl in SGF-1 and below 1,610 feet bgl in SGF-2, a reversal in salinity trends occur and a lower "Freshwater" zone is identified with the formation waters becoming fresher. One exception was seen in SGF-2 where a permeable zone of more brackish water is observed near 1,700 feet bgl. Based on the construction and testing of Class I injection wells in the Sawgrass Utility Complex, formation waters again become highly saline with the lowermost USDW base identified near 1,940 feet bgl.

The intent of the original well design was to complete the open hole intervals within the Lower "Freshwater" Zone. However, it was ultimately considered that the permeability within the thin freshwater lens referred to in this report as the Lower "Freshwater" Zone was too low to be considered a viable production interval. Due in part to the low permeability, there was also concern that vertical migration of more saline groundwaters from either above or below this zone would result in increased salinities that could permanently impact this production interval.

The production intervals for both SGF-1 and SGF-2 were completed within the Upper "Freshwater" Zone. Although this zone possesses greater permeability than the Lower "Freshwater" Zone, pump tests performed in both wells show that multiple days are required for water levels to recover to near static conditions after pumping. This response indicates a local depletion in aquifer storage during testing, and the need for the wells to capture groundwater from a much greater radial distance in order to sustain the withdrawals. If the test wells are placed into service, it is recommended that water levels are monitored carefully to check for declines over time that may indicate depletion in aquifer storage. The operation of both wells at their design rate of 2 MGD should be possible. However the more conservative approach would be

to stagger the operation of the wells by pumping only one well at a time. Following these recommendations should reduce the potential for declining water levels and a likely reduction in well yield over time.

Electronic files of data collected during construction and testing of SGF-1 and SGF-2 and other pertinent information are included on a compact disc (CD) in **Appendix F**.

Tables

Table 1A. Summary of Construction and Testing Activities, Sawgrass Test Well SGF-1, City of Sunrise, Florida

Test Well SGF-1				
Week #	Date	Time		Description
		from	to	
1 thru 6	3/30/12			Notice of Commencement issued for March 30, 2012
	4/2/12			Begin preparing and mobilizing SGF-1 site
	5/3/12			Install 48-inch outside diamter (O.D.), 0.375-inch wall thickness pit casing to 41 feet below ground level (bgl [ground level is top of roadway])
	5/11/12			Mobilization complete for SGF-1
7	5/14/12			Drill out cement plug at base of pit casing using 46-inch bit
	5/15/12		19:00	Begin drilling pilot hole from base of pit casing using 10-inch bit; extend pilot hole to 62 feet bgl
	5/16/12	7:00	19:00	Extend pilot hole from 62 feet to 156 feet bgl
	5/17/12	7:00	14:20	Extend pilot hole from 156 feet to total depth of 225 feet bgl
	5/18/12	7:00	14:50	Perform wiper trip and then perform XY caliper, gamma-ray and dual induction logging to 225 feet bgl
8	5/21/12			Begin reaming from base of pit casing using 46-inch bit; extend reamed borehole to 48 feet bgl
	5/22/12			Extend reamed borehole to 59 feet bgl
	5/23/12			Extend reamed borehole to 77 feet bgl
	5/24/12			Extend reamed borehole to 180 feet bgl
	5/25/12			Extend reamed borehole to total depth of 217 feet bgl; clean and circulate borehole
9	5/28/12			No onsite work performed (Memorial Day)
	5/29/12	10:00	14:15	Perform wiper trip and then perform XY caliper and gamma-ray logging to 229 feet bgl (bottom of stinger bit ~12 feet below 46-inch bit)
	5/30/12	10:25	16:00	Install 36-inch O.D., 0.375-inch wall thickness surface casing to 215 feet bgl
		17:40	18:34	Perform pressure grout (STAGE #1); pump 65 barrels of neat cement
	5/31/12	8:30	9:55	Perform cement-top temperature log and then tag top of cement after STAGE #1 at 157 feet bgl
		13:52	15:17	Perform tremmie grout (STAGE #2); pump 116 barrels of neat cement; cement returns observed at surface
	6/1/12			Performed site maintenance and repairs
10	6/4/12			Begin drilling cement plug inside 36-inch O.D. casing using 30-inch bit
	6/5/12	7:00	23:59	Drill to top of previous pilot hole (225 feet bgl) using 30-inch bit. Begin drilling pilot hole from 225 feet bgl using 12-inch bit; extend pilot hole to approximately 342 feet bgl. Begin working 24 hour work schedule (Day shift and Night Shift)
	6/6/12	0:00	23:59	Extend pilot hole to 728 feet bgl
	6/7/12	0:00	21:00	Extend pilot hole to 1,020 feet bgl; Note: Contractor was directed by Engineer to drill pilot hole an additional 20 feet to 1,020 feet bgl
	6/8/12	10:00	13:30	Perform XY caliper, gamma-ray, dual induction, spontaneous potential and sonic logging

Table 1A. Summary of Construction and Testing Activities, Sawgrass Test Well SGF-1, City of Sunrise, Florida

Test Well SGF-1				
Week #	Date	Time		Description
		from	to	
11 & 12	6/12/12		20:30	Begin reaming from base of 36-inch O.D. surface casing using 34-inch bit; extend reamed borehole to 375 feet bgl
	6/12/12	20:30		Make repairs (replace swivel); resume drilling at 375 feet bgl
	6/19/12		3:00	
	6/19/12	3:00	23:59	Extend reamed hole to 656 feet bgl
	6/20/12	0:00	23:59	Extend reamed hole to approximately 799 feet bgl
	6/21/12	0:00	23:59	Extend reamed hole to 921 feet bgl
	6/22/12	0:00	19:00	Extend reamed hole to 975 feet bgl
13	6/25/12		20:30	Extend reamed hole to 986 feet bgl
	6/26/12		18:30	Extend reamed hole to a total depth of 1,004 feet bgl
		19:00	20:50	Perform XY caliper and gamma-ray logging
	6/27/12	11:00		Perform wiper trip and then begin installing 28-inch O.D., 0.375-inch wall thickness, intermediate casing
	6/28/12		7:20	Complete installation of 28-inch O.D. casing to 1,000 feet bgl
		10:20	11:55	Perform pressure grout (STAGE #1); pump 101 barrels of neat cement
		21:45	23:35	Perform cement-top temperature log and then tag top of cement after Stage #1 at 738 feet bgl
	6/29/12	23:45	1:30	Perform tremmie grout (STAGE #2); pump 121 barrels of cement with 6% bentonite
		6:00	12:55	Perform cement-top temperature log and then tag top of cement after Stage #2 at 255 feet bgl
		16:40	17:50	Perform tremmie grout (STAGE #3); pump 101 barrels of cement with 6% bentonite, cement returns observed at surface
14	7/2/12			Drill out cement plug at base of 28-inch casing; begin converting from mud-rotary drilling to reverse-air drilling. Road cut and pipe installation across International Parkway performed on 7/6/12.
	7/6/12			
15	7/9/12			Continue converting to reverse-air drilling and installing temporary discharge piping. Road cut and pipe installation across NW 8th Street performed on 7/10/12.
	7/13/12			
16	7/16/12			Continue converting to reverse-air drilling and installing temporary discharge piping.
	7/20/12			
17	7/23/12			Continue converting to reverse-air drilling and installing temporary discharge piping. Road cuts and pipe installation within WWTF (2 total) performed on 7/25/12.
	7/27/12			
18	7/30/12			Install 10-inch bit to base of 28-inch casing and clean out remaining drilling mud
	7/31/12			Continue cleaning borehole
	8/1/12			Continue cleaning borehole; collect lab samples of circulation fluid for TSS to correlate turbidity with TSS
	8/2/12			Begin drilling pilot hole at 1,010 feet bgl using 10-inch bit below 28-inch casing (set at 1,000 feet bgl). Extend pilot hole to 1,053 ft bgl
	8/3/12			Extend pilot hole to 1,123 feet bgl

Table 1A. Summary of Construction and Testing Activities, Sawgrass Test Well SGF-1, City of Sunrise, Florida

Test Well SGF-1				
Week #	Date	Time		Description
		from	to	
19	8/6/12			Extend pilot hole to 1,248 feet bgl
	8/7/12			Extend pilot hole to 1,340 feet bgl
	8/8/12			Extend pilot hole to 1,465 feet bgl
	8/9/12			Extend pilot hole to 1,618 feet bgl
	8/10/12			Extend pilot hole to 1,774 feet bgl
20	8/13/12			Extend pilot hole to total depth of 1,800 feet bgl; Perform wiper trip and clean borehole
	8/14/12			Performed site work at SGF-1 & SGF-2; allowed well to establish static conditions prior to geophysical logging
	8/15/12			Perform suite of static & dynamic geophysical logs from base of 28-inch casing to 1,800 feet bgl
	8/16/12			Installing temporary pipeline from SGF-2 to SGF-1
	8/17/12			Continue installing temporary pipeline from SGF-2 to SGF-1
21	8/20/12		18:40	Install single packer to 1,603 ft bgl (centerline of packer); and begin development; PACKER TEST #1 (1,603 - 1,800 ft bgl)
			20:55	Complete development and begin recovery
	8/21/12	7:37	11:39	Perform pumping portion of packer test #1 at a stabilized flow rate of 221 gpm
		11:39		Turn off pump and begin recovery; Note: Between 15:30 and 16:27, Pump was removed from well to create a better seal at wellhead
	8/22/12		7:15	Stop recording recovery data for Packer Test #1
			14:14	Move single packer to 1,153 feet bgl and begin development by allowing annulus to flow; PACKER TEST #2 (1,000 - 1,153 feet bgl)
			20:50	Complete development and begin recovery
	8/23/12	7:10		Perform pumping portion of packer test #2 at a stabilized flow rate of 479 gpm
	8/24/12		17:55	
	8/24/12	17:55		Shut annulus valve and allow water levels to recover for the remainder of the week
22	8/28/12		6:58	Stop recording recovery data for Packer Test #2
	8/29/12		16:54	Install straddle packer to between 1,528 and 1,569 ft bgl; and begin pump portion of test (no development was performed) at a stabilized rate of 203 gpm; PACKER TEST #3A (1,528 - 1,569 ft bgl).
		22:07		Turn off pump and begin recovery
	8/31/12		6:06	End recovery for Packer Test 3A and begin pumping portion of next packer test by allowing the annulus to flow at a stabilized flow rate of 920 gpm; PACKER TEST #3B (1,000 - 1,528 ft bgl)
			12:08	Shut annulus valve and begin recovery. Record recovery data through the weekend
23	9/4/12			Stop recording recovery for Packer Test #3B
	9/5/12			USGS onsite to perform logging
	9/6/12			
24	9/11/12			Contractor provided lab results for all packer tests, Engineer directed Contractor to backfill the pilot hole
	9/13/12			Suppress water level with salt and installed 4.5 yd^3 of gravel between 1,587 and 1,800 feet bgl
	9/14/12			Pumped 60 barrels in pilot hole in 2 cement stages. Cemented pilot hole from 1,587 to 1,259 feet bgl

Table 1A. Summary of Construction and Testing Activities, Sawgrass Test Well SGF-1, City of Sunrise, Florida

Test Well SGF-1				
Week #	Date	Time		Description
		from	to	
25	9/17/12			Pumped an additional 26 barrels in pilot hole in 2 cement stages (Stages 3 and 4). Cemented pilot hole from 1,259 to 1,121 feet
	9/18/12			Begin installing 26-inch bit and drill pipe
	9/19/12	11:00	18:45	Install 26-inch bit and drill pipe to 1,000 feet bgl and begin reaming; extend nominal 28-inch reamed hole to 1,030 feet bgl
	9/20/12	7:00	10:20	Extend reamed hole to 1,055. Discontinued drilling due to high turbidity readings of discharge fluids. Begin converting from open-circulation discharge to closed circulation.
		17:16	19:00	Resume drilling; extend reamed hole to 1,070 feet bgl
	9/21/12	7:00	16:30	Extend reamed hole to total depth of 1,127 feet bgl
26	9/24/12			Suppress water level with salt and remove 26-inch bit from well. Perform maintenance on rig
	9/25/12			Perform XY caliper and gamma-ray logging
				Install 10 yd^3 of gravel in borehole
	9/26/12			Install 16-inch ID FRP tubing to 1,006 feet bgl
	9/27/12			Install 12 yd^3 of gravel through FRP tubing to 1,006 feet bgl (gravel tag outside of FRP tubing)
			16:00	Perform tremmie cement grout (STAGE #1); pump 20 barrels of neat cement
			17:45	Perform background portion of cement-bond log (log between 675 feet and 880 feet bgl); top of gravel inside FRP tubing was tagged by the CBL tool at 880 feet bgl
	9/28/12	7:15	8:00	Tag top of cement at 982 feet bgl. Perform cementing (STAGE #2). Pump 81 barrels of neat cement.
27	10/1/12	7:45	10:00	Tag top of cement at 830 feet bgl. Perform cementing (STAGE #3). Pump 125 barrels of 6% bentonite cement
	10/2/12	8:00	8:55	Tag top of cement at 504 feet bgl. Perform cementing (STAGE #4). Pump 126 barrels of 6% bentonite cement
		17:00		Tag top of cement at 201 feet bgl. Perform cementing (Stage #5). Pump 83 barrels of 6% bentonite cement
	10/3/12			Perform successful plumbness and alignment test
	10/4/12			Install bit in FRP and begin removing gravel from tubing and open hole
	10/5/12			Continue removing gravel from open hole
28	10/8/12			Continue removing gravel from open hole
	10/9/12			Complete removing gravel to 1,127 feet bgl
	10/10/12			Perform brief specific capacity test; Flow Rate: 443 gpm; Sp. Capacity: 13.4 gpm/ft
	10/11/12			Install inflatable packer in FRP tubing to 962 feet bgl in preparation for acidizing well
29	10/15/12			Install acid tubing through drill pipe and packer down to 1,035 feet bgl
	10/18/12	11:00	14:00	Perform acidization. Pump 5,000 gallons of HCL in two pump stages (2,500 gallons each stage)
	10/19/12			Pump out spent acid from well
30	10/22/12			Begin airlift development
	10/23/12			Continue airlift development. Airlift development terminated at end of work day after airlifting for 14 hours
	10/24/12			Begin installing submersible pump in well and reconfiguring discharge piping in preparation for pump development
	10/25/12			
	10/26/12			

Table 1A. Summary of Construction and Testing Activities, Sawgrass Test Well SGF-1, City of Sunrise, Florida

Test Well SGF-1				
Week #	Date	Time		Description
		from	to	
31	10/29/12			Begin pump development
	10/30/12	7:00	19:00	Continue pump development
	10/31/12	7:00	19:00	Continue pump development
	11/1/12	7:00	19:00	Continue pump development
	11/2/12	7:00	17:00	Continue pump development
32	11/5/12	7:00	19:00	Continue pump development
	11/6/12	7:00	19:00	Continue pump development; temporarily discontinue development until 28-inch OD casing is set in SGF-2
	11/7/12			No onsite work performed
	11/9/12			
33	11/12/12		19:00	Resume pump development
	11/13/12	7:00	19:00	Continue pump development
	11/14/12	7:00	14:00	Continue pump development
	11/15/12	7:00	19:00	Continue pump development
	11/16/12	7:00	13:00	Continue pump development
34	11/19/12			Complete pump development
	11/20/12			Perform step rate test (845 gpm, 1,114 gpm, 1,399 gpm, 1,725 gpm)
	11/21/12			Monitor water levels following step rate test
	11/23/12			
35	11/26/12	8:54		Begin 72-hour constant-rate test (1,450 gpm)
	11/27/12			Continue 72-hour constant-rate test
	11/28/12			Continue 72-hour constant-rate test
	11/29/12		9:00	Complete 72-hour constant-rate test; begin recovery
	11/30/12			Continue monitoring recovery water level data
36	12/3/12		7:14	Complete collecting recovery water level data
				Remove submersible pump from well and perform XY caliper, gamma-ray, video and cement-bond logging
	12/4/12			No construction related work performed onsite
	12/7/12			
37	12/11/12			Insert drill bit and remove approximately 20 feet of sand at the bottom of the borehole
	12/12/12			Install temporary wellhead, begin rigging down, No other construction related work performed onsite
	12/14/12			
38 thru 42	12/17/12			No construction related work performed onsite
	1/17/12			
	1/18/12			Remove temporary wellhead and cut off casings in preparation for installing permanent wellhead
43	1/21/13			Install FRP to stainless-steel transition flange
	1/24/13			Install stainless steel wellhead

Table 1A. Summary of Construction and Testing Activities, Sawgrass Test Well SGF-1, City of Sunrise, Florida

Test Well SGF-1				
Week #	Date	Time		Description
		from	to	
44	1/28/13			Reinstall 48-inch casing to just below the finished grade elevation
	1/29/13			No construction related work performed onsite
	2/1/13			
45	2/4/13			No construction related work performed onsite
	2/8/13			
46	2/12/13			Install excavatable fill in the annulus between the 48-inch casing and the final casing
	2/13/13			No construction related work performed onsite
	2/15/13			
47 & 48	2/18/13			No construction related work performed onsite
	3/1/13			
49	3/4/13			Demobilize settling tanks and clean site
	3/8/13			
50	3/11/13			Install submersible pump in well
	3/12/13			
	3/15/13			Install transducer and begin collecting background data for pump testing at SGF-2
51	3/18/13			Collect water level data during testing and recovery at SGF-2
	3/20/13			
52	3/25/13			Collect water level data during testing and recovery at SGF-2
	3/29/13			
53	4/1/13			Continue monitoring recovery water level data
	4/2/13	8:45		Begin 72 hour test, pumping both SGF-1 and SGF-2
	4/3/13			Contiue 72 hour test, pumping both wells
	4/4/13			Continue 72 hour test, pumping both wells
	4/5/13		14:05	Complete 72-hour test of both wells; begin recovery
54	4/9/13		7:30	Complete collecting recovery water level data; begin removing pump from well
57	4/29/13			Pour reinforced concrete pad around well

Table 1B. Summary of Construction and Testing Activities, Sawgrass Test Well SGF-2, City of Sunrise, Florida

Test Well SGF-2				
Week #	Date	Time		Description
		from	to	
21 thru 26	8/24/12			Install 48-inch OD pit casing to 48 feet bgl
	8/27/12			Mobilize and prepare SGF-2 site
	9/24/12			
	9/25/12		19:00	Begin drilling pilot hole from base of pit casing using 10-inch bit; extend pilot hole to 62 feet bgl
	9/26/12	7:00	19:00	Extend pilot hole to 218 feet bgl
	9/27/12	7:00		Extend pilot hole to a total depth of 228 feet bgl; Perform XY caliper, gamma-ray and dual induction logging to 228 feet bgl
	9/28/12			Begin reaming from base of pit casing using 46-inch bit; extend reamed borehole to 48 feet bgl
27	10/1/12	7:00	19:00	Extend reamed hole to 82 feet bgl
	10/2/12	7:00	19:00	Extend reamed hole to 128 feet bgl
	10/3/12	7:00	19:00	Extend reamed hole to 158 feet bgl
	10/4/12	7:00	19:00	Extend reamed hole to 217 feet bgl
	10/5/12	7:00	19:00	Extend reamed hole to 228 feet bgl
28	10/8/12			Perform wiper trip and then perform XY caliper and gamma-ray logging to 226 feet bgl
	10/9/12			Perform wiper trip and then install 36-inch O.D., 0.375-inch wall thickness surface casing to 225 feet bgl
		17:00	17:30	Perform pressure grout (STAGE #1); pump 58 barrels of neat cement
	10/10/12			Tag top of cement at 172 feet bgl. Perform cementing (STAGE #2); pump 101 barrels of neat cement
	10/11/12			Tag top of cement at 40 feet bgl. Perform cementing (STAGE #3); pump 38 barrels of neat cement. Cement observed at surface.
	10/12/12			Begin drilling cement plug inside 36-inch O.D. casing using 34-inch bit
29	10/15/12			Drill to 240 feet bgl using 34-inch bit. Begin drilling pilot hole from 240 feet bgl using 12-inch bit; extend pilot hole to approximately 350 feet bgl.
	10/16/12	7:00	19:00	Extend pilot hole to 555 feet bgl
	10/17/12	7:00	19:00	Extend pilot hole to 744 feet bgl
	10/18/12	7:00	19:00	Extend pilot hole to 875 feet bgl
	10/19/12			Extend pilot hole to 960 feet bgl
30	10/22/12			Extend pilot hole to 980 feet bgl
	10/23/12			Perform wiper trip and then perform XY caliper, gamma-ray, dual induction, spontaneous potential and sonic logging
		16:00	19:00	Begin reaming from base of 36-inch O.D. surface casing using 34-inch bit; extend reamed borehole to 244 feet bgl
	10/24/12	7:00	19:00	Extend reamed borehole to 343 feet bgl
	10/25/12	7:00	19:00	Extend reamed borehole to 374 feet bgl

Table 1B. Summary of Construction and Testing Activities, Sawgrass Test Well SGF-2, City of Sunrise, Florida

Test Well SGF-2				
Week #	Date	Time		Description
		from	to	
31	10/29/12	7:00	19:00	Extend reamed borehole to 492 feet bgl
	10/30/12	7:00	23:59	Extend reamed borehole to 590 feet bgl
	10/31/12	0:00	23:59	Extend reamed borehole to 746 feet bgl
	11/1/12	0:00	19:00	Extend reamed borehole to 850 feet bgl
	11/2/12			Perform onsite repairs/maintenance
32	11/5/12	7:00		Extend reamed borehole to 932 feet bgl
	11/6/12		23:59	Extend reamed borehole to 995 feet bgl
	11/7/12			Extend reamed borehole to total depth of 1,010 feet bgl
		16:30	17:30	Perform XY caliper and gamma-ray logging
		18:00		Begin installing 28-inch O.D., 0.375-inch wall thickness, intermediate casing
	11/8/12		13:00	Complete installation of 28-inch O.D. casing to 1,006 feet bgl
		17:00	17:50	Perform pressure grout (STAGE #1); pump 86 barrels of neat cement
	11/9/12	14:30	17:25	Perform cement-top temperature log and then tag top of cement after Stage #1 at 665 feet bgl; Perform tremmie grout (STAGE #2); pump 151 barrels of cement with 6% bentonite
	11/10/12	9:30	10:35	Perform cement-top temperature log and then tag top of cement after Stage #2 at 236 feet bgl; Perform tremmie grout (STAGE #3); pump 102 barrels of cement with 6% bentonite; cement returns observed at surface
33	11/13/12			Tag top of cement inside 28-inch casing at 1,002 feet bgl using 26-inch bit; begin removing drilling mud from inside casing and begin converting to reverse-air drilling.
	11/14/12			
	11/15/12			Completed converting to reverse-air drilling; drill out cement plug using 26-inch bit to 1,010 feet bgl. Remove 26-inch bit from well.
	11/16/12			Install 10-inch bit to 1,010 feet bgl and begin pilot hole drilling; extend pilot hole to 1,052 feet bgl
34	11/19/12			Extend pilot hole to 1,150 feet bgl. Pull 10-inch bit into 28-inch casing and install pressure transducer at well in preparation for step-rate test at SGF-1.
	11/20/12			Monitor water levels in SGF-2 for remainder of report week during pump testing at SGF-1
	11/23/12			
35	11/26/12			Monitor water levels in SGF-2 for entire report week during pump testing at SGF-1
	11/30/12			
36	12/3/12	16:30	19:00	Reinstall 10-inch bit to base of pilot hole at 1,150 feet bgl. Extend pilot hole to 1,177 feet bgl
	12/4/12	7:00	19:00	Extend pilot hole to 1,332 feet bgl
	12/5/12	7:00	19:00	Extend pilot hole to 1,364 feet bgl
	12/6/12	7:00	19:00	Extend pilot hole to 1,487 feet bgl
	12/7/12	7:00	19:00	Extend pilot hole to 1,643 feet bgl
	12/8/12	7:00	19:00	Extend pilot hole to 1,734 feet bgl

Table 1B. Summary of Construction and Testing Activities, Sawgrass Test Well SGF-2, City of Sunrise, Florida

Test Well SGF-2				
Week #	Date	Time		Description
		from	to	
37	12/10/12	7:00	14:30	Extend pilot hole to 1,800 feet bgl; perform wiper trips.
	12/11/12			Performed site work; allowed well to establish static conditions prior to geophysical logging
	12/12/12			Perform suite of static & dynamic geophysical logs from base of 28-inch casing to 1,800 feet bgl
	12/14/12			Install single packer to 1,628 ft bgl (centerline of packer)
38	12/18/12	11:57	18:02	Perform pumping portion of packer test #1 at a stabilized flow rate of 235 gpm
		18:02		Turn off pump and begin recovery
	12/19/12		9:35	Complete collecting recovery data
	12/20/12			Perform onsite repairs/maintenance/cleanup
	12/21/12			
39	12/24/12			No construction related activity performed onsite
	12/28/12			
40	12/31/12			No construction related activity performed onsite
	1/1/13			
	1/2/13			Contractor was directed to extend the pilot hole an additional 60 feet (to 1,860 feet bgl); Remove packer from borehole
	1/3/13			Install 10-inch bit to base of pilot hole. Extend pilot hole to 1,863 feet bgl. Remove drill pipe and bit from well
	1/4/13			Install single packer to 1,801 ft bgl (centerline of packer)
41	1/7/13	7:31	12:33	Perform pumping portion of packer test #2 at a stabilized flow rate of 166 gpm
		12:33		Turn off pump and begin recovery
	1/8/13		7:40	Complete collecting recovery data
	1/9/13		18:17	Remove packer from well. Install cement tubing to the base of pilot hole and pump 30 barrels of neat cement
	1/10/13		10:23	Tag top of cement after Stage #1 at 1,707feet bgl. Perform cement stage #2, pump 40 barrels of neat cement
			18:40	Tag top of cement after Stage #2 at 1,507 feet bgl. Perform cement stage #3, pump 40 barrels of neat cement
	1/11/13		8:45	Tag top of cement after Stage #3 at 1,280 feet bgl. Perform cement stage #4, pump 19 barrels of neat cement
42	1/14/13		9:15	Tag top of cement after Stage #4 at 1,180 feet bgl. Perform cement stage #5, pump 5 barrels of neat cement
			17:00	Tag top of cement after Stage #5 at 1,155 feet bgl.
	1/15/13			Install 26-inch bit and drill pipe to 1,010 feet bgl and begin reaming; extend nominal 28-inch reamed hole to 1,032 feet bgl
	1/16/13			Extend reamed hole to 1,117 feet bgl
	1/17/13			Extend reamed hole to a total depth of 1,150 feet bgl

Table 1B. Summary of Construction and Testing Activities, Sawgrass Test Well SGF-2, City of Sunrise, Florida

Test Well SGF-2				
Week #	Date	Time		Description
		from	to	
43	1/21/13	8:13	8:36	Perform brief specific capacity test; Flow Rate: 870 gpm; Sp. Capacity: 24.9 gpm/ft
		14:30	16:00	Perform XY caliper and gamma-ray logging
	1/22/13	8:10		Install 16-inch ID FRP tubing to 1,014 feet bgl; Begin installing gravel in FRP tubing
	1/23/13			Complete installation of gravel (approximately 648 ft3)
		11:30	12:10	Perform tremmie cement grout (STAGE #1); pump 8 barrels of neat cement
		16:50	17:30	Tag top of cement at 1,011 feet bgl. Perform cementing (STAGE #2). Pump 52 barrels of neat cement.
	1/24/13	8:45	9:15	Perform background portion of cement-bond log (log between 600 feet and 800 feet bgl); top of gravel inside FRP tubing was tagged by the CBL tool at 814 feet bgl
		9:50	10:38	Tag top of cement at 890 feet bgl. Perform cementing (STAGE #3). Pump 103 barrels of 6% bentonite cement.
		18:00	18:25	Tag top of cement at 669 feet bgl. Perform cementing (STAGE #4). Pump 29 barrels of 6% bentonite cement.
	1/25/13	11:40	13:13	Tag top of cement at 592 feet bgl. Perform cementing (STAGE #5). Pump 151 barrels of 6% bentonite cement.
44	1/28/13			Tag top of cement at 281 feet bgl. Perform cementing (STAGE #6). Pump 111 barrels of 6% bentonite cement.
	1/29/13			Perform successful plumbness and alignment test
	1/31/13			Begin removing gravel inside FRP tubing; remove gravel to 1,026 feet bgl
	2/1/13			Continue removing gravel; remove gravel to 1,095 feet bgl
45	2/4/13			Continue drilling out gravel; remove gravel to 1,105 feet bgl
	2/5/13			Complete drilling out gravel to 1,150 feet bgl
	2/6/13			Perform approximately 4 hours of airlift development, perform specific capacity test (approximately 32 gpm/ft)
	2/7/13			Perform specific test, static WL: 40.45 ft agl, flow rate: 1,040 gpm, Sp Cap: 31.8 gpm/ft
46	2/11/13			No construction related activity performed onsite
	2/15/13			
47	2/18/13			Install inflatable packer to 968 feet bgl and acid tubing to 1,064 feet bgl in preparation for acidizing the well
	2/19/13			Completed preparations for acidizing the well
	2/20/13			Perform acidization. Pump 5,000 gallons of HCL in two pump stages (2,500 gallons each stage)
	2/21/13			Release pressure from well, deflate packer and remove acid tubing
	2/22/13			Remove packer and pump out spent acid; Begin airlift development (6 hours)
48	2/25/13	9:30	11:30	Continue airlift development. Perform onsite maintenance and repairs
	2/26/13	9:00	19:00	Continue airlift development
	2/27/13			Perform brief specific capacity test; Flow Rate: 1,185 gpm; Sp. Capacity: 38.1 gpm/ft; Begin installing pump in preparation for pump development
49	3/4/13			No construction related activity performed onsite; Work performed at SGF-1 site
	3/8/13			

Table 1B. Summary of Construction and Testing Activities, Sawgrass Test Well SGF-2, City of Sunrise, Florida

Test Well SGF-2				
Week #	**Date**	**Time**		**Description**
		from	**to**	
50	3/11/13			Complete preparations for pump development
	3/13/13			
	3/14/13	7:00	19:00	Begin pump development
	3/15/13	7:00	10:30	Complete pump development; Perform specific capacity test; Flow Rate: 1,257 gpm; Sp. Capacity: 37.4 gpm/ft
				Install transducer in preparation for step-rate testing
51	3/18/13	8:22	12:48	Perform step rate test (852 gpm, 1,095 gpm, 1,440 gpm, 1,742 gpm)
	3/19/13			Collect background water level data prior to performing 72 hour constant rate test
	3/22/13			
52	3/25/13	11:52		Begin 72-hour constant-rate test (1,450 gpm)
	3/26/12			Continue 72-hour test
	3/27/13			Continue 72-hour test
	3/28/13		11:53	Complete 72-hour test; begin recovery
	3/29/13			Continue monitoring recovery water level data
53	4/1/13			Continue monitoring recovery water level data
	4/2/13	8:45		Begin 72 hour test, pumping both SGF-1 and SGF-2
	4/3/13			Contiue 72 hour test, pumping both wells
	4/4/13			Continue 72 hour test, pumping both wells
	4/5/13		14:05	Complete 72-hour test of both wells; begin recovery
54	4/9/13		7:30	Complete collecting recovery water level data; begin removing pump from well
	4/11/13			Perform final video survey; bottom of borehole at 1,136 feet bgl
55	4/15/13			Install drill bit and remove approximately 14 feet of sand from bottom of borehole
	4/17/13			Perform XY caliper, gamma-ray and final CBL log
56 & 57	4/22/13			No construction related activity performed onsite
	5/3/13			
58	5/7/13			Remove temporary wellhead and cut off casings in preparation for installing permanent wellhead
	5/8/13			Install FRP to stainless-steel transition flange
	5/10/13			Install stainless steel wellhead
59	5/13/13			No construction related activity performed onsite
	5/17/13			
60	5/20/13			Pour reinforced concrete pad around well on 5/20/13
	5/24/13			

Table 2A. Summary of Inclination Survey Results, Sawgrass Test Well SGF-1 City of Sunrise, Florida

Date	Inclination	Survey Result (degrees)	
	Survey Depth (feet)	Deviation Total	Deviation Change
10-inch Pilot Hole Bit			
5/16/2012	90	0.50	0.50
5/17/2012	180	0.50	0.00
46-inch Diameter Staged Drill Bit			
5/24/2012	96	0.40	0.40
5/25/2012	188	0.50	0.10
12-inch Pilot Hole Bit			
6/6/2012	187	0.50	0.50
6/6/2012	281	0.50	0.00
6/6/2012	373	0.50	0.00
6/6/2012	466	0.45	0.05
6/7/2012	561	0.30	0.15
6/7/2012	654	0.50	0.20
6/7/2012	748	0.50	0.00
6/7/2012	842	0.50	0.00
6/7/2012	936	0.30	0.20
34-inch Diameter Drill Bit			
6/12/2012	190	0.50	0.00
6/12/2012	283	0.50	0.00
6/12/2012	374	0.50	0.00
6/19/2012	466	0.60	0.10
6/19/2012	561	0.50	0.10
6/20/2012	655	0.50	0.00
6/20/2012	749	0.60	0.10
6/21/2012	842	0.50	0.10
6/22/2012	937	0.40	0.10
10-inch Pilot Hole Bit			
8/2/2012	1060	0.40	0.00
8/6/2012	1120	0.45	0.05
8/6/2012	1185	0.30	0.15
8/6/2012	1247	0.50	0.20
8/7/2012	1309	0.50	0.00
8/8/2012	1372	0.50	0.00
8/8/2012	1465	0.50	0.00
8/9/2012	1559	0.50	0.00
8/10/2012	1650	0.50	0.00

Table 2B. Summary of Inclination Survey Results, Sawgrass Test Well SGF-2 City of Sunrise, Florida

Date	Inclination	Survey Result (degrees)	
	Survey Depth (feet)	Deviation Total	Deviation Change
10-inch Pilot Hole Bit			
9/26/2012	90	0.40	0.40
9/26/2012	180	0.30	0.10
46-inch Diameter Staged Drill Bit			
10/3/2012	90	0.30	0.30
10/4/2012	180	0.35	0.05
12-inch Pilot Hole Bit			
10/15/2012	270	0.30	0.30
10/16/2012	360	0.35	0.05
10/16/2012	450	0.40	0.05
10/16/2012	540	0.40	0.00
10/17/2012	630	0.35	0.05
10/17/2012	720	0.10	0.25
10/18/2012	810	0.20	0.10
10/19/2012	900	0.30	0.10
34-inch Diameter Drill Bit			
10/24/2012	270	0.40	0.00
10/29/2012	360	0.40	0.00
10/29/2012	450	0.40	0.00
10/30/2012	540	0.40	0.00
10/31/2012	630	0.40	0.00
10/31/2012	720	0.10	0.30
11/1/2012	810	0.40	0.30
11/5/2012	900	0.40	0.00
11/7/2012	990	0.30	0.10
10-inch Pilot Hole Bit			
11/19/2012	1080	0.30	0.00
12/4/2012	1170	0.30	0.00
12/4/2012	1270	0.40	0.10
12/6/2012	1350	0.50	0.10
12/6/2012	1440	0.40	0.10
12/7/2012	1530	0.50	0.10
12/7/2012	1620	0.40	0.10
12/8/2012	1710	0.40	0.00
1/3/2013	1800	0.40	0.00
26-inch Diameter Drill Bit			
1/16/2013	1080	0.40	0.00

Table 3. Cementing Summary, Sawgrass Test Wells SGF-1 and SGF-2, City of Sunrise, Florida

	Casing String	Outside Diameter (inches)	Inside Diameter (inches)	Casing Depth (feet bgl)	Date	Cement Stage	Type of Cement	Cement Quantity (cubic feet)	Remarks
Test Well SGF-1	**Pit**	48	47.25	41	5/3/2012	N/A	N/A	N/A	
	Surface	36	35.25	215	5/30/2012	1	Neat	365	Pressure grout. Tagged cement top at 157 feet bgl
					5/31/2012	2	Neat	651	Tremied in place. Cement returns to surface.
	Intermediate	28	27.25	1,000	6/28/2012	1	Neat	567	Pressure grout. Tagged cement top at 738 feet bgl
					6/28/2012	2	6% Bentonite	679	Tremied in place. Tagged cement top at 255 feet bpl.
					6/29/2012	3	6% Bentonite	567	Tremied in place. Cement returns to surface.
	Final FRP Casing	17	16	1,006	9/27/2012	1	Neat	112	Tremied in place. Tagged cement top at 982 feet bgl
					9/28/2012	2	Neat	455	Tremied in place. Tagged cement top at 830 feet bgl.
					10/1/2012	3	6% Bentonite	702	Tremied in place. Tagged cement top at 504 feet bgl.
					10/2/2012	4	6% Bentonite	707	Tremied in place. Tagged cement top at 201 feet bgl.
					10/2/2012	5	6% Bentonite	466	Tremied in place. Cement returns to surface.
							Total (cubic feet):	**5,271**	

	Casing String	Outside Diameter (inches)	Inside Diameter (inches)	Casing Depth (feet bpl)	Date	Cement Stage	Type of Cement	Cement Quantity (cubic	Remarks
Test Well SGF-2	**Pit**	48	47.25	48	8/24/2012	N/A	N/A	N/A	
	Surface	36	35.25	226	10/9/2012	1	Neat	134	Pressure grout. Tagged cement top at 172 feet bgl
					10/10/2012	2	Neat	234	Tremied in place. Tagged cement top at 40 feet bgl.
					10/11/2012	3	Neat	88	Tremied in place. Cement returns to surface.
	Intermediate	28	27.25	1,006	11/8/2012	1	Neat	199	Pressure grout. Tagged cement top at 665 feet bgl
					11/9/2012	2	6% Bentonite	349	Tremied in place. Tagged cement top at 236 feet bpl.
					11/10/2012	3	6% Bentonite	236	Tremied in place. Cement returns to surface.
	Final FRP Casing	17	16	1,014	1/23/2013	1	Neat	19	Tremied in place. Tagged cement top at 1,011 feet bgl
					1/23/2013	2	Neat	120	Tremied in place. Tagged cement top at 890 feet bgl.
					1/24/2013	3	6% Bentonite	238	Tremied in place. Tagged cement top at 669 feet bgl.
					1/24/2013	4	6% Bentonite	67	Tremied in place. Tagged cement top at 592 feet bgl.
					1/25/2013	5	6% Bentonite	349	Tremied in place. Tagged cement top at 281 feet bgl.
					1/28/2013	6	6% Bentonite	257	Tremied in place. Cement returns to surface.
							Total (cubic feet):	**2,290**	

"N/A" denotes "data not available"

"feet bgl" denotes feet below ground level.

Neat cement refers to Portland Type I/II cement with no additives

6% bentonite refers to Portland Type I/II cement with a 6% (by weight) bentonite additive

Table 4. Summary of Geophysical Logs Performed in SGF-1 and SGF-2, City of Sunrise, Sawgrass Floridan Test Wells

Date Performed	Geophysical Survey Performed	Casing Depth (feet bgl)	Open Hole Depth (feet bgl)	Casing/Drilled Hole Diameter (inches)
Test Well SGF-1				
05/18/12	X-Y Caliper, Gamma Ray	40	226	48 / 10
05/18/12	Dual Induction LL3 with SP	40	226	48 / 10
05/29/12	X-Y Caliper, Gamma Ray	40	229	48 / 48
05/31/12	Cement Top Temperature	215	229	36 / 48
06/08/12	Borehole Compensated Sonic w/VDL	215	1,018	36 / 12
06/08/12	X-Y Caliper, Gamma Ray	215	1,018	36 / 12
06/08/12	Dual Induction LL3 with SP	215	1,018	36 / 12
06/25/12	X-Y Caliper, Gamma Ray	215	1,004	36 / 36
06/28/12	Cement Top Temperature	1000	988	28 / 10
06/29/12	Cement Top Temperature	1000	988	28 / 10
08/15/12	Borehole Compensated Sonic w/VDL	1000	1,800	28 / 10
08/15/12	X-Y Caliper, Gamma Ray	1000	1,800	28 / 10
08/15/12	TDS Compilation Log	1000	1,800	28 / 10
08/15/12	Dual Induction LL3 with SP	1000	1,800	28 / 10
08/15/12	Fluid Conductivity, Temperature	1000	1,800	28 / 10
08/15/12	Flowmeter	1000	1,800	28 / 10
08/15/12	Flowmeter Interpretation	1000	1,800	28 / 10
08/15/12	Video Survey	1000	1,800	28 / 10
09/25/12	X-Y Caliper, Gamma Ray	1000	1,127	28 / 28
12/03/12	X-Y Caliper, Gamma Ray	1006	1,108	16 / 28
12/03/12	Cement Bond w/ VDL	1,006	1,108	16 / 28
12/03/12	Video Survey	1,006	1,108	16 / 28
Test Well SGF-2				
09/27/12	X-Y Caliper, Gamma Ray	48	228	48 / 10
09/27/12	Dual Induction LL3 with SP	48	228	48 / 10
10/08/12	X-Y Caliper, Gamma Ray	48	228	48 / 48
10/23/12	X-Y Caliper, Gamma Ray	225	228	36 / 12
10/23/12	Borehole Compensated Sonic w/VDL	225	228	36 / 12
10/23/12	Dual Induction LL3 with SP	225	228	36 / 12
11/07/12	X-Y Caliper, Gamma Ray	225	1,010	36 / 36
11/09/13	Cement Top Temperature	1,006	1,010	28 / 36
12/12/12	X-Y Caliper, Gamma Ray	1,006	1,800	28 / 10
12/12/12	Flowmeter	1,006	1,800	28 / 10
12/12/12	Borehole Compensated Sonic w/VDL	1,006	1,800	28 / 10
12/12/12	TDS Compilation Log	1,006	1,800	28 / 10
12/12/12	Flowmeter Interpretation	1,006	1,800	28 / 10
12/12/12	Dual Induction LL3 with SP	1,006	1,800	28 / 10
12/12/12	Fluid Conductivity, Temperature	1,006	1,800	28 / 10
12/12/12	Video Survey	1,006	1,800	28 / 10
01/21/13	X-Y Caliper, Gamma Ray	1,006	1150	28 / 28
01/24/13	Cement Top Temperature	1,014	1014	16 / 28
01/24/13	Cement Bond w/ VDL (Background)	1,014	1014	16 / 28
04/11/13	Video Survey	1,014	1014	16 / 28
04/17/13	Cement Bond w/ VDL	1,014	1150	16 / 28
04/17/13	X-Y Caliper, Gamma Ray	1,014	1150	16 / 28

"feet bpl" denotes feet below pad level

Table 5. Packer Test Analytical Water Quality and Performance Results, Sawgrass Test Wells SGF-1 and SGF-2

Parameters	Units	SGF-1 Packer Tests				SGF-2 Packer Tests	
		Test 2	Test 3B	Test 3A	Test 1	Test 1	Test 2
Test Type		Single Pkr Annulus	Straddle Pkr Annulus	Straddle Pkr Drill Stem	Single Pkr Drill Stem	Single Pkr Drill Stem	Single Pkr Drill Stem
Test Interval	ft bgl	1,000 - 1,155	1,000 - 1,528	1,528 - 1,569	1,603 - 1,800	1,628 - 1,800	1,801 - 1,863
Sample Date		8/24/2012	8/31/2012	8/29/2012	8/21/2012	12/18/2012	1/7/2013
Specific Conductance	uS/cm	9,200	11,300	14,300	8,650	12,400	6,970
Turbidity	NTU	0.3	0.85	9.3	2.8	17	26
Bromide	mg/L	11.5	10.9	14.8	10.8	15.5	5.50
Chloride	mg/L	2580	3250	4280	2420	4030	1810
Fluoride	mg/L	<2.1	<4.2	<4.2	<2.1	<2.10	<2.10
Ortho-Phosphate	mg/L	<1.25	<2.5	<2.5	<1.25	2.50	<1.25
Sulfate	mg/L	875	933	875	670	670	880
Alkalinity (CaCO3)	mg/L	108	102	102	110	118	110
Bicarbonate	mg/L	108	102	102	110	118	109
Carbonate	mg/L	0.13	0.13	0.15	0.2	0.160	0.340
Ammonia	mg/L	0.77	0.81	0.88	0.48	0.840	0.310
Hydrogen Sulfide	mg/L	0.47	0.67	0.44	0.73	1.04	0.264
Color	Pt-Co	5	<1.0	15	10	10	<1.00
TDS	mg/L	5850	6980	9070	5300	7780	4330
pH	mg/L	7.5	7.61	7.83	7.69	8.00	8.10
Silica	mg/L	10.9	9.19	8.71	9.83	9.10	10.2
Calcium Hardness	mg/L	285	330	375	250	337	243
Total Hardness	mg/L	1055	1289	1684	1049	1250	781
Aluminum	mg/L	0.005	0.005	0.004	0.004	<0.0007	<0.0007
Barium	mg/L	0.005	0.007	0.015	0.01	0.0150	0.008
Boron	mg/L	1.26	1.268	1.23	0.831	0.854	0.732
Calcium	mg/L	114	132	150	100	135.1	97.2
Dissolved Iron	mg/L	0.013	0.014	0.08	0.013	0.004	0.0140
Iron	mg/L	0.021	0.024	0.19	0.18	0.265	0.231
Magnesium	mg/L	187	233	318	194	220.7	131
Manganese	mg/L	0.001	0.001	0.007	0.007	0.008	0.0130
Potassium	mg/L	111	127	140	94.4	132.4	79.9
Sodium	mg/L	1710	2128	2913	1593	2245	1121
Strontium	mg/L	9.96	14.7	25.5	19.8	19.0	12.9
Flow / Pump Rate	gpm	479	920	203	221	235	166
Tested Aquifer Thickness	ft	155	528	41	197	172	62
Static Water Level	ft bgl	-40.2	-40.5	-43.5	-46.3	-40.5	-56
Drawdown	ft	38.2	36.7	85.8	39.4	22.8	78.9
Specific Capacity	gpm/ft	12.5	25.1	2.4	5.6	10.3	2.1
Transmissivity (Turcan)	gpd/ft	25,079	50,155	4,734	11,221	20,600	4,200
Horiz. Hydraulic Conductivity (Turcan)	gpd/ft2	162	95	115	57	120	68

-Test type "Single Pkr Annulus" refers to a packer test where a single packer was installed in the boreohole on drill pipe. The annulus outside the drill pipe and above the single packer was then allowed to flow. Water levels in the annulus and inside the drill pipe were monitored.

-Test type "Straddle Pkr Annulus" refers to a packer test where two packers, connected together with perforated pipe, were installed on drill pipe. The annulus outside the drill pipe and above the top packer was then allowed to flow. Water levels in the annulus and inside the drill pipe were monitored. Absolute pressures in the borehole below the bottom packer also were monitored.

-Test type "Straddle Pkr Drill Stem" refers to a packer test where two packers, connected together with perforated pipe, were installed on drill pipe. The interval between the packers (through the perforated pipe) was then pumped. Water levels in the annulus and inside the drill pipe were monitored. Absolute pressures in the borehole below the bottom packer also were monitored.

-Test type "Single Pkr Drill Stem" refers to a packer test where a single packer was installed on drill pipe. The open hole below the single packer was then pumped. Water levels in the annulus and inside the drill pipe were monitored.

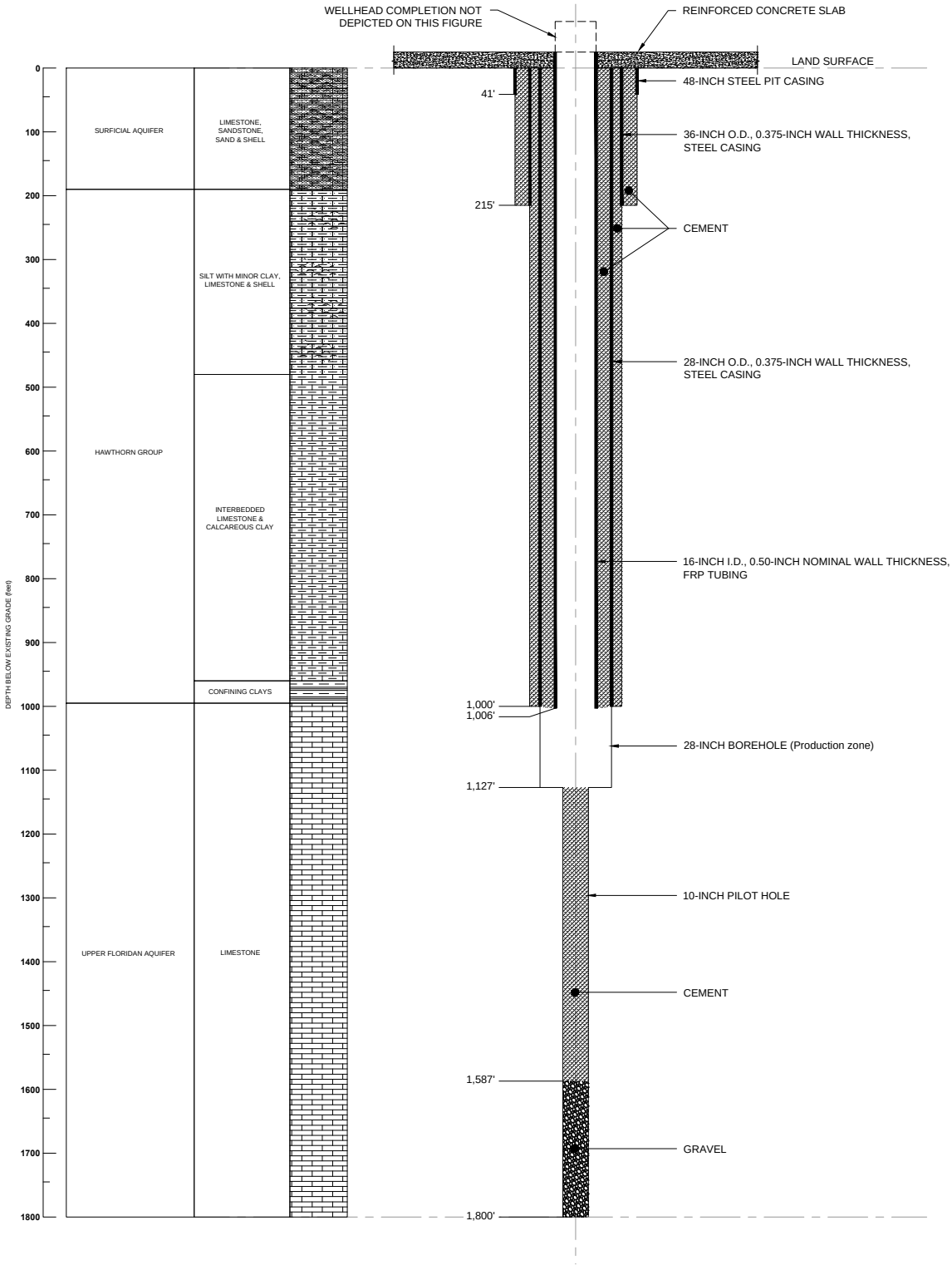
Figures

CITY OF SUNRISE
SAWGRASS FLORIDAN TEST WELLS

GENERAL LOCATION MAP

FIGURE 1

SGF-1

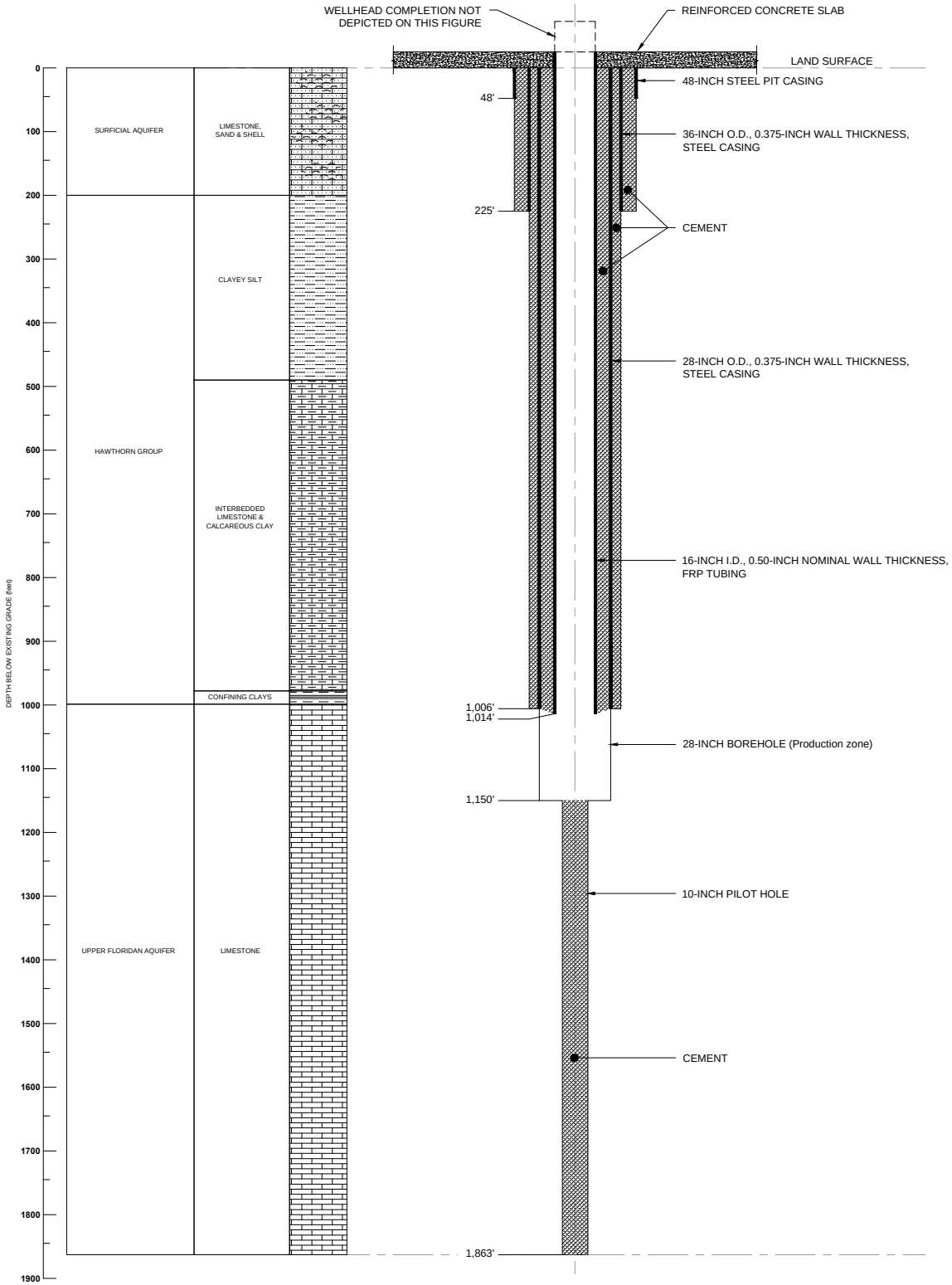


CITY OF SUNRISE
SAWGRASS FLORIDAN TEST WELLS

TEST WELL SGF-1
CONSTRUCTION DETAILS

FIGURE
2

SGF-2



CITY OF SUNRISE
SAWGRASS FLORIDAN TEST WELLS

TEST WELL SGF-2
CONSTRUCTION DETAILS

FIGURE
3

Appendix A

Hydrogeologic Framework and Geologic Logs: SGF-1 and SGF-2

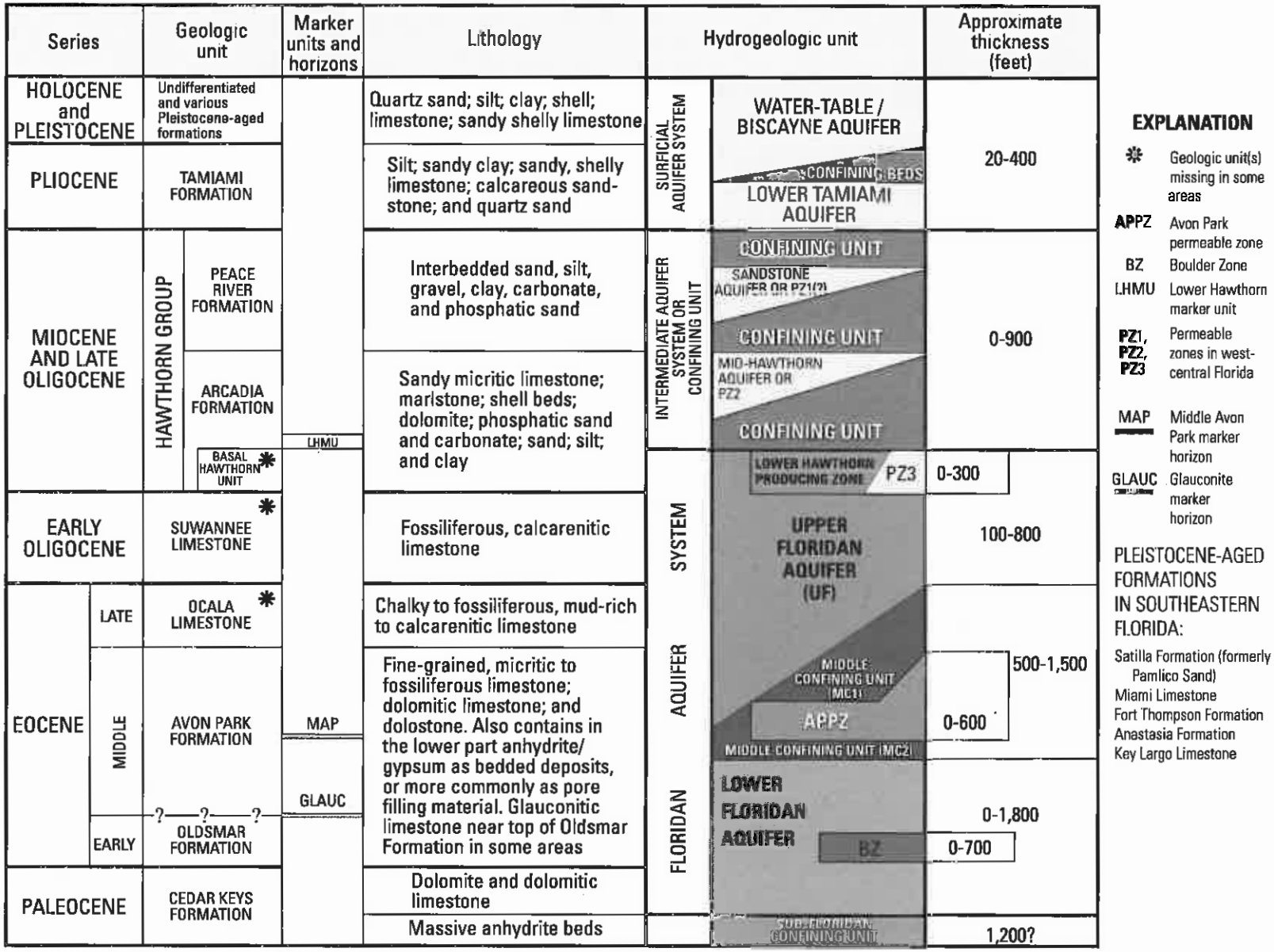


Figure 8. Chart showing relation of hydrogeologic units as defined in this study to geologic units and their lithology.

Geologic Log of Sawgrass Test Well SGF-1
City of Sunrise, SUN 103 Project

LITHOLOGICAL DESCRIPTION	DEPTH INTERVAL	THICKNESS
PAVEMENT AND ROADWAY BASE	0-2	2
SILTY SANDS: Sand, 95%, white (N9) to yellowish gray (5Y 8/1), silt to very fine grained, poorly consolidated with a calcareous mud matrix; Shell and Limerock, 5%.	2-40	38
SANDSTONE: Sandstone, 95%, yellowish gray (5Y 7/2), fine to medium grained, quartz grains with calcareous matrix, moderately hard; Shell, 5%, small fragments, some cement grout fragments in sample.	40-60	20
LIMESTONE: Limestone, 100%, yellowish gray (5Y 8/1), fine to medium grained, primarily calcareous with trace amounts of quartz grains, poorly to moderately cemented, becomes poorly cemented between 70 and 80 feet bgl, trace amount of phosphatic grains.	60-80	20
SANDSTONE, LIMESTONE and SHELL: Sandstone, 70%, light olive gray (5Y 6/1), fine to medium grained, poorly cemented, primarily quartz grains, some phosphatic grains; Limestone, 20%, yellowish gray (5Y 8/1), poorly cemented; Shell, 10%, 1-3 mm fragments.	80-90	10
SAND: Sand, 90%, light olive gray (5Y 5/2), fine grained, primarily quartz with some calcareous grains, slightly phosphatic; Limestone, 10%, yellowish gray (5Y 8/1), very poorly cemented.	90-110	20
SILT: Silt, 70%, olive gray (5Y 4/1), silt size grains with trace amounts of medium size quartz grains, slightly phoshpatic, low plasticity; Limestone, 20%, yellowish gray (5Y 8/1), poorly cemented; Shell, 10%, small fragments.	110-150	40
LIMESTONE and SHELL: Limestone, 80%, primarily light olive gray (5Y 6/1), some yellowish gray (5Y 8/1); very fine to fine grained, quartz and calcareous grains, poorly cemented and soft; Shell, 20%, 1-4 mm fragments.	150-180	30
LIMESTONE: Limestone, 95%, white (N9) to yellowish gray (5Y 8/1), fine grained, moderately well cemented and hard, well-rounded limestone fragments, small amount of limestone consists of very fine grained and soft material similar to 150-180 interval; Shell 5%.	180-190	10
SILTY CLAY, LIMESTONE and SHELL: Clay, 60%, olive gray (5Y 4/1), slightly phosphatic, low plasticity; Limestone, 20%, white (N9) to yellowish gray (5Y 8/1), fine grained, moderately well cemented and hard, well-rounded limestone fragments; Shell, 20%, 1-3 mm fragments.	190-200	10
SILTY CLAY, SOME LIMESTONE AND SHELL, Clay, 80%, olive gray (5Y 4/1), soft, low plasticity, some silt size grains, slightly phosphatic; Limestone, 10%, white (N9) to yellowish gray (5Y 8/1), fine grained, moderately well cemented and hard, well-rounded limestone fragments; Shell, 10%, up to 5 mm fragments.	200-210	10
CLAY: Clay, 100%, olive gray (5Y 4/1), slightly more cohesive and slightly higher plasticity than interval above, moderately phosphatic.	210-230	20
SILT AND SHELL: Silt, 80%, light olive gray (5Y 6/1) to olive gray (5Y 4/1), moderately consolidated, soft, calcareous with some quartz; Shell, 20%, whole pieces.	230-280	50
SILT: Silt, 100%, light olive gray (5Y 5/2), primarily calcareous with some quartz grains.	280-480	200
LIMESTONE, SILT AND SHELL: Limestone, 50%, yellowish gray (5Y 7/2), very fine grained, poorly consolidated, soft; Silt, 40%, light olive gray (5Y 5/2), calcareous; Shell, 10%, small fragments.	480-630	150
CLAY: Clay, 100%, yellowish gray (5Y 7/2), slightly silty, calcareous, low plasticity, few phosphatic grains.	630-650	20
LIMESTONE: Limestone, 90%, yellowish gray (5Y 7/2) to light olive gray (5Y 5/2), with some medium gray (N5), very fine grained, unconsolidated sands, few phosphatic grains; Shell, 10%, small fragments.	650-660	10
CLAY: Clay, 100%, yellowish gray (5Y 7/2) with some medium light gray, similar to description for interval between 630 feet to 650 feet bgl.	660-680	20

Geologic Log of Sawgrass Test Well SGF-1
City of Sunrise, SUN 103 Project

LITHOLOGICAL DESCRIPTION	DEPTH INTERVAL	THICKNESS
LIMESTONE: Limestone, 90%, yellowish gray (5Y 7/2) to light olive gray (5Y 5/2), same as interval between 650 feet and 660 feet bgl, larger shell fragments observed in interval between 750 feet and 760 feet bgl.	680-790	110
CLAYEY LIMESTONE: Limestone, 70%, yellowish gray (5Y 7/2), very fine grained, unconsolidated; Clay, 30%, yellowish gray (5Y 7/2), non-plastic, non-cohesive, clay percentage increases with depth.	790-810	20
CLAY: Clay, 80%, pale olive (10Y 6/2), calcareous, slightly phosphatic, slightly cohesive, few phosphatic grains; Limestone, 20%, yellowish gray (5Y 7/2), very fine grained, unconsolidated, few shells.	810-820	10
PHOSPHATIC CLAYS: Clay, 80%, pale olive (10Y 6/2), numerous dark gray (N3) phosphatic grains with greatest percentage observed between 830 feet and 850 feet bgl, slightly plastic, slightly cohesive; Limestone, 20%, yellowish gray (5Y 7/2), same as interval between 810 feet and 820 feet bgl.	820-870	50
LIMESTONE: Limestone, 90%, yellowish gray (5Y 7/2), very fine grained, non-cemented to poorly cemented; Clay, 10%, yellowish gray (5Y 7/2), non-plastic, noncohesive; Shell and Fossils, trace.	870-910	40
CLAY: Clay, 90%, light olive gray (5Y6/1), calcareous, medium plasticity, cohesive, soft; Limestone, 10%, yellowish gray (5Y 7/2), soft, non-cemented.	910-950	40
CLAYEY LIMESTONE: Limestone, 60%, yellowish gray (5Y 7/2) with some light olive gray (5Y 6/1), very fine grained, soft, poorly cemented; Clay, 40%, yellowish gray (5Y 7/2), non-plastic, noncohesive.	950-960	10
CLAY: Clay, 100%, olive gray (5Y 4/1), medium plasticity, cohesive; Limestone, trace.	960-995	35
LIMESTONE WITH LITTLE CLAY: Limestone, 90%, yellowish gray (5Y 8/1), sparitic, moderately hard, few fossils; Clay, 10%, olive gray (5Y 4/1), thin interbedded layers which slightly decrease with depth.	995-1,020	25
LIMESTONE: Limestone, 100%, primarily yellowish gray (5Y 8/1) with some light olive gray (5Y 6/1), numerous small fossils cemented in a calcareous matrix, 50% recrystallized/sparitic and moderately well cemented, phosphate grains present, few whole shell clasts present.	1,020-1,050	30
LIMESTONE: Limestone, 100%, light olive gray (5Y6/1) to yellowish gray (5Y 8/1), primarily fine grained grainstone, poorly to moderately cemented, few sparite pieces, highly phosphatic, few small fossil fragments.	1,050-1,070	20
LIMESTONE: Limestone, 100%, yellowish gray (5Y 8/1) and light to medium gray (N7 to N6), numerous small fossil fragments in a calcareous matrix, partially recrystalized, poorly to moderately cemented, few phosphatic grains present	1,070-1,110	40
QUARTZ GRAINSTONE, Grainstone, 100%, light olive gray to olive gray (5Y 6/1 to %Y 4/1), very fine to fine grained, primarily quartz, small amount of calcareous clay, poorly to moderately cemented.	1,110-1,120	10
LIMESTONE: Limestone, 100%, yellowish gray (5Y 8/1), very fine grained, recrystalized, poorly to moderately cemented, numerous small fossils, 10% medium dark gray (N4), siltstone, primarily quartz grained.	1,120-1,140	20
LIMESTONE AND MARL: Limestone, 70%, same as interval above; Marl, 30%, (5Y 8/1), soft, medium plasticity.	1,140-1,150	10
LIMESTONE: Limestone, 100%, yellowish gray (5Y 8/1), very fine grained, poorly to moderately cemented with a crystalline matrix, fossils present but fewer than 1,120-1,140 ft interval, 5% medium dark gray (N4) mudstone.	1,150-1,170	20
LIMESTONE: Limestone, 100%, pale yellowish brown (10YR 6/2), very fine grained, poorly to moderately cemented, some fossils present, minor amount of recrystalization, few sparitic well cemented fragments.	1,170-1,180	10
LIMESTONE: Limestone, 100%, primarily pale yellowish brown (10YR 6/2), some yellowish gray (5Y 8/1) and medium gray (N5), microcrystalline to very fine crystalline some very fine grain, few dolomitic limestone fragments, moderately cemented.	1,180-1,190	10

Geologic Log of Sawgrass Test Well SGF-1
City of Sunrise, SUN 103 Project

LITHOLOGICAL DESCRIPTION	DEPTH INTERVAL	THICKNESS
LIMESTONE: Limestone, 100%, 90% yellowish gray (5Y 7/2) to pale yellowish brown (10YR 6/2), 10% yellowish gray (5Y 8/1) and medium light gray (N6) starting at 1,210 ft bgl, very fine grained, almost silty, poorly cemented and soft, slightly vuggy, few fossils.	1,190-1,250	40
LIMESTONE: Limestone, 100%, yellowish gray (5Y 8/1) to pale yellowish brown (10YR 6/2), very fine to fine grain grainstone, poorly cemented, trace amount of calcareous marl in discreet intervals, fossiliferous.	1,250-1,360	110
LIMESTONE: Limestone, 100%, 80%, yellowish gray (5Y 7/2) to pale yellowish brown (10YR 6/2), very fine to fine grained, poorly cemented; 20% olive black (5Y 2/1) to light olive gray (5Y 6/1), moderately to moderately well cemented.	1,360-1,400	40
LIMESTONE: Limestone, 100%, yellowish gray (5Y 7/2) to pale yellowish brown (10YR 6/2), very fine to fine grain grainstone, poorly cemented.	1,400-1,410	10
LIMESTONE and TRACE LIGNITE: Limestone, 100%, yellowish gray (5Y 7/2) to pale yellowish brown (10YR 6/2), very fine to fine grained, poorly cemented; Lignite, trace, black (N1), very thinly interbedded with limestone, soft, smears on contact.	1,410-1,420	10
LIMESTONE: Limestone, 100%, 70% yellowish gray (5Y 7/2) to pale yellowish brown, fine grained, poorly cemented; 30% yellowish gray (5Y 7/2), micritic to very fine grained, well cemented, little to no porosity.	1,420-1,430	10
LIMESTONE: Limestone, 100%, yellowish gray (5Y 7/2) to pale yellowish brown, fine grained, poorly cemented.	1,430-1,450	20
LIMESTONE: Limestone, 100%, 90% yellowish gray (5Y 7/2) to pale yellowish brown (10YR 6/2), fine grained, poorly cemented but slightly more cemented than interval above, slightly vuggy; 10% light olive gray (5Y 6/1), micritic to very fine grained, well cemented, few small wormholes present; Lignite, trace, black (N1), soft, smears on contact; trace amount of anhydrite crystals observed in 1,470-1,480 sample.	1,450-1,500	50
LIMESTONE: Limestone, 100%, 70%, yellowish gray (5Y 7/2) to pale yellowish brown (10YR 6/2), fine grained, trace amount of micritic to very fine grained and slightly dolomitic; 30% medium light gray (N6) and light olive gray (5Y 6/1) to olive gray (5Y 4/1), micritic to very fine grained, hard, moderately well cemented, few fragments slightly vuggy.	1,500-1,560	60
LIMESTONE: Limestone, 100%, 60% light gray (N7) to light olive gray (5Y 6/7), very fine grained, moderately cemented; 40% yellowish gray (%Y 7/2) to pale yellowish brown (10YR 6/2), fine grained, poorly cemented.	1,560-1,570	10
LIMESTONE: Limestone, 100%, yellowish gray (5Y 7/2) to pale yellowish brown (10YR 6/2), fine grained, poorly cemented.	1,570-1,590	20
LIMESTONE: Limestone, 100%, 50% yellowish gray (5Y 7/2) to pale yellowish brown (10YR 6/2), fine grained, poorly cemented; 30% pale yellowish brown (10YR 6/2), micritic to very fine grained, well cemented, hard; 20% medium light gray (N6) and light olive gray (5Y 6/1), micritic to very fine grained, primarily well cemented and hard.	1,590-1,600	10
LIMESTONE and CALCAREOUS CLAY: Limestone, 90%, same as interval above; Clay, 10%, light olive gray (5Y 6/1), very fine grained, stiff, medium plasticity; Driller noted clay during drilling for approximately 2 feet starting at 1,605 feet bgl.	1,600-1,610	10
LIMESTONE: Limestone, 100%, 70% yellowish gray (5Y 8/1) to pale yellowish brown (10YR 6/2), very fine grained, poorly cemented, slightly vuggy; 30% light olive gray (5Y 6/1), micritic to very fine grained, moderately well cemented, slightly dolomitic.	1,610-1,630	20
LIMESTONE: Limestone, 100%, 90% pale yellowish brown (10YR 6/2), very fine grained, poorly cemented; 10% light olive gray (5Y 6/1) to olive gray (5Y 4/1), micritic to very fine grained, hard, well cemented, few fragments slightly vuggy.	1,630-1,640	10
LIMESTONE: Limestone, 100%, white (N9) to yellowish gray (5Y 8/1) and some light olive gray (5Y 6/1) that increases with depth, primarily soft and poorly cemented (chalky) with some fragments moderately cemented and slightly vuggy.	1,640-1,670	30

Geologic Log of Sawgrass Test Well SGF-1
City of Sunrise, SUN 103 Project

LITHOLOGICAL DESCRIPTION	DEPTH INTERVAL	THICKNESS
LIMESTONE and CALCAREOUS CLAY: Limestone, 80%, yellowish gray (5Y 8/1) and medium light gray (N6), micritic to very fine grained, hard, well cemented, slightly dolomitic; Clay, 20%, medium light gray (N6), medium plasticity, calcareous.	1,670-1,680	10
LIMESTONE: Limestone, 100%, 90% white (N9) to yellowish gray (5Y 8/1), very fine grained, poorly cemented, chalky; 5%, medium light gray (N6) to dark gray (N3), primarily micritic, hard, well cemented, slightly dolomitic.	1,680-1,700	20
LIMESTONE: Limestone, 100%, 90% yellowish gray (5Y 8/1) to pale yellowish brown (10YR 6/2), very fine grained, poorly cemented; 10% light olive gray (5Y 6/1) to olive black (5Y 2/1), micritic, hard, well cemented, slightly dolomitic.	1,700-1,760	60
LIMESTONE: Limestone, 100%, 70% yellowish gray (5Y 8/1) to pale yellowish brown (10YR 6/2), very fine grained, poorly cemented; 20% light olive gray (5Y 6/1) to olive gray (5Y 4/1), micritic to very fine grained, poorly cemented mudstone; 10% light olive gray (5Y 6/1) to olive black (5Y 2/1), micritic, hard, well cemented, slightly dolomitic.	1,760-1,780	20
LIMESTONE: Limestone, 100%, 95% yellowish gray (5Y 8/1) to pale yellowish brown (10YR 6/2), very fine grained, poorly cemented; 5% light olive gray (5Y 6/1) to olive black (5Y 2/1), micritic, hard, well cemented, slightly dolomitic.	1,780-1,800	20

Geologic Log of Sawgrass Test Well SGF-2
City of Sunrise, SUN 103 Project

LITHOLOGICAL DESCRIPTION	DEPTH INTERVAL	THICKNESS
SILTY SANDS: Sand, 95%, white (N9) to yellowish gray (5Y 8/1), silt to very fine grained, poorly consolidated with a calcareous mud matrix; Shell and Limerock, 5%.	0-50	50
LIMESTONE: Limestone, 100%, yellowish gray (5Y 8/1), fine to medium grained, primarily calcareous with some quartz grains; Note: circulation polymers (appearance of clear silicone) observed between 80 and 100 feet. Contractor encountered loss circulation zone starting at 85 feet bgl.	50-100	50
SILTY SAND AND SHELL: Sand, 80%, light olive gray (5Y 4/1), primarily very fine to fine grained, quartz and calcareous grains; Shell, 15%, small fragments; Limestone, 5%, poorly cemented.	100-160	60
LIMESTONE and SHELL: Limestone, 80%, primarily light olive gray (5Y 6/1), some yellowish gray (5Y 8/1); very fine to fine grained, quartz and calcareous grains, poorly cemented and soft; Shell, 20%, 1-4 mm fragments.	160-180	20
SILTY SAND AND SHELL: Sand, 80%, light olive gray (5Y 4/1), primarily very fine to fine grained, quartz and calcareous grains; Shell, 15%, small fragments; Limestone, 5%, poorly cemented.	180-190	10
LIMESTONE: Limestone, 95%, white (N9) to yellowish gray (5Y 8/1), fine grained, moderately well cemented and hard, well-rounded limestone fragments, small amount of limestone consists of very fine grained and soft material similar to 150-180 interval; Shell 5%.	190-200	10
CLAY, LITTLE LIMESTONE AND SHELL: Clay, 80%, light olive gray (5Y 6/1) to olive gray (5Y 4/1), soft, low plasticity, silty; Limestone, 10%, white (N9) to yellowish gray (5Y 8/1), fine grained, moderately cemented; Shell, 10%, small fragments.	200-220	20
SILT AND SHELL: Silt, 90%, light olive gray (5Y 6/1) to olive gray (5Y 4/1), soft, some quartz grains; Shell, 10%, larger fragments than above, some whole shells.	220-260	40
CLAYEY SILT AND SHELL: Silt, 90%, light olive gray (5Y 6/1) to olive gray (5Y 4/1), slightly cohesive, soft, some quartz grains; Shell, 10%, small fragments.	260-300	40
SILT: Silt, 100%, light olive gray (5Y 5/2), primarily calcareous with some quartz grains.	300-310	10
CLAYEY SILT AND SHELL: Silt, 90%, light olive gray (5Y 6/1) to olive gray (5Y 4/1), slightly cohesive, soft, some quartz grains; Shell, 10%, small fragments.	310-320	10
SILT: Silt, 100%, light olive gray (5Y 5/2), primarily calcareous with some quartz grains.	320-330	10
CLAYEY SILT AND SHELL: Silt, 90%, light olive gray (5Y 6/1) to olive gray (5Y 4/1), slightly cohesive, soft, some quartz grains; Shell, 10%, small fragments.	330-400	70
SILT: Silt, 100%, light olive gray (5Y 5/2), primarily calcareous with some quartz grains; Limestone and Shell, trace amounts.	400-410	10
CLAYEY SILT: Silt, 100%, light olive gray (5Y 6/1) to olive gray (5Y 4/1), slightly cohesive, soft, some quartz grains; Shell, trace, small fragments.	410-490	80
LIMESTONE, SILT AND SHELL: Limestone, 50%, yellowish gray (5Y 7/2) to light olive gray (5Y 5/2), fine grained, poorly cemented, soft; Silt, 40%, light olive gray (5Y 5/2), calcareous; Shell, 10%, small fragments.	490-550	60
CLAYEY SILT, LIMESTONE, SHELL: Silt, 80%, light olive gray (5Y 5/2), soft, calcareous, slightly cohesive; Limestone, 10%, yellowish gray (5Y 7/2), fine grained, soft; Shell, 10%, small fragments.	550-560	10
LIMESTONE, SILT AND SHELL: Limestone, 50%, yellowish gray (5Y 7/2) to light olive gray (5Y 5/2), fine grained, poorly cemented, soft; Silt, 40%, light olive gray (5Y 5/2), calcareous; Shell, 10%, small fragments.	560-630	70
LIMESTONE AND CLAYEY SILT: Limestone, 80%, yellowish gray (5Y 7/2), fine grained, poorly cemented; Silt, 20%, yellowish gray (5Y 7/2), calcareous, soft.	630-660	30
LIMESTONE WITH VARYING AMOUNTS OF CLAY: Limestone, 70%, yellowish gray (5Y 7/2), very fine grained, unconsolidated sand; Clay, 25%, yellowish gray (5Y 7/2), slightly silty, low plasticity, increased amounts of clay in 670-680 sample and 710-720 sample; Shell, 5%, small fragments, larger shell fragments between 750 and 800 feet bgl.	660-830	170

Geologic Log of Sawgrass Test Well SGF-2
City of Sunrise, SUN 103 Project

LITHOLOGICAL DESCRIPTION	DEPTH INTERVAL	THICKNESS
LIMESTONE, SHELL AND CLAY: Limestone, 50%, yellowish gray (5Y 7/2), very fine grained, harder and more cemented than interval above; Shell, 30%, fragments; Clay, 20%, yellowish gray (5Y 7/2), calcareous marl.	830-840	10
PHOSPHATIC CLAY: Clay, 80%, pale olive (10Y 6/2), low plasticity, slightly cohesive; Limestone, 20%, yellowish gray (5Y 7/2).	840-850	10
CLAYEY SILT AND LIMESTONE: Silt, 70%, yellowish gray (5Y 7/2), soft, slightly cohesive, increase of cohesive clay between 850 and 880 feet bgl; Limestone, 30%, yellowish gray (5Y 7/2), soft, mostly calcareous sands.	850-930	80
CLAY: Clay, 90%, light olive gray (5Y 6/1), calcareous, medium plasticity, cohesive; Driller encountered slightly harder drilling conditions (limestone rock) at approximately 955 feet bgl	930-955	15
CLAY AND LIMESTONE: Clay, 70, light olive gray (5Y 6/1), calcareous, medium plasticity, cohesive; Limestone, 30%, yellowish gray (5Y 7/2), fine grained, poorly cemented, phosphatic grains present, limestone increases with depth.	955-978	20
CLAY: Clay, 100%, olive gray (5Y 4/1), medium plasticity, cohesive; Limestone, trace.	978-999	21
LIMESTONE AND CLAY: Limestone, 60%, yellowish gray (5Y8/1), sparitic, moderately hard, few fossils; Clay, 40%, olive gray (5Y 4/1), thin interbedded layers which slightly decrease with depth.	999-1,010	11
LIMESTONE: Limestone, 100%, yellowish gray (5Y 8/1), sparitic, moderately hard, fossils.	1,010-1,020	10
LIMESTONE: Limestone, 100%, primarily yellowish gray (5Y 8/1) with some light olive gray (5Y 6/1), numerous small fossils cemented in a calcareous matrix, 50% recrystallized/sparitic and moderately well cemented, phosphate grains present, few whole shell clasts present.	1,020-1,050	40
LIMESTONE: Limestone, 100%, light olive gray (5Y6/1) to yellowish gray (5Y 8/1), primarily fine grained grainstone, poorly to moderately cemented, few sparite pieces, highly phosphatic, few small fossil fragments.	1,050-1,080	30
LIMESTONE: Limestone, 100%, yellowish gray (5Y 8/1) and light to medium gray (N7 to N6), numerous small fossil fragments in a calcareous matrix, partially recrystalized, poorly to moderately cemented, few phosphatic grains present	1,080-1,120	40
SANDY CLAY: Clay, 100%, light olive gray to olive gray (5Y 6/1 to %Y 4/1), very fine to fine grained, primarily quartz, small amount of calcareous clay, non-plastic, non-cohesive.	1,120-1,130	10
LIMESTONE: Limestone, 100%, yellowish gray (5Y 8/1), very fine grained, recrystalized, poorly to moderately cemented, numerous small fossils, 10% medium dark gray (N4), siltstone, primarily quartz grained.	1,130-1,160	20
LIMESTONE AND MARL: Limestone, 70%, same as interval above; Marl, 30%, (5Y 8/1), soft, medium plasticity.	1,160-1,170	10
	1,170-1,180	10
LIMESTONE: Limestone, 100%, yellowish gray (5Y 8/1) to pale yellowish brown (10YR 6/2), moderately cemented with some sparitic well cemented fragments.	1,180-1,210	30
LIMESTONE: Limestone, 100%, yellowish gray (5Y 8/1), very fine grained, soft, poorly cemented, numerous small fossils.	1,210-1,220	10
LIMESTONE: Limestone, 100%, 70% pale yellowish (10YR 6/2) and moderately cemented, 30% yellowish gray (5Y 8/1), poorly cemented, all fine grained with few fossils.	1,220-1,240	20
LIMESTONE: Limestone, 100%, yellowish gray (5Y 8/1) to pale yellowish brown (10YR 6/2), very fine to fine grained grainstone, poorly cemented, few fragments, slightly vuggy.	1,240-1,390	170
LIMESTONE: Limestone, 100%, yellowish gray (5Y 7/2) to light olive gray (5Y 5/2), very fine grained, well cemented, slightly vuggy.	1,390-1,410	20
LIMESTONE: Limestone, 100%, yellowish gray (5Y 7/2) to pale yellowish brown (10YR 6/2), very fine to fine grained grainstone, poorly cemented	1,410-1,430	20

Geologic Log of Sawgrass Test Well SGF-2
City of Sunrise, SUN 103 Project

LITHOLOGICAL DESCRIPTION	DEPTH INTERVAL	THICKNESS
LIMESTONE: Limestone, 100%, same as interval above with the exception of 20% light olive (5Y 6/1) to olive gray (5Y 4/1), micritic, hard, well cemented.	1,430-1,450	20
LIMESTONE: Limestone, 100%, primarily pale yellowish brown (10YR 6/2) with some yellowish gray (5Y 7/2), poorly to moderately cemented, very fine to fine grained, slightly vuggy; few fragments micritic and well cemented.	1,450-1,520	70
LIMESTONE: Limestone, 100%, 70%, yellowish gray (5Y 7/2) to pale yellowish brown (10YR 6/2), fine grained, trace amount of micritic to very fine grained and slightly dolomitic; 30% medium light gray (N6) and light olive gray (5Y 6/1) to olive gray (5Y 4/1), micritic to very fine grained, hard, moderately well cemented, few fragments slightly vuggy.	1,520-1,590	70
LIMESTONE: Limestone, 100%, yellowish gray (5Y 7/2) to pale yellowish brown (10YR 6/2), fine grained, poorly to moderately cemented.	1,590-1,610	20
LIMESTONE: Limestone, 100%, primarily yellowish gray (5Y 7/2) to pale yellowish brown (10YR 6/2) with some light olive gray (5Y 6/1), fine grained, moderately well cemented, some intergranular porosity.	1,610-1,620	10
LIMESTONE AND MARL: Limestone, 80%, same as interval above; Clay, 20%, light olive gray (5Y 6/1), very fine grained, soft.	1,620-1,630	10
LIMESTONE: Limestone, 100%, 70% yellowish gray (5Y 8/1) to pale yellowish brown (10YR 6/2), very fine grained, poorly cemented, slightly vuggy; 30% light olive gray (5Y 6/1), micritic to very fine grained, moderately well cemented, slightly dolomitic.	1,630-1,650	20
LIMESTONE: Limestone, 100%, 90% pale yellowish brown (10YR 6/2), very fine grained, poorly cemented; 10% light olive gray (5Y 6/1) to olive gray (5Y 4/1), micritic to very fine grained, hard, well cemented, few fragments slightly vuggy.	1,650-1,660	10
LIMESTONE: Limestone, 100%, yellowish gray (5Y 8/1) and some light olive gray (5Y 6/1), primarily soft and poorly cemented with some fragments moderately well cemented and slightly vuggy.	1,660-1690	30
LIMESTONE: Limestone, 100%, primarily yellowish gray (5Y 7/2) with some pale yellowish brown (10YR 6/2) and light olive gray (5Y 6/1), very fine to fine grained, moderately cemented, slightly vuggy.	1,690-1,700	10
LIMESTONE: Limestone, 100%, 90% white (N9) to yellowish gray (5Y 8/1), very fine grained, poorly cemented, chalky; 5%, medium light gray (N6) to dark gray (N3), primarily micritic, hard, well cemented, slightly dolomitic..	1,700-1,720	10
LIMESTONE: Limestone, 100%, 90% yellowish gray (5Y 8/1) to pale yellowish brown (10YR 6/2), very fine grained, poorly cemented; 10% light olive gray (5Y 6/1) to olive black (5Y 2/1), micritic, hard, well cemented, slightly dolomitic.	1,720-1,780	60
LIMESTONE: Limestone, 100%, 95% yellowish gray (5Y 8/1) to pale yellowish brown (10YR 6/2), very fine grained, poorly cemented; 5% light olive gray (5Y 6/1) to olive black (5Y 2/1), micritic, hard, well cemented, slightly dolomitic.	1,780-1,860	80

Appendix B

Water Quality and Specific Capacity Testing Data from Pilot Hole Drilling: SGF-1 and SGF-2

Water-Quality Sampling Results from Pilot-Hole Reverse-Air Discharge
Sawgrass Test Well SGF-1, City of Sunrise, Florida

Test Well SGF-1												
Date	Time	Depth	Drill Stem					Annulus				
			Cond (uS/cm)	Temp (C)	Chloride (mg/L)	H2S (mg/L)	Sulfate (mg/L)	Cond (uS/cm)	Temp (C)	Chloride (mg/L)	H2S (mg/L)	Sulfate (mg/L)
8/2/2012	11:00	1033	8960	26.4	2250	NA	>200	*Well not free flowing at this depth*				
8/3/2012	10:00	1060	9450	24.1	2250	NA	>200	9360	24.5	2250	NA	>200
8/3/2012	13:30	1092	9230	22.1	2250	NA	>200	9750	23.5	2500	NA	>200
8/3/2012	15:30	1123	9560	23.1	2250	NA	>200		21.5	2250	NA	>200
8/6/2012	9:40	1155	9950	22.3	2250	0.53	>200	9460	22.3	2250	1.54	>200
8/6/2012	11:35	1185	11960	24.4	2750	0.42	>200	9380	23.0	2250	1.54	>200
8/6/2012	14:50	1218	12850	23.9	3000	0.32	>200	9380	23.3	2250	1.64	>200
8/6/2012	18:20	1248	12510	22.7	3000	0.53	>200	9820	22.2	2250	1.48	>200
8/7/2012	9:50	1279	12570	23.1	3250	0.58	>200	10140	23.0	2500	1.48	>200
8/7/2012	16:00	1309	11600	23.8	2750	0.64	>200	10130	23.6	2250	1.38	>200
8/7/2012	18:40	1340	13220	23.0	3250	0.42	>200	10390	22.9	2500	1.48	>200
8/8/2012	9:35	1372	13880	23.2	3750	0.64	>200	10290	22.7	2500	1.70	>200
8/8/2012	12:40	1401	14650	22.7	3500	0.48	>200	10280	23.1	2500	1.54	>200
8/8/2012	15:17	1434	16550	22.7	4000	0.56	>200	10350	23.0	2500	NA	>200
8/8/2012	17:45	1465	16630	22.5	3750	0.37	>200	10530	22.8	2250	NA	>200
8/9/2012	9:10	1496	16460	22.5	3750	0.37	>200	11000	22.3	2500	1.48	>200
8/9/2012	11:50	1528	15830	22.7	3750	0.37	>200	11050	22.7	2750	1.48	>200
8/9/2012	13:45	1558	14360	22.6	3500	0.53	>200	11580	22.6	2750	NA	>200
8/9/2012	16:55	1588	14040	22.5	3500	0.53	>200	11860	22.7	3000	1.54	>200
8/9/2012	19:04	1618	10960	22.3	2500	0.32	>200	11920	22.8	2750	1.38	>200
8/10/2012	9:05	1650	5600	22.1	1500	0.16	>200	11830	22.0	2750	NA	>200
8/10/2012	11:10	1682	5970	22.0	1500	0.27	>200	11340	22.2	2500	1.33	>200
8/10/2012	13:35	1712	6030	22.1	1500	NA	>200	11220	21.7	2500	NA	>200
8/10/2012	15:20	1742	6070	22.2	1500	0.32	>200	10870	22.1	2500	1.54	>200
8/10/2012	17:00	1774	6070	22.0	1500	0.42	>200	10570	23.1	2500	0.64	>200
8/13/2012	9:45	1800	6080	21.4	1500	0.42	>200	9610	21.6	2250	1.64	>200

- Cond (uS/cm) denotes field conductivity measured in microSiemans per centimeter

- Temp (C) denotes field temperature measured in degrees Celsius

- mg/L denotes milligrams per liter

- H2S denotes field hydrogen sulfide using a HACH kit (Model HS-WR)

- Sulfate measured in the field using a HACH kit (Model SF-1)

- Time refers to the time the drill-stem sample was taken. In general, the annulus samples were collected approximately 0.5 to 0.75 hour after the drill stem samples were collected.

- Depth refers to the total depth of the pilot hole at the time both the drill stem and the annulus sample was collected

- Drill stem samples were collected at the location where cuttings and drilling fluids discharge into the onsite settling tanks. The Contractor removed cuttings (cleaned the borehole) for approximately 15 minutes prior to collecting the drill-stem water sample

- Reverse-air, open circulation drilling method was used during pilot hole drilling. The annulus between the drill stem and the open hole was allowed to flow during drilling. Annulus samples are considered a more representative sample (compared to drill stem samples) of the entire borehole between the base of the 28-inch casing (set at 1,000 feet bgl) and the depth of the pilot hole at the time the annulus sample was collected.

Water-Quality Sampling Results from Pilot-Hole Reverse-Air Discharge
Sawgrass Test Well SGF-2, City of Sunrise, Florida

Test Well SGF-2													
Date	Time	Depth	Drill Stem					Annulus					
			Cond (uS/cm)	Temp (C)	Chloride (mg/L)	H2S (mg/L)	pH (mg/L)	Cond (uS/cm)	Temp (C)	Chloride (mg/L)	H2S (mg/L)	pH (mg/L)	
11/16/2012	16:25	1052	3742	26.9	1000	0.27	8.9						
11/19/2012	9:50	1083	9790	24.5	2250	0.37	8.3						
11/19/2012	12:55	1115	9674	23.0	2250	0.48	8.3	9648	23.7	2250	1.22	8.5	
11/19/2012	16:22	1150	10239	22.9	2500	0.37	8.3	9450	23.1	2250	1.33	8.2	
12/4/2012	8:55	1177	11450	21.8	2750	0.27	8.2	9860	24.3	2250	0.48	8.2	
12/4/2012	10:03	1208	11360	22.6	2500	<0.25	8.1	9790	22.8	2250	1.33	8.1	
12/4/2012	11:50	1239	11470	22.9	2750	0.48	8.1	9860	23.2	2500	1.38	8.0	
12/4/2012	13:45	1270	12610	23.0	2750	0.27	8.1	9700	23.4	2250	1.54	8.0	
12/4/2012	16:10	1301	12790	23.0	3000	0.48	8.2	10460	23.3	2500	1.38	8.0	
12/5/2012	17:20	1332	13350	23.1	3000	0.42	8.2	10540	25.2	2500	<0.25	8.2	
12/5/2012	18:33	1364	13660	22.9	3250	0.37	8.2	10960	23.1	2750	NA	8.1	
12/6/2012	12:37	1395	NA	23.4	3250	0.58	8.2	11200	23.6	2750	1.59	8.1	
12/6/2012	14:30	1426	15854	23.9	3500	0.80	8.2	11050	23.9	2750	1.70	8.1	
12/6/2012	16:50	1456	18864	23.5	4250	0.70	8.2	11590	23.5	3000	1.64	8.0	
12/6/2012	18:30	1487	18730	23.0	4750	0.58	8.2	11100	22.9	2750	1.64	8.0	
12/7/2012	8:50	1518	18986	22.3	5000	0.58	8.2	13040	22.5	3750	1.70	8.1	
12/7/2012	11:08	1548	19190	22.8	4750	0.64	8.1	13178	22.1	3750	1.80	8.1	
12/7/2012	14:10	1580	18205	23.1	4750	0.64	8.3	13380	23.1	3700	1.70	8.1	
12/7/2012	16:00	1611	16645	23.1	4500	0.48	8.1	13705	23.1	3700	1.59	8.2	
12/8/2012	7:55	1643	13693	21.9	4000	0.27	8.2	13350	23.1	4000	1.22	8.2	
12/8/2012	9:02	1674	10465	22.2	3250	0.42	8.3	13222	22.7	3500	1.70	7.9	
12/8/2012	11:12	1705	16270	22.4	4500	0.16	8.1	13259	23.1	4000	1.59	8	
12/8/2012	13:13	1734	13937	22.8	4250	0.16	8.2	12997	23.1	4000	1.54	8.1	
12/10/2012	8:30	1765	12215	22.1	3500	0.32	8.3	13995	21.8	3750	1.70	8	
12/10/2012	12:05	1796	9250	22.2	2500	0.48	8.3	13340	22.8	3750	1.59	8	
12/10/2012	0:00	1800	8150	22.4	2500	0.32	8.3	13500	22.6	3750	1.39	8.1	
1/3/2013	11:39	1833	10380	21.1	2750	<0.25	NA	13790	22.3	3750	1.33	NA	
1/3/2013	14:37	1863	7110	22.4	2000	<0.25	NA	13880	22.9	3500	1.33	NA	

- Cond (uS/cm) denotes field conductivity measured in microSiemans per centimeter

- Temp (C) denotes field temperature measured in degrees Celsius

- mg/L denotes milligrams per liter

- H2S denotes field hydrogen sulfide using a HACH kit (Model HS-WR)

- Time refers to the time the drill-stem sample was taken. In general, the annulus samples were collected approximately 0.5 to 0.75 hour after the drill stem samples were collected.

- Depth refers to the total depth of the pilot hole at the time both the drill stem and the annulus sample was collected

- Drill stem samples were collected at the location where cuttings and drilling fluids discharge into the onsite settling tanks. The Contractor removed cuttings (cleaned the borehole) for approximately 15 minutes prior to collecting the drill-stem water sample

- Reverse-air, open circulation drilling method was used during pilot hole drilling. The annulus between the drill stem and the open hole was allowed to flow during drilling. Annulus samples are considered a more representative sample (compared to drill stem samples) of the entire borehole between the base of the 28-inch casing (set at 1,006 feet bgl) and the depth of the pilot hole at the time the annulus sample was collected.

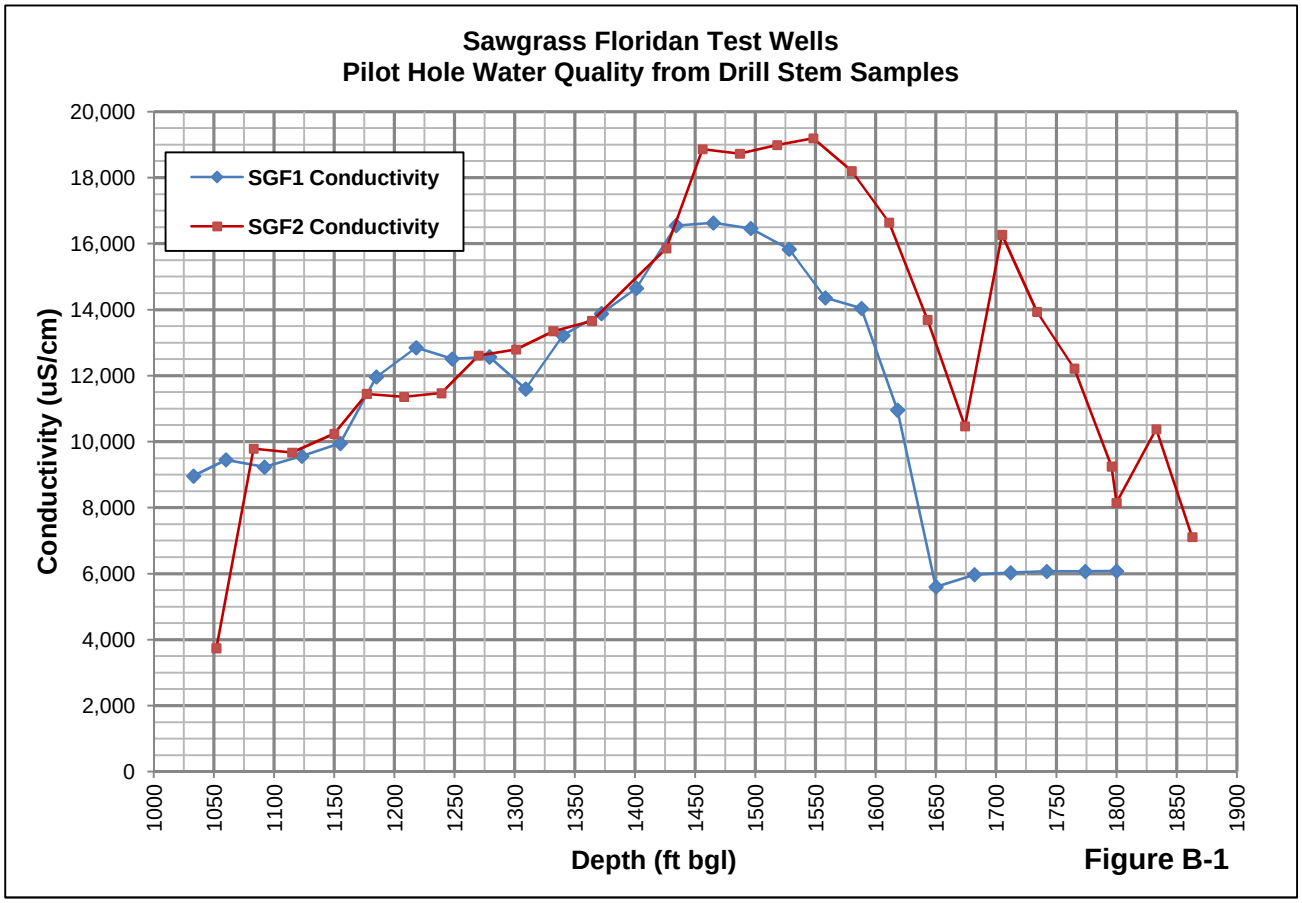


Figure B-1

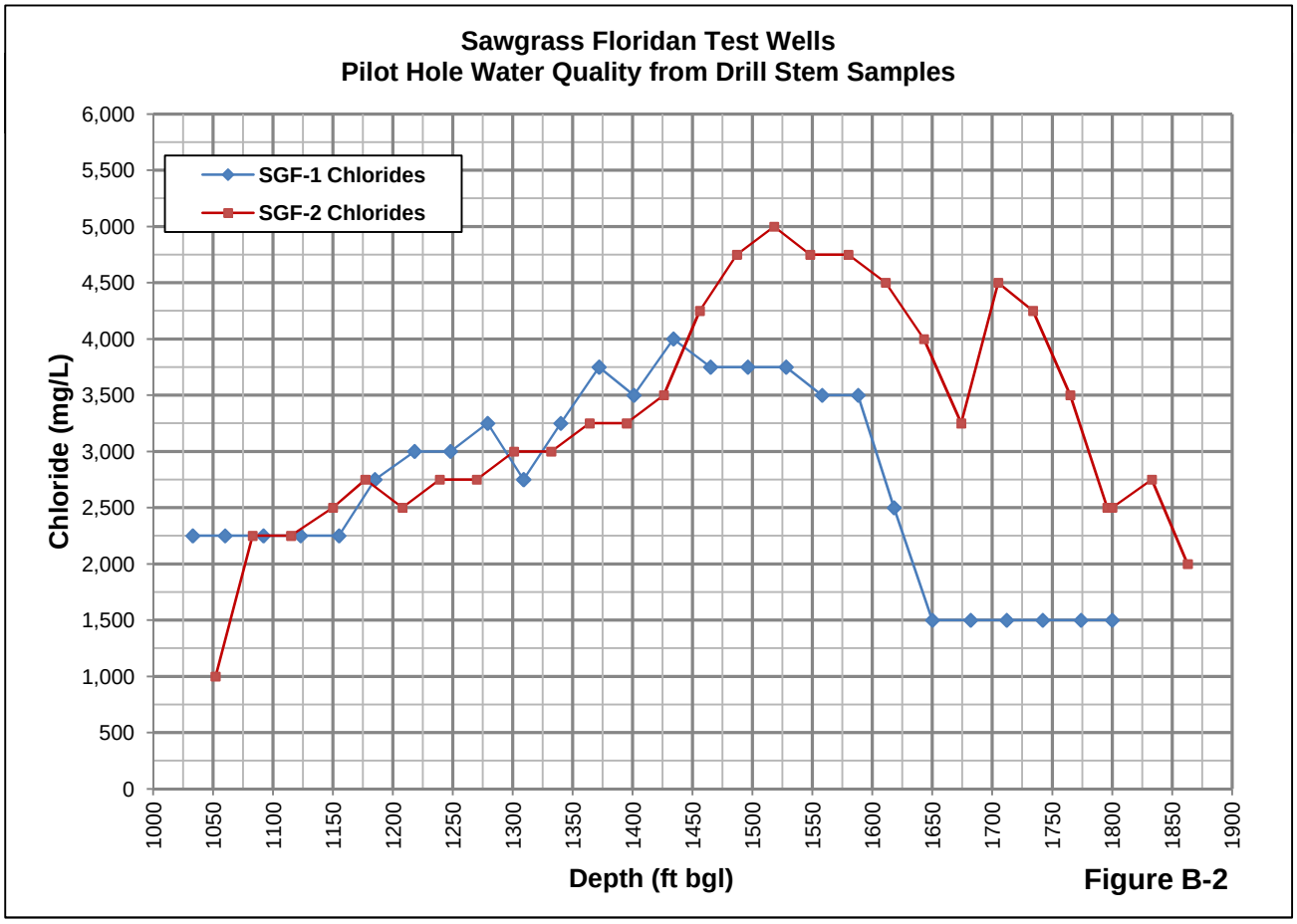


Figure B-2

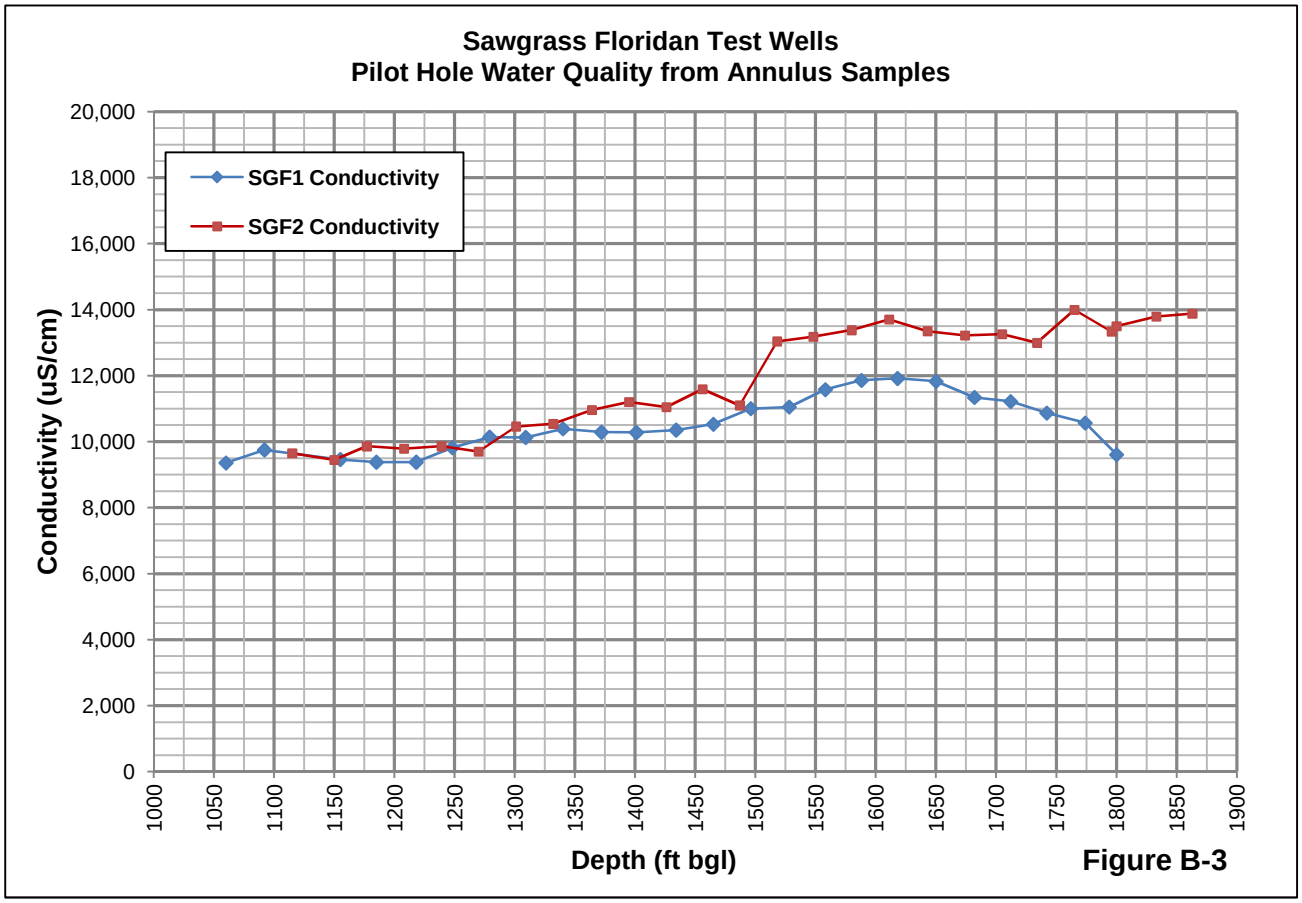


Figure B-3

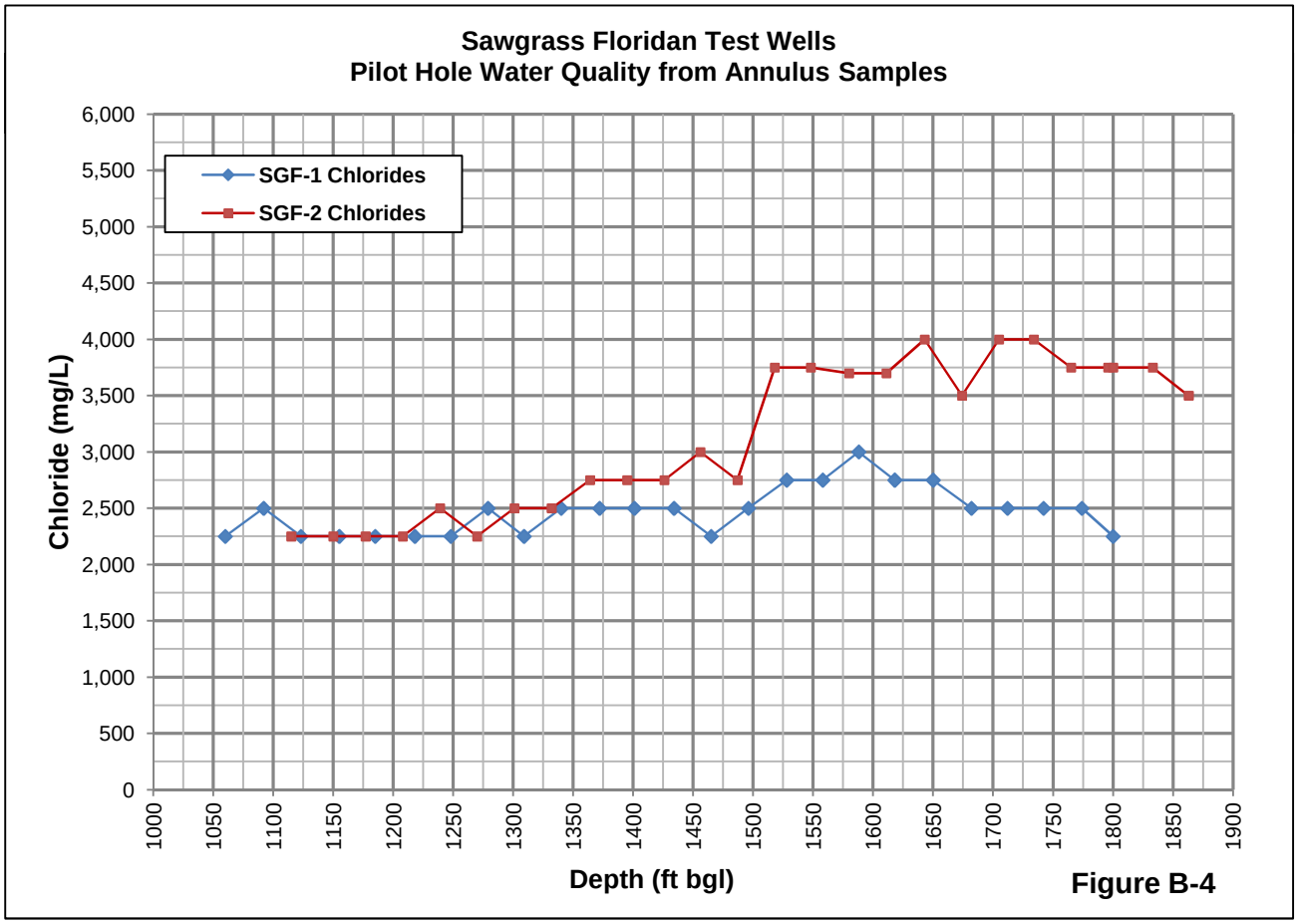


Figure B-4

Specific Capacity Testing Results from Pilot-Hole Drilling
Sawgrass Test Well SGF-1, City of Sunrise, Florida

Test Well SGF-1												
Date	Start Time	P.H. Depth	Test Duration	Volume Purged	Flow Rate	W.L. Start	W.L. Finish	Drawdown	Specific Capacity	Corrected W.L. Start	Corrected Drawdown	Corrected Specific Capacity
		(ft bgl)	(min)	(gal)	(gpm)	(ft agl)	(ft agl)	(ft)	(gpm/ft)	(ft agl)	(ft agl)	(gpm/ft)
8/2/12	10:20	1028	No flow from annulus; no test performed									
8/3/12	9:40	1060	2.14	373	174	45.45	19.75	25.70	6.8	45.4	25.65	6.8
8/3/12	13:06	1092	10.00	5984	598	40.85	10.35	30.50	19.6	44.2	33.85	17.7
8/3/12	15:46	1123	10.78	6643	616	37.25	8.45	28.8	21.4	43.07	34.62	17.8
8/6/12	9:16	1155	11.42	5984	524	37.25	8.64	28.6	18.3	42.7	34.06	15.4
8/6/12	11:49	1185	10.17	5984	588	36.15	6.55	29.6	19.9	42.3	35.75	16.5
8/6/12	14:55	1218	9.25	5984	647	36.85	7.60	29.3	22.1	42.0	34.40	18.8
8/6/12	18:46	1248	9.50	5984	630	35.95	8.35	27.6	22.8	41.65	33.30	18.9
8/7/12	10:09	1279	7.68	5984	779	35.95	9.35	26.6	29.3	41.9	32.55	23.9
8/7/12	16:12	1309	6.67	5984	897	40.95	7.73	33.2	27.0	42.1	34.37	26.1
8/7/12	18:46	1340	6.96	5984	860	35.74	8.25	27.5	31.3	42.35	34.10	25.2
8/8/12	9:45	1379	10.00	8976	898	37.45	8.33	29.1	30.8	42.0	33.67	26.7
8/8/12	13:00	1401	9.83	8976	913	35.85	7.02	28.8	31.7	41.9	34.88	26.2
8/8/12	15:38	1434	9.67	8976	928	37.35	8.81	28.5	32.5	41.7	32.89	28.2
8/8/12	18:10	1465	10.20	8976	880	35.95	6.73	29.2	30.1	41.45	34.72	25.3
8/9/12	9:30	1496	8.75	8976	1026	37.25	8.09	29.2	35.2	41.5	33.41	30.7
8/9/12	12:02	1528	8.50	8976	1056	36.65	7.99	28.7	36.8	41.5	33.51	31.5
8/9/12	14:01	1558	8.62	8976	1041	35.55	8.36	27.2	38.3	41.5	33.14	31.4
8/9/12	16:14	1588	10.17	11969	1177	35.65	6.90	28.8	40.9	41.5	34.60	34.0
8/10/12	7:20	1618	9.58	11969	1249	41.58	9.35	32.2	38.8	41.55	32.20	38.8
8/10/12	9:40	1650	9.50	11969	1260	37.45	10.34	27.1	46.5	42.3	31.96	39.4
8/10/12	11:30	1682	9.33	11969	1283	38.35	9.13	29.2	43.9	43.10	33.97	37.8
8/10/12	13:55	1712	8.83	11969	1355	37.20	10.54	26.7	50.8	43.50	32.96	41.1
8/10/12	15:38	1742	8.30	11969	1442	38.55	9.50	29.1	49.6	44.40	34.90	41.3
8/13/12	7:25	1774	7.68	11969	1558	45.05	7.50	37.6	41.5	45.05	37.55	41.5
8/13/12	10:10	1800	7.66	11969	1563	41.68	3.27	38.4	40.7	45.05	41.78	37.4
10/10/12	14:01	*1127*	15.00	6643	443	37.35	4.24	33.1	13.4			

- P.H. Depth (ft bgl) denotes Pilot Hole Depth, feet below ground level

- min denotes minutes

- gal denotes gallons

-gpm denotes gallons per minute

- ft agl denotes feet above ground level

- gpm/ft denotes specific capacity measured at gallons per minute per feet of drawdown

- W.L. Start refers to the water level just prior to starting a specific capacity test. Water level measured using a clear manometer tube connected to the annulus and running up the drill-rig mast. At each drill rod connection, the Contractor terminated reverse-air discharge and shut-in the annulus. The Contractor then waited approximately 15 to 20 minutes to allow water levels to recover.

- W.L. Finish refers to the water level just prior to terminating the specific capacity while the annulus is flowing at the rate indicated

- Drawdown refers to the difference between W.L. Start and W.L. Finish

- Specific Capacity calculated by dividing the Flow Rate by the Drawdown

- Corrected W.L. is based on the water level measured at the start of each work shift after allowing the water level to recover overnight for several hours. The Corrected W.L. shaded in green are actual water levels measured. Non-shaded values were calculated using a linear regression between the known shaded values.

- Corrected Drawdown refers to the difference between the Corrected W.L. and W.L. Finish

- Corrected Specific Capacity calculated by dividing the Flow Rate by the Corrected Drawdown

-Specific capacity test on 10/10/12 was performed within a nominal 28-inch borehole between 1,006 and 1,127 feet bgl. As with all other specific capacity tests performed, the drill bit and pipe was within the borehole when performing the 10/10/12 test.

Specific Capacity Testing Results from Pilot-Hole Drilling
Sawgrass Test Well SGF-2, City of Sunrise, Florida

Test Well SGF-2												
Date	Start Time	P.H. Depth	Test Duration	Volume Purged	Flow Rate	W.L. Start	W.L. Finish	Drawdown	Specific Capacity	Corrected W.L. Start	Corrected Drawdown	Corrected Specific Capacity
		(ft bgl)	(min)	(gal)	(gpm)	(ft agl)	(ft agl)	(ft)	(gpm/ft)	(ft agl)	(ft agl)	(gpm/ft)
11/19/12	7:15	1052	12.00	1142	95	45.24	10.77	34.5	2.8	45.2	34.47	2.8
11/19/12	10:07	1083	10.00	1593	159	41.15	7.95	33.2	4.8	43.8	35.81	4.4
11/19/12	13:20	1115	10.00	2520	252	31.67	9.03	22.6	11.1	42.3	33.24	7.6
11/19/12	16:46	1150	10.00	221	222	29.23	11.95	17.3	12.8	40.8	28.84	7.7
12/4/12	7:20	1177	8.00	3590	449	39.30	6.85	32.5	13.8	39.3	32.45	13.8
12/4/12	10:25	1208	7.00	2585	369	33.38	8.92	24.5	15.1	39.5	30.55	12.1
12/4/12	12:15	1239	7.00	2886	412	34.15	9.87	24.3	17.0	39.6	29.77	13.8
12/4/12	13:50	1270	8.00	3662	458	33.32	10.30	23.0	19.9	39.8	29.51	15.5
12/4/12	16:20	1301	7.00	3920	560	31.88	9.70	22.2	25.2	40.0	30.28	18.5
12/5/12	16:30	1332	8.00	6000	750	40.15	10.12	30.0	25.0	40.15	30.03	25.0
12/5/12	18:33	1364	8.00	6000	750	32.78	8.85	23.9	31.3	39.8	30.95	24.2
12/6/12	13:13	1395	10.00	8348	835	33.65	7.65	26.0	32.1	39.45	31.80	26.3
12/6/12	15:08	1426	10.00	8663	866	32.35	8.27	24.1	36.0	39.33	31.06	27.9
12/6/12	16:55	1456	10.00	9669	967	31.92	6.45	25.5	38.0	39.26	32.81	29.5
12/6/12	18:50	1487	10.00	8671	867	30.80	8.55	22.3	39.0	39.10	30.55	28.4
12/7/12	8:50	1518	10.00	9540	954	33.60	10.10	23.5	40.6	39.15	29.05	32.8
12/7/12	11:08	1548	10.00	9770	977	33.15	9.25	23.9	40.9	39.20	29.95	32.6
12/7/12	14:10	1580	10.00	10010	1001	31.28	8.03	23.3	43.1	39.24	31.21	32.1
12/7/12	16:00	1611	10.00	10150	1015	30.75	12.00	18.8	54.1	39.29	27.29	37.2
12/8/12	7:55	1643	10.00	11120	1112	39.29	14.50	24.8	44.9	39.96	25.46	43.7
12/8/12	9:02	1674	10.00	11680	1168	36.07	10.60	25.5	45.9	40.63	30.03	38.9
12/8/12	11:12	1705	10.00	12930	1293	36.12	10.05	26.1	49.6	41.29	31.24	41.4
12/8/12	13:13	1734	10.00	12770	1277	35.89	10.50	25.4	50.3	41.96	31.46	40.6
12/10/12	10:17	1765	10.00	14380	1438	38.58	8.45	30.1	47.7	42.63	34.18	42.1
12/10/12	12:43	1796	10.00	14150	1415	38.92	9.10	29.8	47.5	44.06	34.96	40.5
12/10/12	13:57	*1800*	10.00	14740	1474	37.77	9.85	27.9	52.8	45.49	35.64	41.4
1/3/13	13:00	1833	10.00	15380	1538	39.25	7.65	31.6	48.7			
1/3/13	14:45	1863	7.00	10220	1460	37.90	10.60	27.3	53.5			

- P.H. Depth (ft bgl) denotes Pilot Hole Depth, feet below ground level

- min denotes minutes

- gal denotes gallons

-gpm denotes gallons per minute

- ft agl denotes feet above ground level

- gpm/ft denotes specific capacity measured at gallons per minute per feet of drawdown

- W.L. Start refers to the water level just prior to starting a specific capacity test. Water level measured using a clear manometer tube connected to the annulus and running up the drill-rig mast. At each drill rod connection, the Contractor terminated reverse-air discharge and shut-in the annulus. The Contractor then waited approximately 15 to 20 minutes to allow water levels to recover.

- W.L. Finish refers to the water level just prior to terminating the specific capacity test while the annulus is flowing at the rate indicated

- Drawdown refers to the difference between W.L. Start and W.L. Finish

- Specific Capacity calculated by dividing the Flow Rate by the Drawdown

- Corrected W.L. is based on the water level measured at the start of each work shift after allowing the water level to recover overnight for several hours. The Corrected W.L. shaded in green are actual water levels measured. Non-shaded values were calculated using a linear regression between the known shaded values.

- Corrected Drawdown refers to the difference between the Corrected W.L. and W.L. Finish

- Corrected Specific Capacity calculated by dividing the Flow Rate by the Corrected Drawdown

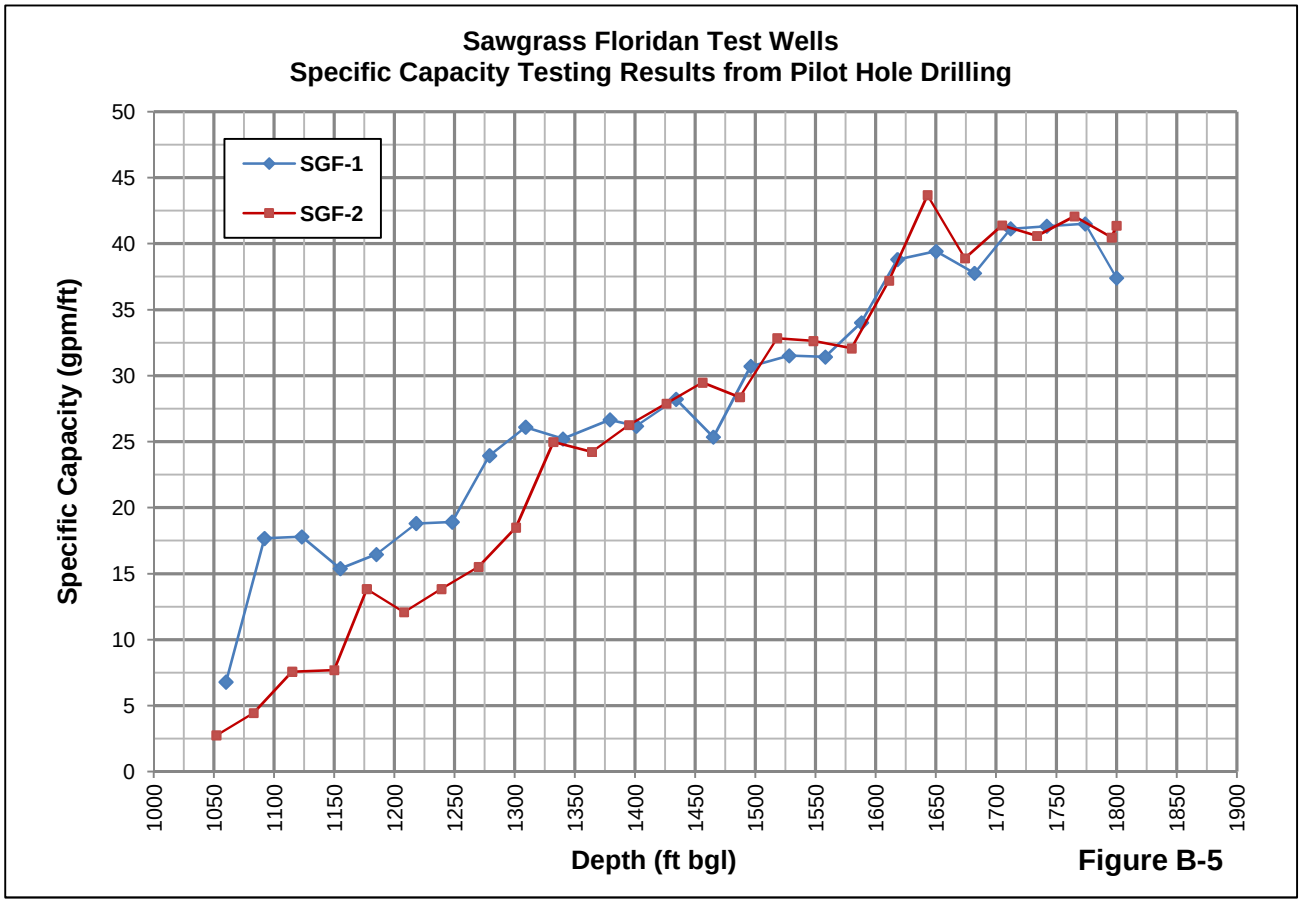


Figure B-5

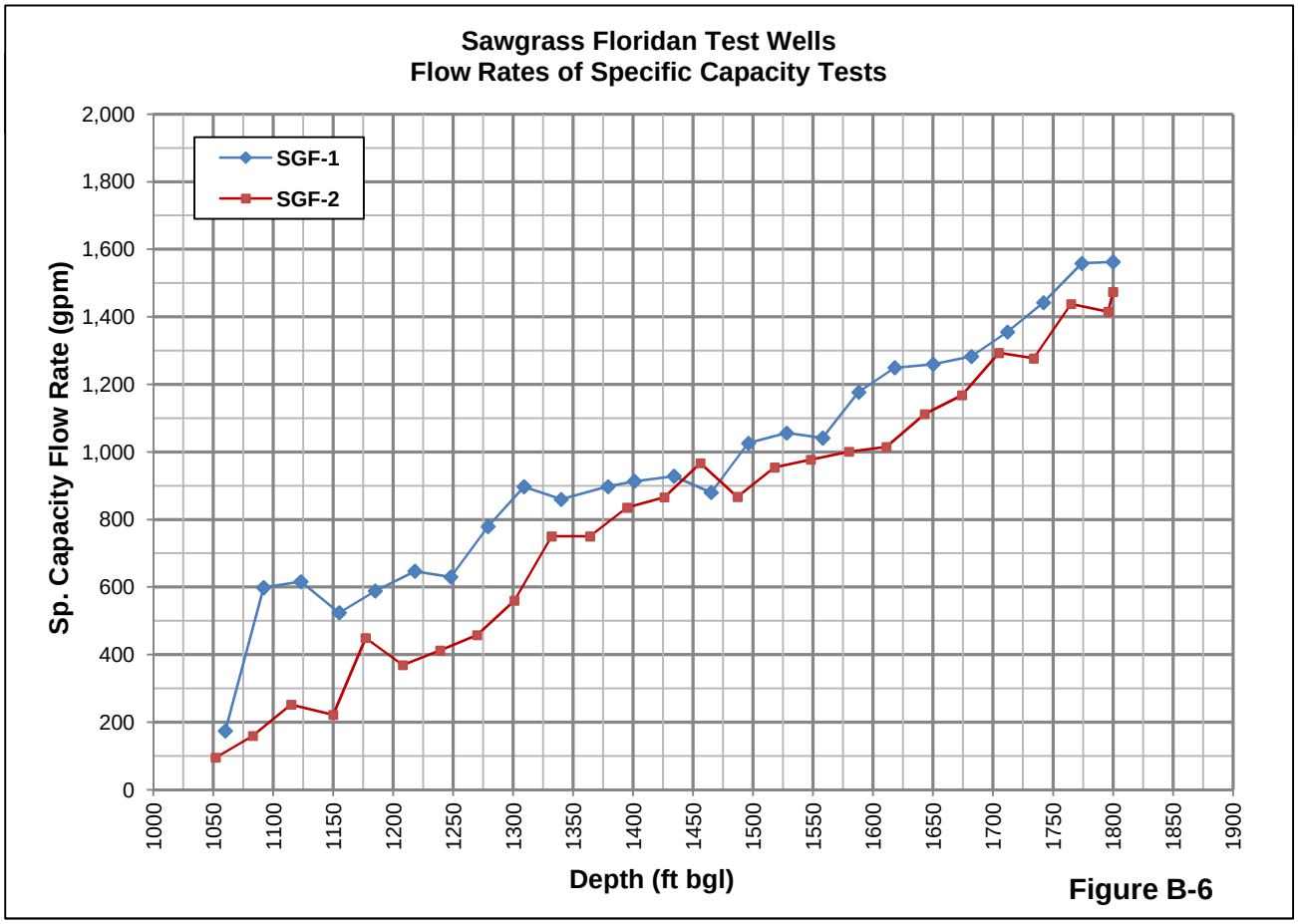


Figure B-6

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Appendix C

Geophysical Logging in SGF-1 and SGF-2

Figure C-1: Test Well SGF-1 Geophysical Logging Between Ground Level and 1,020 Feet BGL

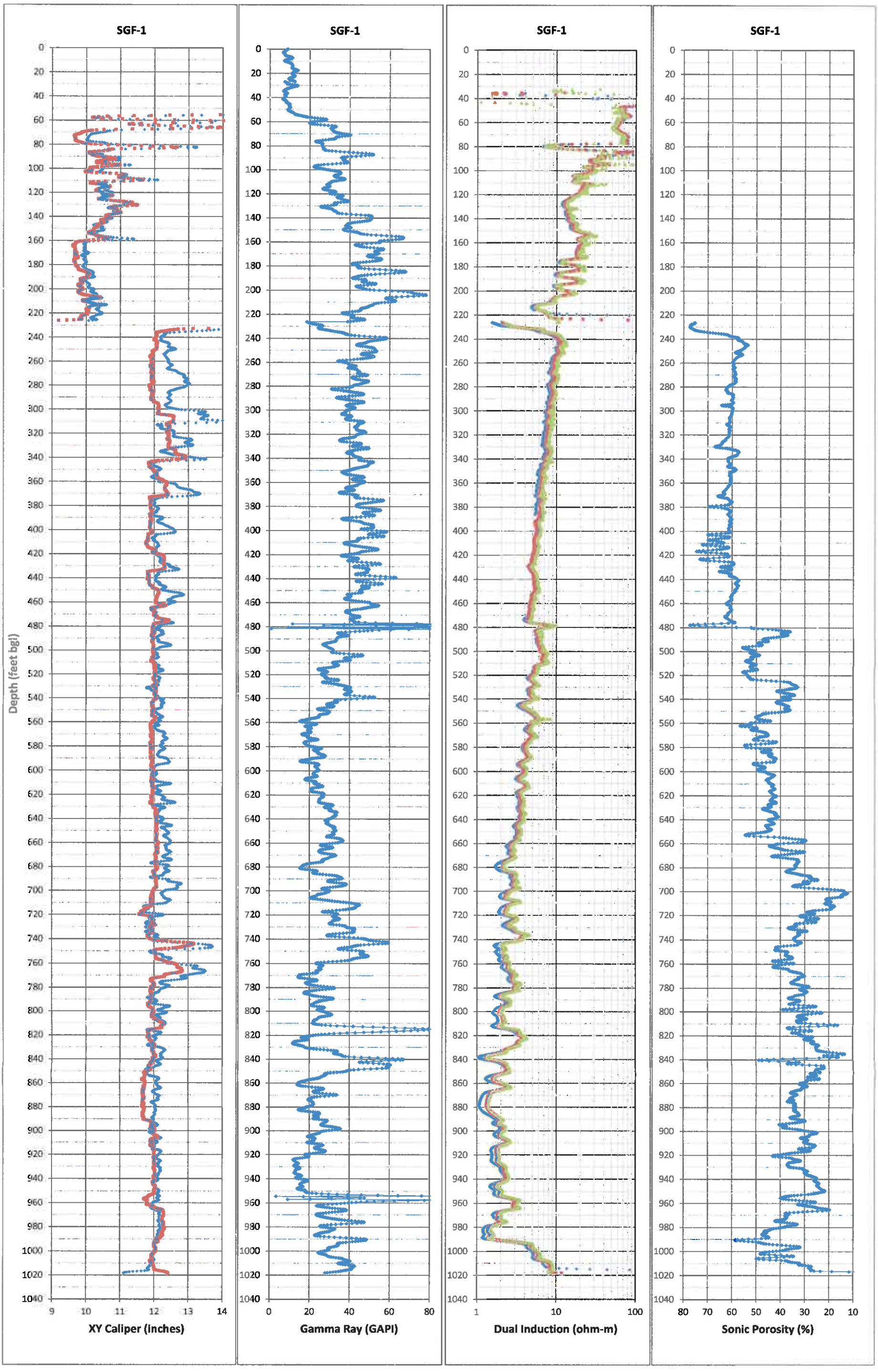

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Figure C-2 Test Well SGF-1 Geophysical Logging Between 1,000 and 1,800 Feet BGL

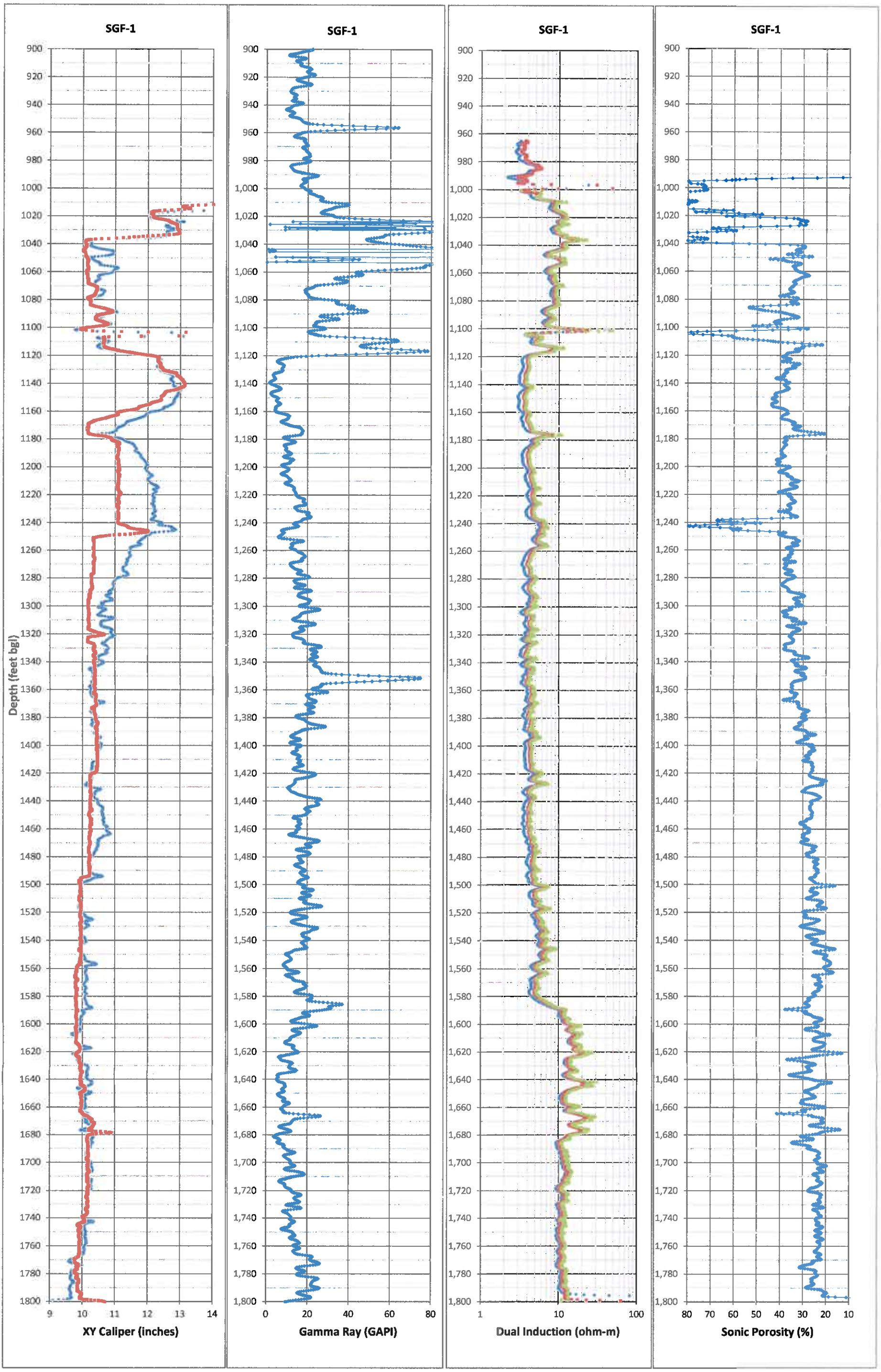

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Figure C-3 Test Well SGF-1 Dynamic Geophysical Logging Between 1,000 and 1,800 Feet BGL

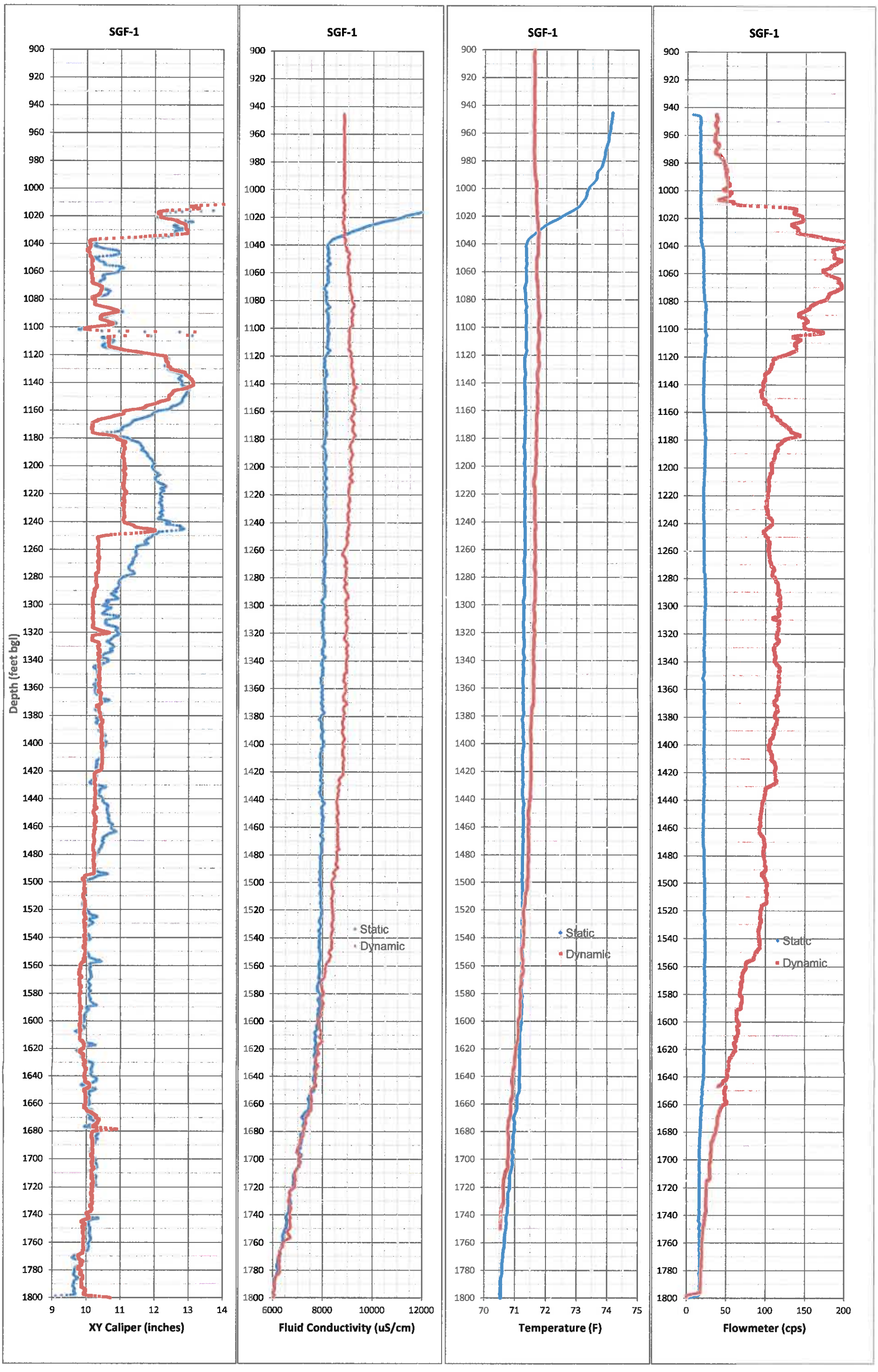

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Figure C-4 Test Well SGF-2 Geophysical Logging Between Ground Level and 980 Feet BGL

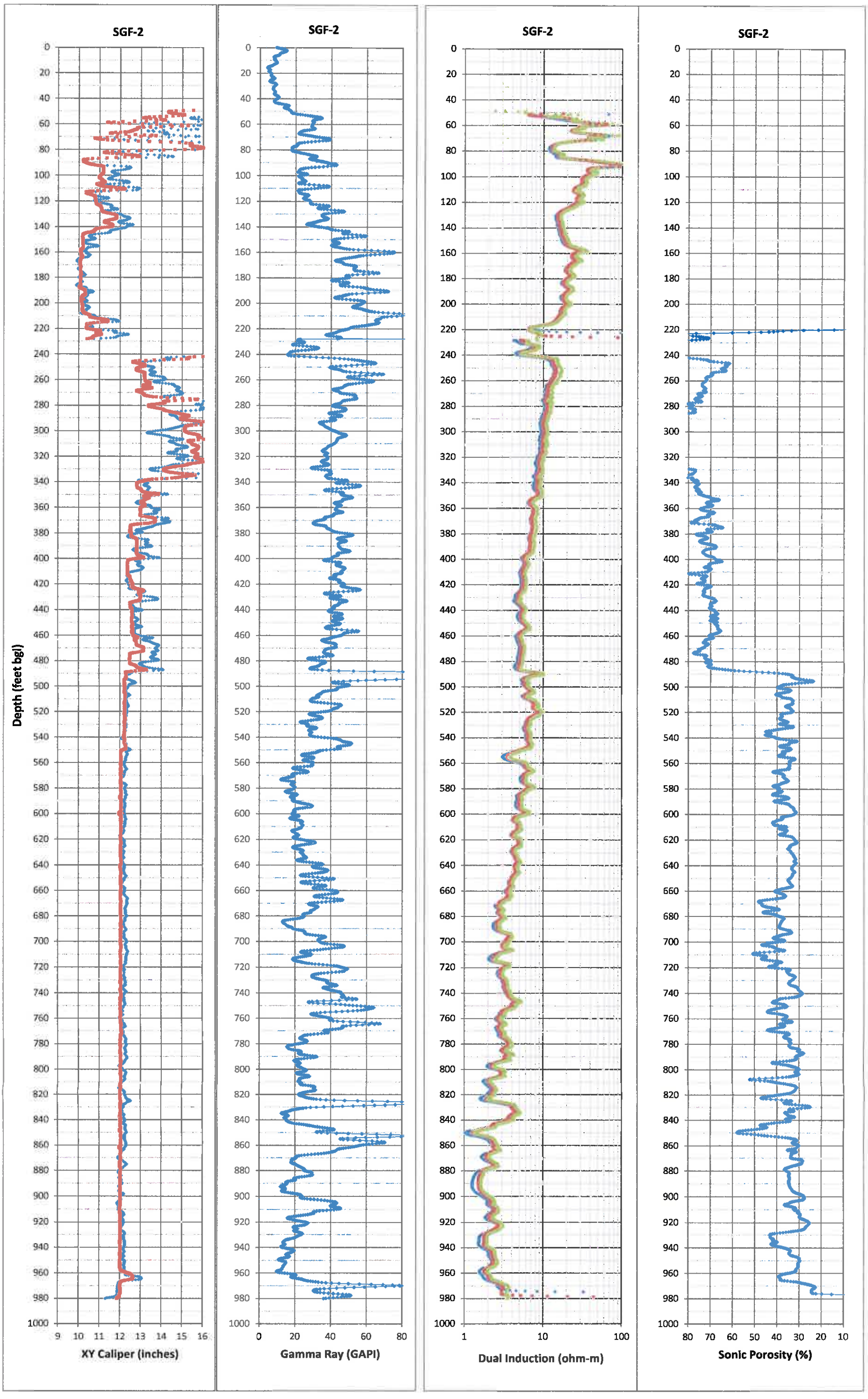

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Figure C-5 Test Well SGF-2 Geophysical Logging Between 1,000 and 1,800 Feet BGL

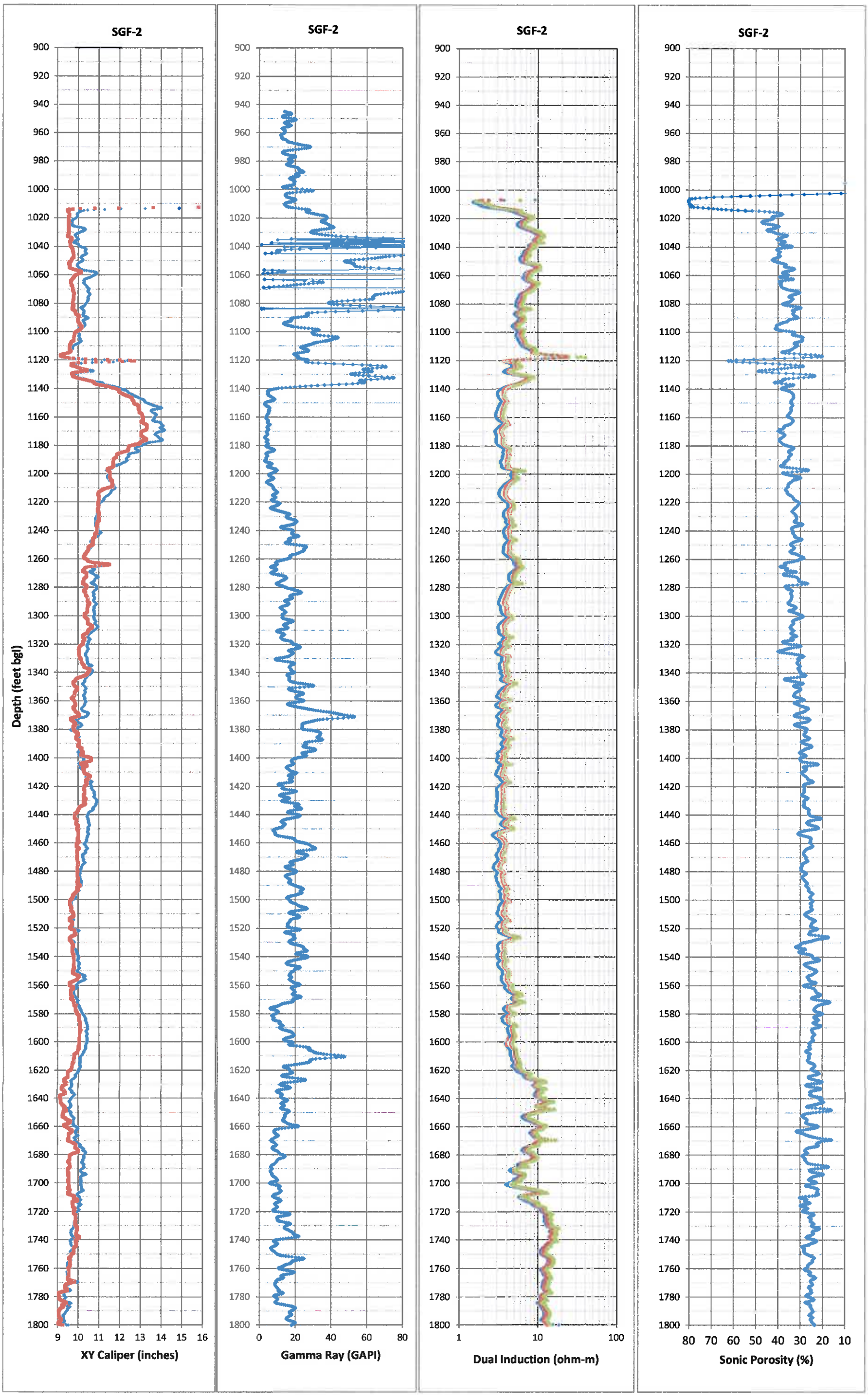
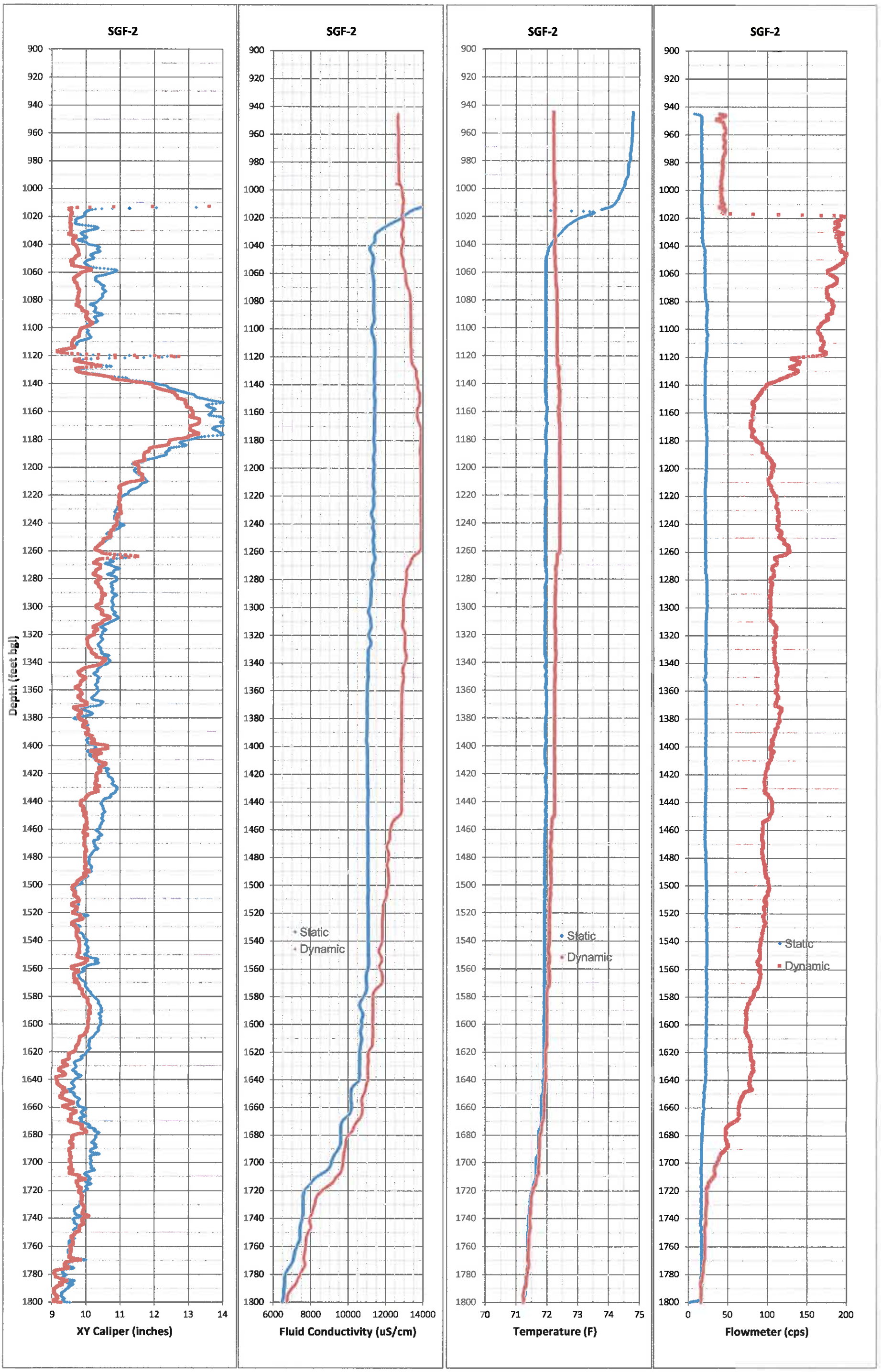


Figure C-6 Test Well SGF-6 Dynamic Geophysical Logging Between 1,000 and 1,800 Feet BGL



G:\AProjects\WR\WF PROJECTS\Sunrise\FL Test Well CA\Floridan Test Wells\Geophysical Logs\SGF2 PH sd50 073013.xlsxDynamic Chart 1000-1800 (2)

Figure C-7: Geophysical Logging Comparison Between Ground Level and 980 Feet BGL

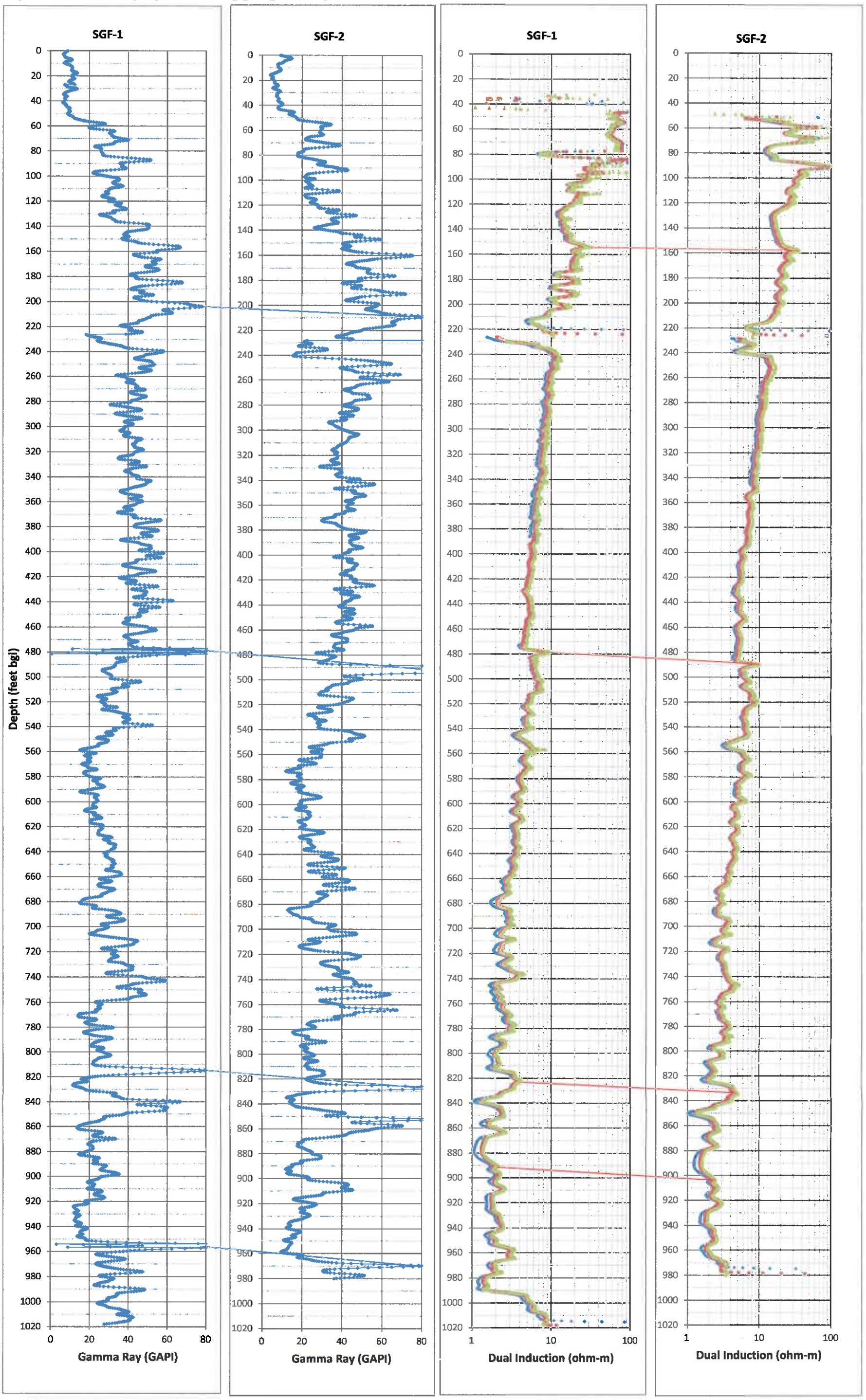


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Figure C-8: Geophysical Logging Comparison Between 1,000 and 1,800 Feet BGL

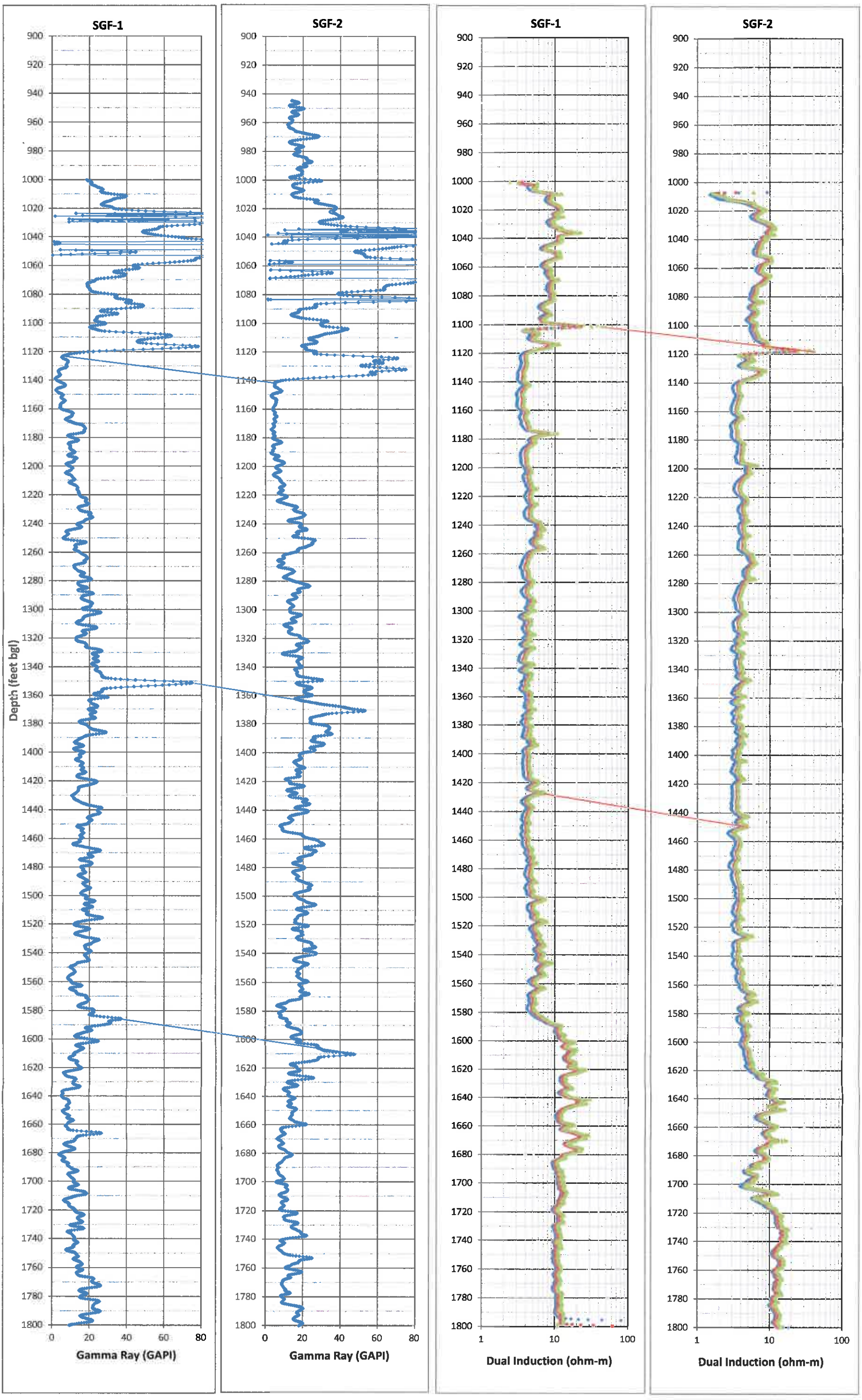

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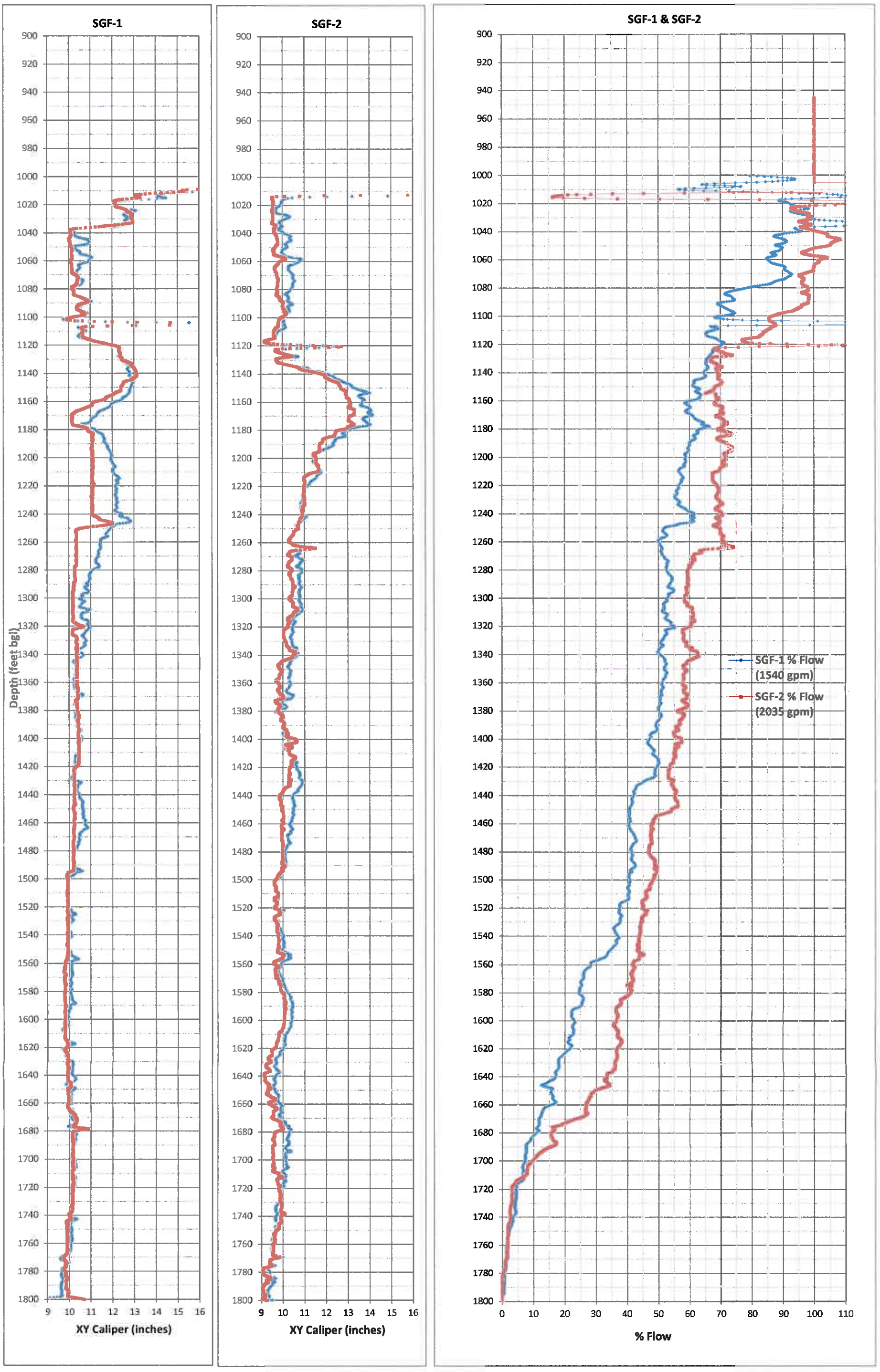
Figure C-9: Percent Flow Comparison Between 1,000 and 1,800 Feet BGL



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Appendix D

Packer Test Summaries, Charts and Laboratory Reports

Test Well SGF-1

Packer Test 1

MALCOLM PIRNIE | ARCADIS
The Water Division of ARCADIS

PACKER TEST WATER QUALITY SUMMARY

Sawgrass Floridan Test Well Construction

City of Sunrise, Florida

Test Well SGF-1
Packer Test No. 1 (Single Packer)

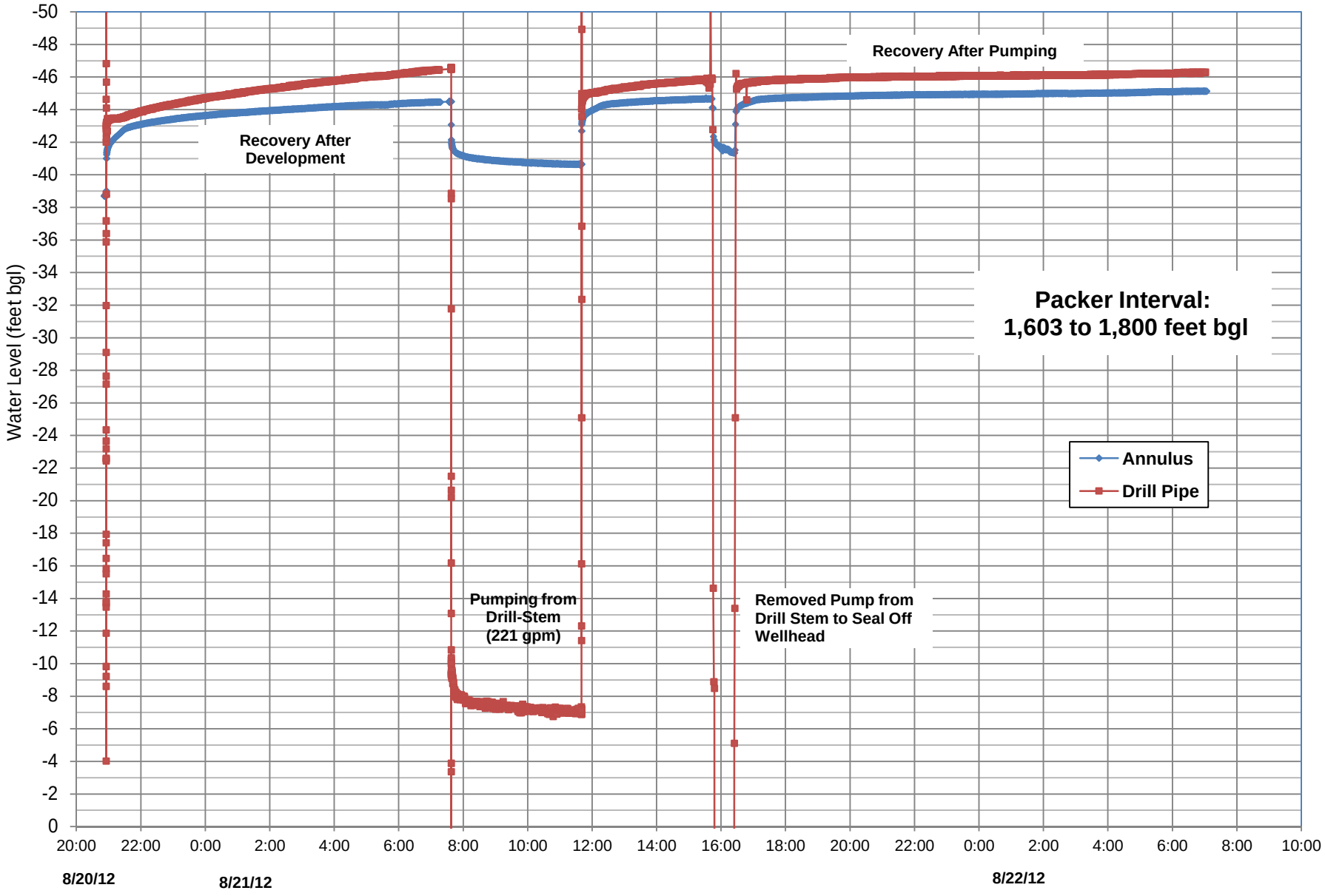
Start date: 8/21/2012 **End date:** 8/21/2012

Flowmeter Total-Start (gal) :	**49673**	**Open Hole Total Depth (feet bgl) :**	**1,800**
Flowmeter Total- End (gal) :	**103140**	**Packer Depth Interval (feet bgl):**	**1,600 - 1,800**
Stabilized Test Pumping Rate (gpm) :	**221**	**Pump Setting Depth (feet bgl):**	**180.0**
Development Duration (hrs):	**2.2**	**Transducer Depth (feet bgl):**	**170.3 (Drill Pipe); 0.0 (Annulus)**
Pump Test Duration (min):	**242**	**Pipe and open hole volume:**	**857 + 809 = 1,666 gallons**
Static DTW Before Test (feet bgl):	**-46**	**Maximum Drawdown (feet):**	**39.2**

Date	Time	Elapsed Time (min)	Pumping Rate (gpm)	Total Volume (gal)	Water Level (feet bgl)	Temp. (^{O}C)	Cond. (µS/cm)	Chlorides (mg/L)	Comments
Development									
8/20/12	18:40	0		0	-39.0				Begin pump development; Tot: 19,817
8/20/12	19:09	29	220	6,380		22	4,610		Tot: 26,197; Pkr Psi: 180
8/20/12	19:43	63	220	13,870		21.9	5,040		Tot: 33,687; Pkr Psi: 180
8/20/12	20:09	89	220			21.9	5,080	2,250	Pkr Psi: 180
8/20/12	20:17	97	220	22,028					Ann: -38.4 ft bgl Tot: 41,845; Pkr Psi: 180
8/20/12	20:55	135	220	29,856					Step Test: Begin Recovery; Tot: 49,673
Pump Test									
8/21/12	7:37	0		0	-46.0				Step Test, Turn on Pump; Ann: -44.46
8/21/12	7:45	8	225	1798	8.2	20.8	4290	1,750	Tot: 51,471
8/21/12	8:05	28	223	6,255	-7.9	21.2	4510		Ann: -41.1 ft; Tot: 55,928; Pkr Psi: ~200
8/21/12	8:30	53	226	11,913	-7.5	21.3	4700		Ann: 41.0 ft; Tot: 61,586; Pkr Psi: ~200
8/21/12	9:00	83	218	18,468	-7.4	21.5	4,750	2,000	Ann: 40.9 ft; Tot: 68,140; Pkr Psi: ~200
8/21/12	9:30	113	218	25,014	-7.2	21.8	4,820		Ann: 40.8 ft; Tot: 74,687; Pkr Psi: ~200
8/21/12	10:00	143	221	31,660	-7.3	21.9	4,850	2,000	Ann: -40.7 ft; Tot: 81,333; Pkr Psi: ~200
8/21/12	10:30	173	218	38,196	-7.2	22.4	4,930		Ann: -40.7 ft; Tot: 87,869; Pkr Psi: ~200
8/21/12	11:01	204	222	45,064	-7.1	22.2	5,030	2,000	Ann: -40.6 ft; Tot: 94,737; Pkr Psi: ~200
8/21/12	11:25	228	221			22.2	5,050		Collect Lab Sample
8/21/12	11:39	242	221	53,467					Step Tests, Turn off Pump; Tot: 103,140

"gal" denotes gallons.
"gpm" denotes gallons per minute.
"min" denotes minutes.
"feet bpl" denotes feet below pad level.
"^{o}C" denotes degrees celcius.
"µS/cm" denotes milliSiemans per cenitmeter.
"mg/L" denotes milligrams per liter.
"psi" denotes pressure in pounds per square inch.
"bgl" denotes below ground level

Sawgrass FL Test Well SGF-1
Packer Test #1



I:\A Project Docs\WR\WF Projects\Sunrise\FL Test Well CA\Floridan Test Wells\FIELD DATA\Packer Tests\PKR Test #1\PKR Tst 01-Merged Data.xlsx

Florida Spectrum Environmental Services, Inc.

Report To:
Dan Ringdahl
Florida Design Drilling Corp.
1405 N. Killian Drive
West Palm Beach, FL 33403

Report Printed: 08/30/12
Submission # 1208000596
Order # 28896

Project: 5080
Site Location: Sunrise, FL
Matrix: Water

Sample I.D.: SGF-1 PKR #1(1,600-1,800)
Collected: 08/21/12 11:37
Received: 08/21/12 13:10
Collected by: Rod Miller

LABORATORY ANALYSIS REPORT

PARAMETER	RESULT	QC	UNITS	MDL	PQL	METHOD	DATE EXT.	DATE ANALY.	ANALYST
Specific Conductance (grab)	8650		uS/cm	1.0	3.0	120.1	08/22 15:20	08/22 15:20	DGK
Turbidity (lab)	2.80		NTU	0.1	0.3	180.1	08/22 10:00	08/22 10:00	DGK
Bromide	10.8		mg/L	2.75	8.25	300.0	08/22 17:44	08/21 17:44	DGK
Chloride	2420		mg/L	5.50	16.50	300.0	08/21 17:44	08/21 17:44	DGK
Fluoride	U	U	mg/L	2.100	6.300	300.0	08/21 17:44	08/21 17:44	DGK
Ortho-Phosphate (as P)	U	U	mg/L	1.250	3.750	300.0	08/21 17:44	08/21 17:44	DGK
Sulfate	670		mg/L	5.35	16.05	300.0	08/21 17:44	08/21 17:44	DGK
Alkalinity, Total (CaCO3) Endpoint 4.3	110		mg/L	0.1	0.3	310.1	08/23 12:05	08/23 12:05	DGK
Bicarbonate	110		mg/L	0.01	0.03	310.1	08/23 12:06	08/23 12:06	DGK
Carbonate	0.20		mg/L	0.01	0.03	310.1	08/23 12:06	08/23 12:06	DGK
Nitrogen (Ammonia) as N	0.48		mg/L	0.01	0.03	350.1	08/22 12:46	08/22 12:46	RPV
Hydrogen Sulfide (Un-ionized)	0.73		mg/L	0.010	0.030	376.2	08/21 17:26	08/21 17:26	RPV
Color/pH (Lab)	10/7.69		Pt-Co	1.0	3.0	SM2120B	08/22 10:00	08/22 10:00	DGK
Total Dissolved Solids (TDS)	5300		mg/L	1.00	3.00	SM 2540C	08/22 11:00	08/23 14:55	MCZ
pH (Lab)	7.69	Q	units	0.1	0.3	SM4500-H+-B	08/22 09:00	08/22 09:00	DGK
Silica	9.83		mg/L	0.22	0.66	SM4500-SiO2	08/28 16:30	08/28 16:30	RPV
Hardness, Calcium	250		mg/L	1.00	3.00	200.7	08/21	08/21 16:47	IMN
Hardness, Total	1049		mg/L	0.035	0.105	200.7	08/21	08/21 16:49	IMN

Report To:
Dan Ringdahl
Florida Design Drilling Corp.
1405 N. Killian Drive
West Palm Beach, FL 33403

Report Printed: 08/30/12
Submission # 120800O596
Order # 28896

Project: 5080
Site Location: Sunrise, FL
Matrix: Water

Sample I.D.: SGF-1 PKR #1(1,600-1,800)
Collected: 08/21/12 11:37
Received: 08/21/12 13:10
Collected by: Rod Miller

LABORATORY ANALYSIS REPORT

PARAMETER	RESULT	QC	UNITS	MDL	PQL	METHOD	DATE EXT.	DATE ANALY.	ANALYST
Aluminum	0.004		mg/L	0.00070	0.00210	200.7	08/21	08/21 16:47	IMN
Barium	0.010		mg/L	0.00003	0.00009	200.7	08/21	08/21 16:47	IMN
Boron	0.831		mg/L	0.0037	0.0111	200.7	08/21	08/21 16:47	IMN
Calcium	100		mg/L	0.0036	0.0108	200.7	08/21	08/21 16:47	IMN
Iron, Dissolved	0.013		mg/L	0.00080	0.00240	200.7	08/21	08/21 16:43	IMN
Iron	0.180		mg/L	0.0008	0.0024	200.7	08/21	08/21 16:47	IMN
Magnesium	194		mg/L	0.0475	0.1425	200.7	08/21	08/22 10:03	IMN
Manganese	0.007		mg/L	0.00009	0.00027	200.7	08/21	08/21 16:47	IMN
Potassium	94.4		mg/L	0.0011	0.0033	200.7	08/21	08/21 16:47	IMN
Sodium	1593		mg/L	0.070	0.210	200.7	08/21	08/22 10:03	IMN
Strontium	19.8		mg/L	0.00075	0.00225	200.7	08/21	08/22 10:03	IMN
Lab. filtration	08/21/2012						08/21	08/21	IMN

* H2S Calculation Based on Lab pH

Unless indicated, soil results are reported based on actual (wet) weight basis.

Analytes not currently NELAC certified denoted by ˜.
Work performed by outside (subcontract) labs denoted by Cert.ID in Analyst Field.
Results relate only to this sample.
QC=Qualifier Codes as defined by DEP 62-160
U=Analyzed for but not detected.
Q=Sample held beyond accepted holding time.
I=Value is between MDL and PQL.
J=Estimated value.

Authorized CSM Signature (954) 978-6400
Florida-Spectrum Environmental Services,Inc.
Certification # E86006

SUBMISSION # 12000-540

Logged in LIMS by NB

CSM assigned

Florida Spectrum Environmental Services, Inc.

CHAIN OF CUSTODY RECORD

☐ 1460 W. McNab Road Ft Laud. FL 33309 Tel: (954) 978-6400 Fax: (954) 978-2233
☐ 630 Indian Street Savannah, GA 31401 Tel: (912) 238-5050 Fax: (912) 234-4815
☐ 528 Gooch Road Fort Meade, FL 33841 Tel: (863) 285-8145 Fax: (863) 285-7030
☐ 610 Parrot Ave. N, Okeechobee, FL 34972 Tel: (863) 763-3336 Fax: (863) 763-1544

Original-Return w/report | Yellow-Lab File Copy | Pink - Sampler Copy

DUE DATE Requested

RUSH RESERVATION #

Rush Surcharges apply

Report to: *(company name)* Florida Design Drilling		**Report to Address:**	
Invoice to: *(company name)*	**Purchase Order #**	**Invoice to Address:**	
Project Name and/or Number 5080		**Site Location:** Sunrise FL	
Project Contact: Dan Ringdahl	**Phone:** 561-324-3885	**Fax:**	**Email:** dan@fldrilling.com
Sampler Name: (printed) Rod Miller	**Affiliation:** Arcadis	**Sampler Signature**	

ORDER # *Lab Control Number* / *Shaded Areas For Laboratory Use Only*	Sample ID	Date Sampled	Time Sampled	Matrix (DW SW GW WW S SED HW BIO SEA OIL X AIR)	Bottle & Pres. Combo Codes	Number of Containers Received & NELAC Letter Suffixes # A-?	Analysis Required	Field Tests TEMP °C	PH	COND	CHLOR
1	2000916	SGF-1 PKR #01 1,600-1,800	8/2/12	11:37	WW	LUTV TSTM GLA	5 See Spec Sheet for Parameters	82.2		5030	
2											
3											
4											
5											
6											
7											
8											
9											
10											

Special Comments:

"I waive TNI protocol" (emergency) (sign here) >

Total

Deliverables: QA/QC Report Needed? Yes No *(additional charge)*

	Signature	Affiliation	Date/Time
1	Relinquished by:		
1	Received by:		8/21/12 1310
2	Relinquished by:		
2	Received by:		
3	Relinquished by:		
3	Received by:		

Sample Custody & Field Comments

Temp as received 4 C
Custody seals? Y N
FIELD TIME:
Sampling _____ hrs
Pick-Up _____ hrs
Misc. Charges _____

Bottle Type

A-liter amber
B-Bacteria bag/bottle
F-500 ml O-125 ml
H-Plastic Amber Liter
L-liter bottle
S2-2 oz soil jar
S4-4 oz soil jar / S8-8 oz soil jar
T-250 ml
V-40 ml vial
W-wide mouth
X-other TED-Tedlar Air Bag

Additional Bottle Types
B-brown liter plastic

Preservatives

A-ascorbic acid P-H3PO4
C-HCL S-H2SO4
Cu-CuSO4 T-Na2S2O3
DI-DI water U-Unpreserved
H-HNO3 N-NaOH
M-MCAB NH4-NH4CL
MeOH-Methanol
Z-zinc acetate

Additional Preservatives
Hex-Hex Cr Buffer
EDA-Ethylene Diamine

Test Well SGF-1

Packer Test 2

MALCOLM PIRNIE | ARCADIS
The Water Division of ARCADIS

PACKER TEST WATER QUALITY SUMMARY

Sawgrass Floridan Test Well Construction

City of Sunrise, Florida

Test Well SGF-1

Packer Test No. 2 (Single Packer - Annulus)

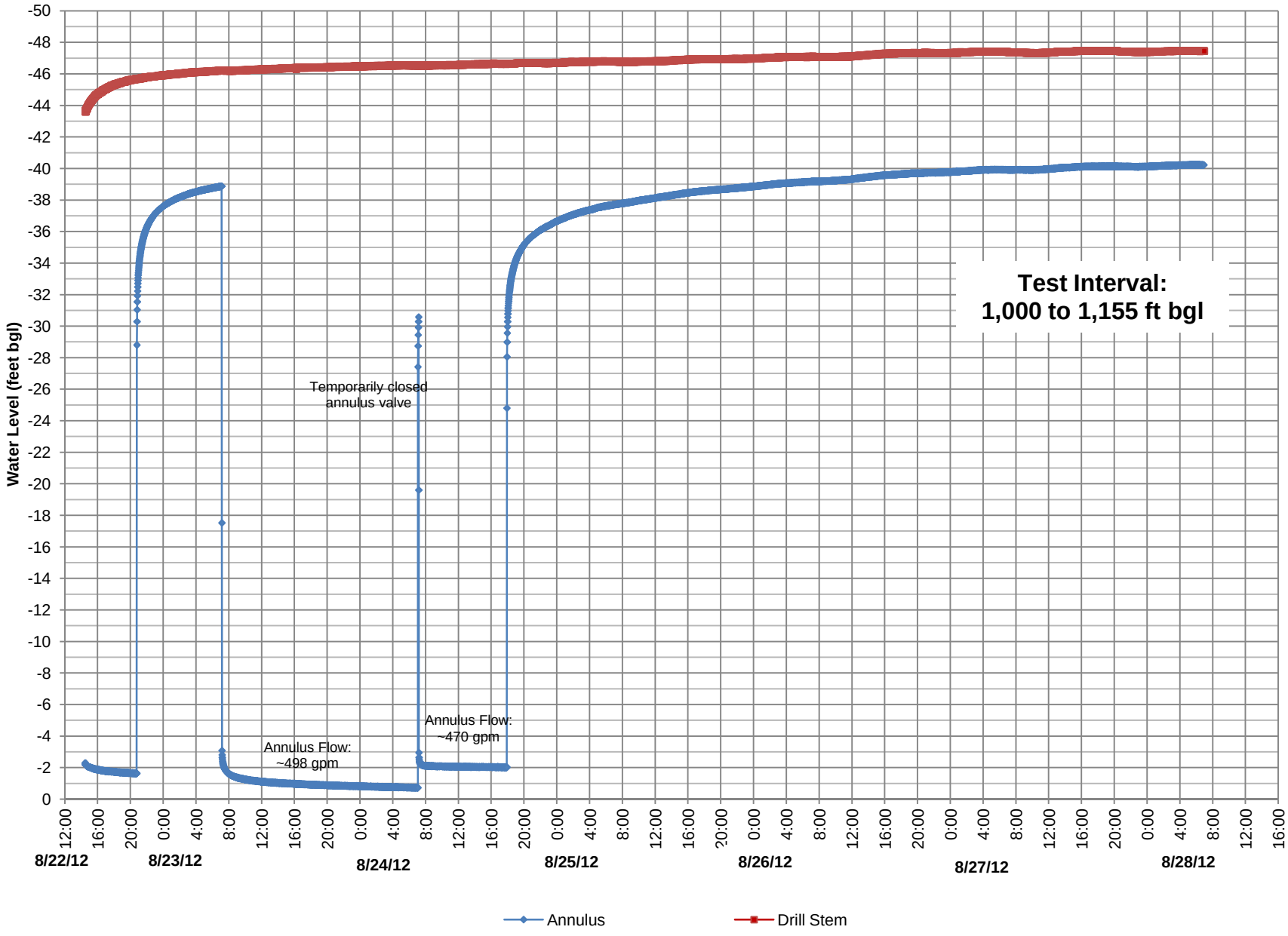
Start date: 8/23/2012 **End date: 8/23/2012**

Flowmeter Total-Start (gal) :	**NA**	**Open Hole Total Depth (feet bgl) :**	**1,800**
Flowmeter Total- End (gal) :	**NA**	**Packer Depth Interval (feet bgl):**	**1,000 - 1,155**
Stabilized Test Pumping Rate (gpm) :	**479**	**Pump Setting Depth (feet bgl):**	**No Pump; Free Flowing Annlulus**
Development Duration (hrs):	**6.6**	**Transducer Depth (feet bgl):**	**40.3 (Drill Pipe); 2.0 (Annulus)**
Pump Test Duration (min):	**2085**	**Pipe and open hole volume:**	**30,274 + 835 = 31,109 gallons**
Static DTW Before Test (feet bgl):	**-38.9**	**Maximum Drawdown (feet):**	**38.2**

Date	Time	Elapsed Time (min)	Pumping Rate (gpm)	Total Volume (gal)	Annulus W.L. (feet bgl)	Temp. (^{O}C)	Cond. (µS/cm)	Chlorides (mg/L)	Comments
Development									
8/22/12	14:14	0		0	-36.16				Begin Flowing Annulus
8/22/12	15:00	46	500	23,000	-2.17		5,670	2,000	Drill Pipe W.L.: -43.64 ft bgl
8/22/12	17:06	172	500	86,000	-1.80	22.1	5,130	2,000	Drill Pipe W.L.: -45.15 ft bgl
8/22/12	18:15	241	470	118,430	-1.70	21.4	5,130		Drill Pipe W.L.: -45.3 ft bgl
8/22/12	19:45	331	508	164,144	-1.65	21.7	5,170		Drill Pipe W.L.: -45.6 ft bgl
8/22/12	20:30	376	511	187,120	-1.60	21.7	5,230		Drill Pipe W.L.: -45.6 ft bgl
8/22/12	20:50	396		194,585					Terminate Flow
Pump Test									
8/23/12	7:10	0		0					Resume Flow; Begin Pump Test
8/23/12	8:33	83		31,430	-1.47	22.4	5,130		Drill Pipe W.L.: -46.21 ft bgl
8/23/12	10:07	177	535	81,763	-1.25	22.6	5,200		Drill Pipe W.L.: -46.23 ft bgl
8/23/12	12:17	307		152,808	-1.10	23.6	5,170		Drill Pipe W.L.: -46.28 ft bgl
8/23/12	14:05	415	524	209,414	-1.04	23.6	5,170		Drill Pipe W.L.: -46.33 ft bgl
8/23/12	17:25	615	480	305,414	-0.93	23.4	5,260		Drill Pipe W.L.: -46.39 ft bgl
8/23/12	18:00	650	480	322,214	-0.92	22.8	5,230		Drill Pipe W.L.: -46.41 ft bgl
8/23/12	20:00	770	480	388,531	-0.88	22.7	5,220	2,250	Drill Pipe W.L.: -46.42 ft bgl
8/23/12	22:00	890	498	439,729	-0.85	22.5	5,240		Drill Pipe W.L.: -46.45 ft bgl
8/24/12	0:00	1010	498	503,108	-0.81	23	5,230		Drill Pipe W.L.: -46.5 ft bgl
8/24/12	2:00	1130	498	559,347	-0.79	22.6	5,240	2,250	Drill Pipe W.L.: -46.51 ft bgl
8/24/12	4:00	1,250	489	618,017	-0.76	22.7	5,240		Drill Pipe W.L.: -46.51 ft bgl
8/24/12	6:00	1,370	485	676,252	-0.75	21.9	5,240	2,250	Drill Pipe W.L.: -46.53 ft bgl
8/24/12	8:30	1520	485	749,002	-2.10	22.5	5,240		Drill Pipe W.L.: -46.54 ft bgl
8/24/12	11:19	1689		830,967	-2.08	22.9	5,250		Drill Pipe W.L.: -46.55 ft bgl
8/24/12	13:59	1849	493	909,813	-2.04	23	5,250		Drill Pipe W.L.: -46.6 ft bgl
8/24/12	15:23	1933	470	949,259	-2.05				Drill Pipe W.L.: -46.63 ft bgl
8/24/12	17:16	2,046	465	1,001,848	-2.02	22.9	5,290		Drill Pipe W.L.: -46.64 ft bgl
8/24/12	17:40	2070			-2.02	23.9	5,290	2,250	Drill Pipe W.L.:-46.66; Collect Lab Sample
8/24/12	17:55	2085	446	1,037,967	-2.02				Drill Pipe W.L.:-46.65 ft bgl; Terminate flow

"gal" denotes gallons.
"gpm" denotes gallons per minute.
"min" denotes minutes.
"feet bpl" denotes feet below pad level.
"^{o}C" denotes degrees celcius.
"µS/cm" denotes milliSiemans per cenitmeter.
"mg/L" denotes milligrams per liter.
"psi" denotes pressure in pounds per square inch.
"bgl" denotes below ground level

Sawgrass FL Test Well SGF-1
Packer Test # 2



Florida Spectrum Environmental Services, Inc.

Report To:
Dan Ringdahl
Florida Design Drilling Corp.
1405 N. Killian Drive
West Palm Beach, FL 33403

Report Printed: 09/06/12
Submission # 1208000765
Order # 29637

Project: Sunrise
Site Location: Sunrise
Matrix: Water

Sample I.D.: PKR Test #2 (1,000-1,155)
Collected: 08/24/12 17:40
Received: 08/28/12 11:40
Collected by: Rod Miller

LABORATORY ANALYSIS REPORT

PARAMETER	RESULT	QC	UNITS	MDL	PQL	METHOD	DATE EXT.	DATE ANALY.	ANALYST
Specific Conductance (grab)	9200		uS/cm	1.0	3.0	120.1	08/28 14:12	08/28 14:12	DGK
Turbidity (lab)	0.30	Q	NTU	0.1	0.3	180.1	08/28 13:48	08/28 13:48	DGK
Bromide	11.5		mg/L	2.75	8.25	300.0	08/28 17:42	08/28 17:42	DGK
Chloride	2580		mg/L	5.50	16.50	300.0	08/28 17:42	08/28 17:42	DGK
Fluoride	U	U	mg/L	2.100	6.300	300.0	08/28 17:42	08/28 17:42	DGK
Ortho-Phosphate (as P)	U	QU	mg/L	1.250	3.750	300.0	08/28 17:42	08/28 17:42	DGK
Sulfate	875		mg/L	5.35	16.05	300.0	08/28 17:42	08/28 17:42	DGK
Alkalinity, Total (CaCO3) Endpoint 4.3	108.0		mg/L	0.1	0.3	310.1	08/30 17:02	08/30 17:02	RPV
Bicarbonate	108.0		mg/L	0.01	0.03	310.1	08/30 17:04	08/30 17:04	RPV
Carbonate	0.13		mg/L	0.01	0.03	310.1	08/30 17:06	08/30 17:06	RPV
Nitrogen (Ammonia) as N	0.77		mg/L	0.01	0.03	350.1	08/29 14:33	08/29 14:33	RPV
Hydrogen Sulfide (Un-ionized)	0.47		mg/L	0.050	0.150	376.2	08/28 17:26	08/28 17:26	RPV
Color/pH (Lab)	5/7.50	Q	Pt-Co	1.0	3.0	SM2120B	08/28 13:47	08/28 13:47	DGK
Total Dissolved Solids (TDS)	5850		mg/L	1.00	3.00	SM 2540C	08/30 14:00	08/31 13:10	MCZ
pH (Lab)	7.50	Q	units	0.1	0.3	SM4500-H+-B	08/28 13:45	08/28 13:45	DGK
Silica	10.9		mg/L	0.22	0.66	SM4500-SiO2	08/28 16:30	08/28 16:30	RPV
Hardness, Calcium	285		mg/L	1.00	3.00	200.7	08/29	08/29 15:27	IMN
Hardness, Total	1055		mg/L	0.035	0.105	200.7	08/29	08/29 15:27	IMN

Report To:
Dan Ringdahl
Florida Design Drilling Corp.
1405 N. Killian Drive
West Palm Beach, FL 33403

Report Printed: 09/06/12
Submission # 120800O765
Order # 29637

Project: Sunrise
Site Location: Sunrise
Matrix: Water

Sample I.D.: PKR Test #2 (1,000-1,155)
Collected: 08/24/12 17:40
Received: 08/28/12 11:40
Collected by: Rod Miller

LABORATORY ANALYSIS REPORT

PARAMETER	RESULT	QC	UNITS	MDL	PQL	METHOD	DATE EXT.	DATE ANALY.	ANALYST
Aluminum	0.005		mg/L	0.00070	0.00210	200.7	08/29	08/29 15:27	IMN
Barium	0.005		mg/L	0.00003	0.00009	200.7	08/29	08/29 15:27	IMN
Boron	1.260		mg/L	0.0037	0.0111	200.7	08/29	08/29 15:27	IMN
Calcium	114		mg/L	0.0036	0.0108	200.7	08/29	08/29 15:27	IMN
Iron, Dissolved	0.013		mg/L	0.00080	0.00240	200.7	08/29	08/29 15:23	IMN
Iron	0.021		mg/L	0.0008	0.0024	200.7	08/29	08/29 15:27	IMN
Magnesium	187		mg/L	0.0475	0.1425	200.7	08/29	08/30 10:25	IMN
Manganese	0.001		mg/L	0.00009	0.00027	200.7	08/29	08/29 15:27	IMN
Potassium	111		mg/L	0.0011	0.0033	200.7	08/29	08/29 15:27	IMN
Sodium	1710		mg/L	0.070	0.210	200.7	08/29	08/30 10:25	IMN
Strontium	9.96		mg/L	0.00075	0.00225	200.7	08/29	08/30 10:25	IMN
Lab. filtration	08/28/2012						08/28	08/28	IMN

* H2S Calculation Based on Lab pH
Unless indicated, soil results are reported based on actual (wet) weight basis.

Analytes not currently NELAC certified denoted by ".
Work performed by outside (subcontract) labs denoted by Cert.ID in Analyst Field.
Results relate only to this sample.
QC=Qualifier Codes as defined by DEP 62-160
U=Analyzed for but not detected.
Q=Sample held beyond accepted holding time.
I=Value is between MDL and PQL.
J=Estimated value.

Authorized CSM Signature (954) 978-6400
Florida-Spectrum Environmental Services,Inc.
Certification # E86006

Test Well SGF-1

Packer Tests 3A and 3B

MALCOLM PIRNIE | ARCADIS
The Water Division of ARCADIS

PACKER TEST WATER QUALITY SUMMARY

Sawgrass Floridan Test Well Construction

City of Sunrise, Florida

Test Well SGF-1

Packer Test No. 3A (Straddle Packer - Drill Stem)

Start date: 8/29/2012 **End date:** 8/29/2012

Flowmeter Total-Start (gal) :	**103141**	**Open Hole Total Depth (feet bgl) :**	**1,800**
Flowmeter Total- End (gal) :	**166259**	**Packer Depth Interval (feet bgl):**	**1,528 - 1,569**
Stabilized Test Pumping Rate (gpm) :	**203**	**Pump Setting Depth (feet bgl):**	**165.0**
Development Duration (hrs):	**0**	**Transducer Depth (feet bgl):**	**144.3 (D.P.); 2.0 (Ann.); ~1,573 (m. troll)**
Pump Test Duration (min):	**313**	**Pipe and open hole volume:**	**819 + 167 = 986 gallons**
Static DTW Before Test (feet bgl):	**-45.2**	**Maximum Drawdown (feet):**	**86.3**

Date	Time	Elapsed Time (min)	Pumping Rate (gpm)	Total Volume (gal)	Drill Stem W.L. (feet bgl)	Temp. (^{O}C)	Cond. (µS/cm)	Chlorides (mg/L)	Comments
Development									
Commenced Pumping Test without Performing Development									
Pump Test									
8/29/12	16:54	0	0	0	-45				Step Test: Begin Pumping Straddle Interval
8/29/12	17:00	6	186	1,116	37.33				Ann W.L. -38.4 ft bgl; Tot: 104,257
8/29/12	17:31	37	203	7,419	39.99	22.5	8,140		Ann W.L. -38.5 ft bgl; Tot: 110,559
8/29/12	18:00	66	204	13,324	41.19	21.9	8,130	3,500	Ann W.L. -38.6 ft bgl; Tot: 116,465
8/29/12	18:30	96	202	19,395	41.39	21.8	8,220		Ann W.L. -38.6 ft bgl; Tot: 122,536
8/29/12	19:01	127	203	25,701	41.67	22.0	8,160	3,500	Ann W.L. -38.8 ft bgl; Tot: 128,842
8/29/12	19:30	156	201	31,520	41.77	21.7	8,190		Ann W.L. -38.8 ft bglTot: 134,661
8/29/12	20:00	186	203	37,620	42.18	21.6	8,190	3,500	Ann W.L. -38.9 ft bglTot: 140,761
8/29/12	20:30	216	204	43,743	42.14	21.8	8,130		Ann W.L. -38.9 ft bglTot: 146,884
8/29/12	21:00	246	194	49,572	41.57	21.7	8,100	3,500	Ann W.L. -38.9 ft bglTot: 152,713
8/29/12	21:30	276	203	55,682	41.39	21.7	8,130		Ann W.L. -39.0 ft bglTot: 158,823
8/29/12	21:45	291	204	58,742	40.73	21.7	8,150	3,500	Collect Lab Sample; YSI probe Cond: 15,580 uS/cm
8/29/12	22:07	313	203	63,118					Step Test: Turn off Pump

"gal" denotes gallons.
"gpm" denotes gallons per minute.
"min" denotes minutes.
"feet bpl" denotes feet below pad level.
"^{o}C" denotes degrees celcius.
"µS/cm" denotes milliSiemans per cenitmeter.
"mg/L" denotes milligrams per liter.
"psi" denotes pressure in pounds per square inch.
"bgl" denotes below ground level

MALCOLM PIRNIE | ARCADIS
The Water Division of ARCADIS

PACKER TEST WATER QUALITY SUMMARY

Sawgrass Floridan Test Well Construction

City of Sunrise, Florida

Test Well SGF-1

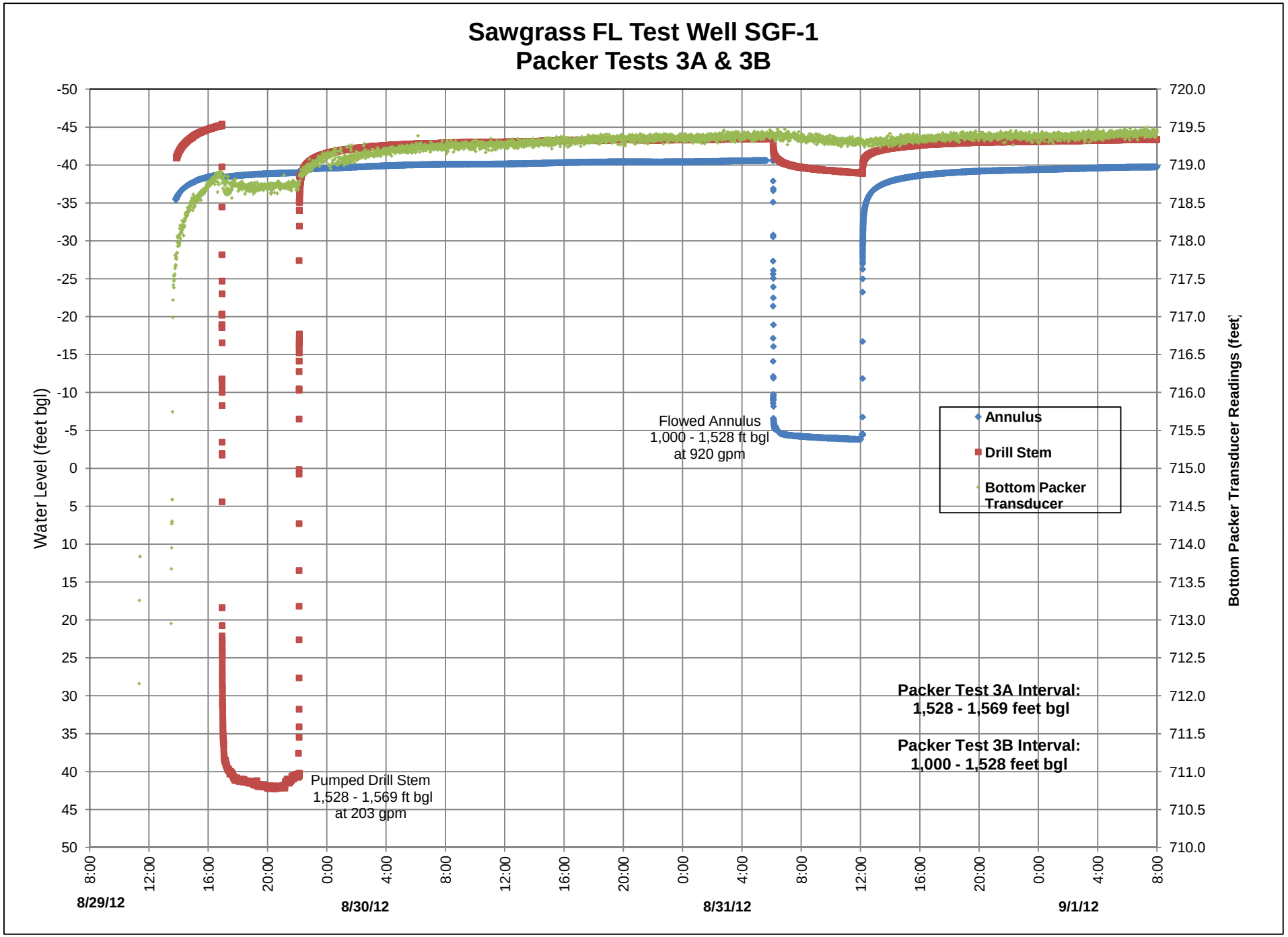
Packer Test No. 3B (Annulus Above Straddle Packer)

Start date: 8/31/2012 **End date:** 8/31/2012

Flowmeter Total-Start (gal) :	**NA**	**Open Hole Total Depth (feet bgl) :**	**1,800**
Flowmeter Total- End (gal) :	**NA**	**Packer Depth Interval (feet bgl):**	**1,528 - 1,569 (Annulus: 1,000 - 1,528)**
Stabilized Test Pumping Rate (gpm) :	**920**	**Pump Setting Depth (feet bgl):**	**Free Flowing Annulus**
Development Duration (hrs):	**0**	**Transducer Depth (feet bgl):**	**144.3 (D.P.); 2.0 (Ann.); ~1,573 (m. troll)**
Pump Test Duration (min):	**362**	**Pipe and open hole volume:**	**30,274 + 2,153 = 32,427 gallons**
Static DTW Before Test (feet bgl):	**40.7**	**Maximum Drawdown (feet):**	**36.7**

Date	Time	Elapsed Time (min)	Pumping Rate (gpm)	Total Volume (gal)	Drill Stem W.L. (feet bgl)	Temp. (^{O}C)	Cond. (µS/cm)	Chlorides (mg/L)	Comments
Development									
Commenced Pumping Test without Performing Development									
Pump Test									
8/31/12	6:06	0	0	0	40.7				Step Test: Begin Flowing Annulus
8/31/12	6:20	14	1,334	18,676	5				Drill Stem W.L. 40.87 ft bgl
8/31/12	6:40	34	860	35,876	4.58	22.1	10,698		Drill Stem W.L. 40.39 ft bgl
8/31/12	7:30	84	912	81,517	4.30	21.9	12,694		Drill Stem W.L. 39.87 ft bgl
8/31/12	8:03	117	961	113,237	4.23	22.4	12,360	3,000	Drill Stem W.L. 39.67 ft bgl
8/31/12	8:34	148	904	141,265	4.15	22.7	12,239		Drill Stem W.L. 39.52 ft bgl
8/31/12	9:04	178	967	170,267	4.09	22.6	12,233		Drill Stem W.L. 39.46 ft bgl
8/31/12	9:36	210	903	199,193	4.03	22.8	12,174		Drill Stem W.L. 39.29 ft bgl
8/31/12	10:07	241	946	228,538	4.00	23.0	12,154	2,750	Drill Stem W.L. 39.27 ft bgl
8/31/12	10:37	271	901	255,589	3.94	23.1	12,174		Drill Stem W.L. 39.16 ft bgl
8/31/12	11:04	298	960	281,505	3.91	23.2	12,207	3,000	Drill Stem W.L. 39.07 ft bgl
8/31/12	11:45	339	920	319,216	3.83	24.2	12,175		Collect Lab Sample; Drill Stem W.L. 38.98 ft bgl
8/31/12	12:08	362	920	340,376	3.84				Step Test: Turn off Pump

"gal" denotes gallons.
"gpm" denotes gallons per minute.
"min" denotes minutes.
"feet bpl" denotes feet below pad level.
"^{o}C" denotes degrees celcius.
"µS/cm" denotes milliSiemans per cenitmeter.
"mg/L" denotes milligrams per liter.
"psi" denotes pressure in pounds per square inch.
"bgl" denotes below ground level



I:\A Project Docs\WR\WF Projects\Sunrise\FL Test Well CA\Floridan Test Wells\FIELD DATA\Packer Tests\Packer Test 3A & 3B\PKR 3A & 3B Merged Data.xlsx

Florida Spectrum
Environmental Services, Inc.

Report To:
Dan Ringdahl
Florida Design Drilling Corp.
1405 N. Killian Drive
West Palm Beach, FL 33403

Report Printed: 09/11/12
Submission # 1208000889
Order # 30293

Project: Sunrise
Site Location: Sunrise
Matrix: Water

Sample I.D.: PKR Test 3A (1528-1569)
Collected: 08/29/12 21:45
Received: 08/31/12 13:05
Collected by: Rodney Miller

LABORATORY ANALYSIS REPORT

PARAMETER	RESULT	QC	UNITS	MDL	PQL	METHOD	DATE EXT.	DATE ANALY.	ANALYST
Specific Conductance (grab)	14300		uS/cm	1.0	3.0	120.1	09/01 14:11	09/01 14:11	DGK
Turbidity (lab)	9.30		NTU	0.1	0.3	180.1	08/31 17:30	08/31 17:30	DGK
Bromide	14.8	I	mg/L	5.50	16.50	300.0	08/31 18:20	08/31 18:20	DGK
Chloride	4280		mg/L	11.00	33.00	300.0	08/31 18:20	08/31 18:20	DGK
Fluoride	U	U	mg/L	4.200	12.600	300.0	08/31 18:20	08/31 18:20	DGK
Ortho-Phosphate (as P)	U	U	mg/L	2.500	7.500	300.0	08/31 18:20	08/31 18:20	DGK
Sulfate	875		mg/L	10.70	32.10	300.0	08/31 18:20	08/31 18:20	DGK
Alkalinity, Total (CaCO3) Endpoint 4.3	102		mg/L	0.1	0.3	310.1	09/05 17:15	09/05 17:15	RPV
Bicarbonate	102		mg/L	0.01	0.03	310.1	09/05 17:15	09/05 17:15	RPV
Carbonate	0.15		mg/L	0.01	0.03	310.1	09/05 17:15	09/05 17:15	RPV
Nitrogen (Ammonia) as N	0.88		mg/L	0.01	0.03	350.1	09/04 13:54	09/04 13:54	RPV
Hydrogen Sulfide (Un-ionized)	0.44		mg/L	0.100	0.300	376.2	08/31 15:28	08/31 15:28	RPV
Color/pH (Lab)	15/7.83		Pt-Co	1.0	3.0	SM2120B	08/31 17:32	08/31 17:32	RPV
Salinity (Lab)	8.4		ppt	0.10	0.30	SM 2520B	09/01 14:15	09/01 14:15	DGK
Total Dissolved Solids (TDS)	9070		mg/L	1.00	3.00	SM 2540C	09/04 14:30	09/05 14:53	MCZ
pH (Lab)	7.83	Q	units	0.1	0.3	SM4500-H+-B	08/31 17:39	08/31 17:39	RPV
Silica	8.71		mg/L	0.22	0.66	SM4500-SiO2	09/10 16:34	09/10 16:34	RPV
Hardness, Calcium	375		mg/L	1.00	3.00	200.7	09/04	09/04 15:20	IMN

Report To:
Dan Ringdahl
Florida Design Drilling Corp.
1405 N. Killian Drive
West Palm Beach, FL 33403

Report Printed: 09/11/12
Submission # 1208000889
Order # 30293

Project: Sunrise
Site Location: Sunrise
Matrix: Water

Sample I.D.: PKR Test 3A (1528-1569)
Collected: 08/29/12 21:45
Received: 08/31/12 13:05
Collected by: Rodney Miller

LABORATORY ANALYSIS REPORT

PARAMETER	RESULT	QC	UNITS	MDL	PQL	METHOD	DATE EXT.	DATE ANALY.	ANALYST
Hardness, Total	1684		mg/L	0.875	2.625	200.7	09/04	09/04 15:20	IMN
Aluminum	0.004		mg/L	0.00070	0.00210	200.7	09/04	09/04 15:20	IMN
Barium	0.015		mg/L	0.00003	0.00009	200.7	09/04	09/04 15:20	IMN
Boron	1.230		mg/L	0.0037	0.0111	200.7	09/04	09/04 15:20	IMN
Calcium	150		mg/L	0.0036	0.0108	200.7	09/04	09/04 15:20	IMN
Iron, Dissolved	0.080		mg/L	0.00080	0.00240	200.7	09/04	09/04 15:16	IMN
Iron	0.190		mg/L	0.0008	0.0024	200.7	09/04	09/04 15:20	IMN
Magnesium	318		mg/L	0.0475	0.1425	200.7	09/04	09/05 09:00	IMN
Manganese	0.007		mg/L	0.00009	0.00027	200.7	09/04	09/04 15:20	IMN
Potassium	140		mg/L	0.0011	0.0033	200.7	09/04	09/04 15:20	IMN
Sodium	2913		mg/L	0.070	0.210	200.7	09/04	09/05 09:00	IMN
Strontium	25.5		mg/L	0.00075	0.00225	200.7	09/04	09/05 09:00	IMN
Lab. filtration	08/31/2012						08/31	08/31	IMN

* H2S Calculation Based on Lab pH

Unless indicated, soil results are reported based on actual (wet) weight basis.

Analytes not currently NELAC certified denoted by ~.
Work performed by outside (subcontract) labs denoted by Cert.ID in Analyst Field.
Results relate only to this sample.
QC=Qualifier Codes as defined by DEP 62-160
U=Analyzed for but not detected.
Q=Sample held beyond accepted holding time.
I=Value is between MDL and PQL.
J=Estimated value.

Authorized CSM Signature (954) 978-6400
Florida-Spectrum Environmental Services,Inc.
Certification # E86006

1

SUBMISSION # 1208-889

Logged in LIMS by NB

CSM assigned

CHAIN OF CUSTODY RECORD

Florida Spectrum Environmental Services, Inc.

☐ 1460 W. McNab Road Ft Laud. FL 33309	Tel: (954) 978-6400	Fax: (954) 978-2233
☐ 630 Indian Street Savannah, GA 31401	Tel: (912) 238-5050	Fax: (912) 234-4815
☐ 528 Gooch Road Fort Meade, FL 33841	Tel: (863) 285-8145	Fax: (863) 285-7030
☐ 610 Parrot Ave. N, Okeechobee, FL 34972	Tel: (863) 763-3336	Fax: (863) 763-1544

Original-Return w/report Yellow-Lab File Copy Pink - Sampler Copy

DUE DATE Requested

RUSH RESERVATION #

Rush Surcharges apply

Report to: (company name) Florida Design Drilling		Report to Address: ~~5081~~ 1905 N Killian dr Lake Park FL	
Invoice to: (company name) Same	Purchase Order # 5080	Invoice to Address: Same	
Project Name and/or Number Sunrise		Site Location:	
Project Contact: Dan Ringdahl	Phone: 561·324·3885	Fax: 561 844 2967	Email: Dan@FLdrilling.com
Sampler Name: (printed) Rod Miller	Affiliation: engineer	Sampler Signature	

	ORDER # Lab Control Number / Shaded Areas For Laboratory Use Only	Sample ID	Date Sampled	Time Sampled	Matrix (DW SW GW WW S SED HW BIO SEA OIL X AIR)	Bottle & Pres. Combo Codes	Number of Containers Received & NELAC Letter Suffixes # A-?	Analysis Required	Field Tests TEMP °C	PH	COND	CHLOR
1	30893	PKR Test 3A	8-29-12	21:45	GW	W T D H O S	5	See attached sheet for list of parameters				
2		1528- 1569 ft bgl										
3												
4												
5												
6												
7												
8												
9												
10												

Special Comments: RUSH SALINITY FOR 9/4

"I waive TNI protocol" (emergency) (sign here) >

Total

Deliverables: QA/QC Report Needed? Yes No *(additional charge)*

	Signature	Affiliation	Date/Time
1	Relinquished by:		
1	Received by:		8-31-12 1305
2	Relinquished by:		8-31-12
2	Received by:		
3	Relinquished by:		
3	Received by:		

Sample Custody & Field Comments

Temp as received 4 C

Custody seals? Y / N

FIELD TIME:

Sampling _____ hrs

Pick-Up _____ hrs

Misc. Charges _____

Bottle Type

A-liter amber
B-Bacteria bag/bottle
F-500 ml O-125 ml
H-Plastic Amber Liter
L-liter bottle
S2-2 oz soil jar
S4-4 oz soil jar / S8-8 oz soil jar
T-250 ml
V-40 ml vial
W-wide mouth
X-other TED-Tedlar Air Bag

Additional Bottle Types
B-brown liter plastic

Preservatives

A-ascorbic acid P-H3PO4
C-HCL S-H2SO4
Cu-CuSO4 T-Na2S2O3
DI-DI water U-Unpreserved
H-HNO3 N-NaOH
M-MCAB NH4-NH4CL
MeOH-Methanol
Z-zinc acetate

Additional Preservatives
Hex-Hex Cr Buffer
EDA-Ethylene Diamine

Florida Spectrum
Environmental Services, Inc.

Report To:
Dan Ringdahl
Florida Design Drilling Corp.
1405 N. Killian Drive
West Palm Beach, FL 33403

Report Printed: 09/11/12
Submission # 1208000888
Order # 30292

Project: Sunrise
Site Location: Sunrise
Matrix: Water

Sample I.D.: PKR Test 3B (1,000-1,528)
Collected: 08/31/12 11:45
Received: 08/31/12 13:05
Collected by: Rod Miller

LABORATORY ANALYSIS REPORT

PARAMETER	RESULT	QC	UNITS	MDL	PQL	METHOD	DATE EXT.	DATE ANALY.	ANALYST
Specific Conductance (grab)	11300		uS/cm	1.0	3.0	120.1	09/01 14:10	09/01 14:10	DGK
Turbidity (lab)	0.85		NTU	0.1	0.3	180.1	08/31 17:30	08/31 17:30	DGK
Bromide	10.9	I	mg/L	5.50	16.50	300.0	08/31 18:20	08/31 18:20	DGK
Chloride	3250		mg/L	11.00	33.00	300.0	08/31 18:20	08/31 18:20	DGK
Fluoride	U	U	mg/L	4.200	12.600	300.0	08/31 18:20	08/31 18:20	DGK
Ortho-Phosphate (as P)	U	U	mg/L	2.500	7.500	300.0	08/31 18:20	08/31 18:20	DGK
Sulfate	933		mg/L	10.70	32.10	300.0	08/31 18:20	08/31 18:20	DGK
Alkalinity, Total (CaCO3) Endpoint 4.3	102		mg/L	0.1	0.3	310.1	09/05 17:11	09/05 17:11	RPV
Bicarbonate	102		mg/L	0.01	0.03	310.1	09/05 17:12	09/05 17:12	RPV
Carbonate	0.13		mg/L	0.01	0.03	310.1	09/05 17:15	09/05 17:15	RPV
Nitrogen (Ammonia) as N	0.81		mg/L	0.01	0.03	350.1	09/04 13:54	09/04 13:54	RPV
Hydrogen Sulfide (Un-ionized)	0.67		mg/L	0.100	0.300	376.2	08/31 15:26	08/31 15:26	RPV
Color/pH (Lab)	U/7.61	U	Pt-Co	1.0	3.0	SM2120B	08/31 17:29	08/31 17:29	RPV
Salinity (Lab)	6.6		ppt	0.10	0.30	SM 2520B	09/01 14:15	09/01 14:15	DGK
Total Dissolved Solids (TDS)	6980		mg/L	1.00	3.00	SM 2540C	09/04 14:30	09/05 14:52	MCZ
pH (Lab)	7.61		units	0.1	0.3	SM4500-H+-B	08/31 17:39	08/31 17:39	RPV
Silica	9.19		mg/L	0.22	0.66	SM4500-SiO2	09/10 16:33	09/10 16:33	RPV
Hardness, Calcium	330		mg/L	1.00	3.00	200.7	09/04	09/04 15:12	IMN

Report To:
Dan Ringdahl
Florida Design Drilling Corp.
1405 N. Killian Drive
West Palm Beach, FL 33403

Report Printed: 09/11/12
Submission # 120800O888
Order # 30292

Project: Sunrise
Site Location: Sunrise
Matrix: Water

Sample I.D.: PKR Test 3B (1,000-1,528)
Collected: 08/31/12 11:45
Received: 08/31/12 13:05
Collected by: Rod Miller

LABORATORY ANALYSIS REPORT

PARAMETER	RESULT	QC	UNITS	MDL	PQL	METHOD	DATE EXT.	DATE ANALY.	ANALYST
Hardness, Total	1289		mg/L	0.035	0.105	200.7	09/04	09/04 15:12	IMN
Aluminum	0.005		mg/L	0.00070	0.00210	200.7	09/04	09/04 15:12	IMN
Barium	0.007		mg/L	0.00003	0.00009	200.7	09/04	09/04 15:12	IMN
Boron	1.268		mg/L	0.0037	0.0111	200.7	09/04	09/04 15:12	IMN
Calcium	132		mg/L	0.0036	0.0108	200.7	09/04	09/04 15:12	IMN
Iron, Dissolved	0.014		mg/L	0.00080	0.00240	200.7	09/04	09/04 15:07	IMN
Iron	0.024		mg/L	0.0008	0.0024	200.7	09/04	09/04 15:12	IMN
Magnesium	233		mg/L	0.0475	0.1425	200.7	09/04	09/05 08:55	IMN
Manganese	0.001		mg/L	0.00009	0.00027	200.7	09/04	09/04 15:12	IMN
Potassium	127		mg/L	0.0011	0.0033	200.7	09/04	09/04 15:12	IMN
Sodium	2128		mg/L	0.070	0.210	200.7	09/04	09/05 08:55	IMN
Strontium	14.7		mg/L	0.00075	0.00225	200.7	09/04	09/05 08:55	IMN
Lab. filtration	08/31/2012						08/31	08/31	IMN

* H2S Calculation Based on Lab pH
Unless indicated, soil results are reported based on actual (wet) weight basis.

Analytes not currently NELAC certified denoted by ~.
Work performed by outside (subcontract) labs denoted by Cert.ID in Analyst Field.
Results relate only to this sample.
QC=Qualifier Codes as defined by DEP 62-160
U=Analyzed for but not detected.
Q=Sample held beyond accepted holding time.
I=Value is between MDL and PQL.
J=Estimated value.

Authorized CSM Signature (954) 978-6400
Florida-Spectrum Environmental Services, Inc.
Certification # E86006

SUBMISSION # 1208-888

Logged in LIMS by NB

CSM assigned _____

CHAIN OF CUSTODY RECORD

☐ 1460 W. McNab Road Ft Laud. FL 33309	Tel: (954) 978-6400	Fax: (954) 978-2233
☐ 630 Indian Street Savannah, GA 31401	Tel: (912) 238-5050	Fax: (912) 234-4815
☐ 528 Gooch Road Fort Meade, FL 33841	Tel: (863) 285-8145	Fax: (863) 285-7030
☐ 610 Parrot Ave. N, Okeechobee, FL 34972	Tel: (863) 763-3336	Fax: (863) 763-1544

Original-Return w/report Yellow-Lab File Copy Pink - Sampler Copy

DUE DATE Requested

RUSH RESERVATION #

Rush Surcharges apply

Report to: (company name) Florida Design Drillers		Report to Address: 1405 N Killian dr Lake Park FL	
Invoice to: (company name) same	Purchase Order # 5080	Invoice to Address: same	
Project Name and/or Number Sunrise		Site Location:	
Project Contact: Dan Ringdahl	Phone: 561-324-3885	Fax: 561 844 2967	Email: Dan@FlDrilling.com
Sampler Name: (printed) Rod Miller	Affiliation: engineer	Sampler Signature	

ORDER # *Lab Control Number* *Shaded Areas For Laboratory Use Only*	Sample ID	Date Sampled	Time Sampled	Matrix (DW SW GW WW S SED HW BIO SEA OIL X AIR)	Bottle & Pres. Combo Codes	Number of Containers Received & NELAC Letter Suffixes # A-?	Analysis Required	Field Tests TEMP °C	PH	COND	CHLOR
1	30292	PKR Tst 3B 1,000 - 1,528 ft	8-31-12	11:45	GW	40 TY THIS 03	5	See Attached Sheet for List of Parameters	24.1		12,175
2											
3											
4											
5											
6											
7											
8											
9											
10											

Special Comments: RUSH FAL SALINITY FOR 9/4

Total

"I waive TNI protocol" (emergency) (sign here) >

Deliverables: QA/QC Report Needed? Yes No *(additional charge)*

	Signature	Affiliation	Date/Time
1	Relinquished by:		
1	Received by:		8-31-12 1245
2	Relinquished by:		8-31-12
2	Received by:		
3	Relinquished by:		
3	Received by:		

Sample Custody & Field Comments

Temp as received 4 C

Custody seals? Y N

FIELD TIME:

Sampling _____ hrs

Pick-Up _____ hrs

Misc. Charges _____

Bottle Type

A-liter amber
B-Bacteria bag/bottle
F-500 ml O-125 ml
H-Plastic Amber Liter
L-liter bottle
S2-2 oz soil jar
S4-4 oz soil jar / S8-8 oz soil jar
T-250 ml
V-40 ml vial
W-wide mouth
X-other TED-Tedlar Air Bag

Additional Bottle Types
B-brown liter plastic

Preservatives

A-ascorbic acid P-H3PO4
C-HCL S-H2SO4
Cu-CuSO4 T-Na2S2O3
DI-DI water U-Unpreserved
H-HNO3 N-NaOH
M-MCAB NH4-NH4CL
MeOH-Methanol
Z-zinc acetate

Additional Preservatives
Hex-Hex Cr Buffer
EDA-Ethylene Diamine

Test Well SGF-2

Packer Test 1

MALCOLM PIRNIE | ARCADIS
The Water Division of ARCADIS

PACKER TEST WATER QUALITY SUMMARY
Sawgrass Floridan Test Well Construction
City of Sunrise, Florida

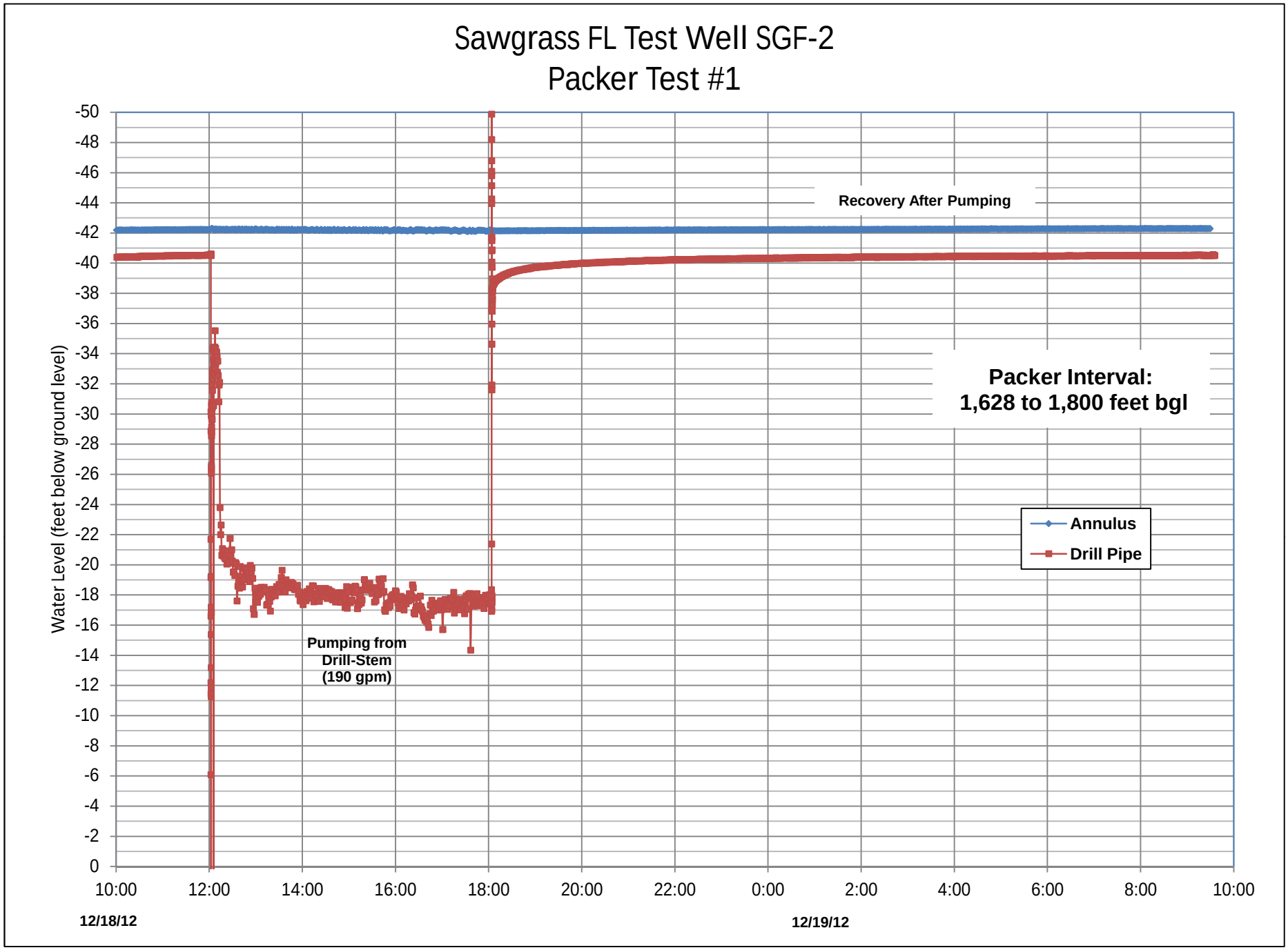
Test Well SGF-2
Packer Test No. 1 (Single Packer)

Start date: 12/18/2012 **End date: 12/18/2012**

Flowmeter Total-Start (gal) :	**47100**	**Open Hole Total Depth (feet bgl) :**	**1,800**
Flowmeter Total- End (gal) :	**115538**	**Packer Depth Interval (feet bgl):**	**1,628 - 1,800**
Stabilized Test Pumping Rate (gpm):	**190**	**Pump Setting Depth (feet bgl):**	**164.0**
Development Duration (hrs):	**1**	**Transducer Depth (feet bgl):**	**40 (Drill Pipe); 1.5 (Annulus)**
Pump Test Duration (min):	**362**	**Pipe and open hole volume:**	**1,063 + 696 = 1,759 gallons**
Static DTW Before Test (feet bgl):	**-40.5**	**Maximum Drawdown (feet):**	**22.8**

Date	Time	Elapsed Time (min)	Pumping Rate (gpm)	Total Volume (gal)	Drill Stem W.L. (feet bgl)	Temp. (^{O}C)	Cond. (µS/cm)	Chlorides (mg/L)	Comments
Pump Test									
12/18/12	12:00	0	235	0	-41				Begin Test
12/18/12	12:17	17	195	3,940	-20.95	23.9	12,120		Annulus WL ft bgl: -42.2
12/18/12	12:39	39	190	7,600	-19.05				Annulus WL ft bgl: -42.21
12/18/12	12:58	58	185	11,000	-17.39	23.2	12,320		Annulus WL ft bgl: -42.21
12/18/12	13:28	88	190	16,800	-19.45				Annulus WL ft bgl: -42.222
12/18/12	13:57	117	190	22,300	-17.50	23.1	12,350		Annulus WL ft bgl: -42.208
12/18/12	14:28	148	190	28,200	-18.11				Annulus WL ft bgl: -42.204
12/18/12	14:57	177	190	33,700	-17.41	23.2	12,350		Annulus WL ft bgl: -42.184
12/18/12	15:28	208	190	39,600	-17.96				Annulus WL ft bgl: -42.19
12/18/12	15:58	238	185	45,300	-17.82	23	12,350		Annulus WL ft bgl: -42.187
12/18/12	16:35	275	182	52,000	-16.54				Annulus WL ft bgl: -42.18
12/18/12	16:57	297	182	56,000	-17.37	23.3	12,320		Annulus WL ft bgl: -42.13
12/18/12	17:27	327	185	61,700	-17.82				Annulus WL ft bgl: -42.156
12/18/12	17:45	345							Collect lab sample
12/18/12	18:02	362	185	68,438	-17.73	22.7	12,420	3,250	Turn off pump

"gal" denotes gallons.
"gpm" denotes gallons per minute.
"min" denotes minutes.
"feet bgl" denotes feet below ground level.
"^{o}C" denotes degrees celcius.
"µS/cm" denotes milliSiemans per cenitmeter.
"mg/L" denotes milligrams per liter.
"psi" denotes pressure in pounds per square inch.



G:\AProjects\WR\WF PROJECTS\Sunrise\FL Test Well CA\Floridan Test Wells\FIELD DATA\Packer Tests\SGF2 Packer Tests\SGF2 PKR Test #1\sgf2 Tst#1 Merged Data.xlsx

Florida Spectrum Environmental Services, Inc.

Report To:
Dan Ringdahl
Florida Design Drilling Corporation
1405 N. Killian Drive
West Palm Beach FL, 33403

Report Printed: 12/31/2012
Work Order # 12L0352
Project:
Sunrise

Sunrise

Lab ID: 12L0352-01
Client Sample ID: Packer Test
Matrix: Water

Collection Date: 12/18/12 18:30
Received Date: 12/19/12 10:45
Collected By: Bruce Balmer

Laboratory Analysis Report

Parameter	Result	QC	Units	Dil	MDL	PQL	Method	Date Ext.	Date Analy.	Analyst
Field Parameter (s)										
pH (Field)	8.00		pH Units	1	0.100	0.300	SM4500 H+	12/18 18:30	12/18 18:30	Rep.
Specific Conductance	12400		uS/cm	1	1.00	3.00	EPA 120.1	12/18 18:30	12/18 18:30	Rep.
Temperature	22.7		°C	1	1.00	1.00	EPA 170.1	12/18 18:30	12/18 18:30	Rep.
Classical Chemistry Parameters										
Bromide	15.5		mg/L	50	2.75	8.25	EPA 300.0	12/19 17:00	12/20 12:25	RPV
Total Hardness	1250		mg/L	1	0.00360	0.0108	EPA 200.7 Calc	12/19 12:00	12/19 21:24	EMC
Turbidity	17		NTU	1	0.050	0.15	EPA 180.1	12/19 14:00	12/19 14:00	ROL
Wet Chemistry										
Total Alkalinity	118		mg/L	1	2.00	6.00	EPA 310.1	12/21 14:00	12/21 15:59	ROL
Ammonia as N	0.840		mg/L	1	0.0140	0.0420	EPA 350.1	12/26 11:34	12/26 11:34	RPV
Bicarbonate Alkalinity	118		mg/L	1	0.0100	0.0300	EPA 310.1	12/21 14:00	12/24 15:34	ROL
Carbonate	0.160		mg/L	1	0.0100	0.0300	EPA 310.1	12/21 14:00	12/24 15:34	ROL
Chloride	4030		mg/L	50	5.50	16.5	EPA 300	12/19 17:00	12/19 17:00	RPV
Color	10.0		CU	1	1.00	3.00	SM 2120B	12/19 14:00	12/19 15:01	ROL
Fluoride	ND	U	mg/L	50	2.10	6.30	EPA 300.0	12/19 17:00	12/20 12:25	RPV
Hydrogen sulfide	1.04		mg/L	1	0.0100	0.0300	EPA 376.2	12/21 12:09	12/21 12:10	ROL
Orthophosphate as P	2.50	I	mg/L	50	1.25	3.75	EPA 300.0	12/19 17:00	12/20 12:25	RPV
Silica (SiO2)	9.10		mg/L	1	0.220	0.660	SM4500SiO2C	12/26 10:53	12/26 10:55	ROL
Sulfate	670		mg/L	50	5.35	16.0	EPA 300.0	12/19 17:00	12/19 17:00	RPV

Report To:
Dan Ringdahl
Florida Design Drilling Corporation
1405 N. Killian Drive
West Palm Beach FL, 33403

Report Printed: 12/31/2012
Work Order # 12L0352
Project:
Sunrise

Sunrise

Lab ID: 12L0352-01
Client Sample ID: Packer Test
Matrix: Water

Collection Date: 12/18/12 18:30
Received Date: 12/19/12 10:45
Collected By: Bruce Balmer

Laboratory Analysis Report

Parameter	Result	QC	Units	Dil	MDL	PQL	Method	Date Ext.	Date Analy.	Analyst
Wet Chemistry										
Total Dissolved Solids	7780		mg/L	1	1.00	3.00	TDS SM 2540C	12/20 17:30	12/21 15:06	MCZ
Metals (Dissolved) by EPA 200 Series Methods										
Iron	0.00400		mg/L	1	0.000800	0.00240	EPA 200.7	12/19 12:00	12/20 16:36	EMC
Metals (Drinking Water) by EPA 200 Series Methods										
Calcium Hardness	337		mg/L	1	1.00	3.00	EPA 200.7	12/19 12:00	12/19 21:24	EMC
Total Recoverable Metals by EPA 200 Series Methods										
Aluminum	ND	U	mg/L	1	0.000700	0.00210	EPA 200.7	12/19 12:00	12/19 21:24	EMC
Barium	0.0150		mg/L	1	0.0000300	0.0000900	EPA 200.7	12/19 12:00	12/19 21:24	EMC
Boron	0.854		mg/L	1	0.00370	0.0111	EPA 200.7	12/19 12:00	12/19 21:24	EMC
Calcium	135.1		mg/L	1	0.0036	0.0108	EPA 200.7	12/19 12:00	12/19 21:24	EMC
Iron	0.265		mg/L	1	0.000800	0.00240	EPA 200.7	12/19 12:00	12/19 21:24	EMC
Magnesium	220.7		mg/L	1	0.0019	0.0057	EPA 200.7	12/19 12:00	12/19 21:24	EMC
Manganese	0.00800		mg/L	1	0.0000900	0.000270	EPA 200.7	12/19 12:00	12/19 21:24	EMC
Potassium	132.4		mg/L	1	0.0011	0.0033	EPA 200.7	12/19 12:00	12/19 21:24	EMC
Sodium	2245		mg/L	1	0.0028	0.0084	EPA 200.7	12/19 12:00	12/19 21:24	EMC
Strontium	19.0		mg/L	10	0.000300	0.000900	EPA 200.7	12/19 12:00	12/24 10:30	EMC

Florida Spectrum
Environmental Services, Inc.

Report To:
Dan Ringdahl
Florida Design Drilling Corporation
1405 N. Killian Drive
West Palm Beach FL, 33403

Report Printed: 12/31/2012
Work Order # 12L0352
Project:
Sunrise

Sunrise

Notes and Definitions

U	Indicated that the compound was analyzed for but not detected. This shall be used to indicate that the specific component was not detected. The value associated with the qualifier shall be the laboratory method detection limit.
J	Estimated value; value not accurate.
DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the detection limit
NR	Not Reported
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference
V	Indicated that the analyte was detected in both the sample and the associated method blank.
I	The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.
Z	Too many colonies were present for accurate counting.

QC=Qualifier Codes as defined by DEP 62-160
Unless indicated, soil results are reported on actual (wet) weight basis.
Work performed by outside (subcontracted) labs denoted by SUB in Analyst Field.

Results relate only to this sample.

Maria Castellanos - Lab Manager

Authorized CSM Signature (954) 978-6400
Florida-Spectrum Environmental Services,Inc.
Certification# E86006

All NELAP certified analysis are performed in accordance with Chapter 64E-1 Florida Administrative code, which has been determined to be equivalent to NELAC standards. Analysis certified by programs other than NELAP are designated with a "~".

WORK ORDER #: 12L0352

Logged in LIMS by: _____
CSM assigned _____

CHAIN OF CUSTODY RECORD

☐ 1460 W. McNab Road Ft Laud. FL 33309 Tel: (954) 978-6400 Fax: (954) 978-2233
☐ 630 Indian Street Savannah, GA 31401 Tel: (912) 238-5050 Fax: (912) 234-4815
☐ 528 Gooch Road Fort Meade, FL 33841 Tel: (863) 285-8145 Fax: (863) 285-7030
☐ 610 Parrot Ave. N, Okeechobee, FL 34972 Tel: (863) 763-3336 Fax: (863) 763-1544

Original-Return w/report Yellow-Lab File Copy Pink - Sampler Copy

DUE DATE Requested

RUSH RESERVATION #

Rush Surcharges apply

Report to: (company name) Florida Design drilling
Report to Address: Florida design drilling
Invoice to: (company name) Same
Purchase Order # 5082-2
Invoice to Address: 1405 N Killian Dr
Project Name and/or Number: Sunrise
Site Location: Sunrise
Project Contact: Dan Ringdahl
Phone: 561-324-3885
Fax: 561 844 2967
Email: Dan@FLdrilling.com
Sampler Name (printed): Bruce A Balmer
Affiliation: Driller
Sampler Signature: [signature]

ORDER # Lab Control Number (Shaded Areas For Laboratory Use Only)	Sample ID	Date Sampled	Time Sampled	Matrix (DW SW GW WW S SED HW BIO SEA OIL X AIR)	Bottle & Pres. Combo Codes	Number of Containers Received & NELAC Letter Suffixes # A-?	Analysis Required	TEMP °C	PH	COND	CHLOR
1 01	see ATT	12/18/12	6:30 pm		4L HNO3 1L 2W	5	see ATT	22.7°C	8.0 pH	12,400	
2											
3											
4											
5											
6											
7											
8											
9											
10											

Special Comments:

Total

"I waive TNI protocol" (emergency) (sign here) >

Deliverables: QA/QC Report Needed? Yes No (additional charge)

	Signature	Affiliation	Date/Time
1	Relinquished by: [signature]		
1	Received by: [signature]	FSES	12/19/12 1045
2	Relinquished by:		
2	Received by:		
3	Relinquished by:		
3	Received by:		

Sample Custody & Field Comments
Temp as received 4 °C
Custody seals? Y / N
FIELD TIME:
Sampling _____ hrs
Pick Up _____ hrs

Bottle Type
A-liter amber
B-Bacteria bag/bottle
F-500 ml G-125 ml
H-Plastic Amber Liter
I-liter bottle

Preservation
A-ascorbic acid P-H3PO4
C-HCL S-H2SO4
Cu-CuSO4 T-Na2S2O3
DI-DI water U-Unpreserved
H-HNO3 N-NaOH
M-MCAA NH4-NH4CL
MeOH-Methanol

Test Well SGF-2

Packer Test 2

MALCOLM PIRNIE | ARCADIS
The Water Division of ARCADIS

PACKER TEST WATER QUALITY SUMMARY
Sawgrass Floridan Test Well Construction
City of Sunrise, Florida

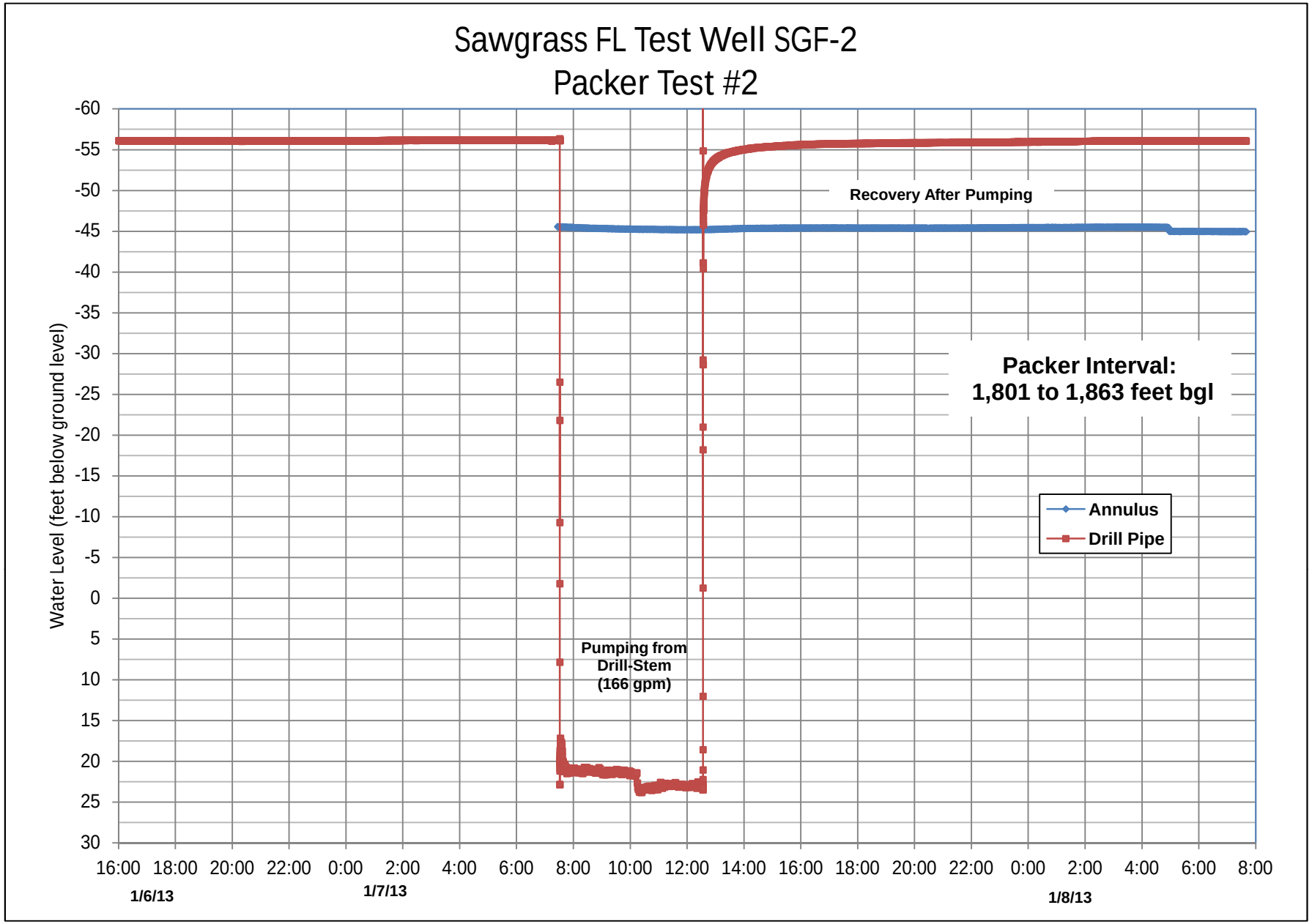
Test Well SGF-2
Packer Test No. 2 (Single Packer)

Start date: 1/7/2013 **End date:** 1/7/2013

Flowmeter Total-Start (gal) :	**116495**	**Open Hole Total Depth (feet bgl) :**	**1,863**
Flowmeter Total- End (gal) :	**166300**	**Packer Depth Interval (feet bgl):**	**1,801 - 1,863**
Stabilized Test Pumping Rate (gpm):	**166**	**Pump Setting Depth (feet bgl):**	**175.0**
Development Duration (hrs):	**1**	**Transducer Depth (feet bgl):**	**121.0 (Drill Pipe); 2.25 (Annulus)**
Pump Test Duration (min):	**302**	**Pipe and open hole volume:**	**1,176 + 251 = 1,427 gallons**
Static DTW Before Test (feet bgl):	**-56**	**Maximum Drawdown (feet):**	**78.9**

Date	Time	Elapsed Time (min)	Pumping Rate (gpm)	Total Volume (gal)	Drill Stem W.L. (feet bgl)	Temp. (^{O}C)	Cond. (µS/cm)	Chlorides (mg/L)	Comments
Pump Test									
1/7/13	7:31	0	0	0	-56				Begin Test; Tot: 116495, Ann W.L. -45.49' bgl
1/7/13	7:34	3	170	505	19.90				Ann W.L.: -45.49' bgl, Tot: 117000
1/7/13	7:52	21	170	3,505	21.10	21.5	7,090	2,000	Tot: 120000
1/7/13	8:27	56	170	9,605	21.13	21.4	7,050		Ann W.L.: -45.37' bgl; Tot: 126100
1/7/13	8:58	87	168	14,705	21.40	21.4	6,960	2,000	Ann W.L.: -45.32
1/7/13	9:31	120	162	19,905	21.09				Ann W.L.: -45.26' bgl; Tot: 136400
1/7/13	9:57	146	162	24,205	21.70	21.8	6,970	2,000	Ann W.L.: -45.2' bgl; Tot: 140700
1/7/13	10:25	174	163	28,905	23.36				Ann W.L.: -45.2' bgl; Tot: 145400
1/7/13	10:56	205	165	33,905	22.74	21.9	6,970	2,000	Ann W.L.: -45.2' bgl; Tot: 150400
1/7/13	11:26	235	166	38,905	23.06				Ann W.L.: -45.2' bgl; Tot: 155400
1/7/13	11:57	266	166	43,805	22.84	22.0	6,970	2,000	Drill Pipe W.L.: -46.51 ft bgl
1/7/13	12:15	284				22.1	6,960	2,000	Collect Lab Sample
1/7/13	12:33	302	166	49,805					Drill Pipe W.L.: -46.53 ft bgl

"gal" denotes gallons.
"gpm" denotes gallons per minute.
"min" denotes minutes.
"feet bgl" denotes feet below ground level.
"^{o}C" denotes degrees celcius.
"µS/cm" denotes milliSiemans per cenitmeter.
"mg/L" denotes milligrams per liter.
"psi" denotes pressure in pounds per square inch.


Sawgrass FL Test Well SGF-2
Packer Test #2
Water Level (feet below ground level)
-60
-55
-50
-45
-40
-35
-30
-25
-20
-15
-10
-5
0
5
10
15
20
25
30
16:00
18:00
20:00
22:00
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00
2:00
4:00
6:00
8:00
1/6/13
1/7/13
1/8/13
Recovery After Pumping
Packer Interval:
1,801 to 1,863 feet bgl
Annulus
Drill Pipe
Pumping from
Drill-Stem
(166 gpm)

Florida Spectrum Environmental Services, Inc.

Report To:
Dan Ringdahl
Florida Design Drilling Corporation
1405 N. Killian Drive
West Palm Beach FL, 33403

Report Printed: 1/21/2013
Work Order # 13A0089
Project:
Sun 103

Sun 103

Lab ID: 13A0089-01
Client Sample ID: SGF 2 packer test - 2
Matrix: Water

Collection Date: 01/07/13 12:15
Received Date: 01/07/13 14:00
Collected By: Bruce Balmer

Laboratory Analysis Report

Parameter	Result	QC	Units	Dil	MDL	PQL	Method	Date Ext.	Date Analy.	Analyst
Field Parameter (s)										
pH (Field)	8.10		pH Units	1	0.100	0.300	SM4500 H+	01/07 12:15	01/07 12:15	Rep.
Specific Conductance	6970		uS/cm	1	1	3	EPA 120.1	01/07 12:15	01/07 12:15	Rep.
Temperature	22.0		°C	1	1.00	1.00	EPA 170.1	01/07 12:15	01/07 12:15	Rep.
Classical Chemistry Parameters										
Bromide	5.50	I	mg/L	50	2.75	8.25	EPA 300.0	01/08 17:10	01/08 17:10	DGK
Total Hardness	781		mg/L	1	0.00360	0.0108	EPA 200.7 Calc	01/07 17:00	01/08 13:19	EMC
Turbidity	26		NTU	1	0.050	0.15	EPA 180.1	01/08 09:00	01/08 09:00	ROL
Wet Chemistry										
Total Alkalinity	110		mg/L	1	2.00	6.00	EPA 310.1	01/08 09:30	01/08 09:30	ROL
Ammonia as N	0.310		mg/L	1	0.0140	0.0420	EPA 350.1	01/09 11:00	01/09 11:03	ROL
Bicarbonate Alkalinity	109		mg/L	1	0.0100	0.0300	EPA 310.1	01/08 09:30	01/08 09:30	ROL
Carbonate	0.340		mg/L	1	0.0100	0.0300	EPA 310.1	01/08 09:30	01/08 09:30	ROL
Chloride	1810		mg/L	50	5.50	16.5	EPA 300	01/08 17:10	01/08 17:10	DGK
Color	ND	U	CU	1	1.00	3.00	SM 2120B	01/08 09:30	01/08 09:30	ROL
Fluoride	ND	U	mg/L	50	2.10	6.30	EPA 300.0	01/08 17:10	01/08 17:10	DGK
Hydrogen sulfide	0.264		mg/L	1	0.0100	0.0300	EPA 376.2	01/08 12:00	01/08 12:00	ROL
Orthophosphate as P	ND	U	mg/L	50	1.25	3.75	EPA 300.0	01/08 17:10	01/08 17:10	DGK
Silica (SiO2)	10.2		mg/L	1	0.220	0.660	SM4500SiO2C	01/15 14:00	01/15 15:30	ROL
Sulfate	880		mg/L	50	5.35	16.0	EPA 300.0	01/08 17:10	01/08 17:10	DGK

Florida Spectrum Environmental Services, Inc.

Report To:
Dan Ringdahl
Florida Design Drilling Corporation
1405 N. Killian Drive
West Palm Beach FL, 33403

Report Printed: 1/21/2013
Work Order # 13A0089
Project:
Sun 103

Sun 103

Lab ID: 13A0089-01
Client Sample ID: SGF 2 packer test - 2
Matrix: Water

Collection Date: 01/07/13 12:15
Received Date: 01/07/13 14:00
Collected By: Bruce Balmer

Laboratory Analysis Report

Parameter	Result	QC	Units	Dil	MDL	PQL	Method	Date Ext.	Date Analy.	Analyst
Wet Chemistry										
Total Dissolved Solids	4330		mg/L	1	1.00	3.00	TDS SM 2540C	01/10 14:00	01/14 12:15	MCZ
Metals (Dissolved) by EPA 200 Series Methods										
Iron	0.0140		mg/L	1	0.000800	0.00240	EPA 200.7	01/07 17:00	01/08 13:15	EMC
Metals (Drinking Water) by EPA 200 Series Methods										
Calcium Hardness	243		mg/L	1	1.00	3.00	EPA 200.7	01/07 17:00	01/08 13:19	EMC
Total Recoverable Metals by EPA 200 Series Methods										
Aluminum	ND	U	mg/L	1	0.000700	0.00210	EPA 200.7	01/07 17:00	01/08 13:19	EMC
Barium	0.00800		mg/L	1	0.0000300	0.0000900	EPA 200.7	01/07 17:00	01/08 13:19	EMC
Boron	0.732		mg/L	1	0.00370	0.0111	EPA 200.7	01/07 17:00	01/08 13:19	EMC
Calcium	97.2		mg/L	1	0.0036	0.0108	EPA 200.7	01/07 17:00	01/08 13:19	EMC
Iron	0.231		mg/L	1	0.000800	0.00240	EPA 200.7	01/07 17:00	01/08 13:19	EMC
Magnesium	131		mg/L	1	0.0019	0.0057	EPA 200.7	01/07 17:00	01/08 13:19	EMC
Manganese	0.0130		mg/L	1	0.0000900	0.000270	EPA 200.7	01/07 17:00	01/08 13:19	EMC
Potassium	79.9		mg/L	1	0.0011	0.0033	EPA 200.7	01/07 17:00	01/08 13:19	EMC
Sodium	1121		mg/L	10	0.028	0.084	EPA 200.7	01/07 17:00	01/08 14:44	EMC
Strontium	12.9		mg/L	10	0.000300	0.000900	EPA 200.7	01/07 17:00	01/08 14:44	EMC

Report To:
Dan Ringdahl
Florida Design Drilling Corporation
1405 N. Killian Drive
West Palm Beach FL, 33403

Report Printed: 1/21/2013
Work Order # 13A0089
Project:
Sun 103

Sun 103

Notes and Definitions

U	Indicated that the compound was analyzed for but not detected. This shall be used to indicate that the specific component was not detected. The value associated with the qualifier shall be the laboratory method detection limit.
Q	Sample held beyond accepted holding time. This code shall be used if the value is derived from a sample that was prepared or analyzed after the approval holding time restrictions for sample preparation or analysis.
J-03	The reported value failed to meet the established quality control criteria for either precision or accuracy.
DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the detection limit
NR	Not Reported
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference
V	Indicated that the analyte was detected in both the sample and the associated method blank.
I	The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.
Z	Too many colonies were present for accurate counting.

QC=Qualifier Codes as defined by DEP 62-160
Unless indicated, soil results are reported on actual (wet) weight basis.
Work performed by outside (subcontracted) labs denoted by SUB in Analyst Field.

Results relate only to this sample.

Suresh (Bobby) Supan - CSM

Authorized CSM Signature (954) 978-6400
Florida-Spectrum Environmental Services,Inc.
Certification# E86006

All NELAP certified analysis are performed in accordance with Chapter 64E-1 Florida Administrative code, which has been determined to be equivalent to NELAC standards. Analysis certified by programs other than NELAP are designated with a "~".

SUBMISSION # 13A-89

Logged in LIMS by AJC

CSM assigned _____

CHAIN OF CUSTODY RECORD

Florida Spectrum Environmental Services, Inc.

☐ 1460 W. McNab Road Ft Laud. FL 33309 Tel: (954) 978-6400 Fax: (954) 978-2237
☐ 630 Indian Street Savannah, GA 31401 Tel: (912) 238-5050 Fax: (912) 234-4851
☐ 528 Gooch Road Fort Meade, FL 33841 Tel: (863) 285-8145 Fax: (863) 285-7150
☐ 610 Parrot Ave. N, Okeechobee, FL 34972 Tel: (863) 763-3336 Fax: (863) 763-1843

Original-Return w/report | Yellow-Lab File Copy | Pink - Sampler Copy

DUE DATE Requested

RUSH RESERVATION #

Rush Surcharges apply

Report to: (company name) Florida Design Drilling

Report to Address: 1405 N Killian Dr Lake park FL 33405

Invoice to: (company name) Same

Purchase Order # 5080-2

Invoice to Address: 1405 N Killian Dr Lake park FL 33403

Project Name and/or Number Sun 103

Site Location: Sunrise 56F-2

Project Contact: Dan Ringdahl Bruce Bulmer

Phone: 561 324 3885 561-315-2454

Fax: 561 844 2967

Email: Dan@FLDrilling.com

Sampler Name: (printed) Bruce A Bulmer

Affiliation: Driller

Sampler Signature

ORDER # Lab Control Number / Shaded Areas For Laboratory Use Only	Sample ID	Date Sampled	Time Sampled	Matrix (DW SW GW WW S SED HW BIO SEA OIL X AIR)	Bottle & Pres. Combo Codes	Number of Containers Received & NELAC Letter Suffixes # A-?	Analysis Required	TEMP °C	PH	COD ug/L	CHLOR
1	01	56F2 packer test-2						22.0	8.1	6720	1.05
2			1/7/13	12:15			See BTT				
3											
4											
5											
6											
7											
8											
9											
10											

Special Comments:

"I waive TNI protocol" (emergency) (sign here) >

Total

Deliverables: QA/QC Report Needed? Yes No *(additional charge)*

	Signature	Affiliation	Date/Time
1	Relinquished by:	Driller	1/7/13
1	Received by:	FSES	1/7/13 14:00
2	Relinquished by:		
2	Received by:		
3	Relinquished by:		
3	Received by:		

Sample Custody & Field Comments

Temp as received 4° C

Custody seals? Y N

FIELD TIME:

Sampling _____ hrs

Pick-Up _____ hrs

Misc. Charges _____

Bottle Type

A-liter amber
B-Bacteria bag/bottle
F-500 ml O-125 ml
H-Plastic Amber Liter
L-liter bottle
S2-2 oz soil jar
S4-4 oz soil jar / S8-8 oz soil jar
T-250 ml
V-40 ml vial
W-wide mouth
X-other TED-Tedlar Air Bag

Additional Bottle Types
B-brown liter plastic

Preservatives

A-ascorbic acid P-H3PO4
C-HCL S-H2SO4
Cu-CuSO4 T-Na2S2O3
DI-DI water U-Unpreserved
H-HNO3 N-NaOH
M-MCAB NH4-NH4CL
MeOH-Methanol
Z-zinc acetate

Additional Preserve
Hex-Hex Cr Buffer
EDA-Ethylene Diamine

Appendix E

Aquifer Performance Testing
Summaries and Charts

Summary of Step Rate Pump Testing, Sawgrass Test Wells SGF-1 and SGF-2

STEP RATE TEST AT TEST WELL SGF-1 (11/20/12)

Pump Rate	Stabilized W.L.	Drawdown	Specific Capacity	Conductivity	Temp	pH	H2S	Chloride	Turbidity	Sand Content	SDI
gpm	ft bgl	feet	gpm/ft	µS/cm	C		mg/L	mg/L	NTU	ppm	
862	-14.0	23.6	36.5	9,070	22.1	7.9	1.45	2,250	1.61	0.11	0.0
1,093	-5.8	31.8	34.4	8,820	22	8	1.7	2,000	NA	0.01	0.1
1,380	4.8	42.4	32.6	8,760	22	7.9	1.64	2,250	1.93	0.35	0.2
1,710	16.2	53.8	31.8	8,805	22.3	NA	1.75	2,250	1.93	2.25	1.6

Static water level in SGF-1 prior to pump startup: -37.58 feet below ground level (ft bgl)

STEP RATE TEST AT TEST WELL SGF-2 (3/18/13)

Pump Rate	Stabilized W.L.	Drawdown	Specific Capacity	Conductivity	Temp	pH	H2S	Chloride	Turbidity	Sand Content	SDI
gpm	ft bgl	feet	gpm/ft	µS/cm	C		mg/L	mg/L	NTU	ppm	
852	-16.7	24.0	35.5	10,220	22.4	7.6	1.33	2,750	16.2	0.02	5.5
1,095	-7.3	33.4	32.8	10,110	22.8	7.2	1.38	2,750	0.52	0.02	3.7
1,440	5.1	45.9	31.4	10,110	23.1	7.9	1.48	2,750	0.45	0.13	2.9
1,742	17.1	57.8	30.1	10,040	23.2	7.8	1.43	2,750	0.42	0.95	1.9

Static water level in SGF-2 prior to pump startup: -40.72 feet bgl

gpm denotes gallons per minute

ft bgl denotes feet below ground level

gpm/ft denotes specific capacity in gallons per minute per foot of drawdown

µS/cm denotes conductivity in microSiemens per centimeter

C denotes temperature in Celsius

mg/L denotes milligrams per liter

NTU denotes turbidity in nephelometric tubidity units

ppm denotes parts per million

SDI denotes Silt Density Index

Sand contents noted above are based on the total sand volume collected for the entire duration of each step rate

MALCOLM PIRNIE | ARCADIS

The Water Division of ARCADIS

SGF-1 STEP RATE TEST

Sawgrass Floridan Test Well Construction

City of Sunrise, Florida

November 20, 2012

Time	Elapse Time per Step Rate	Total Elapse Time	Pump Rate	Totalizer X1000	Volume Pumped	Depth to Water	Draw-down	Sand in Rossum	Sand Content	Comments
			gpm	gallons	gallons	ft bgl		mL	ppm	open valve
8:19	0	0	0	46620		-37.5	0	0		valve open, turn on pump
	1	1								
	2	2	875							
8:21	2	2							0	Start Rossum Sand Testing
8:25	6	6	833	46625	5000	-20.5	17	few grains	0.01	
8:31	12	12	828	46630	10000	-19.2	18.3	<0.01	0.11	
8:37	18	18	832	46635	15000	-18	19.5	<0.01	0.07	
8:47	28	28	839	46643	23000	-17.2	20.3	0.01	0.21	
8:54	35	35	843	46649	29000	-16.6	20.9	0.01	0.16	
9:04	45	45	846	46657	37000	-16	21.5	0.01	0.12	
9:11	52	52	848	46663	43000	-15.5	22	0.01	0.11	
9:17	58	58								Begin SDI Testing
9:34	74	74								Collect WQ Sample
	93	93	862	46698	78000	-13.9	23.6			
	95	95								Increase pump rate
9:54	1	96	1125							Rate still climbing
	1	96							0.00	Begin Rossum
	2	97	1128	46702	82000	-8.7	28.8	few grains	0.05	
	5	100	1122	46705	85000	-8.2	29.3			
	10	105	1122	46711	91000	-7.3	30.2	few grains	0.01	
	15	110	1116	46717	97000	-7	30.5	few grains	0.00	
	20	115	1112	46722	102000	-6.9	30.6	<0.01	0.06	
	25	120	1111	46727	107000	-6.6	30.9	<0.01	0.04	Begin SDI Test (no pre-filter)
	30	125	1108	46734	114000	-6.6	30.9	<0.01	0.04	
	40	135	1102	46744	124000	-6.1	31.4	<0.01	0.03	
	58	153								Collect WQ
	73	168	1093	46780	160000	-5.56	31.9	<0.01	0.01	
11:10	77	172								Increase pump rate
	2	174								Slightly increase rate to 1,431
	3	175							0.00	Begin Rossum Testing
	5	177	1420	46792	172000	2.1	39.6	few grains	0.03	
	10	182	1412	46799	179000	2.6	40.1	few grains	0.01	
	15	187	1407	46805	185000	2.94	40.4	0.01	0.44	
	20	192	1405	46813	193000	3.2	40.7	0.015	0.47	
	35	207	1397	46834	214000	3.69	41.2	0.03	0.50	
	45	217	1392	46847	227000			0.03	0.38	Collect WQ Sample
	60	232	1388	46869	249000	4.32	41.8	0.04	0.37	
	72	244	1386	46886	266000	4.4	41.9	0.045	0.34	
	94	266	1380	46916	296000	4.83	42.3	0.06	0.35	Complete SDI Test (no pre-filter)
12:53	102	274								Increase pump rate
	2	276	1750							Complete adjusting rate
	3	277							0.00	Begin Rossum Testing
	4	278	1740	46934	314000	13.4	50.9	few grains	0.53	
	10	284	1729	46944	324000	14.1	51.6	0.02	1.51	SDI (1.9) (no pre-filter)
	15	289	1728	46953	333000	14.5	52.0	0.07	3.08	SDI #2 (1.6) (no pre-filter)
	20	294	1723	46961	341000	15	52.5	0.1	3.11	
13:18	25	299	1722	46970	350000	15	52.5	0.11	2.64	
	30	304	1717	46979	359000	15.31	52.8	0.12	2.35	
	40	314	1716	46996	376000	15.68	53.2	0.14	2.00	Collect WQ Sample
	50	324	1713	47013	393000	15.98	53.5	0.2	2.25	
	60	334	1710	47031	411000	16.22	53.7			
13:59	66	340								Stop logging transducers
	68	342								Step transducer. Turn off pump
		344	0			12				

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The Water Division of ARCADIS

SGF-2 STEP RATE TEST

Sawgrass Floridan Test Well Construction
City of Sunrise, Florida
March 18, 2013

Time	Elapse Time per Step Rate	Total Elapse Time	Pump Rate	Totalizer X1000	Volume Pumped	Depth to Water	Draw-down	Sand Content	Comments
	min		gpm	gallons	gallons	ft bgl		ppm	
8:22	0	0	0	64951		-40.6	0		Step
8:24	2	2	824						
8:24:25	0	0							Begin Stop Watch
	6	6						0	Begin Rossum Testing
8:30	8	8				-22.35	18.25	0.00	
	10	10	788	64958	7000			0.15	
	13	13	816	64961	10000				Adjust flow rate
	14	14				-20.2	20.4		
8:39	17	17	828	64964	13000	-19.5	21.1	0.07	
8:44	22	22	836	64968	17000	-19.18	21.42		
8:51	29	29	840	64974	23000	-18.64	21.96		
9:00	38	38	845	64981	30000				
	52	52							Collect WQ sample
9:25	62	62	852	65002	51000	-16.58	24.02	0.02	
9:29	67	67							Increase flow, reset stop watch
	1	68	1060						Increase rate
	2	69	1107	65008	57000				
9:32:22	3	70				-10.99	29.61		
	5	72						0.00	Begin Rossum Testing
	10	77	1106	65017	66000	-9.3	31.3	0.11	
9:45	16	83	1105	65024	73000	-8.55	32.05	0.05	
9:49	20	87	1104	65028	77000	-8.77	31.83	0.04	
9:59	30	97	1103	65039	88000	-7.89	32.71	0.02	
10:00	31	98							
10:10	41	108	1099	65052		-7.75		0.03	
10:14	45	112							Collect WQ Sample
10:20	51	118	1097	65062		-7.74		0.02	
10:29	60	127	1095	65073		-7.64		0.02	
10:31:25	62	129							Increase flow, reset stopwatch
	2	131	1477	65078	127000				
	5	134						0.00	Begin Rossum Testing
	7	136				2.23	42.83		
10:41	10	139	1462	65089	138000	2.99	43.59	0.19	
10:52	21	150	1453	65105	154000	3.78	44.38	0.06	
11:01	30	159	1450	65118	167000			0.21	
11:16	45	174	1447	65140	189000	4.12	44.72	0.52	
11:21	50	179				4.8	45.4		Collect WQ Sample
11:36	65	194	1440	65169	218000	5.25	45.85	0.13	
11:43:10	67	196							Increase flow, reset stopwatch
	2	199	1772	65182					
	5	201						0.00	Begin Rossum Testing
	6	202				14.84	55.44	0.35	
11:53	10	206	1759	65196	245000	15.12	55.72	1.92	
	14	210						3.89	
12:00	17	213	1755	65208	257000	15.73	56.33	0.85	
12:06	23	219	1750	65218	267000	16.1	56.7	0.57	
12:13	30	226	1746	65231	280000	16.29	56.89	0.62	
12:23	40	236	1748	65248	297000	16.6	57.2	1.04	
12:28	45	241							Collect WQ Sample
12:43	60	256	1742	65283	332000	17.22	57.82	0.95	
12:48	65	262							Turn off pump, shut in well
12:49:10						-17.45			
12:50						-18.6			
13:15						-31.3			

Figure E-1

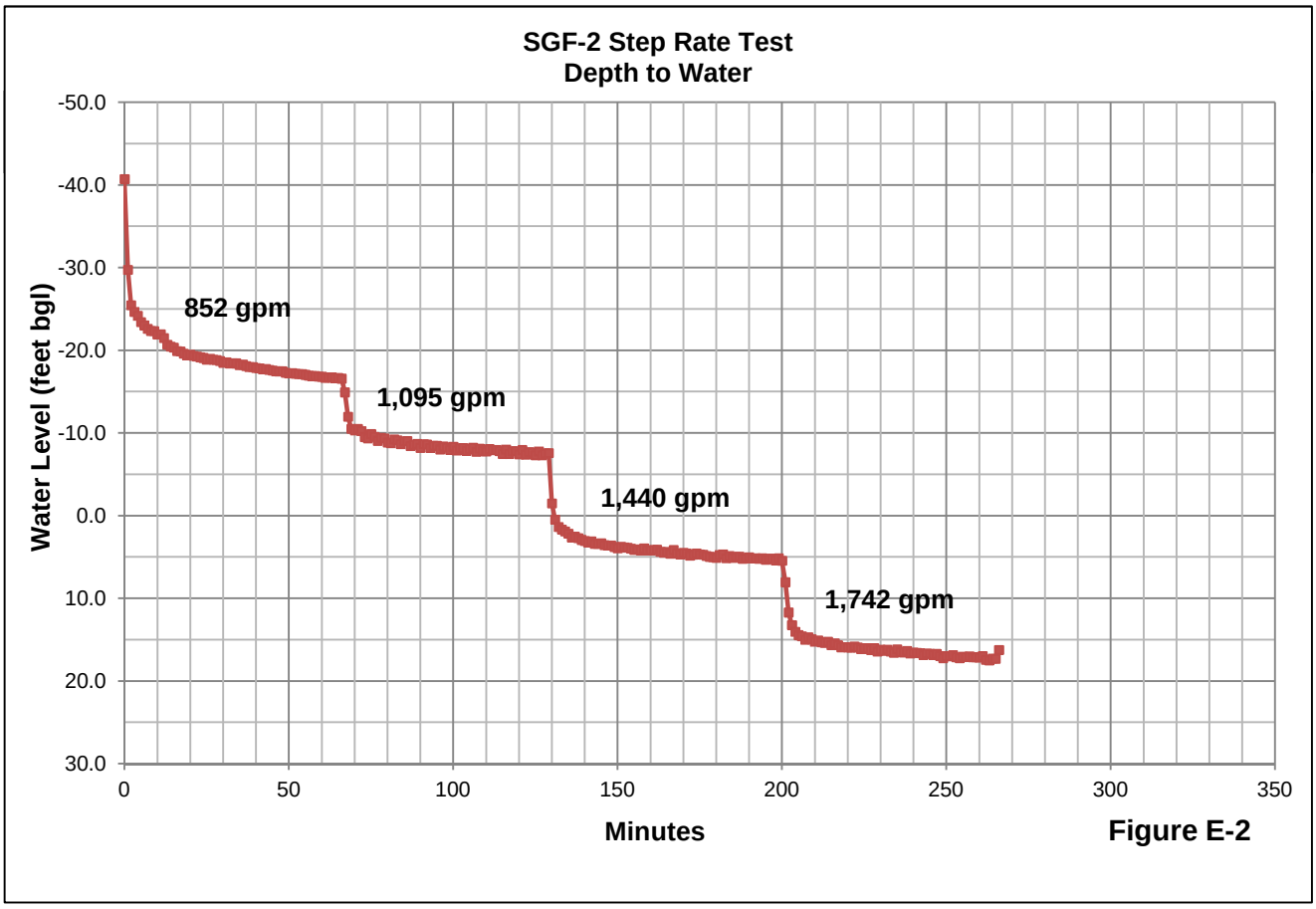

Figure E-2

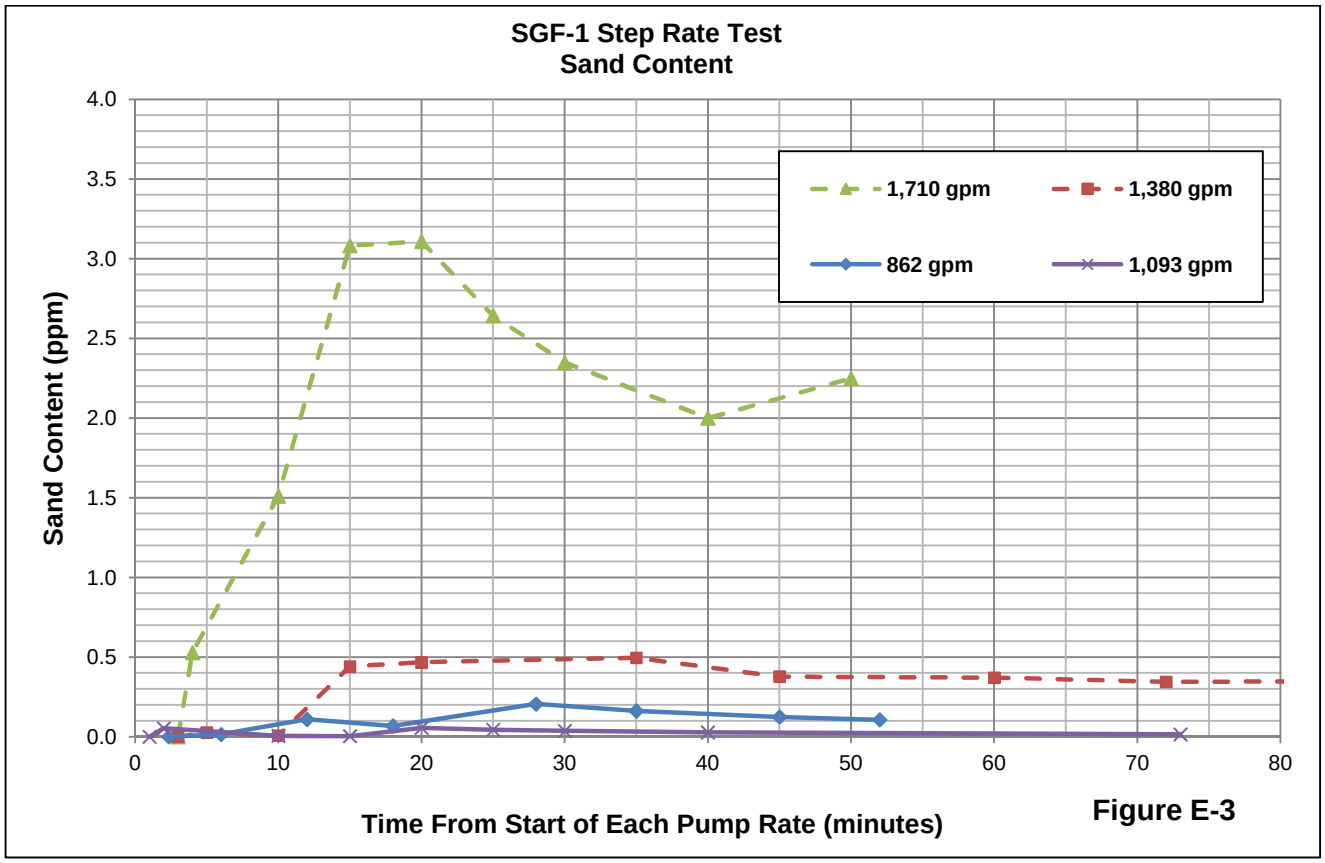

Figure E-3

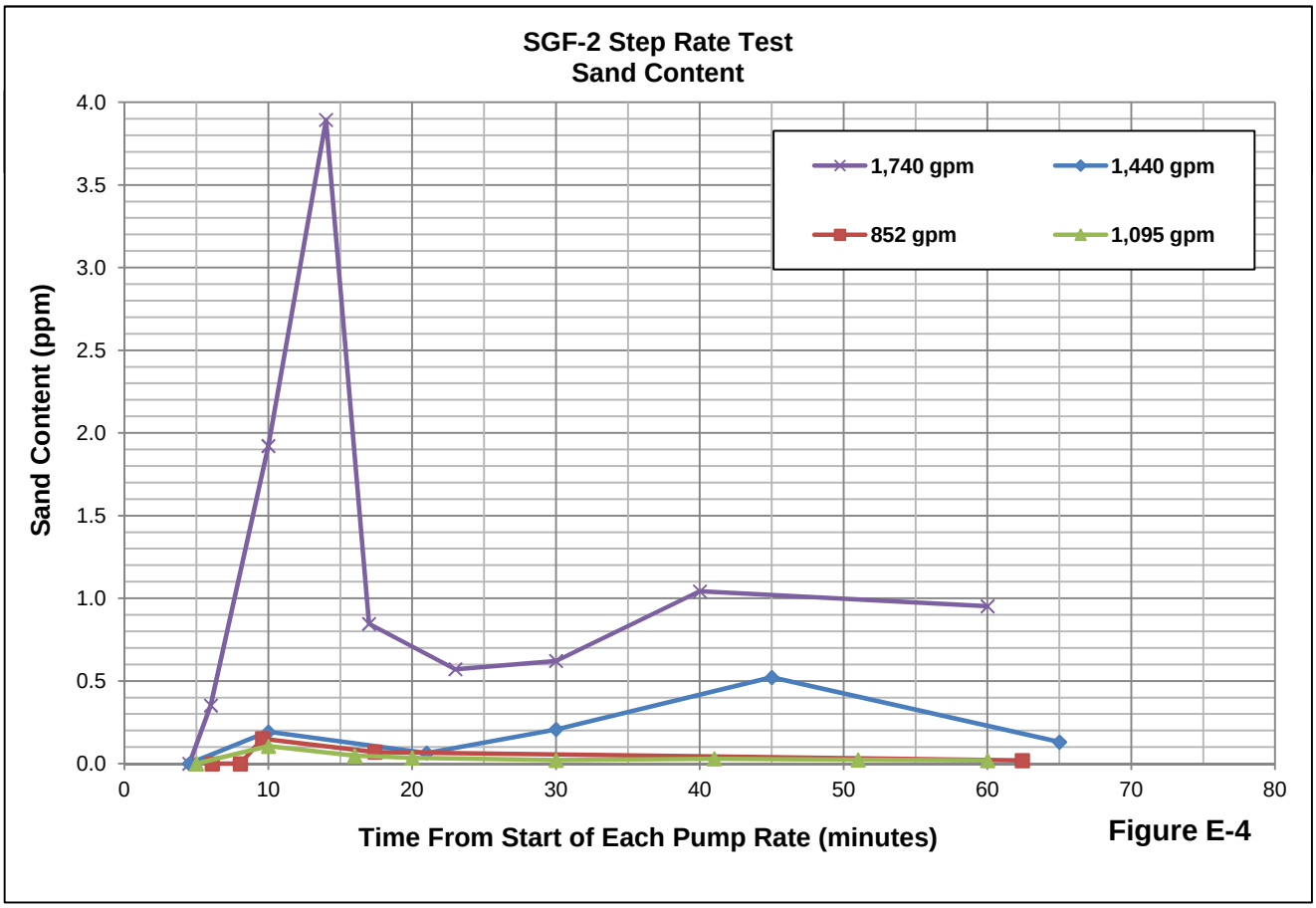

Figure E-4

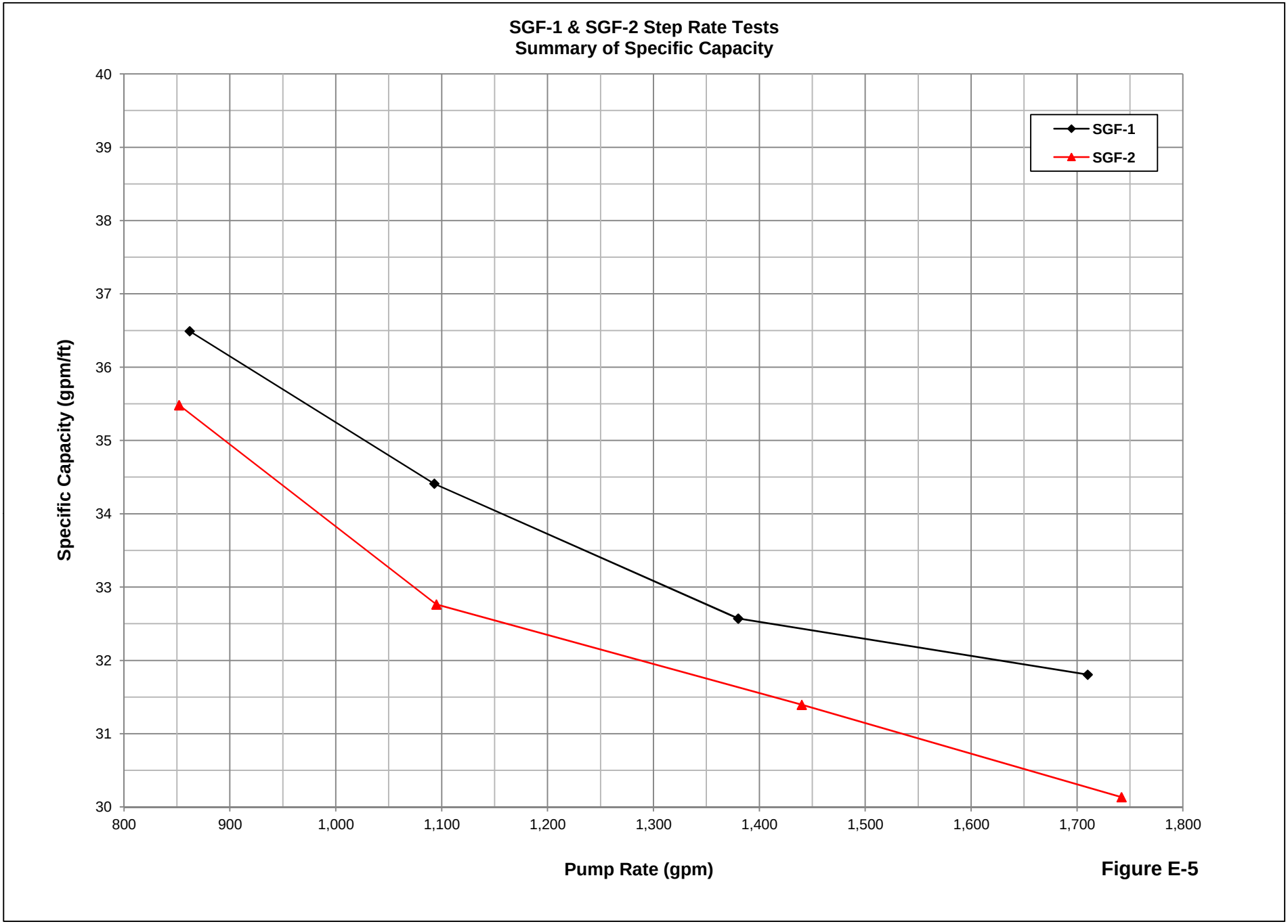
SGF-1 & SGF-2 Step Rate Tests
Summary of Specific Capacity
Specific Capacity (gpm/ft)
40
39
38
37
36
35
34
33
32
31
30
800
900
1,000
1,100
1,200
1,300
1,400
1,500
1,600
1,700
1,800
Pump Rate (gpm)
SGF-1
SGF-2

Figure E-5

MALCOLM PIRNIE | ARCADIS
The Water Division of ARCADIS

SGF-1 PUMP TEST

72-Hour Constant Rate

Sawgrass Floridan Test Well Construction

City of Sunrise, Florida

Date	Time	Elapse Time	Elapse Time	Pump Rate	Totalizer X1000	Volume Pumped	Depth to Water	Draw-down	Sand in Rossum	Sand Content	Comments
		min	hr	gpm	gallons	gallons	ft bgl		mL	ppm	
11/26		0	0.00		47046	0	-38.6	0	0		open valve
11/26		2.5	0.04								Begin Rossum Testing
11/26	8:57	3.0	0.05	1391							Increase Rate
11/26		4.5	0.08	1460						0	Start Rossum Sand Testing
11/26		6.0	0.10	1444	47054	8000	-8.5	30.1	few grains	0.04	
11/26		9.0	0.15	1430	47059	13000					
11/26		9.5	0.16								Increase Rate; Begin SDI Test
11/26	9:05	11.0	0.18	1464	47062	16000	-6	32.6	few grains	0.01	Complete increasing rate
11/26		15.0	0.25	1451	47067	21000	-5.5	33.1	<0.01	0.25	
11/26		20.0	0.33	1445	47074	28000	-4.5	34.1			Increase rate to 1,458 gpm
11/26		27	0.45								SDI: 2.4(5min), 2.3(10min),
11/26	9:24	30	0.50	1457	47089		-2.9	35.7	0.02	0.41	Was 1,445 gpm, Increase R.
11/26	9:34	40	0.67	1458	47103		-1.7	36.9	0.04	0.60	
11/26	9:47	53	0.88	1445	47122	76000	-0.6	38	0.05	0.54	
11/26		75	1.25	1443	47154		0.7	39.3	0.07	0.52	
11/26	10:30	96	1.60	1453	47189		1.862	40.46	0.07	0.40	
11/26		105	1.75	1456	47198		2.2	40.8	0.11	0.58	
11/26	11:03	130	2.17	1448	47234	188000	2.84	41.44	0.12	0.51	
11/26	11:30	153	2.55	1455	47269	223000	3.864	42.5	0.13		
11/26	12:30	211	3.52	1452	47353	307000	4.877	43.5	0.2	0.51	
11/26	13:14	260	4.33	1448	47423	377000	5.7	44.3	0.21	0.43	
11/26	13:30	274	4.57	1465	47445	399000	5.785	44.4	0.22	0.43	
11/26	14:30	337	5.62	1460	47534	488000	6.135	44.7	0.3	0.48	
11/26	15:26	393	6.55	1462	47616	570000	7.6	46.2	0.34	0.46	
11/26	16:30	455	7.58	1458	47709	663000	8.275	46.9	0.4	0.47	
11/26	17:30	513	8.55	1452	47793	747000	8.679	47.3	0.5		
11/26	18:30	570	9.50	1450	47875	829000	9.044	47.6	0.5	0.47	
11/26	19:30	634	10.57	1451	47968	922000	9.331	47.9	0.5		Increase Rate
11/26	20:30	694	11.57	1450	48054	1008000	9.898	48.5	0.5		
11/26	21:30	754	12.57	1451	48412	1366000	10.31	48.9	0.6	0.42	
11/26	22:30	814	13.57	1449	48228	1182000	10.361	49.0	0.6	0.39	Increase Rate
11/26	23:30	874	14.57	1450	48315	1269000	10.774	49.4	0.6	0.36	
11/27	0:30	934	15.57	1450	48404	1358000	11.019	49.6	0.7	0.40	
11/27	1:30	994	16.57	1450	48489	1443000	11.351	50.0	0.7	0.37	Increase Rate
11/27	2:30	1054	17.57	1451	48575	1529000	11.545	50.1	0.8	0.40	
11/27	3:30	1114	18.57	1450	48662	1616000	11.546	50.1	0.9	0.43	Increase Rate
11/27	4:30	1174	19.57	1451	48749	1703000	11.935	50.5	0.9	0.41	
11/27	5:30	1234	20.57	1450	48836	1790000	11.987	50.6	1	0.43	Increase Rate
11/27	6:30	1294	21.57	1449	48924	1878000	12.74	51.3	1.1	0.45	Increase Rate
11/27	7:30	1348	22.47	1450	49003	1957000	12.75	51.4	1.2		
11/27	8:30	1415	23.58	1448	49101	2055000	12.759	51.4	1.2		Increase Rate
11/27	9:30	1475	24.58	1450	49180	2134000	13.175	51.8	1.4	0.50	
11/27	10:30	1533	25.55	1452	49270	2224000	13.092	51.7	1.4	0.48	
11/27	11:30	1601	26.68	1454	49369	2323000	13.325	51.9	1.5	0.50	
11/27	12:30	1649	27.48	1464	49439	2393000	14.094	52.7	1.5	0.48	Decrease Rate
11/27	13:30	1716	28.60	1451	49537	2491000	13.718	52.3	1.5	0.46	
11/27	14:30	1769	29.48	1448	49614	2568000	13.696	52.3	1.6	0.48	
11/27	15:30	1836	30.60	1446	49711	2665000	13.274	51.9	1.7	0.49	Increase Rate
11/27	16:30	1894	31.57	1452	49793	2747000	13.797	52.4	1.6	0.45	
11/27	17:30	1949	32.48	1450	49874	2828000	13.886	52.5	1.8	0.49	
11/27	18:30	2012	33.53	1450	49866	2820000	14.187	52.8	1.9	0.50	
11/27	19:30	2074	34.57	1451	50055	3009000	14.582	53.18	1.9	0.49	

MALCOLM PIRNIE | ARCADIS
The Water Division of ARCADIS

SGF-1 PUMP TEST

72-Hour Constant Rate

Sawgrass Floridan Test Well Construction

City of Sunrise, Florida

Date	Time	Elapse Time	Elapse Time	Pump Rate	Totalizer X1000	Volume Pumped	Depth to Water	Draw-down	Sand in Rossum	Sand Content	Comments
		min	hr	gpm	gallons	gallons	ft bgl		mL	ppm	
11/27	20:30	2134	35.57	1452	50143	3097000	14.726	53.33	1.9	0.47	
11/27	21:30	2194	36.57	1453	50230	3184000	14.73	53.33	2	0.48	
11/27	22:30	2254	37.57	1451	50311	3265000	14.977	53.58	2	0.47	
11/27	23:30	2314	38.57	1451	50405	3359000	14.947	53.55	2.1	0.48	
11/28	0:30	2374	39.57	1449	50492	3446000	14.995	53.6	2.1	0.47	
11/28	1:30	2434	40.57	1448	50578	3532000	15.075	53.68	2.2	0.48	Increase Rate
11/28	2:30	2494	41.57	1450	50664	3618000	15.229	53.83	2.2	0.47	
11/28	3:30	2554	42.57	1450	50752	3706000	15.189	53.79	2.3	0.48	
11/28	4:30	2614	43.57	1449	50841	3795000	15.162	53.76	2.4	0.49	
11/28	5:30	2674	44.57	1447	50925	3879000	15.038	53.64	2.4	0.48	
11/28	6:30	2734	45.57	1452	51012	3966000	15.625	54.23	2.5	0.48	
11/28	7:30	2789	46.48	1449	51093	4047000	15.639	54.24	2.5	0.47	
11/28	8:30	2858	47.63	1451	51193	4147000	15.884	54.48	2.5	0.46	
11/28	9:30	2914	48.57	1450	51274	4228000	15.624	54.22	2.5	0.45	
11/28	10:30	2981	49.68	1448	51371	4325000	15.573	54.17	2.6	0.46	
11/28	11:30	3034	50.57	1449	51447	4401000	15.694	54.29	2.6	0.45	
11/28	12:30	3096	51.60	1450	51537	4491000	15.891	54.49	2.6	0.44	
11/28	13:30	3155	52.58	1451	51623	4577000	15.84	54.44	2.6	0.44	
11/28	14:36	3219	53.65	1449	51717	4671000	16.245	54.85	2.7	0.44	
11/28	15:30	3274	54.57	1447	51796	4750000	16.159	54.76	2.7	0.44	
11/28	16:30	3335	55.58	1448	51884	4838000	15.575	54.18	2.7	0.43	Increase Rate
11/28	17:30	3396	56.60	1455	51975	4929000	16.344	54.94	2.8	0.44	
11/28	18:30	3454	57.57	1455	52058	5012000	16.561	55.16	2.9	0.44	
11/28	19:30	3514	58.57	1456	52144	5098000	16.802	55.4	3	0.45	
11/28	20:30	3574	59.57	1454	52232	5186000	16.952	55.55	3	0.44	
11/28	21:30	3634	60.57	1453	52319	5273000	16.848	55.45	3	0.44	
11/28	22:30	3694	61.57	1451	52406	5360000	16.757	55.36	3.1	0.44	
11/28	23:30	3754	62.57	1450	52494	5448000	16.996	55.6	3.1	0.44	
11/29	0:30	3814	63.57	1450	52580	5534000	16.055	54.66	3.1	0.43	
11/29	1:30	3874	64.57	1451	52672	5626000	16.877	55.48	3.1	0.42	
11/29	2:30	3934	65.57	1447	52154	5108000	17.149	55.75	3.1	0.42	Increase Rate
11/29	3:30	3994	66.57	1448	52842	5796000	17.994	56.59	3.3	0.44	Increase Rate
11/29	4:30	4054	67.57	1449	52928	5882000	17.229	55.83	3.7	0.48	
11/29	5:30	4114	68.57	1450	53015	5969000	17.132	55.73	3.9	0.50	
11/29	6:30	4174	69.57	1450	53101	6055000	17.481	56.08	4	0.51	
11/29	7:06	4210	70.17	1447	53154	6108000	17.27	55.87	4	0.50	
11/29	7:30	4298	71.63	1448			17.447	56.05	4	0.49	
11/29	8:30	4354	72.57	1452	53275		17.406	56.01	4.1	0.50	

MALCOLM PIRNIE | ARCADIS
The Water Division of ARCADIS

SGF-2 PUMP TEST

72-Hour Constant Rate

Sawgrass Floridan Test Well Construction

City of Sunrise, Florida

Date	Time	Elapse Time	Elapse Time	Pump Rate	Totalizer X1000	Volume Pumped	Depth to Water	Draw-down	Sand in Rossum	Sand Content	Comments
		min	hr	gpm	gallons	gallons	ft bgl		mL	ppm	
3/25	11:52	0	0		65440	0	-40.10	0.00			Step trans, start pump
3/25		4	0.1	1470							
3/25		7	0.1								Begin sand testing
3/25		9	0.2				-3.46	36.64			
3/25	12:03	10	0.2	1447	65454	0.01	-2.69	37.41			
3/25	12:09	17	0.3	1435	65463	0.02	-0.70	39.40	<0.01		
3/25	12:14	22	0.4	1448	65471	0.03	-0.15	39.95	0.01	0.35	
3/25	12:22	30	0.5	1439	65482	0.04					
3/25		32	0.5	1452							Increase flow
3/25	12:30	38	0.6	1447	65491	0.05	1.81	41.91	0.02	0.34	
3/25		40	1						0.02	0.32	
3/25	12:35	43	1	1444	65501	0.06	1.68	41.78			
3/25	12:43	0	0								SDI(5) 2.1 &2.0
3/25	12:53	60	1	1434	65526	0.09	2.80	42.90	0.02	0.20	
3/25		63	1	1448							Increase flow
3/25	13:00	68	1	1444	65539	0.10	3.61	43.71	0.05	0.43	
3/25	0.558	92	2	1436	65572	0.13	4.45	44.55	0.03	0.19	
3/25	13:30	98	2	1463	65581	0.14	5.48	45.58	0.05	0.29	
3/25	13:55	123	2	1457	65617	0.18	6.14	46.24	0.05	0.23	
3/25	14:00	128	2	1455	65628	0.19	6.26	46.36	0.05	0.22	
3/25	14:29	157	3	1449	65666	0.23	6.97	47.07	0.07	0.25	
3/25	14:30	158	3	1451	65668	0.23	6.97	47.07	0.08	0.28	
3/25	15:00	188	3	1445	65712	0.27	7.45	47.55	0.08	0.23	
3/25	15:30	218	4	1438	65759	0.32	7.88	47.98	0.08	0.20	
3/25	16:00	248	4	1460	68814	3.37	8.77	48.87	0.08	0.18	
3/25	16:30	278	5	1454	65843	0.40	9.16	49.26	0.08	0.16	
3/25	17:00	308	5	1449	65886	0.45	9.51	49.61	0.1	0.18	
3/25	17:30	338	6	1445	65930	0.49	9.65	49.75	0.1	0.16	
3/25	18:00	368	6	1446	65930	0.49	9.94	50.04	0.1	0.15	
3/25	18:30	398	7	1452	66021	0.58	10.64	50.74	0.2	0.27	
3/25	19:00	428	7	1449	66059	0.62	10.61	50.71	0.2	0.25	
3/25	19:30	458	8	1447	66106	0.67	12.00	52.10	0.2	0.23	
3/25	20:00	488	8	1444	66146	0.71	11.07	51.17	0.2	0.22	
3/25	20:30	518	9	1444	66190	0.75	11.42	51.52	0.2	0.21	
3/25	21:00	548	9	1443	66233	0.79	11.48	51.58	0.2	0.20	
3/25	21:30	578	10	1446	66276	0.84	11.78	51.88	0.2	0.19	
3/25	22:00	608	10	1445	66320	0.88	12.10	52.20	0.2	0.18	
3/25	22:30	638	11	1444	66364	0.92	12.34	52.44	0.2	0.17	
3/25	23:00	668	11	1441	66401	0.96	12.20	52.30	0.2	0.16	
3/25	23:30	698	12	1451	66449	1.01	12.88	52.98	0.2	0.15	
3/26	0:00	728	12	1452	66493	1.05			0.2	0.15	
3/26	0:30	758	13	1446	66537	1.10	12.99	53.09	0.2	0.14	
3/26	1:00	788	13	1446	66580	1.14	13.03	53.13	0.3	0.20	
3/26	1:30	818	14	1446	66624	1.18	13.33	53.43	0.3	0.20	
3/26	2:00	848	14	1447	66668	1.23	13.57	53.67	0.3	0.19	
3/26	2:30	878	15	1443	66711	1.27	13.44	53.54	0.3	0.18	
3/26	3:00	908	15	1442	66754	1.31	13.76	53.86	0.3	0.18	
3/26	3:30	938	16	1441	66797	1.36	13.95	54.05	0.3	0.17	
3/26	4:00	968	16	1445	66840	1.40	13.84	53.94	0.3	0.16	
3/26	4:30	998	17	1450	66884	1.44	14.01	54.11	0.3	0.16	
3/26	5:00	1028	17	1443	66927	1.49	14.03	54.13	0.3	0.16	
3/26	5:30	1058	18	1453	66969	1.53	14.73	54.83	0.3	0.15	

MALCOLM PIRNIE | ARCADIS
The Water Division of ARCADIS

SGF-2 PUMP TEST

72-Hour Constant Rate

Sawgrass Floridan Test Well Construction

City of Sunrise, Florida

Date	Time	Elapse Time	Elapse Time	Pump Rate	Totalizer X1000	Volume Pumped	Depth to Water	Draw-down	Sand in Rossum	Sand Content	Comments
		min	hr	gpm	gallons	gallons	ft bgl		mL	ppm	
3/26	6:00	1088	18	1451	67016	1.58	14.70	54.80	0.4	0.20	
3/26	6:30	1118	19	1450	67058	1.62	14.63	54.73	0.4	0.19	
3/26	7:00	1148	19	1452	67101	1.66	14.81	54.91	0.4	0.19	
3/26	7:30	1178	20	1448	67148	1.71	14.86	54.96	0.4	0.18	
3/26	8:00	1208	20	1447	67189	1.75	15.01	55.11	0.4	0.18	
3/26	8:30	1238	21	1444	67232	1.79	15.08	55.18	0.4	0.17	
3/26	9:00	1268	21	1448	67274	1.83	15.05	55.15	0.4	0.17	
3/26	9:30	1298	22	1446	67318	1.88	15.24	55.34	0.5	0.20	
3/26	9:50	1318	22	1445	67346	1.91	15.18	55.28	0.4	0.16	
3/26	10:00	1328	22	1441	67358	1.92	15.01	55.11	0.5	0.20	
3/26	10:23	1350	23	1445	67393	1.95	15.30	55.40	0.43	0.17	
3/26	10:30	1358	23	1443	67403	1.96	15.46	55.56	0.5	0.20	
3/26	11:00	1388	23	1441	67448	2.01	15.38	55.48	0.5	0.19	
3/26	11:30	1418	24	1442	67489	2.05	15.49	55.59	0.5	0.19	
3/26	12:00	1448	24	1438	67540	2.10	15.38	55.48	0.5	0.18	
3/26	12:30	1478	25	1441	67578	2.14	15.76	55.86	0.5	0.18	
3/26	13:00	1508	25	1440	67620	2.18	15.66	55.76	0.5	0.18	
3/26	13:30	1538	26	1441	67672	2.23	15.70	55.80	0.5	0.17	
3/26	14:00	1568	26	1440	67706	2.27	15.78	55.88	0.5	0.17	
3/26	14:30	1598	27	1440	67749	2.31	15.63	55.73	0.5	0.17	
3/26	15:00	1628	27	1435	67796	2.36	15.91	56.01	0.5	0.16	
3/26	15:30	1658	28	1454	67838	2.40	16.44	56.54	0.5	0.16	
3/26	16:00	1688	28	1455	67887	2.45	16.45	56.55	0.6	0.19	
3/26	16:30	1718	29	1455	67925	2.49	16.63	56.73	0.6	0.19	
3/26		1731	29	1456	67942	2.50	16.44	56.54	0.6	0.18	
3/26	17:00	1748	29	1451	67970	2.53	16.68	56.78	0.6	0.18	
3/26	17:30	1778	30	1450	68008	2.57	16.69	56.79	0.6	0.18	
3/26	18:00	1808	30	1451	68053	2.61	16.75	56.85	0.6	0.18	
3/26	18:30	1838	31	1449	68101	2.66	16.75	56.85	0.6	0.17	
3/26	19:00	1868	31	1447	68141	2.70	16.94	57.04	0.6	0.17	
3/26	19:30	1898	32	1447	68184	2.74	16.78	56.88	0.6	0.17	
3/26	20:00	1928	32	1448	68227	2.79	17.00	57.10	0.6	0.17	
3/26	20:30	1958	33	1446	68271	2.83	16.87	56.97	0.6	0.16	
3/26	21:00	1988	33	1448	68314	2.87	15.04	55.14	0.6	0.16	
3/26	21:30	2018	34	1445	68358	2.92	17.04	57.14	0.6	0.16	
3/26	22:00	2048	34	1443	68402	2.96	17.23	57.33	0.6	0.16	
3/26	22:30	2078	35	1445	68445	3.01	17.39	57.49	0.7	0.18	
3/26	23:00	2108	35	1444	68488	3.05	17.16	57.26	0.7	0.18	
3/26	23:30	2138	36	1446	68531	3.09	17.30	57.40	0.7	0.17	
3/27	0:00	2168	36	1444	68575	3.14	17.61	57.71	0.7	0.17	
3/27	0:30	2198	37	1445	68619	3.18	17.46	57.56	0.7	0.17	
3/27	1:00	2228	37	1445	68661	3.22	17.27	57.37	0.7	0.17	
3/27	1:30	2258	38	1446	68705	3.27	17.61	57.71	0.7	0.16	
3/27	2:00	2288	38	1444	68747	3.31	17.30	57.40	0.7	0.16	
3/27	2:30	2318	39	1443	68791	3.35	17.49	57.59	0.7	0.16	
3/27	3:00	2348	39	1446	68836	3.40	17.50	57.60	0.7	0.16	
3/27	3:30	2378	40	1443	68877	3.44	17.56	57.66	0.7	0.16	
3/27	4:00	2408	40	1443	68920	3.48	17.53	57.63	0.7	0.15	
3/27	4:30	2438	41	1442	68963	3.52	17.56	57.66	0.7	0.15	
3/27	5:00	2468	41	1443	69007	3.57	17.89	57.99	0.8	0.17	
3/27	5:30	2498	42	1442	69049	3.61	17.51	57.61	0.8	0.17	
3/27	6:00	2528	42	1439	69094	3.65	17.68	57.78	0.8	0.17	

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SGF-2 PUMP TEST

72-Hour Constant Rate

Sawgrass Floridan Test Well Construction

City of Sunrise, Florida

Date	Time	Elapse Time	Elapse Time	Pump Rate	Totalizer X1000	Volume Pumped	Depth to Water	Draw-down	Sand in Rossum	Sand Content	Comments
		min	hr	gpm	gallons	gallons	ft bgl		mL	ppm	
3/27	6:30	2558	43	1443	69137	3.70	17.82	57.92	0.8	0.17	
3/27	7:00	2588	43	1441	69180	3.74	17.76	57.86	0.8	0.16	
3/27	7:30	2618	44	1440	69232	3.79	17.64	57.74	0.8	0.16	
3/27	8:00	2648	44	1441	69269	3.83	17.68	57.78	0.8	0.16	
3/27	8:30	2678	45	1440	69311	3.87	18.12	58.22	0.8	0.16	
3/27	9:00	2708	45	1440	69354	3.91	18.11	58.21	0.8	0.16	
3/27	9:30	2738	46	1436	69402	3.96	18.34	58.44	0.8	0.15	
3/27	10:00	2768	46	1445	69441	4.00	18.28	58.38	0.8	0.15	
3/27	10:17	2784	46	1446	69464	4.02	18.46	58.56	0.8	0.15	
3/27	10:30	2798	47	1446	69484	4.04	18.24	58.34	0.8	0.15	
3/27	11:00	2828	47	1445	69527	4.09	18.40	58.50	0.8	0.15	
3/27	11:29	2857	48	1444	69568	4.13	18.65	58.75	0.85	0.16	
3/27	11:30	2858	48	1443	69571	4.13	18.36	58.46	0.8	0.15	
3/27	12:00	2888	48	1444	69613	4.17	18.32	58.42	0.8	0.15	
3/27	12:30	2918	49	1442	69655	4.22	18.31	58.41	0.8	0.15	
3/27	13:00	2948	49	1443	69691	4.25	18.20	58.30	0.8	0.14	
3/27	13:14	2962	49	1442	69719	4.28	18.41	58.51	0.9	0.16	
3/27	13:30	2978	50	1440	69740	4.30	18.19	58.29	0.8	0.14	
3/27	14:00	3008	50	1441	69783	4.34	18.41	58.51	0.8	0.14	
3/27	14:30	3038	51	1440	69825	4.39	18.59	58.69	0.8	0.14	
3/27	15:00	3068	51	1440	69871	4.43	18.67	58.77	0.8	0.14	
3/27	15:21	3089	51	1442	69902	4.46	18.42	58.52	0.9	0.15	
3/27	15:30	3098	52	1440	69917	4.48	18.62	58.72	0.8	0.14	
3/27	16:00	3128	52	1441	69955	4.52	18.49	58.59	0.8	0.14	
3/27	16:30	3158	53	1443	70006	4.57	18.57	58.67	0.9	0.15	
3/27		3166	53	1467	70014	4.57	19.17	59.27		0.00	Increase flow
3/27	17:00	3188	53	1465	70039	4.60	19.33	59.43	0.9	0.15	
3/27	17:30	3218	54	1464	70088	4.65	19.24	59.34	0.9	0.15	
3/27	18:00	3248	54	1462	70128	4.69	19.51	59.61	1	0.16	
3/27	18:30	3278	55	1465	70178	4.74	19.60	59.70	1	0.16	
3/27	19:00	3308	55	1463	70221	4.78	19.63	59.73	1	0.16	
3/27	19:30	3338	56	1463	70265	4.83	19.63	59.73	1	0.16	
3/27	20:00	3368	56	1460	70309	4.87	19.41	59.51	1	0.16	
3/27	20:30	3398	57	1460	70353	4.91	19.59	59.69	1	0.16	
3/27	21:00	3428	57	1464	70396	4.96	19.61	59.71	1	0.15	
3/27	21:30	3458	58	1460	70440	5.00	19.47	59.57	1	0.15	
3/27	22:00	3488	58	1460	70484	5.04	19.73	59.83	1	0.15	
3/27	22:30	3518	59	1458	70528	5.09	19.82	59.92	1	0.15	
3/27	23:00	3548	59	1460	70571	5.13	19.89	59.99	1	0.15	
3/27	23:30	3578	60	1462	70615	5.18	19.93	60.03	1	0.15	
3/28	0:00	3608	60	1455	70660	5.22	19.82	59.92	1	0.15	
3/28	0:30	3638	61	1458	70703	5.26	19.92	60.02	1	0.15	
3/28	1:00	3668	61	1459	70747	5.31	19.94	60.04	1	0.14	
3/28	1:30	3698	62	1458	70791	5.35	19.83	59.93	1	0.14	
3/28	2:00	3728	62	1460	70834	5.39	19.73	59.83	1	0.14	
3/28	2:30	3758	63	1458	70878	5.44	19.78	59.88	1	0.14	
3/28	3:00	3788	63	1457	70922	5.48	19.76	59.86	1.1	0.15	
3/28	3:30	3818	64	1455	70963	5.52	20.10	60.20	1.1	0.15	
3/28	4:00	3848	64	1460	77009	11.57	20.28	60.38	1.1	0.15	
3/28	4:30	3878	65	1456	77053	11.61	20.86	60.96	1.1	0.15	
3/28	5:00	3908	65	1458	71097	5.66	20.25	60.35	1.1	0.15	
3/28	5:30	3938	66	1457	71140	5.70	20.03	60.13	1.1	0.15	

MALCOLM PIRNIE | ARCADIS
The Water Division of ARCADIS

SGF-2 PUMP TEST

72-Hour Constant Rate

Sawgrass Floridan Test Well Construction

City of Sunrise, Florida

Date	Time	Elapse Time	Elapse Time	Pump Rate	Totalizer X1000	Volume Pumped	Depth to Water	Draw-down	Sand in Rossum	Sand Content	Comments
		min	hr	gpm	gallons	gallons	ft bgl		mL	ppm	
3/28	6:00	3968	66	1456	71184	5.74	20.14	60.24	1.1	0.15	
3/28	6:30	3998	67	1457	71227	5.79	20.00	60.10	1.1	0.15	
3/28	7:00	4028	67	1455	71271	5.83	20.10	60.20	1.1	0.14	
3/28	7:30	4058	68	1445	71286	5.85	20.07	60.17	1.1	0.14	
3/28	8:00	4088	68	1455	71328	5.89	20.04	60.14	1.1	0.14	
3/28	8:30	4118	69	1457	71381	5.94	20.43	60.53	1.1	0.14	
3/28	9:00	4148	69	1456	71416	5.98	20.11	60.21	1.1	0.14	
3/28	9:29	4177	70	1461	71457	6.02	20.25	60.35	1.1	0.14	
3/28	9:30	4178	70	1460	71458	6.02	20.31	60.41	1.1	0.14	
3/28	10:00	4208	70	1460	71503	6.06	20.26	60.36	1.1	0.14	Collect lab sample
3/28	10:30	4238	71	1455	71546	6.11	20.12	60.22	1.1	0.14	
3/28	11:00	4268	71	1459	71591	6.15	20.35	60.45	1.1	0.14	
3/28	11:15	4282	71	1457	71611	6.17	20.38	60.48	1.2	0.15	
3/28	11:30	4268	71	1456	71636	6.20	20.35	60.45	1.1	0.14	
3/28	11:53	4320	72		71666	6.23			1.2	0.15	Turn off pump

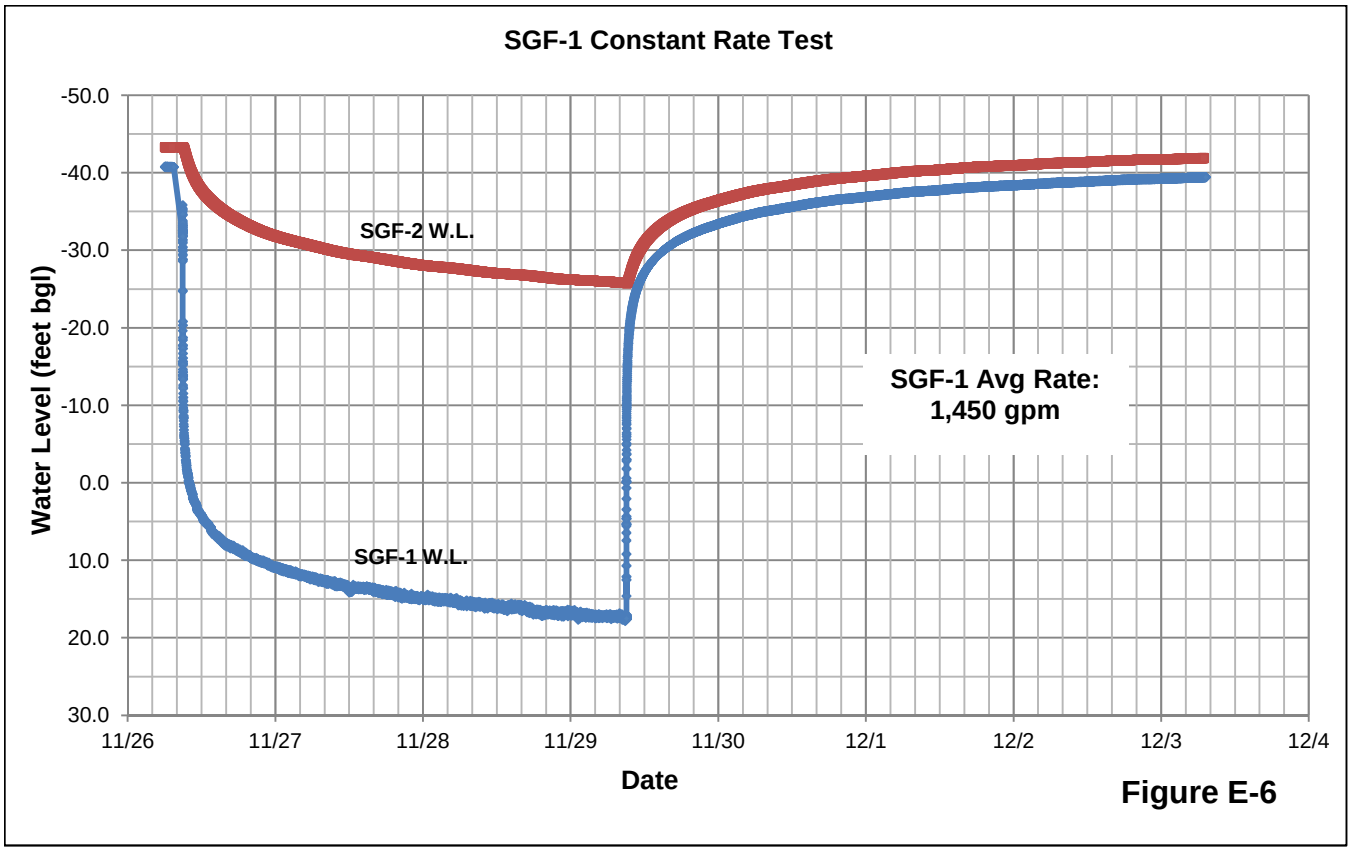

Figure E-6

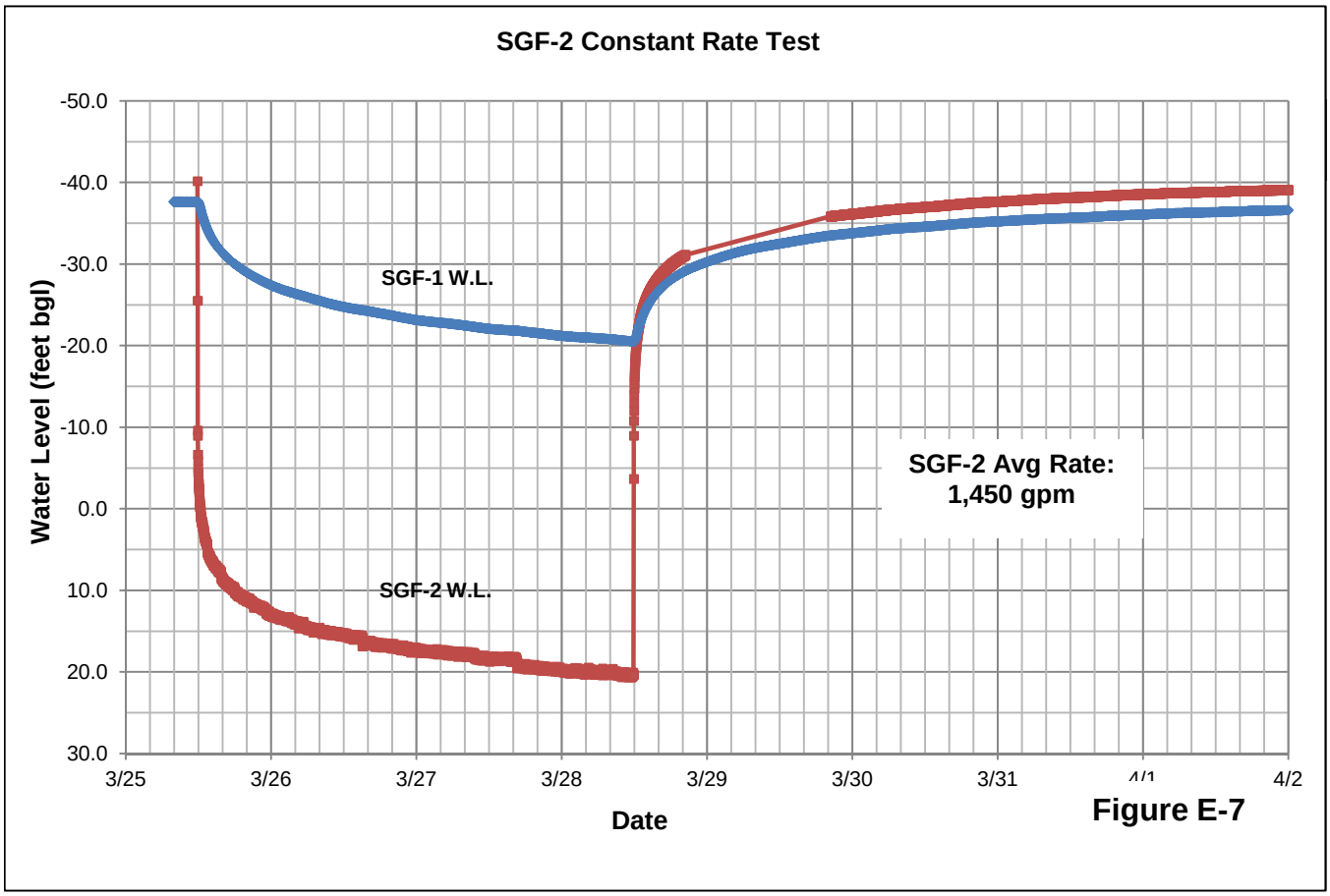

Figure E-7

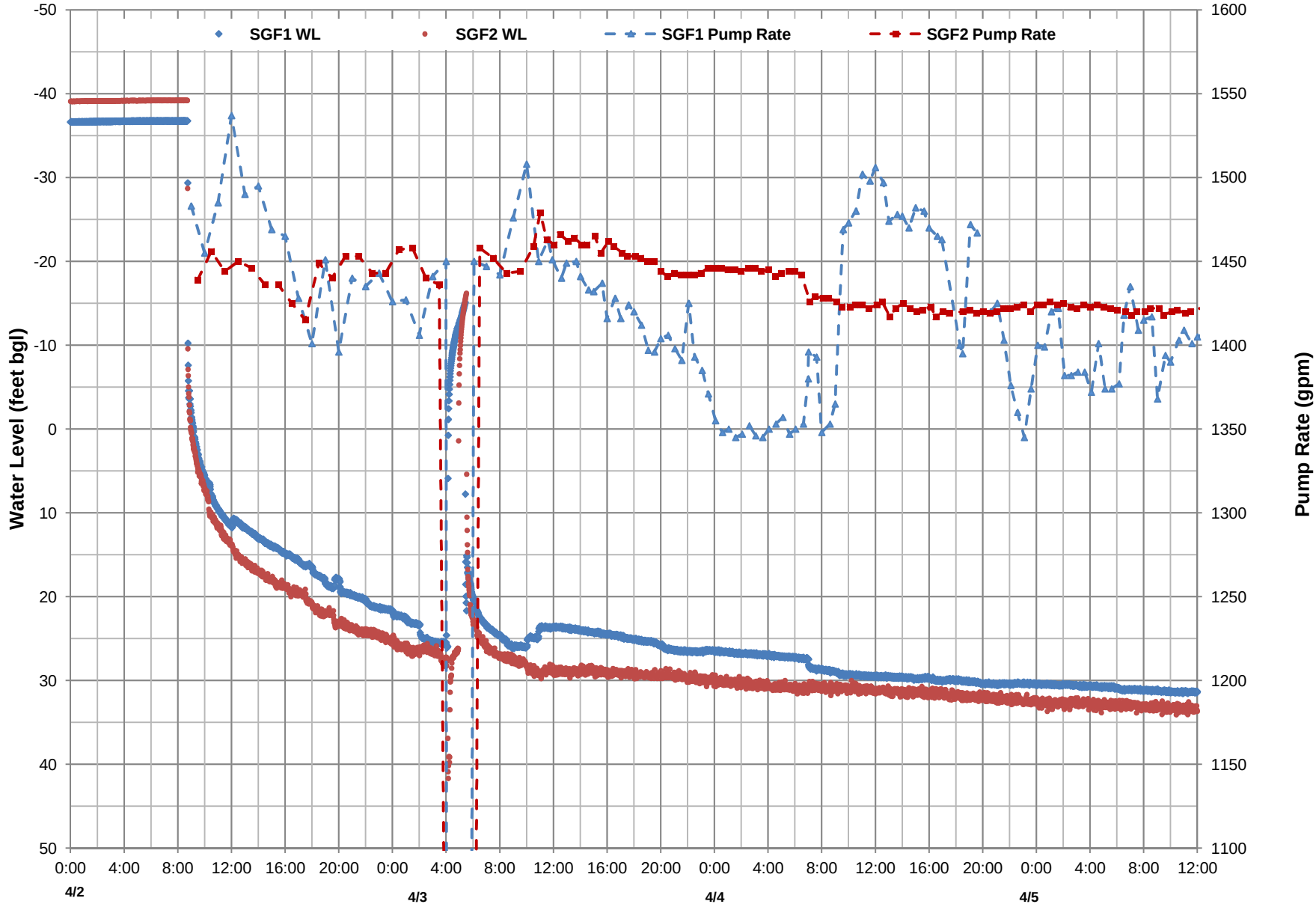

Figure E-8

G:\AProjects\WR\WF PROJECTS\Sunrise\FL Test Well CA\Floridan Test Wells\FIELD DATA\Pump Testing\SGF1 & 2 Constant Rate\Data.xlsx\Chart2

Appendix F

Electronic Files of Data Collected During Construction and Testing