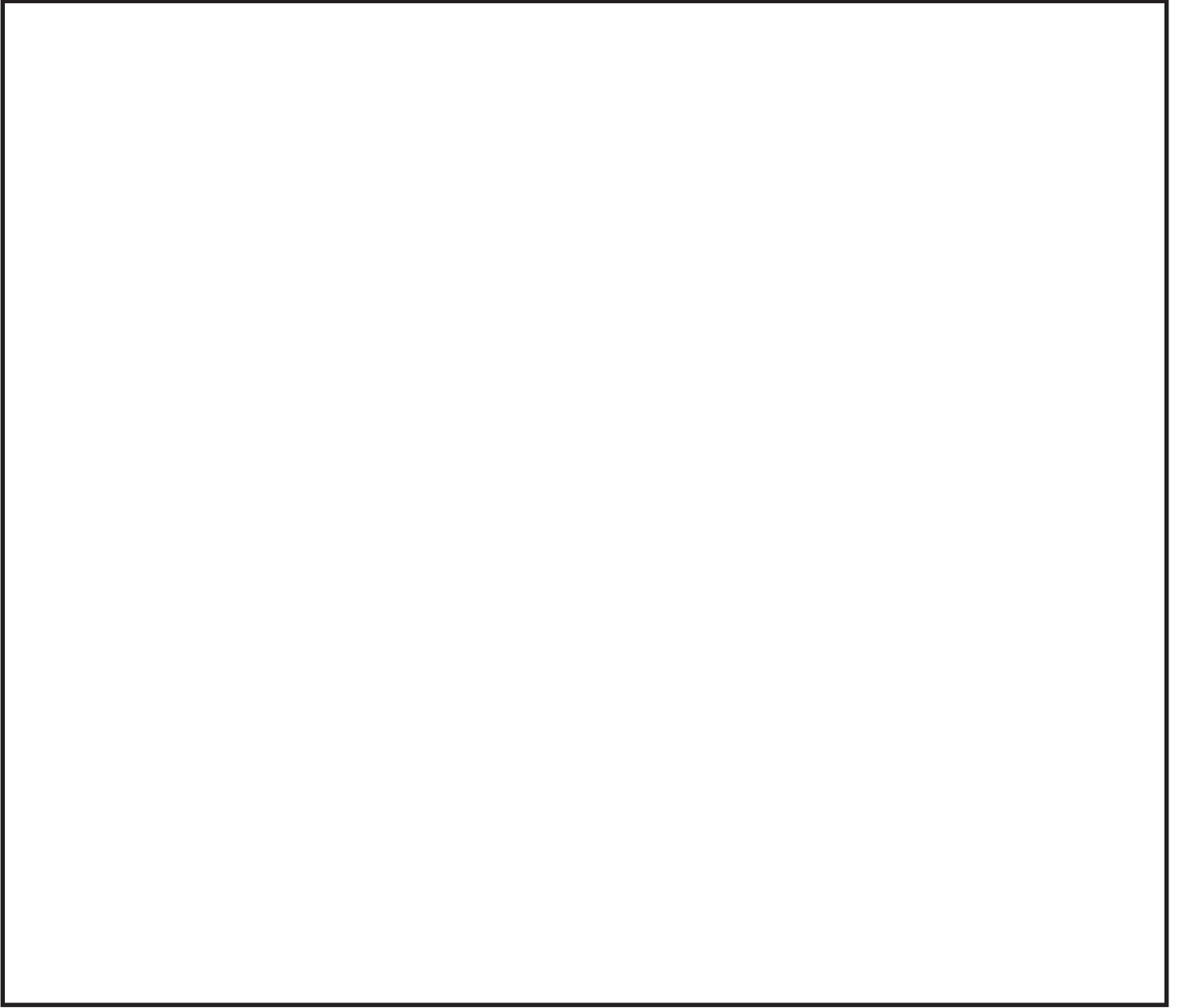


Well Construction at the Lake Marion Well Site in Levy County, Florida





Cover Photo: Upper Floridan and surficial monitor wells at the Lake Marion well site in Levy County, Florida. Photograph by Anna Janosik.

Well Construction at the Lake Marion Well Site in Levy County, Florida

By Anna L. Janosik

January 2012

Southwest Florida Water Management District

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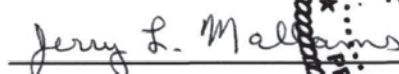
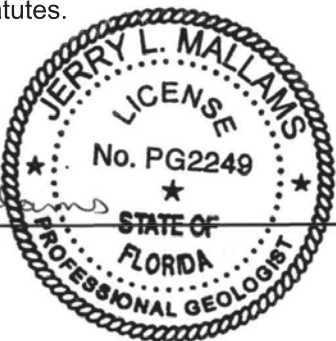
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The hydrogeologic evaluations and interpretations contained in *Well Construction at the Lake Marion Well Site in Levy County, Florida* have been prepared by or approved by a licensed Professional Geologist in the State of Florida, in accordance with Chapter 492, Florida Statutes.

Jerry Mallams
Professional Geologist
State of Florida License No. PG2249

Date: 11/8/11

Preface

The Southwest Florida Water Management District's (District) Geohydrologic Data Section provides technical support services for District groundwater resources projects. These services include exploratory drilling, monitor well installation, aquifer testing, and groundwater quality sampling, to evaluate hydrogeologic systems.

The Northern District Water Resources Assessment Project (NDWRAP) was initiated to assess the impacts of groundwater withdrawals, monitor the fresh-water/saltwater interface, identify areas of poor groundwater quality, determine the nature of flow to major springs, and monitor groundwater levels in both the surficial and Upper Floridan aquifers in the northern six-county region of the District. The Northern District encompasses all of Hernando, Citrus, and Sumter Counties and portions of Pasco, Marion, and Levy Counties.

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Abbreviations and Acronyms

bls	below land surface
CME	Central Mining Equipment
CU	confining unit
District	Southwest Florida Water Management District
ft	feet
Hawth	Hawthorn
Huss	Huss Drilling
ID	identifier
LS	land surface
NGVD29	National Geodetic Vertical Datum of 1929
NDWRAP	Northern District Water Resources Assessment Project
PVC	polyvinyl chloride
Sch 40	Schedule 40
UDSC	undifferentiated sand and clay
WL	water level

Conversion Factors and Datums

Multiply	By	To obtain
Length		
inch (in.)	2.54	centimeter (cm)
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
Mass		
pound, avoirdupois (lb)	0.4536	kilogram (kg)

Well Construction at the Lake Marion Well Site in Levy County, Florida

By Anna L. Janosik

Introduction

As part of the Northern District Water Resources Assessment Project (NDWRAP), several well sites were planned to investigate lake and groundwater interactions. Each site will provide lithologic descriptions from land surface to the top of limestone, and will provide two long-term monitor wells; one to monitor the surficial aquifer and the other to monitor the Upper Floridan aquifer. Groundwater level data collected from these wells will help to assess the hydraulic connection between the lakes and the surficial and Upper Floridan aquifers in the northern part of the Southwest Florida Water Management District (District). Where applicable, data collected from the wells will be used to assess compliance with minimum lake levels established in accordance with Section 373.042, Florida Statutes.

The lakes targeted for study were Lake Tsala-Apopka, Lake Deaton, Lake Miona, Fort Cooper Lake, and Lake Marion (figure 1). The Lake Tsala-Apopka monitor well site was completed in September 2006 (Dawson, 2007), and the Lake Deaton, Lake Miona, and Fort Cooper Lake well sites were completed in October 2009 (Janosik, 2010a, 2010b, and 2010c). This report details the well construction and hydrogeology at the Lake Marion site.

Site Location

The Lake Marion well site is located in eastern Levy County less than a mile east of the District boundary line (figure 2). It is situated in the southeastern quarter, of the southeastern quarter, of Section 02, Township 14 South, Range 17 East. The site is on private property owned by Ronald and Linda Gillman. The site coordinates are latitude 29° 17' 31.2" North and longitude 82° 34' 32.9" West. The land surface elevation is 53.44 feet above the National Geodetic Vertical Datum of 1929 (NGVD29).

The site can be found by traveling 7.8 miles west on County Road 326 from US highway 41 in Morriston, Florida. The well site is located 550 feet north of the county road. It consists of a fenced, 10-foot by 10-foot, perpetual easement (District parcel number 19-020-093), and a 10-foot wide access easement that extends from the perpetual easement to County Road 326. Iron rods have been installed to mark the corners of the easement.

The well site is located on the western edge of the northern portion of the Brooksville Ridge; a division of the Central Highlands region of the midpeninsular zone of Florida (White, 1970). The Brooksville Ridge has highly variable elevation and little surface drainage. In the location of the Lake Marion well site, the ridge is bordered by the Northern Gulf Coastal Lowlands to the west, and the Western Valley to the east.

Methods

Huss Drilling (Huss) collected lithologic samples using a Central Mining Equipment (CME) 75 drill rig equipped for split-spoon sampling. The split-spoon sampler was advanced using a 140-pound hammer through 4 ¼-inch hollow-stem augers, which held the borehole open. Continuous lithologic samples were collected in 2-foot intervals from land surface to refusal. The samples were boxed, labeled, and described. The groundwater level in each well was measured after well development using a Solinst electric water level meter.

Well Construction

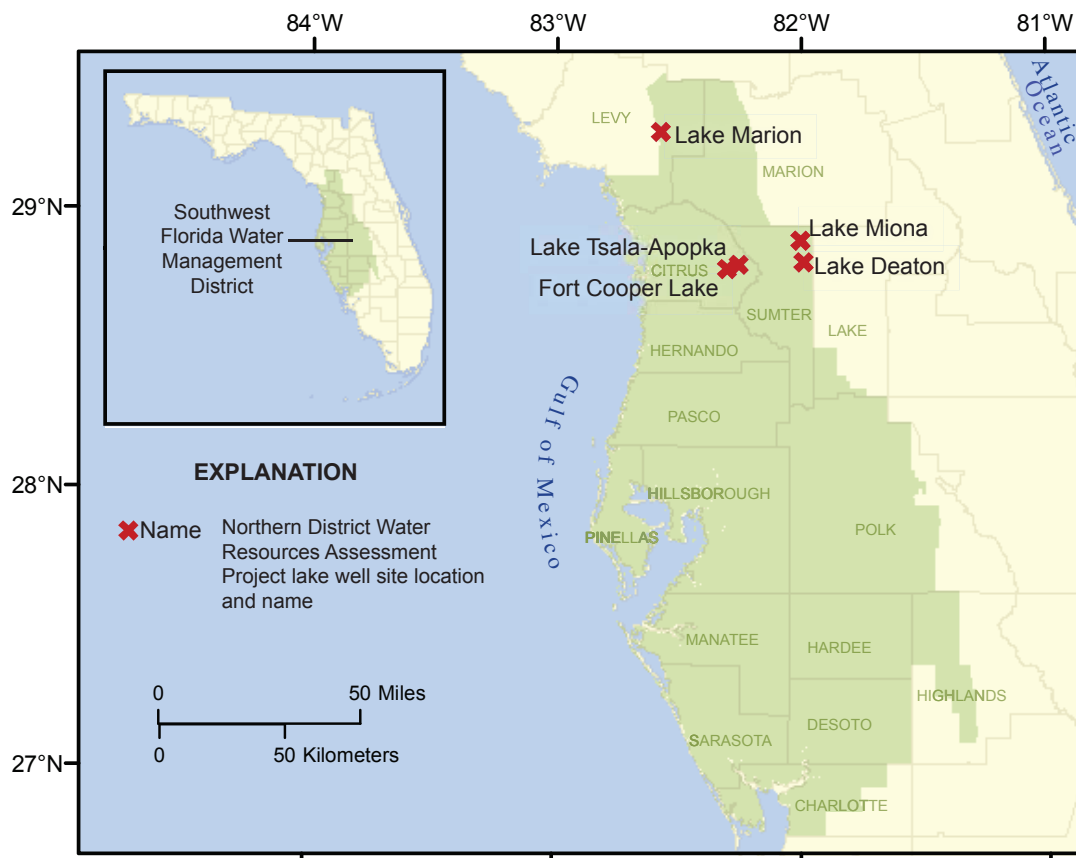
The Lake Marion well site contains a surficial aquifer well (District site ID 780480) and an Upper Floridan aquifer well (District site ID 780479). Huss constructed the two wells between July 6, 2011 and July 7, 2011. The completed wells were turned over to the District's Hydrologic Data Section for long-term monitoring of groundwater levels.

Prior to well construction, split-spoon samples were continuously collected from land surface to 44.5 feet below land surface to characterize the hydrogeology of the site and to aid in the design of the wells. When the formation became too hard to collect split-spoon samples, the augers were advanced to 80 feet below land surface while the penetration rate was observed. Advancement of the augers was halted four times to attempt split-spoon sample collection. The exploratory hole was converted into the Upper Floridan aquifer well after exploration was complete.

Surficial Aquifer Well

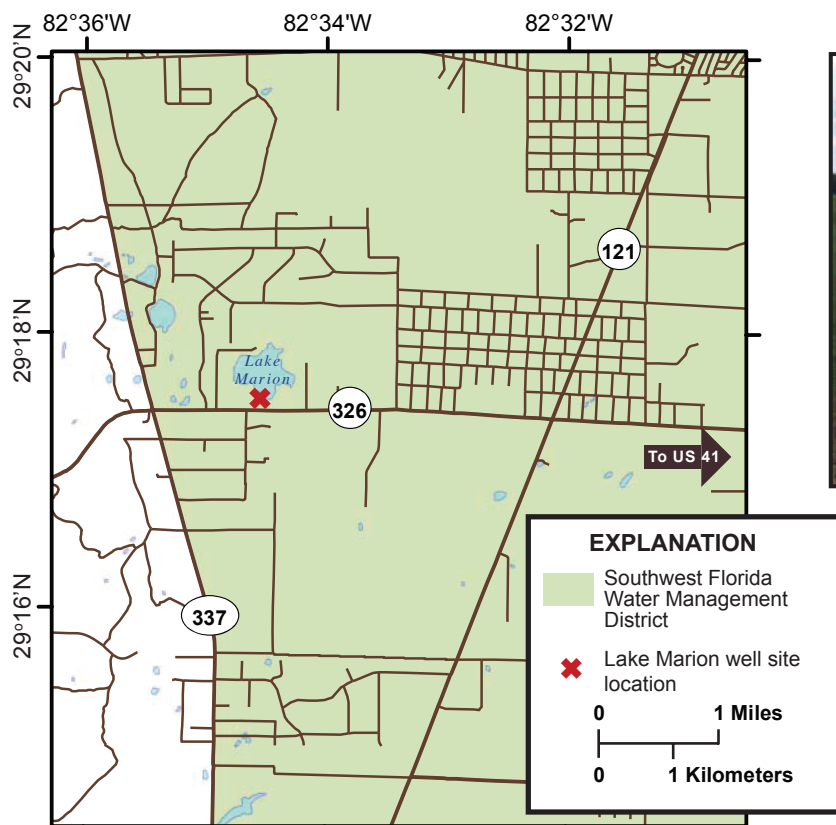
The surficial aquifer well was installed on July 7, 2011, using well construction permit number 813897. The final well

2 Well Construction at the Lake Marion Well Site in Levy County, Florida



Base from Southwest Florida Water Management District digital data, 2009

Figure 1. Northern District Water Resources Assessment Project well sites targeted for the study of lake and groundwater interaction.



Base from Southwest Florida Water Management District digital data, 1:100,000, 2009

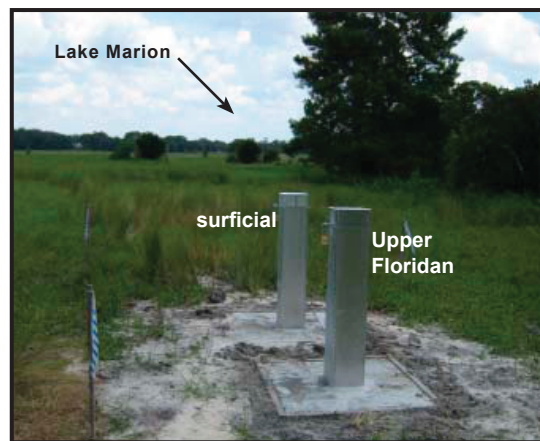


Figure 2. Location of the Upper Floridan and surficial aquifer wells at the Lake Marion well site in Levy County, Florida.

specifications can be found in figure 3. The well is contained within the undifferentiated sand and clay sediments and will be used to monitor the groundwater level in the surficial aquifer.

Huss used hollow-stem augers to drill a nominal 13-inch hole from land surface to 30 feet below land surface. The hole extended one foot beyond the design depth of the well to allow room for the PVC cap and for fall-in. Next, 6-inch, schedule 40, threaded, PVC screen (0.010-inch slot), with a 6-inch cap on the bottom, was installed between 4 and 29 feet below land surface. Then, 6-inch, schedule 40, threaded, PVC casing was installed from 3 feet above land surface to 4 feet below land surface. A 20-30 silica sand filter pack was installed from 4 to 29 feet below land surface, a 40-60 fine silica sand seal was installed from 3 to 4 feet below land surface, and cement grout was installed from land surface to 3 feet below land surface. The well was developed with the rig pump, but ran dry during development. It was allowed to recover and was pumped dry once more. The total depth of the well was measured and found to be 29 feet below land surface, meaning it was free of debris. A lockable, metal well cover and concrete pad was installed around the finished well.

Upper Floridan Aquifer Well

The Upper Floridan aquifer well was installed between July 6, 2011 and July 7, 2011, using well construction permit number 813898. The final well specifications can be found in figure 4. The well is open to the Ocala Limestone and will be used to measure groundwater levels in the Upper Floridan aquifer. The upper portion of the Ocala Limestone is extremely weathered in the location of the well site, which required installation of the well casing at a depth that would ensure stability of the open hole interval.

On July 6, 2011, Huss widened the exploratory hole to 13 inches in diameter, from land surface to 82 feet below land

surface. Next, 6-inch, schedule 40, threaded, PVC casing was installed and grouted between land surface and 82 feet below land surface. The cement was left to harden overnight.

On July 7, 2011, the crew drilled a nominal 6-inch open hole using mud-rotary from 82 to 102 feet below land surface. The well was developed using the reverse-air pumping method, with the drilling rods at the bottom of the hole, for 1 hour and 40 minutes. After development, the total depth of the well was tagged with tremie pipe and found to be 105 feet below land surface. When the well was measured the following week, the total depth was found to be 99 feet below land surface, meaning some debris from the soft formation remains in the well. Lastly, the 6-inch PVC casing was extended to 3 feet above land surface, and a lockable, metal well cover and concrete pad was installed around the finished well.

Geology

The characterization presented below is based on the lithology encountered during split-spoon sampling. Descriptions of the samples can be found in table 1. The geologic units at the Lake Marion site include the Ocala Limestone, undifferentiated Hawthorn Group sediments, and undifferentiated sand and clay sediments (figure 5).

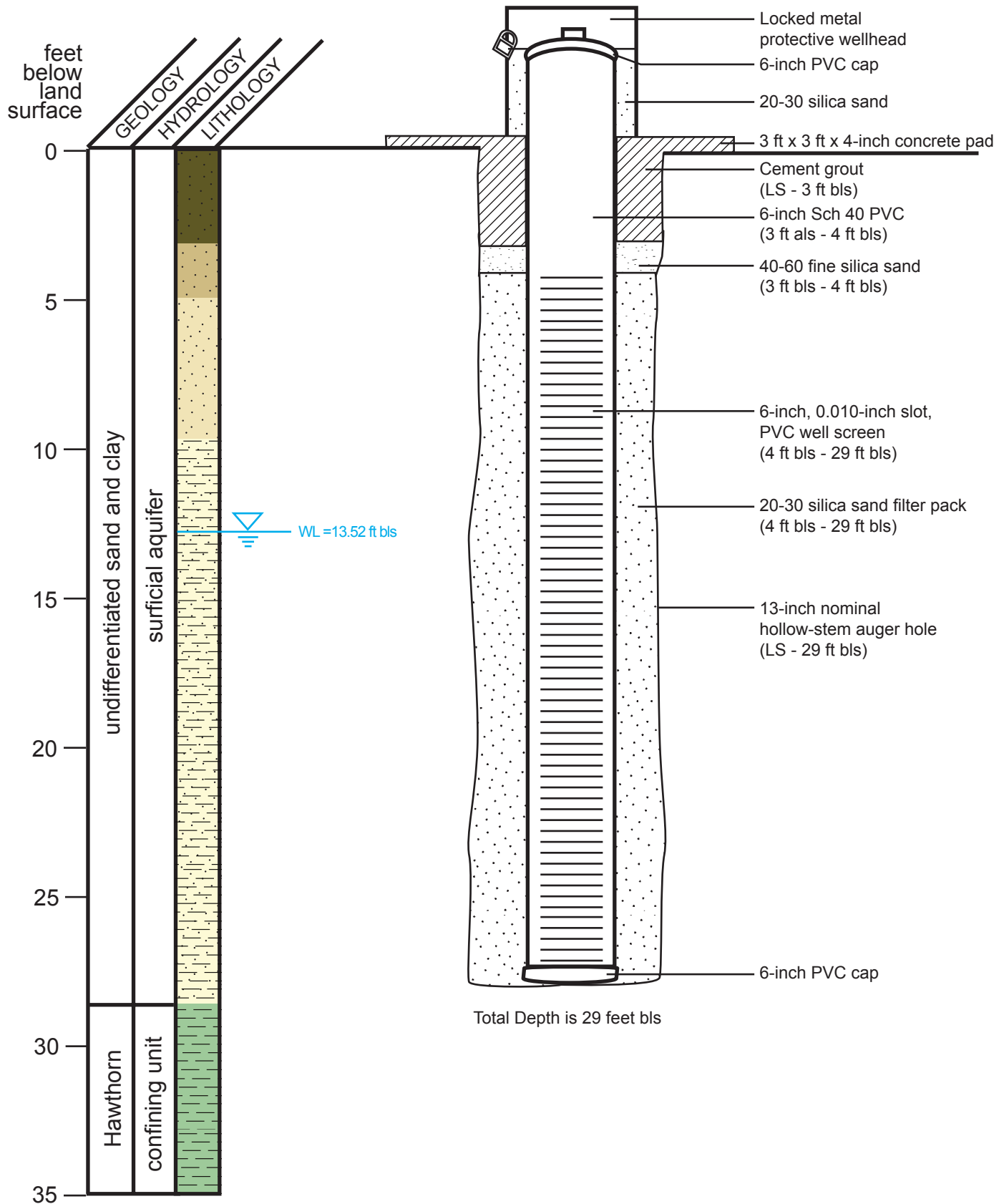
The portion of the Ocala Limestone encountered during well construction extends between 41 and 105 feet below land surface. The top of the formation is heavily iron stained and is the shallowest occurrence of limestone at the site. The base of the formation was not reached during drilling. Samples recovered from this formation were poor, but were generally white, extremely weathered, loosely consolidated, wackestone. During split-spoon sampling, the sampler fell between 41 and 42 feet below land surface and then advanced by just the weight of the rods between 42 and 44 feet below land surface, indicating a void or very soft sediments.

Table 1. Lithologic description of the split-spoon samples collected at the Lake Marion well site

[Depth is in feet below land surface]

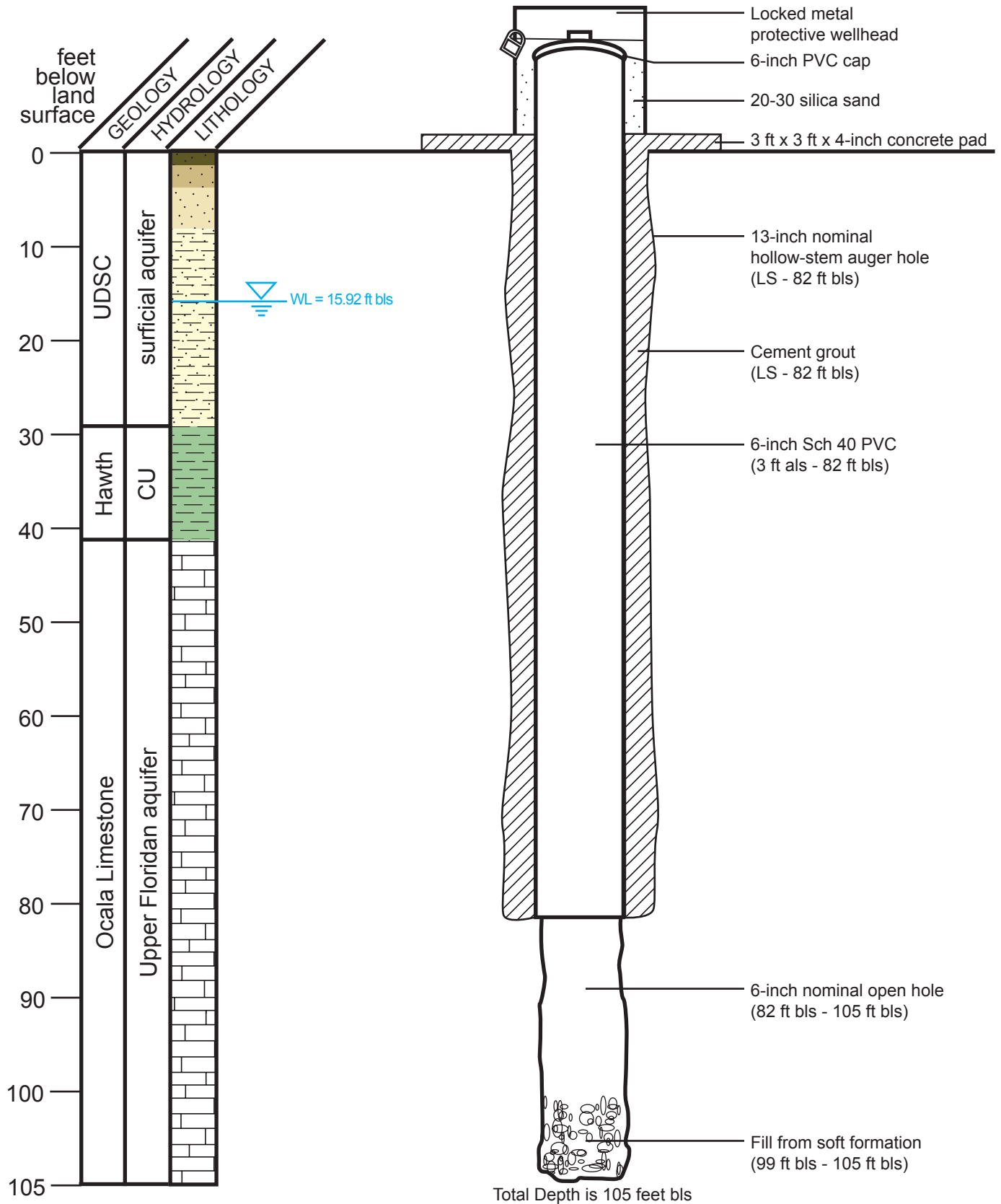
Depth	Description
0-3	Sand, quartz, slightly silty, fine to medium grained; Very dark gray to black; Few organics
3-5	Sand, quartz, fine-grained; Very loose; Grayish brown
5-9	Sand, quartz, fine- to medium-grained; Medium dense; Very pale brown to white
9-10	Clayey sand, quartz, fine-grained; Medium dense; Very pale brown with 10% yellowish brown mottles
10-16	Sandy clay, low to medium plasticity; Stiff; Pale yellow with 10% yellowish brown mottles
16-19	Clayey sand, quartz, fine- to medium-grained; Loose; Very pale brown to white with 10-15% yellowish brown mottles
19-23	Clayey sand; As above, with pebble sized concretions
23-26	Sandy clay, medium plasticity, soft to medium; Pale yellow with 15% yellowish brown mottles; Pebble sized concretions in parts
26-29	Sand, quartz, fine-grained; Very loose; White to pale yellow, mottled in parts; Concretions in parts
29-39	Sandy clay, medium to low plasticity; Very soft; Light greenish gray to white, becomes pale yellow (iron stains) with depth; White pebble-sized concretions in parts
39-41	Sandy clay to clay; As above, but heavily ironed stained (strong brown)
41-82	Highly weathered limestone; Iron stained; Limited samples collected

4 Well Construction at the Lake Marion Well Site in Levy County, Florida



WL, water level; ft, feet; bls, below land surface; als, above land surface; LS, land surface; Sch, Schedule; PVC, polyvinyl chloride; Hawth, undifferentiated Hawthorn Group sediments

Figure 3. As-built diagram of the surficial aquifer well (District site ID 780480) at the Lake Marion well site in Levy County, Florida.



UDSC, undifferentiated sand and clay; Hawth, undifferentiated Hawthorn Group; CU, confining unit; WL, water level; ft, feet; bls, below land surface; als, above land surface; LS, land surface; Sch, Schedule; PVC, polyvinyl chloride

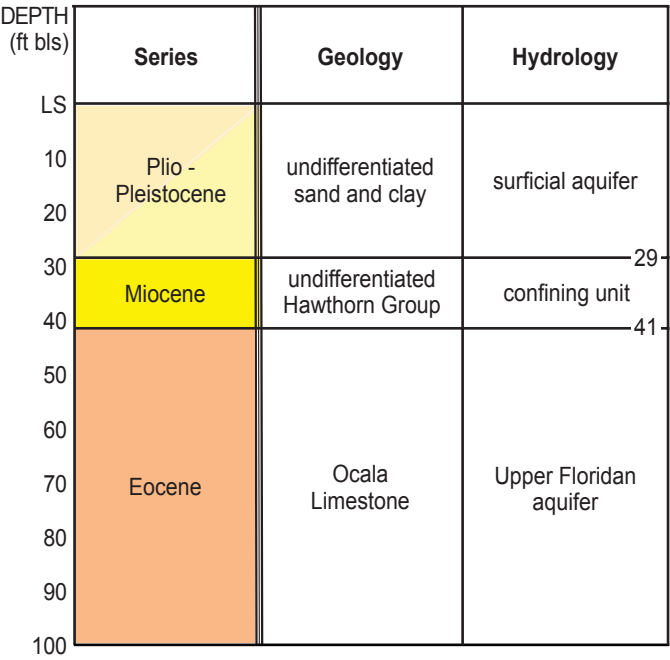
Figure 4. As-built diagram of the Upper Floridan aquifer well (District site ID 780479) at the Lake Marion well site in Levy County, Florida.

Undifferentiated Hawthorn Group sediments extend between 29 and 41 feet below land surface. The lithology is light greenish gray, sandy clay to clay with white sand concretions. The sediments become heavily iron stained and more clayey with depth. During sampling, the sampler advanced by just the weight of the rods between 34 and 36 feet below land surface.

The undifferentiated sand and clay deposits extend from land surface to 29 feet below land surface. The lithology from land surface to 3 feet below land surface is very dark gray to black, slightly silty, fine- to medium-grained, quartz sand. Between 3 and 5 feet below land surface is very loose, grayish brown, fine-grained, quartz sand. Between 5 and 9 feet below land surface is medium dense, very pale brown to white, fine- to medium-grained, quartz sand. Between 9 and 29 feet are layers of clayey sand and sandy clay ranging in color from very pale brown to pale white, with 10 to 15 percent yellowish brown mottles. Between 19 and 29 feet below land surface, the sediments contain pebble-sized sand concretions.

Hydrology

The characterization presented below is based on the lithology encountered during split-spoon sampling and the groundwater levels in the wells. Two aquifers were identified at the Lake Marion well site: the surficial aquifer, and the Upper Floridan aquifer. A confining unit separates the two aquifers (figure 5).



Colors are according to the International Commission on Stratigraphy; ft, feet; bls, below land surface; LS, land surface

Figure 5. Stratigraphy at the Lake Marion well site in Levy County, Florida.

The surficial aquifer is the shallowest hydrologic unit present at the Lake Marion well site. It extends from the land surface to 29 feet below land surface and is unconfined. The aquifer is contained within the undifferentiated sand and clay unit. On July 20, 2011, the groundwater level in the surficial aquifer monitor well was measured 13.52 feet below land surface (39.92 feet NGVD29).

A confining unit is located between 29 and 41 feet below land surface, in the low permeability clays of the undifferentiated Hawthorn Group. The confining unit separates the surficial aquifer from the underlying Upper Floridan aquifer.

The portion of the Upper Floridan aquifer encountered during well construction extends from 41 to 105 feet below land surface and is contained within the Ocala Limestone. The aquifer is confined by the clayey sediments of the undifferentiated Hawthorn Group. The top of the unit was identified 41 feet below land surface where a possible void and/or permeable limestone was encountered. The bottom of the aquifer was not reached during well construction. On July 20, 2011, the groundwater level in the Upper Floridan aquifer monitor well was measured 15.92 feet below land surface (37.52 feet NGVD29).

Summary

Two monitor wells were constructed at the Lake Marion well site in Levy County, Florida during July 2011. The wells were constructed as a part of the NDWRAP to monitor groundwater levels in the surficial and the Upper Floridan aquifers near Lake Marion. The casing and total depth of the surficial aquifer well are 4 feet and 29 feet below land surface, respectively. The casing and total depth of the Upper Floridan aquifer well are 82 feet and 105 feet below land surface, respectively, with fill from 99 to 105 feet below land surface. The groundwater levels in the two wells differed by 2.4 feet on July 20, 2011. Both wells are secured with locked well covers and have been submitted to the District’s Hydrologic Data Section for long-term groundwater level monitoring.

Prior to well construction, split-spoon samples were collected and the hydrogeology of the site was determined. The general geology at the site is: Ocala Limestone from 41 feet below land surface to the total depth of exploration of 105 feet below land surface, undifferentiated Hawthorn Group sediments from 29 to 41 feet below land surface, and undifferentiated sand and clay from land surface to 29 feet below land surface. The general hydrology at the site is: the surficial aquifer from land surface to 29 feet below land surface, a confining unit from 29 to 41 feet below land surface, and the Upper Floridan aquifer from 41 feet to beyond the total depth of exploration of 105 feet below land surface.

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Appendix A. Field Notes

SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT
RESOURCE DATA SECTION
DAILY CORING/DRILLING LOG

REPORT #	SITE HYDROLOGIST	DATE	DATE ON-SITE	SID
1	Anna Janosik	7/6/11	7/6/11	
CONTRACTOR	CREW	PROPOSED T.D.	PROGRESS SS/AUG	DEPTH SS/AUG
HUSS	KEVIN, Josh, Mike	70	80	80
ROMP SITE NUM-NAME	Lake Marion		WELL NAME/ID	UFA

TIME LOG		DEPTH	DETAILS OF OPERATIONS									
FROM	TO											
900			ONSITE - LOCATE CORNERS OF WEBSITE					Blow Counts				
			SETUP RIG					0-6"	6-12"	12-18"	18-24"	
910	915	0-4	Post hole dig 0-4'					4-6	3	5	9	11
915	1130	4-82	Split Spoon					6-8	16	13	13	16
			water @ 5'					8-10	16	16	10	18
			~~18-22 power recovery~~					10-12	4	4	7	8
			42-44 VOID, MOVE AUGERS 7'					12-14	12	9	9	9
			CASE OFF					14-16	6	7	7	6
			44-44.5 80 Blows -- Auger past					16-18	8	10	10	8
			Limestone chunks - auger down 5'					18-20	3	5	6	6
			to get another sample					20-22	2	2	4	5
			46-50 auger sounded like hitting					22-24	3	3	5	8
			chunk of rock, but nothing solid					24-26	2	3	4	4
			50-52 refusal @ 51.5' (want enough					26-28	3	4	4	4
			sample to see mat'l)					28-30	3	3	5	6
max solid		Auger	Auger to 55', sample 55-56.9"					30-32	3	3	2	1
←		Soft -	Auger to 60', sample 60-60.2"					32-34	1	2	1	2
		med. -	Decide to Auger 10' to watch how					34-36	WOR			
			comp. Rock is					36-38	1	2	1	3
			Auger to 65' (soft-med)					38-40	2	2	2	2
			Kevin said "decent"					40-42	1	2	VOID	
lost return		←	Auger to 70' (soft)					42-44	WOR			
			Auger to 75' (soft)					44-46	88 for 6"			
			Auger to 80' (soft)					46-48	F			
			Split Spoon 80'					48-50				
			after cleaning hole w/ pvc					50-52	7	18	50	-
			+ rig pump (flush cleaned w/ water)					52-54				
			38/40/27/50+					54-56	7 21			
								56-58	49 50 (6-3")			
								58-60				

District Representative		Contractor Representative	
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RESOURCE DATA SECTION

DAILY CORING/DRILLING LOG

REPORT #	SITE HYDROLOGIST	DATE	DATE ON-SITE	SID
1	Anna Janosik	7/6/11	7/6/11	

CONTRACTOR	CREW	PROPOSED T.D.	PROGRESS SS/AUG	DEPTH SS/AUG
HUSS	Kevin, Josh, Mike	70	80	80

ROMP SITE NUM-NAME	Lake Marion	WELL NAME/ID	UFA
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[illegible]

District Representative		Contractor Representative	
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SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT
RESOURCE DATA SECTION
DAILY CORING/DRILLING LOG

REPORT #	SITE HYDROLOGIST	DATE	DATE ON-SITE	SID
2	Anna Janosik	7/7/11	7/6/11	

CONTRACTOR	CREW	PROPOSED T.D.	PROGRESS SS/AUG	DEPTH SS/AUG
HUSS	Kevin, Josh, Mike			

ROMP SITE NUM-NAME	Lake Marion	WELL NAME/ID	URA and SA
-----------------------	-------------	-----------------	------------

TIME LOG		DEPTH	DETAILS OF OPERATIONS
FROM	TO		
900			Anna onsite - crew tagged cement w/ 5 ft bls on outside of casing + 78' bls inside casing (so 4' came up inside @ bottom) Kevin said grouting went smoothly last night. Prepare to drill open hole for UFA well
930			Trip in w/ 6" hole bit, mix mud, roller bit
935	1030	82-112	Drill open hole
1030			Trip out, prepare to airlift (using wa rods to 100' ft bls and 70' ft of airline)
11:10	1130		Develop well - airline unglued - resolve
11:20	1200		Anna offsite to check out propose ROMP 131.5 site down road
1200	1305		Develop well (gpm $\approx$ 40 150 gal $\div$ 40 gpm/min = 3.75 min/well) surge + increase air pressure - hammer rods to 103' - Kevin worried about fall-in when pulling up around ledge - give self 1' room for fall-in
1305	1340		Fill VP tanks w/ discharge water
1340	1354		Surge - still picking up some fines - decide to trip out + tag @ 105' bls w/ tremmie/airline
1415			Cover UFA well w/ plug + move rig forward for SA well (design = 29 ft TD w/ 25' of screen)
1430			Auger to 301
1500			Anna offsite

District Representative		Contractor Representative	
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$$(102 \text{ ft})(1.4688 \frac{\text{gal}}{\text{ft}}) = 150 \text{ gal}$$
$$(29.12)(1.4688 \frac{g \cdot P}{P}) = 43 \text{ g}$$