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TECHNICAL MEMORANDUM

Date: May 4, 2010

To: Robert Beltran, P.E., Hydrosolutions/URS
Polk County Utilities

From: Kevin Dorsey, P.G., PBS&J
Michelle Regon, PBS&J

RE: Southeast Polk County Deep Exploratory Well Project
Frostproof, Florida
Surficial Aquifer Monitor Well SE-SA-MW1 Construction

1.0 INTRODUCTION

1.1. Background

The 2005-2006 Kissimmee Basin Water Supply Plan concluded that traditional groundwater sources used in the Central Florida region may be limited over the twenty year planning horizon. This conclusion was, however, based upon a limited amount of information and it was identified that there is a need to gather additional hydrologic information and to look for new potential sources of potable water. In particular, hydrogeologic and geologic information for the upper and lower portions of the Floridan Aquifer System (FAS) in Osceola and Polk Counties was identified for future collection efforts.

In July 2008, Polk County and the South Florida Water Management District (SFWMD) entered into a cooperative agreement to investigate the hydrogeologic conditions of the FAS in southeast Polk County to answer questions regarding the extent and vertical connection of the FAS there and to provide data on the regional extent of the freshwater portion of the FAS in central Florida. The investigation involves the construction and testing of one Upper Floridan aquifer (UFA) exploratory well, SE-UFA-MW1, and one Lower Floridan aquifer (LFA) exploratory well, SE-DEW. Testing during the construction of these wells included the collection of lithologic samples, geophysical logging, the collection and analysis of water quality samples, and conducting aquifer performance tests (APTs). In addition, the investigation included the construction of a shallow monitor well to monitor impacts to the water table of the surficial

aquifer during the APTs. This report summarizes the construction and testing of the shallow monitor well, herein referred to as SE-SA-MW1.
Technical specifications on the construction of SE-SA-MW1 were prepared by PBS&J and submitted to Polk County Utilities for incorporation into contract bid documents used in soliciting construction bids from licensed drilling contractors. SE-SA-MW1 was to be constructed in conjunction with and in close proximity to the UFA and LFA exploratory wells for the primary purpose of monitoring the water table in the surficial aquifer during APTs. In addition, the well was used as a source of water for the construction of the exploratory wells.

The contract for the construction and testing of SE-SA-MW1 was awarded to Rowe Drilling Company, Inc. (RDC) of Polk City, Florida and a Notice to Proceed was issued on September 3, 2008. RDC initiated drilling operations at SE-SA-MW1 on September 18, 2008 after obtaining the required well construction permit (WCP) from the South Florida Water Management District (SFWMD). WCP No.SF091608A, which is included as **Attachment A**, was issued to RDC on September 17, 2008 authorizing the construction of a 6-inch diameter monitor well to a total depth of 80 feet with a casing depth of 40 feet and a 40-feet screened interval.

1.2. SE-SA-MW1 Location

As depicted on **Figure 1**, SE-SA-MW1 is located at the southeast Polk County Deep Exploratory Well site, which is located east of the City of Frostproof, Florida within Section 21, Township 31 South, Range 29 East, on property leased by Polk County Utilities. The Deep Exploratory well site is a 10.3 acre outparcel of the X-Bar ranch property that is bordered on the west by a drainage ditch and County Road (C.R.) 630 on the south. The land surface elevation at the site is approximately 76 feet above the National Geodetic Vertical Datum of 1929. SE-SA-MW1 is geographically located at 27˚ 46’ 02.10” North Latitude and 81˚ 25’ 42.65” West Longitude, approximately 300 feet north of C.R 630, and 100 feet north of the midpoint between SE-UFA-MW1, and SE-DEW.

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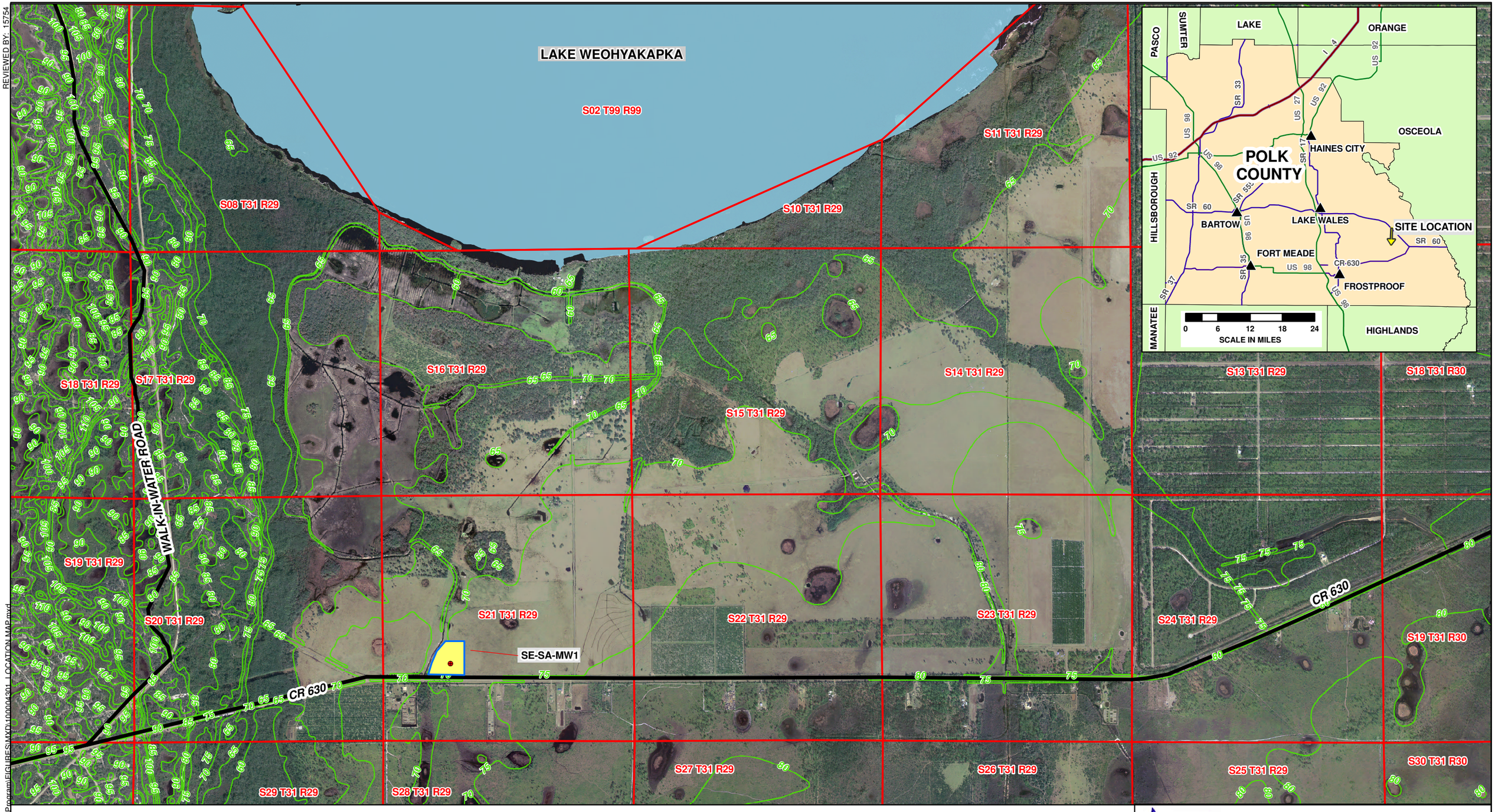
REVIEWED BY: 15754



LEGEND:

- Surficial Aquifer Monitor Well
- Southeast Polk County Deep Exploratory Well Site
- Section, Township & Range
- Topographic Contours - 5 Foot Intervals
- Major Roads

NOTES:

1. THIS FIGURE IS GENERATED IN COLOR. PHOTOCOPYING IN BLACK AND WHITE WILL RESULT IN THE LOSS OF THE PRESENTED DATA.
2. AERIAL PHOTOGRAPH PROVIDED BY THE SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT (03-2006).
3. SHAPEFILES PROVIDED BY POLK COUNTY, THE FLORIDA DEPARTMENT OF TRANSPORTATION AND SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT.

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SCALE IN FEET

Polk County Utilities

330 WEST CHURCH STREET,
BARTOW, POLK COUNTY, FLORIDA

SOUTHEAST POLK COUNTY DEEP EXPLORATORY WELL
SURFICIAL AQUIFER MONITOR WELL
SITE LOCATION MAP
FROSTPROOF, POLK COUNTY

SCALE: AS SHOWN
OCTOBER 2008

PBS&J FIGURE 1

FILE PATH: F:\COMMON\Hydrogeological Program\FIGURES\MXD\100004301_LOCATION MAP.mxd

2.0 WELL CONSTRUCTION

Drilling during construction of SE-SA-MW1 was conducted utilizing a Marlin 6 Truck mounted drilling rig with a top head drive system. Two drill bits were utilized including a nominal 5-inch diameter bit for drilling of a pilot hole and a nominal 12-inch diameter drill bit to ream the pilot hole prior to casing and screen installation. The drill rods were 3.5-inch outside diameter (O.D.) and 20 feet in length.

Mud rotary drilling techniques, described below, were utilized in the construction of SE-SA-MW1. The as-built diagram for SE- SA-MW1 is provided as **Figure 2**. Photographs of the drilling equipment, selected well construction activities, and the completed wellhead are presented in **Attachment B.**

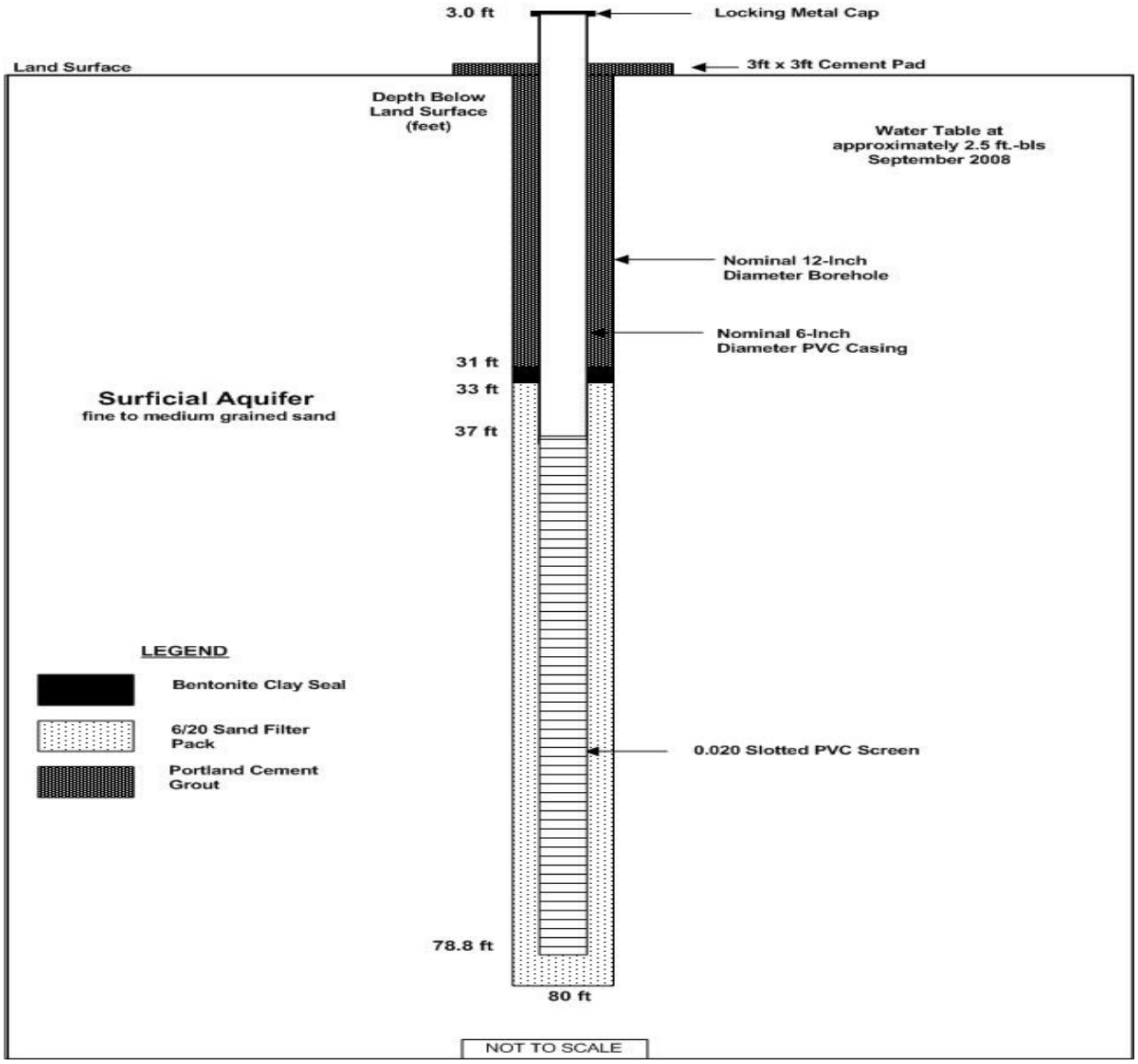


Figure 2. SE-SA-MW1 As-Built Diagram

2.1. Mud Rotary Drilling

Mud rotary drilling is used to drill through unconsolidated or poorly consolidated deposits that generally are unstable, have a tendency to collapse into the borehole, and yield relatively low quantities of groundwater. The drilling mud stabilizes the borehole and removes the drill cuttings during drilling operations. The mud drilling operation at the site used bentonite-drilling mud as the drilling fluid which was mixed in temporary shallow earthen pit that was excavated next to the drill rig.

During mud rotary drilling, the drilling mud is pumped through the drill rods and exits out the drill bit. The viscous drilling fluid suspends the cuttings and circulates back up the borehole to land surface. The returning mud, laden with formation cuttings, is routed back into the open pit, which is tiered allowing the formation cuttings to settle out. The drilling fluids, collected in the last tier, are re-circulated back down the drill rod.

On September 18, 2008, RDC mud rotary drilled a nominal 5-inch pilot hole to a depth of 80 feet below land surface (ft bls) to collect drill cutting for identifying subsurface conditions. The formation material encountered was comprised of unconsolidated tan quartz sand as described in the lithology log, which is included as **Attachment B**. On September 19, 2008, RDC reamed the pilot hole utilizing mud-rotary drilling to a nominal 12-inch diameter in preparation for casing and screen installation.

2.2. Casing and Well Screen Installation

Immediately following drilling of the nominal 12-inch diameter borehole, RDC installed the casing and well screen, which consisted of 40 feet of nominal 6-inch diameter, ASTM 1785 Schedule 40 Certa-Loc PVC pipe and 40 feet of 6-inch diameter, ASTM 2685 Schedule D, 0.020 slotted screen with a 0.7-foot sump. Positioned at 0, 90, 180 degrees around the casing, steel centralizers were placed at the bottom of the screen, then at 20-feet intervals to 20 ft bls. After the bottom of the well screen was landed at 78.8 ft bls, the casing string was rotated by hand to demonstrate that it was hanging free and plumb in the borehole. Following casing installation, 75 feet of 2-inch tremmie pipe was temporarily installed in the annular space between the borehole wall and screen in preparation for installation of the filter pack.

2.3. Filter Pack Installation

RDC installed the filter pack, via 2-inch tremmie pipe using a total of 48 sacks of 6/20 course silica sand at approximately 0.5 cubic feet per sack for a total of approximately 24 cubic feet. The theoretical volume of the annulus from 33 to 80 ft bls is approximately 26 cubic feet. Rowe placed the filter pack from 33 ft bls to 80 ft bls by flushing the sand through the tremmie pipe with clean water. A bentonite seal consisting of 4 sacks of bentonite chips was placed on top of the filter pack and allowed to hydrate before grouting the remainder of the annulus to land surface. The bentonite seal was tagged at approximately 31 ft bls.

2.4. Casing Grouting

Following hydration of the bentonite seal, RDC cemented the casing in place with one tremmie grout stage. Cement grout installed during the tremmie grout stage consisted of Portland Type I cement and 5.2 to 5.5 gallons of water per 94 pounds of cement.

The tremmie grouting was completed on September 19, 2008. Approximately, 14 sacks or approximately 16.6 cubic feet of cement grout were pumped into the annular space through a 2-inch diameter pipe set near the top of the bentonite seal at 31 ft bls. The theoretical volume of the annulus from 31 ft bls to land surface is approximately 17 cubic feet. Approximately eight hours after the tremmie grouting the top of cement was two feet below land surface in the annulus.

2.5. Well Development

Development of the screened interval (37 to 78.8 ft bls) at SE-SA-MW1 was initiated on September 21, 2008. Formation material was removed from the well by air-lift development at pumping rates up to an estimated 30 gallons per minute. The static water level in the well was approximately 2.5 ft bls. After pumping the well for a period of nine hours, the discharge water was clear and free of sand.

2.6. Wellhead Completion

The wellhead of SE-SA-MW1 was completed by cutting the 6-inch diameter PVC casing to a height of approximately three feet above ground surface and capping it with a lockable 6 5/8-inch metal well cap and ring manufactured by Royer Quality Castings, Inc. A square cement pad approximately three feet in diameter and 4-inches thick was poured around the casing. Three protective 4-inch diameter steel poles (bollards) filled with concrete, were installed around the well to a depth of 2 feet below land surface and extending to 3 feet above land surface. The casing and bollards were coated with a black epoxy. The Well Completion Report is included in **Appendix C**. A photograph of the completed wellhead is included in **Appendix B**.

On February 4, 2010, PBS&J installed a Solinst Levelogger Gold Model 3001 water level transducer and recorder and a Solinst Barologger Gold Model 3001 atmospheric pressure transducer and recorder in SE-SA-MW1. The Levelogger and Barologger were programmed to record water levels and barometric pressure in feet of water every hour on the hour. Additional information on the Levelogger, Barologger, and installation setups is provided in **Table 2-1**.

Table 2-1 SE-SA-MW1 Levelogger Data

Make	Water Fluctuation Range (ft)	Serial Number	Installed Depth Below Ring (ft)	Communication Type
F30	29.5	1015841	25 ft	Direct Read Cable
Barologger	Air only	1026575	2 ft on wire	Manual Optical Read

2.7. Surveying

SE-SA-MW1 was surveyed in on February 23, 2010, by a registered professional Florida land surveyor, Accuright Surveys of Orlando, Inc. The survey data shows the land surface, well head, and measuring point elevations referenced to the National Geodetic Vertical Datum of 1929 (NGVD), as well as the location of the well based on latitude and longitude on the state plane coordinate system. The Survey Report is included in **Appendix D**. The results of the surveying are listed in **Table 4.2** below.

Table 4-2 SE-SA-MW1 Survey Data

Part A – Elevation Data in Feet above NGVD

Land Surface	Top of Pad	Top of Metal Ring
76.43	76.63	79.68

Part B – Location Data

NORTHING, FL W	EASTING, FL W	LATITUDE	LONGITUDE
1248516.51	841060.84	27.7672489	-81.4285130

Attachment A - Well Construction Permit

SOUTH FLORIDA WATER MANAGEMENT DISTRICT

CON 24-06

September 17, 2008

PERMITTEE
POLK COUNTY BOCC
2470 CLOWER LANE
BARTOW, FL 33830

CONTRACTOR
SALTER, THOMAS
P.O. BOX 1098
POLK CITY, FL 33868
LICENSE NO:3206

WATER WELL CONSTRUCTION PERMIT #SF091608A
EXPIRATION DATE:March 17, 2009

PROJECT: POLK COUNTY UTILITIES MONITOR WELL
TYPE OF USE: MONITOR
COUNTY: POLK SEC: 21 TWP: 31 RGE: 29

WELL CONSTRUCTION SPECIFICATIONS:	**INNER**	**OUTER**
CASING DIAMETER	**6"**	
CASING DEPTH:	**40.00'**	
SCREENED INTERVAL:	40.00'	60.00'
OPEN HOLE INTERVAL		
TOTAL DEPTH OF WELL:	80.00'	

GROUT REQUIREMENT
Inner casing shall be grouted bottom to top.

See additional conditions of permit on attached sheet.

We appreciate your assistance and cooperation in better managing the water resources of the District. If you have any questions on this matter, please call Ann-Marie Superchi at extension 6929.

Sincerely,

Ann Marie Superchi, Well Permitting
Water Use Division
South Florida Water Management District

Attachment: Additional Conditions of Permit

c:

POLK COUNTY UTILITIES MONITOR WELL
September 17, 2008

ADDITIONAL CONDITIONS OF PERMIT

COMPLETION REPORT REQUIRED

A Water Well Completion Report (Form 0124) must be filled with the District within 30 days of completion of work.

bc: WU Permit # N/A
WATER USE REVIEWER
DAY FILE
PERMIT FILE

STATE OF FLORIDA PERMIT APPLICATION TO CONSTRUCT, REPAIR, MODIFY, OR ABANDON A WELL

☐ Southwest
☐ Northwest
☐ St. Johns River
☐ South Florida
☐ Suwannee River

CHECK BOX FOR APPROPRIATE DISTRICT. ADDRESS ON BACK OF PERMIT FORM.

THIS FORM MUST BE FILLED OUT COMPLETELY.

The water well contractor is responsible for completing this form and forwarding the permit to the appropriate delegated county where applicable.

Permit No. SE0916081
Florida Unique I.D. ______
Permit Stipulations Required (See attached)
62-524 well ☐
CUP/WUP Application No. ______

ABOVE THIS LINE FOR OFFICIAL USE ONLY

1. Polk County BOCC 2470 Clower Lane Bartow 33830 (863)534-5610
Owner, Legal Name of Entity if Corporation — Address — City — Zip — Telephone Number

2. CR 630 E. of Walk in Water Rd Approx. 1 mile
Well Location — Address, Road Name or Number, City

3. Rowe Drilling Co, Inc. 3206 (863) 984-3100
Well Drilling Contractor — License No. — Telephone No.

P.O. Box 1098
Address

Polk City, Fl, 33868
City — State — Zip

4. ____ 1/4 of ____ 1/4 of Section 21
(smallest) (biggest)
(Indicate Well on Chart) NW NE SW SE

5. Township 31 Range 29

6. Polk
County — Subdivision Name — Lot — Block — Unit

7. Number of proposed wells 1 Check the use of well: (See back of permit for additional choices) ______ Domestic Monitor (type) X
______ Irrigation (type) (See Back) Public Water Supply (type) ______ (See Back) List Other ______
Distance from septic system 500± ft. Description of facility NA Estimated start of construction date 9-18-08

8. Application for: X New Construction ______ Repair/Modify ______ Abandonment ______
(Reason for Abandonment)

9. Estimated: Well Depth 80' Casing Depth 40' Screen Interval from 40' to 80'
Casing Material: Blk-Steel / Gal (PVC) Casing Diameter 6" Seal Material ______

Date Stamp

10. If applicable: Proposed Grouting Interval From 0 to 38' Seal Material grout
From ____ to ____ Seal Material ______
From ____ to ____ Seal Material ______

11. Telescope Casing ____ or Liner ____ (check one) Diameter ____
Blk-Steel / Galvanized / PVC Other (specify: ______

12. Method of Construction: X Rotary ____ Cable Tool ____ Combination
____ Auger ____ Other (specify:) ______)

13. Indicate total No. of wells on site 0. List number of unused wells on site 0.

14. Is this well or any other well or water withdrawal on the owner's contiguous property covered under a Consumptive/Water Use Permit (CUP/WUP) or CUP/WUP Application? X No ____ Yes
(If yes, complete the following) CUP/WUP No. ______
District well I.D. No. ______
Latitude ______ Longitude ______
Data obtained from GPS ____ or map ____ or survey ____ (*map datum NAD 27* ____ *NAD 83* ____)

Draw a map of well location and indicate well site with an "X". Identify known roads and landmarks; provide distances between well and landmarks.

North — West — East — South

15. I hereby certify that I will comply with the applicable rules of Title 40, Florida Administrative Code, and that a water use permit or artificial recharge permit, if needed, has been or will be obtained prior to commencement of well construction. I further certify that all information provided on this application is accurate and that I will obtain necessary approval from other federal, state, or local governments, if applicable. I agree to provide a well completion report to the District within 30 days after drilling or the permit expiration, whichever occurs first.

I certify that I am the owner of the property, that the information provided is accurate, and that I am aware of my responsibilities under Chapter 373, Florida Statutes, to maintain or properly abandon this well; or, I certify that I am the agent for the owner, that the information provided is accurate, and that I have informed the owner of his responsibilities as stated above. Owner consents to personnel of the WMD or a representative access to the well site.

L Salter — 3206
Signature of Contractor — License No.

Tara N. [signature] — 9/16/08
Owner's or Agent's Signature — Date

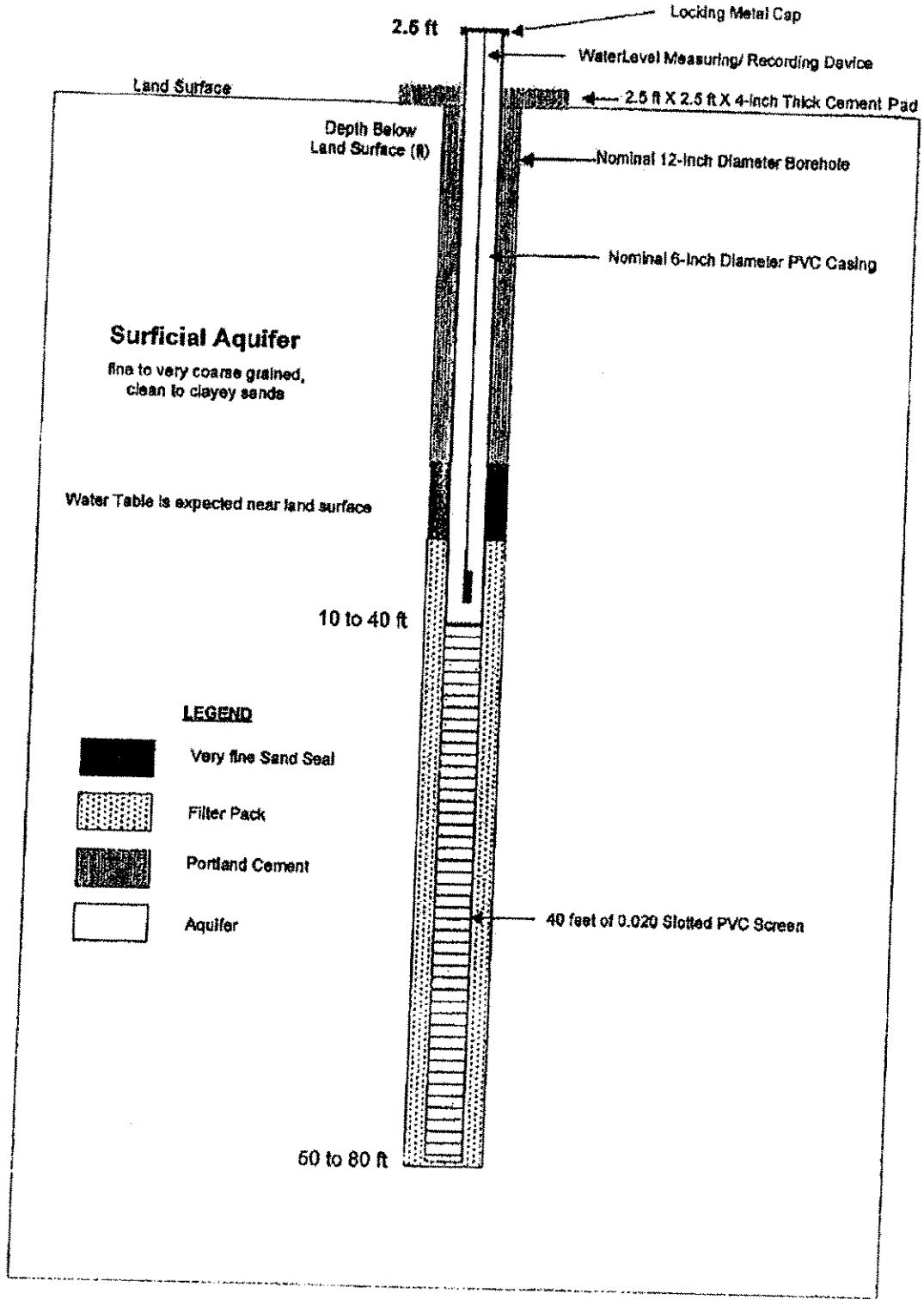
DO NOT WRITE BELOW THIS LINE — FOR OFFICIAL USE ONLY

Approval Granted By: [signature] Issue Date: 9-17-08 Hydrologist Approval ______ initials

Owner Number: ______ Fee Received: $ 100.00 Receipt No.: 08 4320-101 Check No.: ______
Enter numerical month, day and full, four-digit year.

THIS PERMIT NOT VALID UNTIL PROPERLY SIGNED BY AN AUTHORIZED OFFICER OR REPRESENTATIVE OF THE WMD. IT SHALL BE AVAILABLE AT THE WELL SITE DURING ALL DRILLING OPERATIONS. ***This permit is valid for 90 days from date of issue.***

Form 0123 Rev. 4/95



NOTE: ALL DEPTHS ARE ESTIMATED

Drawing No. 2 Proposed Water-Table Monitor Well SE-SA-MW1 Completion Diagram

Attachment B – Photo Log

SE SAMW-1 DRILLING SITE &
MARLIN 6 DRILLING RIG

DRILLING BITS

CERTA-LOK PVC CASING: 6-INCH

SE SAMW-1 WELLHEAD

Attachment C – Lithology Log

LITHOLOGIC LOG

Location: SEDEW Site, Polk County, FL **Owner:** Polk County Utilities **Date Drilled:** September 2008 **Drilling Method:** Mud rotary **Drilling Contractor:** Rowe Drilling, Inc. **Sampling Method**: Grab samples from drill cuttings	**Surficial Aquifer Monitor Well** **SE-SA-MW1**

DEPTH INTERVAL (ft)		**DESCRIPTION**	**BY**
FROM	**TO**		
0	10	SAND, medium to fine grained, angular to sub-angular, quartz brown to colorless; much organics	**MR**
10	20	SAME AS ABOVE; trace organics	**MR**
20	30	SAND, medium to fine grained, angular, quartz, tan to colorless.	**MR**
30	40	SAME AS ABOVE	**MR**
40	50	SAME AS ABOVE	**MR**
50	60	SAME AS ABOVE	**MR**
60	70	SAME AS ABOVE	**MR**
70	80	SAND, medium to large grained, sub-angular, quartz, colorless	**MR**

Attachment D - Well Completion Report

WELL COMPLETION REPORT (Please complete in black ink or type.)

PERMIT #: SF0916088 CUP/WUP#: NA DID#: N/A

Indicate the number of wells drilled/abandoned for this report: 1

Indicate the number of wells permitted but not drilled/abandoned that are being cancelled: _____

WATER WELL CONTRACTOR'S SIGNATURE T Sparks License # 3206

I certify that the information provided in this report is accurate and true.

Grout	No. of Bags	From (ft.)	To (ft.)
Neat Cement:	19	0	35.5
Bentonite:		35.5	37
(Other)			

WELL LOCATION: County _____

_____ 1/4 of _____ 1/4 of Section 21 Township 31 Range 29

Latitude: _____ Longitude: _____

DATE STAMP

Official Use Only

Sketch of well location on property

Give distances from septic tank and house, or other reference points

CHEMICAL ANALYSIS WHEN REQUIRED

Iron: ____ppm Sulfate: ____ppm

Chlorides: ____ ppm TDS ____ mg/l

Conductivity ____ umhos/cm

[ ] Lab Test [ ] Field Test Kit

Pump Type

[ ] Centrifugal [ ] Jet [ ] Submersible [ ] Turbine

Horsepower: _____ Capacity: _____ GPM: _____

Pump Depth: _____ft. Intake Depth: _____ft.

FORM LEG-R.005.01(4/09) RULE 40D-3.411(1)(a), F.A.C.

OWNER'S NAME: Polk County BOCC

COMPLETION DATE: 9/26/08 Florida Unique I.D.: _____

Parcel # (Pin): _____

WELL USE:

[ ] Public Supply [ ] Irrigation [ ] Domestic [X] Monitor

[ ] Injection [ ] Other

DRILL METHOD:

[X] Rotary [ ] Cable Tool [ ] Combination

[ ] Jet [ ] Auger [ ] Other _____

Measured Static Water Level: _____ Measured Pumping Water Level: _____

After ____Hours at ____GPM. Measuring Pt. (Describe): _____

Which is ____ft. [ ] above [ ] below land surface

Casing: [ ] Black Steel [ ] Galvanized [ ] PVC [ ] Other: _____

[ ] Open Hole [X] Screen	Depth (feet)		DRILL CUTTINGS LOG Examine cuttings every 20 ft. or at formation changes. Note cavities, depth to producing zones.
Casing Diameter and Depth (ft.)	From	To	Color | Grain Size | Type of Material
Diameter: 6" From: 0 To: 40			
Diameter: 6" screen From: 40 To: 79			
Liner [ ] or Casing [ ] Diameter: _____ From: _____ To: _____			

Driller's Name (print or type): David Blair

Attachment E - Survey Report

Special Purpose Survey

WELL SITES IN SECTION 20, TOWNSHIP 31 SOUTH, RANGE 29 EAST, POLK COUNTY, FLORIDA

PTNO	Well Name	Northing, FL West Zone)	Easting, FL West Zone)	LATITUDE	LONGITUDE
100	SEDEW	1248435.64	841109.32	27.7670259	-81.4281026
103	SEUFA	1248435.86	841009.72	27.7670277	-81.4284106
104	SED2 4A	1248437.70	840910.33	27.7670341	-81.4287179
105	SED2 4B	1248437.70	840910.33	27.7670341	-81.4287179
106	SAMW1	1248516.51	841060.84	27.7672489	-81.4285130

			ELEVATIONS	NGVD	1929		
	Well Name	Land surface	Top of Concrete	Top of Bottom Flange	Top of Top Flange	Monitoring Points 1 & 2 Top of Fitting	Monitoring Point South Top of Fitting	Top of Ball Valve
	SEDEW	77.46	78.01	81.12	81.23	81.29		
	SEUFA	76.91	77.36	79.92	80.02	80.09	80.12	80.63
	SED2 4A	76.71	77.21		79.24	79.3		
	SED2 4B	76.69	77.19	80.05	80.12	80.2		
	SAMW1	76.43	76.63	79.68				

Notes:

1. Horizontal and vertical datums based on GPS Network L-Net Reference Frame provided by Lengemann of Florida
2. The purpose of this survey is to show the location of well points in Section 20, Township 31 South, Range 29 East, Polk County, Florida, in terms of coordinate data on a spreadsheet.
3. Field Date: February 23, 2010

Accuright Surveys of Orlando, Inc.
LB 4475
2012 E. Robinson St.
Orlando, Florida 32803
Tel. 407-894-6314, Fax. 407-897-3777

Frank A. Raymond

Frank A. Raymond, III, PSM 5325