

Evaluation of Pre-construction Water Level Data for Southern Corkscrew Regional Ecosystem Watershed (CREW) Restoration Project

CERPRA Permit: 0279719-004

Specific Condition: 20 – Hydrological Monitoring Plan

Prepared for the
Florida Department of Environmental Protection

July 26, 2017



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ACRONYMS AND ABBREVIATIONS

bls	below land surface
CERPRA	Comprehensive Everglades Restoration Plan Regulation Act
CREW	Corkscrew Regional Ecosystem Watershed
DBHYDRO	South Florida Water Management District's corporate environmental database
FDEP	Florida Department of Environmental Protection
HRC	hydroperiod restoration criteria
NAVD88	North American Vertical Datum of 1988
NGVD29	National Geodetic Vertical Datum of 1929
SCADA	supervisory control and data acquisition
SFWMD	South Florida Water Management District
Southern CREW Restoration Project	Southern Corkscrew Regional Ecosystem Watershed Imperial River Flow-Way Restoration Project

SUMMARY

Per the requirements of Comprehensive Everglades Restoration Plan Regulation Act (CERPRA) Permit Number 0279719-004, the South Florida Water Management District (SFWMD) implemented a hydrological monitoring plan for the Southern Corkscrew Regional Ecosystem Watershed (CREW) Imperial River Flow-Way Restoration Project (Southern CREW Restoration Project) to evaluate the percent increase of time the water table is within 6 inches of land surface (SFWMD 2015). This elevation was designated as the hydroperiod restoration criterion (HRC). This report provides a one-year hydrologic analysis of water levels as mandated under the permit monitoring requirements. This first year completed the “pre-construction” monitoring and includes one wet season (June to October 2016) and one dry season (November 2016 to May 2017). Pre-construction water levels in the impacted area met the HRC 99 percent of the time.

Based on Florida Department of Environmental Protection (FDEP) permit reporting guidelines, **Table 1** lists key permit-related information associated with this report. **Table 2** lists the attachments included with this report.

Table 1. Key permit-related information.

Project Name:	Southern CREW Restoration Project
Permit Number:	0279719-004
Issue and Expiration Dates:	
0279719-001 (initial permit):	Issued: 3/26/2008; Expired: 3/26/2013
0279719-003 (permit renewal):	Issued: 3/6/2013; Expires: 3/6/2018
0279719-004 (major modification):	Issued: 6/29/2015; Expires 3/6/2018
Project Phase:	Construction
Report Type:	Hydrological Monitoring
Permit Specific Condition Requiring Report:	20
Reporting Period:	June 2016–May 2017
Report Lead:	Jonathan E. Shaw, PG (jshaw@sfwmd.gov , 561-682-6849)
Permit Coordinator:	John Leslie (jleslie@sfwmd.gov , 561-682-6476)

Table 2. Attachments included with this report.

Attachment	Title
A	Monitoring Well Installation Records
B	Registration Worksheets

BACKGROUND

SOUTHERN CREW RESTORATION PROJECT OBJECTIVE

The Southern CREW Restoration Project was identified as a Critical Restoration Project, which was authorized by the United States Congress under Section 528 of the Water Resources Development Act of 1996. The Southern CREW Restoration Project will reestablish historical flow patterns and hydroperiods on portions of the acquired lands, as well as the CREW and Corkscrew Sanctuary (Audubon) wetlands to the east. In addition to increased hydroperiods, the Southern CREW Restoration Project will restore the historical storage potential of the Southern CREW lands, increase aquifer recharge, and reduce flooding of homes and private lands west of the project area.

PROJECT DESCRIPTION

The Southern CREW Restoration Project will restore approximately 4,150 acres of land by removing roads and filling roadside ditches and drainage canals to natural grade. The project will reestablish a more natural flow pattern to 4,150 acres in the Southern CREW. The Southern CREW Restoration Project boundary is completely within Lee County (**Figure 1**).

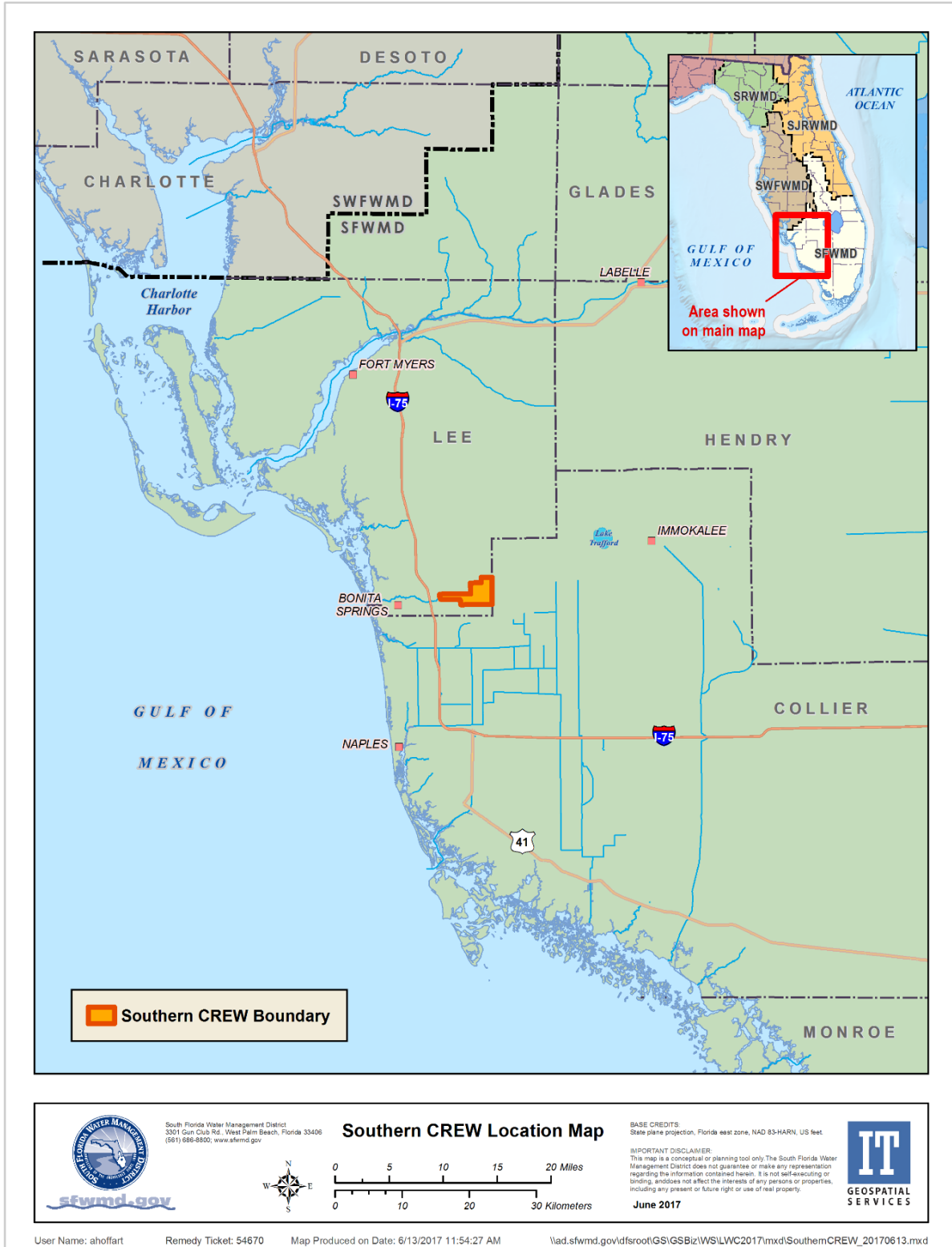


Figure 1. Southern CREW Restoration Project location map.

PERMIT HISTORY

The original CERPRA permit and all modifications and exemptions issued to SFWMD are as follows:

- 0279719-001, issued on March 26, 2008, was the original permit from FDEP to SFWMD for the Southern Crew Restoration, Phase I Southern Crew Ag Field Enhancement: Billy Don Grant Parcel.
- 0279719-002 was a permit application that was withdrawn.
- 0279719-003, issued on March 6, 2013, was a minor modification and permit renewal for the Southern Crew Restoration, Phase I Southern Crew Ag Field Enhancement: Billy Don Grant Parcel.
- 0279719-004 was a major modification issued on June 29, 2015, for the Southern CREW Restoration, Phase II.

HYDROLOGIC EVALUATION

Specific Condition Number 20 of CERPRA Permit Number 0279719-004, requires a hydrological monitoring plan:

The Permittee shall collect and analyze hydrological monitoring data in accordance with the most current approved version of the Hydrological Monitoring Plan using the parameters and frequencies identified in Table 1 and Table 2 of this permit. In accordance with the plan, pre-construction monitoring will be performed for one wet season and one dry season prior to the completion of construction. Post-construction monitoring will be evaluated on an annual basis. The Permittee shall report the results to the Department [FDEP], in accordance with the reporting requirements specified in Annual Reports Specific Condition of this permit. Any subsequent modifications to the Hydrological Monitoring Plan shall be submitted to the Department [FDEP] for review and approval.

The *Hydrological Monitoring Plan for Southern CREW Restoration* (SFWMD 2015) established parameters and frequencies to evaluate the percent increase of time the water table is within 6 inches of land surface (the HRC). The selected restoration alternative modeling results demonstrated increased frequencies of the water table occurring within 6 inches of land surface towards the eastern area of the project (**Figure 2**).

This report provides a one-year hydrologic analysis of water levels as mandated under the permit monitoring requirements. This first year completed the pre-construction monitoring and includes one wet season (June to October 2016) and one dry season (November 2016 to May 2017).

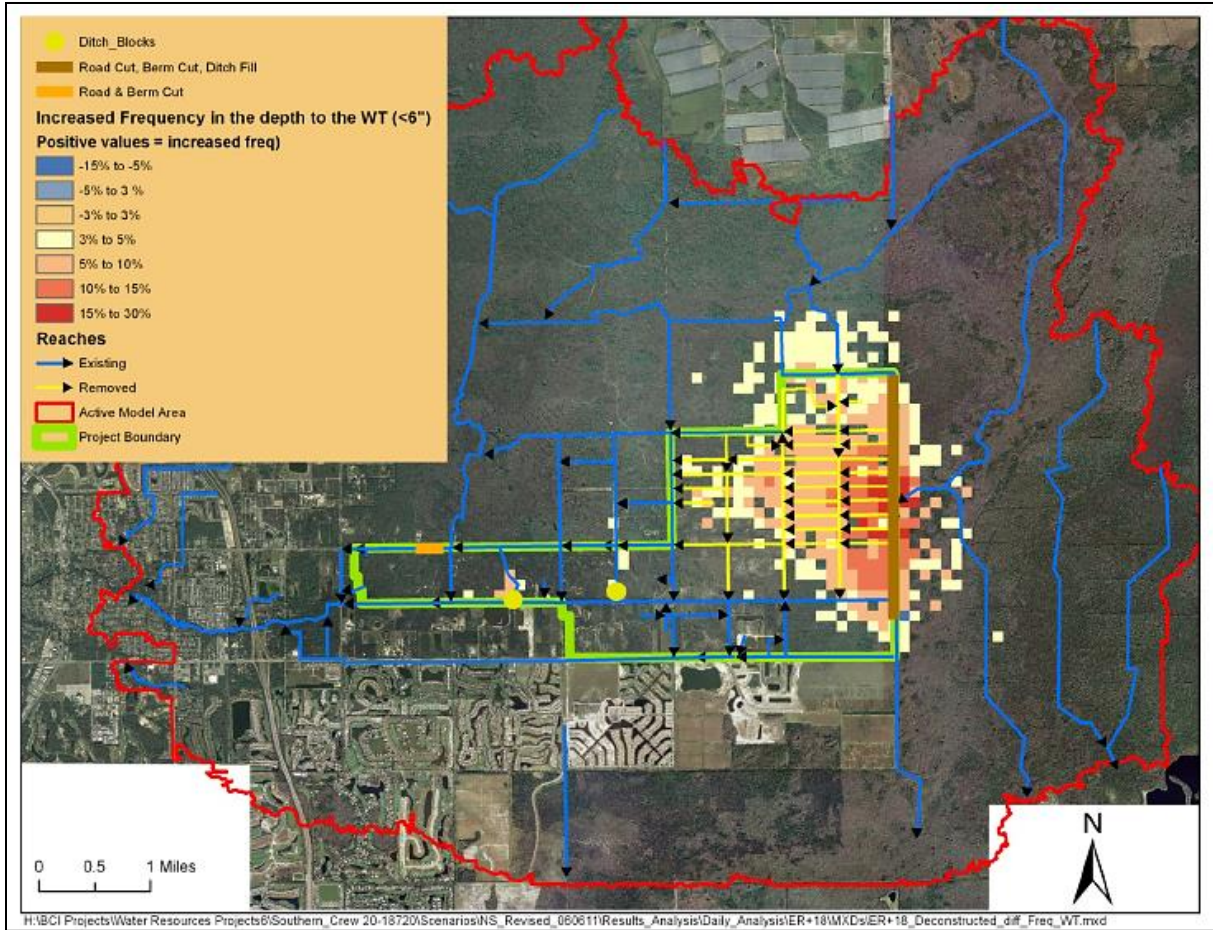


Figure 2. Increased frequency of the water table (WT) being within 6 inches of land surface.

MONITORING PLAN FOR SOUTHERN CREW RESTORATION PROJECT

Hydrological monitoring provides data on the effectiveness of the project in meeting the HRC. As shown in **Figure 2**, the percent increase of time ranges from 3 to 30 percent, occurring primarily in the eastern, impacted portion of the project. A direct comparison of water table elevations between the impacted and unimpacted regions as compared to a pre-construction period baseline to the post-project condition should provide sufficient information to evaluate the permit condition.

The monitoring plan included the installation of two shallow groundwater monitoring wells in locations with similar soils and geology: one within the unimpacted area (SOCREW-1), and another in the impacted portion of the project (SOCREW-2). Well locations were established by survey and are shown in **Figure 3** and described in **Table 3**. An elevation survey was performed to provide the actual land surface elevation at each location as well as the elevation of the measuring point (i.e., the top of each monitoring well).

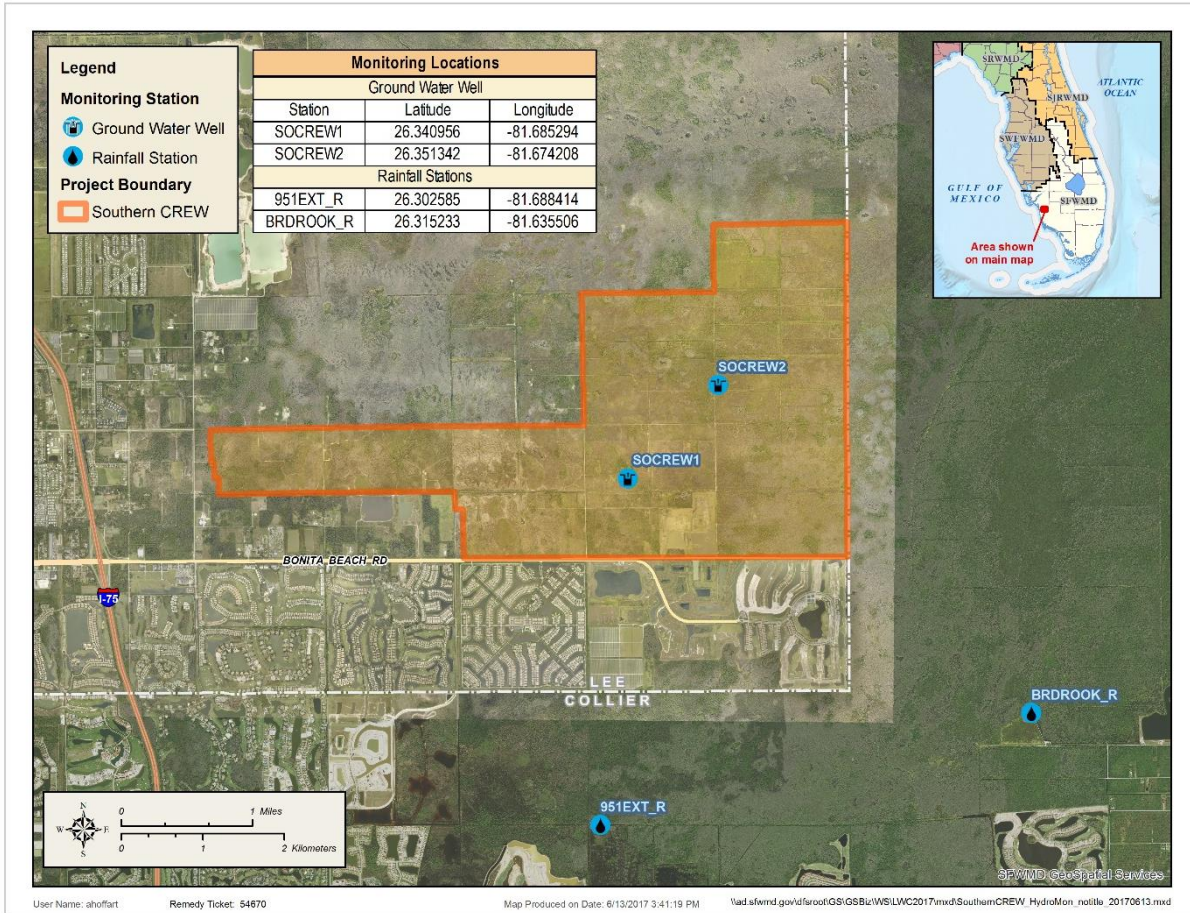


Figure 3. Hydrological monitoring wells and rainfall station location map.

Table 3. Groundwater well hydrological monitoring. ^a

Location	Latitude (Decimal Degrees)	Longitude	Parameter	Units ^b	Sample Type	Frequency
SOCREW-1	26.34117	-81.685567	Stage Elevation	feet NGVD29	Stage Recorder	Biweekly
SOCREW-2	26.35100	-81.673800	Stage Elevation	feet NGVD29	Stage Recorder	Biweekly

a. The standard positional goal for site coordinates is ± 1 meter. This standard can be obtained with a professional grade DGPS system. The coordinates are relative to North American Datum of 1983 (NAD83) High Accuracy Reference Network (HARN) horizontal datum.

b. NGVD29 – National Geodetic Vertical Datum of 1929.

The hydrological monitoring plan called for groundwater level data to be measured on a biweekly basis. The original plan stated, “Baseline monitoring pre-construction will be performed for one wet season and one dry season prior to the completion of construction, providing 26 data points for establishing a baseline of comparison between the two wells. Post-construction monitoring will be evaluated on an annual basis to determine if the percentage increase in time that the water table is less than 6 inches below land surface (bls) is within the 5% to 10% range forecast.”

The two monitoring wells (SOCREW-1 and SOCREW-2) were equipped with data loggers and telemetry to allow groundwater level data to be instantaneously recorded and transmitted electronically. Once reviewed, data are available for daily mean values as well as instantaneous breakpoint point data and can be found in the DBHYDRO database. Therefore, considerably more data are available for analysis than required by the permit.

Additionally, precipitation was evaluated using two rainfall stations in the area: 951EXT_R and BRDROOK_R. These rainfall stations are approximately 3 miles from the project area (**Figure 3**).

Well Construction

Wells were constructed in November 2015. Well construction details are provided in monitoring well installation records provided in Attachment A. Monitoring well locations are shown in **Figure 3**.

Survey

Wells were surveyed in January 2016 and the registration worksheets are provided in **Appendix B**. Land surface elevations were surveyed also (**Table 4**). Land surface elevation data are provided in feet (ft) North American Vertical Datum of 1988. Water elevation data provided in the SFWMD’s corporate environmental database, DBHYDRO, are reported in ft National Geodetic Vertical Datum of 1929 (NGVD29).

Table 4. Land surface elevation and hydroperiod restoration criteria.

Well Identification	Land Surface Elevation (ft NAVD88)	Land Surface Elevation (ft NGVD29)	Hydroperiod Restoration Criteria ^a (ft NGVD29)
SOCREW-1	14.30	15.54	15.04
SOCREW-2	15.40	16.64	16.14

a. Hydroperiod restoration is defined as the water table being within 6 inches of land surface.

HYDROLOGIC MONITORING RESULTS – YEAR ONE: PRE-CONSTRUCTION

Continual water levels (average day) were plotted for SOCREW-1 and SOCREW-2 for one complete wet season (June 1 to October 30, 2016) and one complete dry season (November 1, 2016, to May 31, 2017) (**Figure 4**). This timeframe occurred prior to the completion of the project restoration and is representative of pre-construction conditions. SOCREW-1 represents the area unimpacted by the project and SOCREW-2 represents the area that will be impacted by project restoration.

Figure 4 shows that SOCREW-1 and SOCREW-2 had water levels at or above their respective HRC during most of the wet season, and water levels fell below the HRC during the dry season. **Table 5** summarizes the percent of time each well met the HRC.

During the wet season, SOCREW-1 and SOCREW-2 had a water table within 6 inches of the land surface 87 and 99 percent of the time, respectively. In the future, these baseline values will be compared to post-construction water levels.

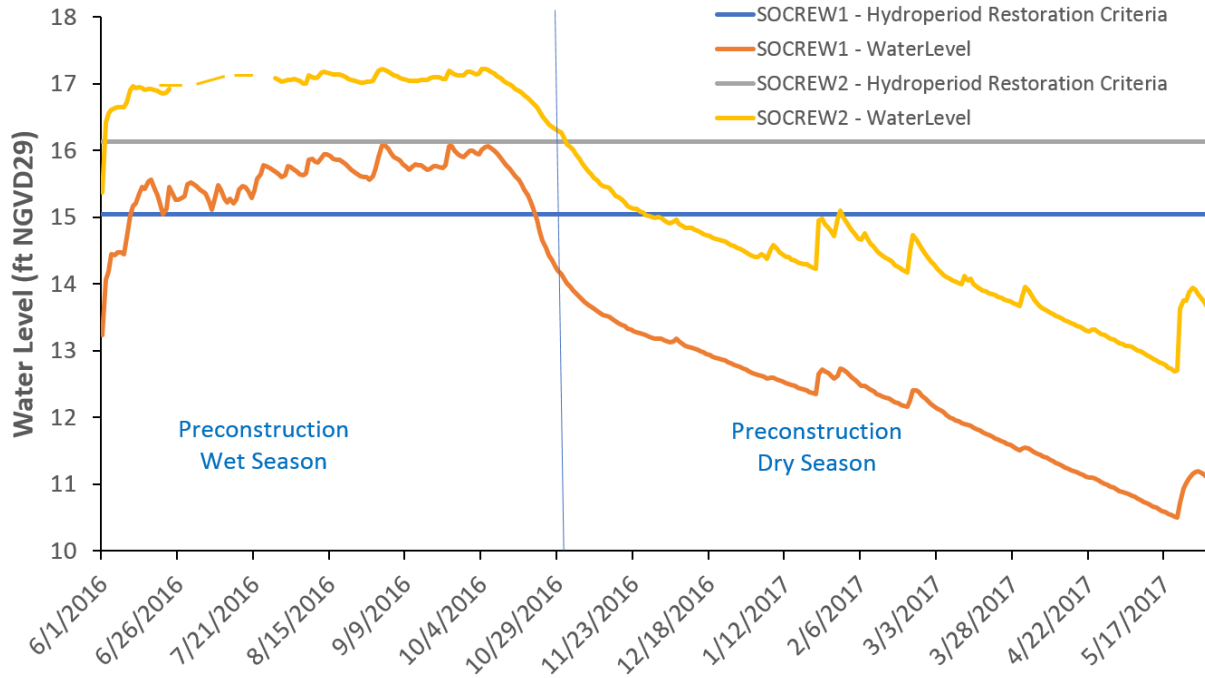


Figure 4. Pre-construction water levels for monitoring wells SOCREW-1 and SOCREW-2.

Table 5. Summary of percent of time HRC are met. ^a

Project Phase	SOCREW-1 (Unimpacted)		SOCREW-2 (Impacted)	
	Wet Season	Dry Season	Wet Season	Dry Season
Pre-Construction	87%	0%	99%	0%
Post-Construction	TBD ^b	TBD	TBD	TBD

a. HRC are met when the water table is within 6 inches of land surface.

b. TBD – to be determined.

RAINFALL DATA FOR EVALUATION PURPOSES

Historical rainfall patterns in the project area are shown in **Figure 5**. Historically, rainfall data were collected from station 951EXT_R through April 1, 2017, when the station was taken out of service and replaced with BRDROOK_R. Both stations are approximately 3 miles from the monitoring wells (**Figure 3**). A comparison of the two rainfall stations during the period of study shows consistent rainfall amounts during the period of overlap (October 12, 2016, to April 1, 2017) (**Figure 6**). The wet season (June 1 to October 31, 2016) was an above-average wet season and the prior dry season was one of the wettest on record.

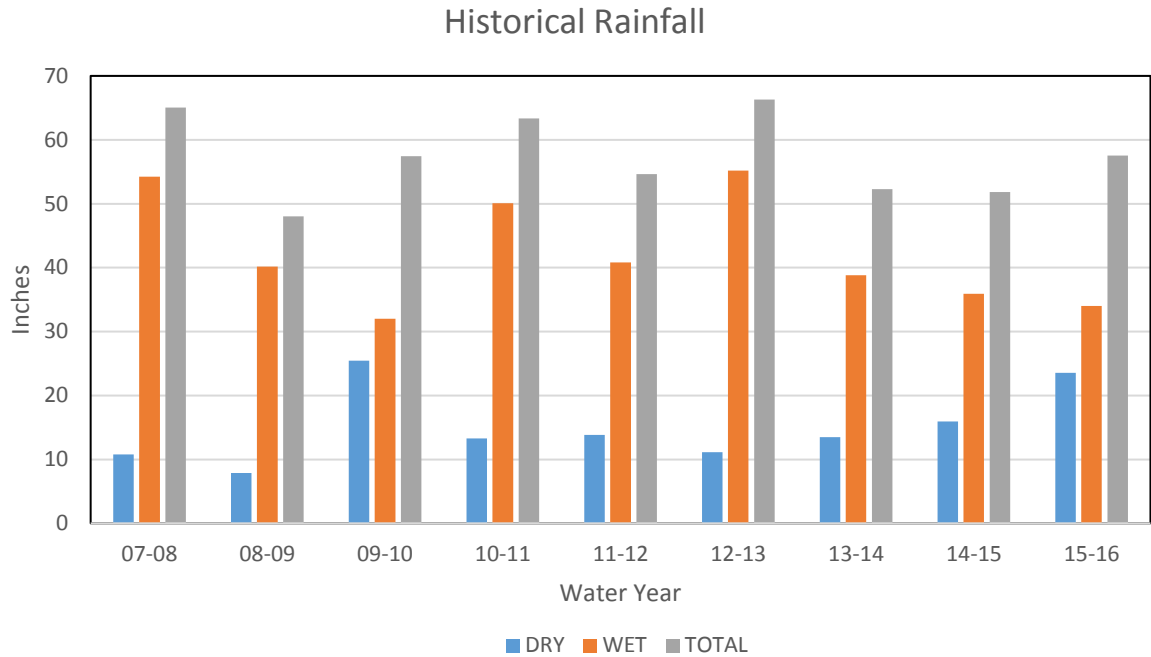


Figure 5. Historical rainfall in the project area.

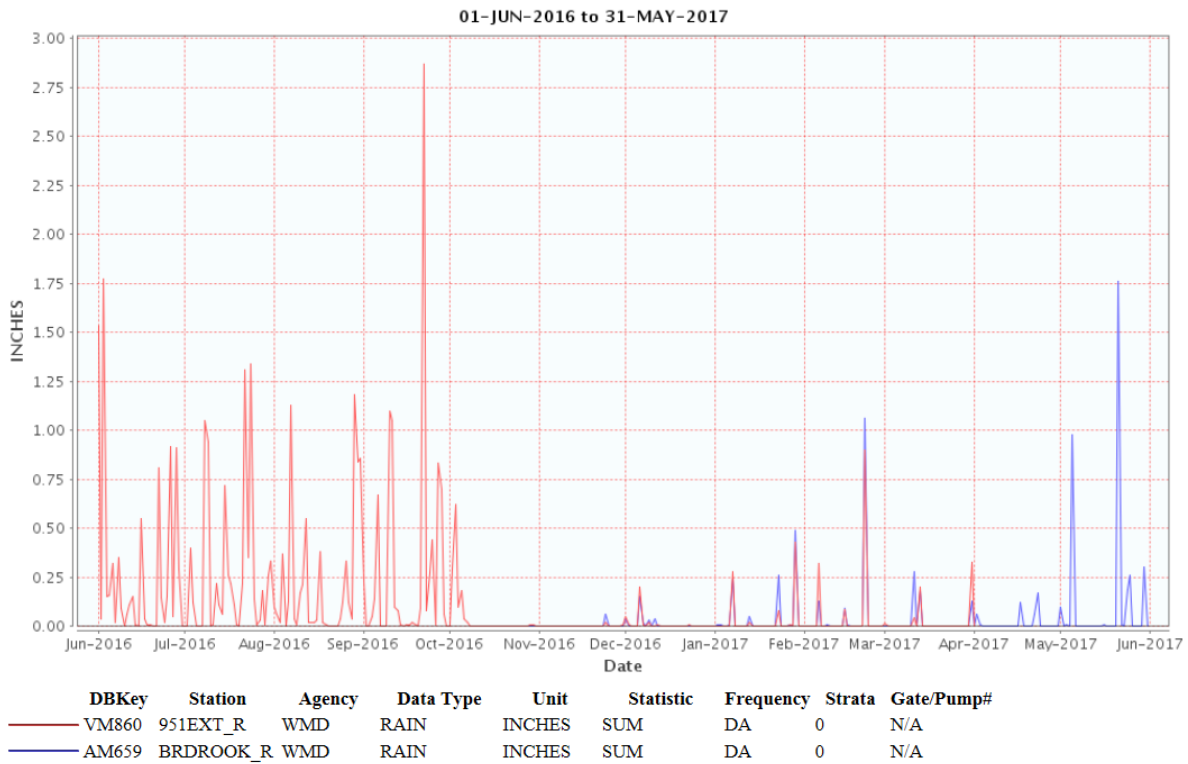


Figure 6. Rainfall data from the period of study with station overlap.
 (Note: DBKey – database key in DBHYDRO; WMD – South Florida Water Management District; RAIN – rainfall; SUM – sum for daily interval; DA – daily; N/A – not applicable.)

CONCLUSIONS

In accordance with Specific Condition Number 20 – Hydrological Monitoring Plan of CERPRA Permit Number 0279719-004, two shallow monitoring wells were constructed at the Southern CREW Restoration Project site. One well (SOCREW-1) was in the unimpacted portion of the site and the other well (SOCREW-2) was in the area to be impacted by site restoration. Daily water levels were collected electronically via a supervisory control and data acquisition (SCADA) system and stored in the SFWMD’s DBHYDRO database.

A HRC was established for each well and defined as the water table being within 6 inches of land surface. The percent of time that water levels fell within the HRC was determined for each well during the wet and dry seasons. During the wet season, the unimpacted and impacted areas were within the HRC 87 and 99 percent of the time, respectively. Between June 1 and October 31, 2016, the water table elevation was below the HRC for 1 day only (June 1, 2016). On the first day of the dry season (November 1, 2016), the water table elevation fell below the HRC.

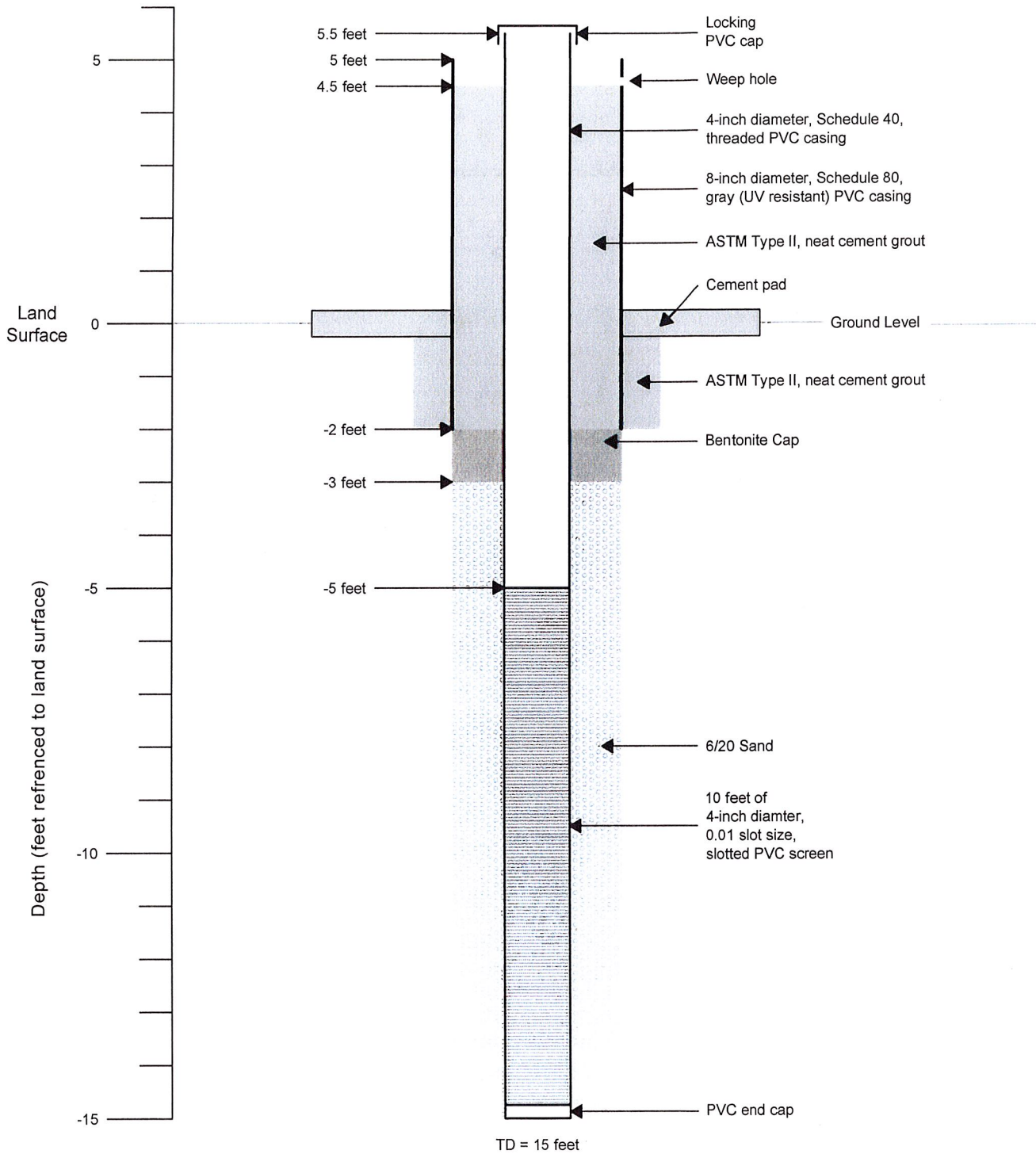
These results set a very high baseline condition as pre-construction water levels in the impacted area met the HRC 99 percent of the time. Post-construction data will need to consider rainfall patterns when comparing future water levels to the pre-construction baseline, which had a “wet” dry season leading up the start of the monitoring period.

LITERATURE CITED


SFWMD. 2015. *Hydrological Monitoring Plan for Southern CREW Restoration*. Operations, Maintenance & Construction Division, South Florida Water Management District, West Palm Beach, FL. May 8, 2015.

Attachment A: Monitoring Well Installation Records

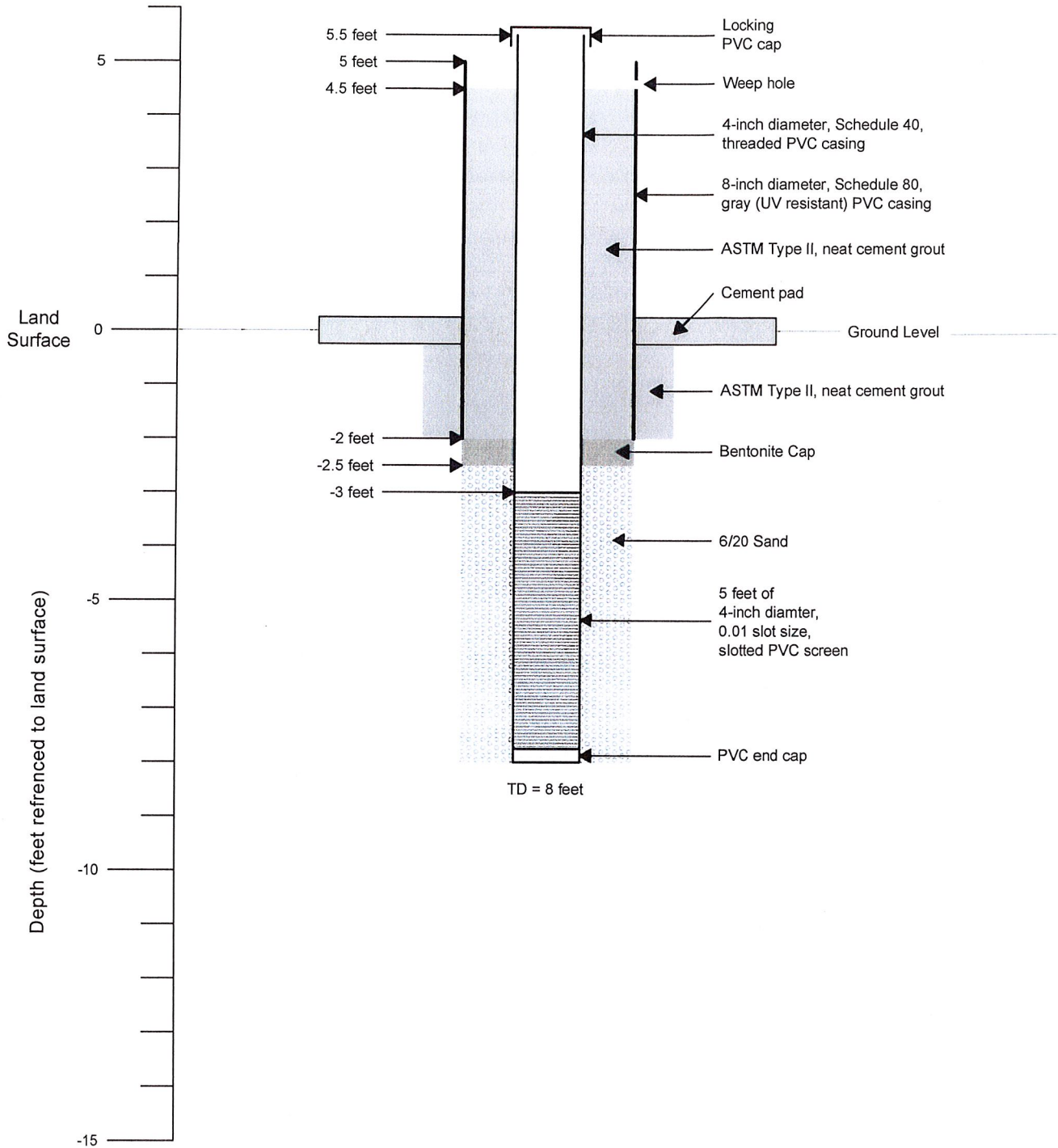
MONITOR WELL INSTALLATION RECORD



WELL NO. SOCREW-1
 BORING DIAMETER 12-inch
 DATE INSTALLED 11-19-15
 LOCATION 262027.3, 814107.4 Lee County, Florida

	GFA INTERNATIONAL, INC. 5851 Country Lakes Drive Fort Myers, Florida 33905 PH: 239-489-2443 FAX: 239-489-3438	
	PROJECT: Southern CREW Monitor Well Installation Bonita Springs, Lee County, FL	
DRAWN BY: <u>WPG</u>	CHECKED BY: _____	DATE: <u>11/24/15</u> 02/22/16 (Rev.)
FILE NO.: <u>15-1450.00</u>	APPROVED BY: <u>S. McManus</u>	

MONITOR WELL INSTALLATION RECORD



WELL NO. SOCREW-2

BORING DIAMETER 12-inch

DATE INSTALLED 11-19-15

LOCATION 262104.4, 814028.8 Lee County, Florida

	GFA INTERNATIONAL, INC. 5851 Country Lakes Drive Fort Myers, Florida 33905 PH: 239-489-2443 FAX: 239-489-3438	
	PROJECT: Southern CREW Monitor Well Installation Bonita Springs, Lee County, FL	
DRAWN BY: <u>WPG</u>	CHECKED BY:	DATE: <u>11/24/15</u> <u>02/22/16 (Rev.)</u>
FILE NO.: <u>15-1450.00</u>	APPROVED BY: <u>S. McManus</u>	

Attachment B: Registration Worksheets

REGISTRATION WORKSHEET - SOCREW1 Activation

Site Name: **SOCREW1** Today's Date: **1/12/2016** Type Recorder: **CR1000**
 Activity: **Activation** Effective Date: _____ Start Date of Data : _____
 Customer: **C. Gomez/SCADA Eng.** Bus. Area: **SCADA** Agency: **SFWMD** Internal Order: _____
 Project Manager: **E. Ebanks** Bus. Area: **InfrStr.Mgt/Survey** Agency: **SFWMD** Fund: _____
 Project Name: _____ Legal Mandate: _____

Short Common Name / Description: _____

Proj. Mgr. Notes: NEW Well site in Southern Crew (BCB) NAVD 88 to NGVD 29 Offset = 1.24ft

Site Directions: From I-75 North in Naples (Exit 116) Bonita Beach Rd. Go East on Bonita Beach Rd. for 3.6miles +/- to a Dirt Rd on left. (Vincent Rd.) Proceed North on Vincent Rd. for 0.63miles +/- to a gate on Right. Enter and proceed East along path for 0.33 mls to Site.

Site Address (if any): _____

Transportation: **4X4 Vehicle** Lock type or combination: **Abloy S** # _____

Recorder Location/Purpose: **Stand-Alone Recorder (Non-Flow Site)** Structure Type: **New Structure**

Array ID Configuration table attached _____

SURVEY INFORMATION

B.M. Elevation: **14.15ft** Date: **7/14/2015** Stamp: **BM SOCREW1 2015**
 Agency: **SFWMD** Type: **ALUM** Datum: **NAVD 88**

Benchmark Location/ Description: From I-75 North in Naples (Exit 116) Bonita Beach Rd. Go East on Bonita Beach Rd. for 3.6miles +/- to a Dirt Rd on left. (Vincent Rd.) Proceed North on Vincent Rd. for 0.63miles +/- to a gate on Right. Enter and proceed East along path for 0.33 mls to Site. Mark located 15ft south of path and 4ft north of dead pine tree.

COMMUNICATIONS INFORMATION

Communications System: _____ Loggernet Server: _____ Loggernet IP Address: _____
 Tower: _____ Communication Type: _____ R.F. Code/Modem Address: _____ R.F. Access Point: _____
 Phone Number: _____
 RTU Address: _____ Gateways: _____

WELL INFORMATION

Sensor	Customer Ref	Ref Elev	Elev Date	Top of Well	Bottom of Well	Ground Elev	Benchmark Elev	Benchmark Datum	Ref Elevation Location
STG1		21.025ft		21.025ft		14.3ft	14.15ft	NAVD 88	Mark Set on Rim of PVC Well.. Denoted by Brass Tag.

Sensor	GW Sensor Location Offset	Meas Pt Elevation	GW Land Elevation	Depth of Well	Type of Well	Top of Monitored Interval	Base of Monitored Interval	Parameter Transmitted								
STG1																

COORDINATE INFORMATION




Item/Param	Lat	Long	X-Coord	Y-Coord	Sec	Township	Range	Quad	Basin	County	Description
STG1	26 20 27.3	81 41 07.4			35	47	26	Corkscrew SW		LEE	

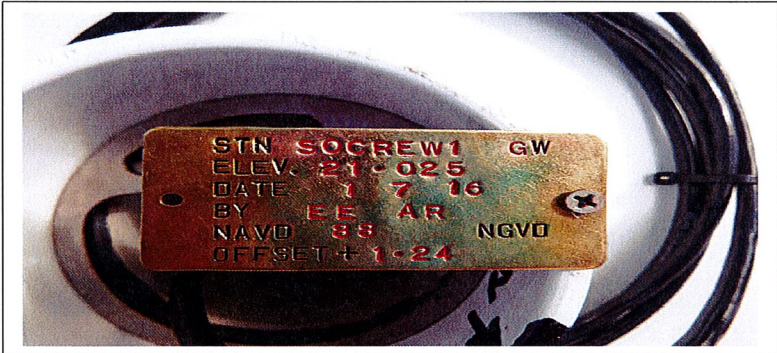
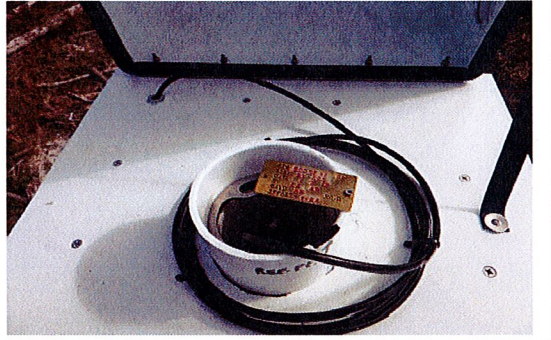
Site Name SOCREW1 GW		Date of Field Work 1/7/2016
Party Chief Ebanks/Rodriguez	Field Book Name/Number SCADA FB #12	Page Number(s) Pg. 9
Site Benchmark Name BM SOCREW1 2015	Benchmark Elevation (NAVD88) 14.15ft	Datum Offset to NGVD29 +1.24'
Reference Elevation (NAVD 88) 21.025ft		Existing Tag Elevation (Datum) N/A
Latitude 26° 20' 27.3"		Longitude 81° 41' 07.4"

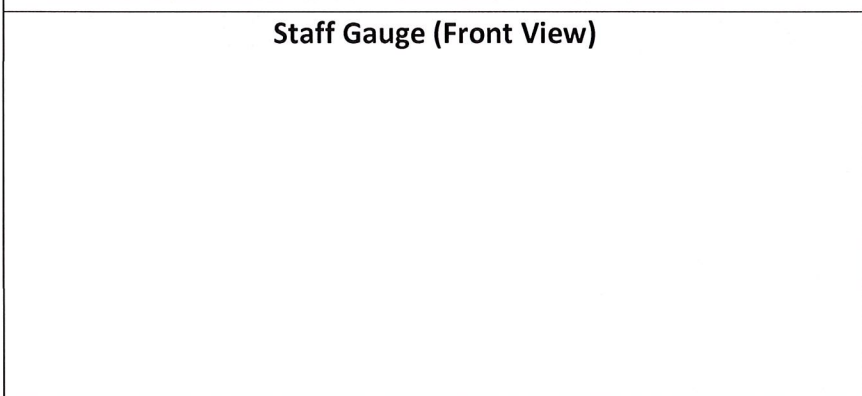

Notes: Datum Upgrade to NAVD 88 from NGVD 29

Surveyor's Note: Natural Ground Elevation at Well Site = 14.30ft (NAVD 88)

Photographs

Overall Site	Benchmark Location	Benchmark Close Up
		

Brass Tag Close Up	Brass Tag + Reference Mark
	

Staff Gauge (Front View)	Staff Gauge (Side View)
	

REGISTRATION WORKSHEET - SOCREW2 Activation

Site Name: **SOCREW2** Today's Date: **1/12/2016** Type Recorder: **CR1000**
 Activity: **Activation** Effective Date: Start Date of Data :
 Customer: **C. Gomez/SCADA Eng.** Bus. Area: **SCADA** Agency: **SFWMD** Internal Order:
 Project Manager: **E. Ebanks** Bus. Area: **InfrStr.Mgt/Survey** Agency: **SFWMD** Fund:
 Contract #:
 Project Name: Legal Mandate:

Short Common Name / Description:

Proj. Mgr. Notes: NEW Well site in Southern Crew (BCB) NAVD 88 to NGVD 29 Offset = 1.24ft

Site Directions: From I-75 North in Naples (Exit 116) Bonita Beach Rd. Go East on Bonita Beach Rd. for 3.6miles +/- to a Dirt Rd on left. (Vincent Rd.) Exit Bonita Beach Rd. onto Dirt Rd going East for 1 mile +/- to a gate on left and Rd. continuing north. Enter gate and proceed 2.6miles +/- to a pea rock access over ditch. Site is visible from Rd. Approx. 100ft

Site Address (if any):

Transportation: **4X4 Vehicle** Lock type or combination: **Abloy S** #
 Recorder Location/Purpose: **Stand-Alone Recorder (Non-Flow Site)** Structure Type: **New Structure**
 Array ID Configuration table attached

SURVEY INFORMATION

B.M. Elevation: **16.10ft** Date: **7/14/2015** Stamp: **BM SOCREW2 2015**
 Agency: **SFWMD** Type: **ALUM** Datum: **NAVD 88**

Benchmark Location/ Description: From I-75 North in Naples (Exit 116) Bonita Beach Rd. Go East on Bonita Beach Rd. for 3.6miles +/- to a Dirt Rd on left. (Vincent Rd.) Exit Bonita Beach Rd. onto Dirt Rd going East for 1 mile +/- to a gate on left and Rd. continuing north. Enter gate and proceed 2.6miles +/- to a pea rock access Rd. on right, (to Well Site) BM is on Left side of Rd

COMMUNICATIONS INFORMATION

Communications System: Loggernet Server: Loggernet IP Address:
 Tower: Communication Type: R.F. Code/Modem Address: R.F. Access Point:
 Phone Number:
 RTU Address: Gateways:

WELL INFORMATION

Sensor	Customer Ref	Ref Elev	Elev Date	Top of Well	Bottom of Well	Ground Elev	Benchmark Elev	Benchmark Datum	Ref Elevation Location
STG1		22.18ft		22.18ft		15.4ft	16.10ft	NAVD 88	Mark Set on Rim of PVC Well. Denoted by Brass Tag.

Sensor	GW Sensor Location Offset	Meas Pt Elevation	GW Land Elevation	Depth of Well	Type of Well	Top of Monitored Interval	Base of Monitored Interval	Parameter Transmitted								
STG1																

COORDINATE INFORMATION

Item/Param	Lat	Long	X-Coord	Y-Coord	Sec	Township	Range	Quad	Basin	County	Description
STG1	28 21 04.4	81 40 28.8			25	47	28	Corkscrew SW		LEE	

Site Name SOCREW2 GW		Date of Field Work 1/7/2016
Party Chief Ebanks/Rodriguez	Field Book Name/Number SCADA FB #12	Page Number(s) Pg. 9
Site Benchmark Name BM SOCREW2 2015	Benchmark Elevation (NAVD88) 16.10ft	Datum Offset to NGVD29 +1.24'
Reference Elevation (NAVD 88) 22.18ft	Existing Tag Elevation (Datum) N/A	
Latitude 26° 21' 04.4"	Longitude 81° 40' 28.8"	
Notes: Datum Upgrade to NAVD 88 from NGVD 29		
Surveyor's Note: Natural Ground Elevation at Well Site = 15.40ft (NAVD 88)		

Photographs

Overall Site



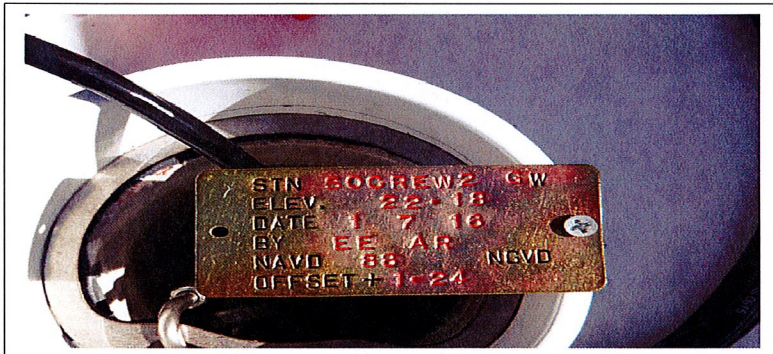
Benchmark Location



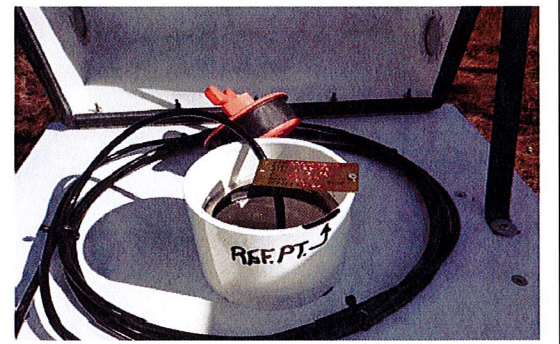
Benchmark Close Up



Brass Tag Close Up



Brass Tag + Reference Mark



Staff Gauge (Front View)

Staff Gauge (Side View)