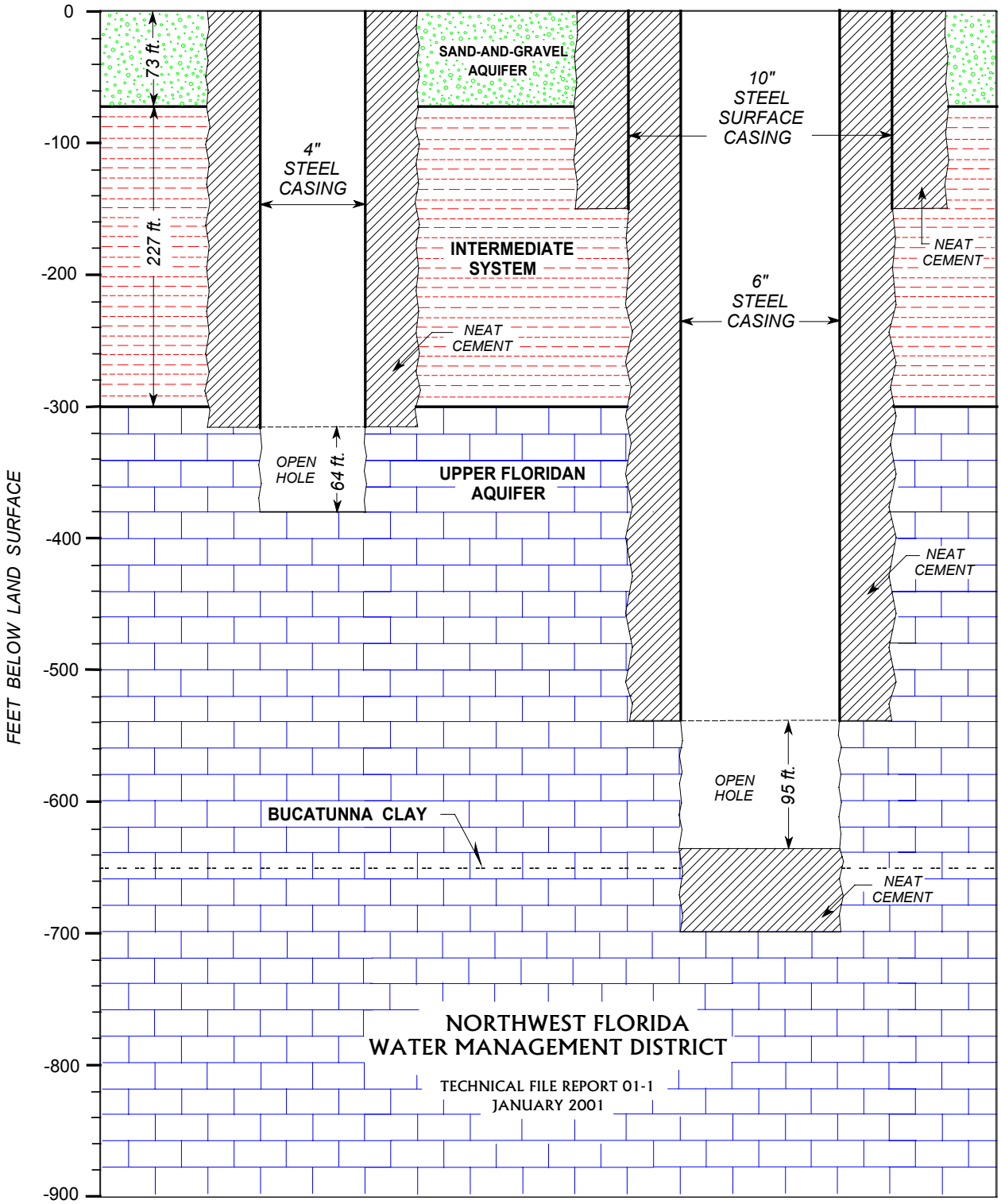
RESULTS OF FLORIDAN AQUIFER DRILLING PROGRAM IN SANTA ROSA, OKALOOSA AND WALTON COUNTIES, FLORIDA



NORTHWEST FLORIDA WATER MANAGEMENT DISTRICT

TECHNICAL FILE REPORT 01-1
JANUARY 2001

RESULTS OF FLORIDAN AQUIFER DRILLING PROGRAM IN SANTA ROSA, OKALOOSA AND WALTON COUNTIES, FLORIDA

By: Thomas R. Pratt

NORTHWEST FLORIDA WATER MANAGEMENT DISTRICT

Technical File Report 01-1

January 2001

NORTHWEST FLORIDA WATER MANAGEMENT DISTRICT
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(850) 539-5999

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ACKNOWLEDGMENTS

The author wishes to acknowledge the cooperation and assistance provided by a number of governmental and personnel throughout Santa Rosa, Okaloosa and Walton counties. Messrs. Mark Van Hala and Alan Lassiter of the City of Fort Walton Beach facilitated access to the Liza Jackson Park site. Mr. Glen Peters (City of Fort Walton Beach) facilitated sampling the completed well. Mr. Larry McDonald and Ms. Janice Rogers (City of Fort Walton Beach) facilitated sampling the Beal Cemetery Lower Floridan Aquifer well. Santa Rosa County Commissioner Mr. Bill Campbell and Mr. Clif Breeland provided access to the Tiger Point Recreation Area. Mr. Vernon Prather (City of Gulf Breeze) helped with disposal of development water. Mr. Richard Delp, formerly of the Midway Water System, assisted by providing potable water for drilling. Mr. Dewey Wilson provided a well site in south Walton County (Seagrove site) on property owned by Regional Utilities, Inc. Mr. Shannon Howell and Ms. Amy Burke facilitated access to the site. Mr. Dave Marell, also of RU, helped with disposal of development water, as did Messrs. Richard Griswold and Darren Alford of Destin Water Users. Mr. Dan Robeen facilitated access to the Eglin AFB wells on Santa Rosa Island. Mr. Pete DeBogory (South Walton Utility Company) provided access to the SWU Mack Bayou Floridan Aquifer monitor well. Messrs. Jim Thomason and Brad Thomason (Thomason Well Drilling, Ft. Walton Beach) ably oversaw well construction. Mr. Harley Means of the Florida Geological Survey oversaw the description of well cuttings generated by the project. The assistance of all these individuals is greatly appreciated.

A number of District staff participated in this project. Ms. Ruth-Ann Womble oversaw the preparation of contract documents. Mr. Chris Richards oversaw much of the drilling operation and either performed or oversaw the geophysical logging operation. Mr. Tony Countryman oversaw portions of the drilling operation and supervised much of the sampling. He also performed the sampling of the EAFB Santa Rosa Island production wells. Messrs. Klint Cowan, Alan Baker and Alex Wood assisted with the drilling operation and with sampling. Mr. Gary Miller prepared figures for this report. The contributions of these individuals are gratefully acknowledged.

INTRODUCTION

Purpose and Scope

This report provides a description of data collected (principally) during 2000 as a part of a Floridan Aquifer drilling program in water supply planning Region II. Wells were constructed at three sites in Santa Rosa, Okaloosa and Walton counties. The purpose of the drilling and testing was to quantify the water quality, lithology and hydraulic properties of the upper Floridan Aquifer along the coastline of Region II. In addition, sampling was also conducted at other wells of interest.

Study Area Location

Three sites were drilled: the Liza Jackson Park in Fort Walton Beach; the Tiger Point Recreation Area in unincorporated Santa Rosa County, east of Gulf Breeze; and at a site in coastal Walton county, in the vicinity of Seagrove Beach. Samples were also collected at a number of wells owned by Eglin AFB and located on Santa Rosa Island.

Methods

All wells were drilled using conventional hydraulic rotary and reverse air circulation techniques. Typically, hydraulic rotary circulation was used to drill the Sand-and-Gravel Aquifer and Intermediate System. Reverse air circulation was used to drill the Upper Floridan Aquifer. In two instances (Tiger Point and Seagrove) potable water had to be added to the borehole to support either reverse air or hydraulic rotary drilling in the uppermost portion of the open hole. This was due to the fact that, for the first 40 or so feet out of casing, the Floridan Aquifer would not produce enough water to clear cutting from the borehole without added water.

Drill stem sampling was accomplished by clearing the borehole of cuttings with air and, subsequently, allowing water to purge from the borehole. Field parameters were monitored until the water quality had sufficiently stabilized and the well was sampled. Typically, the borehole was flushed with the drill rod several feet above the bottom. It required anywhere from 30 minutes to 2.5 hours for field parameters to stabilize. Samples were field filtered with a 0.45 micron filter, preserved, iced and forwarded to the FDEP Central Laboratory for analysis. Samples collected on October 13, 16, 17, 18 and 20 and November 7 and 9 for calcium, iron, magnesium, potassium and sodium were inadvertently not filtered in the field. In addition, most of the samples collected from the Eglin AFB Santa Rosa Island wells in March were not field filtered.

Development water from the Tiger Point and Seagrove sites was transported off-site for disposal. At Tiger Point, a nearby City of Gulf Breeze sanitary sewer was used for disposal. Water was piped a short distance and discharged to the sewer. At Seagrove, development water was pumped from the mud pit and transported to an off-site WWTP. During pump testing Tiger Point water was discharged to the sanitary sewer. At Seagrove, pump test water was containerized and transported to an off-site WWTP.

Lithologic samples were described by personnel of the Florida Geological Survey.

LIZA JACKSON PARK (AAD9903)
WELL CONSTRUCTION CHRONOLOGY

02.01.00 Drilling begins. Driller tags top of upper Floridan Aquifer at a depth of 460 ft. Driller looses circulation at a depth of 495 ft.

02.03.00 Intermediate System and Sand-and-Gravel Aquifer geophysically logged in mudded hole. 480 ft of eight-inch steel surface casing installed.

02.04.00 Eight-inch surface casing pressure grouted into the top of the upper Floridan Aquifer with 160 bags of cement.

02.07.00 Drilling upper Floridan Aquifer with reverse air circulation.

02.08.00 Drilling upper Floridan Aquifer with reverse air circulation.

02.09.00 Driller tags top of Bucatunna Clay confining unit at a depth of 919 ft. Well air developed for 150 minutes at 150 gal/min (22,500 gallons or 10.7 well volumes). One well volume equals 2,100 gallons.

02.10.00 Upper Floridan Aquifer geophysically logged under pumping and non-pumping conditions. Well pump purged for 52 minutes at 150 gal/min (7,800 gallons or 3.7 well volumes) and sampled. Point samples collected at depths of 590 ft and 897 ft.

02.14.00 Four-inch diameter steel well casing installed to a depth of 835 ft. Interval between 835 ft and 919 ft back-filled with sand.

02.15.00 Four-inch well casing pressure grouted with 182 bags of cement.

02.16.00 Open-hole interval cleared of sand. Well developed with air for four hours at about five gal/min (1,200 gallons or 1.7 well volumes). One well volume equals 700 gallons. One open-hole volume equals 220 gallons.

02.17.00 Well developed with air for three hours at about five gal/min (900 gallons or 1.3 well volumes).

11.07.00 Pump installed to a depth of 240 ft. Static water level 114 ft bls. Well pumped at approximately 10 gal/min until it broke suction (at about 13 minutes). Pump throttled back to 4.6 gal/min and water level stabilized just above pump intake. Well purged for 400 minutes at 4.6 gal/min (1,840 gallons or 2.6 well volumes) and sampled.

WELL HYDRAULICS

Specific capacity data were obtained when the well was sampled on 11.07.00. The well was pumped for 6.7 hours (400 minutes) at 4.6 gal/min. Drawdown was approximately 126 ft, yielding a specific capacity of 0.04 gal/min/ft.

LIZA JACKSON UPPER FLORIDAN AQUIFER MONITOR WELL

SEC. 15 T-2-S R-24-W

OKALOOSA COUNTY, FLORIDA

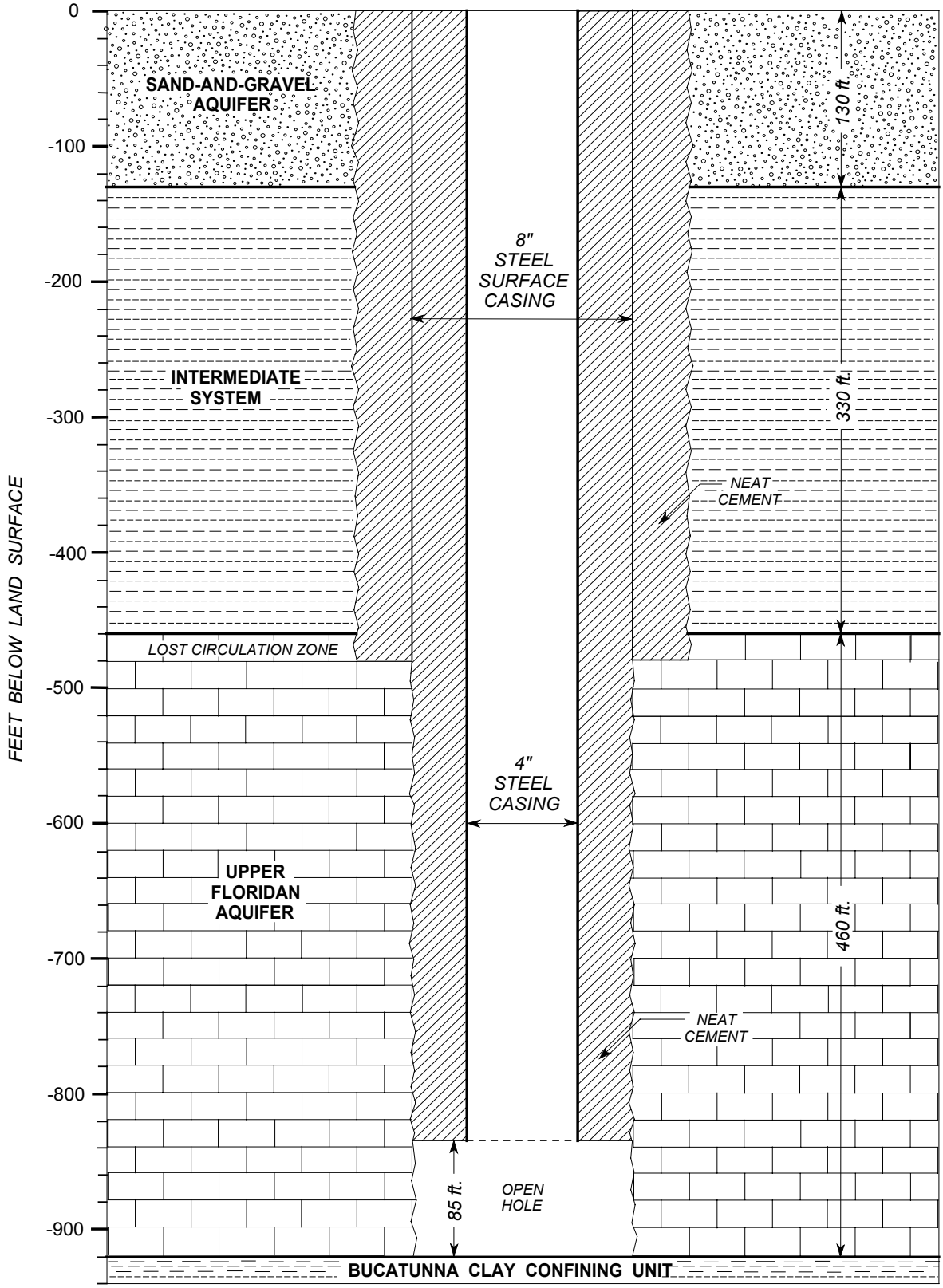


Table 1. Liza Jackson Park (AAD9903) Analytical Results.

Analyte	Point sample from depth of 590 ft	Point sample from depth of 897 ft	Interval between 480 ft and 919 ft	Interval between 835 ft and 919 ft	Units
Bicarbonate alkalinity	140	150	200	150	mg/L
Alkalinity	202	183	202	255	mg $CaCO_3$/L
Chloride	58	98	60	170	mg/L
Fluoride	2	2.8	2.1	2.0	mg/L
Nitrate	<0.02	<0.02	<0.02	<0.02	mg N/L
Orthophosphate	0.012	0.013	0.012	0.016	mg P/L
Silica	8.6	11	13	12	mg SiO_2/L
Sulfate	14	36	13	38	mg/L
Total Dissolved Solids	303	489	326	637	mg/L
Calcium	7.5	53.5	3.2	3.3**	mg/L
Iron	0.74	0.53	0.03	0.03*	mg/L
Magnesium	2	3	2	10.1**	mg/L
Potassium	7.6	7.2	6.2	12.1**	mg/L
Sodium	125	140	126	223**	mg/L
Na^+/Cl^-	2.16	1.43	2.1	1.31	
sample date	02.10.00	02.10.00	02.10.00	11.07.00	
matrix	filtered	filtered	filtered	filtered	
sampling technique	wireline	wireline	airlift	pumped	

*denotes value between MDL and PQL, ** denotes analyte not filtered

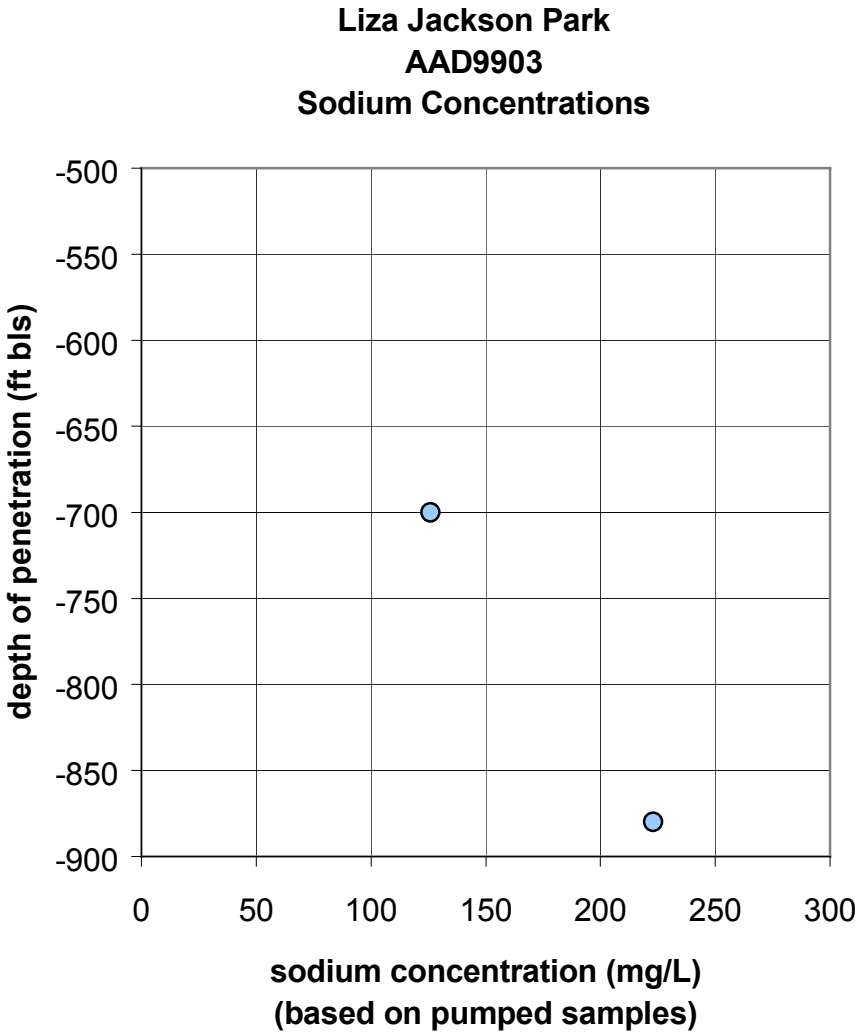


Figure 3. Sodium Concentration Versus Mid-Point of Open Hole Interval, Liza Jackson Park.

NWFWMD Well Inventory Database System

Site Schedule

Site Id	**302421086380701**			NWF ID	**7523**
Well Name	**NWFWMD LIZA JACKSON**			State ID	**AAD9903**
Owner	**NWFWMD**				
Contact Person				Phone	**850-539-5999**
Street	**81 WATER MANAGEMENT DRIVE**				
City	**HAVANA**	State **FL**	Zip **32333**	County	**Okaloosa**
Latitude	**302421**	Longitude **863807**	Datum **NAD83**	Loc Method	**Geographic Information System**
Land Net	**CCDS15T2SR24W**	Loc Accuracy	**15 < 60 meters**	Loc Source	
Elevation	**3**	Datum **NGVD29**	Method	**Topo Map**	
Accuracy	**1 < 5 feet**	Source **NWFWMD**			
Location Map	**MARY ESTHER**	GW Region	**Western Panhandle Embayment Region**		

Site Use	**Monitor / OBS**	Water Use	**Monitor**

Depth Of Well	**917**	Depth Of Casing	**835**
MP Distance From LSD	**-.2**	Diameter	**4**
Construction Data Source	**NWFWMD**	Casing Material	**Steel**
Finish	**Open Hole**	Driller License Number	**1136**
Date of Construction	**20-FEB-00**	Construction Method	**Reverse Rotary**
Screen Length			
Screened Intervals			

Water Level	**-114.2**	Measure Date	**07-NOV-00**
WL Source	**NWFWMD**	WL Method	**Electric Tape**

Hydrogeologic Units	**Upper Floridan**

Lift	**No Pump**	Power	
Horsepower		Pump Intake	
Normal Yield		Spcap Discharge	**5**
Spcap Source	**NWFWMD**	Spcap Discharge Method	**Volumetric**
Spcap Static Level	**-114**	Spcap Pumping Level	**-240**
Spcap Drawdown	**126**	Hours Pumped	**6.7**
Spcap	**.04**		

Field Water Quality		Date of Sample	**07-NOV-00**
Temperature	**25.8**	pH	**9.44**
Specific Conductance	**1179**	Chloride	**170**

Consumptive Use Permit		Construction Permit	**P200001088**
FL Geological Survey #		Abandonment Permit	
DEP Public Supply #			
Project #'s	**75 70 73**		
Geophysical Log #	**138**	Depth Logged	**904**
Available LOG Data	**Caliper Fluid Vel. Temp Sampler Gamma SP Fluid Res. Electric**		

Visited By	**C RICHARDS**	Date Visited	**01-FEB-00**
Data Entered By	**C RICHARDS**	Date Entered	**11-FEB-00**
Last Updated By	**T PRATT**	Last Updated	**24-JAN-01**
Ambient Network	**WL**		

(C.RICHARDS;FEB 11, 2000) WELL DRILLED FOR SALTWATER INTRUSION MONITORING. Open hole interval is 7-7/8 inches in diameter. On 11/07/2000 well was sampled, Thomason installed a pump with 240 ft of drop pipe, well was pumped at approximately 10 gpm and broke suction in about 15 minutes, flow rate was throttled back to 4.5 gpm with valve and well did not break suction for duration of testing. Water level measured at 4.5 gpm and appeared to be very near the pump intake. Well was purged of 3 well volumes, 1,800 gallons, after approximately 6.7 hours and sampled.

TIGER POINT RECREATION AREA (AAD9021)
WELL CONSTRUCTION CHRONOLOGY

03.28.00 Drilling begins. Driller reams hole to a depth of 240 ft.

03.29.00 240 ft of ten-inch diameter steel surface casing installed.

03.30.00 Surface casing pressure grouted with 90 bags of cement.

04.04.00 Drilling Intermediate System with hydraulic rotary circulation.

04.05.00 Drilling Intermediate System with hydraulic rotary circulation. Driller tags top of upper Floridan Aquifer at a depth of 1,030 ft.

04.06.00 Driller advances borehole to 1,165 ft. Upper portion of the upper Floridan Aquifer and the Intermediate System geophysically logged in mudded hole.

04.12.00 Second pass complete to a depth 1,140 ft.

04.14.00 Six-inch diameter steel well casing installed to a depth of 1,140 ft.

04.17.00 Well casing pressure grouted with 290 bags of cement. Driller looses portion of PVC tremie line.

04.19.00 Drill interval from 1,140 ft to 1,200 ft with reverse air circulation and added potable water (between casing and drill stem). Develop with air for 3.75 hours and with 115 ft of airline, minimal formation water yield.

04.20.00 Add airline for a total length of 300 ft. Develop with air for 2.5 hours and sample. Well producing at about 8 gal/min.

04.24.00 Drill interval from 1,200 ft to 1,220 ft with reverse air circulation. Little return of cuttings due to drilled up PVC tremie line lost during well grouting. Forward circulating added potable water in attempt to clear drill stem, no sample.

04.25.00 Forward circulating water in an attempt to clear drill stem of cuttings and plastic. Reverse circulating with air and potable water to clear plastic. Hole cleared of cuttings and plastic to 1,220 ft, developed for 2.5 hours at 40 gal/min and sampled. Drill interval from 1,220 ft to 1,240 ft. Drill stems fouls then clears with added water (between casing and drill stem). Well developed for 1.75 hours at 50 gal/min and sampled.

04.26.00 Drill interval from 1,240 ft to 1,260 ft, develop for 40 minutes and sample. Well producing over 100 gal/min. Drill interval from 1,260 ft to 1,280 ft, develop for 45 minutes and sample. Drill interval from 1,280 ft to 1,300 ft, develop for 30 minutes and sample. Driller tags top of Bucatunna Clay confining unit at a depth of 1,310 ft.

04.27.00 Develop well with 200 ft of airline. Well sampled after two hours of development.

TIGER POINT RECREATION AREA (AAD9021)
WELL CONSTRUCTION CHRONOLOGY (continued)

11.07.00 Wireline point sampling of water column to establish pre-pumping fluid conductivity profile.

11.08.00 20.5-hour specific capacity test. Well pumped at 167 gal/min. Well sampled after being pump purged for 1,140 minutes (190,000 gallons or 103 well volumes). One well volume equals 1,840 gallons. Wireline point sampling of water column to establish post-pumping fluid conductivity profile.

TIGER POINT RECREATION AREA LITHOLOGIC FORMATIONS

0 ft – 70 ft	Pleistocene Sands
70 ft – 470 ft	Miocene Coarse Clastics
470 ft – 610 ft	Pensacola Clay
610 ft – 650 ft	Escambia Sand Member of Pensacola Clay
650 ft – 1030 ft	Pensacola Clay
1030 ft – 1312 ft	Chickasawhay Limestone
1312 ft – 1315 ft	Bucatunna Clay

Formation picks based on cuttings with 20-foot sample interval.

TIGER POINT UPPER FLORIDAN AQUIFER MONITOR WELL

SEC. 28 T-2-S R-28-W

SANTA ROSA COUNTY, FLORIDA

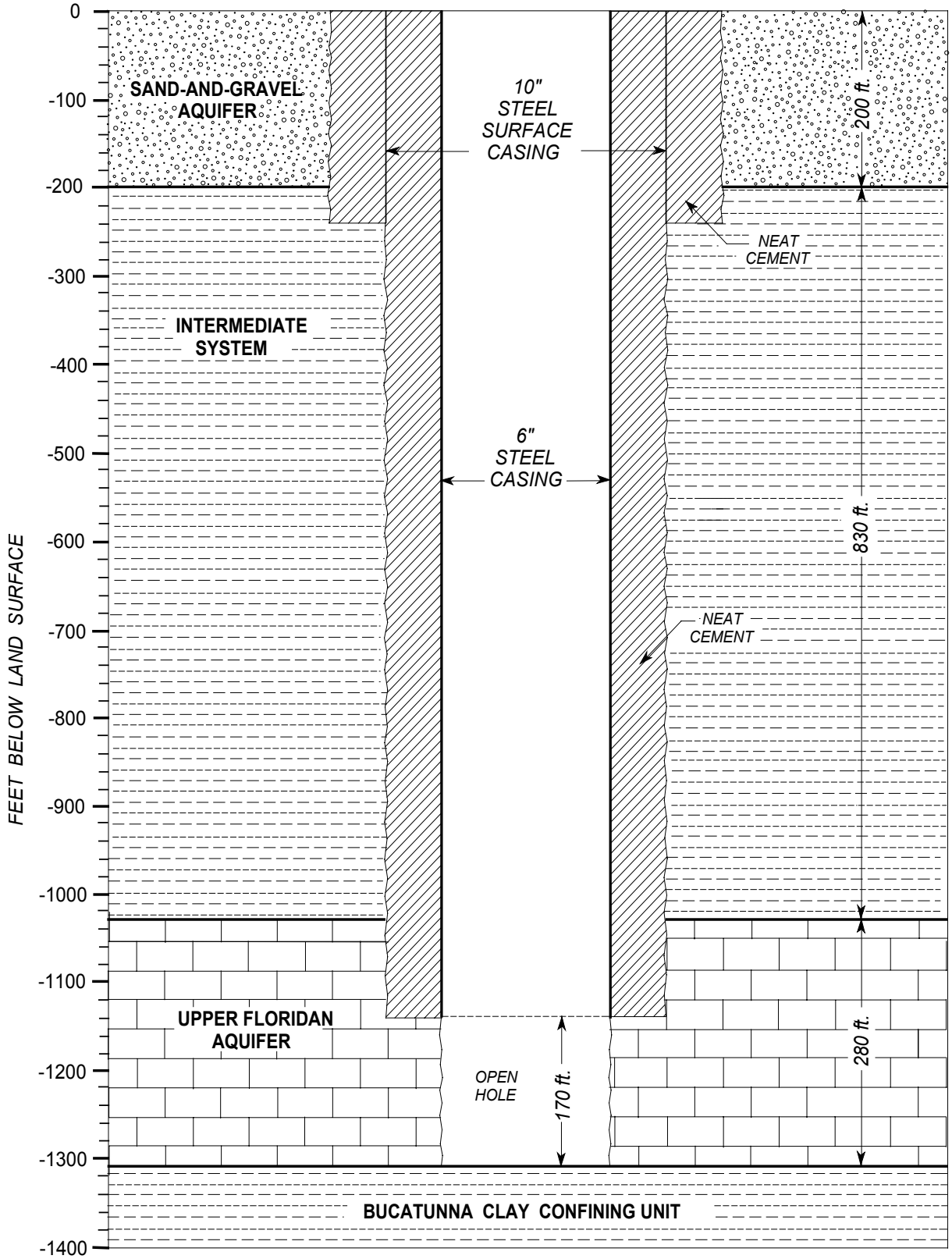


Table 2. Tiger Point Recreation Area (AAD9021) Analytical Results.

Analyte	1,200 ft	1,220 ft	1,240 ft	1,260 ft	1,280 ft	Units
Bicarbonate alkalinity	590	480	470	440	490	mg/L
Alkalinity	643	517	524	551	551	mg $CaCO_3$/L
Chloride	340	390	410	420	520	mg/L
Fluoride	6.2	5.2	5.1	5.4	5.3	mg/L
Nitrate	<0.02	<0.02	<0.02	<0.02	<0.02	mg N/L
Orthophosphate	0.029	0.055***	0.052***	0.056***	0.05***	mg P/L
Silica	16	16	17	17	17	mg SiO_2/L
Sulfate	4.6	6.3	6.3	6.7	9	mg/L
Total dissolved solids	1237	1199	1239	1259	1424	mg/L
Calcium	60.2	2.9	2.7	8.7	3	mg/L
Iron	4.6	0.078	0.043	0.26	0.17	mg/L
Magnesium	3.3	1.6	1.7	2	2.1	mg/L
Potassium	7.6	6.8	6.7	7.1	7.8	mg/L
Sodium	492	448	439	468	507	mg/L
Na^+/Cl^-	1.45	1.15	1.07	1.11	0.98	
sample date	04.19.00	04.25.00	04.25.00	04.26.00	04.26.00	
matrix	filtered	filtered	Filtered	filtered	Filtered	
sampling technique	airlift	airlift	Airlift	airlift	Airlift	

Analyte	1,300 ft	Interval between 1,140 ft and 1,310 ft	Interval between 1,140 ft and 1,310 ft	Units
Bicarbonate alkalinity	510	490	540	mg/L
Alkalinity	549	531	503	mg $CaCO_3$/L
Chloride	590	520	600	mg/L
Fluoride	5.3	5.1	5.0	mg/L
Nitrate	<0.02	<0.02	<0.02	mg N/L
Orthophosphate	0.049***	0.051***	0.056	mg P/L
Silica	17	17	18	mg SiO_2/L
Sulfate	16	1.8	11	mg/L
Total dissolved solids	1546	1434	1568	mg/L
Calcium	3.4	3	4.4**	mg/L
Iron	0.2	0.046	0.055*	mg/L
Magnesium	2.6	2.2	3.2**	mg/L
Potassium	8.4	7.8	9.4**	mg/L
Sodium	598	548	620**	mg/L
Na^+/Cl^-	1.01	1.05	1.03	
sample date	04.26.00	04.27.00	11.09.00	
matrix	filtered	filtered	Filtered	
sampling technique	airlift	airlift	Pumped	

*denotes values between MDL and PQL, **denotes analyte not filtered,*** denotes estimated value

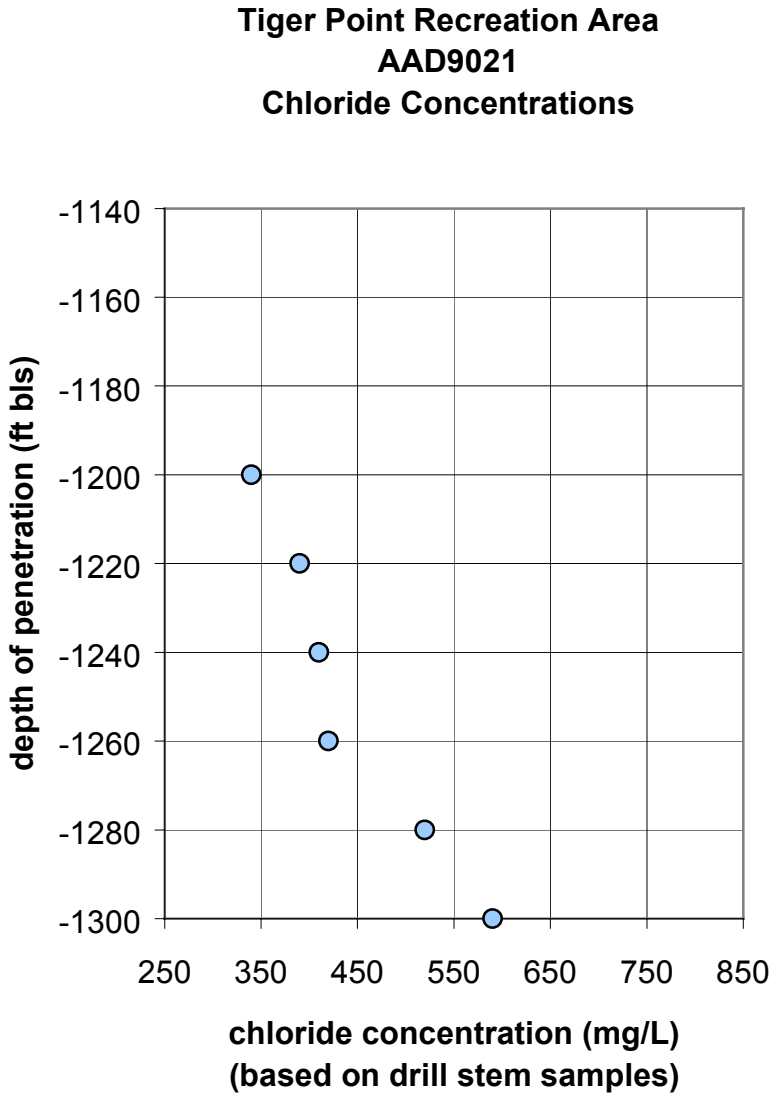


Figure 6. Chloride Concentration Versus Depth of Penetration, Tiger Point Recreation Area.

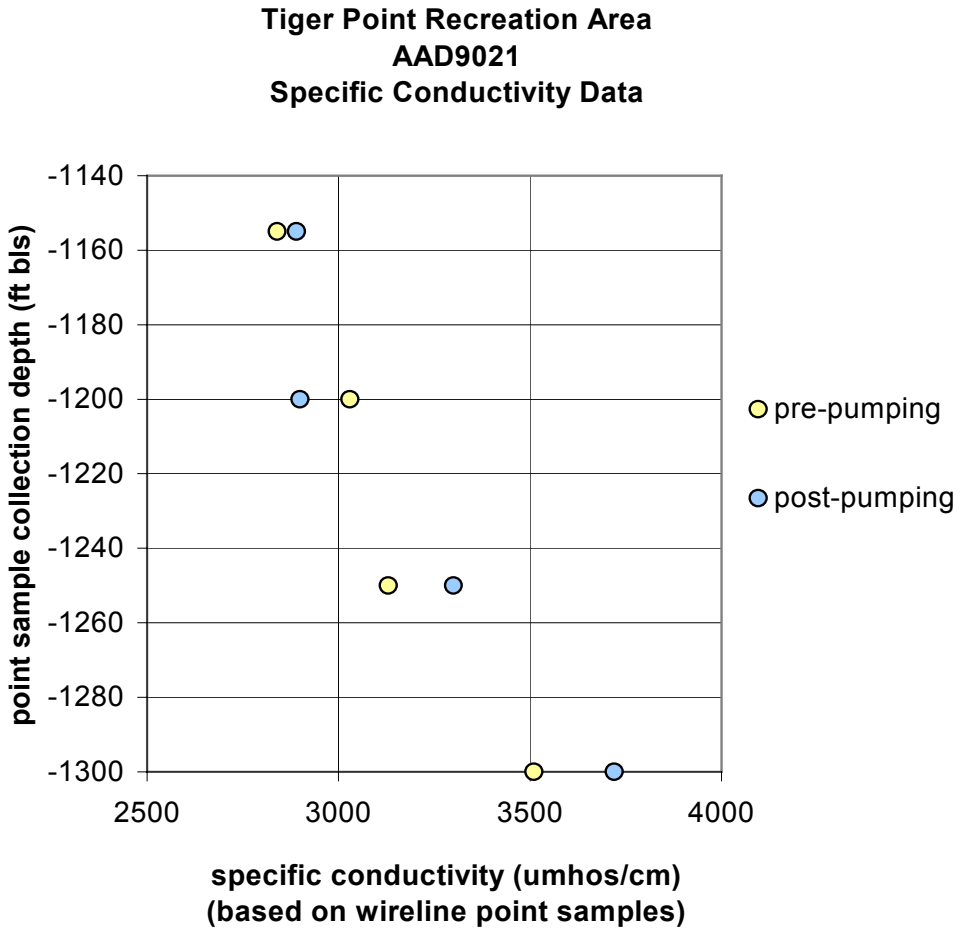
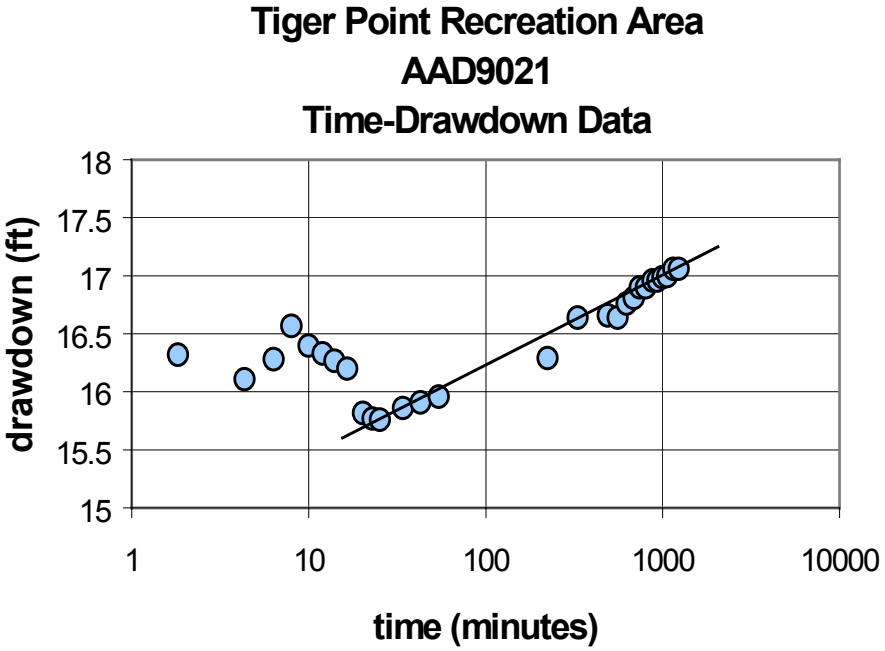


Figure 7. Field Specific Conductance Versus Depth, Tiger Point Recreation Area.



$\Delta s = 0.8$ ft
$r = 0.25$ ft
$q = 167$ gal/min = 32,150 ft^3/d

$T = (0.183\ q)/\Delta s$
$= (0.183 \times 32{,}150\ ft^3/d)/0.8\ ft$
$= 7{,}354\ ft^2/d$
$= 7{,}300\ ft^2/d$ (rounded)

Figure 8. Time-Drawdown Plot, Tiger Point Recreation Area.

NWFWMD Well Inventory Database System

Site Schedule

Site Id	**302314087032501**			NWF ID	**7686**
Well Name	**NWFWMD TIGER POINT**			State ID	**AAD9021**
Owner	**NWFWMD**				
Contact Person	**TOM PRATT**			Phone	**850-539-5999**
Street	**81 WATER MANAGEMENT DRIVE**				
City	**HAVANA**	State **FL**	Zip **32333**	County	**Santa Rosa**
Latitude	**302314.514**	Longitude **870324.347**	Datum **WGS84**	Loc Method	**(GPS)**
Land Net	**DS28T2SR28W**	Loc Accuracy **0.3 < 3 meters**		Loc Source	
Elevation	**17**	Datum **NGVD29**	Method **Topo Map**		
Accuracy	**1 < 5 feet**	Source **NWFWMD**			
Location Map	**GARCON POINT**	GW Region **Western Panhandle Embayment Region**			

Site Use	**Monitor / OBS**	Water Use	**Monitor**

Depth Of Well	**1310**	Depth Of Casing	**1140**
MP Distance From LSD	**-.4**	Diameter	**6**
Construction Data Source	**NWFWMD**	Casing Material	**Steel**
Finish	**Open Hole**	Driller License Number	**1136**
Date of Construction	**28-APR-00**	Construction Method	**Reverse Rotary**
Screen Length			
Screened Intervals			

Water Level	**-49.96**	Measure Date	**23-MAY-00**
WL Source	**NWFWMD**	WL Method	**Steel Tape**

Hydrogeologic Units	**Upper Floridan**

Lift	**No Pump**	Power	
Horsepower		Pump Intake	
Normal Yield		Spcap Discharge	**167**
Spcap Source	**NWFWMD**	Spcap Discharge Method	**Volumetric**
Spcap Static Level	**-53.94**	Spcap Pumping Level	**-71**
Spcap Drawdown	**17.06**	Hours Pumped	**20.75**
Spcap	**9.8**		

Field Water Quality		Date of Sample	**27-APR-00**
Temperature	**27.9**	pH	**8.57**
Specific Conductance	**2610**	Chloride	**520**

Consumptive Use Permit		Construction Permit	**P200001563**
FL Geological Survey #	**W-18120**	Abandonment Permit	
DEP Public Supply #			
Project #'s	**75 70 73**		
Geophysical Log #	**90**	Depth Logged	**1310**
Available LOG Data	**Caliper Gamma Electric Collar Fluid Vel.**		

Visited By	**T PRATT**	Date Visited	**26-APR-00**
Data Entered By	**C RICHARDS**	Date Entered	**28-APR-00**
Last Updated By	**T PRATT**	Last Updated	**14-MAR-01**
Ambient Network	**WL**		

MP is top of 6-inch casing, 0.4 ft below grade and inside the 10-inch casing, edited by TRP, 8/30/2000.

SEAGROVE WELL CONSTRUCTION CHRONOLOGY

10.02.00 Drilling begins on four-inch diameter well (AAD9005). Driller tags top of upper Floridan Aquifer at a depth of 305 ft. Sand-and-Gravel Aquifer and the Intermediate System geophysically logged in mudded hole. Four-inch diameter steel well casing installed to a depth of 314 ft. Well casing pressure grouted with 63 bags of cement.

10.03.00 Drilled out upper Floridan Aquifer to a depth of 378 ft with hydraulic rotary. Open hole developed with air for two hours.

10.04.00 Drilling begins on six-inch diameter well (AAD9004). Driller reams hole to a depth of 160 ft.

10.05.00 147 ft of ten-inch diameter steel surface casing installed. Surface casing pressure grouted with 78 bags of cement.

10.06.00 Drilling Intermediate System with hydraulic rotary circulation.

10.09.00 Drilling upper Floridan Aquifer with hydraulic rotary circulation. Borehole reaches a depth of 543 ft.

10.10.00 Intermediate System and upper Floridan Aquifer geophysically logged in mudded hole. Six-inch diameter steel well casing installed to a depth of 539 ft. Well casing pressure grouted with 155 bags of cement.

10.11.00 Drilling upper Floridan Aquifer with hydraulic rotary from 539 ft to 585 ft. Drilling requires addition of potable water to clear cuttings. Install 100 ft of airline. Develop with air for 2.75 hours at about five gal/min. Well slowly clears.

10.12.00 Develop interval from 539 ft to 585 ft with air and 240 ft of airline. Discharge improves from previous day to 7-8 gal/min. Interval developed for 2.5 hours and sampled. Drill interval from 585 ft to 605 ft with reverse air circulation. Drilling requires addition of potable water. Develop interval for one hour and sample. Drill interval from 605 ft to 625 ft with reverse air circulation and no added potable water. Develop well for 40 minutes and sample.

10.13.00 Drilling upper Floridan Aquifer with reverse air circulation. Drill interval from 625 ft to 645 ft, develop for 55 minutes and sample. Drill interval from 645 ft to 665 ft, develop for two hours and sample. Sample collected with bit 20 ft off bottom of hole or at about 645 ft. New four-inch well (AAD9005) pump purged for 115 minutes at 20 gal/min (2,300 gallons or 10 well volumes). One well volume equals 230 gallons. On-site FCSC well (AAA1108) pump purged for 272 minutes at 92 gal/min (25,000 gallons) and sampled.

10.16.00 Hole cleaned to a depth of 665 ft and developed with air. Airline near bottom of hole. Well developed for 25 minutes and sampled. Drill interval from 665 ft to 685 ft, develop for 75 minutes and sample. Drill interval from 685 ft to 705 ft, develop for one hour and sample. Sample collected with bit just off bottom at 705 ft.

SEAGROVE WELL CONSTRUCTION CHRONOLOGY (continued)

10.17.00 Develop well with bit at a depth of 393 ft. Sample well after two hours of development. Geophysically log open-hole interval. Driller emplaces 10 bags of cement in bottom of open hole.

10.18.00 Driller emplaces 2.5 bags of cement of complete grouting bottom of borehole. West Hewett (AAA0474) pump purged for 160 minutes at 21 gal/min (3,360 gallons or 4.8 well volumes) and sampled.

10.19.00 Top of plug encountered at a depth of 630 ft. Drilled plug out to a depth of 660 ft. Driller emplaces four bags of cement.

10.20.00 Top of plug encountered at a depth of 637 ft. Well developed with airline just above top of plug for 190 minutes at approximately 10 gal/min (1,900 gallons). Airline retracted to a depth of 200 ft and well air developed for 23 minutes at approximately 250 gal/min (5,750 gallons or 6.4 well volumes) and sampled. One well volume equals 900 gallons.

12.20.00 Pumped well for 41 hours at 10 gal/min (24,600 gallons or 27 well volumes) and sampled.

01.31.01 Pumped well for 7.5 hours at 64 gal/min (28,800 gallons or 32 well volumes) and sampled.

SEAGROVE LITHOLOGIC FORMATIONS

0 ft – 90 ft	Undifferentiated sand and clay
90 ft – 240 ft	Intracoastal Formation
240 ft – 300 ft	Four Mile Village Member, Intracoastal Formation
300 ft – 318 ft	Intracoastal Formation
318 ft – 450 ft	Bruce Creek Limestone
450 ft – 650 ft	Chattahoochee/Suwannee Limestone
650 ft – 665 ft	Bucatunna Clay
665 ft – 705 ft	Ocala Limestone

Formation picks based on cuttings with 20-foot sample interval. Bucatunna Clay is not as thick as cuttings indicate. Based on field observations it is more on the order of 5 ft thick.

SEAGROVE UPPER FLORIDAN AQUIFER MONITOR WELLS

SEC. 2 T-3-S R-20-W

WALTON COUNTY, FLORIDA

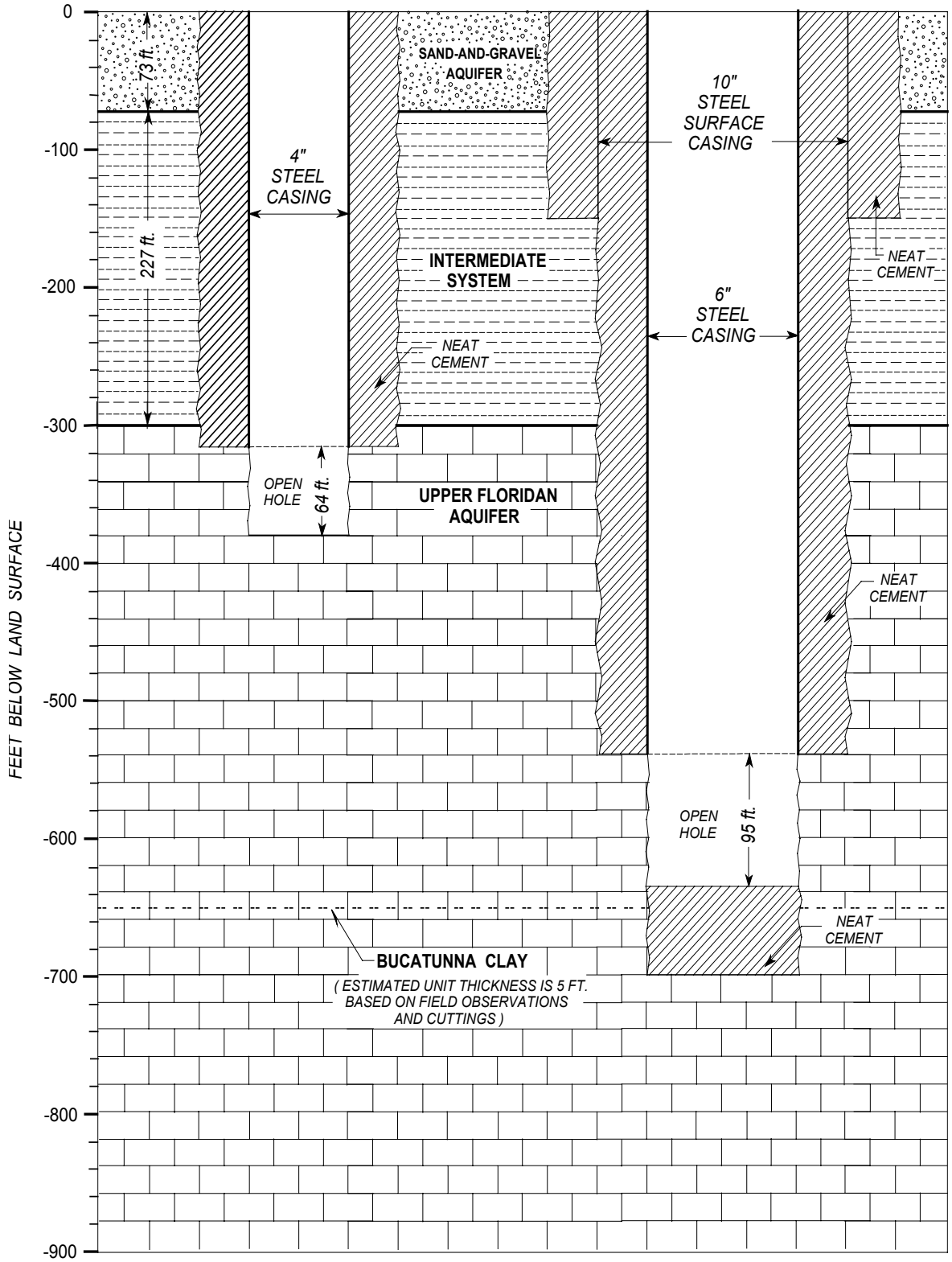


Table 3. Seagrove (AAD9004) Analytical Results.

Analyte	585 ft	605 ft	625 ft	645 ft	665 ft	685 ft	Units
Bicarbonate alkalinity	150	170	160	170**	440**	120**	mg/L
Alkalinity	147	148	151	164	126	103	mg $CaCO_3$/L
Chloride	1400	1600	1600	1400	870	970	mg/L
Fluoride	3.7	4.1	4	3.8	2	2.1	mg/L
Nitrate	<0.02	<0.02	<0.02	<0.10	<0.10	<0.10	mg N/L
Orthophosphate	0.01*	0.006*	0.006*	0.028*	0.004*	0.005*	mg P/L
Silica	14	14	14	14	16	16	mg SiO_2/L
Sulfate	4.2	1.7	2.3	5.5	7.1*	6.3*	mg/L
Total dissolved solids	2568	2818	2794	2830	1572	1722	mg/L
Calcium	49.9	47.4	47.3	58**	147**	42**	mg/L
Iron	0.035*	0.28	0.27	5.2**	2**	0.42**	mg/L
Magnesium	43.4	46	45.4	47.7**	42.9**	30.1**	mg/L
Potassium	19.9	20.7	20.6	22.5**	16.7**	16.5**	mg/L
Sodium	872	966	945	963**	515**	563**	mg/L
Na^+/Cl^-	0.62	0.60	0.59	0.69	0.59	0.58	
sample date	10.12.00	10.12.00	10.12.00	10.13.00	10.16.00	10.16.00	
matrix	filtered	filtered	filtered	filtered	filtered	filtered	
sampling technique	airlift	airlift	airlift	airlift	airlift	airlift	

Analyte	705 ft	Interval between 539 and 705 ft	Interval between 539 and 637 ft	Interval between 539 and 637 ft	Interval between 539 and 637 ft	Units
Bicarbonate alkalinity	150**	150**	37**	110	130	mg/L
Alkalinity	138	129	80	128	120	mg $CaCO_3$/L
Chloride	1100	970	750	860	840	mg/L
Fluoride	2.3	1.8	1.4	1.6	1.7	mg/L
Nitrate	<0.1	<0.1	<0.02	<0.1	<0.02	mg N/L
Orthophosphate	0.005*	0.005*	0.005*	0.006*	0.006*	mg P/L
Silica	16	16	9.7	15	14	mg SiO_2/L
Sulfate	<4	<4	12	4.6	3.6	mg/L
Total dissolved solids	1880	1700	1390	1448	1526	mg/L
Calcium	48.1**	49**	71.7**	41.8	42.6	mg/L
Iron	0.74**	0.92**	0.59**	0.023	0.012*	mg/L
Magnesium	36.4**	35.1**	17.3**	33.2	34.3	mg/L
Potassium	16.5**	14.3**	16.3**	11.9	12.4	mg/L
Sodium	624**	562**	429**	470	487	mg/L
Na^+/Cl^-	0.57	0.58	0.57	0.55	0.58	
sample date	10.16.00	10.17.00	10.20.00	12.20.00	01.31.01	
matrix	filtered	filtered	filtered	filtered	filtered	
sampling technique	airlift	airlift	airlift	pumped	pumped	

* denotes value between MDL and PQL, ** denotes analyte not filtered.

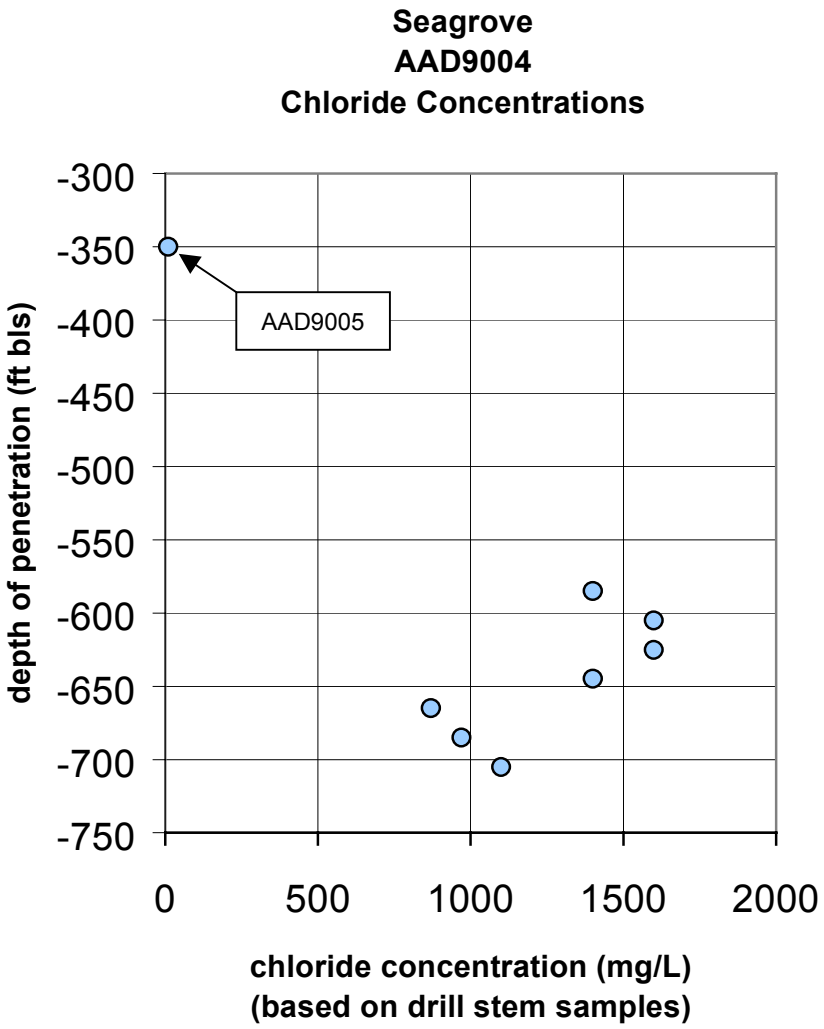


Figure 11. Chloride Concentration Versus Depth of Penetration, Seagrove Site.

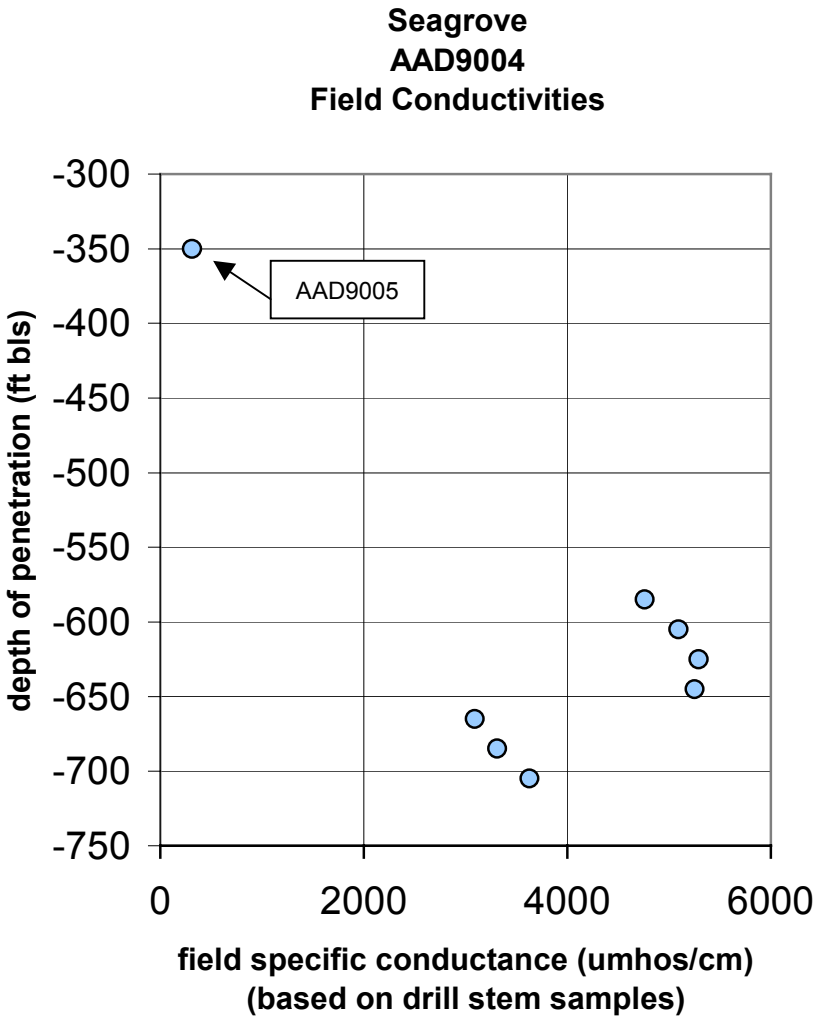
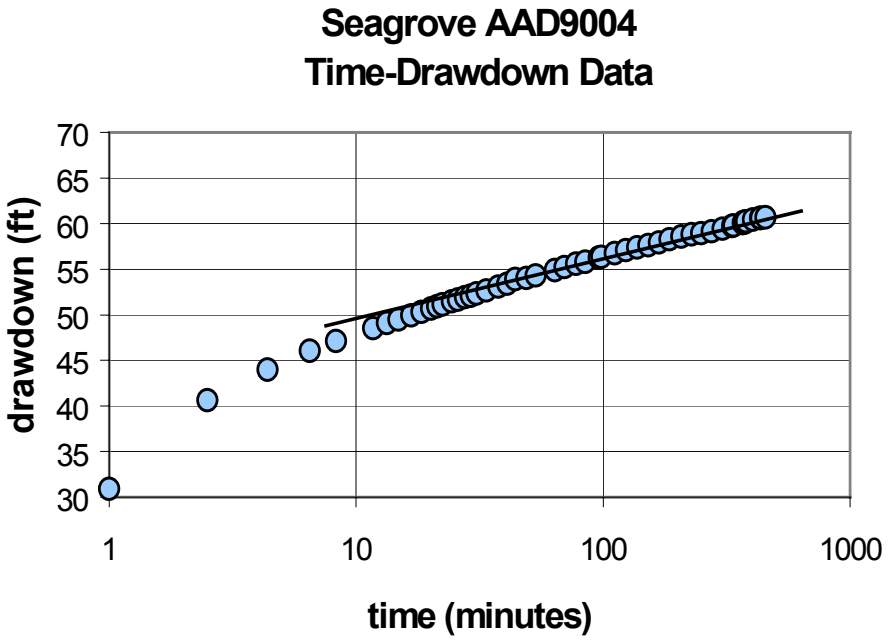


Figure 12. Field Specific Conductance Versus Depth of Penetration, Seagrove Site.



Δs = 6.5 ft
r = 0.25 ft
q = 64 gal/min = 12,320 ft^3/d

T = $(0.183\ q)/\Delta s$
= $(0.183 \times 12{,}320\ ft^3/d)/6.5\ ft$
= 347 ft^2/d
= 350 ft^2/d (rounded)

Figure 13. Time-Drawdown Plot, Seagrove Site.

NWFWMD Well Inventory Database System

Site Schedule

Site Id	**302111086131702**			NWF ID	**7751**
Well Name	**NWFWMD SEAGROVE DEEP**			State ID	**AAD9004**
Owner	**NWFWMD**				
Contact Person	**TOM PRATT**			Phone	**850-539-3999**
Street	**81 WATER MANAGEMENT DRIVE**				
City	**HAVANA**	State **FL**	Zip **32333**	County	**Walton**
Latitude	**302111.62**	Longitude **861319.366**	Datum **WGS84**	Loc Method	**Global Positioning Satellite (GPS)**
Land Net	**DDAS02T3SR20W**	Loc Accuracy **0.3 < 3 meters**		Loc Source	
Elevation	**32**	Datum **NGVD29**	Method **Topo Map**		
Accuracy	**1 < 5 feet**	Source **NWFWMD**			
Location Map	**GRAYTON BEACH**	GW Region **Western Panhandle Embayment Region**			

Site Use	**Monitor / OBS**	Water Use	**Monitor**

Depth Of Well	**645**	Depth Of Casing	**539**
MP Distance From LSD	**2.85**	Diameter	**6**
Construction Data Source	**NWFWMD**	Casing Material	**Steel**
Finish	**Open Hole**	Driller License Number	**1136**
Date of Construction	**20-OCT-00**	Construction Method	**Reverse Rotary**
Screen Length			
Screened Intervals			

Water Level	**-34.05**	Measure Date	**17-OCT-00**
WL Source	**NWFWMD**	WL Method	**Steel Tape**

Hydrogeologic Units	**Upper Floridan**

Lift	**No Pump**	Power	
Horsepower		Pump Intake	
Normal Yield		Spcap Discharge	**64**
Spcap Source	**NWFWMD**	Spcap Discharge Method	**Volumetric**
Spcap Static Level	**-31.75**	Spcap Pumping Level	**-92.46**
Spcap Drawdown	**60.71**	Hours Pumped	**7.6**
Spcap	**1.05**		

Field Water Quality		Date of Sample	**31-JAN-01**
Temperature	**23**	pH	**8.06**
Specific Conductance	**3010**	Chloride	**840**

Consumptive Use Permit		Construction Permit	**P200004253**
FL Geological Survey #	**W-18121**	Abandonment Permit	
DEP Public Supply #			
Project #'s			
Geophysical Log #	**89**	Depth Logged	**639**
Available LOG Data	**Fluid Vel.** **Gamma** **Electric** **Caliper**		

Visited By	**T PRATT**	Date Visited	**31-JAN-01**
Data Entered By	**C RICHARDS**	Date Entered	**31-OCT-00**
Last Updated By	**T PRATT**	Last Updated	**14-MAR-01**
Ambient Network	**WL**		

Edit date 02.01.2001, edited by TRP, MP is top of 10-inch protective casing, 2.85 ft above LSD.

NWFWMD Well Inventory Database System

Site Schedule

Site Id	**302111086131701**			NWF ID	**7687**
Well Name	**NWFWMD SEAGROVE SHAL**			State ID	**AAD9005**
Owner	**NWFWMD**				
Contact Person	**TOM PRATT**			Phone	**850-539-5999**
Street	**81 WATER MANAGEMENT DRIVE**				
City	**HAVANA**	State **FL**	Zip **32333**	County	**Walton**
Latitude	**302111.635**	Longitude **861319.897**	Datum **WGS84**	Loc Method	**Global Positioning Satellite (GPS)**
Land Net	**DDAS2T3SR20W**	Loc Accuracy **0.3 < 3 meters**		Loc Source	
Elevation	**32**	Datum **NGVD29**	Method **Topo Map**		
Accuracy	**>= 5 feet**	Source **NWFWMD**			
Location Map	**GRAYTON BEACH**	GW Region **Western Panhandle Embayment Region**			

Site Use	**Monitor / OBS**	Water Use	**Monitor**
Depth Of Well	**378**	Depth Of Casing	**314**
MP Distance From LSD	**1.6**	Diameter	**4**
Construction Data Source	**NWFWMD**	Casing Material	**Steel**
Finish	**Open Hole**	Driller License Number	**1136**
Date of Construction	**03-OCT-00**	Construction Method	**Hydraulic Rotary**
Screen Length			
Screened Intervals			
Water Level	**-26.29**	Measure Date	**13-OCT-00**
WL Source	**NWFWMD**	WL Method	**Steel Tape**
Hydrogeologic Units	**Upper Floridan**		
Lift	**No Pump**	Power	
Horsepower		Pump Intake	
Normal Yield		Spcap Discharge	**18**
Spcap Source	**NWFWMD**	Spcap Discharge Method	**Volumetric**
Spcap Static Level	**-26.4**	Spcap Pumping Level	**-68.4**
Spcap Drawdown	**42**	Hours Pumped	**2.25**
Spcap	**.42**		
Field Water Quality		Date of Sample	**13-OCT-00**
Temperature	**22.9**	pH	**7.62**
Specific Conductance	**314**	Chloride	**10**
Consumptive Use Permit		Construction Permit	**P200004254**
FL Geological Survey #	**W-18122**	Abandonment Permit	
DEP Public Supply #			
Project #'s	**73**		
Geophysical Log #	**88**	Depth Logged	**378**
Available LOG Data	**Fluid Vel. Caliper Gamma Electric**		
Visited By	**T COUNTRYM**	Date Visited	**03-OCT-00**
Data Entered By	**C RICHARDS**	Date Entered	**28-APR-00**
Last Updated By	**K COWAN**	Last Updated	**16-FEB-01**
Ambient Network	**WL**		

edit date 02.01.2001, edited by TRP, MP = top of 8-inch protective casing, 1.6 ft above LSD.

Table 4. Eglin AFB Santa Rosa Island Analytical Results.

Analyte	EAFB NCO #71 AAA2175	EAFB A-3 Bldg #8351 AAA8820	EAFB A-6 Bldg #8552 AAA2177	EAFB A-10 Bldg #9023 AAA2178	EAFB A-11 Bldg #9262 AAA2179	Units
Bicarbonate alkalinity	220	210	200	190	200	mg/L
Alkalinity	213	201	197	188	195	mg $CaCO_3$/L
Chloride	80	66	56	100	130	mg/L
Fluoride	1.3	1.3	1.3	0.96	1.1**	mg/L
Nitrate	<0.02	<0.02	<0.02	<0.02	<0.02	mg N/L
Orthophosphate	0.009*	0.009*	0.011**	0.009*	0.009*	mg P/L
Silica	13	12	13	13	13	mg SiO_2/L
Sulfate	4	4.2	5.9	13	18	mg/L
Total dissolved solids	380	348	324	383	443	mg/L
Calcium	4.7	4.7	3.6	4.2	5.1	mg/L
Iron	<0.025	<0.025	<0.025	0.22	0.047	mg/L
Magnesium	3.2	2.9	2.2	2.8	3.5	mg/L
Potassium	6.8	6.4	5.3	6.3	6.6	mg/L
Sodium	130	123	110	133	160	mg/L
Na^+/Cl^-	1.63	1.86	1.96	1.33	1.23	
sample date	03.09.00	03.09.00	03.09.00	03.09.00	03.09.00	
matrix	unfiltered	unfiltered	unfiltered	unfiltered	filtered	
sampling technique	pumped	pumped	pumped	pumped	pumped	

Analyte	EAFB A-11 Bldg #9277 AAD5302	EAFB A-13 Bldg #9296 AAA2180	EAFB A-15 Bldg #12503 AAB1301	Units
Bicarbonate alkalinity	200	200	250	mg/L
Alkalinity	193	196	246	mg $CaCO_3$/L
Chloride	120	120	280	mg/L
Fluoride	1.1	1.3	2.3	mg/L
Nitrate	<0.02	<0.02	<0.02	mg N/L
Orthophosphate	0.008*	0.009*	0.1*	mg P/L
Silica	13	12	13	mg SiO_2/L
Sulfate	14	5.2	13	mg/L
Total dissolved solids	418	419	729	mg/L
Calcium	4.5	3.9	5.9	mg/L
Iron	<0.025	0.3	0.084*	mg/L
Magnesium	3.1	2.3	4.2	mg/L
Potassium	6.3	6.4	9.7	mg/L
Sodium	142	144	264	mg/L
Na^+/Cl^-	1.18	1.20	0.94	
sample date	03.09.00	03.09.00	03.09.00	
matrix	unfiltered	unfiltered	unfiltered	
sampling technique	pumped	pumped	pumped	

* denotes value between MDL and PQL, ** denotes estimated value

Table 5. Comparison of Historical and Recent Chloride Concentrations, EAFB Santa Rosa Island Wells.

site	sample date	chloride (mg/L)	sample date	chloride (mg/L)	sample date	chloride (mg/L)
EAFB A-3 Bldg #8351	12.06.60	71	07.06.78	71	03.09.00	66
EAFB A-6 Bldg #8552	02.04.59	56	10.26.71	55	03.09.00	56
EAFB A-10 Bldg #9023	10.07.49	84	10.26.71	87	03.09.00	100
EAFB A-11 Bldg #9262	10.03.60	120	07.07.78	140	03.09.00	130
EAFB A-13 Bldg #9296	10.03.60	110	07.07.78	211	03.09.00	120
EAFB A-15 Bldg #12503	01.17.61	256	--	--	03.09.00	280

Data prior to 2000 were obtained from Wagner, J.R., C. Lewis, L.R. Hayes and D.E. Barr, Hydrologic Data for Okaloosa, Walton, and Southeastern Santa Rosa Counties, Florida, U.S. Geological Survey Open File Report 80-741.

Table 6. Miscellaneous Analytical Results.

Analyte	West Hewett AAA0474	FCSC #11 AAA1108	NWFWMD Seagrove Shallow AAD9005	SWU Mack Bayou Flrd AAD9002	Units
Bicarbonate alkalinity	130**	130**	150**	120	mg/L
Alkalinity	120	123	145	120	mg $CaCO_3$/L
Chloride	170	13	10	32	mg/L
Fluoride	1.1	0.2	0.23	0.65	mg/L
Nitrate	<0.10	<0.10	<0.1	<0.02	mg N/L
Orthophosphate	0.006*	0.009*	0.005*	0.004*	mg P/L
Silica	15	19	21	16	mg SiO_2/L
Sulfate	39	<0.2	0.26*	17	mg/L
Total dissolved solids	470	175	194	193	mg/L
Calcium	17.3**	46.7**	53.7**	20.2	mg/L
Iron	0.14**	0.44**	1**	0.011*	mg/L
Magnesium	13.9**	4.9**	5.4**	16.8	mg/L
Potassium	6.3**	1.1**	1.9**	4.3	mg/L
Sodium	131**	6.3**	5.3**	29.6	mg/L
Na^+/Cl^-	0.77	0.48	0.53	0.93	
sample date	10.18.00	10.13.00	10.13.00	01.31.01	
matrix	filtered	filtered	filtered	filtered	
sampling technique	pumped	pumped	pumped	pumped	

* denotes value between MDL and PQL, ** denotes analyte not filtered.