REVERSE OSMOSIS WTP PRELIMINARY ENGINEERING REPORT

SUBMITTED TO:

TOWN OF BELLEAIR AUGUST 2020

SUBMITTED BY:

MCKIM & CREED | CLEARWATER, FL

McKIM&CREED
ENGINEERS SURVEYORS PLANNERS

Executive Summary

The Town of Belleair (Town) operates an existing water treatment plant (WTP) that was designed to produce 2.2 million gallons per day (MGD). The WTP treats groundwater from seven (7) existing wells and produces an average flow of approximately 800,000 gallons per day (gpd) of potable water to supply the Town's utility customers. The levels of chloride and total dissolved solids (TDS) in the wells have been increasing and are projected to continue increasing in the future. Because of these conditions, the potable water produced by the plant has chloride and TDS levels that periodically approach the Florida Department of Environmental Protection (FDEP) secondary drinking water limit of 250 mg/L and 500 mg/L, respectively.

Additionally, the WTP is nearing the end of its useful life and there are items that need to be addressed as soon as possible. This Preliminary Engineering Report (PER) included evaluations of the Town's existing water supply and treatment systems and considered the following:

1. Drinking water regulations
2. Condition of WTP existing systems and equipment
3. Condition of wells; above- and below-ground
4. Current and projected potable water demands
5. Groundwater supply and quality projections
6. Ability of existing systems to treat projected water quality

If the Town wishes to continue with potable water production, a new Reverse Osmosis (RO) treatment plant is recommended to reduce chloride and TDS concentrations and to address ongoing operational, maintenance and safety concerns at the WTP.

Besides developing preliminary engineering requirements for the proposed RO WTP systems, this PER was developed to provide the Town with capital and operations & maintenance (O&M) costs for the proposed WTP. Also, a potential phased implementation plan was developed that focuses on using the existing WTP infrastructure to the extent possible to reduce initial capital costs. In addition, the phased approach implements new treatment processes and modifications, only as needed, to address chloride and TDS levels projected to increase over time.

The use of a "conventional" RO process was compared with a relatively new high-recovery RO process called "Closed-Circuit RO (CCRO)." In general, the conventional RO process is able to utilize approximately 80% of the water supplied to the process to produce drinking water; whereas the CCRO process is able utilize approximately 90 to 95-percent. The evaluation and comparison of the two (2) processes are detailed in this PER.

Total capital costs for the proposed RO plant were developed and compared with a phased approach. These costs are shown in **Tables ES-1 and ES-2.**

Table ES-1– Proposed Facility Cost Summary

Item	Traditional RO System	High-Recovery CCRO System
Mobilization/Demobilization	$175,000	$175,000
Sitework & Demolition	$325,000	$325,000
Booster Pump Station	$142,000	$142,000
Pressurized Filters and Backwash Holding Tank	$969,000	$969,000
Chemical Building	$84,000	$84,000
Chemical Systems	$362,000	$362,000
RO System	$1,044,000	$1,488,000
RO Building	$434,000	$434,000
High Service Pump Station	$338,000	$338,000
Deep Injection Well	$750,000	------------
Yard Piping	$500,000	$500,000
Electrical	$738,000	$677,000
Instrumentation	$554,000	$508,000
Upper Floridian Wells (4) and Well Rehabilitation	$1,450,000	$1,450,000
Total Construction Cost	$7,865,000	$7,452,000
Contingency (30%)	$2,360,000	$2,236,000
Sub Total	$10,225,000	$9,688,000
Engineering - Design and Legal (15%)	$1,534,000	$1,454,000
TOTAL PROJECT COST	**$11,759,000**	**$11,142,000**

Table ES-2 – Phased Implementation Plan Summary

Phase / Description of Major Systems	Approximate Implementation Year	Project Cost
Phase 1		
1) **Clearwell Roof Rehabilitation** 2) **Additional Well**	2021	$621,000
Phase 2		
1) **Booster Pump Station** 2) **Filtration System** 3) **Chemical Systems** 4) **Yard Piping**	2023	$4,734,000
Phase 3		
1) **RO System** 2) **RO Building** 3) **Additional Chemical Systems** 4) **Deep Injection Well** 5) **Yard Piping**	2027	$5,701,000
Phase 4		
1) **RO System Addition** 2) **RO Building Addition** 3) **New High Service Pump Station** 4) **Yard Piping**	2034	$2,282,000
TOTAL COST WITH PHASED IMPLEMENTATION		**$13,338,000**

Based on the evaluations performed in this PER, McKim & Creed recommends that the Town either begins constructing the proposed RO treatment (either in phases or overall plant) or decommissions the existing WTP and begin utilizing potable water from Pinellas County by the end of calendar year 2021.

Table of Contents

List of Tables

List of Figures

1.0 Project Purpose

The potable water produced by the Town's Water Treatment Plant (WTP) has chloride and TDS levels that periodically approach the Florida Department of Environmental Protection (FDEP) secondary drinking water limit of 250 mg/L and 500 mg/L, respectively. The Town's existing WTP technology was not intended to and is not effective for removing chloride.

If the Town wishes to continue with potable water production, a new Reverse Osmosis (RO) treatment plant is recommended to reduce chloride and TDS concentrations and to address ongoing operational, maintenance and safety concerns at the WTP. One of the main purposes of this Preliminary Engineering Report (PER) is to develop construction and operation & maintenance (O&M) cost estimates to assist the Town with an analysis of long-term water supply options, which may include decommissioning the existing WTP and bulk purchasing potable water from Pinellas County. Also, a relatively new technology was evaluated that can reduce the amount of groundwater needed and may negate the need to construct a deep injection well (DIW).

2.0 Existing Supply and Treatment System

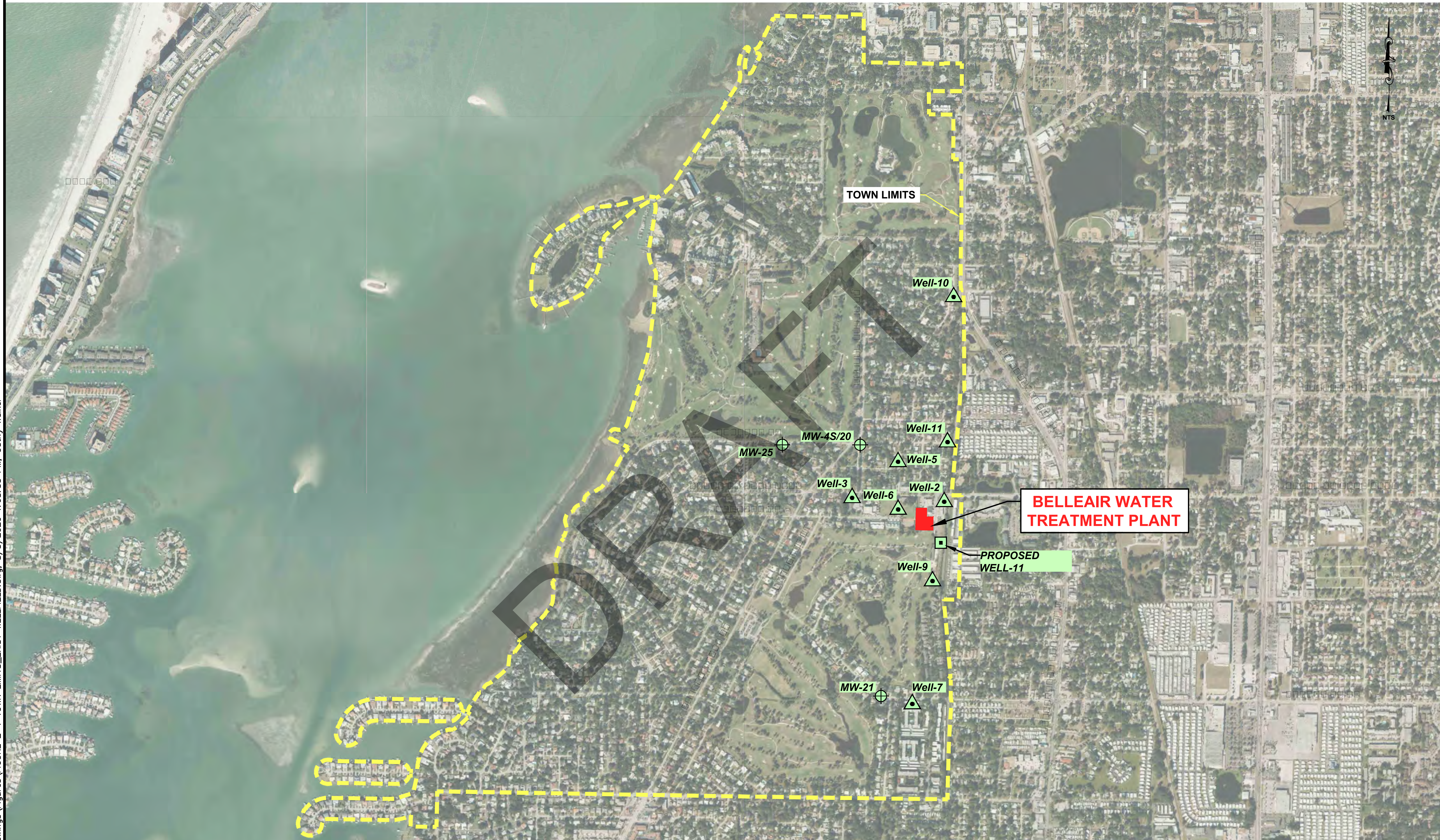
2.1 Overview of Existing Supply and Treatment Facilities

The Town currently meets its water demands by the operation and management of a local groundwater wellfield as source water to the existing WTP. The wellfield is permitted by the Southwest Florida Water Management District (SWFWMD) under Water Use Permit (WUP) No. 20007692.005 and currently includes eight (8) (seven (7) existing + one (1) proposed) upper Floridan aquifer production wells. The current water use permit (Permit No. 20007692.007) was issued on November 27, 2017 and will expire on November 27, 2037.

Of the seven (7) wells currently utilized, Well # 3 is used minimally due to extremely high chloride levels. The wellfield is permitted to withdraw an annual average of 885,900 gallons per day (gpd) with a peak month of 1,063,100 gpd, while the WTP is rated for 2,200,000 gpd. With the exception of periodic use of potable water from Pinellas County along with use of reclaimed water for two (2) golf courses within the Town, the WTP currently provides 100% of the Town's potable water and irrigation needs. Groundwater from the existing wells is pumped to the WTP for treatment using aeration, sedimentation, filtration, and disinfection. Current average daily production is approximately 800,000 gpd and has remained relatively consistent over the past several years.

2.2 Existing Wellfield and Groundwater Supply System

The Town's municipal wellfield is shown on **Figure 2-1** and is located entirely within the Town limits. Water is pumped from the wells and is transferred to the WTP via an existing raw water transmission system (Refer to **Appendix A)**.



I:\01131\0014\Water\80-Drawings\Figures\FIGURE 2-1 TOWN LIMITS_EXIST WELLFIELD.dwg, 8/3/2020 1:08:55 PM, Cathy Walker

McKIM&CREED

BELLEAIR WTP IMPROVEMENTS

TOWN LIMITS & EXISTING WELLFIELD

TOWN OF BELLEAIR INC. 1925

TOWN OF BELLEAIR
901 PONCE DE LEON BOULEVARD
Florida 34104
(727) 588-3769

DWG. No.

FIG 2-1

Table 2-1 summarizes the permitted and current withdrawal rates for the existing wells.

Table 2-1 – Well Characteristics Summary

Well ID	Permitted Withdrawal Average (gpd)	Current Withdrawal Rate (gpd)
2	145,100	120,000 (125 gpm for 16 hrs)
3	145,100	105,600 (110 gpm for 16 hrs)
5	145,100	144,000 (150 gpm for 16 hrs)
6	145,100	115,200 (120 gpm for 16 hrs)
7	193,000	144,000 (150 gpm for 16 hrs)
9	193,000	134,400 (140 gpm for 16 hrs)
10	193,000	115,200 (120 gpm for 16 hrs)
11[1]	145,000	-

[1] *Permitted, but not installed*

The scope of this PER included above- and below-ground well evaluations on the seven (7) existing wells to estimate recommended flows and costs to replace and/or rehabilitate the existing wells. Results from this evaluation are included in **Appendix B.**

2.3 Existing Water Treatment Plant

Slightly brackish raw water is pumped to the WTP from the groundwater wells. The raw water enters the treatment process through a common header that discharges to an existing tray aerator designed for hydrogen sulfide removal. Water cascades down the aeration trays into the sedimentation basin and is treated with chlorine to oxidize iron present in the groundwater wells. The oxidized iron and other suspended solids settle to the bottom of the tank and are later removed. The clarified water then flows to four (4) existing sand filters that further remove suspended solids. After filtration, the water is treated with a corrosion inhibitor, fluoride, and chlorine then flows through the clearwell where it can either be equalized with two storage tanks or pumped by four (4) high service pumps into the distribution system. The treatment process also includes ammonium hydroxide, which forms chloramines to aid with maintaining the required disinfection residual in the potable water distribution system. The two (2) ground storage tanks are located on the plant site and are rated for 0.5 million gallons (MG) and 0.3 MG, respectively. The Town also has an emergency interconnect with Pinellas County Utilities that can be used to provide potable water on a short-term basis.

3.0 Preliminary Engineering Considerations

3.1 Potable Water Demands

As mentioned in **Section 2.1**, the current average daily potable water demand is approximately 800,000 gpd. This rate has been relatively consistent over the past several years due to a population which has remained consistent within the service area. The Town's population is not expected to have significant growth in the future considering the lack of availability of land within the service area. This information was used to confirm the proposed facility's design capacity of 1.0 MGD.

3.2 Water Quality Regulations and Goals

The Town's WTP must meet the requirements of the FDEP and the USEPA, which set national standards for drinking water as authorized by the Safe Drinking Water Act (SDWA). The primary rules and regulations that apply to the Town's WTP are Chapters 62-550 and 62-560 of the FAC, and the maximum contaminant levels defined by the USEPA. McKim & Creed has reviewed the Town's previous annual Water Quality Reports and found that the levels of primary drinking water contaminants have consistently been well below the regulatory limits in terms of maximum contaminant level (MCL).

The State of Florida has adopted the National Primary and Secondary Drinking Water Standards of the USEPA and has created additional rules to fulfill state requirements. There are also contaminants that are listed in one set of the standards but not in the other. Therefore, priority shall be given to the strictest standards. Water quality parameters, according to these regulations, are expected to be met, not only at the plants but also at the customers' taps.

The secondary drinking water MCL set by the FDEP for TDS and chlorides are 500 mg/L and 250 mg/L, respectively. Therefore, in an effort to comfortably and consistently stay below these levels, a goal for the maximum TDS and chloride concentrations has been set at 450mg/L and 225 mg/L, respectively.

3.3 Staffing Considerations

Per Florida Administrative Code 62-699.310, Water Treatment Plant Category II (Microfiltration, ultrafiltration, nanofiltration, or reverse osmosis) Class B (1 MGD to 6.5 MGD) facilities requires the following staffing:

- Staffing by Class C or higher operator: 16 hours/day for 7 days/week. The lead/chief operator must be Class B or higher.

For plants that are under an electronic surveillance system or automatic control system, staffing requirements shall be reduced as follows:

- Staffing for a Class B plant shall be reduced to no less than staffing by a Class C or higher operator 8 hours/day for 7 days/week with the 8 hours/day of staffing occurring during the 8-hour period of greatest influent flow or water production. The class of the lead/chief operator shall not be reduced.

For plants that are under an electronic control system, staffing requirements shall be reduced as follows:

- Staffing for a Class B plant shall be reduced to no less than staffing by a Class C or higher operator 4 hours/day for 5 days/week and one visit by a Class C or higher operator on each weekend day. The class of the lead/chief operator shall not be reduced.

It is recommended that the Town install an electronic control system to have the opportunity to reduce staffing requirements. However, the Town should expect to have a Class C or higher operator at the proposed facility 16 hours per day; 7 days per week for at least the first year of operations.

3.4 Wellfield Water Quality Projections

McKim and Creed developed trendlines using data collected and analyzed for each well in the ***Hydrologic and Environmental Conditions Report Water Use Permit Special Condition 7.B,*** which was prepared in March 2014 by HSW Engineering, Inc. The data was comprised of measured chloride concentrations available for Production Wells 2, 3, 5, 6, 7, 9, and 10 from inception to 2013 to create the referenced trendlines that were used to help develop projected TDS concentrations over the 20-year planning period. Also, groundwater quality data was obtained from the Town and was used to confirm and adjust the projections. The calculations for these projections are included in **Appendix C** and the projections for each well are presented in **Table 3-1.**

Table 3-1 – TDS Projections for Production Wells

Well #	Typical Flow[1] (gpm)	2020 TDS Level (mg/L)	2030 TDS Level (mg/L)	2040 TDS Level (mg/L)
2	125	233	270	305
3	110	3029	4624	6119
5	150	234	265	294
6	120	631	901	1153
7	150	361	417	470
9	140	151	156	160
10	120	158	217	272
Weighted Average	915	620	875	1114

[1] *Flow rates are approximations provided by the Town*

It should be noted that in agreement with the projections above, Wells 3 and 6 routinely produce water with TDS levels above the secondary drinking water MCL of 500 mg/L.

4.0 Proposed Well Improvements

4.1 Recommended Flows

McKim & Creed coordinated with our subconsultants, Applied Drilling, Inc. and WSP, to perform evaluations for the existing wells (refer to **Appendix C)** and developed recommended flows based on the evaluations as shown in **Table 4-1.**

Table 4-1 – Recommended Flows for Existing Wells

Well #	Typical Flow[1] (gpm)	Recommended Flow (gpm)
2	125	220
3	110	N/A[2]
5	150	150
6	120	120
7	150	150
9	140	220
10	120	120
11	N/A	130

[1] Flow rates are approximations provided by the Town
[2] It is recommended that Well 3 be taken out of service

4.2 Additional Supply Wells

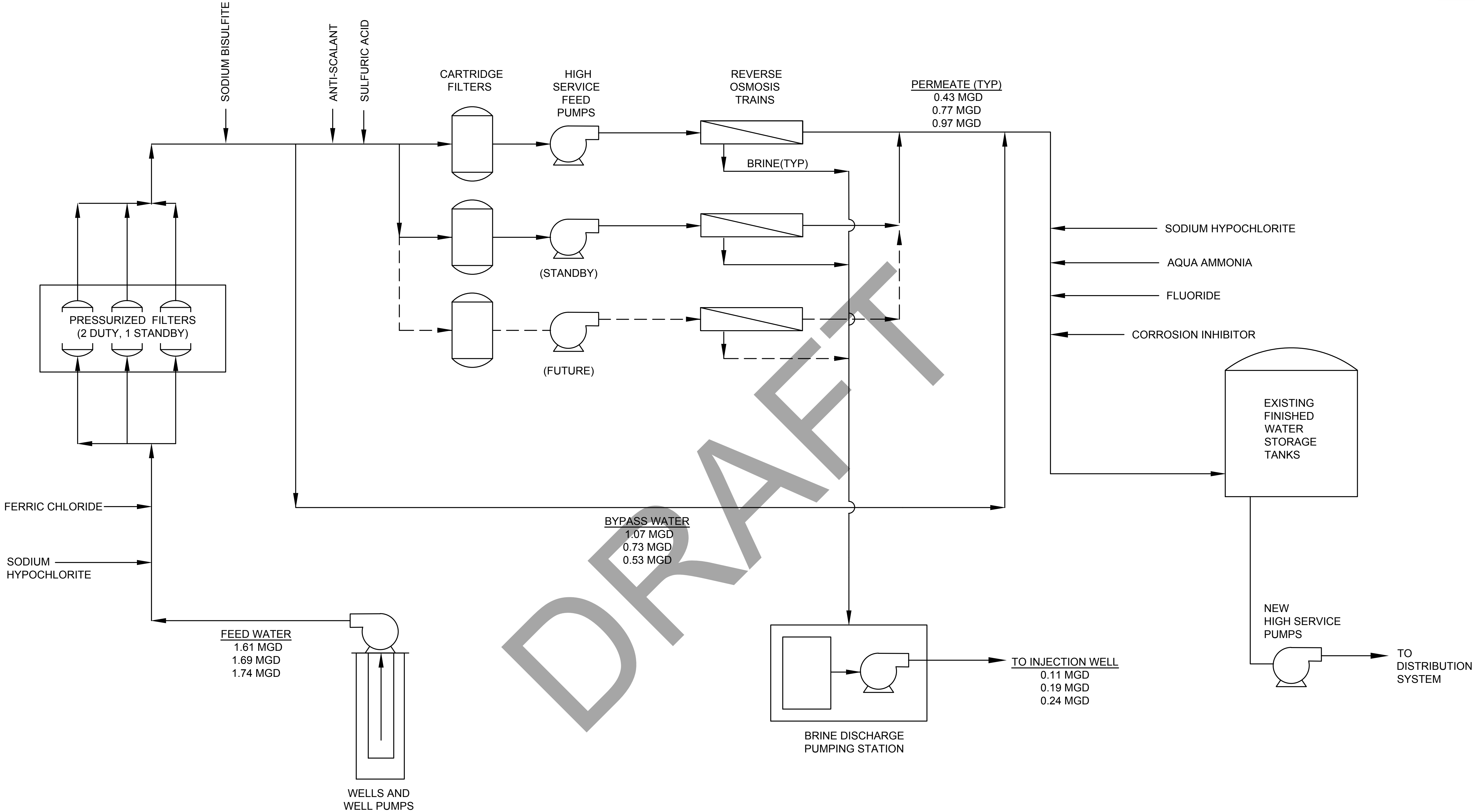
The RO treatment process typically produces approximately 80% of the water supplied to the treatment process as potable water and the remaining water (RO concentrate) is typically disposed. Because of this, additional groundwater supplies will be needed. McKim & Creed performed calculations and estimated that up to six (6) additional wells may be needed to meet the Town's potable water demands within the 20-year planning period.

5.0 Proposed RO Water Treatment Plant

5.1 Overview of Proposed Supply and Treatment System

The proposed treatment process includes treatment of groundwater from the Town's existing and proposed supply wells. The combined flow from the wells will be routed to a booster pump station. Following the booster pump station, the water will be treated with sodium hypochlorite to oxidize iron, and a coagulant, such as ferric chloride, that will improve filtration for the three (3) proposed pressurized dual-media filters. Subsequently, the filtered water will be treated with sodium bisulfite to remove any residual free chlorine and an antiscalant will be added to reduce scaling on the RO membrane elements. The water will then be directed to, or will bypass, the proposed RO system. The flow directed to the RO processes will flow through a cartridge filtration system that will filter out particles larger than 5-microns and will be pumped into the proposed RO treatment system. The RO permeate will be corrosive in nature and will be treated with sodium hydroxide to increase pH and alkalinity. The RO treated water will then be blended with the filtered bypass flow, treated with sodium hypochlorite and fluoride and directed to the two (2) existing ground storage tanks (total of 0.8 MG of storage) after disinfection. Disinfection will be achieved using sodium hypochlorite and ammonium hydroxide to form chloramines that will provide residual disinfection in the Town's potable water distribution system. The disinfected finished water will then be pumped into the community via four (4) high service pumps.

A process flow diagram for the proposed treatment process is shown in **Figure 5-1**.



NOTE:
FLOW VALUES SHOWN FROM TOP TO BOTTOM REFERENCE DESIGN TDS LEVELS OF 620, 875 AND 1,114 MG/L, RESPECTIVELY.

I:\01131\0014\Water\80–Drawings\Figures\FIGURE 5–1 PROP TREATMENT PROCESS FLOW DIAGRAM.dwg, 7/30/2020 12:18:20 PM, Cathy Walker

McKIM&CREED

BELLEAIR WTP IMPROVEMENTS

PROPOSED TREATMENT PROCESS FLOW DIAGRAM

TOWN OF BELLEAIR INC. 1925

TOWN OF BELLEAIR
901 PONCE DE LEON BOULEVARD
Florida 34104
(727) 588-3769

DWG. No.
FIG 5-1

5.2 Sizing of Proposed RO Treatment System

As mentioned above, the proposed RO treatment plant will be designed to produce a total average daily flow of 1.0 MGD over a 24-hour period. It should be noted that the facility would operate for only 16-hours per day and thus the design flow rate of the RO system is actually 1.5 MGD.

Based on RO membrane water quality projections and the weighted average TDS concentration projections from **Table 3-1**, calculations were conducted to estimate the percentage of raw water which would require treatment by the RO system to produce a desired quantity of finished water with a TDS concentration no higher than 450 mg/L. The membrane suppliers were consulted to estimate the TDS concentration of the RO permeate for the projected blend concentrations. **Table 5-1** presents the estimated blend scenarios that would vary as TDS levels increase in the future and **Figure 5-2** shows the bypass and RO process design flow rates over time. It is important to note that the calculation results are based on a traditional (80-percent) recovery system as a conservative approach.

Table 5-1 – Projected TDS Average Concentrations and Design Scenarios

Year	Projected Raw Water TDS (mg/L)	Permeate TDS Conc. (mg/L)	Flow to Bypass (MGD)	Flow to RO Process (MGD)	Design Raw Water Flow (MGD)	Design Finished Water TDS (mg/L)	Design Finished Water Flow (MGD)
2020	620	23.2	1.07	0.54	1.61	450	1.50
2025	748[1]	34.0[1]	0.88	0.78	1.66	450	1.50
2030	875	44.7	0.73	0.96	1.69	450	1.50
2035	995[1]	65.0[1]	0.62	1.10	1.72	450	1.50
2040	1114	85.2	0.53	1.21	1.74	450	1.50

[1] *Interpolated value*

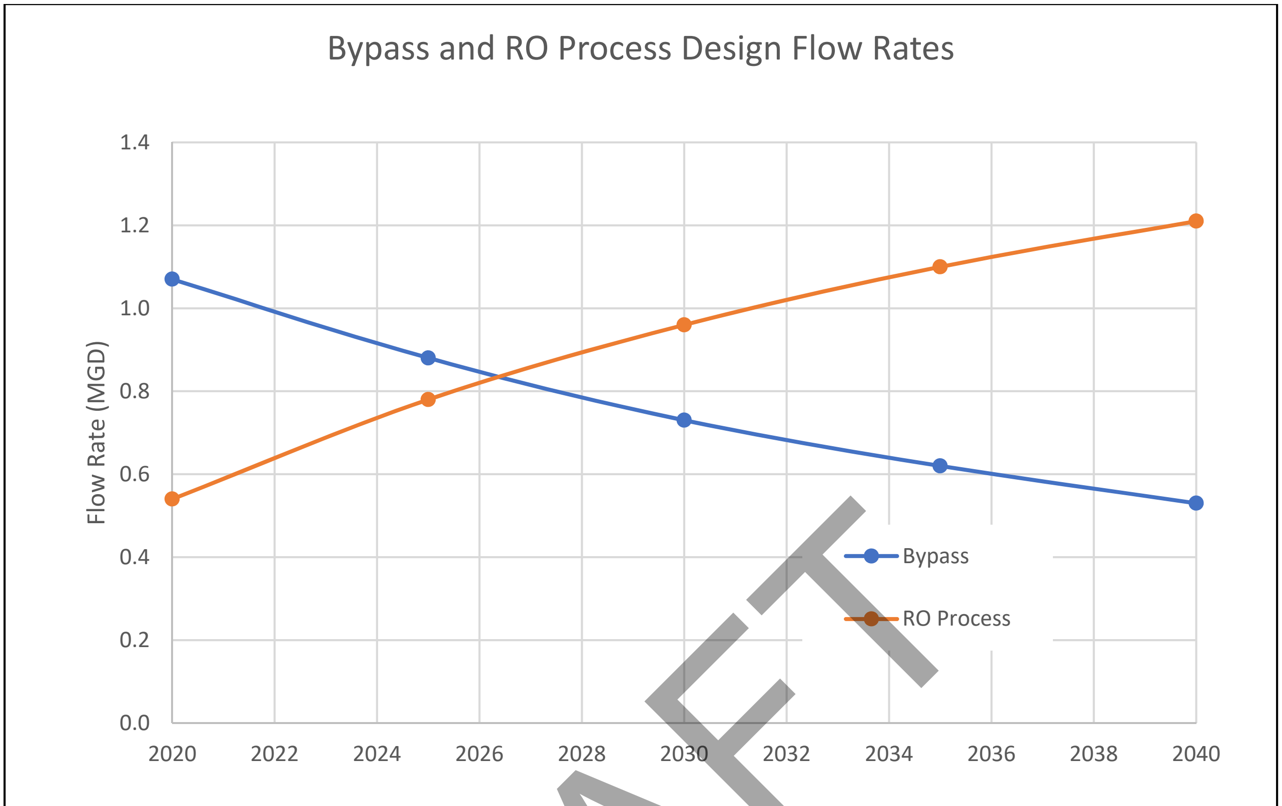


Figure 5-2 – RO and Bypass Design Flow Rates Over Time

5.3 Proposed RO Water Treatment Plant Processes

The following sections describe the various processes that will treat raw water starting from the combined raw water main and culminating at the high service pump station just prior to feeding into the distribution system. Chemical treatment, yard piping, and sitework will be discussed as well. Finally, an alternative to the traditional 2-stage RO system called a closed-circuit RO (CCRO) system will be evaluated.

5.3.1 Booster Pump Station

A booster pump station is required to increase the pressure from the well pumps so that the raw water can pass through the subsequent pressurized dual-media filters. The required pressure to feed the filters is approximately 30 pounds per square inch (psi) at a design flow of 1.74 MGD (1208 gpm). Based on this flow and pressure, each pump will be designed for 604 gpm @ 69.3' TDH and will include variable frequency drives (VFD) to save on energy costs and to provide operational control and flexibility. Therefore, a triplex set-up with three (3) 15-HP pumps (2 duty + 1 stand-by) is recommended for the booster pump station. **Table 5-2** summarizes key design criteria for the booster pumps.

Table 5-2 – Booster Pump Design Criteria

Item	Design Criteria
Quantity	3 (2 +1)
Capacity (gpm)	604 (0.87 MGD) @ 69.3 ft TDH
Power (HP)	15

5.3.2 Pressurized Dual-Media Filter System

Following chemical oxidation and coagulation, the groundwater will be filtered by a bank of three (3) proposed pressurized dual-media filters that will remove precipitated and coagulated iron and other particulates in the chemically treated groundwater. The treated groundwater will enter near the top of the filters; pass through a layer of anthracite and a layer of sand, and will be collected near the bottom of the filters at the filter underdrain system.

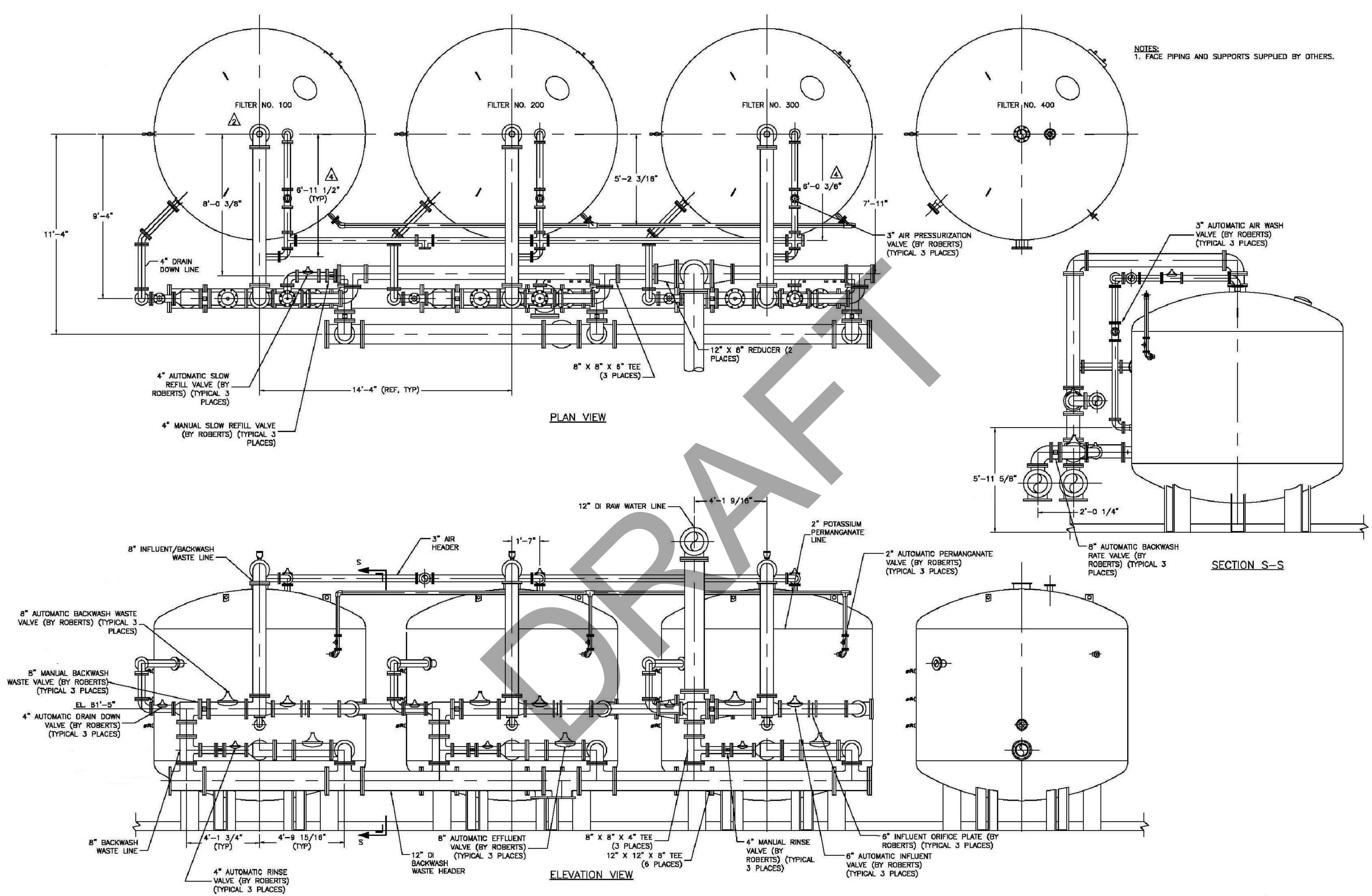
The filters will be constructed of steel in accordance with ASME code requirements and stamped with an ASME code stamp. Each tank will be equipped with the necessary flanges and connections for the main piping system and the top of the tank head will be equipped with a manhole for testing and maintenance. Each unit is to be supported on four structural legs welded to the side shell.

Table 5-3 includes the design criteria for the pressurized dual-media filter system. It is recommended that final design criteria be established during pilot testing of the overall system and it is noted that the proposed filter system may utilize compressed air, rather than sodium hypochlorite, for oxidation.

Table 5-3 – Pressurized Dual-Media Filter System Information

Item	Design Criteria
Total Design Flow (gpm)	1208
Number of Filters Required	3
Normal Loading Rate with All Vessels Online (gpm/ft2)	4.7
Loading Rate with One Vessel Offline (gpm/ft2)	6.3
Tank Diameter (ft)	10.5
Tank Straight Side Height (ft)	11.3

See **Figure 5-3** for a conceptual drawing of the layout of the pressurized filters



NOT TO SCALE

I:\0131\0014\Water\80-Drawings\Figures\FIG 5-3 PRESSURIZED FILTERS.dwg, 7/28/2020 1:42:21 PM, Cathy Walker

McKIM&CREED

BELLEAIR WTP IMPROVEMENTS

PRESSURIZED FILTERS
CONCEPTUAL LAYOUT

TOWN OF BELLEAIR INC. 1925

TOWN OF BELLEAIR
901 PONCE DE LEON BOULEVARD
Florida 34104
(727) 588-3769

DWG. No.

FIG 5-3

See **Figure 5-4** for an example of typical dual-media pressure filters.

Figure 5-4 – Typical Dual-Media Pressurized Dual-Media Filters, City of Clearwater

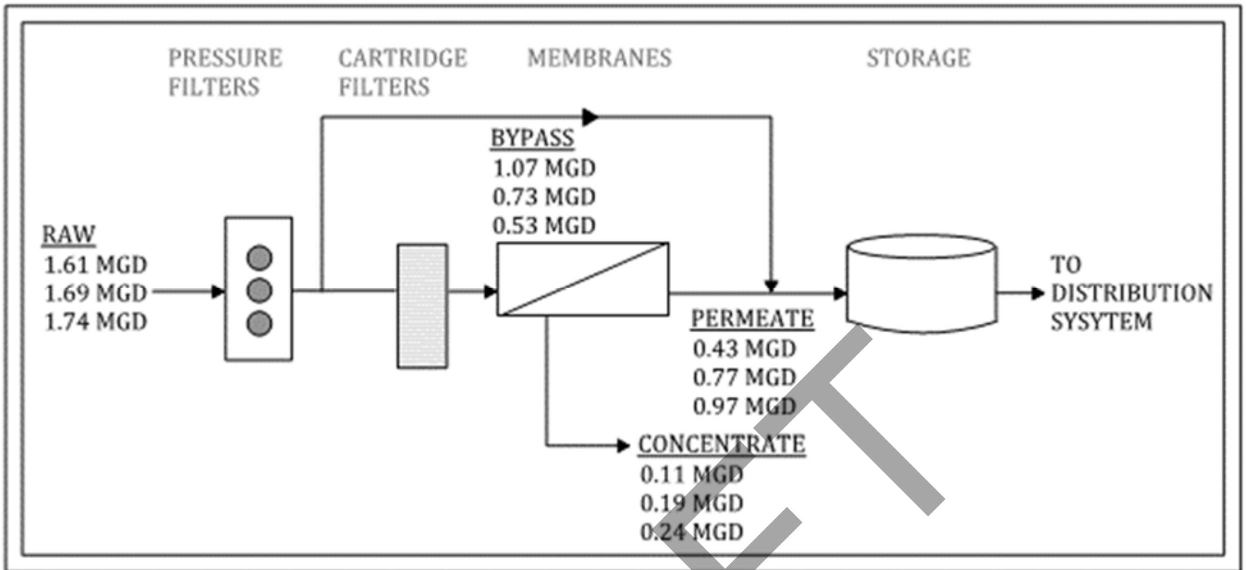
5.3.3 Proposed RO Treatment System

The proposed RO system described herein is based on a system design flow of 1.5 MGD that will be operated for 16-hours per day to provide 1.0 MG over a 24-hour period. The proposed RO system will include three (3) skids; 0.50 MGD each that will remove chloride and hardness causing salts, along with other contaminants. A proposed 2-stage RO system configuration allows for approximately 50% recovery in the first stage. Subsequently, the concentrate from the first stage is directed to a second stage to increase the overall recovery to approximately 80%. The proposed system employs three (3) skids and will allow the Town to perform routine maintenance, cleanings and repairs on one skid, while providing 1.0 MGD of permeate water from the other two (2) skids. High pressure feed pumps are used to transfer pre-treated feedwater through the RO membrane elements. Although a conservative approach is used to establish preliminary engineering criteria, McKim & Creed recommends that pilot testing be performed prior to detailed design to confirm RO design criteria and to optimize the RO treatment process.

5.3.3.1 RO Raw Feed Water Configuration

Plant operations will require that the effluent from the pressurized media filters be divided into two (2) streams prior to the cartridge filters: one stream will bypass the membrane system and the second stream will provide the feedwater to the cartridge filters, RO feed pumps, and membrane units. The membrane feed piping will include automated inlet valves, flow sensors, and pressure transmitters. Additionally, the process piping will include isolation valves for skid shut down for maintenance and cleaning; sample ports will be provided to monitor feedwater quality. After passing through the cartridge filters, the feedwater will be pressurized by high pressure RO feed pumps and fed into the RO pressure vessels. A simplified operational schematic of the pretreatment and RO system is shown in **Figure 5-5**.

Figure 5-5 - Simplified Treatment System Design Flow Diagram



Note: Numbers from top to bottom show calculated design flows using design chloride levels of 620, 875, and 1,114 mg/L, respectively. Actual permeate and bypass flows will be based on nearest 0.5 MGD increment.

5.3.3.2 Cartridge Filter System

A cartridge filter system, using 5-micron cartridge filters, is proposed upstream of the RO membranes as additional protection to remove particles that might pass through the dual-media filters. This system will include one (1) cartridge filter located on each RO skid. The cartridge filter/cartridge filter vessel design criteria are provided in **Table 5-4**.

Table 5-4 – Cartridge Filter Vessel Design Criteria

Feature	Design Criteria
Quantity	3
Hydraulic Loading, each filter vessel (gpm)	434 (0.63 MGD)
Feedwater pH	5.9 – raw water pH
Max. Fouled Element Headloss (psi)	10
Cartridge Filter Material	Continuously Wound Polypropylene
Cartridge Vessel Material	304 SS
Cartridge Filter Vessel Pressure Rating	150 psig @ 300°F per ASME Boiler and Pressure Vessel Code, Section VIII, Division 1

5.3.3.3 Proposed RO Feed Pumps

One (1) RO feed pump will be provided for each RO skid (total of 3 RO feed pumps). Each RO feed pump will have a conservative design capacity of 434 gpm at a design head of 166 feet (72 psi) total dynamic head. Multistage, centrifugal, vertical turbine pumps are recommended for the RO feed pumps. The materials of construction for the wetted parts, bowls, impellers, columns, shafts, discharge heads, pump cans, of each RO feed pump will be 316 stainless steel. Each pump suction pipe will be 4-inch diameter, PVC, and Schedule 80. Each pump discharge pipe will be 4-inch diameter 304 stainless steel, Schedule 10S. Each pump will be driven by a 75-horsepower electric motor, inverter duty, premium efficiency, operating via a 460-volt, 60 hertz, 3-phase electric power source. Each vertical turbine pump will be driven by a variable frequency drive in order to adjust RO feed flow rates and pressures. **Table 5-5** summarizes key design criteria for the RO feed pumps.

Table 5-5 – RO Feed Pump Design Criteria

Feature	Design Criteria
Quantity	3
Capacity (gpm)	434 (0.63 MGD) @ 166 ft TDH
Power (HP)	25

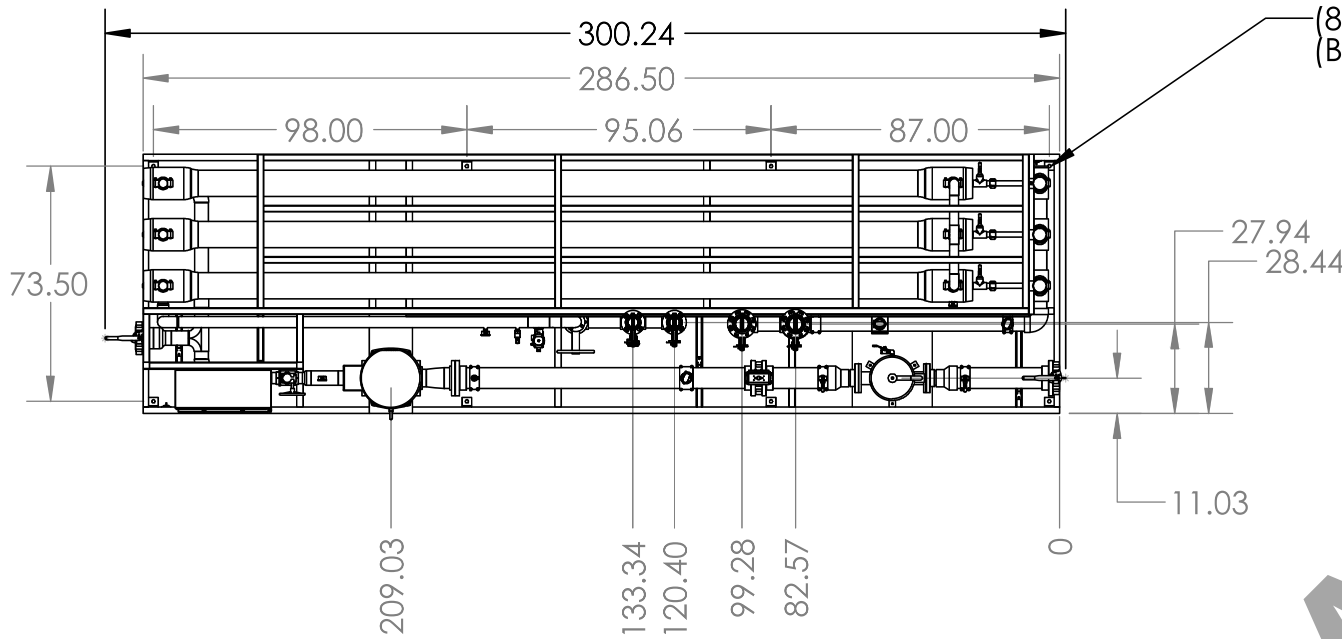
A summary of the RO Skid configuration is presented in **Table 5-6**.

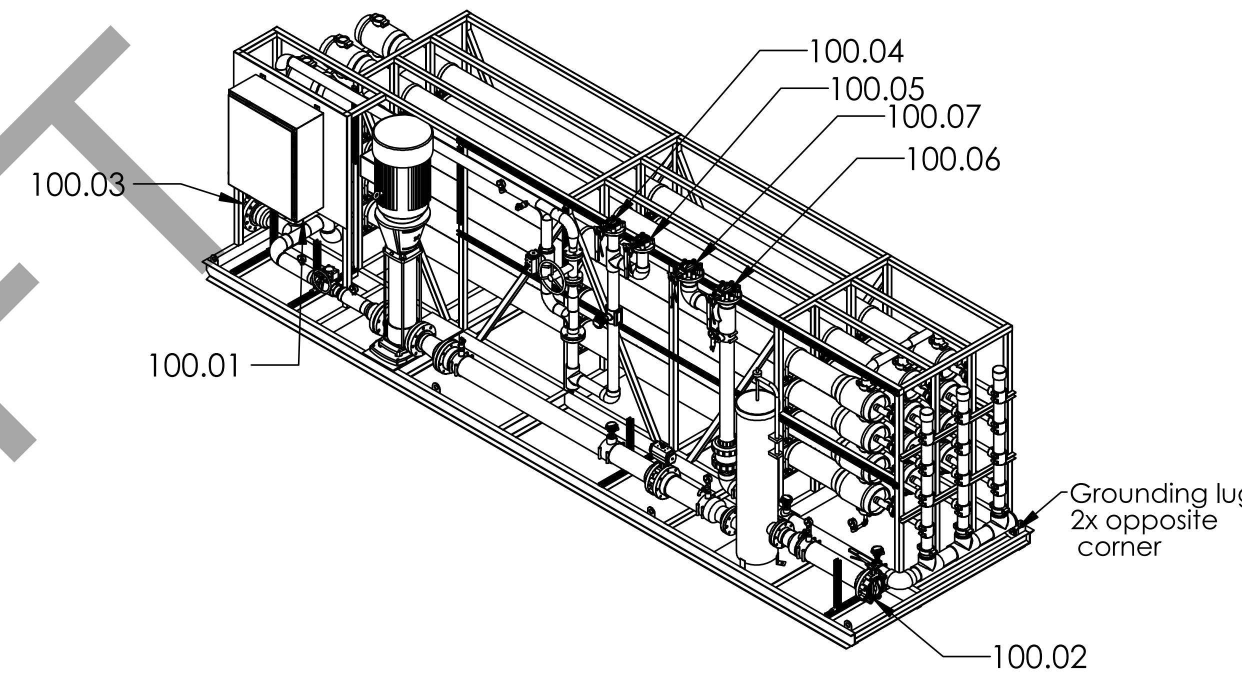
Table 5-6 – RO Skid Configuration Summary

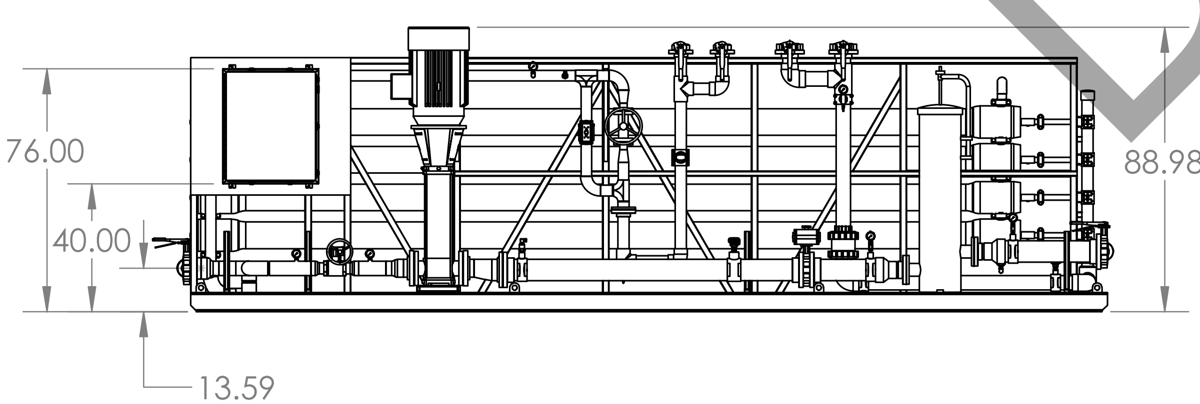
Feature	Design Criteria
Number of RO Treatment Skids	3
Design Feedwater Capacity of Each	0.63 MGD (434 gpm)
Design Permeate Capacity of Each	0.50 MGD (347 gpm)
Design Concentrate Flow	0.13 MGD (90 gpm)
Total Design Feedwater Flow	1.89 MGD (1312 gpm)
Total Permeate Design Flow	1.50 MGD (1042 gpm)
Total Design Concentrate Flow	0.39 MGD (271 gpm)

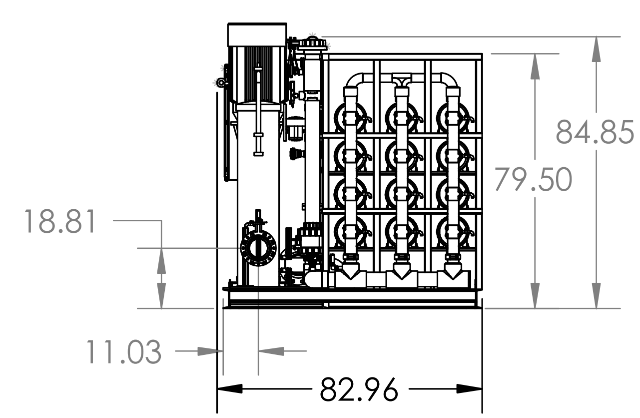
A conceptual membrane skid configuration and isometric view is shown in **Figure 5-6**.

Connection #	Name	Size	Description
100.01	Air Inlet	1/2"	Compression
100.02	Raw Water Inlet	6"	150# RF Flg.
100.03	CIP Inlet	6"	150# RF Flg.
100.04	Reject	3"	150# RF Flg.
100.05	Reject CIP Return	3"	150# RF Flg.
100.06	Permeate	4"	150# RF Flg.
100.07	Permeate CIP Return	4"	150# RF Flg.









Design Specs:
1. Designed inlet flow:
2. Designed inlet pressure:
3. Designed product flow:

Notes:
1. Unloading and install by others.
2. All external loads supported by others.
3. Approx. operating weight: 13,000 lbs
4. Approx. shipping weight: 12,000 lbs
5. Electrical terminations by others.
6. Interconnecting piping by others.
7. Skid coating: Black Powder Coat
8. Skid material: Mild Steel
9. Piping material
   9a: Low pressure piping: Sch. 80 PVC
   9b: High pressure piping: 304SS
10. Allow for 48" of clearance on both ends of RO for membrane removal.
11. Allow for 48" of clearance above filter housing for filter removal.
12. Electrical conduit material to be:
13. Air line material to be: LLDPE

NOT TO SCALE

McKIM&CREED

BELLEAIR WTP IMPROVEMENTS

REVERSE OSMOSIS CONFIGURATION AND ISOMETRIC VIEW

TOWN OF BELLEAIR INC. 1925

TOWN OF BELLEAIR
901 PONCE DE LEON BOULEVARD
Florida 34104
(727) 588-3769

DWG. No.

FIG 5-6

I:\01131\0014\Water\80-Drawings\Figures\FIGURE 5-6 RO CONFIG AND ISO VIEW.dwg, 7/28/2020 1:48:18 PM, Cathy Walker

Each proposed RO skid will have approximate dimensions of 24 feet in length, 7 feet in width, and 9 feet in height. Each skid will include twelve (12) fiberglass reinforced plastic (FRP) pressure vessels, 8-inches in diameter, that will be arrayed on a FRP structural frame (skid). The feedwater and concentrate piping on the skid will be fabricated from 304 stainless steel. The permeate piping on the skid will be fabricated from Schedule 80 PVC pipe. Each permeate connection from each pressure vessel will be equipped with a sampling connection that will be piped to a sampling panel.

The proposed pressure vessel array is based on a 2-stage system having seven (7) membrane elements in each pressure vessel. The array will include eight (8) pressure vessels in the first stage and four (4) in the second stage and will include a total of 108 RO membrane elements. The RO concentrate from the first stage will be directed to the second stage membrane elements to increase the overall recovery to approximately 80-percent.

5.3.3.4 RO Membrane Elements

The proposed low-pressure RO membranes for the skids are fabricated from polyamide, spiral wound, with a fiberglass outer wrap. Each membrane has a surface area of 440 square feet. Typical operating pressures for the membranes range from-75-175 psi, although they can withstand a maximum liquid pressure of 300 psi. Exposure of the membranes to free chlorine can damage them. The membranes are resistant to liquids with pH values between 4 and 11 during normal operation, and 2.5 to 11 during short-term operations such as cleaning. The maximum pressure differential allowed per membrane element is 15 psi and the maximum pressure in the pressure vessels is 300 psi. The turbidity of the raw water feed should be less than 1 Nephelometric Turbidity Unit (NTU), and the silt density index (SDI) should be less than 3.

5.3.3.5 Clean-in-Place (CIP) System

The most common problem with RO membranes is fouling caused by scale buildup, biological growth, or deposition of colloidal material. Fouling leads to an increased resistance to flow through the membranes, which increases differential pressure and decreases the performance of the system. Scaling is caused by a concentration of salts in excess of their saturation point, which precipitates salt deposits on the membrane surface. Fouling reduces permeate flow, increases pressure losses across the membranes, and affects the permeate quality. When the RO membrane system becomes fouled, the membranes must be cleaned to accomplish some or all of the following:

1. Dissolve and remove inorganic scales
2. Flush out particulate material
3. Breakdown bacterial slimes
4. Eliminate bacteria and other microorganisms

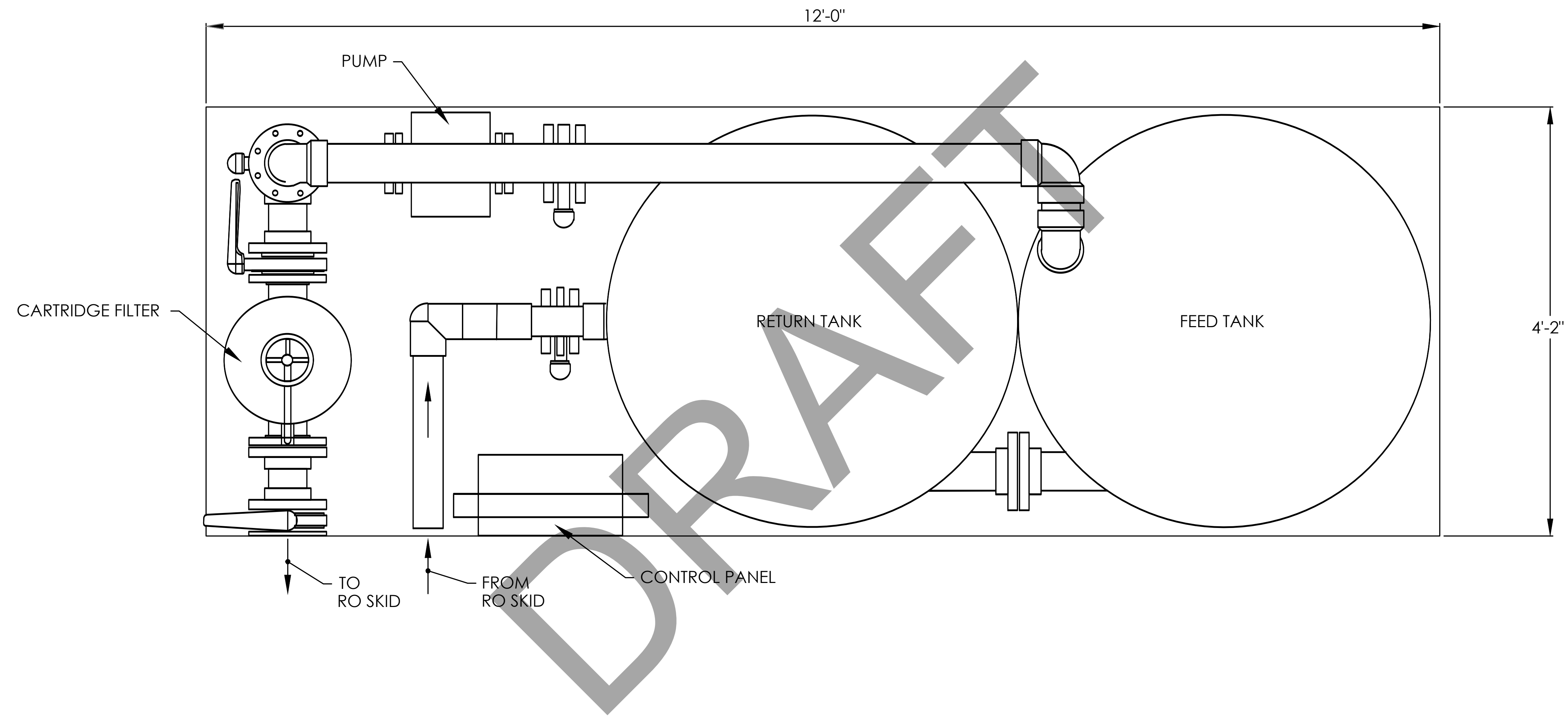
A proposed CIP cleaning system will generally include the following items:

1. Two (2) 500-gallon high density polyethylene (HDPE) cone bottom tanks with carbon steel frame
2. Pump and motor
3. Plumbing and valving to send solution to drain, RO or back to the tank
4. Pressure gauge in pump discharge plumbing
5. Flow meter in recirculation plumbing
6. Cartridge Filter
7. PVC plumbing and connectors
8. Tubing and connectors to connect to RO system

The cleaning fluid is heated to a specific temperature in the mixing tank before being pumped through the membranes, one skid at a time, in the normal direction of flow. Piping connections will allow the cleaning fluid to return to the mixing tanks and re-circulate through the membranes as needed. The CIP system includes a cartridge filter system that removes solid matter from the cleaning fluid.

Concentrated cleaning fluids are mixed with water in the mixing tank to obtain the correct dilution ratio. Cleaning fluids used on the membranes generally include a low pH fluid (such as citric acid) to remove mineral scaling and a high pH fluid (such as caustic) to remove biological foulants from the membranes. Periodically, the membranes may require additional cleaning fluids to restore functionality and recommendations for these cleanings are generally provided by membrane suppliers and/or specially focused chemical suppliers.
Many of the cleaning fluids are proprietary and membrane manufacturers typically provide recommended cleaning fluid lists for specific membranes. Membrane cleaning frequencies vary widely, and this is mainly due to contaminants and contaminant concentrations in the RO feedwater. Since there is no available pilot testing information yet, there is no way to accurately predict how often the Town would need to clean the membranes.

However, based on similar systems and water quality, the Town could anticipate a 2-4-months cleaning interval. A conceptual layout of the proposed CIP equipment is included as **Figure 5-7.**



NOT TO SCALE

MᶜKIM&CREED

BELLEAIR WTP IMPROVEMENTS

CONCEPTUAL CIP SYSTEM

TOWN OF BELLEAIR INC. 1925

TOWN OF BELLEAIR
901 PONCE DE LEON BOULEVARD
Florida 34104
(727) 588-3769

DWG. No.

FIG 5-7

5.3.4 Storage/Disinfection

The current treatment process achieves the required disinfection contact time via the existing clearwell. It is important to note that the roof of the clearwell is in very poor condition and presents a safety concern if not repaired. The proposed RO plant configuration eliminates the clearwell and uses the existing ground storage tanks to provide necessary disinfection contact time. Calculations were performed and indicate the smaller ground storage tank can achieve 4-log virus inactivation. It can be inferred that if the smaller tank can provide the necessary disinfection contact time, the larger tank will be adequate for this purpose.

5.3.5 Chemical Injection, Storage and Feed System

Immediately following the booster pump station, proposed chemical injection systems will introduce sodium hypochlorite and ferric chloride to the raw water stream. Water quality data and information from the Town indicate that precipitation of iron and sulfur constituents are the main source of particulates in the source water. These precipitates are either present in the groundwater or form during transfer of the raw water through the existing piping. Sodium hypochlorite is used to convert the compounds to their insoluble forms via chemical oxidation so that they can then be removed with the pressurized media pressure filters. Ferric chloride, or some other type of coagulant, may be added upstream of the filter units to increase particle size and aide with precipitate removal.

Following filtration and before the cartridge filters of the RO process, sodium bisulfite is added for de-chlorination and an anti-scalant is added to reduce the accumulation of precipitants on the RO membranes. Permeate water leaving the RO process is treated with sodium hydroxide to increase pH and alkalinity and is then blended with the RO bypass stream. The blended water is then treated with sodium hypochlorite for disinfection and then with fluoride prior to entering the ground storage tanks. After the disinfected the water leaves the ground storage tanks, it is treated with aqua ammonia to form chloramines and to help maintain the required level of disinfectant in the distribution system. Finally, a mixture of poly/ortho phosphates is added prior to entering the distribution system. This chemical prevents corrosion in the piping of the distribution system and in the consumer's plumbing pipe and fixtures.

In general, a 30-day supply of all chemicals is desired. **Table 5-7** summarizes the approximate chemical dosages required along with storage volumes.

Table 5-7 Chemical Dosages and 30-day Storage Requirements

Chemical	Dosage (mg/L)	14-day Storage Volume (gal)	Storage Tank Size (gal)
Sodium Hypochlorite (12.5%)	6 pre + 6 post	1333	1500
Ferric Chloride (38%)	2	70	Tote or similar
Sodium Bisulfite (40%)	15	474	Tote or similar
Sulfuric Acid (93%)	20	198	250
Anti-scalant	4	56	Tote or similar
Aqua Ammonia[1]	-	89	Tote or similar
Caustic	46	600	650
Polyorthophosphate[1]	-	30	Tote or similar
Fluoride[1]	-	14	Tote or similar

[1] Based on usage data provided by the Town

5.3.6 High Service Pump Station

The existing high service pump station is comprised of four (4) pumps, two (2) of which are 100 HP each and two (2) smaller (jockey) pumps are 40-HP each. This pump station is nearing the end of its useful life and either needs to be rehabilitated or replaced. A new high service pump station is proposed that will be located southeast of the existing 0.5-MG ground storage tank (refer to **Figure 5-8)**. The proposed high service pump station will feature the same configuration (two (2) smaller pumps + two (2) larger pumps) as the existing high-service pump station. **Table 5-8** summarizes key high-service pump station design criteria.

Table 5-8 – High Service Pump Station Design Criteria

Feature	Design Criteria
Jockey Pumps	2 (1+1)
Main Pumps	2 (1+1)
Jockey Pump Horsepower	40
Main Pump Horsepower	100
Jockey Pump Flow (gpm)	700
Main Pump Flow (gpm)	1400
Pump Head (ft)	162

5.3.7 Deep Injection Well

A deep injection well (DIW) has been proposed to dispose of the estimated peak daily RO concentrate flow of 161,000 gpd. The proposed site for the DIW is located south of the Town Public Works Building. It is noted that this PER includes an evaluation of a Closed-Circuit RO (CCRO) process that may reduce RO concentrate flow to less than 50,000 gpd. In this case, a deep injection may not be required because the Town could potentially dispose of the concentrate via the Pinellas County sanitary sewer system. The CCRO process is evaluated in **Section 5.5.**

5.3.8 Sitework

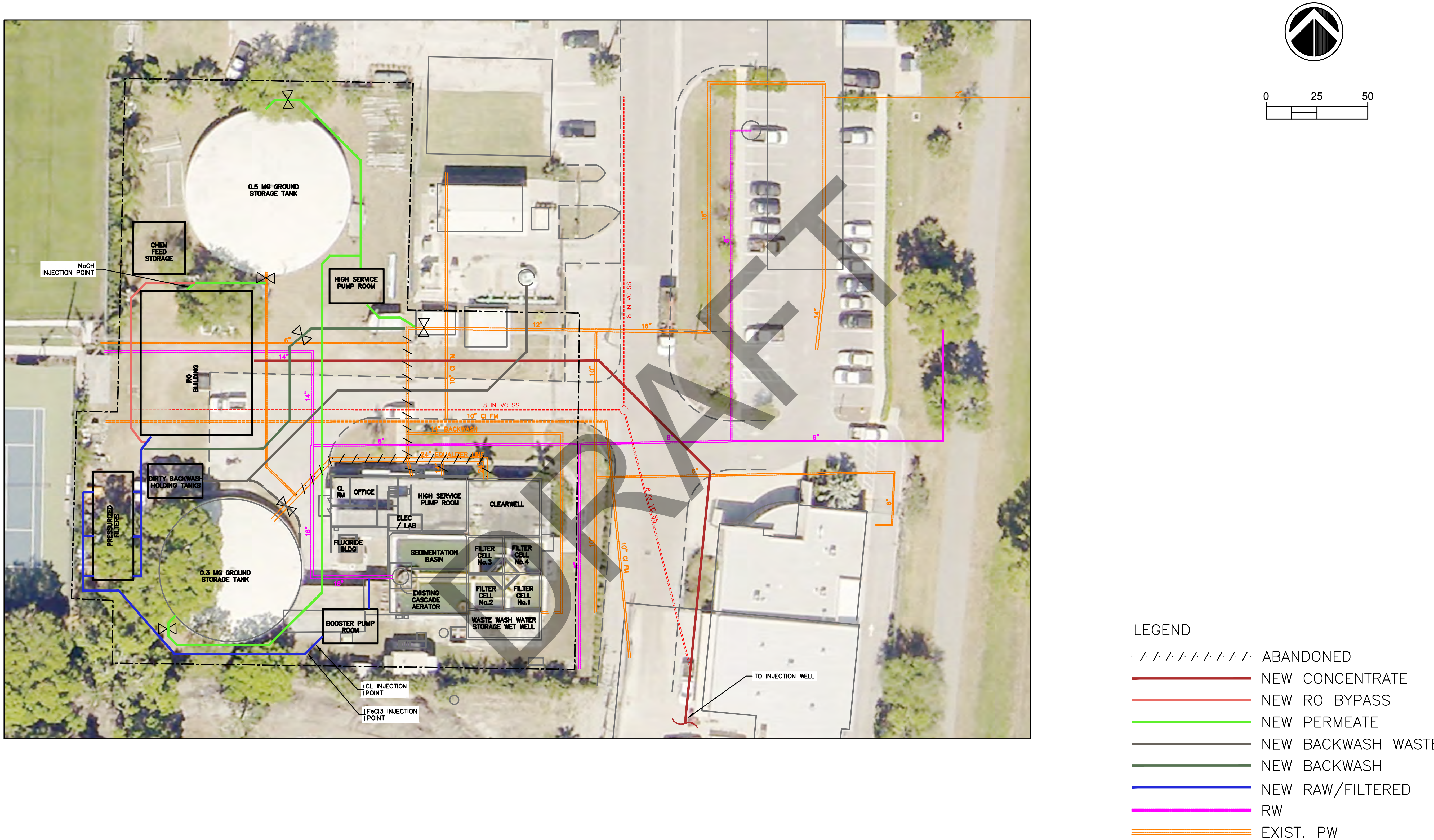
The proposed Chemical Storage, Pressurized Filters, and RO Process Building are shown in **Figure 5-8**. Site improvements include additional dedicated parking and concrete sidewalk adjacent to the RO building. The proposed site plan is only conceptual in nature and its final location would be evaluated further during final design.

5.3.9 Yard Piping

Implementation of the proposed treatment process will substantial changes to the existing yard piping configuration. Most of the existing piping from the 0.3-MG ground storage tank to the existing high service pump station and clearwell will need to be removed or abandoned along with a portion of the distribution line leaving the high service pump station. New yard piping will be required to manifold the existing raw water lines to a common header that would then feed through the new treatment process. The RO permeate will be directed to either the ground storage tanks or the existing clearwell (depending on whether a phased alternative approach is implemented). The concentrate will be directed to the deep injection well using a new pipe. The proposed yard piping configuration includes the following:

1. Existing raw water intake to pressurized media filters
2. Pressurized media filters to the RO process
3. RO bypass line
4. Blended permeate and RO bypass line to the existing line connected to the 0.5-MG ground storage tank
5. 0.5-MG ground storage tank to the new high service pump station
6. 0.3-MG ground storage tank to the new high service pump station
7. High service pump station to existing distribution line
8. Existing distribution line (or high service pump station) to pressurized media filters (for backwash)
9. Dirty backwash tank to existing Pinellas County wastewater lift station
10. RO process to DIW

The proposed yard piping layout is presented in **Figure 5-8**.



BELLEAIR WTP IMPROVEMENTS

PROPOSED FACILITY SITE LAYOUT AND YARD PIPING PLAN

McKIM&CREED

TOWN OF BELLEAIR INC. 1925

TOWN OF BELLEAIR
901 PONCE DE LEON BOULEVARD
Florida 34104
(727) 588-3769

DWG. No.

FIG 5-8

I:\01131\0014\Water\80-Drawings\Figures\FIGURES 5-8 _5-9.dwg, 8/3/2020 1:11:33 PM, Cathy Walker

5.4 Proposed RO Process and Operations Building

The RO building will be a single-story structure, about 2,000 square feet. The rooms will include a RO process area, electrical room, control room, and unisex restroom. A proposed layout is included as **Figure 5-9**. The proposed building will be located southwest of the existing 0.5-MG ground storage tank (refer to **Figure 5-8**). The control room will contain computers and monitor screens necessary for the plant operators to monitor and operate the facility, a work station, and a viewing window out to the process equipment area. The building will be designed in accordance with the current edition of the Florida State Building Code (FBC) and all components and cladding materials will have Florida Product Approval numbers. Building design live and wind loads will be determined in accordance with the aforementioned FBC and the ASCE Standard 7-05 "Minimum Design Loads for Buildings and Other Structures."

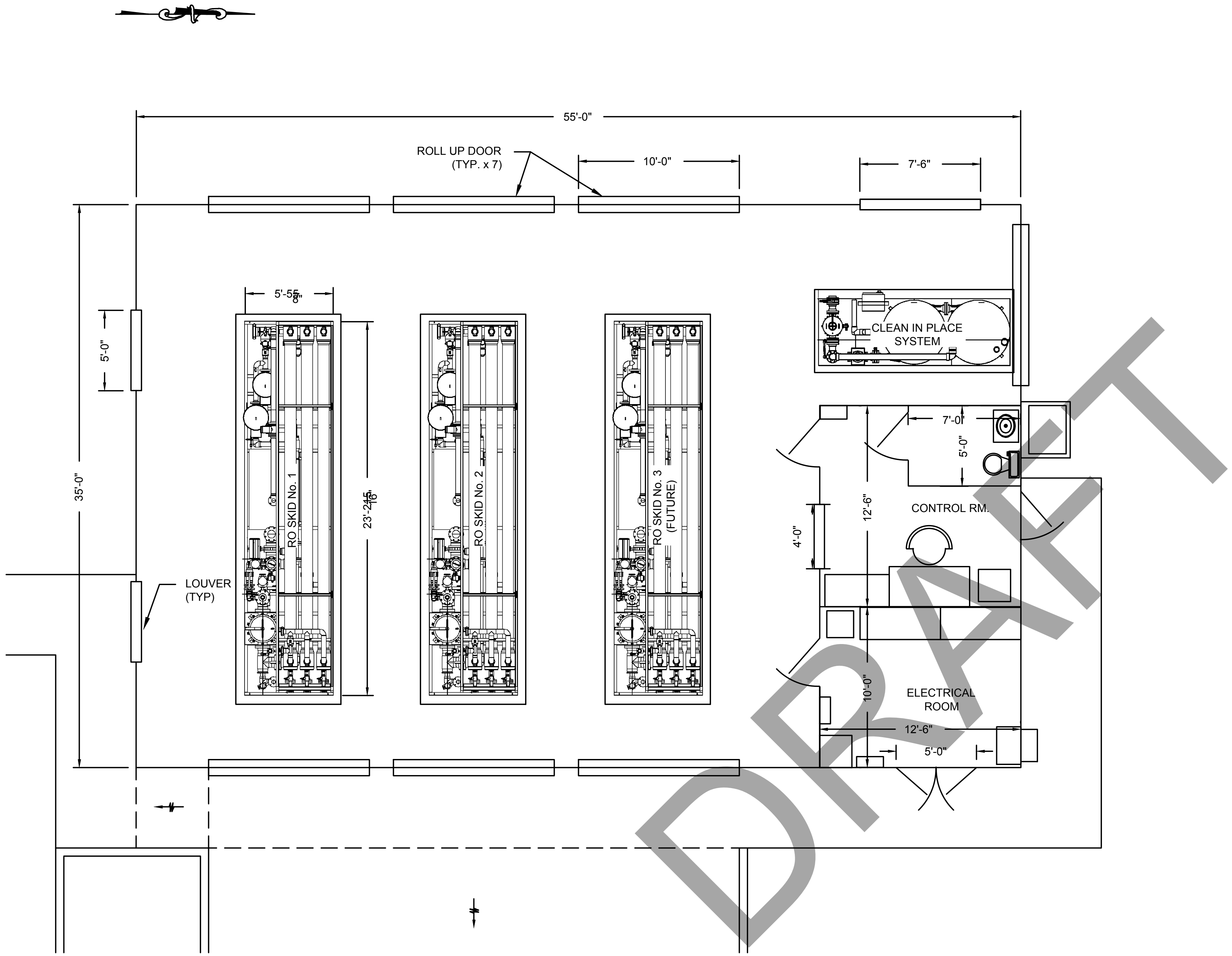
The building will also include the following components:

- The foundation will be either a shallow or deep foundation based on Geotechnical investigations that will be performed during detailed design. It is anticipated that based upon existing adjacent structures a shallow foundation system may be utilized, consisting of reinforced concrete spread footings below columns and strip footings below exterior walls. The interior floor will be a concrete slab on grade constructed independent of the footing system.
- The building framing system will consist of structural steel columns and beams supporting the roof. In addition, the frame will provide support for the exterior walls. The roof and floor diaphragms will help provide lateral stability for the building from the wind loads transferred by the exterior walls. The roof will be standing seam metal roof panels supported by structural steel roof joists.

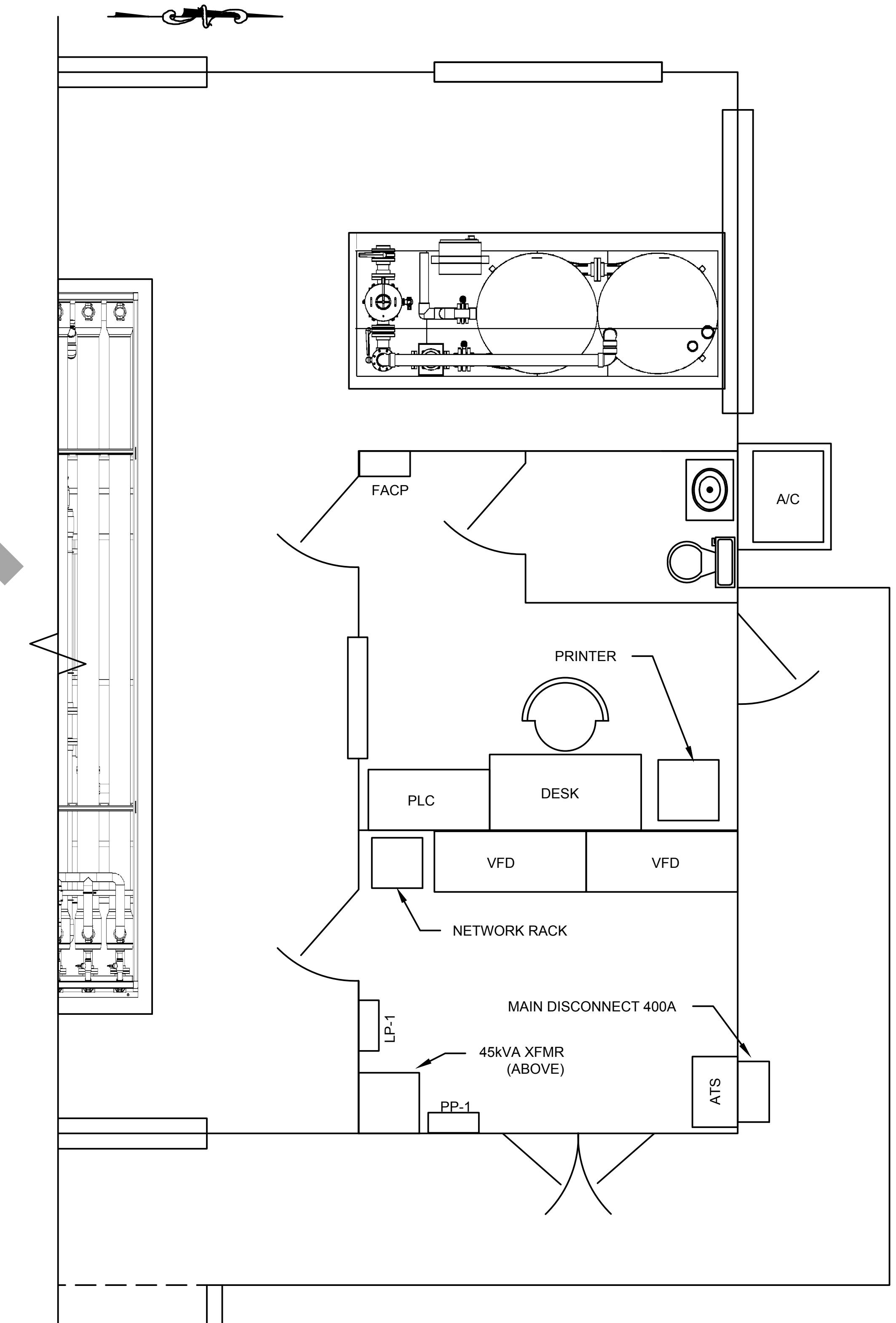
Example building construction, City of North Port
(Belleair Facility would be one-story)

- Stucco, metal panel, and split face block exterior finish.
- FRP Exterior personnel doors with aluminum frames.
- 12′ W x 12′ H overhead coiling doors centered on each of the RO skids.
- Insulated, aluminum frame, laminated glass exterior windows.
- Example building construction, City of North Port (Belleair Facility would be one-story)
- Interior 8″ CMU partitions with a painted finish.
- Aluminum interior doors and frames and doors.
- Suspended ceiling system in the office areas and in conditioned spaces.
- Process area ceiling will be the exposed structural frame and roof deck with a painted finish.
- HVAC will be provided by direct expansion (DX) split systems in all rooms exclusive of the process areas.
- Mechanical ventilation consisting of fixed louvers and exhaust fans will be provided in the process area.
- Hot and cold potable water in the restroom in accordance with the Florida Plumbing Code (FPC).
- Water lines will be CPVC.
- Hot water will be provided by an electric water heater.
- Cold water hose bibs will be provided on the exterior of the building.
- Plumbing fixtures in the restrooms will be vitreous china.
- Floor drains tied to the sanitary waste lines will be provided in the restrooms.

The RO section of the proposed building will contain three (3) RO skids, clean-in-place system, process piping, control panels, electric power and instrumentation conduits, and remote instrumentation units. Space will be provided in the process area to house spare parts, cartridge filters, and membrane cleaning chemicals.



R.O. BUILDING LAYOUT



PARTIAL BUILDING LAYOUT

NOT TO SCALE

McKIM&CREED

BELLEAIR WTP IMPROVEMENTS

CONCEPTUAL RO BUILDING LAYOUT

TOWN OF BELLEAIR INC. 1925

TOWN OF BELLEAIR
901 PONCE DE LEON BOULEVARD
Florida 34104
(727) 588-3769

DWG. No.

FIG 5-9

5.5 Proposed Electrical System Modifications

5.5.1 Existing Conditions

The existing power service is from Duke Energy using a 300kVA transformer single point of connection that is located next to the maintenance building. The primary 12.47kV feed comes from the street, underground to the transformer. The secondary side is connected to a main disconnect that is mounted on the south wall of the filters. An Automatic Transfer Switch (ATS) next to the disconnect serves as the transfer point of power between normal utility service and generator. There is a generator disconnect mounted next to the ATS on the filter wall.

The utility building is fed from the motor control center (MCC) in the high service pump (HSP) room though a junction box also mounted on the filter wall. This allows for the building to be fed by the WTP generator and transformer.

Electricity billing information was obtained from July 2013 to Jun 2014 and has the combined plant and Utility Building average power usage around 103kW with the usage relatively flat throughout the year. The Duke Power Utility rate schedule is GSLM-2 or General Service Load Management in which the operation of the standby generator can be at Duke Power's request. Power to the facility from Duke Power will normally remain as back up for the standby generation. The customer is given 15 minutes to initiate demand reduction (i.e. turn on the generator) before Duke Power capacity is impacted. This rate schedule and requirement affords the plant a lower power cost. However, changes in the Environmental Protection Agency (EPA) air regulations are likely to have a future impact on generator operation.

Standby power is provided by a Caterpillar Model 3412 - 500kW generator located south of the filter building. This generator provides power to both the plant and Utility building across the street. Based on the billing information the generator is at 21% capacity. This is very low for this size unit, as manufacturers typically specify a generator to run at least 30% to avoid wet stacking.

The fuel supply is a belly tank located under the generator. This tank holds 2,000 gallons of usable fuel, which would give approximately 58 hours of running time at full load. The engine generator was relocated in 2008 from the Town's decommissioned/demolished wastewater treatment facility, has 1567 hours of running time, and appears to have been reasonably maintained.

The existing 800 ampere ATS enclosure (1999) has issues of corrosion and should be cleaned and painted. If not performed in the last five years, a complete cleaning and check out by the manufacturer's representative is recommended. This will require a method of bypassing the switch, but once done, will add confidence in the reliability of the system. In conjunction, it is recommended that a load test be done on the generator, if one has not been performed within the past five years.

5.5.2 Proposed Electrical System Modifications

The initial stages of plant upgrades will involve the installation of a new raw-water booster pump station and associated equipment for the new high-pressure filter system. New pumps will utilize a combined starter and control panel. The combined load is estimated at 40kW and will be fed from a new 80A breaker in the existing MCC.

The proposed RO system will be housed in a separate building northwest of the existing plant. The load of the new system involves the proposed and future load which has a combined estimate of around 450kW at build out. Initially the load for the building is estimated to be approximately 125kW.

Because of the age and connectability of the existing electrical system, it is recommended that a separate utility transformer be installed with its own utility meter. This will allow for the RO building energy costs to be easily monitored and will add redundancy to the existing WTP electrical system. If warranted, a manual transfer system could be installed to link the existing WTP distribution and RO transformer together in case of failure of either.

The existing generator will be utilized to provide standby power to the RO building. A connection from the generator to the RO building will be installed around the existing 0.3 MG ground storage tank (GST). This ductbank will be composed of a concrete cap so as to allow for machinery to run on top of it. A new 800 ampere ATS will be installed to handle all of the RO building loads.

An 18' x 12' electrical room will be included in the RO building. This room will house three variable frequency drives (VFD) for the RO skids, which may be installed in phases. The RO buildings' ATS, 480V distribution panel and a 208V/120V 45kVA three phase transformer along with its power distribution panel will also be installed in this room.

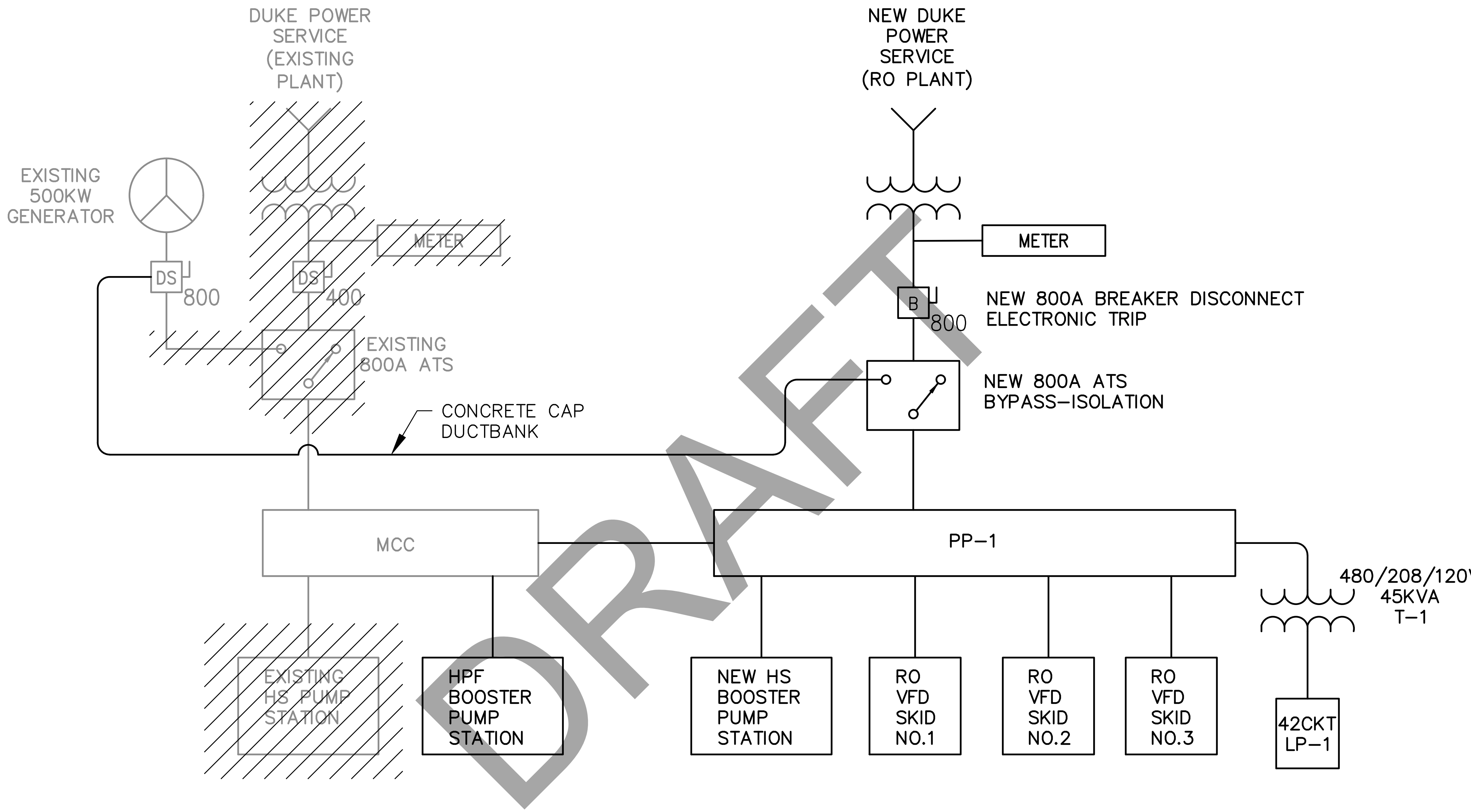
Additional equipment space in the RO electrical room shall be reserved for the new high service pump station soft starters, which will be installed during the final stages of plant upgrades. No new electrical loads are associated with these pumps, as they will be an in-kind replacement of the existing.

The VFDs will be designed as six-pulse modulation with tuned passive filter to mitigate harmonics. No output filters are necessary as the motors are within 100' of the drives. However, VFD rated cable will be used and the motors, along with being premium efficiency, will be inverter duty rated (Type H insulation). It is also suggested the drives be rated for 50^0C ambient in order to be fully operational if there was a failure of the air conditioning (HVAC) system. There are VFD manufacturers that can produce a 50^{0}C rated drive without derating. We would only recommend those manufacturers; otherwise the Town would be paying for an unneeded larger drive to meet the criteria.

Ventilation and air conditioning are planned to be part of the building for the electrical and control room. Corrosion resistant condensing units will be deployed outside as a split system. Only heat will be provided for the control room.

Surge suppression will be incorporated at different points of the electrical distribution. The incoming service entrance will have surge suppression along with the ATS, power distribution panel and VFD's. In addition, a lightning redirection system is recommended on the exterior of the building and bonded to the buildings grounding grid. A low impedance grounding system is critical to direct the path of lightning to earth. This will be all tin-plated copper with grounding rods deployed to maximize the effectiveness. Once installed, the grounding system will be tested using "fall of potential" method to not only meet National Electric Code (NEC) code (<25ohms) but not to exceed <5 ohms.

Building interior and exterior lighting will be LED for maximum efficiency without a decrease in lumens. This lighting will have long bulb life to minimize maintenance. To meet the Town's needs, any exterior lighting will be "Dark Skies" compliant to reduce unnecessary light pollution. A conceptual One Line Diagram is included as **Figure 5-10.**



McKIM&CREED

BELLEAIR WTP IMPROVEMENTS

CONCEPTUAL ONE LINE DIAGRAM

TOWN OF BELLEAIR INC. 1925

TOWN OF BELLEAIR
901 PONCE DE LEON BOULEVARD
Florida 34104
(727) 588-3769

DWG. No.

FIG 5-10

5.6 Proposed Instrumentation Modifications

5.6.1 Instrumentation Existing Conditions

The existing control system of the WTP equipment is a combination of Programmable Logic Controller (PLC) and manual relay controls, providing a limited capability of operation. The functions of the high service pumps are controlled by a Siemens S7 – 300 programmable controller. The plant at one time had the ability to monitor the high service pumping via a computer based human machine interface (HMI) software made by Wonderware. However, this functionality is no longer operational, which means even though the Siemens PLC still has automatic control of the HSP, there is no ability for remote intervention without a direct connection to the PLC via a laptop computer and the PLC programming software. The operator must switch control at the VFD to manual in order to adjust the pump speed when needed. This has not typically been an issue, as the PLCs automatic functionality of pump speed and number of pumps based on pressure has been functioning properly and is the primary control for the HSP.

The filter system control is done using manual relay timers and a Square D Sy/Max micro controller for filter backwash sequencing. The Sy/Max controller was in production until the late 1990s but is now considered beyond end of life by the manufacturer. As such, parts are no longer available through standard retail channels and only available through from third parties. The control panel appears to be in good condition with little to no corrosion and can continue to be used as long as there is no failure of the processor.

The gas chlorine system is controlled using a Depolox 3 Total Chlorine analyzer and the Superior Autovalve chlorinator controller. The controller uses a compound loop of flow and desired chlorine residual setpoint (currently 3.0 mg/l) to control the chlorine dosage. In addition, as the distribution system uses chloramines for complete disinfection, the ammonia flow pace control is performed utilizing the same output from the Autovalve controller. The ratio of ammonia to chlorine is manually adjusted via the stroke settings on the individual pumps (currently 4:1). The Depolox 3 analyzer has been discontinued by Wallace and Tiernan/Evoqua with replacement using the Depolox 400 M, however, the same measurement sensors can be used with the new unit.

The chemical addition of hydrofluosilicic acid and orthopolyphosphate are manually controlled to turn on when the well system is activated. There is no automatic adjustment for flow or setpoint. Stroke and pump speed are manually set based on the dosage requirements. As the well flow is constant, adjustment of these chemicals is rare. However, if wells are taken off line or because of failure, manual adjustment to these settings would become necessary.

The well field pumps are controlled for speed through individual VFDs located at the well. The speed is adjusted manually when needed. Remote start/stop control for the wells are available through an Internet web-based hosted cellular telemetry system which also provides monitoring of the well pump run status. Access is provided through a computer web browser which connects to the host server through a network connection. While basic start/stop control and status monitoring is provided, the operation is limited and availability is contingent on a recurring monthly fee. As more information collection is desired for the wells and the process complexity requires a higher level of control, it will eventually be necessary to replace this capability with a more robust control system.

5.6.2 Proposed Control System Changes

The proposed control system for the new facilities will be designed in stages to help control the implementation costs but with the level of monitoring and control needed from a modern control system. The existing plant control system will mostly remain as is, unless budget can be allocated for it to be incorporated. The control system will be designed around a centralized point for monitoring and control of the plant. The City has utilized a no-cost 50-point license for VTScada by Trihedral as a SCADA software package for monitoring a selection of water quality parameters. The operations staff has been pleased with the performance and the recognition that the software does not require a server computer for operation. Expanding this software with a higher point count license will allow the operations to expand the monitoring and control ability of the plant. Additionally, the software can provide data collection of key plant parameters for trending and reporting, as well as other features such as local and remote alarm notification.

Communication from the SCADA software to fields control panels should be handled over Ethernet communications, with all devices connected together using a managed network switch. The control system will initially be designed for the RO skid system, starting with an open architecture (PLC) that communicates using Ethernet/IP. This main PLC will be housed in a new control room constructed as part of the RO building. The PLC will also be expandable for future hardwired inputs or Ethernet communication to other control panels. This will allow the PLC to communicate with the RO skid PLC(s) and any future PLC that is installed in the plant. The control logic for the RO skids will reside on a PLC that is part of the RO system. This PLC would monitor and control the RO system operation. Options for this control system are to have an individual PLC on each skid or one single PLC mounted in a local control panel near the skids. Having a PLC on each skid as opposed to one for both skids adds another level of redundancy however, this can be decided during the design phase.

The new pressurized filter system will require a separate set of controls with a local control panel for each vessel. Operators on the enclosure will allow local operation including backwashing of the filter. Connection of these control panels to the PLC network, either as remote input/outputs or as standalone system will allow remote operation and monitoring of the system.

The HMI will consist of an industrial computer with a touchscreen monitor installed on the main PLC enclosure and a desktop workstation in the control room. The workstation will act as the primary means of monitoring and control with the screen on the main PLC enclosure as backup. If the budget allows; additional plant systems could be added, during design, to the main PLC in the RO building. The HSP currently is controlled using a Siemens S7. Utilizing this PLC and having it connected to the RO system PLC will require a third party “gateway” along with programing changes. This could introduce issues during construction and implementation, as the gateway translates between protocols. Building a system around the S7 could also be an issue, as support for it is limited and the cost of upgrading the processor to an Ethernet based unit is substantial. The cost of this approach would be enough to warrant the installation of a new PLC and remote I/O rack in the HSP building to monitor and control the high service pumps, chemical feed systems and generator.

With the implementation of the RO process, monitoring and control of the wells will also be increased. It will be important to operate the wells at flow rates controlled to maintain the process, monitor the downstream pressure to recognize piping issues and monitor the well levels to maintain water quality conditions. This will require a greater capability level than available in the current system. While the full capability is not required until the actual RO process is place into operation, it is important to recognize these needs and to incorporate them into the different phases. Ideally, additional instrumentation can be added during the earlier phase, including adding a transmitter to the flow meter and adding new transmitters for discharge pressure and well level. A new local control panel that also functions as the telemetry station can be added as part of the later stages, replacing the existing telemetry. With the decreasing costs associated with cellular communications, it would be recommended to utilize an imbedded input/output Ethernet based PLC processor to handle the local controls and telemetry reporting to the plant. Remote start/stop controls would remain and automatic speed control would be added to better operate the wells locally and as a total well field system.

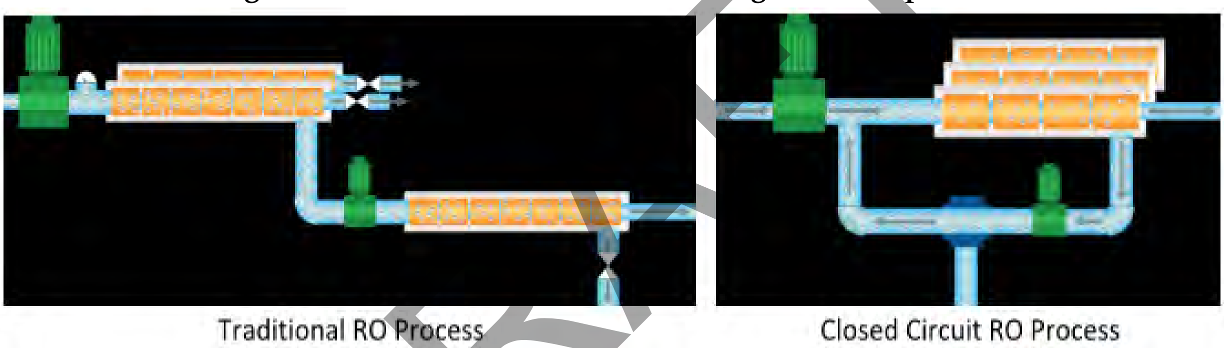
5.7 High-Recovery Closed Circuit RO System Alternative

The following sections evaluate a potential CCRO system and compare it with a traditional RO system.

5.7.1 High-Recovery Closed Circuit RO (CCRO) Description

A CCRO system offers the ability to operate the RO process and achieve higher overall RO recovery that may approach 90 to 95-percent. CCRO systems feature equal feed and permeate flow rates during normal operation mode. At a software-based set point, the system automatically flushes out all of the concentrate, and then returns to its normal operation mode. The concentrate flush is triggered by the CCRO operating software, based on any combination of flow, concentration, pressure and additional set points. During the concentrate flush step, the system continues to be fed and generates permeate, while concentrate is pushed out of the system in one sweep. Concentrate is recirculated to the membrane feed and recovery increases with each concentration cycle. **Figure 5-11** shows a side by side comparison of a traditional 2-stage RO and a and CCRO configuration. As with the 2-stage system, it is recommended that pilot testing be performed to confirm CCRO design criteria and to optimize the CCRO treatment process.

Figure 5-11 Closed Circuit RO and 2-Stage RO Comparison



Images courtesy of Desalitech, Inc.

5.7.2 CCRO System Benefits

The primary benefit of the CCRO system is the ability to achieve a higher recovery rate as compared to a 2-stage system. Higher recovery results in higher RO permeate production and lower RO concentrate production (potentially as low as 40,000 gpd). As a result, the Town may have an opportunity to discharge the CCRO concentrate to the Pinellas County sanitary sewer system instead of constructing and operating a DIW. In addition, the CCRO system requires less cleaning than traditional RO systems which in turn extends RO membrane life.

5.7.3 CCRO System Drawbacks

System challenges of the CCRO system include higher permeate TDS concentrations than those of a 2-stage RO system.. Because of this, a higher percentage of CCRO permeate would be needed while blending with CCRO bypass flow. Also, the CCRO system requires higher pressures than those for traditional RO and the characteristic translates to higher power consumption.

5.7.4 CCRO Evaluation Summary

As previously discussed, there are several differences between 2-stage RO and CCRO systems. **Table 5-9** summarizes the advantages and disadvantages associated with traditional and CCRO systems.

Table 5-9 – RO Process Alternative Comparisons

Alt	Description	Advantages	Disadvantages
1	Conventional RO System	• Lower capital and O&M costs • Known effectiveness (lower risk) • Higher quality RO permeate	• Uses more groundwater • Requires deep injection well • Requires more space
2	High-Recovery (CCRO) System	• Uses less groundwater • May not require deep injection well • Uses less space – may result in smaller RO process building design	• Higher capital and O&M costs • Less available information for prior installations (higher risk) • Higher energy usage costs

Based on our evaluation of a potential CCRO system, we recommend the following:

1) Evaluate the potential discharge (approximately 40,000 gpd) of CCRO concentrate into the County's sanitary sewer system.
2) Determine capital costs and fees for the CCRO flow
3) Compare present value of traditional and CCRO systems
4) Evaluate risks and consider performing a pilot study for a CCRO system

6.0 Potential Use of Existing Treatment Plant Systems

With the exception of the ground storage tanks and some yard piping, the proposed facility will not reuse the existing equipment. Yard piping to be reused can be seen in **Figure 5-8**.

7.0 Phased Implementation Plan

Considerations for a phased design/construction process were evaluated to help the Town with budgeting and providing for capital outlays over an extended period. Of special note, the phasing is designed to minimize capital costs in the earlier phases to provide only the treatment processes needed to achieve chloride and TDS levels of 225 mg/L and 450 mg/L, respectively. The phasing plan includes recommended improvements that would designed and constructed in four (4) phases. **Table 7-1** shows the improvements needed if the complete facility was constructed together and the improvements needed for each of the proposed phases.

Table 7-1 – Phased Alternative Implementation

Task/Improvement	All at Once	Phase 1	Phase 2	Phase 3	Phase 4
Mobilization/Demobilization	✓	✓	✓	✓	✓
Sitework	✓		✓	✓	
Clearwell Roof Rehabilitation		✓			
Booster Pump Station	✓		✓		
Pressurized Filters and Backwash Holding Tank	✓		✓		
Chemical Building	✓		✓		
Chemical Systems	✓		✓	✓	
RO System	✓			✓	✓
RO Building	✓			✓	
Deep Injection Well	✓[1]			✓[1]	
Additional Well(s)	✓	✓		✓	
Well Rehabilitation	✓		✓		
High Service Pump Station Rehabilitation		✓			
New High Service Pump Station	✓				✓
Yard Piping	✓		✓	✓	✓
Electrical	✓	✓[2]	✓	✓	✓
Instrumentation	✓	✓[2]	✓	✓	✓

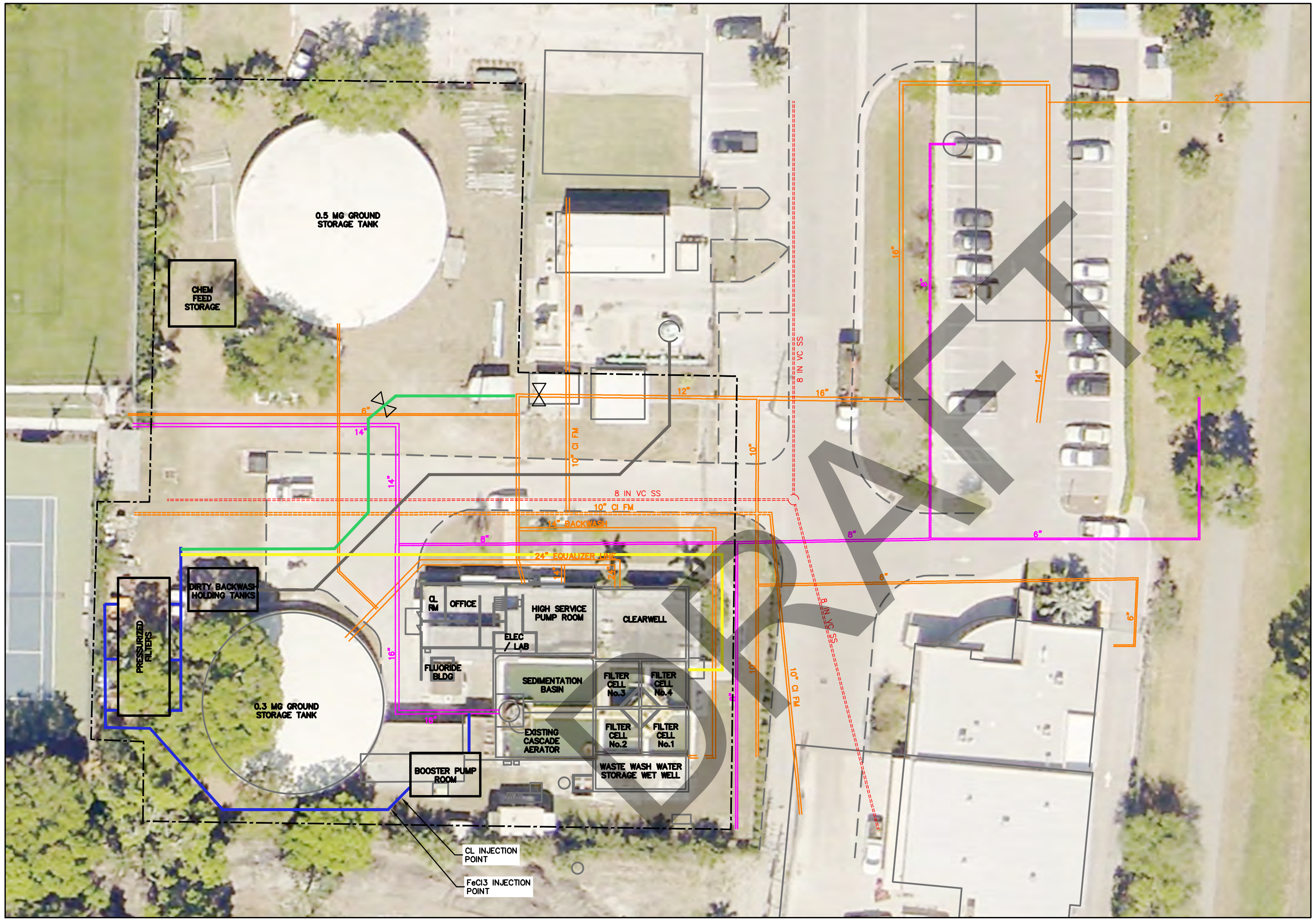
1) *The inclusion of the deep injection well is contingent upon implementation of traditional or closed-circuit RO system*
2) *At proposed well site(s)*

7.1 Phase 1 – Clearwell Roof Rehabilitation and Additional Well

Phase 1 involves the addition of one (1) new production well (Well 11), repairs / rehabilitation at the existing wells, rehabilitation of the existing clearwell, and the existing high service pump station. Due to the rapidly deteriorating water quality from Well 3, we recommend that the Town take this well off-line. The lost flow from Well 3 will be made up from the proposed Well 11. In subsequent Phases 2 and 3, the existing clearwell would remain in operation to achieve the required contact time for disinfection. A tank inspection was performed by Liquid Engineering Corporation on December 11, 2019 and a summary report was provided. In general, the summary report indicated that the clearwell roof is in poor condition and needs to be repaired or replaced. The summary report also indicated that the existing tank walls and bottom are in fair condition would require that tank concrete and coating issues be addressed for continued utilization. A sketch of the roof repair has been included in **Appendix D**. Updates to the high service pump station would include pump rehabilitation, along with updates to exiting electrical, mechanical and instrumentation/control systems. It is noted that the existing walkway running from the sedimentation tank to the filters is in poor condition and that repairs are needed to allow for temporary operation for Phase 1.

7.2 Phase 2 – Pressurized Dual-Media Filters

In Phase 2, the pressurized dual-media filters would be installed along with the proposed booster pump station. All of the ground water would need to flow through the filters; therefore, the existing sedimentation basin, cascading aerator, and filtration system will be decommissioned, while use of the existing clearwell will be retained. **Figure 7-1** shows the proposed yard piping layout for this phase. In addition, a small building for chemical storage and feed systems needed for this phase would be constructed.



0 25 50

LEGEND

- NEW BACKWASH WASTE
- NEW BACKWASH
- NEW FILTERED TO CLEARWELL
- NEW RAW/FILTERED
- RW
- EXIST. PW

McKIM&CREED

BELLEAIR WTP IMPROVEMENTS

PHASE 2 SITE LAYOUT AND YARD PIPING PLAN

TOWN OF BELLEAIR INC. 1925

TOWN OF BELLEAIR
901 PONCE DE LEON BOULEVARD
Florida 34104
(727) 588-3769

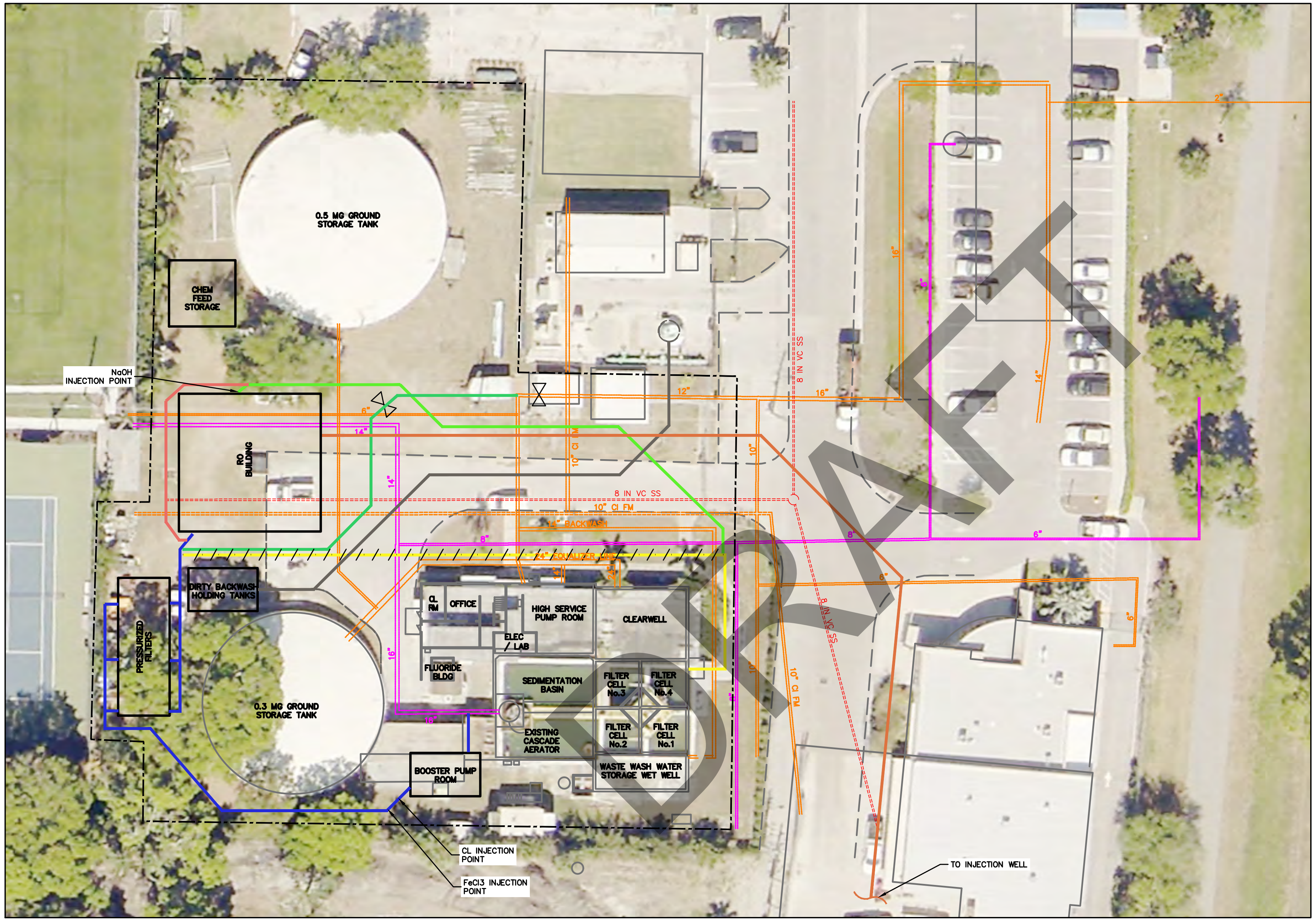
DWG. No.

FIG 7-1

I:\01131\0014\Water\80-Drawings\Figures\FIGURES 7-1 THRU 3.dwg, 7/29/2020 10:34:54 AM, Cathy Walker

7.3 Phase 3 – RO System

During Phase 3, the installation of two (2) RO skids will take place. Due to current raw water quality trends, it is anticipated that approximately 50% of the water coming from the pressurized dual-media filters would be directed to the RO system when placed into operation. The modified high-service pump station and clearwell continues during this phase. **Figure 7-2** shows the proposed yard piping layout for this phase.



0 25 50

LEGEND

- ABANDONED
- NEW CONCENTRATE
- NEW RO BYPASS
- NEW PERMEATE
- NEW BACKWASH WASTE
- NEW BACKWASH
- NEW FILTERED TO CLEARWELL
- NEW RAW/FILTERED
- RW
- EXIST. PW

McKIM&CREED

BELLEAIR WTP IMPROVEMENTS

PHASE 3 SITE LAYOUT AND YARD PIPING PLAN

TOWN OF BELLEAIR INC. 1925

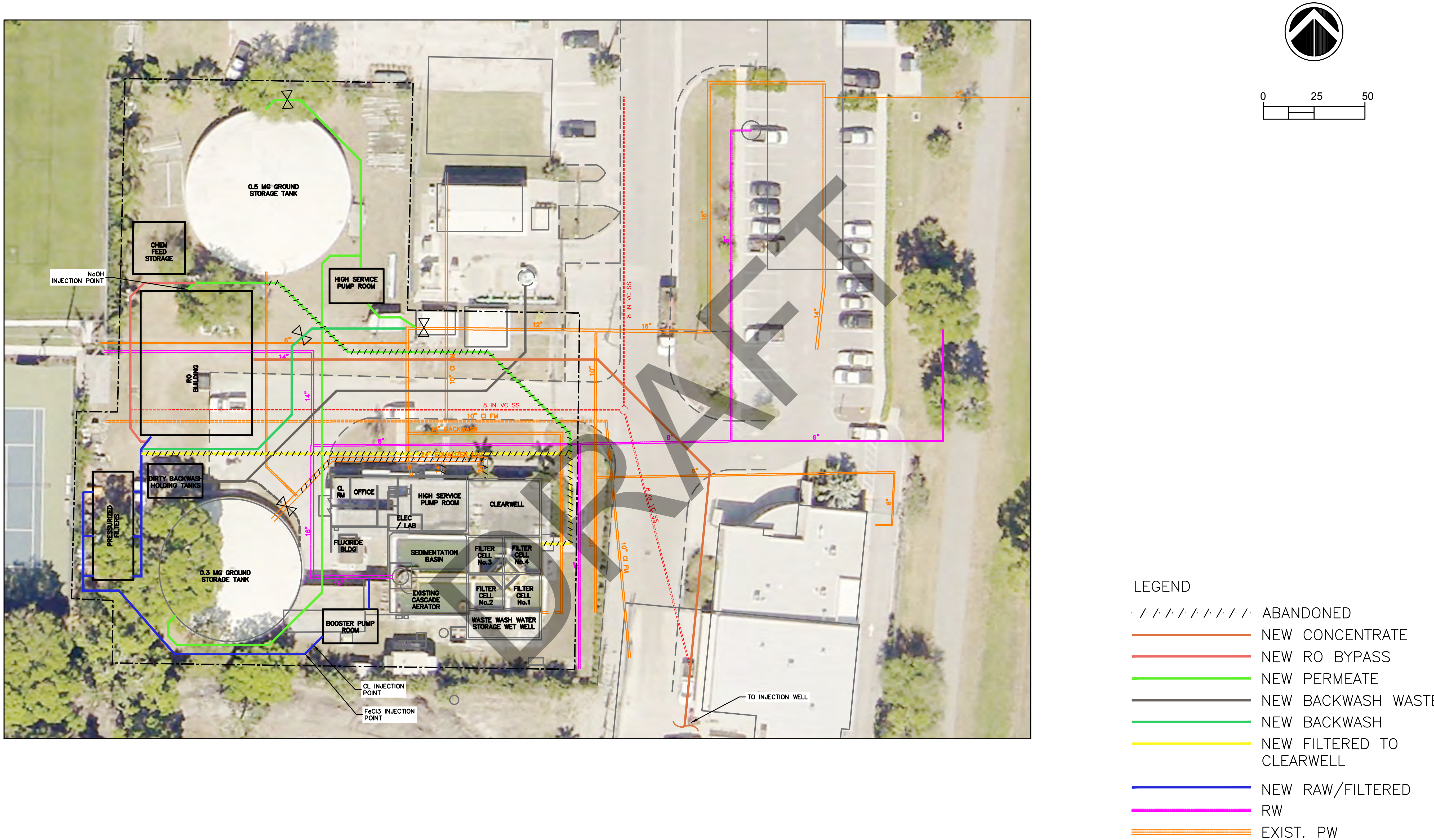
TOWN OF BELLEAIR
901 PONCE DE LEON BOULEVARD
Florida 34104
(727) 588-3769

DWG. No.

FIG 7-2

7.4 Phase 4 – RO System Buildout and New High-Service Pump Station

In the last phase, the final build-out for the RO system is installed along with a new high service pump station. The existing high-service pump station and clearwell will be decommissioned. Required chlorine contact time will be achieved in the existing ground storage tanks. **Figure 7-3** shows the proposed yard piping layout.



I:\01131\0014 Water\80-Drawings\Figures\FIGURES 7-1 THRU 3.dwg, 7/29/2020 10:36:24 AM, Cathy Walker

McKIM&CREED

BELLEAIR WTP IMPROVEMENTS

PHASE 4 SITE LAYOUT AND YARD PIPING PLAN

TOWN OF BELLEAIR INC. 1925

TOWN OF BELLEAIR
901 PONCE DE LEON BOULEVARD
Florida 34104
(727) 588-3769

DWG. No.

FIG 7-3

8.0 Engineer's Opinion of Probable Construction Cost

8.1 Construction Costs

Estimated capital costs were developed for the traditional RO and CCRO supply and treatment systems using similar project costs, bid tabulations, manufacturer/supplier provided estimates, and previous experience with similar facilities.

8.1.1 Proposed Facility

Table 8-1 summarizes the capital costs for the two (2) potential RO supply and treatment systems.

Table 8-1 – Proposed Facility Cost Summary

Item	Traditional RO System	High-Recovery CCRO System
Mobilization/Demobilization	$175,000	$175,000
Sitework	$325,000	$325,000
Booster Pump Station	$142,000	$142,000
Pressurized Filters and Backwash Holding Tank	$969,000	$969,000
Chemical Building	$84,000	$84,000
Chemical Systems	$362,000	$362,000
RO System	$1,044,000	$1,488,000
RO Building	$434,000	$434,000
High Service Pump Station	$338,000	$338,000
Deep Injection Well	$750,000	------------
Yard Piping	$500,000	$500,000
Electrical	$738,000	$677,000
Instrumentation	$554,000	$508,000
Upper Floridian Wells (6) and Well Rehabilitation	$1,450,000	$1,450,000
Total Construction Cost	$7,865,000	$7,452,000
Contingency (30%)	$2,360,000	$2,236,000
Sub Total	$10,225,000	$9,688,000
Engineering - Design and Legal (15%)	$1,534,000	$1,454,000
TOTAL PROJECT COST	**$11,759,000**	**$11,142,000**

8.1.2 Phased Implementation Plan

8.1.2.1 – Phase 1 – Clearwell Roof Rehabilitation and Additional Well

Table 8-2 summarizes the capital costs associated with Phase 1.

Table 8-2 – Phase 1 Capital Cost Estimate

Item	Cost
Mobilization/Demobilization	$20,000
Clearwell Roof Rehab	$125,000
Upper Floridian Well	$250,000
6" Raw Water Transmission Line	$20,000
Total Construction Cost	$415,000
Contingency (30%)	$125,000
Sub Total	$540,000
Engineering - Design and Legal (15%)	$81,000
TOTAL PROJECT COST	**$621,000**

8.1.2.2 – Phase 2 – Pressurized Dual-Media Filters

Table 8-3 summarizes the capital costs associated with Phase 2.

Table 8-3 – Phase 2 Capital Cost Estimate

Item	Cost
Mobilization/Demobilization	$100,000
Sitework	$75,000
Booster Pump Station	$142,000
Pressurized Filters and Backwash Holding Tank	$969,000
Chemical Building	$84,000
Chemical Systems	$201,000
High Service Pump Station Rehabilitation	$169,000
Yard Piping	$268,000
Electrical	$313,000
Instrumentation	$235,000
Upper Floridian Well and Transmission Main	$250,000
Well Rehabilitation	$450,000
Total Construction Cost	$3,166,000
Contingency (30%)	$950,000
Sub Total	$4,116,000
Engineering - Design and Legal (15%)	$618,000
TOTAL PROJECT COST	**$4,734,000**

8.1.2.3 - Phase 3 – RO System

Table 8-4 summarizes the capital costs associated with Phase 3.

Table 8-4 – Phase 3 Capital Cost Estimate

Item	Cost
Mobilization/Demobilization	$120,000
Sitework	$250,000
RO System (2 skids)	$660,000
RO Building	$325,000
Chemical Systems	$161,000
Deep Injection Well	$750,000
Yard Piping	$207,000
Electrical	$480,000
Instrumentation	$360,000
Upper Floridian Wells (2)	$500,000
Total Construction Cost	$4,438,000
Contingency (30%)	$1,332,000
Sub Total	$3,813,000
Engineering - Design and Legal (15%)	$744,000
TOTAL PROJECT COST	**$5,701,000**

8.1.2.4 – Phase 4 – RO System Addition and New High Service Pump Station

Table 8-5 summarizes the capital costs associated with Phase 4.

Table 8-5 – Phase 4 Capital Cost Estimate

Item	Cost
Mobilization/Demobilization	$75,000
Sitework	$200,000
RO System (1 skid)	$384,000
RO Building	$109,000
High Service Pump Station	$338,000
Yard Piping	$128,000
Electrical	$167,000
Instrumentation	$125,000
Total Construction Cost	$1,526,000
Contingency (30%)	$458,000
Sub Total	$1,984,000
Engineering - Design and Legal (15%)	$298,000
TOTAL PROJECT COST	**$2,282,000**

8.2 Operational and Maintenance Cost

8.2.1 Proposed Facility

Operational and Maintenance costs were determined from manufacturer proposals, industry standards, information from local municipalities, and information from equipment providers. **Table 8-6** summarizes the estimated annual operations and maintenance costs associated with the proposed facility.

Table 8-6 – Annual Operations and Maintenance Cost

Item	Traditional RO System	High-Recovery CCRO System
Power[1]	$74,000	$98,000
Chemicals	$146,000	$146,000
RO System – Cartridge Filters	$10,000	$10,000
RO System – Membrane Replacement	$10,000	$8,000
Major Equipment Replacement	$140,000	$140,000
TOTAL ANNUAL COST	**$380,000**	**$402,000**

1. *Based on power cost of $0.1025/kW-hr per www.electricitylocal.com/states/florida/belleair/*

9.0 Summary and Recommendations

This PER was performed and considered the condition of the existing WTP, along with projected increases in chloride and TDS levels in the Town's groundwater. If the Town wishes to continue with potable water production, a reverse osmosis (RO) treatment plant is recommended to reduce chloride and TDS concentrations and to address ongoing operational, maintenance and safety concerns at the WTP.

Besides developing preliminary engineering requirements for the proposed RO WTP, this PER was intended to provide the Town with capital and operational / maintenance (O&M) costs for the proposed WTP. Also, a potential phased implementation plan was developed to spread capital costs over an extended period. This phased implementation plan would install new processes and modifications only as needed as chloride and TDS levels increase over time.

The use of a conventional 2-stage RO system was compared with a high-recovery CCRO system to determine if the CCRO system provides enough benefit, such as removing the requirement for a deep injection well, to offset potential risks. Based on the evaluations performed during the development of this PER, our recommendations include the following:

1. Determine the viability of disposing of RO concentrate into the Pinellas County's sewer system
2. Identify potential locations for six (6) potential well sites and evaluate their viability
3. Compare costs of Town producing water from the proposed RO plant versus long-term bulk purchase from Pinellas County
4. Compare cost impacts for a potential phased implementation plan
5. Perform pilot study for the conventional or CCRO system

Based on the evaluations performed in this PER, McKim & Creed recommends that the Town either begin constructing the proposed RO treatment plant (all at once or in phases) or decommissions the existing WTP and begins utilizing potable water from Pinellas County by the end of calendar year 2021.

Table 9-1 summarizes the total costs associated with the two (2) alternatives.

Table 9-1 Cost Summary

Approach	Total Capital Cost[1]
Alternative 1 – All-At-Once	$11,759,000
Alternative 2 – Four Separate Phases	$13,383,000

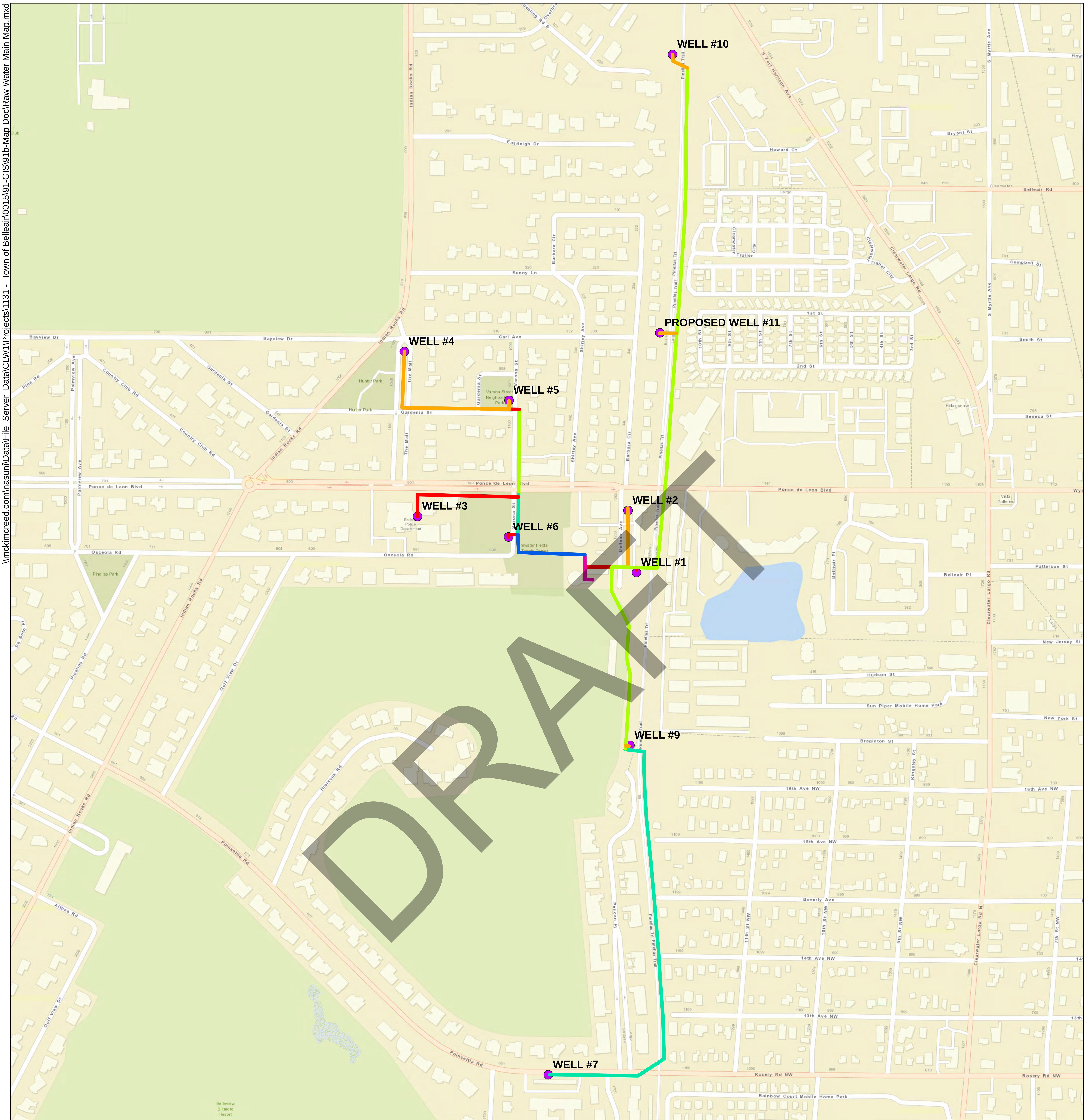
1. *Based on 2020 construction costs*

References

Preliminary Engineering Report for the Town of Belleair Water Treatment Plant Improvements (Cardno, McKim & Creed, Arcadis, 2015)

APPENDIX A

\\mckimcreed.com\nasuni\Data\File_Server_Data\CLW1\Projects\1131 - Town of Belleair\0015\91-GIS\91b-Map Doc\Raw Water Main Map.mxd



Raw Water System

Map Disclaimer: This product is for informational purposes only and is based on some unverified information provided by others. This product has not been prepared for nor is it suitable for legal, engineering, or surveying purposes. It represents only the approximate relative location of property boundaries. McKim & Creed, Inc. assumes no liability or damages due to inaccuracies, errors

0 170 340
Feet

N

Raw Water Main 10 **Well**

DIAM

6
8
12
14
16

TOWN OF BELLEAIR INC. 1925

McKIM&CREED
1365 Hamlet Avenue
Clearwater, FL 33756-3331
Tel: (727) 442-7196

Raw Water Main Map

Prepared For:
TOWN OF BELLEAIR

Jul. 2020

APPENDIX B

MEMO

TO: Phil Locke, P.E.

FROM: Jeff Trommer, P.G.

SUBJECT: Town of Belleair Supply Well Evaluation

DATE: July 31, 2020

WSP reviewed and evaluated data collected by Applied Drilling Engineering, Inc. (ADE) from six Town of Belleair (Town) public supply wells. Data collected in the field by ADE, included geophysical logs, downhole video surveys, specific capacity test data, and observations of the pumping equipment. The data were reviewed to evaluate the following:

1. Physical condition of the well casings, boreholes, and pump equipment;
2. Local hydrogeologic conditions;
3. Production capability and producing zone profile, and;
4. Water-quality characteristics.

Specific capacity tests were performed by ADE using the existing production pumps. The wells were pumped for one hour at their operational pumping rates. Static water levels were measured manually with an electric water level tape for five to 10 minutes prior to the start of pumping. Water levels were measured at intervals from 2 to 13 minutes during pumping. Drawdown is calculated as pumping water level – static water level. Specific capacity is calculated as pumping rate (gpm)/drawdown (ft).

Upon completion of the specific capacity test the production pump was removed from the well, and downhole geophysical logging were performed by Advanced Borehole Services (ABS). ABS performed the following suite of geophysical logs: caliper, natural gamma, long/short normal electrical resistivity, fluid resistivity, temperature, and flow. Fluid resistivity, temperature and flow logs will be performed under static and pumping conditions. The wells were pumped at 100 gallons per minute (gpm) during the pumping logs. A downhole video survey was also performed to the entire depth of the well.

WSP was not on site during the well evaluation work. Data sheets, geophysical logs, and the video survey were provided to WSP by ADE. Data were evaluated as follows:

1) Specific capacity results were reviewed to document the productivity of the wells to assist with recommendations for operational pumping rates.

2) The borehole geophysical logs were reviewed and analyzed as follows:

WSP USA
Suite 300
2202 North West Shore Boulevard
Tampa, FL 33607

Tel.: +1 813 520-4444
Fax: +1 813 520-4290
wsp.com

a. The caliper log provides an outline of the casing and borehole profile and diameter. The log is reviewed to verify diameters and depths of the casing and open borehole section of the well. The log was reviewed to identify intervals of massive non-fractured rock, which typically indicate low water productivity, versus highly-irregular-diameter borehole sections, which indicate potential fracture zones or solution cavities that are water-producing zones.

b. The long/short normal electrical resistivity log measures changes in the electrical resistivity of the rock formation to assist in identifying changes in rock lithology between the formations comprising the aquifer. For example, changes in resistivity mark the contact between the Tampa Limestone and Suwannee Limestone. This mark is used to differentiate upper and lower Zone A. The electrical resistivity log, along with the spontaneous potential (SP) log, also provides indications of porewater salinity variations in the open interval of the well.

c. The natural gamma log responds to changes in natural gamma activity in the formation material. This log most notably responds to the presence of confining layer clays separating the Surficial and Upper Floridan aquifers. The top of the Upper Floridan aquifer is marked by a significant decrease in gamma activity at the contact between the overlying clay confining layer and the top of limestone.

d. The fluid resistivity, specific conductance, and temperature (water-quality logs) measure the resistivity and temperature of the water in the borehole. Under static conditions, the logs measure the variation in water resistivity and temperature with depth. Static logs that show no change with depth indicate that water across the open borehole has a relatively consistent water quality across the depth of the well. Static logs that show a decrease in fluid resistivity/increase in specific conductance with depth indicate that the water in the well increases in salinity with depth. Static logs that show an abrupt change in fluid resistivity or temperature indicate the presence of a specific flow zone with a change in water quality in the aquifer. Changes in fluid resistivity/specific conductance and temperature measured under pumping conditions indicate the presence of flow zones in a well and provide an estimate of the net fluid resistivity being produced during pumping, which can be a relative indication of TDS concentration.

e. The static flow log is run down and up the borehole, and the differential in flow velocity between the two runs is used to identify whether there is a significant vertical flow gradient within the well. The pumping flow log is used to identify zones where flow is entering the well (producing zones).

f. The video survey is used to observe the condition of the casing and borehole wall. The presence of fractures and solution cavities in the formation can be observed, and the presence of bacterial growth, mineral scale, and partial bore hole blockages can be identified.

The following sections provide a summary of our evaluation of the test data provided by ADE. Well evaluation data sheets provided by ADE are included in **Appendix A**. Borehole geophysical logs are provided in **Appendix B**.

Well No. 2

A summary of the well construction information and specific capacity test results is shown in **Table 1**. The specific capacity of 922 gpm/ft is extremely high for the area, and is indicative of flow from a large fracture or solution cavity.

Table 1 – Well No. 2 Data Summary

Casing Diameter (inches)	12
Casing Depth (ft bls)	57
Total Well Depth (ft bls)	282
Specific Capacity (GPM/ft)	922

The borehole geophysical logs in **Appendix B** provided the following information:

- Casing diameter and depth, and total well depth shown in **Table 1** were obtained from the caliper log. The caliper log shows a fracture/cavity interval from 64 to 79 feet bls. An additional fracture/cavity is shown from 190 to 195 feet bls. The remainder of the borehole shows an irregular profile between 12 and 15 inches in diameter.
- The gamma log shows high activity peaks from approximately 15 to 55 feet bls indicative of a clayey layer overlying the Upper Floridan aquifer. Intermittent gamma activity peaks are indicated at 115, 176, 195, and 206 feet bls, which are likely due to clayey layers within and at the base of upper Zone A.
- The long-short normal resistivity log shows a consistent response from 75 to 175 feet bls indicative of the limestone comprising upper Zone A. The decrease in resistivity from 175 to 215 feet bls is due to the higher clay content in the limestone in this interval. The increase at 215 feet bls marks the top of lower Zone A. The decrease and more consistent response below 220 feet bls is indicative of the occurrence of higher TDS water in lower Zone A.
- The static water-quality logs show a shift at 67 feet bls indicative of primary flow zone from the fracture/cavity interval observed in the caliper log from 64 to 79 feet bls. The logs are then consistent to a depth of 227 feet bls, below which specific conductance increases and fluid resistivity decreases, indicating an increase in total dissolved solids (TDS) in lower Zone A.
- The static up hole and downhole flow logs suggests a slight down hole gradient below 205 feet bls and no vertical gradient above 205 feet bls.
- The pumping flow logs show that all the flow occurs from the cavity at 64 to 79 feet bls.

- The pumping water quality log also indicates that the primary producing zone occurs between 64 and 79 feet bls. The pumping flow log also shows the transition to higher TDS water below 227 feet bls, but does not indicate that the higher TDS water is flowing upward under pumping conditions.
- The video survey shows 12-inch steel casing to a depth of 57 feet bls. The static water level was at 41 feet bls. An interval of fractured rock creating a cavity was observed from 65 to 69 feet bls. The open borehole has a thin layer of apparent microbial growth that had scrape marks through it from the caliper tool arms. The borehole wall became smoother from 115 to 178 feet bls due to a change to softer, clayey limestone as indicated on the gamma log. The apparent cavity observed on the caliper log at 190 feet bls is an interval of enlarged borehole and not an actual open cavity or fracture. Visibility decreased significantly below 263 feet bls, indicating no significant flow of water into the borehole below this depth.

As noted in the well evaluation data sheet (**Appendix A**) the production pump and drop pipe had to be cut to be removed and ADE ordered a replacement pump, motor, and drop pipe. Details of the new pump are provided on the well evaluation data sheet.

According to information provided by McKim & Creed, chloride concentrations in well No. 2 showed an increasing trend in chloride concentration at a rate of 1.7 mg/L/year from 1979 through 2013. The well was pumped at 295 gallons per minute for the specific capacity test, which is significantly higher than the rate at which the well is operated (125 gpm). The specific capacity of the well is high enough to support an operational rate greater than this, however higher pumping rates could increase the rate of chloride increase in the well. Recommended pumping rates are discussed later in the Technical Memorandum. Although the well appears to have a thin layer of bacteriologic growth on the borehole, it does not appear to be adversely affecting well performance or water quality. There are no recommendations for well maintenance or rehabilitation activities for well No. 2 at this time.

Well No. 5

A summary of the well construction information and specific capacity test results is shown in **Table 2**. The specific capacity of 11.7 gpm/ft is low for the area, and is indicative of flow from primary porosity in the limestone.

Table 2 – Well No. 5 Data Summary

Casing Diameter (inches)	6
Casing Depth (ft bls)	80
Total Well Depth (ft bls)	257
Specific Capacity (GPM/ft)	11.7

The borehole geophysical logs in **Appendix B** provided the following information:

- Casing diameter and depth, and total well depth shown in **Table 2** were obtained from the caliper log. The caliper log shows an irregular profile between 10 and 15 inches in diameter, with no significant fractures or cavities.
- The gamma log shows high activity peaks from approximately 18 to 80 feet bls indicative of a clayey layer overlying the Upper Floridan aquifer. The gamma activity peaks from 87 to 100 feet bls and 187 to 206 feet bls, are likely due to clayey layers within and at the base of upper Zone A, respectively.
- The long-short normal resistivity log decreases from 130 feet to 205 feet bls due to increasing clay content within and at the base of upper Zone A. The increase at 215 feet bls marks the top of lower Zone A.
- The static water-quality logs are consistent to a depth of 230 feet bls, below which specific conductance increases slightly and fluid resistivity decreases slightly, indicating the start of an increase in total dissolved solids (TDS) in lower Zone A.
- The static up hole and downhole flow logs do not indicate a consistent vertical flow gradient in the borehole.
- The pumping flow log shows that most of the flow is produced between 80 and 90 feet bls.
- The pumping water quality logs also show that most of the flow is produced between 80 and 90 feet bls.
- The video survey shows a 6-inch diameter PVC liner to a depth of 80 feet bls. The static water level was at 43 feet bls. The water in the open borehole was cloudy. A section of cable was observed from 85 to 108 feet bls. Minor bacteriological growth was noted on the borehole wall. No significant fractures or cavities were observed. Water clarity improved between 200 and 220 feet bls, suggesting that this interval of the borehole may be a minor producing zone.

As noted in the well evaluation data sheet (**Appendix A**) minor replacements were made to parts in the existing Cert-lok drop pipe. Since the specific capacity of this well is only 11.7 gpm/ft, flow to the well is via primary porosity, and there is observable bacteriological growth on the bore hole wall, the performance of this well can likely be improved by well acidizing.

Well No. 6

A summary of the well construction information and specific capacity test results is shown in **Table 3**. The specific capacity of 37.6 gpm/ft is moderate for the area, and is indicative of flow from primary porosity and minor fractures in the limestone.

Table 3 – Well No. 6 Data Summary

Casing Diameter (inches)	12
Casing Depth (ft bls)	72
Total Well Depth (ft bls)	302
Specific Capacity (GPM/ft)	37.6

The borehole geophysical logs in **Appendix B** provided the following information:

- Casing diameter and depth, and total well depth shown in **Table 3** were obtained from the caliper log. The caliper log shows an irregular profile between 12 and 24 inches in diameter. Areas of enlarged borehole due to fractured or washed-out limestone are indicated from 208 to 213, 233 to 240, and 261 to 264 feet bls.
- The gamma log shows high activity peaks from approximately 16 to 56 feet bls indicative of a clayey layer overlying the Upper Floridan aquifer. The gamma activity peaks from 185 to 219 feet bls, are likely due to clayey layers in the base of upper Zone A.
- The long-short normal resistivity log shows increased resistivity from 125 to 180 feet bls, which generally indicates higher porosity limestone. The decrease in resistivity 175 to 220 feet bls is due to increasing clay content in the lower portion of upper Zone A. The increase at 220 feet bls marks the top of lower Zone A.
- The static water-quality logs are consistent to a depth of 200 feet bls, below which specific conductance increases slightly and fluid resistivity decreases slightly, indicating the start of an increase in total dissolved solids (TDS) in lower Zone A. Specific conductance increases rapidly below 235 feet bls, indicating the transition to higher TDS concentration water in lower Zone A.
- The static up hole and downhole flow logs do not indicate a consistent vertical flow gradient in the borehole.
- The pumping flow log shows the primary flow zone is from 72 to 100 feet bls.
- The pumping water quality logs also indicate that the primary producing zone occurs at approximately 100 feet bls. The pumping flow logs also show the transition to higher TDS water below 210 feet bls, but do not indicate that the higher TDS water is flowing upward under pumping conditions.
- The video survey shows 12-inch diameter steel casing to a depth of 72 feet bls. The static water level was at 41 feet bls. The water in the open borehole was cloudy. Large moldic porosity was observed from 72 to 90 feet bls. The area of enlarged borehole from 183 to 265 feet bls appears to be due to larger blocks of limestone that broke from the borehole wall during drilling, and not open fractures or cavities. No significant fractures or cavities were observed.

As noted in the well evaluation data sheet (**Appendix A**) the production pump and drop pipe had to be cut to be removed and ADE ordered a replacement pump, motor, and drop pipe. Details of the new pump are provided on the well evaluation data sheet. There are no recommendations for well maintenance or rehabilitation activities for well No. 6. Chloride data shown in a report By HSW (2014) indicate that chloride concentrations began to increase at a higher rate in 2004. Recent data suggest that this rate of increase has continued through the present time. Well No. 6 has the deepest total depth of all the wells evaluated, which could be the main cause of the higher rate of chloride concentration increase. Since most of the production from the wells appears to be from the interval between 72 and 100 feet bls, the lower portion of the well could potentially be back-plugged to reduce the connection to the deeper, higher chloride concentration water. While back-plugging could slightly reduce the specific capacity of the well, this would not significantly impact the performance of the well due to the relatively low operating pumping rate of 120 to 140 gpm. Therefore, consideration should be given to back-plugging the well to approximately 180 feet bls.

Well No. 7

A summary of the well construction information and specific capacity test results is shown in **Table 4**. The specific capacity of 21.6 gpm/ft is low for the area, and is indicative of flow from primary porosity in the limestone.

Table 4 – Well No. 7 Data Summary

Casing Diameter (inches)	12
Casing Depth (ft bls)	80
Total Well Depth (ft bls)	144
Specific Capacity (GPM/ft)	21.6

The borehole geophysical logs in **Appendix B** provided the following information:

- Casing diameter and depth, and total well depth shown in **Table 4** were obtained from the caliper log. The caliper log shows an irregular profile between 12 and 13 inches in diameter. No indications of fractures or cavities were observed.
- The gamma log shows high activity peaks from approximately 20 to 78 feet bls indicative of a clayey layer overlying the Upper Floridan aquifer.
- The long-short normal resistivity log shows consistent resistivity to the total depth of the borehole, indicating consistent lithology.
- The static water-quality logs are consistent to a depth of 100 feet bls, below which specific conductance increases slightly and fluid resistivity decreases slightly, indicating a slight increase in total dissolved solids (TDS).

- The static up hole and downhole flow logs indicate a downward vertical flow gradient in the borehole.
- The pumping flow log shows the primary flow zone is from 110 to 125 feet bls.
- The pumping water quality logs also indicate that the primary producing zone occurs at approximately 110 to 125 feet bls.
- The video survey shows 12-inch diameter steel casing to a depth of 80 feet bls. The static water level was at 46 feet bls. The water in the open borehole was slightly cloudy. Moldic porosity was observed from 80 to 95 feet bls. Visibility decreased with depth below 105 feet bls. No significant fractures or cavities were observed.

As noted in the well evaluation data sheet (**Appendix A**) the production pump and drop pipe had to be cut to be removed and ADE ordered a replacement pump, motor, and drop pipe. Details of the new pump are provided on the well evaluation data sheet. There are no recommendations for well maintenance or rehabilitation activities for well No. 7.

Well No. 9

A summary of the well construction information and specific capacity test results is shown in **Table 5**. The specific capacity of 3,300 gpm/ft is extremely high for the area, and is indicative of flow from a large cavity in the limestone.

Table 5 – Well No. 9 Data Summary

Casing Diameter (inches)	12
Casing Depth (ft bls)	88
Total Well Depth (ft bls)	145
Specific Capacity (GPM/ft)	3,300

The borehole geophysical logs in **Appendix B** provided the following information:

- Casing diameter and depth, and total well depth shown in **Table 5** were obtained from the caliper log. The caliper log shows an interval of apparent fractured rock from 88 to 125 feet bls.
- The gamma log shows high activity peaks from approximately 25 to 46 feet bls indicative of a clayey layer overlying the Upper Floridan aquifer.
- The long-short normal resistivity log shows low resistivity from 74 to 87 feet bls, indicative of a clayey limestone layer. Resistivity increases from 87 to 95 feet bls and then remains consistent to the bottom of the borehole, indicating an increase in porosity.

- The static water-quality logs show a shift between 85 and 91 feet bls, which is likely due to the influence of the flow zone identified from the caliper log.
- The static up hole and downhole flow logs do not indicate a consistent vertical flow gradient in the borehole.
- The pumping flow log shows the primary flow zone is from 87 to 91 feet bls.
- The pumping water quality logs also indicate that the primary producing zone occurs at approximately 87 to 91 feet bls.
- The video survey shows 12-inch diameter steel casing to a depth of 88 feet bls. The static water level was at 45 feet bls. The water in the open borehole was slightly cloudy. Extensive, large moldic porosity and solution cavities were observed from 90 to 125 feet bls. The solution cavities are the source of the extremely high productivity in this well.

As noted in the well evaluation data sheet (**Appendix A**) the production pump and drop pipe were re-installed with no changes or repairs. There are no recommendations for well maintenance or rehabilitation activities for well No. 9.

Well No. 10

A summary of the well construction information and specific capacity test results is shown in **Table 6**. The specific capacity of 3,300 gpm/ft is extremely high for the area, and is indicative of flow from a large cavity in the limestone.

Table 6 – Well No. 10 Data Summary

Casing Diameter (inches)	12
Casing Depth (ft bls)	75
Total Well Depth (ft bls)	146
Specific Capacity (GPM/ft)	29.8

The borehole geophysical logs in **Appendix B** provided the following information:

- Casing diameter and depth, and total well depth shown in **Table 6** were obtained from the caliper log. The caliper log shows fractured interval from 77 to 90 feet bls.
- The gamma log shows high activity peaks from approximately 18 to 66 feet bls indicative of a clayey layer overlying the Upper Floridan aquifer. The gamma activity increase from 105 to 120 feet bls, is likely due to a clayey layer within upper Zone A.
- The long-short normal resistivity log shows a slight increase in resistivity below 120 feet bls, indicating an increase in porosity in the lower portion of the borehole.

- The static water-quality logs show a shift above 90 feet bls, which is likely due to the influence of the flow zone identified from the caliper log.
- The static up hole and downhole flow logs do not indicate a consistent vertical flow gradient in the borehole.
- The pumping flow log shows the primary flow zone is from 77 to 82 feet bls.
- The pumping water quality logs also indicate water quality is relatively consistent with depth in the borehole.
- The video survey shows 12-inch diameter steel casing to a depth of 74 feet bls. The static water level was at 27 feet bls. The water in the open borehole was slightly cloudy. Well-developed moldic porosity was observed from 85 to 95 feet bls. An apparent small cavity was observed at 86 feet bls. Abundant moldic porosity was observed in the interval from 125 feet to 144 feet bls.

As noted in the well evaluation data sheet (**Appendix A**) the production pump and drop pipe had to be cut to be removed and ADE ordered a replacement pump, motor, and drop pipe. Details of the new pump are provided on the well evaluation data sheet. There are no recommendations for well maintenance or rehabilitation activities for well No. 10.

Recommended Pumping Rates

McKim & Creed prepared a flow and raw water quality blend analysis as part of a reverse osmosis treatment plant evaluation. The base analysis used reported current pumping rates for the seven existing wells (note: well 3 was not included in the well evaluation program due to lack of accessibility, and is not included in this report) are shown in **Table 7**. These rates have been established by the plant operators over the past several years to manage the rate of increase of chloride concentrations, and to address wells with higher iron concentrations. If the Town elects to continue with their current water supply and treatment system, the pumping rates should continue to be managed as currently done. However, if additional treatment to reduce iron and TDS concentrations is added, some wells may be able to be operated at higher rates. Our evaluation of potential pumping rates is based on specific capacity of the wells, existing chloride concentration trends from HSW (2014), and well locations. Increasing the pumping rates may increase the rate at which chloride concentrations increase. Projections of chloride increases at higher pumping rates were not included in this evaluation as the data needed to make these projections are not available. Increases in chloride concentration can be accounted for in the design of the reverse osmosis facility and have been factored into the McKim & Creed raw water quality blend analysis. The increases were based on current chloride concentration trends and well pumping rates.

Higher rates of increases could potentially exceed the design parameters for the reverse osmosis plant, increase the TDS concentration of the concentrate, which could limit the concentrate disposal options, or adversely impact other users of the Upper Floridan aquifer near the Towns wells. Therefore, if the Town were to consider increasing pumping rates to the potential rates shown in **Table 7**, chloride concentrations should be monitored closely to avoid undesirable increases.

Jeffrey M. Trommer, P.G.

Lead Hydrogeologist

Table 7 – Well Pumping Rate Summary

Well No.	Current Pumping Rate (gpm)	Potential Rate (gpm)	Comments
2	125	220	High specific capacity Assumes iron removal and RO treatment
5	150	150	Low specific capacity
6	120	120	Current rate of chloride concentration increase
7	150	150	Low specific capacity
9	140	220	High specific capacity Assumes RO treatment
10	120	120	Location relative to existing users

APPENDIX A

Well Evaluation Summary Reports

Applied DRILLING Engineering, Inc.

Town of Belleair

Well Evaluations

Well 2

March 24, 2020 and April 15,2020

Time	Static Water Level
9:09	42.65
9:12	42.65

Pump Test Data at 295 gpm

Time	Dyn. Water Level
9:15	42.73
9:17	42.78
9:19	42.79
9:22	42.80
9:25	42.81
9:33	42:82
9:48	42.85
9:55	42.95
10:08	42.96
10:15	42.96
10:17	42.97

The old pump had to be removed with a torch, and a replacement Pump. Motor, and Certa-lok drop pipe, was ordered.

Static and Dynamic Geophysical Logs were then conducted and a Downhole Video

The Wellhead was modified with a 4" coupling and the new Pump installed.

New Pump Details

Franklin 7.5 Hp 3ph 460v Motor
Grundfos 230S75-3-BB Pump End
(2) Stainless Steel Crossover Subs
50'(2x20' & 1x10') of 4" Certa-lok Drop Pipe with an extra Coupling
60' of Pump Wire with one Splice Kit
65' of 3/16 Stainless Steel Safety Cable with Clamps

Applied DRILLING Engineering, Inc.

Town of Belleair

Well Evaluations

Well 5

April 28, 2020 – April 29,2020

Time	Static Water Level
11:02	44.77
11:09	44.75

Pump Test Data at 150 gpm

Time	Dyn. Water Level
11:15	57.60
11:20	57.58
11:25	57.65
11:30	57.62
11:45	57.64
12:00	57.64
12:15	57.61

Recovery

Pump Off	Water Level
5 minutes	44.92
8 minutes	44.64
10 minutes	44.65
12 minutes	44.64

Pulled 70' of 3" Certa-lok drop pipe from the 6" Well. Need to replace the two plastic Certa-lok cross overs subs with stainless steel ones and replace one leaking 3" Certa-lok coupling. We also need to add a stainless steel safety cable upon re-installation. Parts and materials ordered.

Static and Dynamic Geophysical Logs were then conducted and a Downhole Video

<u>New Items Installed</u>

(1) 3" Certa-lok Coupling with New O-Rings
(2) Stainless Steel Crossover Subs
80' of 3/16 Stainless Steel Safety Cable with Clamps

Applied DRILLING Engineering, Inc.

Town of Belleair

Well Evaluations

Well 6

April 15, 2020

Time	Static Water Level
10:15	44.72
10:20	44.73
10:25	44.73

Pump Test Data at 140 gpm

Time	Dyn. Water Level
10:30	48.43
10:32	48.45
10:34	48.45
10:40	48.45
10:45	48.45
10:50	48.45
10:55	48.46
11:00	48.45
11:05	48.46
11:10	48.45
11:15	48.45

Recovery

Pump Off	Water Level
2 minutes	42.20
3 minutes	43.50
5 minutes	44.70
6 minutes	44.75
7 minutes	44.68
10 minutes	44.66

The old pump had to be cut out, and a replacement Pump. Motor, and Certa-lok drop pipe, was ordered.

Static and Dynamic Geophysical Logs were then conducted and a Downhole Video

Applied DRILLING Engineering, Inc.

Town of Belleair

Well Evaluations

Well 6

April 28,2020

The Wellhead was modified with a 4” coupling and the new Pump installed.

New Pump Details

Franklin 7.5 Hp 3ph 460v Motor
Grundfos 230S75-3-BB Pump End
(2) Stainless Steel Crossover Subs
70’(2x20’ & 1x10’) of 4” Certa-lok Drop Pipe with an extra Coupling
70’ of Pump Wire with one Splice Kit
85’ of 3/16 Stainless Steel Safety Cable with Clamps

Applied DRILLING Engineering, Inc.

Town of Belleair

Well Evaluations

Well 7

May 12, 2020 and May 13,2020

Time	Static Water Level
8:47	47.14
9:10	46.99

Pump Test Data at 100 gpm

Time	Dyn. Water Level
9:15	51.60
9:17	51.61
9:19	51.61
9:23	51.66
9:26	51.66
9:31	51.61
9:39	51.61
9:48	51.61
10:05	51.63
10:15	51.61

Recovery

Pump Off	Water Level
5 minutes	44:14
10 minutes	42.64
14 minutes	46.98
15 minutes	46.94
16 minutes	46.93
18 minutes	46.92

The old pump was removed, and a replacement Pump. Motor, and Certa-lok drop pipe, was ordered.

Static and Dynamic Geophysical Logs were then conducted and a Downhole Video

Applied DRILLING Engineering, Inc.

Town of Belleair

Well Evaluations

Well 7

May 12, 2020 and May 13,2020

The Wellhead was modified with a 4" coupling and the new Pump installed.

New Pump Details

Franklin 7.5 Hp 3ph 460v Motor
Grundfos 230S75-3-BB Pump End
(2) Stainless Steel Crossover Subs
70' (2x20' & 1x10') of 4" Certa-lok Drop Pipe with an extra Coupling
70' of Pump Wire with one Splice Kit
80' of 3/16 Stainless Steel Safety Cable with Clamps

Applied DRILLING Engineering, Inc.

Town of Belleair

Well Evaluations

Well 9

May 5, 2020

Time	Static Water Level
13:42	46.37

Pump Test Data at 100 gpm

Time	Dyn. Water Level
13:45	46.59
13:47	46.48
13:49	46.40
13:52	46.40
14:00	46:40
14:10	46.40
14:20	46:40
14:30	46:40
14:45	46:40

Recovery

Pump Off	Water Level
4 minutes	46:20
6 minutes	46:35
8 minutes	46:33
11 minutes	46:35

Pulled pump 7.5 Hp set on 3" Certa-lok to 80 feet.

Static and Dynamic Geophysical Logs were then conducted and a Downhole Video

Pump re-installed with no changes.

Applied DRILLING Engineering, Inc.

Town of Belleair

Well Evaluations

Well 10

June 9, 2020

Time	Static Water Level
9:00	26.41

Pump Test Data at 125 gpm

Time	Dyn. Water Level
9:14	30.76
9:16	30.75
9:17	30.74
9:18	30.72
9:19	30.71
9:20	30.71
9:30	30.70
9:40	30.70
9:50	30.65
10:05	30.61
10:15	30.61

Recovery

Pump Off	Water Level
10:16	26.85
10:17	27.04
10:18	26.87
10:19	26.71
10:20	26.71
10:22	26.51
10:24	26.51
10.26	26.49
10:27	26.43
10:31	26.41
10:33	26.41

The old pump was removed for logging.

Town of Belleair
Well Evaluations

Well 10
June 10,2020

Static and Dynamic Geophysical Logs were then conducted and a Downhole Video

The Wellhead was modified with a 4" coupling and the new Pump. Motor, and Certa-lok drop pipe, was installed.

New Pump Details
Franklin 7.5 Hp 3ph 460v Motor
Grundfos 230S75-3-BB Pump End
(2) Stainless Steel Crossover Subs
70'(2x20' & 1x10') of 4" Certa-lok Drop Pipe with an extra Coupling
80' of Pump Wire with one Splice Kit
85' of 3/16 Stainless Steel Safety Cable with Clamps

APPENDIX B

Geophysical Logs

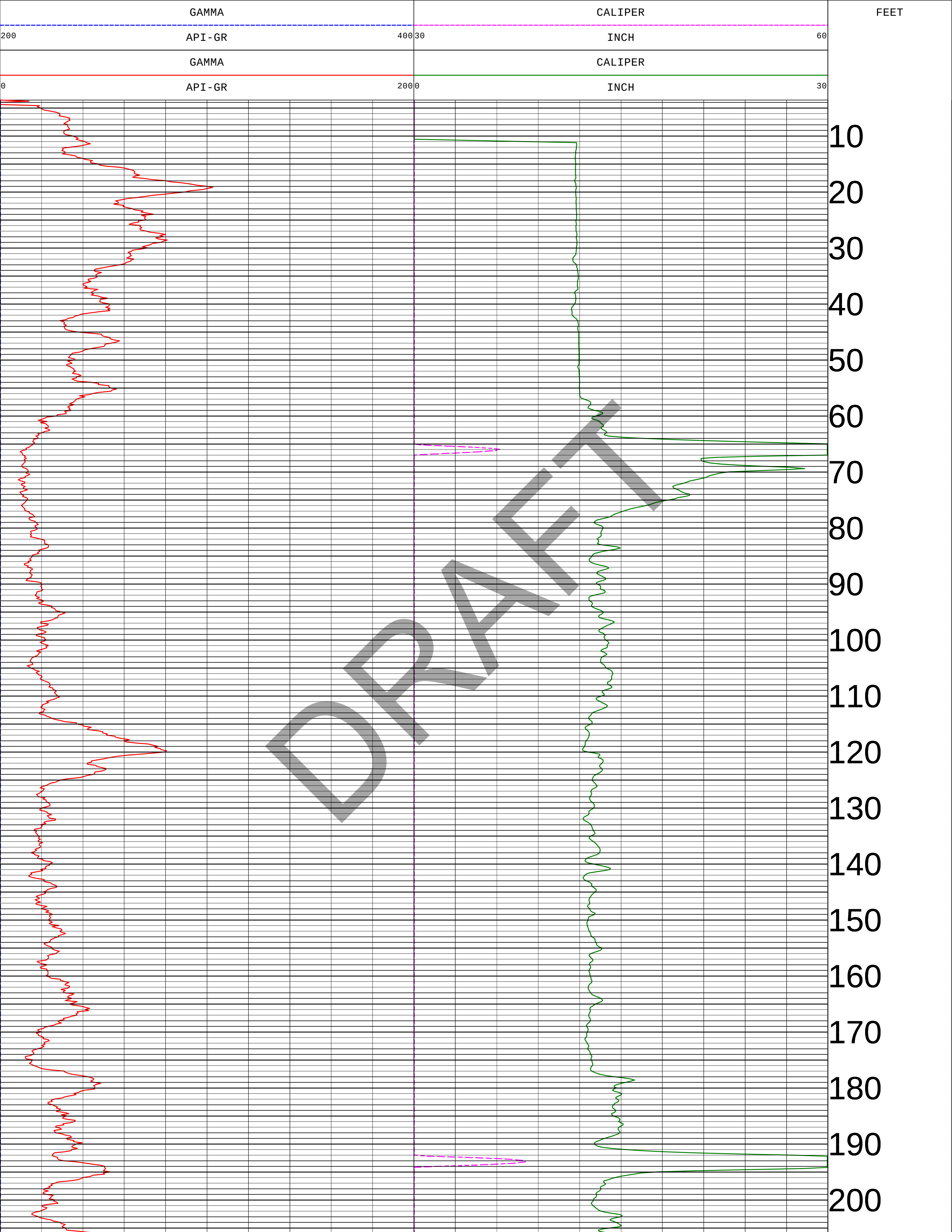
ABS
Advanced Borehole Services

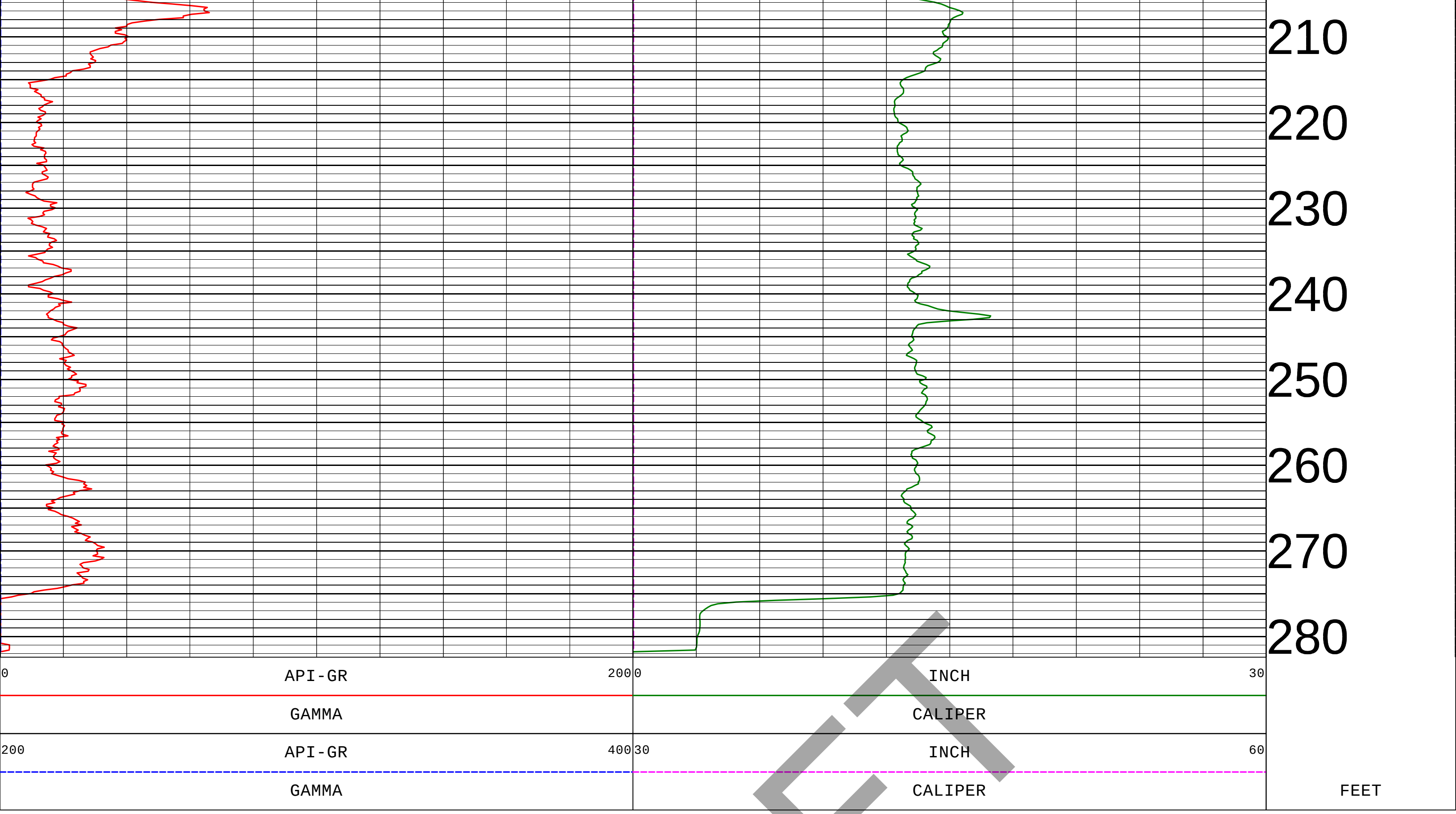
GAMMA RAY (API)-CALIPER

WELL 2

COMPANY	: APPLIED DRILLING ENG.	OTHER SERVICES:	8044, 8711, VIDEO
WELL	: WELL 2		
FIELD	:		
COUNTY	: PINELLAS		
STATE	: FLORIDA		
LOCATION	: BELLEAIRE		
SECTION	:		
TOWNSHIP	:		
RANGE	:		
API NO.	:		
UNIQUE WELL ID.	: NONE		
PERMANENT DATUM	: MSL	ELEVATION KB	:
LOG MEASURED FROM	: PAD	ELEVATION DF	:
DRL MEASURED FROM	: NA	ELEVATION GL	:
DATE	: 03/25/20	RIG NUMBER	:
DEPTH DRILLER	: NA	LOGGER TD	: 151
BIT SIZE	: 6	ARRIVAL TIME	: 0800
LOG TOP	: 3.60	DEPARTURE TIME	:
LOG BOTTOM	: 282.20	CIRC STOPPED	:
CASING OD	: 12		
CASING BOTTOM	: XX		
CASING TYPE	: STEEL		
BOREHOLE FLUID	: FOR		
RM TEMPERATURE	:		
MUD RES	:		
MUD WEIGHT	:		
WITNESSED BY	: MAC DADDY		
RECORDED BY	: AFB		
REMARKS 1	:		
REMARKS 2	:		

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS


GAMMA
API-GR
200
400
CALIPER
INCH
30
60
GAMMA
API-GR
0
200
CALIPER
INCH
0
30
FEET
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
DRAFT



210
220
230
240
250
260
270
280
0
API-GR
200
GAMMA
200
API-GR
400
GAMMA
0
INCH
30
CALIPER
30
INCH
60
CALIPER
FEET

TOOL CALIBRATION WELL 2 03/25/20 09:00
TOOL 9074A1 TM VERSION 2004
SERIAL NUMBER 3158

	DATE	TIME	SENSOR	STANDARD		RESPONSE	
1	Jul16,19	11:01:03	GAMMA	1.000	[API-GR]	0.000	[CPS]
	Jul16,19	11:01:03	GAMMA	340.000	[API-GR]	365.000	[CPS]
2	Jul16,19	11:04:12	CALIPER	4.000	[INCH]	69017.000	[CPS]
	Jul16,19	11:04:12	CALIPER	6.000	[INCH]	85360.000	[CPS]
3	Oct03,19	08:06:13	CALIPERL	8.000	[INCH]	82709.000	[CPS]
	Oct03,19	08:06:13	CALIPERL	12.000	[INCH]	107387.000	[CPS]
4	Jul16,19	11:00:52	CALIPERX	Default	[CPS]	Default	[CPS]
	Jul16,19	11:00:52	CALIPERX	Default	[CPS]	Default	[CPS]

ABS Advanced Borehole Services

COMBINATION LOG
STATIC WATER QUALITY
WELL 2

COMPANY APPLIED DRILLING ENG.
WELL WELL 2
WELL EXT
FIELD
COUNTY PINELLAS
STATE FLORIDA
COUNTRY ---
API NO.

COMPANY : APPLIED DRILLING ENG.
WELL : WELL 2
WELL EXT :
FIELD :
COUNTY : PINELLAS
STATE : FLORIDA
COUNTRY : ---
API NO. :
UNIQ ID : NONE

SECTION: TOWNSHIP: RANGE:

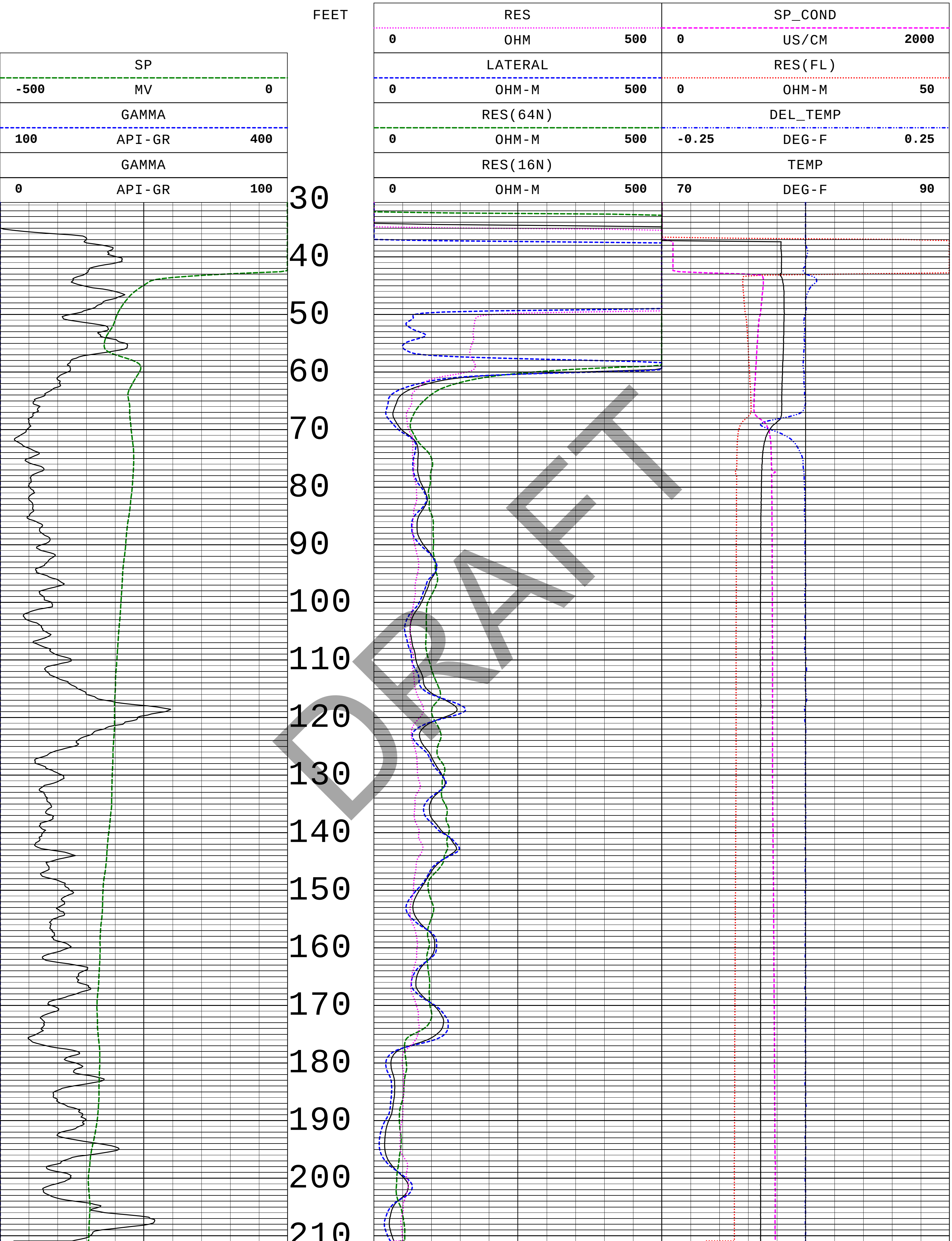
LOCATION : BELLEAIRE
LAT GPS UTM
LON GPS UTM

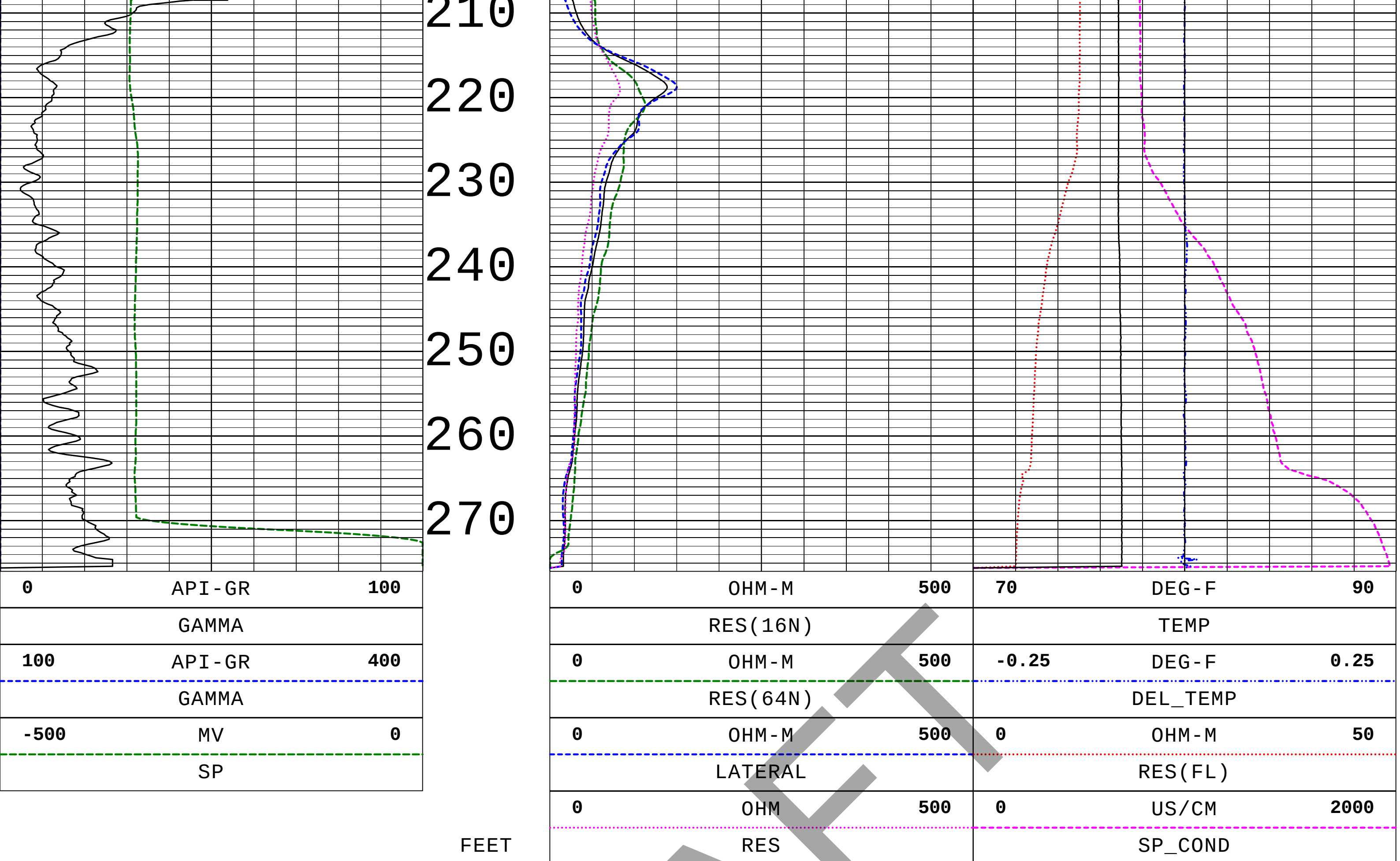
DISPLAY7_JL56

PERMANENT DATUM	MSL	Elevations:		Other Services:	
DRL MEASURED FROM	NA	KB	FT	8044	
LOG MEASURED FROM	PAD	DF	FT	8711	
ELEV. PERM. DATUM	FT	GL	FT	VIDEO	

DATE	TIME			
DEPTH DRILLER	NA	FT		
DEPTH LOGGER	151	FT		
FIRST READING		FT		
LAST READING		FT		
BIT SIZE	6	IN		
CASING -- DRILLER	XX	FT		
CASING -- LOGGER		FT		
CASING O.D.	12	IN		
CASING TYPE	STEEL			
FLUID TYPE	FOR			
FLUID DENSITY		LB/GAL		
FLUID VISCOSITY				
FLUID PH				
MUD SOURCE				
RM @ MEAS TEMP	@ F			
RMF @ MEAS TEMP	@ F			
RMC @ MEAS TEMP	@ F			
CIRC STOPPED				
RIG NUMBER				
RECORDED BY	AFB			
WITNESSED BY	MAC DADDY			
REMARKS 1				
REMARKS 2				
REMARKS 3				

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS


FEET
RES
0 OHM 500
SP_COND
0 US/CM 2000
SP
-500 MV 0
LATERAL
0 OHM-M 500
RES(FL)
0 OHM-M 50
GAMMA
100 API-GR 400
RES(64N)
0 OHM-M 500
DEL_TEMP
-0.25 DEG-F 0.25
GAMMA
0 API-GR 100
RES(16N)
0 OHM-M 500
TEMP
70 DEG-F 90
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
DRAFT


210
220
230
240
250
260
270
0 API-GR 100
GAMMA
100 API-GR 400
GAMMA
-500 MV 0
SP
FEET
0 OHM-M 500
RES(16N)
0 OHM-M 500
RES(64N)
0 OHM-M 500
LATERAL
0 OHM 500
RES
70 DEG-F 90
TEMP
-0.25 DEG-F 0.25
DEL_TEMP
0 OHM-M 50
RES(FL)
0 US/CM 2000
SP_COND
DRAFT

TOOL CALIBRATION WELL 2 03/25/20 09:26
TOOL   8044A   TM VERSION 5500
SERIAL 938

	DATE	TIME	SENSOR		STANDARD Point1	STANDARD Point2	RESPONSE [CPS] Point1	RESPONSE [CPS] Point2
1	Jan03,03	02:49:05	GAMMA	[API-GR]	0.001	180.000	0.000	169
2	Sep29,19	19:01:50	RES(FL)	[OHM-M]	30.300	7.290	34341	16551
3	Aug17,14	12:00:23	SP	[MV]	0.000	395.000	59670	23612
4	Feb02,20	14:59:18	RES(16N)	[OHM-M]	0.000	1996.000	4010	103211
5	Feb02,20	15:00:15	RES(64N)	[OHM-M]	0.000	1990.000	4089	103487
6	Sep29,19	18:57:40	TEMP	[DEG-F]	71.700	86.100	63355	57070
7	Aug17,14	10:39:11	RES	[OHM]	0.000	988.000	9855	58788

PRODUCTION-STATIC-PUMPING
WELL 2

ABS Advanced Borehole Services

COMPANY APPLIED DRILLING ENG.
WELL WELL 2
WELL EXT
FIELD
COUNTY PINELLAS
STATE FLORIDA
COUNTRY ---
API NO.

COMPANY : APPLIED DRILLING ENG.
WELL : WELL 2
WELL EXT :
FIELD :
COUNTY : PINELLAS
STATE : FLORIDA
COUNTRY : ---
API NO. :
UNIQ ID : NONE

SECTION: TOWNSHIP: RANGE:

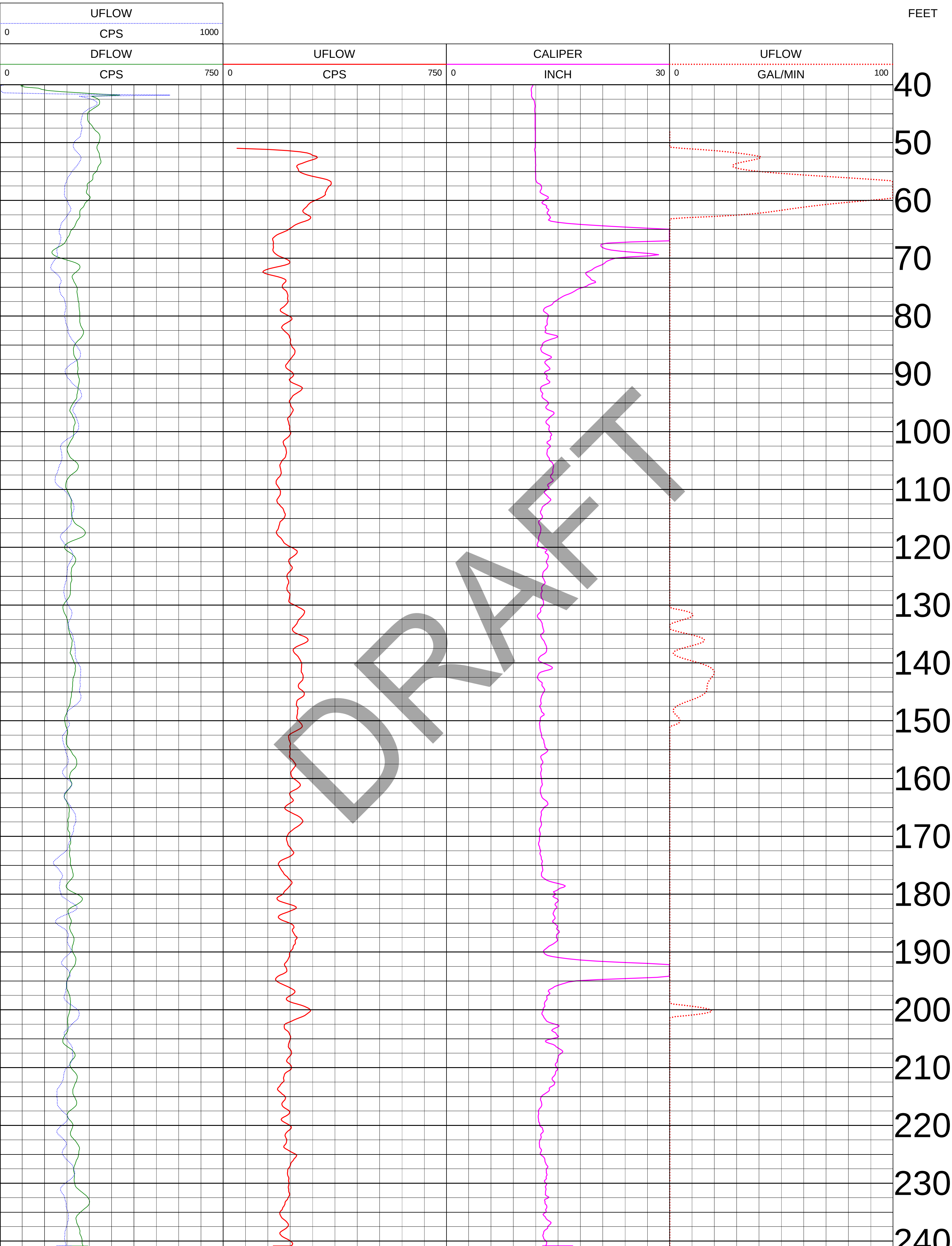
LOCATION : BELLEAIRE
LAT GPS UTM
LON GPS UTM

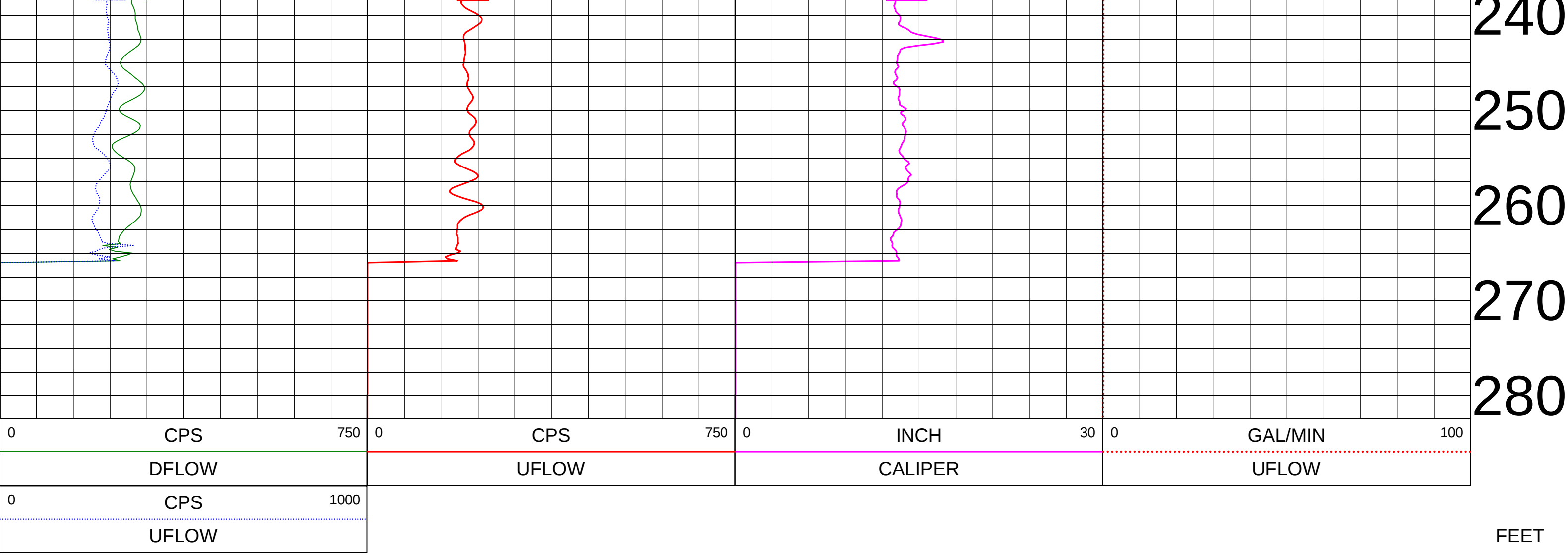
DISPLAY7_JL56

PERMANENT DATUM	MSL	Elevations:		Other Services:	
DRL MEASURED FROM	NA	KB	FT	8044	
LOG MEASURED FROM	PAD	DF	FT	8711	
ELEV. PERM. DATUM	FT	GL	FT	VIDEO	

DATE	TIME			
DEPTH DRILLER	NA	FT		
DEPTH LOGGER	151	FT		
FIRST READING		FT		
LAST READING		FT		
BIT SIZE	6	IN		
CASING -- DRILLER	52	FT		
CASING -- LOGGER		FT		
CASING O.D.	12	IN		
CASING TYPE	STEEL			
FLUID TYPE	FOR			
FLUID DENSITY		LB/GAL		
FLUID VISCOSITY				
FLUID PH				
MUD SOURCE				
RM @ MEAS TEMP	@ F			
RMF @ MEAS TEMP	@ F			
RMC @ MEAS TEMP	@ F			
CIRC STOPPED				
RIG NUMBER				
RECORDED BY	AFB			
WITNESSED BY	MAC DADDY			
REMARKS 1				
REMARKS 2				
REMARKS 3				

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS


UFLOW
0 CPS 1000
DFLOW
0 CPS 750
UFLOW
0 CPS 750
CALIPER
0 INCH 30
UFLOW
0 GAL/MIN 100
FEET
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220
230
240
DRAFT

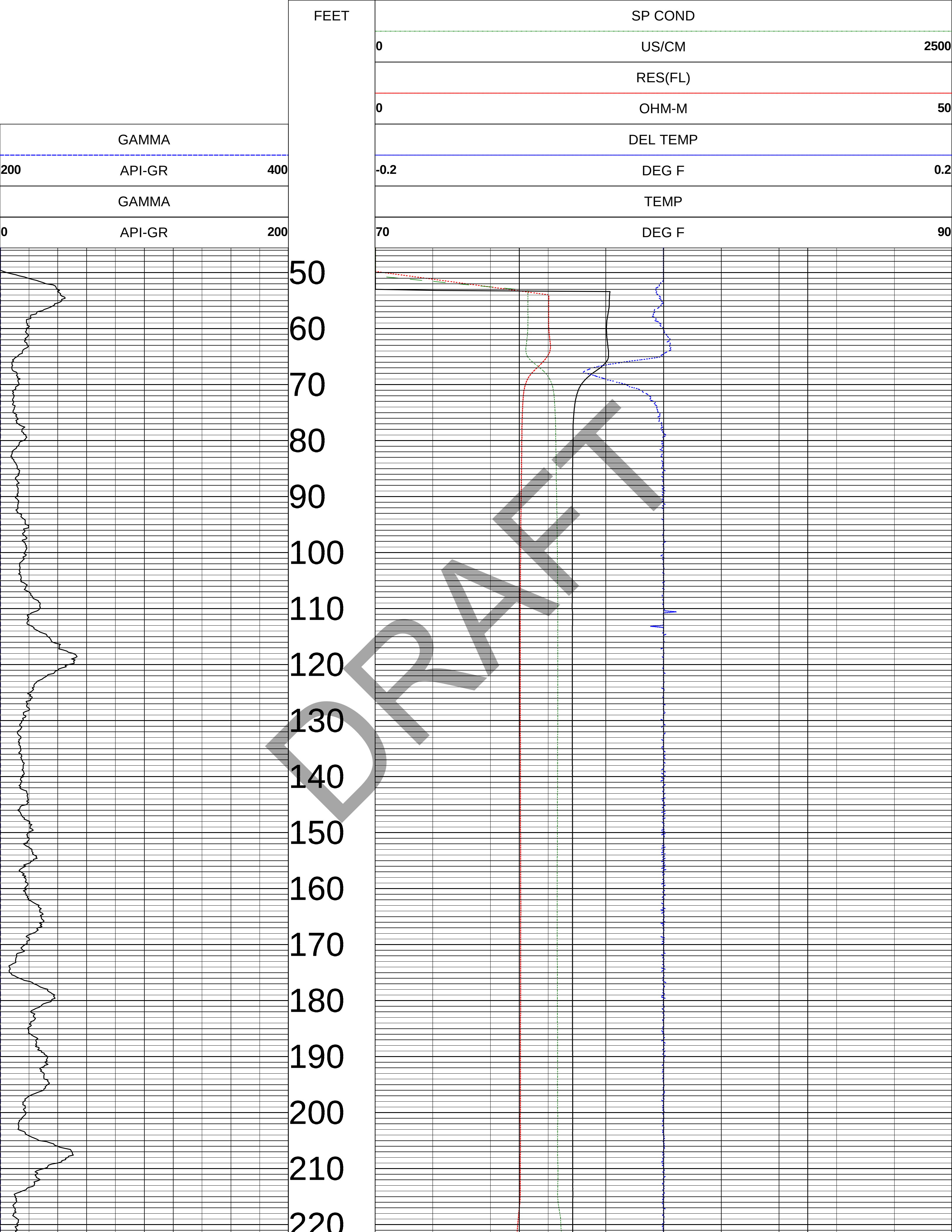

240
250
260
270
280
0 CPS 750
DFLOW
0 CPS 750
UFLOW
0 INCH 30
CALIPER
0 GAL/MIN 100
UFLOW
0 CPS 1000
UFLOW
FEET

PUMPING WATER QUALITY

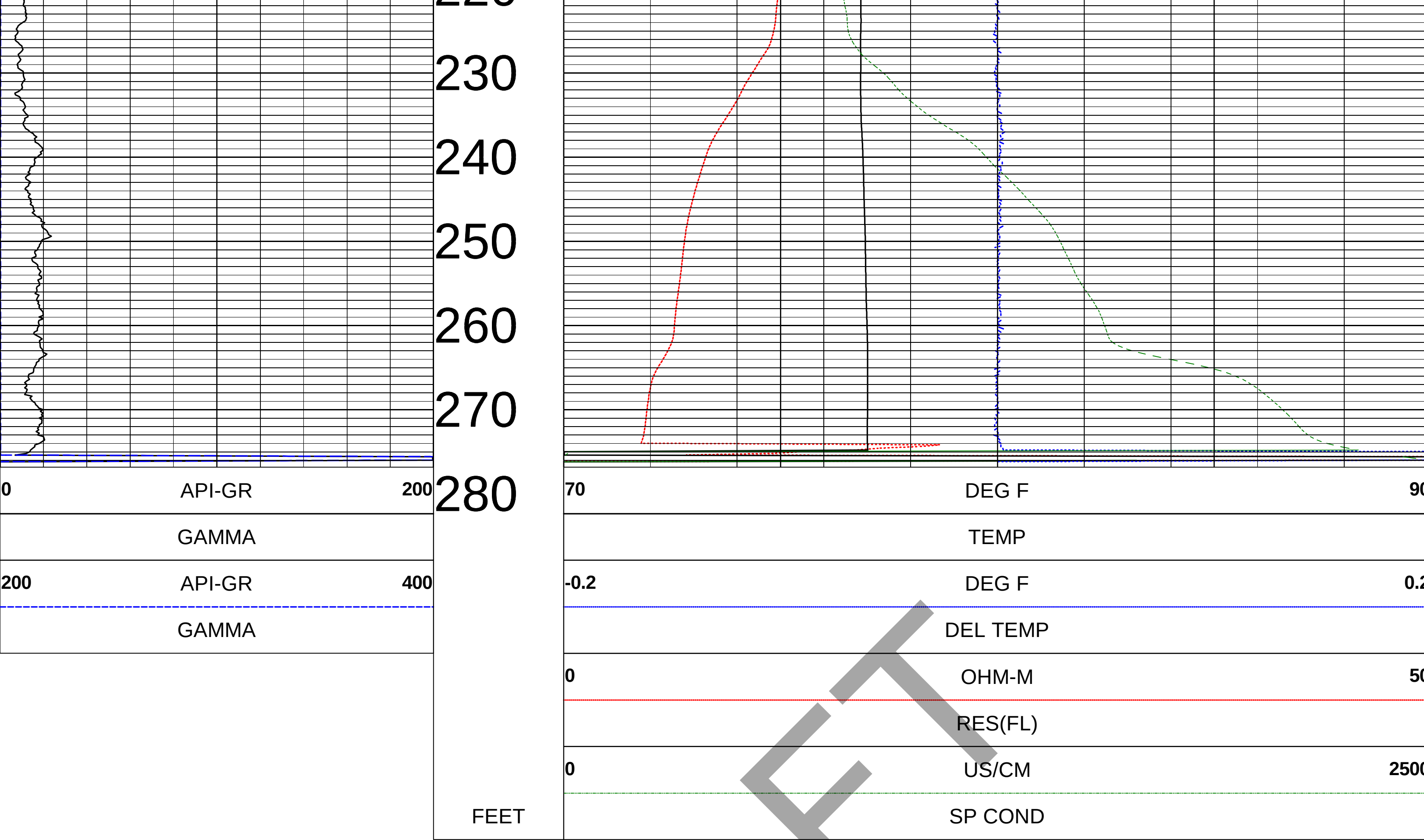
WELL 2

COMPANY	: APPLIED DRILLING ENG.	OTHER SERVICES:	
WELL	: WELL 2	8044	
FIELD	:	8711	
COUNTY	: PINELLAS	VIDEO	
STATE	: FLORIDA		
LOCATION	: BELLEAIRE		
SECTION	:		
TOWNSHIP	:		
RANGE	:		
API NO.	:		
UNIQUE WELL ID.	: NONE		
PERMANENT DATUM	: MSL	ELEVATION KB	:
LOG MEASURED FROM:	PAD	ELEVATION DF	:
DRL MEASURED FROM:	NA	ELEVATION GL	:
DATE	: 03/25/20	RIG NUMBER	:
DEPTH DRILLER	: NA	LOGGER TD	: 151
BIT SIZE	: 6	ARRIVAL TIME	: 0800
LOG TOP	: 45.60	DEPARTURE TIME:	
LOG BOTTOM	: 276.60	CIRC STOPPED	:
CASING OD	: 12		
CASING BOTTOM	: 52		
CASING TYPE	: STEEL		
BOREHOLE FLUID	: FOR		
RM TEMPERATURE	:		
MUD RES	:		
MUD WEIGHT	:		
WITNESSED BY	: MAC DADDY		
RECORDED BY	: AFB		
REMARKS 1	:		
REMARKS 2	:		

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS



FEET
SP COND
0
US/CM
2500
RES(FL)
0
OHM-M
50
GAMMA
200
API-GR
400
DEL TEMP
-0.2
DEG F
0.2
GAMMA
0
API-GR
200
TEMP
70
DEG F
90
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220
DRAFT


230
240
250
260
270
280
0 API-GR 200
GAMMA
200 API-GR 400
GAMMA
FEET
70 DEG F 90
TEMP
-0.2 DEG F 0.2
DEL TEMP
0 OHM-M 50
RES(FL)
0 US/CM 2500
SP COND

TOOL CALIBRATION WELL 2 03/25/20 10:46
TOOL 8044A   TM VERSION 5500
SERIAL NUMBER   938

	DATE	TIME	SENSOR	STANDARD		RESPONSE	
1	Jan03,03	02:49:05	GAMMA	0.001	[API-GR]	0.000	[CPS]
	Jan03,03	02:49:05	GAMMA	180.000	[API-GR]	169.000	[CPS]
2	Sep29,19	19:01:50	RES(FL)	30.300	[OHM-M]	34341.000	[CPS]
	Sep29,19	19:01:50	RES(FL)	7.290	[OHM-M]	16551.000	[CPS]
3	Aug17,14	12:00:23	SP	0.000	[MV]	59670.000	[CPS]
	Aug17,14	12:00:23	SP	395.000	[MV]	23612.000	[CPS]
4	Feb02,20	14:59:18	RES(16N)	0.000	[OHM-M]	4010.000	[CPS]
	Feb02,20	14:59:18	RES(16N)	1996.000	[OHM-M]	103211.000	[CPS]
5	Feb02,20	15:00:15	RES(64N)	0.000	[OHM-M]	4089.000	[CPS]
	Feb02,20	15:00:15	RES(64N)	1990.000	[OHM-M]	103487.000	[CPS]
6	Sep29,19	18:57:40	TEMP	71.700	[DEG F]	63355.000	[CPS]
	Sep29,19	18:57:40	TEMP	86.100	[DEG F]	57070.000	[CPS]
7	Aug17,14	10:39:11	RES	0.000	[OHM]	9855.000	[CPS]
	Aug17,14	10:39:11	RES	988.000	[OHM]	58788.000	[CPS]

GAMMA RAY (API)-CALIPER
WELL 5

ABS Advanced Borehole Services

COMPANY APPLIED DRILLING ENG.
WELL WELL 5
WELL EXT
FIELD
COUNTY PINELLAS
STATE FLORIDA
COUNTRY USA
API NO.

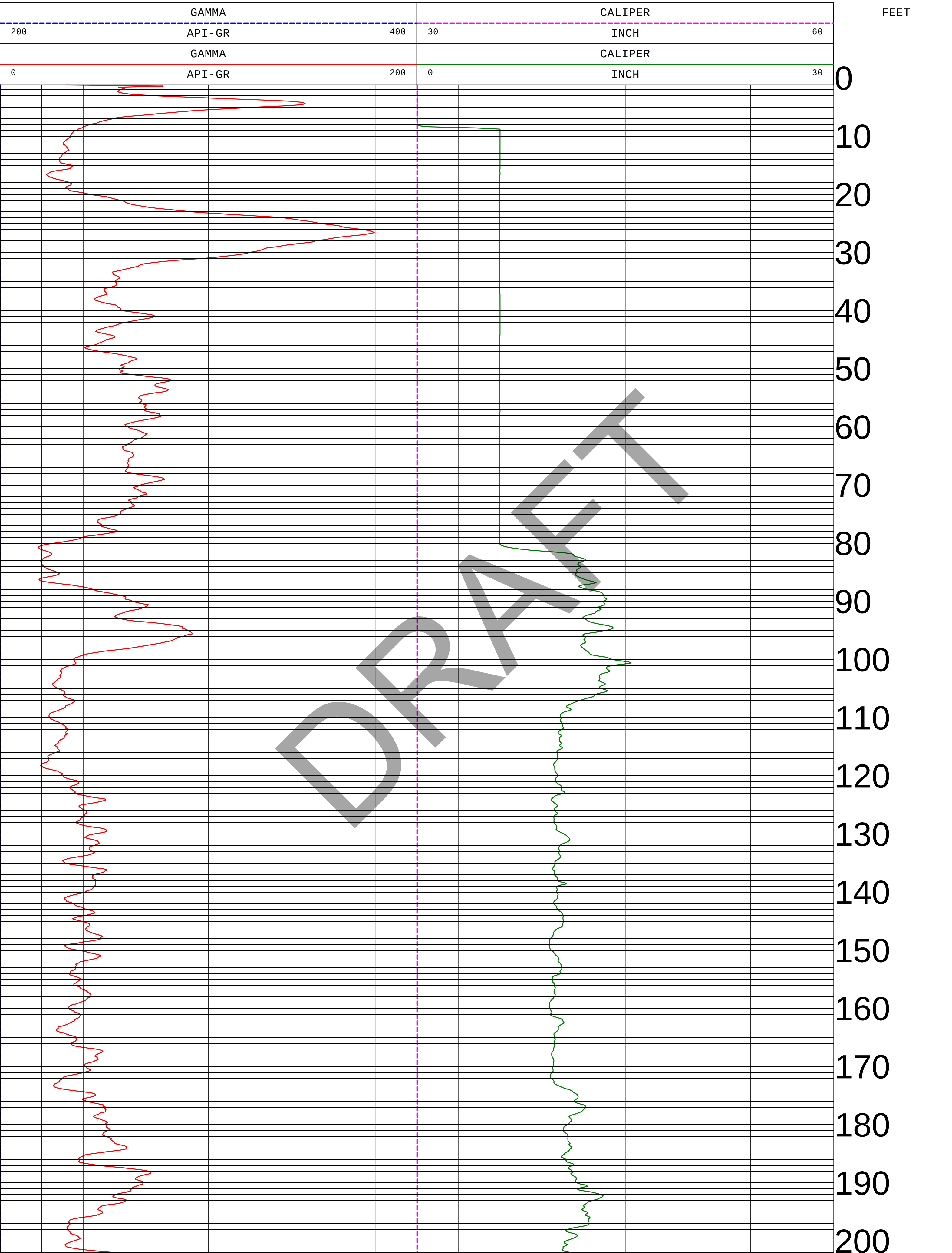
COMPANY : APPLIED DRILLING ENG.
WELL : WELL 5
WELL EXT :
FIELD :
COUNTY : PINELLAS
STATE : FLORIDA
COUNTRY : USA
API NO. :
UNIQ ID : NONE

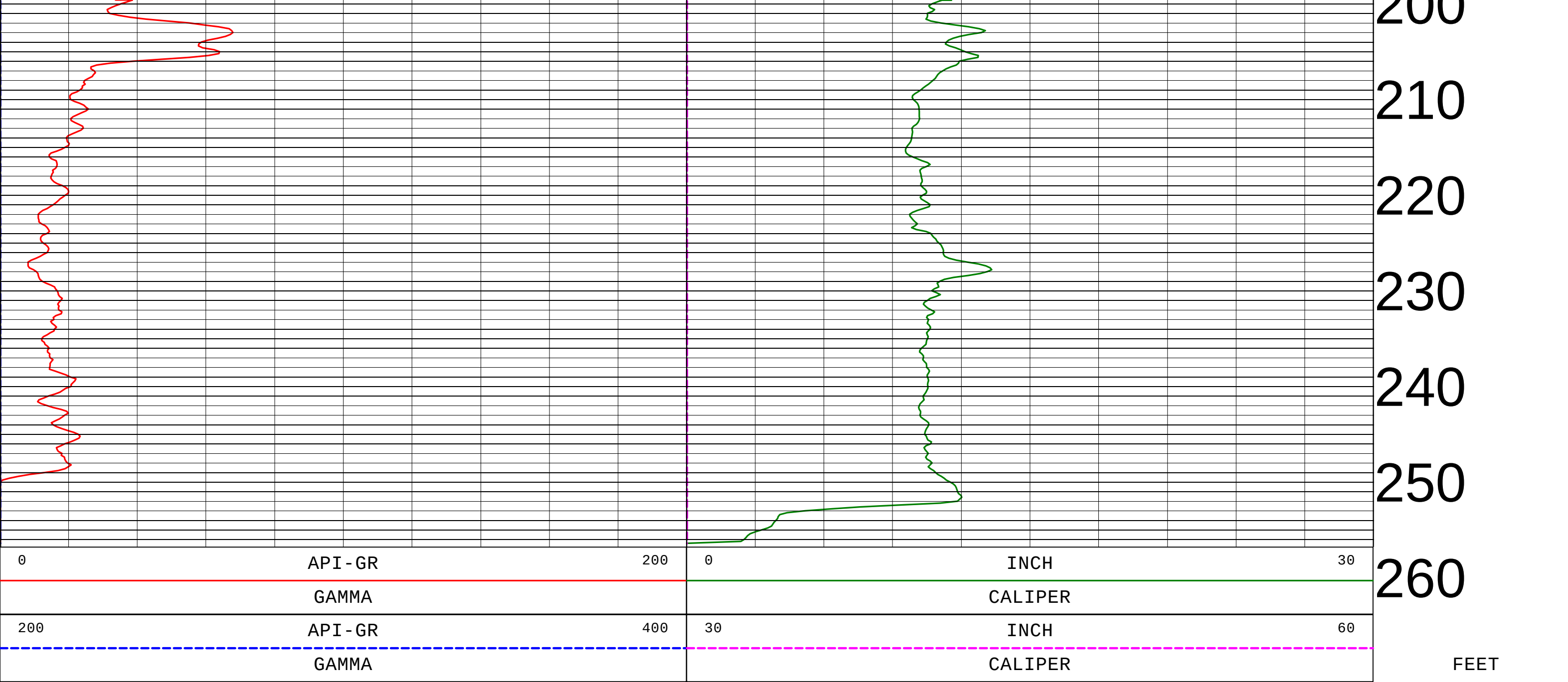
SECTION: TOWNSHIP: RANGE:
LOCATION : BELLEAIRE
LAT GPS UTM
LON GPS UTM

DISPLAY7_JL56

PERMANENT DATUM	MSL	Elevations:		Other Services:	
DRL MEASURED FROM	NA	KB	FT	8044	
LOG MEASURED FROM	PAD	DF	FT	8711	
ELEV. PERM. DATUM	FT	GL	FT	VIDEO	

DATE	TIME			
DEPTH DRILLER	NA	FT		
DEPTH LOGGER	256	FT		
FIRST READING		FT		
LAST READING		FT		
BIT SIZE	6	IN		
CASING -- DRILLER	NA	FT		
CASING -- LOGGER	80	FT		
CASING O.D.	6	IN		
CASING TYPE	PVC			
FLUID TYPE	FOR			
FLUID DENSITY		LB/GAL		
FLUID VISCOSITY				
FLUID PH				
MUD SOURCE				
RM @ MEAS TEMP	@ F			
RMF @ MEAS TEMP	@ F			
RMC @ MEAS TEMP	@ F			
CIRC STOPPED				
RIG NUMBER				
RECORDED BY	AFB			
WITNESSED BY	MAC DADDY			
REMARKS 1				
REMARKS 2				
REMARKS 3				


GAMMA
200 API-GR 400
GAMMA
0 API-GR 200
CALIPER
30 INCH 60
CALIPER
0 INCH 30
FEET
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
DRAFT


200
210
220
230
240
250
260
0
API-GR
200
GAMMA
200
API-GR
400
GAMMA
0
INCH
30
CALIPER
30
INCH
60
CALIPER
FEET

TOOL CALIBRATION WELL 5 04/29/20 08:44
TOOL   9074A1   TM VERSION 2004
SERIAL 3158

	DATE	TIME	SENSOR		STANDARD Point1	STANDARD Point2	RESPONSE [CPS] Point1	RESPONSE [CPS] Point2
1	Jul16,19	11:01:03	GAMMA	[API-GR]	1.000	340.000	0.000	365
2	Jul16,19	11:04:12	CALIPER	[INCH]	4.000	6.000	69017	85360
3	Oct03,19	08:06:13	CALIPERL	[INCH]	8.000	12.000	82709	107387
4	Jul16,19	11:00:52	CALIPERX	[CPS]	Default	Default	Default	Default

ABS
Advanced Borehole Services

COMBINATION LOG
STATIC WATER QUALITY
WELL 5

COMPANY APPLIED DRILLING ENG.
WELL WELL 5
WELL EXT
FIELD
COUNTY PINELLAS
STATE FLORIDA
COUNTRY USA
API NO.

COMPANY : APPLIED DRILLING ENG.
WELL : WELL 5
WELL EXT :
FIELD :
COUNTY : PINELLAS
STATE : FLORIDA
COUNTRY : USA
API NO. :
UNIQ ID : NONE

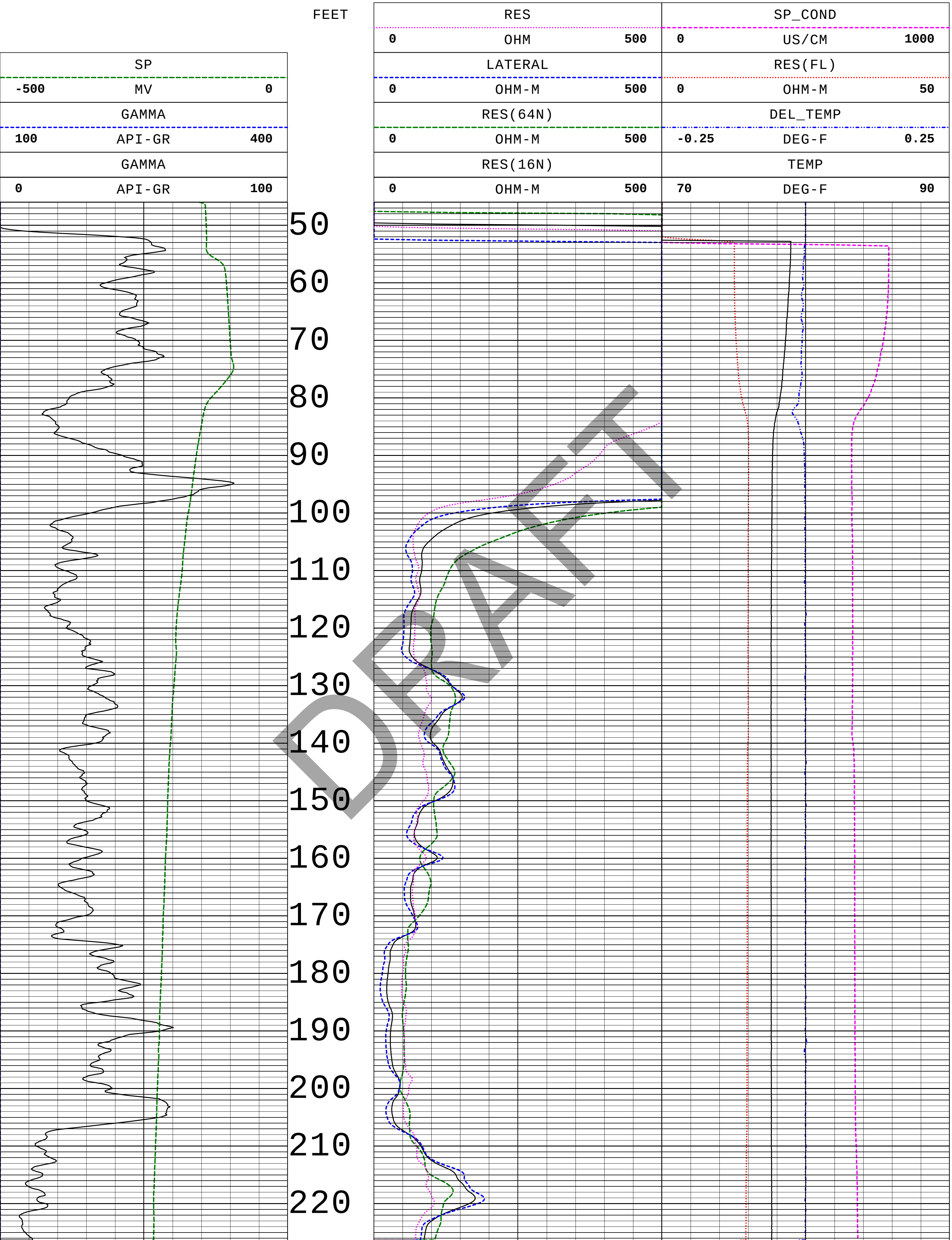
SECTION: TOWNSHIP: RANGE:
LOCATION : BELLEAIRE
LAT GPS UTM
LON GPS UTM

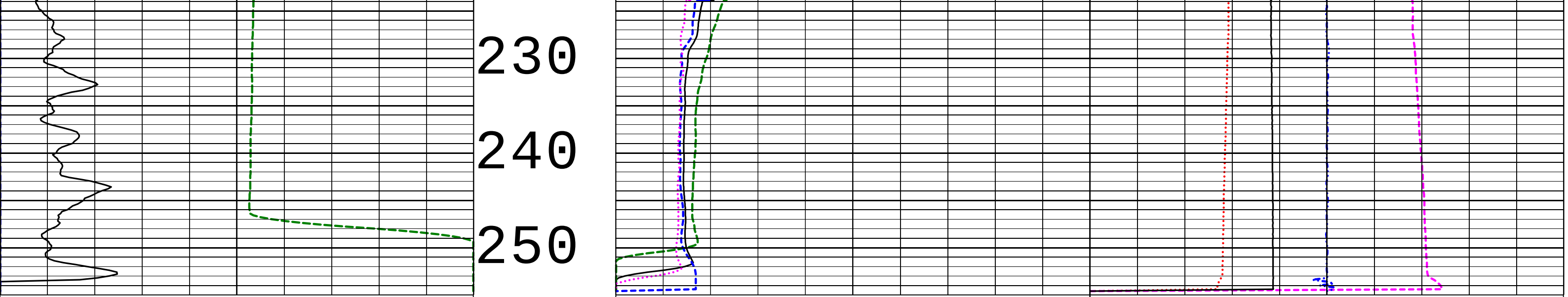
DISPLAY7_JL56

PERMANENT DATUM	MSL	Elevations:		Other Services:	
DRL MEASURED FROM	NA	KB	FT	8044	
LOG MEASURED FROM	PAD	DF	FT	8711	
ELEV. PERM. DATUM	FT	GL	FT	VIDEO	

DATE	TIME			
DEPTH DRILLER	NA	FT		
DEPTH LOGGER	256	FT		
FIRST READING		FT		
LAST READING		FT		
BIT SIZE	6	IN		
CASING -- DRILLER	NA	FT		
CASING -- LOGGER	80	FT		
CASING O.D.	6	IN		
CASING TYPE	PVC			
FLUID TYPE	FOR			
FLUID DENSITY		LB/GAL		
FLUID VISCOSITY				
FLUID PH				
MUD SOURCE				
RM @ MEAS TEMP	@ F			
RMF @ MEAS TEMP	@ F			
RMC @ MEAS TEMP	@ F			
CIRC STOPPED				
RIG NUMBER				
RECORDED BY	AFB			
WITNESSED BY	MAC DADDY			
REMARKS 1				
REMARKS 2				
REMARKS 3				

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS


FEET
SP
-500 MV 0
GAMMA
100 API-GR 400
GAMMA
0 API-GR 100
RES
0 OHM 500
LATERAL
0 OHM-M 500
RES(64N)
0 OHM-M 500
RES(16N)
0 OHM-M 500
SP_COND
0 US/CM 1000
RES(FL)
0 OHM-M 50
DEL_TEMP
-0.25 DEG-F 0.25
TEMP
70 DEG-F 90
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220
DRAFT



0 API-GR 100			0 OHM-M 500	70 DEG-F 90
GAMMA			RES(16N)	TEMP
100 API-GR 400			0 OHM-M 500	-0.25 DEG-F 0.25
GAMMA			RES(64N)	DEL_TEMP
-500 MV 0			0 OHM-M 500	0 OHM-M 50
SP			LATERAL	RES(FL)
			0 OHM 500	0 US/CM 1000
		FEET	RES	SP_COND

TOOL CALIBRATION WELL 5 04/29/20 09:19
TOOL   8044A   TM VERSION 2002
SERIAL 938

	DATE	TIME	SENSOR		STANDARD Point1	STANDARD Point2	RESPONSE [CPS] Point1	RESPONSE [CPS] Point2
1	Jan03,03	02:49:05	GAMMA	[API-GR]	0.001	180.000	0.000	169
2	Apr09,20	11:12:41	RES(FL)	[OHM-M]	3.060	28.160	13413	37152
3	Aug17,14	12:00:23	SP	[MV]	0.000	395.000	59670	23612
4	Feb02,20	14:59:18	RES(16N)	[OHM-M]	0.000	1996.000	4010	103211
5	Feb02,20	15:00:15	RES(64N)	[OHM-M]	0.000	1990.000	4089	103487
6	Sep29,19	18:57:40	TEMP	[DEG-F]	71.700	86.100	63355	57070
7	Aug17,14	10:39:11	RES	[OHM]	0.000	988.000	9855	58788

ABS Advanced Borehole Services

PRODUCTION-STATIC-PUMPING
WELL 5

COMPANY APPLIED DRILLING ENG.
WELL WELL 5
WELL EXT
FIELD
COUNTY PINELLAS
STATE FLORIDA
COUNTRY USA
API NO.

COMPANY : APPLIED DRILLING ENG.
WELL : WELL 5
WELL EXT :
FIELD :
COUNTY : PINELLAS
STATE : FLORIDA
COUNTRY : USA
API NO. :
UNIQ ID : NONE

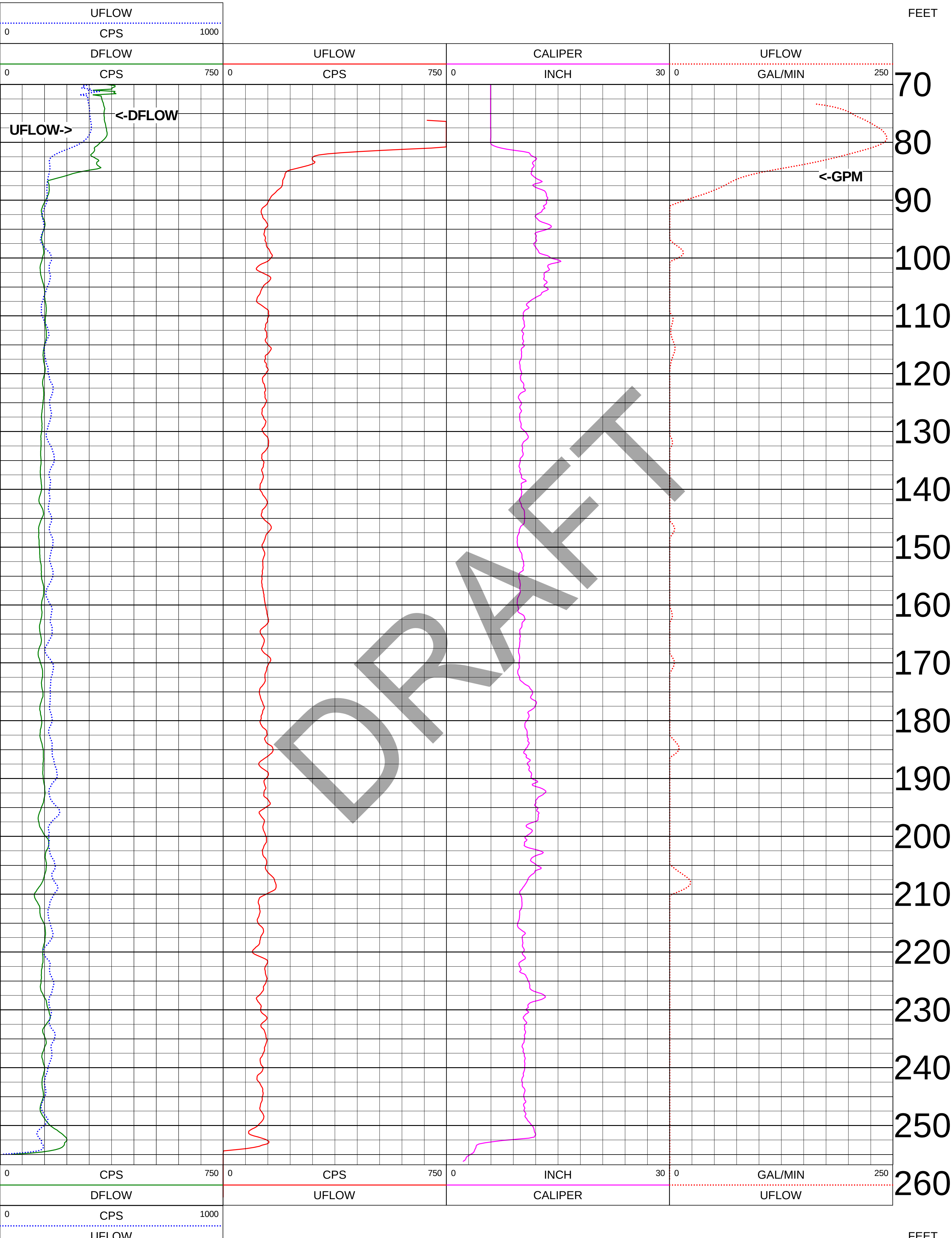
SECTION: TOWNSHIP: RANGE:
LOCATION : BELLEAIRE
LAT GPS UTM
LON GPS UTM

DISPLAY7_JL56

PERMANENT DATUM	MSL	Elevations:		Other Services:	
DRL MEASURED FROM	NA	KB	FT	8044	
LOG MEASURED FROM	PAD	DF	FT	8711	
ELEV. PERM. DATUM	FT	GL	FT	VIDEO	

DATE	TIME			
DEPTH DRILLER	NA	FT		
DEPTH LOGGER	256	FT		
FIRST READING		FT		
LAST READING		FT		
BIT SIZE	6	IN		
CASING -- DRILLER	NA	FT		
CASING -- LOGGER	80	FT		
CASING O.D.	6	IN		
CASING TYPE	PVC			
FLUID TYPE	FOR			
FLUID DENSITY		LB/GAL		
FLUID VISCOSITY				
FLUID PH				
MUD SOURCE				
RM @ MEAS TEMP	@ F			
RMF @ MEAS TEMP	@ F			
RMC @ MEAS TEMP	@ F			
CIRC STOPPED				
RIG NUMBER				
RECORDED BY	AFB			
WITNESSED BY	MAC DADDY			
REMARKS 1				
REMARKS 2				
REMARKS 3				

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS


UFLOW
0 CPS 1000
DFLOW
0 CPS 750
UFLOW
0 CPS 750
CALIPER
0 INCH 30
UFLOW
0 GAL/MIN 250
FEET
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220
230
240
250
260
<-DFLOW
UFLOW->
<-GPM
DRAFT
0 CPS 750
DFLOW
0 CPS 1000
UFLOW
0 CPS 750
UFLOW
0 INCH 30
CALIPER
0 GAL/MIN 250
UFLOW
FEET

PUMPED WATER QUALITY
WELL 5

ABS Advanced Borehole Services

COMPANY APPLIED DRILLING ENG.
WELL WELL 5
WELL EXT
FIELD
COUNTY PINELLAS
STATE FLORIDA
COUNTRY USA
API NO.

COMPANY	: APPLIED DRILLING ENG.
WELL	: WELL 5
WELL EXT	:
FIELD	:
COUNTY	: PINELLAS
STATE	: FLORIDA
COUNTRY	: USA
API NO.	:
UNIQ ID	: NONE

SECTION: TOWNSHIP: RANGE:

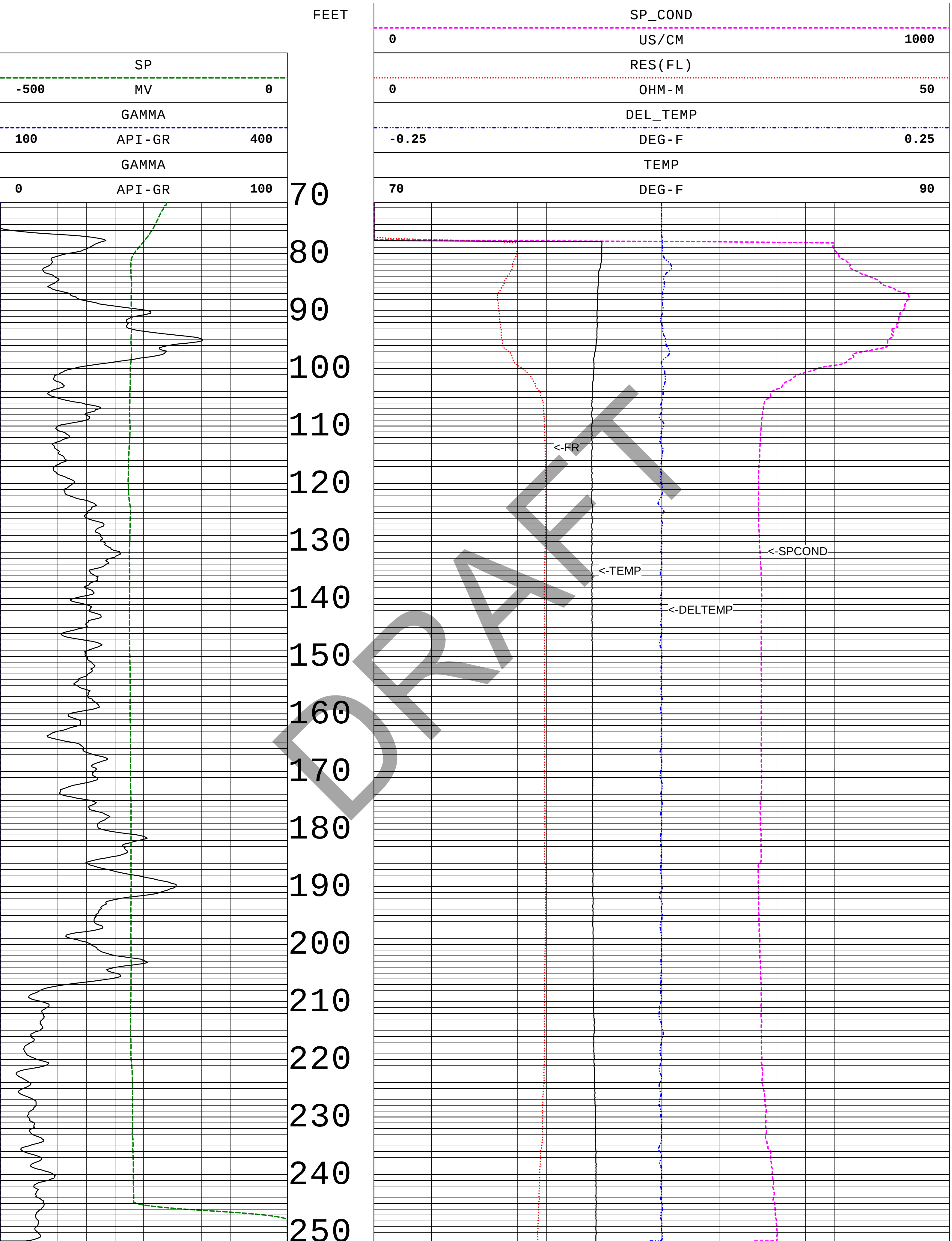
LOCATION : BELLEAIRE
LAT GPS UTM
LON GPS UTM

DISPLAY7_JL56

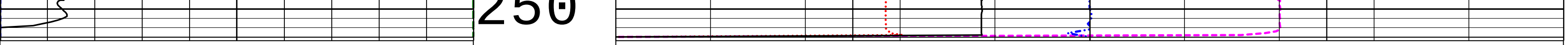
PERMANENT DATUM	MSL	Elevations:		Other Services:	
DRL MEASURED FROM	NA	KB	FT	8044	
LOG MEASURED FROM	PAD	DF	FT	8711	
ELEV. PERM. DATUM	FT	GL	FT	VIDEO	

DATE	TIME			
DEPTH DRILLER	NA	FT		
DEPTH LOGGER	256	FT		
FIRST READING		FT		
LAST READING		FT		
BIT SIZE	6	IN		
CASING -- DRILLER	NA	FT		
CASING -- LOGGER	80	FT		
CASING O.D.	6	IN		
CASING TYPE	PVC			
FLUID TYPE	FOR			
FLUID DENSITY		LB/GAL		
FLUID VISCOSITY				
FLUID PH				
MUD SOURCE				
RM @ MEAS TEMP	@ F			
RMF @ MEAS TEMP	@ F			
RMC @ MEAS TEMP	@ F			
CIRC STOPPED				
RIG NUMBER				
RECORDED BY	AFB			
WITNESSED BY	MAC DADDY			
REMARKS 1				
REMARKS 2				
REMARKS 3				

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS



FEET
SP
-500 MV 0
GAMMA
100 API-GR 400
GAMMA
0 API-GR 100
SP_COND
0 US/CM 1000
RES(FL)
0 OHM-M 50
DEL_TEMP
-0.25 DEG-F 0.25
TEMP
70 DEG-F 90
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220
230
240
250
<-FR
<-TEMP
<-DELTEMP
<-SPCOND
DRAFT



0	API-GR	100
	GAMMA	
100	API-GR	400
	GAMMA	
-500	MV	0
	SP	

FEET

70	DEG-F	90
	TEMP	
-0.25	DEG-F	0.25
	DEL_TEMP	
0	OHM-M	50
	RES(FL)	
0	US/CM	1000
	SP_COND	

TOOL CALIBRATION WELL 5 04/29/20 09:56
TOOL   8044A   TM VERSION 2002
SERIAL 938

	DATE	TIME	SENSOR		STANDARD Point1	STANDARD Point2	RESPONSE [CPS] Point1	RESPONSE [CPS] Point2
1	Jan03,03	02:49:05	GAMMA	[API-GR]	0.001	180.000	0.000	169
2	Apr09,20	11:12:41	RES(FL)	[OHM-M]	3.060	28.160	13413	37152
3	Aug17,14	12:00:23	SP	[MV]	0.000	395.000	59670	23612
4	Feb02,20	14:59:18	RES(16N)	[OHM-M]	0.000	1996.000	4010	103211
5	Feb02,20	15:00:15	RES(64N)	[OHM-M]	0.000	1990.000	4089	103487
6	Sep29,19	18:57:40	TEMP	[DEG-F]	71.700	86.100	63355	57070
7	Aug17,14	10:39:11	RES	[OHM]	0.000	988.000	9855	58788

GAMMA RAY (API)-CALIPER
WELL 6

COMPANY APPLIED DRILLING ENG.
WELL WELL 6
WELL EXT
FIELD
COUNTY PINELLAS
STATE FLORIDA
COUNTRY ---
API NO.

COMPANY	: APPLIED DRILLING ENG.
WELL	: WELL 6
WELL EXT	:
FIELD	:
COUNTY	: PINELLAS
STATE	: FLORIDA
COUNTRY	: ---
API NO.	:
UNIQ ID	: NONE

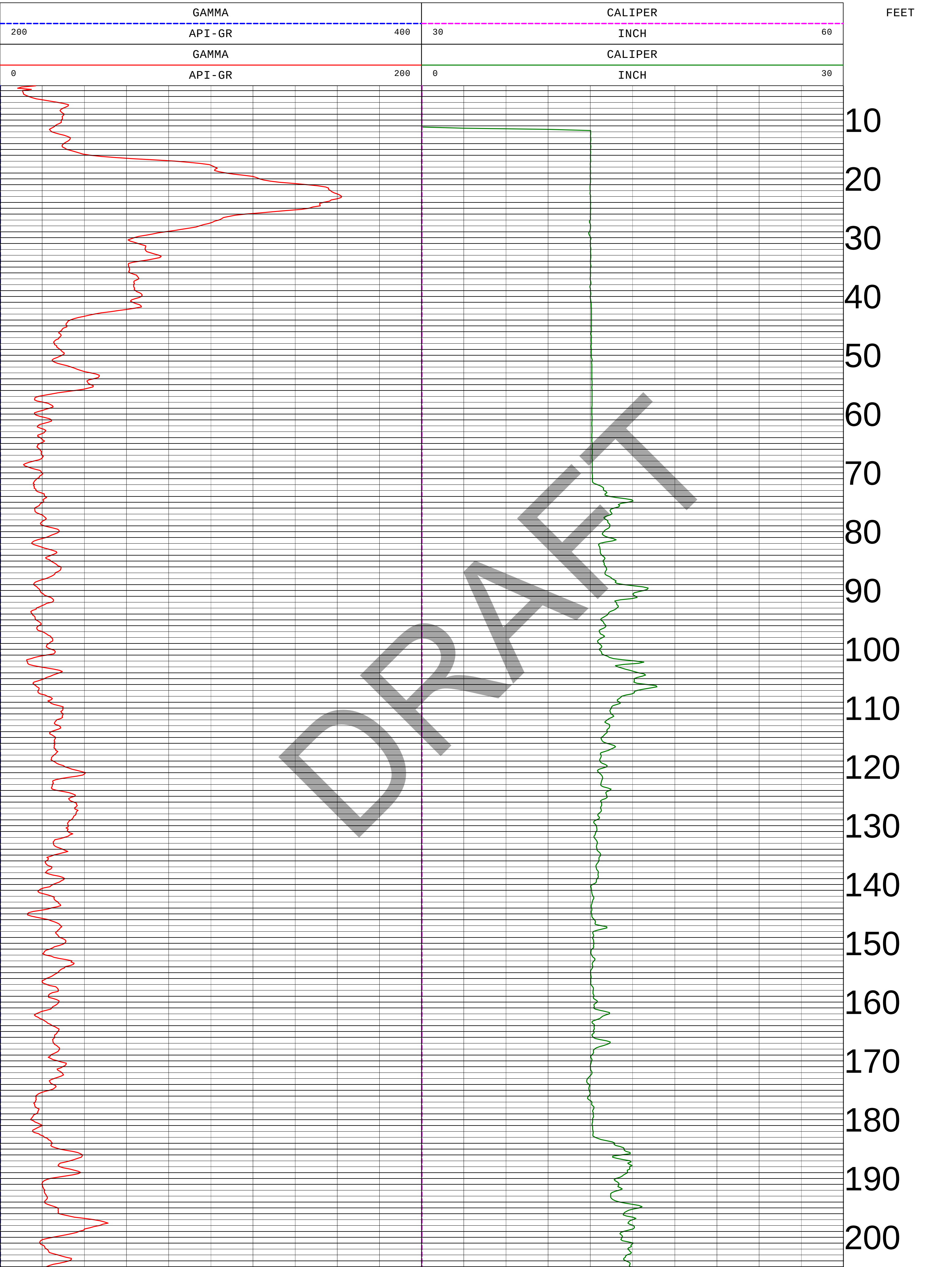
SECTION: TOWNSHIP: RANGE:

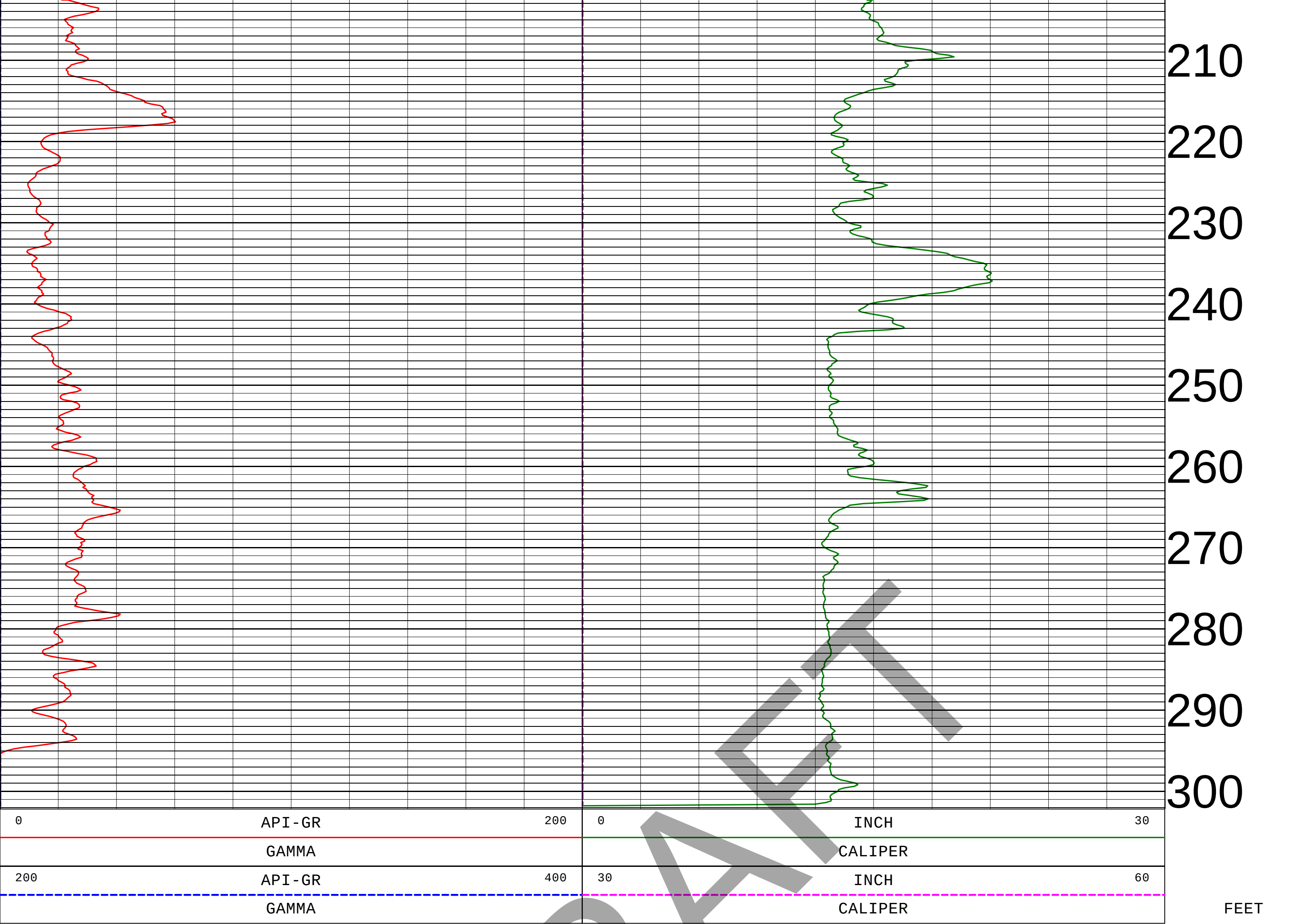
LOCATION : BELLEAIRE
LAT GPS UTM
LON GPS UTM

DISPLAY7_JL56

PERMANENT DATUM	MSL	Elevations:		Other Services:
DRL MEASURED FROM	NA	KB	FT	8044
LOG MEASURED FROM	PAD	DF	FT	8711
ELEV. PERM. DATUM	FT	GL	FT	VIDEO

DATE	TIME			
DEPTH DRILLER	NA	FT		
DEPTH LOGGER	299	FT		
FIRST READING		FT		
LAST READING		FT		
BIT SIZE	6	IN		
CASING -- DRILLER	XX	FT		
CASING -- LOGGER		FT		
CASING O.D.	12	IN		
CASING TYPE	STEEL			
FLUID TYPE	FOR			
FLUID DENSITY		LB/GAL		
FLUID VISCOSITY				
FLUID PH				
MUD SOURCE				
RM @ MEAS TEMP	@ F			
RMF @ MEAS TEMP	@ F			
RMC @ MEAS TEMP	@ F			
CIRC STOPPED				
RIG NUMBER				
RECORDED BY	AFB			
WITNESSED BY	MAC DADDY			
REMARKS 1				
REMARKS 2				
REMARKS 3				


GAMMA
200
API-GR
400
CALIPER
30
INCH
60
FEET
GAMMA
0
API-GR
200
CALIPER
0
INCH
30
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
DRAFT



210
220
230
240
250
260
270
280
290
300
0
API-GR
200
GAMMA
200
API-GR
400
GAMMA
0
INCH
30
CALIPER
30
INCH
60
CALIPER
FEET
DRAFT

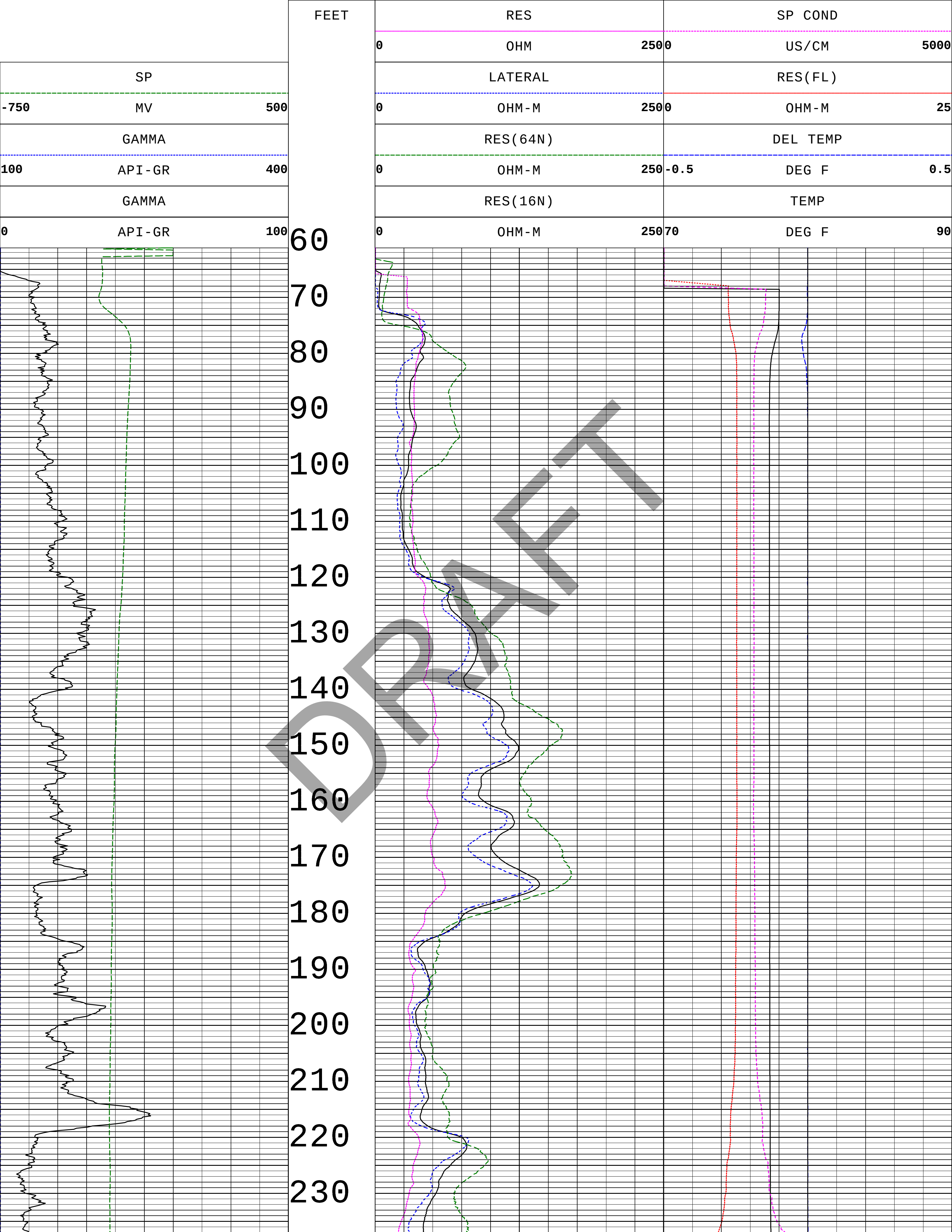
TOOL CALIBRATION WELL 6 04/16/20 09:02
TOOL 9074A1 TM VERSION 2004
SERIAL 3158

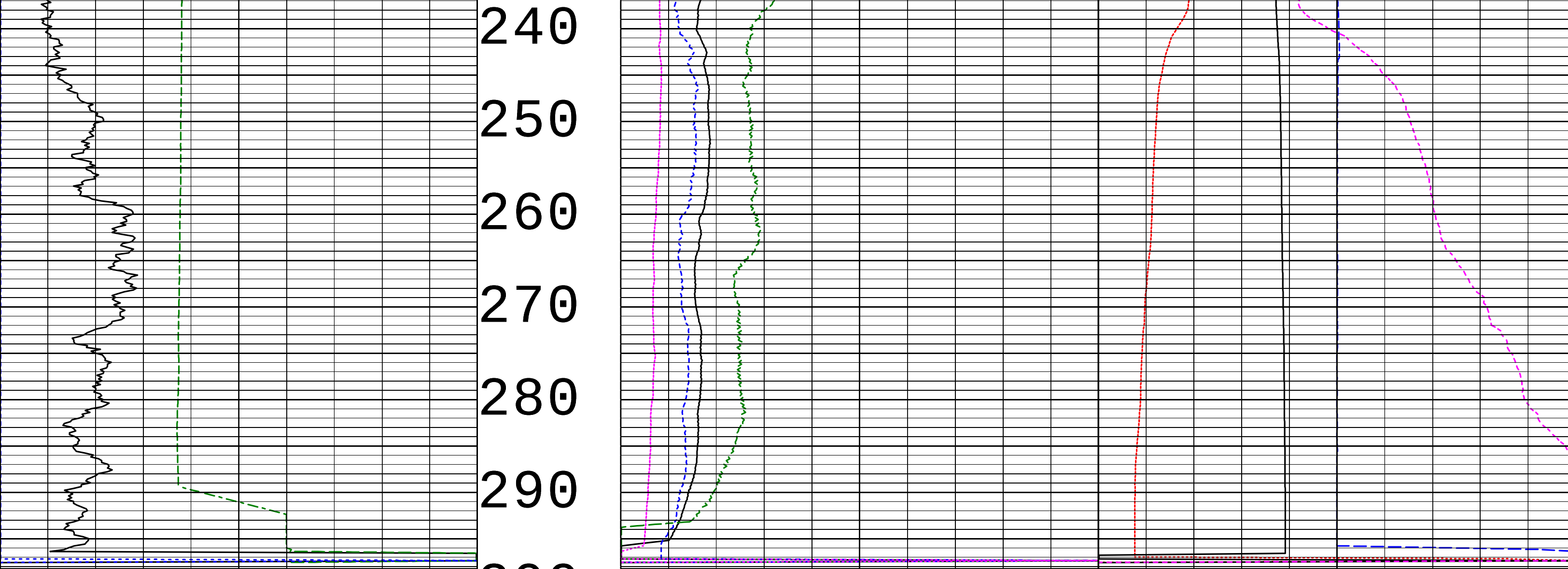
	DATE	TIME	SENSOR		STANDARD Point1	STANDARD Point2	RESPONSE [CPS] Point1	RESPONSE [CPS] Point2
1	Jul16,19	11:01:03	GAMMA	[API-GR]	1.000	340.000	0.000	365
2	Jul16,19	11:04:12	CALIPER	[INCH]	4.000	6.000	69017	85360
3	Oct03,19	08:06:13	CALIPERL	[INCH]	8.000	12.000	82709	107387
4	Jul16,19	11:00:52	CALIPERX	[CPS]	Default	Default	Default	Default

COMBINATION LOG
STATIC WATER QUALITY
WELL 6

COMPANY	APPLIED DRILLING ENG.	OTHER SERVICES:	8044 8711 VIDEO
WELL	WELL 6		
FIELD			
COUNTY	PINELLAS		
STATE	FLORIDA		
LOCATION	BELLEAIRE		
SECTION			
TOWNSHIP			
RANGE			
API NO.			
UNIQUE WELL ID.	NONE		
PERMANENT DATUM	MSL	ELEVATION KB	
LOG MEASURED FROM	PAD	ELEVATION DF	
DRL MEASURED FROM	NA	ELEVATION GL	
DATE	04/16/20	RIG NUMBER	
DEPTH DRILLER	NA	LOGGER TD	299
BIT SIZE	6	ARRIVAL TIME	0800
LOG TOP	61.20	DEPARTURE TIME	
LOG BOTTOM	298.00	CIRC STOPPED	
CASING OD	12		
CASING BOTTOM	XX		
CASING TYPE	STEEL		
BOREHOLE FLUID	FOR		
RM TEMPERATURE			
MUD RES			
MUD WEIGHT			
WITNESSED BY	MAC DADDY		
RECORDED BY	AFB		
REMARKS 1			
REMARKS 2			

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS


FEET
RES
0 OHM 2500
SP COND
0 US/CM 5000
SP
-750 MV 500
LATERAL
0 OHM-M 250
RES(FL)
0 OHM-M 25
GAMMA
100 API-GR 400
RES(64N)
0 OHM-M 250
DEL TEMP
-0.5 DEG F 0.5
GAMMA
0 API-GR 100
RES(16N)
0 OHM-M 250
TEMP
70 DEG F 90
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220
230
DRAFT



0 API-GR 100		0 OHM-M 250	70 DEG F 90
GAMMA		RES(16N)	TEMP
100 API-GR 400		0 OHM-M 250	-0.5 DEG F 0.5
GAMMA		RES(64N)	DEL TEMP
-750 MV 500		0 OHM-M 250	0 OHM-M 25
SP		LATERAL	RES(FL)
		0 OHM 250	0 US/CM 5000
	FEET	RES	SP COND

TOOL CALIBRATION WELL 6 04/16/20 09:41
TOOL 8044A TM VERSION 2002
SERIAL NUMBER 938

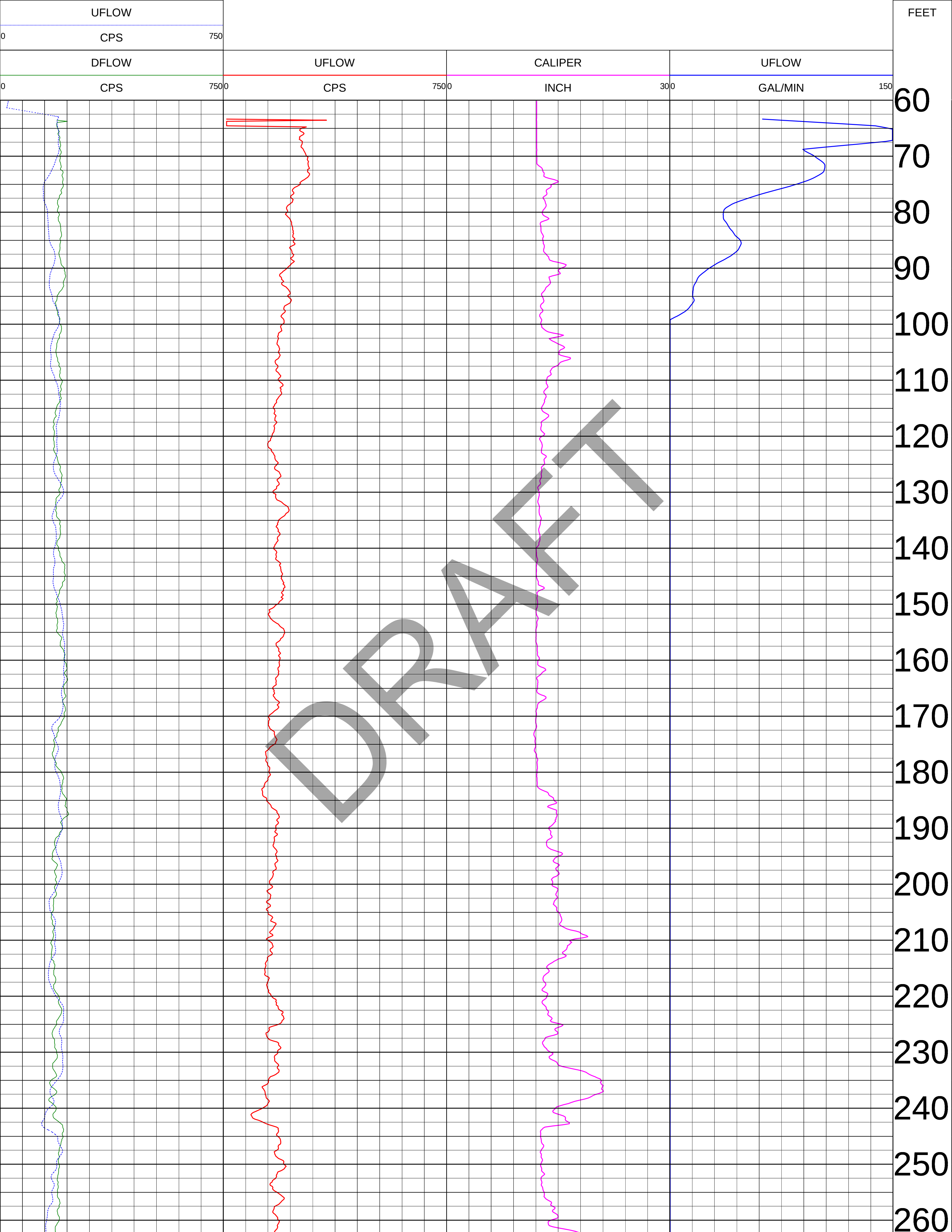
	DATE	TIME	SENSOR	STANDARD		RESPONSE	
1	Jan03,03	02:49:05	GAMMA	0.001	[API-GR]	0.000	[CPS]
	Jan03,03	02:49:05	GAMMA	180.000	[API-GR]	169.000	[CPS]
2	Apr09,20	11:12:41	RES(FL	3.060	[OHM-M]	13413.000	[CPS]
	Apr09,20	11:12:41	RES(FL	28.160	[OHM-M]	37152.000	[CPS]
3	Aug17,14	12:00:23	SP	0.000	[MV]	59670.000	[CPS]
	Aug17,14	12:00:23	SP	395.000	[MV]	23612.000	[CPS]
4	Feb02,20	14:59:18	RES(16I	0.000	[OHM-M]	4010.000	[CPS]
	Feb02,20	14:59:18	RES(16I	1996.000	[OHM-M]	103211.000	[CPS]
5	Feb02,20	15:00:15	RES(64I	0.000	[OHM-M]	4089.000	[CPS]
	Feb02,20	15:00:15	RES(64I	1990.000	[OHM-M]	103487.000	[CPS]
6	Sep29,19	18:57:40	TEMP	71.700	[DEG F]	63355.000	[CPS]
	Sep29,19	18:57:40	TEMP	86.100	[DEG F]	57070.000	[CPS]
7	Aug17,14	10:39:11	RES	0.000	[OHM]	9855.000	[CPS]
	Aug17,14	10:39:11	RES	988.000	[OHM]	58788.000	[CPS]

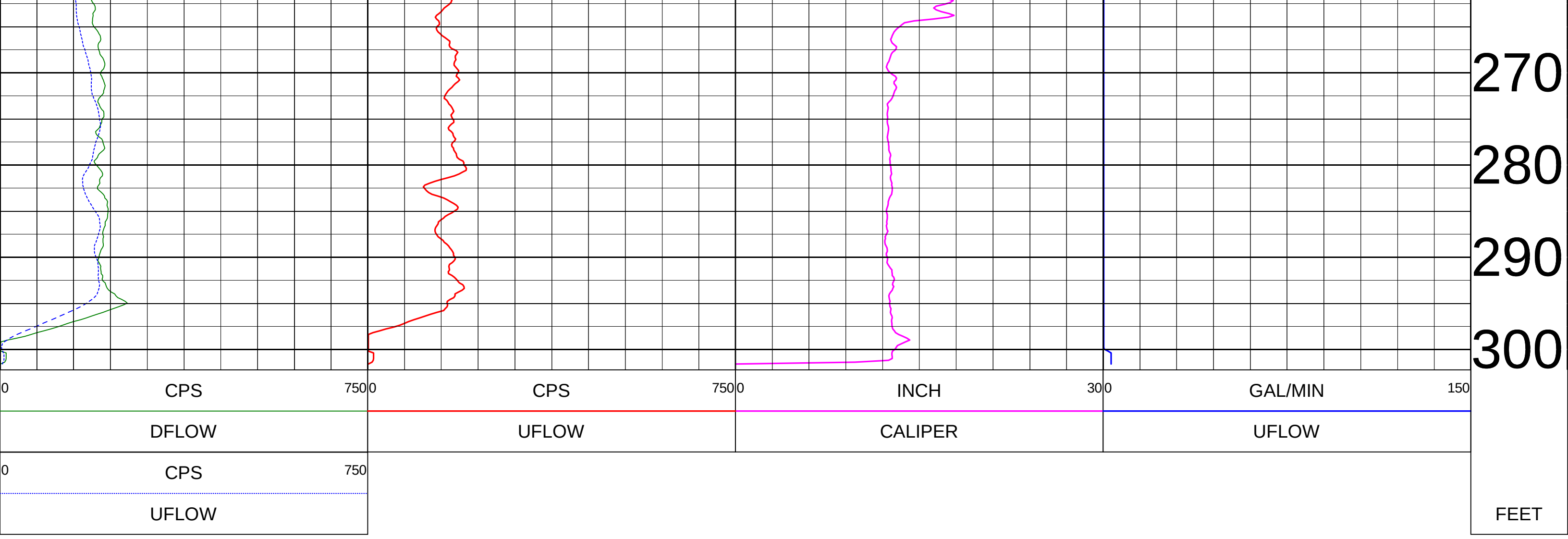
PRODUCTION-STATIC-PUMPING

WELL 6

COMPANY	: APPLIED DRILLING ENG.	OTHER SERVICES:	8044 8711 VIDEO
WELL	: WELL 6		
FIELD	:		
COUNTY	: PINELLAS		
STATE	: FLORIDA		
LOCATION	: BELLEAIRE		
SECTION	:		
TOWNSHIP	:		
RANGE	:		
API NO.	:		
UNIQUE WELL ID.	: NONE		
PERMANENT DATUM	: MSL	ELEVATION KB	:
LOG MEASURED FROM	: PAD	ELEVATION DF	:
DRL MEASURED FROM	: NA	ELEVATION GL	:
DATE	: 04/16/20	RIG NUMBER	:
DEPTH DRILLER	: NA	LOGGER TD	: 299
BIT SIZE	: 6	ARRIVAL TIME	: 0800
LOG TOP	: 4.20	DEPARTURE TIME	:
LOG BOTTOM	: 302.00	CIRC STOPPED	:
CASING OD	: 12		
CASING BOTTOM	: XX		
CASING TYPE	: STEEL		
BOREHOLE FLUID	: FOR		
RM TEMPERATURE	:		
MUD RES	:		
MUD WEIGHT	:		
WITNESSED BY	: MAC DADDY		
RECORDED BY	: AFB		
REMARKS 1	:		
REMARKS 2	:		

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS


UFLOW
CPS
0
750
DFLOW
CPS
0
750
UFLOW
CPS
0
750
CALIPER
INCH
0
30
UFLOW
GAL/MIN
0
150
FEET
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220
230
240
250
260
DRAFT


270
280
290
300
0
CPS
750
DFLOW
0
CPS
750
UFLOW
0
CPS
750
UFLOW
0
INCH
30
CALIPER
0
GAL/MIN
150
UFLOW
FEET

PUMPING WATER QUALITY
WELL 6

COMPANY APPLIED DRILLING ENG.
WELL WELL 6
WELL EXT
FIELD
COUNTY PINELLAS
STATE FLORIDA
COUNTRY ---
API NO.

COMPANY : APPLIED DRILLING ENG.
WELL : WELL 6
WELL EXT :
FIELD :
COUNTY : PINELLAS
STATE : FLORIDA
COUNTRY : ---
API NO. :
UNIQ ID : NONE

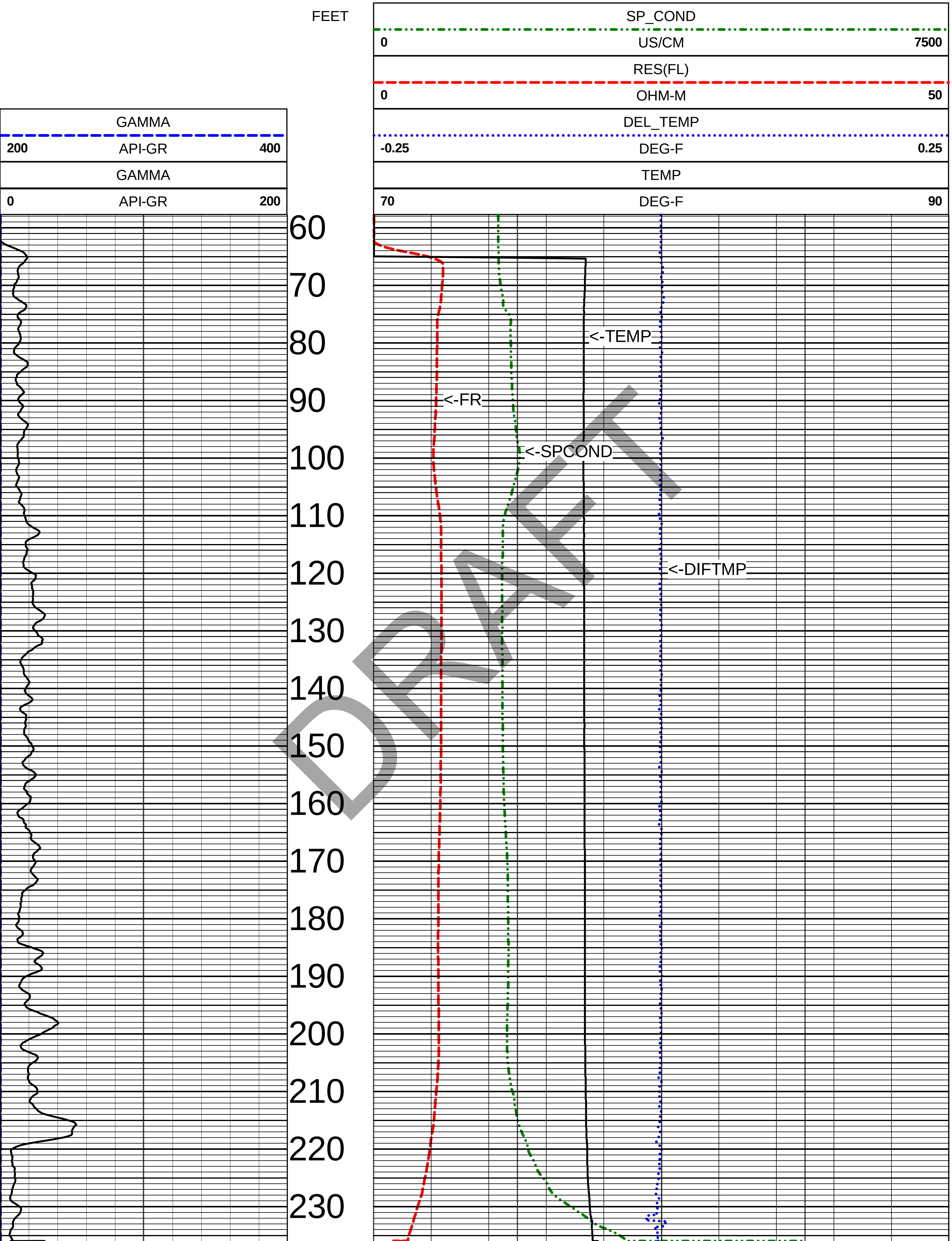
SECTION: TOWNSHIP: RANGE:

LOCATION : BELLEAIRE
LAT GPS UTM
LON GPS UTM

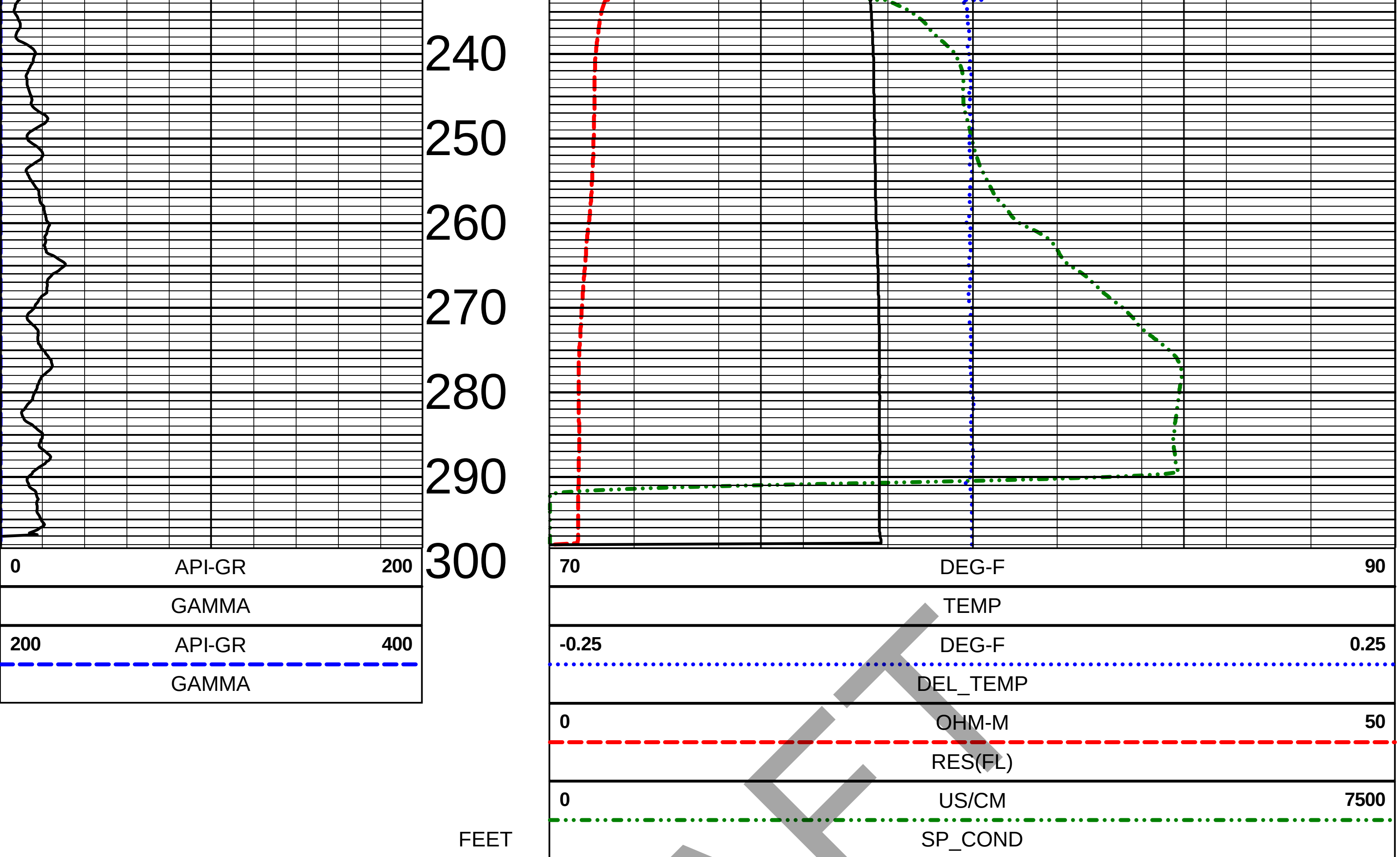
DISPLAY7_JL56

PERMANENT DATUM	MSL	Elevations:	Other Services:
DRL MEASURED FROM	NA	KB FT	8044
LOG MEASURED FROM	PAD	DF FT	8711
ELEV. PERM. DATUM	FT	GL FT	VIDEO

DATE	TIME		
DEPTH DRILLER	NA FT		
DEPTH LOGGER	299 FT		
FIRST READING	FT		
LAST READING	FT		
BIT SIZE	6 IN		
CASING -- DRILLER	XX FT		
CASING -- LOGGER	FT		
CASING O.D.	12 IN		
CASING TYPE	STEEL		
FLUID TYPE	FOR		
FLUID DENSITY	LB/GAL		
FLUID VISCOSITY			
FLUID PH			
MUD SOURCE			
RM @ MEAS TEMP	@ F		
RMF @ MEAS TEMP	@ F		
RMC @ MEAS TEMP	@ F		
CIRC STOPPED			
RIG NUMBER			
RECORDED BY	AFB		
WITNESSED BY	MAC DADDY		
REMARKS 1			
REMARKS 2			
REMARKS 3			



FEET
SP_COND
0 US/CM 7500
RES(FL)
0 OHM-M 50
GAMMA
200 API-GR 400
DEL_TEMP
-0.25 DEG-F 0.25
GAMMA
0 API-GR 200
TEMP
70 DEG-F 90
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220
230
<-TEMP
<-FR
<-SPCOND
<-DIFTMP
DRAFT


240
250
260
270
280
290
300
0 API-GR 200
GAMMA
200 API-GR 400
GAMMA
FEET
70 DEG-F 90
TEMP
-0.25 DEG-F 0.25
DEL_TEMP
0 OHM-M 50
RES(FL)
0 US/CM 7500
SP_COND

TOOL CALIBRATION WELL 6 04/16/20 10:04
TOOL 8044A TM VERSION 2002
SERIAL NUMBER 938

	DATE	TIME	SENSOR	STANDARD		RESPONSE	
1	Jan03,03	02:49:05	GAMMA	0.001	[API-GR]	0.000	[CPS]
	Jan03,03	02:49:05	GAMMA	180.000	[API-GR]	169.000	[CPS]
2	Apr09,20	11:12:41	RES(FL)	3.060	[OHM-M]	13413.000	[CPS]
	Apr09,20	11:12:41	RES(FL)	28.160	[OHM-M]	37152.000	[CPS]
3	Aug17,14	12:00:23	SP	0.000	[MV]	59670.000	[CPS]
	Aug17,14	12:00:23	SP	395.000	[MV]	23612.000	[CPS]
4	Feb02,20	14:59:18	RES(16N)	0.000	[OHM-M]	4010.000	[CPS]
	Feb02,20	14:59:18	RES(16N)	1996.000	[OHM-M]	103211.000	[CPS]
5	Feb02,20	15:00:15	RES(64N)	0.000	[OHM-M]	4089.000	[CPS]
	Feb02,20	15:00:15	RES(64N)	1990.000	[OHM-M]	103487.000	[CPS]
6	Sep29,19	18:57:40	TEMP	71.700	[DEG F]	63355.000	[CPS]
	Sep29,19	18:57:40	TEMP	86.100	[DEG F]	57070.000	[CPS]
7	Aug17,14	10:39:11	RES	0.000	[OHM]	9855.000	[CPS]
	Aug17,14	10:39:11	RES	988.000	[OHM]	58788.000	[CPS]

GAMMA RAY (API)-CALIPER
WELL 7

COMPANY APPLIED DRILLING ENG.
WELL WELL 7
WELL EXT
FIELD
COUNTY PINELLAS
STATE FLORIDA
COUNTRY USA
API NO.

COMPANY : APPLIED DRILLING ENG.
WELL : WELL 7
WELL EXT :
FIELD :
COUNTY : PINELLAS
STATE : FLORIDA
COUNTRY : USA
API NO. :
UNIQ ID : NONE

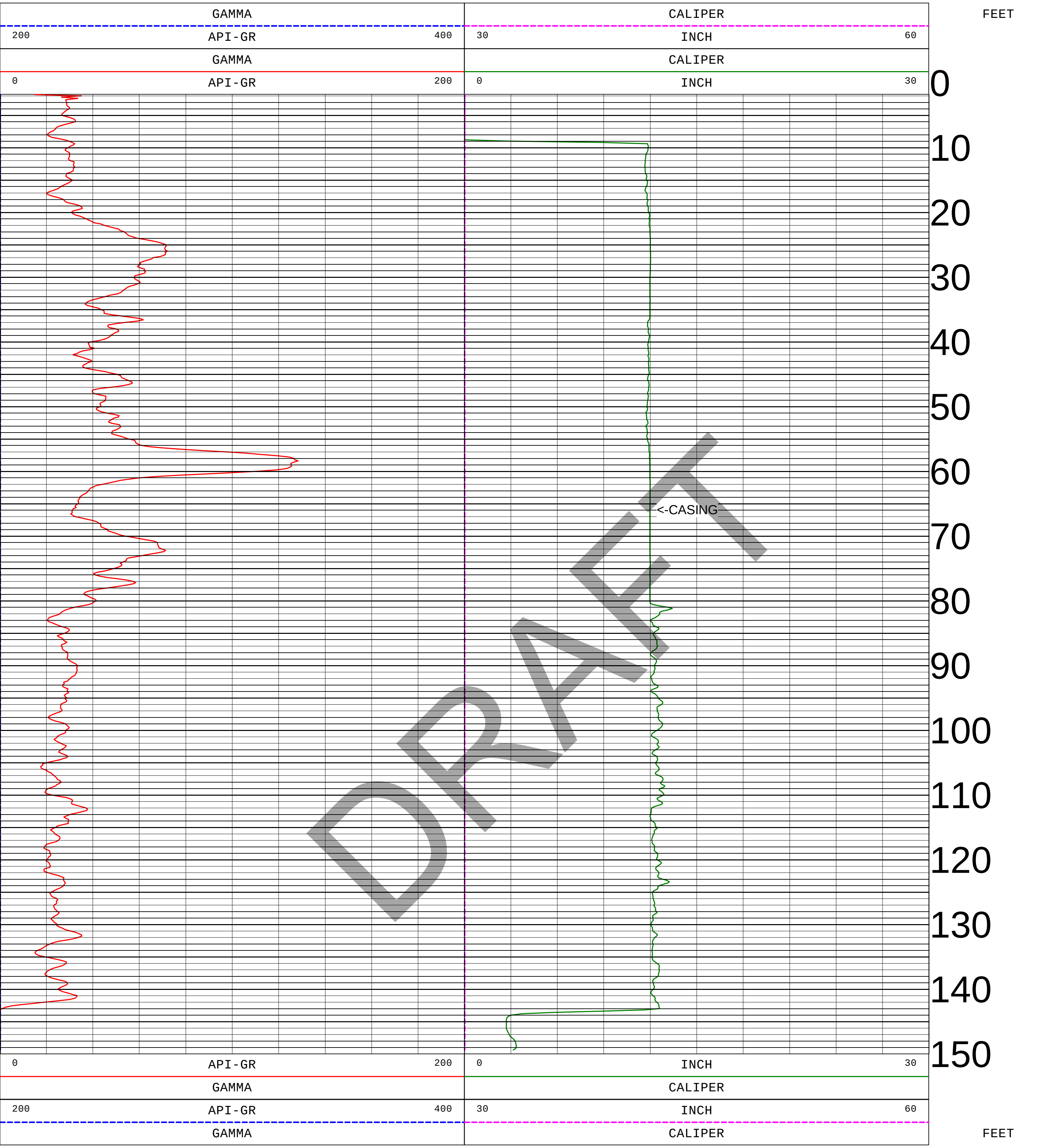
SECTION: TOWNSHIP: RANGE:
LOCATION : BELLEAIR
LAT GPS UTM
LON GPS UTM

DISPLAY7_JL56

PERMANENT DATUM	MSL	Elevations:		Other Services:	
DRL MEASURED FROM	NA	KB	FT	8044	
LOG MEASURED FROM	PAD	DF	FT	8711	
ELEV. PERM. DATUM	FT	GL	FT	VIDEO	

DATE	TIME			
DEPTH DRILLER	NA	FT		
DEPTH LOGGER	148	FT		
FIRST READING		FT		
LAST READING		FT		
BIT SIZE	6	IN		
CASING -- DRILLER	NA	FT		
CASING -- LOGGER	80	FT		
CASING O.D.	12	IN		
CASING TYPE	STEEL			
FLUID TYPE	FOR			
FLUID DENSITY		LB/GAL		
FLUID VISCOSITY				
FLUID PH				
MUD SOURCE				
RM @ MEAS TEMP	@ F			
RMF @ MEAS TEMP	@ F			
RMC @ MEAS TEMP	@ F			
CIRC STOPPED				
RIG NUMBER				
RECORDED BY	AFB			
WITNESSED BY	MAC DADDY			
REMARKS 1				
REMARKS 2				
REMARKS 3				

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS


GAMMA
200 API-GR 400
GAMMA
0 API-GR 200
CALIPER
30 INCH 60
CALIPER
0 INCH 30
FEET
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
<-CASING
DRAFT
0 API-GR 200
GAMMA
200 API-GR 400
GAMMA
0 INCH 30
CALIPER
30 INCH 60
CALIPER
FEET

TOOL CALIBRATION WELL 7 05/13/20 09:05
TOOL   9074A1   TM VERSION 2004
SERIAL 3158

	DATE	TIME	SENSOR		STANDARD Point1	STANDARD Point2	RESPONSE [CPS] Point1	RESPONSE [CPS] Point2
1	Jul16,19	11:01:03	GAMMA	[API-GR]	1.000	340.000	0.000	365
2	Jul16,19	11:04:12	CALIPER	[INCH]	4.000	6.000	69017	85360
3	May06,20	12:24:06	CALIPERL	[INCH]	8.000	12.000	85899	107387
4	Jul16,19	11:00:52	CALIPERX	[CPS]	Default	Default	Default	Default

COMBINATION LOG
WELL 7

COMPANY APPLIED DRILLING ENG.
WELL WELL 7
WELL EXT
FIELD
COUNTY PINELLAS
STATE FLORIDA
COUNTRY USA
API NO.

COMPANY : APPLIED DRILLING ENG.
WELL : WELL 7
WELL EXT :
FIELD :
COUNTY : PINELLAS
STATE : FLORIDA
COUNTRY : USA
API NO. :
UNIQ ID : NONE

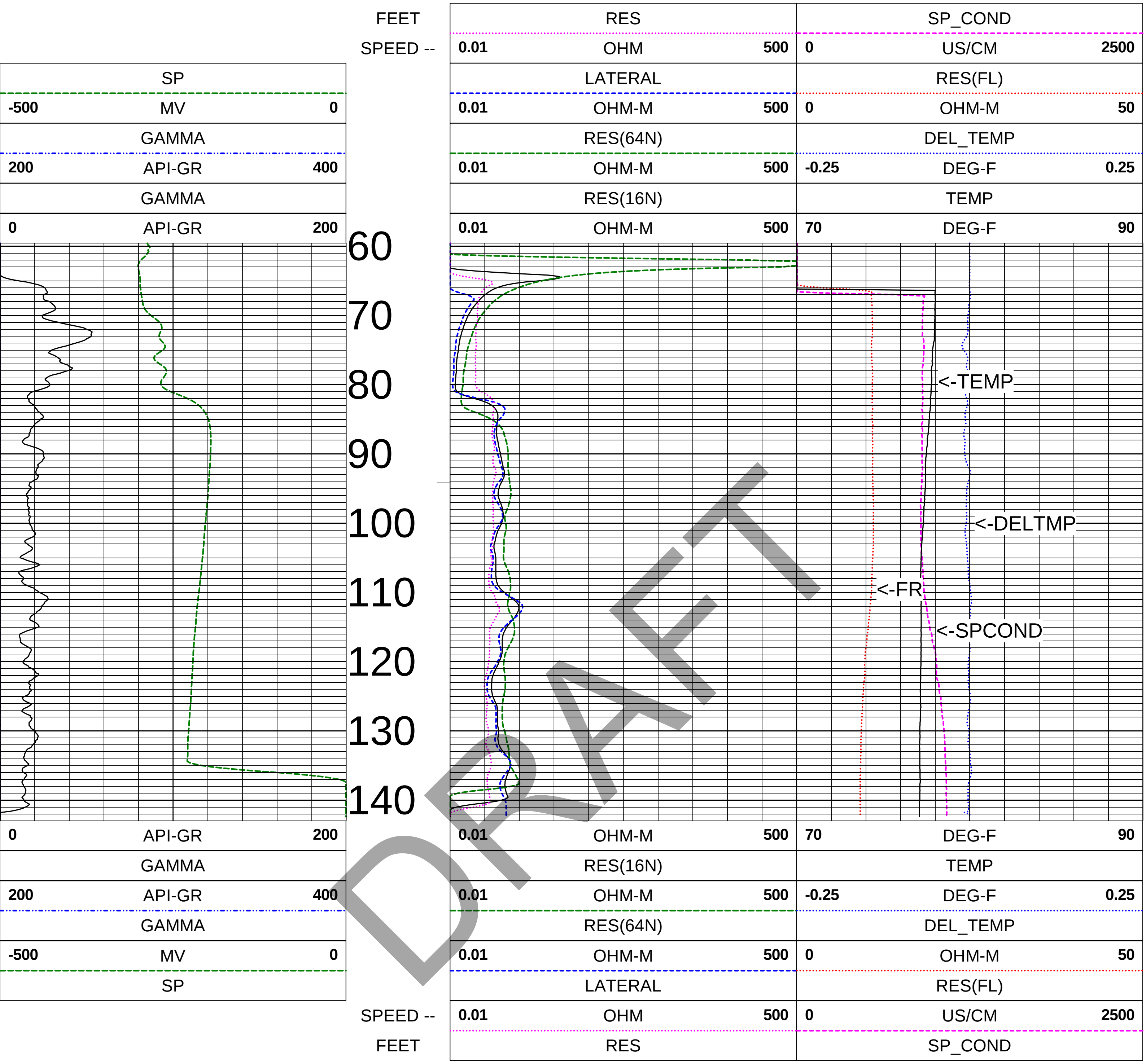
SECTION: TOWNSHIP: RANGE:
LOCATION : BELLEAIRE
LAT GPS UTM
LON GPS UTM

DISPLAY7_JL56

PERMANENT DATUM	MSL	Elevations:		Other Services:
DRL MEASURED FROM	NA	KB	FT	8044
LOG MEASURED FROM	PAD	DF	FT	8711
ELEV. PERM. DATUM	FT	GL	FT	VIDEO

DATE	TIME			
DEPTH DRILLER	NA FT			
DEPTH LOGGER	148 FT			
FIRST READING	FT			
LAST READING	FT			
BIT SIZE	6 IN			
CASING -- DRILLER	NA FT			
CASING -- LOGGER	80 FT			
CASING O.D.	12 IN			
CASING TYPE	STEEL			
FLUID TYPE	FOR			
FLUID DENSITY	LB/GAL			
FLUID VISCOSITY				
FLUID PH				
MUD SOURCE				
RM @ MEAS TEMP	@ F			
RMF @ MEAS TEMP	@ F			
RMC @ MEAS TEMP	@ F			
CIRC STOPPED				
RIG NUMBER				
RECORDED BY	AFB			
WITNESSED BY	MAC DADDY			
REMARKS 1				
REMARKS 2				
REMARKS 3				

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS


FEET
SPEED --
RES
0.01 OHM 500
SP_COND
0 US/CM 2500
SP
-500 MV 0
LATERAL
0.01 OHM-M 500
RES(FL)
0 OHM-M 50
GAMMA
200 API-GR 400
RES(64N)
0.01 OHM-M 500
DEL_TEMP
-0.25 DEG-F 0.25
GAMMA
0 API-GR 200
RES(16N)
0.01 OHM-M 500
TEMP
70 DEG-F 90
60
70
80
90
100
110
120
130
140
<-TEMP
<-DELTMP
<-FR
<-SPCOND
DRAFT
0 API-GR 200
GAMMA
200 API-GR 400
GAMMA
-500 MV 0
SP
0.01 OHM-M 500
RES(16N)
0.01 OHM-M 500
RES(64N)
0.01 OHM-M 500
LATERAL
0.01 OHM 500
RES
70 DEG-F 90
TEMP
-0.25 DEG-F 0.25
DEL_TEMP
0 OHM-M 50
RES(FL)
0 US/CM 2500
SP_COND
SPEED --
FEET

TOOL CALIBRATION WELL 7 05/13/20 09:23
TOOL   8044A   TM VERSION 2002
SERIAL 938

	DATE	TIME	SENSOR		STANDARD Point1	STANDARD Point2	RESPONSE [CPS] Point1	RESPONSE [CPS] Point2
1	Jan03,03	02:49:05	GAMMA	[API-GR]	0.001	180.000	0.000	169
2	Apr09,20	11:12:41	RES(FL)	[OHM-M]	3.060	28.160	13413	37152
3	Aug17,14	12:00:23	SP	[MV]	0.000	395.000	59670	23612
4	Feb02,20	14:59:18	RES(16N)	[OHM-M]	0.000	1996.000	4010	103211
5	Feb02,20	15:00:15	RES(64N)	[OHM-M]	0.000	1990.000	4089	103487
6	Sep29,19	18:57:40	TEMP	[DEG-F]	71.700	86.100	63355	57070
7	Aug17,14	10:39:11	RES	[OHM]	0.000	988.000	9855	58788

PRODUCTION-STATIC-PUMPING
WELL 7

COMPANY APPLIED DRILLING ENG.
WELL WELL 7
WELL EXT
FIELD
COUNTY PINELLAS
STATE FLORIDA
COUNTRY USA
API NO.

COMPANY : APPLIED DRILLING ENG.
WELL : WELL 7
WELL EXT :
FIELD :
COUNTY : PINELLAS
STATE : FLORIDA
COUNTRY : USA
API NO. :
UNIQ ID : NONE

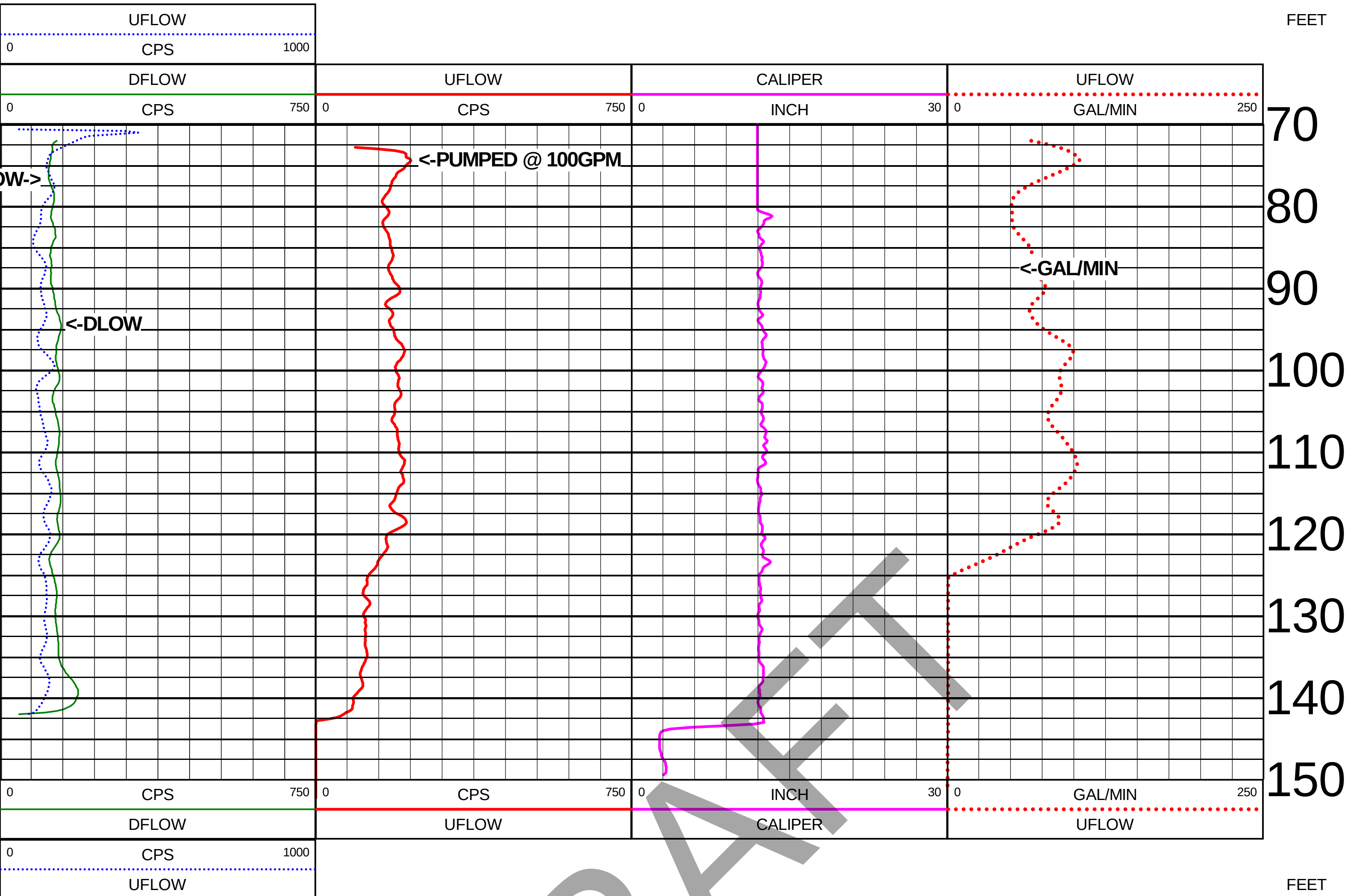
SECTION: TOWNSHIP: RANGE:
LOCATION : BELLEAIRE
LAT GPS UTM
LON GPS UTM

DISPLAY7_JL56

PERMANENT DATUM	MSL	Elevations:	Other Services:
DRL MEASURED FROM	NA	KB FT	8044
LOG MEASURED FROM	PAD	DF FT	8711
ELEV. PERM. DATUM	FT	GL FT	VIDEO

DATE	TIME		
DEPTH DRILLER	NA FT		
DEPTH LOGGER	148 FT		
FIRST READING	FT		
LAST READING	FT		
BIT SIZE	6 IN		
CASING -- DRILLER	NA FT		
CASING -- LOGGER	80 FT		
CASING O.D.	12 IN		
CASING TYPE	STEEL		
FLUID TYPE	FOR		
FLUID DENSITY	LB/GAL		
FLUID VISCOSITY			
FLUID PH			
MUD SOURCE			
RM @ MEAS TEMP	@ F		
RMF @ MEAS TEMP	@ F		
RMC @ MEAS TEMP	@ F		
CIRC STOPPED			
RIG NUMBER			
RECORDED BY	AFB		
WITNESSED BY	MAC DADDY		
REMARKS 1			
REMARKS 2			
REMARKS 3			

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS


UFLOW
0 CPS 1000
DFLOW
0 CPS 750
UFLOW
0 CPS 750
CALIPER
0 INCH 30
UFLOW
0 GAL/MIN 250
FEET
70
80
90
100
110
120
130
140
150
OW->
<-DLOW
<-PUMPED @ 100GPM
<-GAL/MIN
0 CPS 750
DFLOW
0 CPS 750
UFLOW
0 INCH 30
CALIPER
0 GAL/MIN 250
UFLOW
0 CPS 1000
UFLOW
FEET

PUMPING WATER QUALITY
WELL 7

COMPANY APPLIED DRILLING ENG.
WELL WELL 7
WELL EXT
FIELD
COUNTY PINELLAS
STATE FLORIDA
COUNTRY USA
API NO.

COMPANY	: APPLIED DRILLING ENG.
WELL	: WELL 7
WELL EXT	:
FIELD	:
COUNTY	: PINELLAS
STATE	: FLORIDA
COUNTRY	: USA
API NO.	:
UNIQ ID	: NONE

SECTION: TOWNSHIP: RANGE:

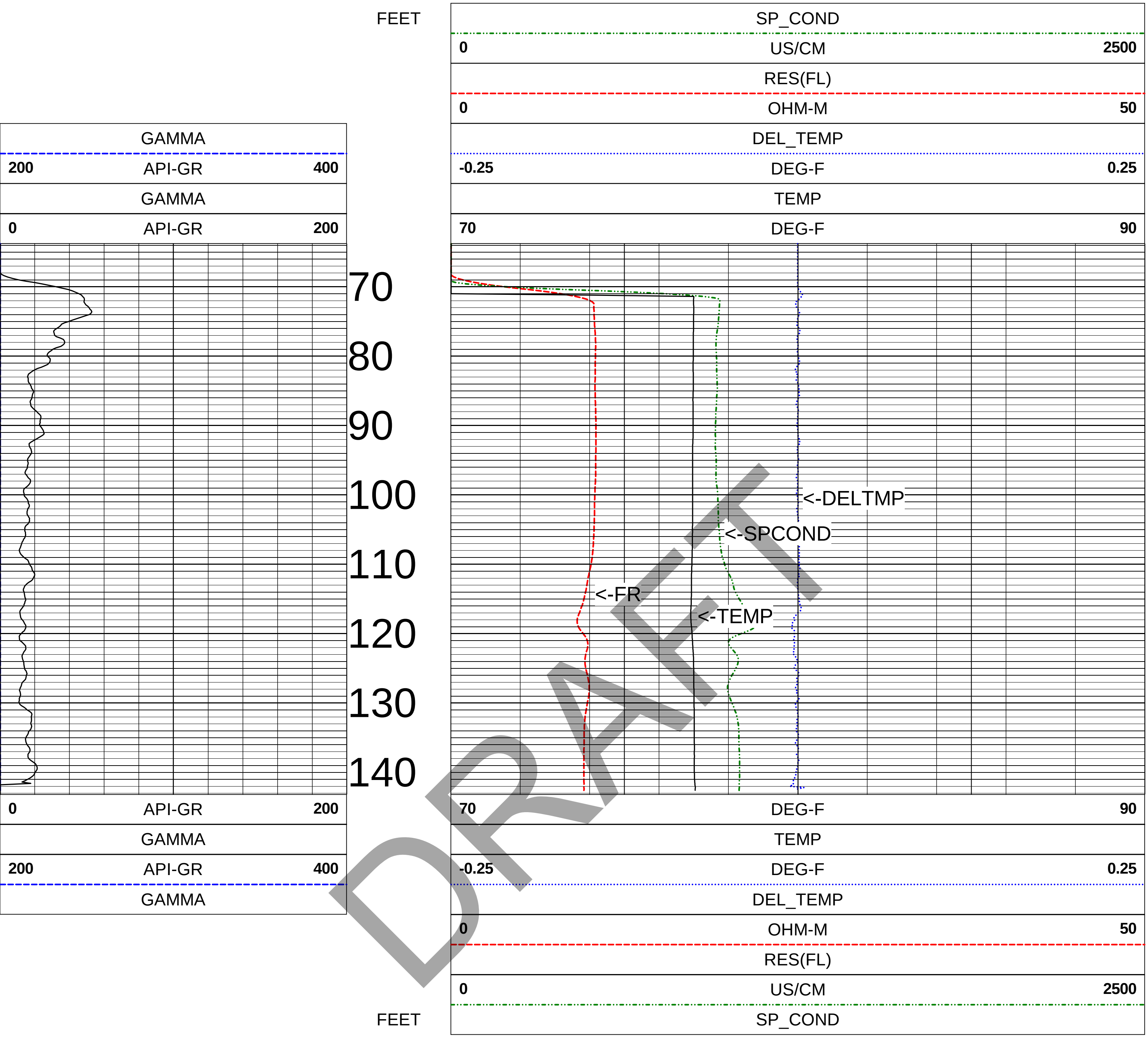
LOCATION : BELLEAIRE
LAT GPS UTM
LON GPS UTM

DISPLAY7_JL56

PERMANENT DATUM	MSL		Elevations:			Other Services:
DRL MEASURED FROM	NA		KB	FT		8044
LOG MEASURED FROM	PAD		DF	FT		8711
ELEV. PERM. DATUM		FT	GL	FT		VIDEO

DATE	TIME			
DEPTH DRILLER	NA	FT		
DEPTH LOGGER	148	FT		
FIRST READING		FT		
LAST READING		FT		
BIT SIZE	6	IN		
CASING -- DRILLER	NA	FT		
CASING -- LOGGER	80	FT		
CASING O.D.	12	IN		
CASING TYPE	STEEL			
FLUID TYPE	FOR			
FLUID DENSITY		LB/GAL		
FLUID VISCOSITY				
FLUID PH				
MUD SOURCE				
RM @ MEAS TEMP	@ F			
RMF @ MEAS TEMP	@ F			
RMC @ MEAS TEMP	@ F			
CIRC STOPPED				
RIG NUMBER				
RECORDED BY	AFB			
WITNESSED BY	MAC DADDY			
REMARKS 1				
REMARKS 2				
REMARKS 3				

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS


FEET
SP_COND
0 US/CM 2500
RES(FL)
0 OHM-M 50
GAMMA
200 API-GR 400
DEL_TEMP
-0.25 DEG-F 0.25
GAMMA
0 API-GR 200
TEMP
70 DEG-F 90
70
80
90
100
110
120
130
140
<-DELTMP
<-SPCOND
<-FR
<-TEMP
0 API-GR 200
GAMMA
200 API-GR 400
GAMMA
70 DEG-F 90
TEMP
-0.25 DEG-F 0.25
DEL_TEMP
0 OHM-M 50
RES(FL)
0 US/CM 2500
FEET
SP_COND

TOOL CALIBRATION WELL 7 05/13/20 09:57
TOOL   8044A   TM VERSION 2002
SERIAL 938

	DATE	TIME	SENSOR		STANDARD Point1	STANDARD Point2	RESPONSE [CPS] Point1	RESPONSE [CPS] Point2
1	Jan03,03	02:49:05	GAMMA	[API-GR]	0.001	180.000	0.000	169
2	Apr09,20	11:12:41	RES(FL)	[OHM-M]	3.060	28.160	13413	37152
3	Aug17,14	12:00:23	SP	[MV]	0.000	395.000	59670	23612
4	Feb02,20	14:59:18	RES(16N)	[OHM-M]	0.000	1996.000	4010	103211
5	Feb02,20	15:00:15	RES(64N)	[OHM-M]	0.000	1990.000	4089	103487
6	Sep29,19	18:57:40	TEMP	[DEG-F]	71.700	86.100	63355	57070
7	Aug17,14	10:39:11	RES	[OHM]	0.000	988.000	9855	58788

ABS
Advanced Borehole Services

GAMMA RAY (API)-CALIPER
WELL 9

COMPANY APPLIED DRILLING ENG.
WELL WELL 9
WELL EXT
FIELD
COUNTY PINELLAS
STATE FLORIDA
COUNTRY USA
API NO.

COMPANY	: APPLIED DRILLING ENG.
WELL	: WELL 9
WELL EXT	:
FIELD	:
COUNTY	: PINELLAS
STATE	: FLORIDA
COUNTRY	: USA
API NO.	:
UNIQ ID	: NONE

SECTION: TOWNSHIP: RANGE:

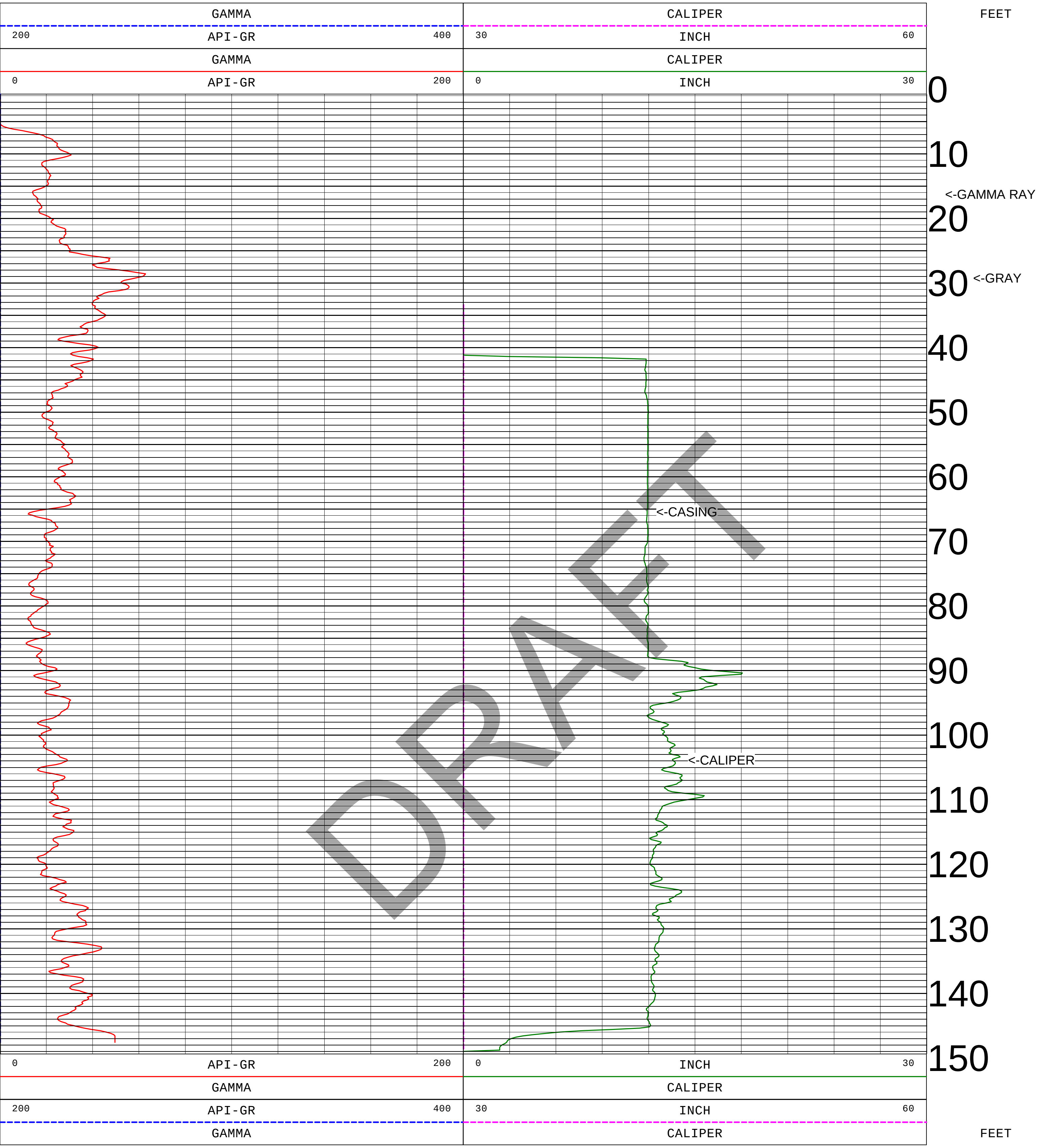
LOCATION : BELLEAIRE
LAT GPS UTM
LON GPS UTM

DISPLAY7_JL56

PERMANENT DATUM	MSL	Elevations:		Other Services:	
DRL MEASURED FROM	NA	KB	FT	8044	
LOG MEASURED FROM	PAD	DF	FT	8711	
ELEV. PERM. DATUM	FT	GL	FT	VIDEO	

DATE	TIME			
DEPTH DRILLER	NA	FT		
DEPTH LOGGER	XXX	FT		
FIRST READING		FT		
LAST READING		FT		
BIT SIZE	6	IN		
CASING -- DRILLER	NA	FT		
CASING -- LOGGER	87	FT		
CASING O.D.	6	IN		
CASING TYPE	PVC			
FLUID TYPE	FOR			
FLUID DENSITY		LB/GAL		
FLUID VISCOSITY				
FLUID PH				
MUD SOURCE				
RM @ MEAS TEMP	@ F			
RMF @ MEAS TEMP	@ F			
RMC @ MEAS TEMP	@ F			
CIRC STOPPED				
RIG NUMBER				
RECORDED BY	AFB			
WITNESSED BY	MAC DADDY			
REMARKS 1				
REMARKS 2				
REMARKS 3				

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS


GAMMA
200 API-GR 400
GAMMA
0 API-GR 200
CALIPER
30 INCH 60
CALIPER
0 INCH 30
FEET
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
<-GAMMA RAY
<-GRAY
<-CASING
<-CALIPER
DRAFT
0 API-GR 200
GAMMA
200 API-GR 400
GAMMA
0 INCH 30
CALIPER
30 INCH 60
CALIPER
FEET

TOOL CALIBRATION WELL 9 05/05/20 13:16
TOOL 9074A1 TM VERSION 2004
SERIAL 3158

	DATE	TIME	SENSOR		STANDARD Point1	STANDARD Point2	RESPONSE [CPS] Point1	RESPONSE [CPS] Point2
1	Jul16,19	11:01:03	GAMMA	[API-GR]	1.000	340.000	0.000	365
2	Jul16,19	11:04:12	CALIPER	[INCH]	4.000	6.000	69017	85360
3	Oct03,19	08:06:13	CALIPERL	[INCH]	8.000	12.000	82709	107387
4	Jul16,19	11:00:52	CALIPERX	[CPS]	Default	Default	Default	Default

TOOL CALIBRATION WELL 9 Jul16,19 11:00:52
TOOL 8044A TM VERSION 0
SERIAL 938

	DATE	TIME	SENSOR		STANDARD Point1	STANDARD Point2	RESPONSE [CPS] Point1	RESPONSE [CPS] Point2
1	Jan03,03	02:49:05	GAMMA	[API-GR]	0.001	180.000	0.000	169
2	Apr09,20	11:12:41	RES(FL)	[OHM-M]	3.060	28.160	13413	37152
3	Aug17,14	12:00:23	SP	[MV]	0.000	395.000	59670	23612
4	Feb02,20	14:59:18	RES(16N)	[OHM-M]	0.000	1996.000	4010	103211
5	Feb02,20	15:00:15	RES(64N)	[OHM-M]	0.000	1990.000	4089	103487
6	Sep29,19	18:57:40	TEMP	[DEG-F]	71.700	86.100	63355	57070
7	Aug17,14	10:39:11	RES	[OHM]	0.000	988.000	9855	58788

COMBINATION LOG
WELL 9

COMPANY	APPLIED DRILLING ENG.
WELL	WELL 9
WELL EXT	
FIELD	
COUNTY	PINELLAS
STATE	FLORIDA
COUNTRY	USA
API NO.	

COMPANY : APPLIED DRILLING ENG.
WELL : WELL 9
WELL EXT :
FIELD :
COUNTY : PINELLAS
STATE : FLORIDA
COUNTRY : USA
API NO. :
UNIQ ID : NONE

SECTION: TOWNSHIP: RANGE:

LOCATION : BELLEAIRE
LAT GPS UTM
LON GPS UTM

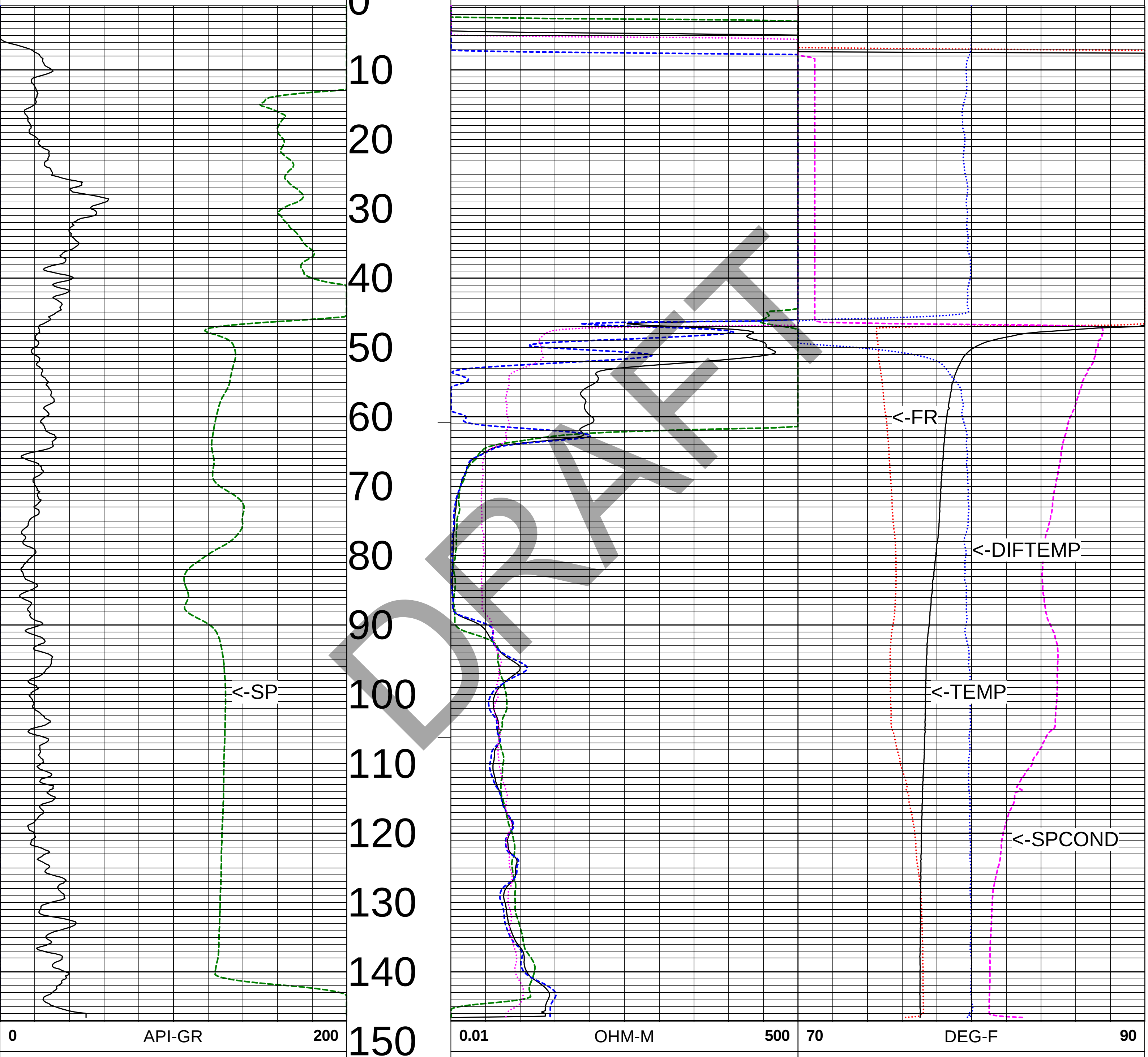
DISPLAY7_JL56

PERMANENT DATUM	MSL	Elevations:	Other Services:
DRL MEASURED FROM	NA	KB FT	8044
LOG MEASURED FROM	PAD	DF FT	8711
ELEV. PERM. DATUM	FT	GL FT	VIDEO

DATE	TIME			
DEPTH DRILLER	NA	FT		
DEPTH LOGGER	XXX	FT		
FIRST READING		FT		
LAST READING		FT		
BIT SIZE	6	IN		
CASING -- DRILLER	NA	FT		
CASING -- LOGGER	80	FT		
CASING O.D.	12	IN		
CASING TYPE	STEEL			
FLUID TYPE	FOR			
FLUID DENSITY		LB/GAL		
FLUID VISCOSITY				
FLUID PH				
MUD SOURCE				
RM @ MEAS TEMP	@ F			
RMF @ MEAS TEMP	@ F			
RMC @ MEAS TEMP	@ F			
CIRC STOPPED				
RIG NUMBER				
RECORDED BY	AFB			
WITNESSED BY	MAC DADDY			
REMARKS 1				
REMARKS 2				
REMARKS 3				

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS

SP	FEET	RES	SP_COND
	SPEED --	0.01 OHM 500	0 US/CM 1000
SP		LATERAL	RES(FL)
-500 MV 0		0.01 OHM-M 500	0 OHM-M 50
GAMMA		RES(64N)	DEL_TEMP
200 API-GR 400		0.01 OHM-M 500	-0.25 DEG-F 0.25
GAMMA		RES(16N)	TEMP
0 API-GR 200		0.01 OHM-M 500	70 DEG-F 90



0 API-GR 200	150	0.01 OHM-M 500	70 DEG-F 90
GAMMA		RES(16N)	TEMP
200 API-GR 400		0.01 OHM-M 500	-0.25 DEG-F 0.25
GAMMA		RES(64N)	DEL_TEMP
-500 MV 0		0.01 OHM-M 500	0 OHM-M 50
SP		LATERAL	RES(FL)
	SPEED --	0.01 OHM 500	0 US/CM 1000
	FEET	RES	SP_COND

TOOL CALIBRATION WELL 9 05/05/20 13:34
TOOL   8044A   TM VERSION 2002
SERIAL 938

	DATE	TIME	SENSOR		STANDARD Point1	STANDARD Point2	RESPONSE [CPS] Point1	RESPONSE [CPS] Point2
1	Jan03,03	02:49:05	GAMMA	[API-GR]	0.001	180.000	0.000	169
2	Apr09,20	11:12:41	RES(FL)	[OHM-M]	3.060	28.160	13413	37152
3	Aug17,14	12:00:23	SP	[MV]	0.000	395.000	59670	23612
4	Feb02,20	14:59:18	RES(16N)	[OHM-M]	0.000	1996.000	4010	103211
5	Feb02,20	15:00:15	RES(64N)	[OHM-M]	0.000	1990.000	4089	103487
6	Sep29,19	18:57:40	TEMP	[DEG-F]	71.700	86.100	63355	57070
7	Aug17,14	10:39:11	RES	[OHM]	0.000	988.000	9855	58788

PRODUCTION-STATIC-PUMPING
WELL 9

ABS
Advanced Borehole Services

COMPANY APPLIED DRILLING ENG.
WELL WELL 9
WELL EXT
FIELD
COUNTY PINELLAS
STATE FLORIDA
COUNTRY USA
API NO.

COMPANY	: APPLIED DRILLING ENG.
WELL	: WELL 9
WELL EXT	:
FIELD	:
COUNTY	: PINELLAS
STATE	: FLORIDA
COUNTRY	: USA
API NO.	:
UNIQ ID	: NONE

SECTION: TOWNSHIP: RANGE:

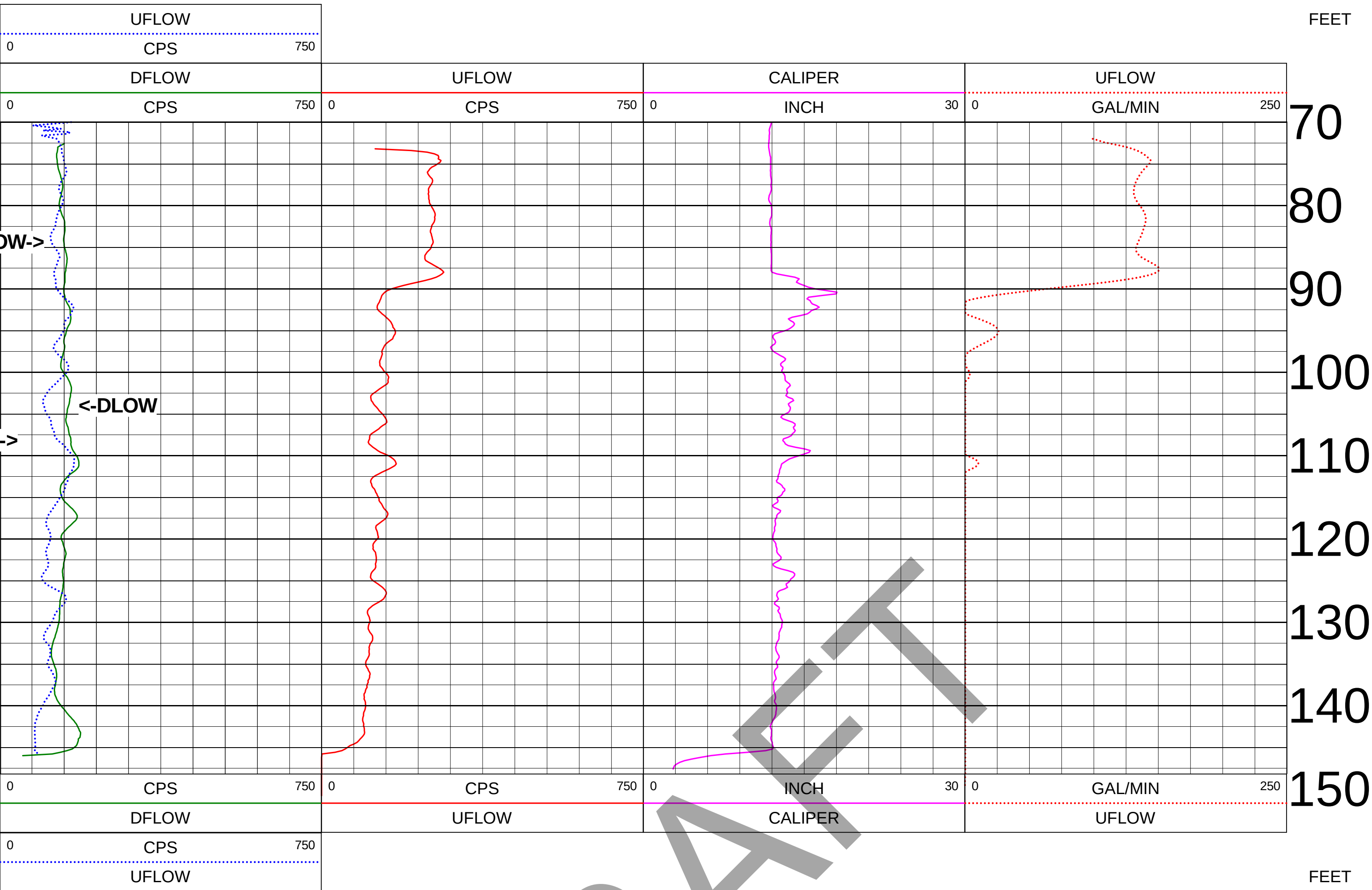
LOCATION : BELLEAIRE
LAT GPS UTM
LON GPS UTM

DISPLAY7_JL56

PERMANENT DATUM	MSL	Elevations:		Other Services:
DRL MEASURED FROM	NA	KB	FT	8044
LOG MEASURED FROM	PAD	DF	FT	8711
ELEV. PERM. DATUM	FT	GL	FT	VIDEO

DATE	TIME			
DEPTH DRILLER	NA	FT		
DEPTH LOGGER	148	FT		
FIRST READING		FT		
LAST READING		FT		
BIT SIZE	6	IN		
CASING -- DRILLER	NA	FT		
CASING -- LOGGER	80	FT		
CASING O.D.	12	IN		
CASING TYPE	STEEL			
FLUID TYPE	FOR			
FLUID DENSITY		LB/GAL		
FLUID VISCOSITY				
FLUID PH				
MUD SOURCE				
RM @ MEAS TEMP	@ F			
RMF @ MEAS TEMP	@ F			
RMC @ MEAS TEMP	@ F			
CIRC STOPPED				
RIG NUMBER				
RECORDED BY	AFB			
WITNESSED BY	MAC DADDY			
REMARKS 1				
REMARKS 2				
REMARKS 3				

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS


UFLOW
0 CPS 750
DFLOW
0 CPS 750
UFLOW
0 CPS 750
CALIPER
0 INCH 30
UFLOW
0 GAL/MIN 250
FEET
70
80
90
100
110
120
130
140
150
OW->
<-DLOW
->
FEET

PUMPING WATER QUALITY
WELL 9

ABS Advanced Borehole Services

COMPANY APPLIED DRILLING ENG.
WELL WELL 9
WELL EXT
FIELD
COUNTY PINELLAS
STATE FLORIDA
COUNTRY USA
API NO.

COMPANY : APPLIED DRILLING ENG.
WELL : WELL 9
WELL EXT :
FIELD :
COUNTY : PINELLAS
STATE : FLORIDA
COUNTRY : USA
API NO. :
UNIQ ID : NONE

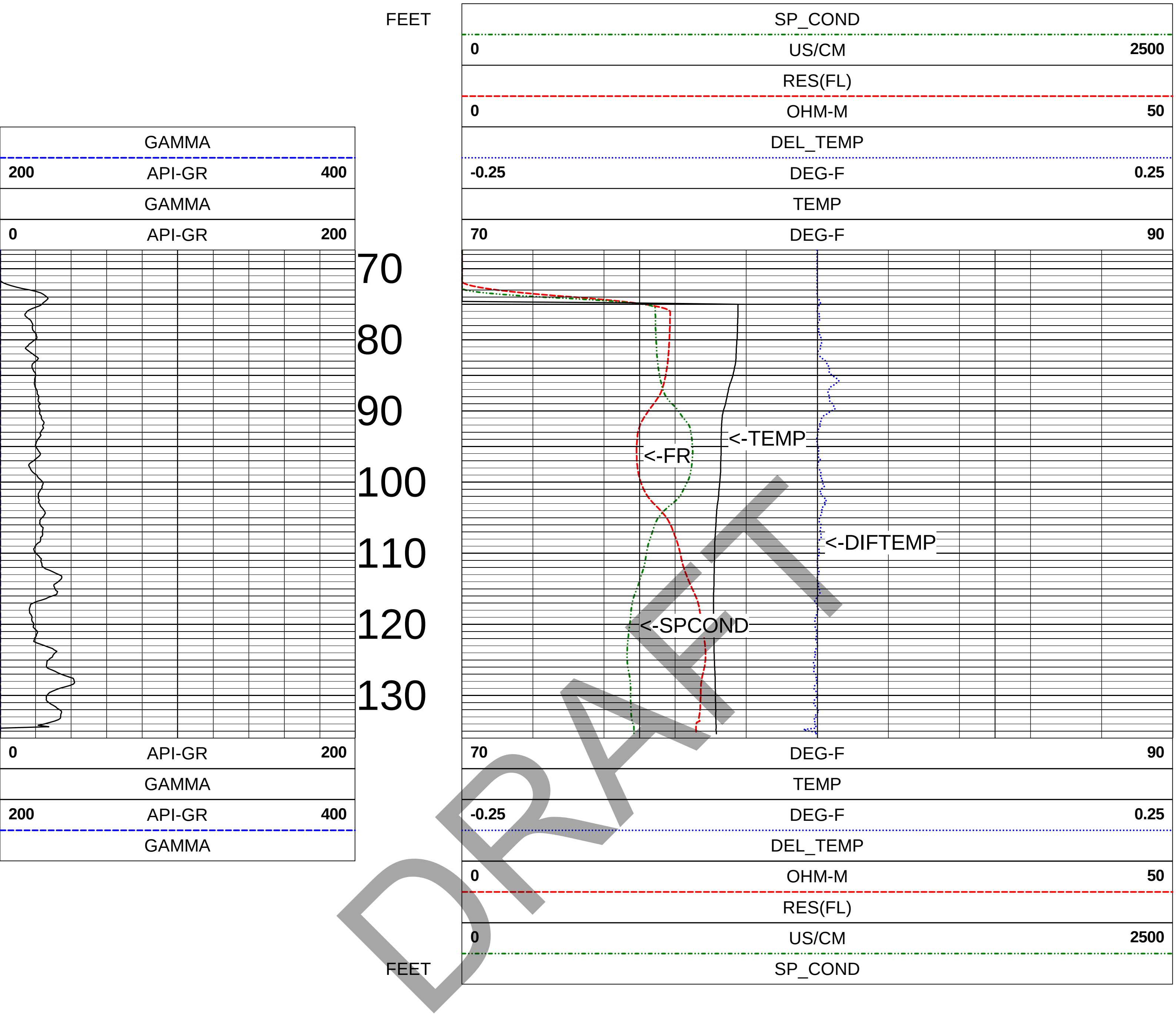
SECTION: TOWNSHIP: RANGE:

LOCATION : BELLEAIRE
LAT GPS UTM
LON GPS UTM

DISPLAY7_JL56

PERMANENT DATUM	MSL	Elevations:		Other Services:	
DRL MEASURED FROM	NA	KB	FT	8044	
LOG MEASURED FROM	PAD	DF	FT	8711	
ELEV. PERM. DATUM	FT	GL	FT	VIDEO	

DATE	TIME			
DEPTH DRILLER	NA	FT		
DEPTH LOGGER	148	FT		
FIRST READING		FT		
LAST READING		FT		
BIT SIZE	6	IN		
CASING -- DRILLER	NA	FT		
CASING -- LOGGER	80	FT		
CASING O.D.	12	IN		
CASING TYPE	STEEL			
FLUID TYPE	FOR			
FLUID DENSITY		LB/GAL		
FLUID VISCOSITY				
FLUID PH				
MUD SOURCE				
RM @ MEAS TEMP	@ F			
RMF @ MEAS TEMP	@ F			
RMC @ MEAS TEMP	@ F			
CIRC STOPPED				
RIG NUMBER				
RECORDED BY	AFB			
WITNESSED BY	MAC DADDY			
REMARKS 1				
REMARKS 2				
REMARKS 3				



FEET
SP_COND
0 US/CM 2500
RES(FL)
0 OHM-M 50
DEL_TEMP
-0.25 DEG-F 0.25
TEMP
70 DEG-F 90
GAMMA
200 API-GR 400
GAMMA
0 API-GR 200
70
80
90
100
110
120
130
<-FR
<-TEMP
<-DIFTEMP
<-SPCOND
0 API-GR 200
GAMMA
200 API-GR 400
GAMMA
70 DEG-F 90
TEMP
-0.25 DEG-F 0.25
DEL_TEMP
0 OHM-M 50
RES(FL)
0 US/CM 2500
SP_COND
FEET

TOOL CALIBRATION WELL 9 05/05/20 13:56
TOOL 8044A TM VERSION 2002
SERIAL 938

	DATE	TIME	SENSOR		STANDARD Point1	STANDARD Point2	RESPONSE [CPS] Point1	RESPONSE [CPS] Point2
1	Jan03,03	02:49:05	GAMMA	[API-GR]	0.001	180.000	0.000	169
2	Apr09,20	11:12:41	RES(FL)	[OHM-M]	3.060	28.160	13413	37152
3	Aug17,14	12:00:23	SP	[MV]	0.000	395.000	59670	23612
4	Feb02,20	14:59:18	RES(16N)	[OHM-M]	0.000	1996.000	4010	103211
5	Feb02,20	15:00:15	RES(64N)	[OHM-M]	0.000	1990.000	4089	103487
6	Sep29,19	18:57:40	TEMP	[DEG-F]	71.700	86.100	63355	57070
7	Aug17,14	10:39:11	RES	[OHM]	0.000	988.000	9855	58788

GAMMA RAY (API)-CALIPER
WELL10

COMPANY APPLIED DRILLING ENG.
WELL WELL10
WELL EXT
FIELD
COUNTY PINELLAS
STATE FLORIDA
COUNTRY USA
API NO.

COMPANY : APPLIED DRILLING ENG.
WELL : WELL10
WELL EXT :
FIELD :
COUNTY : PINELLAS
STATE : FLORIDA
COUNTRY : USA
API NO. :
UNIQ ID : NONE

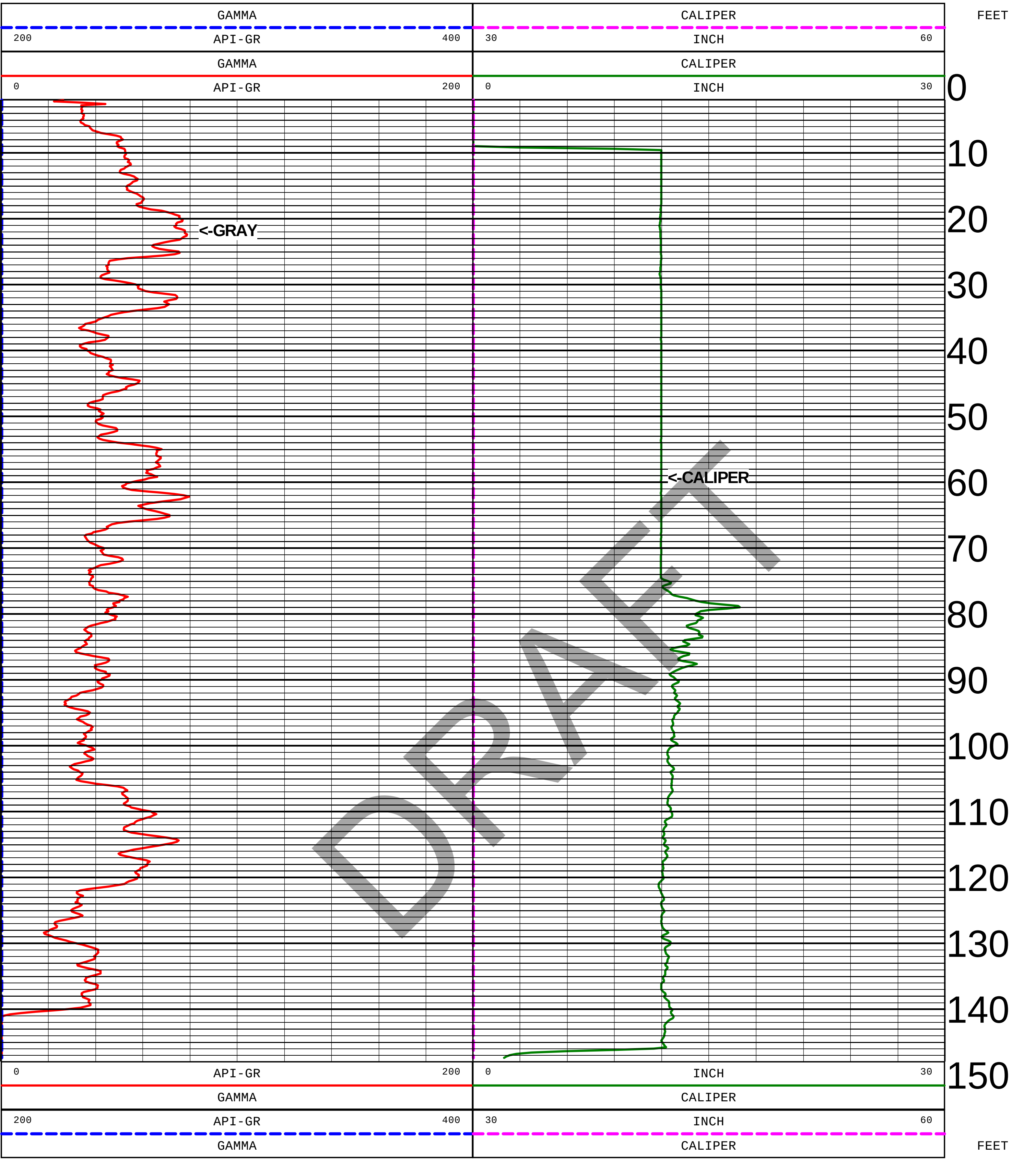
SECTION: TOWNSHIP: RANGE:
LOCATION : BELLAIRE
LAT GPS UTM
LON GPS UTM

DISPLAY7_JL56

PERMANENT DATUM	MSL	Elevations:	Other Services:
DRL MEASURED FROM	NA	KB FT	8044
LOG MEASURED FROM	PAD	DF FT	8711
ELEV. PERM. DATUM	FT	GL FT	VIDEO

DATE	TIME			
DEPTH DRILLER	NA	FT		
DEPTH LOGGER	148	FT		
FIRST READING		FT		
LAST READING		FT		
BIT SIZE	6	IN		
CASING -- DRILLER	NA	FT		
CASING -- LOGGER	74	FT		
CASING O.D.	12	IN		
CASING TYPE	STEEL			
FLUID TYPE	FOR			
FLUID DENSITY		LB/GAL		
FLUID VISCOSITY				
FLUID PH				
MUD SOURCE				
RM @ MEAS TEMP	@ F			
RMF @ MEAS TEMP	@ F			
RMC @ MEAS TEMP	@ F			
CIRC STOPPED				
RIG NUMBER				
RECORDED BY	AFB			
WITNESSED BY	MAC DADDY			
REMARKS 1				
REMARKS 2				
REMARKS 3				

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS


GAMMA
200 API-GR 400
GAMMA
0 API-GR 200
CALIPER
30 INCH 60
CALIPER
0 INCH 30
FEET
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
<-GRAY
<-CALIPER
DRAFT
0 API-GR 200
GAMMA
200 API-GR 400
GAMMA
0 INCH 30
CALIPER
30 INCH 60
CALIPER
FEET

GAMMA RAY (API)-CALIPER
WELL10

COMPANY APPLIED DRILLING ENG.
WELL WELL10
WELL EXT
FIELD
COUNTY PINELLAS
STATE FLORIDA
COUNTRY USA
API NO.

COMPANY : APPLIED DRILLING ENG.
WELL : WELL10
WELL EXT :
FIELD :
COUNTY : PINELLAS
STATE : FLORIDA
COUNTRY : USA
API NO. :
UNIQ ID : NONE

SECTION: TOWNSHIP: RANGE:
LOCATION : BELLAIRE
LAT GPS UTM
LON GPS UTM

DISPLAY7_JL56

PERMANENT DATUM	MSL	Elevations:		Other Services:	
DRL MEASURED FROM	NA	KB	FT	8044	
LOG MEASURED FROM	PAD	DF	FT	8711	
ELEV. PERM. DATUM	FT	GL	FT	VIDEO	

DATE	TIME			
DEPTH DRILLER	NA	FT		
DEPTH LOGGER	148	FT		
FIRST READING		FT		
LAST READING		FT		
BIT SIZE	6	IN		
CASING -- DRILLER	NA	FT		
CASING -- LOGGER	74	FT		
CASING O.D.	12	IN		
CASING TYPE	STEEL			
FLUID TYPE	FOR			
FLUID DENSITY		LB/GAL		
FLUID VISCOSITY				
FLUID PH				
MUD SOURCE				
RM @ MEAS TEMP	@ F			
RMF @ MEAS TEMP	@ F			
RMC @ MEAS TEMP	@ F			
CIRC STOPPED				
RIG NUMBER				
RECORDED BY	AFB			
WITNESSED BY	MAC DADDY			
REMARKS 1				
REMARKS 2				
REMARKS 3				

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS

COMBINATION LOG
STATIC WATER QUALITY
WELL10

COMPANY APPLIED DRILLING ENG.
WELL WELL10
WELL EXT
FIELD
COUNTY PINELLAS
STATE FLORIDA
COUNTRY USA
API NO.

COMPANY : APPLIED DRILLING ENG.
WELL : WELL10
WELL EXT :
FIELD :
COUNTY : PINELLAS
STATE : FLORIDA
COUNTRY : USA
API NO. :
UNIQ ID : NONE

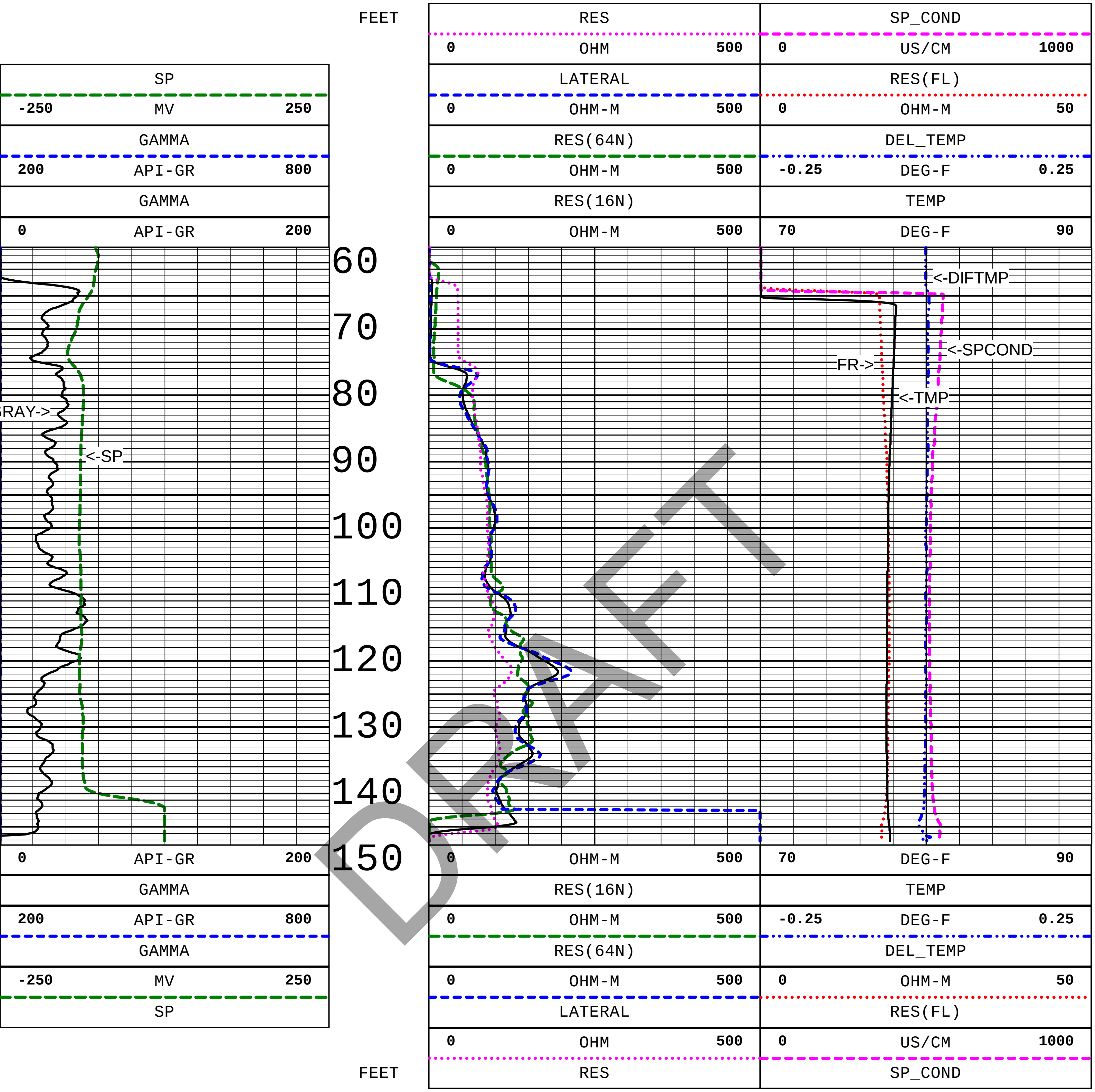
SECTION: TOWNSHIP: RANGE:
LOCATION : BELLAIRE
LAT GPS UTM
LON GPS UTM

DISPLAY7_JL56

PERMANENT DATUM	MSL	Elevations:	Other Services:
DRL MEASURED FROM	NA	KB FT	8044
LOG MEASURED FROM	PAD	DF FT	8711
ELEV. PERM. DATUM	FT	GL FT	VIDEO

DATE	TIME		
DEPTH DRILLER	NA FT		
DEPTH LOGGER	148 FT		
FIRST READING	FT		
LAST READING	FT		
BIT SIZE	6 IN		
CASING -- DRILLER	NA FT		
CASING -- LOGGER	74 FT		
CASING O.D.	12 IN		
CASING TYPE	STEEL		
FLUID TYPE	FOR		
FLUID DENSITY	LB/GAL		
FLUID VISCOSITY			
FLUID PH			
MUD SOURCE			
RM @ MEAS TEMP	@ F		
RMF @ MEAS TEMP	@ F		
RMC @ MEAS TEMP	@ F		
CIRC STOPPED			
RIG NUMBER			
RECORDED BY	AFB		
WITNESSED BY	MAC DADDY		
REMARKS 1			
REMARKS 2			
REMARKS 3			

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS


FEET
RES
0 OHM 500
SP_COND
0 US/CM 1000
SP
-250 MV 250
GAMMA
200 API-GR 800
GAMMA
0 API-GR 200
LATERAL
0 OHM-M 500
RES(64N)
0 OHM-M 500
RES(16N)
0 OHM-M 500
RES(FL)
0 OHM-M 50
DEL_TEMP
-0.25 DEG-F 0.25
TEMP
70 DEG-F 90
60
70
80
90
100
110
120
130
140
150
GRAY->
<-SP
<-DIFTMP
<-SPCOND
FR->
<-TMP

TOOL CALIBRATION WELL10 06/10/20 09:48
TOOL   8044A   TM VERSION 2002
SERIAL 938

	DATE	TIME	SENSOR		STANDARD Point1	STANDARD Point2	RESPONSE [CPS] Point1	RESPONSE [CPS] Point2
1	Jan03,03	02:49:05	GAMMA	[API-GR]	0.001	180.000	0.000	169
2	Apr09,20	11:12:41	RES(FL)	[OHM-M]	3.060	28.160	13413	37152
3	Aug17,14	12:00:23	SP	[MV]	0.000	395.000	59670	23612
4	Feb02,20	14:59:18	RES(16N)	[OHM-M]	0.000	1996.000	4010	103211
5	Feb02,20	15:00:15	RES(64N)	[OHM-M]	0.000	1990.000	4089	103487
6	Sep29,19	18:57:40	TEMP	[DEG-F]	71.700	86.100	63355	57070
7	Aug17,14	10:39:11	RES	[OHM]	0.000	988.000	9855	58788

PRODUCTION-STATIC-PUMPING
WELL10

COMPANY APPLIED DRILLING ENG.
WELL WELL10
WELL EXT
FIELD
COUNTY PINELLAS
STATE FLORIDA
COUNTRY USA
API NO.

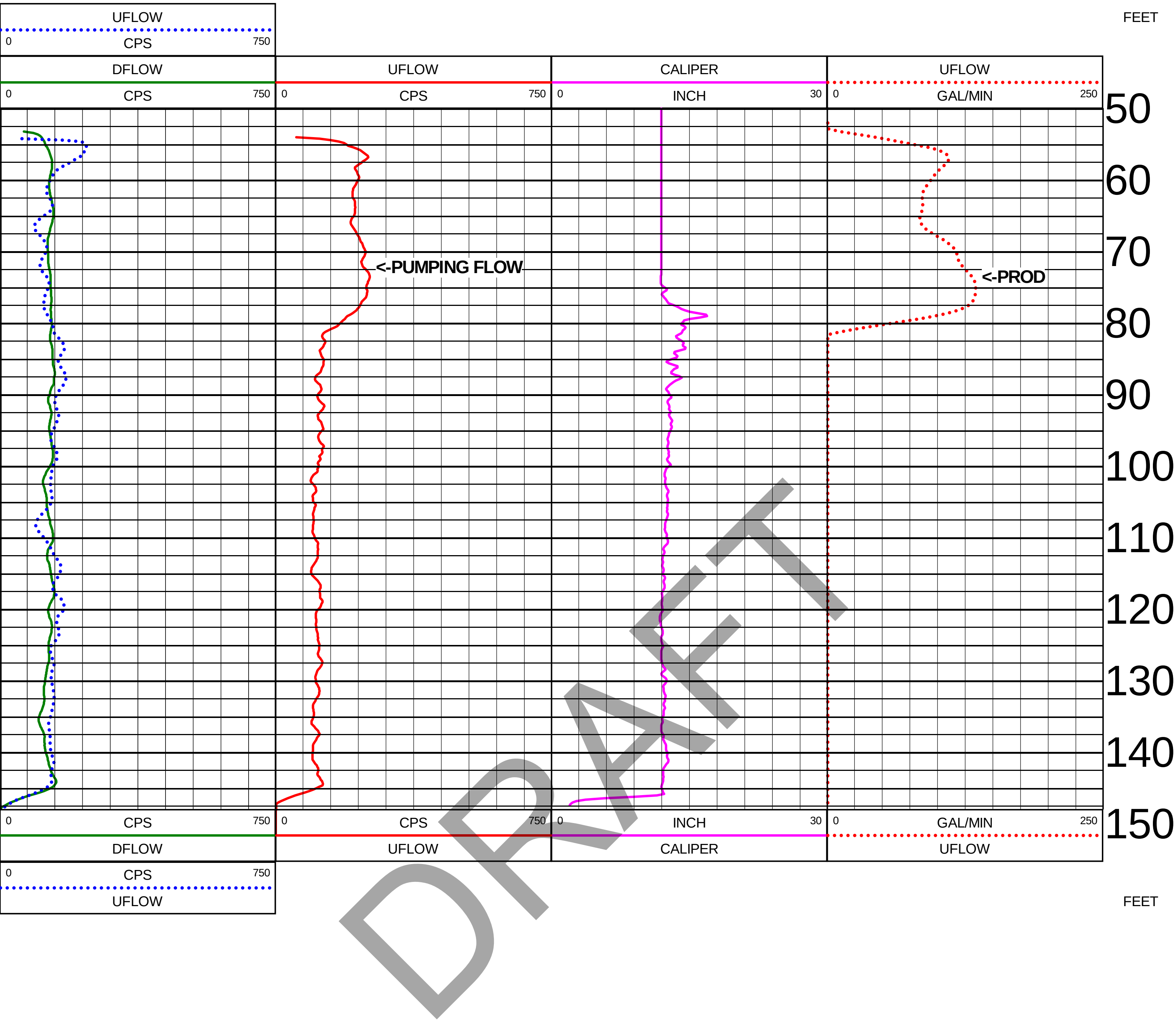
COMPANY : APPLIED DRILLING ENG.
WELL : WELL10
WELL EXT :
FIELD :
COUNTY : PINELLAS
STATE : FLORIDA
COUNTRY : USA
API NO. :
UNIQ ID : NONE

SECTION: TOWNSHIP: RANGE:
LOCATION : BELLAIRE
LAT GPS UTM
LON GPS UTM

DISPLAY7_JL56

PERMANENT DATUM	MSL	Elevations:		Other Services:
DRL MEASURED FROM	NA	KB	FT	8044
LOG MEASURED FROM	PAD	DF	FT	8711
ELEV. PERM. DATUM	FT	GL	FT	VIDEO

DATE	TIME			
DEPTH DRILLER	NA	FT		
DEPTH LOGGER	148	FT		
FIRST READING		FT		
LAST READING		FT		
BIT SIZE	6	IN		
CASING -- DRILLER	NA	FT		
CASING -- LOGGER	74	FT		
CASING O.D.	12	IN		
CASING TYPE	STEEL			
FLUID TYPE	FOR			
FLUID DENSITY		LB/GAL		
FLUID VISCOSITY				
FLUID PH				
MUD SOURCE				
RM @ MEAS TEMP	@ F			
RMF @ MEAS TEMP	@ F			
RMC @ MEAS TEMP	@ F			
CIRC STOPPED				
RIG NUMBER				
RECORDED BY	AFB			
WITNESSED BY	MAC DADDY			
REMARKS 1				
REMARKS 2				
REMARKS 3				



UFLOW
CPS 0 750
DFLOW
CPS 0 750
UFLOW
CPS 0 750
CALIPER
INCH 0 30
UFLOW
GAL/MIN 0 250
FEET
50
60
70
80
90
100
110
120
130
140
150
<-PUMPING FLOW
<-PROD
DRAFT

PUMPING WATER QUALITY
WELL10

COMPANY APPLIED DRILLING ENG.
WELL WELL10
WELL EXT
FIELD
COUNTY PINELLAS
STATE FLORIDA
COUNTRY USA
API NO.

COMPANY : APPLIED DRILLING ENG.
WELL : WELL10
WELL EXT :
FIELD :
COUNTY : PINELLAS
STATE : FLORIDA
COUNTRY : USA
API NO. :
UNIQ ID : NONE

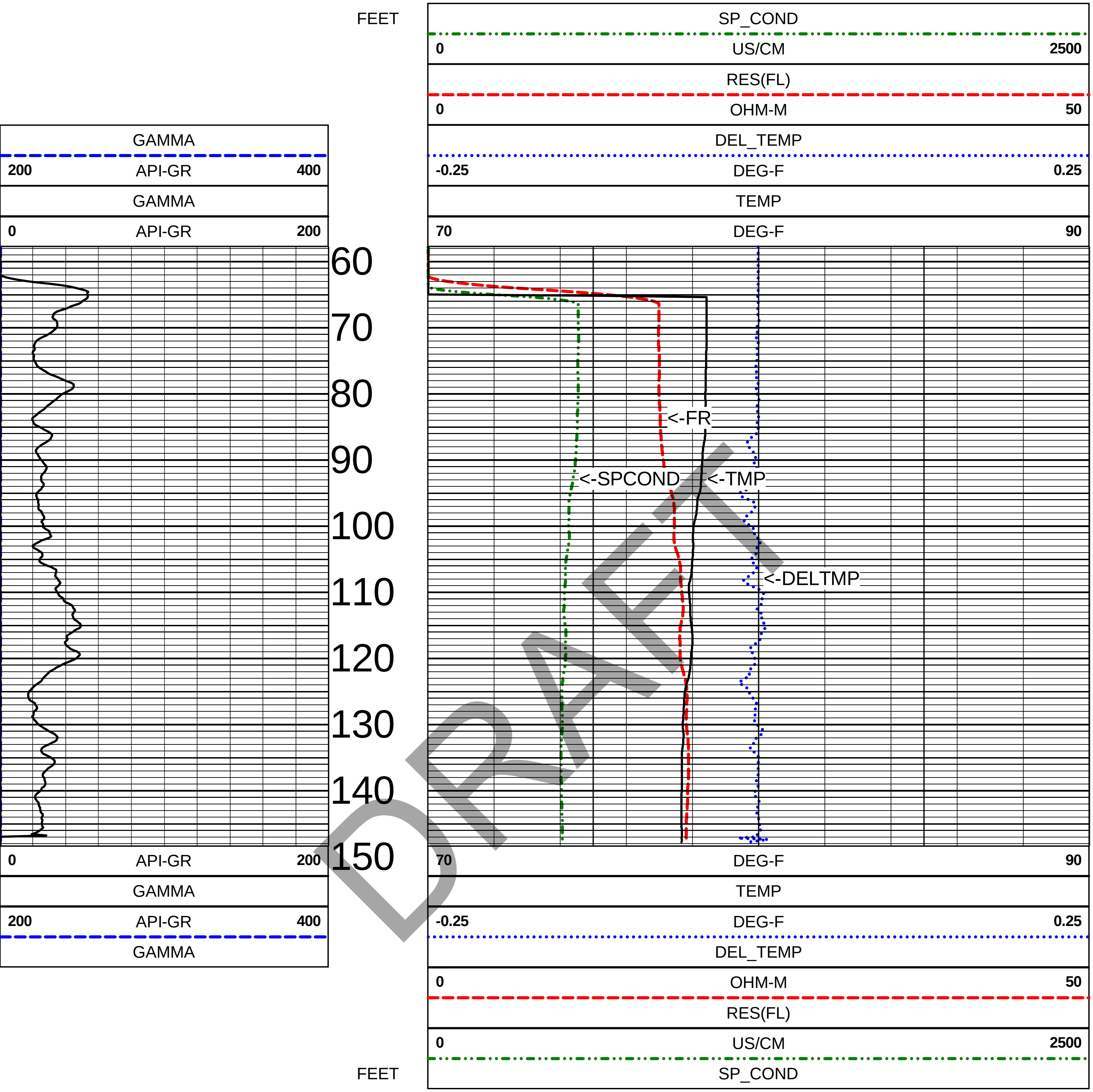
SECTION: TOWNSHIP: RANGE:
LOCATION : BELLAIRE
LAT GPS UTM
LON GPS UTM

DISPLAY7_JL56

PERMANENT DATUM	MSL	Elevations:		Other Services:
DRL MEASURED FROM	NA	KB	FT	8044
LOG MEASURED FROM	PAD	DF	FT	8711
ELEV. PERM. DATUM	FT	GL	FT	VIDEO

DATE	TIME			
DEPTH DRILLER	NA	FT		
DEPTH LOGGER	148	FT		
FIRST READING		FT		
LAST READING		FT		
BIT SIZE	6	IN		
CASING -- DRILLER	NA	FT		
CASING -- LOGGER	74	FT		
CASING O.D.	12	IN		
CASING TYPE	STEEL			
FLUID TYPE	FOR			
FLUID DENSITY		LB/GAL		
FLUID VISCOSITY				
FLUID PH				
MUD SOURCE				
RM @ MEAS TEMP	@ F			
RMF @ MEAS TEMP	@ F			
RMC @ MEAS TEMP	@ F			
CIRC STOPPED				
RIG NUMBER				
RECORDED BY	AFB			
WITNESSED BY	MAC DADDY			
REMARKS 1				
REMARKS 2				
REMARKS 3				

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS



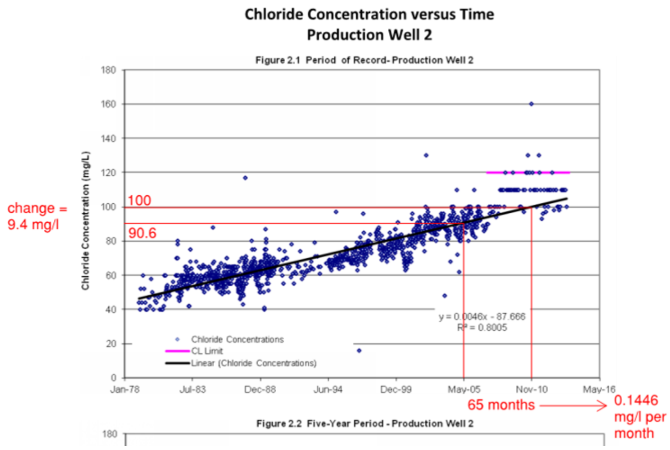
FEET
SP_COND
0 US/CM 2500
RES(FL)
0 OHM-M 50
GAMMA
200 API-GR 400
DEL_TEMP
-0.25 DEG-F 0.25
GAMMA
0 API-GR 200
TEMP
70 DEG-F 90
60
70
80
90
100
110
120
130
140
150
<-FR
<-SPCOND
<-TMP
<-DELTMP
DRAFT
0 API-GR 200
GAMMA
200 API-GR 400
GAMMA
70 DEG-F 90
TEMP
-0.25 DEG-F 0.25
DEL_TEMP
0 OHM-M 50
RES(FL)
0 US/CM 2500
SP_COND
FEET

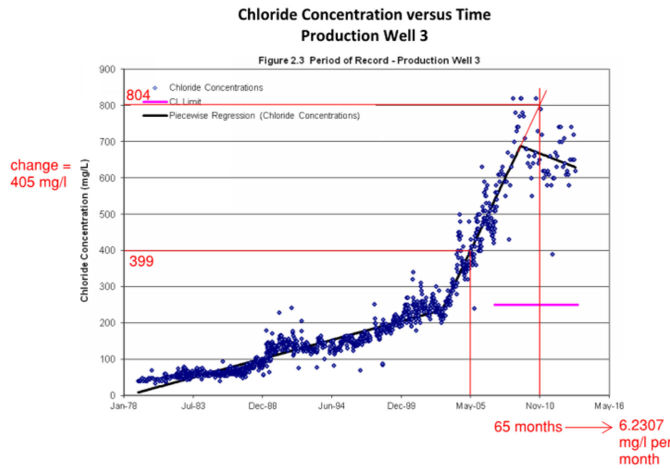
TOOL CALIBRATION WELL10 06/10/20 10:28
TOOL 8044A TM VERSION 2002
SERIAL 938

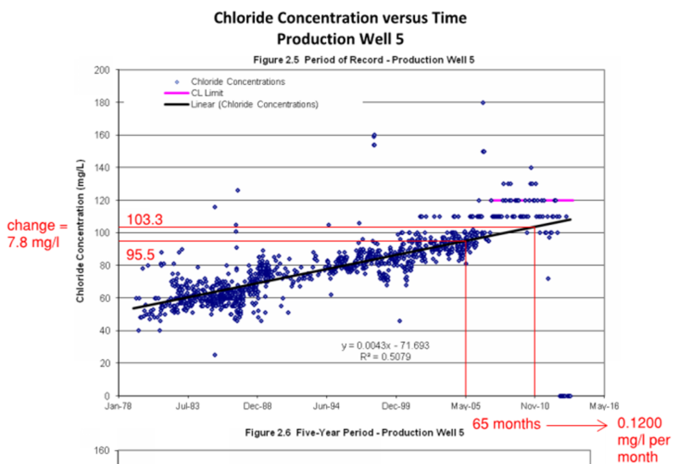
	DATE	TIME	SENSOR		STANDARD Point1	STANDARD Point2	RESPONSE [CPS] Point1	RESPONSE [CPS] Point2
1	Jan03,03	02:49:05	GAMMA	[API-GR]	0.001	180.000	0.000	169
2	Apr09,20	11:12:41	RES(FL)	[OHM-M]	3.060	28.160	13413	37152
3	Aug17,14	12:00:23	SP	[MV]	0.000	395.000	59670	23612
4	Feb02,20	14:59:18	RES(16N)	[OHM-M]	0.000	1996.000	4010	103211
5	Feb02,20	15:00:15	RES(64N)	[OHM-M]	0.000	1990.000	4089	103487
6	Sep29,19	18:57:40	TEMP	[DEG-F]	71.700	86.100	63355	57070
7	Aug17,14	10:39:11	RES	[OHM]	0.000	988.000	9855	58788

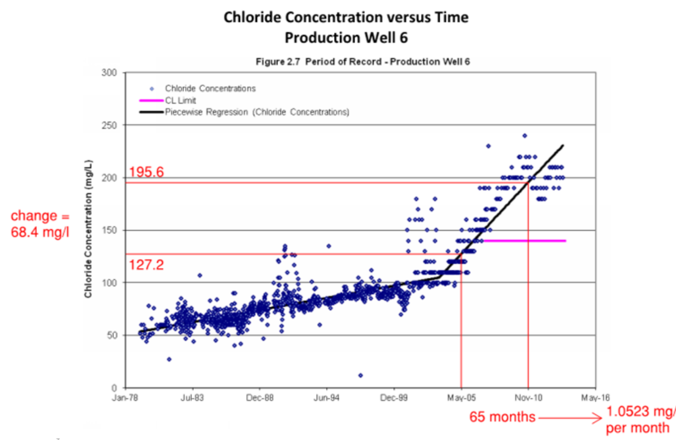
APPENDIX C

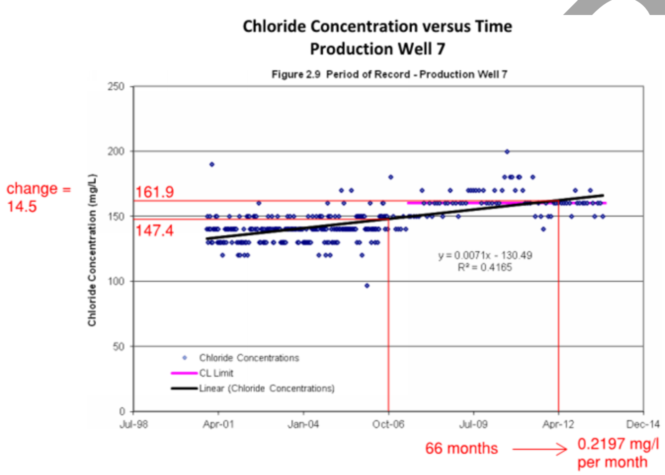
Raw Water Quality (Chloride) Projections Calculations

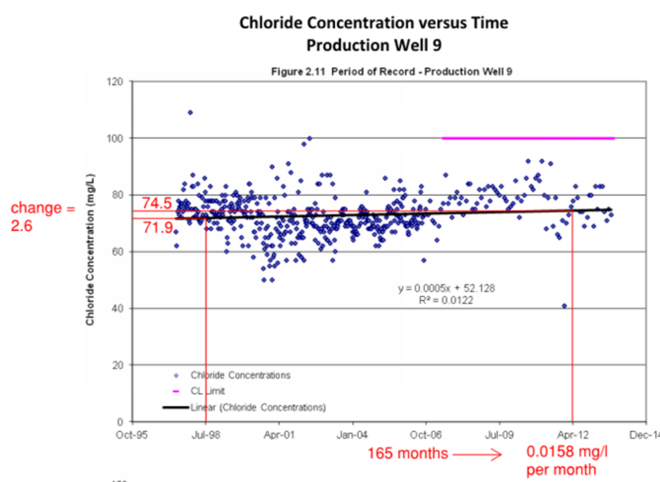


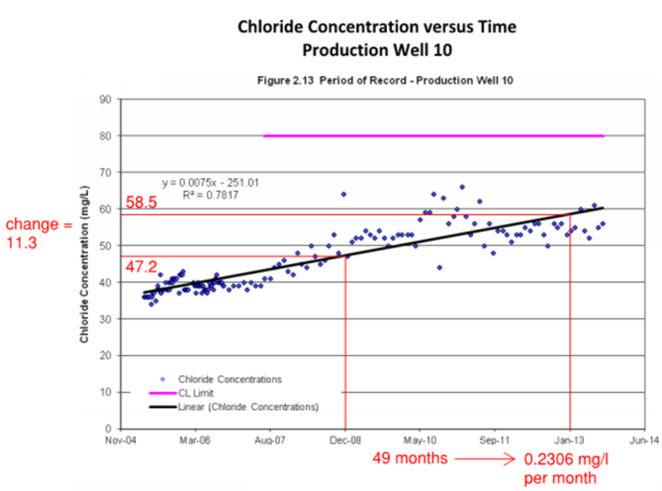




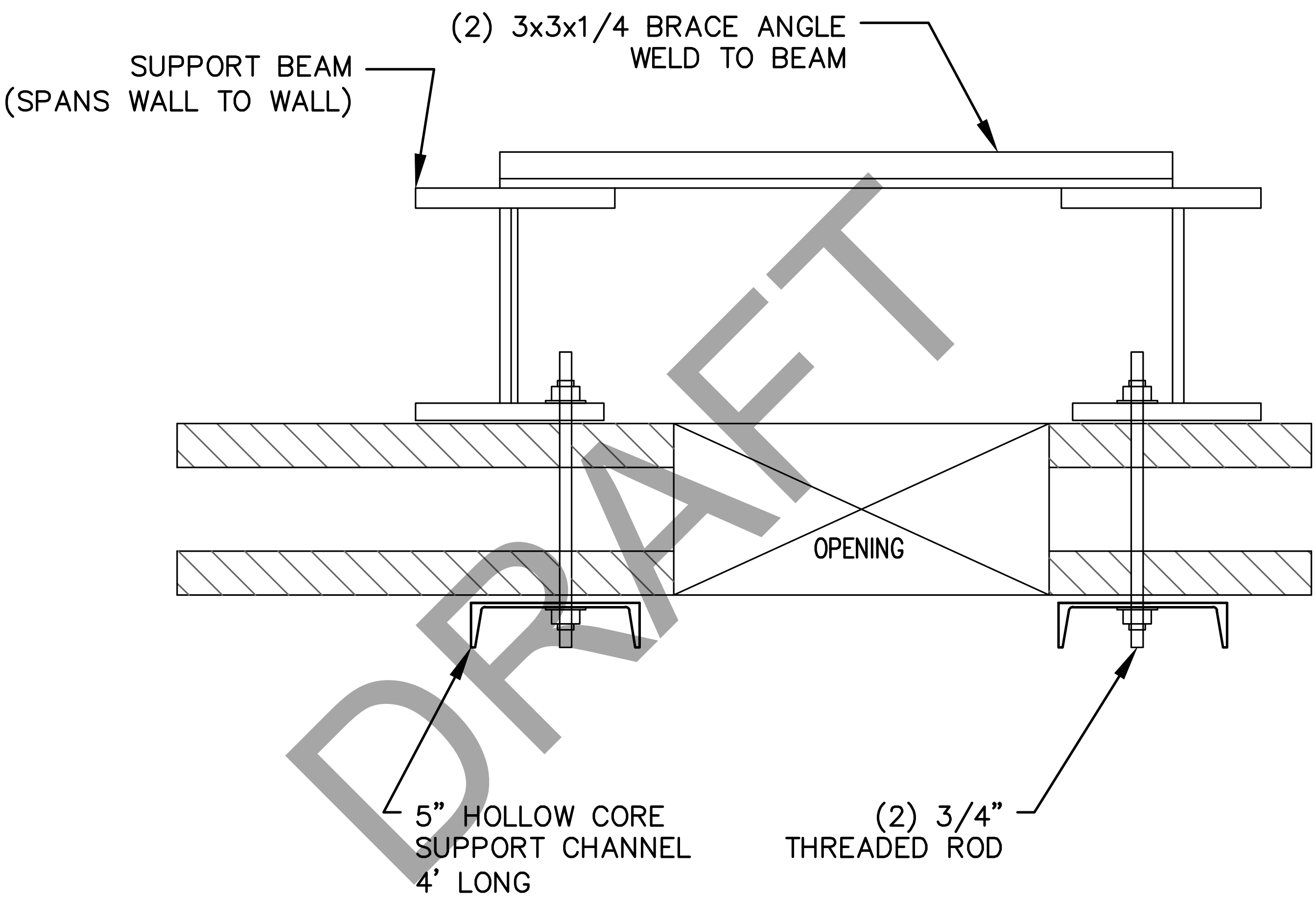








APPENDIX D



I:\01131\0014\WATER\80-DRAWINGS\FIGURES\FIGURE XX CLEARWELL ROOF.DWG 07/29/2020 15:43:45 CATHY WALKER

McKIM&CREED

BELLEAIR WTP IMPROVEMENTS

CLEARWELL ROOF SUPPORT

TOWN OF BELLEAIR INC. 1925

TOWN OF BELLEAIR
901 PONCE DE LEON BOULEVARD
Florida 34104
(727) 588-3769

SUBMITTED BY:
MCKIM & CREED | CLEARWATER, FL
727.442.7196 | MCKIMCREED.COM

McKIM&CREED
ENGINEERS SURVEYORS PLANNERS