Geosyntec consultants

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Memorandum

Date: January 17, 2024

To: Billi Jo Huddleston, CHMM, Florida Power & Light Company

From: Ben Amos, Ph.D., P.E. and Lane Dorman, P.G., Geosyntec Consultants, Inc.

Subject: 2018 Groundwater Velocity Estimate, Gulf Clean Energy Center, Gypsum Storage Area, Pensacola, FL

INTRODUCTION

On behalf of Florida Power & Light Company ("FPL"), Geosyntec Consultants, Inc. ("Geosyntec") prepared this *2018 Groundwater Velocity Estimate Memorandum* ("Memo") for FPL's Gulf Clean Energy Center ("GCEC") Coal Combustion Residuals ("CCR") unit Gypsum Storage Area ("GSA"). The purpose of this Memo is to document the calculated horizontal groundwater velocities at the GSA in 2018. This Memo supplements the summary of CCR groundwater monitoring activities conducted in 2018 and reported in the *2018 Annual Groundwater Monitoring and Corrective Action Report* (Geosyntec, 2019[1]), in accordance with groundwater sampling and analysis requirements of 40 Code of Federal Regulations ("CFR") Section 257.93(c).

GROUNDWATER VELOCITY CALCULATIONS

Groundwater flow rates were calculated based on the following:

1. Horizontal hydraulic gradients estimated from groundwater elevations measured during each sampling event in 2018.

2. The geometric mean (geomean) hydraulic conductivity (64 feet per day [ft/day]) for the GSA documented in the *APT Well Installation, Development, and Testing Report, Crist Generating Plant* (Geosyntec, 2017[2]).

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[1] Geosyntec Consultants, 2019. *2018 Annual Groundwater Monitoring and Corrective Action Report*, Gulf Power Company, Plant Crist, Gypsum Storage Area. January 31, 2019.
[2] Geosyntec Consultants, 2017. *APT Well Installation, Development, and Testing Report, Crist Generating Plant*. November.

3. An estimated effective porosity of 0.25, based on the lithologic materials surrounding the screened interval (Sterrett, 2007[3]).

Input parameters and calculations are summarized in **Table 1**. Groundwater elevation maps from 2018 are included as **Figures 1, 2, and 3**.

Horizontal hydraulic gradients between MW-204 and MW-206, a monitoring well-pair representative of groundwater flow near GSA, were calculated based on groundwater elevation data from 2018 groundwater sampling events. The resulting horizontal gradients were approximately 0.0023 ft/ft, 0.0025 ft/ft, and 0.0023 ft/ft in March, June, and October 2018, respectively.

The geomean hydraulic conductivity for the uppermost aquifer adjacent to GSA was estimated from aquifer testing data from seven extraction wells around the GSA (Geosyntec, 2017). The lithology of this aquifer generally consists of fine to coarse sand (SCS, 2017[4]); the geomean hydraulic conductivity (64 ft/day) is within the anticipated hydraulic conductivity range for a fine to coarse sand (Freeze and Cherry, 1979[5]).

The horizontal groundwater flow velocity was calculated using a form of Darcy's Law:

$V = (K*i)/n_e$

Where:

V = groundwater velocity (ft/day);

K = hydraulic conductivity (ft/day);

i = horizontal hydraulic gradient (ft/ft); and

n_e = effective porosity (unitless).

The calculated horizontal groundwater flow velocities at the GSA were 0.59 ft/day (215 ft/year), 0.63 ft/day (232 ft/year), and 0.58 ft/day (212 ft/year) in March, June, and October 2018, respectively.

CLOSING

In accordance with the groundwater sampling and analysis requirements of 40 CFR Section 257.93(c), the horizontal groundwater velocities calculated for the selected well pair at the GSA (i.e., MW-204 and MW-206) were approximately 0.59 ft/day (215 ft/year), 0.63 ft/day (232 ft/year), and 0.58 ft/day

[3] Sterret, R.J., 2007. *Groundwater and Wells*, Third Edition, New Brighton, MN: Johnson Screens, A Weatherford Company.
[4] Southern Company Services, 2017. *Gulf Power Company, Plant Crist, Ash Landfill No. 1, Ash Landfill No. 2, and Gypsum Storage Area Well Design, Installation, Development and Decommissioning Report*, October.
[5] Freeze, R.A. and J.A. Cherry, 1979. *Groundwater*, Englewood Cliffs, NJ: Prentice Hall.

(212 ft/year) in March, June, and October 2018, respectively. The calculated horizontal groundwater velocities for 2018 are similar to those calculated previously (Geosyntec, 2023[6]). This Memo has been prepared under the supervision of a State of Florida licensed Professional Engineer and Professional Geologist with Geosyntec.

[6] Geosyntec Consultants, Inc., 2023. *2022 Annual Groundwater Monitoring and Corrective Action Report*, Florida Power & Light Company, Gulf Clean Energy Center Gypsum Storage Area, January 31, 2023

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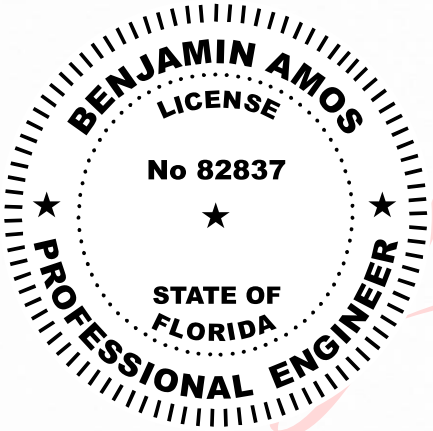

This document has been electronically signed and sealed by Benjamin Amos P.E. on 17 January 2024 using a SHA-1 authentication code. Printed copies of this document are not considered signed and sealed, and the SHA-1 authentication code must be verified on any electronic copies.
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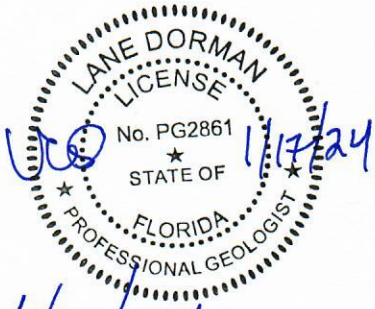
Benjamin K. Amos, Ph.D., P.E.
Florida Professional Engineer No. 82837

Date



Lane Dorman, P.G.
Florida Professional Geologist No. PG2861

1/17/24
Date

TABLE

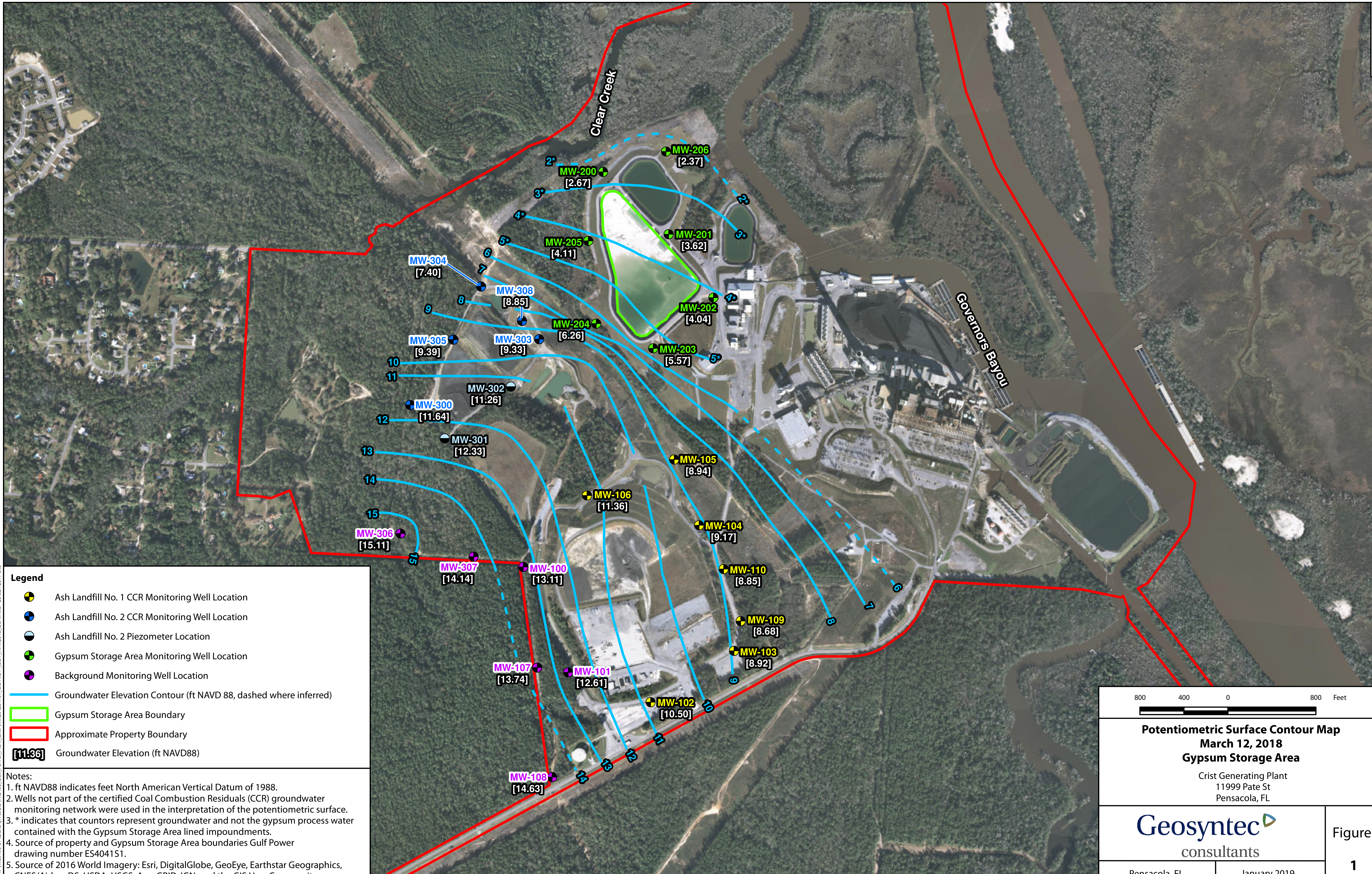
Table 1. 2018 Groundwater Velocity Input Parameters and Calculations
Gulf Clean Energy Center, Gypsum Storage Area
Pensacola, FL

Flow Paths	Groundwater Elevation (ft)[1,2]		Change in Groundwater Elevation (Δh)[3] (ft)	Distance (Δl)[3] (ft)	Hydraulic Gradient ($\Delta h/\Delta l$)[3] (ft/ft)[4]	Hydraulic Conductivity[5], K (ft/day)[6]	Effective Porosity (n_e)	Linear Groundwater Velocity[7]	
								ft/day	ft/year[8]
MW-204/ MW-206	Mar-18	6.26	3.89	1687	0.0023	64	0.25	0.59	215.4
		2.37							
MW-204/ MW-206	Jun-18	5.19	4.18		0.0025			0.63	231.5
		1.01							
MW-204/ MW-206	Oct-18	6.27	3.82		0.0023			0.58	211.5
		2.45							

Notes:

1. Elevations are in feet relative to the North American Vertical Datum of 1988.
2. ft = feet
3. Δh = Change in groundwater elevation, Δl= Distance along flow path
4. ft/ft = feet per foot
5. K is the geometric mean of 2017 aquifer testing results from seven extraction wells around the gypsum storage area.
6. ft/day = feet per day
7. Groundwater flow velocity equation = $(\Delta h/\Delta l * K)/n_e$
8. ft/year = feet per year

FIGURES



Legend

- Ash Landfill No. 1 CCR Monitoring Well Location
- Ash Landfill No. 2 CCR Monitoring Well Location
- Ash Landfill No. 2 Piezometer Location
- Gypsum Storage Area Monitoring Well Location
- Background Monitoring Well Location
- Groundwater Elevation Contour (ft NAVD 88, dashed where inferred)
- Gypsum Storage Area Boundary
- Approximate Property Boundary
- [11.36] Groundwater Elevation (ft NAVD88)

Notes:
1. ft NAVD88 indicates feet North American Vertical Datum of 1988.
2. Wells not part of the certified Coal Combustion Residuals (CCR) groundwater monitoring network were used in the interpretation of the potentiometric surface.
3. * indicates that countors represent groundwater and not the gypsum process water contained with the Gypsum Storage Area lined impoundments.
4. Source of property and Gypsum Storage Area boundaries Gulf Power drawing number ES4041S1.
5. Source of 2016 World Imagery: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community.

Potentiometric Surface Contour Map
March 12, 2018
Gypsum Storage Area

Crist Generating Plant
11999 Pate St
Pensacola, FL

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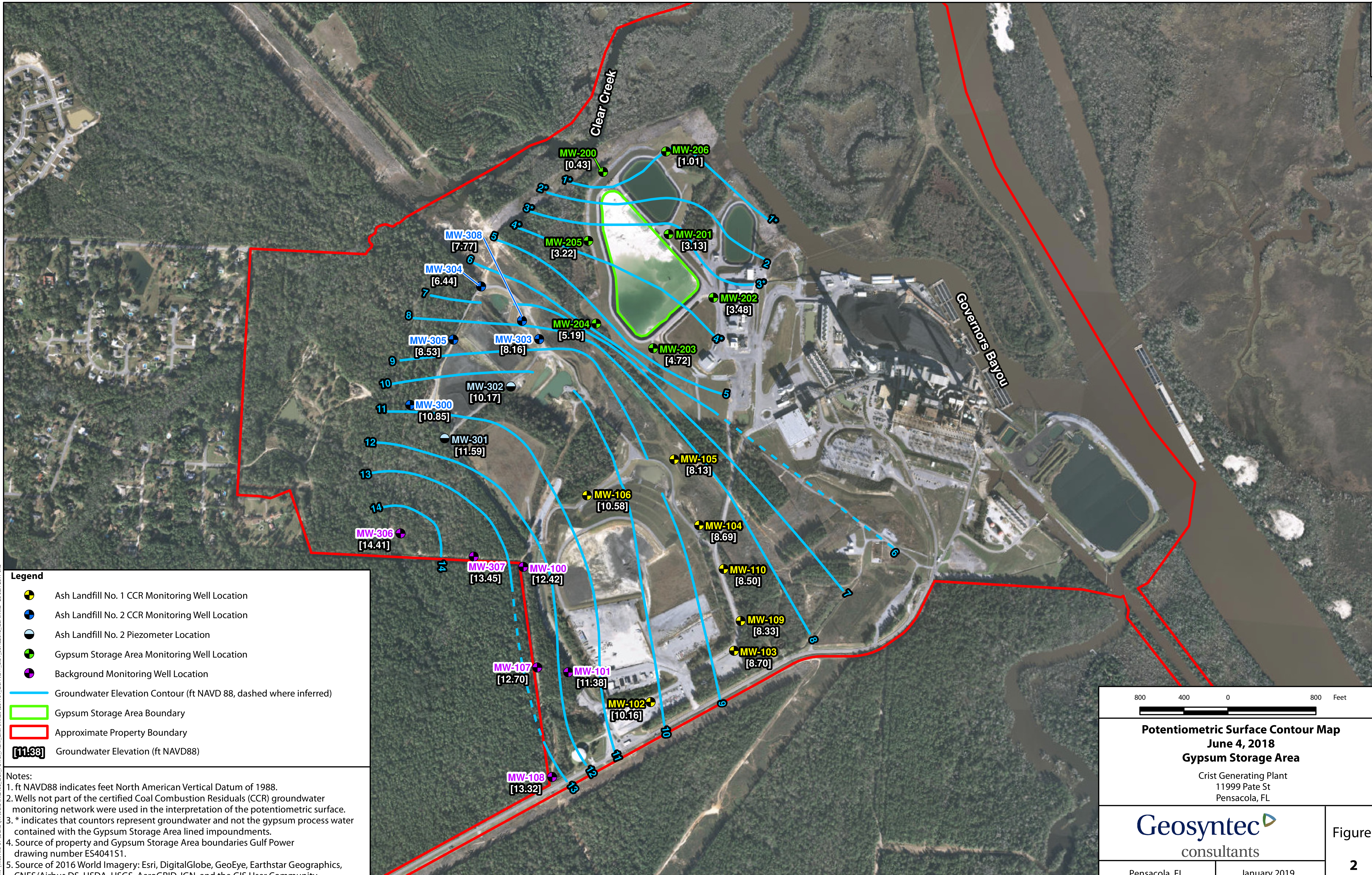
Figure **1**

Pensacola, FL | January 2019



Legend

- Ash Landfill No. 1 CCR Monitoring Well Location
- Ash Landfill No. 2 CCR Monitoring Well Location
- Ash Landfill No. 2 Piezometer Location
- Gypsum Storage Area Monitoring Well Location
- Background Monitoring Well Location
- Groundwater Elevation Contour (ft NAVD 88, dashed where inferred)
- Gypsum Storage Area Boundary
- Approximate Property Boundary
- [11.38] Groundwater Elevation (ft NAVD88)

Notes:
1. ft NAVD88 indicates feet North American Vertical Datum of 1988.
2. Wells not part of the certified Coal Combustion Residuals (CCR) groundwater monitoring network were used in the interpretation of the potentiometric surface.
3. * indicates that countors represent groundwater and not the gypsum process water contained with the Gypsum Storage Area lined impoundments.
4. Source of property and Gypsum Storage Area boundaries Gulf Power drawing number ES4041S1.
5. Source of 2016 World Imagery: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community.

Potentiometric Surface Contour Map
June 4, 2018
Gypsum Storage Area

Crist Generating Plant
11999 Pate St
Pensacola, FL

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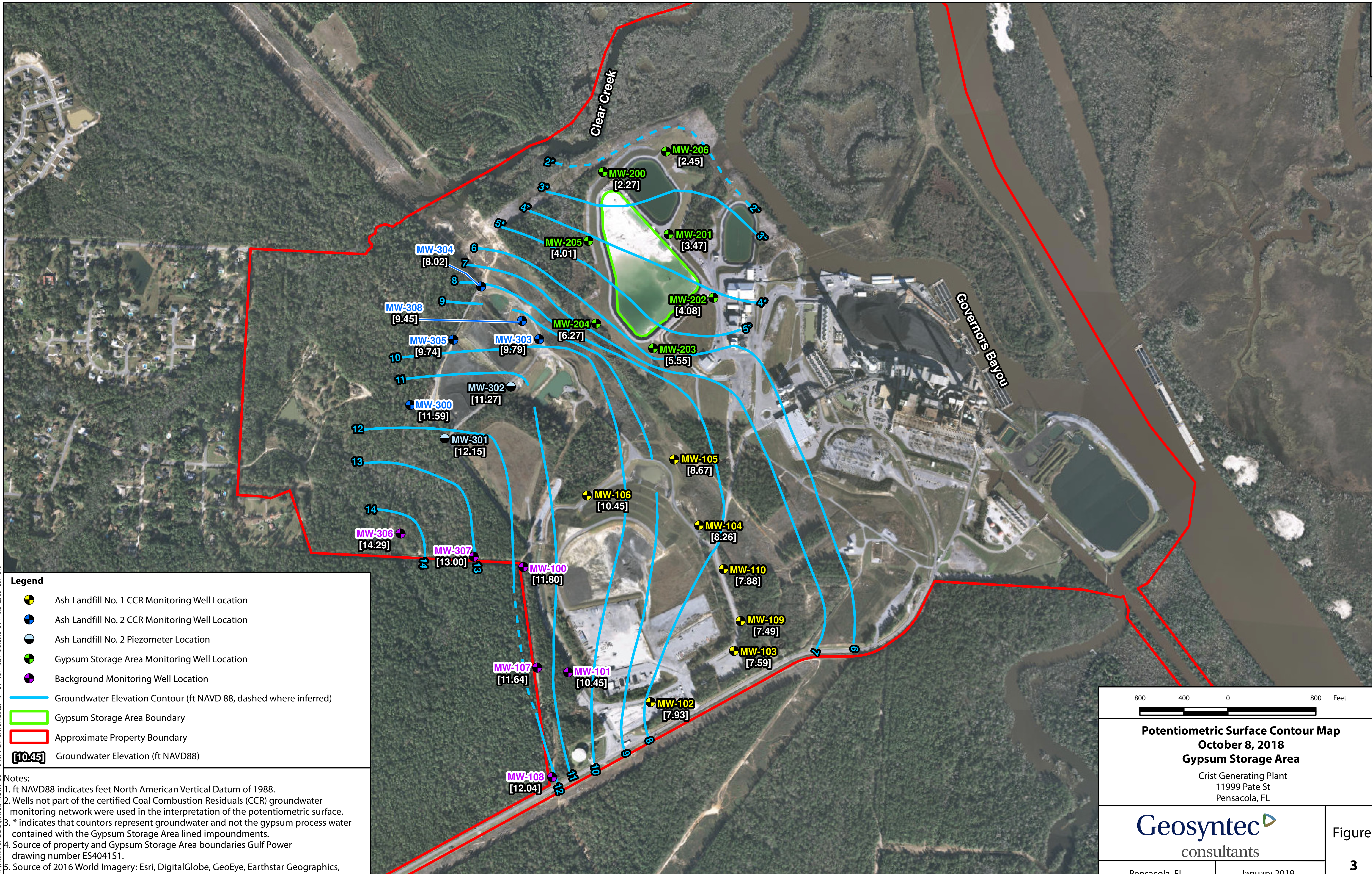
Figure **2**

Pensacola, FL | January 2019

Path: (Titusville-01\Data)\T:\0GIS\FR2406_Gulf_Power_Plant_Crist\MXDs\201901_GSA\GW_elev_JUNE2018_GSA.mxd 23 Jan 2019 JRB



Legend

- Ash Landfill No. 1 CCR Monitoring Well Location
- Ash Landfill No. 2 CCR Monitoring Well Location
- Ash Landfill No. 2 Piezometer Location
- Gypsum Storage Area Monitoring Well Location
- Background Monitoring Well Location
- Groundwater Elevation Contour (ft NAVD 88, dashed where inferred)
- Gypsum Storage Area Boundary
- Approximate Property Boundary
- [10.45] Groundwater Elevation (ft NAVD88)

Notes:
1. ft NAVD88 indicates feet North American Vertical Datum of 1988.
2. Wells not part of the certified Coal Combustion Residuals (CCR) groundwater monitoring network were used in the interpretation of the potentiometric surface.
3. * indicates that countors represent groundwater and not the gypsum process water contained with the Gypsum Storage Area lined impoundments.
4. Source of property and Gypsum Storage Area boundaries Gulf Power drawing number ES4041S1.
5. Source of 2016 World Imagery: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community.

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Potentiometric Surface Contour Map
October 8, 2018
Gypsum Storage Area

Crist Generating Plant
11999 Pate St
Pensacola, FL

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Pensacola, FL | January 2019

Figure 3