

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: 2021 Groundwater Velocity Estimate, Plant Smith, Ash Pond, Southport, FL

INTRODUCTION

On behalf of Florida Power & Light Company (“FPL”), Geosyntec Consultants, Inc. (“Geosyntec”) prepared this *2021 Groundwater Velocity Estimate Memorandum* (“Memo”) for the Plant Smith Ash Pond Coal Combustion Residuals (“CCR”) unit (CCR unit). The purpose of this Memo is to document the calculated horizontal groundwater velocities at the CCR unit in 2021, specifically for MW-11 and MW-13 (i.e., the wells with statistically significant levels [SSLs]). This Memo supplements the summary of CCR groundwater monitoring activities conducted in 2021 and reported in the *2021 Annual Groundwater Monitoring and Corrective Action Report* (Geosyntec, 2022a¹), 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 2021.
2. The hydraulic conductivity (0.42 to 0.47 feet per day [ft/day]) for the CCR unit documented in the *Selection of Remedy Report* (Geosyntec, 2022b²).

¹ Geosyntec, 2022a. *2021 Annual Groundwater Monitoring and Corrective Action Report*, Plant Smith, Ash Pond, January 28, 2022.

² Geosyntec Consultants, 2022b. *Selection of Remedy Report*, Florida Power & Light Company, Plant Smith, Ash Pond, July 29, 2022.

3. An estimated effective porosity of 0.25, based on the lithologic materials surrounding the screened interval (Sterrett, 2007³).

Input parameters and the calculations are summarized in **Table 1**. Groundwater elevations maps from 2021 are included as **Figures 1 and 2**.

Horizontal hydraulic gradients were calculated based on groundwater elevation data from 2021 groundwater sampling events. Since MW-11, MW-13, and select other CCR wells were abandoned in 2020 to allow for pre-closure activities (i.e., removal of the perimeter dike system) and not reinstalled until late 2021 or 2022, limited potentiometric data are available to calculate horizontal hydraulic gradients. As such, the horizontal hydraulic gradients were estimated as follows:

- In the vicinity of MW-13, hydraulic gradients were estimated between PZ-14 and the east bank of Alligator Bayou;
- In the vicinity of MW-11, hydraulic gradients were estimated between MWI-12A and the northern bank of North Bay; and
- The elevation of Alligator Bayou and North Bay were assumed to be the same as measured in MW-12, which is in close proximity to surface water.

The hydraulic conductivity for the uppermost aquifer adjacent to the CCR unit was estimated from pneumatic slug tests performed at MW-13 and PZ-14. Slug test methods and results were documented in the *Selection of Remedy Report* (Geosyntec, 2022b). Based on slug test results, the estimated hydraulic conductivities at MW-13 and PZ-14 were 0.42 and 0.47 ft/day, respectively. The estimated hydraulic conductivities at MW-13 and PZ-14 are within the anticipated hydraulic conductivity range for the fine-grained sands observed at the CCR unit (Domenico and Schwartz, 1990⁴).

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);

³ Sterrett, R.J., 2007. *Groundwater and Wells*, Third Edition, New Brighton, MN: Johnson Screens, A Weatherford Company.

⁴ Domenico, P.A. and F.W. Schwartz, 1990. *Physical and Chemical Hydrogeology*, John Wiley & Sons, New York, 824 p.

i = horizontal hydraulic gradient (unitless); and

n_e = effective porosity (unitless), assumed to be 0.25.

The calculated horizontal groundwater flow velocities at the CCR unit ranges from 0.015 to 0.020 ft/day (5.3 to 7.3 ft/year) in the vicinity of MW-13 and 0.005 to 0.014 ft/day (2 to 5 ft/year) in the vicinity of MW-11 during the 2021 sampling events.

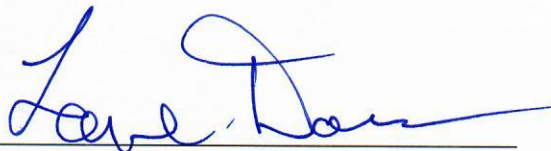
CLOSING

In accordance with groundwater sampling and analysis requirements of 40 CFR Section 257.93(c), the horizontal groundwater velocity at the Plant Smith Ash Pond ranged from 5.3 to 7.3 feet/year in the vicinity of MW-13 and 2 to 5 feet/year in the vicinity of MW-11 during the 2021 semi-annual groundwater sampling events. The calculated horizontal groundwater velocities for 2021 are similar to those calculated previously (Geosyntec, 2022b, 2023⁵). This Memo has been prepared under the supervision of a State of Florida licensed Professional Engineer and Professional Geologist with Geosyntec

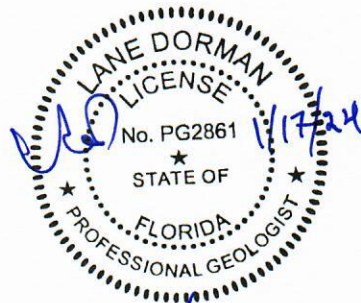
⁵ Geosyntec, 2023. *2022 Annual Groundwater Monitoring and Corrective Action Report*, Plant Smith, Ash Pond, January 31, 2023.
FR8308/PR23045

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Date



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1/17/24
Date

TABLE

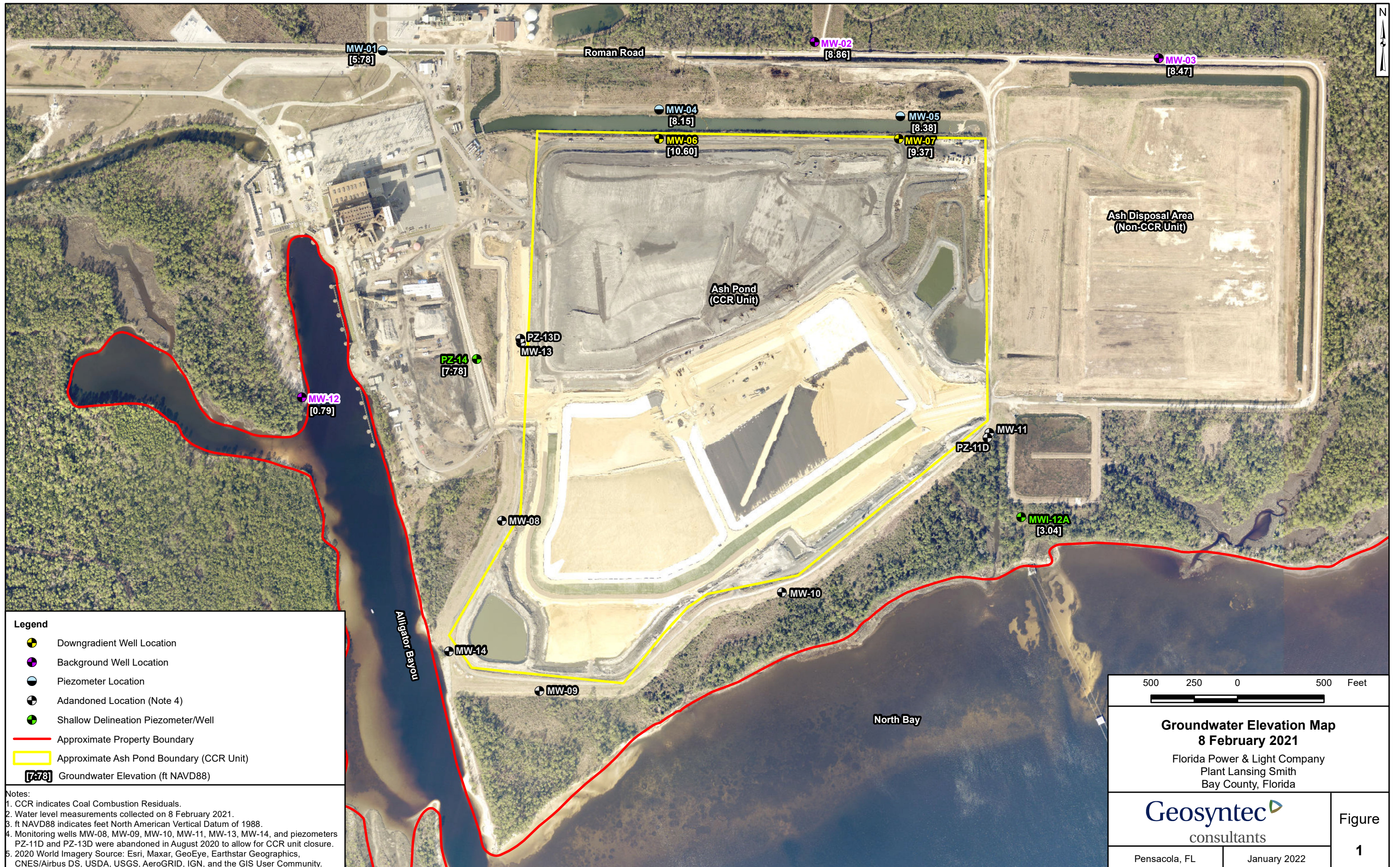
**Table 1. 2021 Groundwater Velocity Input Parameters and Calculations
Florida Power Light Company - Plant Smith Ash Pond, Bay County, Florida**

Flow Paths ^{1,2}	Groundwater Elevation (ft) ^{3,4}		Change in Groundwater Elevation (Δh) ⁵ (ft)	Distance (Δl) ⁵ (ft)	Hydraulic Gradient ($\Delta h/\Delta l$) ⁵ (ft/ft) ⁶	Hydraulic Conductivity ⁷ , K (ft/day) ⁸	Effective Porosity (n_e)	Linear Groundwater Velocity ⁹	
								ft/day	ft/year ¹⁰
PZ-14 to Alligator Bayou	Feb-21	7.78	6.99	658	0.0106	0.47	0.25	0.020	7.3
		0.79							
PZ-14 to Alligator Bayou	Feb-21	7.78	6.99						
		0.79							
PZ-14 to Alligator Bayou	Sep-21	8.02	5.70	658	0.0087	0.47	0.25	0.016	5.9
		2.32							
PZ-14 to Alligator Bayou	Sep-21	8.02	5.70						
		2.32							
MWI-12A to North Bay	Feb-21	3.04	2.25	311	0.0072	0.47	0.25	0.014	5.0
		0.79							
MWI-12A to North Bay	Feb-21	3.04	2.25						
		0.79							
MWI-12A to North Bay	Sep-21	3.32	1.00	311	0.0032	0.47	0.25	0.006	2.2
		2.32							
MWI-12A to North Bay	Sep-21	3.32	1.00						
		2.32							

Notes:

1. PZ-14, MWI-12A, and MW-12 were the only wells available to estimate gradients because other CCR monitoring wells had been abandoned to facilitate CCR unit closure.
2. The elevation of Alligator Bayou and North Bay were assumed to be the same as measured in MW-12, which is in close proximity to surface water.
3. Elevations are in feet relative to the North American Vertical Datum of 1988.
4. ft = feet
5. Δh = Change in groundwater elevation, Δl = Distance along flow path
6. ft/ft = feet per foot
7. K values were calculated based on 2020 slug tests.
8. ft/day = feet per day
9. Groundwater flow velocity equation = $(\Delta h/\Delta l * K)/n_e$
10. ft/year = feet per year

FIGURES

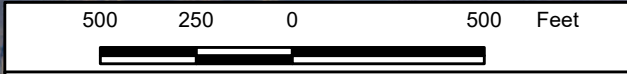


Legend

- Downgradient Well Location
- Background Well Location
- Piezometer Location
- Adandoned Location (Note 4)
- Shallow Delineation Piezometer/Well
- Approximate Property Boundary
- Approximate Ash Pond Boundary (CCR Unit)
- [7.78]** Groundwater Elevation (ft NAVD88)

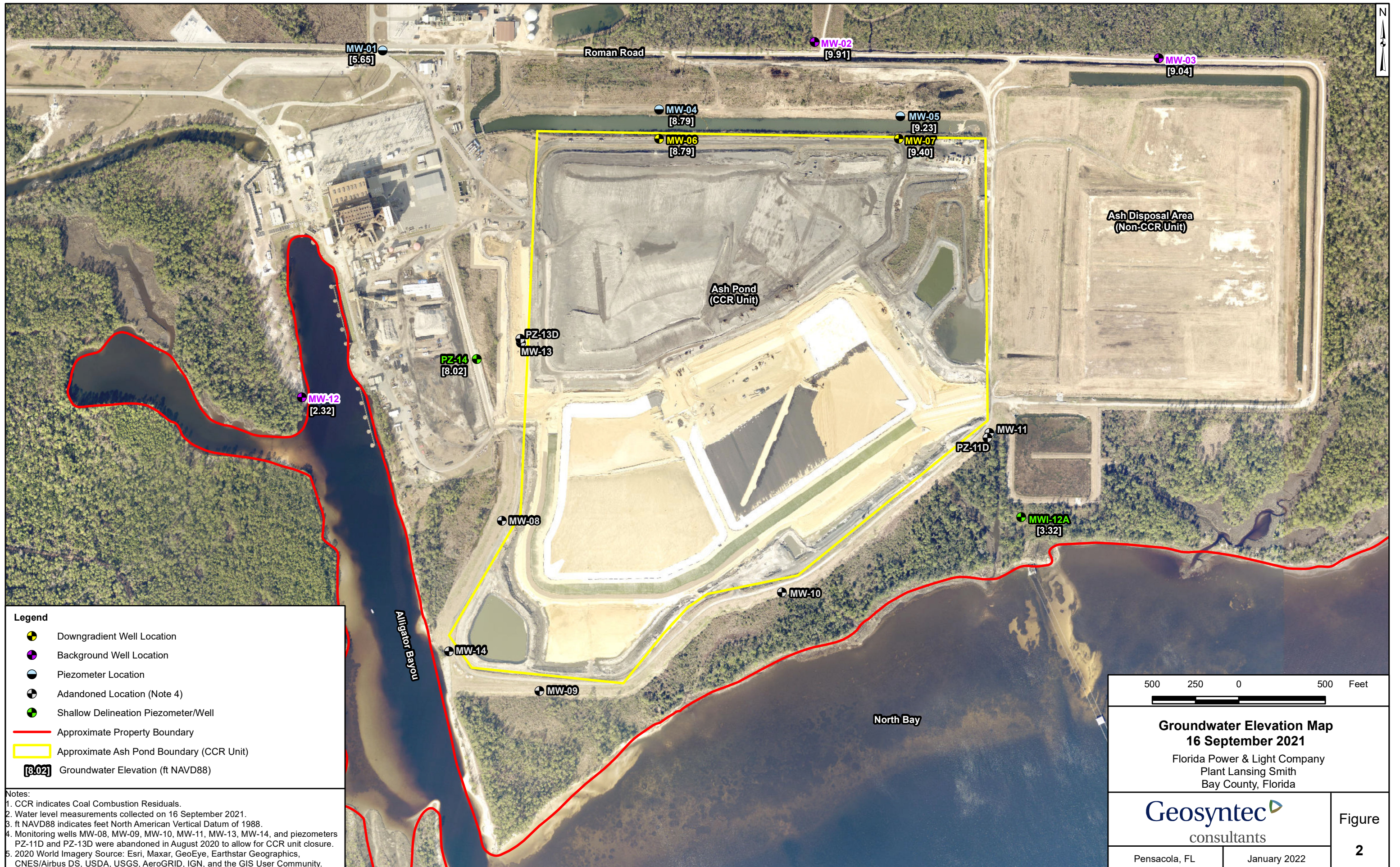
Notes:

1. CCR indicates Coal Combustion Residuals.
2. Water level measurements collected on 8 February 2021.
3. ft NAVD88 indicates feet North American Vertical Datum of 1988.
4. Monitoring wells MW-08, MW-09, MW-10, MW-11, MW-13, MW-14, and piezometers PZ-11D and PZ-13D were abandoned in August 2020 to allow for CCR unit closure.
5. 2020 World Imagery Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community.



Groundwater Elevation Map
8 February 2021
 Florida Power & Light Company
 Plant Lansing Smith
 Bay County, Florida

		Figure 1
Pensacola, FL	January 2022	



Legend

- Downgradient Well Location
- Background Well Location
- Piezometer Location
- Adandoned Location (Note 4)
- Shallow Delineation Piezometer/Well
- Approximate Property Boundary
- Approximate Ash Pond Boundary (CCR Unit)
- [8.02] Groundwater Elevation (ft NAVD88)

Notes:

1. CCR indicates Coal Combustion Residuals.
2. Water level measurements collected on 16 September 2021.
3. ft NAVD88 indicates feet North American Vertical Datum of 1988.
4. Monitoring wells MW-08, MW-09, MW-10, MW-11, MW-13, MW-14, and piezometers PZ-11D and PZ-13D were abandoned in August 2020 to allow for CCR unit closure.
5. 2020 World Imagery Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community.



Groundwater Elevation Map
16 September 2021
 Florida Power & Light Company
 Plant Lansing Smith
 Bay County, Florida

		Figure
Pensacola, FL	January 2022	2