

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: 2019 Groundwater Velocity Estimate, Plant Smith, Ash Pond, Southport, FL

INTRODUCTION

On behalf of Florida Power & Light Company (“FPL”), Geosyntec Consultants, Inc. (“Geosyntec”) prepared this *2019 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 2019, 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 2019 and reported in the *2019 Annual Groundwater Monitoring and Corrective Action Report* (Geosyntec, 2020¹), 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 2019.
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, 2022²).

¹ Geosyntec, 2020. *2019 Annual Groundwater Monitoring and Corrective Action Report*, Gulf Power Company, Plant Smith Ash Pond, January 31, 2020.

² Geosyntec Consultants, 2022. *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 2019 are included as **Figures 1, 2, and 3**.

Horizontal hydraulic gradients, unless noted below, were calculated between MW-11 and MWI-12A and between MW-13 and PZ-14, monitoring well pairs representative of groundwater flow near MW-11 and MW-13, respectively. The horizontal hydraulic gradients were calculated using groundwater elevation data from 2019 groundwater sampling events.

For the March 2019 event, water levels were not gauged in MWI-12A. Therefore, horizontal hydraulic gradients were estimated between MW-11 and the northern bank of North Bay. The elevation of North Bay was 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, 2022). 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);

i = horizontal hydraulic gradient (unitless); and

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

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.

The calculated horizontal groundwater flow velocities at the CCR unit ranged from 0.015 to 0.021 ft/day (5.7 to 7.6 ft/year) in the vicinity of MW-13 and 0.013 to 0.018 ft/day (4.8 to 6.7 ft/year) in the vicinity of MW-11 during the 2019 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 5.7 to 7.6 ft/year in the vicinity of MW-13 and 4.8 to 6.7 ft/year in the vicinity of MW-11 during the 2019 groundwater sampling events. The calculated horizontal groundwater velocities for 2019 are similar to those calculated previously (Geosyntec, 2022, 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/PR23043

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1/17/24

1/17/24
Date

TABLE

**Table 1. 2019 Groundwater Velocity Input Parameters and Calculations
Florida Power Light Company - Plant Smith Ash Pond, Bay County, Florida**

| Flow Paths ¹ | Groundwater Elevation (ft) ^{2,3} | | Change in Groundwater Elevation (Δh) ⁴ (ft) | Distance (Δl) ⁴ (ft) | Hydraulic Gradient ($\Delta h/\Delta l$) ⁴ (ft/ft) ⁵ | Hydraulic Conductivity ⁶ , K (ft/day) ⁷ | Effective Porosity (n_e) | Linear Groundwater Velocity ⁸ | |
|-------------------------|---|------|--|---|--|---|------------------------------|--|----------------------|
| | | | | | | | | ft/day ⁷ | ft/year ⁹ |
| MW-11 to North Bay | Mar-19 | 7.31 | 6.22 | 795 | 0.0078 | 0.42 | 0.25 | 0.013 | 4.8 |
| | | 1.09 | | | | | | | |
| MW-11 to North Bay | Mar-19 | 7.31 | 6.22 | 795 | 0.0078 | 0.47 | 0.25 | 0.015 | 5.4 |
| | | 1.09 | | | | | | | |
| MW-11/MWI-12A | May-19 | 6.31 | 5.08 | 521 | 0.0097 | 0.42 | 0.25 | 0.016 | 6.0 |
| | | 1.23 | | | | | | | |
| MW-11/MWI-12A | May-19 | 6.31 | 5.08 | 521 | 0.0097 | 0.47 | 0.25 | 0.018 | 6.7 |
| | | 1.23 | | | | | | | |
| MW-11/MWI-12A | Nov-19 | 6.96 | 4.44 | 521 | 0.0085 | 0.42 | 0.25 | 0.014 | 5.2 |
| | | 2.52 | | | | | | | |
| MW-11/MWI-12A | Nov-19 | 6.96 | 4.44 | 521 | 0.0085 | 0.47 | 0.25 | 0.016 | 5.8 |
| | | 2.52 | | | | | | | |
| MW-13/PZ-14 | Mar-19 | 9.74 | 2.72 | 271 | 0.0100 | 0.42 | 0.25 | 0.017 | 6.2 |
| | | 7.02 | | | | | | | |
| MW-13/PZ-14 | Mar-19 | 9.74 | 2.72 | 271 | 0.0100 | 0.47 | 0.25 | 0.019 | 6.9 |
| | | 7.02 | | | | | | | |
| MW-13/PZ-14 | May-19 | 7.61 | 3.00 | 271 | 0.0111 | 0.42 | 0.25 | 0.019 | 6.8 |
| | | 4.61 | | | | | | | |
| MW-13/PZ-14 | May-19 | 7.61 | 3.00 | 271 | 0.0111 | 0.47 | 0.25 | 0.021 | 7.6 |
| | | 4.61 | | | | | | | |
| MW-13/ PZ-14 | Nov-19 | 9.82 | 2.50 | 271 | 0.0092 | 0.42 | 0.25 | 0.015 | 5.7 |
| | | 7.32 | | | | | | | |
| MW-13/ PZ-14 | Nov-19 | 9.82 | 2.50 | 271 | 0.0092 | 0.47 | 0.25 | 0.017 | 6.3 |
| | | 7.32 | | | | | | | |

Notes:

1. Data was unavailable for MWI-12A in March 2019, so North Bay was used as an alternative point. The elevation of North Bay was assumed to be the same as measured in MW-12, which is in close proximity to surface water.
2. Elevations are in feet relative to the North American Vertical Datum of 1988.
3. ft = feet
4. Δh = Change in groundwater elevation, Δl = Distance along flow path
5. ft/ft = feet per foot
6. K values were calculated based on 2020 slug tests.
7. ft/day = feet per day
8. Groundwater flow velocity equation = $(\Delta h/\Delta l * K)/n_e$
9. ft/year = feet per year

FIGURES



Legend

- Downgradient Well Location
- Background Well Location
- Piezometer Location
- Shallow Delineation Piezometer and Well
- Deep Delineation Piezometer
- Inferred Groundwater Elevation Contour (ft NAVD88)
- Approximate Property Boundary
- Approximate Ash Pond Boundary (CCR Unit)
- Groundwater Elevation (ft NAVD88)

Notes:

1. * indicates groundwater elevation not used for contouring.
2. NM indicates not measured.
3. CCR indicates Coal Combustion Residuals.
4. Water level measurements collected on 4 March 2019.
5. ft NAVD88 indicates feet North American Vertical Datum of 1988.
6. Source of 2019 World Imagery: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community.

500 250 0 500 Feet

Potentiometric Surface Contour Map
March 4, 2019
Plant Lansing Smith
 Gulf Power Company
 Plant Lansing Smith
 Bay County, Florida

Geosyntec
 consultants

Pensacola, FL January 2020

Figure
1



Legend

- Downgradient Well Location
- Background Well Location
- Piezometer Location
- Shallow Delineation Piezometer and Well
- Deep Delineation Piezometer
- Inferred Groundwater Elevation Contour (ft NAVD88)
- Approximate Property Boundary
- Approximate Ash Pond Boundary (CCR Unit)
- Groundwater Elevation (ft NAVD88)

Notes:

1. * indicates groundwater elevation not used for contouring.
2. CCR indicates Coal Combustion Residuals.
3. Water level measurements collected on 29 May 2019.
4. ft NAVD88 indicates feet North American Vertical Datum of 1988.
5. Source of 2019 World Imagery: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community.

500 250 0 500 Feet

Potentiometric Surface Contour Map
May 29, 2019
Plant Lansing Smith

Gulf Power Company
 Plant Lansing Smith
 Bay County, Florida

Geosyntec
 consultants

Pensacola, FL January 2020

Figure
2



Legend

- Downgradient Well Location
- Background Well Location
- Piezometer Location
- Shallow Delineation Piezometer and Well
- Deep Delineation Piezometer
- Inferred Groundwater Elevation Contour (ft NAVD88)
- Approximate Property Boundary
- Approximate Ash Pond Boundary (CCR Unit)
- Groundwater Elevation (ft NAVD88)

Notes:

1. * indicates groundwater elevation not used for contouring.
2. CCR indicates Coal Combustion Residuals.
3. Water level measurements collected on 18 November 2019.
4. ft NAVD88 indicates feet North American Vertical Datum of 1988.
5. Source of 2019 World Imagery: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community.

500 250 0 500 Feet

Potentiometric Surface Contour Map
November 18, 2019
Plant Lansing Smith

Gulf Power Company
 Plant Lansing Smith
 Bay County, Florida

Geosyntec
 consultants

Pensacola, FL January 2020

Figure
3