Intended for
Dynegy Miami Fort, LLC

Date
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Project No.
1940074922

CORRECTIVE MEASURES ASSESSMENT REVISION 1

MIAMI FORT POND SYSTEM

MIAMI FORT POWER STATION
11021 BROWER ROAD
NORTH BEND, OHIO

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DOCUMENT REVISION RECORD

Issue No.	Date	Details of Revisions
Revision 0	September 5, 2019	• Original Document (prepared by O'Brien & Gere Engineers, Inc., part of Ramboll)
Revision 1	October 30, 2020	• Revised to reflect the characterization of the Miami Fort Pond System as a single multi-unit, including an Alternate Source Demonstration for statistically significant levels of arsenic and molybdenum for the Pond System

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1. INTRODUCTION

Ramboll Americas Engineering Solutions Inc., formerly known as O'Brien & Gere Engineers, Inc (Ramboll), has prepared this revision of the Corrective Measures Assessment (CMA) for the Miami Fort Pond System (Coal Combustion Residuals [CCR] Multi-Unit ID 115) located at the Miami Fort Power Station (MFS) in North Bend, Ohio. The Pond System is a CCR Multi-Unit comprised of two hydraulically connected cells (Basins A and B). This document supersedes the CMA completed on September 5, 2019 for Basin A (O'Brien & Gere Engineers, Inc., part of Ramboll [OBG], 2019).

This CMA report complies with the requirements of Title 40 of the Code of Federal Regulations (40 C.F.R.) § 257, Subpart D Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments (CCR Rule). Under the CCR Rule, owners and operators of existing CCR surface impoundments (SIs) must initiate a CMA, in accordance with 40 C.F.R. § 257.96, when one or more Appendix IV constituents are detected at statistically significant levels (SSLs) above groundwater protection standards (GWPS) in the Uppermost Aquifer, and the owner or operator has not completed an alternate source demonstration (ASD) demonstrating that a source other than the CCR unit has caused the contamination.

As stated in the related notification for the Pond System dated August 13, 2020, SSLs for the following parameters were determined after the most recent Assessment Monitoring sampling event (A3) completed April 6 through April 7, 2020:

- Arsenic
- Cobalt
- Molybdenum

An Alternate Source Demonstration (ASD) has been completed for the arsenic and molybdenum SSLs (Appendix A), as allowed by 40 C.F.R. § 257.95(g)(3)(ii). This CMA is responsive to the 40 C.F.R. § 257.96 and § 257.97 requirements for assessing potential corrective measures to address the cobalt SSL.

This CMA is the first step in developing a long-term corrective action plan and has been prepared to evaluate applicable remedial measures to address cobalt SSLs in the Uppermost Aquifer. The results of the CMA will be used to guide whether additional site-specific data are necessary to develop a long-term corrective action plan for the Uppermost Aquifer, consistent with 40 C.F.R. § 257.96 and § 257.97 requirements.

1.1 Corrective Measures Assessment Objectives and Methodology

The objective of this CMA is to begin the process of evaluating appropriate corrective measure(s) to address impacted groundwater in the Uppermost Aquifer potentially associated with the Pond System at the MFS. The CMA evaluates the effectiveness of the corrective measures in meeting the requirements and objectives of the remedy, as described under 40 C.F.R. § 257.96(c), by addressing the following evaluation criteria:

- Performance
- Reliability
- Ease of implementation

- Potential impacts of appropriate potential remedies (safety impacts, cross-media impacts, and control of exposure to any residual contamination)
- Time required to begin and complete the remedy
- Institutional requirements that may substantially affect implementation of the remedy(s) (permitting, environmental or public health requirements)

The CMA provides a systematic, rational method for evaluating potential corrective measures. The assessment process documented herein: a) identifies the site-specific conditions that will influence the effectiveness of the potential corrective measures (Section 2); b) identifies applicable corrective measures (Section 3); c) assesses the corrective measures against the evaluation criteria to select potentially feasible corrective measures (Section 4); and d) summarizes the remedy selection process and future actions (Section 5).

1.2 Evaluation Criteria

The evaluation criteria are defined below to provide a common understanding and consistent application. The evaluation included qualitative and/or semi-quantitative screening of the corrective measures relative to their general performance, reliability, and ease of implementation characteristics, and their potential impacts, timeframes, and institutional requirements. Evaluations were at a generalized level of detail in order to screen out corrective measures that were not expected to meet 40 C.F.R. § 257.97 design criteria, while retaining corrective measures that would meet the design criteria.

The evaluation does not explicitly address and document compliance with each of the specific elements included in the definitions below. Rather, the evaluation considered the elements qualitatively, applying engineering judgement, to provide a reasoned set of corrective measures that could be used, either individually or in combination, to achieve GWPS in the most effective and protective manner.

1.2.1 Performance

The performance of potentially applicable corrective measures was evaluated for the:

1. Potential to ensure that any environmental releases to groundwater, surface water, soil, and air will be at or below relevant regulatory and health-based benchmarks for human and ecological receptors.
2. Degree to which the corrective measure isolates, removes, or contains SSLs identified in the Uppermost Aquifer.
3. Ability of the corrective measure to achieve GWPS within the Uppermost Aquifer at the compliance boundaries.

1.2.2 Reliability

The reliability of the corrective measure is a description of its ability to function as designed until the GWPS are achieved in the Uppermost Aquifer at the compliance boundaries. Evaluation of the reliability included considering:

1. Type and degree of long-term management required, including monitoring, operation, and maintenance.

2. Long-term reliability of the engineering and institutional controls associated with the corrective measure.
3. Potential need for replacement of the corrective measure.

1.2.3 Ease of Implementation

The ease or difficulty of implementing a given corrective measure was evaluated by considering:

1. Degree of difficulty associated with constructing the corrective measure.
2. Expected operational reliability of the corrective measure.
3. Need to coordinate with and obtain necessary approvals and permits.
4. Availability of necessary equipment and specialists.
5. Available capacity and location of needed treatment, storage, and disposal services.

1.2.4 Potential Impacts of the Remedy

Potential impacts associated with a given corrective measure included consideration of impacts on the distribution and/or transport of contaminants, safety impacts (the short-term risks that might be posed to the community or the environment during implementation), cross-media impacts (increased traffic, noise, fugitive dust) and control of potential exposure of humans and environmental receptors to remaining wastes.

1.2.5 Time Required to Begin, Implement, and Complete the Remedy

Evaluating the time required to begin the remedy focused on the site-specific conditions that could require additional or extended timeframes to characterize, design, and/or field test a corrective measure to verify the applicability and effectiveness of a corrective measure. The length of time that would be required to begin and implement the remedy was considered to be the total time to: 1) verify applicability and effectiveness; 2) design and obtain permits; and 3) complete construction of the corrective measure.

The time required to complete the remedy considered the total time after the corrective measure was implemented until GWPS would be achieved in the Uppermost Aquifer at the compliance boundaries.

1.2.6 Institutional, Environmental or Public Health Requirements

Institutional, environmental and public health requirements considered state, local, and site-specific permitting or other requirements that could substantially affect construction or implementation of a corrective measure.

2. SITE HISTORY AND CHARACTERIZATION

2.1 Site Description and History

The MFS is owned and operated by Dynegy Miami Fort, LLC. The MFS is located in the southwest corner of the State of Ohio on the north shore of the Ohio River, at the confluence with the Great Miami River, as shown in Figure 1. The facility is located within Hamilton County, Miami Township, approximately 5 miles southwest of the village of North Bend, Ohio. The state boundary with Indiana is approximately 1,900 feet to the west of MFS and the boundary with the State of Kentucky lies just offshore to the south, within the Ohio River.

The MFS has two coal-fired units, Units 7 and 8, constructed in 1975 and 1978 with a total capacity of 1,100 megawatts (MW) and four oil-fired facilities constructed in 1971 with a total capacity of 78 MW. The Pond System (Multi-unit 115) covers a total area of approximately 51 acres and is located in the southwest corner of the Miami Fort Power Station property as shown in Figure 1.

Basin A (formerly Unit 111) receives effluent from the sluice lines, which primarily transport bottom ash products as well as flue gas desulfurization (FGD) effluent and some fly ash. Basin A also receives directly discharged miscellaneous yard drainage. The material is discharged into the northern portion of the basin and through a constructed internal ditch line allowing the solids to settle and the water to decant into Basin B. Solid materials collected in Basin A are generally reclaimed for beneficial reuse or landfill placement. The Basin A normal pool level is typically between elevations of 495 and 498 ft. Basin A and Basin B are hydraulically connected with a 48-inch corrugated metal pipe (CMP) culvert sliplined with a 40-inch high density polyethylene (HDPE) pipe that runs through the shared dike, allowing the basins to operate in series. The Basin A outfall is currently not in use and flow-through is controlled by the gate structure (AECOM, 2017).

Basin B (formerly Unit 112) was constructed between 1979 and 1981 (AECOM, 2017). The Basin B normal pool level is typically below the Basin A normal pool and between elevations of 495 and 498 ft. Basin A discharges into Basin B, which is used as a polishing pond prior to discharge to the Ohio River through the permitted outfall structure in Basin B. Miscellaneous yard drainage is currently discharged directly to Basin B (AECOM, 2017).

2.2 Geology and Hydrogeology

The native geologic materials present beneath the Pond System at the Site include alluvial deposits, glacial outwash (Uppermost Aquifer), and bedrock, as described below:

- Alluvial Deposits - The alluvial deposits consist of clay, silt and fine sand deposited by the Ohio River floodwaters. These alluvial deposits are present at a depth ranging from approximately 20 to 60 ft below ground surface (bgs). A silty, sandy clay layer is the primary component of the alluvial deposits. The top of clay elevation ranges from 428 ft, referenced to the North American Vertical Datum of 1988 (NAVD88), in the southwest corner of Basin B, near the confluence of the Ohio River and the Great Miami River, to 495 ft beneath the northeast corner of Basin A. The clay is thin, or absent, near the valley wall north of the Pond System and thickens towards the Ohio River. The clay is thickest beneath the southern half of the Pond System, ranging in thickness from 15 ft to 48 ft. A silt layer, averaging approximately 7 ft thick, overlies the clay in several areas.

- Glacial Outwash (Uppermost Aquifer) - The Uppermost Aquifer consists of glacial outwash sands and gravels deposited during the Illinoian and Wisconsin stages of the Pleistocene. The thickness of the outwash deposits beneath the Site is approximately 100 ft; the outwash deposits directly overlie bedrock. A silt and fine sand layer is present locally overlying the outwash deposits and ranges in thickness from 4 to 30 ft; however, it is not present below the entirety of the Pond System.
- Bedrock - The bedrock consists of interbedded shales and limestones belonging to the Ordovician-aged Fairview and Kope formations (AECOM, 2017). Depth to bedrock beneath the Site varies between approximately 110 to 120 ft bgs. Due to the relatively impermeable nature of the shales and limestones underlying this region, water yields in the bedrock are generally insufficient for domestic use (AECOM, 2017).

The glacial outwash deposits (Uppermost Aquifer) underlying the Pond System are part of the Ohio River Valley Fill Aquifer; a glacial buried-valley deposit aquifer. The valley was cut into the bedrock by pre-glacial and glacial streams and subsequently backfilled with deposits of sand, gravel and other glacial drift by glacial and alluvial processes as the glaciers advanced and receded. The thickness of the deposits ranges from approximately 60 to 100 ft and covers much of the width of the terrace between the valley wall to the Great Miami River and Ohio River confluence. Buried valley aquifers such as the Uppermost Aquifer are Ohio's most productive water-bearing formations. Estimates of transmissivity are in excess of 50,000 gallons per day per foot (USGS, 1997).

Regionally, yields for high-capacity wells in the Uppermost Aquifer range from 450 gallons per minute (gpm) to 3,000 gpm with one well tested as high as 6,000 gpm. (IDNR, 2006). The majority of the water withdrawn by high capacity wells near the Site is from induced flow from the Ohio River (ODNR, undated). The Site operates four production wells east-southeast of Basin A for cooling water. Pumping rates measured at the cooling water production wells range from 1,000 gpm to 1,500 gpm. Additionally. three production wells, located northwest of the Pond System, are operated by Veolia for process (non-potable) water.

The aquifer receives most of its recharge from infiltration of precipitation on the valley floor; however, secondary recharge also comes from bank storage from the Great Miami River and Ohio River during flood stages. Recharge to the aquifer from bank storage is periodic and short-lived.

Groundwater elevations across the Site ranged from approximately 456 to 460 ft during A3, coincident with an approximate Ohio River pool elevation of 461 ft. The groundwater elevation contours shown on Figure 2 are based on groundwater measurements collected on April 6, 2020, the day prior to A3 analytical sampling. Groundwater flow in the Uppermost Aquifer is generally to the west/northwest towards the Great Miami River and Veolia's production wells, and south towards the Ohio River.

2.3 Groundwater Quality

Detection monitoring in the Uppermost Aquifer, per 40 C.F.R. § 257.90, was initiated in October 2017; statistically significant increases (SSIs) of Appendix III parameters over background concentrations were detected in October 2017. Monitoring well locations are shown on Figure 2. Alternate source evaluations were inconclusive for one or more of the SSIs. Therefore, in accordance with 40 C.F.R. § 257.94(e)(2), an Assessment Monitoring Program was established for the Pond System on April 9, 2018. Assessment Monitoring results identified statistically significant levels (SSLs) of the following Appendix IV parameters over the GWPS:

- Arsenic at wells MW-2, MW-10 and MW-13
- Cobalt at wells MW-4 and 4A
- Molybdenum at well MW-6

An ASD has been completed for the arsenic and molybdenum SSLs (Appendix A), as allowed by 40 C.F.R. § 257.95(g)(3)(ii). This CMA has been completed to comply with the 40 C.F.R. § 257.96 and § 257.97 requirements for assessing potential corrective measures to address the cobalt SSL.

SSLs for total cobalt were identified in downgradient monitoring wells MW-4 and MW-4A where concentrations ranged from 0.00503 mg/L to 0.0187 mg/L.

3. DESCRIPTION OF CORRECTIVE MEASURES

The corrective measures described below are frequently used to mitigate impacts from contaminants. The corrective measures are identified as either potential source control or groundwater corrective measures.

3.1 Objectives of the Corrective Measures

The following performance standards, per 40 C.F.R. § 257.97, must be met by the selected corrective measures:

- Be protective of human health and the environment.
- Attain the groundwater protection standards per 40 C.F.R. § 257.95(h).
- Provide source control to reduce or eliminate, to the maximum extent feasible, further releases of Appendix IV constituents.
- Remove from the environment as much of the contaminated material as feasible.
- Comply with waste management standards, per 40 C.F.R. § 257.98(d).

Site-specific considerations regarding the Pond System, provided in Section 2, were used to evaluate potential corrective measures. Each of the corrective measures evaluated may be capable of satisfying the performance standards listed above to varying degrees of effectiveness. The corrective measure review process yields a set of applicable corrective measures that can be used in developing a long-term corrective action plan. The corrective measures may be used independently or may be combined into specific remedial alternatives to leverage the advantages of multiple corrective measures to meet the performance standards.

The following potential corrective measures are commonly used to mitigate groundwater impacts and were considered as a part of the CMA process:

- Potential Source Control Corrective measures
  - Closure in Place (CIP)
  - Closure by Removal (CBR) (Off-Site Landfill)
  - In-Situ Solidification/Stabilization (ISS)
- Potential Groundwater Remedial Corrective measures
  - Monitored Natural Attenuation (MNA)
  - Groundwater Cutoff Wall
  - In-Situ Chemical Treatment
  - Permeable Reactive Barrier (PRB)
  - Groundwater Extraction

3.2 Potential Source Control Corrective Measures

3.2.1 Closure in Place

CIP includes constructing a cover system in direct contact with the graded CCR. Cover systems are designed to significantly minimize water infiltration into the CCR unit and allow surface water to drain off the cover system, thus reducing generation of potentially impacted water and reducing the extent of cobalt impact in the Uppermost Aquifer.

Construction of a cover system typically includes, but is not limited to, the following primary project components:

- Removal of free water and grading the CCR to allow cover system construction.
- Relocating and/or reshaping the existing CCR and cover material within the impoundment to achieve acceptable grades for closure. Borrow soil may be used to supplement fill volume, if necessary, to reach final design grades.
- Constructing a cover system that complies with the CCR Rule, including establishment of a vegetative cover to minimize long-term erosion.
- Constructing a stormwater management system to convey runoff from the cover system to a system of perimeter drainage channels for ultimate routing and discharge to nearby surface water.
- Ongoing inspection and maintenance of the cover system; and, stormwater and property management.

3.2.2 Closure by Removal (Off-Site Landfill)

CBR includes the following components: removal of all CCR from the CCR unit; moisture conditioning the CCR as needed to facilitate excavating, loading and transporting CCR to either an on-site or off-site landfill; and backfilling the excavation. This corrective measure would address the source of groundwater impacts by removing the CCR, but the groundwater impacts would not begin to diminish until the source is completely removed.

CBR would require transporting CCR to an off-site location for disposal, as the MFS property does not have the space required for siting a new on-site landfill. This would result in increased risk to the public, increased greenhouse gas emissions and carbon footprint, and increased potential for fugitive dust exposure. Transporting ash to an off-site landfill also presents concerns about available landfill capacity and community impacts, safety concerns and project duration.

3.2.3 In Situ Solidification/Stabilization

ISS is a corrective measure which consists of encapsulating waste within a cured monolith having increased compressive strength and reduced hydraulic conductivity. Hazards can be reduced by both converting waste constituents into a less soluble and mobile forms and by isolating waste from groundwater, thus facilitating groundwater remediation and reducing leaching to groundwater. ISS includes solidifying all CCR from the CCR unit and encapsulating the CCR through in-place mechanical mixing with reagents in an engineered grout mixture. The grout is typically emplaced using augers, backhoes or injection grouting. ISS also improves the geotechnical stability and material strength of the CCR materials.

ISS construction technologies include vertical rotary mixed ISS, hydraulic auger mixed ISS, hydraulic mixing tool ISS, and excavator mixed ISS. ISS construction may use a combination of these technologies depending on site-specific design requirements. ISS design typically requires data on, but not limited to, the following CCR material properties: geotechnical parameters, inorganic chemical constituents, class of ash, and ash management information (*e.g.,* coal source, co-management). Due to the variability in material properties of CCR, ISS would require an extensive mix design process for assessing ISS performance. Typical design and performance parameters include (but are not limited to): volume expansion (swell), leachability, permeability, and unconfined compressive strength. ISS performance may be evaluated based on both civil design and remedial performance objectives.

3.3 Potential Groundwater Corrective Measures

3.3.1 Monitored Natural Attenuation

Both federal and state regulators have long recognized that MNA can be an acceptable component of a remedial action when it can achieve remedial action objectives in a reasonable timeframe. In 1999, the USEPA published a final policy directive (USEPA, 1999) for use of MNA for groundwater remediation and described the process as follows:

- The reliance on natural attenuation processes (within the context of a carefully controlled and monitored site cleanup approach) to achieve site-specific remediation objectives within a time frame that is reasonable compared to that offered by other more active methods. The 'natural attenuation processes' that are at work in such a remediation approach include a variety of physical, chemical, or biological processes that, under favorable conditions, act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in soil or groundwater. These in-situ processes include biodegradation; dispersion; dilution; sorption; volatilization; radioactive decay; and chemical or biological stabilization, transformation, or destruction of contaminants.

The USEPA has stated that source control was the most effective means of ensuring the timely attainment of remediation objectives (USEPA, 1999). Natural attenuation processes may be appropriate as a "finishing step" after effective source control implementation, if there are no risks to receptors and/or the contaminant plume is not expanding. Thus, MNA would be used in conjunction with source control measures described in Section 3.2.

The 1999 MNA document was focused on organic compounds in groundwater. However, in a 2015 companion document, the USEPA addressed the use of MNA for inorganic compounds in groundwater. The USEPA noted that the use of MNA to address inorganic contaminants: (1) is not intended to constitute a treatment process for inorganic contaminants; (2) when appropriately implemented, can help to restore an aquifer to beneficial uses by immobilizing contaminants onto aquifer solids and providing the primary means for attenuation of contaminants in groundwater; and (3) is not intended to be a "do nothing" response (USEPA, 2015). Rather, documenting the applicability of MNA for groundwater remediation should be thoroughly and adequately supported with site-specific characterization data and analysis in accordance with the USEPA's tiered approach to MNA (USEPA 1999, 2007, and 2015):

1. Demonstrate that the area of groundwater impacts is not expanding.
2. Determine the mechanisms and rates of attenuation.

3. Determine that the capacity of the aquifer is sufficient to attenuate the mass of constituents in groundwater and that the immobilized constituents are stable and will not remobilize.
4. Design a performance monitoring program based on the mechanisms of attenuation and establish contingency remedies (tailored to site-specific conditions) should MNA not perform adequately.

Both physical and chemical attenuation processes can contribute to the reduction in mass, toxicity, mobility, volume, or concentration of contaminants in groundwater. Physical attenuation processes applicable to CCR include dilution, dispersion, and flushing. Chemical attenuation processes applicable to CCR include precipitation and coprecipitation (*i.e.*, incorporation into sulfide minerals), sorption (*i.e.*, to iron, manganese, aluminum, or other metal oxides or oxyhydroxides, or to sulfide minerals or organic matter), and ion exchange. Timeframes to achieve GWPS are dependent on site-specific conditions, actual timeframes would require detailed technical analysis.

Cobalt has the potential to be sorbed onto iron hydroxides or organic matter in the aquifer materials, depending on the geochemical conditions, but is typically mobile (EPRI, 2012). Physical and chemical mechanisms are available natural attenuation processes acting upon CCR constituents such as cobalt. The performance of MNA as a groundwater corrective measure varies based on site-specific conditions. Additional data collection and analysis may be required to support the USEPA’s tiered approach to MNA (USEPA, 2015) and obtain regulatory approval.

3.3.2 Groundwater Extraction

Groundwater extraction is a widely used groundwater corrective measure. This corrective measure includes installation of a series of groundwater pumping wells or trenches to control and extract impacted groundwater. Groundwater extraction captures and contains impacted groundwater and can limit plume expansion and/or off-site migration. Construction of a groundwater extraction system typically includes, but is not limited to, the following primary project components:

- Designing and constructing a groundwater extraction system consisting of a series of extraction wells or trenches located around the perimeter of the site and operating at a rate to allow capture of CCR impacted groundwater within the Uppermost Aquifer.
- Designing a system to manage extracted groundwater, which may include modification to the existing NPDES permit, including treatment prior to discharge, if necessary.
- Ongoing inspection and maintenance of the groundwater extraction system.

Remediation of inorganics by groundwater extraction can be effective, but systems do not always perform as expected. A combination of factors, including geologic heterogeneities, difficulty in flushing low permeability zones, and sorbed contaminants (desorption rate limited cleanup process) can inhibit effective remediation. Groundwater extraction systems require ongoing operation and maintenance to ensure optimal performance and the extracted groundwater must be managed, either by ex-situ treatment or disposal.

3.3.3 Groundwater Cutoff Wall

Since the late 1970s and early 1980s, vertical cutoff walls have been used to control and/or isolate impacted groundwater. Low permeability cutoff walls can be used to prevent horizontal off-site migration of potentially impacted groundwater. Cutoff walls act as barriers to transport of impacted groundwater and can isolate soils that have been impacted by CCR to prevent contact with unimpacted groundwater. Cutoff walls are often used in conjunction with an interior pumping system to establish a reverse gradient within the cutoff wall. The reverse gradient maintains an inward flow through the wall, keeping it from acting as a groundwater dam and controlling potential end-around or breakout flow of contaminated groundwater.

A commonly used cutoff wall construction technology is the slurry trench method, which consists of excavating a trench and backfilling it with a soil-bentonite mixture, often created with the soils excavated from the trench. The trench is temporarily supported with bentonite slurry that is pumped into the trench as it is excavated (D'Appolonia & Ryan, 1979). Excavation for cutoff walls is conducted with conventional hydraulic excavators, hydraulic excavators equipped with specialized booms to extend their reach (*i.e.*, long-stick excavators), or chisels and clamshells, depending upon the depth of the trench and the material to be excavated. In order for a cutoff wall to be technically feasible, there must be a low-permeability lower confining layer into which the barrier can be keyed, and it must be at a technically feasible depth.

3.3.4 Permeable Reactive Barrier

Chemical treatment via a PRB is defined as an emplacement of reactive materials in the subsurface designed to intercept a contaminant plume, provide a flow path through the reactive media, and transform or otherwise render the contaminant(s) into environmentally acceptable forms to attain remediation concentration goals downgradient of the barrier (EPRI, 2006).

As groundwater passes through the PRB under natural gradients, dissolved constituents in the groundwater react with the media and are transformed or immobilized. A variety of media have been used or proposed for use in PRBs. Zero-valent iron has been shown to effectively immobilize CCR constituents, including arsenic, chromium, cobalt, molybdenum, selenium, and sulfate. Zero-valent iron has not been proven effective for boron, antimony, or lithium (EPRI, 2006).

System configurations include continuous PRBs, in which the reactive media extends across the entire path of the contaminant plume; and funnel-and-gate systems, where barrier walls are installed to control groundwater flow through a permeable gate containing the reactive media. Continuous PRBs intersect the entire contaminant plume and do not materially impact the groundwater flow system. Design may or may not include keying the PRB into a low-permeability unit at depth. Funnel-and-gate systems utilize a system of barriers to groundwater flow (funnels) to direct the contaminant plume through the reactive gate. The barriers, typically some form of cutoff wall, are keyed into a low-permeability unit at depth to prevent short circuiting of the plume. Funnel-and-gate design must consider the residence time to allow chemical reactions to occur. Directing the contaminant plume through the reactive gate can significantly increase the flow velocity, thus reducing residence time.

Design of PRB systems requires rigorous site investigation to characterize the site hydrogeology and to delineate the contaminant plume. A thorough understanding of the geochemical and redox characteristics of the plume is critical to assess the feasibility of the process and select appropriate reactive media. Laboratory studies, including batch studies and column studies using samples of site groundwater, are needed to determine the effectiveness of the selected reactive media at the site (EPRI, 2006). The main considerations in selecting reactive media are as follows (Gavaskar et al., 1998; cited by EPRI, 2006):

- Reactivity - The media should be of adequate reactivity to immobilize a contaminant within the residence time of the design.
- Hydraulic performance - The media should provide adequate flow through the barrier, meaning a greater particle size than the surrounding aquifer materials. Alternatively, gravel beds have been emplaced in front of barriers to direct flow through the barrier.
- Stability - The media should remain reactive for an amount of time that makes its use economically advantageous over other technologies.
- Environmentally compatible by-products - Any by-products of media reaction should be environmentally acceptable. For example, iron released by zero-valent iron corrosion should not occur at levels exceeding regulatory acceptance levels.
- Availability and price: The media should be easy to obtain in large quantities at a price that does not negate the economic feasibility of using a PRB.

3.3.5 In-Situ Chemical Treatment

In-situ chemical treatment technologies for inorganics are being tested and applied with increasing frequency (Evanko and Dzombak, 1997). In-situ chemical treatment includes the targeted injection of reactive media into the subsurface to mitigate groundwater impacts. Inorganic contaminants are typically remediated through immobilization by reduction or oxidation followed by precipitation or adsorption (EPRI, 2006). Chemical reactants that have been applied or are in development for application in treating inorganic contaminants include ferrous sulfate, nanoscale zero-valent iron, organo-phosphorus nutrient mixture (PrecipiPHOS™) and sodium dithionite (EPRI, 2006). Zero-valent iron has been shown to effectively immobilize cobalt.

In-situ chemical treatment design considerations include the following (EPRI, 2006):

- Source location and dimensions
- Source contaminant mass
- The ability to comingle the contaminants and reactants in the subsurface
- Competing subsurface reactions (that consume added reactants)
- Hydrologic characteristics of the source and subsurface vicinity
- Delivery options for the cleanup procedure(s)
- Capture of any contaminants mobilized by the procedures
- Long-term stability of any immobilized contaminants

4. EVALUATION OF POTENTIAL CORRECTIVE MEASURES

4.1 Evaluation Criteria

The corrective measures described in the previous section were evaluated relative to the criteria presented in Section 1.2 and reiterated below:

- Performance
- Reliability
- Ease of implementation
- Potential impacts of appropriate potential remedies (safety impacts, cross-media impacts, and control of exposure to any residual contamination)
- Time required to begin and complete the remedy
- Institutional requirements that may substantially affect implementation of the remedy(s) (permitting, environmental or public health requirements)

These factors are presented in Table 1 with the retained corrective measures to allow a qualitative evaluation of the ability of each corrective measure to address SSLs for cobalt in the Uppermost Aquifer. The goal is to understand which corrective measures could be used, either independently or in combination, to protect human health and the environment by attaining GWPS, as discussed in the following report sections.

4.2 Potential Source Control Corrective Measure Evaluation

Based on the corrective measure review presented in Section 3, the following source control corrective measures are potentially viable to address SSLs in the Uppermost Aquifer:

- Potential Source Control Corrective measures
  - Closure in Place (CIP)
  - Closure by Removal (CBR) (Off-Site Landfill)
  - In-Situ Solidification/Stabilization (ISS)

These remedial corrective measures are discussed below relative to their ability to effectively address the cobalt SSL in the Uppermost Aquifer. To attain GWPS these source control corrective measures may be combined with groundwater corrective measures, such as MNA. Additional site-specific data collection and analyses will be required to verify the feasibility of selected corrective measures and to design the corrective measure(s), consistent with 40 C.F.R. § 257.97 requirements.

4.2.1 Closure in Place

CIP is a widely accepted corrective measure for source control of CCR and is routinely approved by the Ohio Environmental Protection Agency (OEPA). The performance of CIP as a source control corrective measure can vary based on site-specific conditions and may require additional data collection or groundwater fate and transport modeling to support the design and regulatory approval. CIP is a reliable remedial technology that does not require active systems to operate and requires limited maintenance.

Cover systems control exposure to CCR by limiting potential contact with CCR material, controlling stormwater runoff and significantly reducing infiltration of water into the CCR material. During construction of the cover system there is the potential for short term exposure.

Implementation of CIP only requires commonly performed construction and earthwork activities as described in Section 3.2 and can typically be completed in 5 to 8 years, including design, permitting, and construction. CIP requires approval by the OEPA to be implemented.

4.2.2 Closure by Removal (Off-Site Landfill)

CBR is a widely accepted corrective measure with regard to source control of CCR. CBR is a reliable corrective measure that does not require active systems to operate and requires limited maintenance. CBR only requires commonly performed construction and earthwork activities as described in Section 3.2. However, dewatering and moisture conditioning of the CCR for transport can often be problematic; and, site access is limited.

CBR of the Pond System could be completed in approximately 17 to 21 years, including design, permitting, and construction. During that timeframe the transport of the CCR could lead to increased risk to the public, particularly for the off-site disposal, increased greenhouse gas emissions and carbon footprint, and increased potential for fugitive dust exposure.

The regulatory approval process for constructing a new on-site landfill, if feasible, would take multiple levels of approval, including environmental permits and local authorization. Opposition to such projects and regulatory approvals would take years before construction could commence. However, most importantly, there is no available space at the MFS on which to site or construct an on-site landfill, requiring that only off-site landfill alternatives be considered.

4.2.3 In-Situ Solidification/Stabilization

Performance of ISS for application as a CCR source control corrective measure is not proven, therefore the reliability of ISS for CCR is unknown. The design of ISS as a source control corrective measure would require additional data collection. During ISS construction there would be the potential for short term exposure.

Implementation of ISS would require extensive pre-implementation testing, specialized equipment, and specialized contractors. ISS construction timeframes would be dependent on application volume. Treatment of all CCR materials may not be feasible dependent upon depth and obstructions. Targeted ISS may reduce the timeframe required; however, another source control corrective measure would be required to address remaining CCR. ISS requires approval by the OEPA to be implemented.

4.3 Potential Groundwater Corrective Measure Evaluation

Based on the corrective measure review presented in Section 3.3, the following remedial corrective measures are considered potentially viable to address SSLs in the Uppermost Aquifer:

- Potential Groundwater Corrective measures
    - Monitored Natural Attenuation (MNA)
    - Groundwater Cutoff Wall
    - In-Situ Chemical Treatment

- Permeable Reactive Barrier (PRB)
- Groundwater Extraction

These corrective measures are discussed below relative to their ability to effectively address the cobalt SSL in the Uppermost Aquifer. Additional site-specific data collection and analyses will be required to verify the feasibility of selected corrective measures and to design the corrective measure(s), consistent with 40 C.F.R. § 257.97 requirements.

4.3.1 Monitored Natural Attenuation

MNA is a widely accepted corrective measure for groundwater remediation and is routinely approved by state and federal regulators when paired with source control. The performance of MNA as a groundwater corrective measure can vary based on site-specific conditions and would require additional data collection to support the design and regulatory approval consistent with the USEPA's tiered approach to MNA (USEPA 1999, 2007, and 2015). MNA would be implemented as a finishing step in combination with source control corrective measures or other groundwater corrective measures described in Section 3.

MNA is a relatively reliable groundwater corrective measure because operation and maintenance requirements are limited. However, the reliability can also vary based on site-specific hydrogeologic and geochemical conditions. Additional groundwater sample collection and analyses would be required to characterize potential attenuation mechanisms as discussed above. Following characterization and approval, implementation of MNA would be relatively easy and may consist of installing additional monitoring wells. Implementation could be completed within 1 year. Time of construction could be reduced if existing groundwater monitoring well systems could be utilized for MNA.

No potential safety impacts or exposure to human health or environmental receptors are expected to result from implementing MNA. Timeframes to achieve GWPS are dependent on site-specific conditions, which require detailed technical analysis. MNA requires approval by the OEPA to be implemented.

4.3.2 Groundwater Extraction

Groundwater extraction is a widely accepted corrective measure for groundwater with a long track record of performance and reliability. It is routinely approved by state and federal regulators. The performance of a groundwater extraction system is dependent on site-specific hydrogeologic conditions and would require additional data collection and possibly groundwater fate and transport modeling to support the design and regulatory approval.

Implementation of a groundwater extraction system presents design challenges due to the significant features controlling hydraulic head and groundwater flow in the Uppermost Aquifer (*i.e.,* Ohio River and Great Miami River). Relatively high horizontal hydraulic conductivities are anticipated to require a high pumping rate to successfully control groundwater in the vicinity of the Pond System. For a corrective measure using groundwater containment to effectively control off-site flow or to remove potentially contaminated groundwater, horizontal and vertical capture zone(s) must be created using pumping wells. Cutoff walls could be used in conjunction with a pumping system to control groundwater movement. Source control measures (Section 3.2) may also reduce the mass loading to the Uppermost Aquifer, thus reducing the total contaminant mass that would need to be pumped to attain GWPS. Depending on the volumetric rate of extraction required, groundwater pumping wells may require high capacity well registration. Extracted groundwater would need to be managed, which may include modification to the existing NPDES permit and treatment prior to discharge, if necessary.

There could be some impacts associated with constructing and operating a groundwater extraction system, including limited exposure to extracted groundwater. Additional data collection and analyses would be required to design an extraction system. Construction could be completed within 1 year. Time of implementation is approximately 3 to 4 years, including characterization, design, permitting and construction. Timeframes to achieve GWPS are dependent on site-specific conditions, which require detailed technical analysis. Groundwater extraction requires approval by the OEPA to be implemented.

4.3.3 Groundwater Cutoff Wall

Groundwater cutoff walls are a widely accepted corrective measure used to control and/or isolate impacted groundwater and are routinely approved by the state and federal regulators. Cutoff walls have a long history of reliable performance as hydraulic barriers provided they are properly designed and constructed. In addition, ongoing operation and maintenance would be needed to ensure performance over time. Construction of a cutoff wall extending to, and keyed into, the bedrock underlying the Uppermost Aquifer would present challenges due to the required depth (estimated thickness of the permeable valley fill at the MFS is approximately 120 feet). Additional site investigation would be required to verify the feasibility of a cutoff wall keyed into the bedrock below the Uppermost Aquifer.

Cutoff walls are designed to act as hydraulic barriers; as a result, cutoff walls inherently alter the existing groundwater flow system. These changes to the existing groundwater flow system may need to be controlled to maximize the effectiveness of the remedy; for example, groundwater extraction may be required to control build-up of hydraulic head upgradient and around the groundwater cutoff walls. The effectiveness of a cutoff wall as a hydraulic barrier also relies on the contrast between the hydraulic conductivity of the aquifer and the cutoff wall. The most effective barriers have hydraulic conductivity values that are several orders of magnitude lower than the aquifer that it is in contact with. Based on literature, and the high yield of the production wells, the hydraulic conductivity is expected to be high. The high horizontal conductivities in the upper aquifer suggest that a barrier wall would have the desired contrast in hydraulic conductivities.

Additional data collection and analyses would be required to design a cutoff wall. Construction could be completed within 3 to 4 years. Time of implementation is approximately 6 to 9 years, including characterization, design, permitting and construction. To attain GWPS, groundwater cutoff walls require a separate groundwater corrective measure to operate in concert with the hydraulic barriers. Groundwater cutoff walls are commonly coupled with MNA and/or groundwater extraction as groundwater corrective measures. Timeframes to achieve GWPS are dependent on site-specific conditions, which require detailed technical analysis. Groundwater cutoff walls require approval by the OEPA to be implemented.

4.3.4 Permeable Reactive Barrier

PRB application as a groundwater corrective measure for cobalt is not well established and more research is needed (EPRI, 2006), therefore, performance is unknown. PRB treatment of cobalt is expected to have variable reliability based on site-specific hydrogeologic and geochemical conditions. The capacity of the reactive media may be exceeded and require replacement or rejuvenation. Conservative estimates indicate iron-based reactive media are expected to require maintenance every 10 years (ITRC, 2005). Implementation of PRBs may have design challenges associated with both groundwater hydraulics and plume configuration.

Funnel-and-gate PRBs inherently alter the existing groundwater flow system. These changes to the existing groundwater flow system may need to be controlled to reduce potential impacts of the remedy. Construction of PRBs could be completed within 2 to 3 years. Time of implementation is approximately 6 to 9 years, including characterization, design, permitting and construction. Timeframes to achieve GWPS are dependent on site-specific conditions, including reactivity and maintenance (replacement or rejuvenation requirements) which require detailed technical analysis. PRBs and potentially associated groundwater cutoff walls (funnel-and-gate system) require approval by the OEPA to be implemented.

4.3.5 In-Situ Chemical Treatment

In-situ chemical treatment of cobalt is not well established and more research is needed (EPRI, 2006); therefore, performance is unknown. Chemical treatment of cobalt is expected to have variable reliability based on site-specific geochemical conditions. The capacity of the reactive media may be exceeded and require replacement or rejuvenation. Conservative estimates indicate iron-based reactive media is expected to require maintenance every 10 years (ITRC, 2005).

Implementation of in-situ chemical treatment may have design challenges associated with groundwater hydraulics.

Injections of reactive media could be completed within 2 to 3 years. Time of implementation is approximately 8 to 13 years, including characterization, design, permitting and injections. Chemical treatment alters groundwater geochemical conditions, which may result in potential impacts associated with implementation of the remedy. Timeframes to achieve GWPS are dependent on site-specific conditions, including reactivity and maintenance (replacement or rejuvenation requirements) which require detailed technical analysis. Since in-situ chemical treatment alters groundwater geochemistry implementation of the remedy may require Underground Injection Control approval (UIC).

5. REMEDY SELECTION PROCESS

5.1 Retained Corrective Measures

This CMA was prepared to address the requirements of 40 C.F.R. § 257.96. The following potentially viable corrective measures were identified based upon site-specific conditions:

- Potential Source Control Corrective measures
  - Closure in Place (CIP)
  - Closure by Removal (CBR) (Off-Site Landfill)
  - In-Situ Solidification/Stabilization (ISS)
- Potential Groundwater Corrective measures
  - Monitored Natural Attenuation (MNA)
  - Groundwater Extraction
  - Groundwater Cutoff Wall
  - Permeable Reactive Barrier (PRB)
  - In-Situ Chemical Treatment

Per 40 C.F.R. § 257.97, a remedy must be selected to address the SSLs in the Uppermost Aquifer, based on the results of the CMA. The remedy should be selected as soon as possible and must meet the following standards:

- Be protective of human health and the environment
- Attain the groundwater protection standard as specified pursuant to § 257.95(h)
- Control the source(s) of releases so as to reduce or eliminate, to the maximum extent feasible, further releases of constituents in Appendix IV to this part into the environment
- Remove from the environment as much of the contaminated material that was released from the CCR unit as is feasible, taking into account factors such as avoiding inappropriate disturbance of sensitive ecosystems
- Comply with standards for management of wastes as specified in § 257.98(d)

5.2 Future Actions

Semiannual reports per § 257.97 will be prepared to describe the progress in selecting and designing the remedy that addresses the cobalt SSL in the Uppermost Aquifer. A final report describing the selected remedy and how it meets the standards listed above will also be prepared, per § 257.97. The corrective action plan may incorporate one or more of the corrective measures identified in this CMA to address impacts from CCR constituents in the Uppermost Aquifer.

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TABLES

Table 1. Corrective Measures Assessment Matrix
Corrective Measures Assessment
Miami Fort Pond System, North Bend, Ohio
October 30, 2020

	Evaluation Factors	Performance	Reliability	Ease of Implementation	Potential Impacts of Remedy (safety impacts, cross-media impacts, control of exposure to any residual contamination)	Time Required to Begin and Implement Remedy[1]	Time to Attain Groundwater Protection Standards	Institutional Requirements (state/local permit requirements, environmental/public health requirements that affect implementation of remedy)
Source Control Corrective Measures	**Closure In Place**	Widely accepted, routinely approved; variable performance based on site-specific conditions.	Reliable technology.	Commonly performed construction and earthwork.	Controls exposure to CCR. Some potential short term exposure during construction.	5 to 8 years.	Dependent on selected groundwater remediation technology.	Requires regulatory approval processes.
	Closure By Removal (Off-Site Landfill)	Widely accepted, good performance with regard to source control.	Reliable technology.	Commonly performed earthwork. Dewatering can be problematic.	Significant exposure potential.	17 to 21 years.	Dependent on selected groundwater remediation technology.	Requires regulatory approval processes.
	In-Situ Solidification /Stabilization	Not proven in CCR applications.	Unknown.	Requires extensive preimplementation testing and specialized equipment and contractors.	Some potential short term exposure during construction.	Dependent on application volume.	Dependent on selected groundwater remediation technology.	Requires regulatory approval processes.
Groundwater Remediation Corrective Measures	**MNA**	Widely accepted, routinely approved; variable performance based on site-specific conditions.	Reliable, but dependent on site-specific conditions.	Easy.	None identified.	2 to 3 years.	Dependent on site-specific conditions.	Requires regulatory approval processes.
	Groundwater Extraction	Widely accepted, routinely approved; variable performance based on site-specific conditions.	Reliable if properly designed, constructed and maintained.	Design challenges due to groundwater hydraulics and plume configuration. Extracted groundwater would require management.	Alters groundwater flow system. Potential for some limited exposure to extracted groundwater.	3 to 4 years.	Dependent on site-specific conditions.	Extracted groundwater will require management and approval from OEPA. May require high capacity well registration.
	Groundwater Cutoff Wall	Widely accepted, routinely approved, good performance if properly designed and constructed. May not be feasible for the Uppermost Aquifer.	Reliable if properly designed and constructed (if feasible).	Widely used, established technology. May be difficult due to required depth and keying wall into bedrock.	Alters groundwater flow system.	6 to 9 years.	Needs to be combined with other remediation technology(ies). Time required to attain GWPS dependent on combined technologies.	Requires regulatory approval processes.
	Permeable Reactive Barrier	Permeable Reactive Barrier treatment not well established for cobalt.	Variable reliability based on site-specific groundwater hydraulics and geochemical conditions.	Design challenges associated with groundwater hydraulics and plume configuration.	Alters groundwater flow system.	6 to 9 years.	Dependent on site-specific conditions.	Requires regulatory approval processes.
	In-Situ Chemical Treatment	In-Situ treatment not well established for cobalt.	Variable reliability based on site-specific geochemical conditions.	Design challenges associated with groundwater hydraulics.	Alters groundwater geochemistry.	8 to 13 years.	Dependent on site-specific conditions.	May require Underground Injection Control approval.

Notes:

[1] Time required to begin and implement remedy includes design, permitting and construction.

FIGURES

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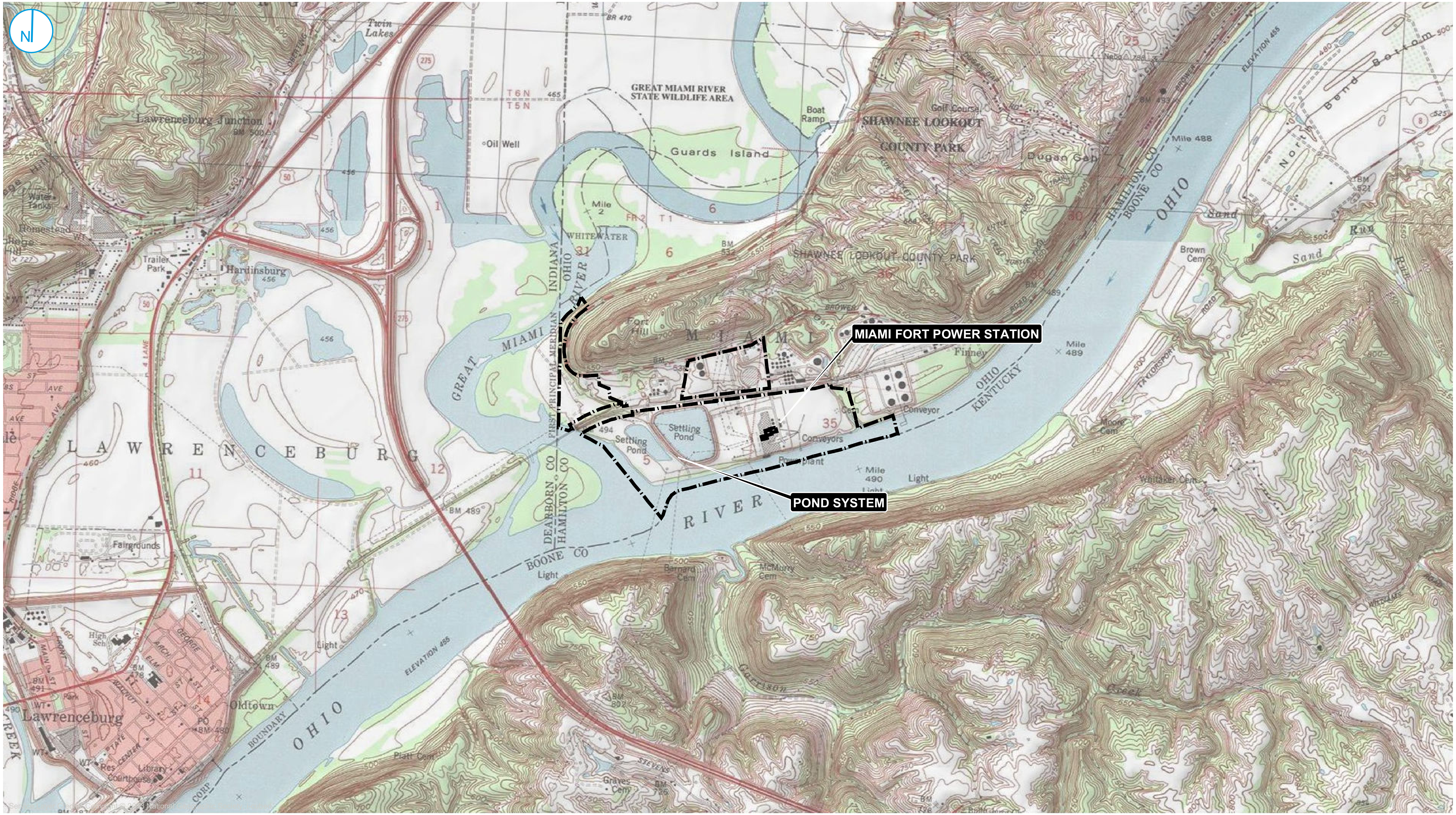
PROJECT: 169000XXXX | DATED: 10/22/2020 | DESIGNER: STOLZSD



▭ APPROXIMATE PROPERTY BOUNDARY

0 1,000 2,000 Feet

SITE LOCATION MAP

FIGURE 1

CORRECTIVE MEASURES ASSESSMENT
MIAMI FORT POND SYSTEM
MIAMI FORT POWER STATION
NORTH BEND, OHIO

O'BRIEN & GERE ENGINEERS, INC.
A RAMBOLL COMPANY

RAMBOLL

⊞ POND SYSTEM DOWNGRADIENT MONITORING WELL
⊞ BACKGROUND MONITORING WELL
⊕ MIAMI FORT PRODUCTION WELLS
⊕ VEOLIA PRODUCTION WELLS
☐ CCR MONITORED MULTI-UNIT
☐ BERM

0 150 300 Feet

CCR GROUNDWATER MONITORING SYSTEM

FIGURE 2

CORRECTIVE MEASURES ASSESSMENT
MIAMI FORT POND SYSTEM
MIAMI FORT POWER STATION
NORTH BEND, OHIO

O'BRIEN & GERE ENGINEERS, INC.
A RAMBOLL COMPANY

RAMBOLL

APPENDIX A
ALTERNATE SOURCE DEMONSTRATION FOR ARSENIC & MOLYBDENUM SSLS

Intended for
Dynegy Miami Fort, LLC

Date
November 12, 2020

Project No.
1940074922

40 C.F.R. § 257.95(g)(3)(ii): ALTERNATE SOURCE DEMONSTRATION

MIAMI FORT POND SYSTEM

RAMBOLL Bright ideas. Sustainable change.

CERTIFICATIONS

I, Jacob J. Walczak, certify that the information in this report is accurate as of the date of my signature below. The content of this report is not to be used for other than its intended purpose and meaning, or for extrapolations beyond the interpretations contained herein.

Jacob J. Walczak
Senior Hydrogeologist
Ramboll Americas Engineering Solutions, Inc.,
f/k/a O'Brien & Gere Engineers, Inc.
Date: November 12, 2020

I, Nicole M. Pagano, a qualified professional engineer in good standing in the State of Ohio, certify that the information in this report is accurate as of the date of my signature below. The content of this report is not to be used for other than its intended purpose and meaning, or for extrapolations beyond the interpretations contained herein.

Nicole M. Pagano
Qualified Professional Engineer
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Ohio
Ramboll Americas Engineering Solutions, Inc.,
f/k/a O'Brien & Gere Engineers, Inc.
Date: November 12, 2020

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ACRONYMS AND ABBREVIATIONS

40 C.F.R.	Title 40 of the Code of Federal Regulations
ASD	Alternate Source Demonstration
bgs	below ground surface
CCR	Coal Combustion Residuals
CMP	corrugated metal pipe
FGD	Flue Gas Desulfurization
f/k/a	formerly known as
ft	feet
GWPS	Groundwater Protection Standards
HDPE	high density polyethylene
LOEs	lines of evidence
MCD	Miami Conservancy District
μg/L	micrograms per liter
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
NAVD88	North American Vertical Datum of 1988
NRT/OBG	Natural Resource Technology, an OBG Company
OEPA	Ohio Environmental Protection Agency
ORP	oxidation-reduction potential
Ramboll	Ramboll Americas Engineering Solutions, Inc., f/k/a O’Brien & Gere Engineers, Inc.
RCRA	Resource Conservation and Recovery Act
Site	Miami Fort Power Station
SSIs	Statistically Significant Increases
SSLs	Statistically Significant Levels
USGS	United States Geological Survey

1. INTRODUCTION

Title 40 of the Code of Federal Regulations (40 C.F.R.) § 257.95(g)(3)(ii) allows the owner or operator of a Coal Combustion Residuals (CCR) unit 90 days from the date of determination of Statistically Significant Levels (SSLs) over Groundwater Protection Standards (GWPS) of groundwater constituents listed in Appendix IV of 40 C.F.R. Part 257 to complete a written demonstration that a source other than the CCR unit being monitored caused the SSL(s), or that the SSL(s) resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality (Alternate Source Demonstration [ASD]).

This ASD has been prepared on behalf of Dynegy Miami Fort, LLC, by Ramboll Americas Engineering Solutions, Inc., formerly known as (f/k/a) O'Brien & Gere Engineers, Inc.(Ramboll), to provide pertinent information pursuant to 40 C.F.R. § 257.95(g)(3)(ii) for the Miami Fort Pond System located near North Bend, Ohio.

The most recent Assessment Monitoring sampling event (A3) was completed on April 6 through April 7, 2020 and analytical data were received on May 4, 2020. Analytical data from all sampling events, from December 2015 through A3, were evaluated in accordance with the Statistical Analysis Plan (Natural Resource Technology, an OBG Company [NRT/OBG], 2017) to determine any Statistically Significant Increases (SSIs) of Appendix III parameters over background concentrations or SSLs of Appendix IV parameters over GWPS. That evaluation identified the following SSLs at downgradient monitoring wells:

- Arsenic at wells MW-2, MW-10 and MW-13
- Cobalt at wells MW-4 and 4A
- Molybdenum at well MW-6

In accordance with the Statistical Analysis Plan, wells MW-13 and 4A were resampled on June 12, 2020 and analyzed only for arsenic and cobalt, respectively, to confirm the SSLs. Following evaluation of analytical data from the resample event, the SSLs listed above for MW-13 and 4A were confirmed.

Pursuant to 40 C.F.R. § 257.95(g)(3)(ii), the following lines of evidence (LOEs) demonstrate that sources other than the Miami Fort Pond System were the cause of the arsenic and molybdenum SSLs listed above. This ASD was completed by November 2, 2020, within 90 days of determination of the SSLs (August 3, 2020), as required by 40 C.F.R. § 257.95(g)(3)(ii). This ASD does not address cobalt SSLs at downgradient monitoring wells MW-4 and 4A which is addressed by the Corrective Measures Assessment for the Pond System.

2. BACKGROUND

2.1 Site Location and Description

Miami Fort Power Station (Site) is located in the southwest corner of Ohio (Hamilton County) adjacent to the state boundaries of Indiana (west) and Kentucky (south), and approximately 5 miles southwest of North Bend, Ohio on the north shore of the Ohio River at the confluence with the Great Miami River (Figure 1). The Miami Fort Pond System (Pond System) is bounded by the Veolia North America property and Brower Road to the north, the Great Miami River to west, the Ohio River to the south, and the Miami Fort electric switch yard to the east. The Miami Fort production wells are located east of Basin A and Veolia's production wells are located northwest of Basin B. Pond System CCR monitoring well locations, production well locations, and source water sampling locations are shown in Figure 1.

2.2 Description of the CCR Multi-Unit

The Pond System is a CCR Multi-Unit consisting of Basins A and B (CCR Multi-Unit ID 115). The Multi-Unit covers a total area of approximately 51 acres and is located in the southwest corner of the Site property as shown in Figure 1.

Basin A (formerly Unit 111) receives effluent from the sluice lines, which primarily transport bottom ash products as well as flue gas desulfurization (FGD) effluent and some fly ash. Basin A also receives directly discharged miscellaneous yard drainage. The material is discharged into the northern portion of the basin and through a constructed internal ditch line allowing the solids to settle and the water to decant into Basin B. Solid materials collected in Basin A are generally reclaimed for beneficial reuse or landfill placement. The Basin A normal pool level is typically between elevations of 495 and 498 ft. Basin A and Basin B are hydraulically connected with a 48-inch corrugated metal pipe (CMP) culvert sliplined with a 40-inch high density polyethylene (HDPE) pipe that runs through the shared dike, allowing the basins to operate in series. The Basin A outfall is currently not in use and flow-through is controlled by the gate structure (AECOM, 2017).

Basin B (formerly Unit 112) was constructed between 1979 and 1981 (AECOM, 2017). The Basin B normal pool level is typically below the Basin A normal pool and between elevations of 495 and 498 ft. Basin A discharges into Basin B, which is used as a polishing pond prior to discharge to the Ohio River through the permitted outfall structure in Basin B. Miscellaneous yard drainage is also currently discharged directly to Basin B (AECOM, 2017).

2.3 Geology and Hydrogeology

The native geologic materials present beneath the Pond System at the Site include alluvial deposits, glacial outwash (Uppermost Aquifer), and bedrock, as described below:

- Alluvial Deposits - The alluvial deposits consist of clay, silt and fine sand deposited by the Ohio River floodwaters. These alluvial deposits are present at a depth ranging from approximately 20 to 60 ft below ground surface (bgs). A silty, sandy clay layer is the primary component of the alluvial deposits. The top of clay elevation ranges from 428 ft referenced to the North American Vertical Datum of 1988 (NAVD88) in the southwest corner of Basin B near the confluence of the Ohio River and the Great Miami River to 495 ft beneath the northeast corner of Basin A. The clay is thin, or absent, near the valley wall north of the Pond System and thickens towards the Ohio River. The clay is thickest beneath the southern half of the

Pond System, ranging in thickness from 15 ft to 48 ft. A silt layer, averaging approximately 7 ft thick, overlies the clay in several areas.

- Glacial Outwash (Uppermost Aquifer) - The Uppermost Aquifer consists of glacial outwash sands and gravels deposited during the Illinoian and Wisconsin stages of the Pleistocene. The thickness of the outwash deposits beneath the Site is approximately 100 ft; the outwash deposits directly overlie bedrock. A silt and fine sand layer is present locally overlying the outwash deposits and ranges in thickness from 4 to 30 ft; however, it is not present below the entirety of the Pond System.
- Bedrock - The bedrock consists of interbedded shales and limestones belonging to the Ordovician-aged Fairview and Kope formations (AECOM, 2017). Depth to bedrock beneath the Site varies between approximately 110 to 120 ft bgs. Due to the relatively impermeable nature of the shales and limestones underlying this region, water yields in the bedrock are generally insufficient for domestic use (AECOM, 2017).

The glacial outwash deposits (Uppermost Aquifer) underlying the Pond System are part of the Ohio River Valley Fill Aquifer; a glacial buried-valley deposit aquifer. The valley was cut into the bedrock by pre-glacial and glacial streams and subsequently backfilled with deposits of sand, gravel, and other glacial drift by glacial and alluvial processes as the glaciers advanced and receded. The thickness of the deposits ranges from approximately 60 to 100 ft and covers much of the width of the terrace between the valley wall to the Great Miami River and Ohio River confluence.

Groundwater elevations across the Site ranged from approximately 456 to 460 ft during A3, coincident with an approximate Ohio River pool elevation of 461 ft. The groundwater elevation contours shown on Figure 2 are based on groundwater measurements collected on April 6, 2020, the day prior to A3 analytical sampling. Groundwater flow in the Uppermost Aquifer is generally to the west/northwest towards the Great Miami River and Veolia’s production wells, and south towards the Ohio River.

3. ALTERNATE SOURCE DEMONSTRATION: LINES OF EVIDENCE

This ASD is based on the following LOEs:

1. Median arsenic and molybdenum concentrations in the Pond System source water are lower than the median arsenic and molybdenum concentrations observed in downgradient wells with arsenic and molybdenum SSLs.
2. Arsenic and molybdenum concentrations associated with monitoring wells MW-2, MW-10 and MW-13, and MW-6, respectively, are not correlated with boron concentrations, a common indicator for CCR impacts to groundwater.
3. Naturally-occurring concentrations of arsenic are commonly found in soils and groundwater in southwestern Ohio. MW-2, MW-10 and MW-13 are located in southwestern Ohio, along the banks of the Great Miami River and Ohio River, where they are susceptible to geochemical conditions that can mobilize naturally-occurring arsenic from the soils into groundwater.

These LOEs are described and supported in greater detail below. Monitoring wells and Pond System source water sample locations are shown on Figure 1.

3.1 LOE #1: Median Arsenic and Molybdenum Concentrations in the Pond System Source Water Are Lower Than the Median Arsenic and Molybdenum Concentrations Observed in Downgradient Wells with Arsenic and Molybdenum SSLs.

Box-and-whisker plots graphically represent the range of values of a given dataset using lines to construct a box where the lower line, midline, and upper line of the box represent the values of the first quartile, median, and third quartile values, respectively. The minimum and maximum values of the dataset (excluding outliers) are illustrated by whisker lines extending beyond the first and third quartiles of (*i.e.*, below and above the box). The interquartile range (IQR) is the distance between the first and third quartiles. Outliers (values that are at least 1.5 times the IQR away from the edges of the box) are represented by single points plotted outside of the range of the whiskers. The number in parentheses below each plot is the number of observations (i.e. samples) represented in that dataset.

Figure A below provides a box-and-whisker plot of the total arsenic concentrations collected between 2015 and 2020 at Pond System monitoring wells and source water locations A-1, B-1, B-2, and B-3 (monitoring well and source water [pond] sampling locations are shown on Figure 1). Total arsenic concentrations obtained in source water samples and presented in Figure A were pooled to provide a median concentration for comparison to arsenic concentrations in monitoring wells.

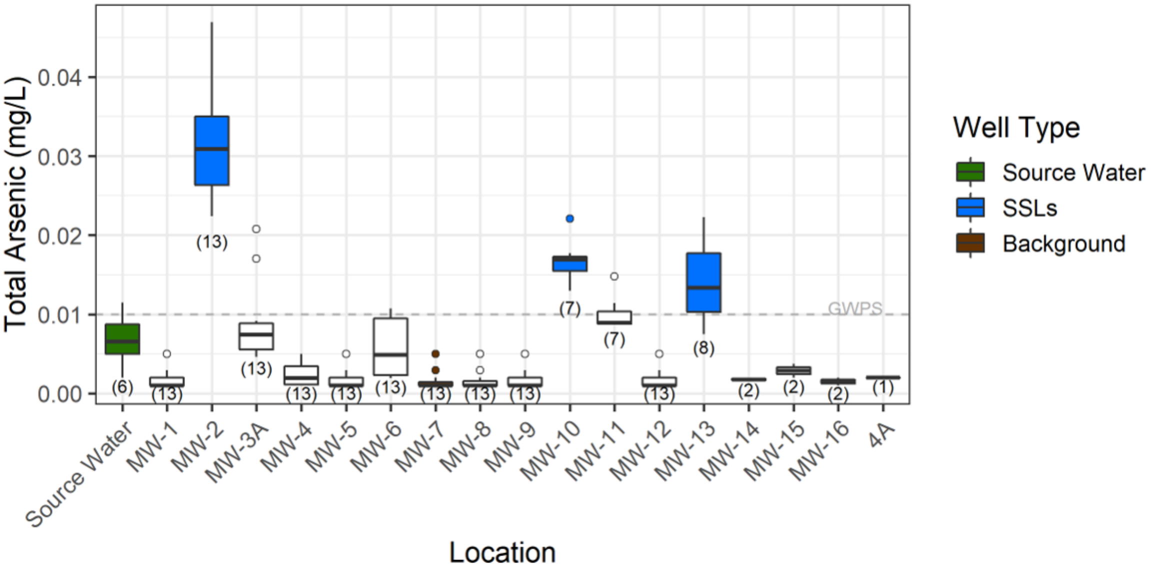

Figure A. Distribution of Arsenic Concentrations at Pond System Monitoring Wells and Source Water Locations (note: source water locations are pooled).

The box-and-whisker plot (Figure A) shows the arsenic concentrations in wells with arsenic SSLs (*i.e.*, MW-2, MW-10, and MW-13) have median arsenic concentrations greater than the median arsenic concentration observed in the source water (A-1, B-1, B-2, and B-3). If the Pond System was the source of arsenic in downgradient groundwater at wells with arsenic SSLs (*i.e.*, MW-2, MW-10, and MW-13), Pond System source water concentrations would be higher than the groundwater concentrations at those wells. Therefore, the Pond System is not the source of the arsenic in the downgradient groundwater.

Figure B below provides a box-and-whisker plot of the molybdenum concentrations collected between 2015 and 2020 at Pond System monitoring wells and source water locations A-1, B-1, B-2 and B-3 (monitoring well and source water sampling locations are shown on Figure 1).

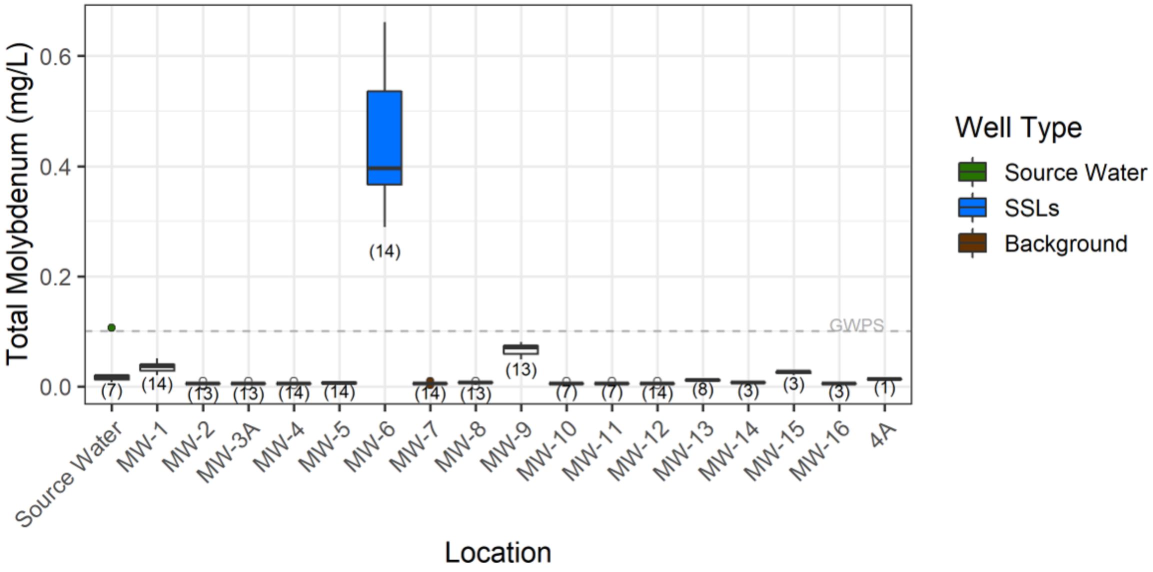

Figure B. Distribution of Molybdenum Concentrations at Pond System Monitoring Wells and Source Water Locations (note: source water locations are pooled).

The box-and-whisker plot (Figure B) shows the median molybdenum concentration in the well with a molybdenum SSL (*i.e.*, MW-6) is greater than the median molybdenum concentration observed in the source water (A-1, B-1, B-2, and B-3). If the Pond System was the source of molybdenum in downgradient groundwater at the well with a molybdenum SSL (*i.e.*, MW-6), Pond System source water concentrations would be higher than the groundwater concentrations at that well. Therefore, the Pond System is not the source of the molybdenum in the downgradient groundwater.

3.2 LOE #2: Arsenic and Molybdenum Concentrations Associated with Monitoring Wells MW-2, MW-10 and MW-13, and MW-6, respectively, are Not Correlated with Boron Concentrations, a Common Indicator for CCR Impacts to Groundwater.

Boron is a common indicator of CCR impacts to groundwater due to its leachability from CCR and mobility in groundwater. If a CCR constituent is identified as an SSL but boron is not correlated with that constituent, it is unlikely that the CCR unit is the source of the SSL.

Figure C below provides a scatter plot of arsenic versus boron concentrations (collected between 2015 and 2020) in downgradient groundwater at wells with arsenic SSLs, along with the results of a Kendall correlation test for non-parametric data. The results of the test at each well are described by the p-value and tau (Kendall's correlation coefficient) included in each plot. Typically, a p-value greater than 0.05 is considered to be a statistically insignificant relationship. The range of tau falls between -1 and 1, with a perfect correlation equal to -1 or 1. The closer tau is to 0, the less of a correlation exists in the data.

The results of the correlation analyses indicated that groundwater concentrations of arsenic observed at monitoring wells MW 2, MW-10, and MW-13 do not correlate with concentrations of boron, a common indicator of CCR impacts to groundwater. Figure C below illustrates the lack of a relationship between arsenic concentrations and boron concentrations in groundwater at MW-2, MW-10, and MW-13, where the p-values are greater than 0.05 and tau is close to 0.

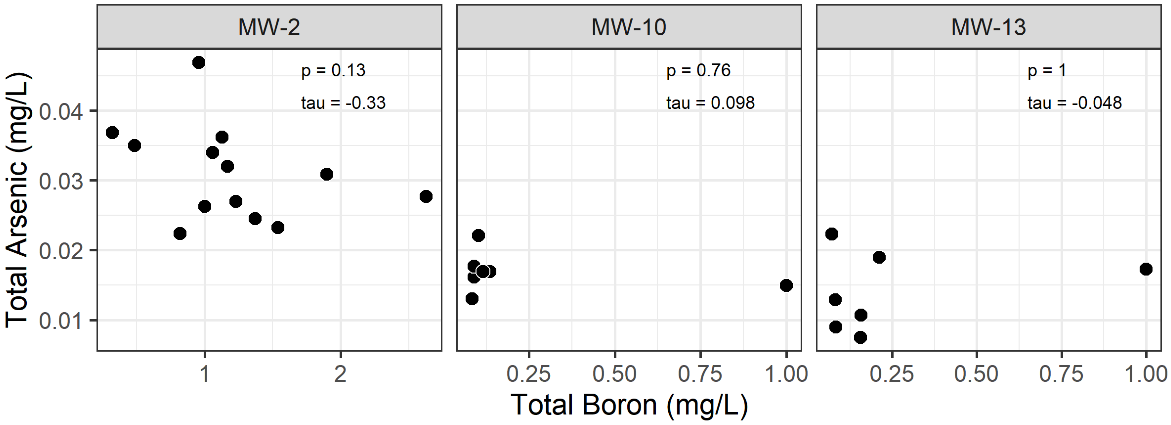

Figure C. Arsenic Concentrations Versus Boron Concentrations at Wells MW-2, MW-10, and MW-13 (2015-2020).

Figure D below provides a scatter plot of molybdenum versus boron concentrations (collected between 2015-2020) in downgradient groundwater at the only well with a molybdenum SSL, MW-6, along with the results of Kendall correlation analysis at MW-6 as described by the p-values and tau correlation coefficients included in the plot. The results of the Kendall correlation analysis indicated that groundwater molybdenum concentrations observed at monitoring well MW-6 do not correlate with concentrations of boron, a common indicator of CCR impacts to groundwater. Figure D below illustrates the lack of a relationship between molybdenum concentrations and boron concentrations in groundwater at MW-6, where the p-value is greater than 0.05 and tau is close to 0.

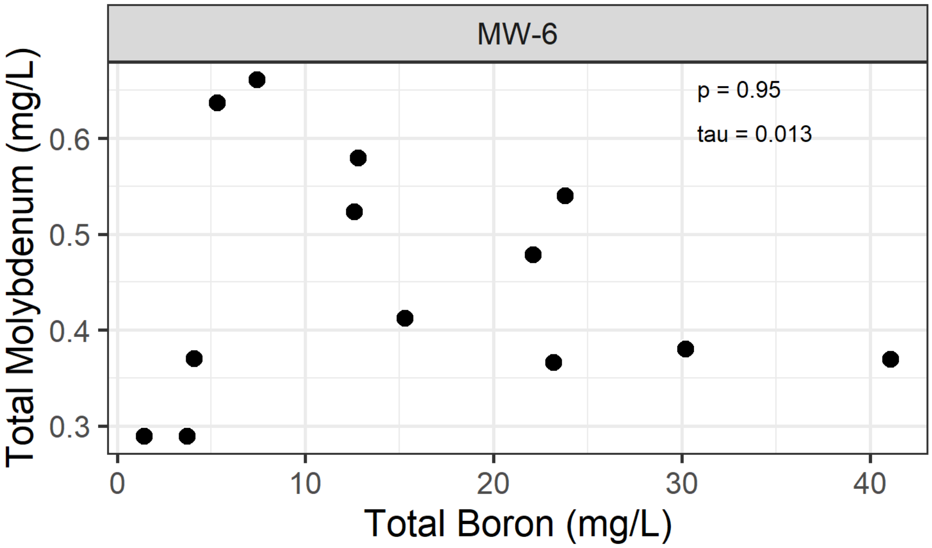

Figure D. Molybdenum Concentrations Versus Boron Concentrations at Well MW-6 (2015-2020).

Arsenic and molybdenum concentrations do not correlate with boron concentrations in downgradient monitoring wells with arsenic and molybdenum SSLs, indicating the Pond System is not the source of CCR constituents detected in the downgradient monitoring wells.

3.3 LOE #3: Naturally-Occurring Concentrations of Arsenic are Commonly Found in Soils and Groundwater in Southwestern Ohio. MW-2, MW-10, and MW-13 are Located in Southwestern Ohio, Along the Banks of the Great Miami River and Ohio River, Where They are Susceptible to Geochemical Conditions that can Mobilize Naturally-Occurring Arsenic from the Soils into Groundwater.

Naturally-occurring concentrations of arsenic are commonly found in nearby soils. Ten surficial soil samples (0 to 2 ft bgs) were collected by Ohio Environmental Protection Agency (OEPA), approximately 3,000 ft northeast of the Pond System (Figure 1), near Shawnee Lookout in Hamilton County Park, and analyzed for arsenic as part of a study to evaluate background soil concentrations of Resource Conservation and Recovery Act (RCRA) metals in the Cincinnati area (OEPA, 2015). Results of the analysis indicated surficial terrace soils (clay) adjacent to the Pond System have background arsenic concentrations ranging from 5.61 to 8.20 milligrams per kilogram (mg/kg).

Arsenic occurs naturally in southwestern Ohio glacial buried-valley deposit aquifers like the Uppermost Aquifer. Fifty-seven (57) groundwater samples were collected by the United States Geological Survey (USGS) in cooperation with the Miami Conservancy District (MCD) to increase understanding of arsenic occurrence in southwest Ohio (Thomas et al., 2005). The study included samples collected from carbonate bedrock, glacial buried-valley deposits and glacial till with interbedded sand and gravel aquifers within the Great Miami River drainage basin, and included samples from domestic wells in Preble, Miami, and Shelby counties. The USGS reported that 37 percent of the samples analyzed had elevated concentrations of arsenic (greater than or equal to 10 micrograms per liter [μg/L]) and elevated arsenic concentrations were found in all three aquifer types studied. Geochemical conditions were also evaluated and the USGS determined that elevated arsenic concentrations in the study area were associated with iron-reducing, sulfate-reducing, or methanic conditions, and all samples with elevated arsenic concentrations had iron concentrations that exceeded 1 milligrams per liter (mg/L), indicating the potential for the reduction of arsenic-bearing iron oxides present in soil.

Based on previous studies discussed above, naturally-occurring concentrations of arsenic are known to exist in both soils and groundwater in the same region (southwestern Ohio) and aquifer type (glacial buried-valley deposit aquifer) as the Pond System. The OEPA study showed arsenic-bearing soils were found in close proximity (approximately 3,000 ft northeast) to the Pond System. The USGS study showed that iron-reducing, sulfate-reducing, or methanic geochemical conditions needed to mobilize arsenic were common in southwestern Ohio aquifers. Reducing conditions indicating the potential for arsenic mobilization are likely to occur at the Pond System monitoring wells MW-2, MW-10, and MW-13, where arsenic SSLs were determined, as indicated by the following factors discussed below:

- Most riverbank boring logs indicate organic materials are present in the soils.
- MW-2, MW-10, and MW-13 are among the monitoring wells adjacent to the riverbank, where the lowest oxidation-reduction potential (ORP) at the Site were observed.

- Dissolved iron concentrations present in groundwater at monitoring well MW-2 correlate with dissolved arsenic concentrations.

Arsenic is naturally present in groundwater and soils at variable concentrations. The arsenic is co-precipitated with iron oxyhydroxides and incorporated into the mineral structure of the soils, and can also be adsorbed to organic matter or the iron oxyhydroxides in the aquifer. Both of these sources of arsenic can be mobilized in groundwater by dissolution or desorption under reducing geochemical conditions, where organic carbon commonly acts as the reducing agent (Thomas et al., 2005; McArthur et al., 2001). Arsenic-bearing soils are known to be present in the areas near the Pond System (OEPA, 2015); and, organic matter, a source of organic carbon and potential reducing agent, was observed in the most riverbank boring logs for monitoring wells located along the banks of the Great Miami River and Ohio River (see boring logs for wells MW-2, MW-3A, MW-4, MW-10, and MW-11 in Appendix A). The presence of organic material and arsenic-bearing soils indicates there is potential for naturally-occurring arsenic to become mobilized through reductive dissolution or desorption.

Reducing conditions sufficient to mobilize naturally-occurring arsenic have also been observed along the riverbanks of the Great Miami River and Ohio River as evidenced by the low ORP measurements observed in the groundwater at monitoring wells MW-2, MW-3A, MW-10, MW-11, MW-13 and MW-14 (presented in Figure E below; monitoring wells adjacent to the riverbank are illustrated with solid lines, upland wells are illustrated with dashed lines).

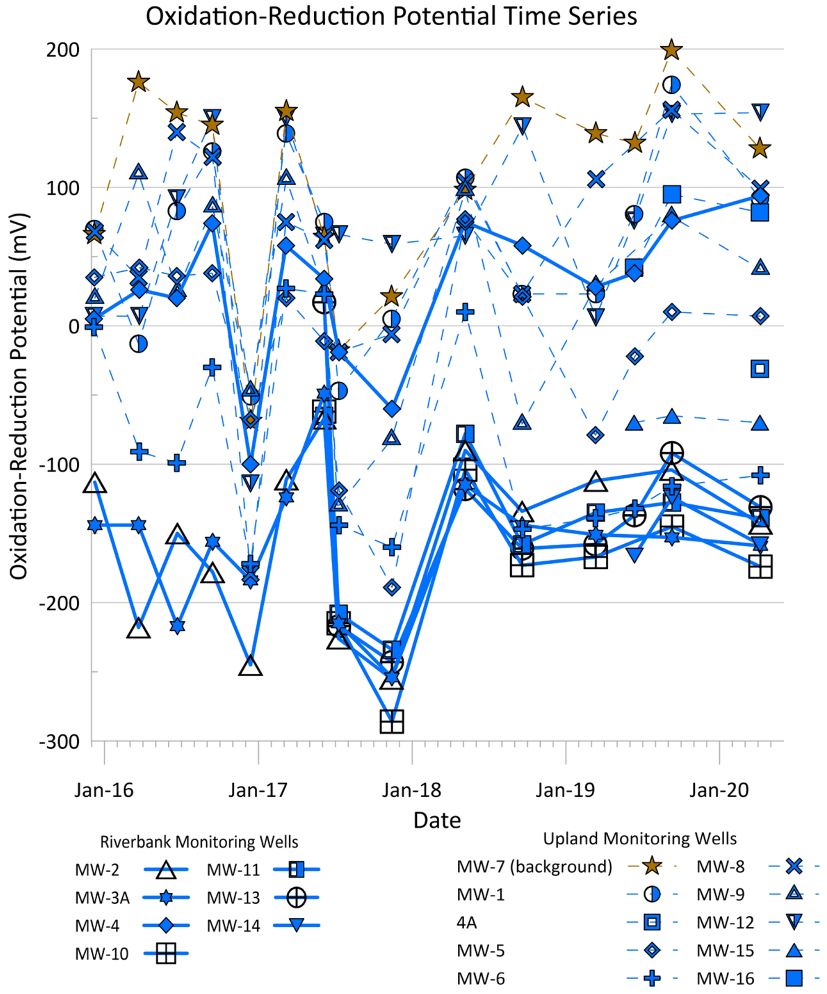

Figure E. Oxidation Reduction Potential Time-Series for Groundwater Samples (Monitoring Wells Adjacent to the Riverbank are Illustrated with Solid Lines, Upland Wells are Illustrated with Dashed Lines).

Available data indicated that concentrations of dissolved iron observed in groundwater at monitoring well MW-2 from 2008 to 2014 correlate with dissolved arsenic concentrations. Dissolved iron concentrations ranged from 11.8 to 52.1 mg/L at monitoring well MW-2 from 2008 to 2014, at least an order of magnitude greater than the 1 mg/L reported by the USGS as being indicative of iron-reducing geochemical conditions. Dissolved iron concentrations were also near or greater than 1 mg/L in A3 for MW-2, MW-10, and MW-13 at 45, 2.5 and 0.91 mg/L, respectively. Figure F below illustrates the relationship between dissolved iron concentrations and dissolved arsenic concentrations in groundwater at MW-2, where the R-squared value is 0.87, indicating a good correlation between dissolved iron and dissolved arsenic.

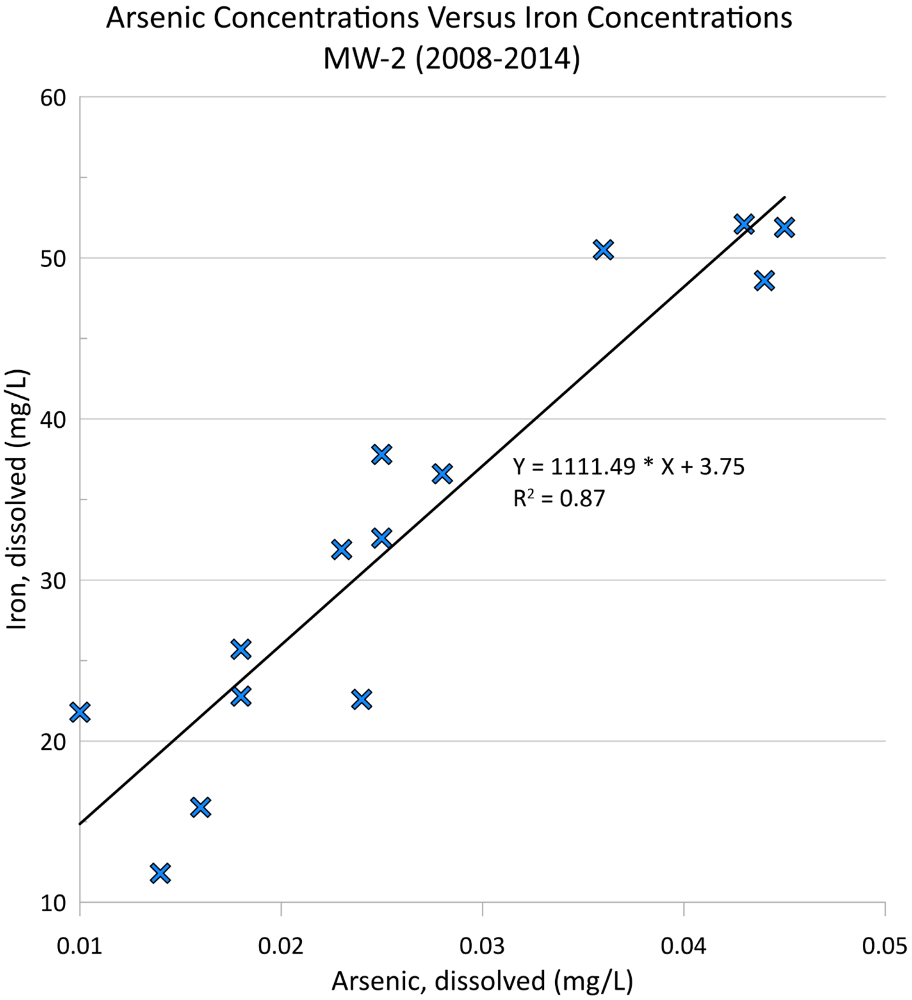

Figure F. Arsenic Concentrations Versus Iron Concentrations at Well MW-2 (2008-2014).

The presence of elevated concentrations of arsenic in background soil and groundwater in surrounding areas, as well as the presence of geochemical conditions (*i.e.*, reducing conditions) necessary to mobilize arsenic from soil to groundwater indicate that elevated concentrations of arsenic at monitoring wells MW-2, MW-10, and MW-13 are likely the result of naturally-occurring geochemical variations within the Uppermost Aquifer.

4. CONCLUSIONS

Based on the following three LOEs, it has been demonstrated that the arsenic SSLs at MW-2, MW-10, and MW-13, and the molybdenum SSL at MW-6 are not due to Miami Fort Pond System but are from a source other than the CCR unit being monitored:

1. Median arsenic and molybdenum concentrations in the Pond System source water are lower than the median arsenic and molybdenum concentrations observed in downgradient wells with arsenic and molybdenum SSLs.
2. Arsenic and molybdenum concentrations associated with monitoring wells MW-2, MW-10 and MW-13, and MW-6, respectively, are not correlated with boron concentrations, a common indicator for CCR impacts to groundwater.
3. Naturally-occurring concentrations of arsenic are commonly found in soils and groundwater in southwestern Ohio. MW-2, MW-10 and MW-13 are located in southwestern Ohio, along the banks of the Great Miami River and Ohio River, where they are susceptible to geochemical conditions that can mobilize naturally-occurring arsenic from the soils into groundwater.

This information serves as the written ASD prepared in accordance with 40 C.F.R. § 257.95(g)(3)(ii) that the SSLs for arsenic and molybdenum observed during the A3 sampling event were not due to the Pond System. Therefore, a corrective measures assessment is not required for arsenic and molybdenum at the Miami Fort Pond System.

5. REFERENCES

AECOM, 2017. Hydrogeologic Characterization Report, CCR Management Units 111 (Basin A) and 112 (Basin B). Prepared for Dynegy Miami Fort, LLC by AECOM. October 11, 2017.

McArthur, J.M., Ravenscroft, R., Safiulla, S., and Thirwall, M.F., 2001, Arsenic in groundwater—Testing pollution mechanisms for sedimentary aquifers in Bangladesh: Water Resources Research, v. 37, no. 1, p. 109–117.

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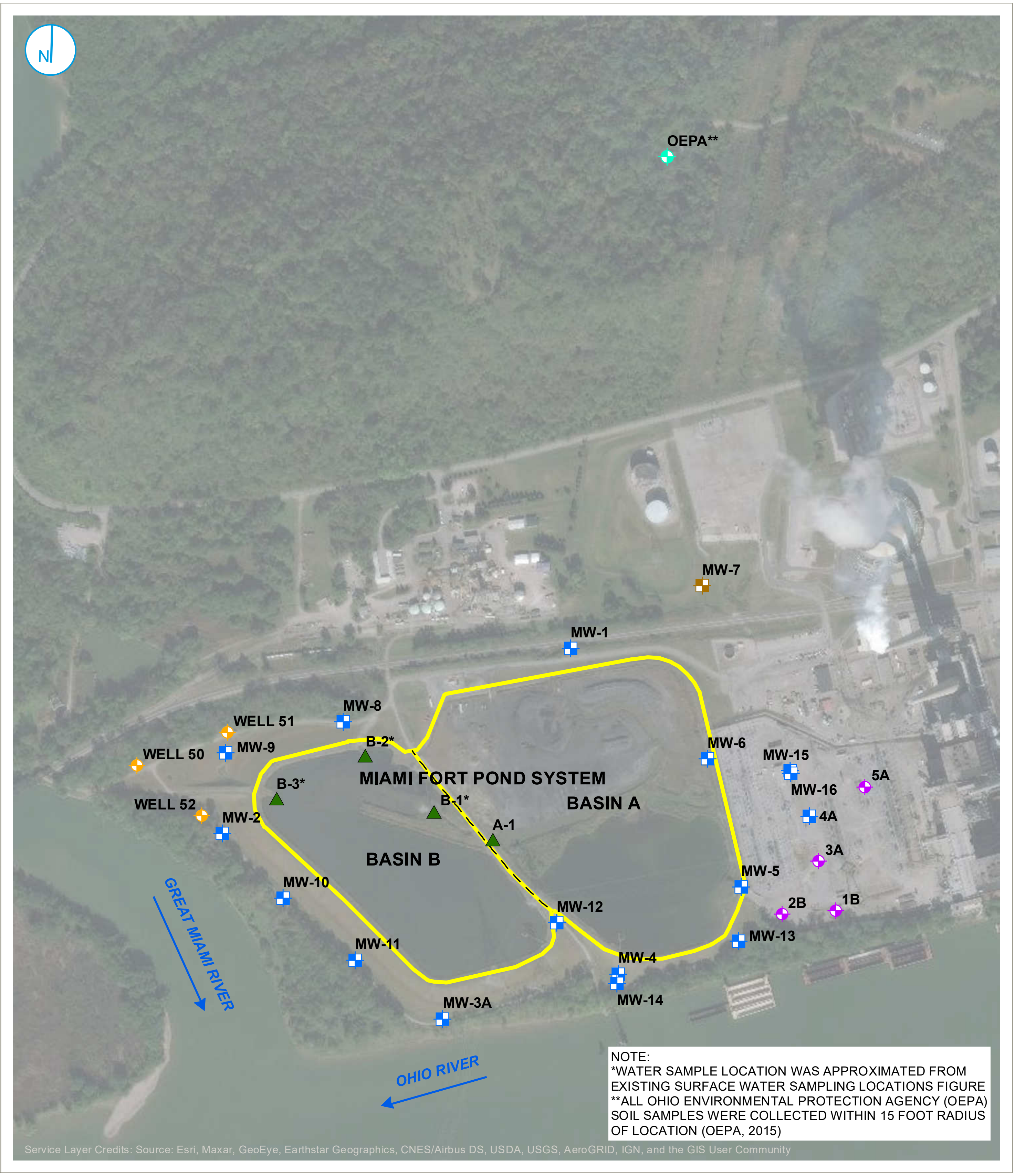
Ohio Environmental Protection Agency (OEPA), 2015, Evaluation of Background Metal Soil Concentrations in Hamilton County – Cincinnati Area, Developed in Support of the Ohio Voluntary Action Program, Summary Report, May 2015.

Thomas, M.A., Schumann, T.L., and Pletsch, B.A., 2005, Arsenic in ground water in selected parts of southwestern Ohio, 2002–03: U.S. Geological Survey Scientific Investigations Report 2005–5138, 30 p.

FIGURES

Y:\Mapping\Projects\22\2285\MXD\Miami_Fort\asd\A3\Figure 1_Monitoring Well and Sampling Locations.mxd

PROJECT: 169000XXXX | DATED: 10/20/2020 | DESIGNER: galarnmc



NOTE:
*WATER SAMPLE LOCATION WAS APPROXIMATED FROM EXISTING SURFACE WATER SAMPLING LOCATIONS FIGURE
**ALL OHIO ENVIRONMENTAL PROTECTION AGENCY (OEPA) SOIL SAMPLES WERE COLLECTED WITHIN 15 FOOT RADIUS OF LOCATION (OEPA, 2015)

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

- DOWNGRADIENT CCR MONITORING WELL LOCATION
- BACKGROUND CCR MONITORING WELL LOCATION
- ▲ SOURCE WATER SAMPLING LOCATION
- OEPA SOIL SAMPLE LOCATION
- MIAMI FORT PRODUCTION WELL
- VEOLIA PRODUCTION WELL
- CCR MONITORED MULTI-UNIT
- BERM
- ← RIVER FLOW DIRECTION

0 300 600
Feet

MONITORING WELL AND SAMPLING LOCATION MAP

FIGURE 1

MIAMI FORT POND SYSTEM (UNIT ID:115)
ALTERNATE SOURCE DEMONSTRATION
VISTRA ENERGY
MIAMI FORT POWER STATION
NORTH BEND, OHIO

RAMBOLL US CORPORATION
A RAMBOLL COMPANY

Y:\Mapping\Projects\22\2285\MXD\Miami_Fort\asd\A3\Figure 2_2020_1Q_MiamiFort_GW_Contours.mxd

NOTES:
GAUGING DATA FROM USGS 03255000 OHIO RIVER AT CINCINNATI, OH.
ELEVATIONS IN PARENTHESES NOT USED FOR CONTOURING

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Graphics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

PROJECT: 72799 | DATED: 10/22/2020 | DESIGNER: STOLZSD

⊞ CCR MONITORING WELL LOCATION
⊕ MIAMI FORT PRODUCTION WELLS
⊕ VEOLIA PRODUCTION WELLS
▭ CCR MONITORED MULTI-UNIT
▭ BERM
← RIVER FLOW DIRECTION
— SURFACE WATER FEATURE

— GROUNDWATER ELEVATION CONTOUR (1-FOOT CONTOUR INTERVAL, NAVD 88)
- - INFERRED GROUNDWATER ELEVATION CONTOUR
➡ GROUNDWATER FLOW DIRECTION

0 250 500
Feet

GROUNDWATER ELEVATION CONTOUR MAP
APRIL 6, 2020

MIAMI FORT POND SYSTEM (UNIT ID: 115)
ALTERNATE SOURCE DEMONSTRATION
MIAMI FORT POWER STATION
NORTH BEND, OHIO

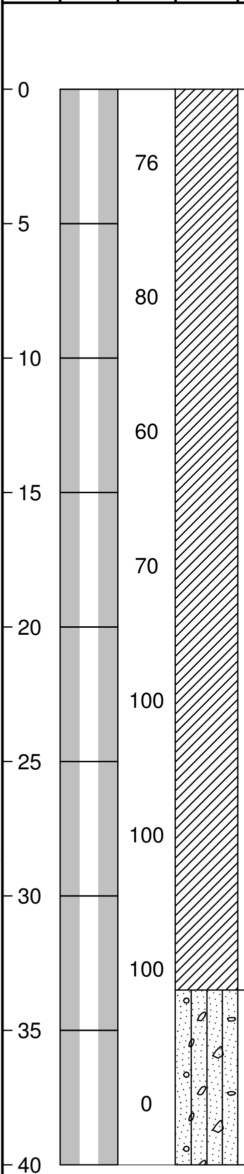
FIGURE 2

RAMBOLL US CORPORATION
A RAMBOLL COMPANY

RAMBOLL

APPENDIX A
BORING LOGS FOR MONITORING WELLS MW-2, MW-3A, MW-4, MW-10, AND MW-11

Depth (Feet)	Sample Location	Percent Recovery	USCS Symbol	DESCRIPTION OF SUBSURFACE MATERIALS	WELL CONSTRUCTION DETAIL



Brown to dark brown sandy CLAY with silt and trace pebbles and rounded gravel, soft, plastic, moist

grades with organics

grades with less sand, pebbles, and gravel, stiff, no plasticity

grades with increasing sand and pebbles, single 3" cobble
grades soft, plastic, very moist

grades brownish yellow to brown, without organics

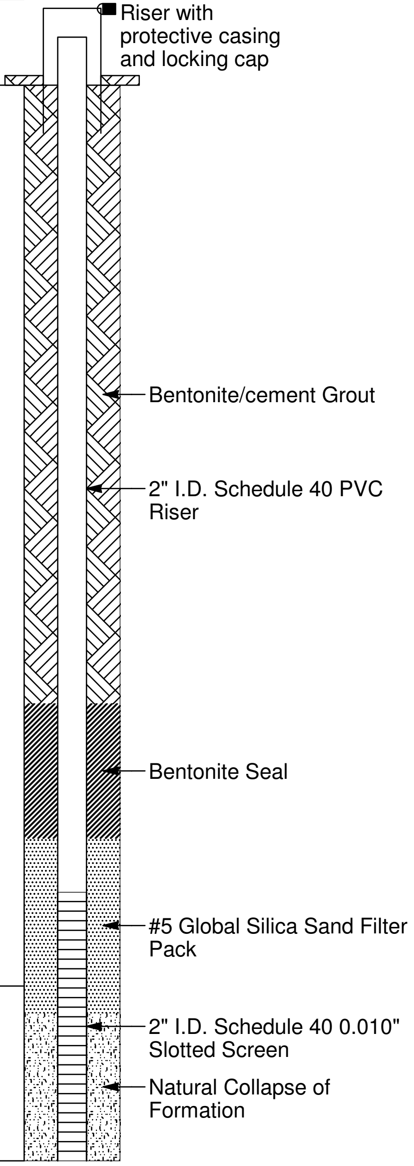
grades medium stiff to stiff, very slight plasticity to no plasticity

grades with increasing fine sand, plastic, soft

grades gray to dark gray, with increasing silt and sand

grades wet

Gray fine to coarse SAND and rounded GRAVEL, very loose, poorly sorted, wet



Boring terminated 40' bgs on 12/11/2007.
2" I.D. Schedule 40 PVC monitoring well installed 40' bgs with 10' 0.010" slotted screen.

LEGEND:

▥	Rotosonic
bgs	Below ground surface
NR	Not recorded

URS

JOB NO. 14947868

Duke Energy
Miami Fort Station
11021 Brower Road
North Bend, OH

MONITORING WELL
MW-2

Page 1 of 1

Duke Energy - 14947868 - North Bend, OH

DUKE ENERGY MIAMI FORT STATION MIAMI FORT STATION.GPJ 2/5/08

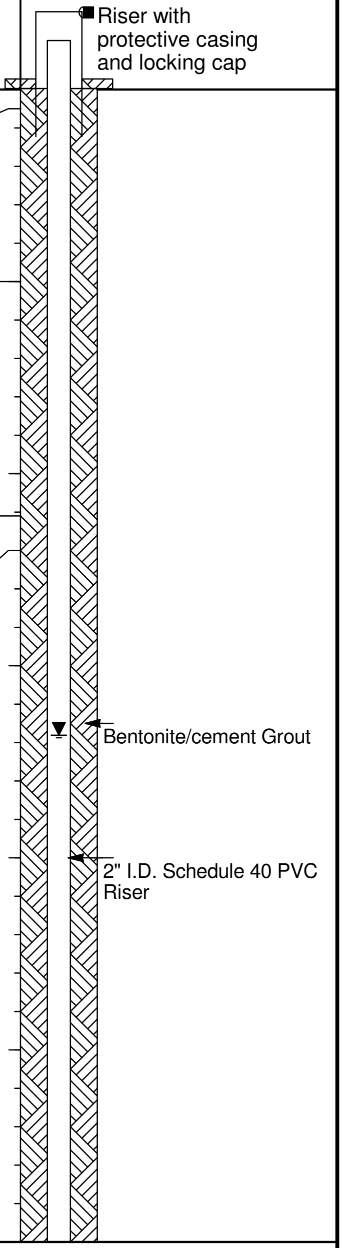
Project: Duke Energy
Project Location: Miami Fort Station
Project Number: 14948624

Monitoring Well
MW-3A
Sheet 1 of 2

Date(s) Drilled	**2/25/2009**	Logged By	**K. Pritchard**	Checked By	**M. Wagner**
Drilling Method	**4.25 in. Hollow Stem Auger**	Drilling Contractor	**Belasco Drilling Services**	Total Depth of Borehole	**52.0 feet**
Drill Rig Type	**Truck-Mounted Auger**	Sampler Type	**Split Spoon**	Surface Elevation	**471.17 feet, msl**
Groundwater Elevation(s)	**456.42 ft, msl**	Hammer Weight and Drop	**140 lb, Dropped 30-inches**	Top of PVC Elevation	**473.23 feet, msl**
Diameter of Hole (inches)	**8.25** Diameter of Well (inches) **2**	Type of Well Casing	**Schedule 40 PVC**	Screen Perforation	**0.010-Inch**
Type of Sand Pack	**Natural Collapse**	Well Completion at Ground Surface	**Riser, With Locking Cap**		
Comments	**** Split spoon sampler advanced through interval under weight of hammer and rods only**				

Elevation, feet	Depth, feet	SAMPLES Blows per 1-foot Interval	SAMPLES Percent Recovery	MATERIAL DESCRIPTION
470	0	12	83	Yellowish red CLAY TOPSOIL, moist Gray to brownish gray clayey SILT with medium sand and organics, soft, moist to very moist
		19	100	
	5	6	83	grades brownish yellow with increasing clay Dark gray silty CLAY with trace fine sand and organics, plastic, very soft, moist
465		3	100	grades with increasing fine to medium sand, without organics, with iron staining
		3	83	grades with medium to coarse grained sand lenses, without staining grades high plasticity, very moist to wet
460	10	3	75	Yellowish brown clayey fine to coarse grained SAND, very loose, well sorted, wet
		2	100	Yellowish brown fine grained sandy to silty CLAY, very soft, high plasticity, very moist to wet
	15	1	100	grades wet with increasing fine sand
455		1	100	grades with fine grained sand lenses
		2	100	grades brown with increasing fine sand
450	20	2	100	
		2	100	grades with gray to reddish gray lenses, decreasing sand, without sand lenses grades gray, without gray to reddish gray lenses, medium plasticity
	25	**	100	grades high plasticity grades with increasing sand
445		3	100	grades with organics, sulphur odor, decreasing sand
	30	2	100	grades without sand, without odor grades with fine sand lenses, without organics

WELL CONSTRUCTION DETAILS



Project: Duke Energy
Project Location: Miami Fort Station
Project Number: 14948624

Monitoring Well MW-3A

Sheet 2 of 2

Elevation, feet: 440, 435, 430, 425, 420, 415, 410, 405

Depth, feet: 30, 35, 40, 45, 50, 55, 60, 65, 70

SAMPLES		
Type	Blows per 1-foot Interval	Percent Recovery
☒	1	100
☒	4	100
☒	4	100
☒	3	100
☒	6	100
☒	4	100
☒	8	100
☒	14	42
☒	7	100
☒	22	63
☒	13	50

MATERIAL DESCRIPTION

grades without sand, with trace organics

grades with sand, without organics

grades with trace fine sand and increasing silt, without sand lenses, medium plasticity

grades with increasing sand, without organics

grades with increasing silt, trace sand, very low plasticity, stiff

grades with sand, plastic, very soft

grades stiff, very low plasticity, very moist

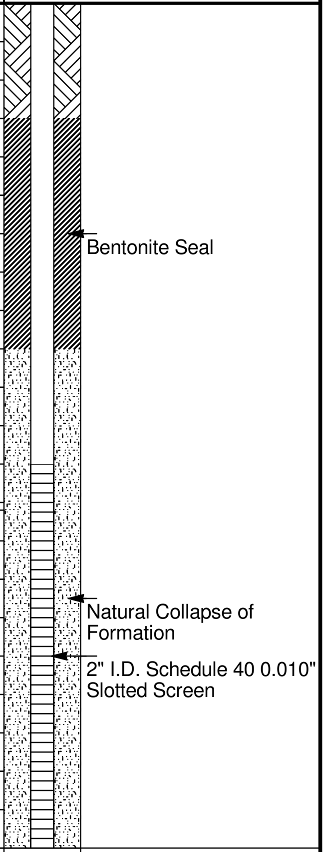
grades with trace organcis, less sand, increasing silt

Gray fine to coarse grained SAND and sub-rounded to rounded GRAVEL, pebble-sized gravel with trace 1" diameter clasts, very loose, sorted, wet

grades with increasing diameter gravel

Boring terminated 52' bgs on 2/25/2009.
2" I.D. Schedule 40 PVC monitoring well installed 52' bgs with 10' 0.010" slotted screen.

WELL CONSTRUCTION DETAILS



Depth (Feet)	Sample Location	Percent Recovery	USCS Symbol
0			
		100	
5			
		50	
10			
		62	
15			
		80	
20			
		80	
25			
		80	
30			
		40	
35			
		100	
40			
		0	
45			

DESCRIPTION OF SUBSURFACE MATERIALS

Dark gray fine to coarse SAND and GRAVEL FILL with clay, soft, moist

grades very hard to brittle (FILL) with glass piece

grades dry, very loose with angular clasts (FILL)

Yellowish red silty CLAY with trace fine sand, medium stiff, very slightly moist to moist

grades soft

Brownish yellow to yellowish red sandy CLAY, soft, moist (sand is very fine grained to fine grained)

grades loose, with increasing sand

grades soft

grades sandy clay/clayey sand (increasing sand), very moist to wet

grades very moist

grades with less sand, with red staining and organics, medium stiff

grades with increasing sand

grades with less sand

grades gray

grades with increasing sand (clayey sand), very moist

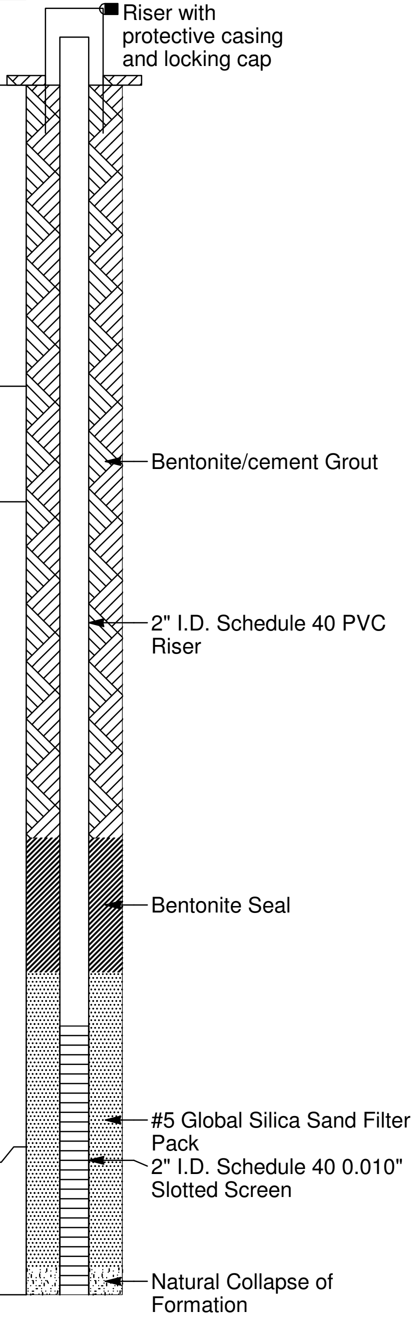
large wood piece through core sample

Gray medium to coarse grained SAND and rounded GRAVEL, poorly sorted, wet

NO RECOVERY 40-45 feet bgs

Boring terminated 45' bgs on 12/12/2007.
2" I.D. Schedule 40 PVC monitoring well installed 45' bgs with 10' 0.010" slotted screen.

WELL CONSTRUCTION DETAIL



LEGEND:

▥	Rotosonic
bgs	Below ground surface
NR	Not recorded

URS

JOB NO. 14947868

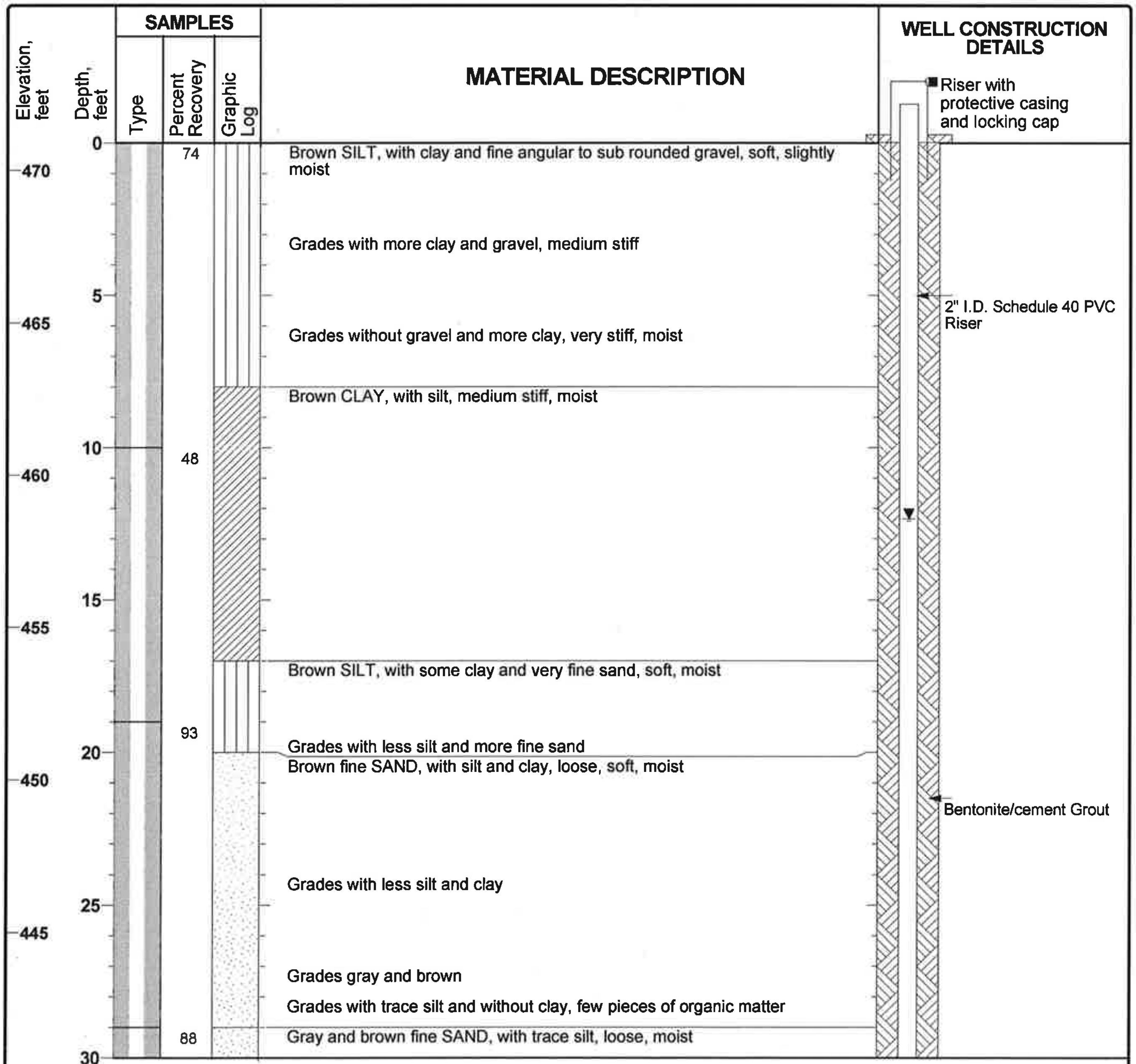
Duke Energy
Miami Fort Station
11021 Brower Road
North Bend, OH

MONITORING WELL
MW-4

Project: Dynegy
Project Location: Miami Fort Station
Project Number: 60442412

Monitoring Well
MW-10
Sheet 1 of 2

Date(s) Drilled	4/10/2017	Logged By	J. Alten	Checked By	M. Wagner
Drilling Method	Rotosonic	Drilling Contractor	Frontz Drilling	Total Depth of Borehole	59.0 feet
Drill Rig Type	Rotosonic	Sampler Type	Sonic Sleeve	Surface Elevation	470.90 feet, msl
Depth to Groundwater	12.34 ft bgs	Seal Material	Hydrated 3/8-inch Bentonite Chips	Top of PVC Elevation	473.35 feet, msl
Diameter of Hole (inches) 6.0	Diameter of Well (inches) 2	Type of Well Casing	Schedule 40 PVC	Screen Perforation	0.010-Inch
Type of Sand Pack	#5 Silica Sand	Well Completion at Ground Surface	Riser, With locking cap and protective casing.		
Comments					



Brown SILT, with clay and fine angular to sub rounded gravel, soft, slightly moist

Grades with more clay and gravel, medium stiff

Grades without gravel and more clay, very stiff, moist

Brown CLAY, with silt, medium stiff, moist

Brown SILT, with some clay and very fine sand, soft, moist

Grades with less silt and more fine sand

Brown fine SAND, with silt and clay, loose, soft, moist

Grades with less silt and clay

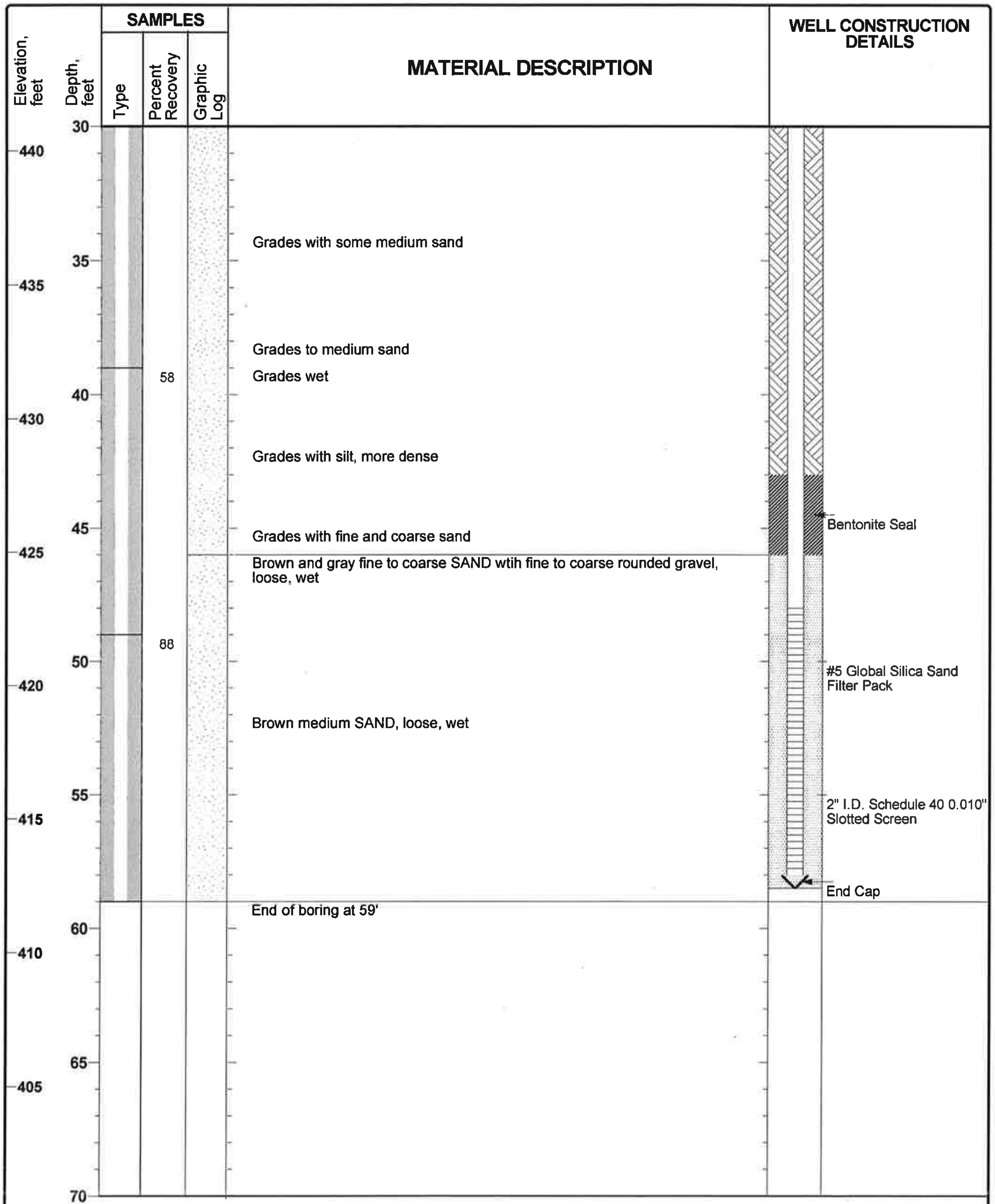
Grades gray and brown

Grades with trace silt and without clay, few pieces of organic matter

Gray and brown fine SAND, with trace silt, loose, moist

Project: Dynegy
Project Location: Miami Fort Station
Project Number: 60442412

Monitoring Well
MW-10
Sheet 2 of 2



Grades with some medium sand

Grades to medium sand

Grades wet

Grades with silt, more dense

Grades with fine and coarse sand

Brown and gray fine to coarse SAND wtih fine to coarse rounded gravel, loose, wet

Brown medium SAND, loose, wet

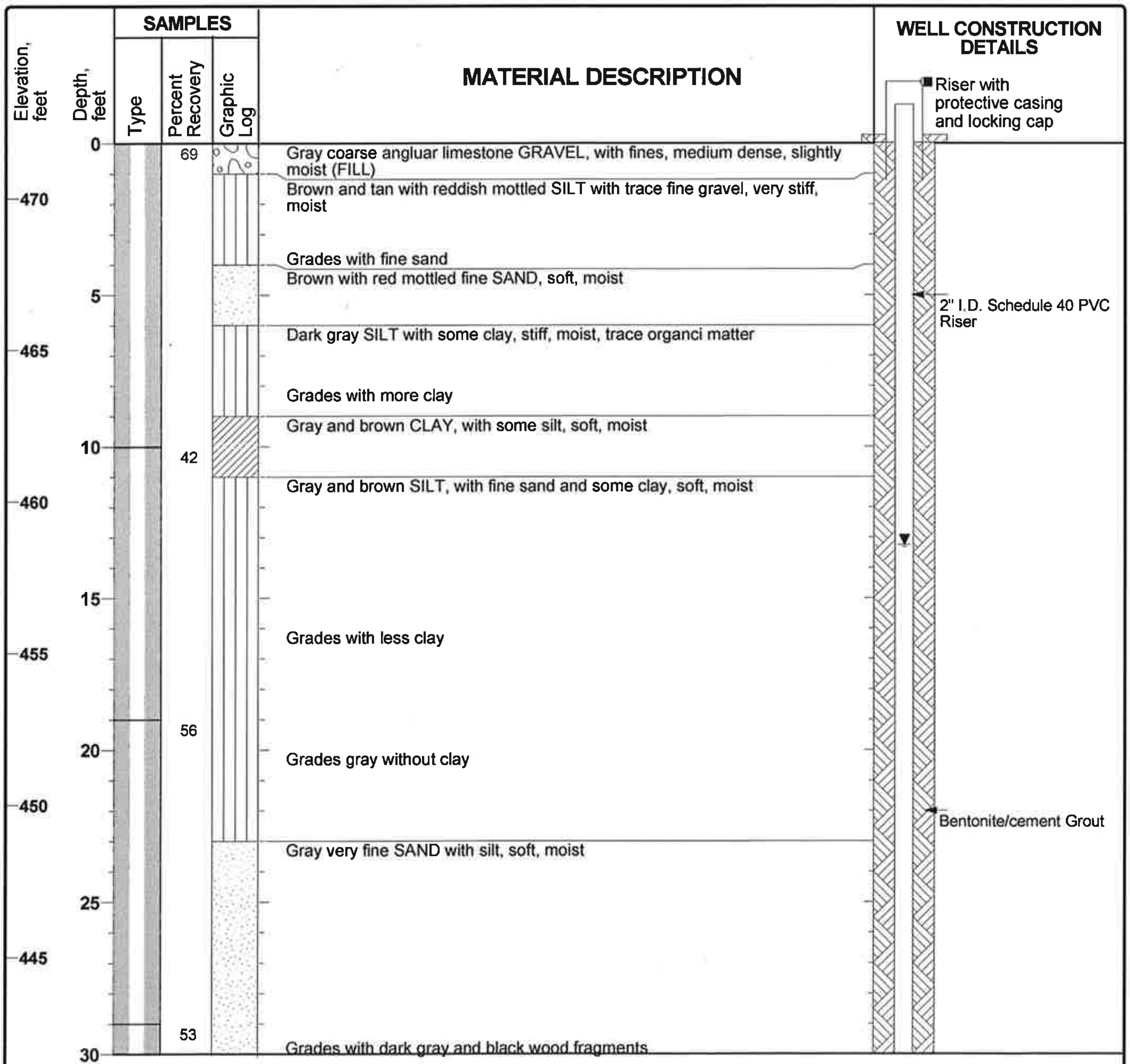
End of boring at 59'

Project: Dynegy
Project Location: Miami Fort Station
Project Number: 60442412

Monitoring Well MW-11

Sheet 1 of 2

Date(s) Drilled	4/11/2017	Logged By	J. Alten	Checked By	M. Wagner
Drilling Method	Rotosonic	Drilling Contractor	Frontz Drilling	Total Depth of Borehole	59.0 feet
Drill Rig Type	Rotosonic	Sampler Type	Sonic Sleeve	Surface Elevation	471.81 feet, msl
Depth to Groundwater	13.25 ft bgs	Seal Material	Hydrated 3/8-inch Bentonite Chips	Top of PVC Elevation	474.45 feet, msl
Diameter of Hole (inches)	6.0 / Diameter of Well (inches) 2	Type of Well Casing	Schedule 40 PVC	Screen Perforation	0.010-Inch
Type of Sand Pack	#5 Silica Sand	Well Completion at Ground Surface	Riser, With locking cap and protective casing.		
Comments					



MATERIAL DESCRIPTION

Gray coarse angluar limestone GRAVEL, with fines, medium dense, slightly moist (FILL)

Brown and tan with reddish mottled SILT with trace fine gravel, very stiff, moist

Grades with fine sand

Brown with red mottled fine SAND, soft, moist

Dark gray SILT with some clay, stiff, moist, trace organci matter

Grades with more clay

Gray and brown CLAY, with some silt, soft, moist

Gray and brown SILT, with fine sand and some clay, soft, moist

Grades with less clay

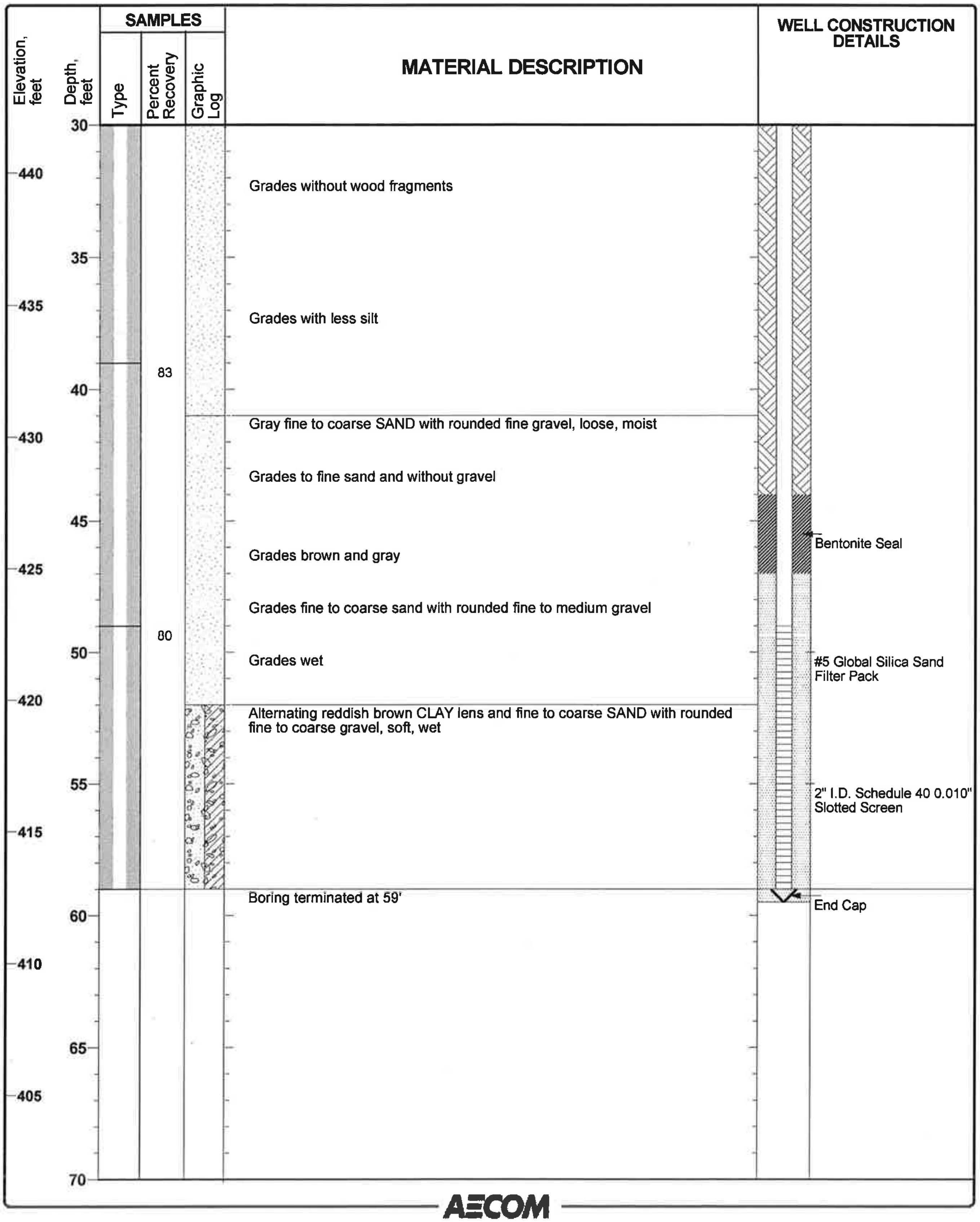
Grades gray without clay

Gray very fine SAND with silt, soft, moist

Grades with dark gray and black wood fragments

Project: Dynegy
Project Location: Miami Fort Station
Project Number: 60442412

Monitoring Well
MW-11
Sheet 2 of 2



Grades without wood fragments

Grades with less silt

Gray fine to coarse SAND with rounded fine gravel, loose, moist

Grades to fine sand and without gravel

Grades brown and gray

Grades fine to coarse sand with rounded fine to medium gravel

Grades wet

Alternating reddish brown CLAY lens and fine to coarse SAND with rounded fine to coarse gravel, soft, wet

Boring terminated at 59'