Assessment of Corrective Measures

Consumers Energy Company
JC Weadock Bottom Ash Pond and Landfill
Coal Combustion Residual Units
Essexville, Michigan

September 2019

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Prepared For
Consumers Energy Company

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Executive Summary

On April 17, 2015, the United States Environmental Protection Agency (USEPA) published the final rule for the regulation and management of Coal Combustion Residuals (CCR) under the Resource Conservation and Recovery Act (RCRA) (the CCR Rule), as amended July 30, 2018. The CCR Rule, which became effective on October 19, 2015 (amendment effective August 29, 2018), applies to the JC Weadock (Weadock) Bottom Ash Pond and Landfill. The CCR Rule 40 CFR §257.96(a) requires that an owner or operator initiate an assessment of corrective measures (ACM) to prevent further release, to remediate any releases, and to restore impacted areas to original conditions if any Appendix IV constituent has been detected at a statistically significant level exceeding a Groundwater Protection Standard (GWPS). Per §257.96(a), the ACM must be completed within 90 days. The CCR Rule allows up to an additional 60 days to complete the ACM if a demonstration is made that more time is needed due to site-specific conditions or circumstances.

The ACM is required whenever an Appendix IV constituent has been detected at a statistically significant level exceeding the established federal GWPS. TRC has prepared this ACM for the Weadock Bottom Ash Pond and the Weadock Landfill, on behalf of Consumers Energy, to evaluate the effectiveness of potential corrective measures in meeting the requirements and objectives of selecting a remedy that is protective of human health and the environment, achieves the GWPS, and source control. The requirements for conducting the ACM are contained in federal rules and state rules promulgated under Michigan's Natural Resources and Environmental Protection Act (NREPA), Part 115, Solid Waste Management, as amended by Public Act 640 of 2018.

On January 14, 2019, Consumers Energy provided notification that beryllium and lithium at the Weadock Bottom Ash Pond and arsenic at the Weadock Landfill were present at statistically significant levels above the federal GWPS. This notification was followed up with a Response Action Plan submitted to the Michigan Department of Environment, Great Lakes, and Energy (EGLE) [1] on March 15, 2019 laying out the preliminary understanding of water quality and actions that were underway to mitigate or eliminate unacceptable risk associated with the identified release from the CCR unit. This plan necessitated the development and submittal of the ACM under the timeframes provided under the CCR Rule.

As documented in the October 12, 2018 Notification of Intent to Initiate Closure letter submitted in accordance with §257.102(g), Consumers Energy intends to close the Weadock Bottom Ash Pond under the CCR Rule's closure by removal provisions in §257.102(c). Consumers Energy

[1] Effective Monday, April 22, 2019, the Michigan Department of Environmental Quality (MDEQ) became known as the Michigan Department of Environment, Great Lakes, and Energy (EGLE).

has also submitted a closure work plan to EGLE (Golder, April 2018) that included a multiple lines of evidence approach for verifying CCR removal. The closure work plan was reviewed and approved by EGLE on December 20, 2018.

Additionally, Consumers Energy has submitted a revised closure plan to EGLE for closure of the Weadock Landfill under the CCR Rule's closure in place provisions in §257.102(d) at final grades that would promote positive drainage across the site and minimize the potential for future O&M (November 19, 2018). This plan is under review by EGLE.

The groundwater nature and extent has been defined, as required in §257.95(g)(1). The nature and extent characterization was performed using additional data collected from existing groundwater monitoring wells. Additionally, hydrogeological investigations have demonstrated that a shallow water-bearing unit is not present towards the southern portion of the property. The nature and extent of data consist of Appendix IV constituents collected from the background and downgradient CCR monitoring well networks and select Appendix IV constituents collected from the Weadock Landfill state monitoring well network between March 2016 and April 2019. Based on this network, installation of additional downgradient monitoring wells was not necessary.

Nature and Extent (N&E) Evaluation Wells			
Weadock Background Wells	**Weadock Bottom Ash Pond Wells**	**Weadock Landfill Wells**	**N&E Delineation Wells**
MW-15002	JCW-MW-15007	JCW-MW-18001	MW-53R
MW-15008	JCW-MW-15009	JCW-MW-18004	
MW-15016	JCW-MW-15010	JCW-MW-18005	
MW-15019	JCW-MW-15028	JCW-MW-18006	
		MW-50	
		MW-51	
		MW-52	
		MW-53	
		MW-54R	
		MW-55	
		OW-57ROUT	

Although constituents of concern (COCs) (*i.e.*, arsenic, beryllium, and lithium) have been identified in groundwater monitoring locations at concentrations exceeding their respective GWPS, COCs are delineated within the limits of the property owned by Consumers Energy and there are **currently no adverse effects on human health or the environment** from either surface water or groundwater due to CCR management at the Weadock Bottom Ash Pond or Weadock Landfill.

Several groundwater remediation alternatives evaluated in this ACM are considered technically feasible to reduce on-site groundwater concentrations to below the GWPS as discussed in Sections 4 and 5. Consumers Energy plans to proactively utilize an adaptive management strategy for selecting the final groundwater remedy for the Weadock Bottom Ash Pond and Weadock Landfill in coordination with the specified CCR source material management strategies. Under this remedy selection strategy, measures that remove source material, reduce infiltration, and/or minimize the potential for future migration during the closure process may be implemented to address existing conditions followed by monitoring and evaluation of the performance after closure. Adjustments will be made to the corrective measure remedy, as needed, to achieve the remedial goals (*e.g.* GWPS and/or risk/exposure/pathway-based criteria).

Consumers Energy will continue executing the self-implementing groundwater compliance schedule in conformance with §257.90 - §257.98, which includes semiannual assessment monitoring in accordance with §257.95 to monitor groundwater conditions and inform the remedy selection. The next semiannual assessment monitoring event is scheduled to occur in October 2019 with results summarized in the 2019 Annual Groundwater Monitoring Report issued in January 2020.

Consumers Energy will, as soon as feasible, select remedies for impacted groundwater at the Weadock Bottom Ash Pond and Weadock Landfill that, at a minimum, meets the federal standards of §257.97(b) and state standards of R 299.4444(2). It is anticipated that the remedy selection process for addressing impacted groundwater will proceed following implementation of the specified CCR source material management strategies. A public meeting with interested and affected parties will be scheduled in accordance with §257.96(e) and R 299.4443(4) once one or more preferred remedial approach(s) for groundwater are identified. A final report describing the selected remedy and how it meets the standards specified in §257.97 will be prepared following selection of a final remedy.

Section 1
Introduction

On April 17, 2015, the United States Environmental Protection Agency (USEPA) published the final rule for the regulation and management of Coal Combustion Residuals (CCR) under the Resource Conservation and Recovery Act (RCRA) (the CCR Rule), as amended July 30, 2018. The CCR Rule, which became effective on October 19, 2015 (amendment effective August 29, 2018), applies to the JC Weadock (Weadock) Bottom Ash Pond and Landfill. The CCR Rule 40 CFR §257.96(a) requires that an owner or operator initiate an assessment of corrective measures (ACM) to prevent further release, to remediate any releases, and to restore impacted areas to original conditions if any Appendix IV constituent has been detected at a statistically significant level exceeding a Groundwater Protection Standard (GWPS). Per §257.96(a), the ACM must be completed within 90 days. The CCR Rule allows up to an additional 60 days to complete the ACM if a demonstration is made that more time is needed due to site-specific conditions or circumstances. A certification from a qualified professional engineer attesting that the demonstration is accurate is required. The owner or operator must include the certified demonstration in the annual groundwater monitoring and corrective action report required by §257.90(e). For informational purposes, the 60-day extension is included in this report as Appendix A.

1.1 Purpose/Objectives

The purpose of this report is to present the ACM for the Weadock Bottom Ash Pond and Landfill in satisfaction of the requirements of the CCR Rule § 257.96 and the requirement to initiate an assessment of corrective measures pursuant to R 299.4443(1) of Michigan Part 115. TRC has prepared this ACM for the Weadock Bottom Ash Pond and Weadock Landfill, on behalf of Consumers Energy, to evaluate the effectiveness of potential corrective measures in meeting the requirements and objectives of selecting a remedy that is protective of human health and the environment, achieves the GWPS, and source control. This report also serves to document substantial progress towards the requirements for feasibility studies contained in Part 201 of the act.

Consumers Energy previously evaluated source material management technologies and determined to utilize a source removal strategy for closure of the Weadock Bottom Ash Pond and a closure-in-place strategy for closure of the Weadock Landfill as documented in Section 3.1 of this ACM. Closure by removal was the method of closure for the Weadock Bottom Ash Pond selected and implemented by Consumers Energy prior to triggering the requirements for assessing corrective measures. The performance standards that must be achieved in order to close by removal are anticipated to support some of the performance standards for the assessment of corrective measures, especially with respect to addressing source control. Based on the strategy, this ACM focuses on the evaluation of viable alternatives for groundwater management for the Weadock Bottom Ash Pond in conjunction with the selected closure method – closure by removal – source material control option without specifically evaluating construction of a final cover or other impermeable cap.

Table 1 provides a visual evaluation of the relative effectiveness of each groundwater treatment alternative. Balancing criteria were selected based on remedy selection criteria in §257.97 and R 299.4444. In addition, R 299.4443 for an ACM under Part 115 requires the ACM to comply with the requirements for feasibility studies contained in Part 201. As such, the balancing criteria encompass the criteria for remedial action selection under Section 20120(1).

Each groundwater treatment alternative was evaluated with regards to each balancing criterion based on its anticipated effectiveness, implementability, and sustainability. Color-coding is used to categorize each alternative on a scale from ineffective to highly effective. The evaluation of each alternative is discussed in Section 4. The relative effectiveness of each alternative compared to other alternatives based on the balance of the criteria is also included in Table 1.

This ACM was initiated on April 14, 2019, following the January 14, 2019 *Notification of Appendix IV Constituent Exceeding Groundwater Protection Standard per* §257.95(g) letters, which documented that beryllium and lithium were present at statistically significant levels above the GWPS in one or more downgradient monitoring wells at the Weadock Bottom Ash Pond and arsenic was present at statistically significant levels above the GWPS in one downgradient monitoring well at the Weadock Landfill. Consumers Energy notified the Michigan Department of Environment, Great Lakes, and Energy (EGLE) in the Response Action Plans submitted on March 15, 2019 for each the Weadock Bottom Ash Pond and Weadock Landfill that this ACM would be submitted by September 11, 2019. The professional engineer certification attesting to the accuracy of the demonstration justifying the 60-day time extension was placed in the operating record on July 12, 2019.

1.2 Assessment of Corrective Measures Requirements

1.2.1 Federal Requirements

In accordance with §257.96, this ACM evaluates the effectiveness of potential corrective measures in meeting the requirements and objectives of the remedy specified in §257.97, including protectiveness of human health and the environment, achievement of the GWPS, and source control. Remedy selection shall commence upon completion of this assessment and will be completed as soon as feasible. The ACM is an analysis of the effectiveness of potential corrective measures and addresses the following factors:

- The performance, reliability, ease of implementation, and potential impacts of appropriate potential remedies, including safety impacts, cross-media impacts, and control of exposure to any residual contamination;
- The time required to begin and complete the remedy; and
- The institutional requirements, such as state or local permit requirements or other requirements that may affect implementation of the remedy.

These requirements are the basis for evaluation of each corrective measures approach tabulated for comparison in Table 1. Description of the potential remedy approaches are provided in Section 3 and then discussed in context of applicability at the Weadock Bottom Ash Pond and Weadock Landfill based on site-specific characteristics in Section 4. The remedy evaluation summary is discussed in Section 5 leading to considerations and limitations in selection of a remedy presented in Section 6.

The ACM will be considered completed when it is placed in the facility's operating record as required by §257.105(h)(10). In addition to providing notification to EGLE that the ACM has been placed in the facility's operating record; the report is being submitted in satisfaction of the timelines in the Response Action Plan.

1.2.2 State Requirements

On December 28, 2018, the State of Michigan enacted Public Act No. 640 of 2018 (PA 640) to amend the Natural Resources and Environmental Protection Act, also known as Part 115 of PA 451 of 1994, as amended (a.k.a., Michigan Part 115 Solid Waste Management). The December 2018 amendments to Part 115 were developed to provide the State of Michigan oversight of CCR impoundments and landfills and to better align existing state solid waste management rules and statutes with the CCR Rule. This alignment would ensure compliance with the federal CCR standards through a state-approved permitting program that would be deemed to be "equivalent to" or "as protective as" through an administrative application that would be reviewed and authorized by USEPA. It should be noted that the Michigan statute does not act in lieu of the federal standards until such a time as the USEPA authorizes the permit program after a public notice and comment on the elements of the program that are authorized.

Michigan's Part 115 references Michigan's Part 201 (Environmental Cleanup) which adopts by reference the requirements for feasibility studies. This ACM has been prepared in compliance with the requirements for feasibility studies contained in Part 201 and includes an analysis of the effectiveness of potential corrective measures in meeting the requirements and objectives of the remedy. Requirements for evaluating effectiveness of potential remedies under Michigan rules are the same as those under the CCR Rule with the exception that state rules allow cost to be a balancing consideration for selecting a remedy.

1.3 Program Summary

The CCR Rule applies to the Weadock Bottom Ash Pond and the Weadock Landfill. In accordance with the schedule defined in §257.90(b)(1) for existing CCR units, a groundwater monitoring system has been installed around the Weadock Bottom Ash Pond and the Weadock Landfill as required by §257.91, and background groundwater monitoring well sampling has been completed as required by §257.93.

As documented in the January 14, 2019 *Notification of Appendix IV Constituent Exceeding Groundwater Protection Standard per* §257.95(g) letters, beryllium and lithium were present at statistically significant levels above the federal GWPS in one or more downgradient monitoring wells at the Weadock Bottom Ash Pond and arsenic was present at statistically significant levels above the federal GWPS in one or more downgradient monitoring wells at the Weadock Landfill, thus necessitating the development of this ACM.

Evaluation of groundwater under the CCR Rule focused on the following constituents that were collected *unfiltered* in the field:

CCR Rule Monitoring Constituents	
Appendix III	**Appendix IV**
Boron	Antimony
Calcium	Arsenic
Chloride	Barium
Fluoride	Beryllium
pH	Cadmium
Sulfate	Chromium
Total Dissolved Solids (TDS)	Cobalt
	Fluoride
	Lead
	Lithium
	Mercury
	Molybdenum
	Radium 226/228
	Selenium
	Thallium

Prior to remedy selection, Consumers Energy will also collect a sufficient number of samples to evaluate Michigan state-specific constituents as follows:

Additional Monitoring Constituents (Michigan Part 115)	
Detection Monitoring	**Assessment Monitoring**
Iron	Copper
	Nickel
	Silver
	Vanadium
	Zinc

1.4 Bottom Ash Pond Closure

Consumers Energy evaluated source material management technologies and determined to close the Weadock Bottom Ash Pond under the CCR Rule's closure by removal provisions in §257.102(c) as referenced in Section 11519b(9)(a) in P.A. 640. Consumers Energy submitted the *JC Weadock Generating Facility Revised Bottom Ash Pond Closure Work Plan (*Closure Work Plan*)* *(*Golder, April 2018*)* to the EGLE for review to meet the objectives for state and federal requirements. EGLE provided written agreement with the plan on December 20, 2018. Consumers Energy provided formal Notification of Intent to Initiate Closure of the Weadock Bottom Ash Pond to the EGLE on October 12, 2018, per §257.102(g).

Consumers Energy ceased hydraulic loading to the Weadock Bottom Ash Pond in April 2018 and has allowed the area to dewater by gravity. The dewatering and excavation work is scheduled to be initiated in the second quarter 2020 with a certification report submitted to EGLE once CCR removal is complete. The excavation will extend six inches below the known CCR elevations established from previous investigations. CCR will be removed and placed in an-onsite landfill facility (Weadock Landfill) that consists of a fully enclosed soil-bentonite slurry wall keyed into a competently confining clay unit. Groundwater chemistry already appears to be improving as a result of discontinuing the hydraulic loading to the Weadock Bottom Ash Pond and is expected to further improve following the completed source removal.

1.5 Landfill Closure

Pursuant to §257.102, Consumers Energy prepared the *Closure Plan for the Consumers Weadock Complex J.C. Weadock Solid Waste Disposal Area* (Geosyntec, October 2016). The Weadock Landfill will be closed in place in accordance with the requirements for CCR landfills under RCRA (§ 257.102(b)) and P.A. 640 (section 11519b(9)). Details regarding the cover system structural components, construction, and estimated schedule are included in the closure plan for the landfill. A revised closure plan was submitted to the EGLE on November 19, 2018 and is currently under review. As described in the closure plan, final closure design and permitting are anticipated to be completed in 2019. Incremental, partial capping activities of the areas that achieve final grades are anticipated to occur in 2022 through 2030 with the installation of the final cover installed by December 31, 2030.

Section 2
Hydrogeology/Current Conditions

The Weadock Bottom Ash Pond and Weadock Landfill are located south of the DE Karn Power Plant, east of the Saginaw River, west of Underwood Drain and Saginaw Bay, and north of Tacey Drain and agricultural land (Figure 1). A discharge channel separates the Weadock Bottom Ash Pond and Weadock Landfill from the Karn Power Plant to the north. The Weadock Power Plant, located on the western edge of the property, began generating electricity in 1940. Six power generating units were in operation from 1940 until they were retired in 1980. In 1958 and 1959, two additional units were added. The Weadock Power Plant ceased generating electricity on April 15, 2016.

2.1 Description of CCR Units

The locations of the Weadock Bottom Ash Pond and Weadock Landfill are shown on Figure 1. The area authorized for disposal of solid waste is located east of the Weadock Power Plant (Figure 1). The Weadock Solid Waste Disposal Area is a 292-acre Type III low hazard industrial waste landfill, permitted for construction in 1992, and is governed by the Part 115[2] Solid Waste Disposal Area Operating License No. 9440 dated June 26, 2015. The majority of the perimeter of the Solid Waste Disposal Area consists of containment dikes that generally have a 20-ft wide crest with a crest elevation of 590 feet International Great Lakes Datum of 1985 (IGLD85). The Weadock Landfill is delineated by the acreage of the solid waste disposal area permitted for the vertical expansion and bounded by a soil-bentonite slurry wall constructed along the centerline of the perimeter embankment dike to a depth that it is keyed in the competent confining clay underlying the unit. The Weadock Landfill is being monitored in accordance with the EGLE-approved Part 115 *Hydrogeological Monitoring Plan Rev. 2: JC Weadock Solid Waste Disposal Area* (June 5, 2015) (HMP).

The Weadock Bottom Ash Pond is located immediately west of the historic pond/landfill area and outside of the soil-bentonite slurry wall. The Weadock Bottom Ash Pond is the primary settling/detention structure for the National Pollutant Discharge Elimination System (NPDES) Treatment System prior to discharge. Consumers Energy provided notification of initiation of closure for the Weadock Bottom Ash Pond on October 12, 2018 to implement the certified closure plan by removal of CCR under the self-implementing requirements and schedule of the CCR Rule.

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[2] Part 115, Solid Waste Management, of the Natural Resources and Environmental Protection Act (NREPA), Public Act 451 of 1994.

2.2 Geologic/Hydrogeologic Setting

The majority of the Weadock Bottom Ash Pond area is comprised of surficial CCR and sand fill. USGS topographic maps and aerial photographs dating back to 1938, in addition to field descriptions of subsurface soil, indicate the area was largely developed by reclaiming low-lands through construction of breakwater dikes that ultimately were developed into perimeter dikes and subsequent ash filling.

The surficial fill consists of a mixture of varying percentages of ash, sand, and clay-rich fill ranging from 5 to 15 feet thick. Below the surficial fill, native alluvium and lacustrine soils are present at varying depths. Generally, there is a well graded sand unit present to depths of 10-30 feet below ground surface (ft bgs) overlying a clay till which is observed at depths ranging from 25 to 75 ft bgs. A sandstone unit, which is part of the Saginaw Formation, was generally encountered at 80-90 ft bgs. In general, the alluvium soils (sands) are deeper along the Saginaw River and there are shallower lacustrine deposits (clays, silts, and sands deposited in or on the shores of glacial lakes) at other areas. Along the perimeter of the landfill, there is a well graded sand present at depths ranging from 10 to 20 ft-bgs. The sand is variable in thickness, ranging from <1 to ~6.5 feet, and is discontinuous along the perimeter, as evidenced by the soil boring logs and slurry wall construction documentation.

The alluvium soils pinch out and are not observed in soil borings located south and east of the Weadock Bottom Ash Pond and Weadock Landfill, along the location of the historic shoreline. The non-water-bearing region south of these units extends for at least a mile south and southeast of the site.

Beneath the surficial fill and sand unit (where present) is 70 to 80 feet of clay till. Along the southern perimeter of the landfill, some of the upper portion of the clay till is sand-rich (generally greater than 20 ft-bgs). The clay till acts as a hydraulic barrier that separates the shallow groundwater from the underlying sandstone. The sandstone unit, which is part of the Saginaw Formation, is generally encountered at 80-90 ft-bgs.

The Weadock Bottom Ash Pond and Weadock Landfill is bounded by several surface water features (Figure 1): the Saginaw River to the west, a discharge channel and Saginaw Bay (Lake Huron) to the north, Underwood Drain to the east, and Tacey Drain to the south. Groundwater flow in the upper aquifer is largely controlled by the surface water elevations of Saginaw River and Saginaw Bay. In general, shallow groundwater is encountered at a similar or slightly higher elevation relative to the surrounding surface water features. The shallow groundwater flow direction in the vicinity of the Weadock Bottom Ash Pond is to the north toward the discharge channel and to the east toward the Saginaw River. Historical groundwater flow beneath the Weadock Landfill was directed north to the discharge channel due to the bentonite/soil slurry wall. Originally, the slurry wall enclosed the historical fly ash disposal area with the exception of a small segment along the perimeter dike that is designed to vent along the discharge channel immediately upgradient from the NPDES external outfall to prevent water from building up within the facility. In July 2018, this vent was closed and the slurry wall reduced porewater flux around the entire perimeter of the landfill. Following the closure of the vent, the static water level elevations inside of the slurry wall are generally significantly different (>1 ft) than static water levels outside of the slurry wall, which demonstrates the presence of a low permeability feature between the well pairs.

In previous investigations, bedrock groundwater was generally encountered around 578 ft (NAVD88), which is several feet lower than the shallow groundwater. Groundwater flow direction was generally to the northeast under a very shallow gradient. Given the different groundwater flow regime in the bedrock than the shallow saturated unit, bedrock wells near the surface water bodies are several feet below the surface water elevation. Based on the fact that the shallow sand and the bedrock are separated by over 50 ft of clay, the bedrock unit does not appear to be hydraulically connected to the shallow sand.

2.3 Environmental Setting and Monitoring Network

In accordance with §257.91, Consumers Energy established a groundwater monitoring system for the Weadock Bottom Ash Pond and Weadock Landfill that are screened in the uppermost aquifer. The monitoring well locations are shown on Figure 1.

2.3.1 Bottom Ash Pond

Four monitoring wells located south of the Weadock Bottom Ash Pond provide data on background groundwater quality that has not been impacted by a CCR unit (MW-15002, MW-15008, MW-15016, and MW-15019). Analysis for the establishment of these wells as background is detailed in the *Groundwater Statistical Evaluation Plan* for the Karn Bottom Ash Pond, dated October 17, 2017. Due to the regional hydrogeology and operational history of the Weadock Power Plant, a hydraulically upgradient location was not available to monitor the Weadock Bottom Ash Pond and Weadock Landfill. The area where background wells are located, while not upgradient, is not impacted by any CCR units and therefore meets the requirements of § 257.91(a)(1). Background groundwater quality data from these four background wells are used for groundwater monitoring program for the Weadock Bottom Ash Pond and Weadock Landfill as well as the Karn Bottom Ash Pond.

Groundwater around the Weadock Bottom Ash Pond is radial; therefore, the four downgradient wells (JCW-MW-15007, JCW-MW-15009, JCW-MW-15010, and JCW-MW-15028) that were installed in the accessible areas along the perimeter of the Weadock Bottom Ash Pond continue to accurately represent the quality of groundwater passing the waste boundary that ensures detection of groundwater contamination such that all potential contaminant pathways are monitored.

2.3.2 Landfill

When detection monitoring was initiated in October 2017, there was a 1,600-linear-foot section of the perimeter embankment dike that lacked slurry wall construction as a basis of design to coordinate the management of the underlying groundwater with the requirements of the existing NPDES discharge permit. At that time, groundwater flow beneath the Weadock Landfill was directed towards the discharge channel through this vent in the slurry wall for monitoring under the existing NPDES discharge permit. Based on capturing this primary flow pathway, the downgradient monitoring well network for the Weadock Landfill was established as three monitoring wells located within the vent area to assess the quality of groundwater passing the waste boundary (JCW-MW-15011, JCW-MW-15012, and JCW-MW-15023). The four background and three downgradient monitoring wells served as the certified groundwater monitoring system sampled during background and detection monitoring, as well as during the preliminary assessment monitoring that occurred in April 2018 and the subsequent semi-annual assessment monitoring event in May 2018.

In June 2018, the design component of the slurry wall vent was closed with a completed construction of slurry wall that tied into the existing slurry wall alignment. This construction was completed in anticipation of starting closure of portions of the Weadock Landfill. Completing the construction of the slurry wall also serves to reduce porewater flux around the entire perimeter of the Weadock Landfill. The three existing downgradient monitoring wells were decommissioned by overdrilling, removing the well material, and sealing the borehole in order to allow for the slurry wall construction. Consumers Energy installed an additional nine groundwater monitoring wells in August 2018 to revise the certified groundwater monitoring system to meet the groundwater monitoring performance objectives based on the change in groundwater flow path.

The groundwater monitoring data collected from these new wells will be utilized for the purposes of statistically determining if there are additional releases from the Weadock Landfill separate from the decommissioned wells that triggered the ACM for the Weadock Landfill. Additionally, the groundwater monitoring well network developed in coordination of the state permitting and licensing of the landfill will supplement and verify that applicable pathways are evaluated for water quality. Compliance monitoring and performance for these groundwater monitoring wells is currently governed by the approved 2015 HMP that provides appropriate coverage for the collection of groundwater levels and water quality data along the perimeter of the Weadock Landfill. Therefore, the modified CCR monitoring well network now consists of the four (4) background as discussed above, and eleven (11) downgradient monitoring wells as discussed in the *Sample and Analysis Plan* (2018 SAP) (TRC, 2018) and *Statistical Analysis Plan* (2018 Stats Plan) (TRC, 2018b). The addition of these groundwater monitoring wells and evaluation relative to the new, certified groundwater monitoring system are reflected in Figure 3.

2.4 On-Site Groundwater Flow Conditions

Groundwater elevations at the Weadock Bottom Ash Pond and Weadock Landfill range from 580 to 590 ft NAVD88. Near the Weadock Bottom Ash Pond, groundwater flows to the north toward the discharge channel and to the west near the Saginaw River. The static water level elevations inside of the Weadock Landfill slurry wall are typically different (>1 ft) than static water levels outside of the slurry wall, which demonstrates the presence of a low permeability feature between the well pairs. Groundwater elevations measured during the most recent CCR monitoring event (April 2019) were used to construct the shallow groundwater contour map (Figure 2). The following is a summary groundwater flow for each groundwater monitoring system during the recent event:

2.4.1 Bottom Ash Pond

Groundwater near the Weadock Bottom Ash Pond continues to flow to the north toward the discharge channel and to the west near the Saginaw River. The average hydraulic gradient throughout the Weadock Bottom Ash Pond area during April 2019 is estimated at 0.0042 ft/ft. Using the mean hydraulic conductivity of 16 ft/day (ARCADIS, 2016) and an assumed effective porosity of 0.3, the estimated average seepage velocity ranged from approximately 0.22 ft/day or 81 ft/year, which is consistent with previous estimates. The general flow direction is similar to that identified in previous monitoring rounds.

2.4.2 Landfill

The monitoring well network is structured such that there are eleven (11) monitoring well pairs used to evaluate the hydraulic gradient and potential for water flux across the slurry wall. Data collected in March/April 2019 indicate that, although hydraulic gradients between wells inside the slurry wall and outside the slurry wall indicate a potential for outward flow, the static water level elevations inside of the slurry wall are typically different (>1 ft) than static water levels outside of the slurry wall, which demonstrates the presence of a low permeability feature between the well pairs. As such, water level elevations indicate that the slurry wall is performing as designed. The general flow direction observed within the confines of the slurry wall is similar to that identified in previous monitoring rounds since the completion of the slurry wall.

2.5 Nature and Extent of Environmental Impacts

Since one or more Appendix IV constituents were detected at the Weadock Bottom Ash Pond and Weadock Landfill at statistically significant levels above their GWPS, the nature and extent of the release is described below to meet the requirements of §257.95(g)(1).

2.5.1 Bottom Ash Pond: Potential Extent of CCR Source Materials

In addition to ongoing groundwater monitoring activities, characterization activities for the CCR and underlying materials at the Weadock Bottom Ash Pond were completed in 2017 (Golder, 2018; Appendix B). This work included collecting and analyzing samples from 21 soil borings located between 0 and 28 feet bgs in and around the bottom ash pond for select metals and other constituent(s) that could potentially be used as indicators of groundwater impacts. Compositional analysis showed that CCR present generally contained arsenic, boron, and selenium concentrations that exceeded Michigan Part 201 nonresidential drinking water protection or groundwater surface water interface (GSI) protection criteria for soils. Leaching and compositional analysis was also performed on soil and CCRs to spatially determine the potential leachability of constituents above health-based criteria. These soil-CCR interfaces were then compiled to form a subsurface excavation profile that determined the initial depth of excavation before other lines of evidence are sought to determine if the limits of excavation will be satisfied based on the Quality Assurance protocol developed and detailed in the Closure Work Plan submitted to EGLE (Golder, 2018).

The evaluation of the leachability and compositional data from the characterization work in combination with ongoing groundwater monitoring activities has yielded evidence that the remaining ponded CCRs and historical sluice water are the likely source of observed downgradient groundwater impact. Native sand underlying the ponded CCR generally contained lower concentrations of metals. In fact, the relative enrichment of the media with leachable inorganics generally decreased from the surface of the unit as samples were taken closer to and into native sand.

2.5.2 Landfill: Potential Extent of CCR Source Materials

The existing CCR Landfill is delineated by the 292 acres of the solid waste disposal area permitted for the vertical expansion and bounded by a soil-bentonite slurry wall constructed along the centerline of the perimeter embankment dike to a depth that it is keyed in the competent confining clay underlying the unit.

2.5.3 Groundwater: Potential Receptors and Exposure Pathways

The primary potential exposure pathway relevant to this ACM is the drinking water (DW) pathway and attainment of the GWPS. The GSI exposure pathway is also relevant and will be considered during the final remedy selection. Due to the physical/chemical properties of the Appendix III and Appendix IV constituents, volatilization is unlikely to occur; therefore, the groundwater volatilization to indoor/ambient air pathways are not relevant.

Relevant Groundwater Exposure Pathways		
Exposure Pathway	**Applicable Criteria**	**Potential Source Areas**
GSI	Michigan Part 201	Weadock Bottom Ash Pond, Weadock Landfill
Drinking Water	Michigan Part 201/ Federal GWPS	Weadock Bottom Ash Pond, Weadock Landfill

2.5.4 Characterization of Groundwater

Following the initial and subsequent assessment monitoring sampling events (April and May 2018), the compliance well groundwater concentrations for Appendix IV constituents at the Weadock Bottom Ash Pond and Weadock Landfill were compared to the GWPSs to determine if a statistically significant exceedances had occurred in accordance with §257.93 as detailed in the *Statistical Evaluation of Initial Assessment Monitoring Sampling Event* (TRC, January 2019) for each unit. The statistical evaluation of the May 2018 Appendix IV constituents showed that arsenic at the Weadock Landfill, and beryllium and lithium at the Weadock Bottom Ash Pond were present at statistically significant levels (*i.e.* lower confidence limit exceeded the GWPS). The remaining Appendix IV constituents were not present at statistically significant levels during the May 2018 assessment monitoring event. Therefore, for the purposes of this ACM, constituents of concern (COCs) include arsenic, beryllium, and lithium.

	Constituent	GWPS	Units	Bottom Ash Pond GWPS Exceedance [3]	Landfill GWPS Exceedance[5]
Appendix IV	Antimony	6	µg/L		
	Arsenic	21	µg/L		✓[4]
	Barium	2,000	µg/L		
	Beryllium	4	µg/L	✓	
	Cadmium	5	µg/L		
	Chromium	100	µg/L		
	Cobalt	15	µg/L		
	Fluoride	4,000	µg/L		
	Lead	15	µg/L		
	Lithium	180	µg/L	✓	
	Mercury	2	µg/L		
	Molybdenum	100	µg/L		
	Radium 226+228	5	pCi/L		
	Selenium	50	µg/L		
	Thallium	2	µg/L		

µg/L: micrograms per liter; pCi/L: picoCuries per liter

Consumers Energy placed a notification of the statistical exceedances into the operating record on January 14, 2019 as required in §257.95(g) and within the timeframe required by §257.105(h)(8). In addition, as required in §257.95(g)(1), nature and extent groundwater sampling was conducted as described below.

The nature and extent characterization was performed using additional data collected from existing groundwater monitoring wells. Additionally, site hydrogeological investigations have demonstrated that a shallow water-bearing unit is not present towards the southern portion of the property. The nature and extent data consist of Appendix IV constituents collected from the background and downgradient CCR monitoring well network and select Appendix IV constituents collected from the Weadock Landfill state monitoring well network between March 2016 and April 2019.

[3] An exceedance occurs when the lower confidence limit of the downgradient data is above the GWPS.
[4] The statistically significant GWPS exceedance for arsenic was observed at a Weadock Landfill downgradient monitoring well located within the slurry wall vent prior to closing the slurry wall. Appendix IV constituent concentrations at the modified CCR monitoring well network do not show statistically significant exceedances.

Based on this network, installation of additional downgradient monitoring wells was not necessary.

Nature and Extent (N&E) Evaluation Wells			
Weadock Background Wells	**Weadock Bottom Ash Pond Wells**	**Weadock Landfill Wells**	**N&E Delineation Wells**
MW-15002	JCW-MW-15007	JCW-MW-18001	MW-53R
MW-15008	JCW-MW-15009	JCW-MW-18004	
MW-15016	JCW-MW-15010	JCW-MW-18005	
MW-15019	JCW-MW-15028	JCW-MW-18006	
		MW-50	
		MW-51	
		MW-52	
		MW-53	
		MW-54R	
		MW-55	
		OW-57ROUT	

Given the proximity of the Weadock Bottom Ash Pond and the Weadock Landfill at the Weadock property, the nature and extent of contamination was assessed from a site-wide perspective rather than on a per CCR unit basis. The nature and extent of groundwater impacted by a release from the units overlaps. Additionally, looking at impacted groundwater on a site-wide basis was more practical from a risk mitigation standpoint, given:

- the likely age of the release(s);
- a long operational history of ash management;
- the historical use of CCR as fill; and
- The influence of geochemistry on several of the Appendix IV constituent concentrations in groundwater.

These factors combined make it difficult, if not impossible, to determine the quantity of the material released from the CCR unit as required by the CCR rule.

The distribution of Appendix IV constituents in the shallow water-bearing unit as compared to the GWPS is presented in Figure 3. Two categories were assigned, as follows:

- White – No Statistically Significant Exceedances
- Orange – Statistically Significant GWPS Exceedance: the lower confidence limit is above the GWPS

As shown on Figure 3, the following is a summary of the RCRA CCR comparison results organized by constituent:

Arsenic

The semi-annual monitoring event conducted in April 2019 commenced with the revised groundwater monitoring system discussed in Section 2.3 – Landfill. Although during the statistical evaluation of the April 2019 semi-annual data the lower confidence limits of arsenic did not exceed the GWPS of 21 ug/L at either the Weadock Bottom Ash Pond or the Weadock Landfill, the observed upper confidence limit is above the GWPS at two wells near the Weadock Bottom Ash Pond (JCW-MW-15010 and JCW-MW-15007) and at two existing groundwater monitoring wells under the state monitoring program that have been incorporated into the revised Weadock Landfill groundwater monitoring system along the Weadock Landfill perimeter (MW-51 and MW-55) and one existing groundwater monitoring well under the state monitoring program (MW-53R). Arsenic is also present at individual concentrations exceeding the GWPS at one newly installed well in the new groundwater monitoring system along the western perimeter of the Weadock Landfill (JCW-MW-18006). Since assessment of corrective measures was triggered by a decommissioned groundwater monitoring well at the Weadock Landfill, along a portion of the perimeter embankment dike that is common to the Weadock Bottom Ash Pond and Weadock Landfill, it is appropriate to continue evaluating each of those units relative to the observation of arsenic at each.

Since sluicing to the Weadock Bottom Ash Pond ceased in April 2016, concentrations of arsenic in JCW-MW-15010 appear to exhibit a downward trend. The influence of the bottom ash sluice water loading or changes in redox geochemistry impacted by the cessation of sluice water loading to the Weadock Bottom Ash Pond is still being evaluated as additional data collection events are completed.

Beryllium and Lithium

Beryllium and lithium are present at statistically significant levels above their respective GWPSs at JCW-MW-15009 at the Weadock Bottom Ash Pond. Since sluicing to the Weadock Bottom Ash Pond ceased in April 2016, concentrations of beryllium and lithium appear to exhibit a downward trend. The influence of the bottom ash sluice water loading or changes in redox geochemistry impacted by the cessation of sluice water loading to the Weadock Bottom Ash Pond is still being evaluated as additional data collection events are completed.

Consumers Energy additionally notes that JCW-MW-15009 is the westernmost downgradient monitoring well at the Weadock Bottom Ash Pond and located the farthest from the waste limit of the Weadock Bottom Ash Pond. JCW-MW-15009 is located in the general vicinity of the power plant and groundwater quality may be related to industrial activities rather than CCR management at the Weadock Bottom Ash Pond. The pH measured in JCW-MW-15009 (between 4.1 and 5.4 S.U.) is much lower than the other compliance wells for the Weadock Bottom Ash Pond (between 7 and 8 S.U.). Decreased pH in groundwater, such as that observed at JCW-MW-15009, can result in mobilization of metals, including those found naturally in soil as well as those found in coal and ash. Consumers Energy continues to evaluate the potential for an alternative source of the low pH, beryllium, and lithium in this area.

Other Potential Constituents of Concern

In addition to arsenic, beryllium, and lithium, additional Appendix III and Appendix IV constituents shown below have also been identified as potential constituents of concern (COCs) based on their concentrations compared to state cleanup criteria (i.e., Part 201).

Constituent		DW Exceedance	GSI Exceedance
Appendix III	Boron	✓	
	Calcium		✓
	Chloride	✓	✓
	Sulfate	✓	✓
	Total Dissolved Solids (TDS)	✓	✓
	pH	✓	✓
Appendix IV	Arsenic	✓	✓
	Beryllium	✓	
	Chromium		✓
	Lead	✓	
	Lithium	✓	
	Molybdenum	✓	✓
	Selenium		✓

2.5.5 Risk Evaluation

Although COCs (*i.e.*, arsenic, beryllium, and lithium) have been identified in the groundwater at concentrations exceeding applicable criteria, an evaluation of risk demonstrates that there are **currently no adverse effects on human health or the**

environment from either surface water or groundwater due to CCR management at the Weadock Bottom Ash Pond or Weadock Landfill. In terms of addressing potential risk pathways at the Weadock Bottom Ash Pond or Weadock Landfill, the property is owned and operated by Consumers Energy and groundwater is not used for drinking water. There are no on-site drinking water wells, so the drinking water pathway is not complete (Figure 4). A shallow-water bearing unit is not observed to the south of the landfill, which prevents offsite migration of Appendix III and Appendix IV constituents.

The groundwater located immediately beneath the Weadock Bottom Ash Pond and Weadock Landfill has the potential to vent to the adjacent surface water features as depicted by groundwater contours (Figure 2). This groundwater has been determined to be "*groundwater not in an aquifer*" by the Water Resources Commission on August 26, 1986. This determination grants Groundwater Discharge Exemption GWE-005 based on the ability to demonstrate no substantial change in discharge. Compliance with this performance standard is measured and monitored through the hydrogeological monitoring reports submitted to the EGLE on a quarterly basis. The designation of "*groundwater not in an aquifer*" is only a usability determination and is not a restriction on water usage itself, per se. Therefore, a covenant restricting future withdrawal of groundwater would be appropriate, if deemed necessary following source removal and capping activities to mitigate this risk pathway.

As discussed above, the Weadock Power Plant, Weadock Bottom Ash Pond, and Weadock Landfill are also bounded by the Saginaw River on one side and Saginaw Bay on the other side; therefore, if portions of the property are not addressed through active remediation, it may be appropriate to mitigate those risks by revising the monitoring associated with the existing mixing-zone based GSI criteria (EGLE, 2015).

Section 3
Identification of Remedial Options to Develop Corrective Measure Alternatives

In order to perform a thorough assessment of the corrective measure alternatives, Consumers Energy identified and evaluated several technologies for both CCR source material management and groundwater remediation. Section 3.1 describes the previously selected source material management option and Section 3.2 identifies and briefly describes the applicable groundwater remediation technologies. Additional remediation technologies may be evaluated at a later date if determined to be applicable through additional data collection/evaluation or identification of an emerging technology. The assessment of the corrective measure alternatives is detailed in Section 4.

3.1 CCR Source Material Management

Consumers Energy evaluated source material management technologies and determined to close the Weadock Landfill under the CCR Rule's closure in place provisions in §257.102(d) as documented in the October 2016 Closure Plan and the Weadock Bottom Ash Pond under the CCR Rule's closure by removal provisions in §257.102(c) as documented in the January 2018 Closure Plan. Both closure plans are available on Consumers Energy's CCR Rule Compliance Data and Information webpage (https://www.consumersenergy.com/community/sustainability/environment/waste-management/coal-combustion-residuals).

3.1.1 No Action

A source material management strategy of no action involves making no efforts to contain or remove CCR as it currently exists, or as it will exist at the end of the useful life of the unit. CCR would be left in the unit without construction of a low permeability cover or additional containment. A no action CCR source material management strategy is not considered viable due to its ineffectiveness of reducing potential exposures to the CCR material or potential migration of CCR material beyond the confines of the specified unit. A no action CCR source material management strategy is not a regulatory option per the CCR Rule, but was included as a comparative baseline option for the evaluation of corrective measure alternatives.

3.1.2 Bottom Ash Pond Closure by CCR Removal

A source material management strategy of closure by removal involves removing and decontaminating all areas impacted by releases from the CCR unit per the provisions in

§257.102(c). Consumers Energy is planning to perform source removal by excavation of CCR from the Weadock Bottom Ash Pond consistent with the Closure Plan (Golder, 2017) and the EGLE-approved Workplan (Golder, 2018). Field activities are scheduled to begin in second quarter 2020.

The first phase of closure activities will be CCR removal and documentation. Excavation will be performed to remove CCR to elevations identified during investigations; visual observations will be made along with laboratory testing to confirm the CCR removal objective is met. Documentation of CCR removal will then be performed to provide lines of evidence that validate the extent of the excavation and visual observations made in the field

Leaching and compositional analysis was performed on soil and CCRs to spatially determine the extent of CCR removal delineated by health-based standards of CCR constituents and these soil-CCR interfaces were then compiled to form a subsurface excavation profile that determined the threshold depth of excavation. Other lines of evidence will be deployed during field implementation to validate satisfaction with the limits of excavation based on the Quality Assurance protocol developed and detailed in the Workplan (Golder, April 2018). This workplan was reviewed and approved by EGLE on December 20, 2018 and is included as Appendix B. The approved workplan provides additional details regarding the multiple lines of evidence approach to CCR removal. When the CCR removal is complete, Consumers Energy will prepare a documentation report of the removal activities, which will be submitted to EGLE, and placed in the operating record.

After CCR are removed from the bottom ash pond, the area will either be utilized as sedimentation basin for onsite stormwater treatment, backfilled with clean fill to a flat surface to potentially establish a wetland, or backfilled with clean fill to grades that promote overland stormwater flow off of the surface for future use of the open space.

3.1.3 Landfill Closure in Place

Consumers Energy intends to close the Weadock Landfill under the CCR Rule's closure in place provisions in §257.102(d) as documented in the October 2016 Closure Plan that is available on the public facing website. Final closure design and permitting are scheduled to be completed in 2019. Incremental, partial capping activities of the areas to achieve final grades are anticipated to occur in 2022 through 2030 with the installation of the final cover installed by December 31, 2030.

The Weadock Landfill will be closed by:

- bringing the grades up to design grades using on site existing CCRs or supplemented, as necessary, with offsite CCRs or soils;
- construction of the final cover system;
- construction of surface water ditches and letdowns; and,
- revegetating the disturbed areas.

A protective cover or cap would be installed at ground surface to contain the CCR, minimize or eliminate infiltration into the former basin, prevent future impoundment of water, and to prevent the contained materials from migrating or impacting groundwater. The protective cover, along with evidence showing a lack of vertical gradients, will serve to minimize or eliminate the post-closure infiltration of liquid into the CCR. The impermeable slurry wall at the Weadock Landfill effectively prevents lateral migration of constituents and promotes divergent flow of non-impacted groundwater around the landfill. The Weadock Landfill has and will continue to be monitored under Michigan's Part 115 in accordance with the HMP.

The protective cover and slurry wall would serve to isolate the CCR and to minimize the potential for further migration of constituents. Groundwater monitoring and cap maintenance would take place regularly for at least 30 years after closure, in accordance with the Post-Closure Plan (Geosyntec, 2016). These required monitoring and maintenance activities represent a long-term obligation for the Weadock Landfill as well as an ongoing potential risk for release of contaminants from the closed unit to the environment. Additionally, because of the in-place closure, the future land use in the area of the closed unit would be restricted.

3.2 CCR – Impacted Groundwater Management Technologies

Several management technologies exist to eliminate potential risks of CCR-impacted groundwater migration to downgradient receptors. Institutional Controls (ICs) in the form of deed/access restrictions may also be used in conjunction with other remediation technologies to address unacceptable risks to potential receptors. The following list of viable management technologies has been assembled and will be further assessed and reviewed herein:

- Groundwater Monitoring (No Source Removal);
- Post Source Removal Monitoring;
- Groundwater Capture/Control;
- Impermeable Barrier;
- Active Geochemical Sequestration; and,

- Passive Geochemical Sequestration.

Each of these technology options are described in the following subsections and evaluated in Section 4 relative to anticipated effectiveness of the potential corrective measure in meeting the requirements and objectives of the remedy as described under §257.96(c) and R299.4443.

3.2.1 Alternative 1: Groundwater Monitoring (No Source Removal)

Long-term groundwater monitoring relies on physical, chemical, and/or biological *in situ* processes to act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of constituents in the subsurface environment. This groundwater management technology includes implementation of a long-term groundwater monitoring approach in conjunction with a No Action source material management strategy.

Regular monitoring of select groundwater monitoring wells for specific constituents is conducted to ensure COCs in groundwater are stable or attenuating over time.

3.2.2 Alternative 2a: Post Source Removal Monitoring

Post source removal groundwater monitoring is a strategy that can be implemented in combination with a closure in place or closure by removal CCR source material management strategy. Similar to the long-term groundwater monitoring strategy discussed in Section 3.2.1, this approach relies on physical, chemical, and/or biological in situ processes to act without human intervention to reduce the residual mass, toxicity, mobility, volume, or concentration of constituents in the subsurface environment; however, it can be demonstrated that source control/removal would expedite the reduction in concentrations of COCs to levels below regulatory criteria.

For this technology to be effective, the contaminant source areas must be limited in extent, and any residual constituents are separated from any nearby receptors by a sufficient time of groundwater travel (affected by distance, permeability, and/or hydraulic gradient) such that any naturally-occurring *in situ* remediation process may effectively eliminate the potential for the contaminant to reach the receptor at concentrations above applicable criteria. Regular monitoring of select groundwater monitoring wells for specific constituents is conducted to ensure COCs in groundwater are attenuating over time.

3.2.3 Alternative 2b: Groundwater Capture/Control

Groundwater capture approaches are utilized to provide hydraulic control to reduce or prevent the mobility of COCs from migrating offsite and/or to surface water receptors. Capture of groundwater can be accomplished through the use of a conventional vertical groundwater extraction well network screened within the water bearing zone(s), horizontal groundwater extraction wells, or recovery trenches used to intercept groundwater flow. System components for an extraction management strategy typically include extraction points, pumps, electrical feed, well vaults, flow meters, and other miscellaneous appurtenances, and a discharge/treatment option for extracted groundwater. The efficiency of each approach is dependent on site-specific contaminant and hydrogeologic conditions.

3.2.4 Alternative 2c: Impermeable Barrier

Impermeable barriers can be installed below the ground surface to inhibit the lateral flow of groundwater. An impermeable barrier typically consists of a sheet pile or slurry containment wall. A slurry wall is a mixture of soil, water and bentonite clay that is placed into trenches to create an impermeable vertical wall. A sheet pile wall consists of driven rigid materials (pilings) into the ground to form an impermeable barrier.

Impermeable barriers are often used in conjunction with a groundwater capture/control approach to reduce the number of wells required to reduce or prevent COC migration from the CCR unit. Barriers installed without groundwater extraction can be useful in preventing COC migration; however, altered flow conditions due to the barrier may cause water and COC migration around or beneath the installed barrier.

3.2.5 Alternative 2d: Active Geochemical Sequestration

Active geochemical sequestration can be an effective *in situ* groundwater treatment technology to either remove or transform COCs. Active geochemical sequestration relies on an energy dependent operating delivery system to continuously or at scheduled intervals introduce amendments to alter the natural geochemistry to conditions favorable for a reduction in mass or mobility of the COCs. Performance monitoring would determine the effectiveness and operation schedule. One example technology for this category would be Air Sparging. *In situ* treatment of coal ash related constituents in groundwater may be feasible via Air Sparging. Typically, injection below the water table of air, pure oxygen, or other gases is used to remove contaminants by volatilization or bioremediation; however, the technology can also be used to immobilize contaminants through chemical changes such as precipitation.

3.2.6 Alternative 2e: Passive Geochemical Sequestration

Passive geochemical sequestration can be an effective *in situ* groundwater treatment technology to either remove or transform COCs. Geochemical amendments are introduced through direct injection events or trenching rather than continuously as through an active geochemical sequestration approach. One example would be using a Permeable Reactive Barrier installed between the contaminant source and the point(s) of compliance. A Permeable Reactive Barrier is a wall of a designed reactive material constructed *in situ* and perpendicular to the path of groundwater flow using conventional trenching techniques. Permeable Reactive Barriers are constructed with materials that destroy, transform, or enhance the degradation of the constituents or trap the constituents through adsorption or precipitation. The reactive amendment is blended into the trench to form a continuous, flow-through barrier across the plume. The permeability of the installed Permeable Reactive Barrier is targeted to be higher than the native aquifer materials so that the flow through the wall is not impeded at the time of installation or throughout the wall's operational life. Performance monitoring would determine the effectiveness and schedule consideration for reapplication of the amendment.

Section 4
Evaluation of Corrective Measure Alternatives

Section 4 describes the evaluation of the corrective measure alternatives for groundwater remediation identified in Section 3. Each identified alternative has been assessed using the CCR Rule and Michigan Part 115 corrective measure balancing criteria.

Table 1 provides a visual evaluation of the relative effectiveness of each groundwater treatment alternative to address COCs identified in Section 2.5.4. Each groundwater treatment alternative was evaluated with regards to each balancing criterion based on its anticipated effectiveness, implementability, and sustainability. Color-coding is used to categorize the alternative on a scale from ineffective to highly effective. The evaluation of each alternative is discussed in the following sub-sections. The relative effectiveness of each alternative compared to other alternatives based on the summation of the balancing criteria ratings is also included in Table 1.

The discussion in this section highlights the benefits and drawbacks of each option based on currently available data. Additionally, potential COCs will be considered during final remedy selection. The evaluation of these technologies is based on literature review of remediation profiles using these technologies with characteristics similar to the Weadock Bottom Ash Pond and Weadock Landfill, government guidance documents, and previous activities. The extent and magnitude of COC-impacted groundwater will be considered for evaluation of the final remedy.

Balancing criteria were selected based on remedy selection criteria in §257.97 and R 299.4444 described in Section 4.1. In addition, R 299.4443 for an ACM under Part 115 requires the ACM to comply with the requirements for feasibility studies contained in Part 201. As such, the balancing criteria encompass the criteria for remedial action selection under Section 20120(1).

4.1 Groundwater Management Balancing Criteria

The evaluation process for groundwater management technologies contained herein will generally consist of a weighted comparison of each alternative based on the benefits and drawbacks of each option for eliminating the drinking water exposure and relevant GSI pathways, addressing the ACM factors required in §257.96 and R 299.4443 of Part 115, and considering the following remedy selection balancing criteria specified in §257.97, R 299.4444 of Part 115, and Section 20120 of Part 201:

- Effectiveness in Protecting Health, Safety, Welfare, and the Environment;
- Long-Term Uncertainties;

- Persistence, Toxicity, Mobility, and Propensity to Bioaccumulate of the Hazardous Substances;
- Short- and Long-Term Adverse Health Effects;
- Cost of Remedial Action including Long-Term Maintenance;
- Reliability of the Alternatives;
- Potential for Future Response Activity Costs if Alternative Fails;
- Potential Threats associated with Excavation, Transportation, Redisposal, or Containment;
- Ability to Monitor Remedial Performance; and,
- Public's Perspective about Extent to which the Proposed Remedial Action Effectively Addresses Requirements.

The selected corrective measures, as determined during the final remedy selection process described in Section 6, will be based on the balance between these various criteria for each alternative, rather than basing the corrective measure selection on only one of the criteria (e.g., reliability).

Analysis of viable alternatives for groundwater management identified in Section 3 are evaluated in conjunction with the source material control options as specified for each unit, as discussed below.

4.2 Bottom Ash Pond (BAP) Groundwater Management Alternatives

Source removal has been selected as the source control strategy for the Weadock Bottom Ash Pond. Therefore, groundwater management alternatives for the Weadock Bottom Ash Pond will be considered in conjunction with source removal. Each alternative is discussed in the following sub-sections and are summarized in Table 1a.

4.2.1 BAP Alternative 1: No Source Control Action with Long Term Groundwater Monitoring and Institutional Controls (Baseline)

A source material management strategy of no action involves making no efforts to contain or remove CCR as it currently exists, or as it will exist at the end of the useful life of the unit. CCR would be left in the unit without construction of a low permeability cover or additional containment. A no action CCR source material management strategy is not considered viable due to its ineffectiveness of reducing potential exposures to the CCR material or potential migration of CCR material beyond the confines of the specified unit, nor is it a regulatory option. The no action CCR source material management strategy was included in the alternatives evaluation to provide a comparative baseline for other corrective measures alternatives

Typically, a long-term groundwater monitoring approach works best where contaminant source areas have been effectively removed, remediated, and any residual constituents are separated from any nearby receptors by a sufficient time of groundwater travel (affected by distance, permeability, and/or hydraulic gradient) such that any naturally-occurring in situ remediation process may effectively eliminate the potential for the contaminant to reach the receptor at concentrations above applicable criteria. As no efforts to contain or remove CCR would be implemented under this alternative, long-term groundwater monitoring with no source control action is not considered viable for the Weadock Bottom Ash Pond due to the ineffectiveness in protecting health, safety, welfare, and the environment, and the length of time needed to meet remedial goals. This alternative also has a high likelihood for additional future response activities as the reliability is low.

4.2.2 BAP Alternative 2a: Source Removal with Post-Remedy Monitoring

Source removal and post-remedy groundwater monitoring generally offers an advantage over other options considered in that no active remediation system requires installation or maintenance, thus reducing costs, potential threats associated with excavation and material transportation, and long-term uncertainties. As discussed in Section 2.1, closure by removal was the method of closure selected for the Weadock Bottom Ash Pond prior to triggering the requirements for assessing corrective measures; therefore, post-excavation placement of a cap was not considered within this alternative. This approach is likely effective at the Weadock Bottom Ash Pond as the CCR source material will be removed. Residual constituents are separated from any nearby receptors such that naturally-occurring *in situ* remediation process may effectively eliminate the potential for the contaminant to reach the receptor at concentrations above the applicable criteria. Although groundwater chemistry already appears to be improving since Consumers Energy ceased sluicing to the Weadock Bottom Ash Pond, and further improvements can be expected following source removal, there is still some uncertainty surrounding how changes in redox conditions may affect contaminant transport. Since this groundwater monitoring remedy with source removal relies on naturally occurring processes that are hard to predict, the alternative has a relatively high potential need for future response activities. Post-remedy monitoring could be initiated immediately following source removal utilizing the existing monitoring well network. Monitoring would continue until two consecutive rounds of data are below the GWPSs.

4.2.3 BAP Alternative 2b: Source Removal with Groundwater Capture/Control

A groundwater extraction system, if designed, installed, operated, and maintained appropriately in conjunction with source removal could offer an effective remediation solution.

Groundwater extraction can be accomplished using wells screened within water bearing zones or with recovery trenches. Necessary system components for an extraction management strategy include extraction points, pumps, electrical feed, well vaults, flow meters, and other miscellaneous appurtenances. Due to the expected complexity of trench construction near surface water features and the Weadock Bottom Ash Pond, capital costs associated with a trench construction would likely surpass costs expected of an equally effective groundwater extraction well system.

Design and operation of a system shall consider COC migration control, potential changes in oxidation state within water bearing zones that could cause unwanted scale formation in well screens and/or extraction equipment, or the introduction of facultative bacteria within the water bearing zone causing unwanted biogrowth that could affect rates of extraction, or in the case of arsenic, increased solubility and mobilization due to the creation of a more reduced aquifer condition. A routine system inspection and maintenance program would be required to maximize groundwater recovery rates while minimizing system downtime resulting from chemical and/or biological activity.

A groundwater extraction system is expected to be highly effective at capturing groundwater prior to venting to surface water, thus protecting potential receptors. However, this alternative has high capital and long-term costs due to the installation and ongoing operation and maintenance of the groundwater extraction system. Reliability of a groundwater capture/control system is higher than active or passive geochemical sequestration, as it has been proven effective under similar geologic conditions as the Weadock Bottom Ash Pond, but is less reliable than an impermeable barrier due to operation, maintenance, and overall effectiveness. Design and construction of a groundwater extraction system would take longer to implement than groundwater monitoring.

4.2.4 BAP Alternative 2c: Source Removal with Impermeable Barrier

An impermeable barrier wall, constructed of either sheet pile or slurry, could be installed to restrict the groundwater flow paths directly from the Weadock Bottom Ash Pond to the discharge channel. The impermeable wall would need to be installed into the clay confining unit underlying the uppermost groundwater aquifer. In order to evaluate this alternative further, groundwater modeling would be performed to assess the need for groundwater extraction.

An impermeable barrier would effectively minimize the movement of impacted groundwater, providing better protection than remediation relying on physical, chemical, or biological processes. However, due to the high capital cost of construction, the cost of remedial action is higher than other options considered. Installation of an impermeable barrier combined with groundwater extraction would have considerably longer construction duration when compared to other options considered.

4.2.5 BAP Alternative 2d: Source Removal with Active Geochemical Sequestration

Active geochemical sequestration, such as Air Sparge, could be an effective *in situ* groundwater treatment technology to either remove or transforms COCs. Air Sparge can immobilize contaminants through chemical changes (e.g., oxidation of arsenic, its subsequent complexation with iron hydroxides, and precipitation). Aeration increases dissolved oxygen concentration in the groundwater and causes an accompanying increase in oxidation reduction potential (redox). Additionally, Air Sparge can increase pH in groundwater by stripping carbon dioxide (CO_2) which may immobilize the lithium and beryllium observed at JCW-MW-15009 where lower pH conditions (between 4.1 and 5.4 S.U.) have been observed.

Installing air sparge wells, potentially in a curtain configuration perpendicular to flow of groundwater, offers a remedial option for select COCs by creating a reactive (oxidizing) zone in an attempt to remove arsenic through precipitation with dissolved minerals and sorption on metal/iron oxyhydroxides.

Similar to other *in situ* approaches, a limiting process with this *in-situ* remedial approach is the delivery of the compounds within the area of interest. Creating enough contact with target constituents can be difficult in heterogeneous and fine-grained materials. Like the groundwater capture system alternative, design and operation of an active geochemical sequestration system also needs to consider COC migration control and potential changes in oxidation state within water bearing zones that could cause adverse effects such as unwanted scale formation (e.g., fouling) in well screens. System operation and maintenance would be required to monitor operational parameters (e.g., pressures, temperatures, flow rates, etc.), and conduct routine maintenance on the system (e.g., filter cleaning and change-out, blower valve, belt and oil maintenance, etc.). Reliability of an active geochemical sequestration system is also considered lower when compared to other remedial alternatives due to the increased amount of operation, maintenance, and overall effectiveness. Design and installation of an active geochemical sequestration system would take longer than implementing groundwater monitoring.

4.2.6 BAP Alternative 2e: Source Removal with Passive Geochemical Sequestration

Passive geochemical sequestration, such as a Permeable Reactive Barrier, offers a remediation option for select COCs with no active operational costs other than periodic performance monitoring once installed. However, remediation of other COCs may not be equally effective, and therefore such COCs may pass through the Permeable Reactive Barrier with limited-to-no treatment prior to discharge. Although the Permeable Reactive Barrier offers a relatively low-cost remedial alternative, long term performance cannot be guaranteed, and wall failure would not be easily repaired without considerable reconstruction efforts.

The pH and redox conditions in the subsurface environment will control the solubility of arsenic into groundwater. In low pH and oxidized aquifer conditions, dissolved arsenic resides in a low solubility oxidized ionic state [As5+]. At high pH and reduced aquifer conditions, dissolved arsenic resides in a higher solubility reduced ionic state [As3+]. The presence of organic carbon and aerobic bacteria will also impact the concentration of arsenic in groundwater; both tend to create reduced groundwater conditions, thereby increasing the solubility/mobility of arsenic in the subsurface.

Ferric (oxidized) iron and zero-valent (reduced) iron (ZVI) have been demonstrated to be effective in the removal of arsenic in groundwater by way of adsorption onto the iron surfaces. Once adsorbed, the [As5+] and [As3+] ions will form complexes with iron corrosion products including ferrous hydroxide and ferric oxyhydroxides, and then become occluded by successive layers of corrosion products.

To address arsenic in the uppermost aquifer, the Permeable Reactive Barrier could be constructed using ZVI (with sulfide and organic carbon amendments to sustain the reduced environmental condition in this zone). Additional site COC treatment (e.g. lithium) by ZVI is undocumented in literature, and therefore *in situ* treatment with ZVI is not expected.

Arsenic removal by reactive *in situ* chemistry has been implemented in pilot and full-scale field installations; however, to develop confidence of its success and exact construction specifications, the proposed Permeable Reactive Barrier would require an extensive bench treatability study, if a Permeable Reactive Barrier wall was to be implemented.

Treatment of the other COCs for the Weadock Bottom Ash Pond (beryllium and lithium) is undocumented in field installations or treatability studies. Lithium and beryllium, due to the chemical nature of these elements, are not expected to be treated with the ZVI wall and therefore may pass through a Permeable Reactive Barrier without treatment prior to discharging to surface water receptors; however, exceedances for these COCs is limited to one location (JCW-MW-15009) located the farthest from the waste limit of the Weadock Bottom Ash Pond and also located in the general vicinity of the Weadock Power Plant where groundwater quality may be related to industrial activities rather than CCR management, as discussed in Section 2.5.4. A focused geochemical sequestration treatment near JCW-MW-15009 using an alternate approach (e.g., pH buffering) may be required to address lithium and beryllium.

The effectiveness and reliability of passive geochemical sequestration is low compared to other options as not all site COCs are expected to be treated using this alternative and more than one geochemical approach may need to be implemented. The uncertainty of this alternative results in a relatively high potential for future response activities if it fails or proved to be ineffective. The use of chemical additions may cause changes in groundwater chemistry that result in increases in the persistence, toxicity, or mobility of groundwater constituents that would not occur with only monitoring, groundwater capture or control, or an impermeable barrier. Permeable Reactive Barrier wall construction would take a similar amount of time to implement as an impermeable barrier.

4.3 Landfill Groundwater Management Alternatives

Closure in place has been selected as the source control strategy for the Weadock Landfill. The protective final cover and slurry wall would serve to isolate the CCR, reduce infiltration, and to minimize the potential for further migration of constituents. Therefore, groundwater management alternatives for the Weadock Landfill will be considered in conjunction with closure in place. A slurry wall has already been installed to completely enclose the Weadock Landfill. As such, all post-source control alternatives are being evaluated as additions to the existing perimeter low permeability feature. Each alternative is discussed in the following sub-sections and are summarized in Table 1b.

4.3.1 Landfill Alternative 1: No Source Control Action with Long Term Groundwater Monitoring and Institutional Controls (Baseline)

A no action CCR source material management strategy with long-term groundwater monitoring is not considered viable due to its ineffectiveness of reducing potential exposures to the CCR material or potential migration of CCR material beyond the confines of the specified unit, nor is it a regulatory option. The no action CCR source material management strategy was included in the alternatives evaluation to provide a comparative baseline for other corrective measures alternatives.

4.3.2 Landfill Alternative 2a: Close in Place with Post-Source Management Monitoring

Closure in place and post-source management monitoring is likely effective at the Weadock Landfill since the existing slurry wall provides a low permeability feature between the Landfill and surface water and appears to be performing as designed based on observed water elevations inside and outside of the slurry wall. Residual constituents are separated from any nearby receptors such that any naturally-occurring *in situ* remediation process may effectively eliminate the potential for the contaminant to reach the receptor at concentrations above the applicable criteria. Although groundwater chemistry appears to be stable or improving under current conditions, there is still some uncertainty surrounding how changes in redox conditions may affect contaminant transport. Since this groundwater monitoring remedy with source removal relies on naturally occurring processes that need to be documented and validated, the alternative has a relatively high potential need for additional future response activities. Post-remedy monitoring could be initiated immediately following closure in place utilizing the existing monitoring well network. Monitoring would continue until groundwater monitoring data shows that concentrations are statistically below the GWPS (*i.e.* the upper confidence level is below the GWPS).

4.3.3 Landfill Alternative 2b: Close in Place with Groundwater Capture/Control

A groundwater extraction system for the Weadock Landfill is expected to less effective in protecting human health and the environment than other alternatives due to the proximity of the Landfill to the surface water. There is insufficient space to install a groundwater extraction system along the Weadock Landfill perimeter, nor is there space to install monitoring wells or piezometers that would allow the capture zone to be monitored. The difficulty in installing a system would also contribute to higher installation and long-term operation/maintenance costs. Design and construction of a groundwater extraction system would take a significant amount of time to implement.

4.3.4 Landfill Alternative 2c: Close in Place with Active Geochemical Sequestration

Air Sparge could be an effective *in situ* groundwater treatment technology to either remove or transforms COCs. System operation and maintenance would be required to monitor operational parameters (e.g., pressures, temperatures, flow rates, etc.), and conduct routine maintenance on the system (e.g., filter cleaning and change-out, blower valve, belt and oil maintenance, etc.). Reliability of an active geochemical sequestration system is also considered lower when compared to other remedial alternatives due to the increased amount of operation, maintenance, and overall effectiveness. Design and installation of an active geochemical sequestration system would take longer than implementing groundwater monitoring. Furthermore, the efficacy of using passive and active geochemical sequestration would need to be further evaluated to determine if the act of sequestration has the potential to result in unanticipated consequences resulting in the mobilization of other metals that are currently not identified as constituents of concern.

4.3.5 Landfill Alternative 2d: Close in Place with Passive Geochemical Sequestration

Arsenic removal by reactive in situ chemistry has been implemented in pilot and full-scale field installations; however, to develop confidence of its success and exact construction specifications, the proposed Permeable Reactive Barrier would require an extensive bench treatability study for this site, if a Permeable Reactive Barrier wall was to be implemented. Removal of other potential COCs by geochemical sequestration would also require bench treatability studies to assess its effectiveness. The effectiveness and reliability of passive geochemical sequestration is low compared to other options. The uncertainty of this alternative results in a relatively high potential for future response activities if it fails or proved to be ineffective. The use of chemical additions may cause changes in groundwater chemistry that result in increases in the persistence, toxicity, or mobility of groundwater constituents that would not occur with only monitoring, groundwater capture or control, or the existing impermeable barrier which effectively prevents lateral migration of constituents and promotes divergent flow of non-impacted groundwater around the Weadock Landfill. Installation of a Permeable Reactive Barrier wall would have considerably longer construction duration when compared to other options considered. Furthermore, the efficacy of using passive and active geochemical sequestration would need to be further evaluated to determine if the act of sequestration has the potential to result in unanticipated consequences resulting in the mobilization of other metals that are currently not identified as COCs.

Section 5
Remedy Selection Summary

This ACM has been completed to meet the requirements of § 257.96 and to begin the process of selecting corrective measure(s) for groundwater. The CCR source material management strategy is summarized in Section 5.1. The results of the assessment of groundwater remediation technologies are summarized in Section 5.2.

5.1 CCR Source Material Management

As documented in the October 12, 2018 Notification of Intent to Initiate Closure letter submitted in accordance with §257.102(g), Consumers Energy intends to close the Weadock Bottom Ash Pond under the CCR Rule's closure by removal provisions in §257.102(c) and the Weadock Landfill under the CCR Rule's closure in place provisions in §257.102(d) as documented in the January 2018 and October 2016 Closure Plans, respectively, available on the public facing website.

5.1.1 Bottom Ash Pond – Source Removal

Consumers Energy will close of the Weadock Bottom Ash Pond under the CCR Rule's closure by removal provisions in §257.102(c) and in accordance with the EGLE-approved Closure Work Plan (Appendix B). Consumers Energy ceased hydraulic loading to the Weadock Bottom Ash Pond in April 2018 and has allowed the area to dewater by gravity. The dewatering and excavation work is scheduled to be initiated in the second quarter 2020 with a certification report submitted to EGLE once CCR removal is complete. The excavation will extend six inches below the known CCR elevations established from previous investigations. CCR will be removed and placed in an-onsite landfill facility (Weadock Landfill) that consists of a fully enclosed soil-bentonite slurry wall keyed into a competently confining clay unit. Groundwater chemistry already appears to be improving as a result of discontinuing the hydraulic loading to the Weadock Bottom Ash Pond and is expected to further improve following the completed source removal.

5.1.2 Landfill – Closure in Place

As documented in the Weadock Landfill Closure Plan, final closure design and permitting are scheduled to be completed in Calendar Year 2019. Incremental, partial capping activities of the areas that achieve final grades are anticipated to occur in 2022 through 2030 with the installation of the final cover installed by December 31, 2030 according to the following sequence:

1. Final CCR grades will be constructed by placing new CCR material or recovering and regrading historically placed fly ash.
2. After final grading, the CCR subgrade will be prepared by rolling with a smooth drum roller and removing foreign materials that could damage the cover system and to reduce settlement.
3. The cover system will be installed following subgrade preparation.
4. Surface water controls, such as water ditches and letdowns, will be constructed to control erosion.

The protective cover, along with evidence showing a lack of vertical gradients, will serve to minimize or eliminate the post-closure infiltration of liquid into the CCR. The impermeable slurry wall at the Weadock Landfill effectively prevents lateral migration of constituents and promotes divergent flow of non-impacted groundwater around the landfill. The Weadock Landfill will continue to be monitored under Michigan's Part 115 in accordance with the HMP.

5.2 Groundwater Management

This ACM Report provides a high-level assessment of groundwater remediation technologies that could potentially address site-specific COCs (i.e., arsenic, beryllium, and lithium) under known groundwater conditions. Currently, the assessment of remedial technologies is based on the remediation of arsenic, beryllium, and lithium at the Weadock Bottom Ash Pond and arsenic at the Weadock Landfill. Based on the evaluation discussed in Section 4, long term groundwater monitoring in coordination with a no action CCR source material management strategy (Alternative 1) is not viable and as discussed above, is a non-regulatory option that was included only as a comparative baseline for the alternative evaluation process. The remaining alternatives evaluated in this ACM are considered technically feasible final groundwater management strategies to be evaluated following the specified CCR source material management strategy for each unit.

Consumers Energy plans to utilize an adaptive management strategy for selecting the final groundwater remedy for the Weadock Bottom Ash Pond and Weadock Landfill in coordination with the specified CCR source material management strategies. Under this remedy selection strategy, corrective measures may be implemented to address existing conditions followed by monitoring and evaluation of the corrective measure performance. Adjustments will be made to the corrective measure remedy, as needed, to achieve the remedial goals (*e.g.* GWPS and/or risk/exposure/pathway-based criteria).

The groundwater management remedy for the Weadock Bottom Ash Pond and Weadock Landfill will, as soon as feasible, select a final remedy that, at a minimum, meets the standards of § 257.96(b) and R 299.4444(2) as outlined in Section 6. Although arsenic, beryllium, and lithium at Weadock Bottom Ash Pond and arsenic at Weadock Landfill have been identified in groundwater at concentrations exceeding applicable criteria, an evaluation of risk demonstrates that there are **currently no adverse effects on human health or the environment** from either surface water or groundwater due to CCR management at either the Weadock Bottom Ash Pond and the Weadock Landfill. It is anticipated that the remedy selection process will proceed following implementation of the specified CCR source material management strategy. Consumers Energy will continue to evaluate groundwater management alternatives, considering the assumptions and data limitations identified below.

5.3 Assumptions and Limitations

The groundwater monitoring system at the Weadock Bottom Ash Pond and Weadock Landfill has measured constituents in the groundwater system over a relatively short period of time (2015 to 2019). Baseline conditions for the Weadock Bottom Ash Pond and Weadock Landfill were established based on a minimum eight samples collected on a quarterly basis over two years. This short baseline period limits the confidence in assessing the potential variability in groundwater quality over time based on the hydrological and groundwater chemistry changes.

Since beginning CCR groundwater monitoring in 2015, Consumers Energy has ceased sluicing to the Weadock Bottom Ash Pond. The reduction of hydraulic loading is expected to have changed groundwater conditions from aerobic to anaerobic. Water levels in the Weadock Landfill monitoring wells are also trending upwards, resulting in changes in the geochemical conditions of groundwater. Many of the Appendix III and IV constituents will be impacted by this change in redox conditions. These changes in groundwater chemistry are expected to influence trending of Appendix III and IV constituents.

Any remedial strategy depending on geochemical sequestration will need to implicitly include an analysis of the relative stability of groundwater chemistry, including an assessment of future uncertainty based on factors such as fluctuations in groundwater or surface elevations, redox indicators, etc. The efficacy of using passive and active geochemical sequestration methods would also need to be evaluated to determine if the act of sequestration has the potential to result in unanticipated consequences resulting in the mobilization of other metals that are currently not identified as constituents of concern.

Section 6
Next Steps

6.1 Selection of Remedy

The remedy selection process commences following submittal of this ACM. Consumers Energy will, as soon as feasible, select a remedy that, at a minimum, meets the standards of §257.97(b) and R 299.4444(2), that specify that remedies must:

1. Be protective of human health and the environment;
2. Attain the groundwater protection standard as specified pursuant to §257.95(h) and be able to attain groundwater protection standard specified in R 299.4441;
3. Control the source(s) of releases so as to reduce or eliminate, to the maximum extent feasible, further releases of constituents in Appendix IV and PA 640 Section 11511(a)(3) and Section 11519(b)(2) into the environment;
4. 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;
5. Control the source or sources of releases so as to reduce or eliminate, to the maximum extent practicable, further releases of PA 640 Section 11511(a)(3) and Section 11519(b)(2) constituents into the environment that may pose a threat to human health or the environment; and
6. Comply with standards for management of wastes as specified in §257.98(d) and R 299.4445(4).

Upon completion of the ACM leading up to the selection of remedy, Consumers Energy will prepare a semiannual report describing the progress in selecting and designing the remedy in accordance with §257.97. Preferred remedial technologies may be further evaluated as part of the remedy selection process to address site-specific conditions associated with long- and short-term effectiveness and protectiveness, implementability, the practicable capability of Consumers Energy, including a consideration of the technical and economic capability, and other considerations, and the degree to which community concerns are addressed by a potential remedy or remedies.

6.2 Public Meeting Requirement

Consumers Energy will discuss the ACM results in a public meeting with interested and affected parties in accordance with § 257.96(e) and R 299.4443(4) prior to selecting a remedy.

The public meeting will be conducted at least 30 days prior to the selection of remedy in accordance with § 257.96(e).

Consumers Energy will notify stakeholders when the public meeting has been scheduled.

6.3 Final Remedy Selection

A final report describing the selected remedy and how it meets the standards specified in § 257.97 will be prepared following selection of a final remedy. Consumers Energy must obtain a certification from a qualified professional engineer that the remedy selected meets the requirements of § 257.97. The final report will be considered completed when it is placed in the facility's operating record as required by §257.105(h)(12).

Based on the results of the corrective measures assessment pursuant to R 299.4443, Consumers Energy will propose to the EGLE director a remedy that, at a minimum, meets the standards specified in R 299.4444(2). Consumers Energy will within 14 days of selecting a remedy, submit to the director a proposed remedial action plan which is in compliance with Part 201 of the act and which describes the selected remedy and how it also meets the standards of Part 201 of the act.

6.4 Continued Groundwater Monitoring

Consumers Energy will continue executing the self-implementing groundwater compliance schedule in conformance with §257.90 - §257.98, which includes semiannual assessment monitoring in accordance with §257.95 to monitor groundwater conditions and inform the remedy selection. The next semiannual assessment monitoring event is scheduled to occur in October 2019 with results summarized in the 2019 Annual Groundwater Monitoring Report issued in January 2020.

Section 7
References

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ARCADIS. May 13, 2016. Summary of Monitoring Well Design, Installation, and Development – Landfill Unit. JC Weadock Electric Generation Facility – Essexville, Michigan. Prepared for Consumers Energy Company.

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Consumers Energy Company. October 12, 2018. Notification of Intent to Initiate Closure of JC Weadock Bottom Ash Pond.

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Golder Associates Inc. January 2018. J.C. Weadock Generating Facility Bottom Ash Pond Closure Plan, Essexville, Michigan. Prepared for Consumers Energy Company.

TRC. December 2018. Electric Generation Facilities RCRA CCR Monitoring Program. JC Weadock Monitoring Program Sample Analysis Plan Rev. 1, Essexville, Michigan. Prepared for Consumers Energy Company.

TRC. December 2018. Groundwater Statistical Evaluation Plan Rev. 1 – JC Weadock Power Plant, Bottom Ash Pond, Essexville, Michigan. Prepared for Consumers Energy Company.

TRC Environmental Corporation. January 2018. Annual Groundwater Monitoring Report – JC Weadock Power Plant, Bottom Ash Pond CCR Unit. Prepared for Consumers Energy Company.

TRC Environmental Corporation. January 2018. Annual Groundwater Monitoring Report – JC Weadock Power Plant, Landfill CCR Unit. Prepared for Consumers Energy Company.

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TRC Environmental Corporation. January 2019. Statistical Evaluation of Initial Assessment Monitoring Sampling Event, JC Weadock Landfill, Consumers Energy Company, Essexville, Michigan. Prepared for Consumers Energy Company.

USEPA. 2009. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance. Office of Conservation and Recovery. EPA 530/R-09-007.

USEPA. April 2015. 40 CFR Parts 257 and 261. Hazardous and Solid Waste Management System: Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule. 80 Federal Register 74 (April 17, 2015), pp. 21301-21501 (80 FR 21301).

USEPA. July 2018. 40 CFR Part 257. Hazardous and Solid Waste Management System: Disposal of Coal Combustion Residuals from Electric Utilities; Amendments to the National Minimum Criteria (Phase One, Part One); Final Rule. 83 Federal Register 146 (July 30, 2018), pp. 36435-36456 (83 FR 36435).

Tables

Table 1a
Summary Of
Remedial Action Selection
Alternative Evaluation

Site/Impoundment Name: JC Weadock Bottom Ash Pond

Option #		1	2				
CCR Source Management		**None**	**CCR Removal**				
Option #		a	a	b	c	d	e
Groundwater Management (all options will include ICs)		**Long Term Groundwater Monitoring & Institutional Controls (ICs)** **1**	**Post Source Removal Monitoring** **2a**	**Groundwater Capture/Control** **2b**	**Impermeable Barrier (e.g., slurry wall) with Groundwater Capture/Control** **2c**	**Active Geochemical Sequestration (e.g., Air Sparge)** **2d**	**Passive Geochemical Sequestration (e.g. PRB)** **2e**
Balancing Criteria	**Rule Reference**						
i. Effectiveness in Protecting Health, Safety, Welfare, and the Environment	**§257.96(c)(1)** **§257.97(b)(1)** **R 299.4444(2)(a)** **Section 20120(1)(a)**						
ii. Long-Term Uncertainties	**§257.96(c)(1)** **Section 20120(1)(b)**						
iii. Persistence, Toxicity, Mobility, and Propensity to Bioaccumulate of the Hazardous Substances	**§257.96(c)(1)** **Section 20120(1)(c)**						
iv. Short- and Long-Term Adverse Health Effects from Exposure	**§257.96(c)(1)** **§257.97(d)(4)** **R 299.4444(4)(e)** **Section 20120(1)(d)**						
v. Cost of Remedial Action including Long-Term Maintenance	**Section 20120(1)(e)**						
vi. Reliability of the Alternatives	**§257.96(c)(1)** **§257.97(c)(1)(vii)** **§257.97(c)(3)(ii)** **R 299.4444(3)(a)(vii)** **R 299.4444(3)(c)(ii)** **Section 20120(1)(f)**						
vii. Potential for Future Response Activity Costs if Alternative Fails	**§257.96(c)(1)** **§257.97(c)(1)(viii)** **R 299.4444(3)(a)(viii)** **Section 20120(1)(g)**						
viii. Potential Threats associated with Excavation, Transportation, Redisposal, or Containment	**§257.96(c)(1)** **§257.97(c)(1)(iv)** **R 299.4444(3)(a)(iv)** **Section 20120(1)(h)**						
ix. Ability to Monitor Remedial Performance	**Section 20120(1)(i)**						
x. Public's Perspective about Extent to which the Proposed Remedial Action Effectively Addresses Requirements	**§257.97(c)(4)** **R 299.4444(3)(e)** **Section 20120(1)(j)**						
	Relative Effectiveness						

Ineffective, not implementable, and/or not sustainable.

Effectiveness is unsure, challenging implementation, and/or sustainability reduced by at least one operational factor.

Effective, implementable, and/or sustainable.

Notes:
(1) Except as otherwise noted, balancing criteria encompass criteria in the CCR Rule §257.97, Michigan Part 115 R 299.4444, and Michigan Part 201, Section 20120 for remedy selection.
(2) Consumers Energy intends to concurrently close the Weadock Bottom Ash Pond under the RCRA Rule's closure by removal provisions in §257.102(C), as documented in the January 2018 Closure Plan

Table 1b
Summary Of
Remedial Action Selection
Alternative Evaluation

Site/Impoundment Name: JC Weadock Landfill

Option #		1	2			
CCR Source Management		**None**	**Close In Place - Low Permeability Cover**			
Option #		a	a	b	c	d
Groundwater Management (all options will include ICs)		**Long Term Groundwater Monitoring & Institutional Controls (ICs)**	**Impermeable Barrier (existing)**			
			Post Source Management Monitoring	**Groundwater Capture/Control**	**Active Geochemical Sequestration (e.g., Air Sparge)**	**Passive Geochemical Sequestration (e.g. PRB)**
		1	**2a**	**2b**	**2c**	**2d**
Balancing Criteria	**Rule Reference**					
i. Effectiveness in Protecting Health, Safety, Welfare, and the Environment	**§257.96(c)(1) §257.97(b)(1) R 299.4444(2)(a) Section 20120(1)(a)**					
ii. Long-Term Uncertainties	**§257.96(c)(1) Section 20120(1)(b)**					
iii. Persistence, Toxicity, Mobility, and Propensity to Bioaccumulate of the Hazardous Substances	**§257.96(c)(1) Section 20120(1)(c)**					
iv. Short- and Long-Term Adverse Health Effects from Exposure	**§257.96(c)(1) §257.97(d)(4) R 299.4444(4)(e) Section 20120(1)(d)**					
v. Cost of Remedial Action including Long-Term Maintenance	**Section 20120(1)(e)**					
vi. Reliability of the Alternatives	**§257.96(c)(1) §257.97(c)(1)(vii) §257.97(c)(3)(ii) R 299.4444(3)(a)(vii) R 299.4444(3)(c)(ii) Section 20120(1)(f)**					
vii. Potential for Future Response Activity Costs if Alternative Fails	**§257.96(c)(1) §257.97(c)(1)(viii) R 299.4444(3)(a)(viii) Section 20120(1)(g)**					
viii. Potential Threats associated with Excavation, Transportation, Redisposal, or Containment	**§257.96(c)(1) §257.97(c)(1)(iv) R 299.4444(3)(a)(iv) Section 20120(1)(h)**					
ix. Ability to Monitor Remedial Performance	**Section 20120(1)(i)**					
x. Public's Perspective about Extent to which the Proposed Remedial Action Effectively Addresses Requirements	**§257.97(c)(4) R 299.4444(3)(e) Section 20120(1)(j)**					
	Relative Effectiveness					

	Ineffective, not implementable, and/or not sustainable.
	Effectiveness is unsure, challenging implementation, and/or sustainability reduced by at least one operational factor.
	Effective, implementable, and/or sustainable.

Notes:
(1) Except as otherwise noted, balancing criteria encompass criteria in the CCR Rule §257.97, Michigan Part 115 R 299.4444, and Michigan Part 201, Section 20120 for remedy selection.
(2) Consumers Energy intends to close the Weadock Landfill under the CCR Rule's closure in place provisions in §257.102(d) as documented in the October 2016 Closure Plan

Figures

LEGEND

- BACKGROUND MONITORING WELL
- DEK BOTTOM ASH POND & LINED IMPOUNDMENT MONITORING WELL
- DEK BOTTOM ASH POND MONITORING WELL
- DEK LINED IMPOUNDMENT MONITORING WELL
- DECOMMISSIONED MONITORING WELL
- JCW BOTTOM ASH POND MONITORING WELL
- JCW LANDFILL CCR WELL
- MONITORING WELL (STATIC WATER LEVEL ONLY)
- LEACHATE HEADWELL
- SURFACE WATER GAUGING STATION
- NATURE AND EXTENT WELL
- SLURRY WALL (APPROXIMATE)
- EXTENT OF GEOSYNTHETICS (KARN LINED IMPOUNDMENT)

NOTES

1. BASE MAP IMAGERY FROM GOOGLE EARTH PRO, 2018.
2. WELL LOCATIONS SURVEYED BY ROWE PROFESSIONAL SERVICES COMPANY ON 11/4/2015.
3. NOAA/NATIONAL OCEANIC SERVICE GREAT LAKES GAUGING STATION, ESSEXVILLE, MI (ID: 9075035).

N

0 1,000 2,000 Feet

1 " = 1,000 '

1:12,000

PROJECT:

CONSUMERS ENERGY COMPANY
DE KARN AND JC WEADOCK POWER PLANTS
ESSEXVILLE, MICHIGAN

TITLE:

SITE MAP

DRAWN BY:	S. MAJOR	PROJ NO.:	322173-001
CHECKED BY:	K. AMONETTE		**FIGURE 1**
APPROVED BY:	D. LITZ		
DATE:	SEPTEMBER 2019		

TRC

1540 Eisenhower Place
Ann Arbor, MI 48108-3284
Phone: 734.971.7080
www.trccompanies.com

FILE NO.: 322173-001-007.mxd

TRC - GIS

Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl (Foot)
Map Rotation: 0

Plot Date: 9/6/2019, 11:29:50 AM by SMAJOR -- LAYOUT: ANSI B(11"x17")
Path: E:\ConsumersEnergy\CCR_GW\2017_269767\322173-001-007.mxd

LEGEND

- BACKGROUND MONITORING WELL
- DEK BOTTOM ASH POND & LINED IMPOUNDMENT MONITORING WELL
- DEK BOTTOM ASH POND MONITORING WELL
- DEK LINED IMPOUNDMENT MONITORING WELL
- DECOMMISSIONED MONITORING WELL
- JCW BOTTOM ASH POND MONITORING WELL
- JCW LANDFILL CCR WELL
- MONITORING WELL (STATIC WATER LEVEL ONLY)
- LEACHATE HEADWELL
- SURFACE WATER GAUGING STATION
- NATURE AND EXTENT WELL
- SLURRY WALL (APPROXIMATE)
- EXTENT OF GEOSYNTHETICS (KARN LINED IMPOUNDMENT)
- GROUNDWATER ELEVATION CONTOUR (2' INTERVAL, DASHED WHERE INFERRED)
- (580.50) GROUNDWATER ELEVATION (FEET)
- (NM) NOT MEASURED

NOTES

1. BASE MAP IMAGERY FROM GOOGLE EARTH PRO, 2018.
2. WELL LOCATIONS SURVEYED BY ROWE PROFESSIONAL SERVICES COMPANY ON 11/4/2015.
3. NOAA/NATIONAL OCEANIC SERVICE GREAT LAKES GAUGING STATION, ESSEXVILLE, MI (ID: 9075035).
4. GROUNDWATER ELEVATION DATA RECORDED MARCH 11, 2019.
5. GROUNDWATER ELEVATIONS DISPLAYED IN FEET RELATIVE TO THE NORTH AMERICAN VERTICAL DATUM OF 1988.
6. DATA FROM APRIL 7, 2019. NO DATA RECORDED AT NOAA GAUGING STATION ON APRIL 8, 2019.

N

0 1,000 2,000 Feet

1 " = 1,000 '
1:12,000

PROJECT:
CONSUMERS ENERGY COMPANY
DE KARN AND JC WEADOCK POWER PLANTS
ESSEXVILLE, MICHIGAN

TITLE:
SHALLOW GROUNDWATER CONTOUR MAP APRIL 2019

DRAWN BY:	S. MAJOR	PROJ NO.:	322173-001
CHECKED BY:	K. AMONETTE		**FIGURE 2**
APPROVED BY:	D. LITZ		
DATE:	SEPTEMBER 2019		

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FILE NO.: 322173-001-009.mxd

TRC - GIS

Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl (Foot)
Map Rotation: 0

Plot Date: 9/6/2019, 10:01:28 AM by SMAJOR -- LAYOUT: ANSI B(11"x17")
Path: E:\ConsumersEnergy\CCR_GW\2017_269767\322173-001-009.mxd

Constituent	GWPS
Antimony	6 ug/L
Arsenic	21 ug/L
Barium	2,000 ug/L
Beryllium	4 ug/L
Cadmium	5 ug/L
Chromium	100 ug/L
Cobalt	15 ug/L
Fluoride	4,000 ug/L
Lead	15 ug/L
Lithium	180 ug/L
Mercury	2 ug/L
Molybdenum	100 ug/L
Radium-226/228	5 pCi/L
Selenium	50 ug/L
Thallium	2 ug/L

LEGEND

- BACKGROUND MONITORING WELL
- JCW LANDFILL MONITORING WELL
- JCW BOTTOM ASH POND MONITORING WELL
- MONITORING WELL (STATIC WATER LEVEL ONLY)
- LEACHATE HEADWELL
- NATURE AND EXTENT WELL
- NO STATISTICALLY SIGNIFICANT EXCEEDANCES
- STATISTICALLY SIGNIFICANT GWPS EXCEEDANCE
- SLURRY WALL (APPROXIMATE)
- APPROXIMATE WATER-BEARING UNIT BOUNDARY

WELL ID
CONSTITUENT(S) EXCEEDING GWPS

NOTES

1. BASE MAP IMAGERY FROM GOOGLE EARTH PRO, 2018.
2. MONITORING WELL AND SLURRY WALL LOCATIONS PROVIDED BY CEC; SG21733SHT2 REVB.DWG DATED 11/21/2018
3. GWPS (GROUNDWATER PROTECTION STANDARD) IS THE HIGHER OF THE MAXIMUM CONTAMINANT LEVEL (MCL)/REGIONAL SCREENING LEVEL FROM 83 FR 36435 (RSL) AND UPPER TOLERANCE LIMIT (UTL) AS ESTABLISHED IN TRC'S TECHNICAL MEMORANDUM DATED OCTOBER 15, 2018.
4. AN EXCEEDANCE OF THE GWPS OCCURS WHEN THE LOWER CONFIDENCE LIMIT OF THE DOWNGRADIENT DATA EXCEEDS THE GWPS.

0 600 1,200 Feet
1 " = 600 '
1:7,200

PROJECT:
CONSUMERS ENERGY COMPANY
JC WEADOCK POWER PLANT
ESSEXVILLE, MICHIGAN

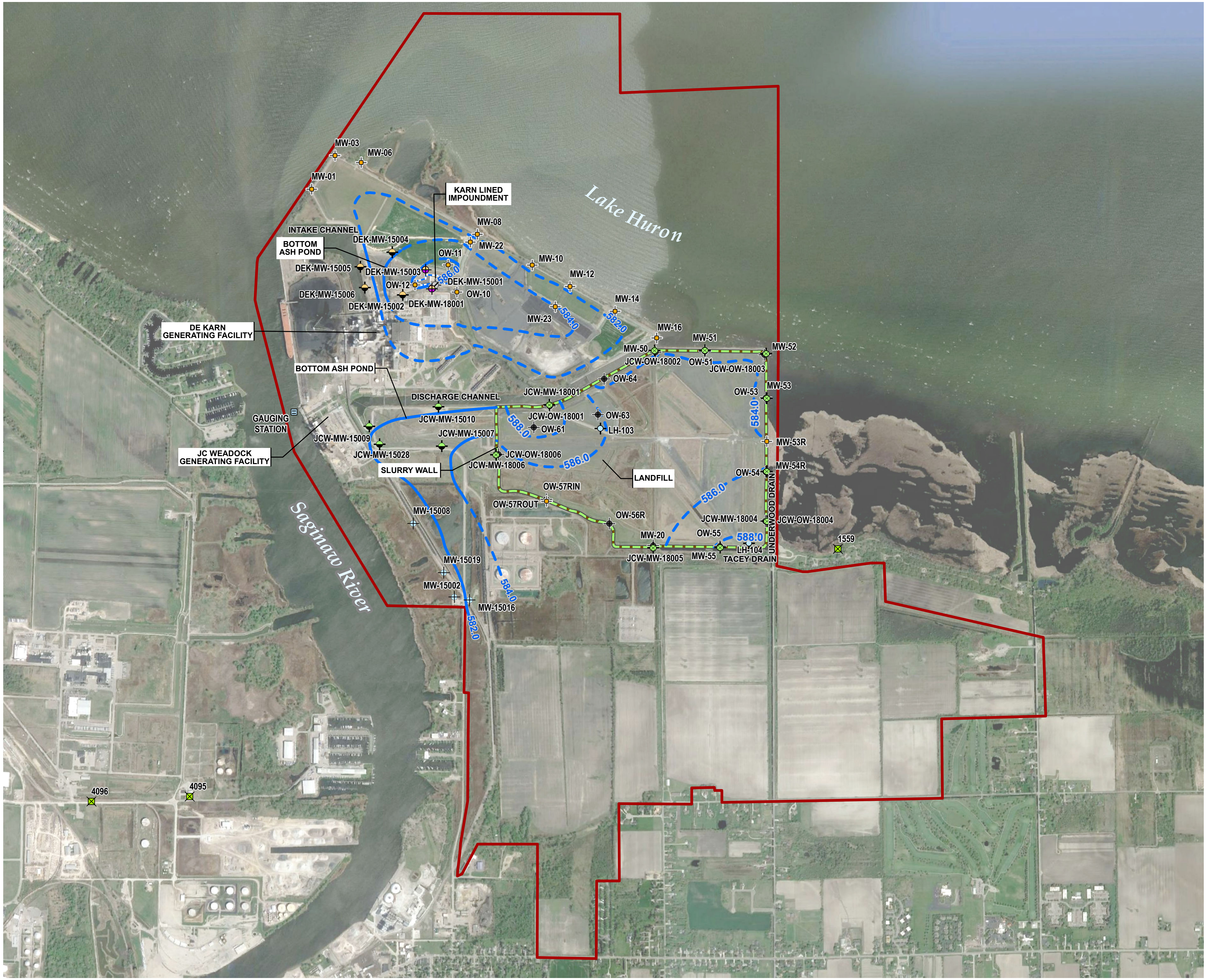
TITLE:
NATURE AND EXTENT SUMMARY
GWPS EXCEEDANCES

DRAWN BY:	S. MAJOR	PROJ NO.:	322173-001
CHECKED BY:	K. AMONETTE		
APPROVED BY:	D. LITZ		**FIGURE 3**
DATE:	SEPTEMBER 2019		

TRC
1540 Eisenhower Place
Ann Arbor, MI 48108-3284
Phone: 734.971.7080
www.trccompanies.com

FILE NO.: 322173-ExceedancesNE_ACM.mxd

TRC - GIS
Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl (Foot)
Map Rotation: 0
Plot Date: 9/10/2019, 12:19:02 PM by SMAJOR -- LAYOUT: ANSI B(11"x17")
Path: E:\ConsumersEnergy\CCR_GW\2017_269767\322173-ExceedancesNE_ACM.mxd



LEGEND

- BACKGROUND MONITORING WELL
- DEK BOTTOM ASH POND & LINED IMPOUNDMENT MONITORING WELL
- DEK BOTTOM ASH POND MONITORING WELL
- DEK LINED IMPOUNDMENT MONITORING WELL
- DECOMMISSIONED MONITORING WELL
- JCW BOTTOM ASH POND MONITORING WELL
- JCW LANDFILL CCR WELL
- MONITORING WELL (STATIC WATER LEVEL ONLY)
- LEACHATE HEADWELL
- SURFACE WATER GAUGING STATION
- NATURE AND EXTENT WELL
- DRINKING WATER WELL
- SLURRY WALL (APPROXIMATE)
- EXTENT OF GEOSYNTHETICS (KARN LINED IMPOUNDMENT)
- PROPERTY BOUNDARY
- GROUNDWATER ELEVATION CONTOUR (2' INTERVAL, DASHED WHERE INFERRED)

NOTES

1. BASE MAP IMAGERY FROM GOOGLE EARTH PRO, 2018.
2. WELL LOCATIONS SURVEYED BY ROWE PROFESSIONAL SERVICES COMPANY ON 11/4/2015.
3. NOAA/NATIONAL OCEANIC SERVICE GREAT LAKES GAUGING STATION, ESSEXVILLE, MI (ID: 9075035).
4. GROUNDWATER ELEVATIONS DISPLAYED IN FEET RELATIVE TO THE NORTH AMERICAN VERTICAL DATUM OF 1988.
5. DRINKING WATER WELL LOCATIONS FROM THE STATE OF MICHIGAN WELLOGIC DATABASE, 7/18/2019.
6. GROUNDWATER ELEVATION DATA RECORDED.

N

0 1,600 3,200 Feet

1 " = 1,600 '

1:19,200

PROJECT:

CONSUMERS ENERGY COMPANY
DE KARN AND JC WEADOCK POWER PLANTS
ESSEXVILLE, MICHIGAN

TITLE:

PROPERTY BOUNDARY AND SURROUNDING FEATURES

DRAWN BY:	S. MAJOR	PROJ NO.:	322173-001
CHECKED BY:	K. AMONETTE	FIGURE 4	
APPROVED BY:	D. LITZ		
DATE:	SEPTEMBER 2019		

TRC
1540 Eisenhower Place
Ann Arbor, MI 48108-3284
Phone: 734.971.7080
www.trccompanies.com

FILE NO.: 322173-001-013x.mxd

TRC - GIS

Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl (Foot)
Map Rotation: 0

Plot Date: 9/6/2019, 11:23:36 AM by SMAJOR -- LAYOUT: ANSI B(11"x17")
Path: E:\ConsumersEnergy\CCR_GW\2017_269767\322173-001-013x.mxd

Appendix A
Demonstration for 60-Day Extension

Consumers Energy
Count on Us®

A CMS Energy Company

Date: July 12, 2019

To: Operating Record

From: Harold D. Register, Jr., P.E.

RE: Demonstration for 60-Day Extension for Assessment of Corrective Measures
Professional Engineer Certification
JC Weadock Landfill and JC Weadock Bottom Ash Pond

Professional Engineer Certification Statement [§257.96(a)]

Consumers Energy has determined that the analysis of the effectiveness of potential corrective measures in meeting all of the requirements and objectives of a selected remedy described in §257.97 cannot be achieved within the 90-day timeline to complete the Assessment of Corrective Measures for JC Weadock Landfill and JC Weadock Bottom Ash Pond due to site-specific conditions that are changing based on initiating closure activities. Notification was made on October 12, 2018 that closure activities had been initiated. Groundwater monitoring data collected to date indicates changing conditions that can influence factors that must be considered in the assessment, including source evaluation, plume delineation, groundwater assessment, and source control. The final published rule allows for a single 60 day extension based on site-specific conditions or circumstances.

I hereby attest that, having reviewed the detection and assessment monitoring documentation and being familiar with the provisions of Title 40 of the Code of Federal Regulations §257.96, that the demonstration justifying a 60-day time extension to the 90-day completion period of the Assessment of Corrective Measures is accurate for JC Weadock Landfill and JC Weadock Bottom Ash Pond in accordance with the requirements of §257.96(a). This will now set the deadline for completing the Assessment of Corrective Measures for September 11, 2019.

Harold D. Register J.
Signature

STATE OF MICHIGAN
HAROLD D. REGISTER, JR.
ENGINEER
No. 6201056266
LICENSED PROFESSIONAL ENGINEER

07/12/2019

July 12, 2019
Date of Certification

Harold D. Register, Jr., P.E.
Name

6201056266
Professional Engineer Certification Number

Appendix B
Closure Work Plan

Consumers Energy

A CMS Energy Company

Environmental Services

April 20, 2018

Phil Roycraft
Michigan Department of Environmental Quality
Waste Management & Radiological Protection Division
Saginaw Bay District Office
401 Ketchum St, Suite B
Bay City, Michigan 48708

TRANSMITAL OF DE KARN BOTTOM ASH POND CLOSURE BY REMOVAL PLAN RESPONSE TO COMMENTS DATED APRIL 3, 2018 AND FOLLOW-UP FROM MEETING ON FEBRUARY 13, 2018; WASTE DATA SYSTEM NUMBER 395457

Dear Mr. Roycraft,

This submittal has been prepared in response to comments provided by Michigan Department of Environmental Quality (MDEQ) on April 3, 2018 the *"J.C. Weadock Generating Facility Bottom Ash Pond Closure Work Plan"* (Closure Work Plan), dated November 29, 2017. This work plan was submitted to request agreement from the Michigan Department of Environmental Quality (MDEQ) on Consumers Energy's plan to close the JC Weadock Bottom Ash Pond by removal of CCR in accordance with the self-implementing schedule and requirements of the CCR Rule.

The JC Weadock Bottom Ash Pond has a certified closure plan pursuant to 40 CFR 257.102(c) depicting closure by removal for this CCR unit enclosed with the response (attached). Upon completing the removal activity described in the Closure Work Plan, it is anticipated that the groundwater conditions will improve for those wells in the JC Weadock Bottom Ash Pond groundwater monitoring system. The balance of the closure period (anticipated to be completed no later than 2023) provided under the CCR RCRA Rule will be used to monitor the improvement in groundwater quality relative to attainment of the groundwater protection standard.

Please feel free to contact me with any questions that you may have about this submittal.

Sincerely,

Harold D. Register, Jr., P.E.
Senior Engineer
Landfill Operations Compliance
Phone: (517) 788-2982
Email: harold.registerjr@cmsenergy.com

cc: Ms. Lori Babcock, MDEQ Saginaw Bay District Office
Mr. Gary Schwerin, MDEQ Saginaw Bay District Office
Mr. Caleb Batts, Consumers Energy Karn-Weadock

Enclosures: "*J.C. Weadock Bottom Ash Pond Closure Work Plan Response to MDEQ Comments*" (April 16, 2018)

*"J.C. Weadock Generating Facility Bottom Ash Pond Closure Plan" (*January 12, 2018).

MEMORANDUM

Date:	April 16, 2018	**Project No.:**	1667572
To:	Bradley Runkel, Harold Register, Jr.	**Company:**	Consumers Energy Company
From:	Hugh Davies, Megan Jehring, Mark Bergeon		
cc:	Jeff Piaskowski, Matt Wachholz	**Email:**	
RE:	**J.C. WEADOCK BOTTOM ASH POND CLOSURE WORK PLAN RESPONSE TO MDEQ COMMENTS**		

1.0 INTRODUCTION

Following are our responses to Michigan Department of Environmental Quality (MDEQ) comments received via email from Consumers Energy Company (CEC) on April 3, 2018. It is our understanding that CEC received these comments from MDEQ District Engineer, Gary Schwerin. We are providing the MDEQ comments in bold with our response following each comment. The referenced figures and tables are attached.

2.0 COMMENTS AND RESPONSES

Section 4.1

How were the lateral boundaries of the Bottom Ash Pond determined?

Response: The lateral boundaries of the coal combustion residuals (CCR) unit were established such that the minimum footprint of CCR material removal encompasses the wetted perimeter of the impoundment and allows removal down to the base of CCR within the footprint. Historical aerial images and design drawings were consulted to confirm the lateral boundaries are based on the largest extent of the wetted perimeter.

Provide a color map indicating excavation depth ranges in the bottom ash pond.

Response: See attached Figure 1.

How will groundwater be prevented from entering the excavation or handled once it does enter the excavation.

Response: The excavation contractor will be responsible for dewatering the excavation during CCR removal activities.

Section 4.2.1.1

Please provide the laboratory data results for the soil (CCR and sand) samples analyzed.

Response: See attached Tables 1 through 4.

Please provide the referenced GSI criteria.

Response: See attached Tables 5 and 6.

In the last paragraph on page 7, the second to last sentence says mixtures of sand and CCR containing less than 5% CCR would, on average, meet drinking water and GSI protection criteria for arsenic. What is meant by "on average"?

Response: "On average" refers to the use of average constituent concentrations, obtained from the chemical analysis of the CCR and native soil samples, for comparison to drinking water and GSI protection criteria. The constituent concentrations shown in the graphs included in Figure 5 of the work plan are the average values from the chemical analysis of multiple samples of each material type obtained from multiple soil borings located across the Bottom Ash Pond, which incorporate the variable nature of the CCR and native soil materials.

In the last paragraph on page 7, the last sentence says a threshold of 5% CCR was selected. The previous sentence stated <u>less</u> than 5% would meet criteria.

Response: A review of the analytical data indicates that a threshold of 5% CCR or less meets the exceedance criteria for the constituents analyzed. A threshold of 5% CCR is protective of groundwater based on the analytical data. The text will be corrected to reflect that 5% CCR is protective of groundwater.

If less than 5% CCR is required to meet criteria, and the target threshold is 5% CCR, are the color cutoff values accurate and precise enough, and the colorimetric analysis accurate and precise enough to distinguish between samples with 5% CCR and 6% CCR?

Response: As indicated in the response immediately preceding this one, 5% CCR meets the criteria. As described in the Work Plan, the color integer cutoff value selected to represent 5% CCR was based on a laboratory-based testing program in which native soil and CCR were mixed in a controlled manner. When this colorimetric assessment method was first implemented at JH Campbell Pond 3N, the accuracy of the color integer cutoff value was retested in the field by preparing additional mixtures of CCR and the native soil, exposed at the base of the excavation, and testing the color. This approach will also be implemented at JC Weadock to assess the accuracy of the color cutoff value.

To address precision, during field implementation of the method at JH Campbell Pond 3N, samples with measured CCR content in the range of 4.5% to 5.5% were tested three additional times using the remaining portion of the sample split three times. This sub-sampling and testing provided four CCR results that were averaged, with the average result being reported as the sample's CCR content.

Section 4.2.2.1

Provide a map showing the locations of the borings.

Response: See attached Figure 2.

Section 4.2.2.2

The plan says photographs will be taken at a standardized height. Specify the height and the pixel resolution to be used.

Response: The camera height will be approximately 2.5 feet above the excavated surface, and photographs will have a pixel resolution of 4608 x 3456 (i.e., 15.9 megapixels). The camera will be positioned directly over the excavated surface facing downwards with as little tilt as possible.

Section 4.2.2.3

Please provide the measured color values for the CCR mixtures analyzed.

Response: See attached Table 7.

Section 4.3

Please provide a map indicating the location of the monitoring wells in relation to the bottom ash pond.

Response: See attached Figure 3.

Please provide a contour map showing groundwater flow direction.

Response: See attached Figure 3.

The third paragraph refers to a 10% threshold.

Response: The threshold is 5% CCR remaining. The work plan will be revised accordingly and reviewed for consistency.

Appendix B

Provide a map showing the locations of the soil borings.

Response: See attached Figure 2.

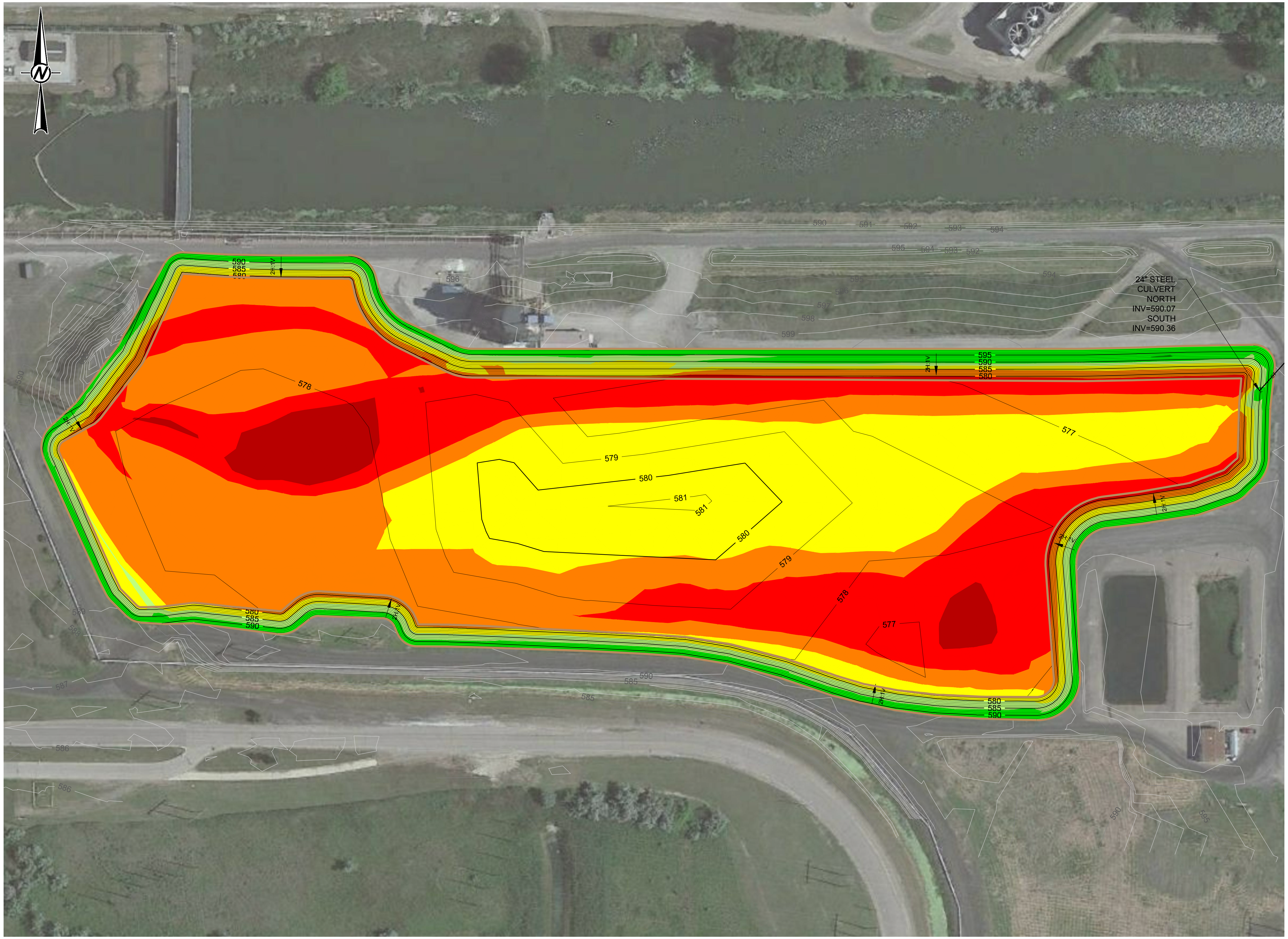
3.0 CLOSING

Please contact us if you have any questions or would like additional information.

Attachments:

Figure 1:	Bottom Ash Pond Depth of CCR Excavation
Figure 2:	Boring Location Plan
Figure 3:	Shallow Groundwater Contour Map February 2017
Tables 1-4:	Summary of Analytical Data
Tables 5-6:	Exceedance Criteria
Table 7:	Colorimetry Results for CCR: J.C. Weadock

FIGURE 1
CCR EXCAVATION PLAN



LEGEND

- EXCAVATION GRADE BREAK LINE
- EXCAVATION 5 ft CONTOUR
- EXCAVATION 1 ft CONTOUR
- EXISTING GROUND 5 ft CONTOUR
- EXISTING GROUND 1 ft CONTOUR

CUT/FILL TABLE (-=CUT, += FILL)

NUMBER	MIN. DEPTH (FT)	MAX. DEPTH (FT)	COLOR
1	-30	-25	
2	-25	-20	
3	-20	-15	
4	-15	-10	
5	-10	-5	
6	-5	0	
7	0	5	

NOT FOR CONSTRUCTION

0 75 150
1" = 150' FEET

REV. YYYY-MM-DD DESCRIPTION DESIGNED PREPARED REVIEWED APPROVED

CLIENT
CONSUMERS ENERGY COMPANY
2742 NORTH WEADOCK HIGHWAY
ESSEXVILLE, MI. 48732

CONSULTANT
Golder Associates
www.golder.com

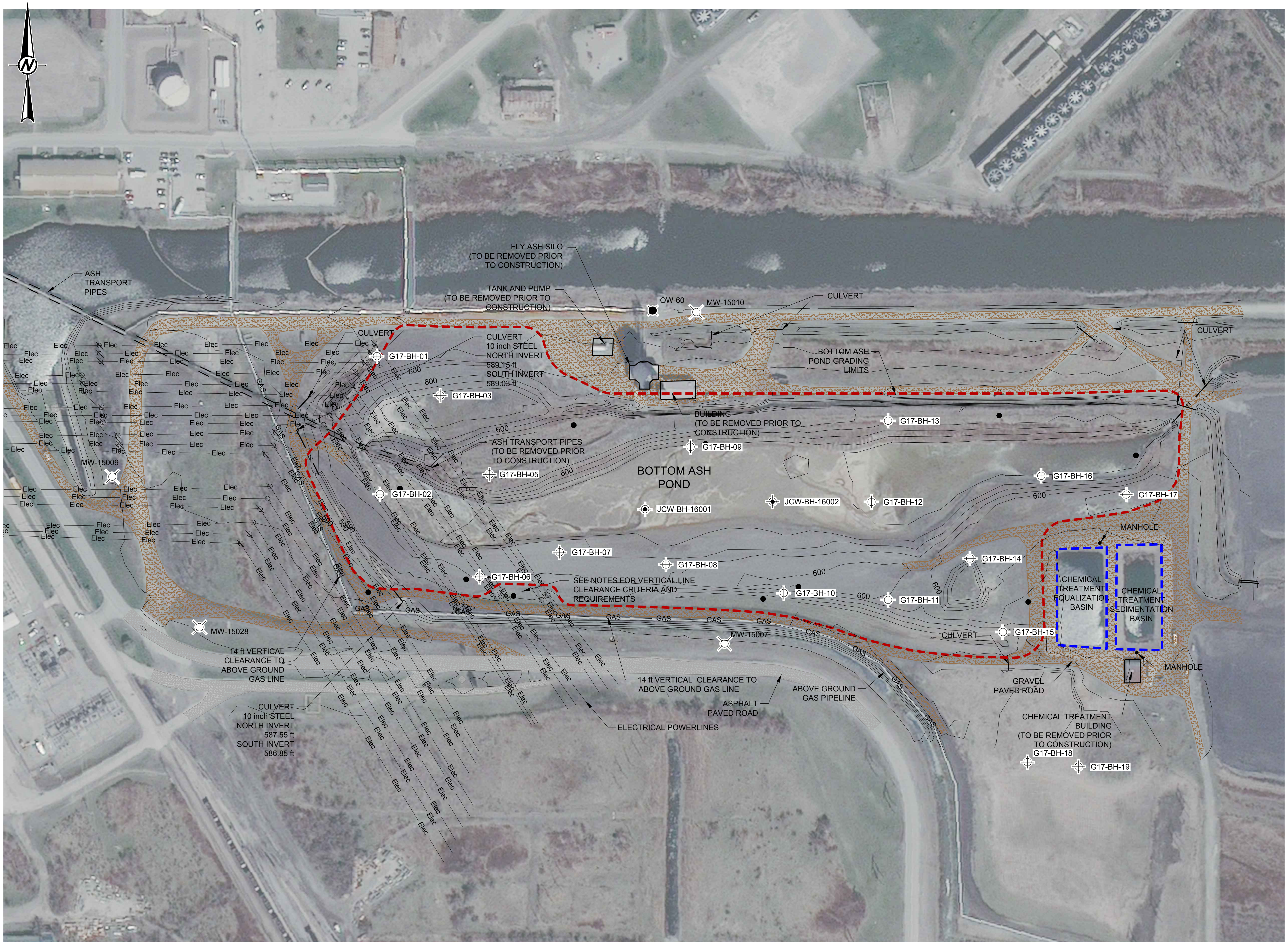
PROJECT
J.C. WEADOCK BOTTOM ASH POND

TITLE
BOTTOM ASH POND DEPTH OF CCR EXCAVATION

PROJECT NO. 1655164 REV. 0 of DRAWING 1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

FIGURE 2
BORING LOCATION PLAN



LEGEND

- BOTTOM ASH POND GRADING LIMITS
- CHEMICAL TREATMENT PONDS
- EXISTING GROUND 5 ft CONTOUR
- EXISTING GROUND 1 ft CONTOUR
- Elec — ELECTRICAL POWERLINES
- Gas — ABOVE GROUND GAS PIPELINE
- ASH TRANSPORT PIPES
- ST — STORMWATER CULVERTS
- GRAVEL PAVED ROAD
- ASPHALT PAVED ROAD
- JCW-BH-16001 — 2016 GOLDER BOREHOLE LOCATION
- MW-15007 — MONITORING WELL LOCATION (BY ARCADIS)
- JCW-G17-BH-05 — 2017 GOLDER BOREHOLE LOCATION

0 100 200
1" = 200' FEET

REFERENCE DRAWINGS	REV	DATE	DESCRIPTION	DR	BY	CHK	APP	CO

REV	DATE	DESCRIPTION	DR	BY	CK	APP	CO
0	2018-04-05		DJC	JRP	MMJ		

SIGNATURE
NAME
MICHIGAN P.E. No.

Consumers Energy

J.C. WEADOCK GENERATING FACILITY
ESSEXVILLE, MI

BORING LOCATION PLAN

J.C. WEADOCK BOTTOM ASH POND

CLOSURE WORK PLAN

SCALE: AS SHOWN
JOB: 1667572.0007
DRAWING NO.
SHEET 2
REV. 0

FIGURE 3
SHALLOW GROUNWATER CONTOUR MAP
APRIL 2018

LEGEND

- HMP MONITORING WELLS
- BACKGROUND MONITORING WELL
- DEK BOTTOM ASH POND MONITORING WELL
- JCW BOTTOM ASH POND MONITORING WELL
- JCW LANDFILL MONITORING WELL
- SURFACE WATER GAUGING STATION
- MONITORING WELL (STATIC WATER LEVEL ONLY)
- SLURRY WALL (APPROXIMATE)
- GROUNDWATER ELEVATION CONTOUR (2' INTERVAL, DASHED WHERE INFERRED)
- (580.85) GROUNDWATER ELEVATION (FEET, MSL)

NOTES

1. BASE MAP IMAGERY FROM USDA – NATIONAL AGRICULTURE IMAGERY PROGRAM, 7/10/2016.
2. WELL LOCATIONS SURVEYED BY ROWE PROFESSIONAL SERVICES COMPANY ON 11/4/2015.
3. NOAA/NATIONAL OCEANIC SERVICE GREAT LAKES GAUGING STATION, ESSEXVILLE, MI (ID: 9075035).
4. MONITORING WELL DEK- MW-15001 TOP OF CASING WAS EXTENDED IN APRIL 2018. NEW SURVEY DATA NOT YET AVAILABLE.

0 1,000 2,000 Feet

1 " = 1,000 '

1:12,000

PROJECT:

CONSUMERS ENERGY COMPANY
DE KARN AND JC WEADOCK POWER PLANTS
ESSEXVILLE, MICHIGAN

TITLE:

SHALLOW GROUNDWATER CONTOUR MAP
APRIL 2018

WORKING COPY

DRAWN BY:	S. MAJOR	PROJ NO.:	290805-00
CHECKED BY:	M. POWERS-TAYLOR		
APPROVED BY:		**FIGURE 1**	
DATE:	APRIL 2018		

TRC
1540 Eisenhower Place
Ann Arbor, MI 48108-3284
Phone: 734.971.7080
www.trcsolutions.com

FILE NO.: 290805-001-001.mxd

Plot Date: 4/19/2018, 12:15:37 PM by SMAJOR -- LAYOUT: ANSI B(11"x17")

Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl (Foot)

Map Rotation: 0

TRC - GIS

TABLES 1-4
SUMMARY OF ANALYTICAL DATA

Table 1. Total Metals Analysis Results for Native Soil

Field Sample Number			JCW-BH-16001 S-3	JCW-BH-16001 S-4	JCW-BH-16002 S-3	JCW-BH-16002 S-4	JCW-BH-16002 S-5	JCW-G17-BH-01 S-9	JCW-G17-BH-02 S-10	JCW-G17-BH-03 S-8	JCW-G17-BH-10 S-12	JCW-G17-BH-14 S-10	JCW-G17-BH-19 S-6
Pond No.			Bottom Ash Pond	Bottom Ash Pond	Bottom Ash Pond	Bottom Ash Pond	Bottom Ash Pond	Bottom Ash Pond	Bottom Ash Pond	Bottom Ash Pond	Bottom Ash Pond	Bottom Ash Pond	Bottom Ash Pond
Boring			JCW-BH-16001	JCW-BH-16001	JCW-BH-16002	JCW-BH-16002	JCW-BH-16002	JCW-G17-BH-01	JCW-G17-BH-02	JCW-G17-BH-03	JCW-G17-BH-10	JCW-G17-BH-14	JCW-G17-BH-19
Sample ID			S-3	S-4	S-3	S-4	S-5	S-9	S-10	S-8	S-12	S-10	S-6
Date Sampled			5/16/2016	5/16/2016	5/16/2016	5/16/2016	5/16/2016	6/2/2017	6/2/2017	6/2/2017	5/31/2017	6/1/2017	6/1/2017
Sample Depth (ft.)			13	15	14	16	18	17	20	17	21	23	15
Location			W end of Bottom Ash Pond	W end of Bottom Ash Pond	E end of Bottom Ash Pond	E end of Bottom Ash Pond	E end of Bottom Ash Pond	NW of Bottom Ash Pond	W of Bottom Ash Pond	NNW of Bottom Ash Pond	S of Bottom Ash Pond	SE of Bottom Ash Pond	NE of Bottom Ash Pond
Groundwater			Below	Below	Below	Below	Below	Below	Below	Below	Below	Below	Below
Sample Material			Native Soil	Native Soil	Native Soil	Native Soil	Native Soil	Native Soil	Native Soil	Native Soil	Native Soil	Native Soil	Native Soil
	Exceedance Limit[1]	Units											
Arsenic	5,800	µg/kg	2,500	2,400	3,770	4,190	2,630	40,000	6,100	19,000	5,600	2,500	1,800
Barium	370,000	µg/kg	8,530	38,100	17,500	36,200	32,400	60,000	5,500	15,000	17,000	13,000	19,000
Boron	14,000	µg/kg	<2,000	<2,000	3,940	3,070	2,060	21,000	<1,600	<2,000	<2,100	<1,700	<1,900
Cadmium	3,200	µg/kg	<200	<200	<200	<200	<200	<1,600	<800	<1,000	<1,100	<860	<960
Chromium	2,600,000,000	µg/kg	<2,000	9,510	2,000	8,470	7,610	9,400	2,700	2,600	2,800	3,700	3,300
Copper	63,000	µg/kg	<1,000	8,540	1,640	6,830	8,110	8,700	<800	1,800	1,600	1,500	<960
Lead	4,400,000	µg/kg	<1,000	4,090	1,300	3,160	3,320	5,500	980	2,600	1,800	1,100	1,300
Mercury	130	µg/kg	<50	<50	<50	<50	<50	42	<18	<18	<19	<17	<19
Selenium	410	µg/kg	<200	240	<200	<200	<200	2,800	<800	1,300	1,200	980	<960
Silver	1,000	µg/kg	<100	<100	<100	<100	<100	NM	NM	NM	NM	NM	NM
Thallium	4,200	µg/kg	<500	<500	<500	<500	<500	<1,600	<800	<1,000	<1,100	<860	<960
Zinc	140,000	µg/kg	5,440	17,800	6,600	14,600	15,300	24,000	4,700	8,200	4,900	5,500	5,100
Percent Solids		%	64	85	59	80	82	52	83	75	76	81	85

Notes:

Sample depth units are feet below ground surface

Total metals analytical results based on dry weights

NM- not measured

[1]Refer to Table 5 for Compositional Exceedance Limits

Table 2. Total Metals Analysis Results for CCR

Field Sample Number			JCW-BH-16001 S-1	JCW-BH-16001 S-2	JCW-BH-16002 S-1	JCW-BH-16002 S-2	JCW-G17-BH-01 S-5
Pond No.			Bottom Ash Pond	Bottom Ash Pond	Bottom Ash Pond	Bottom Ash Pond	Bottom Ash Pond
Boring			JCW-BH-16001	JCW-BH-16001	JCW-BH-16002	JCW-BH-16002	JCW-G17-BH-01
Sample ID			S-1	S-2	S-1	S-2	S-5
Date Sampled			5/16/2016	5/16/2016	5/16/2016	5/16/2016	6/2/2017
Sample Depth (ft.)			2	9	3	9	14
Location			W end of Bottom Ash Pond	W end of Bottom Ash Pond	E end of Bottom Ash Pond	E end of Bottom Ash Pond	NW of Bottom Ash Pond
Groundwater			Below	Below	Below	Below	Below
Sample Material			CCR	CCR	CCR	CCR	CCR
	Exceedance Limit[1]	Units					
Arsenic	5,800	µg/kg	71,600	35,900	17,800	33,800	23,000
Barium	370,000	µg/kg	288,000	72,400	219,000	52,700	210,000
Boron	14,000	µg/kg	33,900	35,400	19,100	27,300	<2,400
Cadmium	3,200	µg/kg	466	<200	<200	<200	<1,200
Chromium	2,600,000,000	µg/kg	19,300	8,660	6,000	5,160	17,000
Copper	63,000	µg/kg	27,800	8,680	10,800	6,940	18,000
Lead	4,400,000	µg/kg	8,560	4,040	3,030	2,000	6,900
Mercury	130	µg/kg	130	200	120	260	91
Selenium	410	µg/kg	8,800	5,900	1,300	3,700	5,800
Silver	1,000	µg/kg	<100	<100	<100	<100	NM
Thallium	4,200	µg/kg	1,880	941	502	1,040	<1,200
Zinc	140,000	µg/kg	48,700	8,260	12,200	4,360	34,000
Percent Solids		%	56	56	86	45	63

Notes:

Sample depth units are feet below ground surface

Total metals analytical results based on dry weights

NM- not measured

[1]Refer to Table 5 for Compositional Exceedance Limits

Table 3. SPLP Analysis Results for Native Soil

Field Sample Number			JCW-BH-16001 S-3	JCW-BH-16001 S-4	JCW-BH-16002 S-3	JCW-BH-16002 S-4	JCW-BH-16002 S-5	JCW-G17-BH-01 S-9	JCW-G17-BH-02 S-10	JCW-G17-BH-03 S-8	JCW-G17-BH-10 S-12	JCW-G17-BH-14 S-10	JCW-G17-BH-19 S-6
Pond No.			Bottom Ash Pond	Bottom Ash Pond	Bottom Ash Pond	Bottom Ash Pond	Bottom Ash Pond	Bottom Ash Pond	Bottom Ash Pond	Bottom Ash Pond	Bottom Ash Pond	Bottom Ash Pond	Bottom Ash Pond
Boring			JCW-BH-16001	JCW-BH-16001	JCW-BH-16002	JCW-BH-16002	JCW-BH-16002	JCW-G17-BH-01	JCW-G17-BH-02	JCW-G17-BH-03	JCW-G17-BH-10	JCW-G17-BH-14	JCW-G17-BH-19
Sample ID			S-3	S-4	S-3	S-4	S-5	S-9	S-10	S-8	S-12	S-10	S-6
Date Sampled			5/16/2016	5/16/2016	5/16/2016	5/16/2016	5/16/2016	6/2/2017	6/2/2017	6/2/2017	5/31/2017	6/1/2017	6/1/2017
Sample Depth (ft.)			13	15	14	16	18	17	20	17	21	23	15
Location			W end of Bottom Ash Pond	W end of Bottom Ash Pond	E end of Bottom Ash Pond	E end of Bottom Ash Pond	E end of Bottom Ash Pond	NW of Bottom Ash Pond	W of Bottom Ash Pond	NNW of Bottom Ash Pond	S of Bottom Ash Pond	SE of Bottom Ash Pond	NE of Bottom Ash Pond
Groundwater			Below	Below	Below	Below	Below	Below	Below	Below	Below	Below	Below
Sample Material			Native Soil	Native Soil	Native Soil	Native Soil	Native Soil	Native Soil	Native Soil	Native Soil	Native Soil	Native Soil	Native Soil
	Exceedance Limit[1]	Units											
Arsenic	10	µg/L	5	<1	7	2	1	15	8	18	9	12	15
Barium	560	µg/L	1,080	1,250	816	260	541	44	12	32	16	59	270
Boron	7,200	µg/L	192	152	125	130	103	260	25	230	95	86	55
Cadmium	2.7	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2	<2	<2	<2	<2	<2	<2
Chromium	90	µg/L	3	2	4	1	1	<5	<5	<5	<5	7	27
Copper	11	µg/L	2	<1	2	1	<1	<5	<5	<5	<5	5	13
Lead	25	µg/L	1	<1	2	1	<1	<5	<5	<5	<5	<5	10
Mercury	0.2	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Selenium	5	µg/L	<1	<1	1	<1	<1	<5	<5	<5	<5	<5	<5
Silver	0.2	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	NM	NM	NM	NM	NM	NM
Thallium	3.7	µg/L	<2	<2	<2	<2	<2	<5	<5	<5	<5	<5	<5
Zinc	140	µg/L	30	36	25	49	19	<10	11	<10	<10	13	46

Notes:

Sample depth units are feet below ground surface

NM- not measured

[1]Refer to Table 6 for SPLP Exceedance Limits

Table 4. SPLP Analysis Results for CCR

Field Sample Number			JCW-BH-16001 S-1	JCW-BH-16001 S-2	JCW-BH-16002 S-1	JCW-BH-16002 S-2	JCW-G17-BH-01 S-5
Pond No.			Bottom Ash Pond	Bottom Ash Pond	Bottom Ash Pond	Bottom Ash Pond	Bottom Ash Pond
Boring			JCW-BH-16001	JCW-BH-16001	JCW-BH-16002	JCW-BH-16002	JCW-G17-BH-01
Sample ID			S-1	S-2	S-1	S-2	S-5
Date Sampled			5/16/2016	5/16/2016	5/16/2016	5/16/2016	6/2/2017
Sample Depth (ft.)			2	9	3	9	14
Location			W end of Bottom Ash Pond	W end of Bottom Ash Pond	E end of Bottom Ash Pond	E end of Bottom Ash Pond	NW of Bottom Ash Pond
Groundwater			Below	Below	Below	Below	Below
Sample Material			CCR	CCR	CCR	CCR	CCR
	Exceedance Limit[1]	Units					
Arsenic	10	µg/L	44	56	31	109	<5
Barium	560	µg/L	656	876	1,140	834	55
Boron	7,200	µg/L	124	186	236	175	50
Cadmium	2.7	µg/L	<0.2	<0.2	<0.2	<0.2	<2
Chromium	90	µg/L	2	2	4	2	<5
Copper	11	µg/L	1	<1	4	<1	<5
Lead	25	µg/L	<1	<1	<1	<1	<5
Mercury	0.2	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Selenium	5	µg/L	10	11	7	10	5
Silver	0.2	µg/L	<0.5	<0.5	<0.5	<0.5	NM
Thallium	3.7	µg/L	<2	<2	<2	<2	<5
Zinc	140	µg/L	12	14	37	13	<10

Notes:

Sample depth units are feet below ground surface

NM- not measured

[1]Refer to Table 6 for SPLP Exceedance Limits

TABLES 5-6
EXCEEDANCE CRITERIA

Table 5. Compositional Exceedance Limits: J.C. Weadock Ash Pond Characterization

Metal	Exceedance Limit[1] (µg/kg)
Arsenic[4]	5800
Barium[2]	3.70E+05
Boron	1.40E+04
Cadmium[2]	3.20E+03
Chromium[2,3]	2.60E+09
Copper[2]	6.30E+04
Lead[2]	4.40E+06
Mercury	130
Selenium	410
Silver	1000
Thallium	4200
Zinc[2]	1.40E+05

[1]Exceedance limits from MDEQ Part 201 Table 3 GSI Protection Criteria

[2]GSI Protection Criteria calculated following MDEQ Part 201 Table 3 footnote G procedure assuming hardness of 126 ppm. Hardness based on water quality data obtained from the EPA for Lake Huron.

[3]Limits shown for Chromium (III)

[4]Statewide Default Background Level

Table 6. SPLP Exceedance Limits: J.C. Weadock Ash Pond Characterization

Metal	Drinking Water Limit[1] (µg/L)	GSI Protection Criteria[2] (µg/L)	Exceedance Limit[3] (µg/L)
Arsenic	10	10	10
Barium[4]	2000	560	560
Boron	500	7200	500
Cadmium[4]	5	2.7	2.7
Chromium[4,5]	100	90	90
Copper[4]	1000	11	11
Lead[4]	4	25	4
Mercury[7]	2	0.0013	0.2
Selenium	50	5	5
Silver[6]	34	0.2	0.2
Thallium	2	3.7	2
Zinc[4]	2400	140	140

[1]Limits from MDEQ Part 201 Table 1 Nonresidential Drinking Water Criteria

[2]Limits from MDEQ Part 201 Table 1 Groundwater Nonresidential GSI Protection Criteria

[3]Exceedance Limit taken as the minimum of the MDEQ drinking water limit and GSI Protection Criteria

[4]GSI Protection Criteria calculated following MDEQ Part 201 Table 1 footnote G procedure assuming hardness of 126 ppm. Hardness based on water quality data obtained from the EPA for Lake Huron.

[5]Limits shown for Chromium (III)

[6]Actual GSI Protection Criteria is 0.06, which is below target detection limit (TDL); limit defaults to TDL

[7]Actual GSI Protection Criteria is 0.0013, which is below target detection limit (TDL); limit defaults to TDL

TABLE 7
COLORIMETRY RESULTS FOR CCR: J.C. WEADOCK

Table 7. Colorimetry Results for CCR: J.C. Weadock

Sample ID	% CCR	RGB Integer
Bulk sample	0	9888814.05
Laboratory Prepared Mixtures	5	8144984.16
	8	7513633.798
	10	7290800.931
JCW-G17-BH-01 S-5	100	4912243.226
JCW-G17-BH-07 S-7	100	4709412.044
JCW-BH-16001 S-1	100	5240277.786
JCW-BH-16002 S-1	100	6285982.788
JCW-BH-16002 S-2	100	5243086.149
JCW-G17-BH-12 S-5	0	9963812.19
JCW-G17-BH-19 S-5	0	7894991.887
JCW-G17-BH-19 S-6	0	9666195.315
JCW-G17-BH-08 S-7	0	6466363.537
JCW-G17-BH-01 S-8	0	9126798.989
JCW-G17-BH-01 S-9	0	6714159.946
JCW-G17-BH-14 S-10	0	5522965.735
JCW-G17-BH-02 S-11	0	10564817.72
JCW-G17-BH-10 S-12	0	7188974.797
JCW-G17-BH-04 S-13	0	9433346.664
JCW-G17-BH-10 S-13	0	9906808.04
JCW-BH-16001 S-4	0	10595987.9
JCW-BH-16002 S-4	0	10556712.13

Note: Colorimetric relationships will be confirmed in the field and the threshold will be recalibrated if needed.

J.C. WEADOCK GENERATING FACILITY

BOTTOM ASH POND CLOSURE PLAN

Essexville, Michigan

Pursuant to 40 CFR 257.102

Submitted To: Consumers Energy Company
1945 W. Parnall Road
Jackson, Michigan 49201

Submitted By: Golder Associates Inc.
15851 South US 27, Suite 50
Lansing, Michigan 48906

January 2018 **1667572.0007**

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CERTIFICATION

Professional Engineer Certification Statement [40 CFR 257.102(b)(4)]

I hereby certify that, having reviewed the attached documentation and being familiar with the provisions of Title 40 of the Code of Federal Regulations Section 257.102 (40 CFR Part 257.102), I attest that this Closure Plan is accurate and has been prepared in accordance with good engineering practices, including the consideration of applicable industry standards, and with the requirements of 40 CFR Part 257.102.

Golder Associates Inc.

Signature

January 12, 2018

Date of Report Certification

Jeffrey R. Piaskowski, PE

Name

6201061033

Professional Engineer Certification Number

STATE OF MICHIGAN
JEFFREY R. PIASKOWSKI
ENGINEER
No.
6201061033
LICENSED PROFESSIONAL ENGINEER

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1.0 INTRODUCTION

On April 17, 2015, the United States Environmental Protection Agency (EPA) issued the Coal Combustion Residual (CCR) Resource Conservation and Recovery Act (RCRA) Rule (40 CFR 257 Subpart D) ("CCR RCRA Rule") to regulate the beneficial use and disposal of CCR materials generated at coal-fired electrical power generating complexes. In accordance with the CCR RCRA Rule, any CCR surface impoundment or CCR landfill that was actively receiving CCR on the effective date of the CCR RCRA Rule (October 19, 2015) was deemed to be an "Existing CCR Unit" on that date and subject to self-implementing compliance standards and schedules. Consumers Energy Company (CEC) identified the Bottom Ash Pond as an existing CCR surface impoundment at the J.C. Weadock Generating Facility (JC Weadock).

JC Weadock is located in Essexville, Michigan as presented on Figure 1 – Site Location Map. The location of the Bottom Ash Pond is presented on Figure 2 – General Site Plan.

This written closure plan is being generated pursuant to 40 CFR 257.102(b) and describes the steps necessary to close the JC Weadock Bottom Ash Pond CCR unit consistent with recognized and generally accepted good engineering practices.

2.0 CLOSURE PLAN CONTENT [40 CFR 257.102(b)(1)]

This section complies with 40 CFR 257.102(b)(1), which specifies the content that is required in the written closure plan for CCR units. It is understood that the written closure plan must include the information specified in 40 CFR 257.102(b)(1)(i), (b)(1)(ii), (b)(1)(iv), (b)(1)(v), and (b)(1)(vi) when closing by removal of CCR.

2.1 Narrative Description [40 CFR 257.102(b)(1)(i-ii)]

The Bottom Ash Pond at JC Weadock will be closed by removing and decontaminating all areas affected by releases from the CCR unit. CCR removal and decontamination of the CCR unit will be complete when constituent concentrations throughout the CCR unit and any areas affected by releases from the CCR unit have been removed and groundwater monitoring concentrations do not exceed the groundwater protection standard established pursuant to 40 CFR 257.95(h) for constituents listed in Table 2.1.1 – Groundwater Assessment Monitoring Constituents.

Table 2.1.1 – Groundwater Assessment Monitoring Constituents

Common Name		
Antimony	Chromium	Mercury
Arsenic	Cobalt	Molybdenum
Barium	Fluoride	Selenium
Beryllium	Lead	Thallium
Cadmium	Lithium	Radium 226 and 228 combined

Prior to removal of CCR, the Bottom Ash Pond influent pipe will be properly abandoned, and the CCR unit will be dewatered by actively pumping decant downstream in a manner that maintains National Pollutant Discharge Elimination System (NPDES) permitted effluent limits.

Once the Bottom Ash Pond is dewatered and hydraulic structures are abandoned, the remaining CCR and all areas affected by releases from the CCR unit will be removed. It is anticipated that the areas potentially affected by releases from the CCR unit extend a maximum of six inches below the base of the existing CCR. As a result, the planned excavation extends to six inches below the CCR to elevations provided in Figure 3 – Proposed CCR Excavation Grades, Figure 4 – Bottom Ash Pond Cross Section A-A', and Figure 5 – Bottom Ash Pond Cross Section B-B'.

Photographic documentation and soil sampling will be conducted in the field during closure to provide multiple lines of physical evidence documenting CCR removal. Decontamination of any areas affected by releases from the CCR unit will be confirmed when at least two consecutive quarterly groundwater monitoring events demonstrate that groundwater monitoring concentrations do not exceed the groundwater protection standard established pursuant to 40 CFR 257.95(h) for constituents listed in Table 2.1.1.

2.2 Bottom Ash Pond CCR Quantity and Area [40 CFR 257.102(b)(1)(iv,v)]

Golder Associates Inc. (Golder) performed an investigation of the CCR in the Bottom Ash Pond in May 2016. Through visual observation, the investigation sampling determined that the CCR in the Bottom Ash Pond extended to depths that ranged from 10 to 11 feet below mudline, which extended to elevations of approximately 582 to 577 (NAVD88). The largest quantity of CCR estimated in the Bottom Ash Pond was approximately 400,000 cubic yards (cy). The approximate area of Bottom Ash Pond is 16.6 acres.

2.3 CCR Removal and Unit Decontamination [40 CFR 257.102(b)(1)(ii)]

Per 40 CFR 257.102(b)(1)(ii), if closure of the CCR unit will be accomplished through removal of CCR from the CCR unit, a description of the procedures to remove the CCR and decontaminate the CCR unit in accordance with this section must be provided in the closure plan. Per 40 CFR 257.102(c), CCR removal and decontamination of the CCR unit are complete when constituent concentrations throughout the CCR unit and any areas affected by releases from the CCR unit have been removed, and groundwater monitoring concentrations do not exceed the groundwater protection standard established pursuant to 40 CFR 257.95(h) for constituents listed in Table 2.1.1. The following description includes the procedures to remove and decontaminate the JC Weadock Bottom Ash Pond CCR unit.

The Bottom Ash Pond will be dewatered, its hydraulic structures will be abandoned, and CCR will be removed. It is anticipated that the excavation will extend to six inches below the known CCR elevations. Proposed conceptual excavation limits with approximate elevations are provided in Figures 3 through 5. Photographic documentation and soil sampling will be conducted in the field during closure to provide multiple lines of physical evidence documenting CCR removal.

Groundwater monitoring will be conducted to document that constituent concentrations throughout the CCR unit and any areas affected by releases from the CCR unit do not exceed the groundwater protection standards per 40 CFR 257.95(h) for constituents listed in Table 2.1.1. Closure will be complete when two consecutive quarterly groundwater monitoring events demonstrate no exceedances.

Twelve groundwater monitoring wells were installed around the Bottom Ash Pond to establish a groundwater monitoring system under 40 CFR 257.91(a) during the fourth quarter of 2015. In conformance with 40 CFR 257.93, a groundwater sampling and analysis procedure plan was developed for the groundwater monitoring program. The plan is included in Appendix A – Groundwater Sampling Analysis and Procedure Plan and includes direction on how to perform or acquire the following:

- Groundwater elevations
- Sample collection and handling procedures
- Equipment decontamination procedures
- Chain of custody control
- Sample preservation and shipment
- Quality assurance/quality control (QA/QC)
- Investigation derived waste (IDW)
- Field documentation
- Analytical suite and procedures
- Optional additional analyses
- Data evaluation

The detection monitoring program for the Bottom Ash Pond commenced on October 17, 2017. The collection of a minimum of two consecutive quarterly groundwater monitoring events to confirm that groundwater monitoring concentrations do not exceed the groundwater protection standard established pursuant to 40 CFR 257.95(h) for constituents listed in Table 2.1.1 will commence once the CCR has been removed and coordinated with any efforts to decontaminate areas affected by releases of the CCR unit. The collection of a minimum of eight background samples and presentation of data will be certified in an annual groundwater monitoring and corrective action report no later than January 31, 2018 per 40 CFR 257.90(e) and annually thereafter until groundwater monitoring concentrations do not exceed the groundwater protection standard established pursuant to 40 CFR 257.95(h) for constituents listed in Table 2.1.1.

3.0 SCHEDULE [40 CFR 257.102(b)(1)(vi)]

3.1 Introduction

CEC will initiate closure by providing notification pursuant to 40 CFR 257.102(g) when CCR placement is expected to cease and at least one of the following actions or activities will have been completed:

- Steps taken to implement the written closure plan
- Completed application submitted for any required state or agency permit or permit modification
- Necessary steps taken to comply with any state or other agency standards that are a prerequisite, or are otherwise applicable, to initiating or completing the closure of a CCR unit

In accordance with 40 CFR 257.102(f)(1)(ii), closure activities are anticipated to commence by October 1, 2018 and expected to be completed within five years of the notification of intent to initiate closure (by October 1, 2023).

3.2 Closure Construction

CEC anticipates that the Bottom Ash Pond will receive its final receipt of CCR by October 1, 2018 and initiation of closure activities will commence shortly thereafter. Removal of CCR and areas affected by releases from the CCR unit are anticipated to be completed in seventeen weeks or by August 28, 2020. Once the removal of CCR has been completed, at least two consecutive quarterly groundwater monitoring events will be necessary to complete the clean closure certification. Table 3.2.1 – Conceptual CCR Removal Schedule Milestones contains a list of milestone dates that were developed as part of the closure construction schedule to demonstrate that closure will be completed within the self-implementing closure schedule per 40 CFR 257.102(f)(1)(ii).

Table 3.2.1 – Conceptual CCR Removal Schedule Milestones

Closure Component	Start Date	End Date
Notification of intent to initiate closure	October 1, 2018	October 1, 2018
Dewatering	May 1, 2020	August 28, 2020
Removal of CCR and areas affected by releases of the CCR unit	May 1, 2020	August 28, 2020
Document constituent concentrations do not exceed groundwater protection standards	September 1, 2020	October 1, 2022
Closure activities complete	NA	October 1, 2022
Certified closure report	NA	December 31, 2022

3.3 Closure Deadline Extension [40 CFR 257.102(f)(2)]

As previously indicated in Section 3.1, closure of existing CCR surface impoundments must be completed within five years of initiating closure in accordance with 40 CFR 257.102(f)(1)(ii). A deadline extension can be obtained as outlined in 40 CFR 257.102(f)(2) if completion of closure is not feasible within five years (e.g., shortened construction season, significant weather delays during construction, time required for dewatering CCR, delays due to state or local permitting or approval, etc.). An extension must include a narrative description that demonstrates closure is not feasible in the required timeframe in accordance with 40 CFR 257.102(f)(2)(i, iii). The closure deadline for the Bottom Ash Pond may be extended up to two years per 40 CFR 257.102(f)(2)(ii)(A).

4.0 REFERENCES

"Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments" Title 40 – Protection of the Environment Part 257 – Criteria for Classification of Solid Waste Disposal Facilities and Practices Subpart D – Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments

Established in 1960, Golder Associates is a global, employee-owned organization that helps clients find sustainable solutions to the challenges of finite resources, energy and water supply and management, waste management, urbanization, and climate change. We provide a wide range of independent consulting, design, and construction services in our specialist areas of earth, environment, and energy. By building strong relationships and meeting the needs of clients, our people have created one of the most trusted professional services organizations in the world.

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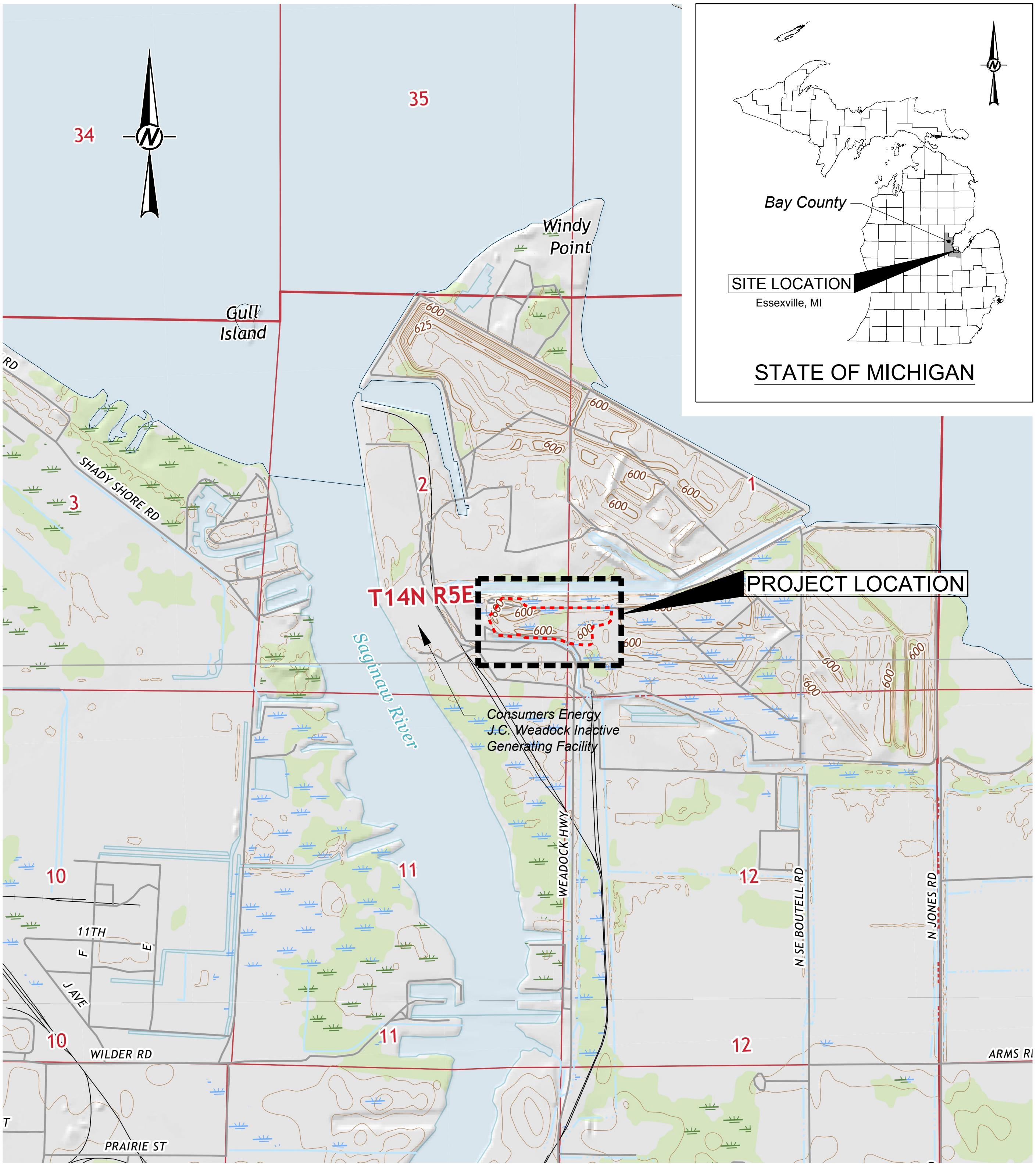
Engineering Earth's Development, Preserving Earth's Integrity

FIGURE 1
SITE LOCATION MAP



REFERENCE
BASE MAP IMAGERY DERIVED FROM U.S. DEPARTMENT OF INTERIOR, UNITED STATES GEOLOGICAL SURVEY (USGS), MICHIGAN-BAY COUNTY, 7.5-MINUTE SERIES QUADRANGLE MAPS "BAY CITY NE" AND "ESSEXVILLE", BOTH DATED 2017.

0 1000 2000
1" = 2000' FEET

CLIENT
CONSUMERS ENERGY COMPANY
2555 NORTH WEADOCK HIGHWAY
ESSEXVILLE, MICHIGAN 48732

PROJECT
J.C. WEADOCK GENERATING FACILITY
BOTTOM ASH POND RCRA CLOSURE PLAN

CONSULTANT
Golder Associates

YYYY-MM-DD	2017-12-01
DESIGNED	JRP
PREPARED	SDA
REVIEWED	JDP
APPROVED	MAB

TITLE
SITE LOCATION MAP

PROJECT NO. 1667572.0007.03 | REV. 0 | FIGURE 1

P:\0 projects\Consumers Energy\1667572 DE Karn BAP Closure Plan\CAD\02_FIGURES\D - JCW Closure RCRA Compliance Report Figures\1667572_JCW-BAP_CP_RCRA_USGS-Location-Map.dwg Dec 01, 2017 - 12:29pm By: STAnderson

1 in
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI A

FIGURE 2
GENERAL SITE PLAN

REFERENCES

1. AERIAL IMAGE FROM THE U.S. DEPARTMENT OF AGRICULTURE, ARM SERVICE CENTER, AERIAL PHOTOGRAPHY FIELD OFFICE HTTP://WWW.APFO.USDA.GOV). PUBLICATION DATE: 2016, PROCESS DATE: OCTOBER 2016.
2. HORIZONTAL DATUM AND COORDINATES SHOWN BASED ON MICHIGAN STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM 1983 (NAD83), SOUTH ZONE, INTERNATIONAL FOOT.

0 200 400
1" = 400' FEET

REV	DATE	DESCRIPTION	DR	BY	CK	APP	CO
0	2017-12-01	FILED IN OWNER'S OPERATING RECORD	CEI	MX	JDP	MAP	

REFERENCE DRAWINGS | REV | DATE | DESCRIPTION | DR | BY | CHK | APP | CO

SIGNATURE
NAME
MICHIGAN P.E. No.

Consumers Energy

J.C. WEADOCK GENERATING FACILITY
ESSEXVILLE, MI

GENERAL SITE PLAN

BOTTOM ASH POND RCRA CLOSURE PLAN

SCALE: AS SHOWN
JOB: 1667572.0007.03
DRAWING NO.
FIGURE 2
REV. 0

FIGURE 3
PROPOSED CCR EXCAVATION GRADES

LEGEND

- BOTTOM ASH POND GRADING LIMITS
- CHEMICAL TREATMENT PONDS
- EXISTING GROUND 5 ft CONTOUR
- EXISTING GROUND 1 ft CONTOUR
- 580 — ESTIMATED EXCAVATION 5 ft CONTOUR
- ESTIMATED EXCAVATION 1 ft CONTOUR
- Elec — ELECTRICAL POWERLINES
- Gas — ABOVE GROUND GAS PIPELINE
- ASH TRANSPORT PIPES
- ST — STORMWATER CULVERTS
- GRAVEL PAVED ROAD
- ASPHALT PAVED ROAD
- OW-60 — HISTORICAL POTENTIOMETRIC MONITORING WELL
- MW-15007 — MONITORING WELL LOCATION (BY ARCADIS)

0 75 150
1" = 150' FEET

REFERENCE DRAWINGS	REV	DATE	DESCRIPTION	DR	BY	CHK	APP	CO

REV	DATE	DESCRIPTION	DR	BY	CK	APP	CO
0	2017-12-01	FILED IN OWNER'S OPERATING RECORD	CEI	MX	JDP	MAP	

SIGNATURE

NAME

MICHIGAN P.E. No.

Consumers Energy

J.C. WEADOCK GENERATING FACILITY
ESSEXVILLE, MI

PROPOSED CCR EXCAVATION GRADES

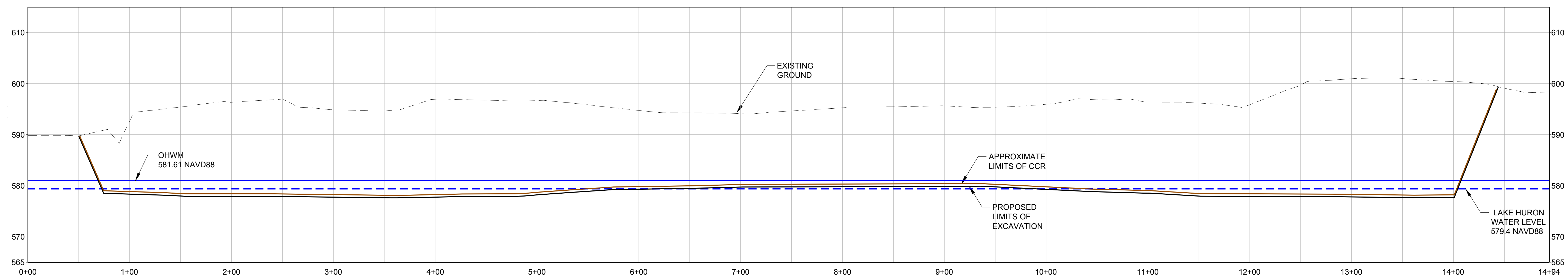
BOTTOM ASH POND RCRA CLOSURE PLAN

SCALE:	AS SHOWN	DRAWING NO.	SHEET	REV.
JOB:	1667572.0007.03		3	0

FIGURE 4
BOTTOM ASH POND CROSS SECTION A-A’

LEGEND

- EXISTING GROUND
- APPROXIMATE LIMITS OF CCR
- PROPOSED LIMITS OF EXCAVATION
- ORDINARY HIGH WATER MARK (OHWM)
- LONG TERM LAKE LEVEL ELEVATION FOR LAKE HURON



SCALE 1" = 100'
VERT. SCALE 1:5
A
FIG. 3
BOTTOM ASH POND

0 50 100
1" = 100' FEET

REV	DATE	DESCRIPTION	DR	BY	CK	APP	CO
0	2017-12-01	FILED IN OWNER'S OPERATING RECORD	CEI	MX	JDP	MAP	

REFERENCE DRAWINGS | REV | DATE | DESCRIPTION | DR | BY | CHK | APP | CO

SIGNATURE
NAME
MICHIGAN P.E. No.

Consumers Energy

J.C. WEADOCK GENERATING FACILITY
ESSEXVILLE, MI

BOTTOM ASH PONDS CROSS SECTION A-A'

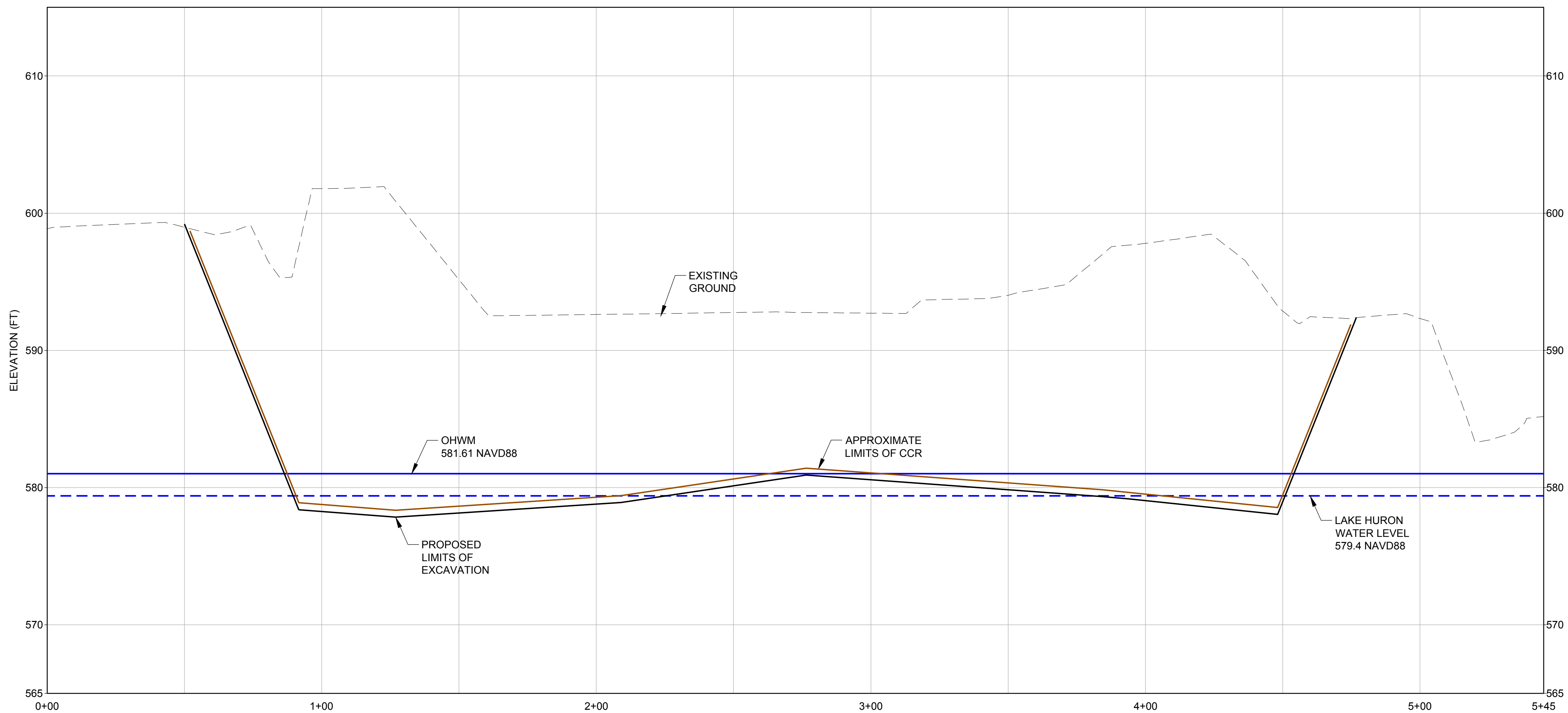
BOTTOM ASH POND RCRA CLOSURE PLAN

SCALE: AS SHOWN
JOB: 1667572.0007.03
DRAWING NO.
SHEET 4
REV. 0

FIGURE 5
BOTTOM ASH POND CROSS SECTION B-B’

LEGEND

- EXISTING GROUND
- APPROXIMATE LIMITS OF CCR
- PROPOSED LIMITS OF EXCAVATION
- ORDINARY HIGH WATER MARK (OHWM)
- LONG TERM LAKE LEVEL ELEVATION FOR LAKE HURON



SCALE 1" = 50'
VERT. SCALE 1:5
B FIG. 3 BOTTOM ASH POND

0 25 50
1" = 50' FEET

REFERENCE DRAWINGS	REV	DATE	DESCRIPTION	DR	BY	CHK	APP	CO	REV	DATE	DESCRIPTION	DR	BY	CK	APP	CO
									0	2017-12-01	FILED IN OWNER'S OPERATING RECORD	CEI	MX	JDP	MAP	

SIGNATURE

NAME

MICHIGAN P.E. No.

Consumers Energy

J.C. WEADOCK GENERATING FACILITY
ESSEXVILLE, MI

BOTTOM ASH PONDS CROSS SECTION B-B'

BOTTOM ASH POND RCRA CLOSURE PLAN

SCALE: AS SHOWN
JOB: 1667572.0007.03
DRAWING NO.
SHEET 5
REV. 0

APPENDIX A
GROUNDWATER SAMPLING ANALYSIS AND PROCEDURE PLAN

Consumers Energy Company

ELECTRIC GENERATION FACILITIES RCRA CCR DETECTION MONITORING PROGRAM

JC Weadock Monitoring Program

Sample and Analysis Plan

Essexville, Michigan

May 18, 2016

,

ELECTRIC GENERATION FACILITIES RCRA CCR DETECTION MONITORING PROGRAM

JC Weadock Monitoring Program
Sample and Analysis Plan

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Our Ref.:

DE000722.0001.00004

Date:

May 18, 2016

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1 INTRODUCTION

ARCADIS has prepared this Groundwater Sampling and Analysis Plan (SAP) to evaluate background and downgradient groundwater quality in bedrock at the JC Weadock electric generation facility (JCW), located in Essexville, Michigan (Site). The collection of groundwater data will be completed to achieve compliance under the recently published 40 CFR Part 257, Subpart D – Standards for the Disposal of Coal Combustion Residuals (CCR) in Landfills and Surface Impoundments. The methodologies outlined in this SAP are consistent with the regulations, general federal and state guidance, ARCADIS and Consumers Energy (CE) Standard Operating Procedures (SOPs), and industry standards.

2 PURPOSE AND OBJECTIVES

The groundwater monitoring and corrective action compliance requirements for existing CCR units are set forth in 40 CFR 257.90 through 257.98. The groundwater sampling and analysis requirements are detailed in 40 CFR 257.93, require the development of a SAP which details the sampling and analysis procedures that will be utilized to provide an accurate representation of groundwater quality at the background and downgradient wells. As per, 40 CFR 257.93(a) this SAP includes a description of the procedures and techniques that will be implemented for:

- Sample collection
- Sample preservation and shipment
- Analytical procedures
- Chain of custody control
- Quality assurance and quality control

3 IMPLEMENTATION AND SAMPLING SCHEDULE

As set forth in 40 CFR 257.93, a minimum of eight (8) background samples must be collected prior to October 17, 2017. The JCW Landfill and Surface Impoundment are characterized as an Active CCR Landfill and an Active CCR Surface Impoundment, respectively. Background and detection monitoring events will be completed concurrently by comparison of data from monitoring wells located both away from (background) and downgradient of any impoundments still receiving ash as of the implementation date of the rule (October 19, 2015).

The sampling events will be distributed to account for seasonal variability and will be spaced at least 30 days apart to be considered statistically independent. The following is a conceptual schedule to be followed assuming sampling is completed in the middle of each calendar quarterly sampling interval beginning December 2015 and ending in September 2017 for a total of eight (8) independent samples. Adjustments to the timing of sampling events can be made as long as the requirements listed above are still met.

- Event 1 – 4th Quarter 2015 (December)

- Event 2 – 1st Quarter 2016 (March)
- Event 3 – 2nd Quarter 2016 (June)
- Event 4 – 3rd Quarter 2016 (September)
- Event 5 – 4th Quarter 2016 (December)
- Event 6 – 1st Quarter 2017 (March)
- Event 7 – 2nd Quarter 2017 (June)
- Event 8 – 3rd Quarter 2017 (September)

Resampling of a well due to an anomalous result, either relative to data collected from other monitoring wells of similar type, or relative to other time-series data at an individual monitoring well may be completed at any time. The timing of the resampling event, and the reason for additional data collection will determine if events are statistically dependent and inform the appropriate method for addressing interpretation or inclusion of data. Additional analytes may also be required pending the results of the quarterly monitoring events (in accordance with Section 257.94(e)). This document does not cover collection and analysis of such additional data.

4 SAMPLE COLLECTION AND HANDLING PROCEDURES

The following sections address the methods and procedures associated with the collection and handling of groundwater samples at the Site. The monitoring well locations are shown in Drawing SG-22354, and relevant construction details and monitoring purpose (e.g. background or downgradient) provided in Table 1. A total of fifteen 15 monitoring wells were installed at the JC Weadock facility to assess groundwater quality within the uppermost aquifer, which consists primarily of sand and clay till with occasional silt and clay lenses overlying the bedrock aquifer. A total of eight (8) monitoring wells are designated as background monitoring wells. The remaining wells monitor downgradient groundwater quality (Drawing SG-22354). Of the 15 monitoring wells, two (2) are existing monitoring wells, designated as follows:

Historical Well Name	RCRA Well Name
MW-106A	JCW MW-15028
MW-116A	JCW MW-15027

Supplementing the sampling protocol and better understanding the hydrogeological framework, a total of seven (7) monitoring wells were installed in the underlying bedrock formation (Table 1, Drawing SG-22354).

4.1 Groundwater Elevations

Groundwater level data will be collected from all monitoring wells during each sampling event, prior to sampling. The monitoring well locations are depicted on Drawing SG-22354. Groundwater level monitoring will be conducted in accordance with Section 9.2 of the Low Stress (Low Flow) Purging and Sampling of Groundwater Monitoring Wells SOP presented in Appendix A.

Upon arrival at the site, all monitoring wells will be opened and allowed to equilibrate with ambient air pressures prior to measuring the depths to water. Groundwater level measurements will then be made to the nearest 0.01 foot with an electronic water level indicator from the entire monitoring well network prior to sampling – monitoring wells that constitute a groundwater monitoring system for a CCR Unit shall be preferentially sampled in order to further minimize water level elevational changes relative to the CCR Unit. The entire monitoring well network shall be gauged on the same day in order to provide an interpretative groundwater flow map and to minimize temporal bias of measured groundwater elevation changes for the monitoring well network.

Depth to water will be measured from established top of casing reference points as referenced in the record survey drawing. Groundwater levels, well conditions, and any pertinent observations will be recorded on the depth to water level measurements field log provided in Appendix A.

The calculated hydraulic gradient will be used along with previously completed hydraulic conductivity testing to determine the apparent groundwater rate and direction during each sampling event.

4.2 Groundwater Sample Collection

Groundwater samples will be collected from the monitoring wells following Low-Flow (Minimal Drawdown) Groundwater Sampling Procedures (US EPA, 1996), as detailed in the Low Stress (Low Flow) Purging and Sampling of Groundwater Monitoring Wells SOP (Appendix A). Low flow sampling will commence with the installation of either a peristaltic, stainless-steel 12-volt submersible impeller pump or bladder pump to a depth representing the middle of the saturated screen interval. An appropriate length of polyethylene tubing will be connected to the pump discharge prior to pump placement. The discharge line will be connected to a flow-cell and multi-meter to collect water quality indicator parameters (described below) during well purging to determine water quality stabilization.

The pump will be operated at a flow rate that ensures low volatilization and low well disturbance. Water quality indicator parameters and depth to water will be recorded at 3 to 5 minute intervals during the purging process and recorded on the sampling worksheet provided in Appendix B. Purging and sampling will proceed at a low pumping rate, expected to be between approximately 0.1 and 0.5 liters per minute or less, such that the water column in the well is not lowered more than 0.3 feet below the initial static depth to water measurement. The subject well will be considered ready to sample when three consecutive water quality measurements meet the stabilization criteria presented below.

Parameter	Stabilization Criteria
pH	3 readings within +/- 0.1 standard units (SU)
Specific Conductance	3 readings within +/- 3% millisiemens per centimeter (mS/cm)
Temperature	For information only

Turbidity	+/- 10% Nephelometric Turbidity Unit (NTU) variance between three consecutive readings and a turbidity less than 10 NTU
Oxygen Reduction Potential (ORP)	3 readings within +/- 10 millivolts (mV)
Dissolved Oxygen (DO)	3 readings within +/- 0.3 milligrams per liter (mg/L)

If the well is dry, no attempt at sampling will be conducted, as the aquifer is not considered to have sufficient quantity at that location. If the recharge rate of the well is very low, and notable drawdown or the well is purged dry even at very low purge rates, alternative purging techniques should be used, which will vary based on the well construction and screen position. For wells screened across the water table, the well should be pumped dry and sampling should commence within 24 hours, as soon as practical after the volume in the well has recovered sufficiently to permit collection of samples. For wells screened entirely below the water table, the well should be pumped until a stabilized level (which may be below the maximum displacement goal of 0.3 feet) can be maintained and monitoring for stabilization of field indicator parameters can commence. If a lower stabilization level cannot be maintained, the well should be pumped until the drawdown is at a level slightly higher than the bentonite seal above the well screen. Sampling should commence after one well volume has been removed and the well has recovered sufficiently to permit collection of samples.

Equipment will be calibrated in accordance with the manufactures recommendations. Calibration information will be recorded in the field notes.

4.3 Sample Preservation and Shipment

Samples will be collected immediately following stabilization of field parameters as set forth in in the preceding section. Groundwater samples will be collected into the laboratory provided sample containers required for the analyses specified in the following section. The groundwater samples will be collected from the discharge tubing upstream of the water quality meter flow cell. Care will be taken to allow for a non-turbulent filling of laboratory containers. Routine samples will not be filtered in the field to provide a measure of total recoverable metals that will include both the dissolved and particulate fractions of metals as per the CCR RCRA Rule.

If a more detailed understanding of the source of metals concentrations in groundwater is required for select monitoring wells, field filtered samples may be analyzed in addition to routine analysis. Field filtering may also be completed on highly turbid samples (greater than 10 NTU at stabilization). Field filtering will be completed using a 0.45 micron filter. If required, prior to the subsequent sampling event, an attempt will be made to redevelop any monitoring wells that produce highly turbid samples (e.g. greater than 10 to 50 NTU) even following extensive field purging. Where samples are filtered, a corresponding, unfiltered sample will also be collected.

The samples will be labelled, stored and transported to the laboratory according to the Chain-of-Custody, Handling, Packing and Shipping SOP presented in Appendix B. Following collection, samples will be immediately labelled, logged on the chain-of-custody, and placed in a cooler with ice. Sample coolers transported to the laboratory via overnight or next day air freight will be sealed with packing tape and a signed Chain-of-Custody seal. Sample coolers transported to the laboratory directly must be secured to ensure sample integrity is maintained. The samples will be packaged and shipped according to U. S. Department of Transportation and EPA regulations. The documentation of actual sample storage and transport will be by the use of chain-of-custody procedures. A laboratory provided chain-of-custody record will contain the dates and times of collection, receipt, and completion of all the analyses on a particular set of samples. The laboratory will return a copy of the chain-of-custody with the analytical report.

4.4 Quality Assurance/Quality Control (QA/QC)

Quality assurance/quality control (QA/QC) samples will be collected to ensure sample containers are free of analytes of interest, assess the variability of the sampling and laboratory methods, and monitor the effectiveness of decontamination protocols. The following QA/QC samples will be collected during each groundwater sampling event:

- Field duplicates will be collected at a frequency of one duplicate sample per 10 groundwater samples with at least one duplicate collected from each Unit. The field duplicates will be collected at the same time and in the same manner as the original sample.
- Matrix spike/matrix spike duplicate (MS/MSD) samples will be collected at a frequency of one MS/MSD sample per 20 groundwater samples with at least one MS/MSD collected from each Unit. Duplicate and MS/MSD samples will be collected from different monitoring wells.
- Field blanks will be collected at a frequency of one field blank per 20 groundwater samples with at least one field blank collected from each Unit.
- Equipment blanks will be collected at a frequency of one equipment blank per 10 groundwater samples with at least one duplicate collected from each Unit. The equipment blank will be collected by pouring distilled (or de-ionized) water over the decontaminated static water level meter or low flow pump and into the laboratory supplied containers.

The groundwater monitoring system at JCW consists of 22 monitoring wells. Therefore, a total of 3 field duplicate, 2 MS/MSD, 2 field blank, and 3 equipment blank will be collected during each sample event. The QA/QC samples will be submitted to the laboratory for the routine analyses specified in Section 5 and in Appendix III and IV to Part 257. The laboratory should provide adequate documentation of laboratory reporting and QA/QC procedures.

4.5 Equipment Decontamination Procedures

All non-dedicated equipment will be decontaminated prior to use and between samples, following procedures presented in paragraph 9.6 of the SOP in Appendix A (CHEM-2.7.06). Non-dedicated equipment will include a water level meter and low flow sampling pump (submersible). Each item will be cleaned using distilled or deionized water, and when necessary, non-phosphate detergent wash followed by a distilled or deionized water rinse. When a peristaltic pump is used for low flow sampling, decontamination is not required, only replacement of the pump head tubing.

All dedicated equipment will be disposed of after each sampling point. Dedicated equipment will include polyethylene tubing and bladders if a bladder pump is used for low-flow sampling.

The flow-cell and water quality multi-meter will be decontaminated at the completion of low-flow sampling. All sample collection will occur upstream of this device and therefore will not affect groundwater sample analytical results.

4.6 Investigation Derived Waste (IDW)

All waste created during monitoring well sampling will remain on site. All purge water from wells installed within the CCR Units will be discharged back onto the ground near the well it was purged from. All purge water from wells installed outside of a CCR Unit will be discharged to the ground in a manner that it doesn't directly enter a surface water or drain. All IDW will be handled according to details provided in paragraphs 9.3.8 and 9.4.10 of the SOP provided in Appendix A (CHEM-2.7.06).

4.7 Field Documentation

All information pertinent to the field activities and sampling efforts will be recorded in a log or notebook, following the documentation procedures presented in section 5.4 of the SOP in Appendix B (CHEM-2.7.06). Field logs are provided in the Attachments to Appendix A. At a minimum, entries in the sample logs will include the following:

- Property details and location
- Type of sample (for example, groundwater, surface water, waste)
- Number and volume of samples taken
- Sampling methodology
- Date and time of collection
- Sample identification number(s)
- Field observations including weather
- Any field measurements made (for example, pH, temperature and water depth)
- Personnel present

Records shall contain sufficient information so that the sampling activity can be reconstructed without relying on the collector's memory. The sample logs will be preserved in electronic format.

5 ANALYTICAL SUITE AND PROCEDURES

As required for existing CCR units, all bedrock groundwater samples collected at the JCW facility will be submitted to a laboratory for the analyses specified in Appendix III and IV to Part 257. The analytical methods and reporting limits for each constituent are summarized below. If required, and in consultation with the laboratory, a comparable analytical method may be substituted for the analytical method recommended below. Analytical methods may also be modified to incorporate newer versions of the stated methods. All groundwater samples will be submitted to Consumers Energy Trail Street Laboratory. If any analyses are subsequently subcontracted to another accredited laboratory, the samples will be shipped using appropriate methods and documentation. All analyses will be performed within required hold times and consistent with the data quality objectives of this SAP.

Appendix III to Part 257—Constituents

Constituent	Analytical method	Preservation	Hold Time (Days)	Reporting Limit (µg/L)
Boron	EPA 6020B	HNO_3, pH <2	180	20
Calcium	EPA 6020B	HNO_3, pH <2	180	1,000
Chloride	EPA 300.0	None, <6ºC	28	1,000
Fluoride#	EPA 300.0	None	28	1,000
pH	Stabilized field measurement	NA	NA	0.1 standard units
Sulfate	EPA 300.0	None, <6ºC	28	2,000
Total Dissolved Solids	SM 2540C	None, <6ºC	7	1,000

HNO_3 – Nitric acid
NA – Not applicable

Appendix IV to Part 257—Constituents

Constituent	Analytical method	Preservation	Hold Time (Days)	Reporting Limit (µg/L)
Antimony	EPA 6020B	HNO_3, pH <2	180	1
Arsenic*	EPA 6020B	HNO_3, pH <2	180	1
Barium	EPA 6020B	HNO_3, pH <2	180	5
Beryllium	EPA 6020B	HNO_3, pH <2	180	1
Cadmium	EPA 6020B	HNO_3, pH <2	180	0.2
Chromium, total	EPA 6020B	HNO_3, pH <2	180	1
Cobalt	EPA 6020B	HNO_3, pH <2	180	15
Fluoride#	EPA 300	None, <6ºC	28	1,000
Lead	EPA 6020B	HNO_3, pH <2	180	1
Lithium	EPA 6020B	HNO_3, pH <2	180	10
Mercury	EPA 7470A	HNO_3, pH <2	28	0.2
Molybdenum	EPA 6020B	HNO_3, pH <2	180	5
Selenium	EPA 6020B	HNO_3, pH <2	180	1
Thallium	EPA 6020B	HNO_3, pH <2	180	2
Radium 226 and 228	EPA 903.1/904.0	HNO_3, pH <2	None	1 picocurie per

Constituent	Analytical method	Preservation	Hold Time (Days)	Reporting Limit (µg/L)
combined^				liter (pCi/L)

[#] *Listed in both Appendix III and Appendix IV*

^Requires a larger sample volume (minimum 2.5 liter)

5.1 Optional Additional Analyses

To interpret groundwater monitoring data and determine the appropriate statistical methods for use in comparison of background and downgradient data sets, an understanding of aquifer connectivity and water types may be required. To determine if samples are collected from comparable aquifer units the predominant water type will be determined using Piper and Stiff diagrams.

Piper and Stiff diagrams are a graphical representation of the major anion and cation composition of a water sample and are useful in establishing if groundwater samples are from the same or a similar aquifer unit. To generate Piper and Stiff diagrams additional analytical data beyond that collected during routine sampling will be required. The additional analytical requirements are shown in the table below.

Constituent	Analytical method	Preservation	Hold Time (Days)	Reporting Limit (µg/L)
Bicarbonate, carbonate and total alkalinity	ASM 2320B	None, 6ºC	14	10,000
Magnesium	EPA 6020B	HNO_3, pH <2	180	1,000
Sodium	EPA 6020B	HNO_3, pH <2	180	1,000
Potassium	EPA 6020B	HNO_3, pH <2	180	100

6 DATA EVALUATION

In accordance with 40 CFR 257.93 data collected from eight samples from each background well will be used to calculate background concentrations for each constituent at each site. Background concentrations for each constituent will be calculated using an appropriate statistical method for each background well and constituent pair at the site, selected based on the distribution of the data in accordance with 40 CFR 257.93.

The data collected from background and downgradient monitoring wells will be compared using an appropriate statistical method, to be determined based on the distribution of data for each constituent, to assess if downgradient concentrations are consistent with background concentrations for each constituent. The statistical method used for this analysis will be one, or a combination, of the four statistical methods described below and in 40 CFR 257.93(f) and will meet the performance standards outlined in 40 CFR 257.93(g).

A combination of statistical methods may be applied depending on the statistical distribution observed for each specified constituent in each monitoring well. The four specific statistical procedures provided in 40 CFR 257.93(f) are: (1) a parametric analysis of variance followed by multiple comparison procedures to identify statistically significant evidence of contamination; (2) an analysis of variance based on ranks followed by multiple comparison procedures to identify statistically significant evidence of contamination; (3) a tolerance or prediction interval procedure; and (4) a control chart approach.

The potential for seasonal and spatial variability as well as temporal trends will be considered when selecting the statistical method for comparison. Data will also be displayed graphically using box-and–whisker plots, which provide a visual representation of the statistical properties and distribution of each data set, to aid in interpretation of the statistical analysis.

In order to select the appropriate method for statistical analysis for each constituent at each monitoring well, the distribution type for each constituent/well pair will be calculated. Normally distributed data will use parametric methods for comparisons and non-normally distributed data will use non-parametric methods, consistent with the requirements outlined in 40 CFR 257.93(g).

Statistical comparisons will be performed using a confidence level of 99 percent (alpha of 0.01) for comparisons of individual data point to background concentrations, and a confidence level of 95 percent (alpha of 0.05) where multiple data points will be compared to background, consistent with 40 CFR 257.93(g).

TABLES

Table 1
Monitoring Well Construction Summary
Consumers Energy Co.
J.C. Weadock Generating Facility
Essexville, Michigan

MW ID	Former MW ID	Site Coordinates				Date Installed	Geologic Unit of Screen Interval	Well Construction	Well Screen Length (ft)	Screen Interval (ft bgs)	Static DTW (ft below TOC)	Total Depth
		Northing	Easting	Ground Surface Elevation (ft above msl)	TOC Elevation (ft above msl)							
Background Monitoring Well												
MW-15002	--	777616.5	13263683.7	584.90	587.71	9/17/2015	Sand	2" PVC, 10 slot	10	4 - 14	7.8	16.9
MW-15008	--	778850.3	13262994.1	582.70	585.36	9/24/2015	Sand	2" PVC, 10 slot	10	4 - 14	4.78	17.46
MW-15016	--	777566.2	13263941.7	583.70	586.49	9/30/2015	Sand	2" PVC, 10 slot	3	2.5-5.5	4.33	8.03
MW-15018	--	777822.4	13263663.8	583.60	586.42	10/1/2015	Sand	2" PVC, 10 slot	4	3 - 7	6.26	10.03
MW-15019	--	778024.1	13263504.9	583.50	586.17	10/1/2015	Sand/Clay-Sand	2" PVC, 10 slot	10	4 - 14	6.02	16.00
MW-15020	--	778708.4	13263077.4	582.50	585.95	10/1/2015	Sand	2" PVC, 10 slot	10	4 - 14	5.41	17.03
MW-15024	--	778249.1	13263347.9	583.70	586.56	10/8/2015	Sand	2" PVC, 10 slot	10	4 - 14	6.40	17.11
MW-15027	MW-116A	778601.3	13263139.3	583.20	586.25	4/26/2005	Sand	NR	10	5 - 15	5.73	18.29
Impoundment Monitoring Well												
JCW MW-15007	--	780148.9	13263474.2	585.20	587.40	9/23/2015	Sand	2" PVC, 10 slot	3.5	2.5 - 6	NR	NR
JCW MW-15009	--	780481.4	13262254.9	586.90	589.64	9/24/2015	Sand	2" PVC, 10 slot	5	5 - 10	8.78	13
JCW MW-15010	--	780809.2	13263418.0	595.20	597.76	9/24/2015	Sand	2" PVC, 10 slot	1.5	15.5 - 17	15.55	19.45
JCW MW-15028	MW-106A	780181.7	13262428.8	586.70	589.37	9/24/2002	Sand	Unknown	3	19 - 22	7.23	24.98
Landfill Monitoring Well												
JCW MW-15011	--	780807.4	13265133.1	594.9	597.07	9/29/2015	Sand	2" PVC, 10 slot	3.5	12.5 - 16	12.58	18.25
JCW MW-15012	--	780995.6	13265672.5	592.2	595.07	9/29/2015	Sand (10.8-15) / Clay (15-15.8)	2" PVC, 10 slot	5	10.8 - 15.8	14.29	18.75
JCW MW-15023	--	780840.7	13265275.9	592.7	595.32	10/8/2015	Sand	2" PVC, 10 slot	5	13 - 18	11.05	20.85
Bedrock Monitoring Well												
JCW-MW-15001	--	777615.4	13263677.1	587.99	585.3	9/16/2015	Sandstone	2" PVC, 10 slot	10	90 - 100	9.77	103.58
JCW-MW-15003	--	780479.7	13262242.2	589.1	586.4	9/21/2015	Sandstone	2" PVC, 10 slot	10	98 - 108	NR	NR
JCW-MW-15006	--	781147.2	13265077.1	590.5	587.9	9/22/2015	Sandstone	2" PVC, 10 slot	10	91 - 101	12.71	103.12
JCW-MW-15021	--	778462.7	13268914.4	595.05	592.1	10/5/2015	Shale/Sandstone	2" PVC, 10 slot	10	99 - 109	15.72	112.55
JCW-MW-15022	--	781673.5	13268937.1	594.72	591.9	10/7/2015	Sandstone	2" PVC, 10 slot	10	91 - 101	NR	NR
JCW-MW-15025	--	776221.6	13267177.6	588.51	585.7	10/14/2015	Sandstone	2" PVC, 10 slot	10	89 - 99	10.50	103.95
JCW-MW-15026	--	780242.6	13268936.2	591.3	594.03	10/16/2015	Sandstone	2" PVC, 10 slot	10	91 - 101	15.41	NR

Notes:
DTW: depth to water
ft = feet
bgs = below ground surface
TOC = top of casing elevation
NR = Not recorded
msl = mean sea level

FIGURES

1 inch = 300 ft.

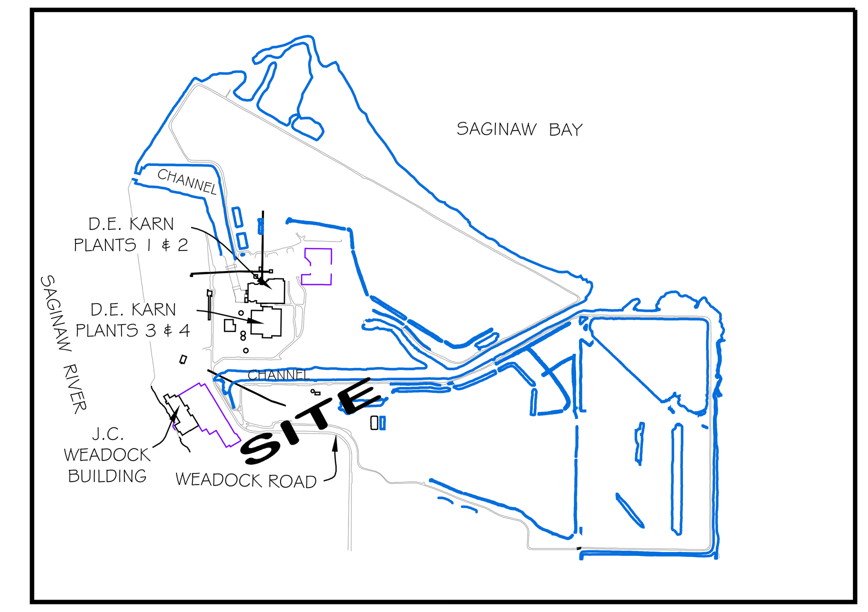
KARN / WEADOCK CCR MONITORING BENCHMARKS AFTER ADJUSTMENTS

BM #	ELEV	DESCRIPTION
150	584.18	NAIL, WEST FACE POWER POLE, 80'± NORTH OF RAILROAD TRACKS, 140' EAST WEADOCK ROAD
151	584.84	NAIL, SOUTHEAST FACE LIGHT POLE, 170'± NORTHWEST CENTERLINE WEADOCK ROAD, 8' SOUTHWEST RAILROAD TRACKS
152	586.80	SOUTH SOUTHEASTERLY FLANGE BOLT HYDRANT NEAR SOUTHEAST PC OF RAILROAD TRACKS
5035H	585.12	NGS BENCHMARK DISK OVER STEEL ROD IN NOAA CASING & COVER
153	586.50	NAIL, NORTH SIDE LIGHT POLE, SOUTH SIDE WEADOCK ROAD, 100'± EAST "DEER XING/DO NOT PASS" SIGN
154	587.31	NAIL, WEST SIDE LIGHT POLE, SOUTHWEST CORNER WEADOCK ASH POND
155	596.21	MARKER "SQUARE", TOP OF EAST END CONCRETE CURB NORTH OF DIESEL PUMP @ FLY ASH SILO
156	592.51	FOUND RAILROAD SPIKE, SOUTH FACE LIGHT POLE, SOUTH SIDE BARRIER ACROSS DISCHARGE CHANNEL
157	592.59	FOUND NAIL, SOUTH FACE WESTERLY MOST POWER POLE @ NORTH SIDE DIKE
158	591.71	FOUND NAIL, SOUTH FACE 4TH POWER POLE FROM THE WEST 5 POWER POLES @ NORTH SIDE DIKE
159	592.51	FOUND NAIL, SOUTH FACE POWER POLE @ NORTHEAST CORNER DIKE
160	591.38	SET CHISELED "SQUARE" IN CONCRETE BASE MONITORING WELL 53R @ EAST SIDE DIKE/ EAST-WEST HAUL ROAD INTERSECTION
161	588.77	FOUND NAIL, NORTH FACE 26" COTTONWOOD @ INTERSECTION OF SLURRY WALL & NORTH-SOUTH ROAD
162	584.50	NAIL, WEST FACE POWER POLE, 45'± EAST OF CENTERLINE BOUTELL ROAD, 45'± SOUTH MW15025

SURVEYOR'S NOTES:

1) THE HORIZONTAL COORDINATE VALUES AND GROUND ELEVATIONS WERE OBTAINED WITH GPS RTK EQUIPMENT UTILIZING THE EXISTING SITE SURVEY MONUMENT PERMANENT CONTROL AS FOR THE LOCATION AND ELEVATION CONTROL OF THE BASE STATION. CHECKS WERE MADE BY LOCATING OTHER BASELINE OR PERMANENT CONTROL POINTS OF KNOWN/REPORTED VALUES FOR ACCURACY VERIFICATION. THE TOP OF CASING ELEVATION VALUES WERE ESTABLISHED BY UTILIZING A DIGITAL LEVEL AND RUNNING A CLOSED LEVEL LOOP FROM POINTS OF KNOWN ELEVATION (BASELINE/PERMANENT CONTROL MONUMENTATION AND PREVIOUSLY UTILIZED SITE BENCHMARKS). EACH TOP OF CASING WAS INCLUDED AS A TURN POINT FOR THE LEVEL LOOP. NO SIDE SHOTS WERE USED AS PART OF THE LEVEL LOOP.

2) AERIAL IMAGERY IS SHOWN FROM JUNE 2007 FLIGHT FOR THE PORTION SOUTH OF THE STORAGE TANKS AT THE SOUTH END OF THE SITE AND APRIL 2013 FLIGHT FOR THE IMAGERY NORTH OF THE STORAGE TANKS. IMAGERY PROVIDED BY AIR-LAND SURVEYS.



LOCATION MAP

NOT TO SCALE

SECTION 1, 2, 11 & 12
HAMPTON TOWNSHIP

T14N-R5E
BAY COUNTY

BASIS OF BEARING

MICHIGAN STATE PLANE COORDINATE SYSTEM, SOUTH ZONE NAD83 (1994). COMBINED SCALE FACTOR = 0.99996843

BASIS OF ELEVATION

NORTH AMERICAN VERTICAL DATUM 1988 (NAVD88)

*NAVD88 = NORTH AMERICAN VERTICAL DATUM OF 1988
*NGVD29 = NATIONAL GEODETIC VERTICAL DATUM OF 1929
*USLS = UNITED STATE LAKE SURVEY 1935
*IGLD55 = INTERNATIONAL GREAT LAKES DATUM 1955 ADJUSTMENT
*IGLD85 = INTERNATIONAL GREAT LAKES DATUM 1985 ADJUSTMENT
* REPORTED IN UNITS OF FEET.

CONVERSIONS

NAVD88 TO USLS = +0.92'
NAVD88 TO IGLD85 = -0.11'
USLS TO IGLD55 = -1.754'
USLS TO NGVD29 = -0.297'
IGLD55 TO IGLD85 = +0.72'

NOTE: THE CONVERSIONS TO USLS AND TO IGLD DATUMS ONLY APPLY TO THE IMMEDIATE AREA AT THE KARN PLANT AND SHOULD NOT BE USED ELSEWHERE.

JC WEADOCK - MONITORING WELLS; WO#25477893; ROWE #15L0109; OCTOBER 2015

ROWE POINT #	WELL NAME	NORTHING (MSPC NAD83(1994) INTERNATIONAL FEET)	EASTING (MSPC NAD83(1994) INTERNATIONAL FEET)	GROUND ELEV. (NAVD88)	T/CASING ELEV. (NAVD88)	LATITUDE (DECIMAL DEGREES)	LONGITUDE (DECIMAL DEGREES)
15017	JCW MW-15001	777615.4	13263677.1	585.3	587.99	43.6325013	-83.8366837
150091	JCW MW-15003	780479.7	13262242.2	586.4	589.10	43.6403837	-83.8420358
15006	JCW MW-15006	781147.2	13265077.1	587.9	590.50	43.6421658	-83.8313111
15021	JCW MW-15021	778462.7	13268914.4	592.1	595.05	43.6347336	-83.8168819
15022	JCW MW-15022	781673.5	13268937.1	591.9	594.72	43.6435414	-83.8167172
15025	JCW MW-15025	776221.6	13267177.6	585.7	588.51	43.6286164	-83.8234966
15026	JCW MW-15026	780242.6	13268936.2	591.3	594.03	43.6396161	-83.8167560
15007	JCW MW-15007	780148.9	13263474.2	585.2	587.40	43.6394549	-83.8373899
15009	JCW MW-15009	780481.4	13262254.9	586.9	589.64	43.6403880	-83.8419878
15010	JCW MW-15010	780809.2	13263418.0	595.2	597.76	43.6412674	-83.8375867
15011	JCW MW-15011	780807.4	13265133.1	594.9	597.07	43.6412327	-83.8311080
15012	JCW MW-15012	780995.6	13265672.5	592.2	595.07	43.6417396	-83.8290659
15023	JCW MW-15023	780840.7	13265275.9	592.7	595.32	43.6413214	-83.8305676
15002	MW-15002	777616.5	13263683.7	584.9	587.71	43.6325042	-83.8366589
15008	MW-15008	778850.3	13262994.1	582.7	585.36	43.6359007	-83.8392343
15016	MW-15016	777566.2	13263941.7	583.7	586.49	43.6323619	-83.8356858
15018	MW-15018	777822.4	13263663.8	583.6	586.42	43.6330693	-83.8367291
15019	MW-15019	778024.1	13263504.9	583.5	586.17	43.6336254	-83.8373244
15020	MW-15020	778708.4	13263077.4	582.5	585.95	43.6355101	-83.8389231
15024	MW-15024	778249.1	13263347.9	583.7	586.56	43.6342456	-83.8379121
15027	MW 116A/MW-15027	778601.3	13263139.3	583.2	586.25	43.6352151	-83.8386919
15028	MW-106A/MW-15028	780181.7	13262428.8	586.7	589.37	43.6395629	-83.8413382

LEGEND

- JCW MW-406 (red) JC WEADOCK BOTTOM ASH POND WELL
- MW-408 (blue) BACKGROUND MONITORING WELL
- JCW MW-407 (yellow) LANDFILL MONITORING WELL
- JCW MW-410 (green) BEDROCK MONITORING WELL

DRAWING NO.	REFERENCE DRAWINGS	REV.	DATE	DESCRIPTION	BY	APP.
FIG 1, REV 4	ARCADIS RCRA CCR GROUNDWATER MONITORING PROGRAM	A	11/30/15	EDIT TABLE AND LEGEND	EMB	
FIG 1, REV 2	ARCADIS RCRA CCR DEEP GROUNDWATER MONITORING PROGRAM					

	DATE
DR. J. PLUMMER	11/05/15
FIELD BOOK # 1989 FLD. BC/DM	11/4/15
CHKD. H. HORTON	11/06/15
APP.	

Consumers Energy

ROWE PROFESSIONAL SERVICES COMPANY

JC WEADOCK MONITORING WELLS CCR MONITORING

SECTION 1,2,11 & 12
HAMPTON TOWNSHIP
SAP 25477893
T14N-R5E
BAY COUNTY

SCALE:	DRAWING NO.	SHEET	REV.
1"=300'	SG-22354	1	A

FILE NAME: 22354BASE.DWG
ROWE # 15L0109

APPENDIX A

Low Stress (Low Flow) Purging and Sampling of Groundwater Monitoring Wells SOP (Procedure CHEM-2.7.06)

TITLE: LOW STRESS (LOW FLOW) PURGING AND SAMPLING OF GROUND WATER MONITORING WELLS

Written or Revised by Katharyn L Schlueter Date 08/07/09
Level I or Above

Technical Review by Gordon L Cattell Date 08/07/09
Level II or Above (not author)

Technical Approval by Emil Blaj Date 08/07/09
Level III

This electronically produced document has been reviewed and approved by the above-named individuals. The original document bearing the approval signatures is maintained on file by Consumers Energy, Laboratory Services.

TITLE: LOW STRESS (LOW FLOW) PURGING AND SAMPLING OF GROUND WATER MONITORING WELLS

1.0 SCOPE

1.1 This procedure is a general method for collecting low stress/low flow ground water samples from monitoring wells. Upon approval by the responsible party, this procedure may be used as a substitute for macro-purging techniques where 3 to 5 well volumes have traditionally been purged prior to sampling. The low stress/low flow method is the preferred technique for ground water monitoring wells located at the former Manufactured Gas Plant (MGP) sites of Consumers Energy.

1.2 The presented technique applies to monitoring wells that have an inner casing with a nominal diameter of at least 1.0 inch, and maximum-screened lengths of ten feet per interval.

1.3 The technique is appropriate for collection of ground water samples that will be analyzed for: volatile and semi-volatile organics including pesticides and polychlorinated biphenyls (PCBs), total and dissolved metals, and various other analytes such as sulfates, cyanides, and nitrates/nitrites.

1.4 The technique is also appropriate when the following conditions are desired: lower turbidity in the sample containers, significantly less purge water for disposal, and higher analyte repeatability.

2.0 APPLICABLE DOCUMENTS AND REFERENCES

2.1 CHEM-1.1.02, Chemistry Department Procedure Requirements.

2.2 Ground Water Issue, Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures, Puls and Barcelona, USEPA, Office of Research and Development, Office of Solid Waste and Emergency Response, EPA/540/S-95/504, April 1996.

2.3 Low Stress (Low Flow) Purging and Sampling Procedure for the Collection of Ground Water Samples From Monitoring Wells, USEPA Region 1, SOP No GW 0001, Revision 2, July 30, 1996.

2.4 Technical Guidance on Low-Flow Purging and Sampling and Passive Sampling, D M and G L Nielson, The Nielson Environmental Field School, NEFS-TG001-99, December 1999.

2.5 Manufacturer Operation Manual, as appropriate.

2.6 Standard Guide for Purging Methods for Wells Used for Ground-Water Quality Investigations, D6452-99, American Society for Testing and Materials.

2.7 MDEQ RRD Operational Memorandum 2, Attachment 5, Sampling and Analysis, October 2004, Revision.

2.8 Field worksheets (Attachments A-D).

3.0 DEFINITIONS

3.1 COC – Chain of Custody

3.2 NAPL – Non-aqueous Phase Liquids

3.3 LNAPL – Light Non-aqueous Phase Liquids

3.4 DNAPL – Dense Non-aqueous Phase Liquids

3.5 DTW – Depth-to-Groundwater

4.0 SUMMARY OF METHOD

4.1 Once depth-to-water is measured; a suitable pumping device is lowered to the target depth, generally mid-screen. Ground water is purged from the well casing at a slow rate, typically 100-500 mL/minute. While drawdown is measured and minimized, the purged water is diverted to a flow cell that contains several probes for indicating stabilization parameters, such as pH, conductively, etc. Once the parameters have stabilized within pre-determined limits, the purged water stream is diverted from the flow cell to sample containers for collection of proper test parameters.

5.0 PREREQUISITES

5.1 MEASURING AND TEST EQUIPMENT

5.1.1 Flow-cell, hand-held monitor, and sonde, containing in-line probes calibrated for at least dissolved oxygen and oxidation-reduction potential (ORP). If necessary, pH and conductivity may be monitored with external monitors, although in-line probes are recommended. Turbidity or other probes/monitors may be added as site-specific requirements dictate.

5.1.2 Adjustable rate groundwater pumping devices including: Peristaltic pump with pump head and electrical power source; bladder pump(s) with controller and a source of compressed air; gear pump (Keck or "bullet"), with controller and electrical power source. Gear and bladder pumps should be constructed of stainless steel or PTFE.

5.1.3 Tubing of the appropriate size, length, and material.

5.1.4 Interface probe for determining the presence or absence of NAPLs.

5.1.5 Water level measuring device with a minimum 0.01-foot accuracy.

5.1.6 Flow measurement supplies such as a rotometer or graduated cylinder with a stopwatch.

5.1.7 Portable PID meter, calibrated the same day as use.

5.1.8 Decontamination supplies, including deionized water, brushes, buckets, and commercially available 2-propanol soaked wipes.

5.1.9 Sample bottles with appropriate preservatives.

5.1.10 Field hazardous materials kit, including eyewash, sampling gloves, goggles, earplugs, etc.

5.1.11 Purge water collection device, such as a sturdy plastic bucket.

5.2 REAGENTS

5.2.1 Assorted standards as needed to fully calibrate the above system.

5.3 CALIBRATION REQUIREMENTS

5.3.1 All meters, probes, etc must be calibrated according to manufacturer's instructions. Periodic checks are recommended during or at the end of the day to ensure the calibration curves. Written documentation is required for all calibrations and periodic checks.

5.3.1.1 In general, daily recalibration will be required. In some cases where a periodic check indicates the calibration curves are still valid, no daily calibration may be necessary.

5.4 QUALITY CONTROL DOCUMENTS AND RECORDS

5.4.1 Historical documentation, including well construction data (eg, screen depth), well location map, and field data from a previous sampling event.

5.4.2 Material Safety Data Sheets (MSDSs) for all reagents taken to the job site.

5.4.3 A field log book or field worksheet must be kept at each sampling event (see Attachments A-D). The following should be documented:

5.4.3.1 Field instrumentation calibration data.

5.4.3.2 Monitoring well identification number and physical condition.

5.4.3.3 Monitoring well data such as casing material, casing diameter, and screen length.

5.4.3.4 Monitoring well depth and DTW, measurement technique, date and time of measurement.

5.4.3.5 Presence and thickness of NAPLs and detection method.

5.4.3.6 Sample tubing material, diameter, length, placement, and pump type.

5.4.3.7 Pumping rate, water level, water quality indicator values, date and time of measurements.

5.4.3.8 Identification of any unacceptable water quality indicator values.

5.4.3.9 Time and date of sample collection.

5.4.3.10 Sample ID and control number.

5.4.3.11 Field observations.

5.4.3.12 Sampler’s name or initials.

5.4.4 The COC must contain the analytical parameters requested, sample time and date, sampler’s name or initials, site location, sample ID, control number, preservatives added, and filtration status.

5.4.5 The sample labels must contain the sample ID, control number, sample time and date, sampler's initials, preservative, filtration status, and analytical parameter requested.

5.4.6 Field worksheets (Attachments A-D).

5.4.6.1 Monitoring Well Sampling Worksheet (Attachment A)

5.4.6.2 Monitoring Well Depth-To-Water Measurements Worksheet (Attachment B)

5.4.6.3 Flowcell/Sonde Calibration and Periodic Checks Worksheets (Attachment C)

5.4.6.4 Field Screening of Monitoring Wells Via PID (Attachment D)

5.5 PERSONNEL REQUIREMENTS

5.5.1 All tests and data reporting shall be performed by certified persons of Level I or above, in the appropriate discipline. (The project report shall be issued and reviewed by a certified person of Level II or above, in the appropriate discipline. The project report, if so indicated on the work request [or form similar in intent], may require approval from a certified person of Level III, in the appropriate discipline.)

5.6 ENVIRONMENTAL CONDITIONS

See Section 6.0.

6.0 PRECAUTIONS

6.1 The site-specific Health and Safety Plan is used to identify any physical or chemical precautions and actions to be taken to prevent injury. A pre-job briefing shall be conducted prior to initiating sampling.

6.2 Observe normal safety practices as specified in the latest online revision of the Environmental and Laboratory Services Accident Prevention Manual and the Consumers Energy Chemical Hygiene Plan in Lotus Notes.

7.0 LIMITATIONS AND ACTIONS

7.1 This technique is generally not suitable for very low-yield wells (<50 mL/minute with continued drawdown).

7.2 Even with pre-planning, a number of problems may be encountered which will challenge the sampler. These include: insufficient yield, failure of one or more key indicator parameters to stabilize, cascading, and equipment failure. Each of these problems will be addressed on a case-by-case basis and their impact can be minimized by consulting the references in Section 2.

7.3 This method does not address the collection of light or dense non-aqueous phase liquids (LNAPLs and DNAPLs). Collection of these sample types is both atypical and non-standardized and must therefore be addressed on an as-needed basis.

8.0 ACCEPTANCE CRITERIA

Refer to Section 9.3.9.3 in this procedure.

9.0 PROCEDURE

9.1 Orient the equipment and yourself upwind of the monitoring wells if possible.

9.2 DETERMINATION OF DEPTH-TO-GROUNDWATER (DTW)

9.2.1 Start at either the well known, or believed to have, the least contaminated groundwater and proceed systematically to the well known, or believed to have, the highest level of contamination.

9.2.2 Check the well casing protector, lock, locking cap, and well casing for obvious damage or evidence of tampering. Record any abnormal observations.

9.2.3 The sampler may desire to minimize contamination from the ground and provide a clean area for laying down equipment. This can be accomplished by cutting a section from a sheet of plastic and fitting it around the well casing protector.

9.2.4 Remove the well cap. At some sites, it may be necessary to remove all well caps first, then proceed to 9.2.5. This will be determined prior to any field events.

9.2.5 If the site has not been characterized yet, or there is insufficient history, it will be useful to determine the concentration of organic vapors in the heads case. Using a portable, calibrated, PID meter measure and record the organic vapor concentration as follows: (1) At the highest risk breathing zone elevation, defined here as the point located at roughly 6" above the center of the top of the well casing. (2) At 0-6" within the well casing.

9.2.6 If the well casing does not have a reference point, make one. The reference point is typically a V-cut or an indelible mark in the well casing.

9.2.7 Measure and record the DTW to 0.01 feet. Duplicate the reading. Hold the tape against the reference point when making the reading. Care should be taken to minimize disturbance of the water column.

9.2.8 Measure and record the thickness and depth of any NAPLs.

9.2.9 If desired or required by the site plan, measure the depth of the well. Care should be taken to minimize disturbance of the water column and any sediment that has accumulated.

9.2.10 Decontaminate the electronic tape and interface meter. Wipe dry using a clean Kaydry-type material. Rinse with DI water and wipe dry again. If organic contamination is suspected, the sampler must decontaminate accordingly before proceeding. One option is to use commercially prepared decontamination wipes that are saturated with 2-propanol.

9.2.11 If the monitoring well will be sampled the same day and will remain in visual range and/or without a reasonable risk of tampering, loosely recap the well and leave the well casing protector unlocked. Otherwise, secure the well as if not returning.

9.2.12 If a sheet of plastic has been fitted around the well casing protector, leave it in place if the well will be sampled the same day.

9.2.13 Continue with the determination of DTW on the rest of the monitoring wells. Continue with purging and sampling when appropriate (ie, large distance between wells).

TITLE: LOW STRESS (LOW FLOW) PURGING AND SAMPLING OF GROUND WATER MONITORING WELLS

9.3 PURGING

9.3.1 If not already determined at the laboratory or by prior sampling events, determine the type of pump to be used (operation of each pump type will not be covered here).

9.3.2 For ease of use and portability, a peristaltic pump may generally be used for any well where DTW plus casing height above grade does not exceed 15 feet.

9.3.3 Keck (gear or “bullet”) and bladder pumps can be used in any instance where there is sufficient water in the casing to completely submerge the pump and intake screen at all times.

9.3.4 Use well installation and historical data to determine the length of tubing needed to place the pump intake or tubing at the desired sample depth, generally mid-screen. Attach the tubing to the pump and prepare to lower the tubing or tubing/pump down the well. To keep from introducing contamination into the monitoring well, never allow the tubing or tubing/pump to touch bare ground.

9.3.5 Install the tubing or pump/tubing. Slowly lower the pump, tubing, and any safety cable and electrical lines into the monitoring well. Final placement is generally at mid-screen. Typically, the intake must be kept at least 2 feet above the bottom of the well to prevent disturbance and resuspension of any sediment or NAPL present in the bottom of the well. Once the desired depth is reached, clamp or otherwise secure the tubing to prevent the pump/tubing from dropping any lower. Record the depth to which the pump was lowered.

9.3.6 Before starting the pump, wait a few minutes and measure the water level again. Record this level. This short waiting period allows for reduced turbidity and reequilibrium of the water level. Leave the electronic tape in the well for later use.

9.3.7 Attach the in-line flow cell. Start the pump and collect roughly 100 mL/minute. Start with a faster or slower pumping rate if historical data suggests to do so.

9.3.8 Collect all water for proper disposal.

9.3.9 Monitor and record the water quality parameters and water level every 3-5 minutes.

9.3.9.1 Ideally, a steady flow rate should be maintained that results in a stabilized water level. Pumping rates should be reduced or increased to ensure stabilization of the water level in the well. Avoid entrainment of air in the tubing.

9.3.9.2 Record the time of the readings and the pump rate.

9.3.9.3 The well is considered stabilized and ready for sample collection when the indicator parameters have stabilized for three consecutive readings as follows:

- ± 0.1 pH units
- ± 3% conductivity units (specific conductance)
- ± 10 mV for redox potential (Eh/ORP)
- ± 10% for DO and turbidity
- Temperature – For information only. Record only.

Dissolved oxygen and turbidity usually require the longest time to achieve stabilization. (Above criteria may not apply to very clean wells.)

9.4 SAMPLE COLLECTION

9.4.1 The pump must not be removed from the well between purging and sample collection. It is recommended that the pump not be turned off between purging and sample collection. Continue to collect excess groundwater for proper disposal.

9.4.2 Disconnect or bypass the flow cell.

9.4.3 Collect samples at the same flow rate as the purging rate. Minimize potential contamination from dust, rain, etc by shielding the open bottles as needed.

9.4.4 Samples will be collected directly into the sample containers. Minimize aeration by allowing the water to flow down the side of the container rather than splashing against the bottom of the bottle. Avoid placing the sample tubing below the liquid level of the sample being collected. Label the containers and chill immediately.

9.4.5 VOC samples must be collected first except as noted below for Low Level Mercury. Check for air bubbles in the container before proceeding to collecting the next parameter. Carbonacious waters will naturally produce bubbles in the containers, which cannot, and should not, be removed.

NOTE: A sample for low level mercury should be the first sample collected when multiple analyte containers will be filled. Low level mercury sample bottles should be pre-cleaned and individually stored in Ziploc®-style plastic bags. Use clean nitrile gloves for each sample collection point, immediately prior to handling any bagged sample bottles.

When collecting a sample from a monitoring well:

- Remove the sample bottle from the plastic bag and remove the cap.
- The bottle should be thoroughly rinsed with the sample stream, holding the sample tubing very close to, not within, the open bottle (approximately 1/8"). Never place the sample tubing within the bottle.
- Fill to approximately ¼" below the bottle threads, affix a label, cap the bottle, and return it to the plastic bag.
- Place the bagged bottle in a cooler designated only for low level mercury.

9.4.6 Semi-volatile samples must be collected next, followed by any other parameters that do not require filtration.

9.4.7 Samples that require only filtration with no additional preparation steps should be collected using in-line filters. Filtered samples are typically collected last One exception is collection for available cyanide, which must be collected last due to the potential for cross-contamination from the lead carbonate reagent.

9.4.8 Once all samples from the monitoring well are collected, remove the tubing or pump/tubing. Record the stop time, if required. In addition, the total volume purged can be calculated and recorded.

9.4.9 Cap and secure the monitoring well.

9.4.10 In general, the purged water is poured on to the ground next to the monitoring well. Whether to collect in a drum or to use another strategy will be determined prior to starting any field activities.

9.4.11 Continue with sampling all of the other monitoring wells.

9.5 FIELD QUALITY CONTROL (QC) SAMPLES

9.5.1 Field QC samples must be collected to determine if sample collection and handling procedures have adversely affected the quality of the ground water samples. All QC samples are treated the same as samples with regard to volume, bottle type, preservatives, and any pretreatment.

9.5.2 TYPES OF QC SAMPLES

9.5.2.1 Trip Blank – For VOCs only. Consists of DI water in a VOC vial (contains preservative) and is prepared at the lab prior to the field event. The vial is left capped and chilled while sampling. Used to determine if sample holding and transport has introduced contamination into the samples.

9.5.2.2 Field Blank – Consists of DI water in an appropriate bottle with the appropriate preservative. Obtained from the lab prior to the sampling event and can prepare for a variety of analytes. The bottle is uncapped while sampling to indicate contamination that may have occurred during the operation.

9.5.2.3 Equipment Blank – DI water is exposed to the sample path at any time decontamination needs to be verified. Collect for any suspect parameter and treat it exactly the same as if collecting a sample.

9.5.2.4 Sample Duplicate – One monitoring well per 20 will be selected for collection of a duplicate sample. This is simply an additional set of the sample collected in exactly the same manner as the original sample. The sample type is used to determine precision.

9.5.2.5 Matrix Spike and Matrix Spike Duplicate – One monitoring well per 20 will be selected. These are additional sets of samples collected in exactly the same manner as the sample is collected. This sample type is used to determine accuracy but can also indicate matrix bias.

9.6 DECONTAMINATION

9.6.1 **General Considerations**

9.6.1.1 All nondedicated sampling equipment that is to be reused must be decontaminated prior to its reuse.

9.6.1.2 All disposable tubing will be properly discarded and new tubing used in its place. No tubing will be reused.

9.6.1.3 All equipment washings/rinsates must be collected for proper disposal.

9.6.1.4 The flow cell may be cleaned using the procedure in Section 9.6.2.1 or a manufacturer recommended procedure. Special attention must be paid to care of the probes on the sonde portion of the unit.

9.6.1.5 To avoid cross-contamination, pumps that are contaminated with NAPLs will be isolated and decontaminated at the laboratory.

9.6.2 **Between Well and End-of-Day Decontamination Process**

9.6.2.1 Flow Cell

A. In the case of the flow cell when new tubing will be used, a double rinse at half volume using deionized water is typically adequate. Continue with sampling. If the sample location is historically not contaminated, this step may be omitted.

B. If NAPLs, odors, or colors are present and cannot be flushed out, assess if the probes are fouled by spot-checking the calibration curves. If the probes are not fouled, no further action is necessary since the flow cell does not contact the sample. Continue with sampling.

C. If the probes are fouled, contact the MGP sample coordinator at the laboratory for guidance.

D. At the end of the day, the in-line flow cell should be free of sediment and NAPLs. Fill the cell with tap water, insert the sonde, and store.

9.6.3 **Pumps**

9.6.3.1 Peristaltic pumps need to only have the pump head tubing and sample tubing replaced.

9.6.3.2 If the equipment, such as the peristaltic pump case, is contaminated with organic material, wipe down with commercially available wipes presaturated with 2-propanol. If the organic material does not dislodge, stop now, isolate for decontamination at the lab, and use different equipment for the next monitoring well.

9.6.4 **Specific Bladder and Keck (gear or bullet) Pump Decontamination Measures**

TITLE: LOW STRESS (LOW FLOW) PURGING AND SAMPLING OF GROUND WATER MONITORING WELLS

9.6.4.1 Pump pre-rinse – Operate the pump in a deep basin containing 1-5 gallons of deionized water and continue through several cycles.

9.6.4.2 Pump wash – Operate the pump in a deep basin containing 1-5 gallons of nonphosphate detergent solution, such as Alconox. Operate through several cycles.

9.6.4.3 Pump rinse – Operate the pump in a deep basin containing 1-5 gallons of DI water. Continue for several cycles.

9.6.4.4 Disassemble pump, if required, and continue with 9.6.4.5. If not required, go to 9.6.4.7.

9.6.4.5 Pre-rinse, wash, and rinse as above, scrubbing as needed at the wash stage.

9.6.4.6 Reassemble the pump.

9.6.4.7 Store the pump so as to keep it clean until needed.

10.0 CALCULATIONS

None

11.0 DATA REPORTING

Refer to Section 5.4 in this procedure. At a minimum the COC shall be stored in the project folder.

TITLE: LOW STRESS (LOW FLOW) PURGING AND SAMPLING OF GROUND WATER MONITORING WELLS

Consumers Energy Company
Chemistry Section – Laboratory Services Department
Monitoring Well Sampling Worksheet

MW_ID		**Today's Date**		**Control Number**			
Location							
MW Reference Name				**GPS Grid Reference**			
Top-of-Casing Elevation (ft)		**Depth-to-Screen Bottom (ft)**		**Depth-to-MidScreen (ft)**			
Screen Length (ft)		**Casing ID (in)**		**Typical Purge Volume**		**Protective Casing Mount**	
Comments							

Field Measurements

Depth-to-Water (ft)		**HC Layer Detected**		**PID Reading (ppm)**	

Time	**pH**	**Temp**	**Sp Cond**	**DO**	**DO**	**ORP**	**Pump Rate Indicate**	**Water Level**	**Turbidity**
Hr : Min	Units	°C	µS/cm	ppm	% Sat	mV	mL/min gal/min	Draftdown (ft)	NTU
3-5 Min	± 0.1	na	± 3%	± 10%	± 10%	± 10%	See Notes	<0.33	± 10%
Completed By >>				**Total Pump Time >>**			**Total Purge Volume >>**		

Acceptance criteria are low-flow general acceptance. Pump rate should be <500 mL/min for low-flow and <1 gal/min for high-volume.

TITLE: LOW STRESS (LOW FLOW) PURGING AND SAMPLING OF GROUND WATER MONITORING WELLS

Monitoring Well Depth-to-Water Measurements

Site: ______________________

Analyst: ______________________

Date: ______________________

Project No: ______________________

Method: Electronic Tape

Tape ID: Solinst, Model 122, S/N 122001406-1

Sample

Well ID Number	Time of Measurement	Trial 1	Trial 2	Depth to Bottom of Screen, ft	Remarks
		DWL, ft	DWL, ft		

TITLE: LOW STRESS (LOW FLOW) PURGING AND SAMPLING OF GROUND WATER MONITORING WELLS

Project Sonde Check; As-Found Readings & Recalibration

Page 1 of 2

I. *Site or Project Tracking*

Site or Project : ________________ Chem. Control # : ________________

II. *System Identifiers*

Monitor Brand, Model & S/N:	YSI 650MDS S/N 08C100135
Sonde Brand, Model & S/N:	YSI 6820V2 S/N 08C101426
Flow Cell Brand & Model:	YSI 6160
DO Probe Brand, Model & S/N:	YSI 6150 S/N 08C101539
Turbidity Probe Brand, Model & S/N:	YSI 6136 S/N 08C101363
pH With ORP Brand, Probe Model & Lot:	YSI 6565 Lot Number 08B*26
Conductivity & Temperature Probe Model & S/N:	YSI No additional information

Sample

III. *pH Check*

Standard vs As-found, pH Units	Standard Source	Catalog # & Lot #	Exp. Date
4.00			
7.00			
10.00			

Analyst Initials: ________________ Date & Time: ________________

As-Found Evaluation

Are the readings within +/- 0.10 of their calibration points? Yes No

If 'No' **and** you are at the start of a project, then recalibration is **required**.

If 'No' and you are **within, or at the end** of project, indicate whether recalibration has been performed. Yes No

Note: If recalibration was performed, the solutions listed above were used.

IV. *ORP Check With Zobell Solution*

Standard vs As-found, mV	Source	Catalog # & Lot #	Exp. Date
231			

Analyst Initials: ________________ Date & Time: ________________

As-Found Evaluation

Is the reading in the 221-241mV range? Yes No

If 'No' **and** you are at the start of a project, then recalibration is **required**.

If 'No' and you are **within, or at the end** of project, indicate whether recalibration has been performed. Yes No

Note: If recalibration was performed, the solution listed above was used.

V. *DO Check With DI Water; 100% Saturation*

As-Found: ________________ Analyst Initials, Date & Time: ________________

As-Found Evaluation

Is the reading in the 90-110 % saturation range? Yes No

If 'No' **and** you are at the start of a project, then recalibration is **required**.

If 'No' and you are **within, or at the end** of project, indicate whether recalibration has been performed. Yes No

Note: If recalibration was performed, lab DI water was used.

TITLE: LOW STRESS (LOW FLOW) PURGING AND SAMPLING OF GROUND WATER MONITORING WELLS

Project Sonde Check; As-Found Readings & Recalibration

Page 2 of 2

Site or Project : ________________ Chem. Control # : ________________

VI. *Conductivity Check*

Standard vs As-Found, us	Source	Catalog # & Lot #	Exp. Date
0 (DI Water)	Lab DI System	----	----

Analyst Initials: ________________ Date & Time: ________________

Sample

As-Found Evaluation

Is the reading +/- 3% of the reference point? Yes No

If 'No' **and** you are at the start of a project, then recalibration is **required**.

If 'No' and you are **within, or at the end** of project, indicate whether recalibration has been performed. Yes No

Note: If recalibration was performed, the solutions listed above were used.

Linearity Check

Standard vs As-Found, us	Source	Catalog # & Lot #	Exp. Date

Analyst Initials: ________________ Date & Time: ________________

VII. *Turbidity Check*

Standard vs As-Found, NTU	Source	Catalog # & Lot #	Exp. Date
0 (DI Water)	Lab DI System	----	----

Analyst Initials: ________________ Date & Time: ________________

As-Found Evaluation

Is the reading +/- 10% of the reference point? Yes No

If 'No' **and** you are at the start of a project, then recalibration is **required**.

If 'No' and you are **within, or at the end** of project, indicate whether recalibration has been performed. Yes No

Note: If recalibration was performed, the solutions listed above were used.

Linearity Check

Standard vs As-Found, NTU	Source	Catalog # & Lot #	Exp. Date

Analyst Initials: ________________ Date & Time: ________________

Reviewed By ______________________________ Date ______________________

TITLE: LOW STRESS (LOW FLOW) PURGING AND SAMPLING OF GROUND WATER MONITORING WELLS

Field Screening of Monitoring Wells Via PID

Sample

Project Information

Site: ______________________

Project No: ______________________

Date: ______________________

Instrument Information

Instrument ID and Serial Number: ______________________

Calibration (Span) Gas ID, Lot Number Concentration, etc: ______________________

Zero Gas ID, Lot Number, Concentration, etc: ______________________

Periodic Calibration Checks

Time	Analyst	Cal Gas Conc, ppm v/v	Display Conc, ppm v/v

Monitoring Well Screening

MW ID	Time	Analyst	Breathing Zone Display Conc	0-6" Within Casing Display Conc
Background Air				NA

APPENDIX B

Chain-of-Custody, Handling, Packing and Shipping SOP (Procedure CHEM-1.2.04)

TITLE: CHAIN OF CUSTODY REQUIREMENTS (CoC)

1.0 PURPOSE

To provide guidance for uniform preparation of a Chain-of-Custody document.

2.0 SCOPE

The Chain-of-Custody (CoC) document is required for all samples where the analysis results are used for environmental reporting. It may also be used as requested by the customer for other forms of reporting. This method provides guidance for the use of the CoC document.

3.0 DEFINITIONS

Chain-of-Custody (CoC) – A document that is a management tool used to verify sample identification information, sample inventory and sample possession from the time the sample is collected to the time the sample is received by a laboratory.

4.0 REFERENCE DOCUMENTS

4.1 Chapter 1 – SW-846, Test Method for Evaluating Solid Waste, USEPA

4.2 ASTM Method D 5283-92, Standard Practice for Generation of Environmental Data Related to Waste Management Activities: Quality Assurance and Quality Control Planning and Implementation

4.3 ASTM Method D 4840-95, Standard Guide for Sampling Chain-of-Custody Procedures

4.4 Chemistry Department Standard Operating Procedures, as applicable

4.5 Laboratory Services Quality Assurance (LSQA) Procedure Manual, as applicable

5.0 PROCEDURE

5.1 Prior to sampling, the sample team shall be provided with CoC forms. It shall be the responsibility of the on-site supervisor or designated representative to ensure that CoC requirements, sample collection protocol and proper sample handling protocol are initiated on-site.

5.2 A sample is considered under custody if one or more of the following criteria are met:

- The sample is in the sampler's possession.
- The sample is within the sampler's view after being in possession.
- The sample was in the sampler's possession and then placed in a secure container to prevent tampering.
- It is in a designated secure area.

5.3 Each CoC shall identify basic site information and include the following:

- The sampling site name, project name or other site/project identification.
- The initials of the sampling teams.
- Project Leader or report distribution personnel.
- If a site sketch or other documents are to be found with the CoC.
- Necessary remarks as required.

5.4 Each sample entry into the CoC shall include the following:

- Date of sample collection.
- Time of sample collection.
- Type of sample matrix (soil, water, vapor, product, etc).
- Sample identification, name or description.
- Sample depth, if applicable.
- Number of sample containers.
- Specific analytical test parameters. In some cases the specific test parameters may not be known at the time of sample collection. However, the samples are collected in accordance with the protocol for a general group of analytes (e.g., dissolved metals, volatile organic compounds) and the specific test analytes are determined after the sampling event. In these cases, the entry for the analytical test parameter is not required.

5.5 The original of the CoC record shall accompany the samples and a copy should be maintained by the on-site supervisor.

5.6 When transferring the possession of samples, the individuals relinquishing and the individuals receiving the samples should sign, date and note the time on the CoC record.

5.7 In cases where the sample leaves the originator's immediate control, such as shipment to the laboratory by a common carrier (e.g., Federal Express or

Consumers Energy's internal mail) a seal should be placed on the shipping container to detect unauthorized entry to the samples. Any shipping containers that arrive at the Laboratory with the seals damaged should be evaluated to ascertain if the contents have been in valid custody.

5.8 In the event samples requiring the CoC protocol arrive at the Laboratory without the CoC document, the Laboratory shall complete the CoC document upon sample login and under the supervision of the assigned Laboratory Project Leader or Area Coordinator. The person completing the CoC shall enter the statement "CoC completed by the Laboratory upon receipt of sample(s)" in the remarks section of the CoC and initial the entry.

5.9 A sample CoC form is attached (Attachment A).

5.10 Other CoC formats and forms may be used as long as the CoC meets the recommendations of this procedure.

5.11 The CoC shall be stored in the project folder and retained according to CHEM-1.1.7, Record Retention.

QA Review Katharyn L Schlueter Date 02/27/08
Chemistry Quality Assurance Coordinator

Administrative Approval Gordon L Cattell Date 02/27/08
Chemistry Department Supervisor

This electronically produced document has been reviewed and approved by the above-named individuals. The original document bearing the approval signatures is maintained on file by Consumers Energy, Laboratory Services.

TITLE: CHAIN OF CUSTODY FORM (CoC)

CHAIN OF CUSTODY

Consumers Energy

CONSUMERS ENERGY COMPANY – LABORATORY SERVICES

135 WEST TRAIL ST., JACKSON, MI 49201 • (517) 788-1251 • FAX (517) 788-2533

SAMPLING SITE:	PROJECT NUMBER:	PAGE ____ OF ____ SEND REPORT TO:
SAMPLING TEAM:	DATE SHIPPED:	SITE SKETCH ATTACHED? CIRCLE ONE: YES NO PHONE:

CE CONTROL #	SAMPLE DATE	SAMPLE TIME	SAMPLE MATRIX	SAMPLE DESCRIPTION / LOCATION	DEPTH	# OF CONTAINERS	ANALYSIS REQUESTED							REMARKS

RELINQUISHED BY: (SIGNATURE)	DATE / TIME	RECEIVED BY: (SIGNATURE)	COMMENTS
RELINQUISHED BY: (SIGNATURE)	DATE / TIME	RECEIVED BY: (SIGNATURE)	
RELINQUISHED BY: (SIGNATURE)	DATE / TIME	RECEIVED BY: (SIGNATURE)	ORIGINAL TO LAB COPY TO CUSTOMER

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