2019 Annual Groundwater Monitoring and Corrective Action Report

JC Weadock Power Plant
Bottom Ash Pond CCR Unit

Essexville, Michigan

January 2020

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Prepared For
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Executive Summary

TRC prepared this Annual Groundwater Monitoring and Corrective Action Report for the Weadock Bottom Ash Pond, on behalf of Consumers Energy to cover the period of January 1, 2019 to December 31, 2019. The Weadock Bottom Ash Pond was in assessment monitoring at the beginning and the end of the period covered by this report. Data that has been collected and evaluated in 2019, including assessment monitoring data from November 2018, are presented in this report.

Consumers Energy first reported the potential for statistically significant increases (SSIs) for Appendix III constituents in the *"Annual Groundwater Monitoring Report DE Karn Power Plant Bottom Ash Pond CCR Unit"* (TRC, January 2018). The statistical evaluation of the Appendix III indicator parameters confirming SSIs over background were as follows:

- Boron at JCW-MW-15010;
- Calcium at JCW-MW-15009;
- Field pH at JCW-MW-15009 (low), JCW-MW-15010 (high), JCW-MW-15028 (high); and
- Sulfate at JCW-MW-15009.

On April 25, 2018, Consumers Energy entered assessment monitoring upon determining that an Alternate Source Demonstration for the Appendix III constituents was not successful. After subsequent sampling for Appendix IV constituents, Consumers Energy provided notification that beryllium and lithium were present at statistically significant levels above the Groundwater Protection Standards (GWPSs) established at 4 ug/L and 180 ug/L for beryllium and lithium, respectively (TRC, 2019) in one of the downgradient monitoring wells at the Weadock Bottom Ash Pond as follows:

- Beryllium at JCW-MW-15009; and
- Lithium at JCW-MW-15009.

The notification of the GWPS exceedance on January 14, 2019 was followed up with a Response Action Plan submitted to the Michigan Department of Environment, Great Lakes, and Energy (EGLE) 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. The *Assessment of Corrective Measures* (ACM) (TRC, September 2019) was initiated on April 14, 2019 and submitted to EGLE on September 11, 2019 in accordance with the schedule in §257.96 and provided in the Response Action Plan. The certification for a 60-day time extension to the 90-day completion period of the ACM required per §257.96(a) is included in this report.

The ACM documents that the groundwater nature and extent has been defined, as required in §257.95(g)(1). Although site-specific constituents of concern (COCs) (*i.e.*, 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. Per §257.96(b), Consumers Energy is continuing to monitor groundwater in accordance with the assessment monitoring program as specified in §257.95. Overall, the assessment monitoring statistical evaluations have confirmed that Appendix IV constituents historically present above the GWPS are beryllium, and lithium.

Consumers Energy has not selected a remedy pursuant to §257.97. The semi-annual progress report describing the progress in selecting and designing the remedy required pursuant to §257.97(a) is included in this report. 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 (*J.C. Weadock Generating Facility Bottom Ash Pond Closure Plan*, Golder, January 2018). Consumers Energy ceased hydraulic loading to the Weadock Bottom Ash Pond in April 2018 and has allowed the area to dewater by gravity. The active dewatering and excavation work are scheduled to be initiated in 2020 with a certification report submitted to EGLE once CCR removal is complete.

Based on the observations of decreasing lithium concentrations in JCW-MW-15009 and statistically significant decreases of beryllium concentrations in JCW-MW-15009 during the 2019 monitoring period, groundwater results are expected to continue to improve following the completion of source removal of CCR from the Weadock Bottom Ash Pond. Groundwater monitoring in 2020 will reduce uncertainty surrounding potential changes in redox conditions and the effect on contaminant transport. These observations will be critical for the comparison of corrective measures alternatives.

Consumers Energy will continue to evaluate corrective measures in accordance with §257.96 and §257.97 as outlined in the ACM. The groundwater management remedy for the Weadock Bottom Ash Pond will be selected as soon as feasible to meet the federal standards of §257.96(b) of the CCR Rule and state standards in R299.4444(2) of PA 640[1]. Consumers Energy will

[1] 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

continue executing the self-implementing groundwater compliance schedule in conformance with §257.90 - §257.98. The next semiannual monitoring event is tentatively scheduled for the second calendar quarter of 2020.

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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.

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. Standards for groundwater monitoring and corrective action codified in the CCR Rule (40 CFR 257.90 – 257.98) apply to the Consumers Energy JC Weadock Bottom Ash Pond CCR Unit (Weadock Bottom Ash Pond). Pursuant to the CCR Rule, no later than January 31, 2018, and annually thereafter, the owner or operator of a CCR unit must prepare an annual groundwater monitoring and corrective action report for the CCR unit documenting the status of groundwater monitoring and corrective action for the preceding year in accordance with §257.90(e).

TRC prepared this Annual Groundwater Monitoring and Corrective Action Report for the Weadock Bottom Ash Pond, on behalf of Consumers Energy. Corrective action has been triggered and assessment monitoring is ongoing at the Weadock Bottom Ash Pond CCR unit. Data that has been collected and evaluated in 2019, including assessment monitoring data from November 2018, are presented in this report.

1.1 Program Summary

Groundwater monitoring for the Weadock Bottom Ash Pond commenced after the installation of the monitoring well network in December 2015 to establish background conditions. Detection Monitoring was initiated on October 17, 2017 in conformance with the self-implementing schedule in the CCR Rule.

Consumers Energy first reported the potential for statistically significant increases (SSIs) for Appendix III constituents in the *"Annual Groundwater Monitoring Report DE Karn Power Plant Bottom Ash Pond CCR Unit"* (TRC, January 2018). The statistical evaluation of the Appendix III indicator parameters confirming SSIs over background were as follows:

- Boron at JCW-MW-15010;
- Calcium at JCW-MW-15009;
- Field pH at JCW-MW-15009 (low), JCW-MW-15010 (high), JCW-MW-15028 (high); and
- Sulfate at JCW-MW-15009.

On April 25, 2018, Consumers Energy entered assessment monitoring upon determining that an Alternate Source Demonstration for the Appendix III constituents was not successful. After

subsequent sampling for Appendix IV constituents, Consumers Energy provided notification that beryllium and lithium were present at statistically significant levels above the Groundwater Protection Standards (GWPSs) established at 4 ug/L and 180 ug/L for beryllium and lithium, respectively (TRC, 2019) in one of the downgradient monitoring wells at the Weadock Bottom Ash Pond as follows:

- Beryllium at JCW-MW-15009; and
- Lithium at JCW-MW-15009.

The notification of the GWPS exceedance on January 14, 2019 was followed up with a Response Action Plan submitted to the Michigan Department of Environment, Great Lakes, and Energy (EGLE) 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. The *Assessment of Corrective Measures* (ACM) (TRC, September 2019) was submitted on September 11, 2019 in accordance with the schedule in §257.96 and the requirements of the Response Action Plan.

The ACM documents that the groundwater nature and extent has been defined, as required in §257.95(g)(1). Although site-specific constituents of concern (COCs) (*i.e.,* 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.

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	Mercury
Calcium	Arsenic	Molybdenum
Chloride	Barium	Radium 226/228
Fluoride	Beryllium	Selenium
pH	Cadmium	Thallium
Sulfate	Chromium	
Total Dissolved Solids (TDS)	Cobalt	
	Fluoride	
	Lead	
	Lithium	

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/PA 640[2])	
Detection Monitoring	**Assessment Monitoring**
Iron	Copper
	Nickel
	Silver
	Vanadium
	Zinc

The Weadock Bottom Ash Pond groundwater monitoring system has been sampled for the Appendix III and Appendix IV constituents on a semiannual basis, in accordance with §257.95. Assessment monitoring data that has been collected and evaluated in 2019 are presented in this report. The monitoring was performed in accordance with the *JC Weadock Monitoring Program Sample Analysis Plan* (SAP) (ARCADIS, May 2016) and statistically evaluated per the *Groundwater Statistical Evaluation Plan* (Stats Plan) (TRC, October 2017).

1.2 Site Overview

The JC Weadock coal-fired Power Plant site is located south of the DE Karn Power Plant site, 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 JC Weadock site from the DE Karn Power Plant site 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. JC Weadock ceased generating electricity on April 15, 2016.

The locations of the Weadock Bottom Ash Pond and Weadock Landfill are shown on Figure 2. 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[3] Solid Waste

[2] 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.

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

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 bottom ash pond is the primary settling/detention structure for the National Pollutant Discharge Elimination System (NPDES) Treatment System prior to discharge and characterized as an existing CCR surface impoundment. Consumers Energy provided notification of the 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. This report focuses on the Weadock Bottom Ash Pond.

1.3 Geology/Hydrogeology

The majority of 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 at the site, indicate that the site was largely developed by reclaiming low-lands through construction of 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 are 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.

Section 2
Groundwater Monitoring

2.1 Monitoring Well Network

In accordance with 40 CFR 257.91, Consumers Energy established a groundwater monitoring system for the Weadock Bottom Ash Pond, which consists of eight monitoring wells (four background monitoring wells and four downgradient monitoring wells) that are screened in the uppermost aquifer. The monitoring well locations are shown on Figure 2.

Groundwater around the Weadock Bottom Ash Pond was characterized as radial based on the eight initial background sampling events prior to commencing detection monitoring; 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.

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 Weadock Bottom Ash Pond, dated October 17, 2017.

There were no changes to the groundwater monitoring system during the time period covered by this report. There were no wells that were installed or decommissioned.

2.2 November 2018 Assessment Monitoring

As discussed in the *2018 Annual Groundwater Monitoring Report* (2018 Annual Report) (TRC, January 2019), the second 2018 semiannual monitoring event was conducted in November 2018, but laboratory analysis and data quality review were ongoing as of the writing of the 2018 Annual Report. A summary of the November 2018 assessment monitoring event was prepared under a separate cover and is provided in Appendix A.

2.3 2019 Semiannual Groundwater Monitoring

Per §257.95, all wells in the CCR unit groundwater monitoring program must be sampled semiannually. At least one semi-annual event must include analysis for all Appendix III and Appendix IV constituents and one-semi-annual event may include analysis for all Appendix III

constituents and those constituents in Appendix IV of the CCR Rule that were detected during prior sampling. In addition to the Appendix III and IV indicator constituents, field parameters including dissolved oxygen, oxidation reduction potential, specific conductivity, temperature, and turbidity were collected at each well concurrent with each sampling location. Samples were collected and analyzed according to the SAP.

2.3.1 Data Summary

The first semiannual groundwater assessment monitoring event for 2019 was performed on April 9 to April 12, 2019. TRC personnel collected samples and recorded field measurements and water elevations. Samples were submitted to Test America in accordance with the SAP. Static water elevation data were collected at all CCR unit monitoring well locations. Groundwater samples were collected from the four background monitoring wells and four downgradient monitoring wells for all Appendix III and Appendix IV constituents and field parameters. A summary of the groundwater data collected during the April 2019 event is provided in Table 1 (static groundwater elevation data), Table 2 (field data), Table 3 (analytical results for background wells), and Table 4 (analytical results for downgradient wells). Analytical results for additional detection and assessment monitoring parameters per State of Michigan Public Act No. 640 of 2018 (PA 640) are provided in Table 5.

The second semiannual groundwater assessment monitoring event for 2019 was performed on October 14 and 15, 2019. TRC personnel collected samples and recorded field measurements and water elevations. Samples were submitted to Test America where they were analyzed and reported in accordance with the SAP. Static water elevation data were collected at CCR unit monitoring well locations. Groundwater samples were collected from the four background monitoring wells and four downgradient monitoring wells for all Appendix III and Appendix IV constituents and field parameters. A summary of the groundwater data collected during the April 2019 event is provided in Table 1 (static groundwater elevation data), Table 2 (field data), Table 3 (analytical results for background wells), and Table 4 (analytical results for downgradient wells). Analytical results for additional detection and assessment monitoring parameters per PA 640 are provided in Table 5.

2.3.2 Data Quality Review

Data from each round were evaluated for completeness, overall quality and usability, method-specified sample holding times, precision and accuracy, and potential sample contamination. The data were found to be complete and usable for the purposes of the CCR monitoring program. The data quality reviews are summarized in Appendix B.

2.3.3 Groundwater Flow Rate and Direction

Groundwater elevation data collected during the April and October 2019 sampling events depicted a potentiometric surface similar to elevation data collected previously in the background and detection monitoring events.

Groundwater elevations at the site are generally within the range of 580 to 591 feet NAVD88 and groundwater is typically encountered at equal elevation relative to the surrounding surface water features, flowing outward toward the bounding surface water features or within 10 feet higher. Groundwater elevations measured during the April and October 2019 sampling events are provided on Table 1 and were used to construct groundwater contour maps (Figures 3 and 4).

The figure shows that groundwater continues to flow to the north toward the discharge channel and to the west near the Saginaw River. The general flow direction is similar to that identified in previous monitoring rounds and continues to demonstrate that the downgradient wells are appropriately positioned to detect the presence of Appendix IV constituents that could potentially migrate from the Weadock Bottom Ash Pond CCR unit. The hydraulic gradient throughout the Weadock Bottom Ash Pond CCR unit area during the April 2019 event is estimated at 0.0042 ft/ft (average) and during the October 2019 event is estimated at 0.0015 ft/ft (geomean). The gradient was calculated using the well pairs JCW-MW-15028/JCW-MW-15009, JCW-MW-15007/JCW-MW-15010, and JCW-MW-15016/JCW-MW-15002. Using the mean hydraulic conductivity of 16 ft/day (ARCADIS, 2016) and an assumed effective porosity of 0.3, the estimated average seepage velocity was approximately 0.22 ft/day or 81 ft/year in April 2019, or 0.081 ft/day or 30 ft/year. The April 2019 groundwater flow velocity is similar to previous estimates, whereas the October 2019 groundwater flow velocity is slightly lower than previous estimates. The lower hydraulic gradient and flow velocity is likely due to the approximately 1.5-ft increase in the surface water elevation of Lake Huron between April and October 2019.

The general flow direction is similar to that identified in previous monitoring rounds and continues to demonstrate that the downgradient wells are appropriately positioned to detect the presence of Appendix IV constituents that could potentially migrate from the Weadock Bottom Ash Pond.

Section 3
Statistical Evaluation

Assessment monitoring is continuing at the Weadock Bottom Ash Pond while Consumers Energy further evaluates corrective measures in accordance with §257.96 and §257.97 as outlined in the ACM. The following section summarizes the statistical approach applied to assess the 2019 groundwater data in accordance with the assessment monitoring program. The statistical evaluations details are provided in Appendix A (*November 2018 Assessment Monitoring Data Summary and Statistical Evaluation),* Appendix D *(May 2018 Statistical Evaluation of Initial Assessment Monitoring Event),* Appendix E *(April 2019 Assessment Monitoring Data Summary and Statistical Evaluation) and* Appendix F *(October 2019 Assessment Monitoring Data Summary and Statistical Evaluation).*

3.1 Establishing Groundwater Protection Standards

The GWPSs are used to assess whether Appendix IV constituent concentrations are present in groundwater at unacceptable levels as a result of CCR Unit operations by statistically comparing concentrations in the downgradient wells to the GWPSs for each Appendix IV constituent. In accordance with §257.95(h) and the Stats Plan, GWPSs were established for the Appendix IV constituents following the preliminary assessment monitoring event using nine rounds of data collected from the background monitoring wells MW-15002, MW-15008, MW-15016, and MW-15019 (December 2015 through April 2018). The calculation of the GWPSs is documented in the *Groundwater Protection Standards* technical memorandum included as Appendix B of the 2018 Annual Report. The GWPS is established as the higher of the EPA Maximum Contaminant Level (MCL) or statistically derived background level for constituents with MCLs and the higher of the EPA Regional Screening Levels (RSLs) or background level for constituents with RSLs.

3.2 Data Comparison to Groundwater Protection Standards

Consistent with the *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance* (Unified Guidance) (USEPA, 2009), the preferred method for comparisons to a fixed standard are confidence limits. An exceedance of the standard occurs when the 99 percent lower confidence level of the downgradient data exceeds the GWPS. As documented in the January 14, 2019 *Notification of Appendix IV Constituent Exceeding Groundwater Protection Standard per* §257.95(g), beryllium and lithium were present at statistically significant levels exceeding the GWPS in one of the downgradient wells at the Weadock Bottom Ash Pond.

Overall, the assessment monitoring statistical evaluations have confirmed that Appendix IV constituents historically present above the GWPS are beryllium, and lithium. Recent data evaluations (Appendices E & F) demonstrate that 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 of CCR. A summary of the confidence intervals for April 2019 is provided in Table 6 and a summary of the confidence intervals for October 2019 is provided in Table 7. Arsenic concentrations in JCW-MW-15010 and lithium concentrations in JCW-MW-15009 appear to be decreasing; beryllium concentrations in JCW-MW-15009 exhibit a statistically significant downward trend (Appendix F: Attachment 1). There still is some uncertainty surrounding how changes in redox conditions may affect contaminant transport which will be further evaluated during groundwater monitoring in 2020.

Section 4
Corrective Action

Consumers Energy provided notification that beryllium and lithium were present at statistically significant levels above the Groundwater Protection Standards (GWPSs) established at 4 ug/L and 180 ug/L for beryllium and lithium, respectively (TRC, 2019) in one of the downgradient monitoring wells at the Weadock Bottom Ash Pond as follows:

- Beryllium at JCW-MW-15009; and
- Lithium at JCW-MW-15009.

The notification of the GWPS exceedance was followed up with a Response Action Plan submitted to EGLE 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. The Response Action Plan was approved by EGLE on May 14, 2019. The ACM was submitted to EGLE on September 11, 2019 in accordance with the schedule in §257.96 and provided in the Response Action Plan.

4.1 Nature and Extent Groundwater Sampling

Since one or more Appendix IV constituents have been detected at the Weadock Bottom Ash Pond at statistically significant levels above the GWPSs (*i.e.*, beryllium and lithium), the nature and extent of the release was characterized in accordance with the requirements of §257.95(g)(1). The nature and extent characterization are included in the ACM. The nature and extent characterization of groundwater was performed using data collected from existing site monitoring wells. Nature and extent data are included in Appendix C. Although beryllium and lithium concentrations exceed the GWPS in on-site groundwater monitoring locations, these 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. 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. 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.

4.2 Assessment of Corrective Measures

The Assessment of Corrective Measures (ACM) Report (TRC, September 2019) was completed on September 11, 2019 as a step towards developing a final remedy. The certification for a 60-day time extension to the 90-day completion period of the ACM required per §257.96(a) is included in Appendix G of this report. Several groundwater remediation alternatives evaluated in the ACM are considered technically feasible to reduce on-site groundwater concentrations and discussed in the ACM Report. The following corrective measures were retained for further evaluation:

- Source removal with post-remedy monitoring
- Source removal with groundwater capture/control
- Source removal with impermeable barrier
- Source removal with active geochemical sequestration
- Source removal with passive geochemical sequestration

Consumers Energy plans to utilize an adaptive management strategy for selecting the final groundwater remedy for the Weadock Bottom Ash Pond in coordination with the specified CCR source material management strategies discussed in the ACM Report. 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).

4.3 Remedy Selection

Consumers Energy has not selected a remedy pursuant to §257.97. The semi-annual progress report describing the progress in selecting and designing the remedy required pursuant to §257.97(a) is included as Appendix H this report. 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 (*J.C. Weadock Generating Facility Bottom Ash Pond Closure Plan*, Golder, January 2018). Consumers Energy ceased hydraulic loading to the Weadock Bottom Ash Pond in April 2018 and has allowed the area to dewater by gravity. The active dewatering and excavation work are scheduled to be initiated in 2020 with a certification report submitted to EGLE once CCR removal is complete.

Based on the observations of decreasing lithium concentrations in JCW-MW-15009 and statistically significant decreases of beryllium concentrations in JCW-MW-15009 during the 2019 monitoring period, groundwater results are expected to continue to improve following the completion of source removal of CCR from the Weadock Bottom Ash Pond. Groundwater monitoring in 2020 will reduce uncertainty surrounding potential changes in redox conditions and the effect on contaminant transport. These observations will be critical for the comparison of corrective measures alternatives.

Section 5
Conclusions and Recommendations

Corrective action has been triggered and assessment monitoring is ongoing at the Weadock Bottom Ash Pond CCR unit. Data that has been collected and evaluated in 2019, including assessment monitoring data from November 2018, are presented in this report.

Overall, the statistical assessments have confirmed that beryllium and lithium are the only Appendix IV constituent present at statistically significant levels above the GWPS. Consumers Energy will close 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 (*J.C. Weadock Generating Facility Bottom Ash Pond Closure Plan*, Golder, January 2018). Consumers Energy ceased hydraulic loading to the Weadock Bottom Ash Pond in April 2018 and has allowed the area to dewater by gravity. The active dewatering and excavation work are scheduled to be initiated in 2020 with a certification report submitted to EGLE once CCR removal is complete.

The ACM Report provided a high-level assessment of groundwater remediation technologies that could potentially address site-specific COCs (i.e., beryllium and lithium) under known groundwater conditions. 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 completion of source removal of CCR. Lithium concentrations in JCW-MW-15009 appear to be decreasing and beryllium concentrations in JCW-MW-15009 exhibit a statistically significant downward trend. There still is some uncertainty surrounding how changes in redox conditions may affect contaminant transport which will be further evaluated during groundwater monitoring in 2020.

Consumers Energy will continue to evaluate corrective measures in accordance with §257.96 and §257.97 as outlined in the ACM. The groundwater management remedy for the Weadock Bottom Ash Pond will, as soon as feasible, select a final remedy that, at a minimum, meets the federal standards of §257.96(b) of the CCR Rule and state standards in R299.4444(2) of PA 640. Consumers Energy will continue executing the self-implementing groundwater compliance schedule in conformance with §257.90 - §257.98. The next semiannual monitoring event is tentatively scheduled for the second calendar quarter of 2020.

Section 6
References

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

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Tables

Table 1
Summary of Groundwater Elevation Data
DE Karn and JC Weadock – RCRA CCR Monitoring Program
Essexville, Michigan

Well Location	TOC Elevation (ft)	Geologic Unit of Screen Interval	Screen Interval Elevation (ft)			March 11, 2019		April 8, 2019		October 7, 2019	
						Depth to Water (ft BTOC)	Groundwater Elevation (ft)	Depth to Water (ft BTOC)	Groundwater Elevation (ft)	Depth to Water (ft BTOC)	Groundwater Elevation (ft)
Background											
MW-15002	587.71	Sand	580.9	to	570.9	6.65	581.06	6.50	581.21	5.84	581.87
MW-15008	585.36	Sand with clay	578.7	to	568.7	4.37	580.99	4.37	580.99	3.23	582.13
MW-15016	586.49	Sand	581.2	to	578.2	4.41	582.08	4.12	582.37	4.39	582.10
MW-15019	586.17	Sand and Sand/Clay	579.5	to	569.5	5.03	581.14	5.13	581.04	4.16	582.01
JCW Bottom Ash Pond											
JCW-MW-15007	587.40	Sand	582.7	to	579.2	3.83	583.57	3.63	583.77	3.74	583.66
JCW-MW-15009	589.64	Sand	581.9	to	576.9	8.66	580.98	8.15	581.49	6.77	582.87
JCW-MW-15010	597.76	Sand	579.7	to	578.2	16.28	581.48	16.29	581.47	14.92	582.84
JCW-MW-15028	589.64	Sand	567.7	to	564.7	7.20	582.44	6.56	583.08	5.65	583.99
JCW Landfill											
JCW-MW-18001	596.73	Sand and Sandy Clay	578.3	to	573.3	16.47	580.26	16.42	580.31	14.82	581.91
JCW-MW-18004	593.04	Sandy Clay	583.9	to	578.9	12.13	580.91	11.58	581.46	10.77	582.27
JCW-MW-18005	590.89	Sand and Sandy Clay	580.0	to	575.0	9.56	581.33	8.68	582.21	9.78	581.11
JCW-MW-18006	600.72	Fly Ash and Sandy Clay	582.8	to	577.8	13.87	586.85	12.37	588.35	14.05	586.67
MW-50	593.36	Sand	577.8	to	574.8	13.06	580.30	13.05	580.31	11.50	581.86
MW-51	594.29	Sand and Clay	577.8	to	574.8	14.07	580.22	13.79	580.50	12.48	581.81
MW-52	594.90	Sand	579.3	to	576.3	14.57	580.33	14.46	580.44	13.09	581.81
MW-53	593.68	Sand and Clay	579.1	to	576.1	13.37	580.31	13.35	580.33	11.83	581.85
MW-53R	594.25	Sand and Clay	580.4	to	575.4	13.87	580.38	13.92	580.33	12.20	582.05
MW-54R	593.89	Clay and Sand	581.3	to	576.3	13.27	580.62	13.50	580.39	11.77	582.12
MW-55	593.82	Sand	581.5	to	578.5	13.34	580.48	13.43	580.39	11.95	581.87
OW-57ROUT	591.00	Sandy Clay	577.0	to	572.0	9.71	581.29	9.43	581.57	9.14	581.86
JCW Landfill (water level only)											
JCW-OW-18001	595.84	Fly Ash and Sand	581.1	to	576.1	6.76	589.08	--	--	7.07	588.77
JCW-OW-18002	593.63	Sand	578.9	to	573.9	9.73	583.90	--	--	9.43	584.20
JCW-OW-18003	593.99	Sand and Clay	580.5	to	575.5	10.41	583.58	--	--	12.22	581.77
JCW-OW-18004	594.19	Sandy Clay	584.6	to	579.6	6.97	587.22	--	--	8.22	585.97
JCW-OW-18006	600.61	Fly Ash and Clay with Sand	582.9	to	577.9	11.26	589.35	--	--	10.03	590.58
MW-20	592.73	NR	~581.1	to	~578.1	7.06	585.67	--	--	7.06	585.67
OW-51	593.62	Clay and Sand	578.9	to	575.9	11.64	582.64	--	--	9.87	583.75
OW-53	593.64	Clay and Sand	579.0	to	576.0	12.46	581.18	--	--	13.78	579.86
OW-54	594.10	Clay and Sand	580.0	to	577.0	8.00	586.10	--	--	8.35	585.75
OW-55	594.67	Clay (or Sand and Clay)	580.9	to	577.9	6.58	588.09	--	--	6.15	588.52
OW-56R	592.01	Ash and Sand	577.5	to	572.5	6.36	585.65	--	--	7.66	584.36
OW-57R IN	590.86	Sandy Clay	575.7	to	570.7	6.67	584.19	--	--	6.99	583.87
OW-61	612.37	Ash and Sand	588.0	to	585.0	21.76	590.61	--	--	21.20	591.17
OW-63	612.53	Ash and Sand	594.2	to	591.2	26.23	586.30	--	--	24.93	587.60
OW-64	593.37	Ash and Sand	576.4	to	573.4	10.07	583.30	--	--	NM	NM
JCW Leachate Headwells											
LH-103	603.49	Fly Ash	30.2	to	33.2	16.43	587.06	--	--	14.95	588.54
LH-104	596.56	Fly Ash	8.0	to	11.0	7.64	588.92	--	--	8.50	588.06

Notes:

Survey data from: Rowe Professional Services Company (Nov. 2015) and Consumers Energy Company drawings: SG-21733, Sheet 1, Rev. G (Karn, 11/27/18); and SG-21733, Sheet 2, Rev. C (Weadock, 11/27/18).

Elevation in feet relative to North American Vertical Datum 1988 (NAVD 88).

TOC: Top of well casing.

ft BTOC: Feet below top of well casing.

Table 2
Summary of Field Parameter Results – April 2019 to October 2019
JC Weadock Bottom Ash Pond – RCRA CCR Monitoring Program
Essexville, Michigan

Sample Location	Sample Date	Dissolved Oxygen (mg/L)	Oxidation Reduction Potential (mV)	pH (SU)	Specific Conductivity (umhos/cm)	Temperature (°C)	Turbidity (NTU)
Background							
MW-15002	4/8/2019	0.17	-18.1	7.0	6,665	9.7	1.2
	10/16/2019	0.21	-56.5	7.3	1,337	14.9	4.0
MW-15008	4/8/2019	0.13	-30.8	6.7	1,440	9.0	2.2
	10/15/2019	0.16	-18.0	6.6	1,658	13.7	3.4
MW-15016	4/9/2019	0.25	48.6	6.9	1,276	5.9	5.2
	10/16/2019	2.32	91.0	7.0	1,445	12.8	2.1
MW-15019	4/8/2019	0.12	-49.4	7.0	1,921	7.6	3.1
	10/16/2019	0.59	-20.9	6.8	1,860	13.6	4.5
JC Weadock Bottom Ash Pond							
JCW-MW-15007	4/9/2019	0.17	12.3	7.2	5,133	5.7	5.6
	10/15/2019	0.73	-11.1	7.1	4,539	15.2	3.9
JCW-MW-15009	4/9/2019	0.10	45.0	5.4	2,308	8.7	7.8
	10/15/2019	0.52	-69.2	6.1	2,441	16.0	2.6
JCW-MW-15010	4/9/2019	0.11	-279.5	7.6	1,068	12.4	1.2
	10/14/2019	0.43	-273.6	7.3	1,110	13.3	2.3
JCW-MW-15028	4/9/2019	0.10	-28.9	8.0	2,501	11.3	0.8
	10/14/2019	0.44	-188.8	7.8	2,639	12.5	1.2

Notes:

mg/L - Milligrams per Liter.

mV - Millivolts.

SU - Standard units.

umhos/cm - Micromhos per centimeter.

°C - Degrees Celcius

NTU - Nephelometric Turbidity Unit.

Table 3
Summary of Background Well Groundwater Sampling Results (Analytical): April 2019 - October 2019
DE Karn JC Weadock Background – RCRA CCR Monitoring Program
Essexville, Michigan

					Sample Location:	MW-15002		MW-15008		MW-15016		MW-15019	
					Sample Date:	4/8/2019	10/16/2019	4/8/2019	10/15/2019	4/9/2019	10/16/2019	4/8/2019	10/16/2019
Constituent	Unit	EPA MCL	MI Residential*	MI Non-Residential*	MI GSI^	Background							
Appendix III													
Boron	ug/L	NC	500	500	4,000	110	< 50	150	200	270	460	270	230
Calcium	mg/L	NC	NC	NC	500	230	61	110	120	180	230	140	120
Chloride	mg/L	**250****	**250**	**250**	**50**	**2,200**	**250**	**280**	**320**	**75**	**65**	**430**	**320**
Fluoride	ug/L	4,000	NC	NC	NC	< 20,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Sulfate	mg/L	**250****	**250**	**250**	**500**	< 40	16	4.9	11	**370**	**530**	46	71
Total Dissolved Solids	mg/L	**500****	**500**	**500**	**500**	**4,700**	**700**	**880**	**890**	**970**	**1,000**	**1,200**	**1,000**
pH, Field	SU	6.5 - 8.5**	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	7.0	7.3	6.7	6.6	6.9	7.0	7.0	6.8
Appendix IV													
Antimony	ug/L	6	6.0	6.0	2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	10	10	10	10	< 1.0	2.6	< 1.0	< 1.0	2.1	1.0	< 1.0	3.0
Barium	ug/L	2,000	2,000	2,000	1,200	510	77	65	70	43	58	300	220
Beryllium	ug/L	4	4.0	4.0	33	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	5	5.0	5.0	2.5	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Chromium	ug/L	100	100	100	**11**	1.2	11	2.2	2.1	< 1.0	**16**	< 1.0	< 1.0
Cobalt	ug/L	NC	40	100	100	< 6.0	< 6.0	< 6.0	< 6.0	< 6.0	< 6.0	< 6.0	< 6.0
Fluoride	ug/L	4,000	NC	NC	NC	< 20,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Lead	ug/L	NC	4.0	4.0	14	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lithium	ug/L	NC	170	350	440	17	< 10	19	20	110	92	12	14
Mercury	ug/L	2	2.0	2.0	0.20#	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	NC	73	210	120	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	5.5	< 5.0	< 5.0
Radium-226	pCi/L	NC	NC	NC	NC	0.677	0.203	0.250	0.365	< 0.110	< 0.213	0.259	0.458
Radium-228	pCi/L	NC	NC	NC	NC	1.81	< 0.580	0.570	< 0.559	< 0.529	< 0.552	0.772	0.559
Radium-226/228	pCi/L	5	NC	NC	NC	2.48	< 0.580	0.820	0.702	< 0.529	< 0.552	1.03	1.02
Selenium	ug/L	50	50	50	5.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Thallium	ug/L	2	2.0	2.0	2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0

Notes:

ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units; pH is a field parameter.
pCi/L - picocuries per liter.
MCL - Maximum Contaminant Level, EPA Drinking Water Standards and Health Advisories, April, 2012.
NC - no criteria.
* - Michigan Part 201 Generic Drinking Water Cleanup Criteria, December 30, 2013.
** - Secondary Maximum Contaminant Level (SMCL), EPA Secondary Drinking Water Regulations (SDWR) April, 2012.
^ - Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria. Hardness-dependent criteria calculated using hardness of 258 mg CaCO3/L (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018) per footnote {G} of Michigan Part 201 criteria tables. Chromium GSI criterion based on hexavalent chromium per footnote {H}. GSI criterion is protective for surface water used as a drinking water source as described in footnote {X}. GSI criterion for chloride is 50 mg/L when the discharge is to the Great Lakes or connecting waters per footnote {FF}
# - If detected above 0.20 ug/L, further evaluation of low-level mercury may be necessary to evaluate the GSI pathway per Michigan Part 201 and EGLE policy and procedure 09-014 dated June 20, 2012.
BOLD value indicates an exceedance of one or more of the listed criteria.
RED value indicates an exceedance of the MCL.
All metals were analyzed as total unless otherwise specified.

Table 4
Summary of Downgradient Groundwater Sampling Results (Analytical): April 2019 - October 2019
JC Weadock Bottom Ash Pond – RCRA CCR Monitoring Program
Essexville, Michigan

						Sample Location:	JCW-MW-15007		JCW-MW-15009		JCW-MW-15010		JCW-MW-15028	
						Sample Date:	4/9/2019	10/15/2019	4/9/2019	10/15/2019	4/9/2019	10/14/2019	4/9/2019	10/14/2019
Constituent	Unit	EPA MCL	MI Residential*	MI Non-Residential*	MI GSI^		Downgradient							
Appendix III														
Boron	ug/L	NC	**500**	**500**	4,000		290	470	290	330	**1,400**	**1,400**	**530**	**550**
Calcium	mg/L	NC	NC	NC	**500**		200	130	**510**	**520**	120	110	170	170
Chloride	mg/L	**250****	**250**	**250**	**50**		**1,600**	**1,200**	43	18	**140**	**140**	**660**	**640**
Fluoride	ug/L	4,000	NC	NC	NC		< 10,000	< 5,000	< 2,000	< 1,000	< 1,000	< 1,000	< 2,000	< 1,000
Sulfate	mg/L	**250****	**250**	**250**	**500**		< 20	44	**1,600**	**1,400**	36	30	120	120
Total Dissolved Solids	mg/L	**500****	**500**	**500**	**500**		**3,400**	**2,300**	**2,400**	**2,100**	**670**	**600**	**1,800**	**1,500**
pH, Field	SU	**6.5 - 8.5****	**6.5 - 8.5**	**6.5 - 8.5**	**6.5 - 9.0**		7.2	7.1	**5.4**	**6.1**	7.6	7.3	8.0	7.8
Appendix IV														
Antimony	ug/L	6	6.0	6.0	2.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	**10**	**10**	**10**	**10**		9.8	**34**	< 1.0	< 1.0	**16**	**13**	1.1	< 1.0
Barium	ug/L	2,000	2,000	2,000	1,200		950	970	14	66	190	180	250	230
Beryllium	ug/L	**4**	**4.0**	**4.0**	33		< 1.0	< 1.0	**4.3**	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	5	5.0	5.0	2.5		< 0.20	< 0.20	0.24	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Chromium	ug/L	100	100	100	11		< 1.0	< 1.0	1.4	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cobalt	ug/L	NC	40	100	100		< 6.0	< 6.0	< 6.0	< 6.0	< 6.0	< 6.0	< 6.0	< 6.0
Fluoride	ug/L	4,000	NC	NC	NC		< 10,000	< 5,000	< 2,000	< 1,000	< 1,000	< 1,000	< 2,000	< 1,000
Lead	ug/L	NC	4.0	4.0	14		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lithium	ug/L	NC	170	350	440		67	70	150	94	73	84	53	48
Mercury	ug/L	2	2.0	2.0	0.20#		< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	NC	73	210	120		6.2	9.7	< 5.0	9.3	< 5.0	< 5.0	< 5.0	< 5.0
Radium-226	pCi/L	NC	NC	NC	NC		0.628	9.7	< 0.0879	0.175	0.215	< 0.134	0.621	0.576
Radium-228	pCi/L	NC	NC	NC	NC		0.492	0.659	< 0.411	0.548	0.424	0.412	0.729	0.585
Radium-226/228	pCi/L	5	NC	NC	NC		1.12	0.796	< 0.411	0.723	0.639	0.536	1.35	1.16
Selenium	ug/L	50	50	50	5.0		3.2	1.45	2.0	2.0	< 1.0	< 1.0	< 1.0	< 1.0
Thallium	ug/L	2	2.0	2.0	2.0		< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0

Notes:
ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units; pH is a field parameter.
pCi/L - picocuries per liter.
MCL - Maximum Contaminant Level, EPA Drinking Water Standards and Health Advisories, April, 2012.
NC - no criteria.
* - Michigan Part 201 Generic Drinking Water Cleanup Criteria, December 30, 2013.
** - Secondary Maximum Contaminant Level (SMCL), EPA Secondary Drinking Water Regulations (SDWR) April, 2012.
^ - Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria. Hardness-dependent criteria calculated using hardness of 258 mg CaCO3/L (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018) per footnote {G} of Michigan Part 201 criteria tables. Chromium GSI criterion based on hexavalent chromium per footnote {H}. GSI criterion is protective for surface water used as a drinking water source as described in footnote {X}. GSI criterion for chloride is 50 mg/L when the discharge is to the Great Lakes or connecting waters per footnote {FF}
# - If detected above 0.20 ug/L, further evaluation of low-level mercury may be necessary to evaluate the GSI pathway per Michigan Part 201 and EGLE policy and procedure 09-014 dated June 20, 2012.
BOLD value indicates an exceedance of one or more of the listed criteria.
RED value indicates an exceedance of the MCL.
All metals were analyzed as total unless otherwise specified.

Table 5
Summary of Part 115 Groundwater Sampling Results (Analytical): April 2019 - October 2019
JC Weadock Bottom Ash Pond – RCRA CCR Monitoring Program
Essexville, Michigan

								JCW-MW-15007		JCW-MW-15009		JCW-MW-15010		JCW-MW-15028	
							Sample Location:								
							Sample Date:	4/9/2019	10/15/2019	4/9/2019	10/15/2019	4/9/2019	10/14/2019	4/9/2019	10/14/2019
Constituent	Unit	EPA MCL	MI Residential*	MI Residential Aesthetic**	MI Non-Residential*	MI Non-Residential Aesthetic**	MI GSI^	downgradient							
Copper	ug/L	1,000***	1,400	1,000	4,000	1,000	20	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Iron	ug/L	**300*** **	**2,000**	**300**	**5,600**	**300**	500,000	**1,400**	**1,900**	**34,000**	**16,000**	12	< 20	190	**340**
Nickel	ug/L	NC	100	NA	100	NA	120	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Silver	ug/L	100***	34	NA	98	NA	**0.2**	< 0.20	< 0.20	**0.21**	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Vanadium	ug/L	NC	4.5	NA	62	NA	27	3.6	3.1	2.5	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Zinc	ug/L	5,000***	2,400	NA	NA	5,000	260	< 10	< 10	< 10	< 10	< 10	12	< 10	< 10

Notes:

ug/L - micrograms per liter.

MCL - Maximum Contaminant Level, EPA Drinking Water Standards and Health Advisories, April, 2012.

NC - no criteria.

NA- Not applicable.

* - Michigan Part 201 Generic Drinking Water Cleanup Criteria, December 30, 2013, where aesthetic drinking water values are provided, criterion is the health-based drinking water value.

** - Criterion is the asethetic drinking water value per footnote {E} of the Michigan Part 201 Generic Drinking Water Cleanup Criteria.

*** - Secondary Maximum Contaminant Level (SMCL), EPA Secondary Drinking Water Regulations (SDWR) April, 2012.

^ - Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria. Hardness-dependent criteria calculated using hardness of 258 mg CaCO3/L (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018) per footnote {G} of Michigan Part 201 criteria tables. GSI criterion is protective for surface water used as a drinking water source as described in footnote {X}.

Additional specific detection and assessment monitoring constituents per State of Michigan Public Act 640 (PA 640), December 28, 2019.

BOLD value indicates an exceedance of one or more of the listed criteria.

All metals were analyzed as total unless otherwise specified.

Table 6

Summary of Groundwater Protection Standard Exceedances – April 2019

JC Weadock Bottom Ash Pond – RCRA CCR Monitoring Program

Essexville, Michigan

Constituent	Units	GWPS	JCW-MW-15007		JCW-MW-15009		JCW-MW-15010	
			LCL	UCL	LCL	UCL	LCL	UCL
Arsenic	ug/L	21	14	38	NA	NA	11	26
Beryllium	ug/L	4	NA	NA	4.9	12	NA	NA
Lithium	ug/L	180	NA	NA	170	270	NA	NA

Notes:

ug/L - micrograms per Liter.

NA - Not Applicable; well/parameter pair did not directly exceed the GWPS and was not included in further analysis.

GWPS - Groundwater Protection Standard as established in TRC's Technical Memorandum dated October 15, 2018.

UCL - Upper Confidence Limit (α = 0.01) of the downgradient data set.

LCL - Lower Confidence Limit (α = 0.01) of the downgradient data set.

Indicates a statistically significant exceedance of the GWPS. An exceedance occurs when the LCL is greater than the GWPS.

Table 7

Summary of Groundwater Protection Standard Exceedances – October 2019

JC Weadock Bottom Ash Pond – RCRA CCR Monitoring Program

Essexville, Michigan

Constituent	Units	GWPS	JCW-MW-15007		JCW-MW-15009		JCW-MW-15010	
			LCL	UCL	LCL	UCL	LCL	UCL
Arsenic	ug/L	21	14	37	NA	NA	10	23
Beryllium	ug/L	4	NA	NA	3.1	9.5	NA	NA
Lithium	ug/L	180	NA	NA	130	250	NA	NA

Notes:

ug/L - micrograms per Liter.

NA - Not Applicable; well/parameter pair did not directly exceed the GWPS and was not included in further analysis.

GWPS - Groundwater Protection Standard as established in TRC's Technical Memorandum dated October 15, 2018.

UCL - Upper Confidence Limit (α = 0.01) of the downgradient data set.

LCL - Lower Confidence Limit (α = 0.01) of the downgradient data set.

Indicates a statistically significant exceedance of the GWPS. An exceedance occurs when the LCL is greater than the GWPS.

Figures

BASE MAP FROM USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLE SERIES.

N

1 " = 3,000 '
1:36,000

0 3,000 6,000
FEET

TRC
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PROJECT:

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

TITLE:

SITE LOCATION MAP

DRAWN BY:	S. MAJOR
CHECKED BY:	J. KRENZ
APPROVED BY:	D. LITZ
DATE:	JANUARY 2020
PROJ. NO.:	322172/3
FILE:	322172_3-002SLM.mxd

FIGURE 1

E:\ConsumersEnergy\CCR_GW\2017_269767\322172_3-002SLM.mxd -- Saved By: MVAPHIADIS on 1/29/2020, 13:59:05 PM

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).
4. A SINGLE WELL SYMBOL IS SHOWN FOR WELL PAIRS MW-01/MW-02, MW-03/MW-04, OW-02/MW-22, AND OW-07/MW-23 AS THE WELLS ARE LOCATED WITHIN 15-FT OF EACH OTHER.

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:	J. KRENZ		
APPROVED BY:	D. LITZ		**FIGURE 2**
DATE:	JANUARY 2020		

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FILE NO.: 322172_3-003-02.mxd

Plot Date: 1/29/2020, 14:03:57 PM by MVAPHIADIS -- LAYOUT: ANSI B(11"x17")
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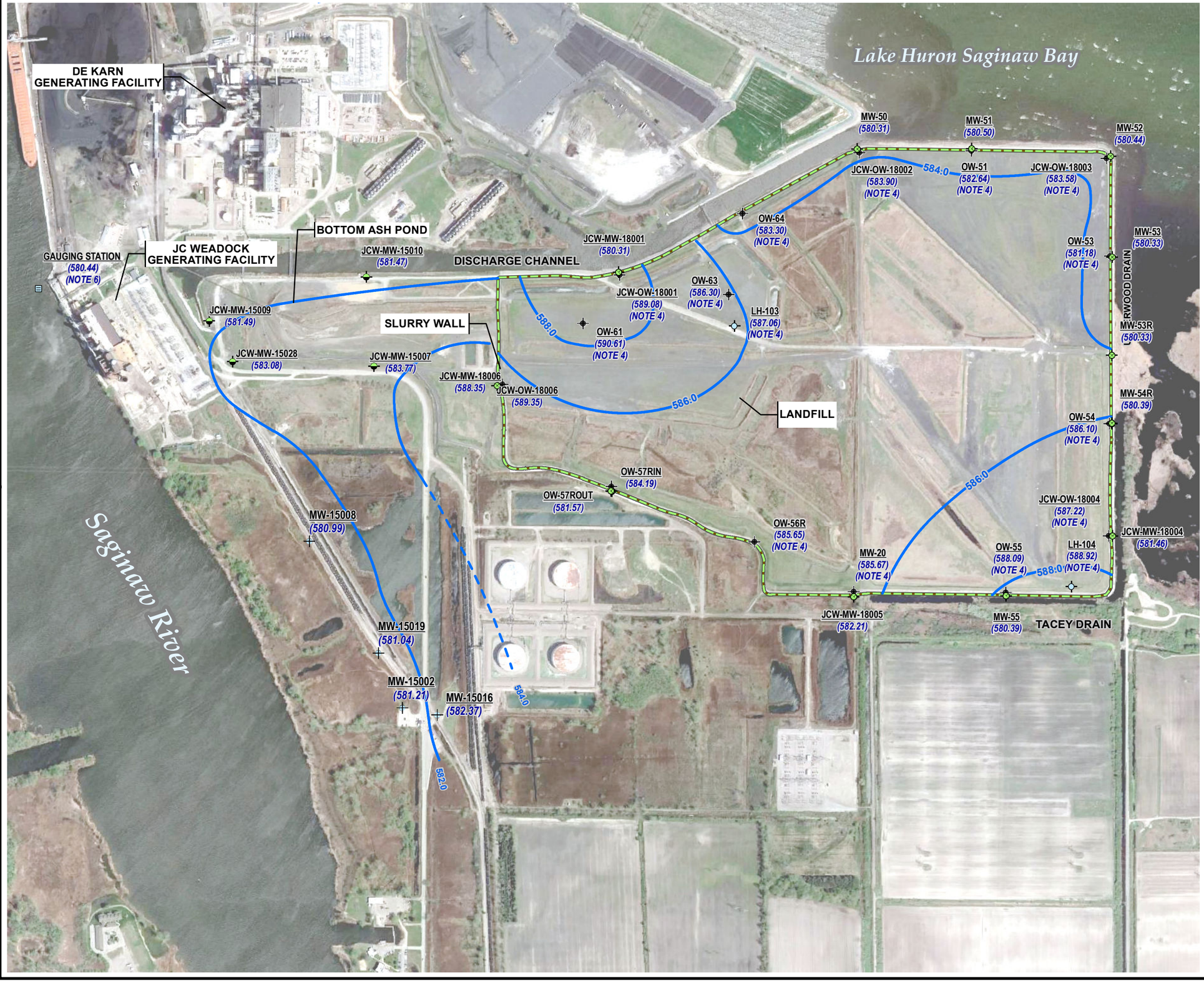
Map Rotation: 0



LEGEND

- BACKGROUND MONITORING WELL
- JCW BOTTOM ASH POND MONITORING WELL
- JCW LANDFILL CCR WELL
- MONITORING WELL (STATIC WATER LEVEL ONLY)
- LEACHATE HEADWELL
- SURFACE WATER GAUGING STATION
- SLURRY WALL (APPROXIMATE)
- 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

0 700 1,400 Feet

1 " = 700 '

1:8,400

PROJECT:

CONSUMERS ENERGY COMPANY
JC WEADOCK POWER PLANTS
ESSEXVILLE, MICHIGAN

TITLE:

SHALLOW GROUNDWATER CONTOUR MAP APRIL 2019

DRAWN BY:	S. MAJOR	PROJ NO.:	322173-001
CHECKED BY:	J. KRENZ		
APPROVED BY:	D. LITZ		**FIGURE 3**
DATE:	JANUARY 2020		

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FILE NO.: 322173-001-022_Figure3.mxd

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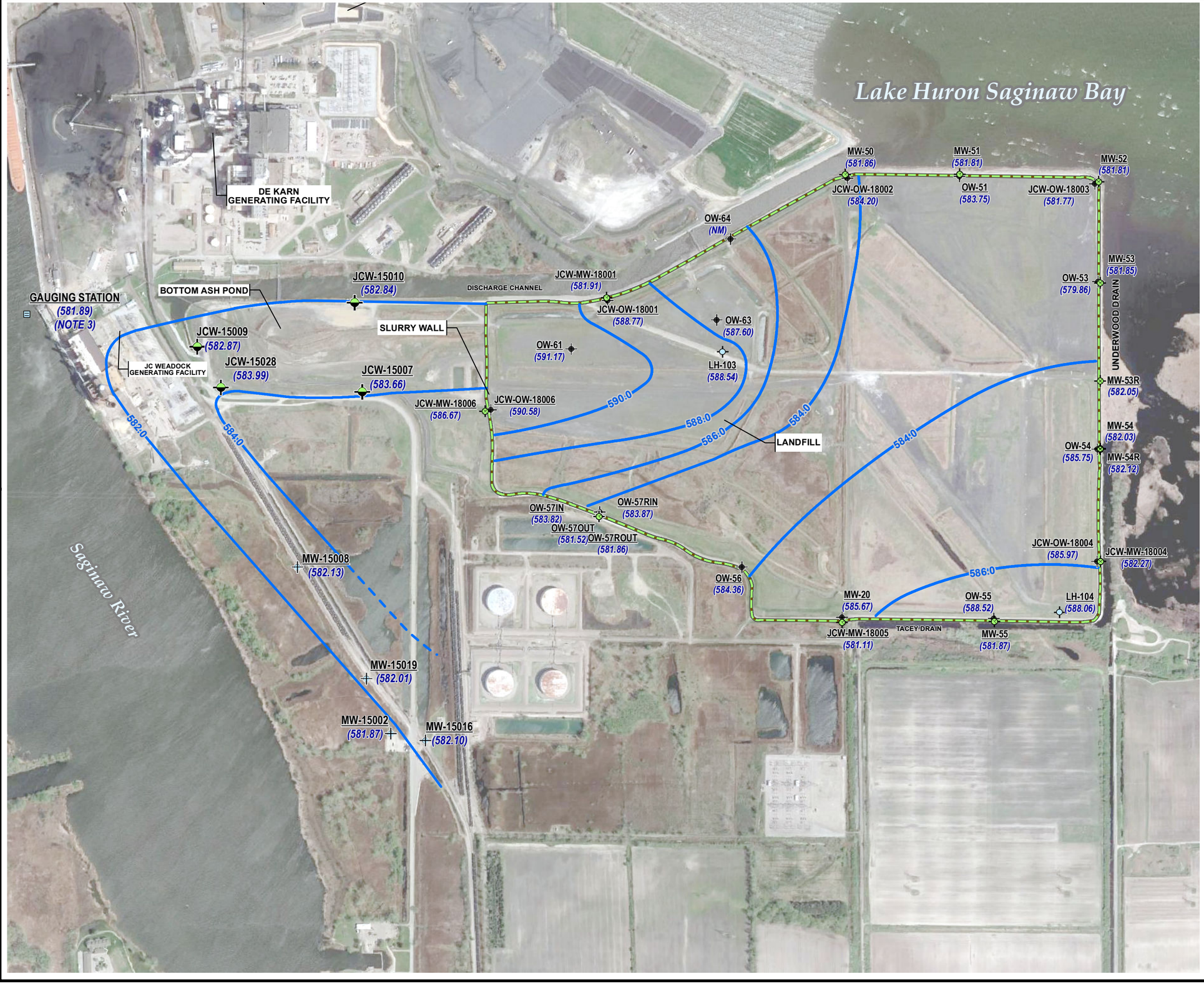

LEGEND

- JCW LANDFILL HMP WELL
- LEACHATE HEADWELL
- MONITORING WELL (STATIC WATER LEVEL ONLY)
- SLURRY WALL (APPROXIMATE)
- GROUND WATER ELEVATION CONTOUR (2' INTERVAL, DASHED WHERE INFERRED)
- (580.85) GROUNDWATER ELEVATION (FEET, MSL)
- (NM) NOT MEASURED

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. NOAA/NATIONAL OCEANIC SERVICE GREAT LAKES GAUGING STATION, ESSEXVILLE, MI (ID: 9075035).

0 700 1,400 Feet

1 " = 700 '

1:8,400

PROJECT:

CONSUMERS ENERGY COMPANY
JC WEADOCK POWER PLANT
ESSEXVILLE, MICHIGAN

TITLE:

SHALLOW GROUNDWATER CONTOUR MAP OCTOBER 2019

DRAWN BY:	M. VAPHIADIS	PROJ NO.:	322173-001
CHECKED BY:	J. KRENZ		
APPROVED BY:	D. LITZ		**FIGURE 4**
DATE:	JANUARY 2020		

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FILE NO.: 322173-001-023_Figure4.mxd

TRC - GIS
Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl (Foot)
Map Rotation: 0
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Path: E:\ConsumersEnergy\CCR_GW\2017_269767\322173-001-023_Figure4.mxd

Appendix A
Summary of November 2018 Assessment Monitoring Event

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March 14, 2019

Harold Register
Environmental Services
Consumers Energy Company
1945 W. Parnall Road
Jackson, MI 49201

Subject: November 2018 Assessment Monitoring Data Summary and Statistical Evaluation
Consumers Energy, JC Weadock Site, Bottom Ash Pond CCR Unit

Dear Mr. Register:

Consumers Energy Company (CEC) is continuing semiannual assessment monitoring in accordance with §257.95 of the CCR Rule[1] for the JC Weadock (JCW) site in Essexville, Michigan. During the statistical evaluation of the initial assessment monitoring event, beryllium and lithium were present in downgradient monitoring wells at statistically significant levels above the Groundwater Protection Standards (GWPSs). Therefore, CEC will initiate an Assessment of Corrective Measures (ACM) within 90 days from when the Appendix IV exceedance was determined (no later than April 14, 2019). As discussed in the *2018 Annual Groundwater Monitoring Report* (2018 Annual Report) (TRC, January 2019), prepared by TRC on behalf of CEC, the second semiannual monitoring event was conducted in November 2018, but laboratory analysis and data quality review were ongoing as of the writing of the 2018 Annual Report. Therefore, the summary of the November 2018 groundwater data would be prepared under separate cover after laboratory analysis is complete and results have been reviewed for usability. This letter report has been prepared to provide the summary of the November 2018 assessment groundwater monitoring results, data quality review, and statistical data evaluation.

Assessment Monitoring Sampling Summary

TRC conducted the second semiannual assessment monitoring events of 2018 for Appendix III and Appendix IV constituents at the JCW Bottom Ash Pond (BAP) CCR Unit in accordance with the *JC Weadock Monitoring Program Sample Analysis Plan* (ARCADIS, 2016) (SAP). The semiannual assessment monitoring event was performed on November 5 through November 8, 2018. Downgradient

[1] USEPA final rule for the regulation and management of Coal Combustion Residuals (CCR) under the Resource Conservation and Recovery Act (RCRA) published April 17, 2015, as amended per Phase One, Part One of the CCR Rule (83 FR 36435).

monitoring wells JCW-MW-15007, JCW-MW-15009, JCW-MW-15010, and JCW-MW-15028 and background monitoring wells MW-15002, MW-15008, MW-15016, and MW-15019 were sampled during the monitoring event. The locations of the monitoring wells are depicted on Figure 1.

TRC personnel collected static water level measurements at all monitoring wells. Static water elevation data are summarized in Table 1 and groundwater elevation data are shown on Figure 2. Monitoring wells were purged with peristaltic pumps or submersible pumps utilizing low-flow sampling methodology. Field parameters were stabilized at each monitoring well prior to collecting groundwater samples. Field parameters for each monitoring well are summarized in Table 2.

The groundwater samples were analyzed by Pace Analytical Services, LLC (Pace) for Appendix III and IV parameters in accordance with the SAP. The analytical results for the background monitoring wells are summarized in Table 3, and the analytical results for the downgradient monitoring wells are summarized in Table 4.

Groundwater Flow Rate and Direction

Groundwater elevation data collected during the November 2018 assessment monitoring event are provided in Table 1, as well as additional groundwater elevation data collected from October 2018 (two weeks prior to the assessment monitoring event). The October and November 2018 groundwater elevation data were used to construct the groundwater contour map (Figure 2). Groundwater elevation data collected during the October/November 2018 assessment monitoring sampling event were generally similar to data collected previously during the background and detection monitoring events.

Groundwater elevations at the site are generally within the range of 579 to 584 feet (ft NAVD88) and groundwater is typically encountered at a similar or slightly higher elevation relative to the surrounding surface water features, flowing outward toward the bounding surface water features. The figure shows that groundwater near the JCW BAP CCR Unit continues to flow to the north toward the discharge channel and to the west near the Saginaw River. The average hydraulic gradient throughout the JCW BAP CCR unit area during these events is estimated at 0.0044 ft/ft. The gradient was calculated using the well pairs JCW-MW-15028/JCW-MW-15009, JCW-MW-15007/JCW-MW-15010, and MW-15016/MW-15002. 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 0.23 ft/day or 85 ft/year, which is consistent with previous estimates. The general flow direction is similar to that identified in previous monitoring rounds and continues to demonstrate that the downgradient wells are appropriately positioned to detect the presence of Appendix III/IV constituents that could potentially migrate from the JCW BAP CCR unit.

Data Quality

Analytical data were found to be usable for assessment monitoring and were generally consistent with previous sampling events. The Data Quality Reviews are included as Attachment A.

Assessment Monitoring Statistical Evaluation

Following the second semiannual assessment monitoring sampling event, the compliance well groundwater concentrations for Appendix IV constituents were compared to the GWPSs to determine if a statistically significant exceedance had occurred in accordance with §257.95. Consistent with the *Unified Guidance*[2], the preferred method for comparisons to a fixed standard are confidence limits. An exceedance of the standard occurs when the 99 percent lower confidence level of the downgradient data exceeds the GWPSs. GWPSs were established in accordance with §257.95(h), as detailed in the October 15, 2018 *Groundwater Protection Standards* technical memorandum, which was also included in 2018 Annual Report.

Confidence intervals were established per the statistical methods detailed in the *Statistical Evaluation of November 2018 Assessment Monitoring Sampling Event* technical memorandum provided in Attachment B. For each Appendix IV constituent, the concentrations were first compared directly to the GWPSs. Constituent-well combinations that included a direct exceedance of the GWPSs were retained for further statistical analysis using confidence limits.

The statistical evaluation of the assessment monitoring data indicates that the following constituent is present at statistically significant levels exceeding the GWPS in downgradient monitoring wells at the JCW BAP:

Constituent	**GWPS**	**#Downgradient Wells Observed**
Beryllium	4 ug/L	1 of 4
Lithium	180 ug/L	1 of 4

These results are consistent with the initial assessment monitoring data statistical evaluation. CEC will continue to initiate an assessment of corrective measures by April 14, 2019, per §257.95(g). CEC will continue executing the self-implementing groundwater compliance schedule in conformance with §257.90 - §257.98.

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

Sincerely,

TRC

Graham Crockford
Program Manager

Darby Litz
Hydrogeologist/Project Manager

Attachments

Table 1.	Summary of Groundwater Elevation Data
Table 2.	Summary of Field Parameter Results
Table 3.	Summary of Background Well Groundwater Sampling Results (Analytical)
Table 4.	Summary of Groundwater Sampling Results (Analytical)
Table 5.	Summary of Groundwater Protection Standard Exceedances – November 2018
Figure 1.	Monitoring Well Network and Site Plan
Figure 2.	Groundwater Contour Map – November 5, 2018
Attachment A	Data Quality Reviews
Attachment B	Statistical Evaluation of November 2018 Assessment Monitoring Sampling Event

cc: Brad Runkel, Consumers Energy
Bethany Swanberg, Consumers Energy
Central Files

Tables

Table 1
Summary of Groundwater Elevation Data
DE Karn and JC Weadock – RCRA CCR Monitoring Program
Essexville, Michigan

Well Location	TOC Elevation (ft)	Geologic Unit of Screen Interval	Screen Interval Elevation (ft)			October 22, 2018		November 5, 2018	
						Depth to Water (ft BTOC)	Groundwater Elevation (ft)	Depth to Water (ft BTOC)	Groundwater Elevation (ft)
Background									
MW-15002	587.71	Sand	580.9	to	570.9	NM	NM	6.71	581.00
MW-15008	585.36	Sand with clay	578.7	to	568.7	NM	NM	4.55	580.81
MW-15016	586.49	Sand	581.2	to	578.2	NM	NM	3.94	582.55
MW-15019	586.17	Sand and Sand/Clay	579.5	to	569.5	NM	NM	5.28	580.89
DEK Bottom Ash Pond									
DEK-MW-15002	590.87	Sand	578.3	to	575.3	5.75	585.12	5.85	585.02
DEK-MW-15004	611.04	Sand	576.6	to	571.6	25.10	585.94	25.45	585.59
DEK-MW-15005	589.72	Sand	572.3	to	567.3	8.76	580.96	9.53	580.19
DEK-MW-15006	589.24	Sand	573.0	to	568.0	8.27	580.97	9.09	580.15
DEK Bottom Ash Pond & Karn Lined Impoundment									
DEK-MW-15003	602.74	Sand	578.8	to	574.8	15.47	587.27	15.71	587.03
DEK-MW-18001	593.47	Sand	579.2	to	574.2	8.10	585.37	8.13	585.34
OW-10	591.58	Silty Sand and Silty Clay	576.0	to	571.0	6.14	585.44	6.18	585.40
OW-11	607.90	Silt/Fly Ash	587.5	to	582.5	20.20	587.70	20.40	587.50
OW-12	603.07	Silty Sand	584.2	to	579.2	16.42	586.65	16.60	586.47
JCW Bottom Ash Pond									
JCW-MW-15007	587.40	Sand	582.7	to	579.2	NM	NM	3.78	583.62
JCW-MW-15009	589.64	Sand	581.9	to	576.9	NM	NM	8.40	581.24
JCW-MW-15010	597.76	Sand	579.7	to	578.2	NM	NM	16.41	581.35
JCW-MW-15028	589.64	Sand	567.7	to	564.7	NM	NM	7.08	582.56
JCW Landfill									
JCW-MW-18001	596.73	Sand and Sandy Clay	578.3	to	573.3	16.19	580.54	16.85	579.88
JCW-MW-18004	593.04	Sandy Clay	583.9	to	578.9	11.70	581.34	11.78	581.26
JCW-MW-18005	590.89	Sand and Sandy Clay	580.0	to	575.0	10.99	579.90	10.98	579.91
JCW-MW-18006	600.72	Fly Ash and Sandy Clay	582.8	to	577.8	14.90	585.82	14.79	585.93
MW-50	593.36	Sand	577.8	to	574.8	12.85	580.51	13.41	579.95
MW-51	594.29	Sand and Clay	577.8	to	574.8	13.74	580.55	13.96	580.33
MW-52	594.90	Sand	579.3	to	576.3	14.34	580.56	14.72	580.18
MW-53	593.68	Sand and Clay	579.1	to	576.1	13.20	580.48	13.72	579.96
MW-53R	594.25	Sand and Clay	580.4	to	575.4	13.65	580.60	14.36	579.89
MW-54R	593.89	Clay and Sand	581.3	to	576.3	13.24	580.65	13.89	580.00
MW-55	593.82	Sand	581.5	to	578.5	13.30	580.52	13.52	580.30
OW-57ROUT	591.00	Sandy Clay	577.0	to	572.0	NI	NI	10.19	580.81

Notes:

Survey data from: Rowe Professional Services Company (Nov. 2015) and Consumers Energy Company drawings: SG-21733, Sheet 1, Rev. G (Karn, 11/27/18); and SG-21733, Sheet 2, Rev. C (Weadock, 11/27/18).

Elevation in feet relative to North American Vertical Datum 1988 (NAVD 88).

TOC: Top of well casing.

ft BTOC: Feet below top of well casing.

NI: Not Installed; NM: Not Measured; NR: Not Recorded

Table 1
Summary of Groundwater Elevation Data
DE Karn and JC Weadock – RCRA CCR Monitoring Program
Essexville, Michigan

Well Location	TOC Elevation (ft)	Geologic Unit of Screen Interval	Screen Interval Elevation (ft)			October 22, 2018		November 5, 2018	
						Depth to Water (ft BTOC)	Groundwater Elevation (ft)	Depth to Water (ft BTOC)	Groundwater Elevation (ft)
JCW Landfill (water level only)									
JCW-OW-18001	595.84	Fly Ash and Sand	581.1	to	576.1	9.37	586.47	NM	NM
JCW-OW-18002	593.63	Sand	578.9	to	573.9	12.09	581.54	NM	NM
JCW-OW-18003	593.99	Sand and Clay	580.5	to	575.5	13.00	580.99	NM	NM
JCW-OW-18004	594.19	Sandy Clay	584.6	to	579.6	8.40	585.79	NM	NM
JCW-OW-18006	600.61	Fly Ash and Clay with Sand	582.9	to	577.9	12.29	588.32	NM	NM
MW-20	592.73	NR	~581.1	to	~578.1	8.38	584.35	NM	NM
OW-51	593.62	Clay and Sand	578.9	to	575.9	12.84	580.78	NM	NM
OW-53	593.64	Clay and Sand	579.0	to	576.0	12.86	580.78	NM	NM
OW-54	594.10	Clay and Sand	580.0	to	577.0	10.05	584.05	NM	NM
OW-55	594.67	Clay (or Sand and Clay)	580.9	to	577.9	8.48	586.19	NM	NM
OW-56R	592.01	Ash and Sand	577.5	to	572.5	NI	NI	NM	NM
OW-57R IN	590.86	Sandy Clay	575.7	to	570.7	NI	NI	NM	NM
OW-61	612.37	Ash and Sand	588.0	to	585.0	23.90	588.47	NM	NM
OW-63	612.53	Ash and Sand	594.2	to	591.2	27.40	585.13	NM	NM
OW-64	593.37	Ash and Sand	576.4	to	573.4	11.70	581.67	NM	NM
JCW Leachate Headwells									
LH-103	603.49	Fly Ash	30.2	to	33.2	19.62	583.87	NM	NM
LH-104	596.56	Fly Ash	8.0	to	11.0	9.84	586.72	NM	NM

Notes:

Survey data from: Rowe Professional Services Company (Nov. 2015) and Consumers Energy Company drawings: SG-21733, Sheet 1, Rev. G (Karn, 11/27/18); and SG-21733, Sheet 2, Rev. C (Weadock, 11/27/18).

Elevation in feet relative to North American Vertical Datum 1988 (NAVD 88).

TOC: Top of well casing.

ft BTOC: Feet below top of well casing.

NI: Not Installed; NM: Not Measured; NR: Not Recorded

Table 2
Summary of Field Parameter Results – November 2018
JC Weadock Bottom Ash Pond – RCRA CCR Monitoring Program
Essexville, Michigan

Sample Location	Sample Date	Dissolved Oxygen (mg/L)	Oxidation Reduction Potential (mV)	pH (SU)	Specific Conductivity (umhos/cm)	Temperature (°C)	Turbidity (NTU)
Background							
MW-15002	11/8/2018	0.19	-54.3	7.3	1,755	13.13	4.42
MW-15008	11/8/2018	0.23	9.2	6.8	1,216	12.97	6.25
MW-15016	11/8/2018	2.78	90.3	7.3	773	9.01	2.32
MW-15019	11/8/2018	0.26	-13.1	6.9	1,533	12.18	3.53
Bottom Ash Pond							
JCW-MW-15007	11/7/2018	0.19	-41.9	7.1	2,436	11.09	5.83
JCW-MW-15009	11/7/2018	0.24	71.6	4.8	2,106	13.61	8.14
JCW-MW-15010	11/7/2018	0.21	-97.5	7.4	611	12.72	2.15
JCW-MW-15028	11/7/2018	0.20	-13.8	7.9	1,295	12.19	1.60

Notes:

mg/L - Milligrams per Liter.

mV - Millivolts.

SU - Standard units.

umhos/cm - Micromhos per centimeter.

°C - Degrees Celsius

NTU - Nephelometric Turbidity Unit.

Table 3
Summary of Background Well Groundwater Sampling Results (Analytical): November 2018
DE Karn & JC Weadock – RCRA CCR Monitoring Program
Essexville, Michigan

					Sample Location:	**MW-15002**	**MW-15008**	**MW-15016**	**MW-15019**
					Sample Date:	11/8/2018	11/8/2018	11/8/2018	11/8/2018
Constituent	Unit	EPA MCL	MI Residential*	MI Non-Residential*	MI GSI^	Background			
Appendix III									
Boron	ug/L	NC	500	500	4,000	76.8	209	329	328
Calcium	mg/L	NC	NC	NC	500	88.5	129	171	142
Chloride	mg/L	**250****	**250**	**250**	**50**	**499**	**302**	**57.5**	**415**
Fluoride	ug/L	4,000	NC	NC	NC	< 1,000	< 1,000	< 1,000	< 1,000
Sulfate	mg/L	**250****	**250**	**250**	500	25.6	11.2	**347**	40.6
Total Dissolved Solids	mg/L	**500****	**500**	**500**	**500**	**1,230**	**882**	**806**	**1,080**
pH, Field	SU	6.5 - 8.5**	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	7.3	6.8	7.3	6.9
Appendix IV									
Antimony	ug/L	6	6.0	6.0	2.0	< 1.0	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	10	10	10	10	2.8	1.6	< 1.0	< 1.0
Barium	ug/L	2,000	2,000	2,000	1,200	290	71.4	31.3	281
Beryllium	ug/L	4	4.0	4.0	33	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	5	5.0	5.0	2.5	< 0.20	< 0.20	< 0.20	< 0.20
Chromium	ug/L	100	100	100	11	< 1.0	1.1	< 1.0	< 1.0
Cobalt	ug/L	NC	40	100	100	< 6.0	< 6.0	< 6.0	< 6.0
Fluoride	ug/L	4,000	NC	NC	NC	< 1,000	< 1,000	< 1,000	< 1,000
Lead	ug/L	NC	4.0	4.0	14	< 1.0	< 1.0	< 1.0	< 1.0
Lithium	ug/L	NC	170	350	440	16	33	81	17
Mercury	ug/L	2	2.0	2.0	0.20#	< 0.20	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	NC	73	210	120	< 5.0	< 5.0	5.6	< 5.0
Radium-226	pCi/L	NC	NC	NC	NC	< 0.904	< 1.00	< 0.650	< 0.863
Radium-228	pCi/L	NC	NC	NC	NC	1.30	< 0.672	0.867	1.67
Radium-226/228	pCi/L	5	NC	NC	NC	1.90	< 1.67	< 1.25	2.04
Selenium	ug/L	50	50	50	5	< 1.0	< 1.0	2.2	< 1.0
Thallium	ug/L	2	2.0	2.0	2.0	< 2.0	< 2.0	< 2.0	< 2.0

Notes:

ug/L - micrograms per liter.

mg/L - milligrams per liter.

SU - standard units; pH is a field parameter.

pCi/L - picocuries per liter.

MCL - Maximum Contaminant Level, EPA Drinking Water Standards and Health Advisories, April 2012.

NC - no criteria.

* - Michigan Part 201 Generic Drinking Water Cleanup Criteria, December 30, 2013.

** - Secondary Maximum Contaminant Level (SMCL), EPA Secondary Drinking Water Regulations (SDWR) April 2012.

^ - Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria. Hardness-dependent criteria calculated using hardness of 258 mg CaCO3/L (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018) per footnote {G} of Michigan Part 201 criteria tables. Chromium GSI criterion based on hexavalent chromium per footnote {H}. GSI criterion is protective for surface water used as a drinking water source as described in footnote {X}. GSI criterion for chloride is 50 mg/L when the discharge is to the Great Lakes or connecting waters per footnote {FF}

- If detected above 0.20 ug/L, further evaluation of low-level mercury may be necessary to evaluate the GSI pathway per Michigan Part 201 and MDEQ policy and procedure 09-014 dated June 20, 2012.

BOLD value indicates an exceedance of one or more of the listed criteria.

RED value indicates an exceedance of the MCL.

All metals were analyzed as total unless otherwise specified.

Table 4
Summary of Groundwater Sampling Results (Analytical): November 2018
JC Weadock Bottom Ash Pond – RCRA CCR Monitoring Program
Essexville, Michigan

					Sample Location:	JCW-MW-15007	JCW-MW-15009	JCW-MW-15010	JCW-MW-15028
					Sample Date:	11/7/2018	11/7/2018	11/7/2018	11/7/2018
Constituent	Unit	EPA MCL	MI Residential*	MI Non-Residential*	MI GSI^	downgradient			
Appendix III									
Boron	ug/L	NC	**500**	**500**	4,000	**656**	422	**1,360**	**517**
Calcium	mg/L	NC	NC	NC	**500**	153	**589**	84.4	153
Chloride	mg/L	250**	**250**	**250**	**50**	**788**	**64.9**	**96.5**	**352**
Fluoride	ug/L	4,000	NC	NC	NC	< 1,000	< 1,000	< 1,000	< 1,000
Sulfate	mg/L	250**	**250**	**250**	**500**	23.9	**1,980**	22.3	111
Total Dissolved Solids	mg/L	500**	**500**	**500**	**500**	**1,790**	**2,620**	492	**976**
pH, Field	SU	**6.5 - 8.5****	**6.5 - 8.5**	**6.5 - 8.5**	**6.5 - 9.0**	7.1	**4.8**	7.4	7.9
Appendix IV									
Antimony	ug/L	6	6.0	6.0	2.0	< 1.0	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	**10**	**10**	**10**	**10**	**46.3**	< 5.0	9.5	< 1.0
Barium	ug/L	2,000	2,000	2,000	1,200	1,060	14.8	114	156
Beryllium	ug/L	**4**	**4.0**	**4.0**	33	< 1.0	**6.6**	< 1.0	< 1.0
Cadmium	ug/L	5	5.0	5.0	2.5	< 1.0	< 1.0	< 0.20	< 0.20
Chromium	ug/L	100	100	100	11	< 5.0	< 5.0	1.2	< 1.0
Cobalt	ug/L	NC	40	100	100	< 30.0	< 30.0	< 6.0	< 6.0
Fluoride	ug/L	4,000	NC	NC	NC	< 1,000	< 1,000	< 1,000	< 1,000
Lead	ug/L	NC	4.0	4.0	14	< 5.0 (1)	< 5.0 (1)	< 1.0	< 1.0
Lithium	ug/L	NC	**170**	350	440	87	**240**	70	51
Mercury	ug/L	2	2.0	2.0	0.20#	< 0.20	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	NC	73	210	120	< 25.0	< 25.0	< 5.0	< 5.0
Radium-226	pCi/L	NC	NC	NC	NC	1.33	< 0.803	< 0.879	1.13
Radium-228	pCi/L	NC	NC	NC	NC	0.975	1.25	< 0.776	< 0.685
Radium-226/228	pCi/L	5	NC	NC	NC	2.31	< 1.54	< 1.66	1.60
Selenium	ug/L	50	50	50	5	< 1.0	< 5.0	< 1.0	< 1.0
Thallium	ug/L	2	2.0	2.0	2.0	< 10.0 (1)	< 10.0 (1)	< 2.0	< 2.0

Notes:

ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units; pH is a field parameter.
pCi/L - picocuries per liter.
MCL - Maximum Contaminant Level, EPA Drinking Water Standards and Health Advisories, April 2012.
NC - no criteria.
* - Michigan Part 201 Generic Drinking Water Cleanup Criteria, December 30, 2013.
** - Secondary Maximum Contaminant Level (SMCL), EPA Secondary Drinking Water Regulations (SDWR) April 2012.
^ - Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria. Hardness-dependent criteria calculated using hardness of 258 mg CaCO3/L (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018) per footnote {G} of Michigan Part 201 criteria tables. Chromium GSI criterion based on hexavalent chromium per footnote {H}. GSI criterion is protective for surface water used as a drinking water source as described in footnote {X}. GSI criterion for chloride is 50 mg/L when the discharge is to the Great Lakes or connecting waters per footnote {FF}
# - If detected above 0.20 ug/L, further evaluation of low-level mercury may be necessary to evaluate the GSI pathway per Michigan Part 201 and MDEQ policy and procedure 09-014 dated June 20, 2012.
BOLD value indicates an exceedance of one or more of the listed criteria.
RED value indicates an exceedance of the MCL.
All metals were analyzed as total unless otherwise specified.
(1) Laboratory reporting limit exceeds one or more applicable criteria due to sample dilutions performed as a result of sample matrix interferences.

Table 5
Summary of Groundwater Protection Standard Exceedances – November 2018
JC Weadock Bottom Ash Pond – RCRA CCR Monitoring Program
Essexville, Michigan

Constituent	Units	GWPS	JCW-MW-15007		JCW-MW-15009		JCW-MW-15010	
			LCL	UCL	LCL	UCL	LCL	UCL
Arsenic	ug/L	21	18	46	NA	NA	11	30
Beryllium	ug/L	4	NA	NA	6.5	19	NA	NA
Cobalt	ug/L	15	NA	NA	15	30	NA	NA
Lithium	ug/L	180	NA	NA	190	280	NA	NA

Notes:

ug/L - micrograms per Liter.

NA - Not Applicable; well/parameter pair did not directly exceed the GWPS and was not included in further analysis.

GWPS - Groundwater Protection Standard as established in TRC's Technical Memorandum dated October 15, 2018.

UCL - Upper Confidence Limit (α = 0.01) of the downgradient data set.

LCL - Lower Confidence Limit (α = 0.01) of the downgradient data set.

Indicates a statistically significant exceedance of the GWPS. An exceedance occurs when the LCL is greater than the GWPS.

Figures

LEGEND

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

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).

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:	J. KRENZ		
APPROVED BY:	D. LITZ		**FIGURE 1**
DATE:	MARCH 2019		

TRC

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FILE NO.: 290805-001-023.mxd

TRC - GIS
Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl (Foot)
Map Rotation: 0
Plot Date: 3/14/2019, 09:32:21 AM by SMAJOR -- LAYOUT: ANSI B(11"x17")
Path: E:\ConsumersEnergy\CCR GW\2017 269767\290805-001-023.mxd

TRC - GIS

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

Plot Date: 3/14/2019, 09:51:54 AM by SMAJOR -- LAYOUT: ANSI B(11"x17")
Path: E:\Consumers Energy\CCR GW\2017 269767\290805-001-022.mxd

Lake Huron

INTAKE CHANNEL
BOTTOM ASH POND
DE KARN GENERATING FACILITY
KARN LINED IMPOUNDMENT
DISCHARGE CHANNEL
BOTTOM ASH POND
GAUGING STATION (580.06)
JC WEADOCK GENERATING FACILITY
SLURRY WALL
LANDFILL
TACEY DRAIN
UNDERWOOD DRAIN
Saginaw River

DEK-MW-15004 (585.59)
DEK-MW-15003 (587.03)
OW-11 (587.50)
DEK-MW-15005 (580.19)
OW-12 (586.47)
DEK-MW-15006 (580.15)
DEK-MW-15002 (585.02)
DEK-MW-18001 (585.34)
OW-10 (585.40)
JCW-MW-15010 (581.35)
JCW-MW-15009 (581.24)
JCW-MW-15028 (582.56)
JCW-MW-15007 (583.62)
JCW-MW-18006 (585.93)
JCW-OW-18006 (588.32) (NOTE 4)
MW-15008 (580.81)
MW-15019 (580.89)
MW-15002 (581.00)
MW-15016 (582.55)
JCW-MW-18001 (579.88)
JCW-OW-18001 (585.13) (586.47) (NOTE 4)
OW-63 (NOTE 4)
LH-103 (583.87) (NOTE 4)
OW-61 (588.47) (NOTE 4)
OW-57RIN (NM)
OW-57ROUT (580.81)
OW-56R (NM)
MW-50 (579.95)
MW-51 (580.33)
MW-52 (580.18)
JCW-OW-18002 (581.54) (NOTE 4)
OW-51 (580.78) (NOTE 4)
JCW-OW-18003 (580.99) (NOTE 4)
OW-64 (581.67) (NOTE 4)
OW-53 (580.78) (NOTE 4)
MW-53 (579.96)
MW-53R (579.89)
OW-54 (584.05) (NOTE 4)
MW-54R (580.00)
JCW-OW-18004 (585.79) (NOTE 4)
JCW-MW-18004 (581.26)
MW-20 (584.35) (NOTE 4)
OW-55 (586.19) (NOTE 4)
LH-104 (586.72) (NOTE 4)
JCW-MW-18005 (579.91)
MW-55 (580.30)

583.0
581.0
587.0
585.0
588.0
586.0
584.0
582.0

LEGEND

- BACKGROUND MONITORING WELL
- DEK BOTTOM ASH POND & LINED IMPOUNDMENT MONITORING WELL
- DEK BOTTOM ASH POND MONITORING WELL
- DEK LINED IMPOUNDMENT MONITORING WELL
- JCW BOTTOM ASH POND MONITORING WELL
- JCW LANDFILL CCR WELL
- MONITORING WELL (STATIC WATER LEVEL ONLY)
- LEACHATE HEADWELL
- SURFACE WATER GAUGING STATION
- 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 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. GROUNDWATER ELEVATION DATA RECORDED OCTOBER 22, 2018.
5. GROUNDWATER ELEVATIONS DISPLAYED IN FEET RELATIVE TO THE NORTH AMERICAN VERTICAL DATUM OF 1988.

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 NOVEMBER 2018

DRAWN BY:	S. MAJOR	PROJ NO.:	322173-001
CHECKED BY:	J. KRENZ		
APPROVED BY:	D. LITZ		**FIGURE 2**
DATE:	MARCH 2019		

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FILE NO.: 290805-001-022.mxd

Attachment A
Data Quality Reviews

Laboratory Data Quality Review
Groundwater Monitoring Event November 2018
JC Weadock/Karn Background

Groundwater samples were collected by TRC for the November 2018 sampling event. Samples were analyzed for anions, alkalinity, total dissolved solids, and total metals by Pace Analytical Services, LLC (Pace), located in Grand Rapids, Michigan, and for radium by Pace located in Greensburg, Pennsylvania. The antimony, selenium, and vanadium analyses were subcontracted by Pace in Grand Rapids, MI to the Pace facility in Indianapolis, Indiana. The laboratory analytical results are reported in laboratory reports 4620177 and 4620182.

During the November 2018 sampling event, a groundwater sample was collected from each of the following wells:

- MW-15002
- MW-15008
- MW-15016
- MW-15019

Each sample was analyzed for the following constituents:

Analyte Group	Method
Anions (Fluoride, Chloride, Sulfate)	EPA 300.0
Alkalinity	SM 2320B-11
Total Dissolved Solids (TDS)	SM 2540C-11
Total Metals	SW-846 6020A, SW-846 6010C, SW-846 7470A
Radium (Radium-226, Radium-228, Total Radium)	EPA 903.1, EPA 904.0

TRC reviewed the laboratory data to assess data usability. The following sections summarize the data review procedure and the results of the review.

Data Usability Review Procedure

The analytical data were reviewed using the USEPA National Functional Guidelines for Inorganic Superfund Methods Data Review (USEPA, 2017) and the Department of Energy Evaluation of Radiochemical Data Usability (USDOE, 1997). The following items were included in the evaluation of the data:

- Sample receipt;
- Technical holding times for analyses;
- Reporting limits (RLs) compared to project-required RLs;

- Data for method blanks, equipment blanks, and field blanks. Method blanks are used to assess potential contamination arising from laboratory sample preparation and/or analytical procedures. Field and equipment blanks are used to assess potential contamination arising from field procedures;
- Data for laboratory control samples (LCSs). The LCSs are used to assess the accuracy of the analytical method using a clean matrix;
- Percent recoveries for matrix spike (MS) and matrix spike duplicates (MSD), when performed on project samples. Percent recoveries are calculated for each analyte spiked and used to assess bias due to sample matrix effects;
- Data for laboratory duplicates, when performed on project samples. The laboratory duplicates are replicate analyses of one sample and are used to assess the precision of the analytical method;
- Percent recoveries for tracer and carriers, where applicable, for radiochemistry only. Tracers and/or carriers are used to assess the chemical yield for the preparation and/or instrument efficiency;
- Data for blind field duplicates. Field duplicate samples are used to assess variability introduced by the sampling and analytical processes; and
- Overall usability of the data.

This data usability report addresses the following items:

- Usability of the data if quality control (QC) results suggest potential problems with all or some of the data;
- Actions regarding specific QC criteria exceedances.

Review Summary

The data quality objectives and laboratory completeness goals for the project were met, and the data are usable for their intended purpose. A summary of the data quality review, including non-conformances and issues identified in this evaluation, are noted below.

- Appendix III and IV constituents as well as iron, copper, nickel, silver, vanadium, and zinc will be utilized for the purposes of an assessment monitoring program.
- Data are usable for the purposes of the assessment monitoring program.
- When the data are evaluated through an assessment monitoring statistical program, findings below may be used to support the removal of outliers.

QA/QC Sample Summary:

- A method blank was analyzed with each analytical batch; no analytes were detected in the method blank samples.

- One field blank (FB-01) was collected; no analytes were detected in this blank sample.
- The LCS recoveries for all analytes were within QC limits.
- MS and/or MSD analyses were not performed on any samples in this data set.
- The field duplicate pair samples were Dup-01 and MW-15016; relative percent differences (RPDs) between the parent and duplicate sample were within the QC limits for all analytes except iron (RPD=30.5%; >30%). Potential variability exists for the results for iron in all groundwater samples in this data set due to field duplicate variability, as summarized in the attached table, Attachment A.
- Laboratory duplicate analysis was performed on sample MW-15008_20181108 for TDS. The RPD was within laboratory control limit.
- Carrier and tracer recoveries, where applicable, were within 30-110%.

Laboratory Data Quality Review
Groundwater Monitoring Event November 2018
JC Weadock Bottom Ash Pond

Groundwater samples were collected by TRC for the November 2018 sampling event. Samples were analyzed for anions, alkalinity, total dissolved solids, and total metals by Pace Analytical Services, LLC (Pace), located in Grand Rapids, Michigan, and for radium by Pace located in Greensburg, Pennsylvania. The antimony, selenium, and vanadium analyses were subcontracted by Pace in Grand Rapids, MI to the Pace facility in Indianapolis, Indiana. The laboratory analytical results are reported in laboratory reports 4620174 and 4620179.

During the November 2018 sampling event, a groundwater sample was collected from each of the following wells:

- JCW-MW-15007
- JCW-MW-15009
- JCW-MW-15010
- JCW-MW-15028

Each sample was analyzed for one or more of the following constituents:

Analyte Group	Method
Anions (Fluoride, Chloride, Sulfate)	EPA 300.0
Alkalinity	SM 2320B-11
Total Dissolved Solids (TDS)	SM 2540C-11
Total Metals	SW-846 6020A, SW-846 6010C, SW-846 7470A
Radium (Radium-226, Radium-228, Total Radium)	EPA 903.1, EPA 904.0

TRC reviewed the laboratory data to assess data usability. The following sections summarize the data review procedure and the results of the review.

Data Usability Review Procedure

The analytical data were reviewed using the USEPA National Functional Guidelines for Inorganic Superfund Methods Data Review (USEPA, 2017) and the Department of Energy Evaluation of Radiochemical Data Usability (USDOE, 1997). The following items were included in the evaluation of the data:

- Sample receipt;
- Technical holding times for analyses;
- Reporting limits (RLs) compared to project-required RLs;

- Data for method blanks, equipment blanks, and field blanks. Method blanks are used to assess potential contamination arising from laboratory sample preparation and/or analytical procedures. Field and equipment blanks are used to assess potential contamination arising from field procedures;
- Data for laboratory control samples (LCSs). The LCSs are used to assess the accuracy of the analytical method using a clean matrix;
- Percent recoveries for matrix spike (MS) and matrix spike duplicates (MSD), when performed on project samples. Percent recoveries are calculated for each analyte spiked and used to assess bias due to sample matrix effects;
- Data for laboratory duplicates, when performed on project samples. The laboratory duplicates are replicate analyses of one sample and are used to assess the precision of the analytical method;
- Percent recoveries for tracer and carriers, where applicable, for radiochemistry only. Tracers and/or carriers are used to assess the chemical yield for the preparation and/or instrument efficiency;
- Data for blind field duplicates. Field duplicate samples are used to assess variability introduced by the sampling and analytical processes; and
- Overall usability of the data.

This data usability report addresses the following items:

- Usability of the data if quality control (QC) results suggest potential problems with all or some of the data;
- Actions regarding specific QC criteria exceedances.

Review Summary

The data quality objectives and laboratory completeness goals for the project were met, and the data are usable for their intended purpose. A summary of the data quality review, including non-conformances and issues identified in this evaluation, are noted below.

- Appendix III and IV constituents as well as iron, copper, nickel, silver, vanadium, and zinc will be utilized for the purposes of an assessment monitoring program.
- Data are usable for the purposes of the assessment monitoring program.
- When the data are evaluated through an assessment monitoring statistical program, findings below may be used to support the removal of outliers.

QA/QC Sample Summary:

- A method blank was analyzed with each analytical batch; no analytes were detected in the method blank samples.

- One equipment blank (EB-01) and one field blank (FB-02) were collected; no analytes were detected in these blank samples.
- The LCS recoveries for all analytes were within QC limits.
- MS and/or MSD analyses were performed on sample JCW-MW-15009 for anions, mercury, alkalinity, radium, and metals. All recoveries and relative percent differences (RPDs) were within the QC limits with the following exception.
  - The recoveries of iron, calcium, and sulfate were outside of the acceptance criteria. The iron and calcium concentrations in sample JCW-MW-15009 were >4x the spike concentration and the MS/MSD analyses for sulfate were diluted 50-fold; therefore, the MS/MSD results for iron, calcium, and sulfate were not evaluated. Data usability was not affected.
- The field duplicate pair samples were Dup-02 and JCW-MW-15028; RPDs between the parent and duplicate sample were within the QC limits.
- Laboratory duplicate analyses were performed on sample JCW-MW-15009 for anions, alkalinity, and TDS; RPDs were within QC limits.
- Select nondetect 6020A metals results were reported from 5-fold dilutions for samples JCW-MW-15007 and JCW-MW-15009 due to matrix-related internal standard failures in the undiluted analyses. Per method requirements, the laboratory analyzed these samples at a dilution; thus, RLs were adjusted accordingly and may be above project action limits in these samples.
- Carrier and tracer recoveries, where applicable, were within 30-110%.

Attachment A
Summary of Data Non-Conformances for Groundwater Analytical Data
JC Weadock/Karn Background – RCRA CCR Monitoring Program
Essexville, Michigan

Samples	Collection Date	Analyte	Non-Conformance/Issue
Dup-01_20181108	11/8/2018	Iron	RPD for the field duplicate pair slightly exceeded 30% (RPD = 30.5%). Potential uncertainty exists for iron results due to the field duplicate variability.
MW-15002_20181108	11/8/2018		
MW-15008_20181108	11/8/2018		
MW-15019_20181108	11/8/2018		
MW-15016_20181108	11/8/2018		

Attachment B
Statistical Evaluation of November 2018 Assessment Monitoring Sampling Event

Technical Memorandum

Date:	March 14, 2019
To:	J.R. Register, CEC
cc:	Brad Runkel, CEC Bethany Swanberg, CEC
From:	Darby Litz, TRC Sarah Holmstrom, TRC Kristin Lowery, TRC
Project No.:	290805.0000 Phase 001, Task 002
Subject:	Statistical Evaluation of November 2018 Assessment Monitoring Sampling Event JC Weadock Bottom Ash Pond, Consumers Energy Company, Essexville, Michigan

During the statistical evaluation of the initial assessment monitoring event, beryllium and lithium were present in one or more downgradient monitoring wells at statistically significant levels exceeding the Groundwater Protection Standards (GWPSs). Therefore, Consumers Energy Company (CEC) will initiate an Assessment of Corrective Measures (ACM) within 90 days from when the Appendix IV exceedance was determined (no later than April 14, 2019). Currently, CEC is continuing semiannual assessment monitoring in accordance with §257.95 of the CCR Rule[1] at the JC Weadock Power Plant (JCW) Bottom Ash Pond (BAP). The second semiannual assessment monitoring event for 2018 was conducted on November 5 through November 8, 2018. In accordance with §257.95, the assessment monitoring data must be compared to GWPSs to determine whether or not Appendix IV constituents are detected at statistically significant levels above the GWPSs. GWPSs were established in accordance with §257.95(h), as detailed in the October 15, 2018 *Groundwater Protection Standards* technical memorandum, which was also included in the *2018 Annual Groundwater Monitoring Report* (TRC, January 2019). The following narrative describes the methods employed and the results obtained and the Sanitas™ output files are included as an attachment.

[1] USEPA final rule for the regulation and management of Coal Combustion Residuals (CCR) under the Resource Conservation and Recovery Act (RCRA) published April 17, 2015, as amended per Phase One, Part One of the CCR Rule (83 FR 36435).

The statistical evaluation of the second semiannual assessment monitoring event data indicate the following constituent(s) are present at statistically significant levels exceeding the GWPS in downgradient monitoring wells at the JCW BAP:

Constituent	GWPS	#Downgradient Wells Observed
Beryllium	4 ug/L	1 of 4
Lithium	180 ug/L	1 of 4

These results are consistent with the results of the initial assessment monitoring data statistical evaluation and CEC will continue to initiate an assessment of corrective measures per §257.95(g). CEC will continue executing the self-implementing groundwater compliance schedule in conformance with §257.90 - §257.98.

Assessment Monitoring Statistical Evaluation

The four downgradient wells (JCW-MW-15007, JCW-MW-15009, JCW-MW-15010, and JCW-MW-15028) are located in accessible areas along the downgradient perimeter of the JCW BAP CCR Unit. Following the second semiannual assessment monitoring sampling event, compliance well data for the JCW BAP CCR unit were evaluated in accordance with the *Groundwater Statistical Evaluation Plan* (Stats Plan) (TRC, October 2017).

An assessment monitoring program was developed to evaluate concentrations of CCR constituents present in the uppermost aquifer relative to acceptable levels (i.e. GWPSs). In order to decide as to whether or not the GWPSs have been exceeded, the change in concentration observed at the downgradient wells during a given assessment monitoring event must be large enough, after accounting for variability in the sample data, that the result is unlikely to have occurred merely by chance. Consistent with the Unified Guidance[2], the preferred method for comparisons to a fixed standard are confidence limits. Based on the number of historical observations in the representative sample population, the population mean, the population standard deviation, and a selected confidence level (i.e., 99 percent), an upper and lower confidence limit is calculated. The true concentration, with 99 percent confidence, will fall between the lower and upper confidence limits.

The concentrations observed in the downgradient wells are deemed to be a statistically significant exceedance when the 99 percent lower confidence limit of the downgradient data exceeds the GWPS. If the confidence interval straddles the GWPS (i.e., the lower confidence level is below the GWPS, but the upper confidence level is above), the statistical test results are inconclusive and there is not compelling evidence that the measured concentration is a result of a release from the CCR unit versus

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

the inherent variability of the sample data. This statistical approach is consistent with the statistical methods for assessment monitoring presented in §257.93(f) and (g). Statistical evaluation methodologies built into the CCR Rule, and numerous other federal rules, are key in determining whether or not individually measured data points represent a concentration increase over the baseline or a fixed standard (such as a GWPS in an assessment monitoring program).

For each detected Appendix IV constituent, the concentrations from each well were first compared directly to the GWPS, as shown on Table A1. Parameter-well combinations that included a direct exceedance of the GWPS within the past eight sampling events (August 2016 through November 2018) were retained for further analysis. Arsenic in JCW-MW-15007 and JCW-MW-15010, beryllium in JCW-MW-15009, and lithium in JCW-MW-15009 had individual results exceeding their respective GWPSs within this time period. In JCW-MW-15007 and JCW-MW-15009, cobalt and thallium reporting limits exceeded the GWPSs in November 2018 due to sample dilutions performed due to sample matrix interferences during analysis. With the exception of cobalt at JCW-MW-15009, cobalt and thallium have historically been non-detect at these locations. Therefore, the elevated reporting limits are treated as an outlier and no statistical evaluation will be completed for these parameter-well combinations. Cobalt in JCW-MW-15009 did not have a detected direct exceedance of the GWPS within the past eight sampling events; however, the reporting limit was above the GWPS in November 2018 and cobalt was detected above the GWPS in December 2015 and May 2016. Therefore, to be conservative, cobalt at JCW-MW-15009 was retained for further evaluation.

Groundwater data were then evaluated utilizing Sanitas™ statistical software. Sanitas™ is a software tool that is commercially available for performing statistical evaluation consistent with procedures outlined in the Unified Guidance. Within the Sanitas™ statistical program, confidence limits were selected to perform the statistical comparison of compliance data to a fixed standard. Parametric and non-parametric confidence intervals, as appropriate, were calculated for each of the CCR Appendix IV parameters using a 99 percent confidence level, i.e., a significance level (α) of 0.01. The following narrative describes the methods employed, the results obtained and the Sanitas™ output files are included as an attachment.

The statistical data evaluation included the following steps:

- Review of data quality checklists for the data sets;
- Graphical representation of the monitoring data as time versus concentration by well/constituent pair;
- Outlier testing of individual data points that appear from the graphical representations as potential outliers;
- Evaluation of visual trends apparent in the graphical representations for statistical significance;
- Evaluation of percentage of non-detects for each well/constituent (w/c) pair;

- Distribution of the data; and
- Calculation of the confidence intervals for each cumulative dataset.

The results of these evaluations are presented and discussed below.

Initially, the baseline (December 2015 through August 2017) results and the assessment monitoring results (April through November 2018) were observed visually for potential trends. No trends or outliers were identified. Data from each round were evaluated for completeness, overall quality, and usability and were deemed appropriate for the purposes of the CCR assessment monitoring program. The Sanitas™ software was then used to test compliance at the downgradient monitoring wells using the confidence interval method for the most recent 8 sampling events. Eight independent sampling events provide the appropriate density of data as recommended per the Unified Guidance, yet are collected recently enough to provide an indication of current condition. The tests were run with a per-well significance of $\alpha = 0.01$. The software outputs are included in Attachment 1 along with data reports showing the values used for the evaluation. The percentage of non-detect observations are also included in Attachment 1. Non-detect data was handled in accordance with the Stats Plan for the purposes of calculating the confidence intervals.

The Sanitas™ software generates an output that includes graphs of the parametric or non-parametric confidence intervals for each well along with notes data transformations, as appropriate. In each case, the data sets were found to be normally distributed except for beryllium and cobalt in JCW-MW-15009, for which non-parametric confidence intervals were calculated. The confidence interval test compares the lower confidence limit to the GWPS. The statistical evaluation of the Appendix IV parameters shows exceedances for beryllium and lithium at JCW-MW-15009. These results are consistent with the results of the initial assessment monitoring data statistical evaluation and CEC will continue to initiate an assessment of corrective measures per §257.95(g). CEC will continue executing the self-implementing groundwater compliance schedule in conformance with §257.90 - §257.98.

Attachments

Table A1 Comparison of Groundwater Sampling Results to Groundwater Protection Standards – December 2015 to November 2018

Attachment 1 Sanitas™ Output Files

Table

Table A1
Comparison of Groundwater Sampling Results to Groundwater Protection Standards – December 2015 to November 2018
JC Weadock Bottom Ash Pond – RCRA CCR Monitoring Program
Essexville, Michigan

Sample Location:						JCW-MW-15007													
Sample Date:						12/9/2015	4/1/2016	5/24/2016	8/23/2016	12/1/2016	2/23/2017	5/17/2017	8/3/2017	8/3/2017	9/19/2017	9/19/2017	4/10/2018	5/23/2018	11/7/2018
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS	downgradient													
Appendix III														Field Dup		Field Dup			
Boron	ug/L	NC	NA	619	NA	296	163	238	547	439	270	263	< 20.0	345	384	479	--	308	656
Calcium	mg/L	NC	NA	302	NA	115	119	133	106	124	226	177	182	171	140	153	--	145	153
Chloride	mg/L	250*	NA	2,440	NA	763	1,220	990	333	521	1,720	1,570	1,870	1,830	1,340	1,370	--	1,660	788
Fluoride	ug/L	4,000	NA	1,000	NA	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Sulfate	mg/L	250*	NA	407	NA	48.3	20.1	21.0	30.5	26.3	20.9	22.9	34.5	34.6	8.8	9.2	--	19.6	23.9
Total Dissolved Solids	mg/L	500*	NA	4,600	NA	1,800	2,300	2,200	1,100	1,400	3,700	3,100	3,410	3,500	2,560	2,530	--	3,210	1,790
pH, Field	SU	6.5 - 8.5*	NA	6.5-7.3	NA	7.0	7.2	7.1	7.0	7.1	7.0	7.2	6.8	--	7.1	--	7.1	7.2	7.1
Appendix IV																			
Antimony	ug/L	6	NA	1	6	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1.0	--	--	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	10	NA	21	**21**	13	15	20	**55**	**37**	**26**	**23**	< 1.0	**48.6**	--	--	16.7	**25.6**	**46.3**
Barium	ug/L	2,000	NA	1,300	2,000	392	443	472	733	821	1,150	719	< 1.0	934	--	--	957	941	1,060
Beryllium	ug/L	4	NA	1	**4**	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1.0	--	--	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	5	NA	0.2	5	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	< 0.20	--	--	< 0.20	< 0.20	< 1.0
Chromium	ug/L	100	NA	3	100	< 1	1	1	< 1	1	2	1	< 1.0	< 1.0	--	--	< 1.0	< 1.0	< 5.0
Cobalt	ug/L	NC	6	15	**15**	< 15	< 15	< 15	< 15	< 15	< 15	< 15	< 15.0	< 15.0	--	--	< 15.0	< 15.0	< 30.0 (1)
Fluoride	ug/L	4,000	NA	1,000	4,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Lead	ug/L	NC	15	1	15	< 1	< 1	< 1	3	< 1	< 1	< 1	< 1.0	< 1.0	--	--	< 1.0	< 1.0	< 5.0
Lithium	ug/L	NC	40	180	**180**	50	52.3	61	65	61	77	75	100	97	--	--	80	88	87
Mercury	ug/L	2	NA	0.2	2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	< 0.20	--	--	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	NC	100	6	100	20	8	8	10	10	9	7	< 5.0	< 5.0	--	--	6.4	7.6	< 25.0
Radium-226	pCi/L	NC	NA	NA	NA	0.380	0.467	0.700	0.355	0.365	1.08	0.476	1.82	1.23	--	--	0.878	0.239	1.33
Radium-228	pCi/L	NC	NA	NA	NA	0.872	0.786	0.997	1.11	0.893	1.53	1.32	1.07	< 0.671	--	--	0.761	0.795	0.975
Radium-226/228	pCi/L	5	NA	3.32	5	1.252	1.253	1.697	1.465	1.258	2.61	1.80	2.89	1.88	--	--	1.64	1.03	2.31
Selenium	ug/L	50	NA	2	50	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1.0	--	--	1.2	< 1.0	< 1.0
Thallium	ug/L	2	NA	2	2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2.0	< 2.0	--	--	< 2.0	< 2.0	< 10.0 (1)

Notes:

ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units; pH is a field parameter.
pCi/L - picocuries per liter.
NA - not applicable.
NC - no criteria.
-- - not analyzed.
MCL - Maximum Contaminant Level, EPA Drinking Water Standards and Health Advisories, April 2012.
RSL - Regional Screening Level from 83 FR 36435.
UTL - Upper Tolerance Limit (95%) of the background data set.
GWPS - Groundwater Protection Standard. GWPS is the higher of the MCL/RSL and UTL as established in TRC's Technical Memorandum dated October 15, 2018.
* - Secondary Maximum Contaminant Level (SMCL), EPA Secondary Drinking Water Regulations (SDWR) April 2012.
Bold value indicates an exceedance of the GWPS. Data from downgradient monitoring wells are screened against the GWPS for evaluation purposes only. Confidence intervals will be used to determine compliance per the CCR rules.
All metals were analyzed as total unless otherwise specified.
(1) Laboratory reporting limit exceeds GWPS due to sample dilutions performed as a result of sample matrix interferences.

Table A1
Comparison of Groundwater Sampling Results to Groundwater Protection Standards – December 2015 to November 2018
JC Weadock Bottom Ash Pond – RCRA CCR Monitoring Program
Essexville, Michigan

						Sample Location:	JCW-MW-15009											
						Sample Date:	12/9/2015	3/31/2016	5/25/2016	8/23/2016	12/1/2016	2/23/2017	5/18/2017	8/2/2017	9/18/2017	4/10/2018	5/23/2018	11/7/2018
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS		downgradient											
Appendix III																		
Boron	ug/L	NC	NA	619	NA		546	284	402	501	498	366	329	429	533	--	297	422
Calcium	mg/L	NC	NA	302	NA		520	526	546	622	549	618	558	554	470	--	530	589
Chloride	mg/L	250*	NA	2,440	NA		189	97.4	163	171	154	95.5	52.6	84.8	113	--	41.0	64.9
Fluoride	ug/L	4,000	NA	1,000	NA		< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Sulfate	mg/L	250*	NA	407	NA		2,520	1,790	2,650	2,030	2,280	1,880	1,710	2,680	3,090	--	1,690	1,980
Total Dissolved Solids	mg/L	500*	NA	4,600	NA		1,700	2,800	1,800	3,300	3,200	2,700	2,600	2,590	3,020	--	2,510	2,620
pH, Field	SU	6.5 - 8.5*	NA	6.5-7.3	NA		4.1	4.8	4.1	4.2	4.1	4.6	4.7	4.6	4.6	4.7	4.9	4.8
Appendix IV																		
Antimony	ug/L	6	NA	1	6		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	10	NA	21	**21**		2	< 1	2	< 1	< 1	< 1	< 1	< 1.0	--	1.6	1.4	< 5.0
Barium	ug/L	2,000	NA	1,300	2,000		20	17	14	23	18	15	15	16.6	--	12.3	14.4	14.8
Beryllium	ug/L	4	NA	1	**4**		**27**	**9**	**20**	**17**	**19**	**11**	**7**	**7.4**	--	**7.1**	**6.5**	**6.6**
Cadmium	ug/L	5	NA	0.2	5		< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 1.0
Chromium	ug/L	100	NA	3	100		6	2	5	4	4	3	1	1.5	--	1.4	1.4	< 5.0
Cobalt	ug/L	NC	6	15	**15**		**22**	< 15	**21**	< 15	< 15	< 15	< 15	< 15.0	--	< 15.0	< 15.0	< 30.0 (1)
Fluoride	ug/L	4,000	NA	1,000	4,000		< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Lead	ug/L	NC	15	1	15		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 5.0
Lithium	ug/L	NC	40	180	**180**		**367**	139	**238**	**280**	**300**	**216**	**182**	**270**	--	**210**	**190**	**240**
Mercury	ug/L	2	NA	0.2	2		< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	NC	100	6	100		< 5	10	< 5	< 5	< 5	< 5	< 5	< 5.0	--	< 5.0	< 5.0	< 25.0
Radium-226	pCi/L	NC	NA	NA	NA		0.274	< 0.234	< 0.186	0.159	< 0.318	0.403	< 0.27	< 0.644	--	< 0.703	< 0.723	< 0.803
Radium-228	pCi/L	NC	NA	NA	NA		1.20	0.842	0.700	1.43	1.33	1.35	1.24	0.833	--	0.707	1.11	1.25
Radium-226/228	pCi/L	5	NA	3.32	5		1.474	1.069	0.683	1.589	1.608	1.753	1.31	< 1.39	--	< 1.37	< 1.37	< 1.54
Selenium	ug/L	50	NA	2	50		4	3	3	1	3	2	1	1.4	--	14.2	5.2	< 5.0
Thallium	ug/L	2	NA	2	2		< 2	< 2	2	< 2	< 2	< 2	< 2	< 2.0	--	< 2.0	< 2.0	< 10.0 (1)

Notes:

ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units; pH is a field parameter.
pCi/L - picocuries per liter.
NA - not applicable.
NC - no criteria.
-- - not analyzed.
MCL - Maximum Contaminant Level, EPA Drinking Water Standards and Health Advisories, April 2012.
RSL - Regional Screening Level from 83 FR 36435.
UTL - Upper Tolerance Limit (95%) of the background data set.
GWPS - Groundwater Protection Standard. GWPS is the higher of the MCL/RSL and UTL as established in TRC's Technical Memorandum dated October 15, 2018.
* - Secondary Maximum Contaminant Level (SMCL), EPA Secondary Drinking Water Regulations (SDWR) April 2012.
Bold value indicates an exceedance of the GWPS. Data from downgradient monitoring wells are screened against the GWPS for evaluation purposes only. Confidence intervals will be used to determine compliance per the CCR rules.
All metals were analyzed as total unless otherwise specified.
(1) Laboratory reporting limit exceeds GWPS due to sample dilutions performed as a result of sample matrix interferences.

Table A1
Comparison of Groundwater Sampling Results to Groundwater Protection Standards – December 2015 to November 2018
JC Weadock Bottom Ash Pond – RCRA CCR Monitoring Program
Essexville, Michigan

Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS	Sample Location: JCW-MW-15010												
						Sample Date: 12/10/2015	3/31/2016	5/25/2016	8/24/2016	12/1/2016	2/23/2017	5/17/2017	8/2/2017	9/19/2017	4/10/2018	5/22/2018	5/22/2018	11/7/2018
						downgradient												
Appendix III																	Field Dup	
Boron	ug/L	NC	NA	619	NA	1,220	987	1,070	1,320	1,370	1,360	1,390	1,580	1,340	--	1,330	1,220	1,360
Calcium	mg/L	NC	NA	302	NA	68.0	85.4	74.3	74.0	79.1	103	84.8	69.9	63.6	--	78.3	78.8	84.4
Chloride	mg/L	250*	NA	2,440	NA	83.6	87.8	81.5	78.1	92.8	88.8	89.8	92.7	89.5	--	99.8	99.7	96.5
Fluoride	ug/L	4,000	NA	1,000	NA	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	1,300	< 1,000	1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Sulfate	mg/L	250*	NA	407	NA	72.3	91.6	62.8	53.9	80.7	57.9	72.9	59.0	39.9	--	24.3	23.2	22.3
Total Dissolved Solids	mg/L	500*	NA	4,600	NA	430	500	440	400	490	460	480	832	392	--	458	486	492
pH, Field	SU	6.5 - 8.5*	NA	6.5-7.3	NA	7.7	7.4	7.4	7.6	7.5	7.3	7.5	7.5	7.5	7.3	7.5	--	7.4
Appendix IV																		
Antimony	ug/L	6	NA	1	6	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	10	NA	21	**21**	**22**	**39**	**25**	**34**	**27**	**25**	**23**	**23.2**	--	12.5	11.4	11.1	9.5
Barium	ug/L	2,000	NA	1,300	2,000	99	115	99	98	125	111	123	109	--	121	123	116	114
Beryllium	ug/L	4	NA	1	**4**	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	5	NA	0.2	5	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20	< 0.20
Chromium	ug/L	100	NA	3	100	< 1	1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	1.2
Cobalt	ug/L	NC	6	15	**15**	< 15	< 15	< 15	< 15	< 15	< 15	< 15	< 15.0	--	< 15.0	< 15.0	< 15.0	< 6.0
Fluoride	ug/L	4,000	NA	1,000	4,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	1,300	< 1,000	1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Lead	ug/L	NC	15	1	15	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0
Lithium	ug/L	NC	40	180	**180**	63	52.7	55	53	60	57	61	61	--	77	72	72	70
Mercury	ug/L	2	NA	0.2	2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	NC	100	6	100	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5.0	--	< 5.0	< 5.0	< 5.0	< 5.0
Radium-226	pCi/L	NC	NA	NA	NA	< 0.240	< 0.278	< 0.189	< 0.201	< 0.318	0.358	< 0.269	< 0.643	--	< 0.831	< 0.618	< 0.668	< 0.879
Radium-228	pCi/L	NC	NA	NA	NA	0.524	< 0.364	< 0.585	0.604	< 0.584	< 0.631	0.917	< 0.707	--	1.39	< 0.741	< 0.701	< 0.776
Radium-226/228	pCi/L	5	NA	3.32	5	0.58	< 0.364	< 0.585	0.731	< 0.584	0.683	0.981	< 1.35	--	< 2.04	< 1.36	< 1.37	< 1.66
Selenium	ug/L	50	NA	2	50	1	< 1	< 1	< 1	< 1	1	6	< 1.0	--	< 1.0	1.0	< 1.0	< 1.0
Thallium	ug/L	2	NA	2	2	< 2	< 2	2	< 2	< 2	< 2	< 2	< 2.0	--	< 2.0	< 2.0	< 2.0	< 2.0

Notes:

ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units; pH is a field parameter.
pCi/L - picocuries per liter.
NA - not applicable.
NC - no criteria.
-- - not analyzed.
MCL - Maximum Contaminant Level, EPA Drinking Water Standards and Health Advisories, April 2012.
RSL - Regional Screening Level from 83 FR 36435.
UTL - Upper Tolerance Limit (95%) of the background data set.
GWPS - Groundwater Protection Standard. GWPS is the higher of the MCL/RSL and UTL as established in TRC's Technical Memorandum dated October 15, 2018.
* - Secondary Maximum Contaminant Level (SMCL), EPA Secondary Drinking Water Regulations (SDWR) April 2012.
Bold value indicates an exceedance of the GWPS. Data from downgradient monitoring wells are screened against the GWPS for evaluation purposes only. Confidence intervals will be used to determine compliance per the CCR rules.
All metals were analyzed as total unless otherwise specified.
(1) Laboratory reporting limit exceeds GWPS due to sample dilutions performed as a result of sample matrix interferences.

Table A1
Comparison of Groundwater Sampling Results to Groundwater Protection Standards – December 2015 to November 2018
JC Weadock Bottom Ash Pond – RCRA CCR Monitoring Program
Essexville, Michigan

						Sample Location:	JCW-MW-15028													
						Sample Date:	12/9/2015	3/31/2016	5/25/2016	8/23/2016	12/1/2016	2/23/2017	5/17/2017	8/2/2017	9/19/2017	4/11/2018	4/11/2018	5/23/2018	11/7/2018	11/7/2018
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS		downgradient													
Appendix III																	Field Dup			Field Dup
Boron	ug/L	NC	NA	619	NA		357	333	345	433	455	425	427	444	419	--	--	444	517	525
Calcium	mg/L	NC	NA	302	NA		63.4	72.2	71.2	97.7	90.7	98.5	86.2	92.4	75.5	--	--	125	153	153
Chloride	mg/L	250*	NA	2,440	NA		71.7	69.3	69.4	72.2	64.2	70.0	60.1	106	91.0	--	--	69.5	352	347
Fluoride	ug/L	4,000	NA	1,000	NA		< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Sulfate	mg/L	250*	NA	407	NA		62.5	49.3	69.8	113	142	116	62.8	93.0	85.7	--	--	32.2	111	110
Total Dissolved Solids	mg/L	500*	NA	4,600	NA		410	400	390	520	550	530	470	514	506	--	--	1,030	976	966
pH, Field	SU	6.5 - 8.5*	NA	6.5-7.3	NA		8.1	7.9	7.8	7.6	8.1	8.0	7.9	7.7	8.0	7.8	--	8.0	7.9	--
Appendix IV																				
Antimony	ug/L	6	NA	1	6		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	10	NA	21	**21**		2	< 1	1	1	2	2	1	1.2	--	1.2	1.4	< 1.0	< 1.0	1.1
Barium	ug/L	2,000	NA	1,300	2,000		65	63	69	90	102	92	82	97.4	--	148	145	148	156	158
Beryllium	ug/L	4	NA	1	**4**		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	5	NA	0.2	5		< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Chromium	ug/L	100	NA	3	100		< 1	1	1	< 1	< 1	1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cobalt	ug/L	NC	6	15	**15**		< 15	< 15	< 15	< 15	< 15	< 15	< 15	< 15.0	--	< 15.0	< 15.0	< 15.0	< 6.0	< 6.0
Fluoride	ug/L	4,000	NA	1,000	4,000		< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Lead	ug/L	NC	15	1	15		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lithium	ug/L	NC	40	180	**180**		25.9	22.7	25	29	32	32	30	35	--	48	47	48	51	49
Mercury	ug/L	2	NA	0.2	2		< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	NC	100	6	100		< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5.0	--	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Radium-226	pCi/L	NC	NA	NA	NA		< 0.182	< 0.448	< 0.189	< 0.220	< 0.361	0.285	< 0.247	< 0.952	--	< 0.934	< 0.450	< 0.739	1.13	0.786
Radium-228	pCi/L	NC	NA	NA	NA		< 0.646	0.571	0.479	0.441	< 0.374	0.674	0.819	< 0.772	--	0.988	0.874	< 0.676	< 0.685	<0.591
Radium-226/228	pCi/L	5	NA	3.32	5		< 0.646	0.673	0.63	0.565	< 0.374	0.959	0.829	< 1.72	--	1.65	1.30	< 1.42	1.60	1.26
Selenium	ug/L	50	NA	2	50		2	< 1	< 1	< 1	< 1	1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Thallium	ug/L	2	NA	2	2		< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2.0	--	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0

Notes:

ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units; pH is a field parameter.
pCi/L - picocuries per liter.
NA - not applicable.
NC - no criteria.
-- - not analyzed.
MCL - Maximum Contaminant Level, EPA Drinking Water Standards and Health Advisories, April 2012.
RSL - Regional Screening Level from 83 FR 36435.
UTL - Upper Tolerance Limit (95%) of the background data set.
GWPS - Groundwater Protection Standard. GWPS is the higher of the MCL/RSL and UTL as established in TRC's Technical Memorandum dated October 15, 2018.
* - Secondary Maximum Contaminant Level (SMCL), EPA Secondary Drinking Water Regulations (SDWR) April 2012.
Bold value indicates an exceedance of the GWPS. Data from downgradient monitoring wells are screened against the GWPS for evaluation purposes only. Confidence intervals will be used to determine compliance per the CCR rules.
All metals were analyzed as total unless otherwise specified.
(1) Laboratory reporting limit exceeds GWPS due to sample dilutions performed as a result of sample matrix interferences.

Technical Memorandum

Sanitas™ Output Files

Summary Report

Constituent: Antimony, Total Analysis Run 2/25/2019 1:27 PM
Client: Consumers Energy Data: JCW_Sanitas.19.02.22

For observations made between 12/9/2015 and 11/7/2018, a summary of the selected data set:

Observations = 44
ND/Trace = 44
Wells = 4
Minimum Value = 1
Maximum Value = 1
Mean Value = 1
Median Value = 1
Standard Deviation = 0
Coefficient of Variation = 0
Skewness = NaN

Well	#Obs.	ND/Trace	Min	Max	Mean	Median	Std.Dev.	CV	Skewness
JCW-MW-15007	11	11	1	1	1	1	0	0	NaN
JCW-MW-15009	11	11	1	1	1	1	0	0	NaN
JCW-MW-15010	11	11	1	1	1	1	0	0	NaN
JCW-MW-15028	11	11	1	1	1	1	0	0	NaN

Summary Report

Constituent: Arsenic, Total Analysis Run 2/25/2019 1:27 PM
Client: Consumers Energy Data: JCW_Sanitas.19.02.22

For observations made between 12/9/2015 and 11/7/2018, a summary of the selected data set:

Observations = 44
ND/Trace = 9
Wells = 4
Minimum Value = 1
Maximum Value = 55
Mean Value = 13.33
Median Value = 7.25
Standard Deviation = 14.4
Coefficient of Variation = 1.08
Skewness = 0.9844

Well	#Obs.	ND/Trace	Min	Max	Mean	Median	Std.Dev.	CV	Skewness
JCW-MW-15007	11	0	13	55	27.49	24.8	13.31	0.4843	0.9573
JCW-MW-15009	11	7	1	5	1.636	1	1.186	0.7248	2.301
JCW-MW-15010	11	0	9.5	39	22.86	23.2	9.124	0.3991	0.0853
JCW-MW-15028	11	2	1	2	1.323	1.05	0.4457	0.337	0.8785

Summary Report

Constituent: Barium, Total Analysis Run 2/25/2019 1:27 PM
Client: Consumers Energy Data: JCW_Sanitas.19.02.22

For observations made between 12/9/2015 and 11/7/2018, a summary of the selected data set:

Observations = 44
ND/Trace = 0
Wells = 4
Minimum Value = 12.3
Maximum Value = 1150
Mean Value = 242.8
Median Value = 105.5
Standard Deviation = 321.4
Coefficient of Variation = 1.324
Skewness = 1.604

Well	#Obs.	ND/Trace	Min	Max	Mean	Median	Std.Dev.	CV	Skewness
JCW-MW-15007	11	0	392	1150	741.4	733	268.4	0.362	0.0525
JCW-MW-15009	11	0	12.3	23	16.37	15	3.042	0.1858	0.9157
JCW-MW-15010	11	0	98	125	112.1	114	9.92	0.08846	-0.3067
JCW-MW-15028	11	0	63	157	101.1	92	34.29	0.3392	0.5919

Summary Report

Constituent: Beryllium, Total Analysis Run 2/25/2019 1:27 PM
Client: Consumers Energy Data: JCW_Sanitas.19.02.22

For observations made between 12/9/2015 and 11/7/2018, a summary of the selected data set:

Observations = 44
ND/Trace = 33
Wells = 4
Minimum Value = 1
Maximum Value = 27
Mean Value = 3.877
Median Value = 1
Standard Deviation = 6.086
Coefficient of Variation = 1.57
Skewness = 2.31

Well	#Obs.	ND/Trace	Min	Max	Mean	Median	Std.Dev.	CV	Skewness
JCW-MW-15007	11	11	1	1	1	1	0	0	NaN
JCW-MW-15009	11	0	6.5	27	12.51	9	7.069	0.5651	0.8605
JCW-MW-15010	11	11	1	1	1	1	0	0	NaN
JCW-MW-15028	11	11	1	1	1	1	0	0	NaN

Summary Report

Constituent: Cadmium, Total Analysis Run 2/25/2019 1:27 PM
Client: Consumers Energy Data: JCW_Sanitas.19.02.22

For observations made between 12/9/2015 and 11/7/2018, a summary of the selected data set:

Observations = 44
ND/Trace = 44
Wells = 4
Minimum Value = 0.2
Maximum Value = 1
Mean Value = 0.2364
Median Value = 0.2
Standard Deviation = 0.1686
Coefficient of Variation = 0.7132
Skewness = 4.364

Well	#Obs.	ND/Trace	Min	Max	Mean	Median	Std.Dev.	CV	Skewness
JCW-MW-15007	11	11	0.2	1	0.2727	0.2	0.2412	0.8844	2.846
JCW-MW-15009	11	11	0.2	1	0.2727	0.2	0.2412	0.8844	2.846
JCW-MW-15010	11	11	0.2	0.2	0.2	0.2	0	0	NaN
JCW-MW-15028	11	11	0.2	0.2	0.2	0.2	0	0	NaN

Summary Report

Constituent: Chromium, Total Analysis Run 2/25/2019 1:27 PM
Client: Consumers Energy Data: JCW_Sanitas.19.02.22

For observations made between 12/9/2015 and 11/7/2018, a summary of the selected data set:

Observations = 44
ND/Trace = 24
Wells = 4
Minimum Value = 1
Maximum Value = 6
Mean Value = 1.648
Median Value = 1
Standard Deviation = 1.357
Coefficient of Variation = 0.8234
Skewness = 2.03

Well	#Obs.	ND/Trace	Min	Max	Mean	Median	Std.Dev.	CV	Skewness
JCW-MW-15007	11	6	1	5	1.455	1	1.214	0.8343	2.575
JCW-MW-15009	11	1	1	6	3.118	3	1.767	0.5666	0.2538
JCW-MW-15010	11	9	1	1.2	1.018	1	0.0603	0.05923	2.846
JCW-MW-15028	11	8	1	1	1	1	0	0	NaN

Summary Report

Constituent: Cobalt, Total Analysis Run 2/25/2019 1:27 PM
Client: Consumers Energy Data: JCW_Sanitas.19.02.22

For observations made between 12/9/2015 and 11/7/2018, a summary of the selected data set:

Observations = 44
ND/Trace = 42
Wells = 4
Minimum Value = 6
Maximum Value = 30
Mean Value = 15.57
Median Value = 15
Standard Deviation = 3.985
Coefficient of Variation = 0.256
Skewness = 1.74

Well	#Obs.	ND/Trace	Min	Max	Mean	Median	Std.Dev.	CV	Skewness
JCW-MW-15007	11	11	15	30	16.36	15	4.523	0.2764	2.846
JCW-MW-15009	11	9	15	30	17.55	15	4.886	0.2785	1.735
JCW-MW-15010	11	11	6	15	14.18	15	2.714	0.1913	-2.846
JCW-MW-15028	11	11	6	15	14.18	15	2.714	0.1913	-2.846

Summary Report

Constituent: Fluoride Analysis Run 2/25/2019 1:27 PM
Client: Consumers Energy Data: JCW_Sanitas.19.02.22

For observations made between 12/9/2015 and 11/7/2018, a summary of the selected data set:

Observations = 48
ND/Trace = 46
Wells = 4
Minimum Value = 1000
Maximum Value = 1300
Mean Value = 1006
Median Value = 1000
Standard Deviation = 43.3
Coefficient of Variation = 0.04303
Skewness = 6.71

Well	#Obs.	ND/Trace	Min	Max	Mean	Median	Std.Dev.	CV	Skewness
JCW-MW-15007	12	12	1000	1000	1000	1000	0	0	NaN
JCW-MW-15009	12	12	1000	1000	1000	1000	0	0	NaN
JCW-MW-15010	12	10	1000	1300	1025	1000	86.6	0.08449	3.015
JCW-MW-15028	12	12	1000	1000	1000	1000	0	0	NaN

Summary Report

Constituent: Lead, Total Analysis Run 2/25/2019 1:27 PM
Client: Consumers Energy Data: JCW_Sanitas.19.02.22

For observations made between 12/9/2015 and 11/7/2018, a summary of the selected data set:

Observations = 44
ND/Trace = 43
Wells = 4
Minimum Value = 1
Maximum Value = 5
Mean Value = 1.227
Median Value = 1
Standard Deviation = 0.8856
Coefficient of Variation = 0.7216
Skewness = 3.809

Well	#Obs.	ND/Trace	Min	Max	Mean	Median	Std.Dev.	CV	Skewness
JCW-MW-15007	11	10	1	5	1.545	1	1.293	0.8369	2.077
JCW-MW-15009	11	11	1	5	1.364	1	1.206	0.8844	2.846
JCW-MW-15010	11	11	1	1	1	1	0	0	NaN
JCW-MW-15028	11	11	1	1	1	1	0	0	NaN

Summary Report

Constituent: Lithium, Total Analysis Run 2/25/2019 1:27 PM
Client: Consumers Energy Data: JCW_Sanitas.19.02.22

For observations made between 12/9/2015 and 11/7/2018, a summary of the selected data set:

Observations = 44
ND/Trace = 0
Wells = 4
Minimum Value = 22.7
Maximum Value = 367
Mean Value = 101.9
Median Value = 62
Standard Deviation = 87.46
Coefficient of Variation = 0.8579
Skewness = 1.444

Well	#Obs.	ND/Trace	Min	Max	Mean	Median	Std.Dev.	CV	Skewness
JCW-MW-15007	11	0	50	98.5	72.25	75	15.63	0.2163	0.09829
JCW-MW-15009	11	0	139	367	239.3	238	63.06	0.2636	0.4395
JCW-MW-15010	11	0	52.7	77	61.97	61	7.984	0.1288	0.6035
JCW-MW-15028	11	0	22.7	50	34.28	32	9.786	0.2855	0.6248

Summary Report

Constituent: Mercury, Total Analysis Run 2/25/2019 1:27 PM
Client: Consumers Energy Data: JCW_Sanitas.19.02.22

For observations made between 12/9/2015 and 11/7/2018, a summary of the selected data set:

Observations = 44
ND/Trace = 44
Wells = 4
Minimum Value = 0.2
Maximum Value = 0.2
Mean Value = 0.2
Median Value = 0.2
Standard Deviation = 0
Coefficient of Variation = 0
Skewness = NaN

Well	#Obs.	ND/Trace	Min	Max	Mean	Median	Std.Dev.	CV	Skewness
JCW-MW-15007	11	11	0.2	0.2	0.2	0.2	0	0	NaN
JCW-MW-15009	11	11	0.2	0.2	0.2	0.2	0	0	NaN
JCW-MW-15010	11	11	0.2	0.2	0.2	0.2	0	0	NaN
JCW-MW-15028	11	11	0.2	0.2	0.2	0.2	0	0	NaN

Summary Report

Constituent: Molybdenum, Total Analysis Run 2/25/2019 1:27 PM
Client: Consumers Energy Data: JCW_Sanitas.19.02.22

For observations made between 12/9/2015 and 11/7/2018, a summary of the selected data set:

Observations = 44
ND/Trace = 34
Wells = 4
Minimum Value = 5
Maximum Value = 25
Mean Value = 6.955
Median Value = 5
Standard Deviation = 4.771
Coefficient of Variation = 0.686
Skewness = 2.996

Well	#Obs.	ND/Trace	Min	Max	Mean	Median	Std.Dev.	CV	Skewness
JCW-MW-15007	11	2	5	25	10.55	8	6.192	0.5872	1.553
JCW-MW-15009	11	10	5	25	7.273	5	6.068	0.8343	2.575
JCW-MW-15010	11	11	5	5	5	5	0	0	NaN
JCW-MW-15028	11	11	5	5	5	5	0	0	NaN

Summary Report

Constituent: Radium-226 Analysis Run 2/25/2019 1:27 PM
Client: Consumers Energy Data: JCW_Sanitas.19.02.22

For observations made between 12/9/2015 and 11/7/2018, a summary of the selected data set:

Observations = 44
ND/Trace = 27
Wells = 4
Minimum Value = 0.159
Maximum Value = 1.525
Mean Value = 0.5205
Median Value = 0.3725
Standard Deviation = 0.3334
Coefficient of Variation = 0.6405
Skewness = 1.066

Well	#Obs.	ND/Trace	Min	Max	Mean	Median	Std.Dev.	CV	Skewness
JCW-MW-15007	11	0	0.239	1.525	0.7086	0.476	0.4363	0.6157	0.7445
JCW-MW-15009	11	8	0.159	0.803	0.4288	0.318	0.2408	0.5616	0.4354
JCW-MW-15010	11	10	0.189	0.879	0.4431	0.318	0.26	0.5867	0.652
JCW-MW-15028	11	9	0.182	0.958	0.5014	0.361	0.3268	0.6518	0.4997

Summary Report

Constituent: Radium-226/228 Analysis Run 2/25/2019 1:27 PM
Client: Consumers Energy Data: JCW_Sanitas.19.02.22

For observations made between 12/9/2015 and 11/7/2018, a summary of the selected data set:

Observations = 44
ND/Trace = 15
Wells = 4
Minimum Value = 0.364
Maximum Value = 2.61
Mean Value = 1.261
Median Value = 1.36
Standard Deviation = 0.5403
Coefficient of Variation = 0.4283
Skewness = 0.3185

Well	#Obs.	ND/Trace	Min	Max	Mean	Median	Std.Dev.	CV	Skewness
JCW-MW-15007	11	0	1.03	2.61	1.7	1.64	0.5275	0.3103	0.5168
JCW-MW-15009	11	4	0.683	1.753	1.378	1.39	0.2927	0.2125	-1.194
JCW-MW-15010	11	7	0.364	2.04	0.9935	0.731	0.5362	0.5398	0.7048
JCW-MW-15028	11	4	0.374	1.72	0.9746	0.829	0.456	0.4679	0.3647

Summary Report

Constituent: Radium-228 Analysis Run 2/25/2019 1:27 PM
Client: Consumers Energy Data: JCW_Sanitas.19.02.22

For observations made between 12/9/2015 and 11/7/2018, a summary of the selected data set:

Observations = 44
ND/Trace = 12
Wells = 4
Minimum Value = 0.364
Maximum Value = 1.53
Mean Value = 0.8589
Median Value = 0.7905
Standard Deviation = 0.299
Coefficient of Variation = 0.3481
Skewness = 0.5399

Well	#Obs.	ND/Trace	Min	Max	Mean	Median	Std.Dev.	CV	Skewness
JCW-MW-15007	11	0	0.761	1.53	0.9918	0.893	0.2418	0.2438	1.185
JCW-MW-15009	11	0	0.7	1.43	1.09	1.2	0.2698	0.2475	-0.3665
JCW-MW-15010	11	7	0.364	1.39	0.7112	0.631	0.2672	0.3757	1.472
JCW-MW-15028	11	5	0.374	0.931	0.6425	0.674	0.1672	0.2602	-0.01086

Summary Report

Constituent: Selenium, Total Analysis Run 2/25/2019 1:27 PM
Client: Consumers Energy Data: JCW_Sanitas.19.02.22

For observations made between 12/9/2015 and 11/7/2018, a summary of the selected data set:

Observations = 44
ND/Trace = 27
Wells = 4
Minimum Value = 1
Maximum Value = 14.2
Mean Value = 1.864
Median Value = 1
Standard Deviation = 2.279
Coefficient of Variation = 1.223
Skewness = 3.995

Well	#Obs.	ND/Trace	Min	Max	Mean	Median	Std.Dev.	CV	Skewness
JCW-MW-15007	11	10	1	1.2	1.018	1	0.0603	0.05923	2.846
JCW-MW-15009	11	1	1	14.2	3.891	3	3.716	0.9551	2.098
JCW-MW-15010	11	7	1	6	1.455	1	1.508	1.036	2.846
JCW-MW-15028	11	9	1	2	1.091	1	0.3015	0.2764	2.846

Summary Report

Constituent: Thallium, Total Analysis Run 2/25/2019 1:27 PM
Client: Consumers Energy Data: JCW_Sanitas.19.02.22

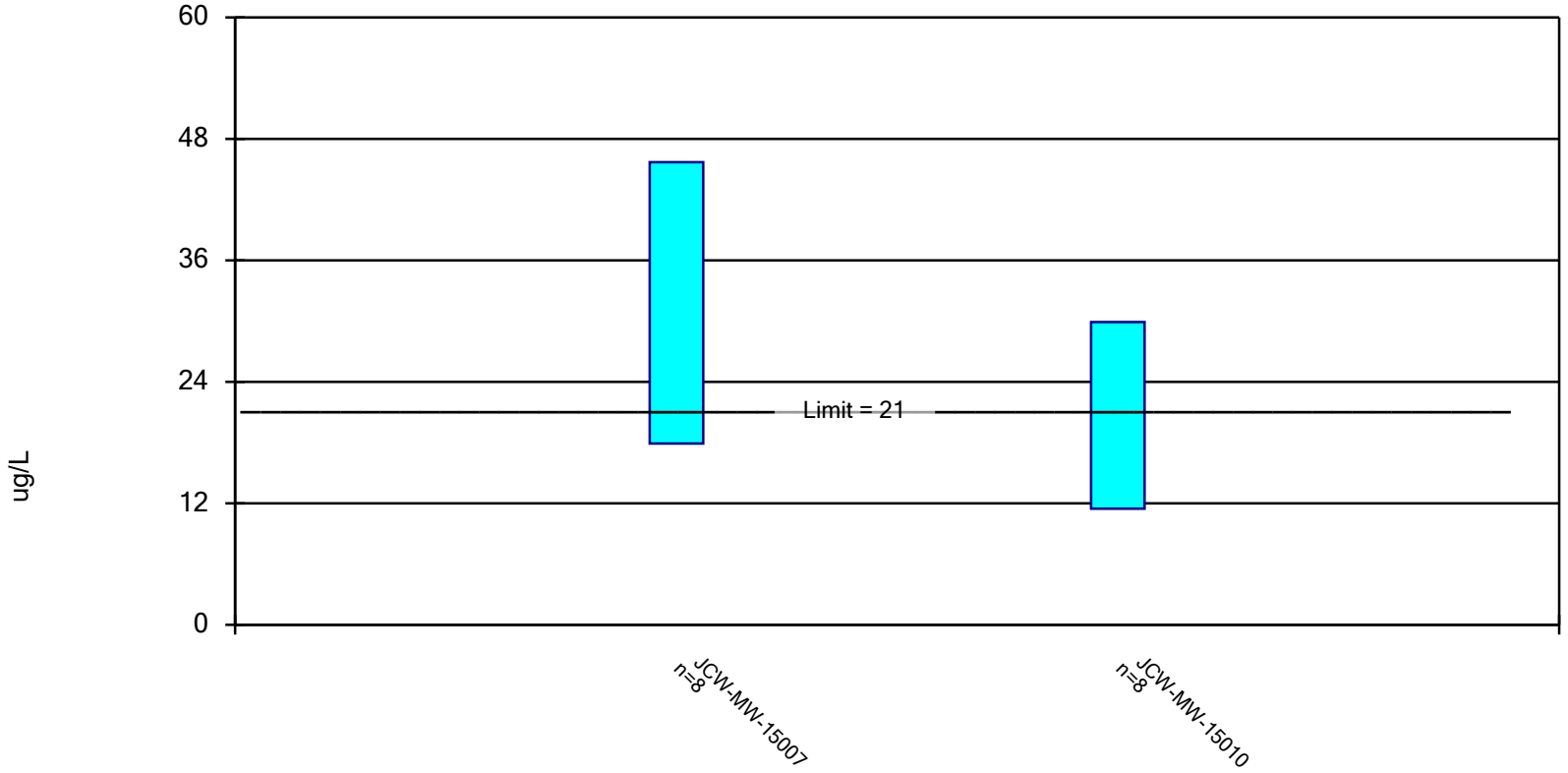
For observations made between 12/9/2015 and 11/7/2018, a summary of the selected data set:

Observations = 44
ND/Trace = 42
Wells = 4
Minimum Value = 2
Maximum Value = 10
Mean Value = 2.364
Median Value = 2
Standard Deviation = 1.686
Coefficient of Variation = 0.7132
Skewness = 4.364

Well	#Obs.	ND/Trace	Min	Max	Mean	Median	Std.Dev.	CV	Skewness
JCW-MW-15007	11	11	2	10	2.727	2	2.412	0.8844	2.846
JCW-MW-15009	11	10	2	10	2.727	2	2.412	0.8844	2.846
JCW-MW-15010	11	10	2	2	2	2	0	0	NaN
JCW-MW-15028	11	11	2	2	2	2	0	0	NaN

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Arsenic, Total Analysis Run 2/25/2019 2:41 PM

Client: Consumers Energy Data: JCW_Sanitas.19.02.22

Confidence Interval

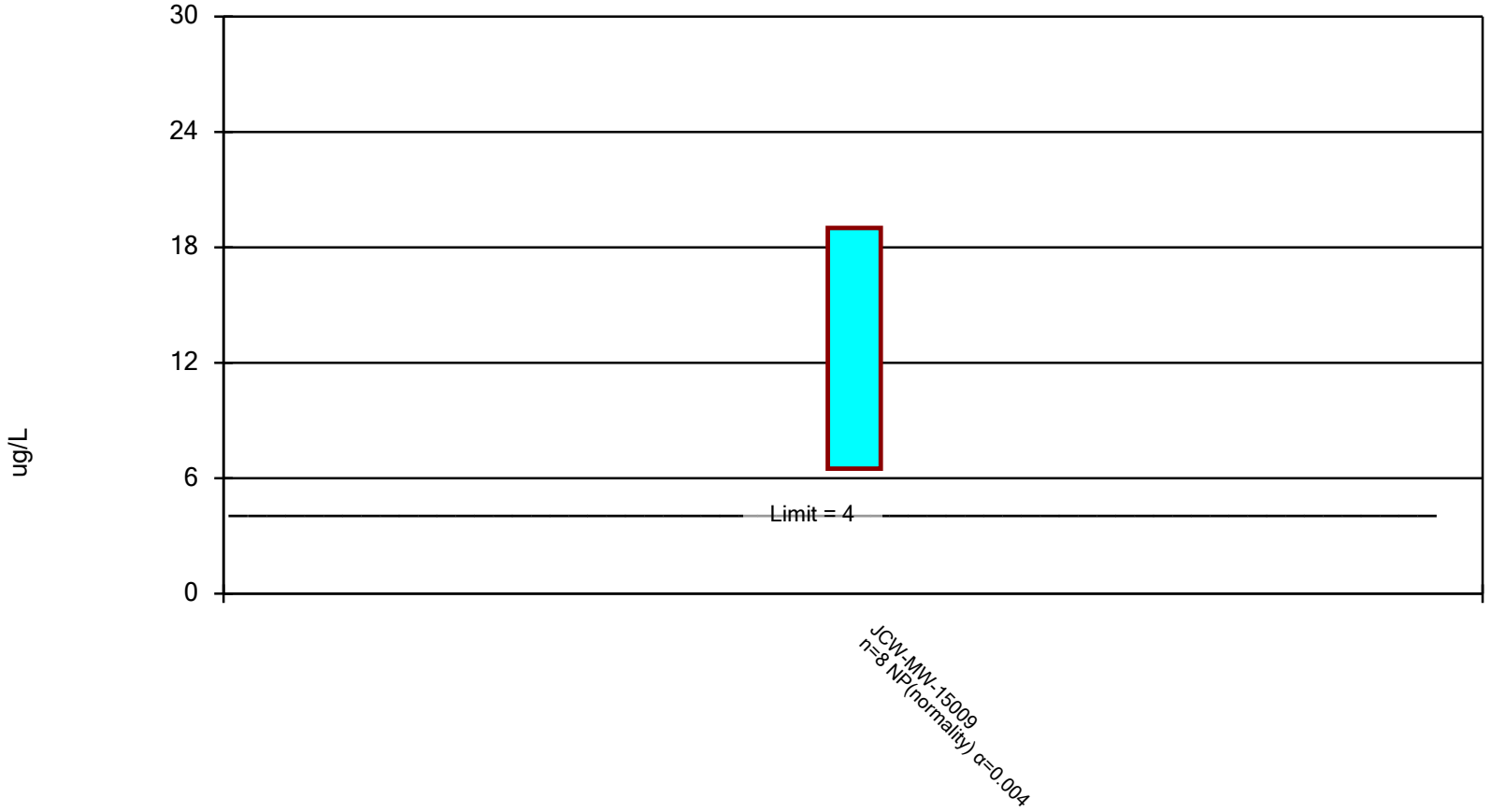
Constituent: Arsenic, Total (ug/L) Analysis Run 2/25/2019 2:42 PM

Client: Consumers Energy Data: JCW_Sanitas.19.02.22

	JCW-MW-15007	JCW-MW-15010
8/23/2016	55	
8/24/2016		34
12/1/2016	37	27
2/23/2017	26	25
5/17/2017	23	23
8/2/2017		23.2
8/3/2017	24.8 (D)	
4/10/2018	16.7	12.5
5/22/2018		11.25 (D)
5/23/2018	25.6	
11/7/2018	46.3	9.5
Mean	31.8	20.68
Std. Dev.	13.1	8.69
Upper Lim.	45.69	29.89
Lower Lim.	17.91	11.47

Non-Parametric Confidence Interval

Compliance limit is exceeded.



Constituent: Beryllium, Total Analysis Run 2/25/2019 2:42 PM

Client: Consumers Energy Data: JCW_Sanitas.19.02.22

Confidence Interval

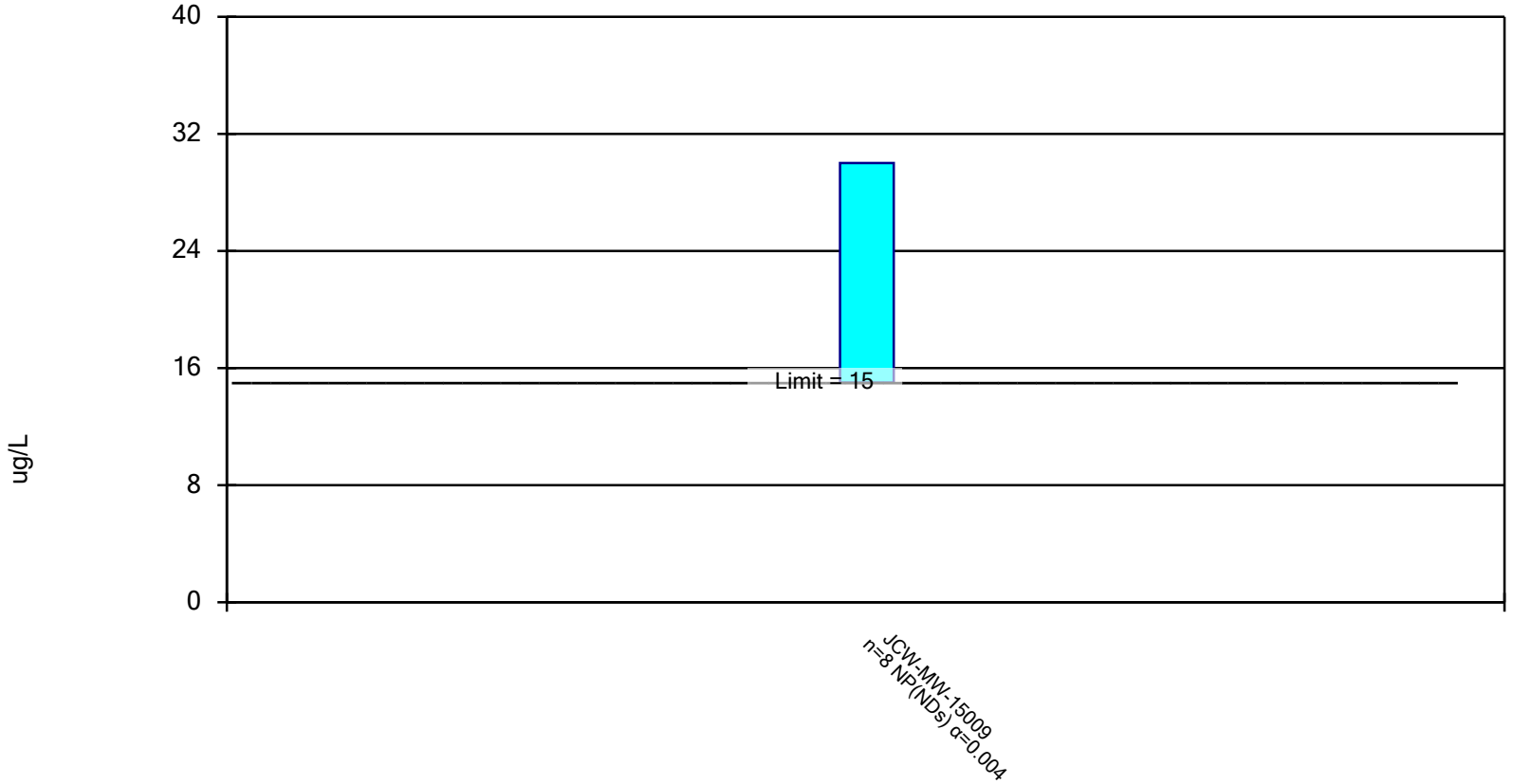
Constituent: Beryllium, Total (ug/L) Analysis Run 2/25/2019 2:43 PM

Client: Consumers Energy Data: JCW_Sanitas.19.02.22

	JCW-MW-15009
8/23/2016	17
12/1/2016	19
2/23/2017	11
5/18/2017	7
8/2/2017	7.4
4/10/2018	7.1
5/23/2018	6.5
11/7/2018	6.6
Mean	10.2
Std. Dev.	5.052
Upper Lim.	19
Lower Lim.	6.5

Non-Parametric Confidence Interval

Compliance Limit is not exceeded.



Constituent: Cobalt, Total Analysis Run 2/25/2019 2:43 PM

Client: Consumers Energy Data: JCW_Sanitas.19.02.22

Confidence Interval

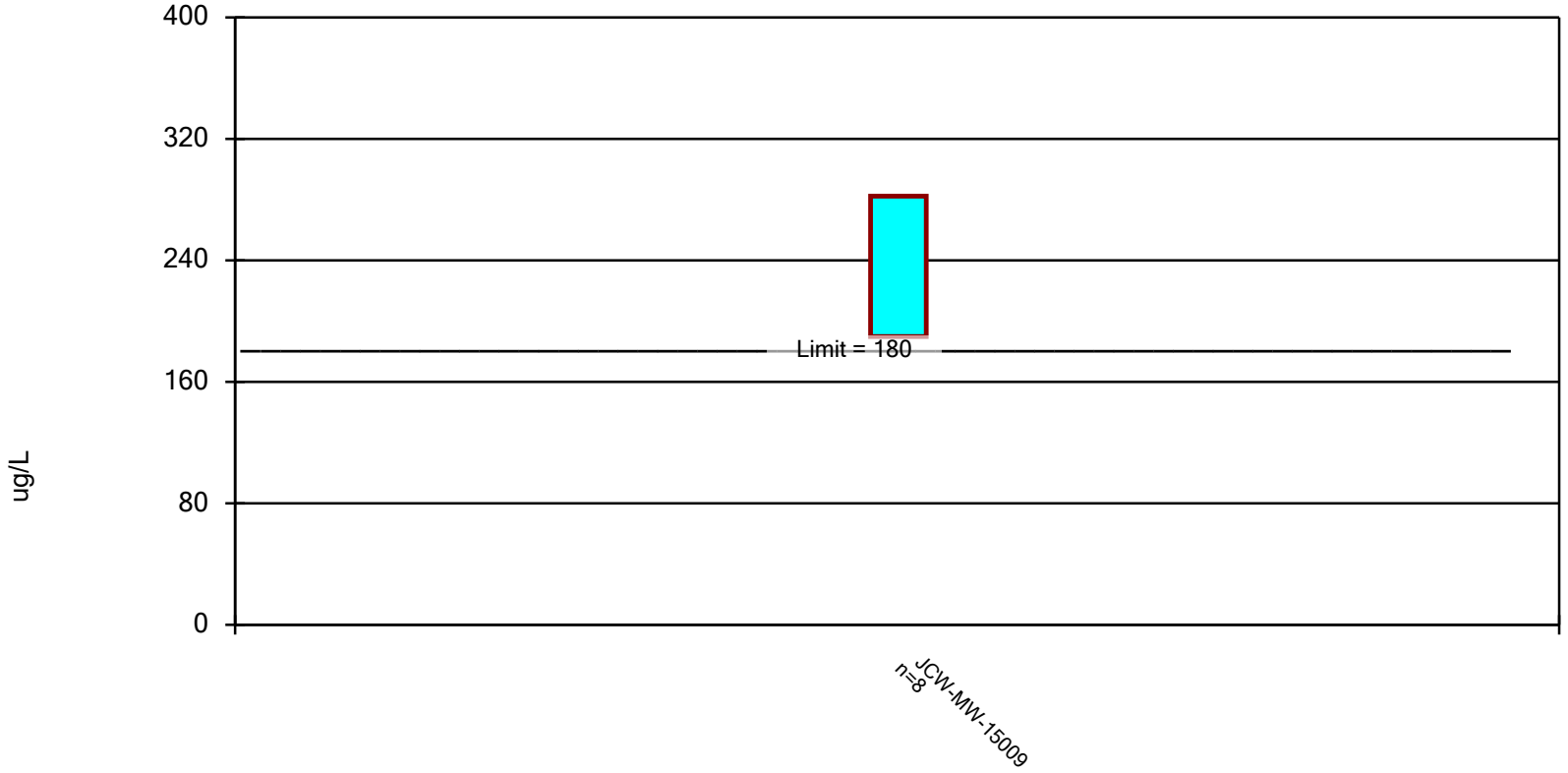
Constituent: Cobalt, Total (ug/L) Analysis Run 2/25/2019 2:44 PM

Client: Consumers Energy Data: JCW_Sanitas.19.02.22

	JCW-MW-15009
8/23/2016	<15
12/1/2016	<15
2/23/2017	<15
5/18/2017	<15
8/2/2017	<15
4/10/2018	<15
5/23/2018	<15
11/7/2018	<30
Mean	16.88
Std. Dev.	5.303
Upper Lim.	30
Lower Lim.	15

Parametric Confidence Interval

Compliance limit is exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Lithium, Total Analysis Run 2/25/2019 2:44 PM

Client: Consumers Energy Data: JCW_Sanitas.19.02.22

Confidence Interval

Constituent: Lithium, Total (ug/L) Analysis Run 2/25/2019 2:44 PM

Client: Consumers Energy Data: JCW_Sanitas.19.02.22

	JCW-MW-15009
8/23/2016	280
12/1/2016	300
2/23/2017	216
5/18/2017	182
8/2/2017	270
4/10/2018	210
5/23/2018	190
11/7/2018	240
Mean	236
Std. Dev.	43.61
Upper Lim.	282.2
Lower Lim.	189.8

Appendix B
Data Quality Reviews

Laboratory Data Quality Review
Groundwater Monitoring Event April 2019
JC Weadock and DE Karn Background Wells

Groundwater samples were collected by TRC for the April 2019 sampling event. Samples were analyzed for anions, alkalinity, total dissolved solids, and total metals by Eurofins TestAmerica, located in Irvine, California (Eurofins TA - Irvine). The lithium analyses by method SW846 6020 were subcontracted to Eurofins TA in North Canton, Ohio (Eurofins TA – Canton). The radium analyses were subcontracted to Eurofins TA in St. Louis, Missouri (Eurofins TA – St. Louis). The laboratory analytical results were reported in laboratory sample delivery groups (SDGs) 440-238634-1 and 440-238628-1.

During the April 2019 sampling event, a groundwater sample was collected from each of the following wells:

- MW-15002
- MW-15008
- MW-15016
- MW-15019

Each sample was analyzed for the following constituents:

Analyte Group	Method
Anions (Fluoride, Chloride, Sulfate)	EPA 300.0
Alkalinity	SM 2320B
Total Dissolved Solids (TDS)	SM 2540C
Total Metals	SW846 3005A/6010B/6020/7470A
Radium (Ra-226, Ra-228, Combined Ra-226 & Ra-228)	EPA 903.0, EPA 904.0

TRC reviewed the laboratory data to assess data usability. The following sections summarize the data review procedure and the results of the review.

Data Usability Review Procedure

The analytical data were reviewed using the USEPA National Functional Guidelines for Inorganic Superfund Methods Data Review (USEPA, 2017) and the Department of Energy Evaluation of Radiochemical Data Usability (USDOE, 1997). The following items were included in the evaluation of the data:

- Sample receipt, as noted in the cover page or case narrative;
- Technical holding times for analyses;
- Reporting limits (RLs) compared to project-required RLs;

- Data for method blanks, equipment blanks, and field blanks, if applicable. Method blanks are used to assess potential contamination arising from laboratory sample preparation and/or analytical procedures. Field and equipment blanks are used to assess potential contamination arising from field procedures;
- Data for laboratory control samples (LCSs) and/or the LCS duplicate samples. The LCSs and/or LCSDs are used to assess the accuracy of the analytical method using a clean matrix. The LCS/LCSDs are used to assess the accuracy and precision of the analytical method for each analyte spiked;
- Percent recoveries for matrix spike (MS) and matrix spike duplicates (MSD), when performed on project samples. The MS/MSDs are used to assess the accuracy and precision of the analytical method for each analyte spiked and used to assess bias due to sample matrix effects;
- Data for laboratory duplicates, when performed on project samples. The laboratory duplicates are replicate analyses of one sample and are used to assess the precision of the analytical method;
- Percent recoveries for tracer and carriers, where applicable, for radiochemistry only. Tracers and/or carriers are used to assess the chemical yield for the preparation and/or instrument efficiency;
- Data for blind field duplicates. Field duplicate samples are used to assess variability introduced by the sampling and analytical processes; and
- Overall usability of the data.

This data usability report addresses the following items:

- Usability of the data if quality control (QC) results suggest potential problems with all or some of the data;
- Actions regarding specific QC criteria exceedances.

Review Summary

The data quality objectives and laboratory completeness goals for the project were met, and the data are usable for their intended purpose. A summary of the data quality review, including non-conformances and issues identified in this evaluation, are noted below.

- Appendix III and IV constituents as well as iron, copper, nickel, silver, vanadium, and zinc will be utilized for the purposes of an assessment monitoring program.
- Data are usable for the purposes of the assessment monitoring program.
- When the data are evaluated through an assessment monitoring statistical program, findings below may be used to support the removal of outliers.

QA/QC Sample Summary:

- The holding times were met for all parameters for all samples.
- A method blank was analyzed with each analytical batch; no analytes were detected in the method blank samples.
- One field blank (FB-05) was collected; chromium was detected at a concentration of 0.0014 mg/L. The chromium results in samples MW-15002, MW-15008, and DUP-05 were detected at concentrations less than 5x the field blank concentration; thus, these results may be false positives, as summarized in the attached table, Attachment 1.
- The LCS and/or LCSD recoveries for all analytes were within QC limits.
- The relative error ratio (RER) was within laboratory control limit for the LCS/LCSD for radium analyses.
- MS and/or MSD analyses were not performed on any samples in this data set.
- Carrier and tracer recoveries for radium analyses, where applicable, were within 40-110%.
- The field duplicate pair samples were DUP-05 with MW-15008. The relative percent differences (RPDs) between the parent and duplicate sample were within the QC limits (20%).
- Laboratory duplicate analysis was performed on sample MW-15002 for alkalinity. The RPD was within laboratory control limit.
- The nondetect RLs for fluoride and sulfate in sample MW-15002 exceeded the project-required RLs due to the 20-fold dilution which was performed because of interference from the high concentration of chloride in the sample.

Attachment 1

Summary of Data Non-Conformances for Background Groundwater Analytical Data

DE Karn JC Weadock - RCRA CCR Monitoring Program

Essexville, Michigan

Samples	Collection Date	Analyte	Non-Conformance/Issue
MW-15002	4/8/2019	Chromium	Detection in field blank. Sample results ≤5X the blank concentration. Results may be false positives.
MW-15008	4/8/2019		
DUP-05	4/8/2019		

Laboratory Data Quality Review
Groundwater Monitoring Event April 2019
JC Weadock Bottom Ash Pond

Groundwater samples were collected by TRC for the April 2019 sampling event. Samples were analyzed for anions, alkalinity, total dissolved solids, and total metals by Eurofins TestAmerica, located in Irvine, California (Eurofins TA - Irvine). The lithium analyses by method SW846 6020 were subcontracted to Eurofins TA in North Canton, Ohio (Eurofins TA – Canton). The radium analyses were subcontracted to Eurofins TA in St. Louis, Missouri (Eurofins TA – St. Louis). The laboratory analytical results were reported in laboratory sample delivery groups (SDGs) 440-238636-1 and 440-238630-1.

During the April 2019 sampling event, a groundwater sample was collected from each of the following wells:

- JCW-MW-15007
- JCW-MW-15009
- JCW-MW-15010
- JCW-MW-15028

Each sample was analyzed for one or more of the following constituents:

Analyte Group	Method
Anions (Fluoride, Chloride, Sulfate)	EPA 300.0
Alkalinity	SM 2320B
Total Dissolved Solids (TDS)	SM 2540C
Total Metals	SW846 3005A/6010B/6020A/7470A
Radium (Ra-226, Ra-228, Combined Ra-226 & Ra-228)	EPA 903.0, EPA 904.0

TRC reviewed the laboratory data to assess data usability. The following sections summarize the data review procedure and the results of the review.

Data Usability Review Procedure

The analytical data were reviewed using the USEPA National Functional Guidelines for Inorganic Superfund Methods Data Review (USEPA, 2017) and the Department of Energy Evaluation of Radiochemical Data Usability (USDOE, 1997). The following items were included in the evaluation of the data:

- Sample receipt;
- Technical holding times for analyses;
- Reporting limits (RLs) compared to project-required RLs;

- Data for method blanks, equipment blanks, and field blanks, if applicable. Method blanks are used to assess potential contamination arising from laboratory sample preparation and/or analytical procedures. Field and equipment blanks are used to assess potential contamination arising from field procedures;
- Data for laboratory control samples (LCSs) and/or the LCS duplicate samples. The LCSs and/or LCSDs are used to assess the accuracy of the analytical method using a clean matrix. The LCS/LCSDs are used to assess the accuracy and precision of the analytical method for each analyte spiked;
- Percent recoveries for matrix spike (MS) and matrix spike duplicates (MSD), when performed on project samples. The MS/MSDs are used to assess the accuracy and precision of the analytical method for each analyte spiked and used to assess bias due to sample matrix effects;
- Data for laboratory duplicates, when performed on project samples. The laboratory duplicates are replicate analyses of one sample and are used to assess the precision of the analytical method; Percent recoveries for tracer and carriers, where applicable, for radiochemistry only. Tracers and/or carriers are used to assess the chemical yield for the preparation and/or instrument efficiency;
- Data for blind field duplicates. Field duplicate samples are used to assess variability introduced by the sampling and analytical processes; and
- Overall usability of the data.

This data usability report addresses the following items:

- Usability of the data if quality control (QC) results suggest potential problems with all or some of the data;
- Actions regarding specific QC criteria exceedances.

Review Summary

The data quality objectives and laboratory completeness goals for the project were met, and the data are usable for their intended purpose. A summary of the data quality review, including non-conformances and issues identified in this evaluation, are noted below.

- Appendix III and IV constituents as well as iron, copper, nickel, silver, vanadium, and zinc will be utilized for the purposes of an assessment monitoring program.
- Data are usable for the purposes of the assessment monitoring program.
- When the data are evaluated through an assessment monitoring statistical program, findings below may be used to support the removal of outliers.

QA/QC Sample Summary:

- The holding times were met for all parameters for all samples.
- A method blank was analyzed with each analytical batch; no analytes were detected in the method blank samples.
- One equipment blank (EB-02) and one field blank (FB-02) were collected; FB-02 was not submitted for radium analyses. No analytes were detected in sample FB-02.
  - Ra-228 was detected in EB-02 at 0.414 ± 0.269 pCi/L. The positive results for Ra-228 in samples DUP-02, JCW-MW-15007, JCW-MW-15010, and JCW-MW-15028 may be false positives. (See attached table)
  - Combined Ra-226 & Ra-228 was detected in EB-02 at 0.428 $\pm$ 0.271 pCi/L. The positive results for Combined Ra-226 & Ra-228 in samples DUP-02, JCW-MW-15007, and JCW-MW-15010 may be false positives. The positive result for Combined Ra-226 & Ra-228 in sample JCW-MW-15028 may be biased high. (See attached table)
- The LCS and/or LCSD recoveries for all analytes were within QC limits.
- The relative error ratio (RER) was within laboratory control limit for the LCS/LCSD for radium analyses.
- MS/MSD analyses were performed on sample JCW-MW-15009 for anions, mercury, and metals. All recoveries and relative percent differences (RPDs) were within the QC limits with the following exceptions.
  - The MS/MSD percent recoveries (%Rs) for selenium (43% and 35%, respectively) were below the lower acceptance limit; therefore, the positive and nondetect results for selenium in all the groundwater samples in this dataset may be biased low (refer to attached table).
  - The MS/MSD %Rs for calcium, iron, and magnesium were outside of the acceptance criteria. The concentrations for these analytes in the parent sample JCW-MW-15009 were >4x the spike concentrations; therefore, the MS/MSD results for calcium, iron, and magnesium were not evaluated. Data usability was not affected.
- Carrier and tracer recoveries for radium analyses, where applicable, were within 40-110%.
- The field duplicate pair samples were DUP-02 and JCW-MW-15028; RPDs and/or duplicate error ratios (for radium analyses only) between the parent and duplicate sample were within the QC limits.
- Laboratory duplicate analyses were performed on sample JCW-MW-15009 for lithium, alkalinity, and TDS; RPDs were within QC limits.

- The RLs for the following nondetect results were not met.
  - The nondetect RLs for fluoride and sulfate in sample JCW-MW-15007 exceeded the project-required RLs due to the 10-fold dilution which was performed because of interference from the high concentration of chloride in the sample.
  - The nondetect RLs for fluoride in samples JCW-MW-15009, JCW-MW-15028, and DUP-02 exceeded the project-required RLs due to the 2-fold dilutions which were performed because of interference from the high concentrations of chloride and/or sulfate in these samples.

Attachment 1

Summary of Data Non-Conformances for Bottom Ash Pond Groundwater Analytical Data

JC Weadock - RCRA CCR Monitoring Program

Essexville, Michigan

Samples	Collection Date	Analyte	Non-Conformance/Issue
JCW-MW-15007	4/9/2019	Seleniium	MS/MSD %Rs below the lower acceptance limit; the positive and nondetect results may be biased low.
JCW-MW-15028	4/9/2019		
DUP-02	4/9/2019		
JCW-MW-15009	4/9/2019		
JCW-MW-15010	4/9/2019		
JCW-MW-15007	4/9/2019	Ra-228	Detection in equipment blank EB-02 . Normalized absolute difference between blank and sample result <1.96. Results may be false positives.
JCW-MW-15010	4/9/2019		
JCW-MW-15028	4/9/2019		
DUP-02	4/9/2019		
JCW-MW-15007	4/9/2019	Combined Ra-226 & Ra-228	
JCW-MW-15010	4/9/2019		
DUP-02	4/9/2019		
JCW-MW-15028	4/9/2019	Combined Ra-226 & Ra-228	Detection in equipment blank EB-02. Normalized absolute difference between blank and sample result >1.96, but <2.48. Result may be biased high.

Laboratory Data Quality Review
Groundwater Monitoring Event October 2019
JC Weadock/Karn DEK Background

Groundwater samples were collected by TRC for the October 2019 sampling event. Samples were analyzed for lithium, anions, and total dissolved solids by Eurofins TA in North Canton, Ohio (Eurofins TA – Canton). The remaining metals analyses were subcontracted to Eurofins TA in Irvine, California (Eurofins TA - Irvine). The radium analyses were subcontracted to Eurofins TA in St. Louis, Missouri (Eurofins TA – St. Louis). The laboratory analytical results were reported in laboratory sample delivery groups (SDGs) 240-120782-1 and 240-120782-2.

During the October 2019 sampling event, a groundwater sample was collected from each of the following wells:

- MW-15002
- MW-15008
- MW-15016
- MW-15019

Each sample was analyzed for the following constituents:

Analyte Group	Method
Anions (Fluoride, Chloride, Sulfate)	EPA 300.0
Total Dissolved Solids (TDS)	SM 2540C-11
Total Metals	SW-846 6020, SW-846 6010B, SW-846 7470A
Radium (Radium-226, Radium-228, Combined Radium)	EPA 903.0, EPA 904.0

TRC reviewed the laboratory data to assess data usability. The following sections summarize the data review procedure and the results of the review.

Data Usability Review Procedure

The analytical data were reviewed using the USEPA National Functional Guidelines for Inorganic Superfund Methods Data Review (USEPA, 2017) and the Department of Energy Evaluation of Radiochemical Data Usability (USDOE, 1997). The following items were included in the evaluation of the data:

- Sample receipt;
- Technical holding times for analyses;
- Reporting limits (RLs) compared to project-required RLs;

- Data for method blanks and field blanks. Method blanks are used to assess potential contamination arising from laboratory sample preparation and/or analytical procedures. Field blanks are used to assess potential contamination arising from field procedures;
- Data for laboratory control samples (LCSs) and laboratory control sample duplicates (LCSDs), when performed. The LCSs and/or LCSDs are used to assess the accuracy of the analytical method using a clean matrix;
- Percent recoveries for matrix spike (MS) and matrix spike duplicates (MSD), when performed on project samples. Percent recoveries are calculated for each analyte spiked and used to assess bias due to sample matrix effects;
- Data for laboratory duplicates, when performed on project samples. The laboratory duplicates are replicate analyses of one sample and are used to assess the precision of the analytical method;
- Percent recoveries for carriers, where applicable, for radiochemistry only. Carriers are used to assess the chemical yield for the preparation and/or instrument efficiency;
- Data for blind field duplicates. Field duplicate samples are used to assess variability introduced by the sampling and analytical processes; and
- Overall usability of the data.

This data usability report addresses the following items:

- Usability of the data if quality control (QC) results suggest potential problems with all or some of the data;
- Actions regarding specific QC criteria exceedances.

Review Summary

The data quality objectives and laboratory completeness goals for the project were met, and the data are usable for their intended purpose. A summary of the data quality review, including non-conformances and issues identified in this evaluation, are noted below.

- Appendix III and IV constituents as well as iron, copper, nickel, silver, vanadium, and zinc will be utilized for the purposes of an assessment monitoring program.
- Data are usable for the purposes of the assessment monitoring program.
- When the data are evaluated through an assessment monitoring statistical program, findings below may be used to support the removal of outliers.

QA/QC Sample Summary:

- A method blank was analyzed with each analytical batch; no analytes were detected in the method blank samples.

- One field blank (FB-5) was collected. The following analytes were detected in this blank sample:
  - Radium-228 and combined radium were detected in field blank FB-05 at concentrations of 0.726 ± 0.358 pCi/L and 0.596 ± 0.369 pCi/L, respectively. The detected radium-228 and combined radium results for select samples associated with this field blank were potentially impacted, as summarized in the attached table, Attachment 1.
- The LCS and/or LCSD recoveries and relative percent differences (RPDs), where applicable, for all analytes were within QC limits.
- MS and MSD analyses were performed on sample MW-15002 for select metals. All recoveries and RPDs were within the QC limits with the following exceptions.
  - The recovery of calcium was outside of the acceptance criteria in the MS analysis. The calcium concentration in this sample was >4x the spike concentration; therefore, the MS/MSD results for calcium were not evaluated. Data usability was not affected.
- An MS/MSD was not analyzed for anions, lithium, and mercury per the Sampling and Analysis Plan at a frequency of 1 per 20 samples.
- The field duplicate pair samples were Dup-05 and MW-15016; RPDs between the parent and duplicate sample were within the QC limits.
- Laboratory duplicate analysis was performed on sample MW-15002 for TDS; the RPD was within QC limits.
- Samples did not undergo a 21-day wait period prior to radium analysis; however, combined radium results were < 5 pCi/L so there is no impact on data usability.
- Carrier recoveries, where applicable, were within 40-110%.

Attachment 1

Summary of Data Non-Conformances for Groundwater Analytical Data
JC Weadock/Karn Background – RCRA CCR Monitoring Program
Essexville, Michigan

Samples	Collection Date	Analyte	Non-Conformance/Issue
MW-15008	10/15/2019	Combined Radium	Detection in field blank (FB-05). Normalized absolute difference between blank and samples <1.96; indicates possible false positive results.
MW-15019	10/16/2019		
MW-15019	10/16/2019	Radium-228	Detection in field blank (FB-05). Normalized absolute difference between blank and sample <1.96; indicates possible false positive result.

Laboratory Data Quality Review
Groundwater Monitoring Event October 2019
JC Weadock Bottom Ash Pond

Groundwater samples were collected by TRC for the October 2019 sampling event. Samples were analyzed for lithium, anions, and total dissolved solids by Eurofins TA in North Canton, Ohio (Eurofins TA – Canton). The remaining metals analyses were subcontracted to Eurofins TA in Irvine, California (Eurofins TA - Irvine). The radium analyses were subcontracted to Eurofins TA in St. Louis, Missouri (Eurofins TA – St. Louis). The laboratory analytical results were reported in laboratory sample delivery groups (SDGs) 240-120635-1 and 240-120635-2.

During the October 2019 sampling event, a groundwater sample was collected from each of the following wells:

- JCW-MW-15007
- JCW-MW-15009
- JCW-MW-15010
- JCW-MW-15028

Each sample was analyzed for one or more of the following constituents:

Analyte Group	Method
Anions (Fluoride, Chloride, Sulfate)	EPA 300.0
Total Dissolved Solids (TDS)	SM 2540C-11
Total Metals	SW-846 6020, SW-846 6010B, SW-846 7470A
Radium (Radium-226, Radium-228, Combined Radium)	EPA 903.0, EPA 904.0

TRC reviewed the laboratory data to assess data usability. The following sections summarize the data review procedure and the results of the review.

Data Usability Review Procedure

The analytical data were reviewed using the USEPA National Functional Guidelines for Inorganic Superfund Methods Data Review (USEPA, 2017) and the Department of Energy Evaluation of Radiochemical Data Usability (USDOE, 1997). The following items were included in the evaluation of the data:

- Sample receipt;
- Technical holding times for analyses;
- Reporting limits (RLs) compared to project-required RLs;

- Data for method blanks, equipment blanks, and field blanks. Method blanks are used to assess potential contamination arising from laboratory sample preparation and/or analytical procedures. Field and equipment blanks are used to assess potential contamination arising from field procedures;
- Data for laboratory control samples (LCSs) and laboratory control sample duplicates (LCSDs), when performed. The LCSs and/or LCSDs are used to assess the accuracy of the analytical method using a clean matrix;
- Percent recoveries for matrix spike (MS) and matrix spike duplicates (MSD), when performed on project samples. Percent recoveries are calculated for each analyte spiked and used to assess bias due to sample matrix effects;
- Data for laboratory duplicates, when performed on project samples. The laboratory duplicates are replicate analyses of one sample and are used to assess the precision of the analytical method;
- Percent recoveries for carriers, where applicable, for radiochemistry only. Carriers are used to assess the chemical yield for the preparation and/or instrument efficiency;
- Data for blind field duplicates. Field duplicate samples are used to assess variability introduced by the sampling and analytical processes; and
- Overall usability of the data.

This data usability report addresses the following items:

- Usability of the data if quality control (QC) results suggest potential problems with all or some of the data;
- Actions regarding specific QC criteria exceedances.

Review Summary

The data quality objectives and laboratory completeness goals for the project were met, and the data are usable for their intended purpose. A summary of the data quality review, including non-conformances and issues identified in this evaluation, are noted below.

- Appendix III and IV constituents as well as iron, copper, nickel, silver, vanadium, and zinc will be utilized for the purposes of an assessment monitoring program.
- Data are usable for the purposes of the assessment monitoring program.
- When the data are evaluated through an assessment monitoring statistical program, findings below may be used to support the removal of outliers.

QA/QC Sample Summary:

- A method blank was analyzed with each analytical batch; no analytes were detected in the method blank samples.

- One equipment blank (EB-02) and one field blank (FB-02) were collected. The following analytes were detected in these blank samples:
  - Zinc was detected in EB-02 at 0.012 mg/L. The detected zinc result in one sample, JCW-MW-15010, associated with the equipment blank was potentially impacted, as summarized in the attached table, Attachment 1.
  - The following analytes were detected in FB-02: chromium at 0.0031 mg/L, iron at 0.024 mg/L, and nickel at 0.0021 mg/L. The presence of chromium, iron, and nickel in this field blank has no effect on the sample results since these analytes were either not detected or >5x the blank concentration.
- The LCS and/or LCSD recoveries and relative percent differences (RPDs), where applicable, for all analytes were within QC limits.
- MS and MSD analyses were performed on were performed sample JCW-MW-15009 for metals and anions. All recoveries and RPDs were within the QC limits with the following exceptions.
  - The recoveries of calcium and iron were outside of the acceptance criteria in the MS/MSD analyses. The calcium and iron concentrations in this sample were >4x the spike concentrations; therefore, the MS/MSD results for calcium and iron were not evaluated. Data usability was not affected.
  - The recoveries for selenium and sulfate in the MSD analyses performed on sample JCW-MW-15009 were below the control limits. Potential low bias exists for the results for selenium and sulfate in all samples collected during this event, as summarized in the attached table, Attachment A.
- The field duplicate pair samples were Dup-02 and JCW-MW-15007; RPDs between the parent and duplicate sample were within the QC limits.
- Laboratory duplicate analysis was performed on sample JCW-MW-15009 for TDS; the RPD was within QC limits.
- The nondetect RLs for fluoride in samples JCW-MW-15007 and DUP-02 (5.0 mg/L) were above the project-specified RL (1 mg/L) due to a 5-fold dilution likely performed due to elevated concentrations of chloride.
- Samples did not undergo a 21-day wait period prior to radium analysis; however, combined radium results were < 5 pCi/L so there is no impact on data usability.
- Carrier recoveries, where applicable, were within 40-110%.

Attachment 1

Summary of Data Non-Conformances for Groundwater Analytical Data
JC Weadock/Karn Bottom Ash Pond – RCRA CCR Monitoring Program
Essexville, Michigan

Samples	Collection Date	Analyte	Non-Conformance/Issue
JCW-MW-15010	10/14/2019	Zinc	Detection in equipment blank (EB-02). Resuls <5x the blank result; indicates possible false positive result.
JCW-MW-15007	10/15/2019	Sulfate	Low recovery in matrix spike duplicate analysis; indicates potential low bias. Detected concentrations are within the range of historically observed concetration at these wells; therefore, data deemed usable for intended purpose.
DUP-02	10/15/2019		
JCW-MW-15009	10/15/2019		
JCW-MW-15010	10/14/2019		
JCW-MW-15028	10/14/2019		
JCW-MW-15007	10/15/2019	Selenium	Low recovery in matrix spike duplicate analysis; indicates potential low bias. etected concentrations are within the range of historically observed concetration at these wells; therefore, data deemed usable for intended purpose.
DUP-02	10/15/2019		
JCW-MW-15009	10/15/2019		
JCW-MW-15010	10/14/2019		
JCW-MW-15028	10/14/2019		

Appendix C
Nature and Extent Data

Table 1
Summary of Groundwater Sampling Results (Analytical): March 2016-April 2019
DE Karn & JC Weadock Background – RCRA CCR Monitoring Program
Essexville, Michigan

									Sample Location:	MW-15002									
									Sample Date:	3/28/2016	5/23/2016	8/22/2016	11/30/2016	2/22/2017	5/17/2017	8/1/2017	9/19/2017	4/9/2018	5/22/2018	11/8/2018	4/8/2019
Constituent	Unit	GWPS*	MI Residential*	MI Non-Residential*	MI GSI^	MI AMV***	MI FAV***	Chronic MZ^^	Acute MZ^^	Background											
Appendix III																					
Boron	ug/L	NA	500	500	4,000	34,000	69,000	44,000	69,000	**22**	**163**	**79**	**48**	**133**	**138**	**205**	**313**	--	**69.2**	**76.8**	**110**
Calcium	mg/L	NA	NC	NC	500	NC	NC	NC	NC	**174**	**288**	**114**	**84.7**	**260**	**267**	**255**	**249**	--	**221**	**88.5**	**230**
Chloride	mg/L	NA	250	250	50	NC	NC	NC	NC	**773**	**2,140**	**420**	**260**	**1,470**	**1,970**	**2,290**	**2,270**	--	**2,020**	**499**	**2,200**
Fluoride	ug/L	4,000	NC	NC	NC	9,700	20,000	NC	NC	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 20,000(1)
Sulfate	mg/L	NA	250	250	500	NC	NC	NC	NC	**40.3**	**5.25**	**39.8**	**23.4**	**13.1**	**11.5**	< 2.0	< 2.0	--	**37.8**	**25.6**	< 40
Total Dissolved Solids	mg/L	NA	500	500	500	NC	NC	NC	NC	**1700**	**4,500**	**1,300**	**980**	**3,100**	**4,300**	**4,600**	**4,280**	--	**3,810**	**1,230**	**4,700**
pH, Field	SU	NA	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	NC	NC	NC	NC	**7.0**	**6.6**	**6.9**	**7.2**	**7.0**	**6.8**	**6.9**	**6.9**	**6.7**	**7.0**	**7.3**	**7.0**
Appendix IV																					
Antimony	ug/L	6	6.0	6.0	2.0	1,100	2,300	NC	NC	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	21	10	10	10	340	680	100	680	< 1	**7**	< 1	**2**	**2**	**3**	**4.8**	--	< 1.0	< 1.0	**2.8**	< 1.0
Barium	ug/L	2,000	2,000	2,000	1,200	3,400	7,000	NC	NC	**216**	**796**	**167**	**212**	**851**	**580**	**912**	--	**547**	**364**	**290**	**510**
Beryllium	ug/L	4	4.0	4.0	33	300	600	NC	NC	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	5	5.0	5.0	2.5	12	24	NC	NC	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20	< 0.20
Chromium	ug/L	100	100	100	11	16	32	NC	NC	**1**	**2**	< 1	**1**	**1**	**2**	**1.3**	--	< 1.0	< 1.0	< 1.0	**1.2**
Cobalt	ug/L	15	40	100	100	370	740	NC	NC	< 15	< 15	< 15	< 15	< 15	< 15	< 15.0	--	< 15.0	< 15.0	< 6.0	< 6.0
Fluoride	ug/L	4,000	NC	NC	NC	10,000	20,000	NC	NC	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 20,000(1)
Lead	ug/L	15	4.0	4.0	14	250	500	NC	NC	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0
Lithium	ug/L	180	170	350	440	910	1,800	NC	NC	< 10	**21**	< 10	< 10	**24**	**22**	**31**	--	**24**	**14**	**16**	**17**
Mercury	ug/L	2	2.0	2.0	0.20#	1.4	2.8	NC	NC	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	100	73	210	120	29,000	58,000	NC	NC	< 5	< 5	< 5	< 5	< 5	< 5	< 5.0	--	< 5.0	< 5.0	< 5.0	< 5.0
Radium-226/228	pCi/L	5	NC	NC	NC	NC	NC	NC	NC	< 0.644	**2.52**	< 1.05	< 0.433	**2.04**	**2.98**	**4.65**	--	**2.45**	**2.47**	**1.90**	--
Selenium	ug/L	50	50	50	5.0	62	120	55	120	< 1	**1**	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0
Thallium	ug/L	2	2.0	2.0	2.0	47	94	NC	NC	< 2	< 2	< 2	< 2	< 2	< 2	< 2.0	--	< 2.0	< 2.0	< 2.0	< 2.0

Notes:
ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units; pH is a field parameter.
pCi/L - picocuries per liter.
NA - not applicable.
NC - no criteria.
-- - not analyzed. April 2019 radium data pending.
* - 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.
** - Michigan Part 201 Generic Drinking Water Cleanup Criteria, December 30, 2013.
^ - Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria. Hardness-dependent criteria calculated using hardness of 258 mg CaCO3/L (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018) per footnote {G} of Michigan Part 201 criteria tables. Chromium GSI criterion based on hexavalent chromium per footnote {H}. GSI criterion is protective for surface water used as a drinking water source as described in footnote {X}. GSI criterion for chloride is 50 mg/L when the discharge is to the Great Lakes or connecting waters per footnote {FF}
*** - Aquatic Maximum (AMV) and Final Acute Values (FAV) are taken from MDEQ Rule 323.1057 Part 4 - Water Quality Standards (Rule 57), March 15, 2018. Hardness-dependent criteria calculated using site-specific hardness of 258 mg CaCO3/L as measured at surface water sample SW-01 collected on April 9, 2018 from the Pigeon River. Chromium AMV & FAV criteria is based on hexavalent chromium.
^^ - Mixing Zone GSI Criteria from Michigan Department of Environmental Quality (MDEQ) approval letter dated December 23, 2015.
# - If detected above 0.20 ug/L, further evaluation of low-level mercury may be necessary to evaluate the GSI pathway per Michigan Part 201 and MDEQ policy and procedure 09-014 dated June 20, 2012.
BOLD font denotes concentrations detected above laboratory reporting limits.
Result Indicates an exceedance of one or more applicable criteria.
Result Indicates an exceedance of acute-based mixing zone GSI criteria.
All metals were analyzed as total unless otherwise specified.
(1) Laboratory reporting limit exceeds one or more applicable criteria due to sample dilution.

Table 1

Summary of Groundwater Sampling Results (Analytical): March 2016-April 2019

DE Karn & JC Weadock Background – RCRA CCR Monitoring Program

Essexville, Michigan

									Sample Location:	MW-15008									
									Sample Date:	3/29/2016	5/24/2016	8/23/2016	11/30/2016	2/22/2017	5/17/2017	8/2/2017	9/19/2017	4/10/2018	5/22/2018	11/8/2018	4/8/2019
Constituent	Unit	GWPS*	MI Residential*	MI Non-Residential*	MI GSI^	MI AMV***	MI FAV***	Chronic MZ^^	Acute MZ^^	Background											
Appendix III																					
Boron	ug/L	NA	500	500	4,000	34,000	69,000	44,000	69,000	**169**	**176**	**202**	**204**	**174**	**187**	**164**	**183**	--	**153**	**209**	**150**
Calcium	mg/L	NA	NC	NC	500	NC	NC	NC	NC	**126**	**113**	**114**	**113**	**107**	**114**	**108**	**109**	--	**111**	**129**	**110**
Chloride	mg/L	NA	250	250	50	NC	NC	NC	NC	**231**	**246**	**214**	**192**	**200**	**149**	**300**	**329**	--	**255**	**302**	**280**
Fluoride	ug/L	4,000	NC	NC	NC	9,700	20,000	NC	NC	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Sulfate	mg/L	NA	250	250	500	NC	NC	NC	NC	**26.7**	**8.6**	**17.9**	**25.6**	**27.7**	**10.1**	**13.4**	**3.9**	--	**4.3**	**11.2**	**4.9**
Total Dissolved Solids	mg/L	NA	500	500	500	NC	NC	NC	NC	**720**	**880**	**730**	**790**	**760**	**840**	**866**	**848**	--	**744**	**882**	**880**
pH, Field	SU	NA	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	NC	NC	NC	NC	**6.7**	**6.5**	**6.7**	**6.8**	**6.8**	**6.7**	**6.9**	**6.8**	**6.6**	**6.8**	**6.8**	**6.7**
Appendix IV																					
Antimony	ug/L	6	6.0	6.0	2.0	1,100	2,300	NC	NC	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	21	10	10	10	340	680	100	680	**1**	**1**	**1**	**1**	< 1	< 1	< 1.0	--	< 1.0	< 1.0	**1.6**	< 1.0
Barium	ug/L	2,000	2,000	2,000	1,200	3,400	7,000	NC	NC	**64**	**63**	**58**	**69**	**57**	**60**	**58.2**	--	**57.1**	**54.7**	**71.4**	**65**
Beryllium	ug/L	4	4.0	4.0	33	300	600	NC	NC	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	5	5.0	5.0	2.5	12	24	NC	NC	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20	< 0.20
Chromium	ug/L	100	100	100	11	16	32	NC	NC	**2**	**3**	**2**	**2**	**1**	**2**	**1.1**	--	< 1.0	**2.0**	**1.1**	**2.2**
Cobalt	ug/L	15	40	100	100	370	740	NC	NC	< 15	< 15	< 15	< 15	< 15	< 15	< 15.0	--	< 15.0	< 15.0	< 6.0	< 6.0
Fluoride	ug/L	4,000	NC	NC	NC	10,000	20,000	NC	NC	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Lead	ug/L	15	4.0	4.0	14	250	500	NC	NC	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0
Lithium	ug/L	180	170	350	440	910	1,800	NC	NC	**19.7**	**17**	**20**	**22**	**20**	**19**	**22**	--	**26**	**19**	**33**	**19**
Mercury	ug/L	2	2.0	2.0	0.20#	1.4	2.8	NC	NC	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	100	73	210	120	29,000	58,000	NC	NC	< 5	< 5	< 5	< 5	< 5	< 5	< 5.0	--	< 5.0	< 5.0	< 5.0	< 5.0
Radium-226/228	pCi/L	5	NC	NC	NC	NC	NC	NC	NC	**1.42**	**1.61**	**1.96**	**1.45**	**0.826**	**1.45**	< 1.79	--	< 1.26	**2.00**	< 1.67	--
Selenium	ug/L	50	50	50	5.0	62	120	55	120	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0
Thallium	ug/L	2	2.0	2.0	2.0	47	94	NC	NC	< 2	< 2	< 2	< 2	< 2	< 2	< 2.0	--	< 2.0	< 2.0	< 2.0	< 2.0

Notes:

ug/L - micrograms per liter.

mg/L - milligrams per liter.

SU - standard units; pH is a field parameter.

pCi/L - picocuries per liter.

NA - not applicable.

NC - no criteria.

-- - not analyzed. April 2019 radium data pending.

* - 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.

** - Michigan Part 201 Generic Drinking Water Cleanup Criteria, December 30, 2013.

^ - Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria. Hardness-dependent criteria calculated using hardness of 258 mg CaCO3/L (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018) per footnote {G} of Michigan Part 201 criteria tables. Chromium GSI criterion based on hexavalent chromium per footnote {H}. GSI criterion is protective for surface water used as a drinking water source as described in footnote {X}. GSI criterion for chloride is 50 mg/L when the discharge is to the Great Lakes or connecting waters per footnote {FF}

*** - Aquatic Maximum (AMV) and Final Acute Values (FAV) are taken from MDEQ Rule 323.1057 Part 4 - Water Quality Standards (Rule 57), March 15, 2018. Hardness-dependent criteria calculated using site-specific hardness of 258 mg CaCO3/L as measured at surface water sample SW-01 collected on April 9, 2018 from the Pigeon River. Chromium AMV & FAV criteria is based on hexavalent chromium.

^^ - Mixing Zone GSI Criteria from Michigan Department of Environmental Quality (MDEQ) approval letter dated December 23, 2015.

- If detected above 0.20 ug/L, further evaluation of low-level mercury may be necessary to evaluate the GSI pathway per Michigan Part 201 and MDEQ policy and procedure 09-014 dated June 20, 2012.

BOLD font denotes concentrations detected above laboratory reporting limits.

Result	Indicates an exceedance of one or more applicable criteria.
Result	Indicates an exceedance of acute-based mixing zone GSI criteria.

All metals were analyzed as total unless otherwise specified.

(1) Laboratory reporting limit exceeds one or more applicable criteria due to sample dilution.

Table 1

Summary of Groundwater Sampling Results (Analytical): March 2016-April 2019

DE Karn & JC Weadock Background – RCRA CCR Monitoring Program

Essexville, Michigan

									Sample Location:	MW-15016										
									Sample Date:	3/29/2016	5/24/2016	8/22/2016	11/30/2016	2/22/2017	5/17/2017	8/1/2017	9/19/2017	4/10/2018	5/22/2018	11/8/2018	4/9/2019
Constituent	Unit	GWPS*	MI Residential*	MI Non-Residential*	MI GSI^	MI AMV***	MI FAV***	Chronic MZ^^	Acute MZ^^	Background										
Appendix III																				
Boron	ug/L	NA	500	500	4,000	34,000	69,000	44,000	69,000	**56**	**472**	**660**	**435**	**463**	**491**	**590**	**602**	--	**409**	**329**	**270**
Calcium	mg/L	NA	NC	NC	500	NC	NC	NC	NC	**204**	**188**	**216**	**192**	**295**	**221**	**208**	**160**	--	**212**	**171**	**180**
Chloride	mg/L	NA	250	250	50	NC	NC	NC	NC	**264**	**91**	**94**	**83**	**160**	**110**	**113**	**99.5**	--	**82.4**	**57.5**	**75**
Fluoride	ug/L	4,000	NC	NC	NC	9,700	20,000	NC	NC	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Sulfate	mg/L	NA	250	250	500	NC	NC	NC	NC	**151**	**75**	**70.6**	**18.1**	**817**	**243**	**294**	**13.3**	--	**539**	**347**	**370**
Total Dissolved Solids	mg/L	NA	500	500	500	NC	NC	NC	NC	**1,000**	**900**	**920**	**840**	**1,700**	**1,100**	**1,090**	**756**	--	**1,230**	**806**	**970**
pH, Field	SU	NA	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	NC	NC	NC	NC	**7.1**	**6.8**	**6.8**	**7.0**	**7.2**	**7.0**	**7.0**	**7.1**	**7.3**	**7.3**	**7.3**	**6.9**
Appendix IV																				
Antimony	ug/L	6	6.0	6.0	2.0	1,100	2,300	NC	NC	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	21	10	10	10	340	680	100	680	**2**	**16**	**18**	**16**	**2**	**12**	**20.5**	--	< 1.0	< 1.0	< 1.0	**2.1**
Barium	ug/L	2,000	2,000	2,000	1,200	3,400	7,000	NC	NC	**114**	**233**	**299**	**241**	**109**	**151**	**197**	--	**41.8**	**47.4**	**31.3**	**43**
Beryllium	ug/L	4	4.0	4.0	33	300	600	NC	NC	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	5	5.0	5.0	2.5	12	24	NC	NC	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20	< 0.20
Chromium	ug/L	100	100	100	11	16	32	NC	NC	**1**	**1**	< 1	< 1	**2**	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0
Cobalt	ug/L	15	40	100	100	370	740	NC	NC	< 15	< 15	< 15	< 15	< 15	< 15	< 15.0	--	< 15.0	< 15.0	< 6.0	< 6.0
Fluoride	ug/L	4,000	NC	NC	NC	10,000	20,000	NC	NC	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Lead	ug/L	15	4.0	4.0	14	250	500	NC	NC	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0
Lithium	ug/L	180	170	350	440	910	1,800	NC	NC	**16.9**	**33**	**48**	**28**	**181**	**88**	**83**	--	**120**	**100**	**81**	**110**
Mercury	ug/L	2	2.0	2.0	0.20#	1.4	2.8	NC	NC	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	100	73	210	120	29,000	58,000	NC	NC	< 5	< 5	< 5	< 5	**6**	< 5	< 5.0	--	**5.4**	**6.5**	**5.6**	< 5.0
Radium-226/228	pCi/L	5	NC	NC	NC	NC	NC	NC	NC	**0.750**	**1.40**	< 1.41	**1.08**	**0.736**	**0.958**	< 2.34	--	< 1.36	< 1.48	< 1.25	--
Selenium	ug/L	50	50	50	5.0	62	120	55	120	< 1	< 1	< 1	< 1	**2**	**1**	< 1.0	--	**1.7**	**1.2**	**2.2**	< 1.0
Thallium	ug/L	2	2.0	2.0	2.0	47	94	NC	NC	< 2	< 2	< 2	< 2	< 2	< 2	< 2.0	--	< 2.0	< 2.0	< 2.0	< 2.0

Notes:

ug/L - micrograms per liter.

mg/L - milligrams per liter.

SU - standard units; pH is a field parameter.

pCi/L - picocuries per liter.

NA - not applicable.

NC - no criteria.

-- - not analyzed. April 2019 radium data pending.

* - 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.

** - Michigan Part 201 Generic Drinking Water Cleanup Criteria, December 30, 2013.

^ - Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria. Hardness-dependent criteria calculated using hardness of 258 mg CaCO3/L (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018) per footnote {G} of Michigan Part 201 criteria tables. Chromium GSI criterion based on hexavalent chromium per footnote {H}. GSI criterion is protective for surface water used as a drinking water source as described in footnote {X}. GSI criterion for chloride is 50 mg/L when the discharge is to the Great Lakes or connecting waters per footnote {FF}

*** - Aquatic Maximum (AMV) and Final Acute Values (FAV) are taken from MDEQ Rule 323.1057 Part 4 - Water Quality Standards (Rule 57), March 15, 2018. Hardness-dependent criteria calculated using site-specific hardness of 258 mg CaCO3/L as measured at surface water sample SW-01 collected on April 9, 2018 from the Pigeon River. Chromium AMV & FAV criteria is based on hexavalent chromium.

^^ - Mixing Zone GSI Criteria from Michigan Department of Environmental Quality (MDEQ) approval letter dated December 23, 2015.

- If detected above 0.20 ug/L, further evaluation of low-level mercury may be necessary to evaluate the GSI pathway per Michigan Part 201 and MDEQ policy and procedure 09-014 dated June 20, 2012.

BOLD font denotes concentrations detected above laboratory reporting limits.

Result	Indicates an exceedance of one or more applicable criteria.
Result	Indicates an exceedance of acute-based mixing zone GSI criteria.

All metals were analyzed as total unless otherwise specified.

(1) Laboratory reporting limit exceeds one or more applicable criteria due to sample dilution.

Table 1
Summary of Groundwater Sampling Results (Analytical): March 2016-April 2019
DE Karn & JC Weadock Background – RCRA CCR Monitoring Program
Essexville, Michigan

									Sample Location:	MW-15019									
									Sample Date:	3/29/2016	5/24/2016	8/23/2016	11/30/2016	2/22/2017	5/16/2017	8/2/2017	9/19/2017	4/9/2018	5/22/2018	11/8/2018	4/8/2019
Constituent	Unit	GWPS*	MI Residential*	MI Non-Residential*	MI GSI^	MI AMV***	MI FAV***	Chronic MZ^^	Acute MZ^^	Background											
Appendix III																					
Boron	ug/L	NA	500	500	4,000	34,000	69,000	44,000	69,000	**244**	**279**	**343**	**300**	**317**	**299**	**293**	**324**	--	**225**	**328**	**270**
Calcium	mg/L	NA	NC	NC	500	NC	NC	NC	NC	**150**	**179**	**227**	**154**	**149**	**146**	**165**	**155**	--	**128**	**142**	**140**
Chloride	mg/L	NA	250	250	50	NC	NC	NC	NC	**387**	**408**	**358**	**359**	**379**	**357**	**380**	**438**	--	**382**	**415**	**430**
Fluoride	ug/L	4,000	NC	NC	NC	9,700	20,000	NC	NC	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Sulfate	mg/L	NA	250	250	500	NC	NC	NC	NC	**51.2**	**116**	**195**	**67.3**	**54.2**	**49.5**	**120**	**99.7**	--	**51.6**	**40.6**	**46**
Total Dissolved Solids	mg/L	NA	500	500	500	NC	NC	NC	NC	**1,100**	**1,300**	**1,300**	**1,100**	**1,200**	**1,100**	**1,250**	**1,200**	--	**1,080**	**1,080**	**1,200**
pH, Field	SU	NA	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	NC	NC	NC	NC	**6.8**	**6.7**	**6.7**	**6.8**	**6.8**	**6.8**	**6.9**	**6.9**	**6.8**	**6.9**	**6.9**	**7.0**
Appendix IV																					
Antimony	ug/L	6	6.0	6.0	2.0	1,100	2,300	NC	NC	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	21	10	10	10	340	680	100	680	< 1	**1**	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0
Barium	ug/L	2,000	2,000	2,000	1,200	3,400	7,000	NC	NC	**263**	**269**	**319**	**275**	**289**	**283**	**265**	--	**246**	**258**	**281**	**300**
Beryllium	ug/L	4	4.0	4.0	33	300	600	NC	NC	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	5	5.0	5.0	2.5	12	24	NC	NC	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20	< 0.20
Chromium	ug/L	100	100	100	11	16	32	NC	NC	**2**	**2**	< 1	< 1	**1**	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0
Cobalt	ug/L	15	40	100	100	370	740	NC	NC	< 15	< 15	< 15	< 15	< 15	< 15	< 15.0	--	< 15.0	< 15.0	< 6.0	< 6.0
Fluoride	ug/L	4,000	NC	NC	NC	10,000	20,000	NC	NC	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Lead	ug/L	15	4.0	4.0	14	250	500	NC	NC	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0
Lithium	ug/L	180	170	350	440	910	1,800	NC	NC	**11**	**14**	**21**	**13**	**13**	**14**	**16**	--	**17**	**11**	**17**	**12**
Mercury	ug/L	2	2.0	2.0	0.20#	1.4	2.8	NC	NC	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	100	73	210	120	29,000	58,000	NC	NC	< 5	< 5	< 5	< 5	< 5	< 5	< 5.0	--	< 5.0	< 5.0	< 5.0	< 5.0
Radium-226/228	pCi/L	5	NC	NC	NC	NC	NC	NC	NC	**1.24**	**1.50**	**1.68**	**1.01**	**1.05**	**1.74**	< 1.57	--	**1.03**	< 1.56	**2.04**	--
Selenium	ug/L	50	50	50	5.0	62	120	55	120	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0
Thallium	ug/L	2	2.0	2.0	2.0	47	94	NC	NC	< 2	< 2	< 2	< 2	< 2	< 2	< 2.0	--	< 2.0	< 2.0	< 2.0	< 2.0

Notes:
ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units; pH is a field parameter.
pCi/L - picocuries per liter.
NA - not applicable.
NC - no criteria.
-- - not analyzed. April 2019 radium data pending.
* - 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.
** - Michigan Part 201 Generic Drinking Water Cleanup Criteria, December 30, 2013.
^ - Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria. Hardness-dependent criteria calculated using hardness of 258 mg CaCO3/L (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018) per footnote {G} of Michigan Part 201 criteria tables. Chromium GSI criterion based on hexavalent chromium per footnote {H}. GSI criterion is protective for surface water used as a drinking water source as described in footnote {X}. GSI criterion for chloride is 50 mg/L when the discharge is to the Great Lakes or connecting waters per footnote {FF}
*** - Aquatic Maximum (AMV) and Final Acute Values (FAV) are taken from MDEQ Rule 323.1057 Part 4 - Water Quality Standards (Rule 57), March 15, 2018. Hardness-dependent criteria calculated using site-specific hardness of 258 mg CaCO3/L as measured at surface water sample SW-01 collected on April 9, 2018 from the Pigeon River. Chromium AMV & FAV criteria is based on hexavalent chromium.
^^ - Mixing Zone GSI Criteria from Michigan Department of Environmental Quality (MDEQ) approval letter dated December 23, 2015.
# - If detected above 0.20 ug/L, further evaluation of low-level mercury may be necessary to evaluate the GSI pathway per Michigan Part 201 and MDEQ policy and procedure 09-014 dated June 20, 2012.
BOLD font denotes concentrations detected above laboratory reporting limits.
Result Indicates an exceedance of one or more applicable criteria.
Result Indicates an exceedance of acute-based mixing zone GSI criteria.
All metals were analyzed as total unless otherwise specified.
(1) Laboratory reporting limit exceeds one or more applicable criteria due to sample dilution.

Table 2
Summary of Groundwater Sampling Results (Analytical): March 2016-April 2019
JC Weadock Bottom Ash Pond – RCRA CCR Monitoring Program
Essexville, Michigan

									Sample Location:	JCW-MW-15007									
									Sample Date:	4/1/2016	5/24/2016	8/23/2016	12/1/2016	2/23/2017	5/17/2017	8/3/2017	9/19/2018	4/10/2018	5/23/2018	11/7/2018	4/9/2019
Constituent	Unit	GWPS*	MI Residential*	MI Non-Residential*	MI GSI^	MI AMV***	MI FAV***	Chronic MZ^^	Acute MZ^^	downgradient											
Appendix III																					
Boron	ug/L	NA	500	500	4,000	34,000	69,000	44,000	69,000	**163**	**238**	**547**	**439**	**270**	**263**	< 20.0	**384**	--	**308**	**656**	**290**
Calcium	mg/L	NA	NC	NC	500	NC	NC	NC	NC	**119**	**133**	**106**	**124**	**226**	**177**	**182**	**140**	--	**145**	**153**	**200**
Chloride	mg/L	NA	250	250	50	NC	NC	NC	NC	**1,220**	**990**	**333**	**521**	**1,720**	**1,570**	**1,870**	**1,340**	--	**1,660**	**788**	**1,600**
Fluoride	ug/L	4,000	NC	NC	NC	9,700	20,000	NC	NC	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Sulfate	mg/L	NA	250	250	500	NC	NC	NC	NC	**20.1**	**21**	**30.5**	**26.3**	**20.9**	**22.9**	**34.5**	**8.8**	--	**19.6**	**23.9**	< 20
Total Dissolved Solids	mg/L	NA	500	500	500	NC	NC	NC	NC	**2,300**	**2,200**	**1,100**	**1,400**	**3,700**	**3,100**	**3,410**	**2,560**	--	**3,210**	**1,790**	**3,400**
pH, Field	SU	NA	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	NC	NC	NC	NC	**7.2**	**7.1**	**7.0**	**7.1**	**7.0**	**7.2**	**6.8**	**7.1**	**7.1**	**7.2**	**7.1**	**7.2**
Appendix IV																					
Antimony	ug/L	6	6.0	6.0	2.0	1,100	2,300	NC	NC	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	21	10	10	10	340	680	100	680	**15**	**20**	**55**	**37**	**26**	**23**	< 1.0	--	**16.7**	**25.6**	**46.3**	**9.8**
Barium	ug/L	2,000	2,000	2,000	1,200	3,400	7,000	NC	NC	**443**	**472**	**733**	**821**	**1,150**	**719**	< 1.0	--	**957**	**941**	**1,060**	**950**
Beryllium	ug/L	4[(1)]	4.0	4.0	33	300	600	NC	NC	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	5	5.0	5.0	2.5	12	24	NC	NC	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 1.0	< 0.20
Chromium	ug/L	100	100	100	11	16	32	NC	NC	**1**	**1**	< 1	**1**	**2**	**1**	< 1.0	--	< 1.0	< 1.0	< 5.0	< 1.0
Cobalt	ug/L	15	40	100	100	370	740	NC	NC	< 15	< 15	< 15	< 15	< 15	< 15	< 15.0	--	< 15.0	< 15.0	< 30.0	< 6.0
Fluoride	ug/L	4,000	NC	NC	NC	10,000	20,000	NC	NC	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Lead	ug/L	15	4.0	4.0	14	250	500	NC	NC	< 1	< 1	**3**	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 5.0[(2)]	< 1.0
Lithium	ug/L	180[(1)]	170	350	440	910	1,800	NC	NC	**52.3**	**61**	**65**	**61**	**77**	**75**	**100**	--	**80**	**88**	**87**	**67**
Mercury	ug/L	2	2.0	2.0	0.20#	1.4	2.8	NC	NC	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	100	73	210	120	29,000	58,000	NC	NC	**8**	**8**	**10**	**10**	**9**	**7**	< 5.0	--	**6.4**	**7.6**	< 25.0	**6.2**
Radium-226/228	pCi/L	5	NC	NC	NC	NC	NC	NC	NC	**1.25**	**1.70**	**1.47**	**1.26**	**2.61**	**1.80**	**2.89**	--	**1.64**	**1.03**	**2.31**	--
Selenium	ug/L	50	50	50	5.0	62	120	55	120	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	**1.2**	< 1.0	< 1.0	**3.2**
Thallium	ug/L	2	2.0	2.0	2.0	47	94	NC	NC	< 2	< 2	< 2	< 2	< 2	< 2	< 2.0	--	< 2.0	< 2.0	< 10.0[(2)]	< 2.0

Notes:
ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units; pH is a field parameter.
pCi/L - picocuries per liter.
NA - not applicable.
NC - no criteria.
-- - not analyzed. April 2019 radium data pending.
* - 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.
** - Michigan Part 201 Generic Drinking Water Cleanup Criteria, December 30, 2013.
^ - Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria. Hardness-dependent criteria calculated using hardness of 258 mg CaCO3/L (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018) per footnote {G} of Michigan Part 201 criteria tables. Chromium GSI criterion based on hexavalent chromium per footnote {H}. GSI criterion is protective for surface water used as a drinking water source as described in footnote {X}. GSI criterion for chloride is 50 mg/L when the discharge is to the Great Lakes or connecting waters per footnote {FF}
*** - Aquatic Maximum (AMV) and Final Acute Values (FAV) are taken from MDEQ Rule 323.1057 Part 4 - Water Quality Standards (Rule 57), March 15, 2018. Hardness-dependent criteria calculated using site-specific hardness of 258 mg CaCO3/L as measured at surface water sample SW-01 collected on April 9, 2018 from the Pigeon River. Chromium AMV & FAV criteria is based on hexavalent chromium.
^^ - Mixing Zone GSI Criteria from Michigan Department of Environmental Quality (MDEQ) approval letter dated December 23, 2015.
# - If detected above 0.20 ug/L, further evaluation of low-level mercury may be necessary to evaluate the GSI pathway per Michigan Part 201 and MDEQ policy and procedure 09-014 dated June 20, 2012.
BOLD font denotes concentrations detected above laboratory reporting limits.
Result Indicates an exceedance of one or more applicable criteria.
Result Indicates an exceedance of acute-based mixing zone GSI criteria.
All metals were analyzed as total unless otherwise specified.
(1) Constituent triggered an Assessment of Corrective Measures as described in TRC's letter report dated January 14, 2019.
(2) Laboratory reporting limit exceeds one or more applicable criteria due to sample dilutions.

Table 2
Summary of Groundwater Sampling Results (Analytical): March 2016-April 2019
JC Weadock Bottom Ash Pond – RCRA CCR Monitoring Program
Essexville, Michigan

									Sample Location:	JCW-MW-15009									
									Sample Date:	3/31/2016	5/25/2016	8/23/2016	12/1/2016	2/23/2017	5/18/2017	8/2/2017	9/18/2017	4/10/2018	5/23/2018	11/7/2018	4/9/2019
Constituent	Unit	GWPS*	MI Residential*	MI Non-Residential*	MI GSI^	MI AMV***	MI FAV***	Chronic MZ^^	Acute MZ^^	downgradient											
Appendix III																					
Boron	ug/L	NA	500	500	4,000	34,000	69,000	44,000	69,000	**284**	**402**	**501**	**498**	**366**	**329**	**429**	**533**	--	**297**	**422**	**290**
Calcium	mg/L	NA	NC	NC	500	NC	NC	NC	NC	**526**	**546**	**622**	**549**	**618**	**558**	**554**	**470**	--	**530**	**589**	**510**
Chloride	mg/L	NA	250	250	50	NC	NC	NC	NC	**97.4**	**163**	**171**	**154**	**95.5**	**52.6**	**84.8**	**113**	--	**41.0**	**64.9**	**43**
Fluoride	ug/L	4,000	NC	NC	NC	9,700	20,000	NC	NC	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 2,000
Sulfate	mg/L	NA	250	250	500	NC	NC	NC	NC	**1,790**	**2,650**	**2,030**	**2,280**	**1,880**	**1,710**	**2,680**	**3,090**	--	**1,690**	**1,980**	**1,600**
Total Dissolved Solids	mg/L	NA	500	500	500	NC	NC	NC	NC	**2,800**	**1,800**	**3,300**	**3,200**	**2,700**	**2,600**	**2,590**	**3,020**	--	**2,510**	**2,620**	**2,400**
pH, Field	SU	NA	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	NC	NC	NC	NC	**4.8**	**4.1**	**4.2**	**4.1**	**4.6**	**4.7**	**4.6**	**4.6**	**4.7**	**4.9**	**4.8**	**5.4**
Appendix IV																					
Antimony	ug/L	6	6.0	6.0	2.0	1,100	2,300	NC	NC	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	21	10	10	10	340	680	100	680	< 1	**2**	< 1	< 1	< 1	< 1	< 1.0	--	**1.6**	**1.4**	< 5.0	< 1.0
Barium	ug/L	2,000	2,000	2,000	1,200	3,400	7,000	NC	NC	**17**	**14**	**23**	**18**	**15**	**15**	**16.6**	--	**12.3**	**14.4**	**14.8**	**14**
Beryllium	ug/L	4[(1)]	4.0	4.0	33	300	600	NC	NC	**9**	**20**	**17**	**19**	**11**	**7**	**7.4**	--	**7.1**	**6.5**	**6.6**	**4.3**
Cadmium	ug/L	5	5.0	5.0	2.5	12	24	NC	NC	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 1.0	**0.24**
Chromium	ug/L	100	100	100	11	16	32	NC	NC	**2**	**5**	**4**	**4**	**3**	**1**	**1.5**	--	**1.4**	**1.4**	< 5.0	**1.4**
Cobalt	ug/L	15	40	100	100	370	740	NC	NC	< 15	**21**	< 15	< 15	< 15	< 15	< 15.0	--	< 15.0	< 15.0	< 30.0	< 6.0
Fluoride	ug/L	4,000	NC	NC	NC	10,000	20,000	NC	NC	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 2,000
Lead	ug/L	15	4.0	4.0	14	250	500	NC	NC	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 5.0[(2)]	< 1.0
Lithium	ug/L	180[(1)]	170	350	440	910	1,800	NC	NC	**139**	**238**	**280**	**300**	**216**	**182**	**270**	--	**210**	**190**	**240**	**150**
Mercury	ug/L	2	2.0	2.0	0.20#	1.4	2.8	NC	NC	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	100	73	210	120	29,000	58,000	NC	NC	**10**	< 5	< 5	< 5	< 5	< 5	< 5.0	--	< 5.0	< 5.0	< 25.0	< 5.0
Radium-226/228	pCi/L	5	NC	NC	NC	NC	NC	NC	NC	**1.07**	**0.683**	**1.59**	**1.61**	**1.75**	**1.31**	< 1.39	--	< 1.37	< 1.37	< 1.54	--
Selenium	ug/L	50	50	50	5.0	62	120	55	120	**3**	**3**	**1**	**3**	**2**	**1**	**1.4**	--	**14.2**	**5.2**	< 5.0	**2.0**
Thallium	ug/L	2	2.0	2.0	2.0	47	94	NC	NC	< 2	**2**	< 2	< 2	< 2	< 2	< 2.0	--	< 2.0	< 2.0	< 10.0[(2)]	< 2.0

Notes:
ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units; pH is a field parameter.
pCi/L - picocuries per liter.
NA - not applicable.
NC - no criteria.
-- - not analyzed. April 2019 radium data pending.
* - 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.
** - Michigan Part 201 Generic Drinking Water Cleanup Criteria, December 30, 2013.
^ - Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria. Hardness-dependent criteria calculated using hardness of 258 mg CaCO3/L (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018) per footnote {G} of Michigan Part 201 criteria tables. Chromium GSI criterion based on hexavalent chromium per footnote {H}. GSI criterion is protective for surface water used as a drinking water source as described in footnote {X}. GSI criterion for chloride is 50 mg/L when the discharge is to the Great Lakes or connecting waters per footnote {FF}
*** - Aquatic Maximum (AMV) and Final Acute Values (FAV) are taken from MDEQ Rule 323.1057 Part 4 - Water Quality Standards (Rule 57), March 15, 2018. Hardness-dependent criteria calculated using site-specific hardness of 258 mg CaCO3/L as measured at surface water sample SW-01 collected on April 9, 2018 from the Pigeon River. Chromium AMV & FAV criteria is based on hexavalent chromium.
^^ - Mixing Zone GSI Criteria from Michigan Department of Environmental Quality (MDEQ) approval letter dated December 23, 2015.
# - If detected above 0.20 ug/L, further evaluation of low-level mercury may be necessary to evaluate the GSI pathway per Michigan Part 201 and MDEQ policy and procedure 09-014 dated June 20, 2012.
BOLD font denotes concentrations detected above laboratory reporting limits.
Result Indicates an exceedance of one or more applicable criteria.
Result Indicates an exceedance of acute-based mixing zone GSI criteria.
All metals were analyzed as total unless otherwise specified.
(1) Constituent triggered an Assessment of Corrective Measures as described in TRC's letter report dated January 14, 2019.
(2) Laboratory reporting limit exceeds one or more applicable criteria due to sample dilutions.

Table 2
Summary of Groundwater Sampling Results (Analytical): March 2016-April 2019
JC Weadock Bottom Ash Pond – RCRA CCR Monitoring Program
Essexville, Michigan

										Sample Location:	JCW-MW-15010										
										Sample Date:	3/31/2016	5/25/2016	8/24/2016	12/1/2016	2/23/2017	5/17/2017	8/2/2017	9/19/2018	4/10/2018	5/22/2018	11/7/2018	4/9/2019
Constituent	Unit	GWPS*	MI Residential*	MI Non-Residential*	MI GSI^	MI AMV***	MI FAV***	Chronic MZ^^	Acute MZ^^		downgradient											
Appendix III																						
Boron	ug/L	NA	500	500	4,000	34,000	69,000	44,000	69,000		**987**	**1,070**	**1,320**	**1,370**	**1,360**	**1,390**	**1,580**	**1,340**	--	**1,330**	**1,360**	**1,400**
Calcium	mg/L	NA	NC	NC	500	NC	NC	NC	NC		**85.4**	**74.3**	**74**	**79.1**	**103**	**84.8**	**69.9**	**63.6**	--	**78.3**	**84.4**	**120**
Chloride	mg/L	NA	250	250	50	NC	NC	NC	NC		**87.8**	**81.5**	**78.1**	**92.8**	**88.8**	**89.8**	**92.7**	**89.5**	--	**99.8**	**96.5**	**140**
Fluoride	ug/L	4,000	NC	NC	NC	9,700	20,000	NC	NC		< 1,000	< 1,000	< 1,000	< 1,000	**1,300**	< 1,000	**1,000**	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Sulfate	mg/L	NA	250	250	500	NC	NC	NC	NC		**91.6**	**62.8**	**53.9**	**80.7**	**57.9**	**72.9**	**59.0**	**39.9**	--	**24.3**	**22.3**	**36**
Total Dissolved Solids	mg/L	NA	500	500	500	NC	NC	NC	NC		**500**	**440**	**400**	**490**	**460**	**480**	**832**	**392**	--	**458**	**492**	**670**
pH, Field	SU	NA	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	NC	NC	NC	NC		**7.4**	**7.4**	**7.6**	**7.5**	**7.3**	**7.5**	**7.5**	**7.5**	**7.3**	**7.5**	**7.4**	**7.6**
Appendix IV																						
Antimony	ug/L	6	6.0	6.0	2.0	1,100	2,300	NC	NC		< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	21	10	10	10	340	680	100	680		**39**	**25**	**34**	**27**	**25**	**23**	**23.2**	--	**12.5**	**11.4**	**9.5**	**16**
Barium	ug/L	2,000	2,000	2,000	1,200	3,400	7,000	NC	NC		**115**	**99**	**98**	**125**	**111**	**123**	**109**	--	**121**	**123**	**114**	**190**
Beryllium	ug/L	4[(1)]	4.0	4.0	33	300	600	NC	NC		< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	5	5.0	5.0	2.5	12	24	NC	NC		< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20	< 0.20
Chromium	ug/L	100	100	100	11	16	32	NC	NC		**1**	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	**1.2**	< 1.0
Cobalt	ug/L	15	40	100	100	370	740	NC	NC		< 15	< 15	< 15	< 15	< 15	< 15	< 15.0	--	< 15.0	< 15.0	< 6.0	< 6.0
Fluoride	ug/L	4,000	NC	NC	NC	10,000	20,000	NC	NC		< 1,000	< 1,000	< 1,000	< 1,000	**1,300**	< 1,000	**1,000**	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Lead	ug/L	15	4.0	4.0	14	250	500	NC	NC		< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0
Lithium	ug/L	180[(1)]	170	350	440	910	1,800	NC	NC		**52.7**	**55**	**53**	**60**	**57**	**61**	**61**	--	**77**	**72**	**70**	**73**
Mercury	ug/L	2	2.0	2.0	0.20#	1.4	2.8	NC	NC		< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	100	73	210	120	29,000	58,000	NC	NC		< 5	< 5	< 5	< 5	< 5	< 5	< 5.0	--	< 5.0	< 5.0	< 5.0	< 5.0
Radium-226/228	pCi/L	5	NC	NC	NC	NC	NC	NC	NC		< 0.364	< 0.585	**0.731**	< 0.584	**0.683**	**0.981**	< 1.35	--	< 2.04	< 1.36	< 1.66	--
Selenium	ug/L	50	50	50	5.0	62	120	55	120		< 1	< 1	< 1	< 1	**1**	**6**	< 1.0	--	< 1.0	**1.0**	< 1.0	< 1.0
Thallium	ug/L	2	2.0	2.0	2.0	47	94	NC	NC		< 2	**2**	< 2	< 2	< 2	< 2	< 2.0	--	< 2.0	< 2.0	< 2.0	< 2.0

Notes:
ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units; pH is a field parameter.
pCi/L - picocuries per liter.
NA - not applicable.
NC - no criteria.
-- - not analyzed. April 2019 radium data pending.
* - 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.
** - Michigan Part 201 Generic Drinking Water Cleanup Criteria, December 30, 2013.
^ - Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria. Hardness-dependent criteria calculated using hardness of 258 mg CaCO3/L (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018) per footnote {G} of Michigan Part 201 criteria tables. Chromium GSI criterion based on hexavalent chromium per footnote {H}. GSI criterion is protective for surface water used as a drinking water source as described in footnote {X}. GSI criterion for chloride is 50 mg/L when the discharge is to the Great Lakes or connecting waters per footnote {FF}
*** - Aquatic Maximum (AMV) and Final Acute Values (FAV) are taken from MDEQ Rule 323.1057 Part 4 - Water Quality Standards (Rule 57), March 15, 2018. Hardness-dependent criteria calculated using site-specific hardness of 258 mg CaCO3/L as measured at surface water sample SW-01 collected on April 9, 2018 from the Pigeon River. Chromium AMV & FAV criteria is based on hexavalent chromium.
^^ - Mixing Zone GSI Criteria from Michigan Department of Environmental Quality (MDEQ) approval letter dated December 23, 2015.
# - If detected above 0.20 ug/L, further evaluation of low-level mercury may be necessary to evaluate the GSI pathway per Michigan Part 201 and MDEQ policy and procedure 09-014 dated June 20, 2012.
BOLD font denotes concentrations detected above laboratory reporting limits.
Result Indicates an exceedance of one or more applicable criteria.
Result Indicates an exceedance of acute-based mixing zone GSI criteria.
All metals were analyzed as total unless otherwise specified.
(1) Constituent triggered an Assessment of Corrective Measures as described in TRC's letter report dated January 14, 2019.
(2) Laboratory reporting limit exceeds one or more applicable criteria due to sample dilutions.

Table 2

Summary of Groundwater Sampling Results (Analytical): March 2016-April 2019

JC Weadock Bottom Ash Pond – RCRA CCR Monitoring Program

Essexville, Michigan

										Sample Location:	JCW-MW-15028										
										Sample Date:	3/31/2016	5/25/2016	8/23/2016	12/1/2016	2/23/2017	5/17/2017	8/2/2017	9/19/2018	4/11/2018	5/23/2018	11/7/2018	4/9/2019
Constituent	Unit	GWPS*	MI Residential*	MI Non-Residential*	MI GSI^	MI AMV***	MI FAV***	Chronic MZ^^	Acute MZ^^		downgradient											
Appendix III																						
Boron	ug/L	NA	500	500	4,000	34,000	69,000	44,000	69,000		**333**	**345**	**433**	**455**	**425**	**427**	**444**	**419**	--	**444**	**517**	**530**
Calcium	mg/L	NA	NC	NC	500	NC	NC	NC	NC		**72.2**	**71.2**	**97.7**	**90.7**	**98.5**	**86.2**	**92.4**	**75.5**	--	**125**	**153**	**170**
Chloride	mg/L	NA	250	250	50	NC	NC	NC	NC		**69.3**	**69.4**	**72.2**	**64.2**	**70**	**60.1**	**106**	**91.0**	--	**69.5**	**352**	**660**
Fluoride	ug/L	4,000	NC	NC	NC	9,700	20,000	NC	NC		< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 2,000
Sulfate	mg/L	NA	250	250	500	NC	NC	NC	NC		**49.3**	**69.8**	**113**	**142**	**116**	**62.8**	**93.0**	**85.7**	--	**32.2**	**111**	**120**
Total Dissolved Solids	mg/L	NA	500	500	500	NC	NC	NC	NC		**400**	**390**	**520**	**550**	**530**	**470**	**514**	**506**	--	**1,030**	**976**	**1,800**
pH, Field	SU	NA	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	NC	NC	NC	NC		**7.9**	**7.8**	**7.6**	**8.1**	**8.0**	**7.9**	**7.7**	**8.0**	**7.8**	**8.0**	**7.9**	**8.0**
Appendix IV																						
Antimony	ug/L	6	6.0	6.0	2.0	1,100	2,300	NC	NC		< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	21	10	10	10	340	680	100	680		< 1	**1**	**1**	**2**	**2**	**1**	**1.2**	--	**1.2**	< 1.0	< 1.0	**1.1**
Barium	ug/L	2,000	2,000	2,000	1,200	3,400	7,000	NC	NC		**63**	**69**	**90**	**102**	**92**	**82**	**97.4**	--	**148**	**148**	**156**	**250**
Beryllium	ug/L	4[(1)]	4.0	4.0	33	300	600	NC	NC		< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	5	5.0	5.0	2.5	12	24	NC	NC		< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20	< 0.20
Chromium	ug/L	100	100	100	11	16	32	NC	NC		**1**	**1**	< 1	< 1	**1**	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0
Cobalt	ug/L	15	40	100	100	370	740	NC	NC		< 15	< 15	< 15	< 15	< 15	< 15	< 15.0	--	< 15.0	< 15.0	< 6.0	< 6.0
Fluoride	ug/L	4,000	NC	NC	NC	10,000	20,000	NC	NC		< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 2,000
Lead	ug/L	15	4.0	4.0	14	250	500	NC	NC		< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0
Lithium	ug/L	180[(1)]	170	350	440	910	1,800	NC	NC		**22.7**	**25**	**29**	**32**	**32**	**30**	**35**	--	**48**	**48**	**51**	**53**
Mercury	ug/L	2	2.0	2.0	0.20#	1.4	2.8	NC	NC		< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	100	73	210	120	29,000	58,000	NC	NC		< 5	< 5	< 5	< 5	< 5	< 5	< 5.0	--	< 5.0	< 5.0	< 5.0	< 5.0
Radium-226/228	pCi/L	5	NC	NC	NC	NC	NC	NC	NC		**0.673**	**0.630**	**0.565**	< 0.374	**0.959**	**0.829**	< 1.72	--	**1.65**	< 1.42	**1.60**	**--**
Selenium	ug/L	50	50	50	5.0	62	120	55	120		< 1	< 1	< 1	< 1	**1**	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0
Thallium	ug/L	2	2.0	2.0	2.0	47	94	NC	NC		< 2	< 2	< 2	< 2	< 2	< 2	< 2.0	--	< 2.0	< 2.0	< 2.0	< 2.0

Notes:

ug/L - micrograms per liter.

mg/L - milligrams per liter.

SU - standard units; pH is a field parameter.

pCi/L - picocuries per liter.

NA - not applicable.

NC - no criteria.

-- - not analyzed. April 2019 radium data pending.

* - 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.

** - Michigan Part 201 Generic Drinking Water Cleanup Criteria, December 30, 2013.

^ - Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria. Hardness-dependent criteria calculated using hardness of 258 mg CaCO3/L (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018) per footnote {G} of Michigan Part 201 criteria tables. Chromium GSI criterion based on hexavalent chromium per footnote {H}. GSI criterion is protective for surface water used as a drinking water source as described in footnote {X}. GSI criterion for chloride is 50 mg/L when the discharge is to the Great Lakes or connecting waters per footnote {FF}

*** - Aquatic Maximum (AMV) and Final Acute Values (FAV) are taken from MDEQ Rule 323.1057 Part 4 - Water Quality Standards (Rule 57), March 15, 2018. Hardness-dependent criteria calculated using site-specific hardness of 258 mg CaCO3/L as measured at surface water sample SW-01 collected on April 9, 2018 from the Pigeon River. Chromium AMV & FAV criteria is based on hexavalent chromium.

^^ - Mixing Zone GSI Criteria from Michigan Department of Environmental Quality (MDEQ) approval letter dated December 23, 2015.

- If detected above 0.20 ug/L, further evaluation of low-level mercury may be necessary to evaluate the GSI pathway per Michigan Part 201 and MDEQ policy and procedure 09-014 dated June 20, 2012.

BOLD font denotes concentrations detected above laboratory reporting limits.

Result	Indicates an exceedance of one or more applicable criteria.
Result	Indicates an exceedance of acute-based mixing zone GSI criteria.

All metals were analyzed as total unless otherwise specified.

(1) Constituent triggered an Assessment of Corrective Measures as described in TRC's letter report dated January 14, 2019.

(2) Laboratory reporting limit exceeds one or more applicable criteria due to sample dilutions.

Table 3

Summary of Groundwater Sampling Results (Analytical): March 2016-April 2019

JC Weadock Landfill – RCRA CCR Monitoring Program

Essexville, Michigan

										Sample Location:	JCW-MW-18001				JCW-MW-18004				JCW-MW-18005				JCW-MW-18006			
										Sample Date:	8/31/2018	11/7/2018	3/12/2019	4/12/2019	8/30/2018	11/8/2018	3/13/2019	4/11/2019	8/30/2018	11/8/2018	3/14/2019	4/11/2019	8/31/2018	11/8/2018	3/14/2019	4/11/2019
Constituent	Unit	GWPS*	MI Residential*	MI Non-Residential*	MI GSI^	MI AMV***	MI FAV***	Chronic MZ^^	Acute MZ^^		downgradient				downgradient				downgradient				downgradient			
Appendix III																										
Boron	ug/L	NA	500	500	4,000	34,000	69,000	44,000	69,000		**1,370**	**1,330**	**1,410**	**1,400**	**1,210**	**366**	**315**	**320**	**1,670**	**1,300**	**1,260**	**1,300**	**2,730**	**2,990**	**2,660**	**2,900**
Calcium	mg/L	NA	NC	NC	500	NC	NC	NC	NC		**130**	**138**	--	**140**	**254**	**296**	--	**470**	**358**	**156**	--	**340**	**187**	**188**	--	**190**
Chloride	mg/L	NA	250	250	50	NC	NC	NC	NC		**57.9**	**51.5**	--	**67**	**83.0**	**17.1**	--	**34**	**158**	**81.8**	--	**59**	**98.0**	**96.9**	--	**97**
Fluoride	ug/L	4,000	NC	NC	NC	9,700	20,000	NC	NC		< 1,000	< 1,000	--	< 1,000	< 1,000	< 1,000	--	< 1,000	< 1,000	**1,100**	--	< 1,000	< 1,000	< 1,000	--	< 1,000
Sulfate	mg/L	NA	250	250	500	NC	NC	NC	NC		**93.2**	**97.7**	**110**	**210**	**776**	**727**	**751**	**840**	**767**	**125**	**459**	**680**	**83.6**	**75.8**	**75.5**	**120**
Total Dissolved Solids	mg/L	NA	500	500	500	NC	NC	NC	NC		**624**	**678**	--	**860**	**1,700**	**1,560**	--	**1,900**	**1,780**	**854**	--	**1,700**	**932**	**1,040**	--	**990**
pH, Field	SU	NA	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	NC	NC	NC	NC		**7.1**	**7.2**	**7.2**	**7.2**	**6.9**	**6.8**	**6.9**	**6.6**	**6.5**	**6.9**	**6.7**	**6.6**	**6.7**	**6.8**	**6.9**	**6.9**
Appendix IV																										
Antimony	ug/L	6	6.0	6.0	2.0	1,100	2,300	NC	NC		< 2.0	< 1.0	< 1	< 1.0	< 2.0	< 1.0	< 1	< 1.0	< 2.0	< 1.0	< 1	< 1.0	< 2.0	< 1.0	< 1	< 2.0
Arsenic	ug/L	21(1)	10	10	10	340	680	100	680		**21.3**	**5.8**	**1**	**2.3**	**2.2**	< 5.0	**2**	**4.4**	**1.8**	**2.2**	**4**	**5.3**	**23.6**	**35.1**	**35**	**37**
Barium	ug/L	2,000	2,000	2,000	1,200	3,400	7,000	NC	NC		**191**	**169**	**204**	**200**	**81.9**	**36.3**	**57**	**80**	**116**	**103**	**152**	**180**	**490**	**534**	**532**	**420**
Beryllium	ug/L	4	4.0	4.0	33	300	600	NC	NC		< 1.0	< 1.0	--	< 1.0	< 1.0	< 1.0	--	< 1.0	< 1.0	< 1.0	--	< 1.0	< 1.0	< 1.0	--	< 2.0
Cadmium	ug/L	5	5.0	5.0	2.5	12	24	NC	NC		< 0.20	< 0.20	--	< 0.20	< 0.20	< 0.20	--	< 0.20	< 0.20	< 0.20	--	< 0.20	< 0.20	< 0.20	--	< 0.40
Chromium	ug/L	100	100	100	11	16	32	NC	NC		< 1.0	< 1.0	< 1	< 1.0	< 1.0	< 5.0	**24**	**19**	**1.1**	< 1.0	**14**	**2.0**	< 1.0	< 1.0	< 1	< 2.0
Cobalt	ug/L	15	40	100	100	370	740	NC	NC		< 15.0	< 6.0	--	< 6.0	< 15.0	< 30.0	--	< 6.0	< 15.0	< 6.0	--	< 6.0	< 15.0	< 6.0	--	< 12
Fluoride	ug/L	4,000	NC	NC	NC	10,000	20,000	NC	NC		< 1,000	< 1,000	--	< 1,000	< 1,000	< 1,000	--	< 1,000	< 1,000	**1,100**	**--**	< 1,000	< 1,000	< 1,000	--	< 1,000
Lead	ug/L	15	4.0	4.0	14	250	500	NC	NC		< 1.0	< 1.0	< 1	< 1.0	< 1.0	< 5.0(2)	**3**	**5.6**	< 1.0	< 1.0	< 1	< 1.0	< 1.0	< 1.0	< 1	< 2.0
Lithium	ug/L	180	170	350	440	910	1,800	NC	NC		**41**	**51**	**48**	**43**	**19**	**36**	**29**	**38**	**74**	**36**	**49**	**49**	**76**	**88**	**83**	**67**
Mercury	ug/L	2	2.0	2.0	0.20#	1.4	2.8	NC	NC		< 0.20	< 0.20	--	< 0.20	< 0.20	< 0.20	--	< 0.20	< 0.20	< 0.20	--	< 0.20	< 0.20	< 0.20	--	< 0.20
Molybdenum	ug/L	100	73	210	120	29,000	58,000	NC	NC		**8.3**	< 5.0	< 5	< 5.0	**89.1**	< 5.0	< 5	< 5.0	**5.3**	**5.8**	< 5	< 5.0	< 5.0	< 5.0	< 5	< 10
Radium-226/228	pCi/L	5	NC	NC	NC	NC	NC	NC	NC		< 1.90	< 1.35	--	--	< 1.81	< 1.67	--	--	**2.04**	**1.81**	--	--	**1.37**	**2.50**	--	--
Selenium	ug/L	50	50	50	5.0	62	120	55	120		< 2.0	< 1.0	< 1	< 1.0	< 2.0	< 1.0	**1**	**1.5**	< 2.0	< 1.0	**1**	< 1.0	< 2.0	< 1.0	**1**	< 2.0
Thallium	ug/L	2	2.0	2.0	2.0	47	94	NC	NC		< 2.0	< 2.0	--	< 2.0	< 2.0	< 10.0(2)	--	< 2.0	< 2.0	< 2.0	--	< 2.0	< 2.0	< 2.0	--	< 4.0(2)

Notes:

ug/L - micrograms per liter.

mg/L - milligrams per liter.

SU - standard units; pH is a field parameter.

NA - not applicable.

NC - no criteria.

-- - not analyzed. April 2019 radium data pending.

* - 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.

** - Michigan Part 201 Generic Drinking Water Cleanup Criteria, December 30, 2013.

^ - Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria. Hardness-dependent criteria calculated using hardness of 258 mg CaCO3/L (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018) per footnote {G} of Michigan Part 201 criteria tables. Chromium GSI criterion based on hexavalent chromium per footnote {H}. GSI criterion is protective for surface water used as a drinking water source as described in footnote {X}. GSI criterion for chloride is 50 mg/L when the discharge is to the Great Lakes or connecting waters per footnote {FF}

*** - Aquatic Maximum (AMV) and Final Acute Values (FAV) are taken from MDEQ Rule 323.1057 Part 4 - Water Quality Standards (Rule 57), March 15, 2018. Hardness-dependent criteria calculated using site-specific hardness of 258 mg CaCO3/L as measured at surface water sample SW-01 collected on April 9, 2018 from the Pigeon River. Chromium AMV & FAV criteria is based on hexavalent chromium.

^^ - Mixing Zone GSI Criteria from Michigan Department of Environmental Quality (MDEQ) approval letter dated December 23, 2015.

- If detected above 0.20 ug/L, further evaluation of low-level mercury may be necessary to evaluate the GSI pathway per Michigan Part 201 and MDEQ policy and procedure 09-014 dated June 20, 2012.

BOLD font denotes concentrations detected above laboratory reporting limits.

Result	Indicates an exceedance of one or more applicable criteria.
Result	Indicates an exceedance of acute-based mixing zone GSI criteria.

All metals were analyzed as total unless otherwise specified.

All metals were analyzed as total unless otherwise specified.

(1) Constituent triggered an Assessment of Corrective Measures as described in TRC's letter report dated Janurary 14, 2019.

(2) Laboratory reporting limit exceeds one or more applicable criteria due to sample dilution.

(3) Unconfirmed anomalous result.

Table 3
Summary of Groundwater Sampling Results (Analytical): March 2016-April 2019
JC Weadock Landfill – RCRA CCR Monitoring Program
Essexville, Michigan

									Sample Location:	MW-50														
									Sample Date:	3/15/2016	5/10/2016	8/16/2016	10/18/2016	2/27/2017	5/11/2017	8/9/2017	11/1/2017	3/5/2018	5/15/2018	8/15/2018	10/23/2018	11/7/2018	3/12/2019	4/9/2019
Constituent	Unit	GWPS*	MI Residential*	MI Non-Residential*	MI GSI^	MI AMV***	MI FAV***	Chronic MZ^^	Acute MZ^^	downgradient														
Appendix III																								
Boron	ug/L	NA	500	500	4,000	34,000	69,000	44,000	69,000	**921**	**859**	**751**	**1,030**	**2,020**	**1,340**	**987**	**1,120**	**1,320**	**1,220**	**1,270**	**1,270**	**1,370**	**1,560**	**1,600**
Calcium	mg/L	NA	NC	NC	500	NC	NC	NC	NC	--	--	--	--	--	--	--	--	--	**250**	--	--	**249**	--	**200**
Chloride	mg/L	NA	250	250	50	NC	NC	NC	NC	--	--	--	--	--	--	--	--	--	**73.8**	--	--	**76.3**	--	**62**
Fluoride	ug/L	4,000	NC	NC	NC	9,700	20,000	NC	NC	--	--	--	--	--	--	--	--	--	< 1,000	--	--	< 1,000	--	< 1,000
Sulfate	mg/L	NA	250	250	500	NC	NC	NC	NC	**100**	**100**	**73**	**76**	**200**	**180**	**290**	**580**	**370**	**550**	**490**	**540**	**518**	**361**	**370**
Total Dissolved Solids	mg/L	NA	500	500	500	NC	NC	NC	NC	--	--	--	--	--	--	--	--	--	**1,400**	--	--	**1,360**	--	**1,200**
pH, Field	SU	NA	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	NC	NC	NC	NC	**7.6**	**7.6**	**7.5**	**7.3**	**7.1**	**7.4**	**7.0**	**7.1**	**7.5**	**7.3**	**7.0**	**7.1**	**7.2**	**7.3**	**7.3**
Appendix IV																								
Antimony	ug/L	6	6.0	6.0	2.0	1,100	2,300	NC	NC	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1	< 1.0
Arsenic	ug/L	21(1)	10	10	10	340	680	100	680	**1**	**1**	**5**	**4**	**2**	**2**	**3**	**3**	**2**	**2**	**2**	**3**	< 5.0	**5**	**1.1**
Barium	ug/L	2,000	2,000	2,000	1,200	3,400	7,000	NC	NC	**200**	**192**	**161**	**157**	**393**	**356**	**352**	**299**	**365**	**351**	**292**	**282**	**239**	**661**	**220**
Beryllium	ug/L	4	4.0	4.0	33	300	600	NC	NC	--	--	--	--	--	--	--	--	--	< 1	--	--	< 1.0	--	< 1.0
Cadmium	ug/L	5	5.0	5.0	2.5	12	24	NC	NC	--	--	--	--	--	--	--	--	--	< 0.2	--	--	< 0.20	--	< 0.20
Chromium	ug/L	100	100	100	11	16	32	NC	NC	< 1	< 1	< 1	< 1	**1**	**1**	< 1	< 1	< 1	< 1	< 1	< 1	< 5.0	< 1	< 1.0
Cobalt	ug/L	15	40	100	100	370	740	NC	NC	--	--	--	--	--	--	--	--	--	< 15	--	--	< 30.0	--	< 6.0
Fluoride	ug/L	4,000	NC	NC	NC	10,000	20,000	NC	NC	--	--	--	--	--	--	--	--	--	< 1,000	--	--	< 1,000	--	< 1,000
Lead	ug/L	15	4.0	4.0	14	250	500	NC	NC	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 5.0(2)	< 1	< 1.0
Lithium	ug/L	180	170	350	440	910	1,800	NC	NC	**76**	**61**	**66**	**60**	**72**	**71**	**74**	**72**	**63**	**74**	**77**	**84**	**94**	**67**	**69**
Mercury	ug/L	2	2.0	2.0	0.20#	1.4	2.8	NC	NC	--	--	--	--	--	--	--	--	--	< 0.2	--	--	< 0.20	--	< 0.20
Molybdenum	ug/L	100	73	210	120	29,000	58,000	NC	NC	< 5	< 5	**7**	**5**	< 5	< 5	**6**	**10**	**6**	**6**	**8**	**7**	**8.0**	**17**	< 5.0
Radium-226/228	pCi/L	5	NC	NC	NC	NC	NC	NC	NC	--	--	--	--	--	--	--	--	--	--	--	--	**3.28**	--	--
Selenium	ug/L	50	50	50	5.0	62	120	55	120	**1**	**2**	< 1	< 1	< 1	**1**	< 1	< 1	< 1	< 1	< 1	**1**	< 1.0	**3**	< 1.0
Thallium	ug/L	2	2.0	2.0	2.0	47	94	NC	NC	--	--	--	--	--	--	--	--	--	< 2	--	--	< 10.0(2)	--	< 2.0

Notes:
ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units; pH is a field parameter.
NA - not applicable.
NC - no criteria.
-- - not analyzed. April 2019 radium data pending.
* - 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.
** - Michigan Part 201 Generic Drinking Water Cleanup Criteria, December 30, 2013.
^ - Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria. Hardness-dependent criteria calculated using hardness of 258 mg CaCO3/L (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018) per footnote {G} of Michigan Part 201 criteria tables. Chromium GSI criterion based on hexavalent chromium per footnote {H}. GSI criterion is protective for surface water used as a drinking water source as described in footnote {X}. GSI criterion for chloride is 50 mg/L when the discharge is to the Great Lakes or connecting waters per footnote {FF}
*** - Aquatic Maximum (AMV) and Final Acute Values (FAV) are taken from MDEQ Rule 323.1057 Part 4 - Water Quality Standards (Rule 57), March 15, 2018. Hardness-dependent criteria calculated using site-specific hardness of 258 mg CaCO3/L as measured at surface water sample SW-01 collected on April 9, 2018 from the Pigeon River. Chromium AMV & FAV criteria is based on hexavalent chromium.
^^ - Mixing Zone GSI Criteria from Michigan Department of Environmental Quality (MDEQ) approval letter dated December 23, 2015.
# - If detected above 0.20 ug/L, further evaluation of low-level mercury may be necessary to evaluate the GSI pathway per Michigan Part 201 and MDEQ policy and procedure 09-014 dated June 20, 2012.
BOLD font denotes concentrations detected above laboratory reporting limits.
Result Indicates an exceedance of one or more applicable criteria.
Result Indicates an exceedance of acute-based mixing zone GSI criteria.
All metals were analyzed as total unless otherwise specified.
All metals were analyzed as total unless otherwise specified.
(1) Constituent triggered an Assessment of Corrective Measures as described in TRC's letter report dated Janurary 14, 2019.
(2) Laboratory reporting limit exceeds one or more applicable criteria due to sample dilution.
(3) Unconfirmed anomalous result.

Table 3
Summary of Groundwater Sampling Results (Analytical): March 2016-April 2019
JC Weadock Landfill – RCRA CCR Monitoring Program
Essexville, Michigan

										Sample Location:	MW-51													
										Sample Date:	3/15/2016	5/10/2016	8/18/2016	10/18/2016	2/27/2017	5/11/2017	8/9/2017	11/1/2017	3/6/2018	5/16/2018	8/15/2018	10/23/2018	11/8/2018	3/13/2019	4/9/2019
Constituent	Unit	GWPS*	MI Residential*	MI Non-Residential*	MI GSI^	MI AMV***	MI FAV***	Chronic MZ^^	Acute MZ^^		downgradient														
Appendix III																									
Boron	ug/L	NA	500	500	4,000	34,000	69,000	44,000	69,000		**952**	**954**	**1,290**	**1,840**	**1,440**	**1,370**	**1,060**	**1,280**	**1,040**	**883**	**872**	**872**	**851**	**895**	**940**
Calcium	mg/L	NA	NC	NC	500	NC	NC	NC	NC		--	--	--	--	--	--	--	--	--	**378**	--	--	**331**	--	**310**
Chloride	mg/L	NA	250	250	50	NC	NC	NC	NC		--	--	--	--	--	--	--	--	--	**65**	--	--	**55.8**	--	**84**
Fluoride	ug/L	4,000	NC	NC	NC	9,700	20,000	NC	NC		--	--	--	--	--	--	--	--	--	< 1,000	--	--	< 1,000	--	< 1,000
Sulfate	mg/L	NA	250	250	500	NC	NC	NC	NC		**330**	**420**	**420**	**420**	**480**	**490**	**510**	**560**	**430**	**592**	**450**	**490**	**505**	**535**	**500**
Total Dissolved Solids	mg/L	NA	500	500	500	NC	NC	NC	NC		--	--	--	--	--	--	--	--	--	**1,600**	--	--	**1,410**	--	**1,500**
pH, Field	SU	NA	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	NC	NC	NC	NC		**7.4**	**7.3**	**7.3**	**7.2**	**6.9**	**6.9**	**6.8**	**6.8**	**6.8**	**6.7**	**6.6**	**6.7**	**6.6**	**6.9**	**7.0**
Appendix IV																									
Antimony	ug/L	6	6.0	6.0	2.0	1,100	2,300	NC	NC		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1	< 1.0
Arsenic	ug/L	21(1)	10	10	10	340	680	100	680		**33**	**23**	**44**	**39**	**19**	**24**	**41**	**28**	**16**	**13**	**19**	**27**	**21.8**	**15**	**17**
Barium	ug/L	2,000	2,000	2,000	1,200	3,400	7,000	NC	NC		**382**	**421**	**217**	**299**	**318**	**273**	**268**	**291**	**187**	**189**	**178**	**184**	**163**	**174**	**190**
Beryllium	ug/L	4	4.0	4.0	33	300	600	NC	NC		--	--	--	--	--	--	--	--	--	< 1	--	--	< 1.0	--	< 1.0
Cadmium	ug/L	5	5.0	5.0	2.5	12	24	NC	NC		--	--	--	--	--	--	--	--	--	< 0.2	--	--	< 1.0	--	< 0.20
Chromium	ug/L	100	100	100	11	16	32	NC	NC		< 1	< 1	**2**	< 1	**1**	< 1	< 1	**1**	< 1	< 1	< 1	< 1	< 5.0	< 1	**1.0**
Cobalt	ug/L	15	40	100	100	370	740	NC	NC		--	--	--	--	--	--	--	--	--	< 15	--	--	< 30.0	--	< 6.0
Fluoride	ug/L	4,000	NC	NC	NC	10,000	20,000	NC	NC		--	--	--	--	--	--	--	--	--	< 1,000	--	--	< 1,000	--	< 1,000
Lead	ug/L	15	4.0	4.0	14	250	500	NC	NC		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 5.0(2)	< 1	< 1.0
Lithium	ug/L	180	170	350	440	910	1,800	NC	NC		**49**	**38**	**53**	**54**	**61**	**66**	**68**	**64**	**55**	**62**	**57**	**60**	**71**	**66**	**59**
Mercury	ug/L	2	2.0	2.0	0.20#	1.4	2.8	NC	NC		--	--	--	--	--	--	--	--	--	< 0.2	--	--	< 0.20	--	< 0.20
Molybdenum	ug/L	100	73	210	120	29,000	58,000	NC	NC		< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 25.0	< 5	< 5.0
Radium-226/228	pCi/L	5	NC	NC	NC	NC	NC	NC	NC		--	--	--	--	--	--	--	--	--	--	--	--	< 1.64	--	--
Selenium	ug/L	50	50	50	5.0	62	120	55	120		< 1	**1**	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	**1**	< 1.0	**1**	< 1.0
Thallium	ug/L	2	2.0	2.0	2.0	47	94	NC	NC		--	--	--	--	--	--	--	--	--	< 2	--	--	< 10.0(2)	--	< 2.0

Notes:
ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units; pH is a field parameter.
NA - not applicable.
NC - no criteria.
-- - not analyzed. April 2019 radium data pending.
* - 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.
** - Michigan Part 201 Generic Drinking Water Cleanup Criteria, December 30, 2013.
^ - Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria. Hardness-dependent criteria calculated using hardness of 258 mg CaCO3/L (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018) per footnote {G} of Michigan Part 201 criteria tables. Chromium GSI criterion based on hexavalent chromium per footnote {H}. GSI criterion is protective for surface water used as a drinking water source as described in footnote {X}. GSI criterion for chloride is 50 mg/L when the discharge is to the Great Lakes or connecting waters per footnote {FF}
*** - Aquatic Maximum (AMV) and Final Acute Values (FAV) are taken from MDEQ Rule 323.1057 Part 4 - Water Quality Standards (Rule 57), March 15, 2018. Hardness-dependent criteria calculated using site-specific hardness of 258 mg CaCO3/L as measured at surface water sample SW-01 collected on April 9, 2018 from the Pigeon River. Chromium AMV & FAV criteria is based on hexavalent chromium.
^^ - Mixing Zone GSI Criteria from Michigan Department of Environmental Quality (MDEQ) approval letter dated December 23, 2015.
# - If detected above 0.20 ug/L, further evaluation of low-level mercury may be necessary to evaluate the GSI pathway per Michigan Part 201 and MDEQ policy and procedure 09-014 dated June 20, 2012.
BOLD font denotes concentrations detected above laboratory reporting limits.
Result Indicates an exceedance of one or more applicable criteria.
Result Indicates an exceedance of acute-based mixing zone GSI criteria.
All metals were analyzed as total unless otherwise specified.
All metals were analyzed as total unless otherwise specified.
(1) Constituent triggered an Assessment of Corrective Measures as described in TRC's letter report dated Janurary 14, 2019.
(2) Laboratory reporting limit exceeds one or more applicable criteria due to sample dilution.
(3) Unconfirmed anomalous result.

Table 3
Summary of Groundwater Sampling Results (Analytical): March 2016-April 2019
JC Weadock Landfill – RCRA CCR Monitoring Program
Essexville, Michigan

									Sample Location:	MW-52														
									Sample Date:	3/15/2016	5/10/2016	8/18/2016	10/19/2016	2/27/2017	5/11/2017	8/9/2017	11/1/2017	3/6/2018	5/15/2018	8/15/2018	10/23/2018	11/8/2018	3/13/2019	4/9/2019
Constituent	Unit	GWPS*	MI Residential*	MI Non-Residential*	MI GSI^	MI AMV***	MI FAV***	Chronic MZ^^	Acute MZ^^	downgradient														
Appendix III																								
Boron	ug/L	NA	500	500	4,000	34,000	69,000	44,000	69,000	**775**	**760**	**826**	**1,320**	**1,580**	**1,260**	**1,040**	**991**	**791**	**803**	**904**	**846**	**774**	**1,110**	**1,200**
Calcium	mg/L	NA	NC	NC	500	NC	NC	NC	NC	--	--	--	--	--	--	--	--	--	**241**	--	--	**256**	--	**210**
Chloride	mg/L	NA	250	250	50	NC	NC	NC	NC	--	--	--	--	--	--	--	--	--	**89.5**	--	--	**97.2**	--	**95**
Fluoride	ug/L	4,000	NC	NC	NC	9,700	20,000	NC	NC	--	--	--	--	--	--	--	--	--	< 1,000	--	--	< 1,000	--	< 1,000
Sulfate	mg/L	NA	250	250	500	NC	NC	NC	NC	**460**	**520**	**620**	**720**	**490**	**510**	**530**	**480**	**510**	**536**	**500**	**530**	**517**	**557**	**480**
Total Dissolved Solids	mg/L	NA	500	500	500	NC	NC	NC	NC	--	--	--	--	--	--	--	--	--	**1,500**	--	--	**1,460**	--	**1,400**
pH, Field	SU	NA	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	NC	NC	NC	NC	**6.9**	**7.0**	**6.9**	**6.9**	**7.0**	**7.1**	**6.8**	**7.0**	**7.0**	**7.0**	**6.9**	**6.9**	**6.8**	**7.0**	**7.1**
Appendix IV																								
Antimony	ug/L	6	6.0	6.0	2.0	1,100	2,300	NC	NC	< 1	**1**	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1	< 1.0
Arsenic	ug/L	21(1)	10	10	10	340	680	100	680	< 1	< 1	**1**	< 1	< 1	< 1	< 1	**1**	< 1	< 1	< 1	< 1	< 5.0	< 1	< 1.0
Barium	ug/L	2,000	2,000	2,000	1,200	3,400	7,000	NC	NC	**175**	**167**	**180**	**172**	**144**	**142**	**150**	**144**	**155**	**148**	**160**	**179**	**146**	**148**	**140**
Beryllium	ug/L	4	4.0	4.0	33	300	600	NC	NC	--	--	--	--	--	--	--	--	--	< 1	--	--	< 1.0	--	< 1.0
Cadmium	ug/L	5	5.0	5.0	2.5	12	24	NC	NC	--	--	--	--	--	--	--	--	--	< 0.2	--	--	< 1.0	--	< 0.20
Chromium	ug/L	100	100	100	11	16	32	NC	NC	< 1	**1**	< 1	< 1	**1**	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 5.0	**2**	< 1.0
Cobalt	ug/L	15	40	100	100	370	740	NC	NC	--	--	--	--	--	--	--	--	--	< 15	--	--	< 30.0	--	< 6.0
Fluoride	ug/L	4,000	NC	NC	NC	10,000	20,000	NC	NC	--	--	--	--	--	--	--	--	--	< 1,000	--	--	< 1,000	--	< 1,000
Lead	ug/L	15	4.0	4.0	14	250	500	NC	NC	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 5.0(2)	< 1	< 1.0
Lithium	ug/L	180	170	350	440	910	1,800	NC	NC	**33**	**31**	**34**	**32**	**44**	**51**	**55**	**53**	**58**	**55**	**54**	**52**	**63**	**47**	**39**
Mercury	ug/L	2	2.0	2.0	0.20#	1.4	2.8	NC	NC	--	--	--	--	--	--	--	--	--	< 0.2	--	--	< 0.20	--	< 0.20
Molybdenum	ug/L	100	73	210	120	29,000	58,000	NC	NC	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 25.0	< 5	< 5.0
Radium-226/228	pCi/L	5	NC	NC	NC	NC	NC	NC	NC	--	--	--	--	--	--	--	--	--	--	--	--	< 1.50	--	--
Selenium	ug/L	50	50	50	5.0	62	120	55	120	< 1	**2**	**1**	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	**1**	< 1.0	< 1	< 1.0
Thallium	ug/L	2	2.0	2.0	2.0	47	94	NC	NC	--	--	--	--	--	--	--	--	--	< 2	--	--	< 10.0(2)	--	< 2.0

Notes:
ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units; pH is a field parameter.
NA - not applicable.
NC - no criteria.
-- - not analyzed. April 2019 radium data pending.
* - 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.
** - Michigan Part 201 Generic Drinking Water Cleanup Criteria, December 30, 2013.
^ - Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria. Hardness-dependent criteria calculated using hardness of 258 mg CaCO3/L (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018) per footnote {G} of Michigan Part 201 criteria tables. Chromium GSI criterion based on hexavalent chromium per footnote {H}. GSI criterion is protective for surface water used as a drinking water source as described in footnote {X}. GSI criterion for chloride is 50 mg/L when the discharge is to the Great Lakes or connecting waters per footnote {FF}
*** - Aquatic Maximum (AMV) and Final Acute Values (FAV) are taken from MDEQ Rule 323.1057 Part 4 - Water Quality Standards (Rule 57), March 15, 2018. Hardness-dependent criteria calculated using site-specific hardness of 258 mg CaCO3/L as measured at surface water sample SW-01 collected on April 9, 2018 from the Pigeon River. Chromium AMV & FAV criteria is based on hexavalent chromium.
^^ - Mixing Zone GSI Criteria from Michigan Department of Environmental Quality (MDEQ) approval letter dated December 23, 2015.
# - If detected above 0.20 ug/L, further evaluation of low-level mercury may be necessary to evaluate the GSI pathway per Michigan Part 201 and MDEQ policy and procedure 09-014 dated June 20, 2012.
BOLD font denotes concentrations detected above laboratory reporting limits.
Result Indicates an exceedance of one or more applicable criteria.
Result Indicates an exceedance of acute-based mixing zone GSI criteria.
All metals were analyzed as total unless otherwise specified.
All metals were analyzed as total unless otherwise specified.
(1) Constituent triggered an Assessment of Corrective Measures as described in TRC's letter report dated Janurary 14, 2019.
(2) Laboratory reporting limit exceeds one or more applicable criteria due to sample dilution.
(3) Unconfirmed anomalous result.

Table 3
Summary of Groundwater Sampling Results (Analytical): March 2016-April 2019
JC Weadock Landfill – RCRA CCR Monitoring Program
Essexville, Michigan

									Sample Location:	MW-53														
									Sample Date:	3/15/2016	5/10/2016	8/18/2016	10/19/2016	2/27/2017	5/11/2017	8/9/2017	11/1/2017	3/6/2018	5/15/2018	8/15/2018	10/23/2018	11/8/2018	3/13/2019	4/10/2019
Constituent	Unit	GWPS*	MI Residential*	MI Non-Residential*	MI GSI^	MI AMV***	MI FAV***	Chronic MZ^^	Acute MZ^^	downgradient														
Appendix III																								
Boron	ug/L	NA	500	500	4,000	34,000	69,000	44,000	69,000	**723**	**720**	**433**	**696**	**436**	**963**	**468**	**496**	**490**	**1,260**	**695**	**583**	**519**	**1,330**	**1,500**
Calcium	mg/L	NA	NC	NC	500	NC	NC	NC	NC	--	--	--	--	--	--	--	--	--	**158**	--	--	**465**	--	**200**
Chloride	mg/L	NA	250	250	50	NC	NC	NC	NC	--	--	--	--	--	--	--	--	--	**77.5**	--	--	**84.5**	--	**39**
Fluoride	ug/L	4,000	NC	NC	NC	9,700	20,000	NC	NC	--	--	--	--	--	--	--	--	--	< 1,000	--	--	< 1,000	--	< 1,000
Sulfate	mg/L	NA	250	250	500	NC	NC	NC	NC	**1,000**	**1,100**	**1,100**	**990**	**790**	**660**	**890**	**830**	**510**	**208**	**570**	**780**	**811**	**221**	**330**
Total Dissolved Solids	mg/L	NA	500	500	500	NC	NC	NC	NC	--	--	--	--	--	--	--	--	--	**970**	--	--	**1,950**	--	**1,200**
pH, Field	SU	NA	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	NC	NC	NC	NC	**6.6**	**6.5**	**6.5**	**6.6**	**6.6**	**6.7**	**6.6**	**6.7**	**6.8**	**7.2**	**6.7**	**6.6**	**6.6**	**7.2**	**7.1**
Appendix IV																								
Antimony	ug/L	6	6.0	6.0	2.0	1,100	2,300	NC	NC	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1	< 1.0
Arsenic	ug/L	21(1)	10	10	10	340	680	100	680	**2**	**2**	**3**	**3**	**2**	**2**	**3**	**3**	**2**	**2**	**3**	**4**	**5.1**	**2**	< 1.0
Barium	ug/L	2,000	2,000	2,000	1,200	3,400	7,000	NC	NC	**88**	**72**	**57**	**54**	**56**	**71**	**56**	**50**	**49**	**78**	**87**	**71**	**54.4**	**92**	**120**
Beryllium	ug/L	4	4.0	4.0	33	300	600	NC	NC	--	--	--	--	--	--	--	--	--	< 1	--	--	< 1.0	--	< 1.0
Cadmium	ug/L	5	5.0	5.0	2.5	12	24	NC	NC	--	--	--	--	--	--	--	--	--	< 0.2	--	--	< 1.0	--	< 0.20
Chromium	ug/L	100	100	100	11	16	32	NC	NC	< 1	< 1	< 1	< 1	**1**	**1**	< 1	**1**	< 1	< 1	< 1	< 1	< 5.0	**3**	**1.6**
Cobalt	ug/L	15	40	100	100	370	740	NC	NC	--	--	--	--	--	--	--	--	--	< 15	--	--	< 30.0	--	< 6.0
Fluoride	ug/L	4,000	NC	NC	NC	10,000	20,000	NC	NC	--	--	--	--	--	--	--	--	--	< 1,000	--	--	< 1,000	--	< 1,000
Lead	ug/L	15	4.0	4.0	14	250	500	NC	NC	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 5.0(2)	< 1	< 1.0
Lithium	ug/L	180	170	350	440	910	1,800	NC	NC	**50**	**49**	**55**	**48**	**40**	**49**	**48**	**45**	**35**	**49**	**48**	**47**	**59**	**54**	**53**
Mercury	ug/L	2	2.0	2.0	0.20#	1.4	2.8	NC	NC	--	--	--	--	--	--	--	--	--	< 0.2	--	--	< 0.20	--	< 0.20
Molybdenum	ug/L	100	73	210	120	29,000	58,000	NC	NC	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 25.0	< 5	< 5.0
Radium-226/228	pCi/L	5	NC	NC	NC	NC	NC	NC	NC	--	--	--	--	--	--	--	--	--	--	--	--	< 1.32	--	--
Selenium	ug/L	50	50	50	5.0	62	120	55	120	< 1	**2**	< 1	< 1	< 1	**1**	< 1	< 1	< 1	< 1	< 1	**1**	< 1.0	< 1	< 1.0
Thallium	ug/L	2	2.0	2.0	2.0	47	94	NC	NC	--	--	--	--	--	--	--	--	--	< 2	--	--	< 10.0(2)	--	< 2.0

Notes:
ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units; pH is a field parameter.
NA - not applicable.
NC - no criteria.
-- - not analyzed. April 2019 radium data pending.
* - 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.
** - Michigan Part 201 Generic Drinking Water Cleanup Criteria, December 30, 2013.
^ - Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria. Hardness-dependent criteria calculated using hardness of 258 mg CaCO3/L (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018) per footnote {G} of Michigan Part 201 criteria tables. Chromium GSI criterion based on hexavalent chromium per footnote {H}. GSI criterion is protective for surface water used as a drinking water source as described in footnote {X}. GSI criterion for chloride is 50 mg/L when the discharge is to the Great Lakes or connecting waters per footnote {FF}
*** - Aquatic Maximum (AMV) and Final Acute Values (FAV) are taken from MDEQ Rule 323.1057 Part 4 - Water Quality Standards (Rule 57), March 15, 2018. Hardness-dependent criteria calculated using site-specific hardness of 258 mg CaCO3/L as measured at surface water sample SW-01 collected on April 9, 2018 from the Pigeon River. Chromium AMV & FAV criteria is based on hexavalent chromium.
^^ - Mixing Zone GSI Criteria from Michigan Department of Environmental Quality (MDEQ) approval letter dated December 23, 2015.
# - If detected above 0.20 ug/L, further evaluation of low-level mercury may be necessary to evaluate the GSI pathway per Michigan Part 201 and MDEQ policy and procedure 09-014 dated June 20, 2012.
BOLD font denotes concentrations detected above laboratory reporting limits.
Result Indicates an exceedance of one or more applicable criteria.
Result Indicates an exceedance of acute-based mixing zone GSI criteria.
All metals were analyzed as total unless otherwise specified.
All metals were analyzed as total unless otherwise specified.
(1) Constituent triggered an Assessment of Corrective Measures as described in TRC's letter report dated Janurary 14, 2019.
(2) Laboratory reporting limit exceeds one or more applicable criteria due to sample dilution.
(3) Unconfirmed anomalous result.

Table 3
Summary of Groundwater Sampling Results (Analytical): March 2016-April 2019
JC Weadock Landfill – RCRA CCR Monitoring Program
Essexville, Michigan

									Sample Location:	MW-53R														
									Sample Date:	3/16/2016	5/10/2016	8/18/2016	10/19/2016	2/27/2017	5/11/2017	8/9/2017	11/2/2017	3/6/2018	5/15/2018	8/15/2018	10/23/2018	11/8/2018	3/13/2019	4/10/2019
Constituent	Unit	GWPS*	MI Residential*	MI Non-Residential*	MI GSI^	MI AMV***	MI FAV***	Chronic MZ^^	Acute MZ^^	downgradient														
Appendix III																								
Boron	ug/L	NA	500	500	4,000	34,000	69,000	44,000	69,000	**2,530**	**1,820**	**2,130**	**2,870**	**2,060**	**1,540**	**1,500**	**1,850**	**1,570**	**1,500**	**1,640**	**1,830**	**1,800**	**1,680**	**1,500**
Calcium	mg/L	NA	NC	NC	500	NC	NC	NC	NC	--	--	--	--	--	--	--	--	--	**232**	--	--	**217**	--	**220**
Chloride	mg/L	NA	250	250	50	NC	NC	NC	NC	--	--	--	--	--	--	--	--	--	**43.1**	--	--	**44.2**	--	**35**
Fluoride	ug/L	4,000	NC	NC	NC	9,700	20,000	NC	NC	--	--	--	--	--	--	--	--	--	< 1,000	--	--	< 1,000	--	< 1,000
Sulfate	mg/L	NA	250	250	500	NC	NC	NC	NC	**150**	**280**	**260**	**320**	**190**	**220**	**230**	**230**	**200**	**235**	**260**	**200**	**163**	**176**	**180**
Total Dissolved Solids	mg/L	NA	500	500	500	NC	NC	NC	NC	--	--	--	--	--	--	--	--	--	**1,100**	--	--	**978**	--	**1,000**
pH, Field	SU	NA	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	NC	NC	NC	NC	**7.1**	**6.8**	**6.9**	**6.9**	**7.0**	**6.8**	**6.8**	**6.8**	**7.0**	**6.9**	**6.8**	**6.9**	**6.9**	**6.9**	**6.9**
Appendix IV																								
Antimony	ug/L	6	6.0	6.0	2.0	1,100	2,300	NC	NC	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1	< 1.0
Arsenic	ug/L	21(1)	10	10	10	340	680	100	680	**21**	**10**	**30**	**31**	**28**	**14**	**30**	**32**	**17**	**16**	**28**	**28**	**33.0**	**18**	**20**
Barium	ug/L	2,000	2,000	2,000	1,200	3,400	7,000	NC	NC	**162**	**140**	**150**	**160**	**244**	**190**	**225**	**220**	**245**	**240**	**221**	**206**	**186**	**257**	**260**
Beryllium	ug/L	4	4.0	4.0	33	300	600	NC	NC	--	--	--	--	--	--	--	--	--	< 1	--	--	< 1.0	--	< 1.0
Cadmium	ug/L	5	5.0	5.0	2.5	12	24	NC	NC	--	--	--	--	--	--	--	--	--	< 0.2	--	--	< 0.20	--	< 0.20
Chromium	ug/L	100	100	100	11	16	32	NC	NC	< 1	< 1	**1**	< 1	**1**	**1**	< 1	**2**	< 1	< 1	< 1	< 1	< 1.0	**4**	**1.3**
Cobalt	ug/L	15	40	100	100	370	740	NC	NC	--	--	--	--	--	--	--	--	--	< 15	--	--	< 6.0	--	< 6.0
Fluoride	ug/L	4,000	NC	NC	NC	10,000	20,000	NC	NC	--	--	--	--	--	--	--	--	--	< 1,000	--	--	< 1,000	--	< 1,000
Lead	ug/L	15	4.0	4.0	14	250	500	NC	NC	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 5.0(2)	< 1	< 1.0
Lithium	ug/L	180	170	350	440	910	1,800	NC	NC	**48**	**64**	**73**	**70**	**70**	**60**	**70**	**72**	**62**	**63**	**70**	**74**	**81**	**61**	**58**
Mercury	ug/L	2	2.0	2.0	0.20#	1.4	2.8	NC	NC	--	--	--	--	--	--	--	--	--	< 0.2	--	--	< 0.20	--	< 0.20
Molybdenum	ug/L	100	73	210	120	29,000	58,000	NC	NC	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5.0	< 5	< 5.0
Radium-226/228	pCi/L	5	NC	NC	NC	NC	NC	NC	NC	--	--	--	--	--	--	--	--	--	--	--	--	< 1.91	--	--
Selenium	ug/L	50	50	50	5.0	62	120	55	120	< 1	**1**	< 1	< 1	< 1	< 1	**1**	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1	< 1.0
Thallium	ug/L	2	2.0	2.0	2.0	47	94	NC	NC	--	--	--	--	--	--	--	--	--	< 2	--	--	< 10.0(2)	--	< 2.0

Notes:
ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units; pH is a field parameter.
NA - not applicable.
NC - no criteria.
-- - not analyzed. April 2019 radium data pending.
* - 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.
** - Michigan Part 201 Generic Drinking Water Cleanup Criteria, December 30, 2013.
^ - Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria. Hardness-dependent criteria calculated using hardness of 258 mg CaCO3/L (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018) per footnote {G} of Michigan Part 201 criteria tables. Chromium GSI criterion based on hexavalent chromium per footnote {H}. GSI criterion is protective for surface water used as a drinking water source as described in footnote {X}. GSI criterion for chloride is 50 mg/L when the discharge is to the Great Lakes or connecting waters per footnote {FF}
*** - Aquatic Maximum (AMV) and Final Acute Values (FAV) are taken from MDEQ Rule 323.1057 Part 4 - Water Quality Standards (Rule 57), March 15, 2018. Hardness-dependent criteria calculated using site-specific hardness of 258 mg CaCO3/L as measured at surface water sample SW-01 collected on April 9, 2018 from the Pigeon River. Chromium AMV & FAV criteria is based on hexavalent chromium.
^^ - Mixing Zone GSI Criteria from Michigan Department of Environmental Quality (MDEQ) approval letter dated December 23, 2015.
# - If detected above 0.20 ug/L, further evaluation of low-level mercury may be necessary to evaluate the GSI pathway per Michigan Part 201 and MDEQ policy and procedure 09-014 dated June 20, 2012.
BOLD font denotes concentrations detected above laboratory reporting limits.
Result Indicates an exceedance of one or more applicable criteria.
Result Indicates an exceedance of acute-based mixing zone GSI criteria.
All metals were analyzed as total unless otherwise specified.
All metals were analyzed as total unless otherwise specified.
(1) Constituent triggered an Assessment of Corrective Measures as described in TRC's letter report dated Janurary 14, 2019.
(2) Laboratory reporting limit exceeds one or more applicable criteria due to sample dilution.
(3) Unconfirmed anomalous result.

Table 3
Summary of Groundwater Sampling Results (Analytical): March 2016-April 2019
JC Weadock Landfill – RCRA CCR Monitoring Program
Essexville, Michigan

									Sample Location:	MW-54R														
									Sample Date:	3/16/2016	5/10/2016	8/17/2016	10/19/2016	2/28/2017	5/11/2017	8/9/2017	11/2/2017	3/6/2018	5/15/2018	8/16/2018	10/23/2018	11/8/2018	3/13/2019	4/11/2019
Constituent	Unit	GWPS*	MI Residential*	MI Non-Residential*	MI GSI^	MI AMV***	MI FAV***	Chronic MZ^^	Acute MZ^^	downgradient														
Appendix III																								
Boron	ug/L	NA	500	500	4,000	34,000	69,000	44,000	69,000	**1,250**	**1,230**	**1,350**	**1,800**	**1,460**	**1,030**	**1,100**	**1,280**	**1,060**	**1,150**	**1,340**	**1,380**	**1,290**	**1,000**	**960**
Calcium	mg/L	NA	NC	NC	500	NC	NC	NC	NC	--	--	--	--	--	--	--	--	--	**179**	--	--	**173**	--	**180**
Chloride	mg/L	NA	250	250	50	NC	NC	NC	NC	--	--	--	--	--	--	--	--	--	**20**	--	--	**18.0**	--	**16**
Fluoride	ug/L	4,000	NC	NC	NC	9,700	20,000	NC	NC	--	--	--	--	--	--	--	--	--	< 1,000	--	--	< 1,000	--	< 1,000
Sulfate	mg/L	NA	250	250	500	NC	NC	NC	NC	**210**	**190**	**180**	**170**	**170**	**200**	**180**	**160**	**160**	**208**	**180**	**150**	**152**	**146**	**160**
Total Dissolved Solids	mg/L	NA	500	500	500	NC	NC	NC	NC	--	--	--	--	--	--	--	--	--	**890**	--	--	**710**	--	**770**
pH, Field	SU	NA	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	NC	NC	NC	NC	**6.9**	**6.8**	**6.8**	**6.8**	**6.9**	**6.8**	**6.8**	**6.9**	**7.1**	**7.0**	**6.9**	**6.9**	**7.0**	**7.0**	**6.9**
Appendix IV																								
Antimony	ug/L	6	6.0	6.0	2.0	1,100	2,300	NC	NC	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1	< 1.0
Arsenic	ug/L	21(1)	10	10	10	340	680	100	680	**1**	**2**	**2**	< 1	< 1	< 1	< 1	< 1	**1**	< 1	< 1	< 1	< 1.0	**1**	**1.6**
Barium	ug/L	2,000	2,000	2,000	1,200	3,400	7,000	NC	NC	**69**	**66**	**75**	**82**	**75**	**63**	**74**	**74**	**70**	**74**	**79**	**79**	**59.9**	**68**	**74**
Beryllium	ug/L	4	4.0	4.0	33	300	600	NC	NC	--	--	--	--	--	--	--	--	--	< 1	--	--	< 1.0	--	< 1.0
Cadmium	ug/L	5	5.0	5.0	2.5	12	24	NC	NC	--	--	--	--	--	--	--	--	--	< 0.2	--	--	< 0.20	--	< 0.20
Chromium	ug/L	100	100	100	11	16	32	NC	NC	**1**	< 1	< 1	< 1	**1**	**1**	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	**1**	< 1.0
Cobalt	ug/L	15	40	100	100	370	740	NC	NC	--	--	--	--	--	--	--	--	--	< 15	--	--	< 6.0	--	< 6.0
Fluoride	ug/L	4,000	NC	NC	NC	10,000	20,000	NC	NC	--	--	--	--	--	--	--	--	--	< 1,000	--	--	< 1,000	--	< 1,000
Lead	ug/L	15	4.0	4.0	14	250	500	NC	NC	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1	< 1.0
Lithium	ug/L	180	170	350	440	910	1,800	NC	NC	**55**	**55**	**67**	**60**	**61**	**53**	**58**	**58**	**52**	**57**	**58**	**59**	**62**	**54**	**48**
Mercury	ug/L	2	2.0	2.0	0.20#	1.4	2.8	NC	NC	--	--	--	--	--	--	--	--	--	< 0.2	--	--	< 0.20	--	< 0.20
Molybdenum	ug/L	100	73	210	120	29,000	58,000	NC	NC	< 5	< 5	**5**	< 5	< 5	**6**	**6**	**5**	< 5	< 5	< 5	< 5	< 5.0	< 5	< 5.0
Radium-226/228	pCi/L	5	NC	NC	NC	NC	NC	NC	NC	--	--	--	--	--	--	--	--	--	--	--	--	< 1.88	--	--
Selenium	ug/L	50	50	50	5.0	62	120	55	120	< 1	**3**	< 1	**1**	< 1	< 1	**1**	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1	< 1.0
Thallium	ug/L	2	2.0	2.0	2.0	47	94	NC	NC	--	--	--	--	--	--	--	--	--	< 2	--	--	< 2.0	--	< 2.0

Notes:
ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units; pH is a field parameter.
NA - not applicable.
NC - no criteria.
-- - not analyzed. April 2019 radium data pending.
* - 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.
** - Michigan Part 201 Generic Drinking Water Cleanup Criteria, December 30, 2013.
^ - Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria. Hardness-dependent criteria calculated using hardness of 258 mg CaCO3/L (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018) per footnote {G} of Michigan Part 201 criteria tables. Chromium GSI criterion based on hexavalent chromium per footnote {H}. GSI criterion is protective for surface water used as a drinking water source as described in footnote {X}. GSI criterion for chloride is 50 mg/L when the discharge is to the Great Lakes or connecting waters per footnote {FF}
*** - Aquatic Maximum (AMV) and Final Acute Values (FAV) are taken from MDEQ Rule 323.1057 Part 4 - Water Quality Standards (Rule 57), March 15, 2018. Hardness-dependent criteria calculated using site-specific hardness of 258 mg CaCO3/L as measured at surface water sample SW-01 collected on April 9, 2018 from the Pigeon River. Chromium AMV & FAV criteria is based on hexavalent chromium.
^^ - Mixing Zone GSI Criteria from Michigan Department of Environmental Quality (MDEQ) approval letter dated December 23, 2015.
# - If detected above 0.20 ug/L, further evaluation of low-level mercury may be necessary to evaluate the GSI pathway per Michigan Part 201 and MDEQ policy and procedure 09-014 dated June 20, 2012.
BOLD font denotes concentrations detected above laboratory reporting limits.
Result Indicates an exceedance of one or more applicable criteria.
Result Indicates an exceedance of acute-based mixing zone GSI criteria.
All metals were analyzed as total unless otherwise specified.
All metals were analyzed as total unless otherwise specified.
(1) Constituent triggered an Assessment of Corrective Measures as described in TRC's letter report dated Janurary 14, 2019.
(2) Laboratory reporting limit exceeds one or more applicable criteria due to sample dilution.
(3) Unconfirmed anomalous result.

Table 3
Summary of Groundwater Sampling Results (Analytical): March 2016-April 2019
JC Weadock Landfill – RCRA CCR Monitoring Program
Essexville, Michigan

									Sample Location:	MW-55															
									Sample Date:	3/16/2016	5/10/2016	8/17/2016	10/19/2016	2/28/2017	5/11/2017	8/10/2017	11/2/2017	3/6/2018	5/15/2018	8/16/2018	8/30/2018	10/23/2018	11/8/2018	3/14/2019	4/11/2019
Constituent	Unit	GWPS*	MI Residential*	MI Non-Residential*	MI GSI^	MI AMV***	MI FAV***	Chronic MZ^^	Acute MZ^^	downgradient															
Appendix III																									
Boron	ug/L	NA	500	500	4,000	34,000	69,000	44,000	69,000	**453**	**570**	**504**	**708**	**547**	**493**	**519**	**619**	**680**	**539**	**670**	**665**	**677**	**582**	**705**	**800**
Calcium	mg/L	NA	NC	NC	500	NC	NC	NC	NC	--	--	--	--	--	--	--	--	--	**189**	--	**187**	--	**202**	--	**140**
Chloride	mg/L	NA	250	250	50	NC	NC	NC	NC	--	--	--	--	--	--	--	--	--	**15.7**	--	**15.9**	--	**15.8**	--	**26**
Fluoride	ug/L	4,000	NC	NC	NC	9,700	20,000	NC	NC	--	--	--	--	--	--	--	--	--	< 1,000	--	--	--	< 1,000	--	< 1,000
Sulfate	mg/L	NA	250	250	500	NC	NC	NC	NC	**560**	**530**	**460**	**380**	**310**	**440**	**360**	**280**	**100**	**257**	**250**	**173**	**180**	**157**	**68.6**	**70**
Total Dissolved Solids	mg/L	NA	500	500	500	NC	NC	NC	NC	--	--	--	--	--	--	--	--	--	**980**	--	--	--	**894**	--	**770**
pH, Field	SU	NA	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	NC	NC	NC	NC	**6.7**	**6.7**	**6.7**	**6.7**	**6.9**	**6.8**	**6.8**	**6.8**	**7.0**	**7.0**	**6.8**	**6.8**	**6.9**	**7.0**	**6.9**	**7.1**
Appendix IV																									
Antimony	ug/L	6	6.0	6.0	2.0	1,100	2,300	NC	NC	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 2.0	< 1	< 1.0	< 1	< 1.0
Arsenic	ug/L	21[(1)]	10	10	10	340	680	100	680	**11**	**6**	**6**	**19**	**18**	**6**	**15**	**19**	**18**	**17**	**37**	**29.4**	**38**	**35.1**	**49**	**34**
Barium	ug/L	2,000	2,000	2,000	1,200	3,400	7,000	NC	NC	**69**	**64**	**72**	**90**	**75**	**69**	**83**	**86**	**133**	**148**	**183**	**161**	**190**	**158**	**259**	**200**
Beryllium	ug/L	4	4.0	4.0	33	300	600	NC	NC	--	--	--	--	--	--	--	--	--	< 1	--	--	--	< 1.0	--	< 1.0
Cadmium	ug/L	5	5.0	5.0	2.5	12	24	NC	NC	--	--	--	--	--	--	--	--	--	**0.3**	--	--	--	**0.32**	**--**	< 0.20
Chromium	ug/L	100	100	100	11	16	32	NC	NC	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1	< 5.0	< 1	< 1.0
Cobalt	ug/L	15	40	100	100	370	740	NC	NC	--	--	--	--	--	--	--	--	--	< 15	--	--	--	< 30.0	--	< 6.0
Fluoride	ug/L	4,000	NC	NC	NC	10,000	20,000	NC	NC	--	--	--	--	--	--	--	--	--	< 1,000	--	--	--	< 1,000	--	< 1,000
Lead	ug/L	15	4.0	4.0	14	250	500	NC	NC	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1	< 5.0[(2)]	< 1	< 1.0
Lithium	ug/L	180	170	350	440	910	1,800	NC	NC	**21**	**15**	**25**	**22**	**17**	**16**	**23**	**28**	**16**	**20**	**32**	**30**	**34**	**40**	**22**	**17**
Mercury	ug/L	2	2.0	2.0	0.20#	1.4	2.8	NC	NC	--	--	--	--	--	--	--	--	--	< 0.2	--	--	--	< 0.20	--	< 0.20
Molybdenum	ug/L	100	73	210	120	29,000	58,000	NC	NC	**87**	**51**	**63**	**95**	**84**	**65**	**88**	**139**	**132**	**119**	**172**	**140**	**168**	**171**	**145**	**93**
Radium-226/228	pCi/L	5	NC	NC	NC	NC	NC	NC	NC	--	--	--	--	--	--	--	--	--	--	--	--	--	< 1.61	--	--
Selenium	ug/L	50	50	50	5.0	62	120	55	120	< 1	**18**	< 1	< 1	< 1	**17**	**10**	< 1	< 1	**1**	**2**	< 2.0	< 1	< 1.0	< 1	< 1.0
Thallium	ug/L	2	2.0	2.0	2.0	47	94	NC	NC	--	--	--	--	--	--	--	--	--	< 2	--	--	--	< 10.0[(2)]	--	< 2.0

Notes:
ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units; pH is a field parameter.
NA - not applicable.
NC - no criteria.
-- - not analyzed. April 2019 radium data pending.
* - 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.
** - Michigan Part 201 Generic Drinking Water Cleanup Criteria, December 30, 2013.
^ - Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria. Hardness-dependent criteria calculated using hardness of 258 mg CaCO3/L (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018) per footnote {G} of Michigan Part 201 criteria tables. Chromium GSI criterion based on hexavalent chromium per footnote {H}. GSI criterion is protective for surface water used as a drinking water source as described in footnote {X}. GSI criterion for chloride is 50 mg/L when the discharge is to the Great Lakes or connecting waters per footnote {FF}
*** - Aquatic Maximum (AMV) and Final Acute Values (FAV) are taken from MDEQ Rule 323.1057 Part 4 - Water Quality Standards (Rule 57), March 15, 2018. Hardness-dependent criteria calculated using site-specific hardness of 258 mg CaCO3/L as measured at surface water sample SW-01 collected on April 9, 2018 from the Pigeon River. Chromium AMV & FAV criteria is based on hexavalent chromium.
^^ - Mixing Zone GSI Criteria from Michigan Department of Environmental Quality (MDEQ) approval letter dated December 23, 2015.
# - If detected above 0.20 ug/L, further evaluation of low-level mercury may be necessary to evaluate the GSI pathway per Michigan Part 201 and MDEQ policy and procedure 09-014 dated June 20, 2012.
BOLD font denotes concentrations detected above laboratory reporting limits.
Result Indicates an exceedance of one or more applicable criteria.
Result Indicates an exceedance of acute-based mixing zone GSI criteria.
All metals were analyzed as total unless otherwise specified.
All metals were analyzed as total unless otherwise specified.
(1) Constituent triggered an Assessment of Corrective Measures as described in TRC's letter report dated Janurary 14, 2019.
(2) Laboratory reporting limit exceeds one or more applicable criteria due to sample dilution.
(3) Unconfirmed anomalous result.

Table 3

Summary of Groundwater Sampling Results (Analytical): March 2016-April 2019

JC Weadock Landfill – RCRA CCR Monitoring Program

Essexville, Michigan

									Sample Location:	OW-57OUT				OW-57ROUT			
									Sample Date:	8/31/2018	11/8/2018	3/14/2019	4/12/2019	11/8/2018	3/14/2019	4/12/2019
Constituent	Unit	GWPS*	MI Residential*	MI Non-Residential*	MI GSI^	MI AMV***	MI FAV***	Chronic MZ^^	Acute MZ^^	downgradient				downgradient		
Appendix III																	
Boron	ug/L	NA	500	500	4,000	34,000	69,000	44,000	69,000	**1,780**	**1,830**	**1,680**	**1,700**	**1,850**	**1,720**	**1,700**
Calcium	mg/L	NA	NC	NC	500	NC	NC	NC	NC	**138**	**143**	--	**140**	**141**	--	**130**
Chloride	mg/L	NA	250	250	50	NC	NC	NC	NC	**53.4**	**54.5**	--	**46**	**70.3**	--	**68**
Fluoride	ug/L	4,000	NC	NC	NC	9,700	20,000	NC	NC	**1,000**	**1,200**	--	**1,100**	**1,200**	--	**1,200**
Sulfate	mg/L	NA	250	250	500	NC	NC	NC	NC	**59.3**	**65.7**	**67.2**	**68**	**112**	**123**	**110**
Total Dissolved Solids	mg/L	NA	500	500	500	NC	NC	NC	NC	**712**	**704**	--	**720**	**808**	--	**780**
pH, Field	SU	NA	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	NC	NC	NC	NC	**6.8**	**7.0**	**7.1**	**7.0**	**7.0**	**7.0**	**7.1**
Appendix IV																	
Antimony	ug/L	6	6.0	6.0	2.0	1,100	2,300	NC	NC	< 2.0	< 1.0	< 1	< 1.0	< 1.0	< 1	< 1.0
Arsenic	ug/L	21[(1)]	10	10	10	340	680	100	680	**1.2**	**1.6**	< 1	< 1.0	**1.4**	**1**	< 1.0
Barium	ug/L	2,000	2,000	2,000	1,200	3,400	7,000	NC	NC	**92.3**	**81.7**	**83**	**87**	**73.7**	**69**	**72**
Beryllium	ug/L	4	4.0	4.0	33	300	600	NC	NC	< 1.0	< 1.0	--	< 1.0	< 1.0	--	< 1.0
Cadmium	ug/L	5	5.0	5.0	2.5	12	24	NC	NC	< 0.20	< 0.20	--	< 0.20	< 0.20	--	< 0.20
Chromium	ug/L	100	100	100	11	16	32	NC	NC	< 1.0	< 1.0	**16**	**1.4**	< 1.0	**41[(3)]**	< 1.0
Cobalt	ug/L	15	40	100	100	370	740	NC	NC	< 15.0	< 6.0	--	< 6.0	< 6.0	--	< 6.0
Fluoride	ug/L	4,000	NC	NC	NC	10,000	20,000	NC	NC	**1,000**	**1,200**	--	**1,100**	**1,200**	--	**1,200**
Lead	ug/L	15	4.0	4.0	14	250	500	NC	NC	< 1.0	< 1.0	**4**	< 1.0	< 1.0	< 1	< 1.0
Lithium	ug/L	180	170	350	440	910	1,800	NC	NC	**25**	**29**	**22**	**21**	**35**	**23**	**23**
Mercury	ug/L	2	2.0	2.0	0.20#	1.4	2.8	NC	NC	< 0.20	< 0.20	--	< 0.20	< 0.20	--	< 0.20
Molybdenum	ug/L	100	73	210	120	29,000	58,000	NC	NC	**7.1**	**7.2**	**7**	**6.5**	**8.9**	**11**	**7.9**
Radium-226/228	pCi/L	5	NC	NC	NC	NC	NC	NC	NC	< 1.93	< 1.68	--	--	< 1.81	--	--
Selenium	ug/L	50	50	50	5.0	62	120	55	120	< 2.0	< 1.0	< 1	< 1.0	< 1.0	< 1	< 1.0
Thallium	ug/L	2	2.0	2.0	2.0	47	94	NC	NC	< 2.0	< 2.0	--	< 2.0	< 2.0	--	< 2.0

Notes:

ug/L - micrograms per liter.

mg/L - milligrams per liter.

SU - standard units; pH is a field parameter.

NA - not applicable.

NC - no criteria.

-- - not analyzed. April 2019 radium data pending.

* - 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.

** - Michigan Part 201 Generic Drinking Water Cleanup Criteria, December 30, 2013.

^ - Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria. Hardness-dependent criteria calculated using hardness of 258 mg CaCO3/L (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018) per footnote {G} of Michigan Part 201 criteria tables. Chromium GSI criterion based on hexavalent chromium per footnote {H}. GSI criterion is protective for surface water used as a drinking water source as described in footnote {X}. GSI criterion for chloride is 50 mg/L when the discharge is to the Great Lakes or connecting waters per footnote {FF}

*** - Aquatic Maximum (AMV) and Final Acute Values (FAV) are taken from MDEQ Rule 323.1057 Part 4 - Water Quality Standards (Rule 57), March 15, 2018. Hardness-dependent criteria calculated using site-specific hardness of 258 mg CaCO3/L as measured at surface water sample SW-01 collected on April 9, 2018 from the Pigeon River. Chromium AMV & FAV criteria is based on hexavalent chromium.

^^ - Mixing Zone GSI Criteria from Michigan Department of Environmental Quality (MDEQ) approval letter dated December 23, 2015.

- If detected above 0.20 ug/L, further evaluation of low-level mercury may be necessary to evaluate the GSI pathway per Michigan Part 201 and MDEQ policy and procedure 09-014 dated June 20, 2012.

BOLD font denotes concentrations detected above laboratory reporting limits.

Result Indicates an exceedance of one or more applicable criteria.

Result Indicates an exceedance of acute-based mixing zone GSI criteria.

All metals were analyzed as total unless otherwise specified.

All metals were analyzed as total unless otherwise specified.

(1) Constituent triggered an Assessment of Corrective Measures as described in TRC's letter report dated Janurary 14, 2019.

(2) Laboratory reporting limit exceeds one or more applicable criteria due to sample dilution.

(3) Unconfirmed anomalous result.

Table 4

Summary of Groundwater Sampling Results (Analytical): March 2016 - March 2019

JC Weadock Landfill HMP Monitoring Well

Essexville, Michigan

									Sample Location:	MW-58												
									Sample Date:	3/16/2016	5/10/2016	8/17/2016	10/20/2016	2/28/2017	5/11/2017	8/9/2017	11/2/2017	3/5/2018	5/16/2018	8/16/2018	10/23/2018	3/14/2019
Constituent	Unit	GWPS*	MI Residential**	MI Non-Residential**	MI GSI^	MI AMV***	MI FAV***	Chronic MZ^^	Acute MZ^^	supplemental												
Appendix III																						
Boron	ug/L	NA	500	500	4,000	34,000	69,000	44,000	69,000	**87**	**166**	**31**	**219**	**129**	**158**	**162**	**211**	**192**	**155**	**250**	**234**	**165**
Calcium	mg/L	NA	NC	NC	500	NC	NC	NC	NC	--	--	--	--	--	--	--	--	--	**103**	--	--	--
Chloride	mg/L	NA	**250**	**250**	**50**	NC	NC	NC	NC	--	--	--	--	--	--	--	--	--	**330**	--	--	--
Fluoride	ug/L	4,000	NC	NC	NC	9,700	20,000	NC	NC	--	--	--	--	--	--	--	--	--	< 1,000	--	--	--
Sulfate	mg/L	NA	250	250	500	NC	NC	NC	NC	**34**	**15**	**23**	**21**	**35**	**6.3**	**3.8**	**16**	**15**	**16.1**	**3**	**11**	**7.38**
Total Dissolved Solids	mg/L	NA	**500**	**500**	**500**	NC	NC	NC	NC	--	--	--	--	--	--	--	--	--	**850**	--	--	--
pH, Field	SU	NA	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	NC	NC	NC	NC	**7.0**	**6.9**	**6.9**	**6.9**	**7.0**	**6.9**	**6.7**	**6.9**	**6.9**	**7.0**	**6.9**	**6.8**	**6.8**
Appendix IV																						
Antimony	ug/L	6	6.0	6.0	2.0	1,100	2,300	NC	NC	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Arsenic	ug/L	21	10	10	10	340	680	100	680	< 1	< 1	**1**	< 1	< 1	**1**	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Barium	ug/L	2,000	2,000	2,000	1,200	3,400	7,000	NC	NC	**92**	**102**	**88**	**91**	**85**	**97**	**119**	**99**	**86**	**94**	**111**	**126**	**104**
Beryllium	ug/L	4	4.0	4.0	33	300	600	NC	NC	--	--	--	--	--	--	--	--	--	< 1	--	--	--
Cadmium	ug/L	5	5.0	5.0	2.5	12	24	NC	NC	--	--	--	--	--	--	--	--	--	< 0.2	--	--	--
Chromium	ug/L	100	100	100	11	16	32	NC	NC	**1**	**1**	**1**	< 1	**1**	**1**	< 1	**1**	< 1	< 1	< 1	< 1	< 1
Cobalt	ug/L	15	40	100	100	370	740	NC	NC	--	--	--	--	--	--	--	--	--	< 15	--	--	--
Fluoride	ug/L	4,000	NC	NC	NC	10,000	20,000	NC	NC	--	--	--	--	--	--	--	--	--	< 1,000	--	--	--
Lead	ug/L	15	4.0	4.0	14	250	500	NC	NC	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	**1**	< 1	< 1
Lithium	ug/L	180	170	350	440	910	1,800	NC	NC	**22**	**22**	**26**	**19**	**21**	**21**	**22**	**21**	**14**	**21**	**25**	**25**	**23**
Mercury	ug/L	2	2.0	2.0	0.20	1.4	2.8	NC	NC	--	--	--	--	--	--	--	--	--	< 0.2	--	--	--
Molybdenum	ug/L	100	73	210	120	29,000	58,000	NC	NC	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Selenium	ug/L	50	50	50	5.0	62	120	55	120	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	**1**	**3**
Thallium	ug/L	2	2.0	2.0	2.0	47	94	NC	NC	--	--	--	--	--	--	--	--	--	< 2	--	--	--

Notes:

ug/L - micrograms per liter.

mg/L - milligrams per liter.

SU - standard units; pH is a field parameter.

NA - not applicable.

NC - no criteria.

-- - not analyzed.

* - 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.

** - Michigan Part 201 Generic Drinking Water Cleanup Criteria, December 30, 2013.

^ - Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria. Hardness-dependent criteria calculated using hardness of 258 mg CaCO3/L (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018) per footnote {G} of Michigan Part 201 criteria tables. Chromium GSI criterion based on hexavalent chromium per footnote {H}. GSI criterion is protective for surface water used as a drinking water source as described in footnote {X}. GSI criterion for chloride is 50 mg/L when the discharge is to the Great Lakes or connecting waters per footnote {FF}

*** - Aquatic Maximum (AMV) and Final Acute Values (FAV) are taken from MDEQ Rule 323.1057 Part 4 - Water Quality Standards (Rule 57), March 15, 2018. Hardness-dependent criteria calculated using site-specific hardness of 258 mg CaCO3/L as measured at surface water sample SW-01 collected on April 9, 2018 from the Pigeon River. Chromium AMV & FAV criteria is based on hexavalent chromium.

^^ - Mixing Zone GSI Criteria from Michigan Department of Environmental Quality (MDEQ) approval letter dated December 23, 2015.

- If detected above 0.20 ug/L, further evaluation of low-level mercury may be necessary to evaluate the GSI pathway per Michigan Part 201 and MDEQ policy and procedure 09-014 dated June 20, 2012.

BOLD font denotes concentrations detected above laboratory reporting limits.

Result	Indicates an exceedance of one or more applicable criteria.
Result	Indicates an exceedance of acute-based mixing zone GSI criteria.

All metals were analyzed as total unless otherwise specified.

Table 5
Summary of Part 115 Groundwater Sampling Results (Analytical): November 2018 - April 2019
DE Karn & JC Weadock Background – RCRA CCR Monitoring Program
Essexville, Michigan

						Sample Location:	MW-15002		MW-15008		MW-15016		MW-15019	
						Sample Date:	11/8/2018	4/8/2019	11/8/2018	4/8/2019	11/8/2018	4/9/2019	11/8/2018	4/8/2019
Constituent	Unit	MI Residential*	MI Non-Residential*	MI GSI^	MI AMV***	MI FAV***	Background							
Appendix III														
Iron	ug/L	300**	300**	NA	NC	NC	**8,550**	**10,000**	**17,500**	**17,000**	**136**	**1,400**	**21,200**	**21,000**
Appendix IV														
Copper	ug/L	1,000**	1,000**	20	33	66	< 1.0	< 1.0	< 1.0	**7.6**	**2.6**	< 1.0	< 1.0	< 1.0
Nickel	ug/L	100	100	120	1,000	2,100	< 1.0	< 2.0	< 1.0	< 2.0	**1.3**	**2.3**	< 1.0	< 2.0
Silver	ug/L	34	98	0.2	0.54	1.1	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Vanadium	ug/L	4.5	62	27	79	160	**1.1**	**2.1**	**5.3**	**4.5**	< 1.0	< 2.0	< 1.0	< 2.0
Zinc	ug/L	2,400	5,000**	260	260	520	< 10.0	**19**	< 10.0	< 10	< 10.0	**26**	< 10.0	< 10

Notes:

ug/L - micrograms per liter.

NC - no criteria.

NA - not applicable.

* - Michigan Part 201 Generic Drinking Water Cleanup Criteria, December 30, 2013.

** - Drinking water criterion is the aesthetic drinking water value as described in footnote {E}.

^ - Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria. Hardness-dependent criteria calculated using hardness of 258 mg CaCO3/L (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018) per footnote {G} of Michigan Part 201 criteria tables.. GSI criterion is protective for surface water used as a drinking water source as described in footnote {X}.

*** - Aquatic Maximum (AMV) and Final Acute Values (FAV) are taken from MDEQ Rule 323.1057 Part 4 - Water Quality Standards (Rule 57), March 15, 2018. Hardness-dependent criteria calculated using site-specific hardness of 258 mg CaCO3/L as measured at surface water sample SW-01 collected on April 9, 2018 from the Pigeon River. Chromium AMV & FAV criteria is based on hexavalent chromium.

BOLD font denotes concentrations detected above laboratory reporting limits.

Result Indicates an exceedance of one or more applicable criteria.

All metals were analyzed as total unless otherwise specified.

Table 6
Summary of Part 115 Groundwater Sampling Results (Analytical): November 2018 - April 2019
JC Weadock Bottom Ash Pond – RCRA CCR Monitoring Program
Essexville, Michigan

						Sample Location:	JCW-MW-15007		JCW-MW-15009		JCW-MW-15010		JCW-MW-15028	
						Sample Date:	11/7/2018	4/9/2019	11/7/2018	4/9/2019	11/7/2018	4/9/2019	11/7/2018	4/9/2019
Constituent	Unit	MI Residential*	MI Non-Residential*	MI GSI^	MI AMV***	MI FAV***	downgradient							
Appendix III														
Iron	ug/L	300**	300**	NA	NC	NC	**4,790**	**1,400**	**35,100**	**34,000**	**20.7**	**12**	**522**	**190**
Appendix IV														
Copper	ug/L	1,000**	1,000**	20	33	66	< 5.0	< 1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Nickel	ug/L	100	100	120	1,000	2,100	< 5.0	< 2.0	< 5.0	< 2.0	**1.1**	< 2.0	< 1.0	< 2.0
Silver	ug/L	34	98	0.2	0.54	1.1	< 1.0	< 0.20	< 1.0	**0.21**	< 0.20	< 0.20	< 0.20	< 0.20
Vanadium	ug/L	4.5	62	27	79	160	< 1.0	**3.6**	**5.6**	**2.5**	< 1.0	< 2.0	< 1.0	< 2.0
Zinc	ug/L	2,400	5,000**	260	260	520	< 50.0	< 10	< 50.0	< 10	< 10.0	< 10	< 10.0	< 10

Notes:

ug/L - micrograms per liter.

NC - no criteria.

NA - not applicable.

* - Michigan Part 201 Generic Drinking Water Cleanup Criteria, December 30, 2013.

** - Drinking water criterion is the aesthetic drinking water value as described in footnote {E}.

^ - Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria. Hardness-dependent criteria calculated using hardness of 258 mg CaCO3/L (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018) per footnote {G} of Michigan Part 201 criteria tables.. GSI criterion is protective for surface water used as a drinking water source as described in footnote {X}.

*** - Aquatic Maximum (AMV) and Final Acute Values (FAV) are taken from MDEQ Rule 323.1057 Part 4 - Water Quality Standards (Rule 57), March 15, 2018. Hardness-dependent criteria calculated using site-specific hardness of 258 mg CaCO3/L as measured at surface water sample SW-01 collected on April 9, 2018 from the Pigeon River. Chromium AMV & FAV criteria is based on hexavalent chromium.

BOLD font denotes concentrations detected above laboratory reporting limits.

Result Indicates an exceedance of one or more applicable criteria.

All metals were analyzed as total unless otherwise specified.

Table 7
Summary of Part 115 Groundwater Sampling Results (Analytical): March 2016 - April 2019
JC Weadock Landfill – RCRA CCR Monitoring Program
Essexville, Michigan

							JCW-MW-18001				JCW-MW-18004			
Sample Location:														
Sample Date:							8/31/2018	11/7/2018	3/12/2019	4/12/2019	8/30/2018	11/8/2018	3/13/2019	4/11/2019
Constituent	Unit	MI Residential*	MI Non-Residential*	MI GSI^	MI AMV***	MI FAV***	Downgradient							
Appendix III														
Iron	ug/L	300**	300**	NA	NC	NC	**310**	**73.8**	**281**	**450**	**150**	**70.0**	**3,170**	**11,000**
Appendix IV														
Copper	ug/L	1,000**	1,000**	20	33	66	< 1.0	< 1.0	< 1	< 1.0	**1.8**	< 5.0	**11**	**11**
Nickel	ug/L	100	100	120	1,000	2,100	--	< 1.0	--	< 2.0	--	< 5.0	--	**12**
Silver	ug/L	34	98	0.2	0.54	1.1	< 0.20	< 0.20	< 0.2	< 0.20	< 0.20	< 0.20	< 0.2	< 0.20
Vanadium	ug/L	4.5	62	27	79	160	< 4.0	< 1.0	< 2	< 2.0	< 4.0	**1.7**	**8**	**14**
Zinc	ug/L	2,400	5,000**	260	260	520	--	< 10.0	--	< 10	--	< 50.0	--	**36**

Notes:

ug/L - micrograms per liter.

NC - no criteria.

NA - not applicable.

* - Michigan Part 201 Generic Drinking Water Cleanup Criteria, December 30, 2013.

** - Drinking water criterion is the aesthetic drinking water value as described in footnote {E}.

^ - Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria. Hardness-dependent criteria calculated using hardness of 258 mg CaCO3/L (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018) per footnote {G} of Michigan Part 201 criteria tables.. GSI criterion is protective for surface water used as a drinking water source as described in footnote {X}.

*** - Aquatic Maximum (AMV) and Final Acute Values (FAV) are taken from MDEQ Rule 323.1057 Part 4 - Water Quality Standards (Rule 57), March 15, 2018. Hardness-dependent criteria calculated using site-specific hardness of 258 mg CaCO3/L as measured at surface water sample SW-01 collected on April 9, 2018 from the Pigeon River. Chromium AMV & FAV criteria is based on hexavalent chromium.

BOLD font denotes concentrations detected above laboratory reporting limits.

Result Indicates an exceedance of one or more applicable criteria.

All metals were analyzed as total unless otherwise specified.

Table 7
Summary of Part 115 Groundwater Sampling Results (Analytical): March 2016 - April 2019
JC Weadock Landfill – RCRA CCR Monitoring Program
Essexville, Michigan

							JCW-MW-18005				JCW-MW-18006			
Sample Location:														
Sample Date:							8/30/2018	11/8/2018	3/14/2019	4/11/2019	8/31/2018	11/8/2018	3/14/2019	4/11/2019
Constituent	Unit	MI Residential*	MI Non-Residential*	MI GSI^	MI AMV***	MI FAV***	Downgradient							
Appendix III														
Iron	ug/L	300**	300**	NA	NC	NC	**4,700**	**2,600**	**5,890**	**9,400**	**8,300**	**11,900**	**8,200**	**12,000**
Appendix IV														
Copper	ug/L	1,000**	1,000**	20	33	66	**2.6**	< 1.0	**2**	< 1.0	< 1.0	< 1.0	**1**	< 2.0
Nickel	ug/L	100	100	120	1,000	2,100	--	**13.6**	--	**7.8**	--	**5.3**	--	**5.0**
Silver	ug/L	34	98	0.2	0.54	1.1	< 0.20	< 0.20	< 0.2	< 0.20	< 0.20	< 0.20	< 0.2	< 0.40
Vanadium	ug/L	4.5	62	27	79	160	< 4.0	< 1.0	< 2	< 2.0	< 4.0	**3.1**	**3**	< 4.0
Zinc	ug/L	2,400	5,000**	260	260	520	--	< 10.0	--	< 10	--	< 10.0	--	< 20

Notes:

ug/L - micrograms per liter.

NC - no criteria.

NA - not applicable.

* - Michigan Part 201 Generic Drinking Water Cleanup Criteria, December 30, 2013.

** - Drinking water criterion is the aesthetic drinking water value as described in footnote {E}.

^ - Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria. Hardness-dependent criteria calculated using hardness of 258 mg CaCO3/L (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018) per footnote {G} of Michigan Part 201 criteria tables.. GSI criterion is protective for surface water used as a drinking water source as described in footnote {X}.

*** - Aquatic Maximum (AMV) and Final Acute Values (FAV) are taken from MDEQ Rule 323.1057 Part 4 - Water Quality Standards (Rule 57), March 15, 2018. Hardness-dependent criteria calculated using site-specific hardness of 258 mg CaCO3/L as measured at surface water sample SW-01 collected on April 9, 2018 from the Pigeon River. Chromium AMV & FAV criteria is based on hexavalent chromium.

BOLD font denotes concentrations detected above laboratory reporting limits.

Result Indicates an exceedance of one or more applicable criteria.

All metals were analyzed as total unless otherwise specified.

Table 7
Summary of Part 115 Groundwater Sampling Results (Analytical): March 2016 - April 2019
JC Weadock Landfill – RCRA CCR Monitoring Program
Essexville, Michigan

							MW-50														
Sample Location:																					
Sample Date:							3/15/2016	5/10/2016	8/16/2016	10/18/2016	2/27/2017	5/11/2017	8/9/2017	11/1/2017	3/5/2018	5/15/2018	8/15/2018	10/23/2018	11/7/2018	3/12/2019	4/9/2019
Constituent	Unit	MI Residential*	MI Non-Residential*	MI GSI^	MI AMV***	MI FAV***	Downgradient														
Appendix III																					
Iron	ug/L	300**	300**	NA	NC	NC	**487**	**128**	**870**	**764**	**208**	**220**	**924**	**2,120**	**268**	**517**	**803**	**1,450**	**1,650**	**306**	**590**
Appendix IV																					
Copper	ug/L	1,000**	1,000**	20	33	66	< 1	< 1	< 1	< 1	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**1**	< 5.0	**8**	< 1.0
Nickel	ug/L	100	100	120	1,000	2,100	--	--	--	--	--	--	--	--	--	--	--	--	< 5.0	--	**2.7**
Silver	ug/L	34	98	0.2	0.54	1.1	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	< 0.2	< 0.20
Vanadium	ug/L	4.5	62	27	79	160	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 1.0	**2**	< 2.0
Zinc	ug/L	2,400	5,000**	260	260	520	--	--	--	--	--	--	--	--	--	--	--	--	< 50.0	--	< 10

Notes:

ug/L - micrograms per liter.

NC - no criteria.

NA - not applicable.

* - Michigan Part 201 Generic Drinking Water Cleanup Criteria, December 30, 2013.

** - Drinking water criterion is the aesthetic drinking water value as described in footnote {E}.

^ - Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria. Hardness-dependent criteria calculated using hardness of 258 mg CaCO3/L (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018) per footnote {G} of Michigan Part 201 criteria tables.. GSI criterion is protective for surface water used as a drinking water source as described in footnote {X}.

*** - Aquatic Maximum (AMV) and Final Acute Values (FAV) are taken from MDEQ Rule 323.1057 Part 4 - Water Quality Standards (Rule 57), March 15, 2018. Hardness-dependent criteria calculated using site-specific hardness of 258 mg CaCO3/L as measured at surface water sample SW-01 collected on April 9, 2018 from the Pigeon River. Chromium AMV & FAV criteria is based on hexavalent chromium.

BOLD font denotes concentrations detected above laboratory reporting limits.

Result Indicates an exceedance of one or more applicable criteria.

All metals were analyzed as total unless otherwise specified.

Table 7
Summary of Part 115 Groundwater Sampling Results (Analytical): March 2016 - April 2019
JC Weadock Landfill – RCRA CCR Monitoring Program
Essexville, Michigan

							Sample Location:	MW-51													
							Sample Date:	3/15/2016	5/10/2016	8/18/2016	10/18/2016	2/27/2017	5/11/2017	8/9/2017	11/1/2017	3/6/2018	5/16/2018	8/15/2018	10/23/2018	11/8/2018	3/13/2019	4/9/2019
Constituent	Unit	MI Residential*	MI Non-Residential*	MI GSI^	MI AMV***	MI FAV***		Downgradient													
Appendix III																					
Iron	ug/L	300**	300**	NA	NC	NC		**1,180**	**994**	**1,450**	**1,720**	**2,840**	**4,740**	**5,880**	**6,130**	**3,100**	**4,820**	**4,920**	**6,430**	**7,370**	**3,170**	**5,300**
Appendix IV																					
Copper	ug/L	1,000**	1,000**	20	33	66		< 1	< 1	**2**	**1**	< 1	**2**	**1**	**2**	**1**	**3**	**1**	**1**	< 5.0	**2**	< 1.0
Nickel	ug/L	100	100	120	1,000	2,100		--	--	--	--	--	--	--	--	--	--	--	--	< 5.0	--	< 2.0
Silver	ug/L	34	98	0.2	0.54	1.1		< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 1.0	< 0.2	< 0.20
Vanadium	ug/L	4.5	62	27	79	160		< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 1.0	< 2	< 2.0
Zinc	ug/L	2,400	5,000**	260	260	520		--	--	--	--	--	--	--	--	--	--	--	--	< 50.0	--	< 10

Notes:
ug/L - micrograms per liter.
NC - no criteria.
NA - not applicable.
* - Michigan Part 201 Generic Drinking Water Cleanup Criteria, December 30, 2013.
** - Drinking water criterion is the aesthetic drinking water value as described in footnote {E}.
^ - Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria. Hardness-dependent criteria calculated using hardness of 258 mg CaCO3/L (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018) per footnote {G} of Michigan Part 201 criteria tables.. GSI criterion is protective for surface water used as a drinking water source as described in footnote {X}.
*** - Aquatic Maximum (AMV) and Final Acute Values (FAV) are taken from MDEQ Rule 323.1057 Part 4 - Water Quality Standards (Rule 57), March 15, 2018. Hardness-dependent criteria calculated using site-specific hardness of 258 mg CaCO3/L as measured at surface water sample SW-01 collected on April 9, 2018 from the Pigeon River. Chromium AMV & FAV criteria is based on hexavalent chromium.
BOLD font denotes concentrations detected above laboratory reporting limits.
Result Indicates an exceedance of one or more applicable criteria.
All metals were analyzed as total unless otherwise specified.

Table 7
Summary of Part 115 Groundwater Sampling Results (Analytical): March 2016 - April 2019
JC Weadock Landfill – RCRA CCR Monitoring Program
Essexville, Michigan

							Sample Location:	MW-52													
							Sample Date:	3/15/2016	5/10/2016	8/18/2016	10/19/2016	2/27/2017	5/11/2017	8/9/2017	11/1/2017	3/6/2018	5/15/2018	8/15/2018	10/23/2018	11/8/2018	3/13/2019	4/9/2019
Constituent	Unit	MI Residential*	MI Non-Residential*	MI GSI^	MI AMV***	MI FAV***		Downgradient													
Appendix III																					
Iron	ug/L	300**	300**	NA	NC	NC		**1,690**	**897**	**2,880**	**4,700**	**1,510**	**2,030**	**4,210**	**4,780**	**1,390**	**1,480**	**2,230**	**3,910**	**4,880**	**1,960**	**2,100**
Appendix IV																					
Copper	ug/L	1,000**	1,000**	20	33	66		< 1	< 1	**2**	**2**	< 1	**2**	**1**	**2**	**2**	**2**	**2**	**1**	< 5.0	**2**	< 1.0
Nickel	ug/L	100	100	120	1,000	2,100		--	--	--	--	--	--	--	--	--	--	--	--	< 5.0	--	< 2.0
Silver	ug/L	34	98	0.2	0.54	1.1		< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 1.0	< 0.2	< 0.20
Vanadium	ug/L	4.5	62	27	79	160		< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 1.0	< 2	< 2.0
Zinc	ug/L	2,400	5,000**	260	260	520		--	--	--	--	--	--	--	--	--	--	--	--	< 50.0	--	< 10

Notes:

ug/L - micrograms per liter.

NC - no criteria.

NA - not applicable.

* - Michigan Part 201 Generic Drinking Water Cleanup Criteria, December 30, 2013.

** - Drinking water criterion is the aesthetic drinking water value as described in footnote {E}.

^ - Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria. Hardness-dependent criteria calculated using hardness of 258 mg CaCO3/L (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018) per footnote {G} of Michigan Part 201 criteria tables.. GSI criterion is protective for surface water used as a drinking water source as described in footnote {X}.

*** - Aquatic Maximum (AMV) and Final Acute Values (FAV) are taken from MDEQ Rule 323.1057 Part 4 - Water Quality Standards (Rule 57), March 15, 2018. Hardness-dependent criteria calculated using site-specific hardness of 258 mg CaCO3/L as measured at surface water sample SW-01 collected on April 9, 2018 from the Pigeon River. Chromium AMV & FAV criteria is based on hexavalent chromium.

BOLD font denotes concentrations detected above laboratory reporting limits.

Result Indicates an exceedance of one or more applicable criteria.

All metals were analyzed as total unless otherwise specified.

Table 7
Summary of Part 115 Groundwater Sampling Results (Analytical): March 2016 - April 2019
JC Weadock Landfill – RCRA CCR Monitoring Program
Essexville, Michigan

							Sample Location:	MW-53													
							Sample Date:	3/15/2016	5/10/2016	8/18/2016	10/19/2016	2/27/2017	5/11/2017	8/9/2017	11/1/2017	3/6/2018	5/15/2018	8/15/2018	10/23/2018	11/8/2018	3/13/2019	4/10/2019
Constituent	Unit	MI Residential*	MI Non-Residential*	MI GSI^	MI AMV***	MI FAV***		Downgradient													
Appendix III																					
Iron	ug/L	300**	300**	NA	NC	NC		**5,140**	**4,280**	**5,900**	**6,550**	**6,150**	**3,060**	**3,910**	**7,450**	**4,150**	**1,370**	**3,670**	**8,060**	**13,500**	**1,930**	**1,900**
Appendix IV																					
Copper	ug/L	1,000**	1,000**	20	33	66		**2**	**1**	**3**	**2**	< 1	**3**	**2**	**2**	**2**	**1**	**2**	< 1	< 5.0	**1**	< 1.0
Nickel	ug/L	100	100	120	1,000	2,100		--	--	--	--	--	--	--	--	--	--	--	--	< 5.0	--	< 2.0
Silver	ug/L	34	98	0.2	0.54	1.1		< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 1.0	< 0.2	< 0.20
Vanadium	ug/L	4.5	62	27	79	160		< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 1.0	< 2	< 2.0
Zinc	ug/L	2,400	5,000**	260	260	520		--	--	--	--	--	--	--	--	--	--	--	--	< 50.0	--	< 10

Notes:

ug/L - micrograms per liter.

NC - no criteria.

NA - not applicable.

* - Michigan Part 201 Generic Drinking Water Cleanup Criteria, December 30, 2013.

** - Drinking water criterion is the aesthetic drinking water value as described in footnote {E}.

^ - Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria. Hardness-dependent criteria calculated using hardness of 258 mg CaCO3/L (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018) per footnote {G} of Michigan Part 201 criteria tables.. GSI criterion is protective for surface water used as a drinking water source as described in footnote {X}.

*** - Aquatic Maximum (AMV) and Final Acute Values (FAV) are taken from MDEQ Rule 323.1057 Part 4 - Water Quality Standards (Rule 57), March 15, 2018. Hardness-dependent criteria calculated using site-specific hardness of 258 mg CaCO3/L as measured at surface water sample SW-01 collected on April 9, 2018 from the Pigeon River. Chromium AMV & FAV criteria is based on hexavalent chromium.

BOLD font denotes concentrations detected above laboratory reporting limits.

Result Indicates an exceedance of one or more applicable criteria.

All metals were analyzed as total unless otherwise specified.

Table 7
Summary of Part 115 Groundwater Sampling Results (Analytical): March 2016 - April 2019
JC Weadock Landfill – RCRA CCR Monitoring Program
Essexville, Michigan

							Sample Location:	MW-53R													
							Sample Date:	3/16/2016	5/10/2016	8/18/2016	10/19/2016	2/27/2017	5/11/2017	8/9/2017	11/2/2017	3/6/2018	5/15/2018	8/15/2018	10/23/2018	11/8/2018	3/13/2019	4/10/2019
Constituent	Unit	MI Residential*	MI Non-Residential*	MI GSI^	MI AMV***	MI FAV***		Downgradient													
Appendix III																					
Iron	ug/L	300**	300**	NA	NC	NC		**201**	**356**	**910**	**1,390**	**1,580**	**1,170**	**971**	**1,950**	**505**	**720**	**1,440**	**1,230**	**1,450**	**743**	**1,200**
Appendix IV																					
Copper	ug/L	1,000**	1,000**	20	33	66		**1**	**3**	**2**	**2**	< 1	**2**	**1**	**2**	**2**	**3**	**1**	**1**	< 1.0	**1**	< 1.0
Nickel	ug/L	100	100	120	1,000	2,100		--	--	--	--	--	--	--	--	--	--	--	--	**1.4**	--	< 2.0
Silver	ug/L	34	98	0.2	0.54	1.1		< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	< 0.20	< 0.20
Vanadium	ug/L	4.5	62	27	79	160		< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 1.0	< 2	< 2.0
Zinc	ug/L	2,400	5,000**	260	260	520		--	--	--	--	--	--	--	--	--	--	--	--	< 10.0	--	< 10

Notes:
ug/L - micrograms per liter.
NC - no criteria.
NA - not applicable.
* - Michigan Part 201 Generic Drinking Water Cleanup Criteria, December 30, 2013.
** - Drinking water criterion is the aesthetic drinking water value as described in footnote {E}.
^ - Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria. Hardness-dependent criteria calculated using hardness of 258 mg CaCO3/L (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018) per footnote {G} of Michigan Part 201 criteria tables.. GSI criterion is protective for surface water used as a drinking water source as described in footnote {X}.
*** - Aquatic Maximum (AMV) and Final Acute Values (FAV) are taken from MDEQ Rule 323.1057 Part 4 - Water Quality Standards (Rule 57), March 15, 2018. Hardness-dependent criteria calculated using site-specific hardness of 258 mg CaCO3/L as measured at surface water sample SW-01 collected on April 9, 2018 from the Pigeon River. Chromium AMV & FAV criteria is based on hexavalent chromium.
BOLD font denotes concentrations detected above laboratory reporting limits.
Result Indicates an exceedance of one or more applicable criteria.
All metals were analyzed as total unless otherwise specified.

Table 7
Summary of Part 115 Groundwater Sampling Results (Analytical): March 2016 - April 2019
JC Weadock Landfill – RCRA CCR Monitoring Program
Essexville, Michigan

							Sample Location:	MW-54R												
							Sample Date:	3/16/2016	5/10/2016	8/17/2016	10/19/2016	2/28/2017	5/11/2017	8/9/2017	11/2/2017	3/6/2018	5/15/2018	8/16/2018	10/23/2018	11/8/2018	3/13/2019	4/11/2019
Constituent	Unit	MI Residential*	MI Non-Residential*	MI GSI^	MI AMV***	MI FAV***		Downgradient												
Appendix III																				
Iron	ug/L	300**	300**	NA	NC	NC		**176**	< 20	**152**	**90**	**572**	**72**	< 20	**551**	< 20	**260**	< 20	**34**	**53.5**	**160**	**600**
Appendix IV																				
Copper	ug/L	1,000**	1,000**	20	33	66		**1**	< 1	**2**	**2**	< 1	**3**	**2**	**2**	**1**	**2**	**2**	**3**	< 1.0	**1**	< 1.0
Nickel	ug/L	100	100	120	1,000	2,100		--	--	--	--	--	--	--	--	--	--	--	--	**1.7**	--	< 2.0
Silver	ug/L	34	98	0.2	0.54	1.1		< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	< 0.2	< 0.20
Vanadium	ug/L	4.5	62	27	79	160		< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 1.0	< 2	< 2.0
Zinc	ug/L	2,400	5,000**	260	260	520		--	--	--	--	--	--	--	--	--	--	--	--	< 10.0	--	< 10

Notes:
ug/L - micrograms per liter.
NC - no criteria.
NA - not applicable.
* - Michigan Part 201 Generic Drinking Water Cleanup Criteria, December 30, 2013.
** - Drinking water criterion is the aesthetic drinking water value as described in footnote {E}.
^ - Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria. Hardness-dependent criteria calculated using hardness of 258 mg CaCO3/L (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018) per footnote {G} of Michigan Part 201 criteria tables.. GSI criterion is protective for surface water used as a drinking water source as described in footnote {X}.
*** - Aquatic Maximum (AMV) and Final Acute Values (FAV) are taken from MDEQ Rule 323.1057 Part 4 - Water Quality Standards (Rule 57), March 15, 2018. Hardness-dependent criteria calculated using site-specific hardness of 258 mg CaCO3/L as measured at surface water sample SW-01 collected on April 9, 2018 from the Pigeon River. Chromium AMV & FAV criteria is based on hexavalent chromium.
BOLD font denotes concentrations detected above laboratory reporting limits.
Result Indicates an exceedance of one or more applicable criteria.
All metals were analyzed as total unless otherwise specified.

Table 7
Summary of Part 115 Groundwater Sampling Results (Analytical): March 2016 - April 2019
JC Weadock Landfill – RCRA CCR Monitoring Program
Essexville, Michigan

							MW-55														
						Sample Location:															
						Sample Date:	3/16/2016	5/10/2016	8/17/2016	10/19/2016	2/28/2017	5/11/2017	8/10/2017	11/2/2017	3/6/2018	5/15/2018	8/16/2018	8/30/2018	10/23/2018	11/8/2018	3/14/2019	4/11/2019
Constituent	Unit	MI Residential*	MI Non-Residential*	MI GSI^	MI AMV***	MI FAV***	Downgradient														
Appendix III																					
Iron	ug/L	300**	300**	NA	NC	NC	**8,700**	**608**	**2,760**	**12,700**	**10,800**	**4,540**	**8,210**	**12,000**	**12,600**	**12,000**	**16,200**	**18,800**	**15,300**	**24,000**	**16,800**	**16,000**
Appendix IV																					
Copper	ug/L	1,000**	1,000**	20	33	66	**1**	< 1	**2**	**1**	**2**	**2**	**16**	**1**	**1**	**1**	**1**	< 1.0	< 1	< 5.0	< 1	< 1.0
Nickel	ug/L	100	100	120	1,000	2,100	--	--	--	--	--	--	--	--	--	--	--	--	--	< 5.0	--	**2.1**
Silver	ug/L	34	98	0.2	0.54	1.1	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	< 0.2	< 0.20	< 0.2	< 0.20
Vanadium	ug/L	4.5	62	27	79	160	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 4.0	< 2	< 1.0	< 2	< 2.0
Zinc	ug/L	2,400	5,000**	260	260	520	--	--	--	--	--	--	--	--	--	--	--	--	--	< 50.0	--	< 10

Notes:

ug/L - micrograms per liter.

NC - no criteria.

NA - not applicable.

* - Michigan Part 201 Generic Drinking Water Cleanup Criteria, December 30, 2013.

** - Drinking water criterion is the aesthetic drinking water value as described in footnote {E}.

^ - Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria. Hardness-dependent criteria calculated using hardness of 258 mg CaCO3/L (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018) per footnote {G} of Michigan Part 201 criteria tables.. GSI criterion is protective for surface water used as a drinking water source as described in footnote {X}.

*** - Aquatic Maximum (AMV) and Final Acute Values (FAV) are taken from MDEQ Rule 323.1057 Part 4 - Water Quality Standards (Rule 57), March 15, 2018. Hardness-dependent criteria calculated using site-specific hardness of 258 mg CaCO3/L as measured at surface water sample SW-01 collected on April 9, 2018 from the Pigeon River. Chromium AMV & FAV criteria is based on hexavalent chromium.

BOLD font denotes concentrations detected above laboratory reporting limits.

Result Indicates an exceedance of one or more applicable criteria.

All metals were analyzed as total unless otherwise specified.

Table 7
Summary of Part 115 Groundwater Sampling Results (Analytical): March 2016 - April 2019
JC Weadock Landfill – RCRA CCR Monitoring Program
Essexville, Michigan

							OW-57OUT				OW-57ROUT		
						Sample Location:							
						Sample Date:	8/31/2018	11/8/2018	3/14/2019	4/12/2019	11/8/2018	3/14/2019	4/12/2019
Constituent	Unit	MI Residential*	MI Non-Residential*	MI GSI^	MI AMV***	MI FAV***	Downgradient						
Appendix III													
Iron	ug/L	300**	300**	NA	NC	NC	**220**	**463**	**111**	**87**	**243**	**244**	**53**
Appendix IV													
Copper	ug/L	1,000**	1,000**	20	33	66	< 1.0	< 1.0	**2**	< 1.0	< 1.0	**2**	< 1.0
Nickel	ug/L	100	100	120	1,000	2,100	--	**17.7**	--	**17**	**16**	--	**17**
Silver	ug/L	34	98	0.2	0.54	1.1	< 0.20	< 0.20	< 0.2	< 0.20	< 0.20	< 0.2	< 0.20
Vanadium	ug/L	4.5	62	27	79	160	< 4.0	< 1.0	< 2	< 2.0	**1.1**	< 2	< 2.0
Zinc	ug/L	2,400	5,000**	260	260	520	--	**11.4**	--	< 10	< 10.0	--	< 10

Notes:

ug/L - micrograms per liter.

NC - no criteria.

NA - not applicable.

* - Michigan Part 201 Generic Drinking Water Cleanup Criteria, December 30, 2013.

** - Drinking water criterion is the aesthetic drinking water value as described in footnote {E}.

^ - Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria. Hardness-dependent criteria calculated using hardness of 258 mg CaCO3/L (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018) per footnote {G} of Michigan Part 201 criteria tables.. GSI criterion is protective for surface water used as a drinking water source as described in footnote {X}.

*** - Aquatic Maximum (AMV) and Final Acute Values (FAV) are taken from MDEQ Rule 323.1057 Part 4 - Water Quality Standards (Rule 57), March 15, 2018. Hardness-dependent criteria calculated using site-specific hardness of 258 mg CaCO3/L as measured at surface water sample SW-01 collected on April 9, 2018 from the Pigeon River. Chromium AMV & FAV criteria is based on hexavalent chromium.

BOLD font denotes concentrations detected above laboratory reporting limits.

Result Indicates an exceedance of one or more applicable criteria.

All metals were analyzed as total unless otherwise specified.

Appendix D
May 2018 Assessment Monitoring Statistical Evaluation

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January 14, 2019

Harold Register
Environmental Services
Consumers Energy Company
1945 W. Parnall Road
Jackson, MI 49201

Subject: Statistical Evaluation of Initial Assessment Monitoring Sampling Event
JC Weadock Bottom Ash Pond, Consumers Energy Company, Essexville, Michigan

Dear Mr. Register:

Consumers Energy Company (CEC) reported in the January 31, 2018 *Annual Groundwater Monitoring Report for the JC Weadock Bottom Ash Pond CCR Unit* for the JC Weadock (JCW) site in Essexville, Michigan, that boron, calcium, pH, and sulfate were observed within groundwater at one or more downgradient monitoring well(s) with potential statistically significant increases (SSIs) above background concentration levels. TRC completed an Alternate Source Demonstration for the parameters listed above and did not find strong enough evidence within 90 days to determine that the observation of constituents above background was attributable to an error or source other than the coal combustion residual (CCR) unit.

Therefore, CEC initiated an Assessment Monitoring Program for the Bottom Ash Pond CCR Unit pursuant to §257.95 of the CCR Rule[1] that included sampling and analyzing groundwater within the groundwater monitoring system for all constituents listed in Appendix IV. The results from the initial assessment monitoring sampling event were used to establish groundwater protection standards (GWPSs) for the Appendix IV constituents in accordance with §257.95(h), as presented in the October 15, 2018 *Assessment Monitoring Data Summary and Establishment of Groundwater Protection Standards.* The GWPS is established as the higher of the EPA Maximum Contaminant Level (MCL) or statistically derived background level for constituents with MCLs and the higher of the EPA Regional Screening Levels (RSLs) or background level for Appendix IV constituents with RSLs. The JCW Bottom Ash Pond monitoring system was subsequently sampled for the Appendix III and Appendix IV constituents within 90 days from the initial Appendix IV sampling event (May 2018). In accordance

[1] USEPA final rule for the regulation and management of Coal Combustion Residuals (CCR) under the Resource Conservation and Recovery Act (RCRA) published April 17, 2015, as amended per Phase One, Part One of the CCR Rule (83 FR 36435).

with §257.95, the assessment monitoring data must be compared to GWPSs to determine whether or not Appendix IV constituents are detected at statistically significant levels above the GWPSs.

This letter report presents a summary of the collected assessment monitoring data and the comparison of the assessment monitoring data to the GWPSs. The results of the assessment monitoring evaluation indicate the following constituent(s) are present at statistically significant levels exceeding the GWPS in downgradient monitoring wells at the JC Weadock Bottom Ash Pond:

Constituent	GWPS	#Downgradient Wells Observed
Beryllium	4 ug/L	1 of 4
Lithium	180 ug/L	1 of 4

As such, per §257.95(g), the facility must either conduct an alternate source demonstration or initiate an assessment of corrective measures according to §257.96 within 90 days of detecting a statistical exceedance of the GWPSs.

Background

The JCW coal-fired Power Plant site (the site) is located south of the DE Karn Power Plant site (DEK site), 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 runs along the majority of the northern perimeter of the site and separates the facility from the DEK site to the north. The 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. JC Weadock ceased generating electricity on April 15, 2016.

The area authorized for disposal of solid waste is located east of the JCW plant (Figure 2). The 292-acre licensed disposal area is comprised of a Type III low hazard industrial waste landfill, permitted for construction in 1992, and is governed by the Part 115 Solid Waste Disposal Area Operating License No. 9440 dated June 26, 2015 and a surface impoundment. This existing CCR 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 JCW landfill is also being monitored in accordance with the Michigan Department of Environmental Quality (MDEQ)-approved HMP[2].

[2] Consumers Energy Company. 2015. *Hydrogeological Monitoring Plan Rev. 2: JC Weadock Solid Waste Disposal Area.* June.

The surface impoundment subject to the CCR rule is the JCW Bottom Ash Pond, which is located immediately west of the historic pond/landfill area and outside of the soil-bentonite slurry wall. The bottom ash pond is the primary settling/detention structure for the NPDES Treatment System prior to discharge and characterized as an existing CCR surface impoundment. CEC provided notification of initiation of closure on October 12, 2018 to the MDEQ to implement the certified closure plan by removal of CCR under the self-implementing requirements and schedule of the CCR Rule.

Groundwater Monitoring System

In accordance with 40 CFR 257.91, Consumers Energy established a groundwater monitoring system for the JCW Bottom Ash Pond CCR unit, which consists of 8 monitoring wells (four background monitoring wells and four downgradient monitoring wells) that are screened in the uppermost aquifer. The monitoring well locations are shown on Figure 2. Four monitoring wells located between ¼ and ½ mile south of the JCW Bottom Ash Pond provide data on background groundwater quality that has not been affected by the CCR unit (MW-15002, MW-15008, MW-15016, and MW-15019). Due to the site hydrogeology and operational history of the site, a hydraulically upgradient location was not available to monitor this CCR unit. The area where background wells are located, while not upgradient, is not affected by any CCR units and therefore meets the requirements of §257.91(a)(1). Background groundwater quality data from these four background wells are additionally used for the CCR groundwater monitoring program at JCW Landfill CCR unit and the DEK Bottom Ash Pond CCR unit.

In the vicinity of the JCW Bottom Ash Pond, the shallow groundwater flows to the north toward the discharge channel and to the west near the Saginaw River. The potentiometric surface data from the May 2018 assessment monitoring event is illustrated on Figure 3. The slurry wall of the JCW Ash Disposal Area is located immediately east of the JCW BAP. Therefore, the four downgradient wells (JCW-MW-15007, JCW-MW-15009, JCW-MW-15010, and JCW-MW-15028) were installed in the accessible areas along the downgradient perimeter of the CCR Unit.

Data Quality

Data from each sampling round were evaluated for completeness, overall quality and usability, method-specified sample holding times, precision and accuracy, and potential sample contamination. The review was completed using the following quality control (QC) information which at a minimum included chain-of-custody forms, investigative sample results including blind field duplicates, and, as provided by the laboratory, method blanks, laboratory control spikes, laboratory duplicates. The data were found to be complete and usable for the purposes of the CCR monitoring program.

Assessment Monitoring Statistical Evaluation

Following the initial and resample assessment monitoring sampling event, compliance well data for the JCW Bottom Ash Pond CCR unit were evaluated in accordance with the *Groundwater Statistical Evaluation Plan* (Stats Plan) (TRC, October 2017). Consistent with the Unified Guidance[3], the preferred method for comparisons to a fixed standard are confidence limits. An exceedance of the standard occurs when the 99 percent lower confidence level of the downgradient data exceeds the GWPS.

For each detected Appendix IV constituent, the concentrations from each well were first compared directly to the GWPS, as shown on Table 1. Parameter-well combinations that included a direct exceedance of the GWPS were retained for further analysis. Arsenic in JCW-MW-15007 and JCW-MW-15010, beryllium in JCW-MW-15009, cobalt in JCW-MW-15009, and lithium in JCW-MW-15009 had individual results exceeding their respective GWPSs.

Groundwater data were then evaluated utilizing Sanitas™ statistical software. Sanitas™ is a software tool that is commercially available for performing statistical evaluation consistent with procedures outlined in the Unified Guidance. Within the Sanitas™ statistical program, confidence limits were selected to perform the statistical comparison of compliance data to a fixed standard. Parametric and non-parametric confidence intervals, as appropriate, were calculated for each of the CCR Appendix IV parameters using a 99 percent confidence level, i.e., a significance level (α) of 0.01. The following narrative describes the methods employed, the results obtained and the Sanitas™ output files are included as an attachment.

The statistical data evaluation included the following steps:

- Review of data quality checklists for the data sets for CCR Appendix IV constituents;
- Graphical representation of the monitoring data as time versus concentration by well/constituent pair;
- Outlier testing of individual data points that appear from the graphical representations as potential outliers;
- Evaluation of visual trends apparent in the graphical representations for statistical significance;
- Evaluation of percentage of non-detects for each well-constituent (w/c) pair;
- Distribution of the data; and
- Calculation of the confidence intervals for each cumulative dataset.

The results of these evaluations are presented and discussed below.

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

Initially, the baseline (December 2015 through August 2017) results and the two assessment monitoring results (April and May 2018) were observed visually for potential trends. No outliers were identified. The Sanitas™ software was then used to test compliance at the downgradient monitoring wells using the confidence interval method for the most recent 8 sampling events. Eight independent sampling events provide the appropriate density of data as recommended per the UG, yet are collected recently enough to provide an indication of current condition. The tests were run with a per-well significance of $\alpha = 0.01$. The software outputs are included in Attachment A along with data reports showing the values used for the evaluation. The percentage of non-detect observations are also included in Attachment A. Non-detect data was handled in accordance with the Stats Plan for the purposes of calculating the confidence intervals.

The Sanitas™ software generates an output that includes graphs of the parametric or non-parametric confidence intervals for each well along with notes data transformations, as appropriate. The confidence interval test compares the lower confidence limit to the GWPS. The calculated upper and lower confidence limits and comparison of the lower confidence limits to the GWPSs are also summarized in Table 2.

The statistical evaluation of the Appendix IV parameters shows exceedances for lithium and beryllium at JCW-MW-15009. Per §257.95(g), the facility must either conduct an alternate source demonstration or initiate an assessment of corrective measures according to §257.96 within 90 days of detecting a statistical exceedance of the GWPSs.

JCW-MW-15009 is the westernmost downgradient monitoring well at the JCW Bottom Ash Pond and located the furthest from the waste limit of the Bottom Ash Pond CCR unit. 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 JCW Bottom Ash Pond CCR unit. The pH measured in JCW-MW-15009 (between 4 and 5 S.U.) is much lower than the other compliance wells for the JCW 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. CEC continues to evaluate the potential for an alternative source of the low pH, beryllium, and lithium in this area.

Next Steps

In accordance with the CCR Rule, CEC will enter this statistical evaluation of the assessment monitoring data into the operating record by January 14, 2019. The notification of the GWPS exceedances to the state will be posted to a public CCR compliance website as required by §257.105(h)(8) by February 13, 2019. By April 14, 2019, in accordance with §257.95(g)(3), an assessment of corrective measures will be initiated. This assessment will be completed no later than September 11, 2019 in accordance with the timeframes provided in §257.96(a)(1).

Sincerely,

TRC

Graham Crockford
Program Manager

Darby Litz
Hydrogeologist/Project Manager

Attachments

Table 1.	Comparison of Groundwater Sampling Results to Groundwater Protection Standards – December 2015 to May 2018
Table 2.	Summary of Groundwater Protection Standard Exceedances – May 2018
Figure 1.	Site Location Map
Figure 2.	Site Plan
Figure 3.	Shallow Groundwater Contour Map – May 2018
Attachment A	Sanitas Output

cc: Brad Runkel, Consumers Energy
Bethany Swanberg, Consumers Energy
Central Files

Tables

Table 1
Comparison of Groundwater Sampling Results to Groundwater Protection Standards – December 2015 to May 2018
JC Weadock Bottom Ash Pond – RCRA CCR Monitoring Program
Essexville, Michigan

						Sample Location:	JCW-MW-15007												
						Sample Date:	12/9/2015	4/1/2016	5/24/2016	8/23/2016	12/1/2016	2/23/2017	5/17/2017	8/3/2017	8/3/2017	9/19/2017	9/19/2017	4/10/2018	5/23/2018
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS		downgradient								Field Dup		Field Dup		
Appendix III																			
Boron	ug/L	NC	NA	619	NA		296	163	238	547	439	270	263	< 20.0	345	384	479	--	308
Calcium	mg/L	NC	NA	302	NA		115	119	133	106	124	226	177	182	171	140	153	--	145
Chloride	mg/L	250*	NA	2,440	NA		763	1,220	990	333	521	1,720	1,570	1,870	1,830	1,340	1,370	--	1,660
Fluoride	ug/L	4,000	NA	1,000	NA		< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
pH, Field	SU	6.5 - 8.5*	NA	6.5-7.3	NA		7.0	7.2	7.1	7.0	7.1	7.0	7.2	6.8	--	7.1	--	7.1	7.2
Sulfate	mg/L	250*	NA	407	NA		48.3	20.1	21	30.5	26.3	20.9	22.9	34.5	34.6	8.8	9.2	--	19.6
Total Dissolved Solids	mg/L	500*	NA	4,600	NA		1,800	2,300	2,200	1,100	1,400	3,700	3,100	3,410	3,500	2,560	2,530	--	3,210
Appendix IV																			
Antimony	ug/L	6	NA	1	6		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1.0	--	--	< 1.0	< 1.0
Arsenic	ug/L	10	NA	21	**21**		13	15	20	**55**	**37**	**26**	**23**	< 1.0	**48.6**	--	--	16.7	**25.6**
Barium	ug/L	2,000	NA	1,300	2,000		392	443	472	733	821	1,150	719	< 1.0	934	--	--	957	941
Beryllium	ug/L	4	NA	1	**4**		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1.0	--	--	< 1.0	< 1.0
Cadmium	ug/L	5	NA	0.2	5		< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	< 0.20	--	--	< 0.20	< 0.20
Chromium	ug/L	100	NA	3	100		< 1	1	1	< 1	1	2	1	< 1.0	< 1.0	--	--	< 1.0	< 1.0
Cobalt	ug/L	NC	6	15	**15**		< 15	< 15	< 15	< 15	< 15	< 15	< 15	< 15.0	< 15.0	--	--	< 15.0	< 15.0
Fluoride	ug/L	4,000	NA	1,000	4,000		< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Lead	ug/L	NC	15	1	15		< 1	< 1	< 1	3	< 1	< 1	< 1	< 1.0	< 1.0	--	--	< 1.0	< 1.0
Lithium	ug/L	NC	40	180	**180**		50	52.3	61	65	61	77	75	100	97	--	--	80	88
Mercury	ug/L	2	NA	0.2	2		< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	< 0.20	--	--	< 0.20	< 0.20
Molybdenum	ug/L	NC	100	6	100		20	8	8	10	10	9	7	< 5.0	< 5.0	--	--	6.4	7.6
Radium-226	pCi/L	5	NA	NA	NA		0.38	0.467	0.7	0.355	0.365	1.08	0.476	1.82	1.23	--	--	0.878	0.239
Radium-226/228	pCi/L	5	NA	3.32	5		1.252	1.253	1.697	1.465	1.258	2.61	1.8	2.89	1.88	--	--	1.64	1.03
Radium-228	pCi/L	5	NA	NA	NA		0.872	0.786	0.997	1.11	0.893	1.53	1.32	1.07	< 0.671	--	--	0.761	0.795
Selenium	ug/L	50	NA	2	50		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1.0	--	--	1.2	< 1.0
Thallium	ug/L	2	NA	2	2		< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2.0	< 2.0	--	--	< 2.0	< 2.0

Notes:

ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units; pH is a field parameter.
pCi/L - picocuries per liter.
NA - not applicable.
NC - no criteria.
-- - not analyzed.
MCL - Maximum Contaminant Level, EPA Drinking Water Standards and Health Advisories, April, 2012.
RSL - Regional Screening Level from 83 FR 36435.
UTL - Upper Tolerance Limit (95%) of the background data set.
GWPS - Groundwater Protection Standard. GWPS is the higher of the MCL/RSL and UTL as established in TRC's Technical Memorandum dated October 15, 2018.
* - Secondary Maximum Contaminant Level (SMCL), EPA Secondary Drinking Water Regulations (SDWR) April, 2012.
Bold value indicates an exceedance of the GWPS. Data from downgradient monitoring wells are screened against the GWPS for evaluation purposes only. Confidence intervals will be used to determine compliance per the CCR rules.
All metals were analyzed as total unless otherwise specified.

Table 1
Comparison of Groundwater Sampling Results to Groundwater Protection Standards – December 2015 to May 2018
JC Weadock Bottom Ash Pond – RCRA CCR Monitoring Program
Essexville, Michigan

						Sample Location:	JCW-MW-15009										
						Sample Date:	12/9/2015	3/31/2016	5/25/2016	8/23/2016	12/1/2016	2/23/2017	5/18/2017	8/2/2017	9/18/2017	4/10/2018	5/23/2018
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS		downgradient										
Appendix III																	
Boron	ug/L	NC	NA	619	NA		546	284	402	501	498	366	329	429	533	--	297
Calcium	mg/L	NC	NA	302	NA		520	526	546	622	549	618	558	554	470	--	530
Chloride	mg/L	250*	NA	2,440	NA		189	97.4	163	171	154	95.5	52.6	84.8	113	--	41.0
Fluoride	ug/L	4,000	NA	1,000	NA		< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
pH, Field	SU	6.5 - 8.5*	NA	6.5-7.3	NA		4.1	4.8	4.1	4.2	4.1	4.6	4.7	4.6	4.6	4.7	4.9
Sulfate	mg/L	250*	NA	407	NA		2,520	1,790	2,650	2,030	2,280	1,880	1,710	2,680	3,090	--	1,690
Total Dissolved Solids	mg/L	500*	NA	4,600	NA		1,700	2,800	1,800	3,300	3,200	2,700	2,600	2,590	3,020	--	2,510
Appendix IV																	
Antimony	ug/L	6	NA	1	6		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0
Arsenic	ug/L	10	NA	21	**21**		2	< 1	2	< 1	< 1	< 1	< 1	< 1.0	--	1.6	1.4
Barium	ug/L	2,000	NA	1,300	2,000		20	17	14	23	18	15	15	16.6	--	12.3	14.4
Beryllium	ug/L	4	NA	1	**4**		**27**	**9**	**20**	**17**	**19**	**11**	**7**	**7.4**	--	**7.1**	**6.5**
Cadmium	ug/L	5	NA	0.2	5		< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20
Chromium	ug/L	100	NA	3	100		6	2	5	4	4	3	1	1.5	--	1.4	1.4
Cobalt	ug/L	NC	6	15	**15**		**22**	< 15	**21**	< 15	< 15	< 15	< 15	< 15.0	--	< 15.0	< 15.0
Fluoride	ug/L	4,000	NA	1,000	4,000		< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Lead	ug/L	NC	15	1	15		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0
Lithium	ug/L	NC	40	180	**180**		**367**	139	**238**	**280**	**300**	**216**	**182**	**270**	--	**210**	**190**
Mercury	ug/L	2	NA	0.2	2		< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20
Molybdenum	ug/L	NC	100	6	100		< 5	10	< 5	< 5	< 5	< 5	< 5	< 5.0	--	< 5.0	< 5.0
Radium-226	pCi/L	5	NA	NA	NA		0.274	< 0.234	< 0.186	0.159	< 0.318	0.403	< 0.27	< 0.644	--	< 0.703	< 0.723
Radium-226/228	pCi/L	5	NA	3.32	5		1.474	1.069	0.683	1.589	1.608	1.753	1.31	< 1.39	--	< 1.37	< 1.37
Radium-228	pCi/L	5	NA	NA	NA		1.2	0.842	0.7	1.43	1.33	1.35	1.24	0.833	--	0.707	1.11
Selenium	ug/L	50	NA	2	50		4	3	3	1	3	2	1	1.4	--	14.2	5.2
Thallium	ug/L	2	NA	2	2		< 2	< 2	2	< 2	< 2	< 2	< 2	< 2.0	--	< 2.0	< 2.0

Notes:

ug/L - micrograms per liter.

mg/L - milligrams per liter.

SU - standard units; pH is a field parameter.

pCi/L - picocuries per liter.

NA - not applicable.

NC - no criteria.

-- - not analyzed.

MCL - Maximum Contaminant Level, EPA Drinking Water Standards and Health Advisories, April, 2012.

RSL - Regional Screening Level from 83 FR 36435.

UTL - Upper Tolerance Limit (95%) of the background data set.

GWPS - Groundwater Protection Standard. GWPS is the higher of the MCL/RSL and UTL as established in TRC's Technical Memorandum dated October 15, 2018.

* - Secondary Maximum Contaminant Level (SMCL), EPA Secondary Drinking Water Regulations (SDWR) April, 2012.

Bold value indicates an exceedance of the GWPS. Data from downgradient monitoring wells are screened against the GWPS for evaluation purposes only. Confidence intervals will be used to determine compliance per the CCR rules.

All metals were analyzed as total unless otherwise specified.

Table 1
Comparison of Groundwater Sampling Results to Groundwater Protection Standards – December 2015 to May 2018
JC Weadock Bottom Ash Pond – RCRA CCR Monitoring Program
Essexville, Michigan

						Sample Location:	JCW-MW-15010										
						Sample Date:	12/10/2015	3/31/2016	5/25/2016	8/24/2016	12/1/2016	2/23/2017	5/17/2017	8/2/2017	9/19/2017	4/10/2018	5/22/2018	5/22/2018
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS		downgradient											
Appendix III																		Field Dup
Boron	ug/L	NC	NA	619	NA		1,220	987	1,070	1,320	1,370	1,360	1,390	1,580	1,340	--	1,330	1,220
Calcium	mg/L	NC	NA	302	NA		68	85.4	74.3	74	79.1	103	84.8	69.9	63.6	--	78.3	78.8
Chloride	mg/L	250*	NA	2,440	NA		83.6	87.8	81.5	78.1	92.8	88.8	89.8	92.7	89.5	--	99.8	99.7
Fluoride	ug/L	4,000	NA	1,000	NA		< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	1,300	< 1,000	1,000	< 1,000	< 1,000	< 1,000	< 1,000
pH, Field	SU	6.5 - 8.5*	NA	6.5-7.3	NA		7.7	7.4	7.4	7.6	7.5	7.3	7.5	7.5	7.5	7.3	7.5	--
Sulfate	mg/L	250*	NA	407	NA		72.3	91.6	62.8	53.9	80.7	57.9	72.9	59.0	39.9	--	24.3	23.2
Total Dissolved Solids	mg/L	500*	NA	4,600	NA		430	500	440	400	490	460	480	832	392	--	458	486
Appendix IV																		
Antimony	ug/L	6	NA	1	6		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	10	NA	21	**21**		**22**	**39**	**25**	**34**	**27**	**25**	**23**	**23.2**	--	12.5	11.4	11.1
Barium	ug/L	2,000	NA	1,300	2,000		99	115	99	98	125	111	123	109	--	121	123	116
Beryllium	ug/L	4	NA	1	**4**		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	5	NA	0.2	5		< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20
Chromium	ug/L	100	NA	3	100		< 1	1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0
Cobalt	ug/L	NC	6	15	**15**		< 15	< 15	< 15	< 15	< 15	< 15	< 15	< 15.0	--	< 15.0	< 15.0	< 15.0
Fluoride	ug/L	4,000	NA	1,000	4,000		< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	1,300	< 1,000	1,000	< 1,000	< 1,000	< 1,000	< 1,000
Lead	ug/L	NC	15	1	15		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0
Lithium	ug/L	NC	40	180	**180**		63	52.7	55	53	60	57	61	61	--	77	72	72
Mercury	ug/L	2	NA	0.2	2		< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	NC	100	6	100		< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5.0	--	< 5.0	< 5.0	< 5.0
Radium-226	pCi/L	5	NA	NA	NA		< 0.24	< 0.278	< 0.189	< 0.201	< 0.318	0.358	< 0.269	< 0.643	--	< 0.831	< 0.618	< 0.668
Radium-226/228	pCi/L	5	NA	3.32	5		0.58	< 0.364	< 0.585	0.731	< 0.584	0.683	0.981	< 1.35	--	< 2.04	< 1.36	< 1.37
Radium-228	pCi/L	5	NA	NA	NA		0.524	< 0.364	< 0.585	0.604	< 0.584	< 0.631	0.917	< 0.707	--	1.39	< 0.741	< 0.701
Selenium	ug/L	50	NA	2	50		1	< 1	< 1	< 1	< 1	1	6	< 1.0	--	< 1.0	1.0	< 1.0
Thallium	ug/L	2	NA	2	2		< 2	< 2	2	< 2	< 2	< 2	< 2	< 2.0	--	< 2.0	< 2.0	< 2.0

Notes:

ug/L - micrograms per liter.

mg/L - milligrams per liter.

SU - standard units; pH is a field parameter.

pCi/L - picocuries per liter.

NA - not applicable.

NC - no criteria.

-- - not analyzed.

MCL - Maximum Contaminant Level, EPA Drinking Water Standards and Health Advisories, April, 2012.

RSL - Regional Screening Level from 83 FR 36435.

UTL - Upper Tolerance Limit (95%) of the background data set.

GWPS - Groundwater Protection Standard. GWPS is the higher of the MCL/RSL and UTL as established in TRC's Technical Memorandum dated October 15, 2018.

* - Secondary Maximum Contaminant Level (SMCL), EPA Secondary Drinking Water Regulations (SDWR) April, 2012.

Bold value indicates an exceedance of the GWPS. Data from downgradient monitoring wells are screened against the GWPS for evaluation purposes only. Confidence intervals will be used to determine compliance per the CCR rules.

All metals were analyzed as total unless otherwise specified.

Table 1
Comparison of Groundwater Sampling Results to Groundwater Protection Standards – December 2015 to May 2018
JC Weadock Bottom Ash Pond – RCRA CCR Monitoring Program
Essexville, Michigan

						Sample Location:	JCW-MW-15028											
						Sample Date:	12/9/2015	3/31/2016	5/25/2016	8/23/2016	12/1/2016	2/23/2017	5/17/2017	8/2/2017	9/19/2017	4/11/2018	4/11/2018	5/23/2018
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS		downgradient											
Appendix III																	Field Dup	
Boron	ug/L	NC	NA	619	NA		357	333	345	433	455	425	427	444	419	--	--	444
Calcium	mg/L	NC	NA	302	NA		63.4	72.2	71.2	97.7	90.7	98.5	86.2	92.4	75.5	--	--	125
Chloride	mg/L	250*	NA	2,440	NA		71.7	69.3	69.4	72.2	64.2	70	60.1	106	91.0	--	--	69.5
Fluoride	ug/L	4,000	NA	1,000	NA		< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
pH, Field	SU	6.5 - 8.5*	NA	6.5-7.3	NA		8.1	7.9	7.8	7.6	8.1	8.0	7.9	7.7	8.0	7.8	--	8.0
Sulfate	mg/L	250*	NA	407	NA		62.5	49.3	69.8	113	142	116	62.8	93.0	85.7	--	--	32.2
Total Dissolved Solids	mg/L	500*	NA	4,600	NA		410	400	390	520	550	530	470	514	506	--	--	1,030
Appendix IV																		
Antimony	ug/L	6	NA	1	6		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	10	NA	21	**21**		2	< 1	1	1	2	2	1	1.2	--	1.2	1.4	< 1.0
Barium	ug/L	2,000	NA	1,300	2,000		65	63	69	90	102	92	82	97.4	--	148	145	148
Beryllium	ug/L	4	NA	1	**4**		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	5	NA	0.2	5		< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20
Chromium	ug/L	100	NA	3	100		< 1	1	1	< 1	< 1	1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0
Cobalt	ug/L	NC	6	15	**15**		< 15	< 15	< 15	< 15	< 15	< 15	< 15	< 15.0	--	< 15.0	< 15.0	< 15.0
Fluoride	ug/L	4,000	NA	1,000	4,000		< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Lead	ug/L	NC	15	1	15		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0
Lithium	ug/L	NC	40	180	**180**		25.9	22.7	25	29	32	32	30	35	--	48	47	48
Mercury	ug/L	2	NA	0.2	2		< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	NC	100	6	100		< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5.0	--	< 5.0	< 5.0	< 5.0
Radium-226	pCi/L	5	NA	NA	NA		< 0.182	< 0.448	< 0.189	< 0.22	< 0.361	0.285	< 0.247	< 0.952	--	< 0.934	< 0.450	< 0.739
Radium-226/228	pCi/L	5	NA	3.32	5		< 0.646	0.673	0.63	0.565	< 0.374	0.959	0.829	< 1.72	--	1.65	1.3	< 1.42
Radium-228	pCi/L	5	NA	NA	NA		< 0.646	0.571	0.479	0.441	< 0.374	0.674	0.819	< 0.772	--	0.988	0.874	< 0.676
Selenium	ug/L	50	NA	2	50		2	< 1	< 1	< 1	< 1	1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0
Thallium	ug/L	2	NA	2	2		< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2.0	--	< 2.0	< 2.0	< 2.0

Notes:

ug/L - micrograms per liter.

mg/L - milligrams per liter.

SU - standard units; pH is a field parameter.

pCi/L - picocuries per liter.

NA - not applicable.

NC - no criteria.

-- - not analyzed.

MCL - Maximum Contaminant Level, EPA Drinking Water Standards and Health Advisories, April, 2012.

RSL - Regional Screening Level from 83 FR 36435.

UTL - Upper Tolerance Limit (95%) of the background data set.

GWPS - Groundwater Protection Standard. GWPS is the higher of the MCL/RSL and UTL as established in TRC's Technical Memorandum dated October 15, 2018.

* - Secondary Maximum Contaminant Level (SMCL), EPA Secondary Drinking Water Regulations (SDWR) April, 2012.

Bold value indicates an exceedance of the GWPS. Data from downgradient monitoring wells are screened against the GWPS for evaluation purposes only. Confidence intervals will be used to determine compliance per the CCR rules.

All metals were analyzed as total unless otherwise specified.

Table 2
Summary of Groundwater Protection Standard Exceedances – May 2018
JC Weadock Bottom Ash Pond – RCRA CCR Monitoring Program
Essexville, Michigan

Constituent	Units	GWPS	JCW-MW-15007		JCW-MW-15009		JCW-MW-15010	
			LCL	UCL	LCL	UCL	LCL	UCL
Arsenic	ug/L	21	17	40	NA	NA	15	31
Beryllium	ug/L	4	NA	NA	6.5	20	NA	NA
Cobalt	ug/L	15	NA	NA	15	21	NA	NA
Lithium	ug/L	180	NA	NA	190	280	NA	NA

Notes:

ug/L - micrograms per Liter.

NA - Not Applicable; well/parameter pair did not directly exceed the GWPS and was not included in further analysis.

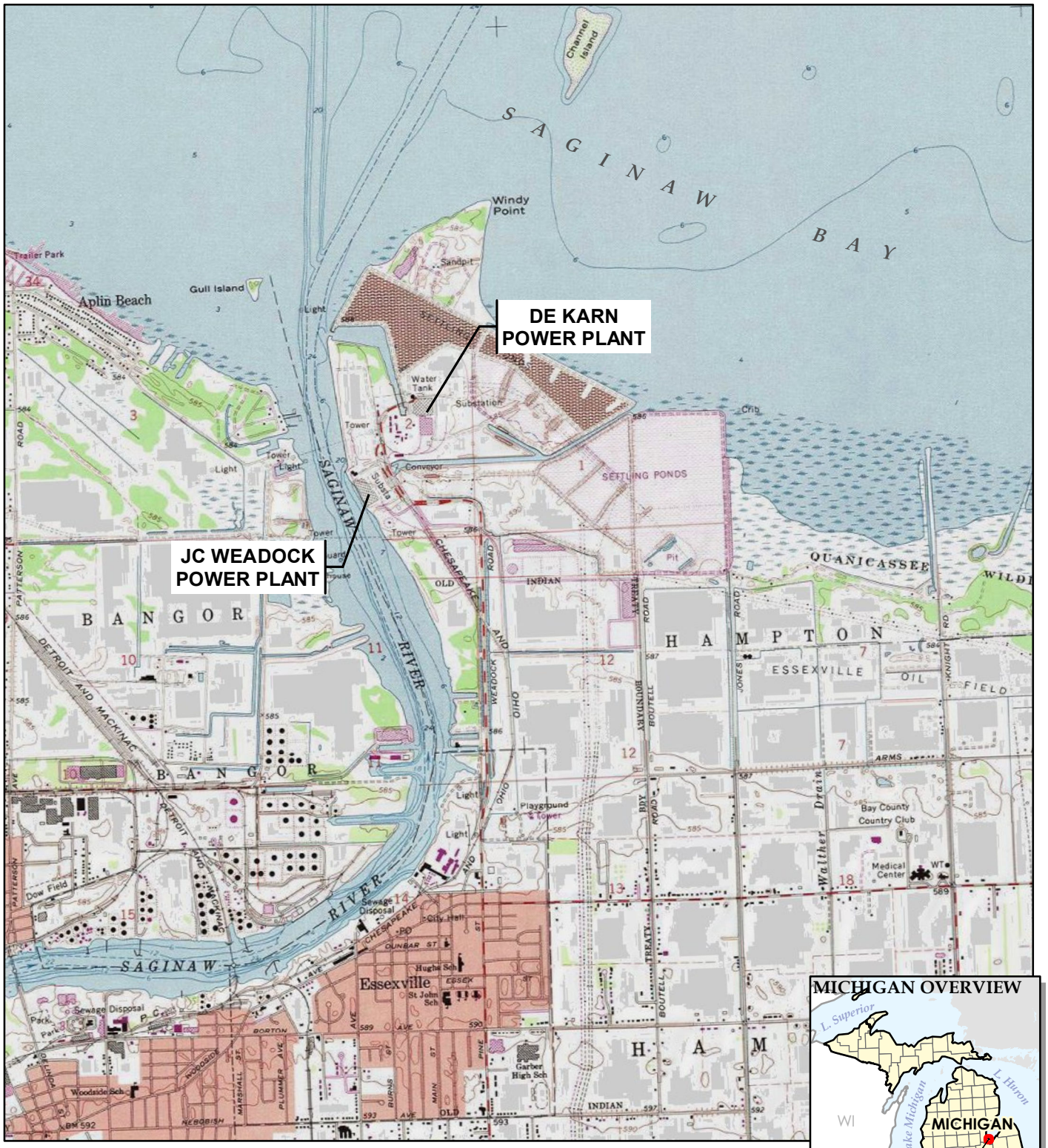
GWPS - Groundwater Protection Standard as established in TRC's Technical Memorandum dated October 15, 2018.

UCL - Upper Confidence Limit (α = 0.01) of the downgradient data set.

LCL - Lower Confidence Limit (α = 0.01) of the downgradient data set.

Indicates a statistically significant exceedance of the GWPS. An exceedance occurs when the LCL is greater than the GWPS.

Figures



BASE MAP FROM USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLE SERIES.

N

1 " = 3,000 '
1:36,000

0 3,000 6,000 FEET

TRC
1540 Eisenhower Place
Ann Arbor, MI 48108-3284
Phone: 734.971.7080
TRC - GIS

PROJECT:

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

TITLE:

SITE LOCATION MAP

DRAWN BY:	J. PAPEZ
CHECKED BY:	D. LITZ
APPROVED BY:	G. CROCKFORD
DATE:	OCTOBER 2017
PROJ. NO.:	269767-002/3
FILE:	269767-002_3-007SLM.mxd

FIGURE 1

E:\ConsumersEnergy\CCR_GW\2017_269767\269767-002_3-007SLM.mxd -- Saved By: SMAJOR on 10/12/2017, 08:42:53 AM

TRC - GIS

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

Plot Date: 10/8/2018, 11:28:38 AM by SMAJOR -- LAYOUT: ANSI B (11"x17")
Path: E:\ConsumersEnergy\CCR GW\2017 289767\290805-001-003.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
- EXTRACTION WELL
- JCW BEDROCK MONITORING WELL
- JCW BOTTOM ASH POND MONITORING WELL
- JCW LANDFILL MONITORING WELL
- MONITORING WELL (STATIC WATER LEVEL ONLY)
- PIEZOMETER
- SURFACE WATER GAUGING STATION
- SLURRY WALL (APPROXIMATE)
- EXTENT OF GEOSYNTHETICS (KARN LINED IMPOUNDMENT)

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).

N

0 1,000 2,000 Feet

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

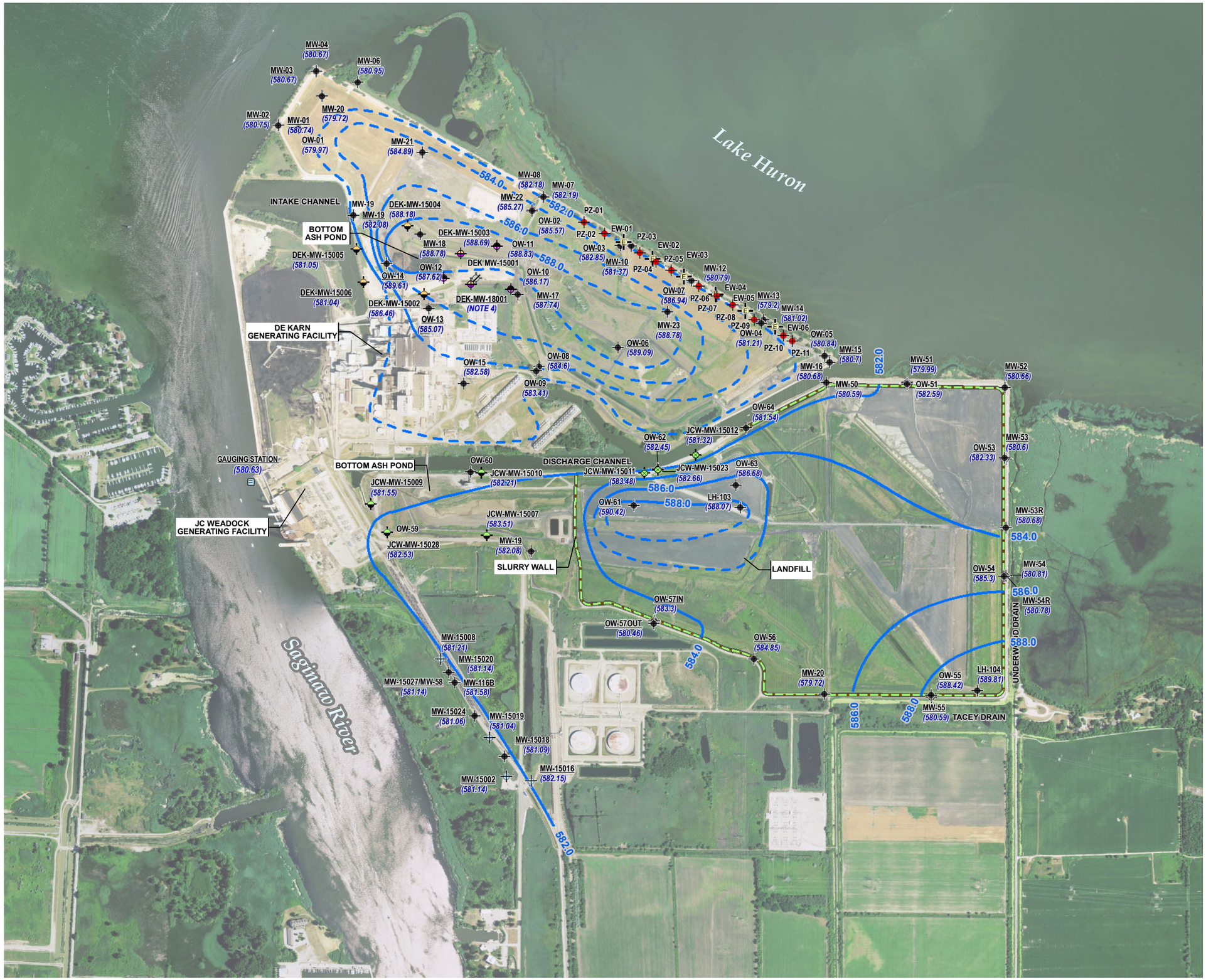
PROJECT:
CONSUMERS ENERGY COMPANY
DE KARN AND JC WEADOCK POWER PLANTS
ESSEXVILLE, MICHIGAN

TITLE:
SITE PLAN

DRAWN BY:	S. MAJOR	PROJ NO.:	290805-001
CHECKED BY:	C. SCIESZKA		
APPROVED BY:	D. LITZ		**FIGURE 2**
DATE:	OCTOBER 2018		

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

FILE NO.: 290805-001-003.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
- EXTRACTION WELL
- JCW BEDROCK MONITORING WELL
- JCW BOTTOM ASH POND MONITORING WELL
- JCW LANDFILL MONITORING WELL
- MONITORING WELL (STATIC WATER LEVEL ONLY)
- PIEZOMETER
- GROUNDWATER ELEVATION CONTOUR (2' INTERVAL, DASHED WHERE INFERRED)
- SLURRY WALL (APPROXIMATE)
- *(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-18001 WAS INSTALLED IN MAY 2018. 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 MAY 2018

DRAWN BY:	S. MAJOR	PROJ NO.:	290805-001
CHECKED BY:	C. SCIESZKA		
APPROVED BY:	D. LITZ		**FIGURE 3**
DATE:	OCTOBER 2018		

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

FILE NO.: 290805-001-005.mxd

TRC - GIS
Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl (Foot)
Map Rotation: 0
Plot Date: 10/8/2018, 13:09:27 PM by SMAJOR -- LAYOUT: ANSI B (11"x17")
Path: E:\ConsumersEnergy\CCR_GW\2017_269767\290805-001-005.mxd

Attachment A
Sanitas Output

Summary Report

Constituent: Antimony, Total Analysis Run 11/16/2018 11:55 AM
Client: Consumers Energy Data: JCW_BAP_CCR_Sanitas

For observations made between 12/10/2015 and 5/23/2018, a summary of the selected data set:

Observations = 40
ND/Trace = 40
Wells = 4
Minimum Value = 1
Maximum Value = 1
Mean Value = 1
Median Value = 1
Standard Deviation = 0
Coefficient of Variation = 0
Skewness = NaN

Well	#Obs.	ND/Trace	Min	Max	Mean	Median	Std.Dev.	CV	Skewness
JCW-MW-15007	10	10	1	1	1	1	0	0	NaN
JCW-MW-15009	10	10	1	1	1	1	0	0	NaN
JCW-MW-15010	10	10	1	1	1	1	0	0	NaN
JCW-MW-15028	10	10	1	1	1	1	0	0	NaN

Summary Report

Constituent: Arsenic, Total Analysis Run 11/16/2018 11:55 AM
Client: Consumers Energy Data: JCW_BAP_CCR_Sanitas

For observations made between 12/10/2015 and 5/23/2018, a summary of the selected data set:

Observations = 40
ND/Trace = 8
Wells = 4
Minimum Value = 1
Maximum Value = 55
Mean Value = 13.11
Median Value = 6.625
Standard Deviation = 13.95
Coefficient of Variation = 1.064
Skewness = 0.922

Well	#Obs.	ND/Trace	Min	Max	Mean	Median	Std.Dev.	CV	Skewness
JCW-MW-15007	10	0	13	55	25.61	23.9	12.4	0.4841	1.399
JCW-MW-15009	10	6	1	2	1.3	1	0.4243	0.3264	0.8466
JCW-MW-15010	10	0	11.25	39	24.2	24.1	8.407	0.3475	0.08452
JCW-MW-15028	10	2	1	2	1.35	1.1	0.4601	0.3408	0.7288

Summary Report

Constituent: Barium, Total Analysis Run 11/16/2018 11:55 AM
Client: Consumers Energy Data: JCW_BAP_CCR_Sanitas

For observations made between 12/10/2015 and 5/23/2018, a summary of the selected data set:

Observations = 40
ND/Trace = 0
Wells = 4
Minimum Value = 12.3
Maximum Value = 1150
Mean Value = 233.4
Median Value = 100.5
Standard Deviation = 307.7
Coefficient of Variation = 1.319
Skewness = 1.635

Well	#Obs.	ND/Trace	Min	Max	Mean	Median	Std.Dev.	CV	Skewness
JCW-MW-15007	10	0	392	1150	709.6	726	260.1	0.3665	0.2387
JCW-MW-15009	10	0	12.3	23	16.53	15.8	3.159	0.1911	0.7699
JCW-MW-15010	10	0	98	125	112	113	10.44	0.09322	-0.2383
JCW-MW-15028	10	0	63	148	95.49	91	30.4	0.3183	0.8085

Summary Report

Constituent: Beryllium, Total Analysis Run 11/16/2018 11:55 AM
Client: Consumers Energy Data: JCW_BAP_CCR_Sanitas

For observations made between 12/10/2015 and 5/23/2018, a summary of the selected data set:

Observations = 40
ND/Trace = 30
Wells = 4
Minimum Value = 1
Maximum Value = 27
Mean Value = 4.025
Median Value = 1
Standard Deviation = 6.323
Coefficient of Variation = 1.571
Skewness = 2.207

Well	#Obs.	ND/Trace	Min	Max	Mean	Median	Std.Dev.	CV	Skewness
JCW-MW-15007	10	10	1	1	1	1	0	0	NaN
JCW-MW-15009	10	0	6.5	27	13.1	10	7.159	0.5465	0.7293
JCW-MW-15010	10	10	1	1	1	1	0	0	NaN
JCW-MW-15028	10	10	1	1	1	1	0	0	NaN

Summary Report

Constituent: Cadmium, Total Analysis Run 11/16/2018 11:55 AM
Client: Consumers Energy Data: JCW_BAP_CCR_Sanitas

For observations made between 12/10/2015 and 5/23/2018, a summary of the selected data set:

Observations = 40
ND/Trace = 40
Wells = 4
Minimum Value = 0.2
Maximum Value = 0.2
Mean Value = 0.2
Median Value = 0.2
Standard Deviation = 0
Coefficient of Variation = 0
Skewness = NaN

Well	#Obs.	ND/Trace	Min	Max	Mean	Median	Std.Dev.	CV	Skewness
JCW-MW-15007	10	10	0.2	0.2	0.2	0.2	0	0	NaN
JCW-MW-15009	10	10	0.2	0.2	0.2	0.2	0	0	NaN
JCW-MW-15010	10	10	0.2	0.2	0.2	0.2	0	0	NaN
JCW-MW-15028	10	10	0.2	0.2	0.2	0.2	0	0	NaN

Summary Report

Constituent: Chromium, Total Analysis Run 11/16/2018 11:55 AM
Client: Consumers Energy Data: JCW_BAP_CCR_Sanitas

For observations made between 12/10/2015 and 5/23/2018, a summary of the selected data set:

Observations = 40
ND/Trace = 21
Wells = 4
Minimum Value = 1
Maximum Value = 6
Mean Value = 1.508
Median Value = 1
Standard Deviation = 1.19
Coefficient of Variation = 0.7897
Skewness = 2.523

Well	#Obs.	ND/Trace	Min	Max	Mean	Median	Std.Dev.	CV	Skewness
JCW-MW-15007	10	5	1	2	1.1	1	0.3162	0.2875	2.667
JCW-MW-15009	10	0	1	6	2.93	2.5	1.742	0.5946	0.491
JCW-MW-15010	10	9	1	1	1	1	0	0	NaN
JCW-MW-15028	10	7	1	1	1	1	0	0	NaN

Summary Report

Constituent: Cobalt, Total Analysis Run 11/16/2018 11:55 AM
Client: Consumers Energy Data: JCW_BAP_CCR_Sanitas

For observations made between 12/10/2015 and 5/23/2018, a summary of the selected data set:

Observations = 40
ND/Trace = 38
Wells = 4
Minimum Value = 15
Maximum Value = 22
Mean Value = 15.33
Median Value = 15
Standard Deviation = 1.439
Coefficient of Variation = 0.09391
Skewness = 4.172

Well	#Obs.	ND/Trace	Min	Max	Mean	Median	Std.Dev.	CV	Skewness
JCW-MW-15007	10	10	15	15	15	15	0	0	NaN
JCW-MW-15009	10	8	15	22	16.3	15	2.751	0.1688	1.527
JCW-MW-15010	10	10	15	15	15	15	0	0	NaN
JCW-MW-15028	10	10	15	15	15	15	0	0	NaN

Summary Report

Constituent: Fluoride Analysis Run 11/16/2018 11:55 AM
Client: Consumers Energy Data: JCW_BAP_CCR_Sanitas

For observations made between 12/10/2015 and 5/23/2018, a summary of the selected data set:

Observations = 44
ND/Trace = 42
Wells = 4
Minimum Value = 1000
Maximum Value = 1300
Mean Value = 1007
Median Value = 1000
Standard Deviation = 45.23
Coefficient of Variation = 0.04492
Skewness = 6.405

Well	#Obs.	ND/Trace	Min	Max	Mean	Median	Std.Dev.	CV	Skewness
JCW-MW-15007	11	11	1000	1000	1000	1000	0	0	NaN
JCW-MW-15009	11	11	1000	1000	1000	1000	0	0	NaN
JCW-MW-15010	11	9	1000	1300	1027	1000	90.45	0.08805	2.846
JCW-MW-15028	11	11	1000	1000	1000	1000	0	0	NaN

Summary Report

Constituent: Lead, Total Analysis Run 11/16/2018 11:55 AM
Client: Consumers Energy Data: JCW_BAP_CCR_Sanitas

For observations made between 12/10/2015 and 5/23/2018, a summary of the selected data set:

Observations = 40
ND/Trace = 39
Wells = 4
Minimum Value = 1
Maximum Value = 3
Mean Value = 1.05
Median Value = 1
Standard Deviation = 0.3162
Coefficient of Variation = 0.3012
Skewness = 6.085

Well	#Obs.	ND/Trace	Min	Max	Mean	Median	Std.Dev.	CV	Skewness
JCW-MW-15007	10	9	1	3	1.2	1	0.6325	0.527	2.667
JCW-MW-15009	10	10	1	1	1	1	0	0	NaN
JCW-MW-15010	10	10	1	1	1	1	0	0	NaN
JCW-MW-15028	10	10	1	1	1	1	0	0	NaN

Summary Report

Constituent: Lithium, Total Analysis Run 11/16/2018 11:55 AM
Client: Consumers Energy Data: JCW_BAP_CCR_Sanitas

For observations made between 12/10/2015 and 5/23/2018, a summary of the selected data set:

Observations = 40
ND/Trace = 0
Wells = 4
Minimum Value = 22.7
Maximum Value = 367
Mean Value = 101
Median Value = 61
Standard Deviation = 88.56
Coefficient of Variation = 0.8771
Skewness = 1.477

Well	#Obs.	ND/Trace	Min	Max	Mean	Median	Std.Dev.	CV	Skewness
JCW-MW-15007	10	0	50	98.5	70.78	70	15.65	0.2211	0.3103
JCW-MW-15009	10	0	139	367	239.2	227	66.47	0.2779	0.4225
JCW-MW-15010	10	0	52.7	77	61.17	60.5	7.934	0.1297	0.8866
JCW-MW-15028	10	0	22.7	48	32.71	31	8.73	0.2669	0.8754

Summary Report

Constituent: Mercury, Total Analysis Run 11/16/2018 11:55 AM
Client: Consumers Energy Data: JCW_BAP_CCR_Sanitas

For observations made between 12/10/2015 and 5/23/2018, a summary of the selected data set:

Observations = 40
ND/Trace = 40
Wells = 4
Minimum Value = 0.2
Maximum Value = 0.2
Mean Value = 0.2
Median Value = 0.2
Standard Deviation = 0
Coefficient of Variation = 0
Skewness = NaN

Well	#Obs.	ND/Trace	Min	Max	Mean	Median	Std.Dev.	CV	Skewness
JCW-MW-15007	10	10	0.2	0.2	0.2	0.2	0	0	NaN
JCW-MW-15009	10	10	0.2	0.2	0.2	0.2	0	0	NaN
JCW-MW-15010	10	10	0.2	0.2	0.2	0.2	0	0	NaN
JCW-MW-15028	10	10	0.2	0.2	0.2	0.2	0	0	NaN

Summary Report

Constituent: Molybdenum, Total Analysis Run 11/16/2018 11:55 AM
Client: Consumers Energy Data: JCW_BAP_CCR_Sanitas

For observations made between 12/10/2015 and 5/23/2018, a summary of the selected data set:

Observations = 40
ND/Trace = 30
Wells = 4
Minimum Value = 5
Maximum Value = 20
Mean Value = 6.15
Median Value = 5
Standard Deviation = 2.745
Coefficient of Variation = 0.4463
Skewness = 3.544

Well	#Obs.	ND/Trace	Min	Max	Mean	Median	Std.Dev.	CV	Skewness
JCW-MW-15007	10	1	5	20	9.1	8	4.131	0.454	1.981
JCW-MW-15009	10	9	5	10	5.5	5	1.581	0.2875	2.667
JCW-MW-15010	10	10	5	5	5	5	0	0	NaN
JCW-MW-15028	10	10	5	5	5	5	0	0	NaN

Summary Report

Constituent: Radium-226/228 Analysis Run 11/16/2018 11:55 AM
Client: Consumers Energy Data: JCW_BAP_CCR_Sanitas

For observations made between 12/10/2015 and 5/23/2018, a summary of the selected data set:

Observations = 40
ND/Trace = 13
Wells = 4
Minimum Value = 0.364
Maximum Value = 2.61
Mean Value = 1.214
Median Value = 1.284
Standard Deviation = 0.5335
Coefficient of Variation = 0.4394
Skewness = 0.4232

Well	#Obs.	ND/Trace	Min	Max	Mean	Median	Std.Dev.	CV	Skewness
JCW-MW-15007	10	0	1.03	2.61	1.639	1.553	0.5136	0.3133	0.8068
JCW-MW-15009	10	3	0.683	1.753	1.362	1.38	0.3033	0.2228	-1.047
JCW-MW-15010	10	6	0.364	2.04	0.9268	0.707	0.515	0.5556	1.047
JCW-MW-15028	10	4	0.374	1.72	0.9291	0.751	0.4535	0.4882	0.6141

Summary Report

Constituent: Selenium, Total Analysis Run 11/16/2018 11:55 AM
Client: Consumers Energy Data: JCW_BAP_CCR_Sanitas

For observations made between 12/10/2015 and 5/23/2018, a summary of the selected data set:

Observations = 40
ND/Trace = 23
Wells = 4
Minimum Value = 1
Maximum Value = 14.2
Mean Value = 1.85
Median Value = 1
Standard Deviation = 2.327
Coefficient of Variation = 1.258
Skewness = 4.099

Well	#Obs.	ND/Trace	Min	Max	Mean	Median	Std.Dev.	CV	Skewness
JCW-MW-15007	10	9	1	1.2	1.02	1	0.06325	0.06201	2.667
JCW-MW-15009	10	0	1	14.2	3.78	3	3.898	1.031	2.117
JCW-MW-15010	10	6	1	6	1.5	1	1.581	1.054	2.667
JCW-MW-15028	10	8	1	2	1.1	1	0.3162	0.2875	2.667

Summary Report

Constituent: Thallium, Total Analysis Run 11/16/2018 11:55 AM
Client: Consumers Energy Data: JCW_BAP_CCR_Sanitas

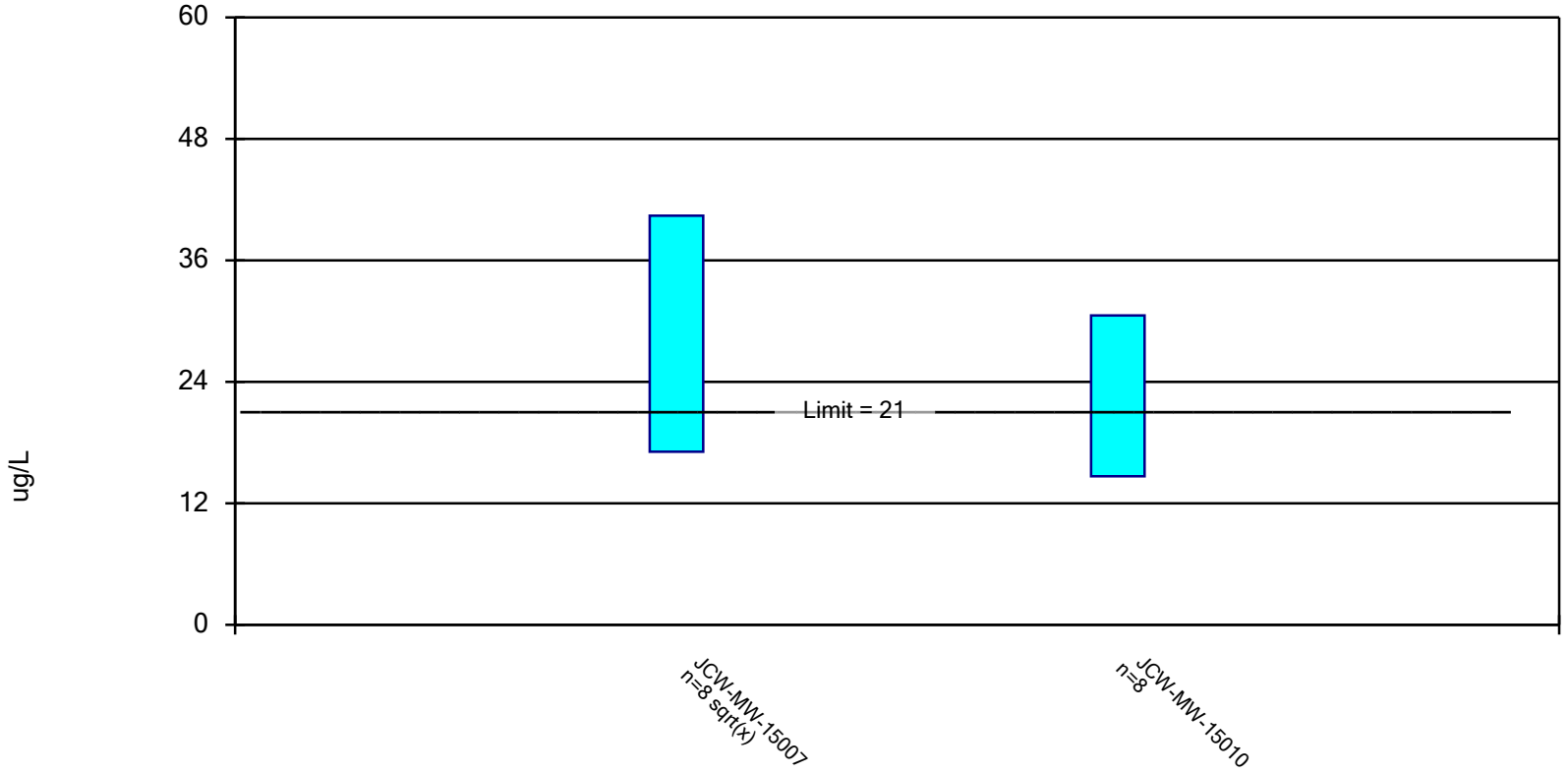
For observations made between 12/10/2015 and 5/23/2018, a summary of the selected data set:

Observations = 40
ND/Trace = 38
Wells = 4
Minimum Value = 2
Maximum Value = 2
Mean Value = 2
Median Value = 2
Standard Deviation = 0
Coefficient of Variation = 0
Skewness = NaN

Well	#Obs.	ND/Trace	Min	Max	Mean	Median	Std.Dev.	CV	Skewness
JCW-MW-15007	10	10	2	2	2	2	0	0	NaN
JCW-MW-15009	10	9	2	2	2	2	0	0	NaN
JCW-MW-15010	10	9	2	2	2	2	0	0	NaN
JCW-MW-15028	10	10	2	2	2	2	0	0	NaN

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Arsenic, Total Analysis Run 11/27/2018 5:13 PM

Client: Consumers Energy Data: JCW_BAP_CCR_Sanitas

Confidence Interval

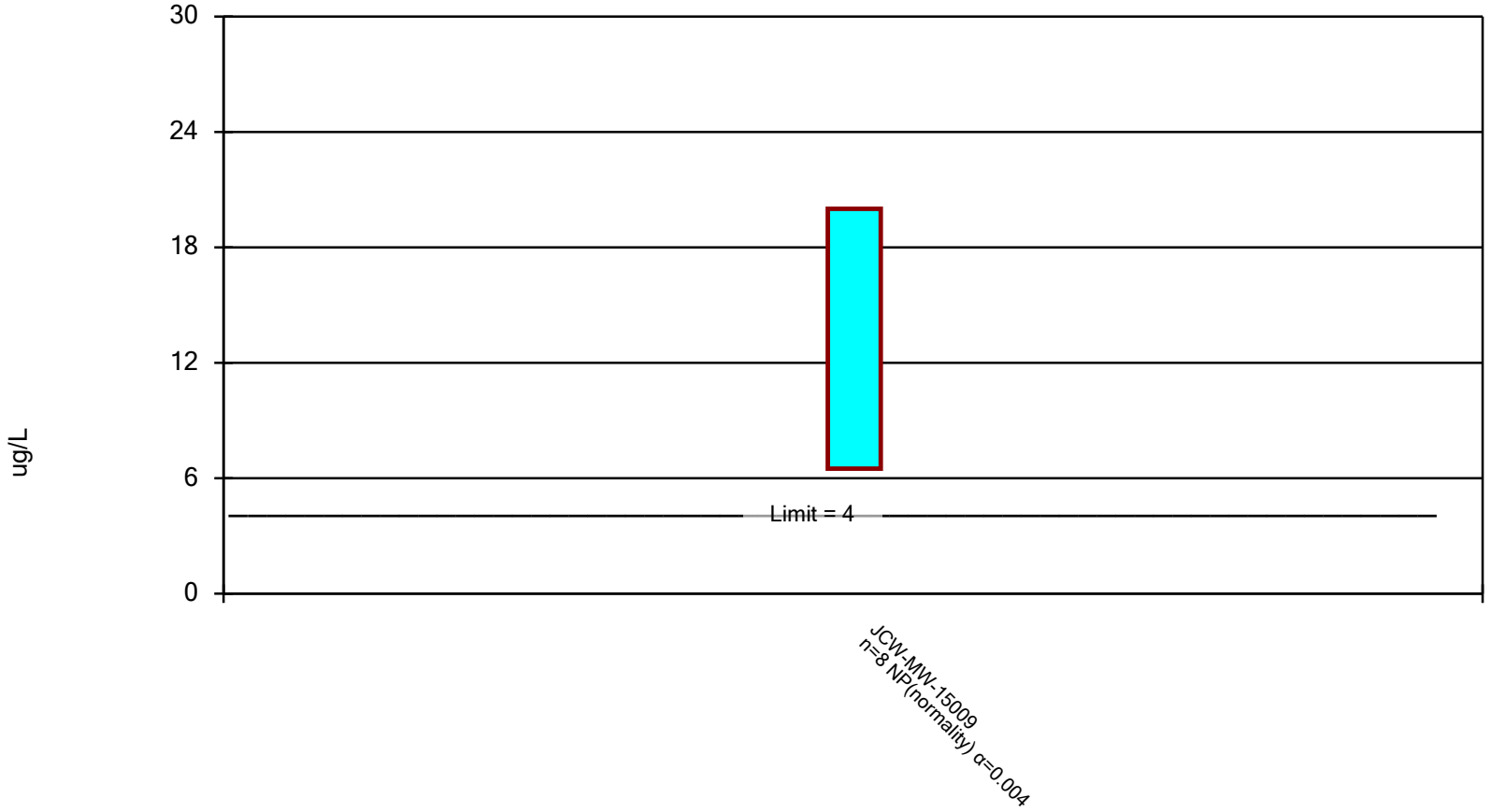
Constituent: Arsenic, Total (ug/L) Analysis Run 11/27/2018 5:14 PM

Client: Consumers Energy Data: JCW_BAP_CCR_Sanitas

	JCW-MW-15007	JCW-MW-15010
5/25/2016	20	25
8/24/2016	55	34
12/1/2016	37	
12/2/2016		27
2/23/2017	26	
2/24/2017		25
5/18/2017	23	23
8/3/2017	24.55 (D)	23.2
4/11/2018	16.7	12.5
5/22/2018		11.25 (D)
5/23/2018	25.6	
Mean	28.48	22.62
Std. Dev.	12.23	7.485
Upper Lim.	40.42	30.55
Lower Lim.	17.09	14.68

Non-Parametric Confidence Interval

Compliance limit is exceeded.



Constituent: Beryllium, Total Analysis Run 11/27/2018 5:09 PM

Client: Consumers Energy Data: JCW_BAP_CCR_Sanitas

Confidence Interval

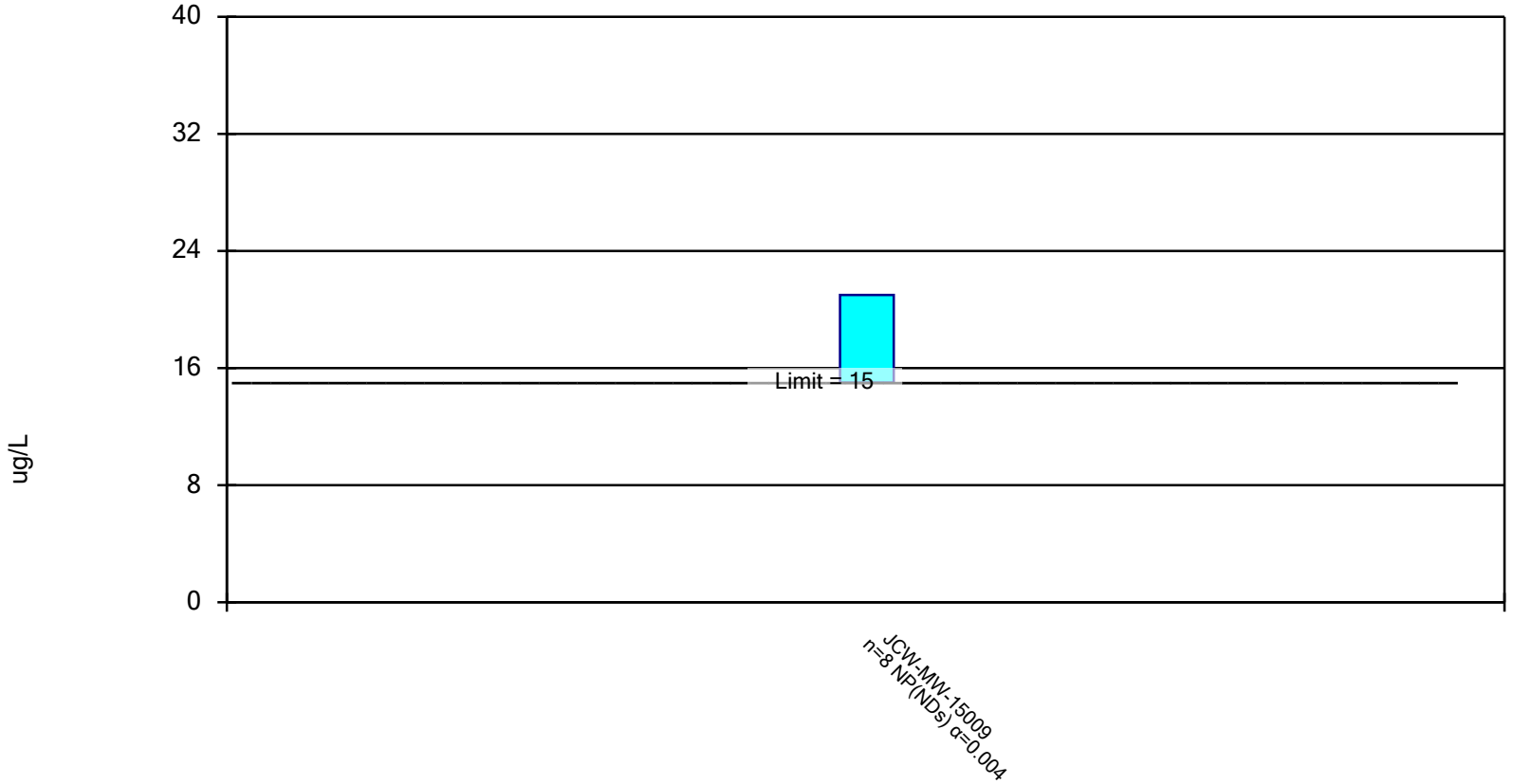
Constituent: Beryllium, Total (ug/L) Analysis Run 11/27/2018 5:10 PM

Client: Consumers Energy Data: JCW_BAP_CCR_Sanitas

	JCW-MW-15009
5/25/2016	20
8/24/2016	17
12/2/2016	19
2/23/2017	11
5/18/2017	7
8/3/2017	7.4
4/11/2018	7.1
5/23/2018	6.5
Mean	11.88
Std. Dev.	5.847
Upper Lim.	20
Lower Lim.	6.5

Non-Parametric Confidence Interval

Compliance Limit is not exceeded.



Constituent: Cobalt, Total Analysis Run 11/28/2018 11:57 AM

Client: Consumers Energy Data: JCW_BAP_CCR_Sanitas

Confidence Interval

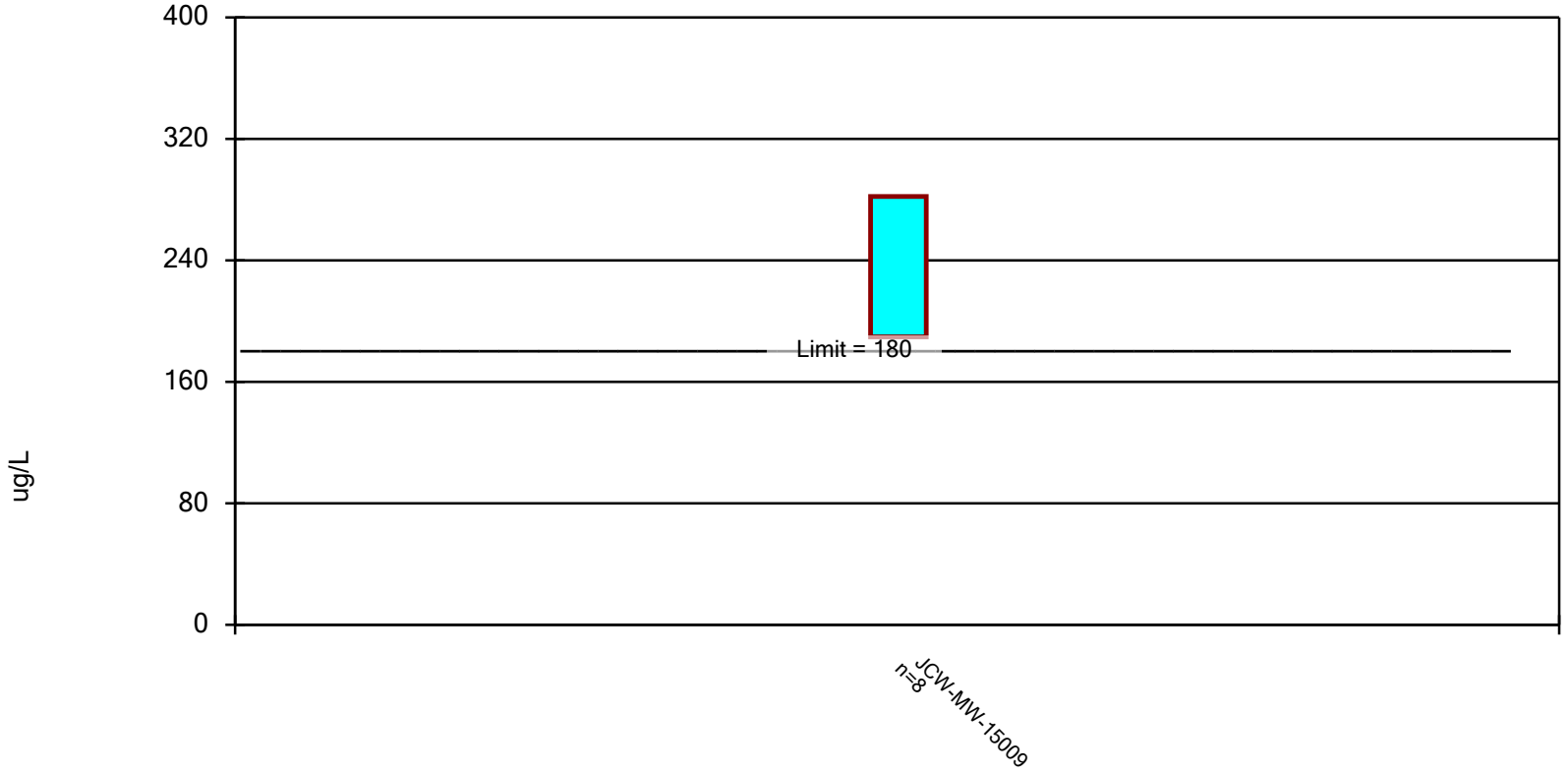
Constituent: Cobalt, Total (ug/L) Analysis Run 11/28/2018 11:58 AM

Client: Consumers Energy Data: JCW_BAP_CCR_Sanitas

	JCW-MW-15009
5/25/2016	21
8/24/2016	<15
12/2/2016	<15
2/23/2017	<15
5/18/2017	<15
8/3/2017	<15
4/11/2018	<15
5/23/2018	<15
Mean	15.75
Std. Dev.	2.121
Upper Lim.	21
Lower Lim.	15

Parametric Confidence Interval

Compliance limit is exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Lithium, Total Analysis Run 11/27/2018 5:12 PM

Client: Consumers Energy Data: JCW_BAP_CCR_Sanitas

Confidence Interval

Constituent: Lithium, Total (ug/L) Analysis Run 11/27/2018 5:12 PM

Client: Consumers Energy Data: JCW_BAP_CCR_Sanitas

	JCW-MW-15009
5/25/2016	238
8/24/2016	280
12/2/2016	300
2/23/2017	216
5/18/2017	182
8/3/2017	270
4/11/2018	210
5/23/2018	190
Mean	235.8
Std. Dev.	43.59
Upper Lim.	282
Lower Lim.	189.5

Appendix E
April 2019 Assessment Monitoring Statistical Evaluation

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Technical Memorandum

Date: July 2, 2019

To: J.R. Register, CEC

From: Darby Litz, TRC
Sarah Holmstrom, TRC
Kristin Lowery, TRC

cc: Brad Runkel, CEC
Bethany Swanberg, CEC

Project No.: 322173.0000 Phase 001, Task 003

Subject: Statistical Evaluation of April 2019 Assessment Monitoring Sampling Event
JC Weadock Bottom Ash Pond, Consumers Energy Company, Essexville, Michigan

During the statistical evaluation of the initial assessment monitoring event (May 2018), beryllium and lithium were present in one or more downgradient monitoring wells at statistically significant levels exceeding the Groundwater Protection Standards (GWPSs). Therefore, Consumers Energy Company (CEC) initiated an Assessment of Corrective Measures (ACM) within 90 days from when the Appendix IV exceedance was determined. Currently, CEC is continuing semiannual assessment monitoring in accordance with §257.95 of the CCR Rule[1] at the JC Weadock Power Plant (JCW) Bottom Ash Pond (BAP). The first semiannual assessment monitoring event for 2019 was conducted on April 9 through April 12, 2019. In accordance with §257.95, the assessment monitoring data must be compared to GWPSs to determine whether or not Appendix IV constituents are detected at statistically significant levels above the GWPSs. GWPSs were established in accordance with §257.95(h), as detailed in the October 15, 2018 *Groundwater Protection Standards* technical memorandum, which was also included in the *2018 Annual Groundwater Monitoring Report* (TRC, January 2019). The following narrative describes the methods employed and the results obtained and the Sanitas™ output files are included as an attachment.

[1] USEPA final rule for the regulation and management of Coal Combustion Residuals (CCR) under the Resource Conservation and Recovery Act (RCRA) published April 17, 2015, as amended per Phase One, Part One of the CCR Rule (83 FR 36435).

The statistical evaluation of the third semiannual assessment monitoring event data indicate the following constituent(s) are present at statistically significant levels exceeding the GWPS in downgradient monitoring wells at the JCW BAP:

Constituent	GWPS	#Downgradient Wells Observed
Beryllium	4 ug/L	1 of 4

The beryllium results are consistent with the results of previous assessment monitoring data statistical evaluations. Previously, lithium was present in downgradient well JCW-MW-15009 at a statistically significant level; however, the April 2019 statistical evaluation shows that the lower confidence limit for lithium is currently below the GWPS. CEC will continue the assessment of corrective measures per §257.95(g). CEC will continue executing the self-implementing groundwater compliance schedule in conformance with §257.90 - §257.98.

Assessment Monitoring Statistical Evaluation

The four downgradient wells (JCW-MW-15007, JCW-MW-15009, JCW-MW-15010, and JCW-MW-15028) are located in accessible areas along the downgradient perimeter of the JCW BAP CCR Unit. Following the first semiannual assessment monitoring sampling event for 2019, compliance well data for the JCW BAP CCR unit were evaluated in accordance with the *Groundwater Statistical Evaluation Plan* (Stats Plan) (TRC, October 2017).

An assessment monitoring program was developed to evaluate concentrations of CCR constituents present in the uppermost aquifer relative to acceptable levels (i.e. GWPSs). In order to decide as to whether or not the GWPSs have been exceeded, the change in concentration observed at the downgradient wells during a given assessment monitoring event must be large enough, after accounting for variability in the sample data, that the result is unlikely to have occurred merely by chance. Consistent with the Unified Guidance[2], the preferred method for comparisons to a fixed standard are confidence limits. Based on the number of historical observations in the representative sample population, the population mean, the population standard deviation, and a selected confidence level (i.e., 99 percent), an upper and lower confidence limit is calculated. The true concentration, with 99 percent confidence, will fall between the lower and upper confidence limits.

The concentrations observed in the downgradient wells are deemed to be a statistically significant exceedance when the 99 percent lower confidence limit of the downgradient data exceeds the GWPS. If the confidence interval straddles the GWPS (i.e., the lower confidence level is below the GWPS, but the upper confidence level is above), the statistical test results are inconclusive and there is not compelling evidence that the measured concentration is a result of a release from the CCR unit versus the inherent variability of the sample data. This statistical approach is consistent with the statistical

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

methods for assessment monitoring presented in §257.93(f) and (g). Statistical evaluation methodologies built into the CCR Rule, and numerous other federal rules, are key in determining whether or not individually measured data points represent a concentration increase over the baseline or a fixed standard (such as a GWPS in an assessment monitoring program).

For each detected Appendix IV constituent, the concentrations from each well were first compared directly to the GWPS, as shown on Table A1. Parameter-well combinations that included a direct exceedance of the GWPS within the past eight sampling events (December 2016 through April 2019) were retained for further analysis. Arsenic in JCW-MW-15007 and JCW-MW-15010, beryllium in JCW-MW-15009, and lithium in JCW-MW-15009 had individual results exceeding their respective GWPSs within this time period. In JCW-MW-15007 and JCW-MW-15009, cobalt and thallium reporting limits exceeded the GWPSs in November 2018 due to sample dilutions performed due to sample matrix interferences during analysis. The April 2019 results indicate that cobalt and thallium were not detected above the reporting limits or the GWPS. In JCW-MW-15007, fluoride reporting limits exceeded the GWPS in April 2019 due to sample dilutions. Fluoride has historically been non-detect at this location. Therefore, the elevated reporting limits are treated as an outlier and no statistical evaluation will be completed for these parameter-well combinations.

Groundwater data were then evaluated utilizing Sanitas™ statistical software. Sanitas™ is a software tool that is commercially available for performing statistical evaluation consistent with procedures outlined in the Unified Guidance. Within the Sanitas™ statistical program, confidence limits were selected to perform the statistical comparison of compliance data to a fixed standard. Parametric and non-parametric confidence intervals, as appropriate, were calculated for each of the CCR Appendix IV parameters using a 99 percent confidence level, i.e., a significance level (α) of 0.01. The following narrative describes the methods employed, the results obtained and the Sanitas™ output files are included as an attachment.

The statistical data evaluation included the following steps:

- Review of data quality checklists for the data sets;
- Graphical representation of the monitoring data as time versus concentration by well/constituent pair;
- Outlier testing of individual data points that appear from the graphical representations as potential outliers;
- Evaluation of visual trends apparent in the graphical representations for statistical significance;
- Evaluation of percentage of non-detects for each well/constituent (w/c) pair;
- Distribution of the data; and
- Calculation of the confidence intervals for each cumulative dataset.

The results of these evaluations are presented and discussed below.

Initially, the baseline (December 2015 through August 2017) results and the assessment monitoring results (April 2018 through April 2019) were observed visually for potential trends. No trends or outliers were identified. Data from each round were evaluated for completeness, overall quality, and usability and were deemed appropriate for the purposes of the CCR assessment monitoring program. The Sanitas™ software was then used to test compliance at the downgradient monitoring wells using the confidence interval method for the most recent 8 sampling events. Eight independent sampling events provide the appropriate density of data as recommended per the Unified Guidance, yet are collected recently enough to provide an indication of current condition. The tests were run with a per-well significance of $\alpha = 0.01$. The software outputs are included in Attachment 1 along with data reports showing the values used for the evaluation. The percentage of non-detect observations are also included in Attachment 1. Non-detect data was handled in accordance with the Stats Plan for the purposes of calculating the confidence intervals.

The Sanitas™ software generates an output that includes graphs of the parametric or non-parametric confidence intervals for each well along with notes data transformations, as appropriate. In each case, the data sets were found to be normally distributed except for beryllium in JCW-MW-15009, for which a parametric confidence interval was calculated on the natural log transformed data. The confidence interval test compares the lower confidence limit to the GWPS. The statistical evaluation of the Appendix IV parameters shows an exceedance for beryllium at JCW-MW-15009. These results are consistent with the results of previous assessment monitoring data statistical evaluations and CEC will continue the assessment of corrective measures per §257.95(g). CEC will continue executing the self-implementing groundwater compliance schedule in conformance with §257.90 - §257.98.

Attachments

Table A1 Comparison of Groundwater Sampling Results to Groundwater Protection Standards – December 2015 to April 2019

Attachment 1 Sanitas™ Output Files

Table

Table A1
Comparison of Groundwater Sampling Results to Groundwater Protection Standards – December 2015 to April 2019
JC Weadock Bottom Ash Pond – RCRA CCR Monitoring Program
Essexville, Michigan

						Sample Location:	JCW-MW-15007													
						Sample Date:	12/9/2015	4/1/2016	5/24/2016	8/23/2016	12/1/2016	2/23/2017	5/17/2017	8/3/2017	8/3/2017	9/19/2017	9/19/2017	4/10/2018	5/23/2018	11/7/2018	4/9/2019
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS		downgradient														
Appendix III															Field Dup		Field Dup				
Boron	ug/L	NC	NA	619	NA		296	163	238	547	439	270	263	< 20.0	345	384	479	--	308	656	290
Calcium	mg/L	NC	NA	302	NA		115	119	133	106	124	226	177	182	171	140	153	--	145	153	200
Chloride	mg/L	250*	NA	2,440	NA		763	1,220	990	333	521	1,720	1,570	1,870	1,830	1,340	1,370	--	1,660	788	1,600
Fluoride	ug/L	4,000	NA	1,000	NA		< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 10,000 (1)
Sulfate	mg/L	250*	NA	407	NA		48.3	20.1	21.0	30.5	26.3	20.9	22.9	34.5	34.6	8.8	9.2	--	19.6	23.9	< 20
Total Dissolved Solids	mg/L	500*	NA	4,600	NA		1,800	2,300	2,200	1,100	1,400	3,700	3,100	3,410	3,500	2,560	2,530	--	3,210	1,790	3,400
pH, Field	SU	6.5 - 8.5*	NA	6.5-7.3	NA		7.0	7.2	7.1	7.0	7.1	7.0	7.2	6.8	--	7.1	--	7.1	7.2	7.1	7.2
Appendix IV																					
Antimony	ug/L	6	NA	1	6		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1.0	--	--	< 1.0	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	10	NA	21	**21**		13	15	20	**55**	**37**	**26**	**23**	< 1.0	**48.6**	--	--	16.7	**25.6**	**46.3**	9.8
Barium	ug/L	2,000	NA	1,300	2,000		392	443	472	733	821	1,150	719	< 1.0	934	--	--	957	941	1,060	950
Beryllium	ug/L	4	NA	1	**4**		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1.0	--	--	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	5	NA	0.2	5		< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	< 0.20	--	--	< 0.20	< 0.20	< 1.0	< 0.20
Chromium	ug/L	100	NA	3	100		< 1	1	1	< 1	1	2	1	< 1.0	< 1.0	--	--	< 1.0	< 1.0	< 5.0	< 1.0
Cobalt	ug/L	NC	6	15	**15**		< 15	< 15	< 15	< 15	< 15	< 15	< 15	< 15.0	< 15.0	--	--	< 15.0	< 15.0	< 30.0 (1)	< 6.0
Fluoride	ug/L	4,000	NA	1,000	4,000		< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 10,000 (1)
Lead	ug/L	NC	15	1	15		< 1	< 1	< 1	3	< 1	< 1	< 1	< 1.0	< 1.0	--	--	< 1.0	< 1.0	< 5.0	< 1.0
Lithium	ug/L	NC	40	180	**180**		50	52.3	61	65	61	77	75	100	97	--	--	80	88	87	67
Mercury	ug/L	2	NA	0.2	2		< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	< 0.20	--	--	< 0.20	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	NC	100	6	100		20	8	8	10	10	9	7	< 5.0	< 5.0	--	--	6.4	7.6	< 25.0	6.2
Radium-226	pCi/L	NC	NA	NA	NA		0.380	0.467	0.700	0.355	0.365	1.08	0.476	1.82	1.23	--	--	0.878	0.239	1.33	--
Radium-228	pCi/L	NC	NA	NA	NA		0.872	0.786	0.997	1.11	0.893	1.53	1.32	1.07	< 0.671	--	--	0.761	0.795	0.975	--
Radium-226/228	pCi/L	5	NA	3.32	5		1.252	1.253	1.697	1.465	1.258	2.61	1.80	2.89	1.88	--	--	1.64	1.03	2.31	--
Selenium	ug/L	50	NA	2	50		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1.0	--	--	1.2	< 1.0	< 1.0	3.2
Thallium	ug/L	2	NA	2	2		< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2.0	< 2.0	--	--	< 2.0	< 2.0	< 10.0 (1)	< 2.0

Notes:

ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units; pH is a field parameter.
pCi/L - picocuries per liter.
NA - not applicable.
NC - no criteria.
-- - not analyzed. April 2019 Radium data pending.
MCL - Maximum Contaminant Level, EPA Drinking Water Standards and Health Advisories, April 2012.
RSL - Regional Screening Level from 83 FR 36435.
UTL - Upper Tolerance Limit (95%) of the background data set.
GWPS - Groundwater Protection Standard. GWPS is the higher of the MCL/RSL and UTL as established in TRC's Technical Memorandum dated October 15, 2018.
* - Secondary Maximum Contaminant Level (SMCL), EPA Secondary Drinking Water Regulations (SDWR) April 2012.
Bold value indicates an exceedance of the GWPS. Data from downgradient monitoring wells are screened against the GWPS for evaluation purposes only. Confidence intervals will be used to determine compliance per the CCR rules.
All metals were analyzed as total unless otherwise specified.
(1) Laboratory reporting limit exceeds GWPS due to sample dilutions performed as a result of sample matrix interferences. and/or concentrations of other constituents present.

Table A1
Comparison of Groundwater Sampling Results to Groundwater Protection Standards – December 2015 to April 2019
JC Weadock Bottom Ash Pond – RCRA CCR Monitoring Program
Essexville, Michigan

						Sample Location:	JCW-MW-15009												
						Sample Date:	12/9/2015	3/31/2016	5/25/2016	8/23/2016	12/1/2016	2/23/2017	5/18/2017	8/2/2017	9/18/2017	4/10/2018	5/23/2018	11/7/2018	4/9/2019
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS		downgradient												
Appendix III																			
Boron	ug/L	NC	NA	619	NA		546	284	402	501	498	366	329	429	533	--	297	422	290
Calcium	mg/L	NC	NA	302	NA		520	526	546	622	549	618	558	554	470	--	530	589	510
Chloride	mg/L	250*	NA	2,440	NA		189	97.4	163	171	154	95.5	52.6	84.8	113	--	41.0	64.9	43
Fluoride	ug/L	4,000	NA	1,000	NA		< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 2,000
Sulfate	mg/L	250*	NA	407	NA		2,520	1,790	2,650	2,030	2,280	1,880	1,710	2,680	3,090	--	1,690	1,980	1,600
Total Dissolved Solids	mg/L	500*	NA	4,600	NA		1,700	2,800	1,800	3,300	3,200	2,700	2,600	2,590	3,020	--	2,510	2,620	2,400
pH, Field	SU	6.5 - 8.5*	NA	6.5-7.3	NA		4.1	4.8	4.1	4.2	4.1	4.6	4.7	4.6	4.6	4.7	4.9	4.8	5.4
Appendix IV																			
Antimony	ug/L	6	NA	1	6		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	10	NA	21	**21**		2	< 1	2	< 1	< 1	< 1	< 1	< 1.0	--	1.6	1.4	< 5.0	< 1.0
Barium	ug/L	2,000	NA	1,300	2,000		20	17	14	23	18	15	15	16.6	--	12.3	14.4	14.8	14
Beryllium	ug/L	4	NA	1	**4**		**27**	**9**	**20**	**17**	**19**	**11**	**7**	**7.4**	--	**7.1**	**6.5**	**6.6**	**4.3**
Cadmium	ug/L	5	NA	0.2	5		< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 1.0	0.24
Chromium	ug/L	100	NA	3	100		6	2	5	4	4	3	1	1.5	--	1.4	1.4	< 5.0	1.4
Cobalt	ug/L	NC	6	15	**15**		**22**	< 15	**21**	< 15	< 15	< 15	< 15	< 15.0	--	< 15.0	< 15.0	< 30.0 (1)	< 6.0
Fluoride	ug/L	4,000	NA	1,000	4,000		< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 2,000
Lead	ug/L	NC	15	1	15		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 5.0	< 1.0
Lithium	ug/L	NC	40	180	**180**		**367**	139	**238**	**280**	**300**	**216**	**182**	**270**	--	**210**	**190**	**240**	150
Mercury	ug/L	2	NA	0.2	2		< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	NC	100	6	100		< 5	10	< 5	< 5	< 5	< 5	< 5	< 5.0	--	< 5.0	< 5.0	< 25.0	< 5.0
Radium-226	pCi/L	NC	NA	NA	NA		0.274	< 0.234	< 0.186	0.159	< 0.318	0.403	< 0.27	< 0.644	--	< 0.703	< 0.723	< 0.803	--
Radium-228	pCi/L	NC	NA	NA	NA		1.20	0.842	0.700	1.43	1.33	1.35	1.24	0.833	--	0.707	1.11	1.25	--
Radium-226/228	pCi/L	5	NA	3.32	5		1.474	1.069	0.683	1.589	1.608	1.753	1.31	< 1.39	--	< 1.37	< 1.37	< 1.54	--
Selenium	ug/L	50	NA	2	50		4	3	3	1	3	2	1	1.4	--	14.2	5.2	< 5.0	2.0
Thallium	ug/L	2	NA	2	2		< 2	< 2	2	< 2	< 2	< 2	< 2	< 2.0	--	< 2.0	< 2.0	< 10.0 (1)	< 2.0

Notes:
ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units; pH is a field parameter.
pCi/L - picocuries per liter.
NA - not applicable.
NC - no criteria.
-- - not analyzed. April 2019 Radium data pending.
MCL - Maximum Contaminant Level, EPA Drinking Water Standards and Health Advisories, April 2012.
RSL - Regional Screening Level from 83 FR 36435.
UTL - Upper Tolerance Limit (95%) of the background data set.
GWPS - Groundwater Protection Standard. GWPS is the higher of the MCL/RSL and UTL as established in TRC's Technical Memorandum dated October 15, 2018.
* - Secondary Maximum Contaminant Level (SMCL), EPA Secondary Drinking Water Regulations (SDWR) April 2012.
Bold value indicates an exceedance of the GWPS. Data from downgradient monitoring wells are screened against the GWPS for evaluation purposes only. Confidence intervals will be used to determine compliance per the CCR rules.
All metals were analyzed as total unless otherwise specified.
(1) Laboratory reporting limit exceeds GWPS due to sample dilutions performed as a result of sample matrix interferences. and/or concentrations of other constituents present.

Table A1
Comparison of Groundwater Sampling Results to Groundwater Protection Standards – December 2015 to April 2019
JC Weadock Bottom Ash Pond – RCRA CCR Monitoring Program
Essexville, Michigan

						Sample Location:	JCW-MW-15010													
						Sample Date:	12/10/2015	3/31/2016	5/25/2016	8/24/2016	12/1/2016	2/23/2017	5/17/2017	8/2/2017	9/19/2017	4/10/2018	5/22/2018	5/22/2018	11/7/2018	4/9/2019
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS		downgradient											Field Dup		
Appendix III																				
Boron	ug/L	NC	NA	619	NA		1,220	987	1,070	1,320	1,370	1,360	1,390	1,580	1,340	--	1,330	1,220	1,360	1,400
Calcium	mg/L	NC	NA	302	NA		68.0	85.4	74.3	74.0	79.1	103	84.8	69.9	63.6	--	78.3	78.8	84.4	120
Chloride	mg/L	250*	NA	2,440	NA		83.6	87.8	81.5	78.1	92.8	88.8	89.8	92.7	89.5	--	99.8	99.7	96.5	140
Fluoride	ug/L	4,000	NA	1,000	NA		< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	1,300	< 1,000	1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Sulfate	mg/L	250*	NA	407	NA		72.3	91.6	62.8	53.9	80.7	57.9	72.9	59.0	39.9	--	24.3	23.2	22.3	36
Total Dissolved Solids	mg/L	500*	NA	4,600	NA		430	500	440	400	490	460	480	832	392	--	458	486	492	670
pH, Field	SU	6.5 - 8.5*	NA	6.5-7.3	NA		7.7	7.4	7.4	7.6	7.5	7.3	7.5	7.5	7.5	7.3	7.5	--	7.4	7.6
Appendix IV																				
Antimony	ug/L	6	NA	1	6		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	10	NA	21	**21**		**22**	**39**	**25**	**34**	**27**	**25**	**23**	**23.2**	--	12.5	11.4	11.1	9.5	16
Barium	ug/L	2,000	NA	1,300	2,000		99	115	99	98	125	111	123	109	--	121	123	116	114	190
Beryllium	ug/L	4	NA	1	**4**		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	5	NA	0.2	5		< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Chromium	ug/L	100	NA	3	100		< 1	1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	1.2	< 1.0
Cobalt	ug/L	NC	6	15	**15**		< 15	< 15	< 15	< 15	< 15	< 15	< 15	< 15.0	--	< 15.0	< 15.0	< 15.0	< 6.0	< 6.0
Fluoride	ug/L	4,000	NA	1,000	4,000		< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	1,300	< 1,000	1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Lead	ug/L	NC	15	1	15		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lithium	ug/L	NC	40	180	**180**		63	52.7	55	53	60	57	61	61	--	77	72	72	70	73
Mercury	ug/L	2	NA	0.2	2		< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	NC	100	6	100		< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5.0	--	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Radium-226	pCi/L	NC	NA	NA	NA		< 0.240	< 0.278	< 0.189	< 0.201	< 0.318	0.358	< 0.269	< 0.643	--	< 0.831	< 0.618	< 0.668	< 0.879	--
Radium-228	pCi/L	NC	NA	NA	NA		0.524	< 0.364	< 0.585	0.604	< 0.584	< 0.631	0.917	< 0.707	--	1.39	< 0.741	< 0.701	< 0.776	--
Radium-226/228	pCi/L	5	NA	3.32	5		0.58	< 0.364	< 0.585	0.731	< 0.584	0.683	0.981	< 1.35	--	< 2.04	< 1.36	< 1.37	< 1.66	--
Selenium	ug/L	50	NA	2	50		1	< 1	< 1	< 1	< 1	1	6	< 1.0	--	< 1.0	1.0	< 1.0	< 1.0	< 1.0
Thallium	ug/L	2	NA	2	2		< 2	< 2	2	< 2	< 2	< 2	< 2	< 2.0	--	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0

Notes:
ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units; pH is a field parameter.
pCi/L - picocuries per liter.
NA - not applicable.
NC - no criteria.
-- - not analyzed. April 2019 Radium data pending.
MCL - Maximum Contaminant Level, EPA Drinking Water Standards and Health Advisories, April 2012.
RSL - Regional Screening Level from 83 FR 36435.
UTL - Upper Tolerance Limit (95%) of the background data set.
GWPS - Groundwater Protection Standard. GWPS is the higher of the MCL/RSL and UTL as established in TRC's Technical Memorandum dated October 15, 2018.
* - Secondary Maximum Contaminant Level (SMCL), EPA Secondary Drinking Water Regulations (SDWR) April 2012.
Bold value indicates an exceedance of the GWPS. Data from downgradient monitoring wells are screened against the GWPS for evaluation purposes only. Confidence intervals will be used to determine compliance per the CCR rules.
All metals were analyzed as total unless otherwise specified.
(1) Laboratory reporting limit exceeds GWPS due to sample dilutions performed as a result of sample matrix interferences. and/or concentrations of other constituents present.

Table A1
Comparison of Groundwater Sampling Results to Groundwater Protection Standards – December 2015 to April 2019
JC Weadock Bottom Ash Pond – RCRA CCR Monitoring Program
Essexville, Michigan

						Sample Location:	JCW-MW-15028														
						Sample Date:	12/9/2015	3/31/2016	5/25/2016	8/23/2016	12/1/2016	2/23/2017	5/17/2017	8/2/2017	9/19/2017	4/11/2018	4/11/2018	5/23/2018	11/7/2018	11/7/2018	4/9/2019	4/9/2019
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS		downgradient														
Appendix III																	Field Dup			Field Dup		Field Dup
Boron	ug/L	NC	NA	619	NA		357	333	345	433	455	425	427	444	419	--	--	444	517	525	530	560
Calcium	mg/L	NC	NA	302	NA		63.4	72.2	71.2	97.7	90.7	98.5	86.2	92.4	75.5	--	--	125	153	153	170	180
Chloride	mg/L	250*	NA	2,440	NA		71.7	69.3	69.4	72.2	64.2	70.0	60.1	106	91.0	--	--	69.5	352	347	660	650
Fluoride	ug/L	4,000	NA	1,000	NA		< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 2,000	< 2,000
Sulfate	mg/L	250*	NA	407	NA		62.5	49.3	69.8	113	142	116	62.8	93.0	85.7	--	--	32.2	111	110	120	120
Total Dissolved Solids	mg/L	500*	NA	4,600	NA		410	400	390	520	550	530	470	514	506	--	--	1,030	976	966	1,800	1,800
pH, Field	SU	6.5 - 8.5*	NA	6.5-7.3	NA		8.1	7.9	7.8	7.6	8.1	8.0	7.9	7.7	8.0	7.8	--	8.0	7.9	--	8.0	--
Appendix IV																						
Antimony	ug/L	6	NA	1	6		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	10	NA	21	**21**		2	< 1	1	1	2	2	1	1.2	--	1.2	1.4	< 1.0	< 1.0	1.1	1.1	1.1
Barium	ug/L	2,000	NA	1,300	2,000		65	63	69	90	102	92	82	97.4	--	148	145	148	156	158	250	240
Beryllium	ug/L	4	NA	1	**4**		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	5	NA	0.2	5		< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Chromium	ug/L	100	NA	3	100		< 1	1	1	< 1	< 1	1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cobalt	ug/L	NC	6	15	**15**		< 15	< 15	< 15	< 15	< 15	< 15	< 15	< 15.0	--	< 15.0	< 15.0	< 15.0	< 6.0	< 6.0	< 6.0	< 6.0
Fluoride	ug/L	4,000	NA	1,000	4,000		< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 2,000	< 2,000
Lead	ug/L	NC	15	1	15		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lithium	ug/L	NC	40	180	**180**		25.9	22.7	25	29	32	32	30	35	--	48	47	48	51	49	53	51
Mercury	ug/L	2	NA	0.2	2		< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	NC	100	6	100		< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5.0	--	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Radium-226	pCi/L	NC	NA	NA	NA		< 0.182	< 0.448	< 0.189	< 0.220	< 0.361	0.285	< 0.247	< 0.952	--	< 0.934	< 0.450	< 0.739	1.13	0.786	--	--
Radium-228	pCi/L	NC	NA	NA	NA		< 0.646	0.571	0.479	0.441	< 0.374	0.674	0.819	< 0.772	--	0.988	0.874	< 0.676	< 0.685	<0.591	--	--
Radium-226/228	pCi/L	5	NA	3.32	5		< 0.646	0.673	0.63	0.565	< 0.374	0.959	0.829	< 1.72	--	1.65	1.30	< 1.42	1.60	1.26	--	--
Selenium	ug/L	50	NA	2	50		2	< 1	< 1	< 1	< 1	1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Thallium	ug/L	2	NA	2	2		< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2.0	--	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0

Notes:

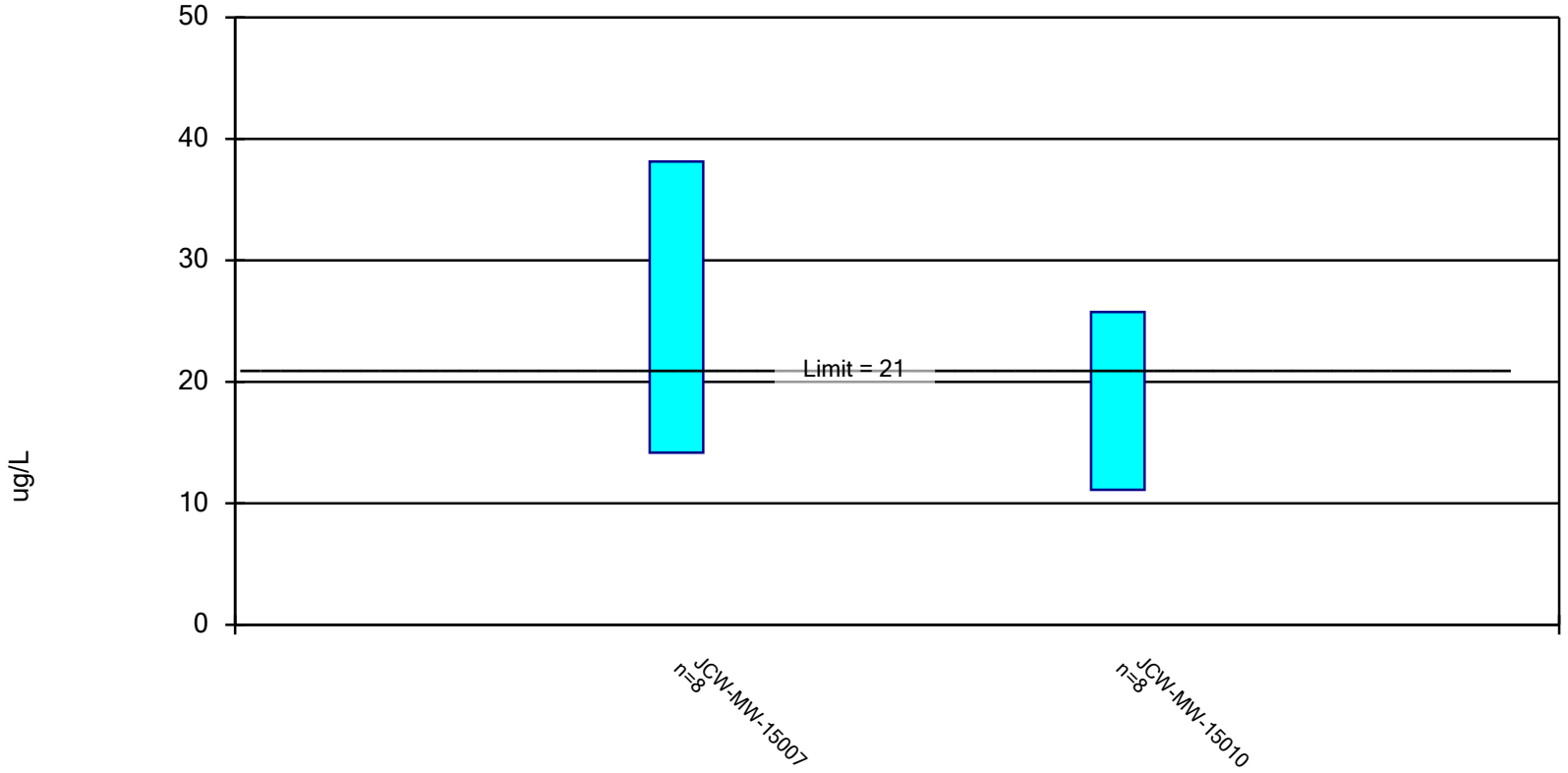
ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units; pH is a field parameter.
pCi/L - picocuries per liter.
NA - not applicable.
NC - no criteria.
-- - not analyzed. April 2019 Radium data pending.
MCL - Maximum Contaminant Level, EPA Drinking Water Standards and Health Advisories, April 2012.
RSL - Regional Screening Level from 83 FR 36435.
UTL - Upper Tolerance Limit (95%) of the background data set.
GWPS - Groundwater Protection Standard. GWPS is the higher of the MCL/RSL and UTL as established in TRC's Technical Memorandum dated October 15, 2018.
* - Secondary Maximum Contaminant Level (SMCL), EPA Secondary Drinking Water Regulations (SDWR) April 2012.
Bold value indicates an exceedance of the GWPS. Data from downgradient monitoring wells are screened against the GWPS for evaluation purposes only. Confidence intervals will be used to determine compliance per the CCR rules.
All metals were analyzed as total unless otherwise specified.
(1) Laboratory reporting limit exceeds GWPS due to sample dilutions performed as a result of sample matrix interferences. and/or concentrations of other constituents present.

Technical Memorandum

Sanitas™ Output Files

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Arsenic, Total Analysis Run 6/7/2019 9:26 AM

Client: Consumers Energy Data: JCW_Sanitas_19.05.30

Confidence Interval

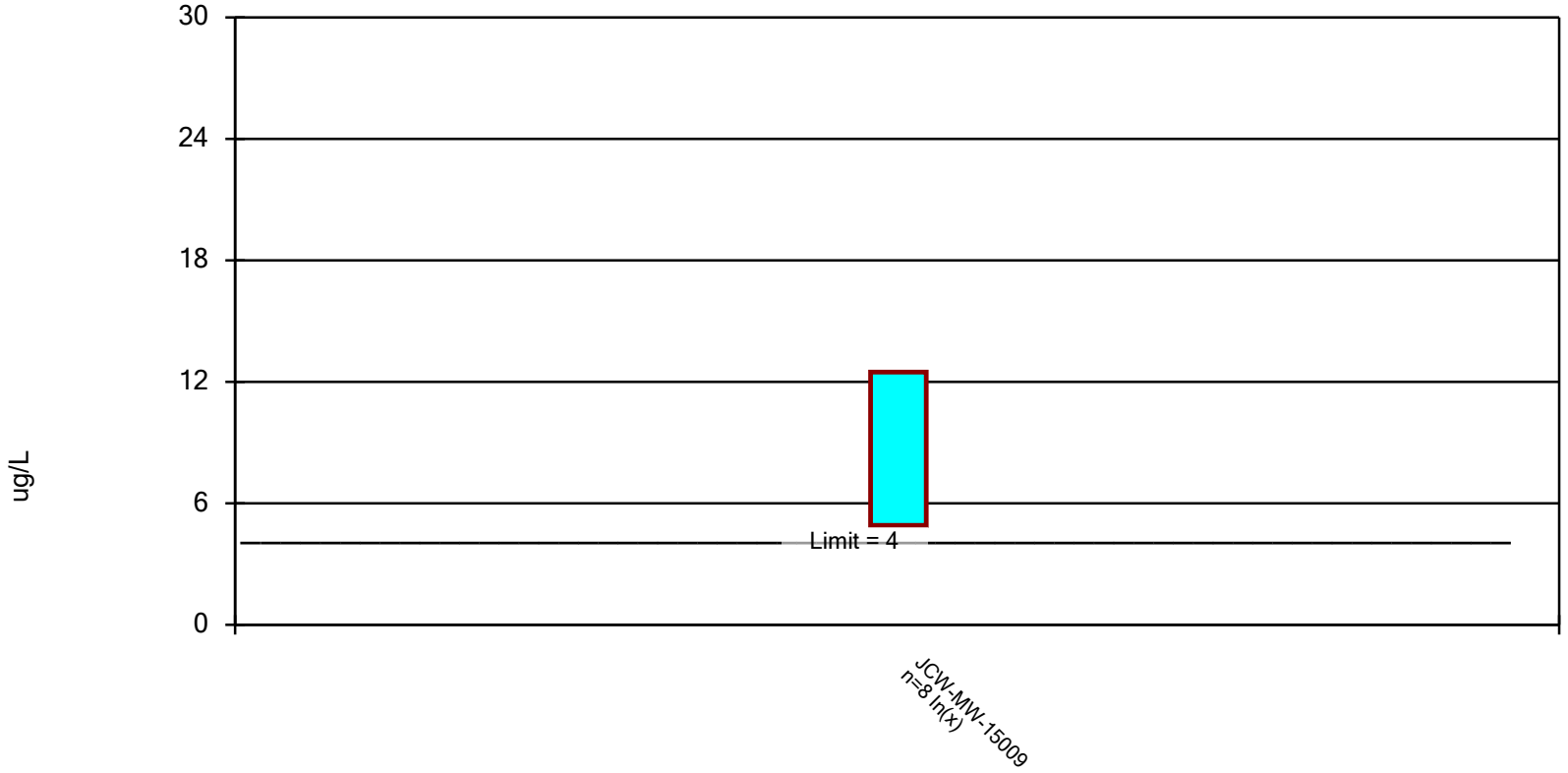
Constituent: Arsenic, Total (ug/L) Analysis Run 6/7/2019 9:27 AM

Client: Consumers Energy Data: JCW_Sanitas_19.05.30

	JCW-MW-15007	JCW-MW-15010
12/1/2016	37	27
2/23/2017	26	25
5/17/2017	23	23
8/2/2017		23.2
8/3/2017	24.8 (D)	
4/10/2018	16.7	12.5
5/22/2018		11.25 (D)
5/23/2018	25.6	
11/7/2018	46.3	9.5
4/9/2019	9.8	16
Mean	26.15	18.43
Std. Dev.	11.29	6.893
Upper Lim.	38.12	25.74
Lower Lim.	14.18	11.12

Parametric Confidence Interval

Compliance limit is exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Beryllium, Total Analysis Run 6/7/2019 9:27 AM

Client: Consumers Energy Data: JCW_Sanitas_19.05.30

Confidence Interval

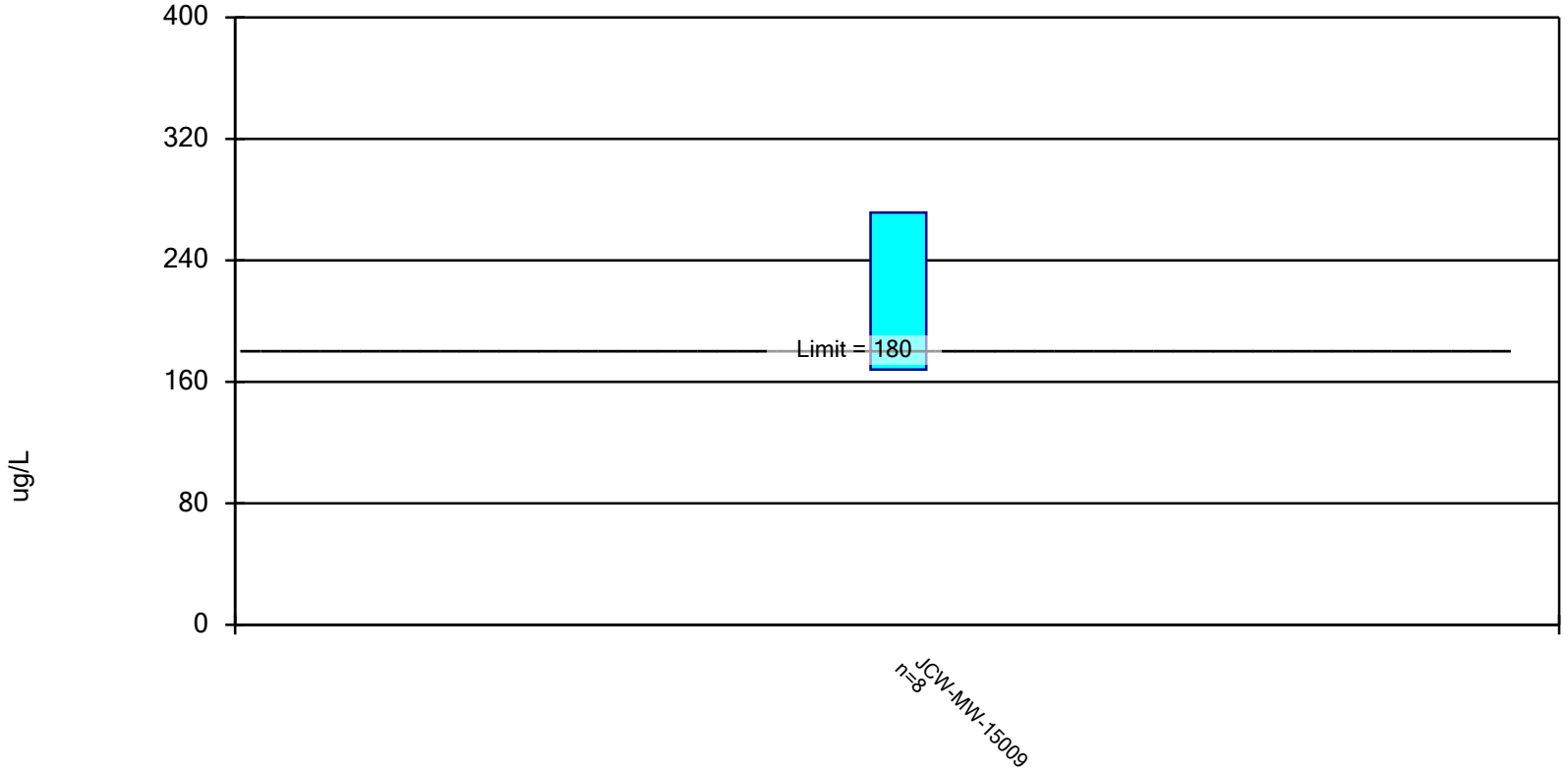
Constituent: Beryllium, Total (ug/L) Analysis Run 6/7/2019 9:28 AM

Client: Consumers Energy Data: JCW_Sanitas_19.05.30

	JCW-MW-15009
12/1/2016	19
2/23/2017	11
5/18/2017	7
8/2/2017	7.4
4/10/2018	7.1
5/23/2018	6.5
11/7/2018	6.6
4/9/2019	4.3
Mean	8.613
Std. Dev.	4.584
Upper Lim.	12.48
Lower Lim.	4.918

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Lithium, Total Analysis Run 6/7/2019 9:28 AM

Client: Consumers Energy Data: JCW_Sanitas_19.05.30

Confidence Interval

Constituent: Lithium, Total (ug/L) Analysis Run 6/7/2019 9:28 AM

Client: Consumers Energy Data: JCW_Sanitas_19.05.30

	JCW-MW-15009
12/1/2016	300
2/23/2017	216
5/18/2017	182
8/2/2017	270
4/10/2018	210
5/23/2018	190
11/7/2018	240
4/9/2019	150
Mean	219.8
Std. Dev.	48.78
Upper Lim.	271.5
Lower Lim.	168

Appendix F
October 2019 Assessment Monitoring Statistical Evaluation

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Technical Memorandum

Date: December 13, 2019

To: J.R. Register, Consumers Energy

From: Darby Litz, TRC
Sarah Holmstrom, TRC
Kristin Lowery, TRC

cc: Brad Runkel, Consumers Energy
Bethany Swanberg, Consumers Energy

Project No.: 322173.0000 Phase 001, Task 003

Subject: Statistical Evaluation of October 2019 Assessment Monitoring Sampling Event
JC Weadock Bottom Ash Pond, Consumers Energy Company, Essexville, Michigan

During the statistical evaluation of the initial assessment monitoring event (May 2018), beryllium and lithium were present in one or more downgradient monitoring wells at statistically significant levels exceeding the Groundwater Protection Standards (GWPSs). Therefore, Consumers Energy Company (Consumers Energy) initiated an Assessment of Corrective Measures (ACM) within 90 days from when the Appendix IV exceedance was determined. The ACM was completed on September 11, 2019.

Currently, Consumers Energy is continuing semiannual assessment monitoring in accordance with §257.95 of the CCR Rule[1] at the JC Weadock Power Plant Bottom Ash Pond. The second semiannual assessment monitoring event for 2019 was conducted on October 7 through October 15, 2019. In accordance with §257.95, the assessment monitoring data must be compared to GWPSs to determine whether or not Appendix IV constituents are detected at statistically significant levels above the GWPSs. GWPSs were established in accordance with §257.95(h), as detailed in the October 15, 2018 *Groundwater Protection Standards* technical memorandum, which was also included in the *2018 Annual Groundwater Monitoring Report* (TRC, January 2019). The following narrative describes the methods employed and the results obtained and the Sanitas™ output files are included as an attachment.

[1] USEPA final rule for the regulation and management of Coal Combustion Residuals (CCR) under the Resource Conservation and Recovery Act (RCRA) published April 17, 2015, as amended per Phase One, Part One of the CCR Rule (83 FR 36435).

The statistical evaluation of the fourth semiannual assessment monitoring event data indicate no constituents are present at statistically significant levels that exceed the GWPSs in downgradient monitoring wells at the Weadock Bottom Ash Pond.

Constituent	GWPS	#Downgradient Wells Observed

No constituents are present at statistically significant levels above the GWPSs.

Previously, lithium and beryllium were present in downgradient well JCW-MW-15009 at statistically significant levels; however, the October 2019 statistical evaluation shows that the lower confidence limit for lithium and beryllium are currently below the GWPS. Although no Appendix IV constituents are present at statistically significant levels above the GWPS based on this data evaluation, concentrations of arsenic at JCW-MW-15007 remain above background levels. Corrective action has been triggered as a result of data collected during the previous assessment monitoring events. Consumers Energy will continue to evaluate corrective measures per §257.96 and §257.97. Consumers Energy will continue executing the self-implementing groundwater compliance schedule in conformance with §257.90 - §257.98.

Assessment Monitoring Statistical Evaluation

The four downgradient wells (JCW-MW-15007, JCW-MW-15009, JCW-MW-15010, and JCW-MW-15028) are located in accessible areas along the downgradient perimeter of the Weadock Bottom Ash Pond. Following the second semiannual assessment monitoring sampling event for 2019, compliance well data for the Weadock Bottom Ash Pond were evaluated in accordance with the *Groundwater Statistical Evaluation Plan* (Stats Plan) (TRC, October 2017).

An assessment monitoring program was developed to evaluate concentrations of CCR constituents present in the uppermost aquifer relative to acceptable levels (i.e. GWPSs). To evaluate whether or not a GWPS exceedance is statistically significant, the difference in concentration observed at the downgradient wells during a given assessment monitoring event compared to the GWPS must be large enough, after accounting for variability in the sample data, that the result is unlikely to have occurred merely by chance. Consistent with the Unified Guidance [2], the preferred method for comparisons to a fixed standard are confidence limits. Based on the number of historical observations in the representative sample population, the population mean, the population standard deviation, and a selected confidence level (i.e., 99 percent), an upper and lower confidence limit is calculated. The true concentration, with 99 percent confidence, will fall between the lower and upper confidence limits.

The concentrations observed in the downgradient wells are deemed to be a statistically significant exceedance when the 99 percent lower confidence limit of the downgradient data exceeds the GWPS. If the confidence interval straddles the GWPS (i.e., the lower confidence level is below the GWPS, but

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

the upper confidence level is above), the statistical test result indicates that there is insufficient confidence that the measured concentrations are different from the GWPS and thus no compelling evidence that the measured concentration is a result of a release from the CCR unit versus the inherent variability of the sample data. This statistical approach is consistent with the statistical methods for assessment monitoring presented in §257.93(f) and (g). Statistical evaluation methodologies built into the CCR Rule, and numerous other federal rules, are key in determining whether or not individually measured data points represent a concentration increase over the baseline or a fixed standard (such as a GWPS in an assessment monitoring program).

For each detected Appendix IV constituent, the concentrations from each well were first compared directly to the GWPS, as shown on Table A1. Parameter-well combinations that included a direct exceedance of the GWPS within the past eight sampling events (February 2017 through October 2019) were retained for further analysis. Arsenic in JCW-MW-15007 and JCW-MW-15010 and beryllium and lithium in JCW-MW-15009 had individual results exceeding their respective GWPSs within this time period.

Groundwater data were evaluated utilizing Sanitas™ statistical software. Sanitas™ is a software tool that is commercially available for performing statistical evaluation consistent with procedures outlined in the Unified Guidance. Within the Sanitas™ statistical program, confidence limits were selected to perform the statistical comparison of compliance data to a fixed standard. Parametric and non-parametric confidence intervals, as appropriate, were calculated for each of the CCR Appendix IV parameters using a per test[3] 99 percent confidence level, i.e., a significance level (α) of 0.01. The following narrative describes the methods employed, the results obtained and the Sanitas™ output files are included as an attachment.

The statistical data evaluation included the following steps:

- Review of data quality checklists for the data sets;
- Graphical representation of the monitoring data as time versus concentration by well/constituent pair;
- Outlier testing of individual data points that appear from the graphical representations as potential outliers;
- Evaluation of visual trends apparent in the graphical representations for statistical significance;
- Evaluation of percentage of non-detects for each well/constituent pair;
- Distribution of the data; and
- Calculation of the confidence intervals for each cumulative dataset.

The results of these evaluations are presented and discussed below.

[3] Confidence level is assessed for each individual comparison (i.e. per well and per constituent).

Data from each round were evaluated for completeness, overall quality, and usability and were deemed appropriate for the purposes of the CCR assessment monitoring program. Initially, the baseline (December 2015 through August 2017) results and the assessment monitoring results (April 2018 through October 2019) were observed visually for potential trends. No outliers were identified. Arsenic concentrations in JCW-MW-15010 and beryllium and lithium concentrations in JCW-MW-15009 appear to exhibit a downward trend on the time series charts (Attachment 1). These data sets were tested further in Sanitas™ utilizing Sen's Slope to estimate the average rate of change in concentration over time and utilizing the Mann-Kendall trend test to test for significance of the trend at the 98% confidence level. The trend tests show that arsenic in JCW-MW-15010 and lithium in JCW-MW-15009 are generally decreasing with time, as evidenced by the negative Sen's Slope, and that the downward trend of beryllium in JCW-MW-15009 is statistically significant (Attachment 1). The decreases in constituent concentrations at JCW-MW-15009 and JCW-MW-15010 are causing the confidence intervals to widen. Calculating a confidence interval around a trending data set incorporates not only variability present naturally in the underlying dataset, but also incorporates variability due to the trend itself. Beryllium and lithium concentrations have already triggered assessment monitoring (e.g., not newly identified GWPS exceedances) and an interim measure has been initiated through cessation of hydraulic loading to the bottom ash pond in April 2018; therefore, traditional confidence interval calculations are presented in this statistical evaluation until more data are available. Once additional data are collected in the absence of hydraulic loading, confidence bands may be a more appropriate assessment to determine compliance with the CCR Rule. Confidence bands are selected by the UG as the appropriate method for calculating confidence intervals on trending data. A confidence band calculates upper and lower confidence limits at each point along the trend to reduce variability and create a narrower confidence interval. At least 8 to 10 measurements should be available when computing a confidence band around a linear regression.

The Sanitas™ software was then used to test compliance at the downgradient monitoring wells using the confidence interval method for the most recent 8 sampling events. Eight independent sampling events provide the appropriate density of data as recommended per the Unified Guidance, yet are collected recently enough to provide an indication of current condition. The tests were run with a per-test significance of $\alpha = 0.01$. The software outputs are included in Attachment 1 along with data reports showing the values used for the evaluation. The percentage of non-detect observations are also included in Attachment 1. Non-detect data was handled in accordance with the Stats Plan for the purposes of calculating the confidence intervals.

The Sanitas™ software generates an output that includes graphs of the parametric or non-parametric confidence intervals for each well along with notes data transformations, as appropriate. In each case, the data sets were found to be normally distributed. The confidence interval test compares the lower confidence limit to the GWPS. The statistical evaluation of the Appendix IV parameters shows no constituents present at statistically significant levels that exceed the GWPSs. Previously, beryllium was present in downgradient well JCW-MW-15009 at a statistically significant level; however, the October 2019 statistical evaluation shows that the lower confidence limit for lithium is currently below the GWPS. The results of the assessment monitoring statistical evaluation for the other

downgradient wells are consistent with the previous (April 2019) assessment monitoring data statistical evaluation. Although no Appendix IV constituents are present at statistically significant levels above the GWPS based on this data evaluation, concentrations remain above background levels and corrective action has been triggered as a result of data collected during the previous assessment monitoring events. Consumers Energy will continue to evaluate corrective measures per §257.96 and §257.97. Consumers Energy will continue executing the self-implementing groundwater compliance schedule in conformance with §257.90 - §257.98.

Attachments

Table 1 Comparison of Groundwater Sampling Results to Groundwater Protection Standards – December 2015 to October 2019

Attachment 1 Sanitas™ Output Files

Table

Table 1
Comparison of Groundwater Sampling Results to Groundwater Protection Standards – December 2015 to October 2019
JC Weadock Bottom Ash Pond – RCRA CCR Monitoring Program
Essexville, Michigan

						Sample Location:	JCW-MW-15007														
						Sample Date:	12/9/2015	4/1/2016	5/24/2016	8/23/2016	12/1/2016	2/23/2017	5/17/2017	8/3/2017	8/3/2017	9/19/2017	9/19/2017	4/10/2018	5/23/2018	11/7/2018	4/9/2019	10/15/2019	10/15/2019
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS		downgradient																
Appendix III																Field Dup		Field Dup					Field Dup
Boron	ug/L	NC	NA	619	NA		296	163	238	547	439	270	263	< 20.0	345	384	479	--	308	656	290	470	460
Calcium	mg/L	NC	NA	302	NA		115	119	133	106	124	226	177	182	171	140	153	--	145	153	200	130	120
Chloride	mg/L	250*	NA	2,440	NA		763	1,220	990	333	521	1,720	1,570	1,870	1,830	1,340	1,370	--	1,660	788	1,600	1,200	1,200
Fluoride	ug/L	4,000	NA	1,000	NA		< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 10,000 (1)	< 5,000	< 5,000
Sulfate	mg/L	250*	NA	407	NA		48.3	20.1	21.0	30.5	26.3	20.9	22.9	34.5	34.6	8.8	9.2	--	19.6	23.9	< 20	44	43
Total Dissolved Solids	mg/L	500*	NA	4,600	NA		1,800	2,300	2,200	1,100	1,400	3,700	3,100	3,410	3,500	2,560	2,530	--	3,210	1,790	3,400	2,300	2,400
pH, Field	SU	6.5 - 8.5*	NA	6.5-7.3	NA		7.0	7.2	7.1	7.0	7.1	7.0	7.2	6.8	--	7.1	--	7.1	7.2	7.1	7.2	7.1	--
Appendix IV																							
Antimony	ug/L	6	NA	1	6		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1.0	--	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	10	NA	21	**21**		13	15	20	**55**	**37**	**26**	**23**	< 1.0	**48.6**	--	--	16.7	**25.6**	**46.3**	9.8	**34**	**35**
Barium	ug/L	2,000	NA	1,300	2,000		392	443	472	733	821	1,150	719	< 1.0	934	--	--	957	941	1,060	950	970	970
Beryllium	ug/L	4	NA	1	**4**		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1.0	--	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	5	NA	0.2	5		< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	< 0.20	--	--	< 0.20	< 0.20	< 1.0	< 0.20	< 0.20	< 0.20
Chromium	ug/L	100	NA	3	100		< 1	1	1	< 1	1	2	1	< 1.0	< 1.0	--	--	< 1.0	< 1.0	< 5.0	< 1.0	< 1.0	< 1.0
Cobalt	ug/L	NC	6	15	**15**		< 15	< 15	< 15	< 15	< 15	< 15	< 15	< 15.0	< 15.0	--	--	< 15.0	< 15.0	< 30.0 (1)	< 6.0	< 6.0	< 6.0
Fluoride	ug/L	4,000	NA	1,000	4,000		< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 10,000 (1)	< 5,000	< 5,000
Lead	ug/L	NC	15	1	15		< 1	< 1	< 1	3	< 1	< 1	< 1	< 1.0	< 1.0	--	--	< 1.0	< 1.0	< 5.0	< 1.0	< 1.0	< 1.0
Lithium	ug/L	NC	40	180	**180**		50	52.3	61	65	61	77	75	100	97	--	--	80	88	87	67	70	67
Mercury	ug/L	2	NA	0.2	2		< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	< 0.20	--	--	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	NC	100	6	100		20	8	8	10	10	9	7	< 5.0	< 5.0	--	--	6.4	7.6	< 25.0	6.2	9.7	9.6
Radium-226	pCi/L	NC	NA	NA	NA		0.380	0.467	0.700	0.355	0.365	1.08	0.476	1.82	1.23	--	--	0.878	0.239	1.33	0.628	0.659	0.442
Radium-228	pCi/L	NC	NA	NA	NA		0.872	0.786	0.997	1.11	0.893	1.53	1.32	1.07	< 0.671	--	--	0.761	0.795	0.975	0.492	0.796	0.543
Radium-226/228	pCi/L	5	NA	3.32	5		1.252	1.253	1.697	1.465	1.258	2.61	1.80	2.89	1.88	--	--	1.64	1.03	2.31	1.12	1.45	0.986
Selenium	ug/L	50	NA	2	50		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1.0	--	--	1.2	< 1.0	< 1.0	3.2	< 1.0	< 1.0
Thallium	ug/L	2	NA	2	2		< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2.0	< 2.0	--	--	< 2.0	< 2.0	< 10.0 (1)	< 2.0	< 2.0	< 2.0

Notes:
ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units; pH is a field parameter.
pCi/L - picocuries per liter.
NA - not applicable.
NC - no criteria.
-- - not analyzed.
MCL - Maximum Contaminant Level, EPA Drinking Water Standards and Health Advisories, April 2012.
RSL - Regional Screening Level from 83 FR 36435.
UTL - Upper Tolerance Limit (95%) of the background data set.
GWPS - Groundwater Protection Standard. GWPS is the higher of the MCL/RSL and UTL as established in TRC's Technical Memorandum dated October 15, 2018.
* - Secondary Maximum Contaminant Level (SMCL), EPA Secondary Drinking Water Regulations (SDWR) April 2012.
Bold value indicates an exceedance of the GWPS. Data from downgradient monitoring wells are screened against the GWPS for evaluation purposes only. Confidence intervals will be used to determine compliance per the CCR rules.
All metals were analyzed as total unless otherwise specified.
(1) Laboratory reporting limit exceeds GWPS due to sample dilutions performed as a result of sample matrix interferences. and/or concentrations of other constituents present.

Table 1
Comparison of Groundwater Sampling Results to Groundwater Protection Standards – December 2015 to October 2019
JC Weadock Bottom Ash Pond – RCRA CCR Monitoring Program
Essexville, Michigan

						Sample Location:	JCW-MW-15009												
						Sample Date:	12/9/2015	3/31/2016	5/25/2016	8/23/2016	12/1/2016	2/23/2017	5/18/2017	8/2/2017	9/18/2017	4/10/2018	5/23/2018	11/7/2018	4/9/2019	10/15/2019
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS		downgradient													
Appendix III																				
Boron	ug/L	NC	NA	619	NA		546	284	402	501	498	366	329	429	533	--	297	422	290	330
Calcium	mg/L	NC	NA	302	NA		520	526	546	622	549	618	558	554	470	--	530	589	510	520
Chloride	mg/L	250*	NA	2,440	NA		189	97.4	163	171	154	95.5	52.6	84.8	113	--	41.0	64.9	43	18
Fluoride	ug/L	4,000	NA	1,000	NA		< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 2,000	< 1,000
Sulfate	mg/L	250*	NA	407	NA		2,520	1,790	2,650	2,030	2,280	1,880	1,710	2,680	3,090	--	1,690	1,980	1,600	1,400
Total Dissolved Solids	mg/L	500*	NA	4,600	NA		1,700	2,800	1,800	3,300	3,200	2,700	2,600	2,590	3,020	--	2,510	2,620	2,400	2,100
pH, Field	SU	6.5 - 8.5*	NA	6.5-7.3	NA		4.1	4.8	4.1	4.2	4.1	4.6	4.7	4.6	4.6	4.7	4.9	4.8	5.4	6.1
Appendix IV																				
Antimony	ug/L	6	NA	1	6		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	10	NA	21	**21**		2	< 1	2	< 1	< 1	< 1	< 1	< 1.0	--	1.6	1.4	< 5.0	< 1.0	< 1.0
Barium	ug/L	2,000	NA	1,300	2,000		20	17	14	23	18	15	15	16.6	--	12.3	14.4	14.8	14	66
Beryllium	ug/L	4	NA	1	**4**		**27**	**9**	**20**	**17**	**19**	**11**	**7**	**7.4**	--	**7.1**	**6.5**	**6.6**	**4.3**	< 1.0
Cadmium	ug/L	5	NA	0.2	5		< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 1.0	0.24	< 0.20
Chromium	ug/L	100	NA	3	100		6	2	5	4	4	3	1	1.5	--	1.4	1.4	< 5.0	1.4	< 1.0
Cobalt	ug/L	NC	6	15	**15**		**22**	< 15	**21**	< 15	< 15	< 15	< 15	< 15.0	--	< 15.0	< 15.0	< 30.0 (1)	< 6.0	< 6.0
Fluoride	ug/L	4,000	NA	1,000	4,000		< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 2,000	< 1,000
Lead	ug/L	NC	15	1	15		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 5.0	< 1.0	< 1.0
Lithium	ug/L	NC	40	180	**180**		**367**	139	**238**	**280**	**300**	**216**	**182**	**270**	--	**210**	**190**	**240**	150	94
Mercury	ug/L	2	NA	0.2	2		< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	NC	100	6	100		< 5	10	< 5	< 5	< 5	< 5	< 5	< 5.0	--	< 5.0	< 5.0	< 25.0	< 5.0	9.3
Radium-226	pCi/L	NC	NA	NA	NA		0.274	< 0.234	< 0.186	0.159	< 0.318	0.403	< 0.27	< 0.644	--	< 0.703	< 0.723	< 0.803	< 0.0879	0.175
Radium-228	pCi/L	NC	NA	NA	NA		1.20	0.842	0.700	1.43	1.33	1.35	1.24	0.833	--	0.707	1.11	1.25	< 0.411	0.548
Radium-226/228	pCi/L	5	NA	3.32	5		1.474	1.069	0.683	1.589	1.608	1.753	1.31	< 1.39	--	< 1.37	< 1.37	< 1.54	< 0.411	0.723
Selenium	ug/L	50	NA	2	50		4	3	3	1	3	2	1	1.4	--	14.2	5.2	< 5.0	2	2.0
Thallium	ug/L	2	NA	2	2		< 2	< 2	2	< 2	< 2	< 2	< 2	< 2.0	--	< 2.0	< 2.0	< 10.0 (1)	< 2.0	< 2.0

Notes:
ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units; pH is a field parameter.
pCi/L - picocuries per liter.
NA - not applicable.
NC - no criteria.
-- - not analyzed.
MCL - Maximum Contaminant Level, EPA Drinking Water Standards and Health Advisories, April 2012.
RSL - Regional Screening Level from 83 FR 36435.
UTL - Upper Tolerance Limit (95%) of the background data set.
GWPS - Groundwater Protection Standard. GWPS is the higher of the MCL/RSL and UTL as established in TRC's Technical Memorandum dated October 15, 2018.
* - Secondary Maximum Contaminant Level (SMCL), EPA Secondary Drinking Water Regulations (SDWR) April 2012.
Bold value indicates an exceedance of the GWPS. Data from downgradient monitoring wells are screened against the GWPS for evaluation purposes only. Confidence intervals will be used to determine compliance per the CCR rules.
All metals were analyzed as total unless otherwise specified.
(1) Laboratory reporting limit exceeds GWPS due to sample dilutions performed as a result of sample matrix interferences, and/or concentrations of other constituents present.

Table 1
Comparison of Groundwater Sampling Results to Groundwater Protection Standards – December 2015 to October 2019
JC Weadock Bottom Ash Pond – RCRA CCR Monitoring Program
Essexville, Michigan

						Sample Location:	JCW-MW-15010													
						Sample Date:	12/10/2015	3/31/2016	5/25/2016	8/24/2016	12/1/2016	2/23/2017	5/17/2017	8/2/2017	9/19/2017	4/10/2018	5/22/2018	5/22/2018	11/7/2018	4/9/2019	10/14/2019
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS		downgradient											Field Dup			
Appendix III																					
Boron	ug/L	NC	NA	619	NA		1,220	987	1,070	1,320	1,370	1,360	1,390	1,580	1,340	--	1,330	1,220	1,360	1,400	1,400
Calcium	mg/L	NC	NA	302	NA		68.0	85.4	74.3	74.0	79.1	103	84.8	69.9	63.6	--	78.3	78.8	84.4	120	110
Chloride	mg/L	250*	NA	2,440	NA		83.6	87.8	81.5	78.1	92.8	88.8	89.8	92.7	89.5	--	99.8	99.7	96.5	140	140
Fluoride	ug/L	4,000	NA	1,000	NA		< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	1,300	< 1,000	1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Sulfate	mg/L	250*	NA	407	NA		72.3	91.6	62.8	53.9	80.7	57.9	72.9	59.0	39.9	--	24.3	23.2	22.3	36	30
Total Dissolved Solids	mg/L	500*	NA	4,600	NA		430	500	440	400	490	460	480	832	392	--	458	486	492	670	600
pH, Field	SU	6.5 - 8.5*	NA	6.5-7.3	NA		7.7	7.4	7.4	7.6	7.5	7.3	7.5	7.5	7.5	7.3	7.5	--	7.4	7.6	7.3
Appendix IV																					
Antimony	ug/L	6	NA	1	6		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	10	NA	21	**21**		**22**	**39**	**25**	**34**	**27**	**25**	**23**	**23.2**	--	12.5	11.4	11.1	9.5	16	13
Barium	ug/L	2,000	NA	1,300	2,000		99	115	99	98	125	111	123	109	--	121	123	116	114	190	180
Beryllium	ug/L	4	NA	1	**4**		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	5	NA	0.2	5		< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Chromium	ug/L	100	NA	3	100		< 1	1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	1.2	< 1.0	< 1.0
Cobalt	ug/L	NC	6	15	**15**		< 15	< 15	< 15	< 15	< 15	< 15	< 15	< 15.0	--	< 15.0	< 15.0	< 15.0	< 6.0	< 6.0	< 6.0
Fluoride	ug/L	4,000	NA	1,000	4,000		< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	1,300	< 1,000	1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Lead	ug/L	NC	15	1	15		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lithium	ug/L	NC	40	180	**180**		63	52.7	55	53	60	57	61	61	--	77	72	72	70	73	84
Mercury	ug/L	2	NA	0.2	2		< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	NC	100	6	100		< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5.0	--	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Radium-226	pCi/L	NC	NA	NA	NA		< 0.240	< 0.278	< 0.189	< 0.201	< 0.318	0.358	< 0.269	< 0.643	--	< 0.831	< 0.618	< 0.668	< 0.879	0.215	< 0.134
Radium-228	pCi/L	NC	NA	NA	NA		0.524	< 0.364	< 0.585	0.604	< 0.584	< 0.631	0.917	< 0.707	--	1.39	< 0.741	< 0.701	< 0.776	0.424	0.412
Radium-226/228	pCi/L	5	NA	3.32	5		0.58	< 0.364	< 0.585	0.731	< 0.584	0.683	0.981	< 1.35	--	< 2.04	< 1.36	< 1.37	< 1.66	0.639	0.536
Selenium	ug/L	50	NA	2	50		1	< 1	< 1	< 1	< 1	1	6	< 1.0	--	< 1.0	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Thallium	ug/L	2	NA	2	2		< 2	< 2	2	< 2	< 2	< 2	< 2	< 2.0	--	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0

Notes:

ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units; pH is a field parameter.
pCi/L - picocuries per liter.
NA - not applicable.
NC - no criteria.
-- - not analyzed.
MCL - Maximum Contaminant Level, EPA Drinking Water Standards and Health Advisories, April 2012.
RSL - Regional Screening Level from 83 FR 36435.
UTL - Upper Tolerance Limit (95%) of the background data set.
GWPS - Groundwater Protection Standard. GWPS is the higher of the MCL/RSL and UTL as established in TRC's Technical Memorandum dated October 15, 2018.
* - Secondary Maximum Contaminant Level (SMCL), EPA Secondary Drinking Water Regulations (SDWR) April 2012.
Bold value indicates an exceedance of the GWPS. Data from downgradient monitoring wells are screened against the GWPS for evaluation purposes only. Confidence intervals will be used to determine compliance per the CCR rules.
All metals were analyzed as total unless otherwise specified.
(1) Laboratory reporting limit exceeds GWPS due to sample dilutions performed as a result of sample matrix interferences. and/or concentrations of other constituents present.

Table 1
Comparison of Groundwater Sampling Results to Groundwater Protection Standards – December 2015 to October 2019
JC Weadock Bottom Ash Pond – RCRA CCR Monitoring Program
Essexville, Michigan

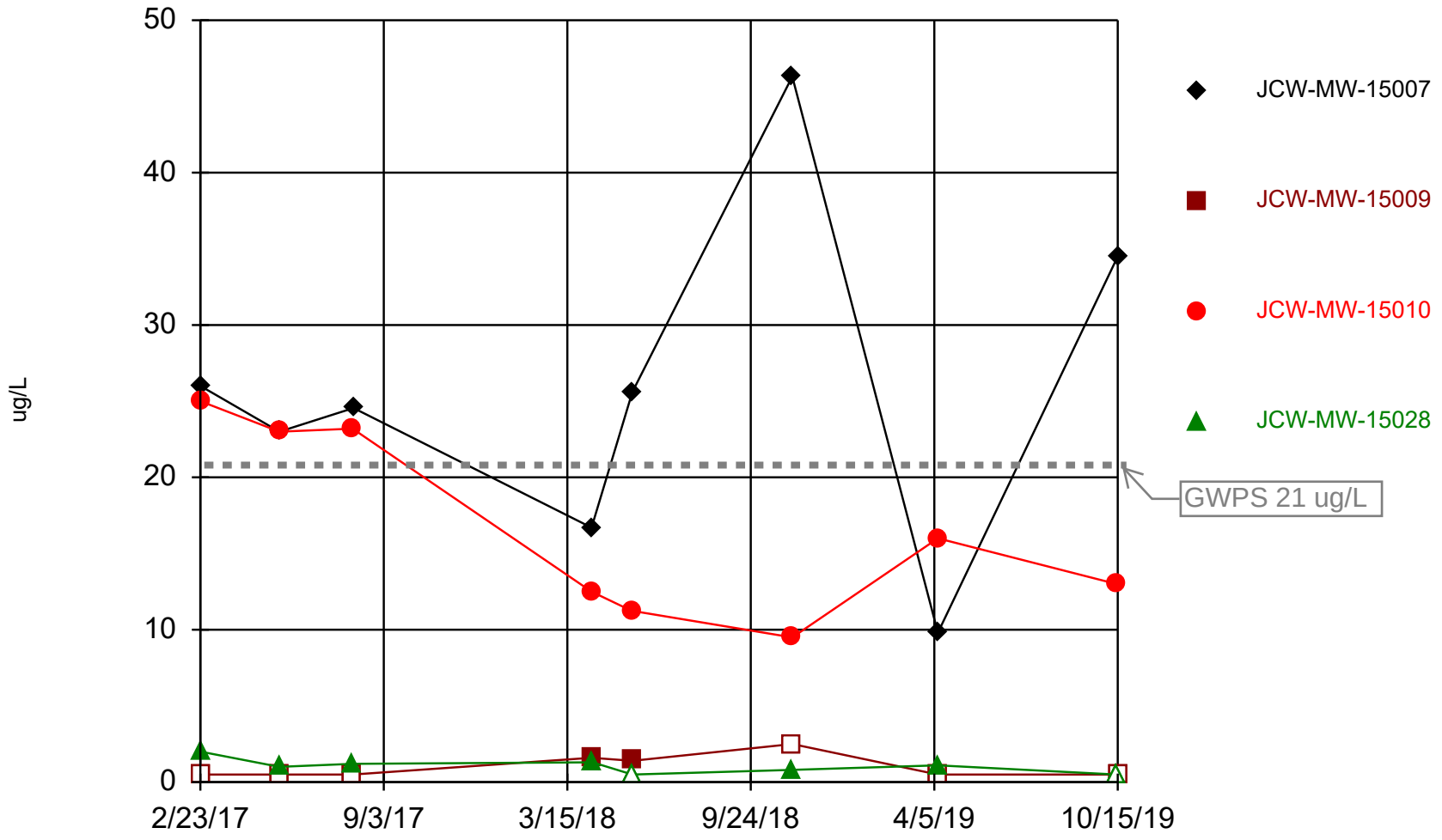
						Sample Location:	JCW-MW-15028															
						Sample Date:	12/9/2015	3/31/2016	5/25/2016	8/23/2016	12/1/2016	2/23/2017	5/17/2017	8/2/2017	9/19/2017	4/11/2018	4/11/2018	5/23/2018	11/7/2018	11/7/2018	4/9/2019	4/9/2019	10/14/2019
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS		downgradient																
Appendix III																	Field Dup			Field Dup		Field Dup	
Boron	ug/L	NC	NA	619	NA		357	333	345	433	455	425	427	444	419	--	--	444	517	525	530	560	550
Calcium	mg/L	NC	NA	302	NA		63.4	72.2	71.2	97.7	90.7	98.5	86.2	92.4	75.5	--	--	125	153	153	170	180	170
Chloride	mg/L	250*	NA	2,440	NA		71.7	69.3	69.4	72.2	64.2	70.0	60.1	106	91.0	--	--	69.5	352	347	660	650	640
Fluoride	ug/L	4,000	NA	1,000	NA		< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 2,000	< 2,000	< 1,000
Sulfate	mg/L	250*	NA	407	NA		62.5	49.3	69.8	113	142	116	62.8	93.0	85.7	--	--	32.2	111	110	120	120	120
Total Dissolved Solids	mg/L	500*	NA	4,600	NA		410	400	390	520	550	530	470	514	506	--	--	1,030	976	966	1,800	1,800	1,500
pH, Field	SU	6.5 - 8.5*	NA	6.5-7.3	NA		8.1	7.9	7.8	7.6	8.1	8.0	7.9	7.7	8.0	7.8	--	8.0	7.9	--	8.0	--	7.8
Appendix IV																							
Antimony	ug/L	6	NA	1	6		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	10	NA	21	**21**		2	< 1	1	1	2	2	1	1.2	--	1.2	1.4	< 1.0	< 1.0	1.1	1.1	1.1	< 1.0
Barium	ug/L	2,000	NA	1,300	2,000		65	63	69	90	102	92	82	97.4	--	148	145	148	156	158	250	240	230
Beryllium	ug/L	4	NA	1	**4**		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	5	NA	0.2	5		< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Chromium	ug/L	100	NA	3	100		< 1	1	1	< 1	< 1	1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cobalt	ug/L	NC	6	15	**15**		< 15	< 15	< 15	< 15	< 15	< 15	< 15	< 15.0	--	< 15.0	< 15.0	< 15.0	< 6.0	< 6.0	< 6.0	< 6.0	< 6.0
Fluoride	ug/L	4,000	NA	1,000	4,000		< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 2,000	< 2,000	< 1,000
Lead	ug/L	NC	15	1	15		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lithium	ug/L	NC	40	180	**180**		25.9	22.7	25	29	32	32	30	35	--	48	47	48	51	49	53	51	48
Mercury	ug/L	2	NA	0.2	2		< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	NC	100	6	100		< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5.0	--	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Radium-226	pCi/L	NC	NA	NA	NA		< 0.182	< 0.448	< 0.189	< 0.220	< 0.361	0.285	< 0.247	< 0.952	--	< 0.934	< 0.450	< 0.739	1.13	0.786	0.621	0.384	0.576
Radium-228	pCi/L	NC	NA	NA	NA		< 0.646	0.571	0.479	0.441	< 0.374	0.674	0.819	< 0.772	--	0.988	0.874	< 0.676	< 0.685	<0.591	0.729	0.658	0.585
Radium-226/228	pCi/L	5	NA	3.32	5		< 0.646	0.673	0.63	0.565	< 0.374	0.959	0.829	< 1.72	--	1.65	1.30	< 1.42	1.60	1.26	1.35	1.04	1.16
Selenium	ug/L	50	NA	2	50		2	< 1	< 1	< 1	< 1	1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Thallium	ug/L	2	NA	2	2		< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2.0	--	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0

Notes:
ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units; pH is a field parameter.
pCi/L - picocuries per liter.
NA - not applicable.
NC - no criteria.
-- - not analyzed.
MCL - Maximum Contaminant Level, EPA Drinking Water Standards and Health Advisories, April 2012.
RSL - Regional Screening Level from 83 FR 36435.
UTL - Upper Tolerance Limit (95%) of the background data set.
GWPS - Groundwater Protection Standard. GWPS is the higher of the MCL/RSL and UTL as established in TRC's Technical Memorandum dated October 15, 2018.
* - Secondary Maximum Contaminant Level (SMCL), EPA Secondary Drinking Water Regulations (SDWR) April 2012.
Bold value indicates an exceedance of the GWPS. Data from downgradient monitoring wells are screened against the GWPS for evaluation purposes only. Confidence intervals will be used to determine compliance per the CCR rules.
All metals were analyzed as total unless otherwise specified.
(1) Laboratory reporting limit exceeds GWPS due to sample dilutions performed as a result of sample matrix interferences. and/or concentrations of other constituents present.

Sanitas™ Output Files

Hollow symbols indicate censored values.

Time Series

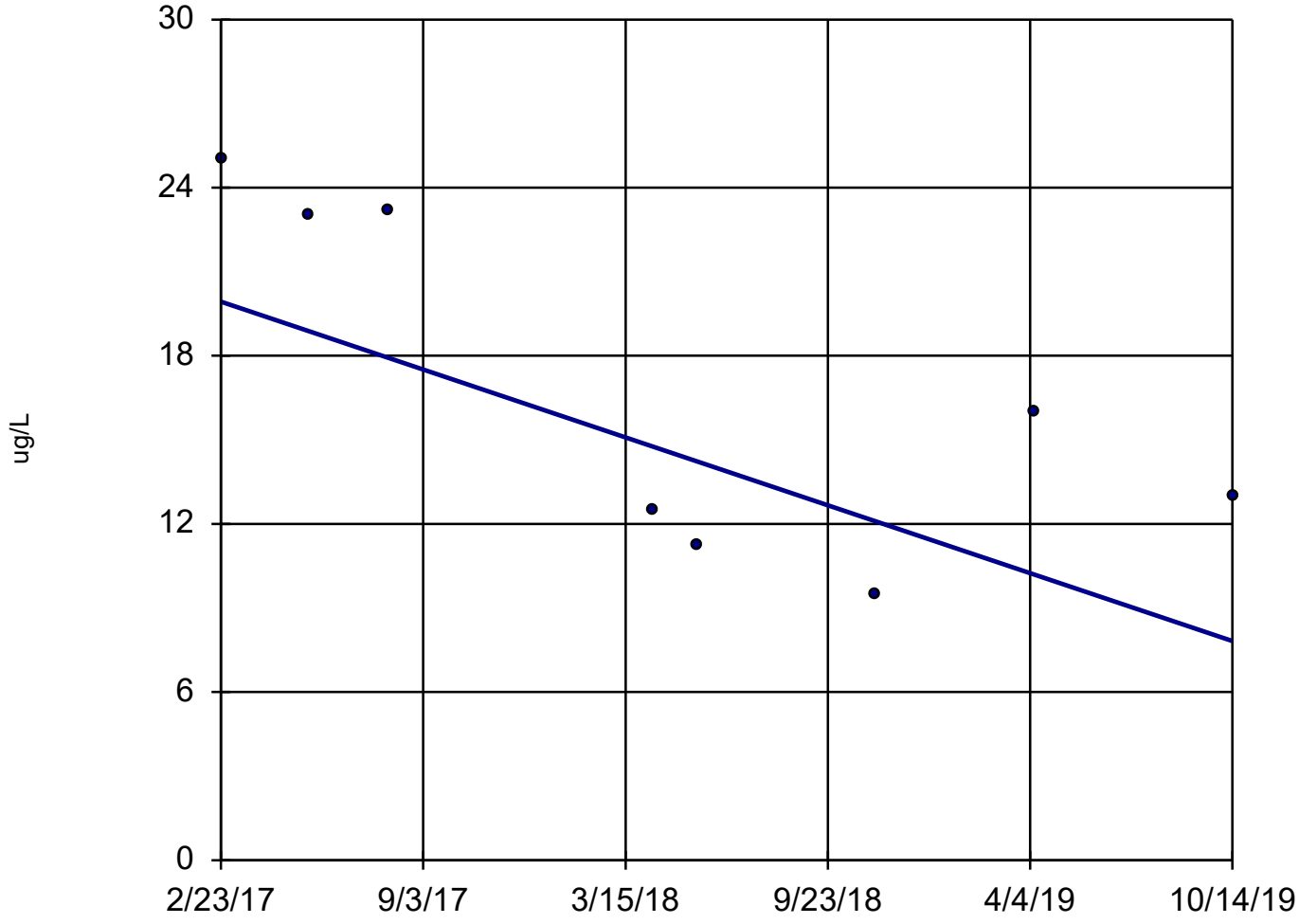


Constituent: Arsenic, Total Analysis Run 12/4/2019 10:00 AM

Client: Consumers Energy Data: JCW_Sanitas_19.11.18

Sen's Slope Estimator

JCW-MW-15010



n = 8

Slope = -4.592 units per year.

Mann-Kendall statistic = -14
critical = -20

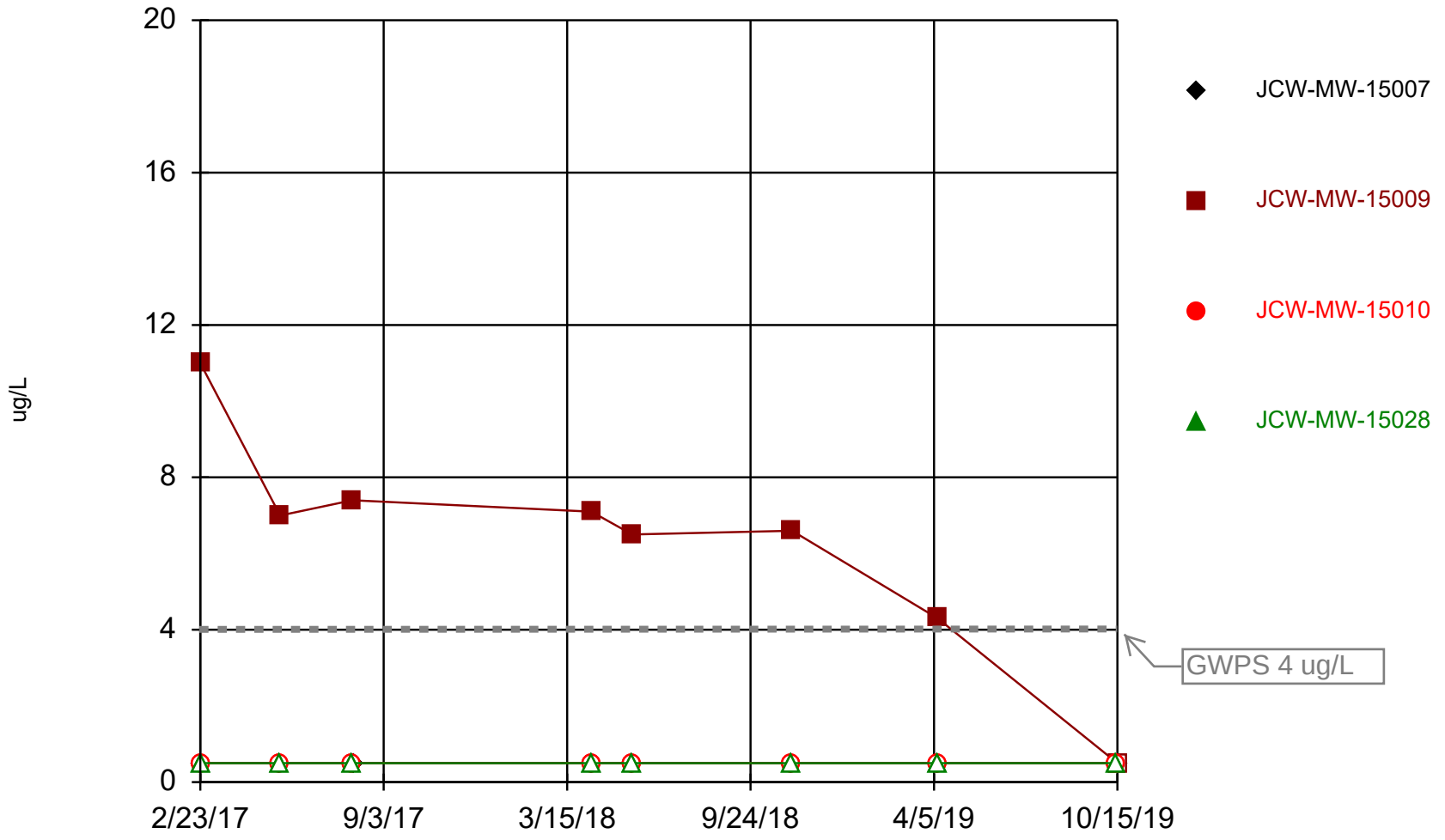
Trend not significant at 98% confidence level (α = 0.01 per tail).

Constituent: Arsenic, Total Analysis Run 11/21/2019 5:01 PM

Client: Consumers Energy Data: JCW_Sanitas_19.11.18

Hollow symbols indicate censored values.

Time Series



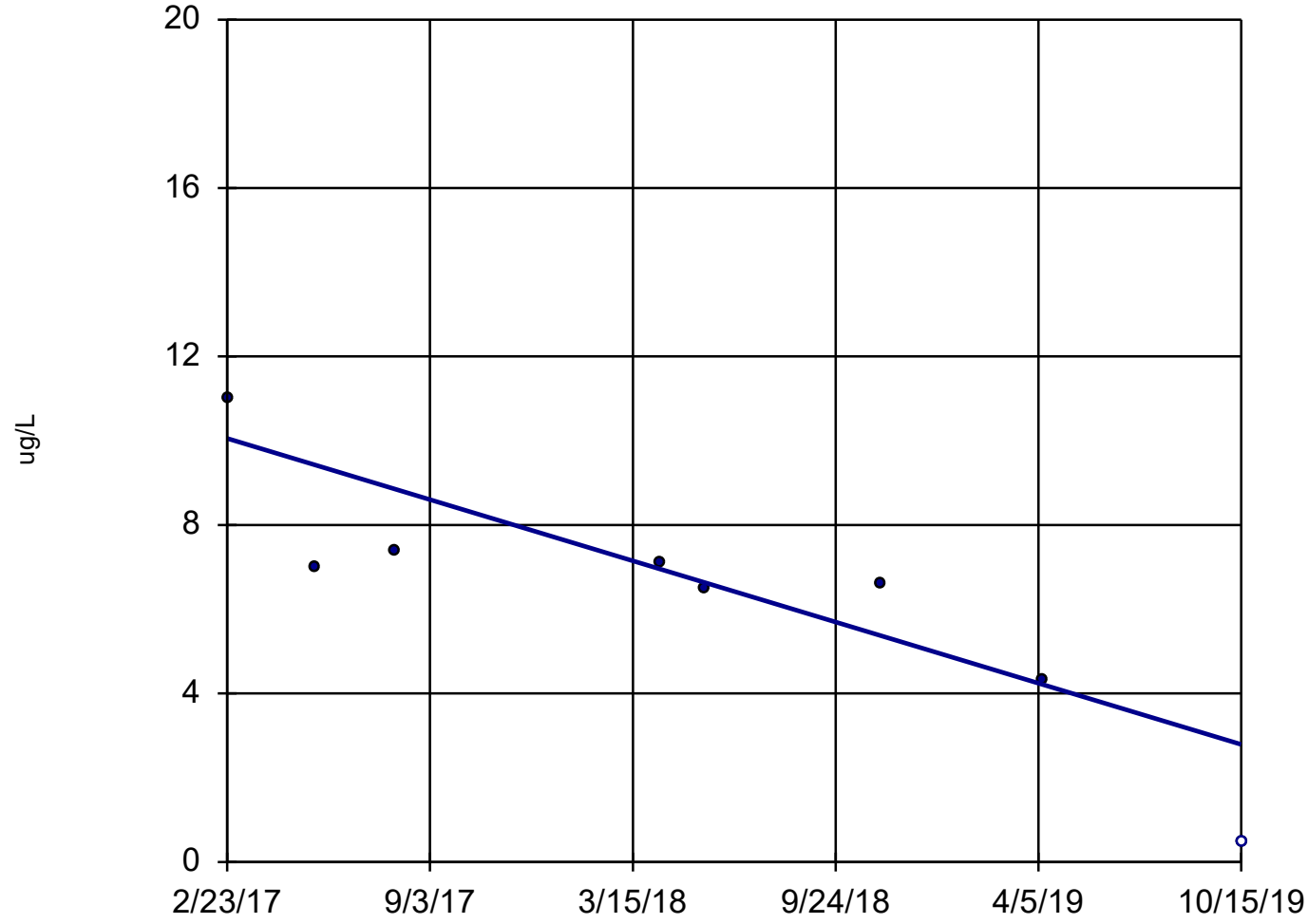
Constituent: Beryllium, Total Analysis Run 12/4/2019 10:00 AM

Client: Consumers Energy Data: JCW_Sanitas_19.11.18

Hollow symbols indicate censored values.

Sen's Slope Estimator

JCW-MW-15009



n = 8

Slope = -2.752 units per year.

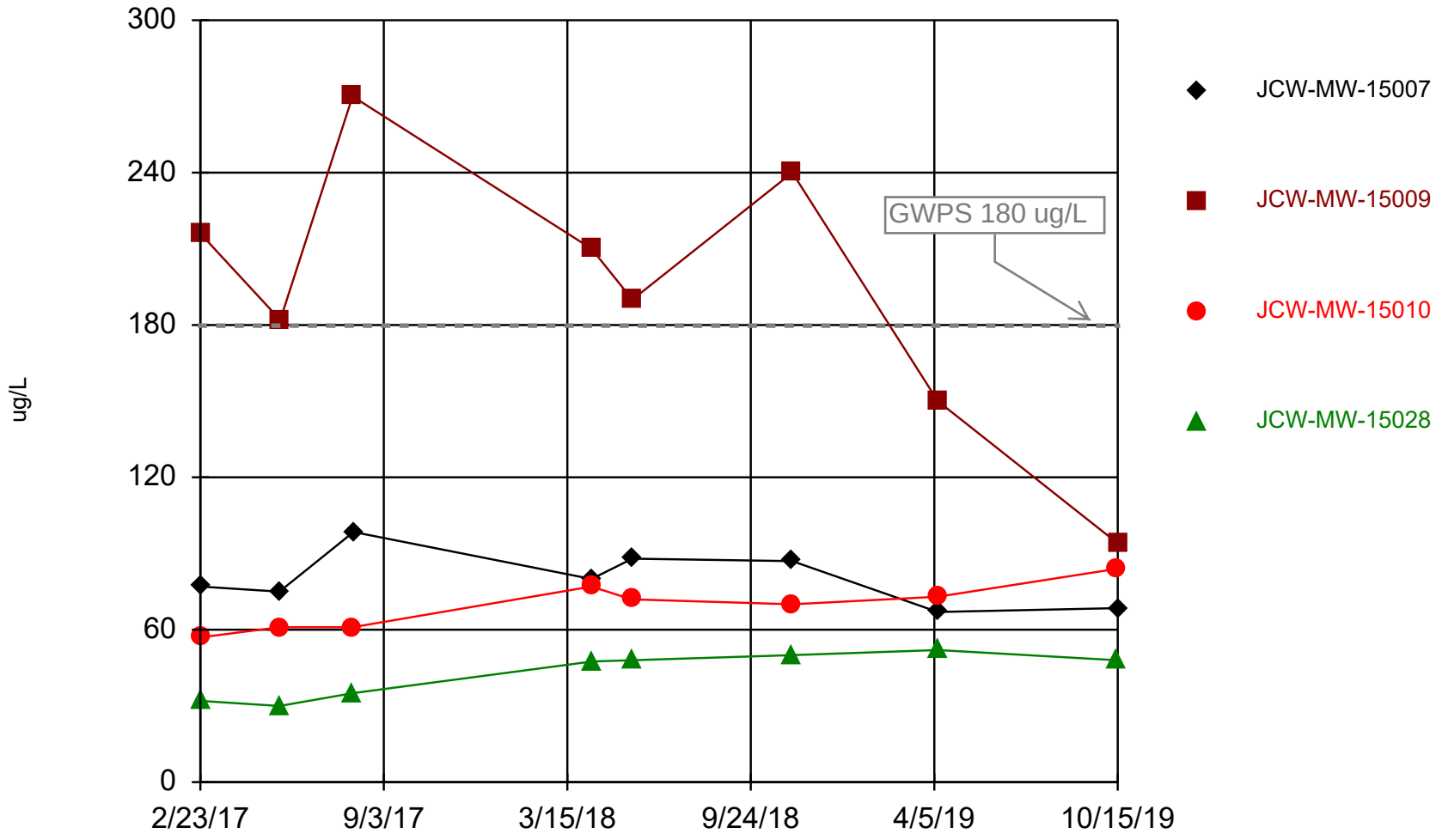
Mann-Kendall statistic = -22
critical = -20

Decreasing trend significant at 98% confidence level (α = 0.01 per tail).

Constituent: Beryllium, Total Analysis Run 11/21/2019 5:02 PM

Client: Consumers Energy Data: JCW_Sanitas_19.11.18

Time Series

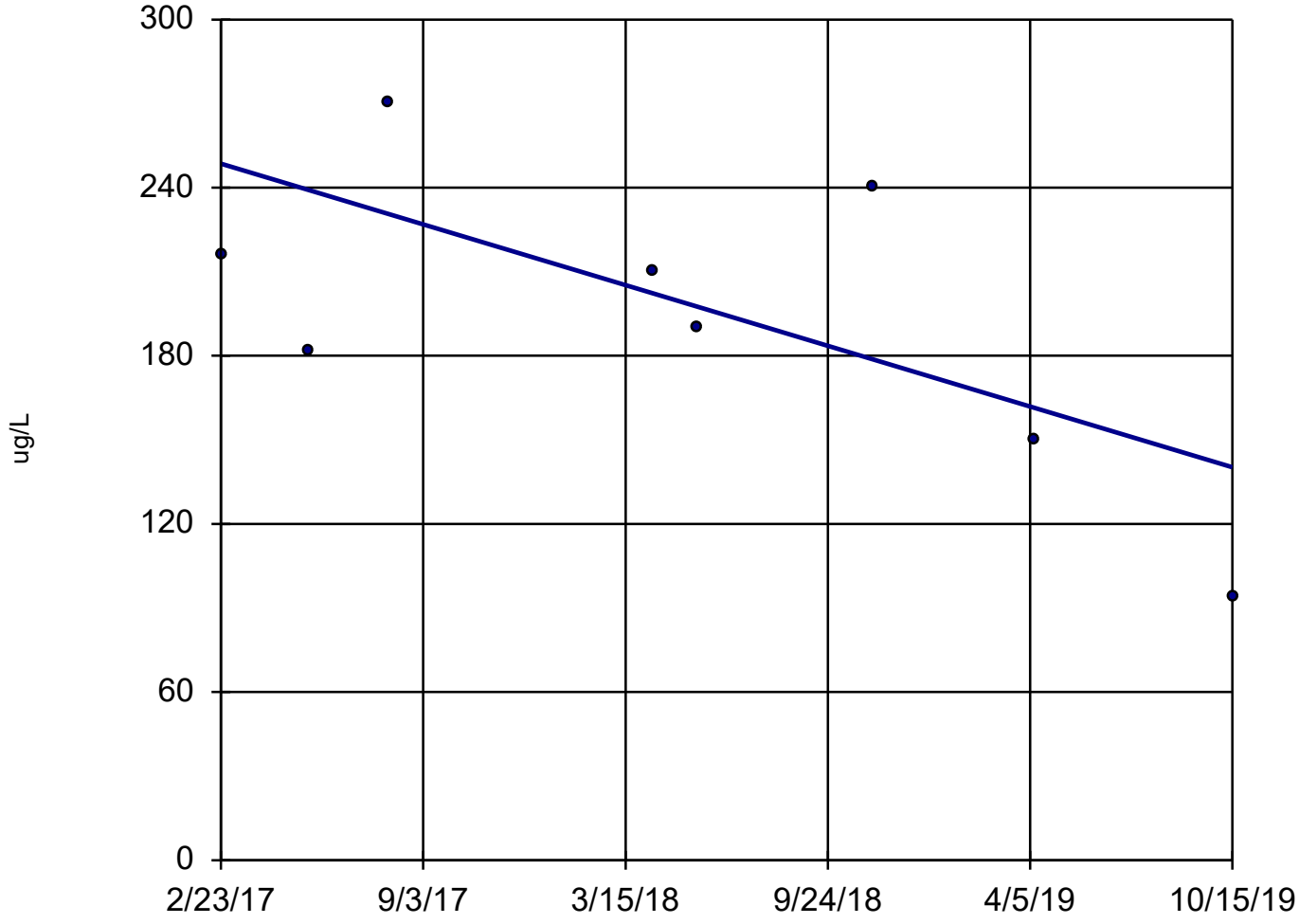


Constituent: Lithium, Total Analysis Run 12/4/2019 10:00 AM

Client: Consumers Energy Data: JCW_Sanitas_19.11.18

Sen's Slope Estimator

JCW-MW-15009



n = 8

Slope = -40.99 units per year.

Mann-Kendall statistic = -12
critical = -20

Trend not significant at 98% confidence level (α = 0.01 per tail).

Constituent: Lithium, Total Analysis Run 11/21/2019 5:02 PM

Client: Consumers Energy Data: JCW_Sanitas_19.11.18

Summary Report

Constituent: Arsenic, Total Analysis Run 11/21/2019 5:14 PM
Client: Consumers Energy Data: JCW_Sanitas_19.11.18

For observations made between 2/23/2017 and 10/15/2019, a summary of the selected data set:

Observations = 16
ND/Trace = 0
Wells = 2
Minimum Value = 9.5
Maximum Value = 46.3
Mean Value = 21.26
Median Value = 23
Standard Deviation = 9.809
Coefficient of Variation = 0.4614
Skewness = 0.9277

Well	#Obs.	ND/Trace	Min	Max	Mean	Median	Std.Dev.	CV	Skewness
JCW-MW-15007	8	0	9.8	46.3	25.84	25.2	10.98	0.4249	0.497
JCW-MW-15010	8	0	9.5	25	16.68	14.5	6.143	0.3683	0.2971

Summary Report

Constituent: Beryllium, Total Analysis Run 11/21/2019 5:14 PM
Client: Consumers Energy Data: JCW_Sanitas_19.11.18

For observations made between 2/23/2017 and 10/15/2019, a summary of the selected data set:

Observations = 8
ND/Trace = 1
Wells = 1
Minimum Value = 1
Maximum Value = 11
Mean Value = 6.363
Median Value = 6.8
Standard Deviation = 2.844
Coefficient of Variation = 0.447
Skewness = -0.408

Well	#Obs.	ND/Trace	Min	Max	Mean	Median	Std.Dev.	CV	Skewness
JCW-MW-15009	8	1	1	11	6.363	6.8	2.844	0.447	-0.408

Summary Report

Constituent: Lithium, Total Analysis Run 11/21/2019 5:14 PM
Client: Consumers Energy Data: JCW_Sanitas_19.11.18

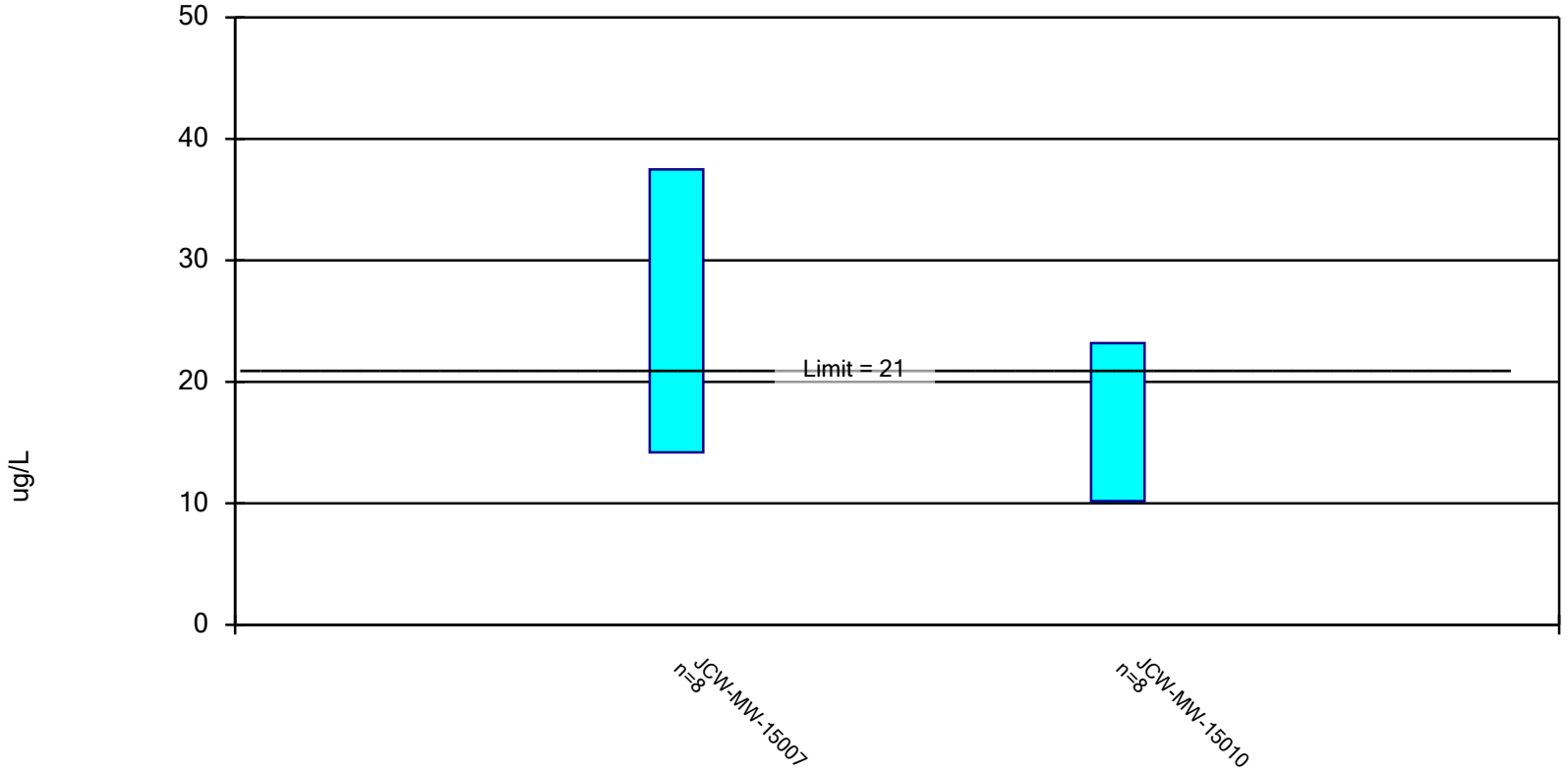
For observations made between 2/23/2017 and 10/15/2019, a summary of the selected data set:

Observations = 8
ND/Trace = 0
Wells = 1
Minimum Value = 94
Maximum Value = 270
Mean Value = 194
Median Value = 200
Standard Deviation = 54.42
Coefficient of Variation = 0.2805
Skewness = -0.5079

Well	#Obs.	ND/Trace	Min	Max	Mean	Median	Std.Dev.	CV	Skewness
JCW-MW-15009	8	0	94	270	194	200	54.42	0.2805	-0.5079

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Arsenic, Total Analysis Run 11/21/2019 5:10 PM

Client: Consumers Energy Data: JCW_Sanitas_19.11.18

Confidence Interval

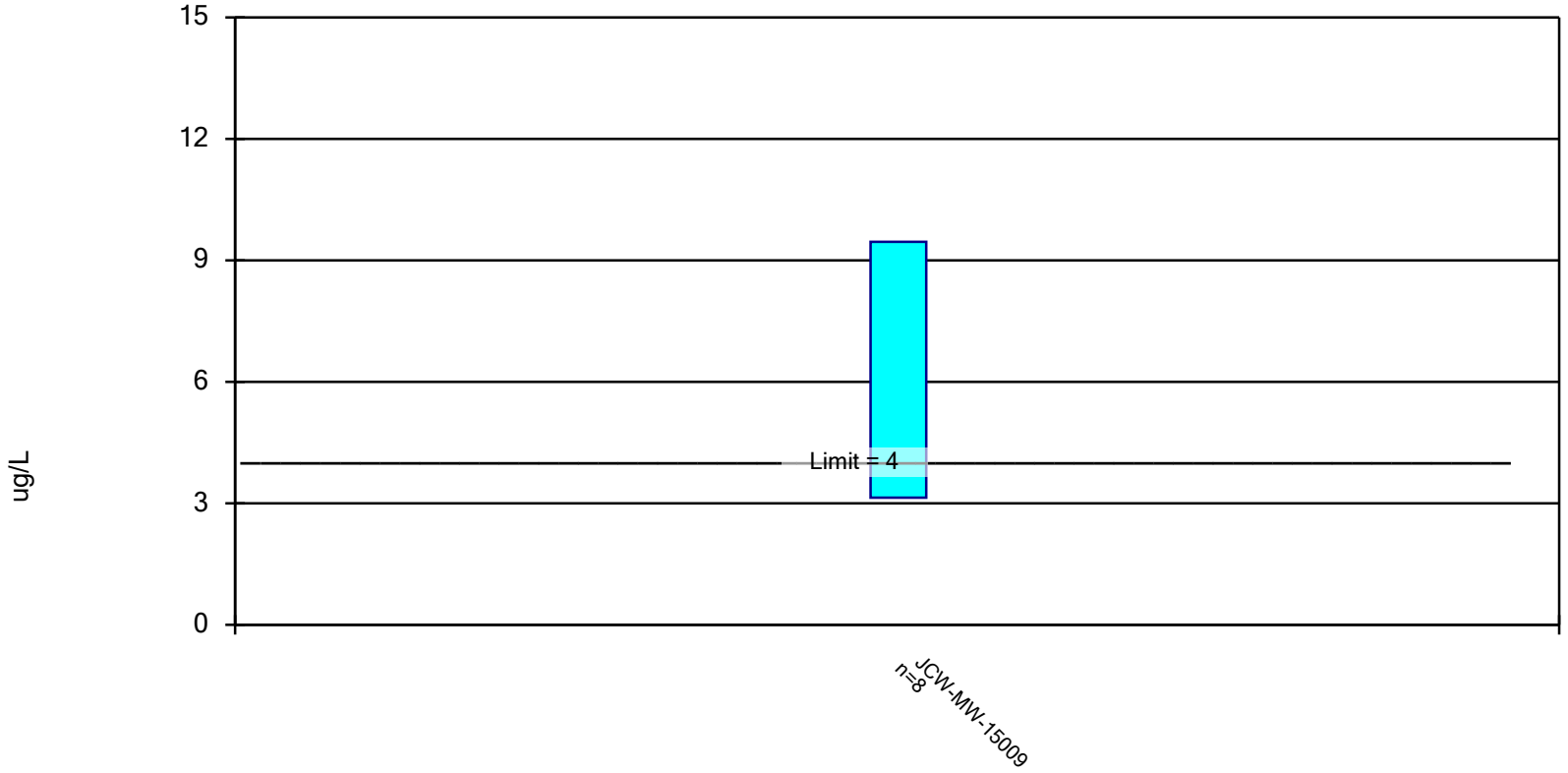
Constituent: Arsenic, Total (ug/L) Analysis Run 11/21/2019 5:10 PM

Client: Consumers Energy Data: JCW_Sanitas_19.11.18

	JCW-MW-15007	JCW-MW-15010
2/23/2017	26	25
5/17/2017	23	23
8/2/2017		23.2
8/3/2017	24.8 (D)	
4/10/2018	16.7	12.5
5/22/2018		11.25 (D)
5/23/2018	25.6	
11/7/2018	46.3	9.5
4/9/2019	9.8	16
10/14/2019		13
10/15/2019	34.5 (D)	
Mean	25.84	16.68
Std. Dev.	10.98	6.143
Upper Lim.	37.47	23.19
Lower Lim.	14.2	10.17

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Beryllium, Total Analysis Run 11/21/2019 5:11 PM

Client: Consumers Energy Data: JCW_Sanitas_19.11.18

Confidence Interval

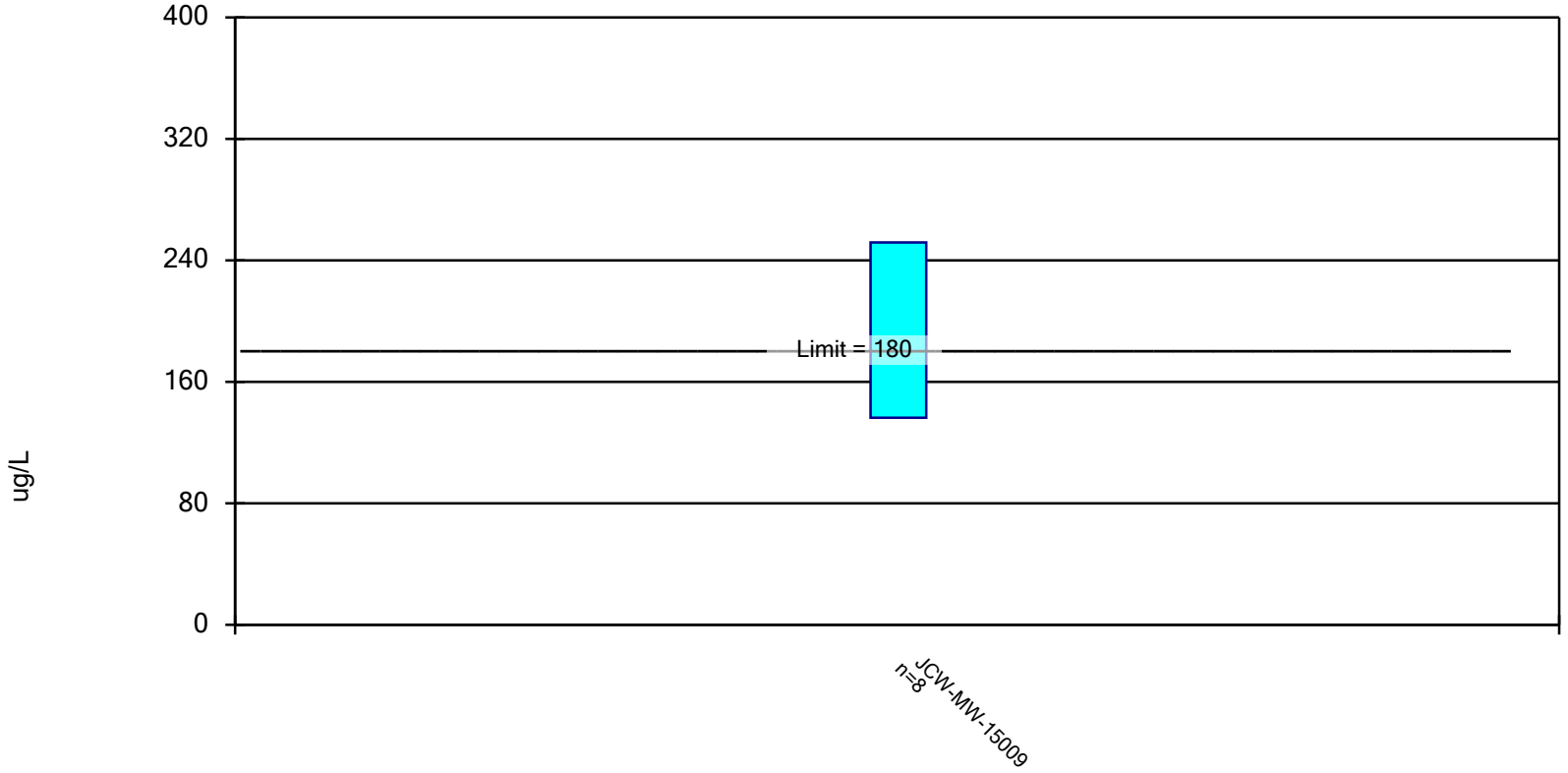
Constituent: Beryllium, Total (ug/L) Analysis Run 11/21/2019 5:11 PM

Client: Consumers Energy Data: JCW_Sanitas_19.11.18

	JCW-MW-15009
2/23/2017	11
5/18/2017	7
8/2/2017	7.4
4/10/2018	7.1
5/23/2018	6.5
11/7/2018	6.6
4/9/2019	4.3
10/15/2019	<1
Mean	6.3
Std. Dev.	2.981
Upper Lim.	9.46
Lower Lim.	3.14

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Lithium, Total Analysis Run 11/21/2019 5:12 PM

Client: Consumers Energy Data: JCW_Sanitas_19.11.18

Confidence Interval

Constituent: Lithium, Total (ug/L) Analysis Run 11/21/2019 5:12 PM

Client: Consumers Energy Data: JCW_Sanitas_19.11.18

	JCW-MW-15009
2/23/2017	216
5/18/2017	182
8/2/2017	270
4/10/2018	210
5/23/2018	190
11/7/2018	240
4/9/2019	150
10/15/2019	94
Mean	194
Std. Dev.	54.42
Upper Lim.	251.7
Lower Lim.	136.3

Appendix G
ACM Extension Certification

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

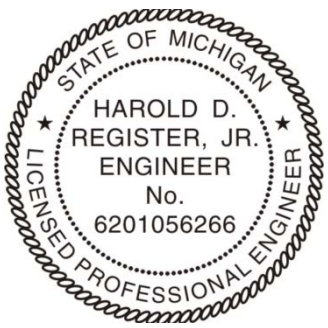
Professional Engineer Certification Statement [§257.96(a)]

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 Jr.

Signature



July 12, 2019

Date of Certification

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

Name

07/12/2019

6201056266

Professional Engineer Certification Number

Appendix H
Semi-Annual Progress Report

January 30, 2020

Ms. Lori Babcock
Michigan Department of Environment, Great Lakes, and Energy
Materials Management Division
Saginaw Bay District Office
401 Ketchum St, Suite B
Bay City, Michigan 48708

SUBJECT: **Initial Semiannual Progress Report – Selection of Final Remedy**
JC Weadock Bottom Ash Pond Coal Combustion Residuals (CCR) Unit

Dear Ms. Babcock,

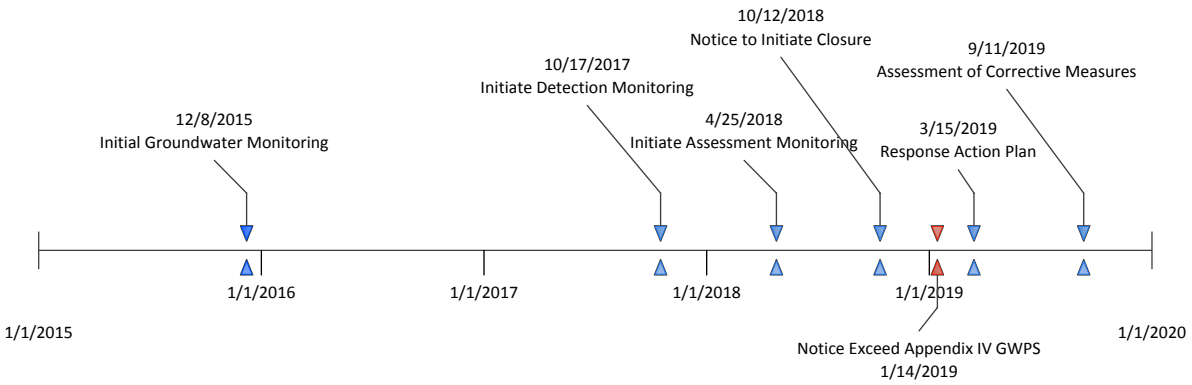
This Semiannual Progress Report, prepared as a requirement of §257.97(a) of the Federal Coal Combustion Residual (CCR Rule), describes progress towards selecting and implementing the final remedy for the Weadock Bottom Ash Pond. A progress report is required to be prepared semiannually upon completion of the Assessment of Corrective Measures (ACM) Report until the final remedy is selected. This progress report is the first developed following the completion of the Weadock Bottom Ash Pond ACM Report.

As presented in the key milestones timeline below, a groundwater monitoring system was installed for the bottom ash pond and background monitoring commenced in December 2015. Consumers Energy first reported the potential for statistically significant increases (SSIs) for Appendix IV constituents in the "*Notification of Appendix IV Constituent Exceeding Groundwater Protection Standard per §257.95(g)*" (TRC, January 2019). Subsequently, the Assessment of Corrective Measures Report (TRC, September 2019) was completed on September 11, 2019 as a step towards developing a final remedy.

Source Control Measures Undertaken

On October 17, 2016, in accordance with the schedule defined in §257.102 of the CCR Rule, Consumers Energy placed into the Operating Record an Initial Written Closure Plan for the Weadock Bottom Ash Pond that detailed a plan for closing the unit in place. This plan was revised on January 12, 2018 to reflect that the bottom ash pond would be closed by removing the CCR. The Weadock Bottom Ash Pond ceased plant operations on April 15, 2016 when the JC Weadock coal-fired units 7&8 ceased operations. Notification for Intent to Initiate Closure of the Weadock Bottom Ash Pond was posted on October 12, 2018 once agreement for the CCR removal criteria had been established with the Michigan Department of Environment, Great Lakes, and Energy (EGLE). Consumers Energy intends to commence active dewatering and excavation of CCR early in 2020 and expects that all removal and decontamination activities will be completed and documented in an excavation completion report that was submitted to EGLE by the end of 2020.

JC Weadock Bottom Ash Pond Timeline for Corrective Action



Results of 2019 Semi-Annual Sampling Events

Statistical analysis from semiannual groundwater monitoring events verified that the only constituents of concern that were present at statistically significant levels above the established Groundwater Protection Standard (GWPS) are beryllium and lithium. 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 once the source removal of the CCR has been completed. Beryllium and lithium concentrations at JCW-MW-15010 demonstrate a decreasing trend from last monitoring event, as discussed in the "*2019 Annual Groundwater Monitoring and Corrective Action Report*" (TRC, January 2020).

Progress Towards Remedy Selection

Consumers Energy first provided the EGLE a Response Action Plan prepared in accordance with Part 115 on March 15, 2019 after calculating a potential SSI for beryllium and lithium for the Weadock Bottom Ash Pond. This report documents identified potential sources of contamination, interim response activities taken to control possible sources of contamination, and a schedule for terminating receipt of waste and initiating closure of the bottom ash pond. This report was approved by EGLE on May 14, 2019.

The Response Action Plan explicitly committed to providing an assessment for potential remedial actions based on recommendations from the ACM Report submitted to EGLE on September 11, 2019. This report stated that the remedial strategy was to manage CCR source material by excavating CCRs consistent with the closure plan and then to manage residual contamination in groundwater.

The ACM Report indicated that groundwater management alternatives under consideration that could potentially address the residual beryllium and lithium under ***known*** groundwater conditions were identified as: 1) Source removal with post-remedy monitoring, 2) Source removal with groundwater capture/control, 3) Source removal with impermeable barrier, 4) Source removal with active geochemical sequestration, and 5) Source removal with passive

geochemical sequestration. These groundwater monitoring alternatives were considered to be technically feasible final groundwater management strategies when following a source removal activity.

Once the source removal activities are completed for the Weadock Bottom Ash Pond next year and the excavation has been restored and graded to minimize future infiltration, groundwater monitoring will be conducted to confirm groundwater improvements. Additional sampling events will be needed to monitor improvements as the groundwater conditions return to a new equilibrium based on site hydrogeology and groundwater and porewater chemistry. These subsequent sampling events will inform the on-going improvements and retention of monitoring-only, passive, or active remedial options following the source removal. The final remedy for the Weadock Bottom Ash Pond will be formally selected per §257.97 and Michigan Solid Waste requirements once the selected option is reviewed and commented on by EGLE and a public meeting is conducted at least 30-days prior to the final selection as required under §257.96(e).

The next semiannual progress report will be submitted in six months by July 30, 2020. Please feel free to contact me with any questions or clarifications.

Sincerely,

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

cc: Mr. Phil Roycraft, EGLE Saginaw Bay District Office
Mr. Gary Schwerin, EGLE Saginaw Bay District Office
Ms. Margie Ring, EGLE Lansing Office
Mr. Caleb Batts, Consumers Energy
Mr. John Puls, Golder Associates, Inc.
Ms. Darby Litz, TRC