



**2020 Annual Groundwater Monitoring and
Corrective Action Report**

JC Weadock Power Plant
Landfill CCR Unit

Essexville, Michigan

January 2020




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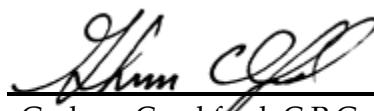
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Landfill CCR Unit**

Essexville, Michigan

January 2020

*Prepared For
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Executive Summary

TRC prepared this Annual Groundwater Monitoring and Corrective Action Report for the Weadock Landfill on behalf of Consumers Energy to cover the period of January 1, 2019 to December 31, 2019. The Weadock Landfill 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-15011, JCW-MW-15012, JCW-MW-15023; and
- Field pH at JCW-MW-15023 (high).

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 arsenic was present at statistically significant levels exceeding the Groundwater Protection Standards (GWPSs) established at 21 ug/L (TRC, 2019) at one downgradient well at the Weadock Landfill, located within the vent area of the slurry wall.

The notification of the GWPS exceedance 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., arsenic) 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 Landfill. 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 arsenic is the only Appendix IV constituent that has been observed at statistically significant levels above the GWPS.

When detection monitoring was initiated at the Weadock Landfill in October 2017, groundwater flow beneath the Weadock Landfill was directed towards the discharge channel through a 1,600 linear foot vent in the otherwise fully enclosing soil-bentonite slurry wall (slurry wall). This vent area represented the preferential flow of groundwater from the landfill, for monitoring under the existing NPDES discharge permit. Based on capturing this primary flow pathway, the downgradient groundwater monitoring well network for the Weadock Landfill was established as three monitoring wells located within the vent area to assess the quality of groundwater passing the waste boundary (JCW MW-15011, JCW-MW-15012, and JCW-MW-15023). The four background and three downgradient monitoring wells served as the certified groundwater monitoring system sampled during the time period of establishing background conditions, detection monitoring, and the preliminary assessment monitoring that occurred in April 2018 and the subsequent semi-annual assessment monitoring event in May 2018.

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. In June 2018, the slurry wall vent was closed by completing construction of the soil-bentonite slurry wall that extended the existing slurry wall alignment to fully enclose the landfill perimeter. This construction was completed in anticipation of starting closure of portions of the Weadock Landfill. Completing the construction of the slurry wall also serves to reduce porewater flux around the entire perimeter of the Weadock Landfill.

The Weadock Landfill will be closed in place in accordance with the *Closure Plan for the Consumers Weadock Complex J.C. Weadock Solid Waste Disposal Area* (Geosyntec, October 2016). The protective cover, along with evidence showing a lack of vertical gradients in the groundwater monitoring system, will serve to minimize or eliminate the post-closure infiltration of liquid into the CCR. The slurry wall was designed, constructed, and verified to meet lower permeability standards at the Weadock Landfill and is expected to effectively prevent lateral migration of constituents.

Currently, as shown by the April and October 2019 data evaluations, there are no Appendix IV constituents present at statistically significant levels above the GWPS. Arsenic in MW-51 and MW-55 and molybdenum in MW-55 had individual results exceeding the GWPS. The concentrations of arsenic and molybdenum at MW-55 are not a result of a release from the unit, as detailed in the Alternate Source Demonstration (ASD) (Appendix G); therefore, confidence intervals were not calculated. Note that the statistical analysis for new wells constructed after the slurry wall vent construction was completed (JCW-MW-18001, JCW-MW-18004, JCW-MW-

18005, and JCW-MW-18006; and OW-57R Out) will commence once sufficient data has been collected (a minimum of four independent sampling events; one more event in 2020 is needed). As discussed in Section 2.3.3, water level elevations also indicate that the slurry wall is performing as designed.

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 Landfill 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. Consumers Energy will continue executing the self-implementing groundwater compliance schedule in conformance with §257.90 - §257.98. Consumers Energy will be submitting an application for renewing the operating license for the JC Weadock to the Michigan Department of Environment, Great Lakes, and Energy (EGLE) which will include a Hydrogeological Monitoring Plan (HMP) that will conform with both the federal CCR rules §257.90 - §257.94 and the state standards in PA 640¹. The next semiannual monitoring event is tentatively scheduled for the second calendar quarter of 2020.

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 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 Landfill CCR unit (Weadock Landfill). 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 has prepared this Annual Groundwater Monitoring Report for calendar year 2019 activities at the Weadock Landfill 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 Landfill 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-15011, JCW-MW-15012, JCW-MW-15023; and
- Field pH at JCW-MW-15023 (high).

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 arsenic was present at statistically significant levels exceeding the Groundwater Protection

Standards (GWPSs) established at 21 ug/L (TRC, 2019) at one downgradient well at the Weadock Landfill.

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.*, arsenic) 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 Landfill. Evaluation of groundwater under the CCR Rule focused on the following constituents that were collected *unfiltered* in the field:

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

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

Additional Monitoring Constituents (Michigan Part 115/PA 640 ²)	
Detection Monitoring	Assessment Monitoring
Iron	Copper Nickel Silver Vanadium Zinc

The Weadock Landfill 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) Rev. 1* (TRC, December 2018) and statistically evaluated per the *Groundwater Statistical Evaluation Plan Rev 1. (Stats Plan)* (TRC, December 2018).

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 site from the DE Karn Power Plant 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 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 115³ 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* (HMP) (June 5, 2015). This report focuses on the Weadock Landfill.

An additional unit subject to the CCR rule is 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.

1.3 Geology/Hydrogeology

The majority of Weadock Landfill 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 depth ranging from 25-75 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 feet below ground surface (ft bgs). The sand is variable in thickness, ranging from <1 to ~6.5 feet, and is discontinuous along the landfill 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 Landfill is bounded by several surface water features (Figure 1): the Saginaw River to the west, a discharge channel and Saginaw Bay (Lake Huron) to the north, Underwood Drain to the east, and Tacey Drain to the south. Groundwater flow in the upper aquifer is largely controlled by the surface water elevations of Saginaw River and Saginaw Bay. 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

When the groundwater monitoring system was first established in October 2017, there was a 1,600-linear-foot section of the perimeter embankment dike that did not have a slurry wall in place. Groundwater flow beneath the Weadock landfill was directed towards the discharge channel through this vent in the slurry wall for management under the existing NPDES discharge permit. The downgradient monitoring well network was established as three monitoring wells located in the vent area to assess the quality of groundwater passing the waste boundary (JCW-MW-15011, JCW-MW-15012, and JCW-MW-15023). Four monitoring wells located south of the Weadock landfill provide data on background groundwater quality that has not been affected by the CCR unit (MW-15002, MW-15008, MW-15016, and MW-15019). The seven groundwater monitoring wells formed the basis of the certified groundwater monitoring system and sampled during the preliminary assessment monitoring that occurred in April 2018 as well as the subsequent semi-annual assessment monitoring event in May 2018.

In June 2018, the slurry wall vent was effectively closed by extending the construction of the slurry wall around the entire perimeter of the Weadock landfill. The three existing downgradient CCR compliance wells were decommissioned by overdrilling, removing the well material, and sealing the borehole in order to allow for the slurry wall construction as discussed in the 2018 Annual Report.

Given the change in groundwater flow conditions, a revised groundwater monitoring system has been established to assess slurry wall integrity and determine if there have been any releases from the Weadock Landfill. The monitoring well network has been designed to provide appropriate coverage for water level and water quality data collection along the perimeter of the landfill. Consumers Energy installed an additional nine monitoring wells in August 2018 to supplement the preexisting groundwater well network currently used under the approved 2015 HMP for Michigan Part 115 compliance to provide appropriate coverage for the collection of groundwater levels and water quality data along the perimeter of the Weadock landfill.

Therefore, the modified CCR monitoring well network now consists of the four (4) background as discussed above, and eleven (11) downgradient monitoring wells as discussed in the *Sample and Analysis Plan* (2018 SAP) (TRC, 2018) and *Statistical Analysis Plan* (2018 Stats Plan) (TRC, 2018b). The downgradient monitoring wells include:

JCW-MW-18001	JCW-MW-18004	JCW-MW-18005	JCW-MW-18006
MW-50	MW-51	MW-52	MW-53
MW-54R	MW-55	OW-57R Out	

These monitoring well locations are shown on Figure 2. 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 through April 12, 2019. TRC personnel collected samples and recorded field measurements and water elevations. Samples were submitted to Test America in accordance with the 2018 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 eleven 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 7 through October 15, 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 three downgradient monitoring wells for all Appendix III and Appendix IV constituents and field parameters. A summary of the groundwater data collected during the October 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 interpretation 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. The static water level elevations inside of the Weadock Landfill slurry wall are typically different (>1 ft) than static water levels outside of the slurry wall, which demonstrates the presence of a low permeability feature between the well pairings inside and outside of the constructed slurry wall. Groundwater elevations measured during the April and October 2019 sampling event are provided on Table 1 and were used to construct groundwater contour maps (Figures 3 and 4).

The monitoring well network is structured such that there are eleven (11) monitoring well pairs used to evaluate the hydraulic gradient and potential for water flux across the slurry wall. Data collected in March/April 2019 and October 2019 indicate that, although hydraulic gradients between wells inside the slurry wall and outside the slurry wall

indicate a potential for outward flow, the static water level elevations inside of the slurry wall are typically different (>1 ft) than static water levels outside of the slurry wall, which demonstrates the presence of a low permeability feature between the well pairs. As such, water level elevations indicate that the slurry wall is performing as designed. The general flow direction observed within the confines of the slurry wall is similar to that identified in previous monitoring rounds since the completion of the slurry wall.

Section 3

Statistical Evaluation

Assessment monitoring is continuing at the Weadock Landfill 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 2017 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 in Appendix C 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)*, arsenic was present at statistically significant levels exceeding the GWPS in one of the three downgradient wells in the original groundwater monitoring system at the Weadock Landfill.

Currently, as shown by the April and October 2019 data evaluations (Appendices E & F), there are no Appendix IV constituents present at statistically significant levels above the GWPS based on the revised groundwater monitoring system discussed in Section 2.1. Arsenic in MW-51 and MW-55 and molybdenum in MW-55 had individual results exceeding the GWPS. The concentrations of arsenic and molybdenum at MW-55 are not a result of a release from the unit, as detailed in the Alternate Source Demonstration (ASD) (Appendix G); therefore, confidence intervals were not calculated. Note that the statistical analysis for new wells (JCW-MW-18001, JCW-MW-18004, JCW-MW-18005, and JCW-MW-18006; and OW-57R Out) will commence once sufficient data has been collected (a minimum of four independent sampling events; one more event is needed). A summary of the April 2019 confidence intervals is provided in Table 6 and a summary of the October 2019 confidence intervals is provided in Table 7. Furthermore, as discussed in Section 2.3.3, water level elevations indicate that the slurry wall is performing as designed.

Section 4

Corrective Action

Consumers Energy provided notification that arsenic was present at statistically significant levels exceeding the Groundwater Protection Standards (GWPSs) established at 21 ug/L (TRC, 2019) at one downgradient well at the Weadock Landfill, located within the vent area of the slurry wall.

The notification of the GWPS exceedance on January 14, 2019 was followed up with a Response Action Plan submitted to the 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 Landfill at statistically significant levels above the GWPSs (*i.e.*, arsenic), 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 monitoring wells. Nature and extent data are included in Appendix C. Although arsenic exceeded the GWPS in on-site groundwater monitoring locations, arsenic is 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 Landfill. The property is owned and operated by Consumers Energy and groundwater is not used for drinking water. There are no on-site drinking water wells, so the drinking water pathway is not complete. 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 H 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. It is noteworthy to recall that construction of a barrier (soil-bentonite slurry wall) has already been completed and is being monitored for effectiveness in meeting remedial objectives prior to the closure of the landfill. Observed improvements in groundwater quality will inform the basis for the need of any additional remedies that may be selected in addition to the slurry wall and final cover construction. The following corrective measures were retained for further evaluation:

- Closure in place with post-closure monitoring
- Closure in place with groundwater capture/control
- Closure in place with active geochemical sequestration
- Closure in place with passive geochemical sequestration

Consumers Energy plans to utilize an adaptive management strategy for selecting the final groundwater remedy for the Weadock Landfill 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 I to this report. In June 2018, the slurry wall vent was closed by completing construction of the soil-bentonite slurry wall that extended the existing slurry wall alignment to fully enclose the landfill perimeter. This construction was completed in anticipation of starting closure of portions of the Weadock Landfill. Completing the construction of the slurry wall also serves to reduce porewater flux around the entire perimeter of the Weadock Landfill.

The Weadock Landfill will be closed in place in accordance with the *Closure Plan for the Consumers Weadock Complex J.C. Weadock Solid Waste Disposal Area* (Geosyntec, October 2016). The protective cover, along with evidence showing a lack of vertical gradients in the groundwater monitoring system, will serve to minimize or eliminate the post-closure infiltration of liquid into the CCR. The slurry wall was designed, constructed, and verified to meet lower permeability standards at the Weadock Landfill and is expected to effectively prevent lateral migration of constituents. Currently, as shown by the April and October 2019

data evaluations, there are no Appendix IV constituents present at statistically significant levels above the GWPS.

Section 5

Conclusions and Recommendations

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

The ACM Report provided a high-level assessment of groundwater remediation technologies that could potentially address site-specific COCs (i.e., arsenic) under known groundwater conditions. Groundwater chemistry already appears to be improving as a result of closing the vent in the Weadock Landfill perimeter slurry wall. Currently, as shown by the April and October 2019 data evaluations, there are no Appendix IV constituents present at statistically significant levels above the GWPS. Note that the statistical analysis for new wells constructed after the slurry wall vent construction was completed (JCW-MW-18001, JCW-MW-18004, JCW-MW-18005, and JCW-MW-18006; and OW-57R Out) will commence once sufficient data has been collected (a minimum of four independent sampling events; one more event in 2020 is needed). As discussed in Section 2.3.3, water level elevations also indicate that the slurry wall is performing as designed.

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 Landfill 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. Consumers Energy will continue executing the self-implementing groundwater compliance schedule in conformance with §257.90 - §257.98. Consumers Energy will be submitting an application for renewing the operating license for the JC Weadock Landfill to the EGLE which will include a HMP that will conform with both the federal CCR rules §257.90 - §257.94 and the state standards in PA 640⁴. The next semiannual monitoring event is tentatively scheduled for the second calendar quarter of 2020.

^{4 4} 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.

Section 6

References

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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
DEK Bottom Ash Pond									
DEK-MW-15002	590.87	Sand	578.3 to 575.3	6.00	584.87	6.02	584.85	6.25	584.62
DEK-MW-15004	611.04	Sand	576.6 to 571.6	26.80	584.24	27.53	583.51	29.14	581.90
DEK-MW-15005	589.72	Sand	572.3 to 567.3	9.12	580.60	9.25	580.47	7.63	582.09
DEK-MW-15006	589.24	Sand	573.0 to 568.0	8.63	580.61	8.69	580.55	7.15	582.09
DEK Bottom Ash Pond & Karn Lined Impoundment									
DEK-MW-15003	602.74	Sand	578.8 to 574.8	16.58	586.16	16.23	586.51	16.72	586.02
DEK-MW-18001	593.47	Sand	579.2 to 574.2	8.02	585.45	8.20	585.27	8.16	585.31
OW-10	591.58	Silty Sand and Silty Clay	576.0 to 571.0	6.42	585.16	6.06	585.52	6.25	585.33
OW-11	607.90	Silt/Fly Ash	587.5 to 582.5	21.50	586.40	21.05	586.85	21.70	586.20
OW-12	603.07	Silty Sand	584.2 to 579.2	17.00	586.07	16.75	586.32	17.17	585.90
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

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 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)
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 Landfill – 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 Landfill							
JCW-MW-18001	4/12/2019	0.53	-35.3	7.2	1,079	10.2	11.6
	10/10/2019	0.27	-26.9	7.0	1,374	14.0	1.3
JCW-MW-18004	4/11/2019	6.28	240.5	6.6	1,437	4.6	36.0
	10/15/2019	2.37	121.0	6.6	2,211	15.9	4.9
JCW-MW-18005	4/11/2019	0.20	30.8	6.6	1,473	6.0	14.6
	10/11/2019	0.27	-3.0	6.7	1,813	13.1	7.8
JCW-MW-18006	4/11/2019	0.13	48.7	6.9	1,500	9.7	7.0
	10/14/2019	0.24	-11.2	6.8	1,558	10.9	1.8

Notes:

mg/L - Milligrams per Liter.

mV - Millivolts.

SU - Standard units.

umhos/cm - Micromhos per centimeter.

°C - Degrees Celcius

NTU - Nephelometric Turbidity Unit.

Table 2
 Summary of Field Parameter Results – April 2019 to October 2019
 JC Weadock Landfill – 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)
JC Weadock Landfill							
MW-50	4/9/2019	0.15	39.4	7.3	1,410	9.6	0.5
	10/10/2019	0.21	-14.9	7.1	1,980	16.0	1.2
MW-51	4/9/2019	0.18	7.1	7.0	1,692	7.9	1.1
	10/10/2019	0.22	-1.6	6.7	2,018	14.6	1.0
MW-52	4/9/2019	0.25	21.8	7.1	1,569	7.9	1.3
	10/10/2019	0.24	-19.8	6.9	1,791	14.3	1.3
MW-53	4/10/2019	0.29	1.5	7.1	1,184	6.0	2.3
	10/10/2019	0.30	17.3	6.7	2,650	16.0	1.3
MW-53R	4/10/2019	0.11	21.2	6.9	1,152	6.5	3.9
	10/10/2019	0.25	-1.9	6.8	1,634	15.7	4.7
MW-54R	4/11/2019	1.50	59.8	6.9	790	4.6	1.8
	10/10/2019	0.20	14.0	6.9	1,131	15.9	2.1

Notes:

mg/L - Milligrams per Liter.

mV - Millivolts.

SU - Standard units.

umhos/cm - Micromhos per centimeter.

°C - Degrees Celcius

NTU - Nephelometric Turbidity Unit.

Table 2
 Summary of Field Parameter Results – April 2019 to October 2019
 JC Weadock Landfill – 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)
JC Weadock Landfill							
MW-55	4/11/2019	10.17	-24.5	7.1	902	5.9	1.9
	10/11/2019	0.25	-65.2	6.9	1,517	15.9	3.0
OW-57OUT	4/12/2019	1.84	99.3	7.0	1,096	6.7	2.6
	10/11/2019	0.57	32.8	6.9	1,219	15.1	1.9
OW-57ROUT	4/12/2019	1.91	99.1	7.1	1,233	7.5	2.6
	10/14/2019	0.33	53.9	6.8	1,253	13.7	2.0

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 Landfill – RCRA CCR Monitoring Program
 Essexville, Michigan

		Sample Location:				JCW-MW-18001		JCW-MW-18004		JCW-MW-18005		JCW-MW-18006		MW-50	
		Sample Date:				4/12/2019	10/10/2019	4/11/2019	10/15/2019	4/11/2019	10/11/2019	4/11/2019	10/14/2019	4/9/2019	10/10/2019
Constituent	Unit	EPA MCL	MI Residential*	MI Non-Residential*	MI GSI [^]	downgradient									
Appendix III															
Boron	ug/L	NC	500	500	4,000	1,400	1,500	320	430	1,300	1,700	2,900	2,800	1,600	1,700
Calcium	mg/L	NC	NC	NC	500	140	170	470	270	340	270	190	170	200	280
Chloride	mg/L	250**	250	250	50	67	58	34	39	59	82	97	97	62	80
Fluoride	ug/L	4,000	NC	NC	NC	< 1,000	< 2,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Sulfate	mg/L	250**	250	250	500	210	170	840	930	680	470	120	100	370	660
Total Dissolved Solids	mg/L	500**	500	500	500	860	870	1,900	1,800	1,700	1,300	990	910	1,200	1,400
pH, Field	SU	6.5 - 8.5**	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	7.2	7.0	6.6	6.6	6.6	6.7	6.9	6.8	7.3	7.1
Appendix IV															
Antimony	ug/L	6	6.0	6.0	2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	10	10	10	10	2.3	2.5	4.4	< 1.0	5.3	11	37	32	1.1	2.8
Barium	ug/L	2,000	2,000	2,000	1,200	200	220	80	43	180	180	420	480	220	180
Beryllium	ug/L	4	4.0	4.0	33	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 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	< 0.40	< 0.20	< 0.20	< 0.20
Chromium	ug/L	100	100	100	11	< 1.0	< 1.0	19	< 1.0	2.0	12	< 2.0	< 1.0	< 1.0	1.4
Cobalt	ug/L	NC	40	100	100	< 6.0	< 6.0	< 6.0	< 6.0	< 6.0	< 6.0	< 12	< 6.0	< 6.0	< 6.0
Fluoride	ug/L	4,000	NC	NC	NC	< 1,000	< 2,000	< 1,000	< 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	5.6	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	< 1.0	< 1.0
Lithium	ug/L	NC	170	350	440	43	53	38	37	49	50	67	72	69	79
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	< 0.20	< 0.20
Molybdenum	ug/L	NC	73	210	120	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 10	< 5.0	< 5.0	6.6
Radium-226	pCi/L	NC	NC	NC	NC	0.300	0.434	< 0.310	< 0.135	0.369	0.397	0.294	0.454	0.347	0.572
Radium-228	pCi/L	NC	NC	NC	NC	< 0.449	< 0.715	< 1.47	< 0.495	< 0.704	< 0.635	< 0.510	0.500	0.828	1.49
Radium-226/228	pCi/L	5	NC	NC	NC	0.590	1.07	< 1.47	< 0.495	< 0.704	0.698	0.709	0.954	1.17	2.06
Selenium	ug/L	50	50	50	5.0	< 1.0	< 1.0	1.5	< 1.0	< 1.0	< 1.0	< 2.0	< 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	< 4.0	< 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 Landfill – RCRA CCR Monitoring Program
 Essexville, Michigan

Sample Location: Sample Date:						MW-51		MW-52		MW-53		MW-53R		MW-54R	
						4/9/2019	10/10/2019	4/9/2019	10/10/2019	4/10/2019	10/10/2019	4/10/2019	10/10/2019	4/11/2019	10/10/2019
Constituent	Unit	EPA MCL	MI Residential*	MI Non-Residential*	MI GSI [^]	downgradient									
Appendix III															
Boron	ug/L	NC	500	500	4,000	940	890	1,200	1,200	1,500	900	1,500	1,800	960	1,500
Calcium	mg/L	NC	NC	NC	500	310	340	210	220	200	420	220	250	180	180
Chloride	mg/L	250**	250	250	50	84	88	95	89	39	150	35	46	16	18
Fluoride	ug/L	4,000	NC	NC	NC	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Sulfate	mg/L	250**	250	250	500	500	570	480	520	330	960	180	240	160	130
Total Dissolved Solids	mg/L	500**	500	500	500	1,500	1,500	1,400	1,200	1,200	2,100	1,000	1,100	770	710
pH, Field	SU	6.5 - 8.5**	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	7.0	6.7	7.1	6.9	7.1	6.7	6.9	6.8	6.9	6.9
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	< 1.0	< 1.0
Arsenic	ug/L	10	10	10	10	17	20	< 1.0	< 1.0	< 1.0	2.9	20	32	1.6	2.3
Barium	ug/L	2,000	2,000	2,000	1,200	190	180	140	120	120	77	260	240	74	88
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	< 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	< 0.20	< 0.20
Chromium	ug/L	100	100	100	11	1.0	< 1.0	< 1.0	< 1.0	1.6	< 1.0	1.3	1.7	< 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	< 6.0	< 6.0
Fluoride	ug/L	4,000	NC	NC	NC	< 1,000	< 1,000	< 1,000	< 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	< 1.0	< 1.0
Lithium	ug/L	NC	170	350	440	59	49	39	30	53	45	58	61	48	53
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	< 0.20	< 0.20
Molybdenum	ug/L	NC	73	210	120	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	6.2
Radium-226	pCi/L	NC	NC	NC	NC	0.216	0.316	0.211	0.252	0.161	0.263	0.291	0.552	< 0.332	0.328
Radium-228	pCi/L	NC	NC	NC	NC	0.643	1.68	1.14	< 0.772	0.500	< 0.750	1.07	< 0.700	< 0.480	< 0.828
Radium-226/228	pCi/L	5	NC	NC	NC	0.859	1.99	1.35	1.01	0.661	0.962	1.36	1.02	0.568	0.860
Selenium	ug/L	50	50	50	5.0	< 1.0	< 1.0	< 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	< 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 Landfill – RCRA CCR Monitoring Program
 Essexville, Michigan

Sample Location:						MW-55		OW-57OUT		OW-57ROUT	
Sample Date:						4/11/2019	10/11/2019	4/12/2019	10/11/2019	4/12/2019	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	800	700	1,700	2,000	1,700	1,700
Calcium	mg/L	NC	NC	NC	500	140	190	140	150	130	130
Chloride	mg/L	250**	250	250	50	26	19	46	54	68	58
Fluoride	ug/L	4,000	NC	NC	NC	< 1,000	< 1,000	1,100	1,200	1,200	1,100
Sulfate	mg/L	250**	250	250	500	70	190	68	77	110	110
Total Dissolved Solids	mg/L	500**	500	500	500	770	950	720	710	780	750
pH, Field	SU	6.5 - 8.5**	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	7.1	6.9	7.0	6.9	7.1	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
Arsenic	ug/L	10	10	10	10	34	76	< 1.0	1.1	< 1.0	1.7
Barium	ug/L	2,000	2,000	2,000	1,200	200	250	87	99	72	73
Beryllium	ug/L	4	4.0	4.0	33	< 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
Chromium	ug/L	100	100	100	11	< 1.0	< 1.0	1.4	1.1	< 1.0	5.4
Cobalt	ug/L	NC	40	100	100	< 6.0	< 6.0	< 6.0	< 6.0	< 6.0	< 6.0
Fluoride	ug/L	4,000	NC	NC	NC	< 1,000	< 1,000	1,100	1,200	1,200	1,100
Lead	ug/L	NC	4.0	4.0	14	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lithium	ug/L	NC	170	350	440	17	27	21	19	23	25
Mercury	ug/L	2	2.0	2.0	0.20#	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	NC	73	210	120	93	190	6.5	7.0	7.9	7.4
Radium-226	pCi/L	NC	NC	NC	NC	0.188	0.409	< 0.182	0.307	0.181	0.195
Radium-228	pCi/L	NC	NC	NC	NC	< 0.660	1.05	< 0.496	< 0.815	< 0.501	< 0.373
Radium-226/228	pCi/L	5	NC	NC	NC	< 0.660	1.45	< 0.496	< 0.815	< 0.501	< 0.373
Selenium	ug/L	50	50	50	5.0	< 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

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 Landfill – RCRA CCR Monitoring Program
 Essexville, Michigan

Constituent	Unit	EPA MCL	MI Residential*	MI Residential Aesthetic**	MI Non-Residential*	MI Non-Residential Aesthetic**	MI GSI [^]	Sample Location:									
								JCW-MW-18001		JCW-MW-18004		JCW-MW-18005		JCW-MW-18006		MW-50	
Sample Date:								4/12/2019	10/10/2019	4/11/2019	10/15/2019	4/11/2019	10/11/2019	4/11/2019	10/14/2019	4/9/2019	10/10/2019
								downgradient									
Copper	ug/L	1,000***	1,400	1,000	4,000	1,000	20	< 1.0	< 1.0	11	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	< 1.0	< 1.0
Iron	ug/L	300***	2,000	300	5,600	300	500,000	450	130	11,000	180	9,400	14,000	12,000	9,900	590	1,800
Nickel	ug/L	NC	100	NA	100	NA	120	< 2.0	< 2.0	12	< 2.0	7.8	12	5.0	4.7	2.7	2.1
Silver	ug/L	100***	34	NA	98	NA	0.2	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.40	< 0.20	< 0.20	< 0.20
Vanadium	ug/L	NC	4.5	NA	62	NA	27	< 2.0	< 2.0	14	< 2.0	< 2.0	< 2.0	< 4.0	3.4	< 2.0	< 2.0
Zinc	ug/L	5,000***	2,400	NA	NA	5,000	260	< 10	< 10	36	< 10	< 10	< 10	< 20	< 10	< 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 aesthetic 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 5
 Summary of Part 115 Groundwater Sampling Results (Analytical): April 2019 - October 2019
 JC Weadock Landfill – RCRA CCR Monitoring Program
 Essexville, Michigan

Sample Location:								MW-51		MW-52		MW-53		MW-53R		MW-54R	
Sample Date:								4/9/2019	10/10/2019	4/9/2019	10/10/2019	4/10/2019	10/10/2019	4/10/2019	10/10/2019	4/11/2019	10/10/2019
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	< 1.0	< 1.0
Iron	ug/L	300***	2,000	300	5,600	300	500,000	5,300	6,700	2,100	5,600	1,900	3,700	1,200	2,600	600	1,400
Nickel	ug/L	NC	100	NA	100	NA	120	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	3.0	< 2.0	< 2.0	< 2.0	8.2
Silver	ug/L	100***	34	NA	98	NA	0.2	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Vanadium	ug/L	NC	4.5	NA	62	NA	27	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 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	< 10	< 10	< 10	< 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 aesthetic 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 5
 Summary of Part 115 Groundwater Sampling Results (Analytical): April 2019 - October 2019
 JC Weadock Landfill – RCRA CCR Monitoring Program
 Essexville, Michigan

Constituent	Unit	EPA MCL	MI Residential*	MI Residential Aesthetic**	MI Non-Residential*	MI Non-Residential Aesthetic**	MI GSI [^]	Sample Location:		OW-57OUT		OW-57ROUT	
								Sample Date:	MW-55	4/11/2019	10/11/2019	4/12/2019	10/11/2019
								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
Iron	ug/L	300***	2,000	300	5,600	300	500,000	16,000	29,000	87	300	53	280
Nickel	ug/L	NC	100	NA	100	NA	120	2.1	< 2.0	17	18	17	20
Silver	ug/L	100***	34	NA	98	NA	0.2	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Vanadium	ug/L	NC	4.5	NA	62	NA	27	< 2.0	< 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	< 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 aesthetic 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 Landfill – RCRA CCR Monitoring Program
 Essexville, Michigan

Constituent	Units	GWPS	MW-51		MW-55	
			LCL	UCL	LCL	UCL
Arsenic	ug/L	21	13	32	11	35
Molybdenum	ug/L	100	NA	NA	81	160

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 ($\alpha = 0.01$) of the downgradient data set.

LCL - Lower Confidence Limit ($\alpha = 0.01$) 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 Landfill – RCRA CCR Monitoring Program
 Essexville, Michigan

Constituent	Units	GWPS	MW-51	
			LCL	UCL
Arsenic	ug/L	21	14	31

Notes:


ug/L - micrograms per Liter

GWPS - Groundwater Protection Standard as established in

TRC's Technical Memorandum dated October 15, 2018.

UCL - Upper Confidence Limit ($\alpha = 0.01$) of the downgradient data set.

LCL - Lower Confidence Limit ($\alpha = 0.01$) 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.

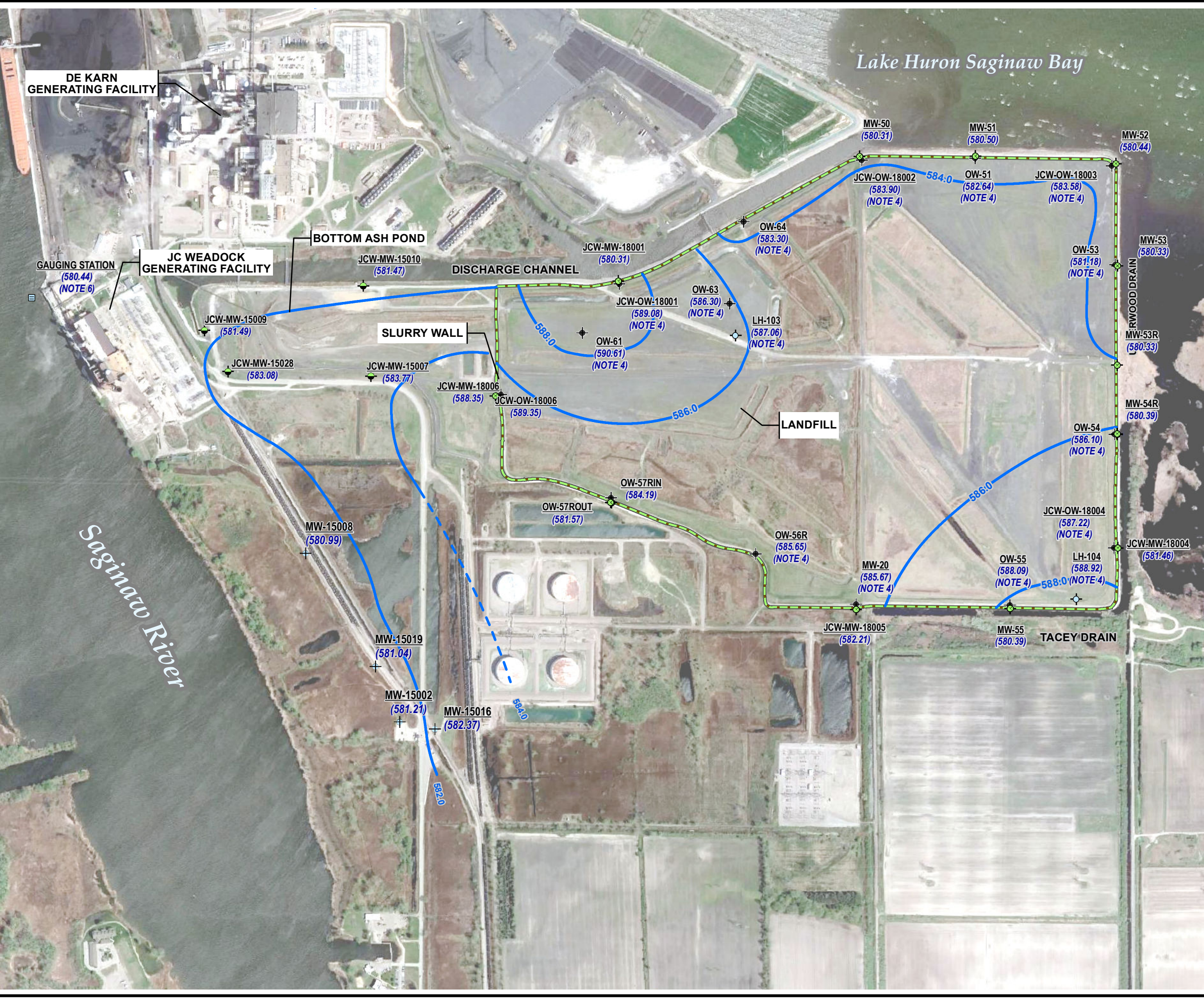


1540 Eisenhower Place
Ann Arbor, MI 48108-3284
Phone: 734.971.7080
www.trccompanies.com

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



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.

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	FIGURE 3
APPROVED BY: D. LITZ	
DATE: JANUARY 2020	

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

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Appendix A

November 2018 Data Summary



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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, Landfill CCR Unit

Dear Mr. Register:

Consumers Energy Company (CEC) is continuing semiannual assessment monitoring in accordance with §257.95 of the CCR Rule¹ for the JC Weadock (JCW) site in Essexville, Michigan. During the statistical evaluation of the initial assessment monitoring event, arsenic was present in one well at a statistically significant level exceeding the Groundwater Protection Standard (GWPS). 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 event for Appendix III and IV constituents at the JCW Landfill CCR Unit in accordance with the *JC Weadock Monitoring Program Sample Analysis Plan* (TRC, 2018) (SAP). The semiannual assessment monitoring event was performed on November 5 through November 8, 2018. The previously established downgradient monitoring wells (JCW-MW-15011, JCW-MW-15012, and JCW-MW-15023) were decommissioned on May 23, 2018 to

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).

accommodate slurry wall construction. Replacement monitoring wells JCW-MW-18001, and JCW-MW-18004 through JCW-MW-18006 were installed in August 2018 to supplement the preexisting groundwater well network currently used under the approved 2015 HMP² for Michigan Part 115 compliance to provide appropriate coverage for the collection of groundwater levels and water quality data along the perimeter of the JCW landfill. The revised downgradient monitoring well network (JCW-MW-18001, JCW-MW-18004, JCW-MW-18005, JCW-MW-18006, OW-57R Out, MW-50, MW-51, MW-52, MW-53, MW-54R, and MW-55) and background monitoring wells (MW-15002, MW-15008, MW-15016, and MW-15019) were sampled during the semiannual assessment monitoring event. The locations of the monitoring wells are depicted on Figure 1.

TRC personnel collected static water level measurements from the JCW Landfill CCR unit well network. 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 constituents 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 elevations at the JCW 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. In order to reduce porewater flux from the land disposal area, CEC completed construction of a soil-bentonite slurry wall at this facility in December 2008. 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 National Pollutant Discharge Elimination System (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.

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



The monitoring well network is structured such that there are eleven (11) monitoring well pairs used to evaluate the hydraulic gradient and potential for water flux across the slurry wall. Data collected in October/November 2018 indicate that, although hydraulic gradients between wells inside the slurry wall and outside the slurry wall indicate a potential for outward flow, the static water level elevations inside of the slurry wall are 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.

The general flow direction observed within the confined of the slurry wall is similar to that identified in previous monitoring rounds. Due to the potential for radial flow, the downgradient wells are appropriately positioned to detect the presence of Appendix III/IV parameters that could potentially migrate from the JCW Landfill 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*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 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.

As a result of the July 2018 modifications to the slurry wall and change in groundwater flow conditions, the groundwater monitoring system was revised⁴ prior to the November 2018 sampling event. The modified CCR monitoring well network now consists of eleven (11) downgradient monitoring

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

⁴ TRC. 2018. *Revised Groundwater Monitoring System Summary Report Technical Memorandum*. December.



Mr. Register
Consumers Energy Company
March 14, 2019
Page 4

wells. The statistical analysis for the 5 new wells will commence once sufficient data has been collected (a minimum of four independent sampling events). Six (6) of the eleven (11) downgradient wells were preexisting and had been sampled under the approved 2015 HMP⁵ for Michigan Part 115 compliance; therefore, the statistical evaluation could be performed for a subset of Appendix III and IV constituents. The statistical evaluation of the November 2018 assessment monitoring data indicates that no constituents are present at statistically significant levels above the GWPSs.

Constituent **GWPS** **#Downgradient Wells Observed**

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

These results of the November 2018 sampling event statistical evaluation differ from the results of the initial assessment monitoring data statistical evaluation, which indicated that arsenic was present at statistically significant levels above the GWPS in one of the three downgradient wells previously located within the slurry wall vent. Although no Appendix IV constituents are present at statistically significant levels above the GWPS based on this November 2018 data evaluation, concentrations remain above background levels and corrective action has been triggered as a result of data collected during the initial May 2018 assessment monitoring event. CEC will continue to initiate an assessment of corrective measures by April 14, 2019, per §257.95(g), and execute the self-implementing groundwater compliance schedule in conformance with §257.90 - §257.98.

Sincerely,

TRC



Graham Crookford
Program Manager



Darby Litz
Hydrogeologist/Project Manager

⁵ Consumers Energy Company. 2015. *Hydrogeological Monitoring Plan Rev. 2: JC Weadock Solid Waste Disposal Area*. June.

Mr. Register
Consumers Energy Company
March 14, 2019
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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 Landfill – 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
Landfill							
JCW-MW-18001	11/7/2018	0.29	-123.1	7.2	1,151	13.13	1.06
JCW-MW-18004	11/8/2018	1.62	2.8	6.8	1,875	11.29	3.10
JCW-MW-18005	11/8/2018	0.43	-10.2	6.9	1,300	11.06	4.75
JCW-MW-18006	11/8/2018	0.34	30.8	6.8	1,530	10.38	3.25
MW-50	11/7/2018	0.28	-54.7	7.2	1,875	13.86	1.08
MW-51	11/8/2018	0.25	43.2	6.6	1,878	12.85	1.57
MW-52	11/8/2018	0.30	8.6	6.8	2,022	12.83	1.18
MW-53	11/8/2018	0.34	-5.1	6.6	2,472	13.15	0.85
MW-54R	11/8/2018	0.77	-8.6	7.0	1,110	12.82	1.62
MW-55	11/8/2018	0.26	-8.1	7.0	1,182	13.56	3.58
OW-57ROUT	11/8/2018	4.93	46.9	7.0	1,012	12.50	8.07

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 Landfill – RCRA CCR Monitoring Program
 Essexville, Michigan

Constituent	Unit	EPA MCL	MI Residential*	MI Non-Residential*	MI GSI [^]	Sample Location:	JCW-MW-18001	JCW-MW-18004	JCW-MW-18005	JCW-MW-18006	MW-50	MW-51	MW-52
						Sample Date:	11/7/2018	11/8/2018	11/8/2018	11/8/2018	11/7/2018	11/8/2018	11/8/2018
						downgradient							
Appendix III													
Boron	ug/L	NC	500	500	4,000	1,330	366	1,300	2,990	1,370	851	774	
Calcium	mg/L	NC	NC	NC	500	138	296	156	188	249	331	256	
Chloride	mg/L	250**	250	250	50	51.5	17.1	81.8	96.9	76.3	55.8	97.2	
Fluoride	ug/L	4,000	NC	NC	NC	< 1,000	< 1,000	1,100	< 1,000	< 1,000	< 1,000	< 1,000	
Sulfate	mg/L	250**	250	250	500	97.7	727	125	75.8	518	505	517	
Total Dissolved Solids	mg/L	500**	500	500	500	678	1,560	854	1,040	1,360	1,410	1,460	
pH, Field	SU	6.5 - 8.5**	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	7.2	6.8	6.9	6.8	7.2	6.6	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	
Arsenic	ug/L	10	10	10	10	5.8	< 5.0	2.2	35.1	< 5.0	21.8	< 5.0	
Barium	ug/L	2,000	2,000	2,000	1,200	169	36.3	103	534	239	163	146	
Beryllium	ug/L	4	4.0	4.0	33	< 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	< 1.0	< 1.0	
Chromium	ug/L	100	100	100	11	< 1.0	< 5.0	< 1.0	< 1.0	< 5.0	< 5.0	< 5.0	
Cobalt	ug/L	NC	40	100	100	< 6.0	< 30.0	< 6.0	< 6.0	< 30.0	< 30.0	< 30.0	
Fluoride	ug/L	4,000	NC	NC	NC	< 1,000	< 1,000	1,100	< 1,000	< 1,000	< 1,000	< 1,000	
Lead	ug/L	NC	4.0	4.0	14	< 1.0	< 5.0 ⁽¹⁾	< 1.0	< 1.0	< 5.0 ⁽¹⁾	< 5.0 ⁽¹⁾	< 5.0 ⁽¹⁾	
Lithium	ug/L	NC	170	350	440	51	36	36	88	94	71	63	
Mercury	ug/L	2	2.0	2.0	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	5.8	< 5.0	8.0	< 25.0	< 25.0	
Radium-226	pCi/L	NC	NC	NC	NC	< 0.542	< 1.04	0.785	0.646	1.40	< 0.715	< 0.651	
Radium-228	pCi/L	NC	NC	NC	NC	< 0.808	< 0.633	1.02	1.85	1.88	1.12	< 0.850	
Radium-226/228	pCi/L	5	NC	NC	NC	< 1.35	< 1.67	1.81	2.50	3.28	< 1.64	< 1.50	
Selenium	ug/L	50	50	50	5	< 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	< 10.0 ⁽¹⁾	< 2.0	< 2.0	< 10.0 ⁽¹⁾	< 10.0 ⁽¹⁾	< 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.

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

						Sample Location:	MW-53	MW-54R	MW-55	OW-57ROUT
						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^	downgradient				
Appendix III										
Boron	ug/L	NC	500	500	4,000	519	1,290	582	1,850	
Calcium	mg/L	NC	NC	NC	500	465	173	202	141	
Chloride	mg/L	250**	250	250	50	84.5	18.0	15.8	70.3	
Fluoride	ug/L	4,000	NC	NC	NC	< 1,000	< 1,000	< 1,000	1,200	
Sulfate	mg/L	250**	250	250	500	811	152	157	112	
Total Dissolved Solids	mg/L	500**	500	500	500	1,950	710	894	808	
pH, Field	SU	6.5 - 8.5**	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	6.6	7.0	7.0	7.0	
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	5.1	< 1.0	35.1	1.4	
Barium	ug/L	2,000	2,000	2,000	1,200	54.4	59.9	158	73.7	
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	< 1.0	< 0.20	0.32	< 0.20	
Chromium	ug/L	100	100	100	11	< 5.0	< 1.0	< 5.0	< 1.0	
Cobalt	ug/L	NC	40	100	100	< 30.0	< 6.0	< 30.0	< 6.0	
Fluoride	ug/L	4,000	NC	NC	NC	< 1,000	< 1,000	< 1,000	1,200	
Lead	ug/L	NC	4.0	4.0	14	< 5.0 ⁽¹⁾	< 1.0	< 5.0 ⁽¹⁾	< 1.0	
Lithium	ug/L	NC	170	350	440	59	62	40	35	
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	< 5.0	171	8.9	
Radium-226	pCi/L	NC	NC	NC	NC	< 0.664	< 1.09	< 0.932	< 1.09	
Radium-228	pCi/L	NC	NC	NC	NC	< 0.655	< 0.786	< 0.679	< 0.718	
Radium-226/228	pCi/L	5	NC	NC	NC	< 1.32	< 1.88	< 1.61	< 1.81	
Selenium	ug/L	50	50	50	5	< 1.0	< 1.0	< 1.0	< 1.0	
Thallium	ug/L	2	2.0	2.0	2.0	< 10.0 ⁽¹⁾	< 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.

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 interferer

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

Constituent	Units	GWPS	MW-51		MW-55	
			LCL	UCL	LCL	UCL
Arsenic	ug/L	21	14	33	10	36
Molybdenum	ug/L	100	NA	NA	89	174

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 ($\alpha = 0.01$) of the downgradient data set.

LCL - Lower Confidence Limit ($\alpha = 0.01$) 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
- BASE MAP IMAGERY FROM USDA - NATIONAL AGRICULTURE IMAGERY PROGRAM, 7/10/2016.
 - WELL LOCATIONS SURVEYED BY ROWE PROFESSIONAL SERVICES COMPANY ON 11/4/2015.
 - NOAA/NATIONAL OCEANIC SERVICE GREAT LAKES GAUGING STATION, ESSEXVILLE, MI (ID: 9075035).

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	FIGURE 1	
APPROVED BY:	D. LITZ		
DATE:	MARCH 2019		
FILE NO.:		290805-001-023.mxd	



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
- BASE MAP IMAGERY FROM USDA - NATIONAL AGRICULTURE IMAGERY PROGRAM, 7/10/2016.
 - WELL LOCATIONS SURVEYED BY ROWE PROFESSIONAL SERVICES COMPANY ON 11/4/2015.
 - NOAA/NATIONAL OCEANIC SERVICE GREAT LAKES GAUGING STATION, ESSEXVILLE, MI (ID: 9075035).
 - GROUNDWATER ELEVATION DATA RECORDED OCTOBER 22, 2018.
 - GROUNDWATER ELEVATIONS DISPLAYED IN FEET RELATIVE TO THE NORTH AMERICAN VERTICAL DATUM OF 1988.

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	FIGURE 2	
APPROVED BY:	D. LITZ		
DATE:	MARCH 2019		
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%.

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		

Laboratory Data Quality Review

Groundwater Monitoring Event November 2018

JC Weadock Landfill

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 4620175 and 4620180.

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

- JCW-MW-18001
- JCW-MW-18006
- MW-52
- MW-54R
- OW-57ROut
- JCW-MW-18004
- MW-50
- MW-53
- MW-55
- JCW-MW-18005
- MW-51
- MW-53R
- OW-57Out

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. Target analytes were not detected in the method blank samples.
- One equipment blank (EB-02) and one field blank (FB-03) were collected. Normalized absolute difference comparisons between blank and sample that are between 1.96 and 2.58 may indicate biased high results and normalized absolute differences <1.96 may indicate a false positive sample result.
 - Barium was detected in FB-03 at 1.3 µg/L. The presence of barium in this field blank has no effect on the sample results since the detected concentrations of barium in the samples were >5x the blank concentration.
 - Radium-228 was detected in EB-02 at 0.663 ± 0.354 pCi/L and in FB-03 at 1.44 ± 0.509 pCi/L. The detected radium-228 results for the samples associated with the field blank were potentially impacted, as summarized in the attached table, Attachment A.
- The LCS recoveries for all analytes were within QC limits.
- MS and/or MSD analyses were performed on sample MW-55 for anions, mercury, alkalinity, radium, and metals, and on sample JCW-MW-18005 for select metals and alkalinity, and on sample JCW-MW-18006 for select metals. All recoveries and relative percent differences (RPDs) were within the QC limits with the following exceptions.
 - The recoveries of iron and boron were outside of the acceptance criteria in the MW-55 MS/MSD analyses. The iron and boron concentrations in this sample were >4x the spike concentrations; therefore, the MS/MSD results for iron and boron were not evaluated. Data usability was not affected.
 - The recoveries of boron were outside of the acceptance criteria in the JCW-MW-18005 MS/MSD analyses. The boron concentration in this sample was >4x the spike concentration; therefore, the MS/MSD results for boron were not evaluated. Data usability was not affected.
- The field duplicate pair samples were Dup-03 and MW-52; RPDs between the parent and duplicate sample were within the QC limits.
- Laboratory duplicate analyses were performed on sample MW-55 for anions, alkalinity, and TDS, OW-57Rout for TDS, JCW-MW-18004 for TDS, and JCW-MW-18005 for alkalinity; RPDs were within QC limits.
- Select nondetect 6020A metals results were reported from 5-fold dilutions for samples JCW-MW-18004, MW-50, MW-51, MW-52, MW-53, MW-53R, and MW-55 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 Landfill Groundwater Analytical Data
JC Weadock Power Plant Landfill – RCRA CCR Monitoring Program
Essexville, Michigan

Samples	Collection Date	Analyte	Non-Conformance/Issue
Dup-03_20181108	11/8/2018	Radium-228	Detections in equipment blank (EB-02) and field blank (FB-03). Normalized absolute difference between blank and samples <1.96; indicates possible false positive results.
JCW-MW-18005_20181108	11/8/2018		
JCW-MW-18006_20181108	11/8/2018		
MW-51_20181108	11/8/2018		
MW-50_20181107	11/7/2018		

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 Landfill, Consumers Energy Company, Essexville, Michigan

During the statistical evaluation of the initial assessment monitoring event, arsenic was 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 Rule¹ at the JC Weadock Power Plant (JCW) Landfill. 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.

The evaluation of the initial semiannual assessment monitoring event data (April and May 2018) indicated that arsenic was present at statistically significant levels above the GWPS at one of the three downgradient wells. The three downgradient wells were located within a vent (e.g., opening) of the

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).

Technical Memorandum

perimeter soil/bentonite slurry wall to assess the quality of groundwater passing the waste boundary. As discussed in detail below, in July 2018, a vent (e.g., opening) in the perimeter soil/bentonite slurry wall was closed and the slurry wall is now continuous along the entire perimeter of the JCW landfill. As a result of the change in groundwater flow conditions, the groundwater monitoring system was revised² prior to the November 2018 sampling event. The modified CCR monitoring well network now consists of eleven (11) downgradient monitoring wells. The statistical analysis for the 5 new wells will commence once sufficient data has been collected (a minimum of four independent sampling events). Six (6) of the downgradient wells were preexisting and had been sampled under the approved 2015 HMP³ for Michigan Part 115 compliance; therefore, the statistical evaluation could be performed for a subset of Appendix III and IV constituents. The statistical evaluation of the second semiannual assessment monitoring event data indicates that no Appendix IV constituents are present at statistically significant levels above the GWPSs.

<u>Constituent</u>	<u>GWPS</u>	<u>#Downgradient Wells Observed</u>
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No constituents are present at statistically significant levels above the GWPSs.

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 initial assessment monitoring event. CEC will continue to initiate an assessment of corrective measures per §257.95(g) and execute the self-implementing groundwater compliance schedule in conformance with §257.90 - §257.98.

Assessment Monitoring Statistical Evaluation

When the monitoring well network was first established in October 2017, there was a 1,600-linear-foot section of the perimeter embankment dike that did not have a slurry wall in place. Groundwater flow beneath the JCW landfill was directed towards the discharge channel through this vent in the slurry wall for management under the existing NPDES discharge permit. The downgradient monitoring well network was established as three monitoring wells located in the vent area to assess the quality of groundwater passing the waste boundary (JCW-MW-15011, JCW-MW-15012, and JCW-MW-15023). In July 2018, the slurry wall vent was closed to reduced porewater flux around the entire perimeter of the JCW Landfill CCR unit. The three downgradient CCR compliance wells were decommissioned by overdrilling, removing the well material, and sealing the borehole in order to allow for the slurry wall construction.

Given the change in groundwater flow conditions, a revised groundwater monitoring system has been established to assess slurry wall integrity and determine if there have been any releases from the JCW Landfill CCR unit. CEC installed an additional nine (9) monitoring wells in August 2018 to

² TRC. 2018. *Revised Groundwater Monitoring System Summary Report Technical Memorandum*. December.

³ Consumers Energy Company. 2015. *Hydrogeological Monitoring Plan Rev. 2: JC Weadock Solid Waste Disposal Area*. June.

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supplement the preexisting groundwater well network currently used under the approved 2015 HMP for Michigan Part 115 compliance to provide appropriate coverage for the collection of groundwater levels and water quality data along the perimeter of the JCW Landfill CCR unit.

Therefore, the modified CCR monitoring well network now consists of eleven (11) downgradient monitoring wells as discussed in the *Sample and Analysis Plan* (2018 SAP) and *Statistical Analysis Plan* (2018 Stats Plan). The downgradient monitoring wells include:

JCW-MW-18001	JCW-MW-18004	JCW-MW-18005	JCW-MW-18006
MW-50	MW-51	MW-52	MW-53
MW-54R	MW-55	OW-57R Out	

The statistical analysis for the new wells (JCW-MW-18001, JCW-MW-18004, JCW-MW-18005, and JCW-MW-18006; and OW-57R Out) will commence once sufficient data has been collected (a minimum of four independent sampling events). For the preexisting wells (MW-50 through MW-55), a minimum of eight rounds of data for a subset of Appendix III and IV constituents have been collected in 2017 and 2018 as part of the quarterly HMP monitoring.

Following the second semiannual assessment monitoring sampling event, compliance well data for the JCW Landfill CCR unit were evaluated in accordance with the *Groundwater Statistical Analysis Plan* (TRC, December 2018). 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 Guidance⁴, 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 methods for assessment monitoring presented in §257.93(f) and (g). Statistical evaluation methodologies

⁴ USEPA. 2009. *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance*. Office of Conservation and Recovery. EPA 530/R-09-007.

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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 for 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 most recent eight sampling events (May 2017 through November 2018) were retained for further analysis. Arsenic in MW-51 and MW-55 and molybdenum in MW-55 had individual results exceeding the GWPS. In MW-50, MW-51, MW-52, MW-53, MW-55, and JCW-MW-18004, cobalt and thallium reporting limits exceeded the GWPSs in November 2018 due to sample dilutions performed due to matrix interferences during analysis. Cobalt and thallium were non-detect at the HMP locations in a previous sample event (May 2016). These locations do have sufficient data to qualify the November 2018 results as outliers or to calculate confidence intervals; therefore, no statistical evaluation will be completed for these well-constituent pairs.

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 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.

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Initially, the baseline (February 2017 through November 2018) results were observed visually for potential trends. No outliers were identified in the data set. 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. The arsenic data sets were found to be normally distributed. The confidence interval test compares the lower confidence limit to the GWPS. Although no Appendix IV constituents are present at statistically significant levels above the GWPS based on the November 2018 data evaluation, concentrations remain above background levels and corrective action has been triggered as a result of data collected during the initial May 2018 assessment monitoring event. 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 – February 2017 to November 2018
- Attachment 1 Sanitas™ Output Files

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Table

Table A1
 Comparison of Groundwater Sampling Results to Groundwater Protection Standards – February 2017 to November 2018
 JC Weadock Landfill – RCRA CCR Monitoring Program
 Essexville, Michigan

Sample Location:						MW-50								
Sample Date:						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
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS	downgradient								
Appendix III														
Boron	ug/L	NC	NA	619	NA	2,020	1,340	987	1,120	1,320	1,220	1,270	1,270	1,370
Calcium	mg/L	NC	NA	302	NA	--	--	--	--	--	250	--	--	249
Chloride	mg/L	250**	NA	2,440	NA	--	--	--	--	--	73.8	--	--	76.3
Fluoride	ug/L	4,000	NA	1,000	NA	--	--	--	--	--	< 1,000	--	--	< 1,000
Sulfate	mg/L	250**	NA	407	NA	200	180	290	580	370	550	490	540	518
Total Dissolved Solids	mg/L	500**	NA	4,600	NA	--	--	--	--	--	1,400	--	--	1,360
pH, Field	SU	6.5 - 8.5**	6.5 - 8.5	6.5 - 7.3	NA	7.1	7.4	7.0	7.1	7.5	7.3	7.0	7.1	7.2
Appendix IV														
Antimony	ug/L	6	NA	1	6	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0
Arsenic	ug/L	10	NA	21	21	2	2	3	3	2	2	2	3	< 5.0
Barium	ug/L	2,000	NA	1,300	2,000	393	356	352	299	365	351	292	282	239
Beryllium	ug/L	4	NA	1	4	--	--	--	--	--	< 1	--	--	< 1.0
Cadmium	ug/L	5	NA	0.2	5	--	--	--	--	--	< 0.2	--	--	< 0.20
Chromium	ug/L	100	NA	3	100	1	1	< 1	< 1	< 1	< 1	< 1	< 1	< 5.0
Cobalt	ug/L	NC	6	15	15	--	--	--	--	--	< 15	--	--	< 30.0 ⁽¹⁾
Fluoride	ug/L	4,000	NA	1,000	4,000	--	--	--	--	--	< 1,000	--	--	< 1,000
Lead	ug/L	NC	15	1	15	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 5.0
Lithium	ug/L	NC	40	180	180	72	71	74	72	63	74	77	84	94
Mercury	ug/L	2	NA	0.2	2	--	--	--	--	--	< 0.2	--	--	< 0.20
Molybdenum	ug/L	NC	100	6	100	< 5	< 5	6	10	6	6	8	7	8.0
Radium-226	pCi/L	NC	NA	NA	NA	--	--	--	--	--	--	--	--	1.40
Radium-228	pCi/L	NC	NA	NA	NA	--	--	--	--	--	--	--	--	1.88
Radium-226/228	pCi/L	5	NA	3.32	5	--	--	--	--	--	--	--	--	3.28
Selenium	ug/L	50	NA	2	50	< 1	1	< 1	< 1	< 1	< 1	< 1	1	< 1.0
Thallium	ug/L	2	NA	2	2	--	--	--	--	--	< 2	--	--	< 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 – February 2017 to November 2018
 JC Weadock Landfill – RCRA CCR Monitoring Program
 Essexville, Michigan

Sample Location:						MW-51									
Sample Date:						2/27/2017	5/11/2017	8/9/2017	11/1/2017	3/6/2018	5/16/2018	8/15/2018	10/23/2018	10/23/2018	11/8/2018
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS	downgradient									
Appendix III															
Boron	ug/L	NC	NA	619	NA	1,440	1,370	1,060	1,280	1,040	883	872	895	Field Dup 872	851
Calcium	mg/L	NC	NA	302	NA	--	--	--	--	--	378	--	--	--	331
Chloride	mg/L	250**	NA	2,440	NA	--	--	--	--	--	65	--	--	--	55.8
Fluoride	ug/L	4,000	NA	1,000	NA	--	--	--	--	--	< 1,000	--	--	--	< 1,000
Sulfate	mg/L	250**	NA	407	NA	480	490	510	560	430	592	450	490	500	505
Total Dissolved Solids	mg/L	500**	NA	4,600	NA	--	--	--	--	--	1,600	--	--	--	1,410
pH, Field	SU	6.5 - 8.5**	6.5 - 8.5	6.5 - 7.3	NA	6.9	6.9	6.8	6.8	6.8	6.7	6.6	6.7	--	6.6
Appendix IV															
Antimony	ug/L	6	NA	1	6	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0
Arsenic	ug/L	10	NA	21	21	19	24	41	28	16	13	19	27	25	21.8
Barium	ug/L	2,000	NA	1,300	2,000	318	273	268	291	187	189	178	184	208	163
Beryllium	ug/L	4	NA	1	4	--	--	--	--	--	< 1	--	--	--	< 1.0
Cadmium	ug/L	5	NA	0.2	5	--	--	--	--	--	< 0.2	--	--	--	< 1.0
Chromium	ug/L	100	NA	3	100	1	< 1	< 1	1	< 1	< 1	< 1	< 1	< 1	< 5.0
Cobalt	ug/L	NC	6	15	15	--	--	--	--	--	< 15	--	--	--	< 30.0 ⁽¹⁾
Fluoride	ug/L	4,000	NA	1,000	4,000	--	--	--	--	--	< 1,000	--	--	--	< 1,000
Lead	ug/L	NC	15	1	15	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 5.0
Lithium	ug/L	NC	40	180	180	61	66	68	64	55	62	57	60	59	71
Mercury	ug/L	2	NA	0.2	2	--	--	--	--	--	< 0.2	--	--	--	< 0.20
Molybdenum	ug/L	NC	100	6	100	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 25.0
Radium-226	pCi/L	NC	NA	NA	NA	--	--	--	--	--	--	--	--	--	< 0.715
Radium-228	pCi/L	NC	NA	NA	NA	--	--	--	--	--	--	--	--	--	1.12
Radium-226/228	pCi/L	5	NA	3.32	5	--	--	--	--	--	--	--	--	--	< 1.64
Selenium	ug/L	50	NA	2	50	< 1	< 1	< 1	< 1	< 1	< 1	< 1	1	< 1	< 1.0
Thallium	ug/L	2	NA	2	2	--	--	--	--	--	< 2	--	--	--	< 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 – February 2017 to November 2018
 JC Weadock Landfill – RCRA CCR Monitoring Program
 Essexville, Michigan

Sample Location:						MW-52										
Sample Date:						2/27/2017	5/11/2017	8/9/2017	11/1/2017	3/6/2018	3/6/2018	5/15/2018	8/15/2018	10/23/2018	11/8/2018	11/8/2018
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS	downgradient										
Appendix III										Field Dup					Field Dup	
Boron	ug/L	NC	NA	619	NA	1,580	1,260	1,040	991	795	791	803	904	846	896	774
Calcium	mg/L	NC	NA	302	NA	--	--	--	--	--	--	241	--	--	263	256
Chloride	mg/L	250**	NA	2,440	NA	--	--	--	--	--	--	89.5	--	--	96.6	97.2
Fluoride	ug/L	4,000	NA	1,000	NA	--	--	--	--	--	--	< 1,000	--	--	< 1,000	< 1,000
Sulfate	mg/L	250**	NA	407	NA	490	510	530	480	530	510	536	500	530	512	517
Total Dissolved Solids	mg/L	500**	NA	4,600	NA	--	--	--	--	--	--	1,500	--	--	1,520	1,460
pH, Field	SU	6.5 - 8.5**	6.5 - 8.5	6.5 - 7.3	NA	7.0	7.1	6.8	7.0	--	7.0	7.0	6.9	6.9	--	6.8
Appendix IV																
Antimony	ug/L	6	NA	1	6	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1.0
Arsenic	ug/L	10	NA	21	21	< 1	< 1	< 1	1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 5.0
Barium	ug/L	2,000	NA	1,300	2,000	144	142	150	144	153	155	148	160	179	170	146
Beryllium	ug/L	4	NA	1	4	--	--	--	--	--	--	< 1	--	--	< 1.0	< 1.0
Cadmium	ug/L	5	NA	0.2	5	--	--	--	--	--	--	< 0.2	--	--	< 0.20	< 1.0
Chromium	ug/L	100	NA	3	100	1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 5.0
Cobalt	ug/L	NC	6	15	15	--	--	--	--	--	--	< 15	--	--	< 6.0	< 30.0 ⁽¹⁾
Fluoride	ug/L	4,000	NA	1,000	4,000	--	--	--	--	--	--	< 1,000	--	--	< 1,000	< 1,000
Lead	ug/L	NC	15	1	15	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 5.0
Lithium	ug/L	NC	40	180	180	44	51	55	53	55	58	55	54	52	60	63
Mercury	ug/L	2	NA	0.2	2	--	--	--	--	--	--	< 0.2	--	--	< 0.20	< 0.20
Molybdenum	ug/L	NC	100	6	100	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5.0	< 25.0
Radium-226	pCi/L	NC	NA	NA	NA	--	--	--	--	--	--	--	--	--	0.840	< 0.651
Radium-228	pCi/L	NC	NA	NA	NA	--	--	--	--	--	--	--	--	--	0.683	< 0.850
Radium-226/228	pCi/L	5	NA	3.32	5	--	--	--	--	--	--	--	--	--	1.52	< 1.50
Selenium	ug/L	50	NA	2	50	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	1	< 1.0	< 1.0
Thallium	ug/L	2	NA	2	2	--	--	--	--	--	--	< 2	--	--	< 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 – February 2017 to November 2018
 JC Weadock Landfill – RCRA CCR Monitoring Program
 Essexville, Michigan

Sample Location:						MW-53								
Sample Date:						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
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS	downgradient								
Appendix III														
Boron	ug/L	NC	NA	619	NA	436	963	468	496	490	1,260	695	583	519
Calcium	mg/L	NC	NA	302	NA	--	--	--	--	--	158	--	--	465
Chloride	mg/L	250**	NA	2,440	NA	--	--	--	--	--	77.5	--	--	84.5
Fluoride	ug/L	4,000	NA	1,000	NA	--	--	--	--	--	< 1,000	--	--	< 1,000
Sulfate	mg/L	250**	NA	407	NA	790	660	890	830	510	208	570	780	811
Total Dissolved Solids	mg/L	500**	NA	4,600	NA	--	--	--	--	--	970	--	--	1,950
pH, Field	SU	6.5 - 8.5**	6.5 - 8.5	6.5 - 7.3	NA	6.6	6.7	6.6	6.7	6.8	7.2	6.7	6.6	6.6
Appendix IV														
Antimony	ug/L	6	NA	1	6	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0
Arsenic	ug/L	10	NA	21	21	2	2	3	3	2	2	3	4	5.1
Barium	ug/L	2,000	NA	1,300	2,000	56	71	56	50	49	78	87	71	54.4
Beryllium	ug/L	4	NA	1	4	--	--	--	--	--	< 1	--	--	< 1.0
Cadmium	ug/L	5	NA	0.2	5	--	--	--	--	--	< 0.2	--	--	< 1.0
Chromium	ug/L	100	NA	3	100	1	1	< 1	1	< 1	< 1	< 1	< 1	< 5.0
Cobalt	ug/L	NC	6	15	15	--	--	--	--	--	< 15	--	--	< 30.0 ⁽¹⁾
Fluoride	ug/L	4,000	NA	1,000	4,000	--	--	--	--	--	< 1,000	--	--	< 1,000
Lead	ug/L	NC	15	1	15	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 5.0
Lithium	ug/L	NC	40	180	180	40	49	48	45	35	49	48	47	59
Mercury	ug/L	2	NA	0.2	2	--	--	--	--	--	< 0.2	--	--	< 0.20
Molybdenum	ug/L	NC	100	6	100	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 25.0
Radium-226	pCi/L	NC	NA	NA	NA	--	--	--	--	--	--	--	--	< 0.664
Radium-228	pCi/L	NC	NA	NA	NA	--	--	--	--	--	--	--	--	< 0.655
Radium-226/228	pCi/L	5	NA	3.32	5	--	--	--	--	--	--	--	--	< 1.32
Selenium	ug/L	50	NA	2	50	< 1	1	< 1	< 1	< 1	< 1	< 1	1	< 1.0
Thallium	ug/L	2	NA	2	2	--	--	--	--	--	< 2	--	--	< 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 – February 2017 to November 2018
 JC Weadock Landfill – RCRA CCR Monitoring Program
 Essexville, Michigan

Sample Location:						MW-54R									
Sample Date:						2/28/2017	5/11/2017	8/9/2017	11/2/2017	3/6/2018	5/15/2018	8/16/2018	8/16/2018	10/23/2018	11/8/2018
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS	downgradient									
Appendix III															
Boron	ug/L	NC	NA	619	NA	1,460	1,030	1,100	1,280	1,060	1,150	Field Dup 1,240	1,340	1,380	1,290
Calcium	mg/L	NC	NA	302	NA	--	--	--	--	--	179	--	--	--	173
Chloride	mg/L	250**	NA	2,440	NA	--	--	--	--	--	20	--	--	--	18.0
Fluoride	ug/L	4,000	NA	1,000	NA	--	--	--	--	--	< 1,000	--	--	--	< 1,000
Sulfate	mg/L	250**	NA	407	NA	170	200	180	160	160	208	190	180	150	152
Total Dissolved Solids	mg/L	500**	NA	4,600	NA	--	--	--	--	--	890	--	--	--	710
pH, Field	SU	6.5 - 8.5**	6.5 - 8.5	6.5 - 7.3	NA	6.9	6.8	6.8	6.9	7.1	7.0	--	6.9	6.9	7.0
Appendix IV															
Antimony	ug/L	6	NA	1	6	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0
Arsenic	ug/L	10	NA	21	21	< 1	< 1	< 1	< 1	1	< 1	< 1	< 1	< 1	< 1.0
Barium	ug/L	2,000	NA	1,300	2,000	75	63	74	74	70	74	80	79	79	59.9
Beryllium	ug/L	4	NA	1	4	--	--	--	--	--	< 1	--	--	--	< 1.0
Cadmium	ug/L	5	NA	0.2	5	--	--	--	--	--	< 0.2	--	--	--	< 0.20
Chromium	ug/L	100	NA	3	100	1	1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0
Cobalt	ug/L	NC	6	15	15	--	--	--	--	--	< 15	--	--	--	< 6.0
Fluoride	ug/L	4,000	NA	1,000	4,000	--	--	--	--	--	< 1,000	--	--	--	< 1,000
Lead	ug/L	NC	15	1	15	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0
Lithium	ug/L	NC	40	180	180	61	53	58	58	52	57	56	58	59	62
Mercury	ug/L	2	NA	0.2	2	--	--	--	--	--	< 0.2	--	--	--	< 0.20
Molybdenum	ug/L	NC	100	6	100	< 5	6	6	5	< 5	< 5	< 5	< 5	< 5	< 5.0
Radium-226	pCi/L	NC	NA	NA	NA	--	--	--	--	--	--	--	--	--	< 1.09
Radium-228	pCi/L	NC	NA	NA	NA	--	--	--	--	--	--	--	--	--	< 0.786
Radium-226/228	pCi/L	5	NA	3.32	5	--	--	--	--	--	--	--	--	--	< 1.88
Selenium	ug/L	50	NA	2	50	< 1	< 1	1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0
Thallium	ug/L	2	NA	2	2	--	--	--	--	--	< 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.
 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 – February 2017 to November 2018
 JC Weadock Landfill – RCRA CCR Monitoring Program
 Essexville, Michigan

Sample Location:						MW-55									
Sample Date:						2/28/2017	5/11/2017	8/10/2017	11/2/2017	3/6/2018	5/15/2018	5/15/2018	8/16/2018	10/23/2018	11/8/2018
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS	downgradient									
Appendix III											Field Dup				
Boron	ug/L	NC	NA	619	NA	547	493	519	619	680	533	539	670	677	582
Calcium	mg/L	NC	NA	302	NA	--	--	--	--	--	193	189	--	--	202
Chloride	mg/L	250**	NA	2,440	NA	--	--	--	--	--	16.4	15.7	--	--	15.8
Fluoride	ug/L	4,000	NA	1,000	NA	--	--	--	--	--	< 1,000	< 1,000	--	--	< 1,000
Sulfate	mg/L	250**	NA	407	NA	310	440	360	280	100	260	257	250	180	157
Total Dissolved Solids	mg/L	500**	NA	4,600	NA	--	--	--	--	--	940	980	--	--	894
pH, Field	SU	6.5 - 8.5**	6.5 - 8.5	6.5 - 7.3	NA	6.9	6.8	6.8	6.8	7.0	--	7.0	6.8	6.9	7.0
Appendix IV															
Antimony	ug/L	6	NA	1	6	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0
Arsenic	ug/L	10	NA	21	21	18	6	15	19	18	16	17	37	38	35.1
Barium	ug/L	2,000	NA	1,300	2,000	75	69	83	86	133	148	148	183	190	158
Beryllium	ug/L	4	NA	1	4	--	--	--	--	--	< 1	< 1	--	--	< 1.0
Cadmium	ug/L	5	NA	0.2	5	--	--	--	--	--	0.3	0.3	--	--	0.32
Chromium	ug/L	100	NA	3	100	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 5.0
Cobalt	ug/L	NC	6	15	15	--	--	--	--	--	< 15	< 15	--	--	< 30.0 ⁽¹⁾
Fluoride	ug/L	4,000	NA	1,000	4,000	--	--	--	--	--	< 1,000	< 1,000	--	--	< 1,000
Lead	ug/L	NC	15	1	15	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 5.0
Lithium	ug/L	NC	40	180	180	17	16	23	28	16	21	20	32	34	40
Mercury	ug/L	2	NA	0.2	2	--	--	--	--	--	< 0.2	< 0.2	--	--	< 0.20
Molybdenum	ug/L	NC	100	6	100	84	65	88	139	132	116	119	172	168	171
Radium-226	pCi/L	NC	NA	NA	NA	--	--	--	--	--	--	--	--	--	< 0.932
Radium-228	pCi/L	NC	NA	NA	NA	--	--	--	--	--	--	--	--	--	< 0.679
Radium-226/228	pCi/L	5	NA	3.32	5	--	--	--	--	--	--	--	--	--	< 1.61
Selenium	ug/L	50	NA	2	50	< 1	17	10	< 1	< 1	1	1	2	< 1	< 1.0
Thallium	ug/L	2	NA	2	2	--	--	--	--	--	< 2	< 2	--	--	< 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 – February 2017 to November 2018
 JC Weadock Landfill – RCRA CCR Monitoring Program
 Essexville, Michigan

		Sample Location:				OW-57ROUT	JCW-MW-18001	JCW-MW-18004	JCW-MW-18005	JCW-MW-18006
		Sample Date:				11/8/2018	11/7/2018	11/8/2018	11/8/2018	11/8/2018
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS	downgradient				
Appendix III										
Boron	ug/L	NC	NA	619	NA	1,850	1,330	366	1,300	2,990
Calcium	mg/L	NC	NA	302	NA	141	138	296	156	188
Chloride	mg/L	250**	NA	2,440	NA	70.3	51.5	17.1	81.8	96.9
Fluoride	ug/L	4,000	NA	1,000	NA	1,200	< 1,000	< 1,000	1,100	< 1,000
Sulfate	mg/L	250**	NA	407	NA	112	97.7	727	125	75.8
Total Dissolved Solids	mg/L	500**	NA	4,600	NA	808	678	1,560	854	1,040
pH, Field	SU	6.5 - 8.5**	6.5 - 8.5	6.5 - 7.3	NA	7.0	7.2	6.8	6.9	6.8
Appendix IV										
Antimony	ug/L	6	NA	1	6	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	10	NA	21	21	1.4	5.8	< 5.0	2.2	35.1
Barium	ug/L	2,000	NA	1,300	2,000	73.7	169	36.3	103	534
Beryllium	ug/L	4	NA	1	4	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	5	NA	0.2	5	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Chromium	ug/L	100	NA	3	100	< 1.0	< 1.0	< 5.0	< 1.0	< 1.0
Cobalt	ug/L	NC	6	15	15	< 6.0	< 6.0	< 30.0 ⁽¹⁾	< 6.0	< 6.0
Fluoride	ug/L	4,000	NA	1,000	4,000	1,200	< 1,000	< 1,000	1,100	< 1,000
Lead	ug/L	NC	15	1	15	< 1.0	< 1.0	< 5.0	< 1.0	< 1.0
Lithium	ug/L	NC	40	180	180	35	51	36	36	88
Mercury	ug/L	2	NA	0.2	2	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	NC	100	6	100	8.9	< 5.0	< 5.0	5.8	< 5.0
Radium-226	pCi/L	NC	NA	NA	NA	< 1.09	< 0.542	< 1.04	0.785	0.646
Radium-228	pCi/L	NC	NA	NA	NA	< 0.718	< 0.808	< 0.633	1.02	1.85
Radium-226/228	pCi/L	5	NA	3.32	5	< 1.81	< 1.35	< 1.67	1.81	2.50
Selenium	ug/L	50	NA	2	50	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Thallium	ug/L	2	NA	2	2	< 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.

Technical Memorandum

Sanitas™ Output Files

Summary Report

Constituent: Antimony, Total Analysis Run 2/26/2019 2:53 PM
Client: Consumers Energy Data: JCW_Sanitas.19.02.22

For observations made between 2/27/2017 and 11/8/2018, a summary of the selected data set:

Observations = 54
ND/Trace = 54
Wells = 6
Minimum Value = 1
Maximum Value = 1
Mean Value = 1
Median Value = 1
Standard Deviation = 0
Coefficient of Variation = 0
Skewness = NaN

<u>Well</u>	<u>#Obs.</u>	<u>ND/Trace</u>	<u>Min</u>	<u>Max</u>	<u>Mean</u>	<u>Median</u>	<u>Std.Dev.</u>	<u>CV</u>	<u>Skewness</u>
MW-50	9	9	1	1	1	1	0	0	NaN
MW-51	9	9	1	1	1	1	0	0	NaN
MW-52	9	9	1	1	1	1	0	0	NaN
MW-53	9	9	1	1	1	1	0	0	NaN
MW-54R	9	9	1	1	1	1	0	0	NaN
MW-55	9	9	1	1	1	1	0	0	NaN

Summary Report

Constituent: Arsenic, Total Analysis Run 2/26/2019 2:53 PM
Client: Consumers Energy Data: JCW_Sanitas.19.02.22

For observations made between 2/27/2017 and 11/8/2018, a summary of the selected data set:

Observations = 54
ND/Trace = 17
Wells = 6
Minimum Value = 1
Maximum Value = 41
Mean Value = 8.935
Median Value = 3
Standard Deviation = 11.34
Coefficient of Variation = 1.269
Skewness = 1.405

<u>Well</u>	<u>#Obs.</u>	<u>ND/Trace</u>	<u>Min</u>	<u>Max</u>	<u>Mean</u>	<u>Median</u>	<u>Std.Dev.</u>	<u>CV</u>	<u>Skewness</u>
MW-50	9	1	2	5	2.667	2	1	0.375	1.503
MW-51	9	0	13	41	23.09	21.8	8.226	0.3563	1.04
MW-52	9	8	1	5	1.444	1	1.333	0.9231	2.475
MW-53	9	0	2	5.1	2.9	3	1.079	0.3722	0.9559
MW-54R	9	8	1	1	1	1	0	0	NaN
MW-55	9	0	6	38	22.51	18	11.33	0.5032	0.3086

Summary Report

Constituent: Barium, Total Analysis Run 2/26/2019 2:53 PM
 Client: Consumers Energy Data: JCW_Sanitas.19.02.22

For observations made between 2/27/2017 and 11/8/2018, a summary of the selected data set:

Observations = 54
 ND/Trace = 0
 Wells = 6
 Minimum Value = 49
 Maximum Value = 393
 Mean Value = 161.4
 Median Value = 148
 Standard Deviation = 99.18
 Coefficient of Variation = 0.6144
 Skewness = 0.7805

<u>Well</u>	<u>#Obs.</u>	<u>ND/Trace</u>	<u>Min</u>	<u>Max</u>	<u>Mean</u>	<u>Median</u>	<u>Std.Dev.</u>	<u>CV</u>	<u>Skewness</u>
MW-50	9	0	239	393	325.4	351	49.5	0.1521	-0.3824
MW-51	9	0	163	318	229.2	196	57.7	0.2517	0.3285
MW-52	9	0	142	179	153.2	150	11.55	0.07539	1.238
MW-53	9	0	49	87	63.6	56	13.52	0.2126	0.5001
MW-54R	9	0	59.9	79.5	72.04	74	6.686	0.09281	-0.772
MW-55	9	0	69	190	125	133	47.69	0.3815	0.1031

Summary Report

Constituent: Beryllium, Total Analysis Run 2/26/2019 2:53 PM
Client: Consumers Energy Data: JCW_Sanitas.19.02.22

For observations made between 5/15/2018 and 11/8/2018, a summary of the selected data set:

Observations = 12
ND/Trace = 12
Wells = 6
Minimum Value = 1
Maximum Value = 1
Mean Value = 1
Median Value = 1
Standard Deviation = 0
Coefficient of Variation = 0
Skewness = NaN

<u>Well</u>	<u>#Obs.</u>	<u>ND/Trace</u>	<u>Min</u>	<u>Max</u>	<u>Mean</u>	<u>Median</u>	<u>Std.Dev.</u>	<u>CV</u>	<u>Skewness</u>
MW-50	2	2	1	1	1	1	0	0	NaN
MW-51	2	2	1	1	1	1	0	0	NaN
MW-52	2	2	1	1	1	1	0	0	NaN
MW-53	2	2	1	1	1	1	0	0	NaN
MW-54R	2	2	1	1	1	1	0	0	NaN
MW-55	2	2	1	1	1	1	0	0	NaN

Summary Report

Constituent: Cadmium, Total Analysis Run 2/26/2019 2:53 PM
Client: Consumers Energy Data: JCW_Sanitas.19.02.22

For observations made between 5/15/2018 and 11/8/2018, a summary of the selected data set:

Observations = 12
ND/Trace = 10
Wells = 6
Minimum Value = 0.2
Maximum Value = 1
Mean Value = 0.4183
Median Value = 0.2
Standard Deviation = 0.3532
Coefficient of Variation = 0.8443
Skewness = 1.11

<u>Well</u>	<u>#Obs.</u>	<u>ND/Trace</u>	<u>Min</u>	<u>Max</u>	<u>Mean</u>	<u>Median</u>	<u>Std.Dev.</u>	<u>CV</u>	<u>Skewness</u>
MW-50	2	2	0.2	0.2	0.2	0.2	0	0	NaN
MW-51	2	2	0.2	1	0.6	0.6	0.5657	0.9428	0
MW-52	2	2	0.2	1	0.6	0.6	0.5657	0.9428	0
MW-53	2	2	0.2	1	0.6	0.6	0.5657	0.9428	0
MW-54R	2	2	0.2	0.2	0.2	0.2	0	0	NaN
MW-55	2	0	0.3	0.32	0.31	0.31	0.01414	0.04562	0

Summary Report

Constituent: Chromium, Total Analysis Run 2/26/2019 2:53 PM
Client: Consumers Energy Data: JCW_Sanitas.19.02.22

For observations made between 2/27/2017 and 11/8/2018, a summary of the selected data set:

Observations = 54
ND/Trace = 44
Wells = 6
Minimum Value = 1
Maximum Value = 5
Mean Value = 1.37
Median Value = 1
Standard Deviation = 1.17
Coefficient of Variation = 0.854
Skewness = 2.811

<u>Well</u>	<u>#Obs.</u>	<u>ND/Trace</u>	<u>Min</u>	<u>Max</u>	<u>Mean</u>	<u>Median</u>	<u>Std.Dev.</u>	<u>CV</u>	<u>Skewness</u>
MW-50	9	7	1	5	1.444	1	1.333	0.9231	2.475
MW-51	9	7	1	5	1.444	1	1.333	0.9231	2.475
MW-52	9	8	1	5	1.444	1	1.333	0.9231	2.475
MW-53	9	6	1	5	1.444	1	1.333	0.9231	2.475
MW-54R	9	7	1	1	1	1	0	0	NaN
MW-55	9	9	1	5	1.444	1	1.333	0.9231	2.475

Summary Report

Constituent: Cobalt, Total Analysis Run 2/26/2019 2:53 PM
Client: Consumers Energy Data: JCW_Sanitas.19.02.22

For observations made between 5/15/2018 and 11/8/2018, a summary of the selected data set:

Observations = 12
ND/Trace = 12
Wells = 6
Minimum Value = 6
Maximum Value = 30
Mean Value = 20.5
Median Value = 15
Standard Deviation = 8.754
Coefficient of Variation = 0.427
Skewness = 0.03397

<u>Well</u>	<u>#Obs.</u>	<u>ND/Trace</u>	<u>Min</u>	<u>Max</u>	<u>Mean</u>	<u>Median</u>	<u>Std.Dev.</u>	<u>CV</u>	<u>Skewness</u>
MW-50	2	2	15	30	22.5	22.5	10.61	0.4714	0
MW-51	2	2	15	30	22.5	22.5	10.61	0.4714	0
MW-52	2	2	15	30	22.5	22.5	10.61	0.4714	0
MW-53	2	2	15	30	22.5	22.5	10.61	0.4714	0
MW-54R	2	2	6	15	10.5	10.5	6.364	0.6061	0
MW-55	2	2	15	30	22.5	22.5	10.61	0.4714	0

Summary Report

Constituent: Fluoride Analysis Run 2/26/2019 2:53 PM
Client: Consumers Energy Data: JCW_Sanitas.19.02.22

For observations made between 5/15/2018 and 11/8/2018, a summary of the selected data set:

Observations = 12
ND/Trace = 12
Wells = 6
Minimum Value = 1000
Maximum Value = 1000
Mean Value = 1000
Median Value = 1000
Standard Deviation = 0
Coefficient of Variation = 0
Skewness = NaN

<u>Well</u>	<u>#Obs.</u>	<u>ND/Trace</u>	<u>Min</u>	<u>Max</u>	<u>Mean</u>	<u>Median</u>	<u>Std.Dev.</u>	<u>CV</u>	<u>Skewness</u>
MW-50	2	2	1000	1000	1000	1000	0	0	NaN
MW-51	2	2	1000	1000	1000	1000	0	0	NaN
MW-52	2	2	1000	1000	1000	1000	0	0	NaN
MW-53	2	2	1000	1000	1000	1000	0	0	NaN
MW-54R	2	2	1000	1000	1000	1000	0	0	NaN
MW-55	2	2	1000	1000	1000	1000	0	0	NaN

Summary Report

Constituent: Lead, Total Analysis Run 2/26/2019 2:53 PM
Client: Consumers Energy Data: JCW_Sanitas.19.02.22

For observations made between 2/27/2017 and 11/8/2018, a summary of the selected data set:

Observations = 54
ND/Trace = 54
Wells = 6
Minimum Value = 1
Maximum Value = 5
Mean Value = 1.37
Median Value = 1
Standard Deviation = 1.17
Coefficient of Variation = 0.854
Skewness = 2.811

<u>Well</u>	<u>#Obs.</u>	<u>ND/Trace</u>	<u>Min</u>	<u>Max</u>	<u>Mean</u>	<u>Median</u>	<u>Std.Dev.</u>	<u>CV</u>	<u>Skewness</u>
MW-50	9	9	1	5	1.444	1	1.333	0.9231	2.475
MW-51	9	9	1	5	1.444	1	1.333	0.9231	2.475
MW-52	9	9	1	5	1.444	1	1.333	0.9231	2.475
MW-53	9	9	1	5	1.444	1	1.333	0.9231	2.475
MW-54R	9	9	1	1	1	1	0	0	NaN
MW-55	9	9	1	5	1.444	1	1.333	0.9231	2.475

Summary Report

Constituent: Lithium, Total Analysis Run 2/26/2019 2:53 PM
Client: Consumers Energy Data: JCW_Sanitas.19.02.22

For observations made between 2/27/2017 and 11/8/2018, a summary of the selected data set:

Observations = 54
ND/Trace = 0
Wells = 6
Minimum Value = 16
Maximum Value = 94
Mean Value = 53.52
Median Value = 55.75
Standard Deviation = 16.83
Coefficient of Variation = 0.3145
Skewness = -0.4305

<u>Well</u>	<u>#Obs.</u>	<u>ND/Trace</u>	<u>Min</u>	<u>Max</u>	<u>Mean</u>	<u>Median</u>	<u>Std.Dev.</u>	<u>CV</u>	<u>Skewness</u>
MW-50	9	0	63	94	75.67	74	8.818	0.1165	0.8705
MW-51	9	0	55	71	62.61	62	5.183	0.08278	0.1299
MW-52	9	0	44	61.5	53.56	54	4.7	0.08776	-0.4598
MW-53	9	0	35	59	46.67	48	6.614	0.1417	0.007941
MW-54R	9	0	52	62	57.44	58	3.283	0.05715	-0.3963
MW-55	9	0	16	40	25.17	23	8.761	0.3481	0.4137

Summary Report

Constituent: Mercury, Total Analysis Run 2/26/2019 2:53 PM
Client: Consumers Energy Data: JCW_Sanitas.19.02.22

For observations made between 5/15/2018 and 11/8/2018, a summary of the selected data set:

Observations = 12
ND/Trace = 12
Wells = 6
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

<u>Well</u>	<u>#Obs.</u>	<u>ND/Trace</u>	<u>Min</u>	<u>Max</u>	<u>Mean</u>	<u>Median</u>	<u>Std.Dev.</u>	<u>CV</u>	<u>Skewness</u>
MW-50	2	2	0.2	0.2	0.2	0.2	0	0	NaN
MW-51	2	2	0.2	0.2	0.2	0.2	0	0	NaN
MW-52	2	2	0.2	0.2	0.2	0.2	0	0	NaN
MW-53	2	2	0.2	0.2	0.2	0.2	0	0	NaN
MW-54R	2	2	0.2	0.2	0.2	0.2	0	0	NaN
MW-55	2	2	0.2	0.2	0.2	0.2	0	0	NaN

Summary Report

Constituent: Molybdenum, Total Analysis Run 2/26/2019 2:53 PM
 Client: Consumers Energy Data: JCW_Sanitas.19.02.22

For observations made between 2/27/2017 and 11/8/2018, a summary of the selected data set:

Observations = 54
 ND/Trace = 35
 Wells = 6
 Minimum Value = 5
 Maximum Value = 172
 Mean Value = 26.66
 Median Value = 5
 Standard Deviation = 47.86
 Coefficient of Variation = 1.795
 Skewness = 2.138

<u>Well</u>	<u>#Obs.</u>	<u>ND/Trace</u>	<u>Min</u>	<u>Max</u>	<u>Mean</u>	<u>Median</u>	<u>Std.Dev.</u>	<u>CV</u>	<u>Skewness</u>
MW-50	9	2	5	10	6.778	6	1.641	0.2422	0.7335
MW-51	9	9	5	25	7.222	5	6.667	0.9231	2.475
MW-52	9	9	5	25	7.222	5	6.667	0.9231	2.475
MW-53	9	9	5	25	7.222	5	6.667	0.9231	2.475
MW-54R	9	6	5	6	5.222	5	0.441	0.08444	1.336
MW-55	9	0	65	172	126.3	132	40.48	0.3206	-0.2049

Summary Report

Constituent: Radium-226 Analysis Run 2/26/2019 2:53 PM
Client: Consumers Energy Data: JCW_Sanitas.19.02.22

For observations made between 11/7/2018 and 11/8/2018, a summary of the selected data set:

Observations = 6
ND/Trace = 4
Wells = 6
Minimum Value = 0.664
Maximum Value = 1.4
Mean Value = 0.9244
Median Value = 0.8387
Standard Deviation = 0.2819
Coefficient of Variation = 0.3049
Skewness = 0.7779

<u>Well</u>	<u>#Obs.</u>	<u>ND/Trace</u>	<u>Min</u>	<u>Max</u>	<u>Mean</u>	<u>Median</u>	<u>Std.Dev.</u>	<u>CV</u>	<u>Skewness</u>
MW-50	1	0	1.4	1.4	1.4	1.4	0	0	NaN
MW-51	1	1	0.715	0.715	0.715	0.715	0	0	NaN
MW-52	1	0	0.7455	0.7455	0.7455	0.7455	0	0	NaN
MW-53	1	1	0.664	0.664	0.664	0.664	0	0	NaN
MW-54R	1	1	1.09	1.09	1.09	1.09	0	0	NaN
MW-55	1	1	0.932	0.932	0.932	0.932	0	0	NaN

Summary Report

Constituent: Radium-226/228 Analysis Run 2/26/2019 2:53 PM
Client: Consumers Energy Data: JCW_Sanitas.19.02.22

For observations made between 11/7/2018 and 11/8/2018, a summary of the selected data set:

Observations = 6
ND/Trace = 4
Wells = 6
Minimum Value = 1.32
Maximum Value = 3.28
Mean Value = 1.873
Median Value = 1.625
Standard Deviation = 0.7128
Coefficient of Variation = 0.3805
Skewness = 1.533

<u>Well</u>	<u>#Obs.</u>	<u>ND/Trace</u>	<u>Min</u>	<u>Max</u>	<u>Mean</u>	<u>Median</u>	<u>Std.Dev.</u>	<u>CV</u>	<u>Skewness</u>
MW-50	1	0	3.28	3.28	3.28	3.28	0	0	NaN
MW-51	1	1	1.64	1.64	1.64	1.64	0	0	NaN
MW-52	1	0	1.51	1.51	1.51	1.51	0	0	NaN
MW-53	1	1	1.32	1.32	1.32	1.32	0	0	NaN
MW-54R	1	1	1.88	1.88	1.88	1.88	0	0	NaN
MW-55	1	1	1.61	1.61	1.61	1.61	0	0	NaN

Summary Report

Constituent: Radium-228 Analysis Run 2/26/2019 2:53 PM
Client: Consumers Energy Data: JCW_Sanitas.19.02.22

For observations made between 11/7/2018 and 11/8/2018, a summary of the selected data set:

Observations = 6
ND/Trace = 3
Wells = 6
Minimum Value = 0.655
Maximum Value = 1.88
Mean Value = 0.9811
Median Value = 0.7763
Standard Deviation = 0.471
Coefficient of Variation = 0.48
Skewness = 1.362

<u>Well</u>	<u>#Obs.</u>	<u>ND/Trace</u>	<u>Min</u>	<u>Max</u>	<u>Mean</u>	<u>Median</u>	<u>Std.Dev.</u>	<u>CV</u>	<u>Skewness</u>
MW-50	1	0	1.88	1.88	1.88	1.88	0	0	NaN
MW-51	1	0	1.12	1.12	1.12	1.12	0	0	NaN
MW-52	1	0	0.7665	0.7665	0.7665	0.7665	0	0	NaN
MW-53	1	1	0.655	0.655	0.655	0.655	0	0	NaN
MW-54R	1	1	0.786	0.786	0.786	0.786	0	0	NaN
MW-55	1	1	0.679	0.679	0.679	0.679	0	0	NaN

Summary Report

Constituent: Selenium, Total Analysis Run 2/26/2019 2:53 PM
Client: Consumers Energy Data: JCW_Sanitas.19.02.22

For observations made between 2/27/2017 and 11/8/2018, a summary of the selected data set:

Observations = 54
ND/Trace = 43
Wells = 6
Minimum Value = 1
Maximum Value = 17
Mean Value = 1.481
Median Value = 1
Standard Deviation = 2.478
Coefficient of Variation = 1.673
Skewness = 5.444

<u>Well</u>	<u>#Obs.</u>	<u>ND/Trace</u>	<u>Min</u>	<u>Max</u>	<u>Mean</u>	<u>Median</u>	<u>Std.Dev.</u>	<u>CV</u>	<u>Skewness</u>
MW-50	9	7	1	1	1	1	0	0	NaN
MW-51	9	8	1	1	1	1	0	0	NaN
MW-52	9	8	1	1	1	1	0	0	NaN
MW-53	9	7	1	1	1	1	0	0	NaN
MW-54R	9	8	1	1	1	1	0	0	NaN
MW-55	9	5	1	17	3.889	1	5.732	1.474	1.64

Summary Report

Constituent: Thallium, Total Analysis Run 2/26/2019 2:53 PM
Client: Consumers Energy Data: JCW_Sanitas.19.02.22

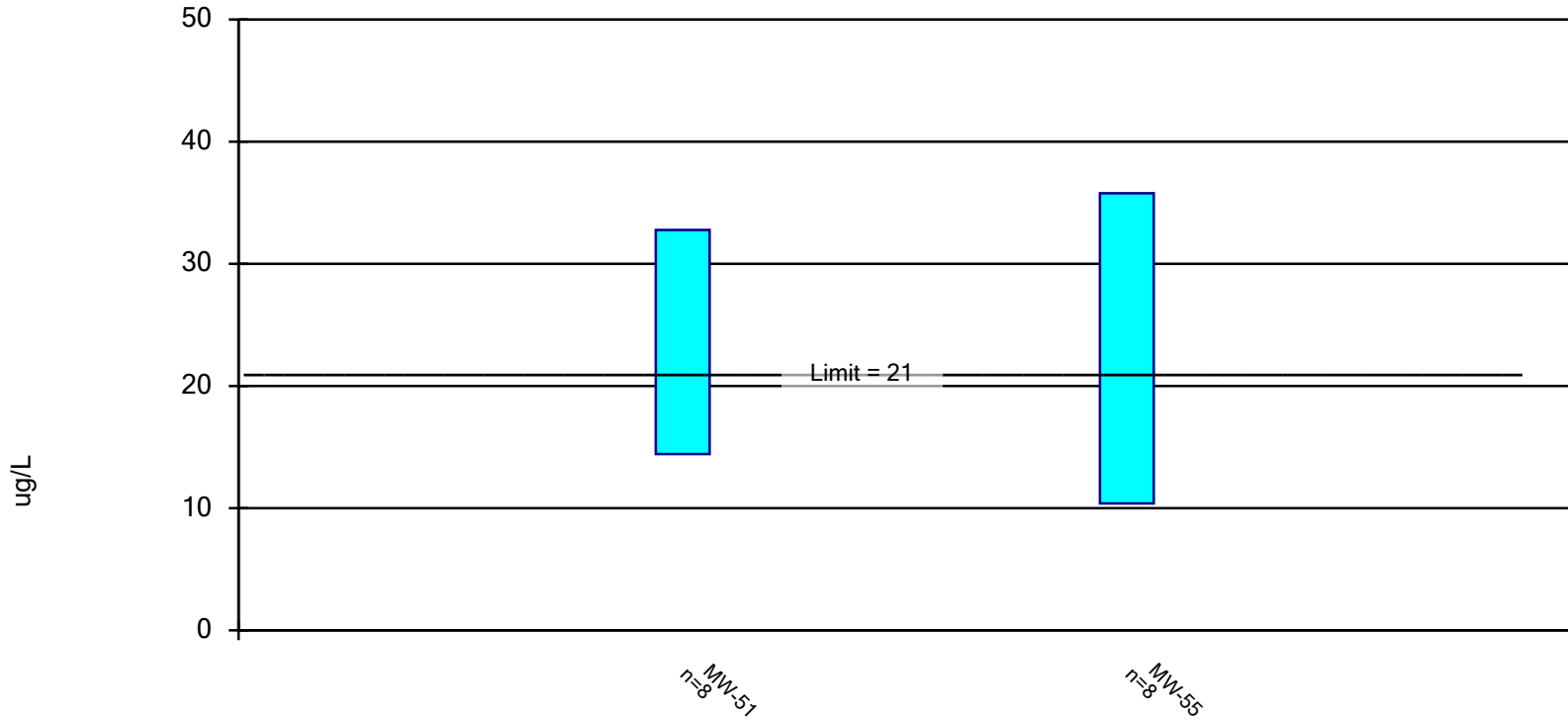
For observations made between 5/15/2018 and 11/8/2018, a summary of the selected data set:

Observations = 12
ND/Trace = 12
Wells = 6
Minimum Value = 2
Maximum Value = 10
Mean Value = 5.333
Median Value = 2
Standard Deviation = 4.119
Coefficient of Variation = 0.7724
Skewness = 0.3381

<u>Well</u>	<u>#Obs.</u>	<u>ND/Trace</u>	<u>Min</u>	<u>Max</u>	<u>Mean</u>	<u>Median</u>	<u>Std.Dev.</u>	<u>CV</u>	<u>Skewness</u>
MW-50	2	2	2	10	6	6	5.657	0.9428	0
MW-51	2	2	2	10	6	6	5.657	0.9428	0
MW-52	2	2	2	10	6	6	5.657	0.9428	0
MW-53	2	2	2	10	6	6	5.657	0.9428	0
MW-54R	2	2	2	2	2	2	0	0	NaN
MW-55	2	2	2	10	6	6	5.657	0.9428	0

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 2/26/2019 2:56 PM

Client: Consumers Energy Data: JCW_Sanitas.19.02.22

Confidence Interval

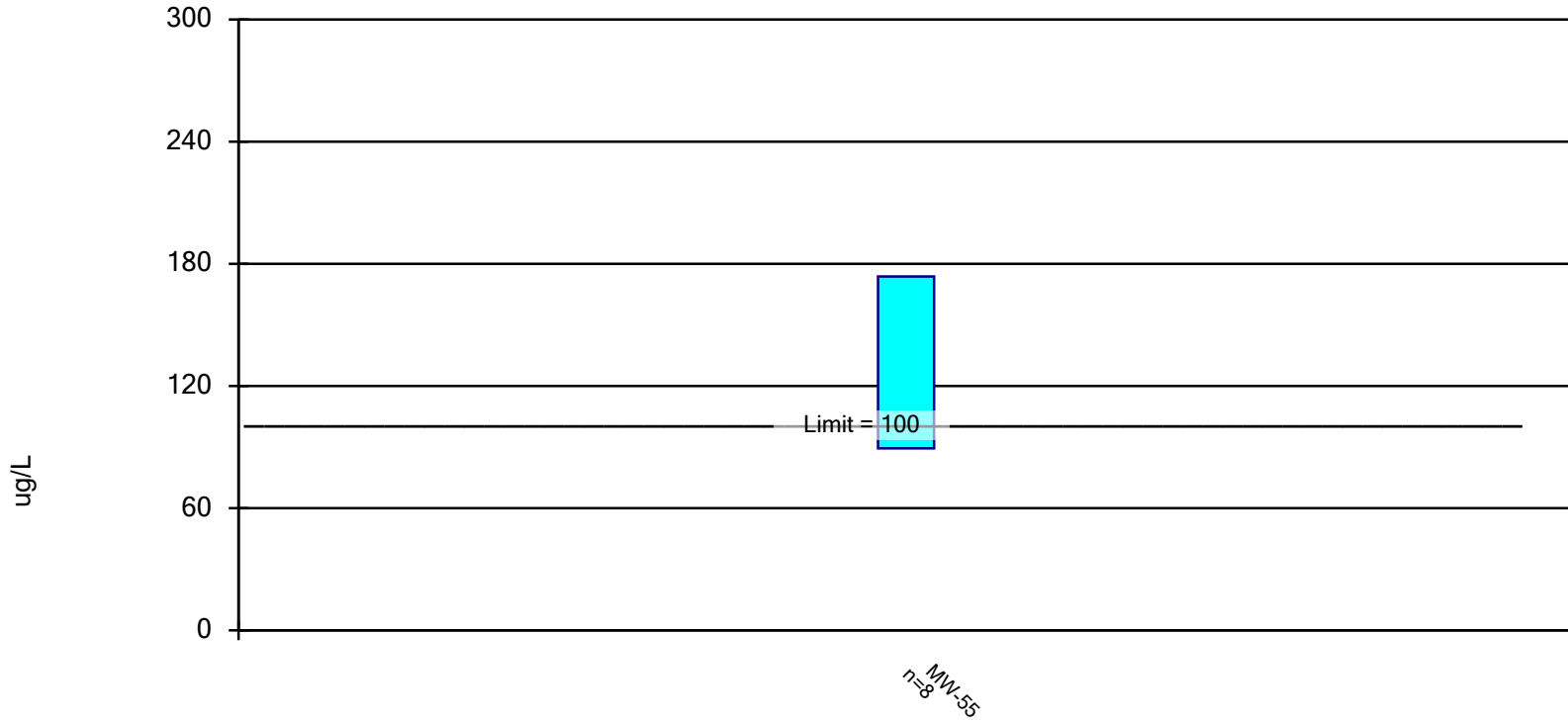
Constituent: Arsenic, Total (ug/L) Analysis Run 2/26/2019 2:57 PM

Client: Consumers Energy Data: JCW_Sanitas.19.02.22

	MW-51	MW-55
5/11/2017	24	6
8/9/2017	41	
8/10/2017		15
11/1/2017	28	
11/2/2017		19
3/6/2018	16	18
5/15/2018		16.5 (D)
5/16/2018	13	
8/15/2018	19	
8/16/2018		37
10/23/2018	26 (D)	38
11/8/2018	21.8	35.1
Mean	23.6	23.08
Std. Dev.	8.64	11.97
Upper Lim.	32.76	35.77
Lower Lim.	14.44	10.38

Parametric Confidence Interval

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



Constituent: Molybdenum, Total Analysis Run 2/26/2019 2:57 PM

Client: Consumers Energy Data: JCW_Sanitas.19.02.22

Confidence Interval

Constituent: Molybdenum, Total (ug/L) Analysis Run 2/26/2019 2:58 PM

Client: Consumers Energy Data: JCW_Sanitas.19.02.22

	MW-55
5/11/2017	65
8/10/2017	88
11/2/2017	139
3/6/2018	132
5/15/2018	117.5 (D)
8/16/2018	172
10/23/2018	168
11/8/2018	171
Mean	131.6
Std. Dev.	39.82
Upper Lim.	173.8
Lower Lim.	89.36

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 $\leq 5X$ 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 Landfill

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) 440-238633-1, 440-238851-1, 440-238627-1, and 440-238848-1.

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

- JCW-MW-18001
- JCW-MW-18006
- MW-52
- MW-54R
- OW-57R Out
- JCW-MW-18004
- MW-50
- MW-53
- MW-55
- JCW-MW-18005
- MW-51
- MW-53R
- OW-57 Out

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/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.
- 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.
- A method blank was analyzed with each analytical batch. Target analytes were not detected in the method blanks except for the following:
 - Lead was detected in method blank 440-541702/1-A associated with all the samples in SDG 440-238851-1 (preparation batch 541702) at a concentration of 0.00349 mg/L. The positive result for lead in sample JCW-MW-18004 may be a false positive due to method blank contamination since the result was detected at a concentration less than 5x the method blank concentration, as summarized in the attached table.
- One equipment blank (EB-03) and one field blank (Field Blank) were collected and analyzed for metals and mercury. Target analytes were not detected in the field blank, but the following analytes were detected in the equipment blank:
 - Iron and zinc were detected in EB-03 at concentrations of 0.016 mg/L and 0.013 mg/L, respectively. The positive results for iron in sample OW-57R OUT and for zinc in sample JCW-MW-18004 may be false positives due to equipment blank contamination since these results were detected at concentrations less than 5x the equipment blank concentrations, as summarized in the attached table.
- MS/MSD analyses were performed on sample JCW-MW-18004 for lead; on sample MW-52 for chloride; on sample OW-57R OUT for chloride and sulfate; and on sample JCW-MW-18001 for anions, mercury, and metals. All recoveries and relative percent differences (RPDs) were within the QC limits with the following exceptions.
 - The recoveries of calcium, magnesium, and/or sodium were outside of the acceptance criteria in the MS/MSD analyses performed on sample JCW-MW-18001. These analytes were detected in this parent sample at concentrations >4x the spike concentrations; therefore, the MS/MSD results for calcium, magnesium, and/or sodium 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-03 and JCW-MW-18006; RPDs between the parent and duplicate sample were within the QC limits.
- Laboratory duplicate analyses were performed on sample JCW-MW-18001 for alkalinity and TDS, and sample OW-57 OUT for alkalinity; RPDs were within QC limits.

- The RLs for nondetect results for metals by SW846 6020 in samples JCW-MW-18006 and DUP-03 exceeded the project-required RLs due to the 2-fold dilution which was performed because of interference from the sample matrix.

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	Selenium	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 A.
- 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. Results are within the range of historically observed concentration at these wells; therefore, data deemed usable for intended purpose.
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. Results are within the range of historically observed concentration at these wells; therefore, data deemed usable for intended purpose.

Laboratory Data Quality Review Groundwater Monitoring Event October 2019 JC Weadock Landfill

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) 240-120410-1, 240-120410-2, 240-120634-1, and 240-120634-2.

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

- JCW-MW-18001
- JCW-MW-18006
- MW-52
- MW-54R
- OW-57R Out
- JCW-MW-18004
- MW-50
- MW-53
- MW-55
- JCW-MW-18005
- MW-51
- MW-53R
- OW-57 Out

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, 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. Target analytes were not detected in the method blank samples with the following exception. Normalized absolute difference comparisons between blank and sample that are between 1.96 and 2.58 may indicate biased high results and normalized absolute differences <1.96 may indicate a false positive sample result.
 - Radium-226 was detected in method blank 160-446464/22-A at a concentration of 0.158 ± 0.105 pCi/L. The detected radium-226 results for the samples associated with this method blank were potentially impacted (either potential false positives or potential high biases), as summarized in the attached table, Attachment A.
- One equipment blank (EB-03) and one field blank (FB-03) were collected. Target analytes were not detected in these blank samples with the following exceptions.
 - Chromium was detected in EB-03 at 0.003 mg/L. The detected chromium results for the samples associated with the equipment blank were potentially impacted, as summarized in the attached table, Attachment A.
 - Zinc was detected in FB-03 at 0.011 mg/L. The presence of zinc in this field blank has no effect on the sample results since zinc was not detected in the samples.
- The LCS and/or LCSD recoveries and relative percent differences (RPDs), where applicable, for all analytes were within QC limits with the following exception.
 - Radium-228 recovered above the QC limits in one of the LCSs. The detected radium-228 results for the samples associated with this LCS were potentially impacted, as summarized in the attached table, Attachment A.
- MS and MSD analyses were performed on were performed sample JCW-MW-18001 for metals and anions. All recoveries and RPDs were within the QC limits with the following exceptions.
 - The recoveries of calcium were outside of the acceptance criteria in the MS/MSD analyses. The calcium concentration in this sample was >4x the spike concentrations; therefore, the MS/MSD results for calcium were not evaluated. Data usability was not affected.
 - The recoveries for selenium in the MS/MSD analyses performed on sample JCW-MW-18001 were below the control limits. Potential low bias exists for the results for selenium in all samples collected during this event, as summarized in the attached table, Attachment A.
- The field duplicate pair samples were Dup-03 and MW-51; RPDs between the parent and duplicate sample were within the QC limits.
- Laboratory duplicate analyses were performed on samples JCW-MW-18006, JCW-MW-18001, and MW-55 for TDS; RPDs were within QC limits.

- The nondetect RL (2.0 mg/L) for fluoride in sample JCW-MW-18001 was above the project-specified RL (1.0 mg/L) due to a 2-fold dilution likely performed due to the elevated concentration of sulfate.
- 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, where applicable, were within 40-110%.

Attachment 1

Summary of Data Non-Conformances for Landfill Groundwater Analytical Data
 JC Weadock Power Plant Landfill – RCRA CCR Monitoring Program
 Essexville, Michigan

Samples	Collection Date	Analyte	Non-Conformance/Issue
JCW-MW-18005	10/11/2019	Chromium	Detection in equipment blank (EB-03). Results <5x the blank result; indicates possible false positive results.
OW-57 OUT	10/11/2019		
MW-53R	10/10/2019		
MW-50	10/10/2019		
OW-57R OUT	10/14/2019		
JCW-MW-18001	10/10/2019	Selenium	Low recoveries in matrix spike and matrix spike duplicate analyses; indicates potential low bias.
JCW-MW-18005	10/11/2019		
MW-50	10/10/2019		
MW-51	10/10/2019		
MW-52	10/10/2019		
MW-53	10/10/2019		
MW-53R	10/10/2019		
MW-54R	10/10/2019		
MW-55	10/11/2019		
OW-57 OUT	10/11/2019		
DUP-03	10/10/2019		
JCW-MW-18004	10/15/2019		
JCW-MW-18006	10/14/2019		
OW-57R OUT	10/14/2019		
MW-50	10/10/2019		
MW-51	10/10/2019		
MW-55	10/11/2019		
DUP-03	10/10/2019		
MW-50	10/10/2019	Radium-226	Detection in method blank. Normalized absolute difference between blank and samples between 1.96 and 2.58; indicates possible high bias results.
MW-53R	10/10/2019		
JCW-MW-18001	10/10/2019	Radium-226	Detection in method blank. Normalized absolute difference between blank and samples <1.96; indicates possible false positive results.
JCW-MW-18005	10/11/2019		
MW-51	10/10/2019		
MW-52	10/10/2019		
MW-53	10/10/2019		
MW-54R	10/10/2019		
MW-55	10/11/2019		
OW-57 OUT	10/10/2019		
DUP-03	10/11/2019		

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	< 1.0	--	< 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	< 1.0	--	< 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	< 0.20	--	< 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	1.3	--	< 1.0	< 1.0	< 1.0	< 1.0	1.2
Cobalt	ug/L	15	40	100	100	370	740	NC	NC	< 15	< 15	< 15	< 15	< 15	< 15.0	--	< 15.0	< 15.0	< 6.0	< 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	< 1.0	--	< 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	< 0.20	--	< 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	< 5.0	--	< 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	< 1.0	--	< 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	< 2.0	--	< 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.
 * - 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	< 1.0	--	< 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	< 1.0	--	< 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	< 1.0	--	< 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	< 0.20	--	< 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	< 1.0	--	< 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	< 15.0	--	< 15.0	< 15.0	< 6.0	< 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	< 1.0	--	< 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	< 0.20	--	< 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	< 5.0	--	< 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	< 1.0	--	< 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	< 2.0	--	< 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.
 * - 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	9/19/2017	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	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	< 1.0	< 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	--	4.9	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	9/19/2017	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
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	9/19/2017	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

Constituent	Unit	GWPS*	Sample Location:								JCW-MW-18001				JCW-MW-18004				JCW-MW-18005				JCW-MW-18006			
			MI Residential*	MI Non-Residential*	MI GSI^	MI AMV***	MI FAV***	Chronic MZ^^	Acute MZ^^	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
										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	< 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	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.

- (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 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	
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	3	3	2	3	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	--	--	--	--	--	--	--	--	--	--	--	--	< 1.0	--	< 1.0	
Cadmium	ug/L	5	5.0	5.0	2.5	12	24	NC	NC	--	--	--	--	--	--	--	--	--	--	--	--	< 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	--	--	--	--	--	--	--	--	--	--	--	--	< 30.0	--	< 6.0	
Fluoride	ug/L	4,000	NC	NC	NC	10,000	20,000	NC	NC	--	--	--	--	--	--	--	--	--	--	--	--	< 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	--	--	--	--	--	--	--	--	--	--	--	--	< 0.20	--	< 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	--	< 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 January 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
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	< 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	< 5	< 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 January 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
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	< 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	< 1	< 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	< 1	< 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	< 1	< 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	< 5	< 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 January 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	< 1	< 1.0	
Arsenic	ug/L	21 ⁽¹⁾	10	10	10	340	680	100	680	2	2	3	3	2	3	3	3	2	3	4	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	71	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	< 5	< 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 January 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	
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	< 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	< 1	< 5.0 ⁽²⁾	< 1	
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	< 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	< 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.
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 *** - 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 January 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	< 1.0	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	< 1.0	< 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	< 1.0	< 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.
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 *** - 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 January 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										downgradient																	
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^^																		
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	< 1	< 1	< 1	< 1	< 1		
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 January 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

Constituent	Unit	GWPS*	MI Residential*	MI Non-Residential*	MI GSI^	MI AMV***	MI FAV***	Chronic MZ^^	Acute MZ^^	OW-57OUT				OW-57ROUT		
										Sample Date:	8/31/2018	11/8/2018	3/14/2019	4/12/2019	11/8/2018	3/14/2019
										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 January 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 Kam & 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

		Sample Location: JCW-MW-18001					Sample Date: JCW-MW-18004							
		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

							Sample Location: JCW-MW-18005				Sample Location: JCW-MW-18006			
							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

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	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 ^{***}	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	< 0.2	< 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

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 ^{***}	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

		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	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

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	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 Landfill, 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 Power Plant Landfill CCR Unit* for the JC Weadock (JCW) site in Essexville, Michigan, that boron and pH 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 JCW Landfill CCR unit pursuant to §257.95 of the CCR Rule¹ 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 Landfill 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 with §257.95, the assessment

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 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 is present at statistically significant levels exceeding the GWPS in downgradient monitoring wells at the JC Weadock Landfill:

<u>Constituent</u>	<u>GWPS</u>	<u>#Downgradient Wells Observed</u>
Arsenic	21 ug/L	1 of 3

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 HMP².

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

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

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, CEC established a groundwater monitoring system for the JCW Landfill CCR unit, which consists of 7 monitoring wells (four background monitoring wells and three downgradient monitoring wells) that are screened in the uppermost aquifer. The monitoring well locations are shown on Figure 2. Four monitoring wells located between $\frac{1}{4}$ and $\frac{1}{2}$ mile south of the JCW Landfill CCR unit 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 Bottom Ash Pond CCR unit as well as the DEK Bottom Ash Pond CCR unit.

In order to reduce porewater flux from the land disposal area, CEC completed construction of a soil-bentonite slurry wall at the site in December 2008. Originally, the slurry wall enclosed the historical fly ash disposal area except for a small segment along the perimeter dike that was designed to vent along the discharge channel immediately upgradient from the National Pollutant Discharge Elimination System (NPDES) external outfall to prevent water from building up within the site. Three groundwater monitoring wells were installed within the vent area to monitor downgradient water quality (JCW-MW-15011, JCW-MW-15012, and JCW-MW-15023). Subsequent changes to the groundwater monitoring system that occurred after this assessment monitoring event will be described in detail in the 2018 Annual Groundwater Monitoring which will be completed on January 31, 2019.

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 Landfill CCR Unit were evaluated in accordance with the *Groundwater Statistical Evaluation*



Plan (Stats Plan) (TRC, October 2017). Consistent with the Unified Guidance³, 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 for 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-15012 and JCW-MW-15023 had individual results exceeding the GWPS. Radium-226/228 was detected in JCW-MW-15011 at a concentration of 5.634 ug/L during the November 2016 event, which exceeds its GWPS (5 ug/L). However, this detection of Radium-226/228 is an order of magnitude greater than the majority of the reported concentrations for this well during either baseline sampling or assessment monitoring, and it qualifies as an outlier. Radium-226/228 was not retained for further analysis as the remaining concentrations observed in the JCW Landfill CCR unit monitoring well network were below the GWPS.

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 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 in the arsenic data set. 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 arsenic data sets were found to be normally distributed. 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 arsenic at JCW-MW-15023. 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.

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



Mr. Register
Consumers Energy Company
January 14, 2019
Page 6

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 Landfill – RCRA CCR Monitoring Program
 Essexville, Michigan

Sample Location:						JCW-MW-15011											
Sample Date:						12/10/2015	3/31/2016	5/25/2016	8/25/2016	11/30/2016	2/22/2017	5/17/2017	8/3/2017	9/19/2017	4/11/2018	4/11/2018	5/21/2018
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS	downgradient											
Appendix III																	
Boron	ug/L	NC	NA	619	NA	1,260	878	883	1,470	1,690	1,970	1,310	1,390	1,680	--	Field Dup	1,790
Calcium	mg/L	NC	NA	302	NA	222	226	182	199	125	112	182	158	168	--	--	131
Chloride	mg/L	250*	NA	2,440	NA	70.3	60.9	54.3	77.5	84.2	84.3	69.3	74.0	70.1	--	--	65.5
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	7.08	7.3	7.4	7.4	7.4	7.3	7.1	7.2	7.2	7.1	--	7.0
Sulfate	mg/L	250*	NA	407	NA	386	386	310	220	110	79.4	376	267	304	--	--	85.2
Total Dissolved Solids	mg/L	500*	NA	4,600	NA	960	910	820	800	630	580	880	768	810	--	--	666
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	8	6	4	7	4	3	7	5.8	--	< 1.0	< 1.0	1.7
Barium	ug/L	2,000	NA	1,300	2,000	61	67	85	166	110	104	65	97.8	--	99.7	97.9	98.9
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	2	< 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	25.6	18.5	15	16	16	16	23	22	--	35	34	31
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	< 0.14	< 0.26	0.237	< 0.261	< 0.301	0.359	< 0.26	< 0.599	--	< 0.807	< 0.798	< 0.867
Radium-226/228	pCi/L	5	NA	3.32	5	0.679	< 0.471	< 0.753	< 0.71	5.634	0.776	1.48	< 1.48	--	< 1.72	< 1.76	< 1.71
Radium-228	pCi/L	5	NA	NA	NA	0.54	< 0.471	< 0.753	< 0.71	5.53	< 0.584	1.38	< 0.876	--	< 0.910	< 0.963	< 0.842
Selenium	ug/L	50	NA	2	50	< 1	< 1	< 1	< 1	< 1	2	< 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 1
 Comparison of Groundwater Sampling Results to Groundwater Protection Standards – December 2015 to May 2018
 JC Weadock Landfill – RCRA CCR Monitoring Program
 Essexville, Michigan

Sample Location:						JCW-MW-15012											
Sample Date:						12/10/2015	4/1/2016	5/25/2016	8/25/2016	11/30/2016	2/22/2017	5/17/2017	8/3/2017	8/11/2017	9/19/2017	4/11/2018	5/21/2018
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS	downgradient											
Appendix III																	
Boron	ug/L	NC	NA	619	NA	1,760	1,220	1,540	2,000	2,260	1,570	1,540	1,790	--	2,110	--	1,040
Calcium	mg/L	NC	NA	302	NA	94.5	121	107	92.3	129	113	124	148	--	127	--	102
Chloride	mg/L	250*	NA	2,440	NA	69.3	43.3	58	68.4	61.9	40.5	42.8	--	59.3	69.1	--	32.7
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	7.1	7.1	7.0	7.2	7.0	7.3	7.0	--	6.7	6.9	6.9	7.0
Sulfate	mg/L	250*	NA	407	NA	70.9	86	81.7	45.6	65.4	74.6	90.6	--	116	98.0	--	72.1
Total Dissolved Solids	mg/L	500*	NA	4,600	NA	510	530	510	460	610	520	570	--	626	638	--	506
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	25	12	13	36	26	19	40	28.0	--	--	20.0	22.9
Barium	ug/L	2,000	NA	1,300	2,000	90	73	69	89	152	123	140	150	--	--	116	109
Beryllium	ug/L	4	NA	1	4	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 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
Chromium	ug/L	100	NA	3	100	1	2	1	< 1	< 1	1	1	3.5	--	--	< 1.0	< 1.0
Cobalt	ug/L	NC	6	15	15	< 15	< 15	< 15	< 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	53.1	46.6	50	51	79	66	70	79	--	--	71	61
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	27	27	34	44	13	13	47	18.7	--	--	12.0	15.7
Radium-226	pCi/L	5	NA	NA	NA	0.254	< 0.375	< 0.316	< 0.19	< 0.373	0.508	< 0.18	0.443	--	--	< 0.847	< 0.676
Radium-226/228	pCi/L	5	NA	3.32	5	0.97	< 0.475	< 0.7	< 0.479	1.68	1.048	0.85	1.42	--	--	< 1.74	< 1.50
Radium-228	pCi/L	5	NA	NA	NA	0.716	< 0.475	< 0.7	< 0.479	1.64	0.54	0.816	0.975	--	--	1.03	< 0.826
Selenium	ug/L	50	NA	2	50	< 1	26	7	< 1	< 1	< 1	1	< 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

Notes:

ug/L - micrograms per liter.
 mg/L - milligrams per liter.
 SU - standard units; pH is a field parameter.
 pCi/L - picocuries per liter.
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 * - 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 Landfill – RCRA CCR Monitoring Program
 Essexville, Michigan

Sample Location:						JCW-MW-15023														
Sample Date:						12/10/2015	4/1/2016	5/25/2016	8/25/2016	11/30/2016	2/22/2017	5/17/2017	8/3/2017	8/3/2017	9/19/2017	9/19/2017	4/11/2018	5/21/2018	5/21/2018	
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS	downgradient														
Appendix III															Field Dup		Field Dup			Field Dup
Boron	ug/L	NC	NA	619	NA	761	765	1,220	1,410	1,320	1,390	1,340	1,320	1,460	1,060	1,200	--	1,170	1,300	
Calcium	mg/L	NC	NA	302	NA	73	76.1	74.2	66.2	67.2	82	146	122	120	86.6	86.8	--	62.2	62.2	
Chloride	mg/L	250*	NA	2,440	NA	67.9	59.5	56.3	68.1	69.8	70.5	36.7	56.5	57.7	72.3	72.3	--	70.1	70.3	
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	
pH, Field	SU	6.5 - 8.5*	NA	6.5-7.3	NA	7.4	7.6	7.4	7.5	7.5	7.6	7.4	7.3	--	7.4	--	7.4	7.5	--	
Sulfate	mg/L	250*	NA	407	NA	46.8	69.2	60.7	50.7	65.1	138	224	174	163	99.2	98.1	--	92.9	93.3	
Total Dissolved Solids	mg/L	500*	NA	4,600	NA	440	430	430	390	440	520	710	612	684	490	494	--	402	442	
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	20	25	47	78	117	102	38	122	138	--	--	101	110	112	
Barium	ug/L	2,000	NA	1,300	2,000	210	218	222	222	180	255	326	342	360	--	--	244	166	163	
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	2	< 1	< 1	< 1	< 1	< 1	3.2	1.1	--	--	< 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	< 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	< 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	33.8	22	27	27	32	28	45	58	59	--	--	34	26	26	
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	6	< 5	< 5.0	< 5.0	--	--	< 5.0	< 5.0	< 5.0	
Radium-226	pCi/L	5	NA	NA	NA	0.293	< 0.239	0.201	< 0.162	0.281	0.336	0.204	0.88	< 0.662	--	--	< 0.908	< 0.745	< 0.862	
Radium-226/228	pCi/L	5	NA	3.32	5	0.947	< 0.449	0.607	< 0.459	2.111	0.771	1.97	1.98	1.62	--	--	< 1.79	< 1.83	< 1.74	
Radium-228	pCi/L	5	NA	NA	NA	0.654	< 0.449	< 0.592	< 0.459	1.83	< 0.629	1.77	1.1	0.98	--	--	< 0.884	< 1.08	< 0.880	
Selenium	ug/L	50	NA	2	50	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 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.

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

Constituent	Units	GWPS	JCW-MW-15012		JCW-MW-15023	
			LCL	UCL	LCL	UCL
Arsenic	ug/L	21	16	35	55	130

Notes:

ug/L - micrograms per Liter

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

UCL - Upper Confidence Limit ($\alpha = 0.01$) of the downgradient data set.

LCL - Lower Confidence Limit ($\alpha = 0.01$) 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

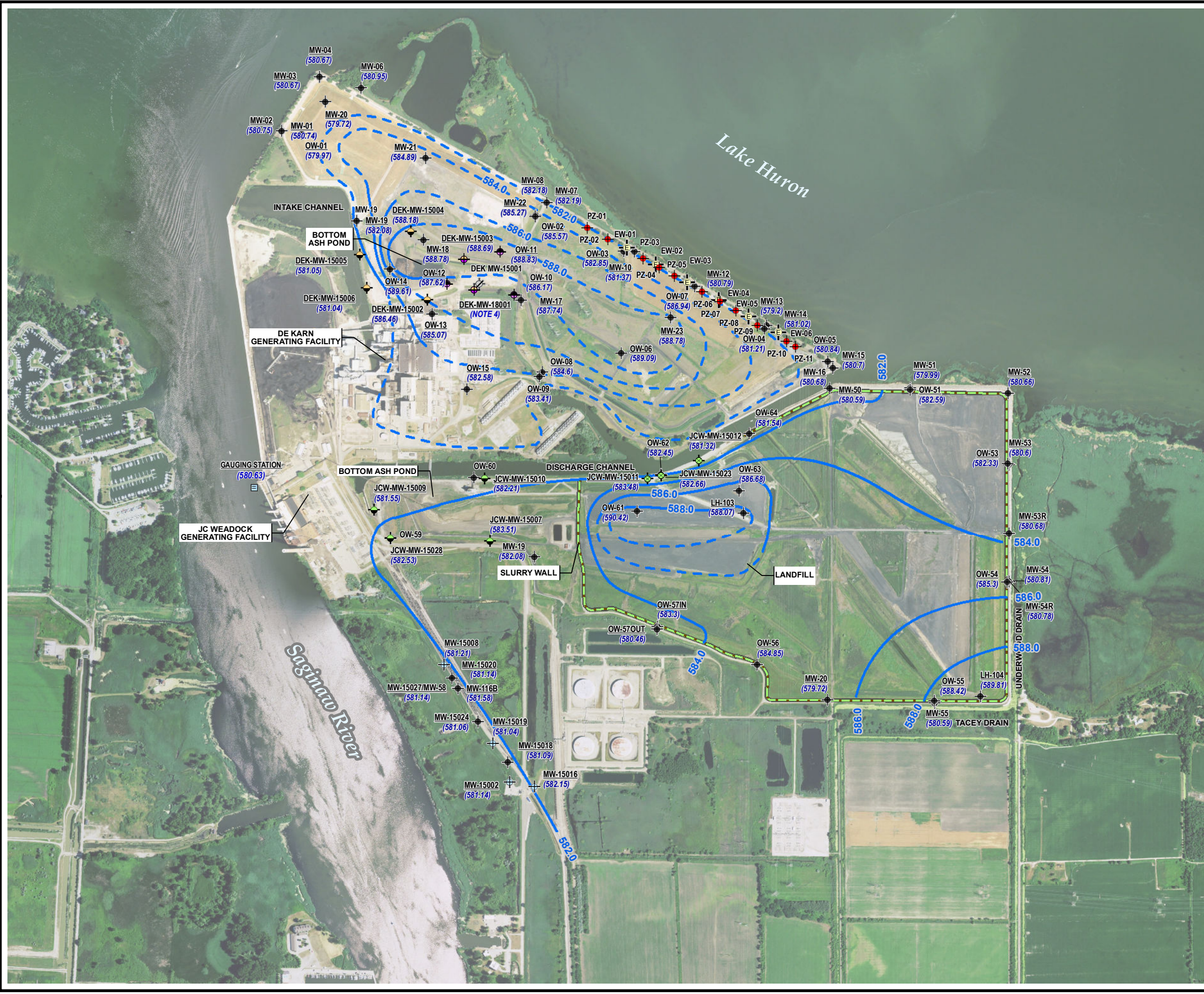
- BACKGROUND MONITORING WELL
- DEK BOTTOM ASH POND & LINED IMPOUNDMENT MONITORING WELL
- DEK BOTTOM ASH POND MONITORING WELL
- DEK LINED IMPOUNDMENT MONITORING WELL
- DECOMMISSIONED MONITORING WELL
- EXTRACTION WELL
- JCW BEDROCK MONITORING WELL
- JCW BOTTOM ASH POND MONITORING WELL
- JCW LANDFILL MONITORING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

- ### NOTES
- BASE MAP IMAGERY FROM USDA - NATIONAL AGRICULTURE IMAGERY PROGRAM, 7/10/2016.
 - WELL LOCATIONS SURVEYED BY ROWE PROFESSIONAL SERVICES COMPANY ON 11/4/2015.
 - 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 PLAN	
DRAWN BY: S. MAJOR	PROJ NO: 290805-001
CHECKED BY: C. SCIESZKA	FIGURE 2
APPROVED BY: D. LITZ	
DATE: OCTOBER 2018	
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
- BASE MAP IMAGERY FROM USDA - NATIONAL AGRICULTURE IMAGERY PROGRAM, 7/10/2016.
 - WELL LOCATIONS SURVEYED BY ROWE PROFESSIONAL SERVICES COMPANY ON 11/4/2015.
 - NOAA/NATIONAL OCEANIC SERVICE GREAT LAKES GAUGING STATION, ESSEXVILLE, MI (ID: 9075035).
 - MONITORING WELL DEK- MW-18001 WAS INSTALLED IN MAY 2018. SURVEY DATA NOT YET AVAILABLE.

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	FIGURE 3	
APPROVED BY:	D. LITZ		
DATE:	OCTOBER 2018		
FILE NO.:	290805-001-005.mxd		

Attachment A

Sanitas Output

Summary Report

Constituent: Antimony, Total Analysis Run 11/16/2018 12:28 PM
Client: Consumers Energy Data: JCW_LF_CCR_Sanitas

For observations made between 12/10/2015 and 5/22/2018, a summary of the selected data set:

Observations = 30
ND/Trace = 30
Wells = 3
Minimum Value = 1
Maximum Value = 1
Mean Value = 1
Median Value = 1
Standard Deviation = 0
Coefficient of Variation = 0
Skewness = NaN

<u>Well</u>	<u>#Obs.</u>	<u>ND/Trace</u>	<u>Min</u>	<u>Max</u>	<u>Mean</u>	<u>Median</u>	<u>Std.Dev.</u>	<u>CV</u>	<u>Skewness</u>
JCW-MW-15011	10	10	1	1	1	1	0	0	NaN
JCW-MW-15012	10	10	1	1	1	1	0	0	NaN
JCW-MW-15023	10	10	1	1	1	1	0	0	NaN

Summary Report

Constituent: Arsenic, Total Analysis Run 11/16/2018 12:28 PM
Client: Consumers Energy Data: JCW_LF_CCR_Sanitas

For observations made between 12/10/2015 and 5/22/2018, a summary of the selected data set:

Observations = 30
ND/Trace = 1
Wells = 3
Minimum Value = 1
Maximum Value = 130
Mean Value = 35.28
Median Value = 21.45
Standard Deviation = 38.86
Coefficient of Variation = 1.101
Skewness = 1.291

<u>Well</u>	<u>#Obs.</u>	<u>ND/Trace</u>	<u>Min</u>	<u>Max</u>	<u>Mean</u>	<u>Median</u>	<u>Std.Dev.</u>	<u>CV</u>	<u>Skewness</u>
JCW-MW-15011	10	1	1	8	4.75	4.9	2.378	0.5007	-0.2359
JCW-MW-15012	10	0	12	40	24.19	23.95	8.993	0.3718	0.3596
JCW-MW-15023	10	0	20	130	76.9	89.5	41.02	0.5334	-0.2138

Summary Report

Constituent: Barium, Total Analysis Run 11/16/2018 12:28 PM
Client: Consumers Energy Data: JCW_LF_CCR_Sanitas

For observations made between 12/10/2015 and 5/22/2018, a summary of the selected data set:

Observations = 30
ND/Trace = 0
Wells = 3
Minimum Value = 61
Maximum Value = 351
Mean Value = 148.6
Standard Deviation = 119.5
Median Value = 77.14
Coefficient of Variation = 0.5192
Skewness = 1.018

<u>Well</u>	<u>#Obs.</u>	<u>ND/Trace</u>	<u>Min</u>	<u>Max</u>	<u>Mean</u>	<u>Median</u>	<u>Std.Dev.</u>	<u>CV</u>	<u>Skewness</u>
JCW-MW-15011	10	0	61	166	95.35	98.3	30.41	0.3189	1.1
JCW-MW-15012	10	0	69	152	111.1	112.5	30.46	0.2741	0.01285
JCW-MW-15023	10	0	164.5	351	239.3	222	58.96	0.2464	0.7897

Summary Report

Constituent: Beryllium, Total Analysis Run 11/16/2018 12:28 PM
Client: Consumers Energy Data: JCW_LF_CCR_Sanitas

For observations made between 12/10/2015 and 5/22/2018, a summary of the selected data set:

Observations = 30
ND/Trace = 30
Wells = 3
Minimum Value = 1
Maximum Value = 1
Mean Value = 1
Median Value = 1
Standard Deviation = 0
Coefficient of Variation = 0
Skewness = NaN

<u>Well</u>	<u>#Obs.</u>	<u>ND/Trace</u>	<u>Min</u>	<u>Max</u>	<u>Mean</u>	<u>Median</u>	<u>Std.Dev.</u>	<u>CV</u>	<u>Skewness</u>
JCW-MW-15011	10	10	1	1	1	1	0	0	NaN
JCW-MW-15012	10	10	1	1	1	1	0	0	NaN
JCW-MW-15023	10	10	1	1	1	1	0	0	NaN

Summary Report

Constituent: Cadmium, Total Analysis Run 11/16/2018 12:28 PM
Client: Consumers Energy Data: JCW_LF_CCR_Sanitas

For observations made between 12/10/2015 and 5/22/2018, a summary of the selected data set:

Observations = 30
ND/Trace = 30
Wells = 3
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

<u>Well</u>	<u>#Obs.</u>	<u>ND/Trace</u>	<u>Min</u>	<u>Max</u>	<u>Mean</u>	<u>Median</u>	<u>Std.Dev.</u>	<u>CV</u>	<u>Skewness</u>
JCW-MW-15011	10	10	0.2	0.2	0.2	0.2	0	0	NaN
JCW-MW-15012	10	10	0.2	0.2	0.2	0.2	0	0	NaN
JCW-MW-15023	10	10	0.2	0.2	0.2	0.2	0	0	NaN

Summary Report

Constituent: Chromium, Total Analysis Run 11/16/2018 12:28 PM
Client: Consumers Energy Data: JCW_LF_CCR_Sanitas

For observations made between 12/10/2015 and 5/22/2018, a summary of the selected data set:

Observations = 30
ND/Trace = 16
Wells = 3
Minimum Value = 1
Maximum Value = 3.5
Mean Value = 1.222
Median Value = 1
Standard Deviation = 0.5601
Coefficient of Variation = 0.4585
Skewness = 2.748

<u>Well</u>	<u>#Obs.</u>	<u>ND/Trace</u>	<u>Min</u>	<u>Max</u>	<u>Mean</u>	<u>Median</u>	<u>Std.Dev.</u>	<u>CV</u>	<u>Skewness</u>
JCW-MW-15011	10	5	1	2	1.1	1	0.3162	0.2875	2.667
JCW-MW-15012	10	4	1	3.5	1.35	1	0.8182	0.6061	2.11
JCW-MW-15023	10	7	1	2.15	1.215	1	0.4546	0.3742	1.523

Summary Report

Constituent: Cobalt, Total Analysis Run 11/16/2018 12:28 PM
Client: Consumers Energy Data: JCW_LF_CCR_Sanitas

For observations made between 12/10/2015 and 5/22/2018, a summary of the selected data set:

Observations = 30
ND/Trace = 30
Wells = 3
Minimum Value = 15
Maximum Value = 15
Mean Value = 15
Median Value = 15
Standard Deviation = 0
Coefficient of Variation = 0
Skewness = NaN

<u>Well</u>	<u>#Obs.</u>	<u>ND/Trace</u>	<u>Min</u>	<u>Max</u>	<u>Mean</u>	<u>Median</u>	<u>Std.Dev.</u>	<u>CV</u>	<u>Skewness</u>
JCW-MW-15011	10	10	15	15	15	15	0	0	NaN
JCW-MW-15012	10	10	15	15	15	15	0	0	NaN
JCW-MW-15023	10	10	15	15	15	15	0	0	NaN

Summary Report

Constituent: Fluoride Analysis Run 11/16/2018 12:28 PM
Client: Consumers Energy Data: JCW_LF_CCR_Sanitas

For observations made between 12/10/2015 and 5/22/2018, a summary of the selected data set:

Observations = 33
ND/Trace = 33
Wells = 3
Minimum Value = 1000
Maximum Value = 1000
Mean Value = 1000
Median Value = 1000
Standard Deviation = 0
Coefficient of Variation = 0
Skewness = NaN

<u>Well</u>	<u>#Obs.</u>	<u>ND/Trace</u>	<u>Min</u>	<u>Max</u>	<u>Mean</u>	<u>Median</u>	<u>Std.Dev.</u>	<u>CV</u>	<u>Skewness</u>
JCW-MW-15011	11	11	1000	1000	1000	1000	0	0	NaN
JCW-MW-15012	11	11	1000	1000	1000	1000	0	0	NaN
JCW-MW-15023	11	11	1000	1000	1000	1000	0	0	NaN

Summary Report

Constituent: Lead, Total Analysis Run 11/16/2018 12:28 PM
Client: Consumers Energy Data: JCW_LF_CCR_Sanitas

For observations made between 12/10/2015 and 5/22/2018, a summary of the selected data set:

Observations = 30
ND/Trace = 30
Wells = 3
Minimum Value = 1
Maximum Value = 1
Mean Value = 1
Median Value = 1
Standard Deviation = 0
Coefficient of Variation = 0
Skewness = NaN

<u>Well</u>	<u>#Obs.</u>	<u>ND/Trace</u>	<u>Min</u>	<u>Max</u>	<u>Mean</u>	<u>Median</u>	<u>Std.Dev.</u>	<u>CV</u>	<u>Skewness</u>
JCW-MW-15011	10	10	1	1	1	1	0	0	NaN
JCW-MW-15012	10	10	1	1	1	1	0	0	NaN
JCW-MW-15023	10	10	1	1	1	1	0	0	NaN

Summary Report

Constituent: Lithium, Total Analysis Run 11/16/2018 12:28 PM
Client: Consumers Energy Data: JCW_LF_CCR_Sanitas

For observations made between 12/10/2015 and 5/22/2018, a summary of the selected data set:

Observations = 30
ND/Trace = 0
Wells = 3
Minimum Value = 15
Maximum Value = 79
Mean Value = 39.25
Median Value = 32.9
Standard Deviation = 20.08
Coefficient of Variation = 0.5116
Skewness = 0.6171

<u>Well</u>	<u>#Obs.</u>	<u>ND/Trace</u>	<u>Min</u>	<u>Max</u>	<u>Mean</u>	<u>Median</u>	<u>Std.Dev.</u>	<u>CV</u>	<u>Skewness</u>
JCW-MW-15011	10	0	15	34.5	21.76	20.25	6.83	0.3139	0.7345
JCW-MW-15012	10	0	46.6	79	62.67	63.5	12.1	0.193	0.0704
JCW-MW-15023	10	0	22	58.5	33.33	30	10.87	0.326	1.371

Summary Report

Constituent: Mercury, Total Analysis Run 11/16/2018 12:28 PM
Client: Consumers Energy Data: JCW_LF_CCR_Sanitas

For observations made between 12/10/2015 and 5/22/2018, a summary of the selected data set:

Observations = 30
ND/Trace = 30
Wells = 3
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

<u>Well</u>	<u>#Obs.</u>	<u>ND/Trace</u>	<u>Min</u>	<u>Max</u>	<u>Mean</u>	<u>Median</u>	<u>Std.Dev.</u>	<u>CV</u>	<u>Skewness</u>
JCW-MW-15011	10	10	0.2	0.2	0.2	0.2	0	0	NaN
JCW-MW-15012	10	10	0.2	0.2	0.2	0.2	0	0	NaN
JCW-MW-15023	10	10	0.2	0.2	0.2	0.2	0	0	NaN

Summary Report

Constituent: Molybdenum, Total Analysis Run 11/16/2018 12:28 PM
Client: Consumers Energy Data: JCW_LF_CCR_Sanitas

For observations made between 12/10/2015 and 5/22/2018, a summary of the selected data set:

Observations = 30
ND/Trace = 18
Wells = 3
Minimum Value = 5
Maximum Value = 47
Mean Value = 11.75
Median Value = 5
Standard Deviation = 12.05
Coefficient of Variation = 1.026
Skewness = 1.803

<u>Well</u>	<u>#Obs.</u>	<u>ND/Trace</u>	<u>Min</u>	<u>Max</u>	<u>Mean</u>	<u>Median</u>	<u>Std.Dev.</u>	<u>CV</u>	<u>Skewness</u>
JCW-MW-15011	10	9	5	5	5	5	0	0	NaN
JCW-MW-15012	10	0	12	47	25.14	22.85	12.98	0.5164	0.5838
JCW-MW-15023	10	9	5	6	5.1	5	0.3162	0.06201	2.667

Summary Report

Constituent: Radium-226/228 Analysis Run 11/16/2018 12:28 PM
Client: Consumers Energy Data: JCW_LF_CCR_Sanitas

For observations made between 12/10/2015 and 5/22/2018, a summary of the selected data set:

Observations = 30
ND/Trace = 15
Wells = 3
Minimum Value = 0.449
Maximum Value = 5.634
Mean Value = 1.302
Median Value = 1.009
Standard Deviation = 0.9808
Coefficient of Variation = 0.7535
Skewness = 2.91

<u>Well</u>	<u>#Obs.</u>	<u>ND/Trace</u>	<u>Min</u>	<u>Max</u>	<u>Mean</u>	<u>Median</u>	<u>Std.Dev.</u>	<u>CV</u>	<u>Skewness</u>
JCW-MW-15011	10	6	0.471	5.634	1.545	1.128	1.514	0.9795	2.193
JCW-MW-15012	10	5	0.475	1.74	1.086	1.009	0.4743	0.4367	0.07934
JCW-MW-15023	10	4	0.449	2.111	1.273	1.368	0.682	0.5356	-0.06495

Summary Report

Constituent: Selenium, Total Analysis Run 11/16/2018 12:28 PM
Client: Consumers Energy Data: JCW_LF_CCR_Sanitas

For observations made between 12/10/2015 and 5/22/2018, a summary of the selected data set:

Observations = 30
ND/Trace = 26
Wells = 3
Minimum Value = 1
Maximum Value = 26
Mean Value = 2.067
Median Value = 1
Standard Deviation = 4.653
Coefficient of Variation = 2.251
Skewness = 4.803

<u>Well</u>	<u>#Obs.</u>	<u>ND/Trace</u>	<u>Min</u>	<u>Max</u>	<u>Mean</u>	<u>Median</u>	<u>Std.Dev.</u>	<u>CV</u>	<u>Skewness</u>
JCW-MW-15011	10	9	1	2	1.1	1	0.3162	0.2875	2.667
JCW-MW-15012	10	7	1	26	4.1	1	7.923	1.932	2.423
JCW-MW-15023	10	10	1	1	1	1	0	0	NaN

Summary Report

Constituent: Thallium, Total Analysis Run 11/16/2018 12:28 PM
Client: Consumers Energy Data: JCW_LF_CCR_Sanitas

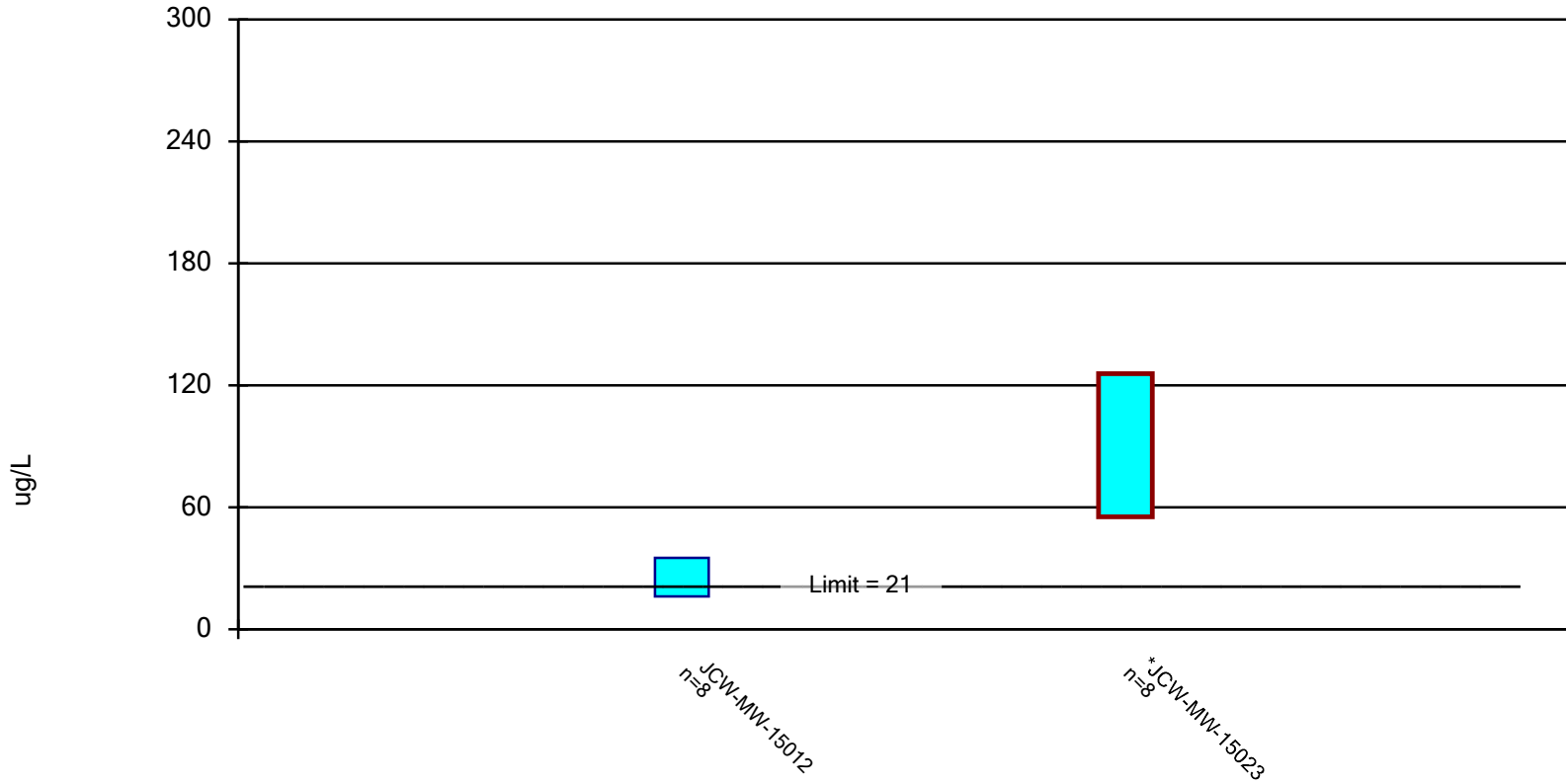
For observations made between 12/10/2015 and 5/22/2018, a summary of the selected data set:

Observations = 30
ND/Trace = 30
Wells = 3
Minimum Value = 2
Maximum Value = 2
Mean Value = 2
Median Value = 2
Standard Deviation = 0
Coefficient of Variation = 0
Skewness = NaN

<u>Well</u>	<u>#Obs.</u>	<u>ND/Trace</u>	<u>Min</u>	<u>Max</u>	<u>Mean</u>	<u>Median</u>	<u>Std.Dev.</u>	<u>CV</u>	<u>Skewness</u>
JCW-MW-15011	10	10	2	2	2	2	0	0	NaN
JCW-MW-15012	10	10	2	2	2	2	0	0	NaN
JCW-MW-15023	10	10	2	2	2	2	0	0	NaN

Parametric Confidence Interval

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



Constituent: Arsenic, Total Analysis Run 11/27/2018 5:17 PM

Client: Consumers Energy Data: JCW_LF_CCR_Sanitas

Confidence Interval

Constituent: Arsenic, Total (ug/L) Analysis Run 11/27/2018 5:18 PM

Client: Consumers Energy Data: JCW_LF_CCR_Sanitas

	JCW-MW-15012	JCW-MW-15023
5/26/2016	13	47
8/25/2016	36	78
12/1/2016	26	117
2/23/2017	19	102
5/17/2017		38
5/18/2017	40	
8/3/2017		130 (D)
8/4/2017	28	
4/11/2018		101
4/12/2018	20	
5/21/2018		111 (D)
5/22/2018	22.9	
Mean	25.61	90.5
Std. Dev.	8.963	33.23
Upper Lim.	35.11	125.7
Lower Lim.	16.11	55.28

Appendix E

April 2019 Assessment Monitoring Statistical Evaluation

Technical Memorandum

Date: July 8, 2019

To: J.R. Register, CEC

From: Darby Litz, TRC
Sarah Holmstrom, TRC
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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 Landfill, Consumers Energy Company, Essexville, Michigan

During the statistical evaluation of the initial assessment monitoring event (May 2018), arsenic was 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 Rule¹ at the JC Weadock Power Plant (JCW) Landfill. 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.

The evaluation of the initial semiannual assessment monitoring event data (April and May 2018) indicated that arsenic was present at statistically significant levels above the GWPS at one of the three downgradient wells. The three downgradient wells were located within a vent (e.g., opening) of the perimeter soil/bentonite slurry wall to assess the quality of groundwater passing the waste boundary. As discussed in detail below, in July 2018, a vent (e.g., opening) in the perimeter soil/bentonite slurry

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).

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wall was closed and the slurry wall is now continuous along the entire perimeter of the JCW landfill. As a result of the change in groundwater flow conditions, the groundwater monitoring system was revised² prior to the November 2018 sampling event. The modified CCR monitoring well network now consists of eleven (11) downgradient monitoring wells. The statistical analysis for the 5 new wells will commence once sufficient data has been collected (a minimum of four independent sampling events). Six (6) of the downgradient wells were preexisting and had been sampled under the approved 2015 HMP³ for Michigan Part 115 compliance; therefore, the statistical evaluation could be performed for a subset of Appendix III and IV constituents. The statistical evaluation of the third semiannual assessment monitoring event data indicates that no Appendix IV constituents are present at statistically significant levels above the GWPSs in downgradient monitoring wells at the JCW Landfill.

<u>Constituent</u>	<u>GWPS</u>	<u>#Downgradient Wells Observed</u>
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No constituents are present at statistically significant levels above the GWPSs.

These results are consistent with the results of the previous assessment monitoring data statistical evaluation (November 2018). 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 initial assessment monitoring event. CEC will continue the assessment of corrective measures per §257.95(g) and execute the self-implementing groundwater compliance schedule in conformance with §257.90 - §257.98.

Assessment Monitoring Statistical Evaluation

When the monitoring well network was first established in October 2017, there was a 1,600-linear-foot section of the perimeter embankment dike that did not have a slurry wall in place. Groundwater flow beneath the JCW landfill was directed towards the discharge channel through this vent in the slurry wall for management under the existing NPDES discharge permit. The downgradient monitoring well network was established as three monitoring wells located in the vent area to assess the quality of groundwater passing the waste boundary (JCW-MW-15011, JCW-MW-15012, and JCW-MW-15023). In July 2018, the slurry wall vent was closed to reduced porewater flux around the entire perimeter of the JCW Landfill CCR unit. The three downgradient CCR compliance wells were decommissioned by over drilling, removing the well material, and sealing the borehole in order to allow for the slurry wall construction.

Given the change in groundwater flow conditions, a revised groundwater monitoring system has been established to assess slurry wall integrity and determine if there have been any releases from the JCW Landfill CCR unit. CEC installed an additional nine (9) monitoring wells in August 2018 to supplement the preexisting groundwater well network currently used under the approved 2015 HMP

² TRC. 2018. *Revised Groundwater Monitoring System Summary Report Technical Memorandum*. December.

³ Consumers Energy Company. 2015. *Hydrogeological Monitoring Plan Rev. 2: JC Weadock Solid Waste Disposal Area*. June.

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for Michigan Part 115 compliance to provide appropriate coverage for the collection of groundwater levels and water quality data along the perimeter of the JCW Landfill CCR unit.

Therefore, the modified CCR monitoring well network now consists of eleven (11) downgradient monitoring wells as discussed in the *Sample and Analysis Plan* (2018 SAP) and *Statistical Analysis Plan* (2018 Stats Plan). The downgradient monitoring wells include:

JCW-MW-18001	JCW-MW-18004	JCW-MW-18005	JCW-MW-18006
MW-50	MW-51	MW-52	MW-53
MW-54R	MW-55	OW-57R Out	

The statistical analysis for the new wells (JCW-MW-18001, JCW-MW-18004, JCW-MW-18005, and JCW-MW-18006; and OW-57R Out) will commence once sufficient data has been collected (a minimum of four independent sampling events). Data from the HMP monitoring program may be used to supplement the CCR program as long as temporal independence is maintained. For the preexisting wells (MW-50 through MW-55), a minimum of eight rounds of data for a subset of Appendix III and IV constituents have been collected in 2017 and 2018 as part of the quarterly HMP monitoring.

Following the second semiannual assessment monitoring sampling event, compliance well data for the JCW Landfill CCR unit were evaluated in accordance with the *Groundwater Statistical Analysis Plan* (TRC, December 2018). 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 Guidance⁴, 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 methods for assessment monitoring presented in §257.93(f) and (g). Statistical evaluation methodologies

⁴ USEPA. 2009. *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance*. Office of Conservation and Recovery. EPA 530/R-09-007.

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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 for 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 within the most recent eight sampling events (November 2017 through April 2019) were retained for further analysis. Arsenic in MW-51 and MW-55 and molybdenum in MW-55 had individual results exceeding the GWPS. In MW-50, MW-51, MW-52, MW-53, MW-55, and JCW-MW-18004, cobalt and thallium reporting limits exceeded the GWPSs in November 2018 due to sample dilutions performed due to matrix interferences during analysis. In JCW-MW-18006, thallium reporting limits exceeded the GWPS in April 2019 due to sample dilutions. Cobalt and thallium were non-detect at the HMP locations in a previous sample event (May 2016) and in the April 2019 sampling event. These locations do have sufficient data to qualify the November 2018 or April 2019 results as outliers or to calculate confidence intervals; therefore, no statistical evaluation will be completed for these well-constituent pairs.

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 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.

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Initially, the baseline (February 2017 through April 2019) results were observed visually for potential trends. No outliers were identified in the data set. 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. The confidence interval test compares the lower confidence limit to the GWPS. Although no Appendix IV constituents are present at statistically significant levels above the GWPS based on the November 2018 data evaluation, concentrations remain above background levels and corrective action has been triggered as a result of data collected during the initial May 2018 assessment monitoring event. CEC 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 – February 2017 to April 2019

Attachment 1 Sanitas™ Output Files

Table

Table 1
 Comparison of Groundwater Sampling Results to Groundwater Protection Standards – February 2017 to April 2019
 JC Weadock Landfill – RCRA CCR Monitoring Program
 Essexville, Michigan

Sample Location:						MW-50								
Sample Date:						2/27/2017	5/11/2017	8/9/2017	11/1/2017	3/5/2018	5/15/2018	8/15/2018	11/7/2018	4/9/2019
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS	downgradient								
Appendix III														
Boron	ug/L	NC	NA	619	NA	2,020	1,340	987	1,120	1,320	1,220	1,270	1,370	1,600
Calcium	mg/L	NC	NA	302	NA	--	--	--	--	--	250	--	249	200
Chloride	mg/L	250**	NA	2,440	NA	--	--	--	--	--	73.8	--	76.3	62
Fluoride	ug/L	4,000	NA	1,000	NA	--	--	--	--	--	< 1,000	--	< 1,000	< 1,000
Sulfate	mg/L	250**	NA	407	NA	200	180	290	580	370	550	490	518	370
Total Dissolved Solids	mg/L	500**	NA	4,600	NA	--	--	--	--	--	1,400	--	1,360	1,200
pH, Field	SU	6.5 - 8.5**	6.5 - 8.5	6.5 - 7.3	NA	7.1	7.4	7.0	7.1	7.5	7.3	7.0	7.2	7.3
Appendix IV														
Antimony	ug/L	6	NA	1	6	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1.0
Arsenic	ug/L	10	NA	21	21	2	2	3	3	2	2	2	< 5.0	1.1
Barium	ug/L	2,000	NA	1,300	2,000	393	356	352	299	365	351	292	239	220
Beryllium	ug/L	4	NA	1	4	--	--	--	--	--	< 1	--	< 1.0	< 1.0
Cadmium	ug/L	5	NA	0.2	5	--	--	--	--	--	< 0.2	--	< 0.20	< 0.20
Chromium	ug/L	100	NA	3	100	1	1	< 1	< 1	< 1	< 1	< 1	< 5.0	< 1.0
Cobalt	ug/L	NC	6	15	15	--	--	--	--	--	< 15	--	< 30.0 ⁽¹⁾	< 6.0
Fluoride	ug/L	4,000	NA	1,000	4,000	--	--	--	--	--	< 1,000	--	< 1,000	< 1,000
Lead	ug/L	NC	15	1	15	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 5.0	< 1.0
Lithium	ug/L	NC	40	180	180	72	71	74	72	63	74	77	94	69
Mercury	ug/L	2	NA	0.2	2	--	--	--	--	--	< 0.2	--	< 0.20	< 0.20
Molybdenum	ug/L	NC	100	6	100	< 5	< 5	6	10	6	6	8	8.0	< 5.0
Radium-226	pCi/L	NC	NA	NA	NA	--	--	--	--	--	--	--	1.40	--
Radium-228	pCi/L	NC	NA	NA	NA	--	--	--	--	--	--	--	1.88	--
Radium-226/228	pCi/L	5	NA	3.32	5	--	--	--	--	--	--	--	3.28	--
Selenium	ug/L	50	NA	2	50	< 1	1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1.0
Thallium	ug/L	2	NA	2	2	--	--	--	--	--	< 2	--	< 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 1
 Comparison of Groundwater Sampling Results to Groundwater Protection Standards – February 2017 to April 2019
 JC Weadock Landfill – RCRA CCR Monitoring Program
 Essexville, Michigan

Sample Location:						MW-51								
Sample Date:						2/27/2017	5/11/2017	8/9/2017	11/1/2017	3/6/2018	5/16/2018	8/15/2018	11/8/2018	4/9/2019
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS	downgradient								
Appendix III														
Boron	ug/L	NC	NA	619	NA	1,440	1,370	1,060	1,280	1,040	883	872	851	940
Calcium	mg/L	NC	NA	302	NA	--	--	--	--	--	378	--	331	310
Chloride	mg/L	250**	NA	2,440	NA	--	--	--	--	--	65	--	55.8	84
Fluoride	ug/L	4,000	NA	1,000	NA	--	--	--	--	--	< 1,000	--	< 1,000	< 1,000
Sulfate	mg/L	250**	NA	407	NA	480	490	510	560	430	592	450	505	500
Total Dissolved Solids	mg/L	500**	NA	4,600	NA	--	--	--	--	--	1,600	--	1,410	1,500
pH, Field	SU	6.5 - 8.5**	6.5 - 8.5	6.5 - 7.3	NA	6.9	6.9	6.8	6.8	6.8	6.7	6.6	6.6	7.0
Appendix IV														
Antimony	ug/L	6	NA	1	6	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1.0
Arsenic	ug/L	10	NA	21	21	19	24	41	28	16	13	19	21.8	17
Barium	ug/L	2,000	NA	1,300	2,000	318	273	268	291	187	189	178	163	190
Beryllium	ug/L	4	NA	1	4	--	--	--	--	--	< 1	--	< 1.0	< 1.0
Cadmium	ug/L	5	NA	0.2	5	--	--	--	--	--	< 0.2	--	< 1.0	< 0.20
Chromium	ug/L	100	NA	3	100	1	< 1	< 1	1	< 1	< 1	< 1	< 5.0	1.0
Cobalt	ug/L	NC	6	15	15	--	--	--	--	--	< 15	--	< 30.0 ⁽¹⁾	< 6.0
Fluoride	ug/L	4,000	NA	1,000	4,000	--	--	--	--	--	< 1,000	--	< 1,000	< 1,000
Lead	ug/L	NC	15	1	15	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 5.0	< 1.0
Lithium	ug/L	NC	40	180	180	61	66	68	64	55	62	57	71	59
Mercury	ug/L	2	NA	0.2	2	--	--	--	--	--	< 0.2	--	< 0.20	< 0.20
Molybdenum	ug/L	NC	100	6	100	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 25.0	< 5.0
Radium-226	pCi/L	NC	NA	NA	NA	--	--	--	--	--	--	--	< 0.715	--
Radium-228	pCi/L	NC	NA	NA	NA	--	--	--	--	--	--	--	1.12	--
Radium-226/228	pCi/L	5	NA	3.32	5	--	--	--	--	--	--	--	< 1.64	--
Selenium	ug/L	50	NA	2	50	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1.0
Thallium	ug/L	2	NA	2	2	--	--	--	--	--	< 2	--	< 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 1
 Comparison of Groundwater Sampling Results to Groundwater Protection Standards – February 2017 to April 2019
 JC Weadock Landfill – RCRA CCR Monitoring Program
 Essexville, Michigan

Sample Location:						MW-52										
Sample Date:						2/27/2017	5/11/2017	8/9/2017	11/1/2017	3/6/2018	3/6/2018	5/15/2018	8/15/2018	11/8/2018	11/8/2018	4/9/2019
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS	downgradient										
Appendix III																
Boron	ug/L	NC	NA	619	NA	1,580	1,260	1,040	991	Field Dup 795	791	803	904	Field Dup 896	774	1,200
Calcium	mg/L	NC	NA	302	NA	--	--	--	--	--	--	241	--	263	256	210
Chloride	mg/L	250**	NA	2,440	NA	--	--	--	--	--	--	89.5	--	96.6	97.2	95
Fluoride	ug/L	4,000	NA	1,000	NA	--	--	--	--	--	--	< 1,000	--	< 1,000	< 1,000	< 1,000
Sulfate	mg/L	250**	NA	407	NA	490	510	530	480	530	510	536	500	512	517	480
Total Dissolved Solids	mg/L	500**	NA	4,600	NA	--	--	--	--	--	--	1,500	--	1,520	1,460	1,400
pH, Field	SU	6.5 - 8.5**	6.5 - 8.5	6.5 - 7.3	NA	7.0	7.1	6.8	7.0	--	7.0	7.0	6.9	--	6.8	7.1
Appendix IV																
Antimony	ug/L	6	NA	1	6	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	10	NA	21	21	< 1	< 1	< 1	1	< 1	< 1	< 1	< 1	< 1.0	< 5.0	< 1.0
Barium	ug/L	2,000	NA	1,300	2,000	144	142	150	144	153	155	148	160	170	146	140
Beryllium	ug/L	4	NA	1	4	--	--	--	--	--	--	< 1	--	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	5	NA	0.2	5	--	--	--	--	--	--	< 0.2	--	< 0.20	< 1.0	< 0.20
Chromium	ug/L	100	NA	3	100	1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 5.0	< 1.0
Cobalt	ug/L	NC	6	15	15	--	--	--	--	--	--	< 15	--	< 6.0	< 30.0 ⁽¹⁾	< 6.0
Fluoride	ug/L	4,000	NA	1,000	4,000	--	--	--	--	--	--	< 1,000	--	< 1,000	< 1,000	< 1,000
Lead	ug/L	NC	15	1	15	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 5.0	< 1.0
Lithium	ug/L	NC	40	180	180	44	51	55	53	55	58	55	54	60	63	39
Mercury	ug/L	2	NA	0.2	2	--	--	--	--	--	--	< 0.2	--	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	NC	100	6	100	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5.0	< 25.0	< 5.0
Radium-226	pCi/L	NC	NA	NA	NA	--	--	--	--	--	--	--	--	0.840	< 0.651	--
Radium-228	pCi/L	NC	NA	NA	NA	--	--	--	--	--	--	--	--	0.683	< 0.850	--
Radium-226/228	pCi/L	5	NA	3.32	5	--	--	--	--	--	--	--	--	1.52	< 1.50	--
Selenium	ug/L	50	NA	2	50	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1.0	< 1.0
Thallium	ug/L	2	NA	2	2	--	--	--	--	--	--	< 2	--	< 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 1
 Comparison of Groundwater Sampling Results to Groundwater Protection Standards – February 2017 to April 2019
 JC Weadock Landfill – RCRA CCR Monitoring Program
 Essexville, Michigan

Sample Location:						MW-53								
Sample Date:						2/27/2017	5/11/2017	8/9/2017	11/1/2017	3/6/2018	5/15/2018	8/15/2018	11/8/2018	4/10/2019
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS	downgradient								
Appendix III														
Boron	ug/L	NC	NA	619	NA	436	963	468	496	490	1,260	695	519	1,500
Calcium	mg/L	NC	NA	302	NA	--	--	--	--	--	158	--	465	200
Chloride	mg/L	250**	NA	2,440	NA	--	--	--	--	--	77.5	--	84.5	39
Fluoride	ug/L	4,000	NA	1,000	NA	--	--	--	--	--	< 1,000	--	< 1,000	< 1,000
Sulfate	mg/L	250**	NA	407	NA	790	660	890	830	510	208	570	811	330
Total Dissolved Solids	mg/L	500**	NA	4,600	NA	--	--	--	--	--	970	--	1,950	1,200
pH, Field	SU	6.5 - 8.5**	6.5 - 8.5	6.5 - 7.3	NA	6.6	6.7	6.6	6.7	6.8	7.2	6.7	6.6	7.1
Appendix IV														
Antimony	ug/L	6	NA	1	6	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1.0
Arsenic	ug/L	10	NA	21	21	2	2	3	3	2	2	3	5.1	< 1.0
Barium	ug/L	2,000	NA	1,300	2,000	56	71	56	50	49	78	87	54.4	120
Beryllium	ug/L	4	NA	1	4	--	--	--	--	--	< 1	--	< 1.0	< 1.0
Cadmium	ug/L	5	NA	0.2	5	--	--	--	--	--	< 0.2	--	< 1.0	< 0.20
Chromium	ug/L	100	NA	3	100	1	1	< 1	1	< 1	< 1	< 1	< 5.0	1.6
Cobalt	ug/L	NC	6	15	15	--	--	--	--	--	< 15	--	< 30.0 ⁽¹⁾	< 6.0
Fluoride	ug/L	4,000	NA	1,000	4,000	--	--	--	--	--	< 1,000	--	< 1,000	< 1,000
Lead	ug/L	NC	15	1	15	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 5.0	< 1.0
Lithium	ug/L	NC	40	180	180	40	49	48	45	35	49	48	59	53
Mercury	ug/L	2	NA	0.2	2	--	--	--	--	--	< 0.2	--	< 0.20	< 0.20
Molybdenum	ug/L	NC	100	6	100	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 25.0	< 5.0
Radium-226	pCi/L	NC	NA	NA	NA	--	--	--	--	--	--	--	< 0.664	--
Radium-228	pCi/L	NC	NA	NA	NA	--	--	--	--	--	--	--	< 0.655	--
Radium-226/228	pCi/L	5	NA	3.32	5	--	--	--	--	--	--	--	< 1.32	--
Selenium	ug/L	50	NA	2	50	< 1	1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1.0
Thallium	ug/L	2	NA	2	2	--	--	--	--	--	< 2	--	< 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 1
 Comparison of Groundwater Sampling Results to Groundwater Protection Standards – February 2017 to April 2019
 JC Weadock Landfill – RCRA CCR Monitoring Program
 Essexville, Michigan

Sample Location:						MW-54R										
Sample Date:						2/28/2017	5/11/2017	8/9/2017	11/2/2017	3/6/2018	5/15/2018	8/16/2018	8/16/2018	11/8/2018	4/11/2019	
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS	downgradient										
Appendix III																
Boron	ug/L	NC	NA	619	NA	1,460	1,030	1,100	1,280	1,060	1,150	Field Dup	1,240	1,340	1,290	960
Calcium	mg/L	NC	NA	302	NA	--	--	--	--	--	179	--	--	--	173	180
Chloride	mg/L	250**	NA	2,440	NA	--	--	--	--	--	20	--	--	--	18.0	16
Fluoride	ug/L	4,000	NA	1,000	NA	--	--	--	--	--	< 1,000	--	--	--	< 1,000	< 1,000
Sulfate	mg/L	250**	NA	407	NA	170	200	180	160	160	208	190	180	152	160	160
Total Dissolved Solids	mg/L	500**	NA	4,600	NA	--	--	--	--	--	890	--	--	--	710	770
pH, Field	SU	6.5 - 8.5**	6.5 - 8.5	6.5 - 7.3	NA	6.9	6.8	6.8	6.9	7.1	7.0	--	6.9	7.0	6.9	6.9
Appendix IV																
Antimony	ug/L	6	NA	1	6	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1.0
Arsenic	ug/L	10	NA	21	21	< 1	< 1	< 1	< 1	1	< 1	< 1	< 1	< 1	< 1.0	1.6
Barium	ug/L	2,000	NA	1,300	2,000	75	63	74	74	70	74	80	79	59.9	74	74
Beryllium	ug/L	4	NA	1	4	--	--	--	--	--	< 1	--	--	--	< 1.0	< 1.0
Cadmium	ug/L	5	NA	0.2	5	--	--	--	--	--	< 0.2	--	--	--	< 0.20	< 0.20
Chromium	ug/L	100	NA	3	100	1	1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1.0
Cobalt	ug/L	NC	6	15	15	--	--	--	--	--	< 15	--	--	--	< 6.0	< 6.0
Fluoride	ug/L	4,000	NA	1,000	4,000	--	--	--	--	--	< 1,000	--	--	--	< 1,000	< 1,000
Lead	ug/L	NC	15	1	15	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1.0
Lithium	ug/L	NC	40	180	180	61	53	58	58	52	57	56	58	58	62	48
Mercury	ug/L	2	NA	0.2	2	--	--	--	--	--	< 0.2	--	--	--	< 0.20	< 0.20
Molybdenum	ug/L	NC	100	6	100	< 5	6	6	5	< 5	< 5	< 5	< 5	< 5	< 5.0	< 5.0
Radium-226	pCi/L	NC	NA	NA	NA	--	--	--	--	--	--	--	--	--	< 1.09	--
Radium-228	pCi/L	NC	NA	NA	NA	--	--	--	--	--	--	--	--	--	< 0.786	--
Radium-226/228	pCi/L	5	NA	3.32	5	--	--	--	--	--	--	--	--	--	< 1.88	--
Selenium	ug/L	50	NA	2	50	< 1	< 1	1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1.0
Thallium	ug/L	2	NA	2	2	--	--	--	--	--	< 2	--	--	--	< 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 1
 Comparison of Groundwater Sampling Results to Groundwater Protection Standards – February 2017 to April 2019
 JC Weadock Landfill – RCRA CCR Monitoring Program
 Essexville, Michigan

Sample Location:						MW-55									
Sample Date:						2/28/2017	5/11/2017	8/10/2017	11/2/2017	3/6/2018	5/15/2018	5/15/2018	8/16/2018	11/8/2018	4/11/2019
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS	downgradient									
Appendix III											Field Dup				
Boron	ug/L	NC	NA	619	NA	547	493	519	619	680	533	539	670	582	800
Calcium	mg/L	NC	NA	302	NA	--	--	--	--	--	193	189	--	202	140
Chloride	mg/L	250**	NA	2,440	NA	--	--	--	--	--	16.4	15.7	--	15.8	26
Fluoride	ug/L	4,000	NA	1,000	NA	--	--	--	--	--	< 1,000	< 1,000	--	< 1,000	< 1,000
Sulfate	mg/L	250**	NA	407	NA	310	440	360	280	100	260	257	250	157	70
Total Dissolved Solids	mg/L	500**	NA	4,600	NA	--	--	--	--	--	940	980	--	894	770
pH, Field	SU	6.5 - 8.5**	6.5 - 8.5	6.5 - 7.3	NA	6.9	6.8	6.8	6.8	7.0	--	7.0	6.8	7.0	7.1
Appendix IV															
Antimony	ug/L	6	NA	1	6	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1.0
Arsenic	ug/L	10	NA	21	21	18	6	15	19	18	16	17	37	35.1	34
Barium	ug/L	2,000	NA	1,300	2,000	75	69	83	86	133	148	148	183	158	200
Beryllium	ug/L	4	NA	1	4	--	--	--	--	--	< 1	< 1	--	< 1.0	< 1.0
Cadmium	ug/L	5	NA	0.2	5	--	--	--	--	--	0.3	0.3	--	0.32	< 0.20
Chromium	ug/L	100	NA	3	100	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 5.0	< 1.0
Cobalt	ug/L	NC	6	15	15	--	--	--	--	--	< 15	< 15	--	< 30.0 ⁽¹⁾	< 6.0
Fluoride	ug/L	4,000	NA	1,000	4,000	--	--	--	--	--	< 1,000	< 1,000	--	< 1,000	< 1,000
Lead	ug/L	NC	15	1	15	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 5.0	< 1.0
Lithium	ug/L	NC	40	180	180	17	16	23	28	16	21	20	32	40	17
Mercury	ug/L	2	NA	0.2	2	--	--	--	--	--	< 0.2	< 0.2	--	< 0.20	< 0.20
Molybdenum	ug/L	NC	100	6	100	84	65	88	139	132	116	119	172	171	93
Radium-226	pCi/L	NC	NA	NA	NA	--	--	--	--	--	--	--	--	< 0.932	--
Radium-228	pCi/L	NC	NA	NA	NA	--	--	--	--	--	--	--	--	< 0.679	--
Radium-226/228	pCi/L	5	NA	3.32	5	--	--	--	--	--	--	--	--	< 1.61	--
Selenium	ug/L	50	NA	2	50	< 1	17	10	< 1	< 1	1	1	2	< 1.0	< 1.0
Thallium	ug/L	2	NA	2	2	--	--	--	--	--	< 2	< 2	--	< 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 1
 Comparison of Groundwater Sampling Results to Groundwater Protection Standards – February 2017 to April 2019
 JC Weadock Landfill – RCRA CCR Monitoring Program
 Essexville, Michigan

Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS	OW-57ROUT		JCW-MW-18001	
						Sample Date: 11/8/2018	Sample Date: 4/12/2019	Sample Date: 11/7/2018	Sample Date: 4/12/2019
						downgradient			
Appendix III									
Boron	ug/L	NC	NA	619	NA	1,850	1,700	1,330	1,400
Calcium	mg/L	NC	NA	302	NA	141	130	138	140
Chloride	mg/L	250**	NA	2,440	NA	70.3	68	51.5	67
Fluoride	ug/L	4,000	NA	1,000	NA	1,200	1,200	< 1,000	< 1,000
Sulfate	mg/L	250**	NA	407	NA	112	110	97.7	210
Total Dissolved Solids	mg/L	500**	NA	4,600	NA	808	780	678	860
pH, Field	SU	6.5 - 8.5**	6.5 - 8.5	6.5 - 7.3	NA	7.0	7.1	7.2	7.2
Appendix IV									
Antimony	ug/L	6	NA	1	6	< 1.0	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	10	NA	21	21	1.4	< 1.0	5.8	2.3
Barium	ug/L	2,000	NA	1,300	2,000	73.7	72	169	200
Beryllium	ug/L	4	NA	1	4	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	5	NA	0.2	5	< 0.20	< 0.20	< 0.20	< 0.20
Chromium	ug/L	100	NA	3	100	< 1.0	< 1.0	< 1.0	< 1.0
Cobalt	ug/L	NC	6	15	15	< 6.0	< 6.0	< 6.0	< 6.0
Fluoride	ug/L	4,000	NA	1,000	4,000	1,200	1,200	< 1,000	< 1,000
Lead	ug/L	NC	15	1	15	< 1.0	< 1.0	< 1.0	< 1.0
Lithium	ug/L	NC	40	180	180	35	23	51	43
Mercury	ug/L	2	NA	0.2	2	< 0.20	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	NC	100	6	100	8.9	7.9	< 5.0	< 5.0
Radium-226	pCi/L	NC	NA	NA	NA	< 1.09	--	< 0.542	--
Radium-228	pCi/L	NC	NA	NA	NA	< 0.718	--	< 0.808	--
Radium-226/228	pCi/L	5	NA	3.32	5	< 1.81	--	< 1.35	--
Selenium	ug/L	50	NA	2	50	< 1.0	< 1.0	< 1.0	< 1.0
Thallium	ug/L	2	NA	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. 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 1
 Comparison of Groundwater Sampling Results to Groundwater Protection Standards – February 2017 to April 2019
 JC Weadock Landfill – RCRA CCR Monitoring Program
 Essexville, Michigan

		Sample Location:				JCW-MW-18004		JCW-MW-18005		JCW-MW-18006		
		Sample Date:				11/8/2018	4/11/2019	11/8/2018	4/11/2019	11/8/2018	4/11/2019	4/11/2019
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS	downgradient						Field Dup
Appendix III												
Boron	ug/L	NC	NA	619	NA	366	320	1,300	1,300	2,990	2,900	2,800
Calcium	mg/L	NC	NA	302	NA	296	470	156	340	188	190	190
Chloride	mg/L	250**	NA	2,440	NA	17.1	34	81.8	59	96.9	97	98
Fluoride	ug/L	4,000	NA	1,000	NA	< 1,000	< 1,000	1,100	< 1,000	< 1,000	< 1,000	< 1,000
Sulfate	mg/L	250**	NA	407	NA	727	840	125	680	75.8	120	120
Total Dissolved Solids	mg/L	500**	NA	4,600	NA	1,560	1,900	854	1,700	1,040	990	980
pH, Field	SU	6.5 - 8.5**	6.5 - 8.5	6.5 - 7.3	NA	6.8	6.6	6.9	6.6	6.8	6.9	--
Appendix IV												
Antimony	ug/L	6	NA	1	6	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 2.0
Arsenic	ug/L	10	NA	21	21	< 5.0	4.4	2.2	5.3	35.1	37	38
Barium	ug/L	2,000	NA	1,300	2,000	36.3	80	103	180	534	420	450
Beryllium	ug/L	4	NA	1	4	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 2.0
Cadmium	ug/L	5	NA	0.2	5	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.40	< 0.40
Chromium	ug/L	100	NA	3	100	< 5.0	19	< 1.0	2.0	< 1.0	< 2.0	< 2.0
Cobalt	ug/L	NC	6	15	15	< 30.0 ⁽¹⁾	< 6.0	< 6.0	< 6.0	< 6.0	< 12	< 12
Fluoride	ug/L	4,000	NA	1,000	4,000	< 1,000	< 1,000	1,100	< 1,000	< 1,000	< 1,000	< 1,000
Lead	ug/L	NC	15	1	15	< 5.0	5.6	< 1.0	< 1.0	< 1.0	< 2.0	< 2.0
Lithium	ug/L	NC	40	180	180	36	38	36	49	88	67	66
Mercury	ug/L	2	NA	0.2	2	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	NC	100	6	100	< 5.0	< 5.0	5.8	< 5.0	< 5.0	< 10	< 10
Radium-226	pCi/L	NC	NA	NA	NA	< 1.04	--	0.785	--	0.646	--	--
Radium-228	pCi/L	NC	NA	NA	NA	< 0.633	--	1.02	--	1.85	--	--
Radium-226/228	pCi/L	5	NA	3.32	5	< 1.67	--	1.81	--	2.50	--	--
Selenium	ug/L	50	NA	2	50	< 1.0	1.5	< 1.0	< 1.0	< 1.0	< 2.0	< 2.0
Thallium	ug/L	2	NA	2	2	< 10.0 ⁽¹⁾	< 2.0	< 2.0	< 2.0	< 2.0	< 4.0 ⁽¹⁾	< 4.0 ⁽¹⁾

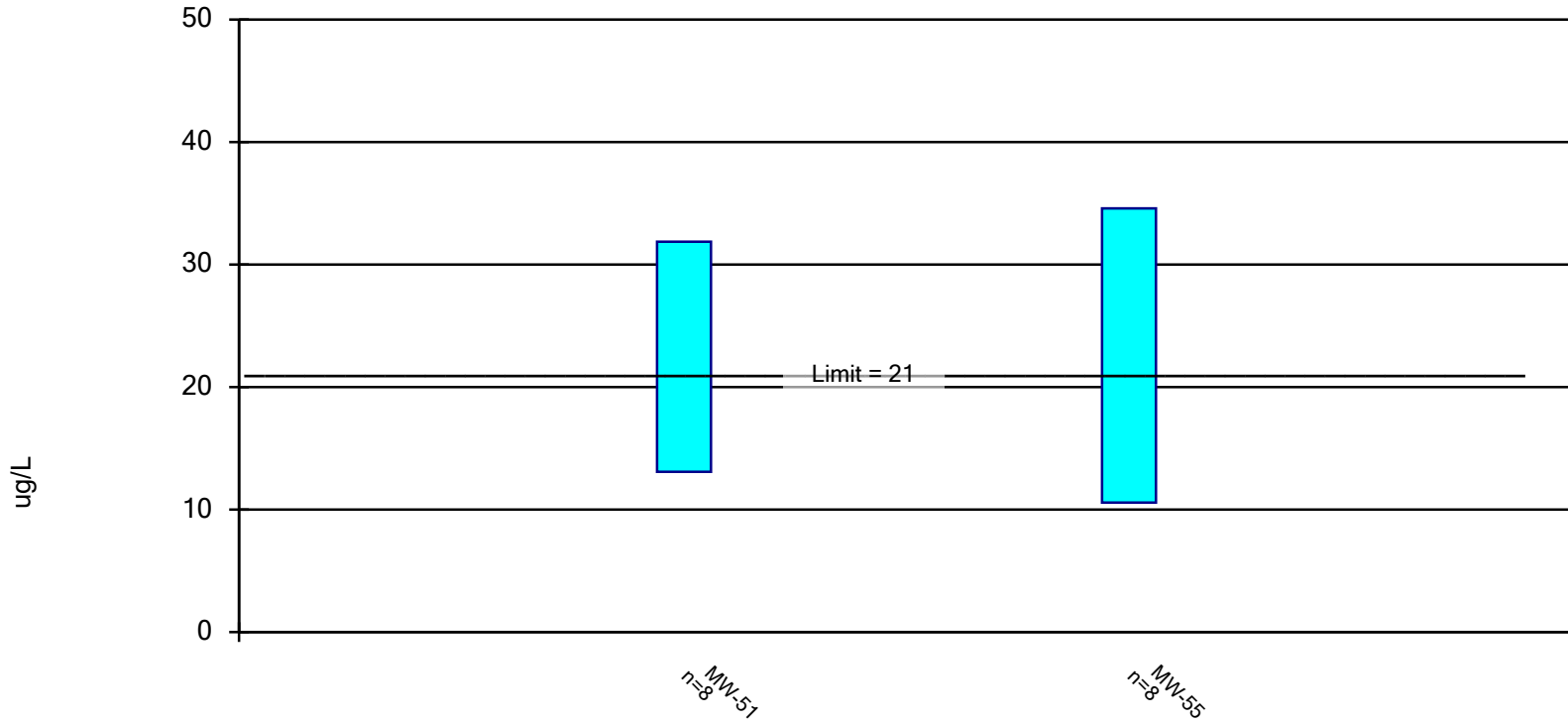
Notes:

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. 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.

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 6/25/2019 10:03 AM

Client: Consumers Energy Data: JCW_Sanitas_19.05.30

Confidence Interval

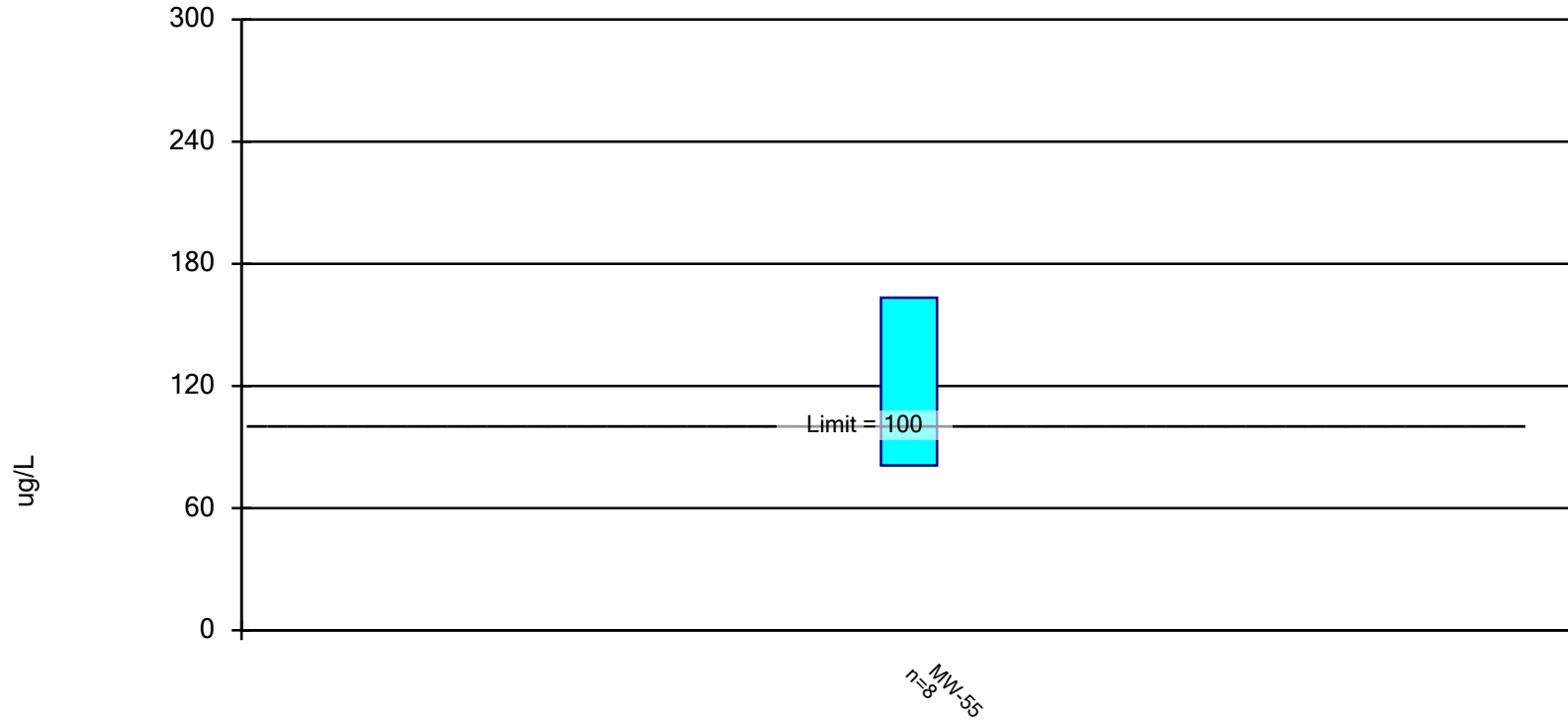
Constituent: Arsenic, Total (ug/L) Analysis Run 6/25/2019 10:03 AM

Client: Consumers Energy Data: JCW_Sanitas_19.05.30

	MW-51	MW-55
5/11/2017	24	6
8/9/2017	41	
8/10/2017		15
11/1/2017	28	
11/2/2017		19
3/6/2018	16	18
5/15/2018		16.5 (D)
5/16/2018	13	
8/15/2018	19	
8/16/2018		37
11/8/2018	21.8	35.1
4/9/2019	17	
4/11/2019		34
Mean	22.48	22.58
Std. Dev.	8.866	11.33
Upper Lim.	31.87	34.58
Lower Lim.	13.08	10.57

Parametric Confidence Interval

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



Constituent: Molybdenum, Total Analysis Run 6/25/2019 10:03 AM

Client: Consumers Energy Data: JCW_Sanitas_19.05.30

Confidence Interval

Constituent: Molybdenum, Total (ug/L) Analysis Run 6/25/2019 10:04 AM

Client: Consumers Energy Data: JCW_Sanitas_19.05.30

MW-55

5/11/2017	65
8/10/2017	88
11/2/2017	139
3/6/2018	132
5/15/2018	117.5 (D)
8/16/2018	172
11/8/2018	171
4/11/2019	93
Mean	122.2
Std. Dev.	38.83
Upper Lim.	163.3
Lower Lim.	81.03

Appendix F October 2019 Assessment Monitoring Statistical Evaluation

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 Landfill, Consumers Energy Company, Essexville, Michigan

During the statistical evaluation of the initial assessment monitoring event (May 2018), arsenic was 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 Rule¹ at the JC Weadock Power Plant Landfill. 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.

The evaluation of the initial semiannual assessment monitoring event data (April and May 2018) indicated that arsenic was present at statistically significant levels above the GWPS at one of the three downgradient wells. The three downgradient wells were located within a vent (e.g., opening) of the

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).

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perimeter soil/bentonite slurry wall to assess the quality of groundwater passing the waste boundary. As discussed in detail below, in July 2018, a vent (e.g., opening) in the perimeter soil/bentonite slurry wall was closed and the slurry wall is now continuous along the entire perimeter of the Weadock Landfill. As a result of the change in groundwater flow conditions, the groundwater monitoring system was revised² prior to the November 2018 sampling event. The modified CCR monitoring well network now consists of eleven (11) downgradient monitoring wells. The statistical analysis for the 5 new wells will commence once sufficient data has been collected (a minimum of four independent sampling events). Six (6) of the downgradient wells were preexisting and had been sampled under the approved 2015 HMP³ for Michigan Part 115 compliance; therefore, the statistical evaluation could be performed for a subset of Appendix III and IV constituents. The statistical evaluation of the fourth semiannual assessment monitoring event data indicates that no Appendix IV constituents are present at statistically significant levels above the GWPSs in downgradient monitoring wells at the Weadock Landfill.

<u>Constituent</u>	<u>GWPS</u>	<u>#Downgradient Wells Observed</u>
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No constituents are present at statistically significant levels above the GWPSs.

These results are consistent with the results of the previous assessment monitoring data statistical evaluations for the modified monitoring well network. 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 initial assessment monitoring event. Consumers Energy will continue to evaluate corrective measures per §257.96 and §257.97 and execute the self-implementing groundwater compliance schedule in conformance with §257.90 - §257.98.

Assessment Monitoring Statistical Evaluation

When the monitoring well network was first established in October 2017, there was a 1,600-linear-foot section of the perimeter embankment dike that did not have a slurry wall in place. Groundwater flow beneath the Weadock Landfill was directed towards the discharge channel through this vent in the slurry wall for management under the existing NPDES discharge permit. The downgradient monitoring well network was established as three monitoring wells located in the vent area to assess the quality of groundwater passing the waste boundary (JCW-MW-15011, JCW-MW-15012, and JCW-MW-15023). In July 2018, the slurry wall vent was closed to reduced porewater flux around the entire perimeter of the Weadock Landfill. The three downgradient CCR compliance wells were decommissioned by over drilling, removing the well material, and sealing the borehole in order to allow for the slurry wall construction.

Given the change in groundwater flow conditions, a revised groundwater monitoring system has been established to assess slurry wall integrity and determine if there have been any releases from the

² TRC. 2018. *Revised Groundwater Monitoring System Summary Report Technical Memorandum*. December.

³ Consumers Energy Company. 2015. *Hydrogeological Monitoring Plan Rev. 2: JC Weadock Solid Waste Disposal Area*. June.

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Weadock Landfill. Consumers Energy installed an additional nine (9) monitoring wells in August 2018 to supplement the preexisting groundwater well network currently used under the approved 2015 HMP for Michigan Part 115 compliance to provide appropriate coverage for the collection of groundwater levels and water quality data along the perimeter of the Weadock Landfill.

Therefore, the modified CCR monitoring well network now consists of eleven (11) downgradient monitoring wells as discussed in the *Sample and Analysis Plan* (2018 SAP) and *Statistical Analysis Plan* (2018 Stats Plan). The downgradient monitoring wells include:

JCW-MW-18001	JCW-MW-18004	JCW-MW-18005	JCW-MW-18006
MW-50	MW-51	MW-52	MW-53
MW-54R	MW-55	OW-57R Out	

The statistical analysis for the new wells (JCW-MW-18001, JCW-MW-18004, JCW-MW-18005, and JCW-MW-18006; and OW-57R Out) will commence once sufficient data has been collected (a minimum of four independent sampling events; one more event is needed). Data from the HMP monitoring program may be used to supplement the CCR program as long as temporal independence is maintained. For the preexisting wells (MW-50 through MW-55), a minimum of eight rounds of data for a subset of Appendix III and IV constituents have been collected in 2017 and 2018 as part of the quarterly HMP monitoring.

Following the second semiannual assessment monitoring sampling event, compliance well data for the Weadock Landfill were evaluated in accordance with the *Groundwater Statistical Analysis Plan* (TRC, December 2018). 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 Guidance⁴, 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 result indicates that there is insufficient

⁴ USEPA. 2009. *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance*. Office of Conservation and Recovery. EPA 530/R-09-007.

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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 for 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 within the most recent eight sampling events (August 2017 through October 2019) were retained for further analysis. Arsenic in MW-51 and MW-55 and molybdenum in MW-55 had individual results exceeding the GWPS. The concentrations of arsenic and molybdenum at MW-55 are not a result of a release from the unit, as detailed in the *Alternate Source Demonstration* (TRC, December 2019); therefore, confidence intervals were not calculated.

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 were calculated for each of the CCR Appendix IV parameters using a per test⁵ 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.

⁵ Confidence level is assessed for each individual comparison (i.e. per well and per constituent).

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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 (August 2017 through October 2019) results were observed visually for potential trends. No outliers were identified in the data set. The concentrations of arsenic and molybdenum at MW-55 are not a result of a release from the unit, as detailed in the *Alternate Source Demonstration* (TRC, December 2019); therefore, confidence intervals were not calculated.

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. The arsenic data sets were transformed as noted on the graph. The molybdenum data set was 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. Although no Appendix IV constituents are present at statistically significant levels above the GWPS based on the October 2019 data evaluation, concentrations remain above background levels and corrective action has been triggered as a result of data collected during the initial May 2018 assessment monitoring event. Consumers Energy will continue to evaluate corrective measures per §257.96 and §257.97 and 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 – August 2017 to October 2019

Attachment 1 Sanitas™ Output Files

Table

Table 1
 Comparison of Groundwater Sampling Results to Groundwater Protection Standards – August 2017 to October 2019
 JC Weadock Landfill – RCRA CCR Monitoring Program
 Essexville, Michigan

		Sample Location:				MW-50							
		Sample Date:				8/9/2017	11/1/2017	3/5/2018	5/15/2018	8/15/2018	11/7/2018	4/9/2019	10/10/2019
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS								
Appendix III													
Boron	ug/L	NC	NA	619	NA	987	1,120	1,320	1,220	1,270	1,370	1,600	1,700
Calcium	mg/L	NC	NA	302	NA	--	--	--	250	--	249	200	280
Chloride	mg/L	250**	NA	2,440	NA	--	--	--	73.8	--	76.3	62	80
Fluoride	ug/L	4,000	NA	1,000	NA	--	--	--	< 1,000	--	< 1,000	< 1,000	< 1,000
Sulfate	mg/L	250**	NA	407	NA	290	580	370	550	490	518	370	660
Total Dissolved Solids	mg/L	500**	NA	4,600	NA	--	--	--	1,400	--	1,360	1,200	1,400
pH, Field	SU	6.5 - 8.5**	6.5 - 8.5	6.5 - 7.3	NA	7.0	7.1	7.5	7.3	7.0	7.2	7.3	7.1
Appendix IV													
Antimony	ug/L	6	NA	1	6	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	10	NA	21	21	3	3	2	2	2	< 5.0	1.1	2.8
Barium	ug/L	2,000	NA	1,300	2,000	352	299	365	351	292	239	220	180
Beryllium	ug/L	4	NA	1	4	--	--	--	< 1	--	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	5	NA	0.2	5	--	--	--	< 0.2	--	< 0.20	< 0.20	< 0.20
Chromium	ug/L	100	NA	3	100	< 1	< 1	< 1	< 1	< 1	< 5.0	< 1.0	1.4
Cobalt	ug/L	NC	6	15	15	--	--	--	< 15	--	< 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
Lead	ug/L	NC	15	1	15	< 1	< 1	< 1	< 1	< 1	< 5.0	< 1.0	< 1.0
Lithium	ug/L	NC	40	180	180	74	72	63	74	77	94	69	79
Mercury	ug/L	2	NA	0.2	2	--	--	--	< 0.2	--	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	NC	100	6	100	6	10	6	6	8	8.0	< 5.0	6.6
Radium-226	pCi/L	NC	NA	NA	NA	--	--	--	--	--	1.40	0.347	0.572
Radium-228	pCi/L	NC	NA	NA	NA	--	--	--	--	--	1.88	0.828	1.49
Radium-226/228	pCi/L	5	NA	3.32	5	--	--	--	--	--	3.28	1.17	2.06
Selenium	ug/L	50	NA	2	50	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1.0	< 1.0
Thallium	ug/L	2	NA	2	2	--	--	--	< 2	--	< 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 – August 2017 to October 2019
 JC Weadock Landfill – RCRA CCR Monitoring Program
 Essexville, Michigan

Sample Location:						MW-51								
Sample Date:						8/9/2017	11/1/2017	3/6/2018	5/16/2018	8/15/2018	11/8/2018	4/9/2019	10/10/2019	10/10/2019
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS									
Appendix III														
Boron	ug/L	NC	NA	619	NA	1,060	1,280	1,040	883	872	851	940	890	900
Calcium	mg/L	NC	NA	302	NA	--	--	--	378	--	331	310	340	350
Chloride	mg/L	250**	NA	2,440	NA	--	--	--	65	--	55.8	84	88	88
Fluoride	ug/L	4,000	NA	1,000	NA	--	--	--	< 1,000	--	< 1,000	< 1,000	< 1,000	< 1,000
Sulfate	mg/L	250**	NA	407	NA	510	560	430	592	450	505	500	570	580
Total Dissolved Solids	mg/L	500**	NA	4,600	NA	--	--	--	1,600	--	1,410	1,500	1,500	1,500
pH, Field	SU	6.5 - 8.5**	6.5 - 8.5	6.5 - 7.3	NA	6.8	6.8	6.8	6.7	6.6	6.6	7.0	6.7	--
Appendix IV														
Antimony	ug/L	6	NA	1	6	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	10	NA	21	21	41	28	16	13	19	21.8	17	20	19
Barium	ug/L	2,000	NA	1,300	2,000	268	291	187	189	178	163	190	180	180
Beryllium	ug/L	4	NA	1	4	--	--	--	< 1	--	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	5	NA	0.2	5	--	--	--	< 0.2	--	< 1.0	< 0.20	< 0.20	< 0.20
Chromium	ug/L	100	NA	3	100	< 1	1	< 1	< 1	< 1	< 5.0	1.0	< 1.0	< 1.0
Cobalt	ug/L	NC	6	15	15	--	--	--	< 15	--	< 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
Lead	ug/L	NC	15	1	15	< 1	< 1	< 1	< 1	< 1	< 5.0	< 1.0	< 1.0	< 1.0
Lithium	ug/L	NC	40	180	180	68	64	55	62	57	71	59	49	50
Mercury	ug/L	2	NA	0.2	2	--	--	--	< 0.2	--	< 0.20	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	NC	100	6	100	< 5	< 5	< 5	< 5	< 5	< 25.0	< 5.0	< 5.0	< 5.0
Radium-226	pCi/L	NC	NA	NA	NA	--	--	--	--	--	< 0.715	0.216	0.316	0.365
Radium-228	pCi/L	NC	NA	NA	NA	--	--	--	--	--	1.12	0.643	1.68	1.26
Radium-226/228	pCi/L	5	NA	3.32	5	--	--	--	--	--	< 1.64	0.859	1.99	1.63
Selenium	ug/L	50	NA	2	50	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1.0	< 1.0	< 1.0
Thallium	ug/L	2	NA	2	2	--	--	--	< 2	--	< 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 – August 2017 to October 2019
 JC Weadock Landfill – RCRA CCR Monitoring Program
 Essexville, Michigan

Sample Location:						MW-52									
Sample Date:						8/9/2017	11/1/2017	3/6/2018	3/6/2018	5/15/2018	8/15/2018	11/8/2018	11/8/2018	4/9/2019	10/10/2019
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS										
Appendix III															
								Field Dup				Field Dup			
Boron	ug/L	NC	NA	619	NA	1,040	991	795	791	803	904	896	774	1,200	1,200
Calcium	mg/L	NC	NA	302	NA	--	--	--	--	241	--	263	256	210	220
Chloride	mg/L	250**	NA	2,440	NA	--	--	--	--	89.5	--	96.6	97.2	95	89
Fluoride	ug/L	4,000	NA	1,000	NA	--	--	--	--	< 1,000	--	< 1,000	< 1,000	< 1,000	< 1,000
Sulfate	mg/L	250**	NA	407	NA	530	480	530	510	536	500	512	517	480	520
Total Dissolved Solids	mg/L	500**	NA	4,600	NA	--	--	--	--	1,500	--	1,520	1,460	1,400	1,200
pH, Field	SU	6.5 - 8.5**	6.5 - 8.5	6.5 - 7.3	NA	6.8	7.0	--	7.0	7.0	6.9	--	6.8	7.1	6.9
Appendix IV															
Antimony	ug/L	6	NA	1	6	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	10	NA	21	21	< 1	1	< 1	< 1	< 1	< 1	< 1.0	< 5.0	< 1.0	< 1.0
Barium	ug/L	2,000	NA	1,300	2,000	150	144	153	155	148	160	170	146	140	120
Beryllium	ug/L	4	NA	1	4	--	--	--	--	< 1	--	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	5	NA	0.2	5	--	--	--	--	< 0.2	--	< 0.20	< 1.0	< 0.20	< 0.20
Chromium	ug/L	100	NA	3	100	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 5.0	< 1.0	< 1.0
Cobalt	ug/L	NC	6	15	15	--	--	--	--	< 15	--	< 6.0	< 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
Lead	ug/L	NC	15	1	15	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 5.0	< 1.0	< 1.0
Lithium	ug/L	NC	40	180	180	55	53	55	58	55	54	60	63	39	30
Mercury	ug/L	2	NA	0.2	2	--	--	--	--	< 0.2	--	< 0.20	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	NC	100	6	100	< 5	< 5	< 5	< 5	< 5	< 5	< 5.0	< 25.0	< 5.0	< 5.0
Radium-226	pCi/L	NC	NA	NA	NA	--	--	--	--	--	--	0.840	< 0.651	0.211	0.252
Radium-228	pCi/L	NC	NA	NA	NA	--	--	--	--	--	--	0.683	< 0.850	1.14	< 0.772
Radium-226/228	pCi/L	5	NA	3.32	5	--	--	--	--	--	--	1.52	< 1.50	1.35	1.01
Selenium	ug/L	50	NA	2	50	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1.0	< 1.0	< 1.0
Thallium	ug/L	2	NA	2	2	--	--	--	--	< 2	--	< 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 – August 2017 to October 2019
 JC Weadock Landfill – RCRA CCR Monitoring Program
 Essexville, Michigan

Sample Location:						MW-53							
Sample Date:						8/9/2017	11/1/2017	3/6/2018	5/15/2018	8/15/2018	11/8/2018	4/10/2019	10/10/2019
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS								
Appendix III													
Boron	ug/L	NC	NA	619	NA	468	496	490	1,260	695	519	1,500	900
Calcium	mg/L	NC	NA	302	NA	--	--	--	158	--	465	200	420
Chloride	mg/L	250**	NA	2,440	NA	--	--	--	77.5	--	84.5	39	150
Fluoride	ug/L	4,000	NA	1,000	NA	--	--	--	< 1,000	--	< 1,000	< 1,000	< 1,000
Sulfate	mg/L	250**	NA	407	NA	890	830	510	208	570	811	330	960
Total Dissolved Solids	mg/L	500**	NA	4,600	NA	--	--	--	970	--	1,950	1,200	2,100
pH, Field	SU	6.5 - 8.5**	6.5 - 8.5	6.5 - 7.3	NA	6.6	6.7	6.8	7.2	6.7	6.6	7.1	6.7
Appendix IV													
Antimony	ug/L	6	NA	1	6	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	10	NA	21	21	3	3	2	2	3	5.1	< 1.0	2.9
Barium	ug/L	2,000	NA	1,300	2,000	56	50	49	78	87	54.4	120	77
Beryllium	ug/L	4	NA	1	4	--	--	--	< 1	--	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	5	NA	0.2	5	--	--	--	< 0.2	--	< 1.0	< 0.20	< 0.20
Chromium	ug/L	100	NA	3	100	< 1	1	< 1	< 1	< 1	< 5.0	1.6	< 1.0
Cobalt	ug/L	NC	6	15	15	--	--	--	< 15	--	< 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
Lead	ug/L	NC	15	1	15	< 1	< 1	< 1	< 1	< 1	< 5.0	< 1.0	< 1.0
Lithium	ug/L	NC	40	180	180	48	45	35	49	48	59	53	45
Mercury	ug/L	2	NA	0.2	2	--	--	--	< 0.2	--	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	NC	100	6	100	< 5	< 5	< 5	< 5	< 5	< 25.0	< 5.0	< 5.0
Radium-226	pCi/L	NC	NA	NA	NA	--	--	--	--	--	< 0.664	0.161	0.263
Radium-228	pCi/L	NC	NA	NA	NA	--	--	--	--	--	< 0.655	0.500	< 0.750
Radium-226/228	pCi/L	5	NA	3.32	5	--	--	--	--	--	< 1.32	0.661	0.962
Selenium	ug/L	50	NA	2	50	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1.0	< 1.0
Thallium	ug/L	2	NA	2	2	--	--	--	< 2	--	< 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 – August 2017 to October 2019
 JC Weadock Landfill – RCRA CCR Monitoring Program
 Essexville, Michigan

Sample Location:						MW-54R								
Sample Date:						8/9/2017	11/2/2017	3/6/2018	5/15/2018	8/16/2018	8/16/2018	11/8/2018	4/11/2019	10/10/2019
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS									
Appendix III														
Boron	ug/L	NC	NA	619	NA	1,100	1,280	1,060	1,150	1,340	1,240	1,290	960	1,500
Calcium	mg/L	NC	NA	302	NA	--	--	--	179	--	--	173	180	180
Chloride	mg/L	250**	NA	2,440	NA	--	--	--	20	--	--	18.0	16	18
Fluoride	ug/L	4,000	NA	1,000	NA	--	--	--	< 1,000	--	--	< 1,000	< 1,000	< 1,000
Sulfate	mg/L	250**	NA	407	NA	180	160	160	208	180	190	152	160	130
Total Dissolved Solids	mg/L	500**	NA	4,600	NA	--	--	--	890	--	--	710	770	710
pH, Field	SU	6.5 - 8.5**	6.5 - 8.5	6.5 - 7.3	NA	6.8	6.9	7.1	7.0	6.9	--	7.0	6.9	6.9
Appendix IV														
Antimony	ug/L	6	NA	1	6	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	10	NA	21	21	< 1	< 1	1	< 1	< 1	< 1	< 1.0	1.6	2.3
Barium	ug/L	2,000	NA	1,300	2,000	74	74	70	74	79	80	59.9	74	88
Beryllium	ug/L	4	NA	1	4	--	--	--	< 1	--	--	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	5	NA	0.2	5	--	--	--	< 0.2	--	--	< 0.20	< 0.20	< 0.20
Chromium	ug/L	100	NA	3	100	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1.0	< 1.0
Cobalt	ug/L	NC	6	15	15	--	--	--	< 15	--	--	< 6.0	< 6.0	< 6.0
Fluoride	ug/L	4,000	NA	1,000	4,000	--	--	--	< 1,000	--	--	< 1,000	< 1,000	< 1,000
Lead	ug/L	NC	15	1	15	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1.0	< 1.0
Lithium	ug/L	NC	40	180	180	58	58	52	57	58	56	62	48	53
Mercury	ug/L	2	NA	0.2	2	--	--	--	< 0.2	--	--	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	NC	100	6	100	6	5	< 5	< 5	< 5	< 5	< 5.0	< 5.0	6.2
Radium-226	pCi/L	NC	NA	NA	NA	--	--	--	--	--	--	< 1.09	< 0.332	0.328
Radium-228	pCi/L	NC	NA	NA	NA	--	--	--	--	--	--	< 0.786	< 0.480	< 0.828
Radium-226/228	pCi/L	5	NA	3.32	5	--	--	--	--	--	--	< 1.88	0.568	0.860
Selenium	ug/L	50	NA	2	50	1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1.0	< 1.0
Thallium	ug/L	2	NA	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.
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 ** - 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 – August 2017 to October 2019
 JC Weadock Landfill – RCRA CCR Monitoring Program
 Essexville, Michigan

		Sample Location:				MW-55									
		Sample Date:				8/10/2017	11/2/2017	3/6/2018	5/15/2018	5/15/2018	8/16/2018	11/8/2018	4/11/2019	10/11/2019	
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS										
Appendix III															
Boron	ug/L	NC	NA	619	NA	519	619	680	539	533	670	582	800	700	
Calcium	mg/L	NC	NA	302	NA	--	--	--	189	193	--	202	140	190	
Chloride	mg/L	250**	NA	2,440	NA	--	--	--	15.7	16.4	--	15.8	26	19	
Fluoride	ug/L	4,000	NA	1,000	NA	--	--	--	< 1,000	< 1,000	--	< 1,000	< 1,000	< 1,000	
Sulfate	mg/L	250**	NA	407	NA	360	280	100	257	260	250	157	70	190	
Total Dissolved Solids	mg/L	500**	NA	4,600	NA	--	--	--	980	940	--	894	770	950	
pH, Field	SU	6.5 - 8.5**	6.5 - 8.5	6.5 - 7.3	NA	6.8	6.8	7.0	7.0	--	6.8	7.0	7.1	6.9	
Appendix IV															
Antimony	ug/L	6	NA	1	6	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1.0	< 1.0	
Arsenic	ug/L	10	NA	21	21	15	19	18	17	16	37	35.1	34	76	
Barium	ug/L	2,000	NA	1,300	2,000	83	86	133	148	148	183	158	200	250	
Beryllium	ug/L	4	NA	1	4	--	--	--	< 1	< 1	--	< 1.0	< 1.0	< 1.0	
Cadmium	ug/L	5	NA	0.2	5	--	--	--	0.3	0.3	--	0.32	< 0.20	< 0.20	
Chromium	ug/L	100	NA	3	100	< 1	< 1	< 1	< 1	< 1	< 1	< 5.0	< 1.0	< 1.0	
Cobalt	ug/L	NC	6	15	15	--	--	--	< 15	< 15	--	< 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	
Lead	ug/L	NC	15	1	15	< 1	< 1	< 1	< 1	< 1	< 1	< 5.0	< 1.0	< 1.0	
Lithium	ug/L	NC	40	180	180	23	28	16	20	21	32	40	17	27	
Mercury	ug/L	2	NA	0.2	2	--	--	--	< 0.2	< 0.2	--	< 0.20	< 0.20	< 0.20	
Molybdenum	ug/L	NC	100	6	100	88	139	132	119	116	172	171	93	190	
Radium-226	pCi/L	NC	NA	NA	NA	--	--	--	--	--	--	< 0.932	0.188	0.409	
Radium-228	pCi/L	NC	NA	NA	NA	--	--	--	--	--	--	< 0.679	< 0.660	1.05	
Radium-226/228	pCi/L	5	NA	3.32	5	--	--	--	--	--	--	< 1.61	< 0.660	1.45	
Selenium	ug/L	50	NA	2	50	10	< 1	< 1	1	1	2	< 1.0	< 1.0	< 1.0	
Thallium	ug/L	2	NA	2	2	--	--	--	< 2	< 2	--	< 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.
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Table 1
 Comparison of Groundwater Sampling Results to Groundwater Protection Standards – August 2017 to October 2019
 JC Weadock Landfill – RCRA CCR Monitoring Program
 Essexville, Michigan

		Sample Location:				OW-57ROUT			JCW-MW-18001		
		Sample Date:				11/8/2018	4/12/2019	10/14/2019	11/7/2018	4/12/2019	10/10/2019
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS	downgradient					
Appendix III											
Boron	ug/L	NC	NA	619	NA	1,850	1,700	1,700	1,330	1,400	1,500
Calcium	mg/L	NC	NA	302	NA	141	130	130	138	140	170
Chloride	mg/L	250**	NA	2,440	NA	70.3	68	58	51.5	67	58
Fluoride	ug/L	4,000	NA	1,000	NA	1,200	1,200	1,100	< 1,000	< 1,000	< 2,000
Sulfate	mg/L	250**	NA	407	NA	112	110	110	97.7	210	170
Total Dissolved Solids	mg/L	500**	NA	4,600	NA	808	780	750	678	860	870
pH, Field	SU	6.5 - 8.5**	6.5 - 8.5	6.5 - 7.3	NA	7.0	7.1	6.8	7.2	7.2	7.0
Appendix IV											
Antimony	ug/L	6	NA	1	6	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	10	NA	21	21	1.4	< 1.0	1.7	5.8	2.3	2.5
Barium	ug/L	2,000	NA	1,300	2,000	73.7	72	73	169	200	220
Beryllium	ug/L	4	NA	1	4	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	5	NA	0.2	5	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Chromium	ug/L	100	NA	3	100	< 1.0	< 1.0	5.4	< 1.0	< 1.0	< 1.0
Cobalt	ug/L	NC	6	15	15	< 6.0	< 6.0	< 6.0	< 6.0	< 6.0	< 6.0
Fluoride	ug/L	4,000	NA	1,000	4,000	1,200	1,200	1,100	< 1,000	< 1,000	< 2,000
Lead	ug/L	NC	15	1	15	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lithium	ug/L	NC	40	180	180	35	23	25	51	43	53
Mercury	ug/L	2	NA	0.2	2	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	NC	100	6	100	8.9	7.9	7.4	< 5.0	< 5.0	< 5.0
Radium-226	pCi/L	NC	NA	NA	NA	< 1.09	0.181	0.195	< 0.542	0.300	0.434
Radium-228	pCi/L	NC	NA	NA	NA	< 0.718	< 0.501	< 0.373	< 0.808	< 0.449	< 0.715
Radium-226/228	pCi/L	5	NA	3.32	5	< 1.81	< 0.501	< 0.373	< 1.35	0.590	1.07
Selenium	ug/L	50	NA	2	50	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Thallium	ug/L	2	NA	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.
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- ** - 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.
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Table 1
 Comparison of Groundwater Sampling Results to Groundwater Protection Standards – August 2017 to October 2019
 JC Weadock Landfill – RCRA CCR Monitoring Program
 Essexville, Michigan

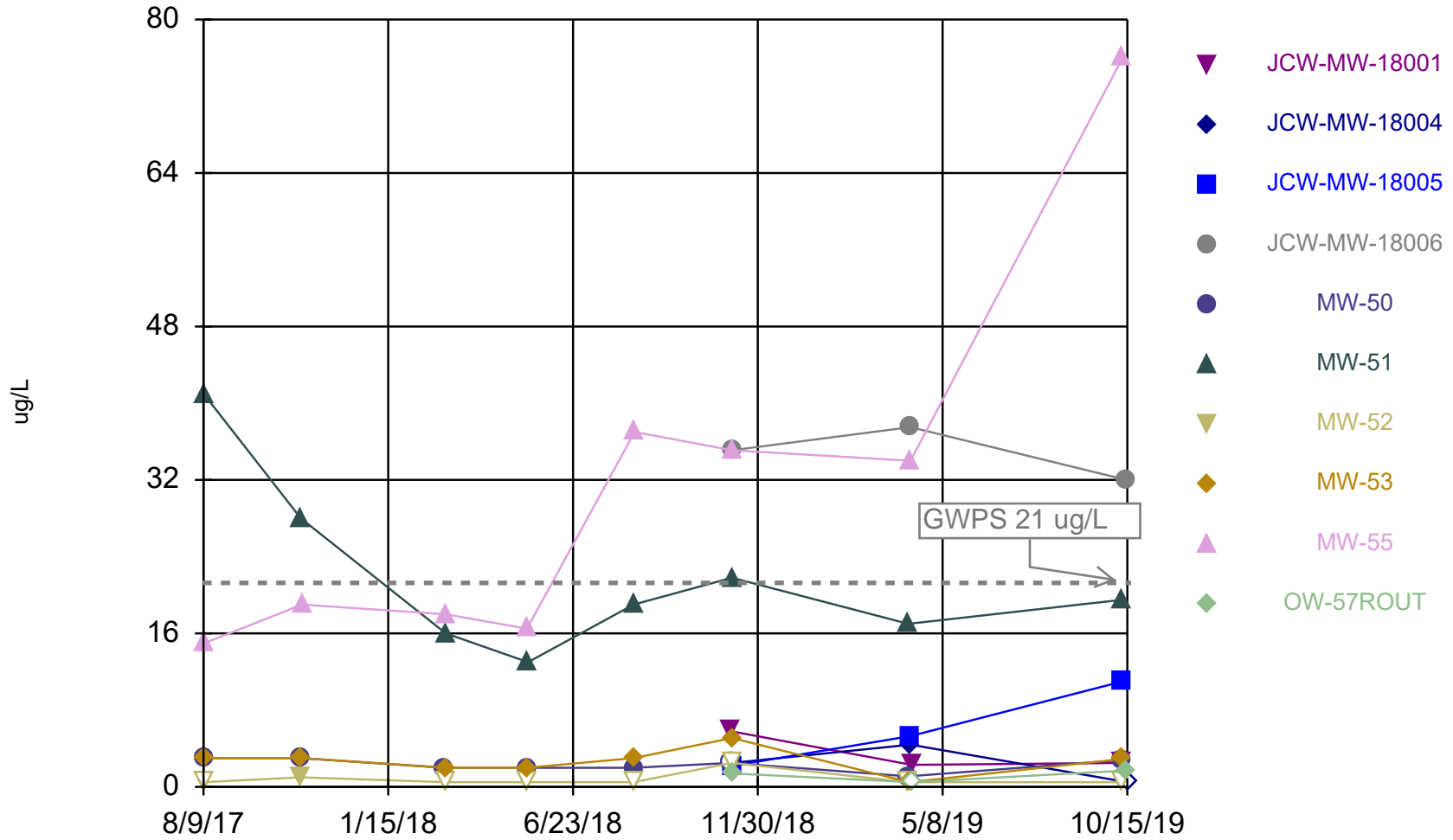
		Sample Location:				JCW-MW-18004			JCW-MW-18005			JCW-MW-18006			
		Sample Date:				11/8/2018	4/11/2019	10/15/2019	11/8/2018	4/11/2019	10/11/2019	11/8/2018	4/11/2019	4/11/2019	10/14/2019
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS	downgradient									
Appendix III															
Boron	ug/L	NC	NA	619	NA	366	320	430	1,300	1,300	1,700	2,990	2,900	Field Dup 2,800	2,800
Calcium	mg/L	NC	NA	302	NA	296	470	270	156	340	270	188	190	190	170
Chloride	mg/L	250**	NA	2,440	NA	17.1	34	39	81.8	59	82	96.9	97	98	97
Fluoride	ug/L	4,000	NA	1,000	NA	< 1,000	< 1,000	< 1,000	1,100	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Sulfate	mg/L	250**	NA	407	NA	727	840	930	125	680	470	75.8	120	120	100
Total Dissolved Solids	mg/L	500**	NA	4,600	NA	1,560	1,900	1,800	854	1,700	1,300	1,040	990	980	910
pH, Field	SU	6.5 - 8.5**	6.5 - 8.5	6.5 - 7.3	NA	6.8	6.6	6.6	6.9	6.6	6.7	6.8	6.9	--	6.8
Appendix IV															
Antimony	ug/L	6	NA	1	6	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 2.0	< 1.0
Arsenic	ug/L	10	NA	21	21	< 5.0	4.4	< 1.0	2.2	5.3	11	35.1	37	38	32
Barium	ug/L	2,000	NA	1,300	2,000	36.3	80	43	103	180	180	534	420	450	480
Beryllium	ug/L	4	NA	1	4	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 2.0	< 1.0
Cadmium	ug/L	5	NA	0.2	5	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.40	< 0.40	< 0.20
Chromium	ug/L	100	NA	3	100	< 5.0	19	< 1.0	< 1.0	2.0	12	< 1.0	< 2.0	< 2.0	< 1.0
Cobalt	ug/L	NC	6	15	15	< 30.0 ⁽¹⁾	< 6.0	< 6.0	< 6.0	< 6.0	< 6.0	< 6.0	< 12	< 12	< 6.0
Fluoride	ug/L	4,000	NA	1,000	4,000	< 1,000	< 1,000	< 1,000	1,100	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Lead	ug/L	NC	15	1	15	< 5.0	5.6	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 2.0	< 1.0
Lithium	ug/L	NC	40	180	180	36	38	37	36	49	50	88	67	66	72
Mercury	ug/L	2	NA	0.2	2	< 0.20	< 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	< 5.0	< 5.0	< 5.0	5.8	< 5.0	< 5.0	< 5.0	< 10	< 10	< 5.0
Radium-226	pCi/L	NC	NA	NA	NA	< 1.04	< 0.310	< 0.135	0.785	0.369	0.397	0.646	0.294	0.365	0.454
Radium-228	pCi/L	NC	NA	NA	NA	< 0.633	< 1.47	< 0.495	1.02	< 0.704	< 0.635	1.85	< 0.510	0.741	0.500
Radium-226/228	pCi/L	5	NA	3.32	5	< 1.67	< 1.47	< 0.495	1.81	< 0.704	0.698	2.50	0.709	1.11	0.954
Selenium	ug/L	50	NA	2	50	< 1.0	1.5	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 2.0	< 1.0
Thallium	ug/L	2	NA	2	2	< 10.0 ⁽¹⁾	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 4.0 ⁽¹⁾	< 4.0 ⁽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.
- MCL - Maximum Contaminant Level, EPA Drinking Water Standards and Health Advisories, April 2012.
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Sanitas™ Output Files

Time Series



Constituent: Arsenic, Total Analysis Run 12/4/2019 10:40 AM

Client: Consumers Energy Data: JCW_Sanitas_19.11.18

Summary Report

Constituent: Arsenic, Total Analysis Run 12/10/2019 10:58 AM
Client: Consumers Energy Data: JCW_Sanitas_19.11.18

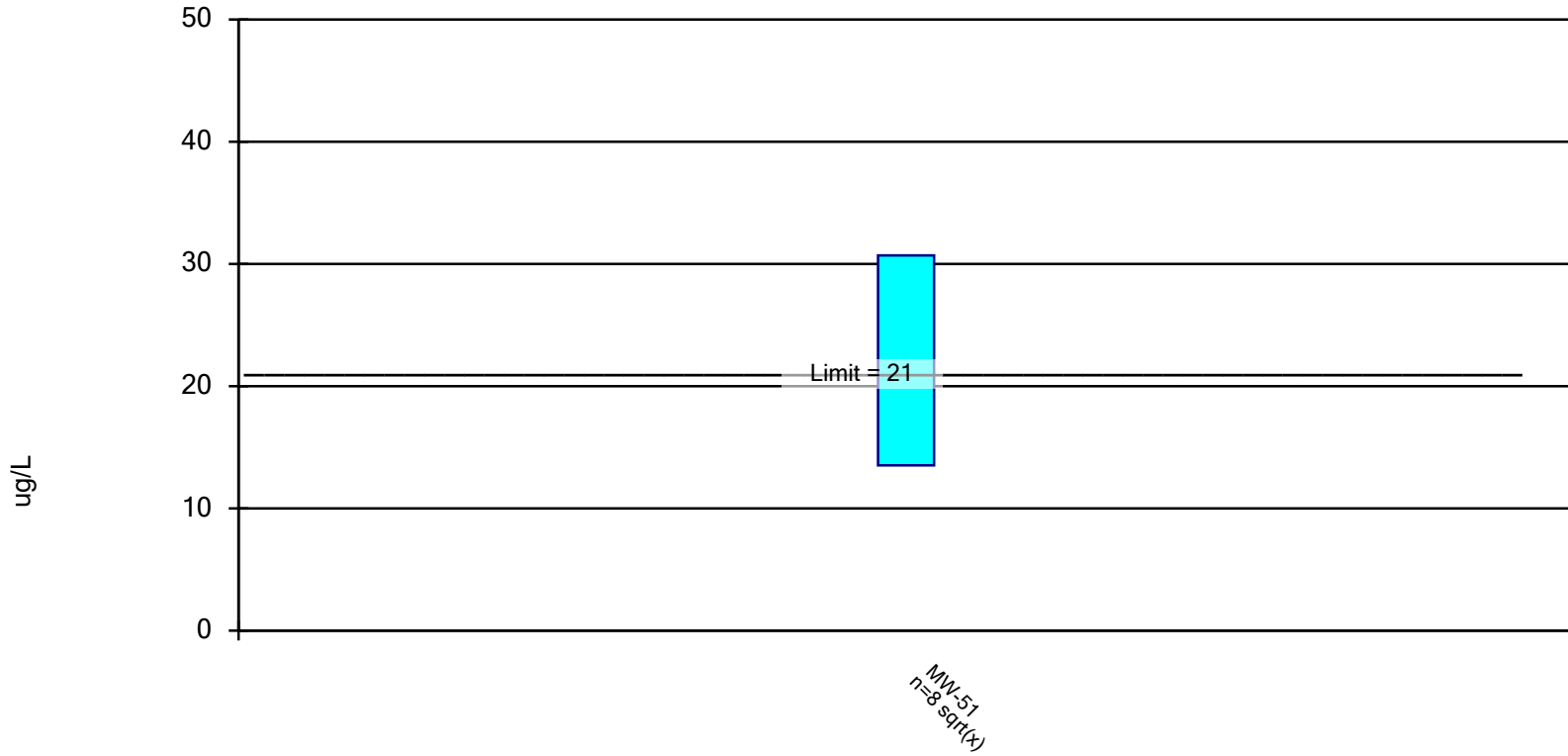
For observations made between 8/9/2017 and 10/10/2019, a summary of the selected data set:

Observations = 8
ND/Trace = 0
Wells = 1
Minimum Value = 13
Maximum Value = 41
Mean Value = 21.91
Median Value = 19.25
Standard Deviation = 8.898
Coefficient of Variation = 0.4061
Skewness = 1.324

<u>Well</u>	<u>#Obs.</u>	<u>ND/Trace</u>	<u>Min</u>	<u>Max</u>	<u>Mean</u>	<u>Median</u>	<u>Std.Dev.</u>	<u>CV</u>	<u>Skewness</u>
MW-51	8	0	13	41	21.91	19.25	8.898	0.4061	1.324

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 12/10/2019 10:58 AM

Client: Consumers Energy Data: JCW_Sanitas_19.11.18

Confidence Interval

Constituent: Arsenic, Total (ug/L) Analysis Run 12/10/2019 10:58 AM

Client: Consumers Energy Data: JCW_Sanitas_19.11.18

	MW-51
8/9/2017	41
11/1/2017	28
3/6/2018	16
5/16/2018	13
8/15/2018	19
11/8/2018	21.8
4/9/2019	17
10/10/2019	19.5 (D)
Mean	21.91
Std. Dev.	8.898
Upper Lim.	30.69
Lower Lim.	13.52


Appendix G

Alternate Source Demonstration for MW-55

A CMS Energy Company

Date: January 27, 2020

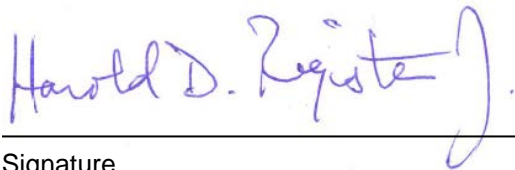
To: Operating Record

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

RE: Alternate Source Demonstration Professional Engineer Certification, §257.94(e)(2)
JC Weadock Landfill CCR Unit

Professional Engineer Certification Statement [40 CFR 257.94(e)(2)]

I hereby certify that the alternative source demonstration presented within this document for the JC Weadock Bottom Ash Pond CCR unit has been prepared to meet the requirements of Title 40 CFR §257.94(e)(2) of the Federal CCR Rule. This document is accurate and has been prepared in accordance with good engineering practices, including the consideration of applicable industry standards, and with the requirements of Title 40 CFR §257.94(e)(2).



Signature

January 27, 2020

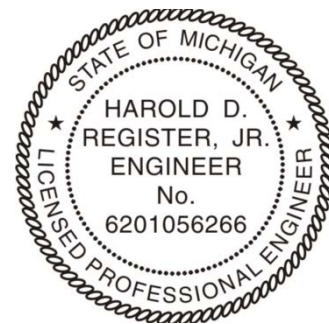
Date of Certification

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

Name

6201056266

Professional Engineer Certification Number



01/27/2020

ENCLOSURES

TRC (December 2019). "Alternate Source Demonstration: October 2019 Assessment Monitoring Sampling Event JC Weadock Landfill, Consumers Energy Company, Essexville, Michigan"

Technical Memorandum

Date: January 16, 2020

To: J.R. Register, Consumers Energy

From: Darby Litz, TRC
Graham Crockford, TRC

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

Project No.: 322173.0000 Phase 001, Task 003

Subject: Alternate Source Demonstration:
October 2019 Assessment Monitoring Sampling Event
JC Weadock Landfill, Consumers Energy Company, Essexville, Michigan

Introduction

Consumers Energy is continuing semiannual assessment monitoring in accordance with §257.95 of the CCR Rule¹ for the JC Weadock (JCW) site in Essexville, Michigan. Assessment monitoring includes semiannual sampling for constituents listed in Appendix III and Appendix IV to the CCR Rule. Corrective action has been triggered and assessment monitoring is ongoing at the Weadock Landfill CCR unit.

Consumers Energy is performing this Alternate Source Demonstration (ASD) to address recent increasing trends in molybdenum and arsenic at monitoring well MW-55 and is not specific to a detection of an Appendix IV constituent at a Statistically Significant Level above the Groundwater Protection Standard this reporting period (October 2019).

Alternate Source Demonstration

The Weadock Landfill CCR unit groundwater monitoring system is shown on Figure 1. The recent increase in arsenic and molybdenum at MW-55 appears to be a result of a change in geochemistry, such as a shift in redox conditions, rather than a result of landfill leachate or impacted groundwater migrating beyond the confines of the slurry wall.

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).

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A targeted groundwater investigation was completed in August 2018 as a part of Michigan Part 115² compliance reporting to further evaluate whether arsenic or molybdenum observed in MW-55 is potentially coming from the landfill or from another source. The investigation included advancement of 5 soil borings near MW-55 for the purposes of evaluating lithology and for temporary well installation and porewater sample collection (Figure 2). Soil boring logs are included in Attachment 2.

During this investigation, porewater was also collected from monitoring wells OW-55 and LH-104, located inside the landfill and a surface water sample was collected from Tacey Drain near MW-55. Analytical and field results are tabulated in Table 1 and 2. The boring logs for the ASD temporary monitoring wells show limited coal ash present in the subsurface outside of the landfill (outside of the soil-bentonite slurry wall), which may be influencing chemistry at MW-55.

Data collected from the 2018 investigation as well as data collected during routine sampling events for Part 115 and Federal CCR groundwater compliance show the following:

- **Distinct Chemistry from Leachate** – The leachate chemistry from a monitoring well screened at the base of the ash fill (LH-104) is distinctly different from the groundwater chemistry near MW-55 and the temporary monitoring wells installed by TRC in the investigation area, as illustrated in Table 1 and the piper diagram in Attachment 1. OW-55 was also sampled as part of this evaluation. OW-55 is located inside of the slurry wall and closer to MW-55 than LH-104. However, the boring log for OW-55 does not indicate coal ash is present at that location; therefore, water quality from LH-104 is likely more representative of leachate chemistry (coal ash impacted groundwater within the landfill) than OW-55.
- **Conservative Tracer** – Boron is a metalloid known to be present in coal ash and can be used as a conservative tracer in groundwater. Concentrations of boron in Leachate Headwell LH-104 are significantly higher than concentrations observed at any of the other location sampled as a part of this ASD. Additionally, boron concentrations at MW-55 have decreased since 2010, as evidenced by the time series plots in Attachment 1. A downward trend in concentration for boron is strong evidence that the water quality at MW-55 is not directly affected by groundwater migrating from the landfill.
- **Reducing Conditions and Groundwater Head Levels** – The two soil borings which exhibit the most similar chemistry to MW-55 (based on the piper diagrams) are JCW-SB-ASD1 and JCW-SB-ASD4. The oxidation-reduction potential (ORP) at these two locations is lower (i.e., more reducing) and more similar to the ORP at MW-55 than the other locations sampled in this investigation. Also, the water level within the saturated sand unit at these two temporary well locations is observed at or above an upper confining clay, as shown on the soil boring logs, meaning the sand unit is fully saturated and would be expected to have lower dissolved oxygen. Water levels for MW-55, as shown in Attachment 1, are trending upwards and have increased

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

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approximately 3-ft since 2010. This shift in ORP has changed the geochemical conditions in the vicinity of MW-55, and the resulting increased solubility of arsenic and molybdenum.

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Additionally, the results of the sample collected from temporary well JCW-MW-ASD1, located between the well and Tacey Drain, indicate that concentrations of arsenic and molybdenum decrease between MW-55 and the groundwater-surface water interface (GSI) along Tacey Drain. The elevated concentrations of arsenic and molybdenum observed at MW-55 appear to be delineated to the immediate vicinity of MW-55.

Conclusions and Recommendations

The information provided in this report serves as the ASD for the Weadock Landfill and demonstrates that the elevated concentrations of arsenic and molybdenum observed at MW-55 are not due to a release of CCR leachate from the Weadock Landfill into the groundwater. Therefore, based on the information provided in this ASD, Consumers Energy will continue assessment monitoring as per 40 CFR 257.95 at the Weadock Landfill.

Attachments

Table 1	MW-55 Alternate Source Demonstration Data
Table 2	Field Data
Figure 1	Site Map
Figure 2	Alternate Source Demonstration Sampling Locations
Attachment 1	Piper Diagrams and Time Series Charts
Attachment 2	Soil Boring Logs

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Tables

Table 1
 MW-55 Alternate Source Demonstration Data
 Third Quarter 2018 Quarterly Report
 JC Weadock Solid Waste Disposal Area, Essexville, Michigan

Analyte	Antimony	Arsenic	Barium	Boron	Chromium	Copper	Lead	Lithium	Molybdenum	Selenium	Silver	Vanadium	Alkalinity, Bicarbonate	Iron	Sodium	Sulfate	
Generic GSI Criteria	2.0 ⁽¹⁾	10	1,200 ⁽²⁾	4,000 ⁽¹⁾	11 ⁽³⁾	20 ⁽²⁾	44 ⁽²⁾	440	120 ⁽¹⁾	5.0	0.2	27	N/A	N/A	N/A	N/A	
Chronic-Based Mixing Zone GSI Criteria	N/A	100	N/A	44,000	N/A	N/A	N/A	N/A	N/A	55	N/A	N/A	N/A	N/A	N/A	N/A	
Acute-Based Mixing Zone GSI Criteria	N/A	680	N/A	69,000	N/A	N/A	N/A	N/A	N/A	120	N/A	N/A	N/A	N/A	N/A	N/A	
Units	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	
Porewater Samples: Inside Slurry Wall ⁽⁴⁾																	
LH-104	8/30/2018	3.7	12.9	101	9,400	<1.0	<1.0	<1.0	21	183	14.1	<0.20	83.3	128,000	26	59,400	420,000
OW-55	8/30/2018	<2.0	6.4	203	2,020	1.0	1.1	<1.0	22	7.4	<2.0	<0.20	<4.0	585,000	2,000	74,000	47,300
Porewater Samples: Outside Slurry Wall ⁽⁴⁾																	
MW-55	8/30/2018	<2.0	29.4	161	665	<1.0	<1.0	<1.0	30	140	<2.0	<0.20	<4.0	665,000	18,800	100,000	173,000
JCW-SB-ASD1	8/29/2018	<2.0	22.7	79.4	582	<1.0	<1.0	<1.0	19	112	2.9	<0.20	<4.0	490,000	10,500	90,900	311,000
JCW-SB-ASD2	8/29/2018	<2.0	6.6	55.4	663	<1.0	<1.0	<1.0	19	93.3	6.4	<0.20	<4.0	469,000	4,600	99,500	529,000
JCW-SB-ASD3	8/29/2018	<2.0	3.8	53.4	403	<1.0	<1.0	<1.0	18	54.4	4.5	<0.20	<4.0	558,000	680	133,000	516,000
JCW-SB-ASD4	8/29/2018	<2.0	50.5	110	1,120	<1.0	<1.0	<1.0	58	157	<2.0	<0.20	<4.0	645,000	3,600	126,000	222,000
JCW-SB-ASD5	8/29/2018	<2.0	1.6	57.8	1,130	<1.0	<1.0	<1.0	12	62.0	54.4	<0.20	<4.0	382,000	830	76,100	384,000
Surface Water Sample																	
JCW-SW-ASD1	8/29/2018	<2.0	2.4	36.8	107	<1.0	1.1	<1.0	<10	<5.0	<2.0	<0.20	<4.0	177,000	110	27,600	21,100

Notes:

Groundwater Surface Water Interface (GSI) Criteria from Michigan Part 201 Generic Cleanup Criteria and Screening Levels as promulgated on December 30, 2013.
 Mixing Zone GSI Criteria from Michigan Department of Environmental Quality (MDEQ) approval letter dated December 23, 2015. Arsenic, boron, and selenium data compared to Mixing Zone GSI Criteria.
 µg/L = micrograms per Liter
 N/A = Not Applicable

Bold font denotes concentrations detected above laboratory reporting limits

 Denotes concentrations above one or more applicable GSI criteria

- (1) Criterion is protective for surface water used as a drinking water source as described in Footnote {X} of Michigan Part 201 criteria tables.
- (2) GSI Criteria for Barium, Copper, and Lead are dependent on hardness; Criteria calculated using hardness of 258 mg CaCO₃/L (based on April 2018 surface water samples collected by TRC) per footnote {G} of Michigan Part 201 criteria tables.
- (3) Total chromium data compared to Chromium (VI) GSI criterion as described in Footnote {H} of Michigan Part 201 criteria tables.
- (4) GSI criteria are used for screening purposes only. GSI compliance is determined in accordance with Section 4 of the Hydrogeological Monitoring Plan (rev. 2, June 2015).

Table 2
 Field Data
 Third Quarter 2018 Quarterly Report
 Weadock Solid Waste Disposal Area, Essexville, Michigan

Field Parameter		pH	Temperature	Specific Conductivity	Dissolved Oxygen	O.R.P.	Turbidity
Units		S.U.	Deg C	uS/cm	mg/L	mV	ntu
Porewater Samples: Inside Slurry Wall							
LH-104	8/30/2018	8.57	14.46	955.2	0.42	17.8	1.22
OW-55	8/30/2018	7.14	16.40	1,155.6	0.81	-9.9	8.17
Porewater Samples: Outside Slurry Wall							
MW-55	8/30/2018	6.80	16.47	1,472.5	0.29	-70.3	1.51
JCW-SB-ASD1	8/29/2018	6.68	17.95	1,450.7	1.79	-33.4	2.62
JCW-SB-ASD2	8/29/2018	6.71	17.54	1,731.1	0.52	-12.5	2.18
JCW-SB-ASD3	8/29/2018	6.75	17.66	1,853.2	0.35	5.7	1.75
JCW-SB-ASD4	8/29/2018	6.98	16.74	1,583.1	0.23	-19.4	7.62
JCW-SB-ASD5	8/29/2018	6.79	18.45	1,401.1	0.97	-18.8	2.49
Surface Water Sample							
JCW-SW-ASD1	8/29/2018	7.41	23.47	536.3	0.59	-7.7	4.35

Notes:

S.U. = Standard unit
 Deg C = Degrees Celsius
 uS/cm = microSiemens per centimeter
 mg/L = milligrams per Liter
 O.R.P. = Oxidation-Reduction Potential
 mV = Millivolts

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Figures

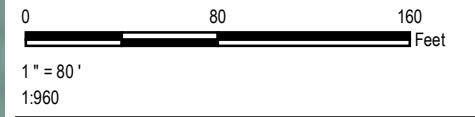
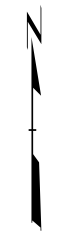


LEGEND

- JCW LANDFILL HMP WELL
- LEACHATE HEADWELL
- MONITORING WELL (STATIC WATER LEVEL ONLY)
- TEMPORARY WELL/ SOIL BORING
- SURFACE WATER SAMPLE
- SLURRY WALL (APPROXIMATE)

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.



PROJECT:		CONSUMERS ENERGY COMPANY JC WEADOCK POWER PLANT ESSEXVILLE, MICHIGAN	
TITLE:		ALTERNATE SOURCE DEMONSTRATION SAMPLING LOCATIONS	
DRAWN BY:	S. MAJOR	PROJ NO.:	290805-001
CHECKED BY:	D. LITZ	FIGURE 2	
APPROVED BY:	G. CROCKFORD		
DATE:	OCTOBER 2018		



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

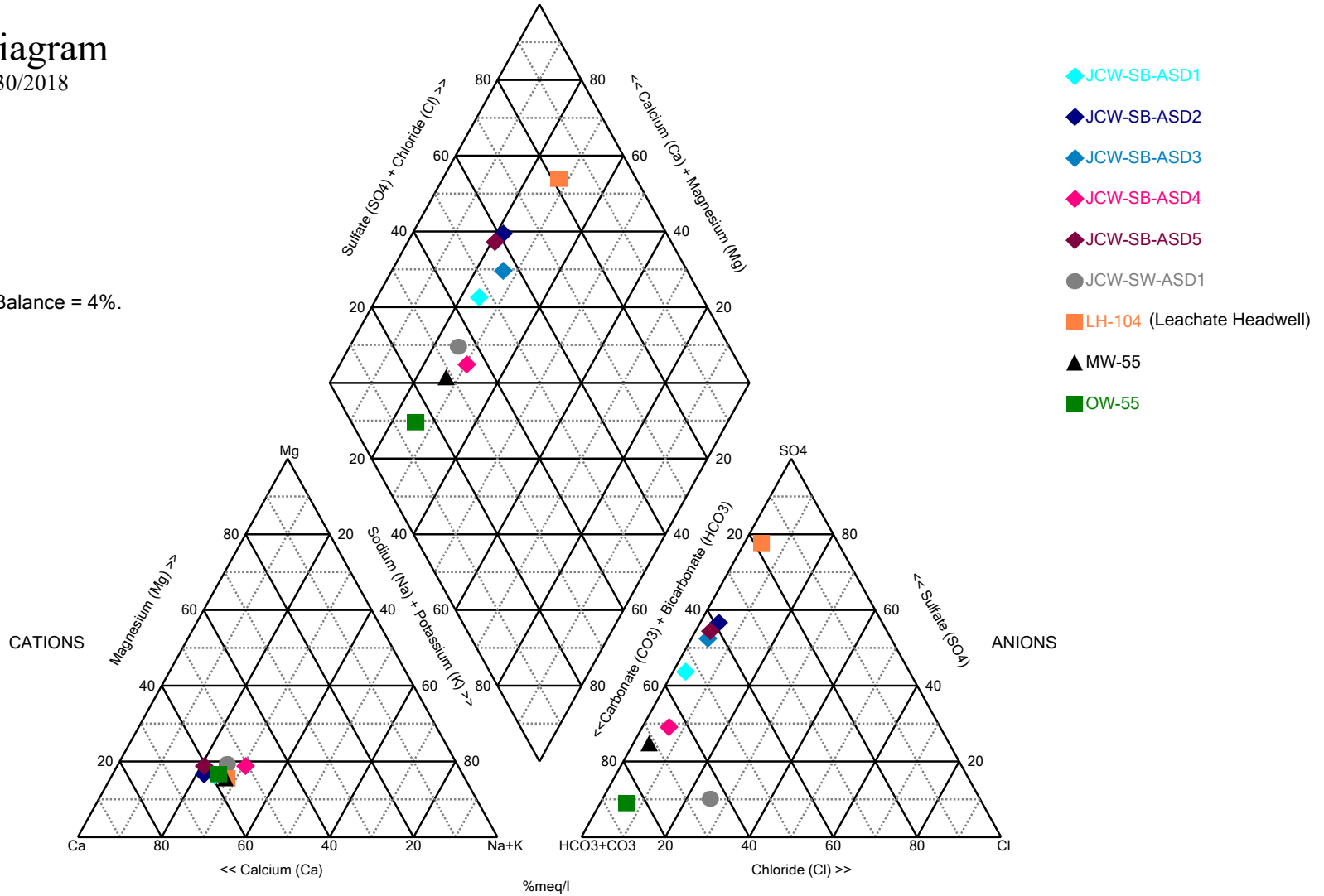
Technical Memorandum

Attachment 1 Piper Diagram and Time Series Charts

Piper Diagram

8/29/2018, 8/30/2018

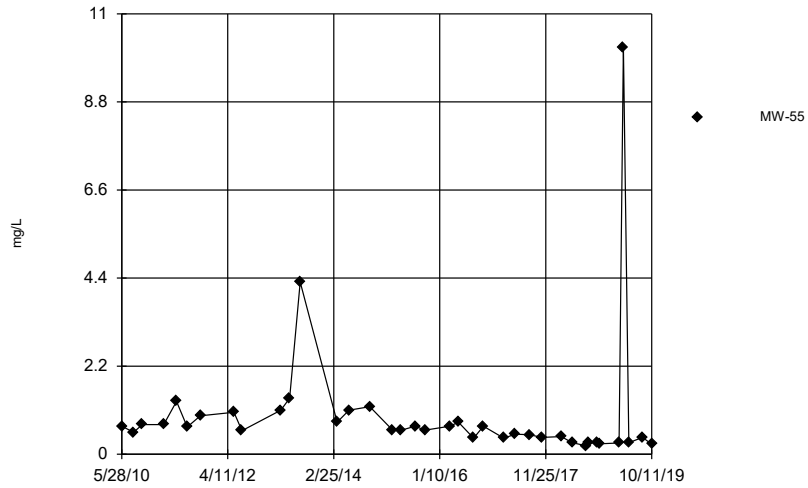
Cation-Anion Balance = 4%.



Analysis Run 10/22/2018 10:29 AM

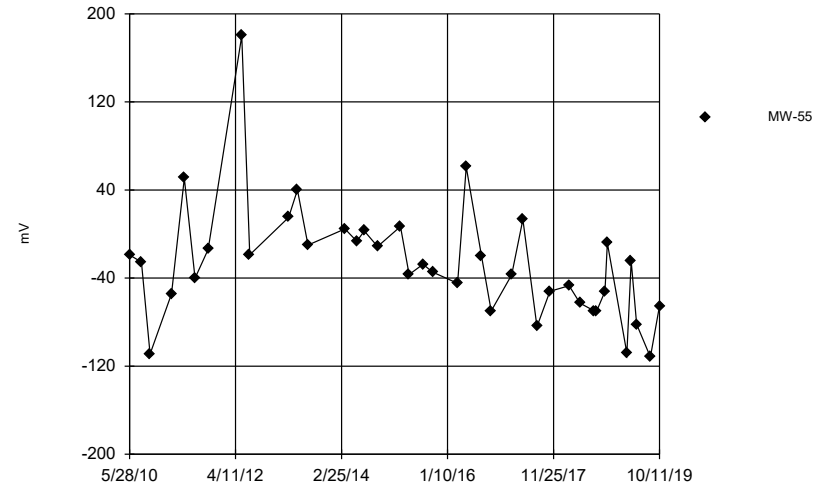
Client: Consumers Energy Data: MW55 ASD Sanitas

Dissolved Oxygen, Field



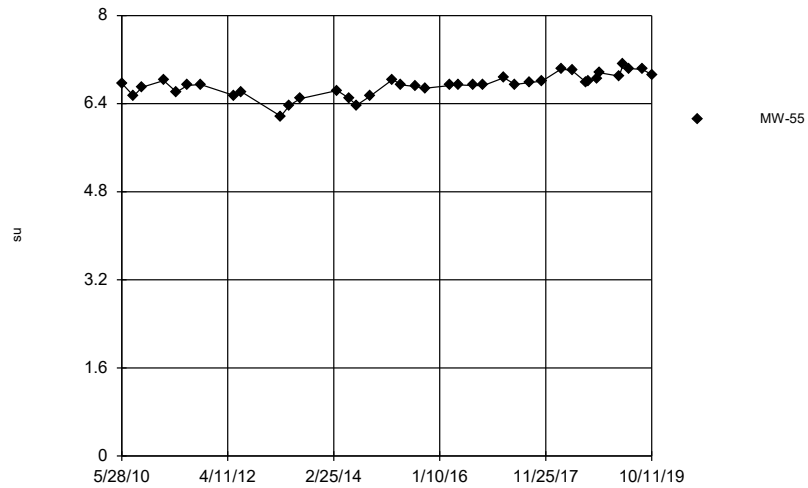
Time Series Analysis Run 1/15/2020 10:46 AM
Client: Consumers Energy Data: JCW_MW55_ASD_Sanitas

Oxidation Reduction Potential, Field

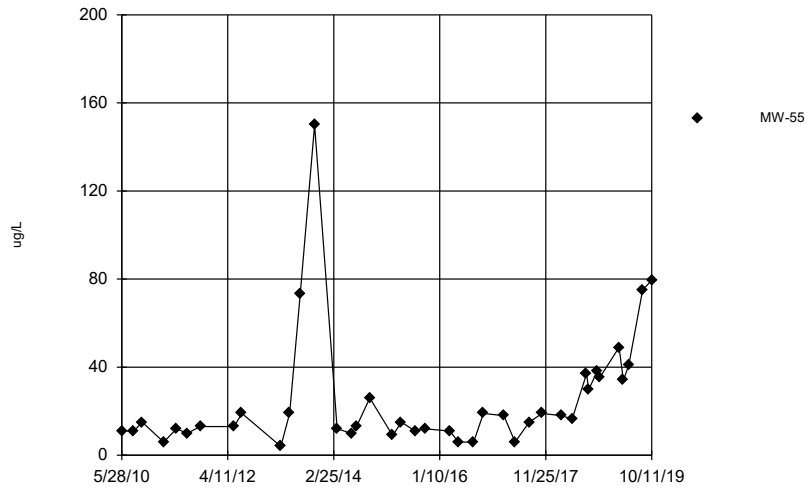


Time Series Analysis Run 1/15/2020 10:48 AM
Client: Consumers Energy Data: JCW_MW55_ASD_Sanitas

pH, Field



Arsenic, Total



Technical Memorandum

Attachment 2: Soil Boring Logs



SOIL BORING LOG

BORING NO. JCW-SB-ASD1

Page 1 of 1

Facility/Project Name: JC Weadock: ASD Temporary Well Installation		Date Drilling Started: 8/28/18	Date Drilling Completed: 8/28/18	Project Number: 290805.0001
Drilling Firm: Cascade Drilling	Drilling Method: Hand Auger	Surface Elev. (ft) ---	TOC Elevation (ft) ---	Total Depth (ft bgs) 14.5
Boring Location: Approximately 5-feet south of MW-55.		Personnel Logged By - Tanner Hess Driller - Mike Leadingham		Drilling Equipment: Hand Auger
Civil Town/City/or Village: Essexville	County: Bay	State: Michigan	Water Level Observations: While Drilling: Date/Time 8/28/18 10:00 ∇ Depth (ft bgs) 11.0 After Drilling: Date/Time 8/28/18 10:50 ∇ Depth (ft bgs) 10.0	

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	COMMENTS
1 HA	100		2	TOPSOIL black (10YR 2/1), dry, loose.			
			2	SAND mostly fine to medium sand fill material, dark grayish brown (10YR 4/2), no odor, dry, loose, fill.			
			2.5	Change to brown (10YR 5/3) at 2.5 feet.			
			4		SP		
2 HA	100		6				
			8	SANDY CLAY mostly clay, some fine to medium sand, low to medium plasticity, brown (10YR 5/3), no odor, dry, medium stiff.	CL		Temporary well screen set at 8.0 to 13.0 feet below ground surface.
			10	∇ SAND mostly fine to coarse sand, very dark grayish brown (10YR 3/2), no odor, moist, loose.			
			11	∇ Change to saturated at 11.0 feet.			
3 HA	100		12		SW		
			14	CLAY mostly clay, medium to high plasticity, gray (10YR 5/1), no odor, moist, stiff.	CL		
			14.5	End of boring at 14.5 feet below ground surface.			

SOIL BORING WELL CONSTRUCTION LOG ASD MW55 SBL5 BY GPJ TRC CORP INCHES GDT 10/24/18

Signature: Firm: TRC Environmental Corporation 734.971.7080
1540 Eisenhower Place Ann Arbor, MI 48108 Fax 734.971.9022



SOIL BORING LOG

BORING NO. JCW-SB-ASD2

Facility/Project Name: JC Weadock: ASD Temporary Well Installation		Date Drilling Started: 8/28/18	Date Drilling Completed: 8/28/18	Project Number: 290805.0001	
Drilling Firm: Cascade Drilling	Drilling Method: Direct Push	Surface Elev. (ft) ---	TOC Elevation (ft) ---	Total Depth (ft bgs) 15.0	Borehole Dia. (in) 4
Boring Location: Approximately 20-feet west of MW-55.		Personnel Logged By - Tanner Hess Driller - Mike Leadingham		Drilling Equipment: Geoprobe 6620 DT	
Civil Town/City/or Village: Essexville	County: Bay	State: Michigan	Water Level Observations: While Drilling: Date/Time 8/28/18 12:30 ∇ Depth (ft bgs) 10.0 After Drilling: Date/Time 8/28/18 12:50 ∇ Depth (ft bgs) 11.1		

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	COMMENTS
1 GP	60		0	COAL ASH black (10YR 2/1), dry, loose.			
			2	SANDY CLAY mostly clay, some fine to medium sand, no to low plasticity, pale brown (10 YR 6/3), no odor, dry, stiff, fill.	CL		
			4	SAND mostly fine to medium sand, very dark grayish brown (10YR 3/2), no odor, dry, loose, fill.	SP		
			6	SANDY CLAY mostly clay, some fine to medium sand, no to low plasticity, pale brown (10 YR 6/3), no odor, dry, stiff, fill.	CL		
2 GP	75		8	SAND mostly fine to medium sand, very dark grayish brown (10YR 3/2), no odor, dry, loose, fill.	SP		
			10	SANDY CLAY mostly clay, some fine to medium sand, no to low plasticity, pale brown (10 YR 6/3), no odor, dry, stiff, fill.	CL		
3 GP	75		10	∇ Change to mostly fine to coarse sand, saturated at 10.0 feet.	SP		
			12	∇ Change to pale brown (10YR 6/3) at 12.0 feet.			
			12	CLAY mostly clay, medium to high plasticity, gray (10YR 5/1), no odor, saturated, stiff.	CL		Temporary well screen set at 9.5 to 14.5 feet below ground surface.
			14	SANDY CLAY mostly clay, some fine to medium sand, medium to high plasticity, gray (10YR 5/1), no odor, saturated, stiff.	CL		
			14	CLAY mostly clay, medium to high plasticity, gray (10YR 5/1), no odor, saturated, stiff.	CL		
			16	End of boring at 15.0 feet below ground surface.			
			18				

SOIL BORING WELL CONSTRUCTION LOG ASD MW65 SBL5 BY GPJ TRC CORP INCHES GDT 10/24/18

Signature: Firm: TRC Environmental Corporation 734.971.7080
1540 Eisenhower Place Ann Arbor, MI 48108 Fax 734.971.9022



SOIL BORING LOG


BORING NO. JCW-SB-ASD3

Facility/Project Name: JC Weadock: ASD Temporary Well Installation		Date Drilling Started: 8/28/18	Date Drilling Completed: 8/28/18	Project Number: 290805.0001
Drilling Firm: Cascade Drilling	Drilling Method: Direct Push	Surface Elev. (ft) ---	TOC Elevation (ft) ---	Total Depth (ft bgs) 15.0
Boring Location: Approximately 20-feet east of MW-55.		Personnel Logged By - Tanner Hess Driller - Mike Leadingham		Drilling Equipment: Geoprobe 6620 DT
Civil Town/City/or Village: Essexville	County: Bay	State: Michigan	Water Level Observations: While Drilling: Date/Time 8/28/18 13:00 ∇ Depth (ft bgs) 10.5 After Drilling: Date/Time 8/28/18 13:23 ∇ Depth (ft bgs) 11.1	

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	COMMENTS
1 GP	75		0	COAL ASH black (10YR 2/1), dry, loose.			
			2	SANDY CLAY mostly clay, some fine to medium sand, no to low plasticity, brown (10 YR 5/3), no odor, dry, stiff, fill.	CL		
			4	SAND mostly fine to medium sand, very dark grayish brown (10YR 3/2), no odor, dry, loose, fill.	SP		
2 GP	75		4	SANDY CLAY mostly clay, some fine to medium sand, no to low plasticity, brown (10 YR 5/3), no odor, dry, stiff, fill.	CL		
			6	SAND mostly fine to medium sand, very dark grayish brown (10YR 3/2), no odor, dry, loose, fill. 4-inch thick interval of peat, black (10YR 2/1) at 7.0 feet.	SP		
			8	COAL ASH black (10YR 2/1), dry, loose.			
3 GP	75		10	SANDY CLAY mostly clay, some fine to medium sand, no to low plasticity, brown (10 YR 5/3), no odor, dry, stiff, fill.	CL		
			12	SAND mostly fine to coarse sand, dark grayish brown (10YR 4/2), no odor, saturated, loose.	SW		
			14	CLAY mostly clay, medium to high plasticity, gray (10YR 5/1), no odor, saturated, stiff.	CL		
			16	End of boring at 15.0 feet below ground surface.			
			18				

Temporary well screen set at 9.5 to 14.5 feet below ground surface.

SOIL BORING WELL CONSTRUCTION LOG ASD MW55_SBL5_BY GPJ TRC_CORP_INCHES.GDT 10/24/18

Signature:  Firm: TRC Environmental Corporation 734.971.7080
1540 Eisenhower Place Ann Arbor, MI 48108 Fax 734.971.9022



SOIL BORING LOG

BORING NO. JCW-SB-ASD4

Page 1 of 2

Facility/Project Name: JC Weadock: ASD Temporary Well Installation		Date Drilling Started: 8/28/18	Date Drilling Completed: 8/28/18	Project Number: 290805.0001
Drilling Firm: Cascade Drilling	Drilling Method: Direct Push	Surface Elev. (ft) ---	TOC Elevation (ft) ---	Total Depth (ft bgs) 20.0
Boring Location: Approximately 40-feet east of MW-55.		Personnel Logged By - Tanner Hess Driller - Mike Leadingham		Drilling Equipment: Geoprobe 6620 DT
Civil Town/City/or Village: Essexville	County: Bay	State: Michigan	Water Level Observations: While Drilling: Date/Time 8/28/18 13:40 ∇ Depth (ft bgs) 11.0 After Drilling: Date/Time 8/28/18 14:20 ∇ Depth (ft bgs) 10.3	

SAMPLE	NUMBER AND TYPE	RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	COMMENTS
	1	75		0	COAL ASH black (10YR 2/1), dry, loose.			
				2	SANDY CLAY mostly clay, some fine to medium sand, no to low plasticity, brown (10 YR 5/3), no odor, dry, stiff, fill.	CL		
				4	SAND mostly fine to medium sand, very dark grayish brown (10YR 3/2), no odor, dry, loose, fill.	SP		
				6	SANDY CLAY mostly clay, some fine to medium sand, no to low plasticity, brown (10 YR 5/3), no odor, dry, stiff, fill.	CL		
				8	SAND mostly fine to medium sand, very dark grayish brown (10YR 3/2), no odor, dry, loose, fill.	SP		
				10	SANDY CLAY mostly clay, some fine to medium sand, no to low plasticity, brown (10 YR 5/3), no odor, dry, stiff, fill.	CL		
				10	SAND mostly fine to medium sand, very dark grayish brown (10YR 3/2), no odor, dry, loose, fill.	SP		
				11	CLAYEY SAND mostly fine to medium sand, some clay, dark grayish brown (10YR 5/1), no odor, moist, loose. Change to saturated at 11.0 feet.	SC		
				12	Change to very dark brown (10YR 4/2) at 12.0 feet.			
				13	CLAY mostly clay, medium plasticity, gray (10YR 5/1), no odor, saturated, stiff.	CL		
				14	SAND mostly fine to coarse sand, trace clay, dark grayish brown (10YR 4/2), no odor, saturated, loose.	SW		

Temporary well screen set at 11.5 to 16.5 feet below ground surface.

SOIL BORING WELL CONSTRUCTION LOG ASD_MW55_SBL5_BY_GPJ_TRC_CORP_INCHES.GDT 10/24/18



Signature:	Firm: TRC Environmental Corporation 1540 Eisenhower Place Ann Arbor, MI 48108	734.971.7080 Fax 734.971.9022
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SOIL BORING LOG

BORING NO. JCW-SB-ASD4

SOIL BORING WELL CONSTRUCTION LOG ASD MW65 SBL5 BY GPJ TRC CORP INCHES.GDT 10/24/18

SAMPLE		BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	COMMENTS
NUMBER AND TYPE	RECOVERY (%)						
4 GP	80		16	SAND mostly fine to coarse sand, trace clay, dark grayish brown (10YR 4/2), no odor, saturated, loose.	SW		
			18	CLAY mostly clay, medium plasticity, gray (10YR 5/1), no odor, saturated, stiff. Change to grayish brown (10YR 5/2) at 18.5 feet.	CL		
			20	End of boring at 20.0 feet below ground surface.			
			22				
			24				
			26				
			28				
			30				
			32				



SOIL BORING LOG

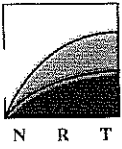
BORING NO. JCW-SB-ASD5

Facility/Project Name: JC Weadock: ASD Temporary Well Installation		Date Drilling Started: 8/28/18	Date Drilling Completed: 8/28/18	Project Number: 290805.0001
Drilling Firm: Cascade Drilling	Drilling Method: Direct Push	Surface Elev. (ft) ---	TOC Elevation (ft) ---	Total Depth (ft bgs) 15.0
Boring Location: Approximately 40-feet west of MW-55.		Personnel Logged By - Tanner Hess Driller - Mike Leadingham		Drilling Equipment: Geoprobe 6620 DT
Civil Town/City/or Village: Essexville	County: Bay	State: Michigan	Water Level Observations: While Drilling: Date/Time 8/28/18 11:20 ∇ Depth (ft bgs) 11.0 After Drilling: Date/Time 8/28/18 13:23 ∇ Depth (ft bgs) 11.0	

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	COMMENTS
				COAL ASH black (10YR 2/1), dry, loose.			
			2	CLAY mostly clay, no to low plasticity, pale brown (10YR 6/3), no odor, dry, stiff, fill.	CL		
1 GP	75			SAND mostly fine sand, very dark grayish brown (10YR 3/2), no odor, dry, loose, fill.	SP		
			4				
			6	SANDY CLAY mostly clay, some fine to medium sand, low plasticity, brown (10 YR 5/3), no odor, dry, stiff, fill.	CL		
			8	SAND mostly fine to medium sand, dark grayish brown (10YR 4/2), no odor, dry, loose, fill.	SP		
2 GP	80						
			10	SANDY CLAY mostly clay, some fine to medium sand, low plasticity, brown (10 YR 5/3), no odor, dry, stiff, fill. 3-inch thick interval of coal ash at 9.5 feet.	CL		
			12	SAND mostly fine to coarse sand, brown (10YR 4/3), no odor, moist, loose. Change to saturated at 11.0 feet.	SW		Temporary well screen set at 8.0 to 13.0 feet below ground surface.
3 GP	75						
			14	CLAY mostly clay, medium to high plasticity, gray (10YR 5/1), no odor, saturated, stiff.	CL		
			16	End of boring at 15.0 feet below ground surface.			
			18				

SOIL BORING WELL CONSTRUCTION LOG ASD MW65 SBLS BY GPJ TRC CORP INCHES GDT 10/24/18

Signature: Firm: TRC Environmental Corporation 734.971.7080
1540 Eisenhower Place Ann Arbor, MI 48108 Fax 734.971.9022



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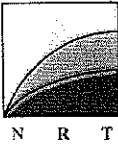
SOIL BORING LOG

Facility/Project Name Consumers Energy, Bay City, MI-1589		License/Permit/Monitoring Number n/a		Boring Number MW-111 OW-55	
Boring Drilled By: Name of crew chief (first, last) and Firm Al Rau Rau Drilling		Date Drilling Started 10/23/2003	Date Drilling Completed 10/23/2003	Drilling Method hollow stem auger	
Unique Well No.	Well ID No. MW-111	Common Well Name MW-111	Final Static Water Level Feet MSL	Surface Elevation 592.3 Feet MSL	Borehole Diameter 8.0 inches
Local Grid Origin <input type="checkbox"/> (estimated: <input type="checkbox"/>) or Boring Location <input checked="" type="checkbox"/>		State Plane 778,470 N, 13,268,152 E <input checked="" type="checkbox"/> C/N		Local Grid Location	
1/4 of		1/4 of Section, T R		Lat _____ "	Long _____ "
Facility ID		County	State	Civil Town/City/ or Village Bay City	

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth From Surface (feet)	Soil/Rock Description And Geologic Origin For Each Major Unit	Hand Pen (tsf)	Field Moisture Condition	U S C S Symbol	Graphic Log	PID/FID (ppm)	Well Diagram	RQD/ Comments/ Lab Test
3 SS	24 20	5/4 5/6		0-10 <u>FILL</u> Sand and clay fill of Pond F dike. Ash at surface.							
5 SS	24 24	3/4 4/5	5	1-4.5 <u>SILTY SAND</u> Brown fine - grades to brown, fine, loose, dry sand at 3 feet.			FILL				
7 SH	24 0	Push		4.5-6 <u>SANDY CLAY</u> Brown to red brown, soft to firm, moist, fine sand. - Push Shelby - much of the material is sand and it falls out - empty tube.							
9 SH	24 +10	Push		- Push Shelby - Sand at top, black clayey sand at bottom.							
11 SS	24 20	1/1 1/1	10	10-12 <u>SAND</u> Beach sand, light brown to gray, fine, trace broken shells, wet.			SAND				
13 SH	24 +10	Push		- Push Shelby - Clay at bottom.							
15 SS	24 18	4/11 14/18	15	14-16 <u>CLAY</u> Till, very hard, dense, light red-brown with gray mottling, trace silt/sand.	4.5		CLAY				
				<u>END OF BORING AT 16 FEET</u>							

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature <i>Eric Kovatch</i>	Firm Natural Resource Technology, Inc. 23713 W. Paul Road, Unit D, Pewaukee, WI 53072	Tel: (262) 523-9000 Fax: (262) 523-9001
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N R T

SOIL BORING LOG

Page 1 of 1

Facility/Project Name Consumers Energy, Bay City, MI-1589		License/Permit/Monitoring Number n/a		Boring Number MW-112 MW-55	
Boring Drilled By: Name of crew chief (first, last) and Firm Al Rau Rau Drilling			Date Drilling Started 10/23/2003	Date Drilling Completed 10/23/2003	Drilling Method hollow stem auger
Unique Well No.	Well ID No. MW-112	Common Well Name	Final Static Water Level Feet MSL	Surface Elevation 592.5 Feet MSL	Borehole Diameter 8.0 inches
Local Grid Origin <input type="checkbox"/> (estimated: <input type="checkbox"/>) or Boring Location <input checked="" type="checkbox"/>			Local Grid Location		
State Plane 778,449 N, 13,268,125 E <input checked="" type="checkbox"/> C/N			Lat _____ "	<input type="checkbox"/> N <input type="checkbox"/> E	
1/4 of _____ 1/4 of Section _____, T _____ R _____			Long _____ "	Feet <input type="checkbox"/> S <input type="checkbox"/> W	
Facility ID		County	State	Civil Town/City/ or Village Bay City	

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth From Surface (feet)	Soil/Rock Description And Geologic Origin For Each Major Unit	Hand Pen (tsf)	Field Moisture Condition	U S S Symbol	Graphic Log	PID/FID (ppm)	Well Diagram	RQD/ Comments/ Lab Test
3 SS	24 24	6/7 7/9		0-9.5 FILL Sand and clay fill of Pond F dike. Sand at surface.							
5 SS	24 20	3/7 6/7	5	1-6.5 SAND Brown, fine, loose, dry. Thin clay layer (3") at 2.5 feet.			FILL				
7 SS	24 20	3/4 5/5		6.5-7.5 SANDY CLAY Brown to red brown, soft to firm, moist, plastic, fine sand.							
9 SS	24 21	3/4 4/3		7.5-9 SAND Brown, fine, loose, dry, similar to above.							
11 SS	24 24	2/2 2/2	10	9-9.5 SANDY CLAY Tan to red brown, similar to above.							
13 SS	24 20	3/2 2/3		9.5-14.5 SAND Beach sand, dark brown to black, fine, wet.			SAND				
15 SS	24 24	4/9 14/19	15	14.5-16 CLAY Till, very hard, dense, light red-brown with gray mottling, trace silt/sand. END OF BORING AT 16 FEET	4.5		CLAY				

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature 	Firm Natural Resource Technology, Inc. 23713 W. Paul Road, Unit D, Pewaukee, WI 53072	Tel: (262) 523-9000 Fax: (262) 523-9001
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soil and materials engineers, inc.

PROJECT NAME: JC WEADOCK HYDROLOGICAL MONITORING PLAN A/E: CONSUMERS ENERGY

PROJECT LOCATION: ESSEXVILLE, MICHIGAN

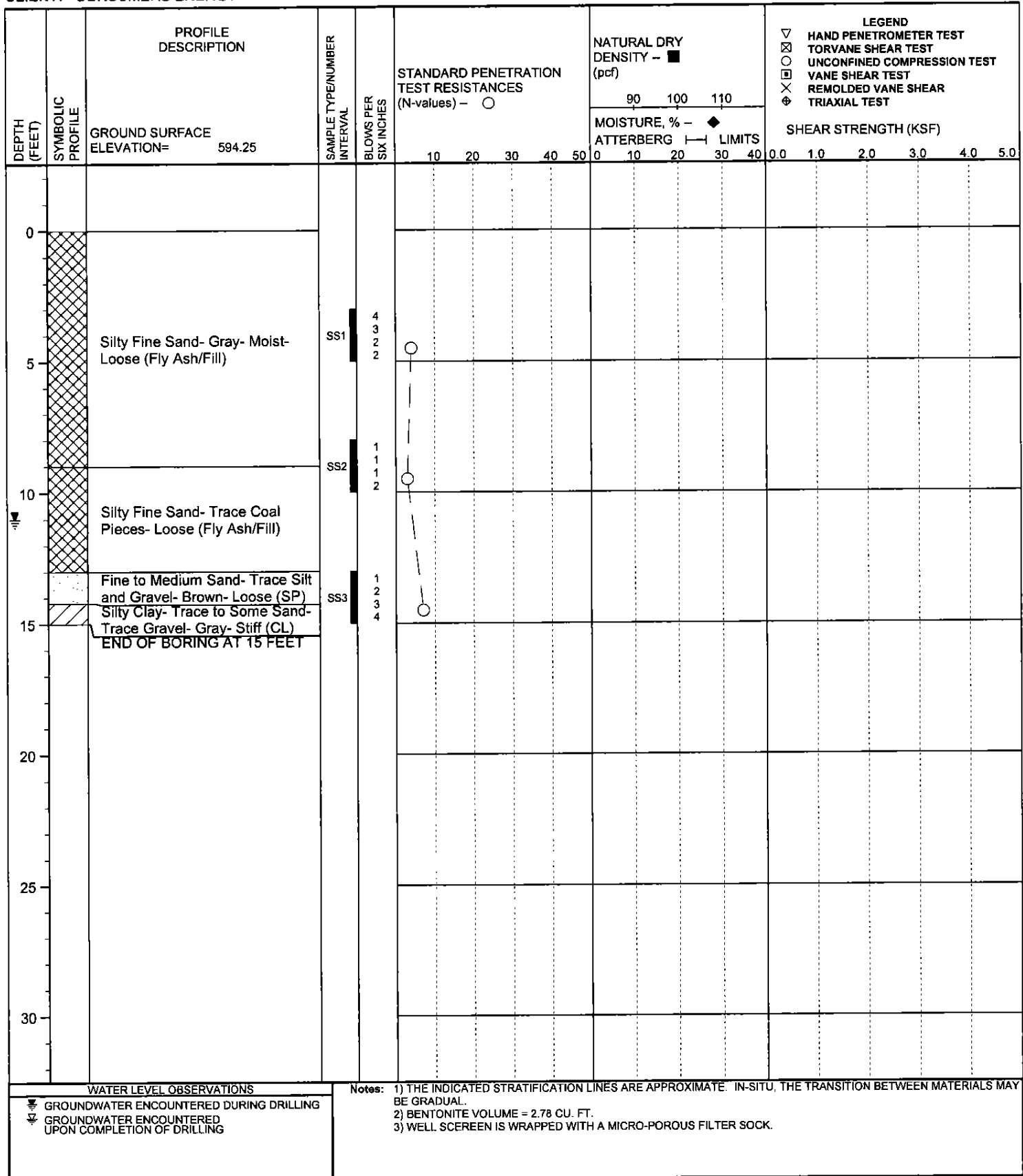
BY: JAR DATE: 4/20/10

BORING LH-104

CLIENT: CONSUMERS ENERGY

PROJECT NUMBER: BE61444

SHEET: 1



DRILLER: RAU

DRILL METHOD: HOLLOW STEM AUGERS

WATER LEVEL DURING DRILLING: 11

WATER LEVEL

HOURS AFTER COMPLETION:

RIG NO.: RAU ATV BACKFILL METHOD:

WATER LEVEL UPON COMPLETION:

CAVE OF BOREHOLE AT



MONITORING WELL LOG
SME PROJECT No. BE61444

PROJECT NAME: JC WEADOCK HYDROLOGICAL MONITORING PLAN

PROJECT LOCATION: ESSEXVILLE, MICHIGAN

BY: JAR

DATE: 4/20/10

CLIENT: CONSUMERS ENERGY

ELEVATION (FL)	WELL DIAGRAM	DEPTH (FL) PROFILE	PROFILE DESCRIPTION	WELL CONSTRUCTION DETAILS
			GROUND SURFACE ELEVATION IN FEET = 594.25	
595		0		Top of Casing Elevation: 596.75
590		5	Silty Fine Sand- Gray- Moist- Loose (Fly Ash/ Fill)	Well Screen Tip Elevation: 585.25 Borehole Diameter: 8 IN Filter Pack Type: SAND
585		10	Silty Fine Sand- Trace Coal Pieces- Loose (Fly Ash/Fill)	Well Casing Diameter: 2 IN Length: 14 FT Type: PVC Joint Type: THREADED
580		15	Fine to Medium Sand- Trace Silt and Gravel- Brown- Loose (SP) Silty Clay- Trace to Some Sand- Trace Gravel- Gray- Stiff (CL)	Well Screen Diameter: 2 IN Length: 3 FT Type: PVC Mesh: 10-MESH Screen Plug (Y/N): Y
575		20	END OF BORING AT 15 FEET	Protective Casing Total Length: 6 FT Length Above Ground: 2.5 FT Diameter: 4 IN Type: STEEL
570		25		Well Cap Type: J-PLUG
565		30		Northing: Easting:

WELL TYPE:
 DRILLER: RAU
 RIG NUMBER OR
 CONTRACTOR: RAU ATV

DRILLING METHODS: HOLLOW STEM
 GROUNDWATER DURING DRILLING
 GROUNDWATER AFTER DRILLING

Notes:

- 1) THE INDICATED STRATIFICATION LINES ARE APPROXIMATE. IN-SITU, THE TRANSITION BETWEEN MATERIALS MAY BE GRADUAL.
- 2) BENTONITE VOLUME = 2.78 CU. FT.
- 3) WELL SCREEN IS WRAPPED WITH A MICRO-POROUS FILTER SOCK.

WATER LEVEL DATA

DATE	DEPTH (Feet)	ELEVATION (Feet)
4/20/10	11	


Appendix H

ACM Extension Certification

A CMS Energy Company

Date: July 12, 2019

To: Operating Record

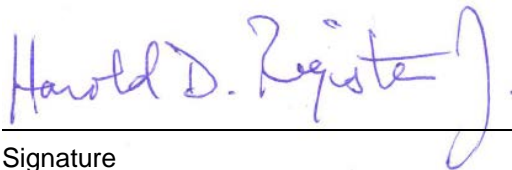
From: Harold D. Register, Jr., P.E. 

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.



Signature

July 12, 2019

Date of Certification

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

Name

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

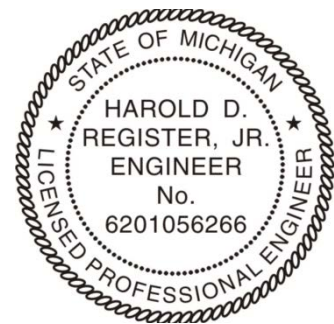
Name

6201056266

Professional Engineer Certification Number

6201056266

Professional Engineer Certification Number



07/12/2019

Appendix I

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 Landfill 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 Landfill. 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 Landfill ACM Report.

As presented in the key milestones timeline below, a groundwater monitoring system was installed for the landfill 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 Landfill that detailed a plan for closing the CCR unit in place. Previously, Consumers Energy constructed a partially enclosing soil-bentonite slurry wall around the landfill in 2008. The remainder of the construction to fully enclose the slurry wall was completed in 2018 with the construction certification documents approved by EGLE on December 19, 2018.

Results of 2019 Semi-Annual Sampling Events

Statistical analysis from semiannual groundwater monitoring events verified that the only Appendix IV constituents that is present at a statistically significant level above the established Groundwater Protection Standard (GWPS) is arsenic. Given the change in groundwater flow

conditions, a revised groundwater monitoring system has been established to assess slurry wall integrity and determine if there have been any releases from the Weadock Landfill. Therefore, the modified CCR monitoring well network now consists of the four (4) background as discussed above, and eleven (11) downgradient monitoring wells as discussed in the *Sample and Analysis Plan* (2018 SAP) (TRC, 2018) and *Statistical Analysis Plan* (2018 Stats Plan) (TRC, 2018b). The downgradient monitoring wells include:

JCW-MW-18001	JCW-MW-18004	JCW-MW-18005	JCW-MW-18006
MW-50	MW-51	MW-52	MW-53
MW-54R	MW-55	OW-57R Out	

Progress Towards Remedy Selection

Consumers Energy first provided the Michigan Department of Environment, Great Lakes, and Energy (EGLE) a Response Action Plan prepared in accordance with Part 115 on March 15, 2019 after calculating a potential SSI for arsenic for the Weadock Landfill. 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 landfill. This report was approved by EGLE on May 14, 2019 based on the following additional documentation:

- Hydrogeological Monitoring Plan (HMP) of compliance monitoring addressing groundwater monitoring and porewater at the groundwater/surface water interface approved by EGLE January 8, 2018. This compliance monitoring program addresses groundwater and surface water interface monitoring for all coal ash management regulated by the EGLE Materials Management Division.
- Quarterly groundwater monitoring reports demonstrating compliance with all required monitoring under the HMP verifying that water quality standards are being achieved through the monitoring of an authorized mixing zone at all monitoring points in the program ensuring that there are currently no adverse effects on human health or the environment from either surface water or groundwater. These reports are submitted 30-days after the calendar quarter in which monitoring was performed as follows: April 30th, July 30th, October 30th, January 30th.

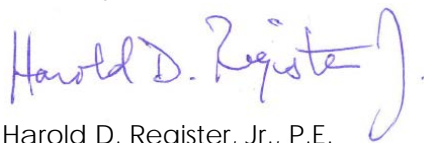
The Response Action Plan also explicitly committed to providing an assessment for potential remedial actions based on recommendations from the ACM Report submitted to EGLE on September 11, 2019. The ACM Report indicated that groundwater management alternatives under consideration that could potentially address the residual arsenic under *known* groundwater conditions were identified as: 1) Closure in place with post-remedy monitoring, 2) Closure in place with groundwater capture/control, 3) Closure in place with active

geochemical sequestration, and 4) Closure in place with passive geochemical sequestration. These groundwater monitoring alternatives were considered to be technically feasible final groundwater management strategies when following source control activities that include constructing a fully enclosed soil-bentonite slurry wall around the landfill and placing a final cover over the area.

Now that the fully-enclosing soil-bentonite slurry wall has been completed for the Weadock Landfill, groundwater monitoring events conducted in 2019 confirm that improvements to groundwater continue to be observed. Additional sampling events will be needed to monitor continued 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 final cover construction. The final remedy for the Weadock Landfill 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