



**2019 Annual Groundwater Monitoring and
Corrective Action Report**

DE Karn Power Plant
Bottom Ash Pond CCR Unit

Essexville, Michigan

January 2020




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*Prepared For
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Executive Summary

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

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

- Boron at DEK-MW-15001, DEK-MW-15002, DEK-MW-15003, DEK-MW-15004, DEK-MW-15005, DEK-MW-15006;
- Fluoride at DEK-MW-15001;
- Field pH at DEK-MW-15001, DEK-MW-15002, DEK-MW-15003, DEK-MW-15005, DEK-MW-15006; and
- Sulfate at DEK-MW-15006.

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 above the Ground Water Protection Standards (GWPS) established at 21 ug/L (TRC, 2019) in five of the six downgradient monitoring wells at the Karn Bottom Ash Pond as follows:

- Arsenic at DEK-MW-15001, DEK-MW-15002, DEK-MW-15003, DEK-MW-15004, and DEK-MW-15005.

The notification of the GWPS exceedance on January 14, 2019 was followed up with a Response Action Plan submitted to the Michigan Department of Environment, Great Lakes, and Energy (EGLE) on March 15, 2019 laying out the preliminary understanding of water quality and actions that were underway to mitigate or eliminate unacceptable risk associated with the identified release from the CCR unit. The *Assessment of Corrective Measures (ACM)* (TRC, September 2019) was initiated on April 14, 2019 and submitted to the 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 arsenic concentrations exceed 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 Karn Bottom Ash Pond. Per §257.96(b), Consumers Energy is continuing to monitor groundwater in accordance with the assessment monitoring program as specified in §257.95. Overall, the assessment monitoring statistical evaluations have confirmed that arsenic is the only Appendix IV constituent present at statistically significant levels above the GWPS.

Consumers Energy has not selected a remedy pursuant to §257.97. The semi-annual progress report describing the progress in selecting and designing the remedy required pursuant to §257.97(a) is included in this report. Consumers Energy has completed the removal of CCR consistent with the timeline for closure of the Karn Bottom Ash Pond under the DE Karn Bottom Ash Pond Closure Plan (*Golder, January 2018; Revised April 2018*) and the CCR Rule's closure by removal provisions in §257.102(c). Based on observations of decreasing arsenic concentrations at DEK-MW-15002, DEK-MW-15003, and DEK-MW-18001 during the 2019 monitoring period, groundwater results are expected to continue to improve following the completion of source removal of CCR from the Karn Bottom Ash Pond. Groundwater monitoring in 2020 will reduce uncertainty surrounding potential changes in redox conditions and the effect on contaminant transport. These observations will be critical for the comparison of corrective measures alternatives.

Consumers Energy will continue to evaluate corrective measures in accordance with §257.96 and §257.97 as outlined in the ACM. The groundwater management remedy for the Karn Bottom Ash Pond will be selected as soon as feasible to meet the federal standards of §257.96(b) of the CCR Rule and state standards in R299.4444(2) of PA 640¹. Consumers Energy will continue executing the self-implementing groundwater compliance schedule in conformance with §257.90 - §257.98. The next semiannual monitoring event is tentatively scheduled for the second calendar quarter of 2020.

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 DE Karn Bottom Ash Pond CCR Unit (Karn Bottom Ash Pond). Pursuant to the CCR Rule, no later than January 31, 2018, and annually thereafter, the owner or operator of a CCR unit must prepare an annual groundwater monitoring and corrective action report for the CCR unit documenting the status of groundwater monitoring and corrective action for the preceding year in accordance with §257.90(e).

TRC prepared this Annual Groundwater Monitoring and Corrective Action Report for the Karn Bottom Ash Pond, on behalf of Consumers Energy. Corrective action has been triggered and assessment monitoring is ongoing at the Karn Bottom Ash Pond. 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 Karn Bottom Ash Pond commenced after the installation of the monitoring well network in December 2015 to establish background conditions. Detection Monitoring was initiated on October 17, 2017 in conformance with the self-implementing schedule in the CCR Rule.

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

- Boron at DEK-MW-15001, DEK-MW-15002, DEK-MW-15003, DEK-MW-15004, DEK-MW-15005, DEK-MW-15006;
- Fluoride at DEK-MW-15001;
- Field pH at DEK-MW-15001, DEK-MW-15002, DEK-MW-15003, DEK-MW-15005, DEK-MW-15006; and
- Sulfate at DEK-MW-15006.

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 above the Ground Water Protection Standards (GWPS) established at 21 ug/L (TRC, 2019) in five of the six downgradient monitoring wells at the Karn Bottom Ash Pond as follows:

- Arsenic at DEK-MW-15001, DEK-MW-15002, DEK-MW-15003, DEK-MW-15004, and DEK-MW-15005.

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 arsenic concentrations exceed 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 Karn Bottom Ash Pond. Per §257.96(b), Consumers Energy is continuing to monitor groundwater in accordance with the assessment monitoring program as specified in §257.95.

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

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

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

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

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

1.2 Site Overview

The DE Karn Power Plant site is located north of the JC Weadock Power Plant site, east of the Saginaw River, south and west of Saginaw Bay (Figure 1). A discharge channel runs along the majority of the southern perimeter of the site and separates the facility from the JC Weadock Power Plant Site to the south. The plant began generating electricity in 1959. Two power generating units (Units 1 & 2) are coal-fueled and two units (Units 3 & 4) are oil- and natural gas-fueled.

The locations of the Karn Lined Impoundment and the Karn Bottom Ash Pond are shown on Figure 2. Previously, the Karn Bottom Ash Pond was used for wet ash dewatering and was the primary settling/detention structure for the National Pollutant Discharge Elimination System (NPDES) treatment system prior to discharge. Consumers Energy provided notification of initiation of closure on October 12, 2018 to implement the certified closure plan by removal of CCR under the self-implementing requirements and schedule of the CCR Rule.

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.

In preparation for removal of the Karn Bottom Ash Pond, a new lined impoundment (Karn Lined Impoundment) was constructed meeting the requirements of the CCR Rule and the operational needs at the Karn Power Plant. The liner system for the new impoundment is an alternative composite liner system consisting of primary and secondary composite liners each consisting of 60-mil High Density Polyethylene (HDPE) geomembrane (GM) overlaying a 236-mil geosynthetic clay liner (GCL)³. There is also a leachate collection system consisting of 175-mil GSE HyperNet geonet located between the primary and secondary liner system. The Karn Lined Impoundment began receipt of CCR and non-CCR on June 7, 2018 when it replaced the Karn Bottom Ash Pond operations.

Consumers Energy has completed the removal of CCR consistent with the timeline for closure of the Karn Bottom Ash Pond under the DE Karn Bottom Ash Pond Closure Plan (*Golder, January 2018; Revised April 2018*) and the CCR Rule's closure by removal provisions in §257.102(c). Consumers Energy ceased hydraulic loading to the Karn Bottom Ash Pond in June 2018 and allowed the area to dewater by gravity. Consumers Energy then operated a construction dewatering system to allow for excavation of the vertical and lateral extent of CCR that commenced on March 20, 2019 and has operated through the construction and restoration period. The excavation extended to six inches below known CCR elevations established from previous investigations. Excavated CCR has been placed in the neighboring Weadock Landfill that consists of a fully encapsulation soil-bentonite slurry wall keyed into a competently confining clay unit. The Karn Bottom Ash Pond has been restored by backfilling and grading the surface with clean fill in accordance with the plan to promote stormwater drainage, minimize ponding of surface water, and to reduce the potential of infiltration and migration of residual arsenic and any future constituents of concern (COCs). With the CCR removal complete, Consumers Energy is preparing the documentation report of the removal activities, which will be submitted to EGLE, and placed in the operating record.

The Karn Bottom Ash Pond and Karn Lined Impoundment are located adjacent to the licensed DE Karn 1&2 Solid Waste Disposal Area consisting of 174-acres designated as the DE Karn Landfill. Consumers Energy received the Solid Waste Construction Permit No. 0195 on December 12, 1986 for constructing the Type III Landfill and is currently licensed – License No. 9442 issued on June 26, 2015. This landfill ceased receiving CCR prior to the Effective Date of the CCR Rule (October 19, 2015) and is completing construction of the final cover construction in Calendar Year 2019.

³ Golder Associates Inc. 2018. *Bottom Ash Lined Impoundment Liner System Design Certification Report, DE Karn Generating Facility, Essexville, Michigan*. April.

The DE Karn Landfill is being monitored in accordance with the EGLE-approved *Hydrogeological Monitoring Plan, Rev. 3, DE Karn Solid Waste Disposal Area* (December 19, 2017) (HMP). In addition to the HMP, the DE Karn 1&2 Solid Waste Disposal Area is currently authorized under a permit (Groundwater Discharge Authorization GWE-0005) issued pursuant to Part 31⁴ to discharge to the unusable aquifer directly underlying the solid waste t. Compliance monitoring pursuant to Part 31 and Part 115⁵ detailed in the revised HMP was approved by the EGLE on January 8, 2018.

1.3 Geology/Hydrogeology

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

The surficial fill consists of a mixture of varying percentages of ash, sand, and clay-rich fill ranging from 5 to 15 feet thick. Below the surficial fill, native alluvium and lacustrine soils are present at varying depths. Generally, there is a well graded sand unit present to depths of 10-30 feet below ground surface (ft bgs) overlying a clay till which is observed at depths ranging from 25 to 75 ft bgs. 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. The clay till acts as a hydraulic barrier that separates the shallow groundwater from the underlying sandstone. A sandstone unit, which is part of the Saginaw formation, was generally encountered at 80-90 ft bgs.

The Karn Bottom Ash Pond is bounded by several surface water features (Figure 1): the Saginaw River to the west, Saginaw Bay (Lake Huron) to the north and east, and a discharge channel to the south. In general, shallow groundwater is encountered at a similar or slightly higher elevation relative to the surrounding surface water features. Groundwater flow in the upper aquifer is largely controlled by the surface water elevations of Saginaw River and Saginaw Bay. In the vicinity of the Karn Bottom Ash Pond, the shallow groundwater flow is generally radial, flowing outward from the pond area toward the surrounding surface water bodies.

In previous investigations to the south, bedrock groundwater was generally encountered around 578 feet NAVD88, which is several feet lower than the shallow groundwater. Groundwater flow direction was generally to the northeast under a very shallow gradient.

⁴ Part 31, Water Resources Protection, of the Natural Resources and Environmental Protection Act (NREPA), Public Act 451 of 1994.

⁵ Part 115, Solid Waste Management, of the Natural Resources and Environmental Protection Act (NREPA), Public Act 451 of 1994.

Given the different groundwater flow regime in the bedrock than the shallow saturated unit, bedrock wells near the surface water bodies are several feet below the surface water elevation. Based on the fact that the shallow sand and the bedrock are separated by over 50 ft of clay, the bedrock unit does not appear to be hydraulically connected to the shallow sand.

Section 2

Groundwater Monitoring

2.1 Monitoring Well Network

In accordance with 40 CFR 257.91, Consumers Energy established a groundwater monitoring system for the Karn Bottom Ash Pond, which consists of 10 monitoring wells (four background monitoring wells and six downgradient monitoring wells) that are screened in the uppermost aquifer. The monitoring well locations are shown on Figure 2.

Groundwater around the Karn Bottom Ash Pond was characterized as radial based on the eight initial background sampling events prior to commencing detection monitoring; therefore, six downgradient wells (DEK-MW-15001 through DEK-MW-15006) that were installed and spaced along the circumference of the Karn Bottom Ash Pond continue to accurately represent the quality of groundwater passing the waste boundary that ensures detection of groundwater contamination such that all potential contaminant pathways are monitored. Monitoring well DEK-MW-15001 was decommissioned on April 18, 2018 due to the installation of the new Karn Lined Impoundment, which is a new double composite lined CCR unit constructed as a replacement to the DEK BAP. Monitoring well DEK-MW-18001 was installed on May 21, 2018 approximately 80 feet southeast of DEK-MW-15001 to maintain the perimeter downgradient monitoring well network. The locations of these monitoring wells are shown on Figure 2. The decommissioning log for DEK-MW-15001 as well as the soil boring log and well construction diagram for DEK-MW-18001 are included in Appendix A of the 2018 Annual Report.

Four monitoring wells located south of the Karn Bottom Ash Pond on the JC Weadock Power Plant site provide data on background groundwater quality that has not been affected by the CCR unit (MW-15002, MW-15008, MW-15016, and MW-15019). Analysis for the establishment of these wells as background is detailed in the *Groundwater Statistical Evaluation Plan* for the Karn Bottom Ash Pond, dated October 17, 2017.

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 Groundwater 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 Assessment Groundwater Monitoring

Per §257.95, all wells in the CCR unit groundwater monitoring program must be sampled semiannually. At least one semiannual 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 for those constituents in Appendix IV of the CCR Rule that were detected during prior sampling. In addition to the Appendix III and IV 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 assessment monitoring event for 2019 was performed on April 8 through April 12, 2019. TRC personnel collected samples and recorded field measurements and water elevations. Samples were submitted to Test America where they were analyzed and reported in accordance with the SAP. Static water elevation data were collected at all CCR unit monitoring well locations. Downgradient monitoring wells DEK-MW-15002 through DEK-MW-15006, DEK-MW-18001, and background monitoring wells MW-15002, MW-15008, MW-15016, and MW-15019 were sampled during this event for all Appendix III and Appendix IV constituents and field parameters. A summary of the groundwater data collected during the April 2019 event is provided in Table 1 (static groundwater elevation data), Table 2 (field data), Table 3 (analytical results for background wells), and Table 4 (analytical results for downgradient wells). Analytical results for additional detection and assessment monitoring parameters per State of Michigan Public Act No. 640 of 2018 (PA 640) are provided in Table 5.

The second semiannual groundwater assessment monitoring event for 2019 was performed on October 14 through October 16, 2019. TRC personnel collected samples and recorded field measurements and water elevations. Samples were submitted to Test America where they were analyzed and reported in accordance with the SAP. Static water elevation data were collected at all CCR unit monitoring well locations. Downgradient monitoring wells DEK-MW-15002 through DEK-MW-15006, DEK-MW-18001, and background monitoring wells MW-15002, MW-15008, MW-15016, and MW-15019 were sampled during this event 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 high with the area near the Karn Bottom Ash Pond with radial flow moving towards the surface water features similar to data collected previously in the background and detection monitoring sampling events. Groundwater elevations at the site are generally within the range of 580 to 588 feet NAVD88 and groundwater is typically encountered at equal elevation relative to the surrounding surface water features or within 8 feet higher, flowing outward toward the bounding surface water features. 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).

Although historically the point source discharge of sluiced bottom ash into the Karn Bottom Ash Pond created localized mounding of the potentiometric surface, the new Karn Lined Impoundment went into service on June 7, 2018 and has been continuously collecting all of the process water and bottom ash that went into the former bottom ash pond. Since the pond has been dewatered by gravity and the contents excavated for disposal in an on-site landfill, the characteristic groundwater mound centered within the pooled area is no longer present. Porewater at the facility is locally influenced by incidental infiltration from precipitation over the uncovered acreage. OW-11, OW-12, and DEK-MW-15003 represent a groundwater elevation high point with porewater flow generally flowing radially towards the adjacent surface water features. Due to the operational changes of the bottom ash pond and the progress of the landfill capping activities, the gradient between the Karn Bottom Ash Pond area and the surrounding surface water bodies appears to be flattening out as compared to previous quarters, as expected.

The hydraulic gradient throughout the Karn Bottom Ash Pond area during the April 2019 event is estimated at 0.0044 ft/ft (average) and during the October 2019 event is estimated at 0.00089 ft/ft (geomean). The gradient was calculated using the well pair DEK-MW-15004/DEK-MW-15005, as well as the well water elevation difference and distance between DEK-MW-15003 and the discharge channel. Using the mean hydraulic conductivity of 15 ft/day (ARCADIS, 2016) and an assumed effective porosity of 0.3, the

estimated average seepage velocity was approximately 0.22 ft/day or 79 ft/year in April 2019 and 0.044 ft/day or 16 ft/year in October 2019, which are lower than previous estimates (140 ft/year April 2018; 120 ft/year November 2018).

Due to the reduced groundwater gradients observed recently near the Karn Bottom Ash Pond, the general flow direction has shifted from radial to being predominantly to the west, toward the Saginaw River. The changes in flow direction as a result of site activities will continue to be monitored. Downgradient wells remain appropriately positioned to detect the presence of Appendix III or Appendix IV constituents that could potentially migrate from the Karn Bottom Ash Pond.

Section 3

Statistical Evaluation

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

3.1 Establishing Groundwater Protection Standards

The GWPSs are used to assess whether Appendix IV constituent concentrations are present in groundwater at unacceptable levels as a result of CCR Unit operations by statistically comparing concentrations in the downgradient wells to the GWPSs for each Appendix IV constituent. In accordance with §257.95(h) and the Stats Plan, GWPSs were established for the Appendix IV constituents following the preliminary assessment monitoring event using nine rounds of data collected from the background monitoring wells MW-15002, MW-15008, MW-15016, and MW-15019 (December 2015 through April 2018). The calculation of the GWPSs is documented in the *Groundwater Protection Standards* technical memorandum included as Appendix 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 above the federal GWPS in five of the six downgradient wells at the Karn Bottom Ash Pond.

Overall, the assessment monitoring statistical evaluations have confirmed that arsenic is the only Appendix IV constituent present at statistically significant levels above the GWPS.

Previously, arsenic was present in downgradient well DEK-MW-15002 at a statistically significant level; however, the statistical evaluation of the October 2019 data shows that the lower confidence limit for arsenic is currently below the GWPS. A summary of the confidence intervals for April 2019 is provided in Table 6 and for October 2019 is provided in Table 7.

Arsenic concentrations at DEK-MW-15002, DEK-MW-15003, and DEK-MW-18001 appear to exhibit a downward trend on the time-series chart (Appendix E: Attachment 1). These data sets were tested further in Sanitas™ utilizing Sen's Slope to estimate the average rate of change in concentration over time and utilizing the Mann-Kendall trend test to test for significance of the trend at the 98% confidence level. The trend tests showed that arsenic concentrations are generally decreasing with time, as evidenced by the negative Sen's Slope, and that the downward trend of arsenic at DEK-MW-18001 is statistically significant. Groundwater chemistry already appears to be improving as a result of discontinuing the hydraulic loading to the Karn Bottom Ash Pond and is expected to further improve following the completed source removal of CCR. There still is some uncertainty surrounding how changes in redox conditions may affect contaminant transport which will be further evaluated during groundwater monitoring in 2020.

Section 4

Corrective Action

Consumers Energy provided notification that arsenic was present at statistically significant levels above the GWPS established at 21 ug/L (TRC, 2019) in five of the six downgradient monitoring wells at the Karn Bottom Ash Pond as follows:

- Arsenic at DEK-MW-15001, DEK-MW-15002, DEK-MW-15003, DEK-MW-15004, and DEK-MW-15005.

The notification of the GWPS exceedance was followed up with a Response Action Plan submitted to EGLE on March 15, 2019 laying out the preliminary understanding of water quality and actions that were underway to mitigate or eliminate unacceptable risk associated with the identified release from the CCR unit. The Response Action Plan was approved by EGLE on May 14, 2019. The ACM was submitted to EGLE on September 11, 2019 in accordance with the schedule in §257.96 and provided in the Response Action Plan.

4.1 Nature and Extent Groundwater Sampling

Since one or more Appendix IV constituents have been detected at the Karn Bottom Ash Pond 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 is 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 concentrations exceed 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 Karn Bottom Ash Pond. The property is owned and operated by Consumers Energy and groundwater is not used for drinking water. There are no on-site drinking water wells, so the drinking water pathway is not complete.

4.2 Assessment of Corrective Measures

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

and discussed in the ACM Report (TRC, Sept 2019). The following corrective measures were retained for further evaluation:

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

Consumers Energy plans to utilize an adaptive management strategy for selecting the final groundwater remedy for the Karn Bottom Ash Pond in coordination with the specified CCR source material management strategies discussed in the ACM Report. Under this remedy selection strategy, measures that remove source material, reduce infiltration, and/or minimize the potential for future migration during the closure process may be implemented to address existing conditions followed by monitoring and evaluation of the performance after closure. Adjustments will be made to the corrective measure remedy, as needed, to achieve the remedial goals (e.g. GWPS and/or risk/exposure/pathway-based criteria).

4.3 Remedy Selection

Consumers Energy has not selected a remedy pursuant to §257.97. The semi-annual progress report describing the progress in selecting and designing the remedy required pursuant to §257.97(a) is included as Appendix H of this report. Consumers Energy has completed the removal of CCR consistent with the timeline for closure of the Karn Bottom Ash Pond under the DE Karn Bottom Ash Pond Closure Plan (*Golder, January 2018; Revised April 2018*) and the CCR Rule's closure by removal provisions in §257.102(c). Based on observations of decreasing arsenic concentrations at DEK-MW-15002, DEK-MW-15003, and DEK-MW-18001 during the 2019 monitoring period, groundwater results are expected to continue to improve following the completion of source removal of CCR from the Karn Bottom Ash Pond. Groundwater monitoring in 2020 will reduce uncertainty surrounding potential changes in redox conditions and the effect on contaminant transport. These observations will be critical for the comparison of corrective measures alternatives.

Section 5

Conclusions and Recommendations

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

Overall, the statistical assessments have confirmed that arsenic is the only Appendix IV constituent present at statistically significant levels above the GWPS. Consumers Energy has completed the removal of CCR consistent with the timeline for closure of the Karn Bottom Ash Pond under the DE Karn Bottom Ash Pond Closure Plan (*Golder, January 2018; Revised April 2018*) and the CCR Rule's closure by removal provisions in §257.102(c).

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 discontinuing the hydraulic loading to the Karn Bottom Ash Pond and is expected to further improve following the completed source removal of CCR. Arsenic concentrations at DEK-MW-15002, DEK-MW-15003, and DEK-MW-18001 are decreasing. There still is some uncertainty surrounding how changes in redox conditions may affect contaminant transport which will be further evaluated during groundwater monitoring in 2020.

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

Section 6

References

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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)		April 8, 2019		October 7, 2019	
					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	6.50	581.21	5.84	581.87
MW-15008	585.36	Sand with clay	578.7	to 568.7	4.37	580.99	3.23	582.13
MW-15016	586.49	Sand	581.2	to 578.2	4.12	582.37	4.39	582.10
MW-15019	586.17	Sand and Sand/Clay	579.5	to 569.5	5.13	581.04	4.16	582.01
DEK Bottom Ash Pond								
DEK-MW-15002	590.87	Sand	578.3	to 575.3	6.02	584.85	6.25	584.62
DEK-MW-15004	611.04	Sand	576.6	to 571.6	27.53	583.51	29.14	581.90
DEK-MW-15005	589.72	Sand	572.3	to 567.3	9.25	580.47	7.63	582.09
DEK-MW-15006	589.24	Sand	573.0	to 568.0	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	16.23	586.51	16.72	586.02
DEK-MW-18001	593.47	Sand	579.2	to 574.2	8.20	585.27	8.16	585.31
OW-10	591.58	Silty Sand and Silty Clay	576.0	to 571.0	6.06	585.52	6.25	585.33
OW-11	607.90	Silt/Fly Ash	587.5	to 582.5	21.05	586.85	21.70	586.20
OW-12	603.07	Silty Sand	584.2	to 579.2	16.75	586.32	17.17	585.90

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
 DE Karn Bottom Ash Pond – RCRA CCR Monitoring Program
 Essexville, Michigan

Sample Location	Sample Date	Dissolved Oxygen (mg/L)	Oxidation Reduction Potential (mV)	pH (SU)	Specific Conductivity (umhos/cm)	Temperature (°C)	Turbidity (NTU)
Background							
MW-15002	4/8/2019	0.17	-18.1	7.0	6,665	9.7	1.2
	10/16/2019	0.21	-56.5	7.3	1,337	14.9	4.0
MW-15008	4/8/2019	0.13	-30.8	6.7	1,440	9.0	2.2
	10/15/2019	0.16	-18.0	6.6	1,658	13.7	3.4
MW-15016	4/9/2019	0.25	48.6	6.9	1,276	5.9	5.2
	10/16/2019	2.32	91.0	7.0	1,445	12.8	2.1
MW-15019	4/8/2019	0.12	-49.4	7.0	1,921	7.6	3.1
	10/16/2019	0.59	-20.9	6.8	1,860	13.6	4.5
Karn Bottom Ash Pond							
DEK-MW-15002	4/11/2019	0.20	92.1	7.5	890	7.6	3.6
	10/15/2019	0.16	-28.7	7.3	1,920	14.0	2.6
DEK-MW-15003	4/11/2019	0.27	88.0	8.0	565	9.4	3.2
	10/15/2019	0.19	-101.5	7.9	526	20.2	2.1
DEK-MW-15004	4/11/2019	0.18	34.4	7.1	717	12.7	1.4
	10/15/2019	0.19	-78.4	7.4	855	15.3	2.4
DEK-MW-15005	4/11/2019	0.18	91.6	7.7	705	7.9	3.1
	10/15/2019	0.23	-97.9	7.6	642	18.2	1.7
DEK-MW-15006	4/11/2019	0.17	78.3	7.8	1,130	8.7	2.9
	10/14/2019	0.14	-116.7	7.8	682	16.2	4.3
DEK-MW-18001	4/10/2019	0.12	58.7	7.2	592	8.5	3.2
	10/15/2019	0.22	-35.1	7.3	864	13.2	2.2

Notes:

mg/L - Milligrams per Liter.

mV - Millivolts.

SU - Standard units.

umhos/cm - Micromhos per centimeter.

°C - Degrees Celcius

NTU - Nephelometric Turbidity Unit.

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

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

Notes:

ug/L - micrograms per liter.

mg/L - milligrams per liter.

SU - standard units; pH is a field parameter.

pCi/L - picocuries per liter.

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

NC - no criteria.

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

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

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

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

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

RED value indicates an exceedance of the MCL.

All metals were analyzed as total unless otherwise specified.

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

Sample Location:						DEK-MW-15002		DEK-MW-15003		DEK-MW-15004		DEK-MW-15005	
Sample Date:						4/11/2019	10/15/2019	4/11/2019	10/15/2019	4/11/2019	10/15/2019	4/11/2019	10/15/2019
Constituent	Unit	EPA MCL	MI Residential*	MI Non-Residential*	MI GSI^	downgradient							
Appendix III													
Boron	ug/L	NC	500	500	4,000	860	1,600	960	1,100	840	540	910	700
Calcium	mg/L	NC	NC	NC	500	72	130	52	39	50	60	31	60
Chloride	mg/L	250**	250	250	50	80	410	58	58	63	77	60	64
Fluoride	ug/L	4,000	NC	NC	NC	< 1,000	< 1,000	< 1,000	< 1,000	1,100	1,100	< 1,000	< 1,000
Sulfate	mg/L	250**	250	250	500	45	150	47	52	150	160	140	5.2
Total Dissolved Solids	mg/L	500**	500	500	500	560	1,300	360	330	490	530	470	390
pH, Field	SU	6.5 - 8.5**	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	7.5	7.3	8.0	7.9	7.1	7.4	7.7	7.6
Appendix IV													
Antimony	ug/L	6	6.0	6.0	2.0	< 1.0	< 1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	10	10	10	10	9.0	6.5	380	420	110	180	24	120
Barium	ug/L	2,000	2,000	2,000	1,200	71	140	62	58	77	99	46	110
Beryllium	ug/L	4	4.0	4.0	33	< 1.0	< 1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	5	5.0	5.0	2.5	< 0.20	< 0.20	< 1.0	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Chromium	ug/L	100	100	100	11	1.3	< 1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cobalt	ug/L	NC	40	100	100	< 6.0	< 6.0	< 30	< 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	1,100	1,100	< 1,000	< 1,000
Lead	ug/L	NC	4.0	4.0	14	< 1.0	< 1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lithium	ug/L	NC	170	350	440	26	35	28	29	26	34	15	16
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	< 25	28	23	< 5.0	39	< 5.0
Radium-226	pCi/L	NC	NC	NC	NC	< 0.376	0.334	< 0.424	< 0.150	< 0.316	0.204	< 0.379	0.165
Radium-228	pCi/L	NC	NC	NC	NC	0.684	0.654	< 0.495	< 0.449	0.924	0.537	< 0.754	< 0.456
Radium-226/228	pCi/L	5	NC	NC	NC	0.846	0.987	< 0.495	< 0.449	1.07	0.741	< 0.754	0.524
Selenium	ug/L	50	50	50	5.0	< 1.0	< 1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Thallium	ug/L	2	2.0	2.0	2.0	< 2.0	< 2.0	< 10	< 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 Groundwater Sampling Results (Analytical): April 2019 - October 2019
 DE Karn Bottom Ash Pond – RCRA CCR Monitoring Program
 Essexville, Michigan

						Sample Location:		Sample Date:	
						DEK-MW-15006		DEK-MW-18001	
						4/11/2019	10/14/2019	4/10/2019	10/15/2019
Constituent	Unit	EPA MCL	MI Residential*	MI Non-Residential*	MI GSI^	downgradient			
Appendix III									
Boron	ug/L	NC	500	500	4,000	1,700	1,200	970	2,200
Calcium	mg/L	NC	NC	NC	500	35	34	48	84
Chloride	mg/L	250**	250	250	50	75	45	69	81
Fluoride	ug/L	4,000	NC	NC	NC	< 1,000	< 1,000	1,200	1,000
Sulfate	mg/L	250**	250	250	500	320	74	< 2.0	31
Total Dissolved Solids	mg/L	500**	500	500	500	780	450	360	500
pH, Field	SU	6.5 - 8.5**	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	7.8	7.8	7.2	7.3
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	21	27	68	63
Barium	ug/L	2,000	2,000	2,000	1,200	43	51	75	160
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	1,200	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	< 10	11	24	36
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	59	11	< 5.0	< 5.0
Radium-226	pCi/L	NC	NC	NC	NC	< 0.459	< 0.159	0.173	0.206
Radium-228	pCi/L	NC	NC	NC	NC	< 0.677	< 0.581	0.694	0.746
Radium-226/228	pCi/L	5	NC	NC	NC	< 0.677	< 0.581	0.867	0.952
Selenium	ug/L	50	50	50	5.0	< 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

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
 DE Karn Bottom Ash Pond – 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:							
								DEK-MW-15002		DEK-MW-15003		DEK-MW-15004		DEK-MW-15005	
Sample Date:								4/11/2019	10/15/2019	4/11/2019	10/15/2019	4/11/2019	10/15/2019	4/11/2019	10/15/2019
								downgradient							
Copper	ug/L	1,000***	1,400	1,000	4,000	1,000	20	< 1.0	< 1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Iron	ug/L	300***	2,000	300	5,600	300	500,000	390	510	390	360	1,500	2,100	87	1,400
Nickel	ug/L	NC	100	NA	100	NA	120	< 2.0	< 2.0	< 10	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Silver	ug/L	100***	34	NA	98	NA	0.2	< 0.20	< 0.20	< 1.0	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Vanadium	ug/L	NC	4.5	NA	62	NA	27	< 2.0	< 2.0	< 10	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Zinc	ug/L	5,000***	2,400	NA	NA	5,000	260	< 10	< 10	< 50	< 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.

(1) Laboratory reporting limits exceeds one or more criteria due to sample dilutions performed as a result of the nature of the sample matrix.

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

								Sample Location:		DEK-MW-15006		DEK-MW-18001	
								Sample Date:		4/11/2019	10/14/2019	4/10/2019	10/15/2019
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		
Iron	ug/L	300***	2,000	300	5,600	300	500,000	380	890	730	1,200		
Nickel	ug/L	NC	100	NA	100	NA	120	< 2.0	< 2.0	3.4	< 2.0		
Silver	ug/L	100***	34	NA	98	NA	0.2	< 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		
Zinc	ug/L	5,000***	2,400	NA	NA	5,000	260	< 10	16	< 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.

(1) Laboratory reporting limits exceeds one or more criteria due to sample dilutions performed as a result of the nature of the sample matrix.

Table 6
 Summary of Groundwater Protection Standard Exceedances – April 2019
 DE Karn Bottom Ash Pond – RCRA CCR Monitoring Program
 Essexville, Michigan

Constituent	Units	GWPS	DEW-MW-15002		DEK-MW-15003		DEK-MW-15004		DEK-MW-15005		DEK-MW-15006		DEK-MW-18001	
			LCL	UCL	LCL	UCL	LCL	UCL	LCL	UCL	LCL	UCL	LCL	UCL
Arsenic	ug/L	21	28	73	390	490	110	130	26	33	17	23	-11	290

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.

Table 7
 Summary of Groundwater Protection Standard Exceedances – October 2019
 DE Karn Bottom Ash Pond – RCRA CCR Monitoring Program
 Essexville, Michigan

Constituent	Units	GWPS	DEW-MW-15002		DEK-MW-15003		DEK-MW-15004		DEK-MW-15005		DEK-MW-15006		DEK-MW-18001	
			LCL	UCL	LCL	UCL	LCL	UCL	LCL	UCL	LCL	UCL	LCL	UCL
Arsenic	ug/L	21	17	72	390	460	110	180	24	120	17	25	-53	290

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



**DE KARN
POWER PLANT**

**JC WEADOCK
POWER PLANT**



BASE MAP FROM USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLE SERIES.




1540 Eisenhower Place
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TRC - GIS

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

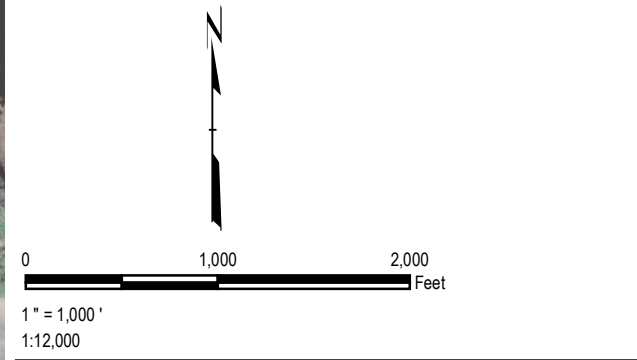


LEGEND

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

NOTES

1. BASE MAP IMAGERY FROM GOOGLE EARTH PRO, 2018.
2. WELL LOCATIONS SURVEYED BY ROWE PROFESSIONAL SERVICES COMPANY ON 11/4/2015.
3. NOAA/NATIONAL OCEANIC SERVICE GREAT LAKES GAUGING STATION, ESSEXVILLE, MI (ID: 9075035).
4. A SINGLE WELL SYMBOL IS SHOWN FOR WELL PAIRS MW-01/MW-02, MW-03/MW-04, OW-02/MW-22, AND OW-07/MW-23 AS THE WELLS ARE LOCATED WITHIN 15-FT OF EACH OTHER.



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 2	
APPROVED BY:	D. LITZ		
DATE:	JANUARY 2020		
		1540 Eisenhower Place Ann Arbor, MI 48108-3284 Phone: 734.971.7080 www.trccompanies.com	
FILE NO.:		322172_3-003-02.mxd	



LEGEND

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

NOTES

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

0 600 1200
Feet

1" = 600'
1:7,200

PROJECT: **CONSUMERS ENERGY COMPANY
DE KARN POWER PLANT
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	

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FILE NO.: 322172_3-004-02.mxd



LEGEND

- DEK BOTTOM ASH POND & LINED IMPOUNDMENT MONITORING WELL
- DEK BOTTOM ASH POND MONITORING WELL
- DEK LINED IMPOUNDMENT MONITORING WELL
- DECOMMISSIONED MONITORING WELL
- MONITORING WELL (STATIC WATER LEVEL ONLY)
- SURFACE WATER GAUGING STATION
- NATURE AND EXTENT WELL
- SLURRY WALL (APPROXIMATE)
- GROUNDWATER ELEVATION CONTOUR (1' INTERVAL, DASHED WHERE INFERRED)
- EXTENT OF GEOSYNTHETICS (KARN LINED IMPOUNDMENT)
- (580.21)** GROUNDWATER ELEVATION (FEET)
- (NM)** NOT MEASURED

NOTES

- BASE MAP IMAGERY FROM GOOGLE EARTH PRO, 2018.
- WELL LOCATIONS SURVEYED BY ROWE PROFESSIONAL SERVICES COMPANY ON 11/4/2015.
- NOAA/NATIONAL OCEANIC SERVICE GREAT LAKES GAUGING STATION, ESSEXVILLE, MI (ID: 9075035).
- A SINGLE WELL SYMBOL IS SHOWN FOR WELL PAIRS MW-01/MW-02 AND MW-03/MW-04 AS THE WELLS ARE LOCATED WITHIN 3-FT OF EACH OTHER.
- GROUND WATER ELEVATIONS DISPLAYED IN FEET RELATIVE TO THE NORTH AMERICAN VERTICAL DATUM OF 1988.

0 600 1200
Feet

1" = 600'
1:7,200

PROJECT: **CONSUMERS ENERGY COMPANY
DE KARN POWER PLANT
ESSEXVILLE, MICHIGAN**

TITLE: **SHALLOW GROUNDWATER CONTOUR MAP
OCTOBER 2019**

DRAWN BY: S. MAJOR	PROJ NO.: 322172-001
CHECKED BY: J. KRENZ	FIGURE 4
APPROVED BY: D. LITZ	
DATE: JANUARY 2020	

TRC

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FILE NO.: 322172_3-005-02.mxd

Appendix A Summary of November 2018 Assessment Monitoring Event



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March 14, 2019

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

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

Dear Mr. Register:

Consumers Energy Company (CEC) is continuing semiannual assessment monitoring in accordance with §257.95 of the CCR Rule¹ for the for the DE Karn Power Plant (DEK) Bottom Ash Pond located in 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 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 of 2018 for Appendix III and IV constituents at the Bottom Ash Pond (BAP) CCR Unit in accordance with the *DE Karn Monitoring Program Sample Analysis Plan (ARCADIS, 2016) (SAP)*. The semiannual assessment monitoring event was performed on November 6 through November 8, 2018. Downgradient monitoring wells

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).

DEK-MW-18001, DEK-MW-15002 through DEK-MW-15006 and background monitoring wells MW-15002, MW-15008, MW-15016, and MW-15019 were sampled during this monitoring event.

TRC personnel collected static water level measurements from the DEK BAP CCR unit well network during the November 2018 sampling event. 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 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 wells are summarized in Table 3, and the analytical results for the downgradient monitoring wells are summarized in Table 4.

Groundwater Flow Rate and Direction

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

Groundwater elevation data collected in October/November 2018 were generally similar to data collected previously during the background and detection monitoring events. Groundwater elevations at the site are generally within the range of 579 to 588 feet (ft NAVD88) and groundwater is typically encountered at a similar or slightly higher elevation relative to the surrounding surface water features, flowing outward toward the bounding surface water features.

Although historically the point source discharge of sluiced bottom ash into the bottom ash pond created localized mounding of the potentiometric surface, the new Karn Lined Impoundment went into service on June 7, 2018 and has been continuously collecting all of the process water and bottom ash that went into the former bottom ash pond. Since the pond is no longer being hydraulically loaded with sluiced ash, there is no longer standing water in the bottom ash pond. Porewater at the facility is locally influenced by incidental infiltration from precipitation over the uncovered acreage. OW-11 and DEK-MW-15003 represent a groundwater elevation high point with porewater flow generally flowing radially towards the adjacent surface water features.

The figure shows that current groundwater flow continues to radiate outward from the DEK BAP area toward the surface water. The average hydraulic gradient observed on November 5, 2018 in the DEK BAP CCR unit area during these events is estimated at 0.0066 ft/ft. The gradient was calculated using the well pair DEK-MW-15004/DEK-MW-15005, as well as the well water elevation difference and



distance between DEK-MW-15003 and the discharge channel. Using the mean hydraulic conductivity of 15 ft/day (ARCADIS, 2016) and an assumed effective porosity of 0.3, the estimated average seepage velocity was 0.33 ft/day or 120 ft/year which is consistent with previous estimates. The general flow direction is similar to that identified in previous monitoring rounds and continues to demonstrate that the downgradient wells are appropriately positioned to detect the presence of Appendix III/IV constituents that could potentially migrate from the DEK BAP CCR unit.

Data Quality

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

Assessment Monitoring Statistical Evaluation

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

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

The statistical evaluation of the second semiannual assessment monitoring event data indicate the following constituent is present at statistically significant levels exceeding the GWPS in downgradient monitoring wells at the DEK BAP:

<u>Constituent</u>	<u>GWPS</u>	<u>#Downgradient Wells Observed</u>
Arsenic	21 ug/L	4 of 5

These results are consistent with the results of the initial assessment monitoring data statistical evaluation and CEC will continue to initiate an assessment of corrective measures by April 14, 2019

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

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

per §257.95(g). CEC will continue executing the self-implementing groundwater compliance schedule in conformance with §257.90 - §257.98.

Sincerely,

TRC



Graham Crockford
Program Manager



Darby Litz
Hydrogeologist/Project Manager

Attachments

- | | |
|--------------|--|
| Table 1. | Summary of Groundwater Elevation Data |
| Table 2. | Summary of Field Parameter Results |
| Table 3. | Summary of Background Wells 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
 DE Karn Bottom Ash Pond – RCRA CCR Monitoring Program
 Essexville, Michigan

Sample Location	Sample Date	Dissolved Oxygen (mg/L)	Oxidation Reduction Potential (mV)	pH (SU)	Specific Conductivity (umhos/cm)	Temperature (°C)	Turbidity (NTU)
Background							
MW-15002	11/8/2018	0.19	-54.3	7.3	1,755	13.13	4.42
MW-15008	11/8/2018	0.23	9.2	6.8	1,216	12.97	6.25
MW-15016	11/8/2018	2.78	90.3	7.3	773	9.01	2.32
MW-15019	11/8/2018	0.26	-13.1	6.9	1,533	12.18	3.53
Downgradient							
DEK-MW-15002	11/5/2018	0.30	108.2	7.3	709	13.67	3.16
DEK-MW-15003	11/6/2018	0.31	37.2	8.0	551	15.37	1.86
DEK-MW-15004	11/6/2018	0.23	-30.6	7.4	707	15.37	2.31
DEK-MW-15005	11/6/2018	0.26	17.8	7.9	615	13.52	2.11
DEK-MW-15006	11/5/2018	0.66	66.7	7.9	941	13.04	2.14
DEK-MW-18001	11/6/2018	0.21	58.0	7.5	504	13.17	2.12

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
 DE Karn Bottom Ash Pond – RCRA CCR Monitoring Program
 Essexville, Michigan

		Sample Location:				DEK-MW-15002	DEK-MW-15003	DEK-MW-15004	DEK-MW-15005	DEK-MW-15006	DEK-MW-18001
		Sample Date:				11/5/2018	11/6/2018	11/6/2018	11/6/2018	11/5/2018	11/6/2018
Constituent	Unit	EPA MCL	MI Residential*	MI Non-Residential*	MI GSI^	downgradient					
Appendix III											
Boron	ug/L	NC	500	500	4,000	894	944	910	947	1,340	1,020
Calcium	mg/L	NC	NC	NC	500	67.8	62.9	62.2	32.9	29.4	51.1
Chloride	mg/L	250**	250	250	50	83.5	61.7	70.6	69.1	87.9	76.6
Fluoride	ug/L	4,000	NC	NC	NC	< 1,000	< 1,000	1,100	< 1,000	< 1,000	1,300
Sulfate	mg/L	250**	250	250	500	77.2	37.8	168	160	341	< 2.0
Total Dissolved Solids	mg/L	500**	500	500	500	536	370	482	474	792	340
pH, Field	SU	6.5 - 8.5**	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	7.3	8.0	7.4	7.9	7.9	7.5
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	31.7	420	123	35.0	20.9	116
Barium	ug/L	2,000	2,000	2,000	1,200	71.6	70.9	95.1	56.7	38.5	79.5
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	1.4	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cobalt	ug/L	NC	40	100	100	< 6.0	< 6.0	< 6.0	< 6.0	< 6.0	< 6.0
Fluoride	ug/L	4,000	NC	NC	NC	< 1,000	< 1,000	1,100	< 1,000	< 1,000	1,300
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	32	33	33	17	< 10	24
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	< 5.0	5.2	28.0	45.3	50.3	< 5.0
Radium-226	pCi/L	NC	NC	NC	NC	< 0.850	< 0.661	< 0.743	< 0.865	< 0.885	< 0.813
Radium-228	pCi/L	NC	NC	NC	NC	0.730	< 0.789	< 0.794	< 0.598	< 0.649	0.811
Radium-226/228	pCi/L	5	NC	NC	NC	< 1.39	< 1.45	< 1.54	< 1.46	< 1.53	1.56
Selenium	ug/L	50	50	50	5	< 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 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 5
 Summary of Groundwater Protection Standard Exceedances – November 2018
 DE Karn Bottom Ash Pond – RCRA CCR Monitoring Program
 Essexville, Michigan

Constituent	Units	GWPS	DEW-MW-15002		DEK-MW-15003		DEK-MW-15004		DEK-MW-15005		DEK-MW-15006	
			LCL	UCL	LCL	UCL	LCL	UCL	LCL	UCL	LCL	UCL
Arsenic	ug/L	21	43	76	400	500	110	130	26	33	15	26

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
- 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).

0 1,000 2,000 Feet

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

PROJECT:		CONSUMERS ENERGY COMPANY DE KARN AND JC WEADOCK POWER PLANTS ESSEXVILLE, MICHIGAN	
TITLE:		SITE MAP	
DRAWN BY:	S. MAJOR	PROJ NO.:	322173-001
CHECKED BY:	J. KRENZ	FIGURE 1	
APPROVED BY:	D. LITZ		
DATE:	MARCH 2019		
		1540 Eisenhower Place Ann Arbor, MI 48108-3284 Phone: 734.971.7080 www.trcsolutions.com	
FILE NO.:		290805-001-023.mxd	

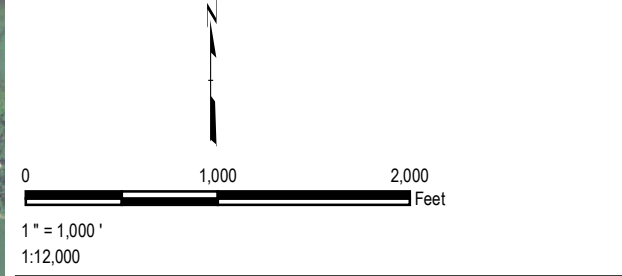


LEGEND

- 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

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



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		

TRC

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

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; 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

CEC DE Karn Lined Impoundment and Bottom Ash Pond

Groundwater samples were collected by TRC for the November 2018 sampling event. Samples were analyzed for anions, alkalinity, total dissolved solids, and total metals by Pace Analytical Services, LLC (Pace), located in Grand Rapids, Michigan, and for radium by Pace located in Greensburg, Pennsylvania. The antimony, selenium, and vanadium analyses were subcontracted by Pace in Grand Rapids, MI to the Pace facility in Indianapolis, Indiana. The laboratory analytical results are reported in laboratory reports 4620009, 4620031, 4620173, 4620178, 4620174 and 4620179.

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

- DEK-MW-15002
- DEK-MW-15003
- DEK-MW-15004
- DEK-MW-15005
- DEK-MW-15006
- DEK-MW-18001
- OW-10
- OW-11
- OW-12
- KLI-SCS

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	EPA 6020A, EPA 6010C, EPA 7470A
Radium (Radium-226, Radium-228, Total Radium)*	EPA 903.1, EPA 904.0

* Sample KLI-SCS was analyzed for all constituents except radium.

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

Data Usability Review Procedure

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

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

This data usability report addresses the following items:

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

Review Summary

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

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

QA/QC Sample Summary:

- A method blank was analyzed with each analytical batch; no analytes were detected in the method blank samples.
- One equipment blank (EB-03) and two field blanks (FB-03 and FB-04) were collected.
 - Copper was detected in FB-04 at 5.9 µg/L. The detected copper result in sample KLI-SCS_20181107 may be a false positive since the results was less than 5x the blank result.
- The LCS recoveries for all analytes were within QC limits.
- MS and/or MSD analyses were performed on sample DEK-MW-18001 for anions, mercury, alkalinity, radium, and metals. All recoveries and relative percent differences (RPDs) were within the QC limits with the following exception.
 - The recoveries of born were outside of the acceptance criteria. The boron concentration in sample DEK-MW-18001 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-04 and DEK-MW-15006; RPDs between the parent and duplicate sample were within the QC limits.
- Laboratory duplicate analyses were performed on sample DEK-MW-18001 for anions, alkalinity, and TDS, DEK-MW-15002 for anions, DEK-MW-15005 for TDS, and KLI-SCS_20181107 for anions; RPDs were within QC limits.
- The laboratory noted that the sample bottle submitted for anions, TDS, and alkalinity analyses for sample DEK-MW-15004 was slightly unscrewed and laying sideways in the cooler water upon receipt at the laboratory. The laboratory noted that the sample was leaking and that contamination from the cooler water was possible for anions, TDS, and alkalinity. Results were consistent with previous rounds. Conservatively, results for anions, TDS, and alkalinity in this sample should be considered estimated; however, concentrations were generally consistent with previous data. Refer to Attachment A.
- Carrier and tracer recoveries, where applicable, were within 30-110%.

Attachment A
 Summary of Data Non-Conformances for DE Karn Groundwater Analytical Data
 DEK Bottom Ash Pond and Karn Lined Impoundment – RCRA CCR Monitoring Program
 Essexville, Michigan

Samples	Collection Date	Analyte	Non-Conformance/Issue
DEK-MW-15004_20181106	11/6/2018	Chloride, fluoride, sulfate, total dissolved solids, alkalinity bicarbonate (CaCO ₃), alkalinity carbonate (CaCO ₃), and total alkalinity	The lab noted that the sample bottle was slightly unscrewed and laying sideways in the cooler water upon receipt at the laboratory. The lab noted that the sample was leaking and that contamination from the cooler water was possible. Conservatively, results for anions, TDS, and alkalinity in this sample should be considered estimated; however concentrations were generally consistent with previous data.
KLI-SCS_20181107	11/7/2018	Copper	Detection in field blank (FB-04). Sample result ≤5X the blank concentration. Result may be a false positive.

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.: 290804.0000 Phase 001, Task 002

Subject: Statistical Evaluation of November 2018 Assessment Monitoring Sampling Event
DE Karn Bottom Ash Pond, 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 DE Karn Power Plant (DEK) Bottom Ash Pond (BAP). The second semiannual assessment monitoring event for 2018 was conducted on November 5 through November 8, 2018. In accordance with §257.95, the assessment monitoring data must be compared to GWPSs to determine whether or not Appendix IV constituents are detected at statistically significant levels above the GWPSs. GWPSs were established in accordance with §257.95(h), as detailed in the October 15, 2018 *Groundwater Protection Standards* technical memorandum, which was also included in the 2018 *Annual Groundwater Monitoring Report* (TRC, January 2019). The following narrative describes the methods employed and the results obtained and the Sanitas™ output files are included as an attachment.

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

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The statistical evaluation of the second semiannual assessment monitoring event data indicate the following constituent is present at statistically significant levels exceeding the GWPS in downgradient monitoring wells at the DEK Bottom Ash Pond:

<u>Constituent</u>	<u>GWPS</u>	<u>#Downgradient Wells Observed</u>
Arsenic	21 ug/L	4 of 5

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

Assessment Monitoring Statistical Evaluation

The compliance well network at the DEK BAP CCR Unit includes six wells encircling the unit (DEK-MW-15002 through DEK-MW-15006 and DEK-MW-18001). Former downgradient monitoring well DEK-MW-15001 was decommissioned on April 18, 2018 to allow for construction of the new Karn Lined Impoundment CCR unit. DEK-MW-18001 was installed approximately 80 feet southeast of the former DEK-MW-15001 location to maintain the perimeter downgradient monitoring well network. Although DEK-MW-18001 is considered to be a replacement well, the data from the two wells are not being combined in the statistical analyses at this time due to an insufficient amount of data from the new well to compare the two data sets. Therefore, the statistical analysis for DEK-MW-15001 terminates at the April 2018 sampling event and statistical analysis for DEK-MW-18001 will commence once sufficient data have been collected from the new well (a minimum of four independent sampling events).

Following the second semiannual assessment monitoring sampling event, compliance well data for the DEK BAP were evaluated in accordance with the *Groundwater Statistical Evaluation Plan* (Stats Plan) (TRC, October 2017). An assessment monitoring program was developed to evaluate concentrations of CCR constituents present in the uppermost aquifer relative to acceptable levels (i.e., GWPSs). In order to decide as to whether or not the GWPSs have been exceeded, the change in concentration observed at the downgradient wells during a given assessment monitoring event must be large enough, after accounting for variability in the sample data, that the result is unlikely to have occurred merely by chance. Consistent with the Unified Guidance², 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.

² 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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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 built into the CCR Rule, and numerous other federal rules, are key in determining whether or not individually measured data points represent a concentration increase over the baseline or a fixed standard (such as a GWPS in an assessment monitoring program).

For each detected Appendix IV constituent, the concentrations from each well were first compared directly to the GWPS, as shown on Table A1. Parameter-well combinations that included a direct exceedance of the GWPS were retained for further analysis. Arsenic in each of the downgradient monitoring wells at the Bottom Ash Pond had individual results exceeding the GWPS. Lead was detected in DEK-MW-15006 during May 2018 at a concentration of 320 ug/L, which exceeds its GWPS. However, this is the only detection of lead in the Bottom Ash Pond wells during either baseline sampling or assessment monitoring. Sampling conducted in November 2018 did not confirm the lead detection. Therefore, the single detection was classified as an outlier per the Double Quantification Rule as outlined in the Stats Plan and the Unified Guidance. As a result, only arsenic was retained for evaluation in all downgradient monitoring wells.

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;

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

The results of these evaluations are presented and discussed below.

Initially, the baseline (December 2015 through August 2017) results and the assessment monitoring results (April through November 2018) were observed visually for potential trends. No outliers or trends were identified. Data from each round were evaluated for completeness, overall quality, and usability and were deemed appropriate for the purposes of the CCR assessment monitoring program. The Sanitas™ software was then used to test compliance at the downgradient monitoring wells using the confidence interval method for the most recent 8 sampling events. Eight independent sampling events provide the appropriate density of data as recommended per the 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 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. Note that, as mentioned above, the statistical analysis for DEK-MW-15001 terminates at the April 2018 sampling event as it was decommissioned on April 18, 2018, and statistical analysis for DEK-MW-18001 will commence once sufficient data have been collected from the new well (a minimum of four independent sampling events).

The Sanitas™ software generates an output graph for the confidence intervals of each well. In each case, the data sets were found to be normally distributed except the set for DEK-MW-15006, for which a non-parametric confidence interval was calculated. The confidence interval test compares the lower confidence limit to the GWPS. The statistical evaluation of the Appendix IV parameters shows exceedances for arsenic at four of the five monitoring locations (DEK-MW-15002 through DEK-MW-15005). These results are consistent with the results of the initial assessment monitoring data statistical evaluation and CEC will continue to initiate an assessment of corrective measures per §257.95(g). CEC will continue executing the self-implementing groundwater compliance schedule in conformance with §257.90 - §257.98.

Attachments

- Table A1 Comparison of Groundwater Sampling Results to Groundwater Protection Standards –
December 2015 to November 2018
- Attachment 1 Sanitas™ Output Files

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Table

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

		Sample Location:				DEK-MW-15001 ⁽¹⁾									
		Sample Date:				12/10/2015	3/30/2016	5/26/2016	8/24/2016	12/1/2016	2/23/2017	5/18/2017	8/3/2017	9/18/2017	4/10/2018
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS	downgradient									
Appendix III															
Boron	ug/L	NC	NA	619	NA	3,630	2,420	3,110	2,810	2,740	2,520	3,270	2,690	2,700	--
Calcium	mg/L	NC	NA	302	NA	108	87.8	92.2	95	75.1	96.8	85.8	71.8	82.4	--
Chloride	mg/L	250*	NA	2,440	NA	75.7	79.0	75.7	72.5	71.0	76.5	75.0	81.9	82.2	--
Fluoride	ug/L	4,000	NA	1,000	NA	< 1,000	1,530	1,440	1,160	1,500	1,650	1,330	1,700	2,100	1,600
Sulfate	mg/L	250*	NA	407	NA	72.4	53.3	64.9	37.4	52.7	53.4	59.9	66.3	36.2	--
Total Dissolved Solids	mg/L	500*	NA	4,600	NA	600	470	510	480	470	450	510	516	594	--
pH, Field	SU	6.5 - 8.5*	NA	6.5-7.3	NA	7.6	7.5	7.5	7.4	7.4	7.4	7.4	7.6	7.5	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	118	159	138	108	144	133	145	158	--	103
Barium	ug/L	2,000	NA	1,300	2,000	114	69	73	100	98	91	95	94.2	--	117
Beryllium	ug/L	4	NA	1	4	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 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
Chromium	ug/L	100	NA	3	100	< 1	1	< 1	< 1	< 1	< 1	1	< 1.0	--	< 1.0
Cobalt	ug/L	NC	6	15	15	< 15	< 15	< 15	< 15	< 15	< 15	< 15	< 15.0	--	< 15.0
Fluoride	ug/L	4,000	NA	1,000	4,000	< 1,000	1,530	1,440	1,160	1,500	1,650	1,330	1,700	2,100	1,600
Lead	ug/L	NC	15	1	15	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0
Lithium	ug/L	NC	40	180	180	71.9	48.7	51	55	52	48	55	53	--	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
Molybdenum	ug/L	NC	100	6	100	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5.0	--	< 5.0
Radium-226	pCi/L	NC	NA	NA	NA	< 0.297	0.244	0.240	< 0.195	< 0.292	0.565	< 0.315	< 0.934	--	< 0.686
Radium-228	pCi/L	NC	NA	NA	NA	0.909	1.32	0.639	< 0.509	< 0.405	0.642	1.20	< 0.770	--	1.08
Radium-226/228	pCi/L	5	NA	3.32	5	1.181	1.564	0.879	< 0.509	< 0.405	1.207	1.29	< 1.70	--	< 1.42
Selenium	ug/L	50	NA	2	50	4	3	3	1	2	< 1	< 1	< 1.0	--	1.2
Thallium	ug/L	2	NA	2	2	< 2	< 2	< 2	< 2	< 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.
 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) DEK-MW-15001 was decommissioned on April 18, 2018.
 (2) Outlier; single detection above reporting limit.

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

Sample Location:						DEK-MW-15002											
Sample Date:						12/10/2015	3/30/2016	5/26/2016	8/24/2016	12/1/2016	2/23/2017	5/18/2017	8/3/2017	9/18/2017	4/12/2018	5/23/2018	11/5/2018
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS	downgradient											
Appendix III																	
Boron	ug/L	NC	NA	619	NA	780	676	668	746	893	858	824	805	870	--	967	894
Calcium	mg/L	NC	NA	302	NA	102	119	99.6	105	94.8	149	80.1	71.1	66.9	--	53.7	67.8
Chloride	mg/L	250*	NA	2,440	NA	83.5	97.6	90.0	89.2	86.1	88.2	80.5	87.8	84.9	--	79.7	83.5
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
Sulfate	mg/L	250*	NA	407	NA	275	418	291	384	326	289	299	256	290	--	263	77.2
Total Dissolved Solids	mg/L	500*	NA	4,600	NA	790	890	800	1,700	810	810	1,500	696	722	--	660	536
pH, Field	SU	6.5 - 8.5*	NA	6.5-7.3	NA	7.8	7.5	7.6	7.5	7.6	7.5	7.5	7.8	7.9	7.5	8.0	7.3
Appendix IV																	
Antimony	ug/L	6	NA	1	6	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	10	NA	21	21	61	118	82	79	54	62	76	48.3	--	56.4	67.0	31.7
Barium	ug/L	2,000	NA	1,300	2,000	140	148	136	131	121	120	107	96.1	--	82.7	84.5	71.6
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	2	1	< 1	1	2	2	< 1.0	--	< 1.0	< 1.0	1.4
Cobalt	ug/L	NC	6	15	15	< 15	< 15	< 15	< 15	< 15	< 15	< 15	< 15.0	--	< 15.0	< 15.0	< 6.0
Fluoride	ug/L	4,000	NA	1,000	4,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 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	3	< 1.0	--	< 1.0	< 1.0	< 1.0
Lithium	ug/L	NC	40	180	180	50.7	53	43	44	40	41	42	36	--	43	35	32
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	19	30	29	41	26	27	38	27.7	--	30.8	35.4	< 5.0
Radium-226	pCi/L	NC	NA	NA	NA	< 0.301	0.301	0.314	0.513	0.255	0.68	0.321	< 0.854	--	< 0.478	< 0.698	< 0.850
Radium-228	pCi/L	NC	NA	NA	NA	0.809	0.645	1.26	0.908	0.547	0.844	0.929	1.17	--	1.16	< 0.744	0.730
Radium-226/228	pCi/L	5	NA	3.32	5	1.067	0.946	1.574	1.421	0.802	1.524	1.25	1.88	--	1.42	< 1.44	< 1.39
Selenium	ug/L	50	NA	2	50	< 1	< 1	2	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0
Thallium	ug/L	2	NA	2	2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2.0	--	< 2.0	< 2.0	< 2.0

Notes:

ug/L - micrograms per liter.
 mg/L - milligrams per liter.
 SU - standard units; pH is a field parameter.
 pCi/L - picocuries per liter.
 NA - not applicable.
 NC - no criteria.
 -- - not analyzed.
 MCL - Maximum Contaminant Level, EPA Drinking Water Standards and Health Advisories, April 2012.
 RSL - Regional Screening Level from 83 FR 36435.
 UTL - Upper Tolerance Limit (95%) of the background data set.
 GWPS - Groundwater Protection Standard. GWPS is the higher of the MCL/RSL and UTL as established in TRC's Technical Memorandum dated October 15, 2018.
 * - Secondary Maximum Contaminant Level (SMCL), EPA Secondary Drinking Water Regulations (SDWR) April 2012.
Bold value indicates an exceedance of the GWPS. Data from downgradient monitoring wells are screened against the GWPS for evaluation purposes only. Confidence intervals will be used to determine compliance per the CCR rules.
 All metals were analyzed as total unless otherwise specified.
 (1) DEK-MW-15001 was decommissioned on April 18, 2018.
 (2) Outlier; single detection above reporting limit.

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

		Sample Location:				DEK-MW-15003												
		Sample Date:				12/10/2015	3/30/2016	5/26/2016	8/24/2016	12/1/2016	2/23/2017	5/18/2017	8/4/2017	9/18/2017	4/12/2018	5/23/2018	8/16/2018	11/6/2018
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS	downgradient												
Appendix III																		
Boron	ug/L	NC	NA	619	NA	1,020	920	982	1,010	1,140	1,090	1,270	1,160	1,030	--	1,010	913	944
Calcium	mg/L	NC	NA	302	NA	41.7	57.3	56.3	64.1	64.1	85.4	68.2	58.8	62.1	--	58.1	59.1	62.9
Chloride	mg/L	250*	NA	2,440	NA	63.8	62.0	61.2	59.8	54.8	56.3	54.9	61.7	60.2	--	57.2	59.4	61.7
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	< 1,000	< 1,000
Sulfate	mg/L	250*	NA	407	NA	64.3	71.6	75.7	76.8	71.9	64.5	57.6	55.8	54.3	--	39.1	38.0	37.8
Total Dissolved Solids	mg/L	500*	NA	4,600	NA	370	400	420	430	440	430	420	506	426	--	354	374	370
pH, Field	SU	6.5 - 8.5*	NA	6.5-7.3	NA	8.4	7.8	7.9	7.7	7.8	7.7	7.8	7.9	7.9	7.8	8.2	7.9	8.0
Appendix IV																		
Antimony	ug/L	6	NA	1	6	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 2.0	< 1.0
Arsenic	ug/L	10	NA	21	21	498	517	543	527	525	372	450	437	--	478	450	456	420
Barium	ug/L	2,000	NA	1,300	2,000	96	69	68	73	71	71	66	68.5	--	61.2	73.3	66.8	70.9
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	2	2	2	< 1	< 1	< 1	1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0
Cobalt	ug/L	NC	6	15	15	< 15	< 15	< 15	< 15	< 15	< 15	< 15	< 15.0	--	< 15.0	< 15.0	< 15.0	< 6.0
Fluoride	ug/L	4,000	NA	1,000	4,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Lead	ug/L	NC	15	1	15	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0
Lithium	ug/L	NC	40	180	180	22.8	22.6	26	27	30	30	35	35	--	39	33	35	33
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	8	7	8	6	5	5	5	5.0	--	< 5.0	5.3	< 5.0	5.2
Radium-226	pCi/L	NC	NA	NA	NA	< 0.221	< 0.227	< 0.235	< 0.184	< 0.287	0.252	< 0.324	0.226	--	0.686	< 0.842	1.20	< 0.661
Radium-228	pCi/L	NC	NA	NA	NA	< 0.473	< 0.52	< 0.546	0.423	< 0.363	< 0.34	< 0.646	< 0.936	--	< 0.755	1.12	< 0.837	< 0.789
Radium-226/228	pCi/L	5	NA	3.32	5	< 0.473	< 0.52	< 0.546	0.469	< 0.363	< 0.34	< 0.646	< 1.14	--	< 1.33	1.63	< 1.76	< 1.45
Selenium	ug/L	50	NA	2	50	< 5	< 1	2	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 2.0	< 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.
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 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) DEK-MW-15001 was decommissioned on April 18, 2018.
 (2) Outlier; single detection above reporting limit.

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

Sample Location: Sample Date:						DEK-MW-15004																	
						12/10/2015	3/30/2016	5/26/2016	8/24/2016	12/1/2016	2/23/2017	5/18/2017	8/3/2017	8/3/2017	9/19/2017	9/19/2017	4/12/2018	5/23/2018	5/23/2018	11/6/2018			
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS	downgradient																	
Appendix III																							
Boron	ug/L	NC	NA	619	NA	478	435	514	472	535	637	839	785	Field Dup	768	730	Field Dup	750	--	800	Field Dup	842	910
Calcium	mg/L	NC	NA	302	NA	61.7	68.3	71.1	78.9	73	108	74.2	67.4	68.1	66.5	67.9	--	47.8	50.7	62.2			
Chloride	mg/L	250*	NA	2,440	NA	71.5	72.7	72.3	77.4	73.3	75.3	70.3	81.4	81.5	79.8	79.9	--	72.5	72.6	70.6			
Fluoride	ug/L	4,000	NA	1,000	NA	< 1,000	< 1,000	< 1,000	1,550	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	1,200	1,100	1,100	1,100			
Sulfate	mg/L	250*	NA	407	NA	213	188	184	198	215	211	220	258	261	283	281	--	176	178	168			
Total Dissolved Solids	mg/L	500*	NA	4,600	NA	680	560	560	580	590	580	590	642	582	596	564	--	494	504	482			
pH, Field	SU	6.5 - 8.5*	NA	6.5-7.3	NA	8.0	7.7	7.4	7.4	7.5	7.5	7.5	7.6	--	7.3	--	7.3	7.7	--	7.4			
Appendix IV																							
Antimony	ug/L	6	NA	1	6	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1.0	--	--	< 1.0	< 1.0	< 1.0	< 1.0			
Arsenic	ug/L	10	NA	21	21	56	95	108	104	117	116	111	121	129	--	--	134	119	126	123			
Barium	ug/L	2,000	NA	1,300	2,000	107	94	102	110	115	110	103	111	115	--	--	86.9	79.6	82.6	95.1			
Beryllium	ug/L	4	NA	1	4	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1.0	--	--	< 1.0	< 1.0	< 1.0	< 1.0			
Cadmium	ug/L	5	NA	0.2	5	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	< 0.20	--	--	< 0.20	< 0.20	< 0.20	< 0.20			
Chromium	ug/L	100	NA	3	100	< 1	2	< 1	< 1	< 1	1	< 1	< 1.0	< 1.0	--	--	< 1.0	< 1.0	< 1.0	< 1.0			
Cobalt	ug/L	NC	6	15	15	< 15	< 15	< 15	< 15	< 15	< 15	< 15	< 15.0	< 15.0	--	--	< 15.0	< 15.0	< 15.0	< 6.0			
Fluoride	ug/L	4,000	NA	1,000	4,000	< 1,000	< 1,000	< 1,000	1,550	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	1,200	1,100	1,100	1,100			
Lead	ug/L	NC	15	1	15	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1.0	--	--	< 1.0	< 1.0	< 1.0	< 1.0			
Lithium	ug/L	NC	40	180	180	35.8	29.5	36	34	37	36	38	39	38	--	--	39	30	32	33			
Mercury	ug/L	2	NA	0.2	2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	< 0.20	--	--	< 0.20	< 0.20	< 0.20	< 0.20			
Molybdenum	ug/L	NC	100	6	100	29	25	21	24	27	30	29	30.4	31.4	--	--	32.0	30.9	30.4	28.0			
Radium-226	pCi/L	NC	NA	NA	NA	< 0.258	0.400	0.233	0.264	0.244	0.328	0.347	0.805	< 0.623	--	--	< 0.641	< 0.791	< 0.679	< 0.743			
Radium-228	pCi/L	NC	NA	NA	NA	< 0.556	0.532	0.527	0.672	< 0.396	< 0.458	1.28	0.833	0.864	--	--	< 0.847	< 0.753	0.845	< 0.794			
Radium-226/228	pCi/L	5	NA	3.32	5	< 0.556	0.932	0.76	0.936	0.588	0.665	1.63	1.64	< 1.46	--	--	< 1.49	< 1.54	1.29	< 1.54			
Selenium	ug/L	50	NA	2	50	< 1	< 1	1	< 1	< 1	< 1	< 1	< 1.0	< 1.0	--	--	< 1.0	< 1.0	< 1.0	< 1.0			
Thallium	ug/L	2	NA	2	2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2.0	< 2.0	--	--	< 2.0	< 2.0	< 2.0	< 2.0			

Notes:

ug/L - micrograms per liter.
 mg/L - milligrams per liter.
 SU - standard units; pH is a field parameter.
 pCi/L - picocuries per liter.
 NA - not applicable.
 NC - no criteria.
 -- - not analyzed.
 MCL - Maximum Contaminant Level, EPA Drinking Water Standards and Health Advisories, April 2012.
 RSL - Regional Screening Level from 83 FR 36435.
 UTL - Upper Tolerance Limit (95%) of the background data set.
 GWPS - Groundwater Protection Standard. GWPS is the higher of the MCL/RSL and UTL as established in TRC's Technical Memorandum dated October 15, 2018.
 * - Secondary Maximum Contaminant Level (SMCL), EPA Secondary Drinking Water Regulations (SDWR) April 2012.
Bold value indicates an exceedance of the GWPS. Data from downgradient monitoring wells are screened against the GWPS for evaluation purposes only. Confidence intervals will be used to determine compliance per the CCR rules.
 All metals were analyzed as total unless otherwise specified.
 (1) DEK-MW-15001 was decommissioned on April 18, 2018.
 (2) Outlier; single detection above reporting limit.

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

		Sample Location:				DEK-MW-15005													
		Sample Date:				12/10/2015	3/30/2016	5/26/2016	8/24/2016	12/1/2016	2/23/2017	5/18/2017	8/3/2017	9/18/2017	4/11/2018	4/11/2018	5/24/2018	11/6/2018	
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS	downgradient													
Appendix III																			
Boron	ug/L	NC	NA	619	NA	410	396	465	589	687	712	788	792	714	--	Field Dup	806	947	
Calcium	mg/L	NC	NA	302	NA	58.5	68.6	72.7	98.4	71.1	76.3	55	49.2	44.3	--	--	33.4	32.9	
Chloride	mg/L	250*	NA	2,440	NA	77.9	82.6	82.3	93.9	80.1	77.5	73.3	81.4	79.3	--	--	72.6	69.1	
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	
Sulfate	mg/L	250*	NA	407	NA	223	251	269	355	329	281	263	300	273	--	--	182	160	
Total Dissolved Solids	mg/L	500*	NA	4,600	NA	620	660	660	810	740	680	650	732	638	--	--	524	474	
pH, Field	SU	6.5 - 8.5*	NA	6.5-7.3	NA	8.0	7.7	7.5	7.6	7.7	7.7	7.6	7.9	7.9	7.7	--	7.8	7.9	
Appendix IV																			
Antimony	ug/L	6	NA	1	6	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	
Arsenic	ug/L	10	NA	21	21	5	15	16	23	29	29	28	31.9	--	28.3	29.1	31.7	35.0	
Barium	ug/L	2,000	NA	1,300	2,000	87	94	104	149	120	101	83	92.2	--	54.9	55.8	58.5	56.7	
Beryllium	ug/L	4	NA	1	4	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	
Cadmium	ug/L	5	NA	0.2	5	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20	< 0.20	
Chromium	ug/L	100	NA	3	100	< 1	1	1	< 1	< 1	1	2	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	
Cobalt	ug/L	NC	6	15	15	< 15	< 15	< 15	< 15	< 15	< 15	< 15	< 15.0	--	< 15.0	< 15.0	< 15.0	< 6.0	
Fluoride	ug/L	4,000	NA	1,000	4,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	
Lead	ug/L	NC	15	1	15	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	
Lithium	ug/L	NC	40	180	180	23.7	23	29	30	26	23	26	27	--	24	24	19	17	
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	40	33	32	37	44	40	36	41.9	--	39.0	40.5	41.9	45.3	
Radium-226	pCi/L	NC	NA	NA	NA	< 0.238	0.263	0.180	0.300	0.367	0.490	< 0.321	0.707	--	< 0.587	0.606	< 0.740	< 0.865	
Radium-228	pCi/L	NC	NA	NA	NA	1.03	< 0.429	< 0.404	0.919	0.550	0.450	0.685	1.01	--	0.756	0.886	0.857	< 0.598	
Radium-226/228	pCi/L	5	NA	3.32	5	1.197	0.686	0.458	1.219	0.917	0.940	0.875	1.72	--	< 1.34	1.49	< 1.53	< 1.46	
Selenium	ug/L	50	NA	2	50	2	< 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.
 (1) DEK-MW-15001 was decommissioned on April 18, 2018.
 (2) Outlier; single detection above reporting limit.

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

		Sample Location:				DEK-MW-15006													
		Sample Date:				12/10/2015	3/30/2016	5/25/2016	8/24/2016	12/1/2016	2/23/2017	5/18/2017	8/3/2017	9/18/2017	4/11/2018	5/24/2018	11/5/2018	11/5/2018	
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS	downgradient													
Appendix III																			
Boron	ug/L	NC	NA	619	NA	1,070	706	942	979	1,230	1,120	1,420	1,240	1,070	--	1,200	1,340	1,270	
Calcium	mg/L	NC	NA	302	NA	196	130	105	130	79.1	83.9	38.6	39.9	76.8	--	21.9	29.4	29.6	
Chloride	mg/L	250*	NA	2,440	NA	153	152	135	188	128	102	97.1	104	133	--	85.8	87.9	88.3	
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	
Sulfate	mg/L	250*	NA	407	NA	1,320	1,130	917	1,160	886	636	513	547	886	--	401	341	344	
Total Dissolved Solids	mg/L	500*	NA	4,600	NA	2,400	2,100	1,700	2,200	1,800	1,300	1,100	1,110	1,670	--	944	792	784	
pH, Field	SU	6.5 - 8.5*	NA	6.5-7.3	NA	7.4	7.5	7.5	7.6	7.8	7.7	8.1	7.9	7.8	7.9	8.2	7.9	--	
Appendix IV																			
Antimony	ug/L	6	NA	1	6	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	
Arsenic	ug/L	10	NA	21	21	13	19	18	20	20	20	20	14.6	--	18.3	25.7	20.9	19.6	
Barium	ug/L	2,000	NA	1,300	2,000	97	55	44	58	41	30	27	31.0	--	39.6	22.8	38.5	38.3	
Beryllium	ug/L	4	NA	1	4	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	
Cadmium	ug/L	5	NA	0.2	5	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20	< 0.20	
Chromium	ug/L	100	NA	3	100	< 1	1	1	< 1	1	1	2	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	
Cobalt	ug/L	NC	6	15	15	< 15	< 15	< 15	< 15	< 15	< 15	< 15	< 15.0	--	< 15.0	< 15.0	< 6.0	< 6.0	
Fluoride	ug/L	4,000	NA	1,000	4,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	
Lead	ug/L	NC	15	1	15	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	320 ⁽²⁾	< 1.0	< 1.0	
Lithium	ug/L	NC	40	180	180	36.1	20.7	22	22	19	16	16	17	--	18	< 10	< 10	10	
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	23	37	34	36	64	82	68	64.2	--	71.6	48.7	50.3	48.0	
Radium-226	pCi/L	NC	NA	NA	NA	0.392	0.363	0.463	0.286	< 0.362	< 0.307	< 0.354	< 0.945	--	< 0.688	< 0.738	< 0.885	< 1.06	
Radium-228	pCi/L	NC	NA	NA	NA	0.901	0.743	0.501	< 0.578	< 0.421	< 0.562	0.483	< 0.906	--	< 0.755	< 1.12	< 0.649	< 0.897	
Radium-226/228	pCi/L	5	NA	3.32	5	1.293	1.106	0.964	0.748	< 0.421	< 0.562	0.585	< 1.85	--	< 1.44	< 1.86	< 1.53	< 1.96	
Selenium	ug/L	50	NA	2	50	3	2	2	< 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.
 (1) DEK-MW-15001 was decommissioned on April 18, 2018.
 (2) Outlier, single detection above reporting limit.

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

Sample Location:						DEK-MW-18001		
Sample Date:						5/23/2018	8/17/2018	11/6/2018
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS	downgradient		
Appendix III								
Boron	ug/L	NC	NA	619	NA	1,600	1,080	1,020
Calcium	mg/L	NC	NA	302	NA	64.9	47.7	51.1
Chloride	mg/L	250*	NA	2,440	NA	69.1	78.3	76.6
Fluoride	ug/L	4,000	NA	1,000	NA	< 1,000	1000	1,300
Sulfate	mg/L	250*	NA	407	NA	30.6	< 2.0	< 2.0
Total Dissolved Solids	mg/L	500*	NA	4,600	NA	434	356	340
pH, Field	SU	6.5 - 8.5*	NA	6.5-7.3	NA	7.8	7.5	7.5
Appendix IV								
Antimony	ug/L	6	NA	1	6	< 1.0	< 2.0	< 1.0
Arsenic	ug/L	10	NA	21	21	225	146	116
Barium	ug/L	2,000	NA	1,300	2,000	101	82.4	79.5
Beryllium	ug/L	4	NA	1	4	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	5	NA	0.2	5	< 0.20	< 0.20	< 0.20
Chromium	ug/L	100	NA	3	100	< 1.0	< 1.0	< 1.0
Cobalt	ug/L	NC	6	15	15	< 15.0	< 15.0	< 6.0
Fluoride	ug/L	4,000	NA	1,000	4,000	< 1,000	1000	1,300
Lead	ug/L	NC	15	1	15	< 1.0	< 1.0	< 1.0
Lithium	ug/L	NC	40	180	180	23	28	24
Mercury	ug/L	2	NA	0.2	2	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	NC	100	6	100	< 5.0	< 5.0	< 5.0
Radium-226	pCi/L	NC	NA	NA	NA	0.906	< 0.938	< 0.813
Radium-228	pCi/L	NC	NA	NA	NA	< 0.733	< 0.717	0.811
Radium-226/228	pCi/L	5	NA	3.32	5	1.63	< 1.66	1.56
Selenium	ug/L	50	NA	2	50	< 1.0	< 2.0	< 1.0
Thallium	ug/L	2	NA	2	2	< 2.0	< 2.0	< 2.0

Notes:

ug/L - micrograms per liter.
 mg/L - milligrams per liter.
 SU - standard units; pH is a field parameter.
 pCi/L - picocuries per liter.
 NA - not applicable.
 NC - no criteria.
 -- - not analyzed.
 MCL - Maximum Contaminant Level, EPA Drinking Water Standards and Health Advisories, April 2012.
 RSL - Regional Screening Level from 83 FR 36435.
 UTL - Upper Tolerance Limit (95%) of the background data set.
 GWPS - Groundwater Protection Standard. GWPS is the higher of the MCL/RSL and UTL as established in TRC's Technical Memorandum dated October 15, 2018.
 * - Secondary Maximum Contaminant Level (SMCL), EPA Secondary Drinking Water Regulations (SDWR) April 2012.
Bold value indicates an exceedance of the GWPS. Data from downgradient monitoring wells are screened against the GWPS for evaluation purposes only. Confidence intervals will be used to determine compliance per the CCR rules. All metals were analyzed as total unless otherwise specified.
 (1) DEK-MW-15001 was decommissioned on April 18, 2018.
 (2) Outlier; single detection above reporting limit.

Technical Memorandum

Sanitas™ Output Files

Summary Report

Constituent: Antimony, Total Analysis Run 2/20/2019 1:01 PM
Client: Consumers Energy Data: DEK_CCR_Sanitas_19.01.31

For observations made between 12/10/2015 and 11/6/2018, a summary of the selected data set:

Observations = 59
ND/Trace = 59
Wells = 6
Minimum Value = 1
Maximum Value = 2
Mean Value = 1.034
Median Value = 1
Standard Deviation = 0.1825
Coefficient of Variation = 0.1765
Skewness = 5.151

<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>
DEK-MW-15002	11	11	1	1	1	1	0	0	NaN
DEK-MW-15003	12	12	1	2	1.083	1	0.2887	0.2665	3.015
DEK-MW-15004	11	11	1	1	1	1	0	0	NaN
DEK-MW-15005	11	11	1	1	1	1	0	0	NaN
DEK-MW-15006	11	11	1	1	1	1	0	0	NaN
DEK-MW-18001	3	3	1	2	1.333	1	0.5774	0.433	0.7071

Summary Report

Constituent: Arsenic, Total Analysis Run 2/20/2019 1:01 PM
 Client: Consumers Energy Data: DEK_CCR_Sanitas_19.01.31

For observations made between 12/10/2015 and 11/6/2018, a summary of the selected data set:

Observations = 59
 ND/Trace = 0
 Wells = 6
 Minimum Value = 5
 Maximum Value = 543
 Mean Value = 145.6
 Median Value = 67
 Standard Deviation = 173.7
 Coefficient of Variation = 1.193
 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>
DEK-MW-15002	11	0	31.7	118	66.85	62	22.34	0.3341	0.8133
DEK-MW-15003	12	0	372	543	472.8	467	51.13	0.1082	-0.3491
DEK-MW-15004	11	0	56	134	110.1	116	20.96	0.1903	-1.606
DEK-MW-15005	11	0	5	35	24.75	28.7	9.119	0.3684	-1.008
DEK-MW-15006	11	0	13	25.7	18.99	20	3.276	0.1725	0.0256
DEK-MW-18001	3	0	116	225	162.3	146	56.31	0.3469	0.4881

Summary Report

Constituent: Barium, Total Analysis Run 2/20/2019 1:01 PM
Client: Consumers Energy Data: DEK_CCR_Sanitas_19.01.31

For observations made between 12/10/2015 and 11/6/2018, a summary of the selected data set:

Observations = 59
ND/Trace = 0
Wells = 6
Minimum Value = 22.8
Maximum Value = 149
Mean Value = 84.02
Median Value = 83
Standard Deviation = 30.46
Coefficient of Variation = 0.3626
Skewness = 0.03523

<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>
DEK-MW-15002	11	0	71.6	148	112.5	120	25.85	0.2297	-0.2201
DEK-MW-15003	12	0	61.2	96	71.23	69.95	8.483	0.1191	2.165
DEK-MW-15004	11	0	81.1	115	101.6	103	11.04	0.1087	-0.5543
DEK-MW-15005	11	0	55.35	149	90.98	92.2	28.4	0.3122	0.4701
DEK-MW-15006	11	0	22.8	97	43.98	39.6	20.71	0.4709	1.576
DEK-MW-18001	3	0	79.5	101	87.63	82.4	11.67	0.1331	0.6583

Summary Report

Constituent: Beryllium, Total Analysis Run 2/20/2019 1:01 PM
Client: Consumers Energy Data: DEK_CCR_Sanitas_19.01.31

For observations made between 12/10/2015 and 11/6/2018, a summary of the selected data set:

Observations = 59
ND/Trace = 59
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>
DEK-MW-15002	11	11	1	1	1	1	0	0	NaN
DEK-MW-15003	12	12	1	1	1	1	0	0	NaN
DEK-MW-15004	11	11	1	1	1	1	0	0	NaN
DEK-MW-15005	11	11	1	1	1	1	0	0	NaN
DEK-MW-15006	11	11	1	1	1	1	0	0	NaN
DEK-MW-18001	3	3	1	1	1	1	0	0	NaN

Summary Report

Constituent: Cadmium, Total Analysis Run 2/20/2019 1:01 PM
Client: Consumers Energy Data: DEK_CCR_Sanitas_19.01.31

For observations made between 12/10/2015 and 11/6/2018, a summary of the selected data set:

Observations = 59
ND/Trace = 59
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>
DEK-MW-15002	11	11	0.2	0.2	0.2	0.2	0	0	NaN
DEK-MW-15003	12	12	0.2	0.2	0.2	0.2	0	0	NaN
DEK-MW-15004	11	11	0.2	0.2	0.2	0.2	0	0	NaN
DEK-MW-15005	11	11	0.2	0.2	0.2	0.2	0	0	NaN
DEK-MW-15006	11	11	0.2	0.2	0.2	0.2	0	0	NaN
DEK-MW-18001	3	3	0.2	0.2	0.2	0.2	0	0	NaN

Summary Report

Constituent: Chromium, Total Analysis Run 2/20/2019 1:01 PM
 Client: Consumers Energy Data: DEK_CCR_Sanitas_19.01.31

For observations made between 12/10/2015 and 11/6/2018, a summary of the selected data set:

Observations = 59
 ND/Trace = 37
 Wells = 6
 Minimum Value = 1
 Maximum Value = 2
 Mean Value = 1.159
 Median Value = 1
 Standard Deviation = 0.3635
 Coefficient of Variation = 0.3135
 Skewness = 1.87

<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>
DEK-MW-15002	11	4	1	2	1.309	1	0.4592	0.3508	0.8484
DEK-MW-15003	12	8	1	2	1.25	1	0.4523	0.3618	1.155
DEK-MW-15004	11	9	1	2	1.091	1	0.3015	0.2764	2.846
DEK-MW-15005	11	7	1	2	1.091	1	0.3015	0.2764	2.846
DEK-MW-15006	11	6	1	2	1.091	1	0.3015	0.2764	2.846
DEK-MW-18001	3	3	1	1	1	1	0	0	NaN

Summary Report

Constituent: Cobalt, Total Analysis Run 2/20/2019 1:01 PM
 Client: Consumers Energy Data: DEK_CCR_Sanitas_19.01.31

For observations made between 12/10/2015 and 11/6/2018, a summary of the selected data set:

Observations = 59
 ND/Trace = 59
 Wells = 6
 Minimum Value = 6
 Maximum Value = 15
 Mean Value = 14.08
 Median Value = 15
 Standard Deviation = 2.744
 Coefficient of Variation = 0.1948
 Skewness = -2.636

<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>
DEK-MW-15002	11	11	6	15	14.18	15	2.714	0.1913	-2.846
DEK-MW-15003	12	12	6	15	14.25	15	2.598	0.1823	-3.015
DEK-MW-15004	11	11	6	15	14.18	15	2.714	0.1913	-2.846
DEK-MW-15005	11	11	6	15	14.18	15	2.714	0.1913	-2.846
DEK-MW-15006	11	11	6	15	14.18	15	2.714	0.1913	-2.846
DEK-MW-18001	3	3	6	15	12	15	5.196	0.433	-0.7071

Summary Report

Constituent: Fluoride Analysis Run 2/20/2019 1:01 PM
Client: Consumers Energy Data: DEK_CCR_Sanitas_19.01.31

For observations made between 12/10/2015 and 11/6/2018, a summary of the selected data set:

Observations = 64
ND/Trace = 58
Wells = 6
Minimum Value = 1000
Maximum Value = 1550
Mean Value = 1020
Median Value = 1000
Standard Deviation = 82.43
Coefficient of Variation = 0.08085
Skewness = 5.079

<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>
DEK-MW-15002	12	12	1000	1000	1000	1000	0	0	NaN
DEK-MW-15003	13	13	1000	1000	1000	1000	0	0	NaN
DEK-MW-15004	12	8	1000	1550	1079	1000	161.6	0.1498	2.299
DEK-MW-15005	12	12	1000	1000	1000	1000	0	0	NaN
DEK-MW-15006	12	12	1000	1000	1000	1000	0	0	NaN
DEK-MW-18001	3	1	1000	1300	1100	1000	173.2	0.1575	0.7071

Summary Report

Constituent: Lead, Total Analysis Run 2/20/2019 1:01 PM
Client: Consumers Energy Data: DEK_CCR_Sanitas_19.01.31

For observations made between 12/10/2015 and 11/6/2018, a summary of the selected data set:

Observations = 59
ND/Trace = 57
Wells = 6
Minimum Value = 1
Maximum Value = 320
Mean Value = 6.441
Median Value = 1
Standard Deviation = 41.53
Coefficient of Variation = 6.448
Skewness = 7.484

<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>
DEK-MW-15002	11	10	1	3	1.182	1	0.603	0.5102	2.846
DEK-MW-15003	12	12	1	1	1	1	0	0	NaN
DEK-MW-15004	11	11	1	1	1	1	0	0	NaN
DEK-MW-15005	11	11	1	1	1	1	0	0	NaN
DEK-MW-15006	11	10	1	320	30	1	96.18	3.206	2.846
DEK-MW-18001	3	3	1	1	1	1	0	0	NaN

Summary Report

Constituent: Lithium, Total Analysis Run 2/20/2019 1:01 PM
 Client: Consumers Energy Data: DEK_CCR_Sanitas_19.01.31

For observations made between 12/10/2015 and 11/6/2018, a summary of the selected data set:

Observations = 59
 ND/Trace = 1
 Wells = 6
 Minimum Value = 10
 Maximum Value = 53
 Mean Value = 29.92
 Median Value = 30
 Standard Deviation = 9.375
 Coefficient of Variation = 0.3133
 Skewness = 0.06822

<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>
DEK-MW-15002	11	0	32	53	41.79	42	6.263	0.1499	0.2893
DEK-MW-15003	12	0	22.6	39	30.7	31.5	5.22	0.17	-0.2303
DEK-MW-15004	11	0	29.5	39	35.25	36	3.073	0.08716	-0.6046
DEK-MW-15005	11	0	17	30	24.34	24	3.91	0.1606	-0.4224
DEK-MW-15006	11	1	10	36.1	18.8	18	7.056	0.3753	1.146
DEK-MW-18001	3	0	23	28	25	24	2.646	0.1058	0.5952

Summary Report

Constituent: Mercury, Total Analysis Run 2/20/2019 1:01 PM
Client: Consumers Energy Data: DEK_CCR_Sanitas_19.01.31

For observations made between 12/10/2015 and 11/6/2018, a summary of the selected data set:

Observations = 59
ND/Trace = 59
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>
DEK-MW-15002	11	11	0.2	0.2	0.2	0.2	0	0	NaN
DEK-MW-15003	12	12	0.2	0.2	0.2	0.2	0	0	NaN
DEK-MW-15004	11	11	0.2	0.2	0.2	0.2	0	0	NaN
DEK-MW-15005	11	11	0.2	0.2	0.2	0.2	0	0	NaN
DEK-MW-15006	11	11	0.2	0.2	0.2	0.2	0	0	NaN
DEK-MW-18001	3	3	0.2	0.2	0.2	0.2	0	0	NaN

Summary Report

Constituent: Molybdenum, Total Analysis Run 2/20/2019 1:01 PM
 Client: Consumers Energy Data: DEK_CCR_Sanitas_19.01.31

For observations made between 12/10/2015 and 11/6/2018, a summary of the selected data set:

Observations = 59
 ND/Trace = 6
 Wells = 6
 Minimum Value = 5
 Maximum Value = 82
 Mean Value = 28.96
 Median Value = 30
 Standard Deviation = 18.66
 Coefficient of Variation = 0.6443
 Skewness = 0.5427

<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>
DEK-MW-15002	11	1	5	41	28.08	29	9.755	0.3474	-1.074
DEK-MW-15003	12	2	5	8	5.792	5.1	1.191	0.2057	1.124
DEK-MW-15004	11	0	21	32	27.87	29	3.35	0.1202	-0.7631
DEK-MW-15005	11	0	32	45.3	39.17	40	4.263	0.1088	-0.3512
DEK-MW-15006	11	0	23	82	52.51	49.15	18.7	0.356	-0.01555
DEK-MW-18001	3	3	5	5	5	5	0	0	NaN

Summary Report

Constituent: Radium-226 Analysis Run 2/20/2019 1:01 PM
Client: Consumers Energy Data: DEK_CCR_Sanitas_19.01.31

For observations made between 12/10/2015 and 11/6/2018, a summary of the selected data set:

Observations = 59
ND/Trace = 30
Wells = 6
Minimum Value = 0.18
Maximum Value = 1.2
Mean Value = 0.4958
Median Value = 0.367
Standard Deviation = 0.2618
Coefficient of Variation = 0.528
Skewness = 0.7342

<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>
DEK-MW-15002	11	5	0.255	0.854	0.5059	0.478	0.2292	0.4531	0.4254
DEK-MW-15003	12	8	0.184	1.2	0.4454	0.2695	0.3257	0.7313	1.219
DEK-MW-15004	11	4	0.233	0.791	0.437	0.347	0.2092	0.4786	0.6258
DEK-MW-15005	11	4	0.18	0.865	0.4473	0.367	0.2286	0.5111	0.6602
DEK-MW-15006	11	7	0.286	1.06	0.5416	0.392	0.272	0.5022	0.8552
DEK-MW-18001	3	2	0.813	0.938	0.8857	0.906	0.06493	0.07332	-0.5189

Summary Report

Constituent: Radium-226/228 Analysis Run 2/20/2019 1:01 PM
 Client: Consumers Energy Data: DEK_CCR_Sanitas_19.01.31

For observations made between 12/10/2015 and 11/6/2018, a summary of the selected data set:

Observations = 59
 ND/Trace = 24
 Wells = 6
 Minimum Value = 0.34
 Maximum Value = 1.96
 Mean Value = 1.144
 Median Value = 1.219
 Standard Deviation = 0.4634
 Coefficient of Variation = 0.405
 Skewness = -0.1486

<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>
DEK-MW-15002	11	2	0.802	1.88	1.338	1.42	0.3054	0.2283	-0.1939
DEK-MW-15003	12	10	0.34	1.76	0.8889	0.596	0.5326	0.5992	0.4931
DEK-MW-15004	11	3	0.556	1.63	1.097	0.936	0.4297	0.3918	0.01179
DEK-MW-15005	11	2	0.458	1.72	1.129	1.197	0.3881	0.3438	-0.1603
DEK-MW-15006	11	6	0.421	1.96	1.163	1.106	0.561	0.4825	0.1768
DEK-MW-18001	3	1	1.56	1.66	1.617	1.63	0.05132	0.03174	-0.4451

Summary Report

Constituent: Radium-228 Analysis Run 2/20/2019 1:01 PM
Client: Consumers Energy Data: DEK_CCR_Sanitas_19.01.31

For observations made between 12/10/2015 and 11/6/2018, a summary of the selected data set:

Observations = 59
ND/Trace = 28
Wells = 6
Minimum Value = 0.34
Maximum Value = 1.28
Mean Value = 0.7302
Median Value = 0.743
Standard Deviation = 0.2362
Coefficient of Variation = 0.3234
Skewness = 0.3782

<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>
DEK-MW-15002	11	1	0.547	1.26	0.886	0.844	0.2287	0.2582	0.3132
DEK-MW-15003	12	10	0.34	1.12	0.6457	0.596	0.2444	0.3785	0.4695
DEK-MW-15004	11	5	0.396	1.28	0.7009	0.672	0.2509	0.3579	0.9735
DEK-MW-15005	11	3	0.404	1.03	0.7048	0.685	0.2342	0.3323	0.0656
DEK-MW-15006	11	7	0.421	1.12	0.7152	0.743	0.2233	0.3123	0.2996
DEK-MW-18001	3	2	0.717	0.811	0.7537	0.733	0.05029	0.06673	0.6274

Summary Report

Constituent: Selenium, Total Analysis Run 2/20/2019 1:01 PM
 Client: Consumers Energy Data: DEK_CCR_Sanitas_19.01.31

For observations made between 12/10/2015 and 11/6/2018, a summary of the selected data set:

Observations = 59
 ND/Trace = 49
 Wells = 6
 Minimum Value = 1
 Maximum Value = 5
 Mean Value = 1.22
 Median Value = 1
 Standard Deviation = 0.6451
 Coefficient of Variation = 0.5286
 Skewness = 4.043

<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>
DEK-MW-15002	11	10	1	2	1.091	1	0.3015	0.2764	2.846
DEK-MW-15003	12	11	1	5	1.5	1	1.168	0.7785	2.504
DEK-MW-15004	11	10	1	1	1	1	0	0	NaN
DEK-MW-15005	11	9	1	2	1.091	1	0.3015	0.2764	2.846
DEK-MW-15006	11	6	1	3	1.364	1	0.6742	0.4944	1.544
DEK-MW-18001	3	3	1	2	1.333	1	0.5774	0.433	0.7071

Summary Report

Constituent: Thallium, Total Analysis Run 2/20/2019 1:01 PM
Client: Consumers Energy Data: DEK_CCR_Sanitas_19.01.31

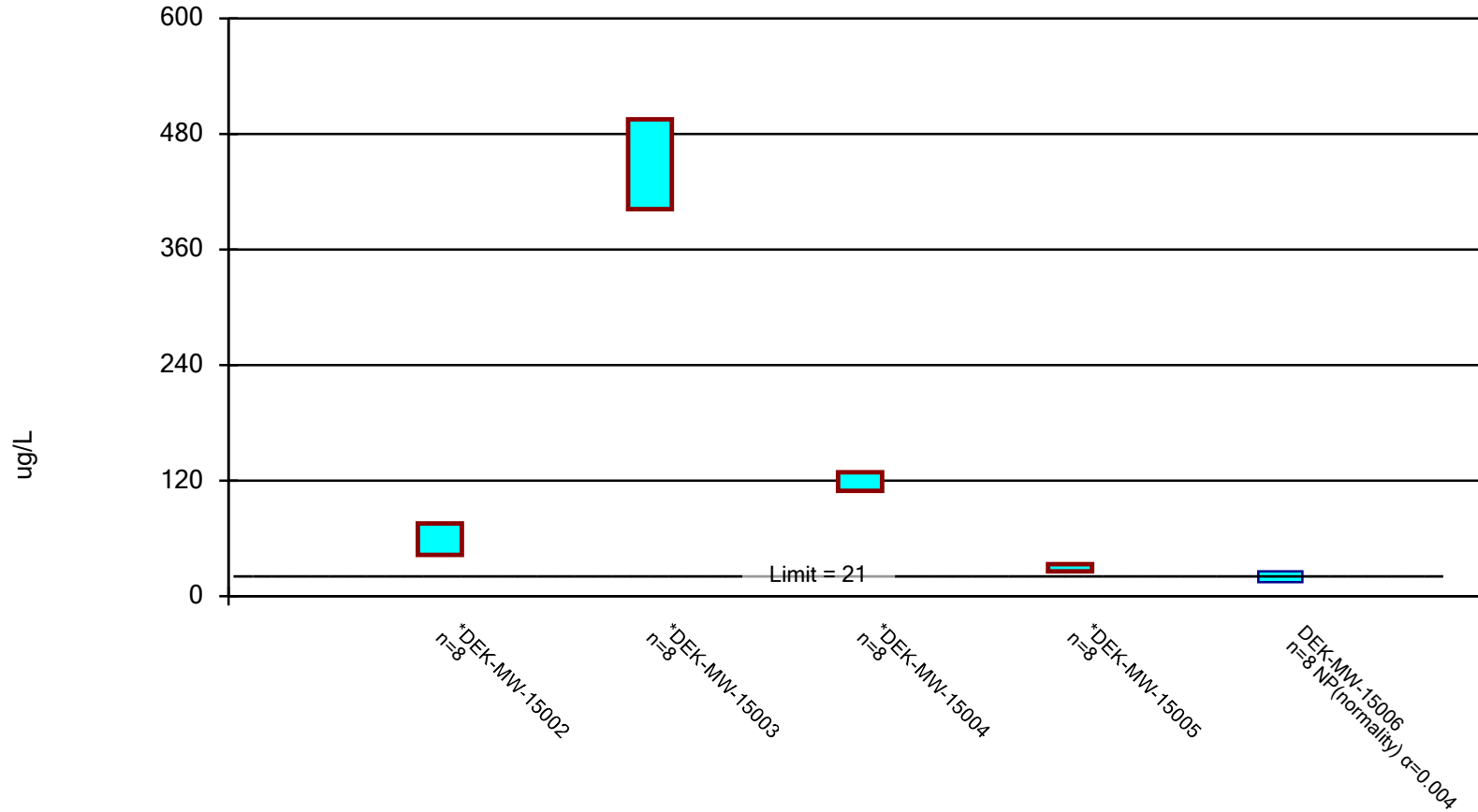
For observations made between 12/10/2015 and 11/6/2018, a summary of the selected data set:

Observations = 59
ND/Trace = 59
Wells = 6
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>
DEK-MW-15002	11	11	2	2	2	2	0	0	NaN
DEK-MW-15003	12	12	2	2	2	2	0	0	NaN
DEK-MW-15004	11	11	2	2	2	2	0	0	NaN
DEK-MW-15005	11	11	2	2	2	2	0	0	NaN
DEK-MW-15006	11	11	2	2	2	2	0	0	NaN
DEK-MW-18001	3	3	2	2	2	2	0	0	NaN

Parametric and Non-Parametric (NP) Confidence Interval

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



Constituent: Arsenic, Total Analysis Run 2/11/2019 1:42 PM
Client: Consumers Energy Data: DEK_CCR_Sanitas_19.01.31

Confidence Interval

Constituent: Arsenic, Total (ug/L) Analysis Run 2/11/2019 1:42 PM

Client: Consumers Energy Data: DEK_CCR_Sanitas_19.01.31

	DEK-MW-15002	DEK-MW-15003	DEK-MW-15004	DEK-MW-15005	DEK-MW-15006
8/24/2016	79		104	23	20
12/1/2016	54	525	117	29	20
2/23/2017	62	372	116	29	20
5/18/2017	76	450	111	28	20
8/3/2017	48.3		125 (D)	31.9	14.6
8/4/2017		437			
4/11/2018				28.7 (D)	18.3
4/12/2018	56.4	478	134		
5/23/2018	67	450	122.5 (D)		
5/24/2018				31.7	25.7
8/16/2018		456			
11/5/2018	31.7				20.25 (D)
11/6/2018		420	123	35	
Mean	59.3	448.5	119.1	29.54	19.86
Std. Dev.	15.37	44.05	9.19	3.515	3.034
Upper Lim.	75.59	495.2	128.8	33.26	25.7
Lower Lim.	43.01	401.8	109.3	25.81	14.6

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-15019
- MW-15008
- MW-15016

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 A.
- 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
CEC DE Karn Lined Impoundment and Bottom Ash Pond**

Groundwater samples were collected by TRC for the April 2019 sampling event. Samples were analyzed for anions, alkalinity, total dissolved solids, and total metals by Eurofins TestAmerica, located in Irvine, California (Eurofins TA - Irvine). The lithium analyses by method SW846 6020 were subcontracted to Eurofins TA in North Canton, Ohio (Eurofins TA – Canton). The radium analyses were subcontracted to Eurofins TA in St. Louis, Missouri (Eurofins TA – St. Louis). The laboratory analytical results were reported in laboratory sample delivery groups (SDGs) 440-238631-1, 440-238639-1, 440-238849-1, 440-238625-1, 440-238626-1, and 440-238846-1.

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

- DEK-MW-15002
- DEK-MW-15003
- DEK-MW-15004
- DEK-MW-15005
- DEK-MW-15006
- DEK-MW-18001
- OW-10
- OW-11
- OW-12
- KLI-SCS

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 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. 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 samples in SDG 440-238849-1 from preparation batch 541899 at a concentration of 0.00349 mg/L. There was no impact on data usability since lead was not detected in the associated samples.
- One equipment blank (EB-01) was collected and analyzed for metals, mercury, Ra-226, and Ra-228; and two field blanks (FB-01 and FB-04) were collected and analyzed for metals and mercury. Target Appendix III and IV analytes were not detected in EB-01 and FB-04.
- The LCS and/or LCSD recoveries for all analytes were within QC limits, except for Ra-226 in LCS 160-427723/1-A associated with samples DEK-MW-18001 and OW-12. The LCS %R (65%) was below the lower acceptance limit of 75%; thus, the Ra-226 results in samples DEK-MW-18001 and OW-12 may be biased low as summarized in the attached table.
- MS and/or MSD analyses were performed on sample OW-10 for metals by SW846 method 6010; on sample OW-12 for metals by SW846 method 6020 and mercury; on sample DEK-MW-18001 for anions, mercury, and metals; and on sample OW-11 for lithium. All recoveries and relative percent differences (RPDs) were within the QC limits
- The field duplicate pair samples were DUP-04 and DEK-MW-15005, and DUP-01 and OW-10; RPDs between the parent and duplicate samples were within the QC limits.
- Laboratory duplicate analyses were performed on sample DEK-MW-18001 for alkalinity and TDS; on sample DEK-MW-15003 for TDS, and on sample OW-11 for alkalinity; RPDs were within QC limits.
- The nondetect RLs for metals by SW846 6020 in sample DEK-MW-15003 exceeded the project-required RLs due to the 5-fold dilution which was performed because of interference from the sample matrix.

Attachment 1

Summary of Data Non-Conformances for DE Karn Groundwater Analytical Data
DEK Bottom Ash Pond and Karn Lined Impoundment – RCRA CCR Monitoring Program
Essexville, Michigan

Samples	Collection Date	Analyte	Non-Conformance/Issue
DEK-MW-18001	4/10/2019	Ra-226	LCS %R (65%) below the lower QC limit of 75%. Results may be biased low.
OW-12	4/9/2019		

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 will be utilized for the purposes of an assessment monitoring program.
- Data are usable for the purposes of the assessment monitoring program.
- When the data are evaluated through an assessment monitoring statistical program, findings below may be used to support the removal of outliers.

QA/QC Sample Summary:

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

- One field blank (FB-5) was collected. The following analytes were detected in this blank sample:
 - Radium-228 and combined radium were detected in field blank FB-05 at concentrations of 0.726 ± 0.358 pCi/L and 0.596 ± 0.369 pCi/L, respectively. The detected radium-228 and combined radium results for select samples associated with this field blank were potentially impacted, as summarized in the attached table, Attachment 1.
- The LCS and/or LCSD recoveries and relative percent differences (RPDs), where applicable, for all analytes were within QC limits.
- MS and MSD analyses were performed on sample MW-15002 for select metals. All recoveries and RPDs were within the QC limits with the following exceptions.
 - The recovery of calcium was outside of the acceptance criteria in the MS analysis. The calcium concentration in this sample was >4x the spike concentration; therefore, the MS/MSD results for calcium were not evaluated. Data usability was not affected.
- 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.
- The combined radium results were < 5 pCi/L; therefore, samples were not selected to undergo the full 21-day wait period prior to radium-226 reporting. There is no impact on data usability.
- Carrier recoveries, where applicable, were within 40-110%.

Attachment 1

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

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

Laboratory Data Quality Review Groundwater Monitoring Event October 2019 CEC DE Karn Bottom Ash Pond

Groundwater samples were collected by TRC for the October 2019 sampling event. Samples were analyzed for lithium, anions, alkalinity, 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) 240-120630-1, 240-120630-2, 240-120631-1, and 240-120631-2.

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

- DEK-MW-15002
- DEK-MW-15003
- DEK-MW-15004
- DEK-MW-15005
- DEK-MW-15006
- DEK-MW-18001

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
Metals	EPA 6020, EPA 6010B, EPA 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 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-04) as collected; no analytes were detected in the field blank sample.
- An equipment blank was not included in the SDGs associated with the Karn Bottom Ash Pond; however, target analytes were not detected in EB-01 (SDG 240-120650-1) collected from the adjacent Karn Lined Impoundment unit during the October 2019 sampling event..
- The LCS and/or LCSD recoveries and relative percent differences (RPDs), where applicable, for all analytes were within QC limits.
- MS/MSD analyses were performed on samples DEK-MW-15002 for mercury and DEK-MW-18001 for metals and anions. All recoveries and relative percent differences (RPDs) were within the QC limits with the following exception.
 - The recoveries of calcium were above the acceptance criteria in the MS/MSD performed on sample DEK-MW-18001. However, the calcium concentration in the parent sample was >4x the spike concentration; therefore, the laboratory control limits for calcium were not applicable. Data usability was not affected.
- The field duplicate pair samples were Dup-04 and DEK-MW-15005; RPDs between the parent and duplicate sample were within the QC limits.
- Laboratory duplicate analyses were performed on samples DEK-MW-15006 for alkalinity and DEK-MW-18001 for alkalinity and TDS; the RPDs were within QC limits.
- The combined radium results were < 5 pCi/L; therefore, samples were not selected to undergo the full 21-day wait period prior to radium-226 reporting. There is no impact on data usability.
- Carrier recoveries, where applicable, were within 40-110%.

Appendix C

Nature and Extent Data

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

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

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										Background											
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^^												
Appendix III																					
Boron	ug/L	NA	500	500	4,000	34,000	69,000	44,000	69,000	244	279	343	300	317	299	293	324	--	225	328	270
Calcium	mg/L	NA	NC	NC	500	NC	NC	NC	NC	150	179	227	154	149	146	165	155	--	128	142	140
Chloride	mg/L	NA	250	250	50	NC	NC	NC	NC	387	408	358	359	379	357	380	438	--	382	415	430
Fluoride	ug/L	4,000	NC	NC	NC	9,700	20,000	NC	NC	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Sulfate	mg/L	NA	250	250	500	NC	NC	NC	NC	51.2	116	195	67.3	54.2	49.5	120	99.7	--	51.6	40.6	46
Total Dissolved Solids	mg/L	NA	500	500	500	NC	NC	NC	NC	1,100	1,300	1,300	1,100	1,200	1,100	1,250	1,200	--	1,080	1,080	1,200
pH, Field	SU	NA	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	NC	NC	NC	NC	6.8	6.7	6.7	6.8	6.8	6.8	6.9	6.9	6.8	6.9	6.9	7.0
Appendix IV																					
Antimony	ug/L	6	6.0	6.0	2.0	1,100	2,300	NC	NC	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	21	10	10	10	340	680	100	680	< 1	1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0
Barium	ug/L	2,000	2,000	2,000	1,200	3,400	7,000	NC	NC	263	269	319	275	289	283	265	--	246	258	281	300
Beryllium	ug/L	4	4.0	4.0	33	300	600	NC	NC	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	
Cadmium	ug/L	5	5.0	5.0	2.5	12	24	NC	NC	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20	< 0.20
Chromium	ug/L	100	100	100	11	16	32	NC	NC	2	2	< 1	< 1	1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0
Cobalt	ug/L	15	40	100	100	370	740	NC	NC	< 15	< 15	< 15	< 15	< 15	< 15.0	--	< 15.0	< 15.0	< 6.0	< 6.0	
Fluoride	ug/L	4,000	NC	NC	NC	10,000	20,000	NC	NC	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Lead	ug/L	15	4.0	4.0	14	250	500	NC	NC	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0
Lithium	ug/L	180	170	350	440	910	1,800	NC	NC	11	14	21	13	13	14	16	--	17	11	17	12
Mercury	ug/L	2	2.0	2.0	0.20#	1.4	2.8	NC	NC	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 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	
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	
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	

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
 DE Karn Lined Impoundment and Bottom Ash Pond – RCRA CCR Monitoring Program
 Essexville, Michigan

Sample Location:										DEK-MW-15001 ⁽⁴⁾								
Sample Date:										3/30/2016	5/26/2016	8/24/2016	12/1/2016	2/23/2017	5/18/2017	8/3/2017	9/18/2017	4/10/2018
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	2,420	3,110	2,810	2,740	2,520	3,270	2,690	2,700	--
Calcium	mg/L	NA	NC	NC	500	NC	NC	NC	NC	87.8	92.2	95	75.1	96.8	85.8	71.8	82.4	--
Chloride	mg/L	NA	250	250	50	NC	NC	NC	NC	79	75.7	72.5	71	76.5	75	81.9	82.2	--
Fluoride	ug/L	4,000	NC	NC	NC	9,700	20,000	NC	NC	1,530	1,440	1,160	1,500	1,650	1,330	1,700	2,100	1,600
Sulfate	mg/L	NA	250	250	500	NC	NC	NC	NC	53.3	64.9	37.4	52.7	53.4	59.9	66.3	36.2	--
Total Dissolved Solids	mg/L	NA	500	500	500	NC	NC	NC	NC	470	510	480	470	450	510	516	594	--
pH, Field	SU	NA	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	NC	NC	NC	NC	7.5	7.5	7.4	7.4	7.4	7.4	7.6	7.5	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	< 1.0	--	< 1.0
Arsenic	ug/L	21 ⁽¹⁾	10	10	10	340	680	100	680	159	138	108	144	133	145	158	--	103
Barium	ug/L	2,000	2,000	2,000	1,200	3,400	7,000	NC	NC	69	73	100	98	91	95	94.2	--	117
Beryllium	ug/L	4	4.0	4.0	33	300	600	NC	NC	< 1	< 1	< 1	< 1	< 1	< 1	< 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
Chromium	ug/L	100	100	100	11	16	32	NC	NC	1	< 1	< 1	< 1	< 1	1	< 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
Fluoride	ug/L	4,000	NC	NC	NC	10,000	20,000	NC	NC	1,530	1,440	1,160	1,500	1,650	1,330	1,700	2,100	1,600
Lead	ug/L	15	4.0	4.0	14	250	500	NC	NC	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0
Lithium	ug/L	180	170	350	440	910	1,800	NC	NC	48.7	51	55	52	48	55	53	--	61
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
Molybdenum	ug/L	100	73	210	120	29,000	58,000	NC	NC	< 5	< 5	< 5	< 5	< 5	< 5.0	--	< 5.0	
Radium-226/228	pCi/L	5	NC	NC	NC	NC	NC	NC	NC	1.56	0.879	< 0.509	< 0.405	1.21	1.29	< 1.70	--	< 1.42
Selenium	ug/L	50	50	50	5.0	62	120	55	120	3	3	1	2	< 1	< 1	< 1.0	--	1.2
Thallium	ug/L	2	2.0	2.0	2.0	47	94	NC	NC	< 2	< 2	< 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.
- * - 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 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 (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018). 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 GSI criteria.

All metals were analyzed as total unless otherwise specified.

- (1) Constituent triggered an Assessment of Corrective Measures for the Karn Bottom Ash Pond as described in TRC's letter report dated January 14, 2019.
- (2) Outlier; single detection above reporting limit.
- (3) Laboratory reporting limit exceeds one or more applicable criteria due to sample dilutions.
- (4) DEK-MW-15001 was decommissioned on April 18, 2018 due to the installation of the new Karn Lined Impoundment.
- (5) Anomalous result; not confirmed by subsequent sampling event.

Table 2
 Summary of Groundwater Sampling Results (Analytical): March 2016 - April 2019
 DE Karn Lined Impoundment and Bottom Ash Pond – RCRA CCR Monitoring Program
 Essexville, Michigan

Sample Location:										DEK-MW-15002											
Sample Date:										3/30/2016	5/26/2016	8/24/2016	12/1/2016	2/23/2017	5/18/2017	8/3/2017	9/18/2017	4/12/2018	5/23/2018	11/5/2018	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	676	668	746	893	858	824	805	870	--	967	894	860
Calcium	mg/L	NA	NC	NC	500	NC	NC	NC	NC	119	99.6	105	94.8	149	80.1	71.1	66.9	--	53.7	67.8	72
Chloride	mg/L	NA	250	250	50	NC	NC	NC	NC	97.6	90	89.2	86.1	88.2	80.5	87.8	84.9	--	79.7	83.5	80
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	418	291	384	326	289	299	256	290	--	263	77.2	45
Total Dissolved Solids	mg/L	NA	500	500	500	NC	NC	NC	NC	890	800	1,700	810	810	1,500	696	722	--	660	536	560
pH, Field	SU	NA	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	NC	NC	NC	NC	7.5	7.6	7.5	7.6	7.5	7.5	7.8	7.9	7.5	8.0	7.3	7.5
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 ⁽¹⁾	10	10	10	340	680	100	680	118	82	79	54	62	76	48.3	--	56.4	67.0	31.7	9.0
Barium	ug/L	2,000	2,000	2,000	1,200	3,400	7,000	NC	NC	148	136	131	121	120	107	96.1	--	82.7	84.5	71.6	71
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	< 0.2	< 0.2	--	< 0.20	< 0.20	< 0.20	< 0.20
Chromium	ug/L	100	100	100	11	16	32	NC	NC	2	1	< 1	1	2	2	< 1.0	--	< 1.0	< 1.0	1.4	1.3
Cobalt	ug/L	15	40	100	100	370	740	NC	NC	< 15	< 15	< 15	< 15	< 15	< 15.0	< 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	3	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0
Lithium	ug/L	180	170	350	440	910	1,800	NC	NC	53	43	44	40	41	42	36	--	43	35	32	26
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	30	29	41	26	27	38	27.7	--	30.8	35.4	< 5.0	< 5.0
Radium-226/228	pCi/L	5	NC	NC	NC	NC	NC	NC	NC	0.946	1.57	1.42	0.802	1.52	1.25	1.88	--	1.42	< 1.44	< 1.39	--
Selenium	ug/L	50	50	50	5.0	62	120	55	120	< 1	2	< 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 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 (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018). 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 GSI criteria.

All metals were analyzed as total unless otherwise specified.
 (1) Constituent triggered an Assessment of Corrective Measures for the Karn Bottom Ash Pond as described in TRC's letter report dated January 14, 2019.
 (2) Outlier; single detection above reporting limit.
 (3) Laboratory reporting limit exceeds one or more applicable criteria due to sample dilutions.
 (4) DEK-MW-15001 was decommissioned on April 18, 2018 due to the installation of the new Karn Lined Impoundment.
 (5) Anomalous result; not confirmed by subsequent sampling event.

Table 2
 Summary of Groundwater Sampling Results (Analytical): March 2016 - April 2019
 DE Karn Lined Impoundment and Bottom Ash Pond – RCRA CCR Monitoring Program
 Essexville, Michigan

Sample Location:										DEK-MW-15003													
Sample Date:										3/30/2016	5/26/2016	8/24/2016	12/1/2016	2/23/2017	5/18/2017	8/4/2017	9/18/2017	4/12/2018	5/23/2018	8/16/2018	11/6/2018	2/18/2019	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	920	982	1,010	1,140	1,090	1,270	1,160	1,030	--	1,010	913	944	1,100	960
Calcium	mg/L	NA	NC	NC	500	NC	NC	NC	NC	57.3	56.3	64.1	64.1	85.4	68.2	58.8	62.1	--	58.1	59.1	62.9	58	52
Chloride	mg/L	NA	250	250	50	NC	NC	NC	NC	62	61.2	59.8	54.8	56.3	54.9	61.7	60.2	--	57.2	59.4	61.7	53	58
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	< 1,000	< 1,000
Sulfate	mg/L	NA	250	250	500	NC	NC	NC	NC	71.6	75.7	76.8	71.9	64.5	57.6	55.8	54.3	--	39.1	38.0	37.8	34	47
Total Dissolved Solids	mg/L	NA	500	500	500	NC	NC	NC	NC	400	420	430	440	430	420	506	426	--	354	374	370	370	360
pH, Field	SU	NA	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	NC	NC	NC	NC	7.8	7.9	7.7	7.8	7.7	7.8	7.9	7.9	7.8	8.2	7.9	8.0	8.7	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	< 2.0	< 1.0	< 2.0	< 5.0
Arsenic	ug/L	21 ⁽¹⁾	10	10	10	340	680	100	680	517	543	527	525	372	450	437	--	478	450	456	420	330	380
Barium	ug/L	2,000	2,000	2,000	1,200	3,400	7,000	NC	NC	69	68	73	71	71	66	68.5	--	61.2	73.3	66.8	70.9	65	62
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	< 2.0	< 5.0 ⁽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	< 0.20	< 0.20	< 0.40	< 1.0
Chromium	ug/L	100	100	100	11	16	32	NC	NC	2	2	< 1	< 1	< 1	1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	2.2	< 5.0
Cobalt	ug/L	15	40	100	100	370	740	NC	NC	< 15	< 15	< 15	< 15	< 15	< 15	< 15.0	--	< 15.0	< 15.0	< 15.0	< 6.0	< 12	< 30
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	< 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	< 2.0	< 5.0 ⁽³⁾
Lithium	ug/L	180	170	350	440	910	1,800	NC	NC	22.6	26	27	30	30	35	35	--	39	33	35	33	34	28
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	< 0.20	< 0.20
Molybdenum	ug/L	100	73	210	120	29,000	58,000	NC	NC	7	8	6	5	5	5	5.0	--	< 5.0	5.3	< 5.0	5.2	< 10	< 25
Radium-226/228	pCi/L	5	NC	NC	NC	NC	NC	NC	NC	< 0.52	< 0.546	0.469	< 0.363	< 0.34	< 0.646	< 1.14	--	< 1.33	1.63	< 1.76	< 1.45	< 0.416	--
Selenium	ug/L	50	50	50	5.0	62	120	55	120	< 1	2	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 2.0	< 1.0	< 2.0	< 5.0
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	< 4.0 ⁽³⁾	< 10 ⁽³⁾

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 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 (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018). 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 GSI criteria.

All metals were analyzed as total unless otherwise specified.
 (1) Constituent triggered an Assessment of Corrective Measures for the Karn Bottom Ash Pond as described in TRC's letter report dated January 14, 2019.
 (2) Outlier; single detection above reporting limit.
 (3) Laboratory reporting limit exceeds one or more applicable criteria due to sample dilutions.
 (4) DEK-MW-15001 was decommissioned on April 18, 2018 due to the installation of the new Karn Lined Impoundment.
 (5) Anomalous result; not confirmed by subsequent sampling event.

Table 2
 Summary of Groundwater Sampling Results (Analytical): March 2016 - April 2019
 DE Karn Lined Impoundment and Bottom Ash Pond – RCRA CCR Monitoring Program
 Essexville, Michigan

Sample Location:										DEK-MW-15004											
Sample Date:										3/30/2016	5/26/2016	8/24/2016	12/1/2016	2/23/2017	5/18/2017	8/3/2017	9/19/2017	4/12/2018	5/23/2018	11/6/2018	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	435	514	472	535	637	839	785	730	--	800	910	840
Calcium	mg/L	NA	NC	NC	500	NC	NC	NC	NC	68.3	71.1	78.9	73	108	74.2	67.4	66.5	--	47.8	62.2	50
Chloride	mg/L	NA	250	250	50	NC	NC	NC	NC	72.7	72.3	77.4	73.3	75.3	70.3	81.4	79.8	--	72.5	70.6	63
Fluoride	ug/L	4,000	NC	NC	NC	9,700	20,000	NC	NC	< 1,000	< 1,000	1,550	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	1,200	1,100	1,100	1,100
Sulfate	mg/L	NA	250	250	500	NC	NC	NC	NC	188	184	198	215	211	220	258	283	--	176	168	150
Total Dissolved Solids	mg/L	NA	500	500	500	NC	NC	NC	NC	560	560	580	590	580	590	642	596	--	494	482	490
pH, Field	SU	NA	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	NC	NC	NC	NC	7.7	7.4	7.4	7.5	7.5	7.5	7.6	7.3	7.3	7.7	7.4	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	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	21 ⁽¹⁾	10	10	10	340	680	100	680	95	108	104	117	116	111	121	--	134	119	123	110
Barium	ug/L	2,000	2,000	2,000	1,200	3,400	7,000	NC	NC	94	102	110	115	110	103	111	--	86.9	79.6	95.1	77
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	< 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	1,550	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	1,200	1,100	1,100	1,100
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	29.5	36	34	37	36	38	39	--	39	30	33	26
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	25	21	24	27	30	29	30.4	--	32.0	30.9	28.0	23
Radium-226/228	pCi/L	5	NC	NC	NC	NC	NC	NC	NC	0.932	0.760	0.936	0.588	0.665	1.63	1.64	--	< 1.49	< 1.54	< 1.54	--
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 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 (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018). 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 GSI criteria.

All metals were analyzed as total unless otherwise specified.
 (1) Constituent triggered an Assessment of Corrective Measures for the Karn Bottom Ash Pond as described in TRC's letter report dated January 14, 2019.
 (2) Outlier; single detection above reporting limit.
 (3) Laboratory reporting limit exceeds one or more applicable criteria due to sample dilutions.
 (4) DEK-MW-15001 was decommissioned on April 18, 2018 due to the installation of the new Karn Lined Impoundment.
 (5) Anomalous result; not confirmed by subsequent sampling event.

Table 2
 Summary of Groundwater Sampling Results (Analytical): March 2016 - April 2019
 DE Karn Lined Impoundment and Bottom Ash Pond – RCRA CCR Monitoring Program
 Essexville, Michigan

Sample Location:										DEK-MW-15005											
Sample Date:										3/30/2016	5/26/2016	8/24/2016	12/1/2016	2/23/2017	5/18/2017	8/3/2017	9/18/2017	4/11/2018	5/24/2018	11/6/2018	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	396	465	589	687	712	788	792	714	--	806	947	910
Calcium	mg/L	NA	NC	NC	500	NC	NC	NC	NC	68.6	72.7	98.4	71.1	76.3	55	49.2	44.3	--	33.4	32.9	31
Chloride	mg/L	NA	250	250	50	NC	NC	NC	NC	82.6	82.3	93.9	80.1	77.5	73.3	81.4	79.3	--	72.6	69.1	60
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	251	269	355	329	281	263	300	273	--	182	160	140
Total Dissolved Solids	mg/L	NA	500	500	500	NC	NC	NC	NC	660	660	810	740	680	650	732	638	--	524	474	470
pH, Field	SU	NA	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	NC	NC	NC	NC	7.7	7.5	7.6	7.7	7.7	7.6	7.9	7.9	--	7.7	7.8	7.9
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 ⁽¹⁾	10	10	10	340	680	100	680	15	16	23	29	29	28	31.9	--	28.3	31.7	35.0	24
Barium	ug/L	2,000	2,000	2,000	1,200	3,400	7,000	NC	NC	94	104	149	120	101	83	92.2	--	54.9	58.5	56.7	46
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	1	2	< 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	23	29	30	26	23	26	27	--	24	19	17	15
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	33	32	37	44	40	36	41.9	--	39.0	41.9	45.3	39
Radium-226/228	pCi/L	5	NC	NC	NC	NC	NC	NC	NC	0.686	0.458	1.22	0.917	0.940	0.875	1.72	--	< 1.34	< 1.53	< 1.46	--
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 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 (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018). 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 GSI criteria.

All metals were analyzed as total unless otherwise specified.
 (1) Constituent triggered an Assessment of Corrective Measures for the Karn Bottom Ash Pond as described in TRC's letter report dated January 14, 2019.
 (2) Outlier; single detection above reporting limit.
 (3) Laboratory reporting limit exceeds one or more applicable criteria due to sample dilutions.
 (4) DEK-MW-15001 was decommissioned on April 18, 2018 due to the installation of the new Karn Lined Impoundment.
 (5) Anomalous result; not confirmed by subsequent sampling event.

Table 2
 Summary of Groundwater Sampling Results (Analytical): March 2016 - April 2019
 DE Karn Lined Impoundment and Bottom Ash Pond – RCRA CCR Monitoring Program
 Essexville, Michigan

Sample Location:										DEK-MW-15006											
Sample Date:										3/30/2016	5/25/2016	8/24/2016	12/1/2016	2/23/2017	5/18/2017	8/3/2017	9/18/2017	4/11/2018	5/24/2018	11/5/2018	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	706	942	979	1,230	1,120	1,420	1,240	1,070	--	1,200	1,340	1,700
Calcium	mg/L	NA	NC	NC	500	NC	NC	NC	NC	130	105	130	79.1	83.9	38.6	39.9	76.8	--	21.9	29.4	35
Chloride	mg/L	NA	250	250	50	NC	NC	NC	NC	152	135	188	128	102	97.1	104	133	--	85.8	87.9	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	1,130	917	1,160	886	636	513	547	886	--	401	341	320
Total Dissolved Solids	mg/L	NA	500	500	500	NC	NC	NC	NC	2,100	1,700	2,200	1,800	1,300	1,100	1,110	1,670	--	944	792	780
pH, Field	SU	NA	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	NC	NC	NC	NC	7.5	7.5	7.6	7.8	7.7	8.1	7.9	7.8	7.9	8.2	7.9	7.8
Appendix IV																					
Antimony	ug/L	6	6.0	6.0	2.0	1,100	2,300	NC	NC	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	21 ⁽¹⁾	10	10	10	340	680	100	680	19	18	20	20	20	20	14.6	--	18.3	25.7	20.9	21
Barium	ug/L	2,000	2,000	2,000	1,200	3,400	7,000	NC	NC	55	44	58	41	30	27	31.0	--	39.6	22.8	38.5	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	1	2	< 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	320 ⁽²⁾	< 1.0	< 1.0
Lithium	ug/L	180	170	350	440	910	1,800	NC	NC	20.7	22	22	19	16	16	17	--	18	< 10	< 10	< 10
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	37	34	36	64	82	68	64.2	--	71.6	48.7	50.3	59
Radium-226/228	pCi/L	5	NC	NC	NC	NC	NC	NC	NC	1.11	0.964	0.748	< 0.421	< 0.562	0.585	< 1.85	--	< 1.44	< 1.86	< 1.53	--
Selenium	ug/L	50	50	50	5.0	62	120	55	120	2	2	< 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.
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 ^ - 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 (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018). 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 GSI criteria.

All metals were analyzed as total unless otherwise specified.
 (1) Constituent triggered an Assessment of Corrective Measures for the Karn Bottom Ash Pond as described in TRC's letter report dated January 14, 2019.
 (2) Outlier; single detection above reporting limit.
 (3) Laboratory reporting limit exceeds one or more applicable criteria due to sample dilutions.
 (4) DEK-MW-15001 was decommissioned on April 18, 2018 due to the installation of the new Karn Lined Impoundment.
 (5) Anomalous result; not confirmed by subsequent sampling event.

Table 2
 Summary of Groundwater Sampling Results (Analytical): March 2016 - April 2019
 DE Karn Lined Impoundment and Bottom Ash Pond – RCRA CCR Monitoring Program
 Essexville, Michigan

Constituent	Unit	GWPS*	MI Residential**	MI Non-Residential**	MI GSI^	MI AMV***	MI FAV***	Chronic MZ^^	Acute MZ^^	Sample Location: Sample Date:					OW-10									
										DEK-MW-18001					8/16/2018	11/6/2018	2/18/2019	4/10/2019	8/16/2018	11/6/2018	2/18/2019	4/10/2019		
										downgradient					downgradient									
Appendix III																								
Boron	ug/L	NA	500	500	4,000	34,000	69,000	44,000	69,000	1,600	1,080	1,020	1,000	970	1,340	1,410	1,400	1,300						
Calcium	mg/L	NA	NC	NC	500	NC	NC	NC	NC	64.9	47.7	51.1	51	48	82.6	77.9	82	84						
Chloride	mg/L	NA	250	250	50	NC	NC	NC	NC	69.1	78.3	76.6	72	69	79.0	83.6	79	69						
Fluoride	ug/L	4,000	NC	NC	NC	9,700	20,000	NC	NC	< 1,000	1,000	1,300	1,100	1,200	< 1,000	< 1,000	< 1,000	< 1,000						
Sulfate	mg/L	NA	250	250	500	NC	NC	NC	NC	30.6	< 2.0	< 2.0	< 2.0	< 2.0	10.3	< 2.0	4.1	8.2						
Total Dissolved Solids	mg/L	NA	500	500	500	NC	NC	NC	NC	434	356	340	350	360	464	492	470	490						
pH, Field	SU	NA	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	NC	NC	NC	NC	7.8	7.5	7.5	7.9	7.2	7.4	7.4	7.8	7.2						
Appendix IV																								
Antimony	ug/L	6	6.0	6.0	2.0	1,100	2,300	NC	NC	< 1.0	< 2.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	< 1.0	< 1.0						
Arsenic	ug/L	21 ⁽¹⁾	10	10	10	340	680	100	680	225	146	116	86	68	10.6	10.6	7.6	6.3						
Barium	ug/L	2,000	2,000	2,000	1,200	3,400	7,000	NC	NC	101	82.4	79.5	85	75	113	93.0	100	110						
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							
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							
Chromium	ug/L	100	100	100	11	16	32	NC	NC	< 1.0	< 1.0	< 1.0	6.9	< 1.0	1.1	< 1.0	2.9							
Cobalt	ug/L	15	40	100	100	370	740	NC	NC	< 15.0	< 15.0	< 6.0	< 6.0	< 6.0	< 15.0	< 6.0	< 6.0							
Fluoride	ug/L	4,000	NC	NC	NC	10,000	20,000	NC	NC	< 1,000	1,000	1,300	1,100	1,200	< 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	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0							
Lithium	ug/L	180	170	350	440	910	1,800	NC	NC	23	28	24	25	24	35	31	32	30						
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							
Molybdenum	ug/L	100	73	210	120	29,000	58,000	NC	NC	< 5.0	< 5.0	< 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	1.63	< 1.66	1.56	0.757	--	< 1.78	< 1.40	< 0.493	--						
Selenium	ug/L	50	50	50	5.0	62	120	55	120	< 1.0	< 2.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	< 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	< 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.
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- * - 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 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}
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- ^^ - 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 GSI criteria.

- All metals were analyzed as total unless otherwise specified.
- (1) Constituent triggered an Assessment of Corrective Measures for the Karn Bottom Ash Pond as described in TRC's letter report dated January 14, 2019.
- (2) Outlier; single detection above reporting limit.
- (3) Laboratory reporting limit exceeds one or more applicable criteria due to sample dilutions.
- (4) DEK-MW-15001 was decommissioned on April 18, 2018 due to the installation of the new Karn Lined Impoundment.
- (5) Anomalous result; not confirmed by subsequent sampling event.

Table 2
 Summary of Groundwater Sampling Results (Analytical): March 2016 - April 2019
 DE Karn Lined Impoundment and Bottom Ash Pond – RCRA CCR Monitoring Program
 Essexville, Michigan

Constituent	Unit	GWPS*	MI Residential**	MI Non-Residential**	MI GSI^	MI AMV***	MI FAV***	Chronic MZ^^	Acute MZ^^	Sample Location: Sample Date:				OW-12				
										8/16/2018	11/6/2018	2/19/2019	4/11/2019	4/19/2018	8/16/2018	11/7/2018	2/19/2019	4/9/2019
										OW-11				OW-12				
										downgradient				downgradient				
Appendix III																		
Boron	ug/L	NA	500	500	4,000	34,000	69,000	44,000	69,000	2,370	2,560	2,500	2,400	985	748	994	680	640
Calcium	mg/L	NA	NC	NC	500	NC	NC	NC	NC	84.5	67.2	43	38	26.6	39.5	61.1	47	40
Chloride	mg/L	NA	250	250	50	NC	NC	NC	NC	102	100	92	90	66.0	59.6	68.8	64	64
Fluoride	ug/L	4,000	NC	NC	NC	9,700	20,000	NC	NC	1,100	1,600	2,200	2,400	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Sulfate	mg/L	NA	250	250	500	NC	NC	NC	NC	177	118	81	72	98.3	91.8	114	77	69
Total Dissolved Solids	mg/L	NA	500	500	500	NC	NC	NC	NC	608	516	370	350	570	372	464	400	390
pH, Field	SU	NA	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	NC	NC	NC	NC	8.4	8.6	9.1	8.7	7.4	7.5	7.4	7.6	7.8
Appendix IV																		
Antimony	ug/L	6	6.0	6.0	2.0	1,100	2,300	NC	NC	2.3	1.8	4.1	2.5	< 1.0	< 2.0	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	21 ⁽¹⁾	10	10	10	340	680	100	680	446	486	350	380	23.5	25.3	24.4	22	19
Barium	ug/L	2,000	2,000	2,000	1,200	3,400	7,000	NC	NC	252	192	130	120	38.6	49.7	67.0	65	56
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
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
Chromium	ug/L	100	100	100	11	16	32	NC	NC	< 1.0	< 1.0	1.2	< 1.0	< 1.0	< 1.0	< 1.0	24⁽⁵⁾	< 1.0
Cobalt	ug/L	15	40	100	100	370	740	NC	NC	< 15.0	< 6.0	< 6.0	< 6.0	< 15.0	< 15.0	< 6.0	< 6.0	< 6.0
Fluoride	ug/L	4,000	NC	NC	NC	10,000	20,000	NC	NC	1,100	1,600	2,200	2,400	< 1,000	< 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	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lithium	ug/L	180	170	350	440	910	1,800	NC	NC	48	40	29	26	27	27	40	32	27
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
Molybdenum	ug/L	100	73	210	120	29,000	58,000	NC	NC	562	550	640	590	17.9	20.6	15.3	19	15
Radium-226/228	pCi/L	5	NC	NC	NC	NC	NC	NC	NC	< 1.52	< 1.55	< 0.403	--	--	< 1.95	< 1.39	< 0.448	--
Selenium	ug/L	50	50	50	5.0	62	120	55	120	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	< 1.0	< 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	< 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 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 (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018). 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 GSI criteria.

- All metals were analyzed as total unless otherwise specified.
- (1) Constituent triggered an Assessment of Corrective Measures for the Karn Bottom Ash Pond as described in TRC's letter report dated January 14, 2019.
 - (2) Outlier; single detection above reporting limit.
 - (3) Laboratory reporting limit exceeds one or more applicable criteria due to sample dilutions.
 - (4) DEK-MW-15001 was decommissioned on April 18, 2018 due to the installation of the new Karn Lined Impoundment.
 - (5) Anomalous result; not confirmed by subsequent sampling event.

Table 3
 Summary of Groundwater Sampling Results (Analytical): March 2016 - April 2019
 DE Karn Landfill HMP Monitoring Wells
 Essexville, Michigan

Sample Location:										MW-01														
Sample Date:										3/16/2016	5/12/2016	8/11/2016	10/19/2016	2/28/2017	5/10/2017	8/9/2017	11/2/2017	3/7/2018	5/14/2018	8/16/2018	10/23/2018	3/13/2019		
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	6,600	6,330	6,170	7,000	6,670	6,790	6,370	6,350	6,010	6,010	6,020	5,320	5,960		
Calcium	mg/L	NA	NC	NC	500	NC	NC	NC	NC	--	--	--	--	--	--	--	--	90.6	86.6	86.1	80.2	83.5		
Chloride	mg/L	NA	250	250	50	NC	NC	NC	NC	--	--	--	--	--	--	--	--	--	83.1	76	81	74		
Fluoride	ug/L	4,000	NC	NC	NC	9,700	20,000	NC	NC	--	--	--	--	--	--	--	--	--	1,370	--	--	--		
Sulfate	mg/L	NA	250	250	500	NC	NC	NC	NC	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 2	< 2	< 2	< 2		
Total Dissolved Solids	mg/L	NA	500	500	500	NC	NC	NC	NC	--	--	--	--	--	--	--	--	--	420	--	--	--		
pH, Field	su	NA	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	NC	NC	NC	NC	8.2	8.2	8.3	8.3	8.0	8.3	8.2	8.6	8.4	8.2	8.6	8.6	8.3		
Appendix IV																								
Antimony	ug/L	6	6.0	6.0	2.0	1,100	2,300	NC	NC	--	--	--	--	--	--	--	--	--	< 1	--	--	--		
Arsenic	ug/L	21 ⁽¹⁾	10	10	10	340	680	100	680	8	8	8	9	9	10	8	10	7	8	9	8	8		
Barium	ug/L	2,000	2,000	2,000	1,200	3,400	7,000	NC	NC	--	--	--	--	--	--	--	--	--	46	--	--	--		
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	2	2	2	1	2	2	2	1	1	1	2	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	--	--	--	--	--	--	--	--	--	1,370	--	--	--		
Lead	ug/L	15	4.0	4.0	14	250	500	NC	NC	--	--	--	--	--	--	--	--	--	< 1	--	--	--		
Lithium	ug/L	180	170	350	440	910	1,800	NC	NC	108	106	103	106	104	107	100	99	87	94	90	95	87		
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	2	2	2	< 1	1	< 1	2	1	< 1	1	1	2	< 1		
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 (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018). 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 GSI criteria.

All metals were analyzed as total unless otherwise specified.

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

Table 3
 Summary of Groundwater Sampling Results (Analytical): March 2016 - April 2019
 DE Karn Landfill HMP Monitoring Wells
 Essexville, Michigan

Sample Location:										MW-03														
Sample Date:										3/17/2016	5/12/2016	8/11/2016	10/19/2016	2/28/2017	5/10/2017	8/9/2017	11/2/2017	3/7/2018	5/15/2018	8/16/2018	10/23/2018	3/13/2019		
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	7,220	7,080	8,130	9,400	9,920	11,100	9,630	10,600	9,000	7,480	7,210	7,710	8,670		
Calcium	mg/L	NA	NC	NC	500	NC	NC	NC	NC	--	--	--	--	--	--	--	--	135	111	112	116	121		
Chloride	mg/L	NA	250	250	50	NC	NC	NC	NC	--	--	--	--	--	--	--	--	--	80.5	71	76	65		
Fluoride	ug/L	4,000	NC	NC	NC	9,700	20,000	NC	NC	--	--	--	--	--	--	--	--	--	1,050	--	--	--		
Sulfate	mg/L	NA	250	250	500	NC	NC	NC	NC	18	18	< 1	< 1	1.6	< 1	7.5	3.3	78	30.3	28	24	9		
Total Dissolved Solids	mg/L	NA	500	500	500	NC	NC	NC	NC	--	--	--	--	--	--	--	--	--	520	--	--	--		
pH, Field	su	NA	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	NC	NC	NC	NC	8.6	8.6	8.0	8.1	7.7	8.2	8.6	8.2	7.6	7.8	8.4	8.2	7.7		
Appendix IV																								
Antimony	ug/L	6	6.0	6.0	2.0	1,100	2,300	NC	NC	--	--	--	--	--	--	--	--	--	< 1	--	--	--		
Arsenic	ug/L	21 ⁽¹⁾	10	10	10	340	680	100	680	5	5	3	2	2	3	4	4	3	5	8	4	5		
Barium	ug/L	2,000	2,000	2,000	1,200	3,400	7,000	NC	NC	--	--	--	--	--	--	--	--	--	152	--	--	--		
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	5	2	2	3	3	2	3	4	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	--	--	--	--	--	--	--	--	--	1,050	--	--	--		
Lead	ug/L	15	4.0	4.0	14	250	500	NC	NC	--	--	--	--	--	--	--	--	--	< 1	--	--	--		
Lithium	ug/L	180	170	350	440	910	1,800	NC	NC	93	94	101	100	98	96	90	92	97	89	93	93	97		
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	7	5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	5	10	5	< 5		
Selenium	ug/L	50	50	50	5.0	62	120	55	120	2	2	2	< 1	1	< 1	1	< 1	< 1	1	1	2	1		
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 (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018). 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 GSI criteria.

All metals were analyzed as total unless otherwise specified.

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

Table 3
 Summary of Groundwater Sampling Results (Analytical): March 2016 - April 2019
 DE Karn Landfill HMP Monitoring Wells
 Essexville, Michigan

Sample Location:										MW-06														
Sample Date:										3/16/2016	5/12/2016	8/11/2016	10/19/2016	2/28/2017	5/10/2017	8/9/2017	11/2/2017	3/7/2018	5/15/2018	8/15/2018	10/23/2018	3/13/2019		
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	5,170	4,590	3,350	3,530	3,110	4,030	3,190	1,740	2,170	2,180	1,970	1,540	1,260		
Calcium	mg/L	NA	NC	NC	500	NC	NC	NC	NC	--	--	--	--	--	--	--	--	334	355	215	178	188		
Chloride	mg/L	NA	250	250	50	NC	NC	NC	NC	--	--	--	--	--	--	--	--	46	54	44	31	19		
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	600	880	310	330	600	960	400	350	630	844	400	300	250		
Total Dissolved Solids	mg/L	NA	500	500	500	NC	NC	NC	NC	--	--	--	--	--	--	--	--	--	1,700	--	--	--		
pH, Field	su	NA	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	NC	NC	NC	NC	6.9	6.8	7.4	7.3	6.9	6.9	7.1	7.3	7.0	7.1	7.4	7.5	7.2		
Appendix IV																								
Antimony	ug/L	6	6.0	6.0	2.0	1,100	2,300	NC	NC	--	--	--	--	--	--	--	--	--	< 1	--	--	--		
Arsenic	ug/L	21 ⁽¹⁾	10	10	10	340	680	100	680	239	274	273	280	190	141	232	319	161	135	281	301	164		
Barium	ug/L	2,000	2,000	2,000	1,200	3,400	7,000	NC	NC	--	--	--	--	--	--	--	--	--	157	--	--	--		
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	2	2	1	< 1	2	2	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	--	--	--		
Lithium	ug/L	180	170	350	440	910	1,800	NC	NC	147	150	128	113	130	134	116	85	106	101	78	67	50		
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	31	29	< 5	< 5	21	20	< 5	< 5	16	17	< 5		
Selenium	ug/L	50	50	50	5.0	62	120	55	120	1	2	3	< 1	2	1	2	< 1	< 1	< 1	< 1	< 1	< 1		
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 (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018). 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 GSI criteria.

 All metals were analyzed as total unless otherwise specified.
 (1) Constituent triggered an Assessment of Corrective Measures for the Karn Bottom Ash Pond as described in TRC's letter report dated January 14, 2019.

Table 3
 Summary of Groundwater Sampling Results (Analytical): March 2016 - April 2019
 DE Karn Landfill HMP Monitoring Wells
 Essexville, Michigan

Sample Location:										MW-08														
Sample Date:										3/16/2016	5/11/2016	8/11/2016	10/19/2016	2/27/2017	5/10/2017	8/9/2017	11/2/2017	3/7/2018	5/15/2018	8/15/2018	10/23/2018	3/13/2019		
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	4,330	4,050	4,740	4,770	4,290	4,490	4,480	4,400	4,480	4,180	4,820	4,090	4,660		
Calcium	mg/L	NA	NC	NC	500	NC	NC	NC	NC	--	--	--	--	--	--	--	--	263	219	217	227	222		
Chloride	mg/L	NA	250	250	50	NC	NC	NC	NC	--	--	--	--	--	--	--	--	47	59	40	44	59		
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	410	490	390	410	430	540	510	390	500	449	350	420	410		
Total Dissolved Solids	mg/L	NA	500	500	500	NC	NC	NC	NC	--	--	--	--	--	--	--	--	--	950	--	--	--		
pH, Field	su	NA	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	NC	NC	NC	NC	7.0	7.0	7.0	6.9	6.9	7.0	6.8	7.0	7.2	7.2	7.1	7.1	7.1		
Appendix IV																								
Antimony	ug/L	6	6.0	6.0	2.0	1,100	2,300	NC	NC	--	--	--	--	--	--	--	--	--	< 1	--	--	--		
Arsenic	ug/L	21 ⁽¹⁾	10	10	10	340	680	100	680	70	55	67	60	62	67	49	62	64	68	92	89	102		
Barium	ug/L	2,000	2,000	2,000	1,200	3,400	7,000	NC	NC	--	--	--	--	--	--	--	--	--	48	--	--	--		
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	2	1	2	1	1	2	1	2	< 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	--	--	--		
Lithium	ug/L	180	170	350	440	910	1,800	NC	NC	133	136	149	139	155	140	141	148	135	136	125	125	137		
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	32	26	33	22	16	16	25	25	19	27	25	26	37		
Selenium	ug/L	50	50	50	5.0	62	120	55	120	1	2	4	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	1	< 1		
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 (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018). 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 GSI criteria.

All metals were analyzed as total unless otherwise specified.
 (1) Constituent triggered an Assessment of Corrective Measures for the Karn Bottom Ash Pond as described in TRC's letter report dated January 14, 2019.

Table 3
 Summary of Groundwater Sampling Results (Analytical): March 2016 - April 2019
 DE Karn Landfill HMP Monitoring Wells
 Essexville, Michigan

Sample Location:										MW-10																	
Sample Date:										3/17/2016	5/11/2016	8/11/2016	10/19/2016	2/27/2017	5/11/2017	8/9/2017	9/26/2017	11/2/2017	3/7/2018	5/15/2018	8/15/2018	10/23/2018	3/13/2019	4/12/2019			
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	2,590	2,820	2,840	3,220	2,920	2,900	2,940	2,830	3,490	2,920	3,380	3,650	3,530	4,130	3,820			
Calcium	mg/L	NA	NC	NC	500	NC	NC	NC	NC	--	--	--	--	--	--	--	285	--	345	280	332	275	246	225			
Chloride	mg/L	NA	250	250	50	NC	NC	NC	NC	--	--	--	--	--	--	--	36.8	--	33	49.8	34	43	50	54			
Fluoride	ug/L	4,000	NC	NC	NC	9,700	20,000	NC	NC	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--			
Sulfate	mg/L	NA	250	250	500	NC	NC	NC	NC	730	650	600	380	460	590	700	588	320	630	444	530	410	270	250			
Total Dissolved Solids	mg/L	NA	500	500	500	NC	NC	NC	NC	--	--	--	--	--	--	--	--	--	--	1,100	--	--	--	--			
pH, Field	su	NA	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	NC	NC	NC	NC	6.9	7.0	7.0	7.0	7.0	7.1	7.0	7.4	7.3	7.3	7.3	7.2	7.2	7.3	7.3			
Appendix IV																											
Antimony	ug/L	6	6.0	6.0	2.0	1,100	2,300	NC	NC	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--			
Arsenic	ug/L	21 ⁽¹⁾	10	10	10	340	680	100	680	617	710	979	834	747	635	745	719	934	625	518	970	759	909	716			
Barium	ug/L	2,000	2,000	2,000	1,200	3,400	7,000	NC	NC	--	--	--	--	--	--	--	--	--	--	67	--	--	--	--			
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	2	< 1	< 1.0	2	< 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	--	--	--	--			
Lithium	ug/L	180	170	350	440	910	1,800	NC	NC	77	86	99	108	87	87	93	103	125	95	100	97	108	119	117			
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	14	16	15	12	15	18	22	17.2	15	21	18	23	18	12	12			
Selenium	ug/L	50	50	50	5.0	62	120	55	120	1	2	3	< 1	1	1	2	< 1.0	< 1	< 1	1	1	2	< 1	< 1			
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 (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018). 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 GSI criteria.

All metals were analyzed as total unless otherwise specified.
 (1) Constituent triggered an Assessment of Corrective Measures for the Karn Bottom Ash Pond as described in TRC's letter report dated January 14, 2019.

Table 3
 Summary of Groundwater Sampling Results (Analytical): March 2016 - April 2019
 DE Karn Landfill HMP Monitoring Wells
 Essexville, Michigan

Sample Location:										MW-12																	
Sample Date:										3/17/2016	5/11/2016	8/12/2016	10/20/2016	2/27/2017	5/10/2017	8/9/2017	9/26/2017	11/2/2017	3/7/2018	5/15/2018	8/15/2018	10/23/2018	3/13/2019	4/12/2019			
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	2,370	2,560	2,080	2,740	2,090	2,260	2,620	2,600	2,700	2,690	3,490	4,040	3,620	4,240	4,310			
Calcium	mg/L	NA	NC	NC	500	NC	NC	NC	NC	--	--	--	--	--	--	--	213	--	246	210	235	227	227	222			
Chloride	mg/L	NA	250	250	50	NC	NC	NC	NC	--	--	--	--	--	--	--	60.5	--	70	74.5	71	68	76	81			
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	230	260	280	160	220	310	400	293	290	270	214	270	260	210	210			
Total Dissolved Solids	mg/L	NA	500	500	500	NC	NC	NC	NC	--	--	--	--	--	--	--	--	--	--	950	--	--	--	--			
pH, Field	su	NA	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	NC	NC	NC	NC	7.1	7.1	7.2	7.2	7.2	7.2	7.0	7.4	7.1	7.4	7.3	7.2	7.3	7.3	7.1			
Appendix IV																											
Antimony	ug/L	6	6.0	6.0	2.0	1,100	2,300	NC	NC	--	--	--	--	--	--	--	--	--	--	< 1	--	--	--	--			
Arsenic	ug/L	21 ⁽¹⁾	10	10	10	340	680	100	680	411	306	375	575	472	190	241	416	409	487	292	452	485	495	341			
Barium	ug/L	2,000	2,000	2,000	1,200	3,400	7,000	NC	NC	--	--	--	--	--	--	--	--	--	--	105	--	--	--	--			
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	2	< 1	4.0	< 1	< 1	< 1	< 1	< 1	< 1	3			
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	--	--	--	--			
Lithium	ug/L	180	170	350	440	910	1,800	NC	NC	63	72	74	83	82	87	98	91.3	94	100	94	88	100	92	94			
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	10	12	17	< 5	8	12	12	13.0	13	12	10	17	15	14	16			
Selenium	ug/L	50	50	50	5.0	62	120	55	120	2	2	2	< 1	2	3	3	< 1.0	< 1	1	3	2	2	2	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 (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018). 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 GSI criteria.

All metals were analyzed as total unless otherwise specified.
 (1) Constituent triggered an Assessment of Corrective Measures for the Karn Bottom Ash Pond as described in TRC's letter report dated January 14, 2019.

Table 3
 Summary of Groundwater Sampling Results (Analytical): March 2016 - April 2019
 DE Karn Landfill HMP Monitoring Wells
 Essexville, Michigan

Sample Location:										MW-14																
Sample Date:										3/18/2016	5/11/2016	8/12/2016	10/19/2016	2/27/2017	5/10/2017	8/10/2017	11/2/2017	3/7/2018	5/15/2018	8/16/2018	10/23/2018	3/14/2019	4/12/2019			
Constituent	Unit	GWPS*	MI Residential**	MI Non-Residential**	MI GSI^	MI AMV***	MI FAV***	Chronic MZ^^	Acute MZ^^	downgradient																
Appendix III																										
Boron	ug/L	NA	500	500	4,000	34,000	69,000	44,000	69,000	2,170	2,080	2,790	3,430	2,360	2,780	3,080	2,540	2,390	2,680	2,480	2,640	2,860	2,940			
Calcium	mg/L	NA	NC	NC	500	NC	NC	NC	NC	--	--	--	--	--	--	--	--	299	252	311	266	247	219			
Chloride	mg/L	NA	250	250	50	NC	NC	NC	NC	--	--	--	--	--	--	--	--	84	73.3	87	81	75	71			
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	470	710	310	780	270	570	1,300	730	490	373	550	350	300	240			
Total Dissolved Solids	mg/L	NA	500	500	500	NC	NC	NC	NC	--	--	--	--	--	--	--	--	--	1,100	--	--	--	--			
pH, Field	su	NA	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	NC	NC	NC	NC	7.1	7.1	7.1	6.9	7.1	7.1	6.8	7.1	7.2	7.3	7.1	7.2	7.0	7.1			
Appendix IV																										
Antimony	ug/L	6	6.0	6.0	2.0	1,100	2,300	NC	NC	--	--	--	--	--	--	--	--	--	< 1	--	--	--	--			
Arsenic	ug/L	21 ⁽¹⁾	10	10	10	340	680	100	680	456	163	637	635	861	249	227	1,150	695	460	441	727	698	490			
Barium	ug/L	2,000	2,000	2,000	1,200	3,400	7,000	NC	NC	--	--	--	--	--	--	--	--	--	64	--	--	--	--			
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	3	1	4	< 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	--	--	--	--			
Lithium	ug/L	180	170	350	440	910	1,800	NC	NC	85	90	96	116	88	173	198	107	86	97	101	98	92	88			
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	88	51	53	90	55	29	10	36	20	17	18	26	21	22			
Selenium	ug/L	50	50	50	5.0	62	120	55	120	21	89	3	3	4	53	6	19	4	4	5	3	6	2			
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.
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- * - 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 (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018). 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 GSI criteria.

All metals were analyzed as total unless otherwise specified.

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

Table 3
 Summary of Groundwater Sampling Results (Analytical): March 2016 - April 2019
 DE Karn Landfill HMP Monitoring Wells
 Essexville, Michigan

Sample Location:										MW-16															
Sample Date:										3/18/2016	5/11/2016	8/12/2016	10/18/2016	2/28/2017	5/10/2017	8/9/2017	11/3/2017	3/7/2018	5/16/2018	8/15/2018	10/23/2018	3/14/2019			
Constituent	Unit	GWPS*	MI Residential**	MI Non-Residential**	MI GSI^	MI AMV***	MI FAV***	Chronic MZ^^	Acute MZ^^	downgradient															
Appendix III																									
Boron	ug/L	NA	500	500	4,000	34,000	69,000	44,000	69,000	1,050	1,100	901	1,160	1,020	1,320	1,500	1,410	1,340	1,640	1,460	1,480	1,230			
Calcium	mg/L	NA	NC	NC	500	NC	NC	NC	NC	--	--	--	--	--	--	--	--	389	385	376	333	323			
Chloride	mg/L	NA	250	250	50	NC	NC	NC	NC	--	--	--	--	--	--	--	--	81	91.4	93	85	85			
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	320	380	330	480	750	650	910	1,000	1,100	1,220	1,200	960	760			
Total Dissolved Solids	mg/L	NA	500	500	500	NC	NC	NC	NC	--	--	--	--	--	--	--	--	--	2,400	--	--	--			
pH, Field	su	NA	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	NC	NC	NC	NC	7.5	7.5	7.4	7.4	7.2	7.4	7.2	7.1	7.4	7.2	7.3	7.4	7.3			
Appendix IV																									
Antimony	ug/L	6	6.0	6.0	2.0	1,100	2,300	NC	NC	--	--	--	--	--	--	--	--	--	< 1	--	--	--			
Arsenic	ug/L	21 ⁽¹⁾	10	10	10	340	680	100	680	9	4	6	9	4	4	2	5	2	1	1	2	4			
Barium	ug/L	2,000	2,000	2,000	1,200	3,400	7,000	NC	NC	--	--	--	--	--	--	--	--	--	58	--	--	--			
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	3	2	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	--	--	--			
Lithium	ug/L	180	170	350	440	910	1,800	NC	NC	50	57	56	68	79	94	110	124	105	125	113	118	97			
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	14	16	15	15	14	17	19	21	19	25	46	32	27			
Selenium	ug/L	50	50	50	5.0	62	120	55	120	1	< 1	2	< 1	3	1	3	1	2	16	18	3	2			
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 (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018). 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 GSI criteria.

 All metals were analyzed as total unless otherwise specified.
 (1) Constituent triggered an Assessment of Corrective Measures for the Karn Bottom Ash Pond as described in TRC's letter report dated January 14, 2019.

Table 3
 Summary of Groundwater Sampling Results (Analytical): March 2016 - April 2019
 DE Karn Landfill HMP Monitoring Wells
 Essexville, Michigan

Constituent	Unit	GWPS*	MI Residential**	MI Non-Residential**	MI GSI^	MI AMV***	MI FAV***	Chronic MZ^^	Acute MZ^^	Sample Location:	
										MW-22	MW-23
										Sample Date:	
										9/26/2017	9/26/2017
Appendix III											
Boron	ug/L	NA	500	500	4,000	34,000	69,000	44,000	69,000	--	--
Calcium	mg/L	NA	NC	NC	500	NC	NC	NC	NC	69.9	147
Chloride	mg/L	NA	250	250	50	NC	NC	NC	NC	91.7	87.6
Fluoride	ug/L	4,000	NC	NC	NC	9,700	20,000	NC	NC	--	--
Sulfate	mg/L	NA	250	250	500	NC	NC	NC	NC	145	165
Total Dissolved Solids	mg/L	NA	500	500	500	NC	NC	NC	NC	--	--
pH, Field	su	NA	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	NC	NC	NC	NC	8.5	8.0
Appendix IV											
Antimony	ug/L	6	6.0	6.0	2.0	1,100	2,300	NC	NC	--	--
Arsenic	ug/L	21 ⁽¹⁾	10	10	10	340	680	100	680	502	367
Barium	ug/L	2,000	2,000	2,000	1,200	3,400	7,000	NC	NC	--	--
Beryllium	ug/L	4	4.0	4.0	33	300	600	NC	NC	--	--
Cadmium	ug/L	5	5.0	5.0	2.5	12	24	NC	NC	--	--
Chromium	ug/L	100	100	100	11	16	32	NC	NC	--	--
Cobalt	ug/L	15	40	100	100	370	740	NC	NC	--	--
Fluoride	ug/L	4,000	NC	NC	NC	10,000	20,000	NC	NC	--	--
Lead	ug/L	15	4.0	4.0	14	250	500	NC	NC	--	--
Lithium	ug/L	180	170	350	440	910	1,800	NC	NC	--	--
Mercury	ug/L	2	2.0	2.0	0.20#	1.4	2.8	NC	NC	--	--
Molybdenum	ug/L	100	73	210	120	29,000	58,000	NC	NC	--	--
Selenium	ug/L	50	50	50	5.0	62	120	55	120	--	--
Thallium	ug/L	2	2.0	2.0	2.0	47	94	NC	NC	--	--

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 (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018). 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.
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Result	Indicates an exceedance of acute-based GSI criteria.
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All metals were analyzed as total unless otherwise specified.

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

Table 4
 Summary of Part 115 Groundwater Sampling Results (Analytical): November 2018 - April 2019
 DE Karn & JC Weadock Background – RCRA CCR Monitoring Program
 Essexville, Michigan

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

Notes:

ug/L - micrograms per liter.

NC - no criteria.

NA - not applicable.

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

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

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

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

BOLD font denotes concentrations detected above laboratory reporting limits.

Result Indicates an exceedance of one or more applicable criteria.

All metals were analyzed as total unless otherwise specified.

Table 5
 Summary of Groundwater Sampling Results (Analytical): November 2018 - April 2019
 DE Karn Lined Impoundment and Bottom Ash Pond – RCRA CCR Monitoring Program
 Essexville, Michigan

							Sample Location:		DEK-MW-15002			DEK-MW-15003			DEK-MW-15004		DEK-MW-15005	
							Sample Date:		11/5/2018	4/11/2019	11/6/2018	2/18/2019	4/11/2019	11/6/2018	4/11/2019	11/6/2018	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	905	390	439	490	390	2,140	1,500	366	87			
Appendix IV																		
Copper	ug/L	1,000**	1,000**	20	33	66	< 1.0	< 1.0	< 1.0	< 2.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	
Nickel	ug/L	100	100	120	1,000	2,100	< 1.0	< 2.0	< 1.0	< 4.0	< 10	< 1.0	< 2.0	< 1.0	< 2.0	< 1.0	< 2.0	
Silver	ug/L	34	98	0.2	0.54	1.1	< 0.20	< 0.20	< 0.20	< 0.40	< 1.0	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	
Vanadium	ug/L	4.5	62	27	79	160	< 1.0	< 2.0	< 1.0	< 4.0	< 10	< 1.0	< 2.0	< 1.0	< 2.0	< 1.0	< 2.0	
Zinc	ug/L	2,400	5,000**	260	260	520	< 10.0	< 10	< 10.0	< 20	< 50	< 10.0	< 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 5
 Summary of Groundwater Sampling Results (Analytical): November 2018 - April 2019
 DE Karn Lined Impoundment and Bottom Ash Pond – RCRA CCR Monitoring Program
 Essexville, Michigan

							Sample Location:		DEK-MW-15006			DEK-MW-18001			OW-10		
							Sample Date:		11/5/2018	4/11/2019	11/6/2018	2/18/2019	4/10/2019	11/6/2018	2/18/2019	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	394	380	637	870	730	1,580	1,800	2,000			
Appendix IV																	
Copper	ug/L	1,000**	1,000**	20	33	66	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0			
Nickel	ug/L	100	100	120	1,000	2,100	1.2	< 2.0	3.2	7.3	3.4	1.7	2.8	< 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	< 2.0	1.1	< 2.0	< 2.0	1.1	< 2.0	< 2.0			
Zinc	ug/L	2,400	5,000**	260	260	520	< 10.0	< 10	< 10.0	< 10	< 10	< 10.0	< 10	< 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 5
 Summary of Groundwater Sampling Results (Analytical): November 2018 - April 2019
 DE Karn Lined Impoundment and Bottom Ash Pond – RCRA CCR Monitoring Program
 Essexville, Michigan

Sample Location:							OW-11			OW-12		
Sample Date:							11/6/2018	2/19/2019	4/11/2019	11/7/2018	2/19/2019	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	333	53	46	400	870	780
Appendix IV												
Copper	ug/L	1,000**	1,000**	20	33	66	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Nickel	ug/L	100	100	120	1,000	2,100	1.7	2.0	< 2.0	< 1.0	16	< 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
Vanadium	ug/L	4.5	62	27	79	160	18.4	67	37	< 1.0	< 2.0	< 2.0
Zinc	ug/L	2,400	5,000**	260	260	520	< 10.0	< 10	< 10	< 10.0	< 10	< 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 Groundwater Sampling Results (Analytical): March 2016 - April 2019
 DE Karn Landfill HMP Monitoring Wells
 Essexville, Michigan

Sample Location:							MW-01													
Sample Date:							3/16/2016	5/12/2016	8/11/2016	10/19/2016	2/28/2017	5/10/2017	8/9/2017	11/2/2017	3/7/2018	5/14/2018	8/16/2018	10/23/2018	3/13/2019	
Constituent	Unit	MI Residential*	MI Non-Residential*	MI GSI^	MI AMV***	MI FAV***														
Appendix III																				
Iron	ug/L	300**	300**	NA	NC	NC	146	128	154	163	1,340	184	194	713	< 20	163	201	137	154	
Appendix IV																				
Copper	ug/L	1,000**	1,000**	20	33	66	--	--	--	--	--	--	--	--	--	3	--	--	--	
Nickel	ug/L	100	100	120	1,000	2,100	--	--	--	--	--	--	--	--	--	--	--	--	--	
Silver	ug/L	34	98	0.2	0.54	1.1	--	--	--	--	--	--	--	--	--	< 0.2	--	--	--	
Vanadium	ug/L	4.5	62	27	79	160	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	
Zinc	ug/L	2,400	5,000**	260	260	520	--	--	--	--	--	--	--	--	--	--	--	--	--	

Notes:

ug/L - micrograms per liter.

NC - no criteria.

NA - not applicable.

-- - not analyzed.

* - 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 Groundwater Sampling Results (Analytical): March 2016 - April 2019
 DE Karn Landfill HMP Monitoring Wells
 Essexville, Michigan

Sample Location:							MW-03												
Sample Date:							3/17/2016	5/12/2016	8/11/2016	10/19/2016	2/28/2017	5/10/2017	8/9/2017	11/2/2017	3/7/2018	5/15/2018	8/16/2018	10/23/2018	3/13/2019
Constituent	Unit	MI Residential*	MI Non-Residential*	MI GSI^	MI AMV***	MI FAV***													
Appendix III																			
Iron	ug/L	300**	300**	NA	NC	NC	48	20	113	116	753	168	150	627	< 20	236	85	69	168
Appendix IV																			
Copper	ug/L	1,000**	1,000**	20	33	66	--	--	--	--	--	--	--	--	--	3	--	--	--
Nickel	ug/L	100	100	120	1,000	2,100	--	--	--	--	--	--	--	--	--	--	--	--	--
Silver	ug/L	34	98	0.2	0.54	1.1	--	--	--	--	--	--	--	--	--	< 0.2	--	--	--
Vanadium	ug/L	4.5	62	27	79	160	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2
Zinc	ug/L	2,400	5,000**	260	260	520	--	--	--	--	--	--	--	--	--	--	--	--	--

Notes:

ug/L - micrograms per liter.

NC - no criteria.

NA - not applicable.

-- not analyzed.

* - 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 Groundwater Sampling Results (Analytical): March 2016 - April 2019
 DE Karn Landfill HMP Monitoring Wells
 Essexville, Michigan

Sample Location:							MW-06												
Sample Date:							3/16/2016	5/12/2016	8/11/2016	10/19/2016	2/28/2017	5/10/2017	8/9/2017	11/2/2017	3/7/2018	5/15/2018	8/15/2018	10/23/2018	3/13/2019
Constituent	Unit	MI Residential*	MI Non-Residential*	MI GSI^	MI AMV***	MI FAV***													
Appendix III																			
Iron	ug/L	300**	300**	NA	NC	NC	4,080	5,710	1,340	1,490	4,240	7,390	2,020	2,430	3,050	4,890	2,120	1,510	1,750
Appendix IV																			
Copper	ug/L	1,000**	1,000**	20	33	66	--	--	--	--	--	--	--	--	--	< 1	--	--	--
Nickel	ug/L	100	100	120	1,000	2,100	--	--	--	--	--	--	--	--	--	--	--	--	--
Silver	ug/L	34	98	0.2	0.54	1.1	--	--	--	--	--	--	--	--	--	< 0.2	--	--	--
Vanadium	ug/L	4.5	62	27	79	160	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2
Zinc	ug/L	2,400	5,000**	260	260	520	--	--	--	--	--	--	--	--	--	--	--	--	--

Notes:

ug/L - micrograms per liter.

NC - no criteria.

NA - not applicable.

-- not analyzed.

* - 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 Groundwater Sampling Results (Analytical): March 2016 - April 2019
 DE Karn Landfill HMP Monitoring Wells
 Essexville, Michigan

Sample Location:							MW-08												
Sample Date:							3/16/2016	5/11/2016	8/11/2016	10/19/2016	2/27/2017	5/10/2017	8/9/2017	11/2/2017	3/7/2018	5/15/2018	8/15/2018	10/23/2018	3/13/2019
Constituent	Unit	MI Residential*	MI Non-Residential*	MI GSI^	MI AMV***	MI FAV***													
Appendix III																			
Iron	ug/L	300**	300**	NA	NC	NC	8,940	9,280	9,640	11,500	11,900	12,600	10,700	10,100	9,000	9,110	9,400	10,500	9,310
Appendix IV																			
Copper	ug/L	1,000**	1,000**	20	33	66	--	--	--	--	--	--	--	--	--	< 1	--	--	--
Nickel	ug/L	100	100	120	1,000	2,100	--	--	--	--	--	--	--	--	--	--	--	--	--
Silver	ug/L	34	98	0.2	0.54	1.1	--	--	--	--	--	--	--	--	--	< 0.2	--	--	--
Vanadium	ug/L	4.5	62	27	79	160	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2
Zinc	ug/L	2,400	5,000**	260	260	520	--	--	--	--	--	--	--	--	--	--	--	--	--

Notes:

ug/L - micrograms per liter.

NC - no criteria.

NA - not applicable.

-- not analyzed.

* - 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 Groundwater Sampling Results (Analytical): March 2016 - April 2019
 DE Karn Landfill HMP Monitoring Wells
 Essexville, Michigan

Sample Location:							MW-10														
Sample Date:							3/17/2016	5/11/2016	8/11/2016	10/19/2016	2/27/2017	5/11/2017	8/9/2017	9/26/2017	11/2/2017	3/7/2018	5/15/2018	8/15/2018	10/23/2018	3/13/2019	4/12/2019
Constituent	Unit	MI Residential*	MI Non-Residential*	MI GSI^	MI AMV***	MI FAV***															
Appendix III																					
Iron	ug/L	300**	300**	NA	NC	NC	10,900	9,980	12,100	10,900	10,200	9,800	8,390	10,100	7,060	7,530	5,470	8,840	6,740	6,790	5,190
Appendix IV																					
Copper	ug/L	1,000**	1,000**	20	33	66	--	--	--	--	--	--	--	--	--	--	< 1	--	--	--	--
Nickel	ug/L	100	100	120	1,000	2,100	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Silver	ug/L	34	98	0.2	0.54	1.1	--	--	--	--	--	--	--	--	--	--	< 0.2	--	--	--	--
Vanadium	ug/L	4.5	62	27	79	160	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2.0	< 2	< 2	< 2	< 2	< 2	< 2	< 2
Zinc	ug/L	2,400	5,000**	260	260	520	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Notes:

ug/L - micrograms per liter.

NC - no criteria.

NA - not applicable.

-- - not analyzed.

* - 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 Groundwater Sampling Results (Analytical): March 2016 - April 2019
 DE Karn Landfill HMP Monitoring Wells
 Essexville, Michigan

Sample Location:							MW-12															
Sample Date:							3/17/2016	5/11/2016	8/12/2016	10/20/2016	2/27/2017	5/10/2017	8/9/2017	9/26/2017	11/2/2017	3/7/2018	5/15/2018	8/15/2018	10/23/2018	3/13/2019	4/12/2019	
Constituent	Unit	MI Residential*	MI Non-Residential*	MI GSI^	MI AMV***	MI FAV***																
Appendix III																						
Iron	ug/L	300**	300**	NA	NC	NC	3,910	2,430	2,930	4,270	5,210	1,910	2,690	4,060	4,170	2,820	1,780	4,040	3,360	3,490	2,810	
Appendix IV																						
Copper	ug/L	1,000**	1,000**	20	33	66	--	--	--	--	--	--	--	--	--	--	< 1	--	--	--	--	
Nickel	ug/L	100	100	120	1,000	2,100	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Silver	ug/L	34	98	0.2	0.54	1.1	--	--	--	--	--	--	--	--	--	--	< 0.2	--	--	--	--	
Vanadium	ug/L	4.5	62	27	79	160	< 2	< 2	< 2	< 2	< 2	< 2	< 2.0	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	
Zinc	ug/L	2,400	5,000**	260	260	520	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	

Notes:

ug/L - micrograms per liter.

NC - no criteria.

NA - not applicable.

-- - not analyzed.

* - 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 Groundwater Sampling Results (Analytical): March 2016 - April 2019
 DE Karn Landfill HMP Monitoring Wells
 Essexville, Michigan

Sample Location:							MW-14														
Sample Date:							3/18/2016	5/11/2016	8/12/2016	10/19/2016	2/27/2017	5/10/2017	8/10/2017	11/2/2017	3/7/2018	5/15/2018	8/16/2018	10/23/2018	3/14/2019	4/12/2019	
Constituent	Unit	MI Residential*	MI Non-Residential*	MI GSI [^]	MI AMV ^{***}	MI FAV ^{***}															
Appendix III																					
Iron	ug/L	300**	300**	NA	NC	NC	3,330	1,030	6,670	10,600	5,930	1,940	5,300	10,800	3,540	2,060	3,520	3,380	4,530	3,130	
Appendix IV																					
Copper	ug/L	1,000**	1,000**	20	33	66	--	--	--	--	--	--	--	--	--	1	--	--	--	--	
Nickel	ug/L	100	100	120	1,000	2,100	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Silver	ug/L	34	98	0.2	0.54	1.1	--	--	--	--	--	--	--	--	--	< 0.2	--	--	--	--	
Vanadium	ug/L	4.5	62	27	79	160	< 2	< 2	< 2	< 2	3	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	
Zinc	ug/L	2,400	5,000**	260	260	520	--	--	--	--	--	--	--	--	--	--	--	--	--	--	

Notes:

ug/L - micrograms per liter.

NC - no criteria.

NA - not applicable.

-- - not analyzed.

* - 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 Groundwater Sampling Results (Analytical): March 2016 - April 2019
 DE Karn Landfill HMP Monitoring Wells
 Essexville, Michigan

Sample Location:							MW-16											MW-22	MW-23		
Sample Date:							3/18/2016	5/11/2016	8/12/2016	10/18/2016	2/28/2017	5/10/2017	8/9/2017	11/3/2017	3/7/2018	5/16/2018	8/15/2018	10/23/2018	3/14/2019	9/26/2017	9/26/2017
Constituent	Unit	MI Residential*	MI Non-Residential*	MI GSI^	MI AMV***	MI FAV***															
Appendix III																					
Iron	ug/L	300**	300**	NA	NC	NC	985	374	537	1,440	2,190	545	315	1,850	< 20	108	140	333	538	284	1,630
Appendix IV																					
Copper	ug/L	1,000**	1,000**	20	33	66	--	--	--	--	--	--	--	--	--	3	--	--	--	--	--
Nickel	ug/L	100	100	120	1,000	2,100	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Silver	ug/L	34	98	0.2	0.54	1.1	--	--	--	--	--	--	--	--	--	< 0.2	--	--	--	--	--
Vanadium	ug/L	4.5	62	27	79	160	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	--	--
Zinc	ug/L	2,400	5,000**	260	260	520	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Notes:
 ug/L - micrograms per liter.
 NC - no criteria.
 NA - not applicable.
 -- - not analyzed.
 * - 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 Statistical Evaluation of Initial Assessment Monitoring Event



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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,
DE Karn Bottom Ash Pond, Consumers Energy Company, Essexville, Michigan

Dear Mr. Register:

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

Therefore, CEC initiated an Assessment Monitoring Program for the Bottom Ash Pond CCR Unit pursuant to §257.95 of the CCR Rule¹ that included sampling and analyzing groundwater within the groundwater monitoring system for all constituents listed in Appendix IV (April 2018). 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 DEK Bottom Ash Pond monitoring system was subsequently sampled for the Appendix III and Appendix IV constituents within 90 days from the initial Appendix IV sampling event (May 2018). In accordance with §257.95, the assessment monitoring data must be compared to GWPSs to determine

¹ United States Environmental Protection Agency (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).

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 DEK Bottom Ash Pond:

<u>Constituent</u>	<u>GWPS</u>	<u>#Downgradient Wells Observed</u>
Arsenic	21 ug/L	5 of 6

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 DE Karn (DEK) Power Plant site (the Site) is located north of the JC Weadock (JCW) Power Plant site (JCW Site), east of the Saginaw River, south and west of Saginaw Bay (Figure 1). A discharge channel runs along the majority of the southern perimeter of the site and separates the facility from the JCW Site to the south. The plant began generating electricity in 1959. Two power generating units (Units 1 & 2) are coal-fueled and two units (Units 3 & 4) are oil- and natural gas-fueled.

The location of the DEK Bottom Ash Pond is shown on Figure 2. Previously, the DEK Bottom Ash Pond was used for wet ash dewatering and was the primary settling/detention structure for the NPDES treatment system prior to discharge. CEC provided notification of initiation of closure on October 12, 2018 to the Michigan Department of Environmental Quality (MDEQ) to implement the certified closure plan by removal of CCR under the self-implementing requirements and schedule of the CCR Rule. In preparation for removal of the Bottom Ash Pond, a new lined impoundment CCR unit (Karn Lined Impoundment CCR unit) has been constructed. The liner system for the new impoundment was designed as a double composite liner system, with the primary and secondary composite liners each consisting of 60-mil High Density Polyethylene (HDPE) geomembrane (GM) overlaying a 236-mil geosynthetic clay liner (GCL)². The wet ash dewatering was relocated to the new impoundment (KLI CCR unit), which began receipt of CCR in June 2018.

The DEK Bottom Ash Pond located adjacent to the DEK Solid Waste Disposal Area. The Solid Waste Disposal Area received sluiced fly ash until the conversion to Dry Fly Ash handling was completed in December 2008. While the fly ash sluicing was in operation, the Solid Waste Disposal Area received

² Golder Associates Inc. 2018. *Bottom Ash Lined Impoundment Liner System Design Certification Report, DE Karn Generating Facility, Essexville, Michigan*. April.



slurried ash that traveled through a series of ponds to an eventual NPDES outfall on Saginaw Bay. The ponds were routinely dredged, and the ash was placed within the DEK Landfill. Consumers Energy received Solid Waste Construction Permit No. 0195 on December 12, 1986 for constructing a Type III Landfill based on the vertical expansion over the historically sluiced fly ash through dredge and stack operations and moisture conditioned dry fly ash.

Closure activities at the DEK Landfill commenced prior to the Effective Date of the CCR Rule (October 17, 2015); therefore, the landfill is subject only to permitting under state authorities. The DEK Landfill is being monitored in accordance with the MDEQ-approved HMP³. The DEK Solid Waste Disposal Area is currently authorized under a permit (Groundwater Discharge Authorization GWE-0005) issued pursuant to Part 31⁴ to discharge to the unusable aquifer directly underlying the solid waste that vents almost immediately to the Saginaw River and Saginaw Bay. Interim monitoring and compliance monitoring pursuant to Part 31 and Part 115⁵ detailed in the revised HMP was approved by the MDEQ on January 8, 2018.

Groundwater Monitoring System

In accordance with 40 CFR 257.91, Consumers Energy established a groundwater monitoring system for the DEK Bottom Ash Pond unit, which consists of 10 monitoring wells (four background monitoring wells and six downgradient monitoring wells) that are screened in the uppermost aquifer. The monitoring well locations are shown on Figure 2. Four monitoring wells located between $\frac{3}{4}$ and 1 mile south of the DEK Bottom Ash Pond on the JCW site 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 two active CCR units on the JCW site.

In the vicinity of the DEK Bottom Ash Pond, the shallow groundwater flow is generally radial, flowing outward from the pond area toward the surrounding surface water bodies. The potentiometric surface data from the May 2018 assessment monitoring event is illustrated on Figure 3. Therefore, the six wells downgradient of the DEK Bottom Ash Pond encircle the unit (DEK-MW-15001 through DEK-MW-15006). Following the April 2018 sampling event, DEK-MW-15001 was decommissioned by over drilling, removing the well casing material, and sealing the borehole, to allow for construction of the new Karn Lined Impoundment CCR unit. A new monitoring well

³ Consumers Energy Company. 2017. *Hydrogeological Monitoring Plan Rev. 2: DE Karn Solid Waste Disposal Area*. December.

⁴ Part 31, Water Resources Protection, of the Natural Resources and Environmental Protection Act (NREPA), Public Act 451 of 1994.

⁵ Part 115, Solid Waste Management, of the Natural Resources and Environmental Protection Act (NREPA), Public Act 451 of 1994.



(DEK-MW-18001) was installed approximately 80 feet southeast of the former DEK-MW-15001 location to maintain the perimeter downgradient monitoring well network. Although the new well is considered to be a replacement well, the data from the two wells are not being combined in the statistical analyses at this time due to an insufficient amount of data from the new well to compare the two data sets. Therefore, the statistical analysis for DEK-MW-15001 terminates at the April 2018 sampling event and statistical analysis for DEK-MW-18001 will commence once sufficient data have been collected from the new well (a minimum of four independent sampling events).

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 DEK Bottom Ash Pond were evaluated in accordance with the *Groundwater Statistical Evaluation Plan* (Stats Plan) (TRC, October 2017). Consistent with the Unified Guidance⁶, the preferred method for comparisons to a fixed standard are confidence limits. An exceedance of the standard occurs when the 99 percent lower confidence level of the downgradient data exceeds the GWPS.

For each detected Appendix IV constituent, the concentrations from each well were first compared directly to the GWPS, as shown on Table 1. Parameter-well combinations that included a direct exceedance of the GWPS were retained for further analysis. Arsenic in each of the downgradient monitoring wells at the Bottom Ash Pond had individual results exceeding the GWPS. Lead was detected in DEK-MW-15006 at a concentration of 320 ug/L, which exceeds its GWPS. However, this is the only detection of lead in the Bottom Ash Pond wells during either baseline sampling or assessment monitoring, and it qualifies as an outlier. Verification resampling is being conducted to assess whether lead is present in groundwater at that monitoring well. Per the Stats Plan and the Unified Guidance, if lead is found to be present, it will be subject to the double quantification rule to assess whether the GWPS has been exceeded.

Groundwater data were then evaluated utilizing SanitasTM statistical software. SanitasTM is a software tool that is commercially available for performing statistical evaluation consistent with procedures outlined in the Unified Guidance. Within the SanitasTM statistical program, confidence limits were

⁶ USEPA. 2009. *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance*. Office of Conservation and Recovery. EPA 530/R-09-007.



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.

Initially, the baseline (December 2015 through August 2017) results and the two assessment monitoring results (April and May 2018) were observed visually for potential trends. No outliers were identified. The Sanitas™ software was then used to test compliance at the downgradient monitoring wells using the confidence interval method for the most recent 8 sampling events. Eight independent sampling events provide the appropriate density of data as recommended per the UG yet are collected recently enough to provide an indication of current condition. The tests were run with a per-well significance of $\alpha = 0.01$. The software outputs are included in Attachment A along with data reports showing the values used for the evaluation. The percentage of non-detect observations are also included in Attachment A. Non-detect data was handled in accordance with the Stats Plan for the purposes of calculating the confidence intervals. Note that, as mentioned above, the statistical analysis for DEK-MW-15001 terminates at the April 2018 sampling event as it was decommissioned on April 18, 2018, and statistical analysis for DEK-MW-18001 will commence once sufficient data have been collected from the new well (a minimum of four independent sampling events).

The Sanitas™ software generates an output graph for the confidence intervals of each well. In each case, the data sets were found to be normally distributed except the set for DEK-MW-15005 which was first transformed before running the statistical test as noted on the graph. 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.



Mr. Register
Consumers Energy Company
January 14, 2019
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The statistical evaluation of the Appendix IV parameters shows exceedances for arsenic at five of the six monitoring locations (DEK-MW-15001 through DEK-MW-15005). 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

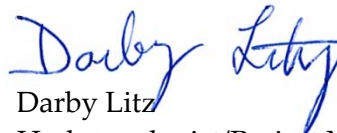
In accordance with the CCR Rule, CEC will enter this statistical evaluation of the assessment monitoring data into the operating record by January 14, 2019. The notification of the GWPS exceedances to the state will be posted to a public CCR Compliance website as required by §257.105(h)(8) by February 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

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
 DE Karn Bottom Ash Pond – RCRA CCR Monitoring Program
 Essexville, Michigan

		Sample Location:				DEK-MW-15001 ⁽¹⁾									
		Sample Date:				12/10/2015	3/30/2016	5/26/2016	8/24/2016	12/1/2016	2/23/2017	5/18/2017	8/3/2017	9/18/2017	4/10/2018
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS	downgradient									
Appendix III															
Boron	ug/L	NC	NA	619	NA	3,630	2,420	3,110	2,810	2,740	2,520	3,270	2,690	2,700	--
Calcium	mg/L	NC	NA	302	NA	108	87.8	92.2	95	75.1	96.8	85.8	71.8	82.4	--
Chloride	mg/L	250*	NA	2,440	NA	75.7	79	75.7	72.5	71	76.5	75	81.9	82.2	--
Fluoride	ug/L	4,000	NA	1,000	NA	< 1,000	1,530	1,440	1,160	1,500	1,650	1,330	1,700	2,100	1,600
pH, Field	SU	6.5 - 8.5*	NA	6.5-7.3	NA	7.6	7.5	7.5	7.4	7.4	7.4	7.4	7.6	7.5	7.3
Sulfate	mg/L	250*	NA	407	NA	72.4	53.3	64.9	37.4	52.7	53.4	59.9	66.3	36.2	--
Total Dissolved Solids	mg/L	500*	NA	4,600	NA	600	470	510	480	470	450	510	516	594	--
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	118	159	138	108	144	133	145	158	--	103
Barium	ug/L	2,000	NA	1,300	2,000	114	69	73	100	98	91	95	94.2	--	117
Beryllium	ug/L	4	NA	1	4	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 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
Chromium	ug/L	100	NA	3	100	< 1	1	< 1	< 1	< 1	< 1	1	< 1.0	--	< 1.0
Cobalt	ug/L	NC	6	15	15	< 15	< 15	< 15	< 15	< 15	< 15	< 15	< 15.0	--	< 15.0
Fluoride	ug/L	4,000	NA	1,000	4,000	< 1,000	1,530	1,440	1,160	1,500	1,650	1,330	1,700	2,100	1,600
Lead	ug/L	NC	15	1	15	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0
Lithium	ug/L	NC	40	180	180	71.9	48.7	51	55	52	48	55	53	--	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
Molybdenum	ug/L	NC	100	6	100	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5.0	--	< 5.0
Radium-226	pCi/L	5	NA	NA	5	< 0.297	0.244	0.24	< 0.195	< 0.292	0.565	< 0.315	< 0.934	--	< 0.686
Radium-226/228	pCi/L	5	NA	3.32	5	1.181	1.564	0.879	< 0.509	< 0.405	1.207	1.29	< 1.70	--	< 1.42
Radium-228	pCi/L	5	NA	NA	5	0.909	1.32	0.639	< 0.509	< 0.405	0.642	1.2	< 0.770	--	1.08
Selenium	ug/L	50	NA	2	50	4	3	3	1	2	< 1	< 1	< 1.0	--	1.2
Thallium	ug/L	2	NA	2	2	< 2	< 2	< 2	< 2	< 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.
- 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) DEK-MW-15001 was decommissioned on April 18, 2018.
- (2) Outlier; single detection above reporting limit.

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

		Sample Location:				DEK-MW-15002										
		Sample Date:				12/10/2015	3/30/2016	5/26/2016	8/24/2016	12/1/2016	2/23/2017	5/18/2017	8/3/2017	9/18/2017	4/12/2018	5/23/2018
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS	downgradient										
Appendix III																
Boron	ug/L	NC	NA	619	NA	780	676	668	746	893	858	824	805	870	--	967
Calcium	mg/L	NC	NA	302	NA	102	119	99.6	105	94.8	149	80.1	71.1	66.9	--	53.7
Chloride	mg/L	250*	NA	2,440	NA	83.5	97.6	90	89.2	86.1	88.2	80.5	87.8	84.9	--	79.7
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	7.8	7.5	7.6	7.5	7.6	7.5	7.5	7.8	7.9	7.5	8.0
Sulfate	mg/L	250*	NA	407	NA	275	418	291	384	326	289	299	256	290	--	263
Total Dissolved Solids	mg/L	500*	NA	4,600	NA	790	890	800	1,700	810	810	1,500	696	722	--	660
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	61	118	82	79	54	62	76	48.3	--	56.4	67.0
Barium	ug/L	2,000	NA	1,300	2,000	140	148	136	131	121	120	107	96.1	--	82.7	84.5
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	2	2	< 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
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	3	< 1.0	--	< 1.0	< 1.0
Lithium	ug/L	NC	40	180	180	50.7	53	43	44	40	41	42	36	--	43	35
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	19	30	29	41	26	27	38	27.7	--	30.8	35.4
Radium-226	pCi/L	5	NA	NA	5	< 0.301	0.301	0.314	0.513	0.255	0.68	0.321	< 0.854	--	< 0.478	< 0.698
Radium-226/228	pCi/L	5	NA	3.32	5	1.067	0.946	1.574	1.421	0.802	1.524	1.25	1.88	--	1.42	< 1.44
Radium-228	pCi/L	5	NA	NA	5	0.809	0.645	1.26	0.908	0.547	0.844	0.929	1.17	--	1.16	< 0.744
Selenium	ug/L	50	NA	2	50	< 1	< 1	2	< 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.

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 Techn

* - 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 rul

All metals were analyzed as total unless otherwise specified.

(1) DEK-MW-15001 was decommissioned on April 18, 2018.

(2) Outlier; single detection above reporting limit.

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

		Sample Location:				DEK-MW-15003										
		Sample Date:				12/10/2015	3/30/2016	5/26/2016	8/24/2016	12/1/2016	2/23/2017	5/18/2017	8/4/2017	9/18/2017	4/12/2018	5/23/2018
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS	downgradient										
Appendix III																
Boron	ug/L	NC	NA	619	NA	1,020	920	982	1,010	1,140	1,090	1,270	1,160	1,030	--	1,010
Calcium	mg/L	NC	NA	302	NA	41.7	57.3	56.3	64.1	64.1	85.4	68.2	58.8	62.1	--	58.1
Chloride	mg/L	250*	NA	2,440	NA	63.8	62	61.2	59.8	54.8	56.3	54.9	61.7	60.2	--	57.2
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	8.4	7.8	7.9	7.7	7.8	7.7	7.8	7.9	7.9	7.8	8.2
Sulfate	mg/L	250*	NA	407	NA	64.3	71.6	75.7	76.8	71.9	64.5	57.6	55.8	54.3	--	39.1
Total Dissolved Solids	mg/L	500*	NA	4,600	NA	370	400	420	430	440	430	420	506	426	--	354
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	498	517	543	527	525	372	450	437	--	478	450
Barium	ug/L	2,000	NA	1,300	2,000	96	69	68	73	71	71	66	68.5	--	61.2	73.3
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	2	2	2	< 1	< 1	< 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
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	22.8	22.6	26	27	30	30	35	35	--	39	33
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	8	7	8	6	5	5	5	5.0	--	< 5.0	5.3
Radium-226	pCi/L	5	NA	NA	5	< 0.221	< 0.227	< 0.235	< 0.184	< 0.287	0.252	< 0.324	0.226	--	0.686	< 0.842
Radium-226/228	pCi/L	5	NA	3.32	5	< 0.473	< 0.52	< 0.546	0.469	< 0.363	< 0.34	< 0.646	< 1.14	--	< 1.33	1.63
Radium-228	pCi/L	5	NA	NA	5	< 0.473	< 0.52	< 0.546	0.423	< 0.363	< 0.34	< 0.646	< 0.936	--	< 0.755	1.12
Selenium	ug/L	50	NA	2	50	< 5	< 1	2	< 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.
- 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 Techn
- * - 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 rule.
- All metals were analyzed as total unless otherwise specified.
- (1) DEK-MW-15001 was decommissioned on April 18, 2018.
- (2) Outlier; single detection above reporting limit.

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

		DEK-MW-15004																	
		downgradient																	
		downgradient																	
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS	12/10/2015	3/30/2016	5/26/2016	8/24/2016	12/1/2016	2/23/2017	5/18/2017	8/3/2017	8/3/2017	9/19/2017	9/19/2017	4/12/2018	5/23/2018	5/23/2018
Appendix III														Field Dup		Field Dup			Field Dup
Boron	ug/L	NC	NA	619	NA	478	435	514	472	535	637	839	785	768	730	750	--	800	842
Calcium	mg/L	NC	NA	302	NA	61.7	68.3	71.1	78.9	73	108	74.2	67.4	68.1	66.5	67.9	--	47.8	50.7
Chloride	mg/L	250*	NA	2,440	NA	71.5	72.7	72.3	77.4	73.3	75.3	70.3	81.4	81.5	79.8	79.9	--	72.5	72.6
Fluoride	ug/L	4,000	NA	1,000	NA	< 1,000	< 1,000	< 1,000	1,550	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	1,200	1,100	1,100
pH, Field	SU	6.5 - 8.5*	NA	6.5-7.3	NA	8.0	7.7	7.4	7.4	7.5	7.5	7.5	7.6	--	7.3	--	7.3	7.7	--
Sulfate	mg/L	250*	NA	407	NA	213	188	184	198	215	211	220	258	261	283	281	--	176	178
Total Dissolved Solids	mg/L	500*	NA	4,600	NA	680	560	560	580	590	580	590	642	582	596	564	--	494	504
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	56	95	108	104	117	116	111	121	129	--	--	134	119	126
Barium	ug/L	2,000	NA	1,300	2,000	107	94	102	110	115	110	103	111	115	--	--	86.9	79.6	82.6
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	< 1.0	< 1.0	--	--	< 1.0	< 1.0	< 1.0
Cobalt	ug/L	NC	6	15	15	< 15	< 15	< 15	< 15	< 15	< 15	< 15	< 15.0	< 15.0	--	--	< 15.0	< 15.0	< 15.0
Fluoride	ug/L	4,000	NA	1,000	4,000	< 1,000	< 1,000	< 1,000	1,550	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	1,200	1,100	1,100
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	35.8	29.5	36	34	37	36	38	39	38	--	--	39	30	32
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	29	25	21	24	27	30	29	30.4	31.4	--	--	32	30.9	30.4
Radium-226	pCi/L	5	NA	NA	5	< 0.258	0.4	0.233	0.264	0.244	0.328	0.347	0.805	< 0.623	--	--	< 0.641	< 0.791	< 0.679
Radium-226/228	pCi/L	5	NA	3.32	5	< 0.556	0.932	0.76	0.936	0.588	0.665	1.63	1.64	< 1.46	--	--	< 1.49	< 1.54	1.29
Radium-228	pCi/L	5	NA	NA	5	< 0.556	0.532	0.527	0.672	< 0.396	< 0.458	1.28	0.833	0.864	--	--	< 0.847	< 0.753	0.845
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 Techn
 * - 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 rule
 All metals were analyzed as total unless otherwise specified.
 (1) DEK-MW-15001 was decommissioned on April 18, 2018.
 (2) Outlier; single detection above reporting limit.

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

		Sample Location: DEK-MW-15005															
		Sample Date:															
		12/10/2015	3/30/2016	5/26/2016	8/24/2016	12/1/2016	2/23/2017	5/18/2017	8/3/2017	9/18/2017	4/11/2018	4/11/2018	5/24/2018				
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS downgradient												Field Dup
Appendix III																	
Boron	ug/L	NC	NA	619	NA	410	396	465	589	687	712	788	792	714	--	--	806
Calcium	mg/L	NC	NA	302	NA	58.5	68.6	72.7	98.4	71.1	76.3	55	49.2	44.3	--	--	33.4
Chloride	mg/L	250*	NA	2,440	NA	77.9	82.6	82.3	93.9	80.1	77.5	73.3	81.4	79.3	--	--	72.6
Fluoride	ug/L	4,000	NA	1,000	NA	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
pH, Field	SU	6.5 - 8.5*	NA	6.5-7.3	NA	8.0	7.7	7.5	7.6	7.7	7.7	7.6	7.9	7.9	7.7	--	7.8
Sulfate	mg/L	250*	NA	407	NA	223	251	269	355	329	281	263	300	273	--	--	182
Total Dissolved Solids	mg/L	500*	NA	4,600	NA	620	660	660	810	740	680	650	732	638	--	--	524
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	5	15	16	23	29	29	28	31.9	--	28.3	29.1	31.7
Barium	ug/L	2,000	NA	1,300	2,000	87	94	104	149	120	101	83	92.2	--	54.9	55.8	58.5
Beryllium	ug/L	4	NA	1	4	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	5	NA	0.2	5	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20
Chromium	ug/L	100	NA	3	100	< 1	1	1	< 1	< 1	1	2	< 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	23.7	23	29	30	26	23	26	27	--	24	24	19
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	40	33	32	37	44	40	36	41.9	--	39.0	40.5	41.9
Radium-226	pCi/L	5	NA	NA	5	< 0.238	0.263	0.18	0.3	0.367	0.49	< 0.321	0.707	--	< 0.587	0.606	< 0.740
Radium-226/228	pCi/L	5	NA	3.32	5	1.197	0.686	0.458	1.219	0.917	0.94	0.875	1.72	--	< 1.34	1.49	< 1.53
Radium-228	pCi/L	5	NA	NA	5	1.03	< 0.429	< 0.404	0.919	0.55	0.45	0.685	1.01	--	0.756	0.886	0.857
Selenium	ug/L	50	NA	2	50	2	< 1	1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0
Thallium	ug/L	2	NA	2	2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2.0	--	< 2.0	< 2.0	< 2.0

Notes:

ug/L - micrograms per liter.

mg/L - milligrams per liter.

SU - standard units; pH is a field parameter.

pCi/L - picocuries per liter.

NA - not applicable.

NC - no criteria.

-- - not analyzed.

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

RSL - Regional Screening Level from 83 FR 36435.

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

GWPS - Groundwater Protection Standard. GWPS is the higher of the MCL/RSL and UTL as established in TRC's Techn

* - 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 rule

All metals were analyzed as total unless otherwise specified.

(1) DEK-MW-15001 was decommissioned on April 18, 2018.

(2) Outlier; single detection above reporting limit.

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

		Sample Location:				DEK-MW-15006											DEK-MW-18001
		Sample Date:				12/10/2015	3/30/2016	5/25/2016	8/24/2016	12/1/2016	2/23/2017	5/18/2017	8/3/2017	9/18/2017	4/11/2018	5/24/2018	5/23/2018
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS	downgradient											
Appendix III																	
Boron	ug/L	NC	NA	619	NA	1,070	706	942	979	1,230	1,120	1,420	1,240	1,070	--	1,200	1,600
Calcium	mg/L	NC	NA	302	NA	196	130	105	130	79.1	83.9	38.6	39.9	76.8	--	21.9	64.9
Chloride	mg/L	250*	NA	2,440	NA	153	152	135	188	128	102	97.1	104	133	--	85.8	69.1
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	7.4	7.5	7.5	7.6	7.8	7.7	8.1	7.9	7.8	7.9	8.2	7.8
Sulfate	mg/L	250*	NA	407	NA	1,320	1,130	917	1,160	886	636	513	547	886	--	401	30.6
Total Dissolved Solids	mg/L	500*	NA	4,600	NA	2,400	2,100	1,700	2,200	1,800	1,300	1,100	1,110	1,670	--	944	434
Appendix IV																	
Antimony	ug/L	6	NA	1	6	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	10	NA	21	21	13	19	18	20	20	20	20	14.6	--	18.3	25.7	225
Barium	ug/L	2,000	NA	1,300	2,000	97	55	44	58	41	30	27	31.0	--	39.6	22.8	101
Beryllium	ug/L	4	NA	1	4	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	5	NA	0.2	5	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20
Chromium	ug/L	100	NA	3	100	< 1	1	1	< 1	1	1	2	< 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	320 ⁽²⁾	< 1.0
Lithium	ug/L	NC	40	180	180	36.1	20.7	22	22	19	16	16	17	--	18	< 10	23
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	23	37	34	36	64	82	68	64.2	--	71.6	48.7	< 5.0
Radium-226	pCi/L	5	NA	NA	5	0.392	0.363	0.463	0.286	< 0.362	< 0.307	< 0.354	< 0.945	--	< 0.688	< 0.738	0.906
Radium-226/228	pCi/L	5	NA	3.32	5	1.293	1.106	0.964	0.748	< 0.421	< 0.562	0.585	< 1.85	--	< 1.44	< 1.86	1.63
Radium-228	pCi/L	5	NA	NA	5	0.901	0.743	0.501	< 0.578	< 0.421	< 0.562	0.483	< 0.906	--	< 0.755	< 1.12	< 0.733
Selenium	ug/L	50	NA	2	50	3	2	2	< 1	< 1	1	1	< 1.0	--	< 1.0	< 1.0	< 1.0
Thallium	ug/L	2	NA	2	2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2.0	--	< 2.0	< 2.0	< 2.0

Notes:

ug/L - micrograms per liter.

mg/L - milligrams per liter.

SU - standard units; pH is a field parameter.

pCi/L - picocuries per liter.

NA - not applicable.

NC - no criteria.

-- - not analyzed.

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

RSL - Regional Screening Level from 83 FR 36435.

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

GWPS - Groundwater Protection Standard. GWPS is the higher of the MCL/RSL and UTL as established in TRC's Techn

* - 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 rul

All metals were analyzed as total unless otherwise specified.

(1) DEK-MW-15001 was decommissioned on April 18, 2018.

(2) Outlier; single detection above reporting limit.

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

Constituent	Units	GWPS	DEK-MW-15001		DEW-MW-15002		DEK-MW-15003		DEK-MW-15004		DEK-MW-15005		DEK-MW-15006	
			LCL	UCL	LCL	UCL	LCL	UCL	LCL	UCL	LCL	UCL	LCL	UCL
Arsenic	ug/L	21	110	160	52	79	410	530	110	130	22	32	16	23

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.

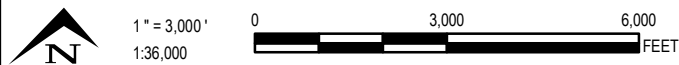
LCL - Lower Confidence Limit ($\alpha = 0.01$) of the downgradient data set.

 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

TRC - GIS

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

TITLE:
SITE LOCATION MAP

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

FIGURE 1



LEGEND

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

- ### NOTES
1. BASE MAP IMAGERY FROM USDA - NATIONAL AGRICULTURE IMAGERY PROGRAM, 7/10/2016.
 2. WELL LOCATIONS SURVEYED BY ROWE PROFESSIONAL SERVICES COMPANY ON 11/4/2015.
 3. NOAA/NATIONAL OCEANIC SERVICE GREAT LAKES GAUGING STATION, ESSEXVILLE, MI (ID: 9075035).

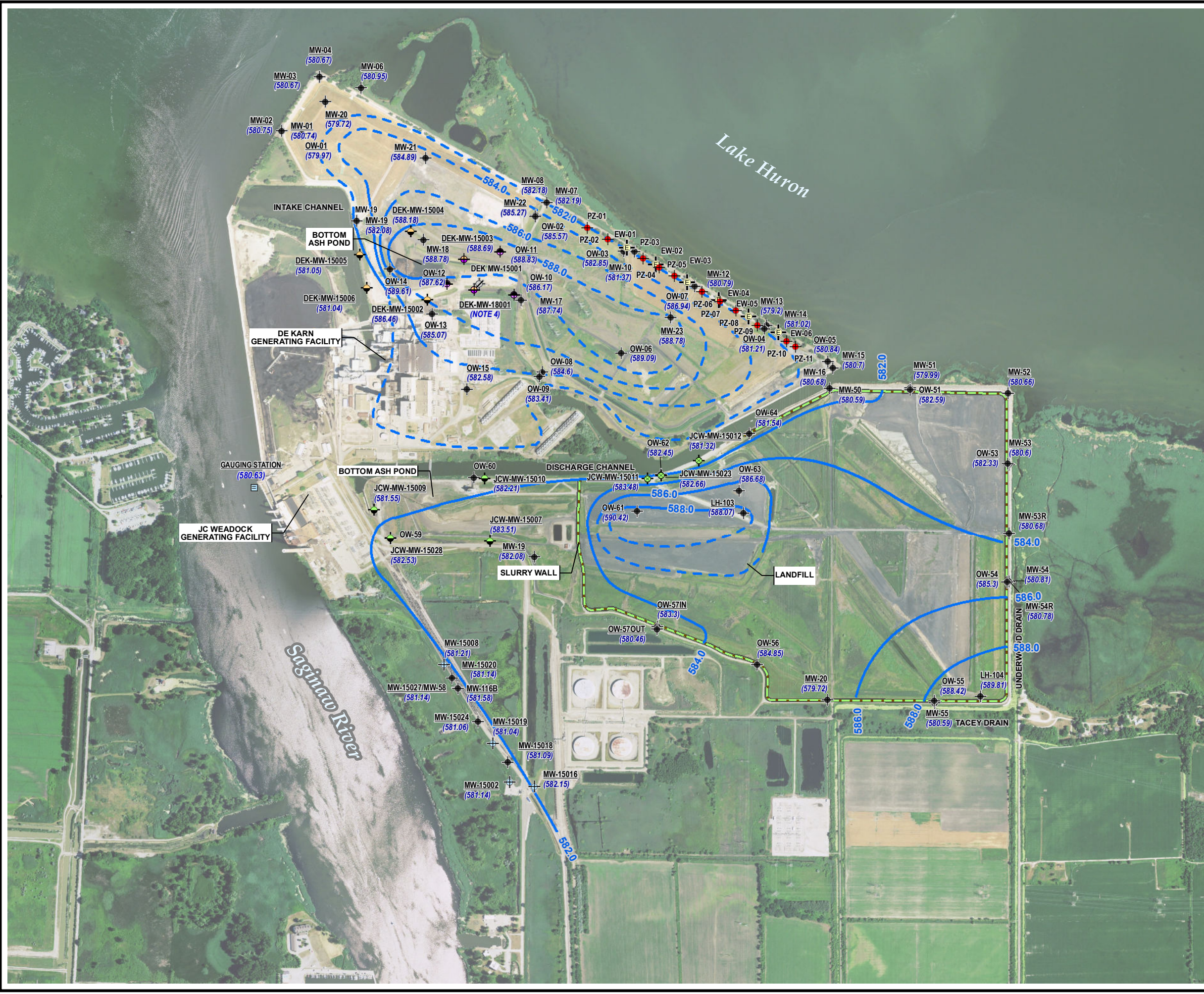
0 1,000 2,000 Feet

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.

0 1,000 2,000 Feet

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

PROJECT:		CONSUMERS ENERGY COMPANY DE KARN AND JC WEADOCK POWER PLANTS ESSEXVILLE, MICHIGAN	
TITLE:		SHALLOW GROUNDWATER CONTOUR MAP MAY 2018	
DRAWN BY:	S. MAJOR	PROJ NO.:	290805-001
CHECKED BY:	C. SCIESZKA	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 11/13/2018 3:24 PM
 Client: Consumers Energy Data: DEK_BAP_CCR_Sanitas_18.21.08

For observations made between 12/10/2015 and 5/24/2018, a summary of the selected data set:

Observations = 60
 ND/Trace = 60
 Wells = 7
 Minimum Value = 0.5
 Maximum Value = 0.5
 Mean Value = 0.5
 Median Value = 0.5
 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>
DEK-MW-15001	9	9	0.5	0.5	0.5	0.5	0	0	NaN
DEK-MW-15002	10	10	0.5	0.5	0.5	0.5	0	0	NaN
DEK-MW-15003	10	10	0.5	0.5	0.5	0.5	0	0	NaN
DEK-MW-15004	10	10	0.5	0.5	0.5	0.5	0	0	NaN
DEK-MW-15005	10	10	0.5	0.5	0.5	0.5	0	0	NaN
DEK-MW-15006	10	10	0.5	0.5	0.5	0.5	0	0	NaN
DEK-MW-18001	1	1	0.5	0.5	0.5	0.5	0	0	NaN

Summary Report

Constituent: Arsenic, Total Analysis Run 11/13/2018 3:24 PM
 Client: Consumers Energy Data: DEK_BAP_CCR_Sanitas_18.21.08

For observations made between 12/10/2015 and 5/24/2018, a summary of the selected data set:

Observations = 60
 ND/Trace = 0
 Wells = 7
 Minimum Value = 5
 Maximum Value = 543
 Mean Value = 140.8
 Median Value = 88.5
 Standard Deviation = 161.5
 Coefficient of Variation = 1.147
 Skewness = 1.522

<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>
DEK-MW-15001	9	0	103	159	134	138	20.41	0.1523	-0.306
DEK-MW-15002	10	0	48.3	118	70.37	64.5	20.08	0.2854	1.318
DEK-MW-15003	10	0	372	543	479.7	488	52.93	0.1103	-0.6865
DEK-MW-15004	10	0	56	134	108.9	113.5	21.63	0.1987	-1.467
DEK-MW-15005	10	0	5	31.9	23.73	28.35	8.92	0.3759	-1.016
DEK-MW-15006	10	0	13	25.7	18.86	19.5	3.424	0.1816	0.1359
DEK-MW-18001	1	0	225	225	225	225	0	0	NaN

Summary Report

Constituent: Barium, Total Analysis Run 11/13/2018 3:24 PM
 Client: Consumers Energy Data: DEK_BAP_CCR_Sanitas_18.21.08

For observations made between 12/10/2015 and 5/24/2018, a summary of the selected data set:

Observations = 60
 ND/Trace = 0
 Wells = 7
 Minimum Value = 22.8
 Maximum Value = 149
 Mean Value = 87.45
 Median Value = 93.1
 Standard Deviation = 29.85
 Coefficient of Variation = 0.3414
 Skewness = -0.1896

<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>
DEK-MW-15001	9	0	69	117	94.58	95	16.02	0.1694	-0.2587
DEK-MW-15002	10	0	82.7	148	116.6	120.5	23.19	0.1988	-0.2609
DEK-MW-15003	10	0	61.2	96	71.7	70	9.248	0.129	1.912
DEK-MW-15004	10	0	81.1	115	102.2	105	11.41	0.1117	-0.7176
DEK-MW-15005	10	0	55.35	149	94.41	93.1	27.44	0.2906	0.4134
DEK-MW-15006	10	0	22.8	97	44.54	40.3	21.74	0.4882	1.442
DEK-MW-18001	1	0	101	101	101	101	0	0	NaN

Summary Report

Constituent: Beryllium, Total Analysis Run 11/13/2018 3:24 PM
Client: Consumers Energy Data: DEK_BAP_CCR_Sanitas_18.21.08

For observations made between 12/10/2015 and 5/24/2018, a summary of the selected data set:

Observations = 60
ND/Trace = 60
Wells = 7
Minimum Value = 0.5
Maximum Value = 0.5
Mean Value = 0.5
Median Value = 0.5
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>
DEK-MW-15001	9	9	0.5	0.5	0.5	0.5	0	0	NaN
DEK-MW-15002	10	10	0.5	0.5	0.5	0.5	0	0	NaN
DEK-MW-15003	10	10	0.5	0.5	0.5	0.5	0	0	NaN
DEK-MW-15004	10	10	0.5	0.5	0.5	0.5	0	0	NaN
DEK-MW-15005	10	10	0.5	0.5	0.5	0.5	0	0	NaN
DEK-MW-15006	10	10	0.5	0.5	0.5	0.5	0	0	NaN
DEK-MW-18001	1	1	0.5	0.5	0.5	0.5	0	0	NaN

Summary Report

Constituent: Cadmium, Total Analysis Run 11/13/2018 3:24 PM
Client: Consumers Energy Data: DEK_BAP_CCR_Sanitas_18.21.08

For observations made between 12/10/2015 and 5/24/2018, a summary of the selected data set:

Observations = 60
ND/Trace = 60
Wells = 7
Minimum Value = 0.1
Maximum Value = 0.1
Mean Value = 0.1
Median Value = 0.1
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>
DEK-MW-15001	9	9	0.1	0.1	0.1	0.1	0	0	NaN
DEK-MW-15002	10	10	0.1	0.1	0.1	0.1	0	0	NaN
DEK-MW-15003	10	10	0.1	0.1	0.1	0.1	0	0	NaN
DEK-MW-15004	10	10	0.1	0.1	0.1	0.1	0	0	NaN
DEK-MW-15005	10	10	0.1	0.1	0.1	0.1	0	0	NaN
DEK-MW-15006	10	10	0.1	0.1	0.1	0.1	0	0	NaN
DEK-MW-18001	1	1	0.1	0.1	0.1	0.1	0	0	NaN

Summary Report

Constituent: Chromium, Total Analysis Run 11/13/2018 3:24 PM
 Client: Consumers Energy Data: DEK_BAP_CCR_Sanitas_18.21.08

For observations made between 12/10/2015 and 5/24/2018, a summary of the selected data set:

Observations = 60
 ND/Trace = 37
 Wells = 7
 Minimum Value = 0.5
 Maximum Value = 2
 Mean Value = 0.8417
 Median Value = 0.5
 Standard Deviation = 0.5328
 Coefficient of Variation = 0.633
 Skewness = 1.421

<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>
DEK-MW-15001	9	7	0.5	1	0.6111	0.5	0.2205	0.3608	1.336
DEK-MW-15002	10	4	0.5	2	1.1	1	0.6583	0.5984	0.542
DEK-MW-15003	10	6	0.5	2	1	0.5	0.7071	0.7071	0.7454
DEK-MW-15004	10	8	0.5	2	0.7	0.5	0.483	0.6901	2.245
DEK-MW-15005	10	6	0.5	2	0.8	0.5	0.483	0.6038	1.652
DEK-MW-15006	10	5	0.5	2	0.85	0.75	0.4743	0.558	1.449
DEK-MW-18001	1	1	0.5	0.5	0.5	0.5	0	0	NaN

Summary Report

Constituent: Cobalt, Total Analysis Run 11/13/2018 3:24 PM
 Client: Consumers Energy Data: DEK_BAP_CCR_Sanitas_18.21.08

For observations made between 12/10/2015 and 5/24/2018, a summary of the selected data set:

Observations = 60
 ND/Trace = 60
 Wells = 7
 Minimum Value = 7.5
 Maximum Value = 7.5
 Mean Value = 7.5
 Median Value = 7.5
 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>
DEK-MW-15001	9	9	7.5	7.5	7.5	7.5	0	0	NaN
DEK-MW-15002	10	10	7.5	7.5	7.5	7.5	0	0	NaN
DEK-MW-15003	10	10	7.5	7.5	7.5	7.5	0	0	NaN
DEK-MW-15004	10	10	7.5	7.5	7.5	7.5	0	0	NaN
DEK-MW-15005	10	10	7.5	7.5	7.5	7.5	0	0	NaN
DEK-MW-15006	10	10	7.5	7.5	7.5	7.5	0	0	NaN
DEK-MW-18001	1	1	7.5	7.5	7.5	7.5	0	0	NaN

Summary Report

Constituent: Fluoride Analysis Run 11/13/2018 3:24 PM
 Client: Consumers Energy Data: DEK_BAP_CCR_Sanitas_18.21.08

For observations made between 12/10/2015 and 5/24/2018, a summary of the selected data set:

Observations = 66
 ND/Trace = 54
 Wells = 7
 Minimum Value = 500
 Maximum Value = 2100
 Mean Value = 679.7
 Median Value = 500
 Standard Deviation = 400.4
 Coefficient of Variation = 0.5891
 Skewness = 1.973

<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>
DEK-MW-15001	10	1	500	2100	1451	1515	416	0.2867	-0.9532
DEK-MW-15002	11	11	500	500	500	500	0	0	NaN
DEK-MW-15003	11	11	500	500	500	500	0	0	NaN
DEK-MW-15004	11	8	500	1550	713.6	500	380.8	0.5337	1.291
DEK-MW-15005	11	11	500	500	500	500	0	0	NaN
DEK-MW-15006	11	11	500	500	500	500	0	0	NaN
DEK-MW-18001	1	1	500	500	500	500	0	0	NaN

Summary Report

Constituent: Lead, Total Analysis Run 11/13/2018 3:24 PM
 Client: Consumers Energy Data: DEK_BAP_CCR_Sanitas_18.21.08

For observations made between 12/10/2015 and 5/24/2018, a summary of the selected data set:

Observations = 60
 ND/Trace = 58
 Wells = 7
 Minimum Value = 0.5
 Maximum Value = 320
 Mean Value = 5.867
 Median Value = 0.5
 Standard Deviation = 41.24
 Coefficient of Variation = 7.03
 Skewness = 7.55

<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>
DEK-MW-15001	9	9	0.5	0.5	0.5	0.5	0	0	NaN
DEK-MW-15002	10	9	0.5	3	0.75	0.5	0.7906	1.054	2.667
DEK-MW-15003	10	10	0.5	0.5	0.5	0.5	0	0	NaN
DEK-MW-15004	10	10	0.5	0.5	0.5	0.5	0	0	NaN
DEK-MW-15005	10	10	0.5	0.5	0.5	0.5	0	0	NaN
DEK-MW-15006	10	9	0.5	320	32.45	0.5	101	3.114	2.667
DEK-MW-18001	1	1	0.5	0.5	0.5	0.5	0	0	NaN

Summary Report

Constituent: Lithium, Total Analysis Run 11/13/2018 3:24 PM
 Client: Consumers Energy Data: DEK_BAP_CCR_Sanitas_18.21.08

For observations made between 12/10/2015 and 5/24/2018, a summary of the selected data set:

Observations = 60
 ND/Trace = 1
 Wells = 7
 Minimum Value = 5
 Maximum Value = 71.9
 Mean Value = 34.07
 Median Value = 34.5
 Standard Deviation = 12.87
 Coefficient of Variation = 0.3777
 Skewness = 0.4853

<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>
DEK-MW-15001	9	0	48	71.9	55.07	53	7.41	0.1346	1.389
DEK-MW-15002	10	0	35	53	42.77	42.5	5.645	0.132	0.4979
DEK-MW-15003	10	0	22.6	39	30.04	30	5.493	0.1829	0.07344
DEK-MW-15004	10	0	29.5	39	35.48	36	3.142	0.08855	-0.8158
DEK-MW-15005	10	0	19	30	25.07	25	3.226	0.1287	-0.195
DEK-MW-15006	10	1	5	36.1	19.18	18.5	7.688	0.4008	0.5064
DEK-MW-18001	1	0	23	23	23	23	0	0	NaN

Summary Report

Constituent: Mercury, Total Analysis Run 11/13/2018 3:24 PM
Client: Consumers Energy Data: DEK_BAP_CCR_Sanitas_18.21.08

For observations made between 12/10/2015 and 5/24/2018, a summary of the selected data set:

Observations = 60
ND/Trace = 60
Wells = 7
Minimum Value = 0.1
Maximum Value = 0.1
Mean Value = 0.1
Median Value = 0.1
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>
DEK-MW-15001	9	9	0.1	0.1	0.1	0.1	0	0	NaN
DEK-MW-15002	10	10	0.1	0.1	0.1	0.1	0	0	NaN
DEK-MW-15003	10	10	0.1	0.1	0.1	0.1	0	0	NaN
DEK-MW-15004	10	10	0.1	0.1	0.1	0.1	0	0	NaN
DEK-MW-15005	10	10	0.1	0.1	0.1	0.1	0	0	NaN
DEK-MW-15006	10	10	0.1	0.1	0.1	0.1	0	0	NaN
DEK-MW-18001	1	1	0.1	0.1	0.1	0.1	0	0	NaN

Summary Report

Constituent: Molybdenum, Total Analysis Run 11/13/2018 3:24 PM
 Client: Consumers Energy Data: DEK_BAP_CCR_Sanitas_18.21.08

For observations made between 12/10/2015 and 5/24/2018, a summary of the selected data set:

Observations = 60
 ND/Trace = 11
 Wells = 7
 Minimum Value = 2.5
 Maximum Value = 82
 Mean Value = 26.31
 Median Value = 29
 Standard Deviation = 19.65
 Coefficient of Variation = 0.7471
 Skewness = 0.5961

<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>
DEK-MW-15001	9	9	2.5	2.5	2.5	2.5	0	0	NaN
DEK-MW-15002	10	0	19	41	30.39	29.5	6.373	0.2097	0.06221
DEK-MW-15003	10	1	2.5	8	5.68	5.15	1.657	0.2918	-0.1586
DEK-MW-15004	10	0	21	32	27.86	29	3.531	0.1268	-0.716
DEK-MW-15005	10	0	32	44	38.56	39.88	3.95	0.1024	-0.4362
DEK-MW-15006	10	0	23	82	52.85	56.35	19.67	0.3722	-0.0684
DEK-MW-18001	1	1	2.5	2.5	2.5	2.5	0	0	NaN

Summary Report

Constituent: Radium-226 Analysis Run 11/13/2018 3:24 PM
 Client: Consumers Energy Data: DEK_BAP_CCR_Sanitas_18.21.08

For observations made between 12/10/2015 and 5/24/2018, a summary of the selected data set:

Observations = 60
 ND/Trace = 29
 Wells = 7
 Minimum Value = 0.092
 Maximum Value = 0.906
 Mean Value = 0.3169
 Median Value = 0.3005
 Standard Deviation = 0.1707
 Coefficient of Variation = 0.5387
 Skewness = 1.073

<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>
DEK-MW-15001	9	6	0.0975	0.565	0.2676	0.24	0.1602	0.5985	0.8026
DEK-MW-15002	10	4	0.1505	0.68	0.3549	0.3175	0.1516	0.4271	0.9177
DEK-MW-15003	10	7	0.092	0.686	0.2324	0.1528	0.1875	0.8069	1.62
DEK-MW-15004	10	3	0.129	0.5583	0.3219	0.3242	0.1167	0.3625	0.408
DEK-MW-15005	10	3	0.119	0.707	0.3406	0.3335	0.178	0.5225	0.6742
DEK-MW-15006	10	6	0.1535	0.4725	0.3201	0.3535	0.1166	0.3643	-0.2399
DEK-MW-18001	1	0	0.906	0.906	0.906	0.906	0	0	NaN

Summary Report

Constituent: Radium-226/228 Analysis Run 11/13/2018 3:24 PM
 Client: Consumers Energy Data: DEK_BAP_CCR_Sanitas_18.21.08

For observations made between 12/10/2015 and 5/24/2018, a summary of the selected data set:

Observations = 60
 ND/Trace = 21
 Wells = 7
 Minimum Value = 0.17
 Maximum Value = 1.88
 Mean Value = 0.892
 Median Value = 0.898
 Standard Deviation = 0.4486
 Coefficient of Variation = 0.503
 Skewness = 0.1682

<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>
DEK-MW-15001	9	4	0.2025	1.564	0.9042	0.879	0.4621	0.511	-0.3141
DEK-MW-15002	10	1	0.72	1.88	1.26	1.335	0.3714	0.2947	0.006358
DEK-MW-15003	10	8	0.17	1.63	0.4778	0.298	0.4378	0.9164	2.017
DEK-MW-15004	10	2	0.278	1.63	0.8749	0.846	0.3667	0.4191	0.5114
DEK-MW-15005	10	1	0.458	1.72	0.9857	0.9285	0.3469	0.352	0.6522
DEK-MW-15006	10	5	0.2105	1.293	0.7763	0.8365	0.3436	0.4427	-0.3532
DEK-MW-18001	1	0	1.63	1.63	1.63	1.63	0	0	NaN

Summary Report

Constituent: Radium-228 Analysis Run 11/13/2018 3:24 PM
 Client: Consumers Energy Data: DEK_BAP_CCR_Sanitas_18.21.08

For observations made between 12/10/2015 and 5/24/2018, a summary of the selected data set:

Observations = 60
 ND/Trace = 25
 Wells = 7
 Minimum Value = 0.17
 Maximum Value = 1.32
 Mean Value = 0.6102
 Median Value = 0.5395
 Standard Deviation = 0.3349
 Coefficient of Variation = 0.5488
 Skewness = 0.5017

<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>
DEK-MW-15001	9	3	0.2025	1.32	0.7369	0.642	0.4127	0.56	0.06199
DEK-MW-15002	10	1	0.372	1.26	0.8644	0.876	0.2864	0.3313	-0.2267
DEK-MW-15003	10	8	0.17	1.12	0.3832	0.298	0.2769	0.7226	2.074
DEK-MW-15004	10	4	0.198	1.28	0.5599	0.5295	0.3262	0.5825	0.9804
DEK-MW-15005	10	2	0.202	1.03	0.6739	0.753	0.3081	0.4572	-0.432
DEK-MW-15006	10	6	0.2105	0.901	0.4799	0.468	0.2143	0.4465	0.6898
DEK-MW-18001	1	1	0.3665	0.3665	0.3665	0.3665	0	0	NaN

Summary Report

Constituent: Selenium, Total Analysis Run 11/13/2018 3:24 PM
 Client: Consumers Energy Data: DEK_BAP_CCR_Sanitas_18.21.08

For observations made between 12/10/2015 and 5/24/2018, a summary of the selected data set:

Observations = 60
 ND/Trace = 44
 Wells = 7
 Minimum Value = 0.5
 Maximum Value = 4
 Mean Value = 0.92
 Median Value = 0.5
 Standard Deviation = 0.8198
 Coefficient of Variation = 0.8911
 Skewness = 2.002

<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>
DEK-MW-15001	9	3	0.5	4	1.744	1.2	1.313	0.753	0.5321
DEK-MW-15002	10	9	0.5	2	0.65	0.5	0.4743	0.7298	2.667
DEK-MW-15003	10	9	0.5	2.5	0.85	0.5	0.7472	0.8791	1.592
DEK-MW-15004	10	9	0.5	1	0.55	0.5	0.1581	0.2875	2.667
DEK-MW-15005	10	8	0.5	2	0.7	0.5	0.483	0.6901	2.245
DEK-MW-15006	10	5	0.5	3	1.15	0.75	0.8835	0.7683	1.05
DEK-MW-18001	1	1	0.5	0.5	0.5	0.5	0	0	NaN

Summary Report

Constituent: Thallium, Total Analysis Run 11/13/2018 3:24 PM
Client: Consumers Energy Data: DEK_BAP_CCR_Sanitas_18.21.08

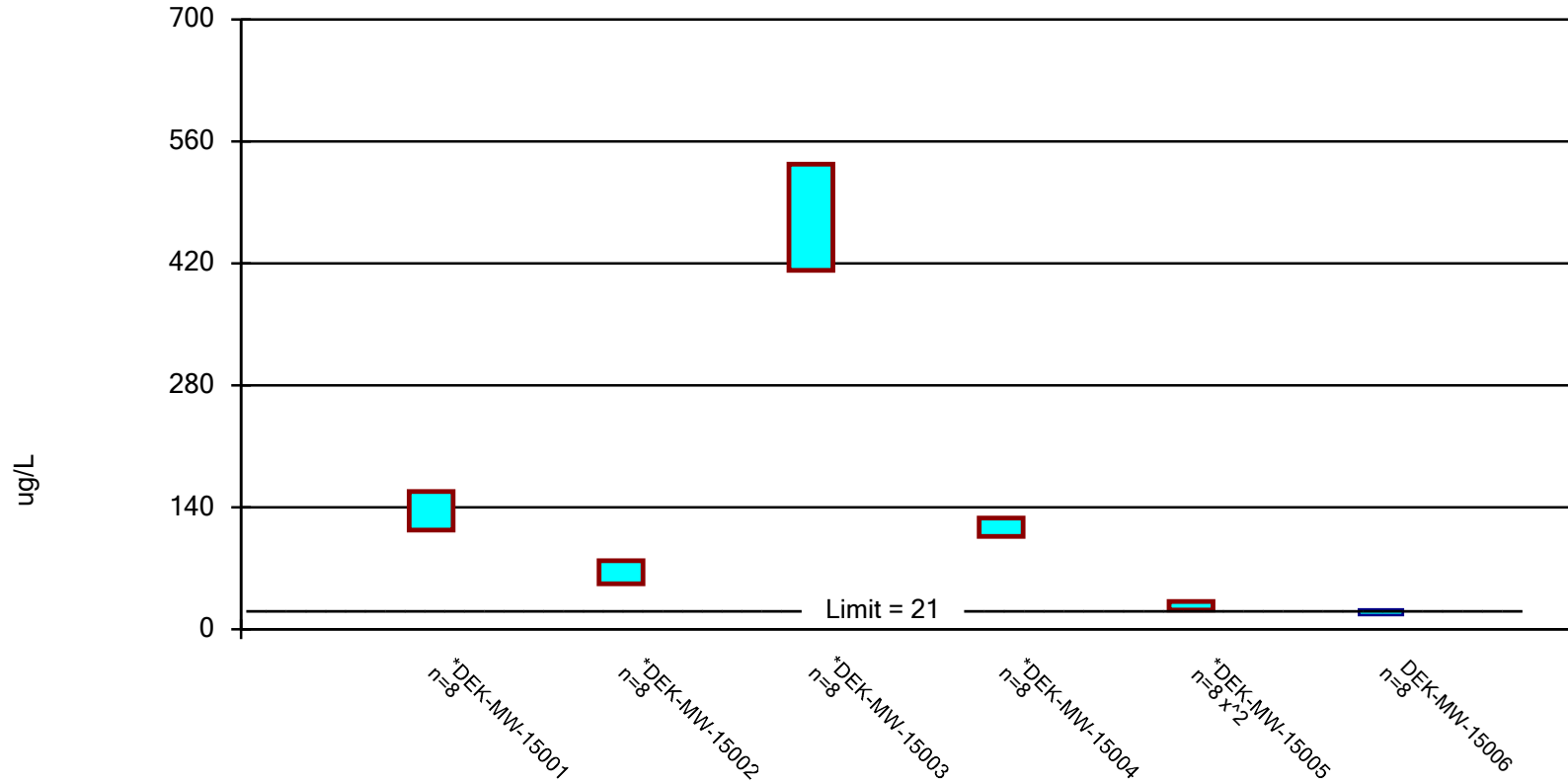
For observations made between 12/10/2015 and 5/24/2018, a summary of the selected data set:

Observations = 60
ND/Trace = 60
Wells = 7
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>
DEK-MW-15001	9	9	1	1	1	1	0	0	NaN
DEK-MW-15002	10	10	1	1	1	1	0	0	NaN
DEK-MW-15003	10	10	1	1	1	1	0	0	NaN
DEK-MW-15004	10	10	1	1	1	1	0	0	NaN
DEK-MW-15005	10	10	1	1	1	1	0	0	NaN
DEK-MW-15006	10	10	1	1	1	1	0	0	NaN
DEK-MW-18001	1	1	1	1	1	1	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 9/28/2018 1:03 PM
Client: Consumers Energy Data: DEK_BAP_CCR_Sanitas_18.21.08

Confidence Interval

Constituent: Arsenic, Total (ug/L) Analysis Run 9/28/2018 1:32 PM

Client: Consumers Energy Data: DEK_BAP_CCR_Sanitas_18.21.08

	DEK-MW-15001	DEK-MW-15002	DEK-MW-15003	DEK-MW-15004	DEK-MW-15005	DEK-MW-15006
3/30/2016	159					
5/26/2016	138	82	543	108	16	18
8/24/2016	108	79				
8/25/2016			527	104	23	20
12/1/2016	144	54	525			
12/2/2016				117	29	20
2/23/2017				116	29	20
2/24/2017	133	62	372			
5/18/2017	145				28	20
5/19/2017		76	450	111		
8/3/2017	158	48.3		125 (D)		14.6
8/4/2017			437		31.9	
4/10/2018	103					
4/11/2018					28.7 (D)	
4/12/2018		56.4	478	134		18.3
5/23/2018				122.5 (D)		
5/24/2018		67	450		31.7	25.7
Mean	136	65.59	472.8	117.2	27.16	19.58
Std. Dev.	20.85	12.48	57.45	9.783	5.275	3.096
Upper Lim.	158.1	78.81	533.6	127.6	32.11	22.86
Lower Lim.	113.9	52.36	411.9	106.8	22.2	16.29

Appendix E

April 2019 Assessment Monitoring Data Summary and Statistical Evaluation

Technical Memorandum

Date: July 8, 2019

To: J.R. Register, CEC

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

cc: Brad Runkel, CEC
Bethany Swanberg, CEC

Project No.: 322172.0000 Phase 001, Task 003

Subject: Statistical Evaluation of April 2019 Assessment Monitoring Sampling Event
DE Karn Bottom Ash Pond, 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 DE Karn Power Plant (DEK) Bottom Ash Pond (BAP). The first semiannual assessment monitoring event for 2019 was conducted on April 8 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 statistical evaluation of the third semiannual assessment monitoring event data indicate the following constituent is present at statistically significant levels exceeding the GWPS in downgradient monitoring wells at the DEK Bottom Ash Pond:

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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<u>Constituent</u>	<u>GWPS</u>	<u>#Downgradient Wells Observed</u>
Arsenic	21 ug/L	4 of 6

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

Assessment Monitoring Statistical Evaluation

The compliance well network at the DEK BAP CCR Unit includes six wells encircling the unit (DEK-MW-15002 through DEK-MW-15006 and DEK-MW-18001). Former downgradient monitoring well DEK-MW-15001 was decommissioned on April 18, 2018 to allow for construction of the new Karn Lined Impoundment CCR unit. DEK-MW-18001 was installed approximately 80 feet southeast of the former DEK-MW-15001 location to maintain the perimeter downgradient monitoring well network. Although DEK-MW-18001 is considered to be a replacement well, the data from the two wells are not being combined in the statistical analyses at this time as groundwater chemistry data at DEK-MW-18001 is not comparable to DEK-MW-15001. Therefore, the statistical analysis for DEK-MW-15001 terminates at the April 2018 sampling event and statistical analysis for DEK-MW-18001 commences with the first semiannual assessment monitoring event for 2019, following the collection of the minimum of four independent sampling events. Three rounds of assessment monitoring data have been collected for DEK-MW-18001; however, DEK-MW-18001 is also included in the detection monitoring well network for the new Karn Lined Impoundment (KLI) CCR Unit. Therefore, data from the third quarter 2018 background monitoring event for the KLI CCR Unit has been used to supplement the assessment monitoring data at DEK-MW-18001 to provide the minimum of four independent sampling events.

Following the first semiannual assessment monitoring sampling event for 2019, compliance well data for the DEK BAP were evaluated in accordance with the *Groundwater Statistical Evaluation Plan* (Stats Plan) (TRC, October 2017). An assessment monitoring program was developed to evaluate concentrations of CCR constituents present in the uppermost aquifer relative to acceptable levels (i.e., GWPSs). To evaluate whether or not a GWPS exceedance is statistically significant, the difference in concentration observed at the downgradient wells during a given assessment monitoring event compared to the GWPS must be large enough, after accounting for variability in the sample data, that the result is unlikely to have occurred merely by chance. Consistent with the Unified Guidance², 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

² 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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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 confidence that the measured concentrations are different from the GWPS and thus no compelling evidence that the measured concentration is a result of a release from the CCR unit versus the inherent variability of the sample data. This statistical approach is consistent with the statistical methods for assessment monitoring presented in §257.93(f) and (g). Statistical evaluation methodologies built into the CCR Rule, and numerous other federal rules, are key in determining whether or not individually measured data points represent a concentration increase over the baseline or a fixed standard (such as a GWPS in an assessment monitoring program).

For each detected Appendix IV constituent, the concentrations from each well were first compared directly to the GWPS, as shown on Table 1. Parameter-well combinations that included a direct exceedance of the GWPS within the past eight sampling events (December 2016 through April 2019) were retained for further analysis. Arsenic in each of the downgradient monitoring wells at the Bottom Ash Pond had individual results exceeding the GWPS. Lead was detected in DEK-MW-15006 during May 2018 at a concentration of 320 ug/L, which exceeds its GWPS. However, this is the only detection of lead in the Bottom Ash Pond wells during either baseline sampling or assessment monitoring. Sampling conducted in November 2018 did not confirm the lead detection. Therefore, the single detection was classified as an outlier per the Double Quantification Rule as outlined in the Stats Plan and the Unified Guidance. As a result, only arsenic was retained for evaluation in all downgradient monitoring wells. In DEK-MW-15003, beryllium, cobalt, and thallium reporting limits exceeded the GWPSs in April 2019 due to sample dilutions performed due to the nature of the sample matrix. Beryllium, cobalt and thallium have historically been non-detect at this location. Therefore, the elevated reporting limits are treated as outliers and no statistical evaluation will be completed for these parameter-well combinations.

Groundwater data were then evaluated utilizing Sanitas™ statistical software. Sanitas™ is a software tool that is commercially available for performing statistical evaluation consistent with procedures outlined in the Unified Guidance. Within the Sanitas™ statistical program, confidence limits were selected to perform the statistical comparison of compliance data to a fixed standard. Parametric and non-parametric confidence intervals were calculated for each of the CCR Appendix IV parameters using a using a per test³ 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:

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

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

The results of these evaluations are presented and discussed below.

Initially, the baseline (December 2015 through August 2017) results and the assessment monitoring results (April 2018 through April 2019) were observed visually for potential trends. No outliers or trends were identified. Data from each round were evaluated for completeness, overall quality, and usability and were deemed appropriate for the purposes of the CCR assessment monitoring program. The Sanitas™ software was then used to test compliance at the downgradient monitoring wells using the confidence interval method for the most recent 8 sampling events, with the exception of DEK-MW-18001, for which only four independent sampling events have been completed. 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-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 for well/constituent pairs with a direct GWPS exceedance 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. Note that, as mentioned above, the statistical analysis for DEK-MW-15001 terminates at the April 2018 sampling event as it was decommissioned on April 18, 2018, and statistical analysis for DEK-MW-18001 commences with the first semiannual sampling event for 2019.

The Sanitas™ software generates an output graph for the confidence intervals of each well. In each case, the data sets were found to be normally distributed. The confidence interval test compares the lower confidence limit to the GWPS. The statistical evaluation of the Appendix IV parameters shows exceedances for arsenic at four of the six monitoring locations (DEK-MW-15002 through DEK-MW-15005). These results are consistent with the results of the previous assessment monitoring data statistical evaluations and CEC will continue the assessment of corrective measures per §257.95(g). CEC will continue executing the self-implementing groundwater compliance schedule in conformance with §257.90 - §257.98.

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Attachments

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

Attachment 1 Sanitas™ Output Files

Table

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

		Sample Location:				DEK-MW-15001 ⁽¹⁾									
		Sample Date:				12/10/2015	3/30/2016	5/26/2016	8/24/2016	12/1/2016	2/23/2017	5/18/2017	8/3/2017	9/18/2017	4/10/2018
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS	downgradient									
Appendix III															
Boron	ug/L	NC	NA	619	NA	3,630	2,420	3,110	2,810	2,740	2,520	3,270	2,690	2,700	--
Calcium	mg/L	NC	NA	302	NA	108	87.8	92.2	95	75.1	96.8	85.8	71.8	82.4	--
Chloride	mg/L	250*	NA	2,440	NA	75.7	79.0	75.7	72.5	71.0	76.5	75.0	81.9	82.2	--
Fluoride	ug/L	4,000	NA	1,000	NA	< 1,000	1,530	1,440	1,160	1,500	1,650	1,330	1,700	2,100	1,600
Sulfate	mg/L	250*	NA	407	NA	72.4	53.3	64.9	37.4	52.7	53.4	59.9	66.3	36.2	--
Total Dissolved Solids	mg/L	500*	NA	4,600	NA	600	470	510	480	470	450	510	516	594	--
pH, Field	SU	6.5 - 8.5*	NA	6.5-7.3	NA	7.6	7.5	7.5	7.4	7.4	7.4	7.4	7.6	7.5	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	118	159	138	108	144	133	145	158	--	103
Barium	ug/L	2,000	NA	1,300	2,000	114	69	73	100	98	91	95	94.2	--	117
Beryllium	ug/L	4	NA	1	4	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 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
Chromium	ug/L	100	NA	3	100	< 1	1	< 1	< 1	< 1	< 1	1	< 1.0	--	< 1.0
Cobalt	ug/L	NC	6	15	15	< 15	< 15	< 15	< 15	< 15	< 15	< 15	< 15.0	--	< 15.0
Fluoride	ug/L	4,000	NA	1,000	4,000	< 1,000	1,530	1,440	1,160	1,500	1,650	1,330	1,700	2,100	1,600
Lead	ug/L	NC	15	1	15	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0
Lithium	ug/L	NC	40	180	180	71.9	48.7	51	55	52	48	55	53	--	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
Molybdenum	ug/L	NC	100	6	100	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5.0	--	< 5.0
Radium-226	pCi/L	NC	NA	NA	NA	< 0.297	0.244	0.240	< 0.195	< 0.292	0.565	< 0.315	< 0.934	--	< 0.686
Radium-228	pCi/L	NC	NA	NA	NA	0.909	1.32	0.639	< 0.509	< 0.405	0.642	1.20	< 0.770	--	1.08
Radium-226/228	pCi/L	5	NA	3.32	5	1.181	1.564	0.879	< 0.509	< 0.405	1.207	1.29	< 1.70	--	< 1.42
Selenium	ug/L	50	NA	2	50	4	3	3	1	2	< 1	< 1	< 1.0	--	1.2
Thallium	ug/L	2	NA	2	2	< 2	< 2	< 2	< 2	< 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) DEK-MW-15001 was decommissioned on April 18, 2018.

(2) Outlier; single detection above reporting limit.

(3) Laboratory reporting limits exceeds GWPS due to sample dilutions performed as a result of the sample matrix.

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

		Sample Location:				DEK-MW-15002													
		Sample Date:				12/10/2015	3/30/2016	5/26/2016	8/24/2016	12/1/2016	2/23/2017	5/18/2017	8/3/2017	9/18/2017	4/12/2018	5/23/2018	11/5/2018	4/11/2019	
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS	downgradient													
Appendix III																			
Boron	ug/L	NC	NA	619	NA	780	676	668	746	893	858	824	805	870	--	967	894	860	
Calcium	mg/L	NC	NA	302	NA	102	119	99.6	105	94.8	149	80.1	71.1	66.9	--	53.7	67.8	72	
Chloride	mg/L	250*	NA	2,440	NA	83.5	97.6	90.0	89.2	86.1	88.2	80.5	87.8	84.9	--	79.7	83.5	80	
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	
Sulfate	mg/L	250*	NA	407	NA	275	418	291	384	326	289	299	256	290	--	263	77.2	45	
Total Dissolved Solids	mg/L	500*	NA	4,600	NA	790	890	800	1,700	810	810	1,500	696	722	--	660	536	560	
pH, Field	SU	6.5 - 8.5*	NA	6.5-7.3	NA	7.8	7.5	7.6	7.5	7.6	7.5	7.5	7.8	7.9	7.5	8.0	7.3	7.5	
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	61	118	82	79	54	62	76	48.3	--	56.4	67.0	31.7	9.0	
Barium	ug/L	2,000	NA	1,300	2,000	140	148	136	131	121	120	107	96.1	--	82.7	84.5	71.6	71	
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	2	2	< 1.0	--	< 1.0	< 1.0	1.4	1.3	
Cobalt	ug/L	NC	6	15	15	< 15	< 15	< 15	< 15	< 15	< 15	< 15	< 15.0	--	< 15.0	< 15.0	< 6.0	< 6.0	
Fluoride	ug/L	4,000	NA	1,000	4,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	
Lead	ug/L	NC	15	1	15	< 1	< 1	< 1	< 1	< 1	< 1	3	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	
Lithium	ug/L	NC	40	180	180	50.7	53	43	44	40	41	42	36	--	43	35	32	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	19	30	29	41	26	27	38	27.7	--	30.8	35.4	< 5.0	< 5.0	
Radium-226	pCi/L	NC	NA	NA	NA	< 0.301	0.301	0.314	0.513	0.255	0.68	0.321	< 0.854	--	< 0.478	< 0.698	< 0.850	--	
Radium-228	pCi/L	NC	NA	NA	NA	0.809	0.645	1.26	0.908	0.547	0.844	0.929	1.17	--	1.16	< 0.744	0.730	--	
Radium-226/228	pCi/L	5	NA	3.32	5	1.067	0.946	1.574	1.421	0.802	1.524	1.25	1.88	--	1.42	< 1.44	< 1.39	--	
Selenium	ug/L	50	NA	2	50	< 1	< 1	2	< 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. 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) DEK-MW-15001 was decommissioned on April 18, 2018.
- (2) Outlier; single detection above reporting limit.
- (3) Laboratory reporting limits exceeds GWPS due to sample dilutions performed as a result of the sample matrix.

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

Sample Location:						DEK-MW-15003													
Sample Date:						12/10/2015	3/30/2016	5/26/2016	8/24/2016	12/1/2016	2/23/2017	5/18/2017	8/4/2017	9/18/2017	4/12/2018	5/23/2018	11/6/2018	4/11/2019	
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS	downgradient													
Appendix III																			
Boron	ug/L	NC	NA	619	NA	1,020	920	982	1,010	1,140	1,090	1,270	1,160	1,030	--	1,010	944	960	
Calcium	mg/L	NC	NA	302	NA	41.7	57.3	56.3	64.1	64.1	85.4	68.2	58.8	62.1	--	58.1	62.9	52	
Chloride	mg/L	250*	NA	2,440	NA	63.8	62.0	61.2	59.8	54.8	56.3	54.9	61.7	60.2	--	57.2	61.7	58	
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	
Sulfate	mg/L	250*	NA	407	NA	64.3	71.6	75.7	76.8	71.9	64.5	57.6	55.8	54.3	--	39.1	37.8	47	
Total Dissolved Solids	mg/L	500*	NA	4,600	NA	370	400	420	430	440	430	420	506	426	--	354	370	360	
pH, Field	SU	6.5 - 8.5*	NA	6.5-7.3	NA	8.4	7.8	7.9	7.7	7.8	7.7	7.8	7.9	7.9	7.8	8.2	8.0	8.0	
Appendix IV																			
Antimony	ug/L	6	NA	1	6	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 5.0	
Arsenic	ug/L	10	NA	21	21	498	517	543	527	525	372	450	437	--	478	450	420	380	
Barium	ug/L	2,000	NA	1,300	2,000	96	69	68	73	71	71	66	68.5	--	61.2	73.3	70.9	62	
Beryllium	ug/L	4	NA	1	4	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 5.0 ⁽³⁾	
Cadmium	ug/L	5	NA	0.2	5	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20	< 1.0	
Chromium	ug/L	100	NA	3	100	2	2	2	< 1	< 1	< 1	1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 5.0	
Cobalt	ug/L	NC	6	15	15	< 15	< 15	< 15	< 15	< 15	< 15	< 15	< 15.0	--	< 15.0	< 15.0	< 6.0	< 30 ⁽³⁾	
Fluoride	ug/L	4,000	NA	1,000	4,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	
Lead	ug/L	NC	15	1	15	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 5.0	
Lithium	ug/L	NC	40	180	180	22.8	22.6	26	27	30	30	35	35	--	39	33	33	28	
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	8	7	8	6	5	5	5	5.0	--	< 5.0	5.3	5.2	< 25	
Radium-226	pCi/L	NC	NA	NA	NA	< 0.221	< 0.227	< 0.235	< 0.184	< 0.287	0.252	< 0.324	0.226	--	0.686	< 0.842	< 0.661	--	
Radium-228	pCi/L	NC	NA	NA	NA	< 0.473	< 0.52	< 0.546	0.423	< 0.363	< 0.34	< 0.646	< 0.936	--	< 0.755	1.12	< 0.789	--	
Radium-226/228	pCi/L	5	NA	3.32	5	< 0.473	< 0.52	< 0.546	0.469	< 0.363	< 0.34	< 0.646	< 1.14	--	< 1.33	1.63	< 1.45	--	
Selenium	ug/L	50	NA	2	50	< 5	< 1	2	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 5.0	
Thallium	ug/L	2	NA	2	2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2.0	--	< 2.0	< 2.0	< 2.0	< 10 ⁽³⁾	

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) DEK-MW-15001 was decommissioned on April 18, 2018.
- (2) Outlier; single detection above reporting limit.
- (3) Laboratory reporting limits exceeds GWPS due to sample dilutions performed as a result of the sample matrix.

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

Sample Location:						DEK-MW-15004																		
Sample Date:						12/10/2015	3/30/2016	5/26/2016	8/24/2016	12/1/2016	2/23/2017	5/18/2017	8/3/2017	8/3/2017	9/19/2017	9/19/2017	4/12/2018	5/23/2018	5/23/2018	11/6/2018	4/11/2019			
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS	downgradient																		
Appendix III																								
Boron	ug/L	NC	NA	619	NA	478	435	514	472	535	637	839	785	Field Dup	768	730	Field Dup	750	--	800	Field Dup	842	910	840
Calcium	mg/L	NC	NA	302	NA	61.7	68.3	71.1	78.9	73	108	74.2	67.4	68.1	66.5	67.9	--	47.8	50.7	62.2	50			
Chloride	mg/L	250*	NA	2,440	NA	71.5	72.7	72.3	77.4	73.3	75.3	70.3	81.4	81.5	79.8	79.9	--	72.5	72.6	70.6	63			
Fluoride	ug/L	4,000	NA	1,000	NA	< 1,000	< 1,000	< 1,000	1,550	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	1,200	1,100	1,100	1,100	1,100			
Sulfate	mg/L	250*	NA	407	NA	213	188	184	198	215	211	220	258	261	283	281	--	176	178	168	150			
Total Dissolved Solids	mg/L	500*	NA	4,600	NA	680	560	560	580	590	580	590	642	582	596	564	--	494	504	482	490			
pH, Field	SU	6.5 - 8.5*	NA	6.5-7.3	NA	8.0	7.7	7.4	7.4	7.5	7.5	7.5	7.6	--	7.3	--	7.3	7.7	--	7.4	7.1			
Appendix IV																								
Antimony	ug/L	6	NA	1	6	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1.0	--	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0			
Arsenic	ug/L	10	NA	21	21	56	95	108	104	117	116	111	121	129	--	--	134	119	126	123	110			
Barium	ug/L	2,000	NA	1,300	2,000	107	94	102	110	115	110	103	111	115	--	--	86.9	79.6	82.6	95.1	77			
Beryllium	ug/L	4	NA	1	4	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1.0	--	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0			
Cadmium	ug/L	5	NA	0.2	5	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	< 0.20	--	--	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20			
Chromium	ug/L	100	NA	3	100	< 1	2	< 1	< 1	< 1	1	< 1	< 1.0	< 1.0	--	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0			
Cobalt	ug/L	NC	6	15	15	< 15	< 15	< 15	< 15	< 15	< 15	< 15	< 15.0	< 15.0	--	--	< 15.0	< 15.0	< 15.0	< 6.0	< 6.0			
Fluoride	ug/L	4,000	NA	1,000	4,000	< 1,000	< 1,000	< 1,000	1,550	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	1,200	1,100	1,100	1,100	1,100			
Lead	ug/L	NC	15	1	15	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1.0	--	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0			
Lithium	ug/L	NC	40	180	180	35.8	29.5	36	34	37	36	38	39	38	--	--	39	30	32	33	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	< 0.20	< 0.20			
Molybdenum	ug/L	NC	100	6	100	29	25	21	24	27	30	29	30.4	31.4	--	--	32.0	30.9	30.4	28.0	23			
Radium-226	pCi/L	NC	NA	NA	NA	< 0.258	0.400	0.233	0.264	0.244	0.328	0.347	0.805	< 0.623	--	--	< 0.641	< 0.791	< 0.679	< 0.743	--			
Radium-228	pCi/L	NC	NA	NA	NA	< 0.556	0.532	0.527	0.672	< 0.396	< 0.458	1.28	0.833	0.864	--	--	< 0.847	< 0.753	0.845	< 0.794	--			
Radium-226/228	pCi/L	5	NA	3.32	5	< 0.556	0.932	0.76	0.936	0.588	0.665	1.63	1.64	< 1.46	--	--	< 1.49	< 1.54	1.29	< 1.54	--			
Selenium	ug/L	50	NA	2	50	< 1	< 1	1	< 1	< 1	< 1	< 1	< 1.0	< 1.0	--	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0			
Thallium	ug/L	2	NA	2	2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2.0	< 2.0	--	--	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0			

Notes:

- ug/L - micrograms per liter.
- mg/L - milligrams per liter.
- SU - standard units; pH is a field parameter.
- pCi/L - picocuries per liter.
- NA - not applicable.
- NC - no criteria.
- - not analyzed. 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) DEK-MW-15001 was decommissioned on April 18, 2018.
- (2) Outlier; single detection above reporting limit.
- (3) Laboratory reporting limits exceeds GWPS due to sample dilutions performed as a result of the sample matrix.

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

		Sample Location:				DEK-MW-15005														
		Sample Date:				12/10/2015	3/30/2016	5/26/2016	8/24/2016	12/1/2016	2/23/2017	5/18/2017	8/3/2017	9/18/2017	4/11/2018	4/11/2018	5/24/2018	11/6/2018	4/11/2019	4/11/2019
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS	downgradient														
Appendix III																				
Boron	ug/L	NC	NA	619	NA	410	396	465	589	687	712	788	792	714	--	Field Dup	806	947	910	Field Dup
Calcium	mg/L	NC	NA	302	NA	58.5	68.6	72.7	98.4	71.1	76.3	55	49.2	44.3	--	--	33.4	32.9	31	31
Chloride	mg/L	250*	NA	2,440	NA	77.9	82.6	82.3	93.9	80.1	77.5	73.3	81.4	79.3	--	--	72.6	69.1	60	60
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	< 1,000
Sulfate	mg/L	250*	NA	407	NA	223	251	269	355	329	281	263	300	273	--	--	182	160	140	140
Total Dissolved Solids	mg/L	500*	NA	4,600	NA	620	660	660	810	740	680	650	732	638	--	--	524	474	470	470
pH, Field	SU	6.5 - 8.5*	NA	6.5-7.3	NA	8.0	7.7	7.5	7.6	7.7	7.7	7.6	7.9	7.9	7.7	--	7.8	7.9	7.7	--
Appendix IV																				
Antimony	ug/L	6	NA	1	6	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	10	NA	21	21	5	15	16	23	29	29	28	31.9	--	28.3	29.1	31.7	35.0	24	24
Barium	ug/L	2,000	NA	1,300	2,000	87	94	104	149	120	101	83	92.2	--	54.9	55.8	58.5	56.7	46	45
Beryllium	ug/L	4	NA	1	4	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	5	NA	0.2	5	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Chromium	ug/L	100	NA	3	100	< 1	1	1	< 1	< 1	1	2	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cobalt	ug/L	NC	6	15	15	< 15	< 15	< 15	< 15	< 15	< 15	< 15	< 15.0	--	< 15.0	< 15.0	< 15.0	< 15.0	< 6.0	< 6.0
Fluoride	ug/L	4,000	NA	1,000	4,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Lead	ug/L	NC	15	1	15	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lithium	ug/L	NC	40	180	180	23.7	23	29	30	26	23	26	27	--	24	24	19	17	15	14
Mercury	ug/L	2	NA	0.2	2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	NC	100	6	100	40	33	32	37	44	40	36	41.9	--	39.0	40.5	41.9	45.3	39	38
Radium-226	pCi/L	NC	NA	NA	NA	< 0.238	0.263	0.180	0.300	0.367	0.490	< 0.321	0.707	--	< 0.587	0.606	< 0.740	< 0.865	--	--
Radium-228	pCi/L	NC	NA	NA	NA	1.03	< 0.429	< 0.404	0.919	0.550	0.450	0.685	1.01	--	0.756	0.886	0.857	< 0.598	--	--
Radium-226/228	pCi/L	5	NA	3.32	5	1.197	0.686	0.458	1.219	0.917	0.940	0.875	1.72	--	< 1.34	1.49	< 1.53	< 1.46	--	--
Selenium	ug/L	50	NA	2	50	2	< 1	1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Thallium	ug/L	2	NA	2	2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2.0	--	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0

Notes:
 ug/L - micrograms per liter.
 mg/L - milligrams per liter.
 SU - standard units; pH is a field parameter.
 pCi/L - picocuries per liter.
 NA - not applicable.
 NC - no criteria.
 -- - not analyzed. 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) DEK-MW-15001 was decommissioned on April 18, 2018.
 (2) Outlier; single detection above reporting limit.
 (3) Laboratory reporting limits exceeds GWPS due to sample dilutions performed as a result of the sample matrix.

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

		Sample Location:				DEK-MW-15006													
		Sample Date:				12/10/2015	3/30/2016	5/25/2016	8/24/2016	12/1/2016	2/23/2017	5/18/2017	8/3/2017	9/18/2017	4/11/2018	5/24/2018	11/5/2018	11/5/2018	4/11/2019
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS	downgradient													
Appendix III																			
Boron	ug/L	NC	NA	619	NA	1,070	706	942	979	1,230	1,120	1,420	1,240	1,070	--	1,200	1,340	1,270	1,700
Calcium	mg/L	NC	NA	302	NA	196	130	105	130	79.1	83.9	38.6	39.9	76.8	--	21.9	29.4	29.6	35
Chloride	mg/L	250*	NA	2,440	NA	153	152	135	188	128	102	97.1	104	133	--	85.8	87.9	88.3	75
Fluoride	ug/L	4,000	NA	1,000	NA	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Sulfate	mg/L	250*	NA	407	NA	1,320	1,130	917	1,160	886	636	513	547	886	--	401	341	344	320
Total Dissolved Solids	mg/L	500*	NA	4,600	NA	2,400	2,100	1,700	2,200	1,800	1,300	1,100	1,110	1,670	--	944	792	784	780
pH, Field	SU	6.5 - 8.5*	NA	6.5-7.3	NA	7.4	7.5	7.5	7.6	7.8	7.7	8.1	7.9	7.8	7.9	8.2	7.9	--	7.8
Appendix IV																			
Antimony	ug/L	6	NA	1	6	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	10	NA	21	21	13	19	18	20	20	20	20	14.6	--	18.3	25.7	20.9	19.6	21
Barium	ug/L	2,000	NA	1,300	2,000	97	55	44	58	41	30	27	31.0	--	39.6	22.8	38.5	38.3	43
Beryllium	ug/L	4	NA	1	4	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	5	NA	0.2	5	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Chromium	ug/L	100	NA	3	100	< 1	1	1	< 1	1	1	2	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cobalt	ug/L	NC	6	15	15	< 15	< 15	< 15	< 15	< 15	< 15	< 15	< 15.0	--	< 15.0	< 15.0	< 6.0	< 6.0	< 6.0
Fluoride	ug/L	4,000	NA	1,000	4,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Lead	ug/L	NC	15	1	15	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	320 ⁽²⁾	< 1.0	< 1.0	< 1.0
Lithium	ug/L	NC	40	180	180	36.1	20.7	22	22	19	16	16	17	--	18	< 10	< 10	10	< 10
Mercury	ug/L	2	NA	0.2	2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	NC	100	6	100	23	37	34	36	64	82	68	64.2	--	71.6	48.7	50.3	48.0	59
Radium-226	pCi/L	NC	NA	NA	NA	0.392	0.363	0.463	0.286	< 0.362	< 0.307	< 0.354	< 0.945	--	< 0.688	< 0.738	< 0.885	< 1.06	--
Radium-228	pCi/L	NC	NA	NA	NA	0.901	0.743	0.501	< 0.578	< 0.421	< 0.562	0.483	< 0.906	--	< 0.755	< 1.12	< 0.649	< 0.897	--
Radium-226/228	pCi/L	5	NA	3.32	5	1.293	1.106	0.964	0.748	< 0.421	< 0.562	0.585	< 1.85	--	< 1.44	< 1.86	< 1.53	< 1.96	--
Selenium	ug/L	50	NA	2	50	3	2	2	< 1	< 1	1	1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Thallium	ug/L	2	NA	2	2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2.0	--	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0

Notes:
 ug/L - micrograms per liter.
 mg/L - milligrams per liter.
 SU - standard units; pH is a field parameter.
 pCi/L - picocuries per liter.
 NA - not applicable.
 NC - no criteria.
 -- - not analyzed. 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.
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 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) DEK-MW-15001 was decommissioned on April 18, 2018.
 (2) Outlier; single detection above reporting limit.
 (3) Laboratory reporting limits exceeds GWPS due to sample dilutions performed as a result of the sample matrix.

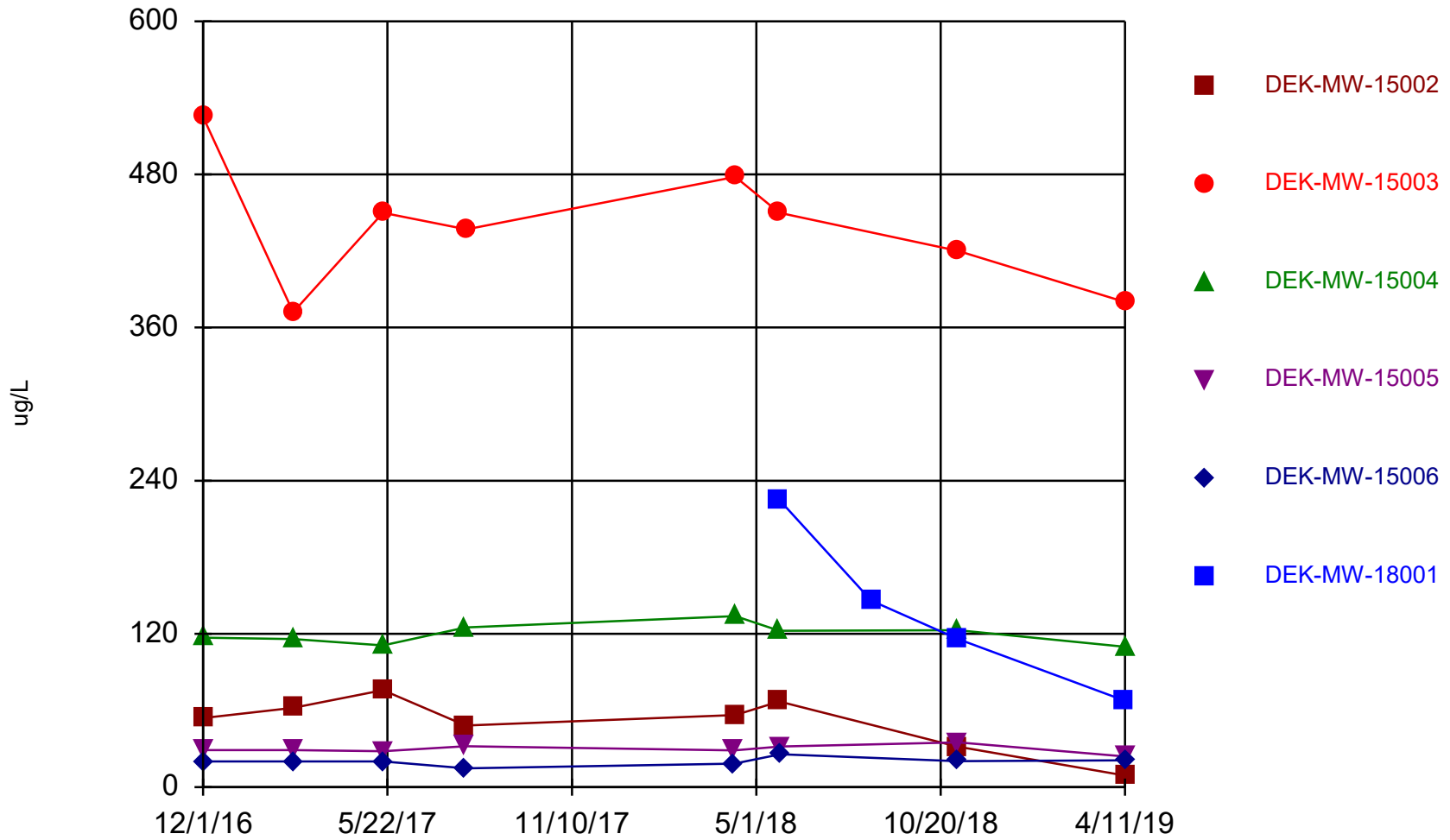
Table 1
 Comparison of Groundwater Sampling Results to Groundwater Protection Standards – December 2015 to April 2019
 DE Karn Bottom Ash Pond – RCRA CCR Monitoring Program
 Essexville, Michigan

		Sample Location:				DEK-MW-18001			
		Sample Date:				5/23/2018	8/17/2018	11/6/2018	4/10/2019
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS	downgradient			
Appendix III									
Boron	ug/L	NC	NA	619	NA	1,600	1,080	1,020	970
Calcium	mg/L	NC	NA	302	NA	64.9	47.7	51.1	48
Chloride	mg/L	250*	NA	2,440	NA	69.1	78.3	76.6	69
Fluoride	ug/L	4,000	NA	1,000	NA	< 1,000	1,000	1,300	1,200
Sulfate	mg/L	250*	NA	407	NA	30.6	< 2.0	< 2.0	< 2.0
Total Dissolved Solids	mg/L	500*	NA	4,600	NA	434	356	340	360
pH, Field	SU	6.5 - 8.5*	NA	6.5-7.3	NA	7.8	7.5	7.5	7.2
Appendix IV									
Antimony	ug/L	6	NA	1	6	< 1.0	< 2.0	< 1.0	< 1.0
Arsenic	ug/L	10	NA	21	21	225	146	116	68
Barium	ug/L	2,000	NA	1,300	2,000	101	82.4	79.5	75
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	< 15.0	< 15.0	< 6.0	< 6.0
Fluoride	ug/L	4,000	NA	1,000	4,000	< 1,000	1,000	1,300	1,200
Lead	ug/L	NC	15	1	15	< 1.0	< 1.0	< 1.0	< 1.0
Lithium	ug/L	NC	40	180	180	23	28	24	24
Mercury	ug/L	2	NA	0.2	2	< 0.20	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	NC	100	6	100	< 5.0	< 5.0	< 5.0	< 5.0
Radium-226	pCi/L	NC	NA	NA	NA	0.906	< 0.938	< 0.813	--
Radium-228	pCi/L	NC	NA	NA	NA	< 0.733	< 0.717	0.811	--
Radium-226/228	pCi/L	5	NA	3.32	5	1.63	< 1.66	1.56	--
Selenium	ug/L	50	NA	2	50	< 1.0	< 2.0	< 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) DEK-MW-15001 was decommissioned on April 18, 2018.
 (2) Outlier; single detection above reporting limit.
 (3) Laboratory reporting limits exceeds GWPS due to sample dilutions performed as a result of the sample matrix.

Sanitas™ Output Files

Time Series

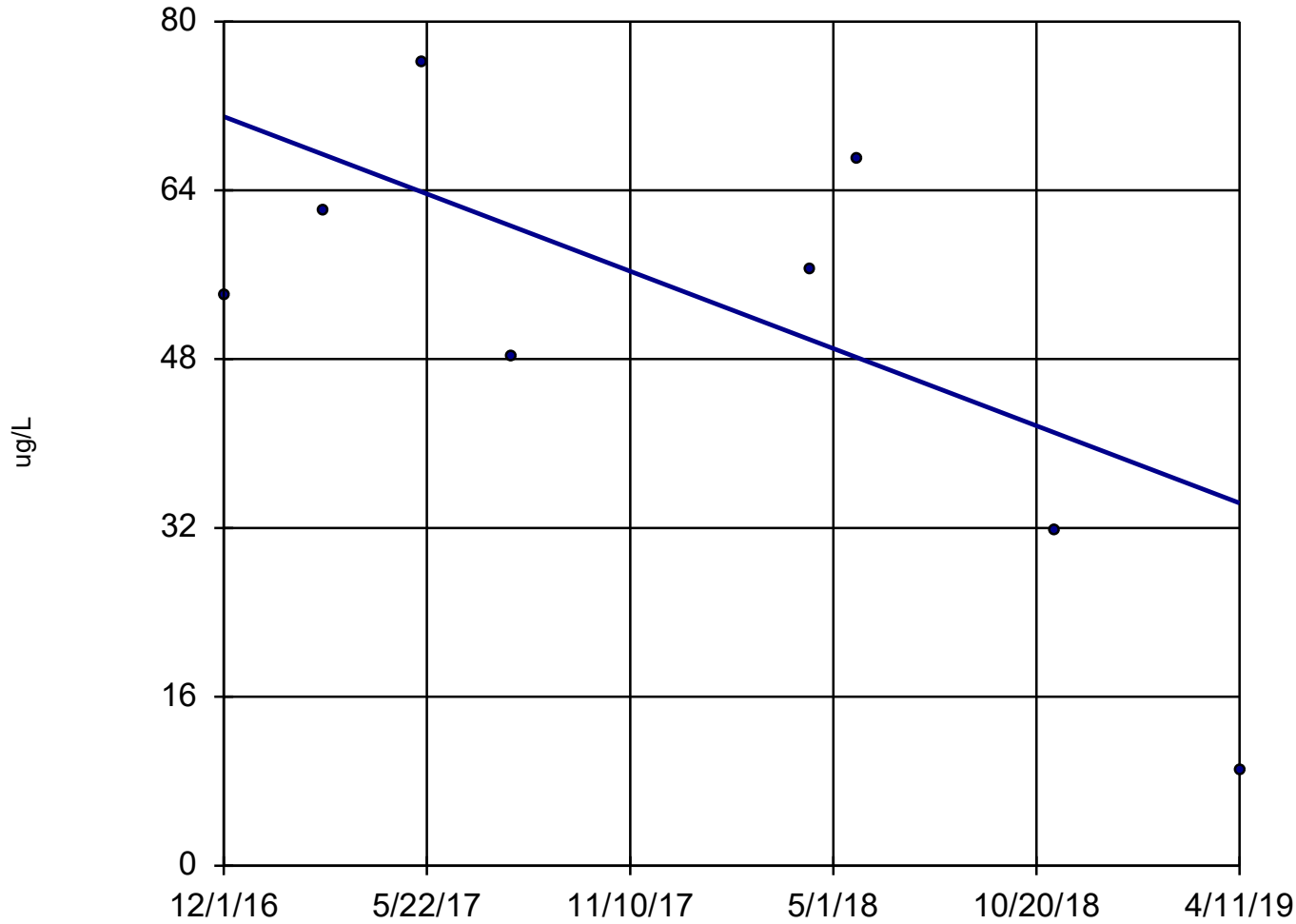


Constituent: Arsenic, Total Analysis Run 12/11/2019 9:33 AM

Client: Consumers Energy Data: DEK_Sanitas_19.11.21

Sen's Slope Estimator

DEK-MW-15002



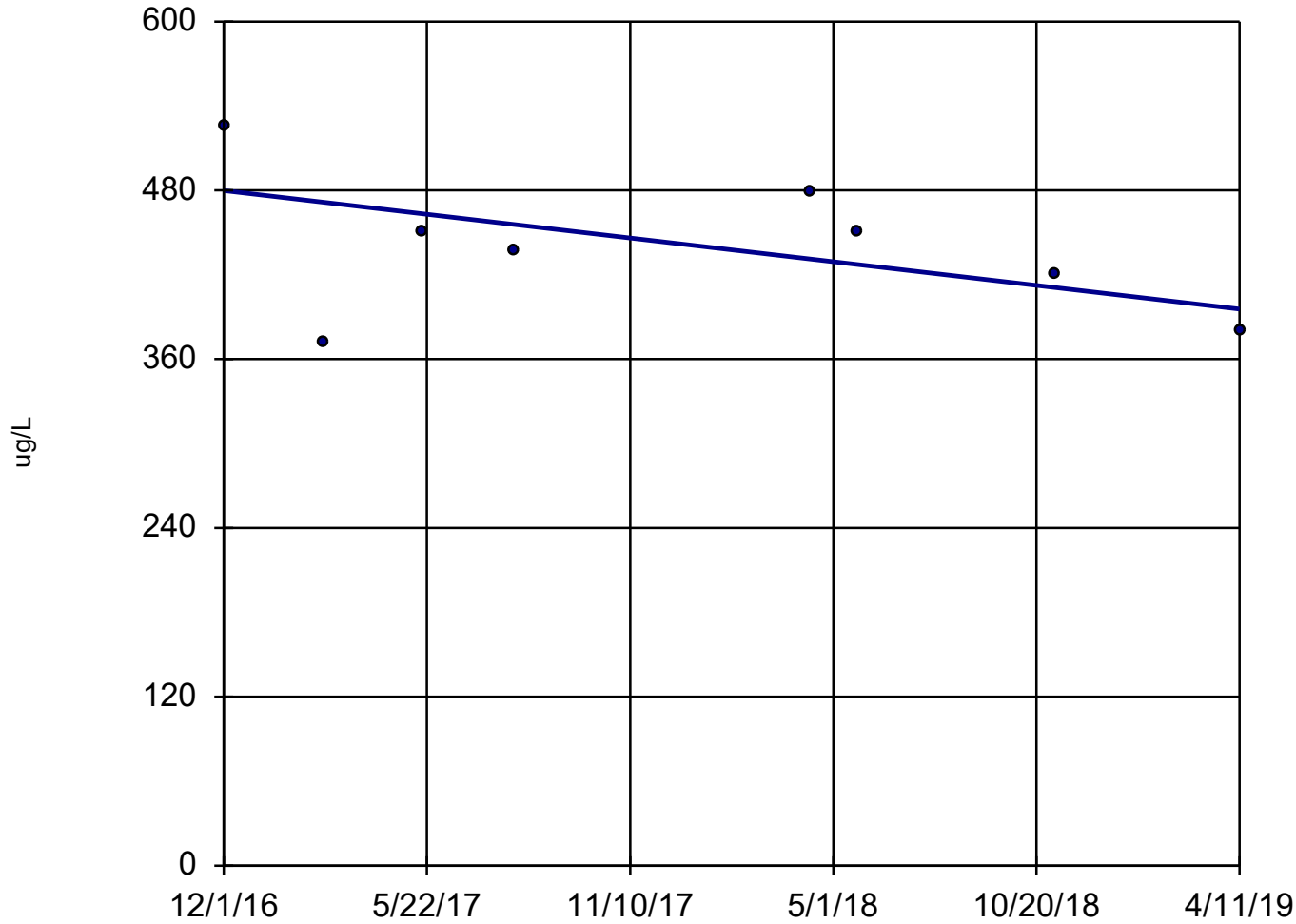
n = 8
Slope = -15.52
units per year.
Mann-Kendall
statistic = -10
critical = -20
Trend not sig-
nificant at 98%
confidence level
($\alpha = 0.01$ per
tail).

Constituent: Arsenic, Total Analysis Run 12/11/2019 9:29 AM

Client: Consumers Energy Data: DEK_Sanitas_19.11.21

Sen's Slope Estimator

DEK-MW-15003



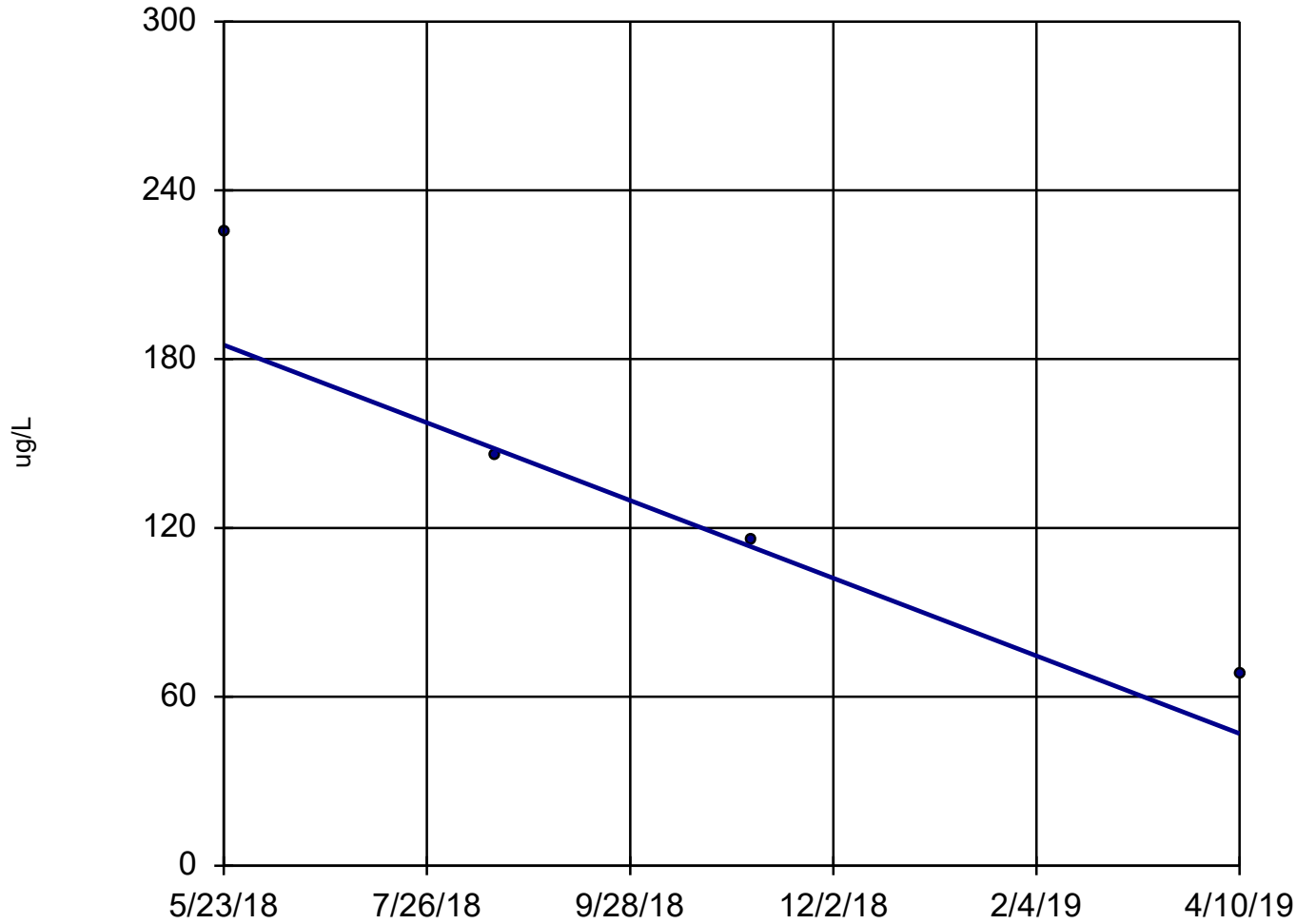
n = 8
Slope = -35.69
units per year.
Mann-Kendall
statistic = -9
critical = -20
Trend not sig-
nificant at 98%
confidence level
($\alpha = 0.01$ per
tail).

Constituent: Arsenic, Total Analysis Run 12/11/2019 9:33 AM

Client: Consumers Energy Data: DEK_Sanitas_19.11.21

Sen's Slope Estimator

DEK-MW-18001



n = 4

Slope = -156.6
units per year.

Mann-Kendall
statistic = -6
critical = -8

Trend not sig-
nificant at 98%
confidence level
($\alpha = 0.01$ per
tail).

With n = 4, no data
set will result in
a significant Mann-
Kendall statistic.

Constituent: Arsenic, Total Analysis Run 12/11/2019 9:29 AM

Client: Consumers Energy Data: DEK_Sanitas_19.11.21

Summary Report

Constituent: Arsenic, Total Analysis Run 12/11/2019 9:33 AM
Client: Consumers Energy Data: DEK_Sanitas_19.11.21

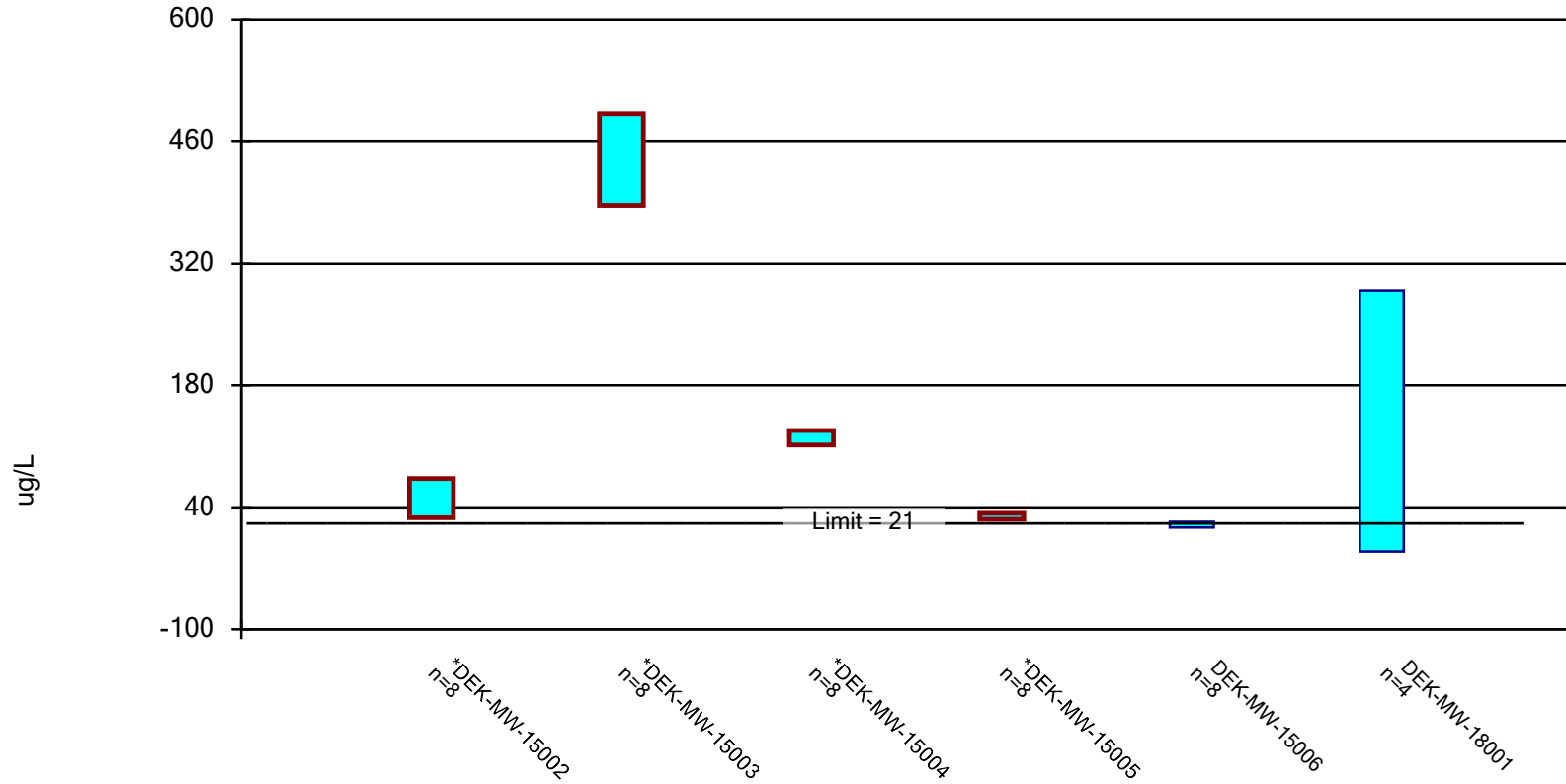
For observations made between 12/1/2016 and 4/11/2019, a summary of the selected data set:

Observations = 44
ND/Trace = 0
Wells = 6
Minimum Value = 9
Maximum Value = 525
Mean Value = 132.4
Median Value = 64.5
Standard Deviation = 154.5
Coefficient of Variation = 1.167
Skewness = 1.415

<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>
DEK-MW-15002	8	0	9	76	50.55	55.2	21.32	0.4218	-0.8786
DEK-MW-15003	8	0	372	525	439	443.5	49.99	0.1139	0.2262
DEK-MW-15004	8	0	110	134	119.8	119.8	7.946	0.06632	0.408
DEK-MW-15005	8	0	24	35	29.66	29	3.257	0.1098	-0.07029
DEK-MW-15006	8	0	14.6	25.7	19.98	20	3.061	0.1532	0.1465
DEK-MW-18001	4	0	68	225	138.8	131	65.87	0.4747	0.3719

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 12/11/2019 9:33 AM

Client: Consumers Energy Data: DEK_Sanitas_19.11.21

Confidence Interval

Constituent: Arsenic, Total (ug/L) Analysis Run 12/11/2019 9:34 AM

Client: Consumers Energy Data: DEK_Sanitas_19.11.21

	DEK-MW-15002	DEK-MW-15003	DEK-MW-15004	DEK-MW-15005	DEK-MW-15006	DEK-MW-18001
12/1/2016	54	525	117	29	20	
2/23/2017	62	372	116	29	20	
5/18/2017	76	450	111	28	20	
8/3/2017	48.3		125 (D)	31.9	14.6	
8/4/2017		437				
4/11/2018				28.7 (D)	18.3	
4/12/2018	56.4	478	134			
5/23/2018	67	450	122.5 (D)			225
5/24/2018				31.7	25.7	
8/17/2018						146
11/5/2018	31.7				20.25 (D)	
11/6/2018		420	123	35		116
4/10/2019						68
4/11/2019	9	380	110	24 (D)	21	
Mean	50.55	439	119.8	29.66	19.98	138.8
Std. Dev.	21.32	49.99	7.946	3.257	3.061	65.87
Upper Lim.	73.15	492	128.2	33.12	23.23	288.3
Lower Lim.	27.95	386	111.4	26.21	16.74	-10.79

Appendix F

October 2019 Assessment Monitoring Data Summary and 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.: 322172.0000 Phase 001, Task 003

Subject: Statistical Evaluation of October 2019 Assessment Monitoring Sampling Event
DE Karn Bottom Ash Pond, 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 DE Karn Power Plant Bottom Ash Pond (Karn Bottom Ash Pond).

The second semiannual assessment monitoring event for 2019 was conducted on October 14 through October 16, 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. The Sanitas™ output files are included as an attachment.

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

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The statistical evaluation of the third semiannual assessment monitoring event data indicate the following constituent is present at statistically significant levels exceeding the GWPS in downgradient monitoring wells at the Karn Bottom Ash Pond:

<u>Constituent</u>	<u>GWPS</u>	<u>#Downgradient Wells Observed</u>
Arsenic	21 ug/L	3 of 6

Previously, arsenic was present in downgradient well DEK-MW-15002 at a statistically significant level; however, the statistical evaluation of the October 2019 data shows that the lower confidence limit for arsenic is currently below the GWPS. The results of the assessment monitoring statistical evaluation for the other downgradient wells are consistent with the results of the previous assessment monitoring data statistical evaluations, indicating that arsenic is the only constituent present at concentrations above the GWPS. Consumers Energy will continue to evaluate corrective measures per §257.96 and §257.97. Consumers Energy will continue executing the self-implementing groundwater compliance schedule in conformance with §257.90 - §257.98.

Assessment Monitoring Statistical Evaluation

The compliance well network at the Karn Bottom Ash Pond includes six wells encircling the unit (DEK-MW-15002 through DEK-MW-15006 and DEK-MW-18001). Former downgradient monitoring well DEK-MW-15001 was decommissioned on April 18, 2018 to allow for construction of the new Karn Lined Impoundment. DEK-MW-18001 was installed approximately 80 feet southeast of the former DEK-MW-15001 location to maintain the perimeter downgradient monitoring well network. Although DEK-MW-18001 is considered to be a replacement well, the data from the two wells are not being combined in the statistical analyses at this time as groundwater chemistry data at DEK-MW-18001 is not comparable to DEK-MW-15001. Therefore, the statistical analysis for DEK-MW-15001 terminates at the April 2018 sampling event and statistical analysis for DEK-MW-18001 commences with the first semiannual assessment monitoring event for 2019, following the collection of the minimum of four independent sampling events.

Following the second semiannual assessment monitoring sampling event for 2019, compliance well data for the DEK BAP were evaluated in accordance with the *Groundwater Statistical Evaluation Plan* (Stats Plan) (TRC, October 2017). An assessment monitoring program was developed to evaluate concentrations of CCR constituents present in the uppermost aquifer relative to acceptable levels (i.e., GWPSs). To evaluate whether or not a GWPS exceedance is statistically significant, the difference in concentration observed at the downgradient wells during a given assessment monitoring event compared to the GWPS must be large enough, after accounting for variability in the sample data, that the result is unlikely to have occurred merely by chance. Consistent with the Unified Guidance², 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

² 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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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 confidence that the measured concentrations are different from the GWPS and thus no compelling evidence that the measured concentration is a result of a release from the CCR unit versus the inherent variability of the sample data. This statistical approach is consistent with the statistical methods for assessment monitoring presented in §257.93(f) and (g). Statistical evaluation methodologies built into the CCR Rule, and numerous other federal rules, are key in determining whether or not individually measured data points represent a concentration increase over the baseline or a fixed standard (such as a GWPS in an assessment monitoring program).

For each detected Appendix IV constituent, the concentrations from each well were first compared directly to the GWPS, as shown on Table A1. Parameter-well combinations that included a direct exceedance of the GWPS within the past eight sampling events (February 2017 through October 2019) were retained for further analysis. Arsenic in each of the downgradient monitoring wells at the Bottom Ash Pond had individual results exceeding the GWPS. Lead was detected in DEK-MW-15006 during May 2018 at a concentration of 320 ug/L, which exceeds its GWPS. However, this is the only detection of lead in the Bottom Ash Pond wells during either baseline sampling or assessment monitoring. Sampling conducted in November 2018 did not confirm the lead detection. Therefore, the single detection was classified as an outlier per the Double Quantification Rule as outlined in the Stats Plan and the Unified Guidance. As a result, only arsenic was retained for evaluation in all downgradient monitoring wells. In DEK-MW-15003, beryllium, cobalt, and thallium reporting limits exceeded the GWPSs in April 2019 due to sample dilutions performed due to the nature of the sample matrix. Beryllium, cobalt and thallium have historically been non-detect at this location and results from October 2019 confirmed that these constituents are not detected above the GWPSs. Therefore, the elevated reporting limits are treated as outliers and no statistical evaluation will be completed for these parameter-well combinations.

Groundwater data were then evaluated utilizing Sanitas™ statistical software. Sanitas™ is a software tool that is commercially available for performing statistical evaluation consistent with procedures outlined in the Unified Guidance. Within the Sanitas™ statistical program, confidence limits were selected to perform the statistical comparison of compliance data to a fixed standard. Parametric and non-parametric confidence intervals were calculated for each of the CCR Appendix IV parameters using a using a per test³ 99 percent confidence level, i.e., a significance level (α) of 0.01. The following

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

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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.

Data from each round were evaluated for completeness, overall quality, and usability and were deemed appropriate for the purposes of the CCR assessment monitoring program. Initially, the baseline (December 2015 through August 2017) results and the assessment monitoring results (April 2018 through October 2019) were observed visually for potential trends. No outliers were identified. Arsenic concentrations at DEK-MW-15002, DEK-MW-15003, and DEK-MW-18001 appear to exhibit a downward trend on the time-series chart (Attachment 1). These data sets were tested further in Sanitas™ utilizing Sen's Slope to estimate the average rate of change in concentration over time and utilizing the Mann-Kendall trend test to test for significance of the trend at the 98% confidence level. The trend tests showed that arsenic concentrations are generally decreasing with time, as evidenced by the negative Sen's Slope, and that the downward trend of arsenic at DEK-MW-18001 is statistically significant (Attachment 1). The decreases in arsenic concentrations at DEK-MW-15002, DEK-MW-15003, and DEK-MW-18001 are causing the confidence intervals to widen. Calculating a confidence interval around a trending data set incorporates not only variability present naturally in the underlying dataset, but also incorporates variability due to the trend itself. Arsenic concentrations have already triggered assessment monitoring (e.g., not a newly identified GWPS exceedance) and an interim measure has been initiated through the removal of CCR from the bottom ash pond in 2019; therefore, traditional confidence interval calculations are presented in this statistical evaluation until more post-CCR removal data are available. Once additional post-CCR removal data are collected, confidence bands may be a more appropriate assessment to determine compliance with the CCR Rule. Confidence bands are selected by the UG as the appropriate method for calculating confidence intervals on trending data. A confidence band calculates upper and lower confidence limits at each point along the trend to reduce variability and create a narrower confidence interval. At least 8 to 10 measurements should be available when computing a confidence band around a linear regression.

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The Sanitas™ software was used to test compliance at the downgradient monitoring wells using the confidence interval method for the most recent 8 sampling events, with the exception of DEK-MW-18001, for which only four independent assessment monitoring sampling events have been completed. 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-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 for well/constituent pairs with a direct GWPS exceedance 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. Note that, as mentioned above, the statistical analysis for DEK-MW-15001 terminates at the April 2018 sampling event as it was decommissioned on April 18, 2018, and statistical analysis for DEK-MW-18001 commences with the first semiannual sampling event for 2019.

The Sanitas™ software generates an output graph for the confidence intervals of each well. The data sets were found to be normally distributed with the exception of DEK-MW-15004 and DEK-MW-15005, which used non-parametric confidence intervals due to non-normal data sets. The confidence interval test compares the lower confidence limit to the GWPS. The statistical evaluation of the Appendix IV parameters shows exceedances for arsenic at three of the six monitoring locations (DEK-MW-15003 through DEK-MW-15005 and DEK-MW-18001). Previously, arsenic was present in downgradient well DEK-MW-15002 at a statistically significant level; however, the statistical evaluation of the October 2019 data shows that the lower confidence limit for arsenic is currently below the GWPS. The results of the assessment monitoring statistical evaluation for the other downgradient wells are consistent with the results of the previous assessment monitoring data statistical evaluations, indicating that arsenic is the only constituent present at concentrations above the GWPS. Consumers Energy will continue to evaluate corrective measures per §257.96 and §257.97. Consumers Energy will continue executing the self-implementing groundwater compliance schedule in conformance with §257.90 - §257.98.

Attachments

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

Attachment 1 Sanitas™ Output Files

Table

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

		Sample Location:				DEK-MW-15001 ⁽¹⁾									
		Sample Date:				12/10/2015	3/30/2016	5/26/2016	8/24/2016	12/1/2016	2/23/2017	5/18/2017	8/3/2017	9/18/2017	4/10/2018
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS	downgradient									
Appendix III															
Boron	ug/L	NC	NA	619	NA	3,630	2,420	3,110	2,810	2,740	2,520	3,270	2,690	2,700	--
Calcium	mg/L	NC	NA	302	NA	108	87.8	92.2	95	75.1	96.8	85.8	71.8	82.4	--
Chloride	mg/L	250*	NA	2,440	NA	75.7	79.0	75.7	72.5	71.0	76.5	75.0	81.9	82.2	--
Fluoride	ug/L	4,000	NA	1,000	NA	< 1,000	1,530	1,440	1,160	1,500	1,650	1,330	1,700	2,100	1,600
Sulfate	mg/L	250*	NA	407	NA	72.4	53.3	64.9	37.4	52.7	53.4	59.9	66.3	36.2	--
Total Dissolved Solids	mg/L	500*	NA	4,600	NA	600	470	510	480	470	450	510	516	594	--
pH, Field	SU	6.5 - 8.5*	NA	6.5-7.3	NA	7.6	7.5	7.5	7.4	7.4	7.4	7.4	7.6	7.5	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	118	159	138	108	144	133	145	158	--	103
Barium	ug/L	2,000	NA	1,300	2,000	114	69	73	100	98	91	95	94.2	--	117
Beryllium	ug/L	4	NA	1	4	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 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
Chromium	ug/L	100	NA	3	100	< 1	1	< 1	< 1	< 1	< 1	1	< 1.0	--	< 1.0
Cobalt	ug/L	NC	6	15	15	< 15	< 15	< 15	< 15	< 15	< 15	< 15	< 15.0	--	< 15.0
Fluoride	ug/L	4,000	NA	1,000	4,000	< 1,000	1,530	1,440	1,160	1,500	1,650	1,330	1,700	2,100	1,600
Lead	ug/L	NC	15	1	15	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0
Lithium	ug/L	NC	40	180	180	71.9	48.7	51	55	52	48	55	53	--	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
Molybdenum	ug/L	NC	100	6	100	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5.0	--	< 5.0
Radium-226	pCi/L	NC	NA	NA	NA	< 0.297	0.244	0.240	< 0.195	< 0.292	0.565	< 0.315	< 0.934	--	< 0.686
Radium-228	pCi/L	NC	NA	NA	NA	0.909	1.32	0.639	< 0.509	< 0.405	0.642	1.20	< 0.770	--	1.08
Radium-226/228	pCi/L	5	NA	3.32	5	1.181	1.564	0.879	< 0.509	< 0.405	1.207	1.29	< 1.70	--	< 1.42
Selenium	ug/L	50	NA	2	50	4	3	3	1	2	< 1	< 1	< 1.0	--	1.2
Thallium	ug/L	2	NA	2	2	< 2	< 2	< 2	< 2	< 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.
- 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) DEK-MW-15001 was decommissioned on April 18, 2018.
- (2) Outlier; single detection above reporting limit.
- (3) Laboratory reporting limits exceeds GWPS due to sample dilutions performed as a result of the sample matrix.

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

Sample Location:						DEK-MW-15002													
Sample Date:						12/10/2015	3/30/2016	5/26/2016	8/24/2016	12/1/2016	2/23/2017	5/18/2017	8/3/2017	9/18/2017	4/12/2018	5/23/2018	11/5/2018	4/11/2019	10/15/2019
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS	downgradient													
Appendix III																			
Boron	ug/L	NC	NA	619	NA	780	676	668	746	893	858	824	805	870	--	967	894	860	1,600
Calcium	mg/L	NC	NA	302	NA	102	119	99.6	105	94.8	149	80.1	71.1	66.9	--	53.7	67.8	72	130
Chloride	mg/L	250*	NA	2,440	NA	83.5	97.6	90.0	89.2	86.1	88.2	80.5	87.8	84.9	--	79.7	83.5	80	410
Fluoride	ug/L	4,000	NA	1,000	NA	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Sulfate	mg/L	250*	NA	407	NA	275	418	291	384	326	289	299	256	290	--	263	77.2	45	150
Total Dissolved Solids	mg/L	500*	NA	4,600	NA	790	890	800	1,700	810	810	1,500	696	722	--	660	536	560	1,300
pH, Field	SU	6.5 - 8.5*	NA	6.5-7.3	NA	7.8	7.5	7.6	7.5	7.6	7.5	7.5	7.8	7.9	7.5	8.0	7.3	7.5	7.3
Appendix IV																			
Antimony	ug/L	6	NA	1	6	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	10	NA	21	21	61	118	82	79	54	62	76	48.3	--	56.4	67.0	31.7	9.0	6.5
Barium	ug/L	2,000	NA	1,300	2,000	140	148	136	131	121	120	107	96.1	--	82.7	84.5	71.6	71	140
Beryllium	ug/L	4	NA	1	4	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	5	NA	0.2	5	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Chromium	ug/L	100	NA	3	100	1	2	1	< 1	1	2	2	< 1.0	--	< 1.0	< 1.0	1.4	1.3	< 1.0
Cobalt	ug/L	NC	6	15	15	< 15	< 15	< 15	< 15	< 15	< 15	< 15	< 15.0	--	< 15.0	< 15.0	< 6.0	< 6.0	< 6.0
Fluoride	ug/L	4,000	NA	1,000	4,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 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	3	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lithium	ug/L	NC	40	180	180	50.7	53	43	44	40	41	42	36	--	43	35	32	26	35
Mercury	ug/L	2	NA	0.2	2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	NC	100	6	100	19	30	29	41	26	27	38	27.7	--	30.8	35.4	< 5.0	< 5.0	< 5.0
Radium-226	pCi/L	NC	NA	NA	NA	< 0.301	0.301	0.314	0.513	0.255	0.68	0.321	< 0.854	--	< 0.478	< 0.698	< 0.850	< 0.376	0.334
Radium-228	pCi/L	NC	NA	NA	NA	0.809	0.645	1.26	0.908	0.547	0.844	0.929	1.17	--	1.16	< 0.744	0.730	0.684	0.654
Radium-226/228	pCi/L	5	NA	3.32	5	1.067	0.946	1.574	1.421	0.802	1.524	1.25	1.88	--	1.42	< 1.44	< 1.39	0.846	0.987
Selenium	ug/L	50	NA	2	50	< 1	< 1	2	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Thallium	ug/L	2	NA	2	2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2.0	--	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0

Notes:

- ug/L - micrograms per liter.
- mg/L - milligrams per liter.
- SU - standard units; pH is a field parameter.
- pCi/L - picocuries per liter.
- NA - not applicable.
- NC - no criteria.
- - not analyzed.
- MCL - Maximum Contaminant Level, EPA Drinking Water Standards and Health Advisories, April 2012.
- RSL - Regional Screening Level from 83 FR 36435.
- UTL - Upper Tolerance Limit (95%) of the background data set.
- GWPS - Groundwater Protection Standard. GWPS is the higher of the MCL/RSL and UTL as established in TRC's Technical Memorandum dated October 15, 2018.
- * - Secondary Maximum Contaminant Level (SMCL), EPA Secondary Drinking Water Regulations (SDWR) April 2012.
- Bold** value indicates an exceedance of the GWPS. Data from downgradient monitoring wells are screened against the GWPS for evaluation purposes only. Confidence intervals will be used to determine compliance per the CCR rules.
- All metals were analyzed as total unless otherwise specified.
- (1) DEK-MW-15001 was decommissioned on April 18, 2018.
- (2) Outlier; single detection above reporting limit.
- (3) Laboratory reporting limits exceeds GWPS due to sample dilutions performed as a result of the sample matrix.

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

		Sample Location:				DEK-MW-15003													
		Sample Date:				12/10/2015	3/30/2016	5/26/2016	8/24/2016	12/1/2016	2/23/2017	5/18/2017	8/4/2017	9/18/2017	4/12/2018	5/23/2018	11/6/2018	4/11/2019	10/15/2019
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS	downgradient													
Appendix III																			
Boron	ug/L	NC	NA	619	NA	1,020	920	982	1,010	1,140	1,090	1,270	1,160	1,030	--	1,010	944	960	1,100
Calcium	mg/L	NC	NA	302	NA	41.7	57.3	56.3	64.1	64.1	85.4	68.2	58.8	62.1	--	58.1	62.9	52	39
Chloride	mg/L	250*	NA	2,440	NA	63.8	62.0	61.2	59.8	54.8	56.3	54.9	61.7	60.2	--	57.2	61.7	58	58
Fluoride	ug/L	4,000	NA	1,000	NA	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Sulfate	mg/L	250*	NA	407	NA	64.3	71.6	75.7	76.8	71.9	64.5	57.6	55.8	54.3	--	39.1	37.8	47	52
Total Dissolved Solids	mg/L	500*	NA	4,600	NA	370	400	420	430	440	430	420	506	426	--	354	370	360	330
pH, Field	SU	6.5 - 8.5*	NA	6.5-7.3	NA	8.4	7.8	7.9	7.7	7.8	7.7	7.8	7.9	7.9	7.8	8.2	8.0	8.0	7.9
Appendix IV																			
Antimony	ug/L	6	NA	1	6	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 5.0	< 1.0
Arsenic	ug/L	10	NA	21	21	498	517	543	527	525	372	450	437	--	478	450	420	380	420
Barium	ug/L	2,000	NA	1,300	2,000	96	69	68	73	71	71	66	68.5	--	61.2	73.3	70.9	62	58
Beryllium	ug/L	4	NA	1	4	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 5.0 ⁽³⁾	< 1.0
Cadmium	ug/L	5	NA	0.2	5	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20	< 1.0	< 0.20
Chromium	ug/L	100	NA	3	100	2	2	2	< 1	< 1	< 1	1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 5.0	< 1.0
Cobalt	ug/L	NC	6	15	15	< 15	< 15	< 15	< 15	< 15	< 15	< 15	< 15.0	--	< 15.0	< 15.0	< 6.0	< 30 ⁽³⁾	< 6.0
Fluoride	ug/L	4,000	NA	1,000	4,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Lead	ug/L	NC	15	1	15	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 5.0	< 1.0
Lithium	ug/L	NC	40	180	180	22.8	22.6	26	27	30	30	35	35	--	39	33	33	28	29
Mercury	ug/L	2	NA	0.2	2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	NC	100	6	100	8	7	8	6	5	5	5	5.0	--	< 5.0	5.3	5.2	< 25	28
Radium-226	pCi/L	NC	NA	NA	NA	< 0.221	< 0.227	< 0.235	< 0.184	< 0.287	0.252	< 0.324	0.226	--	0.686	< 0.842	< 0.661	< 0.424	< 0.150
Radium-228	pCi/L	NC	NA	NA	NA	< 0.473	< 0.52	< 0.546	0.423	< 0.363	< 0.34	< 0.646	< 0.936	--	< 0.755	1.12	< 0.789	< 0.495	< 0.449
Radium-226/228	pCi/L	5	NA	3.32	5	< 0.473	< 0.52	< 0.546	0.469	< 0.363	< 0.34	< 0.646	< 1.14	--	< 1.33	1.63	< 1.45	< 0.495	< 0.449
Selenium	ug/L	50	NA	2	50	< 5	< 1	2	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 5.0	< 1.0
Thallium	ug/L	2	NA	2	2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2.0	--	< 2.0	< 2.0	< 2.0	< 10 ⁽³⁾	< 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) DEK-MW-15001 was decommissioned on April 18, 2018.
- (2) Outlier; single detection above reporting limit.
- (3) Laboratory reporting limits exceeds GWPS due to sample dilutions performed as a result of the sample matrix.

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

Sample Location:						DEK-MW-15004																		
Sample Date:						12/10/2015	3/30/2016	5/26/2016	8/24/2016	12/1/2016	2/23/2017	5/18/2017	8/3/2017	8/3/2017	9/19/2017	9/19/2017	4/12/2018	5/23/2018	5/23/2018	11/6/2018	4/11/2019	10/15/2019		
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS	downgradient																		
Appendix III																								
Boron	ug/L	NC	NA	619	NA	478	435	514	472	535	637	839	785	Field Dup	730	Field Dup	750	--	800	Field Dup	842	910	840	540
Calcium	mg/L	NC	NA	302	NA	61.7	68.3	71.1	78.9	73	108	74.2	67.4	68.1	66.5	67.9	--	47.8	50.7	62.2	50	60		
Chloride	mg/L	250*	NA	2,440	NA	71.5	72.7	72.3	77.4	73.3	75.3	70.3	81.4	81.5	79.8	79.9	--	72.5	72.6	70.6	63	77		
Fluoride	ug/L	4,000	NA	1,000	NA	< 1,000	< 1,000	< 1,000	1,550	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	1,200	1,100	1,100	1,100	1,100	1,100	1,100	1,100
Sulfate	mg/L	250*	NA	407	NA	213	188	184	198	215	211	220	258	261	283	281	--	176	178	168	150	160		
Total Dissolved Solids	mg/L	500*	NA	4,600	NA	680	560	560	580	590	580	590	642	582	596	564	--	494	504	482	490	530		
pH, Field	SU	6.5 - 8.5*	NA	6.5-7.3	NA	8.0	7.7	7.4	7.4	7.5	7.5	7.5	7.6	--	7.3	--	7.3	7.7	--	7.4	7.1	7.4		
Appendix IV																								
Antimony	ug/L	6	NA	1	6	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1.0	--	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	10	NA	21	21	56	95	108	104	117	116	111	121	129	--	--	134	119	126	123	110	180		
Barium	ug/L	2,000	NA	1,300	2,000	107	94	102	110	115	110	103	111	115	--	--	86.9	79.6	82.6	95.1	77	99		
Beryllium	ug/L	4	NA	1	4	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1.0	--	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	5	NA	0.2	5	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	< 0.20	--	--	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Chromium	ug/L	100	NA	3	100	< 1	2	< 1	< 1	< 1	1	< 1	< 1.0	< 1.0	--	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cobalt	ug/L	NC	6	15	15	< 15	< 15	< 15	< 15	< 15	< 15	< 15	< 15.0	< 15.0	--	--	< 15.0	< 15.0	< 15.0	< 6.0	< 6.0	< 6.0		
Fluoride	ug/L	4,000	NA	1,000	4,000	< 1,000	< 1,000	< 1,000	1,550	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	1,200	1,100	1,100	1,100	1,100	1,100	1,100	1,100
Lead	ug/L	NC	15	1	15	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	< 1.0	--	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lithium	ug/L	NC	40	180	180	35.8	29.5	36	34	37	36	38	39	38	--	--	39	30	32	33	26	34		
Mercury	ug/L	2	NA	0.2	2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	< 0.20	--	--	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	NC	100	6	100	29	25	21	24	27	30	29	30.4	31.4	--	--	32.0	30.9	30.4	28.0	23	< 5.0		
Radium-226	pCi/L	NC	NA	NA	NA	< 0.258	0.400	0.233	0.264	0.244	0.328	0.347	0.805	< 0.623	--	--	< 0.641	< 0.791	< 0.679	< 0.743	< 0.316	0.204		
Radium-228	pCi/L	NC	NA	NA	NA	< 0.556	0.532	0.527	0.672	< 0.396	< 0.458	1.28	0.833	0.864	--	--	< 0.847	< 0.753	0.845	< 0.794	0.924	0.537		
Radium-226/228	pCi/L	5	NA	3.32	5	< 0.556	0.932	0.76	0.936	0.588	0.665	1.63	1.64	< 1.46	--	--	< 1.49	< 1.54	1.29	< 1.54	1.07	0.741		
Selenium	ug/L	50	NA	2	50	< 1	< 1	1	< 1	< 1	< 1	< 1	< 1.0	< 1.0	--	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Thallium	ug/L	2	NA	2	2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2.0	< 2.0	--	--	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 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) DEK-MW-15001 was decommissioned on April 18, 2018.
- (2) Outlier; single detection above reporting limit.
- (3) Laboratory reporting limits exceeds GWPS due to sample dilutions performed as a result of the sample matrix.

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

		Sample Location:				DEK-MW-15005																
		Sample Date:				12/10/2015	3/30/2016	5/26/2016	8/24/2016	12/1/2016	2/23/2017	5/18/2017	8/3/2017	9/18/2017	4/11/2018	4/11/2018	5/24/2018	11/6/2018	4/11/2019	4/11/2019	10/15/2019	10/15/2019
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS	downgradient																
Appendix III																						
Boron	ug/L	NC	NA	619	NA	410	396	465	589	687	712	788	792	714	--	Field Dup	806	947	910	Field Dup	700	650
Calcium	mg/L	NC	NA	302	NA	58.5	68.6	72.7	98.4	71.1	76.3	55	49.2	44.3	--	--	33.4	32.9	31	31	60	59
Chloride	mg/L	250*	NA	2,440	NA	77.9	82.6	82.3	93.9	80.1	77.5	73.3	81.4	79.3	--	--	72.6	69.1	60	60	64	64
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	< 1,000	< 1,000	< 1,000
Sulfate	mg/L	250*	NA	407	NA	223	251	269	355	329	281	263	300	273	--	--	182	160	140	140	5.2	5.0
Total Dissolved Solids	mg/L	500*	NA	4,600	NA	620	660	660	810	740	680	650	732	638	--	--	524	474	470	470	390	400
pH, Field	SU	6.5 - 8.5*	NA	6.5-7.3	NA	8.0	7.7	7.5	7.6	7.7	7.7	7.6	7.9	7.9	7.7	--	7.8	7.9	7.7	--	7.6	--
Appendix IV																						
Antimony	ug/L	6	NA	1	6	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	10	NA	21	21	5	15	16	23	29	29	28	31.9	--	28.3	29.1	31.7	35.0	24	24	120	120
Barium	ug/L	2,000	NA	1,300	2,000	87	94	104	149	120	101	83	92.2	--	54.9	55.8	58.5	56.7	46	45	110	100
Beryllium	ug/L	4	NA	1	4	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	5	NA	0.2	5	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Chromium	ug/L	100	NA	3	100	< 1	1	1	< 1	< 1	1	2	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cobalt	ug/L	NC	6	15	15	< 15	< 15	< 15	< 15	< 15	< 15	< 15	< 15.0	--	< 15.0	< 15.0	< 15.0	< 6.0	< 6.0	< 6.0	< 6.0	< 6.0
Fluoride	ug/L	4,000	NA	1,000	4,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Lead	ug/L	NC	15	1	15	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lithium	ug/L	NC	40	180	180	23.7	23	29	30	26	23	26	27	--	24	24	19	17	15	14	16	15
Mercury	ug/L	2	NA	0.2	2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	NC	100	6	100	40	33	32	37	44	40	36	41.9	--	39.0	40.5	41.9	45.3	39	38	< 5.0	< 5.0
Radium-226	pCi/L	NC	NA	NA	NA	< 0.238	0.263	0.180	0.300	0.367	0.490	< 0.321	0.707	--	< 0.587	0.606	< 0.740	< 0.865	< 0.379	< 0.406	0.165	0.185
Radium-228	pCi/L	NC	NA	NA	NA	1.03	< 0.429	< 0.404	0.919	0.550	0.450	0.685	1.01	--	0.756	0.886	0.857	< 0.598	< 0.754	< 0.586	< 0.456	0.497
Radium-226/228	pCi/L	5	NA	3.32	5	1.197	0.686	0.458	1.219	0.917	0.940	0.875	1.72	--	< 1.34	1.49	< 1.53	< 1.46	< 0.754	< 0.586	0.524	0.682
Selenium	ug/L	50	NA	2	50	2	< 1	1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Thallium	ug/L	2	NA	2	2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2.0	--	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0

Notes:

- ug/L - micrograms per liter.
- mg/L - milligrams per liter.
- SU - standard units; pH is a field parameter.
- pCi/L - picocuries per liter.
- NA - not applicable.
- NC - no criteria.
- - not analyzed.
- MCL - Maximum Contaminant Level, EPA Drinking Water Standards and Health Advisories, April 2012.
- RSL - Regional Screening Level from 83 FR 36435.
- UTL - Upper Tolerance Limit (95%) of the background data set.
- GWPS - Groundwater Protection Standard. GWPS is the higher of the MCL/RSL and UTL as established in TRC's Technical Memorandum dated October 15, 2018.
- * - Secondary Maximum Contaminant Level (SMCL), EPA Secondary Drinking Water Regulations (SDWR) April 2012.
- Bold** value indicates an exceedance of the GWPS. Data from downgradient monitoring wells are screened against the GWPS for evaluation purposes only. Confidence intervals will be used to determine compliance per the CCR rules. All metals were analyzed as total unless otherwise specified.
- (1) DEK-MW-15001 was decommissioned on April 18, 2018.
- (2) Outlier; single detection above reporting limit.
- (3) Laboratory reporting limits exceeds GWPS due to sample dilutions performed as a result of the sample matrix.

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

Sample Location:						DEK-MW-15006														
Sample Date:						12/10/2015	3/30/2016	5/25/2016	8/24/2016	12/1/2016	2/23/2017	5/18/2017	8/3/2017	9/18/2017	4/11/2018	5/24/2018	11/5/2018	11/5/2018	4/11/2019	10/14/2019
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS	downgradient														
Appendix III																				
Boron	ug/L	NC	NA	619	NA	1,070	706	942	979	1,230	1,120	1,420	1,240	1,070	--	1,200	1,340	1,270	1,700	1,200
Calcium	mg/L	NC	NA	302	NA	196	130	105	130	79.1	83.9	38.6	39.9	76.8	--	21.9	29.4	29.6	35	34
Chloride	mg/L	250*	NA	2,440	NA	153	152	135	188	128	102	97.1	104	133	--	85.8	87.9	88.3	75	45
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	< 1,000
Sulfate	mg/L	250*	NA	407	NA	1,320	1,130	917	1,160	886	636	513	547	886	--	401	341	344	320	74
Total Dissolved Solids	mg/L	500*	NA	4,600	NA	2,400	2,100	1,700	2,200	1,800	1,300	1,100	1,110	1,670	--	944	792	784	780	450
pH, Field	SU	6.5 - 8.5*	NA	6.5-7.3	NA	7.4	7.5	7.5	7.6	7.8	7.7	8.1	7.9	7.8	7.9	8.2	7.9	--	7.8	7.8
Appendix IV																				
Antimony	ug/L	6	NA	1	6	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	10	NA	21	21	13	19	18	20	20	20	20	14.6	--	18.3	25.7	20.9	19.6	21	27
Barium	ug/L	2,000	NA	1,300	2,000	97	55	44	58	41	30	27	31.0	--	39.6	22.8	38.5	38.3	43	51
Beryllium	ug/L	4	NA	1	4	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	5	NA	0.2	5	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Chromium	ug/L	100	NA	3	100	< 1	1	1	< 1	1	1	2	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.1
Cobalt	ug/L	NC	6	15	15	< 15	< 15	< 15	< 15	< 15	< 15	< 15	< 15.0	--	< 15.0	< 15.0	< 6.0	< 6.0	< 6.0	< 6.0
Fluoride	ug/L	4,000	NA	1,000	4,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Lead	ug/L	NC	15	1	15	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	320 ⁽²⁾	< 1.0	< 1.0	< 1.0	< 1.0
Lithium	ug/L	NC	40	180	180	36.1	20.7	22	22	19	16	16	17	--	18	< 10	< 10	10	< 10	11
Mercury	ug/L	2	NA	0.2	2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	NC	100	6	100	23	37	34	36	64	82	68	64.2	--	71.6	48.7	50.3	48.0	59	11
Radium-226	pCi/L	NC	NA	NA	NA	0.392	0.363	0.463	0.286	< 0.362	< 0.307	< 0.354	< 0.945	--	< 0.688	< 0.738	< 0.885	< 1.06	< 0.459	< 0.159
Radium-228	pCi/L	NC	NA	NA	NA	0.901	0.743	0.501	< 0.578	< 0.421	< 0.562	0.483	< 0.906	--	< 0.755	< 1.12	< 0.649	< 0.897	< 0.677	< 0.581
Radium-226/228	pCi/L	5	NA	3.32	5	1.293	1.106	0.964	0.748	< 0.421	< 0.562	0.585	< 1.85	--	< 1.44	< 1.86	< 1.53	< 1.96	< 0.677	< 0.581
Selenium	ug/L	50	NA	2	50	3	2	2	< 1	< 1	1	1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Thallium	ug/L	2	NA	2	2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2.0	--	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0

Notes:
 ug/L - micrograms per liter.
 mg/L - milligrams per liter.
 SU - standard units; pH is a field parameter.
 pCi/L - picocuries per liter.
 NA - not applicable.
 NC - no criteria.
 -- - not analyzed.
 MCL - Maximum Contaminant Level, EPA Drinking Water Standards and Health Advisories, April 2012.
 RSL - Regional Screening Level from 83 FR 36435.
 UTL - Upper Tolerance Limit (95%) of the background data set.
 GWPS - Groundwater Protection Standard. GWPS is the higher of the MCL/RSL and UTL as established in TRC's Technical Memorandum dated October 15, 2018.
 * - Secondary Maximum Contaminant Level (SMCL), EPA Secondary Drinking Water Regulations (SDWR) April 2012.
Bold value indicates an exceedance of the GWPS. Data from downgradient monitoring wells are screened against the GWPS for evaluation purposes only. Confidence intervals will be used to determine compliance per the CCR rules.
 All metals were analyzed as total unless otherwise specified.
 (1) DEK-MW-15001 was decommissioned on April 18, 2018.
 (2) Outlier; single detection above reporting limit.
 (3) Laboratory reporting limits exceeds GWPS due to sample dilutions performed as a result of the sample matrix.

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

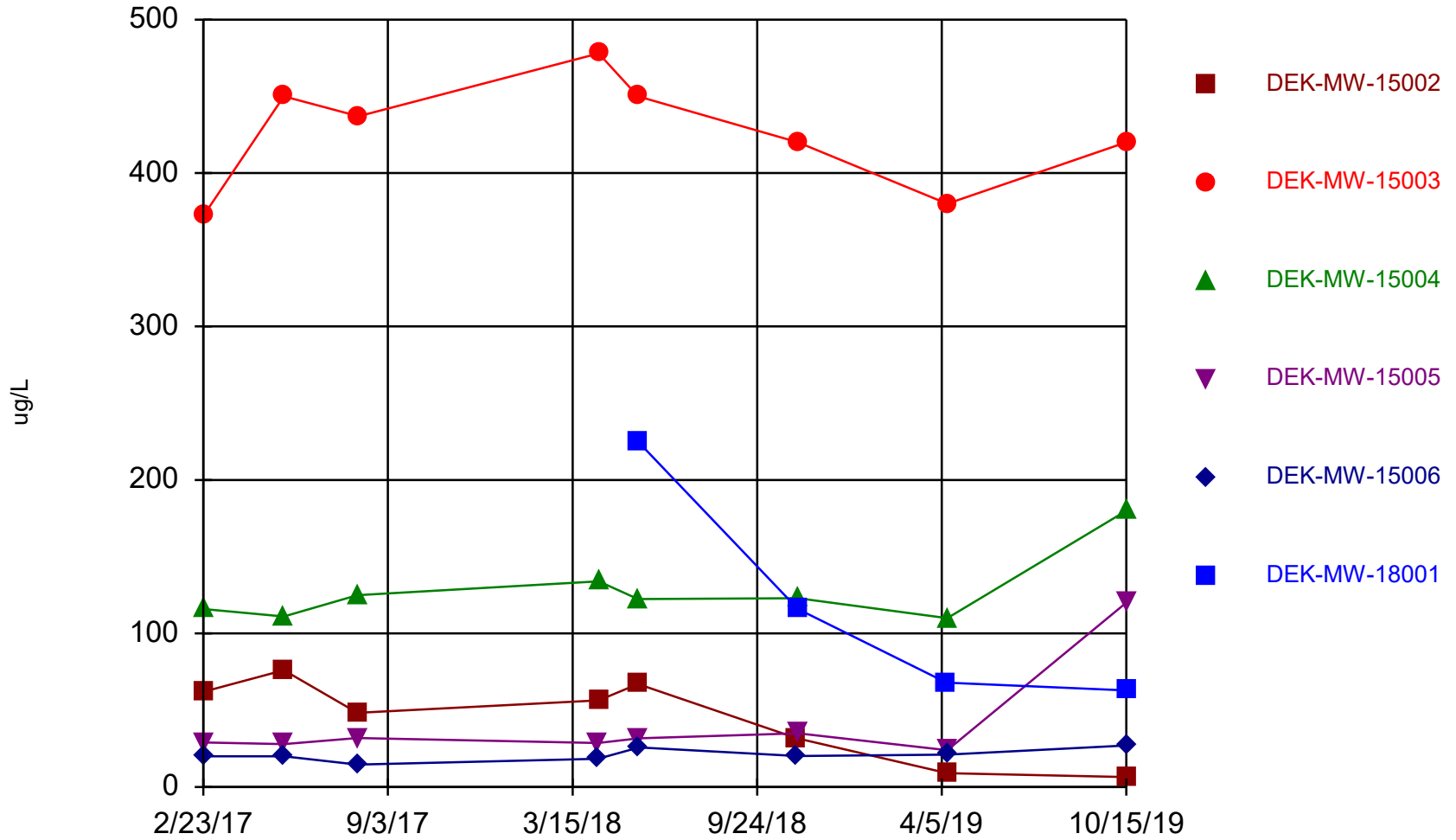
Sample Location:						DEK-MW-18001			
Sample Date:						5/23/2018	11/6/2018	4/10/2019	10/15/2019
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS	downgradient			
Appendix III									
Boron	ug/L	NC	NA	619	NA	1,600	1,020	970	2,200
Calcium	mg/L	NC	NA	302	NA	64.9	51.1	48	84
Chloride	mg/L	250*	NA	2,440	NA	69.1	76.6	69	81
Fluoride	ug/L	4,000	NA	1,000	NA	< 1,000	1,300	1,200	1,000
Sulfate	mg/L	250*	NA	407	NA	30.6	< 2.0	< 2.0	31
Total Dissolved Solids	mg/L	500*	NA	4,600	NA	434	340	360	500
pH, Field	SU	6.5 - 8.5*	NA	6.5-7.3	NA	7.8	7.5	7.2	7.3
Appendix IV									
Antimony	ug/L	6	NA	1	6	< 1.0	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	10	NA	21	21	225	116	68	63
Barium	ug/L	2,000	NA	1,300	2,000	101	79.5	75	160
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	< 15.0	< 6.0	< 6.0	< 6.0
Fluoride	ug/L	4,000	NA	1,000	4,000	< 1,000	1,300	1,200	1,000
Lead	ug/L	NC	15	1	15	< 1.0	< 1.0	< 1.0	< 1.0
Lithium	ug/L	NC	40	180	180	23	24	24	36
Mercury	ug/L	2	NA	0.2	2	< 0.20	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	NC	100	6	100	< 5.0	< 5.0	< 5.0	< 5.0
Radium-226	pCi/L	NC	NA	NA	NA	0.906	< 0.813	0.173	0.206
Radium-228	pCi/L	NC	NA	NA	NA	< 0.733	0.811	0.694	0.746
Radium-226/228	pCi/L	5	NA	3.32	5	1.63	1.56	0.867	0.952
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.
- 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) DEK-MW-15001 was decommissioned on April 18, 2018.
- (2) Outlier; single detection above reporting limit.
- (3) Laboratory reporting limits exceeds GWPS due to sample dilutions performed as a result of the sample matrix.

Sanitas™ Output Files

Time Series

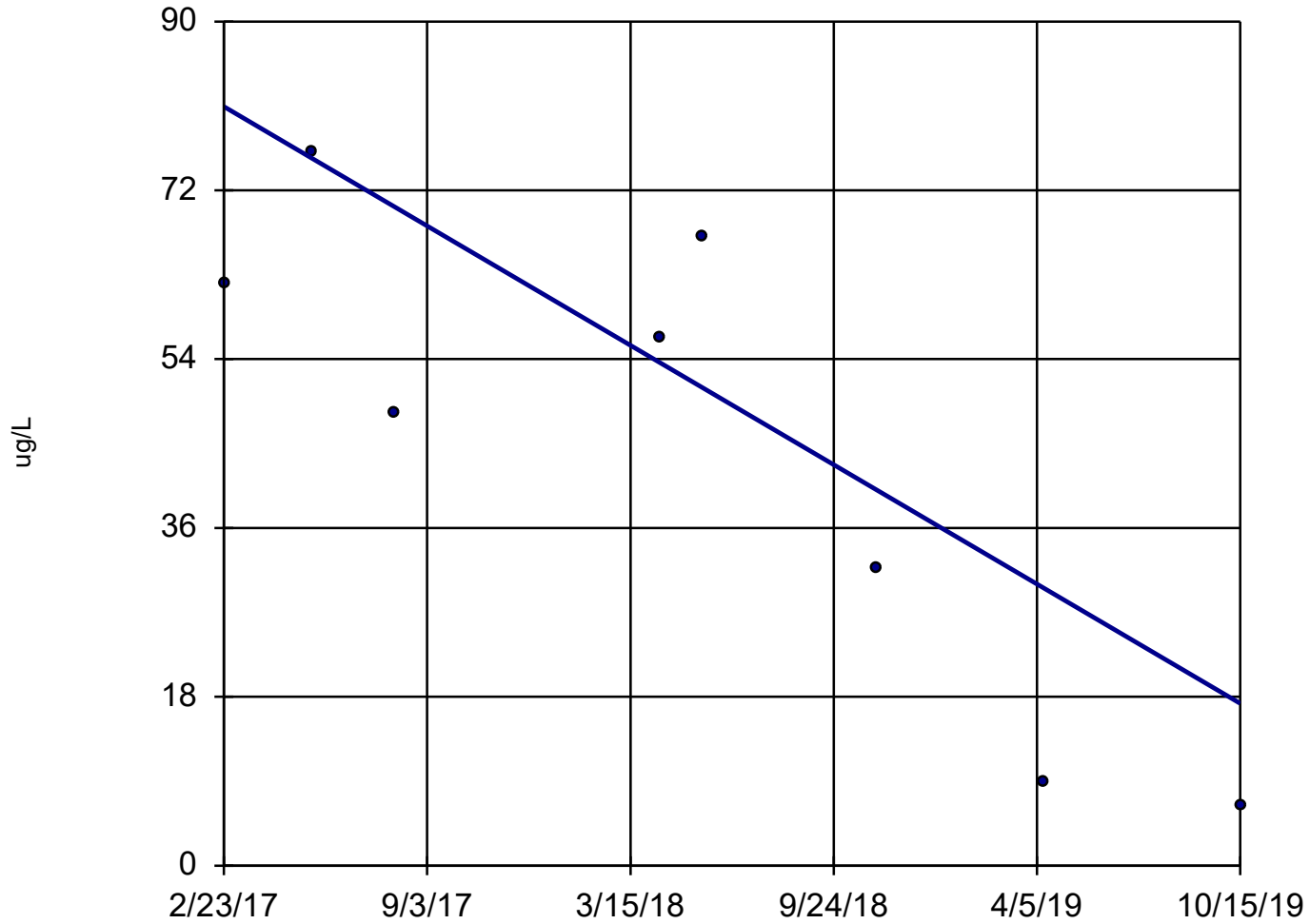


Constituent: Arsenic, Total Analysis Run 12/11/2019 9:44 AM

Client: Consumers Energy Data: DEK_Sanitas_19.11.21

Sen's Slope Estimator

DEK-MW-15002



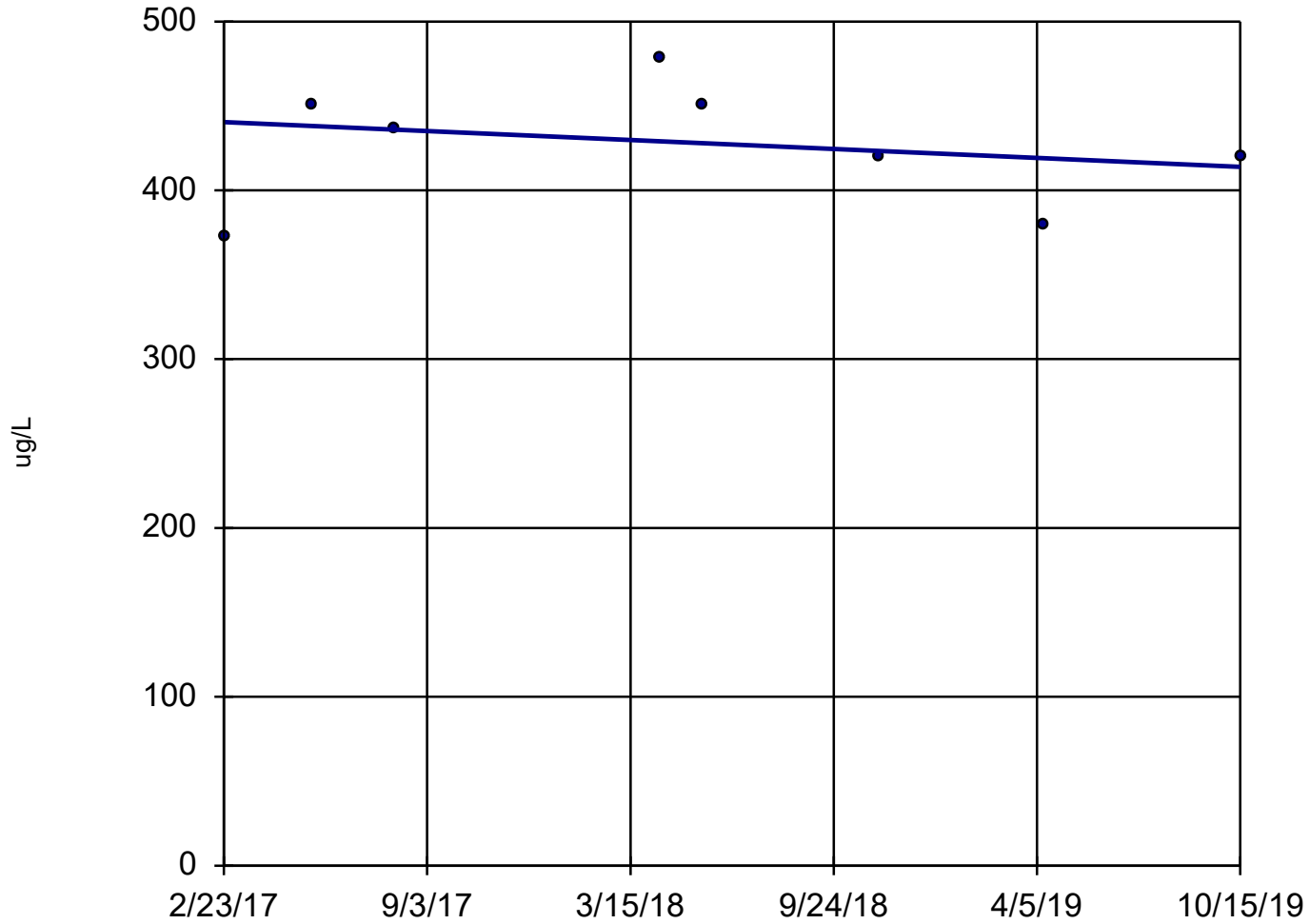
n = 8
Slope = -24.09
units per year.
Mann-Kendall
statistic = -18
critical = -20
Trend not sig-
nificant at 98%
confidence level
($\alpha = 0.01$ per
tail).

Constituent: Arsenic, Total Analysis Run 12/11/2019 9:45 AM

Client: Consumers Energy Data: DEK_Sanitas_19.11.21

Sen's Slope Estimator

DEK-MW-15003



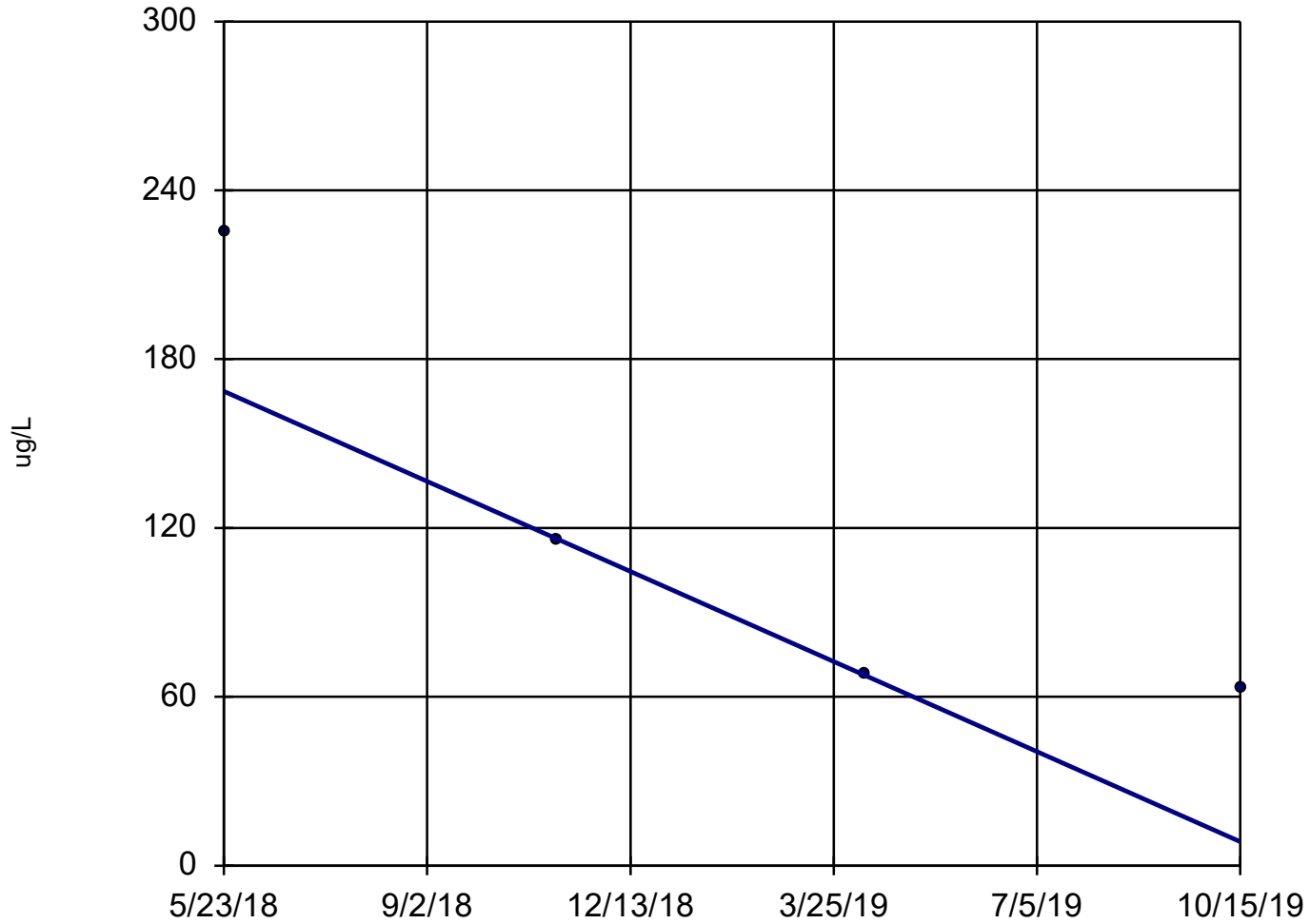
n = 8
Slope = -10.09 units per year.
Mann-Kendall statistic = -4
critical = -20
Trend not significant at 98% confidence level ($\alpha = 0.01$ per tail).

Constituent: Arsenic, Total Analysis Run 12/11/2019 9:45 AM

Client: Consumers Energy Data: DEK_Sanitas_19.11.21

Sen's Slope Estimator

DEK-MW-18001



n = 4

Slope = -114.5
units per year.

Mann-Kendall
statistic = -6
critical = -8

Trend not sig-
nificant at 98%
confidence level
($\alpha = 0.01$ per
tail).

With n = 4, no data
set will result in
a significant Mann-
Kendall statistic.

Constituent: Arsenic, Total Analysis Run 12/11/2019 9:45 AM

Client: Consumers Energy Data: DEK_Sanitas_19.11.21

Summary Report

Constituent: Arsenic, Total Analysis Run 12/11/2019 9:46 AM
 Client: Consumers Energy Data: DEK_Sanitas_19.11.21

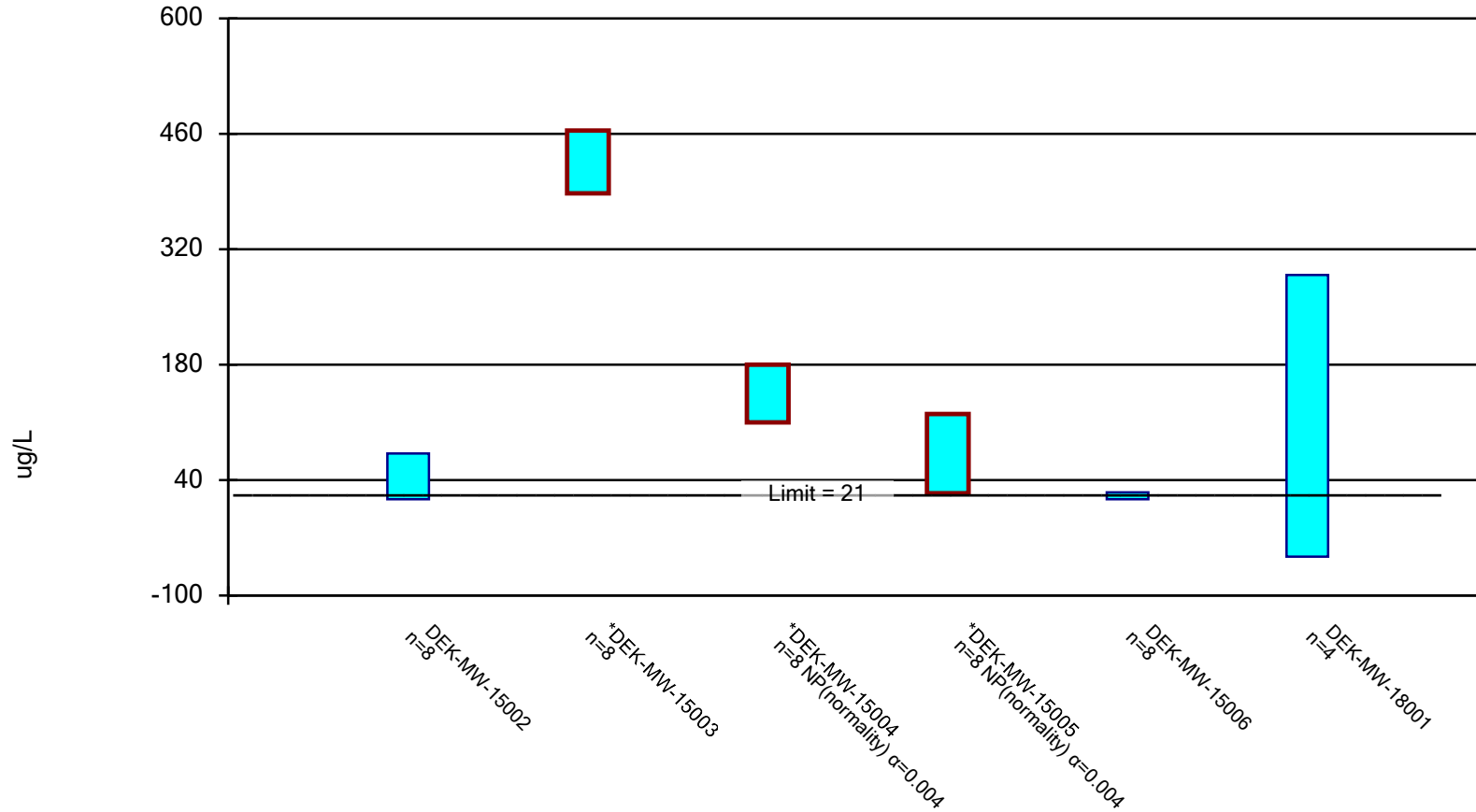
For observations made between 2/23/2017 and 10/15/2019, a summary of the selected data set:

Observations = 44
 ND/Trace = 0
 Wells = 6
 Minimum Value = 6.5
 Maximum Value = 478
 Mean Value = 130.7
 Median Value = 65
 Standard Deviation = 149.4
 Coefficient of Variation = 1.143
 Skewness = 1.339

<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>
DEK-MW-15002	8	0	6.5	76	44.61	52.35	26.26	0.5887	-0.4517
DEK-MW-15003	8	0	372	478	425.9	428.5	36.02	0.08457	-0.2688
DEK-MW-15004	8	0	110	180	127.7	122.8	22.55	0.1766	1.749
DEK-MW-15005	8	0	24	120	41.04	30.35	32.07	0.7815	2.221
DEK-MW-15006	8	0	14.6	27	20.86	20.13	3.941	0.189	0.2058
DEK-MW-18001	4	0	63	225	118	92	75.23	0.6375	0.8441

Parametric and Non-Parametric (NP) Confidence Interval

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



Constituent: Arsenic, Total Analysis Run 12/11/2019 9:46 AM

Client: Consumers Energy Data: DEK_Sanitas_19.11.21

Confidence Interval

Constituent: Arsenic, Total (ug/L) Analysis Run 12/11/2019 9:47 AM

Client: Consumers Energy Data: DEK_Sanitas_19.11.21

	DEK-MW-15002	DEK-MW-15003	DEK-MW-15004	DEK-MW-15005	DEK-MW-15006	DEK-MW-18001
2/23/2017	62	372	116	29	20	
5/18/2017	76	450	111	28	20	
8/3/2017	48.3		125 (D)	31.9	14.6	
8/4/2017		437				
4/11/2018				28.7 (D)	18.3	
4/12/2018	56.4	478	134			
5/23/2018	67	450	122.5 (D)			225
5/24/2018				31.7	25.7	
11/5/2018	31.7				20.25 (D)	
11/6/2018		420	123	35		116
4/10/2019						68
4/11/2019	9	380	110	24 (D)	21	
10/15/2019	6.5	420	180	120 (D)	27	63
Mean	44.61	425.9	127.7	41.04	20.86	118
Std. Dev.	26.26	36.02	22.55	32.07	3.941	75.23
Upper Lim.	72.45	464.1	180	120	25.03	288.8
Lower Lim.	16.77	387.7	110	24	16.68	-52.8


Appendix G

ACM Extension Certification

A CMS Energy Company

Date: July 12, 2019

To: Operating Record

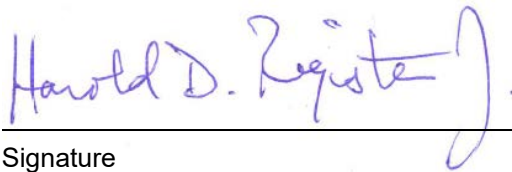
From: Harold D. Register, Jr., P.E. 

RE: Demonstration for 60-Day Extension for Assessment of Corrective Measures
Professional Engineer Certification
DE Karn 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 DE Karn Bottom Ash Pond due to site-specific conditions that are changing based on initiating closure activities. Notification was made 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 DE Karn 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.

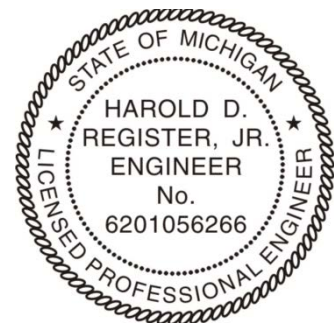
Name

6201056266

Professional Engineer Certification Number

6201056266

Professional Engineer Certification Number



07/12/2019

Appendix H

Semi-Annual Progress Report

January 30, 2020

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

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

Dear Ms. Babcock,

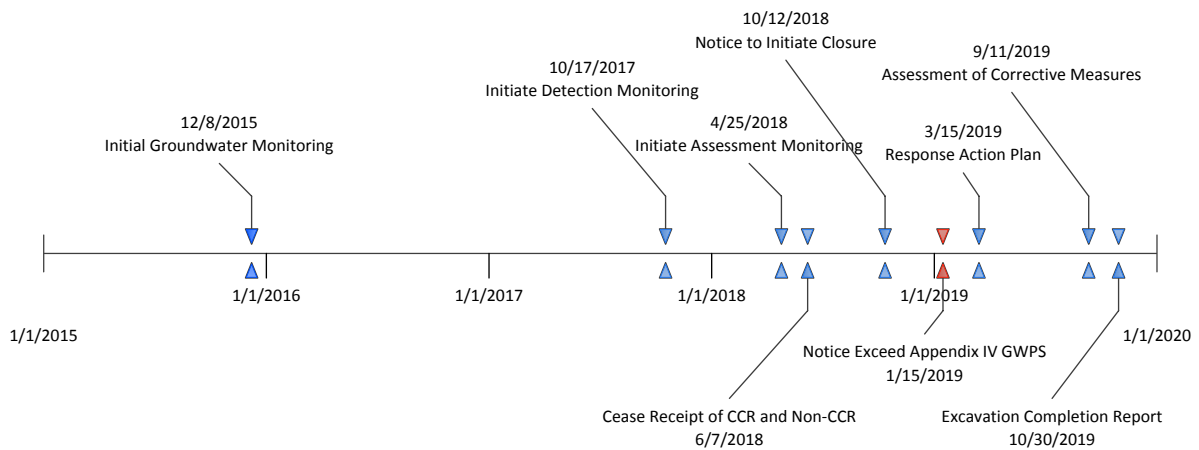
This Semiannual Progress Report, prepared as a requirement of §257.97(a) of the Federal Coal Combustion Residual (CCR Rule), describes progress towards selecting and implementing the final remedy for the Karn Bottom Ash Pond. A progress report is required to be prepared semiannually upon completion of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

As presented in the key milestones timeline below, a groundwater monitoring system was installed for the bottom ash pond and background monitoring commenced in December 2015. Consumers Energy first reported the exceedence above statistically significant levels (SSLs) 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 Karn Bottom Ash Pond that detailed a plan for closing the unit in place. This plan was revised on January 12, 2018 to reflect that the bottom ash pond would be closed by removing the CCR. A new double-lined, double composite surface impoundment was constructed immediately adjacent to the bottom ash pond and put into service on June 8, 2018 to replace the Karn Bottom Ash Pond. Notification for Intent to Initiate Closure of the Karn Bottom Ash Pond was posted on October 12, 2018 with dewatering activity commencing on March 20, 2019. Excavation of CCR removal commenced in April 2019 with all removal and decontamination activities completed and documented in an excavation completion report that was submitted to EGLE dated October 30, 2019 (Golder, 2019).

DE Karn Timeline for Corrective Action



Results of 2019 Semi-Annual Sampling Events

Statistical analysis from semiannual groundwater monitoring events verified that the only constituent of concern that is present at statistically significant levels above the established Groundwater Protection Standard (GWPS) is arsenic. Groundwater chemistry already appears to be improving as a result of discontinuing the hydraulic loading to the Karn Bottom Ash Pond and is expected to further improve now that source removal of the CCR has been completed. Arsenic concentrations at DEK-MW-15002, DEK-MW-15003, and DEK-MW-18001 demonstrate a decreasing trend from last monitoring event as discussed in the "2019 Annual Groundwater Monitoring and Corrective Action Report" (TRC, January 2020).

Progress Towards Remedy Selection

Consumers Energy first provided the 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 Karn Bottom Ash Pond. This report documents identified potential sources of contamination, interim response activities taken to control possible sources of contamination, and a schedule for terminating receipt of waste and initiating closure of the bottom ash pond. This report was approved by EGLE on May 14, 2019 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.
- Groundwater Extraction and Treatment System approved as an Interim Measure to

improve reliability of achieving compliance at alternative monitoring points in compliance with a groundwater mixing zone authorized on December 23, 2015 as detailed in the HMP approved by EGLE January 8, 2018.

- 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.
- DE Karn Bottom Ash Pond Workplan and Workplan dated November 29, 2017 and approved by EGLE on December 20, 2018. This workplan provided the template for excavation and the post-excavation confirmation that CCRs were removed so that constituent concentrations were less than health-based criteria.

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. This report stated that the remedial strategy was to manage CCR source material by excavating CCRs consistent with the closure plan and then to manage residual contamination in groundwater. As noted in the timeline, Consumers Energy commenced removing CCR from the Karn Bottom Ash Pond by ceasing hydraulic loading in the pond in June 2018 when bottom ash and process waters were diverted to a newly installed double-lined, double-composite impoundment. The former bottom ash pond area was then allowed to dewater by gravity and commenced operation of a construction dewatering system on March 20, 2019. Excavation of the CCRs from the pond and restoration activities to grade the excavation with clean fill and slope to promote stormwater drainage, reducing future precipitation infiltration was completed in September 2019. A final report documenting excavation activities, lines of evidence verifying CCR above health-based criteria was removed and completed the removal of CCR was submitted to the EGLE on October 30, 2019.

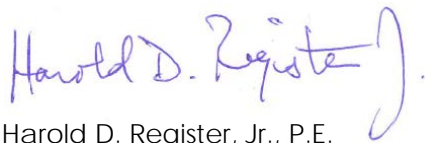
The ACM Report indicated that groundwater management alternatives under consideration that could potentially address the residual arsenic under *known* groundwater conditions were identified as: 1) Source removal with post-remedy monitoring, 2) Source removal with groundwater capture/control, 3) Source removal with impermeable barrier, 4) Source removal with active geochemical sequestration, and 5) Source removal with passive geochemical sequestration. These groundwater monitoring alternatives were considered to be technically feasible final groundwater management strategies when following a source removal activity.

Now that the source removal activities have been completed for the Karn Bottom Ash Pond and the excavation has been restored and graded to minimize future infiltration, an initial groundwater monitoring event conducted in October 2019 confirms 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 source removal. The final remedy for the Karn Bottom Ash Pond will be formally selected per §257.97 and Michigan Solid Waste requirements once the selected option is reviewed and commented on by EGLE and a public meeting is conducted at least 30-days prior to the final selection as required under §257.96(e).

The next semiannual progress report will be submitted in six months by July 30, 2020. Please feel free to contact me with any questions or clarifications.

Sincerely,



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