July 30, 2021 ***TRANSMITTAL VIA EMAIL 07/30/2021***

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

Dear Ms. Babcock,

Consumers Energy prepared and submitted to the Michigan Department of Environment, Great Lakes, and Energy (EGLE) a closure work plan for the Karn Bottom Ash Pond (Karn Bottom Ash Pond Work Plan) and a Response Action Plan developed in accordance with Part 115 dated November 30, 2018 and March 15, 2019, respectively. These plans were developed in anticipation of supporting the Assessment of Corrective Measures that would be necessary for evaluating and selecting a final remedy for the Karn Bottom Ash Pond after Consumers Energy provided notification of exceeding Groundwater Protection Standard per §257.95(g) that arsenic was present at statistically significant levels above the federal GWPS in five of six downgradient wells at the Karn Bottom Ash Pond.

EGLE approved the Karn Bottom Ash Pond Work Plan on December 20, 2019 based on expectation that a report documenting the removal activities and certifying solid waste has been removed in accordance with the work plan would be submitted at the completion of activities. Subsequently, ELGE approved the Response Action Plan on May 14, 2020 based on submittal of the Assessment of Corrective Measures. Consumers Energy submitted for review and approval, *D.E. Karn Generating Facility Bottom Ash Pond CCR Removal Documentation Report* (Karn Bottom Ash Pond Closure Report) on October 30, 2019 to satisfy requirements for completing the removal of solid waste so that obtaining a solid waste operating license was unnecessary. The certification of solid waste removal was approved by EGLE on December 1, 2020.

The certification report satisfied requirements under the response action plan to remove identified sources of contamination on a schedule that required consideration of concentrations of hazardous substances, rate of migration, and risks to human health and the environment. Additional steps needed to address residual groundwater contamination are discussed in the observations and results sections below.

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 after the completion of the *Assessment of Corrective Measures, DE Karn Bottom Ash Pond Coal Combustion Residual Unit*, dated September, 11, 2019 (Karn Bottom Ash Pond ACM) (TRC, 2019). Groundwater management alternatives considered to be technically feasible following source removal activities that could potentially address the residual arsenic under *known* groundwater conditions were identified in the report 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.

Results of May 2021 Sampling Event

Statistical analysis from the May 2021 semiannual groundwater monitoring event verified that the only constituent of concern that is present at statistically significant levels above the established Groundwater Protection Standard (GWPS) is arsenic. Results are presented in *May 2021 Assessment Monitoring Data Summary and Statistical Evaluation Consumers Energy, DE Karn Site, Bottom Ash Pond CCR Unit* (May 2021 Event Summary) (TRC, 2021a). Additionally, monitoring performed under the Karn Groundwater Surface-Water Interface (GSI) Compliance Plan demonstrates protection of human health and the environment with criteria determined to be protective at the point of exposure. These results are presented in the *First Semiannual 2021 Nature and Extent Data Summary, DE Karn Bottom Ash Pond, Consumers Energy* (N&E Summary) (TRC, 2021b).

Significant observations from the event summary are as follows:

- No additional Appendix IV constituents have been observed at statistically significant levels above GWPS for the Karn Bottom Ash Pond groundwater monitoring system;
- Groundwater potentiometric surface continues to exhibit radial flow but the "high" point has shifted from the former Karn Bottom Ash Pond pool area to an area delineated by Monitoring Wells OW-11 and DEK-MW-15003;
- As a result of the shifted potentiometric "high" point, monitoring wells DEK-MW-15003 and DEK-MW-15004 are no longer downgradient of the former Karn Bottom Ash Pond area;
- Arsenic concentrations at DEK-MW-15002, DEK-MW-15003, and DEK-MW-18001 demonstrate a decreasing trend; and
- Monitoring wells DEK-MW-15002 and DEK-MW-15006 (2 of the 4 monitoring wells downgradient of the former Karn Bottom Ash Pond) demonstrate the Lower Confidence Limit is observed to be less than the GWPS.

Conclusions

Source removal activities for the Karn Bottom Ash Pond have been completed and documented in the Karn Bottom Ash Pond Closure Report submitted to EGLE on October 30, 2019. Improvements in groundwater quality have been observed in the groundwater monitoring system, but changes in groundwater potentiometric surface that may influence groundwater

flow characteristics and/or alter groundwater redox conditions at monitoring locations that could influence constituent concentrations still require further evaluation before a final remedy can be selected. Subsequent sampling events will inform the on-going improvements and retention of monitoring-only, passive, or active remedial options following the source removal. As conditions continue to be evaluated post-source removal, the drinking water and groundwater-surface water interface (GSI) pathway are protected by quarterly monitoring performed under the Michigan-approved hydrogeological monitoring plan that includes a GSI Compliance Monitoring Program.

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 January 31, 2022. Please feel free to contact me with any questions or clarifications.

Sincerely,

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Mr. Gary Schwerin, EGLE Saginaw Bay District Office
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Ms. Darby Litz, TRC

Enclosure: *May 2021 Assessment Monitoring Data Summary and Statistical Evaluation Consumers Energy, DE Karn Site, Bottom Ash Pond CCR Unit*. (TRC, July 30, 2021(a)).

First Semiannual 2021 Nature and Extent Data Summary, DE Karn Bottom Ash Pond, Consumers Energy. (TRC, July 28, 2021(b)).

May 2021 Assessment Monitoring Data Summary and Statistical Evaluation

DE Karn, Bottom Ash Pond CCR Unit

Essexville, Michigan

July 2021

Prepared For:

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TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

1.0 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).

Consumers Energy is continuing semiannual assessment monitoring in accordance with §257.95 of the CCR Rule for the Karn Bottom Ash Pond located in Essexville, Michigan. This report has been prepared to provide the summary of the May 2021 assessment groundwater monitoring results, data quality review, and statistical data evaluation for the Karn Bottom Ash Pond groundwater system.

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 statistically significant increases (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 (Consumers Energy, January 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[1])	
Detection Monitoring	**Assessment Monitoring**
Iron	Copper

[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.

Additional Monitoring Constituents (Michigan Part 115/PA 640[1])	
Detection Monitoring	**Assessment Monitoring**
	Nickel
	Silver
	Vanadium
	Zinc

Consumers Energy will continue to evaluate corrective measures for the Karn Bottom Ash Pond per §257.96 and §257.97 and is continuing semiannual assessment monitoring in accordance with §257.95.

1.2 Site Overview

The Karn Bottom Ash Pond is located within the DE Karn Power Plant site, which is located north of the JC Weadock Power Plant, east of the Saginaw River, south and west of Saginaw Bay (Figure 1). Two coal-fired power generating units (Karn Units 1 & 2) began generating electricity in 1958 and 1959, respectively. Karn Units 3 & 4, co-located with the coal-fired generating units, are oil- and natural gas-fueled. Two other areas of coal ash management within the Karn site are the Karn Landfill and the Karn Lined Impoundment. The Karn Landfill has been certified closed and is now in post-closure care and is being monitored in accordance with the EGLE-approved *Hydrogeological Monitoring Plan, Rev. 3, DE Karn Solid Waste Disposal Area* (December 19, 2017). The Karn Lined Impoundment has been licensed to operate by the EGLE under Part 115 (License Number 9629) and is being monitored in accordance with the EGLE-approved Karn Lined Impoundment Hydrogeological Monitoring Plan (November 13, 2020). The locations of the Karn Landfill, 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. 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 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 is constructed with 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 submitted the *DE Karn Generating Facility Bottom Ash Pond CCR Removal Documentation Report* (Golder, October 2019) on October 30, 2019. EGLE approved the documentation removal report on December 1, 2020. Groundwater conditions post-CCR removal continue to be monitored.

1.3 Geology/Hydrogeology

The majority of the 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 (AECOM, 2009).

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 to 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 to 90 ft bgs.

The DE Karn Power Plant site 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 to the west, toward the intake channel.

2.0 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 initially 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 Karn Bottom Ash Pond. 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.

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.

2.2 May 2021 Assessment Monitoring

Per §257.95, all wells in the CCR unit groundwater monitoring program must be sampled semiannually. TRC conducted the first semiannual assessment monitoring event of 2021 for Appendix III and IV constituents at the Karn Bottom Ash Pond CCR Unit in accordance with the *DE Karn Monitoring Program Sample Analysis Plan* (ARCADIS, May 2016) (SAP). The semiannual assessment monitoring event was performed on May 3 through May 6, 2021.

The May 2021 sampling event included collection of static water level measurements from the Karn Bottom Ash Pond groundwater monitoring system and other site wells to support preparation of a groundwater contour map. Static water elevation data are summarized in Table 1 and groundwater elevation data are shown on Figure 3. The Karn Bottom Ash Pond monitoring wells (DEK-MW-15002 through DEK-MW-15006 and DEK-MW-18001) and background monitoring wells (MW-15002, MW-15008, MW-15016, and MW-15019) were purged with peristaltic pumps utilizing low-flow sampling methodology. Field parameters were stabilized at each monitoring well prior to collecting groundwater samples. Stabilized field parameters for each monitoring well are summarized in Table 2.

The groundwater samples were analyzed by the Consumers Energy Trail Street Laboratory for Appendix III and IV constituents in accordance with the SAP. Radium analyses were completed

by Eurofins TestAmerica Inc. (TestAmerica). 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.

2.2.1 Groundwater Flow Rate and Direction

Groundwater elevation data collected during the May 2021 assessment monitoring event are provided in Table 1. These data were used to construct the groundwater contour map (Figure 3). Groundwater elevations measured at the site in May 2021 are generally within the range of 581 to 587 feet above mean sea level (ft NAVD88) and groundwater is typically encountered at equal elevation relative to the surrounding surface water features measured by the NOAA gauging station or within approximately 6 feet higher, flowing toward the bounding surface water features.

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 the process water and bottom ash that went into the former bottom ash pond. Since the former bottom ash pond is no longer being hydraulically loaded with sluiced ash and has been dewatered by gravity, the characteristic groundwater mound centered within the pooled area is no longer present. The groundwater elevation data collected from the groundwater monitoring system of the former bottom ash pond in May 2021 demonstrate a reduction in groundwater elevation measurements by several feet when compared to groundwater elevations measured prior to June 2018. Due to the operational changes of the bottom ash pond and the completion of the landfill capping activities, the gradient between the bottom ash pond area and the surrounding surface water bodies is flattening out as compared to previous quarters as the groundwater elevations are reaching a new equilibrium, as expected. Groundwater at the facility is locally influenced by incidental infiltration from precipitation over the uncovered acreage. Monitoring Wells OW-11 and DEK-MW-15003 delineate the newly established groundwater elevation high point with porewater flow generally flowing radially towards the adjacent surface water features from this newly established potentiometric “high”, as illustrated in Figure 3. As such, the groundwater flow across the footprint of the former bottom ash pond is generally to the west.

The average hydraulic gradient observed on May 3, 2021 in the Karn Bottom Ash Pond area during these events is estimated at 0.0050 ft/ft. The gradient was calculated using the monitoring well pair DEK-MW-15004/DEK-MW-15005, as well as the well water elevation difference and distance between DEK-MW-15003/DEK-MW-15006. 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 0.25 ft/day or 91 ft/year.

Appendix C includes a series of groundwater contour maps to illustrate the changes in groundwater flow direction from 2015, when the monitoring well network was originally established and background sampling was initiated, to the most recent May 2021 groundwater sampling event. Given this shift in groundwater flow direction, DEK-MW-15003 and DEK-MW-15004 are now located upgradient to side gradient of the CCR unit and are no longer

representative of groundwater chemistry downgradient of the Karn Bottom Ash Pond. Therefore, DEK-MW-15003 and DEK-MW-15004 will no longer be used for assessment monitoring or for evaluating the effectiveness of the CCR removal activities.

2.2.2 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 Appendix A.

3.0 Assessment Monitoring 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 May 2021 groundwater data in accordance with the assessment monitoring program.

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 as documented in the Groundwater Protection Standards technical memorandum (Appendix C of the *2018 Annual Groundwater Monitoring Report,* TRC, January 2019). 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 without an established MCL.

3.2 Data Comparison to Groundwater Protection Standards

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 *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 monitoring well data exceeds the GWPS of any Appendix IV constituent. 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.

Confidence intervals were established per the statistical methods detailed in the *Statistical Evaluation of May 2021 Assessment Monitoring Sampling Event* technical memorandum provided in Appendix B. For each Appendix IV constituent, the concentrations were first compared directly to their respective GWPS. Constituent-well combinations that included a direct exceedance of the GWPSs were retained for further statistical analysis using confidence limits.

Overall, the assessment monitoring statistical evaluations have confirmed that arsenic is the only Appendix IV constituent present at statistically significant levels above the GWPS. The statistical evaluation of the May 2021 semiannual assessment monitoring event data indicate that arsenic is present at statistically significant levels exceeding the GWPS in downgradient monitoring wells at the Karn Bottom Ash Pond:

Constituent	GWPS	#Downgradient Wells Observed
Arsenic	21 ug/L	2 of 4

Due to changes in groundwater flow direction on site, monitoring wells DEK-MW-15003 and DEK-MW-15004 are no longer located downgradient of the unit and were determined to be no longer indicative of groundwater conditions influenced by the Karn Bottom Ash Pond. Therefore, monitoring wells DEK-MW-15003 and DEK-MW-15004 are no longer included for assessment monitoring statistical analysis. The monitoring well network for statistical evaluation consists of the four monitoring wells located downgradient of the bottom ash pond (DEK-MW-15002, DEK-MW-15005, DEK-MW-15006, 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 2020 and May 2021 data show that the lower confidence limit for arsenic is currently below the GWPS. A summary of the confidence intervals for May 2021 is provided in Table 5.

Arsenic concentrations at DEK-MW-15002, and DEK-MW-18001 appear to exhibit a downward trend on the time-series chart (Appendix B: 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-15002 is statistically significant.

4.0 Conclusions and Recommendations

Corrective action has been triggered and assessment monitoring is ongoing at the Karn Bottom Ash Pond CCR unit. A summary of the May 2021 assessment monitoring event is 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 the completed source removal of CCR, as shown by the decreasing concentrations of arsenic at DEK-MW-15002 and DEK-MW-18001; however, attainment of the GWPS at all of the Bottom Ash Pond compliance wells may not be feasible due to influences other than the former pond, such as the presence and former operation of the nearby Karn Landfill. Redox conditions, which affect contaminant transport, are still stabilizing following pond removal and will continue to be evaluated further.

Consumers Energy will continue assessment monitoring and evaluate corrective measures in accordance with §257.96 and §257.97 as outlined in the Karn Bottom Ash Pond 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. 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 fourth calendar quarter of 2021.

5.0 References

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USEPA. April 2018. Barnes Johnson (Office of Resource Conservation and Recovery) to James Roewer (c/o Edison Electric Institute) and Douglas Green, Margaret Fawal (Venable LLP). Re: Coal Combustion Residuals Rule Groundwater Monitoring Requirements. April 30, 2018. United States Environmental Protection Agency, Washington, D.C. 20460. Office of Solid Waste and Emergency Response, now the Office of Land and Emergency Management.

Tables

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

Well Location	TOC Elevation (ft)	Geologic Unit of Screen Interval	Screen Interval Elevation (ft)	May 3, 2021	
				Depth to Water (ft BTOC)	Groundwater Elevation (ft)
Background					
MW-15002	587.71	Sand	580.9 to 570.9	6.56	581.15
MW-15008	585.36	Sand with clay	578.7 to 568.7	4.13	581.23
MW-15016	586.49	Sand	581.2 to 578.2	4.38	582.11
MW-15019	586.17	Sand and Sand/Clay	579.5 to 569.5	4.85	581.32
DEK Bottom Ash Pond					
DEK-MW-15002	590.87	Sand	578.3 to 575.3	6.75	584.12
DEK-MW-15004	611.04	Sand	576.6 to 571.6	27.75	583.29
DEK-MW-15005	589.72	Sand	572.3 to 567.3	8.78	580.94
DEK-MW-15006	589.24	Sand	573.0 to 568.0	8.28	580.96
DEK Bottom Ash Pond & Karn Lined Impoundment					
DEK-MW-15003	602.74	Sand	578.8 to 574.8	15.40	587.34
DEK-MW-18001	593.47	Sand	579.2 to 574.2	8.41	585.06
OW-10	591.58	Silty Sand and Silty Clay	576.0 to 571.0	6.75	584.83
OW-11	607.90	Silt/Fly Ash	587.5 to 582.5	21.35	586.55
OW-12	603.07	Silty Sand	584.2 to 579.2	17.10	585.97
DEK Nature and Extent					
MW-01	597.02	Sand	573.0 to 570.0	16.10	580.92
MW-03	597.30	Sand	569.8 to 566.8	16.36	580.94
MW-06	589.44	Sand and Silty Sand	578.5 to 563.5	8.30	581.14
MW-08	598.78	Sand and Silty Clay	580.9 to 570.9	17.22	581.56
MW-10	596.97	Sand	582.5 to 572.5	16.00	580.97
MW-12	598.60	Sand	583.9 to 573.9	17.55	581.05
MW-14	594.37	Sand and Silty Clay	584.7 to 574.7	13.45	580.92
MW-16	595.80	Sand and Sand/Bottom Ash	584.1 to 574.1	14.92	580.88
MW-22	598.99	Ash/Sand	571.4 to 568.4	16.29	582.70
MW-23	595.57	Ash/Sand	576.9 to 571.9	13.09	582.48
DEK Static Water Level					
MW-02	597.34	Sand and Silty Clay	572.5 to 567.5	16.42	580.92
MW-04	598.01	NR	569.5 to 564.5	17.09	580.92
MW-17	597.91	Sand	577.0 to 574.0	13.00	584.91
MW-18	609.22	Silty Sand and Silty Clay	575.8 to 573.8	25.33	583.89
MW-19	597.28	NR	572.1 to 567.1	16.10	581.18
MW-20	632.75	Sand	582.3 to 579.3	51.73	581.02
MW-21	632.91	Sand	587.1 to 584.1	50.55	582.36
OW-01	631.33	NR	572.5 to 567.5	50.33	581.00
OW-02	598.01	Fly Ash	579.4 to 576.4	15.18	582.83
OW-03	597.94	Fly Ash and Sand	573.6 to 568.6	16.88	581.06
OW-04	590.21	Sand and Bottom/Fly Ash	579.1 to 574.1	9.26	580.95
OW-05	593.53	Sand	576.9 to 571.9	12.30	581.23
OW-06	603.95	NR	580.9 to 575.9	21.10	582.85
OW-07	596.41	Ash	583.3 to 580.3	13.38	583.03
OW-08	593.93	NR	581.0 to 576.0	10.66	583.27
OW-09	593.45	NR	585.5 to 580.5	10.12	583.33
OW-13	588.52	NR	579.5 to 574.5	4.68	583.84
OW-15	587.75	NR	572.8 to 567.8	4.00	583.75

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.
NR: Not Recorded

Table 2
Summary of Field Parameters: May 2021
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	5/3/2021	1.67	-53.1	6.5	6,236	10.4	4.4
MW-15008	5/3/2021	0.24	-225.3	6.8	967	9.0	5.4
MW-15016	5/3/2021	1.74	-10.4	7.2	991	10.2	3.1
MW-15019	5/3/2021	1.79	-69.2	6.8	1,398	8.6	3.4
Karn Bottom Ash Pond							
DEK-MW-15002	5/3/2021	0.09	-181.4	7.4	1,023	9.9	10.2
DEK-MW-15003	5/3/2021	1.88	13.0	8.0	340	14.9	4.6
DEK-MW-15004	5/3/2021	0.20	-174.6	7.5	362	14.8	7.8
DEK-MW-15005	5/3/2021	0.07	-199.7	7.6	629	10.6	3.7
DEK-MW-15006	5/3/2021	0.09	-152.6	7.5	1,140	10.7	5.3
DEK-MW-18001	5/3/2021	1.72	-64.3	7.3	558	10.6	2.4

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 Groundwater Sampling Results (Analytical): May 2021
DE Karn & JC Weadock Background – RCRA CCR Monitoring Program
Essexville, Michigan

					Sample Location:	**MW-15002**	**MW-15008**	**MW-15016**	**MW-15019**
					Sample Date:	5/3/2021	5/3/2021	5/3/2021	5/3/2021
Constituent	Unit	EPA MCL	MI Residential*	MI Non-Residential*	MI GSI^	Background			
Appendix III[(1)]									
Boron	ug/L	NC	**500**	**500**	4,000	102	121	349	239
Calcium	mg/L	NC	NC	NC	500[EE]	364	105	219	155
Chloride	mg/L	**250****	**250**[E]**	**250**[E]**	**50**	**2,630**	**225**	**108**	**344**
Fluoride	ug/L	4,000	NC	NC	NC	< 1,000	< 1,000	< 1,000	< 1,000
Sulfate	mg/L	**250****	**250**[E]**	**250**[E]**	500[EE]	31.3	< 1	**255**	52.4
Total Dissolved Solids	mg/L	**500****	**500**[E]**	**500**[E]**	**500**	**5,390**	**822**	**979**	**1,160**
pH, Field	SU	6.5 - 8.5**	6.5 - 8.5[E]	6.5 - 8.5[E]	6.5 - 9.0	6.5	6.8	7.2	6.8
Appendix IV[(1)]									
Antimony	ug/L	6	6	6	2	< 1	< 1	< 1	< 1
Arsenic	ug/L	10	10	10	10	1	< 1	4	1
Barium	ug/L	2,000	2,000	2,000	1,200	1,040	62	53	335
Beryllium	ug/L	4	4	4	33	< 1	< 1	< 1	< 1
Cadmium	ug/L	5	5	5	2.5	< 0.2	< 0.2	< 0.2	< 0.2
Chromium	ug/L	100	100	100	11	< 1	< 1	< 1	< 1
Cobalt	ug/L	NC	40	100	100	< 6	< 6	< 6	< 6
Fluoride	ug/L	4,000	NC	NC	NC	< 1,000	< 1,000	< 1,000	< 1,000
Lead	ug/L	NC	4	4	14	< 1	< 1	< 1	< 1
Lithium	ug/L	NC	170	350	440	19	15	79	12
Mercury	ug/L	2	2	2	0.20#	< 0.2	< 0.2	< 0.2	< 0.2
Molybdenum	ug/L	NC	73	210	120	< 5	< 5	< 5	< 5
Radium-226/228	pCi/L	5	NC	NC	NC	3.72	0.804	0.658	0.902
Selenium	ug/L	50	50	50	5	< 1	< 1	< 1	4
Thallium	ug/L	2	2	2	2	< 2	< 2	< 2	< 2
Additional MI Part 115[(2)]									
Iron	ug/L	**300****	**300**[E]**	**300**[E]**	500,000[EE]	**14,600**	**11,300**	**1,170**	**14,300**
Copper	ug/L	1,000**	1,000[E]	1,000[E]	20	1	1	1	< 1
Nickel	ug/L	NC	100	100	120	7	< 2	6	28
Silver	ug/L	100**	34	98	0.2	< 0.2	< 0.2	< 0.2	< 0.2
Vanadium	ug/L	NC	**4.5**	62	27	**12**	**8**	2	4
Zinc	ug/L	5,000**	2,400	5,000[E]	260	< 10	< 10	< 10	< 10

Notes:

ug/L - micrograms per liter. mg/L - milligrams per liter.

pCi/L - picocuries per liter; SU - standard units; pH is a field parameter.

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.

[E] - Criterion is the aesthetic drinking water value per footnote {E}.

[EE] - Criterion is based on the total dissolved solids GSI value per footnote {EE}.

(1) 40 CFR Part 257 Appendix III Detection Monitoring Constituents and Appendix IV Assessment Monitoring Constituents.

(2) Per Michigan Part 115 Amendments - Public Act No. 640 of 2018 Section 11511a(3)(c) and 11519b(2) additional detection monitoring constituents (iron) and assessment monitoring constituents (copper, nickel, silver, vanadium, and zinc) are reported.

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): May 2021
DE Karn Bottom Ash Pond – RCRA CCR Monitoring Program
Essexville, Michigan

Constituent	Unit	EPA MCL	MI Residential*	MI Non-Residential*	MI GSI^	Sample Location: DEK-MW-15002 Sample Date: 5/3/2021 downgradient	DEK-MW-15003 5/3/2021 upgradient	DEK-MW-15004 5/3/2021 sidegradient	DEK-MW-15005 5/3/2021 downgradient	DEK-MW-15006 5/3/2021 downgradient	DEK-MW-18001 5/3/2021 downgradient
Appendix III(1)											
Boron	ug/L	NC	**500**	**500**	4,000	**1,420**	**862**	**914**	**926**	**938**	**1,180**
Calcium	mg/L	NC	NC	NC	500EE	148	27.4	60.2	95.6	115	65.2
Chloride	mg/L	250**	250E	250E	**50**	**148**	**50.6**	**68**	**65.2**	**63.5**	**51.6**
Fluoride	ug/L	4,000	NC	NC	NC	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Sulfate	mg/L	**250****	**250E**	**250E**	500EE	216	32.5	143	50.8	**324**	121
Total Dissolved Solids	mg/L	**500****	**500E**	**500E**	**500**	**926**	246	493	**534**	**790**	486
pH, Field	SU	**6.5 - 8.5****	**6.5 - 8.5E**	**6.5 - 8.5E**	6.5 - 9.0	7.4	8.0	7.5	7.6	7.5	7.3
Appendix IV(1)											
Antimony	ug/L	6	6	6	2	< 1	< 1	1	< 1	< 1	< 1
Arsenic	ug/L	**10**	**10**	**10**	**10**	2	**545**	**194**	**45**	**24**	**92**
Barium	ug/L	2,000	2,000	2,000	1,200	211	42	104	173	139	135
Beryllium	ug/L	4	4	4	33	< 1	< 1	< 1	< 1	< 1	< 1
Cadmium	ug/L	5	5	5	2.5	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Chromium	ug/L	100	100	100	11	< 1	< 1	< 1	< 1	< 1	< 1
Cobalt	ug/L	NC	40	100	100	< 6	< 6	< 6	< 6	< 6	< 6
Fluoride	ug/L	4,000	NC	NC	NC	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Lead	ug/L	NC	4	4	14	< 1	< 1	< 1	< 1	< 1	< 1
Lithium	ug/L	NC	170	350	440	36	20	34	38	21	25
Mercury	ug/L	2	2	2	0.20#	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Molybdenum	ug/L	NC	73	210	120	< 5	25	11	8	9	< 5
Radium-226/228	pCi/L	5	NC	NC	NC	0.811	< 0.548	0.856	0.722	1.16	0.828
Selenium	ug/L	50	50	50	5	< 1	1	< 1	1	< 1	< 1
Thallium	ug/L	2	2	2	2	< 2	< 2	< 2	< 2	< 2	< 2
Additional MI Part 115(2)											
Iron	ug/L	**300****	**300E**	**300E**	500,000EE	**2,800**	141	**1,980**	**421**	**1,560**	**761**
Copper	ug/L	1,000**	1,000E	1,000E	20	< 1	< 1	< 1	1	< 1	< 1
Nickel	ug/L	NC	**100**	**100**	120	2	< 2	< 2	3	7	< 2
Silver	ug/L	100**	34	98	0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Vanadium	ug/L	NC	4.5	62	27	< 2	< 2	< 2	< 2	< 2	< 2
Zinc	ug/L	5,000**	2,400	5,000E	260	< 10	< 10	< 10	< 10	< 10	< 10

Notes:

ug/L - micrograms per liter. mg/L - milligrams per liter.

pCi/L - picocuries per liter. SU - standard units; pH is a field parameter.

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.

E - Criterion is the aesthetic drinking water value per footnote {E}.

EE - Criterion is based on the total dissolved solids GSI value per footnote {EE}.

(1) 40 CFR Part 257 Appendix III Detection Monitoring Constituents and Appendix IV Assessment Monitoring Constituents.

(2) Per Michigan Part 115 Amendments - Public Act No. 640 of 2018 Section 11511a(3)(c) and 11519b(2) additional detection monitoring constituents (iron) and assessment monitoring constituents (copper, nickel, silver, vanadium, and zinc) are reported.

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 – May 2021
DE Karn Bottom Ash Pond – RCRA CCR Monitoring Program
Essexville, Michigan

Constituent	Units	GWPS	DEW-MW-15002		DEK-MW-15005		DEK-MW-15006		DEK-MW-18001	
			LCL	UCL	LCL	UCL	LCL	UCL	LCL	UCL
Arsenic	ug/L	21	1.7	48	24	120	20	27	57	158

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 (α = 0.01) of the downgradient data set.

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

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

Figures

BASE MAP FROM USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLE SERIES.

N

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

0 3,000 6,000 FEET

TRC
1540 Eisenhower Place
Ann Arbor, MI 48108-3284
Phone: 734.971.7080
www.trccompanies.com
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:	JULY 2020
PROJ. NO.:	367388.0001
FILE:	367388-001-004.mxd

FIGURE 1

S:\1-PROJECTS\Consumers_Energy_Company\Michigan\CCR_GW\2017_269767\367388-001-004.mxd -- Saved By: SMAJOR on 7/15/2020, 14:00:57 PM

LEGEND

- DEK BOTTOM ASH POND & LINED IMPOUNDMENT MONITORING WELL
- DEK BOTTOM ASH POND MONITORING WELL
- DEK LINED IMPOUNDMENT MONITORING WELL
- DECOMMISSIONED MONITORING WELL
- SURFACE WATER GAUGING STATION
- NATURE AND EXTENT WELL
- SECONDARY CONTAINMENT SUMP (KLI-SCS)
- PRIMARY CONTAINMENT SYSTEM SAMPLE (KLI-PCS)
- SURFACE WATER SAMPLE (SW-DITCH)
- SLURRY WALL (APPROXIMATE)
- LINED IMPOUNDMENT (COVENANT BOUNDARY)

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.

0 600 1,200 Feet

1 " = 600 '

1:7,200

PROJECT:

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

TITLE:

SITE LAYOUT MAP

DRAWN BY:	A. ADAIR	PROJ NO.:	418425.0001
CHECKED BY:	J. KRENZ		
APPROVED BY:	L. DARBY		**FIGURE 2**
DATE:	APRIL 2021		

TRC
1540 Eisenhower Place
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FILE NO.: 418425-101-002.mxd

Plot Date: 4/26/2021, 14:19:45 PM by AADAIR -- LAYOUT: ANSI B (11"x17")
Path: S:\1-PROJECTS\Consumers Energy Company\Michigan\CCR GW\2017 26976\71 DEKARN\2021 MXDs\2021 001 MARCH\418425-101-002.mxd
Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl (Foot)
Map Rotation: 0
TRC - GIS

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)
- LINED IMPOUNDMENT (COVENANT BOUNDARY)
- GROUNDWATER ELEVATION CONTOUR (1' INTERVAL, DASHED WHERE INFERRED)
- *(580.50)* GROUNDWATER ELEVATION (FEET)

NOTES

1. BASE MAP IMAGERY FROM GOOGLE EARTH PRO, 2018.
2. WELL LOCATIONS SURVEYED BY ROWE PROFESSIONAL SERVICES COMPANY ON 11/4/2015.
3. NOAA/NATIONAL OCEANIC SERVICE GREAT LAKES GAUGING STATION, ESSEXVILLE, MI (ID: 9075035).
4. GROUNDWATER ELEVATIONS DISPLAYED IN FEET RELATIVE TO THE NORTH AMERICAN VERTICAL DATUM OF 1988.

N

0 600 1,200 Feet

1 " = 600 '

1:7,200

PROJECT:

CONSUMERS ENERGY COMPANY
DE KARN POWER PLANT
ESSEXVILLE, MICHIGAN

TITLE:

SHALLOW GROUNDWATER CONTOUR MAP MAY 3, 2021

DRAWN BY:	A. ADAIR	PROJ NO.:	418425.0001
CHECKED BY:	J. KRENZ		
APPROVED BY:	L. DARBY		**FIGURE 3**
DATE:	JULY 2021		

TRC
1540 Eisenhower Place
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FILE NO.: 418425-201-012.mxd

Plot Date: 7/28/2021, 12:48:26 PM by AADAIR -- LAYOUT: ANSI B (11"x17")
Path: S:\1-PROJECTS\Consumers Energy Company\Michigan\CCR GW\2017 2697671 DEKARN\2021 MXDs\2021 002 MAY\418425-201-012.mxd
Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl (Foot)
Map Rotation: 0
TRC - GIS

Appendix A
Data Quality Reviews

Laboratory Data Quality Review
Groundwater Monitoring Event May 2021
JC Weadock/Karn DEK Background

Groundwater samples were collected by TRC for the May 2021 sampling event. Samples were analyzed for total metals, anions, total dissolved solids, and alkalinity by Consumers Energy (CE) Laboratory Services, located in Jackson, Michigan. The laboratory analytical results were reported in laboratory sample delivery group (SDG) 21-0525.

During the May 2021 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 (Chloride, Fluoride, Sulfate)	EPA 300.0
Total Dissolved Solids	SM 2540C
Total Metals	SW-846 6020B/7470A
Alkalinity	SM 2320B

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 Data Review (USEPA, 2020). 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, field blanks, and equipment 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;
- 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.

It should be noted that results for method blanks and laboratory control samples were not provided for review by CE Laboratory Services. Therefore, potential contamination arising from laboratory sample preparation and/or analytical procedures and the accuracy of the analytical method using a clean matrix could not be evaluated for the metals, anions, TDS, and alkalinity analyses.

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.

- The reviewed 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

- One field blank (FB-Background) was collected. Total metals and anions were not detected in this blank sample.
- An equipment blank was not collected with this data set.
- MS and MSD analyses were not performed on a sample from this data set.
- The field duplicate pair samples were DUP-Background/ MW-15002. All criteria were met.
- Laboratory duplicate analyses were not performed on a sample from this data set.

Laboratory Data Quality Review
Groundwater Monitoring Event May 2021
DE Karn Bottom Ash Pond and Lined Impoundment

Groundwater samples were collected by TRC for the May 2021 sampling event. Samples were analyzed for total metals, anions, total dissolved solids, and alkalinity by Consumers Energy (CE) Laboratory Services in Jackson, Michigan. The laboratory analytical results were reported in laboratory sample delivery group (SDG) 21-0529.

During the May 2021 sampling event, a groundwater sample was collected from each of the following wells:

- DEK-MW-15003
- DEK-MW-18001

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

Analyte Group	Method
Anions (Fluoride, Chloride, Sulfate)	EPA 300.0
Total Dissolved Solids (TDS)	SM 2540C
Total Metals	SW-846 6020B/7470A
Alkalinity	SM 2320B

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, 2020). 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, where 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 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;
- Data for blind field duplicates, when collected. Field duplicate samples are used to assess variability introduced by the sampling and analytical processes; and
- Overall usability of the data.

It should be noted that results for method blanks and LCSs were not provided for review by CE Laboratory Services. Therefore, potential contamination arising from laboratory sample preparation and/or analytical procedures and the accuracy of the analytical method using a clean matrix could not be evaluated for the metals, anions, TDS, and alkalinity analyses.

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.

- The reviewed Appendix III, IV, optional Piper Diagram analyses, and additional Part 115 constituents will be utilized for the purposes of a detection or assessment monitoring program.
- Data are usable for the purposes of the detection or assessment monitoring program.
- When the data are evaluated through a detection or assessment monitoring statistical program, findings below may be used to support the removal of outliers.

QA/QC Sample Summary

- A field blank was not collected with this data set.
- An equipment blank was not collected with this data set.
- MS and MSD analyses were performed on sample DEK-MW-18001 for total metals, anions, and alkalinity. The recoveries were within the acceptance limits. Relative percent differences (RPDs) were not provided by the laboratory and therefore were not evaluated; further, MS/MSD concentrations were not provided by the laboratory. However, since all recoveries were within the acceptance limits, there is no impact on data usability due to this issue.
- A field duplicate pair was not collected with this data set.
- Laboratory duplicate analyses were not performed on a sample from this data set.

Laboratory Data Quality Review
Groundwater Monitoring Event May 2021
DE Karn Bottom Ash Pond

Groundwater samples were collected by TRC for the May 2021 sampling event. Samples were analyzed for total and dissolved metals, anions, total dissolved solids, and alkalinity by Consumers Energy (CE) Laboratory Services in Jackson, Michigan. The laboratory analytical results were reported in laboratory sample delivery group (SDG) 21-0528.

During the May 2021 sampling event, a groundwater sample was collected from each of the following wells:

- DEK-MW-15002
- DEK-MW-15004
- DEK-MW-15005
- DEK-MW-15006

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

Analyte Group	Method
Anions (Fluoride, Chloride, Sulfate)	EPA 300.0
Total Dissolved Solids (TDS)	SM 2540C
Total and Dissolved Metals	SW-846 6020B/7470A
Alkalinity (Bicarbonate, Carbonate, and Total)	SM 2320B

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, 2020). 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, where 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 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;
- 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.

It should be noted that results for method blanks and LCSs were not provided for review by CE Laboratory Services. Therefore, potential contamination arising from laboratory sample preparation and/or analytical procedures and the accuracy of the analytical method using a clean matrix could not be evaluated for the metals, anions, alkalinity, and TDS analyses.

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.

- The reviewed Appendix III, IV, optional Piper diagram analyses, and additional Part 115 constituents will be utilized for the purposes of the detection 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

- One field blank (FB-DEK-BAP) was collected. Total metals were not detected in the field blank sample with the exception of copper (1 ug/L). The copper detected in sample DEK-MW-15005 is potentially a false positive result due to field blank contamination, as summarized in the attached table, attachment 1.
- An equipment blank was not collected with this data set.
- MS and MSD analyses were not performed on a sample from this data set.
- The field duplicate pair samples were DUP-DEK-BAP with DEK-MW-15005; relative percent differences (RPDs) between the parent and duplicate sample were within the QC limits.
- Laboratory duplicate analyses were not performed on a sample from this data set.

Attachment 1
Summary of Data Non-Conformances for Groundwater Analytical Data
DE Karn Bottom Ash Pond – RCRA CCR Monitoring Program
Erie, Michigan

Samples	Collection Date	Analyte	Non-Conformance/Issue
DEK-MW-15005	5/3/2021	Copper	Field blank contamination; indicates potential false positive copper result.

Laboratory Data Quality Review
Groundwater Monitoring Event May 2021
JC Weadock/Karn DEK Background

Groundwater samples were collected by TRC for the May 2021 sampling event. Samples were analyzed for radium; the radium analyses were subcontracted by Eurofins-TestAmerica in Canton, Ohio to Eurofins-TestAmerica in St. Louis, Missouri. The laboratory analytical results were reported in laboratory sample delivery group (SDG) 240-149188-1.

During the May 2021 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
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 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 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. 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.

- The reviewed Appendix 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 for radium. Target analytes were not detected in the method blank samples.
- One field blank (FB-BACKGROUND) was collected. Target analytes were not detected in this blank sample.
- The LCS and LCSD recoveries and relative percent differences (RPDs) for radium were within QC limits.
- MS and MSD analyses were not performed on a sample from this data set.
- The field duplicate pair samples were DUP-BACKGROUND/MW-15002. All criteria were met.
- Laboratory duplicate analyses were not performed on a sample from this data set.
- Carrier recoveries were within 40-110%.

Laboratory Data Quality Review
Groundwater Monitoring Event May 2021
DE Karn Bottom Ash Pond/Lined Impoundment

Groundwater samples were collected by TRC for the May 2021 sampling event. Samples were analyzed for radium; the radium analyses were subcontracted by Eurofins-TestAmerica in Canton, Ohio to Eurofins-TestAmerica in St. Louis, Missouri. The laboratory analytical results were reported in laboratory sample delivery group (SDG) 240-149195-1.

During the May 2021 sampling event, a groundwater sample was collected from each of the following wells:

- DEK-MW-15003
- DEK-MW-18001

Each sample was analyzed for the following constituents:

Analyte Group	Method
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 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. 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 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.

- The reviewed Appendix IV analyses 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 for radium; target analytes were not detected in the method blank samples.
- An equipment blank was not collected in this data set.
- A field blank was not collected in this data set.
- The LCS and LCSD recoveries and relative percent differences (RPDs) were within QC limits.
- MS and MSD analyses were not performed on a sample from this data set.
- A field duplicate pair was not collected in this data set.
- Laboratory duplicate analyses were not performed on a sample from this data set.
- Carrier recoveries, where applicable, were within 40-110%.

Laboratory Data Quality Review
Groundwater Monitoring Event May 2021
CEC DE Karn Bottom Ash Pond

Groundwater samples were collected by TRC for the May 2021 sampling event. Samples were analyzed for radium; the radium analyses were subcontracted by Eurofins-TestAmerica in Canton, Ohio to Eurofins-TestAmerica in St. Louis, Missouri. The laboratory analytical results were reported in laboratory sample delivery group (SDG) 240-149197-1 (revision 1, dated 7/16/21).

During the May 2021 sampling event, a groundwater sample was collected from each of the following wells:

- DEK-MW-15002
- DEK-MW-15004
- DEK-MW-15005
- DEK-MW-15006

Each sample was analyzed for the following constituents:

Analyte Group	Method
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 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. 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 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.

- The reviewed Appendix IV analyses 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 for radium; target analytes were not detected in the method blank samples.
- An equipment blank was not collected in this data set.
- A field blank was not collected in this data set.
- The LCS and LCSD recoveries and relative percent differences (RPDs) were within QC limits.
- MS and MSD analyses were not performed on a sample from this data set.
- The field duplicate pair samples were DUP-DEK-BAP and DEK-MW-15005; RPDs between the parent and duplicate sample were within the QC limits.
- Laboratory duplicate analyses were not performed on a sample from this data set.
- Carrier recoveries, where applicable, were within 40-110%.

Appendix B
Statistical Evaluation of May 2021 Assessment Monitoring Sampling Event

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Technical Memorandum

Date: July 27, 2021

To: J.R. Register, Consumers Energy

From: Darby Litz, TRC
Katy Reminga, TRC

Project No.: 418425.0001.0000 Phase 002, Task 002

Subject: Statistical Evaluation of May 2021 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 Rule [1] at the DE Karn Power Plant Bottom Ash Pond (Karn Bottom Ash Pond).

An assessment monitoring event was conducted on May 3 through May 7, 2021. 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 statistical evaluation of the 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:

Constituent	GWPS	#Downgradient Wells Observed
Arsenic	21 ug/L	2 of 4

The results of the assessment monitoring statistical evaluation for the 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

[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).

executing the self-implementing groundwater compliance schedule in conformance with §257.90 - §257.98.

Assessment Monitoring Statistical Evaluation

When the initial assessment monitoring event was completed in May 2018, the compliance well network at the Karn Bottom Ash Pond included six wells encircling the unit (DEK-MW-15002 through DEK-MW-15006 and DEK-MW-18001). Starting with this May 2021 statistical evaluation, the compliance well network includes DEK-MW-15002, DEK-MW-15005, DEK-MW-15006, and DEK-MW-18001. Due to changes in groundwater flow direction on site, monitoring wells DEK-MW-15003 and DEK-MW-15004 are no longer located downgradient of the unit and were determined to be no longer indicative of groundwater conditions influenced by the Karn Bottom Ash Pond. Therefore, monitoring wells DEK-MW-15003 and DEK-MW-15004 are no longer included for statistical analysis.

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

The concentrations observed in the downgradient wells are deemed to be a statistically significant exceedance when the 99 percent lower confidence limit of the downgradient data exceeds the GWPS. If the confidence interval straddles the GWPS (i.e., the lower confidence level is below the GWPS, but 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 (April 2018 through May 2021) were retained for further analysis. Arsenic in each of the downgradient monitoring wells at the Karn Bottom

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

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 constituents using a using a per test[3] 99 percent confidence level, i.e., a significance level (α) of 0.01. The following narrative describes the methods employed, the results obtained and the Sanitas™ output files are included as an attachment.

The statistical data evaluation included the following steps:

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

The results of these evaluations are presented and discussed below.

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 results (December 2015 through August 2017) and the assessment monitoring results (April 2018 through May 2021) were visually assessed for potential trends. No outliers were identified. Arsenic concentrations at DEK-MW-15002 and DEK-MW-18001 appear to exhibit a downward trend on the time-series chart (Attachment 1). These two 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 at DEK-MW-15002 and DEK-MW-18001 are generally decreasing with time, as evidenced by the negative Sen's Slope. Additionally, the decrease in concentrations at DEK-MW-15002 was shown to be statistically significant and arsenic concentrations have been below the GWPS for the 5 most recent sampling events (Attachment 1). The decreases in arsenic concentrations at

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

DEK-MW-15002 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. If trends continued to be observed as 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, and as of the May 2021 event, 7 semi-annual sampling events have been completed post-CCR removal.

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. 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.

The Sanitas™ software generates an output graph for the confidence intervals of each well. The arsenic data set at DEK-MW-15006 was found to be normally distributed, DEK-MW-15005 used a non-parametric confidence interval due to non-normal data set, DEK-MW-15002 was normalized using a square root transformation, and DEK-MW-18001 was normalized using a logarithmic transformation. 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 two of the four monitoring locations (DEK-MW-15005 and DEK-MW-18001). 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 – April 2018 to May 2021

Attachment 1 Sanitas™ Output Files

Table

Table 1
Comparison of Groundwater Sampling Results to Groundwater Protection Standards – April 2018 to May 2021
DE Karn Bottom Ash Pond – RCRA CCR Monitoring Program
Essexville, Michigan

					Sample Location:	DEK-MW-15002								
					Sample Date:	4/12/2018	5/23/2018	11/5/2018	4/11/2019	10/15/2019	5/13/2020	10/6/2020	10/6/2020	5/3/2021
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS	downgradient								
Appendix III													Field Dup	
Boron	ug/L	NC	NA	619	NA	--	967	894	860	1,600	1,390	1,580	1,600	1,420
Calcium	mg/L	NC	NA	302	NA	--	53.7	67.8	72	130	170	126	122	148
Chloride	mg/L	250*	NA	2,440	NA	--	79.7	83.5	80	410	130	106	102	148
Fluoride	ug/L	4,000	NA	1,000	NA	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	1,300	< 1,000	< 1,000
Sulfate	mg/L	250*	NA	407	NA	--	263	77.2	45	150	367	142	139	216
Total Dissolved Solids	mg/L	500*	NA	4,600	NA	--	660	536	560	1,300	1,100	791	776	926
pH, Field	SU	6.5 - 8.5*	NA	6.5 - 7.3	NA	7.5	8.0	7.3	7.5	7.3	7.1	7.1	--	7.4
Appendix IV														
Antimony	ug/L	6	NA	1	6	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1	< 1	< 1	< 1
Arsenic	ug/L	10	NA	21	**21**	**56.4**	**67.0**	**31.7**	9.0	6.5	3	8	8	2
Barium	ug/L	2,000	NA	1,300	2,000	82.7	84.5	71.6	71	140	196	133	131	211
Beryllium	ug/L	4	NA	1	4	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1	< 1	< 1	< 1
Cadmium	ug/L	5	NA	0.2	5	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.2	< 0.2	< 0.2	< 0.2
Chromium	ug/L	100	NA	3	100	< 1.0	< 1.0	1.4	1.3	< 1.0	< 1	1	1	< 1
Cobalt	ug/L	NC	6	15	15	< 15.0	< 15.0	< 6.0	< 6.0	< 6.0	< 6	< 6	< 6	< 6
Fluoride	ug/L	4,000	NA	1,000	4,000	< 1,000	< 1,000	< 1,000	< 1,000	<1,000	< 1,000	1,300	< 1,000	< 1,000
Lead	ug/L	NC	15	1	15	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1	< 1	< 1	< 1
Lithium	ug/L	NC	40	180	180	43	35	32	26	35	48	35	36	36
Mercury	ug/L	2	NA	0.2	2	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.2	< 0.2	< 0.2	< 0.2
Molybdenum	ug/L	NC	100	6	100	30.8	35.4	< 5.0	< 5.0	< 5.0	< 5	< 5	< 5	< 5
Radium-226	pCi/L	NC	NA	NA	NA	< 0.478	< 0.698	< 0.850	< 0.376	0.334	0.673	< 0.430	< 0.577	0.582
Radium-228	pCi/L	NC	NA	NA	NA	1.16	< 0.744	0.730	0.684	0.654	< 0.763	0.642	< 0.460	< 0.537
Radium-226/228	pCi/L	5	NA	3.32	5	1.42	< 1.44	< 1.39	0.846	0.987	0.899	1.06	< 0.577	0.811
Selenium	ug/L	50	NA	2	50	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1	< 1	1	< 1
Thallium	ug/L	2	NA	2	2	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2	< 2	< 2	< 2

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) Outlier; single detection above reporting limit.

Table 1
Comparison of Groundwater Sampling Results to Groundwater Protection Standards – April 2018 to May 2021
DE Karn Bottom Ash Pond – RCRA CCR Monitoring Program
Essexville, Michigan

						Sample Location:	DEK-MW-15005											
						Sample Date:	4/11/2018	4/11/2018	5/24/2018	11/6/2018	4/11/2019	4/11/2019	10/15/2019	10/15/2019	5/13/2020	5/13/2020	10/7/2020	5/3/2021	5/3/2021
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS		downgradient												
Appendix III								Field Dup				Field Dup		Field Dup		Field Dup			Field Dup
Boron	ug/L	NC	NA	619	NA		--	--	806	947	910	910	700	650	863	858	847	926	948
Calcium	mg/L	NC	NA	302	NA		--	--	33.4	32.9	31	31	60	59	71.0	72.1	155.0	95.6	97.6
Chloride	mg/L	250*	NA	2,440	NA		--	--	72.6	69.1	60	60	64	64	48.0	47.5	52.7	65.2	65.1
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		--	--	182	160	140	140	5.2	5.0	18.9	18.9	102	50.8	50.2
Total Dissolved Solids	mg/L	500*	NA	4,600	NA		--	--	524	474	470	470	390	400	419	425	687	534	561
pH, Field	SU	6.5 - 8.5*	NA	6.5 - 7.3	NA		7.7	--	7.8	7.9	7.7	--	7.6	--	8.1	--	7.7	7.6	--
Appendix IV																			
Antimony	ug/L	6	NA	1	6		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1	< 1	< 1	< 1	< 1
Arsenic	ug/L	10	NA	21	**21**		**28.3**	**29.1**	**31.7**	**35.0**	**24**	**24**	**120**	**120**	**34**	**34**	**42**	**45**	**44**
Barium	ug/L	2,000	NA	1,300	2,000		54.9	55.8	58.5	56.7	46	45	110	100	127	127	248	173	170
Beryllium	ug/L	4	NA	1	4		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1	< 1	< 1	< 1	< 1
Cadmium	ug/L	5	NA	0.2	5		< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Chromium	ug/L	100	NA	3	100		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1	< 1	< 1	< 1	< 1
Cobalt	ug/L	NC	6	15	15		< 15.0	< 15.0	< 15.0	< 6.0	< 6.0	< 6.0	< 6.0	< 6.0	< 6	< 6	< 6	< 6	< 6
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		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1	< 1	< 1	< 1	< 1
Lithium	ug/L	NC	40	180	180		24	24	19	17	15	14	16	15	20	20	45	38	39
Mercury	ug/L	2	NA	0.2	2		< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Molybdenum	ug/L	NC	100	6	100		39.0	40.5	41.9	45.3	39	38	< 5.0	< 5.0	< 5	< 5	< 5	8	8
Radium-226	pCi/L	NC	NA	NA	NA		< 0.587	0.606	< 0.740	< 0.865	< 0.379	< 0.406	0.165	0.185	< 0.469	< 0.335	0.621	0.291	< 0.187
Radium-228	pCi/L	NC	NA	NA	NA		0.756	0.886	0.857	< 0.598	< 0.754	< 0.586	< 0.456	0.497	1.14	< 0.554	< 0.502	< 0.459	0.479
Radium-226/228	pCi/L	5	NA	3.32	5		< 1.34	1.49	< 1.53	< 1.46	< 0.754	< 0.586	0.524	0.682	1.34	0.662	0.875	0.722	0.65
Selenium	ug/L	50	NA	2	50		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1	< 1	< 1	1	1
Thallium	ug/L	2	NA	2	2		< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2	< 2	< 2	< 2	< 2

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) Outlier; single detection above reporting limit.

Table 1
Comparison of Groundwater Sampling Results to Groundwater Protection Standards – April 2018 to May 2021
DE Karn Bottom Ash Pond – RCRA CCR Monitoring Program
Essexville, Michigan

Sample Location:						DEK-MW-15006								
Sample Date:						4/11/2018	5/24/2018	11/5/2018	11/5/2018	4/11/2019	10/14/2019	5/13/2020	10/7/2020	5/3/2021
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS	downgradient								
Appendix III									Field Dup					
Boron	ug/L	NC	NA	619	NA	--	1,200	1,340	1,270	1,700	1,200	1,090	1,220	938
Calcium	mg/L	NC	NA	302	NA	--	21.9	29.4	29.6	35	34	70.4	106	115
Chloride	mg/L	250*	NA	2,440	NA	--	85.8	87.9	88.3	75	45	71.5	102	63.5
Fluoride	ug/L	4,000	NA	1,000	NA	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	1,060	< 1,000
Sulfate	mg/L	250*	NA	407	NA	--	401	341	344	320	74	316	296	324
Total Dissolved Solids	mg/L	500*	NA	4,600	NA	--	944	792	784	780	450	833	1,010	790
pH, Field	SU	6.5 - 8.5*	NA	6.5 - 7.3	NA	7.9	8.2	7.9	--	7.8	7.8	8.1	7.7	7.5
Appendix IV														
Antimony	ug/L	6	NA	1	6	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	3	< 1	< 1
Arsenic	ug/L	10	NA	21	**21**	18.3	**25.7**	20.9	19.6	21	**27**	21	**27**	**24**
Barium	ug/L	2,000	NA	1,300	2,000	39.6	22.8	38.5	38.3	43	51	86	141	139
Beryllium	ug/L	4	NA	1	4	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1	< 1	< 1
Cadmium	ug/L	5	NA	0.2	5	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.2	< 0.2	< 0.2
Chromium	ug/L	100	NA	3	100	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.1	2	6	< 1
Cobalt	ug/L	NC	6	15	15	< 15.0	< 15.0	< 6.0	< 6.0	< 6.0	< 6.0	< 6	< 6	< 6
Fluoride	ug/L	4,000	NA	1,000	4,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	<1,000	< 1,000	1,060	< 1,000
Lead	ug/L	NC	15	1	15	< 1.0	320[(1)]	< 1.0	< 1.0	< 1.0	< 1.0	< 1	< 1	< 1
Lithium	ug/L	NC	40	180	180	18	< 10	< 10	10	< 10	11	15	22	21
Mercury	ug/L	2	NA	0.2	2	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.2	< 0.2	< 0.2
Molybdenum	ug/L	NC	100	6	100	71.6	48.7	50.3	48.0	59	11	18	11	9
Radium-226	pCi/L	NC	NA	NA	NA	< 0.688	< 0.738	< 0.885	< 1.06	< 0.459	< 0.159	< 0.370	0.629	0.353
Radium-228	pCi/L	NC	NA	NA	NA	< 0.755	< 1.12	< 0.649	< 0.897	< 0.677	< 0.581	0.78	0.492	0.804
Radium-226/228	pCi/L	5	NA	3.32	5	< 1.44	< 1.86	< 1.53	< 1.96	< 0.677	< 0.581	1.01	1.12	1.16
Selenium	ug/L	50	NA	2	50	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1	< 1	< 1
Thallium	ug/L	2	NA	2	2	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2	< 2	< 2

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) Outlier; single detection above reporting limit.

Table 1
Comparison of Groundwater Sampling Results to Groundwater Protection Standards – April 2018 to May 2021
DE Karn Bottom Ash Pond – RCRA CCR Monitoring Program
Essexville, Michigan

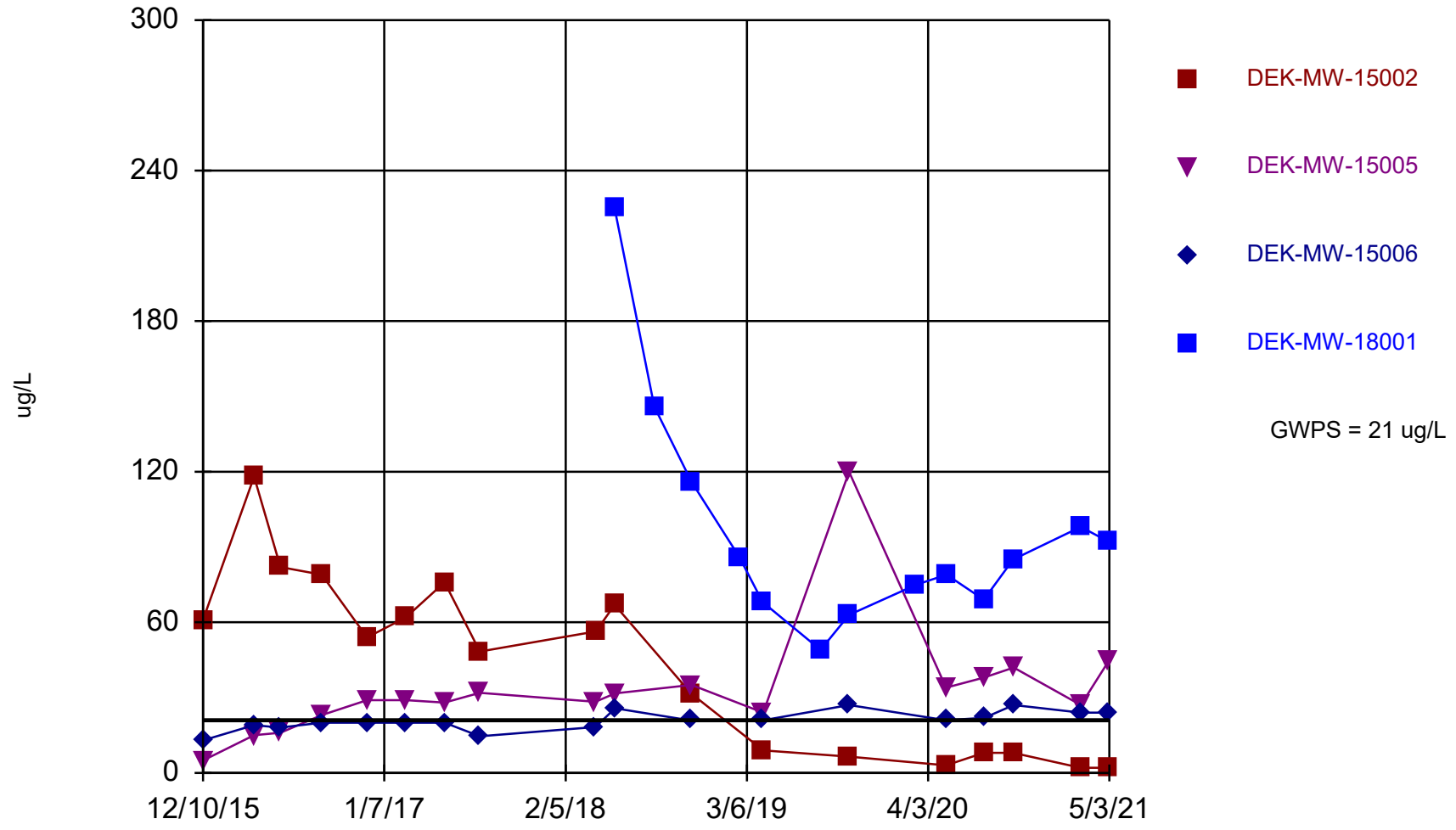
						Sample Location:	DEK-MW-18001					
						Sample Date:	5/23/2018	11/6/2018	4/10/2019	10/15/2019	5/14/2020	10/6/2020	5/3/2021
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS		downgradient						
Appendix III													
Boron	ug/L	NC	NA	619	NA		1,600	1,020	970	2,200	1,670	1,740	1,180
Calcium	mg/L	NC	NA	302	NA		64.9	51.1	48	84	72.1	71.7	65.2
Chloride	mg/L	250*	NA	2,440	NA		69.1	76.6	69	81	64.7	60.7	51.6
Fluoride	ug/L	4,000	NA	1,000	NA		< 1,000	1,300	1,200	1,000	1,090	1,240	< 1,000
Sulfate	mg/L	250*	NA	407	NA		30.6	< 2.0	< 2.0	31	51.1	91.9	121
Total Dissolved Solids	mg/L	500*	NA	4,600	NA		434	340	360	500	484	476	486
pH, Field	SU	6.5 - 8.5*	NA	6.5 - 7.3	NA		7.8	7.5	7.2	7.3	7.7	7.6	7.3
Appendix IV													
Antimony	ug/L	6	NA	1	6		< 1.0	< 1.0	< 1.0	< 1.0	< 1	< 1	< 1
Arsenic	ug/L	10	NA	21	**21**		**225**	**116**	**68**	**63**	**79**	**85**	**92**
Barium	ug/L	2,000	NA	1,300	2,000		101	79.5	75	160	130	136	135
Beryllium	ug/L	4	NA	1	4		< 1.0	< 1.0	< 1.0	< 1.0	< 1	< 1	< 1
Cadmium	ug/L	5	NA	0.2	5		< 0.20	< 0.20	< 0.20	< 0.20	< 0.2	< 0.2	< 0.2
Chromium	ug/L	100	NA	3	100		< 1.0	< 1.0	< 1.0	< 1.0	< 1	< 1	< 1
Cobalt	ug/L	NC	6	15	15		< 15.0	< 6.0	< 6.0	< 6.0	< 6	< 6	< 6
Fluoride	ug/L	4,000	NA	1,000	4,000		< 1,000	1,300	1,200	1,000	1,090	1,240	< 1,000
Lead	ug/L	NC	15	1	15		< 1.0	< 1.0	< 1.0	< 1.0	< 1	< 1	< 1
Lithium	ug/L	NC	40	180	180		23	24	24	36	27	26	25
Mercury	ug/L	2	NA	0.2	2		< 0.20	< 0.20	< 0.20	< 0.20	< 0.2	< 0.2	< 0.2
Molybdenum	ug/L	NC	100	6	100		< 5.0	< 5.0	< 5.0	< 5.0	< 5	< 5	< 5
Radium-226	pCi/L	NC	NA	NA	NA		0.906	< 0.813	0.173	0.206	< 0.608	< 0.473	0.189
Radium-228	pCi/L	NC	NA	NA	NA		< 0.733	0.811	0.694	0.746	< 0.676	0.463	0.639
Radium-226/228	pCi/L	5	NA	3.32	5		1.63	1.56	0.867	0.952	< 0.676	0.591	0.828
Selenium	ug/L	50	NA	2	50		< 1.0	< 1.0	< 1.0	< 1.0	< 1	1	< 1
Thallium	ug/L	2	NA	2	2		< 2.0	< 2.0	< 2.0	< 2.0	< 2	< 2	< 2

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) Outlier; single detection above reporting limit.

Attachment 1
Sanitas™ Output Files

Arsenic, Total

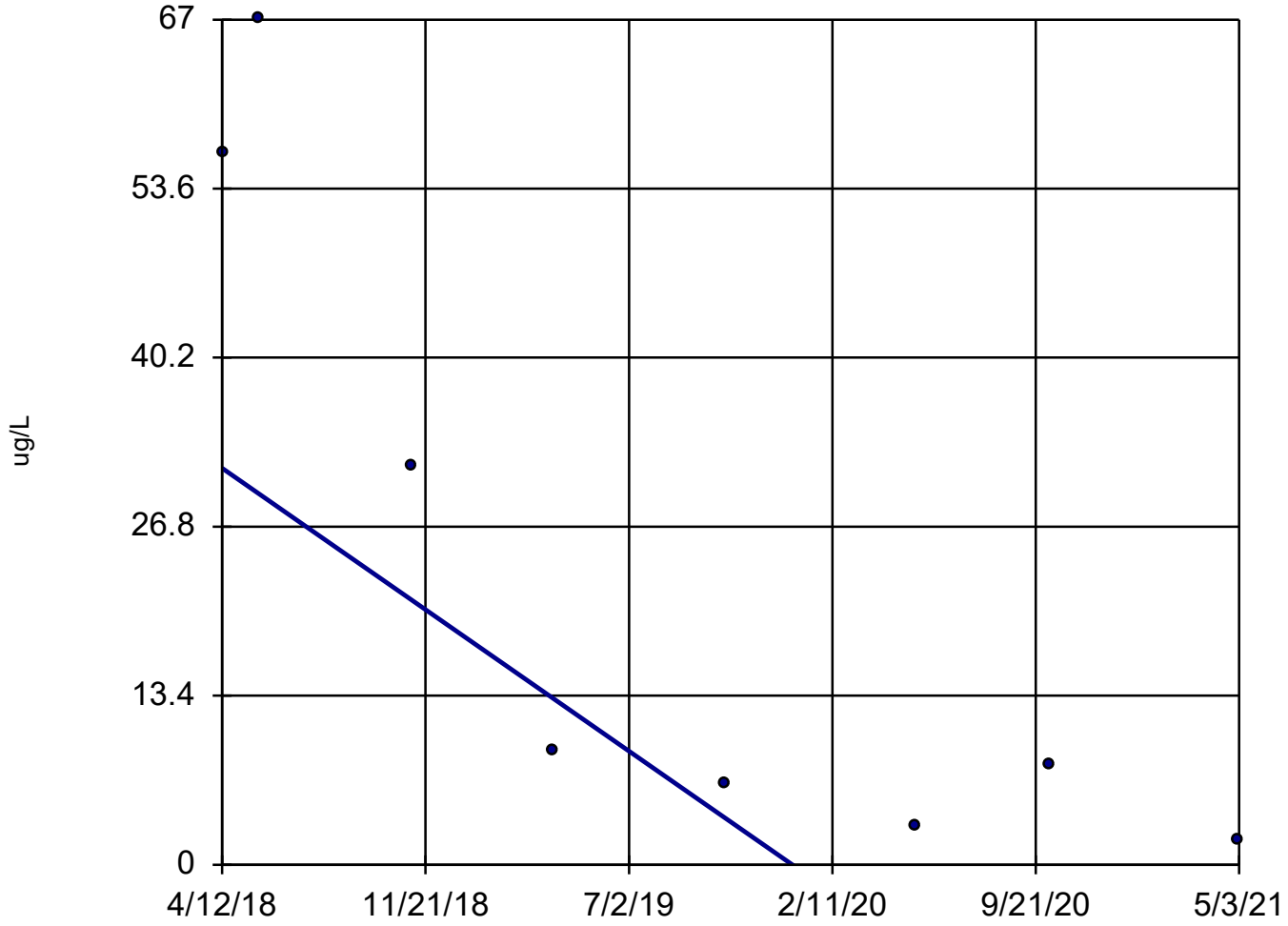


Time Series Analysis Run 6/30/2021 8:38 AM

Client: Consumers Energy Data: DEK_HMPCCR_Sanitas_21Q2.rev1

Arsenic, Total

DEK-MW-15002



n = 8

Slope = -18.33 units per year.

Mann-Kendall statistic = -22
critical = -20

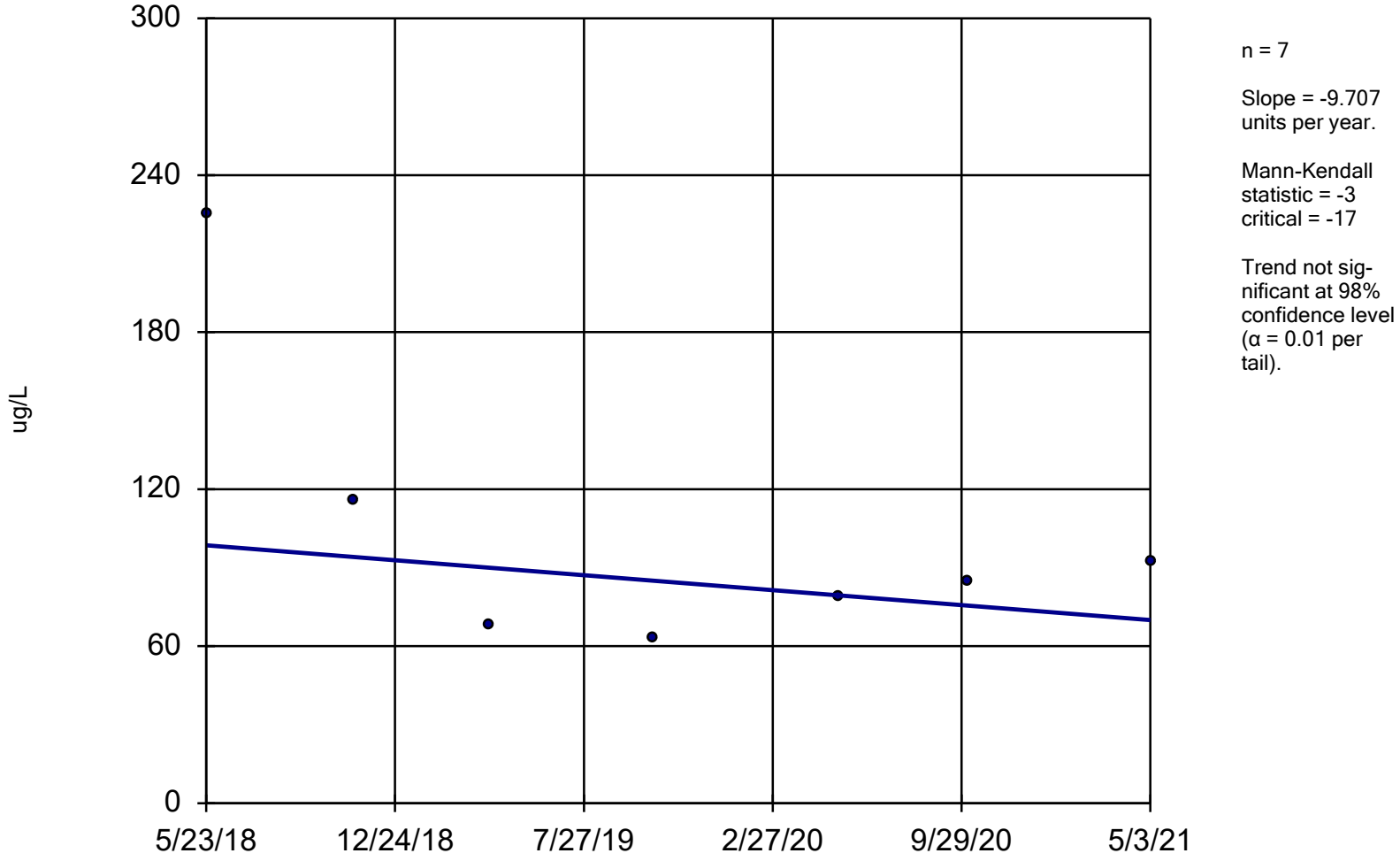
Decreasing trend significant at 98% confidence level (α = 0.01 per tail).

Sen's Slope Estimator Analysis Run 6/21/2021 5:27 PM

Client: Consumers Energy Data: DEK_HMPCCR_Sanitas_21Q2 - Copy

Arsenic, Total

DEK-MW-18001



n = 7

Slope = -9.707 units per year.

Mann-Kendall statistic = -3
critical = -17

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

Sen's Slope Estimator Analysis Run 6/21/2021 5:29 PM

Client: Consumers Energy Data: DEK_HMPCCR_Sanitas_21Q2 - Copy

Summary Report

Constituent: Arsenic, Total Analysis Run 6/21/2021 5:30 PM
Client: Consumers Energy Data: DEK_HMPCCR_Sanitas_21Q2 - Copy

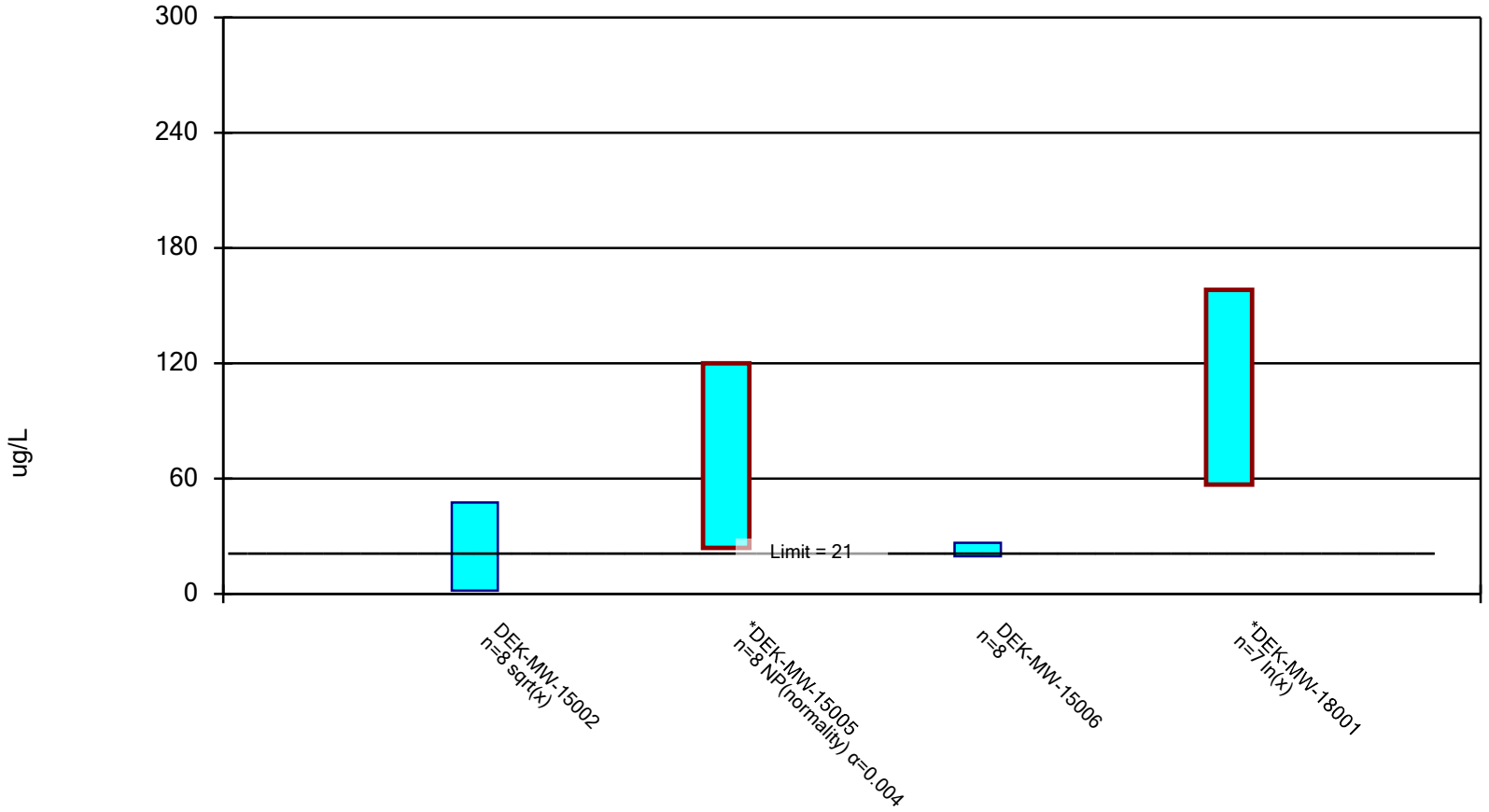
For observations made between 4/11/2018 and 5/3/2021, a summary of the selected data set:

Observations = 31
ND/Trace = 0
Wells = 4
Minimum Value = 2
Maximum Value = 225
Mean Value = 46.98
Median Value = 31.7
Standard Deviation = 45.59
Coefficient of Variation = 0.9703
Skewness = 2.167

Well	#Obs.	ND/Trace	Min	Max	Mean	Median	Std.Dev.	CV	Skewness
DEK-MW-15002	8	0	2	67	22.95	8.5	25.81	1.124	0.8525
DEK-MW-15005	8	0	24	120	45	34.5	31.06	0.6902	2.056
DEK-MW-15006	8	0	18.3	27	23.11	22.5	3.266	0.1413	-0.02463
DEK-MW-18001	7	0	63	225	104	85	56.11	0.5395	1.664

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 n.



Constituent: Arsenic, Total Analysis Run 6/21/2021 5:31 PM

Client: Consumers Energy Data: DEK_HMPCCR_Sanitas_21Q2 - Copy

Confidence Interval

Constituent: Arsenic, Total (ug/L) Analysis Run 6/21/2021 5:31 PM

Client: Consumers Energy Data: DEK_HMPCCR_Sanitas_21Q2 - Copy

	DEK-MW-15002	DEK-MW-15005	DEK-MW-15006	DEK-MW-18001
4/11/2018		28.3	18.3	
4/12/2018	56.4			
5/23/2018	67			225
5/24/2018		31.7	25.7	
11/5/2018	31.7		20.9	
11/6/2018		35		116
4/10/2019				68
4/11/2019	9	24	21	
10/15/2019	6.5	120	27	63
5/13/2020	3	34	21	
5/14/2020				79
10/6/2020	8			85
10/7/2020		42	27	
5/3/2021	2	45	24	92
Mean	22.95	45	23.11	104
Std. Dev.	25.81	31.06	3.266	56.11
Upper Lim.	47.64	120	26.57	158.1
Lower Lim.	1.717	24	19.65	56.89

Appendix C
Groundwater Flow Evaluation

LEGEND

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

NOTES

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

N

0 1,000 2,000 Feet

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

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

TITLE:
SHALLOW GROUNDWATER CONTOUR MAP DECEMBER 2015

DRAWN BY:	J. PAPEZ	PROJ NO.:	269767-002/3
CHECKED BY:	D. LITZ		
APPROVED BY:	G. CROCKFORD		**FIGURE 1**
DATE:	OCTOBER 2017		

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

FILE NO.: 269767-002_3-001.mxd

TRC - GIS
Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl (Foot)
Map Rotation: 0
Plot Date: 10/12/2017, 14:02:33 PM by SMAJOR -- LAYOUT: ANSI B(11"x17")
Path: E:\ConsumersEnergy\CCR_GW\2017_269767\269767-002_3-001.mxd

Plot Date: 10/12/2017, 14:05:46 PM by SMAJOR -- LAYOUT: ANSI B(11"x17")
Path: E:\ConsumersEnergy\CCR_GW\2017_269767\269767-002_3-002.mxd
Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl (Foot)
Map Rotation: 0

Lake Huron

Approximate Groundwater Flow Direction
(Pond in Operation until June 2018)

INTAKE CHANNEL

DEK MW-15004 (589.40)
DEK MW-15005 (580.77)
DEK MW-15003 (589.83)
DEK MW-15002 (586.89)
DEK MW-15006 (580.68)
DEK MW-15001 (587.84)

588.0
586.0
584.0
582.0

DE KARN GENERATING FACILITY

Pine St
Oak St
Shady Shore Dr

JCW MW-15022
JCW MW-15006
JCW MW-15012 (581.74)
JCW MW-15010 (583.12)
GAUGING STATION (580.20)
BOTTOM ASH POND
DISCHARGE CHANNEL
JCW MW-15011 (584.68)
JCW MW-15023 (584.92)
582.0
584.0
JCW MW-15003
JCW MW-15009 (582.59)
JCW MW-15028 (584.91)
JCW MW-15007 (584.42)
JC WEADOCK GENERATING FACILITY
SLURRY WALL
LANDFILL
JCW MW-15026
UNDERWOOD DRAIN
MW-15008 (581.02)
MW-15027 (580.96)
MW-15020 (580.96)
MW-15024 (581.06)
584.0
JCW MW-15021
TACEY DRAIN
Tacey Rd
MW-15019 (581.11)
MW-15018 (581.39)
MW-15016 (583.39)
MW-15002 (581.51)
JCW MW-15001
Saginaw River
582.0
Weadock Hwy
SE Boutell Rd
N Jones Rd
JCW MW-15025

LEGEND

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

NOTES

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

N

0 1,000 2,000 Feet

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

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

TITLE:
SHALLOW GROUNDWATER CONTOUR MAP MARCH 2016

DRAWN BY:	J. PAPEZ	PROJ NO.:	269767-002/3
CHECKED BY:	D. LITZ		
APPROVED BY:	G. CROCKFORD		**FIGURE 2**
DATE:	OCTOBER 2017		

TRC
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FILE NO.: 269767-002_3-002.mxd

Plot Date: 10/12/2017, 14:08:40 PM by SMAJOR -- LAYOUT: ANSI B(11"x17")
Path: E:\ConsumersEnergy\CCR_GW\2017_269767\269767-002_3-003.mxd
Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl (Foot)
Map Rotation: 0

LEGEND

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

NOTES

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

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 2016

DRAWN BY:	J. PAPEZ	PROJ NO.:	269767-002/3
CHECKED BY:	D. LITZ		
APPROVED BY:	G. CROCKFORD		**FIGURE 3**
DATE:	OCTOBER 2017		

TRC
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FILE NO.: 269767-002_3-003.mxd

LEGEND

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

NOTES

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

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 AUGUST 2016

DRAWN BY:	J. PAPEZ	PROJ NO.:	269767-002/3
CHECKED BY:	D. LITZ		
APPROVED BY:	G. CROCKFORD		**FIGURE 4**
DATE:	OCTOBER 2017		

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FILE NO.: 269767-002_3-004.mxd

TRC - GIS
Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl (Foot)
Map Rotation: 0
Plot Date: 10/12/2017, 14:10:26 PM by SMAJOR - - LAYOUT: ANSI B(11"x17")
Path: E:\ConsumersEnergy\CCR_GW\2017_269767\269767-002_3-004.mxd

Plot Date: 10/12/2017, 14:13:29 PM by SMAJOR -- LAYOUT: ANSI B(11"x17")
Path: E:\ConsumersEnergy\CCR_GW\2017_269767\269767-002_3-005.mxd
Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl (Foot)
Map Rotation: 0

Lake Huron

Approximate Groundwater Flow Direction
(Pond in Operation until June 2018)

INTAKE CHANNEL

DEK MW-15004 (589.05)
DEK MW-15005 (579.39)
DEK MW-15003 (589.58)
DEK MW-15001 (587.26)
DEK MW-15006 (579.29)
DEK MW-15002 (586.67)

588.0 584.0 582.0 586.0 580.0

DE KARN GENERATING FACILITY

Pine St
Oak St
Shady Shore Dr

JCW MW-15022

JCW MW-15006
JCW MW-15012 (579.59)

GAUGING STATION (578.81)
BOTTOM ASH POND
DISCHARGE CHANNEL
JCW MW-15010 (581.07)
JCW MW-15011 (582.39)
JCW MW-15023 (581.37)
580.0
582.0
582.0
582.0

JCW MW-15003
JCW MW-15009 (580.45)
JCW MW-15028 (582.32)
JCW MW-15007 (584.15)

JC WEADOCK GENERATING FACILITY

SLURRY WALL

LANDFILL

JCW MW-15026

UNDERWOOD DRAIN

MW-15008 (580.76)
MW-15027 (580.69)
MW-15020 (580.74)
MW-15024 (580.60)
MW-15019 (580.76)
MW-15018 (581.07)
MW-15002 (581.09)
MW-15016 (583.27)
JCW MW-15001

Saginaw River

Weadock Hwy

JCW MW-15021

TACEY DRAIN

Tacey Rd

SE Boutell Rd

N Jones Rd

JCW MW-15025

580.0
582.0

LEGEND

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

NOTES

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

N

0 1,000 2,000 Feet

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

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

TITLE:
SHALLOW GROUNDWATER CONTOUR MAP NOVEMBER 2016

DRAWN BY:	J. PAPEZ	PROJ NO.:	269767-002/3
CHECKED BY:	D. LITZ		
APPROVED BY:	G. CROCKFORD		**FIGURE 5**
DATE:	OCTOBER 2017		

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FILE NO.: 269767-002_3-005.mxd

LEGEND

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

NOTES

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

N

0 1,000 2,000 Feet

1 " = 1,000 '

1:12,000

PROJECT:

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

TITLE:

SHALLOW GROUNDWATER CONTOUR MAP FEBRUARY 2017

DRAWN BY:	J. PAPEZ	PROJ NO.:	269767-002/3
CHECKED BY:	D. LITZ		
APPROVED BY:	G. CROCKFORD		**FIGURE 6**
DATE:	OCTOBER 2017		

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FILE NO.: 269767-002_3-006.mxd

Plot Date: 10/12/2017, 14:15:17 PM by SMAJOR -- LAYOUT: ANSI B(11"x17")
Path: E:\ConsumersEnergy\CCR_GW\2017_269767\269767-002_3-006.mxd
Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl (Foot)
Map Rotation: 0

TRC - GIS

LEGEND

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

NOTES

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

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 2017

DRAWN BY:	J. PAPEZ	PROJ NO.:	269767-002/3
CHECKED BY:	D. LITZ		
APPROVED BY:	G. CROCKFORD		**FIGURE 7**
DATE:	OCTOBER 2017		

TRC
1540 Eisenhower Place
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FILE NO.: 269767-002_3-009.mxd

TRC - GIS
Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl (Foot)
Map Rotation: 0
Plot Date: 10/12/2017, 08:48:34 AM by SMAJOR -- LAYOUT: ANSI B (11"x17")
Path: E:\ConsumersEnergy\CCR_GW\2017_269767\269767-002_3-009.mxd

LEGEND

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

NOTES

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

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 AUGUST 2017

DRAWN BY:	J. PAPEZ	PROJ NO.:	269767-002/3
CHECKED BY:	D. LITZ		
APPROVED BY:	G. CROCKFORD		**FIGURE 8**
DATE:	OCTOBER 2017		

TRC
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FILE NO.: 269767-002_3-019.mxd

TRC - GIS
Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl (Foot)
Map Rotation: 0
Plot Date: 10/12/2017, 14:19:59 PM by SMAJOR -- LAYOUT: ANSI B(11"x17")
Path: E:\ConsumersEnergy\CCR_GW\2017_269767\269767-002_3-019.mxd

LEGEND

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

NOTES

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

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 SEPTEMBER 2017

DRAWN BY:	S. MAJOR	PROJ NO.:	269767-002
CHECKED BY:	D. LITZ		
APPROVED BY:	G. CROCKFORD		
DATE:	JANUARY 2018		

FIGURE 3

TRC
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FILE NO.: 269767-002_3-021.mxd

Plot Date: 1/3/2018, 16:55:59 PM by SMAJOR -- LAYOUT: ANSI B(11"x17")
Path: E:\ConsumersEnergy\CCR_GW\2017_269767\269767-002_3-021.mxd
Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl (Foot)
Map Rotation: 0

TRC - GIS

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 BOTTOM ASH POND MONITORING WELL
- JCW LANDFILL MONITORING WELL
- MONITORING WELL (STATIC WATER LEVEL ONLY)
- PIEZOMETER
- SLURRY WALL (APPROXIMATE)
- GROUNDWATER ELEVATION CONTOUR (2' INTERVAL, DASHED WHERE INFERRED)
- (580.85) GROUNDWATER ELEVATION (FEET, MSL)

NOTES

1. BASE MAP IMAGERY FROM USDA – NATIONAL AGRICULTURE IMAGERY PROGRAM, 7/10/2016.
2. WELL LOCATIONS SURVEYED BY ROWE PROFESSIONAL SERVICES COMPANY ON 11/4/2015.
3. NOAA/NATIONAL OCEANIC SERVICE GREAT LAKES GAUGING STATION, ESSEXVILLE, MI (ID: 9075035).
4. MONITORING WELL DEK- MW-18001 INSTALLED IN MAY 2018. SURVEY DATA NOT YET AVAILABLE.

N

0 1,000 2,000 Feet

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

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

TITLE:
SHALLOW GROUNDWATER CONTOUR MAP APRIL 2018

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

TRC
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Phone: 734.971.7080
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FILE NO.: 290805-001-001x.mxd

TRC - GIS
Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl (Foot)
Map Rotation: 0
Plot Date: 10/8/2018, 13:17:59 PM by SMAJOR -- LAYOUT: ANSI B (11"x17")
Path: E:\ConsumersEnergy\CCR GW\2017 Data\290805-001\GW\MXD\290805-001-001x.mxd

LEGEND

- BACKGROUND MONITORING WELL
- DEK BOTTOM ASH POND & LINED IMPOUNDMENT MONITORING WELL
- DEK BOTTOM ASH POND MONITORING WELL
- DEK LINED IMPOUNDMENT MONITORING WELL
- DECOMMISSIONED MONITORING WELL
- EXTRACTION WELL
- JCW BEDROCK MONITORING WELL
- JCW BOTTOM ASH POND MONITORING WELL
- JCW LANDFILL MONITORING WELL
- MONITORING WELL (STATIC WATER LEVEL ONLY)
- PIEZOMETER
- GROUNDWATER ELEVATION CONTOUR (2' INTERVAL, DASHED WHERE INFERRED)
- SLURRY WALL (APPROXIMATE)
- (580.85) GROUNDWATER ELEVATION (FEET, MSL)

NOTES

1. BASE MAP IMAGERY FROM USDA – NATIONAL AGRICULTURE IMAGERY PROGRAM, 7/10/2016.
2. WELL LOCATIONS SURVEYED BY ROWE PROFESSIONAL SERVICES COMPANY ON 11/4/2015.
3. NOAA/NATIONAL OCEANIC SERVICE GREAT LAKES GAUGING STATION, ESSEXVILLE, MI (ID: 9075035).
4. MONITORING WELL DEK- MW-18001 WAS INSTALLED IN MAY 2018. SURVEY DATA NOT YET AVAILABLE.

0 1,000 2,000 Feet

1 " = 1,000 '

1:12,000

PROJECT:

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

TITLE:

SHALLOW GROUNDWATER CONTOUR MAP MAY 2018

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

TRC
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FILE NO.: 290805-001-005.mxd

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

LEGEND

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

NOTES

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

N

0 1,000 2,000 Feet

1 " = 1,000 '

1:12,000

PROJECT:

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

TITLE:

SHALLOW GROUNDWATER CONTOUR MAP NOVEMBER 2018

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

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

FILE NO.: 290805-001-022.mxd

Plot Date: 3/14/2019, 09:51:54 AM by SMAJOR -- LAYOUT: ANSI B(11"x17")
Path: E:\ConsumersEnergy\CCR GW\2017_2697672\290805-001-022.mxd
Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl (Foot)
Map Rotation: 0
TRC - GIS

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.

N

0 600 1,200 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		
APPROVED BY:	D. LITZ		**FIGURE 3**
DATE:	JANUARY 2020		

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

Plot Date: 1/29/2020, 16:24:18 PM by MVAPHADS -- LAYOUT: ANSI B(11"x17")
Path: E:\Consumers\Energy\CCR GW\2017 26976\322172_3-004-02.mxd
Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl (Foot)
Map Rotation: 0
TRC - GIS

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

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 AND MW-03/MW-04 AS THE WELLS ARE LOCATED WITHIN 3-FT OF EACH OTHER.
5. GROUND WATER ELEVATIONS DISPLAYED IN FEET RELATIVE TO THE NORTH AMERICAN VERTICAL DATUM OF 1988.

N

0 600 1,200 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		
APPROVED BY:	D. LITZ		**FIGURE 4**
DATE:	JANUARY 2020		

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

TRC - GIS
Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl (Foot)
Map Rotation: 0
Plot Date: 1/29/2020, 16:23:59 PM by MVAPHADIS -- LAYOUT: ANSI B(11"x17")
Path: E:\Consumers\Energy\CCR GW\2017 269767\322172 3-005-02.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 (1' 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 ELEVATIONS DISPLAYED IN FEET RELATIVE TO THE NORTH AMERICAN VERTICAL DATUM OF 1988.

N

0 600 1,200 Feet

1 " = 600 '

1:7,200

PROJECT:

CONSUMERS ENERGY COMPANY
DE KARN POWER PLANT
ESSEXVILLE, MICHIGAN

TITLE:

SHALLOW GROUNDWATER CONTOUR MAP MAY 11, 2020

DRAWN BY:	S. MAJOR	PROJ NO.:	367388.0001
CHECKED BY:	J. KRENZ		
APPROVED BY:	D. LITZ		**FIGURE 3**
DATE:	JULY 2020		

TRC
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FILE NO.: 367388-001-006.mxd

Plot Date: 7/23/2020, 14:28:11 PM by SMAJOR -- LAYOUT: ANSI B(11"x17")
Path: S:\1-PROJECTS\Consumers Energy Company\Michigan\CCR GW\2017 269767\367388-001\mxd\367388-001-006.mxd
Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl (Foot)
Projection:
Rotation: 0
TRC - GIS

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)
- LINED IMPOUNDMENT (COVENANT BOUNDARY)
- GROUNDWATER ELEVATION CONTOUR (1' INTERVAL, DASHED WHERE INFERRED)
- *(580.50)* GROUNDWATER ELEVATION (FEET)

NOTES

1. BASE MAP IMAGERY FROM GOOGLE EARTH PRO, 2018.
2. WELL LOCATIONS SURVEYED BY ROWE PROFESSIONAL SERVICES COMPANY ON 11/4/2015.
3. NOAA/NATIONAL OCEANIC SERVICE GREAT LAKES GAUGING STATION, ESSEXVILLE, MI (ID: 9075035).
4. GROUNDWATER ELEVATIONS DISPLAYED IN FEET RELATIVE TO THE NORTH AMERICAN VERTICAL DATUM OF 1988.

N

0 600 1,200 Feet

1 " = 600 '

1:7,200

PROJECT:

CONSUMERS ENERGY COMPANY
DE KARN POWER PLANT
ESSEXVILLE, MICHIGAN

TITLE:

SHALLOW GROUNDWATER CONTOUR MAP OCTOBER 5, 2020

DRAWN BY:	S. MAJOR	PROJ NO.:	367388.0001
CHECKED BY:	J. KRENZ		
APPROVED BY:	D. LITZ		**FIGURE 3**
DATE:	JANUARY 2021		

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

FILE NO.: 367388-001-012.mxd

TRC - GIS
Plot Date: 1/26/2021, 14:13:45 PM by SMAJOR -- LAYOUT: ANSI B (11"x17")
Path: S:\1-PROJECTS\Consumers Energy Company\Michigan\CCR GW\2017 2697\367388-001-012.mxd
Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl (Foot)
Map Rotation: 0

1540 Eisenhower Pl.
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Technical Memorandum

Date:	July 28, 2021
To:	J.R. Register, Consumers Energy
From:	Darby Litz, TRC Kristin Lowery, TRC
Project No.:	418425.0001.0000 Phase 2 Task 2
Subject:	First Semiannual 2021 Nature and Extent Data Summary, DE Karn Bottom Ash Pond, Consumers Energy, Essexville, Michigan

In response to the United States Environmental Protection Agency's (U.S. EPA's) Resource Conservation and Recovery Act (RCRA) Coal Combustion Residual rule ("CCR Rule") promulgated on April 17, 2015, as amended, Consumers Energy Company (Consumers Energy) has conducted groundwater monitoring at the DE Karn Bottom Ash Pond CCR Unit. During the statistical evaluation of the initial assessment monitoring event (May 2018) for the Karn Bottom Ash Pond, arsenic was present in one or more downgradient monitoring well(s) at statistically significant levels exceeding the Groundwater Protection Standards (GWPSs)[1].

The CCR Rule 40 CFR §257.96(a) requires that an owner or operator initiate an assessment of corrective measures (ACM) to prevent further release, to remediate any releases, and to restore impacted areas to original conditions if any Appendix IV constituent has been detected at a statistically significant level exceeding a GWPS. The *Assessment of Corrective Measures* (ACM) (TRC, September 2019) was initiated on April 15, 2019 and was certified and submitted to the Michigan Department of Environment, Great Lakes, and Energy (EGLE) on September 11, 2019 in accordance with the schedule in §257.96.

Per §257.95(g)(1), in the event that the facility determines, pursuant to §257.93(h), that there is a statistical exceedance of the GWPSs for one or more of the Appendix IV constituents, the facility must characterize the nature and extent of the release of CCR as well as any site conditions that may affect the remedy selected. Installation of additional monitoring wells at locations downgradient of the Karn Bottom Ash Pond groundwater monitoring system was not necessary or feasible due to the presence of existing monitoring wells sampled under the groundwater surface water interface (GSI) Compliance Monitoring Program administered under a Michigan-approved Hydrogeological Monitoring Plan (Consumers Energy, 2019), and the proximity of the surface water bodies. Monitoring wells designated for nature and extent characterization are shown on Figures 1 and 2 and data collected over the past year (August 2020 through May 2021) from these nature and extent groundwater monitoring wells are included in Tables 1 and 2.

[1] TRC. 2019. *Statistical Evaluation of Initial Assessment Monitoring Sampling Event, DE Karn Bottom Ash Pond, Consumers Energy Company, Essexville, Michigan*. January 14.

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

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

As discussed in the ACM, the nature and extent of contamination (e.g. arsenic) in groundwater relative to GWPSs has been defined per the RCRA CCR Rule requirements based on the site-specific hydrogeology. 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 and there are no surface water potable water intakes within 3 miles of the site, so the drinking water pathway is not complete.

The distribution of arsenic relative to the Karn Bottom Ash Pond groundwater monitoring system in the shallow water-bearing unit as compared to the GWPS is presented in Figure 1. Three categories were assigned to groundwater data collected from April 2018 to May 2021, as follows:

- White – No Exceedances: all concentrations were below the GWPS
- Yellow – Two or More Exceedances: individual observations above the GWPS[2]
- Orange – Statistically Significant GWPS Exceedances[3]

The highest concentrations of arsenic observed in the Karn Bottom Ash Pond monitoring well network have been observed at DEK MW-15003, a monitoring well located to the north of the bottom ash pond and associated with the shifted “highest” elevation of mounded groundwater relative to the Karn Bottom Ash Pond. 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 the process water and bottom ash that went into the former bottom ash pond. Since the former bottom ash pond is no longer being hydraulically loaded with sluiced ash and has been dewatered by gravity, the characteristic

[2] Although an exceedance is defined as a single detection above the GWPS, confidence intervals will be used to determine compliance per the CCR Rule. Compliance with the GWPSs established under § 257.95(h) will be achieved by demonstrating that concentrations of constituents listed in Appendix IV to this part have not exceeded the GWPSs for a period of three consecutive years using the statistical procedures and performance standards in § 257.93(f) and (g).

[3] Lower confidence limit is above the GWPS based upon most recent assessment monitoring statistical evaluation.

groundwater mound centered within the pooled area is no longer present. The groundwater elevation data collected from the groundwater monitoring system of the former bottom ash pond in May 2021 demonstrate a reduction in groundwater elevation measurements by several feet when compared to groundwater elevations measured prior to June 2018. Given this shift in groundwater flow direction, DEK-MW-15003 and DEK-MW-15004 are now located upgradient to side gradient of the CCR unit ant and are no longer representative of groundwater chemistry downgradient of the Karn Bottom Ash Pond. DEK-MW-15003 and DEK-MW-15004 cannot reliably be used to assess the effectiveness of the CCR removal activities and are influenced by the long operational history of ash management in this area of the site.

Recent data show that groundwater quality is improving for select constituents (e.g., downward trends in arsenic concentrations) since sluicing to the Karn Bottom Ash Pond ceased in June 2018 when the bottom ash and transport water was diverted to the Karn Lined Impoundment. Arsenic concentrations at DEK-MW-15002 and DEK-MW-18001 appear to exhibit a downward trend on the time-series chart (Attachment A). 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. The decreasing trend at DEK-MW-15002 was deemed statistically significant at the 98% confidence level. The trend at DEK-MW-18001 was not deemed to be statistically significant at the 98% confidence level. Groundwater chemistry appears to be improving as a result of discontinuing the hydraulic loading to the Karn Bottom Ash Pond and the completed source removal of CCR, as shown by the decreasing concentrations of arsenic at DEK-MW-15002 and DEK-MW-18001; however, attainment of the GWPS at all of the Bottom Ash Pond downgradient monitoring wells may not be feasible due to influences other than the former pond, such as the presence and former operation of the nearby Karn Landfill. Arsenic in the nature and extent monitoring wells located along the landfill perimeter bordering Saginaw Bay also exhibit concentrations above the GWPS. Although arsenic is present above the GWPS, the drinking water pathway is not complete as there are no drinking water wells on-site. Redox conditions, which affect contaminant transport, are still stabilizing in the Bottom Ash Pond Area following removal activities and will continue to be evaluated further.

Additionally, monitoring performed under the Michigan-approved GSI Compliance Monitoring Program demonstrates protection of human health and the environment with criteria determined to be protective at the potential point of exposure. Transect/porewater GSI compliance sampling data collected quarterly show that biogeochemical conditions are contributing to the reduction of arsenic in groundwater as observed in arsenic concentrations in transect push-point samples located along the water's edge of Saginaw Bay are much lower than the arsenic concentrations observed in the perimeter dike wells. Compliance with water quality criteria is demonstrated on a quarterly basis by evaluating the total chronic loading based on the authorization for the mixing zone.

The distribution of arsenic in the shallow water-bearing unit as compared to the mixing zone GSI criteria is presented in Figure 2. Three categories were assigned to the data from August 2020 to May 2021[4], as follows:

[4] Given the dynamic nature of the groundwater surface water interactions, it is appropriate to look at a shorter timeframe for data analysis (one year).

- White – No Exceedances: all concentrations were below the mixing zone GSI criteria
- Light Blue – Two consecutive exceedances of the chronic mixing zone GSI criterion
- Dark Blue – Two consecutive exceedances of the acute mixing zone GSI criterion

Groundwater monitoring locations along the DE Karn Intake Channel and boundary between the coal ash management areas and the power plant complex (DEK-MW-15002, DEK-MW-15005, DEK-MW-15006, and DEK-MW-18001) document contaminant concentrations of arsenic are less than the authorized Mixing Zone-Based Chronic Concentration of 100 ug/L indicating current conditions are protective of the GSI pathway. Total chronic loading, calculated from concentrations observed in groundwater samples collected from push-point samplers advanced at locations T1-3GSI through T6-3GSI, remains below the chronic mixing zone GSI criterion.

Attachments

Table 1 Summary of Groundwater Sampling Results (Analytical): August 2020 – May 2021; DE Karn Nature and Extent Monitoring Wells
Table 2 Summary of Groundwater Sampling Results (Analytical): August 2020 – May 2021; DE Karn Nature and Extent GSI Monitoring Locations

Figure 1 Nature and Extent Summary: GWPS Exceedances
Figure 2 Nature and Extent Summary: GSI Pathway Compliance

Attachment A Trend Evaluation

Tables

Table 1
Summary of Groundwater Sampling Results (Analytical): August 2020 - May 2021
DE Karn Nature and Extent Monitoring Wells
Essexville, Michigan

									Sample Location:	MW-01				MW-03				MW-06			
									Sample Date:	8/7/2020	10/6/2020	3/2/2021	5/3/2021	8/7/2020	10/6/2020	3/2/2021	5/4/2021	8/7/2020	10/6/2020	3/2/2021	5/4/2021
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	**5,800**	**5,570**	**5,510**	**6,330**	**8,390**	**8,030**	**7,760**	**9,610**	**1,240**	**1,460**	**986**	**1,080**
Calcium	mg/L	NA	NC	NC	500[EE]	NC	NC	NC	NC	**90.6**	**79.9**	**87.2**	**97.5**	**119**	**113**	**123**	**146**	**158**	**159**	**131**	**155**
Chloride	mg/L	NA	250[E]	250[E]	50	NC	NC	NC	NC	**76.6**	**76.6**	**84.5**	**81.8**	**70.7**	**65.9**	**72.8**	**70.9**	**17.1**	**27.2**	**11.7**	**11.4**
Fluoride	ug/L	4,000	NC	NC	NC	9,800	20,000	NC	NC	--	--	--	--	--	--	--	--	--	--	--	--
Sulfate	mg/L	NA	250[E]	250[E]	500[EE]	NC	NC	NC	NC	< 1	< 2	< 2	< 1	**4.37**	< 2	**2.26**	< 1	**215**	**233**	**106**	**188**
Total Dissolved Solids	mg/L	NA	500[E]	500[E]	500	NC	NC	NC	NC	**504**	--	**--**	--	**619**	--	**--**	--	**884**	--	**--**	--
pH, Field	su	NA	6.5 - 8.5[E]	6.5 - 8.5[E]	6.5 - 9.0	NC	NC	NC	NC	**8.3**	**8.8**	**8.3**	**8.4**	**7.8**	**8.7**	**8.5**	**7.8**	**7.2**	**7.4**	**7.3**	**7.0**
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	**7**	**10**	**11**	**10**	**4**	**3**	**3**	**5**	**207**	**217**	**158**	**127**
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	< 1	**1**	**1**	< 1	**1**	**1**	**2**	**1**	< 1	< 1	**2**	**1**
Cobalt	ug/L	15	40	100	100	370	740	NC	NC	--	--	--	--	--	--	--	--	--	--	--	--
Fluoride	ug/L	4,000	NC	NC	NC	9,800	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	**102**	**86**	**92**	**88**	**97**	**83**	**93**	**89**	**66**	**61**	**53**	**52**
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	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	**9**	**10**	< 5	< 5
Radium-226/228	pci/L	5	NC	NC	NC	NC	NC	NC	NC	--	--	--	--	--	--	--	--	--	--	--	--
Selenium	ug/L	50	50	50	5.0	62	120	55	120	< 1	**1**	< 1	**1**	< 1	**2**	< 1	**1**	< 1	< 1	< 1	< 1
Thallium	ug/L	2	2.0	2.0	2.0	47	94	NC	NC	--	--	--	--	--	--	--	--	--	--	--	--
MI Part 115 Parameters																					
Iron	ug/L	NA	300[E]	300[E]	500,000[EE]	NC	NC	NC	NC	**119**	**145**	**128**	**110**	**112**	< 20	**64**	**164**	**1,770**	**1,820**	**1,500**	**2,060**
Copper	ug/L	NA	1,000[E]	1,000[E]	20	33	66	NC	NC	--	--	--	--	--	--	--	--	--	--	--	--
Nickel	ug/L	NA	100	100	120	1,000	2,100	NC	NC	--	--	--	--	--	--	--	--	--	--	--	--
Silver	ug/L	NA	34	98	0.2	0.54	1.1	NC	NC	--	--	--	--	--	--	--	--	--	--	--	--
Vanadium	ug/L	NA	4.5	62	27	79	160	NC	NC	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2
Zinc	ug/L	NA	2,400	5,000[E]	260	260	520	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 EGLE 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 are 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 EGLE policy and procedure 09-014 dated June 20, 2012.

[E] - Criterion is the aesthetic drinking water value per footnote {E}.

[EE] - Criterion is based on the total dissolved solids GSI value per footnote {EE}.

[H] - Sample was analyzed out of hold time.

BOLD font denotes concentrations detected above laboratory reporting limits.

Result	Indicates an exceedance of one or more applicable health-based drinking water and GSI 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 Janurary 14, 2019.

Table 1
Summary of Groundwater Sampling Results (Analytical): August 2020 - May 2021
DE Karn Nature and Extent Monitoring Wells
Essexville, Michigan

										Sample Location:	MW-08				MW-10					MW-12				
										Sample Date:	8/7/2020	10/6/2020	3/2/2021	5/4/2021	8/7/2020	10/7/2020	3/2/2021	3/23/2021	5/4/2021	8/7/2020	10/7/2020	3/2/2021	3/23/2021	5/4/2021
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		**4,980**	**4,560**	**4,230**	**5,020**	**4,260**	**4,580**	**3,900**	**3,940**	**4,900**	**3,740**	**3,750**	**3,290**	**3,530**	**3,730**
Calcium	mg/L	NA	NC	NC	500[EE]	NC	NC	NC	NC		**238**	**240**	**205**	**228**	**216**	**184**	**192**	**247**	**194**	**242**	**239**	**263**	**299**	**272**
Chloride	mg/L	NA	250[E]	250[E]	50	NC	NC	NC	NC		**60.4**	**63.8**	**71.5**	**51.4**	**49.5**	**62.5**	**57.3**	**46.1**	**60.9**	**63.4**	**60.3**	**51.9**	**49**	**50.5**
Fluoride	ug/L	4,000	NC	NC	NC	9,800	20,000	NC	NC		--	--	--	--	--	--	--	--	--	--	--	--	--	--
Sulfate	mg/L	NA	250[E]	250[E]	500[EE]	NC	NC	NC	NC		**399**	**492**	**327**	**360**	**228**	**135**	**191**	**368**	**111**	**325**	**414**	**402**	**512**	**397**
Total Dissolved Solids	mg/L	NA	500[E]	500[E]	500	NC	NC	NC	NC		**1,250**	**1,260**	**--**	**--**	**1,010**	**891**	**--**	**--**	**--**	**1,300**	**1,270**	**--**	**--**	**--**
pH, Field	su	NA	6.5 - 8.5[E]	6.5 - 8.5[E]	6.5 - 9.0	NC	NC	NC	NC		**7.2**	**7.3**	**7.1**	**7.1**	**7.3**	**7.4**	**7.3**	**7.0**	**7.3**	**7.2**	**7.3**	**7.2**	**7.0**	**7.2**
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		**92**	**88**	**97**	**91**	**911**	**888**	**610**	**431**	**724**	**247**	**257**	**277**	**287**	**269**
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		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Cobalt	ug/L	15	40	100	100	370	740	NC	NC		--	--	--	--	--	--	--	--	--	--	--	--	--	--
Fluoride	ug/L	4,000	NC	NC	NC	9,800	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		**133**	**110**	**122**	**114**	**143**	**123**	**135**	**115**	**132**	**113**	**102**	**113**	**104**	**108**
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		**29**	**27**	**33**	**33**	**6**	< 5	< 5	**9**	< 5	**15**	**18**	**15**	**16**	**13**
Radium-226/228	pci/L	5	NC	NC	NC	NC	NC	NC	NC		--	--	--	--	--	--	--	--	--	--	--	--	--	--
Selenium	ug/L	50	50	50	5.0	62	120	55	120		< 1	< 1	< 1	< 1	< 1	**1**	< 1	< 1	< 1	**1**	**1**	< 1	**3**	< 1
Thallium	ug/L	2	2.0	2.0	2.0	47	94	NC	NC		--	--	--	--	--	--	--	--	--	--	--	--	--	--
MI Part 115 Parameters																								
Iron	ug/L	NA	300[E]	300[E]	500,000[EE]	NC	NC	NC	NC		**6,300**	**6,190**	**7,030**	**7,060**	**4,890**	**3,050**	**3,990**	**6,460**	**3,140**	**2,120**	**1,980**	**1,920**	**3,510**	**1,970**
Copper	ug/L	NA	1,000[E]	1,000[E]	20	33	66	NC	NC		--	--	--	--	--	--	--	--	--	--	--	--	--	--
Nickel	ug/L	NA	100	100	120	1,000	2,100	NC	NC		--	--	--	--	--	--	--	--	--	--	--	--	--	--
Silver	ug/L	NA	34	98	0.2	0.54	1.1	NC	NC		--	--	--	--	--	--	--	--	--	--	--	--	--	--
Vanadium	ug/L	NA	4.5	62	27	79	160	NC	NC		< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2
Zinc	ug/L	NA	2,400	5,000[E]	260	260	520	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 EGLE 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 are 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 EGLE policy and procedure 09-014 dated June 20, 2012.

[E] - Criterion is the aesthetic drinking water value per footnote {E}.

[EE] - Criterion is based on the total dissolved solids GSI value per footnote {EE}.

[H] - Sample was analyzed out of hold time.

BOLD font denotes concentrations detected above laboratory reporting limits.

Result Indicates an exceedance of one or more applicable health-based drinking water and GSI 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 Janurary 14, 2019.

Table 1
Summary of Groundwater Sampling Results (Analytical): August 2020 - May 2021
DE Karn Nature and Extent Monitoring Wells
Essexville, Michigan

									Sample Location:	MW-14					MW-16				MW-22			
									Sample Date:	8/7/2020	10/7/2020	3/2/2021	3/23/2021	5/4/2021	8/7/2020	10/6/2020	3/2/2021	5/3/2021	8/10/2020	10/8/2020	3/3/2021	5/4/2021
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	**2,320**	**2,320**	**2,380**	**2,360**	**2,260**	**1,350**	**1,290**	**1,300**	**1,190**	**6,450**	**7,000**	**6,570**	**7,220**
Calcium	mg/L	NA	NC	NC	500[EE]	NC	NC	NC	NC	**321**	**309**	**327**	**294**	**326**	**264**	**319**	**338**	**365**	**74.2**	**80.1**	**74.4**	**86.9**
Chloride	mg/L	NA	250[E]	250[E]	50	NC	NC	NC	NC	**62.4**	**48.6**	**79.9**	**64.3**	**67.6**	**51.2**	**75.4**	**130**	**99.2**	**81.2**	**82.9**	**88.5**	**86.5**
Fluoride	ug/L	4,000	NC	NC	NC	9,800	20,000	NC	NC	--	--	--	--	--	--	--	--	--	--	--	--	--
Sulfate	mg/L	NA	250[E]	250[E]	500[EE]	NC	NC	NC	NC	**663**	**703**	**606**	**537**	**651**	**720**	**921**	**972**	**1,020**	**181**	**176**	**164**	**169**
Total Dissolved Solids	mg/L	NA	500[E]	500[E]	500	NC	NC	NC	NC	**1,690**	**1,620**	**--**	**--**	**--**	**1,560**	--	**--**	--	**451**	**494**	**--**	**--**
pH, Field	su	NA	6.5 - 8.5[E]	6.5 - 8.5[E]	6.5 - 9.0	NC	NC	NC	NC	**7.0**	**7.2**	**7.1**	**6.6**	**7.1**	**7.3**	**7.5**	**7.3**	**7.2**	**6.6**	**7.3**	**9.1**	**8.5**
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	**74**	**164**	**809**	**621**	**283**	**1**	< 1	**3**	< 1	**487**	**517**	**555**	**549**
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	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Cobalt	ug/L	15	40	100	100	370	740	NC	NC	--	--	--	--	--	--	--	--	--	--	--	--	--
Fluoride	ug/L	4,000	NC	NC	NC	9,800	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	**118**	**116**	**108**	**89**	**113**	**107**	**103**	**126**	**132**	**142**	**146**	**151**	**144**
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	**11**	**5**	< 5	< 5	< 5	**27**	**27**	**20**	**16**	**748**	**830**	**1,020**	**1,090**
Radium-226/228	pci/L	5	NC	NC	NC	NC	NC	NC	NC	--	--	--	--	--	--	--	--	--	--	--	--	--
Selenium	ug/L	50	50	50	5.0	62	120	55	120	**2**	**2**	**3**	**5**	**4**	**2**	**2**	**2**	**2**	**2**	**2**	< 1	**2**
Thallium	ug/L	2	2.0	2.0	2.0	47	94	NC	NC	--	--	--	--	--	--	--	--	--	--	--	--	--
MI Part 115 Parameters																							
Iron	ug/L	NA	300[E]	300[E]	500,000[EE]	NC	NC	NC	NC	**597**	**1,440**	**5,050**	**4,290**	**4,700**	**350**	**225**	**535**	**151**	**46**	**76**	**49**	**93**
Copper	ug/L	NA	1,000[E]	1,000[E]	20	33	66	NC	NC	--	--	--	--	--	--	--	--	--	--	--	--	--
Nickel	ug/L	NA	100	100	120	1,000	2,100	NC	NC	--	--	--	--	--	--	--	--	--	--	--	--	--
Silver	ug/L	NA	34	98	0.2	0.54	1.1	NC	NC	--	--	--	--	--	--	--	--	--	--	--	--	--
Vanadium	ug/L	NA	4.5	62	27	79	160	NC	NC	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2
Zinc	ug/L	NA	2,400	5,000[E]	260	260	520	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 EGLE 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 are 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 EGLE policy and procedure 09-014 dated June 20, 2012.

[E] - Criterion is the aesthetic drinking water value per footnote {E}.

[EE] - Criterion is based on the total dissolved solids GSI value per footnote {EE}.

[H] - Sample was analyzed out of hold time.

BOLD font denotes concentrations detected above laboratory reporting limits.

Result	Indicates an exceedance of one or more applicable health-based drinking water and GSI 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 Janurary 14, 2019.

Table 1
Summary of Groundwater Sampling Results (Analytical): August 2020 - May 2021
DE Karn Nature and Extent Monitoring Wells
Essexville, Michigan

										Sample Location:	MW-23			OW-10				OW-11			
										Sample Date:	8/11/2020	10/8/2020	3/4/2021	5/6/2021	8/4/2020	10/8/2020	3/2/2021	5/4/2021	8/4/2020	10/8/2020	3/2/2021	5/4/2021
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		**7,210**	**7,750**	**6,840**	**7,500**	**1,210**	**1,400**	**1,380**	**1,300**	**2,800**	**3,040**	**3,050**	**3,300**
Calcium	mg/L	NA	NC	NC	500[EE]	NC	NC	NC	NC		**153**	**164**	**164**	**179**	**110**	**102**	**103**	**107**	**13.7**	**21.3**	**14**	**12.9**
Chloride	mg/L	NA	250[E]	250[E]	50	NC	NC	NC	NC		**55.6**	**61.5**	**61.9**	**56.9**	**61.6**	**78.9**	**66**	**75.1**	**76**	**75.7**	**69**	**67.1**
Fluoride	ug/L	4,000	NC	NC	NC	9,800	20,000	NC	NC		--	--	--	--	< 1,000	< 1,000	< 1,000	< 1,000	**4,790**	**5,160**	**4,150**	**3,750**
Sulfate	mg/L	NA	250[E]	250[E]	500[EE]	NC	NC	NC	NC		**189**	**201**	**196**	**189**	**46.4**	**11.9**	**2.62**	< 1	**24.3**	**25.9**	**25.4**	**25.6**
Total Dissolved Solids	mg/L	NA	500[E]	500[E]	500	NC	NC	NC	NC		**926**	**867**	**--**	**--**	**562**	**527**	**551**	**549**	**271**	**238**	**242**	**239**
pH, Field	su	NA	6.5 - 8.5[E]	6.5 - 8.5[E]	6.5 - 9.0	NC	NC	NC	NC		**7.1**	**6.9**	**7.1**	**6.8**	**7.2**	**7.4**	**7.0**	**7.1**	**9.1**	**9.4**	**9.1**	**9.2**
Appendix IV																						
Antimony	ug/L	6	6.0	6.0	2.0	1,100	2,300	NC	NC		--	--	--	--	< 1	< 1	< 1	< 1	**2**	**1**	**1**	**2**
Arsenic	ug/L	21[1]	10	10	10	340	680	100	680		**60**	**56**	**49**	**29**	**5**	**3**	**3**	**4**	**523**	**557**	**711**	**742**
Barium	ug/L	2,000	2,000	2,000	1,200	3,400	7,000	NC	NC		--	--	--	--	**141**	**129**	**135**	**184**	**43**	**50**	**42**	**37**
Beryllium	ug/L	4	4.0	4.0	33	300	600	NC	NC		--	--	--	--	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
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	**0.6**
Chromium	ug/L	100	100	100	11	16	32	NC	NC		< 1	< 1	< 1	< 1	< 1	**1**	**1**	**4**	**2**	< 1	< 1	< 1
Cobalt	ug/L	15	40	100	100	370	740	NC	NC		--	--	--	--	< 6	< 6	< 6	< 6	< 6	< 6	< 6	< 6
Fluoride	ug/L	4,000	NC	NC	NC	9,800	20,000	NC	NC		--	--	--	--	< 1,000	< 1,000	< 1,000	< 1,000	**4,790**	**5,160**	**4,150**	**3,750**
Lead	ug/L	15	4.0	4.0	14	250	500	NC	NC		--	--	--	--	< 1	< 1	< 1	**2**	< 1	< 1	< 1	< 1
Lithium	ug/L	180	170	350	440	910	1,800	NC	NC		**138**	**141**	**137**	**120**	**31**	**30**	**29**	**33**	**13**	**17**	**12**	**12**
Mercury	ug/L	2	2.0	2.0	0.20#	1.4	2.8	NC	NC		--	--	--	--	< 0.2	< 0.2	< 0.2[H]	< 0.2	< 0.2	< 0.2	< 0.2[H]	< 0.2
Molybdenum	ug/L	100	73	210	120	29,000	58,000	NC	NC		**75**	**78**	**67**	**58**	< 5	< 5	< 5	< 5	**407**	**407**	**317**	**297**
Radium-226/228	pci/L	5	NC	NC	NC	NC	NC	NC	NC		--	--	--	--	--	**0.875**	--	**1.01**	--	< 0.616	--	< 0.498
Selenium	ug/L	50	50	50	5.0	62	120	55	120		**1**	**2**	< 1	**2**	**4**	**2**	**1**	**3**	**2**	**3**	**2**	**3**
Thallium	ug/L	2	2.0	2.0	2.0	47	94	NC	NC		--	--	--	--	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2
MI Part 115 Parameters																						
Iron	ug/L	NA	300[E]	300[E]	500,000[EE]	NC	NC	NC	NC		**21,500**	**17,400**	**19,200**	**11,700**	**1,770**	**991**	**1,480**	**2,070**	**54**	**57**	**35**	**40**
Copper	ug/L	NA	1,000[E]	1,000[E]	20	33	66	NC	NC		--	--	--	--	**2**	**1**	**2**	**6**	**2**	**1**	< 1	< 1
Nickel	ug/L	NA	100	100	120	1,000	2,100	NC	NC		--	--	--	--	< 2	< 2	**2**	**5**	**3**	< 2	**2**	**2**
Silver	ug/L	NA	34	98	0.2	0.54	1.1	NC	NC		--	--	--	--	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Vanadium	ug/L	NA	4.5	62	27	79	160	NC	NC		< 2	< 2	< 2	2	**4**	**3**	**2**	**6**	**351**	**180**	**429**	**536**
Zinc	ug/L	NA	2,400	5,000[E]	260	260	520	NC	NC		--	--	--	--	< 30	< 10	< 10	**12**	< 30	< 10	< 10	< 10

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 EGLE 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 are 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 EGLE policy and procedure 09-014 dated June 20, 2012.

[E] - Criterion is the aesthetic drinking water value per footnote {E}.

[EE] - Criterion is based on the total dissolved solids GSI value per footnote {EE}.

[H] - Sample was analyzed out of hold time.

BOLD font denotes concentrations detected above laboratory reporting limits.

Result	Indicates an exceedance of one or more applicable health-based drinking water and GSI 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 Janurary 14, 2019.

Table 1
Summary of Groundwater Sampling Results (Analytical): August 2020 - May 2021
DE Karn Nature and Extent Monitoring Wells
Essexville, Michigan

										OW-12			
									Sample Location:				
									Sample Date:	8/3/2020	10/8/2020	3/2/2021	5/4/2021
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	**798**	**851**	**906**	**747**
Calcium	mg/L	NA	NC	NC	500[EE]	NC	NC	NC	NC	**109**	**79.6**	**84.9**	**75.1**
Chloride	mg/L	NA	250[E]	250[E]	50	NC	NC	NC	NC	**46.3**	**50**	**50**	**60.8**
Fluoride	ug/L	4,000	NC	NC	NC	9,800	20,000	NC	NC	< 1,000	< 1,000	< 1,000	< 1,000
Sulfate	mg/L	NA	250[E]	250[E]	500[EE]	NC	NC	NC	NC	**192**	**153**	**165**	**139**
Total Dissolved Solids	mg/L	NA	500[E]	500[E]	500	NC	NC	NC	NC	**696**	**492**	**549**	**499**
pH, Field	su	NA	6.5 - 8.5[E]	6.5 - 8.5[E]	6.5 - 9.0	NC	NC	NC	NC	**7.1**	**7.3**	**7.0**	**7.2**
Appendix IV													
Antimony	ug/L	6	6.0	6.0	2.0	1,100	2,300	NC	NC	< 1	< 1	< 1	**1**
Arsenic	ug/L	21[1]	10	10	10	340	680	100	680	**111**	**114**	**121**	**86**
Barium	ug/L	2,000	2,000	2,000	1,200	3,400	7,000	NC	NC	**83**	**71**	**84**	**67**
Beryllium	ug/L	4	4.0	4.0	33	300	600	NC	NC	< 1	< 1	< 1	< 1
Cadmium	ug/L	5	5.0	5.0	2.5	12	24	NC	NC	< 0.2	< 0.2	< 0.2	< 0.2
Chromium	ug/L	100	100	100	11	16	32	NC	NC	< 1	< 1	< 1	< 1
Cobalt	ug/L	15	40	100	100	370	740	NC	NC	< 6	< 6	< 6	< 6
Fluoride	ug/L	4,000	NC	NC	NC	9,800	20,000	NC	NC	< 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
Lithium	ug/L	180	170	350	440	910	1,800	NC	NC	**34**	**31**	**32**	**30**
Mercury	ug/L	2	2.0	2.0	0.20#	1.4	2.8	NC	NC	< 0.2	< 0.2	< 0.2[H]	< 0.2
Molybdenum	ug/L	100	73	210	120	29,000	58,000	NC	NC	**16**	**24**	**11**	**13**
Radium-226/228	pci/L	5	NC	NC	NC	NC	NC	NC	NC	--	< 0.457	--	**0.530**
Selenium	ug/L	50	50	50	5.0	62	120	55	120	< 1	< 1	< 1	**1**
Thallium	ug/L	2	2.0	2.0	2.0	47	94	NC	NC	< 2	< 2	< 2	< 2
MI Part 115 Parameters													
Iron	ug/L	NA	300[E]	300[E]	500,000[EE]	NC	NC	NC	NC	**5,280**	**3,620**	**4,440**	**2,520**
Copper	ug/L	NA	1,000[E]	1,000[E]	20	33	66	NC	NC	**2**	< 1	**1**	< 1
Nickel	ug/L	NA	100	100	120	1,000	2,100	NC	NC	< 2	< 2	< 2	< 2
Silver	ug/L	NA	34	98	0.2	0.54	1.1	NC	NC	< 0.2	< 0.2	< 0.2	< 0.2
Vanadium	ug/L	NA	4.5	62	27	79	160	NC	NC	< 2	< 2	< 2	< 2
Zinc	ug/L	NA	2,400	5,000[E]	260	260	520	NC	NC	< 30	< 10	< 10	< 10

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 EGLE 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 are 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 EGLE policy and procedure 09-014 dated June 20, 2012.

[E] - Criterion is the aesthetic drinking water value per footnote {E}.

[EE] - Criterion is based on the total dissolved solids GSI value per footnote {EE}.

[H] - Sample was analyzed out of hold time.

BOLD font denotes concentrations detected above laboratory reporting limits.

Result	Indicates an exceedance of one or more applicable health-based drinking water and GSI 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 Janurary 14, 2019.

Table 2
Summary of Groundwater Sampling Results (Analytical): August 2020 - May 2021
DE Karn Nature and Extent GSI Monitoring Locations
Essexville, Michigan

										T1-3GSI				T2-3GSI				T3-3GSI			
Sample Location:																					
Sample Date:										8/6/2020	10/5/2020	3/22/2021	5/5/2021	8/6/2020	10/5/2020	3/22/2021	5/5/2021	8/6/2020	10/5/2020	3/22/2021	5/5/2021
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	**62**	**38**	**56**	**2,520**	**4,310**	**5,220**	**2,730**	**2,340**	**3,290**	**2,320**	**923**	**3,440**
Calcium	mg/L	NA	NC	NC	500[EE]	NC	NC	NC	NC	**51.1**	**48.7**	**76.2**	**195**	**387**	**326**	**188**	**176**	**222**	**170**	**141**	**327**
Chloride	mg/L	NA	250[E]	250[E]	50	NC	NC	NC	NC	**60.8**	**49**	**46.5**	**36.3**	**26.9**	**45**	**20.4**	**23**	**54.6**	**53.3**	**29.3**	**62.8**
Fluoride	ug/L	4,000	NC	NC	NC	9,800	20,000	NC	NC	--	--	--	--	--	--	--	--	--	--	--	--
Sulfate	mg/L	NA	250[E]	250[E]	500[EE]	NC	NC	NC	NC	**25**	**24.8**	**37.3**	< 1	**664**	**372**	**261**	**141**	**1**	**3.38**	< 2	< 1
Total Dissolved Solids	mg/L	NA	500[E]	500[E]	500	NC	NC	NC	NC	**359**	--	**--**	--	**1,710**	**1,520**	**--**	**--**	**1,210**	**619**	**--**	**--**
pH, Field	su	NA	6.5 - 8.5[E]	6.5 - 8.5[E]	6.5 - 9.0	NC	NC	NC	NC	**7.8**	**7.4**	**7.4**	**7.1**	**7.3**	**7.0**	**7.0**	**7.0**	**6.9**	**7.3**	**6.6**	**6.9**
Appendix IV																					
Arsenic	ug/L	21[1]	10	10	10	340	680	100[2]	680	**3**	**1**	**3**	**18**	**52**	**18**	**8**	**12**	**1**	< 1	**18**	**1**
Chromium	ug/L	100	100	100	11	16	32	NC	NC	< 1	< 1	< 1	2	**2**	**1**	< 1	**2**	**2**	**2**	**3**	**1**
Fluoride	ug/L	4,000	NC	NC	NC	9,800	20,000	NC	NC	--	--	--	--	--	--	--	--	--	--	--	--
Lithium	ug/L	180	170	350	440	910	1,800	NC	NC	< 10	< 10	< 10	37	**178**	**154**	**83**	**96**	**111**	**82**	**56**	**128**
Molybdenum	ug/L	100	73	210	120	1.4	2.8	NC	NC	< 5	< 5	**6**	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Selenium	ug/L	50	50	50	5.0	29,000	58,000	NC	NC	< 1	< 1	**1**	**1**	< 1	< 1	**2**	< 1	< 1	< 1	**1**	< 1
MI Part 115 Parameters																					
Iron	ug/L	NA	300[E]	300[E]	500,000[EE]	NC	NC	NC	NC	**104**	**35**	**887**	**6,770**	**40,300**	**7,860**	**10,400**	**8,860**	**2,670**	**3,650**	**19,800**	**1,740**
Vanadium	ug/L	NA	4.5	62	27	260	520	NC	NC	< 2	< 2	< 2	< 2	**2**	< 2	< 2	< 2	< 2	< 2	< 2	**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.
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*** - Aquatic Maximum (AMV) and Final Acute Values (FAV) are taken from EGLE 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 are based on hexavalent chromium.
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[2] - Compliance demonstrated on a flux basis.

Table 2
Summary of Groundwater Sampling Results (Analytical): August 2020 - May 2021
DE Karn Nature and Extent GSI Monitoring Locations
Essexville, Michigan

Constituent	Unit	GWPS*	MI Residential**	MI Non-Residential**	MI GSI^	MI AMV***	MI FAV***	Chronic MZ^^	Acute MZ^^	Sample Location:	T4-3GSI				T5-3GSI				T6-3GSI			
										Sample Date:	8/5/2020	10/6/2020	3/22/2021	5/5/2021	8/5/2020	10/6/2020	3/22/2021	5/5/2021	8/5/2020	10/6/2020	3/23/2021	5/5/2021
Appendix III																							
Boron	ug/L	NA	500	500	4,000	34,000	69,000	44,000	69,000		**366**	**131**	**77**	**2,130**	**2,840**	**747**	**824**	**3,100**	**249**	**137**	**103**	**308**
Calcium	mg/L	NA	NC	NC	500[EE]	NC	NC	NC	NC		**143**	**79.1**	**109**	**167**	**290**	**221**	**254**	**279**	**211**	**203**	**199**	**400**
Chloride	mg/L	NA	250[E]	250[E]	50	NC	NC	NC	NC		**38.8**	**45.5**	**44.2**	**45.1**	**67.6**	**72.3**	**74**	**74.3**	**51.7**	**44.1**	**51.6**	**53.6**
Fluoride	ug/L	4,000	NC	NC	NC	9,800	20,000	NC	NC		--	--	--	--	--	--	--	--	--	--	--	--
Sulfate	mg/L	NA	250[E]	250[E]	500[EE]	NC	NC	NC	NC		< 1	< 2	**26.8**	< 1	**15.2**	**146**	**296**	**337**	**1.01**	< 2	< 2	**731**
Total Dissolved Solids	mg/L	NA	500[E]	500[E]	500	NC	NC	NC	NC		**608**	**427**	**--**	**--**	**515**	**1,050**	**--**	**--**	**906**	--	**--**	--
pH, Field	su	NA	6.5 - 8.5[E]	6.5 - 8.5[E]	6.5 - 9.0	NC	NC	NC	NC		**7.2**	**7.3**	**7.4**	**7.0**	**7.3**	**7.5**	**7.3**	**7.1**	**6.9**	**6.9**	**6.6**	**6.4**
Appendix IV																						
Arsenic	ug/L	21[1]	10	10	10	340	680	100[2]	680		**154**	**84**	**18**	**145**	**122**	**93**	**76**	**202**	**48**	**76**	**2**	**11**
Chromium	ug/L	100	100	100	11	16	32	NC	NC		**4**	**2**	< 1	**2**	**2**	**2**	**1**	**4**	**3**	**3**	**2**	**2**
Fluoride	ug/L	4,000	NC	NC	NC	9,800	20,000	NC	NC		--	--	--	--	--	--	--	--	--	--	--	--
Lithium	ug/L	180	170	350	440	910	1,800	NC	NC		**14**	< 10	< 10	**53**	**73**	**35**	**41**	**60**	**14**	**14**	**15**	**29**
Molybdenum	ug/L	100	73	210	120	1.4	2.8	NC	NC		< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Selenium	ug/L	50	50	50	5.0	29,000	58,000	NC	NC		< 1	< 1	**2**	< 1	**1**	**1**	**6**	< 1	< 1	< 1	**2**	**1**
MI Part 115 Parameters																						
Iron	ug/L	NA	300[E]	300[E]	500,000[EE]	NC	NC	NC	NC		**24,200**	**13,000**	**8,820**	**28,100**	**13,200**	**3,530**	**1,210**	**890**	**23,100**	**48,900**	**21,400**	**17,700**
Vanadium	ug/L	NA	4.5	62	27	260	520	NC	NC		**4**	**2**	< 2	< 2	**2**	< 2	< 2	**2**	**2**	**2**	**3**	< 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 EGLE 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 are based on hexavalent chromium.
^^ - Mixing Zone GSI Criteria from Michigan Department of Environmental Quality (MDEQ) approval letter dated December 23, 2015.
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[1] - Constituent triggered an Assessment of Corrective Measures for the Karn Bottom Ash Pond as described in TRC's letter report dated Janurary 14, 2019.
[2] - Compliance demonstrated on a flux basis.

Figures

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

MW-03
MW-06
MW-01
MW-06 Arsenic
POREWATER SAMPLES COLLECTED UNDER MICHIGAN P115 PROGRAM TO DEMONSTRATE COMPLIANCE WITH THE GSI PATHWAY IN THIS AREA
Lake Huron
INTAKE CHANNEL
DEK-MW-15004 Arsenic *
DEK-MW-15004
MW-22 Arsenic
MW-08
MW-08 Arsenic
MW-22
BOTTOM ASH POND
DEK-MW-15003 Arsenic *
OW-11
OW-11 Arsenic
MW-10
MW-10 Arsenic
DEK-MW-15003
DEK-MW-15005 Arsenic *
DEK-MW-15005
KARN LINED IMPOUNDMENT
DEK-MW-15001
OW-12
OW-12 Arsenic
MW-12
MW-12 Arsenic
DEK-MW-15006 Arsenic
DEK-MW-15006
OW-10
DEK-MW-18001
DEK-MW-18001 Arsenic *
MW-23
MW-23 Arsenic
MW-14
MW-14 Arsenic
DEK-MW-15002 Arsenic *
DEK-MW-15002
MW-16
DE KARN GENERATING FACILITY
Saginaw River
BOTTOM ASH POND
JC WEADOCK GENERATING FACILITY
DISCHARGE CHANNEL
SLURRY WALL

LEGEND

- DEK BOTTOM ASH POND & LINED IMPOUNDMENT MONITORING WELL
- DEK BOTTOM ASH POND MONITORING WELL
- DEK LINED IMPOUNDMENT MONITORING WELL
- DECOMMISSIONED MONITORING WELL
- NATURE AND EXTENT WELL
- NO EXCEEDANCES
- TWO OR MORE EXCEEDANCES (NOTES 4 + 5)
- STATISTICALLY SIGNIFICANT GWPS EXCEEDANCE (NOTE 6)
- SLURRY WALL (APPROXIMATE)
- LINED IMPOUNDMENT (COVENANT BOUNDARY)
- POREWATER SAMPLING AREA

* GWPS EXCEEDANCE TRIGGERED ASSESSMENT OF CORRECTIVE MEASURES PURSUANT TO §257.96

WELL ID
CONSTITUENT(S) EXCEEDING GWPS

NOTES

1. BASE MAP IMAGERY FROM GOOGLE EARTH PRO, 2018.
2. MONITORING WELL AND SLURRY WALL LOCATIONS PROVIDED BY CEC; SG21733SHT2 REVB.DWG DATED 11/21/2018.
3. GWPS (GROUNDWATER PROTECTION STANDARD) IS THE HIGHER OF THE MAXIMUM CONTAMINANT LEVEL (MCL)/REGIONAL SCREENING LEVEL FROM 83 FR 36435 (RSL) AND UPPER TOLERANCE LIMIT (UTL) AS ESTABLISHED IN TRC'S TECHNICAL MEMORANDUM DATED OCTOBER 15, 2018.
4. GROUNDWATER DATA FROM APRIL 2018 TO MAY 2020 ARE SCREENED AGAINST THE GWPS FOR EVALUATION PURPOSES ONLY. AN EXCEEDANCE IS DEFINED AS A SINGLE DETECTION ABOVE THE GWPS, HOWEVER, CONFIDENCE INTERVALS WILL BE USED TO DETERMINE COMPLIANCE PER THE CCR RULES.
5. AN EXCEEDANCE OF THE GWPS DOES NOT INDICATE UNACCEPTABLE RISK FROM GROUNDWATER EXPOSURE; THE DRINKING WATER PATHWAY IS NOT COMPLETE ON THE PROPERTY. GROUNDWATER CONDITIONS CONTINUE TO BE MONITORED TO INFORM THE DEK BOTTOM ASH POND REMEDY SELECTION.
6. LOWER CONFIDENCE LIMIT IS ABOVE GWPS.

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

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

TITLE:
NATURE AND EXTENT SUMMARY GWPS EXCEEDANCES

DRAWN BY:	S. MAJOR	PROJ NO.:	367388.0001
CHECKED BY:	J. KRENZ		
APPROVED BY:	D.LITZ		**FIGURE 1**
DATE:	JULY 2021		

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

FILE NO.: 418425-ExceedancesNE_ACM.mxd

Plot Date: 7/6/2021, 15:22:32 PM by RBARBER -- LAYOUT: ANSI B (11"x17")
Path: S:\1-PROJECTS\Consumers Energy Company\Michigan\CCR GW\2017 269767\418425-ExceedancesNE_ACM.mxd
Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl (Foot)
Map Rotation: 0
TRC - GIS

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

LEGEND

- DEK BOTTOM ASH POND & LINED IMPOUNDMENT MONITORING WELL
- DEK BOTTOM ASH POND MONITORING WELL
- DEK LINED IMPOUNDMENT MONITORING WELL
- DECOMMISSIONED MONITORING WELL
- NATURE AND EXTENT WELL
- GSI TRANSECT LOCATION/POREWATER SAMPLE
- NO EXCEEDANCES
- EXCEEDS CHRONIC MIXING ZONE GSI CRITERION (NOTES 3 + 4)
- EXCEEDS ACUTE MIXING ZONE GSI CRITERION (FAV) (NOTES 3 + 4)
- SLURRY WALL (APPROXIMATE)
- LINED IMPOUNDMENT (COVENANT BOUNDARY)
- POREWATER SAMPLING AREA
- * GWPS EXCEEDANCE TRIGGERED ASSESSMENT OF CORRECTIVE MEASURES PURSUANT TO §257.96

WELL ID
CONSTITUENT(S) EXCEEDING GSI

NOTES

1. BASE MAP IMAGERY FROM GOOGLE EARTH PRO, 2018.
2. MONITORING WELL AND SLURRY WALL LOCATIONS PROVIDED BY CEC; SG21733SHT2 REVB.DWG DATED 11/21/2018.
3. MIXING ZONE GSI CRITERIA FROM MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY (MDEQ) APPROVAL LETTER DATED DECEMBER 23, 2015.
4. GROUNDWATER CONCENTRATION DATA FROM AUGUST 2020 THROUGH MAY 2021 ARE SCREENED AGAINST THE MIXING ZONE CRITERIA. AN EXCEEDANCE IS DEFINED AS TWO CONSECUTIVE DETECTIONS ABOVE CRITERIA. COMPLIANCE WITH THE CHRONIC MIXING ZONE CRITERIA CAN BE DEMONSTRATED ON A MASS FLUX BASIS.

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

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

TITLE:
NATURE AND EXTENT SUMMARY GSI PATHWAY COMPLIANCE

DRAWN BY:	S. MAJOR	PROJ NO.:	418425.0002
CHECKED BY:	J. KRENZ		
APPROVED BY:	D. LITZ		**FIGURE 2**
DATE:	JULY 2021		

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FILE NO.: 418425-ExceedancesNE_GSI.mxd

Plot Date: 7/8/2021, 14:54:32 PM by RBARBER -- LAYOUT: ANSI B (11"x17")
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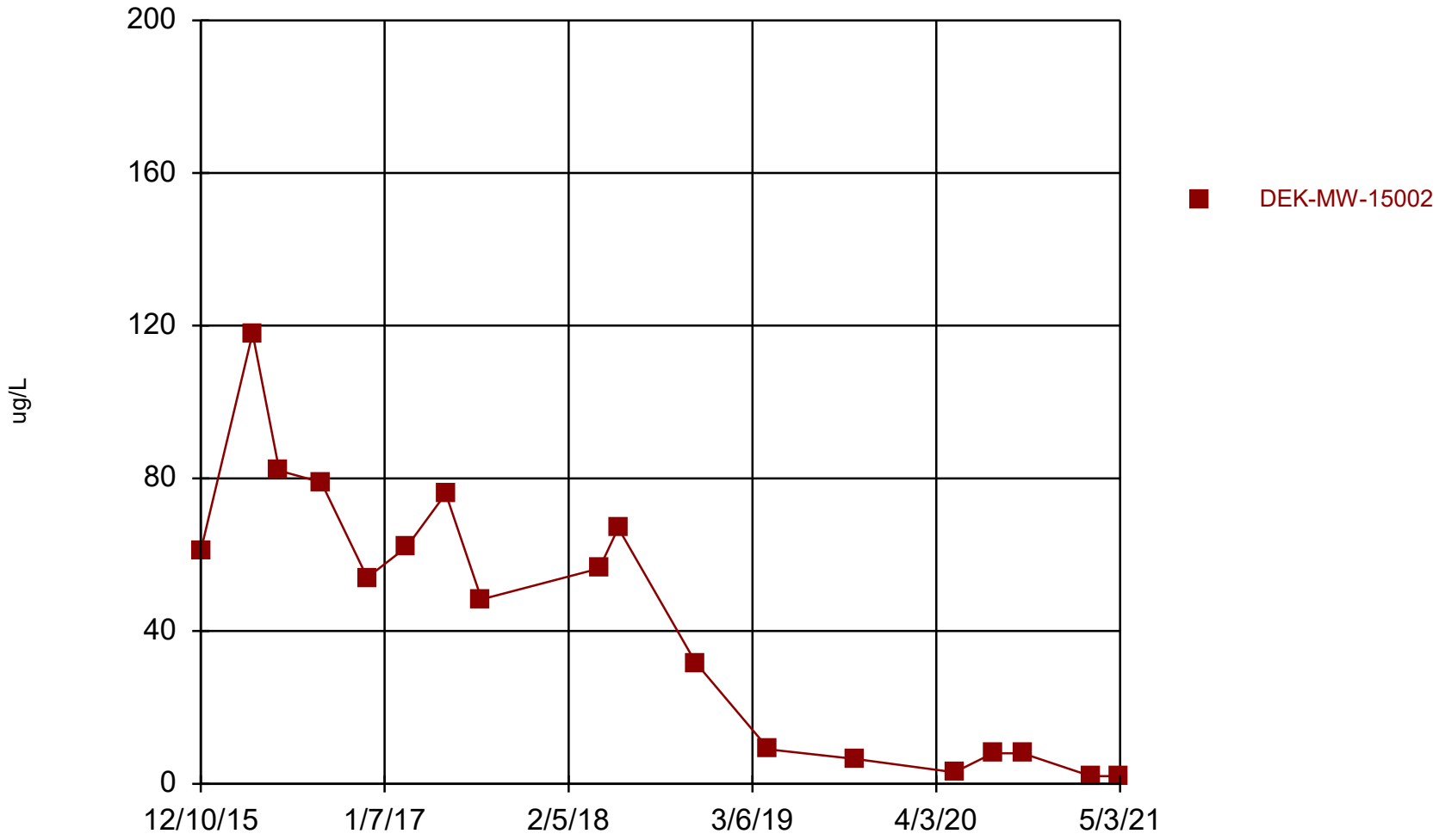
Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl (Foot)
Map Rotation: 0
TRC - GIS

Attachment A
Trend Evaluation

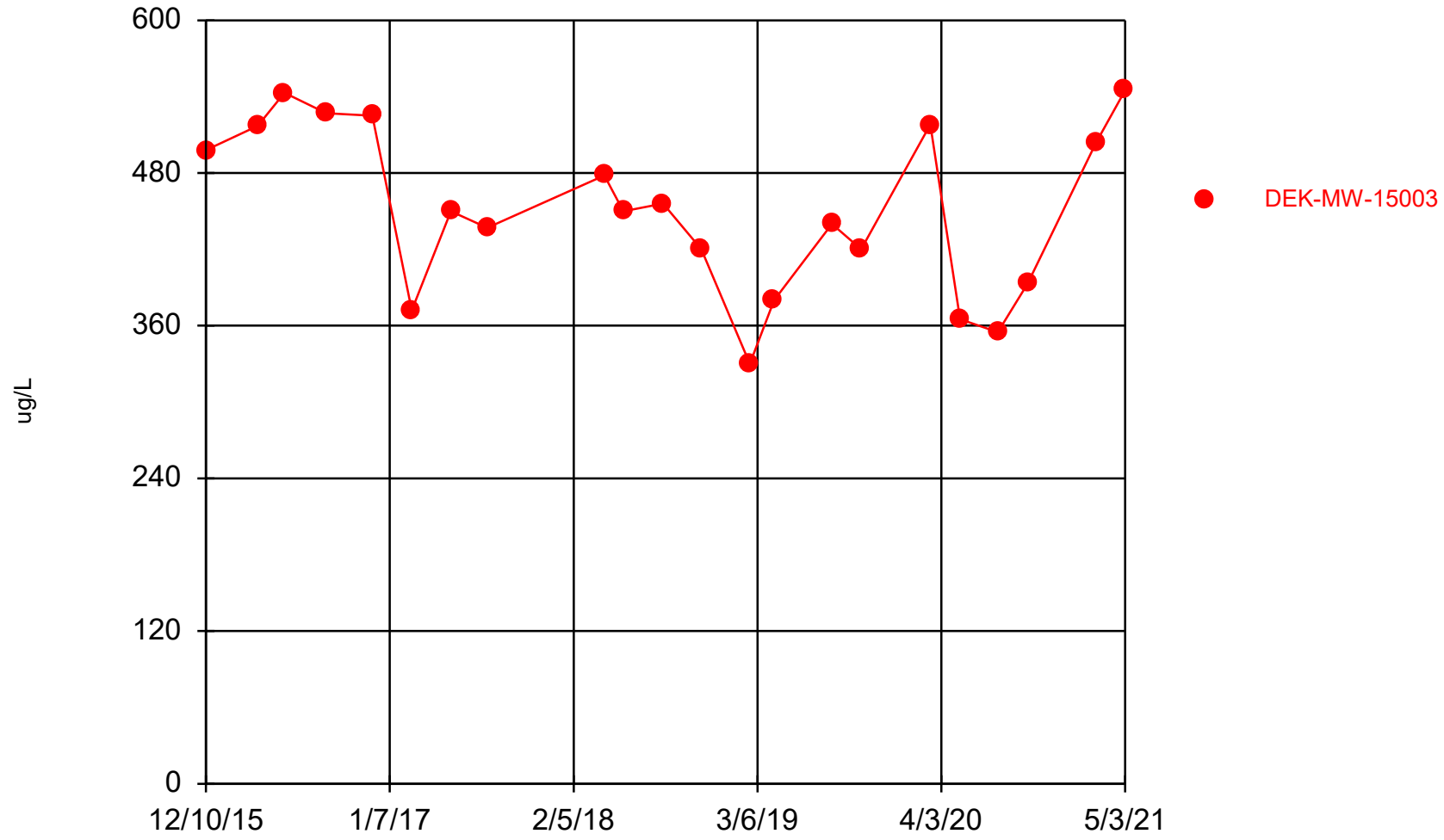
Arsenic, Total



Time Series Analysis Run 7/1/2021 9:46 AM

Client: Consumers Energy Data: DEK_HMPCCR_Sanitas_21Q2.rev1

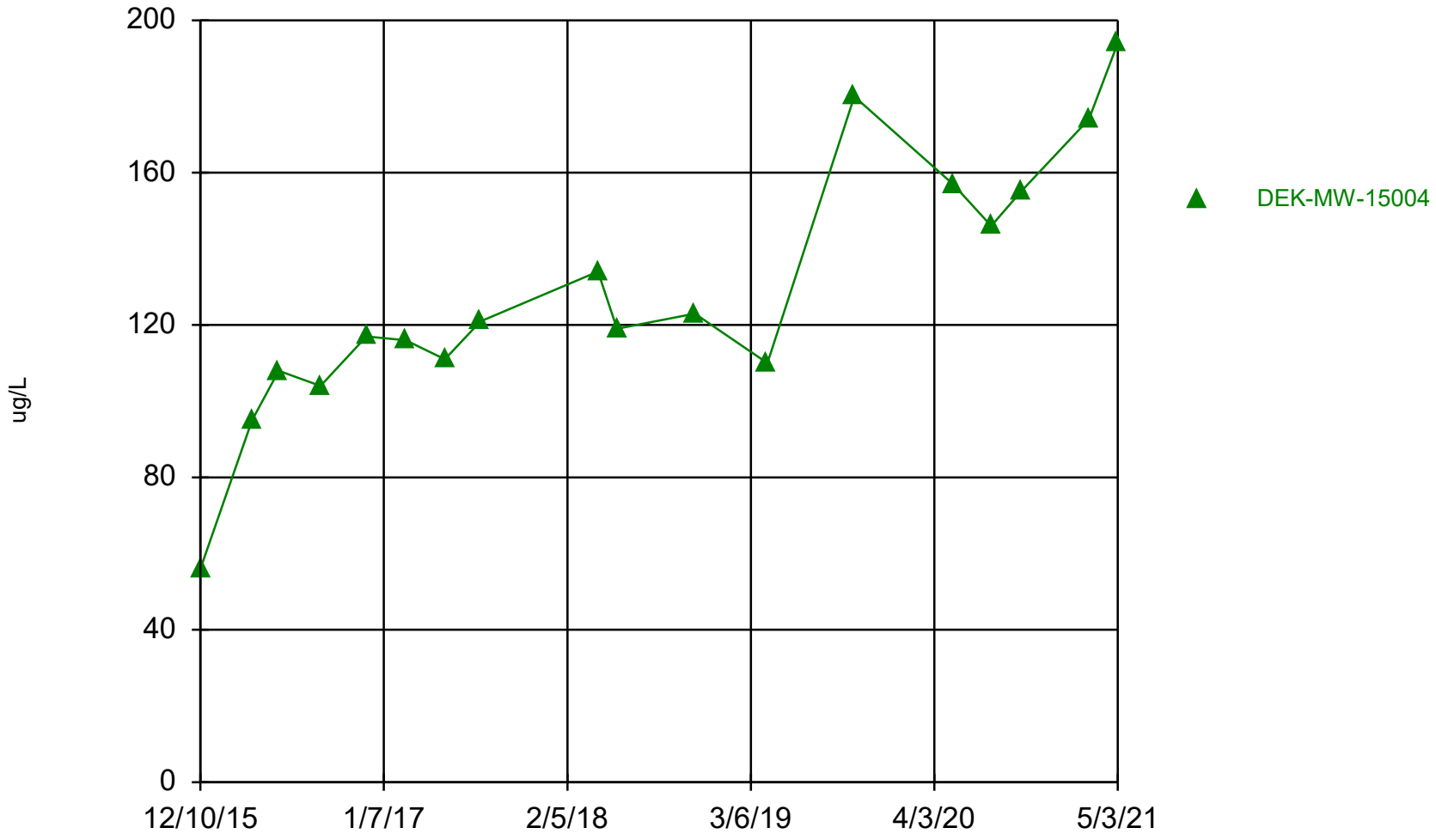
Arsenic, Total



Time Series Analysis Run 7/1/2021 9:47 AM

Client: Consumers Energy Data: DEK_HMPCCR_Sanitas_21Q2.rev1

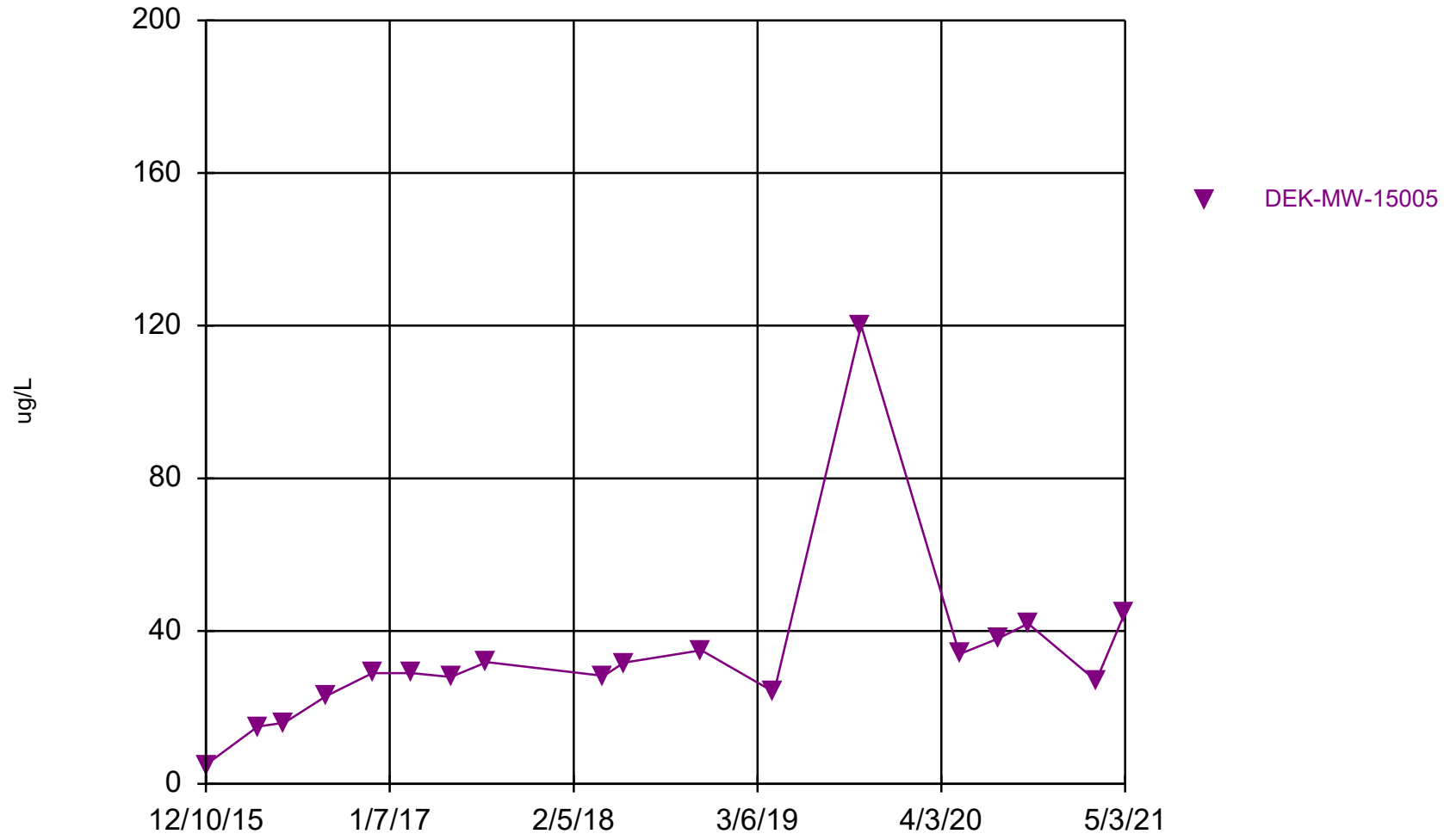
Arsenic, Total



Time Series Analysis Run 7/1/2021 9:47 AM

Client: Consumers Energy Data: DEK_HMPCCR_Sanitas_21Q2.rev1

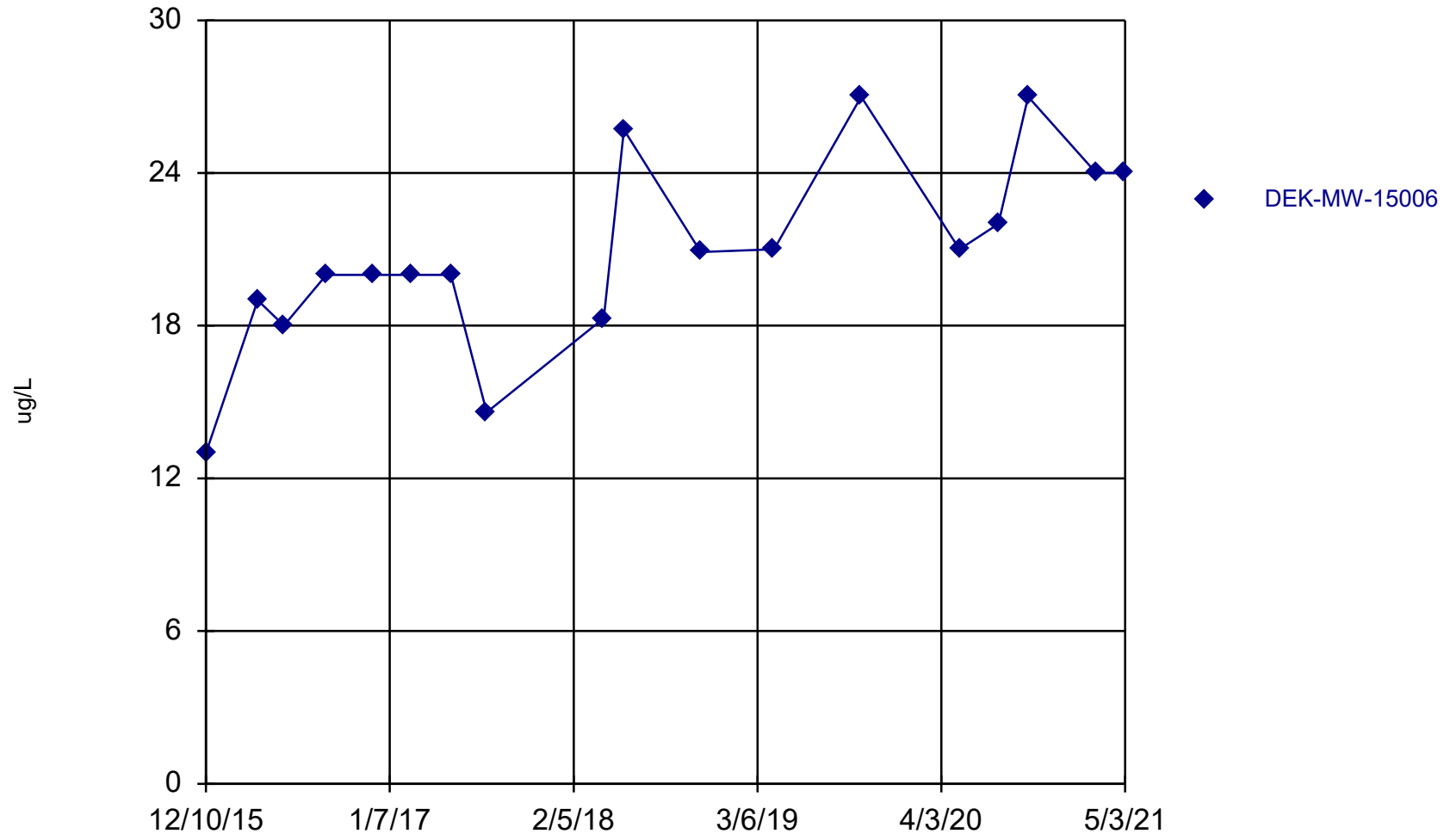
Arsenic, Total



Time Series Analysis Run 7/1/2021 9:47 AM

Client: Consumers Energy Data: DEK_HMPCCR_Sanitas_21Q2.rev1

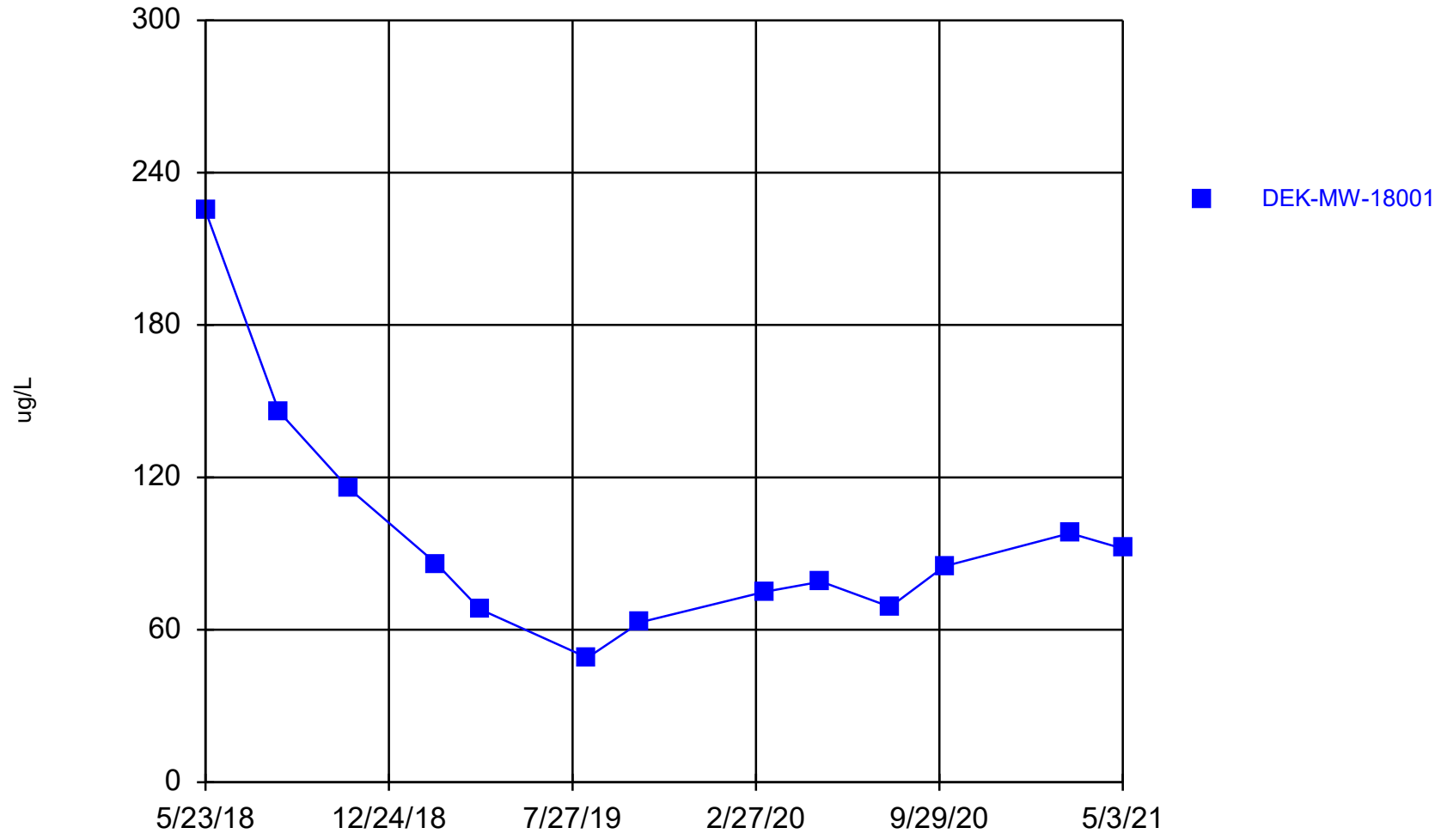
Arsenic, Total



Time Series Analysis Run 7/1/2021 9:47 AM

Client: Consumers Energy Data: DEK_HMPCCR_Sanitas_21Q2.rev1

Arsenic, Total

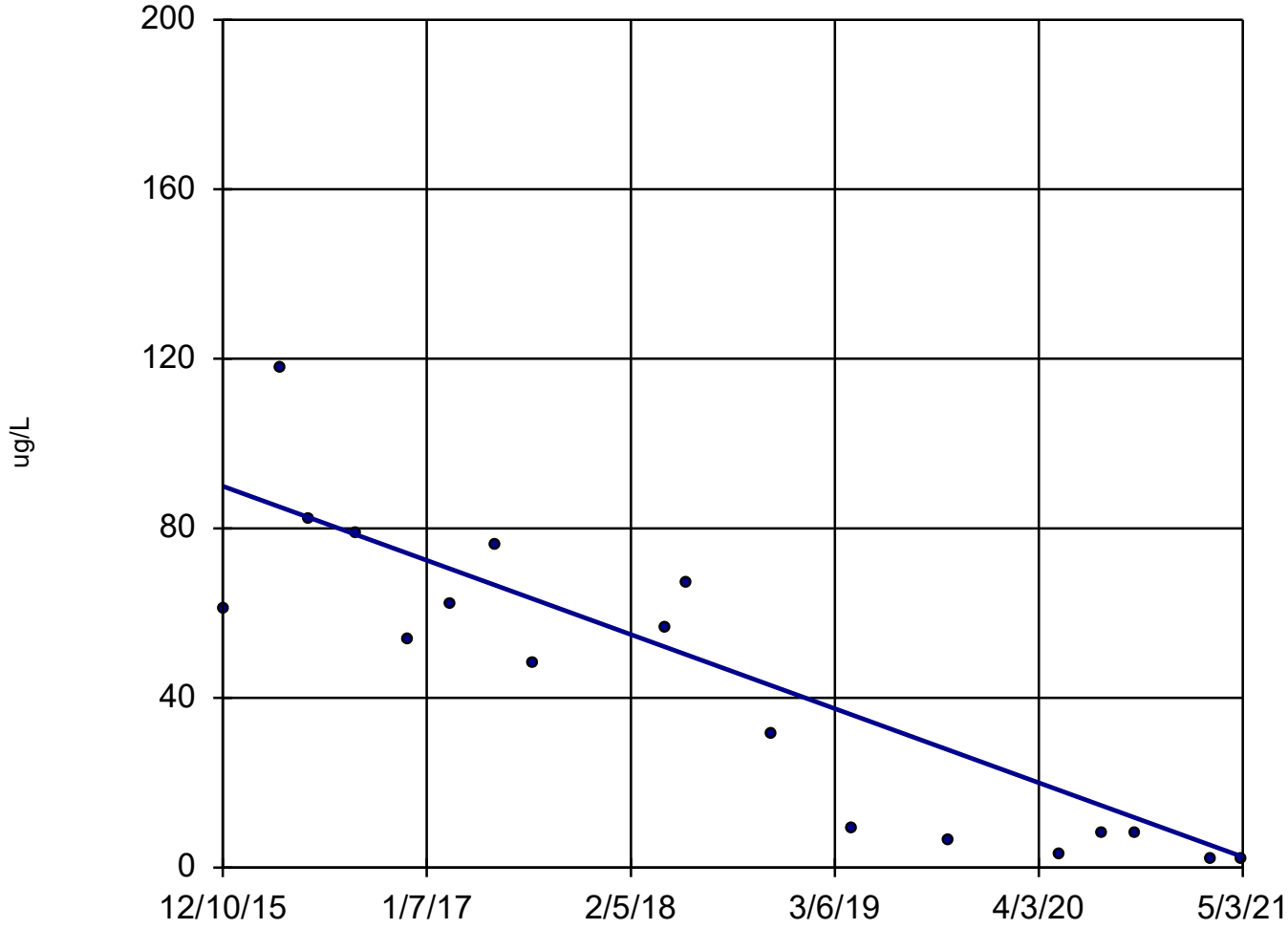


Time Series Analysis Run 7/1/2021 9:47 AM

Client: Consumers Energy Data: DEK_HMPCCR_Sanitas_21Q2.rev1

Arsenic, Total

DEK-MW-15002



n = 18

Slope = -16.2 units per year.

Mann-Kendall statistic = -113
critical = -53

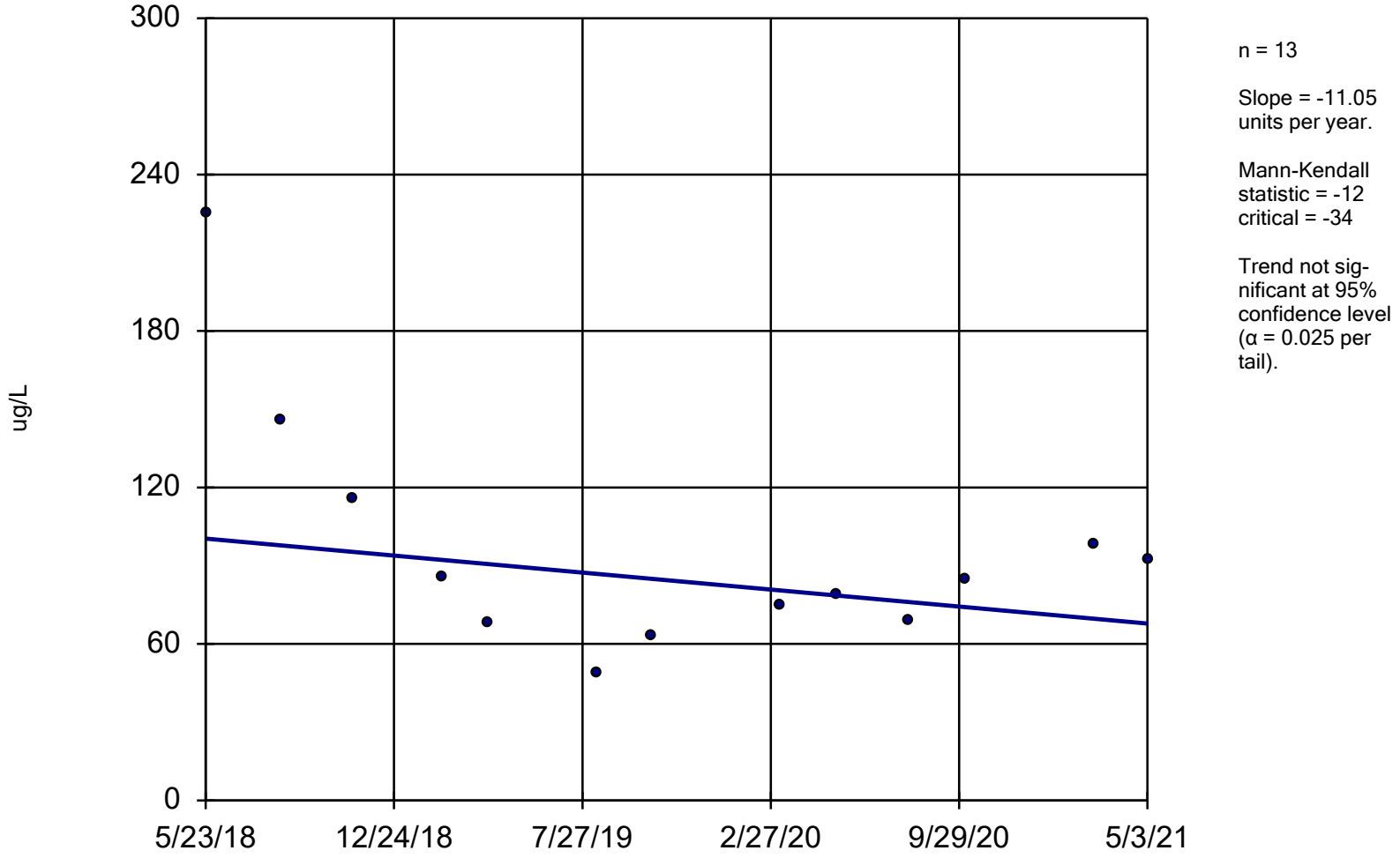
Decreasing trend significant at 95% confidence level (α = 0.025 per tail).

Sen's Slope Estimator Analysis Run 7/1/2021 9:50 AM

Client: Consumers Energy Data: DEK_HMPCCR_Sanitas_21Q2.rev1

Arsenic, Total

DEK-MW-18001



n = 13

Slope = -11.05 units per year.

Mann-Kendall statistic = -12
critical = -34

Trend not significant at 95% confidence level (α = 0.025 per tail).

Sen's Slope Estimator Analysis Run 7/1/2021 9:50 AM

Client: Consumers Energy Data: DEK_HMPCCR_Sanitas_21Q2.rev1