January 29, 2021 ***TRANSMITTAL VIA EMAIL 01/29/2021***

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: 2020 Annual Groundwater Monitoring and Corrective Action Report
DE Karn Bottom Ash Pond Coal Combustion Residuals (CCR) Unit

Dear Ms. Babcock,

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) (USEPA, April 2015 as amended). Standards for groundwater monitoring and corrective action codified in the CCR Rule (40 CFR 257.90 – 257.98), apply to the Consumers Energy Company (Consumers Energy) Bottom Ash Pond CCR Unit at the DE Karn Power Plant Site. Pursuant to the CCR Rule, no later than January 31, 2018, and annually thereafter, the owner or operator of a CCR unit must prepare an annual groundwater monitoring and corrective action report for the CCR unit documenting the status of groundwater monitoring and corrective action for the preceding year in accordance with §257.90(e). This *2020 Annual Groundwater Monitoring and Corrective Action* report documents activities from July 2020 through December 2020 and incorporates by reference the *Semiannual Progress Report* (Consumers Energy, July 2020) that documents activities completed from January 2020 through June 2020. The *Semiannual Progress Report* was prepared, submitted to the EGLE, and posted on Consumers Energy's CCR Rule Compliance Data and Information website on July 30, 2020. Collectively, the two reports cover the period of January 1, 2020 to December 31, 2020.

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 remedy for the Karn Bottom Ash Pond. Consumers Energy provided notification on January 14, 2019 of exceeding a Groundwater Protection Standard (GWPS) per §257.95(g), which documented arsenic was present in five of six downgradient wells at the Karn Bottom Ash Pond. The Karn Bottom Ash Pond was in assessment monitoring at the beginning and at the end of the period covered by this report. Consumers Energy will continue to evaluate corrective measures per §257.96 and §257.97 and is continuing semiannual assessment

monitoring in accordance with §257.95.

Karn Bottom Ash Pond Assessment Activities

EGLE approved the Karn Bottom Ash Pond Work Plan on December 20, 2018 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, EGLE approved the Response Action Plan on May 14, 2019, which identified interim response activities taken or to be taken to control possible sources of contamination and noted that constituents with identified exceedances will be further evaluated as part of the forthcoming nature and extent analysis and 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 which rendered the need for a solid waste operating license was unnecessary. EGLE approved the documentation removal report satisfying state requirements to close on December 1, 2020.

This Semiannual Progress Report, prepared as a requirement of §257.90(e) and §257.97(a) of the Federal Coal Combustion Residual (CCR) Rule, describes progress towards selecting and implementing any additional 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) Post-remedy monitoring, 2) Groundwater capture/control, 3) Impermeable barrier, 4) Active geochemical sequestration, and 5) Passive geochemical sequestration.

Based on completing the source removal activities, Consumers Energy continues to implement the Response Action Plan which has completed the following objectives:

- The source of contamination identified in the Response Action Plan has been removed to health-based criteria through a work plan and quality assurance program. This certification was approved by EGLE on December 1, 2020.
- The potential for future migration from infiltration within the excavated footprint has been minimized by restoring the excavation footprint with placement of a compacted clay soil graded to facilitate stormwater runoff to perimeter stormwater ditches.
- The Nature and Extent of contamination from the Karn Bottom Ash Pond developed in the Response Action Pan and refined in the Assessment of Corrective Measures continues to be validated through the assessment monitoring program and the Karn Landfill Groundwater Surface Water Interface (GSI) Compliance Monitoring Program

approved in Hydrogeological Monitoring Plan, Rev. 3. DE Karn Solid Waste Disposal Area (Consumers, 2017). There are no adverse effects on human health or the environment in either surface water or groundwater due to CCR management at the Karn Bottom Ash Pond.

- The potentiometric "high" from the Karn Bottom Ash Pond pool elevation has been reduced by at least six feet and the potentiometric surface around the previous pool continues to flatten based on observations of the average hydraulic gradient evaluated over time.
- The groundwater monitoring system that identified arsenic at statistically significant concentrations above the §257.95(h) GWPS criteria continues to validate that no other constituents have exceeded the GWPS at statistical significance indicating that further releases from the unit are being mitigated effectively through the source removal.

Results of October 2020 Sampling Event

Statistical analysis from the October 2020 assessment groundwater monitoring event verified that the only constituent of concern that is present at statistically significant levels above the established GWPS is arsenic. Results are presented in the enclosed *October 2020 Assessment Monitoring Data Summary and Statistical Evaluation, DE Karn Site, Bottom Ash Pond CCR Unit* (October 2020 Event Summary) (TRC, 2021). Additionally, monitoring performed under the Karn GSI Compliance Monitoring Program demonstrates protection of human health and the environment with criteria determined to be protective at the potential point of exposure. These results are depicted in Figures 4 and 5 of the October 2020 Event Summary.

Significant observations from the event summary are as follows:

- Arsenic is observed to exceed statistical significance above Groundwater Protection Standard of 21 ug/L at 4 of 6 groundwater monitoring wells;
- 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;
- Arsenic concentrations reflect a negative Sen Slope (decreasing concentration trend) at DEK-MW-15002, DEK-MW-15003, and DEK-MW-18001; and
- Arsenic concentrations at DEK-MW-15002 have been below the GWPS for three consecutive sampling events.

Conclusions

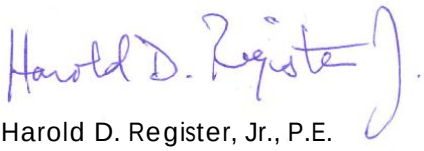
Source removal activities for the Karn Bottom Ash Pond have been completed and documented in the Karn Bottom Ash Pond Closure Report and approved by EGLE on December 1, 2020. Observations from the October 2020 sampling event demonstrate that source removal has resulted in groundwater improvements based on reductions in potentiometric surface elevation and average groundwater flow gradient in combination with decreased concentrations of arsenic and/or decreasing trends observed in the groundwater monitoring system. Observations of ongoing changes in groundwater potentiometric surface that likely 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 to improve the confidence in trends for the groundwater monitoring system will inform the on-going improvements and retention of monitoring-only, passive, or active remedial options following the source removal. Multiple lines of evidence demonstrate that the source removal has been effective in eliminating releases from the Karn Bottom Ash Pond and improving the concentrations of residual arsenic within the groundwater monitoring system through attenuation mechanisms. As conditions continue to be evaluated post-source removal, protection of the drinking water and groundwater-surface water interface (GSI) pathway are demonstrated through 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 July 30, 2021. Please feel free to contact me with any questions or clarifications.

Sincerely,



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cc: Mr. Phil Roycraft, EGLE Saginaw Bay District Office
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Ms. Darby Litz, TRC
Mr. Jacob Krenz, TRC

Enclosure: *October 2020 Assessment Monitoring Data Summary and Statistical Evaluation, Consumers Energy, DE Karn Site, Bottom Ash Pond CCR Unit*. (TRC, January 29, 2021).

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January 29, 2021

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

VIA email: Harold.RegisterJR@cmsenergy.com

Subject: October 2020 Assessment Monitoring Data Summary and Statistical Evaluation
Consumers Energy, DE Karn Site, Bottom Ash Pond CCR Unit

Dear Mr. Register:

Consumers Energy is continuing assessment monitoring in accordance with §257.95 of the CCR Rule[1] for the for the DE Karn Power Plant Bottom Ash Pond (Karn Bottom Ash Pond) located in Essexville, Michigan. Statistical evaluation of the May 2018 initial assessment monitoring event data determined that arsenic was present in one or more downgradient monitoring wells at statistically significant levels exceeding the Groundwater Protection Standard (GWPS). This letter report has been prepared to provide the summary of the October 2020 assessment groundwater monitoring results, data quality review, and statistical data evaluation for the Karn Bottom Ash Pond groundwater system.

Assessment Monitoring Sampling Summary

TRC conducted the second semiannual assessment monitoring event of 2020 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, 2016) (SAP). The semiannual assessment monitoring event was performed on October 5 through October 13, 2020. Downgradient monitoring wells DEK-MW-18001, DEK-MW-15002 through DEK-MW-15006 and background monitoring wells MW-15002, MW-15008, MW-15016, and MW-15019 (Figure 2) were sampled during this monitoring event. There were no changes to the groundwater monitoring system during the time period covered by this report. There were no groundwater monitoring wells that were installed or decommissioned.

The October 2020 sampling event consisted of collecting static water level measurements from the Karn Bottom Ash Pond groundwater monitoring system. Static water elevation data are summarized in Table 1 and groundwater elevation data are shown on Figure 3. Monitoring wells were purged with peristaltic pumps utilizing low-flow sampling methodology. Field parameters were stabilized at each monitoring well prior to collecting groundwater samples. Stabilized field parameters for each monitoring well are summarized in Table 2.

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

The 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.

Groundwater Flow Rate and Direction

Groundwater elevation data collected during the October 2020 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 October 2020 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 October 2020 demonstrate a reduction in groundwater elevation measurements by several feet when compared to groundwater elevations measured prior to June 2018. 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.

The average hydraulic gradient observed on October 5, 2020 in the Karn Bottom Ash Pond area during these events is estimated at 0.0022 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 and the discharge channel. The discharge channel surface water elevation was based upon the NOAA gauging station data recorded the same date as the water level measurements (October 5, 2020). 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 0.16 ft/day or 57 ft/year which is similar to the April 2020 estimates of 0.11 ft/day or 40 ft/year and is slightly higher than the October 2019 estimates of 0.044 ft/day or 16 ft/year. 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. The general flow direction is similar to that identified in previous monitoring rounds and continues to demonstrate that the downgradient wells are appropriately positioned to detect the presence of Appendix III/IV constituents that could potentially migrate from the Karn Bottom Ash Pond.

Data Quality

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

Assessment Monitoring Statistical Evaluation

Based on the results from the October 2020 assessment monitoring event, the Karn Bottom Ash Pond will remain in assessment monitoring in accordance with §257.97. The following section summarizes the statistical approach applied to assess the October 2020 groundwater data in accordance with the assessment monitoring program.

Establishing Groundwater Protection Standards

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

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 *Unified Guidance*[2] , the preferred method for comparisons to a fixed standard are confidence limits. An exceedance of the standard occurs when the 99 percent lower confidence level of the downgradient 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.

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

Confidence intervals were established per the statistical methods detailed in the *Statistical Evaluation of October 2020 Assessment Monitoring Sampling Event* technical memorandum provided in Attachment 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 October 2020 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	4 of 6

Previously, arsenic was present in downgradient well DEK-MW-15002 at a statistically significant level; however, the statistical evaluation of the May and October 2020 data show that the lower confidence limit for arsenic is currently below the GWPS. A summary of the confidence intervals for October 2020 is provided in Table 5.

Nature and Extent of Affected Groundwater

Since one or more Appendix IV constituents have been detected at the Karn Bottom Ash Pond at statistically significant levels above the GWPSs (i.e., arsenic), the nature and extent of the release was characterized in accordance with the requirements of §257.95(g)(1) and discussed in the *Assessment of Corrective Measures, DE Karn Bottom Ash Pond Coal Combustion Residual Unit* (Karn Bottom Ash Pond ACM) (TRC, 2019). 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 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 2 through 5 and data collected in 2020 from these nature and extent groundwater monitoring wells are included in Tables 1 and 2 of Attachment C. Although arsenic concentrations exceed the GWPS in on-site groundwater monitoring locations, arsenic is delineated within the limits of the property owned by Consumers Energy and there are currently no adverse effects on human health or the environment from either surface water or groundwater due to CCR management at the Karn Bottom Ash Pond. The property is owned and operated by Consumers Energy and groundwater is not used for drinking water. There are no on-site drinking water wells 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 4. Three categories were assigned to groundwater data collected from March 2016 to October 2020, as follows:

- White – No Exceedances: all concentrations were below the GWPS
- Yellow – Two or More Exceedances: individual observations above the GWPS[3]
- Orange – Statistically Significant GWPS Exceedances[4]

The groundwater impacts related to arsenic appear to be concentrically located around the Karn Bottom Ash Pond. The highest concentrations of arsenic 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. The other groundwater monitoring wells are observed to be relatively consistent in the same concentration limit over the same time period but also located in "lesser" mounded areas indicating slower response to on-going biogeochemical changes after removing source material and reducing infiltration.

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, DEK-MW-15003, and DEK-MW-18001 appear to exhibit a downward trend on the time-series chart (Attachment B). 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 but not deemed statistically significant at the 98% confidence level. Groundwater chemistry already appears to be improving as a result of discontinuing the hydraulic loading to the Karn Bottom Ash Pond and is expected to further improve as additional measures are implemented to reduce hydraulic loading and reduce the impacts from source materials. The influence of the bottom ash sluice water loading or changes in redox geochemistry impacted by the sluice water loading is still being evaluated as additional data collection events are completed.

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.

Due to the presence of the surrounding surface water bodies, another potentially relevant pathway is the Groundwater-Surface Water Interface (GSI) pathway. Transect/porewater GSI compliance sampling data collected quarterly under the Michigan-approved HMP shows 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

[3] Although an exceedance is defined as a single detection above the GWPS, confidence intervals will be used to determine compliance per the CCR Rule. Once corrective action is triggered (i.e., the lower confidence limit is above the GWPS), the upper confidence limit must be below the GWPS to demonstrate achievement of the GWPS for units that were not closed by removal. For units that are closed by removal, two consecutive rounds of data below the GWPS are needed to demonstrate closure.
[4] Lower confidence limit is above the GWPS based upon most recent assessment monitoring statistical evaluation.

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 5. Three categories were assigned to the 2020 data[5], as follows:

- 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.

Next Steps

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 and state standards in R299.4444(2) of PA 640. Consumers Energy will continue executing the self-implementing groundwater compliance schedule in conformance with §257.90 - §257.98. The next semiannual monitoring event is tentatively scheduled for the second calendar quarter of 2021.

Sincerely,

TRC

Darby Litz
Hydrogeologist/Project Manager

Jacob Krenz
Staff Geologist

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

Attachments

Table 1	Summary of Groundwater Elevation Data
Table 2	Summary of Field Parameter Results
Table 3	Summary of Background Wells Groundwater Sampling Results (Analytical)
Table 4	Summary of Groundwater Sampling Results (Analytical)
Table 5	Summary of Groundwater Protection Standard Exceedances – October 2020
Figure 1	Site Location Map
Figure 2	Karn and Weadock Complex Map
Figure 3	Shallow Groundwater Contour Map – October 2020
Figure 4	Nature and Extent Summary GWPS Exceedances
Figure 5	Nature and Extent Summary GWPS Exceedances
Attachment A	Data Quality Reviews
Attachment B	Statistical Evaluation of October 2020 Assessment Monitoring Sampling Event
Attachment C	Nature and Extent Groundwater Data (2020)

cc: Brad Runkel, Consumers Energy (via email: Bradley.Runkel@cmsenergy.com)

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)	August 3, 2020		October 5, 2020	
				Depth to Water (ft BTOC)	Groundwater Elevation (ft)	Depth to Water (ft BTOC)	Groundwater Elevation (ft)
Background							
MW-15002[(1)]	587.71	Sand	580.9 to 570.9	5.45	582.26	5.75	581.96
MW-15008[(1)]	585.36	Sand with clay	578.7 to 568.7	2.85	582.51	3.29	582.07
MW-15016[(1)]	586.49	Sand	581.2 to 578.2	5.20	581.29	3.94	582.55
MW-15019[(1)]	586.17	Sand and Sand/Clay	579.5 to 569.5	3.87	582.30	4.25	581.92
DEK Bottom Ash Pond							
DEK-MW-15002	590.87	Sand	578.3 to 575.3	6.00	584.87	6.18	584.69
DEK-MW-15004	611.04	Sand	576.6 to 571.6	27.20	583.84	27.20	583.84
DEK-MW-15005	589.72	Sand	572.3 to 567.3	6.91	582.81	7.85	581.87
DEK-MW-15006	589.24	Sand	573.0 to 568.0	6.40	582.84	7.38	581.86
DEK Bottom Ash Pond & Karn Lined Impoundment							
DEK-MW-15003	602.74	Sand	578.8 to 574.8	16.01	586.73	16.20	586.54
DEK-MW-18001	593.47	Sand	579.2 to 574.2	8.08	585.39	8.31	585.16
OW-10	591.58	Silty Sand and Silty Clay	576.0 to 571.0	6.12	585.46	6.40	585.18
OW-11	607.90	Silt/Fly Ash	587.5 to 582.5	21.10	586.80	21.23	586.67
OW-12	603.07	Silty Sand	584.2 to 579.2	17.05	586.02	17.03	586.04
DEK Nature and Extent							
MW-01	597.02	Sand	573.0 to 570.0	14.20	582.82	15.10	581.92
MW-03	597.30	Sand	569.8 to 566.8	14.40	582.90	15.38	581.92
MW-06	589.44	Sand and Silty Sand	578.5 to 563.5	6.60	582.84	7.50	581.94
MW-08	598.78	Sand and Silty Clay	580.9 to 570.9	15.20	583.58	16.57	582.21
MW-10	596.97	Sand	582.5 to 572.5	14.10	582.87	15.33	581.64
MW-12	598.60	Sand	583.9 to 573.9	15.90	582.70	16.64	581.96
MW-14	594.37	Sand and Silty Clay	584.7 to 574.7	11.60	582.77	12.60	581.77
MW-16	595.80	Sand and Sand/Bottom Ash	584.1 to 574.1	13.07	582.73	13.89	581.91
MW-22	598.99	Ash/Sand	571.4 to 568.4	15.32	583.67	15.75	583.24
MW-23	595.57	Ash/Sand	576.9 to 571.9	12.20	583.37	12.41	583.16
DEK Static Water Level							
MW-02	597.34	Sand and Silty Clay	572.5 to 567.5	14.52	582.82	15.48	581.86
MW-04	598.01	NR	569.5 to 564.5	15.10	582.91	16.14	581.87
MW-17	597.91	Sand	577.0 to 574.0	12.51	585.40	12.67	585.24
MW-18	609.22	Silty Sand and Silty Clay	575.8 to 573.8	24.95	584.27	24.95	584.27
MW-19	597.28	NR	572.1 to 567.1	14.40	582.88	15.15	582.13
MW-20	632.75	Sand	582.3 to 579.3	50.02	582.73	50.80	581.95
MW-21	632.91	Sand	587.1 to 584.1	49.80	583.11	49.90	583.01
OW-01	631.33	NR	572.5 to 567.5	48.80	582.53	49.40	581.93
OW-02	598.01	Fly Ash	579.4 to 576.4	14.26	583.75	14.64	583.37
OW-03	597.94	Fly Ash and Sand	573.6 to 568.6	14.90	583.04	16.38	581.56
OW-04	590.21	Sand and Bottom/Fly Ash	579.1 to 574.1	7.45	582.76	8.48	581.73
OW-05	593.53	Sand	576.9 to 571.9	10.87	582.66	11.30	582.23
OW-06	603.95	NR	580.9 to 575.9	12.95	591.00	20.45	583.50
OW-07	596.41	Ash	583.3 to 580.3	13.10	583.31	13.28	583.13
OW-08	593.93	NR	581.0 to 576.0	10.37	583.56	11.58	582.35
OW-09	593.45	NR	585.5 to 580.5	10.12	583.33	10.18	583.27
OW-13	588.52	NR	579.5 to 574.5	3.39	585.13	3.80	584.72
OW-15	587.75	NR	572.8 to 567.8	3.25	584.50	4.30	583.45

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
(1) Water level measurements during the August event were collected on August 10, 2020.

Table 2

Summary of Field Parameters: October 2020

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	10/13/2020	1.09	-148.0	7.6	888	16.6	0.5
MW-15008	10/13/2020	1.12	-118.9	7.1	1,638	14.5	9.3
MW-15016	10/13/2020	2.00	36.0	7.3	1,620	15.9	1.0
MW-15019	10/13/2020	1.27	-105.8	7.0	2,269	14.2	1.2
Karn Bottom Ash Pond							
DEK-MW-15002	10/6/2020	0.83	-26.2	7.1	1,253	15.4	2.7
DEK-MW-15003	10/6/2020	2.21	-148.0	8.5	400	17.7	0.3
DEK-MW-15004	10/7/2020	1.50	-111.9	7.6	872	15.9	0.6
DEK-MW-15005	10/7/2020	1.34	-124.3	7.7	1,170	14.8	0.5
DEK-MW-15006	10/7/2020	1.24	-124.0	7.7	1,604	15.5	0.9
DEK-MW-18001	10/6/2020	1.53	-141.8	7.6	813	13.0	1.4

Notes:

mg/L - Milligrams per Liter.

mV - Millivolts.

SU - Standard units.

umhos/cm - Micromhos per centimeter.

°C - Degrees Celcius

NTU - Nephelometric Turbidity Unit.

Table 3
Summary of Groundwater Sampling Results (Analytical): October 2020
DE Karn & JC Weadock Background – RCRA CCR Monitoring Program
Essexville, Michigan

					Sample Location:	**MW-15002**	**MW-15008**	**MW-15016**	**MW-15019**
					Sample Date:	10/13/2020	10/13/2020	10/13/2020	10/13/2020
Constituent	Unit	EPA MCL	MI Residential*	MI Non-Residential*	MI GSI^	Background			
Appendix III									
Boron	ug/L	NC	**500**	**500**	4,000	28	148	**510**	288
Calcium	mg/L	NC	NC	NC	500[EE]	62.7	115	259	158
Chloride	mg/L	**250****	**250[E]**	**250[E]**	**50**	**74.8**	**246**	**63.3**	**355**
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]**	8.86	2.55	**521**	35
Total Dissolved Solids	mg/L	**500****	**500[E]**	**500[E]**	**500**	466	**871**	**1,150**	**1,180**
pH, Field	SU	6.5 - 8.5**	6.5 - 8.5[E]	6.5 - 8.5[E]	6.5 - 9.0	7.6	7.1	7.3	7.0
Appendix IV									
Antimony	ug/L	6	6	6	2	< 1	< 1	< 1	< 1
Arsenic	ug/L	10	10	10	10	3	< 1	2	< 1
Barium	ug/L	2,000	2,000	2,000	1,200	51	65	55	290
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	< 10	17	84	13
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	6	< 5
Radium-226	pci/L	NC	NC	NC	NC	< 0.295	0.593	< 0.423	0.545
Radium-228	pci/L	NC	NC	NC	NC	< 0.409	< 0.488	< 0.537	0.65
Radium-226/228	pci/L	5	NC	NC	NC	< 0.409	0.806	< 0.537	1.19
Selenium	ug/L	50	50	50	5	< 1	< 1	2	< 1
Thallium	ug/L	2	2	2	2	< 2	< 2	< 2	< 2
MI Part 115 Parameters									
Iron	ug/L	**300****	**300[E]**	**300[E]**	500,000[EE]	**2,720**	**11,700**	139	**14,700**
Copper	ug/L	1,000**	1,000[E]	1,000[E]	20	< 1	< 1	4	< 1
Nickel	ug/L	NC	100	100	120	2	2	7	4
Silver	ug/L	100**	34	98	0.2	< 0.2	< 0.2	< 0.2	< 0.2
Vanadium	ug/L	NC	**4.5**	62	27	< 2	**6**	< 2	< 2
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.

SU - standard units; pH is a field parameter.

pCi/L - picocuries per liter.

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

NC - no criteria.

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

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

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

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

[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}.

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): October 2020
DE Karn Bottom Ash Pond – RCRA CCR Monitoring Program
Essexville, Michigan

					Sample Location:	**DEK-MW-15002**	**DEK-MW-15003**	**DEK-MW-15004**	**DEK-MW-15005**	**DEK-MW-15006**	**DEK-MW-18001**
					Sample Date:	10/6/2020	10/6/2020	10/7/2020	10/7/2020	10/7/2020	10/6/2020
Constituent	Unit	EPA MCL	MI Residential*	MI Non-Residential*	MI GSI^	downgradient					
Appendix III											
Boron	ug/L	NC	**500**	**500**	4,000	**1,580**	**842**	**850**	**847**	**1,220**	**1,740**
Calcium	mg/L	NC	NC	NC	500[EE]	126	29.7	68.4	155	106	71.7
Chloride	mg/L	250**	250[E]	250[E]	**50**	**106**	46.5	**68.9**	**52.7**	**102**	**60.7**
Fluoride	ug/L	4,000	NC	NC	NC	1,300	1,190	1,170	< 1000	1,060	1,240
Sulfate	mg/L	**250****	**250[E]**	**250[E]**	500[EE]	142	44.6	136	102	**296**	91.9
Total Dissolved Solids	mg/L	**500****	**500[E]**	**500[E]**	**500**	**791**	237	**509**	**687**	**1,010**	476
pH, Field	SU	**6.5 - 8.5****	**6.5 - 8.5[E]**	**6.5 - 8.5[E]**	6.5 - 9.0	7.1	8.5	7.6	7.7	7.7	7.6
Appendix IV											
Antimony	ug/L	6	6	6	2	< 1	< 1	< 1	< 1	< 1	< 1
Arsenic	ug/L	**10**	**10**	**10**	**10**	8	**393**	**155**	**42**	**27**	**85**
Barium	ug/L	2,000	2,000	2,000	1,200	133	40	102	248	141	136
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	6	< 1
Cobalt	ug/L	NC	40	100	100	< 6	< 6	< 6	< 6	< 6	< 6
Fluoride	ug/L	4,000	NC	NC	NC	1,300	1,190	1,170	< 1,000	1,060	1,240
Lead	ug/L	NC	4	4	14	< 1	< 1	< 1	< 1	< 1	< 1
Lithium	ug/L	NC	170	350	440	35	19	33	45	22	26
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	59	10	< 5	11	< 5
Radium-226	pci/L	NC	NC	NC	NC	< 0.430	< 0.628	< 0.424	0.621	0.629	< 0.473
Radium-228	pci/L	NC	NC	NC	NC	0.642	< 0.504	0.645	< 0.502	0.492	0.463
Radium-226/228	pci/L	5	NC	NC	NC	1.06	< 0.628	0.891	0.875	1.12	0.591
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
MI Part 115 Parameters											
Iron	ug/L	**300****	**300[E]**	**300[E]**	500,000[EE]	**384**	142	**1,900**	**1,260**	**3,420**	**681**
Copper	ug/L	1,000**	1,000[E]	1,000[E]	20	< 1	< 1	< 1	1	1	< 1
Nickel	ug/L	NC	**100**	**100**	120	< 2	< 2	< 2	2	**111**	< 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	4	< 2
Zinc	ug/L	5,000**	2,400	5,000[E]	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}.

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 – October 2020

DE Karn Bottom Ash Pond – RCRA CCR Monitoring Program

Essexville, Michigan

Constituent	Units	GWPS	DEW-MW-15002		DEK-MW-15003		DEK-MW-15004		DEK-MW-15005		DEK-MW-15006		DEK-MW-18001	
			LCL	UCL	LCL	UCL	LCL	UCL	LCL	UCL	LCL	UCL	LCL	UCL
Arsenic	ug/L	21	1.6	56	380	460	110	160	24	120	17	27	50	180

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

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

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:

KARN AND WEADOCK COMPLEX AREA

DRAWN BY:	S. MAJOR	PROJ NO.:	367388-001
CHECKED BY:	J. KRENZ		
APPROVED BY:	D. LITZ		**FIGURE 2**
DATE:	JANUARY 2021		

TRC

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

FILE NO.: 367388-001-005.mxd

TRC - GIS
Plot Date: 1/26/2021, 12:36:22 PM by SMAJOR -- LAYOUT: ANSI B (11"x17")
Path: S:\1-PROJECTS\Consumers Energy Company\Michigan\CCR GW\2017 269767\367388-0\Map Rotation: 0
Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl (Foot)

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
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Phone: 734.971.7080
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FILE NO.: 367388-001-012.mxd

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 269767\367388-001-012.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

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
DEK-MW-15003
KARN LINED IMPOUNDMENT
MW-10
MW-10
Arsenic
DEK-MW-15005
Arsenic *
DEK-MW-15005
OW-12
DEK-MW-15001
MW-12
MW-12
Arsenic
OW-12
Arsenic
DEK-MW-15006
Arsenic
OW-10
DEK-MW-15006
DEK-MW-18001
MW-23
MW-23
Arsenic
DEK-MW-18001
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
- * 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 MARCH 2016 TO OCTOBER 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 4**
DATE:	JANUARY 2021		

TRC
1540 Eisenhower Place
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Phone: 734.971.7080
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FILE NO.: 367388-ExceedancesNE_ACM.mxd

Plot Date: 1/26/2021, 15:22:22 PM by SMAJOR -- LAYOUT: ANSI B (11"x17")
Path: S:\11-PROJECTS\Consumers Energy Company\Michigan\CCR GW\2017 269767\367388-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

MW-03
T1-3GSI
MW-06
MW-01
MW-06
Arsenic
MASS FLUX IN COMPLIANCE WITH CHRONIC MIXING ZONE CRITERIA
POREWATER SAMPLES COLLECTED UNDER MICHIGAN P115 PROGRAM TO DEMONSTRATE COMPLIANCE WITH THE GSI PATHWAY IN THIS AREA BY CALCULATING A MASS FLUX DISCHARGE TO LAKE HURON
Lake Huron
INTAKE CHANNEL
DEK-MW-15004
Arsenic *
DEK-MW-15004
MW-22
Arsenic
MW-08
T2-3GSI
MW-08
Arsenic
MW-22
BOTTOM ASH POND
DEK-MW-15003
Arsenic*
OW-11
OW-11
Arsenic
T3-3GSI
MW-10
MW-10
Arsenic
DEK-MW-15003
KARN LINED IMPOUNDMENT
DEK-MW-15005
Arsenic *
DEK-MW-15005
OW-12
T4-3GSI
MW-12
MW-12
Arsenic
OW-12
Arsenic
DEK-MW-15001
DEK-MW-15006
Arsenic
OW-10
DEK-MW-15006
DEK-MW-18001
DEK-MW-18001
Arsenic *
MW-23
T5-3GSI
MW-14
DEK-MW-15002
Arsenic*
DEK-MW-15002
MW-14
Arsenic
DE KARN GENERATING FACILITY
MW-23
Arsenic
T6-3GSI
MW-16
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
- 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
- * 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. MIXING ZONE GSI CRITERIA FROM MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY (MDEQ) APPROVAL LETTER DATED DECEMBER 23, 2015.
4. GROUNDWATER CONCENTRATION DATA FROM MARCH THROUGH OCTOBER 2020 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.:	367388.0001
CHECKED BY:	J. KRENZ		
APPROVED BY:	D. LITZ		**FIGURE 5**
DATE:	JANUARY 2021		

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

FILE NO.: 367388-ExceedancesNE_GSI.mxd

Plot Date: 1/26/2021, 15:51:46 PM by SMAJOR -- LAYOUT: ANSI B (11"x17")
Path: S:\1-PROJECTS\Consumers Energy Company\Michigan\CCR_GW\2017 269767\367388-ExceedancesNE_GSI.mxd
Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl (Foot)
Map Rotation: 0
TRC - GIS

Attachment A
Data Quality Reviews

Laboratory Data Quality Review
Groundwater Monitoring Event October 2020
JC Weadock/ DE Karn Background

Groundwater samples were collected by TRC for the October 2020 sampling event. Samples were analyzed for total metals, anions, and total dissolved solids by Consumers Energy (CE) Laboratory Services in Jackson, Michigan. The radium analyses were subcontracted to Eurofins-TestAmerica in St. Louis, Missouri (Eurofins TA – St. Louis). The laboratory analytical results were reported in laboratory sample delivery groups (SDGs) 20-1105 and 240-138442-1.

During the October 2020 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 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
Radium (Ra-226, Ra-228, Combined Ra-226 & Ra-228)	EPA 903.0, EPA 904.0

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

Data Usability Review Procedure

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

- Sample receipt, as noted in the cover page or case narrative
- Technical holding times for analyses;
- Reporting limits (RLs) compared to project-required RLs;
- Data for method blanks, equipment blanks, and field blanks. 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;
- Percent recoveries for carriers, where applicable, for radiochemistry only. Carriers are used to assess the chemical yield for the preparation and/or instrument efficiency;
- Data for 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, 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, 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 method blank was analyzed for the radium 226 analysis only and radium 226 was not detected in the method blank. The laboratory inadvertently did not analyze a method blank for radium 228; therefore, potential contamination arising from laboratory sample preparation and/or analytical procedures could not be evaluated for radium 228.
- One field blank (FB-04) sample was collected. Target analytes were not detected in the field blank.
- An equipment blank was not collected in this data set.
- MS and MSD analyses were not performed on a sample from this data set.
- An LCS and LCSD were analyzed with each analytical batch for radium; the following issues were noted:

  - The recoveries of radium 228 in the LCS 160-488925/1-A (74%) and LCSD 160-488925/2-A (70%) were below the lower control limit (75%); the positive and non-detect results for radium 228 for all samples are potentially biased low, as summarized in the attached Table 1.
- The field duplicate pair samples were DUP-04 and MW-15008; 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.
- Carrier recoveries, where applicable, were within 40-110%.

Table 1

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

Samples	Collection Date	Analyte	Non-Conformance/Issue
MW-15002	10/13/2020	Radium 228	LCS/LCSD recoveries below acceptance limit (75%). Positive and non-detect results are potentially biased low.
MW-15008	10/13/2020		
MW-15016	10/13/2020		
MW-15019	10/13/2020		
DUP-04	10/13/2020		

Laboratory Data Quality Review
Groundwater Monitoring Event October 2020
DE Karn Bottom Ash Pond

Groundwater samples were collected by TRC for the October 2020 sampling event. Samples were analyzed for total metals, anions, and total dissolved solids by Consumers Energy (CE) Laboratory Services in Jackson, Michigan. The radium analyses were subcontracted to Eurofins–TestAmerica in St. Louis, Missouri (Eurofins TA – St. Louis). The laboratory analytical results were reported in laboratory sample delivery groups (SDG) 20-1108 and 240-138058-1.

During the October 2020 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 Metals	SW-846 6020B/7470A
Radium (Ra-226, Ra-228, Combined Ra-226 & Ra-228)	EPA 903.0, EPA 904.0

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

Data Usability Review Procedure

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

- Sample receipt, as noted in the cover page or case narrative
- Technical holding times for analyses;
- Reporting limits (RLs) compared to project-required RLs;
- Data for method blanks, equipment blanks, and field blanks. 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;
- Percent recoveries for carriers, where applicable, for radiochemistry only. Carriers are used to assess the chemical yield for the preparation and/or instrument efficiency;
- Data for 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 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, and additional Part 115 constituents will be utilized for the purposes of the 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:

- Method blanks were analyzed for the radium analyses. Target analytes were not detected in the method blanks.
- One field blank (FB-02) was collected. Target analytes were not detected in the field blank sample.
- An equipment blank was not collected with this data set.
- An LCS and LCSD were analyzed with each analytical batch for radium; the LCS and LCSD recoveries 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-02 and DEK-MW-15002; 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.
- Carrier recoveries, where applicable, were within 40-110%.

Laboratory Data Quality Review
Groundwater Monitoring Event October 2020
DE Karn Bottom Ash Pond and Lined Impoundment

Groundwater samples were collected by TRC for the October 2020 sampling event. Samples were analyzed for total metals, anions, total dissolved solids, and alkalinity by Consumers Energy (CE) Laboratory Services in Jackson, Michigan. The radium analyses were subcontracted to Eurofins-TestAmerica in St. Louis, Missouri (Eurofins TA – St. Louis). The laboratory analytical results were reported in laboratory sample delivery groups (SDGs) 20-1109 and 240-138055-1.

During the October 2020 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
Radium (Ra-226, Ra-228, Combined Ra-226 & Ra-228)	EPA 903.0, EPA 904.0

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

Data Usability Review Procedure

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

- Sample receipt, as noted in the cover page or case narrative
- Technical holding times for analyses;
- Reporting limits (RLs) compared to project-required RLs;
- Data for method blanks, equipment blanks, and field blanks, 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;
- Percent recoveries for carriers, where applicable, for radiochemistry only. Carriers are used to assess the chemical yield for the preparation and/or instrument efficiency;
- Data for 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, 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:

- Method blanks were analyzed for the radium analyses. Target analytes were not detected in the method blanks.
- A field blank was not collected in this data set.
- An equipment blank was not collected in this data set.
- An LCS and LCSD were analyzed with each analytical batch for radium; the LCS and LCSD recoveries were within QC limits.

- MS and MSD analyses were performed on sample DEK-MW-18001 for 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.
- Carrier recoveries, where applicable, were within 40-110%.

Attachment B
Statistical Evaluation of October 2020 Assessment Monitoring Sampling Event

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Technical Memorandum

Date: January 11, 2020

To: J.R. Register, Consumers Energy

From: Darby Litz, TRC
Katy Reminga, TRC

Project No.: 367388.0001 Phase 003, Task 002

Subject: Statistical Evaluation of October 2020 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).

The second semiannual assessment monitoring event for 2020 was conducted on October 6 through October 7, 2020. 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 fifth semiannual assessment monitoring event data indicate the following constituent is present at statistically significant levels exceeding the GWPS in downgradient monitoring wells at the Karn Bottom Ash Pond:

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

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

[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).

§257.98.

Assessment Monitoring Statistical Evaluation

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

Following the second semiannual assessment monitoring sampling event for 2020, 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

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

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 (August 2017 through October 2020) were retained for further analysis. Arsenic in each of the downgradient monitoring wells at the Bottom Ash Pond had individual results exceeding the GWPS. Lead was detected in DEK-MW-15006 during May 2018 at a concentration of 320 ug/L, which exceeds its GWPS. However, this is the only detection of lead in the Bottom Ash Pond wells during either baseline sampling or assessment monitoring. Sampling conducted in November 2018 did not confirm the lead detection. Therefore, the single detection was classified as an outlier per the Double Quantification Rule as outlined in the Stats Plan and the Unified Guidance. As a result, only arsenic was retained for evaluation in all downgradient monitoring wells. In DEK-MW-15003, beryllium, cobalt, and thallium reporting limits exceeded the GWPSs in April 2019 due to sample dilutions performed due to the nature of the sample matrix. Beryllium, cobalt, and thallium have historically been non-detect at this location and results from October 2019 confirmed that these constituents are not detected above the GWPSs. Therefore, the elevated reporting limits are treated as outliers and no statistical evaluation will be completed for these parameter-well combinations.

Groundwater data were then evaluated utilizing Sanitas™ statistical software. Sanitas™ is a software tool that is commercially available for performing statistical evaluation consistent with procedures outlined in the Unified Guidance. Within the Sanitas™ statistical program, confidence limits were selected to perform the statistical comparison of compliance data to a fixed standard. Parametric and non-parametric confidence intervals were calculated for each of the CCR Appendix IV 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 (December 2015 through August 2017) results and the assessment monitoring results (April 2018 through October 2020) were observed visually for potential trends. No outliers were identified. Arsenic

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

concentrations at DEK-MW-15002, DEK-MW-15003, and DEK-MW-18001 appear to exhibit a downward trend on the time-series chart (Attachment 1). These data sets were tested further in Sanitas™ utilizing Sen's Slope to estimate the average rate of change in concentration over time and utilizing the Mann-Kendall trend test to test for significance of the trend at the 98% confidence level. The trend tests showed that arsenic concentrations are generally decreasing with time, as evidenced by the negative Sen's Slope but are not deemed statistically significant (Attachment 1). The decreases in arsenic concentrations at DEK-MW-15002, DEK-MW-15003, and DEK-MW-18001 are causing the confidence intervals to widen. Calculating a confidence interval around a trending data set incorporates not only variability present naturally in the underlying dataset, but also incorporates variability due to the trend itself. Arsenic concentrations have already triggered assessment monitoring (e.g., not a newly identified GWPS exceedance) and an interim measure has been initiated through the removal of CCR from the bottom ash pond in 2019; therefore, traditional confidence interval calculations are presented in this statistical evaluation until more post-CCR removal data are available. Once additional post-CCR removal data are collected, confidence bands may be a more appropriate assessment to determine compliance with the CCR Rule. Confidence bands are selected by the UG as the appropriate method for calculating confidence intervals on trending data. A confidence band calculates upper and lower confidence limits at each point along the trend to reduce variability and create a narrower confidence interval. At least 8 to 10 measurements should be available when computing a confidence band around a linear regression.

The Sanitas™ software was used to test compliance at the downgradient monitoring wells using the confidence interval method for the most recent 8 sampling events, with the exception of DEK-MW-18001, for which only six independent assessment monitoring sampling events have been completed. Eight independent sampling events provide the appropriate density of data as recommended per the UG yet are collected recently enough to provide an indication of current condition. The tests were run with a per-test significance of $\alpha = 0.01$. The software outputs are included in Attachment 1 along with data reports showing the values used for the evaluation. The percentage of non-detect observations for well/constituent pairs with a direct GWPS exceedance are also included in Attachment 1. Non-detect data was handled in accordance with the Stats Plan for the purposes of calculating the confidence intervals. Note that, as mentioned above, the statistical analysis for DEK-MW-15001 terminates at the April 2018 sampling event as it was decommissioned on April 18, 2018, and statistical analysis for DEK-MW-18001 commenced with the first semiannual sampling event for 2019.

The Sanitas™ software generates an output graph for the confidence intervals of each well. The data sets were found to be normally distributed with the exception of DEK-MW-15005, which used a non-parametric confidence interval due to non-normal data set, and DEK-MW-18001, which 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 four of the six monitoring locations (DEK-MW-15003 through 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 – August 2017 to October 2020

Attachment 1 Sanitas™ Output Files

Table

Table 1
Comparison of Groundwater Sampling Results to Groundwater Protection Standards – August 2017 to October 2020
DE Karn Bottom Ash Pond – RCRA CCR Monitoring Program
Essexville, Michigan

					Sample Location:	DEK-MW-15002									
					Sample Date:	8/3/2017	9/18/2017	4/12/2018	5/23/2018	11/5/2018	4/11/2019	10/15/2019	5/13/2020	10/6/2020	10/6/2020
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS	downgradient									
Appendix III															Field Dup
Boron	ug/L	NC	NA	619	NA	805	870	--	967	894	860	1,600	1,390	1,580	1,600
Calcium	mg/L	NC	NA	302	NA	71.1	66.9	--	53.7	67.8	72	130	170	126	122
Chloride	mg/L	250*	NA	2,440	NA	87.8	84.9	--	79.7	83.5	80	410	130	106	102
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	1,300	< 1,000
Sulfate	mg/L	250*	NA	407	NA	256	290	--	263	77.2	45	150	367	142	139
Total Dissolved Solids	mg/L	500*	NA	4,600	NA	696	722	--	660	536	560	1,300	1,100	791	776
pH, Field	SU	6.5 - 8.5*	NA	6.5 - 7.3	NA	7.8	7.9	7.5	8.0	7.3	7.5	7.3	7.1	7.1	--
Appendix IV															
Antimony	ug/L	6	NA	1	6	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1	< 1	< 1
Arsenic	ug/L	10	NA	21	**21**	48.3	--	**56.4**	**67.0**	**31.7**	9.0	6.5	3	8	8
Barium	ug/L	2,000	NA	1,300	2,000	96.1	--	82.7	84.5	71.6	71	140	196	133	131
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	1.4	1.3	< 1.0	< 1	1	1
Cobalt	ug/L	NC	6	15	15	< 15.0	--	< 15.0	< 15.0	< 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	< 1,000	1,300	< 1,000
Lead	ug/L	NC	15	1	15	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1	< 1	< 1
Lithium	ug/L	NC	40	180	180	36	--	43	35	32	26	35	48	35	36
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	27.7	--	30.8	35.4	< 5.0	< 5.0	< 5.0	< 5	< 5	< 5
Radium-226	pCi/L	NC	NA	NA	NA	< 0.854	--	< 0.478	< 0.698	< 0.850	< 0.376	0.334	0.673	< 0.430	< 0.577
Radium-228	pCi/L	NC	NA	NA	NA	1.17	--	1.16	< 0.744	0.730	0.684	0.654	< 0.763	0.642	< 0.460
Radium-226/228	pCi/L	5	NA	3.32	5	1.88	--	1.42	< 1.44	< 1.39	0.846	0.987	0.899	1.06	< 0.577
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.
(2) Laboratory reporting limits exceeds GWPS due to sample dilutions performed as a result of the sample matrix.

Table 1
Comparison of Groundwater Sampling Results to Groundwater Protection Standards – August 2017 to October 2020
DE Karn Bottom Ash Pond – RCRA CCR Monitoring Program
Essexville, Michigan

						Sample Location:	DEK-MW-15003							
						Sample Date:	8/4/2017	9/18/2017	4/12/2018	5/23/2018	11/6/2018	4/11/2019	10/15/2019	5/14/2020	10/6/2020
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS		downgradient								
Appendix III															
Boron	ug/L	NC	NA	619	NA		1,160	1,030	--	1,010	944	960	1,100	739	842
Calcium	mg/L	NC	NA	302	NA		58.8	62.1	--	58.1	62.9	52	39	26.9	29.7
Chloride	mg/L	250*	NA	2,440	NA		61.7	60.2	--	57.2	61.7	58	58	47.9	46.5
Fluoride	ug/L	4,000	NA	1,000	NA		< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	1,190
Sulfate	mg/L	250*	NA	407	NA		55.8	54.3	--	39.1	37.8	47	52	55.6	44.6
Total Dissolved Solids	mg/L	500*	NA	4,600	NA		506	426	--	354	370	360	330	271	237
pH, Field	SU	6.5 - 8.5*	NA	6.5 - 7.3	NA		7.9	7.9	7.8	8.2	8.0	8.0	7.9	8.5	8.5
Appendix IV															
Antimony	ug/L	6	NA	1	6		< 1.0	--	< 1.0	< 1.0	< 1.0	< 5.0	< 1.0	1	< 1
Arsenic	ug/L	10	NA	21	**21**		437	--	**478**	**450**	**420**	**380**	**420**	**365**	**393**
Barium	ug/L	2,000	NA	1,300	2,000		68.5	--	61.2	73.3	70.9	62	58	40	40
Beryllium	ug/L	4	NA	1	4		< 1.0	--	< 1.0	< 1.0	< 1.0	< 5.0 (2)	< 1.0	< 1	< 1
Cadmium	ug/L	5	NA	0.2	5		< 0.20	--	< 0.20	< 0.20	< 0.20	< 1.0	< 0.20	< 0.2	< 0.2
Chromium	ug/L	100	NA	3	100		< 1.0	--	< 1.0	< 1.0	< 1.0	< 5.0	< 1.0	< 1	< 1
Cobalt	ug/L	NC	6	15	15		< 15.0	--	< 15.0	< 15.0	< 6.0	< 30 (2)	< 6.0	< 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	1,190
Lead	ug/L	NC	15	1	15		< 1.0	--	< 1.0	< 1.0	< 1.0	< 5.0	< 1.0	< 1	< 1
Lithium	ug/L	NC	40	180	180		35	--	39	33	33	28	29	18	19
Mercury	ug/L	2	NA	0.2	2		< 0.20	--	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.2	< 0.2
Molybdenum	ug/L	NC	100	6	100		5.0	--	< 5.0	5.3	5.2	< 25	28	52	59
Radium-226	pCi/L	NC	NA	NA	NA		0.226	--	0.686	< 0.842	< 0.661	< 0.424	< 0.150	< 0.271	< 0.628
Radium-228	pCi/L	NC	NA	NA	NA		< 0.936	--	< 0.755	1.12	< 0.789	< 0.495	< 0.449	< 0.468	< 0.504
Radium-226/228	pCi/L	5	NA	3.32	5		< 1.14	--	< 1.33	1.63	< 1.45	< 0.495	< 0.449	0.565	< 0.628
Selenium	ug/L	50	NA	2	50		< 1.0	--	< 1.0	< 1.0	< 1.0	< 5.0	< 1.0	< 1	< 1
Thallium	ug/L	2	NA	2	2		< 2.0	--	< 2.0	< 2.0	< 2.0	< 10 (2)	< 2.0	< 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.
(2) Laboratory reporting limits exceeds GWPS due to sample dilutions performed as a result of the sample matrix.

Table 1
Comparison of Groundwater Sampling Results to Groundwater Protection Standards – August 2017 to October 2020
DE Karn Bottom Ash Pond – RCRA CCR Monitoring Program
Essexville, Michigan

						Sample Location:	DEK-MW-15004											
						Sample Date:	8/3/2017	8/3/2017	9/19/2017	9/19/2017	4/12/2018	5/23/2018	5/23/2018	11/6/2018	4/11/2019	10/15/2019	5/14/2020	10/7/2020
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS		downgradient											
Appendix III								Field Dup		Field Dup			Field Dup					
Boron	ug/L	NC	NA	619	NA		785	768	730	750	--	800	842	910	840	540	795	850
Calcium	mg/L	NC	NA	302	NA		67.4	68.1	66.5	67.9	--	47.8	50.7	62.2	50	60	52.7	68.4
Chloride	mg/L	250*	NA	2,440	NA		81.4	81.5	79.8	79.9	--	72.5	72.6	70.6	63	77	66.6	68.9
Fluoride	ug/L	4,000	NA	1,000	NA		< 1,000	< 1,000	< 1,000	< 1,000	1,200	1,100	1,100	1,100	1,100	1,100	1,140	1,170
Sulfate	mg/L	250*	NA	407	NA		258	261	283	281	--	176	178	168	150	160	125	136
Total Dissolved Solids	mg/L	500*	NA	4,600	NA		642	582	596	564	--	494	504	482	490	530	509	509
pH, Field	SU	6.5 - 8.5*	NA	6.5 - 7.3	NA		7.6	--	7.3	--	7.3	7.7	--	7.4	7.1	7.4	7.8	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
Arsenic	ug/L	10	NA	21	**21**		121	129	--	--	**134**	**119**	**126**	**123**	**110**	**180**	**157**	**155**
Barium	ug/L	2,000	NA	1,300	2,000		111	115	--	--	86.9	79.6	82.6	95.1	77	99	96	102
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
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
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
Cobalt	ug/L	NC	6	15	15		< 15.0	< 15.0	--	--	< 15.0	< 15.0	< 15.0	< 6.0	< 6.0	< 6.0	< 6	< 6
Fluoride	ug/L	4,000	NA	1,000	4,000		< 1,000	< 1,000	< 1,000	< 1,000	1,200	1,100	1,100	1,100	1,100	1,100	1,140	1,170
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
Lithium	ug/L	NC	40	180	180		39	38	--	--	39	30	32	33	26	34	36	33
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
Molybdenum	ug/L	NC	100	6	100		30.4	31.4	--	--	32.0	30.9	30.4	28.0	23	< 5.0	11	10
Radium-226	pCi/L	NC	NA	NA	NA		0.805	< 0.623	--	--	< 0.641	< 0.791	< 0.679	< 0.743	< 0.316	0.204	< 0.494	< 0.424
Radium-228	pCi/L	NC	NA	NA	NA		0.833	0.864	--	--	< 0.847	< 0.753	0.845	< 0.794	0.924	0.537	< 0.700	0.645
Radium-226/228	pCi/L	5	NA	3.32	5		1.64	< 1.46	--	--	< 1.49	< 1.54	1.29	< 1.54	1.07	0.741	< 0.700	0.891
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
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

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

Table 1
Comparison of Groundwater Sampling Results to Groundwater Protection Standards – August 2017 to October 2020
DE Karn Bottom Ash Pond – RCRA CCR Monitoring Program
Essexville, Michigan

						Sample Location:	DEK-MW-15005											
						Sample Date:	8/3/2017	9/18/2017	4/11/2018	4/11/2018	5/24/2018	11/6/2018	4/11/2019	4/11/2019	10/15/2019	10/15/2019	5/13/2020	5/13/2020	10/7/2020
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS		downgradient												
Appendix III										Field Dup				Field Dup		Field Dup		Field Dup	
Boron	ug/L	NC	NA	619	NA		792	714	--	--	806	947	910	910	700	650	863	858	847
Calcium	mg/L	NC	NA	302	NA		49.2	44.3	--	--	33.4	32.9	31	31	60	59	71.0	72.1	155
Chloride	mg/L	250*	NA	2,440	NA		81.4	79.3	--	--	72.6	69.1	60	60	64	64	48.0	47.5	52.7
Fluoride	ug/L	4,000	NA	1,000	NA		< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Sulfate	mg/L	250*	NA	407	NA		300	273	--	--	182	160	140	140	5.2	5.0	18.9	18.9	102
Total Dissolved Solids	mg/L	500*	NA	4,600	NA		732	638	--	--	524	474	470	470	390	400	419	425	687
pH, Field	SU	6.5 - 8.5*	NA	6.5 - 7.3	NA		7.9	7.9	7.7	--	7.8	7.9	7.7	--	7.6	--	8.1	--	7.7
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	< 1.0	< 1	< 1	< 1
Arsenic	ug/L	10	NA	21	**21**		31.9	--	**28.3**	**29.1**	**31.7**	**35.0**	**24**	**24**	**120**	**120**	**34**	**34**	**42**
Barium	ug/L	2,000	NA	1,300	2,000		92.2	--	54.9	55.8	58.5	56.7	46	45	110	100	127	127	248
Beryllium	ug/L	4	NA	1	4		< 1.0	--	< 1.0	< 1.0	< 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	< 0.20	< 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	< 1.0	< 1.0	< 1.0	< 1.0	< 1	< 1	< 1
Cobalt	ug/L	NC	6	15	15		< 15.0	--	< 15.0	< 15.0	< 15.0	< 6.0	< 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	< 1,000	<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	< 1.0	< 1	< 1	< 1
Lithium	ug/L	NC	40	180	180		27	--	24	24	19	17	15	14	16	15	20	20	45
Mercury	ug/L	2	NA	0.2	2		< 0.20	--	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.2	< 0.2	< 0.2
Molybdenum	ug/L	NC	100	6	100		41.9	--	39.0	40.5	41.9	45.3	39	38	< 5.0	< 5.0	< 5	< 5	< 5
Radium-226	pCi/L	NC	NA	NA	NA		0.707	--	< 0.587	0.606	< 0.740	< 0.865	< 0.379	< 0.406	0.165	0.185	< 0.469	< 0.335	0.621
Radium-228	pCi/L	NC	NA	NA	NA		1.01	--	0.756	0.886	0.857	< 0.598	< 0.754	< 0.586	< 0.456	0.497	1.14	< 0.554	< 0.502
Radium-226/228	pCi/L	5	NA	3.32	5		1.72	--	< 1.34	1.49	< 1.53	< 1.46	< 0.754	< 0.586	0.524	0.682	1.34	0.662	0.875
Selenium	ug/L	50	NA	2	50		< 1.0	--	< 1.0	< 1.0	< 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	< 2.0	< 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.
(2) Laboratory reporting limits exceeds GWPS due to sample dilutions performed as a result of the sample matrix.

Table 1
Comparison of Groundwater Sampling Results to Groundwater Protection Standards – August 2017 to October 2020
DE Karn Bottom Ash Pond – RCRA CCR Monitoring Program
Essexville, Michigan

						Sample Location:	DEK-MW-15006								
						Sample Date:	8/3/2017	9/18/2017	4/11/2018	5/24/2018	11/5/2018	11/5/2018	4/11/2019	10/14/2019	5/13/2020	10/7/2020
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS		downgradient					Field Dup				
Appendix III																
Boron	ug/L	NC	NA	619	NA		1,240	1,070	--	1,200	1,340	1,270	1,700	1,200	1,090	1,220
Calcium	mg/L	NC	NA	302	NA		39.9	76.8	--	21.9	29.4	29.6	35	34	70.4	106
Chloride	mg/L	250*	NA	2,440	NA		104	133	--	85.8	87.9	88.3	75	45	71.5	102
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	1,060
Sulfate	mg/L	250*	NA	407	NA		547	886	--	401	341	344	320	74	316	296
Total Dissolved Solids	mg/L	500*	NA	4,600	NA		1,110	1,670	--	944	792	784	780	450	833	1,010
pH, Field	SU	6.5 - 8.5*	NA	6.5 - 7.3	NA		7.9	7.8	7.9	8.2	7.9	--	7.8	7.8	8.1	7.7
Appendix IV																
Antimony	ug/L	6	NA	1	6		< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	3	< 1
Arsenic	ug/L	10	NA	21	**21**		14.6	--	18.3	**25.7**	20.9	19.6	21	**27**	21	**27**
Barium	ug/L	2,000	NA	1,300	2,000		31.0	--	39.6	22.8	38.5	38.3	43	51	86	141
Beryllium	ug/L	4	NA	1	4		< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1	< 1
Cadmium	ug/L	5	NA	0.2	5		< 0.20	--	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.2	< 0.2
Chromium	ug/L	100	NA	3	100		< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.1	2	6
Cobalt	ug/L	NC	6	15	15		< 15.0	--	< 15.0	< 15.0	< 6.0	< 6.0	< 6.0	< 6.0	< 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	1,060
Lead	ug/L	NC	15	1	15		< 1.0	--	< 1.0	320(1)	< 1.0	< 1.0	< 1.0	< 1.0	< 1	< 1
Lithium	ug/L	NC	40	180	180		17	--	18	< 10	< 10	10	< 10	11	15	22
Mercury	ug/L	2	NA	0.2	2		< 0.20	--	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.2	< 0.2
Molybdenum	ug/L	NC	100	6	100		64.2	--	71.6	48.7	50.3	48.0	59	11	18	11
Radium-226	pCi/L	NC	NA	NA	NA		< 0.945	--	< 0.688	< 0.738	< 0.885	< 1.06	< 0.459	< 0.159	< 0.370	0.629
Radium-228	pCi/L	NC	NA	NA	NA		< 0.906	--	< 0.755	< 1.12	< 0.649	< 0.897	< 0.677	< 0.581	0.78	0.492
Radium-226/228	pCi/L	5	NA	3.32	5		< 1.85	--	< 1.44	< 1.86	< 1.53	< 1.96	< 0.677	< 0.581	1.01	1.12
Selenium	ug/L	50	NA	2	50		< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1	< 1
Thallium	ug/L	2	NA	2	2		< 2.0	--	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 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.
(2) Laboratory reporting limits exceeds GWPS due to sample dilutions performed as a result of the sample matrix.

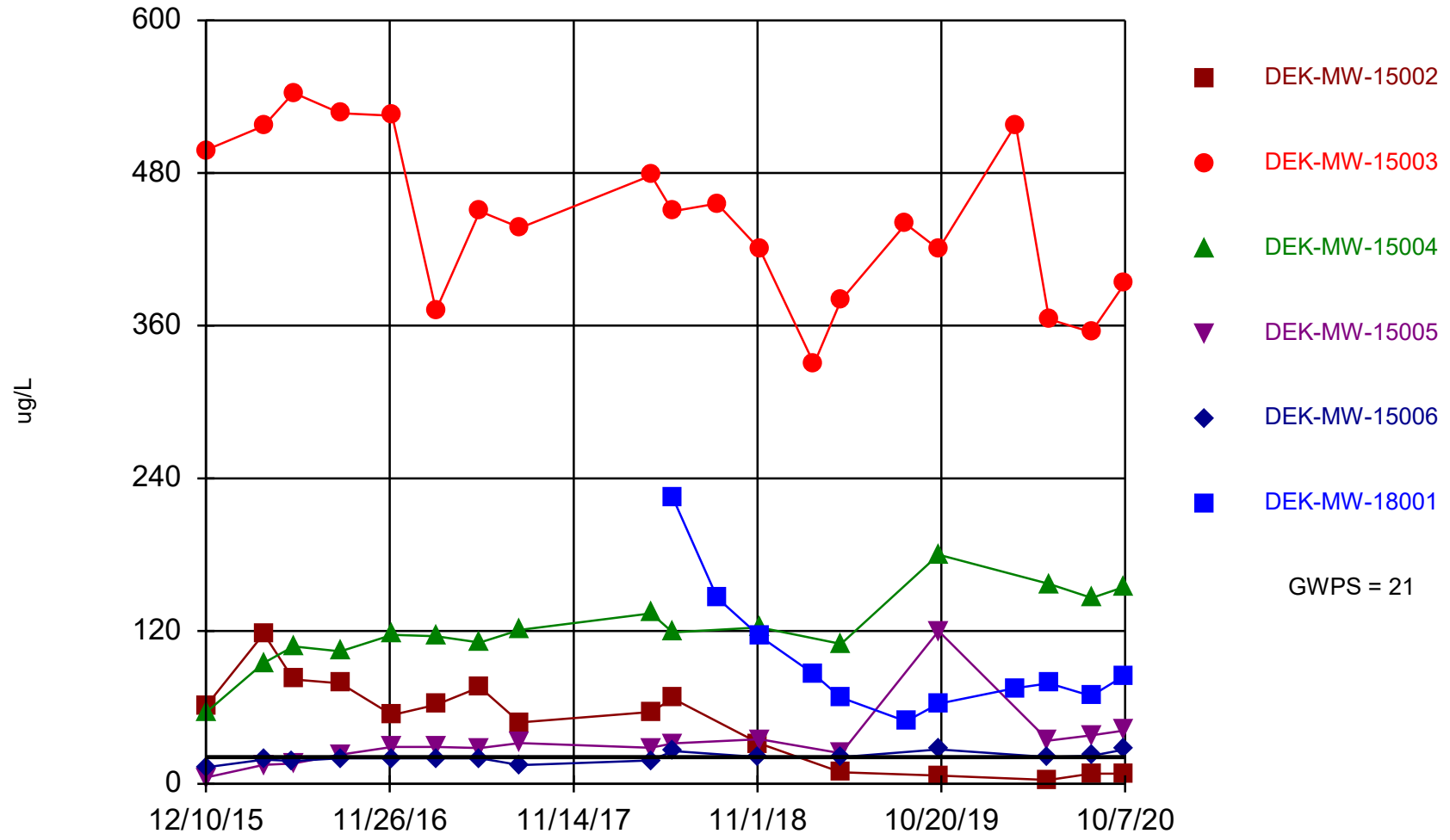
Table 1
Comparison of Groundwater Sampling Results to Groundwater Protection Standards – August 2017 to October 2020
DE Karn Bottom Ash Pond – RCRA CCR Monitoring Program
Essexville, Michigan

						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
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
Calcium	mg/L	NC	NA	302	NA		64.9	51.1	48	84	72.1	71.7
Chloride	mg/L	250*	NA	2,440	NA		69.1	76.6	69	81	64.7	60.7
Fluoride	ug/L	4,000	NA	1,000	NA		< 1,000	1,300	1,200	1,000	1,090	1,240
Sulfate	mg/L	250*	NA	407	NA		30.6	< 2.0	< 2.0	31	51.1	91.9
Total Dissolved Solids	mg/L	500*	NA	4,600	NA		434	340	360	500	484	476
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
Appendix IV												
Antimony	ug/L	6	NA	1	6		< 1.0	< 1.0	< 1.0	< 1.0	< 1	< 1
Arsenic	ug/L	10	NA	21	**21**		**225**	**116**	**68**	**63**	**79**	**85**
Barium	ug/L	2,000	NA	1,300	2,000		101	79.5	75	160	130	136
Beryllium	ug/L	4	NA	1	4		< 1.0	< 1.0	< 1.0	< 1.0	< 1	< 1
Cadmium	ug/L	5	NA	0.2	5		< 0.20	< 0.20	< 0.20	< 0.20	< 0.2	< 0.2
Chromium	ug/L	100	NA	3	100		< 1.0	< 1.0	< 1.0	< 1.0	< 1	< 1
Cobalt	ug/L	NC	6	15	15		< 15.0	< 6.0	< 6.0	< 6.0	< 6	< 6
Fluoride	ug/L	4,000	NA	1,000	4,000		< 1,000	1,300	1,200	1,000	1,090	1,240
Lead	ug/L	NC	15	1	15		< 1.0	< 1.0	< 1.0	< 1.0	< 1	< 1
Lithium	ug/L	NC	40	180	180		23	24	24	36	27	26
Mercury	ug/L	2	NA	0.2	2		< 0.20	< 0.20	< 0.20	< 0.20	< 0.2	< 0.2
Molybdenum	ug/L	NC	100	6	100		< 5.0	< 5.0	< 5.0	< 5.0	< 5	< 5
Radium-226	pCi/L	NC	NA	NA	NA		0.906	< 0.813	0.173	0.206	< 0.608	< 0.473
Radium-228	pCi/L	NC	NA	NA	NA		< 0.733	0.811	0.694	0.746	< 0.676	0.463
Radium-226/228	pCi/L	5	NA	3.32	5		1.63	1.56	0.867	0.952	< 0.676	0.591
Selenium	ug/L	50	NA	2	50		< 1.0	< 1.0	< 1.0	< 1.0	< 1	1
Thallium	ug/L	2	NA	2	2		< 2.0	< 2.0	< 2.0	< 2.0	< 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.
(2) Laboratory reporting limits exceeds GWPS due to sample dilutions performed as a result of the sample matrix.

Attachment 1
Sanitas™ Output Files

Arsenic, Total



Time Series Analysis Run 12/8/2020 4:16 PM

Client: Consumers Energy Data: DEK_CCR_Sanitas_20.11.18 _KR

Summary Report

Constituent: Arsenic, Total Analysis Run 12/9/2020 12:21 PM
Client: Consumers Energy Data: DEK_CCR_Sanitas_20.11.18

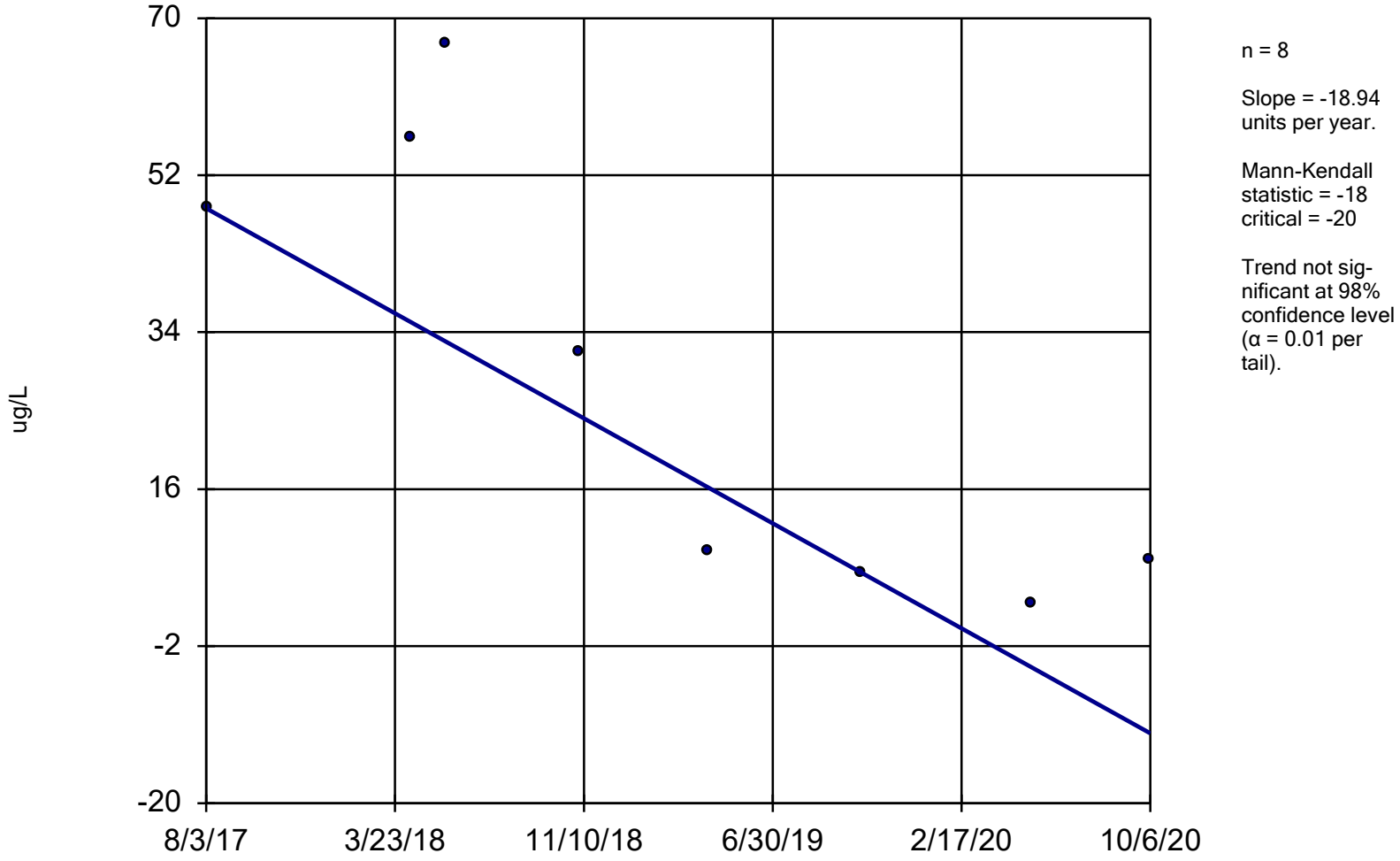
For observations made between 8/3/2017 and 10/7/2020, a summary of the selected data set:

Observations = 46
ND/Trace = 0
Wells = 6
Minimum Value = 3
Maximum Value = 478
Mean Value = 126.7
Median Value = 65
Standard Deviation = 145
Coefficient of Variation = 1.144
Skewness = 1.345

Well	#Obs.	ND/Trace	Min	Max	Mean	Median	Std.Dev.	CV	Skewness
DEK-MW-15002	8	0	3	67	28.74	20.35	25.63	0.8918	0.3634
DEK-MW-15003	8	0	365	478	417.9	420	37.55	0.08986	0.1153
DEK-MW-15004	8	0	110	180	137.4	128.5	24.16	0.1759	0.6104
DEK-MW-15005	8	0	24	120	43.36	32.95	31.4	0.7241	2.145
DEK-MW-15006	8	0	14.6	27	21.94	21	4.397	0.2004	-0.2393
DEK-MW-18001	6	0	63	225	106	82	61.19	0.5773	1.456

Arsenic, Total

DEK-MW-15002



n = 8

Slope = -18.94 units per year.

Mann-Kendall statistic = -18 critical = -20

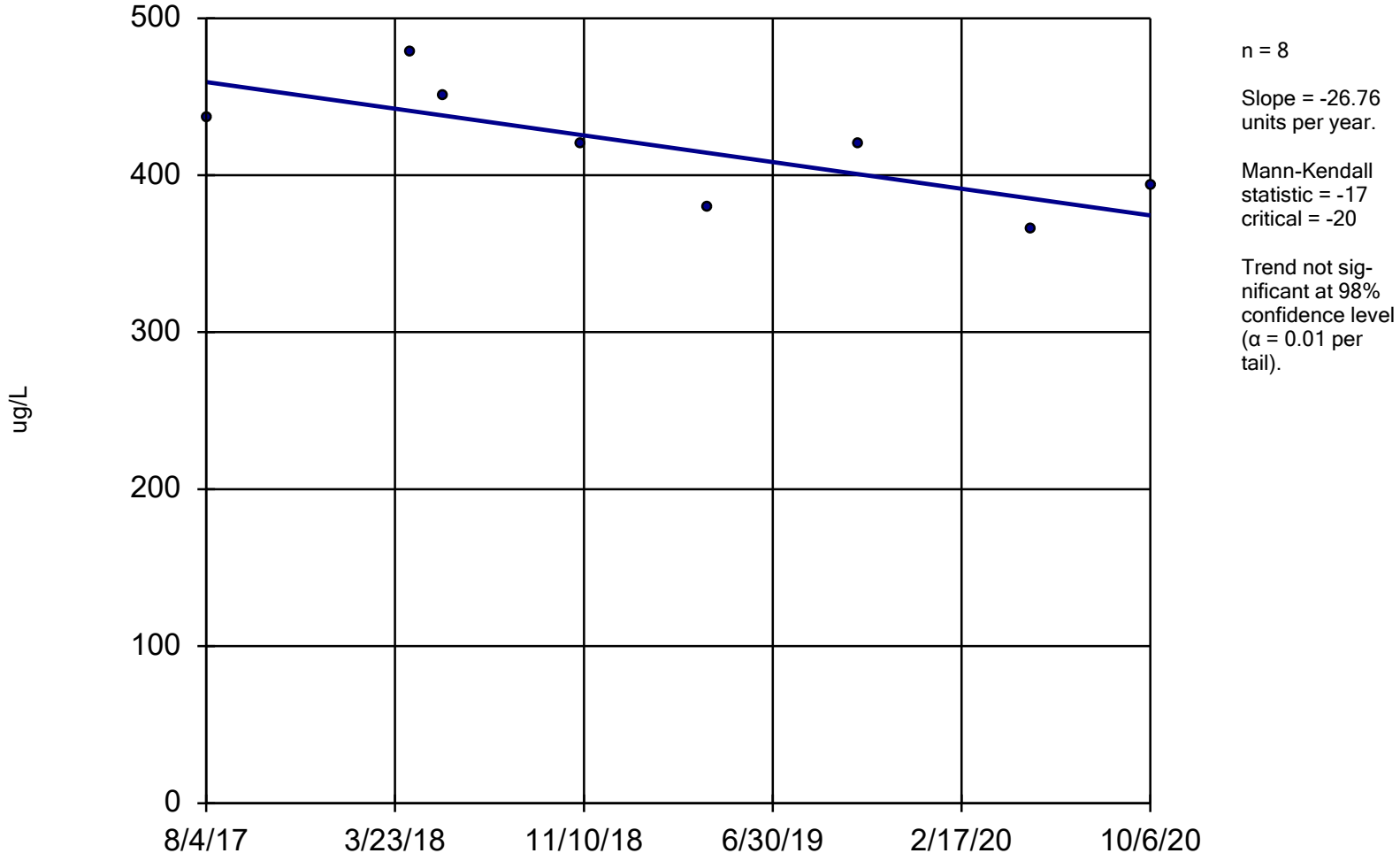
Trend not significant at 98% confidence level (α = 0.01 per tail).

Sen's Slope Estimator Analysis Run 12/8/2020 4:36 PM

Client: Consumers Energy Data: DEK_CCR_Sanitas_20.11.18 _KR

Arsenic, Total

DEK-MW-15003



n = 8

Slope = -26.76 units per year.

Mann-Kendall statistic = -17
critical = -20

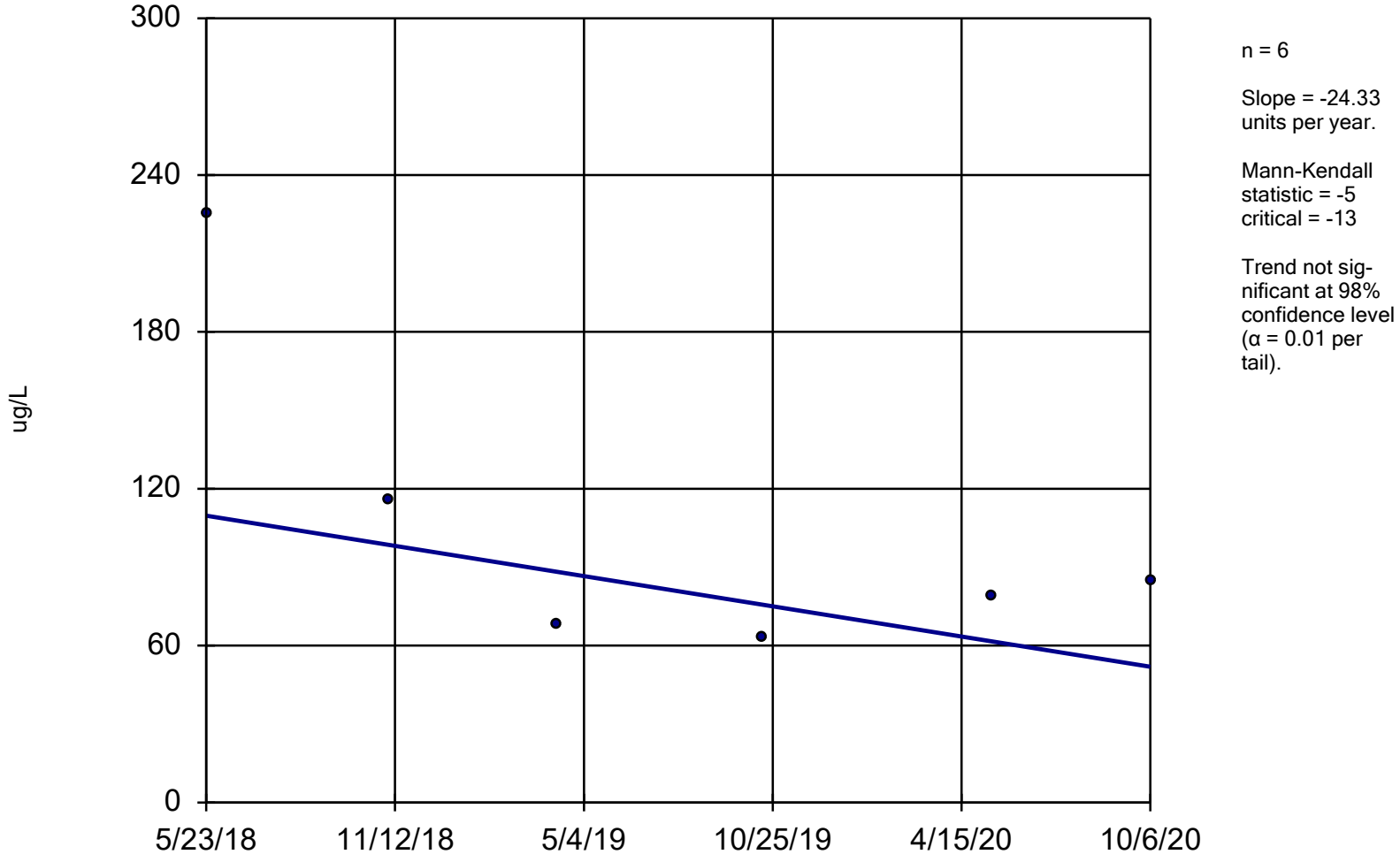
Trend not significant at 98% confidence level (α = 0.01 per tail).

Sen's Slope Estimator Analysis Run 12/8/2020 4:31 PM

Client: Consumers Energy Data: DEK_CCR_Sanitas_20.11.18 _KR

Arsenic, Total

DEK-MW-18001



n = 6

Slope = -24.33 units per year.

Mann-Kendall statistic = -5
critical = -13

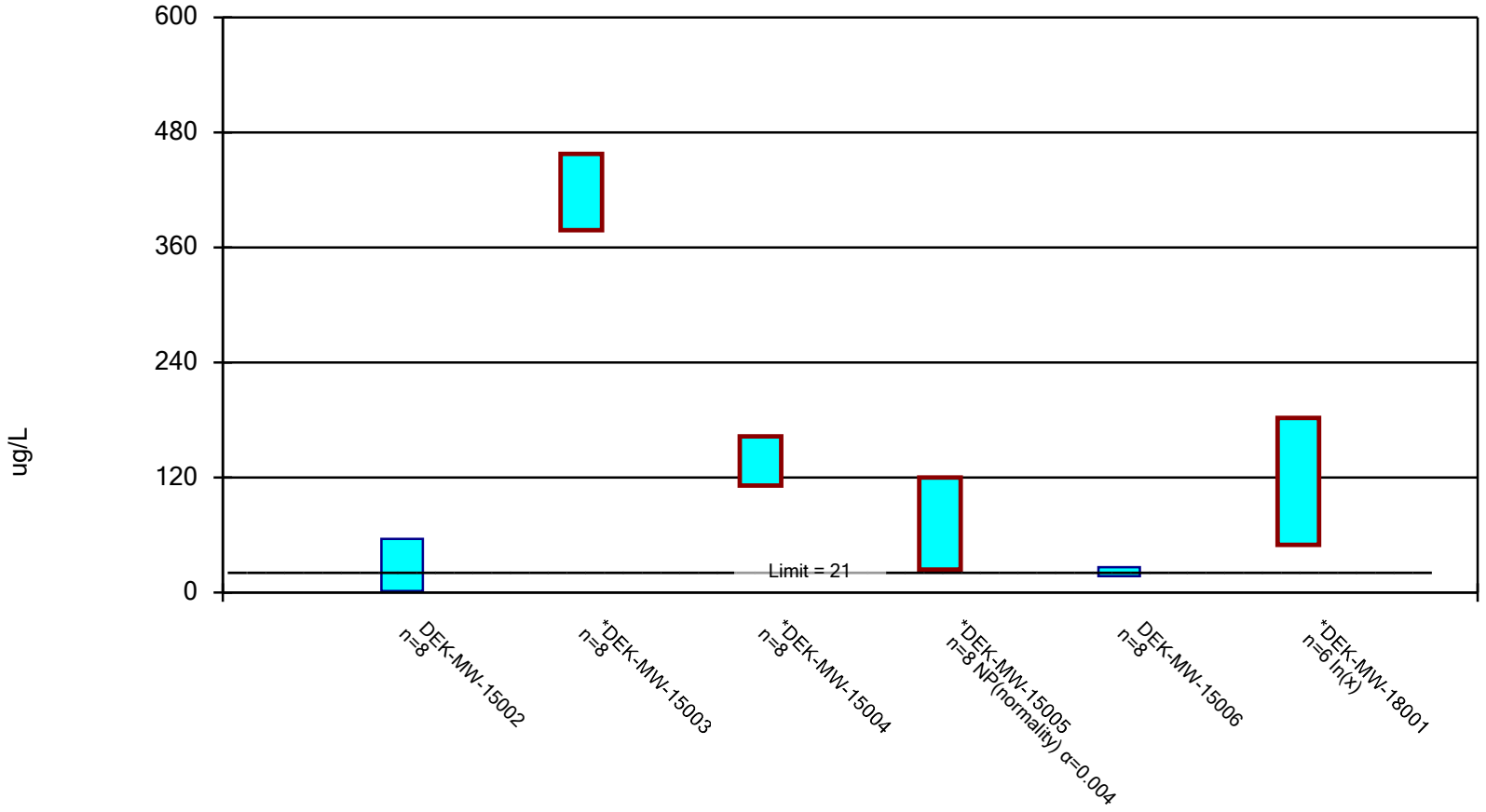
Trend not significant at 98% confidence level (α = 0.01 per tail).

Sen's Slope Estimator Analysis Run 12/8/2020 4:34 PM

Client: Consumers Energy Data: DEK_CCR_Sanitas_20.11.18 _KR

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 12/9/2020 12:21 PM

Client: Consumers Energy Data: DEK_CCR_Sanitas_20.11.18

Confidence Interval

Constituent: Arsenic, Total (ug/L) Analysis Run 12/9/2020 12:22 PM

Client: Consumers Energy Data: DEK_CCR_Sanitas_20.11.18

	DEK-MW-15002	DEK-MW-15003	DEK-MW-15004	DEK-MW-15005	DEK-MW-15006	DEK-MW-18001
8/3/2017	48.3		121	31.9	14.6	
8/4/2017		437				
4/11/2018				28.3	18.3	
4/12/2018	56.4	478	134			
5/23/2018	67	450	119			225
5/24/2018				31.7	25.7	
11/5/2018	31.7				20.9	
11/6/2018		420	123	35		116
4/10/2019						68
4/11/2019	9	380	110	24	21	
10/15/2019	6.5	420	180	120	27	63
5/13/2020	3			34	21	
5/14/2020		365	157			79
10/6/2020	8	393				85
10/7/2020			155	42	27	
Mean	28.74	417.9	137.4	43.36	21.94	106
Std. Dev.	25.63	37.55	24.16	31.4	4.397	61.19
Upper Lim.	55.9	457.7	163	120	26.6	182.1
Lower Lim.	1.574	378.1	111.8	24	17.28	49.9

Attachment C
Nature and Extent Groundwater Data (2020)

Table C1
Summary of Groundwater Sampling Results (Analytical): March 2020 - October 2020
DE Karn Nature and Extent Monitoring Wells
Essexville, Michigan

										Sample Location:	MW-01			MW-03				MW-06			
										Sample Date:	3/9/2020	5/12/2020	8/7/2020	10/6/2020	3/9/2020	5/12/2020	8/7/2020	10/6/2020	3/9/2020	5/12/2020	8/7/2020	10/6/2020
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		**5,930**	**5,100**	**5,800**	**5,570**	**7,180**	**7,230**	**8,390**	**8,030**	**1,180**	**1,280**	**1,240**	**1,460**
Calcium	mg/L	NA	NC	NC	500[EE]	NC	NC	NC	NC		--	**81.3**	**90.6**	**79.9**	--	**98.3**	**119**	**113**	**234**	**304**	**158**	**159**
Chloride	mg/L	NA	250[E]	250[E]	50	NC	NC	NC	NC		--	**72.9**	**76.6**	**76.6**	--	**60.9**	**70.7**	**65.9**	**19.1**	**25.8**	**17.1**	**27.2**
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		< 2	< 1	< 1	< 2	**24**	**9.3**	**4.37**	< 2	**394**	**632**	**215**	**233**
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		**8.6**	**8.5**	**8.3**	**8.8**	**8.6**	**9.3**	**7.8**	**8.7**	**7.5**	**7.2**	**7.2**	**7.4**
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		**12**	**13**	**7**	**10**	**4**	**4**	**4**	**3**	**113**	**112**	**207**	**217**
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		**11**	**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		**96**	**87**	**102**	**86**	**83**	**94**	**97**	**83**	**64**	**74**	**66**	**61**
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	**11**	< 5	< 5	< 5	< 5	< 5	**9**	**10**
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**	**2**	< 1	**1**	< 1	**2**	< 1	**2**	**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		**152**	**113**	**119**	**145**	**52**	< 20	**112**	< 20	**3,100**	**5,390**	**1,770**	**1,820**
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}.
[x] - Unconfirmed elevated detection; anomalous data.
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 C1
Summary of Groundwater Sampling Results (Analytical): March 2020 - October 2020
DE Karn Nature and Extent Monitoring Wells
Essexville, Michigan

										MW-08				MW-10				MW-12			
									Sample Location:												
									Sample Date:	3/9/2020	5/12/2020	8/7/2020	10/6/2020	3/11/2020	5/12/2020	8/7/2020	10/7/2020	3/11/2020	5/12/2020	8/7/2020	10/7/2020
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	**5,060**	**3,840**	**4,980**	**4,560**	**2,870**	**2,370**	**4,260**	**4,580**	**3,360**	**2,750**	**3,740**	**3,750**
Calcium	mg/L	NA	NC	NC	500[EE]	NC	NC	NC	NC	**257**	**265**	**238**	**240**	**288**	**319**	**216**	**184**	**255**	**238**	**242**	**239**
Chloride	mg/L	NA	250[E]	250[E]	50	NC	NC	NC	NC	**48.8**	**62.1**	**60.4**	**63.8**	**38**	**49.8**	**49.5**	**62.5**	**49.8**	**60.2**	**63.4**	**60.3**
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	**447**	**538**	**399**	**492**	**506**	**633**	**228**	**135**	**431**	**328**	**325**	**414**
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	**7.4**	**7.6**	**7.2**	**7.3**	**7.0**	**7.6**	**7.3**	**7.4**	**7.2**	**7.7**	**7.2**	**7.3**
Appendix IV																					
Antimony	ug/L	6	6.0	6.0	2.0	1,100	2,300	NC	NC	--	--	--	--	--	--	--	--	--	--	--	--
Arsenic	ug/L	21[1]	10	10	10	340	680	100	680	**97**	**77**	**92**	**88**	**707**	**730**	**911**	**888**	**152**	**216**	**247**	**257**
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	**3**	< 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	**137**	**121**	**133**	**110**	**89**	**80**	**143**	**123**	**95**	**94**	**113**	**102**
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	**35**	**29**	**29**	**27**	**19**	**22**	**6**	< 5	**22**	**20**	**15**	**18**
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**	**2**	**2**	**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	**6,300**	**6,000**	**6,300**	**6,190**	**6,310**	**6,880**	**4,890**	**3,050**	**1,200**	**1,950**	**2,120**	**1,980**
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}.
[x] - Unconfirmed elevated detection; anomalous data.
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 C1
Summary of Groundwater Sampling Results (Analytical): March 2020 - October 2020
DE Karn Nature and Extent Monitoring Wells
Essexville, Michigan

									Sample Location:	MW-14				MW-16				MW-22			
									Sample Date:	3/11/2020	5/12/2020	8/7/2020	10/7/2020	3/11/2020	5/12/2020	8/7/2020	10/6/2020	3/11/2020	5/13/2020	8/10/2020	10/8/2020
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	**2,410**	**2,040**	**2,320**	**2,320**	**971**	**1,390**	**1,350**	**1,290**	**6,640**	**5,960**	**6,450**	**7,000**
Calcium	mg/L	NA	NC	NC	500[EE]	NC	NC	NC	NC	**207**	**260**	**321**	**309**	**293**	**291**	**264**	**319**	**74.7**	**82.4**	**74.2**	**80.1**
Chloride	mg/L	NA	250[E]	250[E]	50	NC	NC	NC	NC	**71.2**	**95.1**	**62.4**	**48.6**	**61.2**	**69.9**	**51.2**	**75.4**	**72**	**76.6**	**81.2**	**82.9**
Fluoride	ug/L	4,000	NC	NC	NC	9,800	20,000	NC	NC	--	--	--	--	--	--	--	--	**1,800**	--	--	--
Sulfate	mg/L	NA	250[E]	250[E]	500[EE]	NC	NC	NC	NC	**363**	**657**	**663**	**703**	**848**	**895**	**720**	**921**	**180**	**193**	**181**	**176**
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	**7.1**	**7.5**	**7.0**	**7.2**	**7.3**	**7.8**	**7.3**	**7.5**	**8.0**	**7.0**	**6.6**	**7.3**
Appendix IV																					
Antimony	ug/L	6	6.0	6.0	2.0	1,100	2,300	NC	NC	--	--	--	--	--	--	--	--	--	--	--	--
Arsenic	ug/L	21[1]	10	10	10	340	680	100	680	**80**	**49**	**74**	**164**	**1**	**1**	**1**	< 1	**536**	**491**	**487**	**517**
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	**70[x]**	< 1	< 1	< 1	**2**	< 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	--	--	--	--	--	--	--	--	**1,800**	--	--	--
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	**109**	**108**	**118**	**116**	**89**	**121**	**107**	**103**	**129**	**120**	**142**	**146**
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	**13**	**10**	**11**	**5**	**19**	**26**	**27**	**27**	**614**	**638**	**748**	**830**
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	**5**	**9**	**2**	**2**	**3**	**3**	**2**	**2**	**1**	**1**	**2**	**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	**3,800**	**546**	**597**	**1,440**	**92**	**369**	**350**	**225**	**96**	**70**	**46**	**76**
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}.
[x] - Unconfirmed elevated detection; anomalous data.
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 C1
Summary of Groundwater Sampling Results (Analytical): March 2020 - October 2020
DE Karn Nature and Extent Monitoring Wells
Essexville, Michigan

										Sample Location:	MW-23			OW-10				OW-11			
										Sample Date:	3/11/2020	5/13/2020	8/11/2020	10/8/2020	3/11/2020	5/14/2020	8/4/2020	10/8/2020	3/11/2020	5/14/2020	8/4/2020	10/8/2020
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		**6,090**	**6,040**	**7,210**	**7,750**	**1,290**	**1,100**	**1,210**	**1,400**	**2,740**	**2,900**	**2,800**	**3,040**
Calcium	mg/L	NA	NC	NC	500[EE]	NC	NC	NC	NC		**132**	**148**	**153**	**164**	**97.6**	**94.9**	**110**	**102**	**17.6**	**17.9**	**13.7**	**21.3**
Chloride	mg/L	NA	250[E]	250[E]	50	NC	NC	NC	NC		**55**	**57.7**	**55.6**	**61.5**	**61.4**	**64.6**	**61.6**	**78.9**	**65.1**	**79.3**	**76**	**75.7**
Fluoride	ug/L	4,000	NC	NC	NC	9,800	20,000	NC	NC		**1,600**	--	--	--	< 1,000	< 1,000	< 1,000	< 1,000	**2,850**	**4,510**	**4,790**	**5,160**
Sulfate	mg/L	NA	250[E]	250[E]	500[EE]	NC	NC	NC	NC		**180**	**185**	**189**	**201**	**20.6**	**12.4**	**46.4**	**11.9**	**24.9**	**25.7**	**24.3**	**25.9**
Total Dissolved Solids	mg/L	NA	500[E]	500[E]	500	NC	NC	NC	NC		--	--	**926**	**867**	**538**	**480**	**562**	**527**	**260**	**249**	**271**	**238**
pH, Field	su	NA	6.5 - 8.5[E]	6.5 - 8.5[E]	6.5 - 9.0	NC	NC	NC	NC		**7.6**	**7.6**	**7.1**	**6.9**	**7.2**	**7.3**	**7.2**	**7.4**	**8.8**	**8.5**	**9.1**	**9.4**
Appendix IV																						
Antimony	ug/L	6	6.0	6.0	2.0	1,100	2,300	NC	NC		--	--	--	--	< 1	**1**	< 1	< 1	**2**	**1**	**2**	**1**
Arsenic	ug/L	21[1]	10	10	10	340	680	100	680		**48**	**66**	**60**	**56**	**4**	**7**	**5**	**3**	**560**	**505**	**523**	**557**
Barium	ug/L	2,000	2,000	2,000	1,200	3,400	7,000	NC	NC		--	--	--	--	**105**	**137**	**141**	**129**	**50**	**49**	**43**	**50**
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	< 0.5	< 0.2	< 0.2	< 0.2
Chromium	ug/L	100	100	100	11	16	32	NC	NC		< 1	**1**	< 1	< 1	**1**	**2**	< 1	**1**	**4**	< 1	**2**	< 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		**1,600**	--	--	--	< 1,000	< 1,000	< 1,000	< 1,000	**2,850**	**4,510**	**4,790**	**5,160**
Lead	ug/L	15	4.0	4.0	14	250	500	NC	NC		--	--	--	--	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Lithium	ug/L	180	170	350	440	910	1,800	NC	NC		**91**	**105**	**138**	**141**	**31**	**24**	**31**	**30**	**17**	**14**	**13**	**17**
Mercury	ug/L	2	2.0	2.0	0.20#	1.4	2.8	NC	NC		--	--	--	--	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Molybdenum	ug/L	100	73	210	120	29,000	58,000	NC	NC		**85**	**85**	**75**	**78**	< 5	< 5	< 5	< 5	**517**	**467**	**407**	**407**
Radium-226/228	pci/L	5	NC	NC	NC	NC	NC	NC	NC		--	--	--	--	--	< 0.464	--	**0.875**	--	< 0.423	--	< 0.616
Selenium	ug/L	50	50	50	5.0	62	120	55	120		**1**	**2**	**1**	**2**	**2**	**2**	**4**	**2**	**3**	**2**	**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		**13,600**	**21,600**	**21,500**	**17,400**	**982**	**950**	**1,770**	**991**	**38**	< 20	**54**	**57**
Copper	ug/L	NA	1,000[E]	1,000[E]	20	33	66	NC	NC		--	--	--	--	< 1	**4**	**2**	**1**	< 1	< 1	**2**	**1**
Nickel	ug/L	NA	100	100	120	1,000	2,100	NC	NC		--	--	--	--	< 2	**2**	< 2	< 2	**4**	< 2	**3**	< 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	**6**	< 2	< 2	< 2	**5**	**4**	**3**	**63**	**93**	**351**	**180**
Zinc	ug/L	NA	2,400	5,000[E]	260	260	520	NC	NC		--	--	--	--	< 10	< 10	< 30	< 10	< 10	< 10	< 30	< 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}.
[x] - Unconfirmed elevated detection; anomalous data.
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 C1
Summary of Groundwater Sampling Results (Analytical): March 2020 - October 2020
DE Karn Nature and Extent Monitoring Wells
Essexville, Michigan

									Sample Location:	**OW-12**			
									Sample Date:	3/12/2020	5/14/2020	8/3/2020	10/8/2020
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	**816**	**693**	**798**	**851**
Calcium	mg/L	NA	NC	NC	500[EE]	NC	NC	NC	NC	**108**	**84.9**	**109**	**79.6**
Chloride	mg/L	NA	250[E]	250[E]	50	NC	NC	NC	NC	**47.1**	**53.8**	**46.3**	**50**
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	**177**	**169**	**192**	**153**
Total Dissolved Solids	mg/L	NA	500[E]	500[E]	500	NC	NC	NC	NC	**669**	**557**	**696**	**492**
pH, Field	su	NA	6.5 - 8.5[E]	6.5 - 8.5[E]	6.5 - 9.0	NC	NC	NC	NC	**7.0**	**7.1**	**7.1**	**7.3**
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	**71**	**71**	**111**	**114**
Barium	ug/L	2,000	2,000	2,000	1,200	3,400	7,000	NC	NC	**73**	**62**	**83**	**71**
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	**30**	< 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	**38**	**30**	**34**	**31**
Mercury	ug/L	2	2.0	2.0	0.20#	1.4	2.8	NC	NC	< 0.2	< 0.2	< 0.2	< 0.2
Molybdenum	ug/L	100	73	210	120	29,000	58,000	NC	NC	**16**	**20**	**16**	**24**
Radium-226/228	pci/L	5	NC	NC	NC	NC	NC	NC	NC	--	**0.421**	--	< 0.457
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	**7,630**	**4,430**	**5,280**	**3,620**
Copper	ug/L	NA	1,000[E]	1,000[E]	20	33	66	NC	NC	**1**	< 1	**2**	< 1
Nickel	ug/L	NA	100	100	120	1,000	2,100	NC	NC	**16**	< 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	< 10	< 10	< 30	< 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}.
[x] - Unconfirmed elevated detection; anomalous data.
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 C2
Summary of Groundwater Sampling Results (Analytical): March 2020 - October 2020
DE Karn Nature and Extent GSI Monitoring Locations
Essexville, Michigan

										T1-3GSI				T2-3GSI				T3-3GSI			
									Sample Location:												
									Sample Date:	3/10/2020	5/12/2020	8/6/2020	10/5/2020	3/10/2020	5/12/2020	8/6/2020	10/5/2020	3/10/2020	5/12/2020	8/6/2020	10/5/2020
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	**55**	**81**	**62**	**38**	**1,070**	**2,800**	**4,310**	**5,220**	**238**	**1,870**	**3,290**	**2,320**
Calcium	mg/L	NA	NC	NC	500[EE]	NC	NC	NC	NC	**59.5**	**51.5**	**51.1**	**48.7**	**151**	**311**	**387**	**326**	**200**	**180**	**222**	**170**
Chloride	mg/L	NA	250[E]	250[E]	50	NC	NC	NC	NC	**35.7**	**27.9**	**60.8**	**49**	**18**	**35.8**	**26.9**	**45**	**57**	**44.6**	**54.6**	**53.3**
Fluoride	ug/L	4,000	NC	NC	NC	9,800	20,000	NC	NC	--	--	--	--	**1,400**	--	--	--	< 1,000	--	--	--
Sulfate	mg/L	NA	250[E]	250[E]	500[EE]	NC	NC	NC	NC	**21.3**	**19.5**	**25**	**24.8**	**110**	**564**	**664**	**372**	< 1	< 1	**1**	**3.38**
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]	9.0	NC	NC	NC	NC	**7.2**	**7.6**	**7.8**	**7.4**	**7.1**	**7.2**	**7.3**	**7.0**	**6.7**	**7.0**	**6.9**	**7.3**
Appendix IV																					
Arsenic	ug/L	21[1]	10	10	10	340	680	100[2]	680	**6**	**1**	**3**	**1**	**10**	**21**	**52**	**18**	**40**	**72**	**1**	< 1
Chromium	ug/L	100	100	100	11	16	32	NC	NC	< 1	< 1	< 1	< 1	**2**	< 1	**2**	**1**	**4**	**2**	**2**	**2**
Fluoride	ug/L	4,000	NC	NC	NC	9,800	20,000	NC	NC	--	--	--	--	**1,400**	--	--	--	< 1,000	--	--	--
Lithium	ug/L	180	170	350	440	910	1,800	NC	NC	< 10	< 10	< 10	< 10	**36**	**98**	**178**	**154**	**19**	**84**	**111**	**82**
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	< 1	< 1	**2**	**1**	< 1	< 1	**2**	**2**	< 1	< 1
MI Part 115 Parameters																					
Iron	ug/L	NA	300[E]	300[E]	500,000[EE]	NC	NC	NC	NC	**2,950**	**36**	**104**	**35**	**13,300**	**27,600**	**40,300**	**7,860**	**59,300**	**53,100**	**2,670**	**3,650**
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.
^ - 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.
[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}.
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.
[2] - Compliance demonstrated on a flux basis.

Table C2
Summary of Groundwater Sampling Results (Analytical): March 2020 - October 2020
DE Karn Nature and Extent GSI Monitoring Locations
Essexville, Michigan

										Sample Location:	T4-3GSI				T5-3GSI				T6-3GSI			
										Sample Date:	3/10/2020	5/13/2020	8/5/2020	10/6/2020	3/10/2020	5/13/2020	8/5/2020	10/6/2020	3/11/2020	5/13/2020	8/5/2020	10/6/2020
Constituent	Unit	GWPS*	MI Residential**	MI Non-Residential**	MI GSI^	MI AMV***	MI FAV***	Chronic MZ^^	Acute MZ^^		transect not accessible												
Appendix III																							
Boron	ug/L	NA	500	500	4,000	34,000	69,000	44,000	69,000	NS		**60**	**366**	**131**	**2,560**	**2,610**	**2,840**	**747**	**66**	**90**	**249**	**137**
Calcium	mg/L	NA	NC	NC	500[EE]	NC	NC	NC	NC	NS		**153**	**143**	**79.1**	**217**	**270**	**290**	**221**	**152**	**89.6**	**211**	**203**
Chloride	mg/L	NA	250[E]	250[E]	50	NC	NC	NC	NC	NS		**44.9**	**38.8**	**45.5**	**54**	**70.6**	**67.6**	**72.3**	**35.2**	**37.7**	**51.7**	**44.1**
Fluoride	ug/L	4,000	NC	NC	NC	9,800	20,000	NC	NC	NS		--	--	--	< 1,000	--	--	--	--	--	--	--
Sulfate	mg/L	NA	250[E]	250[E]	500[EE]	NC	NC	NC	NC	NS		**3.45**	< 1	< 2	**170**	**248**	**15.2**	**146**	**2.83**	**23.3**	**1.01**	< 2
Total Dissolved Solids	mg/L	NA	500[E]	500[E]	500	NC	NC	NC	NC	NS		--	**608**	**427**	--	--	**515**	**1,050**	--	--	**906**	--
pH, Field	su	NA	6.5 - 8.5[E]	6.5 - 8.5[E]	9.0	NC	NC	NC	NC	NS		**7.4**	**7.2**	**7.3**	**7.5**	**7.6**	**7.3**	**7.5**	**7.1**	**7.6**	**6.9**	**6.9**
Appendix IV																							
Arsenic	ug/L	21[1]	10	10	10	340	680	100[2]	680	NS		**139**	**154**	**84**	**46**	**67**	**122**	**93**	**7**	**10**	**48**	**76**
Chromium	ug/L	100	100	100	11	16	32	NC	NC	NS		**6**	**4**	**2**	< 1	**2**	**2**	**2**	< 1	< 1	**3**	**3**
Fluoride	ug/L	4,000	NC	NC	NC	9,800	20,000	NC	NC	NS		--	--	--	< 1,000	--	--	--	--	--	--	--
Lithium	ug/L	180	170	350	440	910	1,800	NC	NC	NS		**12**	**14**	< 10	**62**	**67**	**73**	**35**	< 10	< 10	**14**	**14**
Molybdenum	ug/L	100	73	210	120	1.4	2.8	NC	NC	NS		< 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	NS		**2**	< 1	< 1	**2**	**1**	**1**	**1**	< 1	**1**	< 1	< 1
MI Part 115 Parameters																							
Iron	ug/L	NA	300[E]	300[E]	500,000[EE]	NC	NC	NC	NC	NS		**37,100**	**24,200**	**13,000**	**7,620**	**13,100**	**13,200**	**3,530**	**9,670**	**3,560**	**23,100**	**48,900**
Vanadium	ug/L	NA	4.5	62	27	260	520	NC	NC	NS		**4**	**4**	**2**	< 2	< 2	**2**	< 2	< 2	< 2	**2**	**2**

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

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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.
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