2019 Annual Groundwater Monitoring and Corrective Action Report

DE Karn Power Plant
Lined Impoundment CCR Unit

Essexville, Michigan

January 2020

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Prepared For
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Executive Summary

TRC prepared this Annual Groundwater Monitoring and Corrective Action Report for the Karn Lined Impoundment, on behalf of Consumers Energy to cover the period of January 1, 2019 to December 31, 2019. As discussed in the *2018 Annual Groundwater Monitoring Report for the DE Karn Power Plant Lined Impoundment CCR Unit* (2018 Annual Report) (TRC, January 2019), the initial detection monitoring event performed to comply with §257.94 was completed in November 2018. The statistical comparison of downgradient detection monitoring concentrations (Appendix III to Part 257 of the CCR Rule) to background levels was completed and submitted to Consumers Energy on March 13, 2019, within 90 days of completing the sampling and analysis for the initial detection monitoring event.

Potential statistically significant increases (SSIs) over background limits were noted for various Appendix III constituents during the November 2018 detection monitoring event. TRC prepared an Alternate Source Demonstration (ASD) to evaluate the November 2018 SSIs. The ASD concluded that a source other than the Karn Lined Impoundment CCR Unit caused the SSIs and did not initiate Assessment Monitoring. The Karn Lined Impoundment is adjacent to the Karn Bottom Ash Pond CCR unit, which has triggered corrective action pursuant to the groundwater and corrective action standards of the CCR Rule. Consumers Energy is continuing to evaluate corrective measures for the Karn Bottom Ash Pond in accordance with §257.96 and §257.97.

The semiannual detection monitoring events for 2019 were completed in April and October and included sampling and analyzing groundwater within the groundwater monitoring system for constituents listed in Appendix III. In addition to the semiannual detection monitoring events completed in accordance with §257.94 of the CCR Rule, the Karn Lined Impoundment groundwater monitoring system was sampled quarterly for all constituents listed in Appendix III and Appendix IV of the CCR Rule to accumulate sufficient data to evaluate the potential of an intra well statistical program for detection monitoring. Quarterly monitoring events were conducted in February, April, August, and October 2019. As part of the statistical evaluation, the data collected during detection monitoring events are evaluated to identify SSIs in detection monitoring parameters to determine if concentrations in detection monitoring wells sampled exceed background levels. Potential SSIs over background limits were again noted for various Appendix III constituents during the April and October 2019 detection monitoring event. TRC updated the November 2018 ASD to include additional constituents. The ASD concluded that a source other than the Karn Lined Impoundment CCR Unit caused the SSIs and did not initiate Assessment Monitoring.

Detection monitoring will be continued at the Karn Lined Impoundment in conformance with the groundwater monitoring and corrective action standards in the CCR Rule. Consumers Energy will be submitting an application for operating a CCR Surface Impoundment to the Michigan Department of Environment, Great Lakes, and Energy (EGLE) in 2020 that will require a Hydrogeological Monitoring Plan (HMP) which will conform with both the federal CCR rules §257.90 - §257.94 and the state standards in PA 640[1]. At that time the statistical evaluation program will be re-evaluated. The next groundwater sampling event at the Karn Lined Impoundment is tentatively scheduled for the March 2020.

[1] [1] On December 28, 2018, the State of Michigan enacted Public Act No. 640 of 2018 (PA 640) to amend the Natural Resources and Environmental Protection Act, also known as Part 115 of PA 451 of 1994, as amended (a.k.a., Michigan Part 115 Solid Waste Management). The December 2018 amendments to Part 115 were developed to provide the State of Michigan oversight of CCR impoundments and landfills and to better align existing state solid waste management rules and statutes with the CCR Rule.

Section 1
Introduction

On April 17, 2015, the United States Environmental Protection Agency (USEPA) published the final rule for the regulation and management of Coal Combustion Residuals (CCR) under the Resource Conservation and Recovery Act (RCRA) (the CCR Rule), as amended. Standards for groundwater monitoring and corrective action codified in the CCR Rule (40 CFR 257.90 – 257.98) apply to the DE Karn Lined Surface Impoundment CCR Unit (Karn Lined Impoundment). Pursuant to the CCR Rule, no later than January 31 of the year following the calendar year a groundwater monitoring system has been established, and annually thereafter, the owner or operator of a CCR unit must prepare an annual groundwater monitoring and corrective action report for the CCR unit documenting the status of groundwater monitoring and corrective action for the preceding year in accordance with §257.90(e).

TRC prepared this Annual Groundwater Monitoring and Corrective Action Report for the Karn Lined Impoundment, on behalf of Consumers Energy to cover the period of January 1, 2019 to December 31, 2019.

1.1 Program Summary

As discussed in the *2018 Annual Groundwater Monitoring Report for the DE Karn Power Plant Lined Impoundment CCR Unit* (2018 Annual Report) (TRC, January 2019), the initial detection monitoring event performed to comply with §257.94 was completed in November 2018. The statistical comparison of downgradient detection monitoring concentrations (Appendix III to Part 257 of the CCR Rule) to background levels was completed and submitted to Consumers Energy on March 13, 2019, within 90 days of completing the sampling and analysis for the initial detection monitoring event. The monitoring was performed in accordance with the *Sample Analysis Plan* (SAP) (TRC, June 2018) and was statistically evaluated per the *Groundwater Statistical Evaluation Plan* (Stats Plan) (TRC, June 2018).

Potential SSIs over background limits were noted for various Appendix III constituents during the initial November 2018 detection monitoring event. TRC prepared an Alternate Source Demonstration (ASD) to evaluate the November 2018 SSIs. The ASD concluded that a source other than the Karn Lined Impoundment CCR unit caused the SSIs and did not initiate Assessment monitoring. The ASD is included in Appendix A. The Karn Lined Impoundment is adjacent to the Bottom Ash Pond CCR unit, which has triggered corrective action. Consumers Energy is continuing to evaluate corrective measures for the Karn Bottom Ash Pond in accordance with §257.96 and §257.97.

The semiannual detection monitoring events for 2019 were completed in April and October 2019 and included sampling and analyzing groundwater within the groundwater monitoring system for constituents listed in Appendix III. In addition to the semiannual detection monitoring events completed in accordance with §257.94 of the CCR Rule, the Karn Lined Impoundment groundwater monitoring system was sampled quarterly for all constituents listed in Appendix III and Appendix IV of the CCR Rule to accumulate sufficient data to evaluate the potential of an intra well statistical program for detection monitoring. Quarterly monitoring events were conducted in February, April, August, and October 2019. As part of the statistical evaluation, the data collected during detection monitoring events are evaluated to identify SSIs in detection monitoring parameters to determine if concentrations in detection monitoring wells sampled exceed background levels. The results of the statistical evaluation are discussed in Section 3.

1.2 Site Overview

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

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

In preparation for removal of the Karn Bottom Ash Pond, a new lined impoundment (Karn Lined Impoundment) was constructed. The liner system for the new impoundment is an alternative composite liner system, with the primary and secondary composite liners each consisting of 60-mil High Density Polyethylene (HDPE) geomembrane (GM) overlaying a 236-mil geosynthetic clay liner (GCL)[2]. There is also a leachate collection system consisting of 175-mil GSE HyperNet geonet located between the primary and secondary liner system. The Karn Lined Impoundment began receipt of CCR and non-CCR on June 7, 2018 when it replaced the Karn Bottom Ash Pond operations.

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

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

The DE Karn Landfill is being monitored in accordance with the EGLE-approved *Hydrogeological Monitoring Plan, Rev. 3, DE Karn Solid Waste Disposal Area* (December 19, 2017) (HMP). In addition to the HMP, the DE Karn 1&2 Solid Waste Disposal Area is currently authorized under a permit (Groundwater Discharge Authorization GWE-0005) issued pursuant to Part 31[3] to discharge to the unusable aquifer directly underlying the solid waste t. Compliance monitoring pursuant to Part 31 and Part 115[4] detailed in the revised HMP was approved by the EGLE on January 8, 2018.

1.3 Geology/Hydrogeology

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

The surficial fill consists of a mixture of varying percentages of ash, sand, and clay-rich fill ranging from 5 to 15 feet thick. Below the surficial fill, native alluvium and lacustrine soils are present at varying depths. Generally, there is a well graded sand unit present to depths of 10-30 feet below ground surface (ft bgs) overlying a clay till which is observed at depths ranging from 25 to 75 ft bgs. In general, the alluvium soils (sands) are deeper along the Saginaw River and there are shallower lacustrine deposits (clays, silts and sands deposited in or on the shores of glacial lakes) at other areas. The clay till acts as a hydraulic barrier that separates the shallow groundwater from the underlying sandstone. A sandstone unit, which is part of the Saginaw formation, was generally encountered at 80-90 ft bgs.

The DE Karn site is bound by several surface water features (Figure 1): the Saginaw River to the west, Saginaw Bay (Lake Huron) to the north and east, and a discharge channel to the south. In general, shallow groundwater is encountered at a similar or slightly higher elevation relative to

[3] Part 31, Water Resources Protection, of the Natural Resources and Environmental Protection Act (NREPA), Public Act 451 of 1994.
[4] Part 115, Solid Waste Management, of the Natural Resources and Environmental Protection Act (NREPA), Public Act 451 of 1994.

the surrounding surface water features. Groundwater flow in the upper aquifer is largely controlled by the surface water elevations of Saginaw River and Saginaw Bay. In the vicinity of the existing DE Karn Bottom Ash Pond and new Karn Lined Impoundment, the shallow groundwater flow is generally radial, flowing outward from the pond area toward the surrounding surface water bodies.

Once the bottom ash removal activities are complete and groundwater elevations re-equilibrate, groundwater flow in the impoundment area will be driven by Saginaw Bay to the north and by the Saginaw River to the west in the absence of the hydraulic head from the former Bottom Ash Pond.

In previous investigations to the south, bedrock groundwater was generally encountered around 578 feet NAVD88, which is several feet lower than the shallow groundwater. Groundwater flow direction was generally to the northeast under a very shallow gradient. Given the different groundwater flow regime in the bedrock than the shallow saturated unit, bedrock wells near the surface water bodies are several feet below the surface water elevation. Based on the fact that the shallow sand and the bedrock are separated by over 50 ft of clay, the bedrock unit does not appear to be hydraulically connected to the shallow sand.

Section 2
Groundwater Monitoring

2.1 Monitoring Well Network

In accordance with §257.91, Consumers Energy has developed a groundwater monitoring system for the new Karn Lined Impoundment. Because of the site hydrogeology and presence of affected groundwater due to the history of CCR-related operations throughout the DE Karn Site, an intra-well statistical approach is recommended for detection monitoring. However, there is currently insufficient data from wells in the Karn Lined Impoundment groundwater monitoring system to support intra-well statistical methods, and based on hydrogeologic conditions, the frequency of sampling to collect data to support the intra-well methods will take several years. Establishing background in a six-month time, per the CCR rule, does not allow for collection of sufficient statistically independent samples. Therefore, for an interim period, Consumers Energy will perform inter-well statistics using DEK-MW-15003 as the upgradient/background well until sufficient data are collected from the wells to support intra-well statistical procedures. The groundwater monitoring system for the Karn Lined Impoundment unit consists of:

Background:

DEK-MW-15003

Downgradient:

OW-12 DEK-MW-18001 OW-10

Supplemental Data Analysis[5]:

OW-11 KLI-SCS[6]

The monitoring well locations are shown on Figure 2. Soil boring logs and well construction diagrams are included in the SAP.

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

[5] OW-11 will be sampled to be potentially utilized in a future intra-well statistical evaluation program.
[6] KLI-SCS will be a sample collected from a sump in the secondary collection system such that leachate chemistry could be compared to groundwater chemistry

2.2 November 2018 Detection Monitoring

In accordance with §257.94, TRC conducted the initial detection monitoring event for the Karn Lined Impoundment on November 5 through November 8, 2018. TRC submitted sampled to Pace for analysis of Appendix III constituents in accordance with the SAP. During the writing of the 2018 Annual Report, the data evaluation for the November 2018 sampling event was still ongoing and TRC was unable to present the data in the 2018 Annual Report. The data summary for the initial detection monitoring event was presented to Consumers Energy in a letter dated March 13, 2019 and is attached as Appendix A.

2.3 2019 Detection Monitoring

The semiannual monitoring constituents for the detection groundwater monitoring program were selected per the CCR Rule's Appendix III to Part 257 – Constituents for Detection Monitoring. The Appendix III constituents consist of boron, calcium, chloride, fluoride, pH (field reading), sulfate, and total dissolved solids (TDS) and were analyzed in accordance with the SAP. In addition to pH, the collected field parameters included dissolved oxygen, oxidation reduction potential, specific conductivity, temperature, and turbidity.

2.3.1 Data Summary

The First Quarter sampling event was performed on February 18 and 19, 2019. TRC personnel collected samples and recorded field measurements and water elevations. Samples were submitted to Test America in accordance with the SAP. Static water level data was collected at all CCR unit monitoring well locations. Downgradient monitoring wells OW-10, OW-12, and DEK-MW-18001; background well DEK-MW-15003; and supplemental monitoring points OW-11 and the Secondary Containment Sump were sampled during this monitoring event for Appendix III and IV constituents.

The Second Quarter sampling event was performed on April 8 through 10, 2019. TRC personnel collected samples and recorded field measurements and water elevations. Samples were submitted to Test America in accordance with the SAP. Static water level data was collected at all monitoring well locations. Downgradient monitoring wells OW-10, OW-12, and DEK-MW-18001; background well DEK-MW-15003; and supplemental monitoring points OW-11 and the Secondary Containment Sump were sampled during this monitoring event for Appendix III and IV constituents.

The Third Quarter sampling event was performed on August 13 and 14, 2019. TRC personnel collected samples and recorded field measurements and water elevations. Samples were submitted to Test America in accordance with the SAP. Static water level data was collected at all CCR unit monitoring well locations. Downgradient monitoring wells OW-10, OW-12, and DEK-MW-18001; background well DEK-MW-15003; and

supplemental monitoring points OW-11 and the Secondary Containment Sump were sampled during this monitoring event for Appendix III and IV constituents.

The Fourth Quarter sampling event was performed on October 14 through 16, 2019. TRC personnel collected samples and recorded field measurements and water elevations. Samples were submitted to Test America in accordance with the SAP. Static water level data was collected at all monitoring well locations. Downgradient monitoring wells OW-10, OW-12, and DEK-MW-18001; background well DEK-MW-15003; and supplemental monitoring points OW-11 and the Secondary Containment Sump were sampled during this monitoring event for Appendix III and IV constituents.

A summary of the groundwater data collected during the 2019 calendar year is provided on Table 1 (summary of groundwater elevation data), Table 2 (field data), and Table 3 (analytical results).

2.3.2 Data Quality Review

Data from each round were evaluated for completeness, overall quality and usability, method-specific sample holding times, precision and accuracy, and potential sample contamination. The data were found to be complete and usable for the purposes of the CCR monitoring program. The data quality review for the November 2018 event is summarized in Appendix A. The data quality review for the February 2019 and April 2019 events are summarized in Appendix B. The data quality reviews for the, August 2019 and October 2019 events are summarized in Appendix C.

2.3.3 Groundwater Flow Rate and Direction

Groundwater elevation data collected during the 2019 quarterly sampling events depicted a potentiometric surface similar to elevation data collected during previous sampling events.

Groundwater elevations at the site are generally within the range of 580 to 588 feet NAVD88 and groundwater is typically encountered at equal elevation relative to the surrounding surface water features, flowing outward toward the bounding surface water features or within 8 feet higher. Groundwater elevations measured during the Second and Fourth quarter 2019 sampling events are provided on Table 1 and were used to construct groundwater contour maps (Figures 3 and 4). Groundwater elevation data from the First and Third quarters in 2019 is presented in Table 1 and shows that the groundwater elevations are similar to the second and fourth quarter data which indicates similar flow direction.

Although historically the point source discharge of sluiced bottom ash into the Karn Bottom Ash pond created localized mounding of the potentiometric surface, the new Karn Lined Impoundment went into service on June 7, 2018 and has been continuously collecting all of the process water and bottom ash that went into the former bottom ash pond. Since the pond is no longer being hydraulically loaded with sluiced ash, there is no longer standing water in the bottom ash pond. Porewater at the facility is locally influenced by incidental infiltration from precipitation over the uncovered acreage. OW-11, OW-12, and DEK-MW-15003 represent a groundwater elevation high point with porewater flow generally flowing radially towards the adjacent surface water features. Due to the operational changes of the bottom ash pond and the progress of the landfill capping activities, the gradient between the bottom ash pond area and the surrounding surface water bodies appears to be flattening out as compared to previous quarters, as expected. Since the bottom ash removal activities are complete and groundwater elevations are beginning to re-equilibrate, groundwater flow in the impoundment area will be driven by Saginaw Bay to the north and by the Saginaw River to the west in the absence of the hydraulic head from the former Bottom Ash Pond.

The hydraulic gradient throughout the Karn Lined Impoundment area during the April 2019 event is estimated at 0.0044 ft/ft (average) and during the October 2019 event is estimated at 0.00089 ft/ft (geomean). The gradient was calculated using the well pair DEK-MW-15004/DEK-MW-15005, as well as the well water elevation difference and distance between DEK-MW-15003 and the discharge channel. Using the mean hydraulic conductivity of 15 ft/day (ARCADIS, 2016) and an assumed effective porosity of 0.3, the estimated average seepage velocity was approximately 0.22 ft/day or 79 ft/year in April 2019 and 0.044 ft/day or 16 ft/year in October 2019, which are lower than previous estimates (140 ft/year April 2018; 120 ft/year November 2018).

The general flow direction near the Karn Lined Impoundment 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 constituents that could potentially migrate from the Karn Lined Impoundment CCR unit.

Section 3
Statistical Evaluation

3.1 Establishing Background Limits

Per the Stats Plan, background limits were established for the Appendix III constituents following the November 2018 sampling event using data collected from DEK-MW-15003. The background limit calculations are included in the November 2018 data summary provided in Appendix A. The Appendix III background limits will be used throughout the detection monitoring period to determine whether groundwater has been impacted from the Karn Lined Impoundment by statistically comparing concentrations in the downgradient wells to the background limits for each Appendix III constituent.

Consumers Energy will be submitting an application for operating a CCR Surface Impoundment to EGLE in 2020 that will require a HMP which will conform with both the federal CCR rules §257.90 - §257.94 and the state standards in PA 640[7]. At that time the statistical evaluation program will be re-evaluated. The next groundwater sampling event at the Karn Lined Impoundment is tentatively scheduled for the March 2020.

3.2 Data Comparison to Background Limits – First Semiannual Event (November 2018)

The concentrations of Appendix III constituents in the downgradient wells were compared to the statistical background limits calculated from the background data collected from DEK-MW-15003. The data comparison for the November 2018 detection monitoring event are presented in Appendix A.

The statistical evaluation of the November 2018 Appendix III indicator parameters showed potential SSIs over background levels for:

- Boron at OW-10;
- Chloride at DEK-MW-18001, OW-10, and OW-12;
- Fluoride at DEK-MW-18001; and
- Sulfate at OW-12.

[7] On December 28, 2018, the State of Michigan enacted Public Act No. 640 of 2018 (PA 640) to amend the Natural Resources and Environmental Protection Act, also known as Part 115 of PA 451 of 1994, as amended (a.k.a., Michigan Part 115 Solid Waste Management). The December 2018 amendments to Part 115 were developed to provide the State of Michigan oversight of CCR impoundments and landfills and to better align existing state solid waste management rules and statutes with the CCR Rule.

In response to the potential SSIs, Consumers Energy prepared an ASD, included in Appendix A. The ASD determined that the observed SSIs are not attributed to the Karn Lined Impoundment.

3.3 Data Comparison to Background Limits – Second Semiannual Event (April 2019)

The concentrations of Appendix III constituents in the downgradient wells were compared to the statistical background limits calculated from the background data collected from DEK-MW-15003. The data comparison for the April 2019 detection monitoring event are presented in Table 4 and Appendix B.

The statistical evaluation of the April 2019 Appendix III indicator parameters showed potential SSIs over background levels for:

- Chloride at OW-10;
- Fluoride at DEK-MW-18001; and
- pH at DEK-MW-18001 and OW-10.

In response to the potential SSIs, Consumers Energy prepared an ASD, included in Appendix B. The ASD determined that the observed SSIs are not attributed to the Karn Lined Impoundment.

3.4 Data Comparison to Background Limits – Third Semiannual Event (October 2019)

The concentrations of Appendix III constituents in the downgradient wells were compared to the statistical background limits calculated from the background data collected from DEK-MW-15003. The data comparison for the October 2019 detection monitoring event are presented in Table 4.

The statistical evaluation of the October 2019 Appendix III indicator parameters showed potential SSIs over background levels for:

- Boron at DEK-MW-18001
- Calcium at OW-12
- Chloride at DEK-MW-18001, OW-11, and OW-12
- Sulfate at OW-12
- Total dissolved solids at OW-12
- pH at DEK-MW-18001 and OW-12

In response to the potential SSIs, Consumers Energy has prepared an ASD, included in Appendix D. The ASD determined that the observed SSIs are not attributed to the Karn Lined Impoundment.

Section 4
Corrective Action

The groundwater monitoring program for the Karn Lined Impoundment is currently in detection monitoring after successfully posting an ASD for observations of potential SSIs over background of certain Appendix III constituents. Therefore, there are currently no corrective action requirements for this CCR unit.

Section 5
Conclusions and Recommendations

Potential SSIs over background limits were noted for various Appendix III constituents in one or more downgradient wells during the November 2018, April 2019, and October 2019 monitoring events. The ASDs developed conclude that these potential SSIs were not are not attributed to the Karn Lined Impoundment. Therefore, detection monitoring will be continued at the Karn Lined Impoundment in conformance with §257.90 - §257.94.

No corrective actions were needed or performed in 2019. The next semiannual monitoring event for the Karn Lined Impoundment is scheduled for March 2020.

Consumers Energy will be submitting an application for operating a CCR Surface Impoundment to EGLE that will include a HMP which will conform with both the federal CCR rules §257.90 - §257.94 and the state standards in PA 640[8]. At that time the statistical evaluation program will be re-evaluated. The next groundwater sampling event at the Karn Lined Impoundment is tentatively scheduled for the March 2020.

[8] On December 28, 2018, the State of Michigan enacted Public Act No. 640 of 2018 (PA 640) to amend the Natural Resources and Environmental Protection Act, also known as Part 115 of PA 451 of 1994, as amended (a.k.a., Michigan Part 115 Solid Waste Management). The December 2018 amendments to Part 115 were developed to provide the State of Michigan oversight of CCR impoundments and landfills and to better align existing state solid waste management rules and statutes with the CCR Rule.

Section 6
References

ARCADIS. May 18, 2016. Electric Generation Facilities RCRA CCR Detection Monitoring Program. DE Karn Monitoring Program Sample Analysis Plan, Essexville, Michigan. Prepared for Consumers Energy Company.

Consumers Energy Company. December 19, 2017. Hydrogeological Monitoring Plan Rev. 3: DE Karn Solid Waste Disposal Area.

TRC. January 2018. Annual Groundwater Monitoring Report for the DE Karn Power Plant Bottom Ash Pond CCR Unit, Essexville, Michigan. Prepared for Consumers Energy Company.

TRC. June 2018. Groundwater Statistical Evaluation Plan – DE Karn Power Plant Lined Impoundment, Essexville, Michigan. Prepared for Consumers Energy Company.

TRC. June 2018. Sample Analysis Plan – Electric Generation Facilities RCRA CCR Detection Monitoring Program. DE Karn Power Plant Lined Impoundment, Essexville, Michigan. Prepared for Consumers Energy Company.

TRC. June 2018. Groundwater Monitoring System Summary Report – Consumers Energy, DE Karn Lined Impoundment (KLI). Prepared for Consumers Energy Company.

TRC. January 2019. 2018 Annual Groundwater Monitoring Report for the DE Karn Power Plant Lined Impoundment CCR Unit, Essexville, Michigan. Prepared for Consumers Energy Company.

USEPA. April 2015. 40 CFR Parts 257 and 261. Hazardous and Solid Waste Management System: Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule. 80 Federal Register 74 (April 17, 2015), pp. 21301-21501 (80 FR 21301).

USEPA. July 2018. 40 CFR Part 257. Hazardous and Solid Waste Management System: Disposal of Coal Combustion Residuals from Electric Utilities; Amendments to the National Minimum Criteria (Phase One, Part One); Final Rule. 83 Federal Register 146 (July 30, 2018), pp. 36435-36456 (83 FR 36435).

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)			February 18, 2019		April 8, 2019		August 12, 2019		October 7, 2019	
						Depth to Water (ft BTOC)	Groundwater Elevation (ft)	Depth to Water (ft BTOC)	Groundwater Elevation (ft)	Depth to Water (ft BTOC)	Groundwater Elevation (ft)	Depth to Water (ft BTOC)	Groundwater Elevation (ft)
Background													
MW-15002	587.71	Sand	580.9	to	570.9	--	--	6.50	581.21	--	--	5.84	581.87
MW-15008	585.36	Sand with clay	578.7	to	568.7	--	--	4.37	580.99	--	--	3.23	582.13
MW-15016	586.49	Sand	581.2	to	578.2	--	--	4.12	582.37	--	--	4.39	582.10
MW-15019	586.17	Sand and Sand/Clay	579.5	to	569.5	--	--	5.13	581.04	--	--	4.16	582.01
DEK Bottom Ash Pond													
DEK-MW-15002	590.87	Sand	578.3	to	575.3	--	--	6.02	584.85	8.26	582.61	6.25	584.62
DEK-MW-15004	611.04	Sand	576.6	to	571.6	--	--	27.53	583.51	31.07	579.97	29.14	581.90
DEK-MW-15005	589.72	Sand	572.3	to	567.3	--	--	9.25	580.47	7.72	582.00	7.63	582.09
DEK-MW-15006	589.24	Sand	573.0	to	568.0	--	--	8.69	580.55	7.04	582.20	7.15	582.09
DEK Bottom Ash Pond & Karn Lined Impoundment													
DEK-MW-15003	602.74	Sand	578.8	to	574.8	16.53	586.21	16.23	586.51	17.54	585.20	16.72	586.02
DEK-MW-18001	593.47	Sand	579.2	to	574.2	8.28	585.19	8.20	585.27	8.71	584.76	8.16	585.31
OW-10	591.58	Silty Sand and Silty Clay	576.0	to	571.0	6.46	585.12	6.06	585.52	6.60	584.98	6.25	585.33
OW-11	607.90	Silt/Fly Ash	587.5	to	582.5	21.30	586.60	21.05	586.85	22.08	585.82	21.70	586.20
OW-12	603.07	Silty Sand	584.2	to	579.2	17.03	586.04	16.75	586.32	18.31	584.76	17.17	585.90

Notes:
Survey data from: Rowe Professional Services Company (Nov. 2015) and Consumers Energy Company drawings: SG-21733, Sheet 1, Rev. G (Karn, 11/27/18)
Elevation in feet relative to North American Vertical Datum 1988 (NAVD 88).
TOC: Top of well casing.
ft BTOC: Feet below top of well casing.

Table 2
Summary of Field Parameter Results – February 2019 to October 2019
Karn Lined Impoundment – RCRA CCR Monitoring Program
Essexville, Michigan

Sample Location	Sample Date	Dissolved Oxygen (mg/L)	Oxidation Reduction Potential (mV)	pH (SU)	Specific Conductivity (umhos/cm)	Temperature (°C)	Turbidity (NTU)
Background							
MW-15002	4/8/2019	0.17	-18.1	7.0	6,665	9.7	1.2
	10/16/2019	0.21	-56.5	7.3	1,337	14.9	4.0
MW-15008	4/8/2019	0.13	-30.8	6.7	1,440	9.0	2.2
	10/15/2019	0.16	-18.0	6.6	1,658	13.7	3.4
MW-15016	4/9/2019	0.25	48.6	6.9	1,276	5.9	5.2
	10/16/2019	2.32	91.0	7.0	1,445	12.8	2.1
MW-15019	4/8/2019	0.12	-49.4	7.0	1,921	7.6	3.1
	10/16/2019	0.59	-20.9	6.8	1,860	13.6	4.5
Karn Lined Impoundment							
DEK-MW-15003	2/18/2019	0.43	-103.8	8.7	615	10.3	2.3
	4/11/2019	0.27	88.0	8.0	565	9.4	3.2
	8/13/2019	0.42	85.0	7.7	886	20.0	0.0
	10/15/2019	0.19	-101.5	7.9	526	20.2	2.1
DEK-MW-18001	2/18/2019	0.23	-48.8	7.9	601	9.2	1.9
	4/10/2019	0.12	58.7	7.2	592	8.5	3.2
	8/14/2019	0.33	104.1	7.3	746	13.4	0.0
	10/15/2019	0.22	-35.1	7.3	864	13.2	2.2
KLI-SCS	2/19/2019	10.02	214.7	7.9	889	7.4	7.7
	4/11/2019	5.81	80.9	7.7	930	11.7	15.1
	8/14/2019	2.18	92.2	7.3	1,151	21.9	6.8
	10/15/2019	5.13	117.0	7.6	1,085	15.4	285.0
OW-10	2/18/2019	0.27	-44.8	7.8	799	9.1	4.2
	4/10/2019	0.11	-70.5	7.2	794	9.4	10.1
	8/13/2019	0.12	59.4	7.3	1,140	12.6	7.8
	10/15/2019	0.48	-67.6	7.4	938	12.7	17.2
OW-11	2/19/2019	0.54	37.4	9.1	652	6.9	2.2
	4/11/2019	0.70	0.3	8.7	597	9.7	5.4
	8/14/2019	0.31	101.0	8.4	480	13.3	9.4
	10/16/2019	0.35	-90.3	8.8	548	10.9	2.1
OW-12	2/19/2019	0.22	-24.9	7.6	636	12.3	3.7
	4/9/2019	0.13	-36.8	7.8	599	13.6	6.3
	8/14/2019	0.18	94.8	7.0	1,011	15.2	1.8
	10/15/2019	0.54	-31.6	7.1	1,494	15.4	1.8

Notes:
mg/L - Milligrams per Liter.
mV - Millivolts.
SU - Standard units.
umhos/cm - Micromhos per centimeter.
°C - Degrees Celcius
NTU - Nephelometric Turbidity Unit.

Table 3
Summary of Groundwater Sampling Results (Analytical): February 2019 - October 2019
Karn Lined Impoundment – RCRA CCR Monitoring Program
Essexville, Michigan

					Sample Location:	DEK-MW-15003				DEK-MW-18001			
					Sample Date:	2/18/2019	4/11/2019	8/13/2019	10/15/2019	2/18/2019	4/10/2019	8/14/2019	10/15/2019
Constituent	Unit	EPA MCL	MI Residential*	MI Non-Residential*	MI GSI^	Background				downgradient			
Appendix III													
Boron	ug/L	NC	**500**	**500**	4,000	**1,100**	**960**	**1,100**	**1,100**	**1,000**	**970**	**2,100**	**2,200**
Calcium	mg/L	NC	NC	NC	500	58	52	42	39	51	48	95	84
Chloride	mg/L	250**	250	250	**50**	**53**	**58**	**56**	**58**	**72**	**69**	**78**	**81**
Fluoride	ug/L	4,000	NC	NC	NC	< 1,000	< 1,000	< 1,000	< 1,000	1,100	1,200	1,000	1,000
Sulfate	mg/L	**250****	**250**	**250**	500	34	47	58	52	< 2.0	< 2.0	20	31
Total Dissolved Solids	mg/L	**500****	**500**	**500**	**500**	370	360	350	330	350	360	480	500
pH, Field	SU	**6.5 - 8.5****	**6.5 - 8.5**	**6.5 - 8.5**	**6.5 - 9.0**	**8.7**	8.0	7.7	7.9	7.9	7.2	7.3	7.3
Appendix IV													
Antimony	ug/L	**6**	**6.0**	**6.0**	**2.0**	< 2.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	**10**	**10**	**10**	**10**	**330**	**380**	**440**	**420**	**86**	**68**	**49**	**63**
Barium	ug/L	2,000	2,000	2,000	1,200	65	62	63	58	85	75	140	160
Beryllium	ug/L	4	4.0	4.0	33	< 2.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	5	5.0	5.0	2.5	< 0.40	< 1.0	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Chromium	ug/L	100	100	100	**11**	2.2	< 5.0	< 1.0	< 1.0	6.9	< 1.0	< 1.0	< 1.0
Cobalt	ug/L	NC	40	100	100	< 12	< 30	< 6.0	< 6.0	< 6.0	< 6.0	< 6.0	< 6.0
Fluoride	ug/L	4,000	NC	NC	NC	< 1,000	< 1,000	< 1,000	< 1,000	1,100	1,200	1,000	1,000
Lead	ug/L	NC	4.0	4.0	14	< 2.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lithium	ug/L	NC	170	350	440	34	28	28	29	25	24	31	36
Mercury	ug/L	2	2.0	2.0	0.20#	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	NC	**73**	**210**	**120**	< 10	< 25	26	28	< 5.0	< 5.0	< 5.0	< 5.0
Radium-226	pCi/L	NC	NC	NC	NC	0.112	< 0.424	< 0.190	< 0.150	0.183	0.173	0.284	0.206
Radium-228	pCi/L	NC	NC	NC	NC	< 0.416	< 0.495	< 0.441	< 0.449	0.574	0.694	< 0.536	0.746
Radium-226/228	pCi/L	5	NC	NC	NC	< 0.416	< 0.495	< 0.441	< 0.449	0.757	0.867	0.780	0.952
Selenium	ug/L	50	50	50	5.0	< 2.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Thallium	ug/L	2	2.0	2.0	2.0	< 4.0	< 10	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0

Notes:

ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units; pH is a field parameter.
pCi/L - picocuries per liter.
MCL - Maximum Contaminant Level, EPA Drinking Water Standards and Health Advisories, April, 2012.
NC - no criteria.
-- - not analyzed.
* - Michigan Part 201 Generic Drinking Water Cleanup Criteria, December 30, 2013.
** - Secondary Maximum Contaminant Level (SMCL), EPA Secondary Drinking Water Regulations (SDWR) April, 2012.
^ - Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria. Hardness-dependent criteria calculated using hardness of 258 mg CaCO3/L (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018) per footnote {G} of Michigan Part 201 criteria tables. Chromium GSI criterion based on hexavalent chromium per footnote {H}. GSI criterion is protective for surface water used as a drinking water source as described in footnote {X}. GSI criterion for chloride is 50 mg/L when the discharge is to the Great Lakes or connecting waters per footnote {FF}
# - If detected above 0.20 ug/L, further evaluation of low-level mercury may be necessary to evaluate the GSI pathway per Michigan Part 201 and EGLE policy and procedure 09-014 dated June 20, 2012.
BOLD value indicates an exceedance of one or more of the listed criteria.
RED value indicates an exceedance of the MCL.
All metals were analyzed as total unless otherwise specified.

Table 3
Summary of Groundwater Sampling Results (Analytical): February 2019 - October 2019
Karn Lined Impoundment – RCRA CCR Monitoring Program
Essexville, Michigan

						OW-10				OW-12			
					Sample Location:								
					Sample Date:	2/18/2019	4/10/2019	8/13/2019	10/15/2019	2/19/2019	4/9/2019	8/14/2019	10/15/2019
Constituent	Unit	EPA MCL	MI Residential*	MI Non-Residential*	MI GSI^	downgradient							
Appendix III													
Boron	ug/L	NC	**500**	**500**	4,000	**1,400**	**1,300**	**1,400**	**1,400**	**680**	**640**	**1,400**	**1,200**
Calcium	mg/L	NC	NC	NC	500	82	84	94	90	47	40	110	130
Chloride	mg/L	250**	250	250	**50**	**79**	**69**	**77**	**82**	**64**	**64**	**78**	**120**
Fluoride	ug/L	4,000	NC	NC	NC	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Sulfate	mg/L	**250****	**250**	**250**	500	4.1	8.2	9.0	31	77	69	230	**310**
Total Dissolved Solids	mg/L	**500****	**500**	**500**	**500**	470	490	**520**	**530**	400	390	**720**	**890**
pH, Field	SU	**6.5 - 8.5****	**6.5 - 8.5**	**6.5 - 8.5**	**6.5 - 9.0**	7.8	7.2	7.3	7.4	7.6	7.8	7.0	7.1
Appendix IV													
Antimony	ug/L	**6**	**6.0**	**6.0**	**2.0**	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	**10**	**10**	**10**	**10**	7.6	6.3	5.3	7.5	**22**	**19**	**18**	**30**
Barium	ug/L	2,000	2,000	2,000	1,200	100	110	110	100	65	56	100	120
Beryllium	ug/L	4	4.0	4.0	33	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	5	5.0	5.0	2.5	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Chromium	ug/L	100	100	100	**11**	2.9	1.3	1.3	< 1.0	**24**	< 1.0	< 1.0	< 1.0
Cobalt	ug/L	NC	40	100	100	< 6.0	< 6.0	< 6.0	< 6.0	< 6.0	< 6.0	< 6.0	< 6.0
Fluoride	ug/L	4,000	NC	NC	NC	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Lead	ug/L	NC	4.0	4.0	14	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lithium	ug/L	NC	170	350	440	32	30	30	30	32	27	32	53
Mercury	ug/L	2	2.0	2.0	0.20#	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	NC	**73**	**210**	**120**	< 5.0	< 5.0	< 5.0	< 5.0	19	15	21	18
Radium-226	pCi/L	NC	NC	NC	NC	0.162	0.205	< 0.223	< 0.239	< 0.0797	0.138	< 0.273	< 0.237
Radium-228	pCi/L	NC	NC	NC	NC	< 0.493	< 0.641	< 0.457	< 0.636	< 0.448	< 0.414	< 0.604	< 0.576
Radium-226/228	pCi/L	5	NC	NC	NC	< 0.493	< 0.641	< 0.457	< 0.636	< 0.448	0.531	< 0.604	< 0.576
Selenium	ug/L	50	50	50	5.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.9	< 1.0
Thallium	ug/L	2	2.0	2.0	2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0

Notes:

ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units; pH is a field parameter.
pCi/L - picocuries per liter.
MCL - Maximum Contaminant Level, EPA Drinking Water Standards and Health Advisories, April, 2012.
NC - no criteria.
-- - not analyzed.
* - 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 Mic Part 201 criteria tables. Chromium GSI criterion based on hexavalent chromium per footnote {H}. GSI criterion is protective for surface water used as a drinking water source as described in footnote {X}. GSI criterion for chloride is 50 mg/L when the discharge is to the Great Lakes or connecting waters per footnote {FF}
# - If detected above 0.20 ug/L, further evaluation of low-level mercury may be necessary to evaluate the GSI pathway per Michigan Part 201 and EGLE policy and procedure 09-014 dated June 20, 2012.
BOLD value indicates an exceedance of one or more of the listed criteria.
RED value indicates an exceedance of the MCL.
All metals were analyzed as total unless otherwise specified.

Table 3
Summary of Groundwater Sampling Results (Analytical): February 2019 - October 2019
Karn Lined Impoundment – RCRA CCR Monitoring Program
Essexville, Michigan

						OW-11				KLI-SCS			
Sample Location:													
Sample Date:						2/19/2019	4/11/2019	8/14/2019	10/16/2019	2/19/2019	4/11/2019	8/14/2019	10/15/2019
Constituent	Unit	EPA MCL	MI Residential*	MI Non-Residential*	MI GSI^	Supplemental							
Appendix III													
Boron	ug/L	NC	**500**	**500**	4,000	**2,500**	**2,400**	**2,500**	**2,500**	330	400	**660**	460
Calcium	mg/L	NC	NC	NC	500	43	38	25	27	120	140	170	140
Chloride	mg/L	250**	250	250	**50**	**92**	**90**	**89**	**91**	17	19	21	24
Fluoride	ug/L	4,000	NC	NC	NC	2,200	2,400	3,300	3,700	< 1,000	< 1,000	< 1,000	< 1,000
Sulfate	mg/L	**250****	**250**	**250**	500	81	72	58	52	200	230	**350**	**320**
Total Dissolved Solids	mg/L	**500****	**500**	**500**	**500**	370	350	300	300	**590**	**700**	**790**	**730**
pH, Field	SU	**6.5 - 8.5****	**6.5 - 8.5**	**6.5 - 8.5**	**6.5 - 9.0**	**9.1**	**8.7**	8.4	**8.8**	7.9	7.7	7.3	7.6
Appendix IV													
Antimony	ug/L	**6**	**6.0**	**6.0**	**2.0**	**4.1**	**2.5**	**13**	1.8	1.2	**3.1**	1.2	1.4
Arsenic	ug/L	**10**	**10**	**10**	**10**	**350**	**380**	**340**	**440**	2.2	1.2	2.0	2.5
Barium	ug/L	2,000	2,000	2,000	1,200	130	120	82	81	99	91	110	94
Beryllium	ug/L	4	4.0	4.0	33	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	5	5.0	5.0	2.5	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Chromium	ug/L	100	100	100	**11**	1.2	< 1.0	1.1	< 1.0	2.0	< 1.0	1.4	1.5
Cobalt	ug/L	NC	40	100	100	< 6.0	< 6.0	< 6.0	< 6.0	< 6.0	< 6.0	< 6.0	< 6.0
Fluoride	ug/L	4,000	NC	NC	NC	2,200	2,400	3,300	3,700	< 1,000	< 1,000	< 1,000	< 1,000
Lead	ug/L	NC	4.0	4.0	14	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	2.1	< 1.0	< 1.0
Lithium	ug/L	NC	170	350	440	29	26	17	21	< 10	< 10	12	12
Mercury	ug/L	2	2.0	2.0	0.20#	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	NC	**73**	**210**	**120**	**640**	**590**	**560**	**540**	14	14	21	13
Radium-226	pCi/L	NC	NC	NC	NC	< 0.0748	< 0.407	< 0.197	< 0.269	0.155	< 0.448	< 0.250	--
Radium-228	pCi/L	NC	NC	NC	NC	< 0.403	< 0.534	< 0.495	< 0.521	< 0.443	< 0.469	< 0.562	--
Radium-226/228	pCi/L	5	NC	NC	NC	< 0.403	< 0.534	< 0.495	< 0.521	0.588	0.471	< 0.562	--
Selenium	ug/L	50	50	50	5.0	< 1.0	< 1.0	3.5	< 1.0	2.3	< 1.0	< 1.0	2.3
Thallium	ug/L	2	2.0	2.0	2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0

Notes:

ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units; pH is a field parameter.
pCi/L - picocuries per liter.
MCL - Maximum Contaminant Level, EPA Drinking Water Standards and Health Advisories, April, 2012.
NC - no criteria.
-- - not analyzed.
* - 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 Mic Part 201 criteria tables. Chromium GSI criterion based on hexavalent chromium per footnote {H}. GSI criterion is protective for surface water used as a drinking water source as described in footnote {X}. GSI criterion for chloride is 50 mg/L when the discharge is to the Great Lakes or connecting waters per footnote {FF}
# - If detected above 0.20 ug/L, further evaluation of low-level mercury may be necessary to evaluate the GSI pathway per Michigan Part 201 and EGLE policy and procedure 09-014 dated June 20, 2012.
BOLD value indicates an exceedance of one or more of the listed criteria.
RED value indicates an exceedance of the MCL.
All metals were analyzed as total unless otherwise specified.

Table 4

Comparison of Appendix III Parameter Results to Background Limits – April 2019 & October 2019

DE Karn Lined Impoundment – RCRA CCR Monitoring Program

Essexville, Michigan

		Sample Location:	DEK-MW-18001		OW-10		OW-12	
		Sample Date:	4/10/2019	10/15/2019	4/10/2019	10/15/2019	4/9/2019	10/15/2019
Constituent	Unit	UTL						
Appendix III								
Boron	ug/L	**1,400**	**970**	**2,200**	**1,300**	**1,400**	**640**	**1,200**
Calcium	mg/L	**94.1**	48	84	84	90	40	**130**
Chloride	mg/L	**67.2**	**69**	**81**	**69**	**82**	**64**	**120**
Fluoride	ug/L	**1,000**	**1,200**	1,000	< 1,000	< 1,000	< 1,000	< 1,000
Sulfate	mg/L	**103**	< 2.0	31	8.2	31	69	**310**
Total Dissolved Solids	mg/L	**559**	360	500	490	**530**	390	**890**
pH, Field	SU	**7.3 - 8.4**	**7.2**	**7.3**	**7.2**	7.4	7.8	**7.1**

Notes:

ug/L - micrograms per liter

mg/L - milligrams per liter

SU - standard units; pH is a field parameter

All metals were analyzed as total unless otherwise specified.

RESULT Shading and bold font indicates an exceedance of the Upper Tolerance Limit (UTL) using the number of significant figures in the UTL.

Table 5
Summary of Part 115 Groundwater Sampling Results (Analytical): February 2019 - October 2019
Karn Lined Impoundment – RCRA CCR Monitoring Program
Essexville, Michigan

							Sample Location:	DEK-MW-15003				DEK-MW-18001				OW-10			
							Sample Date:	2/18/2019	4/11/2019	8/13/2019	10/15/2019	2/18/2019	4/10/2019	8/14/2019	10/15/2019	2/18/2019	4/10/2019	8/13/2019	10/15/2019
Constituent	Unit	EPA MCL	MI Residential*	MI Residential Aesthetic**	MI Non-Residential*	MI Non-Residential Aesthetic**	MI GSI^	background				downgradient							
Copper	ug/L	NC	1,400	1,000	4,000	1,000	20	< 2.0	< 5.0	3.9	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Iron	ug/L	**300*** **	**2,000**	**300**	**5,600**	**300**	500,000	**490**	**390**	**430**	**360**	**870**	**730**	**1,300**	**1,200**	**1,800**	**2,000**	**2,100**	**1,500**
Nickel	ug/L	NC	100	NA	100	NA	120	< 4.0	< 10	< 2.0	< 2.0	7.3	3.4	< 2.0	< 2.0	2.8	< 2.0	< 2.0	< 2.0
Silver	ug/L	100***	34	NA	98	NA	0.2	< 0.40	< 1.0	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Vanadium	ug/L	NC	**4.5**	NA	62	NA	**27**	< 4.0	< 10	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	2.1
Zinc	ug/L	5,000***	2,400	NA	NA	5,000	260	< 20	< 50	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10

Notes:

ug/L - micrograms per liter.

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

NC - no criteria.

NA- Not applicable.

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

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

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

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

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

All metals were analyzed as total unless otherwise specified.

Table 5
Summary of Part 115 Groundwater Sampling Results (Analytical): February 2019 - October 2019
Karn Lined Impoundment – RCRA CCR Monitoring Program
Essexville, Michigan

							Sample Location:	OW-11				OW-12				KLI-SCS		
							Sample Date:	2/19/2019	4/11/2019	8/14/2019	10/16/2019	2/19/2019	4/9/2019	8/14/2019	10/15/2019	2/19/2019	4/11/2019	8/14/2019	10/15/2019
Constituent	Unit	EPA MCL	MI Residential*	MI Residential Aesthetic**	MI Non-Residential*	MI Non-Residential Aesthetic**	MI GSI^	downgradient				supplemental						
Copper	ug/L	NC	1,400	1,000	4,000	1,000	20	< 1.0	< 1.0	1.3	< 1.0	< 1.0	< 1.0	1.1	< 1.0	1.9	1.3	3.1	2.8
Iron	ug/L	**300*** **	**2,000**	**300**	**5,600**	**300**	500,000	53	46	290	27	**870**	**780**	**550**	**3,400**	**480**	160	**1,000**	**6,000**
Nickel	ug/L	NC	100	NA	100	NA	120	2.0	< 2.0	2.4	< 2.0	16	< 2.0	11	9.2	4.2	4.5	9.2	19
Silver	ug/L	100***	34	NA	98	NA	0.2	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Vanadium	ug/L	NC	**4.5**	NA	62	NA	**27**	**67**	**37**	**120**	**27**	< 2.0	< 2.0	**8.0**	4.2	**7.0**	4.1	3.3	**13**
Zinc	ug/L	5,000***	2,400	NA	NA	5,000	260	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	26	85	47	18

Notes:

ug/L - micrograms per liter.

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

NC - no criteria.

NA- Not applicable.

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

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

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

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

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

All metals were analyzed as total unless otherwise specified.

Figures

BASE MAP FROM USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLE SERIES.

N

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

0 3,000 6,000 FEET

TRC
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TRC - GIS

PROJECT:

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

TITLE:

SITE LOCATION MAP

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

FIGURE 1

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

LEGEND

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

NOTES

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

N

0 1,000 2,000 Feet

1 " = 1,000 '

1:12,000

PROJECT:

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

TITLE:

SITE MAP

DRAWN BY:	S. MAJOR	PROJ NO.:	322173-001
CHECKED BY:	J. KRENZ		
APPROVED BY:	D. LITZ		**FIGURE 2**
DATE:	JANUARY 2020		

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

Plot Date: 1/29/2020, 14:03:57 PM by MVAPHIADIS – LAYOUT: ANSI B(11"x17")
Path: E:\ConsumersEnergy\CCR_GW\2017_26976\322172_3-003-02.mxd
Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl (Foot)
Map Rotation: 0

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LEGEND

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

NOTES

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

N

0 600 1,200 Feet

1 " = 600 '

1:7,200

PROJECT:

CONSUMERS ENERGY COMPANY
DE KARN POWER PLANT
ESSEXVILLE, MICHIGAN

TITLE:

SHALLOW GROUNDWATER CONTOUR MAP APRIL 2019

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

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

Plot Date: 1/29/2020, 16:24:18 PM by MVAPHIADIS – LAYOUT: ANSI B (11"x17")
Path: E:\ConsumersEnergy\CCR_GW\2017_269767\322172_3-004-02.mxd
Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl (Foot)
Map Rotation: 0

TRC - GIS

LEGEND

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

NOTES

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

N

0 600 1,200 Feet

1 " = 600 '
1:7,200

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

TITLE:
SHALLOW GROUNDWATER CONTOUR MAP OCTOBER 2019

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

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

TRC - GIS
Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl (Foot)
Map Rotation: 0
Plot Date: 1/29/2020, 16:23:59 PM by MVAPH/ADIS -- LAYOUT: ANSI B(11"x17")
Path: E:\Consumers Energy\CCR GW\2017 269767\322172_3-005-02.mxd

Appendix A
November 2018 Detection Monitoring Data Summary and Background Statistical Evaluation

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March 13, 2019

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

Subject: Detection Monitoring Data Summary and Background Statistical Evaluation
Consumers Energy, DE Karn Site, Lined Impoundment CCR Unit

Dear Mr. Register:

Pursuant to the CCR Rule[1], Consumers Energy Company (CEC) initiated a detection monitoring program for the new Karn Lined Impoundment (KLI) CCR unit. CEC provided notification of initiation of closure of the DE Karn Bottom Ash Pond on October 12, 2018 to implement the certified closure plan by removal of CCR under the self-implementing requirements and schedule of the CCR Rule. In preparation for removal of the Bottom Ash Pond, a new lined impoundment CCR unit (KLI CCR unit) has been constructed. The footprint of the KLI CCR unit overlaps with the DE Karn Bottom Ash Pond CCR Unit. The liner system for the KLI CCR unit was designed as a double composite liner system, with the primary and secondary composite liners each consisting of 60-mil High Density Polyethylene (HDPE) geomembrane (GM) overlaying a 236-mil geosynthetic clay liner (GCL)[2]. The wet ash dewatering was relocated to the new impoundment (KLI CCR unit), which began receipt of CCR in June 2018. Therefore, CEC initiated detection monitoring at the KLI CCR unit within six months, in accordance with §257.94(b) of the CCR Rule.

This letter presents a summary of the collected detection monitoring data and the background statistical evaluation. This letter also serves as the alternate source demonstration for potential statistically significant increases (SSIs) of Appendix III constituents over background levels, pursuant to §257.94(e)(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).

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

Detection Monitoring Sampling Summary

In accordance with §257.94, TRC conducted the initial detection monitoring event for the KLI CCR Unit on November 5 through November 8, 2018. Background monitoring well DEK-MW-15003, downgradient monitoring wells DEK-MW-18001, OW-10, and OW-12, and supplemental monitoring well OW-11 were sampled in accordance with the *Sample Analysis Plan* (SAP) (TRC, June 2018). OW-11 is currently not designated as a background or downgradient well, but potentially will be utilized in a future intra-well statistical evaluation program. Additionally, a sample was collected from a sump in the secondary collection system (KLI-SCS) such that leachate chemistry could be compared to groundwater chemistry.

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

The groundwater samples were analyzed by Pace Analytical Services, LLC (Pace) for both Appendix III and IV constituents in accordance with the SAP. The analytical results are summarized in Table 3.

Groundwater Flow Rate and Direction

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

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

Although historically the point source discharge of sluiced bottom ash into the bottom ash pond created localized mounding of the potentiometric surface, the new Karn Lined Impoundment went into service on June 7, 2018 and has been continuously collecting all of the process water and bottom ash that went into the former bottom ash pond. Since the pond is no longer being hydraulically loaded with sluiced ash, there is no longer standing water in the Bottom Ash Pond. Groundwater at the facility is locally influenced by incidental infiltration from precipitation over the uncovered acreage. OW-11 and DEK-MW-15003 represent a groundwater elevation high point with porewater flow generally flowing radially towards the adjacent surface water features, as illustrated in Figure 2.

The average hydraulic gradient observed on November 5, 2018 in the vicinity of the DEK BAP and KLI CCR units is estimated at 0.0066 ft/ft. The gradient was calculated using the well pair DEK-MW-15004/DEK-MW-15005, as well as the well water elevation difference and distance between DEK-MW-15003 and the discharge channel. Using the mean hydraulic conductivity of 15 ft/day (ARCADIS, 2016) and an assumed effective porosity of 0.3, the estimated average seepage velocity ranged from 0.33 ft/day or 120 ft/year, which is consistent with previous estimates. The general flow direction is similar to that identified in previous monitoring rounds and continues to demonstrate that the downgradient wells are appropriately positioned to detect the presence of Appendix III/IV parameters that could potentially migrate from the KLI CCR unit.

Data Quality

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

Background Statistical Evaluation

Because of the site hydrogeology and presence of affected groundwater due to the history of CCR-related operations throughout the DE Karn Site, an intra-well statistical approach is recommended for detection monitoring. However, there is currently insufficient data from wells in the KLI monitoring well system to support intra-well statistical methods, and based on hydrogeologic conditions, the frequency of sampling to collect data to support the intra-well methods will take several years. Establishing background in a six-month time, per the CCR rule, does not allow for collection of sufficient statistically independent samples. Therefore, for an interim period, CEC will perform inter-well statistics using DEK-MW-15003 as the upgradient/background well until sufficient data are collected from the wells to support intra-well statistical procedures.

Background levels for Appendix III constituents were established according to §257.95(h) and using the data from eight rounds of Appendix III data collected from DEK-MW-15003 before the KLI began receipt of CCR in June 2018 (May 2016 through May 2018). The statistical methods and established background levels are detailed in the *Background Statistical Evaluation* technical memorandum provided in Attachment B.

The concentrations of the detection monitoring constituents in the downgradient and supplemental wells to the statistical background levels is shown on Table 4. The statistical evaluation of the detection monitoring results indicated potential SSIs over background levels for:

- Boron at OW-10;
- Chloride at DEK-MW-18001, OW-10, and OW-12;
- Fluoride at DEK-MW-18001; and
- Sulfate at OW-12.

There were no SSIs over background levels for calcium or TDS at any of the downgradient wells.

In accordance with §257.94(e)(2), CEC may demonstrate that a source other than the CCR unit caused the SSI or that the SSI resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. The following Alternate Source Demonstration (ASD) has been prepared to address the potential SSIs identified in the September 2017 detection monitoring event.

Alternate Source Demonstration

The following ASD evaluation provides multiple lines of evidence of alternative sources for the potential SSIs indicated for boron, chloride, fluoride, and sulfate at the DEK BAP. The groundwater chemistry observed in the KLI CCR unit monitoring well network is due to the history of CCR-related operations throughout the DE Karn Site, rather than a release from the KLI CCR unit.

New Unit Construction

The liner system for the KLI CCR unit was designed as a double composite liner system, with the primary and secondary composite liners each consisting of 60-mil (HDPE) geomembrane (GM) overlaying a 236-mil geosynthetic clay liner (GCL). The double composite liner system construction and the young age of the KLI CCR unit make it highly unlikely that wet ash dewatering liquids managed within the unit have affected groundwater quality.

Secondary Collection System (SCS) Chemistry

A piper diagram was prepared using the groundwater and KLI-SCS sample data collected during the November 2018 event. The leachate chemistry (KLI-SCS) is distinctly different from the groundwater chemistry observed at the KLI CCR unit wells. The piper diagram also illustrates that the groundwater chemistry observed at the downgradient wells are not uniquely different than the background wells, even if an individual downgradient concentration comparison to the background based on DEK-MW-15003 indicates a potential SSI.

Pre-Existing Groundwater Conditions

The footprint of the new KLI CCR unit overlaps with the pre-existing DE Karn Bottom Ash Pond CCR Unit. As reported in the *2017 Annual Groundwater Monitoring Report: DE Karn Bottom Ash Pond CCR Unit* (January 2018, TRC), potential SSIs over background limits were noted for boron, fluoride, pH, and sulfate in one or more downgradient wells during September 2017. Therefore, the groundwater in the vicinity of the KLI CCR unit is documented to have been affected by CCR due to the pre-existing unit.

Box and whiskers plots for the Appendix III data collected at both the KLI CCR unit well network and the DEK BAP CCR unit well network are included in Attachment C. DEK-MW-15003 and DEK-MW-18001 are utilized for CCR monitoring at both units. The groundwater chemistry at the KLI CCR unit wells are not distinctly different than the DEK BAP CCR wells.

The presence of boron, chloride, fluoride, and sulfate in groundwater at concentrations exceeding the KLI CCR unit background level (DEK-MW-15003) predate the receipt of waste in the KLI Unit, as evidenced in the box plots (Attachment C). DEK-MW-15001 was decommissioned on April 18, 2018 in order to construct the KLI CCR unit. The location of DEK-MW-15001 relative to the KLI Unit and nearby wells is shown in Figure 3.

Next Steps

Pursuant to §257.94(e)(2), if a successful ASD is completed within 90 days of detecting an SSI over background, the CCR Unit may continue with the detection monitoring program. The ASD provided above determines that the observed SSIs are not attributed to the KLI CCR Unit. Therefore, CEC will continue semiannual detection monitoring at the KLI CCR Unit. The next semiannual detection monitoring event is scheduled for the second calendar quarter of 2019.

Sincerely,

TRC

Graham Crockford
Program Manager

Darby Litz
Hydrogeologist/Project Manager

Attachments

Table 1.	Summary of Groundwater Elevation Data
Table 2.	Summary of Field Parameter Results
Table 3.	Summary of Groundwater Sampling Results (Analytical)
Table 4.	Comparison of Appendix III Parameter Results to Background Limits – November 2018
Figure 1.	Monitoring Well Network and Site Plan
Figure 2.	Groundwater Contour Map – November 5, 2018
Figure 3.	Karn Lined Impoundment Area
Attachment A	Data Quality Reviews
Attachment B	Background Statistical Evaluation
Attachment C	ASD Supporting Documentation

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

Tables

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

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

Notes:

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

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

TOC: Top of well casing.

ft BTOC: Feet below top of well casing.

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

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

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

Notes:

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

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

TOC: Top of well casing.

ft BTOC: Feet below top of well casing.

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

Table 2
Summary of Field Parameter Results – November 2018
Karn Lined Impoundment – 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							
DEK-MW-15003	11/6/2018	0.31	37.2	8.0	551	15.37	1.86
Downgradient							
DEK-MW-18001	11/6/2018	0.21	58.0	7.5	504	13.17	2.12
OW-10	11/6/2018	0.18	7.3	7.4	615	12.65	22.70
OW-12	11/7/2018	0.19	68.8	7.4	637	14.74	1.73
Supplemental							
KLI-SCS	11/7/2018	8.89	56.3	7.4	656	12.56	1.64
OW-11	11/6/2018	0.32	55.8	8.6	621	11.71	6.34

Notes:

mg/L - Milligrams per Liter

mV - Millivolts

SU - Standard units

umhos/cm - Micromhos per centimeter

°C - Degrees Celsius

NTU - Nephelometric Turbidity Unit

Table 3
Summary of Groundwater Sampling Results (Analytical): November 2018
Karn Lined Impoundment – RCRA CCR Monitoring Program
Essexville, Michigan

					Sample Location:	**DEK-MW-15003**	**DEK-MW-18001**	**OW-10**	**OW-12**	**OW-11**	**KLI-SCS**
					Sample Date:	11/6/2018	11/6/2018	11/6/2018	11/7/2018	11/6/2018	11/7/2018
Constituent	Unit	EPA MCL	MI Residential*	MI Non-Residential*	MI GSI^	Background	downgradient			Supplemental	
Appendix III											
Boron	ug/L	NC	**500**	**500**	4,000	**944**	**1,020**	**1,410**	**994**	**2,560**	481
Calcium	mg/L	NC	NC	NC	500	62.9	51.1	77.9	61.1	67.2	135
Chloride	mg/L	250**	250	250	**50**	**61.7**	**76.6**	**83.6**	**68.8**	**100**	18.1
Fluoride	ug/L	4,000	NC	NC	NC	< 1,000	1,300	< 1,000	< 1,000	1,600	< 1,000
Sulfate	mg/L	250**	250	250	500	37.8	< 2.0	< 2.0	114	118	236
Total Dissolved Solids	mg/L	**500****	**500**	**500**	**500**	370	340	492	464	**516**	**628**
pH, Field	SU	**6.5 - 8.5****	**6.5 - 8.5**	**6.5 - 8.5**	6.5 - 9.0	8.0	7.5	7.4	7.4	**8.6**	7.4
Appendix IV											
Antimony	ug/L	6	6.0	6.0	2.0	< 1.0	< 1.0	< 1.0	< 1.0	1.8	< 1.0
Arsenic	ug/L	**10**	**10**	**10**	**10**	**420**	**116**	**10.6**	**24.4**	**486**	2.0
Barium	ug/L	2,000	2,000	2,000	1,200	70.9	79.5	93.0	67.0	192	81.0
Beryllium	ug/L	4	4.0	4.0	33	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	5	5.0	5.0	2.5	< 0.20	< 0.20	< 0.20	< 0.20	0.20	< 0.20
Chromium	ug/L	100	100	100	11	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cobalt	ug/L	NC	40	100	100	< 6.0	< 6.0	< 6.0	< 6.0	< 6.0	< 6.0
Fluoride	ug/L	4,000	NC	NC	NC	< 1,000	1,300	< 1,000	< 1,000	1,600	< 1,000
Lead	ug/L	NC	4.0	4.0	14	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lithium	ug/L	NC	170	350	440	33	24	31	40	40	16
Mercury	ug/L	2	2.0	2.0	0.20#	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	NC	**73**	**210**	**120**	5.2	< 5.0	< 5.0	15.3	**550**	18.8
Radium-226	pCi/L	NC	NC	NC	NC	< 0.661	< 0.813	0.802	0.659	< 0.912	--
Radium-228	pCi/L	NC	NC	NC	NC	< 0.789	0.811	< 0.776	< 0.774	< 0.642	--
Radium-226/228	pCi/L	5	NC	NC	NC	< 1.45	1.56	< 1.40	< 1.39	< 1.55	--
Selenium	ug/L	50	50	50	5	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.9
Thallium	ug/L	2	2.0	2.0	2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0

Notes:

ug/L - micrograms per liter
mg/L - milligrams per liter
SU - standard units; pH is a field parameter
pCi/L - picocuries per liter
MCL - Maximum Contaminant Level, EPA Drinking Water Standards and Health Advisories, April 2012
NC - no criteria
* - Michigan Part 201 Generic Drinking Water Cleanup Criteria, December 30, 2013
** - Secondary Maximum Contaminant Level (SMCL), EPA Secondary Drinking Water Regulations (SDWR) April 2012
^ - Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria. Hardness-dependent criteria calculated using hardness of 258 mg CaCO3/L (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018) per footnote {G} of Michigan Part 201 criteria tables. Chromium GSI criterion based on hexavalent chromium per footnote {H}. GSI criterion is protective for surface water used as a drinking water source as described in footnote {X}. GSI criterion for chloride is 50 mg/L when the discharge is to the Great Lakes or connecting waters per footnote {FF}
# - If detected above 0.20 ug/L, further evaluation of low-level mercury may be necessary to evaluate the GSI pathway per Michigan Part 201 and MDEQ policy and procedure 09-014 dated June 20, 2012
-- - Not analyzed
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
Comparison of Appendix III Parameter Results to Background Limits – November 2018
DE Karn Lined Impoundment – RCRA CCR Monitoring Program
Essexville, Michigan

		Sample Location:	DEK-MW-18001	OW-10	OW-12
		Sample Date:	11/6/2018	11/6/2018	11/7/2018
Constituent	Unit	UTL	downgradient		
Appendix III					
Boron	ug/L	**1,400**	1,020	**1,410**	994
Calcium	mg/L	94.1	51.1	77.9	61.1
Chloride	mg/L	**67.2**	**76.6**	**83.6**	**68.8**
Fluoride	ug/L	**1,000**	**1,300**	< 1,000	< 1,000
Sulfate	mg/L	**103**	< 2.0	< 2.0	**114**
Total Dissolved Solids	mg/L	559	340	492	464
pH, Field	SU	**7.3 - 8.4**	7.5	7.4	7.4

Notes:

ug/L - micrograms per liter

mg/L - milligrams per liter

SU - standard units; pH is a field parameter

All metals were analyzed as total unless otherwise specified.

RESULT Shading and bold font indicates an exceedance of the Upper Tolerance Limit (UTL) using the number of significant figures in the UTL.

Figures

LEGEND

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

NOTES

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

0 1,000 2,000 Feet

1 " = 1,000 '

1:12,000

PROJECT:

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

TITLE:

SITE MAP

DRAWN BY:	S. MAJOR	PROJ NO.:	290805-001
CHECKED BY:	D.LITZ		
APPROVED BY:	G.CROCKFORD		**FIGURE 1**
DATE:	MARCH 2019		

TRC

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

FILE NO.: 290805-001-023.mxd

Plot Date: 3/7/2019, 13:50:15 PM by SMAJOR -- LAYOUT: ANSI B(11"x17")
Path: E:\ConsumersEnergy\CCR GW\2017 269767\290805-001-023.mxd
Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl (Foot)
Map Rotation: 0

TRC - GIS

TRC - GIS

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

Plot Date: 3/7/2019, 14:13:07 PM by SMAJOR -- LAYOUT: ANSI B(11"x17")
Path: E:\Consumers Energy\CCR_GW\2017_2697671\290805-001-022.mxd

Lake Huron

INTAKE CHANNEL
BOTTOM ASH POND
DEK-MW-15004 (585.59)
OW-11 (587.50)
DEK-MW-15003 (587.03)
KARN LINED IMPOUNDMENT
DEK-MW-15005 (580.19)
OW-12 (586.47)
OW-10 (585.40)
DEK-MW-15006 (580.15)
DEK-MW-18001 (585.34)
DEK-MW-15002 (585.02)
DE KARN GENERATING FACILITY
583.0
581.0
587.0
585.0

MW-50 (579.95)
MW-51 (580.33)
MW-52 (580.18)
OW-51 (580.78) (NOTE 4)
JCW-OW-18002 (581.54) (NOTE 4)
JCW-OW-18003 (580.99) (NOTE 4)
OW-64 (581.67) (NOTE 4)
582.0
JCW-MW-15010 (581.35)
DISCHARGE CHANNEL
JCW-MW-18001 (579.88)
MW-53 (579.96)
OW-53 (580.78) (NOTE 4)
BOTTOM ASH POND
JCW-MW-15009 (581.24)
OW-63 (586.47) (NOTE 4)
JCW-OW-18001 (585.13) (NOTE 4)
LH-103 (583.87) (NOTE 4)
GAUGING STATION (580.06)
JCW-MW-15028 (582.56)
588.0
OW-61 (588.47) (NOTE 4)
MW-53R (579.89)
JC WEADOCK GENERATING FACILITY
JCW-MW-15007 (583.62)
586.0
584.0
JCW-MW-18006 (585.93)
JCW-OW-18006 (588.32) (NOTE 4)
SLURRY WALL
LANDFILL
584.0
OW-54 (584.05) (NOTE 4)
MW-54R (580.00)
OW-57RIN (NM)
OW-57ROUT (580.81)
JCW-OW-18004 (585.79) (NOTE 4)
UNDERWOOD DRAIN
JCW-MW-18004 (581.26)
583.0
581.0
MW-15008 (580.81)
OW-56R (NM)
MW-20 (584.35) (NOTE 4)
OW-55 (586.19) (NOTE 4)
586.0
LH-104 (586.72) (NOTE 4)
JCW-MW-18005 (579.91)
MW-55 (580.30)
TACEY DRAIN
Saginaw River
MW-15019 (580.89)
MW-15002 (581.00)
MW-15016 (582.55)

LEGEND

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

NOTES

1. BASE MAP IMAGERY FROM USDA – NATIONAL AGRICULTURE IMAGERY PROGRAM, 7/10/2016.
2. WELL LOCATIONS SURVEYED BY ROWE PROFESSIONAL SERVICES COMPANY ON 11/4/2015.
3. NOAA/NATIONAL OCEANIC SERVICE GREAT LAKES GAUGING STATION, ESSEXVILLE, MI (ID: 9075035).
4. GROUNDWATER ELEVATION DATA RECORDED OCTOBER 22, 2018.

N

0 1,000 2,000 Feet

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

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

TITLE:
SHALLOW GROUNDWATER CONTOUR MAP NOVEMBER 2018

DRAWN BY:	S. MAJOR	PROJ NO.:	290805-001
CHECKED BY:	D.LITZ		
APPROVED BY:	G.CROCKFORD		**FIGURE 2**
DATE:	MARCH 2019		

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

FILE NO.: 290805-001-022.mxd

LEGEND

- DEK BOTTOM ASH POND MONITORING WELL
- DECOMMISSIONED WELL
- BOTTOM ASH POND & LINED IMPOUNDMENT MONITORING WELL
- DEK LINED IMPOUNDMENT MONITORING WELL
- MONITORING WELL
- EXTENT OF GEOSYNTHETICS

NOTES

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

0 200 400 Feet

1 " = 200 '
1:2,400

PROJECT:

CONSUMERS ENERGY COMPANY
DE KARN POWER PLANT
ESSEXVILLE, MICHIGAN

TITLE:

KARN LINED IMPOUNDMENT AREA

DRAWN BY:	S. MAJOR	PROJ NO.:	290804-001
CHECKED BY:	D. LITZ		
APPROVED BY:	G. CROCKFORD		
DATE:	JUNE 2018		

FIGURE 3

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

FILE NO.: 290804-001-001.mxd

TRC - GIS
Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl (Foot)
Map Rotation: 0
Plot Date: 6/5/2018, 16:10:34 PM by JPAPEZ -- LAYOUT: ANSI B(11"x17")
Path: E:\Consumers Energy\CCR_GW\2017_269767\290804-001-001.mxd

Attachment A
Data Quality Reviews

Laboratory Data Quality Review
Groundwater Monitoring Event November 2018
CEC DE Karn Lined Impoundment and Bottom Ash Pond

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

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

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

Each sample was analyzed for the following constituents:

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

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

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

Data Usability Review Procedure

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

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

This data usability report addresses the following items:

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

Review Summary

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

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

QA/QC Sample Summary:

- A method blank was analyzed with each analytical batch; no analytes were detected in the method blank samples.
- One equipment blank (EB-03) and two field blanks (FB-03 and FB-04) were collected.
  - Copper was detected in FB-04 at 5.9 µg/L. The detected copper result in sample KLI-SCS_20181107 may be a false positive since the results was less than 5x the blank result.
- The LCS recoveries for all analytes were within QC limits.
- MS and/or MSD analyses were performed on sample DEK-MW-18001 for anions, mercury, alkalinity, radium, and metals. All recoveries and relative percent differences (RPDs) were within the QC limits with the following exception.
  - The recoveries of born were outside of the acceptance criteria. The boron concentration in sample DEK-MW-18001 was >4x the spike concentration; therefore, the MS/MSD results for boron were not evaluated. Data usability was not affected.
- The field duplicate pair samples were Dup-04 and DEK-MW-15006; RPDs between the parent and duplicate sample were within the QC limits.
- Laboratory duplicate analyses were performed on sample DEK-MW-18001 for anions, alkalinity, and TDS, DEK-MW-15002 for anions, DEK-MW-15005 for TDS, and KLI-SCS_20181107 for anions; RPDs were within QC limits.
- The laboratory noted that the sample bottle submitted for anions, TDS, and alkalinity analyses for sample DEK-MW-15004 was slightly unscrewed and laying sideways in the cooler water upon receipt at the laboratory. The laboratory noted that the sample was leaking and that contamination from the cooler water was possible for anions, TDS, and alkalinity. Results were consistent with previous rounds. Conservatively, results for anions, TDS, and alkalinity in this sample should be considered estimated; however, concentrations were generally consistent with previous data. Refer to Attachment A.
- Carrier and tracer recoveries, where applicable, were within 30-110%.

Attachment A

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

Samples	Collection Date	Analyte	Non-Conformance/Issue
DEK-MW-15004_20181106	11/6/2018	Chloride, fluoride, sulfate, total dissolved solids, alkalinity bicarbonate (CaCO3), alkalinity carbonate (CaCO3), and total alkalinity	The lab noted that the sample bottle was slightly unscrewed and laying sideways in the cooler water upon receipt at the laboratory. The lab noted that the sample was leaking and that contamination from the cooler water was possible. Conservatively, results for anions, TDS, and alkalinity in this sample should be considered estimated; however concentrations were generally consistent with previous data.
KLI-SCS_20181107	11/7/2018	Copper	Detection in field blank (FB-04). Sample result ≤5X the blank concentration. Result may be a false positive.

Attachment B
Background Statistical Evaluation

Technical Memorandum

Date: March 13, 2019

To: J.R. Register, CEC
Brad Runkel, CEC

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

Project No.: 290804.0000 Phase 002, Task 005

Subject: Background Statistical Evaluation – Consumers Energy, DE Karn Lined Impoundment

---

Pursuant to the United States Environmental Protection Agency's (U.S. EPA's) Resource Conservation and Recovery Act (RCRA) Coal Combustion Residual rule ("CCR Rule") promulgated on April 17, 2015, as amended July 30, 2018, the owner or operator of a CCR Unit must collect a minimum of eight rounds of background groundwater data to initiate a detection monitoring program and evaluate statistically significant increases above background (40 CFR §257.94). This memorandum presents the background statistical limits derived for the Consumers Energy Company (CEC) DE Karn Power Plant (DE Karn site) Lined Impoundment (KLI) in Essexville, Michigan.

Previously, the DE Karn Bottom Ash Pond was used for wet ash dewatering and was the primary settling/detention structure for the NPDES treatment system prior to discharge. In preparation for removal of the Bottom Ash Pond, a new lined impoundment CCR unit (KLI CCR unit) has been constructed. The footprint of the KLI CCR unit overlaps with the DE Karn Bottom Ash Pond CCR unit. The liner system for the new impoundment was designed as a double composite liner system, with the primary and secondary composite liners each consisting of 60-mil high density polyethylene (HDPE) geomembrane overlaying a 236-mil geosynthetic clay liner (GCL)[1]. The wet ash dewatering was relocated to the new impoundment (KLI CCR unit), which began receipt of CCR in June of 2018. On January 14, 2019, CEC provided notice that an Appendix IV constituent (arsenic) was detected in the compliance well network at concentrations exceeding the Groundwater Protection Standards established for the unit. The pre-existing DE Karn Bottom Ash Pond CCR unit has an overlapping footprint with the KLI CCR unit.

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

In accordance with §257.91, CEC has developed a groundwater monitoring system for the new KLI CCR unit consisting of four monitoring wells (DEK-MW-15003, DEK-MW-18001, OW-10, OW-12) and one supplemental monitoring well (OW-11). Because of the site hydrogeology and presence of affected groundwater due to the history of CCR-related operations throughout the DE Karn Site, an intra-well statistical approach is recommended for detection monitoring. However, there is currently insufficient data from wells in the KLI monitoring well system to support intra-well statistical methods, and to collect statistically independent sample data in support of the intra-well methods will take several years. Therefore, for an interim period, CEC will perform inter-well statistics using DEK-MW-15003 as the upgradient/background well until sufficient data are collected from the KLI wells to support intra-well statistical procedures.

The initial background/baseline sampling period for new CCR units is at least eight independent events collected over a six-month period per §257.94(b). This provides a minimal background data set to initiate statistical comparisons. Over time, the short baseline period may result in a high risk of false positive statistical results. However, more than eight independent groundwater samples were collected from DEK-MW-15003 as part of previous CCR unit sampling related to the existing bottom ash pond in 2016 through 2018. Background data for DEK-MW-15003 is summarized in Table A1.

The background data for DEK-MW-15003 were evaluated in accordance with the *Groundwater Statistical Evaluation Plan* (Stats Plan) (TRC, June 2018). The DE Karn site groundwater data are maintained within a database accessible through Sanitas™ statistical software. Sanitas™ is a software tool that is commercially available for performing statistical evaluation consistent with procedures outlined in U.S. EPA's Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities (Unified Guidance; UG). Within the Sanitas™ statistical program (and the UG), tolerance limits were selected to perform the statistical calculation for background limits. Use of tolerance limits is a streamlined approach that offers adequate statistical power under the current, initial stage of establishing background and developing the monitoring program and is an acceptable approach for detection monitoring under the CCR rule. Upper tolerance limits (UTLs) were calculated for each of the CCR Appendix III parameters using the most recent eight sampling events prior to the KLI beginning receipt of CCR in June 2018. 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 following narrative describes the methods employed and the results obtained; the Sanitas™ output files are included as Attachment 1.

The background evaluation included the following steps:

- Review of data quality reports for the baseline/background data sets for CCR Appendix III constituents;
- Graphical representation of the baseline data as time versus concentration (T v. C) by well/constituent pair;

- Outlier testing of individual data points that appear from the graphical representations as potential outliers;
- Evaluation of percentage of nondetects for each baseline/background well-constituent (w/c) pair;
- Distribution of the data; and
- Calculation of the UTL for each cumulative baseline/background data set (upper and lower tolerance limits were calculated for field pH).

The results of these evaluations are presented and discussed below.

Data Quality

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

Time versus Concentration Graphs

Initially, T v. C graphs were created for all baseline results (December 2015 to November 2018) to observe for potential outliers. The T v. C graphs included in Attachment 1 show a potential outlier for calcium (high value for DEK-MW-15003 in February 2017). This data set will be tested by the Sanitas™ software to assess whether the potential outlier is statistically significant.

While variations in results are present, the graphs do not suggest that data sets, as a whole, likely have overall trending or seasonality. The data sets are of relatively short duration for making such observations.

Outlier Testing

The Dixon's Outlier Test in Sanitas™ was used to test the potential outlier in the calcium data set for DEK-MW-15003 that was identified in the T v. C graphs (Attachment 1). The suspect data point was found to not be an outlier. Although higher than the rest of the data set, the potential outlier is within the same order of magnitude and was within 2x the median of the data set, as shown in the Sanitas™ output file (Attachment 1). The potential outlier data point will be included in the background/baseline UTL calculations.

Percentage of Nondetects

Table 1 summarizes the percentage of results below the reporting limit for the background monitoring well.

Table 1
Summary of Percentage of Baseline Results Below Reporting Limit

WELL	CONSTITUENT	PERCENT NON-DETECT
DEK-MW-15003	Boron	0
	Calcium	0
	Chloride	0
	Fluoride	100
	Field pH	0
	Sulfate	0
	Total Dissolved Solids	0

Distribution of the Data Sets

The distribution of the data sets is determined by the Sanitas™ software during calculation of the upper tolerance limit. The Shapiro-Wilk normality test is used for samples sizes less than 50. Non-detect/censored data were handled in accordance with the Stats Plan. If the data appear to be non-normal, mathematical transformations of the data may be utilized such that the transformed data follow a normal distribution (e.g., lognormal distributions). Alternatively, non-parametric tests may be utilized when data cannot be normalized. Table 2 summarizes the distributions determined by the Sanitas™ software.

Table 2
Summary of Background/Baseline Data Distributions

CONSTITUENT	DISTRIBUTION
Boron	Normal
Calcium	Normal
Chloride	Normal
Fluoride	All Non-Detect – use highest Reporting Limit
Field pH	Normal
Sulfate	Normal
Total Dissolved Solids	Normal

Upper Tolerance Limits

Table 3 presents the calculated upper tolerance limits for the background/baseline data sets. The data set with an observed outlier is included both with and without the outlier value included in the data set. For normal and lognormal distributions, UTLs are calculated for 95 percent coverage and 95 percent confidence using parametric tolerance limits. For nonnormal background datasets, a nonparametric tolerance limit is utilized, resulting in the highest value from the background dataset as the UTL. The achieved confidence and/or coverage rates depend entirely on the number of background data points, and coverage rates for various confidence levels are shown in the Sanitas™ outputs for nonparametric tolerance limits. Verification resampling (1 of 2) is recommended per the Stats Plan and UG to achieve a site-wide false positive rate within the range specified in the CCR rules.

Table 3
Summary of Baseline Upper Tolerance Limits

CONSTITUENT	UPPER TOLERANCE LIMIT – FROM SANITAS™
Boron	1,400 µg/L
Calcium	94.1 mg/L
Chloride	67.2 mg/L
Fluoride	1,000 µg/L*
Field pH	7.3 – 8.4 s.u.
Sulfate	103 mg/L
Total Dissolved Solids	559 mg/L

* Nonparametric Tolerance Limit
µg/L – micrograms per liter
mg/L – milligrams per liter
s.u. – standard units

Attachments

Table A1 – Summary of Analytical Results for Background Groundwater Samples
Attachment 1 – Sanitas™ Output Files

Table

Table A1
Summary of Groundwater Sampling Results (Analytical): December 2015-November 2018
DE Karn Lined Impoundment – RCRA CCR Monitoring Program
Essexville, Michigan

						Sample Location:	DEK-MW-15003											
						Sample Date:	12/10/2015	3/30/2016	5/26/2016	8/24/2016	12/1/2016	2/23/2017	5/18/2017	8/4/2017	9/18/2017	4/12/2018	5/23/2018	8/16/2018	11/6/2018
Constituent	Unit	EPA MCL	MI Residential*	MI Non-Residential*	MI GSI^		Background												
Appendix III																			
Boron	ug/L	NC	**500**	**500**	4,000		**1,020**	**920**	**982**	**1,010**	**1,140**	**1,090**	**1,270**	**1,160**	**1,030**	--	**1,010**	**913**	**944**
Calcium	mg/L	NC	NC	NC	500		41.7	57.3	56.3	64.1	64.1	85.4	68.2	58.8	62.1	--	58.1	59.1	62.9
Chloride	mg/L	250**	250	250	**50**		**63.8**	**62.0**	**61.2**	**59.8**	**54.8**	**56.3**	**54.9**	**61.7**	**60.2**	--	**57.2**	**59.4**	**61.7**
Fluoride	ug/L	4,000	NC	NC	NC		< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Sulfate	mg/L	250**	**250**	**250**	**500**		64.3	71.6	75.7	76.8	71.9	64.5	57.6	55.8	54.3	--	39.1	38.0	37.8
Total Dissolved Solids	mg/L	500**	**500**	**500**	**500**		370	400	420	430	440	430	420	**506**	426	--	354	374	370
pH, Field	SU	6.5 - 8.5**	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0		8.4	7.8	7.9	7.7	7.8	7.7	7.8	7.9	7.9	7.8	8.2	7.9	8.0
Appendix IV																			
Antimony	ug/L	6	6.0	6.0	2.0		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 2.0	< 1.0
Arsenic	ug/L	**10**	**10**	**10**	**10**		**498**	**517**	**543**	**527**	**525**	**372**	**450**	**437**	--	**478**	**450**	**456**	**420**
Barium	ug/L	2,000	2,000	2,000	1,200		96	69	68	73	71	71	66	68.5	--	61.2	73.3	66.8	70.9
Beryllium	ug/L	4	4.0	4.0	33		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	5	5.0	5.0	2.5		< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20	< 0.20
Chromium	ug/L	100	100	100	11		2	2	2	< 1	< 1	< 1	1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0
Cobalt	ug/L	NC	40	100	100		< 15	< 15	< 15	< 15	< 15	< 15	< 15	< 15.0	--	< 15.0	< 15.0	< 15.0	< 6.0
Fluoride	ug/L	4,000	NC	NC	NC		< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Lead	ug/L	NC	**4.0**	**4.0**	**14**		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0	< 1.0
Lithium	ug/L	NC	170	350	440		22.8	22.6	26	27	30	30	35	35	--	39	33	35	33
Mercury	ug/L	2	2.0	2.0	0.20#		< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	NC	**73**	210	120		8	7	8	6	5	5	5	5.0	--	< 5.0	5.3	< 5.0	5.2
Radium-226	pCi/L	NC	NC	NC	NC		< 0.221	< 0.227	< 0.235	< 0.184	< 0.287	0.252	< 0.324	0.226	--	0.686	< 0.842	1.20	< 0.661
Radium-228	pCi/L	NC	NC	NC	NC		< 0.473	< 0.520	< 0.546	0.423	< 0.363	< 0.340	< 0.646	< 0.936	--	< 0.755	1.12	< 0.837	< 0.789
Radium-226/228	pCi/L	5	NC	NC	NC		< 0.473	< 0.52	< 0.546	0.469	< 0.363	< 0.34	< 0.646	< 1.14	--	< 1.33	1.63	< 1.76	< 1.45
Selenium	ug/L	50	50	50	5.0		< 5	< 1	2	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 2.0	< 1.0
Thallium	ug/L	2	2.0	2.0	2.0		< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2.0	--	< 2.0	< 2.0	< 2.0	< 2.0

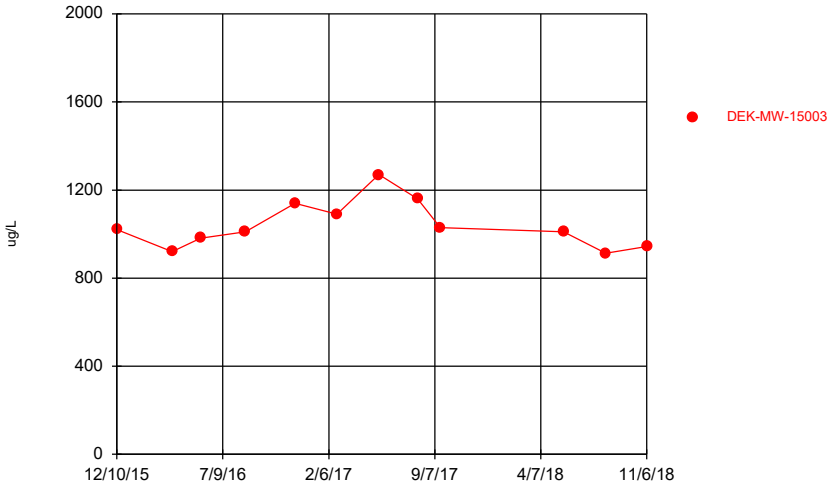
Notes:
ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units; pH is a field parameter.
pCi/L - picocuries per liter.
MCL - Maximum Contaminant Level, EPA Drinking Water Standards and Health Advisories, April, 2012.
NC - no criteria.
-- - not analyzed
* - Michigan Part 201 Generic Drinking Water Cleanup Criteria, December 30, 2013.
** - Secondary Maximum Contaminant Level (SMCL), EPA Secondary Drinking Water Regulations (SDWR) April, 2012.
^ - Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria. Hardness-dependent criteria calculated using hardness of 258 mg CaCO3/L (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018) per footnote {G} of Michigan Part 201 criteria tables. Chromium GSI criterion based on hexavalent chromium per footnote {H}. GSI criterion is protective for surface water used as a drinking water source as described in footnote {X}. GSI criterion for chloride is 50 mg/L when the discharge is to the Great Lakes or connecting waters per footnote {FF}
# - If detected above 0.20 ug/L, further evaluation of low-level mercury may be necessary to evaluate the GSI pathway per Michigan Part 201 and MDEQ policy and procedure 09-014 dated June 20, 2012.
BOLD value indicates an exceedance of one or more of the listed criteria.
RED value indicates an exceedance of the MCL.
All metals were analyzed as total unless otherwise specified.

Technical Memorandum

Sanitas™ Output Files

Sanitas™ v.9.6.12 Sanitas software licensed to Consumers Energy. EPA

Boron, Total

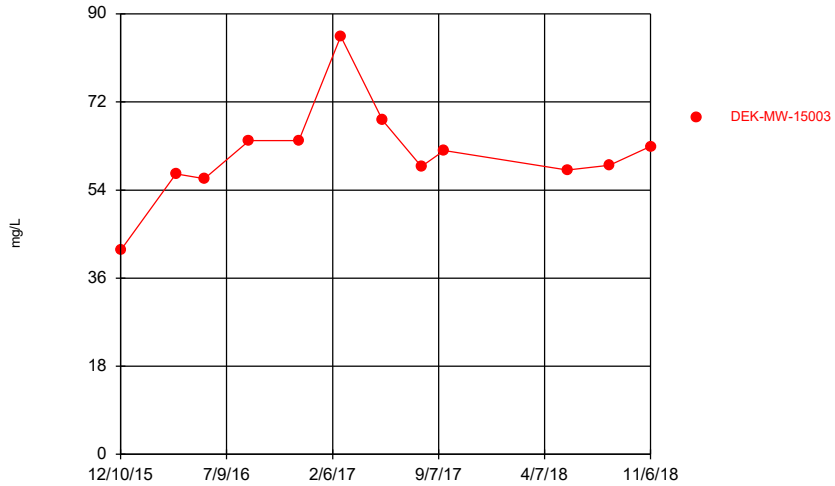


Time Series Analysis Run 2/5/2019 4:46 PM

Client: Consumers Energy Data: DEK_CCR_Sanitas_19.01.31

Sanitas™ v.9.6.12 Sanitas software licensed to Consumers Energy. EPA

Calcium, Total

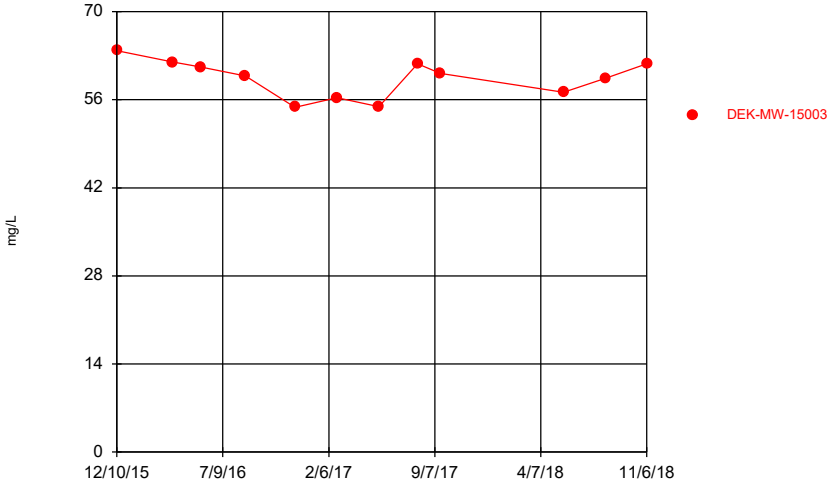


Time Series Analysis Run 2/5/2019 4:46 PM

Client: Consumers Energy Data: DEK_CCR_Sanitas_19.01.31

Sanitas™ v.9.6.12 Sanitas software licensed to Consumers Energy. EPA

Chloride

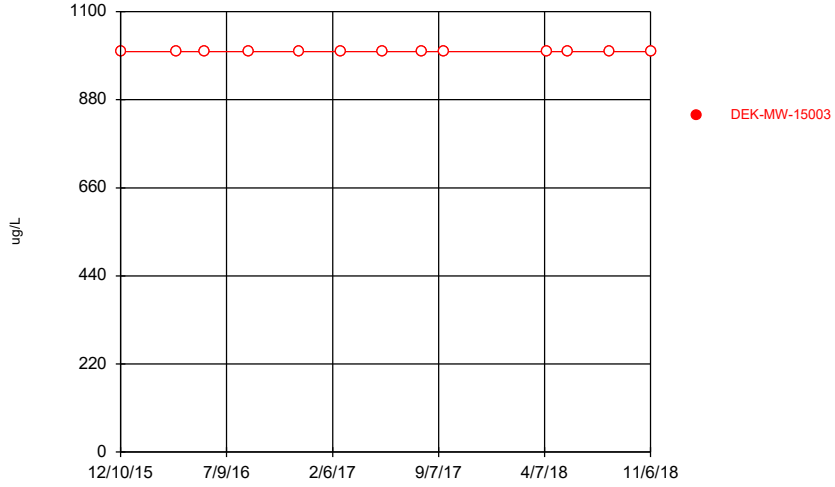


Time Series Analysis Run 2/5/2019 4:46 PM

Client: Consumers Energy Data: DEK_CCR_Sanitas_19.01.31

Sanitas™ v.9.6.12 Sanitas software licensed to Consumers Energy. EPA
Hollow symbols indicate censored values.

Fluoride



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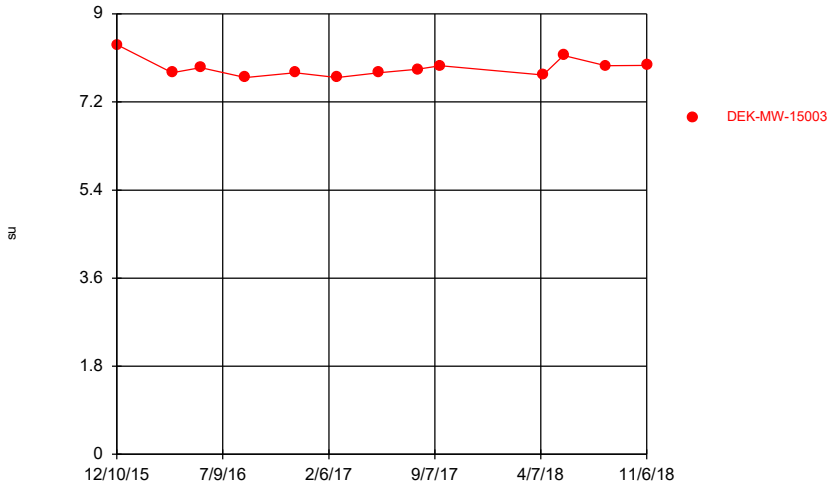
Client: Consumers Energy Data: DEK_CCR_Sanitas_19.01.31

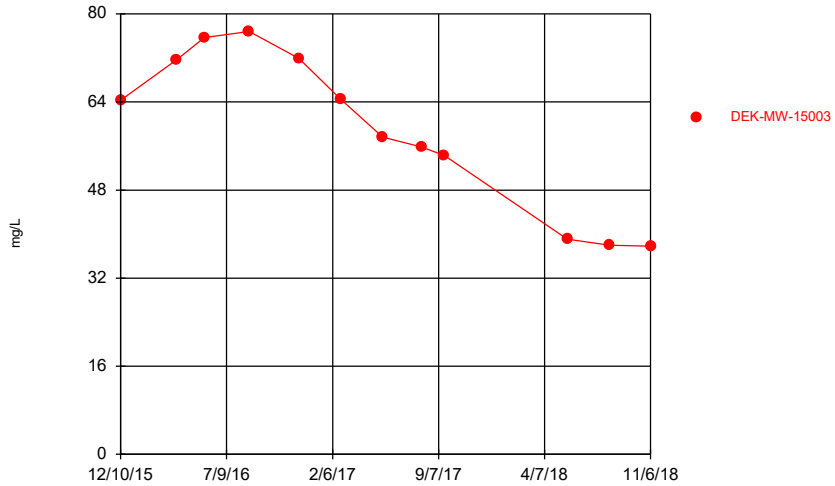
pH, Field



Time Series Analysis Run 2/5/2019 4:46 PM

Client: Consumers Energy Data: DEK_CCR_Sanitas_19.01.31

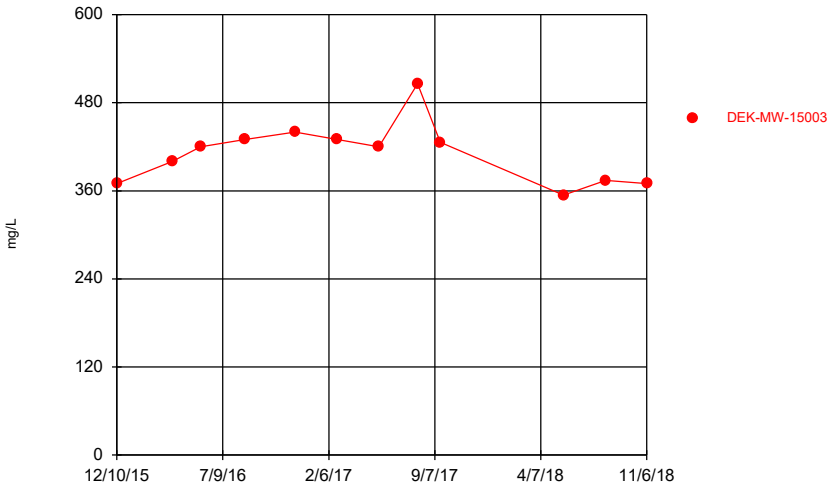
Sulfate



Time Series Analysis Run 2/5/2019 4:46 PM

Client: Consumers Energy Data: DEK_CCR_Sanitas_19.01.31

Total Dissolved Solids, Dissolved

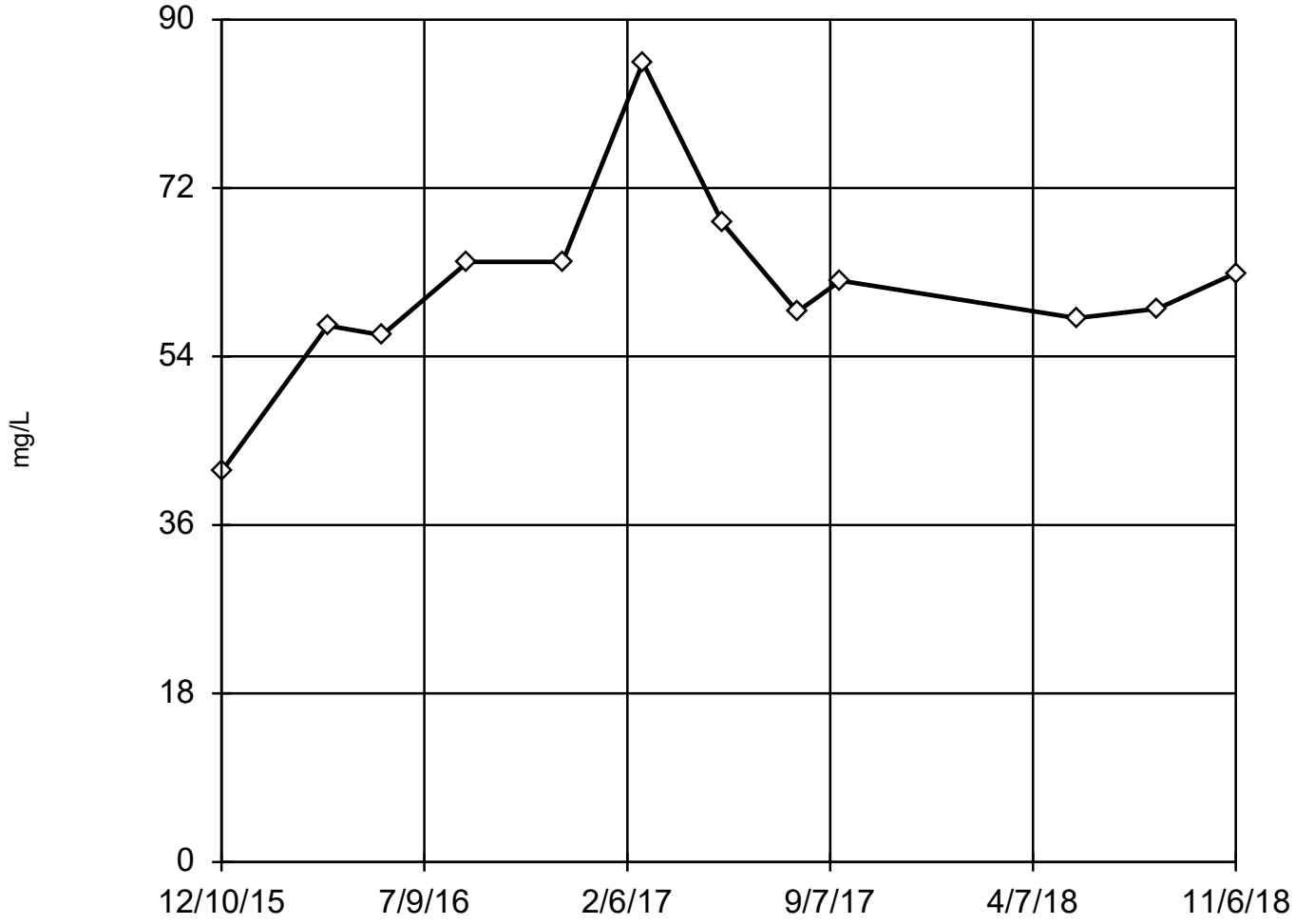


Time Series Analysis Run 2/5/2019 4:46 PM

Client: Consumers Energy Data: DEK_CCR_Sanitas_19.01.31

EPA 1989 Outlier Screening

DEK-MW-15003 (bg)



n = 12

No statistical outliers.
Mean 61.51, std. dev. 9.969, critical Tn 2.285
At least one potential outlier was rejected as < 2.0 x median.

Normality test used:
Shapiro Wilk@alpha = 0.01
Calculated = 0.8733
Critical = 0.805
The distribution was found to be normally distributed.

Constituent: Calcium, Total Analysis Run 2/27/2019 10:29 AM

Client: Consumers Energy Data: DEK_CCR_Sanitas_19.01.31

Shapiro-Wilk Normality Test

Constituent: Boron, Total Analysis Run 2/26/2019 12:10 PM
Client: Consumers Energy Data: DEK_CCR_Sanitas_19.01.31

Well	Transformation	Calculated	Critical	Normal
DEK-MW-15003 (n = 8, alpha = 0.01)				
	no	0.906	0.749	Yes
	square root	0.9117	0.749	Yes
	square	0.8931	0.749	Yes
	cube root	0.9134	0.749	Yes
	cube	0.8781	0.749	Yes
	natural log	0.9168	0.749	Yes
	x^4	0.8612	0.749	Yes
	x^5	0.8426	0.749	Yes
	x^6	0.8226	0.749	Yes

Shapiro-Wilk Normality Test

Constituent: Calcium, Total Analysis Run 2/26/2019 12:10 PM
Client: Consumers Energy Data: DEK_CCR_Sanitas_19.01.31

Well	Transformation	Calculated	Critical	Normal
DEK-MW-15003 (n = 8, alpha = 0.01)				
	no	0.799	0.749	Yes
	square root	0.8219	0.749	Yes
	square	0.7524	0.749	Yes
	cube root	0.8293	0.749	Yes
	cube	0.7065	0.749	No
	natural log	0.8439	0.749	Yes
	x^4	0.6631	0.749	No
	x^5	0.6235	0.749	No
	x^6	0.5885	0.749	No

Shapiro-Wilk Normality Test

Constituent: Chloride Analysis Run 2/26/2019 12:10 PM
Client: Consumers Energy Data: DEK_CCR_Sanitas_19.01.31

Well	Transformation	Calculated	Critical	Normal
DEK-MW-15003 (n = 8, alpha = 0.01)				
	no	0.8922	0.749	Yes
	square root	0.8916	0.749	Yes
	square	0.8933	0.749	Yes
	cube root	0.8914	0.749	Yes
	cube	0.8941	0.749	Yes
	natural log	0.891	0.749	Yes
	x^4	0.8948	0.749	Yes
	x^5	0.8953	0.749	Yes
	x^6	0.8956	0.749	Yes

Shapiro-Wilk Normality Test

Constituent: Fluoride Analysis Run 2/26/2019 12:10 PM

Client: Consumers Energy Data: DEK_CCR_Sanitas_19.01.31

Well	Transformation	Calculated	Critical	Normal
DEK-MW-15003 (n = 9, alpha = 0.01)				
	no	-1	0.764	No
	square root	-1	0.764	No
	square	-1	0.764	No
	cube root	-1	0.764	No
	cube	-1	0.764	No
	natural log	-1	0.764	No
	x^4	-1	0.764	No
	x^5	-1	0.764	No
	x^6	-1	0.764	No

Shapiro-Wilk Normality Test

Constituent: Sulfate Analysis Run 2/26/2019 12:10 PM

Client: Consumers Energy Data: DEK_CCR_Sanitas_19.01.31

Well	Transformation	Calculated	Critical	Normal
DEK-MW-15003 (n = 8, alpha = 0.01)				
	no	0.9324	0.749	Yes
	square root	0.9211	0.749	Yes
	square	0.9388	0.749	Yes
	cube root	0.9161	0.749	Yes
	cube	0.9292	0.749	Yes
	natural log	0.904	0.749	Yes
	x^4	0.9106	0.749	Yes
	x^5	0.8885	0.749	Yes
	x^6	0.8665	0.749	Yes

Shapiro-Wilk Normality Test

Constituent: Total Dissolved Solids, Dissolved Analysis Run 2/26/2019 12:10 PM

Client: Consumers Energy Data: DEK_CCR_Sanitas_19.01.31

Well	Transformation	Calculated	Critical	Normal
DEK-MW-15003 (n = 8, alpha = 0.01)				
	no	0.8492	0.749	Yes
	square root	0.8494	0.749	Yes
	square	0.8408	0.749	Yes
	cube root	0.8489	0.749	Yes
	cube	0.8231	0.749	Yes
	natural log	0.847	0.749	Yes
	x^4	0.798	0.749	Yes
	x^5	0.7681	0.749	Yes
	x^6	0.7357	0.749	No

Shapiro-Wilk Normality Test

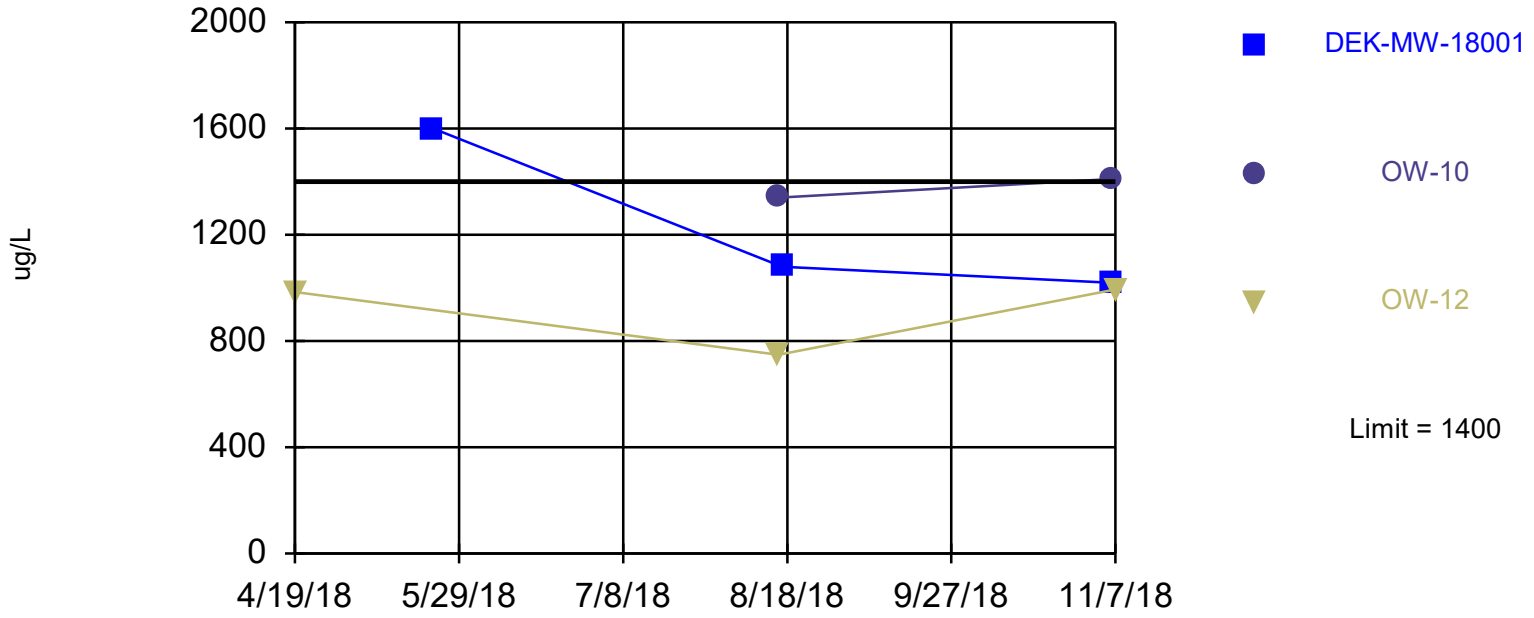
Constituent: pH, Field Analysis Run 2/26/2019 12:12 PM
Client: Consumers Energy Data: DEK_CCR_Sanitas_19.01.31

Well	Transformation	Calculated	Critical	Normal
DEK-MW-15003 (n = 8, alpha = 0.01)				
	no	0.8655	0.749	Yes
	square root	0.8678	0.749	Yes
	square	0.8607	0.749	Yes
	cube root	0.8686	0.749	Yes
	cube	0.8559	0.749	Yes
	natural log	0.8701	0.749	Yes
	x^4	0.8509	0.749	Yes
	x^5	0.8459	0.749	Yes
	x^6	0.8408	0.749	Yes

Within Limit

Tolerance Limit

Interwell Parametric



95% coverage. Background Data Summary: Mean=1087, Std. Dev.=98.39, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.906, critical = 0.749. Report alpha = 0.05.

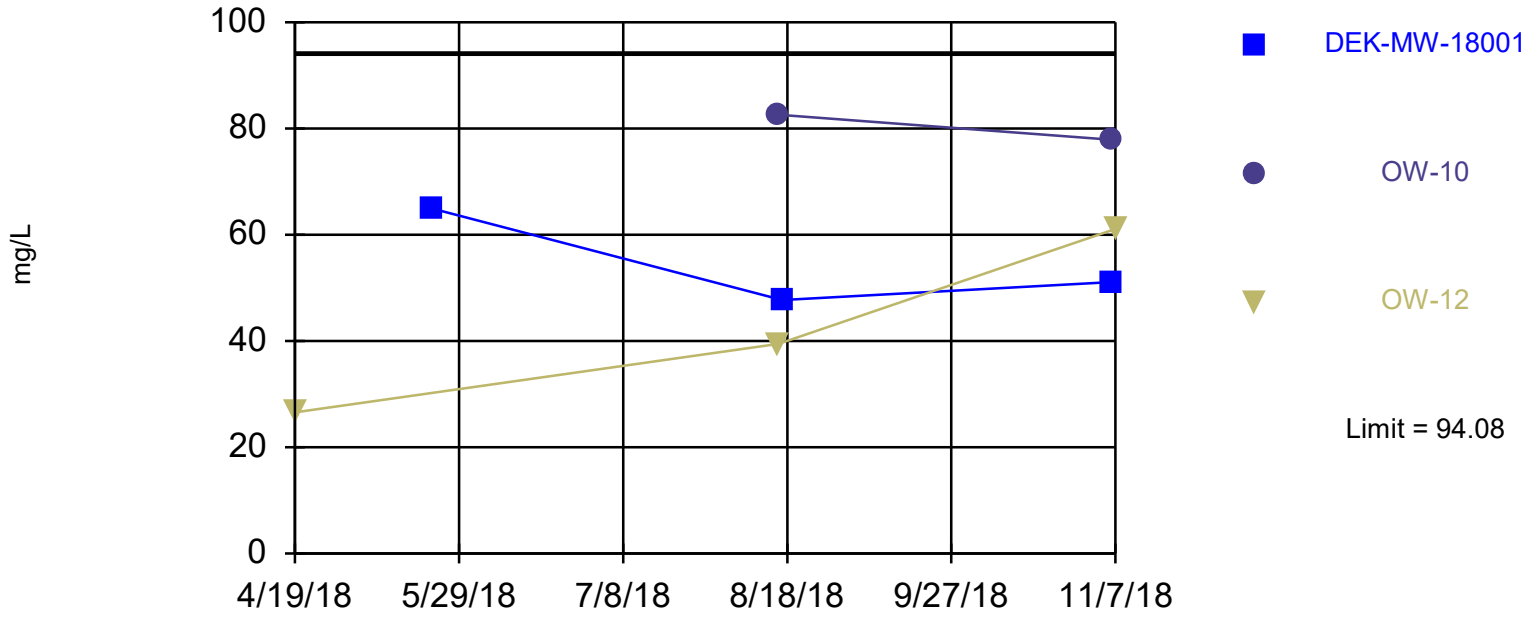
Constituent: Boron, Total Analysis Run 3/7/2019 12:43 PM

Client: Consumers Energy Data: DEK_CCR_Sanitas_19.01.31

Within Limit

Tolerance Limit

Interwell Parametric



95% coverage. Background Data Summary: Mean=64.64, Std. Dev.=9.236, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.799, critical = 0.749. Report alpha = 0.05.

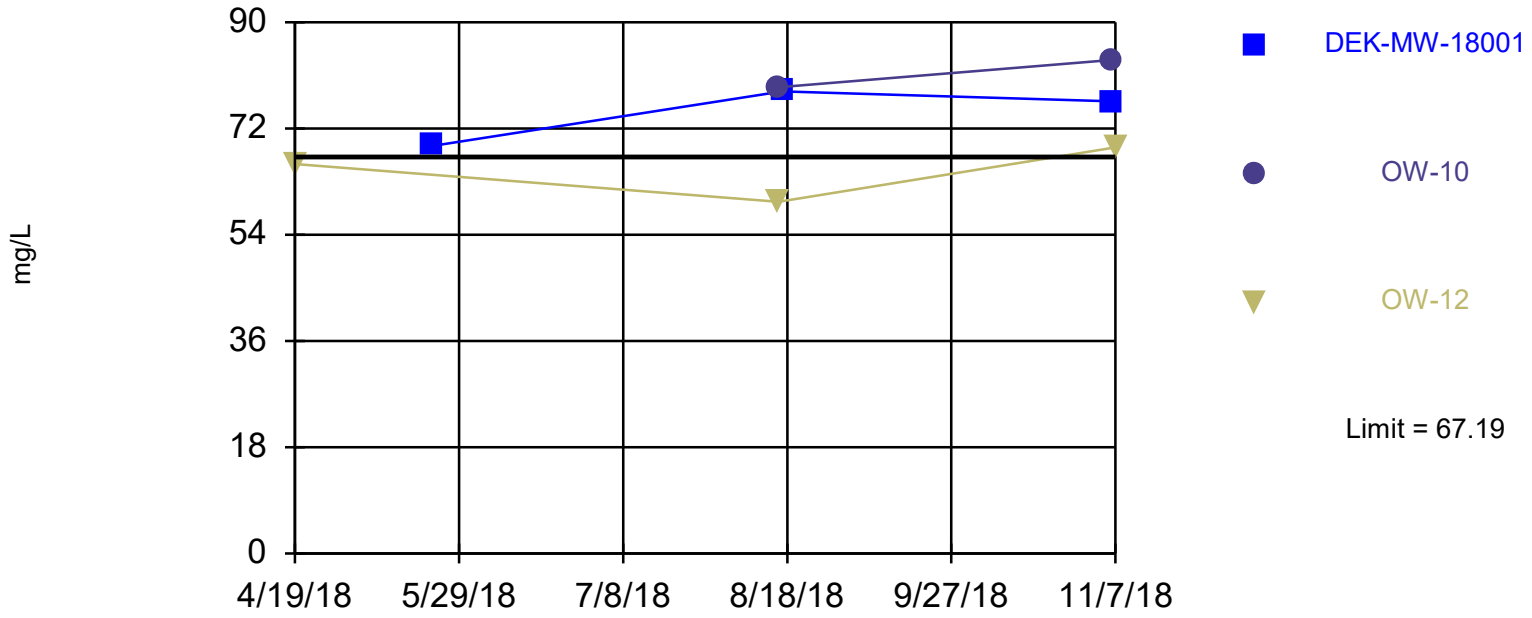
Constituent: Calcium, Total Analysis Run 3/7/2019 12:43 PM

Client: Consumers Energy Data: DEK_CCR_Sanitas_19.01.31

Within Limit

Tolerance Limit

Interwell Parametric



95% coverage. Background Data Summary: Mean=58.26, Std. Dev.=2.799, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8922, critical = 0.749. Report alpha = 0.05.

Constituent: Chloride Analysis Run 3/7/2019 12:44 PM

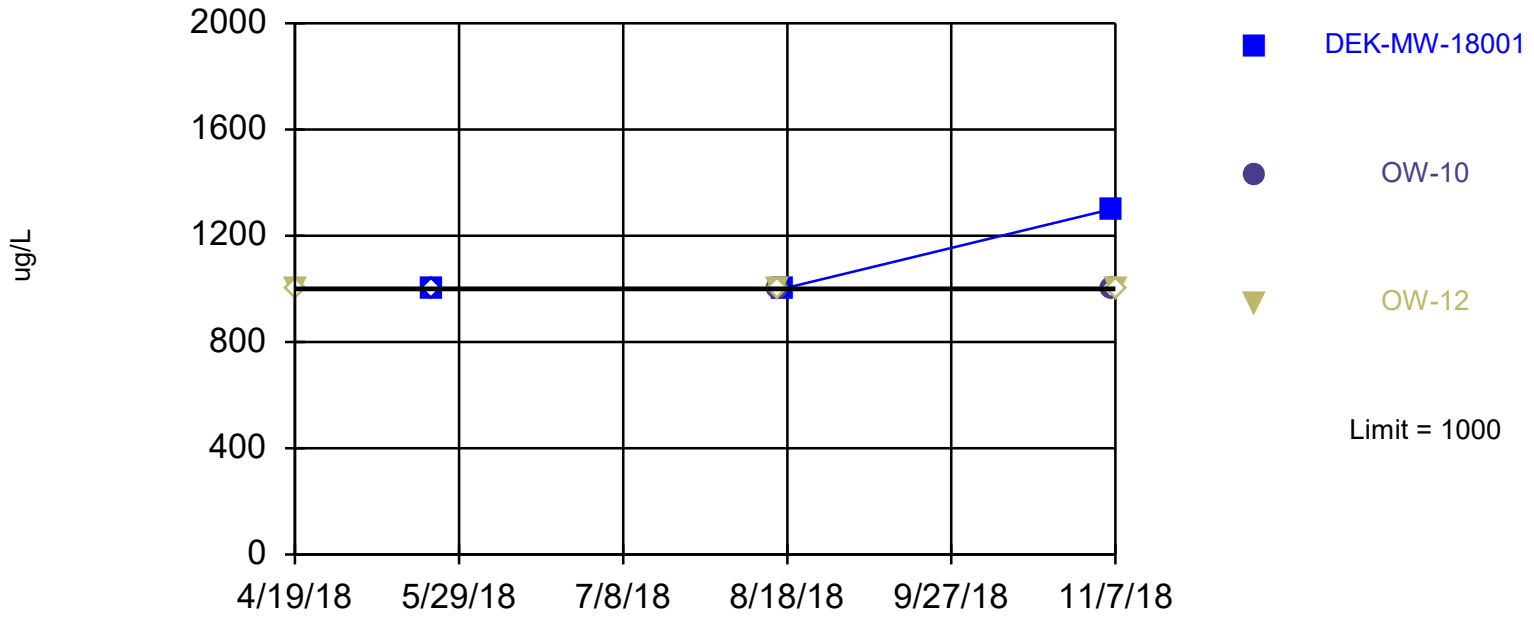
Client: Consumers Energy Data: DEK_CCR_Sanitas_19.01.31

Hollow symbols indicate censored values.

Within Limit

Tolerance Limit

Interwell Non-parametric



Non-parametric test used in lieu of parametric tolerance limit because censored data exceeded 50%. Limit is highest of 8 background values. 100% NDs. 56.05% coverage at alpha=0.01; 68.95% coverage at alpha=0.05; 91.6% coverage at alpha=0.5. Report alpha = 0.6634.

Constituent: Fluoride Analysis Run 3/7/2019 12:44 PM

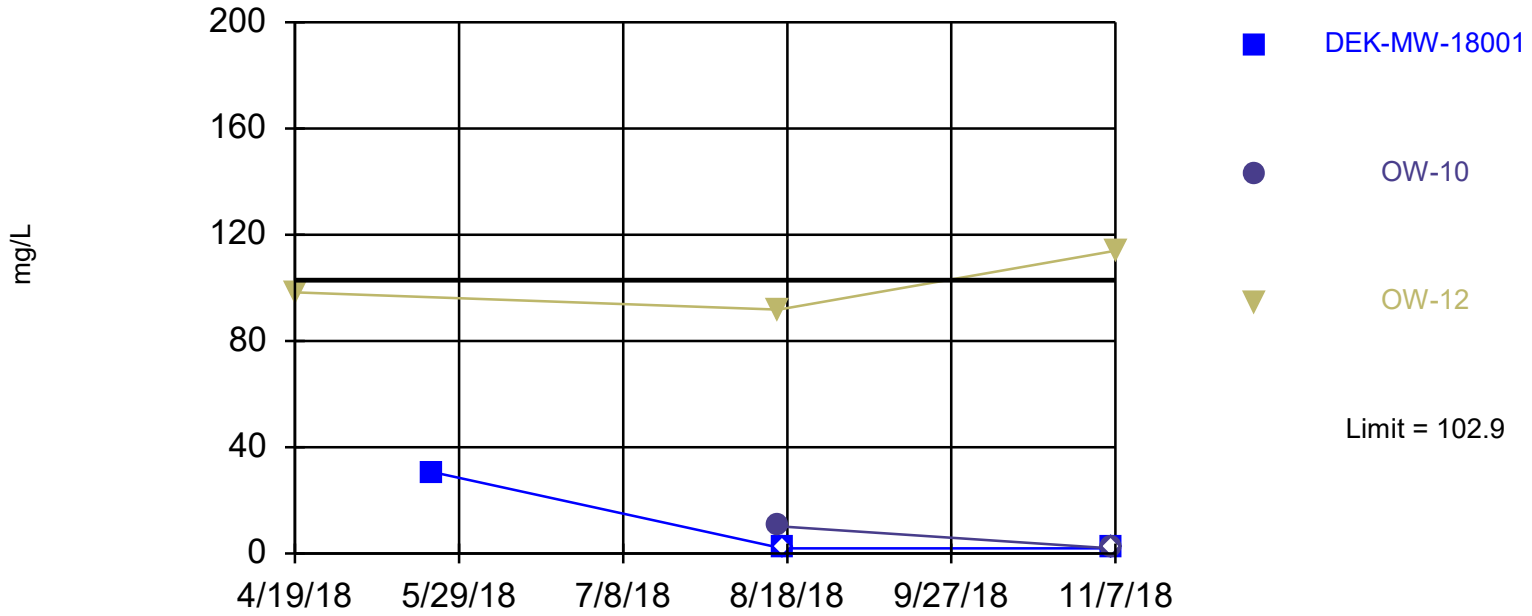
Client: Consumers Energy Data: DEK_CCR_Sanitas_19.01.31

Hollow symbols indicate censored values.

Within Limit

Tolerance Limit

Interwell Parametric



95% coverage. Background Data Summary: Mean=61.96, Std. Dev.=12.83, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9324, critical = 0.749. Report alpha = 0.05.

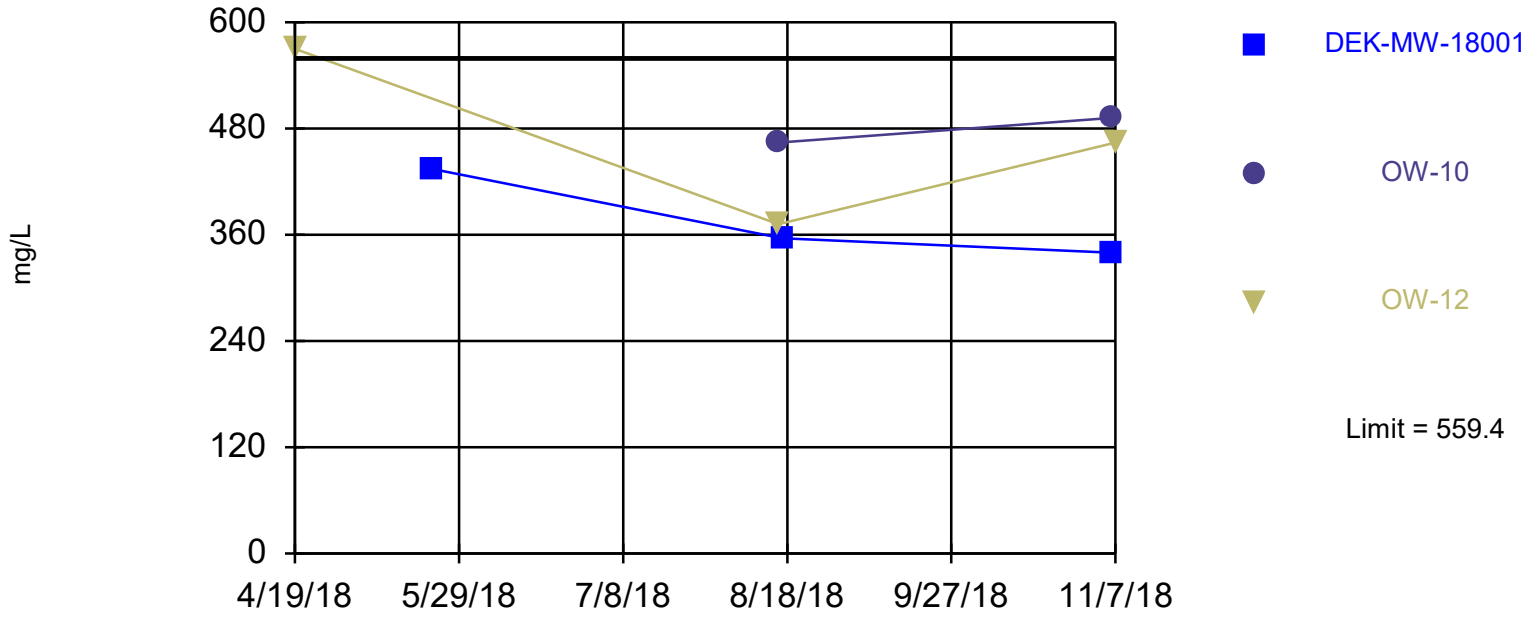
Constituent: Sulfate Analysis Run 3/7/2019 12:45 PM

Client: Consumers Energy Data: DEK_CCR_Sanitas_19.01.31

Within Limit

Tolerance Limit

Interwell Parametric



95% coverage. Background Data Summary: Mean=428.3, Std. Dev.=41.13, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8492, critical = 0.749. Report alpha = 0.05.

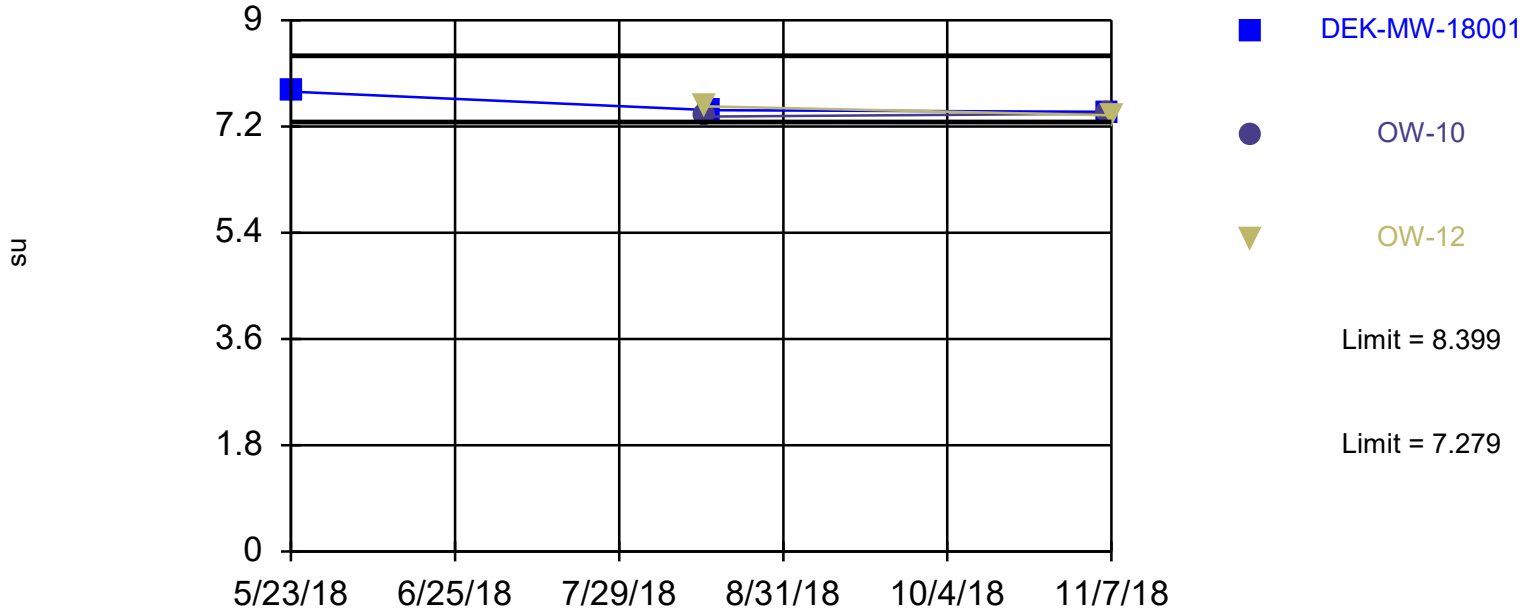
Constituent: Total Dissolved Solids, Dissolved Analysis Run 3/7/2019 12:45 PM

Client: Consumers Energy Data: DEK_CCR_Sanitas_19.01.31

Within Limits

Tolerance Limit

Interwell Parametric



95% coverage. Background Data Summary: Mean=7.839, Std. Dev.=0.15, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8655, critical = 0.749. Report alpha = 0.025 per tail.

Constituent: pH, Field Analysis Run 3/7/2019 12:46 PM

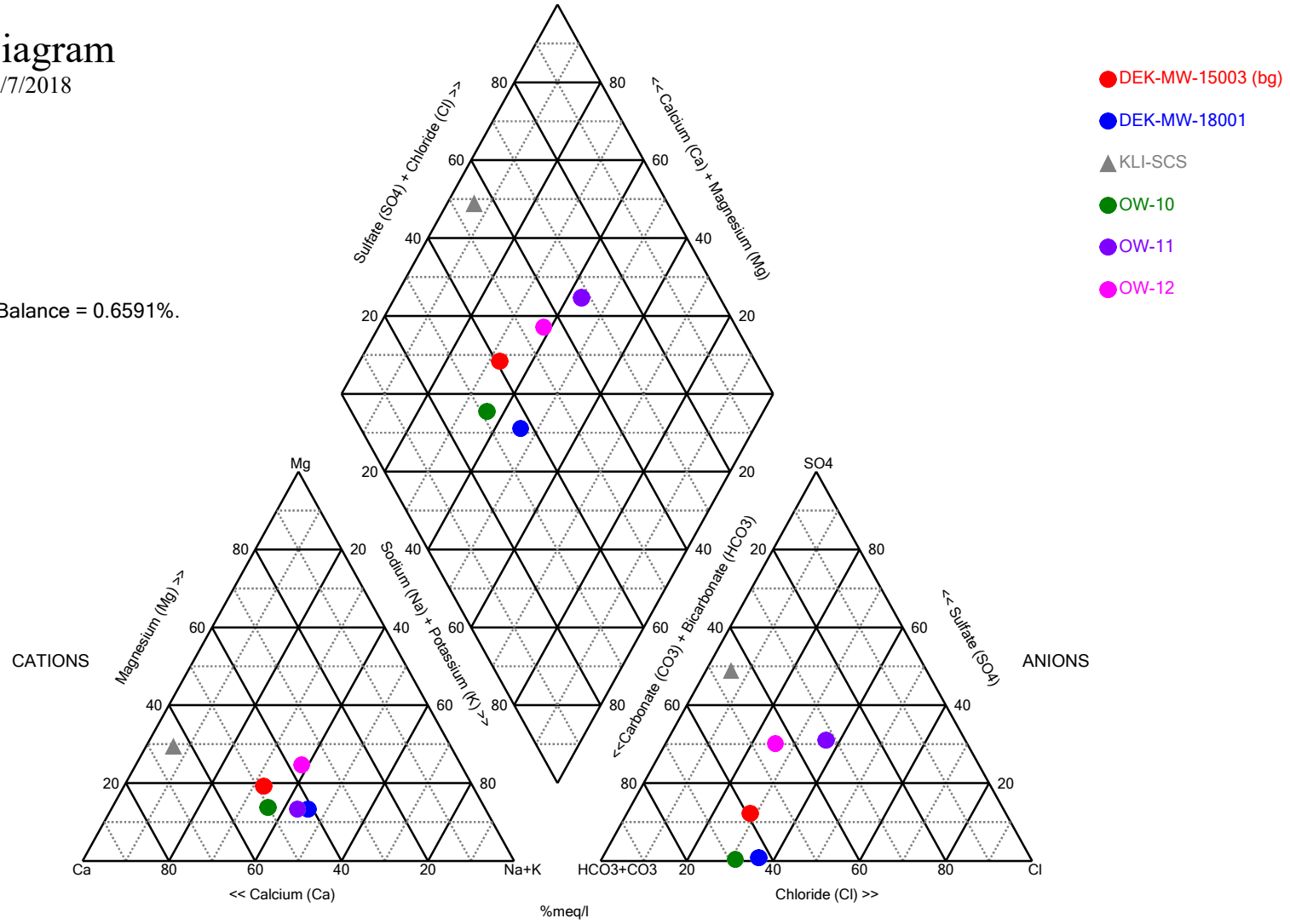
Client: Consumers Energy Data: DEK_CCR_Sanitas_19.01.31

Attachment C
ASD Supporting Documentation

Piper Diagram

11/6/2018, 11/7/2018

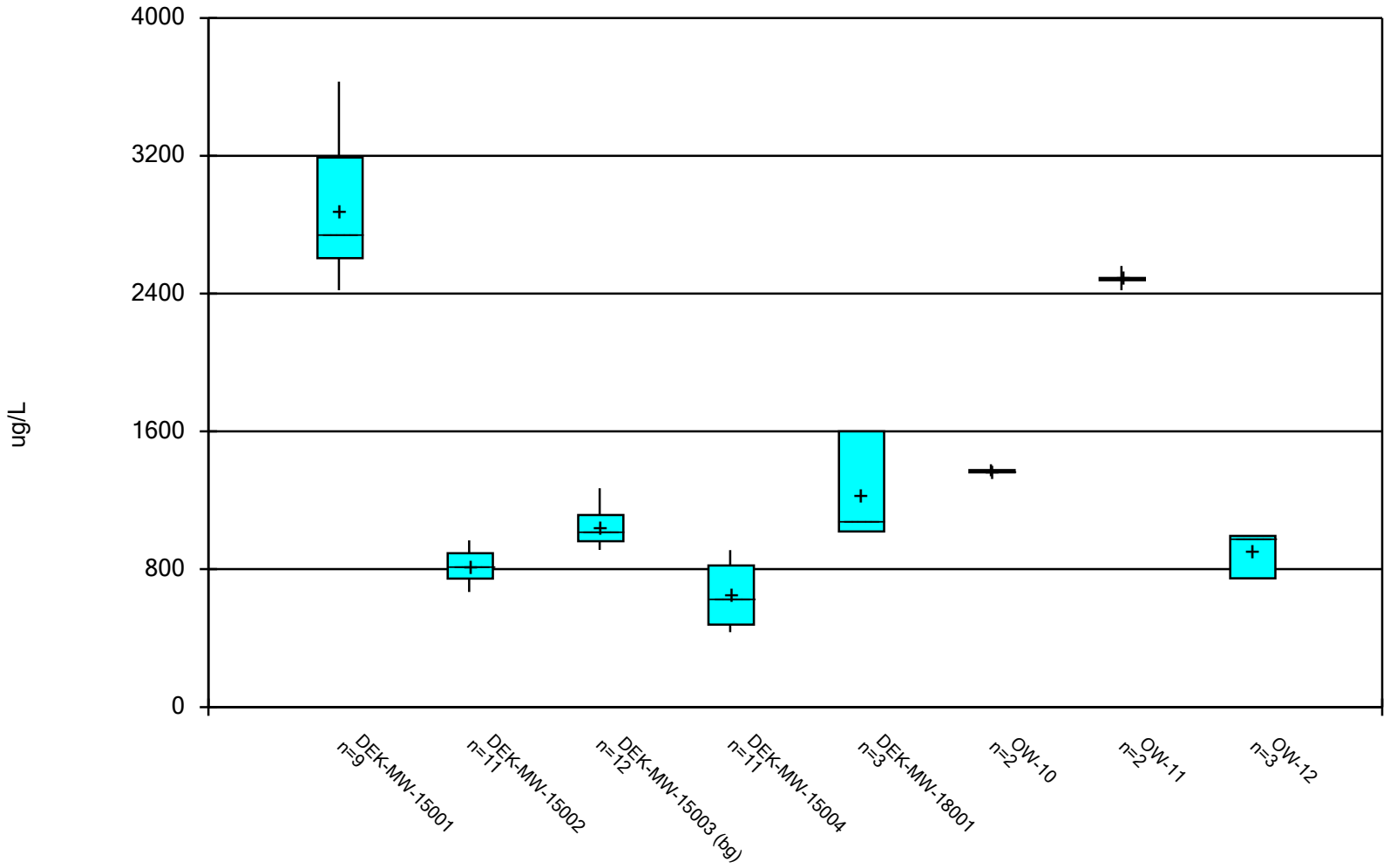
Cation-Anion Balance = 0.6591%.



Analysis Run 2/26/2019 2:20 PM

Client: Consumers Energy Data: DEK_CCR_Sanitas_19.01.31

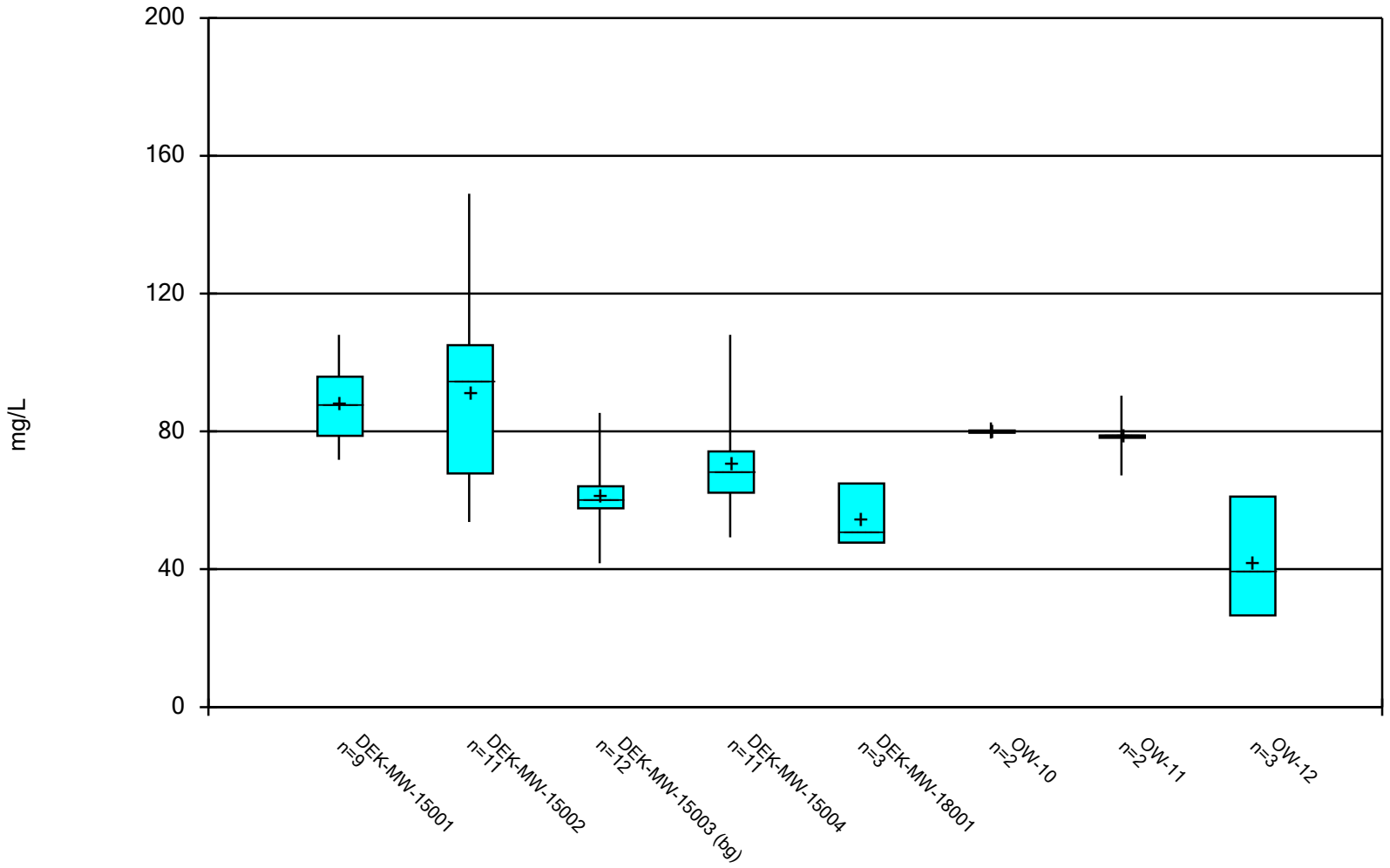
Box & Whiskers Plot



Constituent: Boron, Total Analysis Run 2/26/2019 2:29 PM

Client: Consumers Energy Data: DEK_CCR_Sanitas_19.01.31

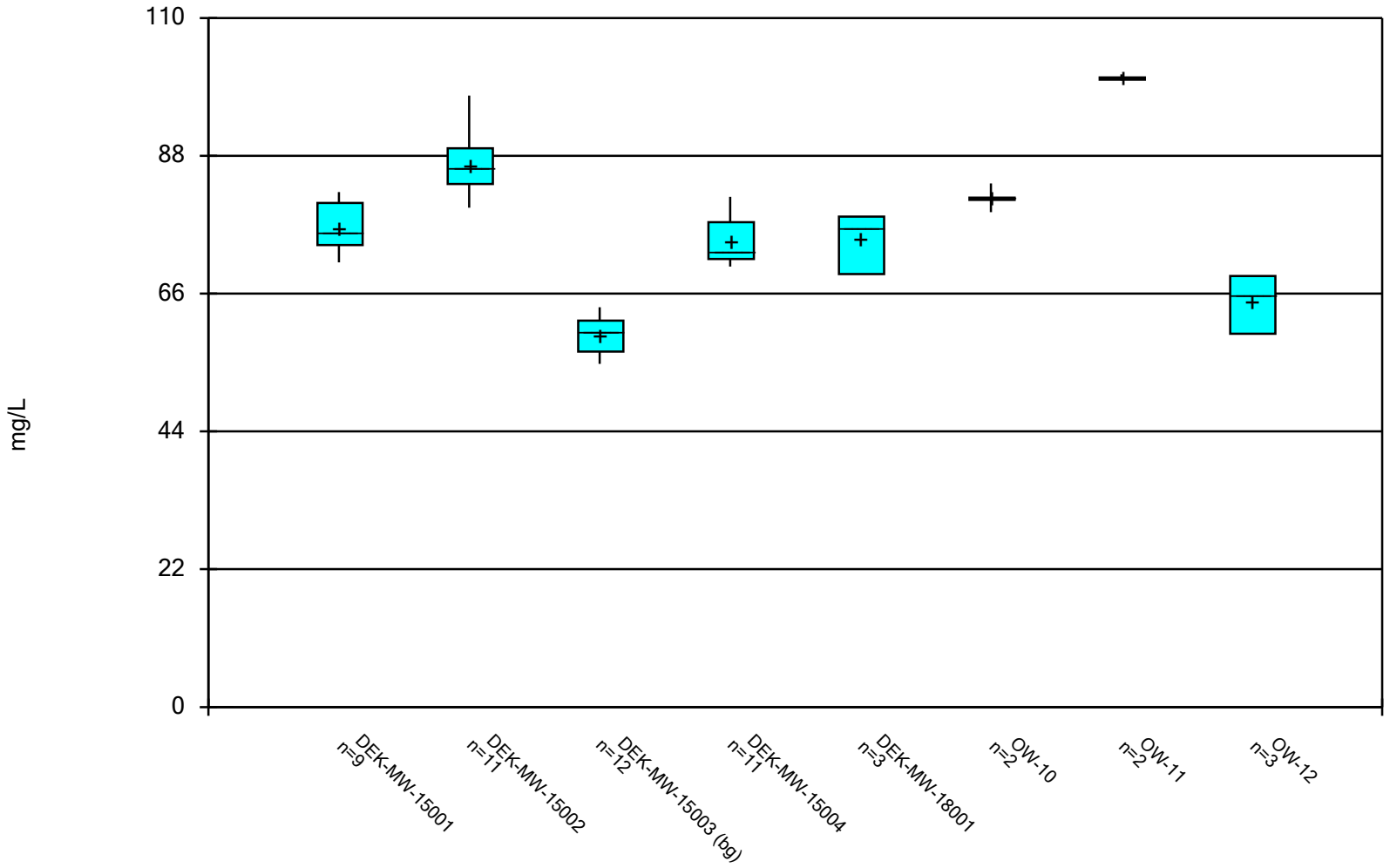
Box & Whiskers Plot



Constituent: Calcium, Total Analysis Run 2/26/2019 2:29 PM

Client: Consumers Energy Data: DEK_CCR_Sanitas_19.01.31

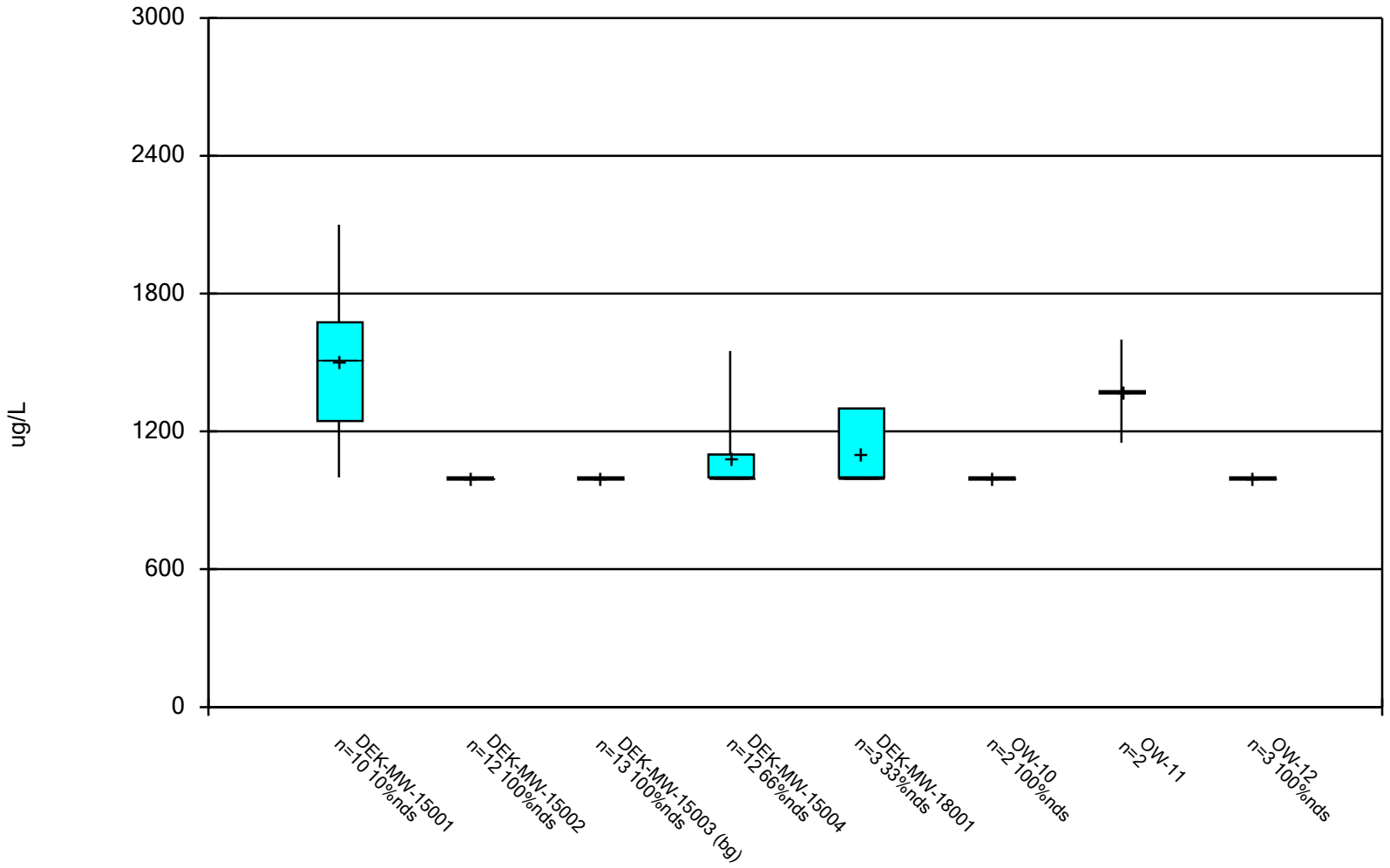
Box & Whiskers Plot



Constituent: Chloride Analysis Run 2/26/2019 2:29 PM

Client: Consumers Energy Data: DEK_CCR_Sanitas_19.01.31

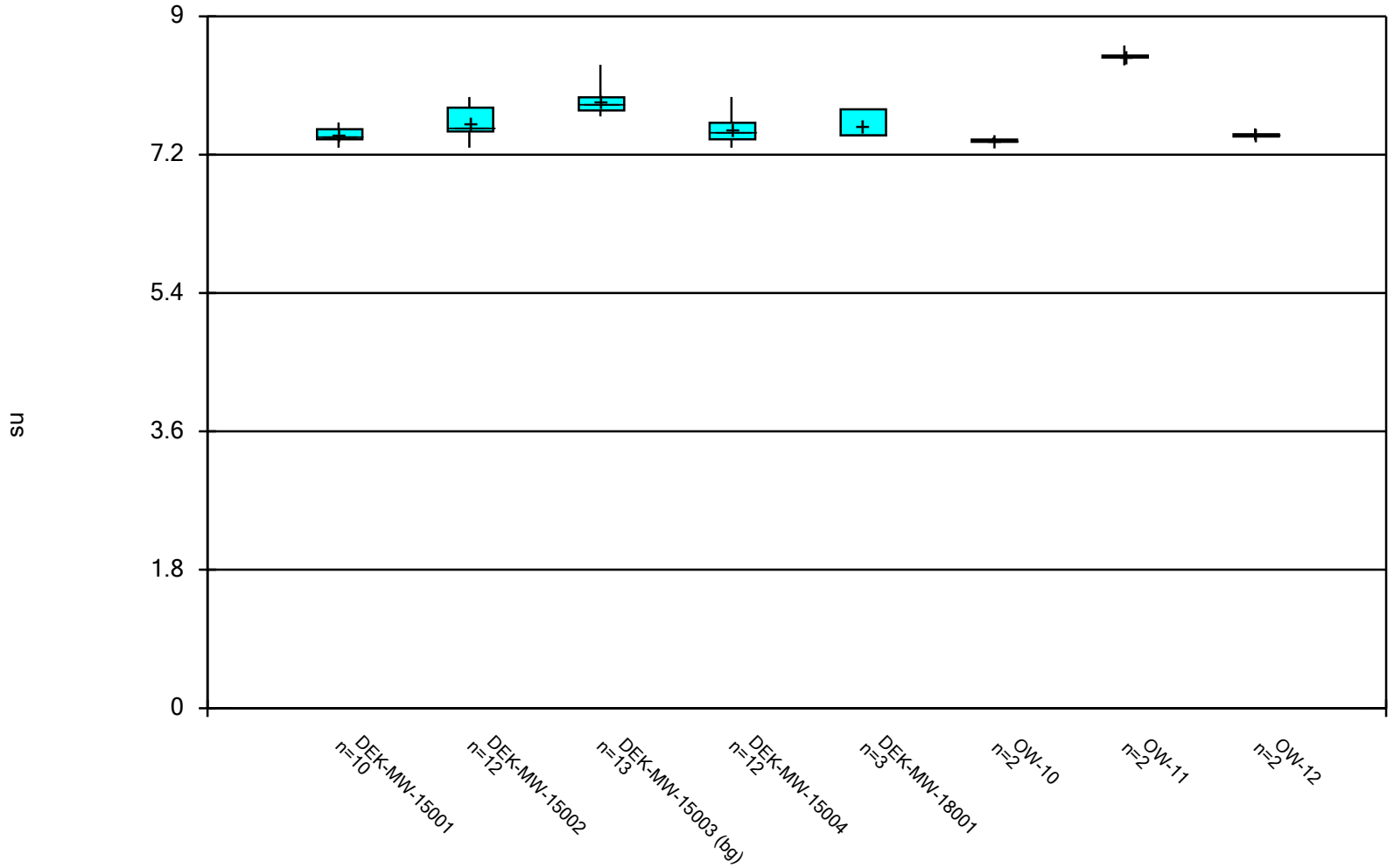
Box & Whiskers Plot



Constituent: Fluoride Analysis Run 2/26/2019 2:29 PM

Client: Consumers Energy Data: DEK_CCR_Sanitas_19.01.31

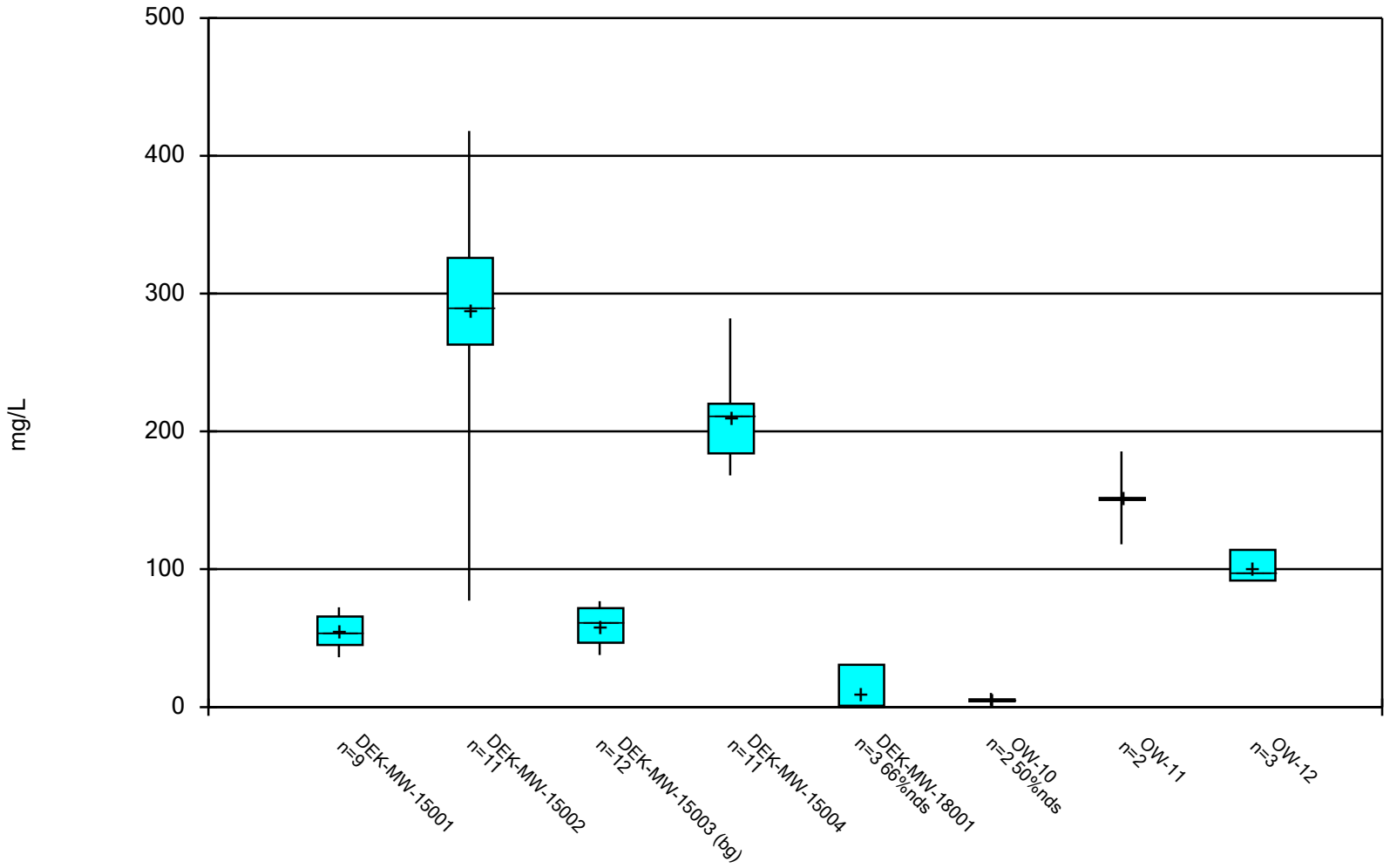
Box & Whiskers Plot



Constituent: pH, Field Analysis Run 2/26/2019 2:29 PM

Client: Consumers Energy Data: DEK_CCR_Sanitas_19.01.31

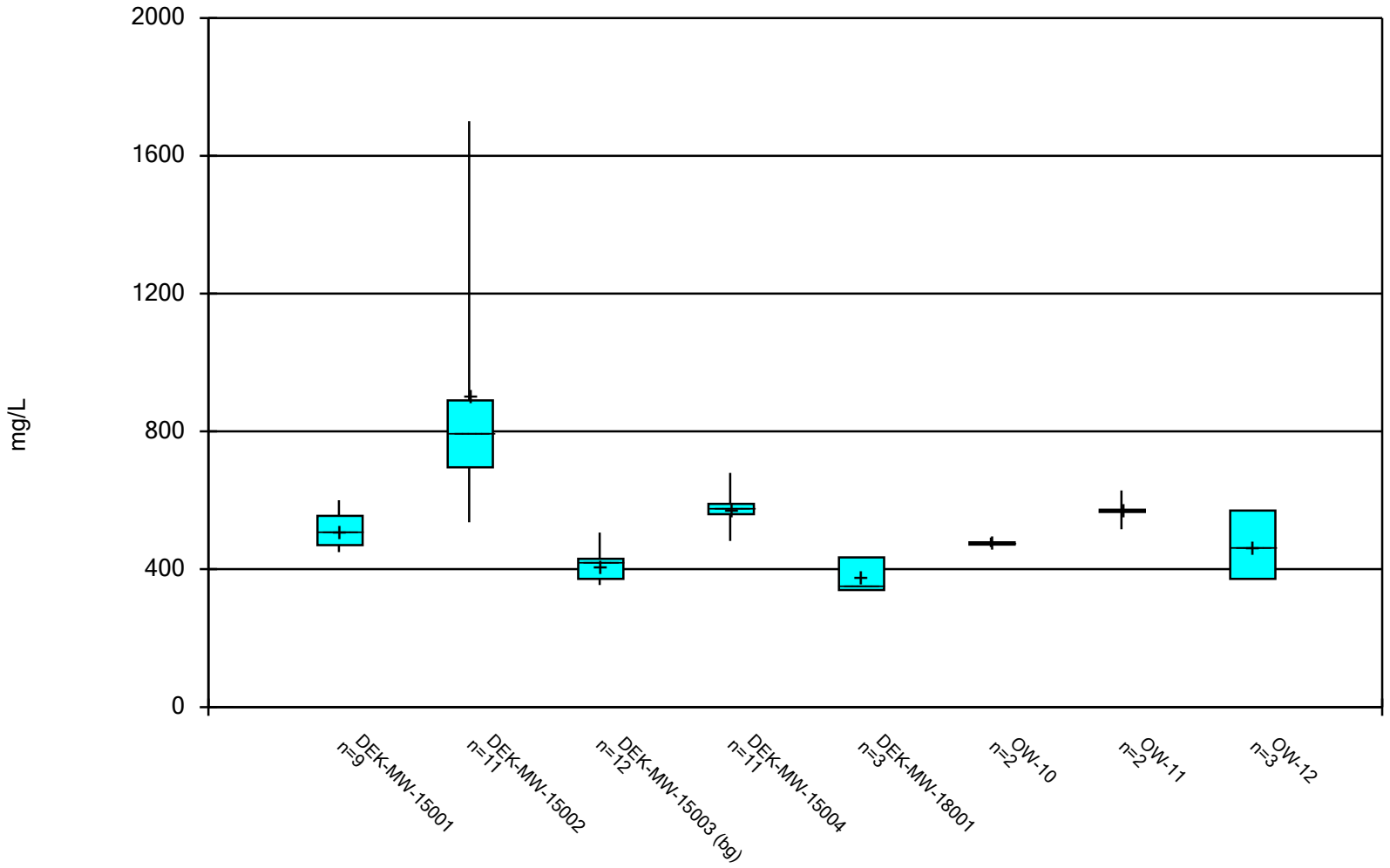
Box & Whiskers Plot



Constituent: Sulfate Analysis Run 2/26/2019 2:29 PM

Client: Consumers Energy Data: DEK_CCR_Sanitas_19.01.31

Box & Whiskers Plot



Constituent: Total Dissolved Solids, Dissolved Analysis Run 2/26/2019 2:29 PM

Client: Consumers Energy Data: DEK_CCR_Sanitas_19.01.31

Appendix B
April 2019 Detection Monitoring Data Summary

1540 Eisenhower Pl.
Ann Arbor, MI 48108

T 734.971.7080
TRCcompanies.com

July 8, 2019; Revised October 15, 2019

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

Subject: April 2019 Detection Monitoring Data Summary
Consumers Energy, DE Karn Site, Lined Impoundment CCR Unit

Dear Mr. Register:

Pursuant to the CCR Rule[1], Consumers Energy initiated a detection monitoring program for the new Karn Lined Impoundment. Notification of initiation of closure of the Karn Bottom Ash Pond was provided on October 12, 2018 to implement the certified closure plan by removal of CCR under the self-implementing requirements and schedule of the CCR Rule. In preparation for removal of the Karn Bottom Ash Pond, a new lined impoundment (Karn Lined Impoundment) has been constructed. The footprint of the Karn Lined Impoundment is immediately adjacent to the Karn Bottom Ash Pond. The liner system for the Karn Lined Impoundment construction consists of a double composite liner system, with the primary and secondary composite liners each consisting of 60-mil High Density Polyethylene (HDPE) geomembrane (GM) overlaying a 236-mil geosynthetic clay liner (GCL)[2]. The bottom ash dewatering and temporary storage from the remaining coal-fired boilers was redirected to the new impoundment, which began receipt of CCR in June 2018. Therefore, Consumers Energy initiated detection monitoring at the Karn Lined Impoundment within six months, in accordance with §257.94(b) of the CCR Rule.

This letter report has been prepared to provide the summary of the April 2019 assessment groundwater monitoring results, data quality review, and statistical data evaluation. This letter also serves as the alternate source demonstration for potential statistically significant increases (SSIs) of Appendix III constituents over background levels, pursuant to §257.94(e)(2).

Detection Monitoring Sampling Summary

In accordance with §257.94, TRC conducted the second semi-annual detection monitoring event for the Karn Lined Impoundment on April 8 through April 10, 2019. The April 2019 event is the CCR detection monitoring compliance event; however, a supplemental sampling event was also conducted on February 18 and 19, 2019 to further assess changing site conditions relative to the dewatering and

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

CCR removal from the Bottom Ash Pond to support evaluation of the potential for a future intra-well statistical program for detection monitoring. Background monitoring well DEK-MW-15003, downgradient monitoring wells DEK-MW-18001, OW-10, and OW-12, and supplemental monitoring well OW-11 were sampled in accordance with the *Sample Analysis Plan* (SAP) (TRC, June 2018). OW-11 is currently not designated as a background or downgradient well, but potentially will be utilized in a future intra-well statistical evaluation program. Additionally, a sample was collected from a sump in the secondary collection system (KLI-SCS) such that leachate chemistry could be compared to groundwater chemistry.

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

The groundwater samples were analyzed by Eurofins TestAmerica Inc. for both Appendix III and IV constituents in accordance with the SAP. The analytical results are summarized in Table 3.

Groundwater Flow Rate and Direction

Groundwater elevation data collected during the February and April 2019 groundwater monitoring events are provided in Table 1, as well as additional groundwater elevation data collected from March 2019 (one month prior to the detection monitoring event). The March and April 2019 groundwater elevation data were used to construct the groundwater contour map (Figure 2).

Groundwater elevations measured at the site in February through April 2019 are generally within the range of 580 to 587 feet above mean sea level (ft NAVD88) and groundwater is typically encountered at equal elevation relative to the surrounding surface water features or within approximately 7 feet higher, flowing toward the bounding surface water features.

Although historically the point source discharge of sluiced bottom ash into the bottom ash pond created localized mounding of the potentiometric surface from the surface water pool, the new Karn Lined Impoundment went into service on June 7, 2018 and has been continuously collecting all of the process water and bottom ash that went into the former bottom ash pond. Since the Karn 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 near the former bottom ash pond in February through April 2019 demonstrate a reduction in groundwater elevation measurements by several feet when compared to measurement taken in June 2018. Groundwater at the facility is locally influenced by incidental infiltration from precipitation over the uncovered acreage. OW-11 and DEK-MW-15003 represent a groundwater elevation high point with porewater flow generally flowing radially towards the adjacent surface water features, as illustrated in Figure 2.

The average hydraulic gradient observed on April 8, 2019 in the vicinity of the Karn Bottom Ash Pond and Karn Lined Impoundment is estimated at 0.0044 ft/ft. The gradient was calculated using the well pair DEK-MW-15004/DEK-MW-15005, as well as the well water elevation difference and distance between DEK-MW-15003 and the discharge channel. The discharge channel elevation was taken from the April 7, 2019 NOAA gauging station data as there was no data recorded at the gauging station from April 8 to April 11, 2019. Using the mean hydraulic conductivity of 15 ft/day (ARCADIS, 2016) and an assumed effective porosity of 0.3, the estimated average seepage velocity ranged from 0.22 ft/day or 79 ft/year, which is reduced relative to previous estimated seepage velocities. Due to the operational changes of the bottom ash pond and the progress 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 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 parameters that could potentially migrate from the Karn Lined Impoundment.

Analytical Results Summary

Analytical data were found to be usable for assessment monitoring and displayed consistent trends with previous sampling events. The Data Quality Reviews for each event are included as Attachment A. Time series plots of Appendix III data collected to-date are included as Attachment B. The concentrations of the Appendix III parameters in each of the detection monitoring wells were compared to the established statistical background limits. The comparisons are presented on Table 4. The statistical evaluation of the April 2019 Appendix III indicator parameters showed potential SSIs over background levels for:

- Chloride at OW-10;
- Fluoride at DEK-MW-18001; and
- pH at DEK-MW-18001; and OW-10.

There were no SSIs over background levels for boron, calcium, chloride, sulfate, or TDS at any of the downgradient wells.

In accordance with §257.94(e)(2), Consumers Energy may demonstrate that a source other than the CCR unit caused the SSI or that the SSI resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. The following Alternate Source Demonstration (ASD) has been prepared to address the potential SSIs identified in the April 2019 detection monitoring event.

Alternate Source Demonstration

The following ASD evaluation provides multiple lines of evidence of alternative sources for the potential SSIs indicated for chloride, fluoride, and pH at the Karn Bottom Ash Pond. The groundwater

chemistry observed in the Karn Lined Impoundment monitoring well network is due to the history of CCR-related operations throughout the DE Karn Site, rather than a release from the new impoundment.

New Unit Construction

The liner system for the Karn Lined Impoundment was designed as a double composite liner system, with the primary and secondary composite liners each consisting of 60-mil (HDPE) geomembrane (GM) overlaying a 236-mil geosynthetic clay liner (GCL). The double composite liner system construction and the limited active life (only one year) of the Karn Lined Impoundment make it unlikely that wet ash dewatering liquids managed within the unit have migrated through the liner system and affected groundwater quality.

Secondary Collection System (SCS) Chemistry

Piper diagrams were prepared using the groundwater and KLI-SCS sample data collected during the February 2019 and March 2019 events (Attachment C). The leachate chemistry (KLI-SCS) is distinctly different from the groundwater chemistry observed at the Karn Lined Impoundment wells. The piper diagrams also illustrate that the groundwater chemistry observed at the downgradient wells are not uniquely different than the background wells, even if an individual downgradient concentration comparison to the background based on DEK-MW-15003 indicates a potential SSI.

Pre-Existing Groundwater Conditions

The footprint of the new Karn Lined Impoundment is immediately adjacent to the pre-existing Karn Bottom Ash Pond. As reported in the *2017 Annual Groundwater Monitoring Report: DE Karn Bottom Ash Pond CCR Unit* (January 2018, TRC), potential SSIs over background limits were noted for boron, fluoride, pH, and sulfate in one or more downgradient wells during September 2017. Therefore, the groundwater in the vicinity of the Karn Lined Impoundment is documented to have been affected by CCR due to the pre-existing unit. This line of evidence is further documented in the ASD included in the *Detection Monitoring Data Summary and Background Statistical Evaluation* (March 2019, TRC).

Limited Background Sampling Timeline to Capture Change in Background Conditions

As mentioned above, the bottom ash pond is no longer being hydraulically loaded and has been dewatered by gravity so that the local groundwater flow regime is equilibrating. DEK-MW-15003 is still located upgradient of the Karn Lined Impoundment; however, conditions at DEK-MW-15003 are changing as evidenced by the attached time-series plots (Appendix B). Limited data are available from after the change in operation of the bottom ash pond (June 2018 – present) to assess a change in background limits. Background values will be reassessed during evaluation of the second 2019 semiannual event groundwater sampling data.

pH Values are Neutral and Within Expected Range

Although the pH of 7.2 standard units measured at DEK-MW-18001 and OW-10 are 0.1 standard units below the background lower tolerance limit of 7.3 standard units, the pH values are neutral and are not indicative of a release from the Karn Lined Impoundment.

- Values for pH observed at DEK-MW-18001 and OW-10 are similar to pH values measured in the Karn Bottom Ash Pond background wells located on the JC Weadock property. Four monitoring wells located between ¾ and 1 mile south of the Karn Bottom Ash Pond on the JC Weadock property provide data on background groundwater quality that has not been affected by the CCR unit (MW-15002, MW-15008, MW-15016, and MW-15019) (Figure 2). Background values for pH were established in these wells ranging from 6.5 to 7.3 standard units as reported in Appendix C of the *2017 Annual Groundwater Monitoring Report* (TRC, January 2018). This demonstrates that the pH value of 7.2 standard units observed at DEK-MW-18001 and OW-10 are within the range of values expected to occur naturally in the shallow saturated unit.
- The DEK-MW-18001 and OW-10 measured pH value is also neutral (7.0 standard units) and in the middle of the USEPA's established range of pH drinking water standards (6.5 to 8.5 S.U.) (USEPA, April 2012).

Next Steps

Pursuant to §257.94(e)(2), if a successful ASD is completed within 90 days of detecting an SSI over background, the CCR Unit may continue with the detection monitoring program. The ASD provided above determines that the observed SSIs are not attributed to the Karn Lined Impoundment. Therefore, Consumers Energy will continue semiannual detection monitoring at the Karn Lined Impoundment. The next semiannual detection monitoring event is scheduled for the fourth calendar quarter of 2019.

Sincerely,

TRC

Graham Crockford
Program Manager

Darby Litz
Hydrogeologist/Project Manager

Attachments:

Table 1.	Summary of Groundwater Elevation Data
Table 2.	Summary of Field Parameter Results
Table 3.	Summary of Groundwater Sampling Results (Analytical)
Table 4.	Comparison of Appendix III Parameter Results to Background Limits – April 2019
Figure 1.	Monitoring Well Network and Site Plan
Figure 2.	Groundwater Contour Map – April 8, 2019
Figure 3.	Karn Lined Impoundment Area
Attachment A	Data Quality Reviews
Attachment B	Time Series Plots
Attachment C	Piper Diagrams

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

Tables

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

Well Location	TOC Elevation (ft)	Geologic Unit of Screen Interval	Screen Interval Elevation (ft)			February 18, 2019		March 11, 2019		April 8, 2019	
						Depth to Water (ft BTOC)	Groundwater Elevation (ft)	Depth to Water (ft BTOC)	Groundwater Elevation (ft)	Depth to Water (ft BTOC)	Groundwater Elevation (ft)
Background											
MW-15002	587.71	Sand	580.9	to	570.9	--	--	6.65	581.06	6.50	581.21
MW-15008	585.36	Sand with clay	578.7	to	568.7	--	--	4.37	580.99	4.37	580.99
MW-15016	586.49	Sand	581.2	to	578.2	--	--	4.41	582.08	4.12	582.37
MW-15019	586.17	Sand and Sand/Clay	579.5	to	569.5	--	--	5.03	581.14	5.13	581.04
DEK Bottom Ash Pond											
DEK-MW-15002	590.87	Sand	578.3	to	575.3	--	--	6.00	584.87	6.02	584.85
DEK-MW-15004	611.04	Sand	576.6	to	571.6	--	--	26.80	584.24	27.53	583.51
DEK-MW-15005	589.72	Sand	572.3	to	567.3	--	--	9.12	580.60	9.25	580.47
DEK-MW-15006	589.24	Sand	573.0	to	568.0	--	--	8.63	580.61	8.69	580.55
DEK Bottom Ash Pond & Karn Lined Impoundment											
DEK-MW-15003	602.74	Sand	578.8	to	574.8	16.53	586.21	16.58	586.16	16.23	586.51
DEK-MW-18001	593.47	Sand	579.2	to	574.2	8.28	585.19	8.02	585.45	8.20	585.27
OW-10	591.58	Silty Sand and Silty Clay	576.0	to	571.0	6.46	585.12	6.42	585.16	6.06	585.52
OW-11	607.90	Silt/Fly Ash	587.5	to	582.5	21.30	586.60	21.50	586.40	21.05	586.85
OW-12	603.07	Silty Sand	584.2	to	579.2	17.03	586.04	17.00	586.07	16.75	586.32
JCW Bottom Ash Pond											
JCW-MW-15007	587.40	Sand	582.7	to	579.2	--	--	3.83	583.57	3.63	583.77
JCW-MW-15009	589.64	Sand	581.9	to	576.9	--	--	8.66	580.98	8.15	581.49
JCW-MW-15010	597.76	Sand	579.7	to	578.2	--	--	16.28	581.48	16.29	581.47
JCW-MW-15028	589.64	Sand	567.7	to	564.7	--	--	7.20	582.44	6.56	583.08
JCW Landfill											
JCW-MW-18001	596.73	Sand and Sandy Clay	578.3	to	573.3	--	--	16.47	580.26	16.42	580.31
JCW-MW-18004	593.04	Sandy Clay	583.9	to	578.9	--	--	12.13	580.91	11.58	581.46
JCW-MW-18005	590.89	Sand and Sandy Clay	580.0	to	575.0	--	--	9.56	581.33	8.68	582.21
JCW-MW-18006	600.72	Fly Ash and Sandy Clay	582.8	to	577.8	--	--	13.87	586.85	12.37	588.35
MW-50	593.36	Sand	577.8	to	574.8	--	--	13.06	580.30	13.05	580.31
MW-51	594.29	Sand and Clay	577.8	to	574.8	--	--	14.07	580.22	13.79	580.50
MW-52	594.90	Sand	579.3	to	576.3	--	--	14.57	580.33	14.46	580.44
MW-53	593.68	Sand and Clay	579.1	to	576.1	--	--	13.37	580.31	13.35	580.33
MW-53R	594.25	Sand and Clay	580.4	to	575.4	--	--	13.87	580.38	13.92	580.33
MW-54R	593.89	Clay and Sand	581.3	to	576.3	--	--	13.27	580.62	13.50	580.39
MW-55	593.82	Sand	581.5	to	578.5	--	--	13.34	580.48	13.43	580.39
OW-57ROUT	591.00	Sandy Clay	577.0	to	572.0	--	--	9.71	581.29	9.43	581.57

Notes:

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

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

TOC: Top of well casing.

ft BTOC: Feet below top of well casing.

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

Well Location	TOC Elevation (ft)	Geologic Unit of Screen Interval	Screen Interval Elevation (ft)			February 18, 2019		March 11, 2019		April 8, 2019	
						Depth to Water (ft BTOC)	Groundwater Elevation (ft)	Depth to Water (ft BTOC)	Groundwater Elevation (ft)	Depth to Water (ft BTOC)	Groundwater Elevation (ft)
JCW Landfill (water level only)											
JCW-OW-18001	595.84	Fly Ash and Sand	581.1	to	576.1	--	--	6.76	589.08	--	--
JCW-OW-18002	593.63	Sand	578.9	to	573.9	--	--	9.73	583.90	--	--
JCW-OW-18003	593.99	Sand and Clay	580.5	to	575.5	--	--	10.41	583.58	--	--
JCW-OW-18004	594.19	Sandy Clay	584.6	to	579.6	--	--	6.97	587.22	--	--
JCW-OW-18006	600.61	Fly Ash and Clay with Sand	582.9	to	577.9	--	--	11.26	589.35	--	--
MW-20	592.73	NR	~581.1	to	~578.1	--	--	7.06	585.67	--	--
OW-51	593.62	Clay and Sand	578.9	to	575.9	--	--	11.64	582.64	--	--
OW-53	593.64	Clay and Sand	579.0	to	576.0	--	--	12.46	581.18	--	--
OW-54	594.10	Clay and Sand	580.0	to	577.0	--	--	8.00	586.10	--	--
OW-55	594.67	Clay (or Sand and Clay)	580.9	to	577.9	--	--	6.58	588.09	--	--
OW-56R	592.01	Ash and Sand	577.5	to	572.5	--	--	6.36	585.65	--	--
OW-57R IN	590.86	Sandy Clay	575.7	to	570.7	--	--	6.67	584.19	--	--
OW-61	612.37	Ash and Sand	588.0	to	585.0	--	--	21.76	590.61	--	--
OW-63	612.53	Ash and Sand	594.2	to	591.2	--	--	26.23	586.30	--	--
OW-64	593.37	Ash and Sand	576.4	to	573.4	--	--	10.07	583.30	--	--
JCW Leachate Headwells											
LH-103	603.49	Fly Ash	30.2	to	33.2	--	--	16.43	587.06	--	--
LH-104	596.56	Fly Ash	8.0	to	11.0	--	--	7.64	588.92	--	--

Notes:

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

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

TOC: Top of well casing.

ft BTOC: Feet below top of well casing.

Table 2
Summary of Field Parameter Results – February & April 2019
DE Karn Bottom Ash Pond – RCRA CCR Monitoring Program
Essexville, Michigan

Sample Location	Sample Date	Dissolved Oxygen (mg/L)	Oxidation Reduction Potential (mV)	pH (SU)	Specific Conductivity (umhos/cm)	Temperature (°C)	Turbidity (NTU)
Background							
DEK-MW-15003	2/18/2019	0.43	-103.8	8.7	615	10.28	2.30
	4/11/2019	0.27	88.0	8.0	565	9.35	3.20
Downgradient							
DEK-MW-18001	2/18/2019	0.23	-48.8	7.9	601	9.22	1.91
	4/10/2019	0.12	58.7	7.2	592	8.45	3.19
OW-10	2/18/2019	0.27	-44.8	7.8	799	9.08	4.17
	4/10/2019	0.11	-70.5	7.2	794	9.35	10.1
OW-12	2/19/2019	0.22	-24.9	7.6	636	12.34	3.72
	4/9/2019	0.13	-36.8	7.8	599	13.57	6.27
Supplemental							
OW-11	2/19/2019	0.54	37.4	9.1	652	6.92	2.23
	4/11/2019	0.30	59.9	8.7	597	9.66	5.42
KLI-SCS	2/19/2019	10.02	214.7	7.9	889	7.41	7.65
	4/11/2019	5.81	80.9	7.7	930	11.69	15.1

Notes:
mg/L - Milligrams per Liter.
mV - Millivolts.
SU - Standard units.
umhos/cm - Micromhos per centimeter.
°C - Degrees Celcius
NTU - Nephelometric Turbidity Unit.

Table 3
Summary of Groundwater Sampling Results (Analytical): February 2019 - April 2019
Karn Lined Impoundment and Bottom Ash Pond – RCRA CCR Monitoring Program
Essexville, Michigan

					Sample Location:	DEK-MW-15003		DEK-MW-18001		OW-10		OW-12		OW-11		KLI-SCS	
					Sample Date:	2/18/2019	4/11/2019	2/18/2019	4/10/2019	2/18/2019	4/10/2019	2/19/2019	4/9/2019	2/19/2019	4/11/2019	2/19/2019	4/11/2019
Constituent	Unit	EPA MCL	MI Residential*	MI Non-Residential*	MI GSI^	Background		Downgradient						Supplemental			
Appendix III																	
Boron	ug/L	NC	**500**	**500**	4,000	**1,100**	**960**	**1,000**	**970**	**1,400**	**1,300**	**680**	**640**	**2,500**	**2,400**	330	400
Calcium	mg/L	NC	NC	NC	500	58	52	51	48	82	84	47	40	43	38	120	140
Chloride	mg/L	250**	250	250	**50**	**53**	**58**	**72**	**69**	**79**	**69**	**64**	**64**	**92**	**90**	17	19
Fluoride	ug/L	4,000	NC	NC	NC	< 1,000	< 1,000	1,100	1,200	< 1,000	< 1,000	< 1,000	< 1,000	2,200	2,400	< 1,000	< 1,000
Sulfate	mg/L	**250****	**250**	**250**	500	34	47	< 2.0	< 2.0	4.1	8.2	77	69	81	72	200	230
Total Dissolved Solids	mg/L	**500****	**500**	**500**	**500**	370	360	350	360	470	490	400	390	370	350	**590**	**700**
pH, Field	SU	**6.5 - 8.5****	**6.5 - 8.5**	**6.5 - 8.5**	**6.5 - 9.0**	**8.7**	8.0	7.9	7.2	7.8	7.2	7.6	7.8	**9.1**	**8.7**	7.9	7.7
Appendix IV																	
Antimony	ug/L	6	6.0	6.0	**2.0**	< 2.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	**4.1**	**2.5**	1.2	**3.1**
Arsenic	ug/L	**10**	**10**	**10**	**10**	**330**	**380**	**86**	**68**	7.6	6.3	**22**	**19**	**350**	**380**	2.2	1.2
Barium	ug/L	2,000	2,000	2,000	1,200	65	62	85	75	100	110	65	56	130	120	99	91
Beryllium	ug/L	4	4.0	4.0	33	< 2.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	5	5.0	5.0	2.5	< 0.40	< 1.0	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Chromium	ug/L	100	100	100	**11**	2.2	< 5.0	6.9	< 1.0	2.9	1.3	**24**	< 1.0	1.2	< 1.0	2.0	< 1.0
Cobalt	ug/L	NC	40	100	100	< 12	< 30	< 6.0	< 6.0	< 6.0	< 6.0	< 6.0	< 6.0	< 6.0	< 6.0	< 6.0	< 6.0
Fluoride	ug/L	4,000	NC	NC	NC	< 10,000	< 1,000	1,100	1,200	< 1,000	< 1,000	< 1,000	< 1,000	2,200	2,400	< 1,000	< 1,000
Lead	ug/L	NC	4.0	4.0	14	< 2.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	2.1
Lithium	ug/L	NC	170	350	440	34	28	25	24	32	30	32	27	29	26	< 10	< 10
Mercury	ug/L	2	2.0	2.0	0.20#	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	NC	**73**	**210**	**120**	< 10	< 25	< 5.0	< 5.0	< 5.0	< 5.0	19	15	**640**	**590**	14	14
Radium-226	pCi/L	NC	NC	NC	NC	0.112	< 0.424	0.183	0.173	0.162	0.205	< 0.0797	0.138	< 0.0748	< 0.407	0.155	< 0.448
Radium-228	pCi/L	NC	NC	NC	NC	< 0.416	< 0.495	0.574	0.694	< 0.493	< 0.641	< 0.448	< 0.414	< 0.403	< 0.534	< 0.443	< 0.469
Radium-226/228	pCi/L	5	NC	NC	NC	< 0.416	< 0.495	0.757	0.867	< 0.493	< 0.641	< 0.448	0.531	< 0.403	< 0.534	0.588	0.471
Selenium	ug/L	50	50	50	5.0	< 2.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	2.3	< 1.0
Thallium	ug/L	2	2.0	2.0	2.0	< 4.0	< 10	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0

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

Table 4
Comparison of Appendix III Parameter Results to Background Limits – April 2019
DE Karn Lined Impoundment – RCRA CCR Monitoring Program
Essexville, Michigan

		Sample Location:	DEK-MW-18001	OW-10	OW-12
		Sample Date:	4/10/2019	4/10/2019	4/9/2019
Constituent	Unit	UTL	downgradient		
Appendix III					
Boron	ug/L	**1,400**	970	1,300	640
Calcium	mg/L	94.1	48	84	40
Chloride	mg/L	**67.2**	**69**	**69**	64
Fluoride	ug/L	**1,000**	**1,200**	< 1,000	< 1,000
Sulfate	mg/L	103	< 2.0	8.2	69
Total Dissolved Solids	mg/L	559	360	490	390
pH, Field	SU	**7.3 - 8.4**	**7.2**	**7.2**	7.8

Notes:

ug/L - micrograms per liter

mg/L - milligrams per liter

SU - standard units; pH is a field parameter

All metals were analyzed as total unless otherwise specified.

RESULT Shading and bold font indicates an exceedance of the Upper Tolerance Limit (UTL) using the number of significant figures in the UTL.

Figures

LEGEND

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

NOTES

1. BASE MAP IMAGERY FROM 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).

N

0 1,000 2,000 Feet

1 " = 1,000 '

1:12,000

PROJECT:

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

TITLE:

SITE MAP

DRAWN BY:	S. MAJOR	PROJ NO.:	322173-001
CHECKED BY:	J. KRENZ		
APPROVED BY:	D. LITZ		**FIGURE 1**
DATE:	JULY 2019		

TRC

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

FILE NO.: 322173-001-006.mxd

TRC - GIS
Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl (Foot)
Map Rotation: 0
Plot Date: 7/2/2019, 14:14:52 PM by SMAJOR -- LAYOUT: ANSI B(11"x17")
Path: E:\ConsumersEnergy\CCR_GW\2017_2697\67\322173-001-006.mxd

TRC - GIS

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

Plot Date: 10/9/2019, 16:10:39 PM by SMAJOR -- LAYOUT: ANSI B (11"x17")
Path: E:\ConsumersEnergy\CCR_GW\2017_269767\322173-001-004.mxd

LEGEND

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

NOTES

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

N

0 1,000 2,000 Feet

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

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

TITLE:
SHALLOW GROUNDWATER CONTOUR MAP APRIL 2019

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

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

FILE NO.: 322173-001-004.mxd

LEGEND

- DEK BOTTOM ASH POND MONITORING WELL
- DECOMMISSIONED WELL
- BOTTOM ASH POND & LINED IMPOUNDMENT MONITORING WELL
- DEK LINED IMPOUNDMENT MONITORING WELL
- MONITORING WELL
- EXTENT OF GEOSYNTHETICS

NOTES

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

0 200 400 Feet

1 " = 200 '
1:2,400

PROJECT:

CONSUMERS ENERGY COMPANY
DE KARN POWER PLANT
ESSEXVILLE, MICHIGAN

TITLE:

KARN LINED IMPOUNDMENT AREA

DRAWN BY:	S. MAJOR	PROJ NO.:	290804-001
CHECKED BY:	D. LITZ		
APPROVED BY:	G. CROCKFORD		
DATE:	JUNE 2018		

FIGURE 3

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

FILE NO.: 290804-001-001.mxd

TRC - GIS
Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl (Foot)
Map Rotation: 0
Plot Date: 6/5/2018, 16:10:34 PM by JPAPEZ -- LAYOUT: ANSI B(11"x17")
Path: E:\Consumers Energy\CCR_GW\2017_269767\290804-001-001.mxd

Attachment A
Data Quality Reviews

Laboratory Data Quality Review
Groundwater Monitoring Event February 2019
CEC DE Karn Lined Impoundment

Groundwater samples were collected by TRC for the February 2019 sampling event. Samples were analyzed for lithium by TestAmerica Laboratories, Inc. (TestAmerica), located in North Canton, Ohio, for anions, alkalinity, total dissolved solids, and select total metals by TestAmerica located in Irvine, California, and for radium by TestAmerica located in Earth City, Missouri. The laboratory analytical results are reported in laboratory reports 240-108418-1 and 240-108418-2.

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

- DEK-MW-15003
- DEK-MW-18001
- OW-10
- OW-11
- OW-12
- KLI-SCS

Each sample was analyzed for the following constituents:

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

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

Data Usability Review Procedure

The analytical data were reviewed using the USEPA National Functional Guidelines for Inorganic Superfund Data Review (USEPA, 2017), Department of Defense (DOD) Department of Energy (DOE) Consolidated Quality Systems Manual for Environmental Laboratories (USDOD/USDOE, Version 5.1.1, 2018), and the DOE Evaluation of Radiochemical Data Usability (USDOE, 1997). The following items were included in the evaluation of the data:

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

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

This data usability report addresses the following items:

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

Review Summary

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

- Appendix III and IV constituents will be utilized for the purposes of a detection monitoring program.
- Data are usable for the purposes of the assessment monitoring program.
- When the data are evaluated through a detection monitoring statistical program, findings below may be used to support the removal of outliers.

QA/QC Sample Summary:

- A method blank was analyzed with each analytical batch; no analytes were detected in the method blank samples.
- One equipment blank (EB-01) and one field blank (FB-01) were collected. No analytes were detected in FB-01.
  - Chromium was detected in EB-01 at 0.034 mg/L, 0.14 mg/L, 0.024 mg/L, and 0.13 mg/L, respectively. The positive results for chromium in samples associated with

this equipment blank were potentially impacted, as summarized in the attached table.

- The LCS recoveries for all analytes were within QC limits.
- MS/MSD analyses were performed on sample DEK-MW-15003 for anions, mercury, radium, and metals. Recoveries and relative percent differences (RPDs) were within the QC limits with the following exceptions.
  - The sodium, calcium, and arsenic concentrations in sample DEK-MW-15003 were >4x the spike concentration; therefore, the MS/MSD results for these metals were not evaluated. Data usability was not affected.
  - Selenium recovered below the QC limits in the MS performed on sample DEK-MW-15003. Potential low bias exists for the positive and nondetect results for selenium in the samples in this data set, as summarized in the attached table.
- The field duplicate pair samples were Dup-01 and DEK-MW-18001; all field duplicate criteria were met except for chromium. The result for chromium in one of the two samples was < 5x the RL, and the absolute differences were > the RL. Potential uncertainty exists for the positive results for chromium in the samples in this data set, as summarized in the attached table.
- Laboratory duplicate analyses were performed on sample DEK-MW-15003 for TDS and alkalinity; RPDs were within QC limits.
- Carrier recoveries, where applicable, were within QC limits.

Attachment A
Summary of Data Non-Conformances for Lined Impoundment Analytical Data
CEC DE Karn Lined Impoundment – CCR Monitoring Program
Essexville, Michigan

Samples	Collection Date	Analyte	Non-Conformance/Issue
DEK-MW-15003_20190218	2/18/2019	Chromium	Detection in equipment blank (EB-01). Result <5x the equipment blank concentration; indicates possible false positive results.
OW-12_20190219	2/19/2019		
OW-11_20190219	2/19/2019		
DEK-MW-18001_20190218	2/18/2019		
KLI-SCS_20190219	2/19/2019		
DUP-01_20190218	2/18/2019		
OW-10_20190218	2/18/2019		
DEK-MW-15003_20190218	2/18/2019	Chromium	Field duplicate variability. Results <5x the RL and absolute difference > the RL; indicates potential uncertainty for detected results.
OW-12_20190219	2/19/2019		
DEK-MW-18001_20190218	2/18/2019		
OW-10_20190218	2/18/2019		
OW-11_20190219	2/19/2019		
KLI-SCS_20190219	2/19/2019		
DUP-01_20190218	2/18/2019		
DEK-MW-15003_20190218	2/18/2019	Selenium	MS recovery below the lower laboratory control limits. Sample results may be biased low.
OW-12_20190219	2/19/2019		
DEK-MW-18001_20190218	2/18/2019		
OW-10_20190218	2/18/2019		
OW-11_20190219	2/19/2019		
KLI-SCS_20190219	2/19/2019		
DUP-01_20190218	2/18/2019		

Laboratory Data Quality Review
Groundwater Monitoring Event April 2019
CEC DE Karn Lined Impoundment and Bottom Ash Pond

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

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

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

Each sample was analyzed for the following constituents:

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

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

Data Usability Review Procedure

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

The following items were included in the evaluation of the data:

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

This data usability report addresses the following items:

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

Review Summary

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

- Appendix III and IV constituents will be utilized for the purposes of an assessment monitoring program.

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

QA/QC Sample Summary:

- The holding times were met for all parameters for all samples.
- A method blank was analyzed with each analytical batch. Target analytes were not detected in the method blanks except for the following:
  - Lead was detected in method blank 440-541702/1-A associated with samples in SDG 440-238849-1 from preparation batch 541899 at a concentration of 0.00349 mg/L. There was no impact on data usability since lead was not detected in the associated samples.
- One equipment blank (EB-01) was collected and analyzed for metals, mercury, Ra-226, and Ra-228; and two field blanks (FB-01 and FB-04) were collected and analyzed for metals and mercury. Target Appendix III and IV analytes were not detected in EB-01 and FB-04.
- The LCS and/or LCSD recoveries for all analytes were within QC limits, except for Ra-226 in LCS 160-427723/1-A associated with samples DEK-MW-18001 and OW-12. The LCS %R (65%) was below the lower acceptance limit of 75%; thus, the Ra-226 results in samples DEK-MW-18001 and OW-12 may be biased low as summarized in the attached table.
- MS and/or MSD analyses were performed on sample OW-10 for metals by SW846 method 6010; on sample OW-12 for metals by SW846 method 6020 and mercury; on sample DEK-MW-18001 for anions, mercury, and metals; and on sample OW-11 for lithium. All recoveries and relative percent differences (RPDs) were within the QC limits
- The field duplicate pair samples were DUP-04 and DEK-MW-15005, and DUP-01 and OW-10; RPDs between the parent and duplicate samples were within the QC limits.
- Laboratory duplicate analyses were performed on sample DEK-MW-18001 for alkalinity and TDS; on sample DEK-MW-15003 for TDS, and on sample OW-11 for alkalinity; RPDs were within QC limits.
- The nondetect RLs for metals by SW846 6020 in sample DEK-MW-15003 exceeded the project-required RLs due to the 5-fold dilution which was performed because of interference from the sample matrix.

Attachment A

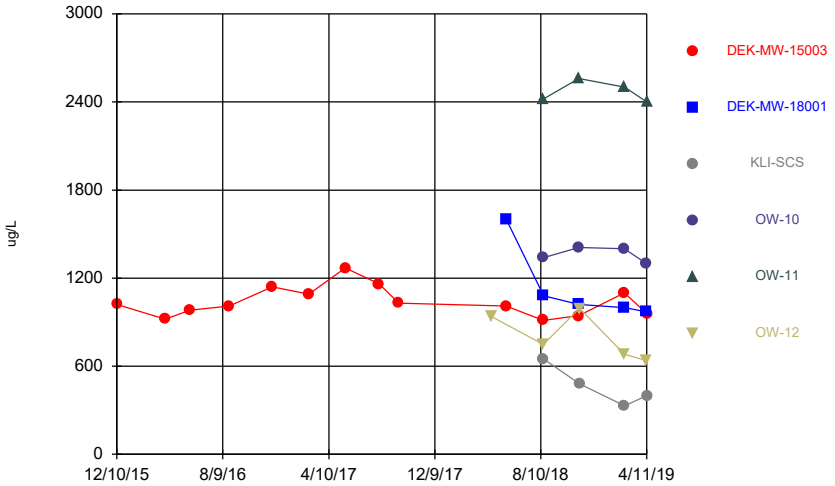
Summary of Data Non-Conformances for DE Karn Groundwater Analytical Data
DEK Bottom Ash Pond and Karn Lined Impoundment – RCRA CCR Monitoring Program
Essexville, Michigan

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

Attachment B
Time Series Plots

Sanitas™ v.9.6.23 Sanitas software licensed to Consumers Energy. EPA

Boron, Total

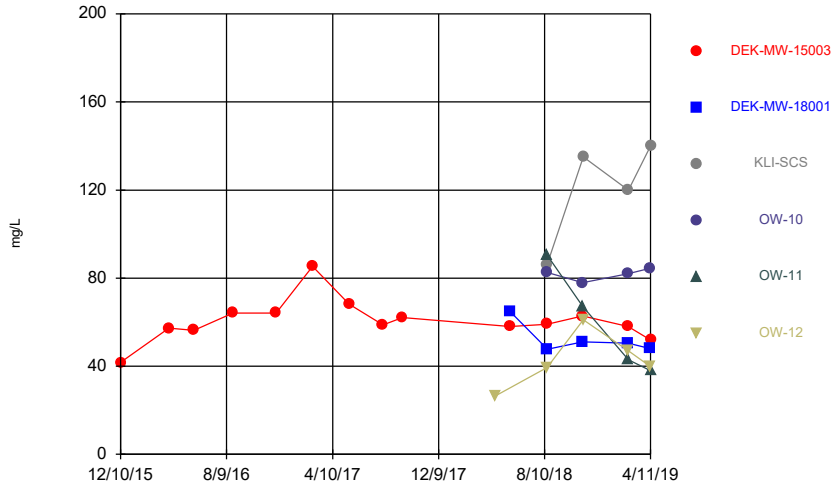


Time Series Analysis Run 10/10/2019 12:15 PM

Client: Consumers Energy Data: DEK_Sanitas_19.10.09

Sanitas™ v.9.6.23 Sanitas software licensed to Consumers Energy. EPA

Calcium, Total

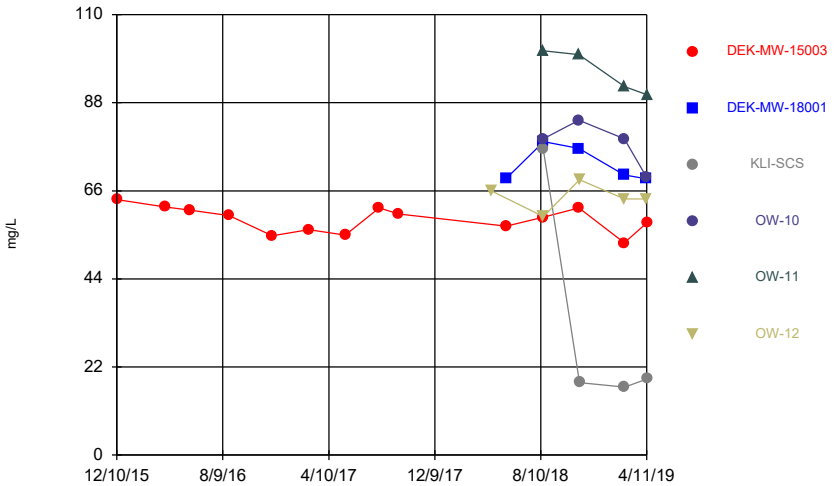


Time Series Analysis Run 10/10/2019 12:15 PM

Client: Consumers Energy Data: DEK_Sanitas_19.10.09

Sanitas™ v.9.6.23 Sanitas software licensed to Consumers Energy. EPA

Chloride

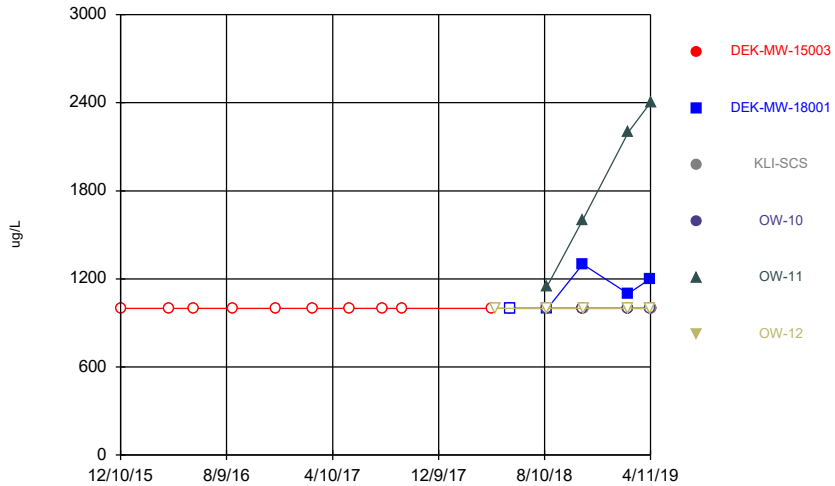


Time Series Analysis Run 10/10/2019 12:15 PM

Client: Consumers Energy Data: DEK_Sanitas_19.10.09

Sanitas™ v.9.6.23 Sanitas software licensed to Consumers Energy. EPA
Hollow symbols indicate censored values.

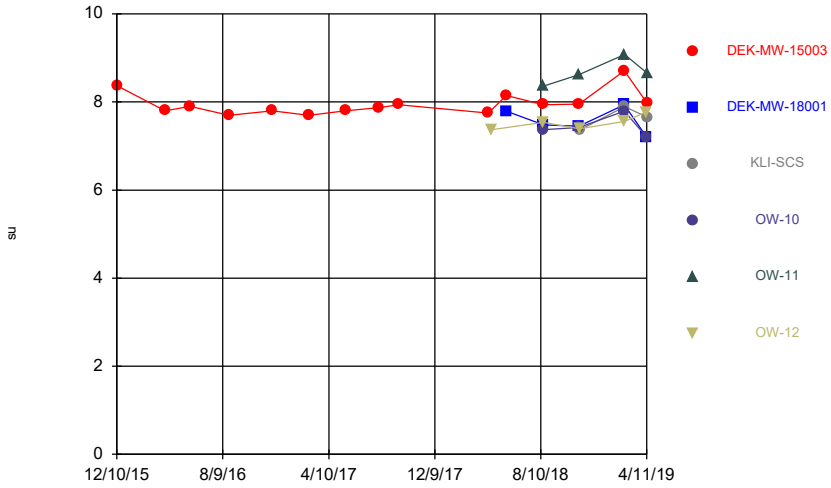
Fluoride



Time Series Analysis Run 10/10/2019 12:15 PM

Client: Consumers Energy Data: DEK_Sanitas_19.10.09

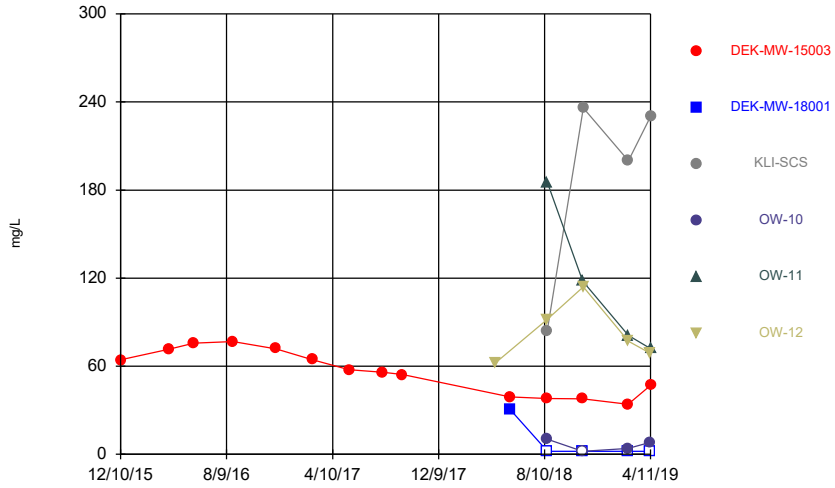
pH, Field



Time Series Analysis Run 10/10/2019 12:15 PM
Client: Consumers Energy Data: DEK_Sanitas_19.10.09

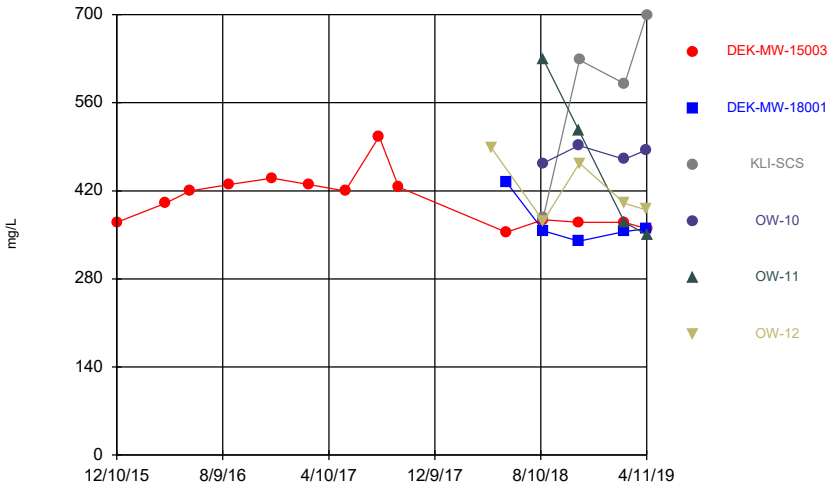
Hollow symbols indicate censored values.

Sulfate



Time Series Analysis Run 10/10/2019 12:15 PM
Client: Consumers Energy Data: DEK_Sanitas_19.10.09

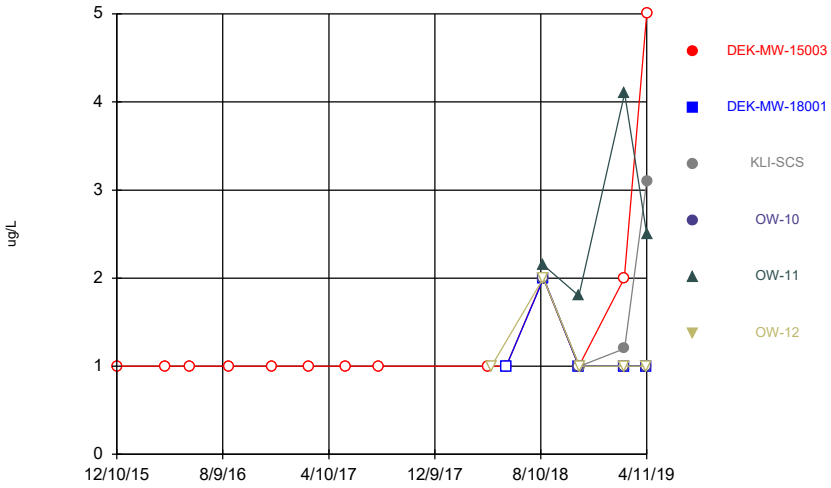
Total Dissolved Solids, Total



Time Series Analysis Run 10/10/2019 12:15 PM
Client: Consumers Energy Data: DEK_Sanitas_19.10.09

Sanitas™ v.9.6.23 Sanitas software licensed to Consumers Energy. EPA
Hollow symbols indicate censored values.

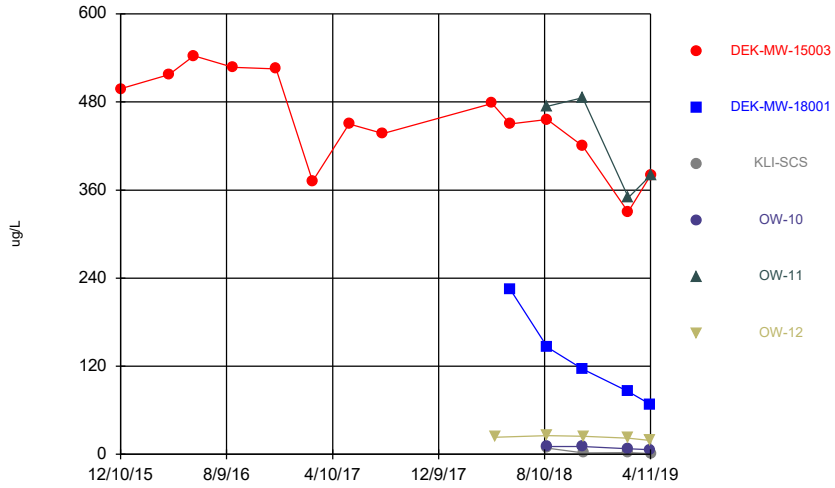
Antimony, Total



Time Series Analysis Run 10/10/2019 12:16 PM
Client: Consumers Energy Data: DEK_Sanitas_19.10.09

Sanitas™ v.9.6.23 Sanitas software licensed to Consumers Energy. EPA

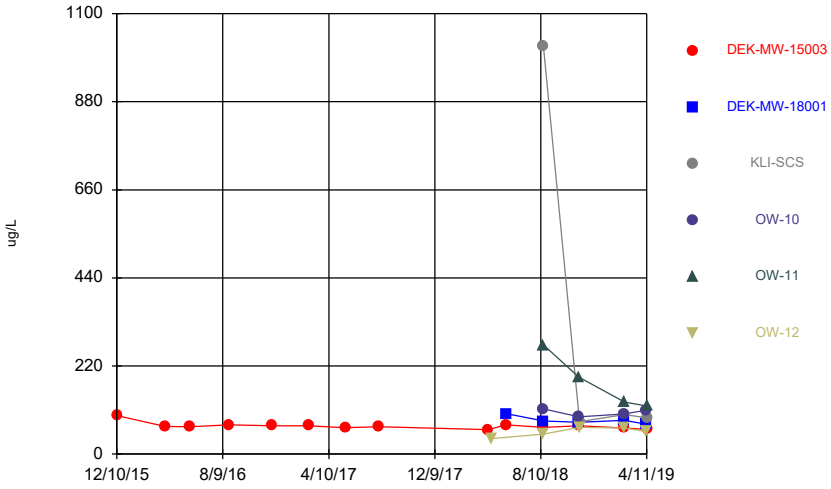
Arsenic, Total



Time Series Analysis Run 10/10/2019 12:16 PM
Client: Consumers Energy Data: DEK_Sanitas_19.10.09

Sanitas™ v.9.6.23 Sanitas software licensed to Consumers Energy. EPA

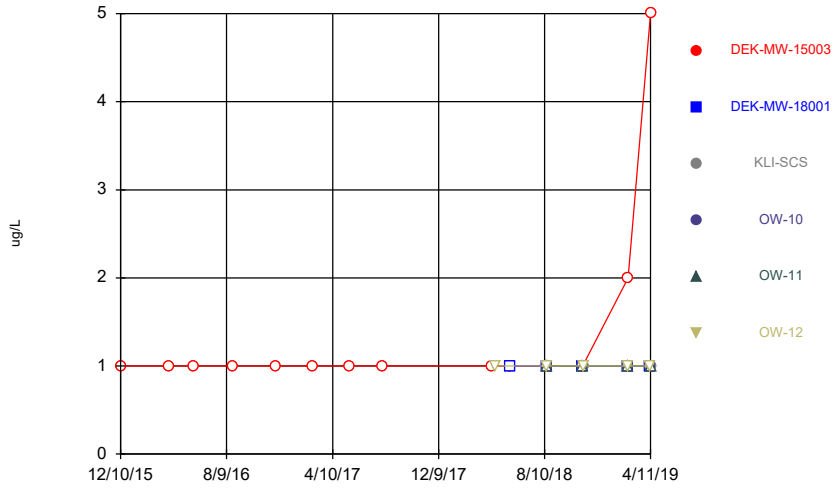
Barium, Total



Time Series Analysis Run 10/10/2019 12:16 PM
Client: Consumers Energy Data: DEK_Sanitas_19.10.09

Sanitas™ v.9.6.23 Sanitas software licensed to Consumers Energy. EPA
Hollow symbols indicate censored values.

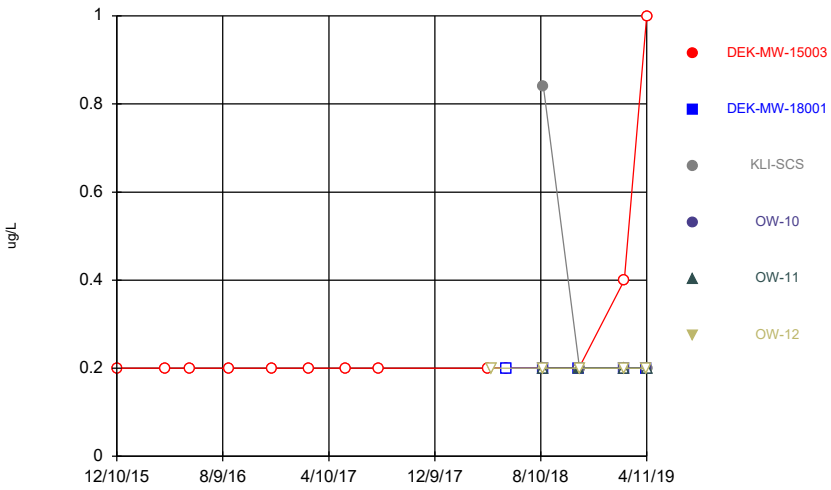
Beryllium, Total



Time Series Analysis Run 10/10/2019 12:16 PM
Client: Consumers Energy Data: DEK_Sanitas_19.10.09

Sanitas™ v.9.6.23 Sanitas software licensed to Consumers Energy. EPA
Hollow symbols indicate censored values.

Cadmium, Total



Time Series Analysis Run 10/10/2019 12:16 PM
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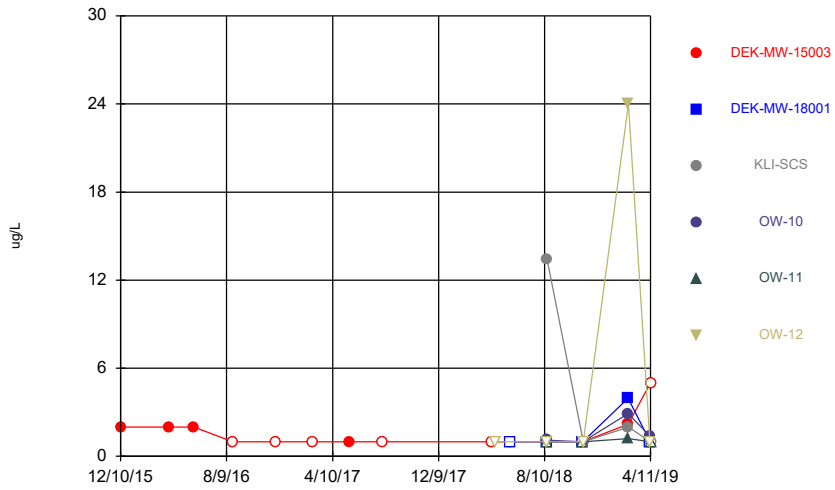
Sanitas™ v.9.6.23 Sanitas software licensed to Consumers Energy. EPA
Hollow symbols indicate censored values.

Chromium, Total



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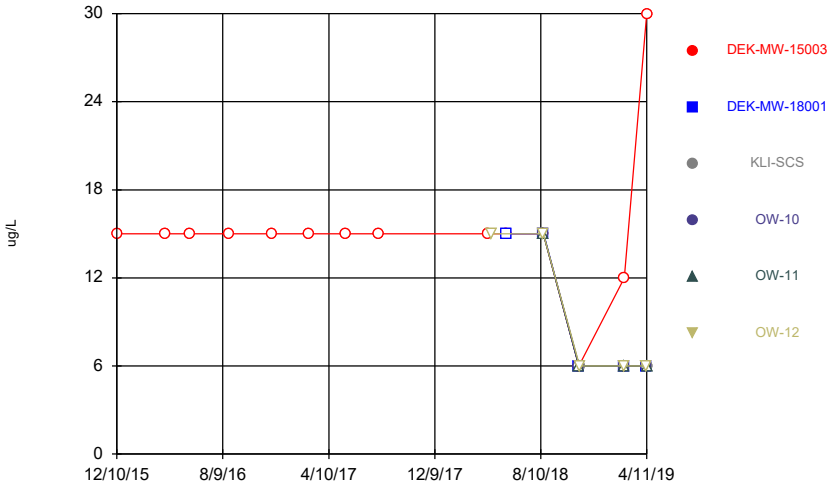
Client: Consumers Energy Data: DEK_Sanitas_19.10.09

Sanitas™ v.9.6.23 Sanitas software licensed to Consumers Energy. EPA
Hollow symbols indicate censored values.

Cobalt, Total



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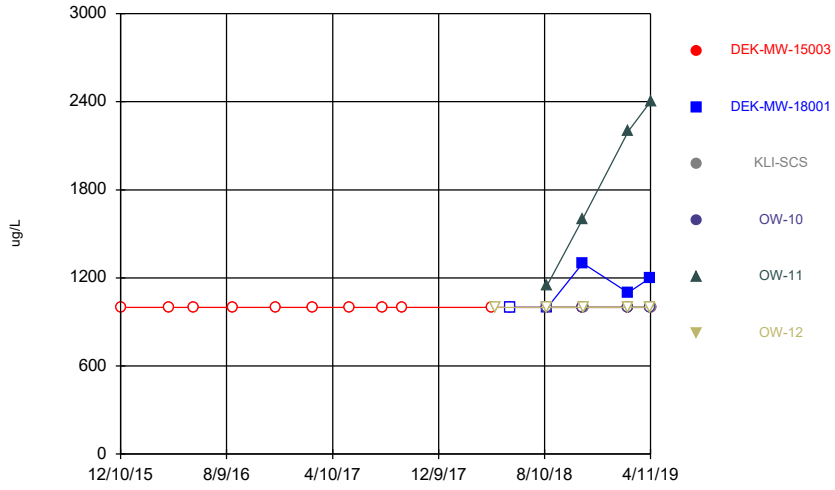
Sanitas™ v.9.6.23 Sanitas software licensed to Consumers Energy. EPA
Hollow symbols indicate censored values.

Fluoride



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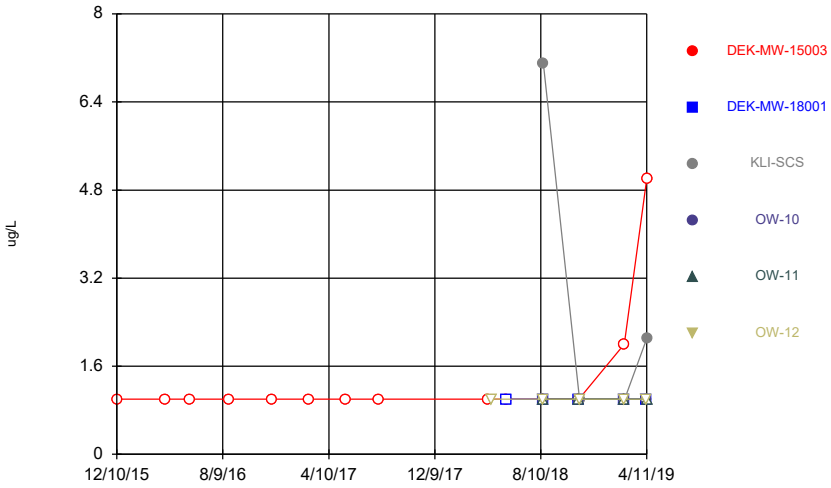
Client: Consumers Energy Data: DEK_Sanitas_19.10.09

Sanitas™ v.9.6.23 Sanitas software licensed to Consumers Energy. EPA
Hollow symbols indicate censored values.

Lead, Total



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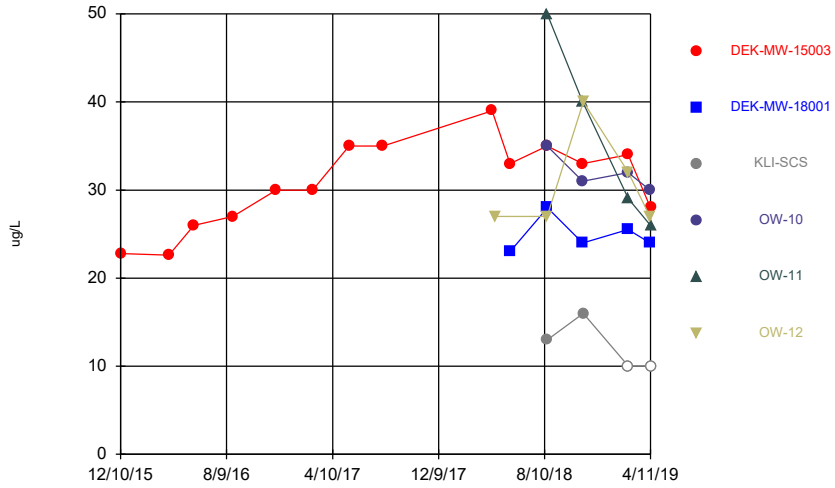
Client: Consumers Energy Data: DEK_Sanitas_19.10.09

Sanitas™ v.9.6.23 Sanitas software licensed to Consumers Energy. EPA
Hollow symbols indicate censored values.

Lithium, Total



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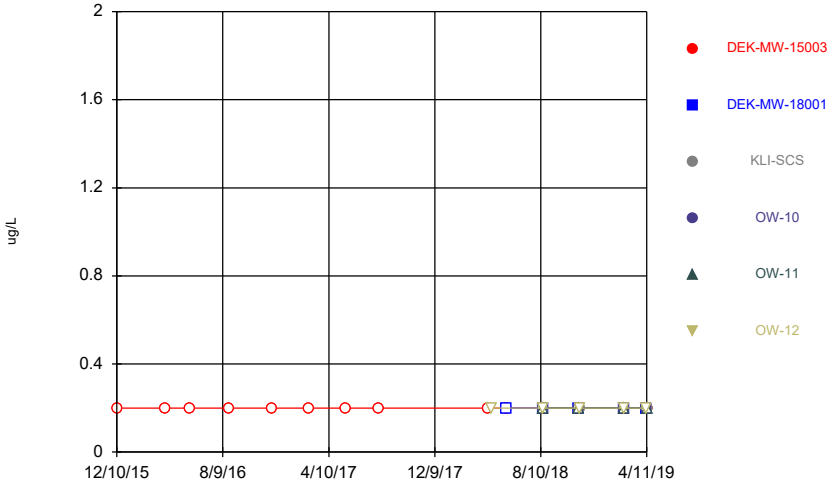
Client: Consumers Energy Data: DEK_Sanitas_19.10.09

Sanitas™ v.9.6.23 Sanitas software licensed to Consumers Energy. EPA
Hollow symbols indicate censored values.

Mercury, Total



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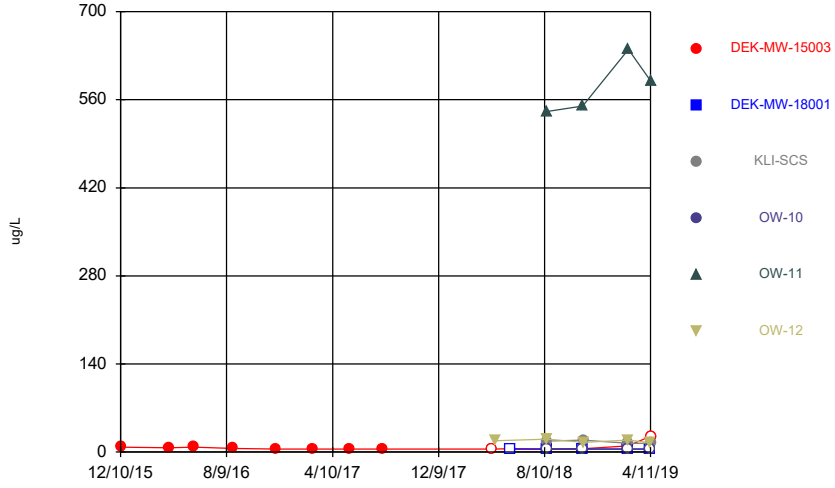
Client: Consumers Energy Data: DEK_Sanitas_19.10.09

Sanitas™ v.9.6.23 Sanitas software licensed to Consumers Energy. EPA
Hollow symbols indicate censored values.

Molybdenum, Total



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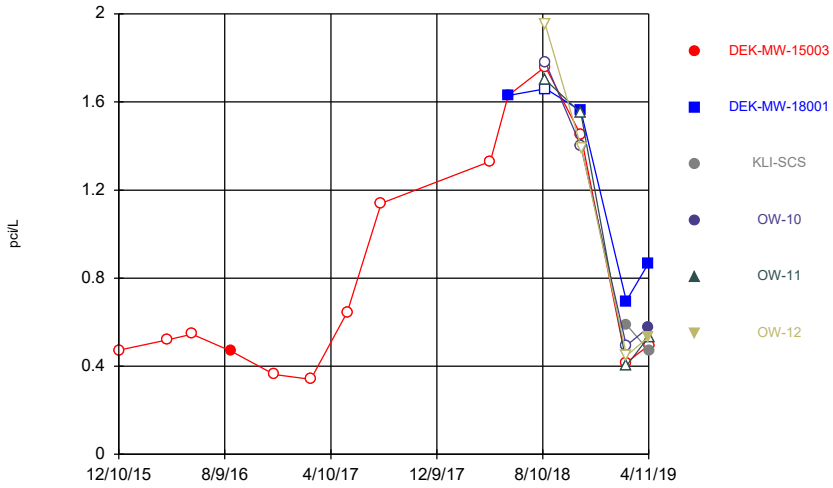
Sanitas™ v.9.6.23 Sanitas software licensed to Consumers Energy. EPA
Hollow symbols indicate censored values.

Radium-226/228



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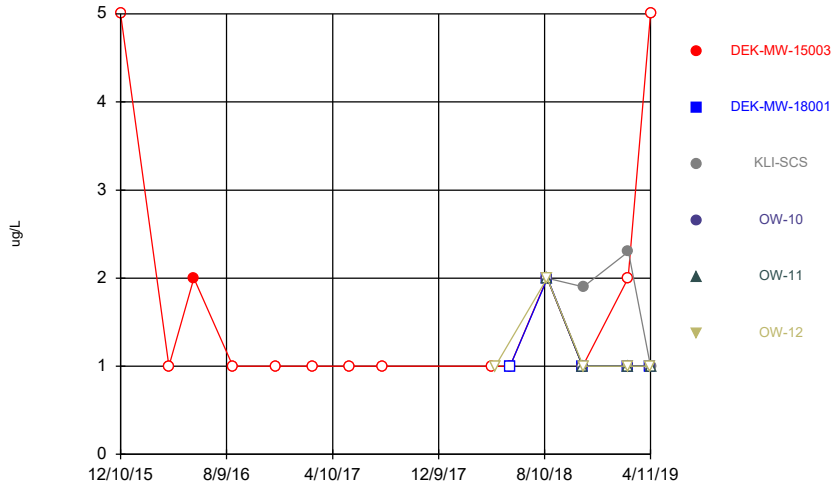
Client: Consumers Energy Data: DEK_Sanitas_19.10.09

Sanitas™ v.9.6.23 Sanitas software licensed to Consumers Energy. EPA
Hollow symbols indicate censored values.

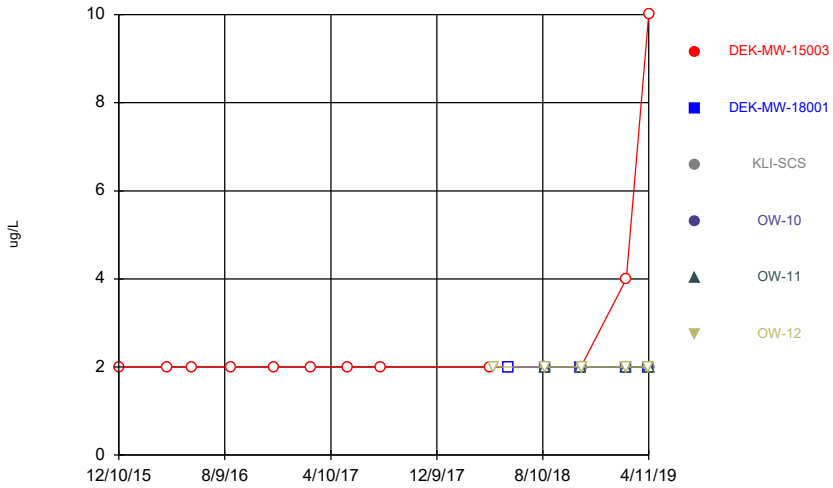
Selenium, Total



Time Series Analysis Run 10/10/2019 12:16 PM
Client: Consumers Energy Data: DEK_Sanitas_19.10.09

Sanitas™ v.9.6.23 Sanitas software licensed to Consumers Energy. EPA
Hollow symbols indicate censored values.

Thallium, Total



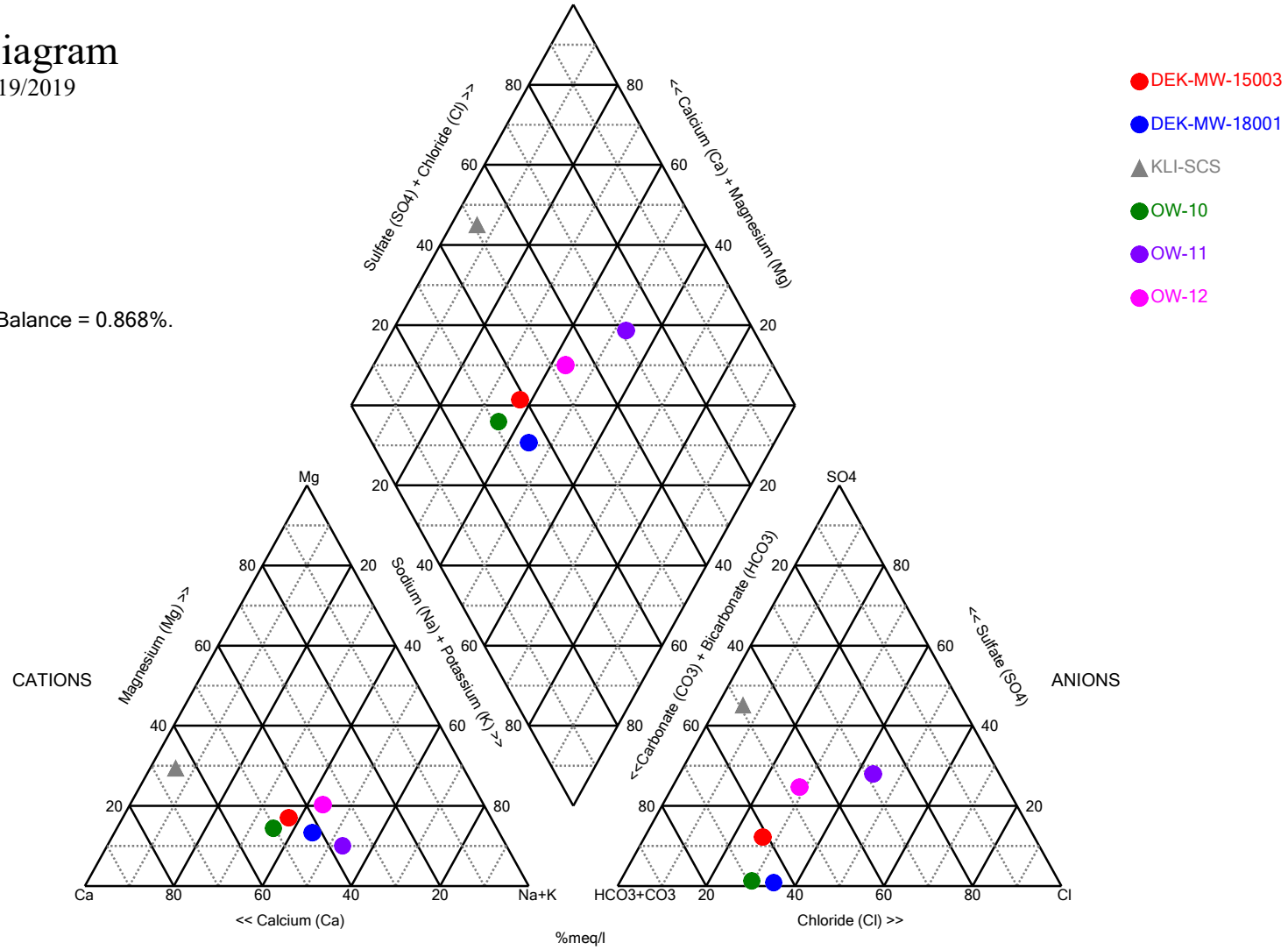
Time Series Analysis Run 10/10/2019 12:16 PM
Client: Consumers Energy Data: DEK_Sanitas_19.10.09

Attachment C
Piper Diagrams

Piper Diagram

2/18/2019, 2/19/2019

Cation-Anion Balance = 0.868%.



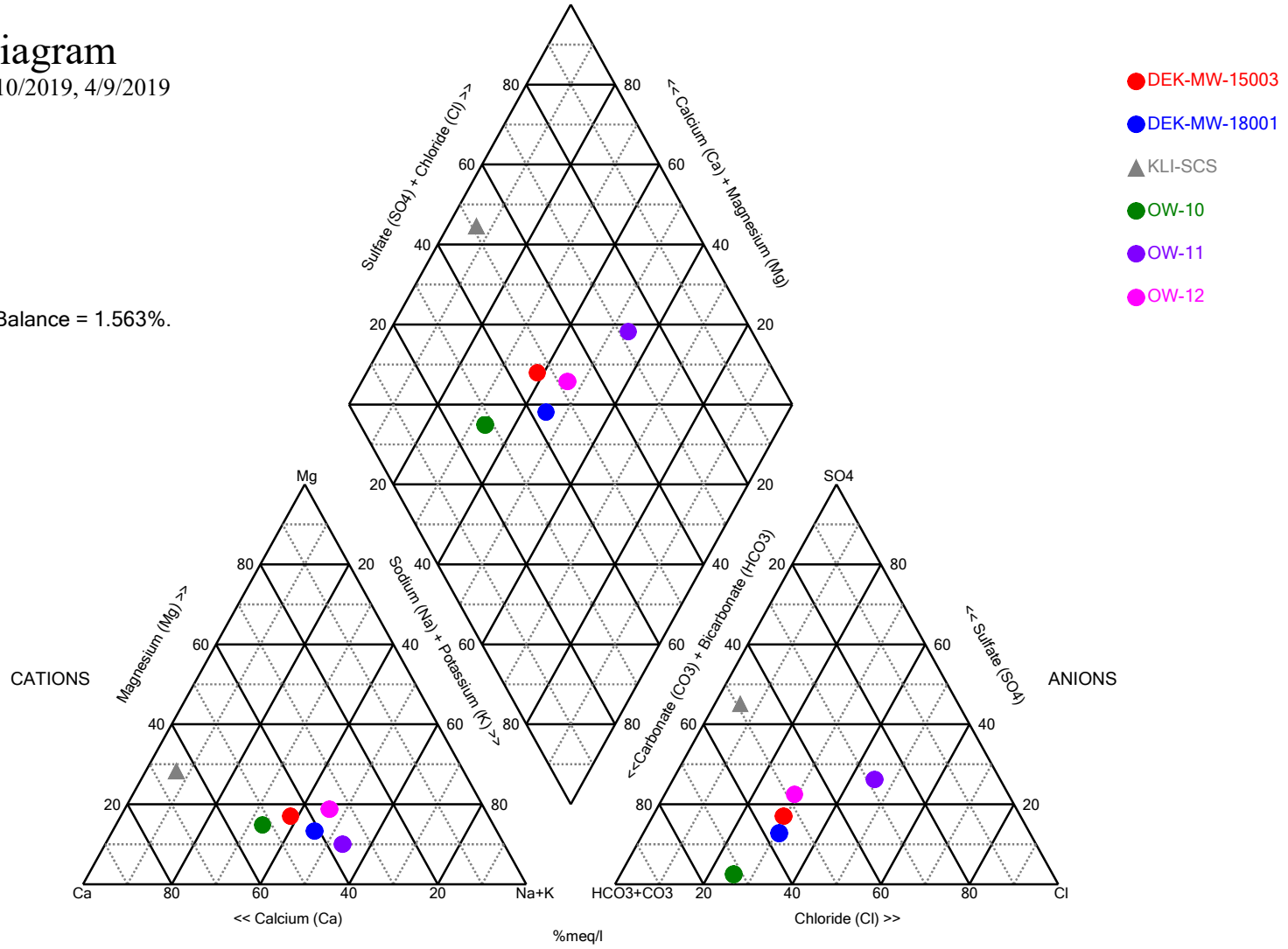
Analysis Run 6/27/2019 10:10 AM

Client: Consumers Energy Data: DEK_Sanitas_19.05.30

Piper Diagram

4/11/2019, 4/10/2019, 4/9/2019

Cation-Anion Balance = 1.563%.



Analysis Run 6/27/2019 10:11 AM

Client: Consumers Energy Data: DEK_Sanitas_19.05.30

Appendix C
Data Quality Reviews (August and October 2019)

Laboratory Data Quality Review
Groundwater Monitoring Event August 2019
CEC DE Karn Lined Impoundment

Groundwater samples were collected by TRC for the August 2019 sampling event. Samples were analyzed for lithium, anions, alkalinity, and total dissolved solids by Eurofins TA in North Canton, Ohio (Eurofins TA – Canton). The remaining metals analyses were subcontracted to Eurofins TA in Irvine, California (Eurofins TA - Irvine). The radium analyses were subcontracted to Eurofins TA in St. Louis, Missouri (Eurofins TA – St. Louis). The laboratory analytical results were reported in laboratory sample delivery groups (SDGs) 240-117437-1 and 240-117437-2.

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

- DEK-MW-15003
- DEK-MW-18001
- KLI SCS
- OW-10
- OW-11
- OW-12

Each sample was analyzed for the following constituents:

Analyte Group	Method
Anions (Fluoride, Chloride, Sulfate)	EPA 300.0
Total Dissolved Solids (TDS)	SM 2540C
Alkalinity	SM 2320B
Total Metals	SW-846 6010B/6020/7470A
Radium (Radium-226, Radium-228, Combined Radium)	EPA 903.0, EPA 904.0

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

Data Usability Review Procedure

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

- Sample receipt, 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). The LCSs are used to assess the accuracy of the analytical method using a clean matrix;
- Percent recoveries for matrix spike (MS) and matrix spike duplicates (MSD), where applicable. 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, where applicable. 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.

This data usability report addresses the following items:

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

Review Summary

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

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

QA/QC Sample Summary

- Holding time criteria were met with one exception. The TDS holding time for sample KLI SCS exceeded the 7-day holding time criteria by approximately two hours. This result may be estimated, biased low, as summarized in the attached table.

- Mercury was detected in one of the method blanks at a concentration of 0.000508 mg/L. However, data usability was not affected since mercury was not detected in the associated samples.
- One field blank (Field Blank) and one equipment blank (Equipment Blank) were collected; no analytes were detected in Field Blank.
  - Chromium was detected at a concentration of 0.0013 mg/L in Equipment Blank. Potential false positives exist for positive results for chromium, as summarized in the attached table.
- LCS recoveries were within laboratory control limits.
- MS/MSDs were performed on sample DEK-MW-18001 for metals and anions. The relative percent differences (RPDs) were within the QC limits.
  - The recoveries of calcium and sodium in the MS and/or MSD were below the acceptance criteria. However, the calcium and sodium concentrations in the parent sample were >4x the spike concentration; therefore, the laboratory control limits for calcium and sodium were not applicable. Data usability was not affected.
- Laboratory duplicate analyses were performed on samples DEK-MW-18001 for alkalinity and TDS, and Field Blank for TDS; the RPDs between the parent and duplicate sample were within the QC limits.
- The field duplicate pair samples were Field Duplicate and OW-12. All criteria were met with the following exception.
  - The RPD for iron (85.7%) exceeded the acceptance limits. Potential uncertainty exists for all positive results for iron, as summarized in the attached table.
- Carrier recoveries, where applicable, were within 40-110%.

Attachment 1

Summary of Data Non-Conformances for DE Karn Groundwater Analytical Data

DEK Karn Lined Impoundment - RCRA CCR Monitoring Program

Essexville, Michigan

Samples	Collection Date	Analyte	Non-Conformance/Issue
KLI SCS	8/14/2019	TDS	Anlaysis performed past holding time; sample result may be biased low.
OW-10	8/13/2019	Chromium	Detection in equipment blank. Results <10x the blank concentration. Results may be false positives.
OW-11	8/14/2019		
KLI SCS	8/14/2019		
OW-10	8/13/2019	Iron	Field duplicate variability (RPD >30%). Potential uncertainty.
DEK-MW-15003	8/13/2019		
OW-12	8/14/2019		
FIELD DUPLICATE	8/14/2019		
DEK-MW-18001	8/14/2019		
OW-11	8/14/2019		
KLI SCS	8/14/2019		

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

Groundwater samples were collected by TRC for the October 2019 sampling event. Samples were analyzed for lithium, anions, alkalinity, and total dissolved solids by Eurofins TA in North Canton, Ohio (Eurofins TA – Canton). The remaining metals analyses were subcontracted to Eurofins TA in Irvine, California (Eurofins TA - Irvine). The radium analyses were subcontracted to Eurofins TA in St. Louis, Missouri (Eurofins TA – St. Louis). The laboratory analytical results were reported in laboratory sample delivery groups (SDGs) 240-120630-1, 240-120630-2, 240-120631-1, and 240-120631-2.

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

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

Each sample was analyzed for the following constituents:

Analyte Group	Method
Anions (Fluoride, Chloride, Sulfate)	EPA 300.0
Alkalinity	SM 2320B-11
Total Dissolved Solids (TDS)	SM 2540C-11
Metals	EPA 6020, EPA 6010B, EPA 7470A
Radium (Radium-226, Radium-228, Combined Radium)	EPA 903.0, EPA 904.0

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

Data Usability Review Procedure

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

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

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

This data usability report addresses the following items:

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

Review Summary

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

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

QA/QC Sample Summary:

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

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

Laboratory Data Quality Review
Groundwater Monitoring Event October 2019
CEC DE Karn Lined Impoundment

Groundwater samples were collected by TRC for the October 2019 sampling event. Samples were analyzed for lithium, anions, alkalinity, and total dissolved solids by Eurofins TA in North Canton, Ohio (Eurofins TA – Canton). The remaining metals analyses were subcontracted to Eurofins TA in Irvine, California (Eurofins TA - Irvine). The radium analyses were subcontracted to Eurofins TA in St. Louis, Missouri (Eurofins TA – St. Louis). The laboratory analytical results were reported in laboratory sample delivery groups (SDGs) 240-120783-1, 240-120783-2, 240-120650-1, and 240-120650-2.

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

- OW-10
- OW-11
- OW-12
- KLI-SCS

Each sample was analyzed for the following constituents:

Analyte Group	Method
Anions (Fluoride, Chloride, Sulfate)	EPA 300.0
Alkalinity	SM 2320B-11
Total Dissolved Solids (TDS)	SM 2540C-11
Total and/or Dissolved** Metals	EPA 6020, EPA 6010B, EPA 7470A
Radium (Radium-226, Radium-228, Combined Radium)*	EPA 903.0, EPA 904.0

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

**Only samples OW-10 and KLI-SCS were analyzed for dissolved metals.

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

Data Usability Review Procedure

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

- Sample receipt;
- Technical holding times for analyses;

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

This data usability report addresses the following items:

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

Review Summary

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

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

QA/QC Sample Summary:

- A method blank was analyzed with each analytical batch; no analytes were detected in the method blank samples.
- One equipment blank (EB-01) and one field blank (FB-01) were collected.
  - Target analytes were not detected in EB-01.
  - Copper was detected at 0.0054 mg/L in FB-01. The detected total copper result in sample KLI-SCS may be a false positive since the result was less than 5x the blank result, as summarized in Attachment 1.
- The LCS and/or LCSD recoveries and relative percent differences (RPDs), where applicable, for all analytes were within QC limits.
- MS and/or MSD analyses were performed on samples OW-11 for total mercury and anions, and OW-10 for select total and/or dissolved metals. The MSD for anions in sample OW-11 was not spiked due to laboratory error so an MSD for anions was not reported. All recoveries and relative percent differences (RPDs) were within the QC limits with the following exceptions.
  - The recoveries of mercury in the MS/MSD analyses performed on sample OW-11 were below the control limits. Potential low bias exists for the results for mercury in all groundwater samples collected during this event, as summarized in Attachment 1.
  - The recovery of dissolved zinc in the MSD analysis and the RPD in the MS/MSD analyses performed on sample OW-10 were above the control limits. Potential uncertainty exists for the detected result for dissolved zinc in sample KLI-SCS, as summarized in Attachment 1.
  - The recovery of total calcium was above the acceptance criteria in the MS analysis performed on sample OW-10. However, the calcium concentration in the parent sample was >4x the spike concentration; therefore, the laboratory control limits for calcium were not applicable. Data usability was not affected.
  - MS/MSD analyses were not performed for total and dissolved lithium, and dissolved potassium, magnesium, calcium, sodium, and boron per the Sampling and Analysis Plan.
- Laboratory duplicate analysis was performed on sample OW-12 for alkalinity; the RPDs were within QC limits.
- The field duplicate pair samples were Dup-01 and OW-12; RPDs between the parent and duplicate sample were within the QC limits.
- The combined radium results were < 5 pCi/L; therefore, samples were not selected to undergo the full 21-day wait period prior to radium-226 reporting. There is no impact on data usability.

- Carrier recoveries, where applicable, were within 40-110%.

Attachment 1

Summary of Data Non-Conformances for DE Karn Groundwater Analytical Data

DEK Karn Lined Impoundment – RCRA CCR Monitoring Program

Essexville, Michigan

Samples	Collection Date	Analyte	Non-Conformance/Issue
OW-10	10/15/2019	Mercury	Low recoveries in MS/MSD analyses; indicates potential low bias.
OW-12	10/15/2019		
DUP-01	10/15/2019		
KLI-SCS	10/15/2019		
OW-11	10/16/2019		
KLI-SCS	10/15/2019	Dissolved zinc	High recovery in MSD and high RPD in the MS/MSD analyses; indicates potential uncertainty.
KLI-SCS	10/15/2019	Total copper	Detection in field blank (FB-01). Sample result ≤5X the blank concentration. Result may be a false positive.

Notes:
RPD: Relative percent difference
MS/MSD: Matrix spike/matrix spike duplicate

Appendix D
October 2019 Alternate Source Demonstration

Consumers Energy
Count on Us®

A CMS Energy Company

Date: January 27. 2020

To: Operating Record

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

RE: Alternate Source Demonstration Professional Engineer Certification, §257.94(e)(2)
DE Karn Lined Surface Impoundment CCR Unit

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

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

Harold D. Register, Jr.

Signature

January 27, 2020

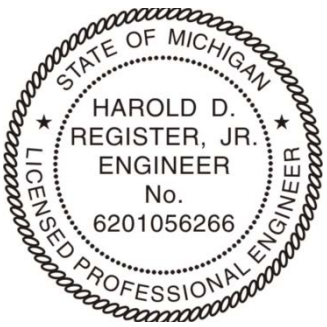
Date of Certification

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

Name

6201056266

Professional Engineer Certification Number



01/27/2020

ENCLOSURES

TRC (December 2019). "*Alternate Source Demonstration: October 2019 Detection Monitoring Sampling Event DE Karn Lined Impoundment, Consumers Energy Company, Essexville, Michigan*"

1540 Eisenhower Pl.
Ann Arbor, MI 48108

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Technical Memorandum

Date: December 19, 2019

To: J.R. Register, Consumers Energy

From: Darby Litz, TRC

Kristin Lowery, TRC

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

Project No.: 322172.0000 Phase 001, Task 003

Subject: Alternate Source Demonstration: October 2019 Detection Monitoring Sampling Event
DE Karn Lined Impoundment, Consumers Energy Company, Essexville, Michigan

Introduction

Pursuant to the United States Environmental Protection Agency's (U.S. EPA's) Resource Conservation and Recovery Act (RCRA) Coal Combustion Residuals rule (the CCR Rule), promulgated on April 17, 2015, Consumers Energy initiated a detection monitoring program for the Karn Lined Impoundment CCR unit that includes semiannual sampling for constituents listed in Appendix III to Part 257 of the CCR Rule. The second semiannual detection monitoring event for 2019 was conducted on October 14 through 16, 2019. The October 2019 event is the detection monitoring compliance event per the CCR Rule; however, a supplemental sampling event was also conducted on August 13 and 14, 2019 to further assess changing site conditions relative to the dewatering and CCR removal from the Karn Bottom Ash Pond to support evaluation of the potential for a future intra-well statistical program for detection monitoring. Pursuant to §257.93(f) and (g), and in accordance with the *Groundwater Statistical Evaluation Plan* (Stats Plan) (TRC, June 2018), the October 2019 detection monitoring results were statistically evaluated to identify potential statistically significant increases (SSIs) in detection monitoring constituents to determine if concentrations in detection monitoring well samples exceed background levels.

The statistical evaluation of the October 2019 Appendix III constituents showed potential SSIs over background levels for:

- Boron at DEK-MW-18001
- Calcium at OW-12

- Chloride at DEK-MW-18001, OW-11, and OW-12
- Sulfate at OW-12
- Total dissolved solids at OW-12
- pH at OW-12

All other Appendix III constituent concentrations were within the statistical background limits.

In accordance with §257.94(e)(2), Consumers Energy may demonstrate that a source other than the CCR unit caused the SSI or that the SSI resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. The following Alternate Source Demonstration (ASD) has been prepared to address the potential SSIs identified in the October 2019 detection monitoring event.

Alternate Source Demonstration

The following ASD evaluation provides multiple lines of evidence of alternative sources for the potential SSIs indicated for boron, calcium, chloride, sulfate, total dissolved solids (TDS), and pH at the Karn Lined Impoundment. The groundwater chemistry observed in the Karn Lined Impoundment monitoring well network is due to the history of CCR-related operations throughout the DE Karn Site, rather than a release from the new impoundment. These lines of evidence have been updated to reflect current site conditions and are consistent with information that has been presented in past ASDs:

- boron, chloride, fluoride, and sulfate[1]
- pH[2].

New Unit Construction

The liner system for the Karn Lined Impoundment was designed as a double composite liner system, with the primary and secondary composite liners each consisting of 60-mil (HDPE) geomembrane (GM) overlaying a 236-mil geosynthetic clay liner (GCL). The double composite liner system construction and the limited active life (only one year) of the Karn Lined Impoundment make it unlikely that wet ash dewatering liquids managed within the unit have migrated through the liner system and affected groundwater quality.

Secondary Collection System (SCS) Chemistry

Piper diagrams were prepared using the groundwater and KLI-SCS sample data collected during the August 2019 and October 2019 events (Attachment 1). The leachate chemistry (KLI-SCS) is distinctly different from the groundwater chemistry observed at the Karn Lined Impoundment wells. The piper diagrams also illustrate that the groundwater chemistry observed at the downgradient wells are not

[1] TRC. 2019. *Detection Monitoring Data Summary and Background Statistical Evaluation, Consumers Energy, DE Karn Site, Lined Impoundment CCR Unit.* March 13.
[2] TRC. 2019. *April 2019 Detection Monitoring Data Summary, Consumers Energy, DE Karn Site, Lined Impoundment CCR Unit*. Revised October 15.

uniquely different than the background wells, even if an individual downgradient concentration comparison to the background based on DEK-MW-15003 indicates a potential SSI.

Pre-Existing Groundwater Conditions

The footprint of the new Karn Lined Impoundment is immediately adjacent to the pre-existing Karn Bottom Ash Pond. As reported in the *2017 Annual Groundwater Monitoring Report: DE Karn Bottom Ash Pond CCR Unit* (January 2018, TRC), potential SSIs over background limits were noted for boron, fluoride, pH, and sulfate in one or more downgradient wells during September 2017. Therefore, the groundwater in the vicinity of the Karn Lined Impoundment is documented to have been affected by CCR due to the pre-existing unit. This line of evidence is further documented in the ASD included in the *Detection Monitoring Data Summary and Background Statistical Evaluation* (March 2019, TRC).

Limited Background Sampling Timeline to Capture Change in Background Conditions

As mentioned above, the Karn Bottom Ash Pond has completed source removal activities which included: reducing hydraulic loading (potential for infiltration to groundwater), dewatering by gravity so that the local groundwater flow regime is returning to equilibrium, and the CCR has been removed and regraded with clean fill to eliminate impacts from precipitation infiltration. DEK-MW-15003 is still located upgradient of the Karn Lined Impoundment; however, conditions at DEK-MW-15003 are changing as evidenced by the attached time-series plots (Attachment 1). Limited data are available from after the change in operation of the bottom ash pond (June 2018 – present) to assess a change in background limits, and due to changes in flow direction, DEK-MW-15003 may not represent upgradient groundwater conditions. Consumers Energy will be submitting an application for operating a CCR Surface Impoundment to the Michigan Department of Environment, Great Lakes, and Energy (EGLE) in 2020 that will require a Hydrogeological Monitoring Plan (HMP). This HMP will conform with both the federal CCR rules §257.90 - §257.94 and the state standards in PA 640. At that time the statistical evaluation program will be re-evaluated.

pH Values are Neutral and Within Expected Range

Although the pH of 7.1 standard units measured at OW-12 is 0.2 standard units below the background lower tolerance limit of 7.3 standard units, the pH value is neutral and are not indicative of a release from the Karn Lined Impoundment.

- The value for pH observed at OW-12 are similar to pH values measured in the Karn Bottom Ash Pond background wells located on the JC Weadock property. Four monitoring wells located between ¾ and 1 mile south of the Karn Bottom Ash Pond on the JC Weadock property provide data on background groundwater quality that has not been affected by the CCR unit (MW-15002, MW-15008, MW-15016, and MW-15019) (Figure 2). Background values for pH were established in these wells ranging from 6.5 to 7.3 standard units as reported in Appendix C of the *2017 Annual Groundwater Monitoring Report* (TRC, January 2018). This demonstrates that the pH value of 7.1 standard units observed at OW-12 is within the range of values expected to occur naturally in the shallow saturated unit.

- The OW-12 measured pH value is also neutral (7.0 standard units) and in the middle of the USEPA's established range of pH drinking water standards (6.5 to 8.5 S.U.) (USEPA, April 2012).

Conclusions and Recommendations

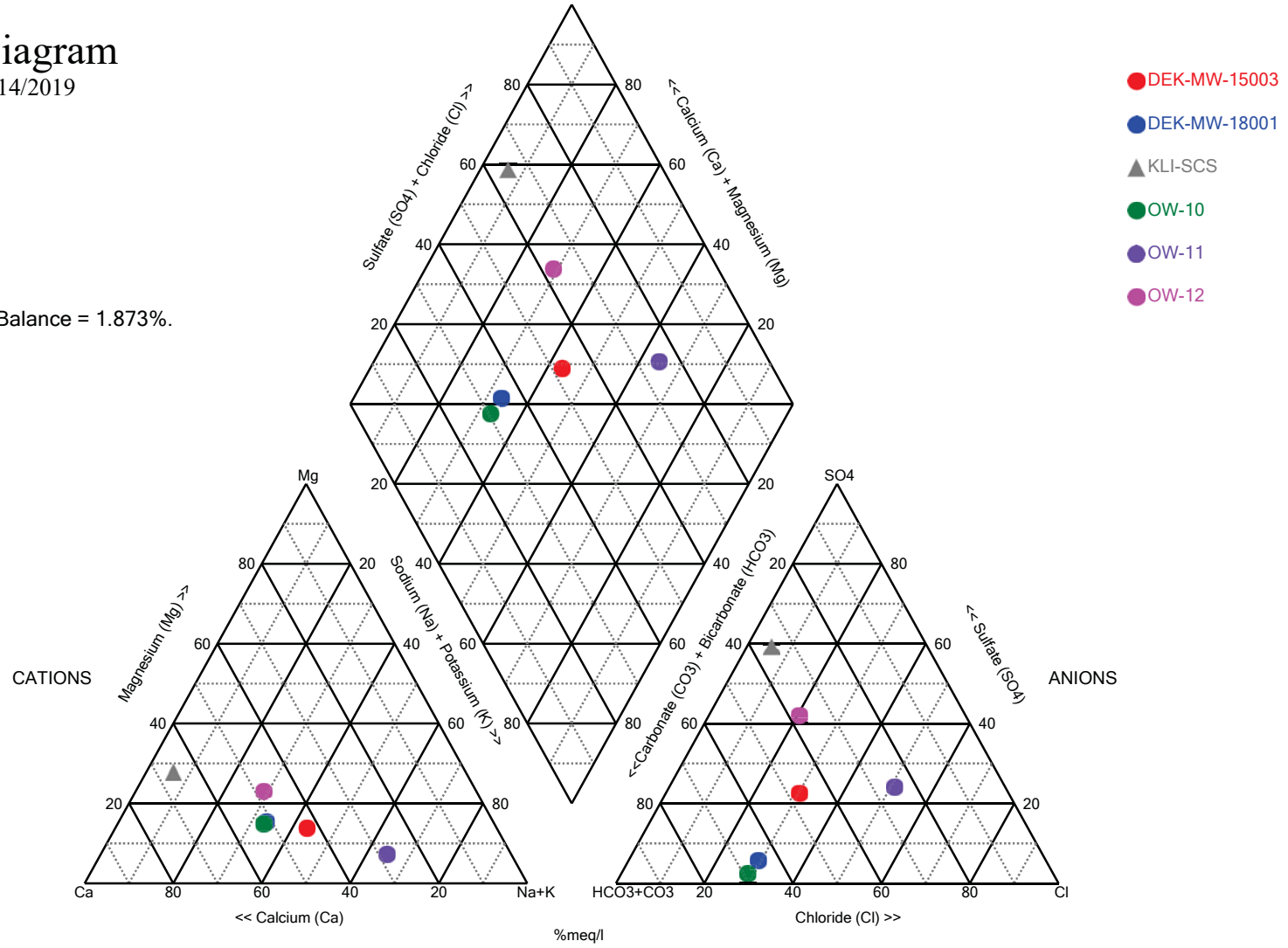
The information provided in this report serves as the ASD for the Karn Lined Impoundment, was prepared in accordance with 40 CFR 257.94(e)(2) of the CCR Rule and demonstrates that the potential SSIs determined based on the second semiannual detection monitoring event performed in 2019 is not due to a release of CCR leachate into the groundwater. Therefore, based on the information provided in this ASD, Consumers Energy will continue detection monitoring as per 40 CFR 257.94 at the Karn Lined Impoundment.

Attachment 1
ASD Supporting Documentation

Piper Diagram

8/13/2019, 8/14/2019

Cation-Anion Balance = 1.873%.



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Client: Consumers Energy Data: DEK_Sanitas_19.11.21_KLI ASD_v2

Piper Diagram

Analysis Run 12/18/2019 5:00 PM

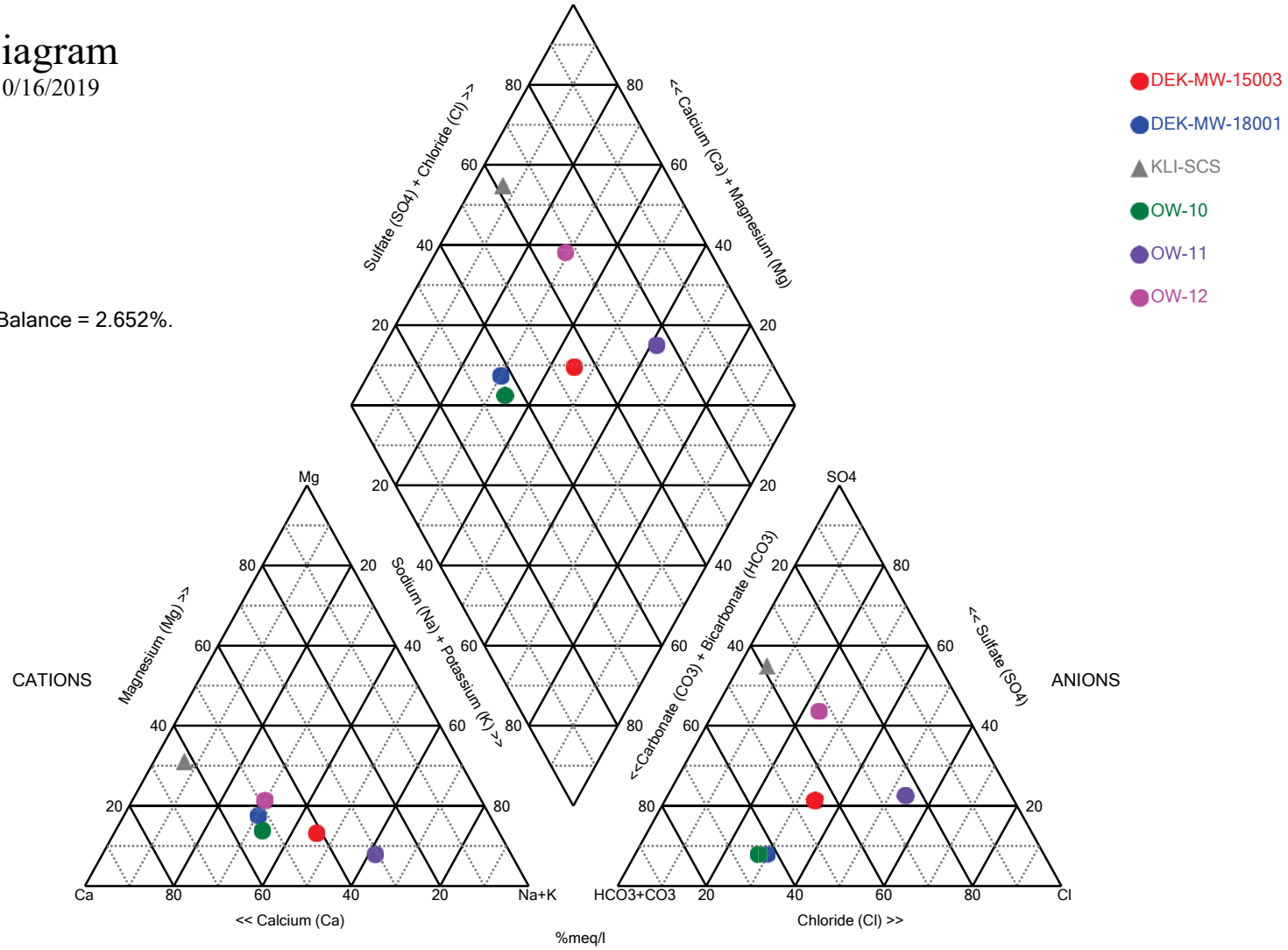
Client: Consumers Energy Data: DEK_Sanitas_19.11.21_KLI ASD_v2

Totals (ppm)	Na	K	Ca	Mg	Cl	SO4	HCO3	CO3
DEK-MW-15003	46	4.6	42	8.2	56	58	140	10
DEK-MW-18001	68	5.4	95	17	78	20	290	10
KLI-SCS	14	6.4	170	43	21	350	250	10
OW-10	65	5.1	94	16	77	9	320	10
OW-11	63	5.1	25	3.8	89	58	59	10
OW-12	71	7.9	110	31.5	80	230	245	10

Piper Diagram

10/15/2019, 10/16/2019

Cation-Anion Balance = 2.652%.



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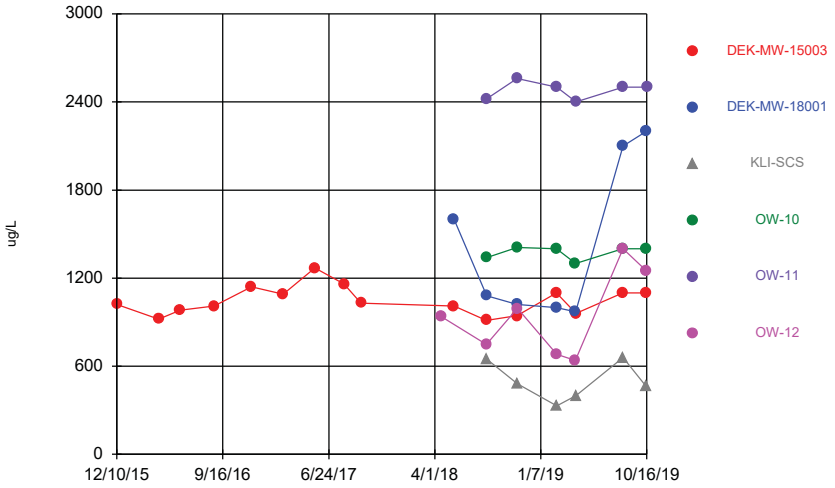
Piper Diagram

Analysis Run 12/18/2019 5:01 PM

Client: Consumers Energy Data: DEK_Sanitas_19.11.21_KLI ASD_v2

Totals (ppm)	Na	K	Ca	Mg	Cl	SO4	HCO3	CO3
DEK-MW-15003	47	4.8	39	7.7	58	52	130	5
DEK-MW-18001	53	4.4	84	17	81	31	300	5
KLI-SCS	14	5.5	140	42	24	320	280	5
OW-10	62	5.1	90	14	82	31	330	5
OW-11	59	5	27	4.2	91	52	57	7.9
OW-12	88	8.95	135	35.5	120	310	290	5

Boron, Total



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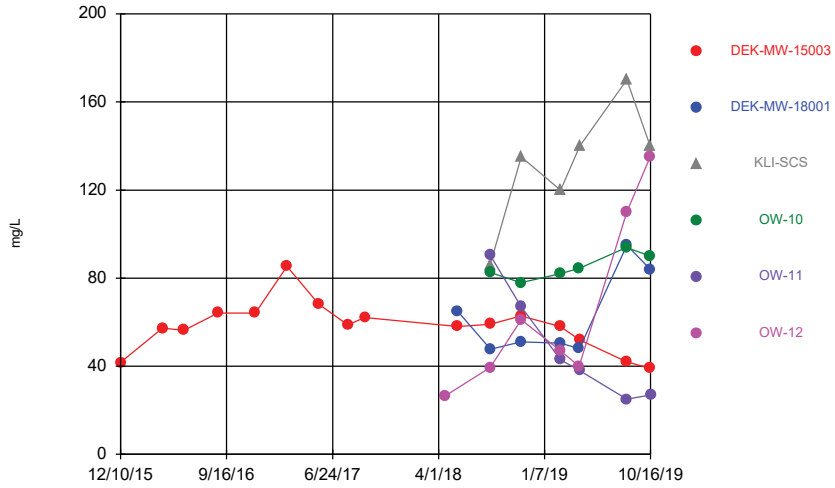
Sanitas™ v.9.6.24 Sanitas software licensed to Consumers Energy. EPA

Calcium, Total



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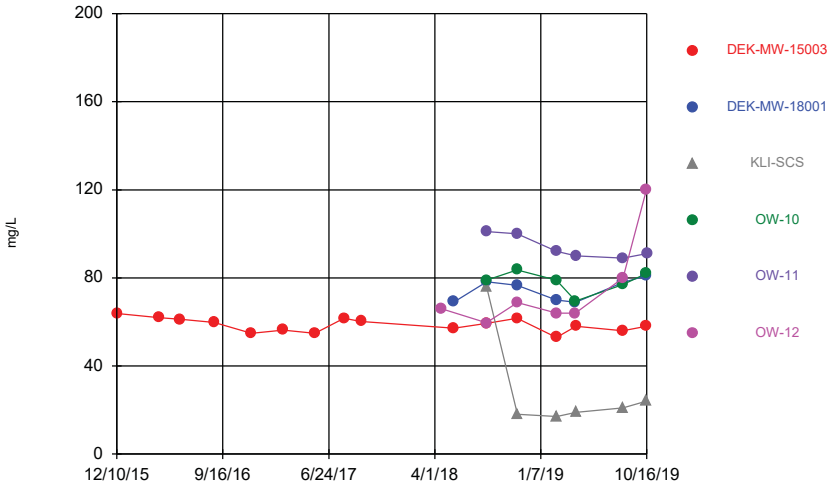
Chloride



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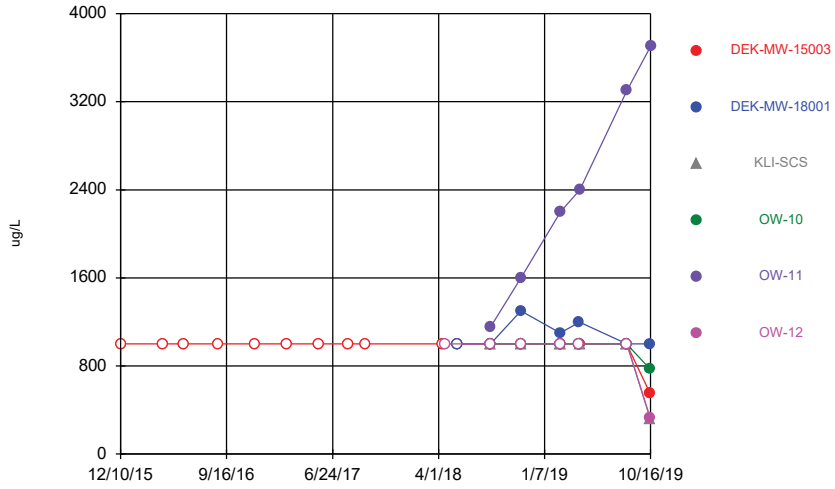
Sanitas™ v.9.6.24 Sanitas software licensed to Consumers Energy. EPA
Hollow symbols indicate censored values.

Fluoride



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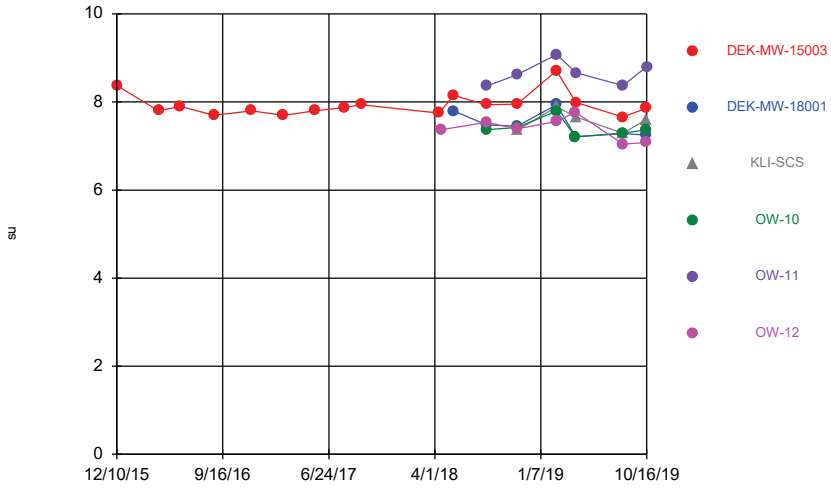
pH, Field



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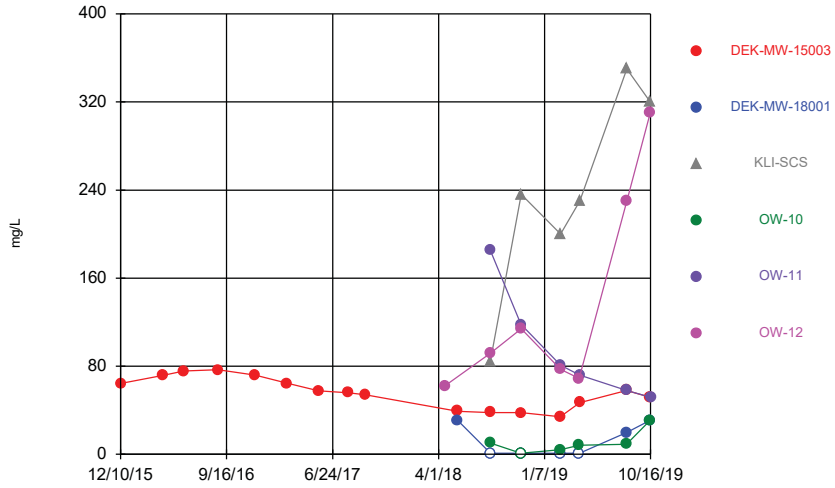
Sanitas™ v.9.6.24 Sanitas software licensed to Consumers Energy. EPA

Hollow symbols indicate censored values.

Sulfate



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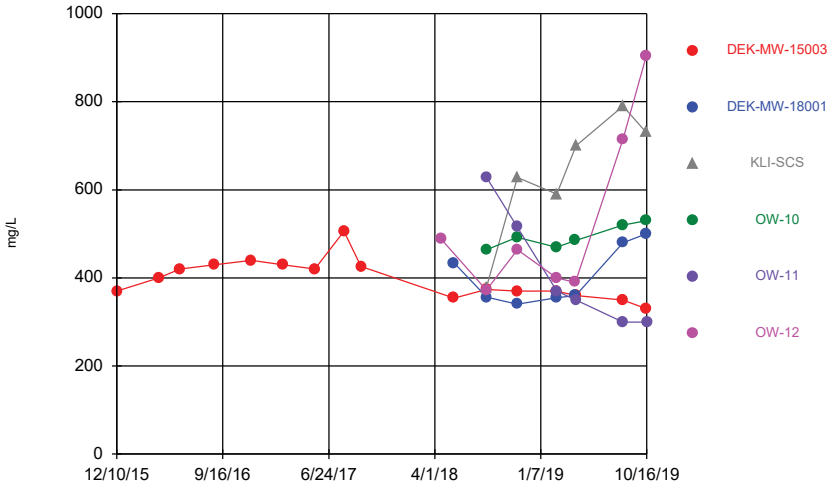
Sanitas™ v.9.6.24 Sanitas software licensed to Consumers Energy. EPA

Total Dissolved Solids, Total



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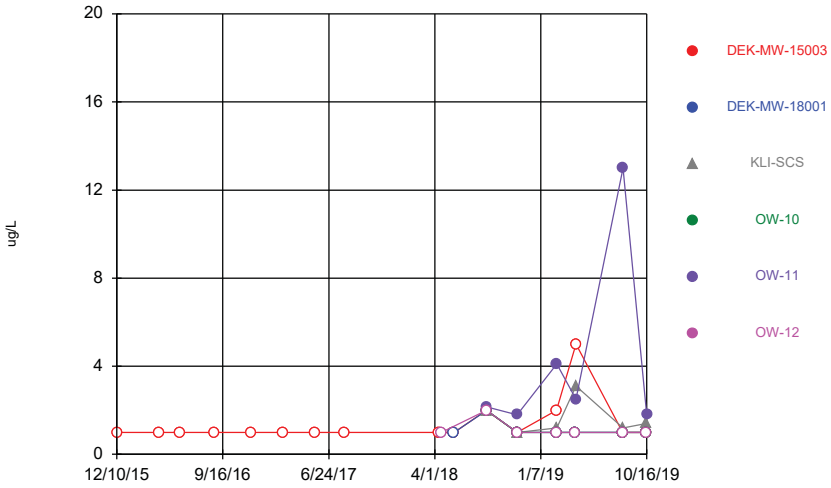
Hollow symbols indicate censored values.

Antimony, Total



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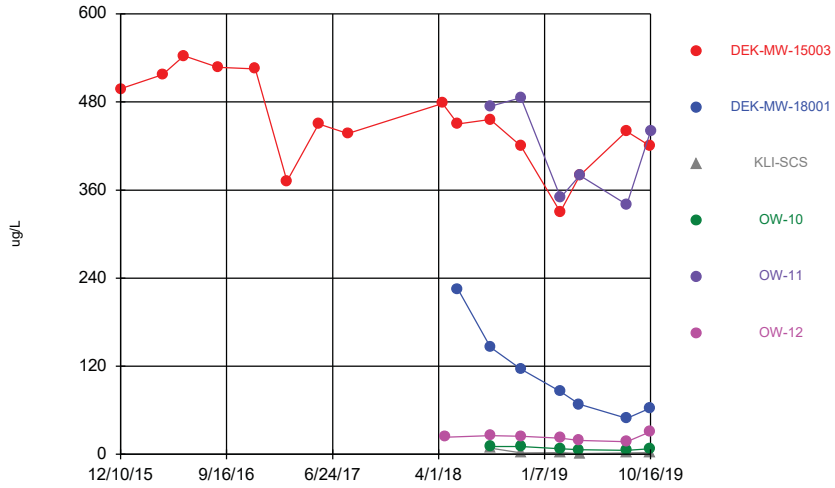
Arsenic, Total



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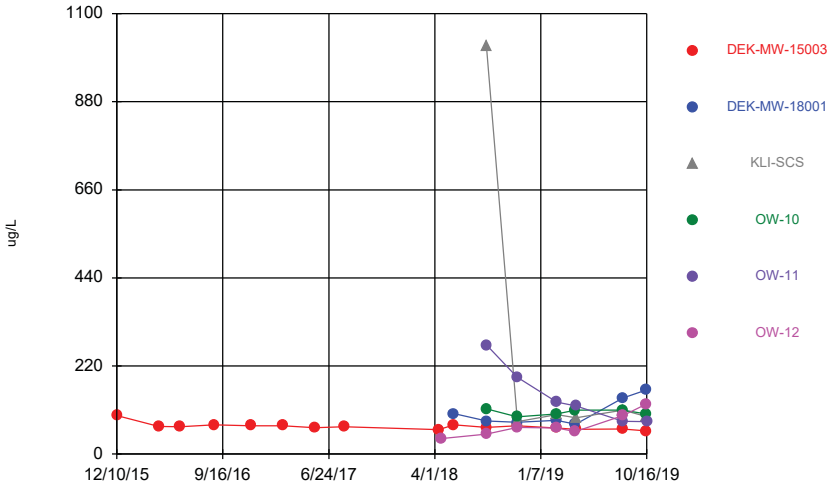
Barium, Total



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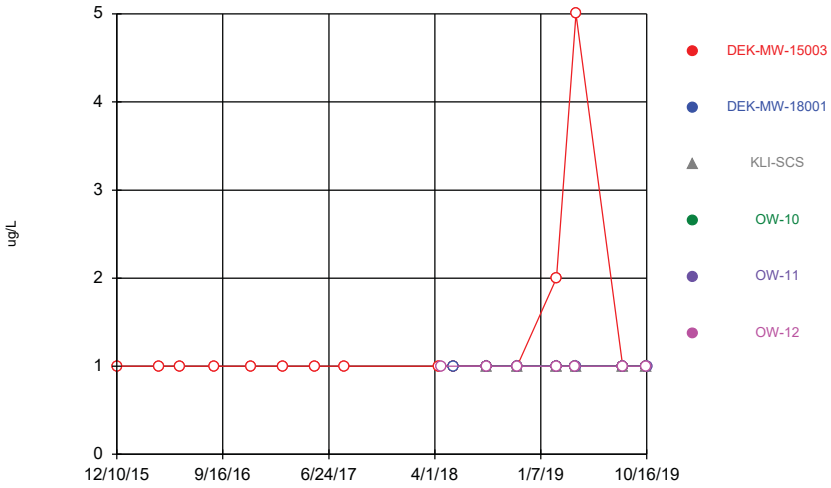
Sanitas™ v.9.6.24 Sanitas software licensed to Consumers Energy. EPA
Hollow symbols indicate censored values.

Beryllium, Total



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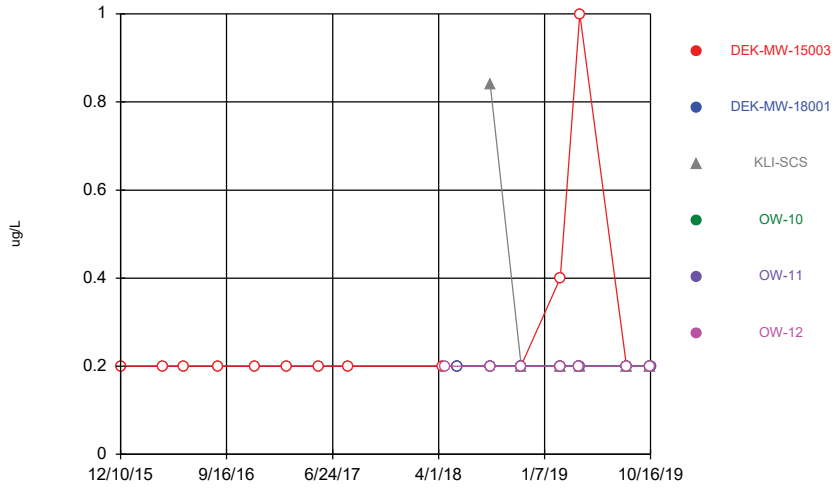
Sanitas™ v.9.6.24 Sanitas software licensed to Consumers Energy. EPA
Hollow symbols indicate censored values.

Cadmium, Total



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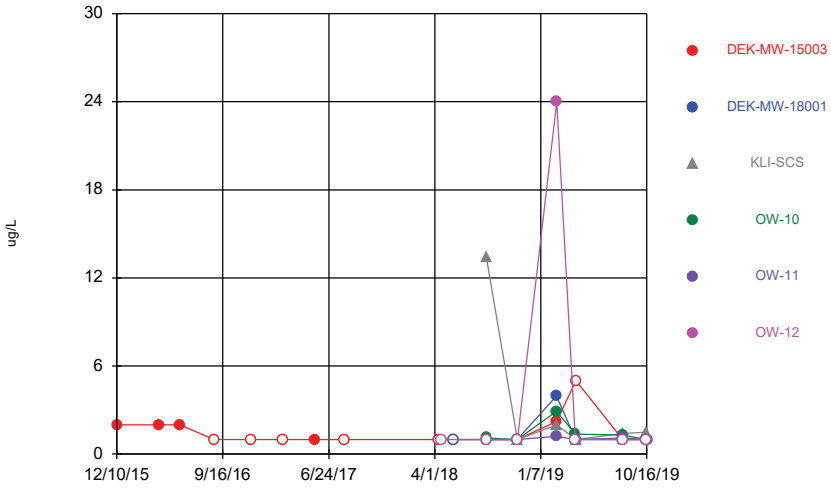
Sanitas™ v.9.6.24 Sanitas software licensed to Consumers Energy. EPA
Hollow symbols indicate censored values.

Chromium, Total



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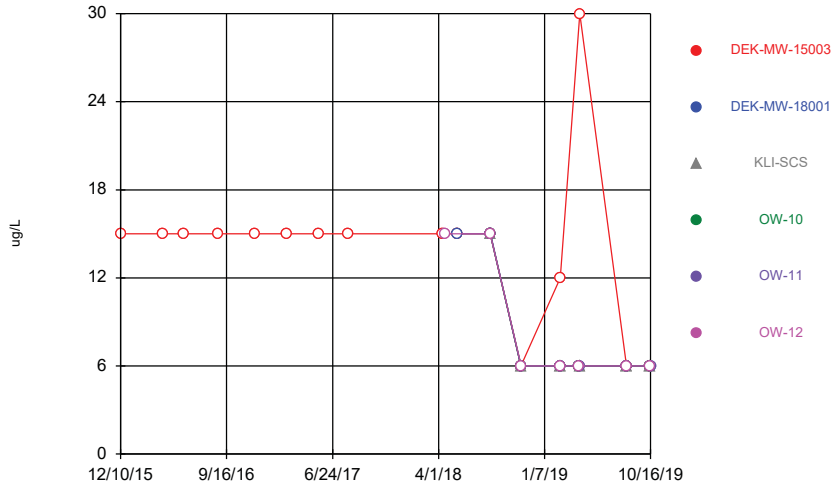
Sanitas™ v.9.6.24 Sanitas software licensed to Consumers Energy. EPA
Hollow symbols indicate censored values.

Cobalt, Total



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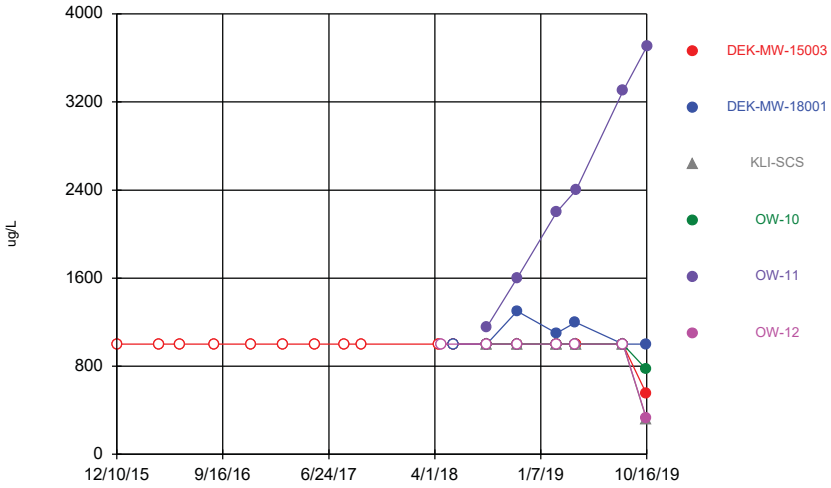
Hollow symbols indicate censored values.

Fluoride



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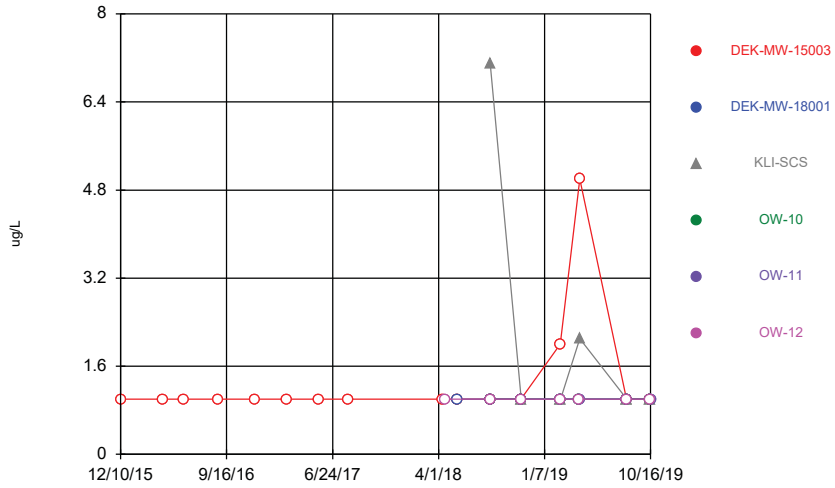
Lead, Total



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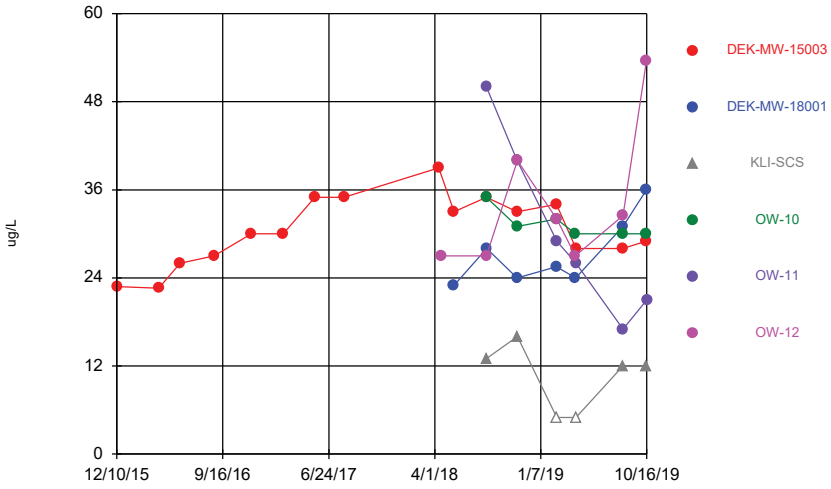
Lithium, Total



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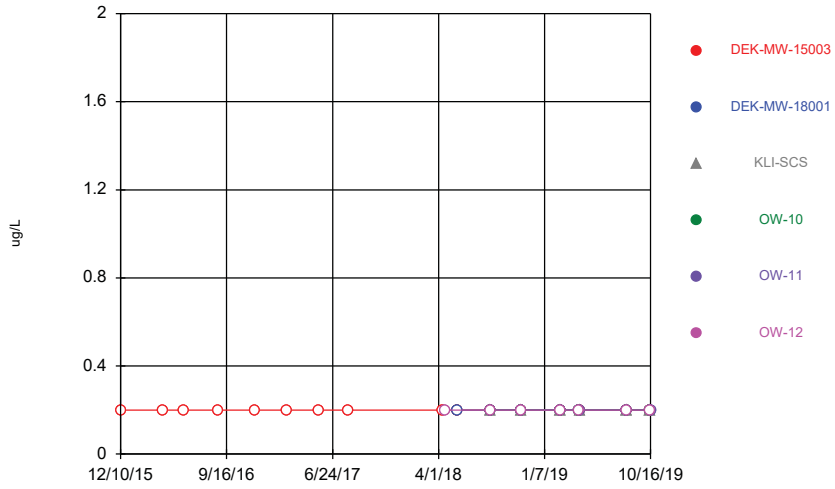
Mercury, Total



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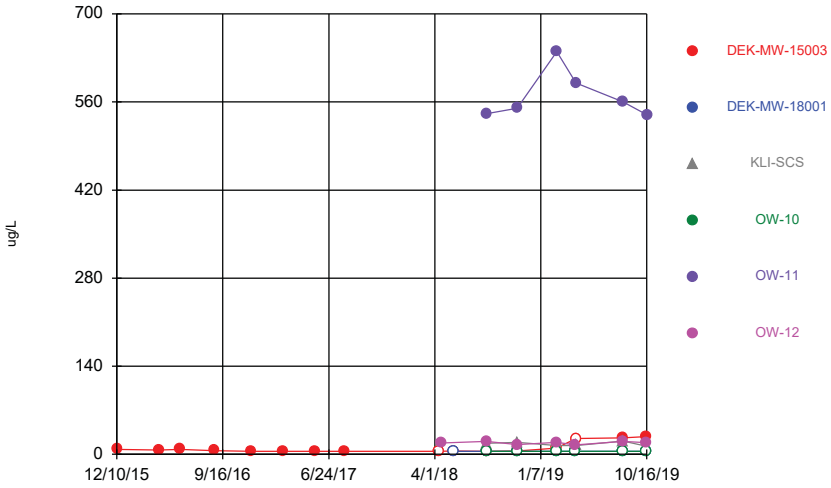
Hollow symbols indicate censored values.

Molybdenum, Total



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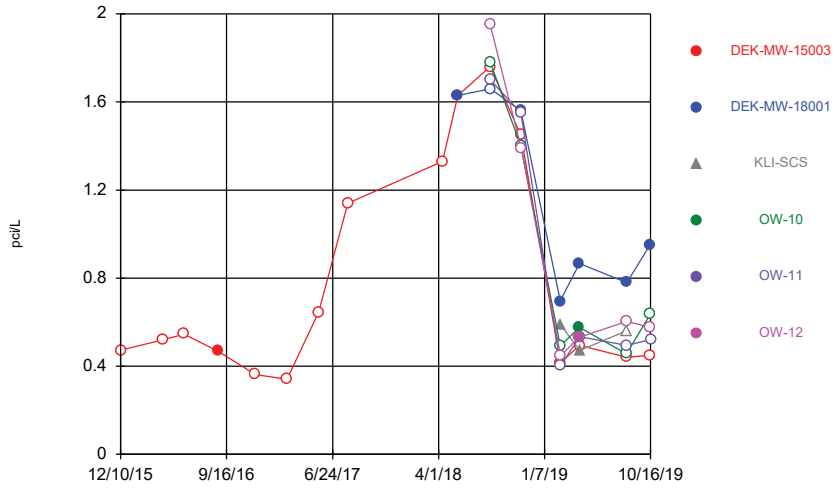
Radium-226/228



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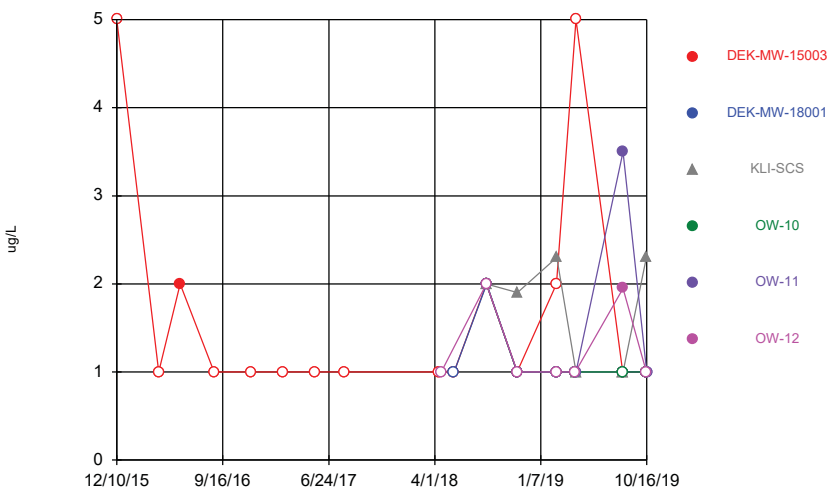
Selenium, Total



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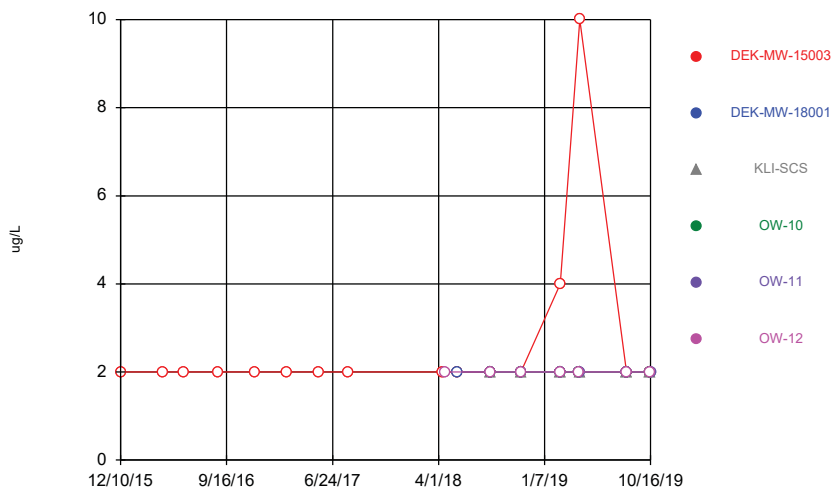
Hollow symbols indicate censored values.

Thallium, Total



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