2019 Annual Groundwater Monitoring and Corrective Action Report

DTE Electric Company
River Rouge Power Plant Bottom Ash Basin
Coal Combustion Residual Unit

1 Belanger Park Drive
River Rouge, Michigan

January 2020

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Prepared For
DTE Electric Company

Graham Crockford, C.P.G.
Senior Project Geologist

David B. McKenzie, P.E.
Senior Project Engineer

1540 Eisenhower Place, Ann Arbor, MI 48108 ● 734.971.7080 Phone ● 734.971.9022 Fax
www.TRCcompanies.com

Table of Contents

List of Tables

List of Figures

List of Appendices

Executive Summary

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. The CCR Rule, which became effective on October 19, 2015, applies to the DTE Electric Company (DTE Electric) River Rouge Power Plant (RRPP) Bottom Ash Basin (BAB) CCR unit. Pursuant to the CCR Rule, no later than January 31, 2018, and annually thereafter, the owner or operator of a CCR unit must prepare an annual groundwater monitoring and corrective action report for the CCR unit documenting the status of groundwater monitoring and corrective action for the preceding year in accordance with §257.90(e).

On behalf of DTE Electric, TRC Engineers Michigan, Inc., the engineering entity of TRC, has prepared this Annual Report for calendar year 2019 activities at the RRPP BAB CCR unit. Corrective action has been triggered and assessment monitoring is ongoing at the RRPP BAB CCR unit as specified in §257.95. Data that have been collected and evaluated in 2019 are presented in this report.

As documented in the January 31, 2018 *Annual Groundwater Monitoring Report for the River Rouge Power Plant*, covering calendar year 2017 activities, DTE Electric noted that boron, fluoride, and pH were observed within groundwater at downgradient monitoring well(s) with statistically significant increases (SSIs) above background limits. Therefore, DTE Electric initiated an assessment monitoring program for the RRPP BAB CCR unit pursuant to §257.95 of the CCR Rule that included sampling and analyzing groundwater within the groundwater monitoring system for all constituents listed in Appendix IV.

DTE Electric proactively constructed and has been operating a groundwater collection system since March 2, 2018 to mitigate any potential risk of migration of any water from the BAB. The installed collection system continues to control groundwater flow within the vicinity of the RRPP BAB CCR unit, and groundwater flow from the entire BAB perimeter is now directed inward toward the extraction wells. DTE Electric has continued to operate this groundwater collection system while proceeding with the prescribed steps per the CCR Rule to follow the assessment of corrective measures (ACM) process as described within this report.

As detailed in the *2018 Annual Groundwater Monitoring Report, DTE Electric Company, River Rouge Power Plant, Bottom Ash Basin Coal Combustion Residual Unit* dated January 2019 (2018 Annual Report), statistically significant groundwater concentrations were reported above the groundwater protection standards (GWPSs) for the Appendix IV constituents arsenic and lithium during the 2018 assessment monitoring events. DTE Electric proceeded with initiating an ACM per §257.96 by January 14, 2019, completed the ACM Report on April 15, 2019 and

completed a Semi-Annual Progress Report on the remedy selection and design on October 15, 2019. The preferred alternative in the ACM is to close the RRPP BAB by CCR removal with offsite CCR disposal and to address the CCR-affected groundwater by continuing to operate the already in-place interim groundwater collection system (see below).

If the groundwater extraction system is selected as part of the final remedy, the system will be operated until the risk of migration of CCR constituents from the RRPP BAB CCR unit to receptors is effectively mitigated and groundwater data demonstrate that groundwater concentrations of Appendix IV constituents are below the relevant GWPSs. A Federal CCR Rule - Notice of Alternative Closure per 40 CFR §257.103(b) was completed on December 16, 2019 setting the time frame for shutdown of the RRPP coal-fired boiler(s) in May 2020, cessation of use of the RRPP BAB for CCR management by approximately July 2020, and the initiation of RRPP BAB CCR unit closure by August 31, 2020.

Currently, DTE Electric is evaluating conceptual closure strategies for the River Rouge BAB, so that, in accordance with 40 CFR §257.101(a)(1), closure can be initiated 30-days after the last known receipt of waste. CCR removal and associated construction activities are anticipated to be completed within the timeframes specified in §257.103(b)(2). The development of BAB closure strategies will plan for necessary diversion of non-CCR wastewater and stormwater streams to and/or from the BAB and removal of BAB infrastructure so that the BAB may be effectively drained and residual CCR may be removed. Once engineering evaluations and initial design work for the BAB closure are completed, the final remedy for RRPP BAB source materials and for addressing affected groundwater will be formally selected per §257.97 at least 30-days after the public meeting required under §257.96(e) is held.

The statistical evaluation of the March 2019 and September 2019 Appendix IV groundwater data continue to show statistically significant groundwater concentrations above the GWPSs for arsenic and lithium at MW-16-01. There were no other results reported at statistically significant concentrations above the GWPSs for the remaining Appendix IV parameters for either 2019 semiannual assessment monitoring event.

DTE Electric continued to collect groundwater samples to define the nature and extent of the potential release of CCR per §257.95(g)(1) in 2019. Concentrations of lithium above the GWPS were observed in monitoring well MW-17-15. This monitoring well is located within the radius of influence of the groundwater extraction system. Concentrations of the Appendix IV parameters were below the GWPSs in other wells located around the perimeter of the RRPP BAB, delineating the extent of the potential CCR groundwater release to be within the capture zone of the groundwater extraction system that has been operational since March 2, 2018. Therefore, as the potential CCR constituents within groundwater are located entirely within the capture zone of the groundwater extraction system, as long as the groundwater extraction system is in

operation, there is no potential for affected groundwater to migrate off site. In addition, all of the land that overlies the potentially affected groundwater is owned by DTE Electric.

Per §257.96(b), DTE Electric will continue semiannual assessment monitoring as specified in §257.95 and annual nature and extent monitoring will continue for the RRPP BAB CCR unit per §257.95(g)(1) in 2020. In addition, the RRPP BAB closure will be initiated by August 31, 2020 as described above.

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. The CCR Rule, which became effective on October 19, 2015, applies to the DTE Electric Company (DTE Electric) River Rouge Power Plant (RRPP) Bottom Ash Basin (BAB). Pursuant to the CCR Rule, no later than January 31, 2018, and annually thereafter, the owner or operator of a CCR unit must prepare an annual groundwater monitoring and corrective action report for the CCR unit documenting the status of groundwater monitoring and corrective action for the preceding year in accordance with §257.90(e).

On behalf of DTE Electric, TRC Engineers Michigan, Inc., the engineering entity of TRC, has prepared this Annual Report for calendar year 2019 activities at the RRPP BAB CCR unit (2019 Annual Report). Corrective action has been triggered and assessment monitoring is ongoing at the RRPP BAB CCR unit as specified in §257.95. Data that have been collected and evaluated in 2019 are presented in this report.

1.1 Program Summary

As documented in the January 31, 2018 *Annual Groundwater Monitoring Report for the River Rouge Power Plant* (TRC, January 2018), covering calendar year 2017 activities, DTE Electric noted that boron, fluoride, and pH were observed within groundwater at downgradient monitoring well(s) with statistically significant increases (SSIs) above background limits. Therefore, DTE Electric initiated an assessment monitoring program for the RRPP BAB CCR unit pursuant to §257.95 of the CCR Rule that included sampling and analyzing groundwater within the groundwater monitoring system for all constituents listed in Appendix IV.

DTE Electric proactively constructed and has been operating a groundwater collection system since March 2, 2018 to mitigate any potential risk of migration of any water from the BAB. The installed collection system continues to control groundwater flow within the vicinity of the RRPP BAB CCR unit, and groundwater flow from the entire BAB perimeter is now directed inward toward the extraction wells. DTE Electric will continue to operate this groundwater collection system as the Company proceeds with the prescribed steps per the CCR Rule to follow the assessment of corrective measures process as described within this report.

As detailed in the *2018 Annual Groundwater Monitoring Report, DTE Electric Company, River Rouge Power Plant, Bottom Ash Basin Coal Combustion Residual Unit* dated January 2019 (2018 Annual Report), statistically significant groundwater concentrations were reported above the

groundwater protection standards (GWPSs) for Appendix IV constituents arsenic and lithium during the 2018 assessment monitoring events. According to §257.95(g)(3), in the event that the facility determines, pursuant to §257.93(h), that a result is reported above GWPSs for one or more of the Appendix IV constituents, the facility will, within 90 days of performing the statistical analysis, initiate an Assessment of Corrective Measures (ACM) to prevent further releases, to remediate the release, and to restore the affected area.

DTE Electric proceeded with initiating an ACM per §257.96 by January 14, 2019, completed the ACM Report on April 15, 2019 and completed a Semi-Annual Progress Report on the remedy selection and design on October 15, 2019 (TRC, April 2019 and October 2019, respectively). The preferred alternative in the ACM is to close the RRPP BAB by CCR removal with offsite CCR disposal and to address the CCR-affected groundwater by continuing to operate the already in-place interim groundwater collection system. If the groundwater extraction system is selected as part of the final remedy, the system will be operated until the risk of migration of CCR constituents from the RRPP BAB CCR unit to receptors is effectively mitigated and groundwater data demonstrate that groundwater concentrations of Appendix IV constituents are below the relevant GWPSs. A Federal CCR Rule - Notice of Alternative Closure per 40 CFR §257.103(b) was completed on December 16, 2019 setting the time frame for shut-down of the RRPP coal-fired boiler(s) in May 2020, cessation of use of the RRPP BAB for CCR management by approximately July 2020, and the initiation of RRPP BAB CCR unit closure by August 31, 2020 (TRC, December 2019).

Currently, DTE Electric is evaluating conceptual closure strategies for the River Rouge BAB, so that, in accordance with 40 CFR §257.101(a)(1), closure can be initiated 30-days after the last known receipt of waste. CCR removal and associated construction activities are anticipated to be completed within the timeframes specified in §257.103(b)(2). The development of BAB closure strategies will plan for necessary diversion of non-CCR wastewater and stormwater streams to and/or from the BAB and removal of BAB infrastructure so that the BAB may be effectively drained and residual CCR may be removed. Once engineering evaluations and initial design work for the BAB closure are completed, the final remedy for RRPP BAB source materials and for addressing affected groundwater will be formally selected per §257.97 at least 30-days after the public meeting required under §257.96(e) is held.

This 2019 Annual Report presents the monitoring results and the statistical evaluation of the assessment monitoring parameters (Appendix IV to Part 257 of the CCR Rule) for the March and September 2019 assessment groundwater monitoring events for the RRPP BAB CCR unit. Assessment monitoring for these events was performed in accordance with the *CCR Groundwater Monitoring and Quality Assurance Project Plan – DTE Electric Company River Rouge Power Plant Bottom Ash Basin* (the QAPP) (TRC, July 2016; revised August 2017) and statistically evaluated per the *Groundwater Statistical Evaluation Plan – DTE Electric Company River Rouge Power Plant*

Coal Combustion Residual Bottom Ash Basin (Stats Plan) (TRC, October 2017). During assessment monitoring, data are evaluated to identify Appendix IV constituents present at statistically significant levels exceeding a GWPS. In addition, nature and extent groundwater sampling data from existing monitoring wells around the BAB that was performed in September 2019 are presented.

1.2 Site Overview

The RRPP BAB is located at 1 Belanger Park Drive, within the City of River Rouge in Wayne County, Michigan. The RRPP, including the BAB CCR unit, was originally constructed in the early 1950s, just northeast of the DTE Electric RRPP. The power plant property is located at the confluence of the Rouge River and the Detroit River.

The RRPP BAB is a sedimentation basin that is an incised CCR surface impoundment. The impoundment is sheet-piled around the perimeters to approximately 30 feet below ground surface (ft bgs) into the native soil. The BAB is used for receiving sluiced bottom ash and other process flow effluent pumped from the power plant to the eastern end of the BAB. There is a sheet pile weir near the middle of the BAB that maintains the water elevation in the eastern portion to approximately 577.5 feet through gravity flow. The water in the western portion of the BAB is maintained at an elevation of no higher than 577 feet before being recirculated back to the RRPP and/or is discharged into the Detroit River in accordance with a National Pollution Discharge Elimination System (NPDES) permit.

1.3 Geology/Hydrogeology

The RRPP BAB CCR unit is located immediately adjacent to the Rouge River to the northeast near the intersection of the Rouge River and Detroit River (Figure 1). The RRPP CCR unit is underlain initially by approximately 10 feet of surficial fill of various composition (gravel, sand, silt and clay, brick and/or concrete fragments). The fill is partially saturated in some areas, but is not continuously saturated across the RRPP, does not represent a significant, usable source of water, and is, therefore, not an aquifer. An organic layer is often encountered beneath the surficial fill that is then underlain by a silt/clay-rich unit that ranges from 3 to about 8 feet thick in the area of the BAB. Beneath the silt/clay-rich unit, there is a saturated sand and gravel unit that often coarsens from sand to gravel with depth. This coarse-grained sand and gravel unit is present from as shallow as 15 ft bgs to as deep as 25.5 ft bgs. This same coarse-grained unit is observed in most of the historical boring logs across the RRPP and appears to be a relatively continuous unit across the RRPP. Based on this information, this coarse-grained sand and gravel unit represents the uppermost aquifer present at the RRPP BAB CCR unit.

The coarse-grained sand and gravel uppermost aquifer is underlain by a more than 60-foot-thick contiguous silty clay-rich deposit that serves as a natural lower confining hydraulic barrier that

isolates the uppermost aquifer from the underlying Dundee limestone that represents the next aquifer. There is no apparent hydraulic connection between the uppermost aquifer and the Dundee limestone aquifer, and the limestone aquifer is artesian.

Historically, a definitive groundwater flow direction to the northeast with an average gradient of 0.00067 foot/foot (using data from June 2016 through September 2017) within the uppermost aquifer was evident around the RRPP BAB CCR unit, with potential groundwater flow rates within the uppermost aquifer ranging from approximately 5.8 to 73 feet/year. Due to the installation and continuous operation of the eleven extraction wells within the groundwater extraction system since March 2, 2018, the current groundwater flow regime is significantly different from previous monitoring events. The series of eleven groundwater extraction wells surrounding the basin creates an inward gradient that extends to the edge of the Rouge River. The radius of influence extends beyond all CCR monitoring wells, with the exception of the upgradient monitoring well MW-17-07 that is a background well located more than 1,500 feet up hydraulic gradient of the RRPP BAB CCR unit. Additionally, there is an eastern groundwater flow component on the southeast edge of the site toward the Detroit River (from MW-17-07 to the Detroit River). The groundwater extraction system well layout is shown on Figure 2.

Section 2
Groundwater Monitoring

2.1 Monitoring Well Network

A groundwater monitoring system has been established for the RRPP BAB CCR unit as detailed in the *Groundwater Monitoring System Summary Report – DTE Electric Company River Rouge Power Plant Bottom Ash Basin Coal Combustion Residual Unit* (GWMS Report) (TRC, October 2017). The monitoring well network for the BAB CCR unit currently consists of five monitoring wells that are screened in the uppermost aquifer. The monitoring well locations are shown on Figure 2. Monitoring wells MW-17-06 and MW-17-07 are located south-southwest of the RRPP BAB and provide data on background groundwater quality that has not been affected by the CCR unit (total of two background wells). Monitoring wells MW-16-01 through MW-16-03 are located north-northeast, historically downgradient of the RRPP BAB CCR unit (total of three downgradient monitoring wells).

As shown on Figure 2, monitoring well MW-16-04S is used for water level measurements only. MW-16-04S had originally been installed as a potential background monitoring well; however, based on concentrations of several Appendix III parameters, the proximity of the well to the BAB and the hydrogeology of the area, monitoring well MW-16-04S does not appear to be representative of background groundwater conditions; therefore, this well was excluded from the background monitoring network. As such, in June 2017, two additional monitoring wells (MW-17-06 and MW-17-07) were installed in the uppermost aquifer further upgradient on the southwest side of the RRPP main building for use as background wells (Figure 2).

In addition, eleven groundwater recovery wells were installed as part of a groundwater extraction system (Figure 2) and additional monitoring wells were added to evaluate the groundwater extraction system groundwater capture (Figure 2) in 2018. Although the groundwater extraction system has changed groundwater flow significantly in the RRPP BAB CCR unit since beginning operation in early March 2018, the three compliance monitoring wells (MW-16-01 through MW-16-03) are appropriately positioned to evaluate groundwater quality in the vicinity of the RRPP BAB CCR unit. However, while the groundwater extraction system is operational, inward hydraulic gradients are maintained toward the extraction wells and the RRPP BAB CCR unit, and the monitoring wells (MW-16-01 through MW-16-03) are not immediately downgradient from the RRPP BAB CCR unit, rather they are on the upgradient edge of the groundwater capture zone on the downgradient side of the RRPP BAB CCR unit adjacent to the Rouge River (Figures 3 and 4).

2.2 Semiannual Assessment Groundwater Monitoring

Per §257.95(d), all wells in the CCR unit monitoring program must be sampled at least semiannually. One semiannual event must include analysis for all parameters from Appendix III and Appendix IV and one semiannual event may include analysis for all Appendix III indicator parameters and those Appendix IV parameters that were detected during prior sampling. In addition to the Appendix III and IV parameters, field parameters including pH, dissolved oxygen, oxidation reduction potential, specific conductivity, temperature, and turbidity were collected at each well. Samples were collected and analyzed in accordance with the QAPP.

2.2.1 Data Summary

The first semiannual groundwater assessment monitoring event for 2019 was performed on March 29, 2019 and the second semiannual groundwater assessment event was performed on September 26 and 27, 2019. Both events were performed by TRC personnel and samples were analyzed by Eurofins TestAmerica Laboratories, Inc. (TestAmerica) in accordance with the QAPP. Static water elevation data were collected at all monitoring well locations in addition to surface water measuring points MP-01 through MP-04 established along the Rouge River and Detroit River (Figure 2). Groundwater samples were collected from the two background monitoring wells and three downgradient monitoring wells for the Appendix III and detected Appendix IV parameters and field parameters. A summary of the groundwater data collected during both the March 2019 event and September 2019 event is provided on Table 1 (static groundwater elevation data), Table 2 (field data), and Table 3 (analytical results).

2.2.2 Data Quality Review

Data from each round were evaluated for completeness, overall quality and usability, method-specified sample holding times, precision and accuracy, and potential sample contamination. The data were found to be complete and usable for the purposes of the CCR monitoring program. Data quality reviews are summarized in Appendix A.

2.2.3 Groundwater Flow Rate and Direction

Groundwater elevation data collected during the March and September 2019 sampling events show that groundwater within the uppermost aquifer in the vicinity of the RRPP BAB is being captured by the recently installed groundwater extraction well system. Similar to the groundwater sampling events reported in the 2018 annual report (TRC, January 2019), the series of eleven extraction wells surrounding the basin creates an inward gradient that extends to the edge of the river. The radius of influence extends beyond all CCR monitoring wells with the exception of MW-17-07 that is a background well located more than 1,500 feet up hydraulic gradient of the RRPP BAB CCR unit.

Additionally, there is an eastern groundwater flow component on the southeast edge of the site toward the Detroit River (from MW-17-07 to the Detroit River). Groundwater elevations measured across the Site during the March and September 2019 sampling events are provided on Table 1 and were used to construct groundwater contour maps (Figures 3 and 4, respectively).

The current groundwater flow is similar to previous monitoring events. The average hydraulic gradients throughout the RRPP BAB CCR unit during the March and September 2019 events show a hydraulic gradient of approximately 0.008 ft/ft and 0.006 ft/ft, respectively. The gradients were calculated using the same well pairs as above (MW-17-06/MW-16-04S and MW-17-07/MW-17-06). Using the aforementioned low hydraulic conductivity of 9.5 feet/day and high hydraulic conductivity of 120 feet/day, and an assumed effective porosity of 0.4, the estimated seepage velocity ranges from approximately 0.19 feet/day (approximately 69 feet/year) to approximately 2.4 feet/day (approximately 869 feet/year) for the March 2019 event and approximately 0.14 feet/day (approximately 51 feet/year) to approximately 1.8 feet/day (approximately 639 feet/year) for the September 2019 event.

Section 3
Statistical Evaluation

Assessment monitoring is continuing at the RRPP BAB CCR unit while corrective measures are further evaluated in accordance with §257.96 and §257.97 as outlined in the ACM. The following section summarizes the statistical approach applied to assess the 2019 groundwater data in accordance with the assessment monitoring program. The statistical evaluation details are provided in Appendix B (Appendix IV Assessment Monitoring Statistical Evaluation – March 2019 Data) and Appendix C (Appendix IV Assessment Monitoring Statistical Evaluation – September 2019 Data).

3.1 Establishing Groundwater Protection Standards

The Appendix IV GWPSs are used to determine whether groundwater has been impacted from the RRPP BAB CCR unit by statistically comparing concentrations in the assessment monitoring wells to their respective GWPS for each Appendix IV parameter. In accordance with §257.95(h) and the Stats Plan, GWPSs were established for the Appendix IV parameters following the preliminary assessment monitoring event using nine rounds of data collected from the background monitoring wells MW-17-06 and MW-17-07 (July 2017 through April 2018). The calculation of the GWPSs is documented in the *Assessment Monitoring Data Summary and Statistical Evaluation* (Initial Assessment Monitoring Statistical Evaluation Memo) (TRC, October 2018a). The GWPS is established as the higher of the USEPA Maximum Contaminant Level (MCL) or statistically derived background level for constituents with MCLs and the higher of the USEPA Regional Screening Levels (RSLs) or background level for constituents with RSLs.

3.2 Data Comparison to Groundwater Protection Standards – First Semiannual Event (March 2019)

Consistent with the *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance* (Unified Guidance) (USEPA, 2009), the preferred method for comparisons to a fixed standard are confidence limits. An exceedance of the standard occurs when the 99 percent lower confidence level of the downgradient data exceeds the GWPS. Confidence intervals were established per the statistical methods detailed in the *Appendix IV Assessment Monitoring Statistical Evaluation for March 2019* technical memorandum provided in Appendix B (TRC, January 2020a).

For each detected constituent, the concentrations for each well were first compared directly to the GWPS. Parameter-well combinations that included a direct exceedance of the GWPS were retained for further statistical analysis using confidence limits as detailed in the Appendix B

technical memorandum. The calculated upper and lower confidence limits and comparison of the lower confidence limits to the GWPSs are provided in Table 4 for the March 2019 event.

The statistical evaluation of the March 2019 Appendix IV parameters shows continued statistical exceedances of the GWPSs for:

- Arsenic at MW-16-01; and
- Lithium at MW-16-01.

No other constituents were observed at statistically significant levels exceeding the Appendix IV GWPSs during the March 2019 assessment monitoring event.

3.3 Data Comparison to Groundwater Protection Standards – Second Semiannual Event (September 2019)

Statistical analysis for the second semiannual monitoring event was performed using the same approach as the initial assessment monitoring statistical evaluation as discussed in the *Appendix IV Assessment Monitoring Statistical Evaluation for September 2019* technical memorandum provided in Appendix C (TRC, January 2020b). The calculated upper and lower confidence limits and comparison of the lower confidence limits to the GWPSs for the September 2019 event are provided in Table 5.

The statistical evaluation of the September 2019 Appendix IV parameters shows continued results above GWPSs for:

- Arsenic at MW-16-01; and
- Lithium at MW-16-01.

No other constituents were observed at statistically significant levels exceeding the Appendix IV GWPSs during the September 2019 assessment monitoring event.

Section 4
Nature and Extent Groundwater Evaluation

4.1 Nature and Extent Groundwater Sampling

Per §257.95(g)(1), in the event that the facility determines, pursuant to §257.93(h), that there is a statistically significant exceedance of the GWPSs for one or more of the Appendix IV constituents, the facility must characterize the nature and extent of the release of CCR as well as any site conditions that may affect the remedy selected. As such, nature and extent groundwater sampling was completed on September 26 and 27, 2019, by TRC personnel from existing CCR network monitoring wells and the presumptive remedy monitoring wells installed in 2018.

DTE collected groundwater elevation data at all site monitoring wells shown on Figure 4. In addition, DTE collected groundwater samples at monitoring wells MW-16-04S, MW-17-05, MW-17-13 through MW-17-15, MW-17-18, and MW-17-20. Field parameters were stabilized at each monitoring well prior to collecting groundwater samples. Field parameters are summarized in Table 2. Groundwater samples were analyzed by TestAmerica for the Appendix III and detected Appendix IV parameters. A summary of the analytical groundwater data collected during the September 2019 nature and extent sampling event is provided on Table 6.

Concentrations of lithium above the GWPS were observed in monitoring well MW-17-15. This monitoring well is located within the radius of influence of the groundwater extraction system as shown on Figure 4. Concentrations of the Appendix IV parameters were below the GWPSs in other wells located farther away from the RRPP BAB CCR unit (e.g., MW-16-04S, MW-17-05, MW-17-14, MW-17-18 and MW-17-20), delineating the extent of the potential CCR groundwater release to be within the capture zone of the groundwater extraction system (Figures 3 and 4) that has been operational since March 2, 2018. Therefore, as long as the groundwater extraction system is in operation, there is no potential for affected groundwater to migrate off site. In addition, all of the land that overlies the potentially affected groundwater is owned by DTE Electric.

Section 5
Conclusions and Recommendations

In 2017, one or more Appendix III constituents were present in one or more downgradient well(s) with SSIs above background limits (TRC, January 2018). Therefore, in April 2018, DTE Electric initiated an assessment monitoring program for the RRPP BAB CCR unit pursuant to §257.95 of the CCR Rule that included sampling and analyzing groundwater within the groundwater monitoring system for all constituents listed in Appendix IV.

In addition, in 2018, an interim presumptive remedy groundwater collection system was installed and began operation on March 2, 2018 and continues to operate and maintain hydraulic control around the RRPP BAB to mitigate any risk of migration from the RRPP BAB to groundwater. This system effectively captures groundwater in the vicinity of the RRPP BAB CCR unit and eliminates the potential for Appendix III and Appendix IV parameters to migrate off-site from the RRPP BAB CCR unit as presented in Section 4 and shown on Figures 3 and 4.

In 2018, statistically significant groundwater concentrations were reported above the GWPSs for Appendix IV constituents (arsenic and lithium) during the 2018 assessment monitoring events, prompting DTE Electric to proceed with initiating and completing the ACM in 2019. The preferred alternative in the ACM was to close the RRPP BAB by CCR removal with offsite CCR disposal and to address the CCR-affected groundwater by continuing to operate the already in place interim groundwater collection system, however, the final remedy is still being evaluated. In 2019, the semiannual assessment monitoring and annual nature and extent groundwater sampling continued, showing that there are no new constituents observed at statistically significant levels exceeding the Appendix IV GWPSs and the extent of the potential release of CCR continues to be well within the radius of influence of the existing groundwater extraction system during the 2019 reporting period.

If the groundwater collection system is selected as part of the final remedy, the system will be operated until the risk of migration of CCR constituents from the RRPP BAB CCR unit to receptors is effectively mitigated and groundwater data demonstrate that groundwater concentrations of Appendix IV constituents are below the relevant GWPSs. A Federal CCR - Rule Notice of Alternative Closure Per 40 CFR §257.103(b) was prepared on December 16, 2019 setting the time frame for shutdown of the RRPP coal-fired boiler(s) in May 2020, cessation of use of the RRPP BAB for CCR management by approximately July 2020, and the initiation of RRPP BAB CCR unit closure by August 31, 2020.

Currently, DTE Electric is evaluating conceptual closure strategies for the River Rouge BAB, so that, in accordance with 40 CFR §257.101(a)(1), closure can be initiated 30-days after the last known receipt of waste. CCR removal and associated construction activities are anticipated to

be completed within the timeframes specified in §257.103(b)(2). The development of BAB closure strategies will consider necessary diversion of non-CCR wastewater and stormwater streams to and/or from the BAB and removal of BAB infrastructure so that the BAB may be effectively drained and residual CCR may be removed. Once engineering evaluations and initial design work for the BAB closure are completed, the final remedy for RRPP BAB source materials and for addressing affected groundwater will be formally selected per §257.97 at least 30-days after the public meeting required under §257.96(e) is held.

Per §257.96(b), DTE Electric will continue semiannual assessment monitoring as specified in §257.95 and annual nature and extent monitoring will continue for the RRPP BAB CCR unit per §257.95(g)(1) in 2020. In addition, the RRPP BAB closure will be initiated by August 31, 2020 as described above.

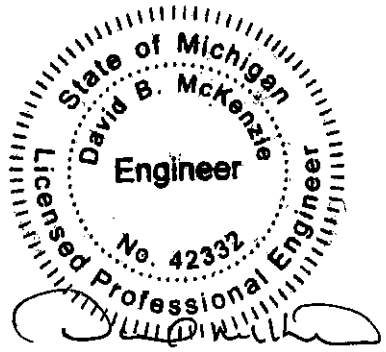
Section 6
Groundwater Monitoring Report Certification

The U.S. EPA's Disposal of Coal Combustion Residuals from Electric Utilities Final Rule Title 40 CFR Part 257 §257.90(e) requires that the owner or operator of an existing CCR unit prepare an annual groundwater monitoring and corrective action report.

Annual Groundwater Monitoring Report Certification
River Rouge Power Plant Bottom Ash Basin
River Rouge, Michigan

CERTIFICATION

I hereby certify that the annual groundwater and corrective action report presented within this document for the RRPP BAB CCR unit has been prepared to meet the requirements of Title 40 CFR §257.90(e) 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 §257.90(e).

Name: David B. McKenzie, P.E.	Expiration Date: October 31, 2021	 Stamp
Company: TRC Engineers Michigan, Inc.	Date: January 30, 2020	

Section 7
References

TRC Environmental Corporation. August 2016; Revised March and August 2017. CCR Groundwater Monitoring and Quality Assurance Project Plan – DTE Electric Company River Rouge Power Plant Bottom Ash Basin, 1 Belanger Park Drive, River Rouge, Michigan. Prepared for DTE Electric Company.

TRC Environmental Corporation. October 2017. Groundwater Monitoring System Summary Report – DTE Electric Company River Rouge Power Plant Bottom Ash Basin Coal Combustion Residual Unit, 1 Belanger Park Drive, River Rouge, Michigan. Prepared for DTE Electric Company.

TRC Environmental Corporation. October 2017; Revised December 2017. Groundwater Statistical Evaluation Plan – River Rouge Power Plant Coal Combustion Residual Bottom Ash Basin, 1 Belanger Park Drive, River Rouge, Michigan. Prepared for DTE Electric Company.

TRC Environmental Corporation. October 15, 2018(a). Assessment Monitoring Data Summary and Statistical Evaluation, DTE Electric Company, River Rouge Power Plant Bottom Ash Basin CCR Unit, River Rouge, Michigan, letter report prepared for DTE Electric Company.

TRC Environmental Corporation. October 15, 2018(b). Appendix IV Assessment Monitoring Statistical Evaluation, DTE Electric Company, River Rouge Power Plant Bottom Ash Basin Coal Combustion Residual Unit, technical memorandum prepared for DTE Electric Company.

TRC Environmental Corporation. January 31, 2019. October 2018 Appendix IV Assessment Monitoring Statistical Evaluation, DTE Electric Company, River Rouge Power Plant, Bottom Ash Basin Coal Combustion Residual Unit, technical memorandum prepared for DTE Electric Company.

TRC Environmental Corporation. January 2018. Annual Groundwater Monitoring Report, DTE Electric Company, River Rouge Power Plant, Bottom Ash Basin Coal Combustion Residual Unit, prepared for DTE Electric Company. TRC Environmental Corporation. January 2019. 2018 Annual Groundwater Monitoring Report, DTE Electric Company, River Rouge Power Plant, Bottom Ash Basin Coal Combustion Residual Unit, prepared for DTE Electric Company.

TRC Environmental Corporation. April 15, 2019. Assessment of Corrective Measures Report, DTE Electric Company, River Rouge Power Plant, Bottom Ash Basin Coal Combustion Residual Unit, prepared for DTE Electric Company.

TRC Environmental Corporation. October 15, 2019. Semi-Annual Progress Report – Remedy Selection and Design, DTE Electric Company, River Rouge Power Plant, Bottom Ash Basin Coal Combustion Residual Unit, prepared for DTE Electric Company.

TRC Environmental Corporation. December 16, 2019. Federal CCR Rule – Notice of Alternative Closure Per 40CFR 257.103(b) Letter, DTE Electric Company, River Rouge Power Plant, Bottom Ash Basin Coal Combustion Residual Unit, prepared for DTE Electric Company.

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

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).

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

Tables

Table 1
Summary of Nature and Extent Well Groundwater Elevation Data – March 2019 and September 2019
River Rouge Power Plant Bottom Ash Basins – RCRA CCR Monitoring Program
River Rouge, Michigan

Well ID	Date Installed	Reference Elevation	Geologic Unit of Screened Interval	Screened Interval Elevation	3/29/2019		9/26/2019	
					Depth to Water	Groundwater Elevation	Depth to Water	Groundwater Elevation
				ft	ft BTOC	ft	ft BTOC	ft
MP-01	6/23/2016	579.25(1)	NA	NA	2.30	576.95	2.30	576.95
MP-02	6/23/2016	579.15(1)	NA	NA	4.16	574.99	NM	NM
MP-03	6/20/2017	578.42(1)	NA	NA	3.30	575.12	2.53	575.89
MP-04	6/20/2017	579.17(1)	NA	NA	3.98	575.19	3.63	575.54
MW-16-01	6/13/2016	583.02	Sand/Silty Clay/Gravel	562.0 to 557.0	15.60	567.42	13.58	569.44
MW-16-02	6/20/2017	582.79	Silty Sand/Sand/Clay/Gravel	561.4 to 556.4	12.21	570.58	10.45	572.34
MW-16-03	6/10/2016	582.75	Sand with Gravel	561.4 to 556.4	15.05	567.70	11.70	571.05
MW-16-04S	3/17/2016	582.41	Sand and Gravel	561.2 to 556.2	16.90	565.51	14.25	568.16
MW-17-01	6/7/2017	578.47	Sand/Silty Sand	558.0 to 563.0	2.83	575.64	3.98	574.49
MW-17-02	6/7/2017	581.24	Sand	553.8 to 558.8	6.25	574.99	7.03	574.21
MW-17-03	6/8/2017	580.20	Sand/Gravel with Sand/Clay	552.5 to 557.5	5.30	574.90	5.41	574.79
MW-17-04	6/8/2017	578.01	Sand	553.5 to 558.5	2.98	575.03	2.60	575.41
MW-17-05	6/9/2017	581.61	Sand/Silty Sand with Gravel	553.6 to 558.6	13.31	568.30	10.31	571.30
MW-17-06	6/7/2017	583.01	Silty Sand/Gravel with Sand	559.9 to 554.9	8.95	574.06	8.44	574.57
MW-17-07	6/14/2017	583.05	Silt with Sand/Clay	564.0 to 559.0	6.38	576.67	6.78(2)	576.27
MW-17-08	6/12/2017	580.52	Clay/Sand/Gravel	553.0 to 558.0	6.40	574.12	5.41	575.11
MW-17-09	6/13/2017	581.05	Clay/Sand/Gravel with Sand	553.6 to 558.6	5.88	575.17	5.38	575.67
MW-17-10	6/13/2017	581.41	Silty Sand/Clay/Sand	555.7 to 560.7	5.55	575.86	5.63	575.78
MW-17-12	12/12/2017	580.51	Silty Sand/Gravel with Sand	555.5 to 560.5	11.30	569.21	9.21	571.30
MW-17-13	12/6/2017	578.90	Silty Sand/Clay/Gravel with Sand	555.9 to 560.9	10.71	568.19	8.64	570.26
MW-17-14	12/7/2017	579.35	Clay/Gravel with Sand	554.9 to 559.9	12.31	567.04	10.26(2)	569.09
MW-17-15	12/8/2017	579.75	Silty Sand/Clay/Gravel with Sand	556.0 to 561.0	12.33	567.42	10.18	569.57
MW-17-16	12/7/2017	579.73	Sand with Silt/Clay with Silt/Gravel with Sand	558.2 to 567.2	8.22	571.51	8.70	571.03
MW-17-17	12/11/2017	579.35	Silty Sand/Sand with Gravel	557.8 to 562.8	10.51	568.84	7.76	571.59
MW-17-18	12/8/2017	579.00	Sand and Clay	557.7 to 562.7	9.70	569.30	7.19	571.81
MW-17-19	12/11/2017	577.99	Sand and Clay	551.4 to 556.4	5.51	572.48	4.10	573.89
MW-17-20	12/12/2017	579.40	Clay/Sand/Gravel with Sand	555.1 to 560.1	9.28	570.12	7.30	572.10

Notes:

Elevations are reported in feet relative to the North American Vertical Datum of 1988.

ft BTOC - feet below top of casing

NA - not applicable

NM - not measured

1) Elevation represents the point of reference used to collect surface water level measurements.

(2) Depth to water collected on September 27, 2019.

Table 2
Summary of Field Data – March 2019 and September 2019
River Rouge Power Plant Bottom Ash Basins – RCRA CCR Monitoring Program
River Rouge, Michigan

Sample Location	Sample Date	Dissolved Oxygen (mg/L)	Oxidation Reduction Potential (mV)	pH (SU)	Specific Conductivity (umhos/cm)	Temperature (deg C)	Turbidity (NTU)
Background							
MW-17-06	3/29/2019	0.21	-41.9	6.7	3,289	13.33	32.30
	9/26/2019	0.11	35.3	6.7	3,310	17.36	14.60
MW-17-07	3/29/2019	0.06	-29.3	6.7	6,962	11.96	13.90
	9/27/2019	0.09	37.8	6.7	7,715	15.88	10.02
Downgradient							
MW-16-01	3/29/2019	0.11	-64.9	7.1	442	11.67	2.55
	9/26/2019	0.18	-6.2	7.4	522	15.12	4.99
MW-16-02	3/29/2019	0.14	-21.9	7.2	532	9.52	2.24
	9/26/2019	0.11	23.2	7.4	412	16.11	1.96
MW-16-03	3/29/2019	0.13	33.1	7.4	572	6.42	2.21
	9/25/2019	0.17	13.6	7.4	390	18.91	1.57
Nature and Extent							
MW-16-04S	9/26/2019	0.13	12.7	7.1	2,243	13.45	1.85
MW-17-05	9/27/2019	0.12	10.3	7.3	588	12.93	1.75
MW-17-08	9/27/2019	0.12	20.0	7.3	754	15.74	1.42
MW-17-12	9/27/2019	0.10	37.3	6.6	3,825	16.10	3.75
MW-17-13	9/26/2019	0.13	33.9	7.0	1,054	15.32	2.51
MW-17-14	9/27/2019	0.14	5.8	7.2	599	13.67	1.62
MW-17-15	9/26/2019	0.14	22.6	6.9	1,620	14.98	2.43
MW-17-18	9/27/2019	0.13	25.3	6.8	1,852	14.89	1.75
MW-17-19	9/27/2019	0.11	-1.2	7.1	2,468	15.06	4.06
MW-17-20	9/26/2019	0.15	14.2	6.8	1,529	15.17	4.81

Notes:

mg/L - milligrams per liter.

mV - milliVolt.

SU - standard unit.

umhos/cm - micro-mhos per centimeter.

deg C - degrees celcius.

NTU - nephelometric turbidity units.

Table 3
Summary of Groundwater Sampling Results (Analytical): March 2019 and September 2019
River Rouge Power Plant Bottom Ash Basin – RCRA CCR Monitoring Program
River Rouge, Michigan

					Sample Location:	**MW-17-06**		**MW-17-07**		**MW-16-01**		**MW-16-02**		**MW-16-03**	
					Sample Date:	3/29/2019	9/26/2019	3/29/2019	9/27/2019	3/29/2019	9/26/2019	3/29/2019	9/26/2019	3/29/2019	9/26/2019
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS	Background				downgradient					
Appendix III															
Boron	ug/L	NC	NA	NA	NA	370	390	570	610	1,900	1,500	610	610	88	160
Calcium	ug/L	NC	NA	NA	NA	300,000	290,000	350,000	370,000	60,000	66,000	64,000	48,000	58,000	45,000
Chloride	mg/L	250*	NA	NA	NA	780	700	2,300	2,200	43	59	84	37	130	30
Fluoride	mg/L	4	NA	NA	NA	0.40	0.39	0.44	0.42	2.2	2.0	0.63	0.74	0.18	0.39
pH, Field	su	6.5 - 8.5*	NA	NA	NA	6.7	6.7	6.7	6.7	7.1	7.4	7.2	7.4	7.4	7.4
Sulfate	mg/L	250*	NA	NA	NA	530	550	1200	1,200	31	16	8.5	1.7	8.4	2.1
Total Dissolved Solids	mg/L	500*	NA	NA	NA	2,300	2,500	5,000	5,300	320	390	400	270	450	230
Appendix IV															
Antimony	ug/L	6	NA	2.0	6	< 2.0	--	< 2.0	--	< 2.0	--	< 2.0	--	< 2.0	--
Arsenic	ug/L	10	NA	32	**32**	15	12	18	21	**170**	**140**	< 5.0	< 5.0	< 5.0	< 5.0
Barium	ug/L	2,000	NA	150	2,000	130	110	30	33	110	120	34	23	25	19
Beryllium	ug/L	4	NA	1.0	4	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.4	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	5	NA	1.0	5	< 1.0	--	< 1.0	--	< 1.0	--	< 1.0	--	< 1.0	--
Chromium	ug/L	100	NA	2.0	100	< 2.0	--	< 2.0	--	< 2.0	--	< 2.0	--	< 2.0	--
Cobalt	ug/L	NC	6	23	23	< 1.0	< 1.0	9.0	8.6	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Fluoride	mg/L	4	NA	1.3	4	0.40	0.39	0.44	0.42	2.2	2.0	0.63	0.74	0.18	0.39
Lead	ug/L	NC	15	1.0	15	< 1.0	--	< 1.0	--	< 1.0	--	< 1.0	--	< 1.0	--
Lithium	ug/L	NC	40	34	**40**	23	20	31	27	**62**	**52**	21	18	< 8.0	< 8.0
Mercury	ug/L	2	NA	0.20	2	< 0.20	--	< 0.20	--	< 0.20	--	< 0.20	--	< 0.20	--
Molybdenum	ug/L	NC	100	22	100	8.3	7.5	14	13	11	6.5	< 5.0	< 5.0	< 5.0	< 5.0
Radium-226	pCi/L	NC	NA	NA	NA	1.03	0.975	0.177	0.402	0.254	0.374	0.0917	0.231	0.111	0.243
Radium-228	pCi/L	NC	NA	NA	NA	1.25	1.52	< 0.515	< 0.501	0.412	< 0.422	< 0.518	< 0.435	< 0.348	< 0.415
Radium-226/228	pCi/L	5	NA	2.83	5	2.28	2.5	0.661	0.582	0.666	0.558	< 0.518	0.549	< 0.348	0.623
Selenium	ug/L	50	NA	5.0	50	< 5.0	--	< 5.0	--	< 5.0	--	< 5.0	--	< 5.0	--
Thallium	ug/L	2	NA	1.0	2	< 1.0	--	< 1.0	--	< 1.0	--	< 1.0	--	< 1.0	--

Notes:

ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units; pH is a field parameter.
pCi/L - picocuries per liter.
NA - not applicable.
NC - no criteria.
-- - not analyzed.
MCL - Maximum Contaminant Level, EPA Drinking Water Standards and Health Advisories, April, 2012.
RSL - Regional Screening Level from 83 FR 36435.
UTL - Upper Tolerance Limit (95%) of the background data set.
GWPS - Groundwater Protection Standard. GWPS is the higher of the MCL/RSL and UTL.
* - Secondary Maximum Contaminant Level (SMCL), EPA Secondary Drinking Water Regulations (SDWR) April, 2012.
Bold value indicates an exceedance of the GWPS. Data from downgradient monitoring wells are screened against the GWPS for evaluation purposes only. Confidence intervals will be used to determine compliance per the CCR rules.

Table 4
Summary of Groundwater Protection Standard Exceedances - March 2019
River Rouge Power Plant Bottom Ash Basin – RCRA CCR Monitoring Program
River Rouge, Michigan

Appendix IV	Units	GWPS	MW-16-01		MW-16-02		MW-16-03	
			LCL	UCL	LCL	UCL	LCL	UCL
Arsenic	ug/L	32	150	180	NA	NA	NA	NA
Beryllium	ug/L	4	NA	NA	1.0	4.5	NA	NA
Lithium	ug/L	40	41	69	6.8	54	-4.4	21

Notes:

ug/L - micrograms per liter.

NA - not applicable.

GWPS - Groundwater Protection Standard.

UCL - Upper Confidence Limit (99%) of the downgradient data set.

LCL - Lower Confidence Limit (99%) of the downgradient data set.

Indicates a statistically significant exceedance of the GWPS. An exceedance occurs when the LCL exceeds the GWPS.

Table 5
Summary of Groundwater Protection Standard Exceedances - September 2019
River Rouge Power Plant Bottom Ash Basin – RCRA CCR Monitoring Program
River Rouge, Michigan

Appendix IV	Units	GWPS	MW-16-01		MW-16-02		MW-16-03	
			LCL	UCL	LCL	UCL	LCL	UCL
Arsenic	ug/L	32	140	180	NA	NA	NA	NA
Beryllium	ug/L	4	NA	NA	1.0	4.5	NA	NA
Lithium	ug/L	40	45	64	10	45	8	15

Notes:

ug/L - micrograms per liter.

NA - not applicable.

GWPS - Groundwater Protection Standard.

UCL - Upper Confidence Limit (99%) of the downgradient data set.

LCL - Lower Confidence Limit (99%) of the downgradient data set.

Indicates a statistically significant exceedance of the GWPS. An exceedance occurs when the LCL exceeds the GWPS.

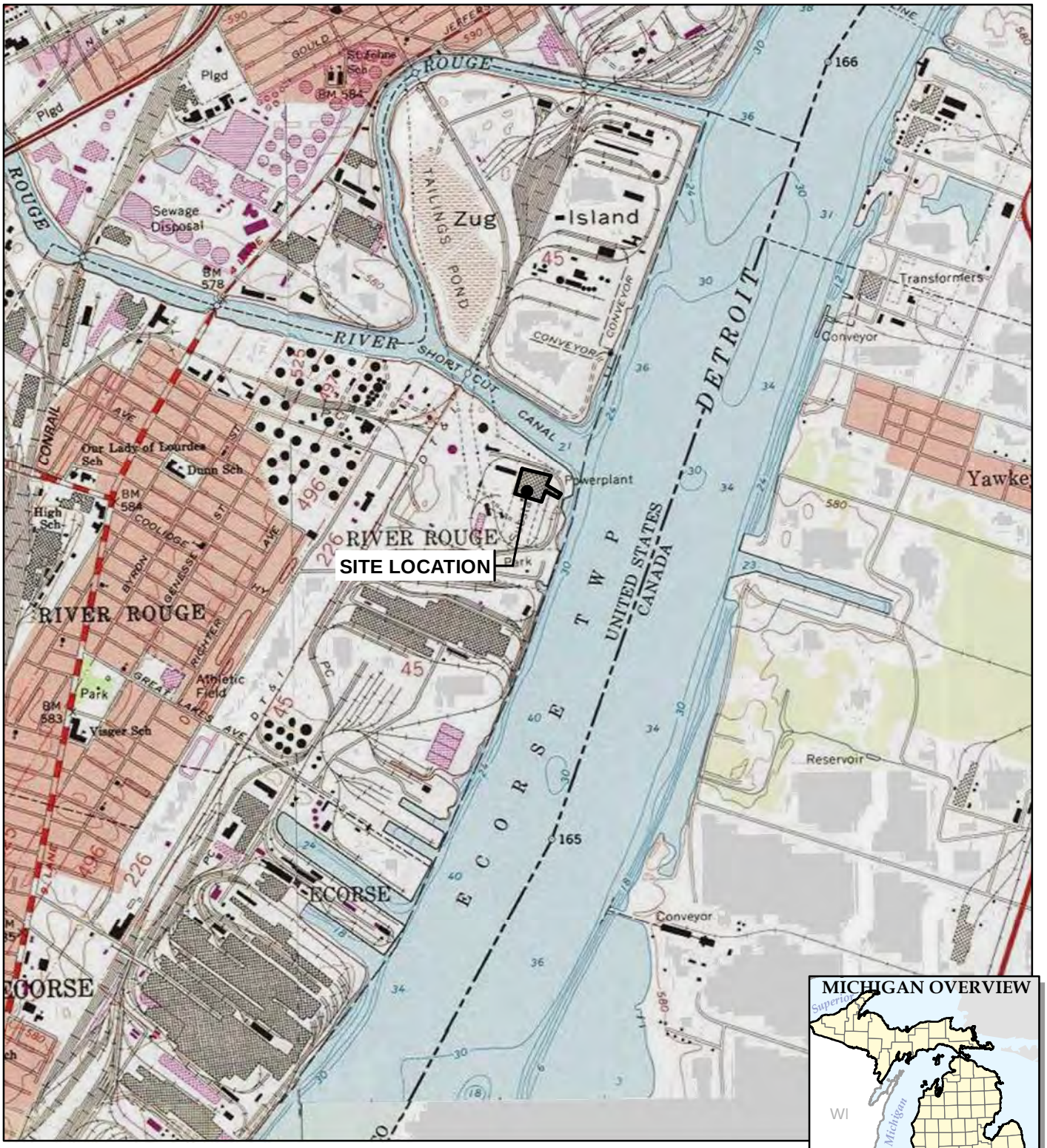
Table 6
Summary of Nature and Extent Analytical Data: September 2019
River Rouge Power Plant Bottom Ash Basin – RCRA CCR Monitoring Program
River Rouge, Michigan

					Sample Location:	**MW-16-04S**	**MW-17-05**	**MW-17-12**	**MW-17-13**	**MW-17-14**	**MW-17-15**	**MW-17-18**	**MW-17-20**
					Sample Date:	9/26/2019	9/27/2019	9/27/2019	9/26/2019	9/27/2019	9/26/2019	9/27/2019	9/26/2019
Constituent	Unit	EPA MCL	EPA RSL	UTL	GWPS	Nature and Extent Wells							
Appendix III													
Boron	ug/L	NC	NA	NA	NA	490	200	--	--	560	940	420	480
Calcium	ug/L	NC	NA	NA	NA	160,000	71,000	--	--	64,000	170,000	200,000	280,000
Chloride	mg/L	250*	NA	NA	NA	560	69	--	--	51	420	380	290
Fluoride	mg/L	4	NA	NA	NA	0.61	0.49	--	--	0.56	0.9	0.4	0.57
pH, Field	su	6.5 - 8.5*	NA	NA	NA	7.1	7.3	6.6	7.0	7.2	6.9	6.8	6.8
Sulfate	mg/L	250*	NA	NA	NA	150	19	--	--	3.1	30	150	590
Total Dissolved Solids	mg/L	500*	NA	NA	NA	1,700	440	--	--	390	1,400	1,400	1,800
Appendix IV													
Arsenic	ug/L	10	NA	32	32	< 5.0	< 5.0	8.4	< 5.0	< 5.0	20	< 5.0	< 5.0
Barium	ug/L	2,000	NA	150	2,000	120	20	--	--	280	420	130	64
Beryllium	ug/L	4	NA	1.0	4	< 1.0	< 1.0	--	--	< 1.0	< 1.0	< 1.0	< 1.0
Cobalt	ug/L	NC	6	23	23	< 1.0	< 1.0	--	--	< 1.0	< 1.0	< 1.0	< 1.0
Fluoride	mg/L	4	NA	1.3	4	0.61	0.49	--	--	0.56	0.93	0.4	0.57
Lithium	ug/L	NC	40	34	**40**	19	9.2	12	< 8.0	14	**49**	17	25
Molybdenum	ug/L	NC	100	22	100	< 5.0	< 5.0	--	--	< 5.0	< 5.0	< 5.0	< 5.0
Radium-226	pCi/L	NC	NA	NA	NA	0.906	0.351	--	--	0.596	0.7	0.697	0.433
Radium-228	pCi/L	NC	NA	NA	NA	< 0.479	< 0.434	--	--	1.15	< 0.487	< 0.538	0.475
Radium-226/228	pCi/L	5	NA	2.83	5	1.31	< 0.434	--	--	1.75	1.1	1.13	0.908

Notes:

ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units; pH is a field parameter.
pCi/L - picocuries per liter.
NA - not applicable.
NC - no criteria.
-- - not analyzed.
MCL - Maximum Contaminant Level, EPA Drinking Water Standards and Health Advisories, April, 2012.
RSL - Regional Screening Level from 83 FR 36435.
UTL - Upper Tolerance Limit (95%) of the background data set.
GWPS - Groundwater Protection Standard. GWPS is the higher of the MCL/RSL and UTL.
* - Secondary Maximum Contaminant Level (SMCL), EPA Secondary Drinking Water Regulations (SDWR) April, 2012.
Bold value indicates an exceedance of the GWPS. Data from downgradient monitoring wells are screened against the GWPS for evaluation purposes only. Confidence intervals will be used to determine compliance per the CCR rules.

Figures



BASE MAP FROM USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLE SERIES.

N

1 " = 2,000 '
1:24,000

0 2,000 4,000
FEET

TRC
1540 Eisenhower Place
Ann Arbor, MI 48108-3284
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www.trccompanies.com
TRC - GIS

PROJECT:
DTE ELECTRIC COMPANY
RIVER ROUGE POWER PLANT
1 BELANGER PARK DRIVE
RIVER ROUGE, MICHIGAN

TITLE:
SITE LOCATION MAP

DRAWN BY:	M. VAPHIADIS
CHECKED BY:	B. YELEN
APPROVED BY:	V. BUENING
DATE:	JANUARY 2020
PROJ. NO.:	320511.0005
FILE:	320511-0005-0001SLMMB-RRPP-Fig01.mxd

FIGURE 1

E:\DTE\CCR_Sites\2017_265996\320511-0005-0001SLMMB-RRPP-Fig01.mxd -- Saved By: MVAPHIADIS on 1/28/2020, 12:27:35 PM

LEGEND

- COMPLIANCE WELLS
- MONITORING POINT
- NATURE AND EXTENT WELLS
- EXTRACTION WELL

NOTES

1. BASE MAP IMAGERY FROM ESRI/MICROSOFT, "WORLD IMAGERY", WEB BASEMAP SERVICE LAYER.
2. WELL LOCATIONS SURVEYED BY BMJ ENGINEERS AND SURVEYORS INC. IN JUNE 2016 & JUNE 2017.

N

0 300 600 Feet

1 " = 300 '

1:3,600

PROJECT:

DTE ELECTRIC COMPANY
RIVER ROUGE POWER PLANT BOTTOM ASH BASIN
1 BELANGER PARK DRIVE
RIVER ROUGE, MICHIGAN

TITLE:

MONITORING NETWORK AND SITE PLAN

DRAWN BY:	M. VAPHIADIS	PROJ NO.:	320511.0005.0000
CHECKED BY:	B. YELEN		
APPROVED BY:	V. BUENING		**FIGURE 2**
DATE:	JANUARY 2020		

TRC
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FILE NO.: 320511-0005-009-RRPP-Fig02.mxd

Plot Date: 1/28/2020, 12:36:36 PM by MVAPHIADIS -- LAYOUT: ANSI B(11"x17")
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Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl (Foot)
Map Rotation: 0

TRC - GIS

LEGEND

- COMPLIANCE WELLS
- MONITORING POINT
- NATURE AND EXTENT WELLS
- EXTRACTION WELL
- GROUNDWATER CONTOUR (2' INTERVAL, DASHED WHERE INFERRED)
- INFERRED GROUNDWATER FLOW DIRECTION
- (575.86) ELEVATION FT (NAVD 88)

NOTES

1. BASE MAP IMAGERY FROM ESRI/MICROSOFT, "WORLD IMAGERY", WEB BASEMAP SERVICE LAYER.
2. WELL LOCATIONS SURVEYED BY BMJ ENGINEERS AND SURVEYORS INC. IN JUNE 2016 & JUNE 2017.
3. GROUNDWATER ELEVATIONS DISPLAYED IN FEET RELATIVE TO NORTH AMERICAN VERTICAL DATUM OF 1988.
4. ELEVATION REPRESENTATIVE OF BOTTOM ASH BASIN SURFACE WATER ELEVATION NOT GROUNDWATER ELEVATION.

N

0 300 600 Feet

1 " = 300 '

1:3,600

PROJECT:
DTE ELECTRIC COMPANY
RIVER ROUGE POWER PLANT BOTTOM ASH BASIN
1 BELANGER PARK DRIVE
RIVER ROUGE, MICHIGAN

TITLE:
GROUNDWATER POTENTIOMETRIC SURFACE MAP MARCH 2019

DRAWN BY:	M. VAPHIADIS	PROJ NO.:	320511.0005.0000
CHECKED BY:	B. YELEN		
APPROVED BY:	V. BUENING		**FIGURE 3**
DATE:	JANUARY 2020		

TRC
1540 Eisenhower Place
Ann Arbor, MI 48108-3284
Phone: 734.971.7080
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FILE NO.: 320511-0005-010-RRPP-Fig03.mxd

Plot Date: 1/28/2020, 12:39:05 PM by MVAPHIADIS -- LAYOUT: ANSI B(11"x17")
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Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl (Foot)
Map Rotation: 0

TRC - GIS

LEGEND

- COMPLIANCE WELLS
- MONITORING POINT
- NATURE AND EXTENT WELLS
- EXTRACTION WELL
- GROUNDWATER CONTOUR (DASHED WHERE INFERRED)
- INFERRED GROUNDWATER FLOW DIRECTION
- (575.25) ELEVATION FT (NAVD 88)

NOTES

1. BASE MAP IMAGERY FROM ESRI/MICROSOFT, "WORLD IMAGERY", WEB BASEMAP SERVICE LAYER.
2. WELL LOCATIONS SURVEYED BY BMJ ENGINEERS AND SURVEYORS INC. IN JUNE 2016 & JUNE 2017.
3. GROUNDWATER ELEVATIONS DISPLAYED IN FEET RELATIVE TO NORTH AMERICAN VERTICAL DATUM OF 1988.
4. ELEVATION REPRESENTATIVE OF BOTTOM ASH BASIN SURFACE WATER ELEVATION NOT GROUNDWATER ELEVATION.

N

0 300 600 Feet

1 " = 300 '

1:3,600

PROJECT:
DTE ELECTRIC COMPANY
RIVER ROUGE POWER PLANT BOTTOM ASH BASIN
1 BELANGER PARK DRIVE
RIVER ROUGE, MICHIGAN

TITLE:
GROUNDWATER POTENTIOMETRIC SURFACE MAP SEPTEMBER 2019

DRAWN BY:	M. VAPHIADIS	PROJ NO.:	320511.0005.0000
CHECKED BY:	B. YELEN		
APPROVED BY:	V. BUENING		**FIGURE 4**
DATE:	JANUARY 2020		

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

FILE NO.: 320511-0005-011-RRPP-Fig04.mxd

Plot Date: 1/28/2020, 12:46:00 PM by MVAPHIADIS -- LAYOUT: ANSI B(11"x17")
Path: E:\DTE\CCR_Sites\2017_265996\320511-0005-011-RRPP-Fig04.mxd
Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl (Foot)
Map Rotation: 0

TRC - GIS

Appendix A
Data Quality Reviews

Laboratory Data Quality Review
Groundwater Monitoring Event March 2019
DTE Electric Company River Rouge Power Plant (DTE RRPP)

Groundwater samples were collected by TRC for the March 2019 sampling event for the DTE RRPP. Samples were analyzed for anions, total dissolved solids, and select total metals by Test America Laboratories, Inc. (Test America) located in North Canton, Ohio and radium by Test America located in St. Louis, Missouri. The laboratory analytical results are reported in laboratory report 240-110261-1.

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

- MW-16-01
- MW-16-02
- MW-16-03
- MW-17-06
- MW-17-07

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

Analyte Group	Method
Anions (Fluoride, Chloride, Sulfate)	SW846 9056A
Total Dissolved Solids (TDS)	SM 2540C
Total Metals	SW846 6010B, SW846 6020
Radium (Radium-226, Radium-228, Total Radium)	SW846 9315, SW846 9320

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

Data Quality Review Procedure

The analytical data were reviewed using the USEPA National Functional Guidelines for Inorganic Superfund 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. Method blanks are used to assess potential contamination arising from laboratory sample preparation and/or analytical procedures;

- Data for laboratory control samples (LCSs) and laboratory control sample duplicates (LCSDs). The LCS/LCSDs are used to assess the accuracy and precision of the analytical method using a clean matrix;
- Percent recoveries for matrix spike (MS) and matrix spike duplicates (MSD), when performed on project samples. Percent recoveries are calculated for each analyte spiked and used to assess bias due to sample matrix effects;
- Data for laboratory duplicates, when performed on project samples. The laboratory duplicates are replicate analyses of one sample and are used to assess the precision of the analytical method
- Data for blind field duplicates. Field duplicate samples are used to assess variability introduced by the sampling and analytical processes;
- Percent recoveries for the carriers for radium-226 and radium-228 analyses; and
- Overall usability of the data.

This data usability report addresses the following items:

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

Review Summary

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

- The reviewed Appendix 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 target analytes were detected in the method blanks.
- The percent recoveries for the carriers for radium-226 and radium-228 analyses were within acceptance limits.
- LCS and/or LCSD recoveries and relative percent differences (RPDs), where applicable, were within laboratory acceptance limits.

- MS/MSD analyses were performed on samples MW-16-01 for all metals except mercury, MW-16-02 for mercury, and DUP-01 for chloride, sulfate, and fluoride. All recoveries and RPDs were within the acceptance limits.
- The field duplicate pair samples were Dup-01/MW-16-02. The RPDs and/or duplicate error ratios (DERs) between the parent and duplicate samples were within the acceptance limits.
- Laboratory duplicates were not performed for inorganic parameters where MS/MSD analyses were not appropriate (i.e., TDS) per the Quality Assurance Project Plan (at least 1 in 20). Therefore, precision could not be evaluated for TDS.

Laboratory Data Quality Review
Groundwater Monitoring Event September 2019
DTE Electric Company River Rouge Power Plant (DTE RRPP)

Groundwater samples were collected by TRC for the September 2019 sampling event for the Bottom Ash Basin at the DTE RRPP. Samples were analyzed for anions, total dissolved solids, and select total metals by Test America Laboratories, Inc. (Test America) located in North Canton, Ohio and radium by Test America located in St. Louis, Missouri. The laboratory analytical results are reported in laboratory report 240-119689-1.

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

- MW-16-01
- MW-16-02
- MW-16-03
- MW-17-06
- MW-17-07

During the September 2019 sampling event, a groundwater sample was also collected from each of the following nature and extent wells:

- MW-17-05
- MW-17-13
- MW-17-14
- MW-17-15
- MW-17-18
- MW-17-20
- MW-17-12

In addition, a groundwater sample was collected from non-compliance monitoring well MW-16-04S which was submitted for analysis along with the compliance well samples and is included for quality review purposes.

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

Analyte Group	Method
Anions (Fluoride, Chloride, Sulfate)	SW846 9056A
Total Dissolved Solids (TDS)	SM 2540C
Total Metals	SW846 6010B, SW846 6020
Radium (Radium-226, Radium-228, Total Radium)	SW846 9315, SW846 9320

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

Data Quality Review Procedure

The analytical data were reviewed using the USEPA National Functional Guidelines for Inorganic Superfund 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. Method blanks are used to assess potential contamination arising from laboratory sample preparation and/or analytical procedures;
- Data for laboratory control samples (LCSs) and laboratory control sample duplicates (LCSDs). The LCS/LCSDs are used to assess the accuracy and precision of the analytical method using a clean matrix;
- Percent recoveries for matrix spike (MS) and matrix spike duplicates (MSD). Percent recoveries are calculated for each analyte spiked and used to assess bias due to sample matrix effects;
- Data for laboratory duplicates, when performed on project samples. The laboratory duplicates are replicate analyses of one sample and are used to assess the precision of the analytical method;
- Data for blind field duplicates. Field duplicate samples are used to assess variability introduced by the sampling and analytical processes;
- Percent recoveries for the carriers for radium-226 and radium-228 analyses for radiochemistry only. Carriers are used to assess the chemical yield for the preparation and/or instrument efficiency; and
- Overall usability of the data.

This data usability report addresses the following items:

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

Review Summary

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

- The reviewed Appendix 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. Target analytes were not detected in the method blank samples with the following exception. Normalized absolute difference comparisons between blank and sample that are between 1.96 and 2.58 may indicate biased high results and normalized absolute differences <1.96 may indicate a false positive sample result.
  - Radium-226 was detected in method blank 160-444910/23-A at a concentration of 0.2208 ± 0.107 pCi/L. The detected radium-226 results for the samples associated with this method blank were potentially impacted (either potential false positives or potential high biases), as summarized in the attached table, Attachment B.
- LCS and/or LCSD recoveries and relative percent differences (RPDs), where applicable, were within laboratory acceptance limits.
- MS/MSD analyses were performed on sample MW-16-01_20190926 for metals and sample MW-16-02_20190926 for anions. All recoveries and RPDs were within the acceptance limits.
- Laboratory duplicate analyses were performed on samples MW-16-01_20190926, MW-17-05_20190927 and MW-17-14_20190927 for TDS; the RPDs between parent and duplicate samples were within the QC limits.
- The field duplicate pair samples were DUP-01_20190926/MW-16-01_20190926 and DUP-02_20190926/MW-16-04S_20190926. The RPDs and/or duplicate error ratios (DERs) between the parent and duplicate samples were within acceptance limits.
- Carrier recoveries, where applicable, were within 40-110%.

Appendix B
Appendix IV Assessment Monitoring Statistical Evaluation – March 2019 Data

1540 Eisenhower Pl.
Ann Arbor, MI 48108

T 734.971.7080
TRCcompanies.com

Technical Memorandum

Date: June 19, 2019

To: DTE Electric Company

From: Darby Litz, TRC
Sarah Holmstrom, TRC
Meredith Brehob, TRC

Project No.: 320511.0005.0000 Phase 001, Task 001

Subject: Appendix IV Assessment Monitoring Statistical Evaluation for March 2019 Groundwater Monitoring Event – DTE Electric Company, River Rouge Power Plant, Bottom Ash Basin Coal Combustion Residual Unit

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 July 30, 2018. The CCR Rule, which became effective on October 19, 2015 (amendment effective August 29, 2018), applies to DTE Electric Company (DTE Electric) River Rouge Power Plant (RRPP) Coal Combustion Residual Bottom Ash Basin (BAB) CCR unit located in River Rouge, Michigan (the Site).

In response to the statistically significant increases (SSIs) above background for boron, fluoride and pH, DTE Electric established an Assessment Monitoring Program for the RRPP BAB CCR unit pursuant to §257.94(e) of the CCR Rule as presented in the April 13, 2018 *Establishment of an Assessment Monitoring Program River Rouge Power Plant Bottom Ash Basin Coal Combustion Residual Unit* letter. In accordance with §257.95, TRC conducted two assessment monitoring events, a preliminary and subsequent initial semiannual assessment monitoring event, at the RRPP BAB CCR unit. The preliminary Appendix IV only assessment monitoring event (per §257.95(b)) was performed on April 6, 2018, and the subsequent initial semiannual assessment monitoring event (per §257.95(d), Appendix III and IV parameters) was performed on May 30 and 31, 2018. The results from the initial assessment monitoring sampling event were used to establish groundwater protection standards (GWPSs) for the Appendix IV constituents in accordance with §257.95(h). The results from the assessment monitoring sampling events were subsequently used to perform the statistical comparison to the established GWPSs.

On October 15, 2018, it was determined that pursuant to §257.93 (h) that arsenic and lithium are present at statistically significant levels above their respective GWPSs at one or more down gradient well locations at the RRPP BAB CCR unit[1].

Although DTE Electric has completed an assessment of corrective measures per §257.95(g)(3), DTE Electric is currently operating a groundwater extraction system as a presumptive remedy to maintain hydraulic control around the RRPP BAB to address the uncertainty around the potential migration of CCR constituents from the RRPP BAB to groundwater. This system has effectively captured groundwater in the vicinity of the RRPP BAB CCR unit since it began operation on March 2, 2018 and eliminates the potential for Appendix III and Appendix IV parameters to migrate from the RRPP BAB CCR unit.

In accordance with §257.96(b), DTE Electric is continuing assessment monitoring for the RRPP BAB CCR unit. The first semiannual assessment monitoring event for the Appendix III and Appendix IV constituents was conducted on March 29, 2019. In accordance with §257.95, the assessment monitoring data must be compared to determine whether or not Appendix IV constituents are detected at statistically significant levels above the GWPSs. This memorandum presents the limits derived for the Appendix IV parameters for the RRPP BAB CCR unit that will be used to compare to the GWPSs.

Assessment Monitoring Statistical Evaluation

The three compliance wells utilized for the BAB CCR Unit are MW-16-01, MW-16-02 and MW-16-03. Following the first semiannual assessment monitoring sampling event, compliance well data for the RRPP BAB were evaluated in accordance with the *Groundwater Statistical Evaluation Plan* (Stats Plan) (TRC, October 2017; Revised December 2017). For each detected constituent, the concentrations for each well were first compared directly to the GWPS within a rolling window of eight sampling events. Parameter-well combinations that included a direct exceedance of the GWPS were retained for further analysis. As a result, arsenic was retained for evaluation at MW-16-01, beryllium at MW-16-02, and lithium at MW-16-01, MW-16-02, and MW-16-03.

Groundwater data were then evaluated utilizing ChemStat™ statistical software. ChemStat™ 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 ChemStat™ statistical program (and the UG), confidence limits were selected to perform the statistical comparison of compliance data to a fixed standard. Parametric and non-parametric confidence intervals were calculated for each of the CCR Appendix IV parameters using a 99 percent confidence level, i.e., a significance level (α) of 0.01. The

[1] TRC. 2018. *Notification of Appendix IV Constituents at Statistically Significant Levels Above the Groundwater Protection Standards; River Rouge Power Plant Bottom Ash Basin Coal Combustion Residual Unit,* October.

following narrative describes the methods employed, the results obtained and the ChemStat™ output files are included as an attachment.

Due to the initiation of operation of the groundwater extraction system to establish groundwater capture in the area of the BAB in March 2018 and subsequent changes in groundwater flow rate and direction, the data set used for the March 2019 statistical evaluation was limited to the four most recent events. Use of the four most recent data points provides the minimum density of data as recommended per the UG and is representative of current conditions at the BAB under the hydraulic influence of the groundwater extraction system. Additional data collected from monitoring events performed subsequent to March 2018 will continue to be incorporated into the statistical evaluation moving forward and will roll after eight rounds have accumulated, as appropriate.

The statistical data evaluation included the following steps:

- Review of data quality checklists for the baseline/background data sets for CCR Appendix IV constituents;
- Evaluation of percentage of non-detects for each baseline/background well-constituent pair;
- 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 visual trends apparent in the graphical representations for statistical significance;
- Distribution of the data; and
- Calculation of the confidence intervals for each cumulative dataset.

The results of these evaluations are presented and discussed below.

Data Quality

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

Percentage of Non-detects

The percentage of non-detect observations for constituents with one or more detection above a GWPS is included in Table 1. Non-detect data was handled in accordance with the Stats Plan for the purposes of calculating confidence intervals.

Time versus Concentration Graphs

The T v. C graphs shows potential outliers for beryllium at MW-16-02 (individual detections in June 2017 and March 2019). This data set was tested using the ChemStat™ software to assess whether the potential outliers are statistically significant, as discussed further below. The T v. C graphs showed potential trending for some Appendix IV well/constituent pairs. These were tested by the ChemStat™ software to assess whether the trends are statistically significant.

Outlier Testing

The Dixon's Outlier Test in ChemStat™ could not be used on the suspected beryllium outliers at MW-16-02 due to the high percentage of non-detects. To be conservative, since beryllium has been detected during two monitoring events at MW-16-02, the suspected outliers were retained for the calculation of confidence intervals.

Trend Analysis

Visual trends apparent in the T v. C graphs were evaluated in ChemStat™ using the Sens Slope estimator to determine if a subset of data should be used in calculating the confidence interval. Trends were evaluated using a 95-percent (two-tailed) confidence level, i.e., a significance level (α) of 0.05. A statistically significant decreasing trend was found in lithium at MW-16-02. This lithium decreasing trend will continue to be monitored and likely results from changes in groundwater quality due to operation of the groundwater extraction system.

Distribution of the Data Sets

ChemStat™ was utilized to evaluate each data set for normality. If the skewness coefficient was calculated to be between negative one and one, then the data were assumed to be approximately normally distributed. If the skewness coefficient was calculated as greater than one (or less than negative one) then the calculation was performed on the natural log (Ln) of the data. If the Ln of the data still determined that the data appeared to be skewed, then the Shapiro-Wilk test of normality (Shapiro-Wilk) was performed. The Shapiro-Wilk statistic was calculated on both non-transformed data, and the Ln-transformed data. If the Shapiro-Wilk statistic indicated that normal distributional assumptions were not valid, then the parameter was considered a candidate for non-parametric statistical evaluation. The data distributions are summarized in Table 1.

Confidence Intervals

Variability is recognized in the data set due to changing groundwater quality in response to the operation of the groundwater extraction system. Calculating a confidence interval around a trending data set incorporates not only variability present naturally in the underlying dataset but can exaggerate variability. The downward trend in lithium concentrations at MW-16-02 is likely causing the confidence interval to be much wider than expected given the confidence level (e.g., 99%) and sample size (n=4). However, lithium concentrations have already triggered assessment monitoring (e.g., not a newly identified GWPS exceedance) and remedial efforts are ongoing; therefore, traditional confidence interval calculations are presented in this statistical evaluation until more data are available. Once groundwater conditions stabilize under the current system operation with a more consistent trend, and additional post-treatment data are collected, confidence bands may be a more appropriate option to determine compliance with the CCR Rule. Confidence bands are selected by the UG as the appropriate method for calculating confidence intervals on trending data. A confidence band calculates upper and lower confidence limits at each point along the trend to reduce variability and create a narrower confidence interval. At least 8 to 10 measurements should be available when computing a confidence band around a linear regression.

Table 1 presents the calculated confidence intervals for each well-constituent pair. For normal and lognormal distributions, confidence intervals are calculated for 99 percent confidence using parametric methods. For non-normal background datasets, a nonparametric confidence interval is utilized, resulting in the highest and lowest values from the contributing dataset as the confidence limits. Confidence intervals were calculated using only the four most recent sampling events to ensure that data was recent enough to be representative of current site conditions.

The confidence intervals calculated through the above-described process will be compared to the GWPS to determine if an exceedance has occurred. An exceedance of the standard occurs when the 99 percent lower confidence level of the downgradient data exceeds the GWPS. If the statistical tests conclude that an exceedance of the GWPS, verification resampling may be conducted by the facility. Once the resampling data are available, the comparison to the GWPS will be evaluated.

Attachments

Table 1 – Summary of Descriptive Statistics and Confidence Interval Calculations
Attachment A – ChemStat™ Outputs

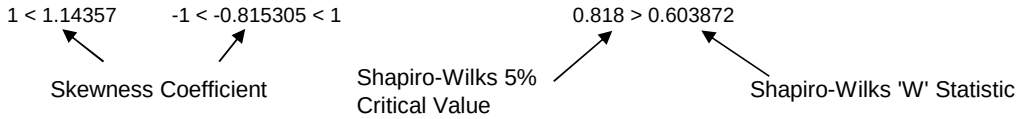
Table 1

Summary of Descriptive Statistics and Confidence Interval Calculations

Table 1
Summary of Descriptive Statistics and Confidence Interval Calculations
Assessment Monitoring Statistical Evaluation - March 2019
DTE Electric Company – River Rouge Power Plant

Parameter[1]	Percent Non-Detect	Outliers?	Trend?	Skewness		Shapiro-Wilks Test (5% Critical Value)		Parametric / Non-Parametric	Confidence Interval[2]
				Un-Transformed	Natural Log	Un-Transformed	Natural Log		
MW-16-01									
Arsenic	0%	No	No	-1 < 0 < 1	--	--	--	Parametric	[150, 180]
Lithium	0%	No	No	-1 < 0.062426 < 1	--	--	--	Parametric	[41, 69]
MW-16-02									
Beryllium	80%	No	No	--	--	--	--	Non-Parametric	[1.0, 4.5]
Lithium	0%	No	Yes	-1 < 0.833578 < 1	--	--	--	Parametric	[6.8, 54]
MW-16-03									
Lithium	17%	No	No	-1 < 0.693561 < 1	--	--	--	Parametric	[-4.4, 21]

Notes:



(1) Well-parameter combinations that have one or more direct exceedances of the Groundwater Protection Standard within a rolling window of eight sampling events.
(2) The most recent four data points are used to calculate the confidence interval to be representative of current conditions.

Attachment A

ChemStat™ Confidence Interval Outputs

Concentrations (ug/L)

Parameter: Arsenic

Original Data (Not Transformed)

Non-Detects Replaced with 1/2 DL

Total Measurements: 36
Total Non-Detect: 6
Percent Non-Detects: 16.6667%
Total Background Measurements: 0
There are 0 background locations

Loc.	Meas.	ND	Date	Conc.	Original

There are 3 compliance locations

Loc.	Meas.	ND	Date	Conc.	Original
MW-16-01	12	0 (0%)	8/5/2016	37	37
			9/30/2016	37	37
			11/18/2016	39	39
			1/20/2017	40	40
			3/10/2017	38	38
			4/28/2017	37	37
			6/16/2017	35	35
			7/21/2017	36	36
			4/6/2018	160	160
			5/30/2018	170	170
			10/16/2018	160	160
			3/29/2019	170	170
MW-16-02	12	2 (16.6667%)	8/5/2016	24	24
			9/30/2016	27	27
			11/18/2016	30	30
			1/20/2017	31	31
			3/10/2017	29	29
			4/28/2017	30	30
			6/16/2017	30	30
			7/21/2017	27	27
			4/6/2018	15	15
			5/30/2018	ND<2.5 U	ND<5 U
			10/16/2018	7.9	7.9
			3/29/2019	ND<2.5 U	ND<5 U
MW-16-03	12	4 (33.3333%)	8/5/2016	91	91
			9/30/2016	40	40
			11/18/2016	21	21
			1/20/2017	13	13
			3/10/2017	12	12
			4/28/2017	12	12
			6/16/2017	12	12
			7/21/2017	12	12
			4/6/2018	ND<2.5 U	ND<5 U
			5/30/2018	ND<2.5 U	ND<5 U
			10/16/2018	ND<2.5 U	ND<5 U
			3/29/2019	ND<2.5 U	ND<5 U

There are 0 unused locations

Loc.	Meas.	ND	Date	Conc.	Original

Concentrations (ug/L)

Parameter: Beryllium

Original Data (Not Transformed)

Non-Detects Replaced with 1/2 DL

Total Measurements: 30
Total Non-Detect: 27
Percent Non-Detects: 90%
Total Background Measurements: 0
There are 0 background locations

Loc.	Meas.	ND	Date	Conc.	Original

There are 3 compliance locations

Loc.	Meas.	ND	Date	Conc.	Original
MW-16-01	10	9 (90%)	8/5/2016	ND<0.5 U	ND<1 U
			9/30/2016	ND<0.5 U	ND<1 U
			11/18/2016	ND<0.5 U	ND<1 U
			1/20/2017	ND<0.5 U	ND<1 U
			3/10/2017	ND<0.5 U	ND<1 U
			4/28/2017	ND<0.5 U	ND<1 U
			6/16/2017	3.8	3.8
			7/21/2017	ND<0.5 U	ND<1 U
			4/6/2018	ND<0.5 U	ND<1 U
			3/29/2019	ND<0.5 U	ND<1 U
MW-16-02	10	8 (80%)	8/5/2016	ND<0.5 U	ND<1 U
			9/30/2016	ND<0.5 U	ND<1 U
			11/18/2016	ND<0.5 U	ND<1 U
			1/20/2017	ND<0.5 U	ND<1 U
			3/10/2017	ND<0.5 U	ND<1 U
			4/28/2017	ND<0.5 U	ND<1 U
			6/16/2017	4.5	4.5
			7/21/2017	ND<0.5 U	ND<1 U
			4/6/2018	ND<0.5 U	ND<1 U
			3/29/2019	1.4	1.4
MW-16-03	10	10 (100%)	8/5/2016	ND<0.5 U	ND<1 U
			9/30/2016	ND<0.5 U	ND<1 U
			11/18/2016	ND<0.5 U	ND<1 U
			1/20/2017	ND<0.5 U	ND<1 U
			3/10/2017	ND<0.5 U	ND<1 U
			4/28/2017	ND<0.5 U	ND<1 U
			6/16/2017	ND<0.5 U	ND<1 U
			7/21/2017	ND<0.5 U	ND<1 U
			4/6/2018	ND<0.5 U	ND<1 U
			3/29/2019	ND<0.5 U	ND<1 U

There are 0 unused locations

Loc.	Meas.	ND	Date	Conc.	Original

Concentrations (ug/L)

Parameter: Lithium

Original Data (Not Transformed)

Non-Detects Replaced with 1/2 DL

Total Measurements: 36
Total Non-Detect: 2
Percent Non-Detects: 5.55556%
Total Background Measurements: 0
There are 0 background locations

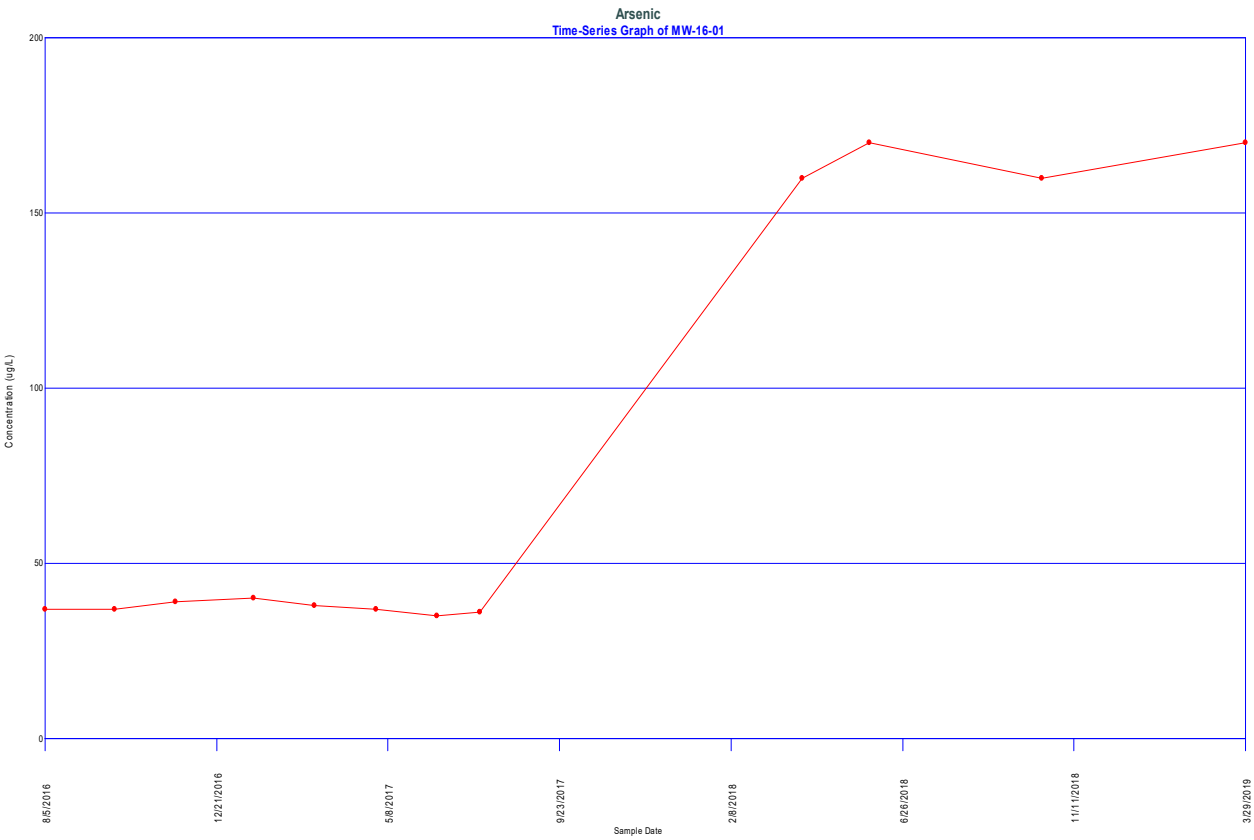
Loc.	Meas.	ND	Date	Conc.	Original

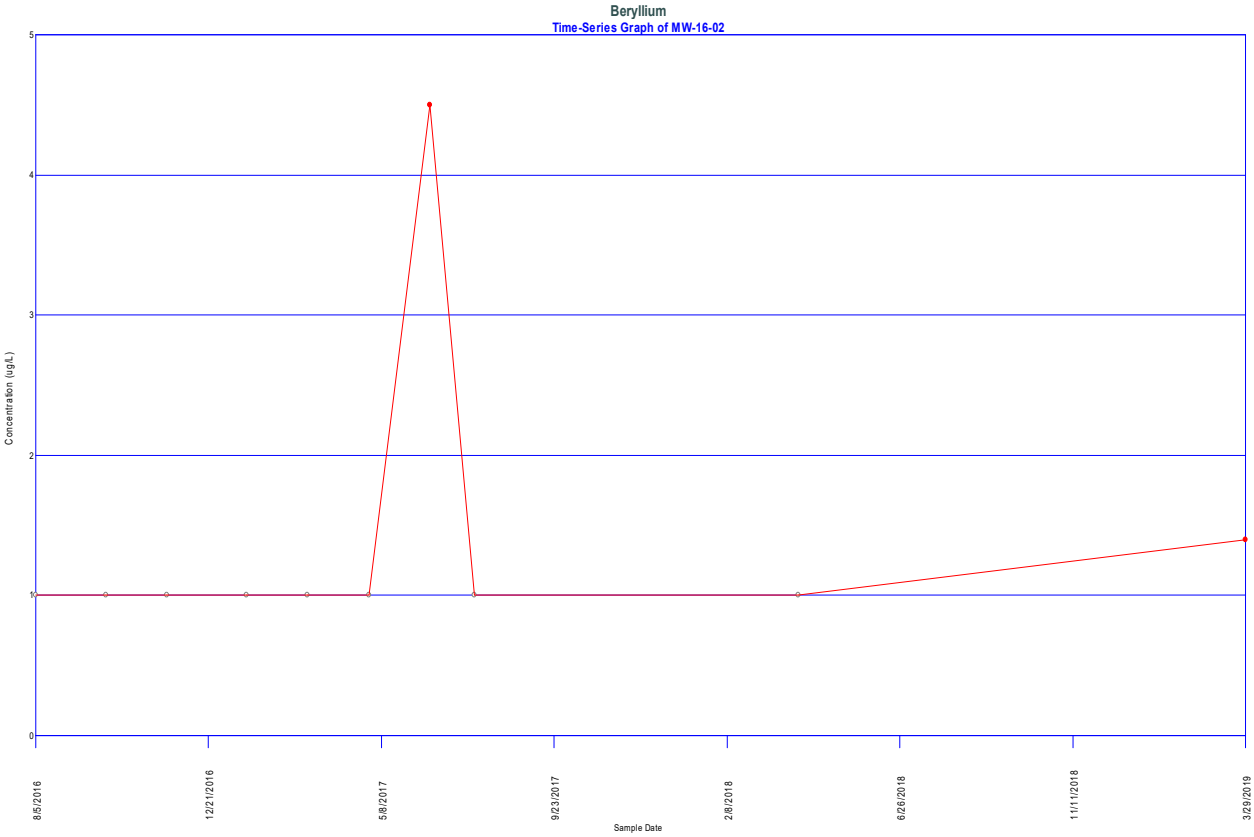
There are 3 compliance locations

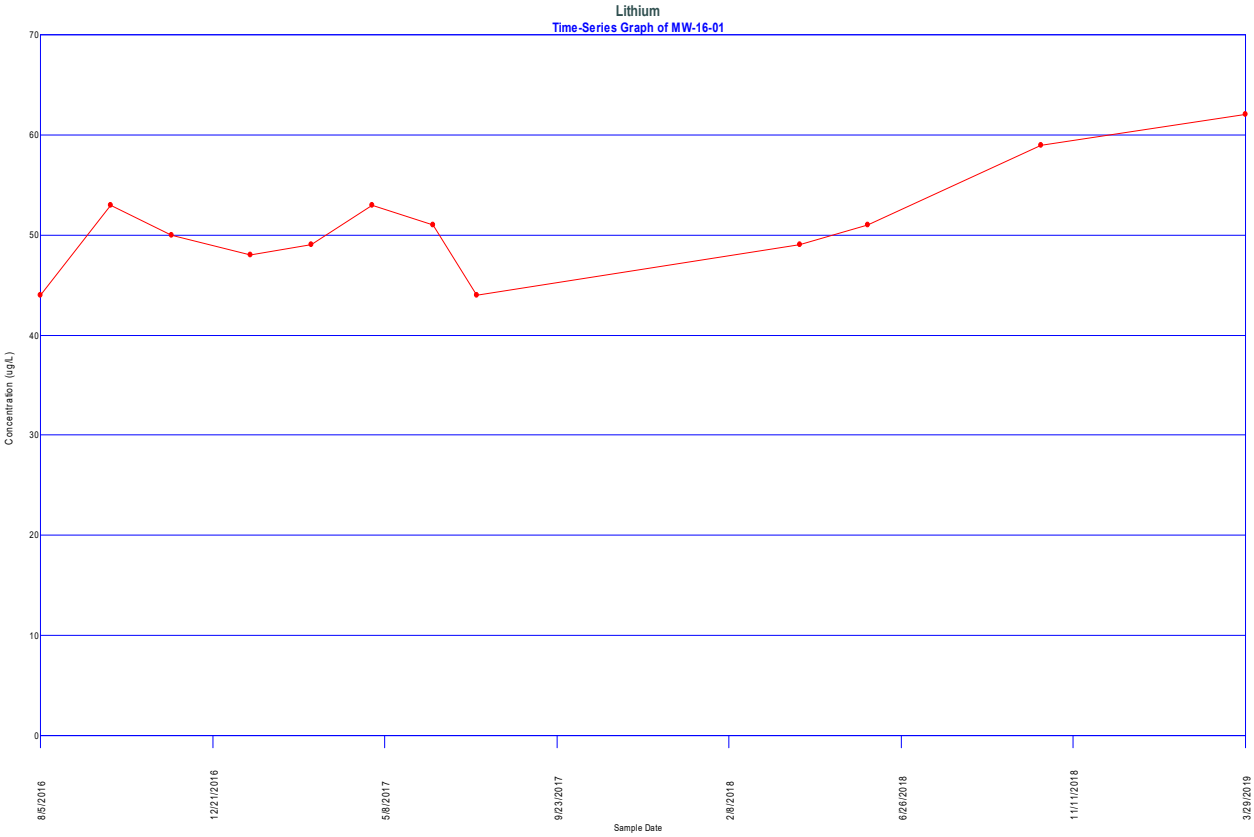
Loc.	Meas.	ND	Date	Conc.	Original
MW-16-01	12	0 (0%)	8/5/2016	44	44
			9/30/2016	53	53
			11/18/2016	50	50
			1/20/2017	48	48
			3/10/2017	49	49
			4/28/2017	53	53
			6/16/2017	51	51
			7/21/2017	44	44
			4/6/2018	49	49
			5/30/2018	51	51
			10/16/2018	59	59
			3/29/2019	62	62
MW-16-02	12	0 (0%)	8/5/2016	57	57
			9/30/2016	64	64
			11/18/2016	62	62
			1/20/2017	64	64
			3/10/2017	58	58
			4/28/2017	71	71
			6/16/2017	64	64
			7/21/2017	52	52
			4/6/2018	45	45
			5/30/2018	28	28
			10/16/2018	27	27
			3/29/2019	21	21
MW-16-03	12	2 (16.6667%)	8/5/2016	29	29
			9/30/2016	44	44
			11/18/2016	44	44
			1/20/2017	49	49
			3/10/2017	45	45
			4/28/2017	51	51
			6/16/2017	49	49
			7/21/2017	41	41
			4/6/2018	15	15
			5/30/2018	11	11
			10/16/2018	ND<4 U	ND<8 U
			3/29/2019	ND<4 U	ND<8 U

There are 0 unused locations

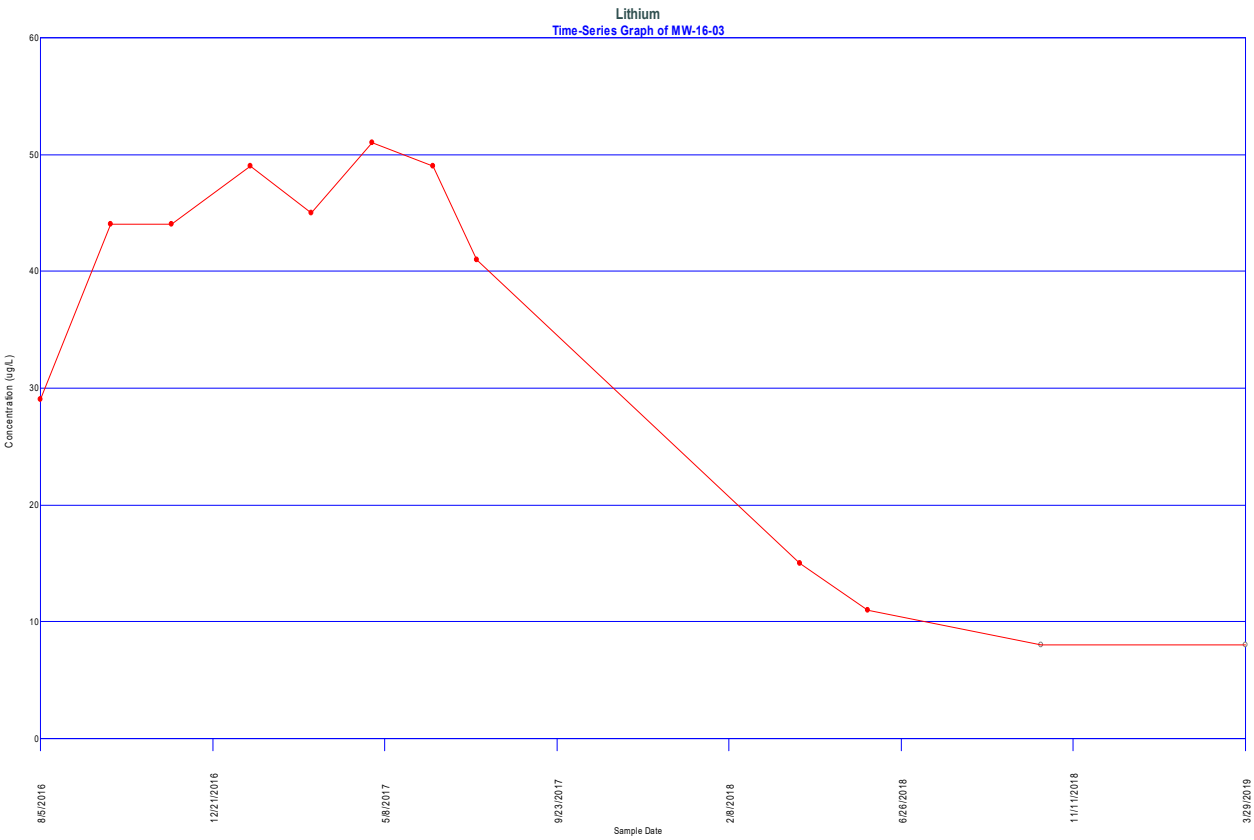
Loc.	Meas.	ND	Date	Conc.	Original


Arsenic
Time-Series Graph of MW-16-01
200
150
100
50
0
Concentration (ug/L)
8/5/2016
12/21/2016
5/8/2017
9/23/2017
2/8/2018
6/26/2018
11/11/2018
3/29/2019
Sample Date


Beryllium
Time-Series Graph of MW-16-02
Concentration (ug/L)
5
4
3
2
1
0
8/5/2016
12/21/2016
5/8/2017
9/23/2017
2/8/2018
6/26/2018
11/11/2018
3/29/2019
Sample Date


Lithium
Time-Series Graph of MW-16-01
70
60
50
40
30
20
10
0
Concentration (ug/L)
8/5/2016
12/21/2016
5/8/2017
9/23/2017
2/8/2018
6/26/2018
11/11/2018
3/29/2019
Sample Date


Lithium
Time-Series Graph of MW-16-02
Concentration (ug/L)
80
70
60
50
40
30
20
10
0
8/5/2016
12/21/2016
5/8/2017
9/23/2017
2/8/2018
6/26/2018
11/11/2018
3/29/2019
Sample Date


Lithium
Time-Series Graph of MW-16-03
Concentration (ug/L)
60
50
40
30
20
10
0
8/5/2016
12/21/2016
5/8/2017
9/23/2017
2/8/2018
6/26/2018
11/11/2018
3/29/2019
Sample Date

Sen's Slope Analysis

Parameter: Arsenic

Location: MW-16-01

Original Data (Not Transformed)

Non-Detects Replaced with 1/2 DL

95% Confidence Level

Xj	Xk	(Xj - Xk)/(j-k)	Q
37 (9/30/2016)	37 (8/5/2016)	(37 - 37)/(2 - 1)	0
39 (11/18/2016)	37 (8/5/2016)	(39 - 37)/(3 - 1)	1
40 (1/20/2017)	37 (8/5/2016)	(40 - 37)/(4 - 1)	1
38 (3/10/2017)	37 (8/5/2016)	(38 - 37)/(5 - 1)	0.25
37 (4/28/2017)	37 (8/5/2016)	(37 - 37)/(6 - 1)	0
35 (6/16/2017)	37 (8/5/2016)	(35 - 37)/(7 - 1)	-0.333333
36 (7/21/2017)	37 (8/5/2016)	(36 - 37)/(8 - 1)	-0.142857
160 (4/6/2018)	37 (8/5/2016)	(160 - 37)/(9 - 1)	15.375
170 (5/30/2018)	37 (8/5/2016)	(170 - 37)/(10 - 1)	14.7778
160 (10/16/2018)	37 (8/5/2016)	(160 - 37)/(11 - 1)	12.3
170 (3/29/2019)	37 (8/5/2016)	(170 - 37)/(12 - 1)	12.0909
39 (11/18/2016)	37 (9/30/2016)	(39 - 37)/(3 - 2)	2
40 (1/20/2017)	37 (9/30/2016)	(40 - 37)/(4 - 2)	1.5
38 (3/10/2017)	37 (9/30/2016)	(38 - 37)/(5 - 2)	0.333333
37 (4/28/2017)	37 (9/30/2016)	(37 - 37)/(6 - 2)	0
35 (6/16/2017)	37 (9/30/2016)	(35 - 37)/(7 - 2)	-0.4
36 (7/21/2017)	37 (9/30/2016)	(36 - 37)/(8 - 2)	-0.166667
160 (4/6/2018)	37 (9/30/2016)	(160 - 37)/(9 - 2)	17.5714
170 (5/30/2018)	37 (9/30/2016)	(170 - 37)/(10 - 2)	16.625
160 (10/16/2018)	37 (9/30/2016)	(160 - 37)/(11 - 2)	13.6667
170 (3/29/2019)	37 (9/30/2016)	(170 - 37)/(12 - 2)	13.3
40 (1/20/2017)	39 (11/18/2016)	(40 - 39)/(4 - 3)	1
38 (3/10/2017)	39 (11/18/2016)	(38 - 39)/(5 - 3)	-0.5
37 (4/28/2017)	39 (11/18/2016)	(37 - 39)/(6 - 3)	-0.666667
35 (6/16/2017)	39 (11/18/2016)	(35 - 39)/(7 - 3)	-1
36 (7/21/2017)	39 (11/18/2016)	(36 - 39)/(8 - 3)	-0.6
160 (4/6/2018)	39 (11/18/2016)	(160 - 39)/(9 - 3)	20.1667
170 (5/30/2018)	39 (11/18/2016)	(170 - 39)/(10 - 3)	18.7143
160 (10/16/2018)	39 (11/18/2016)	(160 - 39)/(11 - 3)	15.125
170 (3/29/2019)	39 (11/18/2016)	(170 - 39)/(12 - 3)	14.5556
38 (3/10/2017)	40 (1/20/2017)	(38 - 40)/(5 - 4)	-2
37 (4/28/2017)	40 (1/20/2017)	(37 - 40)/(6 - 4)	-1.5
35 (6/16/2017)	40 (1/20/2017)	(35 - 40)/(7 - 4)	-1.66667
36 (7/21/2017)	40 (1/20/2017)	(36 - 40)/(8 - 4)	-1
160 (4/6/2018)	40 (1/20/2017)	(160 - 40)/(9 - 4)	24
170 (5/30/2018)	40 (1/20/2017)	(170 - 40)/(10 - 4)	21.6667
160 (10/16/2018)	40 (1/20/2017)	(160 - 40)/(11 - 4)	17.1429
170 (3/29/2019)	40 (1/20/2017)	(170 - 40)/(12 - 4)	16.25
37 (4/28/2017)	38 (3/10/2017)	(37 - 38)/(6 - 5)	-1
35 (6/16/2017)	38 (3/10/2017)	(35 - 38)/(7 - 5)	-1.5
36 (7/21/2017)	38 (3/10/2017)	(36 - 38)/(8 - 5)	-0.666667
160 (4/6/2018)	38 (3/10/2017)	(160 - 38)/(9 - 5)	30.5
170 (5/30/2018)	38 (3/10/2017)	(170 - 38)/(10 - 5)	26.4
160 (10/16/2018)	38 (3/10/2017)	(160 - 38)/(11 - 5)	20.3333
170 (3/29/2019)	38 (3/10/2017)	(170 - 38)/(12 - 5)	18.8571

35 (6/16/2017)	37 (4/28/2017)	(35 - 37)/(7 - 6)	-2
36 (7/21/2017)	37 (4/28/2017)	(36 - 37)/(8 - 6)	-0.5
160 (4/6/2018)	37 (4/28/2017)	(160 - 37)/(9 - 6)	41
170 (5/30/2018)	37 (4/28/2017)	(170 - 37)/(10 - 6)	33.25
160 (10/16/2018)	37 (4/28/2017)	(160 - 37)/(11 - 6)	24.6
170 (3/29/2019)	37 (4/28/2017)	(170 - 37)/(12 - 6)	22.1667
36 (7/21/2017)	35 (6/16/2017)	(36 - 35)/(8 - 7)	1
160 (4/6/2018)	35 (6/16/2017)	(160 - 35)/(9 - 7)	62.5
170 (5/30/2018)	35 (6/16/2017)	(170 - 35)/(10 - 7)	45
160 (10/16/2018)	35 (6/16/2017)	(160 - 35)/(11 - 7)	31.25
170 (3/29/2019)	35 (6/16/2017)	(170 - 35)/(12 - 7)	27
160 (4/6/2018)	36 (7/21/2017)	(160 - 36)/(9 - 8)	124
170 (5/30/2018)	36 (7/21/2017)	(170 - 36)/(10 - 8)	67
160 (10/16/2018)	36 (7/21/2017)	(160 - 36)/(11 - 8)	41.3333
170 (3/29/2019)	36 (7/21/2017)	(170 - 36)/(12 - 8)	33.5
170 (5/30/2018)	160 (4/6/2018)	(170 - 160)/(10 - 9)	10
160 (10/16/2018)	160 (4/6/2018)	(160 - 160)/(11 - 9)	0
170 (3/29/2019)	160 (4/6/2018)	(170 - 160)/(12 - 9)	3.33333
160 (10/16/2018)	170 (5/30/2018)	(160 - 170)/(11 - 10)	-10
170 (3/29/2019)	170 (5/30/2018)	(170 - 170)/(12 - 10)	0
170 (3/29/2019)	160 (10/16/2018)	(170 - 160)/(12 - 11)	10

Number of Q values = 66

Ordered Q Values

n	Q
1	-10
2	-2
3	-2
4	-1.66667
5	-1.5
6	-1.5
7	-1
8	-1
9	-1
10	-0.666667
11	-0.666667
12	-0.6
13	-0.5
14	-0.5
15	-0.4
16	-0.333333
17	-0.166667
18	-0.142857
19	0
20	0
21	0
22	0
23	0
24	0.25
25	0.333333
26	1

27	1
28	1
29	1
30	1.5
31	2
32	3.33333
33	10
34	10
35	12.0909
36	12.3
37	13.3
38	13.6667
39	14.5556
40	14.7778
41	15.125
42	15.375
43	16.25
44	16.625
45	17.1429
46	17.5714
47	18.7143
48	18.8571
49	20.1667
50	20.3333
51	21.6667
52	22.1667
53	24
54	24.6
55	26.4
56	27
57	30.5
58	31.25
59	33.25
60	33.5
61	41
62	41.3333
63	45
64	62.5
65	67
66	124

Sen's Estimator (Median Q) is 10

Tied Group	Value	Members
1	37	3
2	160	2
3	170	2

Time Period	Observations
8/5/2016	1
9/30/2016	1
11/18/2016	1
1/20/2017	1
3/10/2017	1
4/28/2017	1
6/16/2017	1
7/21/2017	1
4/6/2018	1
5/30/2018	1
10/16/2018	1

There are 0 time periods with multiple data

A = 102
B = 0
C = 6
D = 0
E = 10
F = 0
a = 3828
b = 11880
c = 264
Group Variance = 207
For 95% confidence interval (two-tailed), Z at (1-0.95)/2 = 1.97737
C = 28.4494
M1 = (66 - 28.4494)/2.0 = 18.7753
M2 = (66 + 28.4494)/2.0 + 1 = 48.2247
Lower limit is 0 = Q(19)
Upper limit is 18.8571 = Q(48)
0 < 0 < 18.8571 indicating no trend in data.

Sen's Slope Analysis

Parameter: Lithium

Location: MW-16-01

Original Data (Not Transformed)

Non-Detects Replaced with 1/2 DL

95% Confidence Level

Xj	Xk	(Xj - Xk)/(j-k)	Q
53 (9/30/2016)	44 (8/5/2016)	(53 - 44)/(2 - 1)	9
50 (11/18/2016)	44 (8/5/2016)	(50 - 44)/(3 - 1)	3
48 (1/20/2017)	44 (8/5/2016)	(48 - 44)/(4 - 1)	1.33333
49 (3/10/2017)	44 (8/5/2016)	(49 - 44)/(5 - 1)	1.25
53 (4/28/2017)	44 (8/5/2016)	(53 - 44)/(6 - 1)	1.8
51 (6/16/2017)	44 (8/5/2016)	(51 - 44)/(7 - 1)	1.16667
44 (7/21/2017)	44 (8/5/2016)	(44 - 44)/(8 - 1)	0
49 (4/6/2018)	44 (8/5/2016)	(49 - 44)/(9 - 1)	0.625
51 (5/30/2018)	44 (8/5/2016)	(51 - 44)/(10 - 1)	0.777778
59 (10/16/2018)	44 (8/5/2016)	(59 - 44)/(11 - 1)	1.5
62 (3/29/2019)	44 (8/5/2016)	(62 - 44)/(12 - 1)	1.63636
50 (11/18/2016)	53 (9/30/2016)	(50 - 53)/(3 - 2)	-3
48 (1/20/2017)	53 (9/30/2016)	(48 - 53)/(4 - 2)	-2.5
49 (3/10/2017)	53 (9/30/2016)	(49 - 53)/(5 - 2)	-1.33333
53 (4/28/2017)	53 (9/30/2016)	(53 - 53)/(6 - 2)	0
51 (6/16/2017)	53 (9/30/2016)	(51 - 53)/(7 - 2)	-0.4
44 (7/21/2017)	53 (9/30/2016)	(44 - 53)/(8 - 2)	-1.5
49 (4/6/2018)	53 (9/30/2016)	(49 - 53)/(9 - 2)	-0.571429
51 (5/30/2018)	53 (9/30/2016)	(51 - 53)/(10 - 2)	-0.25
59 (10/16/2018)	53 (9/30/2016)	(59 - 53)/(11 - 2)	0.666667
62 (3/29/2019)	53 (9/30/2016)	(62 - 53)/(12 - 2)	0.9
48 (1/20/2017)	50 (11/18/2016)	(48 - 50)/(4 - 3)	-2
49 (3/10/2017)	50 (11/18/2016)	(49 - 50)/(5 - 3)	-0.5
53 (4/28/2017)	50 (11/18/2016)	(53 - 50)/(6 - 3)	1
51 (6/16/2017)	50 (11/18/2016)	(51 - 50)/(7 - 3)	0.25
44 (7/21/2017)	50 (11/18/2016)	(44 - 50)/(8 - 3)	-1.2
49 (4/6/2018)	50 (11/18/2016)	(49 - 50)/(9 - 3)	-0.166667
51 (5/30/2018)	50 (11/18/2016)	(51 - 50)/(10 - 3)	0.142857
59 (10/16/2018)	50 (11/18/2016)	(59 - 50)/(11 - 3)	1.125
62 (3/29/2019)	50 (11/18/2016)	(62 - 50)/(12 - 3)	1.33333
49 (3/10/2017)	48 (1/20/2017)	(49 - 48)/(5 - 4)	1
53 (4/28/2017)	48 (1/20/2017)	(53 - 48)/(6 - 4)	2.5
51 (6/16/2017)	48 (1/20/2017)	(51 - 48)/(7 - 4)	1
44 (7/21/2017)	48 (1/20/2017)	(44 - 48)/(8 - 4)	-1
49 (4/6/2018)	48 (1/20/2017)	(49 - 48)/(9 - 4)	0.2
51 (5/30/2018)	48 (1/20/2017)	(51 - 48)/(10 - 4)	0.5
59 (10/16/2018)	48 (1/20/2017)	(59 - 48)/(11 - 4)	1.57143
62 (3/29/2019)	48 (1/20/2017)	(62 - 48)/(12 - 4)	1.75
53 (4/28/2017)	49 (3/10/2017)	(53 - 49)/(6 - 5)	4
51 (6/16/2017)	49 (3/10/2017)	(51 - 49)/(7 - 5)	1
44 (7/21/2017)	49 (3/10/2017)	(44 - 49)/(8 - 5)	-1.66667
49 (4/6/2018)	49 (3/10/2017)	(49 - 49)/(9 - 5)	0
51 (5/30/2018)	49 (3/10/2017)	(51 - 49)/(10 - 5)	0.4
59 (10/16/2018)	49 (3/10/2017)	(59 - 49)/(11 - 5)	1.66667
62 (3/29/2019)	49 (3/10/2017)	(62 - 49)/(12 - 5)	1.85714

51 (6/16/2017)	53 (4/28/2017)	(51 - 53)/(7 - 6)	-2
44 (7/21/2017)	53 (4/28/2017)	(44 - 53)/(8 - 6)	-4.5
49 (4/6/2018)	53 (4/28/2017)	(49 - 53)/(9 - 6)	-1.33333
51 (5/30/2018)	53 (4/28/2017)	(51 - 53)/(10 - 6)	-0.5
59 (10/16/2018)	53 (4/28/2017)	(59 - 53)/(11 - 6)	1.2
62 (3/29/2019)	53 (4/28/2017)	(62 - 53)/(12 - 6)	1.5
44 (7/21/2017)	51 (6/16/2017)	(44 - 51)/(8 - 7)	-7
49 (4/6/2018)	51 (6/16/2017)	(49 - 51)/(9 - 7)	-1
51 (5/30/2018)	51 (6/16/2017)	(51 - 51)/(10 - 7)	0
59 (10/16/2018)	51 (6/16/2017)	(59 - 51)/(11 - 7)	2
62 (3/29/2019)	51 (6/16/2017)	(62 - 51)/(12 - 7)	2.2
49 (4/6/2018)	44 (7/21/2017)	(49 - 44)/(9 - 8)	5
51 (5/30/2018)	44 (7/21/2017)	(51 - 44)/(10 - 8)	3.5
59 (10/16/2018)	44 (7/21/2017)	(59 - 44)/(11 - 8)	5
62 (3/29/2019)	44 (7/21/2017)	(62 - 44)/(12 - 8)	4.5
51 (5/30/2018)	49 (4/6/2018)	(51 - 49)/(10 - 9)	2
59 (10/16/2018)	49 (4/6/2018)	(59 - 49)/(11 - 9)	5
62 (3/29/2019)	49 (4/6/2018)	(62 - 49)/(12 - 9)	4.33333
59 (10/16/2018)	51 (5/30/2018)	(59 - 51)/(11 - 10)	8
62 (3/29/2019)	51 (5/30/2018)	(62 - 51)/(12 - 10)	5.5
62 (3/29/2019)	59 (10/16/2018)	(62 - 59)/(12 - 11)	3

Number of Q values = 66

Ordered Q Values

n	Q
1	-7
2	-4.5
3	-3
4	-2.5
5	-2
6	-2
7	-1.66667
8	-1.5
9	-1.33333
10	-1.33333
11	-1.2
12	-1
13	-1
14	-0.571429
15	-0.5
16	-0.5
17	-0.4
18	-0.25
19	-0.166667
20	0
21	0
22	0
23	0
24	0.142857
25	0.2
26	0.25

27	0.4
28	0.5
29	0.625
30	0.666667
31	0.777778
32	0.9
33	1
34	1
35	1
36	1
37	1.125
38	1.16667
39	1.2
40	1.25
41	1.33333
42	1.33333
43	1.5
44	1.5
45	1.57143
46	1.63636
47	1.66667
48	1.75
49	1.8
50	1.85714
51	2
52	2
53	2.2
54	2.5
55	3
56	3
57	3.5
58	4
59	4.33333
60	4.5
61	5
62	5
63	5
64	5.5
65	8
66	9

Sen's Estimator (Median Q) is 1

Tied Group	Value	Members
1	44	2
2	53	2
3	49	2
4	51	2

Time Period	Observations
8/5/2016	1
9/30/2016	1
11/18/2016	1
1/20/2017	1
3/10/2017	1
4/28/2017	1
6/16/2017	1
7/21/2017	1
4/6/2018	1
5/30/2018	1

10/16/2018 1
3/29/2019 1
There are 0 time periods with multiple data

A = 72
B = 0
C = 0
D = 0
E = 8
F = 0
a = 3828
b = 11880
c = 264
Group Variance = 208.667
For 95% confidence interval (two-tailed), Z at (1-0.95)/2 = 1.97737
C = 28.5637
M1 = (66 - 28.5637)/2.0 = 18.7182
M2 = (66 + 28.5637)/2.0 + 1 = 48.2818
Lower limit is -0.166667 = Q(19)
Upper limit is 1.75 = Q(48)
-0.166667 < 0 < 1.75 indicating no trend in data.

Sen's Slope Analysis

Parameter: Lithium

Location: MW-16-02

Original Data (Not Transformed)

Non-Detects Replaced with 1/2 DL

95% Confidence Level

Xj	Xk	(Xj - Xk)/(j-k)	Q
64 (9/30/2016)	57 (8/5/2016)	(64 - 57)/(2 - 1)	7
62 (11/18/2016)	57 (8/5/2016)	(62 - 57)/(3 - 1)	2.5
64 (1/20/2017)	57 (8/5/2016)	(64 - 57)/(4 - 1)	2.33333
58 (3/10/2017)	57 (8/5/2016)	(58 - 57)/(5 - 1)	0.25
71 (4/28/2017)	57 (8/5/2016)	(71 - 57)/(6 - 1)	2.8
64 (6/16/2017)	57 (8/5/2016)	(64 - 57)/(7 - 1)	1.16667
52 (7/21/2017)	57 (8/5/2016)	(52 - 57)/(8 - 1)	-0.714286
45 (4/6/2018)	57 (8/5/2016)	(45 - 57)/(9 - 1)	-1.5
28 (5/30/2018)	57 (8/5/2016)	(28 - 57)/(10 - 1)	-3.22222
27 (10/16/2018)	57 (8/5/2016)	(27 - 57)/(11 - 1)	-3
21 (3/29/2019)	57 (8/5/2016)	(21 - 57)/(12 - 1)	-3.27273
62 (11/18/2016)	64 (9/30/2016)	(62 - 64)/(3 - 2)	-2
64 (1/20/2017)	64 (9/30/2016)	(64 - 64)/(4 - 2)	0
58 (3/10/2017)	64 (9/30/2016)	(58 - 64)/(5 - 2)	-2
71 (4/28/2017)	64 (9/30/2016)	(71 - 64)/(6 - 2)	1.75
64 (6/16/2017)	64 (9/30/2016)	(64 - 64)/(7 - 2)	0
52 (7/21/2017)	64 (9/30/2016)	(52 - 64)/(8 - 2)	-2
45 (4/6/2018)	64 (9/30/2016)	(45 - 64)/(9 - 2)	-2.71429
28 (5/30/2018)	64 (9/30/2016)	(28 - 64)/(10 - 2)	-4.5
27 (10/16/2018)	64 (9/30/2016)	(27 - 64)/(11 - 2)	-4.11111
21 (3/29/2019)	64 (9/30/2016)	(21 - 64)/(12 - 2)	-4.3
64 (1/20/2017)	62 (11/18/2016)	(64 - 62)/(4 - 3)	2
58 (3/10/2017)	62 (11/18/2016)	(58 - 62)/(5 - 3)	-2
71 (4/28/2017)	62 (11/18/2016)	(71 - 62)/(6 - 3)	3
64 (6/16/2017)	62 (11/18/2016)	(64 - 62)/(7 - 3)	0.5
52 (7/21/2017)	62 (11/18/2016)	(52 - 62)/(8 - 3)	-2
45 (4/6/2018)	62 (11/18/2016)	(45 - 62)/(9 - 3)	-2.83333
28 (5/30/2018)	62 (11/18/2016)	(28 - 62)/(10 - 3)	-4.85714
27 (10/16/2018)	62 (11/18/2016)	(27 - 62)/(11 - 3)	-4.375
21 (3/29/2019)	62 (11/18/2016)	(21 - 62)/(12 - 3)	-4.55556
58 (3/10/2017)	64 (1/20/2017)	(58 - 64)/(5 - 4)	-6
71 (4/28/2017)	64 (1/20/2017)	(71 - 64)/(6 - 4)	3.5
64 (6/16/2017)	64 (1/20/2017)	(64 - 64)/(7 - 4)	0
52 (7/21/2017)	64 (1/20/2017)	(52 - 64)/(8 - 4)	-3
45 (4/6/2018)	64 (1/20/2017)	(45 - 64)/(9 - 4)	-3.8
28 (5/30/2018)	64 (1/20/2017)	(28 - 64)/(10 - 4)	-6
27 (10/16/2018)	64 (1/20/2017)	(27 - 64)/(11 - 4)	-5.28571
21 (3/29/2019)	64 (1/20/2017)	(21 - 64)/(12 - 4)	-5.375
71 (4/28/2017)	58 (3/10/2017)	(71 - 58)/(6 - 5)	13
64 (6/16/2017)	58 (3/10/2017)	(64 - 58)/(7 - 5)	3
52 (7/21/2017)	58 (3/10/2017)	(52 - 58)/(8 - 5)	-2
45 (4/6/2018)	58 (3/10/2017)	(45 - 58)/(9 - 5)	-3.25
28 (5/30/2018)	58 (3/10/2017)	(28 - 58)/(10 - 5)	-6
27 (10/16/2018)	58 (3/10/2017)	(27 - 58)/(11 - 5)	-5.16667
21 (3/29/2019)	58 (3/10/2017)	(21 - 58)/(12 - 5)	-5.28571

64 (6/16/2017)	71 (4/28/2017)	(64 - 71)/(7 - 6)	-7
52 (7/21/2017)	71 (4/28/2017)	(52 - 71)/(8 - 6)	-9.5
45 (4/6/2018)	71 (4/28/2017)	(45 - 71)/(9 - 6)	-8.66667
28 (5/30/2018)	71 (4/28/2017)	(28 - 71)/(10 - 6)	-10.75
27 (10/16/2018)	71 (4/28/2017)	(27 - 71)/(11 - 6)	-8.8
21 (3/29/2019)	71 (4/28/2017)	(21 - 71)/(12 - 6)	-8.33333
52 (7/21/2017)	64 (6/16/2017)	(52 - 64)/(8 - 7)	-12
45 (4/6/2018)	64 (6/16/2017)	(45 - 64)/(9 - 7)	-9.5
28 (5/30/2018)	64 (6/16/2017)	(28 - 64)/(10 - 7)	-12
27 (10/16/2018)	64 (6/16/2017)	(27 - 64)/(11 - 7)	-9.25
21 (3/29/2019)	64 (6/16/2017)	(21 - 64)/(12 - 7)	-8.6
45 (4/6/2018)	52 (7/21/2017)	(45 - 52)/(9 - 8)	-7
28 (5/30/2018)	52 (7/21/2017)	(28 - 52)/(10 - 8)	-12
27 (10/16/2018)	52 (7/21/2017)	(27 - 52)/(11 - 8)	-8.33333
21 (3/29/2019)	52 (7/21/2017)	(21 - 52)/(12 - 8)	-7.75
28 (5/30/2018)	45 (4/6/2018)	(28 - 45)/(10 - 9)	-17
27 (10/16/2018)	45 (4/6/2018)	(27 - 45)/(11 - 9)	-9
21 (3/29/2019)	45 (4/6/2018)	(21 - 45)/(12 - 9)	-8
27 (10/16/2018)	28 (5/30/2018)	(27 - 28)/(11 - 10)	-1
21 (3/29/2019)	28 (5/30/2018)	(21 - 28)/(12 - 10)	-3.5
21 (3/29/2019)	27 (10/16/2018)	(21 - 27)/(12 - 11)	-6

Number of Q values = 66

Ordered Q Values

n	Q
1	-17
2	-12
3	-12
4	-12
5	-10.75
6	-9.5
7	-9.5
8	-9.25
9	-9
10	-8.8
11	-8.66667
12	-8.6
13	-8.33333
14	-8.33333
15	-8
16	-7.75
17	-7
18	-7
19	-6
20	-6
21	-6
22	-6
23	-5.375
24	-5.28571
25	-5.28571
26	-5.16667

27	-4.85714
28	-4.55556
29	-4.5
30	-4.375
31	-4.3
32	-4.11111
33	-3.8
34	-3.5
35	-3.27273
36	-3.25
37	-3.22222
38	-3
39	-3
40	-2.83333
41	-2.71429
42	-2
43	-2
44	-2
45	-2
46	-2
47	-2
48	-1.5
49	-1
50	-0.714286
51	0
52	0
53	0
54	0.25
55	0.5
56	1.16667
57	1.75
58	2
59	2.33333
60	2.5
61	2.8
62	3
63	3
64	3.5
65	7
66	13

Sen's Estimator (Median Q) is -3.65

Tied Group	Value	Members
1	64	3

Time Period	Observations
8/5/2016	1
9/30/2016	1
11/18/2016	1
1/20/2017	1
3/10/2017	1
4/28/2017	1
6/16/2017	1
7/21/2017	1
4/6/2018	1
5/30/2018	1
10/16/2018	1
3/29/2019	1

There are 0 time periods with multiple data

A = 66
B = 0
C = 6
D = 0
E = 6
F = 0
a = 3828
b = 11880
c = 264
Group Variance = 209
For 95% confidence interval (two-tailed), Z at (1-0.95)/2 = 1.97737
C = 28.5865
M1 = (66 - 28.5865)/2.0 = 18.7068
M2 = (66 + 28.5865)/2.0 + 1 = 48.2932
Lower limit is -6 = Q(19)
Upper limit is -1.5 = Q(48)
-1.5 < 0 indicating a downward trend in data.

Sen's Slope Analysis

Parameter: Lithium

Location: MW-16-03

Original Data (Not Transformed)

Cohen's Adjustment

95% Confidence Level

Xj	Xk	(Xj - Xk)/(j-k)	Q
44 (9/30/2016)	29 (8/5/2016)	(44 - 29)/(2 - 1)	15
44 (11/18/2016)	29 (8/5/2016)	(44 - 29)/(3 - 1)	7.5
49 (1/20/2017)	29 (8/5/2016)	(49 - 29)/(4 - 1)	6.66667
45 (3/10/2017)	29 (8/5/2016)	(45 - 29)/(5 - 1)	4
51 (4/28/2017)	29 (8/5/2016)	(51 - 29)/(6 - 1)	4.4
49 (6/16/2017)	29 (8/5/2016)	(49 - 29)/(7 - 1)	3.33333
41 (7/21/2017)	29 (8/5/2016)	(41 - 29)/(8 - 1)	1.71429
15 (4/6/2018)	29 (8/5/2016)	(15 - 29)/(9 - 1)	-1.75
11 (5/30/2018)	29 (8/5/2016)	(11 - 29)/(10 - 1)	-2
ND<8 U (10/16/2018)	29 (8/5/2016)	(8 - 29)/(11 - 1)	-2.1
ND<8 U (3/29/2019)	29 (8/5/2016)	(8 - 29)/(12 - 1)	-1.90909
44 (11/18/2016)	44 (9/30/2016)	(44 - 44)/(3 - 2)	0
49 (1/20/2017)	44 (9/30/2016)	(49 - 44)/(4 - 2)	2.5
45 (3/10/2017)	44 (9/30/2016)	(45 - 44)/(5 - 2)	0.333333
51 (4/28/2017)	44 (9/30/2016)	(51 - 44)/(6 - 2)	1.75
49 (6/16/2017)	44 (9/30/2016)	(49 - 44)/(7 - 2)	1
41 (7/21/2017)	44 (9/30/2016)	(41 - 44)/(8 - 2)	-0.5
15 (4/6/2018)	44 (9/30/2016)	(15 - 44)/(9 - 2)	-4.14286
11 (5/30/2018)	44 (9/30/2016)	(11 - 44)/(10 - 2)	-4.125
ND<8 U (10/16/2018)	44 (9/30/2016)	(8 - 44)/(11 - 2)	-4
ND<8 U (3/29/2019)	44 (9/30/2016)	(8 - 44)/(12 - 2)	-3.6
49 (1/20/2017)	44 (11/18/2016)	(49 - 44)/(4 - 3)	5
45 (3/10/2017)	44 (11/18/2016)	(45 - 44)/(5 - 3)	0.5
51 (4/28/2017)	44 (11/18/2016)	(51 - 44)/(6 - 3)	2.33333
49 (6/16/2017)	44 (11/18/2016)	(49 - 44)/(7 - 3)	1.25
41 (7/21/2017)	44 (11/18/2016)	(41 - 44)/(8 - 3)	-0.6
15 (4/6/2018)	44 (11/18/2016)	(15 - 44)/(9 - 3)	-4.83333
11 (5/30/2018)	44 (11/18/2016)	(11 - 44)/(10 - 3)	-4.71429
ND<8 U (10/16/2018)	44 (11/18/2016)	(8 - 44)/(11 - 3)	-4.5
ND<8 U (3/29/2019)	44 (11/18/2016)	(8 - 44)/(12 - 3)	-4
45 (3/10/2017)	49 (1/20/2017)	(45 - 49)/(5 - 4)	-4
51 (4/28/2017)	49 (1/20/2017)	(51 - 49)/(6 - 4)	1
49 (6/16/2017)	49 (1/20/2017)	(49 - 49)/(7 - 4)	0
41 (7/21/2017)	49 (1/20/2017)	(41 - 49)/(8 - 4)	-2
15 (4/6/2018)	49 (1/20/2017)	(15 - 49)/(9 - 4)	-6.8
11 (5/30/2018)	49 (1/20/2017)	(11 - 49)/(10 - 4)	-6.33333
ND<8 U (10/16/2018)	49 (1/20/2017)	(8 - 49)/(11 - 4)	-5.85714
ND<8 U (3/29/2019)	49 (1/20/2017)	(8 - 49)/(12 - 4)	-5.125
51 (4/28/2017)	45 (3/10/2017)	(51 - 45)/(6 - 5)	6
49 (6/16/2017)	45 (3/10/2017)	(49 - 45)/(7 - 5)	2
41 (7/21/2017)	45 (3/10/2017)	(41 - 45)/(8 - 5)	-1.33333
15 (4/6/2018)	45 (3/10/2017)	(15 - 45)/(9 - 5)	-7.5
11 (5/30/2018)	45 (3/10/2017)	(11 - 45)/(10 - 5)	-6.8
ND<8 U (10/16/2018)	45 (3/10/2017)	(8 - 45)/(11 - 5)	-6.16667
ND<8 U (3/29/2019)	45 (3/10/2017)	(8 - 45)/(12 - 5)	-5.28571

49 (6/16/2017)	51 (4/28/2017)	(49 - 51)/(7 - 6)	-2
41 (7/21/2017)	51 (4/28/2017)	(41 - 51)/(8 - 6)	-5
15 (4/6/2018)	51 (4/28/2017)	(15 - 51)/(9 - 6)	-12
11 (5/30/2018)	51 (4/28/2017)	(11 - 51)/(10 - 6)	-10
ND<8 U (10/16/2018)	51 (4/28/2017)	(8 - 51)/(11 - 6)	-8.6
ND<8 U (3/29/2019)	51 (4/28/2017)	(8 - 51)/(12 - 6)	-7.16667
41 (7/21/2017)	49 (6/16/2017)	(41 - 49)/(8 - 7)	-8
15 (4/6/2018)	49 (6/16/2017)	(15 - 49)/(9 - 7)	-17
11 (5/30/2018)	49 (6/16/2017)	(11 - 49)/(10 - 7)	-12.6667
ND<8 U (10/16/2018)	49 (6/16/2017)	(8 - 49)/(11 - 7)	-10.25
ND<8 U (3/29/2019)	49 (6/16/2017)	(8 - 49)/(12 - 7)	-8.2
15 (4/6/2018)	41 (7/21/2017)	(15 - 41)/(9 - 8)	-26
11 (5/30/2018)	41 (7/21/2017)	(11 - 41)/(10 - 8)	-15
ND<8 U (10/16/2018)	41 (7/21/2017)	(8 - 41)/(11 - 8)	-11
ND<8 U (3/29/2019)	41 (7/21/2017)	(8 - 41)/(12 - 8)	-8.25
11 (5/30/2018)	15 (4/6/2018)	(11 - 15)/(10 - 9)	-4
ND<8 U (10/16/2018)	15 (4/6/2018)	(8 - 15)/(11 - 9)	-3.5
ND<8 U (3/29/2019)	15 (4/6/2018)	(8 - 15)/(12 - 9)	-2.33333
ND<8 U (10/16/2018)	11 (5/30/2018)	(8 - 11)/(11 - 10)	-3
ND<8 U (3/29/2019)	11 (5/30/2018)	(8 - 11)/(12 - 10)	-1.5
ND<8 U (3/29/2019)	ND<8 U (10/16/2018)	(8 - 8)/(12 - 11)	0

Number of Q values = 66

Ordered Q Values

n	Q
1	-26
2	-17
3	-15
4	-12.6667
5	-12
6	-11
7	-10.25
8	-10
9	-8.6
10	-8.25
11	-8.2
12	-8
13	-7.5
14	-7.16667
15	-6.8
16	-6.8
17	-6.33333
18	-6.16667
19	-5.85714
20	-5.28571
21	-5.125
22	-5
23	-4.83333
24	-4.71429
25	-4.5
26	-4.14286

27	-4.125
28	-4
29	-4
30	-4
31	-4
32	-3.6
33	-3.5
34	-3
35	-2.33333
36	-2.1
37	-2
38	-2
39	-2
40	-1.90909
41	-1.75
42	-1.5
43	-1.33333
44	-0.6
45	-0.5
46	0
47	0
48	0
49	0.333333
50	0.5
51	1
52	1
53	1.25
54	1.71429
55	1.75
56	2
57	2.33333
58	2.5
59	3.33333
60	4
61	4.4
62	5
63	6
64	6.66667
65	7.5
66	15

Sen's Estimator (Median Q) is -3.25

Tied Group	Value	Members
1	44	2
2	49	2
3	8	2

Time Period	Observations
8/5/2016	1
9/30/2016	1
11/18/2016	1
1/20/2017	1
3/10/2017	1
4/28/2017	1
6/16/2017	1
7/21/2017	1
4/6/2018	1
5/30/2018	1
10/16/2018	1

There are 0 time periods with multiple data

A = 54
B = 0
C = 0
D = 0
E = 6
F = 0
a = 3828
b = 11880
c = 264
Group Variance = 209.667
For 95% confidence interval (two-tailed), Z at (1-0.95)/2 = 1.97737
C = 28.632
M1 = (66 - 28.632)/2.0 = 18.684
M2 = (66 + 28.632)/2.0 + 1 = 48.316
Lower limit is -5.85714 = Q(19)
Upper limit is 0 = Q(48)
-5.85714 < 0 < 0 indicating no trend in data.

Skewness Coefficient

Parameter: Arsenic

Original Data (Not Transformed)

Non-Detects Replaced with 1/2 DL

Skewness > 1 indicates positively skewed data
Skewness < -1 indicates negatively skewed data

Compliance Locations

Location	Obs.	Mean	Std. Dev.	Skewness
MW-16-01	4	165	5.7735	0
MW-16-02	4	6.975	5.92474	0.626242
MW-16-03	4	2.5	0	**Div 0**

All Locations

Obs.	Mean	Std. Dev.	Skewness
12	58.1583	79.049	0.837784

Skewness Coefficient

Parameter: Lithium

Original Data (Not Transformed)

Non-Detects Replaced with 1/2 DL

Skewness > 1 indicates positively skewed data
Skewness < -1 indicates negatively skewed data

Compliance Locations

Location	Obs.	Mean	Std. Dev.	Skewness
MW-16-01	4	55.25	6.23832	0.062426
MW-16-02	4	30.25	10.3078	0.833578
MW-16-03	4	8.5	5.44671	0.257258

All Locations

Obs.	Mean	Std. Dev.	Skewness
12	31.3333	21.1115	0.109619

Skewness Coefficient

Parameter: Lithium

Original Data (Not Transformed)

Cohen's Adjustment

Skewness > 1 indicates positively skewed data
Skewness < -1 indicates negatively skewed data

Compliance Locations

Location	Obs.	Mean	Std. Dev.	Skewness
MW-16-01	4	54.6856	8.37249	0.155933
MW-16-02	4	29.9153	10.7878	0.825369
MW-16-03	4	8.3226	5.60241	0.693561

All Locations

Obs.	Mean	Std. Dev.	Skewness
12	29.8923	23.3335	0.342511

Confidence Interval

Parameter: Arsenic

Original Data (Not Transformed)

Non-Detects Replaced with 1/2 DL

Compliance Locations

Location	**MW-16-01**
Mean	165
Std Dev	5.7735
Degrees of Freedom	3
Comparison Level	**32**
Untransformed Comp. Level	32

Confidence	**t-Stat**	**Interval**	**Mid-Point**	**Significant**
99%	4.54071	[151.892, 178.108]	165	**TRUE**
95%	2.35336	[158.206, 171.794]	165	**TRUE**

Location	**MW-16-02**
Mean	6.975
Std Dev	5.92474
Degrees of Freedom	3
Comparison Level	**32**
Untransformed Comp. Level	32

Confidence	**t-Stat**	**Interval**	**Mid-Point**	**Significant**
99%	4.54071	[-6.47625, 20.4262]	6.975	FALSE
95%	2.35336	[0.00347238, 13.9465]	6.975	FALSE

Location	**MW-16-03**
Mean	2.5
Std Dev	0
Degrees of Freedom	3
Comparison Level	**32**
Untransformed Comp. Level	32

Confidence	**t-Stat**	**Interval**	**Mid-Point**	**Significant**
99%	4.54071	[2.5, 2.5]	2.5	FALSE
95%	2.35336	[2.5, 2.5]	2.5	FALSE

Non-Parametric Confidence Interval

Parameter: Beryllium

Well: MW-16-02

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

99% Comparion Level

Total measurements = 4

Ranks

Point	Date	Value	Rank	Bkgrnd
MW-16-02	7/21/2017	ND<1 U	1.5	TRUE
MW-16-02	4/6/2018	ND<1 U	1.5	TRUE
MW-16-02	3/29/2019	1.4	3	TRUE
MW-16-02	6/16/2017	4.5	4	TRUE

M = 4

n + 1 - M = 1

Two Sided Confidence Level = 87.5%

Upper Confidence Interval X(4) = 4.5

Lower Confidence Inverval X(1) = 1

1 <= 4 Indicating No Statistical Significance

Confidence Interval

Parameter: Lithium

Original Data (Not Transformed)

Non-Detects Replaced with 1/2 DL

Compliance Locations

Location	**MW-16-01**
Mean	55.25
Std Dev	6.23832
Degrees of Freedom	3
Comparison Level	**40**
Untransformed Comp. Level	40

Confidence	**t-Stat**	**Interval**	**Mid-Point**	**Significant**
99%	4.54071	[41.0868, 69.4132]	55.25	**TRUE**
95%	2.35336	[47.9095, 62.5905]	55.25	**TRUE**

Location	**MW-16-02**
Mean	30.25
Std Dev	10.3078
Degrees of Freedom	3
Comparison Level	**40**
Untransformed Comp. Level	40

Confidence	**t-Stat**	**Interval**	**Mid-Point**	**Significant**
99%	4.54071	[6.84773, 53.6523]	30.25	FALSE
95%	2.35336	[18.121, 42.379]	30.25	FALSE

Location	**MW-16-03**
Mean	8.5
Std Dev	5.44671
Degrees of Freedom	3
Comparison Level	**40**
Untransformed Comp. Level	40

Confidence	**t-Stat**	**Interval**	**Mid-Point**	**Significant**
99%	4.54071	[-3.86596, 20.866]	8.5	FALSE
95%	2.35336	[2.09096, 14.909]	8.5	FALSE

Confidence Interval

Parameter: Lithium

Original Data (Not Transformed)

Cohen's Adjustment

Compliance Locations

Location	**MW-16-01**
Mean	54.6856
Std Dev	8.37249
Degrees of Freedom	3
Comparison Level	**40**
Untransformed Comp. Level	40

Confidence	**t-Stat**	**Interval**	**Mid-Point**	**Significant**
99%	4.54071	[35.6771, 73.6941]	54.6856	FALSE
95%	2.35336	[44.8339, 64.5374]	54.6856	**TRUE**

Location	**MW-16-02**
Mean	29.9153
Std Dev	10.7878
Degrees of Freedom	3
Comparison Level	**40**
Untransformed Comp. Level	40

Confidence	**t-Stat**	**Interval**	**Mid-Point**	**Significant**
99%	4.54071	[5.42319, 54.4073]	29.9153	FALSE
95%	2.35336	[17.2215, 42.609]	29.9153	FALSE

Location	**MW-16-03**
Mean	8.3226
Std Dev	5.60241
Degrees of Freedom	3
Comparison Level	**40**
Untransformed Comp. Level	40

Confidence	**t-Stat**	**Interval**	**Mid-Point**	**Significant**
99%	4.54071	[-4.39685, 21.0421]	8.3226	FALSE
95%	2.35336	[1.73035, 14.9149]	8.3226	FALSE

Appendix C
Appendix IV Assessment Monitoring Statistical Evaluation – September 2019 Data

1540 Eisenhower Pl.
Ann Arbor, MI 48108

T 734.971.7080
TRCcompanies.com

Technical Memorandum

Date: January 13, 2020

To: DTE Electric Company

From: Darby Litz, TRC
Sarah Holmstrom, TRC
Meredith Brehob, TRC

Project No.: 320511.0005.0000 Phase 001, Task 001

Subject: Appendix IV Assessment Monitoring Statistical Evaluation for September 2019 Groundwater Monitoring Event – DTE Electric Company, River Rouge Power Plant, Bottom Ash Basin Coal Combustion Residual Unit

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 July 30, 2018. The CCR Rule, which became effective on October 19, 2015 (amendment effective August 29, 2018), applies to DTE Electric Company (DTE Electric) River Rouge Power Plant (RRPP) Coal Combustion Residual Bottom Ash Basin (BAB) CCR unit located in River Rouge, Michigan (the Site).

In response to the statistically significant increases (SSIs) above background for boron, fluoride and pH, DTE Electric established an Assessment Monitoring Program for the RRPP BAB CCR unit pursuant to §257.94(e) of the CCR Rule as presented in the April 13, 2018 *Establishment of an Assessment Monitoring Program River Rouge Power Plant Bottom Ash Basin Coal Combustion Residual Unit* letter. In accordance with §257.95, TRC conducted two assessment monitoring events, a preliminary and subsequent initial semiannual assessment monitoring event, at the RRPP BAB CCR unit. The preliminary Appendix IV only assessment monitoring event (per §257.95(b)) was performed on April 6, 2018, and the subsequent initial semiannual assessment monitoring event (per §257.95(d), Appendix III and IV parameters) was performed on May 30 and 31, 2018. The results from the initial assessment monitoring sampling event were used to establish groundwater protection standards (GWPSs) for the Appendix IV constituents in accordance with §257.95(h). The results from the assessment monitoring sampling events were subsequently used to perform the statistical comparison to the established GWPSs.

On October 15, 2018, it was determined that pursuant to §257.93 (h) that arsenic and lithium are present at statistically significant levels above their respective GWPSs at one or more down gradient well locations at the RRPP BAB CCR unit[1].

Although DTE Electric has completed an assessment of corrective measures per §257.95(g)(3), DTE Electric is currently operating a groundwater extraction system as a presumptive remedy to maintain hydraulic control around the RRPP BAB to address the uncertainty around the potential migration of CCR constituents from the RRPP BAB to groundwater. This system has effectively captured groundwater in the vicinity of the RRPP BAB CCR unit since it began operation on March 2, 2018 and eliminates the potential for Appendix III and Appendix IV parameters to migrate from the RRPP BAB CCR unit.

In accordance with §257.96(b), DTE Electric is continuing assessment monitoring for the RRPP BAB CCR unit. The second semiannual assessment monitoring event of 2019 for the Appendix III and Appendix IV constituents that were detected in the first semiannual assessment monitoring event of 2019 was conducted on September 26, 2019. In accordance with §257.95, the assessment monitoring data must be compared to determine whether or not Appendix IV constituents are detected at statistically significant levels above the GWPSs. This memorandum presents the limits derived for the Appendix IV parameters for the RRPP BAB CCR unit that will be used to compare to the GWPSs.

Assessment Monitoring Statistical Evaluation

The three compliance wells utilized for the BAB CCR Unit are MW-16-01, MW-16-02 and MW-16-03. Following the second semiannual assessment monitoring sampling event for 2019, compliance well data for the RRPP BAB were evaluated in accordance with the *Groundwater Statistical Evaluation Plan* (Stats Plan) (TRC, October 2017; Revised December 2017). For each detected constituent, the concentrations for each well were first compared directly to the GWPS within a rolling window of eight sampling events. Parameter-well combinations that included a direct exceedance of the GWPS were retained for further analysis. As a result, arsenic was retained for evaluation at MW-16-01, beryllium at MW-16-02, and lithium at MW-16-01, MW-16-02, and MW-16-03.

Groundwater data were then evaluated utilizing ChemStat™ statistical software. ChemStat™ 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 ChemStat™ statistical program (and the UG), confidence limits were selected to perform the statistical comparison of compliance data to a fixed standard. Parametric and non-parametric confidence intervals were calculated for each of the CCR Appendix IV parameters using a 99 percent confidence level, i.e., a significance level (α) of 0.01. The

[1] TRC. 2018. *Notification of Appendix IV Constituents at Statistically Significant Levels Above the Groundwater Protection Standards; River Rouge Power Plant Bottom Ash Basin Coal Combustion Residual Unit,* October.

following narrative describes the methods employed, the results obtained and the ChemStat™ output files are included as an attachment.

Due to the initiation of operation of the groundwater extraction system to establish groundwater capture in the area of the BAB in March of 2018 and subsequent changes in groundwater flow rate and direction, the data set used for the September 2019 statistical evaluation was limited to the five most recent events. Use of the five most recent data points provides more than the minimum density of data (at least 4 data points) as recommended per the UG and is representative of current conditions at the BAB under the hydraulic influence of the groundwater extraction system. Additional data collected from monitoring events performed subsequent to March 2018 will continue to be incorporated into the statistical evaluation moving forward and will roll after eight rounds have accumulated, as appropriate.

The statistical data evaluation included the following steps:

- Review of data quality checklists for the baseline/background data sets for CCR Appendix IV constituents;
- Evaluation of percentage of non-detects for each baseline/background well-constituent pair;
- 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 visual trends apparent in the graphical representations for statistical significance;
- Distribution of the data; and
- Calculation of the confidence intervals for each cumulative dataset.

The results of these evaluations are presented and discussed below.

Data Quality

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

Percentage of Non-detects

The percentage of non-detect observations for constituents with one or more detection above a GWPS is included in Table 1. Non-detect data was handled in accordance with the Stats Plan for the purposes of calculating confidence intervals.

Time versus Concentration Graphs

The T v. C graphs show potential outliers for beryllium at MW-16-02 (individual detections in June 2017 and March 2019). This data set was assessed to determine whether the potential outliers are statistically significant, as discussed further below. The T v. C graphs showed potential trending for some Appendix IV well/constituent pairs. These were tested by the ChemStat™ software to assess whether the trends are statistically significant.

Outlier Testing

The Dixon's Outlier Test in ChemStat™ could not be used on the suspected beryllium outliers at MW-16-02 due to the high percentage of non-detects. To be conservative, since beryllium has been detected during two monitoring events at MW-16-02, the suspected outliers were retained for the calculation of confidence intervals.

Trend Analysis

Visual trends apparent in the T v. C graphs were evaluated in ChemStat™ using the Sens Slope estimator to determine if a subset of data should be used in calculating the confidence interval. Trends were evaluated using a 95-percent (two-tailed) confidence level, i.e., a significance level (α) of 0.05. A statistically significant decreasing trend was found in lithium at MW-16-02. This lithium decreasing trend will continue to be monitored and likely results from changes in groundwater quality due to operation of the groundwater extraction system.

Distribution of the Data Sets

ChemStat™ was utilized to evaluate each data set for normality. If the skewness coefficient was calculated to be between negative one and one, then the data were assumed to be approximately normally distributed. If the skewness coefficient was calculated as greater than one (or less than negative one) then the calculation was performed on the natural log (Ln) of the data. If the Ln of the data still determined that the data appeared to be skewed, then the Shapiro-Wilk test of normality (Shapiro-Wilk) was performed. The Shapiro-Wilk statistic was calculated on both non-transformed data, and the Ln-transformed data. If the Shapiro-Wilk statistic indicated that normal distributional assumptions were not valid, then the parameter was considered a candidate for non-parametric statistical evaluation. The data distributions are summarized in Table 1.

Confidence Intervals

Variability is recognized in the data set due to changing groundwater quality in response to the operation of the groundwater extraction system. Calculating a confidence interval around a trending data set incorporates not only variability present naturally in the underlying dataset but can exaggerate variability. The downward trend in lithium concentrations at MW-16-02 is likely causing the confidence interval to be much wider than expected given the confidence level (e.g., 99%) and sample size (n=5). However, lithium concentrations have already triggered assessment monitoring (e.g., not a newly identified GWPS exceedance) and remedial efforts are ongoing; therefore, traditional confidence interval calculations are presented in this statistical evaluation until more data are available. Once groundwater conditions stabilize under the current system operation with a more consistent trend, and additional post-treatment data are collected, confidence bands may be a more appropriate option to determine compliance with the CCR Rule. Confidence bands are selected by the UG as the appropriate method for calculating confidence intervals on trending data. A confidence band calculates upper and lower confidence limits at each point along the trend to reduce variability and create a narrower confidence interval. At least 8 to 10 measurements should be available when computing a confidence band around a linear regression.

Table 1 presents the calculated confidence intervals for each well-constituent pair. For normal and lognormal distributions, confidence intervals are calculated for 99 percent confidence using parametric methods. For non-normal background datasets, a nonparametric confidence interval is utilized, resulting in the highest and lowest values from the contributing dataset as the confidence limits. Confidence intervals were calculated using only the five most recent sampling events to ensure that data was recent enough to be representative of current site conditions.

The confidence intervals calculated through the above-described process will be compared to the GWPS to determine if an exceedance has occurred. An exceedance of the standard occurs when the 99 percent lower confidence level of the downgradient data exceeds the GWPS. If the statistical tests conclude that an exceedance of the GWPS, verification resampling may be conducted by the facility. Once the resampling data are available, the comparison to the GWPS will be evaluated.

Attachments

Table 1 – Summary of Descriptive Statistics and Confidence Interval Calculations
Attachment A – ChemStat™ Outputs

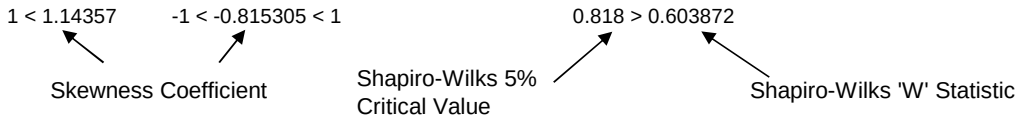
Table 1

Summary of Descriptive Statistics and Confidence Interval Calculations

Table 1
Summary of Descriptive Statistics and Confidence Interval Calculations
Assessment Monitoring Statistical Evaluation - September 2019
DTE Electric Company – River Rouge Power Plant

Parameter[1]	Percent Non-Detect	Outliers?	Trend?	Skewness		Shapiro-Wilks Test (5% Critical Value)		Parametric / Non-Parametric	Confidence Interval[2]
				Un-Transformed	Natural Log	Un-Transformed	Natural Log		
MW-16-01									
Arsenic	0%	No	No	-1 < -0.912871 < 1	--	--	--	Parametric	[140, 180]
Lithium	0%	No	No	-1 < 0.399936 < 1	--	--	--	Parametric	[45, 64]
MW-16-02									
Beryllium	60%	No	No	--	--	--	--	Non-Parametric	[1.0, 4.5]
Lithium	0%	No	Yes	-1 < 0.932281 < 1	--	--	--	Parametric	[10, 45]
MW-16-03									
Lithium	60%	No	No	--	--	--	--	Non-Parametric	[8, 15]

Notes:



(1) Well-parameter combinations that have one or more direct exceedances of the Groundwater Protection Standard within a rolling window of eight sampling events.
(2) The most recent five data points are used to calculate the confidence interval to be representative of current conditions.

Attachment A

ChemStat™ Confidence Interval Outputs

Concentrations (ug/L)

Parameter: Arsenic

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

Total Measurements: 39
Total Non-Detect: 8
Percent Non-Detects: 20.5128%
Total Background Measurements: 0
There are 0 background locations

Loc.	Meas.	ND	Date	Conc.	Original
There are 3 compliance locations					
Loc.	**Meas.**	**ND**	**Date**	**Conc.**	**Original**
MW-16-01	13	0 (0%)	8/5/2016	37	37
			9/30/2016	37	37
			11/18/2016	39	39
			1/20/2017	40	40
			3/10/2017	38	38
			4/28/2017	37	37
			6/16/2017	35	35
			7/21/2017	36	36
			4/6/2018	160	160
			5/30/2018	170	170
			10/16/2018	160	160
			3/29/2019	170	170
			9/26/2019	140	140
MW-16-02	13	3 (23.0769%)	8/5/2016	24	24
			9/30/2016	27	27
			11/18/2016	30	30
			1/20/2017	31	31
			3/10/2017	29	29
			4/28/2017	30	30
			6/16/2017	30	30
			7/21/2017	27	27
			4/6/2018	15	15
			5/30/2018	ND<5 U	ND<5 U
			10/16/2018	7.9	7.9
			3/29/2019	ND<5 U	ND<5 U
			9/26/2019	ND<5 U	ND<5 U
MW-16-03	13	5 (38.4615%)	8/5/2016	91	91
			9/30/2016	40	40
			11/18/2016	21	21
			1/20/2017	13	13
			3/10/2017	12	12
			4/28/2017	12	12
			6/16/2017	12	12
			7/21/2017	12	12
			4/6/2018	ND<5 U	ND<5 U
			5/30/2018	ND<5 U	ND<5 U
			10/16/2018	ND<5 U	ND<5 U
			3/29/2019	ND<5 U	ND<5 U
			9/26/2019	ND<5 U	ND<5 U

There are 0 unused locations

Loc.	Meas.	ND	Date	Conc.	Original

Concentrations (ug/L)

Parameter: Beryllium

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

Total Measurements: 33
Total Non-Detect: 30
Percent Non-Detects: 90.9091%
Total Background Measurements: 0
There are 0 background locations

Loc.	Meas.	ND	Date	Conc.	Original

There are 3 compliance locations

Loc.	Meas.	ND	Date	Conc.	Original
MW-16-01	11	10 (90.9091%)	8/5/2016	ND<1 U	ND<1 U
			9/30/2016	ND<1 U	ND<1 U
			11/18/2016	ND<1 U	ND<1 U
			1/20/2017	ND<1 U	ND<1 U
			3/10/2017	ND<1 U	ND<1 U
			4/28/2017	ND<1 U	ND<1 U
			6/16/2017	3.8	3.8
			7/21/2017	ND<1 U	ND<1 U
			4/6/2018	ND<1 U	ND<1 U
			3/29/2019	ND<1 U	ND<1 U
			9/26/2019	ND<1 U	ND<1 U
MW-16-02	11	9 (81.8182%)	8/5/2016	ND<1 U	ND<1 U
			9/30/2016	ND<1 U	ND<1 U
			11/18/2016	ND<1 U	ND<1 U
			1/20/2017	ND<1 U	ND<1 U
			3/10/2017	ND<1 U	ND<1 U
			4/28/2017	ND<1 U	ND<1 U
			6/16/2017	4.5	4.5
			7/21/2017	ND<1 U	ND<1 U
			4/6/2018	ND<1 U	ND<1 U
			3/29/2019	1.4	1.4
			9/26/2019	ND<1 U	ND<1 U
MW-16-03	11	11 (100%)	8/5/2016	ND<1 U	ND<1 U
			9/30/2016	ND<1 U	ND<1 U
			11/18/2016	ND<1 U	ND<1 U
			1/20/2017	ND<1 U	ND<1 U
			3/10/2017	ND<1 U	ND<1 U
			4/28/2017	ND<1 U	ND<1 U
			6/16/2017	ND<1 U	ND<1 U
			7/21/2017	ND<1 U	ND<1 U
			4/6/2018	ND<1 U	ND<1 U
			3/29/2019	ND<1 U	ND<1 U
			9/26/2019	ND<1 U	ND<1 U

There are 0 unused locations

Loc.	Meas.	ND	Date	Conc.	Original

Concentrations (ug/L)

Parameter: Lithium

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

Total Measurements: 39
Total Non-Detect: 3
Percent Non-Detects: 7.69231%
Total Background Measurements: 0
There are 0 background locations

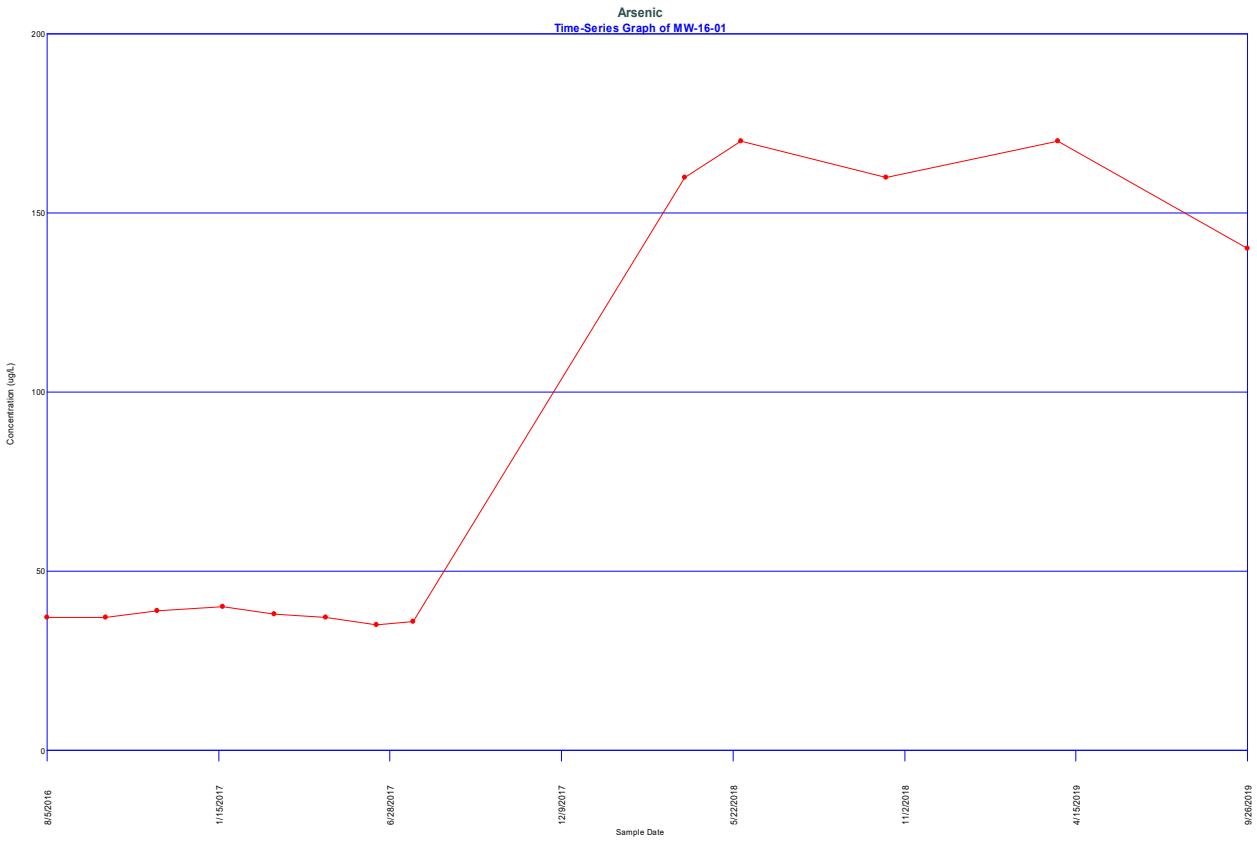
Loc.	Meas.	ND	Date	Conc.	Original

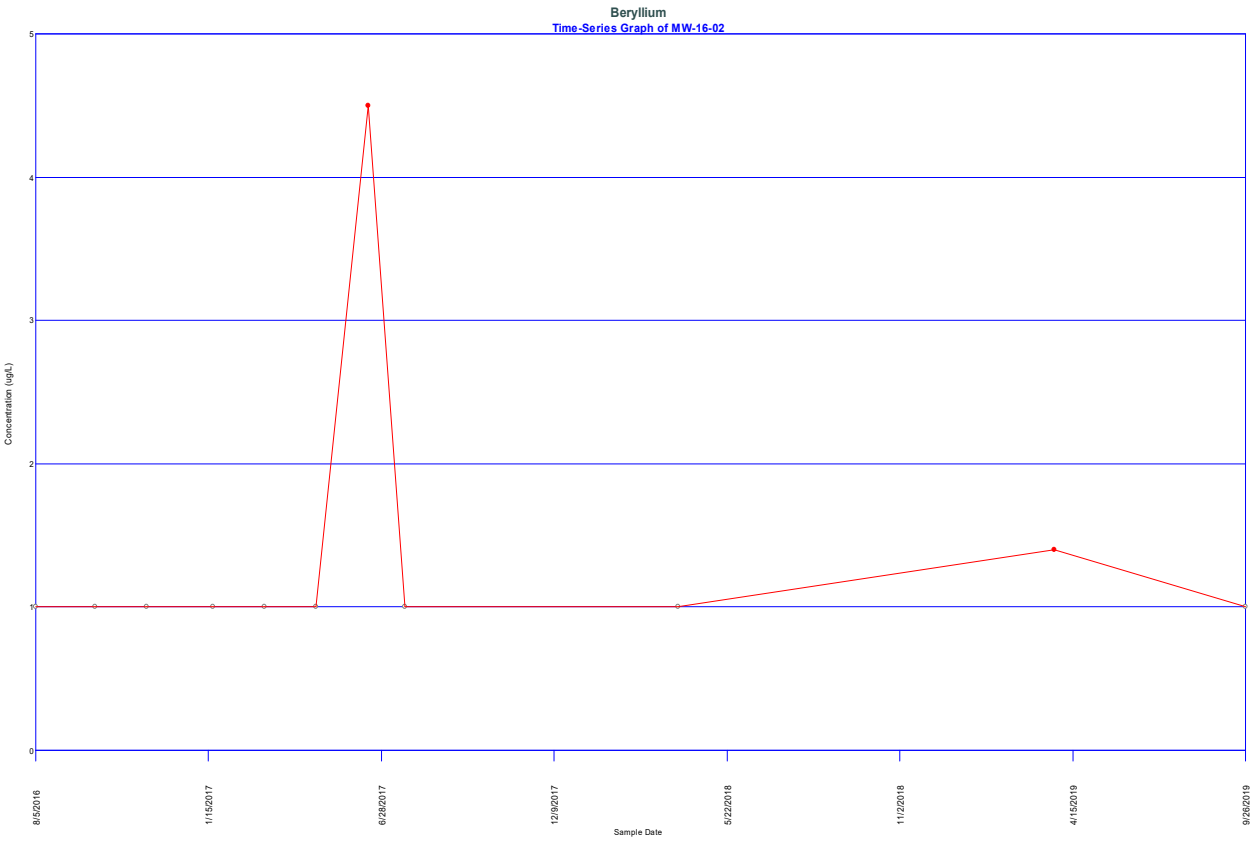
There are 3 compliance locations

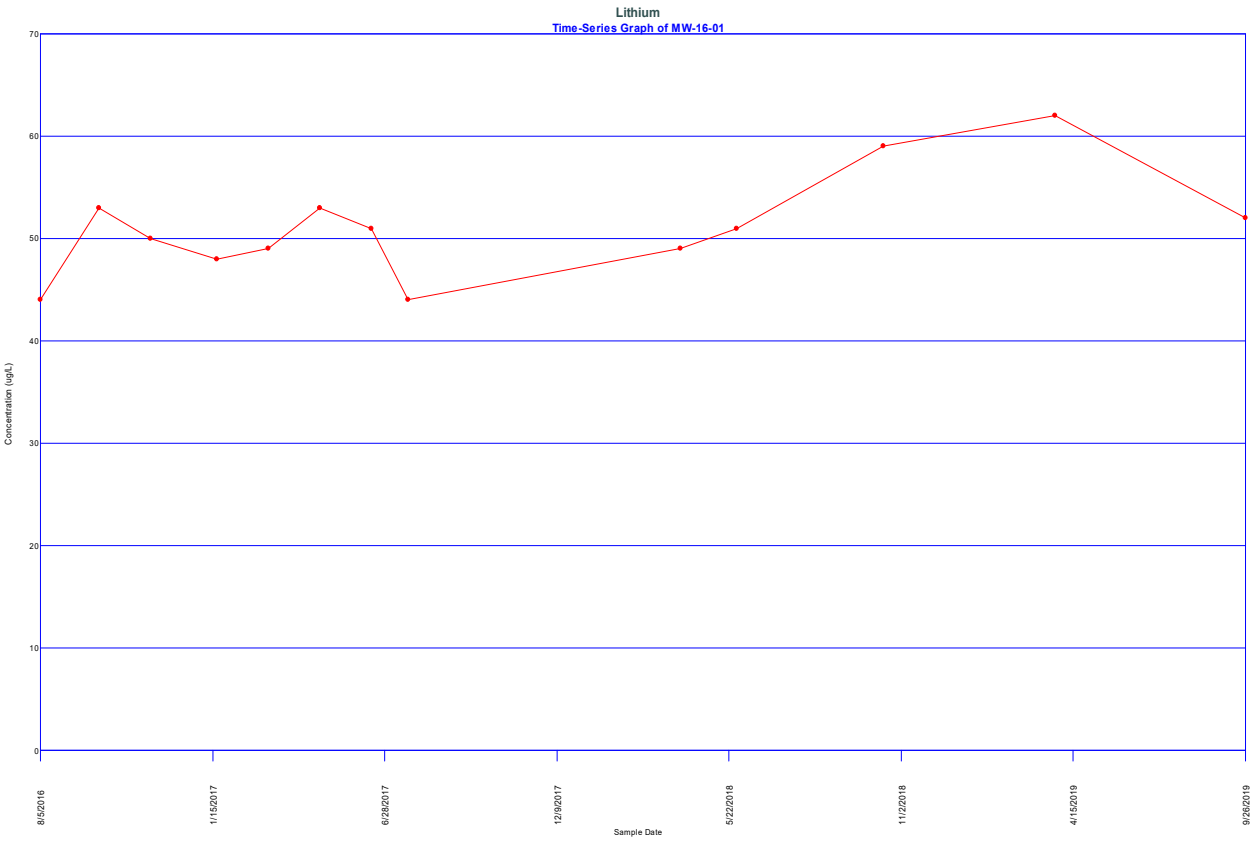
Loc.	Meas.	ND	Date	Conc.	Original
MW-16-01	13	0 (0%)	8/5/2016	44	44
			9/30/2016	53	53
			11/18/2016	50	50
			1/20/2017	48	48
			3/10/2017	49	49
			4/28/2017	53	53
			6/16/2017	51	51
			7/21/2017	44	44
			4/6/2018	49	49
			5/30/2018	51	51
			10/16/2018	59	59
			3/29/2019	62	62
			9/26/2019	52	52
MW-16-02	13	0 (0%)	8/5/2016	57	57
			9/30/2016	64	64
			11/18/2016	62	62
			1/20/2017	64	64
			3/10/2017	58	58
			4/28/2017	71	71
			6/16/2017	64	64
			7/21/2017	52	52
			4/6/2018	45	45
			5/30/2018	28	28
			10/16/2018	27	27
			3/29/2019	21	21
			9/26/2019	18	18
MW-16-03	13	3 (23.0769%)	8/5/2016	29	29
			9/30/2016	44	44
			11/18/2016	44	44
			1/20/2017	49	49
			3/10/2017	45	45
			4/28/2017	51	51
			6/16/2017	49	49
			7/21/2017	41	41
			4/6/2018	15	15
			5/30/2018	11	11
			10/16/2018	ND<8 U	ND<8 U
			3/29/2019	ND<8 U	ND<8 U
			9/26/2019	ND<8 U	ND<8 U

There are 0 unused locations

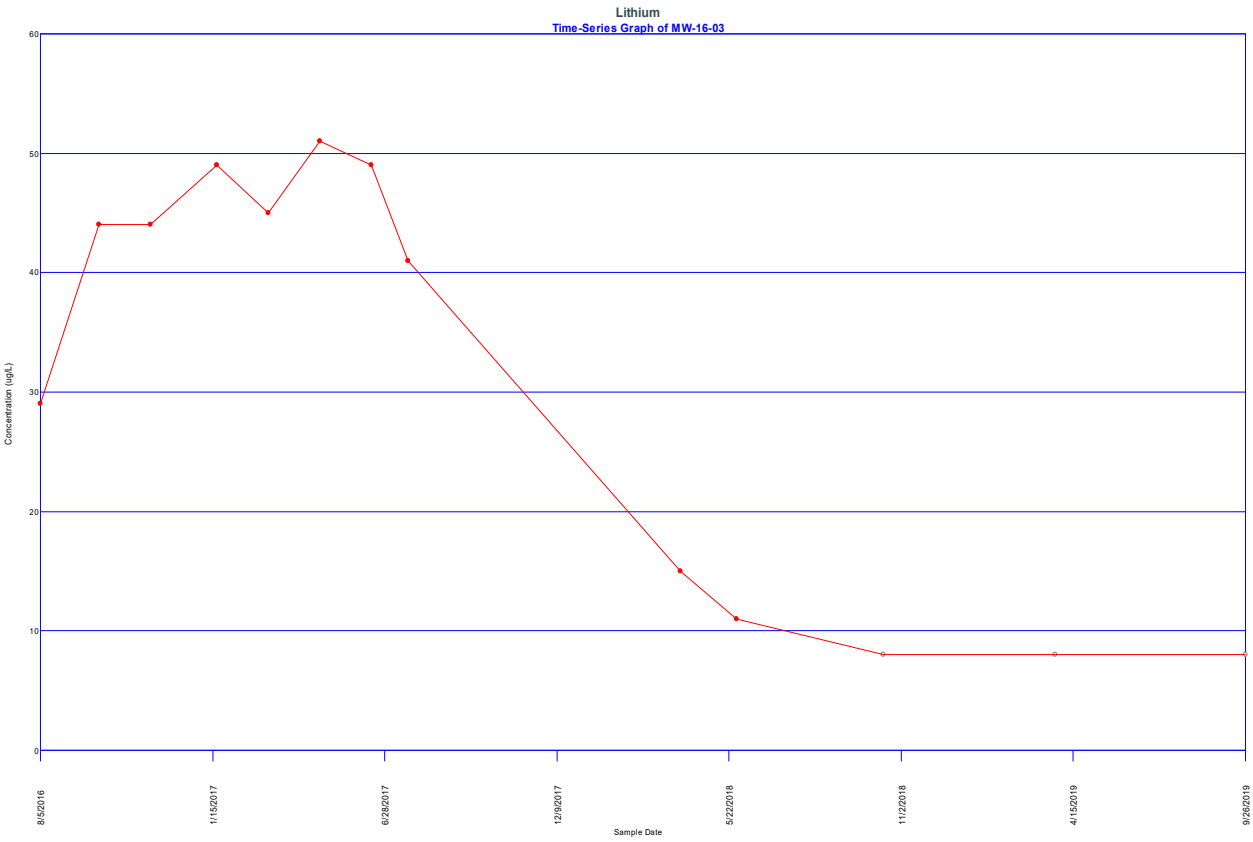
Loc.	Meas.	ND	Date	Conc.	Original


Arsenic
Time-Series Graph of MW-16-01
200
150
100
50
0
Concentration (ug/L)
8/5/2016
1/15/2017
6/28/2017
12/9/2017
5/22/2018
11/2/2018
4/15/2019
9/26/2019
Sample Date


Beryllium
Time-Series Graph of MW-16-02
Concentration (ug/L)
5
4
3
2
1
0
8/5/2016
1/15/2017
6/28/2017
12/9/2017
5/22/2018
11/2/2018
4/15/2019
9/26/2019
Sample Date


Lithium
Time-Series Graph of MW-16-01
70
60
50
40
30
20
10
0
Concentration (ug/L)
8/5/2016
1/15/2017
6/28/2017
12/9/2017
5/22/2018
11/2/2018
4/15/2019
9/26/2019
Sample Date


Lithium
Time-Series Graph of MW-16-02
Concentration (ug/L)
80
70
60
50
40
30
20
10
0
8/5/2016
1/15/2017
6/28/2017
12/9/2017
5/22/2018
11/2/2018
4/15/2019
9/26/2019
Sample Date


Lithium
Time-Series Graph of MW-16-03
Concentration (ug/L)
60
50
40
30
20
10
0
8/5/2016
1/15/2017
6/28/2017
12/9/2017
5/22/2018
11/2/2018
4/15/2019
9/26/2019
Sample Date

Sen's Slope Analysis

Parameter: Lithium
Location: MW-16-02

Original Data (Not Transformed)
Non-Detects Replaced with 1/2 DL

95% Confidence Level

Xj	Xk	(Xj - Xk)/(j-k)	Q
28 (5/30/2018)	45 (4/6/2018)	(28 - 45)/(2 - 1)	-17
27 (10/16/2018)	45 (4/6/2018)	(27 - 45)/(3 - 1)	-9
21 (3/29/2019)	45 (4/6/2018)	(21 - 45)/(4 - 1)	-8
18 (9/26/2019)	45 (4/6/2018)	(18 - 45)/(5 - 1)	-6.75
27 (10/16/2018)	28 (5/30/2018)	(27 - 28)/(3 - 2)	-1
21 (3/29/2019)	28 (5/30/2018)	(21 - 28)/(4 - 2)	-3.5
18 (9/26/2019)	28 (5/30/2018)	(18 - 28)/(5 - 2)	-3.33333
21 (3/29/2019)	27 (10/16/2018)	(21 - 27)/(4 - 3)	-6
18 (9/26/2019)	27 (10/16/2018)	(18 - 27)/(5 - 3)	-4.5
18 (9/26/2019)	21 (3/29/2019)	(18 - 21)/(5 - 4)	-3

Number of Q values = 10

Ordered Q Values

n	Q
1	-17
2	-9
3	-8
4	-6.75
5	-6
6	-4.5
7	-3.5
8	-3.33333
9	-3
10	-1

Sen's Estimator (Median Q) is -5.25

Time Period	Observations
4/6/2018	1
5/30/2018	1
10/16/2018	1
3/29/2019	1
9/26/2019	1

There are 0 time periods with multiple data

A = 0
B = 0
C = 0
D = 0
E = 0
F = 0
a = 300
b = 540
c = 40
Group Variance = 16.6667

For 95% confidence interval (two-tailed), Z at (1-0.95)/2 = 1.97737
C = 8.07257
M1 = (10 - 8.07257)/2.0 = 0.963713
M2 = (10 + 8.07257)/2.0 + 1 = 10.0363
Lower limit is -17 = Q(1)
Upper limit is -1 = Q(10)
-1 < 0 indicating a downward trend in data.

Skewness Coefficient

Parameter: Arsenic

Original Data (Not Transformed)

Non-Detects Replaced with 1/2 DL

Skewness > 1 indicates positively skewed data
Skewness < -1 indicates negatively skewed data

Compliance Locations

Location	Obs.	Mean	Std. Dev.	Skewness
MW-16-01	5	160	12.2474	-0.912871
MW-16-02	13	19.8769	11.9232	-0.590237
MW-16-03	13	17.3462	24.4723	**2.3328**

All Locations

Obs.	Mean	Std. Dev.	Skewness
31	41.4161	55.7872	**1.55885**

Skewness Coefficient

Parameter: Lithium

Original Data (Not Transformed)

Non-Detects Replaced with 1/2 DL

Skewness > 1 indicates positively skewed data
Skewness < -1 indicates negatively skewed data

Compliance Locations

Location	Obs.	Mean	Std. Dev.	Skewness
MW-16-01	5	54.6	5.59464	0.399936
MW-16-02	5	27.8	10.4738	0.932281
MW-16-03	5	7.6	5.12835	0.631152

All Locations

Obs.	Mean	Std. Dev.	Skewness
15	30	21.0916	0.172145

Confidence Interval

Parameter: Arsenic

Original Data (Not Transformed)

Non-Detects Replaced with 1/2 DL

Compliance Locations

Location	**MW-16-01**
Mean	160
Std Dev	12.2474
Degrees of Freedom	4
Comparison Level	**32**
Untransformed Comp. Level	32

Confidence	**t-Stat**	**Interval**	**Mid-Point**	**Significant**
99%	3.74694	[139.477, 180.523]	160	**TRUE**
95%	2.13185	[148.323, 171.677]	160	**TRUE**

Location	**MW-16-02**
Mean	19.8769
Std Dev	11.9232
Degrees of Freedom	12
Comparison Level	**32**
Untransformed Comp. Level	32

Confidence	**t-Stat**	**Interval**	**Mid-Point**	**Significant**
99%	2.68099	[11.0111, 28.7427]	19.8769	FALSE
95%	1.78229	[13.9831, 25.7708]	19.8769	FALSE

Location	**MW-16-03**
Mean	17.3462
Std Dev	24.4723
Degrees of Freedom	12
Comparison Level	**32**
Untransformed Comp. Level	32

Confidence	**t-Stat**	**Interval**	**Mid-Point**	**Significant**
99%	2.68099	[-0.850749, 35.5431]	17.3462	FALSE
95%	1.78229	[5.24909, 29.4432]	17.3462	FALSE

Confidence Interval

Parameter: Lithium

Original Data (Not Transformed)

Non-Detects Replaced with 1/2 DL

Compliance Locations

Location	**MW-16-01**
Mean	54.6
Std Dev	5.59464
Degrees of Freedom	4
Comparison Level	**40**
Untransformed Comp. Level	40

Confidence	**t-Stat**	**Interval**	**Mid-Point**	**Significant**
99%	3.74694	[45.2252, 63.9748]	54.6	**TRUE**
95%	2.13185	[49.2661, 59.9339]	54.6	**TRUE**

Location	**MW-16-02**
Mean	27.8
Std Dev	10.4738
Degrees of Freedom	4
Comparison Level	**40**
Untransformed Comp. Level	40

Confidence	**t-Stat**	**Interval**	**Mid-Point**	**Significant**
99%	3.74694	[10.2493, 45.3507]	27.8	FALSE
95%	2.13185	[17.8144, 37.7856]	27.8	FALSE

Location	**MW-16-03**
Mean	7.6
Std Dev	5.12835
Degrees of Freedom	4
Comparison Level	**40**
Untransformed Comp. Level	40

Confidence	**t-Stat**	**Interval**	**Mid-Point**	**Significant**
99%	3.74694	[-0.993482, 16.1935]	7.6	FALSE
95%	2.13185	[2.71068, 12.4893]	7.6	FALSE

Non-Parametric Confidence Interval

Parameter: Beryllium

Well: MW-16-02

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

99% Comparion Level

Total measurements = 5

Ranks

Point	Date	Value	Rank	Bkgrnd
MW-16-02	9/26/2019	ND<1 U	2	TRUE
MW-16-02	7/21/2017	ND<1 U	2	TRUE
MW-16-02	4/6/2018	ND<1 U	2	TRUE
MW-16-02	3/29/2019	1.4	4	TRUE
MW-16-02	6/16/2017	4.5	5	TRUE

M = 5

n + 1 - M = 1

Two Sided Confidence Level = 93.8%

Upper Confidence Interval X(5) = 4.5

Lower Confidence Inverval X(1) = 1

1 <= 4 Indicating No Statistical Significance

Non-Parametric Confidence Interval

Parameter: Lithium

Well: MW-16-03

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

99% Comparion Level

Total measurements = 5

Ranks

Point	Date	Value	Rank	Bkgrnd
MW-16-03	9/26/2019	ND<8 U	2	TRUE
MW-16-03	10/16/2018	ND<8 U	2	TRUE
MW-16-03	3/29/2019	ND<8 U	2	TRUE
MW-16-03	5/30/2018	11	4	TRUE
MW-16-03	4/6/2018	15	5	TRUE

M = 5

n + 1 - M = 1

Two Sided Confidence Level = 93.8%

Upper Confidence Interval X(5) = 15

Lower Confidence Inverval X(1) = 8

8 <= 40 Indicating No Statistical Significance