REPORT

SPRING 2019
SEMI-ANNUAL MONITORING REPORT

Waste Management of Canada
Richmond Landfill
Town of Greater Napanee, Ontario

Submitted to:

WASTE MANAGEMENT OF CANADA
1271 Beechwood Road
Napanee, ON K7R 3L1

Prepared by:

BluMetric Environmental Inc.
The Tower, The Woolen Mill
4 Cataraqui Street
Kingston, ON K7K 1Z7

Project Number: 190161-03
July 2019

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1. INTRODUCTION

The purpose of this report is to present results and to provide an interpretation of the data that were collected during the spring 2019 monitoring event at the Waste Management of Canada Corporation (WM) Richmond Landfill.

The WM Richmond Landfill is approved as a 16.2 hectare waste disposal (landfilling) facility within a total site area of 138 hectares, located on parts of Lots 1, 2 and 3, Concession IV of the former Township of Richmond, now in the Town of Greater Napanee, Ontario.

2. METHODOLOGY

2.1 PROGRAM SUMMARY

The spring 2019 monitoring event was conducted in accordance with the requirements outlined in the revised interim Environmental Monitoring Plan (EMP; Revision No. 05) dated April 15, 2016, as specified in the Environmental Compliance Approval (ECA) number A371203, issued by MECP January 9, 2012 and amended by Notice No. 1 dated May 3, 2013 and Environmental Review Tribunal (ERT) Order dated December 24, 2015.

The site layout and monitoring locations are shown on Figure 1. The monitoring programs for groundwater, surface water, leachate and landfill gas are summarized in Table 1.

The spring monitoring event was conducted between April 29 and May 6, 2019[1]. The activities completed included the following:

- Water levels were recorded at groundwater monitoring wells on April 29, 2019 (41 installed within the shallow groundwater flow zone and 71 from the intermediate bedrock flow zone). No water level was recorded at groundwater monitor M19 because it was damaged;
- Pond water levels were measured on April 29, 2019 from staff gauges at the three ponds located on the south side of the landfill;
- Liquid levels were measured in landfill leachate wells on April 29, 2019;

[1] One groundwater monitoring well, M192, was sampled on April 10, 2019.

- Leachate samples were collected from the North Chamber, South Chamber, and leachate monitoring wells LW-P1 and LW-P2 on May 3, 2019, and analyzed for the suite of leachate inorganic and general parameters, polycyclic aromatic hydrocarbons (PAHs) and volatile organic compounds (VOCs), as listed in Table 2;
- A total of 62 groundwater monitoring wells were sampled between April 30 and May 2, 2019[(1)], as summarized in Table 1; no sample was collected from monitoring well M58-4 (damaged). Samples were analyzed for the suite of groundwater inorganic and general parameters and VOCs listed in Table 2;
- Surface water sampling was conducted on May 6, 2019 from 10 locations along Marysville Creek, Beechwood Ditch and the unnamed water course located south of Beechwood Road in the central portion of the proposed Contaminant Attenuation Zone (CAZ). Surface water samples were analyzed for the surface water inorganic and general parameters and for 1,4-dioxane, as listed in Table 2;
- Landfill gas monitoring was conducted on May 3, 2019. Field measurements were made with a RKI Eagle probe calibrated to methane gas response at six gas monitors; and
- A total of five Quality Assurance/Quality Control (QA/QC) field duplicate samples were collected during the spring sampling event.

2.2 WATER SAMPLE COLLECTION AND LABORATORY ANALYSIS

Groundwater and surface water samples were collected in accordance with accepted industry protocols. Groundwater samples were collected using dedicated Waterra inertial lift pumps connected to dedicated polyethylene tubing. Three casing volumes of water were purged from each monitoring well prior to the collection of groundwater samples. During purging, readings for pH, conductivity and temperature were recorded on a regular basis. The stabilization of the parameters was used to assess when well purging was complete. Low producing wells were purged dry and allowed to recover prior to sampling. If the monitoring well had not recovered sufficiently for sampling within 24 hours, the monitor was considered dry and a sample was not collected.

Surface water samples were collected using a clean bottle where water depth was sufficient; at sampling locations where water depth was an issue, a 50 cc syringe was used to carefully collect the surface water as not to disturb the bottom sediments.

Surface water sampling locations were sampled from downstream to upstream to prevent any re-suspension of sediment impacting the downstream sampling locations. The pH, temperature, and conductivity of the surface water were obtained in the field at all surface water sampling points while minimizing disturbance of the bottom sediment.

All water samples were placed in bottles supplied and prepared by the laboratory. The samples were packed in coolers with ice and shipped by courier to the laboratory. All samples were analysed by Maxxam Analytics Inc. of Mississauga, ON, which is accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA). Table 2 presents a summary of groundwater, surface water and leachate analytical parameters.

2.3 Groundwater Elevations

Water levels were recorded to the nearest 0.01 m using an electronic water level meter for the groundwater monitoring wells listed in Table 3 in relation to the landfill footprint and groundwater flow zone monitored.

3. RESULTS AND DISCUSSION

Background information concerning the site geology and hydrogeology was described in detail in the Site Conceptual Model (SCM) report(2) and updated based on results from subsequent hydrogeological investigations(3,4,5,6,7,8), and is summarized here. The SCM report describes the groundwater flow conditions at the Richmond Landfill. Based on the results from extensive studies conducted previously at the site, the basic hydrogeological framework for the facility has been defined as follows:

- The active groundwater flow zone at the site extends to a depth of approximately 30 m below the top of bedrock;
- The shallow groundwater flow zone is conceptualized as the overburden, the overburden-bedrock contact and the upper one to two metres of bedrock;

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[2] *Site Conceptual Model Report, WM Richmond Landfill*, prepared by Dr. B.H. Kueper and WESA Inc., October 2009

[3] *Supporting Document, Application to Amend Environmental Compliance Approval No. A371203, Waste Management Richmond Landfill Site*, prepared by BluMetric Environmental Inc., March 2015

[4] *Site Conceptual Model Update and Contaminant Attenuation Zone Delineation, Waste Management Richmond Landfill Site*, prepared by BluMetric Environmental Inc., January 2016

[5] *Addendum to Site Conceptual Model Update and Contaminant Attenuation Zone Delineation, Waste Management Richmond Landfill Site*, prepared by BluMetric Environmental Inc., April 2016

[6] *Site Conceptual Model Update and Contaminant Attenuation Zone Delineation, Waste Management Richmond Landfill Site*, prepared by BluMetric Environmental Inc., July 2017

[7] *Site Conceptual Model Update and Contaminant Attenuation Zone Delineation, Waste Management Richmond Landfill Site*, prepared by BluMetric Environmental Inc., October 2018

[8] *Addendum to Site Conceptual Model Update and Contaminant Attenuation Zone Delineation, Waste Management Richmond Landfill Site*, prepared by BluMetric Environmental Inc., May 2019

- The direction of groundwater flow in the shallow flow zone is strongly influenced by topography;
- The intermediate bedrock flow zone extends from one to two metres below top of bedrock to a depth of approximately 30 m below top of bedrock;
- Groundwater flows through a network of fractures in the upper 30 m of bedrock;
- The dominant fracture orientation is horizontal to sub-horizontal; however, vertical to subvertical fractures are present providing hydraulic connection between horizontal fractures;
- Hydraulic connections of fractures exists in the intermediate bedrock flow zone to the west, south and east of the site (horizontal and vertical connections);
- Intermediate bedrock flownets show that groundwater flow directions are variable with season and generally flows to the west from the western edge of the landfill, to the southeast from the southern edge of the landfill, to the south along the eastern edge of the landfill, and north to northwest from the northern limit of the landfill;
- The hydraulic conductivity of the intermediate bedrock is lower to the north and east of the landfill compared to other areas of the site, implying that the rate of groundwater flow is lower than in areas immediately south, southeast and west of the landfill;
- South of the landfill, the intermediate bedrock flow zone has distinct areas of interacting hydrogeological zones which are not isolated from one another, but are distinct based on hydraulic conductivity, water level variations and the rate of response to recharge events; and
- Groundwater monitoring wells in the southern portion of the proposed CAZ have static groundwater elevations that are similar to each other and much lower than wells further north in the CAZ; these deep groundwater elevations appear to be controlled by karst systems confirmed to exist in the southern portion of the proposed CAZ, as discussed in the latest update to the SCM[7,8].

3.1 GROUNDWATER RESULTS

3.1.1 Groundwater Elevations

Groundwater elevations from program monitoring wells listed in Table 3 were measured on April 29, 2019 and are presented in Table 4. An inventory of monitoring well locations is provided in Appendix A. Groundwater elevation contours within the shallow groundwater flow zone are shown on Figure 2, while Figure 3 shows the groundwater elevation contours for the intermediate bedrock flow zone. Groundwater flow directions were inferred by interpolating the water elevations from wells screened within the corresponding groundwater flow zone, and are consistent with historical results.

The spring 2019 shallow groundwater contours (Figure 2) are consistent with historical results and show that the Empey Hill drumlin southwest from the landfill creates a flow divide, with shallow groundwater being directed both to the north and the south towards areas of lower hydraulic heads. North of the landfill, shallow groundwater converges towards Marysville Creek in the area immediately east of County Road 10 (Deseronto Road), while shallow flow in the southern portion of the site converges on Beechwood Ditch and the southern pond system. Shallow groundwater east of the landfill is influenced by a local zone of higher water levels in the vicinity of monitoring well M96; shallow groundwater north of M96 flows to the north-northwest and ultimately Marysville Creek, while groundwater south of M96 flows to the south-southwest, towards Beechwood Ditch and the ponds.

The spring 2019 intermediate bedrock zone contours are presented on Figure 3. On the landfill property, groundwater in this hydrostratigraphic unit generally flows to the north, west, and south-southeast relative to the landfill. Water levels from intermediate bedrock monitors M70-2 and M191 (low permeability wells with water levels interpreted as not being static) were not used to prepare the spring 2019 groundwater contours. Monitoring wells M178R-1 (low permeability deeper screen) and M178R-4 (shallower screen with lower hydraulic head believed to be reflective of the shallow flow zone in this area) were not used to generate the interpolated groundwater contours for the Intermediate Bedrock flow zone, Additionally, intermediate bedrock zone monitoring wells located farther to the south (e.g., M173, M174, M181-1, M181-2, M182, M187 and M189) were not considered in the groundwater contour interpolation because they exhibit much lower hydraulic heads, and appear to be part of a separate group of hydraulically responsive wells within the intermediate bedrock flow zone. This subset of wells appears to be influenced by karst systems that were identified in the southern part of the proposed CAZ. Additional details from the most recent hydrogeological investigations in the area south and southeast of the Site have been provided under separate cover[7,8].

3.1.2 Groundwater Analytical Results

Results from the groundwater monitoring wells sampled in spring 2019 as part of the EMP are presented in Table 5a. Groundwater quality data for the spring 2019 monitoring event are generally similar to historical results.

3.1.2.1 Shallow Groundwater Flow Zone

As shown in Table 5a, slightly elevated concentrations of a number of water quality parameters (e.g., alkalinity, boron, chloride, conductivity, DOC, sodium and/or TDS) were observed in some shallow groundwater zone monitoring wells located in close proximity to the landfill footprint (e.g., M66-2, M86, M101, M103 and M104), north and northwest from the unlined portion of the landfill. 1,4-dioxane was also detected in monitors M101, M103 and M104, and 1,1-dichloroethane was detected at monitoring well M101. The approximate extents of leachate impacted shallow groundwater, consistent with those delineated from recent hydrogeological investigations[7,8], are shown on Figure 4.

Monitor M54-4, located approximately 200 m south of the landfill footprint, also exhibited slightly elevated alkalinity and conductivity, as well as low but detectable concentrations for some chlorinated VOCs (e.g., 1,1,1-trichloroethane, 1,1-dichloroethane, cis-1,2-dichloroethylene, tetrachloroethylene and trichloroethylene). An assessment of the impacts at shallow monitoring well M54-4, attributed to surface contamination from historical local sources rather than from landfill leachate, was submitted recently under separate cover [9].

In other areas of the site, there is no evidence of groundwater impacts away from the landfill footprint in the shallow groundwater flow zone. Isolated occurrences of elevated concentrations of water quality parameters (i.e., one or two parameters per sample) are seen elsewhere on the Site. No indications of elevated concentrations related to landfill impacts are identified at the property boundary in the shallow flow zone.

3.1.2.2 Intermediate Groundwater Flow Zone

Analytical results from intermediate bedrock groundwater monitors sampled in spring 2019 were generally consistent with historical results.

North of the landfill, elevated concentrations of water quality parameters and detectable 1,4-dioxane concentrations were observed at monitors M6-3 and OW4, which are located in close proximity to the footprint. These results indicate the presence of leachate impacts at these locations.

Despite the relatively higher concentrations of some parameters (e.g., alkalinity at M5-3, M75 and OW1), the absence of 1,4-dioxane indicates that no impacts from the landfill are apparent further north from the footprint and near Marysville Creek (e.g., at OW1, M5-3, M75, M82-1 and M82-2).

South of the landfill, the presence of 1,4-dioxane and elevated concentrations of alkalinity (typically greater than 400 mg/L where 1,4-dioxane is present), DOC, chloride and TDS indicate groundwater impacts from the landfill at several monitoring well locations (M9-2, M9-3, M64-2, M108, M109-1, M110-1, M114-1, M121, M123, M167, M168, M170, M172, M178R-3, M178R-4

[9] *Assessment of Chlorinated VOC Impacts at Shallow Groundwater Monitoring Well M54-4, Waste Management Richmond Landfill, Town of Greater Napanee*, BluMetric Environmental Inc., July 2017

and M192). Several monitoring wells downgradient of these impacted wells (e.g., M177, M179, M185-1[10], M185-2, M186, M187, M188-1 and M190) do not show impacts associated with landfill leachate (i.e. no 1,4-dioxane detected and alkalinity concentrations of 350 mg/L or lower) thus defining the limit of the groundwater plume. The approximate extents of leachate impacted groundwater in the intermediate bedrock flow zone, consistent with those delineated from recent hydrogeological investigations[7,8], are shown on Figure 5. Other locations south and southeast of the landfill with elevated concentrations of chloride, sodium, TDS, and/or BTEX compounds (e.g., M52-2, M70-2, M106, M121, M170, M185-1 and M186) are indicative of naturally poor quality connate (and often saline) groundwater. These pockets of naturally poor quality groundwater are isolated and do not reflect any widespread or significant upwelling of saline groundwater.

To the west of the landfill, monitoring well M91-1, located approximately 200 m west of the landfill, exhibited low concentrations reflective of background conditions for all parameters with the exception of detectable benzene above the laboratory's reportable limit (RL). Other wells in the western part of the landfill site (M58-3, M72, M74, M82-1 and M95-1) exhibit concentrations of water quality parameters that are relatively low and continue to reflect background conditions.

Alkalinity, ammonia and 1,4-dioxane results are shown for the shallow and intermediate bedrock flow zones on Figures 4 and 5, respectively.

3.1.3 Guideline B-7 Reasonable Use Limits (RULs)

Constituent concentrations from selected monitoring wells within the low-head areas of the WM Richmond Landfill in both the Shallow and Intermediate Bedrock Groundwater Flow Zones are compared to the RULs derived from laboratory analytical results in Table 5b. The RULs reported in Table 5b for leachate indicator parameters and trigger wells were presented in the interim EMP (Revision No. 05) dated April 2016, including 1,4-dioxane for which the site-specific RUL of 0.001 mg/L was set as required by the ERT Order dated December 24, 2015.

All results for 1,4-dioxane at trigger wells in the shallow and intermediate bedrock flow zones were below the RUL of 0.001 mg/L[10].

[10] Results from the sample collected at M185-1 on April 30, 2019 indicated the presence of 1,4-dioxane. Because this was the first time that 1,4-dioxane was detected at this monitoring well, verification re-sampling was conducted on May 24, 2019. Re-sampling results were below detection for 1,4-dioxane, consistent with historical results, suggesting that the detection of 1,4-dioxane at M185-1 on April 30, 2019 was a false positive result. Corresponding low alkalinity concentrations relative to other impacted wells (typically greater than 400 mg/L where 1,4-dioxane is present) support this conclusion.

In the shallow groundwater zone, slightly elevated concentrations of a number of inorganic or general water quality parameters above their respective RUL (e.g., alkalinity, iron, manganese and/or TDS) were observed in monitoring wells M54-4, M66-2, M67-2, M80-2 and OW37-s.

Slightly elevated concentrations of a number of water quality parameters above their respective RUL (e.g., alkalinity, chloride, DOC, iron, manganese, sodium, and/or TDS) were also observed in some intermediate groundwater flow zone monitoring wells (e.g., M82-1, M82-2, M106, M179, M185-1, M186 and M188-1).

3.1.4 Status of Monitoring Wells and Compliance with Ontario Regulation 903

During the spring 2019 monitoring event, the conditions of groundwater monitoring wells included in the EMP were inspected. Any repairs, such as new locks, labels or well caps, were made as necessary. Watertight casings and seals remain in place at all monitors to ensure that surface water or foreign materials cannot enter groundwater monitoring wells. Where the outer protective casing was deemed to be part of the well construction by MECP, the protective casing was fitted with a vermin proof cap to meet the requirements of O. Reg 903. All groundwater monitoring wells are locked to provide protection against vandalism as per Waste Management standard operating procedure and in line with industry best practices.

Shallow groundwater monitoring wells M19, M58-4 and M68-4 are damaged and it is recommended that they be decommissioned when a revised EMP is approved as they cannot be repaired. These wells are considered unnecessary because flow in the shallow groundwater flow zone can be adequately assessed across the site without them.

3.1.5 Groundwater Chemistry Quality Assurance / Quality Control (QA/QC)

An evaluation of the QA/QC data (from duplicate and blank samples) is included in Appendix B. A standard margin of error of 20% (relative percent difference (RPD) between regular samples and corresponding field duplicate samples) was deemed acceptable for field duplicates. In general, the comparison between samples and duplicates shows excellent correlation for the majority of analyzed constituents. All parameters for groundwater duplicate QA/QC sampling were within the 20% margin of error, with the exception of manganese which was measured at low concentrations (less than 5 times the RDL) and is therefore within an acceptable margin of error, and sulphate which was also measured at low concentrations (less than 2% of the Ontario Drinking Water Aesthetic Objective).

3.2 LEACHATE RESULTS

3.2.1 Leachate Generation

An estimate of the amount of leachate generated at the site is provided by the site records of the volume of leachate hauled to the Napanee and Cobourg municipal sewer systems and treated at the wastewater treatment plants. The volume of leachate collected from the landfill and hauled to the Napanee municipal sewer system from January to May 2019 was 7,500 m^3, or approximately 1,500 m^3 per month on average. A volume of approximately 6,100 m^3 of leachate was pumped from the North Chamber to the lined leachate holding lagoon during the spring freshet. WM will dispose of the leachate at the Napanee treatment facility when they are able to accept it.

3.2.2 Liquid Levels in Leachate Wells

Liquid levels were measured in the two landfill leachate wells on April 29, 2019 and provided the following:

- The liquid level at LW-P1 was 146.70 m above sea level (masl); and
- The liquid level at LW-P2 was 150.24 masl.

3.2.3 Leachate Chemistry

The leachate chemistry results for May 3, 2019 are summarized in Table 6 and are similar to historical results. Leachate at the Richmond Landfill is characterized by elevated concentrations of general water quality parameters such as alkalinity, ammonia, chloride, conductivity, DOC, hardness, sodium, TDS and TKN, as well as selected VOCs (1,4-dioxane, 1,4-dichlorobenzene, chlorobenzene, cis-1,2-dichloroethylene and BTEX). Generally, the inorganic and general parameters that characterize the leachate were more elevated in the samples collected from the leachate wells compared to the leachate chambers. VOC concentrations were below the laboratory reporting limit (RL) for most parameters, with a few exceptions where VOC concentrations were measured at detectable concentrations in leachate. Concentrations were generally higher in leachate well LW-P2 compared to LW-P1, and were higher in the South Chamber compared to the North Chamber where leachate is diluted by shallow groundwater collected from the perimeter toe drain located in the northwest portion of the landfill footprint.

3.3 Surface Water Results

3.3.1 Pond Elevations

Staff gauges are installed in the three ponds on the south side of the landfill labeled SG1, SG2 and SG3. Staff gauge locations and pond elevations measured on April 29, 2019 are shown on Figure 2.

3.3.2 Surface Water Monitoring Locations

The two water courses that may receive surface water/storm water runoff from the Richmond Landfill site are Marysville Creek to the north of the waste mound and Beechwood Ditch to the south (Figure 1). The Beechwood Ditch is a man-made surface water course that flows from the east onto WM property. It then flows west across a portion of the site before again crossing Beechwood Road and travelling southwest to cross County Road 10, and joins Marysville Creek east of Highway 49 and north of Highway 401. Both the Beechwood Ditch and Marysville Creek flow intermittently in the vicinity of the landfill. Marysville Creek has some base flow locally, and flows on a continuous basis west of County Road 10 (Deseronto Road). Marysville Creek eventually discharges into the Bay of Quinte at Hungry Bay.

An unnamed local surface water course is present in the central portion of the proposed CAZ boundary, originating from a small man made pond located directly the east of Quarry Road (see Figure 1). Surface water flows westerly from this pond over a distance of approximately 600 m along a topographically low area, to a second pond located near monitoring well M187 and finally to a local topographic depression located approximately 75 m farther west, where water enters into the ground through a near-surface local karstic feature.

Surface water monitoring locations are shown on Figure 1.

3.3.3 Surface Water Flow

Visual observations of surface water flow and general water characteristics for the spring sampling program are summarized in Table 7a. Surface water flow velocity was measured between no flow and 1.5 m/s, giving estimated flow rates between no flow and 0.57 m^3/s.

3.3.4 Surface Water Analytical Results

The results from surface water locations sampled during the spring 2019 sampling event are presented in Table 7b.

Surface water quality was compared to the Provincial Water Quality Objectives (PWQO). Background surface water quality was monitored on site from upstream sampling locations S2 for Marysville Creek, S5 for Beechwood Ditch and S18 for the unnamed local water course located in the central portion of the proposed CAZ. Storm water runoff from the existing landfill area flows to one of three storm water sedimentation retention ponds, located to the northeast, northwest and south of the landfill footprint. Sampling location S3 is located near the downstream property boundary along Marysville Creek, while sampling location S8R is located along Beechwood Ditch near the downstream property boundary.

Constituents analysed in surface water samples collected during the spring 2019 sampling event were below their respective PWQO, with the exception of unionized ammonia (sampling locations S4R, S5 and S20), total phosphorous (sampling locations S2, S4R, S18 and S20), hexavalent chromium (sampling locations S2, S3, S6, S7, S18, S19 and S20) and iron (sampling locations S4R and S20). Results from spring 2019 are consistent with historical results and indicate that the landfill is not causing adverse impacts to surface water quality.

3.3.5 Surface Water Quality Assurance / Quality Control (QA/QC)

An evaluation of the QA/QC data (from duplicate and blank samples) is included in Appendix B. A standard margin of error of 20% was deemed acceptable for field duplicates. In general, the comparison between samples and duplicates shows very good correlation for the majority of analyzed constituents. All parameters for the surface water duplicate QA/QC sample were within the 20% margin of error, with the exception of ammonia which was measured at low concentrations.

3.4 SUBSURFACE GAS SAMPLING

On May 3, 2019, BluMetric inspected the subsurface gas monitoring probes and obtained measurements at all locations. The location of the gas monitors and the measurement results are shown in Table 8. Gas well readings were all 0 ppm (the LEL for methane is 5% by volume in air, or 50,000 ppm).

3.5 ADDITIONAL INVESTIGATIONS

Data loggers recording groundwater levels, temperature and electrical conductivity were installed in intermediate bedrock monitoring wells as recommended in the preliminary karst assessment report. Monitoring started in March 2017 (May 2017 at the newest wells) and was completed in May 2019. Monitoring results will be reported in fall 2019.

4. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The spring 2019 monitoring program included the collection of groundwater, leachate and surface water samples, as well as landfill gas monitoring, in accordance with the site monitoring requirements outlined in the revised interim EMP (Revision No. 05) dated April 15, 2016, as specified in the Environmental Compliance Approval (ECA) number A371203, issued by MECP January 9, 2012 and amended by Notice No. 1 dated May 3, 2013 and Environmental Review Tribunal (ERT) Order dated December 24, 2015.

The following were completed as part of the spring 2019 monitoring event conducted between April 29 and May 6, 2019[(1)]:

- Water levels were measured at 112 groundwater monitoring wells (41 in the shallow groundwater flow zone and 71 in the intermediate bedrock flow zone), two leachate monitoring wells and three ponds on the south side of the landfill;
- A total of 62 groundwater monitors were sampled for analytical testing (18 completed in the shallow flow zone and 44 in the intermediate bedrock flow zone);
- Leachate samples were collected from the North Chamber, South Chamber, and two leachate monitoring wells;
- Ten surface water locations were sampled for analytical testing;
- A total of five QA/QC field duplicate samples were collected; and
- Subsurface gas concentrations were recorded from six on-site gas monitoring wells.

Results, interpretations from the spring 2019 monitoring event are summarized below, along with recommendations.

4.1 GROUNDWATER

- Groundwater flow directions interpreted from water elevations measured in monitoring wells were consistent with historical flownets:
  - Shallow groundwater flow on site is influenced by local topographic highs in the southwestern (Empey Hill Drumlin) and eastern (groundwater monitor M96 area) portions of the site, and is characterized by a flow divide with shallow groundwater being directed both to the north (toward Marysville Creek) and the south (toward Beechwood Ditch). South of Beechwood Road shallow groundwater flow converges from local topographic highs to the north and south, and discharges to a local surface water course within a topographically low area running east-west in the central portion of the proposed CAZ;

  - Groundwater in the intermediate bedrock flow zone generally flows to the north, west, and south-southeast relative to the landfill;
- Groundwater quality data from spring 2019 were generally consistent with historical results;
- Slightly elevated concentrations of a number of water quality parameters were observed in the shallow groundwater zone within the property in the immediate vicinity of the landfill footprint to the south, north and northwest of the landfill footprint;
- The geochemical results for the intermediate bedrock groundwater flow zone indicate higher concentrations of water quality parameters associated with landfill leachate impacts to the south-southeast and immediately north of the landfill relative to the concentrations west and east of the landfill;
- Investigations of the groundwater conditions south of the landfill to delineate the groundwater impacts from the landfill and to define the extent of a contaminant attenuation zone have been completed. Results from this investigation have been submitted to MECP;
- Continued groundwater monitoring within the shallow and intermediate bedrock groundwater flow zones between the landfill footprint and the low-head areas is warranted in order to further examine groundwater quality and any trends over time; and
- Shallow groundwater monitoring wells M19, M58-4 and M68-4 are damaged and are considered unnecessary for the EMP monitoring program. Upon approval from MECP, these wells will be decommissioned.

4.2 Surface Water

- The concentrations observed during spring 2019 monitoring events were within the range of historical monitoring results and indicate that the landfill is not causing adverse impacts to surface water quality;
- The concentrations of unionized ammonia, total phosphorous, hexavalent chromium and/or iron were slightly above PWQO at several stations including upstream (S2, S5 and S18) and downstream (S3, S4R, S6, S7, S19 and S20) sampling locations; and,
- All other measured parameters were consistent with natural surface water quality and below PWQO.

4.3 Subsurface Gas

Measurements for methane gas were 0 ppm for all six monitoring locations.

5. LIMITING CONDITIONS

The spring 2019 monitoring program involved the collection of groundwater (from on-site and off-site monitoring wells as well as off-site domestic supply wells) and surface water for analyses at the site monitoring locations. The data collected during this investigation represent the conditions at the sampled locations only.

The conclusions presented in this report represent our professional opinion and are based on the conditions observed on the dates set out in the report, the information available at the time this report was prepared, the scope of work, and any limiting conditions noted herein.

BluMetric Environmental Inc. provides no assurances regarding changes to conditions subsequent to the time of the assessment. BluMetric Environmental Inc. makes no warranty as to the accuracy or completeness of the information provided by others or of the conclusions and recommendations predicated on the accuracy of that information.

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Respectfully submitted,
BluMetric Environmental Inc.

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TABLES

Table 1: Summary of Environmental Monitoring Program

Monitoring Locations		Parameter Suite	Monitoring Frequency
Shallow Groundwater Flow Zone Monitors			
M58-4, M68-4, M70-3, M96, M99-2		Groundwater Inorganic & General	Once each year, in spring
		VOCs	
M53-4, M54-4, M66-2, M67-2, M80-2, M81, M85, M86, M87-2, M101, M103, M104, M114-2, OW37-s		Groundwater Inorganic & General	Twice each year, in spring and fall
		VOCs	
Intermediate Bedrock Groundwater Flow Zone Monitors			
M56-2, M58-3, M59-2, M59-4, M91-1, M95-1		Groundwater Inorganic & General	Once each year, in spring
		VOCs	
M5-3, M6-3, M9-2, M9-3, M52-2, M64-2, M70-2, M72, M74, M75, M80-1, M82-1, M82-2, M106, M108, M109-1, M110-1, M114-1, M121, M123, M167, M168, M170, M172, M177, M178R-2, M178R-3, M178R-4, M179, M185-1, M185-2, M186, M187, M188, M190, M192, OW1, OW4		Groundwater Inorganic & General	Twice each year, in spring and fall
		VOCs	
Surface Water Sampling Locations			
Beechwood Ditch	S4R, S5 and S8R	Surface Water Inorganic and General	Three times each year, in spring, summer[1] and fall.
Marysville Creek	S2, S3, S6 and S7		
Unnamed water course in central portion of proposed CAZ	S18, S19 and S20		
Leachate Monitoring Locations			
North Chamber, South Chamber, LW-P1 and LW-P2		Leachate Inorganic & General	Once each year, in spring
		VOCs	
Landfill Gas Monitoring Wells			
GM1, GM3, GM4-1, GM4-2, GM5, GM6		% methane by volume	Twice each year, in spring and fall
Off-site Domestic Water Supply Wells			
1441 County Road 1 West 1483 County Road 1 West 1494 County Road 1 West (UNKN)[2] 1499 County Road 1 West 1556 County Road 1 West (UNKN)[2] 1614 County Road 1 West 1654 County Road 1 West 1680 County Road 1 West 1695 County Road 1 West 1866 County Road 1 West 614 Belleville Road 696 Belleville Road		1,4 dioxane	Once every two years, starting in 2015

[1] The summer monitoring event shall be scheduled after a rainfall of more than 25 mm

[2] The final list of domestic well locations will depend on confirmation of which addresses have drilled wells (locations where well construction is unknown are denoted UNKN). A residential survey will be completed in order to determine which of these locations are to be sampled. Only those residences with drilled bedrock wells that supply water for domestic use will be sampled; residences that use shallow dug wells or cisterns for water supplies are not included in the program.

Table 2: Analytical Parameters for Water and Leachate Samples

Groundwater Inorganic and General Parameters		
Total dissolved solids Alkalinity Conductivity Dissolved organic carbon Calcium	Magnesium Sodium Potassium Boron Iron	Manganese Ammonia (total) Nitrate Nitrite Chloride Sulphate
Volatile Organic Compounds (VOCs)		
1,4 Dioxane Benzene Toluene Ethylbenzene m&p-Xylene o-Xylene Styrene 1,3,5-Trimethylbenzene Chlorobenzene	1,2-Dichlorobenzene 1,3-Dichlorobenzene 1,4-Dichlorobenzene Methylene chloride Chloromethane Chloroethane 1,1,2,2-Tetrachloroethane 1,1,1,2-Tetrachloroethane 1,1,1-Trichloroethane	1,1,2-Trichloroethane 1,1-Dichloroethane 1,2-Dichloroethane 1,1-Dichloroethylene Cis-1,2-Dichloroethylene Trans-1,2-Dichloroethylene Trichloroethylene Tetrachloroethylene Vinyl chloride
Surface Water Inorganic and General Parameters		
1,4 Dioxane Total suspended solids Total dissolved solids Biological oxygen demand Chemical oxygen demand Alkalinity Conductivity Hardness Calcium Magnesium Sodium	Potassium Boron Cadmium Chromium (Total, Cr6+, Cr3+) Cobalt Copper Iron Lead Nickel Zinc Ammonia (total & un-ionized)	Nitrate Nitrite Chloride Sulphate Phenols Total phosphorous Naphthalene *Field measurements:* *pH, temperature, conductivity, dissolved oxygen, estimated flow rate*
Leachate Inorganic and General Parameters		
Total dissolved solids Conductivity Alkalinity pH Hardness Calcium Magnesium Sodium Potassium Biological oxygen demand Chemical oxygen demand	Dissolved organic carbon Boron Cadmium Chromium (total) Cobalt Copper Iron Lead Manganese Nickel Zinc	Ammonia (total) Total Kjeldahl nitrogen Nitrate Nitrite Chloride Sulphate Total phosphorous Phenols Naphthalene N-nitrosodimethylamine (NDMA)

Table 3: Groundwater Elevation Monitoring Locations

Location	Shallow Groundwater Flow Zone	Intermediate Groundwater Flow Zone
West of landfill footprint	M27, M58-4, M67-2, M84, M87-2, M88-2, M89-2, M97, M98, M99-2, M100, M101, M102, OW37-s	M3A-3, M56-2, M58-3, M59-2, M59-3, M59-4, M72, M73, M74, M82-1, M82-2, M91-1, M95-1
East of landfill footprint	M19, M23, M47-3, M68-4, M70-3, M77, M94-2, M96	M50-3, M52-2, M70-2, M108, M170
North of landfill footprint	M35, M60-4, M65-2, M66-2, M83, M85, M86, M103, M104	M46-2, M60-1, OW1
South of landfill footprint; north of Beechwood Road	M12, M14, M15, M18, M41, M53-4, M54-4, M80-2, M81	M9-2, M9-3, M10-1, M49-1, M53-2, M71, M80-1, M105, M106, M107, M109-1, M109-2, M110-1, M111-1, M112-1, M113-1, M192, M193
South of landfill footprint; south of Beechwood Road	M114-2, M115-2	M63-2, M64-2, M114-1, M116, M121, M122, M123, M125, M166, M167, M168, M173, M174, M176, M177, M178R-1, M178R-2, M178R-3, M178R-4, M179, M180, M181-1, M181-2, M182, M185-1, M185-2, M186, M187, M188, M189, M190, M191

Table 4: Groundwater Elevations - April 29, 2019

Monitoring Well	Water Level (masl)	Monitoring Well	Water Level (masl)	Monitoring Well	Water Level (masl)	Monitoring Well	Water Level (masl)
Shallow Groundwater Flow Zone							
M12	125.72	M54-4	124.54	M83	123.30	M98	130.32
M14	127.29	M58-4	125.22	M84	121.92	M99-2	130.78
M15	125.56	M60-4	124.46	M85	122.04	M100	125.51
M18	127.62	M65-2	123.43	M86	122.08	M101	124.07
M19	damaged	M66-2	123.26	M87-2	124.78	M102	124.18
M23	127.56	M67-2	122.75	M88-2	128.73	M103	123.94
M27	126.36	M68-4	124.47	M89-2	129.94	M104	123.33
M35	124.38	M70-3	127.28	M94-2	123.73	M114-2	123.96
M41	125.81	M77	126.71	M96	129.19	M115-2	124.99
M47-3	123.79	M80-2	123.92	M97	125.81	OW37-s	122.11
M53-4	125.43	M81	124.72				
Intermediate Bedrock Groundwater Flow Zone							
M3A-3	123.93	M71	123.64	M113-1	123.52	M178R-4	116.79
M9-2	125.15	M72	123.35	M114-1	123.70	M179	112.98
M9-3	125.20	M73	123.39	M116	123.72	M180	112.22
M10-1	123.88	M74	123.76	M121	123.47	M181-1	99.66
M46-2	122.78	M80-1	123.62	M122	122.86	M181-2	105.85
M49-1	124.31	M82-1	122.87	M123	122.45	M182	103.66
M50-3	124.19	M82-2	123.04	M125	>122.29	M185-1	116.12
M52-2	123.06	M91-1	123.48	M166	122.47	M185-2	116.69
M53-2	123.21	M95-1	123.43	M167	122.30	M186	114.98
M56-2	123.56	M105	124.86	M168	122.48	M187	100.07
M58-3	123.59	M106	123.47	M170	124.65	M188-1	115.74
M59-2	123.66	M107	124.73	M173	101.46	M189	105.36
M59-3	123.62	M108	122.58	M174	100.13	M190	116.55
M59-4	123.63	M109-1	124.84	M176	111.53	M191	111.54
M60-1	122.59	M109-2	124.99	M177	115.41	M192	122.49
M63-2	121.57	M110-1	124.86	M178R-1	117.05	M193	122.02
M64-2	119.08	M111-1	123.49	M178R-2	122.50	OW1	122.63
M70-2	122.64	M112-1	123.52	M178R-3	122.33		

Table 5a: Groundwater Quality Results - April 30 - May 2, 2019

Name	Date	Alkalinity	Ammonia	Boron	Calcium	Chloride	Conductivity	Dissolved Organic Carbon	Iron	Magnesium	Manganese	Nitrate	Nitrite	Potassium	Sodium	Sulphate	Total Dissolved Solids	1,1,1,2-Tetrachloroethane	1,1,1-Trichloroethane	1,1,2,2-Tetrachloroethane	1,1,2-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethylene	1,2-Dichlorobenzene (o)	1,2-Dichloroethane	1,3,5-Trimethylbenzene	1,3-Dichlorobenzene (m)	1,4-Dichlorobenzene (p)	1,4-Dioxane	Benzene	Chlorobenzene	Chloroethane	Chloromethane	Cis-1,2-Dichloroethylene	Dichloromethane	Ethylbenzene	m+p-Xylene	o-Xylene	Styrene	Tetrachloroethylene	Toluene	Trans-1,2-dichloroethylene	Trichloroethylene	Vinyl Chloride
Name	Date	mg/L	mg/L	mg/L	mg/L	mg/L	mS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Shallow Groundwater Flow Zone[1]																																												
M53-4	5/2/2019	360	< 0.15	< 0.02	130	2.1	720	3.5	< 0.1	19	0.1	< 0.1	< 0.01	< 0.2	19	39	490	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.001	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	0.0002	< 0.0001	< 0.0001	< 0.0002
M54-4	5/2/2019	470	< 0.15	0.038	150	18	960	3.2	< 0.1	28	0.031	< 0.1	< 0.01	1.1	40	43	655	< 0.0002	0.0013	< 0.0002	< 0.0002	0.0015	< 0.0001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.001	< 0.0005	0.00075	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	0.0039	< 0.0002	< 0.0001	0.00055	< 0.0002
M66-2	4/30/2019	220	< 0.15	0.3	110	99	1200	1.6	< 0.1	34	< 0.002	0.27	< 0.01	3.8	91	260	820	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.0004	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0002
M67-2	4/30/2019	370	0.31	0.77	59	5.4	720	2.1	1	31	0.062	< 0.1	0.024	7.8	51	21	410	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.0004	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0002
M68-4	4/30/2019	310	< 0.15	< 0.02	100	12	650	2	0.5	17	0.21	< 0.1	< 0.01	0.27	15	24	425	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.0004	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0002
M70-3	5/1/2019	330	< 0.15	< 0.02	110	15	820	2.9	0.37	23	0.2	< 0.1	< 0.01	0.49	21	100	570	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.0004	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0002
M80-2	5/1/2019	340	< 0.15	0.049	92	44	850	3.3	< 0.1	49	< 0.002	< 0.1	< 0.01	4	29	45	555	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.0004	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0002
M81	5/2/2019	310	< 0.15	0.032	100	84	890	1.9	< 0.1	49	0.004	< 0.1	< 0.01	2.2	10	42	575	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.001	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0002
M85	4/30/2019	420	< 0.15	1.9	51	35	1500	2.4	< 0.1	28	0.007	3.72	< 0.01	15	260	310	1070	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.0004	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0002
M86	4/30/2019	310	< 0.15	0.93	65	37	940	2.3	0.12	33	0.011	0.55	< 0.01	14	98	130	600	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.0004	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0002
M87-2	5/2/2019	200	< 0.15	0.033	53	29	570	1.7	< 0.1	35	0.004	< 0.1	< 0.01	1.8	11	50	395	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.001	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0002
M96	5/1/2019	300	< 0.15	0.036	67	3	590	1.3	< 0.1	32	< 0.002	1.27	< 0.01	3.4	18	32	395	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.0004	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0002
M99-2	5/2/2019	280	< 0.15	0.082	59	22	780	2.5	0.25	59	0.017	< 0.1	0.01	2.4	16	110	555	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.001	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0002
M101	5/2/2019	440	< 0.15	0.046	160	60	1100	2.3	< 0.1	44	0.006	< 0.1	< 0.01	3	15	61	675	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.00047	< 0.0001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	0.0061	< 0.0001	< 0.0001	< 0.001	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0002
M103	4/30/2019	660	< 0.15	0.22	140	180	1800	4.1	< 0.1	89	< 0.002	0.31	< 0.01	5.6	140	57	1110	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	0.014	< 0.0001	< 0.0001	< 0.0004	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0002
M104	4/30/2019	1500	3.25	2.2	150	950	5400	73	< 0.1	160	0.41	1.89	0.03	12	860	51	3230	< 0.005	< 0.0025	< 0.005	< 0.005	< 0.0025	< 0.0025	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.13	< 0.0025	< 0.0025	< 0.01	< 0.013	< 0.0025	< 0.013	< 0.0025	< 0.0025	< 0.0025	< 0.005	< 0.0025	< 0.005	< 0.0025	< 0.0025	< 0.005
M114-2	5/1/2019	310	< 0.15	< 0.02	110	83	900	1.7	< 0.1	17	< 0.002	1.42	< 0.01	0.72	70	39	550	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0002
OW37-s	4/30/2019	230	0.23	0.11	62	41	590	2.9	7.1	21	0.16	< 0.1	< 0.01	10	36	13	310	< 0.0005	< 0.00025	< 0.0005	< 0.0005	< 0.00025	< 0.00025	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.001	< 0.00025	< 0.00025	< 0.0025	< 0.0013	< 0.00025	< 0.0013	< 0.00025	< 0.00025	< 0.00025	< 0.0005	< 0.00025	< 0.0005	< 0.00025	< 0.00025	< 0.0005
Intermediate BedrockGroundwater Flow Zone																																												
M5-3	4/30/2019	440	1.38	1.2	35	42	960	1.4	< 0.1	27	< 0.002	< 0.1	< 0.01	13	150	< 1	600	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.001	0.0002	< 0.0001	< 0.002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	0.00012	0.00019	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0002
M6-3	4/30/2019	380	2.42	1.3	64	1700	5700	68	< 0.1	270	0.008	< 0.1	< 0.01	20	810	91	3910	< 0.005	< 0.0025	< 0.005	< 0.005	< 0.0025	< 0.0025	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.3	< 0.0025	< 0.0025	< 0.01	< 0.013	< 0.0025	< 0.013	< 0.0025	< 0.0025	< 0.0025	< 0.005	< 0.0025	< 0.005	< 0.0025	< 0.0025	< 0.005
M9-2	5/2/2019	570	0.55	0.35	630	2700	8900	7.5	15	430	0.77	< 0.1	0.023	140	2000	68	1490	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	0.0087	0.0019	< 0.0001	0.0019	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0002
M9-3	5/2/2019	360	0.86	0.29	79	92	950	3.8	2.7	26	0.2	< 0.1	< 0.01	13	65	6.3	540	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.00027	< 0.0001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	0.0069	< 0.0001	< 0.0001	0.0073	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0002
M52-2	5/1/2019	300	1.68	1.1	28	390	1900	1.9	< 0.1	19	0.006	< 0.1	< 0.01	14	320	14	960	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.002	< 0.002	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0002
M56-2	5/2/2019	300	< 0.15	0.063	74	15	730	1.9	< 0.1	41	0.059	< 0.1	< 0.01	2.8	12	78	480	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.001	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0002
M58-3	5/2/2019	310	< 0.15	< 0.02	85	4.1	590	1.4	< 0.1	29	< 0.002	0.12	< 0.01	1.4	4.6	35	395	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.001	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0002
M59-2	5/2/2019	440	0.5	0.23	130	72	1100	7.7	< 0.1	37	0.014	0.45	< 0.01	5	33	36	690	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.001	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	0.00064	< 0.0001	< 0.0001	< 0.0002
M59-4	5/2/2019	270	0.16	0.4	66	8.8	640	1.9	0.49	31	0.033	< 0.1	0.017	5.3	14	61	410	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.001	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0002
M64-2	5/1/2019	300	1.08	1	54	140	970	1.8	< 0.1	33	0.008	< 0.1	< 0.01	10	95	3.3	540	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	0.0032	< 0.0001	< 0.0001	< 0.002	< 0.002	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0002
M70-2	5/1/2019	380	1.96	1.4	48	480	2300	2.3	0.83	34	0.015	< 0.1	< 0.01	13	370	19	1270	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.0004	< 0.002	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0002
M72	5/2/2019	270	0.7	0.42	59	27	630	2	< 0.1	34	0.003	< 0.1	< 0.01	7.7	17	29	390	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.001	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	0.0014	< 0.0001	< 0.0001	< 0.0002
M74	5/2/2019	310	1.29	0.79	29	25	670	2.9	0.12	16	0.032	< 0.1	0.017	11	87	8.8	410	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.001	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0002
M75	4/30/2019	390	1.43	0.69	54	44	940	2.9	0.11	28	0.067	< 0.1	< 0.01	12	110	42	550	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.001	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0002
M80-1	5/1/2019	140	0.41	0.41	21	15	360	1.3	< 0.1	12	0.004	< 0.1	< 0.01	4.4	34	16	195	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.001	0.00011	< 0.0001	< 0.0004	< 0.0005	< 0.0001	< 0.0005	< 0.0001	0.00022	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0002
M82-1	4/30/2019	330	1.04	0.92	51	39	850	2.6	< 0.1	28	0.003	< 0.1	< 0.01	10	86	48	490	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0002
M82-2	4/30/2019	330	0.26	0.14	110	21	760	2.7	< 0.1	30	0.018	< 0.1	< 0.01	3.7	17	55	475	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.001	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0002
M91-1	5/2/2019	280	0.65	0.85	44	11	660	1.6	< 0.1	22	0.004	< 0.1	< 0.01	6.7	59	54	415	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.001	0.00022	< 0.0001	< 0.001	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0002
M95-1	5/2/2019	290	< 0.15	0.034	87	6.7	650	1.7	< 0.1	27	0.003	0.57	< 0.01	3	6.3	46	400	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.001	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0002
M106	5/1/2019	330	2.64	1.9	120	1600	5600	1.4	< 0.1	78	0.002	< 0.1	< 0.01	24	900	1.8	3260	< 0.0005	< 0.00025	< 0.0005	< 0.0005	0.0035	0.00088	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.001	0.00072	< 0.00025	< 0.005	< 0.005	< 0.00025	< 0.0013	< 0.00025	< 0.00025	< 0.00025	< 0.0005	< 0.00025	< 0.0005	< 0.00025	< 0.00025	< 0.0005
M108	5/1/2019	460	0.81	0.23	120	87	1100	5.5	2.9	36	0.14	< 0.1	< 0.01	6.9	68	< 1	615	< 0.0005	< 0.00025	< 0.0005	< 0.0005	0.00042	< 0.00025	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.011	< 0.00025	< 0.00025	0.0036	< 0.0013	< 0.00025	< 0.0013	< 0.00025	< 0.00025	< 0.00025	< 0.0005	< 0.00025	< 0.0005	< 0.00025	< 0.00025	< 0.0005
M109-1	5/1/2019	500	1.24	0.33	130	150	1400	8	13	39	0.33	< 0.1	< 0.01	6.5	96	< 1	710	< 0.001	< 0.0005	< 0.001	< 0.001	< 0.0005	< 0.0005	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.026	< 0.0005	< 0.0005	0.0092	< 0.0025	< 0.0005	< 0.0025	< 0.0005	< 0.0005	< 0.0005	< 0.001	< 0.0005	< 0.001	< 0.0005	< 0.0005	< 0.001
M110-1	5/1/2019	640	0.65	0.42	180	200	1800	9.4	< 0.1	61	0.018	< 0.1	< 0.01	7.8	130	< 1	1070	< 0.001	< 0.0005	< 0.001	< 0.001	< 0.0005	< 0.0005	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.033	0.00075	< 0.0005	0.011	< 0.0025	< 0.0005	< 0.0025	< 0.0005	< 0.0005	< 0.0005	< 0.001	< 0.0005	< 0.001	< 0.0005	< 0.0005	< 0.001
M114-1	5/1/2019	400	0.54	0.21	100	100	1000	4.6	5.7	28	0.29	< 0.1	< 0.01	5.8	72	4.5	625	< 0.0005	< 0.00025	< 0.0005	< 0.0005	0.00043	< 0.00025	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.0071	0.00031	< 0.00025	0.0068	< 0.0013	< 0.00025	< 0.0013	< 0.00025	< 0.00025	< 0.00025	< 0.0005	< 0.00025	0.0011	< 0.00025	< 0.00025	< 0.0005
M121	5/2/2019	490	1.32	0.31	93	74	1100	4.7	< 0.1	43	0.003	< 0.1	< 0.01	11	75	9.1	675	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002	1/0/1900	< 0.0002	< 0.0002	0.0082	0.0035	< 0.0001	0.0039	< 0.0005	< 0.0001	< 0.0005	0.00041	0.0017	0.00026	< 0.0002	< 0.0001	0.00029	< 0.0001	< 0.0001	< 0.0002
M123	5/2/2019	410	0.3	0.16	110	62	930	3.9	< 0.1	24	0.011	< 0.1	< 0.01	3.9	46	6.6	560	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.00015	< 0.0001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	0.006	< 0.0001	< 0.0001	0.0038	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	0.00038	< 0.0001	< 0.0001	< 0.0002
M167	4/30/2019	400	2.03	0.94	98	390	2000	3.9	< 0.1	57	0.003	< 0.1	< 0.01	18	210	8.6	1060	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	0.0028	< 0.0001	< 0.0001	< 0.002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0002
M168	4/30/2019	440	1.44	0.66	160	410	2100	4.4	< 0.1	57	0.004	< 0.1	< 0.01	15	180	5.1	1260	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	0.0071	0.00012	< 0.0001	< 0.001	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	0.00076	< 0.0001	< 0.0001	< 0.0002
M170	5/1/2019	690	1.6	2.4	36	580	3000	4.9	< 0.1	28	< 0.002	< 0.1	< 0.01	14	590	4.9	1730	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	0.012	< 0.0001	< 0.0001	< 0.002	< 0.002	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0002
M172	5/2/2019	350	0.69	0.12	95	64	850	5.1	13	22	0.44	< 0.1	< 0.01	3.5	48	5	495	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.0012	0.00012	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	0.0071	< 0.0001	< 0.0001	0.0036	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0002
M177	4/30/2019	240	0.46	0.25	84	3.5	550	2.7	< 0.1	17	0.007	< 0.1	< 0.01	5.1	6.1	43	355	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.001	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0002
M178R-2	4/30/2019	390	0.25	0.18	120	66	930	4.3	1.4	25	0.08	< 0.1	< 0.01	4.9	48	18	550	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.0011	< 0.0001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	0.0012	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0002
M178R-3	4/30/2019	420	0.36	0.24	120	77	1000	4.5	1.1	28	0.059	< 0.1	< 0.01	5.5	55	20	575	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.00082	< 0.0001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	0.006	< 0.0001	< 0.0001	0.0018	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0002
M178R-4	4/30/2019	430	0.34	0.22	130	79	1100	4.6	0.14	29	0.03	< 0.1	< 0.01	5	58	19	570	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.00062	< 0.0001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	0.0069	< 0.0001	< 0.0001	0.0022	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0002
M179	5/2/2019	230	0.21	0.14	74	30	560	3.6	0.39	10	0.022	< 0.1	< 0.01	3.5	26	19	335	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.001	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	0.001	< 0.0001	< 0.0001	< 0.0002
M185-1[2]	4/30/2019	270	1.36	1.4	41	410	2000	1.7	< 0.1	14	0.033	< 0.1	< 0.01	9.6	330	56	1080	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	0.0054	< 0.0001	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	0.0014	< 0.0001	< 0.0001	< 0.0002
M185-1[2]	5/24/2019	300																											< 0.001															
M185-2	4/30/2019	270	< 0.15	0.082	120	4.2	580	2.1	< 0.1	6	0.018	< 0.1	< 0.01	1.8	3.3	30	345	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.001	0.00014	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	0.00032	< 0.0001	< 0.0001	< 0.0002
M186	5/2/2019	350	2.47	1.9	63	1200	4300	1.8	0.2	43	0.044	< 0.1	< 0.01	20	690	9.4	2330	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.001	0.00018	< 0.0001	< 0.001	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	0.00017	< 0.0002	< 0.0001	0.0013	< 0.0001	< 0.0001	< 0.0002
M187	5/1/2019	250	< 0.15	0.078	100	18	550	2.3	< 0.1	6.8	< 0.002	0.3	< 0.01	2.1	15	32	345	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.0004	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0002
M188-1	4/30/2019	300	0.6	0.46	57	38	710	1.9	0.41	19	0.014	< 0.1	< 0.01	5.7	67	15	390	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0002
M190	5/2/2019	230	0.16	0.073	91	43	640	3.3	< 0.1	9.5	0.005	0.39	< 0.01	3.3	20	22	390	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.001	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0002
M192	4/10/2019	540	2.48	2.2	99	580	2900	4	< 0.1	67	0.018	< 0.1	< 0.01	22	400	< 1	1510	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	0.0056	0.00014	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	0.00022	< 0.0001	< 0.0001	< 0.0002
OW1	4/30/2019	410	1.53	1.1	45	61	1000	2	< 0.1	32	0.007	< 0.1	< 0.01	13	130	47	620	< 0.0005	< 0.00025	< 0.0005	< 0.0005	< 0.00025	< 0.00025	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.001	< 0.00025	< 0.00025	< 0.005	< 0.0013	< 0.00025	< 0.0013	0.0014	< 0.00025	< 0.00025	< 0.0005	< 0.00025	< 0.0005	< 0.00025	< 0.00025	< 0.0005
OW4	4/30/2019	960	1.02	1.5	150	500	3200	34	8.1	92	0.15	< 0.1	< 0.01	12	440	20	1820	< 0.005	< 0.0025	< 0.005	< 0.005	< 0.0025	< 0.0025	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.089	< 0.0025	< 0.0025	< 0.025	< 0.013	< 0.0025	< 0.013	< 0.0025	< 0.0025	< 0.0025	< 0.005	< 0.0025	< 0.005	< 0.0025	< 0.0025	< 0.005

[1] M58-4 damaged - no sample collected.

[2] Results from the sample collected at M185-1 on April 30, 2019 indicated the presence of 1,4-dioxane. Because this was the first time that 1,4-dioxane was detected at this monitoring well, verification re-sampling was conducted on May 24, 2019. Re-sampling results were below detection for 1,4-dioxane, consistent with historical results, suggesting that the detection of 1,4-dioxane at M185-1 on April 30, 2019 was a false positive result.

Table 5b: Groundwater Quality Results and Reasonable Use Limits - April 30 - May 2, 2019

Name	Date	1,4-dioxane	Alkalinity	Chloride	Dissolved Organic Carbon	Iron	Manganese	Sodium	Total Dissolved Solids	1,1-dichloroethylene	Benzene	Ethylbenzene	Xylenes (Total)	Toluene
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Shallow Groundwater Flow Zone														
RUL		0.001 [1]	390	130	3.6	0.18	0.034	109	452	0.0035	0.0014	0.0013	0.15	0.0121
M54-4	5/2/2019	< 0.001	470	18	3.2	< 0.1	0.031	40	655	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M66-2	4/30/2019	< 0.001	220	99	1.6	< 0.1	< 0.002	91	820	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M67-2	4/30/2019	< 0.001	370	5.4	2.1	1.0	0.062	51	410	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0002
75% RUL [2]		n/a	293	98	2.7	0.14	0.026	82	339	0.0026	0.0011	0.00098	0.11250	0.0091
M80-2	5/1/2019	< 0.001	340	44	3.3	< 0.1	< 0.002	29	555	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M87-2	5/2/2019	< 0.001	200	29	1.7	< 0.1	0.004	11	395	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0002
OW37-s	4/30/2019	< 0.001	230	41	2.9	7.1	0.16	36	310	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.0005
Intermediate BedrockGroundwater Flow Zone														
RUL		0.001 [1]	400	132	3.5	0.18	0.032	106	465	0.0035	0.0014	0.0013	0.15	0.0121
M177	4/30/2019	< 0.001	240	3.5	2.7	< 0.1	0.007	6.1	355	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M179	5/2/2019	< 0.001	230	30	3.6	0.39	0.022	26	335	< 0.0001	< 0.0001	< 0.0001	< 0.0001	0.001
M185-1 [3]	4/30/2019	< 0.001	270	410	1.7	< 0.1	0.033	330	1080	< 0.0001	< 0.0001	< 0.0001	< 0.0001	0.0014
M185-2	4/30/2019	< 0.001	270	4.2	2.1	< 0.1	0.018	3.3	345	< 0.0001	0.00014	< 0.0001	< 0.0001	0.00032
M186	5/2/2019	< 0.001	350	1200	1.8	0.20	0.044	690	2330	< 0.0001	0.00018	< 0.0001	0.00017	0.0013
M187	5/1/2019	< 0.001	250	18	2.3	< 0.1	< 0.002	15	345	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M188-1	4/30/2019	< 0.001	300	38	1.9	0.41	0.014	67	390	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M190	5/2/2019	< 0.001	230	43	3.3	< 0.1	0.005	20	390	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0002
75% RUL 2		n/a	300	99	2.6	0.14	0.024	80	349	0.0026	0.0011	0.00098	0.11	0.0091
M80-1	5/1/2019	< 0.001	140	15	1.3	< 0.1	0.004	34	195	< 0.0001	0.00011	< 0.0001	0.00022	< 0.0002
M82-1	4/30/2019	< 0.001	330	39	2.6	< 0.1	0.003	86	490	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M82-2	4/30/2019	< 0.001	330	21	2.7	< 0.1	0.018	17	475	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M106	5/1/2019	< 0.001	330	1600	1.4	< 0.1	0.002	900	3260	0.00088	0.00072	< 0.00025	< 0.00025	< 0.0005

0.05 Groundwater results exceed Reasonable Use Limits (RUL)

[1] Site-specific RUL for 1,4 dioxane set by ERT Order dated December 24, 2015

[2] Wells located on the boundary of WM property, including the CAZ boundary, are compared to 75% of RUL concentrations

[3] Results from the sample collected at M185-1 on April 30, 2019 indicated the presence of 1,4-dioxane. Results of verification re-sampling conducted on May 24, 2019 were below detection for 1,4-dioxane, consistent with historical results, suggesting that the detection of 1,4-dioxane at M185-1 on April 30, 2019 was a false positive.

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Table 6: Leachate Chemistry Results - May 3, 2019

		North Chamber	South Chamber	LW-P1	LW-P2
General and Inorganic Parameters					
Alkalinity	mg/L	1200	2500	6000	6300
Ammonia	mg/L	102	296	1170	1050
Biochemical Oxygen Demand	mg/L	19	26	150	260
Boron	mg/L	1	2.9	15	20
Cadmium	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Calcium	mg/L	180	160	98	51
Chemical Oxygen Demand	mg/L	140	320	2800	2600
Chloride	mg/L	210	910	2800	2600
Chromium	mg/L	< 0.05	< 0.05	0.13	0.1
Cobalt	mg/L	< 0.005	0.012	0.098	0.077
Conductivity	µS/cm	2900	7200	19000	19000
Copper	mg/L	< 0.02	< 0.02	< 0.02	< 0.02
Dissolved Organic Carbon	mg/L	50	120	1100	760
Hardness	mg/L	730	800	600	540
Iron	mg/L	15	3.9	4.6	6.3
Lead	mg/L	< 0.005	< 0.005	0.006	< 0.005
Magnesium	mg/L	66	98	86	100
Manganese	mg/L	0.9	0.4	0.12	0.042
Naphthalene	mg/L	0.0069	0.0027	0.01	0.066
Nickel	mg/L	0.025	0.084	0.31	0.35
Nitrate	mg/L	< 0.1	< 0.5	< 2	< 2
Nitrite	mg/L	0.062	0.134	< 0.2	< 0.2
N-nitrosodimethylamine	mg/L	< 8	5.56	< 8	< 8
pH (Lab)	Unitless	7.11	7.36	7.74	7.75
Phenols	mg/L	< 0.02	< 0.02	< 0.2	< 0.2
Phosphorus (total)	mg/L	0.37	1.3	8.7	4.8
Potassium	mg/L	61	170	580	710
Sodium	mg/L	200	790	2200	2400
Sulphate	mg/L	< 10	< 10	< 20	< 20
Total Dissolved Solids	mg/L	1310	3120	8500	8730
Total Kjeldahl Nitrogen	mg/L	94	280	1100	1000
Zinc	mg/L	< 0.1	< 0.1	< 0.1	< 0.1
Volatile Organic Compounds (VOCs)					
1,1,1,2-Tetrachloroethane	mg/L	< 0.01	< 0.005	< 0.1	< 0.01
1,1,1-Trichloroethane	mg/L	< 0.005	< 0.0025	< 0.05	< 0.005
1,1,2,2-Tetrachloroethane	mg/L	< 0.01	< 0.005	< 0.1	< 0.01
1,1,2-Trichloroethane	mg/L	< 0.01	< 0.005	< 0.1	< 0.01
1,1-Dichloroethane	mg/L	< 0.005	< 0.0025	< 0.05	< 0.005
1,1-Dichloroethylene	mg/L	< 0.005	< 0.0025	< 0.05	< 0.005
1,2-Dichlorobenzene (o)	mg/L	< 0.01	< 0.005	< 0.1	< 0.01
1,2-Dichloroethane	mg/L	< 0.01	< 0.005	< 0.1	< 0.01
1,3,5-Trimethylbenzene	mg/L	< 0.01	< 0.005	< 0.1	0.012
1,3-Dichlorobenzene (m)	mg/L	< 0.01	< 0.005	< 0.1	< 0.01
1,4-Dichlorobenzene (p)	mg/L	< 0.01	< 0.005	< 0.1	0.014
1,4-Dioxane	mg/L	0.031	0.025	0.42	0.27
Benzene	mg/L	0.0058	0.0052	< 0.05	< 0.005
Chlorobenzene	mg/L	< 0.005	< 0.0025	< 0.05	< 0.005
Chloroethane	mg/L	< 0.01	< 0.005	< 0.1	< 0.01
Chloromethane	mg/L	< 0.025	< 0.013	< 0.25	< 0.025
Cis-1,2-Dichloroethylene	mg/L	< 0.005	< 0.0025	< 0.05	< 0.005
Dichloromethane	mg/L	< 0.025	< 0.013	< 0.25	< 0.025
Ethylbenzene	mg/L	0.014	0.0063	< 0.05	0.052
m+p-Xylene	mg/L	0.047	0.015	0.078	0.11
o-Xylene	mg/L	0.011	0.0062	< 0.05	0.043
Styrene	mg/L	< 0.01	< 0.005	< 0.1	< 0.01
Tetrachloroethylene	mg/L	< 0.005	< 0.0025	< 0.05	< 0.005
Toluene	mg/L	< 0.01	< 0.005	< 0.1	0.15
Trans-1,2-dichloroethylene	mg/L	< 0.005	< 0.0025	< 0.05	< 0.005
Trichloroethylene	mg/L	< 0.005	< 0.0025	< 0.05	< 0.005
Vinyl Chloride	mg/L	< 0.01	< 0.005	< 0.1	< 0.01

Table 7a: Surface Water Characteristics - May 6, 2019

Date	Parameter	Unit	Surface Water Station									
			S2	S3	S4R	S5	S6	S7	S8R	S18	S19	S20
6-May-19	Velocity:	m/s	0.3	0.50	NM	NM	0.75	1.25	1.50	NM	NM	NM
	Depth:	m	0.45	0.45	0.10	0.18	0.55	0.20	0.15	1.4	0.25	0.1
	Width:	m	4.20	0.55	0.50	1.65	1.25	2.10	0.65	12	3.90	5.0
	Estimated Flow Rate:	m^3/s	0.57	0.12	NM	NM	0.52	0.53	0.15	NM	NM	NM

NM: Not Measured (Flow was insufficient to measure or water was ponded)

Table 7b: Surface Water Quality Results – May 6, 2019

			Marysville Creek				Beechwood Ditch			South of Beechwood Road		
			S2 (upstream)	S3 (downstream)	S6 (downstream)	S7 (downstream)	S5 (upstream)	S4R (downstream)	S8R (downstream)	S18 (upstream)	S19 (downstream)	S20 (downstream)
		Date	5/6/2019	5/6/2019	5/6/2019	5/6/2019	5/6/2019	5/6/2019	5/6/2019	5/6/2019	5/6/2019	5/6/2019
Reading Name	Units	PWQO										
Inorganic and General Parameters												
Alkalinity	mg/L		180	170	170	170	210	320	210	170	210	200
Ammonia	mg/L		0.53	0.7	0.45	0.44	9.2	9.3	0.2	0.4	0.71	2.7
Ammonia (unionized)	mg/L	0.02	0.0033	< 0.00061	0.0036	0.0023	*0.17*	*0.11*	0.0022	0.0057	0.0086	*0.051*
Biochemical Oxygen Demand	mg/L		< 2	2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2
Chemical Oxygen Demand	mg/L		29	23	20	< 4	15	21	19	21	12	15
Chloride	mg/L		19	16	15	16	2.1	1.6	16	9.4	19	9.5
Conductivity	µS/cm		410	400	380	390	400	610	460	370	470	420
Hardness	mg/L		200	180	180	180	210	320	210	180	220	210
Nitrate	mg/L		0.18	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Nitrite	mg/L		< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Nitrate + Nitrite	mg/L											
Phenols	mg/L	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Phosphorus (total)	mg/L	0.03	*0.036*	< 0.03	< 0.03	< 0.03	< 0.03	*0.093*	< 0.03	*0.036*	< 0.03	*0.034*
Sulphate	mg/L		< 1	< 1	< 1	< 1	< 1	18	14	< 1	6.1	< 1
Total Dissolved Solids	mg/L		280	255	215	250	245	400	280	250	250	265
Total Suspended Solids	mg/L		< 10	< 10	< 10	< 10	< 10	60	< 10	< 10	< 10	14
Metals												
Boron	mg/L	0.2	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	0.027	0.033	< 0.02	< 0.02	0.023
Cadmium	mg/L		< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Calcium	mg/L		72	61	63	60	72	110	69	72	86	83
Chromium (III)	mg/L	0.0089	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Chromium (VI)	mg/L	0.001	*0.0013*	*0.0013*	*0.0011*	*0.0014*	< 0.0005	0.005	0.00092	*0.0013*	*0.0012*	*0.0012*
Chromium (Total)	mg/L		< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Cobalt	mg/L	0.0009	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Copper	mg/L	0.005	0.003	< 0.002	0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Iron	mg/L	0.3	0.12	< 0.1	0.15	< 0.1	< 0.1	*0.4*	< 0.1	< 0.1	< 0.1	*0.47*
Lead	mg/L	0.005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Magnesium	mg/L		9.5	8.2	8.3	8.3	11	17	13	3.8	6.4	6.9
Nickel	mg/L	0.025	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Potassium	mg/L		2.3	2	2	1.9	2	2.2	3.4	2.2	3	2.2
Sodium	mg/L		15	11	12	11	3.4	12	16	6.2	13	8.2
Zinc	mg/L	0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Volatile Organic Compounds (VOCs)												
1,4-dioxane	mg/L	0.02	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Naphthalene	mg/L	0.007	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
Field Measurements												
pH (Field)	unitless	6.5-8.5	7.42	6.4	7.53	7.33	7.78	7.58	7.51	7.61	7.52	7.73
Conductivity (Field)	µS/cm		328	391	379	388	399	638	462	359	462	423
Dissoved Oxygen (Field)	mg/L		3.74	4.61	6.08	5.37	3.1	1.83	4.82	3.07	2.14	3.32
Temperature (Field)	°C		10.8	11.7	10.9	11.3	14.2	13.7	15.3	15.7	16.4	15.8

Exceeds PWQO

Table 8: Subsurface Gas Monitoring Results - May 3, 2019

Gas Monitor	Location	Reading (ppm)
GM1	North of garage area, south of waste mound	0
GM3	Northeast corner of waste mound	0
GM4-1	Southeast corner of waste mound	0
GM4-2		0
GM5	Northwest corner of waste mound	0
GM6	North of waste mound	0

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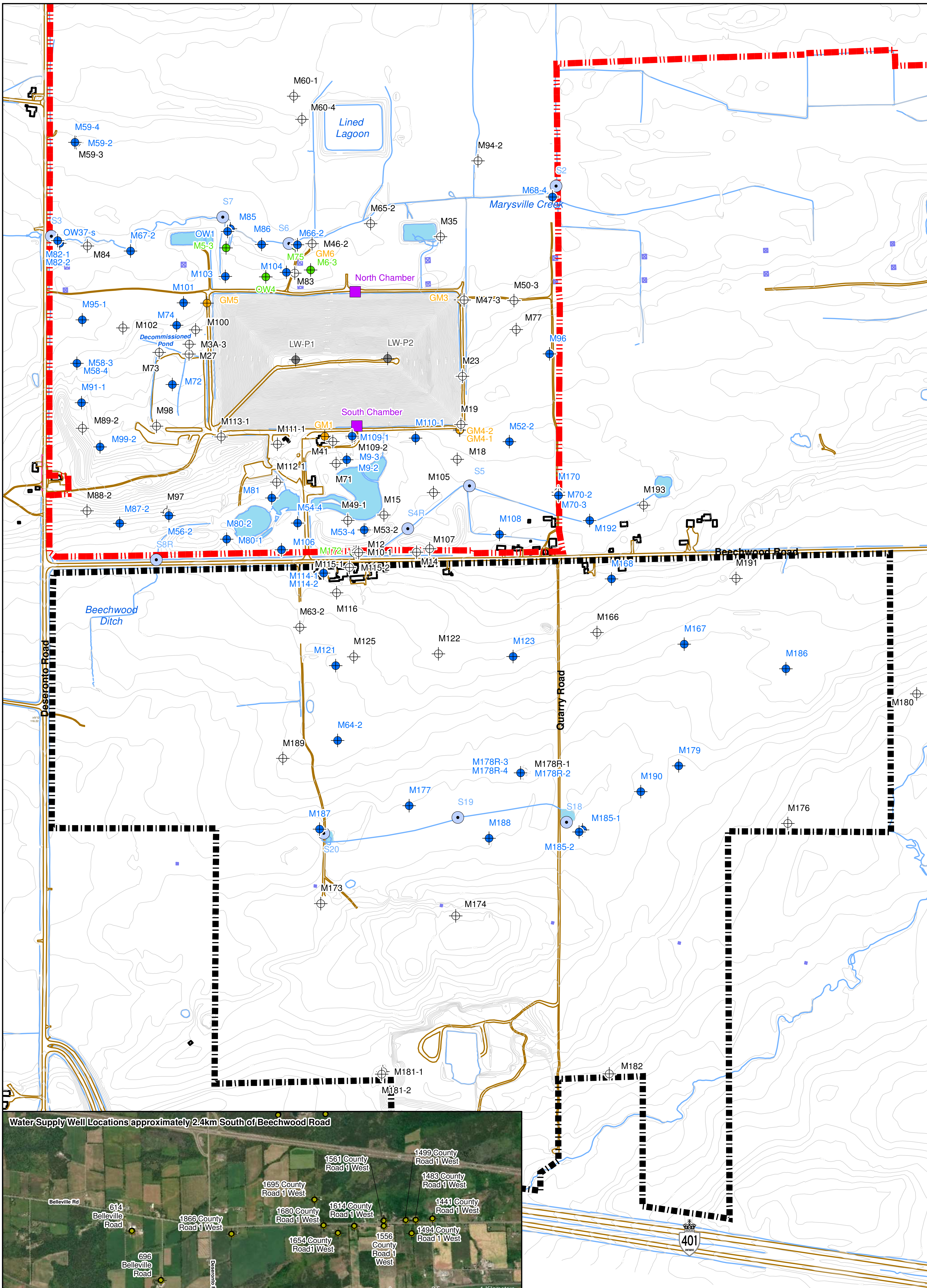
FIGURES



LEGEND

	Topographic Contour Lines
	Surface Water
	Property Boundary
	Proposed CAZ Boundary
M35	Monitoring Well Used to Measure Water Level (Not Sampled)
M53-4	Monitoring Well Used to Measure Water Level and Sampled for Chemistry
M5-3	Monitoring Well Sampled for Chemistry (Not used for Water Levels)
GM1	Gas Monitoring Well
	Leachate Chambers
	Lechate Monitoring Well
S2	Surface Water Monitoring Location
1097 Beechwood	Domestic Water Supply Well Sampled for Chemistry

REFERENCES

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-PROJECTION: UTM NAD83 ZONE 18
-DATA SOURCE: WM CANADA, BLUMETRIC, MNRO, NRCAN

0 25 50 100 150 200
Metres
1:8,000

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WASTE MANAGEMENT

PROJECT

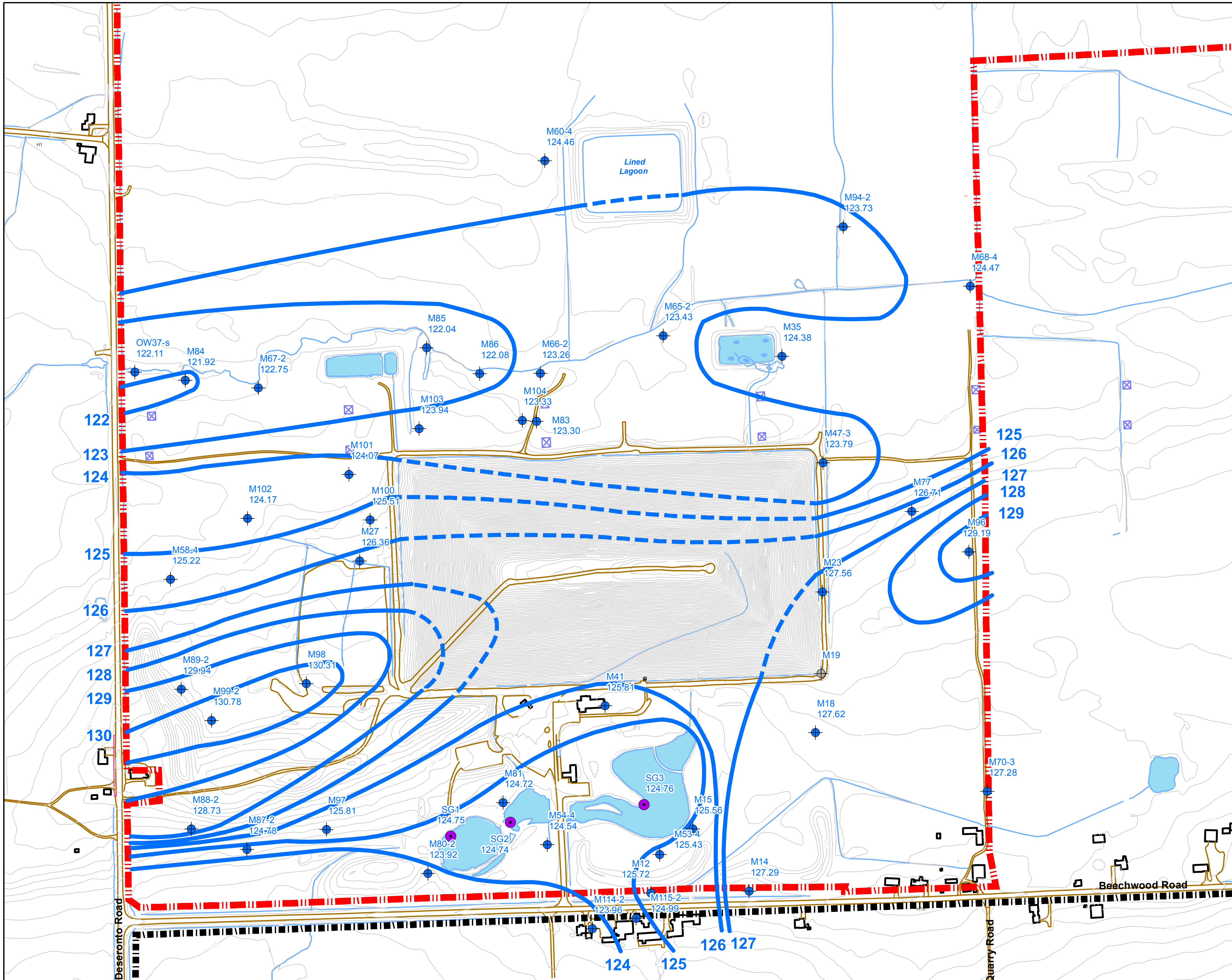
WASTE MANAGEMENT RICHMOND LANDFILL SPRING 2019 SEMI-ANNUAL REPORT

TITLE

SITE PLAN AND MONITORING LOCATIONS

PROJECT #	DATE
190161-03	July 2019

DRAWN	CHECKED	FIG NO.	REV
GM	MC	01	0



LEGEND

- Potentiometric Surface (masl)
- Topographic Contour Lines
- Surface Water
- Property Boundary
- Proposed CAZ Boundary
- M53-4 Shallow Groundwater Zone Elevation Monitor
- M5-3 Monitor Not Used in Contouring
- M35 Staff Gauge Location

REV.	DESCRIPTION	YY/MM/DD	BY	CHK
1				

REFERENCES

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Metres
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WASTE MANAGEMENT RICHMOND LANDFILL SPRING 2019 SEMI-ANNUAL REPORT

TITLE

SHALLOW GROUNDWATER FLOW ZONE POTENTIOMETRIC SURFACE – APRIL 29, 2019

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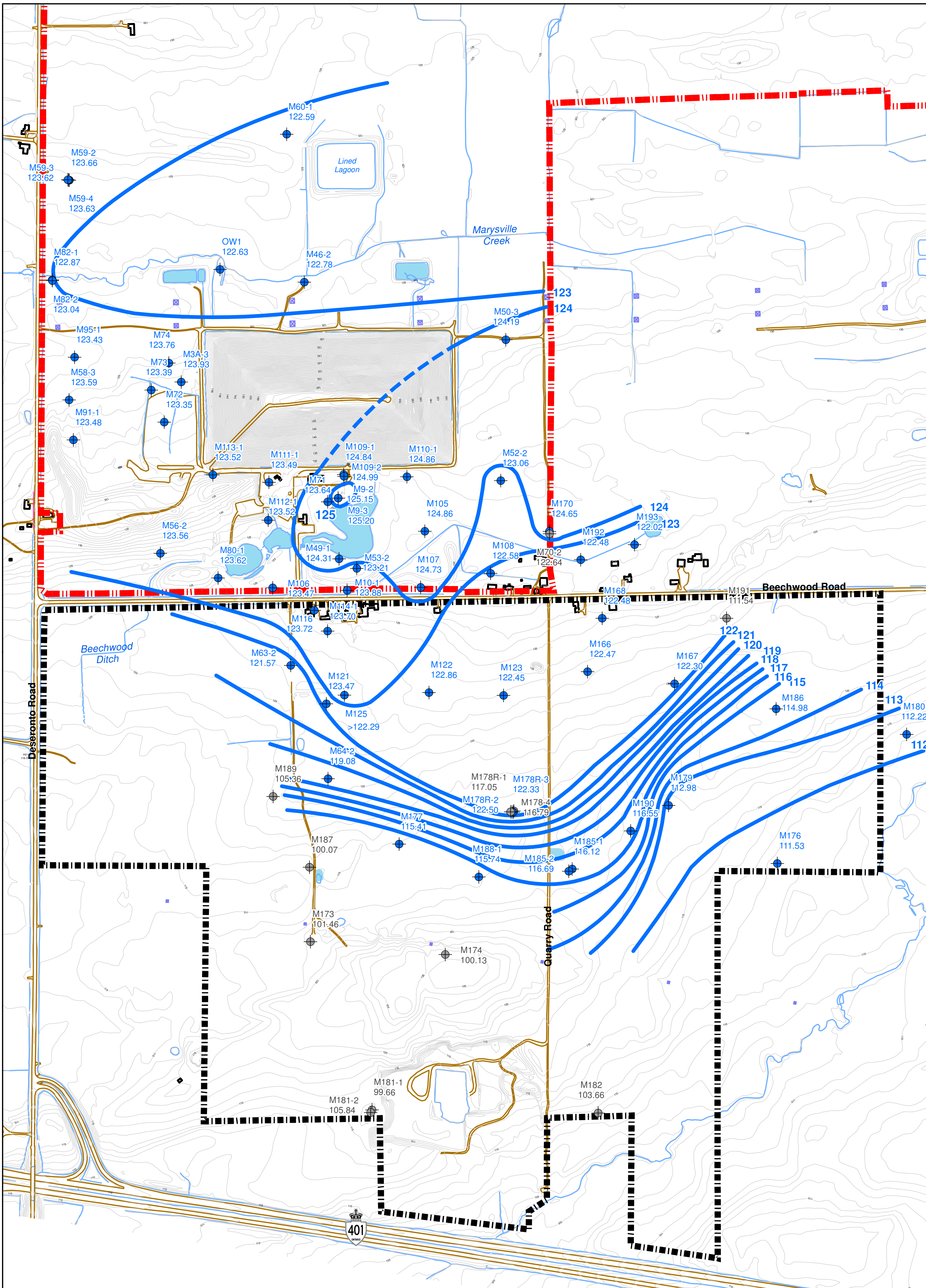
PROJECT #	DATE
190161-03	July 2019

DRAWN	CHECKED	FIG NO.	REV
GM	MC	02	0



LEGEND

- Potentiometric Surface (masl)
- Topographic Contour Lines
- Surface Water
- Property Boundary
- Proposed CAZ Boundary
- M166 Intermediate Groundwater Zone Elevation Monitor
- M189 Monitor Not Used in Contouring

REFERENCES

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-DATA SOURCE: WM CANADA, BLUMETRIC, MNRO, NRCAN

0 50 100 200 300 400

Metres

1:8,000

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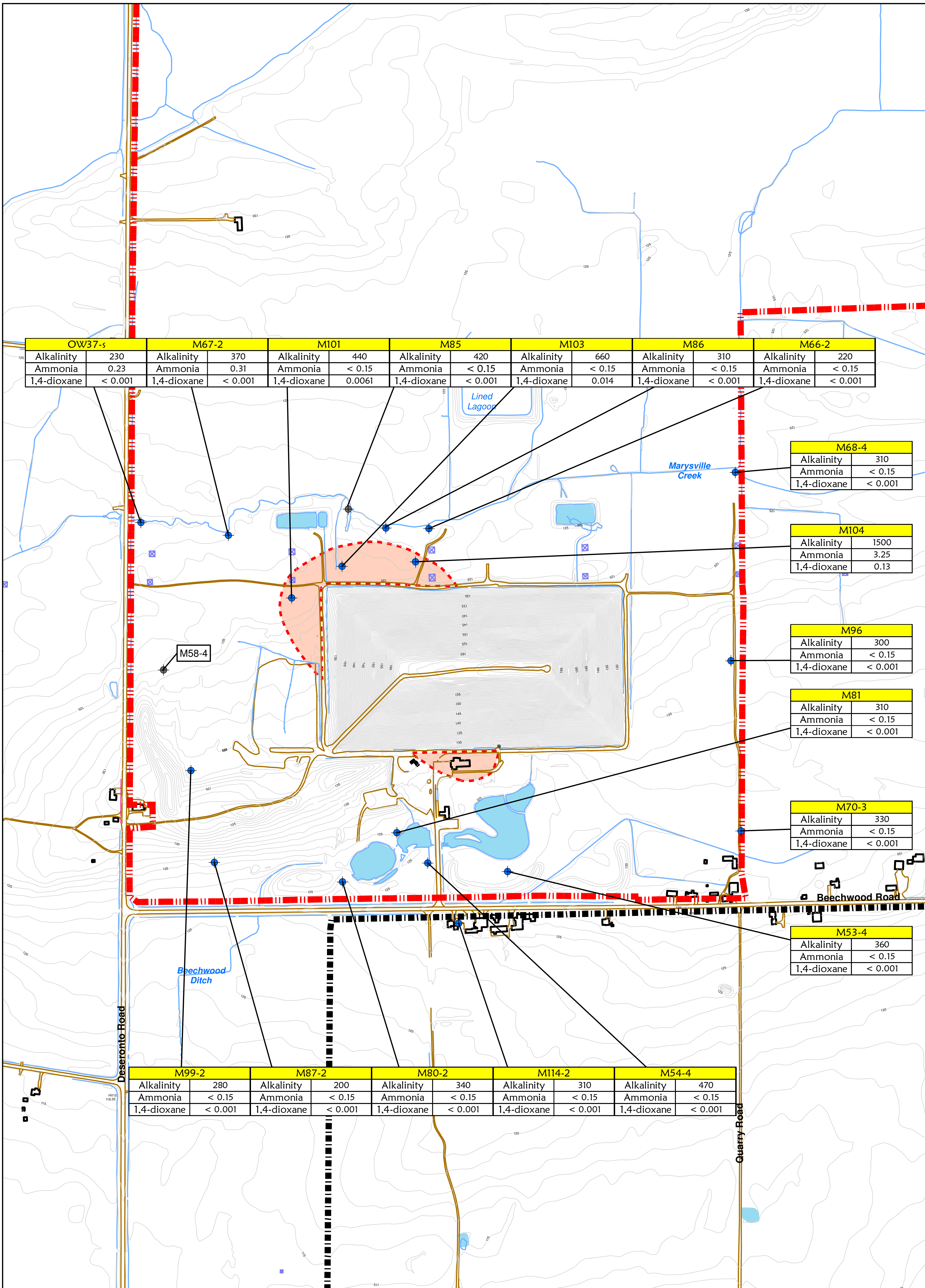
PROJECT

WASTE MANAGEMENT RICHMOND LANDFILL SPRING 2019 SEMI-ANNUAL REPORT

TITLE

INTERMEDIATE BEDROCK GROUNDWATER FLOW ZONE POTENTIOMETRIC SURFACE - APRIL 29, 2019

PROJECT #		DATE	
190161-03		July 2019	
DRAWN	CHECKED	FIG NO.	REV
GM	MC	03	0



LEGEND

- Topographic Contour Lines
- Surface Water
- Property Boundary
- Proposed CAZ Boundary
- M99-2 Shallow Monitoring Well Sampled for Chemistry
- M99-2 Shallow Monitoring Well Not Sampled (see text for detailed)
- 1,4 Dioxane Impacted Area

NOTE:
M58-4 damaged - no sample collected.

Parameter	Units
Alkalinity	mg/L CaCO3
1,4-dioxane	mg/L

REFERENCES

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Metres
1:6,650

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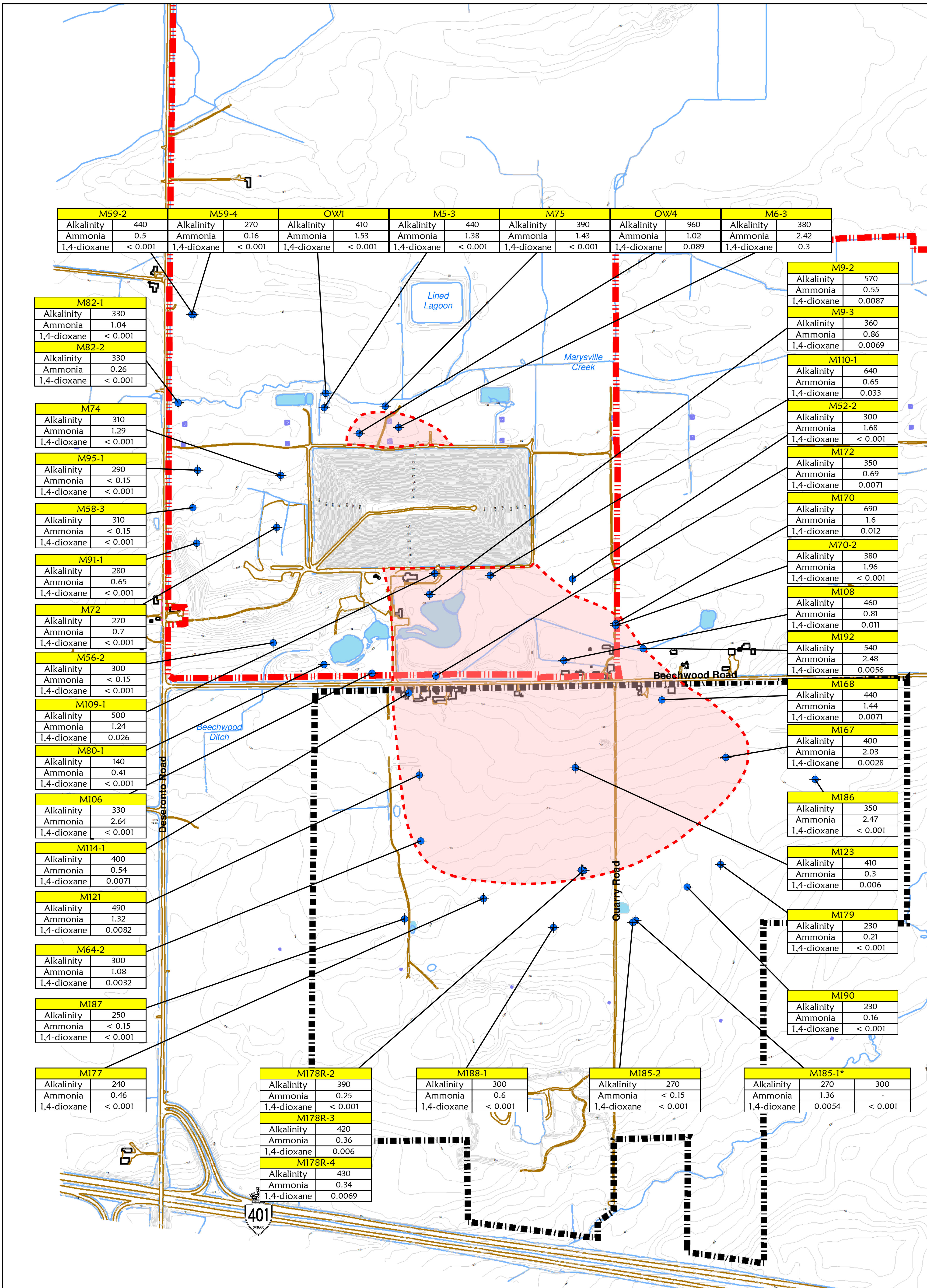
WASTE MANAGEMENT RICHMOND LANDFILL
SPRING 2019 SEMI-ANNUAL REPORT

TITLE
SHALLOW FLOW ZONE CONCENTRATIONS

PROJECT #	DATE		
190161-03	July 2019		
DRAWN	CHECKED	FIG NO.	REV
GM	MC	04	0



LEGEND

- Topographic Contour Lines
- Surface Water
- Property Boundary
- Proposed CAZ Boundary
- M9-2 Intermediate Monitoring Well Sampled for Chemistry
- 1,4 Dioxane Impacted Area

Parameter	Units
Alkalinity	mg/L CaCO3
1,4-dioxane	mg/L

*M185-1: verification re-sampling 5/24/2019 (see text for details)

REFERENCES

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-PROJECTION: UTM NAD83 ZONE 18
-DATA SOURCE: WM CANADA, BLUMETRIC, MNRO, NRCAN

0 25 50 100 150 200
Metres
1:9,100

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PROJECT

WASTE MANAGEMENT RICHMOND LANDFILL SPRING 2019 SEMI-ANNUAL REPORT

TITLE

INTERMEDIATE FLOW ZONE CONCENTRATIONS

PROJECT #	DATE		
180149-02	July 2019		
DRAWN	CHECKED	FIG NO.	REV
GM	MC	05	0

APPENDIX A

Monitoring Well Inventory

Appendix A: Monitoring Well Inventory

Monitoring Well	Easting	Northing
2054	335293	4902797
2055	335402	4902782
M3A-1	334990	4902928
M3A-2	334990	4902930
M3A-3	334990	4902930
M4-1	335006	4903036
M4-2	335006	4903038
M4-3	335006	4903038
M5-1	335003	4903162
M5-2	335003	4903163
M5-3	335003	4903163
M6-1	335200	4903172
M6-2	335201	4903174
M6-3	335201	4903174
M9-1	335410	4902787
M9-2	335410	4902789
M9-3	335410	4902789
M9R-1	335400	4902787
M10-1	335494	4902596
M10-2	335494	4902596
M10-3	335494	4902594
M12	335500	4902596
M14	335625	4902637
M15	335528	4902695
M16	335447	4902710
M18	335648	4902866
M19	335632	4902944
M23	335602	4903049
M27	334997	4902908
M28	334897	4902853
M29	334924	4902983
M30	334999	4903033
M31	334857	4902977
M35	335458	4903336
M38	335006	4902978
M39	335299	4903310
M41	335368	4902818
M42-1	335006	4903006
M42-2	335007	4903008
M42-3	335007	4903008
M43-1	335475	4902588
M43-2	335476	4902590
M43-3	335476	4902590
M45-1	334790	4904582
M45-2	334790	4904582
M45-3	334790	4904582
M46-1	335185	4903230
M46-2	335185	4903232
M47-1	335552	4903214
M47-2	335552	4903215
M47-3	335552	4903215
M48-1	334838	4902564
M48-2	334839	4902565
M48-3	334839	4902565

Appendix A: Monitoring Well Inventory

Monitoring Well	Easting	Northing
M49-1	335454	4902658
M49-2	335455	4902660
M49-3	335455	4902660
M50-1	335660	4903247
M50-2	335660	4903248
M50-3	335660	4903248
M51-1	335714	4903073
M51-2	335714	4903075
M51-3	335714	4903075
M52-1	335748	4902939
M52-2	335748	4902940
M52-3	335748	4902940
M53-1	335501	4902651
M53-2	335499	4902650
M53-3	335498	4902650
M53-4	335496	4902649
M54-1	335346	4902623
M54-2	335347	4902622
M54-3	335347	4902620
M54-4	335348	4902618
M55-1	334961	4903151
M55-2	334962	4903149
M55-3	334962	4903148
M55-4	334963	4903146
M56-1	335066	4902508
M56-2	335065	4902545
M57	335418	4902623
M58-1	334760	4902816
M58-2	334760	4902814
M58-3	334761	4902812
M58-4	334761	4902811
M59-1	334609	4903287
M59-2	334607	4903287
M59-3	334606	4903287
M59-4	334604	4903287
M60-1	335044	4903538
M60-3	335079	4903494
M60-4	335077	4903494
M61-1	334457	4903750
M61-2	334456	4903749
M61-3	334455	4903748
M61-4	334454	4903747
M62-1	335166	4904438
M62-2	335168	4904441
M62-3	335166	4904441
M62-4	335165	4904440
M63-1	335424	4902393
M63-2	335425	4902394
M64-1	335585	4902174
M64-2	335585	4902176
M65-1	335297	4903314
M65-2	335298	4903316

Appendix A: Monitoring Well Inventory

Monitoring Well	Easting	Northing
M66-1	335154	4903218
M66-2	335155	4903219
M67-1	334799	4903089
M67-2	334799	4903090
M68-1	335670	4903504
M68-2	335671	4903502
M68-3	335671	4903500
M68-4	335672	4903499
M69-1	335062	4904299
M69-2	335063	4904298
M69-3	335063	4904296
M69-4	335064	4904295
M70-1	335890	4902862
M70-2	335891	4902860
M70-3	335891	4902858
M71	335390	4902773
M72	334981	4902831
M73	334931	4902891
M74	334950	4902962
M75	335151	4903215
M76	335675	4903217
M77	335685	4903188
M78	335391	4902776
M79	335673	4903215
M80-1	335207	4902532
M80-2	335206	4902534
M81	335275	4902654
M82-1	334640	4903060
M82-2	334641	4903058
M83	335169	4903156
M84	334702	4903072
M85	334999	4903208
M86	335077	4903195
M87-1	334959	4902493
M87-2	334965	4902495
M88-1	334883	4902497
M88-2	334885	4902499
M89-1	334815	4902673
M89-2	334818	4902674
M90-1	334520	4903845
M90-2	334522	4903843
M91-1	334798	4902729
M91-2	334792	4902734
M93	335006	4903908
M94-1	335497	4903519
M94-2	335486	4903526
M95-1	334743	4902908
M95-2	334740	4902917
M96	335774	4903158
M97	335059	4902551
M98	334976	4902730
M99-1	334869	4902646

Appendix A: Monitoring Well Inventory

Monitoring Well	Easting	Northing
M99-2	334869	4902646
M100	334994	4902965
M101	334949	4903015
M102	334836	4902919
M103	335021	4903101
M104	335150	4903152
M105	335620	4902778
M106	335331	4902549
M107	335650	4902654
M108	335791	4902733
M109-1	335405	4902844
M109-2	335407	4902840
M110-1	335543	4902883
M110-2	335546	4902884
M111-1	335250	4902774
M111-2	335254	4902774
M112-1	335274	4902692
M112-2	335277	4902693
M113-1	335123	4902751
M113-2	335119	4902750
M114-1	335437	4902530
M114-2	335439	4902528
M115-1	335489	4902561
M115-2	335490	4902558
M116	335480	4902494
M117	335586	4902525
M121	335529	4902337
M122	335742	4902433
M123	335905	4902479
M125	335561	4902368
M166	336069	4902589
M167	336266	4902624
M168	336063	4902714
M170	335889	4902865
M171	335759	4903206
M172	335490	4902593
M173	335661	4901812
M174	335961	4901879
M176	336613	4902308
M177	335784	4902084
M178-1	336032	4902203
M178-2	336032	4902206
M178-3	336035	4902209
M178R-1	336008	4902236
M178R-2	336008	4902233
M178R-3	336005	4902233
M178R-4	336002	4902232
M178R-5	335997	4902232
M179	336338	4902357
M180	336801	4902677
M181-1	335912	4901492
M181-2	335912	4901492

Appendix A: Monitoring Well Inventory

Monitoring Well	Easting	Northing
M182	336402	4901643
M183	336953	4901770
M184	336176	4901998
M185-1	336170	4902151
M185-2	336170	4902151
M186	336509	4902627
M187	335607	4901972
M188-1	335979	4902069
M188-2	335978	4902068
M189	335479	4902099
M190	336274	4902275
M191	336332	4902802
M192	335976	4902826
M193	336082	4902896
M194-1	335564	4901886
M194-2	335568	4901889
M195	335592	4902084
M199	335717	4902027
M200	335793	4902059
M201	335829	4901991
M202	335932	4902013
M203	335709	4902128
M204	335910	4902186
M205	336077	4902128
M206	335938	4902329
M207	336131	4902261
OW1	334995	4903200
OW4	335108	4903128
OW5	335113	4903134
OW36	334799	4903100
OW37-d	334630	4903063
OW37-s	334634	4903062
OW54-d	335406	4902785
OW54-i	335406	4902785
OW54-s	335406	4902785
OW55-d	335376	4903186
OW55-i	335376	4903186
OW55-s	335376	4903184
OW56-d	335106	4903131
OW56-i	335106	4903131
OW56-s	335106	4903129
OW57	335117	4902762
PW1	335465	4902639
PW2	334988	4903095
PW3	335620	4902778
PW4	335626	4902775
PW5	335066	4902547

APPENDIX B

Results from Analytical Quality Assurance / Quality Control (QA/QC) Program

Appendix B

Summary of Results with Relative Percent Difference (RPD[1]) greater than 20%

Location	Parameter	Unit	Regular Sample	Field Duplicate	RPD (%)	RDL[2]	Comment
M167	Manganese	mg/L	0.003	0.002	40.00	0.002	Within 5x RDL
M167	Sulphate	mg/L	8.6	6.7	24.84	1.0	
S3	Ammonia	mg/L	0.7	0.37	61.68	0.05	

[1] RPD (%) = 100 * ABS (Regular Sample - Duplicate Sample) / ([Regular Sample + Duplicate Sample] / 2)

[2] RDL = Laboratory Reported Detection Limit

Detailed Results from Field Duplicate vs. Regular Samples

Reading Name	Units	M109-1 2019-05-01 Regular Sample	M109-1 2019-05-01 Field Duplicate	RPD (%)
General/Inorganic Parameters				
Alkalinity	mg/L	500	500	0.00
Ammonia	mg/L	1.24	1.25	0.80
Boron	mg/L	0.33	0.37	11.43
Calcium	mg/L	130	140	7.41
Chloride	mg/L	150	140	6.90
Conductivity	µS/cm	1400	1400	0.00
Dissolved Organic Carbon	mg/L	8	8	0.00
Iron	mg/L	13	14	7.41
Magnesium	mg/L	39	42	7.41
Manganese	mg/L	0.33	0.34	2.99
Nitrate	mg/L	< 0.1	< 0.1	0.00
Nitrite	mg/L	< 0.01	< 0.01	0.00
Potassium	mg/L	6.5	7	7.41
Sodium	mg/L	96	110	13.59
Sulphate	mg/L	< 1	< 1	0.00
Total Dissolved Solids	mg/L	710	775	8.75
Volatile Organic Compounds (VOCs)				
1,1,1,2-Tetrachloroethane	mg/L	< 0.001	< 0.001	0.00
1,1,1-Trichloroethane	mg/L	< 0.0005	< 0.0005	0.00
1,1,2,2-Tetrachloroethane	mg/L	< 0.001	< 0.001	0.00
1,1,2-Trichloroethane	mg/L	< 0.001	< 0.001	0.00
1,1-Dichloroethane	mg/L	< 0.0005	< 0.0005	0.00
1,1-Dichloroethylene	mg/L	< 0.0005	< 0.0005	0.00
1,2-Dichlorobenzene (o)	mg/L	< 0.001	< 0.001	0.00
1,2-Dichloroethane	mg/L	< 0.001	< 0.001	0.00
1,3,5-Trimethylbenzene	mg/L	< 0.001	< 0.001	0.00
1,3-Dichlorobenzene (m)	mg/L	< 0.001	< 0.001	0.00
1,4-Dichlorobenzene (p)	mg/L	< 0.001	< 0.001	0.00
1,4-Dioxane	mg/L	0.026	0.028	7.41
Benzene	mg/L	< 0.0005	< 0.0005	0.00
Chlorobenzene	mg/L	< 0.0005	< 0.0005	0.00
Chloroethane	mg/L	0.0092	0.0085	7.91
Chloromethane	mg/L	< 0.0025	< 0.0025	0.00
Cis-1,2-Dichloroethylene	mg/L	< 0.0005	< 0.0005	0.00
Dichloromethane	mg/L	< 0.0025	< 0.0025	0.00
Ethylbenzene	mg/L	< 0.0005	< 0.0005	0.00
m+p-Xylene	mg/L	< 0.0005	< 0.0005	0.00
o-Xylene	mg/L	< 0.0005	< 0.0005	0.00
Styrene	mg/L	< 0.001	< 0.001	0.00
Tetrachloroethylene	mg/L	< 0.0005	< 0.0005	0.00
Toluene	mg/L	< 0.001	< 0.001	0.00
Total Xylenes	mg/L	< 0.0005	< 0.0005	0.00
Trans-1,2-dichloroethylene	mg/L	< 0.0005	< 0.0005	0.00
Trichloroethylene	mg/L	< 0.0005	< 0.0005	0.00
Vinyl Chloride	mg/L	< 0.001	< 0.001	0.00

Detailed Results from Field Duplicate vs. Regular Samples

Reading Name	Units	M167 2019-04-30 Regular Sample	M167 2019-04-30 Field Duplicate	RPD (%)
General/Inorganic Parameters				
Alkalinity	mg/L	400	410	2.47
Ammonia	mg/L	2.03	1.98	2.49
Boron	mg/L	0.94	0.95	1.06
Calcium	mg/L	98	97	1.03
Chloride	mg/L	390	370	5.26
Conductivity	μS/cm	2000	2000	0.00
Dissolved Organic Carbon	mg/L	3.9	4.7	18.60
Iron	mg/L	< 0.1	< 0.1	0.00
Magnesium	mg/L	57	58	1.74
Manganese	mg/L	0.003	0.002	40.00
Nitrate	mg/L	< 0.1	< 0.1	0.00
Nitrite	mg/L	< 0.01	< 0.01	0.00
Potassium	mg/L	18	18	0.00
Sodium	mg/L	210	210	0.00
Sulphate	mg/L	8.6	6.7	24.84
Total Dissolved Solids	mg/L	1060	1110	4.61
Volatile Organic Compounds (VOCs)				
1,1,1,2-Tetrachloroethane	mg/L	< 0.0002	< 0.0002	0.00
1,1,1-Trichloroethane	mg/L	< 0.0001	< 0.0001	0.00
1,1,2,2-Tetrachloroethane	mg/L	< 0.0002	< 0.0002	0.00
1,1,2-Trichloroethane	mg/L	< 0.0002	< 0.0002	0.00
1,1-Dichloroethane	mg/L	< 0.0001	< 0.0001	0.00
1,1-Dichloroethylene	mg/L	< 0.0001	< 0.0001	0.00
1,2-Dichlorobenzene (o)	mg/L	< 0.0002	< 0.0002	0.00
1,2-Dichloroethane	mg/L	< 0.0002	< 0.0002	0.00
1,3,5-Trimethylbenzene	mg/L	< 0.0002	< 0.0002	0.00
1,3-Dichlorobenzene (m)	mg/L	< 0.0002	< 0.0002	0.00
1,4-Dichlorobenzene (p)	mg/L	< 0.0002	< 0.0002	0.00
1,4-Dioxane	mg/L	0.0028	0.0027	3.64
Benzene	mg/L	< 0.0001	< 0.0001	0.00
Chlorobenzene	mg/L	< 0.0001	< 0.0001	0.00
Chloroethane	mg/L	< 0.002	< 0.001	0.00
Chloromethane	mg/L	< 0.0005	< 0.0005	0.00
Cis-1,2-Dichloroethylene	mg/L	< 0.0001	< 0.0001	0.00
Dichloromethane	mg/L	< 0.0005	< 0.0005	0.00
Ethylbenzene	mg/L	< 0.0001	< 0.0001	0.00
m+p-Xylene	mg/L	< 0.0001	< 0.0001	0.00
o-Xylene	mg/L	< 0.0001	< 0.0001	0.00
Styrene	mg/L	< 0.0002	< 0.0002	0.00
Tetrachloroethylene	mg/L	< 0.0001	< 0.0001	0.00
Toluene	mg/L	< 0.0002	< 0.0002	0.00
Total Xylenes	mg/L	< 0.0001	< 0.0001	0.00
Trans-1,2-dichloroethylene	mg/L	< 0.0001	< 0.0001	0.00
Trichloroethylene	mg/L	< 0.0001	< 0.0001	0.00
Vinyl Chloride	mg/L	< 0.0002	< 0.0002	0.00

Detailed Results from Field Duplicate vs. Regular Samples

Reading Name	Units	M187 2019-05-01 Regular Sample	M187 2019-05-01 Field Duplicate	RPD (%)
General/Inorganic Parameters				
Alkalinity	mg/L	250	250	0.00
Ammonia	mg/L	< 0.15	< 0.15	0.00
Boron	mg/L	0.078	0.071	9.40
Calcium	mg/L	100	100	0.00
Chloride	mg/L	18	18	0.00
Conductivity	µS/cm	550	580	5.31
Dissolved Organic Carbon	mg/L	2.3	2.5	8.33
Iron	mg/L	< 0.1	< 0.1	0.00
Magnesium	mg/L	6.8	6.7	1.48
Manganese	mg/L	< 0.002	< 0.002	0.00
Nitrate	mg/L	0.3	0.28	6.90
Nitrite	mg/L	< 0.01	< 0.01	0.00
Potassium	mg/L	2.1	2	4.88
Sodium	mg/L	15	14	6.90
Sulphate	mg/L	32	32	0.00
Total Dissolved Solids	mg/L	345	375	8.33
Volatile Organic Compounds (VOCs)				
1,1,1,2-Tetrachloroethane	mg/L	< 0.0002	< 0.0002	0.00
1,1,1-Trichloroethane	mg/L	< 0.0001	< 0.0001	0.00
1,1,2,2-Tetrachloroethane	mg/L	< 0.0002	< 0.0002	0.00
1,1,2-Trichloroethane	mg/L	< 0.0002	< 0.0002	0.00
1,1-Dichloroethane	mg/L	< 0.0001	< 0.0001	0.00
1,1-Dichloroethylene	mg/L	< 0.0001	< 0.0001	0.00
1,2-Dichlorobenzene (o)	mg/L	< 0.0002	< 0.0002	0.00
1,2-Dichloroethane	mg/L	< 0.0002	< 0.0002	0.00
1,3,5-Trimethylbenzene	mg/L	< 0.0002	< 0.0002	0.00
1,3-Dichlorobenzene (m)	mg/L	< 0.0002	< 0.0002	0.00
1,4-Dichlorobenzene (p)	mg/L	< 0.0002	< 0.0002	0.00
1,4-Dioxane	mg/L	< 0.001	< 0.001	0.00
Benzene	mg/L	< 0.0001	< 0.0001	0.00
Chlorobenzene	mg/L	< 0.0001	< 0.0001	0.00
Chloroethane	mg/L	< 0.0004	< 0.0004	0.00
Chloromethane	mg/L	< 0.0005	< 0.0005	0.00
Cis-1,2-Dichloroethylene	mg/L	< 0.0001	< 0.0001	0.00
Dichloromethane	mg/L	< 0.0005	< 0.0005	0.00
Ethylbenzene	mg/L	< 0.0001	< 0.0001	0.00
m+p-Xylene	mg/L	< 0.0001	< 0.0001	0.00
o-Xylene	mg/L	< 0.0001	< 0.0001	0.00
Styrene	mg/L	< 0.0002	< 0.0002	0.00
Tetrachloroethylene	mg/L	< 0.0001	< 0.0001	0.00
Toluene	mg/L	< 0.0002	< 0.0002	0.00
Total Xylenes	mg/L	< 0.0001	< 0.0001	0.00
Trans-1,2-dichloroethylene	mg/L	< 0.0001	< 0.0001	0.00
Trichloroethylene	mg/L	< 0.0001	< 0.0001	0.00
Vinyl Chloride	mg/L	< 0.0002	< 0.0002	0.00

Detailed Results from Field Duplicate vs. Regular Samples

Reading Name	Units	M59-2 2019-05-02 Regular Sample	M59-2 2019-05-02 Field Duplicate	RPD (%)
General/Inorganic Parameters				
Alkalinity	mg/L	440	440	0.00
Ammonia	mg/L	0.5	0.5	0.00
Boron	mg/L	0.23	0.24	4.26
Calcium	mg/L	130	140	7.41
Chloride	mg/L	72	70	2.82
Conductivity	µS/cm	1100	1000	9.52
Dissolved Organic Carbon	mg/L	7.7	7.7	0.00
Iron	mg/L	< 0.1	< 0.1	0.00
Magnesium	mg/L	37	38	2.67
Manganese	mg/L	0.014	0.015	6.90
Nitrate	mg/L	0.45	< 0.1	0.00
Nitrite	mg/L	< 0.01	< 0.01	0.00
Potassium	mg/L	5	5.5	9.52
Sodium	mg/L	33	35	5.88
Sulphate	mg/L	36	37	2.74
Total Dissolved Solids	mg/L	690	665	3.69
Volatile Organic Compounds (VOCs)				
1,1,1,2-Tetrachloroethane	mg/L	< 0.0002	< 0.0002	0.00
1,1,1-Trichloroethane	mg/L	< 0.0001	< 0.0001	0.00
1,1,2,2-Tetrachloroethane	mg/L	< 0.0002	< 0.0002	0.00
1,1,2-Trichloroethane	mg/L	< 0.0002	< 0.0002	0.00
1,1-Dichloroethane	mg/L	< 0.0001	< 0.0001	0.00
1,1-Dichloroethylene	mg/L	< 0.0001	< 0.0001	0.00
1,2-Dichlorobenzene (o)	mg/L	< 0.0002	< 0.0002	0.00
1,2-Dichloroethane	mg/L	< 0.0002	< 0.0002	0.00
1,3,5-Trimethylbenzene	mg/L	< 0.0002	< 0.0002	0.00
1,3-Dichlorobenzene (m)	mg/L	< 0.0002	< 0.0002	0.00
1,4-Dichlorobenzene (p)	mg/L	< 0.0002	< 0.0002	0.00
1,4-Dioxane	mg/L	< 0.001	< 0.001	0.00
Benzene	mg/L	< 0.0001	< 0.0001	0.00
Chlorobenzene	mg/L	< 0.0001	< 0.0001	0.00
Chloroethane	mg/L	< 0.001	< 0.001	0.00
Chloromethane	mg/L	< 0.0005	< 0.0005	0.00
Cis-1,2-Dichloroethylene	mg/L	< 0.0001	< 0.0001	0.00
Dichloromethane	mg/L	< 0.0005	< 0.0005	0.00
Ethylbenzene	mg/L	< 0.0001	< 0.0001	0.00
m+p-Xylene	mg/L	< 0.0001	< 0.0001	0.00
o-Xylene	mg/L	< 0.0001	< 0.0001	0.00
Styrene	mg/L	< 0.0002	< 0.0002	0.00
Tetrachloroethylene	mg/L	< 0.0001	< 0.0001	0.00
Toluene	mg/L	0.00064	0.00065	1.55
Total Xylenes	mg/L	< 0.0001	< 0.0001	0.00
Trans-1,2-dichloroethylene	mg/L	< 0.0001	< 0.0001	0.00
Trichloroethylene	mg/L	< 0.0001	< 0.0001	0.00
Vinyl Chloride	mg/L	< 0.0002	< 0.0002	0.00

Detailed Results from Field Duplicate vs. Regular Samples

Reading Name	Units	S3 2019-05-06 Regular Sample	S3 2019-05-06 Field Duplicate	RPD (%)
1,4-Dioxane	mg/L	< 0.001	< 0.001	0.00
Alkalinity	mg/L	170	180	5.71
Ammonia	mg/L	0.7	0.37	61.68
Ammonia (unionized)	mg/L	< 0.00061	< 0.00061	0.00
Biochemical Oxygen Demand	mg/L	2	< 2	0.00
Boron	mg/L	< 0.02	< 0.02	0.00
Cadmium	mg/L	< 0.0001	< 0.0001	0.00
Calcium	mg/L	61	61	0.00
Chemical Oxygen Demand	mg/L	23	22	4.44
Chloride	mg/L	16	15	6.45
Chromium (III)	mg/L	< 0.005	< 0.005	0.00
Chromium (Total)	mg/L	< 0.005	< 0.005	0.00
Chromium (VI)	mg/L	0.0013	0.0013	0.00
Cobalt	mg/L	< 0.0005	< 0.0005	0.00
Conductivity	μS/cm	400	400	0.00
Copper	mg/L	< 0.002	< 0.002	0.00
Dissolved Oxygen	mg/L	4.61	4.61	0.00
Hardness	mg/L	180	190	5.41
Iron	mg/L	< 0.1	< 0.1	0.00
Lead	mg/L	< 0.0005	< 0.0005	0.00
Magnesium	mg/L	8.2	8.3	1.21
Naphthalene	mg/L	< 0.00005	< 0.00005	0.00
Nickel	mg/L	< 0.001	< 0.001	0.00
Nitrate	mg/L	< 0.1	< 0.1	0.00
Nitrite	mg/L	< 0.01	< 0.01	0.00
pH (Field)	unitless	6.4	6.4	0.00
Phenols	mg/L	< 0.001	< 0.001	0.00
Phosphorus (total)	mg/L	< 0.03	< 0.03	0.00
Potassium	mg/L	2	2	0.00
Sodium	mg/L	11	11	0.00
Sulphate	mg/L	< 1	< 1	0.00
Total Dissolved Solids	mg/L	255	245	4.00
Total Suspended Solids	mg/L	< 10	< 10	0.00
Zinc	mg/L	< 0.01	< 0.01	0.00

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