REPORT

FALL 2016
SEMI-ANNUAL MONITORING REPORT

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

Submitted to:

WASTE MANAGEMENT

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

Submitted by:

BluMetric Environmental Inc.
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BluMetric File No.: 160061-02

January 2017

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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 summer and fall 2016 monitoring events 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 summer and fall 2016 monitoring events were 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 MOE 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 summer monitoring event was conducted between August 11 and 15, 2016. The activities completed include the following:

- Groundwater monitoring wells installed in the shallow and intermediate bedrock flow zones (see Table 3) were monitored for water levels on August 11 and 12, 2016. No water levels were measured at groundwater monitors M14, M15, M18, M58-4, M68-4 and M70-3 because they were dry, at M19 and M174 (damaged), at M49-1 and M115-2 (missed), or at M192 and M193 (access permission was not granted by the property owner);
- No water levels were recorded at the staff gauges installed at the three ponds located on site between the landfill and Beechwood Road because these locations were dry;
- Liquid levels were measured in landfill leachate wells on August 12, 2016; and
- Surface water sampling was conducted on August 15, 2016 from locations S3, S18 and S20. No samples were collected from locations S2, S4R, S5, S6, S7, S8R and S19 because they were dry. Surface water samples were analyzed for surface water inorganic and general parameters and for 1,4-dioxane, as listed in Table 2;

The fall monitoring event was conducted between October 17 and 21, 2016. The activities completed include the following:

- Groundwater monitoring wells installed in the shallow and intermediate bedrock flow zones (see Table 3) were monitored for water levels on October 17, 2016. No water levels were measured at groundwater monitors M14, M15, M18, M23, M58-4, M68-4 and M70-3 because they were dry, or at M19 and M174 (damaged). Water levels were also measured at the two leachate monitoring wells;
- No water levels were recorded at the staff gauges installed at the three ponds located on site between the landfill and Beechwood Road because these locations were dry;
- Liquid levels were measured in landfill leachate wells on October 17, 2016;
- Groundwater monitoring wells listed in Table 1 were sampled between October 18-20, 2016; no samples were collected from monitoring wells M53-4 and M85 because they were dry. Samples were analyzed for the suite of groundwater inorganic and general parameters and Volatile Organic Compounds (VOCs) listed in Table 2;
- Surface water sampling was conducted on October 18, 2016 from locations S3, S7, S18, S19 and S20. No samples were collected from locations S2, S4R, S5, S6 and S8R because they were dry. Surface water samples were analyzed for surface water inorganic and general parameters and for 1,4-dioxane, as listed in Table 2;
- Landfill gas monitoring was conducted on October 21, 2016. Field measurements were made with a RKI Eagle probe calibrated to methane gas response at six gas monitors (GM1, GM3, GM4-1, GM4-2, GM5 and GM6); and
- A total of 11 Quality Assurance/Quality Control (QA/QC) samples were collected during the fall sampling event, including six field duplicate samples, two field blanks, and three trip blanks. De-ionised water for analysis of blank samples was supplied by the laboratory.

In addition to the aforementioned "routine" sampling requirements (Table 1), recently installed monitoring wells M178R-1, M189, M191 and M193 were sampled as part of additional sampling events as required by the EMP as per amended ECA Condition No. 8.5(c)iv included in the ERT Order dated July 15, 2015. This condition requires that newly installed wells be tested a minimum of four times on a quarterly basis during the first year after being established.

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 and surface water 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, grouped in relation to their location relative 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[(1)] and updated based on results from subsequent hydrogeological investigations[(2,3,4)], and is summarized here. The SCM report describes the groundwater flow conditions at the Richmond Landfill. Based on the results from extensive

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

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

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

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

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;
- 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 sub-vertical fractures are present providing hydraulic connection between horizontal fractures;
- hydraulic connections of fractures exist 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 much deeper than wells further north in the CAZ; an assessment of karst features observed in the central portion of the CAZ and believed to influence groundwater flow conditions in this area is ongoing, and will be used to update the SCM.

3.1 LIQUID LEVELS IN LEACHATE WELLS

Liquid levels were measured in the two landfill leachate wells on August 12 and October 17, 2016:

- The liquid level at LW-P1 was 147.19 and 147.21 m above sea level (masl) , respectively, on August 12 and October 17, 2016; and

- The liquid level at LW-P2 was 151.37 and 155.30 masl, respectively, on August 12 and October 17, 2016.

3.2 GROUNDWATER RESULTS

3.2.1 Groundwater Elevations

Groundwater elevations were measured on August 11-12 and October 17, 2016 from monitoring wells listed in Table 3, and are presented in Tables 4a and 4b, respectively. An inventory of all monitoring well locations is provided in Appendix A. Groundwater elevation contours within the shallow groundwater flow zone are shown on Figure 2a (summer) and Figure 2b (fall), while Figure 3a (summer) and Figure 3b (fall) show 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 summer and fall 2016 shallow groundwater contours (Figures 2a and 2b, respectively) 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. The water level from shallow bedrock monitor M85 was not used to prepare the summer or fall 2016 groundwater contours, as the water level at this location was not static, believed to be influenced by recent sampling events. 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 summer and fall 2016 intermediate bedrock zone contours are presented on Figures 3a and 3b, respectively. On the landfill property, groundwater in this hydrostratigraphic unit generally flows to the north, west, and south-southeast relative to the landfill. Groundwater flow for the intermediate bedrock in the area of well-connected fractures south of the landfill and east of the landfill access road can be distinguished by periods of higher groundwater levels and periods of lower groundwater levels. During periods of high groundwater levels, the groundwater generally flows south-southeast. During periods of lower water levels, as observed during the summer and fall 2016 monitoring events (Figures 3a and 3b), groundwater flow is oriented toward the central portion of the well-connected area immediately south of the landfill, and continues toward the east-southeast as it moves further south of the landfill.

Water levels from intermediate bedrock monitors M71 (damaged), M70-2, M178R-1 and M191 (low permeability wells with water level interpreted as not being representative of static groundwater conditions) were not used to prepare the summer or fall 2016 groundwater contours. Additionally, intermediate bedrock zone monitoring wells located farther to the south (e.g., M173, M174, M178R-4, M181-1, M181-2, M182, M185-1, 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. Additional details on the ongoing hydrogeological investigation in the area south and southeast of the Site have been provided under separate cover(5,6), while ongoing related work, once completed, will be reported in 2017.

3.2.2 Groundwater Analytical Results

Groundwater monitoring results from the wells sampled in fall 2016 as part of the EMP, as well as those from the additional sampling conducted in accordance with ECA Condition 8.5(c)iv, are presented in Table 5a. Groundwater quality data for the fall 2016 monitoring event are consistent with historical results.

3.2.2.1 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, north and northwest from the unlined portion of the landfill (e.g., M66-2, M86, M101, M103 and M104). 1,4-dioxane was also detected at monitoring wells M101, M103 and M104, and 1,1-dichloroethane was detected at M101.

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, 1,1-dichloroethylene, cis-1,2-dichloroethylene, tetrachloroethylene, trichloroethylene and vinyl chloride). An evaluation of these impacts is ongoing and will be reported in 2017.

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

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

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. Monitor M114-2, located approximately 300 m south of the landfill footprint, had slightly elevated alkalinity, chloride, conductivity, sodium and TDS concentrations; these are likely related to road salting activities considering that this shallow monitoring well is adjacent to, and hydraulically downgradient from, Beechwood Road.

3.2.2.2 Intermediate Groundwater Flow Zone

Analytical results from intermediate bedrock groundwater monitors sampled in fall 2016 were generally consistent with historical results. North of the landfill, elevated concentrations of water quality parameters and detectable 1,4-dioxane were observed at M6-3 and OW4, which are in close proximity to the landfill footprint. These results indicate the presence of leachate impacts at these locations. However, despite moderate concentrations of some parameters (e.g., alkalinity at OW1, M5-3 and M75), impacts from the landfill are not apparent further north from the landfill 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 (e.g., M9-2, M9-3, M64-2, M108, M109-1, M110-1, M114-1, M121, M123, M167, M168, M170, M172, M178R-2, M178R-3 and M178R-4). Several monitoring wells downgradient of these impacted wells (e.g. M177, M179, M185-1, M185-2, M186, M187, M188 and M190) do not show impacts from the landfill (i.e. no 1,4-dioxane detected and alkalinity concentrations of 360 mg/L or lower) thus defining the limit of the groundwater plume. Other locations south and southeast of the landfill with elevated concentrations of chloride, sodium, TDS, and/or BTEX compounds (e.g., M106, M186, M189, M191 and M193), 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. Wells sampled in the western part of the landfill site (e.g., M72, M74 and M82-1) exhibit concentrations of water quality parameters that are relatively low and continue to reflect background conditions.

Alkalinity and 1,4-dioxane results are shown for the Shallow and Intermediate Bedrock Flow Zones on Figures 4 and 5, respectively.

3.2.3 Guideline B-7 Reasonable Use Limits (RULs)

Selected monitoring wells located 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 (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.

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, sodium and/or TDS) were observed in monitoring wells M54-4, M66-2, M67-2, M80-2, M87-2 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, M177, M179, M185-1, M186, M187 and M188).

3.2.4 Status of Monitoring Wells and Compliance with Ontario Regulation 903

During the fall 2016 monitoring event, the condition of groundwater monitoring wells included in the EMP was 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 MOECC, the protective casing was fitted with a vermin proof cap to meet the requirements of Ontario Regulation 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.

Intermediate bedrock monitoring well M174 showed the presence of bentonite grout at the bottom and should be inspected in future monitoring events, and possibly be repaired, or replaced and decommissioned.

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

An evaluation of 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 and duplicate samples 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 groundwater duplicate QA/QC sampling were within the 20% margin of error as summarized in Appendix B. All parameters were near or below the RL in field and trip blanks.

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 (Figure 1). No water levels were recorded at the staff gauges because the locations were dry during both summer and fall monitoring events.

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). 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 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 ephemeral 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 east of Quarry Road (see Figure 1). Surface water flows west 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, when flowing, enters into the ground into a near-surface local karst feature.

Surface water monitoring locations are shown on Figure 1. Sampling locations S2, S4R, S5, S6, S7, S8R and S19 were not sampled in August 2016 because they were dry, despite conducting the sampling event shortly after a rainfall event of greater than 25mm. Similarly, S2, S4R, S5, S6 and S8R were not sampled in October 2016 because they were dry.

3.3.3 Surface Water Flow

Visual observations of surface water flow and general water characteristics for the summer and fall sampling programs are summarized in Tables 6a and 6b, respectively. Surface water flow velocities were not measured at any location because of insufficient flow conditions.

3.3.4 Surface Water Analytical Results

The analytical results from surface water locations sampled during the summer and fall 2016 sampling events are presented in Tables 7a and 7b, respectively.

Surface water quality results were compared to Provincial Water Quality Objectives (PWQO). Background surface water quality could not be monitored on site at upstream station S2 for Marysville Creek and station S5 for Beechwood Ditch because they were dry. Background surface water quality was monitored at upstream station S18 for the unnamed local water course located in the central portion of the 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 summer 2016 sampling event were below their respective PWQO, with the exception of total phosphorous and iron at all locations, and phenols, cobalt, copper and zinc at location S20. Field pH was slightly less than PWQO at location S18. Parameters analysed in surface water samples collected during the fall 2016 sampling event were all below PWQO, with the exception of total phosphorous at all locations, cobalt at locations S18 and S20, copper at locations S7 and S20, and phenols, cadmium, lead, zinc and pH at location S20. Total suspended solids were generally elevated at location S20 during both the summer and fall sampling events.

Results from summer and fall 2016 indicate that the landfill is not causing adverse impacts to surface water quality. The generally poor surface water quality at sampling location S20 during the summer and fall 2016 sampling events can be partially attributed to the exceptionally dry conditions and resulting enhanced evaporation in this man made pond, and the fact that it is used by cattle as a source of drinking water.

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

An evaluation of 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 regular samples and duplicates shows very good correlation for the majority of analyzed constituents. All parameters for the summer sampling round surface water field duplicate sample (location S3) were within the 20% margin of error, with the exception of ammonia. Parameters for the fall sampling round surface water field duplicate sample (location S20) were within the 20% margin of error, with the exception of biochemical oxygen demand, cadmium and nitrite.

3.4 SUBSURFACE GAS SAMPLING

On October 21, 2016, BluMetric inspected the subsurface gas monitoring probes and measured methane concentrations at all locations. The locations of the gas monitors are shown on Figure 1 and results are provided in Table 8. Measurements of gas wells were between 0 and 5 ppm, well below the LEL for methane of 5% by volume in air (or 50,000 ppm).

3.5 ANNUAL SUMMARY

A comparative review of groundwater quality results between this and previous sampling events indicates that constituent concentrations vary over time but for the most part have remained relatively consistent over the current calendar year and over the past 10 years or more. Depending on which monitoring point and more importantly the time scale considered, conflicting trends in concentrations can occur sporadically. However since implementing the revised EMP dated June 29, 2010, the majority of the patterns have been observed to be seasonally variable but relatively similar.

Where sufficient historical data are available, alkalinity, chloride, dissolved organic carbon (DOC), iron, manganese, sodium and total dissolved solids (TDS) concentration data were reviewed for all groundwater trigger wells listed in Table 12 of the EMP.

Time-concentration plots are provided in Appendix C. Over the past five years (from the spring of 2012 to the fall of 2016), the vast majority of the analytical results show stabilized and/or variable/oscillating concentrations for almost all parameters. Exceptions to this generalization include:

- For the shallow groundwater monitors:
  - M54-4 for alkalinity, chloride, DOC, sodium and TDS (increasing trend);
  - M66-2 for alkalinity (increasing trend), and chloride and TDS (downward trend);
  - M67-2: sodium (decreasing);
  - M80-2 for alkalinity, chloride, sodium and TDS (increasing trend);
  - M86 for alkalinity (increasing trend), and iron and TDS (decreasing trend); and
  - OW37-s for manganese (increasing trend).

- For the intermediate bedrock groundwater monitors:
  - M106 for chloride, sodium and TDS (increasing trend);

The observed trends in groundwater geochemistry outlined here are not necessarily indicative of landfill leachate impacts, and should be interpreted with caution. 1,4-dioxane has recently been added to the environmental monitoring program as a primary leachate indicator parameter. Any changes over time for this and other parameters will be used in future environmental monitoring events in the comparative review of groundwater quality results and the evaluation of temporal trends that may be indicative of potential impacts to groundwater from landfill leachate.

3.6 ADDITIONAL INVESTIGATIONS

Work outside of the scope of the EMP program was performed throughout the year at the Richmond Landfill Site. Table 9 describes activities performed in 2016.

In response to item 11.1 from the Order issued by the Environmental Review Tribunal (Case 12-033) dated December 24, 2015, specifically as it relates to Condition 8.5(a)i of the ECA, continuous conductivity monitoring on Marysville Creek was implemented, commencing May 1, 2016. Solinst (3001 LTC Levelogger) conductivity loggers were installed at two locations along Marysville Creek; one location upstream of the landfill near surface water sampling location S2, and the second location downstream of the landfill approximately 50 m east of sampling location S3. Interim results of the monitoring program up to December 9, 2016 are included in Appendix D. Final results and interpretation will be included in the spring 2017 semi-annual monitoring report.

4. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The summer and fall 2016 monitoring programs included the collection of groundwater 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 MOE January 9, 2012 and amended by Notice No. 1 dated May 3, 2013 and Environmental Review Tribunal (ERT) Order dated December 24, 2015. Condition 8.5 (b) of the ECA requires that WM carry out monitoring in accordance with the interim EMP until such time as further amendments to the ECA and EMP are directed by the ERT.

The following were completed as part of the summer and fall 2016 EMP monitoring event between August 11 and 15, 2016 and October 17 and 21, 2016, respectively:

- Water levels were recorded from groundwater monitoring wells installed in the Shallow groundwater and Intermediate Bedrock Flow Zones, as well as leachate monitoring wells;
- Groundwater monitors completed in the Shallow and Intermediate Bedrock Flow Zones were sampled for analytical testing;
- Surface water locations were sampled for analytical testing;
- Landfill gas monitoring wells were monitored for methane concentrations; and
- Quality Assurance/Quality Control (QA/QC) samples were collected, including field duplicate samples, field blanks, and trip blanks; and,

In addition to the aforementioned sampling conducted as required by the EMP, monitoring wells M178R-1, M189, M191 and M193 were sampled on October 18, 2016, as part of a supplementary monitoring event scheduled outside of the regular EMP sampling frequency as required by amended ECA Condition No. 8.5(c)iv included in the ERT Order dated December 24, 2015.

4.1 GROUNDWATER

- Groundwater flow directions interpreted from water elevations measured in monitors were consistent with historical flownets:
  - o 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 fall 2016 are generally consistent with historical results;
- Slightly elevated groundwater concentrations of a number of water quality parameters are seen in the Shallow Flow Zone within the property to the south, north and northwest of the landfill footprint. In other areas of the site including at property boundaries, there is no evidence of groundwater impact away from the landfill footprint in the Shallow Flow Zone;
- The groundwater geochemical results for the Intermediate Bedrock 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 concentrations west and east of the landfill;
- Recent investigations of the groundwater conditions south of the landfill were completed to delineate the groundwater impacts from the landfill and to define the extent of a contaminant attenuation zone. Results from these investigations were submitted to MOECC in January and April, 2016;
- 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;
- Shallow groundwater monitoring wells M19, M58-4 and M68-4 are damaged and are considered unnecessary for the EMP monitoring program. Upon approval from MOECC, these wells will be decommissioned; and
- Intermediate bedrock monitoring well M174 showed the presence of bentonite grout at the bottom and should be inspected in future monitoring events, and possibly be repaired, or replaced and decommissioned.

4.2 Surface Water

- The concentrations observed during summer and fall 2016 monitoring events are within the range of historical monitoring results and indicate that the landfill is not causing adverse impacts to surface water quality;
- The concentration of total phosphorous at all locations and various metals amongst locations exceeded PWQO; and
- All other measured parameters were consistent with natural surface water quality and below PWQO and therefore no impact to surface water quality from the landfill is believed to occur.

4.3 Subsurface Gas

Measurements for methane gas were between 0 and 5 ppm for the six monitoring location, well below the LEL for methane of 5% by volume in air (or 50,000 ppm).

4.4 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 municipal sewer system and treated at the wastewater treatment plant. For the 2016 calendar year, the site records show that 15,698 m^3 of leachate were generated and hauled for discharge to the municipal sewer system.

5. LIMITING CONDITIONS

The summer and fall 2016 monitoring program involved the collection of groundwater (from on-site and off-site monitoring 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.

This report has been prepared for Waste Management of Canada. Any use a third party makes of this report, any reliance on the report, or decisions based upon the report, are the responsibility of those third parties unless authorization is received from BluMetric Environmental Inc. in writing. BluMetric Environmental Inc. accepts no responsibility for any loss or damages suffered by any unauthorized third party as a result of decisions made or actions taken based on this report.

Respectfully submitted,
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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, 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 (UNKN)[2] 1556 County Road 1 West (UNKN)[2] 1561 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	Magnesium	Manganese
Alkalinity	Sodium	Ammonia (total)
Conductivity	Potassium	Nitrate
Dissolved organic carbon	Boron	Nitrite
Calcium	Iron	Chloride
		Sulphate
Volatile Organic Compounds (VOCs)		
1,4 Dioxane	1,2-Dichlorobenzene	1,1,2-Trichloroethane
Benzene	1,3-Dichlorobenzene	1,1-Dichloroethane
Toluene	1,4-Dichlorobenzene	1,2-Dichloroethane
Ethylbenzene	Methylene chloride	1,1-Dichloroethylene
m&p-Xylene	Chloromethane	Cis-1,2-Dichloroethylene
o-Xylene	Chloroethane	Trans-1,2-Dichloroethylene
Styrene	1,1,2,2-Tetrachloroethane	Trichloroethylene
1,3,5-Trimethylbenzene	1,1,1,2-Tetrachloroethane	Tetrachloroethylene
Chlorobenzene	1,1,1-Trichloroethane	Vinyl chloride
Surface Water Inorganic and General Parameters		
1,4 Dioxane	Potassium	Nitrate
Total suspended solids	Boron	Nitrite
Total dissolved solids	Cadmium	Chloride
Biological oxygen demand	Chromium (total, Cr6+, Cr3+)	Sulphate
Chemical oxygen demand	Cobalt	Phenols
Alkalinity	Copper	Total phosphorous
Conductivity	Iron	Naphthalene
Hardness	Lead	
Calcium	Nickel	*Field measurements:*
Magnesium	Zinc	*pH, temperature, conductivity, dissolved*
Sodium	Ammonia (total & un-ionized)	*oxygen, estimated flow rate*

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 4a: Groundwater Elevations - August 11-12, 2016

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	123.90	M54-4	123.33	M83	123.28	M98	128.26
M14	Dry	M60-4	123.59	M84	121.88	M99-2	128.52
M15	Dry	M58-4	Dry	M85	119.92	M100	123.57
M18	Dry	M65-2	122.70	M86	121.28	M101	122.46
M19	Damaged	M66-2	122.08	M87-2	122.66	M102	122.33
M23	125.19	M67-2	122.15	M88-2	126.46	M103	122.27
M27	124.29	M68-4	Dry	M89-2	127.56	M104	122.24
M35	123.14	M70-3	Dry	M94-2	124.40	M114-2	122.00
M41	124.42	M77	123.96	M96	126.60	M115-2	Missed
M47-3	123.39	M80-2	122.72	M97	123.46	OW37-s	121.61
M53-4	124.36	M81	123.66				
Intermediate Bedrock Groundwater Flow Zone							
M3A-3	123.98	M71	123.04	M113-1	122.24	M178R-4	115.68
M9-2	118.38	M72	122.07	M114-1	118.297	M179	108.44
M9-3	118.89	M73	122.14	M116	118.33	M180	110.59
M10-1	118.32	M74	122.88	M121	118.209	M181-1	95.87
M46-2	123.02	M80-1	122.34	M122	118.287	M181-2	104.60
M49-1	Missed	M82-1	121.45	M123	118.156	M182	87.87
M50-3	124.20	M82-2	121.97	M125	118.3411	M185-1	103.04
M52-2	121.12	M91-1	122.29	M166	118.19	M185-2	113.23
M53-2	118.10	M95-1	122.16	M167	118.19	M186	113.99
M56-2	122.28	M105	118.37	M168	118.20	M187	88.43
M58-3	122.30	M106	122.23	M170	118.34	M188	114.46
M59-2	122.34	M107	118.35	M173	99.45	M189	104.78
M59-3	122.30	M108	118.19	M174	Damaged	M190	112.34
M59-4	122.31	M109-1	118.35	M176	108.51	M191	97.83
M60-1	122.29	M109-2	118.37	M177	114.14	M192	No access*
M63-2	120.63	M110-1	118.35	M178R-1	114.65	M193	No access*
M64-2	118.61	M111-1	122.22	M178R-2	118.22	OW1	122.48
M70-2	120.97	M112-1	123.24	M178R-3	118.23		

* Access not granted by property owners

Table 4b: Groundwater Elevations - October 17, 2016

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	123.86	M54-4	123.49	M83	123.62	M98	128.15
M14	Dry	M58-4	Dry	M84	121.83	M99-2	128.48
M15	Dry	M60-4	123.52	M85	120.13	M100	123.69
M18	Dry	M65-2	121.99	M86	122.78	M101	122.58
M19	Damaged	M66-2	122.06	M87-2	122.10	M102	122.79
M23	Dry	M67-2	122.09	M88-2	125.75	M103	122.49
M27	124.90	M68-4	Dry	M89-2	127.35	M104	122.59
M35	123.17	M70-3	Dry	M94-2	123.89	M114-2	122.46
M41	124.46	M77	123.43	M96	125.66	M115-2	123.40
M47-3	123.15	M80-2	122.68	M97	123.00	OW37-s	121.72
M53-4	124.33	M81	123.99				
Intermediate Bedrock Groundwater Flow Zone							
M3A-3	124.17	M71	123.17	M113-1	122.33	M178R-4	115.84
M9-2	118.32	M72	122.16	M114-1	118.25	M179	108.52
M9-3	118.88	M73	122.21	M116	118.27	M180	110.61
M10-1	118.30	M74	122.73	M121	118.21	M181-1	95.87
M46-2	123.30	M80-1	122.42	M122	118.27	M181-2	104.59
M49-1	117.93	M82-1	121.92	M123	118.16	M182	87.86
M50-3	124.25	M82-2	122.04	M125	118.30	M185-1	108.54
M52-2	120.74	M91-1	122.37	M166	118.17	M185-2	113.28
M53-2	118.05	M95-1	122.26	M167	118.17	M186	114.14
M56-2	122.36	M105	118.31	M168	118.18	M187	88.39
M58-3	122.38	M106	122.31	M170	118.29	M188	114.63
M59-2	122.41	M107	118.30	M173	99.27	M189	104.77
M59-3	122.39	M108	118.17	M174	Damaged	M190	112.41
M59-4	122.39	M109-1	118.29	M176	108.59	M191	99.32
M60-1	122.01	M109-2	118.30	M177	114.31	M192	118.15
M63-2	120.57	M110-1	118.29	M178R-1	114.06	M193	121.46
M64-2	118.56	M111-1	122.29	M178R-2	118.23	OW1	122.55
M70-2	120.67	M112-1	122.32	M178R-3	118.19		

Table 5a: Groundwater Quality Results - October 18-20, 2016

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
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
Shallow Groundwater Flow Zone																									
M54-4	19/10/2016	450	< 0.15	0.043	140	82	1100	3.2	< 0.1	31	0.025	< 0.1	< 0.01	1.9	68	58	704	< 0.0002	0.0034	< 0.0002	< 0.0002	0.0022	0.00016	< 0.0002	< 0.0002
M66-2	20/10/2016	410	0.27	1.2	80	110	1400	1.8	0.27	33	0.027	< 0.1	< 0.01	8	190	180	822	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M67-2	19/10/2016	350	0.78	0.84	49	5.5	660	2.4	0.64	30	0.063	< 0.1	< 0.01	9.5	51	3.6	386	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M80-2	19/10/2016	330	0.15	0.078	94	81	910	2.1	< 0.1	54	0.038	< 0.1	0.014	5.9	29	45	618	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M81	20/10/2016	350	< 0.15	0.04	100	81	930	1.7	< 0.1	54	0.02	< 0.1	< 0.01	2.6	12	41	326	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M86	19/10/2016	340	< 0.15	1.1	76	37	1000	3.1	0.25	38	0.034	0.39	0.015	19	93	150	622	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M87-2	18/10/2016	240	< 0.15	0.039	57	26	620	1.6	< 0.1	39	0.029	< 0.1	< 0.01	2.3	14	74	358	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M101	20/10/2016	520	< 0.15	0.087	160	69	1200	3.5	< 0.1	53	0.024	< 0.1	< 0.01	4.8	17	65	672	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.00063	< 0.0001	< 0.0002	< 0.0002
M103	20/10/2016	710	< 0.15	0.3	150	190	1900	5	< 0.1	99	0.016	< 0.1	< 0.01	7.9	140	59	1080	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M104	20/10/2016	1500	4.98	2.3	130	740	5000	110	0.76	130	0.61	12	1.44	12	750	53	3080	< 0.002	< 0.001	< 0.002	< 0.002	< 0.001	< 0.001	< 0.002	< 0.002
M114-2	19/10/2016	460	< 0.15	0.043	130	120	1300	3.4	< 0.1	20	< 0.002	1.63	< 0.01	1.2	130	100	776	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
OW37-s	18/10/2016	150	< 0.15	0.11	30	59	470	2.1	0.53	15	0.39	< 0.1	< 0.01	9	34	< 1	260	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
Intermediate BedrockGroundwater Flow Zone																									
M5-3	20/10/2016	450	1.33	1.1	33	47	970	1.6	< 0.1	27	0.003	< 0.1	< 0.01	13	140	< 1	490	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M6-3	20/10/2016	1100	4.41	0.54	320	1400	8800	51	< 0.1	3.5	< 0.002	< 0.1	0.095	38	650	42	3780	< 0.0005	< 0.00025	< 0.0005	< 0.0005	< 0.00025	< 0.00025	< 0.0005	< 0.0005
M9-2	19/10/2016	500	0.76	0.35	150	190	1500	7.3	11	43	0.38	< 0.1	< 0.01	6.5	110	< 1	854	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.00024	< 0.0001	< 0.0002	< 0.0002
M9-3	19/10/2016	270	1.24	0.55	45	110	860	2.2	0.34	29	0.04	< 0.1	< 0.01	14	82	3	466	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M52-2	20/10/2016	340	1.53	1.2	24	300	1700	2.8	0.15	17	0.006	< 0.1	< 0.01	13	330	11	870	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M64-2	20/10/2016	300	1.02	0.97	51	110	950	1.7	< 0.1	31	0.008	< 0.1	< 0.01	10	97	23	486	< 0.0005	< 0.00025	< 0.0005	< 0.0005	< 0.00025	< 0.00025	< 0.0005	< 0.0005
M72	18/10/2016	280	0.58	0.4	55	30	620	1.4	< 0.1	35	0.003	< 0.1	< 0.01	7.8	18	21	354	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M74	18/10/2016	380	2.65	0.95	29	23	790	1.7	< 0.1	18	0.042	< 0.1	< 0.01	14	110	20	450	< 0.0005	< 0.00025	< 0.0005	< 0.0005	< 0.00025	< 0.00025	< 0.0005	< 0.0005
M75	20/10/2016	460	1.42	1.3	34	62	1100	1.4	< 0.1	26	0.005	< 0.1	0.012	16	180	41	622	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M80-1	19/10/2016	150	0.39	0.39	22	30	380	1.2	< 0.1	13	0.005	< 0.1	< 0.01	4.6	37	11	212	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M82-1	18/10/2016	330	0.86	0.98	49	44	880	2.5	< 0.1	27	0.004	< 0.1	< 0.01	10	97	67	498	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M82-2	18/10/2016	340	0.24	0.16	100	26	800	3	< 0.1	30	0.019	< 0.1	< 0.01	3.9	19	66	472	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M106	19/10/2016	360	2.68	1.9	120	1700	5900	1.5	< 0.1	88	0.002	< 0.1	< 0.01	23	910	1.1	3370	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.0016	0.00048	< 0.0002	< 0.0002
M108	19/10/2016	510	0.86	0.3	110	110	1200	5.7	0.26	40	0.062	< 0.1	< 0.01	7.7	84	< 1	676	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.00034	< 0.0001	< 0.0002	< 0.0002
M109-1	20/10/2016	630	1.05	0.52	140	170	1700	10	11	52	0.31	< 0.1	< 0.01	7.5	140	< 1	888	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M110-1	20/10/2016	710	0.63	0.5	180	240	2000	12	< 0.1	63	0.014	< 0.1	< 0.01	7.9	150	< 1	1110	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.00031	< 0.0001	< 0.0002	< 0.0002
M114-1	19/10/2016	400	0.36	0.21	100	120	1100	5.1	5.8	29	0.32	< 0.1	< 0.01	5.7	93	3	612	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	0.00024	< 0.0002	< 0.0002
M121	20/10/2016	550	1.44	0.51	90	220	1700	5	< 0.1	52	0.003	< 0.1	< 0.01	13	200	14	890	< 0.001	< 0.0005	< 0.001	< 0.001	< 0.0005	< 0.0005	< 0.001	< 0.001
M123	20/10/2016	400	0.25	0.16	100	41	870	3.8	< 0.1	22	0.016	< 0.1	< 0.01	3.8	48	8.2	470	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M167	19/10/2016	410	1.89	0.97	89	450	2200	4	< 0.1	58	0.003	< 0.1	< 0.01	17	230	8.3	1150	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M168	19/10/2016	410	1.43	0.41	140	320	1800	5.1	< 0.1	55	0.004	< 0.1	< 0.01	15	140	14	1030	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M170	19/10/2016	600	2.03	2.2	61	1000	4400	3.8	< 0.1	52	0.002	< 0.1	< 0.01	17	740	3.6	2300	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M172	20/10/2016	520	0.74	0.15	160	140	1400	6.9	23	38	0.82	< 0.1	< 0.01	4.9	61	3.2	754	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.0027	0.00023	< 0.0002	< 0.0002
M177	20/10/2016	250	0.56	0.37	76	9.7	560	4.4	< 0.1	17	0.008	< 0.1	< 0.01	6.4	8.5	36	514	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M178R-1[1]	18/10/2016	430	5.4	3.9	230	4900	15000	12	< 0.5	150	0.071	< 0.5	< 0.05	41	2800	430	8680	< 0.005	< 0.0025	< 0.005	< 0.005	< 0.0025	< 0.0025	< 0.005	< 0.005
M178R-2	18/10/2016	380	0.22	0.15	99	41	840	4.5	0.69	21	0.043	< 0.1	< 0.01	4.5	42	15	486	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.0011	< 0.0001	< 0.0002	< 0.0002
M178R-3	18/10/2016	410	0.29	0.17	100	44	900	4.6	3.7	24	0.075	< 0.1	< 0.01	5.3	49	13	530	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.00097	< 0.0001	< 0.0002	< 0.0002
M178R-4	18/10/2016	420	0.25	0.21	110	49	950	4.8	< 0.1	25	0.01	< 0.1	< 0.01	4.5	52	17	536	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.00022	< 0.0001	< 0.0002	< 0.0002
M179	20/10/2016	320	0.27	0.28	98	64	830	3.8	0.83	16	0.044	< 0.1	0.015	4.5	49	30	434	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M185-1	20/10/2016	330	2.1	0.26	39	180	1400	2.2	< 0.1	7.2	0.019	0.5	0.024	9	86	92	630	< 0.0004	< 0.0002	< 0.0004	< 0.0004	< 0.0002	< 0.0002	< 0.0004	< 0.0004
M185-2	20/10/2016	290	0.15	0.27	100	17	650	2	0.11	9.9	0.014	< 0.1	< 0.01	2.7	14	37	374	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M186	19/10/2016	360	2.18	1.9	75	1200	4600	7.7	0.19	53	0.11	< 0.1	< 0.01	21	750	42	2440	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M187	19/10/2016	260	0.32	0.33	140	200	1400	2.1	< 0.1	19	0.013	0.11	0.017	5	110	130	836	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M188	18/10/2016	320	0.68	0.55	59	65	830	2	< 0.1	23	0.009	< 0.1	< 0.01	6.6	86	19	472	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M189[1]	18/10/2016	370	0.24	0.71	120	120	1200	2.2	0.7	28	0.16	< 0.1	< 0.01	8.3	90	110	664	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M190	18/10/2016	310	< 0.15	0.094	120	48	820	2.9	< 0.1	13	0.009	< 0.1	< 0.01	3.6	24	45	458	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M191[1]	18/10/2016	140	25	3.6	5500	44000	> 100000	94	< 5	4600	1.2	< 0.5	0.077	240	20000	290	80700	< 0.01	< 0.005	< 0.01	< 0.01	< 0.005	< 0.005	< 0.01	< 0.01
M192	18/10/2016	320	2.27	1.3	95	650	2700	2.4	< 0.1	68	0.033	< 0.1	< 0.01	21	350	11	1540	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M193[1]	18/10/2016	320	1.43	0.58	42	320	1700	2.4	0.16	42	0.4	< 0.1	< 0.01	17	240	13	882	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
OW1	20/10/2016	410	1.54	1	44	49	1000	2.3	< 0.1	33	0.006	< 0.1	< 0.01	12	140	70	588	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
OW4	20/10/2016	930	0.84	0.71	130	340	2700	35	7	87	0.16	< 0.1	< 0.01	10	370	44	1570	< 0.002	< 0.001	< 0.002	< 0.002	< 0.001	< 0.001	< 0.002	< 0.002

[1] Monitoring wells M178R-1, M189, M191, and M193 were sampled outside of the scheduled Fall EMP as per ECA Condition No. 8.5(c)iv

[2] Monitoring wells M53-4 and M85 were not sampled because they were dry

Table 5a: Groundwater Quality Results - October 18-20, 2016

Name	Date	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
		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																				
M54-4	19/10/2016	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.0002	< 0.0005	0.0026	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	0.0041	< 0.0002	< 0.0001	0.0028	0.00037
M66-2	20/10/2016	< 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
M67-2	19/10/2016	< 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
M80-2	19/10/2016	< 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
M81	20/10/2016	< 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
M86	19/10/2016	< 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
M87-2	18/10/2016	< 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
M101	20/10/2016	< 0.0002	< 0.0002	< 0.0002	0.0056	< 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
M103	20/10/2016	< 0.0002	< 0.0002	< 0.0002	0.013	< 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
M104	20/10/2016	< 0.002	< 0.002	< 0.002	0.1	< 0.001	< 0.001	< 0.002	< 0.005	< 0.001	< 0.005	< 0.001	< 0.001	< 0.001	< 0.002	< 0.001	< 0.002	< 0.001	< 0.001	< 0.002
M114-2	19/10/2016	< 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	18/10/2016	< 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
Intermediate BedrockGroundwater Flow Zone																				
M5-3	20/10/2016	< 0.0002	< 0.0002	< 0.0002	< 0.001	0.00027	< 0.0001	< 0.005	< 0.0005	< 0.0001	< 0.0005	< 0.0001	0.00019	0.00014	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0002
M6-3	20/10/2016	< 0.0005	< 0.0005	< 0.0005	0.19	0.00095	< 0.00025	< 0.005	< 0.0013	< 0.00025	< 0.0013	< 0.00025	0.0017	0.00049	< 0.0005	< 0.00025	0.0081	< 0.00025	< 0.00025	< 0.0005
M9-2	19/10/2016	< 0.0002	< 0.0002	< 0.0002	0.022	0.0005	< 0.0001	0.029	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	0.0006
M9-3	19/10/2016	< 0.0002	< 0.0002	< 0.0002	0.0017	< 0.0001	< 0.0001	0.0017	< 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	20/10/2016	< 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
M64-2	20/10/2016	< 0.0005	< 0.0005	< 0.0005	0.0025	< 0.00025	< 0.00025	< 0.005	< 0.0013	< 0.00025	< 0.0013	< 0.00025	< 0.00025	< 0.00025	< 0.0005	< 0.00025	< 0.0005	< 0.00025	< 0.00025	< 0.0005
M72	18/10/2016	< 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
M74	18/10/2016	< 0.0005	< 0.0005	< 0.0005	< 0.001	< 0.00025	< 0.00025	< 0.0005	< 0.0013	< 0.00025	< 0.0013	< 0.00025	< 0.00025	< 0.00025	< 0.0005	< 0.00025	< 0.0005	< 0.00025	< 0.00025	< 0.0005
M75	20/10/2016	< 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
M80-1	19/10/2016	< 0.0002	< 0.0002	< 0.0002	< 0.001	0.00086	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	0.00044	0.00016	< 0.0002	< 0.0001	0.00056	< 0.0001	< 0.0001	< 0.0002
M82-1	18/10/2016	< 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
M82-2	18/10/2016	< 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
M106	19/10/2016	< 0.0002	< 0.0002	< 0.0002	< 0.001	0.0004	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	0.00014	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0002
M108	19/10/2016	< 0.0002	< 0.0002	< 0.0002	0.011	< 0.0001	< 0.0001	0.0048	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0002
M109-1	20/10/2016	< 0.0002	< 0.0002	< 0.0002	0.024	0.00021	< 0.0001	0.019	< 0.0005	< 0.0001	< 0.0005	< 0.0001	0.00017	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	0.00023
M110-1	20/10/2016	< 0.0002	< 0.0002	< 0.0002	0.035	0.00086	< 0.0001	0.018	< 0.0005	< 0.0001	< 0.0005	< 0.0001	0.00047	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	0.00031
M114-1	19/10/2016	< 0.0002	< 0.0002	< 0.0002	0.0056	< 0.0001	< 0.0001	0.011	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0002
M121	20/10/2016	< 0.001	< 0.001	< 0.001	0.0087	0.039	< 0.0005	< 0.025	< 0.0025	< 0.0005	< 0.0025	0.0013	0.0096	0.00078	< 0.001	< 0.0005	< 0.001	< 0.0005	< 0.0005	< 0.001
M123	20/10/2016	< 0.0002	< 0.0002	< 0.0002	0.0046	< 0.0001	< 0.0001	0.0044	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0002
M167	19/10/2016	< 0.0002	< 0.0002	< 0.0002	0.0033	0.0013	< 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
M168	19/10/2016	< 0.0002	< 0.0002	< 0.0002	0.0063	< 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
M170	19/10/2016	< 0.0002	< 0.0002	< 0.0002	0.0064	0.00012	< 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
M172	20/10/2016	< 0.0002	< 0.0002	< 0.0002	0.0076	< 0.0001	< 0.0001	0.0075	< 0.0005	0.00012	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	0.00026
M177	20/10/2016	< 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
M178R-1[1]	18/10/2016	< 0.005	< 0.005	< 0.005	< 0.001	0.0026	< 0.0025	< 0.005	< 0.013	< 0.0025	< 0.013	< 0.0025	< 0.0025	< 0.0025	< 0.005	< 0.0025	0.005	< 0.0025	< 0.0025	< 0.005
M178R-2	18/10/2016	< 0.0002	< 0.0002	< 0.0002	0.004	< 0.0001	< 0.0001	0.0016	< 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	18/10/2016	< 0.0002	< 0.0002	< 0.0002	0.0053	< 0.0001	< 0.0001	0.0023	< 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	18/10/2016	< 0.0002	< 0.0002	< 0.0002	0.0066	< 0.0001	< 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
M179	20/10/2016	< 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
M185-1	20/10/2016	< 0.0004	< 0.0004	< 0.0004	< 0.001	0.0004	< 0.0002	< 0.004	< 0.001	< 0.0002	< 0.001	< 0.0002	0.00024	< 0.0002	< 0.0004	< 0.0002	0.0013	< 0.0002	< 0.0002	< 0.0004
M185-2	20/10/2016	< 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
M186	19/10/2016	< 0.0002	< 0.0002	< 0.0002	< 0.001	0.00043	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	0.00025	0.00018	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0002
M187	19/10/2016	< 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
M188	18/10/2016	< 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
M189[1]	18/10/2016	< 0.0002	< 0.0002	< 0.0002	< 0.001	0.00053	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	0.00021	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0002
M190	18/10/2016	< 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	0.00035	< 0.0001	< 0.0001	< 0.0002
M191[1]	18/10/2016	< 0.01	< 0.01	< 0.01	< 0.001	0.2	< 0.005	< 0.01	< 0.025	< 0.005	< 0.025	< 0.005	< 0.005	< 0.005	< 0.01	< 0.005	0.042	< 0.005	< 0.005	< 0.01
M192	18/10/2016	< 0.0002	< 0.0002	< 0.0002	< 0.001	0.00029	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	0.0015	< 0.0001	< 0.0001	< 0.0002
M193[1]	18/10/2016	< 0.0002	< 0.0002	< 0.0002	< 0.001	0.0015	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	0.00072	< 0.0001	< 0.0001	< 0.0002
OW1	20/10/2016	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.002	< 0.0005	< 0.0001	< 0.0005	0.0034	0.00012	0.00015	< 0.0002	< 0.0001	0.00025	< 0.0001	< 0.0001	< 0.0002
OW4	20/10/2016	< 0.002	< 0.002	< 0.002	0.047	< 0.001	< 0.001	< 0.02	< 0.005	< 0.001	< 0.005	0.0061	< 0.001	< 0.001	< 0.002	< 0.001	< 0.002	< 0.001	< 0.001	< 0.002

[1] Monitoring wells M178R-1, M189, M191, and M193 were sampled outside of the scheduled Fall EMP as per ECA Condition No. 8.5(c)iv

[2] Monitoring wells M53-4 and M85 were not sampled because they were dry

Table 5b: Groundwater Quality Results and Reasonable Use Limits - October 18-20, 2016

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**	*390*	*130*	*3.6*	*0.18*	*0.034*	*109*	*452*	*0.0035*	*0.0014*	*0.0013*	*0.15*	*0.0121*
M54-4	2016-10-19	< 0.001	450	82	3.2	< 0.1	0.025	68	704	0.00016	< 0.0001	< 0.0001	<0.0001	< 0.0002
M66-2	2016-10-20	< 0.001	410	110	1.8	0.27	0.027	190	822	< 0.0001	< 0.0001	< 0.0001	<0.0001	< 0.0002
M67-2	2016-10-19	< 0.001	350	5.5	2.4	0.64	0.063	51	386	< 0.0001	< 0.0001	< 0.0001	<0.0001	< 0.0002
75% RUL †		*n/a*	*293*	*98*	*2.7*	*0.14*	*0.026*	*82*	*339*	*0.0026*	*0.0011*	*0.00098*	*0.11*	*0.0091*
M80-2	2016-10-19	< 0.001	330	81	2.1	< 0.1	0.038	29	618	< 0.0001	< 0.0001	< 0.0001	<0.0001	< 0.0002
M87-2	2016-10-18	< 0.001	240	26	1.6	< 0.1	0.029	14	358	< 0.0001	< 0.0001	< 0.0001	<0.0001	< 0.0002
OW37-s	2016-10-18	< 0.001	150	59	2.1	0.53	0.39	34	260	< 0.0001	< 0.0001	< 0.0001	<0.0001	< 0.0002
Intermediate BedrockGroundwater Flow Zone														
RUL		*0.001**	*400*	*132*	*3.5*	*0.18*	*0.032*	*106*	*465*	*0.0035*	*0.0014*	*0.0013*	*0.15*	*0.0121*
M177	2016-10-20	< 0.001	250	9.7	4.4	< 0.1	0.008	8.5	514	< 0.0001	< 0.0001	< 0.0001	<0.0001	< 0.0002
M179	2016-10-20	< 0.001	320	64	3.8	0.83	0.044	49	434	< 0.0001	< 0.0001	< 0.0001	<0.0001	< 0.0002
M185-1	2016-10-20	< 0.001	330	180	2.2	< 0.1	0.019	86	630	< 0.0002	0.0004	< 0.0002	0.00024	0.0013
M185-2	2016-10-20	< 0.001	290	17	2	0.11	0.014	14	374	< 0.0001	< 0.0001	< 0.0001	<0.0001	< 0.0002
M186	2016-10-19	< 0.001	360	1200	7.7	0.19	0.11	750	2440	< 0.0001	0.00043	< 0.0001	0.00043	< 0.0002
M187	2016-10-19	< 0.001	260	200	2.1	< 0.1	0.013	110	836	< 0.0001	< 0.0001	< 0.0001	<0.0001	< 0.0002
M188	2016-10-18	< 0.001	320	65	2	< 0.1	0.009	86	472	< 0.0001	< 0.0001	< 0.0001	<0.0001	< 0.0002
M190	2016-10-18	< 0.001	310	48	2.9	< 0.1	0.009	24	458	< 0.0001	< 0.0001	< 0.0001	<0.0001	0.00035
75% RUL †		*n/a*	*300*	*99*	*2.6*	*0.14*	*0.024*	*80*	*349*	*0.0026*	*0.0011*	*0.00098*	*0.11*	*0.0091*
M80-1	2016-10-19	< 0.001	150	30	1.2	< 0.1	0.005	37	212	< 0.0001	0.00086	< 0.0001	0.0006	0.00056
M82-1	2016-10-18	< 0.001	330	44	2.5	< 0.1	0.004	97	498	< 0.0001	< 0.0001	< 0.0001	<0.0001	< 0.0002
M82-2	2016-10-18	< 0.001	340	26	3.0	< 0.1	0.019	19	472	< 0.0001	< 0.0001	< 0.0001	<0.0001	< 0.0002
M106	2016-10-19	< 0.001	360	1700	1.5	< 0.1	0.002	910	3370	0.00048	0.0004	< 0.0001	0.00014	< 0.0002

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

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

Groundwater results exceed Reasonable Use Limits (RUL) *0.05*

Table 6a: Summer Surface Water Characteristics - August 15, 2016

Date	Parameter	Unit	Surface Water Station									
			S2	S3	S4R	S5	S6	S7	S8R	S18	S19	S20
2016-08-15	Velocity:	m/s	Dry	NM	Dry	Dry	Dry	Dry	Dry	NM	Dry	NM
	Depth:	m		0.20						NM		NM
	Width:	m		0.45						NM		NM
	Estimated Flow Rate:	m^3/s		NM						NM		NM

NM: Not Measured (flow was insufficient to register on the flow meter - very small or no flow observed)

Table 6b: Fall Surface Water Characteristics - October 18, 2016

Date	Parameter	Unit	Surface Water Station									
			S2	S3	S4R	S5	S6	S7	S8R	S18	S19	S20
2016-10-18	Velocity:	m/s	Dry	NM	Dry	Dry	Dry	NM	Dry	NM	NM	NM
	Depth:	m		NM				NM		NM	NM	NM
	Width:	m		NM				NM		NM	NM	NM
	Estimated Flow Rate:	m^3/s		NM				NM		NM	NM	NM

NM: Not Measured (flow was insufficient to register on the flow meter - very small or no flow observed)

Table 7a: Surface Water Quality Results – August 15, 2016

			Marysville Creek	South of Beechwood Road	
			S3	S18	S20
			(Downstream)	(Upstream)	(Downstream)
		Date	2016-08-15	2016-08-15	2016-08-15
Reading Name	Units	PWQO			
Inorganic and General Parameters					
Alkalinity	mg/L		320	120	210
Ammonia	mg/L		0.45	1.1	8.18
Ammonia (Unionized)	mg/L	0.02	0.0015	0.0023	0.035
Biochemical Oxygen Demand	mg/L		< 2	< 2	15
Chemical Oxygen Demand	mg/L		17	74	240
Chloride	mg/L		77	39	48
Conductivity	µS/cm		1100	400	740
Dissolved Oxygen	mg/L		4.62	2.77	0.68
Hardness	mg/L		490	140	250
Nitrate	mg/L		< 0.1	< 0.1	< 0.5
Nitrite	mg/L		< 0.01	< 0.01	< 0.05
Phenols	mg/L	0.001	< 0.001	< 0.001	0.0026
Phosphorous (Total)	mg/L	0.03	0.099	0.11	0.25
Sulphate	mg/L		160	8.7	68
Total Dissolved Solids	mg/L		1020	326	636
Total Suspended Solids	mg/L		< 10	31	140
Metals					
Boron	mg/L	0.2	0.13	0.064	0.082
Cadmium	mg/L	0.0002	< 0.0001	< 0.0001	0.0001
Calcium	mg/L		160	49	94
Chromium (III)	mg/L	0.0089	< 0.005	< 0.005	< 0.005
Chromium (VI)	mg/L	0.001	< 0.0005	< 0.0005	< 0.0005
Chromium (Total)	mg/L		< 0.005	< 0.005	0.008
Cobalt	mg/L	0.0009	< 0.0005	0.0007	0.0038
Copper	mg/L	0.005	< 0.002	< 0.002	0.01
Iron	mg/L	0.3	0.92	1.4	7.6
Lead	mg/L	0.005	< 0.0005	0.0007	0.0035
Magnesium	mg/L		30	5.7	12
Nickel	mg/L	0.025	< 0.001	0.002	0.009
Potassium	mg/L		12	17	34
Sodium	mg/L		56	14	21
Zinc	mg/L	0.02	< 0.01	< 0.01	0.022
VOCs					
1,4-dioxane	mg/L	0.02	< 0.001	< 0.001	< 0.001
Naphthalene	mg/L	0.007	< 0.00005	< 0.00005	< 0.00005
Field Measurements					
pH (Field)	Unitless	6.5-8.5	7.06	6.42	6.89
Conductivity (Field)	µS/cm		1019	470	804
Dissoved Oxygen (Field)	mg/L		4.62	2.77	0.68
Temperature (Field)	°C		13.49	27.16	21.76

Exceeds PWQO

*Locations S2, S4R, S5, S6, S7, S8R, and S19 were not sampled - Dry

Table 7b: Surface Water Quality Results – October 18, 2016

			Marysville Creek		South of Beechwood Road		
			S3	S7	S18	S19	S20
			(Downstream)	(Downstream)	(Upstream)	(Downstream)	(Downstream)
		Date	2016-10-18	2016-10-18	2016-10-18	2016-10-18	2016-10-18
Reading Name	Units	PWQO					
Inorganic and General Parameters							
Alkalinity	mg/L		130	100	110	100	230
Ammonia	mg/L		0.27	< 0.15	0.88	< 0.15	15.5
Ammonia (Unionized)	mg/L	0.02	0.0011	< 0.0005	0.0034	< 0.0005	0.013
Biochemical Oxygen Demand	mg/L		< 2	3	3	< 2	33
Chemical Oxygen Demand	mg/L		34	55	57	47	320
Chloride	mg/L		34	9.6	31	110	69
Conductivity	µS/cm		660	360	410	1100	770
Dissolved Oxygen	mg/L		9.58	2.75	7.66	5.63	8.21
Hardness	mg/L		270	140	160	420	180
Nitrate	mg/L		1.95	4.37	0.3	< 0.1	< 0.1
Nitrite	mg/L		0.015	0.197	0.045	< 0.01	0.441
Phenols	mg/L	0.001	< 0.001	< 0.001		< 0.001	*0.0011*
Phosphorous (Total)	mg/L	0.03	0.086	0.23	0.13	0.13	2.1
Sulphate	mg/L		160	46	37	300	39
Total Dissolved Solids	mg/L		454	246	300	776	486
Total Suspended Solids	mg/L		13	14	63	21	260
Metals							
Boron	mg/L	0.2	0.051	0.027	0.033	0.059	0.041
Cadmium	mg/L	0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0001	*0.0002*
Calcium	mg/L		88	46	57	140	69
Chromium (III)	mg/L	0.0089	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Chromium (VI)	mg/L	0.001	< 0.005	< 0.005	< 0.0005	< 0.0005	< 0.0005
Chromium (Total)	mg/L		< 0.0005	< 0.0025	< 0.005	< 0.005	0.012
Cobalt	mg/L	0.0009	0.0005	0.0005	*0.0014*	< 0.0005	*0.0042*
Copper	mg/L	0.005	0.003	*0.006*	0.004	0.002	*0.012*
Iron	mg/L	0.3	*0.41*	*1*	*2.8*	< 0.1	*9.3*
Lead	mg/L	0.005	< 0.0005	< 0.0005	0.001	< 0.0005	*0.0063*
Magnesium	mg/L		12	7.5	5.6	17	12
Nickel	mg/L	0.025	0.001	0.002	0.004	0.002	0.011
Potassium	mg/L		4.7	4.2	9.9	10	50
Sodium	mg/L		21	6.9	9.2	41	21
Zinc	mg/L	0.02	< 0.01	< 0.01	0.01	< 0.01	*0.045*
VOCs							
1,4-dioxane	mg/L	0.02	< 0.001	< 0.001	< 0.001	< 0.001	< 0.004
Naphthalene	mg/L	0.007	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
Field Measurements							
pH (Field)	Unitless	6.5-8.5	7.12	7.10	7.05	6.99	*6.48*
Conductivity (Field)	µS/cm		734	386	402	1023	769
Dissoved Oxygen (Field)	mg/L		9.58	2.75	7.66	5.63	8.21
Temperature (Field)	°C		13.7	13.5	15.5	13.1	13.6

Exceeds PWQO

*Locations S2, S4R, S5, S6, and S8R were not sampled - Dry

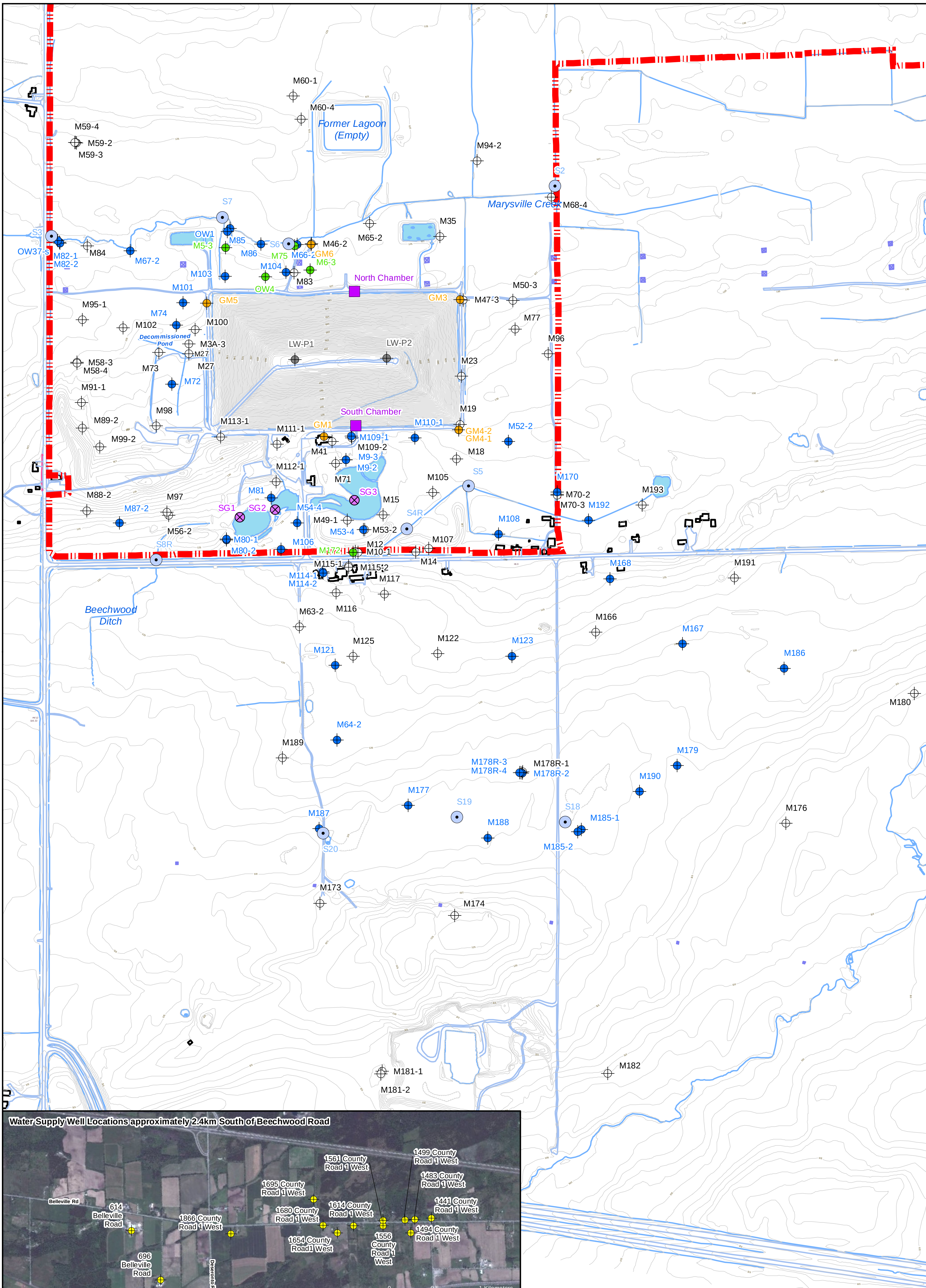
Table 8: Subsurface Gas Monitoring Results - October 21, 2016

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	5
GM4-2		0
GM5	Northwest corner of waste mound	5
GM6	North of waste mound	0

Table 9: Additional Investigations

Description of Activities	Reporting Completed in 2016	Ongoing Work in 2017
CAZ Investigation: • Drilling, testing, monitoring well installation & sampling at two locations on adjacent property • Complementary CAZ Investigation (ongoing) ❖Karst Assessment ❖Drilling of 4 new boreholes and installation of monitoring wells and drive point piezometers in central portion of proposed CAZ	- Site Conceptual Model Update and Contaminant Attenuation Zone Delineation (January 2016) - Site Conceptual Model Update and Contaminant Attenuation Zone Delineation - Addendum (April 2016) - Revised Interim Environmental Monitoring Plan Revision No. 5 (April 15, 2016)	- Continuing investigation of the proposed CAZ area to further delineate the extent of leachate impacts to groundwater - Revised EMP to be prepared on completion of further groundwater investigation
Town of Greater Napanee Requirements: • Monthly North/South Chambers combined leachate sampling (Jan-Dec)	- Monthly reports prepared for the Town of Greater Napanee	- Monitoring and reporting to continue in 2017
ECA Monitoring Requirements - Storm Water Ponds and Leachate: • Storm Water Ponds ❖Monthly sampling for inorganic and general chemistry parameter lists (March, April, May, October, November, December) ❖Quarterly Sampling of the ECA Storm water ponds for Toxicity (March, June, September, December) • Leachate (North Chamber) ❖Quarterly sampling list (March, August, October, December) ❖Annual sampling chemistry list (May)	- Monitoring results from the 2015 calendar year for the stormwater ponds and leachate locations were reported in the 2015 Annual Report, prepared by WSP Canada Inc. and dated March 2016	- Monitoring and reporting to continue in 2017
WMCC Wildlife Learning Centre: • Quarterly sampling of water supply (Bacteria parameters) (March, June, September, December)	- No reporting applicable; monitoring is for WM internal use.	- Monitoring to continue in 2017
Datalogger Study: • Data interpretation and report finalization	- Report on Groundwater Surface Water Investigation ("Datalogger Study") (April 2016)	n/a
Pipeline Investigation: • High resolution RTK GPS ground survey • Installation and sampling of three piezometers	- Pipeline Investigation Report (June 14, 2016)	n/a
Marysville Creek Conductivity Monitoring: • Installation of levelogger equipment at two locations in Marysville Creek • Monthly data download	- Interim data reported in fall 2016 semi-annual monitoring report	- Final data and interpretation to be reported in spring 2017 semi-annual monitoring report

FIGURES



LEGEND

	Topographic Contour Lines
	Surface Water
	Property 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)
1097 Beechwood	Domestic Water Supply Well Sampled for Chemistry
GM1	Gas Monitoring Well
	Lechate Chambers
	Lechate Monitoring Well
S2	Surface Water Monitoring Location
SG1	Surface Water Staff Gauges

REFERENCES

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

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

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CLIENT

WM Waste Management

PROJECT

WASTE MANAGEMENT RICHMOND LANDFILL
FALL 2016 SEMI-ANNUAL REPORT

TITLE

Site Plan and Monitoring Locations

PROJECT #	DATE		
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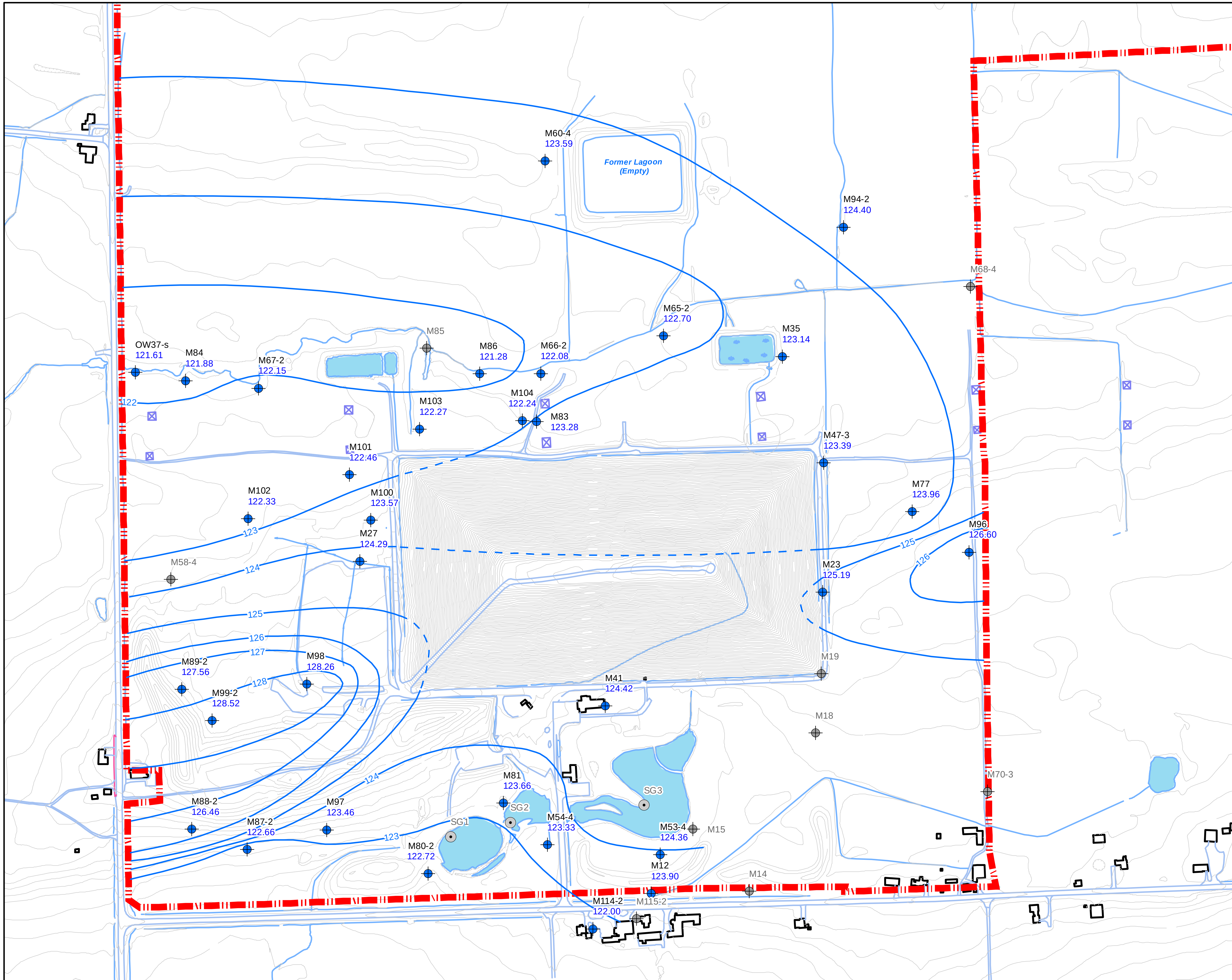
IB	FR	01	0



LEGEND

- Potentiometric Surface (masl)
- Topographic Contour Lines
- Surface Water
- Property Boundary
- M94-2 Shallow Groundwater Zone Elevation Monitor
- M5-3 Monitor Not Used in Contouring
- SG2 Staff Gauge Not Used in Contouring

REV.	DESCRIPTION	YY/MM/DD	BY	CHK
1				

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0 50 100 Meters

N E S W

CLIENT

WASTE MANAGEMENT

PROJECT

WASTE MANAGEMENT RICHMOND LANDFILL FALL 2016 SEMI-ANNUAL REPORT

TITLE

Shallow Groundwater Flow Zone Potentiometric Surface – August 10-12, 2016

BluMetric™ Environmental

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Web: http://www.blumetric.ca

PROJECT #	DATE
160061-00-02	December 13, 2016

DRAWN	CHECKED	FIG NO.	REV
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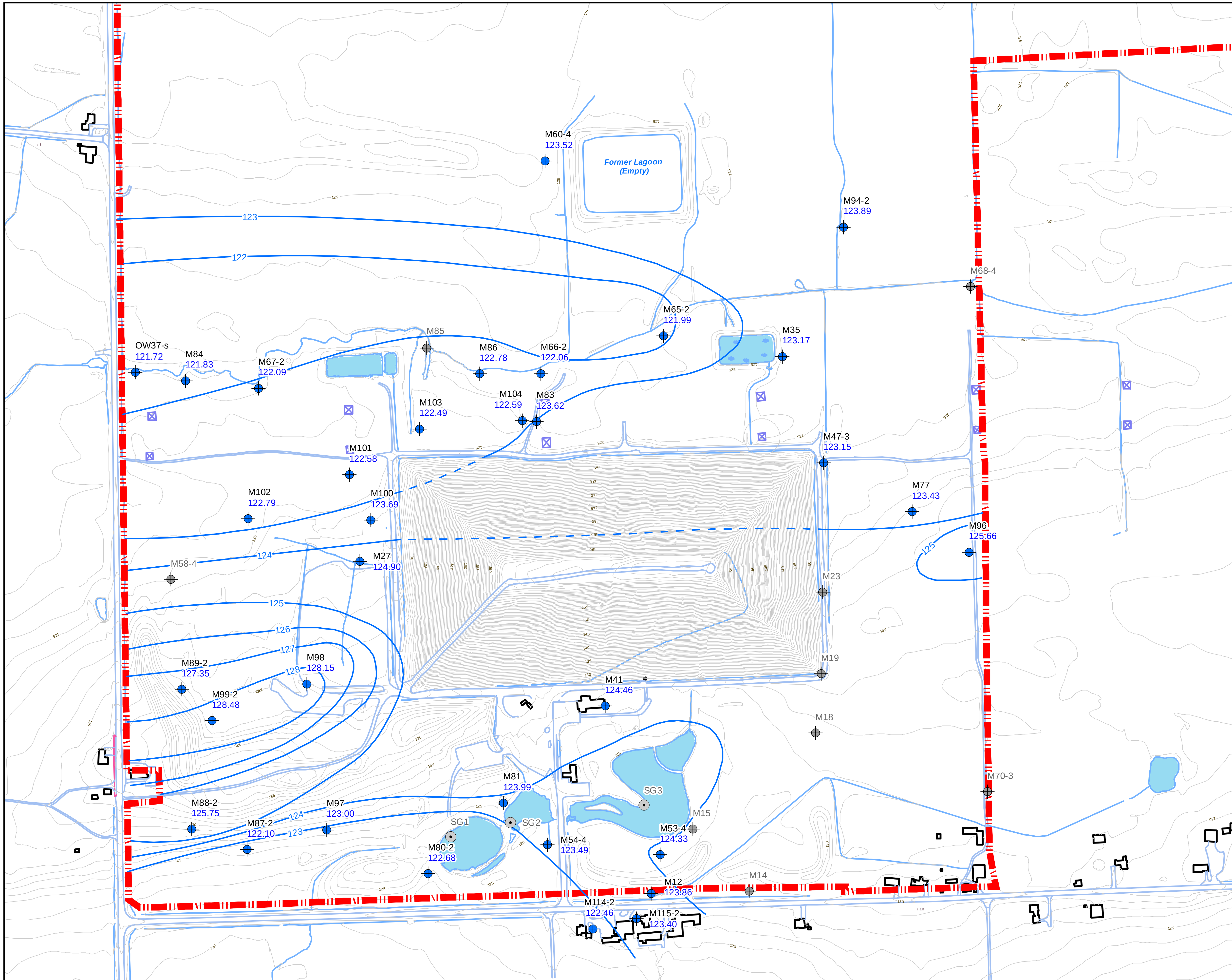

LEGEND

- Potentiometric Surface (masl)
- Topographic Contour Lines
- Surface Water
- Property Boundary
- M94-2 Shallow Groundwater Zone Elevation Monitor
- M5-3 Monitor Not Used in Contouring
- SG2 Staff Gauge Not Used in Contouring

REV.	DESCRIPTION	YY/MM/DD	BY	CHK
1				

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0 50 100 Meters

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WASTE MANAGEMENT

PROJECT

WASTE MANAGEMENT RICHMOND LANDFILL FALL 2016 SEMI-ANNUAL REPORT

TITLE

Shallow Groundwater Flow Zone Potentiometric Surface – October 17, 2016

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PROJECT #	DATE
160061-00-02	December 13, 2016

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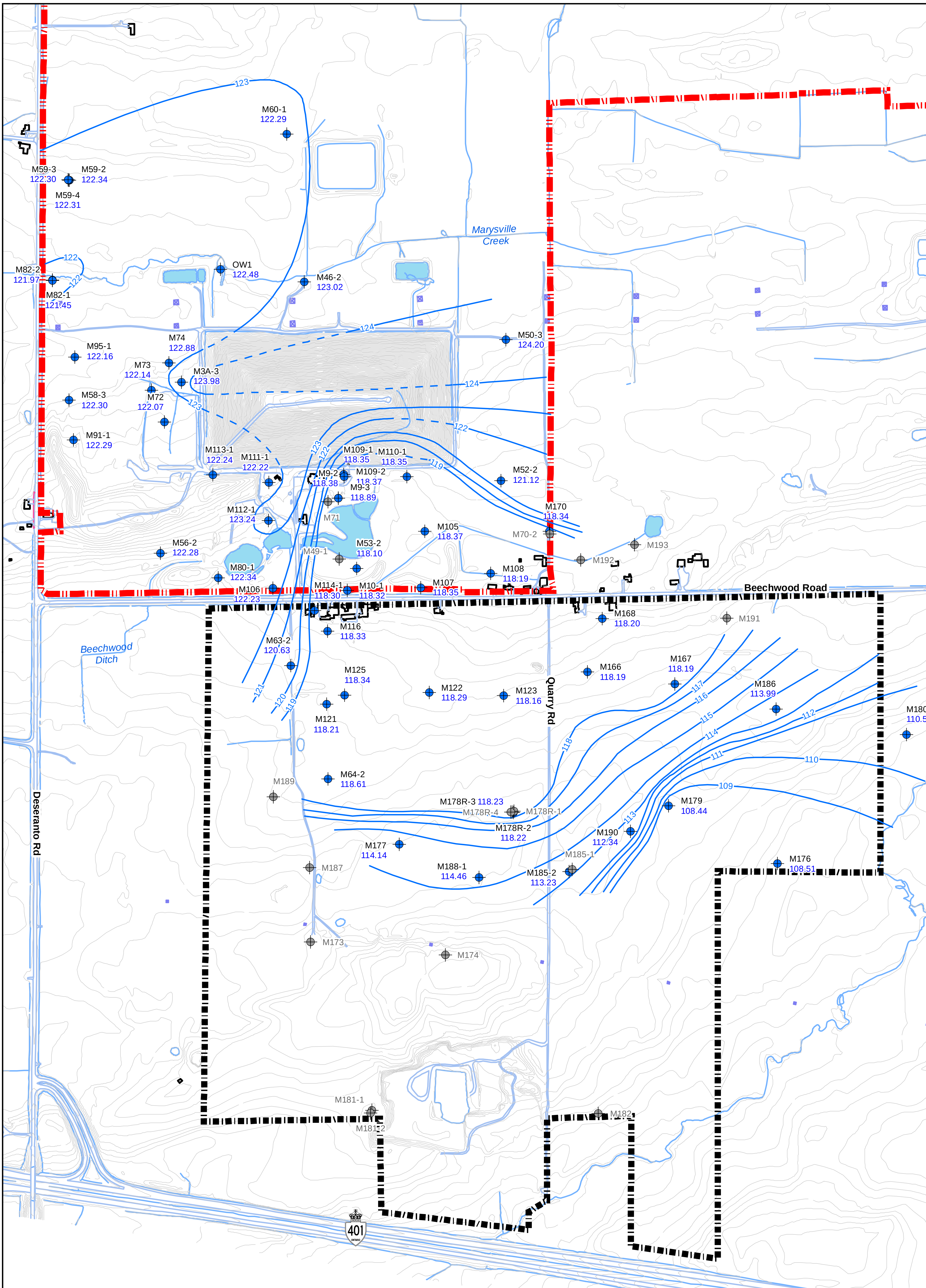

LEGEND

- 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
Meters
1:8,000

BluMetric™ Environmental

The Tower - The Woolen Mill,
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CLIENT

WASTE MANAGEMENT

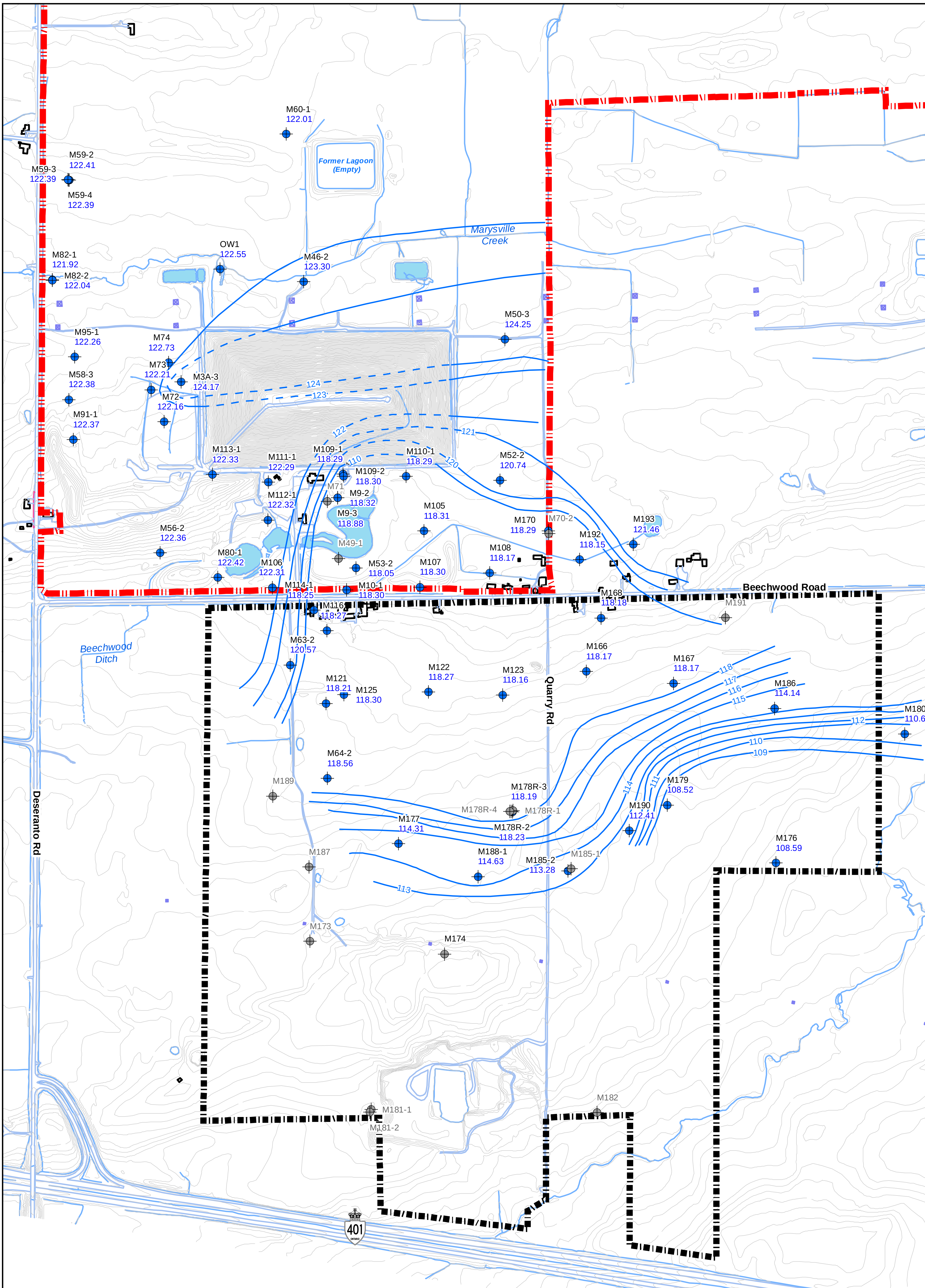
PROJECT

WASTE MANAGEMENT RICHMOND LANDFILL
FALL 2016 SEMI-ANNUAL REPORT

TITLE

INTERMEDIATE BEDROCK GROUNDWATER FLOW ZONE POTENTIOMETRIC SURFACE - AUGUST 10-12, 2016

PROJECT #		DATE	
160061-00-02		December 16, 2016	
DRAWN	CHECKED	FIG NO.	REV
IB	FR	03a	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

PROPRIETARY INFORMATION MAY NOT BE REPRODUCED OR DIVULGED WITHOUT PRIOR WRITTEN CONSENT OF BLUMETRIC ENVIRONMENTAL INC.
DO NOT SCALE DRAWING.
THIS DRAWING MAY HAVE BEEN REDUCED. ALL SCALE NOTATIONS INDICATED ARE BASED ON 11"x17" FORMAT DRAWINGS.
-UNITS: METERS
-PROJECTION: UTM NAD83 ZONE 18
-DATA SOURCE: WM CANADA, BLUMETRIC, MNRO, NRCAN

0 50 100 200 300 400
Meters
1:8,000

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CLIENT

WASTE MANAGEMENT

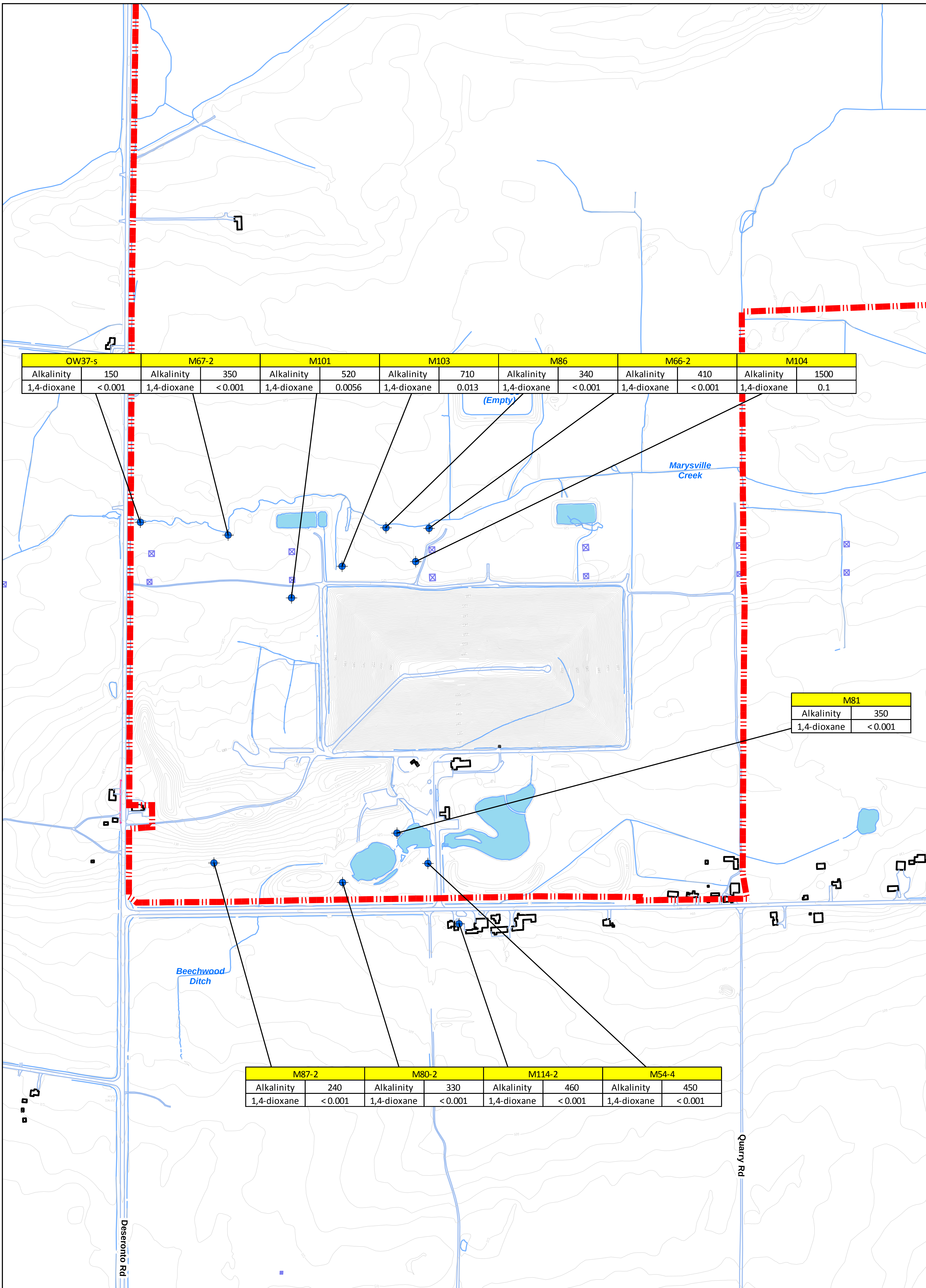
PROJECT

WASTE MANAGEMENT RICHMOND LANDFILL
FALL 2016 SEMI-ANNUAL REPORT

TITLE

INTERMEDIATE BEDROCK GROUNDWATER FLOW ZONE POTENTIOMETRIC SURFACE - OCTOBER 17, 2016

PROJECT #	DATE		
160061-00-02	December 13, 2016		
DRAWN	CHECKED	FIG NO.	REV
IB	FR	03b	0



LEGEND

- Topographic Contour Lines
- Surface Water
- Property Boundary
- M99-2 Shallow Monitoring Well Sampled for Chemistry

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

REFERENCES

PROPRIETARY INFORMATION MAY NOT BE REPRODUCED OR DIVULGED WITHOUT PRIOR WRITTEN CONSENT OF BLUMETRIC ENVIRONMENTAL INC.
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-UNITS: METERS
-PROJECTION: UTM NAD83 ZONE 18
-DATA SOURCE: WM CANADA, BLUMETRIC, MNRO, NRCAN

0 25 50 100 150 200
Meters
1:6,640

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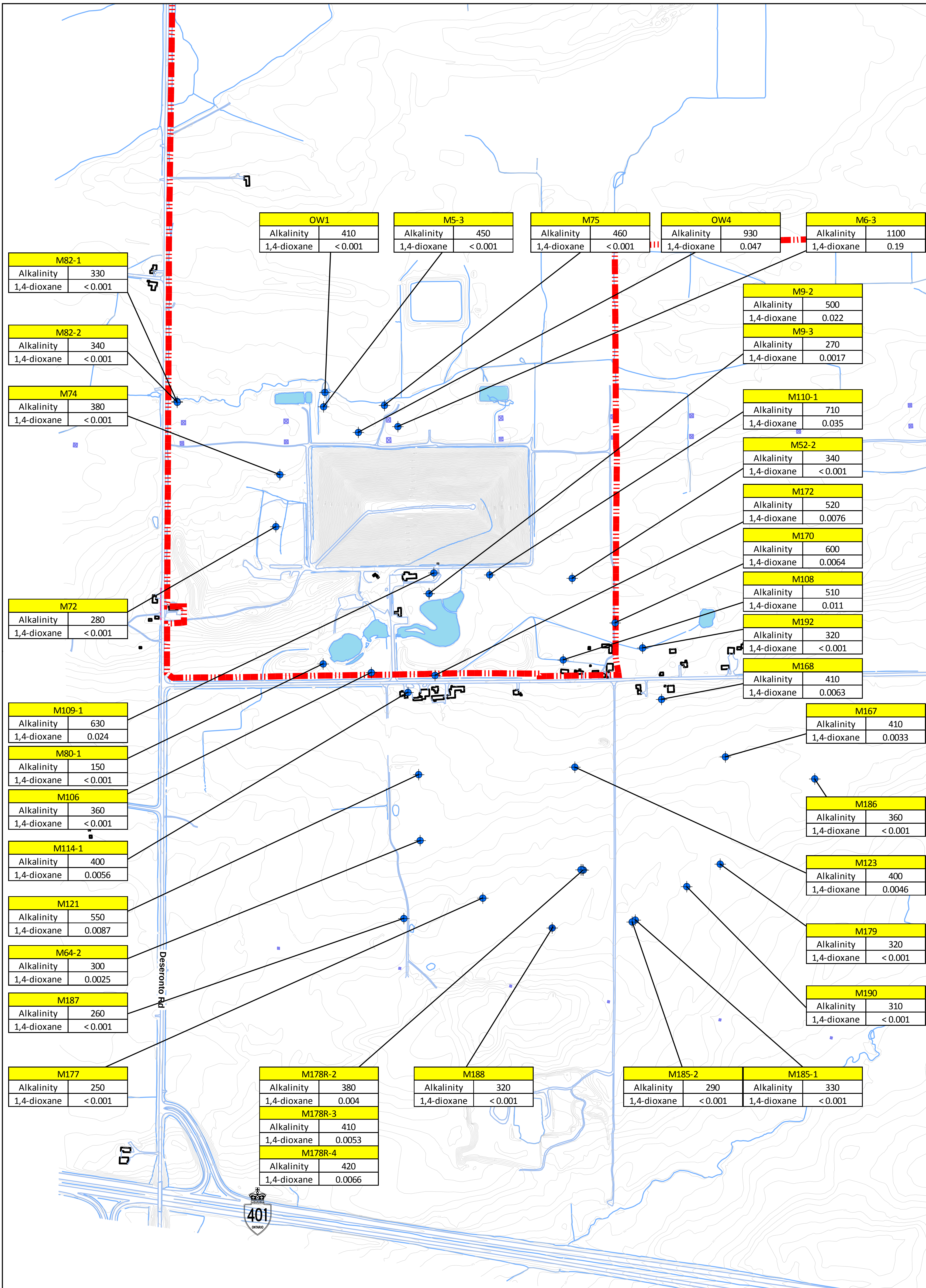
CLIENT
WM WASTE MANAGEMENT

PROJECT
WASTE MANAGEMENT RICHMOND LANDFILL
FALL 2016 SEMI-ANNUAL REPORT

TITLE
Shallow Flow Zone Concentrations

PROJECT #	DATE
160061-00-02	December 07, 2016

DRAWN	CHECKED	FIG NO.	REV
IB	MC	04	0



LEGEND

Topographic Contour Lines

Surface Water

Property Boundary

M9-2 Intermediate Monitoring Well Sampled for Chemistry

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

REFERENCES

PROPRIETARY INFORMATION MAY NOT BE REPRODUCED OR DIVULGED WITHOUT PRIOR WRITTEN CONSENT OF BLUMETRIC ENVIRONMENTAL INC.
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-UNITS: METERS
-PROJECTION: UTM NAD83 ZONE 18
-DATA SOURCE: WM CANADA, BLUMETRIC, MNRO, NRCAN

0 25 50 100 150 200
Meters
1:9,084

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PROJECT

WASTE MANAGEMENT RICHMOND LANDFILL FALL 2016 SEMI-ANNUAL REPORT

TITLE

Intermediate Flow Zone Concentrations

PROJECT #	DATE
160061-00-02	December 07, 2016

DRAWN	CHECKED	FIG NO.	REV
IB	MC	05	0

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

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
M66-1	335154	4903218
M66-2	335155	4903219

Monitoring Well	Easting	Northing
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
M99-2	334869	4902646
M100	334994	4902965
M101	334949	4903015
M102	334836	4902919

Appendix A: Monitoring Well Inventory

Monitoring Well	Easting	Northing
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
M179	336338	4902357
M180	336801	4902677
M181-1	335912	4901492
M181-2	335912	4901492
M182	336402	4901643
M183	336953	4901770
M184	336176	4901998
M185-1	336170	4902151
M185-2	336170	4902151
M186	336509	4902627
M187	335607	4901972

Appendix A: Monitoring Well Inventory

Monitoring Well	Easting	Northing
M188	335979	4902069
M189	335479	4902099
M190	336274	4902275
M191	336332	4902802
M192	335976	4902826
M193	336082	4902896
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

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

Location	Parameter	Unit	Regular Sample	Field Duplicate	RPD (%)	MDL[2]	Comment
S3	Ammonia	mg/L	0.45	0.18	86	0.15	Less than 5x MDL
S20	Biochemical Oxygen Demand	mg/L	33	14	81	2	
S20	Cadmium	mg/L	0.0002	0.0001	67	0.0001	Less than 5x MDL
S20	Nitrite	mg/L	0.441	0.084	136	0.01	

[1] RPD (%) = 100 * ABS (Regular Sample - Duplicate Sample) / ([Regular Sample + Duplicate Sample] / 2)
[2] MDL = Laboratory Method Detection Limit

Detailed Results from Field Duplicate vs. Regular Samples

Reading Name	Units	M108 2016-10-19 Regular Sample	M108 2016-10-19 Field Duplicate	RPD (%)
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	0.00034	0.00033	2.99
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	0.011	0.012	8.70
Benzene	mg/L	< 0.0001	< 0.0001	0.00
Chlorobenzene	mg/L	< 0.0001	< 0.0001	0.00
Chloroethane	mg/L	0.0048	0.0047	2.11
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
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	M114-1 2016-10-19 Regular Sample	M114-1 2016-10-19 Field Duplicate	RPD (%)
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	0.00024	0.00025	4.08
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	0.0056	0.0054	3.64
Benzene	mg/L	< 0.0001	< 0.0001	0.00
Chlorobenzene	mg/L	< 0.0001	< 0.0001	0.00
Chloroethane	mg/L	0.011	0.011	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
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	0.00021	0.00

Detailed Results from Field Duplicate vs. Regular Samples

Reading Name	Units	M192 2016-10-18 Regular Sample	M192 2016-10-18 Field Duplicate	RPD (%)
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	0.00029	0.00028	3.51
Chlorobenzene	mg/L	< 0.0001	< 0.0001	0.00
Chloroethane	mg/L	< 0.0002	< 0.0002	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	0.0015	0.0013	14.29
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	M109-1 2016-10-20 Regular Sample	M109-1 2016-10-20 Field Duplicate	RPD (%)
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	0.024	0.027	11.76
Alkalinity	mg/L	630	620	1.60
Ammonia	mg/L	1.05	1.05	0.00
Benzene	mg/L	0.00021	0.0002	4.88
Boron	mg/L	0.52	0.53	1.90
Calcium	mg/L	140	140	0.00
Chloride	mg/L	170	170	0.00
Chlorobenzene	mg/L	< 0.0001	< 0.0001	0.00
Chloroethane	mg/L	0.019	0.018	5.41
Chloromethane	mg/L	< 0.0005	< 0.0005	0.00
Cis-1,2-Dichloroethylene	mg/L	< 0.0001	< 0.0001	0.00
Conductivity	µS/cm	1700	1700	0.00
Dichloromethane	mg/L	< 0.0005	< 0.0005	0.00
Dissolved Organic Carbon	mg/L	10	10	0.00
Ethylbenzene	mg/L	< 0.0001	< 0.0001	0.00
Iron	mg/L	11	11	0.00
m+p-Xylene	mg/L	0.00017	0.00016	6.06
Magnesium	mg/L	52	51	1.94
Manganese	mg/L	0.31	0.31	0.00
Nitrate	mg/L	< 0.1	< 0.1	0.00
Nitrite	mg/L	< 0.01	< 0.01	0.00
Nitrite + Nitrate	mg/L	< 0.1	< 0.1	0.00
o-Xylene	mg/L	< 0.0001	< 0.0001	0.00
Potassium	mg/L	7.5	7.3	2.70
Sodium	mg/L	140	140	0.00
Styrene	mg/L	< 0.0002	< 0.0002	0.00
Sulphate	mg/L	< 1	< 1	0.00
Tetrachloroethylene	mg/L	< 0.0001	< 0.0001	0.00
Toluene	mg/L	< 0.0002	< 0.0002	0.00
Total Dissolved Solids	mg/L	888	942	5.90
Total Xylenes	mg/L	0.00017	0.00016	6.06
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	0.00023	0.00024	4.26

Detailed Results from Field Duplicate vs. Regular Samples

Reading Name	Units	M121 2016-10-20 Regular Sample	M121 2016-10-20 Field Duplicate	RPD (%)
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	0.0087	0.0083	4.71
Alkalinity	mg/L	550	550	0.00
Ammonia	mg/L	1.44	1.42	1.40
Benzene	mg/L	0.039	0.037	5.26
Boron	mg/L	0.51	0.47	8.16
Calcium	mg/L	90	89	1.12
Chloride	mg/L	220	220	0.00
Chlorobenzene	mg/L	< 0.0005	< 0.0005	0.00
Chloroethane	mg/L	< 0.025	< 0.025	0.00
Chloromethane	mg/L	< 0.0025	< 0.0025	0.00
Cis-1,2-Dichloroethylene	mg/L	< 0.0005	< 0.0005	0.00
Conductivity	µS/cm	1700	1700	0.00
Dichloromethane	mg/L	< 0.0025	< 0.0025	0.00
Dissolved Organic Carbon	mg/L	5	5	0.00
Ethylbenzene	mg/L	0.0013	0.0012	8.00
Iron	mg/L	< 0.1	< 0.1	0.00
m+p-Xylene	mg/L	0.0096	0.009	6.45
Magnesium	mg/L	52	50	3.92
Manganese	mg/L	0.003	0.003	0.00
Nitrate	mg/L	< 0.1	< 0.1	0.00
Nitrite	mg/L	< 0.01	< 0.01	0.00
Nitrite + Nitrate	mg/L	< 0.1	< 0.1	0.00
o-Xylene	mg/L	0.00078	0.00073	6.62
Potassium	mg/L	13	13	0.00
Sodium	mg/L	200	190	5.13
Styrene	mg/L	< 0.001	< 0.001	0.00
Sulphate	mg/L	14	12	15.38
Tetrachloroethylene	mg/L	< 0.0005	< 0.0005	0.00
Toluene	mg/L	< 0.001	< 0.001	0.00
Total Dissolved Solids	mg/L	890	930	4.40
Total Xylenes	mg/L	0.01	0.0097	3.05
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	S3 2016-08-15 Regular Sample	S3 2016-08-15 Field Duplicate	RPD (%)
1,4-Dioxane	mg/L	< 0.001	< 0.001	0.00
Alkalinity	mg/L	320	320	0.00
Ammonia	mg/L	0.45	0.18	85.71
Biochemical Oxygen Demand	mg/L	< 2	< 2	0.00
Boron	mg/L	0.13	0.14	7.41
Cadmium	mg/L	< 0.0001	< 0.0001	0.00
Calcium	mg/L	160	160	0.00
Chemical Oxygen Demand	mg/L	17	15	12.50
Chloride	mg/L	77	82	6.29
Chromium (III)	mg/L	< 0.005	< 0.005	0.00
Chromium (Total)	mg/L	< 0.005	< 0.005	0.00
Chromium (VI)	mg/L	< 0.0005	< 0.0005	0.00
Cobalt	mg/L	< 0.0005	< 0.0005	0.00
Conductivity	μS/cm	1100	1200	8.70
Copper	mg/L	< 0.002	< 0.002	0.00
Dissolved Oxygen	mg/L	4.62	4.62	0.00
Field Conductivity	μS/cm	1000	1000	0.00
Field Temperature	°C	13.49	13.49	0.00
Hardness	mg/L	490	490	0.00
Iron	mg/L	0.92	0.97	5.29
Lead	mg/L	< 0.0005	< 0.0005	0.00
Magnesium	mg/L	30	31	3.28
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
Nitrite + Nitrate	mg/L	< 0.1	< 0.1	0.00
pH (Field)	unitless	7.06	7.06	0.00
Phenols	mg/L	< 0.001	< 0.001	0.00
Phosphorus	mg/L	0.099	0.1	1.01
Potassium	mg/L	12	12	0.00
Sodium	mg/L	56	58	3.51
Sulphate	mg/L	160	170	6.06
Total Dissolved Solids	mg/L	1020	1010	0.99
Total Suspended Solids	mg/L	< 10	< 10	0.00
Zinc	mg/L	< 0.01	0.037	0.00

Detailed Results from Field Duplicate vs. Regular Samples

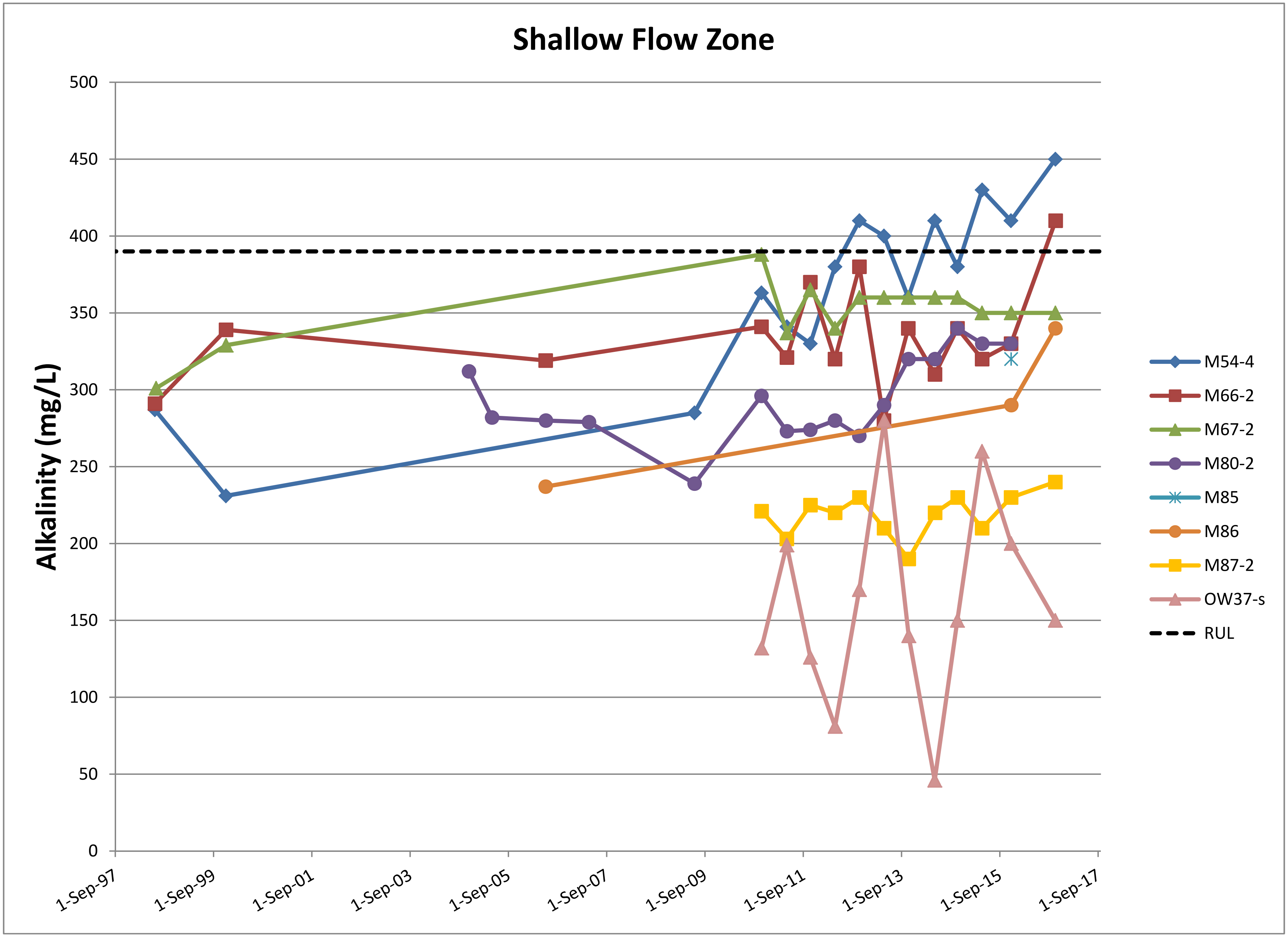
Reading Name	Units	S20 2016-10-18 Regular Sample	S20 2016-10-18 Field Duplicate	RPD (%)
1,4-Dioxane	mg/L	< 0.004	< 0.004	0.00
Alkalinity	mg/L	230	230	0.00
Ammonia	mg/L	15.5	15.2	1.95
Ammonia (unionized)	mg/L	0.013	0.013	0.00
Biochemical Oxygen Demand	mg/L	33	14	80.85
Boron	mg/L	0.041	0.042	2.41
Cadmium	mg/L	0.0002	0.0001	66.67
Calcium	mg/L	69	69	0.00
Chemical Oxygen Demand	mg/L	320	300	6.45
Chloride	mg/L	69	69	0.00
Chromium (III)	mg/L	< 0.005	< 0.005	0.00
Chromium (Total)	mg/L	0.012	0.012	0.00
Chromium (VI)	mg/L	< 0.0005	< 0.0005	0.00
Cobalt	mg/L	0.0042	0.0044	4.65
Conductivity	µS/cm	770	750	2.63
Copper	mg/L	0.012	0.013	8.00
Dissolved Oxygen	mg/L	8.21	8.21	0.00
Field Conductivity	µS/cm	770	770	0.00
Field Temperature	°C	13.01	13.01	0.00
Hardness	mg/L	180	180	0.00
Iron	mg/L	9.3	9.5	2.13
Lead	mg/L	0.0063	0.0061	3.23
Magnesium	mg/L	12	12	0.00
Naphthalene	mg/L	< 0.00005	< 0.00005	0.00
Nickel	mg/L	0.011	0.012	8.70
Nitrate	mg/L	< 0.1	< 0.1	0.00
Nitrite	mg/L	0.441	0.084	136.00
Phenols	mg/L	0.0011	0.0011	0.00
Potassium	mg/L	50	49	2.02
Sodium	mg/L	21	21	0.00
Sulphate	mg/L	39	39	0.00
Total Dissolved Solids	mg/L	486	486	0.00
Total Suspended Solids	mg/L	260	220	16.67
Zinc	mg/L	0.045	0.046	2.20

Detailed Results from Field Blank Samples - Fall 2016

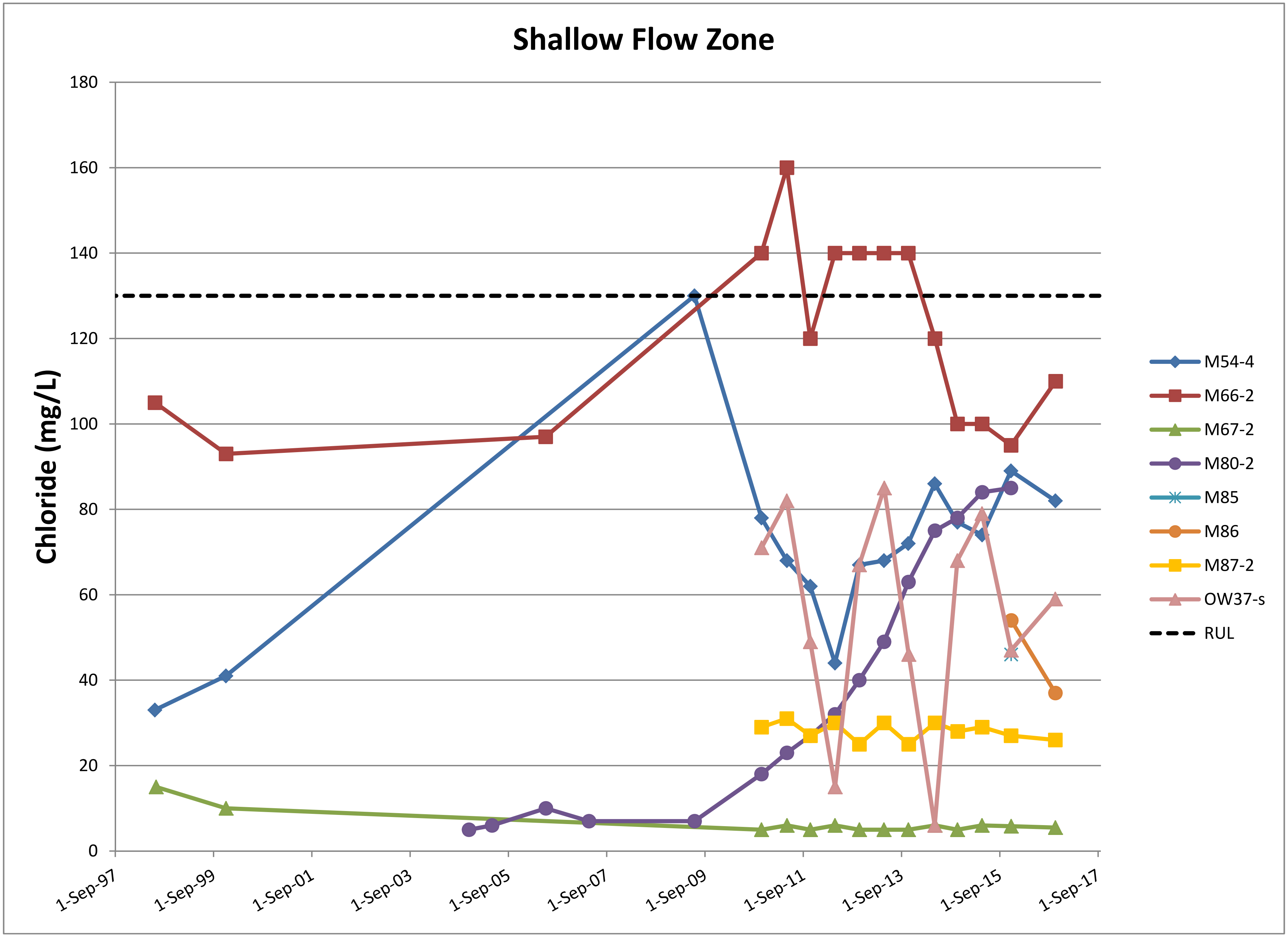
Reading Name	Units	Blank - Trip 2016-10-18	Blank - Trip 2016-10-19	Blank - Trip 2016-10-20	Blank - Field(1) 2016-10-20	Blank - Field(2) 2016-10-20
1,1,1,2-Tetrachloroethane	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
1,1,1-Trichloroethane	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
1,1,2,2-Tetrachloroethane	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
1,1,2-Trichloroethane	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
1,1-Dichloroethane	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
1,1-Dichloroethylene	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
1,2-Dichlorobenzene (o)	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
1,2-Dichloroethane	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
1,3,5-Trimethylbenzene	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
1,3-Dichlorobenzene (m)	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
1,4-Dichlorobenzene (p)	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
1,4-Dioxane	mg/L				< 0.001	< 0.001
Alkalinity	mg/L				2.3	1.2
Ammonia	mg/L				< 0.15	< 0.15
Benzene	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Boron	mg/L				< 0.02	< 0.02
Calcium	mg/L				< 0.2	< 0.2
Chloride	mg/L				< 1	< 1
Chlorobenzene	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Chloroethane	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.002	< 0.0002
Chloromethane	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Cis-1,2-Dichloroethylene	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Conductivity	µS/cm				3	2.7
Dichloromethane	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Dissolved Organic Carbon	mg/L				0.4	0.4
Ethylbenzene	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Iron	mg/L				< 0.1	< 0.1
m+p-Xylene	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Magnesium	mg/L				< 0.05	< 0.05
Manganese	mg/L				< 0.002	< 0.002
Nitrate	mg/L				< 0.1	< 0.1
Nitrite	mg/L				< 0.01	< 0.01
Nitrite + Nitrate	mg/L				< 0.1	< 0.1
o-Xylene	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Potassium	mg/L				< 0.2	< 0.2
Sodium	mg/L				< 0.1	< 0.1
Styrene	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Sulphate	mg/L				< 1	< 1
Tetrachloroethylene	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Toluene	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Total Dissolved Solids	mg/L				64	< 10
Total Xylenes	mg/L				< 0.0001	< 0.0001
Trans-1,2-dichloroethylene	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Trichloroethylene	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Vinyl Chloride	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002

APPENDIX C

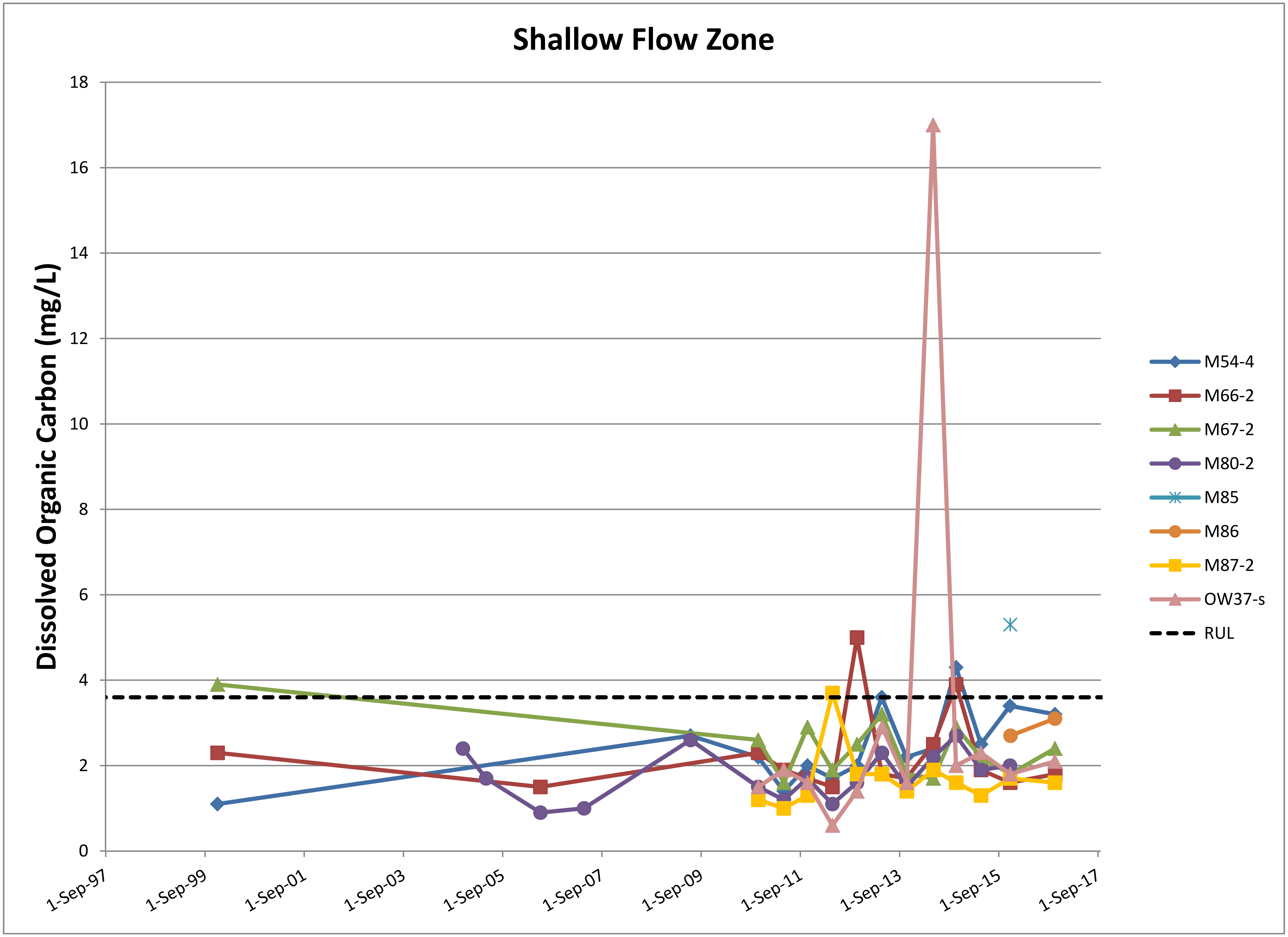
Time-Concentration Plots from Groundwater Trigger Wells



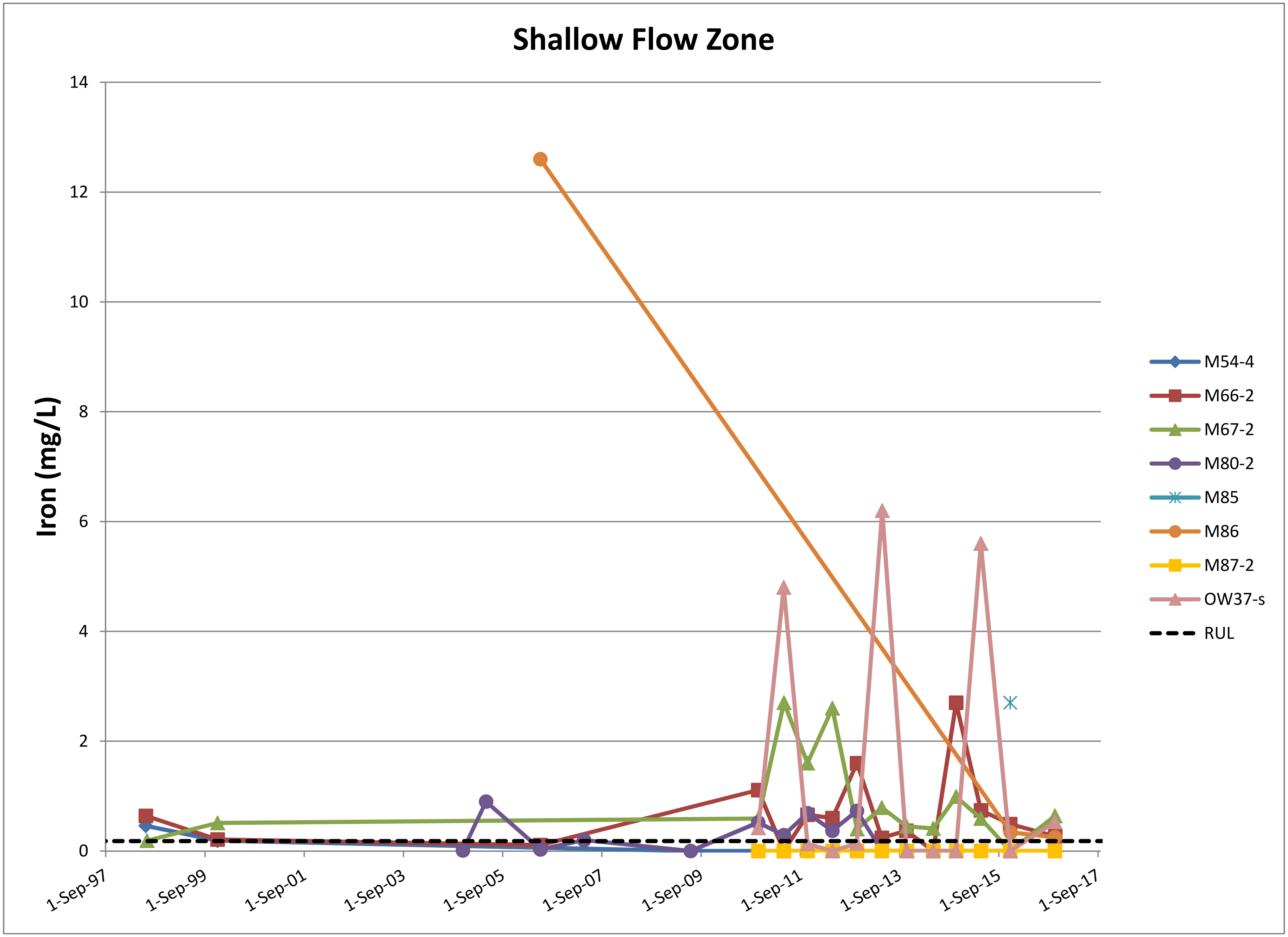
Shallow Flow Zone
Alkalinity (mg/L)
500
450
400
350
300
250
200
150
100
50
0
1-Sep-97
1-Sep-99
1-Sep-01
1-Sep-03
1-Sep-05
1-Sep-07
1-Sep-09
1-Sep-11
1-Sep-13
1-Sep-15
1-Sep-17
M54-4
M66-2
M67-2
M80-2
M85
M86
M87-2
OW37-s
RUL



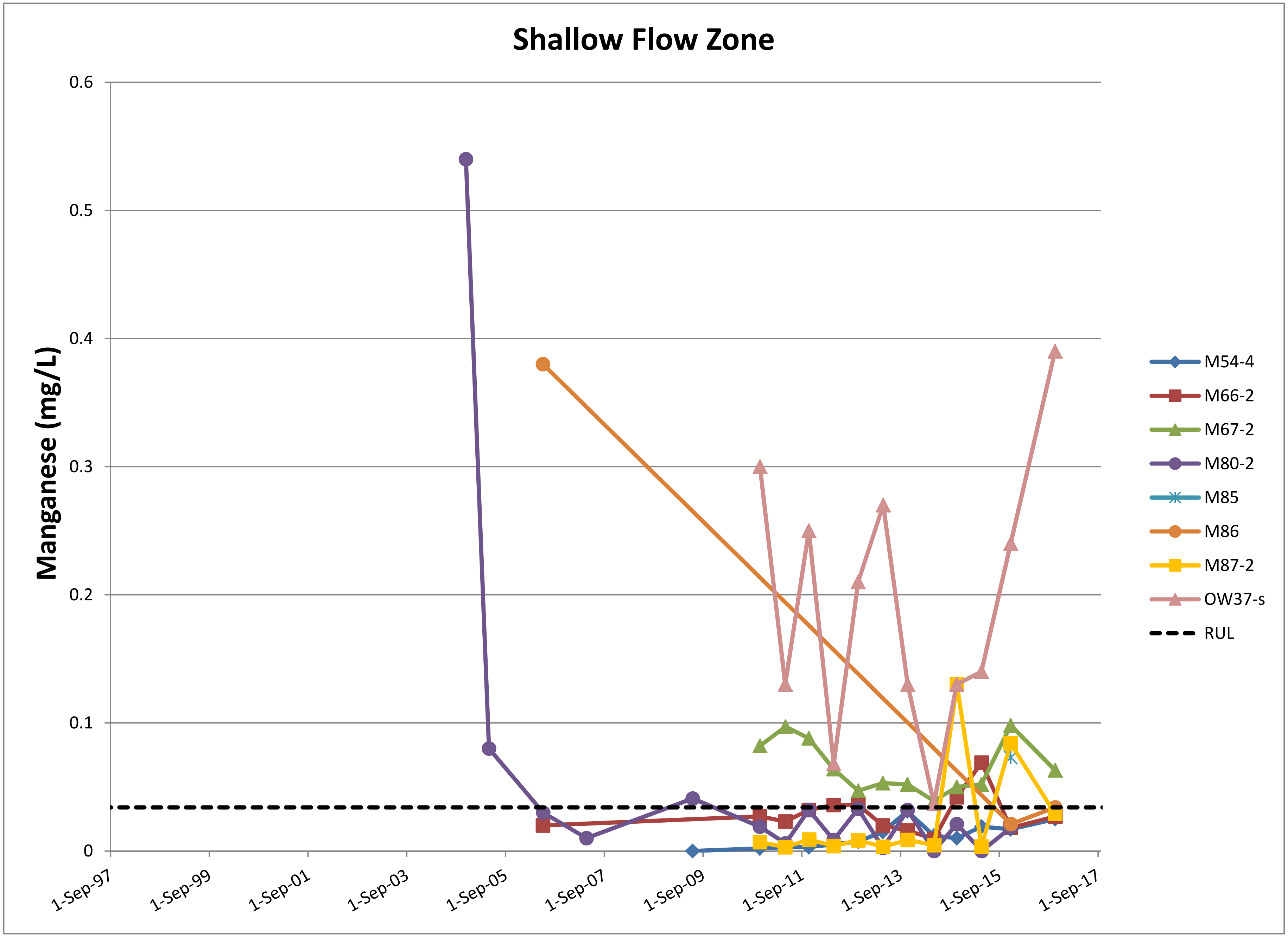
Shallow Flow Zone
Chloride (mg/L)
180
160
140
120
100
80
60
40
20
0
1-Sep-97
1-Sep-99
1-Sep-01
1-Sep-03
1-Sep-05
1-Sep-07
1-Sep-09
1-Sep-11
1-Sep-13
1-Sep-15
1-Sep-17
M54-4
M66-2
M67-2
M80-2
M85
M86
M87-2
OW37-s
RUL



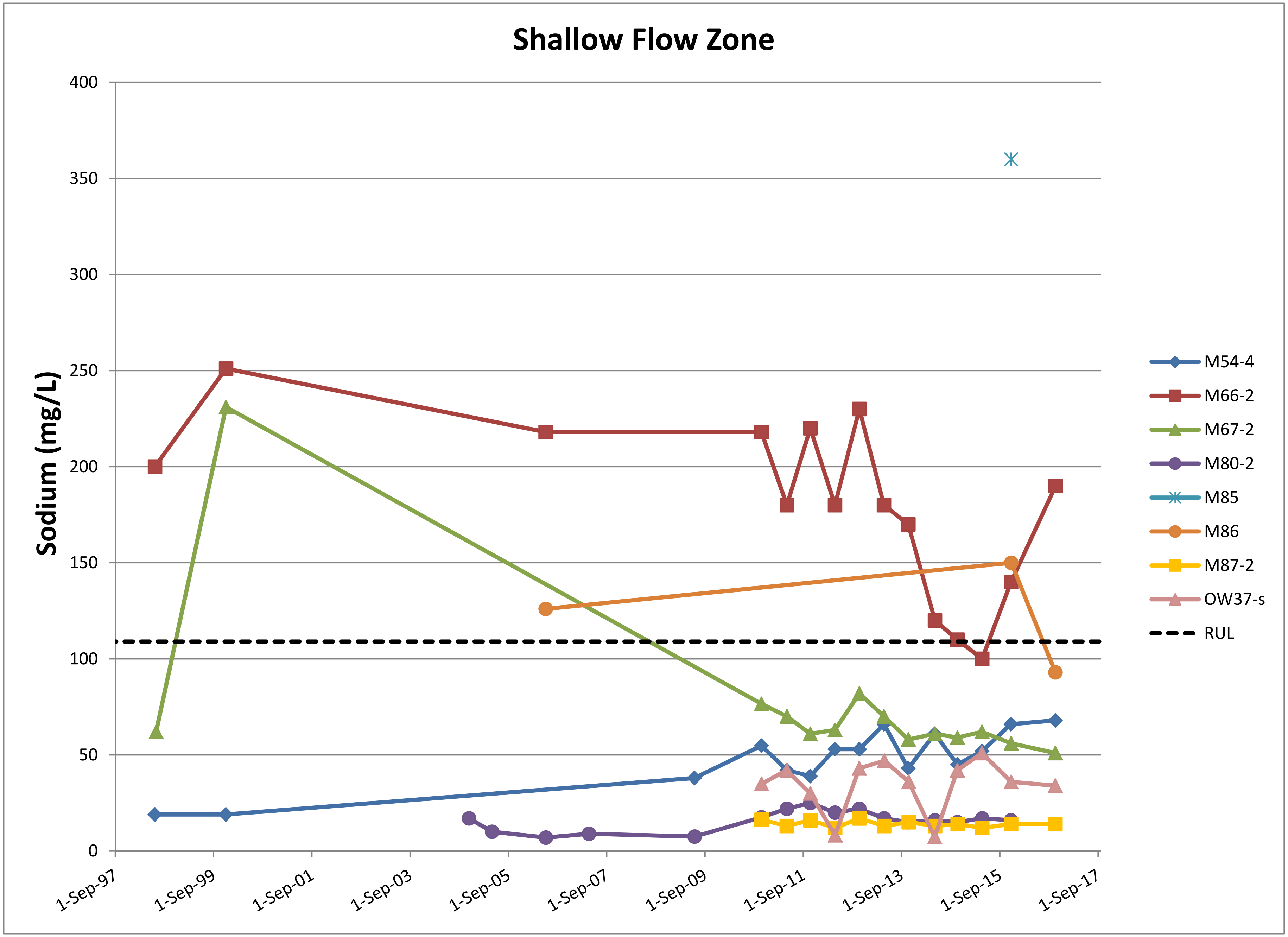
Shallow Flow Zone
Dissolved Organic Carbon (mg/L)
18
16
14
12
10
8
6
4
2
0
1-Sep-97
1-Sep-99
1-Sep-01
1-Sep-03
1-Sep-05
1-Sep-07
1-Sep-09
1-Sep-11
1-Sep-13
1-Sep-15
1-Sep-17
M54-4
M66-2
M67-2
M80-2
M85
M86
M87-2
OW37-s
RUL

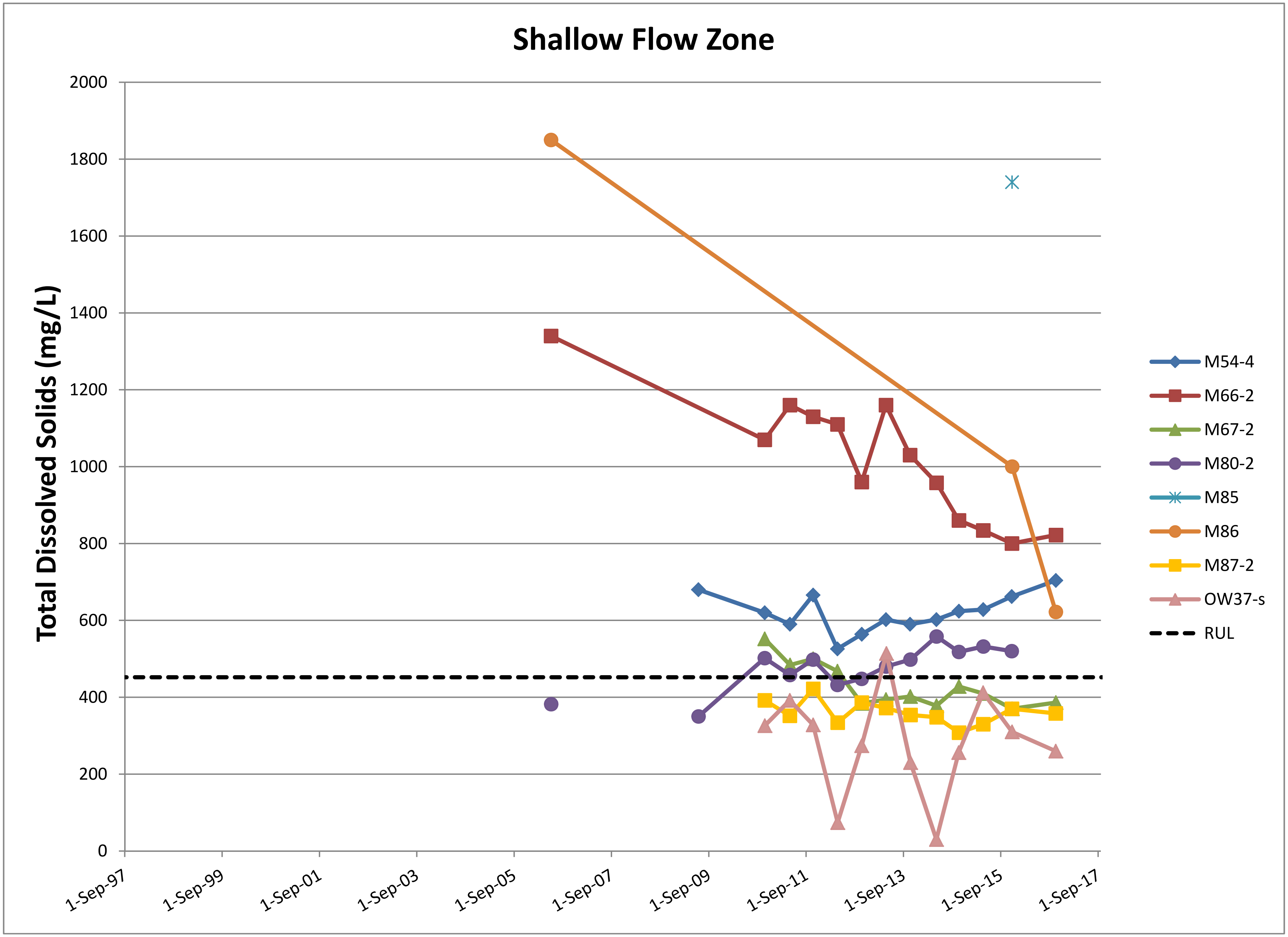


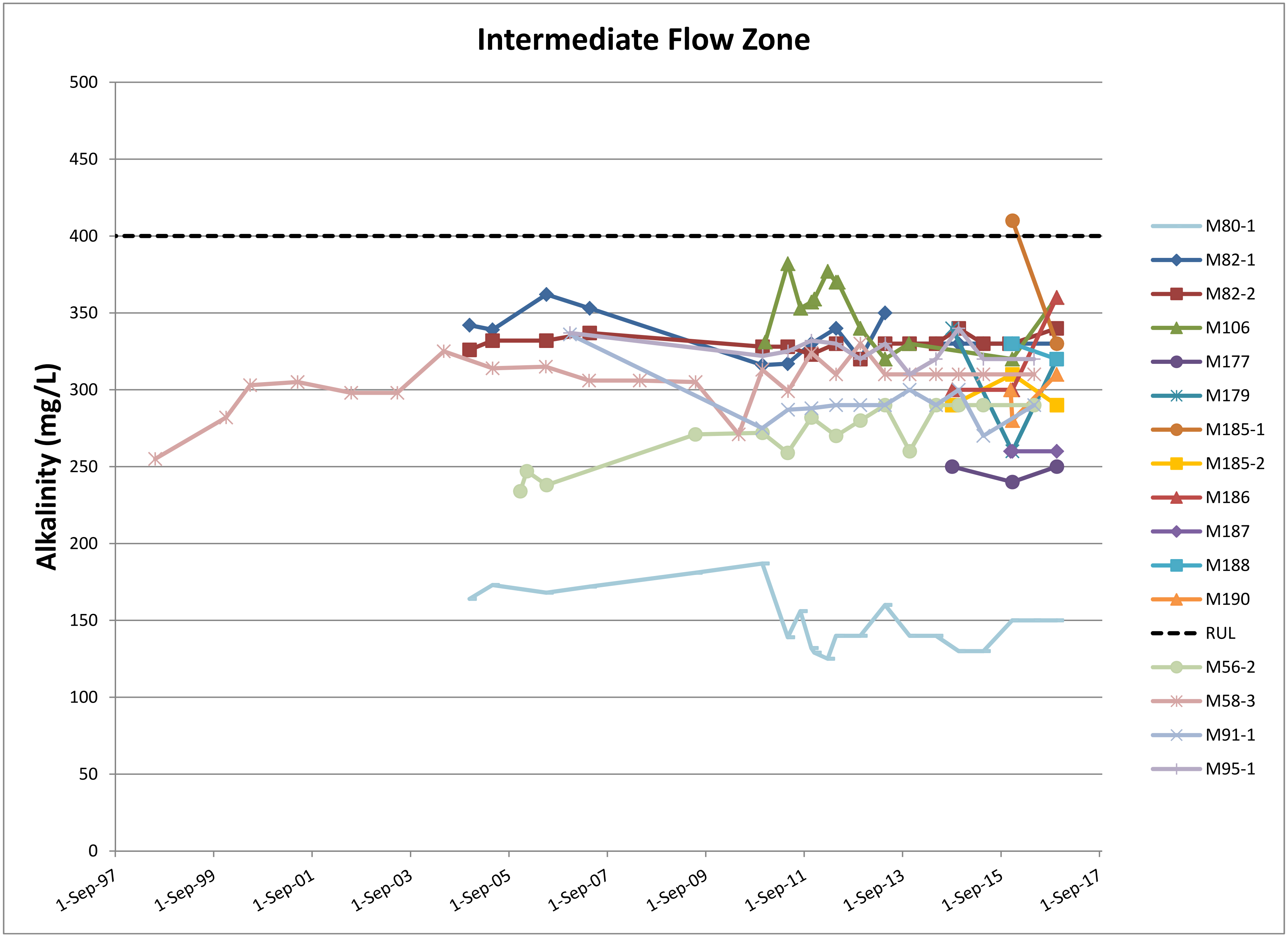
Shallow Flow Zone
Iron (mg/L)
14
12
10
8
6
4
2
0
1-Sep-97
1-Sep-99
1-Sep-01
1-Sep-03
1-Sep-05
1-Sep-07
1-Sep-09
1-Sep-11
1-Sep-13
1-Sep-15
1-Sep-17
M54-4
M66-2
M67-2
M80-2
M85
M86
M87-2
OW37-s
RUL



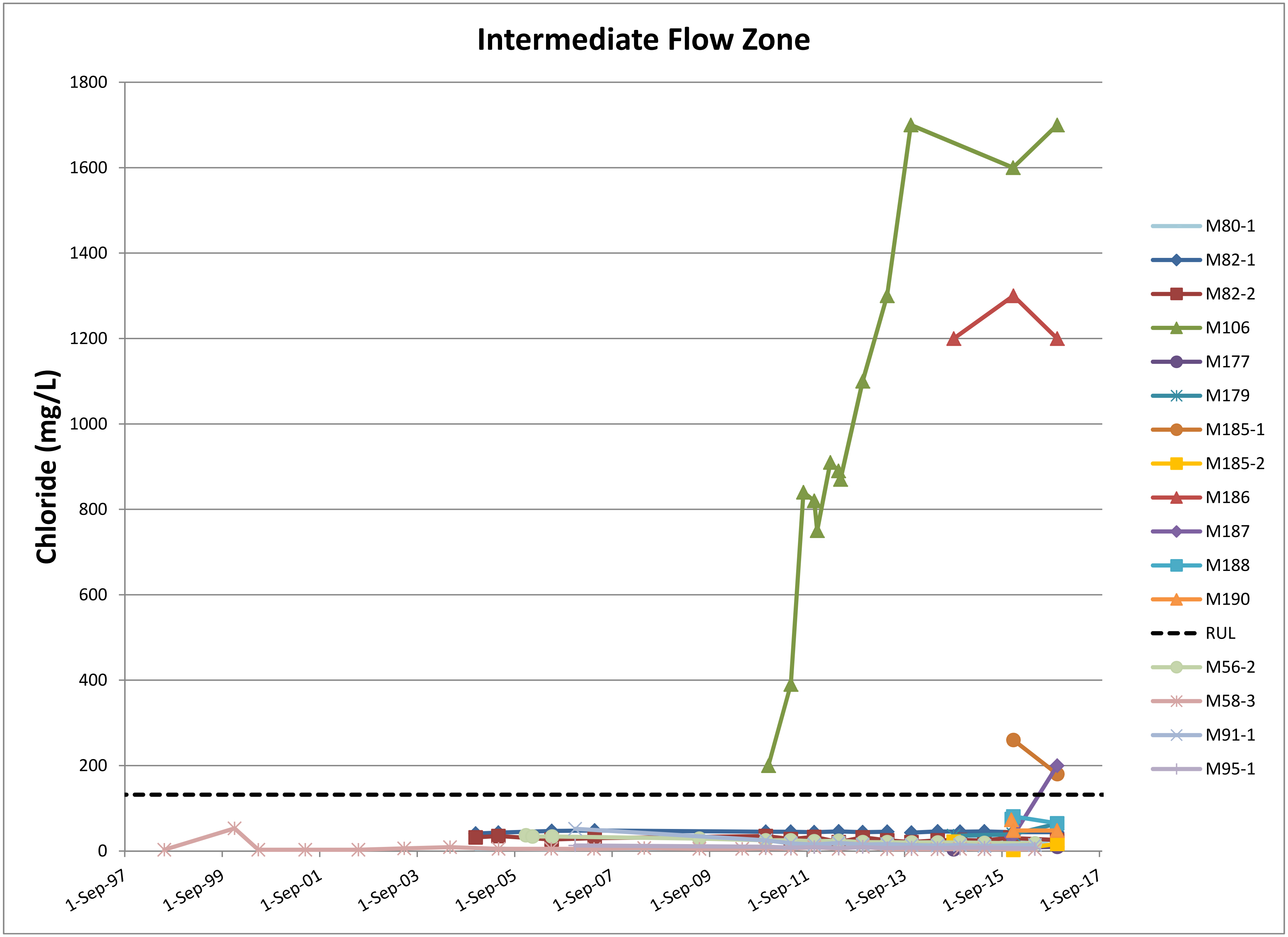
Shallow Flow Zone
Manganese (mg/L)
0.6
0.5
0.4
0.3
0.2
0.1
0
1-Sep-97
1-Sep-99
1-Sep-01
1-Sep-03
1-Sep-05
1-Sep-07
1-Sep-09
1-Sep-11
1-Sep-13
1-Sep-15
1-Sep-17
M54-4
M66-2
M67-2
M80-2
M85
M86
M87-2
OW37-s
RUL


Shallow Flow Zone
Sodium (mg/L)
400
350
300
250
200
150
100
50
0
1-Sep-97
1-Sep-99
1-Sep-01
1-Sep-03
1-Sep-05
1-Sep-07
1-Sep-09
1-Sep-11
1-Sep-13
1-Sep-15
1-Sep-17
M54-4
M66-2
M67-2
M80-2
M85
M86
M87-2
OW37-s
RUL

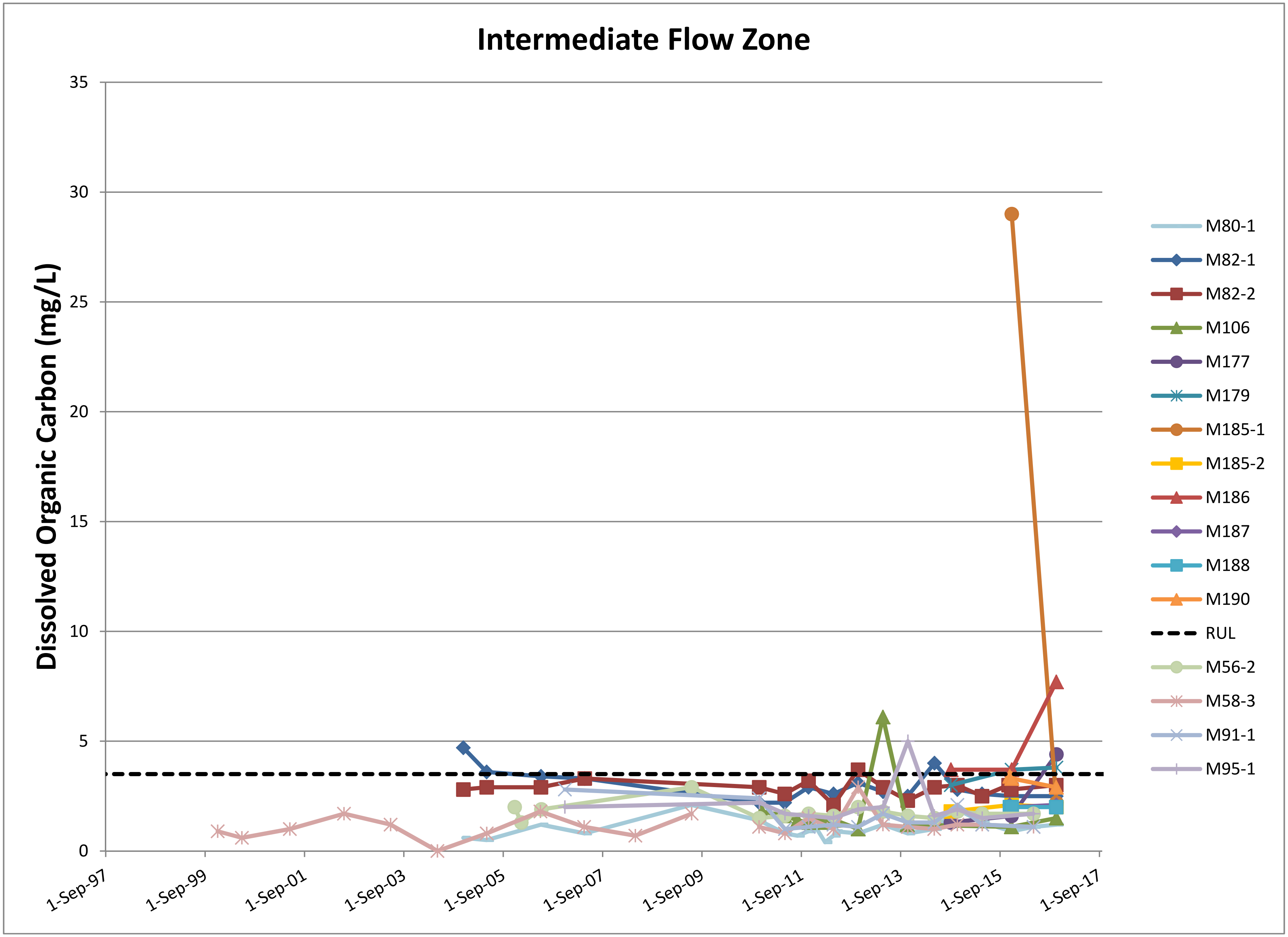

Shallow Flow Zone
Total Dissolved Solids (mg/L)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
1-Sep-97
1-Sep-99
1-Sep-01
1-Sep-03
1-Sep-05
1-Sep-07
1-Sep-09
1-Sep-11
1-Sep-13
1-Sep-15
1-Sep-17
M54-4
M66-2
M67-2
M80-2
M85
M86
M87-2
OW37-s
RUL

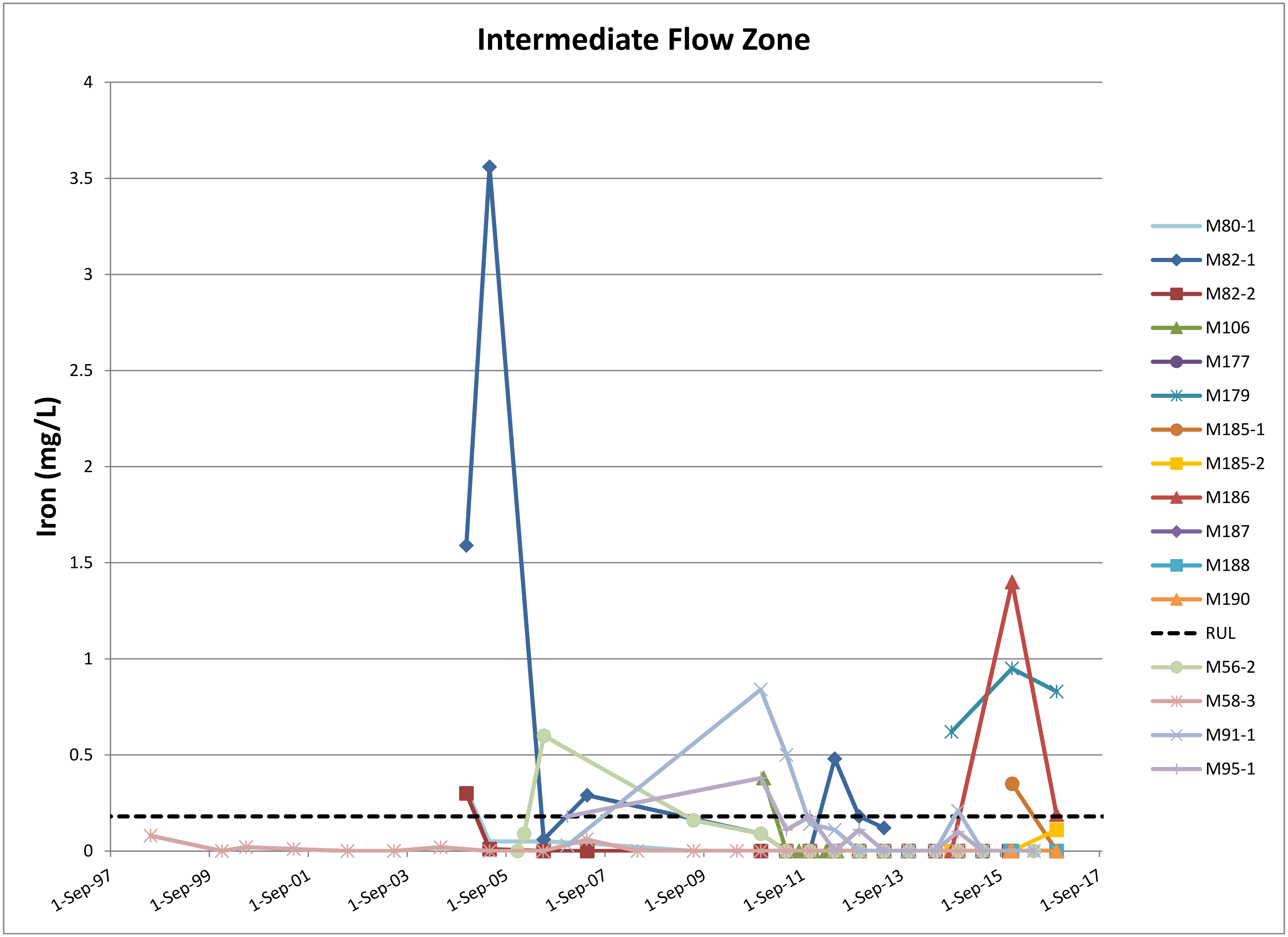


Intermediate Flow Zone
Alkalinity (mg/L)
500
450
400
350
300
250
200
150
100
50
0
1-Sep-97
1-Sep-99
1-Sep-01
1-Sep-03
1-Sep-05
1-Sep-07
1-Sep-09
1-Sep-11
1-Sep-13
1-Sep-15
1-Sep-17
M80-1
M82-1
M82-2
M106
M177
M179
M185-1
M185-2
M186
M187
M188
M190
RUL
M56-2
M58-3
M91-1
M95-1

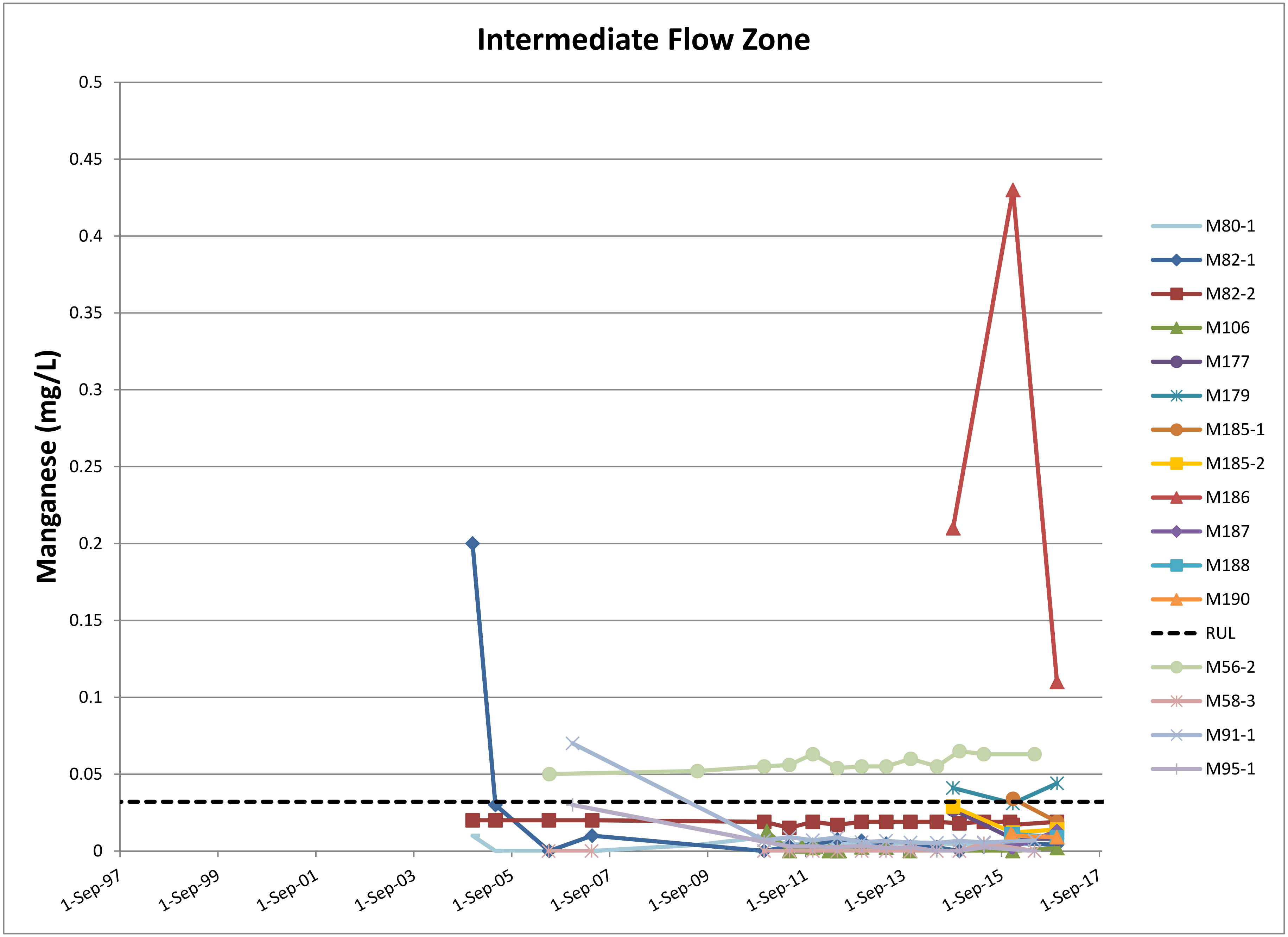


Intermediate Flow Zone
Chloride (mg/L)
0
200
400
600
800
1000
1200
1400
1600
1800
1-Sep-97
1-Sep-99
1-Sep-01
1-Sep-03
1-Sep-05
1-Sep-07
1-Sep-09
1-Sep-11
1-Sep-13
1-Sep-15
1-Sep-17
M80-1
M82-1
M82-2
M106
M177
M179
M185-1
M185-2
M186
M187
M188
M190
RUL
M56-2
M58-3
M91-1
M95-1

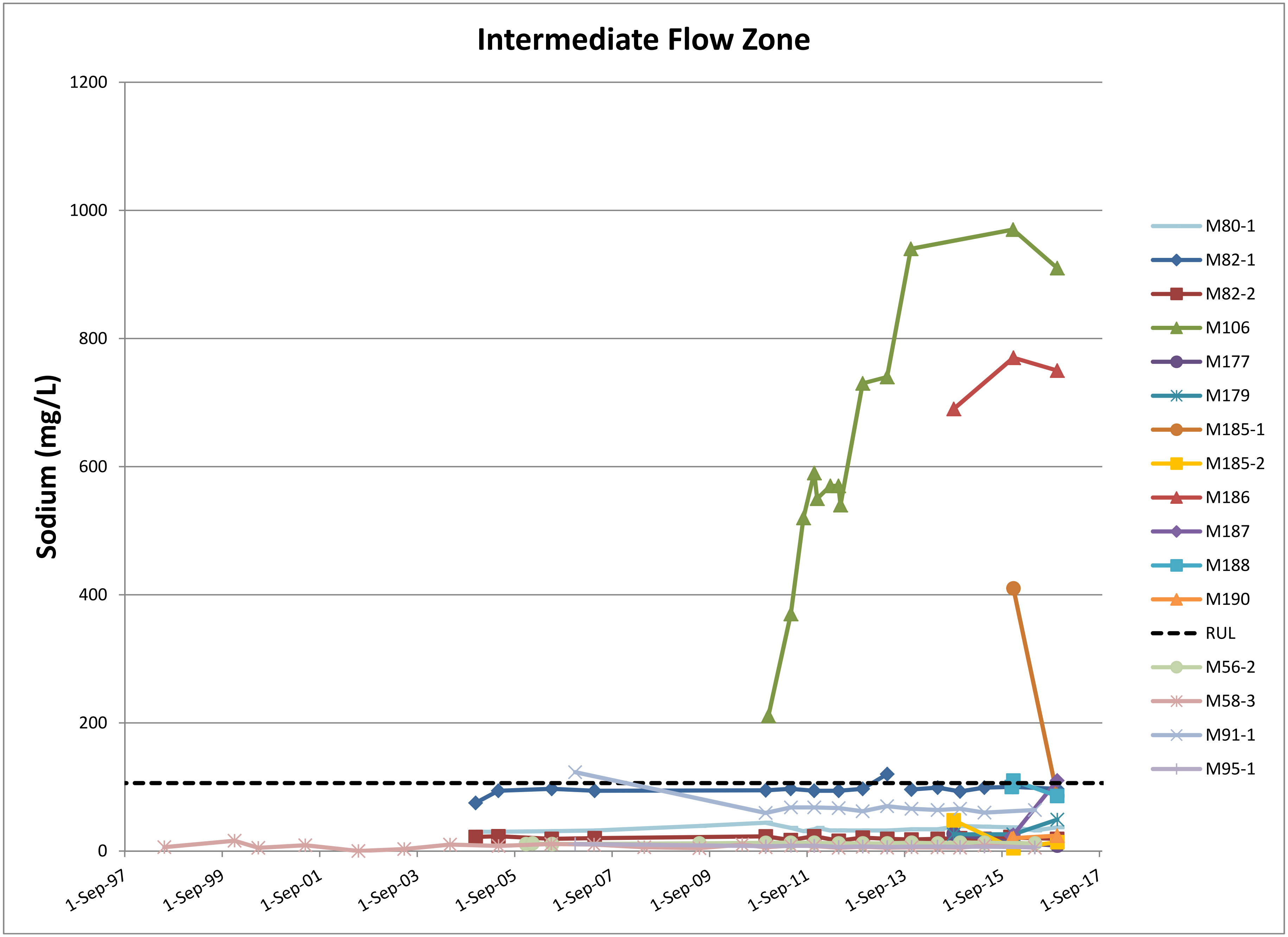

Intermediate Flow Zone
Dissolved Organic Carbon (mg/L)
35
30
25
20
15
10
5
0
1-Sep-97
1-Sep-99
1-Sep-01
1-Sep-03
1-Sep-05
1-Sep-07
1-Sep-09
1-Sep-11
1-Sep-13
1-Sep-15
1-Sep-17
M80-1
M82-1
M82-2
M106
M177
M179
M185-1
M185-2
M186
M187
M188
M190
RUL
M56-2
M58-3
M91-1
M95-1



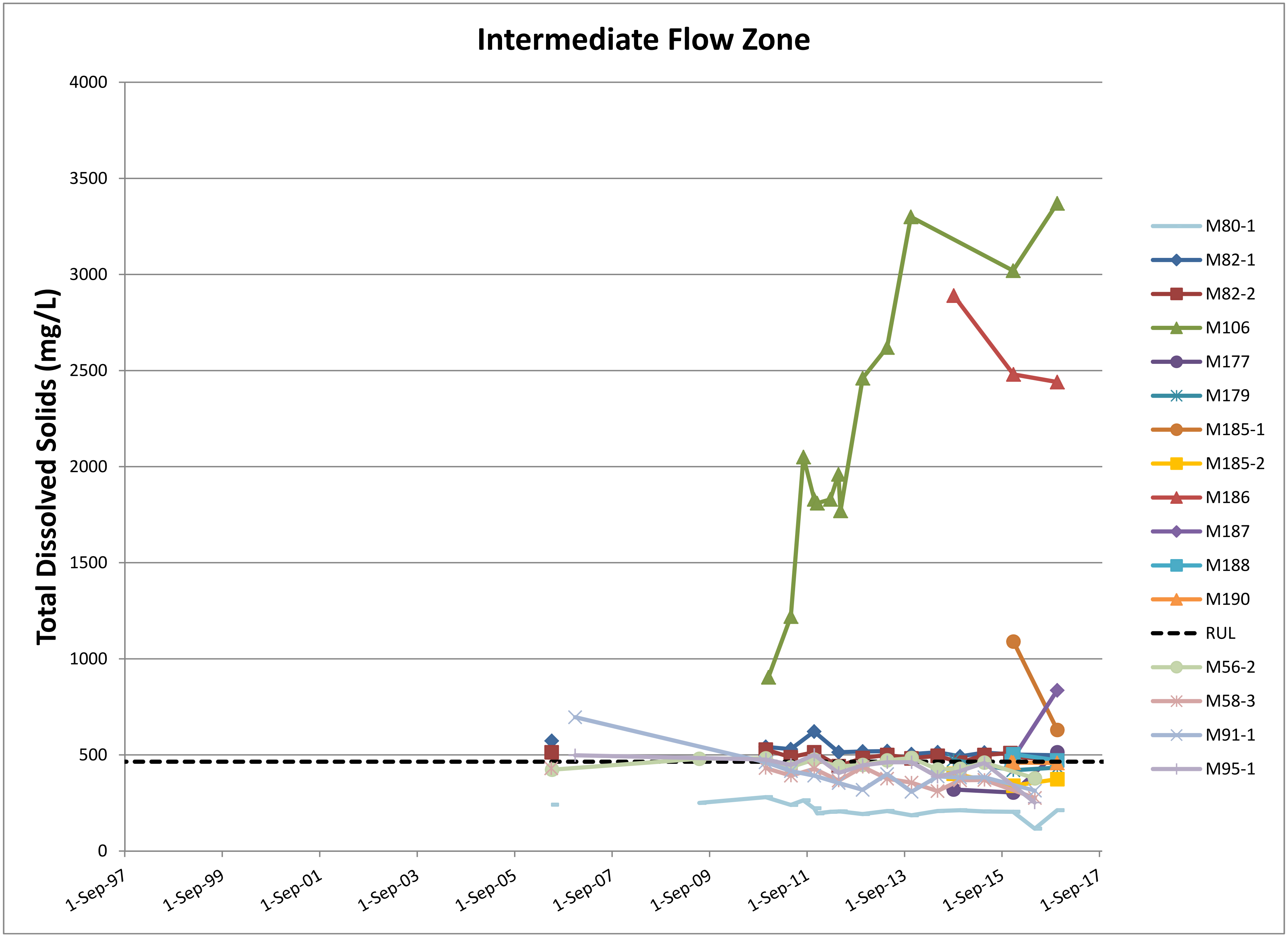
Intermediate Flow Zone
Iron (mg/L)
0
0.5
1
1.5
2
2.5
3
3.5
4
1-Sep-97
1-Sep-99
1-Sep-01
1-Sep-03
1-Sep-05
1-Sep-07
1-Sep-09
1-Sep-11
1-Sep-13
1-Sep-15
1-Sep-17
M80-1
M82-1
M82-2
M106
M177
M179
M185-1
M185-2
M186
M187
M188
M190
RUL
M56-2
M58-3
M91-1
M95-1



Intermediate Flow Zone
Manganese (mg/L)
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
1-Sep-97
1-Sep-99
1-Sep-01
1-Sep-03
1-Sep-05
1-Sep-07
1-Sep-09
1-Sep-11
1-Sep-13
1-Sep-15
1-Sep-17
M80-1
M82-1
M82-2
M106
M177
M179
M185-1
M185-2
M186
M187
M188
M190
RUL
M56-2
M58-3
M91-1
M95-1



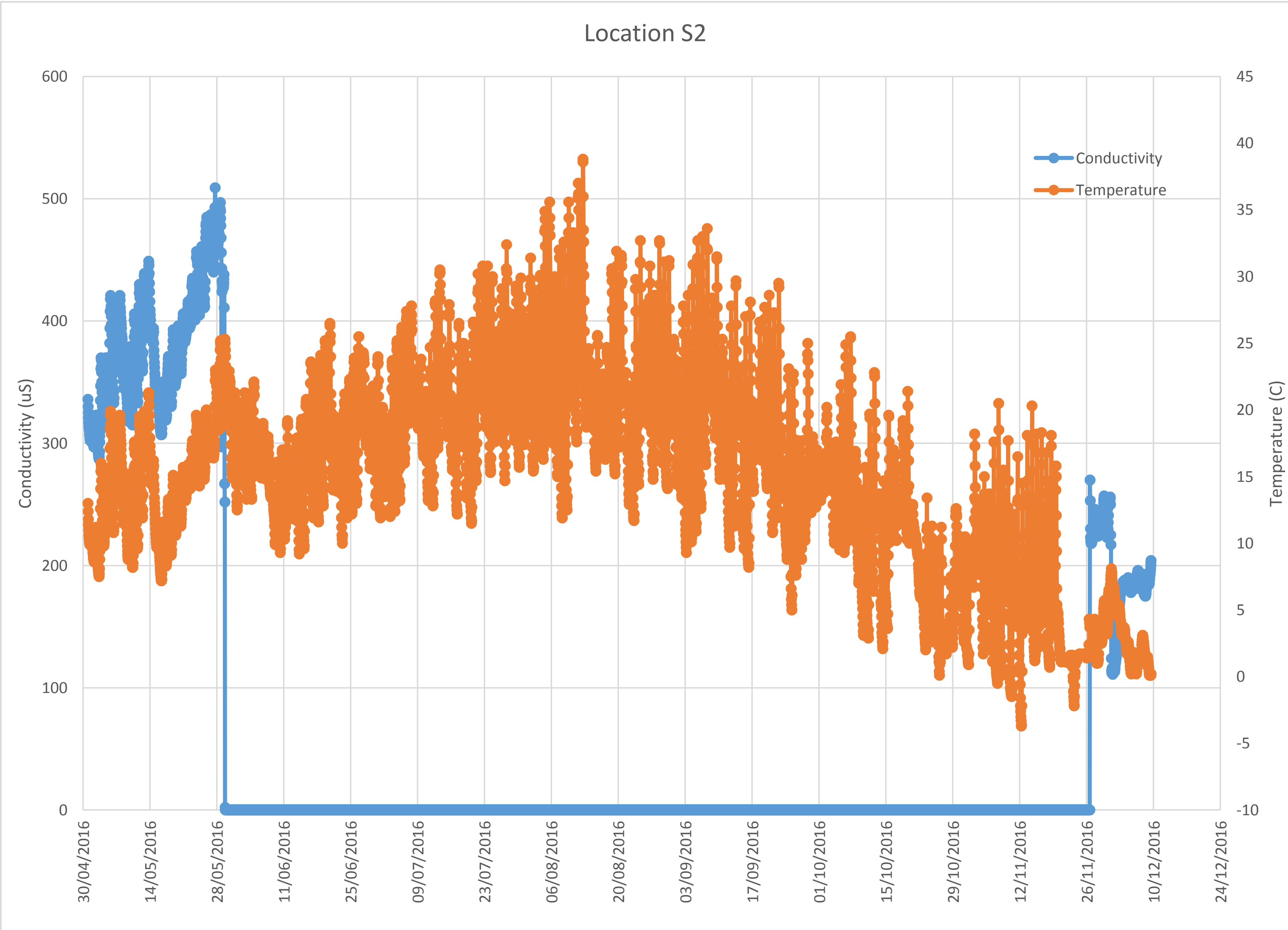
Intermediate Flow Zone
Sodium (mg/L)
0
200
400
600
800
1000
1200
1-Sep-97
1-Sep-99
1-Sep-01
1-Sep-03
1-Sep-05
1-Sep-07
1-Sep-09
1-Sep-11
1-Sep-13
1-Sep-15
1-Sep-17
M80-1
M82-1
M82-2
M106
M177
M179
M185-1
M185-2
M186
M187
M188
M190
RUL
M56-2
M58-3
M91-1
M95-1

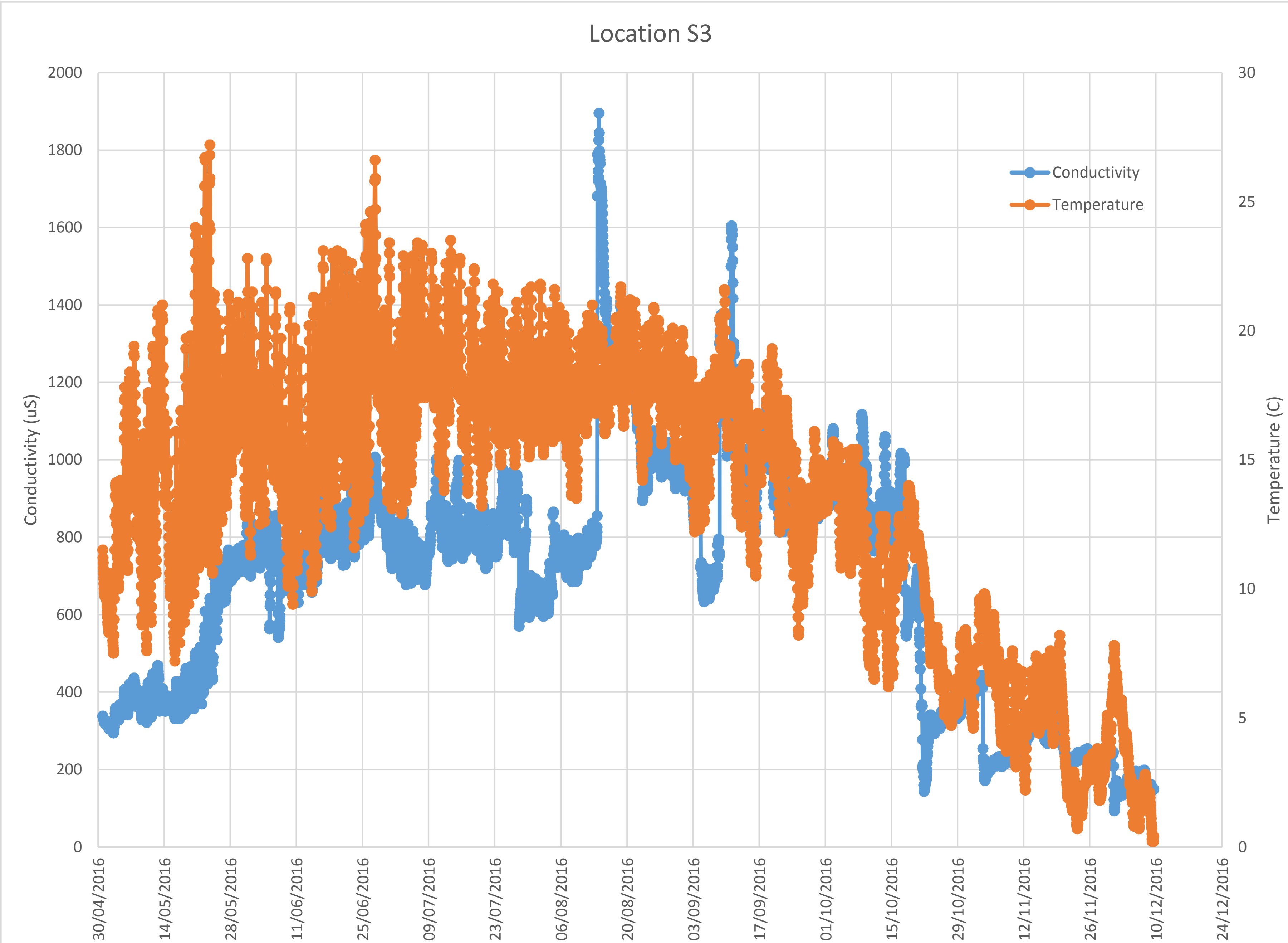


Intermediate Flow Zone
Total Dissolved Solids (mg/L)
4000
3500
3000
2500
2000
1500
1000
500
0
1-Sep-97
1-Sep-99
1-Sep-01
1-Sep-03
1-Sep-05
1-Sep-07
1-Sep-09
1-Sep-11
1-Sep-13
1-Sep-15
1-Sep-17
M80-1
M82-1
M82-2
M106
M177
M179
M185-1
M185-2
M186
M187
M188
M190
RUL
M56-2
M58-3
M91-1
M95-1

APPENDIX D

Marysville Creek Continuous Conductivity Monitoring Interim Data


Location S2
Conductivity
Temperature
Conductivity (uS)
Temperature (C)
600
500
400
300
200
100
0
45
40
35
30
25
20
15
10
5
0
-5
-10
30/04/2016
14/05/2016
28/05/2016
11/06/2016
25/06/2016
09/07/2016
23/07/2016
06/08/2016
20/08/2016
03/09/2016
17/09/2016
01/10/2016
15/10/2016
29/10/2016
12/11/2016
26/11/2016
10/12/2016
24/12/2016


Location S3
2000
1800
1600
1400
1200
1000
800
600
400
200
0
Conductivity (uS)
30
25
20
15
10
5
0
Temperature (C)
Conductivity
Temperature
30/04/2016
14/05/2016
28/05/2016
11/06/2016
25/06/2016
09/07/2016
23/07/2016
06/08/2016
20/08/2016
03/09/2016
17/09/2016
01/10/2016
15/10/2016
29/10/2016
12/11/2016
26/11/2016
10/12/2016
24/12/2016

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