WOLVERINE MINE

MONITORING AND SURVEILLANCE PLAN

2013 ANNUAL REPORT

Prepared for:

Yukon Energy, Mines and Resources

Prepared by:

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Vancouver, British Columbia

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1 Introduction

This report summarizes the results of monitoring and surveillance conducted as per Monitoring and Surveillance Plan V2011-03 for 2013. This report is submitted as part of the requirements of Quartz Mining Licence (QML) 0006. As per Section 10.5, *on or before March 31st of each year... the Licensee must submit a written report covering the period of January 1st to December 31st of the prior year which includes... a summary of the programs undertaken for environmental monitoring and surveillance as outlined in the Monitoring and Surveillance Plan.*

Monitoring results reported herein include:

- Surface water including water quality sampling and hydrology;
- Groundwater including water quality sampling, water levels and water table (piezometers);
- Weather including temperature, precipitation, snowpack, and evaporation;
- Tailings storage facility monitoring;
- Engineering inspections for physical stability;
- Reclamation program effectiveness and Bio-pass system design monitoring;
- Geochemical testwork; and
- Underground mine monitoring.

2 Surface Water Monitoring

The surface water monitoring program for the Wolverine Mine includes the monitoring of hydrology and water quality at 20 locations at the Wolverine Mine site (including tailings storage facility), and in the Wolverine Lake, Go Creek and Money Creek watersheds. Water quality results are compared to the historic (1995-2008) baseline average and 95th percentile values provided in the Lorax Environmental *Baseline Characterization Summary Report* provided in Appendix A of *Monitoring and Surveillance Plan V2011-03* (*Baseline Report*).

2.1 Surface Water Quality Monitoring

Surface water quality for the purposes of baseline monitoring (as per *A Licence QZ04-065* (Yukon Water Board, 2007)) was taken at the locations and dates summarized in Table 2-1. A total of 190 sample sets were analyzed for physical parameters, TSS, dissolved and total metals (by ICP-MS) and mercury (by CVAS), as well as cyanide and dissolved organic carbon for select sampling sites (W16, W31, W85 & T1 – W1, W9, L1, W82, and W12 are DOC only), and total organic carbon (T1).

Table 2-1: Surface Water Monitoring Sites and Dates Sampled - 2013

Sampling Site	January	February	March	April	May	June	July	August	September	October	November	December
L1	A	23-Feb	A	A	A	11-Jun	1-Jul	11-Aug	8-Sep	5-Oct	A	A
W1	A	A	A	A	A	17-Jun	1-Jul	11-Aug	8-Sep	5-Oct	A	A
W8	A	A	A	A	A	9-Jun	1-Jul	11-Aug	8-Sep	5-Oct	A	A
W9	A	A	A	A	A	9-Jun	1-Jul	11-Aug	8-Sep	5-Oct	A	A
W12	A	A	A	A	A	15-Jun	5-Jul	2-Aug	6-Sep	7-Oct	13-Nov	8-Dec
W14	A	A	A	A	A	15-Jun	5-Jul	2-Aug	6-Sep	7-Oct	13-Nov	8-Dec
W15	21-Jan	13-Feb	12-Mar	14-Apr	28-May	25-Jun	8-Jul	22-Aug	30-Sep	6-Oct	15-Nov	15-Dec
W16	23-Jan	13-Feb	11-Mar	16-Apr	26-May	25-Jun	8-Jul	22-Aug	28-Sep	6-Oct	23-Nov	16-Dec
W21	4-Jan	27-Feb	9-Mar	1-Apr	11-May	7-Jun	17-Jul	5-Aug	10-Sep	10-Oct	16-Nov	10-Dec
W22	4-Jan	27-Feb	9-Mar	1-Apr	11-May	7-Jun	17-Jul	5-Aug	10-Sep	10-Oct	16-Nov	10-Dec
W31	D	D	D	D	24-May	29-Jun	22-Jul	18-Aug	21-Sep	20-Oct	D	D
W40	4-Jan	27-Feb	9-Mar	1-Apr	11-May	7-Jun	17-Jul	5-Aug	10-Sep	10-Oct	16-Nov	10-Dec
W71	7-Jan	D	D	2-Apr	11-May	7-Jun	21-Jul	5-Aug	20-Sep	11-Oct	10-Nov	10-Dec
W72	7-Jan	18-Feb	9-Mar	12-Apr	11-May	7-Jun	21-Jul	5-Aug	20-Sep	11-Oct	10-Nov	10-Dec
W73	7-Jan	18-Feb	9-Mar	3-Apr	11-May	12-Jun	21-Jul	5-Aug	20-Sep	11-Oct	10-Nov	10-Dec
W80	A	24-Feb	A	A	A	15-Jun	5-Jul	2-Aug	6-Sep	7-Oct	13-Nov	8-Dec
W81	30-Jan	10-Feb	12-Mar	14-Apr	28-May	25-Jun	8-Jul	22-Aug	13-Sep	6-Oct	15-Nov	15-Dec
W82	D	11-Feb	10-Mar	10-Apr	28-May	25-Jun	22-Jul	18-Aug	27-Sep	14-Oct	20-Nov	16-Dec
W85	25-Jan	11-Feb	10-Mar	3-Apr	27-May	30-Jun	8-Jul	22-Aug	28-Sep	13-Oct	16-Nov	16-Dec
T1	5-Jan	10-Feb	11-Mar	3-Apr	15-May	17-Jun	9-Jul	24-Aug	21-Sep	14-Oct	16-Nov	11-Dec

A = Site not sampled due to lack of safe access

D = Site dry (i.e., all water tied up in storage) or frozen through to ground

E = Transportation equipment under repair/Sampling equipment under repair

🟦 QAQC Sample Taken

Laboratory results for the samples taken in 2013 are compared to baseline average and 95th percentiles provided in *Appendix A* of the *Baseline Report*. Appendix A herein provides graphical representations of the water quality results for all baseline monitoring sites for the following parameters:

- Conductivity
- Hardness
- Total Alkalinity
- pH
- Total Suspended Solids (TSS)
- Turbidity
- Fluoride
- Sulphate
- Ammonia
- Nitrate
- Nitrite
- Total Aluminum
- Total Arsenic
- Total Cadmium
- Total Chromium
- Total Copper
- Total Iron
- Total Lead
- Total Mercury
- Total Molybdenum
- Total Nickel
- Total Selenium
- Total Silver
- Total Zinc

Red symbols in the graphs and in the figures below indicate the result was below the analytical detection limit, and is shown as being equal to the detection limit.

The majority of physical parameters and major anions (conductivity, hardness, pH, DOC, and sulphate) for all sites were within the average provided in the *Baseline Report*, and were generally below the 95th percentile value. TSS concentrations were slightly higher at many of the sites sampled in May, although still below the 95th percentile values, likely due to increased sedimentation associated with freshet flow. High ammonia concentrations in 2010 and early 2011 were due to errors with analytical equipment, and do not necessarily reflects actual values.

Nitrate and nitrite concentrations were much higher than normal in samples taken since September 2011, due to interferences with the analytical equipment, caused by exceedances of the standard hold times. The interferences also resulted in laboratory detection limits that were an order of magnitude greater than the limits used previously (i.e., 0.2 mg/L vs. 0.002 mg/L).

The results for total metals were also within the average baseline range. The majority of results were less than the average values, and almost all were less than the 95th percentile values. ~85% of results for silver and ~96% of the mercury results were below the reportable detection limit hence these parameters were not graphed, nor are provided in Appendix A.

Noticeable exceptions for the period include:

- Station W82 water quality sample had metal concentrations and TSS values above the 95th percentile. The water level at this sampling site is very low in winter, and is at its lowest in January. Consequently, the amount of sediment captured in a water quality sample during this time is higher than when the water level is higher.
- At stations T1, W85, and W15 nitrate and nitrite showed seasonal variability, increasing during spring and summer months and decreasing during winter months. Stations W22, W31, W71, W72, W73, W80 and W81 demonstrated increasing variability specifically during 2012, and then a reduction in concentration in 2013.
- Station T1 showed elevated levels of nitrate and nitrite, in addition to fluoride, sulphate and metals concentrations during 2012. However, concentrations appeared significantly reduced or steady in 2013.

- Stations T1, W15, W16, W82, and W80 show increasing sulphate concentrations during 2012 and 2013. However, W16 showed decreasing sulphate concentrations in late 2013.
- Station W82 experienced increasing concentrations of copper throughout 2012.
- Increased selenium concentrations after July 2012 were evident at stations T1, W15, W16, and W81. However, all 4 of these stations show decreased concentrations in 2013 similar to levels recorded prior to 2012.

2.1.1 Wolverine Lake

Surface water quality results for Wolverine Lake (stations W1 and L1) were mostly below the average baseline concentrations for the parameters outlined above (see graphs in Appendix A). Concentrations remained in a similar range throughout the year, as demonstrated by the lead concentrations shown in Figure 2-1. Samples were not consistently taken at station W1 and L1 through between November 2012 and May 2013, due to a lack of safe access as a result of changing weather conditions and transportation equipment failure. 2013 metal and nutrient concentrations were comparable to 2009-2012 concentrations.

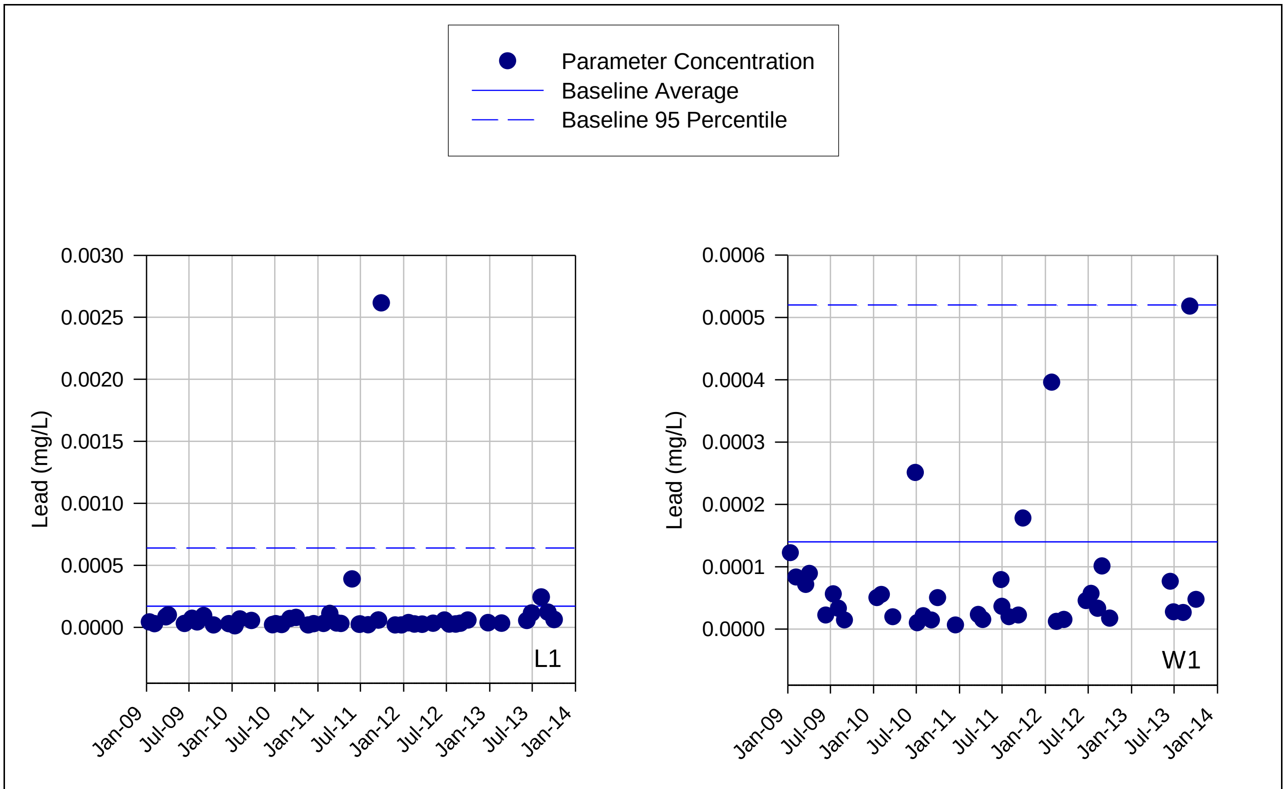


Figure 2-1: Lead in Wolverine Lake Stations, January 2009 – December 2013

2.1.2 Wolverine Creek

Surface water quality results for W8 at the outflow of Campbell Creek into Little Wolverine Lake, and stations W9 and W82 in Wolverine Creek, were also generally within the range of the average and 95th percentile values. Samples were not taken at station W8 and W9 between January and May 2013, due to a lack of safe access as a result of changing weather conditions and transportation equipment failure. In addition, station W9 is typically not sampled during these months, due to the water at that site being frozen through. 2013 metal and nutrient concentrations were comparable to 2009-2012 concentrations.

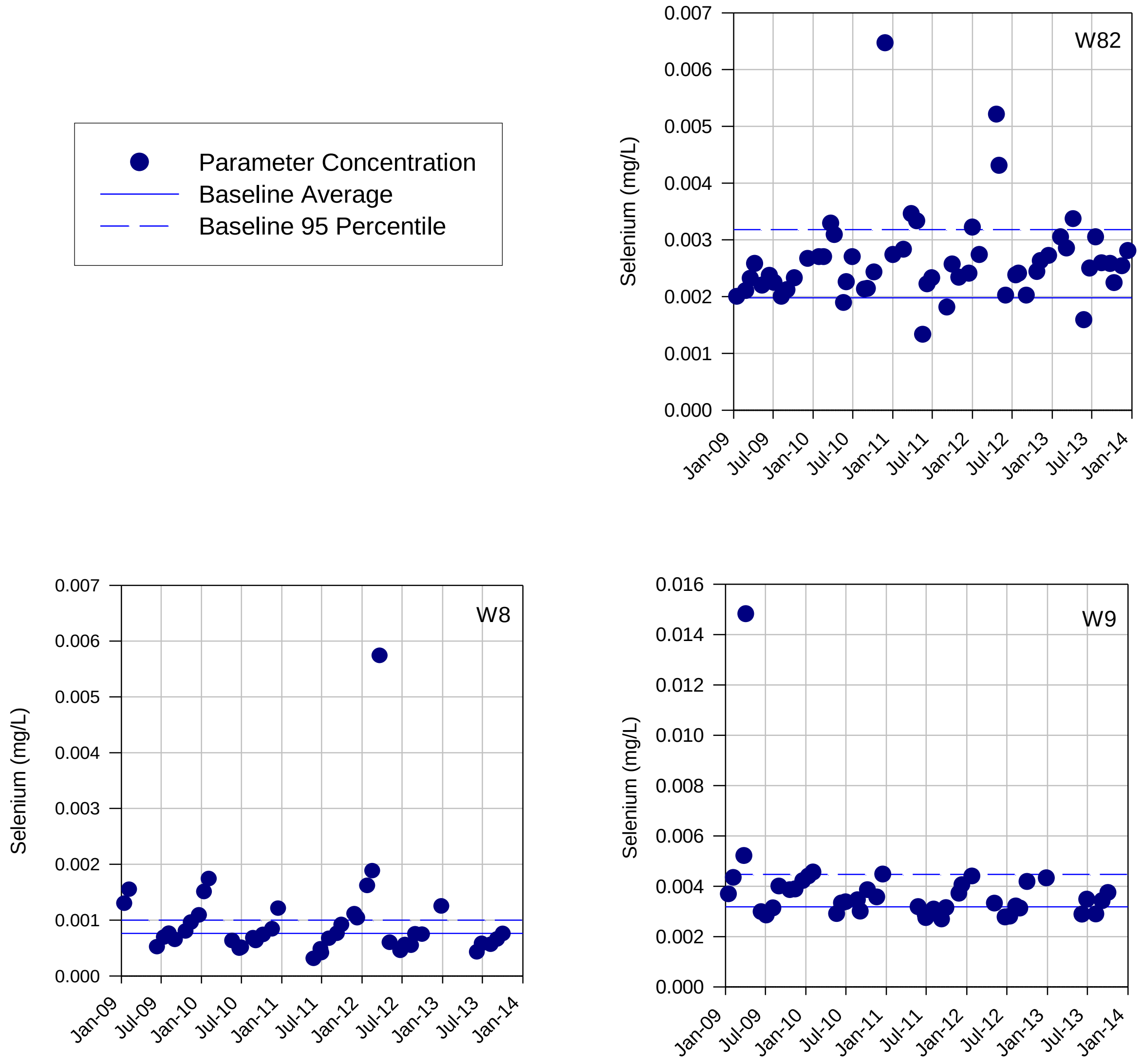


Figure 2-2: Selenium in Wolverine Creek Area Stations, January 2009 – December 2013

2.1.3 Upper Go Creek Watershed

Surface water quality results for the Upper Go Creek watershed (stations W31, W15, W16 and W81) were also generally near or below the range of the average baseline concentrations and 95th percentile values, comparable to 2009-2012 concentrations. Station W31 was not sampled between January and April, November, and December 2013, as the water at that site had frozen through. Metal concentrations were higher in May and June than the rest of the year, as shown in the copper concentrations presented in Figure 2-3, similar to previous years.

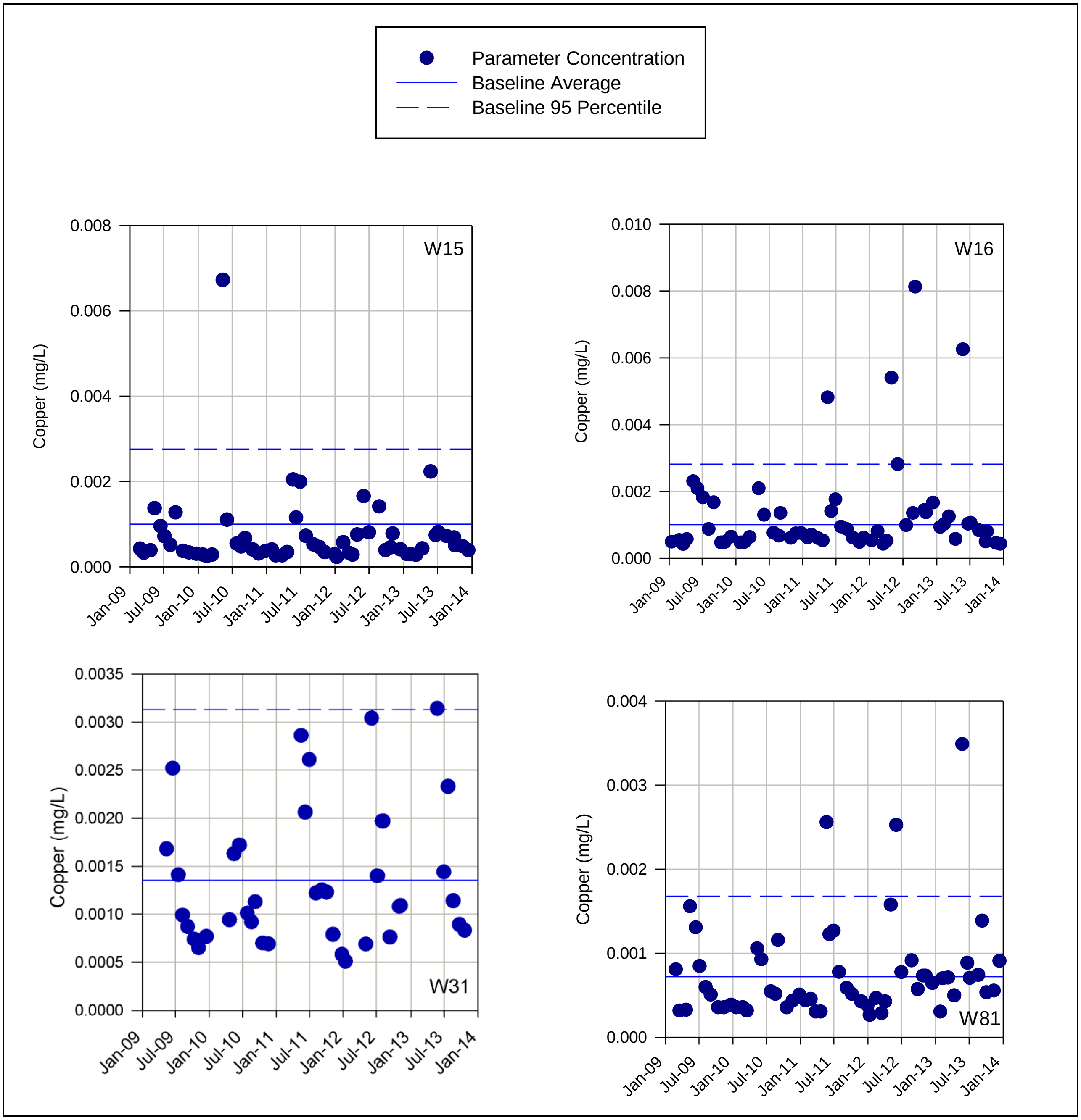


Figure 2-3: Copper in Upper Go Creek Stations, January 2009 – December 2013

2.1.4 Tailings Facility

Tailings facility monitoring (station T1) commenced in July 2010 to examine the chemistry of the tailings supernatant. Also, as mentioned above, a monitoring point (W85) was added in 2011 to represent the future location of effluent discharge from the tailings water treatment plant. The results of sampling at stations T1 and W85 are presented in Figure 2-4 for nickel. As these stations were not included in the *Baseline Report*, there are no average values or 95th percentile values against which to compare the data. Monitoring prior to discharge will represent baseline water quality against which water chemistry during discharge can be compared.

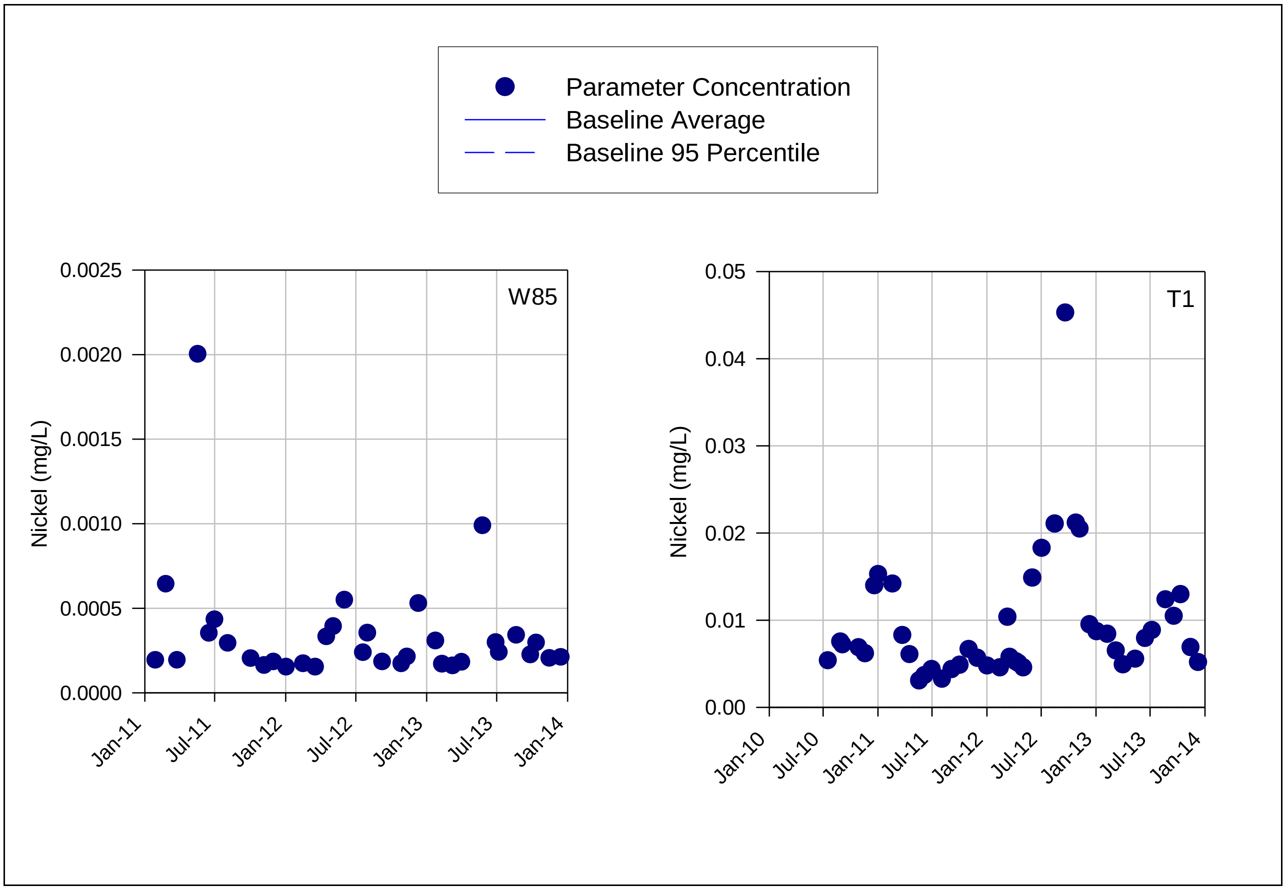


Figure 2-4: Nickel at stations W85 and T1, January 2011 - December 2013 and July 2010 - December 2013, respectively

2.1.5 Lower Go Creek Watershed

Surface water quality results for the Lower Go Creek watershed (stations W80 and W12) indicated metal and nutrient concentrations similar to those in 2009-2012, and concentrations in 2013 were all below the average baseline concentration, as shown for zinc concentrations presented in Figure 2-5. Both stations were not consistently sampled between January and May 2013 due to transportation equipment failure and a lack of safe access.

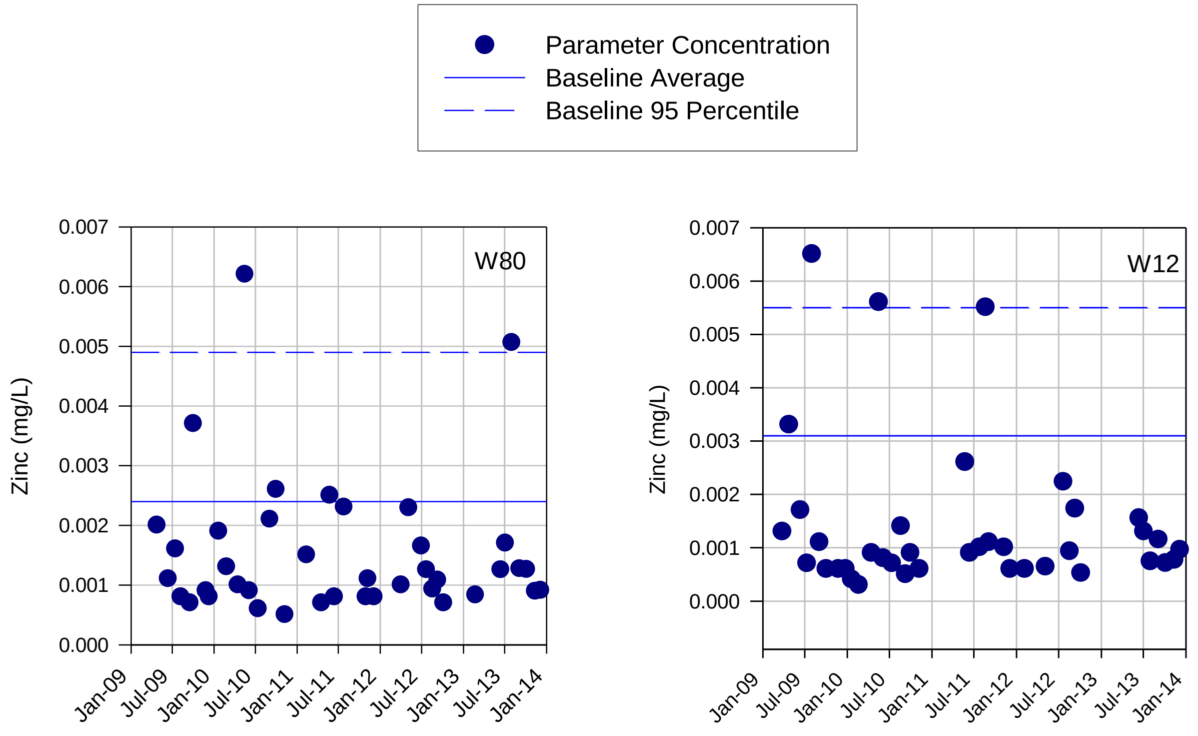


Figure 2-5: Zinc in Lower Go Creek Stations, January 2009 – December 2013

2.1.6 Money Creek Watershed

Surface water quality results for the Money Creek watershed (stations W14, W22 and W40) were also generally similar during 2013, and concentrations were generally below the average baseline concentrations for metal and nutrient parameters. There were spikes in the metal concentrations at station W40 in May and June, associated with high TSS concentrations and increased turbidity, as shown in Figure 2-6 for cadmium.

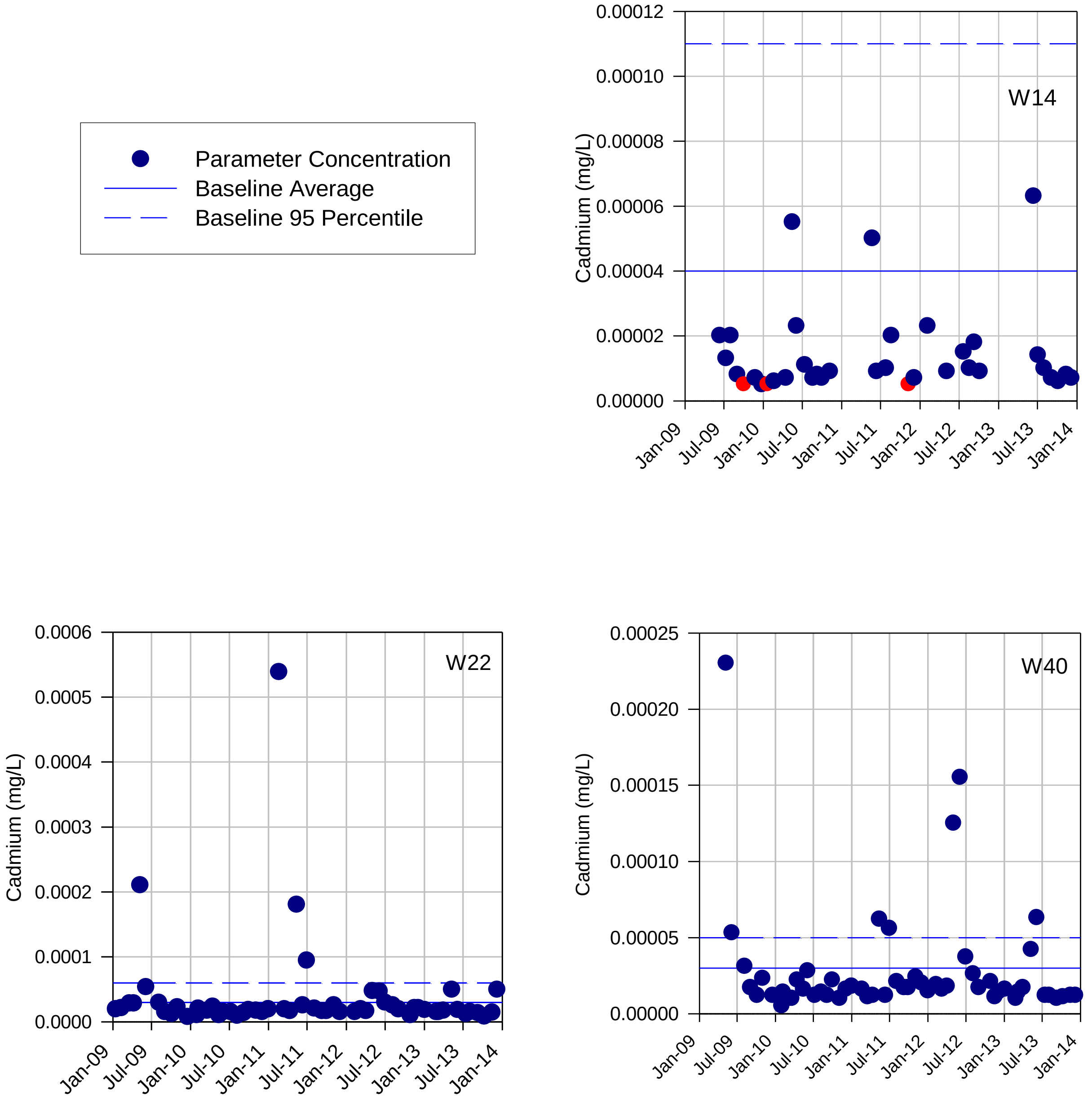


Figure 2-6: Cadmium in Money Creek Stations, Jan 2009 – December 2013

2.1.7 Mine Access Route

Surface water quality results for the Mine Access Route (stations W71, W72 and W73) were also generally the same throughout 2013 for all sites, with slight increases in metal concentrations in the summer months (as seen Figure 2-7 for aluminum). Generally concentrations were below the average baseline concentrations for metal and nutrient parameters. There was an increase in the metal concentrations in May and/or June, associated with higher than normal TSS concentrations.

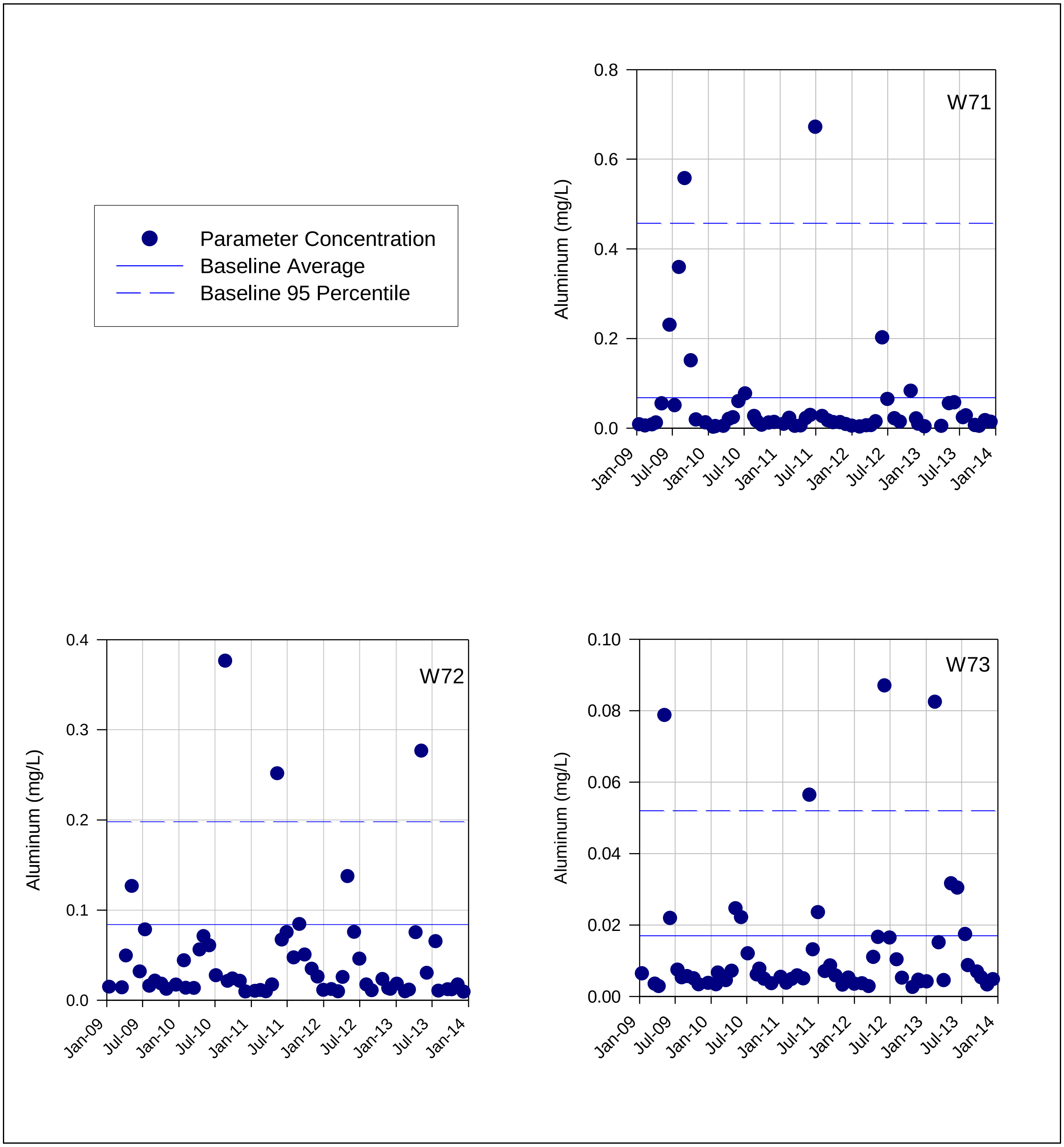


Figure 2-7: Aluminum for Stations Adjacent to the Mine Access Road, Jan 2009 – December 2013

2.2 Hydrology Results

Manual flow monitoring is required at stations W8, W15, W16, W31, W81 and W85, and continuous flow monitoring is required at stations W9, W12, W21, W22, W80 and W82, as outlined in *Type A Water Use Licence QZ04-065*. Manual flow monitoring is taken at all hydrology stations for the purposes of establishing a stage-storage curve from which the stage-discharge curve is calibrated. A power trend line is fit to the stage-storage curve to provide a calibration equation with which to convert downloaded water level (m) data to water flow (m^3). The results of the manual flow monitoring conducted from January to December 2013 are provided in

Table 2-2.

The stage-storage curves and monthly average stage-discharge curves are presented below for continuous flow water monitoring stations W9, W12, W21, W22, W80, and W82.

Table 2-2: Manual flow monitoring results, January - December 2013

Sampling Site	W8	W9	W12	W15	W16	W21	W22	W31	W80	W81	W82	W85
January	*Note 3*	*Note 3*	*Note 3*	0.002	0.004	*Note 1*	*Note 1*	*Note 1*	*Note 3*	*Note 1*	*Note 1*	0.001
February	*Note 2*	*Note 2*	*Note 2*	0.009	0.015	*Note 1*	*Note 1*	*Note 1*	*Note 2*	0.008	*Note 1*	0.009
March	*Note 2*	*Note 2*	*Note 2*	0.010	0.017	*Note 1*	*Note 1*	*Note 1*	*Note 2*	0.009	*Note 1*	0.012
April	*Note 2*	*Note 2*	*Note 2*	*Note 3*	*Note 2*	*Note 1*	*Note 1*	*Note 1*	*Note 2*	0.014	*Note 1*	0.006
May	*Note 2*	*Note 2*	*Note 2*	1.167	0.696	*Note 1*	*Note 2*	0.100	*Note 2*	2.224	0.009	0.370
June	0.400	0.020	1.887	0.281	0.168	*Note 2*	*Note 2*	0.045	1.191	0.605	0.016	0.104
July	0.128	0.016	0.462	0.183	0.152	2.272	3.893	0.102	*Note 2*	0.278	0.019	0.145
August	0.046	0.016	0.342	0.065	*Note 3*	3.473	4.958	0.005	0.390	1.721	0.001	*Note 3*
September	0.086	0.010	0.321	0.224	0.175	*Note 2*	4.913	0.032	0.288	0.218	0.015	0.066
October	0.061	0.009	0.244	0.169	0.108	*Note 2*	4.835	0.025	0.252	0.309	0.014	0.090
November	*Note 2*	*Note 2*	*Note 2*	*Note 2*	*Note 2*	*Note 1*	*Note 1*	*Note 1*	*Note 2*	*Note 2*	*Note 1*	*Note 2*
December	*Note 2*	*Note 2*	*Note 2*	*Note 2*	0.036	*Note 1*	*Note 1*	*Note 1*	*Note 2*	*Note 2*	*Note 1*	0.037

Note 1: Not enough flow to take accurate measurements or ice through to bottom of channel

Note 2: No safe access to sampling site

Note 3: Equipment malfunction

2.2.1 W9 Continuous Flow Monitoring Results

The stage-discharge curve for W9 is presented in Figure 2-8, and the monthly average hydrograph in Figure 2-9. The stage-discharge curve has been updated following the installation of a Parshall flume at station W9 in July 2010, which resulted in a far more consistent stream channel, and more accurate manual and digital hydrology measurements. Readings from the data logger were obscured by ice pressure effects during the winter months of 2007, 2008 and 2009. The November 2009 through March 2010 average stream discharges were 0.034 m^3/s; however, as this was due to ice pressure effects, the value prior to the logger freezing in October was taken to be representative of winter flows. This is shown in Figure 2-9 as an average value of 0.01 m^3/s. The data logger installed at W9 was found to be damaged in March 2010 and was repaired in July, represented by a gap in the data during that time. Data collected showing ice pressure effects in winter 2011 and spring 2012 (i.e., data points < 0) were calibrated to be zero during monthly average stream discharge calculations. However, despite recalibration in July, monthly values appeared to be inconsistent with previous years, and hence, have been omitted from the record. Calibration and re-installation of the logger occurred on June 9th, 2013 and post-installation monitoring shows little variation in stream discharge over time. As a result, this logger has been removed and sent away for assessment and repair.

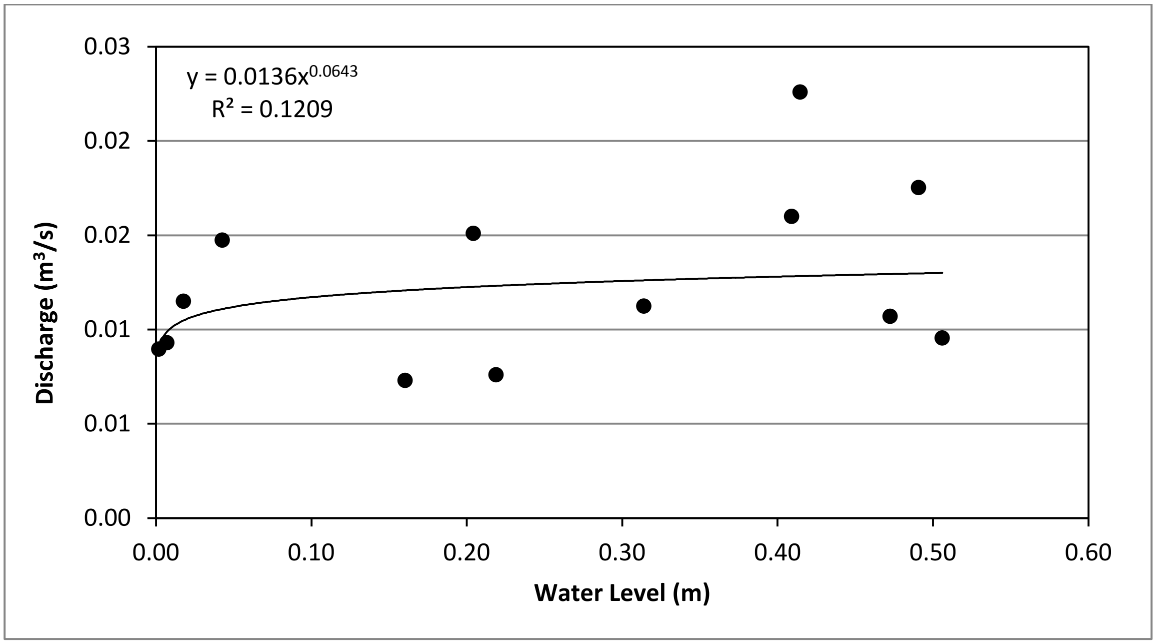


Figure 2-8: W9 Stage-Discharge Curve

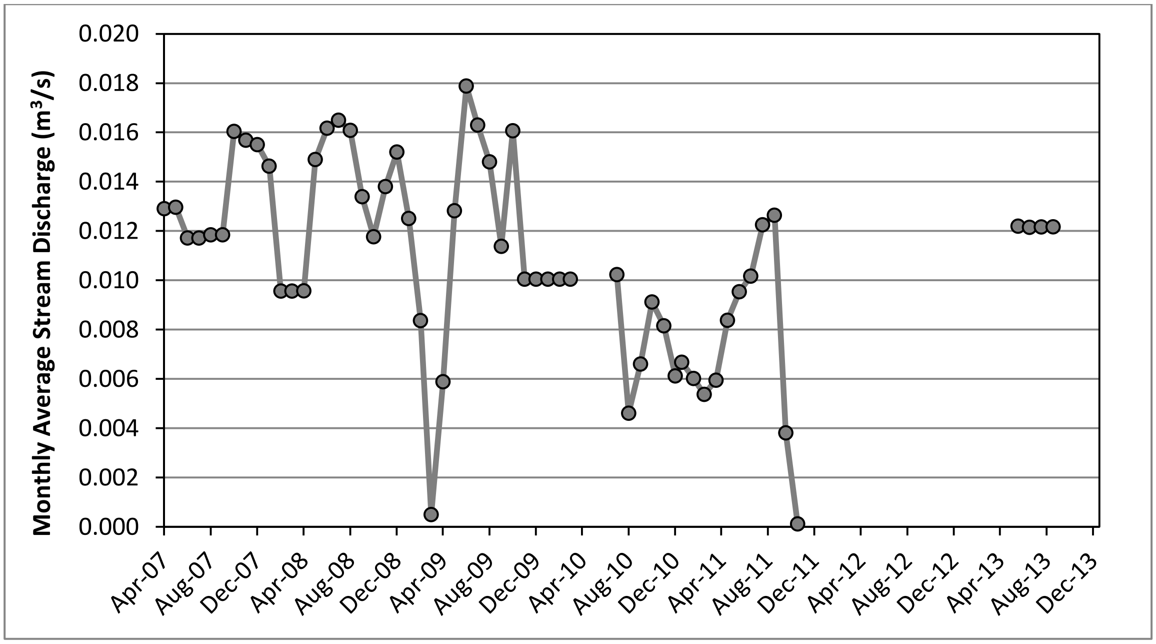


Figure 2-9: W9 Monthly Average Hydrograph, April 2007 – December 2013

2.2.2 W12 Continuous Flow Monitoring Results

The stage-discharge curve for station W12 is provided in Figure 2-10 and the average monthly hydrograph for W12 from May 2009 through December 2013 is presented in Figure 2-11. Data collected prior to May 2009 was omitted due to inconsistencies; and late winter/spring 2010 and 2011 averages were adjusted to zero due to evident ice pressure effects. The logger was recalibrated in August 2012; however, it still presented inaccurate measurements. Therefore, the logger was removed and sent in for repair/replacement. It was re-installed on June 13th, 2013 and monthly values appear to be more consistent with seasonal trends in previous years.

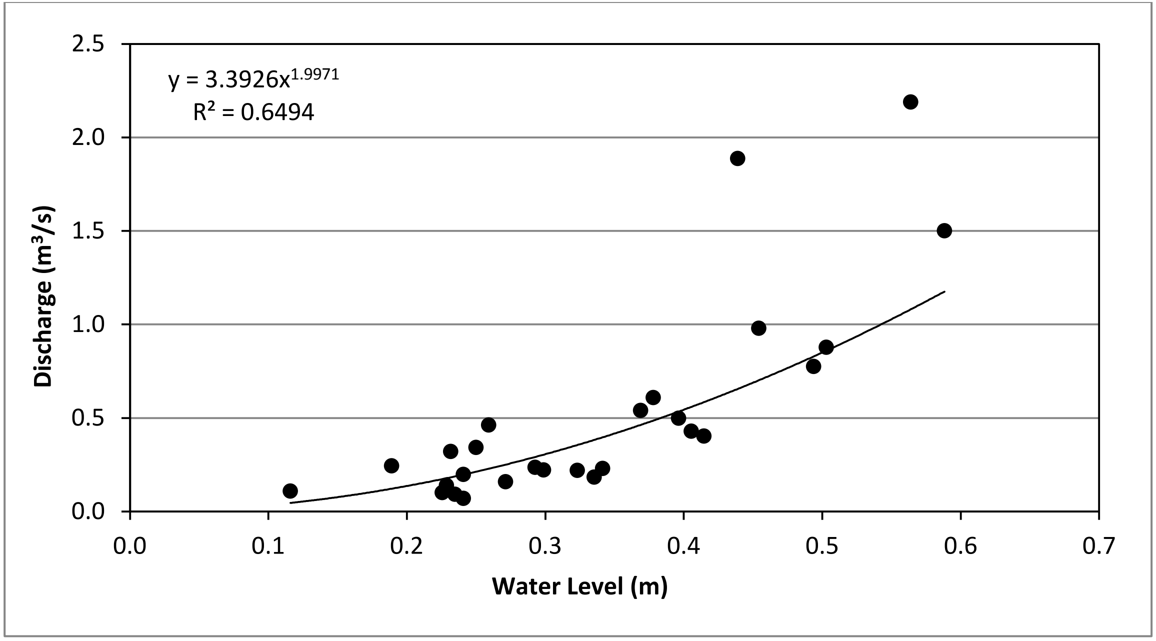


Figure 2-10: W12 Stage-Discharge Curve

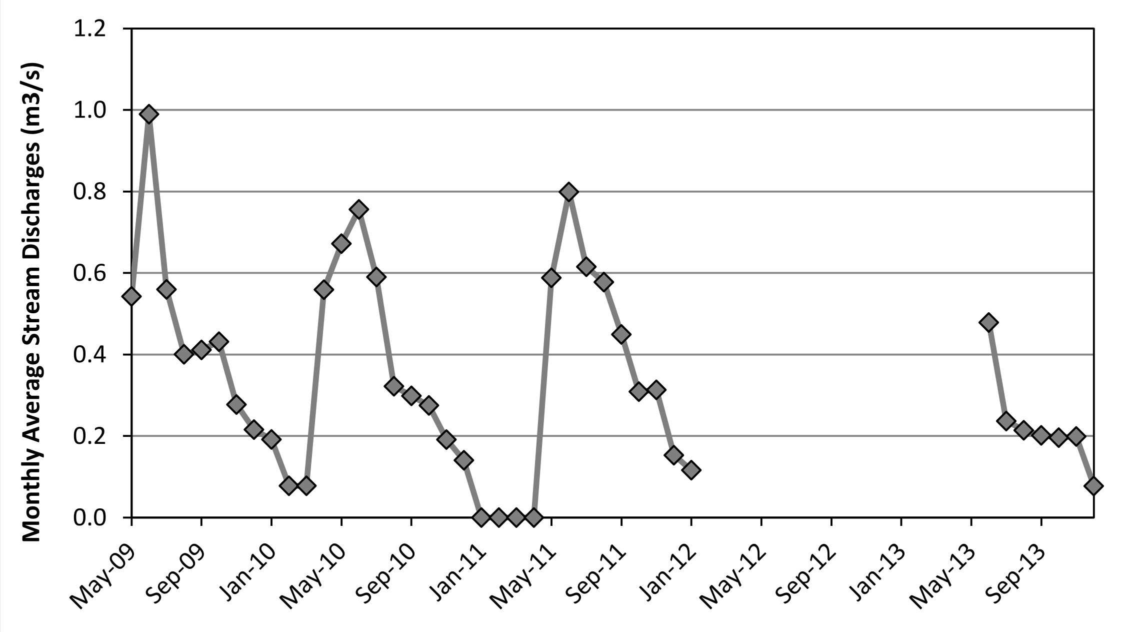


Figure 2-11: W12 Monthly Average Hydrograph, May 2009 – December 2013

2.2.3 W21 Continuous Flow Monitoring Results

The stage-discharge curve for W21 is provided in Figure 2-12 and the monthly average hydrograph for W21 from March 2007 through to December 2013 is presented in Figure 2-13. Ice pressure effects were observed in winter and early spring in 2007 through 20123 The higher flows in winter 2010/2011 are most likely due to ice pressure effects than to an actual increase in flow rate. The in-stream data logger was removed on August 28th and sent in for repair and will be re-installed in the Spring of 2014.

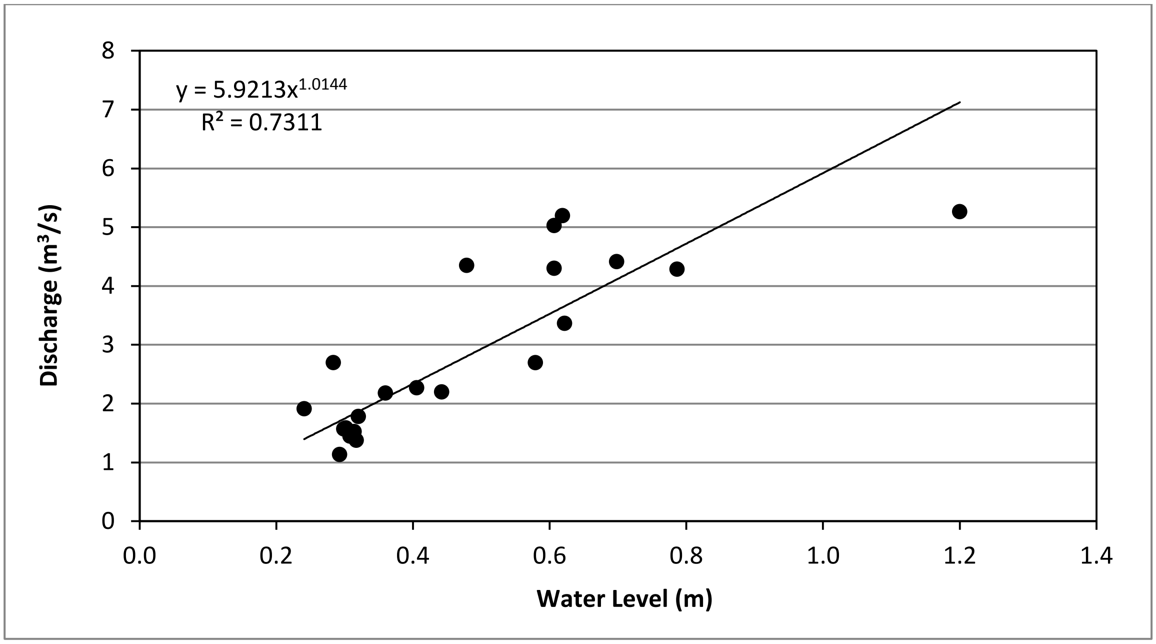


Figure 2-12: W21 Stage-Discharge Curve

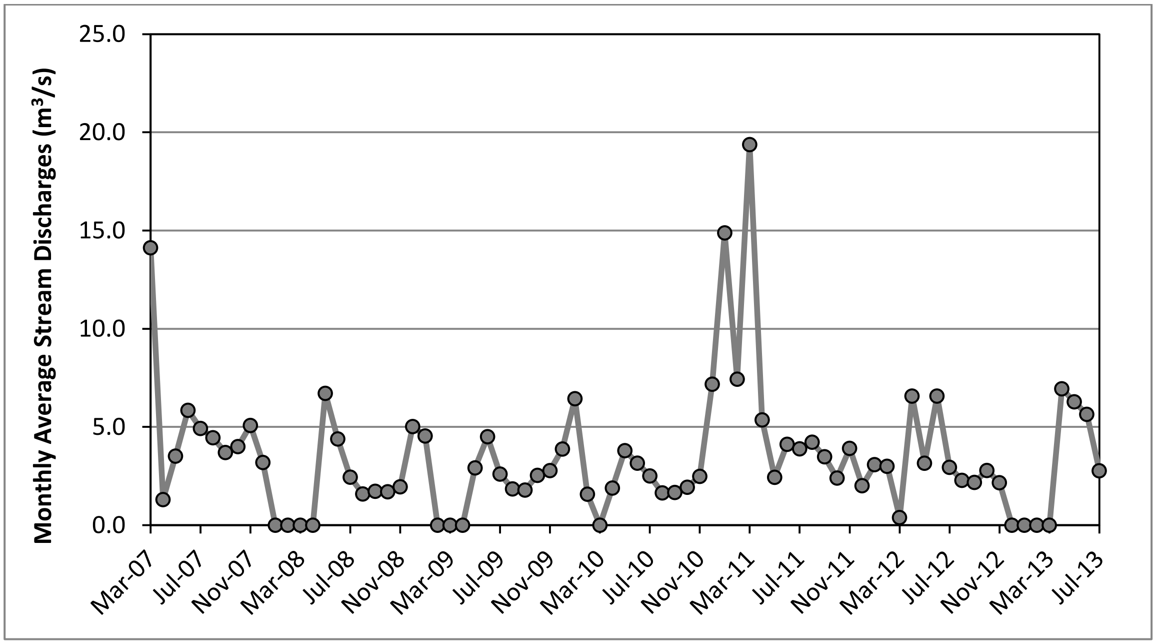


Figure 2-13: W21 Hydrograph, March 2007 – July 2013

2.2.4 W22 Continuous Flow Monitoring Results

The stage-discharge curve for station W22 is provided in Figure 2-14 and the continuous hydrograph for W22 from May 2008 through to December 2013 is presented in Figure 2-15. Ice pressure effects (normalized to zero values in Figure 2-15) are typically evident during the winter months. Note that although flows appear to be increasing during the winter months of 2010, 2011, and 2012 these increases are most likely due to ice pressure effects, as flows are typically low during the this time period. High flows are repeatedly observed in the spring. In August 2013, it was noticed that the logger had been dislodged by high flows. The staff gauge was used to re-position the logger and re-adjust values indicated by the logger.

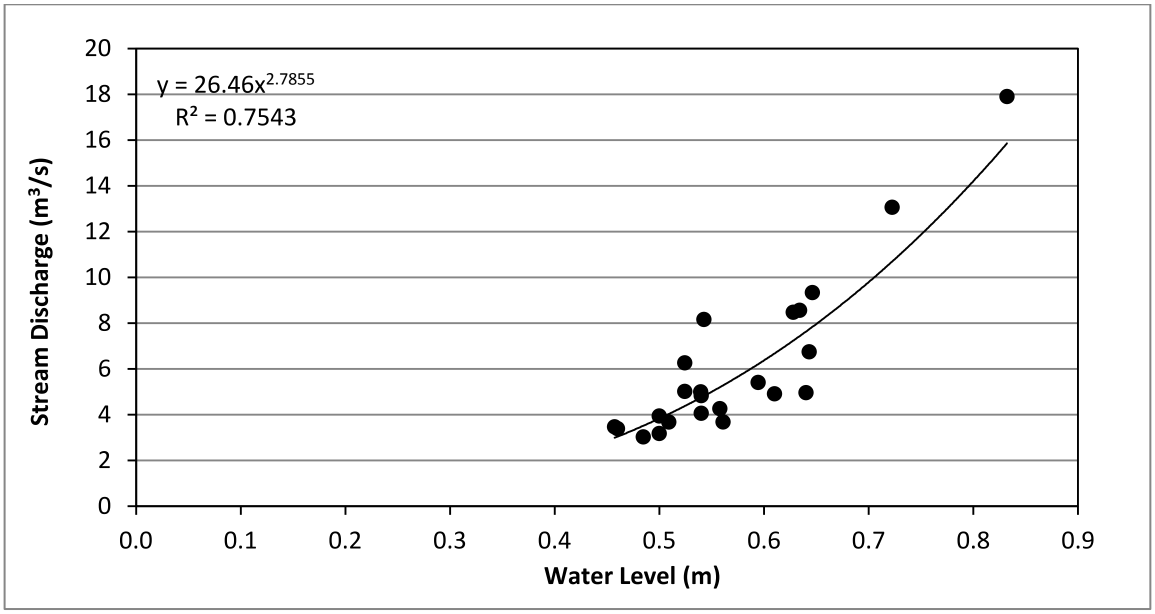


Figure 2-14: W22 Stage-Discharge Curve

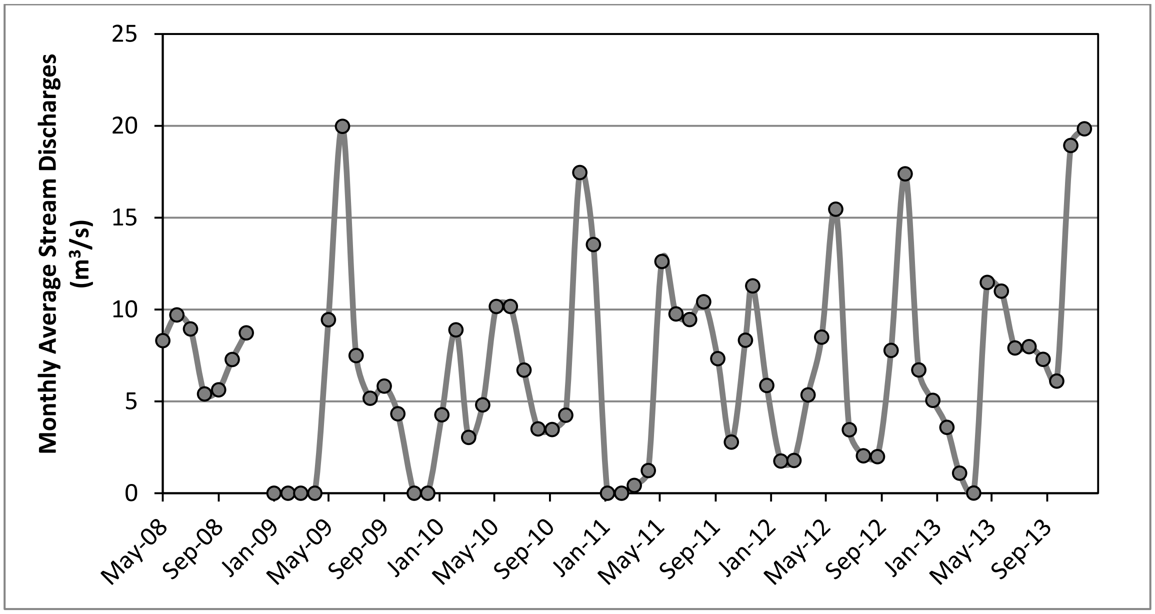


Figure 2-15: W22 Monthly Average Hydrograph, May 2008 – December 2013

2.2.5 W80 Continuous Flow Monitoring Results

Station W80 was sampled frequently in 2009 and consequently, the resulting stage-discharge is quite robust (Figure 2-16). The monthly average hydrograph for W80 from September 2006 through to December 2013 is presented in Figure 2-17. Due to ice pressure effects, when the data logger recorded negative values the values were adjusted to zero for the purposes of calculating monthly average discharges, as represented in Figure 2-17. Generally, low flows are evident at station W80 November through April, and high flows in June and October.

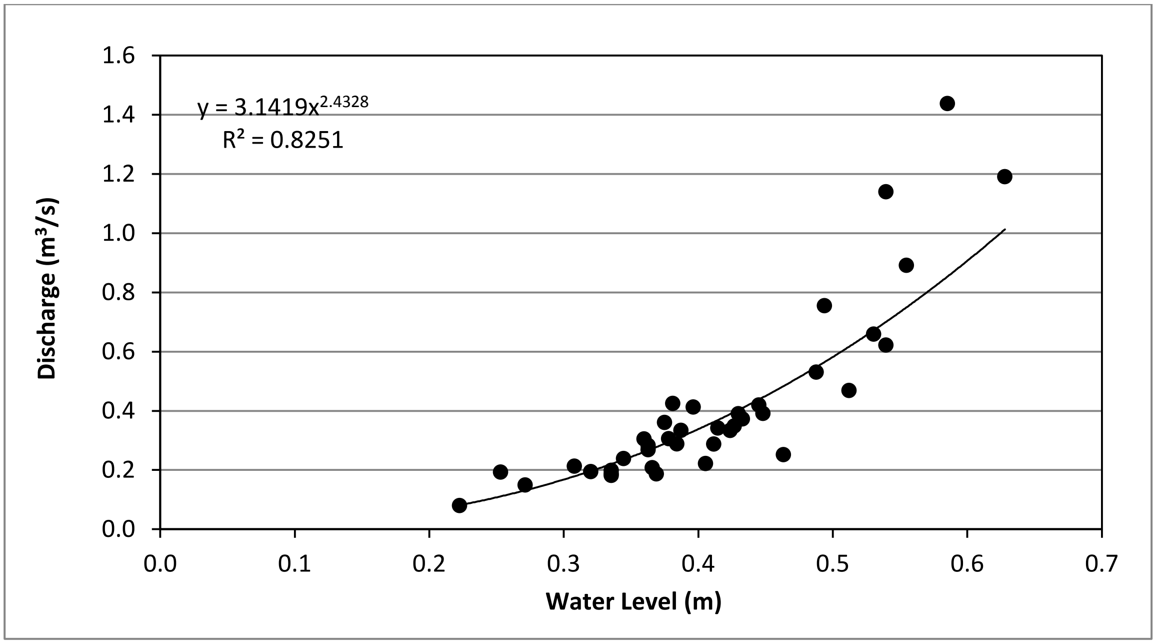


Figure 2-16: W80 Stage-Discharge Curve

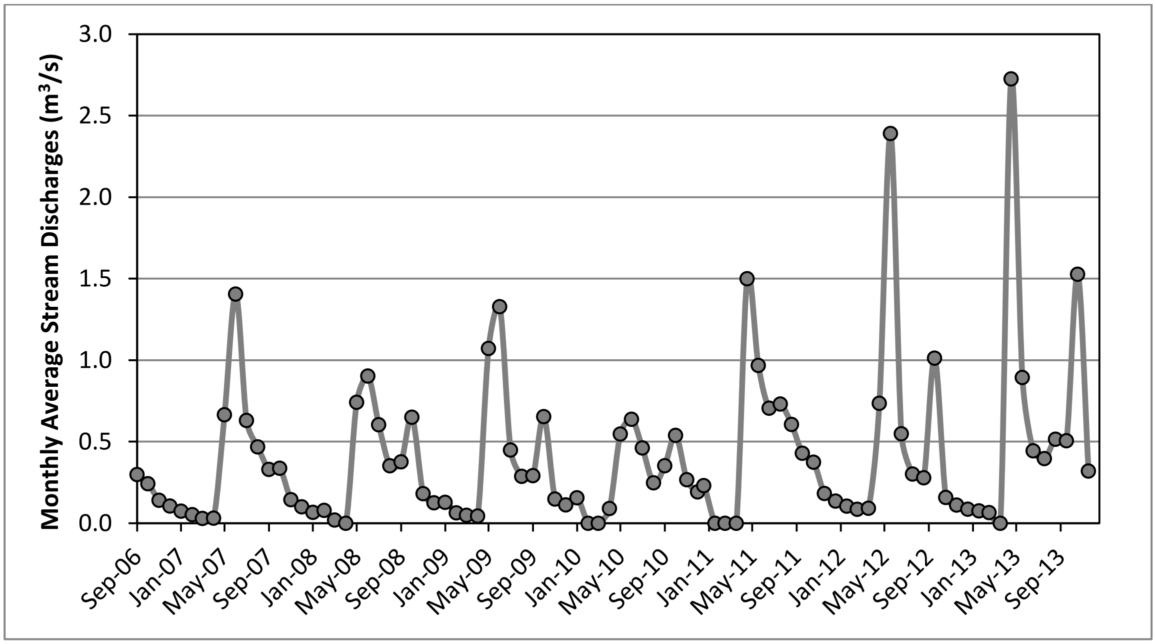


Figure 2-17: W80 Monthly Average Hydrograph, September 2006 – December 2013

2.2.6 W82 Continuous Flow Monitoring Results

The stage-storage curve for Station W82 is comprised of two curves: one prior to May 2009 (Figure 2-18), and one following May 2009 (Figure 2-19), as the logger was broken in April 2009, and replaced with a new logger in May. The average monthly discharges for W82 from November 2007 through December 2013 are presented in Figure 2-20. High flows were observed in spring 2008 – 2013 as expected. Ice pressure effects (negative values have been corrected to zero values in Figure 2-20) were evident in late winter months in 2009 – 2013.

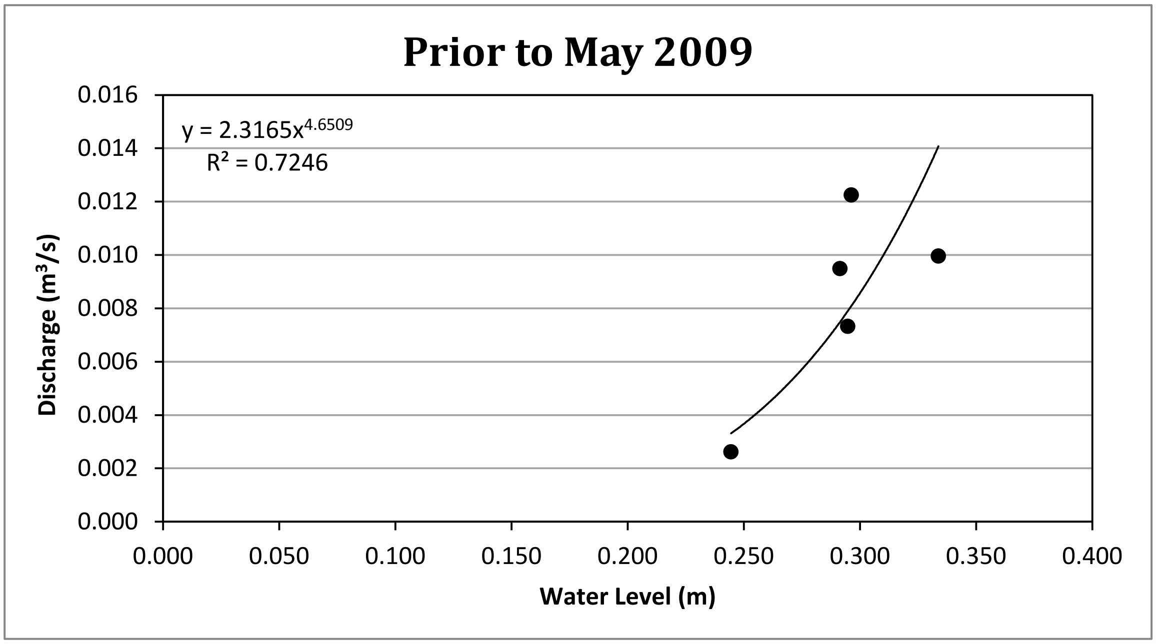


Figure 2-18: W82 Stage-Discharge Curve Prior to May 2009

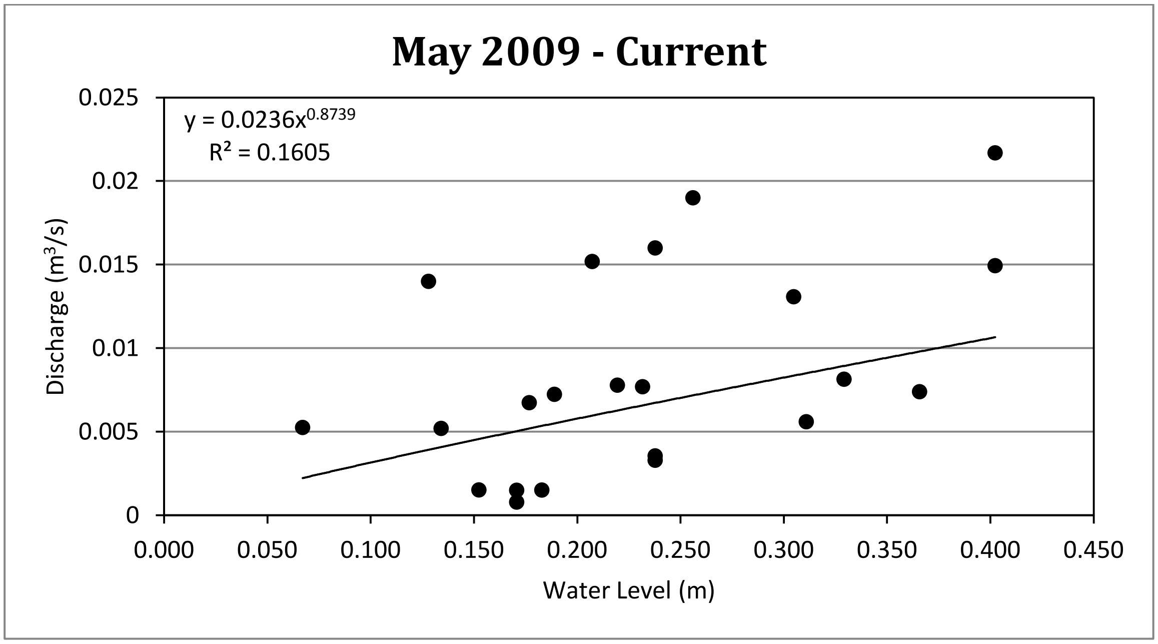


Figure 2-19: W82 Stage-Discharge Curve Following May 2009 - Current

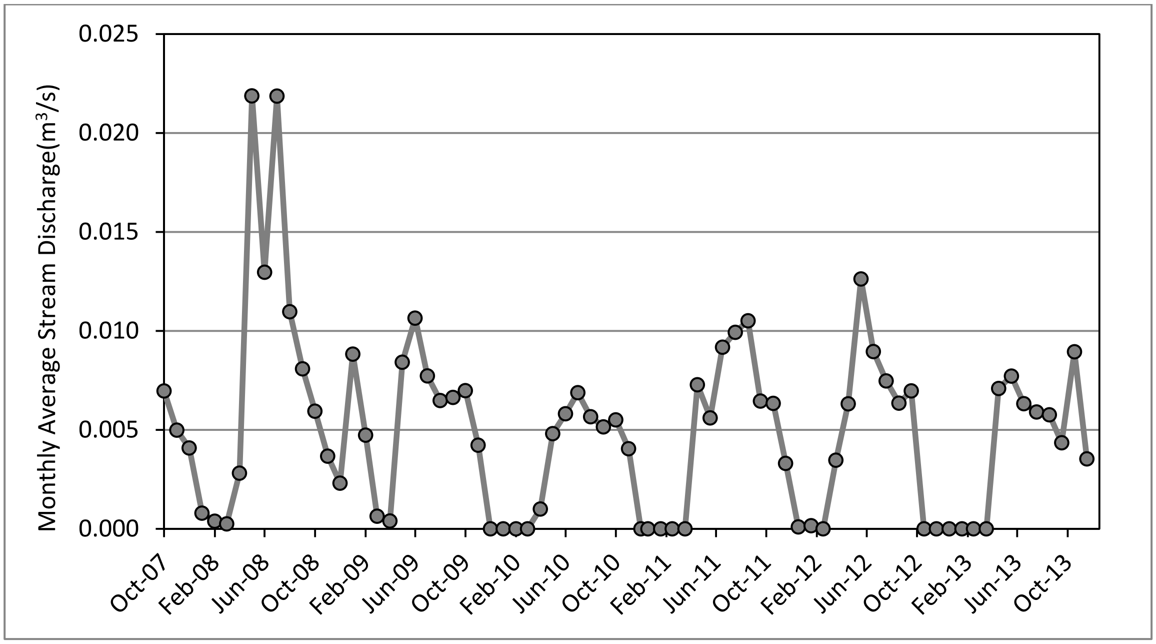


Figure 2-20: W82 Monthly Average Hydrograph, November 2007 – December 2013

3 Ground Water Monitoring Results

The groundwater monitoring program for the Wolverine Project includes the monitoring of water levels and water quality at 24 locations in the Wolverine Creek and Go Creek watersheds. Below are summarized the sampling dates, water quality results and water level and temperatures recorded by in-situ loggers.

3.1 Groundwater Sampling Program

The groundwater monitoring program for the Wolverine Mine includes the monitoring of water levels, temperature and water quality at 24 locations at the Wolverine Mine site in alluvial, shallow and deep bedrock in the Wolverine Lake and Go Creek watersheds. Groundwater quality samples for the purposes of ongoing operations monitoring (as per A Licence QZ04-065) were taken at the locations and dates summarized in Table 3-1. Gaps in the data in Table 3-1 represent times when the sample sites were frozen, and samples were not able to be taken. Well MW08-14 was discontinued in 2011 due to construction activities in the area of the well for the raising of the tailings storage dam.

Overall a total of 160 sample sets were analyzed for dissolved metals by ICP trace metals scan, nutrient parameters, major anions, total suspended solids and laboratory physical parameters. Water quality results are compared to the historic (1995-2008) baseline average and 95th percentile values provided in the Lorax Environmental *Baseline Characterization Summary Report* provided in Appendix A of *Monitoring and Surveillance Plan V2011-03* (*Baseline Report*).

Table 3-1: Groundwater Monitoring Sites and Dates Sampled - 2013

Sampling Site	January	February	March	April	May	June	July	August	September	October	November	December
MW05-1A	D	D	D	D	D	21-Jun	30-Jul	16-Aug	24-Sep	D	D	D
MW05-1B	D	D	D	D	D	21-Jun	30-Jul	16-Aug	24-Sep	D	D	D
MW-05-2A	D	D	D	D	D	23-Jun	31-Jul	20-Aug	23-Sep	D	D	D
MW-05-2B	D	D	D	D	D	23-Jun	31-Jul	🟦 20-Aug	23-Sep	D	D	D
MW05-3A	D	D	D	D	D	24-Jun	14-Jul	8-Aug	27-Sep	D	D	D
MW05-3B	D	D	D	D	D	24-Jun	14-Jul	8-Aug	🟦 27-Sep	D	D	D
MW05-4A	D	D	D	D	D	5-Jun	14-Jul	14-Aug	25-Sep	D	D	D
MW05-4B	D	D	D	D	D	5-Jun	14-Jul	🟦 14-Aug	25-Sep	D	D	D
MW05-5A	6-Jan	8-Feb	8-Mar	🟦 15-Apr	19-May	12-Jun	9-Jul	4-Aug	9-Sep	18-Oct	🟦 22-Nov	A
MW05-5B	D	9-Feb	D	D	19-May	12-Jun	9-Jul	4-Aug	9-Sep	18-Oct	22-Nov	A
MW-05-6A	14-Jan	2-Feb	8-Mar	15-Apr	8-May	16-Jun	9-Jul	3-Aug	9-Sep	18-Oct	11-Nov	A
MW-05-6B	14-Jan	2-Feb	🟦 8-Mar	D	8-May	16-Jun	9-Jul	3-Aug	9-Sep	18-Oct	11-Nov	A
MW05-7B	D	D	D	D	A	23-Jun	15-Jul	8-Aug	9-Sep	D	D	D
MW06-8S	14-Jan	E	5-Mar	8-Apr	7-May	24-Jun	29-Jul	18-Aug	23-Sep	21-Oct	A	24-Dec
MW06-8M	E	E	E	E	5-May	24-Jun	29-Jul	9-Aug	22-Sep	21-Oct	A	23-Dec
MW06-8D	14-Jan	25-Feb	4-Mar	8-Apr	7-May	26-Jun	29-Jul	9-Aug	🟦 22-Sep	21-Oct	25-Nov	🟦 23-Dec
MW06-9S	12-Jan	🟦 3-Feb	D	D	D	5-Jun	15-Jul	21-Aug	25-Sep	24-Oct	D	D
MW06-9M	D	D	D	D	D	24-Jun	15-Jul	21-Aug	25-Sep	D	D	D
MW06-10S	11-Jan	D	7-Mar	8-Apr	🟦 29-May	29-Jun	29-Jul	26-Aug	22-Sep	D	D	D
MW06-10M	D	D	D	D	29-May	E	E	26-Aug	22-Sep	🟦 26-Oct	25-Nov	D
MW06-10D	D	D	D	D	D	D	D	26-Aug	22-Sep	26-Oct	25-Nov	7-Dec
MW06-11S	D	D	D	D	D	🟦 24-Jun	🟦 31-Jul	21-Aug	27-Sep	D	D	D
MW06-12S	🟦 12-Jan	8-Feb	10-Mar	17-Apr	14-May	26-Jun	30-Jul	21-Aug	23-Sep	25-Oct	24-Nov	24-Dec
MW08-13	1-Jan	1-Feb	4-Mar	D	12-May	23-Jun	🟦 15-Jul	17-Aug	9-Sep	26-Oct	23-Nov	D

A = Site not sampled due to lack of safe access
D = Site dry (i.e., all water tied up in storage) or frozen through to ground
E = Transportation equipment under repair/Sampling equipment under repair
🟦 QAQC Sample Taken

3.2 Groundwater Quality Monitoring

Laboratory results for the groundwater samples taken in 2013 are compared to baseline average and 95th percentiles provided in *Appendix A* of the *Baseline Report*, except for stations MW06-8M and MW08-13, which were not installed until 2008, hence there was no baseline established for these sites. Appendix B herein provides graphical representations of the water quality results for all groundwater monitoring sites for the following parameters:

- Conductivity
- Hardness
- Total Alkalinity
- pH
- Total Suspended Solids (TSS)
- Turbidity
- Fluoride
- Sulphate
- Ammonia
- Nitrate
- Nitrite
- Dissolved Aluminum
- Dissolved Arsenic
- Dissolved Cadmium
- Dissolved Chromium
- Dissolved Copper
- Dissolved Iron
- Dissolved Lead
- Dissolved Mercury
- Dissolved Molybdenum
- Dissolved Nickel
- Dissolved Selenium
- Dissolved Silver
- Dissolved Zinc

Red symbols in the graphs and in the figures below indicate the result was below the analytical detection limit, and is shown as being equal to the detection limit. Also, for occasions when the average and 95th percentile are equal, only the blue line indicating the average is visible on the graphs.

The majority of physical parameters and major anions (conductivity, hardness, alkalinity, pH, TSS, turbidity, fluoride, sulphate, ammonia, nitrate and nitrite) for all sites were within the average provided in the *Baseline Report*, and were generally below the 95th percentile value. The 2010 ammonia concentrations were higher than the 95th percentile values and than the 2009 and 2011 concentrations, due to a change in analysis methodology at the analyzing laboratory that was incorrectly detecting ammonia. This inconsistency was remedied for the 2011 sample analysis.

Nitrate and nitrite concentrations were much higher than normal in samples taken since September 2011, due to interferences with the analytical equipment. The interferences also resulted in laboratory detection limits that were an order of magnitude greater than the limits used previously (i.e., 0.2 mg/L vs. 0.002 mg/L).

The results for total metals were also generally within the average baseline range, and 2013 results were comparable to results achieved previously. The majority of results were less than the average values, and almost all were less than the 95th percentile values. ~94% of results for silver and 96% of the mercury results were below the reportable detection limits; hence these parameters were not graphed nor are provided in Appendix B.

Noticeable exceptions in the groundwater sample data include:

MW05-3B:

- Aluminum, selenium, and molybdenum concentrations decreased over the monitoring period. Whereas cadmium, zinc, nickel, and sulphate (after 2012) demonstrated increasing trends. Majority of conductivity and alkalinity concentrations were greater than the 95th percentile concentration for all values in 2009-2013.

MW05-2A:	Zinc concentrations show greater variability between 2009 – 2013, but demonstrate a general increasing trend since 2010.
MW05-4B:	Cadmium concentrations steadily increased from 2009 – 2012, but decreased during 2013.
MW05-6A:	Zinc concentrations steadily increased from 2009 – 2012, but decreased during 2013.
MW05-6B:	Majority of chromium concentrations were greater than the 95th percentile concentration for all values in 2009-2013.
MW06-8M:	Zinc concentrations have demonstrated declining concentrations since 2011.
MW06-8S:	Zinc and nickel concentrations have increased since 2009. However, nickel showed a steady plateau in concentration levels during 2013.
MW06-12S	Arsenic concentrations have decreased since 2009.
MW06-8S, MW06-8D, MW06-9S, MW06-11S, MW06-12S	All stations showed increasing, and greater variability in, iron concentration trends in 2011-2013. Conversely, iron concentrations decreased after 2009 for well MW06-10D.
MW05-1B, MW05-3A, MW05-4A/4B, MW05-5B, MW05-6A/6B, MW06-8D:	Ammonia concentrations were above the 95th percentile for the majority of points in 2010 - 2013. MW05-1B, MW05-4A/B, and MW05-5B demonstrated decreasing ammonia concentration in 2013.
MW05-4A, MW06-8S, MW06-11S:	Fluoride concentrations were above the 95th percentile for the majority of points in 2010 - 2013.
MW05-3B, MW05-4B, MW05-5B (only Zn &Ni), MW06-8S (only Zn & Ni):	Cadmium, Nickel and Zinc concentrations were greater than the 95th percentile concentration for the majority of 2011 – 2013. MW05-5B showed increasing concentrations for nickel in 2012, however, 2013 showed significantly decreased concentration levels.
MW05-4B, MW05-5A/5B, MW05-6A, MW06-9M:	Arsenic concentrations were greater than the 95th percentile concentration for the majority of 2011 - 2013.
MW05-2B, MW05-4B, MW06-6A, MW06-8D, MW06-10S, MW06-11S, MW06-12S:	Iron concentrations were greater than the 95th percentile concentration for the majority of 2011 - 2013.
MW05-4A, MW05-7B, MW06-10S, MW06-11S:	Majority of alkalinity concentrations were greater than the 95th percentile for 2009 - 2013.
MW05-4B, MW05-6A, MW06-8D, MW06-9S, MW06-10M, MW06-11S:	Majority of turbidity concentrations were greater than the 95th percentile for 2009 – 2013.

The results of the groundwater quality are discussed in the below sections by well depth (i.e., alluvial, shallow bedrock or deep bedrock) and location (i.e., Go Creek and Wolverine Creek).

3.2.1 Wolverine Creek – Alluvial Groundwater Wells

Alluvial groundwater wells in the Wolverine Creek drainage include wells MW05-3B, MW05-4B and MW05-5B. Concentrations of cadmium, nickel, copper, and zinc in well 3B demonstrated increasing trends, as shown for cadmium in Figure 3-1. Well 4B similarly demonstrated increases in cadmium while all other graphed parameters did not demonstrate any noticeable trends, and were generally below the baseline average value. Well 5B showed slight increasing trends in 2013 for iron and zinc, while nickel concentrations that had increased in 2012, returned to concentration levels recorded in 2009-2011

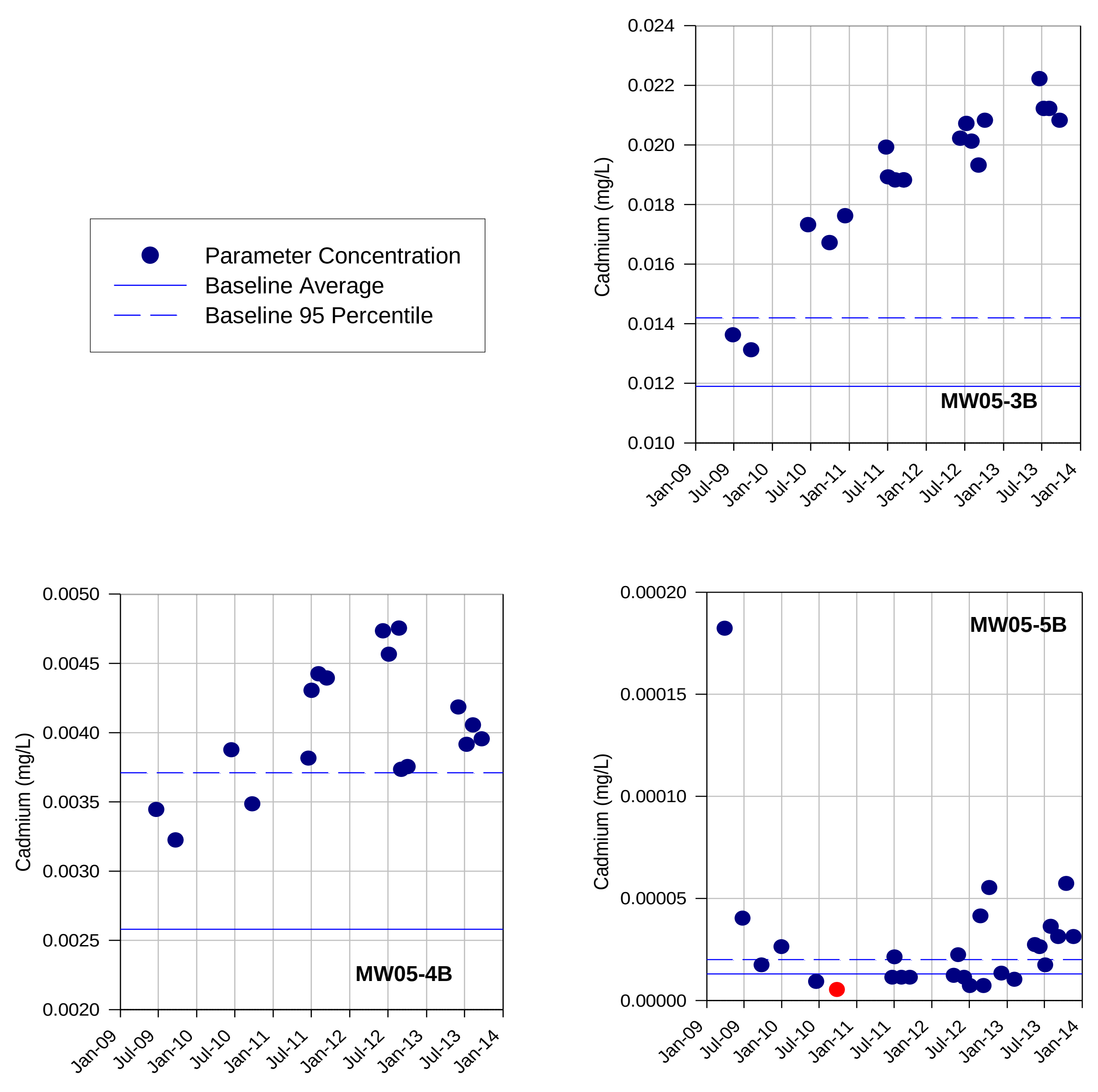
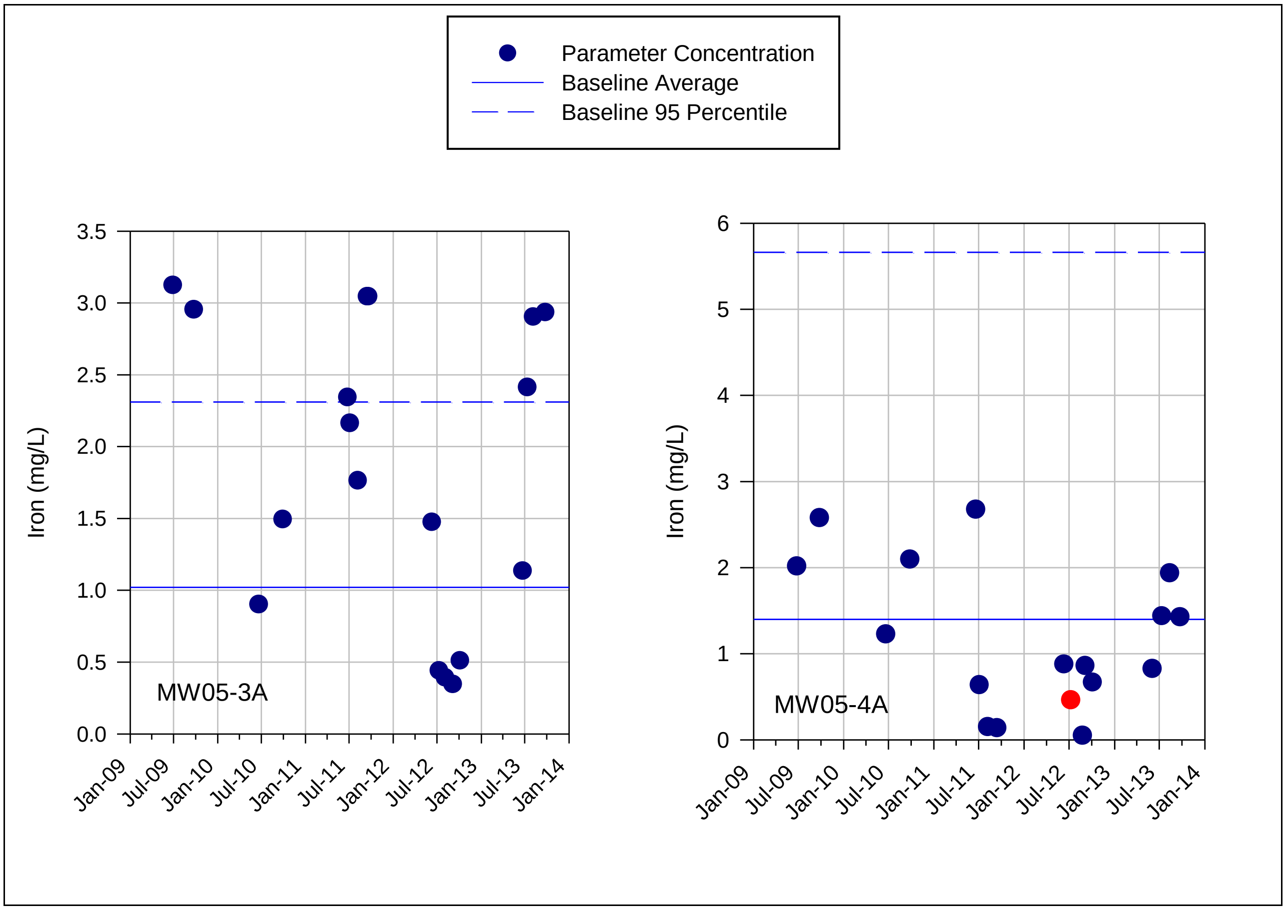
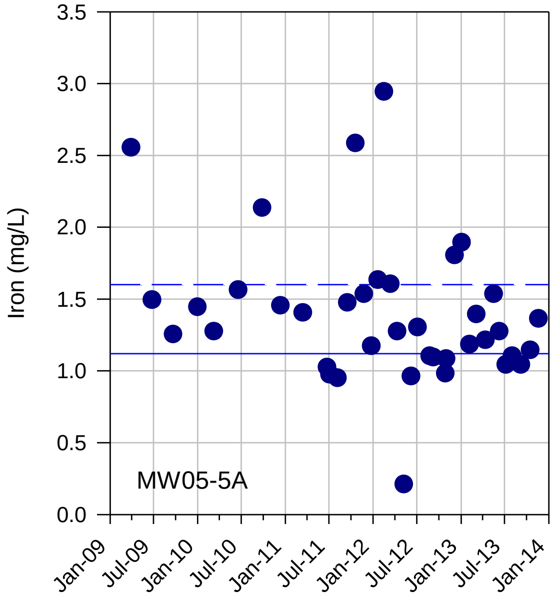


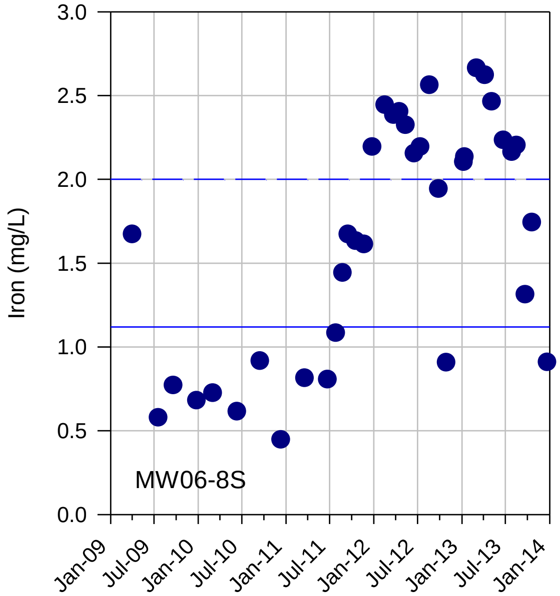
Figure 3-1: Cadmium Concentrations in Wolverine Creek Alluvial Groundwater Stations, Jan 2009 – Dec 2013

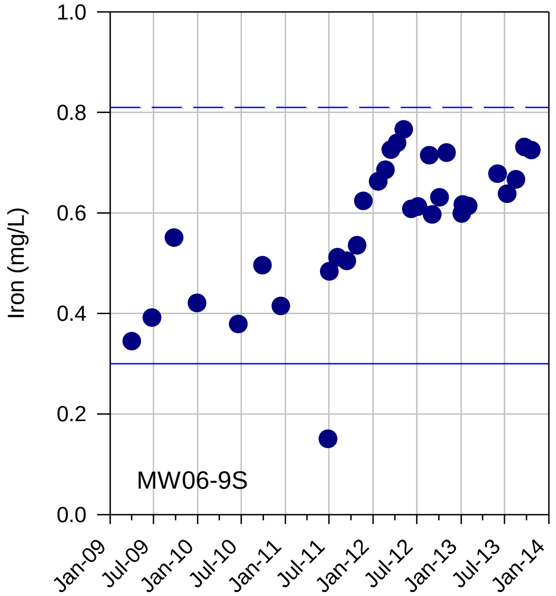
3.2.2 Wolverine Creek – Shallow Bedrock Groundwater Wells

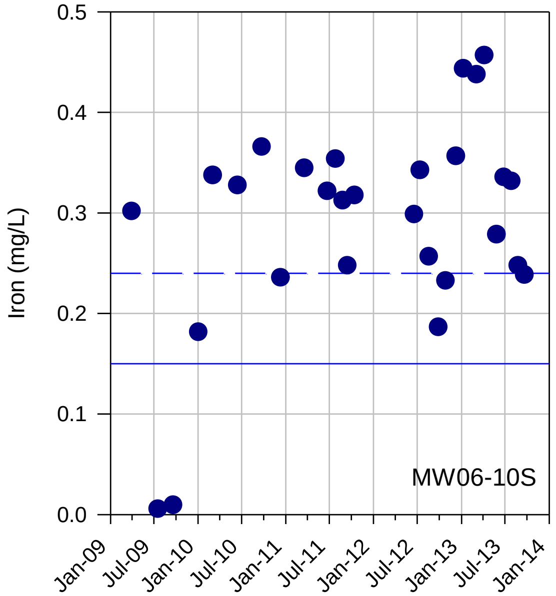
Shallow bedrock groundwater wells in the Wolverine Creek drainage include wells MW05-3A, MW05-4A, MW05-5A, MW06-8S, MW06-9S, MW06-10S, MW06-11S and MW06-12S. Generally the metal concentrations were less than the baseline average concentrations, although iron in wells 10S, 11S and 12S were generally above the 95th percentile, as shown in Figure 3-2. Well MW06-8S also demonstrated increasing trends in the concentrations of iron, nickel and zinc throughout 2009-2011, similarly to wells 3B and 4B, described above.




Iron (mg/L)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
MW05-5A
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14


Iron (mg/L)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
MW06-8S
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14


Iron (mg/L)
1.0
0.8
0.6
0.4
0.2
0.0
MW06-9S
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14


Iron (mg/L)
0.5
0.4
0.3
0.2
0.1
0.0
MW06-10S
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

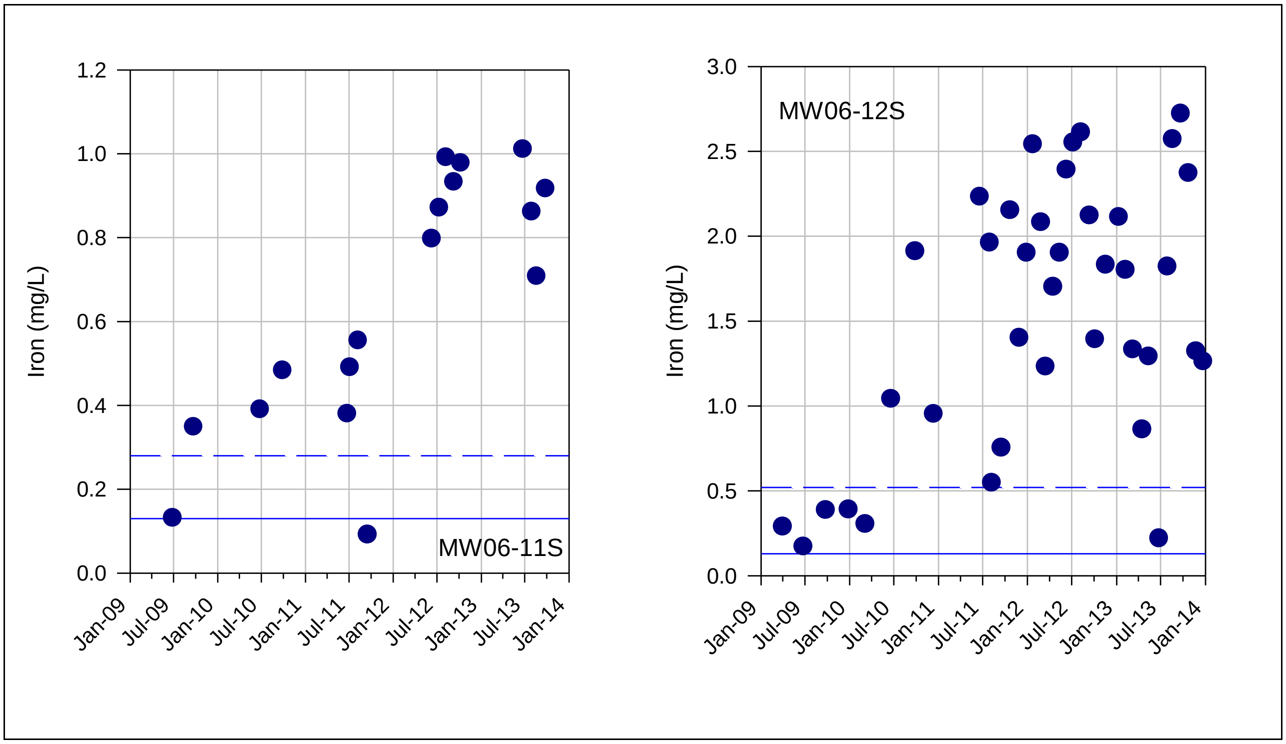
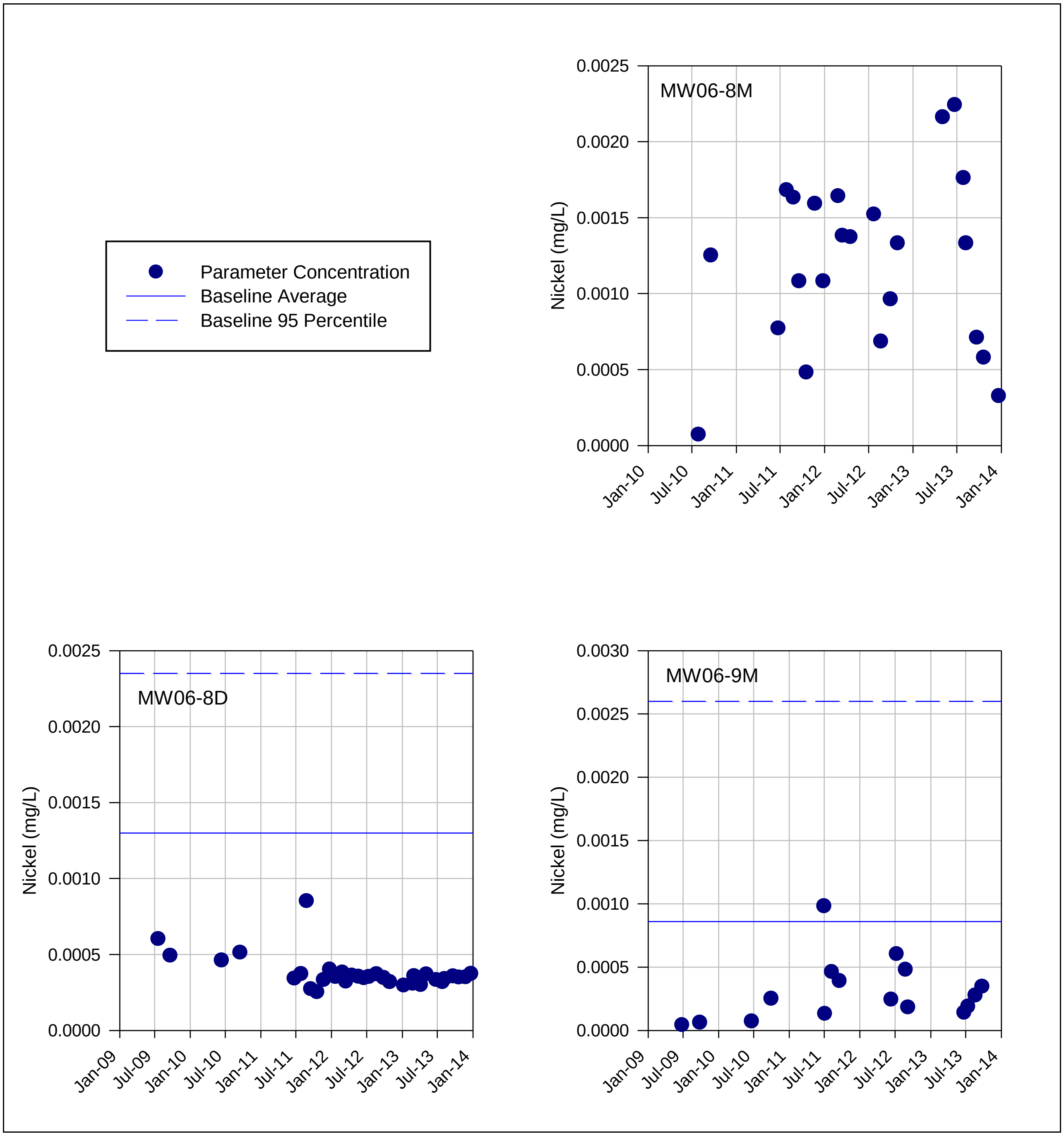


Figure 3-2: **Iron Concentrations in Wolverine Creek Shallow Bedrock Groundwater Stations, Jan 2009 – Dec 2013**

3.2.3 Wolverine Creek – Deep Bedrock Groundwater Wells

Deep bedrock groundwater wells in the Wolverine Creek drainage include wells MW06-8M, MW06-8D, MW06-9M, MW06-10M and MW06-10D. Monitoring well MW06-8M was improperly installed in 2006, hence had to be re-drilled in 2008. Consequently there is no baseline average or 95th percentile to compare with the 2009-2012 results. Overall the results at the deep bedrock wells are comparable to the average results, although some parameters are typically higher than the average (e.g., iron and arsenic) while the others are well below (i.e., nickel and selenium) as shown for nickel in Figure 3-3.



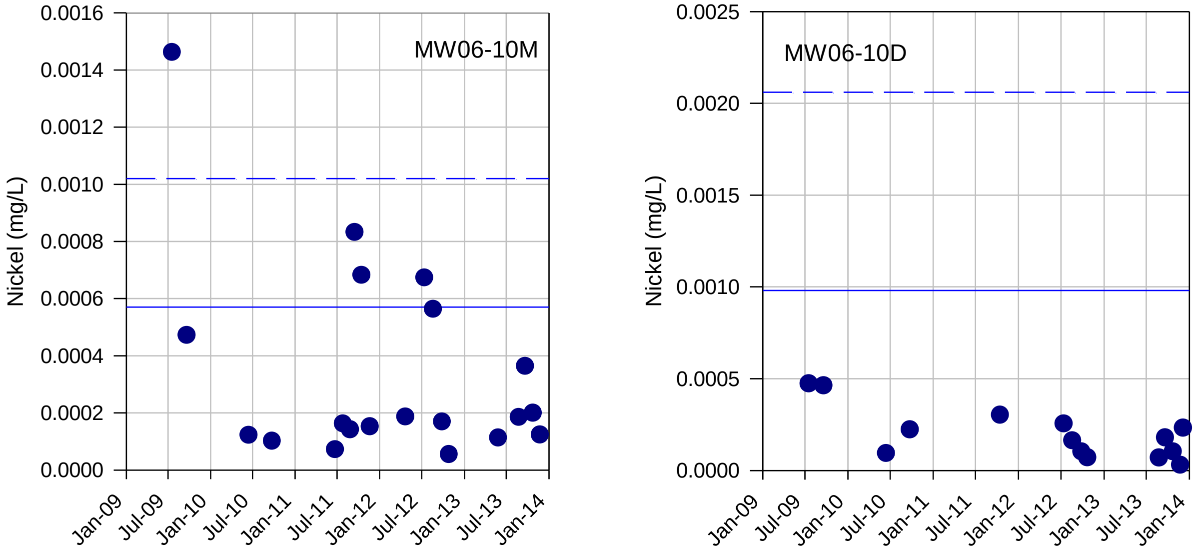
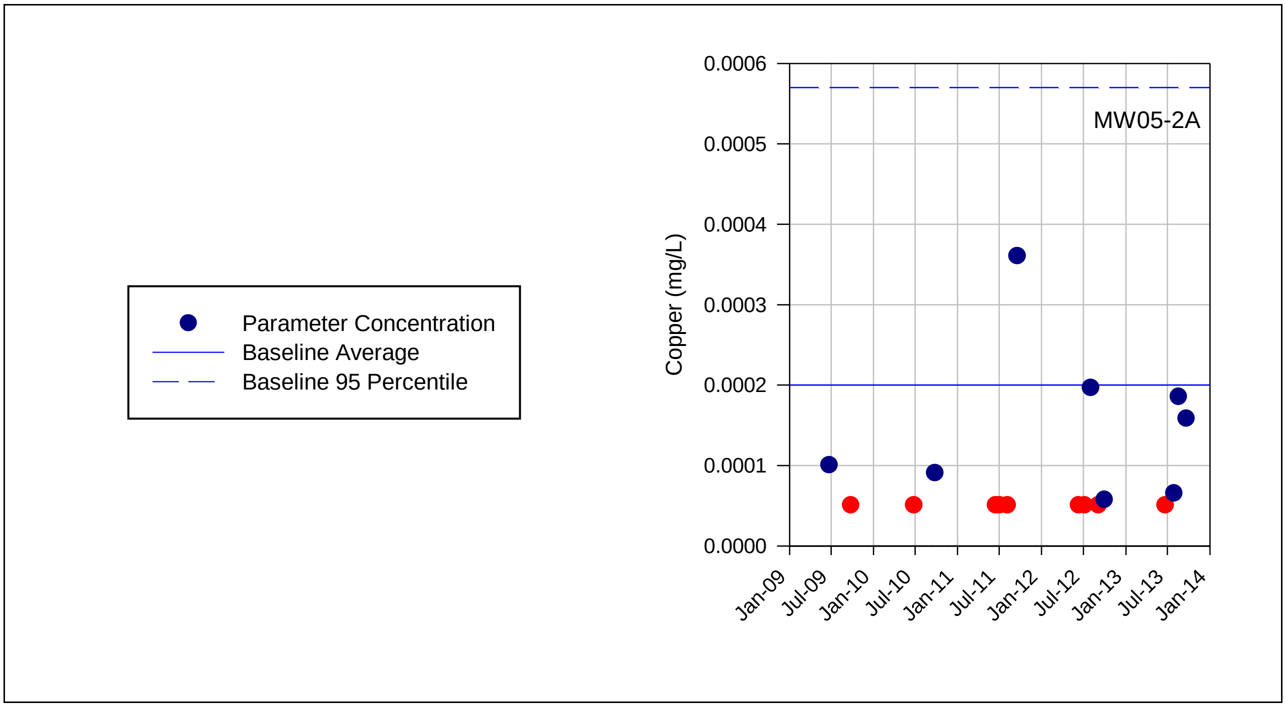


Figure 3-3: Nickel Concentrations in Wolverine Creek Deep Bedrock Groundwater Stations, Jan 2009 – Dec 2013

3.2.4 Tailings Storage Facility – Alluvial and Shallow Bedrock Groundwater Wells

There are four groundwater monitoring wells downslope of the tailings impoundment: MW05-2A (shallow bedrock), MW05-2B, MW05-7B and MW08-13 (alluvial) and one monitoring well upslope (MW08-14 – shallow bedrock). Monitoring wells 13 and 14 weren't installed until 2008; hence there is no baseline average or 95th percentile to compare with the 2009-2012 results. Monitoring well 14 was discontinued during late fall 2011 due to its proximity to the construction of the new waste rock pad, and was terminated during the construction of the Stage 2 tailings dam. Generally the results are similar to the baseline average results, as shown for copper in Figure 3-4. Chromium and selenium concentrations were frequently less than the reportable detection limit (Appendix B). There were no noticeable differences in metal concentrations from the groundwater wells upslope and downslope of the tailings storage facility.



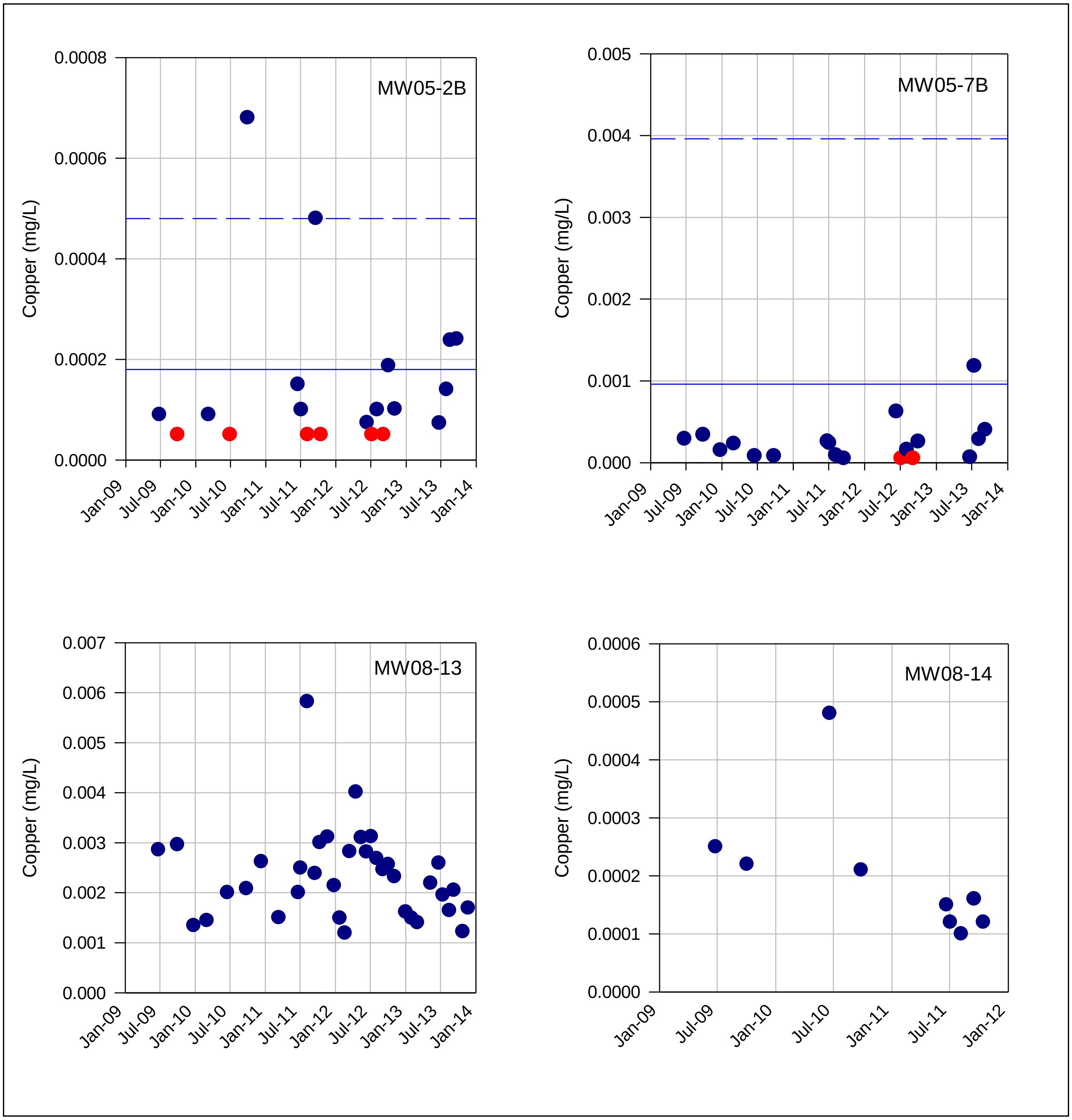
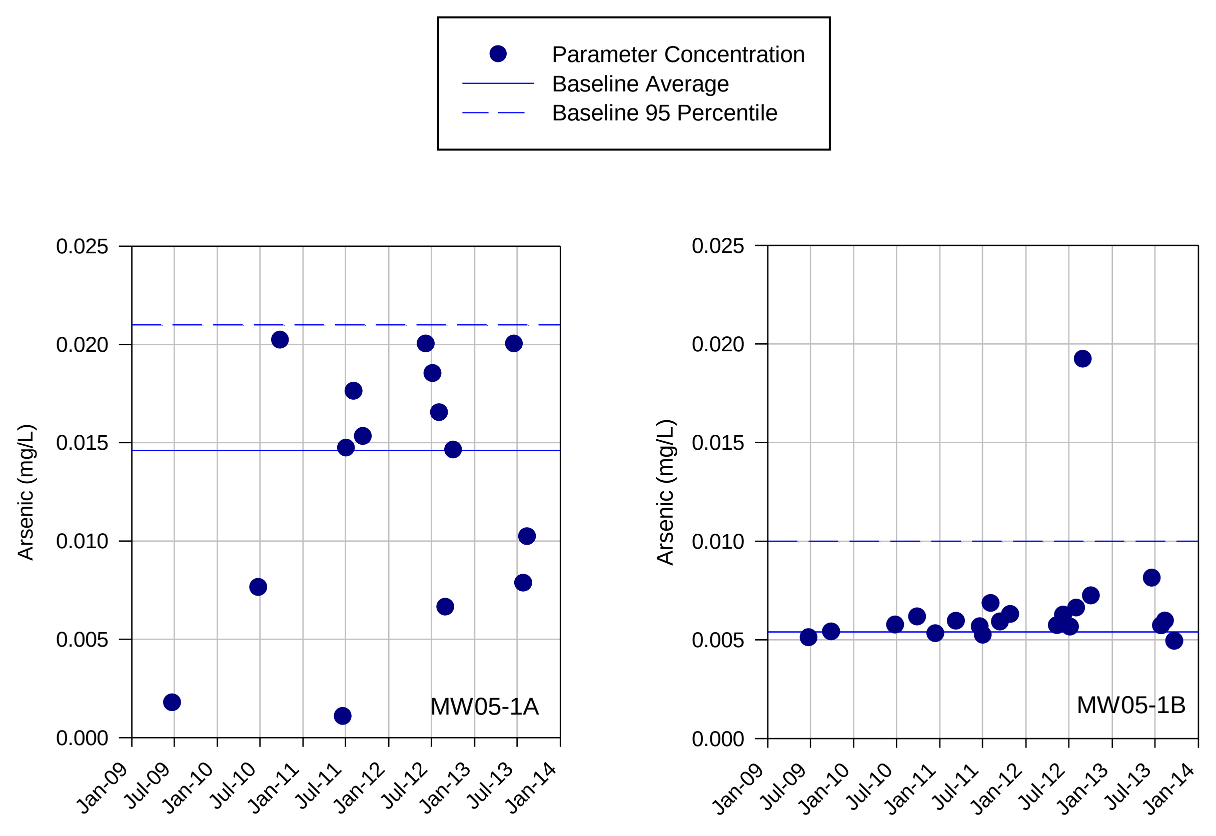


Figure 3-4: **Copper Concentrations in Groundwater Stations near Tailings Storage Facility, Jan 2009 – Dec 2013**

3.2.5 Go Creek – Shallow Bedrock and Alluvial Groundwater Wells

Concentrations in the groundwater from the shallow bedrock (MW05-1A and MW05-6A) and alluvial (MW05-1B and MW05-6B) groundwater wells in the Go Creek drainage demonstrated trends that were generally similar to baseline average concentrations. MW05-1B, MW05-6A, MW05-6B all had ammonia concentrations where the majority of points between 2009 – 2013 were higher than the baseline 95th percentile values. MW05-6A also had arsenic and iron concentrations in 2009 - 2013 there were almost all higher than the baseline 95th percentile values, as shown for arsenic in Figure 3-5.



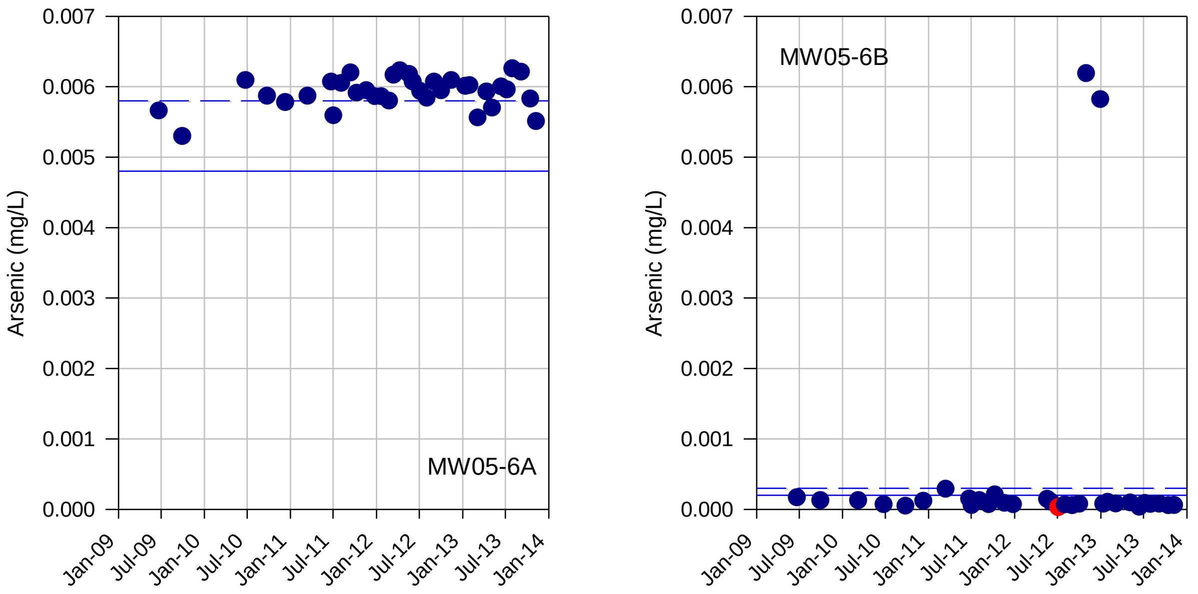


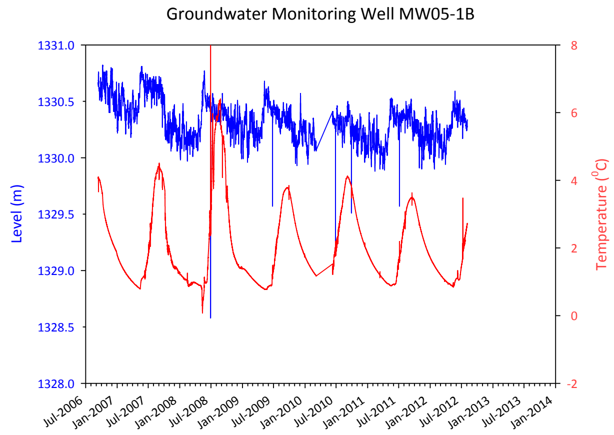
Figure 3-5: **Arsenic Concentrations in Go Creek Alluvial and Shallow Bedrock Groundwater Stations, Jan 2009 – Dec 2013**

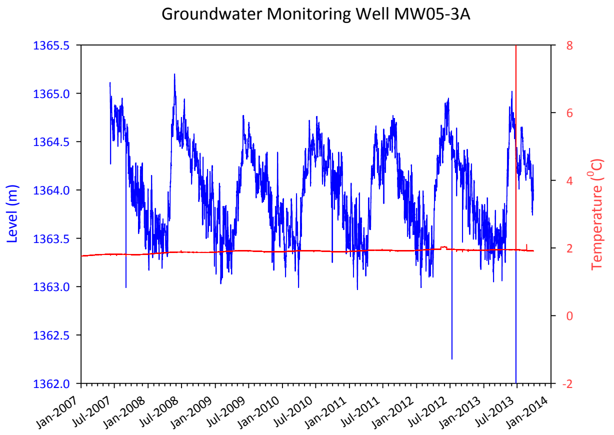
3.3 Groundwater Water Levels and Temperatures

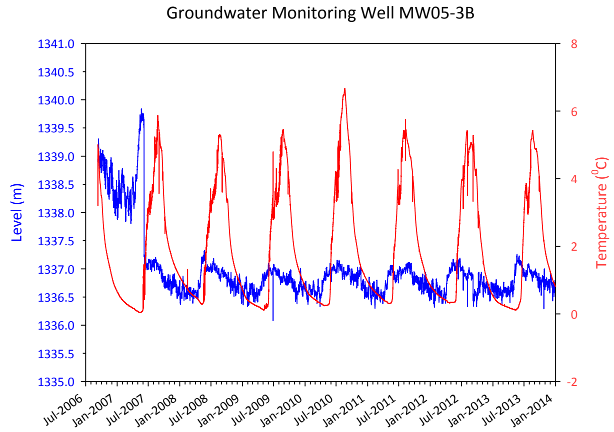
Figure 3-6 provides graphical representations of the water levels and water temperatures in the various groundwater wells. The majority of the wells commenced logging in September 2006; although wells MW05-4A and MW05-4B were decommissioned during construction in 2008, and replaced in the same location in 2009. These wells are not calibrated to reflect depth above sea level (asl), but are instead recording the depth of the water above the logger installation. Loggers are not installed in monitoring wells MW05-6A, MW05-6B, MW05-7B. The logger was removed from well MW08-14 in September 2011, as the well was decommissioned to allow for construction of the waste rock pad in 2011, and construction of the tailings dam raise in 2012; hence the data has not been presented below. There are also no loggers in wells MW05-2A, MW05-2B, MW05-1A and MW05-9M as they are artesian wells, and have a consistent water level of 0 m above ground level. Data for well MW06-9S is only presented up to the end of March 2012, as the logger data was inconsistent after March 27, 2012. Loggers were also removed in late 2012 from wells MW05-1B, MW06-10M, and MW06-12S due to water damage. Loggers were replaced and re-installed in MW06-10M and MW06-12S, fall and spring 2013 respectively. MW05-1B will be installed in early 2014 once the well has thawed in spring.

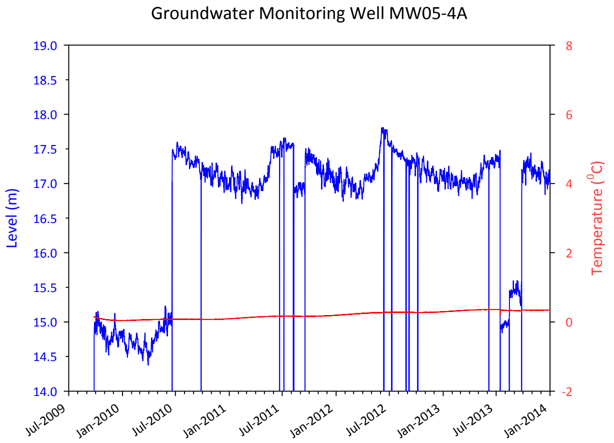
The short lived spike lines in the graphs correspond to sampling periods, when the water levels decrease drastically and the temperatures increase. In general, the water levels increase each year around May/June, and decrease to the lowest seasonal levels in March/April. The water temperatures are highest around July/August, and lowest around December/January.

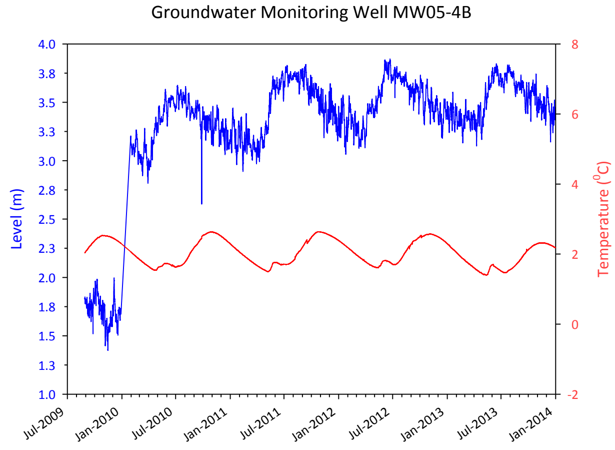
Annual water levels in the various monitoring wells have remained relatively constant over the monitoring period.

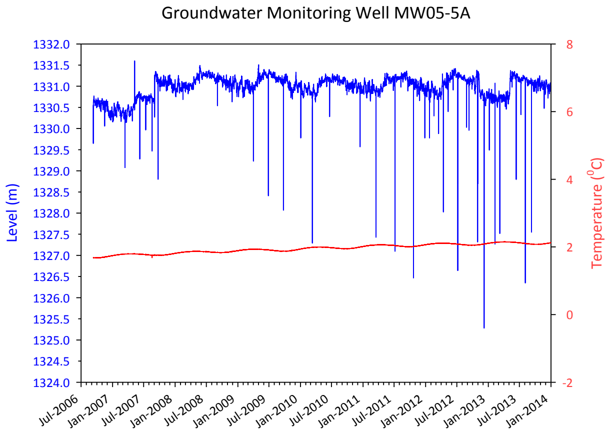

Groundwater Monitoring Well MW05-1B

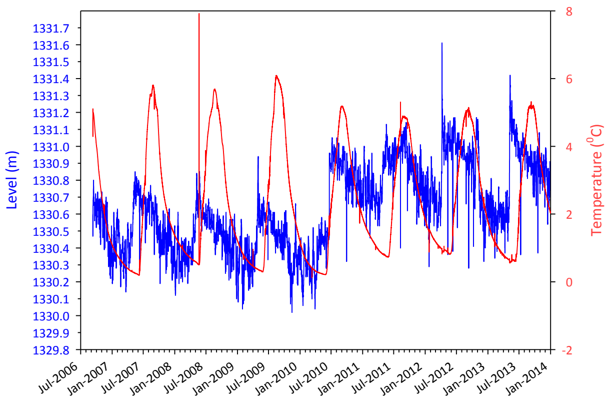

Groundwater Monitoring Well MW05-3A

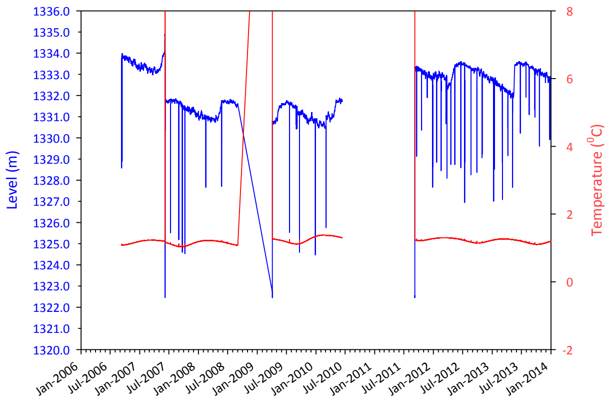

Groundwater Monitoring Well MW05-3B

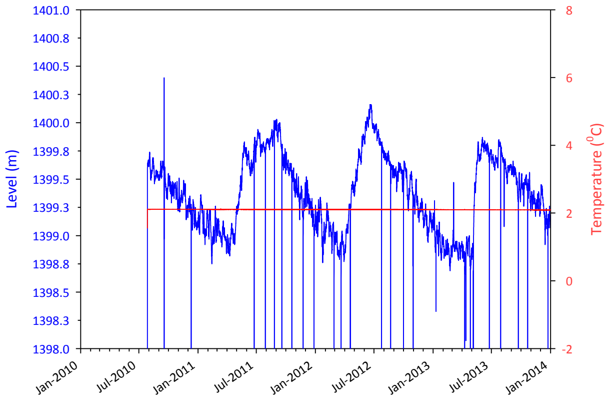

Groundwater Monitoring Well MW05-4A

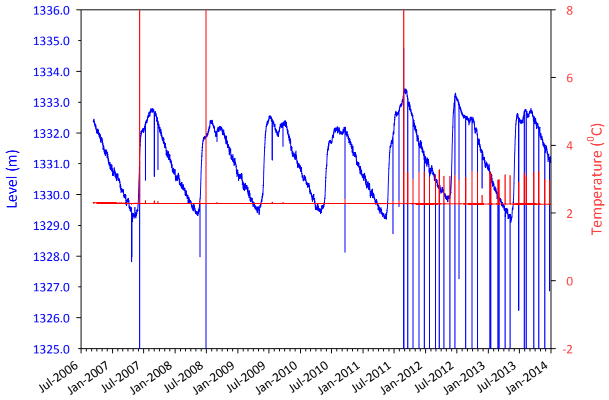

Groundwater Monitoring Well MW05-4B

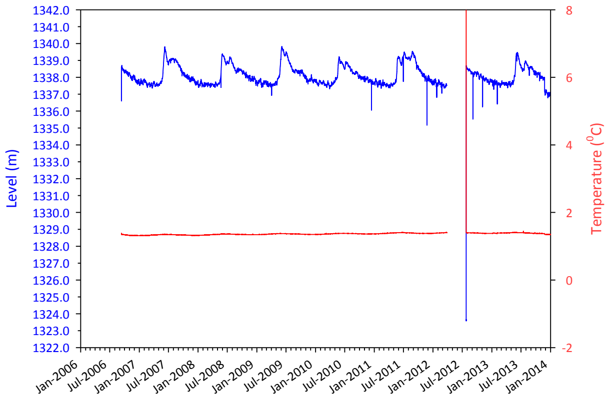

Groundwater Monitoring Well MW05-5A

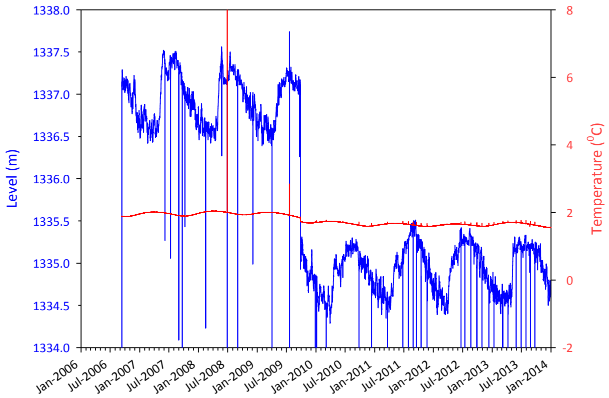

Groundwater Monitoring Well MW05-5B


Groundwater Monitoring Well MW06-8S

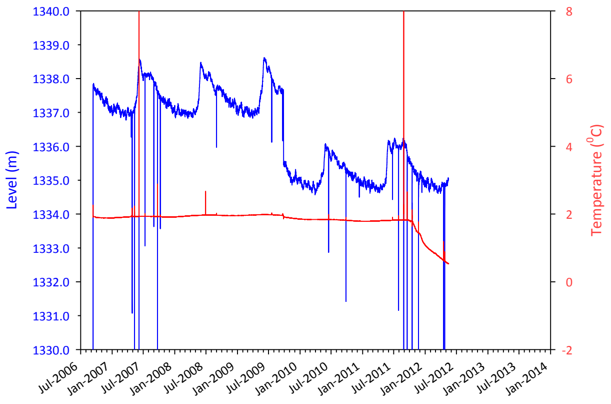

Groundwater Monitoring Well MW06-8M


Groundwater Monitoring Well MW06-8D

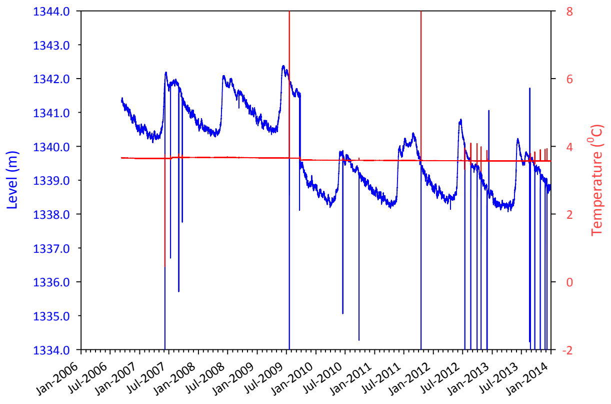

Groundwater Monitoring Well MW06-9S


Groundwater Monitoring Well MW06-10S

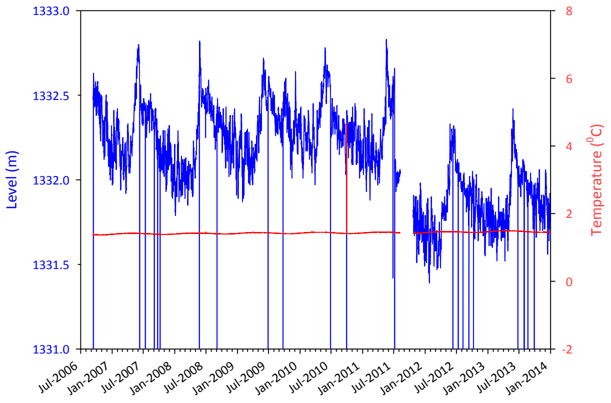
Groundwater Monitoring Well MW06-10M



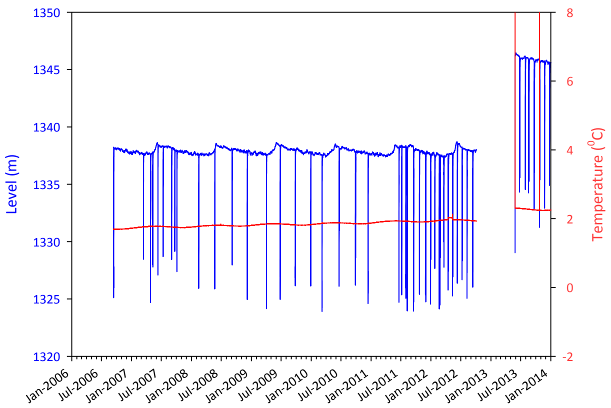
Groundwater Monitoring Well MW06-10D



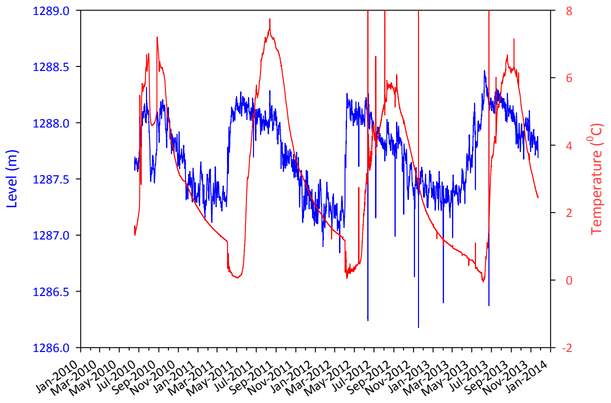
Groundwater Monitoring Well MW06-11S



Groundwater Monitoring Well MW06-12S



Groundwater Monitoring Well MW08-13



Groundwater Monitoring Well MW08-14

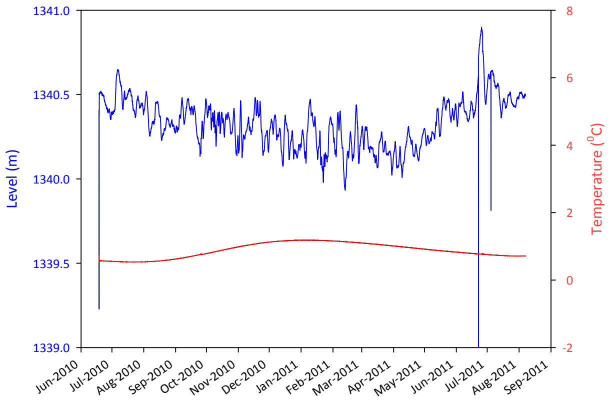


Figure 3-6: Groundwater Monitoring Wells Water Level and Temperature

3.4 Piezometer Monitoring

Four vibrating wire piezometers are installed at two locations (PZA and PZB) above the underground mine. The piezometers measure the water table above the mine and results reveal the effect of underground mining on the water table. Both locations have one shallow and one deep piezometer, and the results for 2005 to 2013 are provided in Figure 3-7. There is no precipitation data prior to the installation of the weather station in late 2007. Battery failure of the piezometers in 2009 resulted in gaps in the data. Water level increases are seen shortly after summer rain events, even in the deep well installations.

The average elevations for the annual monitoring periods are presented in Figure 3-8. The shallow PZA and PZB wells showed a slight decrease in average elevation in 2012 and 2013, compared to previous years. However, the deep PZA and PZB wells showed a marked decrease from 2009 (i.e., 50 m lower), which may be attributed to an intersection of the mining operations with the well, as noted by the mining personnel. PZB Deep showed a steady decline from 2008 to 2013, down 53 m, markedly decreasing in 2009 and 2013 (18 m and 20 m respectively). PZA Deep shows the most significant decline of the four piezometers since 2008, down 110 m. The majority of this decline occurred during 2010 and 2011.

Overall the underground development (started in September 2009) seems to have had a significant overall effect on the lower (or deep) aquifers, with little to no effect on the upper (or shallow) aquifers.

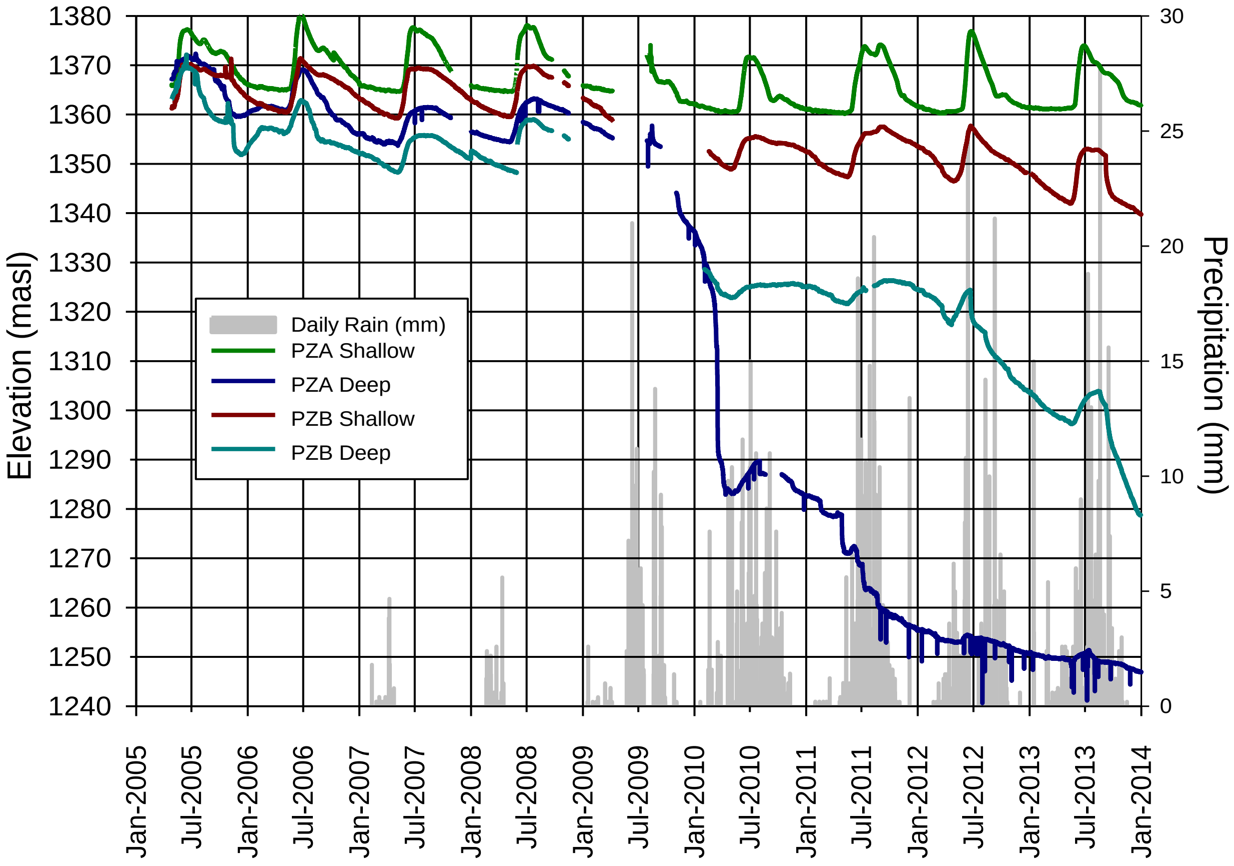


Figure 3-7: 2005-2013 Pieziometric and 2007-2013 Precipitation Data

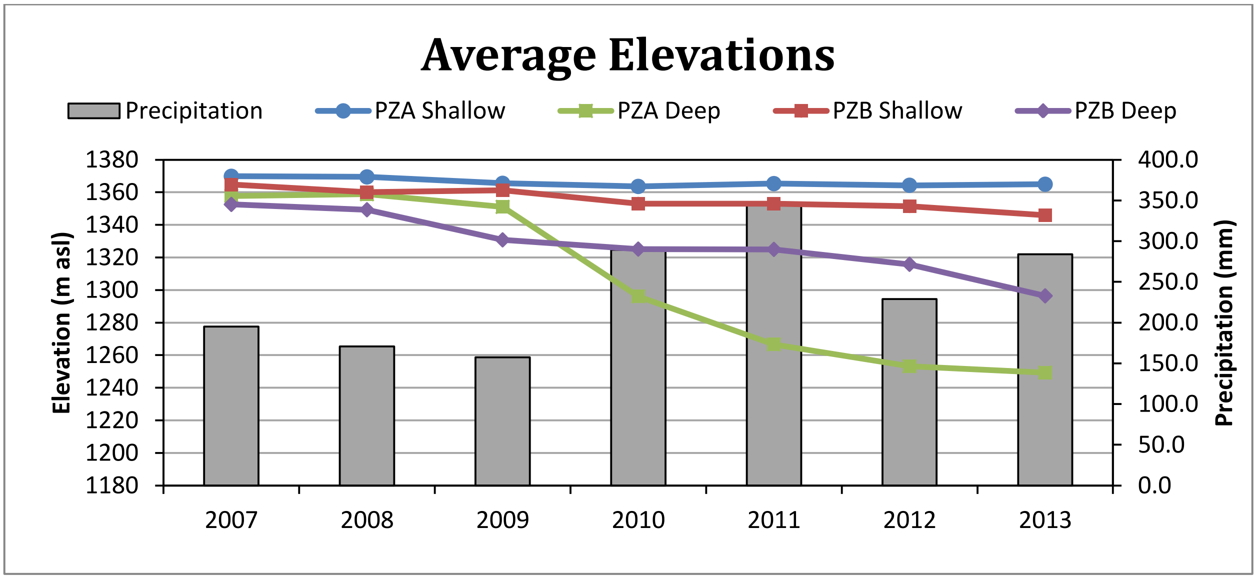


Figure 3-8: Average Pieziometric Elevation Data

4 Aquatic Life and Sediment

Monitoring requirements for stream periphyton, benthic invertebrates, water and sediment quality are outlined in the *Environmental Effects Monitoring First Study Design*, provided in V2011-03 of the Monitoring and Surveillance Plan. Periphyton, benthos, water and sediment quality were all sampled in September 2011, and will be conducted again in 2014.

5 Weather Monitoring Program

Weather monitoring at the Wolverine Mine consists of weather data, collected from an on-site weather station, and snow pack measurements, and the 2013 results of this monitoring program are summarized below.

5.1 Weather Station Data

Weather station data is collected from a HOBO Weather Station installed at the south end of the airstrip. Data collected from the weather station includes:

- Temperature;
- Pressure;
- Precipitation;
- Radiation in and out;
- Wind speed and direction; and
- Relative humidity.

During 2013, the weather station located at the airstrip experienced an equipment malfunction and the logger was removed for repair between April 1st and August 24th, 2013, resulting in a large data gap. In order to accurately depict site conditions during these month data from a second HOBO Weather Station, located above the Tailings Facility, was incorporated for this time period. The last three years have shown only slightly different weather conditions. 2012 was a much drier year than 2011 with 229 mm of rain falling in 2012 compared to 284 mm in 2013, and 346 mm in 2011. Precipitation data was not recorded in 2012 from June 16th – July 18th due to weather station malfunction. However, daily weather descriptions recorded throughout that time period indicate it only rained on 7 days. Therefore, while it was drier in 2012, it may have not have been as significant a difference. In 2013 average temperatures were below freezing late October through April, whereas in 2012 average temperatures dropped below freezing in September and carried through till April. In addition to a milder winter, 2013 also experienced a warmer summer from May to August in comparison to 2012. Annual evaporation was much higher in 2013 compared to 2011 and 2012; 356.5 mm, 320.9 mm, and 248.8 mm, respectively. Overall, as shown in Figure 5-1, temperature and precipitation have been fairly similar at the Wolverine Mine since consistent recording started in 2007.

The daily average temperatures are presented in Figure 5-1. The mean monthly temperature for 2013 was -3.1 °C. Mean monthly temperatures were below freezing from January through April and October through December, and above freezing May through September. The minimum recorded temperature was -41.3°C and the maximum recorded temperature was 25.2 °C.

The monthly precipitation as rain for 2013 is presented in Figure 5-1. The HOBO weather station does not record precipitation that falls as snow, consequently only precipitation as rain is provided in

Figure 5-1. In 2013, August was the wettest month during the summer with 77 mm. The annual cumulative precipitation recorded as rain was 284.0 mm.

Evaporation figures were estimated from the Penmann Combination Equation, and the monthly and annual values are shown in Figure 5-2. The total evaporation in 2013 was 356.5 mm, with July (77.1 mm) having the highest evaporation within a month for 2013.

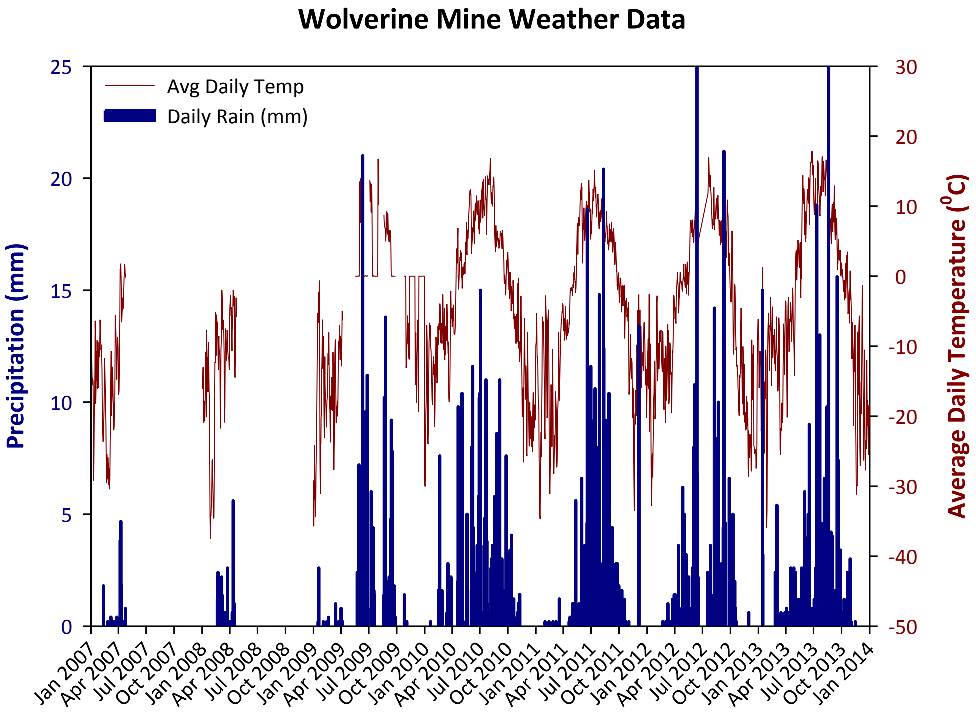


Figure 5-1: Wolverine Mine Daily Precipitation and Average Daily Temperature 2007 - 2013

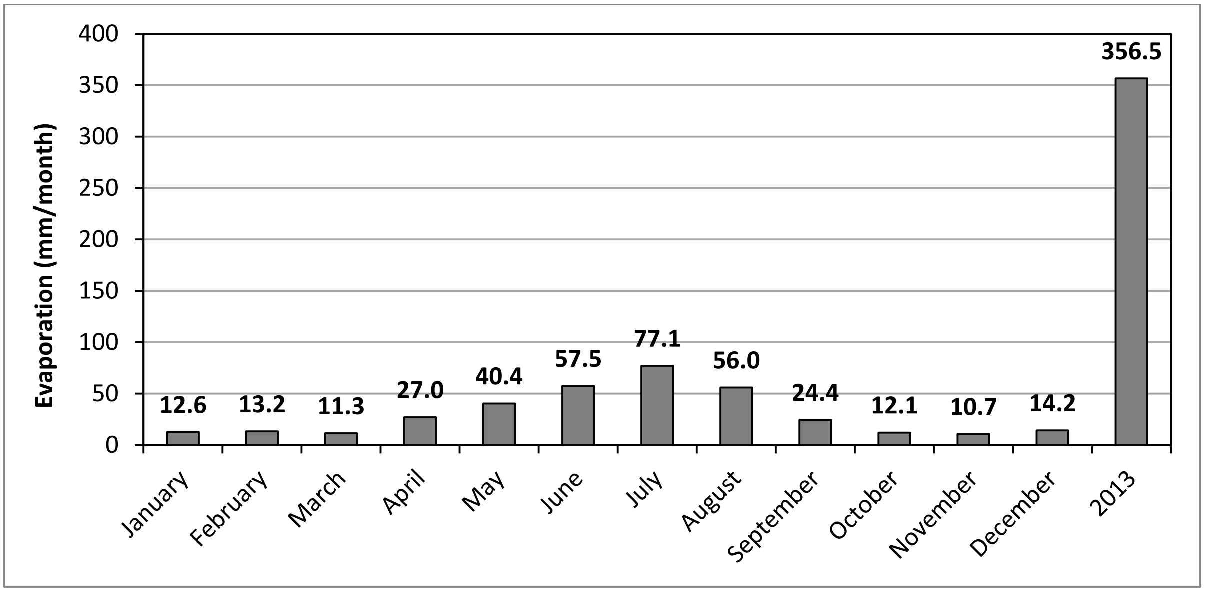


Figure 5-2: 2013 Monthly Evaporation

Snow Water Equivalent

Snow pack measurements were conducted in March and April 2013 at three locations: above the tailings storage facility, KM 25.5, and KM 17.5 on the access road. Each site was measured twice. The 2013 samples results indicate an average snow-water equivalent of 279 mm with a density of 29%. In comparison, in 2010 the snow-water equivalent was 199 mm with a density of 22%, in 2011 the snow-water equivalent was 205 mm with a density of 23%, and in 2012 the snow-water equivalent was 225 with a density of 25%.

Table 5-1: Snow Pack Measurements – March and April 2013

Station:		**Tailings**		**KM17.5**		**KM25.5**		**KM25.5**		**KM17.5**		**Tailings**		**All Sites - Averages**	
Sampling Date:		**13-Mar-13**		**13-Mar-13**		**26-Mar-13**		**06-Apr-13**		**06-Apr-13**		**12-Apr-13**			
		Total	**Average**	**Total**	**Average**	**Total**	**Average**	**Total**	**Average**	**Total**	**Average**	**Total**	**Average**	**Total**	**Average**
Snow Depth	(cm)	840	84	752	75	1078	98	947	105	943	94	874	125	906	97
Core Length	(cm)	636	64	590	59	909	83	812	90	825	82	720	103	748	80
Core Length/ Snow Depth	(%)	757	76	780	78	929	84	772	86	869	87	573	82	780	82
Weight Tube b/f sampling	(g)	20	2.0	20	2.0	20	2.0	18	2.0	20	2.0	14	2.0	19	2
Weight Tube & Core	(g)	23	2	22	2	25	2	21	2	23	2	17	2	22	2
SWE	(mm)	2740	274	2220	222	2360	236	2460	273	2820	282	2720	389	2553	279
Density	(%)	326	33	292	29	260	24	234	26	298	30	215	31	271	29

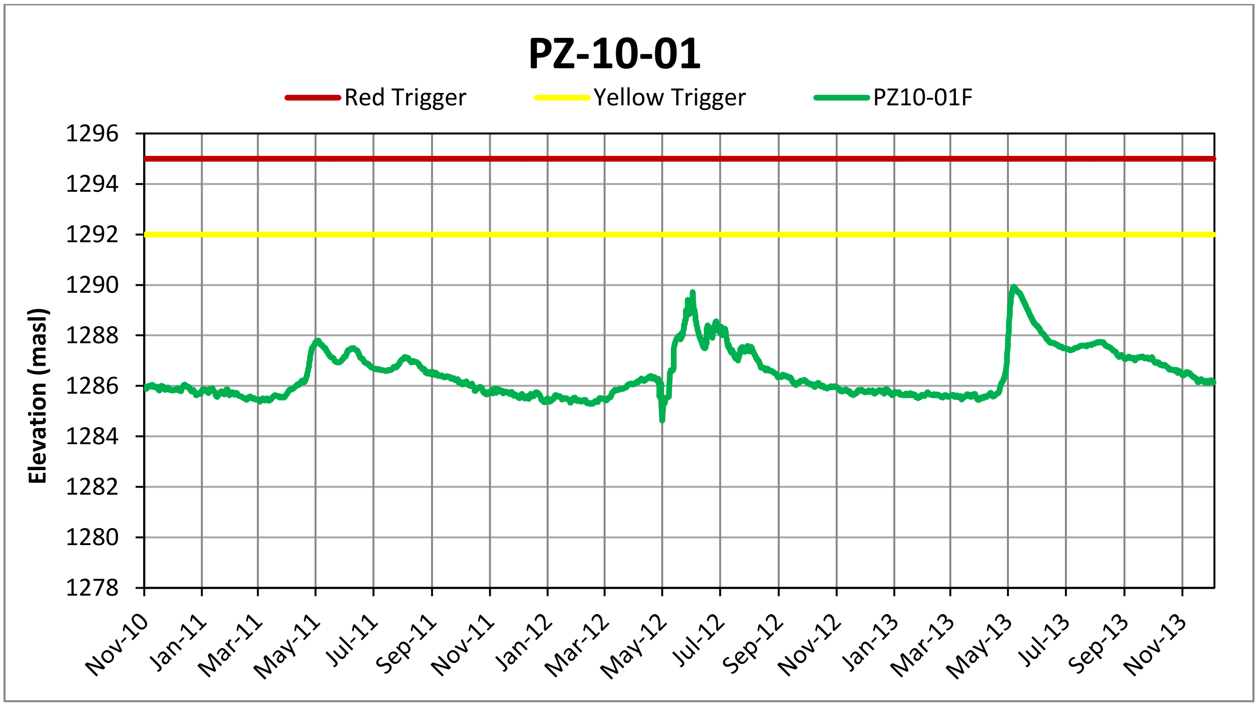
6 Tailings Storage Facility Monitoring

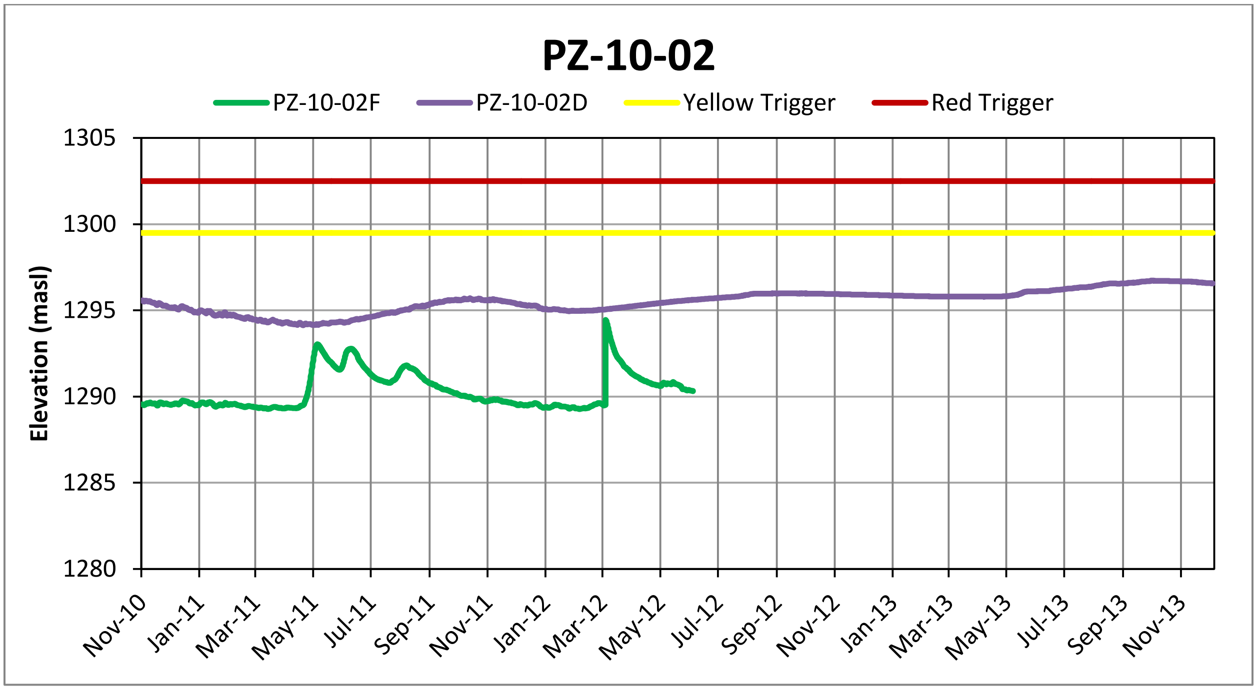
Monitoring of the tailings storage facility is carried out during operations according to the *Tailings Facility Operation, Maintenance and Surveillance Manual V2011-01* (approved August 12, 2010). Monitoring requirements for the tailings facility are summarized in Table 6-1. Routine inspections were carried out weekly and monthly to summarize the flows in and out of the facility. The forms are kept on-site for reference. On August 31st, 2013 a bathymetry of the pond was conducted to get a more accurate estimate tailings volume to water volume ratio. The bathymetry resulted in a total surveyed volume of 711,040 m3, of which 371,777 m3 is estimated to be tailings volume and 339,262 m3 water based. Instrumentation (e.g., piezometers and inclinometers casing) was installed in the dam in September 2010 and sensor locations were maintained during the completion of the Tailings Storage Facility Stage 2 Dam Raise tailings dam in September 2012.

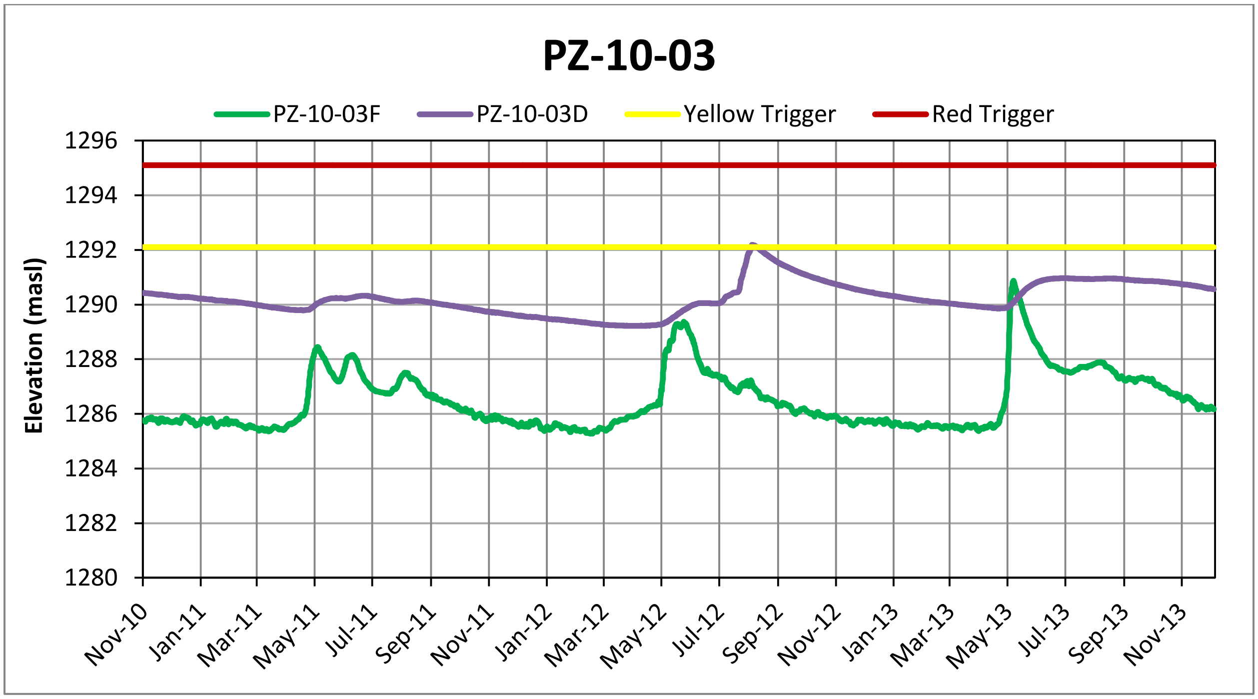
Piezometers at the tailings dam are downloaded monthly, and produce potentiometric measurements of the water in the dam and dam foundation. The results are compared to yellow and red triggers (provided by dam design engineers Klohn Crippen Berger) to ensure the water levels are not nearing elevations where they may cause issues in dam stability. The results of the 2013 downloads are provided in Figure 6-1. It was noted that piezometer PZ-10-03D hit the ‘yellow-trigger’ in August of 2012. However, this increase is atypical for that time in the year, and is thought to be associated with the tailings dam raise construction activities (e.g., extension of the piezometers to new elevation) being conducted during that period. This is substantiated by steady elevations throughout the remainder of 2012 and 2013 for this piezometer. Corrupted data was discovered for piezometer PZ-10-02F, after July 2012 and further investigations conducted to discover the cause of this malfunction indicate potential damage to the sensor during construction or failure. Inclinometers (IN10-01 and IN10-02) were monitored in June, July and September 2011 but monitoring was cancelled during 2012, due to the tailings dam construction project. Results indicate strong consistency between readings, which is important for the identification of potential movement in the dam. After the tailings construction was complete and the casing for the inclinometers extended, monitoring was re-established in May 2013. IN10-02 casing had been damaged too severely during construction and was decommissioned, while IN10-01 was still considered viable. Results between 12m and 20m depths below the surface continue to indicate a strong consistency between readings. However, some variability occurs in the data around the 8m and 12m depths. This is believed to be a result of damage to the casing during construction. Physical resistance is apparent at these two depths when inserting and removing the sensor when monitoring. Further documentation in 2014 will confirm this error in the data.

Table 6-1 **Surveillance Requirements for the Tailings Storage Facility**

Surveillance	Frequency
Routine Inspection	
Dam and Liner	Min. Weekly
Diversion ditches	Min. Weekly
Seepage collection system	Min. Weekly
Spillways	Min. Weekly
Pipelines	Min. Weekly
Annual Inspection	Annually
Event Driven Inspection	Following unusual event
Comprehensive Review	Every 7 years & prior to decommissioning
Tailings Pond Monitoring	
Inflows, Outflows, Condition	Monthly
Topography	Annually
Bathymetry	Annually
Instrumentation	Monthly




PZ-10-02
PZ-10-02F
PZ-10-02D
Yellow Trigger
Red Trigger
Elevation (masl)
1305
1300
1295
1290
1285
1280
Nov-10
Jan-11
Mar-11
May-11
Jul-11
Sep-11
Nov-11
Jan-12
Mar-12
May-12
Jul-12
Sep-12
Nov-12
Jan-13
Mar-13
May-13
Jul-13
Sep-13
Nov-13


PZ-10-03
PZ-10-03F
PZ-10-03D
Yellow Trigger
Red Trigger
Elevation (masl)
1296
1294
1292
1290
1288
1286
1284
1282
1280
Nov-10
Jan-11
Mar-11
May-11
Jul-11
Sep-11
Nov-11
Jan-12
Mar-12
May-12
Jul-12
Sep-12
Nov-12
Jan-13
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May-13
Jul-13
Sep-13
Nov-13

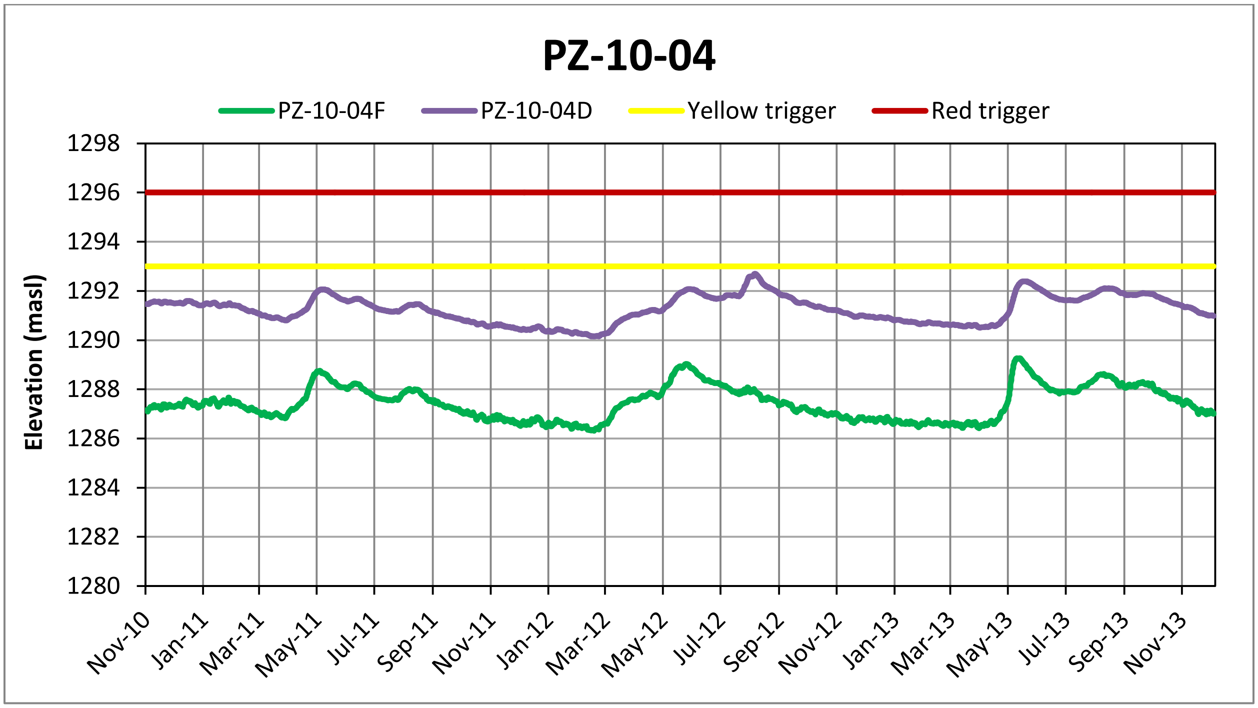


Figure 6-1: Tailings Facility 2013 Piezometer Results

7 Engineering Inspections

Three engineering inspections occurred in 2013 and subsequent reports were submitted to EMR. The inspections and respective reports are as follows:

- Woo Shin PEng. conducted an inspection of geotechnical aspects of the underground mine;
- EBA Engineering Consultants conducted an inspection of the structures at and around the industrial complex on July 9th & 10th, 2013; and
- Klohn Crippen Berger conducted a physical inspection of the Tailings Storage Facility.

The results of these inspections and the actions taken to date by YZC are summarized in the *Wolverine Mine QML-0006 2013 Annual Report*.

8 Progressive Reclamation Effectiveness Monitoring Program

No progressive reclamation effectiveness monitoring has been conducted in 2013. The program was submitted as an addendum to the *Reclamation and Closure Plan V2013-05* and will begin implementation in the fall of 2014.

9 Biopass System

Bench scale test work for the bio-pass system was completed in 2010, with the data analysis completed in early 2012. The results were compiled into a Master's of Science Thesis for Royal Roads University, and is available at http://dspace.royalroads.ca/docs/bitstream/handle/10170/500/mioska_mary.pdf. Based on this research, recommendations have been advanced to further the design of a semi-passive treatment system. In collaboration with Yukon College, a study plan was developed and implemented with Dr. Amelie Janin (Industrial Research Chair) during 2013; establishment of the experimental design is ongoing. Further details on the Biopass Pilot Testing program can be found in the updated *Reclamation and Closure Plan V2013-05*.

10 Geochemical Testwork

Geochemical testwork at the Wolverine Mine was limited to humidity cell testwork, during construction. There were no construction activities in 2013, and no geochemical characterization samples were taken. These humidity cells have since been decommissioned. Humidity cells OA and OD were decommissioned February 3, 2012 and in April 2012 a request was sent to the Yukon Government Department of Energy, Mines and Resources to for approval to shut down the remaining seven operating cells. Approval to shut down the cells was received on May 11, 2012, and the cells were shut down in June 2012. The report summarizing the final results for these last seven decommissioned cells is provided in Appendix D (AMEC report) and Appendix E (MEA Report).

11 Underground Mine Monitoring

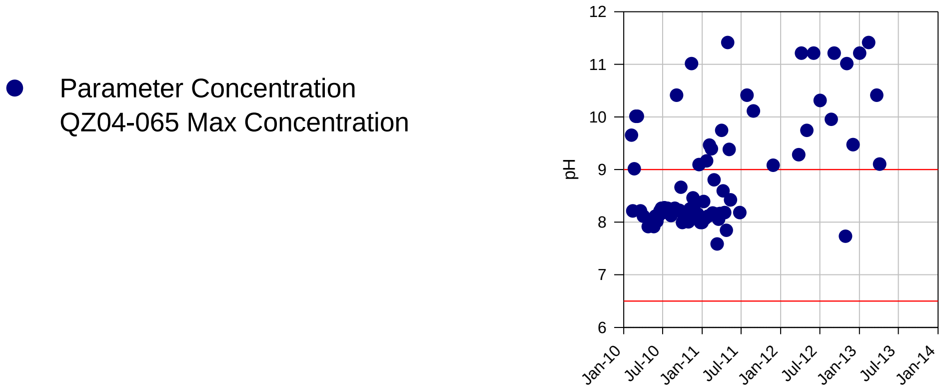
Underground mine monitoring in 2013 consisted of mostly water quality sampling and in-situ geochemical test pads. Paste and waste backfill placement underground continued in 2013. In total 146,850 cubic metre of underground space was filled with paste and waste in 2013. Wall wash stations and paste leachate monitoring stations are to be established in 2014, and the results presented in the 2014 Annual Report. The results of the water quality sampling and in-situ geochemical test pads are summarized below.

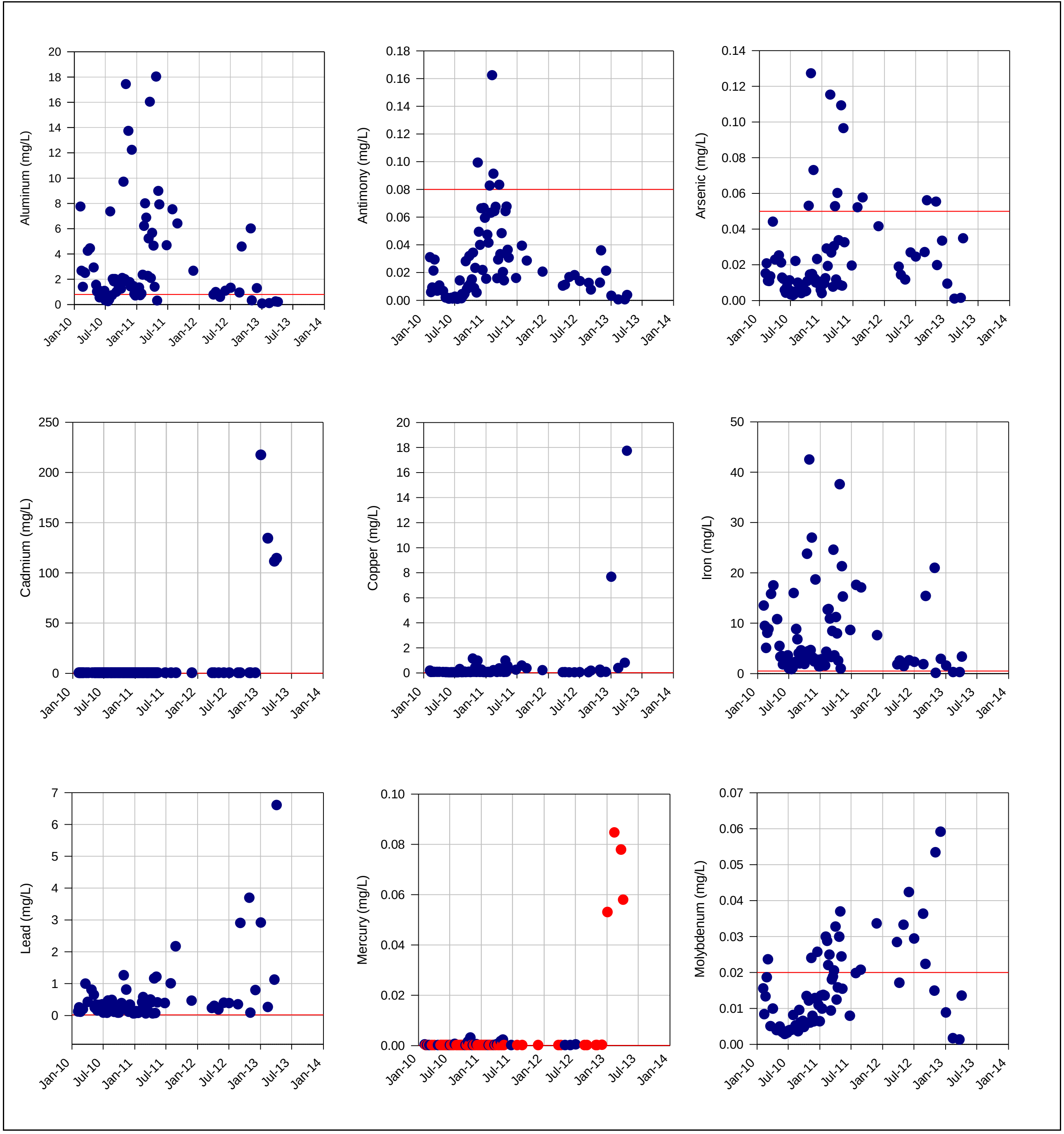
11.1 Underground Water Quality Sampling

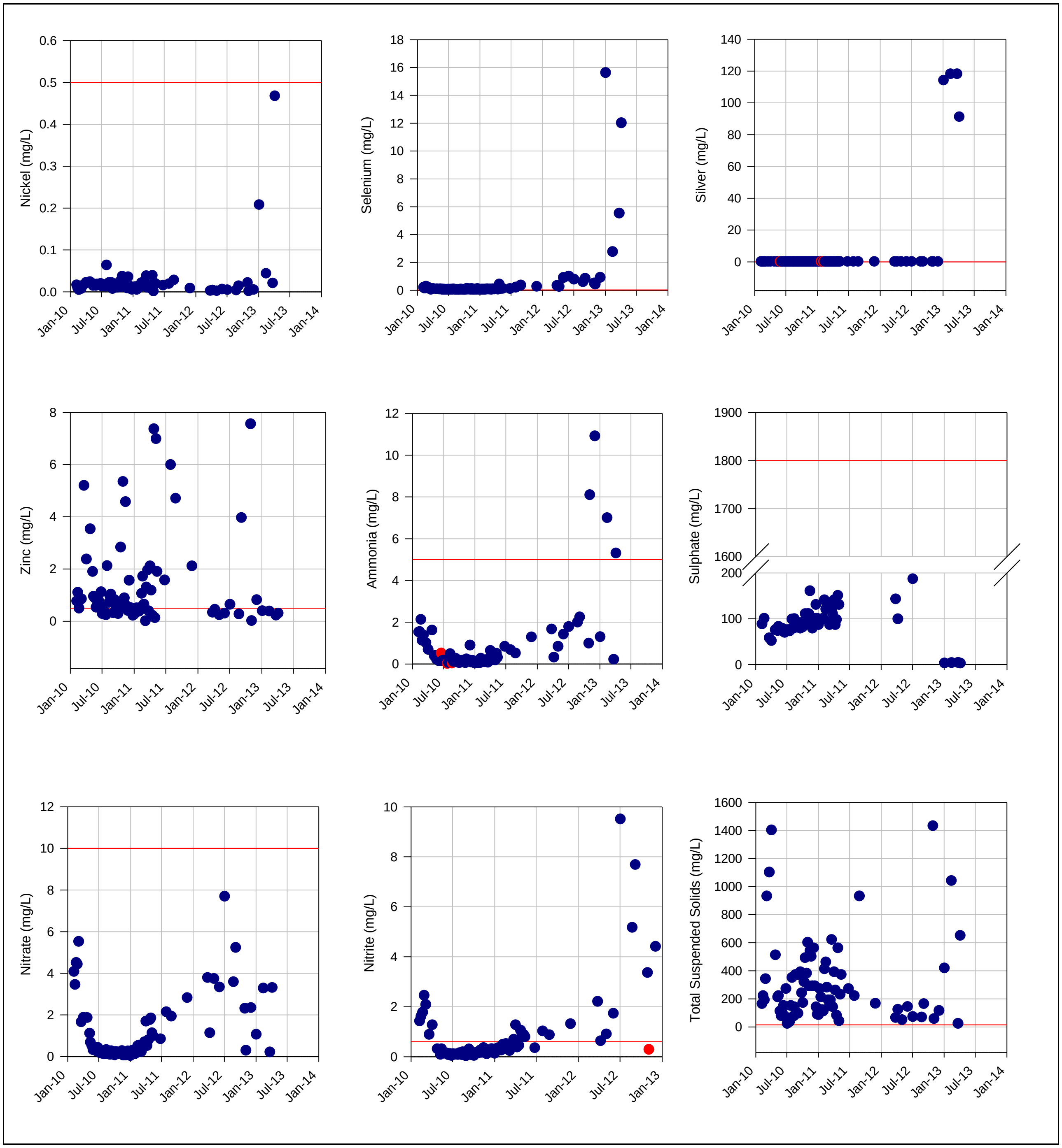
Water quality samples were collected from the end of the pipeline that discharged underground effluent into settling Sump #2, until April 2013. Revisions in June 2011 to the operating phase of the *YZC Wolverine Mine Water Management and Treatment Plan* (December 2009), reflected the operational changes to the majority of water management and treatment infrastructure and mine waste infrastructure. Underground mine effluent is subsequently pumped to the tailings storage facility for storage, and monitored monthly with samples captured from the tailings storage facility (T1). As result, sampling for Underground Test Mine Discharge (UTMD) in Sump #2 was decommissioned.

The results are presented graphically below for parameters limited by Type A Water Use Licence QZ04-065 (Yukon Water Board, 2007), and are compared to the maximum allowable discharge concentrations, as outlined in Part C of Licence QZ04-065. Red symbols in the graphs represent concentrations that were less than the laboratory reportable detection limits, and were taken to be equal to the detection limit in the graphs. The full water quality results for the underground water quality is presented in the *Type B Water Use Licence QZ01-051 2011 Annual Report.*

Water quality in the underground effluent was typically higher than Type A Water Use Licence QZ04-065 discharge limits for total suspended solids, Al, Sb, As, Cd, Cu, Fe, Pb, Hg, Mo, Ag, Se, Zn as well as nitrite.




Aluminum (mg/L)
0
2
4
6
8
10
12
14
16
18
20
Antimony (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
0.18
Arsenic (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
Cadmium (mg/L)
0
50
100
150
200
250
Copper (mg/L)
0
2
4
6
8
10
12
14
16
18
20
Iron (mg/L)
0
10
20
30
40
50
Lead (mg/L)
0
1
2
3
4
5
6
7
Mercury (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
Molybdenum (mg/L)
0.00
0.01
0.02
0.03
0.04
0.05
0.06
0.07
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14


Nickel (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Selenium (mg/L)
0
2
4
6
8
10
12
14
16
18
Silver (mg/L)
0
20
40
60
80
100
120
140
Zinc (mg/L)
0
2
4
6
8
Ammonia (mg/L)
0
2
4
6
8
10
12
Sulphate (mg/L)
0
100
200
1600
1700
1800
1900
Nitrate (mg/L)
0
2
4
6
8
10
12
Nitrite (mg/L)
0
2
4
6
8
10
Total Suspended Solids (mg/L)
0
200
400
600
800
1000
1200
1400
1600
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

11.2 Paste Leachate Monitoring

Paste backfilling of the underground mine commenced in November 2011, and reached steady state in 2013. As paste backfilling continues to develop on site the paste leachate monitoring stations are to be established in 2014.

11.3 Wash Stations

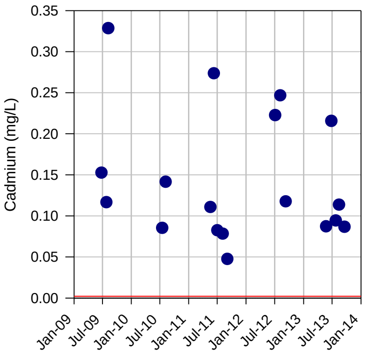
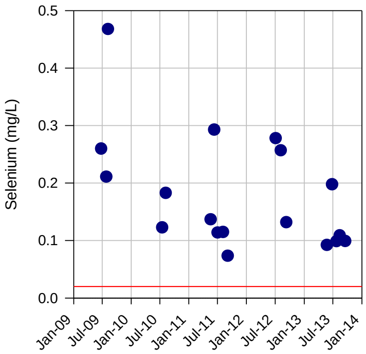
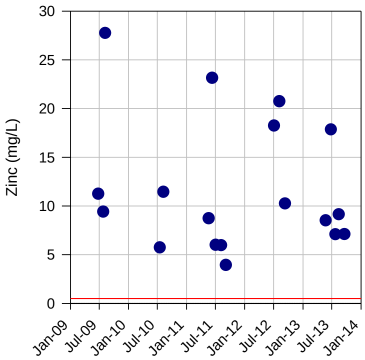
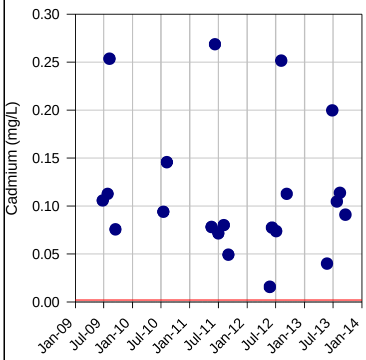
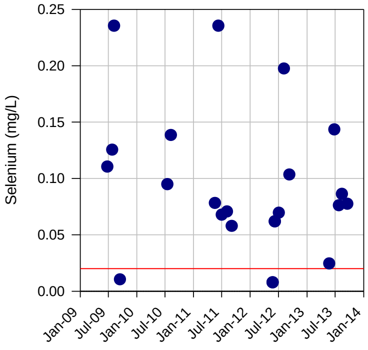
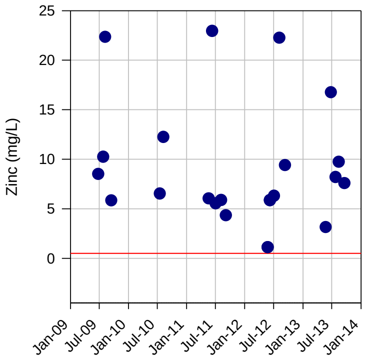
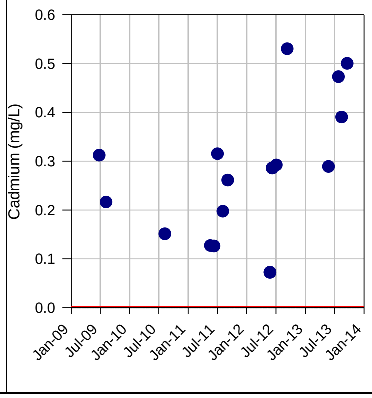
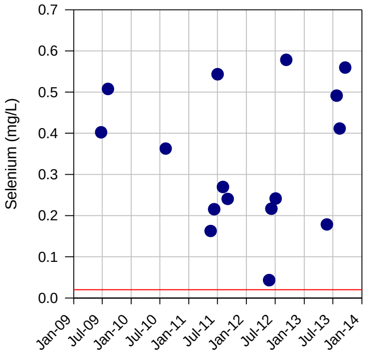
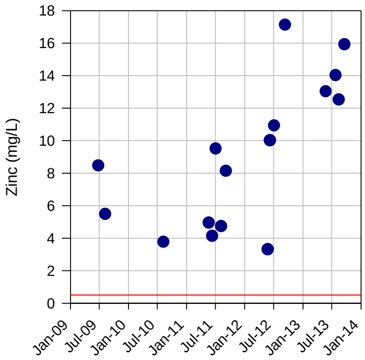
Wall washing techniques measure unit-area geochemical reaction rates and concentrations. Wall washing is to be performed quarterly on selected walls within the mine that represent dominant rock types and paste backfilled stopes. Wall washing was not conducted in 2013, but stations will be established in 2014, and monitoring will be conducted quarterly.

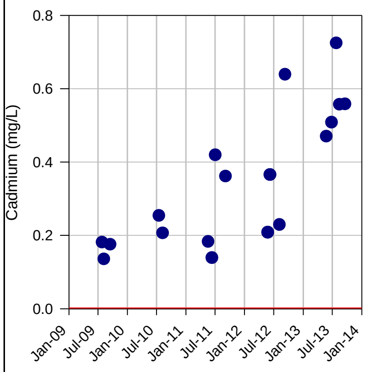
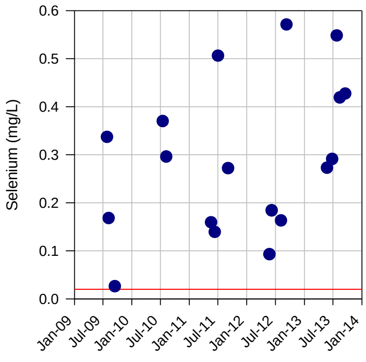
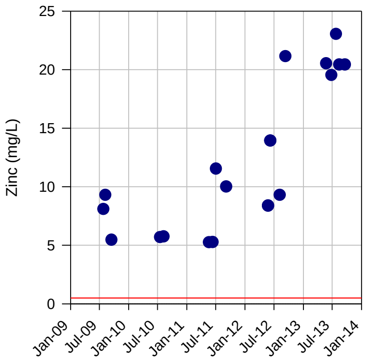
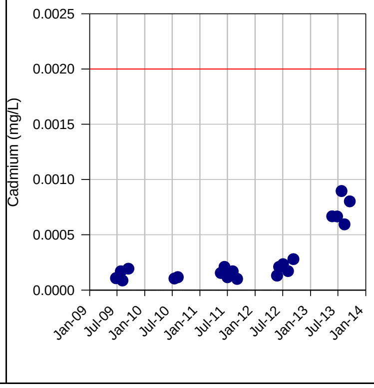
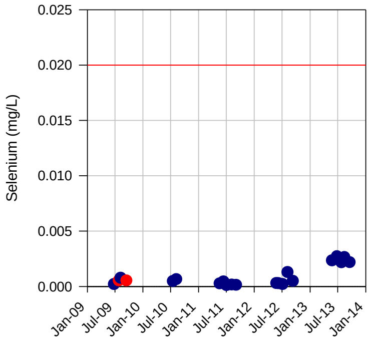
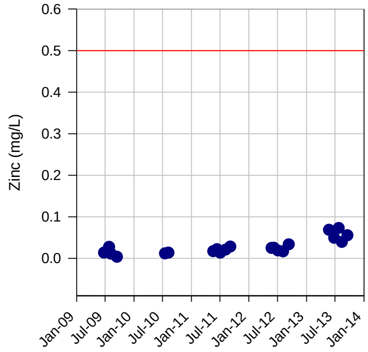
11.4 In-situ Geochemical Test Pads

The geochemical test pads (lysimeters) installed at the Wolverine Mine received precipitation from the environment and the leachate collects in 20L buckets placed below the pads. There are five pads constructed at the Wolverine Mine: two containing 100% ore (lysimeters A & B); two containing 50% ore and 50% waste rock (lysimeters C & D); and one control cell, which collects only rainwater (lysimeter E). Water quality samples were taken in 2013 and the results are summarized graphically below. Four addition test pads (two duplicate pads) are to be established in 2014 for the evaluation of tailings and paste backfill geochemistry.

The water chemistry in the runoff from the lysimeters with 100% ore and 50% ore and waste rock are typified by high metal concentrations, most notably for Cd, Cu, Fe, Pb, Se, and Zn, for which the concentrations are at least one order of magnitude greater than the concentrations in the runoff from the control cell. Cd, Se and Zn concentrations in the runoff from the ore containing cells are three orders of magnitude greater than the control cell, as shown in the figures below. Also, the leachate selenium and zinc concentrations were greater in the cells with 50% ore and 50% waste compared to the cells containing 100% ore.

The figures below have the Type A Water Use Licence QZ04-065 discharge limit shown to allow comparison between cells. Red data points indicate that the result was below the reportable detection limit, and is shown as equal to the limit in the graph. The graphs for the other parameters limited by Licence QZ04-065 are provided in Appendix C, and the full water quality results are available upon request. Water quality in the lysimeters with ore were typically higher than Type A Water Use Licence QZ04-065 discharge limits for cadmium, lead, zinc, selenium, and copper.

Test Pad	Cadmium	Selenium	Zinc
A			
B			
C			

Test Pad	Cadmium	Selenium	Zinc
D			
E			

12 Summary

This report summarized the results of monitoring and surveillance conduced as per Monitoring and Surveillance Plan V2011-02 for the January – December 2013 period. The results indicate that there is no change in environmental performance of the undertaking evident during the monitoring period.

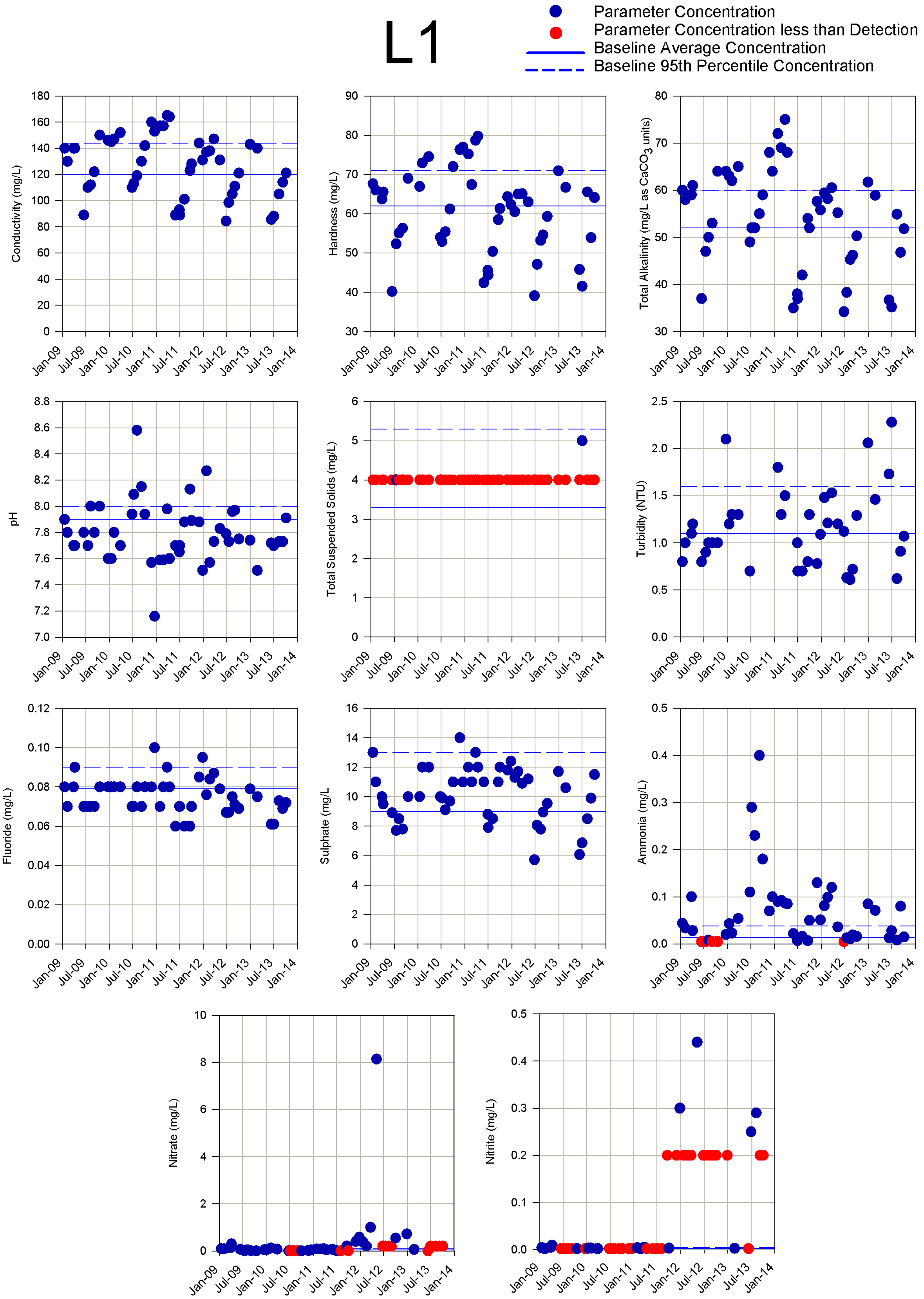
13 Works Cited

Metal Mining Effluent Regulations, SOR/2202-222 (2006).

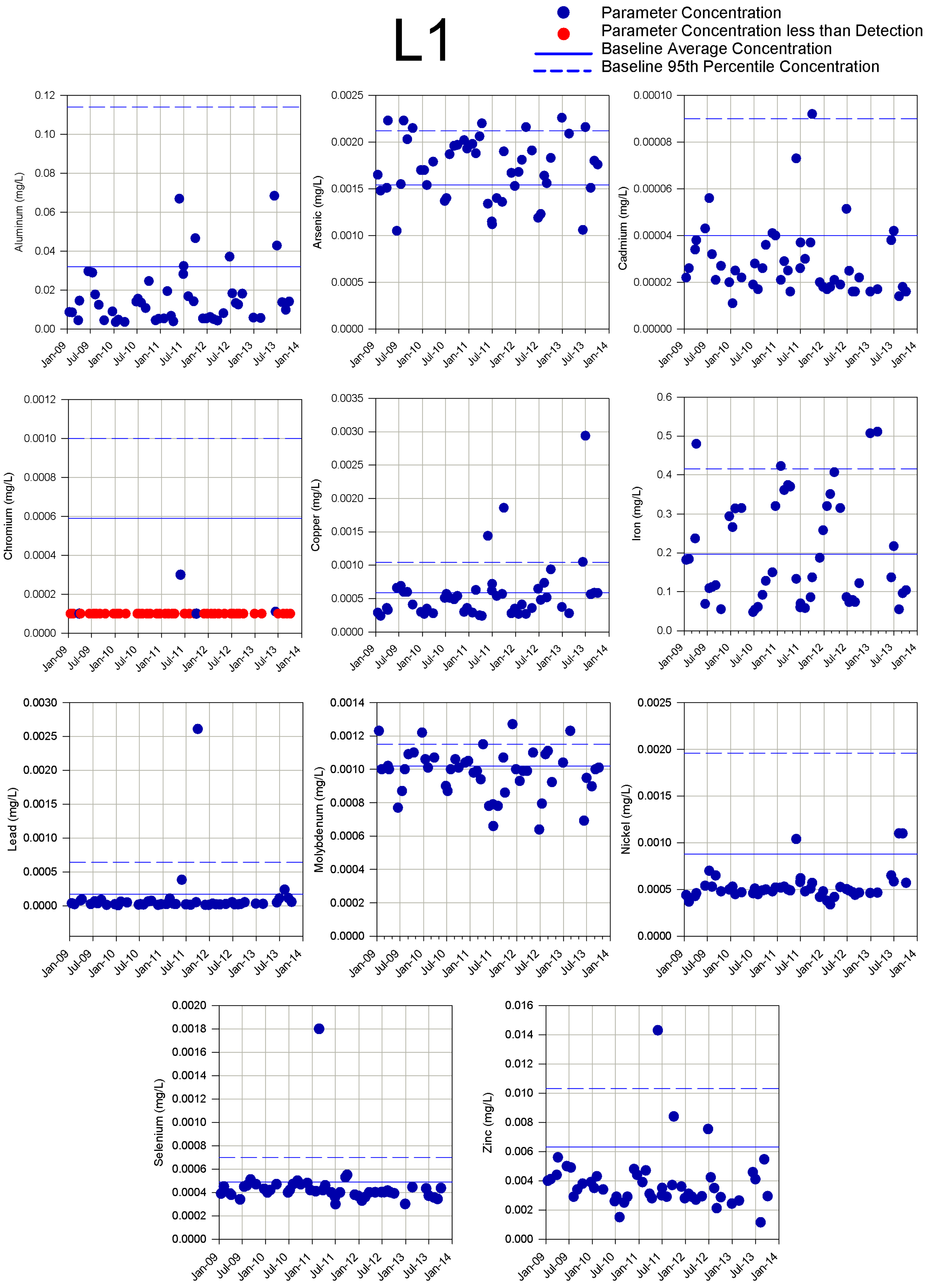
Yukon Water Board. (2007, October 4). Type A Water Use Licence QZ04-065. Whitehorse, YT, Canada.

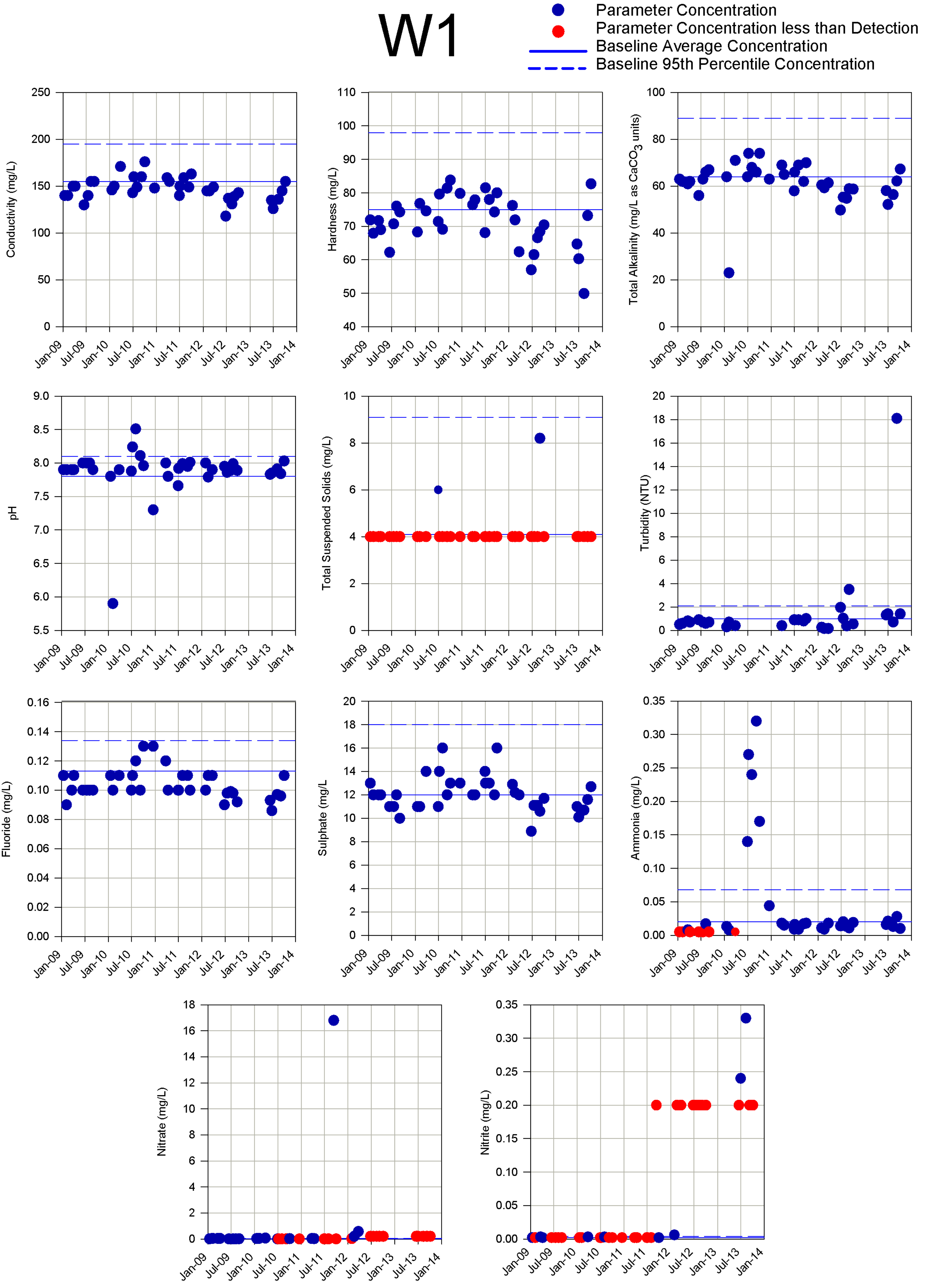
Appendix A: Surface Water Quality – Graphs

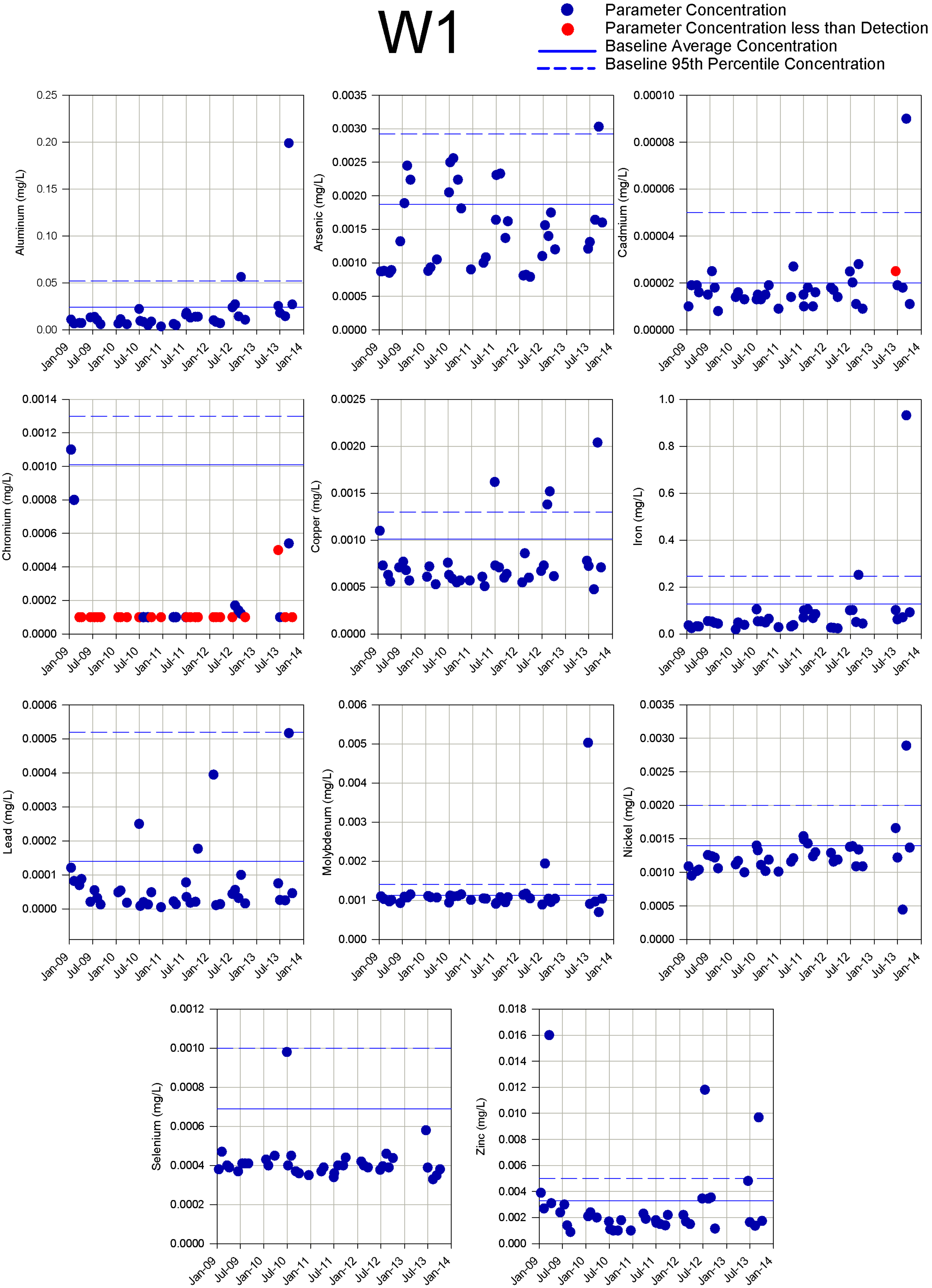
L1


Parameter Concentration
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
Hardness (mg/L)
Total Alkalinity (mg/L as $CaCO_3$ units)
pH
Total Suspended Solids (mg/L)
Turbidity (NTU)
Fluoride (mg/L)
Sulphate (mg/L
Ammonia (mg/L)
Nitrate (mg/L)
Nitrite (mg/L)
0
20
40
60
80
100
120
140
160
180
30
50
70
90
7.0
7.2
7.4
7.6
7.8
8.0
8.2
8.4
8.6
8.8
1
2
3
4
5
6
0.0
0.5
1.0
1.5
2.0
2.5
0.00
0.02
0.04
0.06
0.08
0.10
0.12
8
10
12
14
16
0.1
0.2
0.3
0.4
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

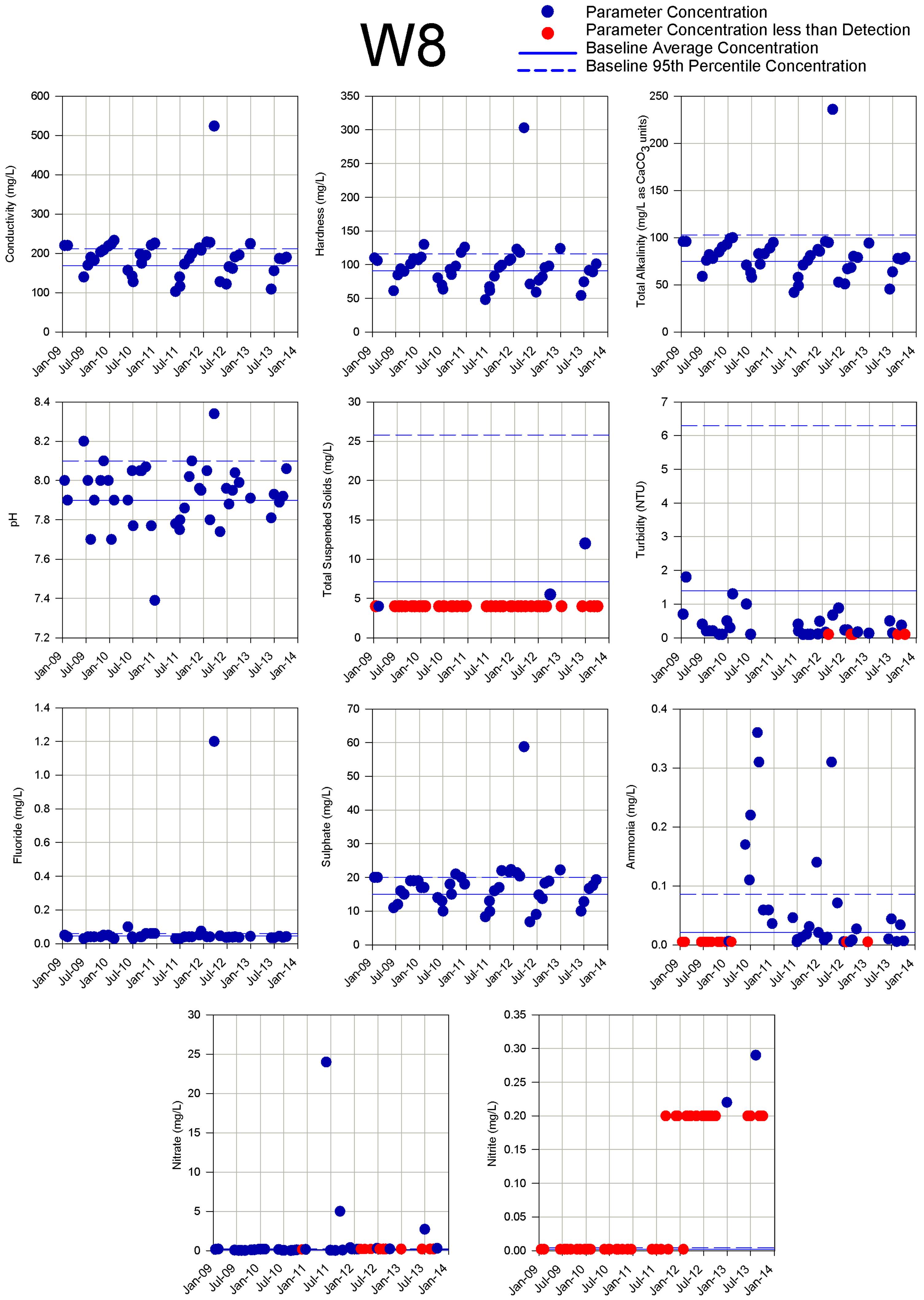
L1


Parameter Concentration
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
0.12
Arsenic (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
Cadmium (mg/L)
0.00000
0.00002
0.00004
0.00006
0.00008
0.00010
Chromium (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
Copper (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
0.0030
0.0035
Iron (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Lead (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
0.0030
Molybdenum (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
Nickel (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
Selenium (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
0.0016
0.0018
0.0020
Zinc (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0.014
0.016
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14


W1
Parameter Concentration
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
0
50
100
150
200
250
Hardness (mg/L)
40
50
60
70
80
90
100
110
Total Alkalinity (mg/L as $CaCO_3$ units)
0
20
40
60
80
100
pH
5.5
6.0
6.5
7.0
7.5
8.0
8.5
9.0
Total Suspended Solids (mg/L)
0
2
4
6
8
10
Turbidity (NTU)
0
2
4
6
8
10
12
14
16
18
20
Fluoride (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
Sulphate (mg/L
0
2
4
6
8
10
12
14
16
18
20
Ammonia (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
Nitrate (mg/L)
0
2
4
6
8
10
12
14
16
18
Nitrite (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

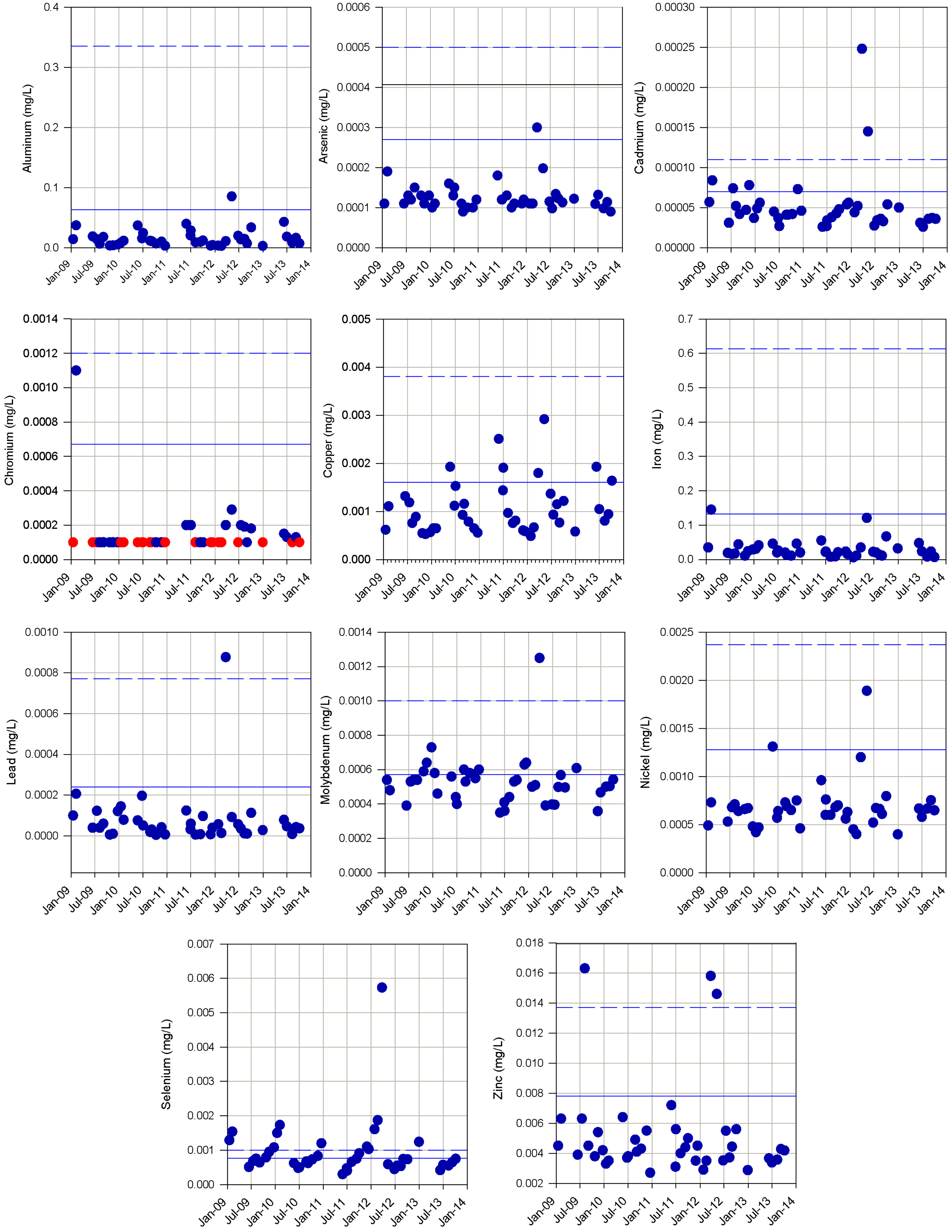

W1
● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
Arsenic (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
0.0030
0.0035
Cadmium (mg/L)
0.00000
0.00002
0.00004
0.00006
0.00008
0.00010
Chromium (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
Copper (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
Iron (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
Lead (mg/L)
0.0000
0.0001
0.0002
0.0003
0.0004
0.0005
0.0006
Molybdenum (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
0.006
Nickel (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
0.0030
0.0035
Selenium (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
Zinc (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0.014
0.016
0.018
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

W8

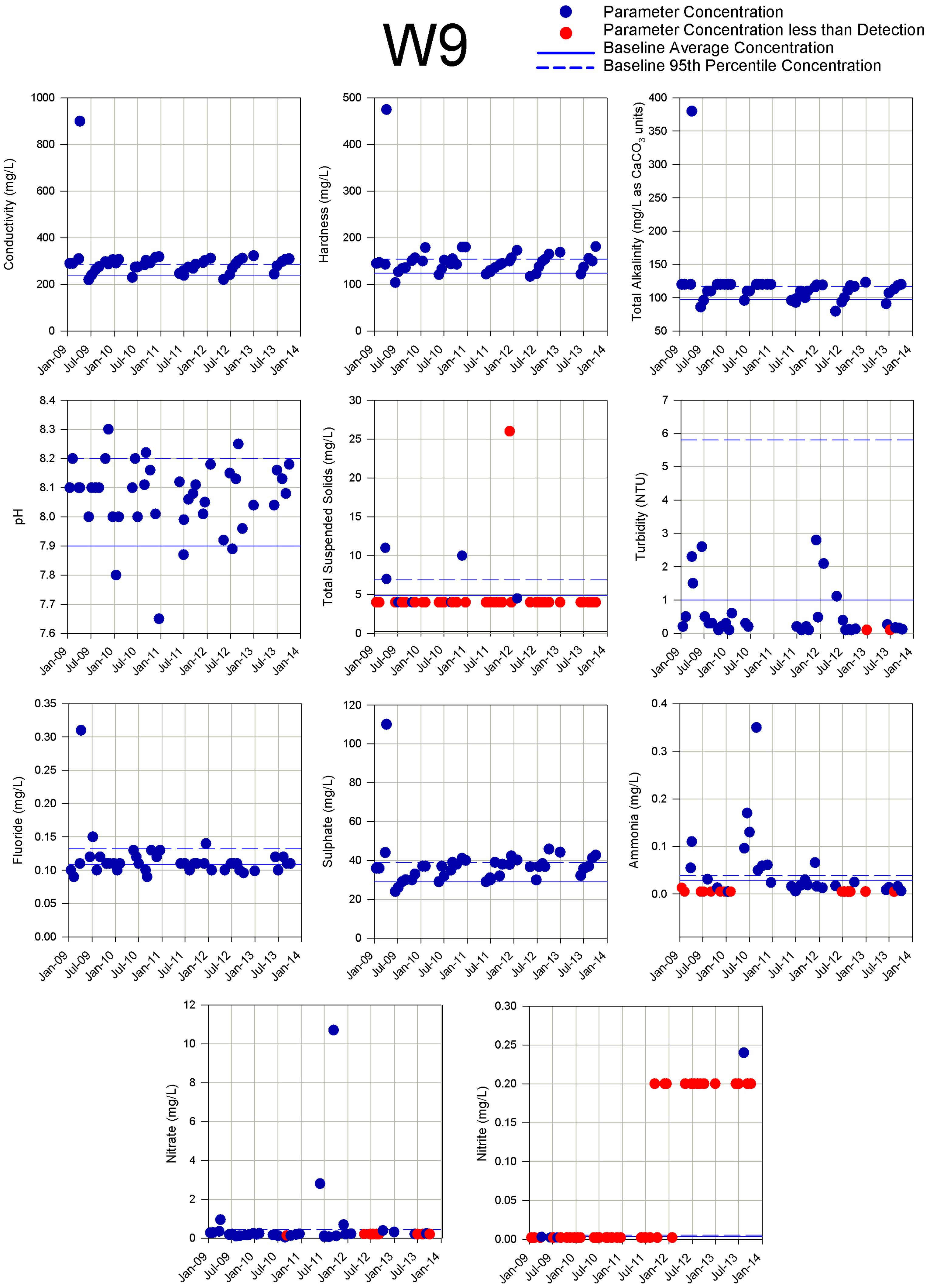

● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
0
100
200
300
400
500
600
Hardness (mg/L)
0
50
100
150
200
250
300
350
Total Alkalinity (mg/L as $CaCO_3$ units)
0
50
100
150
200
250
pH
7.2
7.4
7.6
7.8
8.0
8.2
8.4
Total Suspended Solids (mg/L)
0
5
10
15
20
25
30
Turbidity (NTU)
0
1
2
3
4
5
6
7
Fluoride (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
Sulphate (mg/L)
0
10
20
30
40
50
60
70
Ammonia (mg/L)
0.0
0.1
0.2
0.3
0.4
Nitrate (mg/L)
0
5
10
15
20
25
30
Nitrite (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

W8

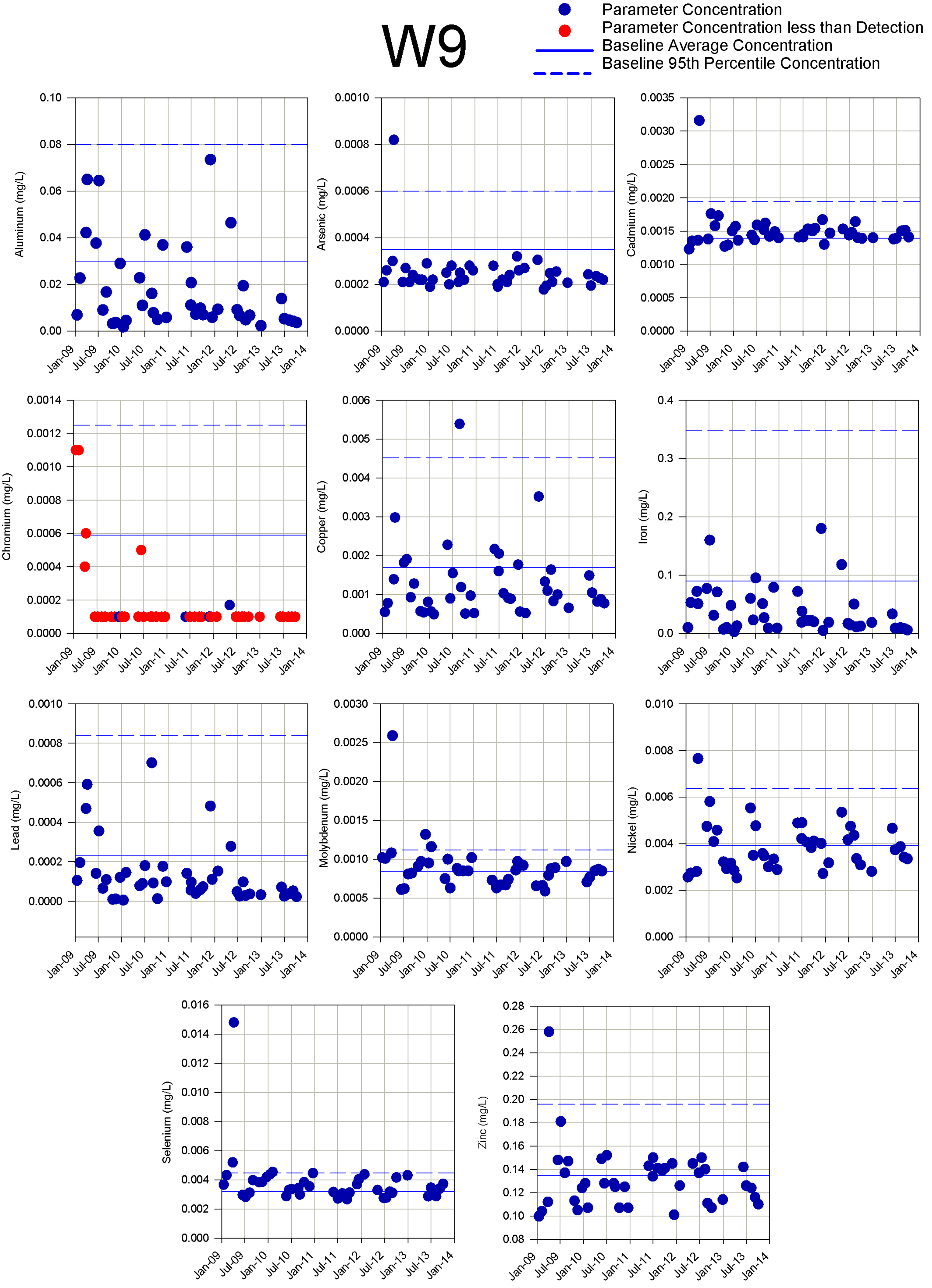
● Parameter Concentration
● Parameter Concentration less than Detection
—— Baseline Average Concentration
– – – Baseline 95th Percentile Concentration



W9

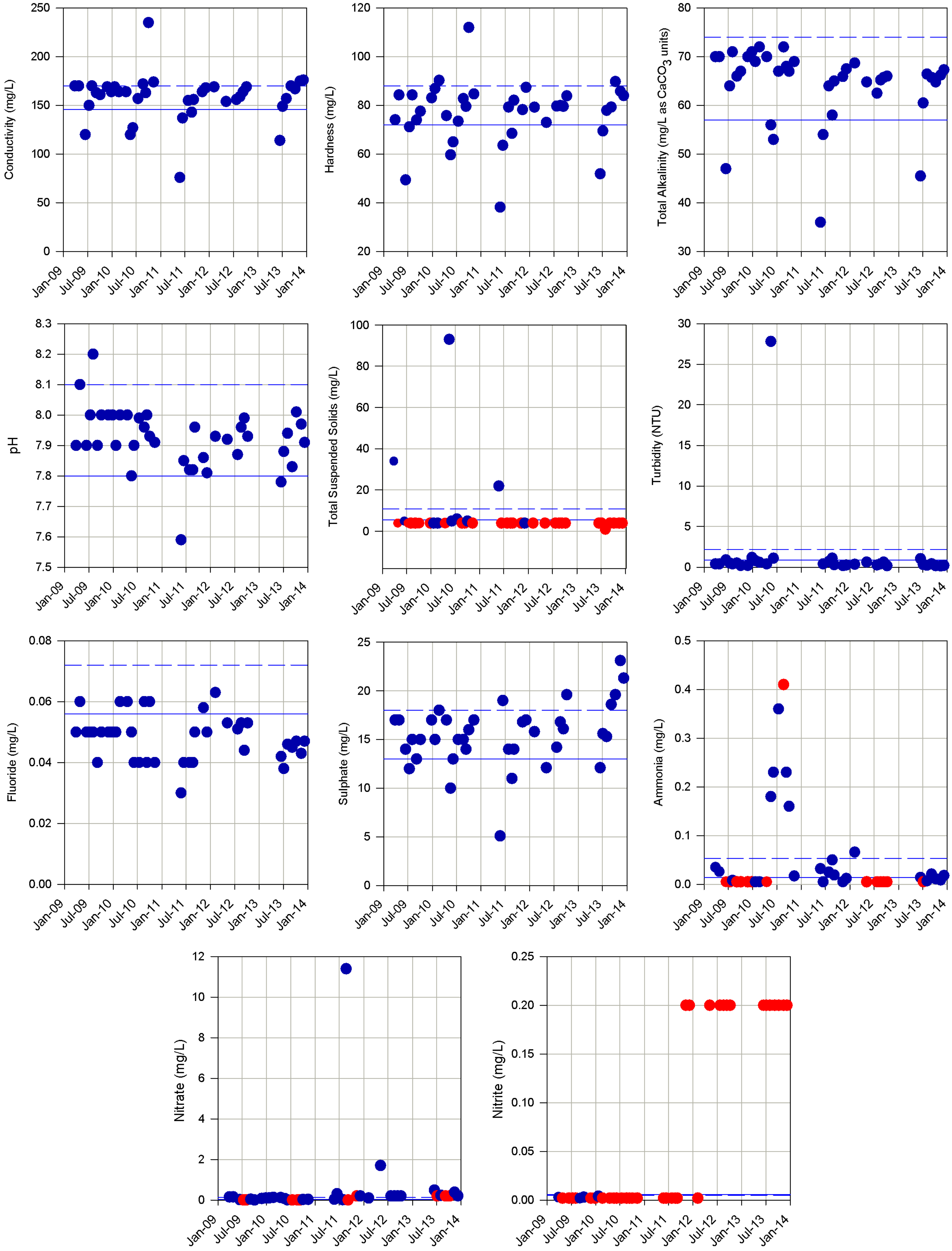

● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
0
200
400
600
800
1000
Hardness (mg/L)
0
100
200
300
400
500
Total Alkalinity (mg/L as $CaCO_3$ units)
50
100
150
200
250
300
350
400
pH
7.6
7.7
7.8
7.9
8.0
8.1
8.2
8.3
8.4
Total Suspended Solids (mg/L)
0
5
10
15
20
25
30
Turbidity (NTU)
0
1
2
3
4
5
6
7
Fluoride (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
Sulphate (mg/L)
0
20
40
60
80
100
120
Ammonia (mg/L)
0.0
0.1
0.2
0.3
0.4
Nitrate (mg/L)
0
2
4
6
8
10
12
Nitrite (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

W9

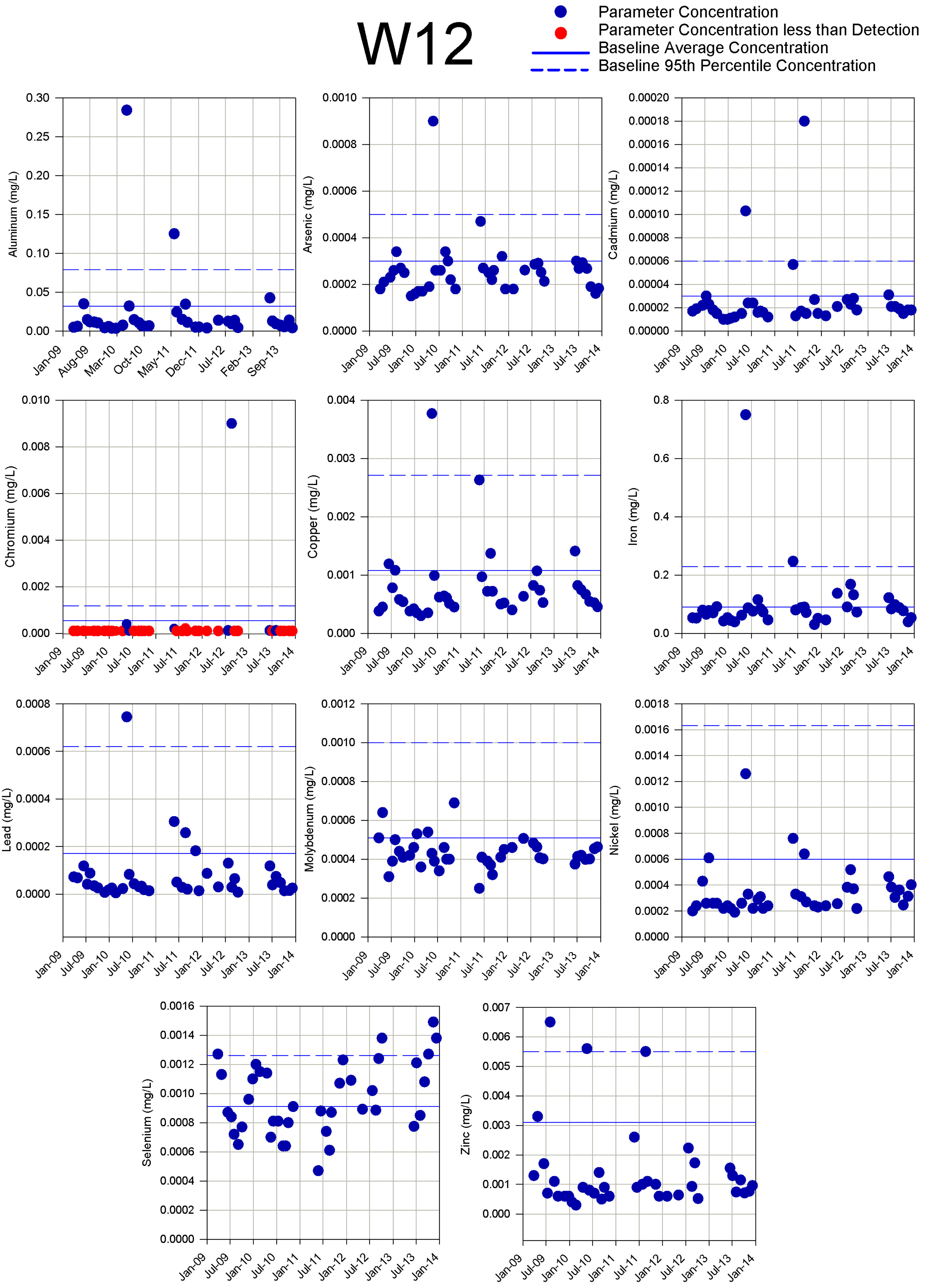

Parameter Concentration
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
Arsenic (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
Cadmium (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
0.0030
0.0035
Chromium (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
Copper (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
0.006
Iron (mg/L)
0.0
0.1
0.2
0.3
0.4
Lead (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
Molybdenum (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
0.0030
Nickel (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
Selenium (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0.014
0.016
Zinc (mg/L)
0.08
0.10
0.12
0.14
0.16
0.18
0.20
0.22
0.24
0.26
0.28
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

W12

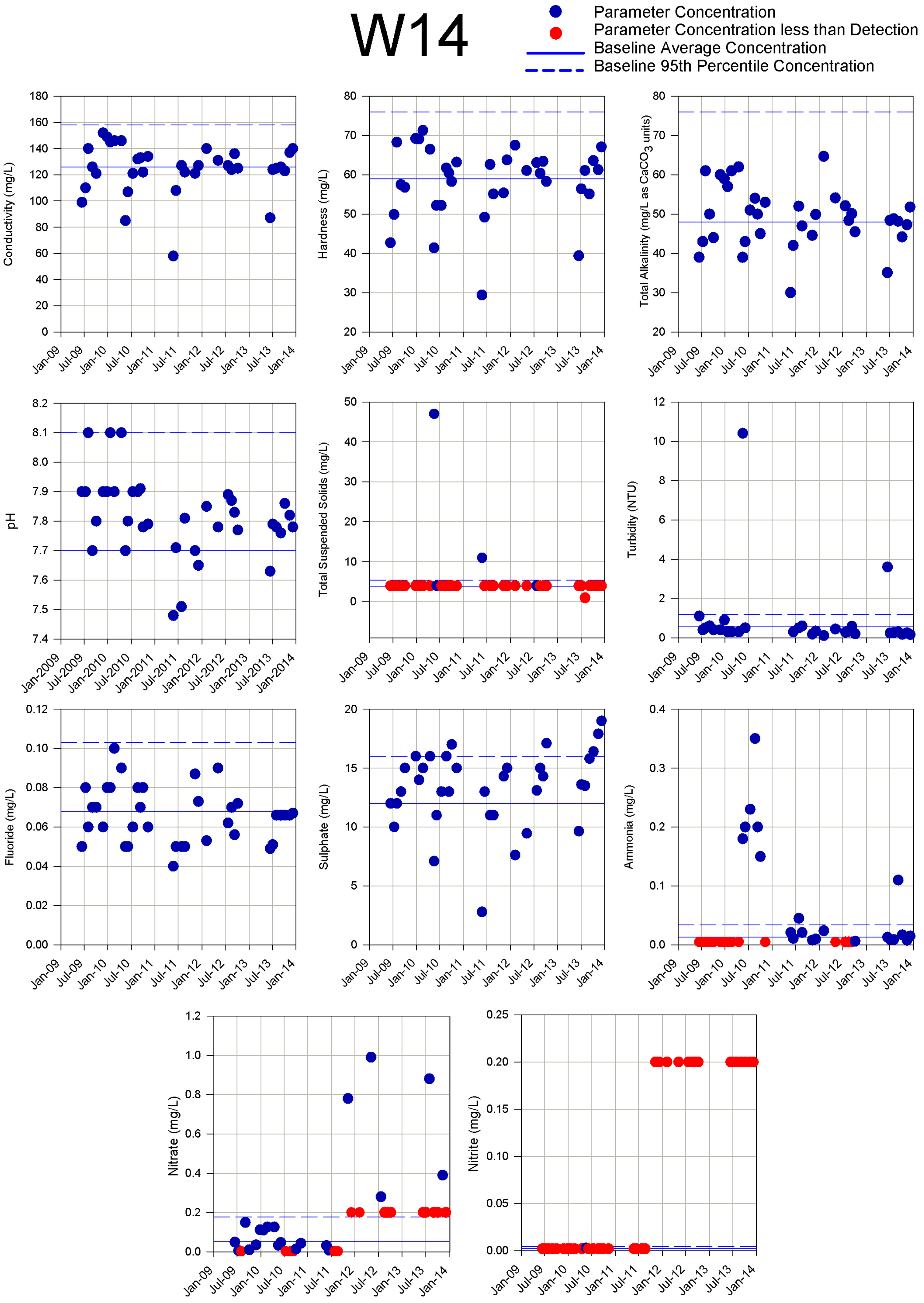
● Parameter Concentration
● Parameter Concentration less than Detection
— Baseline Average Concentration
– – Baseline 95th Percentile Concentration



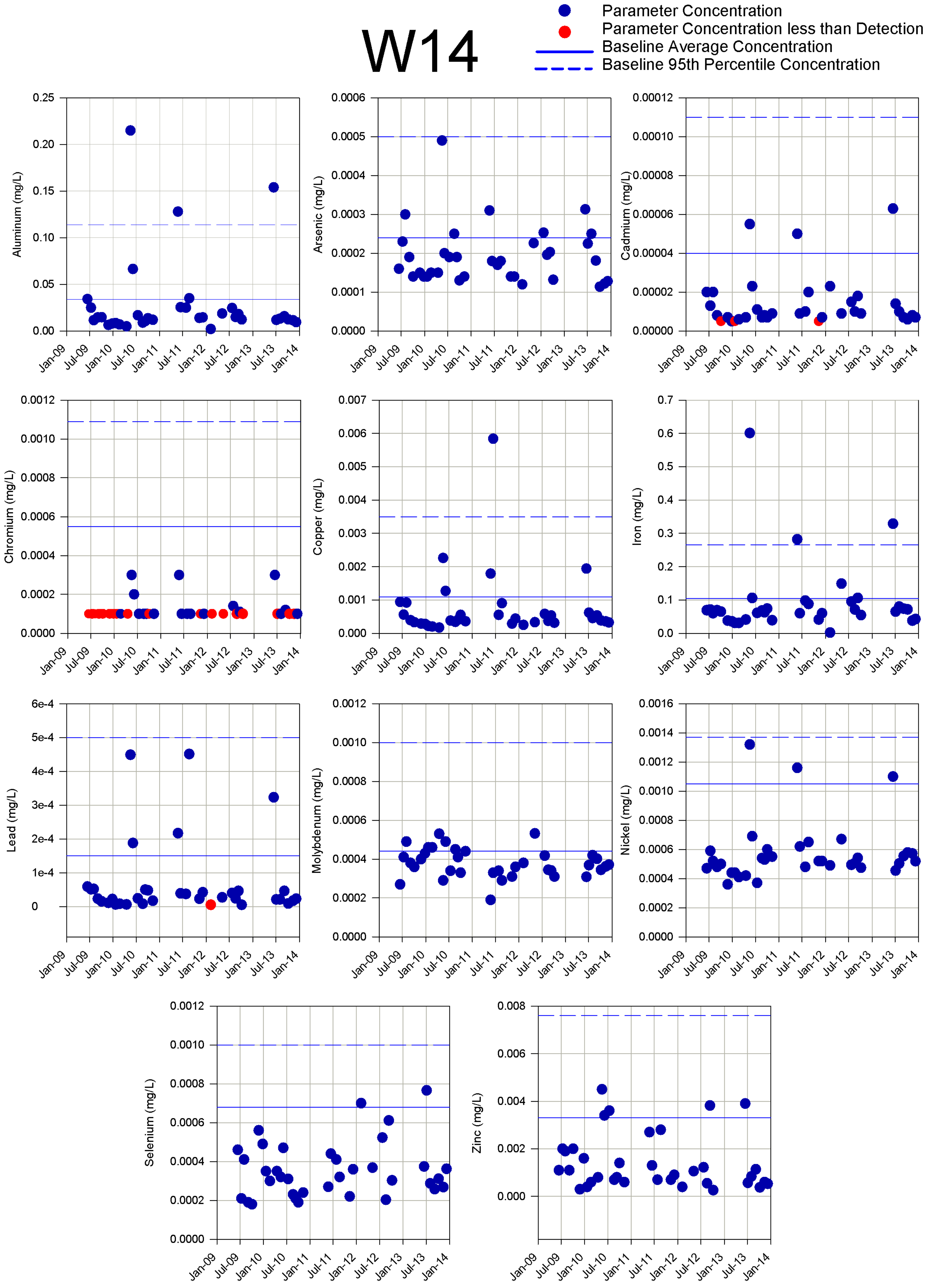
W12



Parameter Concentration
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
Jan-09
Aug-09
Mar-10
Oct-10
May-11
Dec-11
Jul-12
Feb-13
Sep-13
Arsenic (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
Cadmium (mg/L)
0.00000
0.00002
0.00004
0.00006
0.00008
0.00010
0.00012
0.00014
0.00016
0.00018
0.00020
Chromium (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
Copper (mg/L)
0.000
0.001
0.002
0.003
0.004
Iron (mg/L)
0.0
0.2
0.4
0.6
0.8
Lead (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
Molybdenum (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
Nickel (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
0.0016
0.0018
Selenium (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
0.0016
Zinc (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
0.006
0.007
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

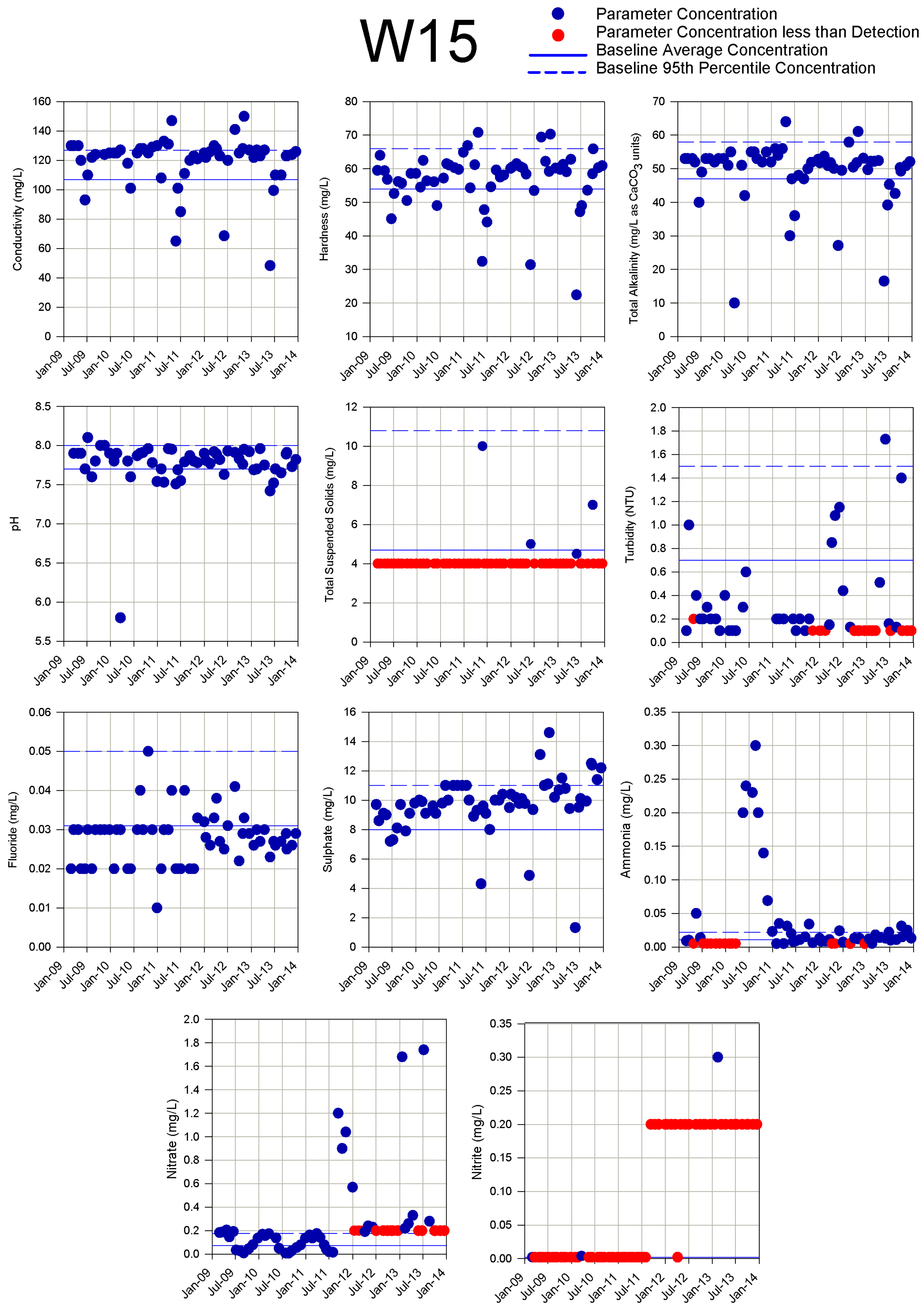

W14
Parameter Concentration
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
0
20
40
60
80
100
120
140
160
180
Hardness (mg/L)
20
30
40
50
60
70
80
Total Alkalinity (mg/L as $CaCO_3$ units)
pH
7.4
7.5
7.6
7.7
7.8
7.9
8.0
8.1
8.2
Jan-2009
Jul-2009
Jan-2010
Jul-2010
Jan-2011
Jul-2011
Jan-2012
Jul-2012
Jan-2013
Jul-2013
Jan-2014
Total Suspended Solids (mg/L)
0
10
20
30
40
50
Turbidity (NTU)
0
2
4
6
8
10
12
Fluoride (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
0.12
Sulphate (mg/L)
0
5
10
15
20
Ammonia (mg/L)
0.0
0.1
0.2
0.3
0.4
Nitrate (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Nitrite (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

W14

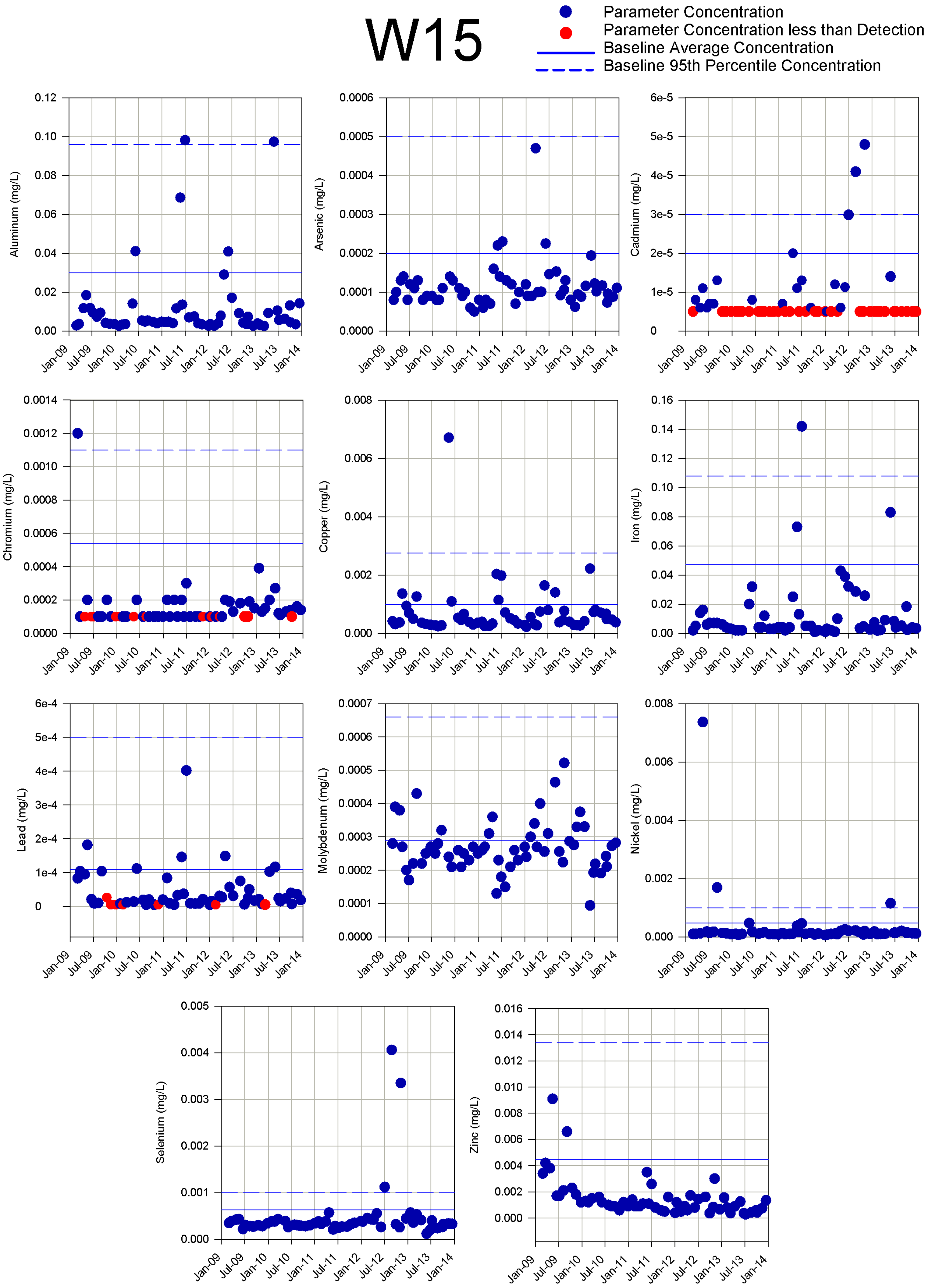


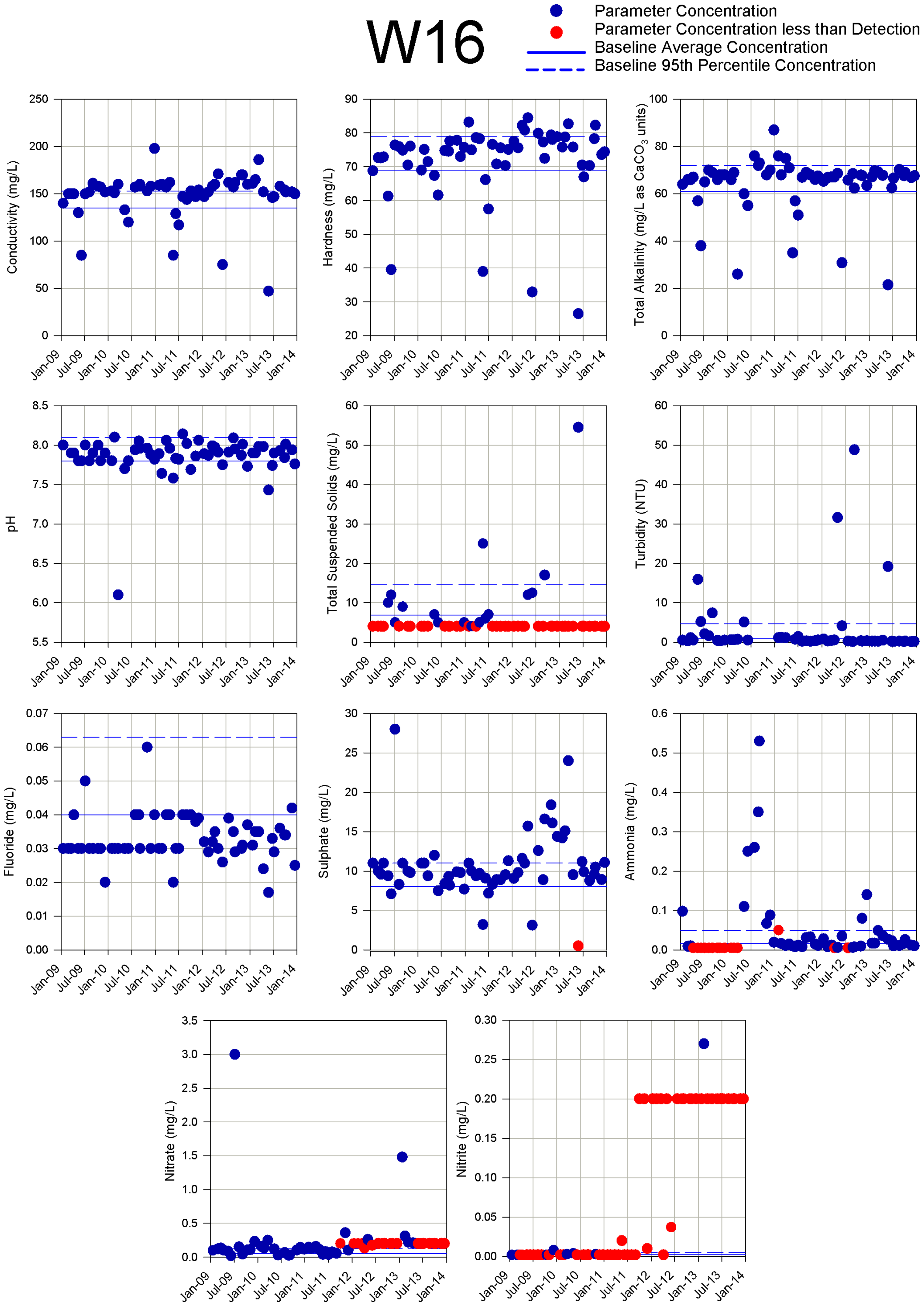
● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.00 0.05 0.10 0.15 0.20 0.25
Arsenic (mg/L)
0.0000 0.0001 0.0002 0.0003 0.0004 0.0005 0.0006
Cadmium (mg/L)
0.00000 0.00002 0.00004 0.00006 0.00008 0.00010 0.00012
Chromium (mg/L)
0.0000 0.0002 0.0004 0.0006 0.0008 0.0010 0.0012
Copper (mg/L)
0.000 0.001 0.002 0.003 0.004 0.005 0.006 0.007
Iron (mg/L)
0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7
Lead (mg/L)
0 1e-4 2e-4 3e-4 4e-4 5e-4 6e-4
Molybdenum (mg/L)
0.0000 0.0002 0.0004 0.0006 0.0008 0.0010 0.0012
Nickel (mg/L)
0.0000 0.0002 0.0004 0.0006 0.0008 0.0010 0.0012 0.0014 0.0016
Selenium (mg/L)
0.0000 0.0002 0.0004 0.0006 0.0008 0.0010 0.0012
Zinc (mg/L)
0.000 0.002 0.004 0.006 0.008
Jan-09 Jul-09 Jan-10 Jul-10 Jan-11 Jul-11 Jan-12 Jul-12 Jan-13 Jul-13 Jan-14

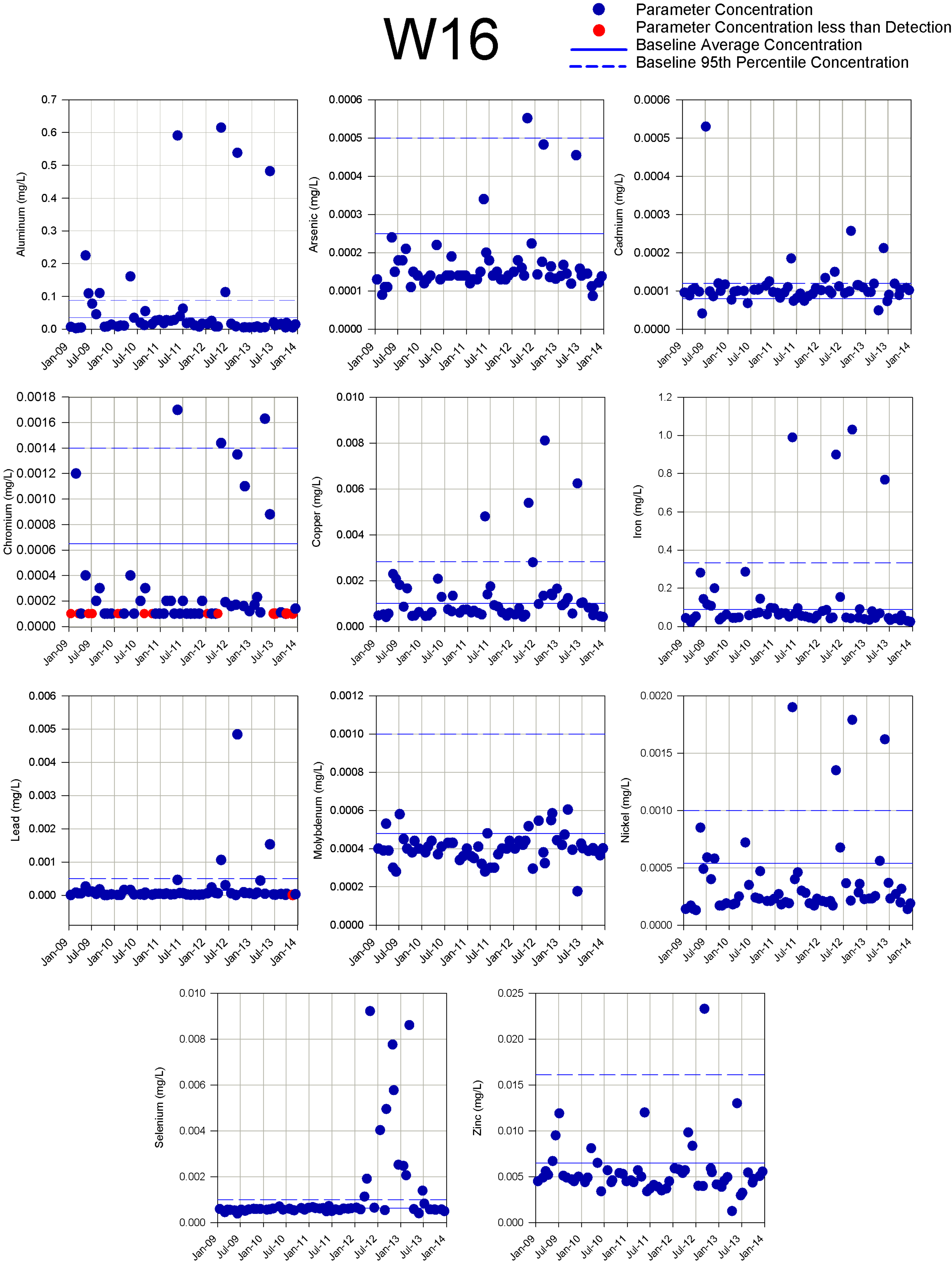
W15


● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
0
20
40
60
80
100
120
140
160
Hardness (mg/L)
10
20
30
40
50
60
70
80
Total Alkalinity (mg/L as $CaCO_3$ units)
0
10
20
30
40
50
60
70
pH
5.5
6.0
6.5
7.0
7.5
8.0
8.5
Total Suspended Solids (mg/L)
0
2
4
6
8
10
12
Turbidity (NTU)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
Fluoride (mg/L)
0.00
0.01
0.02
0.03
0.04
0.05
0.06
Sulphate (mg/L)
0
2
4
6
8
10
12
14
16
Ammonia (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
Nitrate (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
Nitrite (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

W15

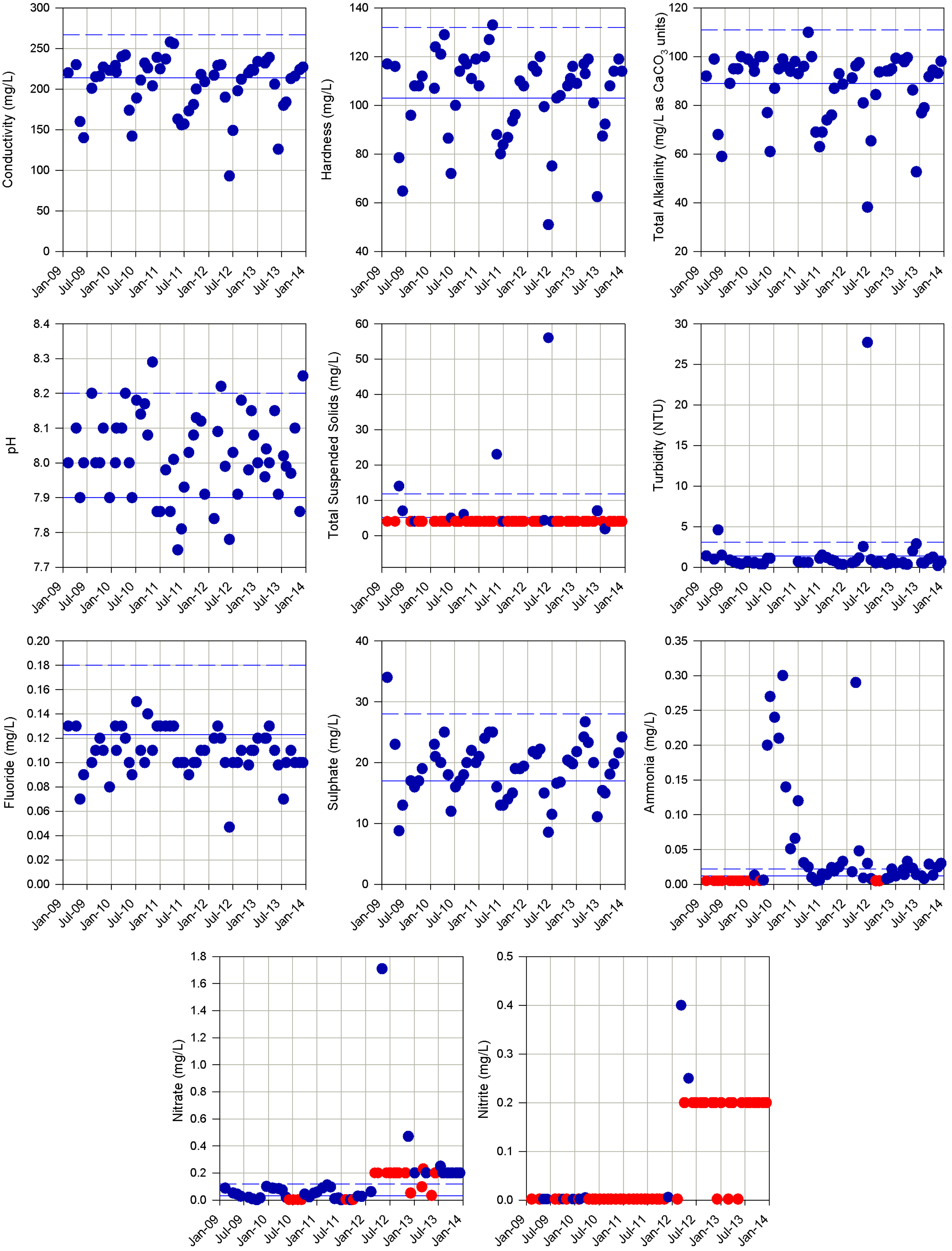

Parameter Concentration
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
0.12
Arsenic (mg/L)
0.0000
0.0001
0.0002
0.0003
0.0004
0.0005
0.0006
Cadmium (mg/L)
0
1e-5
2e-5
3e-5
4e-5
5e-5
6e-5
Chromium (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
Copper (mg/L)
0.000
0.002
0.004
0.006
0.008
Iron (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
Lead (mg/L)
0
1e-4
2e-4
3e-4
4e-4
5e-4
6e-4
Molybdenum (mg/L)
0.0000
0.0001
0.0002
0.0003
0.0004
0.0005
0.0006
0.0007
Nickel (mg/L)
0.000
0.002
0.004
0.006
0.008
Selenium (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
Zinc (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0.014
0.016
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

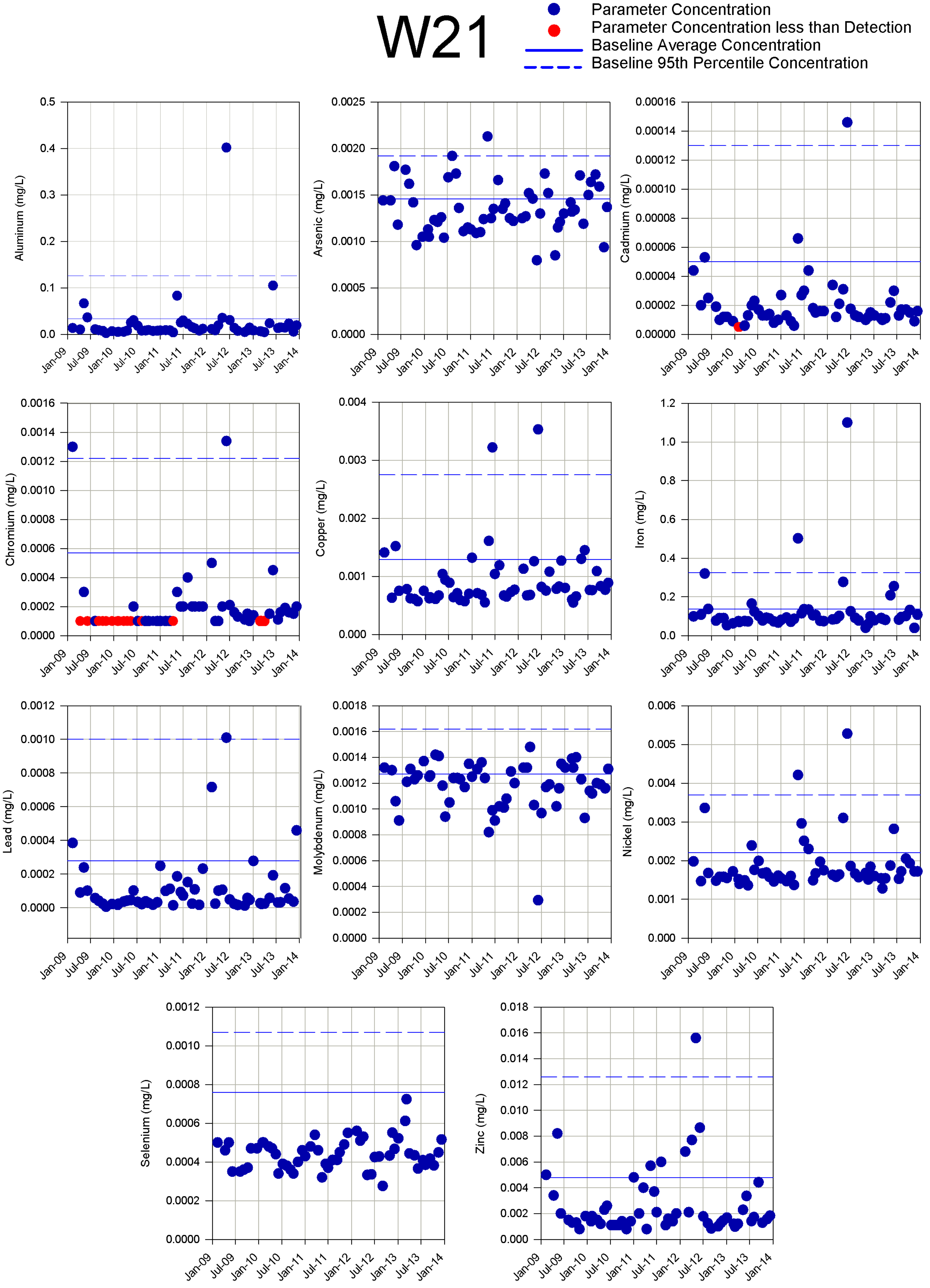

W16
Parameter Concentration
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
0
50
100
150
200
250
Hardness (mg/L)
20
30
40
50
60
70
80
90
Total Alkalinity (mg/L as $CaCO_3$ units)
0
20
40
60
80
100
pH
5.5
6.0
6.5
7.0
7.5
8.0
8.5
Total Suspended Solids (mg/L)
0
10
20
30
40
50
60
Turbidity (NTU)
0
10
20
30
40
50
60
Fluoride (mg/L)
0.00
0.01
0.02
0.03
0.04
0.05
0.06
0.07
Sulphate (mg/L)
0
5
10
15
20
25
30
Ammonia (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Nitrate (mg/L)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
Nitrite (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14


W16
● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Arsenic (mg/L)
0.0000
0.0001
0.0002
0.0003
0.0004
0.0005
0.0006
Cadmium (mg/L)
0.0000
0.0001
0.0002
0.0003
0.0004
0.0005
0.0006
Chromium (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
0.0016
0.0018
Copper (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
Iron (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Lead (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
0.006
Molybdenum (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
Nickel (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
Selenium (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
Zinc (mg/L)
0.000
0.005
0.010
0.015
0.020
0.025
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

W21

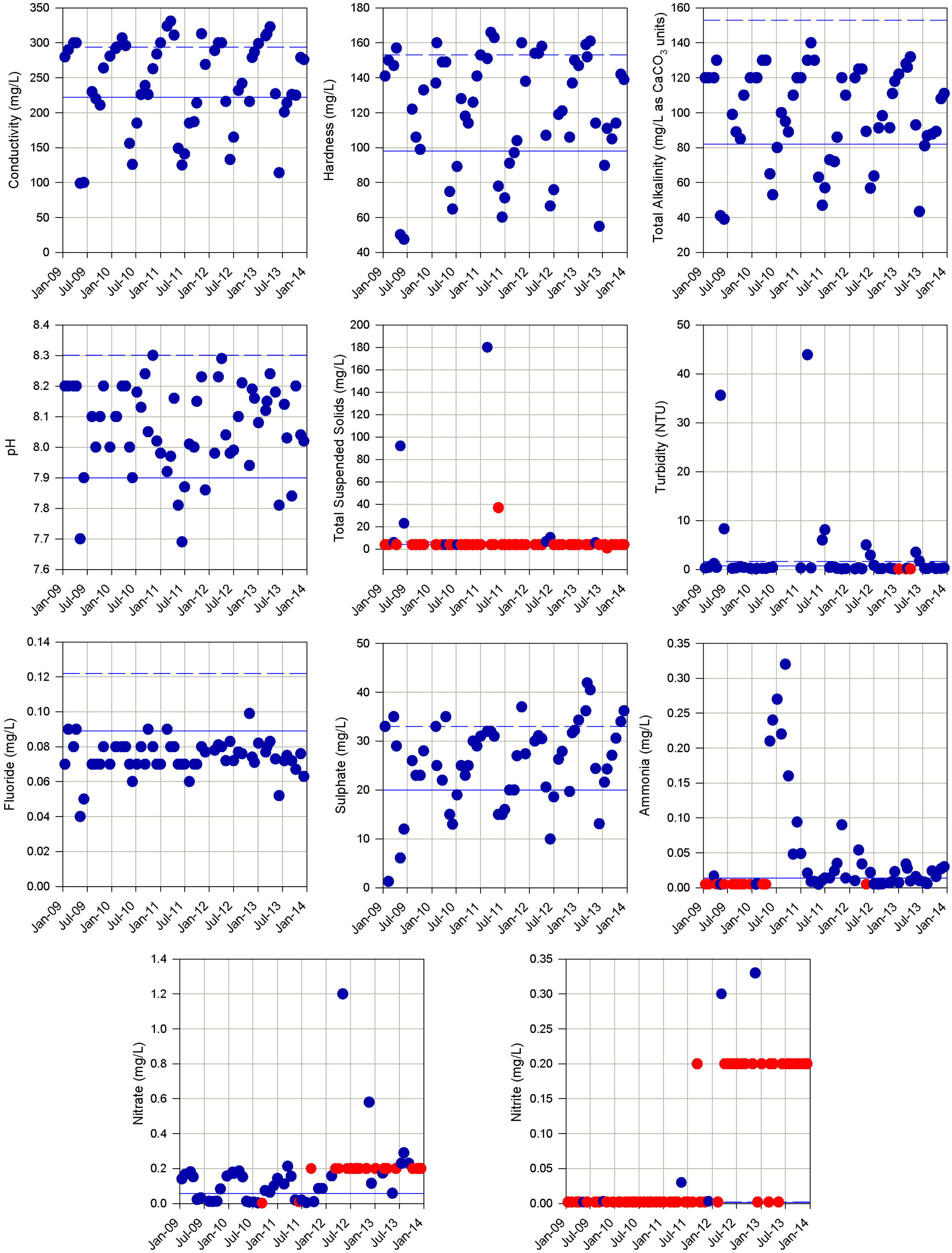
● Parameter Concentration
● Parameter Concentration less than Detection
— Baseline Average Concentration
- - Baseline 95th Percentile Concentration



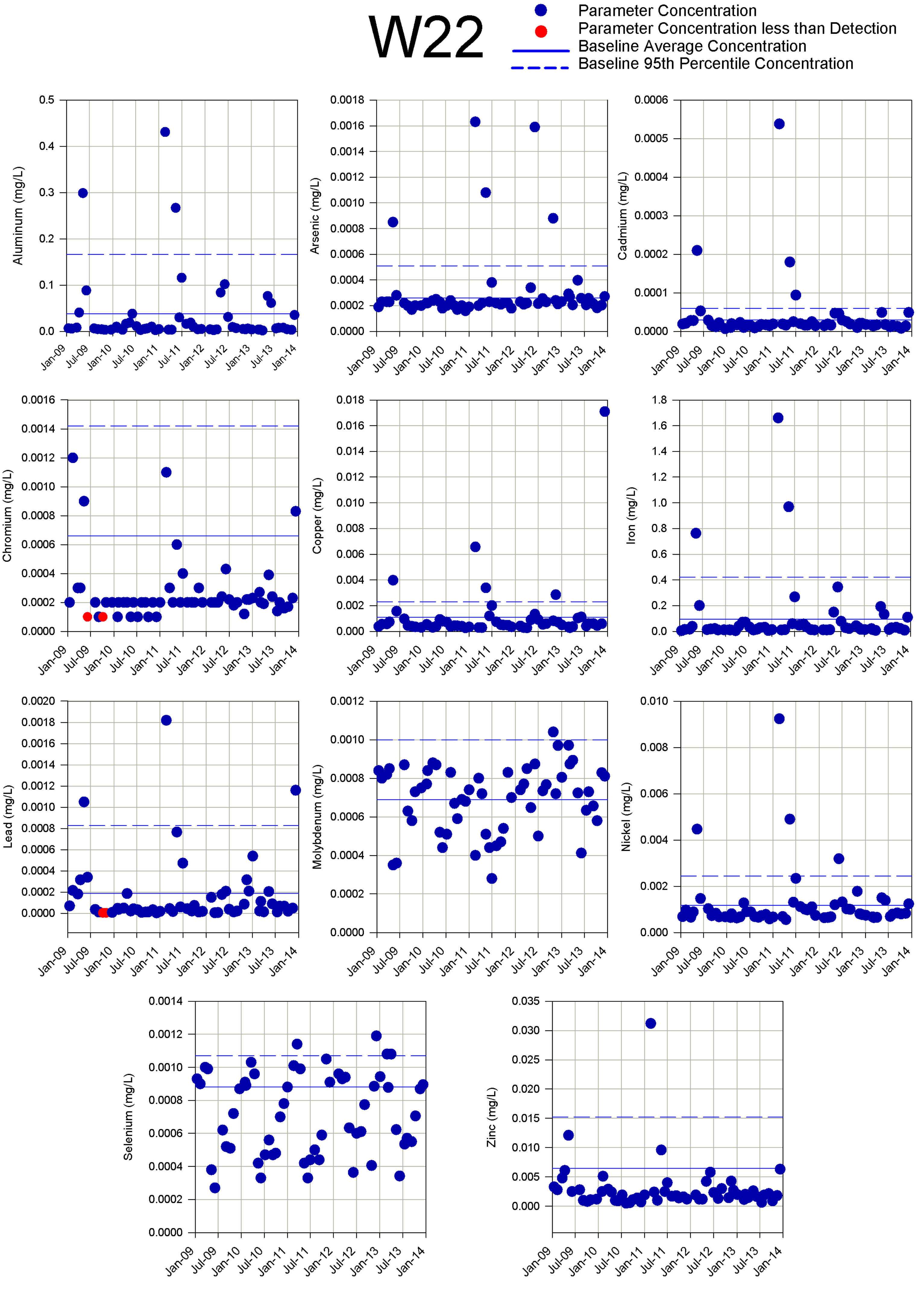
W21
Parameter Concentration
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
Arsenic (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
Cadmium (mg/L)
0.00000
0.00002
0.00004
0.00006
0.00008
0.00010
0.00012
0.00014
0.00016
Chromium (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
0.0016
Copper (mg/L)
0.000
0.001
0.002
0.003
0.004
Iron (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Lead (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
Molybdenum (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
0.0016
0.0018
Nickel (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
0.006
Selenium (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
Zinc (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0.014
0.016
0.018
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

W22

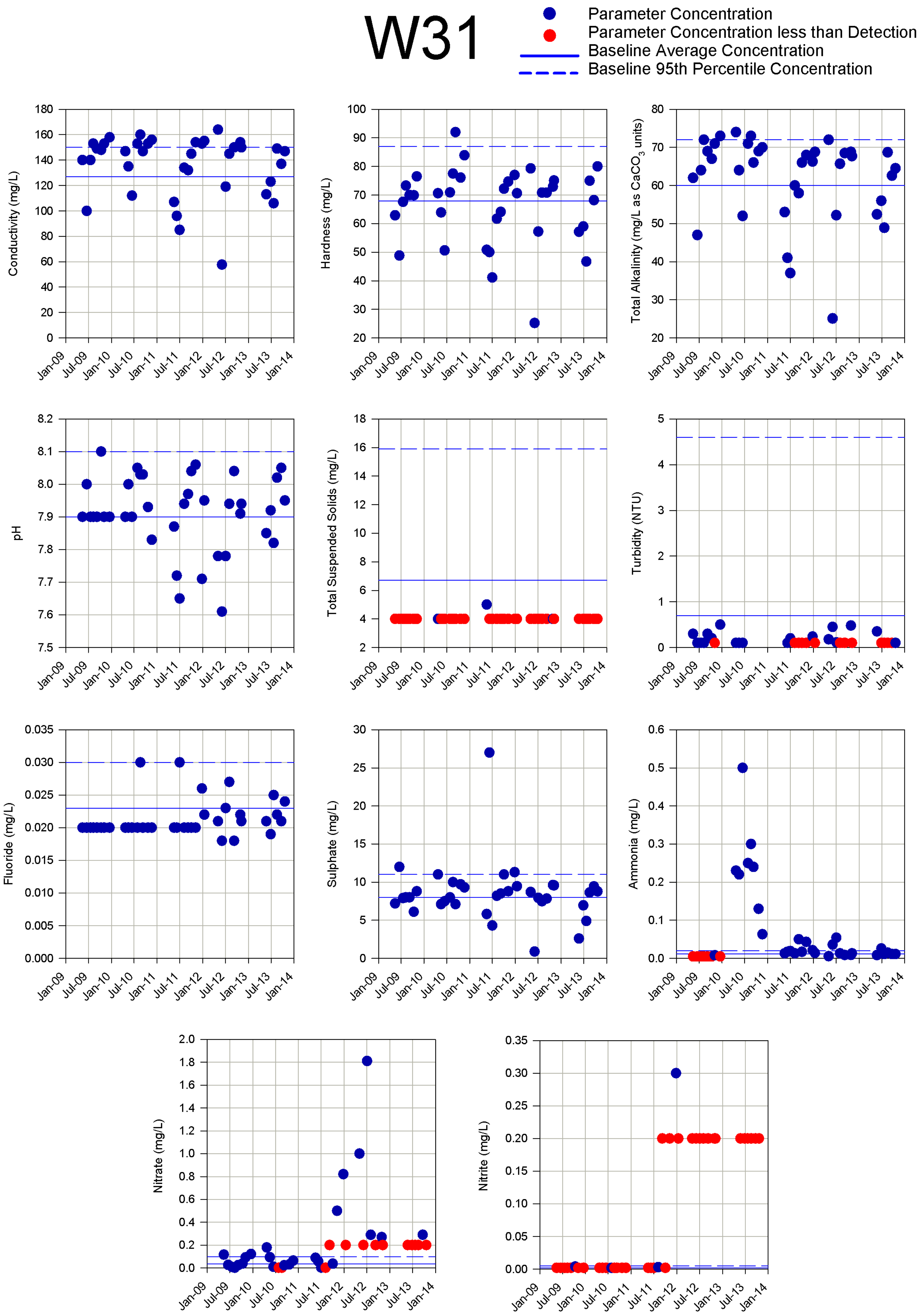
● Parameter Concentration
🔴 Parameter Concentration less than Detection
— Baseline Average Concentration
- - Baseline 95th Percentile Concentration



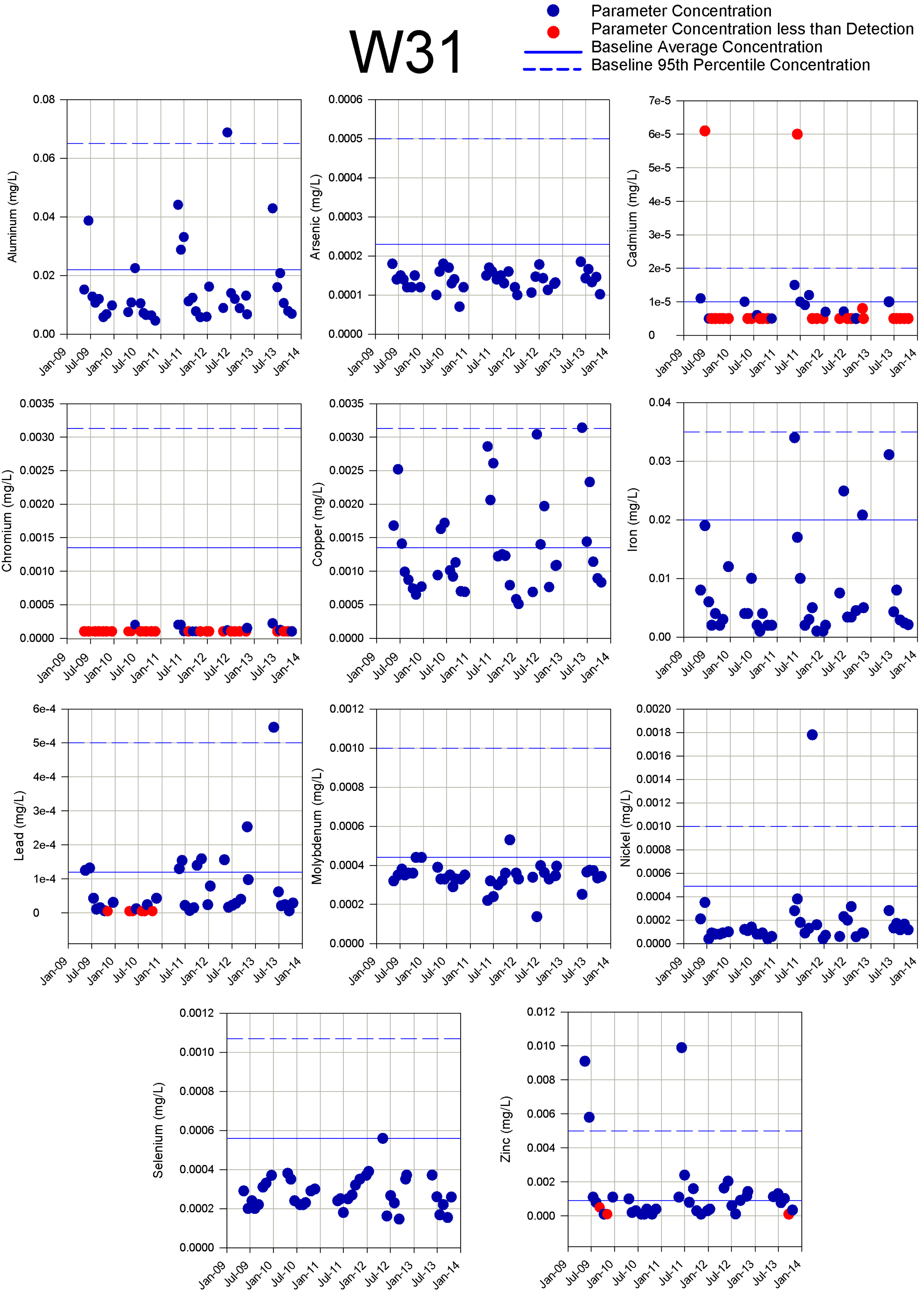
W22



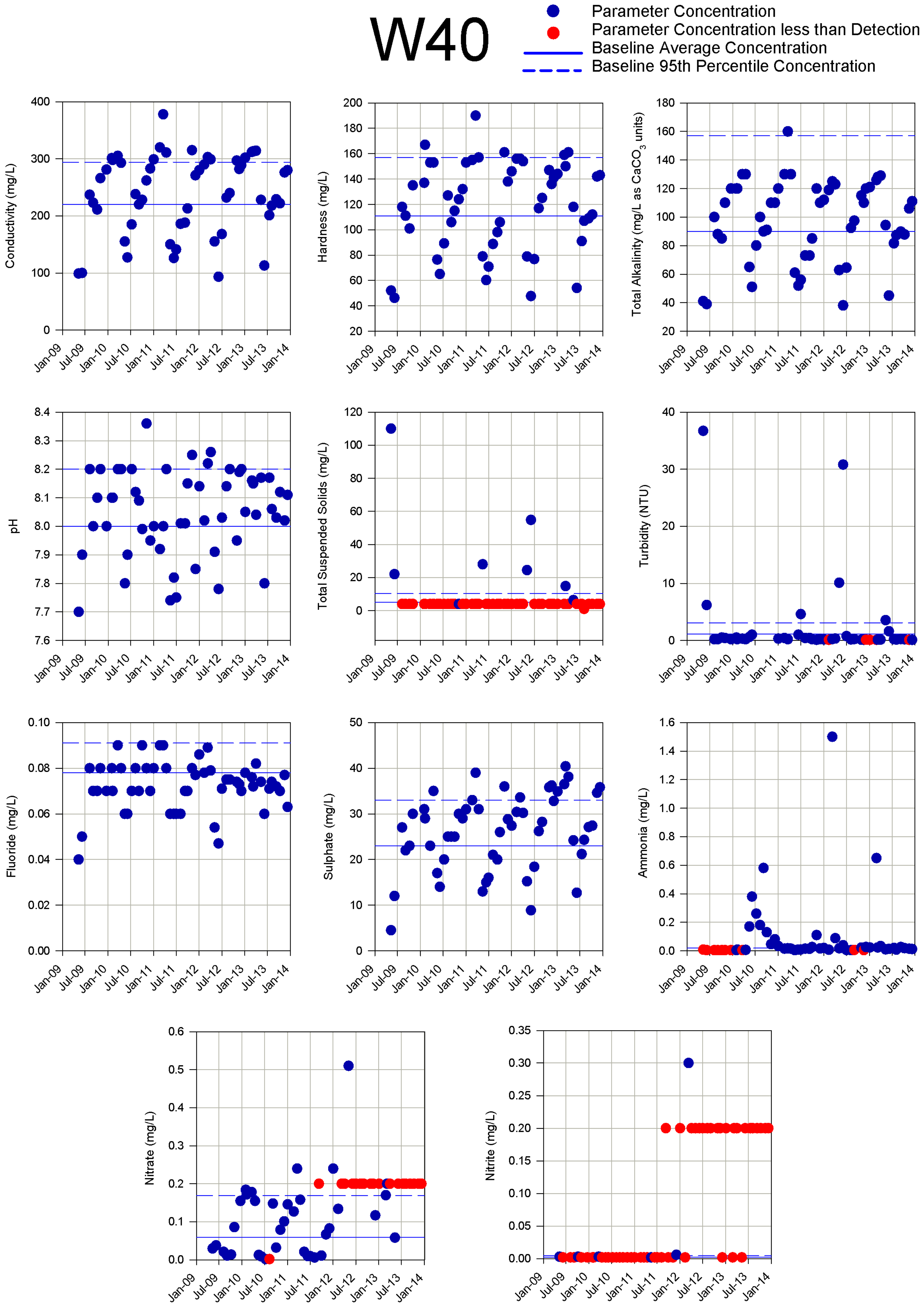
● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
Arsenic (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
0.0016
0.0018
Cadmium (mg/L)
0.0000
0.0001
0.0002
0.0003
0.0004
0.0005
0.0006
Chromium (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
0.0016
Copper (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0.014
0.016
0.018
Iron (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
Lead (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
0.0016
0.0018
0.0020
Molybdenum (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
Nickel (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
Selenium (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
Zinc (mg/L)
0.000
0.005
0.010
0.015
0.020
0.025
0.030
0.035
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14


W31
Parameter Concentration
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
0
20
40
60
80
100
120
140
160
180
Hardness (mg/L)
20
30
40
50
60
70
80
90
100
Total Alkalinity (mg/L as $CaCO_3$ units)
20
30
40
50
60
70
80
pH
7.5
7.6
7.7
7.8
7.9
8.0
8.1
8.2
Total Suspended Solids (mg/L)
2
4
6
8
10
12
14
16
18
Turbidity (NTU)
0
1
2
3
4
5
Fluoride (mg/L)
0.000
0.005
0.010
0.015
0.020
0.025
0.030
0.035
Sulphate (mg/L)
0
5
10
15
20
25
30
Ammonia (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Nitrate (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
Nitrite (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

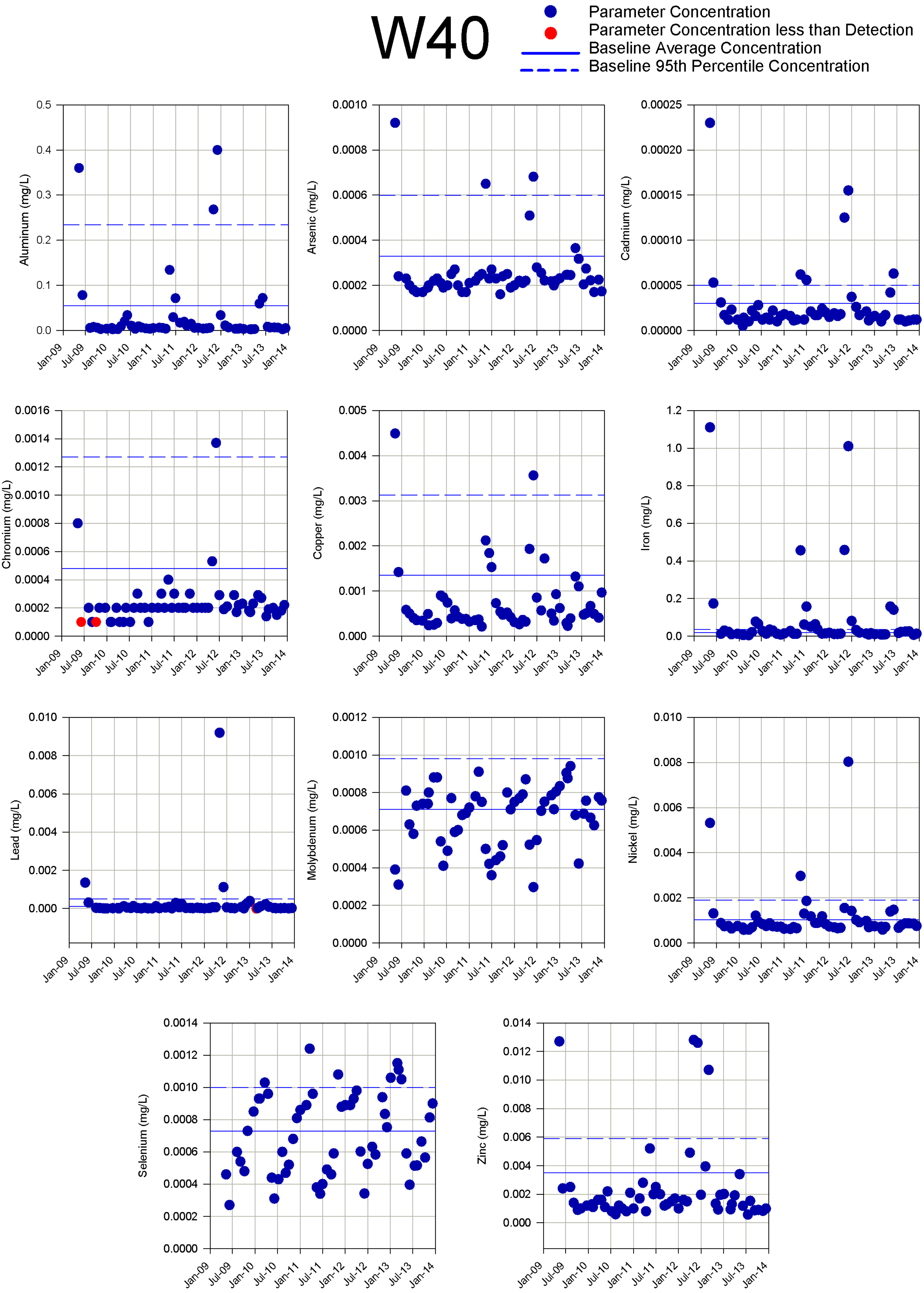
W31


Parameter Concentration
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.00
0.02
0.04
0.06
0.08
Arsenic (mg/L)
0.0000
0.0001
0.0002
0.0003
0.0004
0.0005
0.0006
Cadmium (mg/L)
0
1e-5
2e-5
3e-5
4e-5
5e-5
6e-5
7e-5
Chromium (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
0.0030
0.0035
Copper (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
0.0030
0.0035
Iron (mg/L)
0.00
0.01
0.02
0.03
0.04
Lead (mg/L)
0
1e-4
2e-4
3e-4
4e-4
5e-4
6e-4
Molybdenum (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
Nickel (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
0.0016
0.0018
0.0020
Selenium (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
Zinc (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

W40

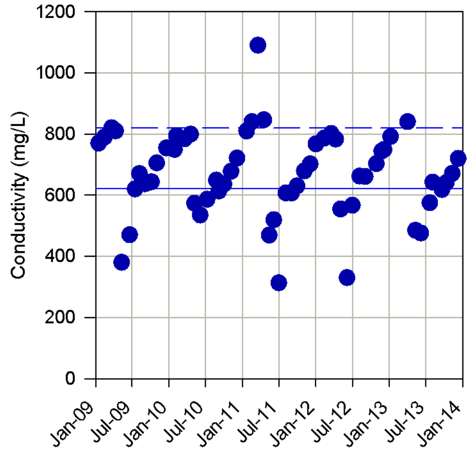

Parameter Concentration
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
Hardness (mg/L)
Total Alkalinity (mg/L as $CaCO_3$ units)
pH
Total Suspended Solids (mg/L)
Turbidity (NTU)
Fluoride (mg/L)
Sulphate (mg/L)
Ammonia (mg/L)
Nitrate (mg/L)
Nitrite (mg/L)
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

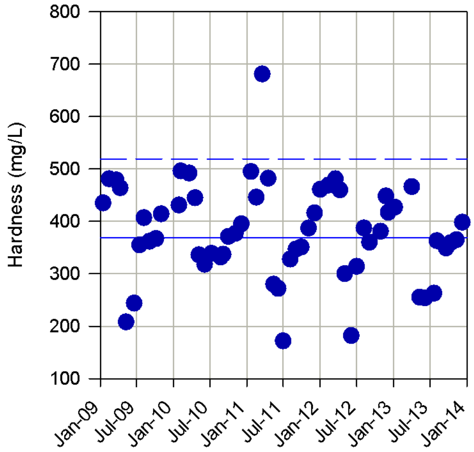
W40

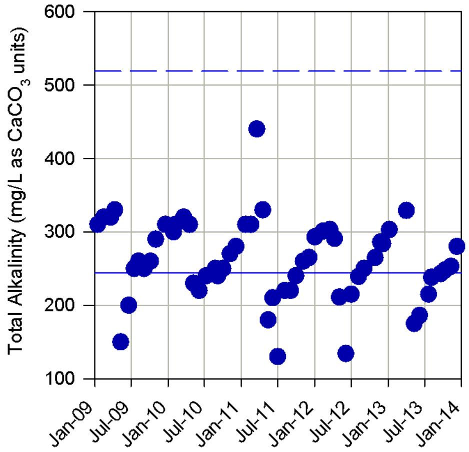

Parameter Concentration
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
Arsenic (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
Cadmium (mg/L)
0.00000
0.00005
0.00010
0.00015
0.00020
0.00025
Chromium (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
0.0016
Copper (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
Iron (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Lead (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
Molybdenum (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
Nickel (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
Selenium (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
Zinc (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0.014
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

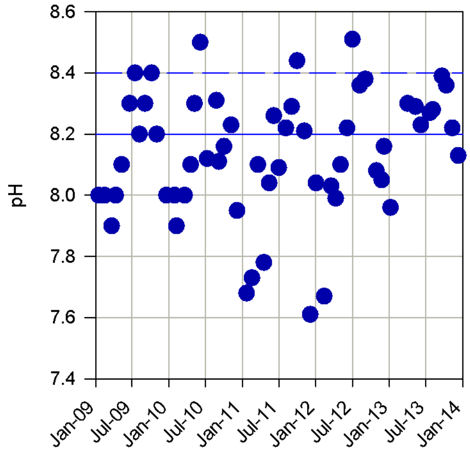
W71

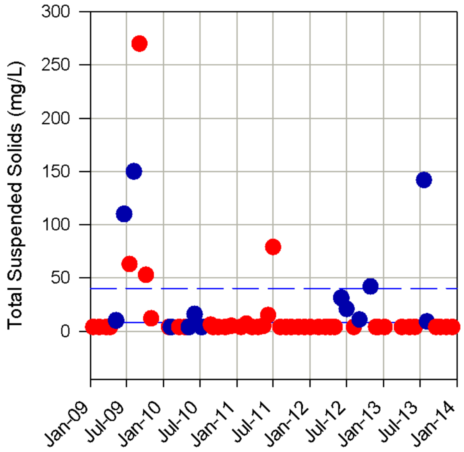
● Parameter Concentration
● Parameter Concentration less than Detection
— Baseline Average Concentration
-- Baseline 95th Percentile Concentration

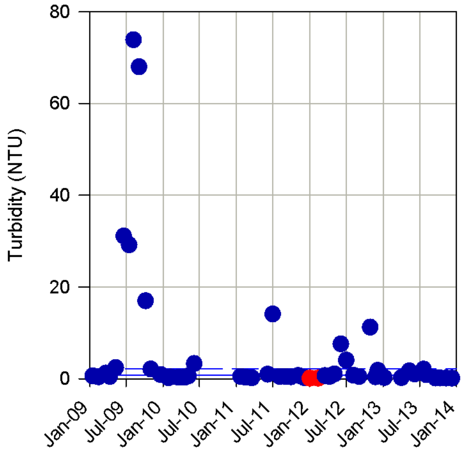


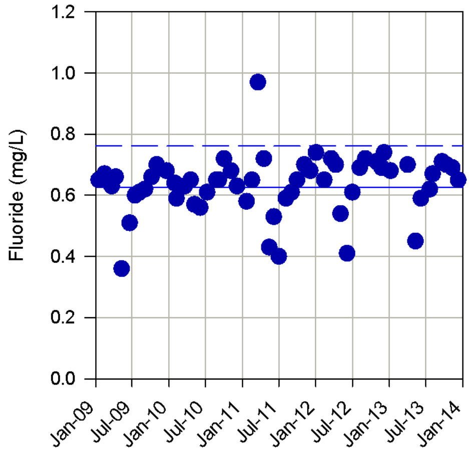


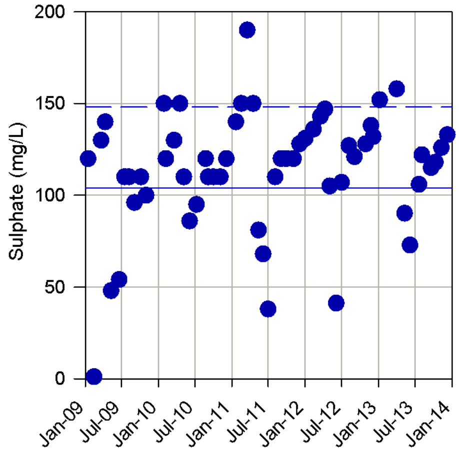


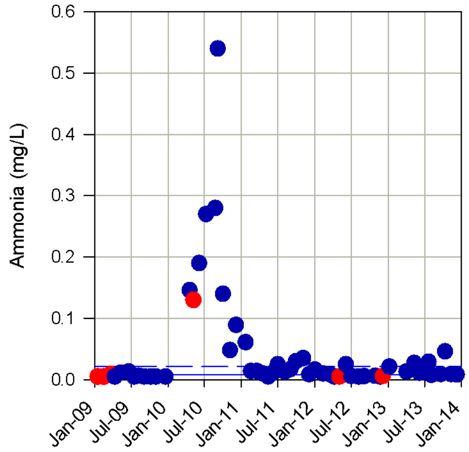


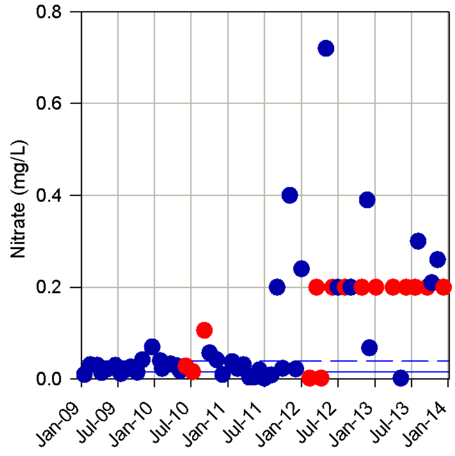


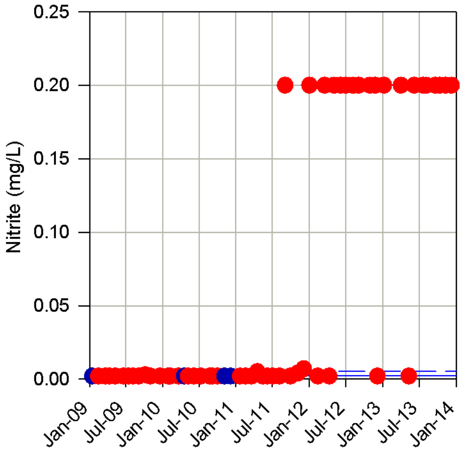




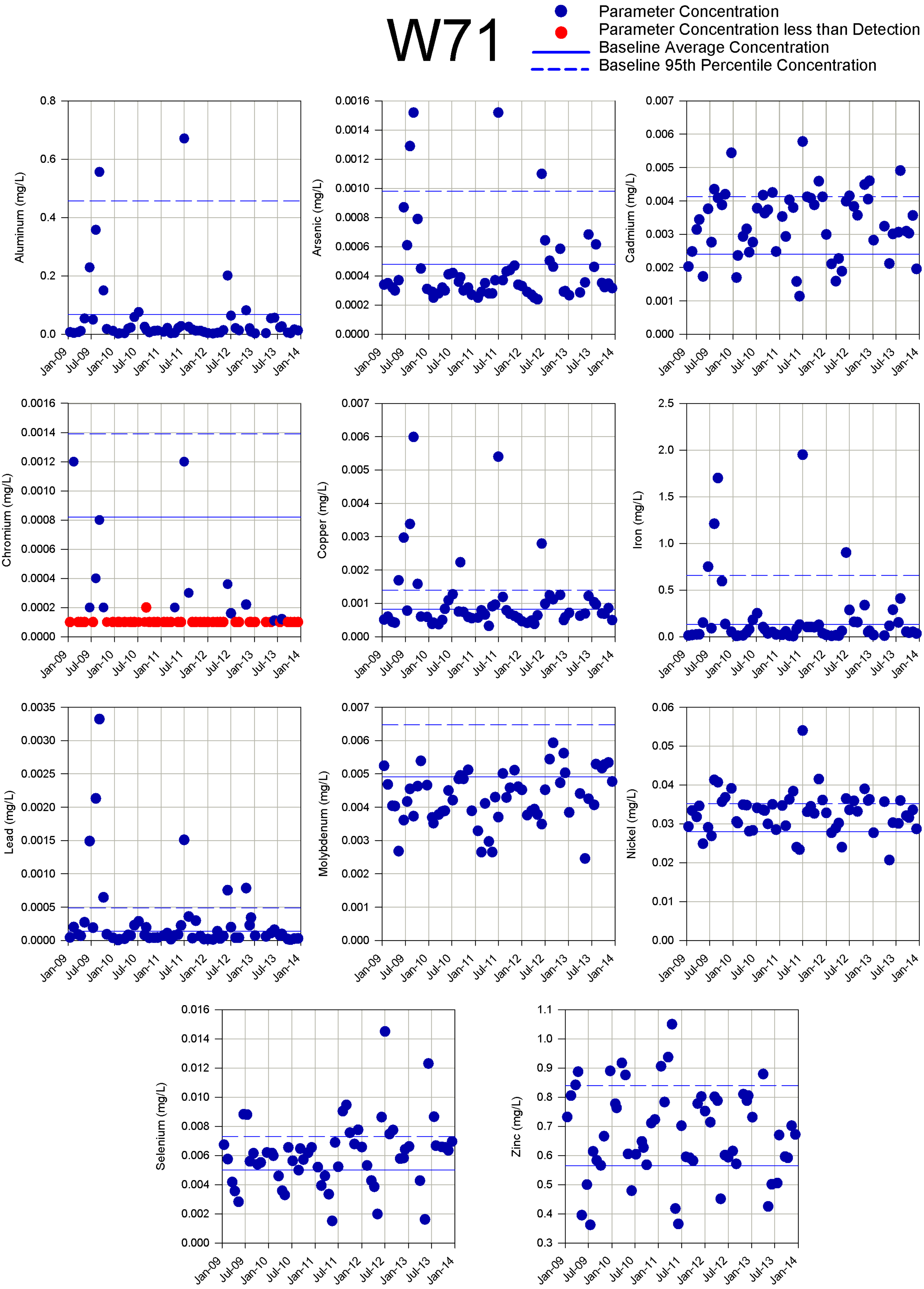




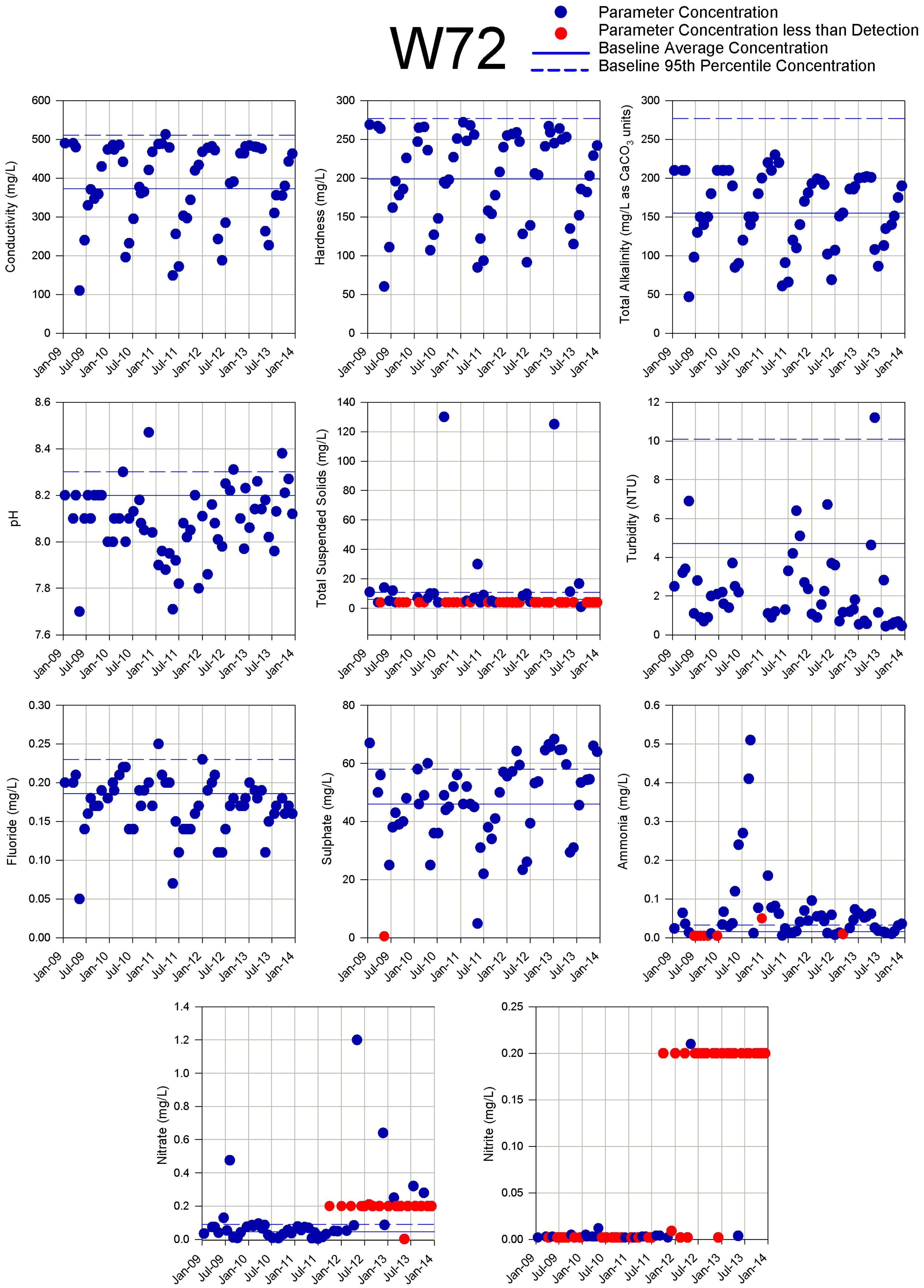


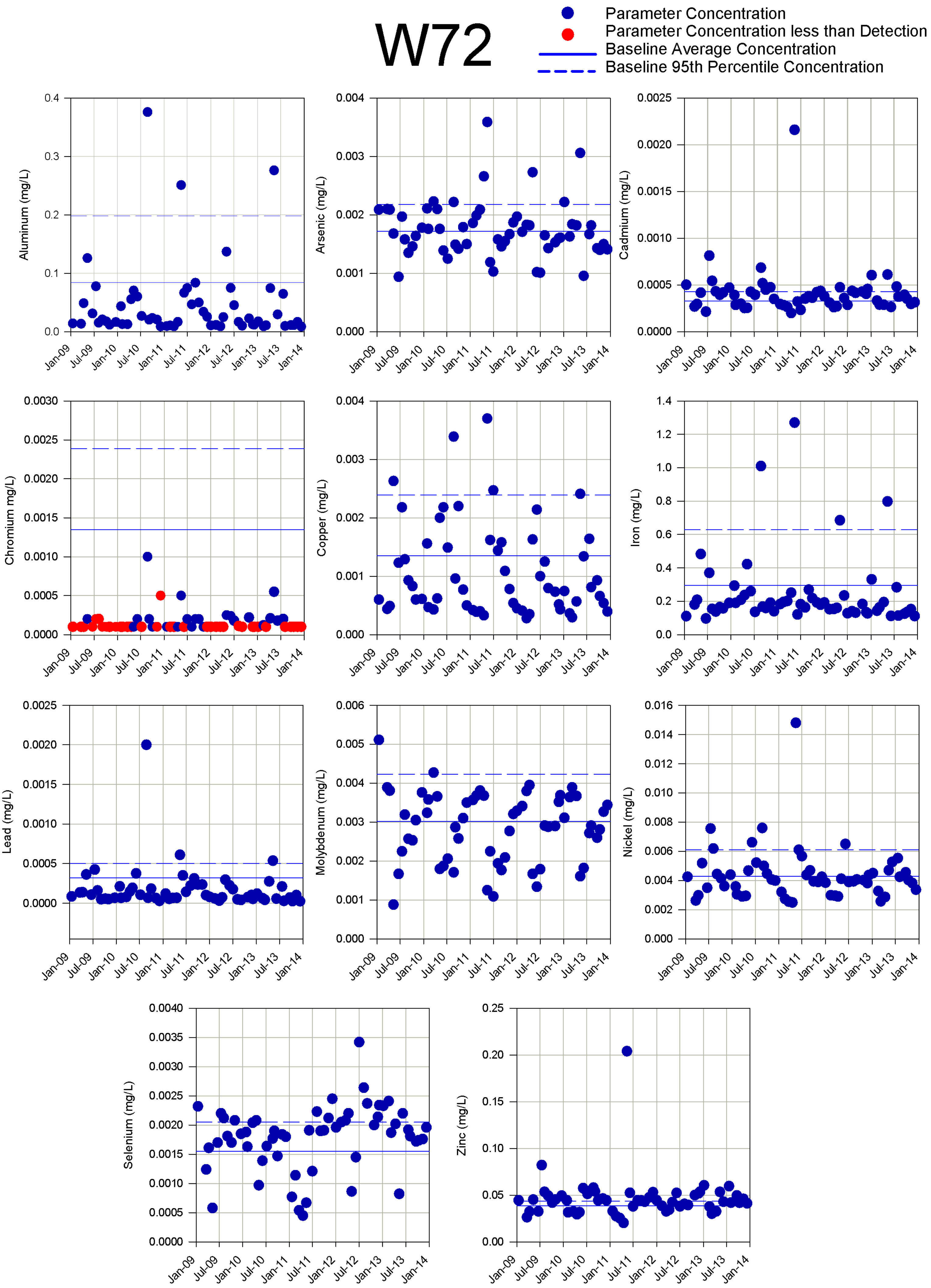


W71

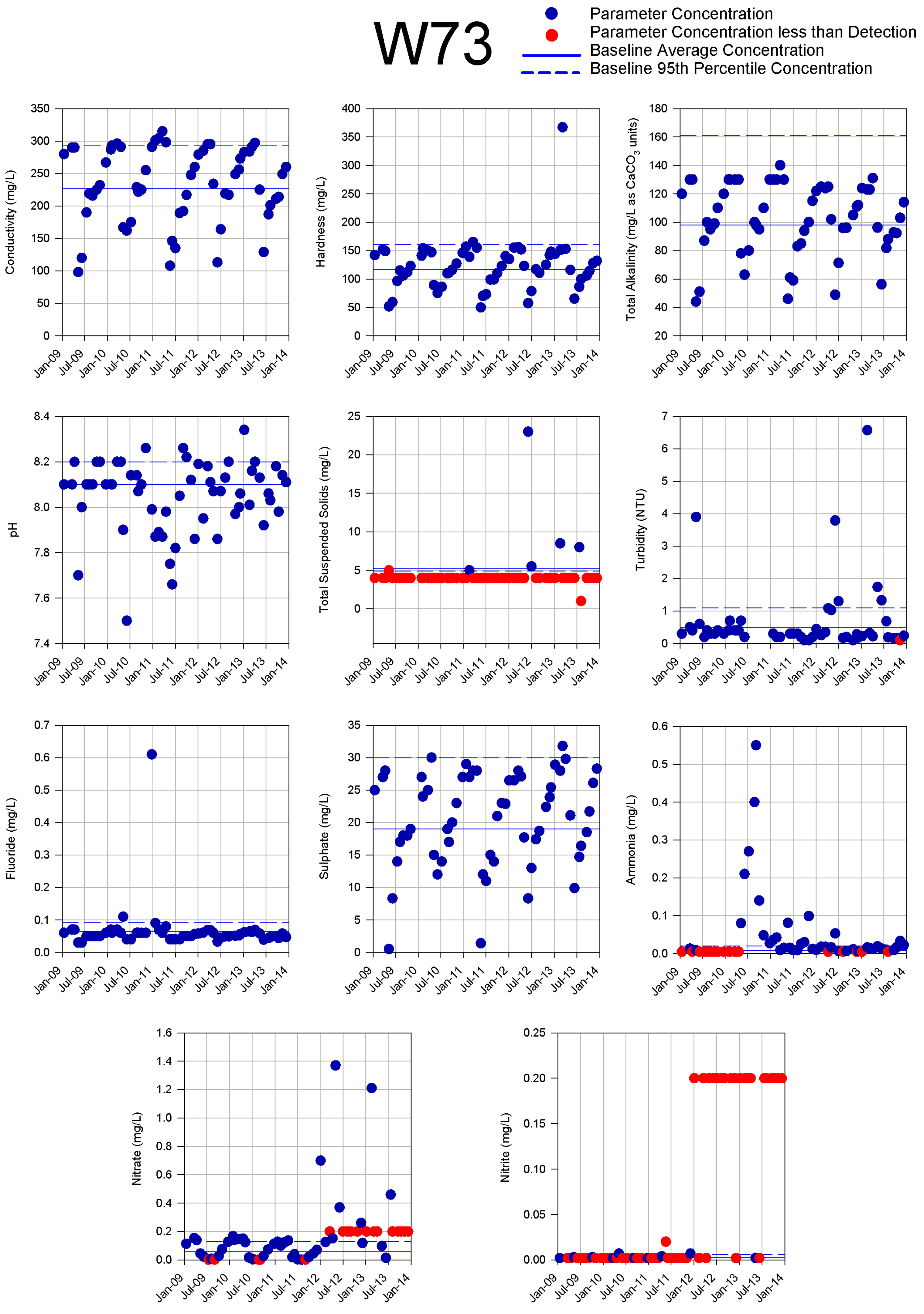

Parameter Concentration
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.0
0.2
0.4
0.6
0.8
Arsenic (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
0.0016
Cadmium (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
0.006
0.007
Chromium (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
0.0016
Copper (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
0.006
0.007
Iron (mg/L)
0.0
0.5
1.0
1.5
2.0
2.5
Lead (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
0.0030
0.0035
Molybdenum (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
0.006
0.007
Nickel (mg/L)
0.00
0.01
0.02
0.03
0.04
0.05
0.06
Selenium (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0.014
0.016
Zinc (mg/L)
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

W72

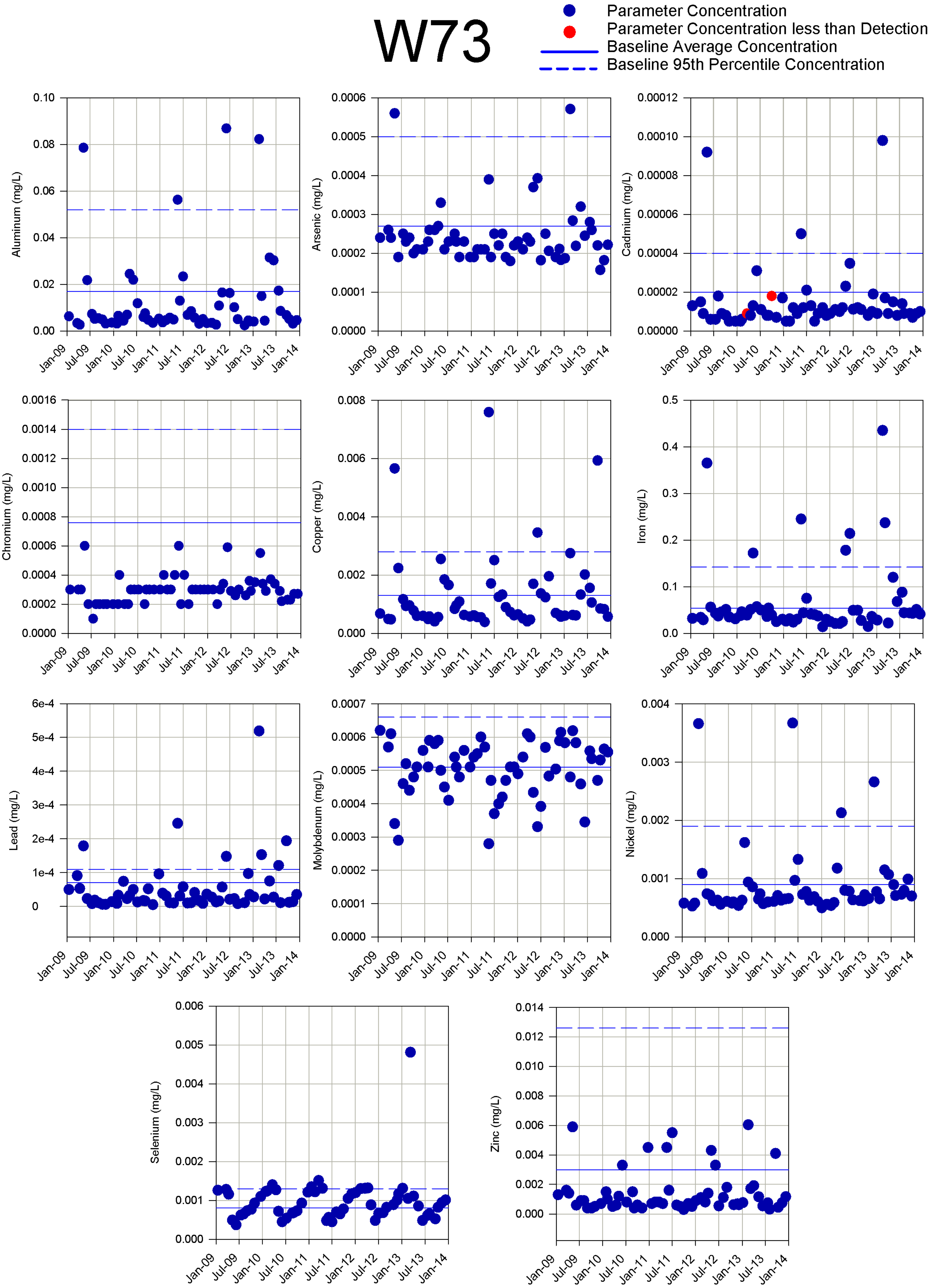

Parameter Concentration
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
0
100
200
300
400
500
600
Hardness (mg/L)
0
50
100
150
200
250
300
Total Alkalinity (mg/L as $CaCO_3$ units)
0
50
100
150
200
250
300
pH
7.6
7.8
8.0
8.2
8.4
8.6
Total Suspended Solids (mg/L)
0
20
40
60
80
100
120
140
Turbidity (NTU)
0
2
4
6
8
10
12
Fluoride (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
Sulphate (mg/L)
0
20
40
60
80
Ammonia (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Nitrate (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
Nitrite (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

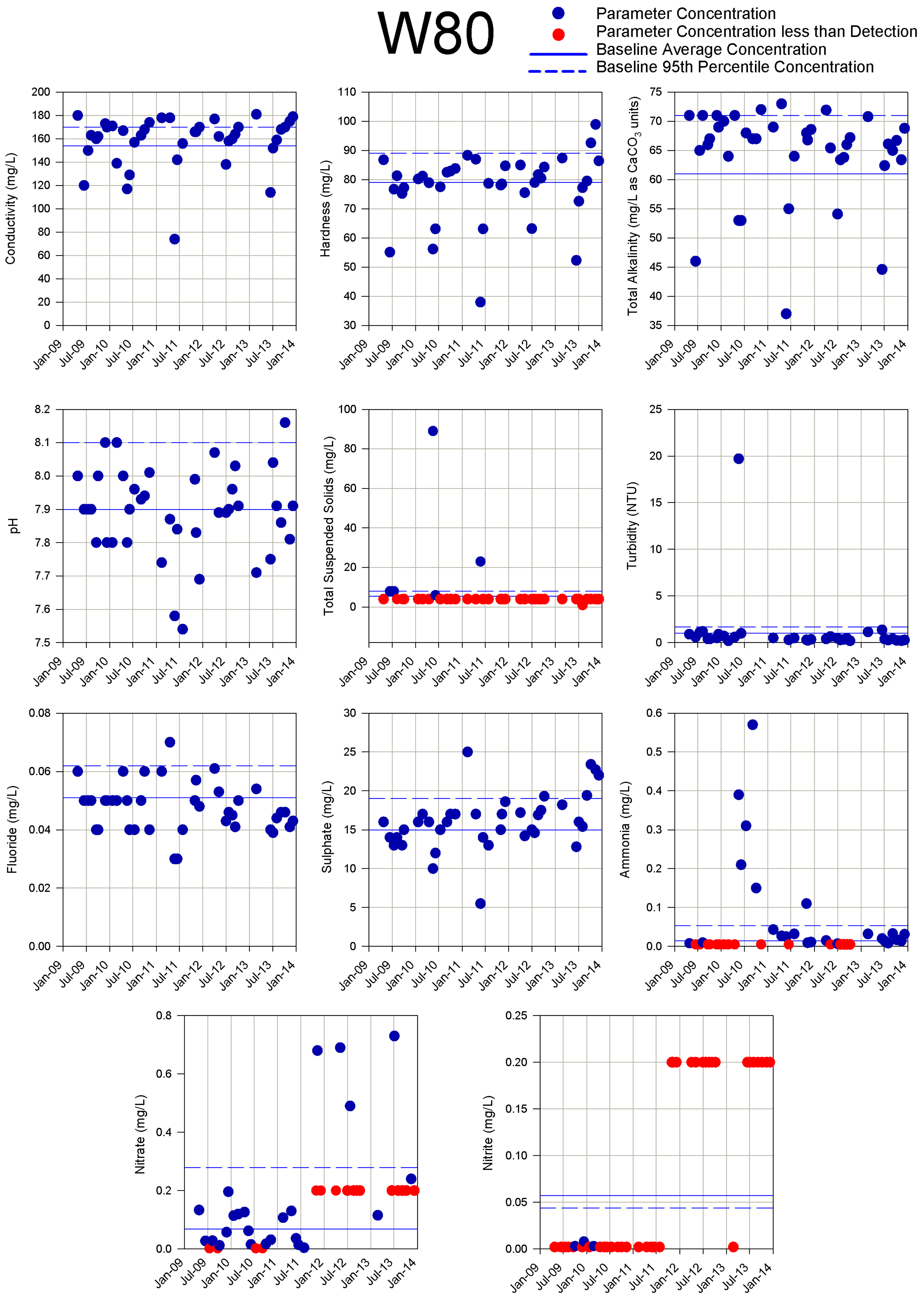

W72
Parameter Concentration
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.0
0.1
0.2
0.3
0.4
Arsenic (mg/L)
0.000
0.001
0.002
0.003
0.004
Cadmium (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
Chromium mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
0.0030
Copper (mg/L)
0.000
0.001
0.002
0.003
0.004
Iron (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
Lead (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
Molybdenum (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
0.006
Nickel (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0.014
0.016
Selenium (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
0.0030
0.0035
0.0040
Zinc (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

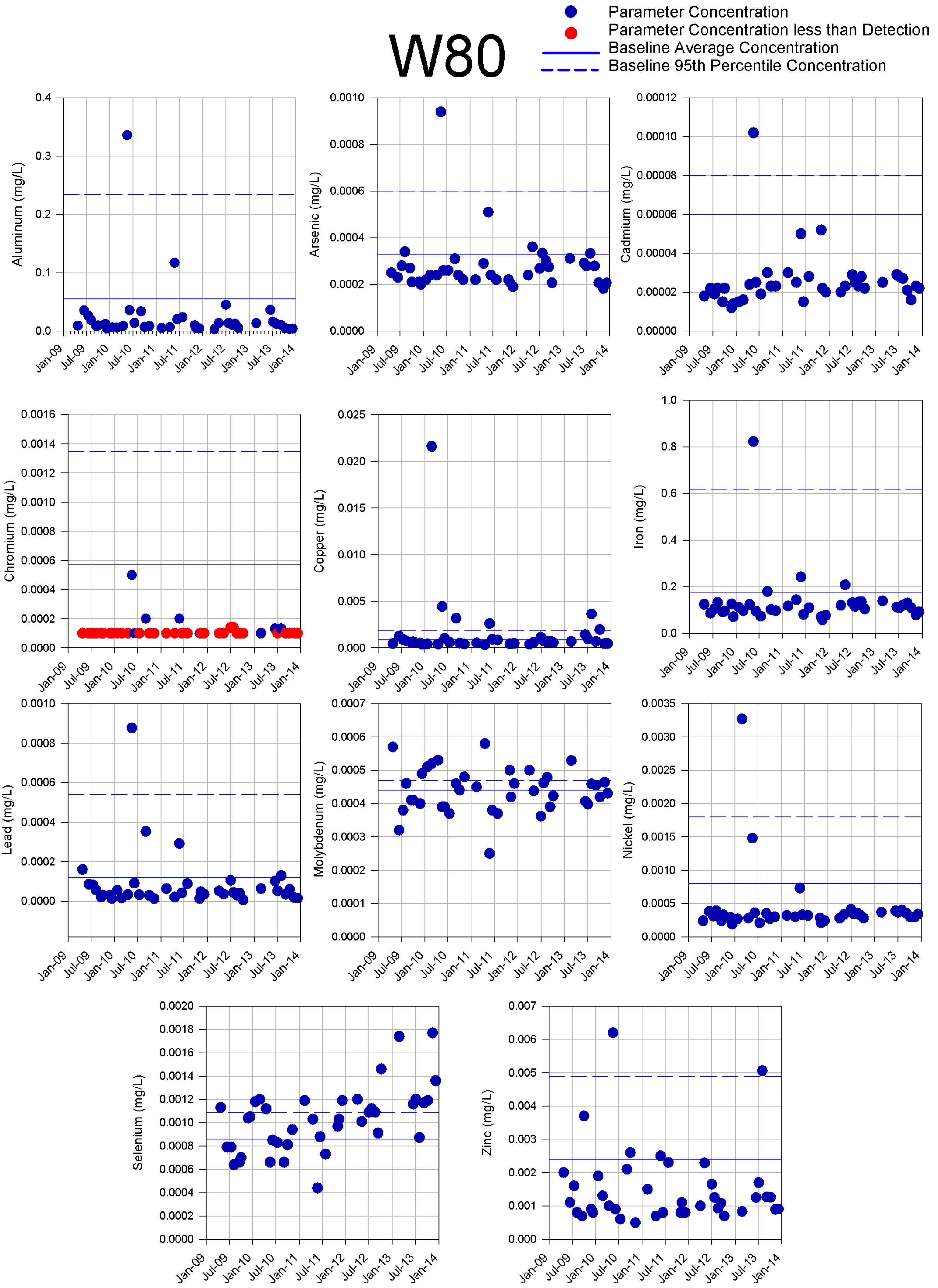
W73

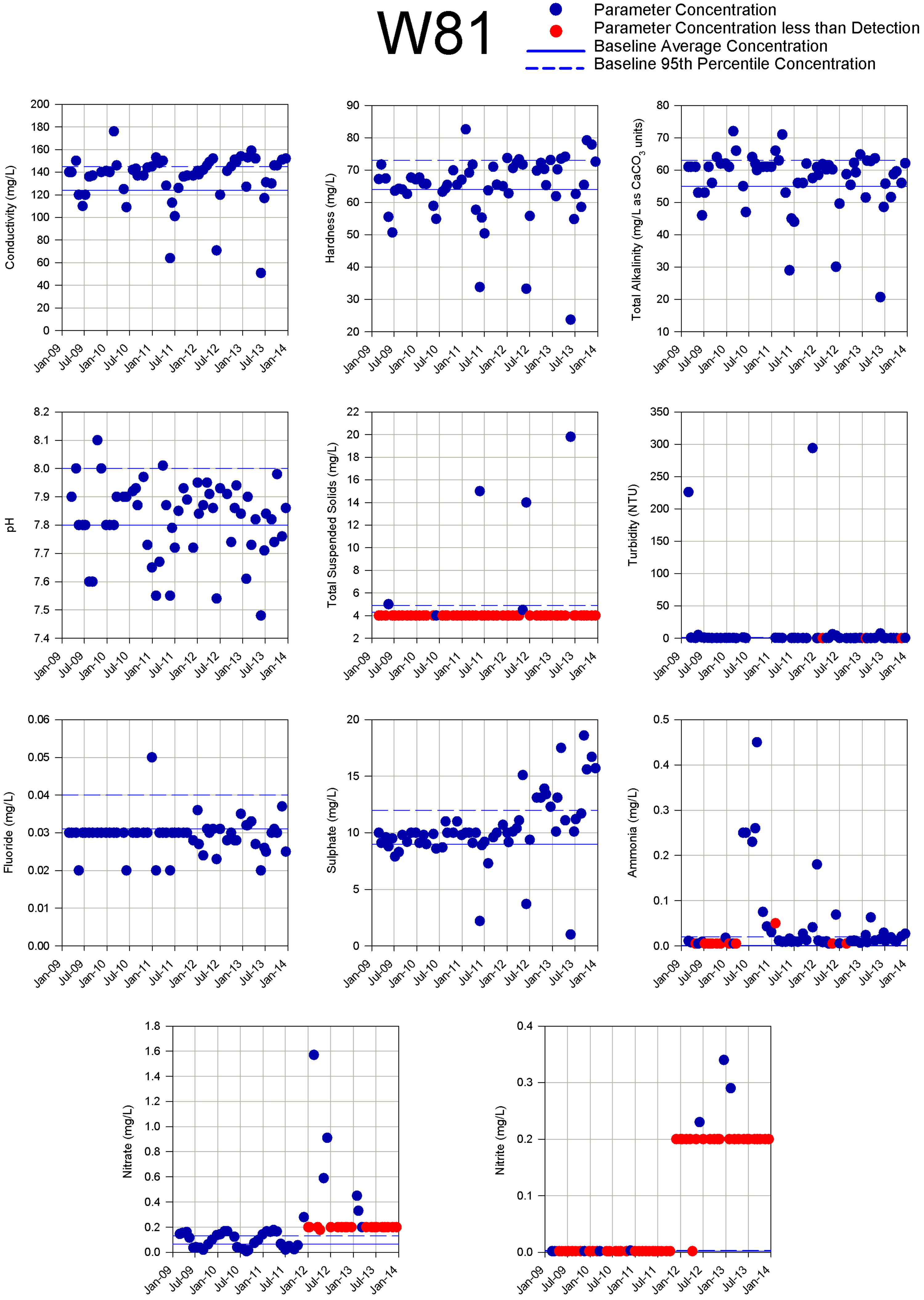

● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
0
50
100
150
200
250
300
350
Hardness (mg/L)
0
50
100
150
200
250
300
350
400
Total Alkalinity (mg/L as CaCO3 units)
20
40
60
80
100
120
140
160
180
pH
7.4
7.6
7.8
8.0
8.2
8.4
Total Suspended Solids (mg/L)
0
5
10
15
20
25
Turbidity (NTU)
0
1
2
3
4
5
6
7
Fluoride (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Sulphate (mg/L)
0
5
10
15
20
25
30
35
Ammonia (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Nitrate (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
Nitrite (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

W73

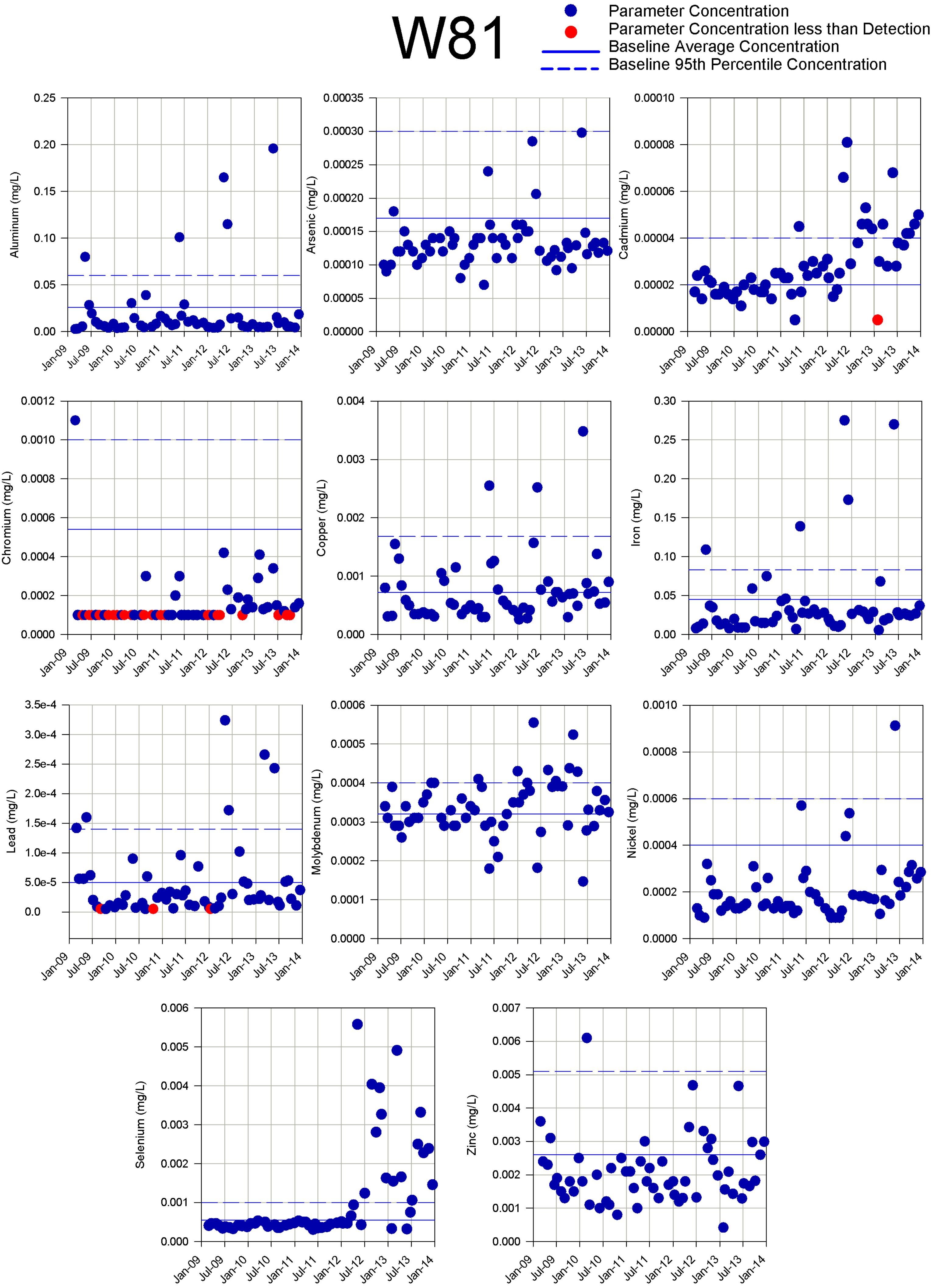

● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
Arsenic (mg/L)
0.0000
0.0001
0.0002
0.0003
0.0004
0.0005
0.0006
Cadmium (mg/L)
0.00000
0.00002
0.00004
0.00006
0.00008
0.00010
0.00012
Chromium (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
0.0016
Copper (mg/L)
0.000
0.002
0.004
0.006
0.008
Iron (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
Lead (mg/L)
0
1e-4
2e-4
3e-4
4e-4
5e-4
6e-4
Molybdenum (mg/L)
0.0000
0.0001
0.0002
0.0003
0.0004
0.0005
0.0006
0.0007
Nickel (mg/L)
0.000
0.001
0.002
0.003
0.004
Selenium (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
0.006
Zinc (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0.014
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14


W80
Parameter Concentration
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
0
20
40
60
80
100
120
140
160
180
200
Hardness (mg/L)
30
40
50
60
70
80
90
100
110
Total Alkalinity (mg/L as $CaCO_3$ units)
35
40
45
50
55
60
65
70
75
pH
7.5
7.6
7.7
7.8
7.9
8.0
8.1
8.2
Total Suspended Solids (mg/L)
0
20
40
60
80
100
Turbidity (NTU)
0
5
10
15
20
25
Fluoride (mg/L)
0.00
0.02
0.04
0.06
0.08
Sulphate (mg/L)
0
5
10
15
20
25
30
Ammonia (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Nitrate (mg/L)
0.0
0.2
0.4
0.6
0.8
Nitrite (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

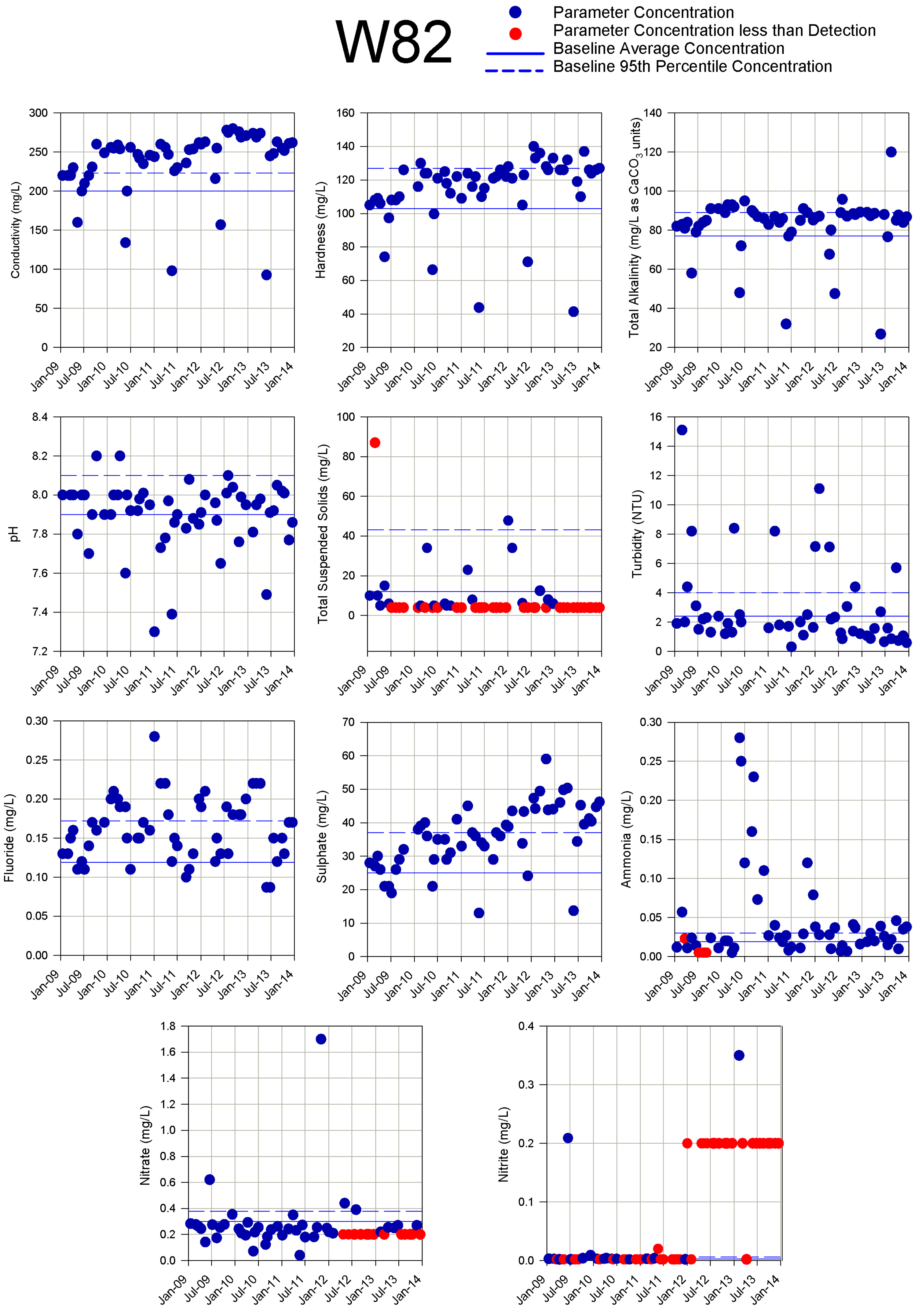

W80
● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.0
0.1
0.2
0.3
0.4
Arsenic (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
Cadmium (mg/L)
0.00000
0.00002
0.00004
0.00006
0.00008
0.00010
0.00012
Chromium (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
0.0016
Copper (mg/L)
0.000
0.005
0.010
0.015
0.020
0.025
Iron (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
Lead (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
Molybdenum (mg/L)
0.0000
0.0001
0.0002
0.0003
0.0004
0.0005
0.0006
0.0007
Nickel (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
0.0030
0.0035
Selenium (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
0.0016
0.0018
0.0020
Zinc (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
0.006
0.007
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14


W81
Parameter Concentration
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
Hardness (mg/L)
Total Alkalinity (mg/L as $CaCO_3$ units)
pH
Total Suspended Solids (mg/L)
Turbidity (NTU)
Fluoride (mg/L)
Sulphate (mg/L)
Ammonia (mg/L)
Nitrate (mg/L)
Nitrite (mg/L)
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

W81

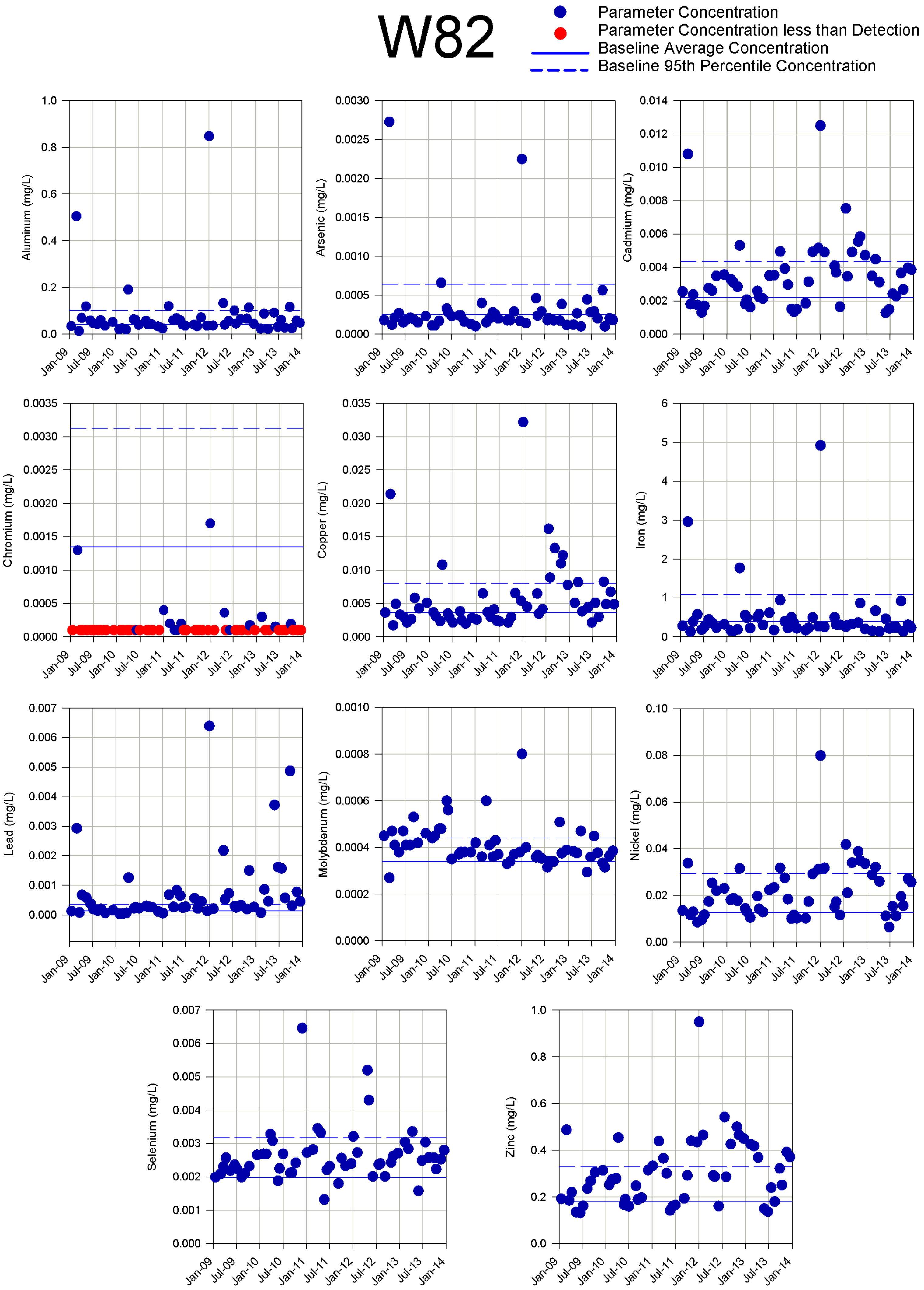

Parameter Concentration
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
Arsenic (mg/L)
0.00000
0.00005
0.00010
0.00015
0.00020
0.00025
0.00030
0.00035
Cadmium (mg/L)
0.00000
0.00002
0.00004
0.00006
0.00008
0.00010
Chromium (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
Copper (mg/L)
0.000
0.001
0.002
0.003
0.004
Iron (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
Lead (mg/L)
0.0
5.0e-5
1.0e-4
1.5e-4
2.0e-4
2.5e-4
3.0e-4
3.5e-4
Molybdenum (mg/L)
0.0000
0.0001
0.0002
0.0003
0.0004
0.0005
0.0006
Nickel (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
Selenium (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
0.006
Zinc (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
0.006
0.007
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

W82

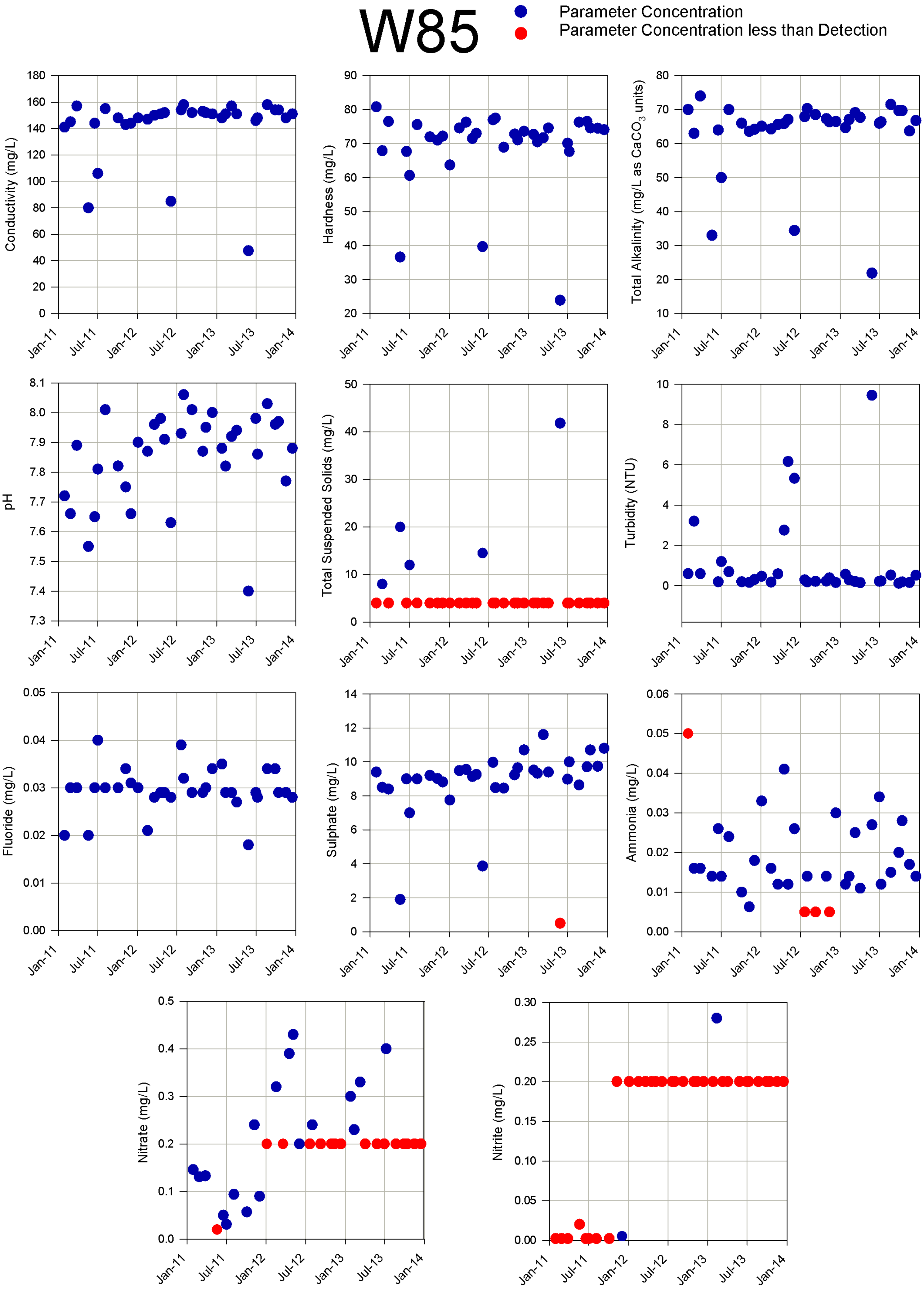


● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
0
50
100
150
200
250
300
Hardness (mg/L)
20
40
60
80
100
120
140
160
Total Alkalinity (mg/L as $CaCO_3$ units)
20
40
60
80
100
120
140
pH
7.2
7.4
7.6
7.8
8.0
8.2
8.4
Total Suspended Solids (mg/L)
0
20
40
60
80
100
Turbidity (NTU)
0
2
4
6
8
10
12
14
16
Fluoride (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
Sulphate (mg/L)
0
10
20
30
40
50
60
70
Ammonia (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
Nitrate (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
Nitrite (mg/L)
0.0
0.1
0.2
0.3
0.4
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

W82


Parameter Concentration
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
Arsenic (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
0.0030
Cadmium (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0.014
Chromium (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
0.0030
0.0035
Copper (mg/L)
0.000
0.005
0.010
0.015
0.020
0.025
0.030
0.035
Iron (mg/L)
0
1
2
3
4
5
6
Lead (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
0.006
0.007
Molybdenum (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
Nickel (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
Selenium (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
0.006
0.007
Zinc (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

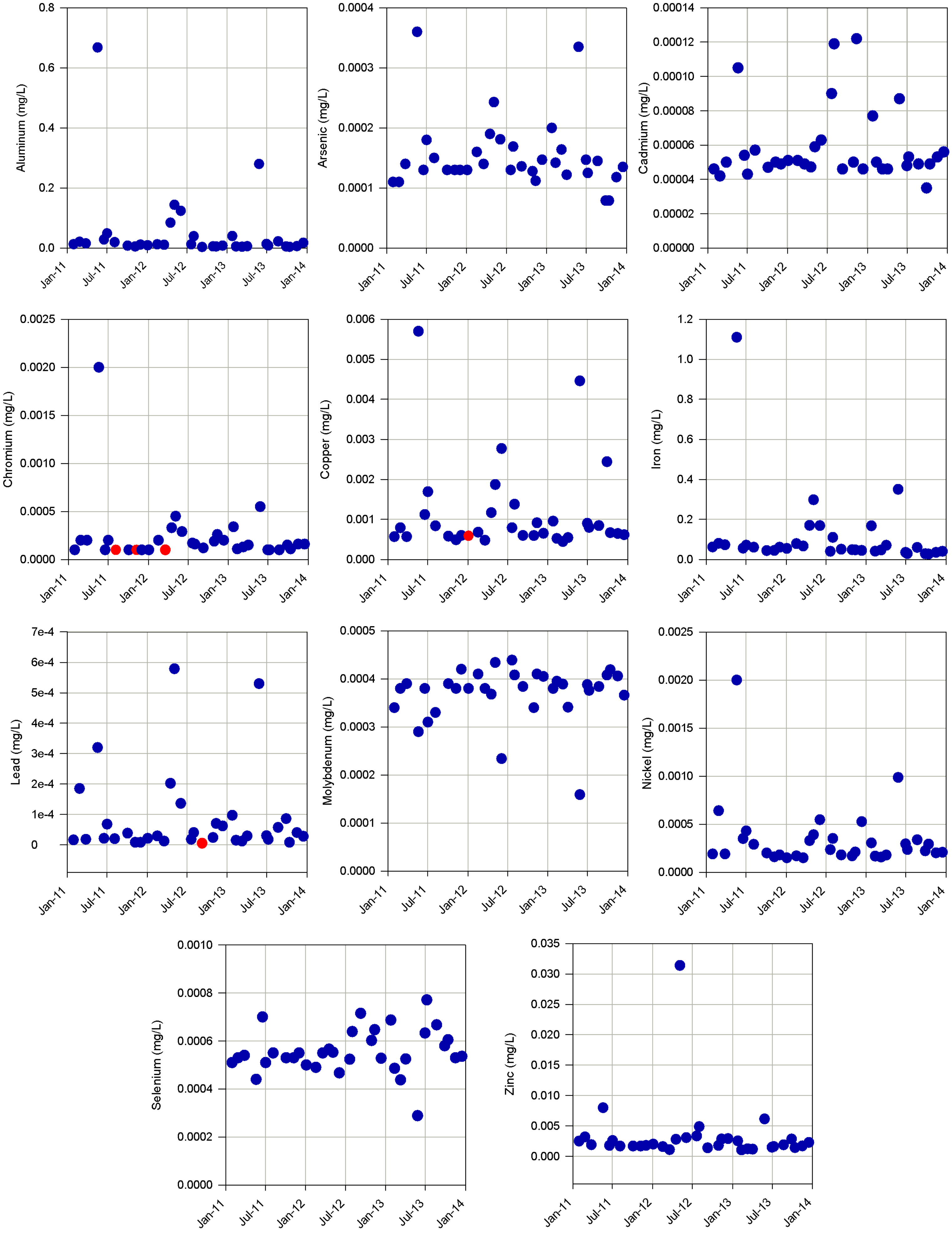
W85



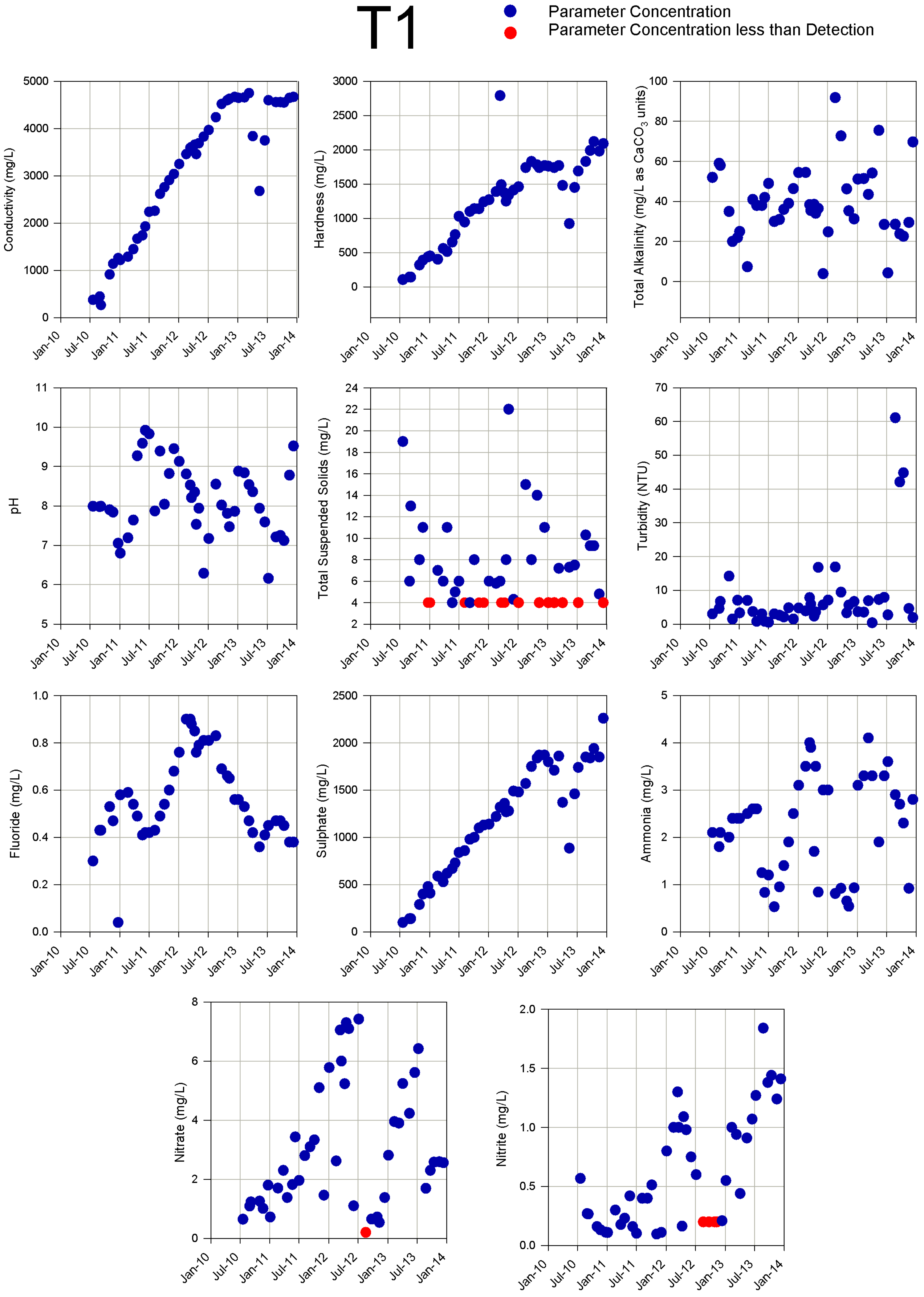
● Parameter Concentration
● Parameter Concentration less than Detection
Conductivity (mg/L)
0
20
40
60
80
100
120
140
160
180
Hardness (mg/L)
20
30
40
50
60
70
80
90
Total Alkalinity (mg/L as $CaCO_3$ units)
10
20
30
40
50
60
70
80
pH
7.3
7.4
7.5
7.6
7.7
7.8
7.9
8.0
8.1
Total Suspended Solids (mg/L)
0
10
20
30
40
50
Turbidity (NTU)
0
2
4
6
8
10
Fluoride (mg/L)
0.00
0.01
0.02
0.03
0.04
0.05
Sulphate (mg/L)
0
2
4
6
8
10
12
14
Ammonia (mg/L)
0.00
0.01
0.02
0.03
0.04
0.05
0.06
Nitrate (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
Nitrite (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

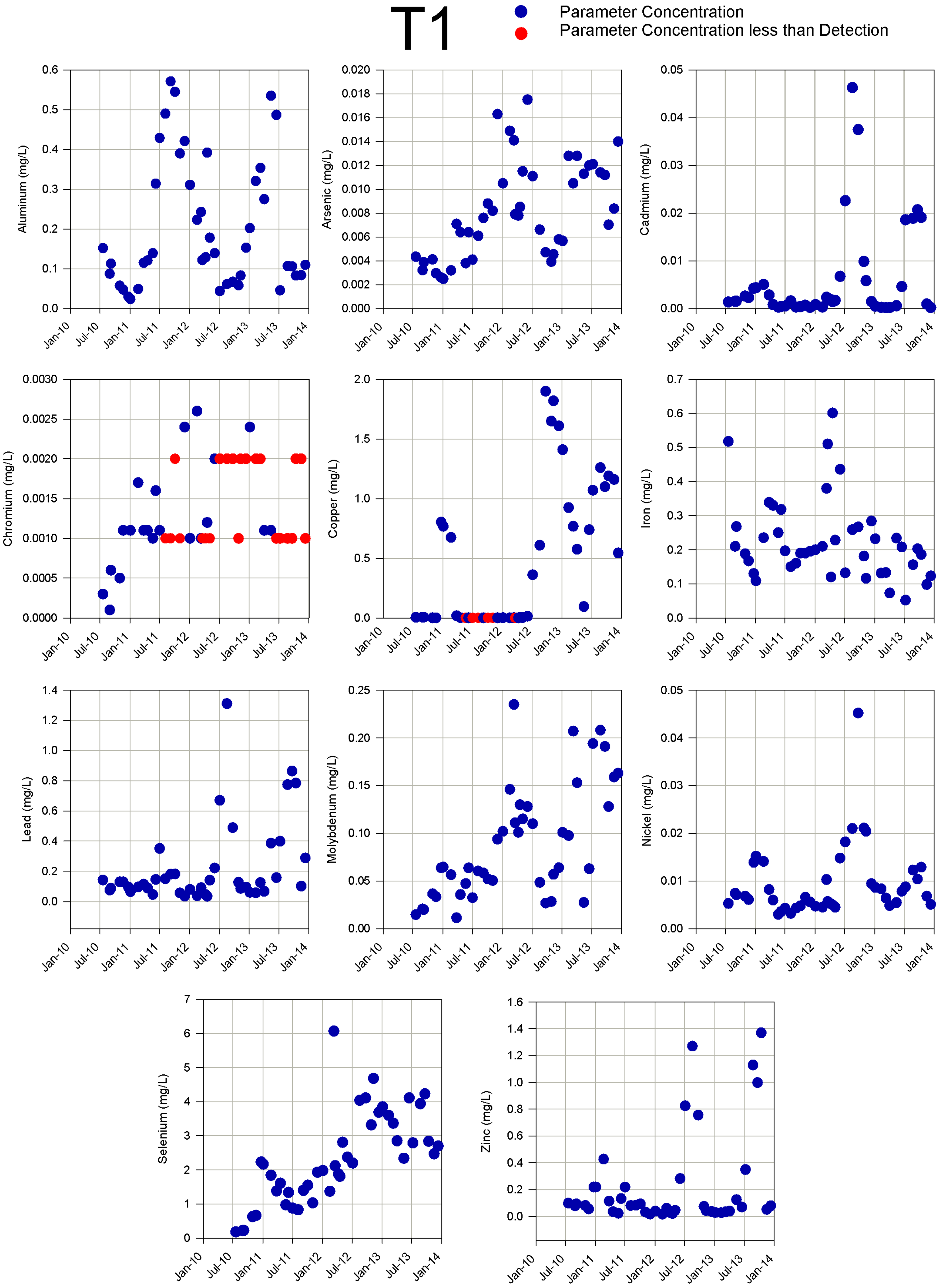
W85

● Parameter Concentration
● Parameter Concentration less than Detection



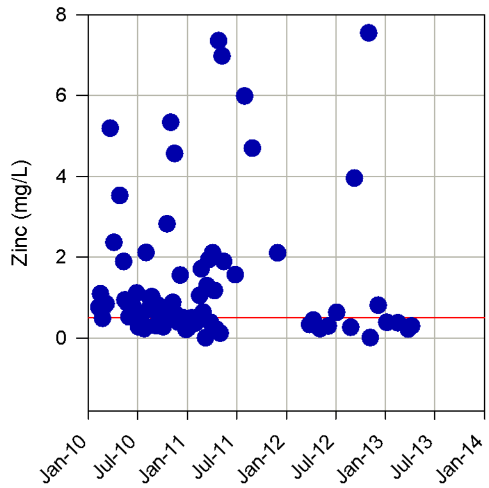
T1

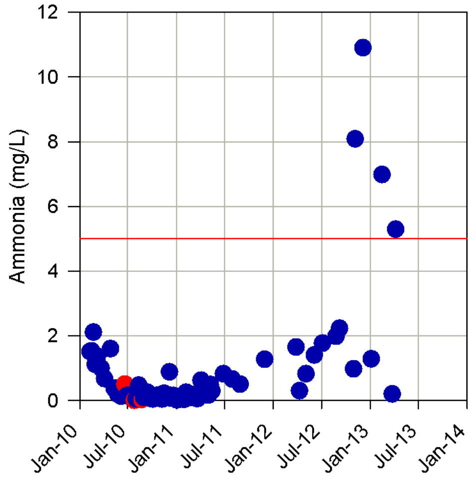

● Parameter Concentration
● Parameter Concentration less than Detection
Conductivity (mg/L)
0
1000
2000
3000
4000
5000
Hardness (mg/L)
0
500
1000
1500
2000
2500
3000
Total Alkalinity (mg/L as $CaCO_3$ units)
0
20
40
60
80
100
pH
5
6
7
8
9
10
11
Total Suspended Solids (mg/L)
2
4
6
8
10
12
14
16
18
20
22
24
Turbidity (NTU)
0
10
20
30
40
50
60
70
Fluoride (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
Sulphate (mg/L)
0
500
1000
1500
2000
2500
Ammonia (mg/L)
0
1
2
3
4
5
Nitrate (mg/L)
0
2
4
6
8
Nitrite (mg/L)
0.0
0.5
1.0
1.5
2.0
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

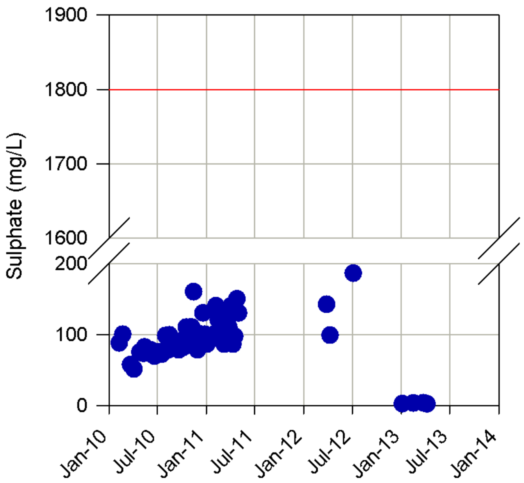

T1
● Parameter Concentration
● Parameter Concentration less than Detection
Aluminum (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Arsenic (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0.014
0.016
0.018
0.020
Cadmium (mg/L)
0.00
0.01
0.02
0.03
0.04
0.05
Chromium (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
0.0030
Copper (mg/L)
0.0
0.5
1.0
1.5
2.0
Iron (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Lead (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
Molybdenum (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
Nickel (mg/L)
0.00
0.01
0.02
0.03
0.04
0.05
Selenium (mg/L)
0
1
2
3
4
5
6
7
Zinc (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

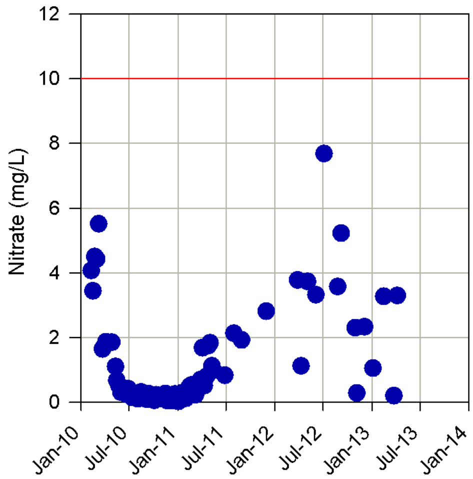
UTMD

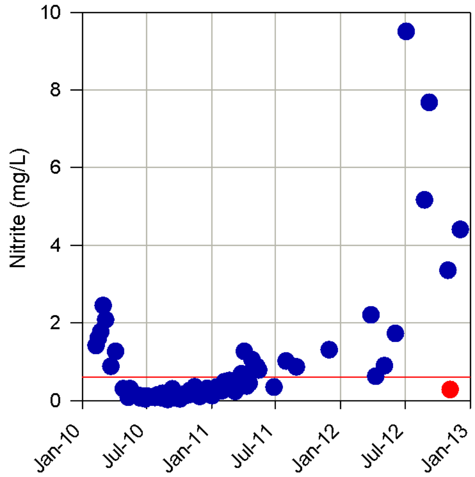
● Parameter Concentration less than detection
● Parameter Concentration
— A-Licence QZ04-065 Discharge Limit

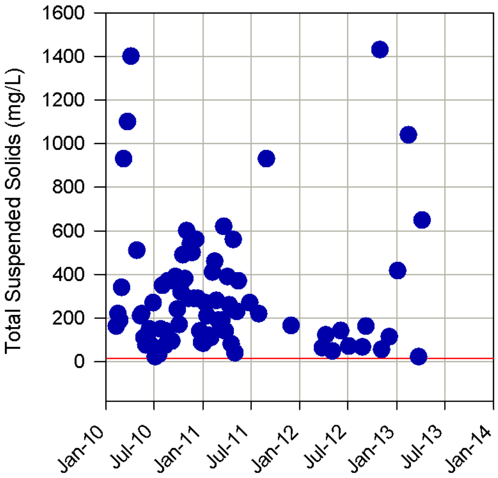


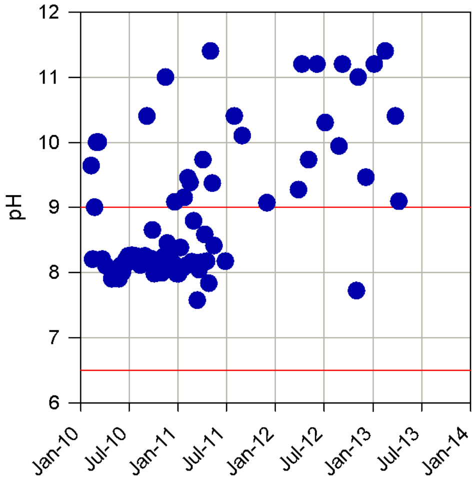




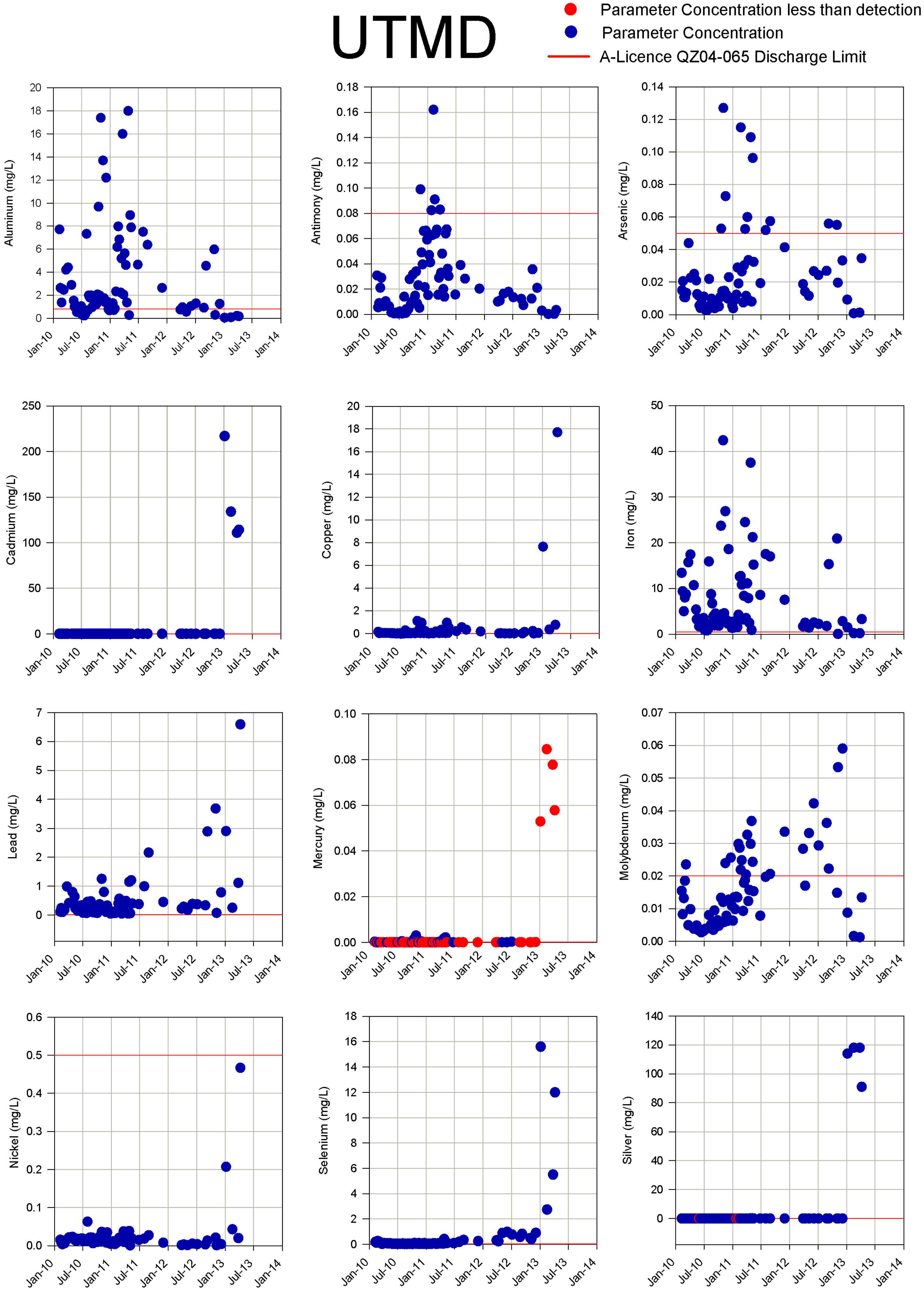






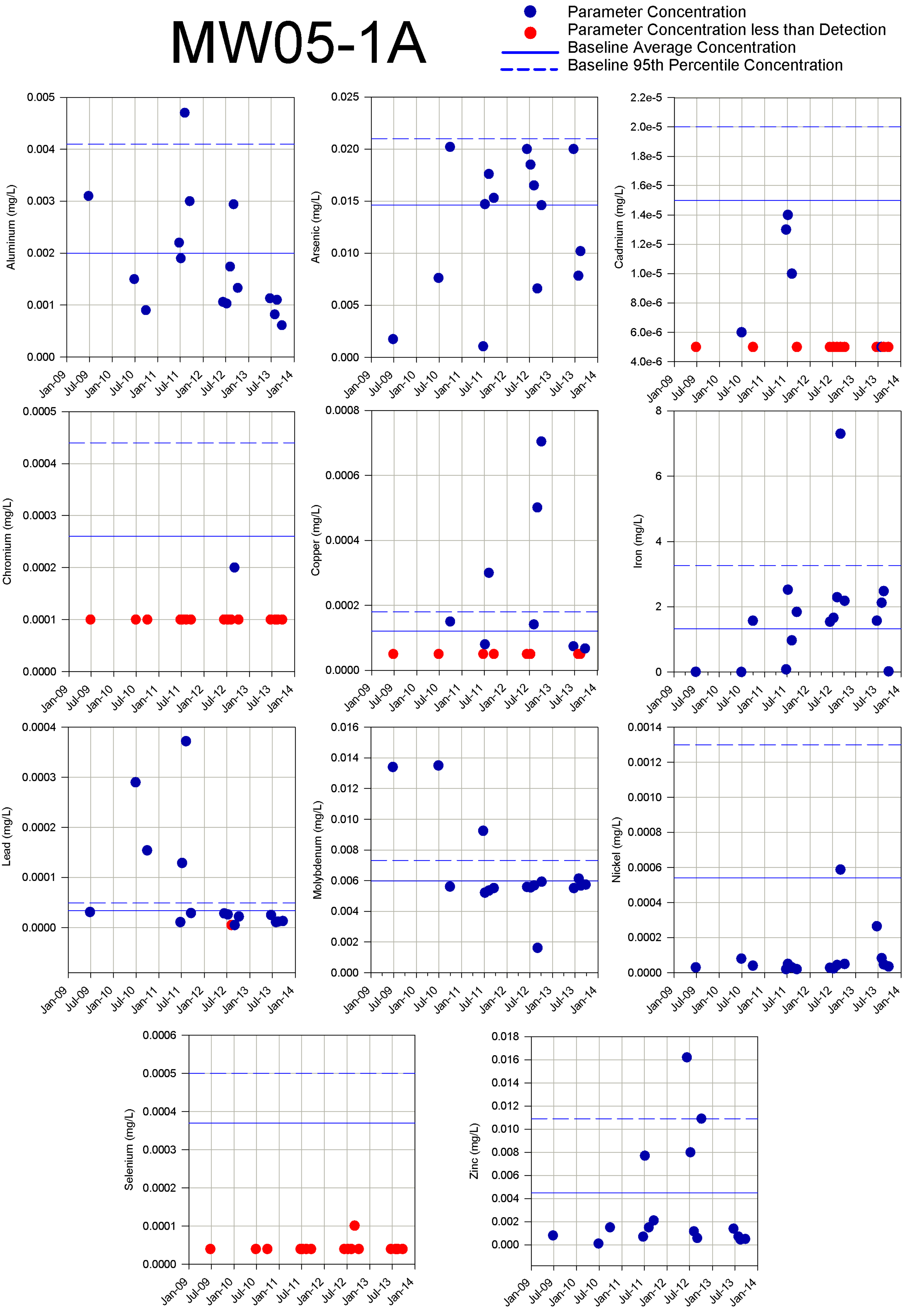


UTMD


● Parameter Concentration less than detection
● Parameter Concentration
A-Licence QZ04-065 Discharge Limit
Aluminum (mg/L)
0
2
4
6
8
10
12
14
16
18
20
Antimony (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
0.18
Arsenic (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
Cadmium (mg/L)
0
50
100
150
200
250
Copper (mg/L)
0
2
4
6
8
10
12
14
16
18
20
Iron (mg/L)
0
10
20
30
40
50
Lead (mg/L)
0
1
2
3
4
5
6
7
Mercury (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
Molybdenum (mg/L)
0.00
0.01
0.02
0.03
0.04
0.05
0.06
0.07
Nickel (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Selenium (mg/L)
0
2
4
6
8
10
12
14
16
18
Silver (mg/L)
0
20
40
60
80
100
120
140
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

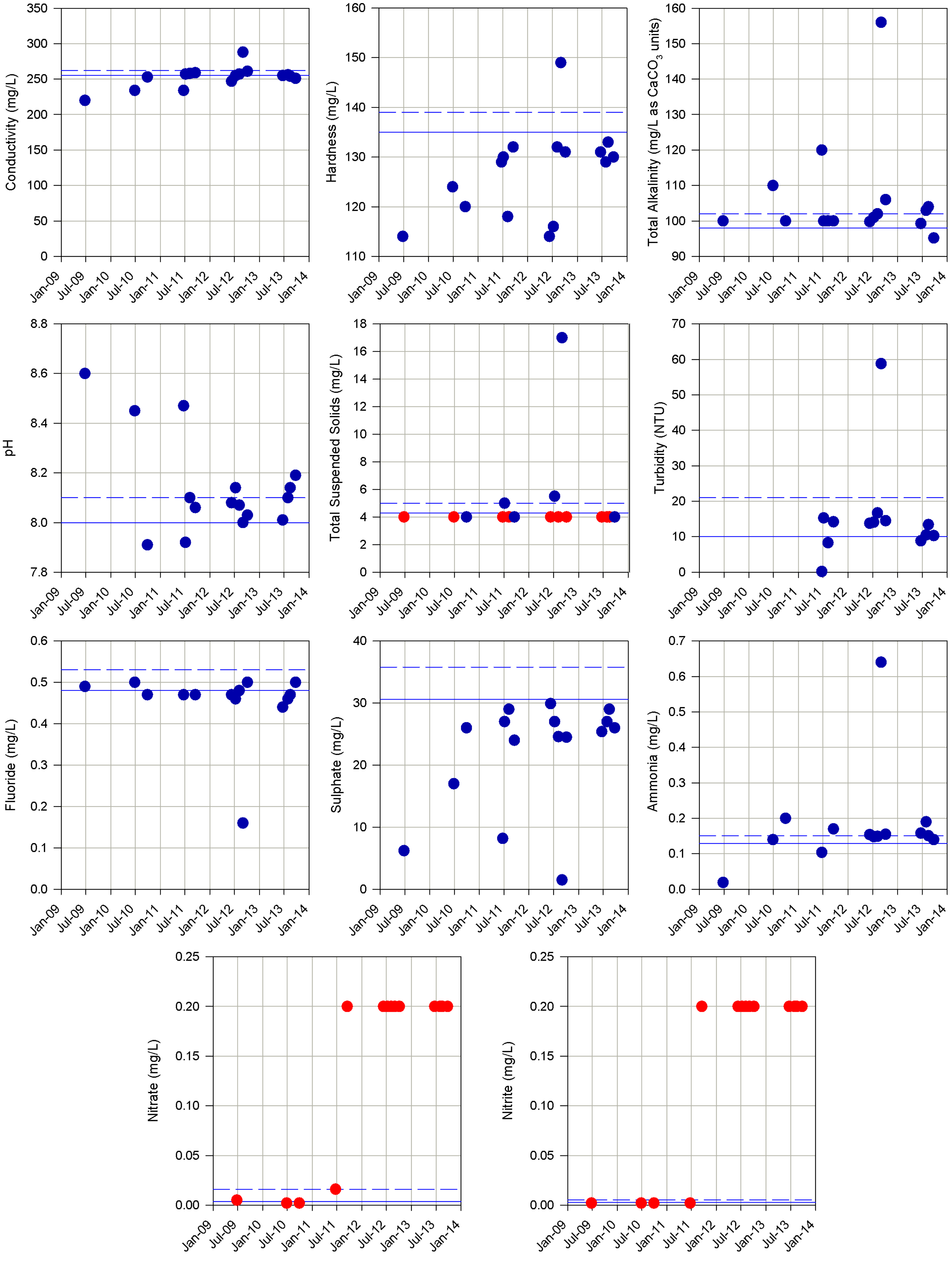
Appendix B: Groundwater Quality – Graphs

MW05-1A


● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
Arsenic (mg/L)
0.000
0.005
0.010
0.015
0.020
0.025
Cadmium (mg/L)
4.0e-6
6.0e-6
8.0e-6
1.0e-5
1.2e-5
1.4e-5
1.6e-5
1.8e-5
2.0e-5
2.2e-5
Chromium (mg/L)
0.0000
0.0001
0.0002
0.0003
0.0004
0.0005
Copper (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
Iron (mg/L)
0
2
4
6
8
Lead (mg/L)
0.0000
0.0001
0.0002
0.0003
0.0004
Molybdenum (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0.014
0.016
Nickel (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
Selenium (mg/L)
0.0000
0.0001
0.0002
0.0003
0.0004
0.0005
0.0006
Zinc (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0.014
0.016
0.018
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

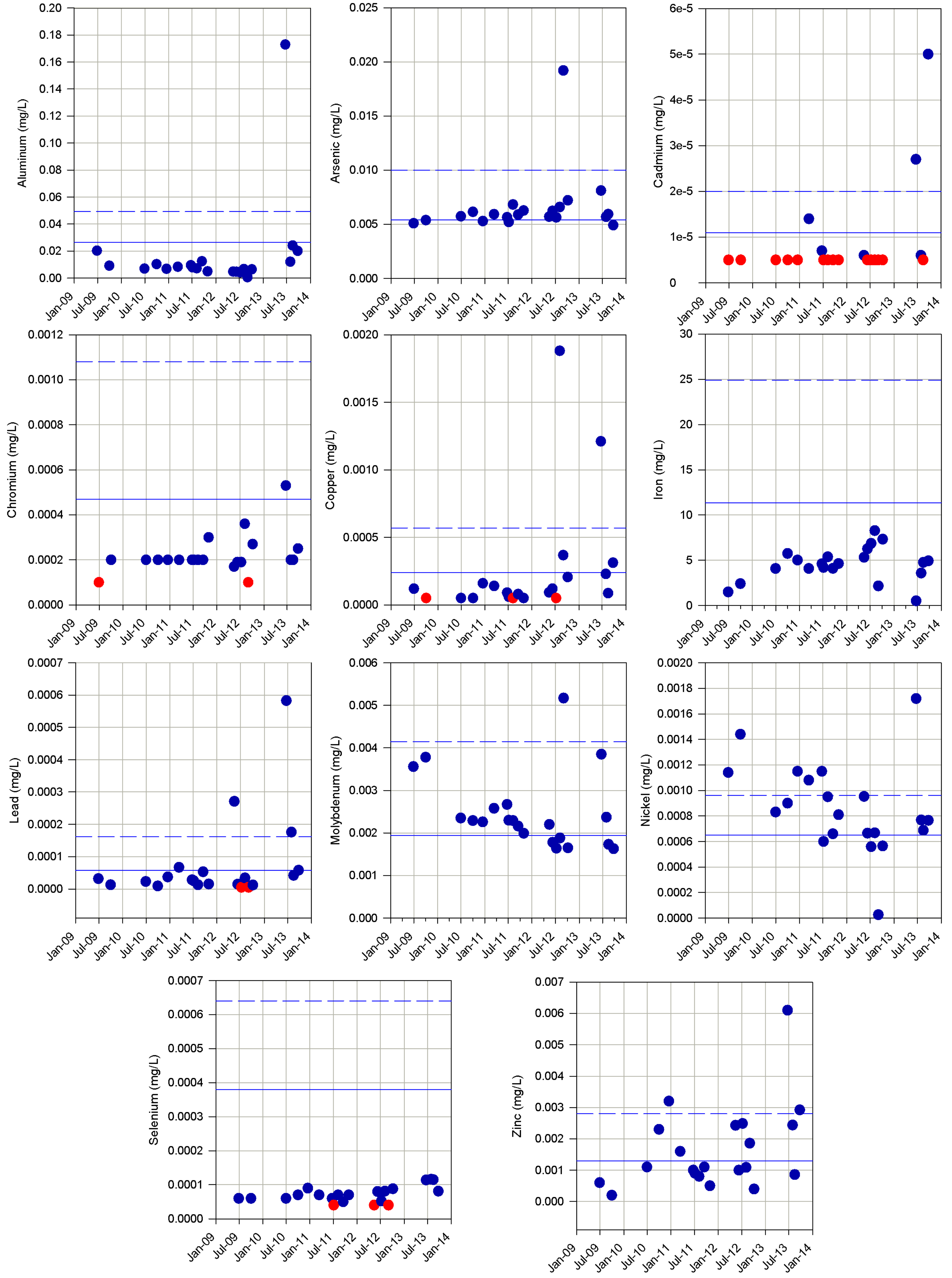
MW05-1A

● Parameter Concentration
● Parameter Concentration less than Detection
— Baseline Average Concentration
- - Baseline 95th Percentile Concentration

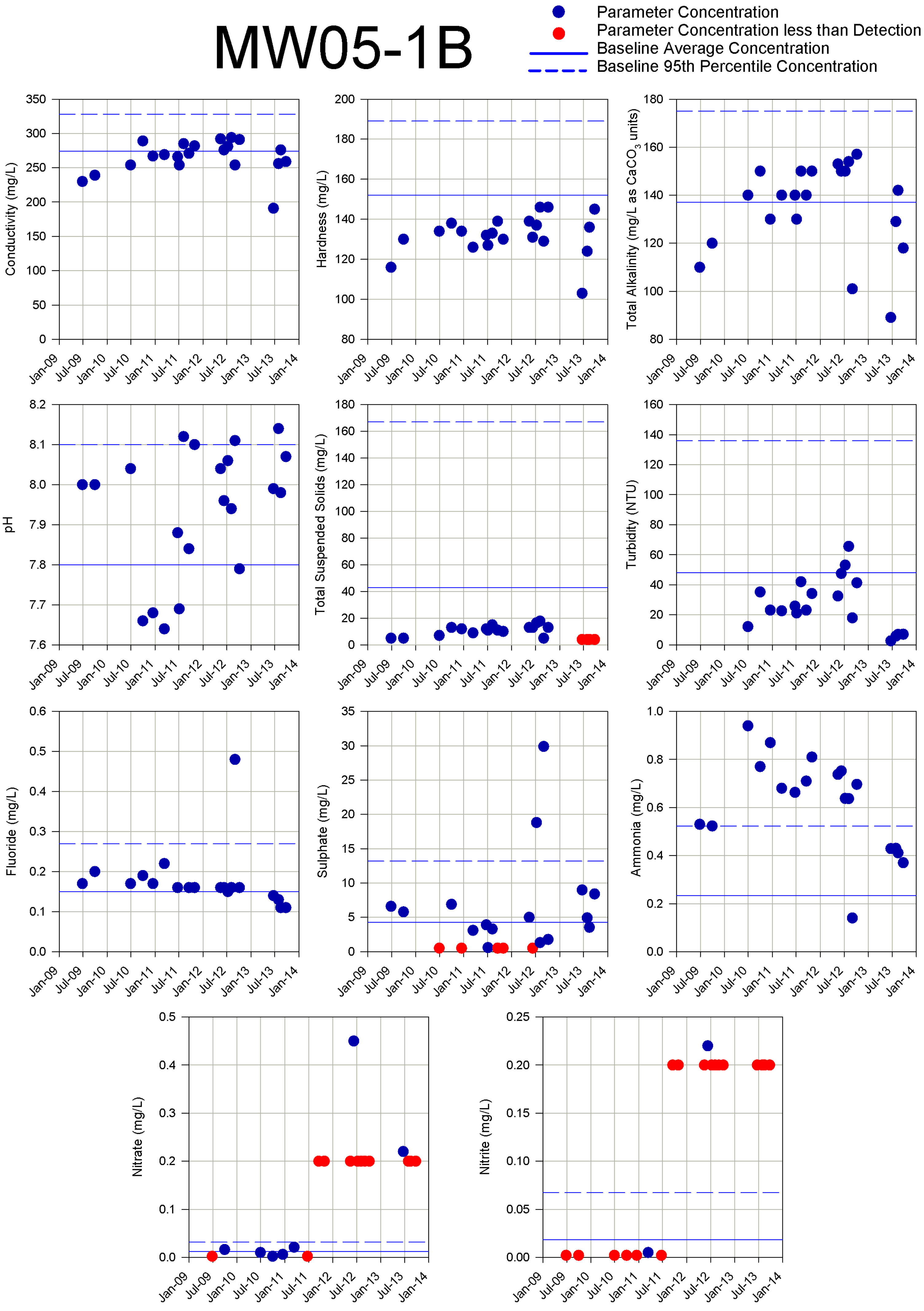


MW05-1B

● Parameter Concentration
● Parameter Concentration less than Detection
— Baseline Average Concentration
- - Baseline 95th Percentile Concentration

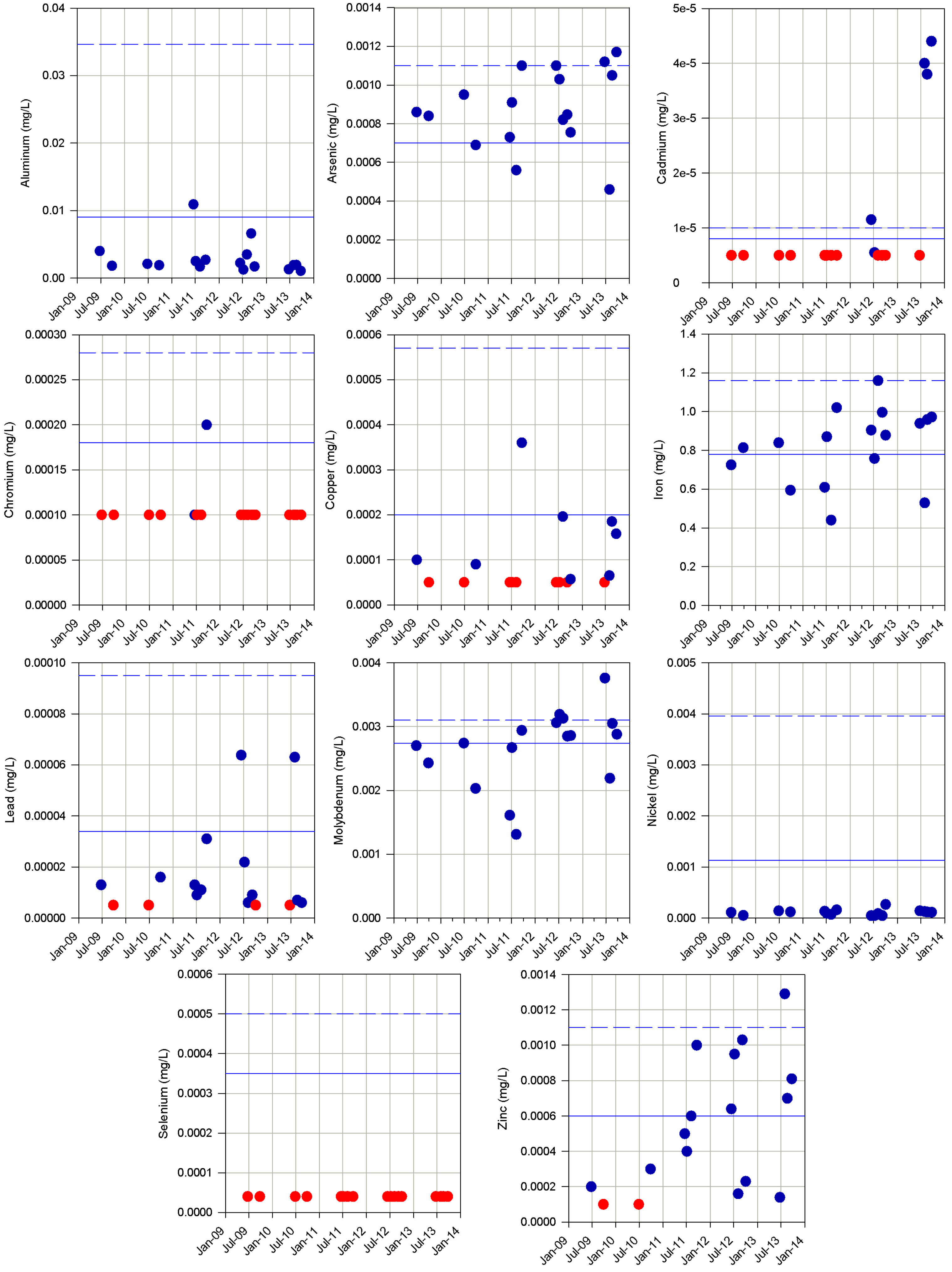


MW05-1B

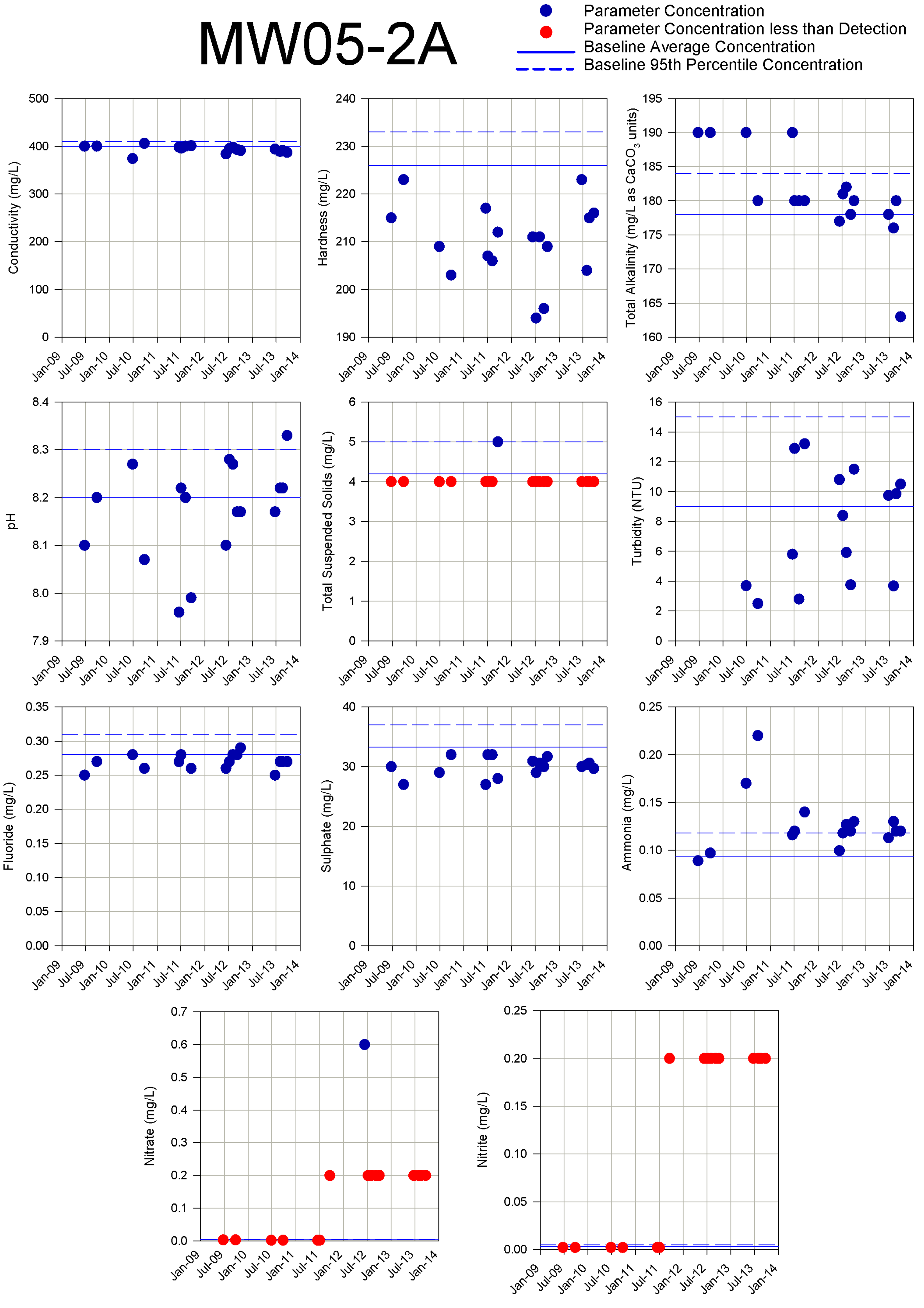

●
Parameter Concentration
●
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
0
50
100
150
200
250
300
350
Hardness (mg/L)
80
100
120
140
160
180
200
Total Alkalinity (mg/L as $CaCO_3$ units)
80
100
120
140
160
180
pH
7.6
7.7
7.8
7.9
8.0
8.1
8.2
Total Suspended Solids (mg/L)
0
20
40
60
80
100
120
140
160
180
Turbidity (NTU)
0
20
40
60
80
100
120
140
160
Fluoride (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Sulphate (mg/L)
0
5
10
15
20
25
30
35
Ammonia (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
Nitrate (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
Nitrite (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

MW05-2A

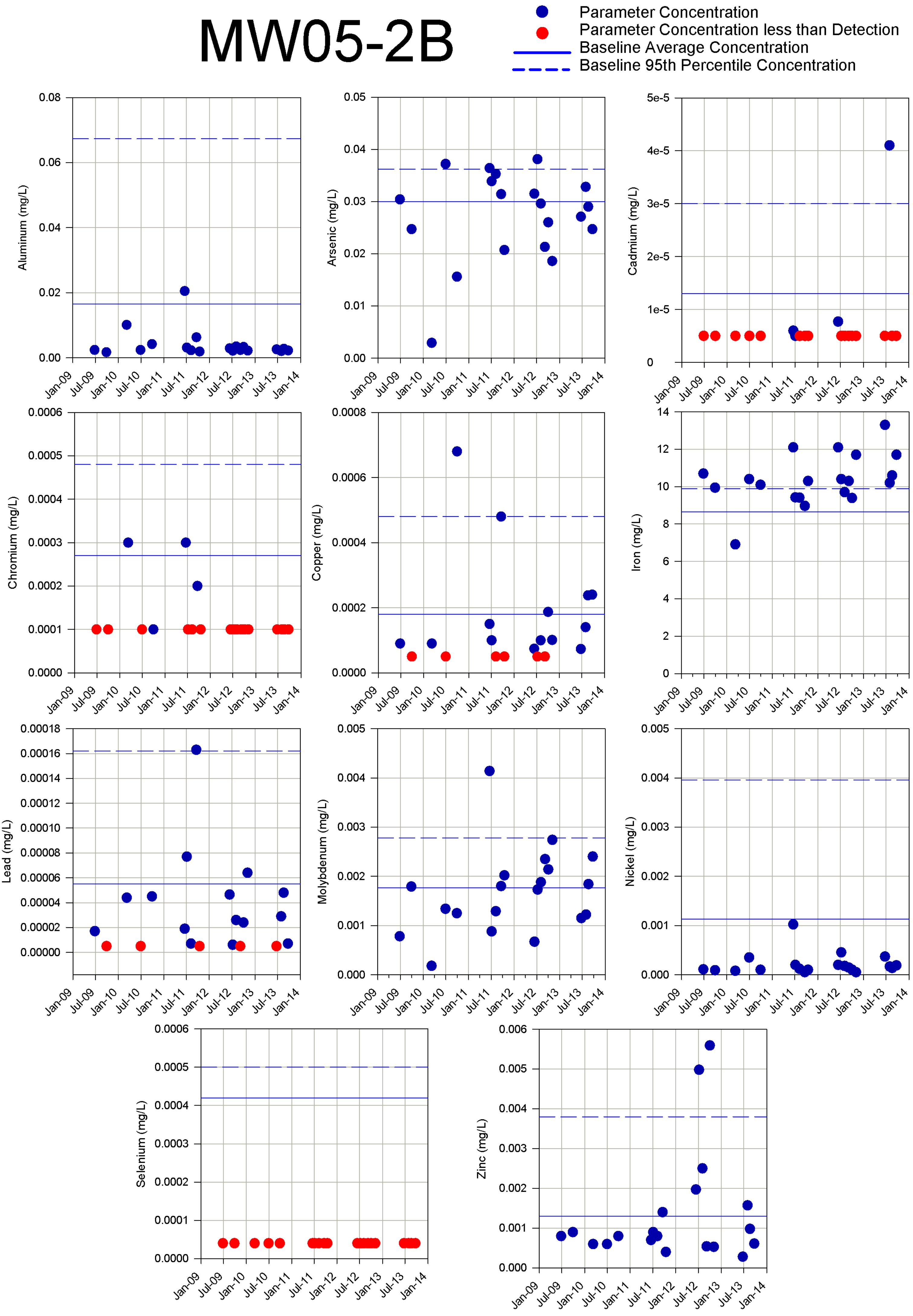
● Parameter Concentration
● Parameter Concentration less than Detection
— Baseline Average Concentration
– – Baseline 95th Percentile Concentration



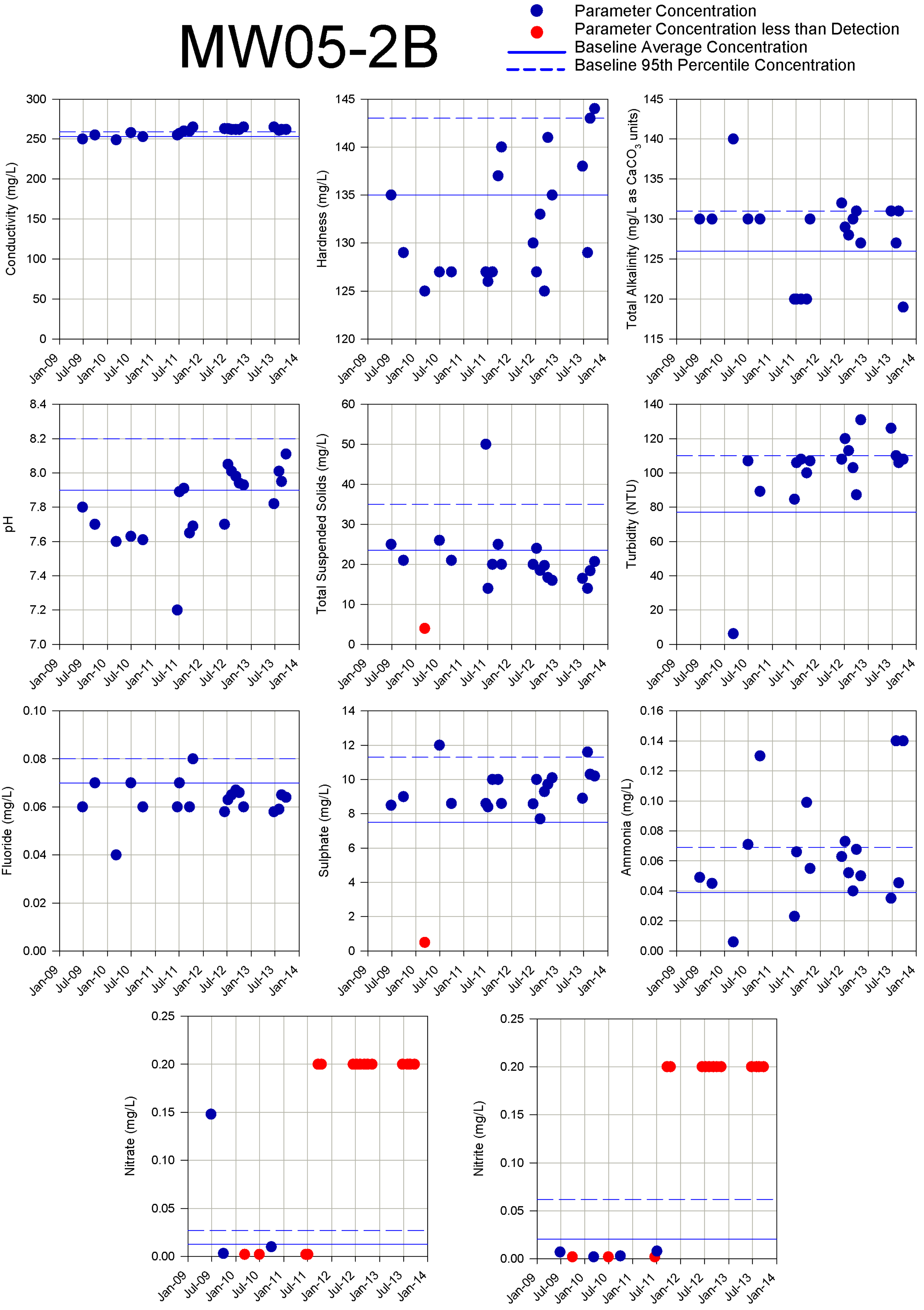
MW05-2A


● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
0
100
200
300
400
500
Hardness (mg/L)
190
200
210
220
230
240
Total Alkalinity (mg/L as $CaCO_3$ units)
160
165
170
175
180
185
190
195
pH
7.9
8.0
8.1
8.2
8.3
8.4
Total Suspended Solids (mg/L)
0
1
2
3
4
5
6
Turbidity (NTU)
0
2
4
6
8
10
12
14
16
Fluoride (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
Sulphate (mg/L)
0
10
20
30
40
Ammonia (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
Nitrate (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Nitrite (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

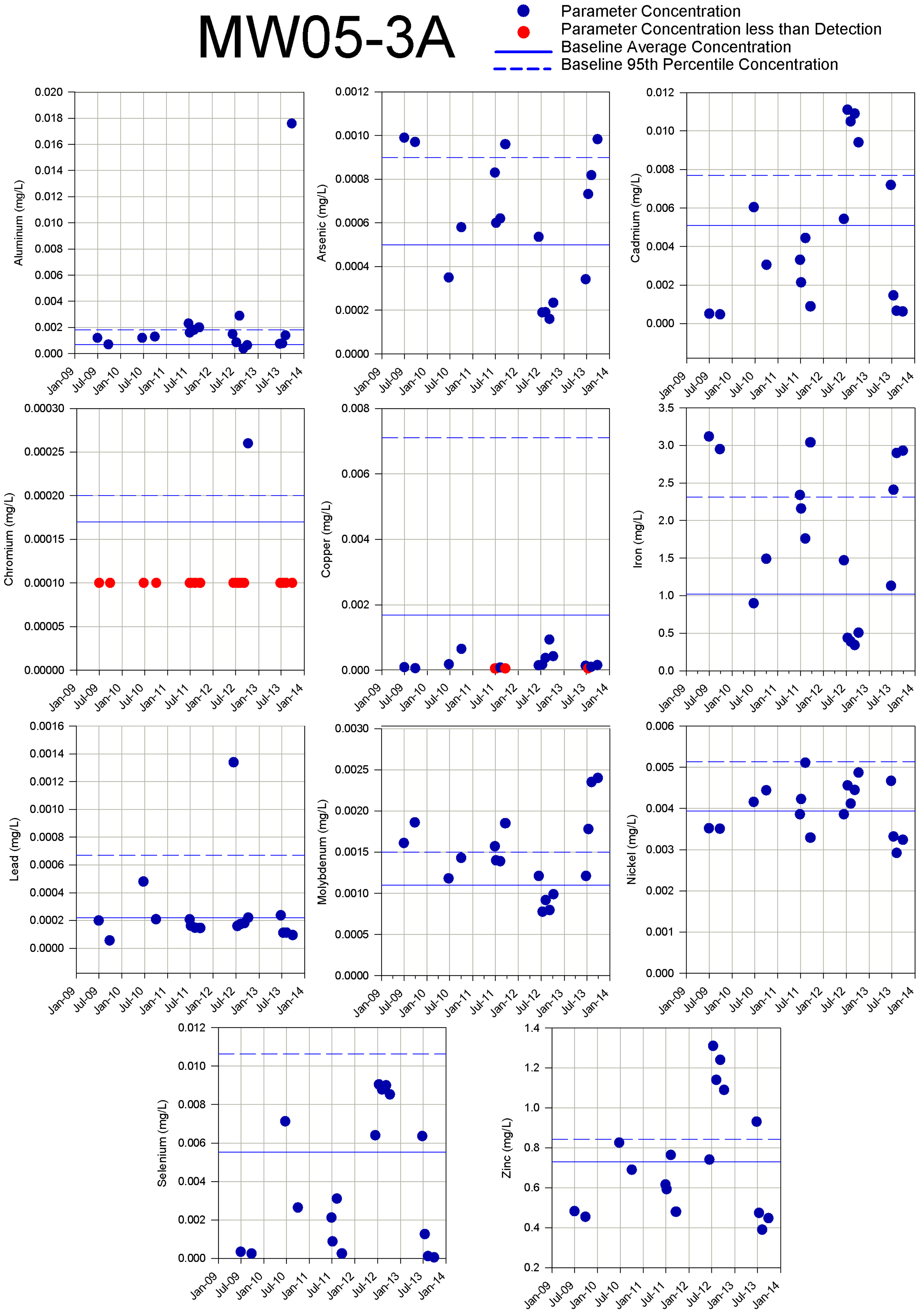
MW05-2B


● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.00
0.02
0.04
0.06
0.08
Arsenic (mg/L)
0.00
0.01
0.02
0.03
0.04
0.05
Cadmium (mg/L)
0
1e-5
2e-5
3e-5
4e-5
5e-5
Chromium (mg/L)
0.0000
0.0001
0.0002
0.0003
0.0004
0.0005
0.0006
Copper (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
Iron (mg/L)
0
2
4
6
8
10
12
14
Lead (mg/L)
0.00000
0.00002
0.00004
0.00006
0.00008
0.00010
0.00012
0.00014
0.00016
0.00018
Molybdenum (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
Nickel (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
Selenium (mg/L)
0.0000
0.0001
0.0002
0.0003
0.0004
0.0005
0.0006
Zinc (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
0.006
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

MW05-2B


● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
0
50
100
150
200
250
300
Hardness (mg/L)
120
125
130
135
140
145
Total Alkalinity (mg/L as $CaCO_3$ units)
115
120
125
130
135
140
145
pH
7.0
7.2
7.4
7.6
7.8
8.0
8.2
8.4
Total Suspended Solids (mg/L)
0
10
20
30
40
50
60
Turbidity (NTU)
0
20
40
60
80
100
120
140
Fluoride (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
Sulphate (mg/L)
0
2
4
6
8
10
12
14
Ammonia (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
Nitrate (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
Nitrite (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

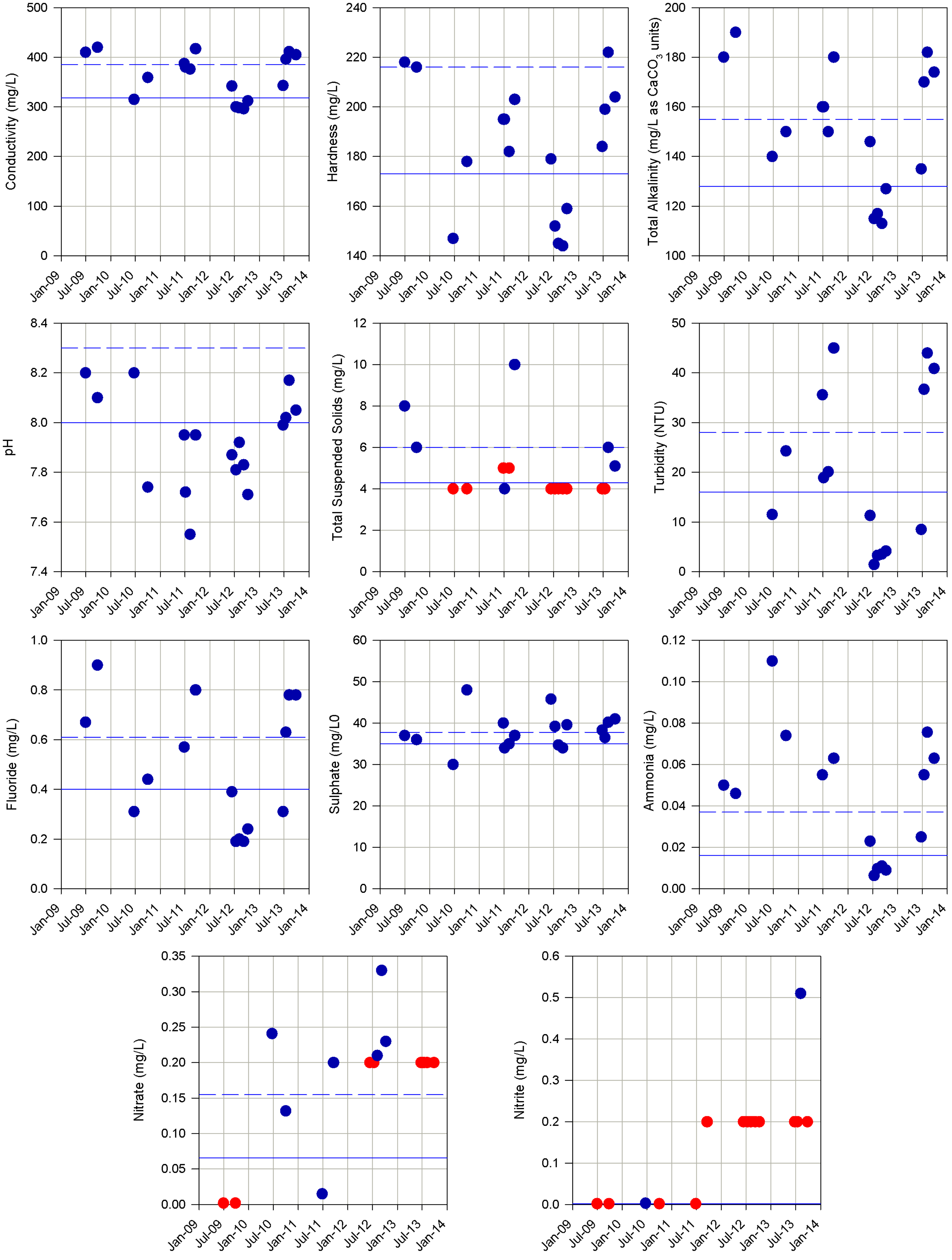
MW05-3A



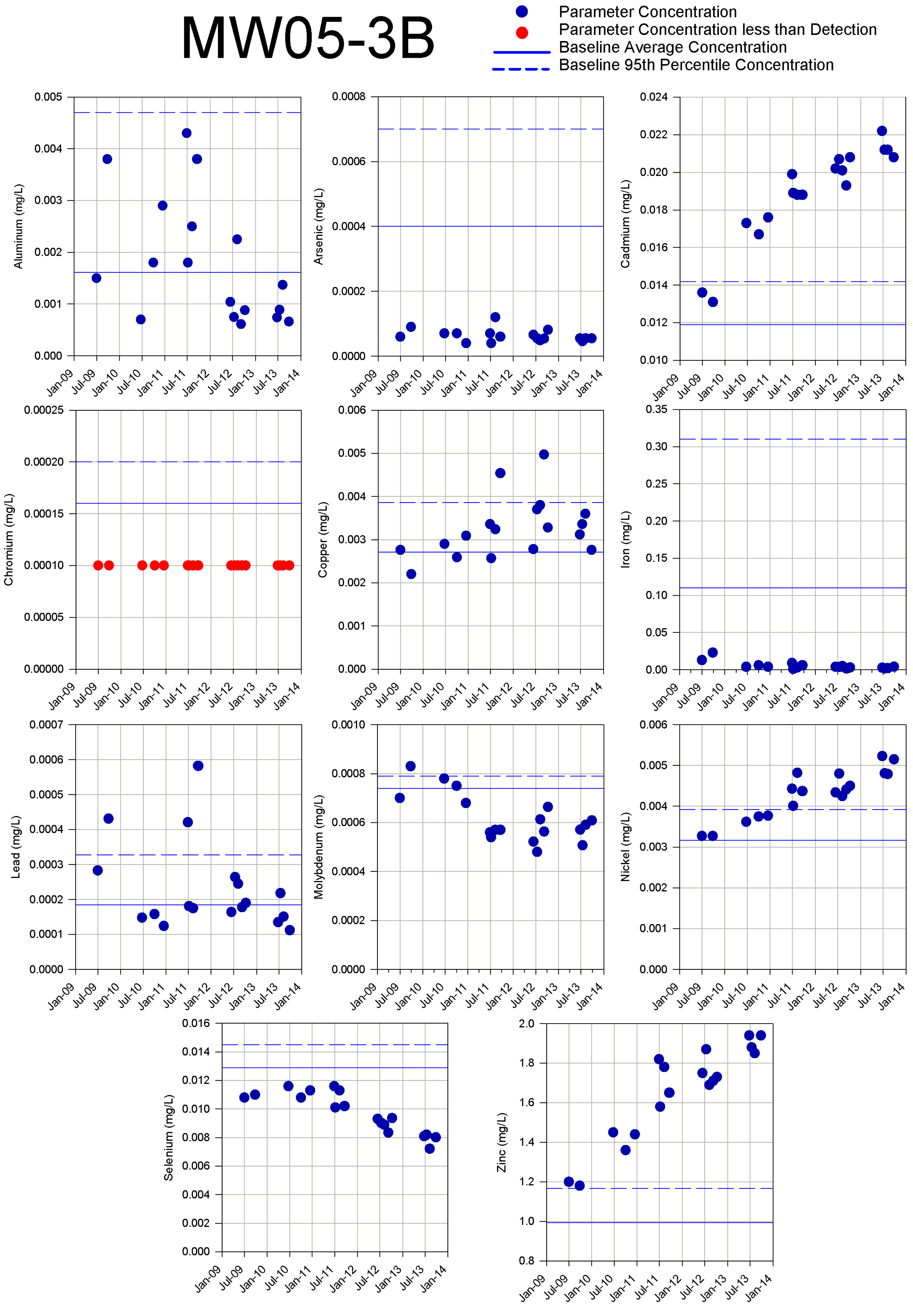
● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0.014
0.016
0.018
0.020
Arsenic (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
Cadmium (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
Chromium (mg/L)
0.00000
0.00005
0.00010
0.00015
0.00020
0.00025
0.00030
Copper (mg/L)
0.000
0.002
0.004
0.006
0.008
Iron (mg/L)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
Lead (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
0.0016
Molybdenum (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
0.0030
Nickel (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
0.006
Selenium (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
Zinc (mg/L)
0.2
0.4
0.6
0.8
1.0
1.2
1.4
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

MW05-3A

● Parameter Concentration
● Parameter Concentration less than Detection
― Baseline Average Concentration
– – Baseline 95th Percentile Concentration

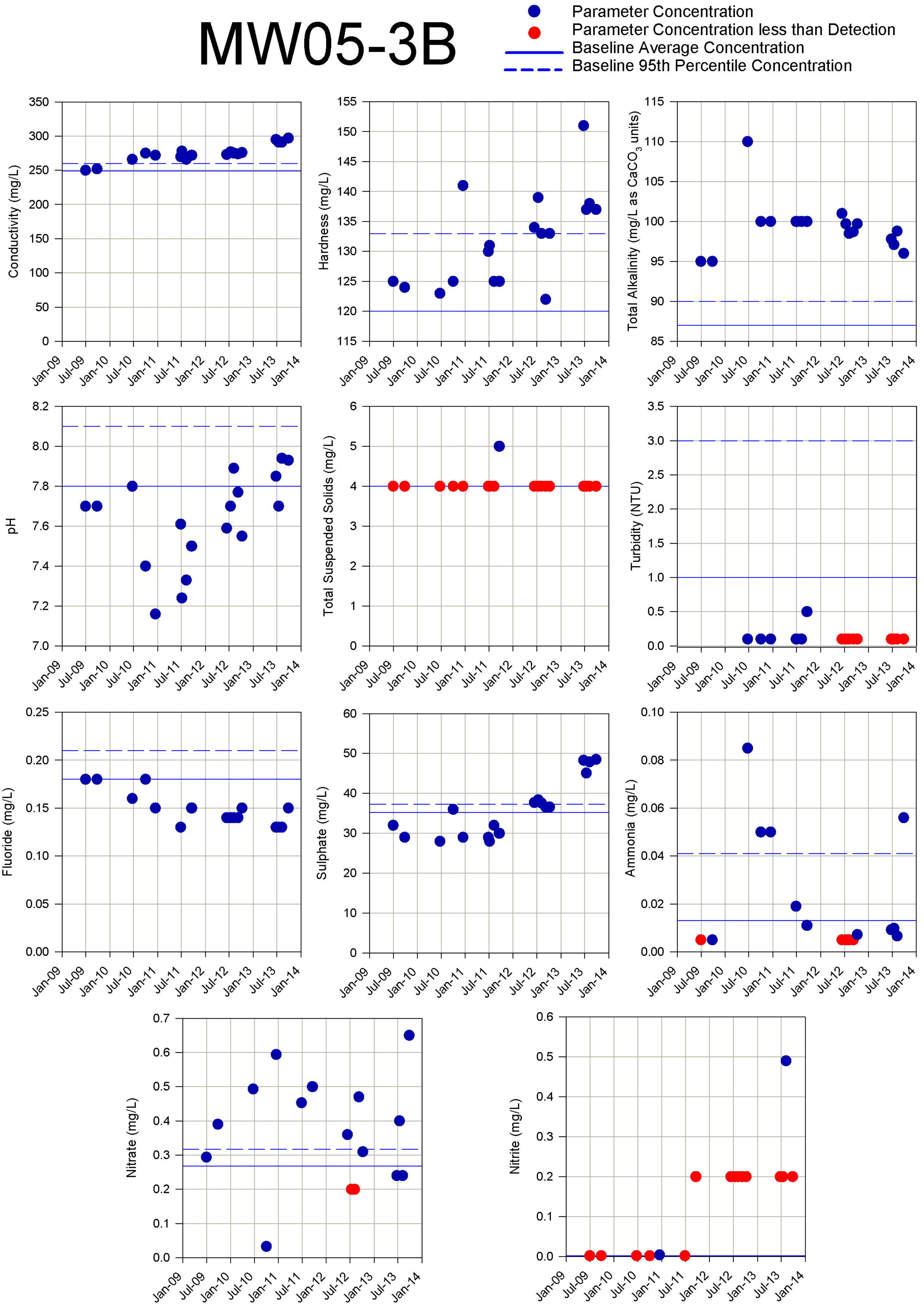


MW05-3B

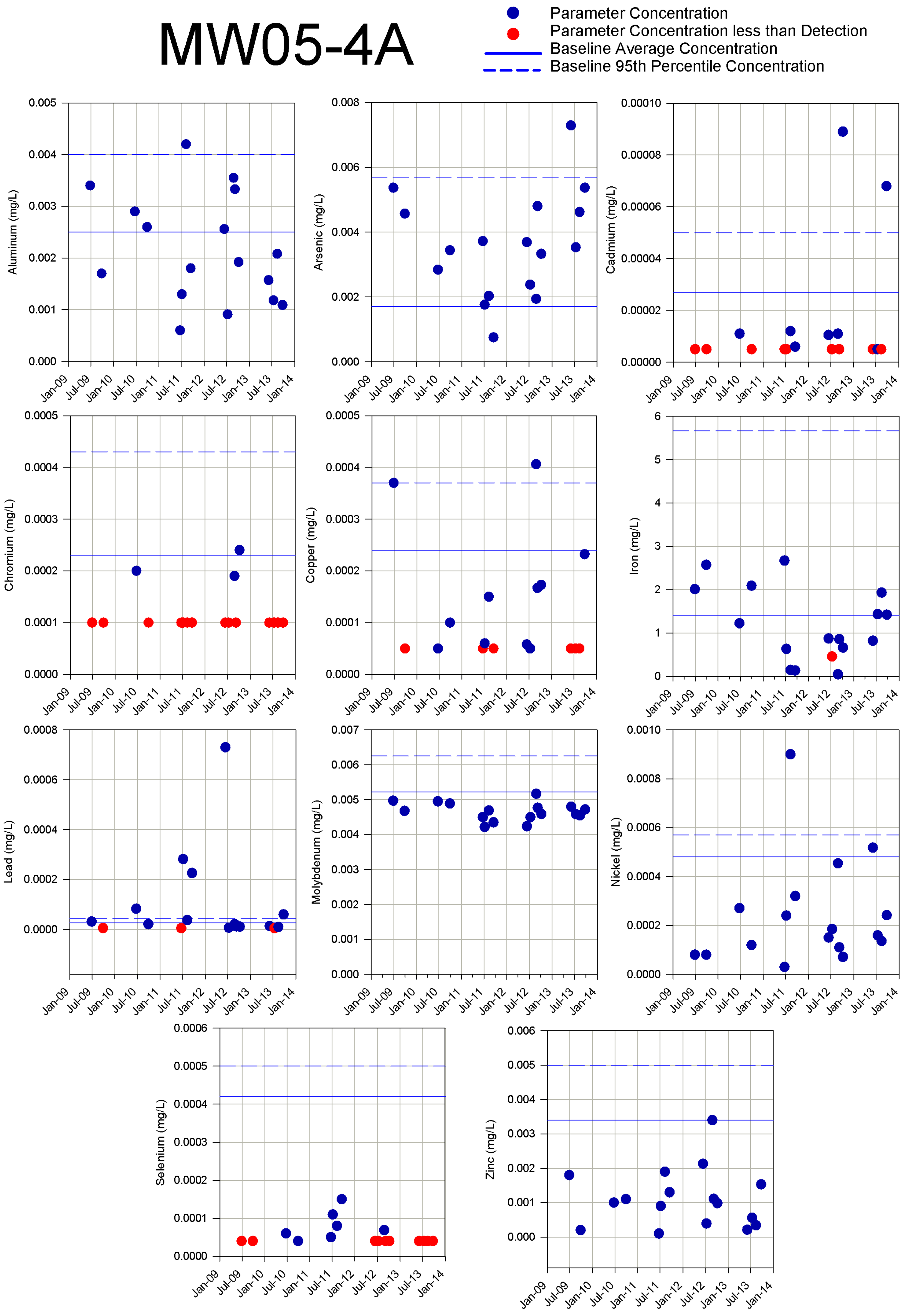


Parameter Concentration
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
Arsenic (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
Cadmium (mg/L)
0.010
0.012
0.014
0.016
0.018
0.020
0.022
0.024
Chromium (mg/L)
0.00000
0.00005
0.00010
0.00015
0.00020
0.00025
Copper (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
0.006
Iron (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
Lead (mg/L)
0.0000
0.0001
0.0002
0.0003
0.0004
0.0005
0.0006
0.0007
Molybdenum (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
Nickel (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
0.006
Selenium (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0.014
0.016
Zinc (mg/L)
0.8
1.0
1.2
1.4
1.6
1.8
2.0
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

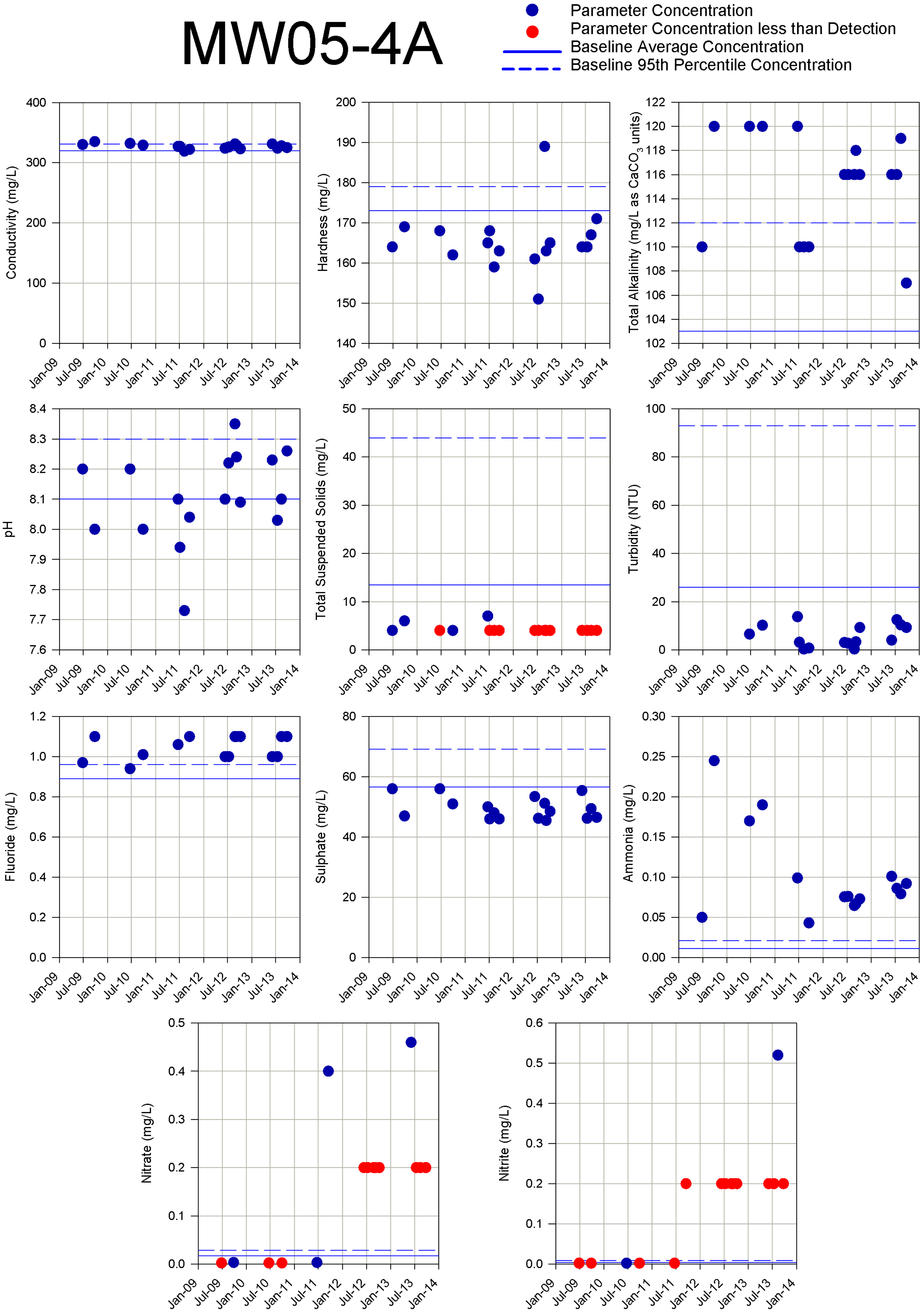
MW05-3B


● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
0 50 100 150 200 250 300 350
Hardness (mg/L)
115 120 125 130 135 140 145 150 155
Total Alkalinity (mg/L as $CaCO_3$ units)
85 90 95 100 105 110 115
pH
7.0 7.2 7.4 7.6 7.8 8.0 8.2
Total Suspended Solids (mg/L)
0 1 2 3 4 5 6
Turbidity (NTU)
0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5
Fluoride (mg/L)
0.00 0.05 0.10 0.15 0.20 0.25
Sulphate (mg/L)
0 10 20 30 40 50 60
Ammonia (mg/L)
0.00 0.02 0.04 0.06 0.08 0.10
Nitrate (mg/L)
0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7
Nitrite (mg/L)
0.0 0.1 0.2 0.3 0.4 0.5 0.6
Jan-09 Jul-09 Jan-10 Jul-10 Jan-11 Jul-11 Jan-12 Jul-12 Jan-13 Jul-13 Jan-14

MW05-4A

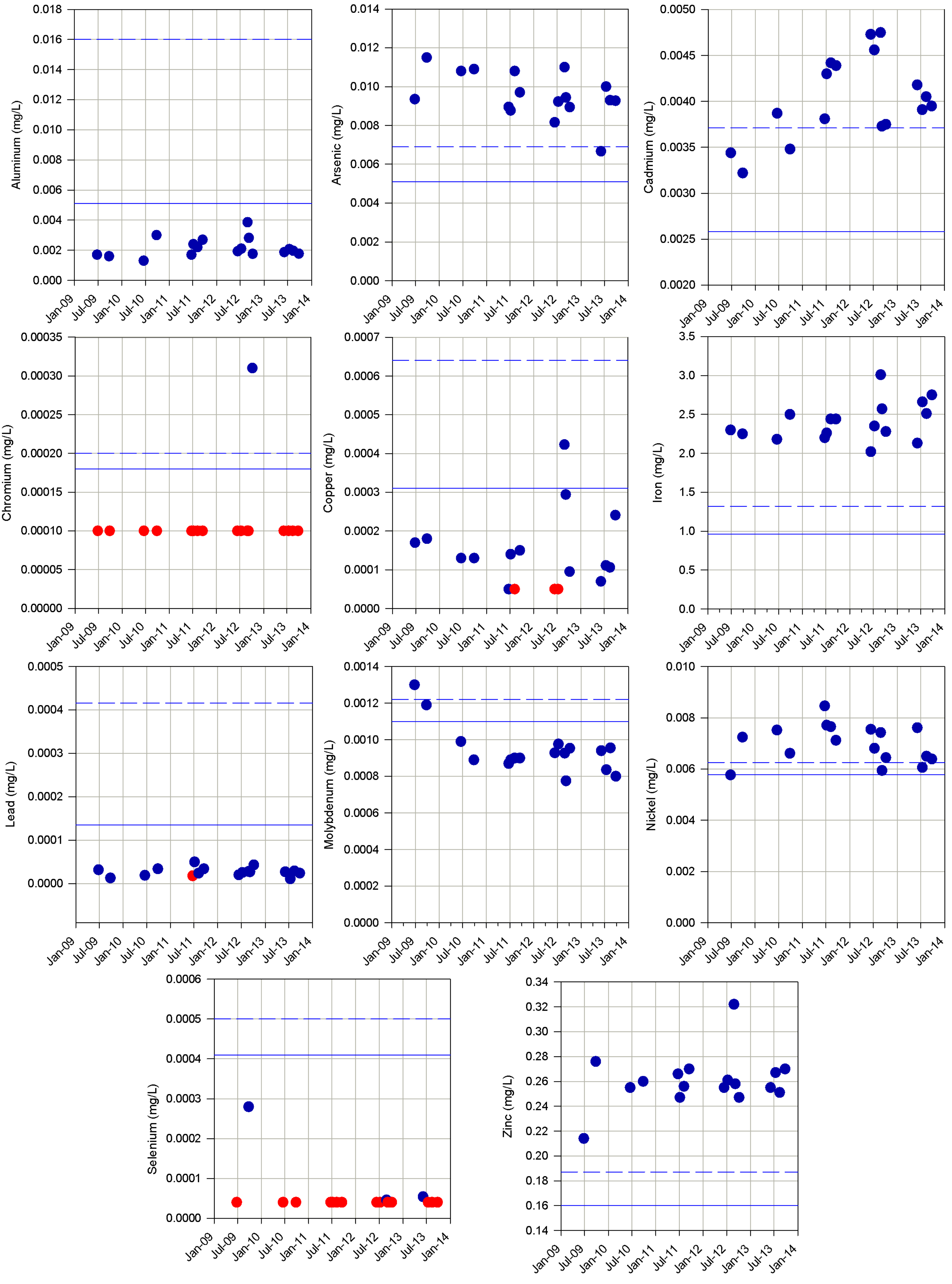

● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.000 0.001 0.002 0.003 0.004 0.005
Arsenic (mg/L)
0.000 0.002 0.004 0.006 0.008
Cadmium (mg/L)
0.00000 0.00002 0.00004 0.00006 0.00008 0.00010
Chromium (mg/L)
0.0000 0.0001 0.0002 0.0003 0.0004 0.0005
Copper (mg/L)
0.0000 0.0001 0.0002 0.0003 0.0004 0.0005
Iron (mg/L)
0 1 2 3 4 5 6
Lead (mg/L)
0.0000 0.0002 0.0004 0.0006 0.0008
Molybdenum (mg/L)
0.000 0.001 0.002 0.003 0.004 0.005 0.006 0.007
Nickel (mg/L)
0.0000 0.0002 0.0004 0.0006 0.0008 0.0010
Selenium (mg/L)
0.0000 0.0001 0.0002 0.0003 0.0004 0.0005 0.0006
Zinc (mg/L)
0.000 0.001 0.002 0.003 0.004 0.005 0.006
Jan-09 Jul-09 Jan-10 Jul-10 Jan-11 Jul-11 Jan-12 Jul-12 Jan-13 Jul-13 Jan-14

MW05-4A

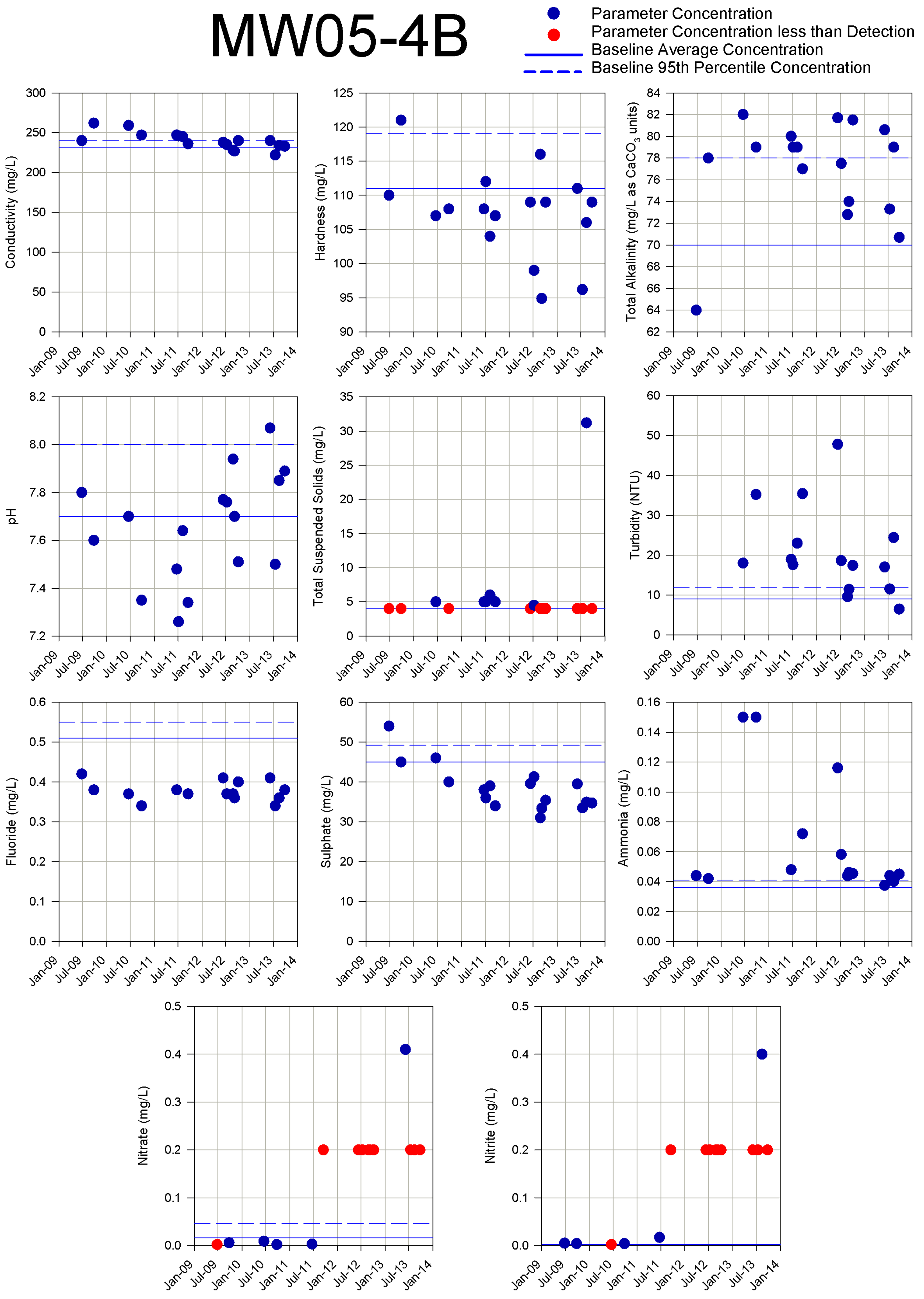

Parameter Concentration
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
0
100
200
300
400
Hardness (mg/L)
140
150
160
170
180
190
200
Total Alkalinity (mg/L as CaCO$_3$ units)
102
104
106
108
110
112
114
116
118
120
122
pH
7.6
7.7
7.8
7.9
8.0
8.1
8.2
8.3
8.4
Total Suspended Solids (mg/L)
0
10
20
30
40
50
Turbidity (NTU)
0
20
40
60
80
100
Fluoride (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Sulphate (mg/L)
0
20
40
60
80
Ammonia (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
Nitrate (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
Nitrite (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

MW05-4B

● Parameter Concentration
● Parameter Concentration less than Detection
— Baseline Average Concentration
– – Baseline 95th Percentile Concentration

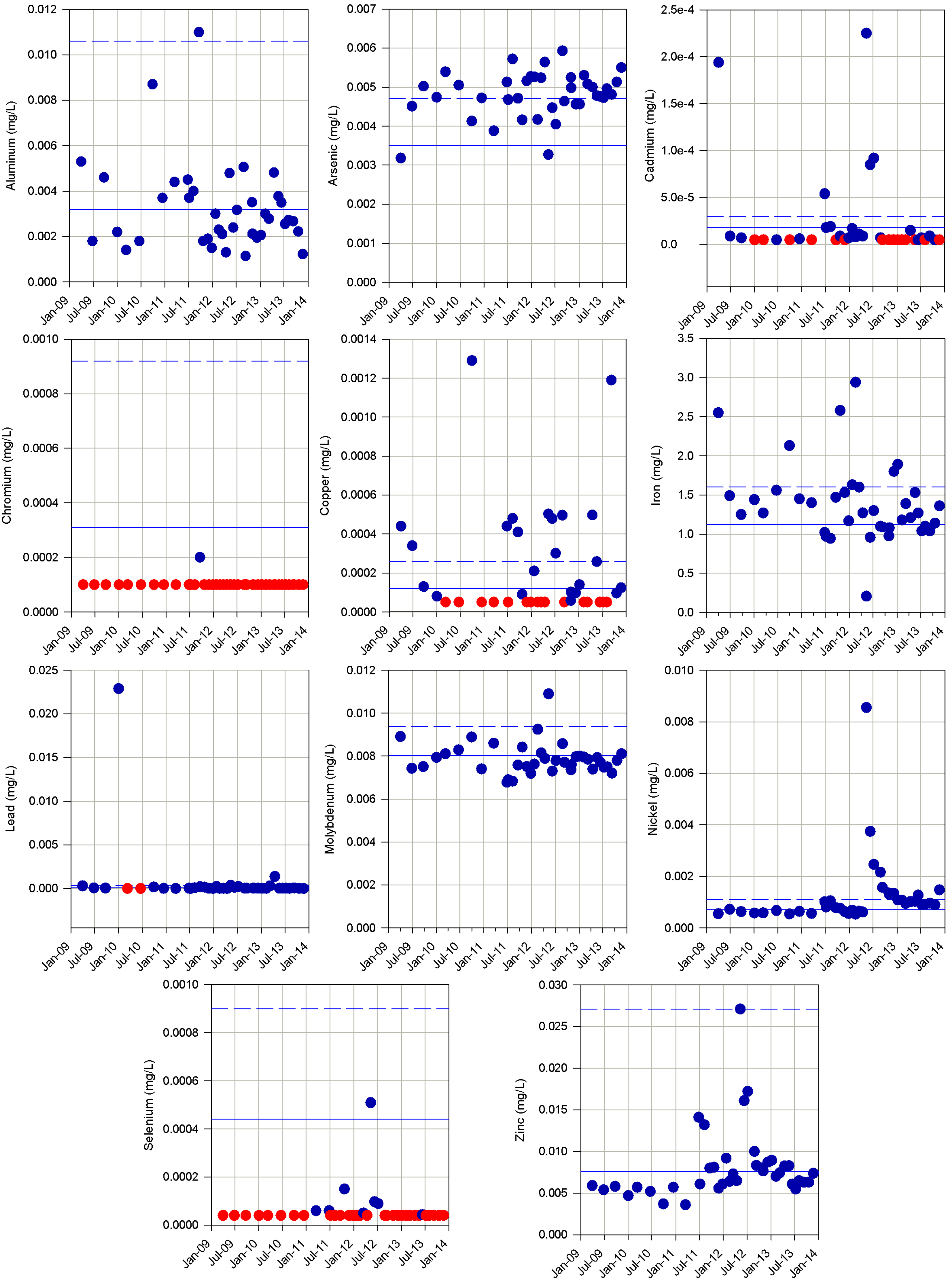


MW05-4B

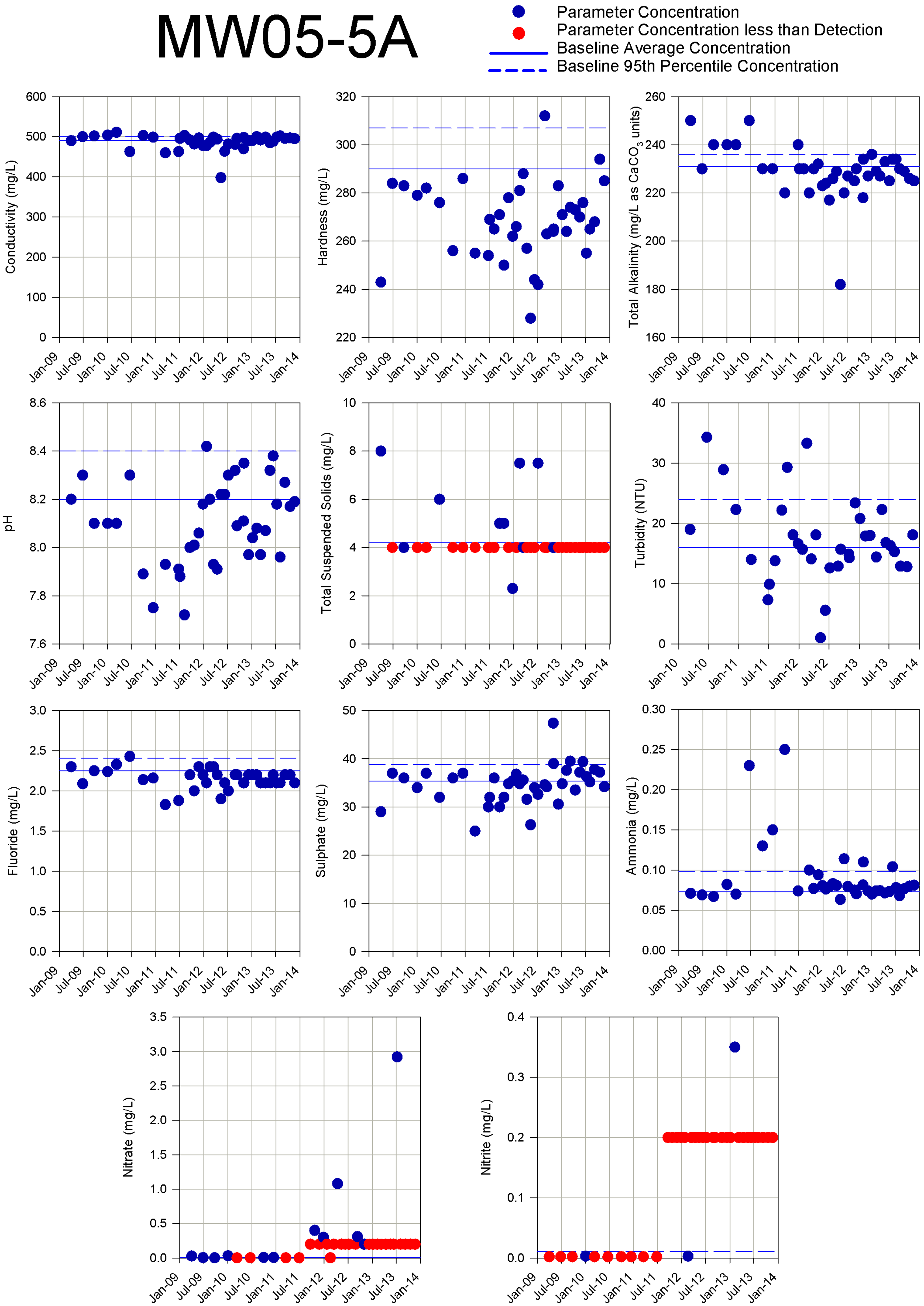

Parameter Concentration
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
0
50
100
150
200
250
300
Hardness (mg/L)
90
95
100
105
110
115
120
125
Total Alkalinity (mg/L as $CaCO_3$ units)
62
64
66
68
70
72
74
76
78
80
82
84
pH
7.2
7.4
7.6
7.8
8.0
8.2
Total Suspended Solids (mg/L)
0
5
10
15
20
25
30
35
Turbidity (NTU)
0
10
20
30
40
50
60
Fluoride (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Sulphate (mg/L)
0
10
20
30
40
50
60
Ammonia (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
Nitrate (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
Nitrite (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

MW05-5A

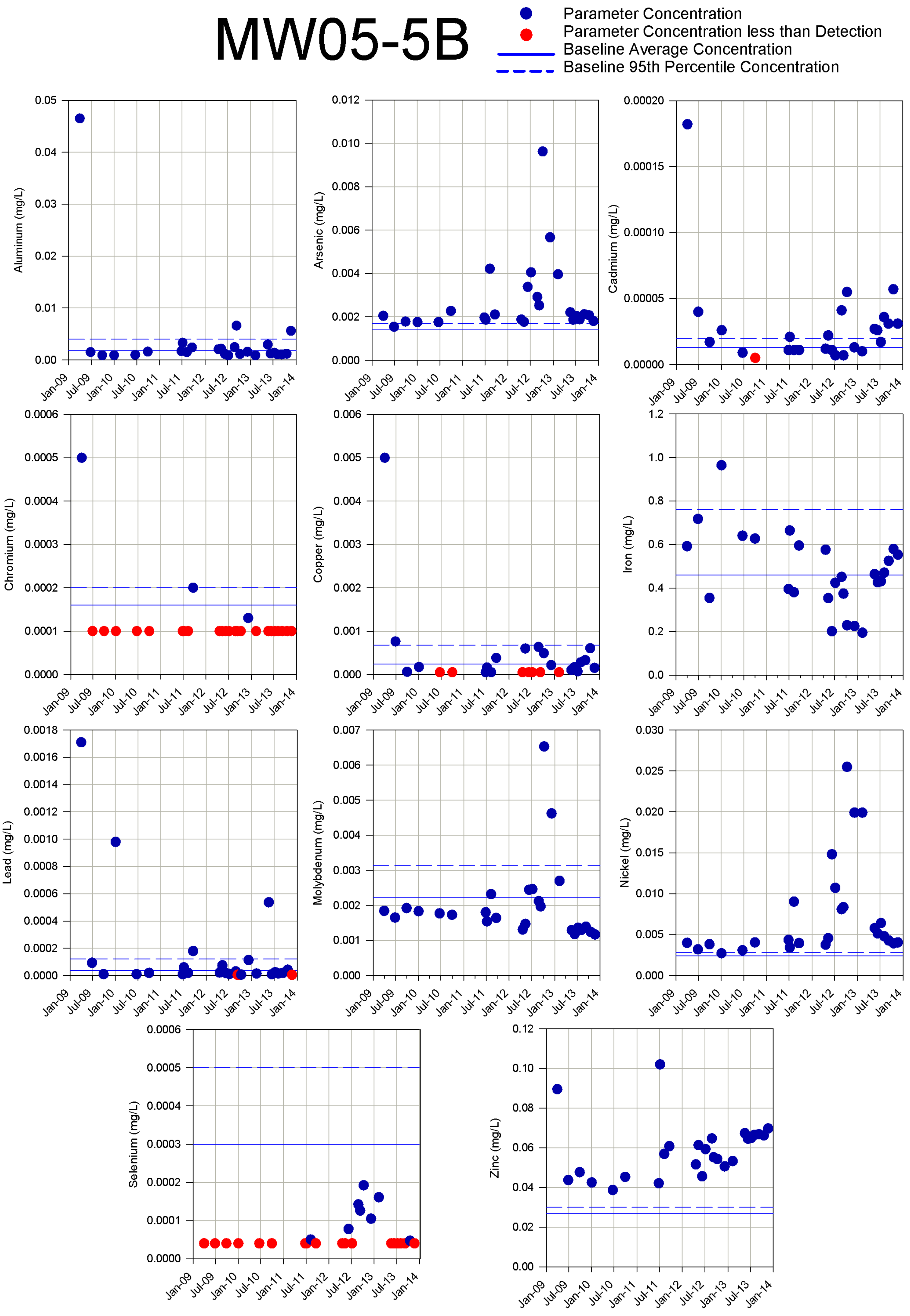
● Parameter Concentration
● Parameter Concentration less than Detection
— Baseline Average Concentration
- - Baseline 95th Percentile Concentration



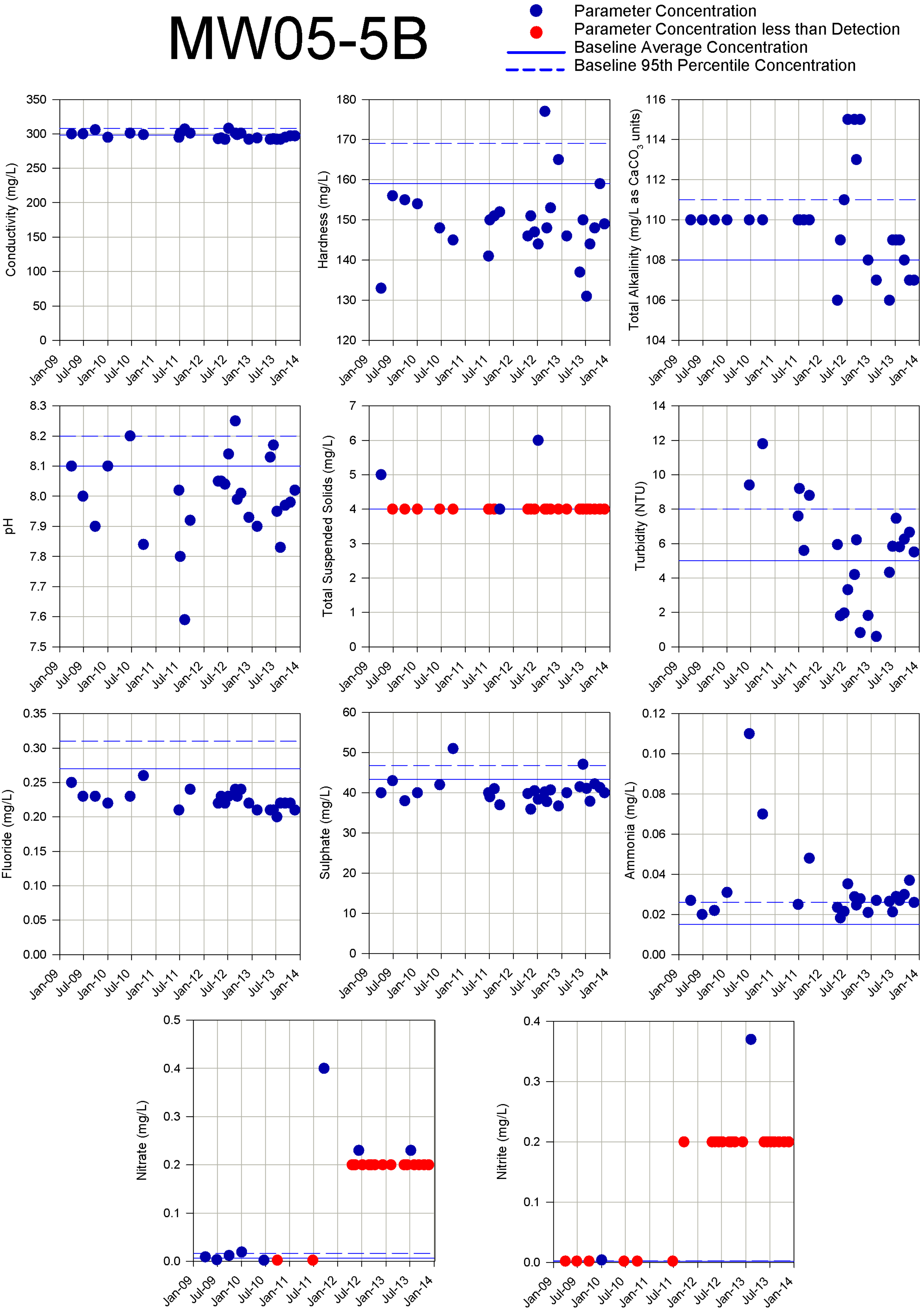
MW05-5A


Parameter Concentration
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
0
100
200
300
400
500
600
Hardness (mg/L)
220
240
260
280
300
320
Total Alkalinity (mg/L as CaCO$_3$ units)
160
180
200
220
240
260
pH
7.6
7.8
8.0
8.2
8.4
8.6
Total Suspended Solids (mg/L)
0
2
4
6
8
10
Turbidity (NTU)
0
10
20
30
40
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14
Fluoride (mg/L)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Sulphate (mg/L)
0
10
20
30
40
50
Ammonia (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
Nitrate (mg/L)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
Nitrite (mg/L)
0.0
0.1
0.2
0.3
0.4
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

MW05-5B

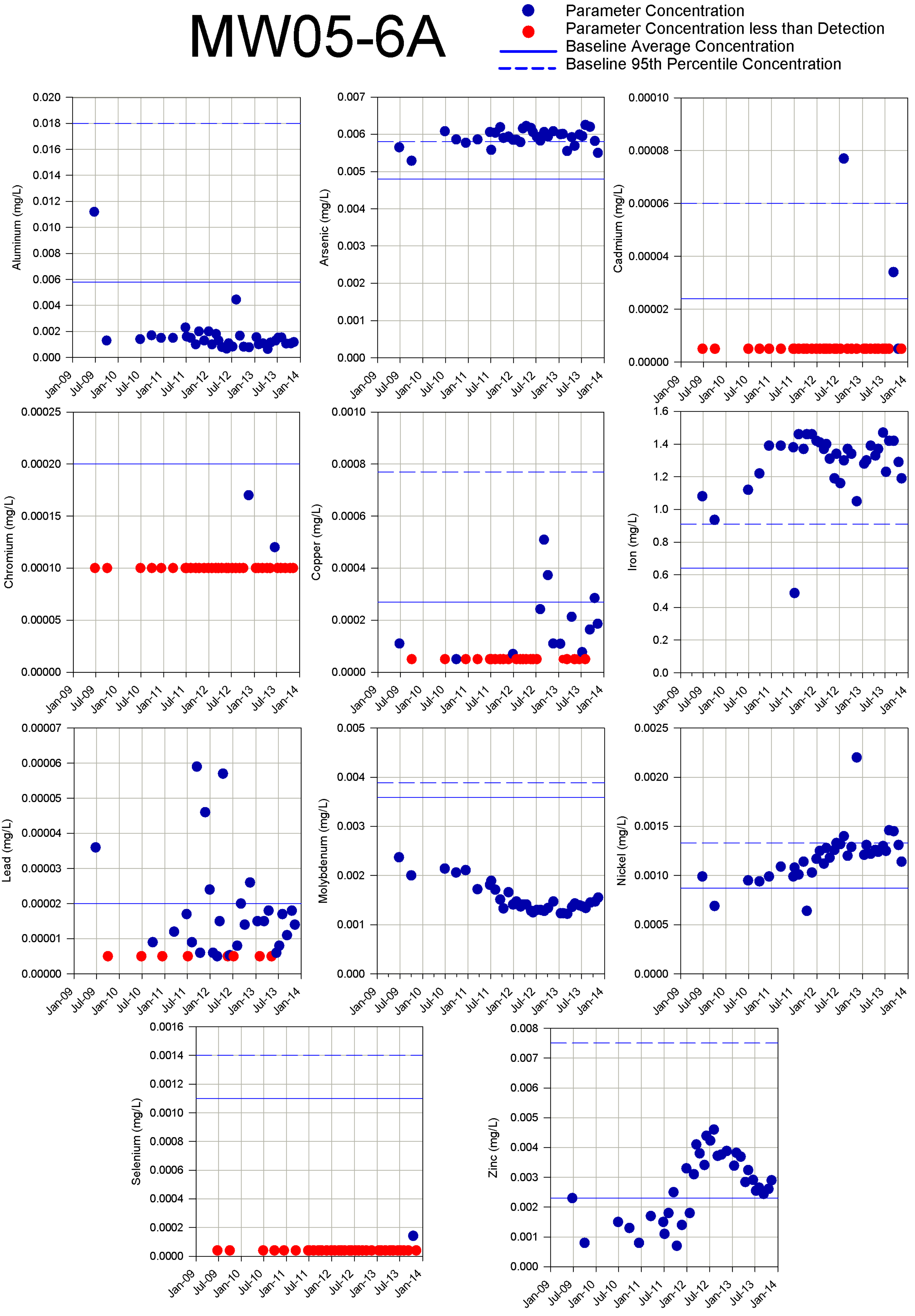

● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.00
0.01
0.02
0.03
0.04
0.05
Arsenic (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
Cadmium (mg/L)
0.00000
0.00005
0.00010
0.00015
0.00020
Chromium (mg/L)
0.0000
0.0001
0.0002
0.0003
0.0004
0.0005
0.0006
Copper (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
0.006
Iron (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Lead (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
0.0016
0.0018
Molybdenum (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
0.006
0.007
Nickel (mg/L)
0.000
0.005
0.010
0.015
0.020
0.025
0.030
Selenium (mg/L)
0.0000
0.0001
0.0002
0.0003
0.0004
0.0005
0.0006
Zinc (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
0.12
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

MW05-5B



● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
0
50
100
150
200
250
300
350
Hardness (mg/L)
120
130
140
150
160
170
180
Total Alkalinity (mg/L as $CaCO_3$ units)
104
106
108
110
112
114
116
pH
7.5
7.6
7.7
7.8
7.9
8.0
8.1
8.2
8.3
Total Suspended Solids (mg/L)
0
1
2
3
4
5
6
7
Turbidity (NTU)
0
2
4
6
8
10
12
14
Fluoride (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
Sulphate (mg/L)
0
10
20
30
40
50
60
Ammonia (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
0.12
Nitrate (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
Nitrite (mg/L)
0.0
0.1
0.2
0.3
0.4
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

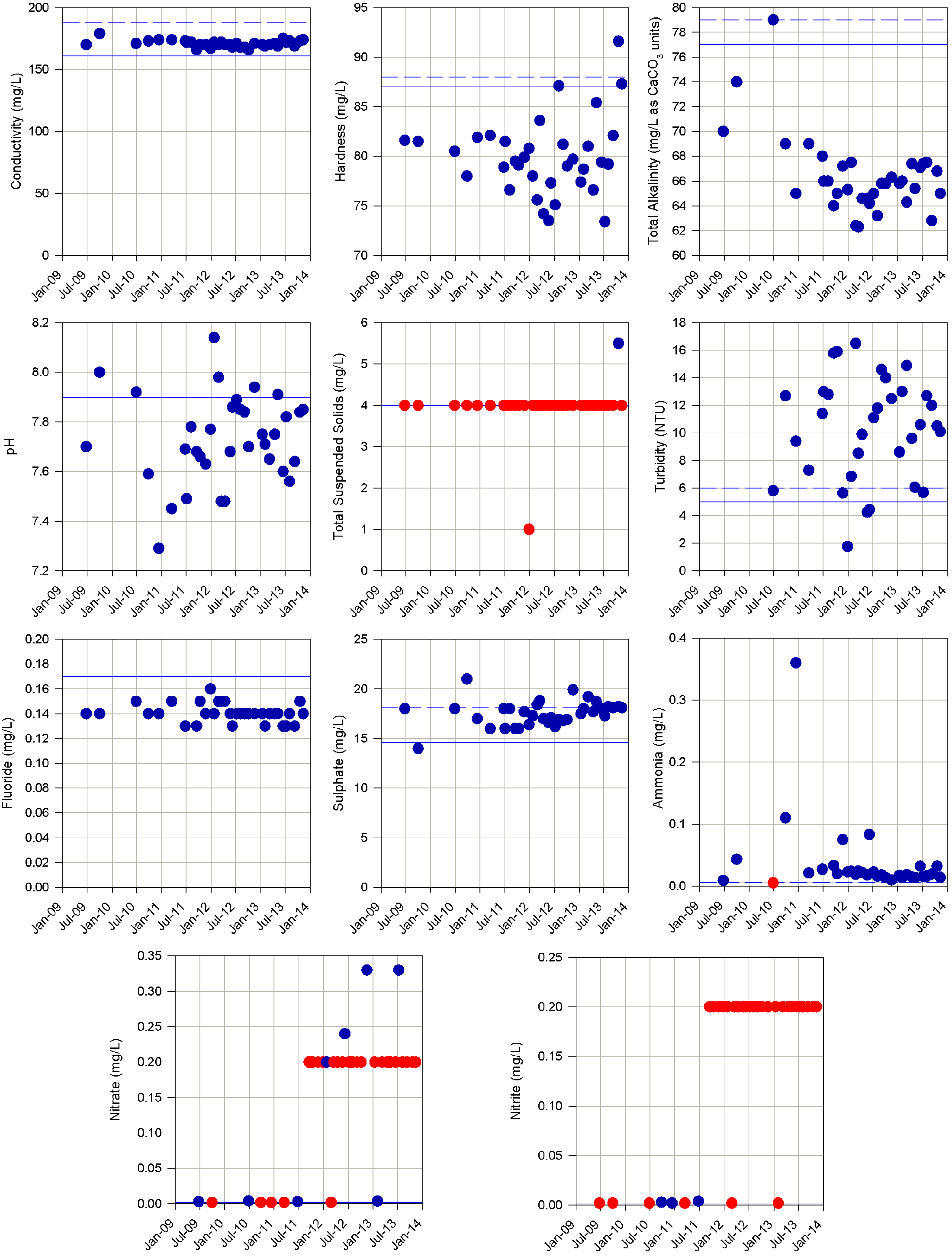
MW05-6A



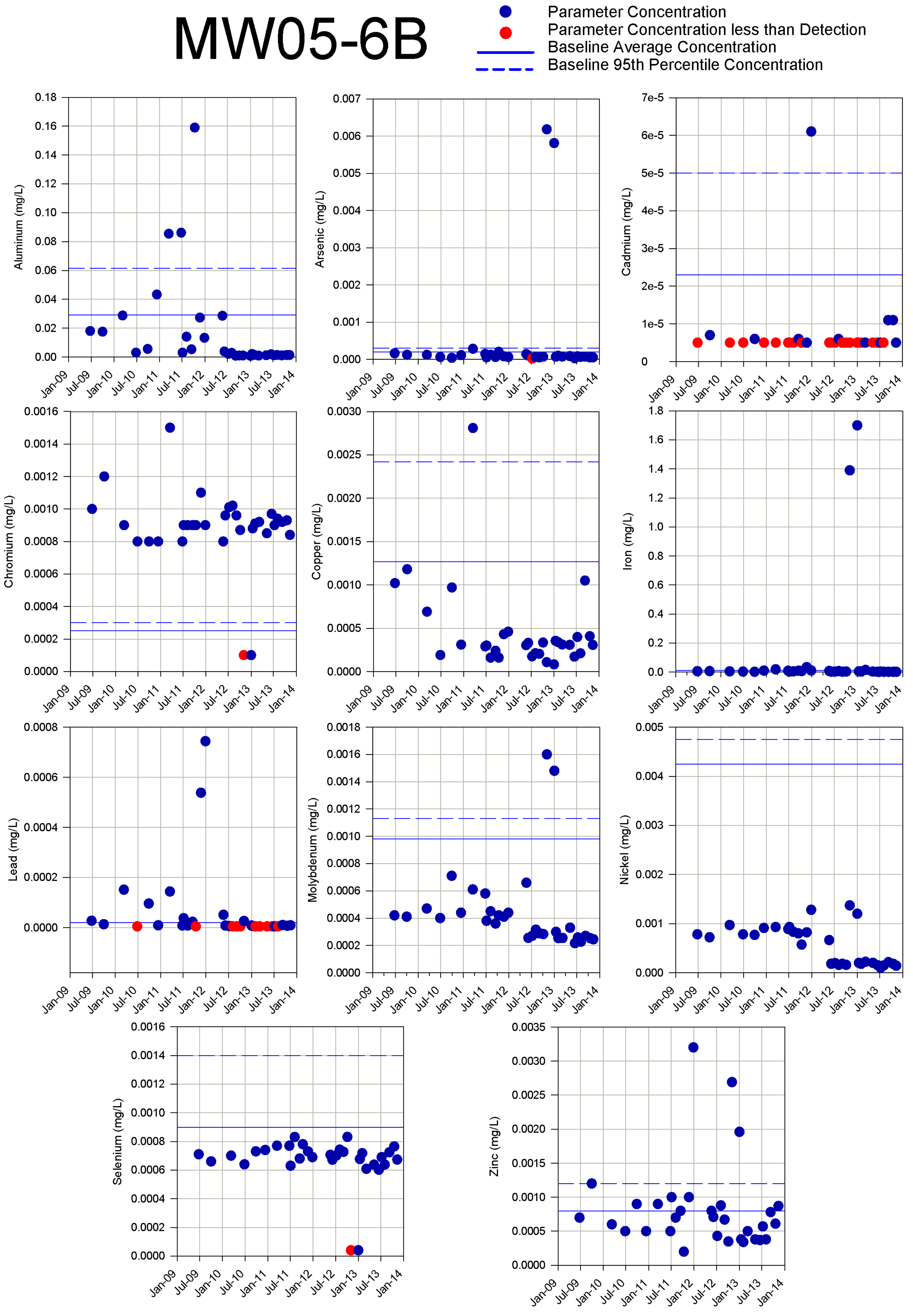
● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.000 0.002 0.004 0.006 0.008 0.010 0.012 0.014 0.016 0.018 0.020
Arsenic (mg/L)
0.000 0.001 0.002 0.003 0.004 0.005 0.006 0.007
Cadmium (mg/L)
0.00000 0.00002 0.00004 0.00006 0.00008 0.00010
Chromium (mg/L)
0.00000 0.00005 0.00010 0.00015 0.00020 0.00025
Copper (mg/L)
0.0000 0.0002 0.0004 0.0006 0.0008 0.0010
Iron (mg/L)
0.0 0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6
Lead (mg/L)
0.00000 0.00001 0.00002 0.00003 0.00004 0.00005 0.00006 0.00007
Molybdenum (mg/L)
0.000 0.001 0.002 0.003 0.004 0.005
Nickel (mg/L)
0.0000 0.0005 0.0010 0.0015 0.0020 0.0025
Selenium (mg/L)
0.0000 0.0002 0.0004 0.0006 0.0008 0.0010 0.0012 0.0014 0.0016
Zinc (mg/L)
0.000 0.001 0.002 0.003 0.004 0.005 0.006 0.007 0.008
Jan-09 Jul-09 Jan-10 Jul-10 Jan-11 Jul-11 Jan-12 Jul-12 Jan-13 Jul-13 Jan-14

MW05-6A

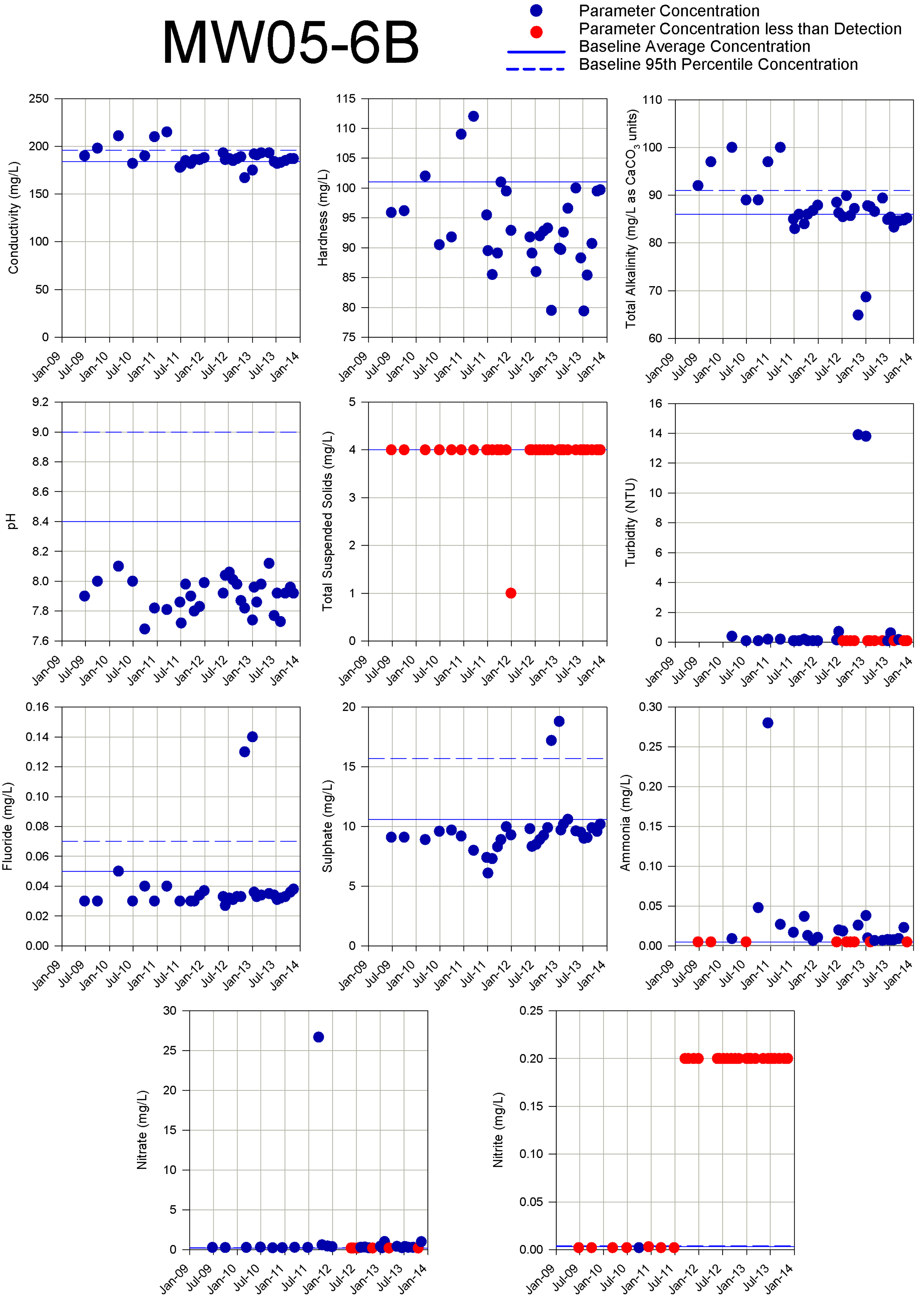
● Parameter Concentration
🔴 Parameter Concentration less than Detection
— Baseline Average Concentration
- - Baseline 95th Percentile Concentration



MW05-6B

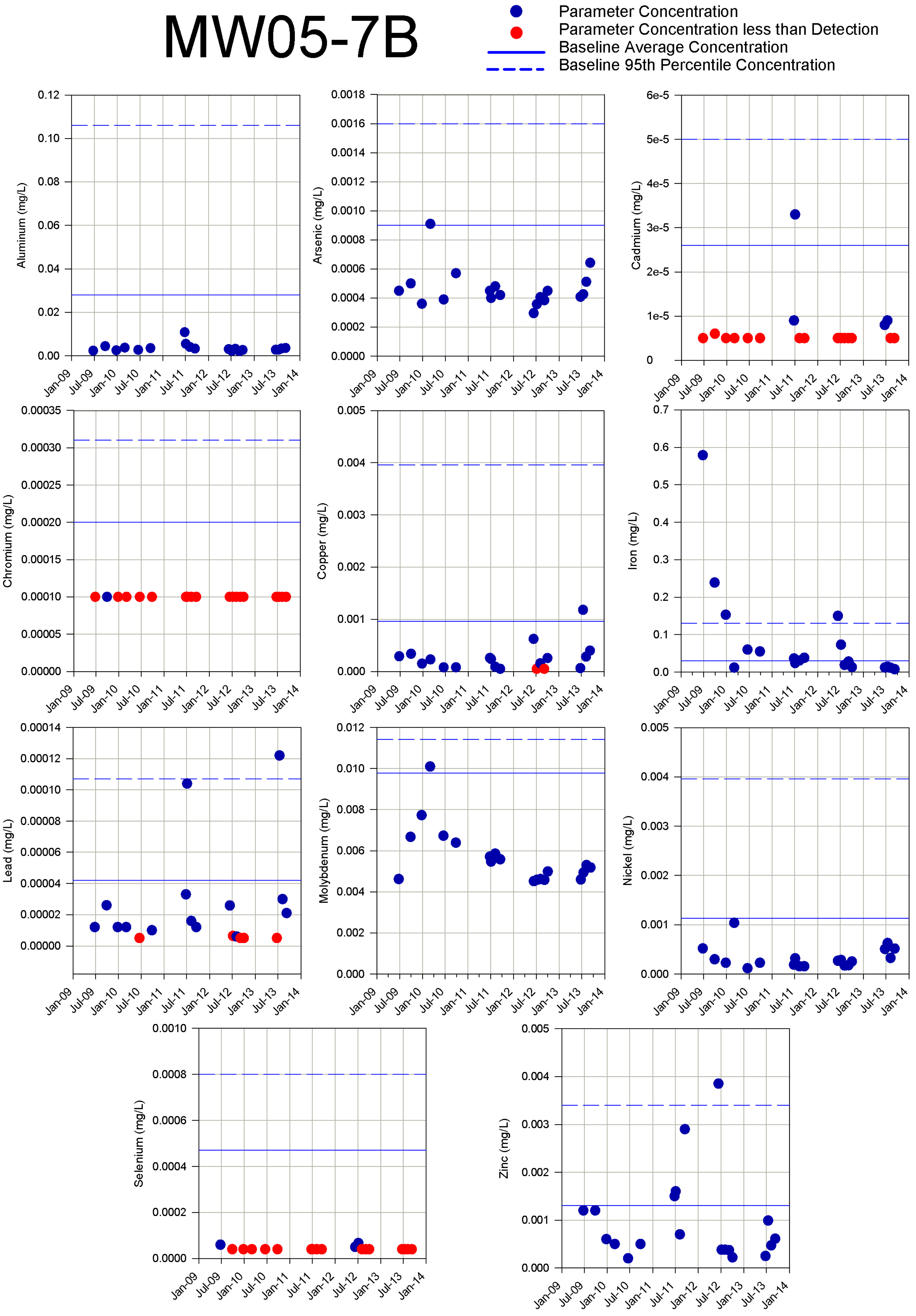

● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
0.18
Arsenic (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
0.006
0.007
Cadmium (mg/L)
0
1e-5
2e-5
3e-5
4e-5
5e-5
6e-5
7e-5
Chromium (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
0.0016
Copper (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
0.0030
Iron (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
Lead (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
Molybdenum (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
0.0016
0.0018
Nickel (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
Selenium (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
0.0016
Zinc (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
0.0030
0.0035
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

MW05-6B



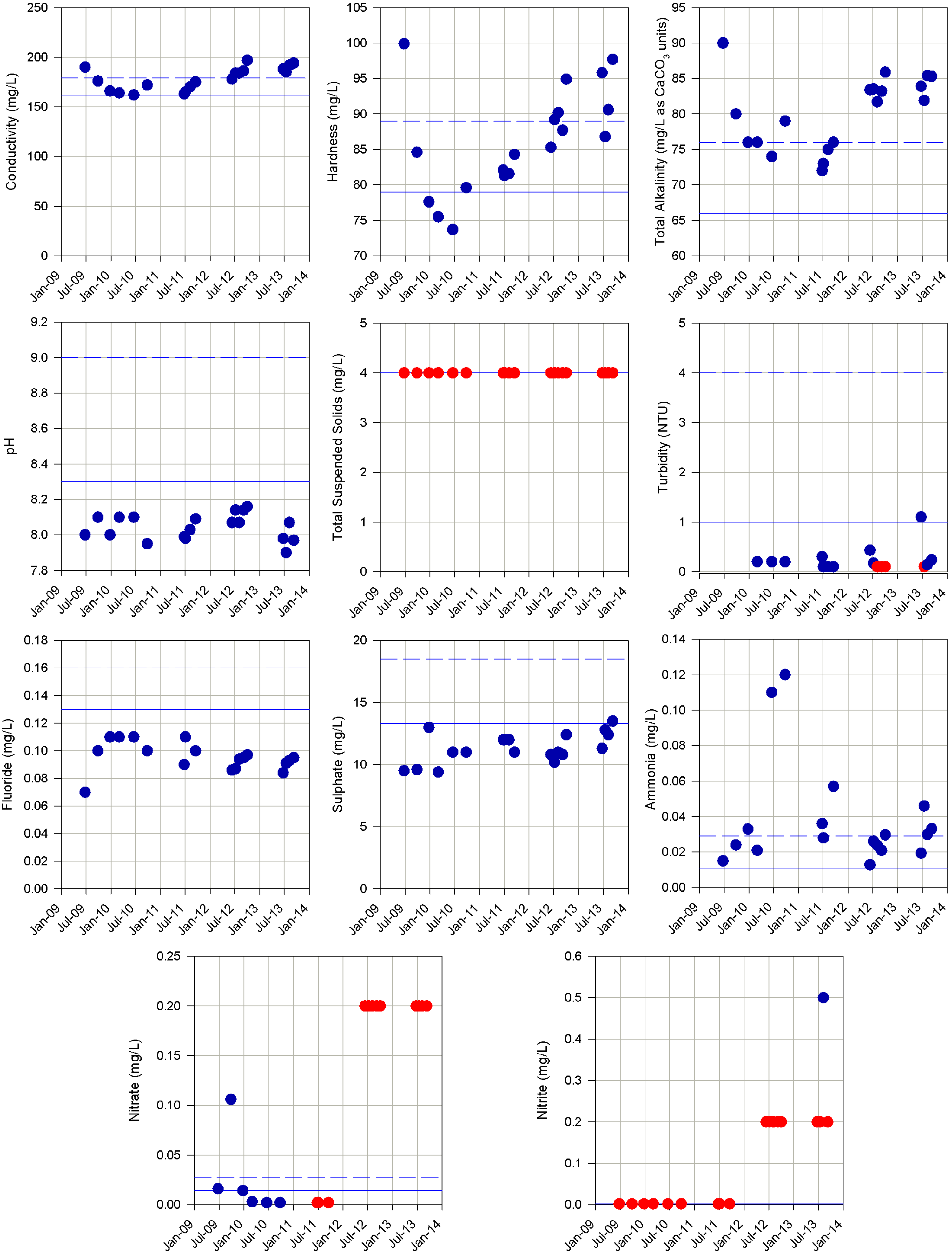
● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
0
50
100
150
200
250
Hardness (mg/L)
75
80
85
90
95
100
105
110
115
Total Alkalinity (mg/L as $CaCO_3$ units)
60
70
80
90
100
110
pH
7.6
7.8
8.0
8.2
8.4
8.6
8.8
9.0
9.2
Total Suspended Solids (mg/L)
0
1
2
3
4
5
Turbidity (NTU)
0
2
4
6
8
10
12
14
16
Fluoride (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
Sulphate (mg/L)
0
5
10
15
20
Ammonia (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
Nitrate (mg/L)
0
5
10
15
20
25
30
Nitrite (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

MW05-7B


Parameter Concentration
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
0.12
Arsenic (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
0.0016
0.0018
Cadmium (mg/L)
0
1e-5
2e-5
3e-5
4e-5
5e-5
6e-5
Chromium (mg/L)
0.00000
0.00005
0.00010
0.00015
0.00020
0.00025
0.00030
0.00035
Copper (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
Iron (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Lead (mg/L)
0.00000
0.00002
0.00004
0.00006
0.00008
0.00010
0.00012
0.00014
Molybdenum (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
Nickel (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
Selenium (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
Zinc (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

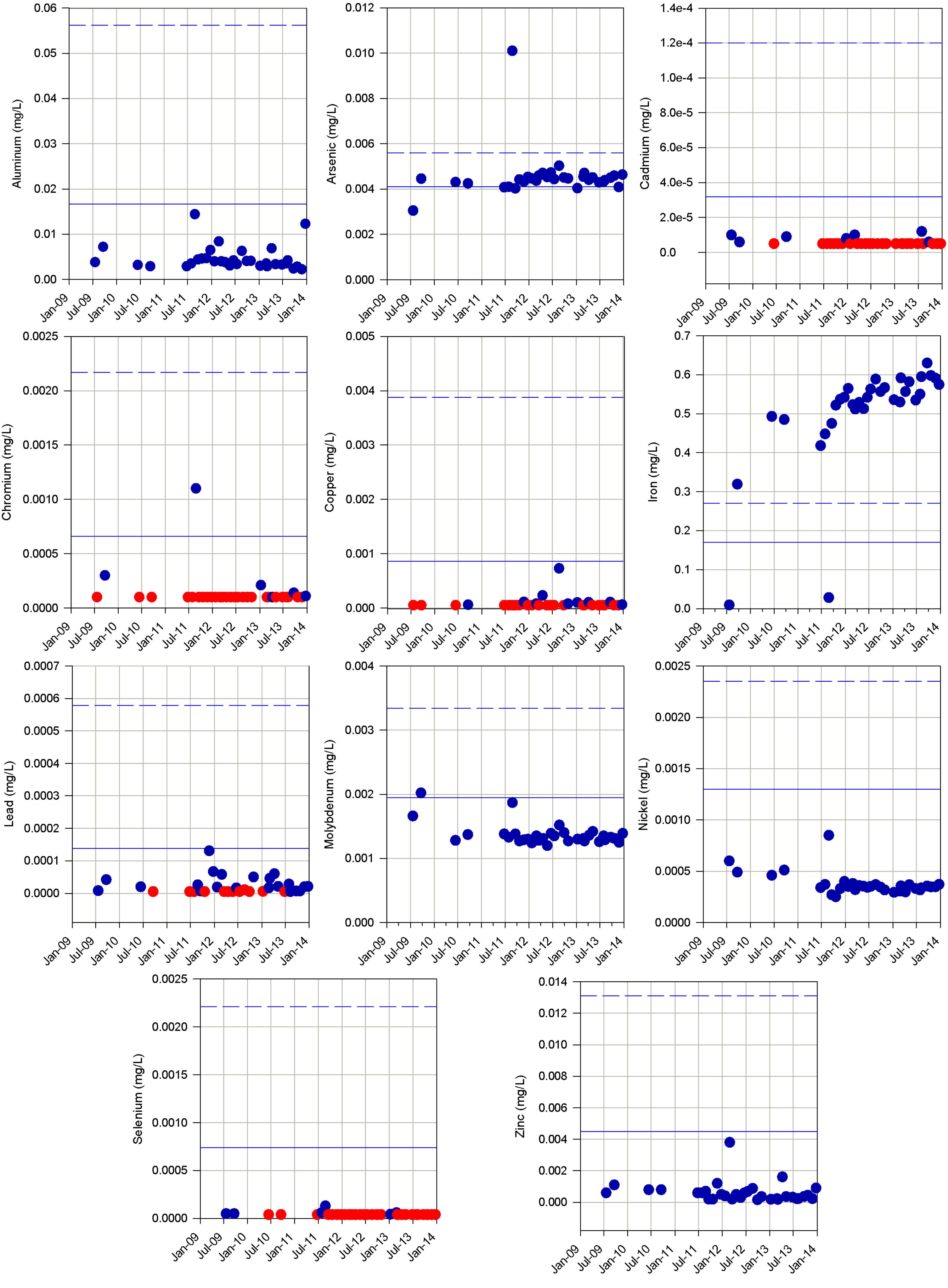
MW05-7B

● Parameter Concentration
● Parameter Concentration less than Detection
— Baseline Average Concentration
– – Baseline 95th Percentile Concentration



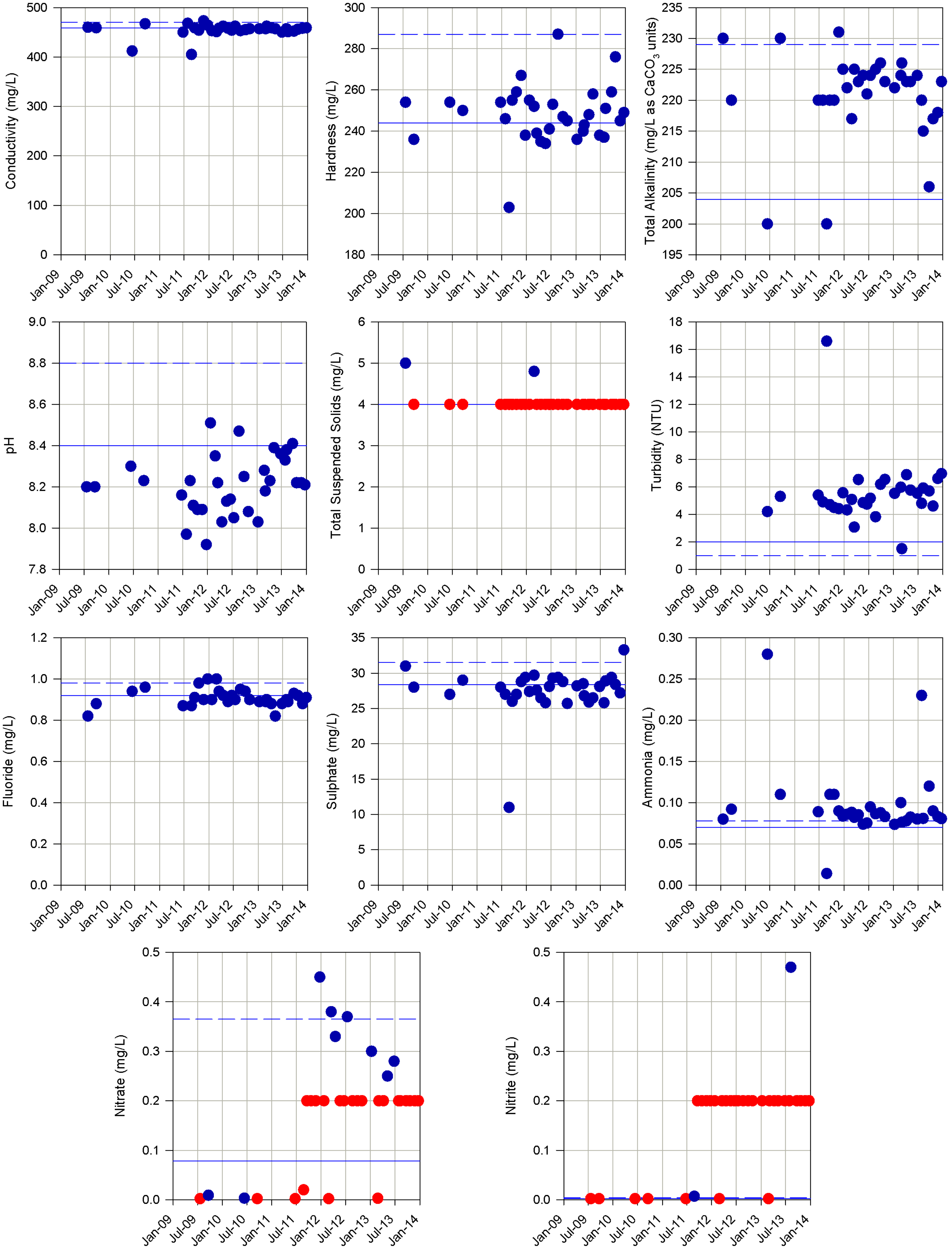
MW06-8D

- ● Parameter Concentration
- ● Parameter Concentration less than Detection
- ─── Baseline Average Concentration
- – – – Baseline 95th Percentile Concentration

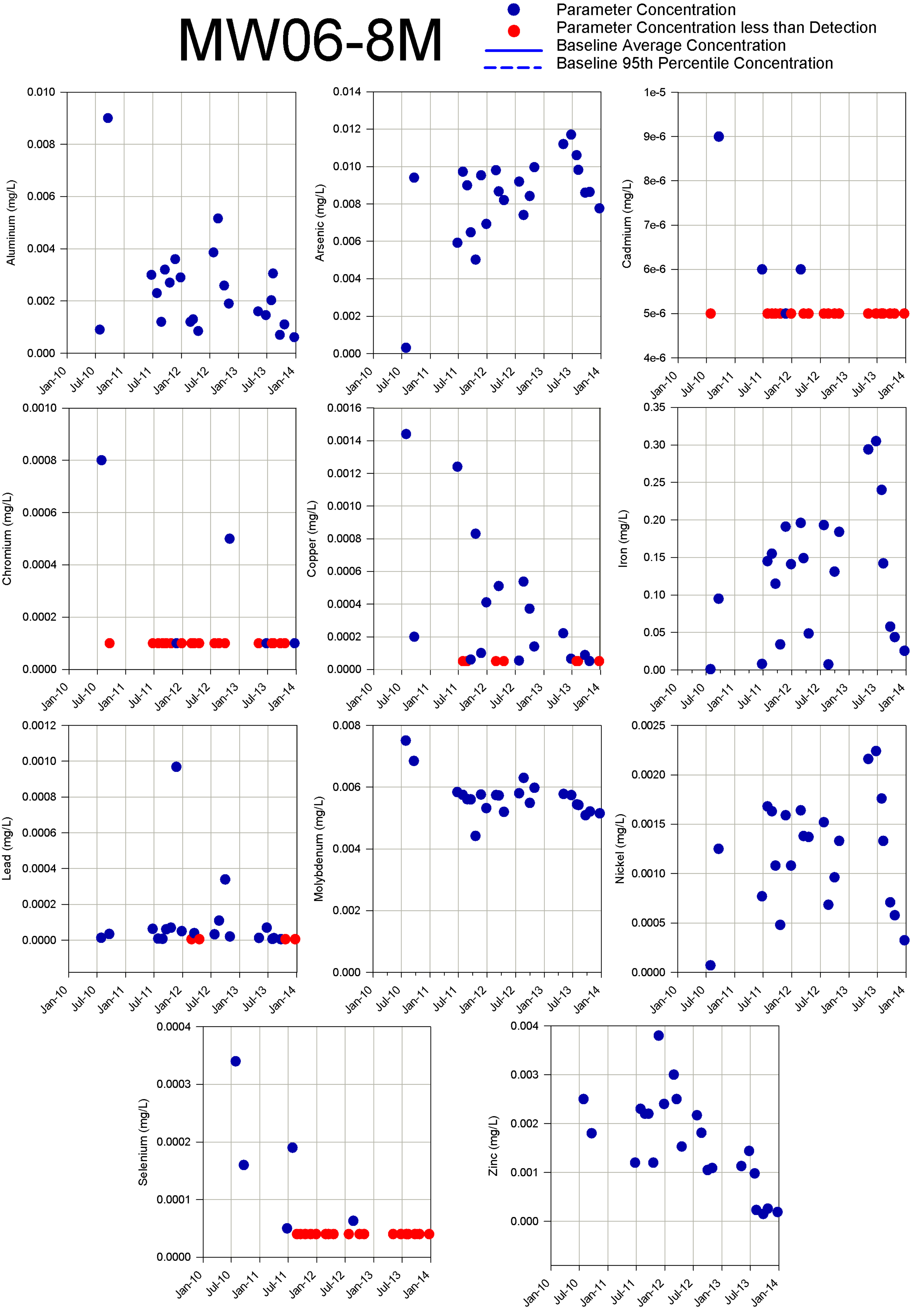


MW06-8D

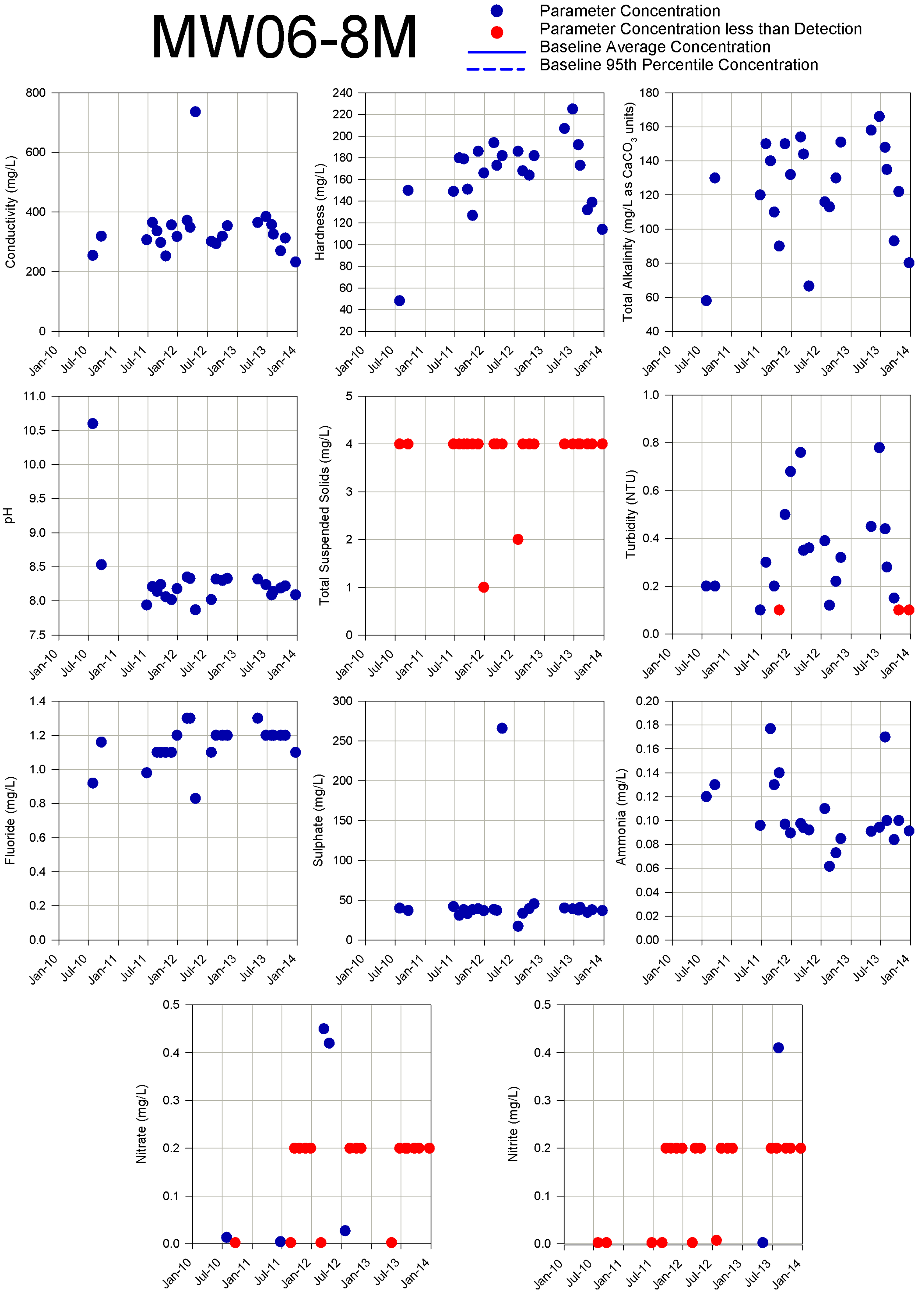
● Parameter Concentration
● Parameter Concentration less than Detection
— Baseline Average Concentration
– – Baseline 95th Percentile Concentration



MW06-8M

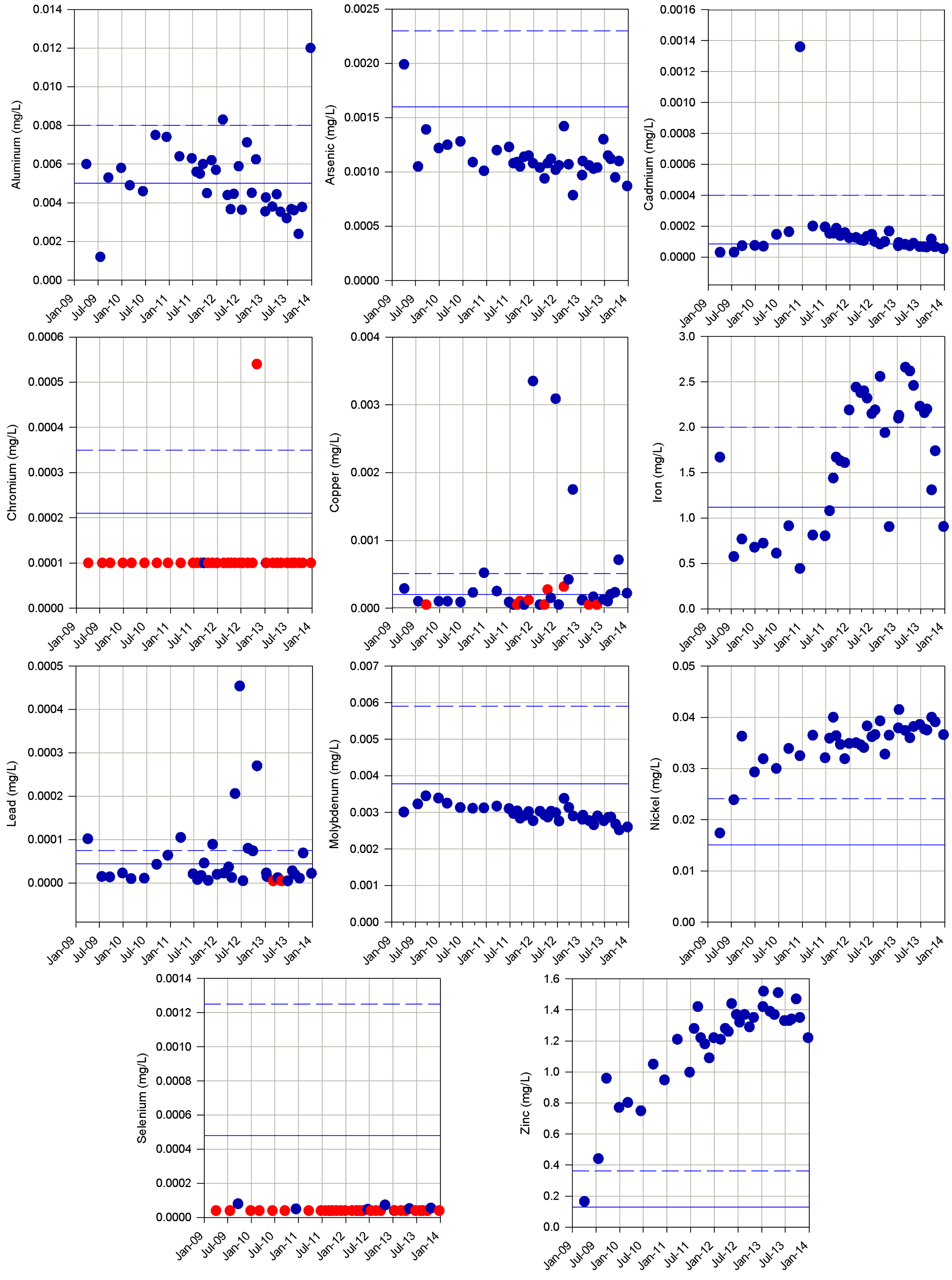

● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
Arsenic (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0.014
Cadmium (mg/L)
4e-6
5e-6
6e-6
7e-6
8e-6
9e-6
1e-5
Chromium (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
Copper (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
0.0016
Iron (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
Lead (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
Molybdenum (mg/L)
0.000
0.002
0.004
0.006
0.008
Nickel (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
Selenium (mg/L)
0.0000
0.0001
0.0002
0.0003
0.0004
Zinc (mg/L)
0.000
0.001
0.002
0.003
0.004
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

MW06-8M

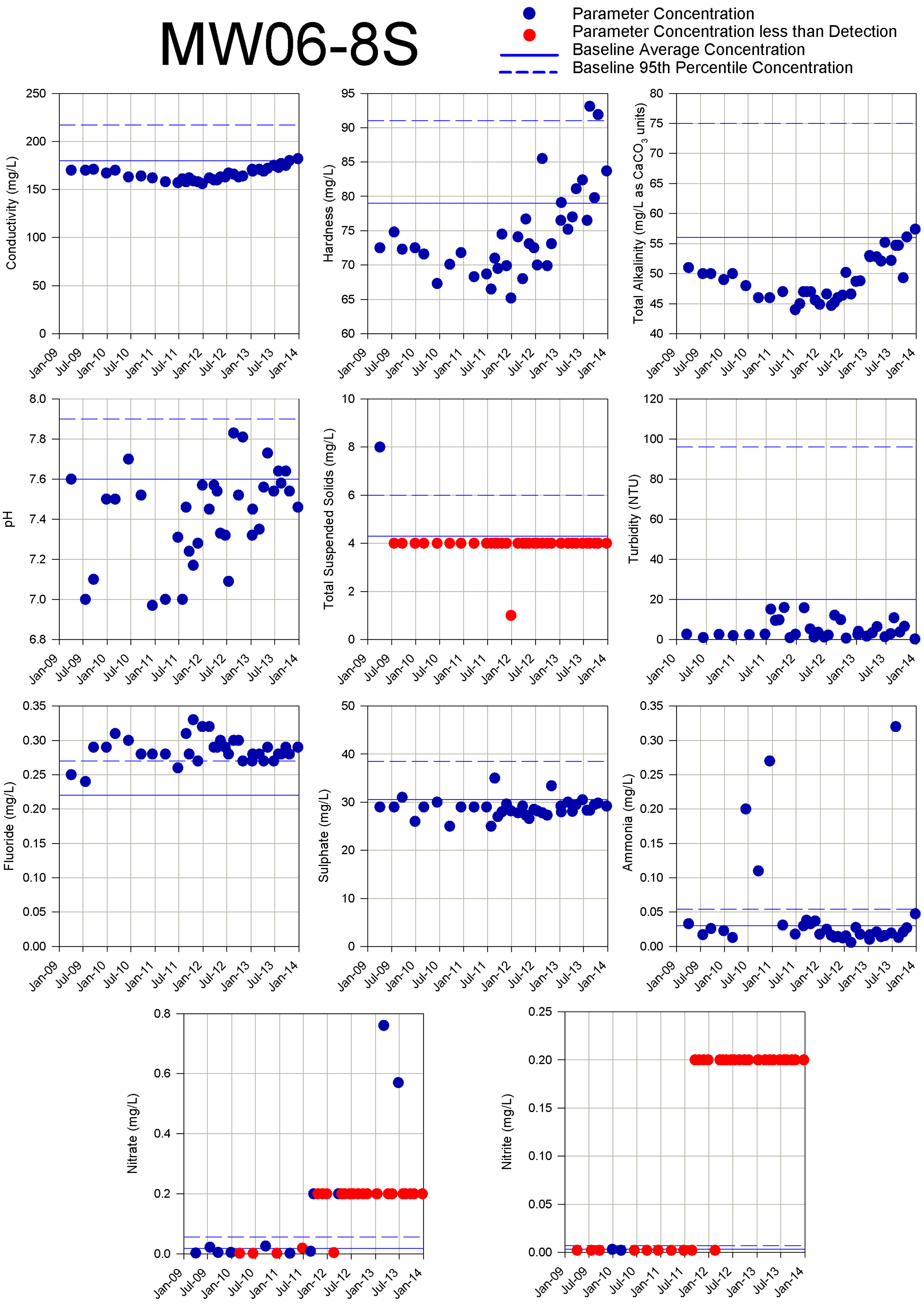

● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
0
200
400
600
800
Hardness (mg/L)
20
40
60
80
100
120
140
160
180
200
220
240
Total Alkalinity (mg/L as $CaCO_3$ units)
40
60
80
100
120
140
160
180
pH
7.5
8.0
8.5
9.0
9.5
10.0
10.5
11.0
Total Suspended Solids (mg/L)
0
1
2
3
4
5
Turbidity (NTU)
0.0
0.2
0.4
0.6
0.8
1.0
Fluoride (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
Sulphate (mg/L)
0
50
100
150
200
250
300
Ammonia (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
0.18
0.20
Nitrate (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
Nitrite (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

MW06-8S

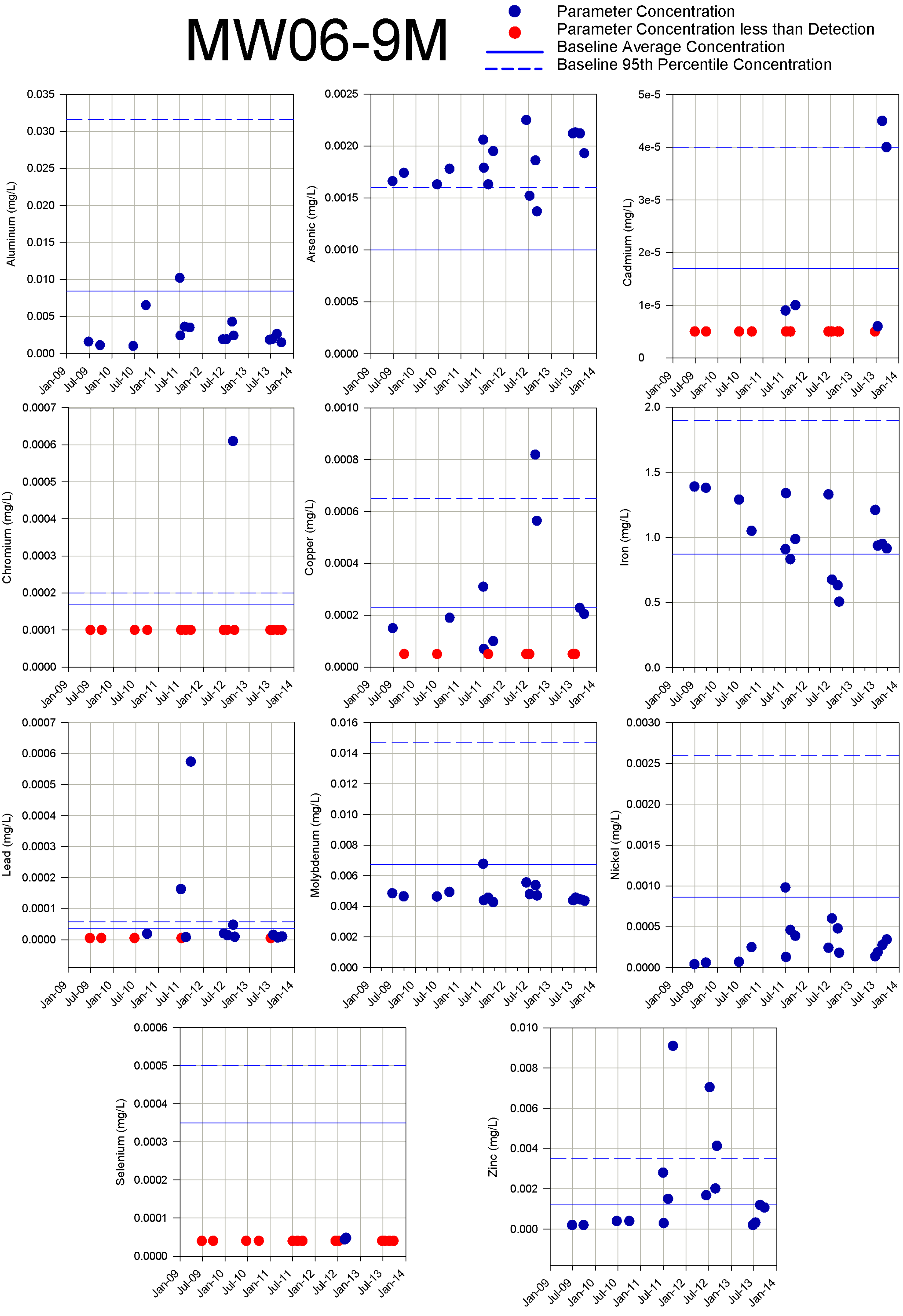
● Parameter Concentration
● Parameter Concentration less than Detection
— Baseline Average Concentration
– – Baseline 95th Percentile Concentration



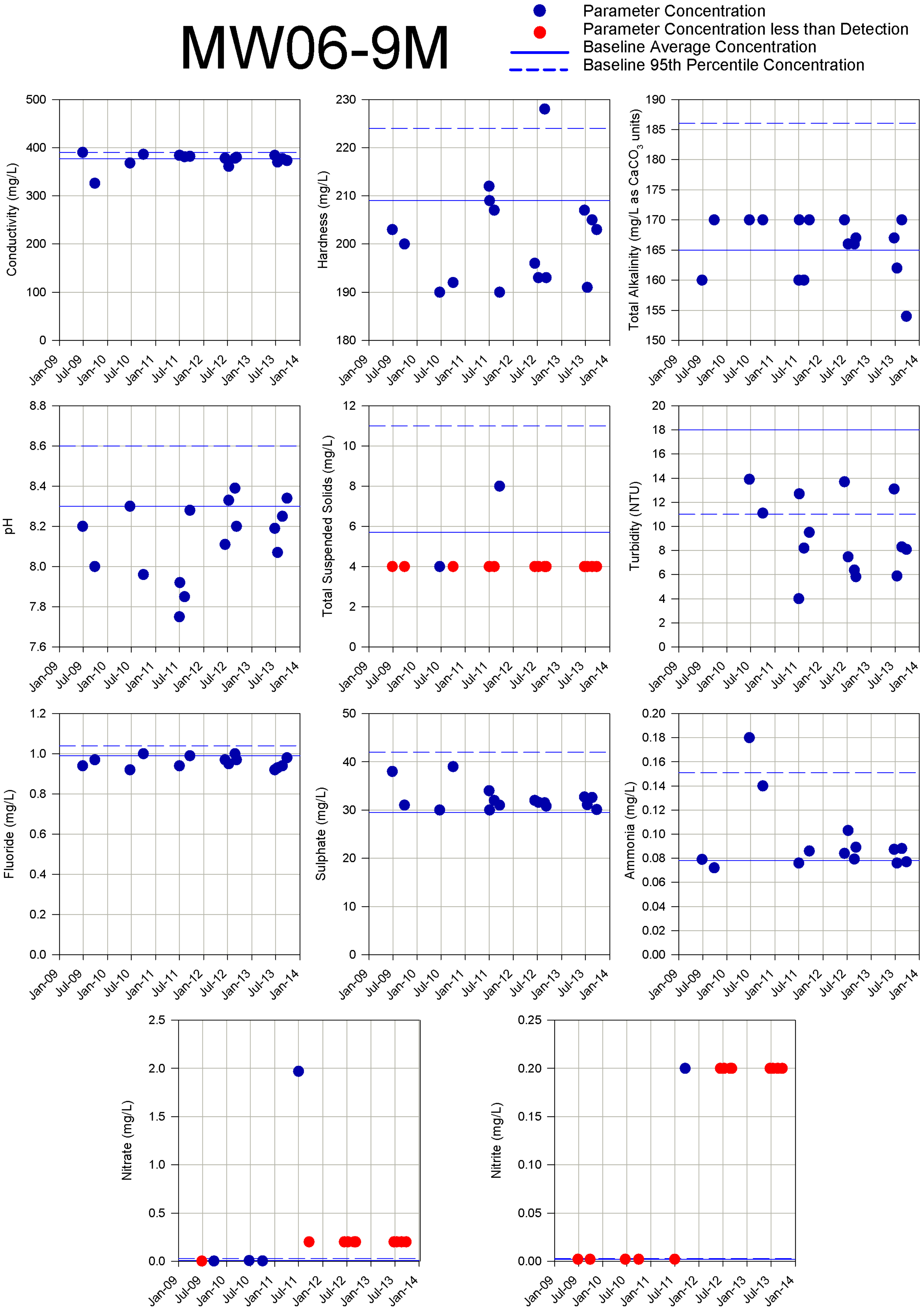
MW06-8S


● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
0
50
100
150
200
250
Hardness (mg/L)
60
65
70
75
80
85
90
95
Total Alkalinity (mg/L as $CaCO_3$ units)
40
45
50
55
60
65
70
75
80
pH
6.8
7.0
7.2
7.4
7.6
7.8
8.0
Total Suspended Solids (mg/L)
0
2
4
6
8
10
Turbidity (NTU)
0
20
40
60
80
100
120
Fluoride (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
Sulphate (mg/L)
0
10
20
30
40
50
Ammonia (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
Nitrate (mg/L)
0.0
0.2
0.4
0.6
0.8
Nitrite (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

MW06-9M


● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.035
0.030
0.025
0.020
0.015
0.010
0.005
0.000
Arsenic (mg/L)
0.0025
0.0020
0.0015
0.0010
0.0005
0.0000
Cadmium (mg/L)
5e-5
4e-5
3e-5
2e-5
1e-5
0
Chromium (mg/L)
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0.0000
Copper (mg/L)
0.0010
0.0008
0.0006
0.0004
0.0002
0.0000
Iron (mg/L)
2.0
1.5
1.0
0.5
0.0
Lead (mg/L)
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0.0000
Molybdenum (mg/L)
0.016
0.014
0.012
0.010
0.008
0.006
0.004
0.002
0.000
Nickel (mg/L)
0.0030
0.0025
0.0020
0.0015
0.0010
0.0005
0.0000
Selenium (mg/L)
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0.0000
Zinc (mg/L)
0.010
0.008
0.006
0.004
0.002
0.000
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

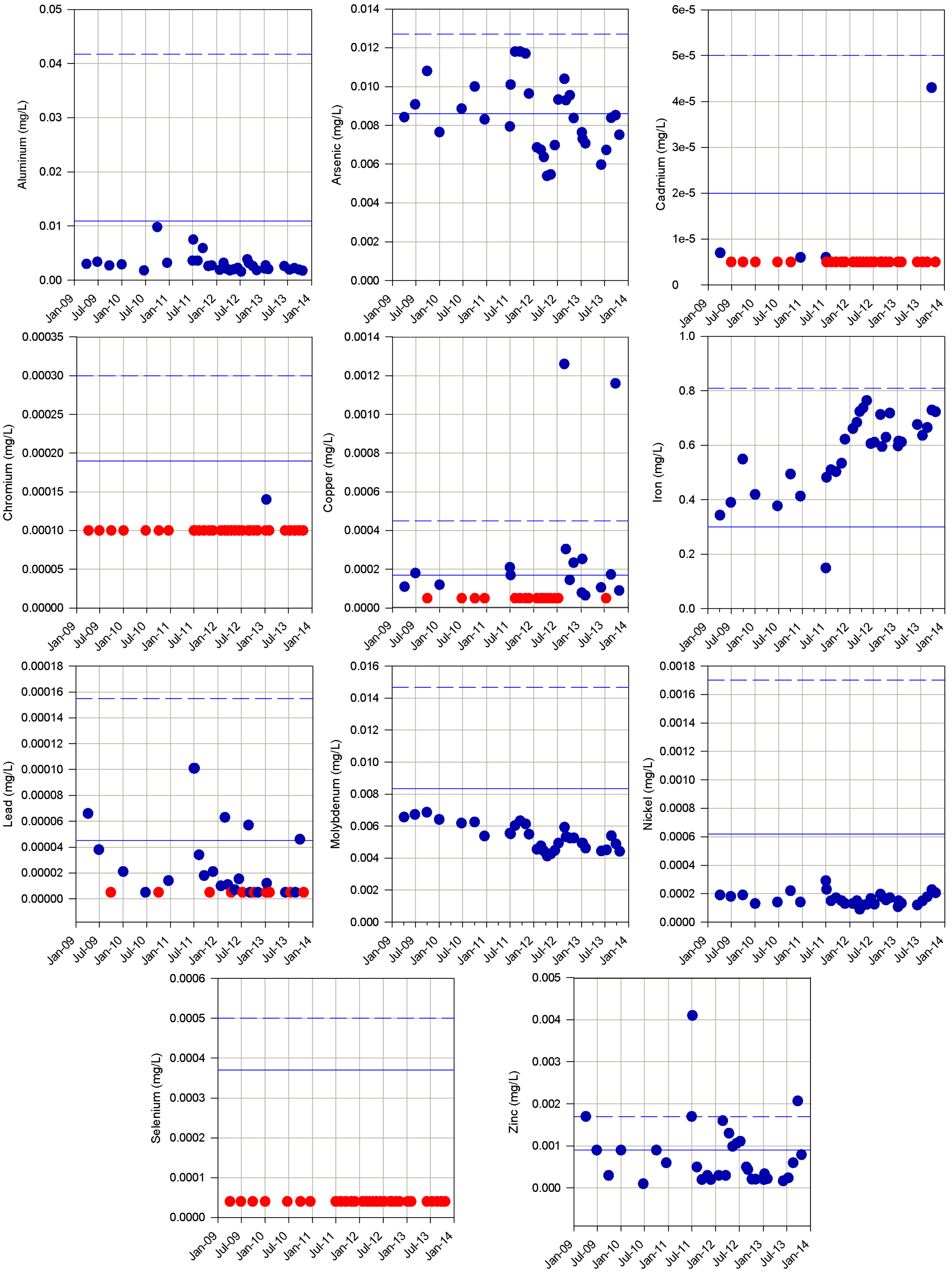
MW06-9M



● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
0
100
200
300
400
500
Hardness (mg/L)
180
190
200
210
220
230
Total Alkalinity (mg/L as $CaCO_3$ units)
150
155
160
165
170
175
180
185
190
pH
7.6
7.8
8.0
8.2
8.4
8.6
8.8
Total Suspended Solids (mg/L)
0
2
4
6
8
10
12
Turbidity (NTU)
0
2
4
6
8
10
12
14
16
18
20
Fluoride (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Sulphate (mg/L)
0
10
20
30
40
50
Ammonia (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
0.18
0.20
Nitrate (mg/L)
0.0
0.5
1.0
1.5
2.0
2.5
Nitrite (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

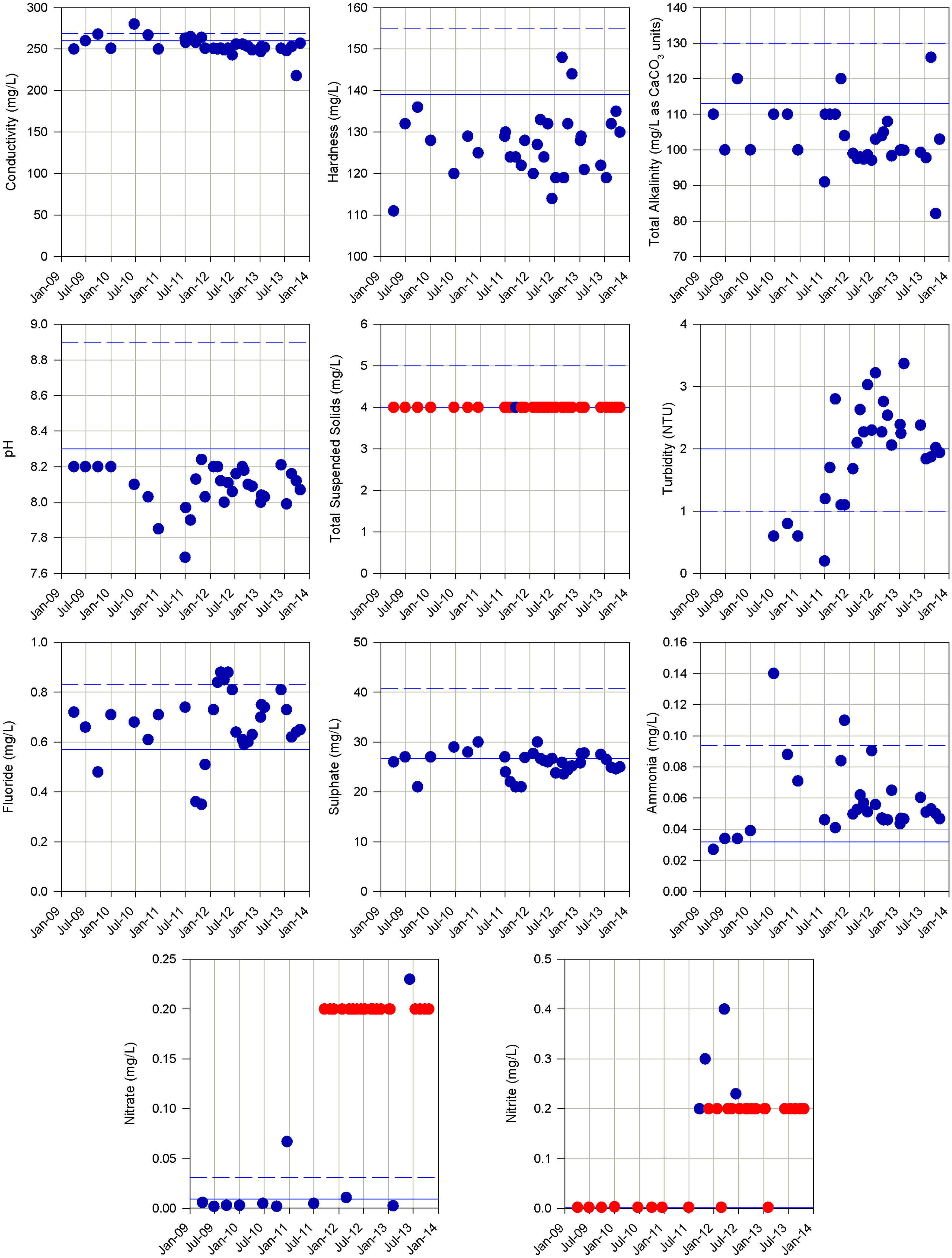
MW06-9S

● Parameter Concentration
● Parameter Concentration less than Detection
— Baseline Average Concentration
- - Baseline 95th Percentile Concentration

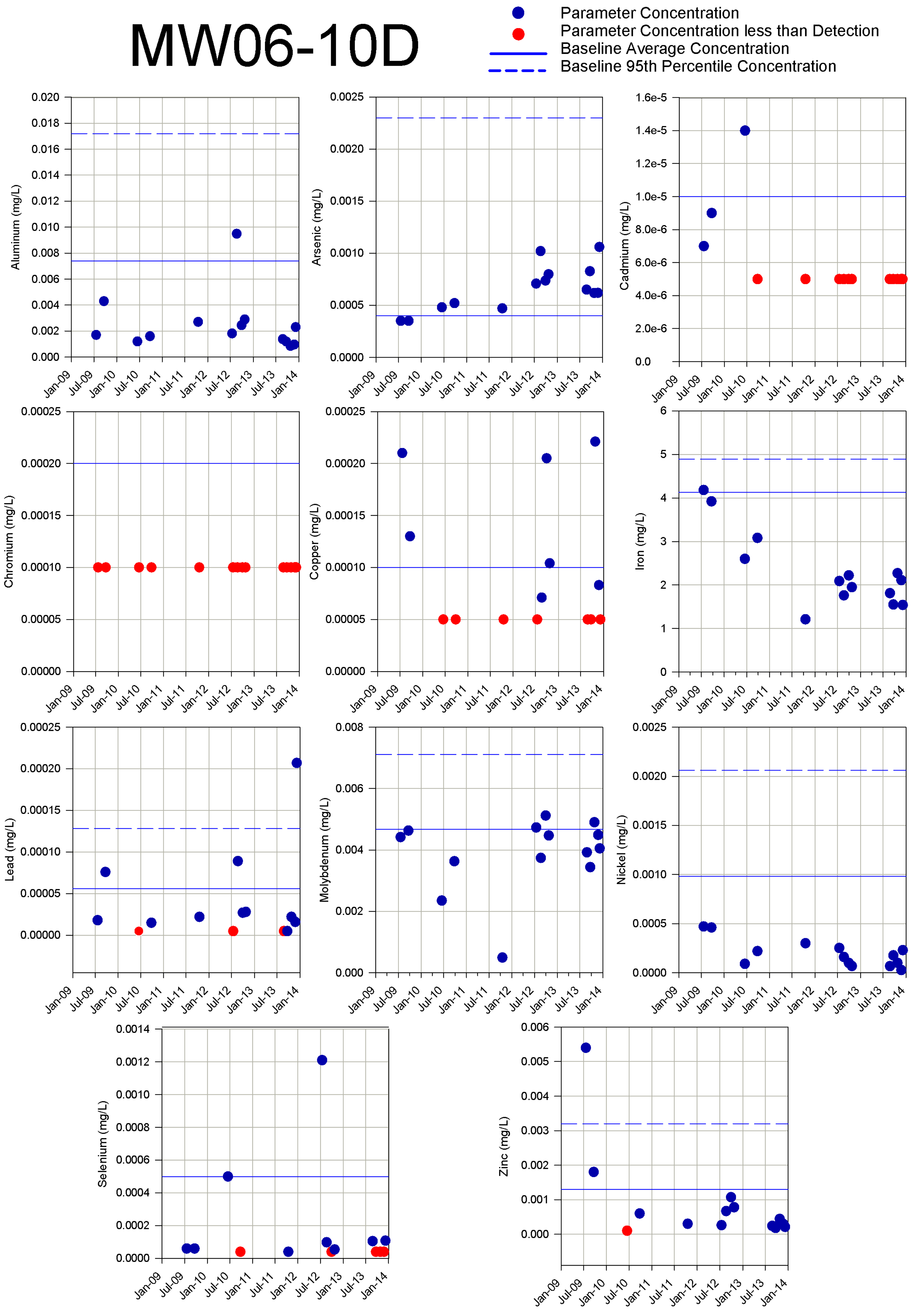


MW06-9S

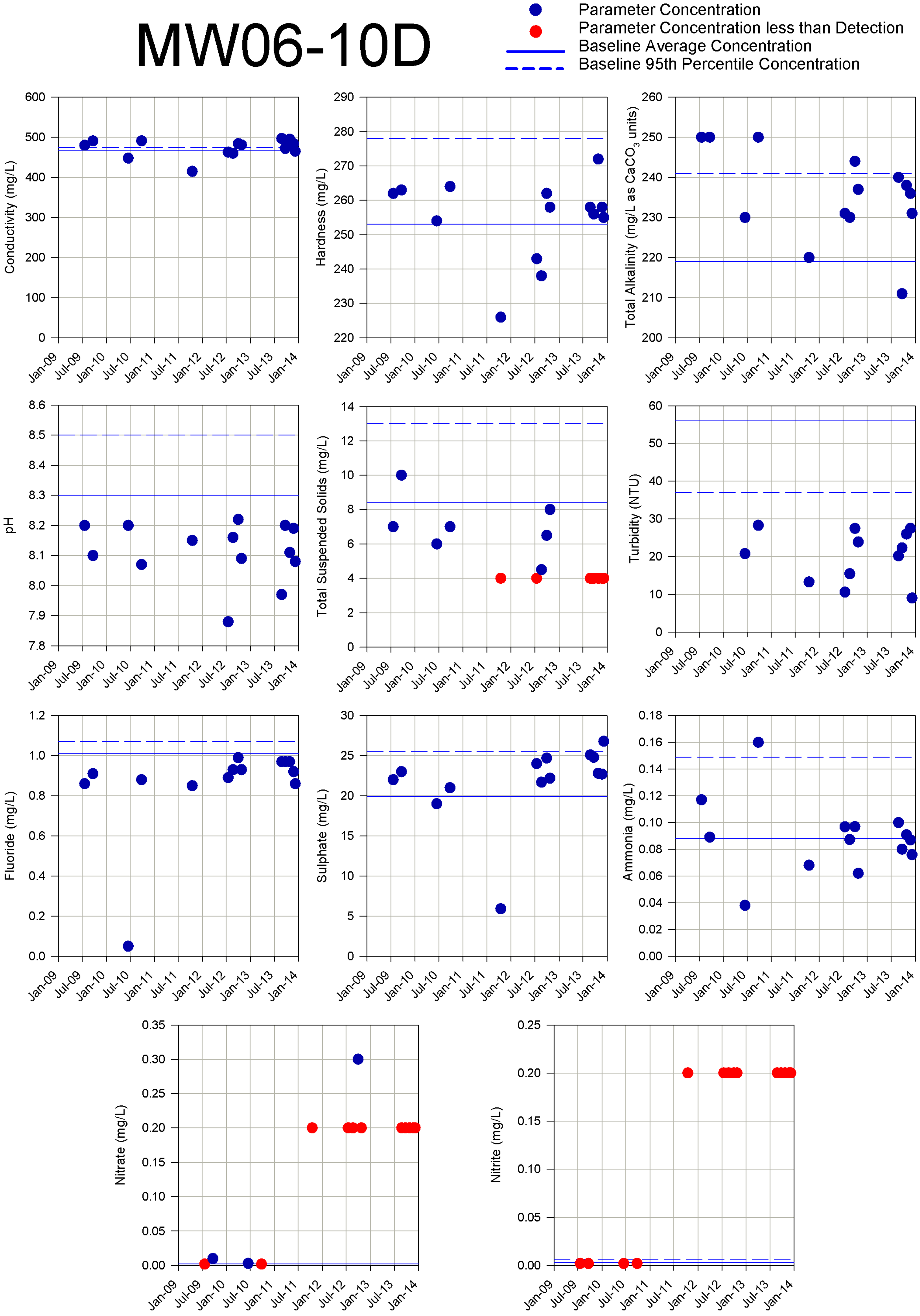
● Parameter Concentration
🔴 Parameter Concentration less than Detection
— Baseline Average Concentration
– – Baseline 95th Percentile Concentration



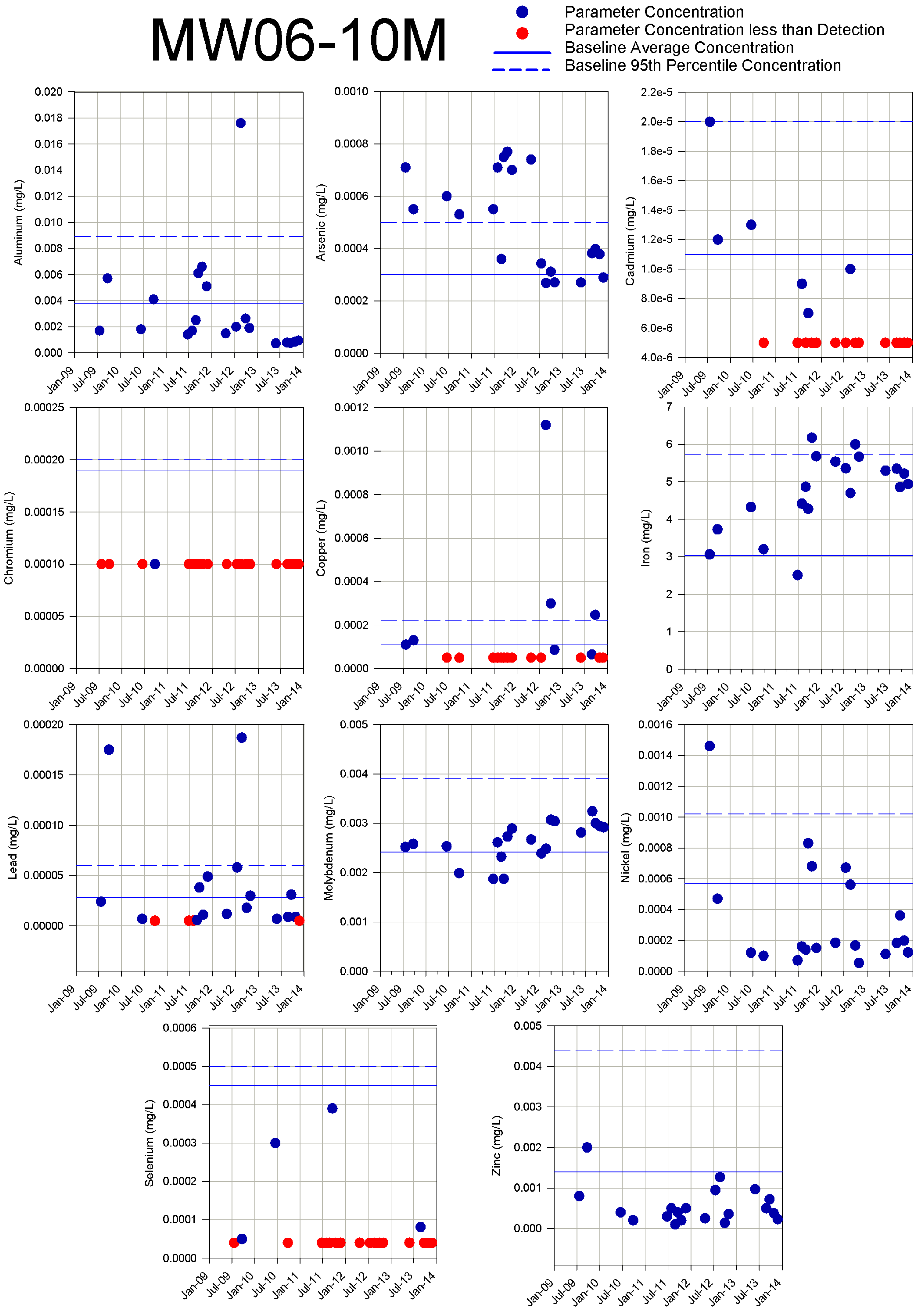
MW06-10D


● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.000 0.002 0.004 0.006 0.008 0.010 0.012 0.014 0.016 0.018 0.020
Arsenic (mg/L)
0.0000 0.0005 0.0010 0.0015 0.0020 0.0025
Cadmium (mg/L)
0.0 2.0e-6 4.0e-6 6.0e-6 8.0e-6 1.0e-5 1.2e-5 1.4e-5 1.6e-5
Chromium (mg/L)
0.00000 0.00005 0.00010 0.00015 0.00020 0.00025
Copper (mg/L)
0.00000 0.00005 0.00010 0.00015 0.00020 0.00025
Iron (mg/L)
0 1 2 3 4 5 6
Lead (mg/L)
0.00000 0.00005 0.00010 0.00015 0.00020 0.00025
Molybdenum (mg/L)
0.000 0.002 0.004 0.006 0.008
Nickel (mg/L)
0.0000 0.0005 0.0010 0.0015 0.0020 0.0025
Selenium (mg/L)
0.0000 0.0002 0.0004 0.0006 0.0008 0.0010 0.0012 0.0014
Zinc (mg/L)
0.000 0.001 0.002 0.003 0.004 0.005 0.006
Jan-09 Jul-09 Jan-10 Jul-10 Jan-11 Jul-11 Jan-12 Jul-12 Jan-13 Jul-13 Jan-14

MW06-10D


● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
0
100
200
300
400
500
600
Hardness (mg/L)
220
230
240
250
260
270
280
290
Total Alkalinity (mg/L as $CaCO_3$ units)
200
210
220
230
240
250
260
pH
7.8
7.9
8.0
8.1
8.2
8.3
8.4
8.5
8.6
Total Suspended Solids (mg/L)
0
2
4
6
8
10
12
14
Turbidity (NTU)
0
10
20
30
40
50
60
Fluoride (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Sulphate (mg/L)
0
5
10
15
20
25
30
Ammonia (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
0.18
Nitrate (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
Nitrite (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

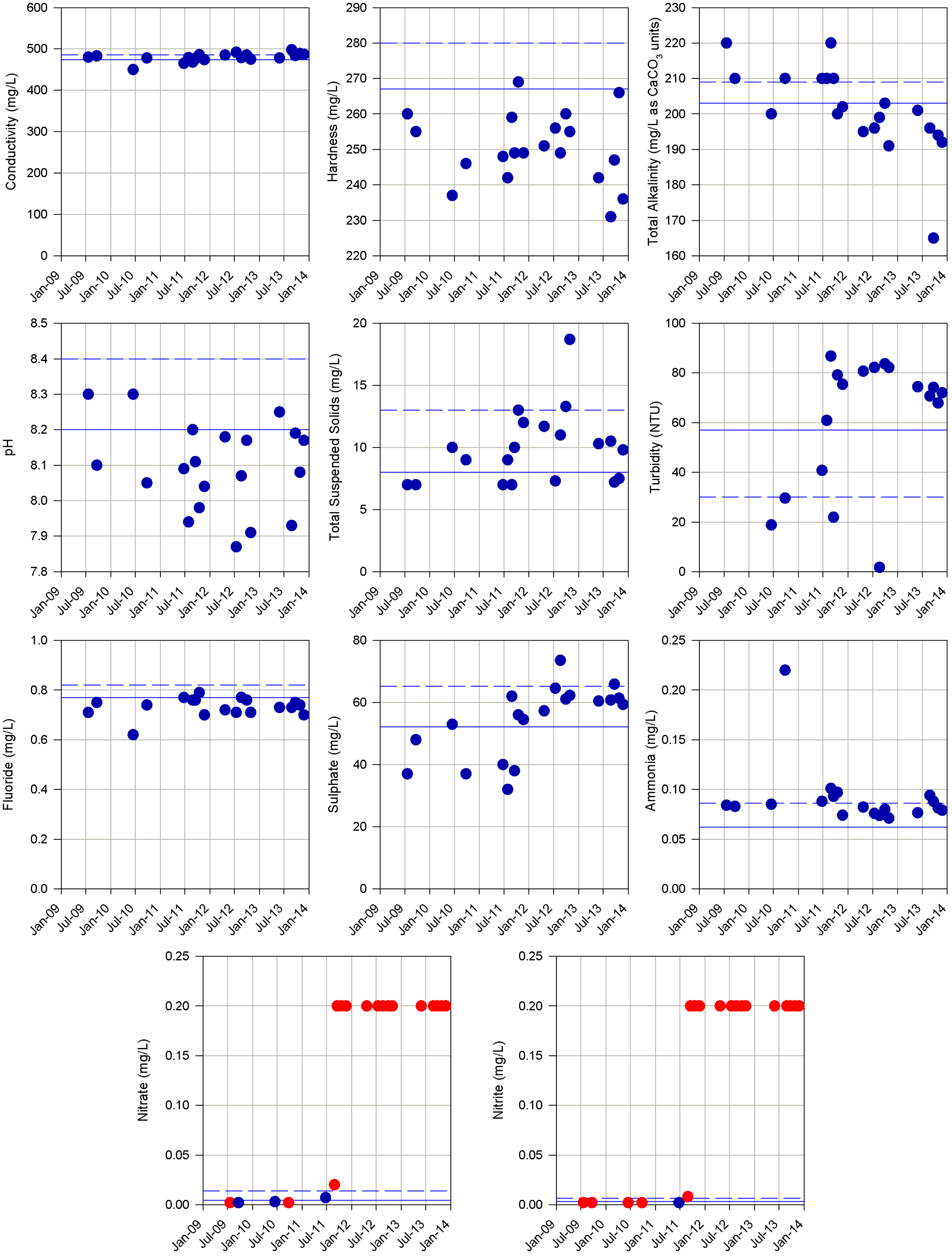
MW06-10M



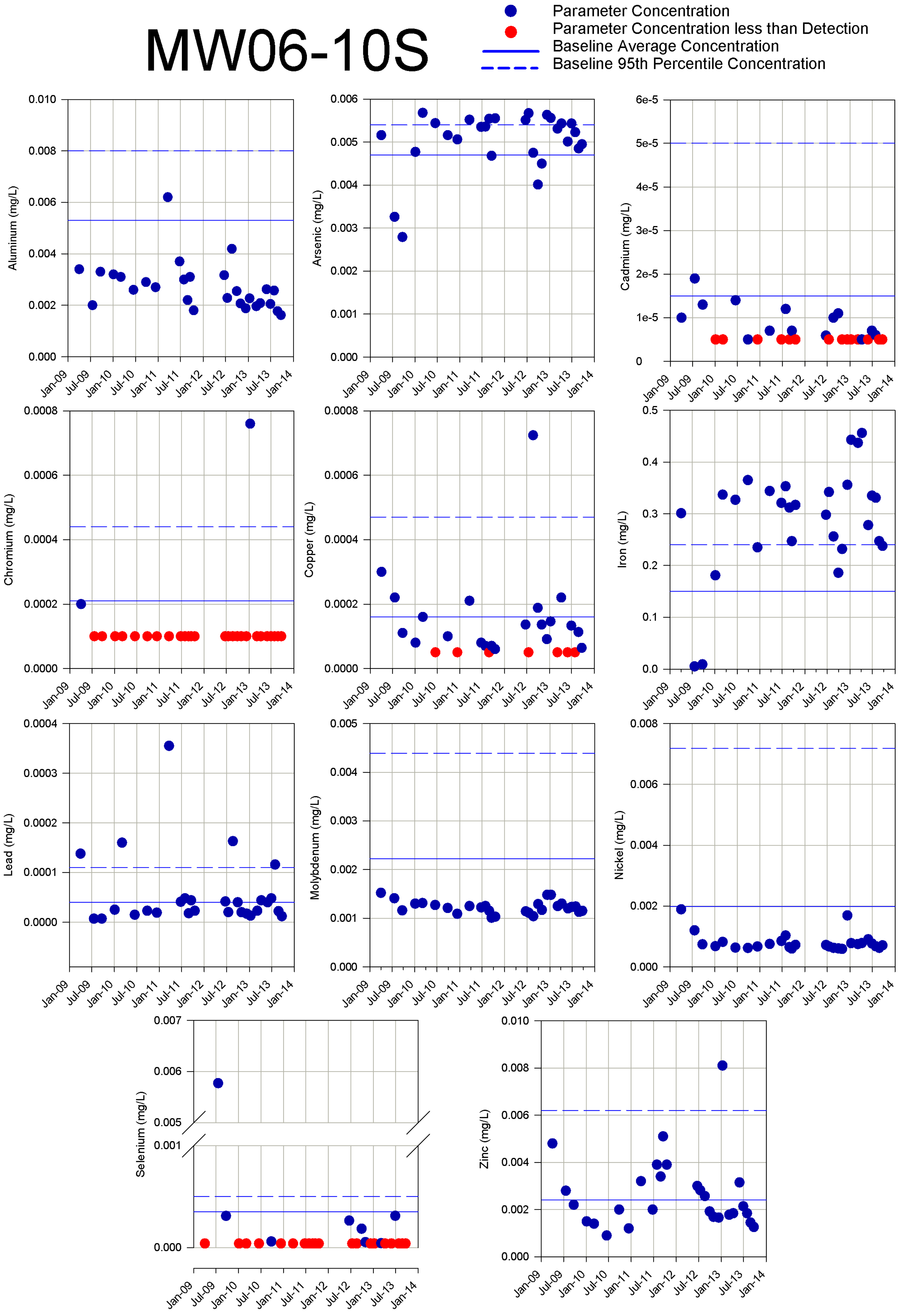
● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.000 0.002 0.004 0.006 0.008 0.010 0.012 0.014 0.016 0.018 0.020
Arsenic (mg/L)
0.0000 0.0002 0.0004 0.0006 0.0008 0.0010
Cadmium (mg/L)
4.0e-6 6.0e-6 8.0e-6 1.0e-5 1.2e-5 1.4e-5 1.6e-5 1.8e-5 2.0e-5 2.2e-5
Chromium (mg/L)
0.00000 0.00005 0.00010 0.00015 0.00020 0.00025
Copper (mg/L)
0.0000 0.0002 0.0004 0.0006 0.0008 0.0010 0.0012
Iron (mg/L)
0 1 2 3 4 5 6 7
Lead (mg/L)
0.00000 0.00005 0.00010 0.00015 0.00020
Molybdenum (mg/L)
0.000 0.001 0.002 0.003 0.004 0.005
Nickel (mg/L)
0.0000 0.0002 0.0004 0.0006 0.0008 0.0010 0.0012 0.0014 0.0016
Selenium (mg/L)
0.0000 0.0001 0.0002 0.0003 0.0004 0.0005 0.0006
Zinc (mg/L)
0.000 0.001 0.002 0.003 0.004 0.005
Jan-09 Jul-09 Jan-10 Jul-10 Jan-11 Jul-11 Jan-12 Jul-12 Jan-13 Jul-13 Jan-14

MW06-10M

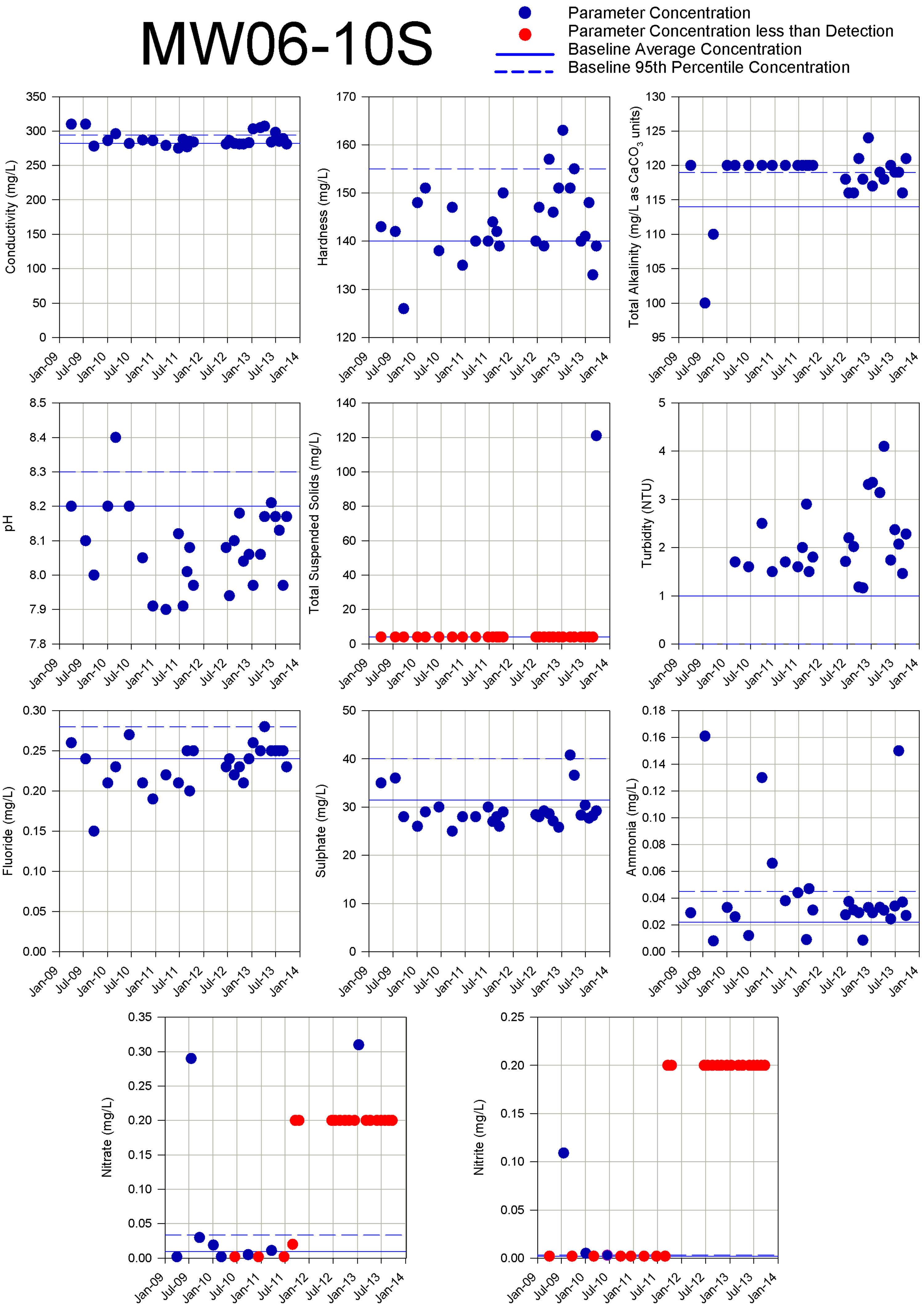
● Parameter Concentration
● Parameter Concentration less than Detection
─ Baseline Average Concentration
– – Baseline 95th Percentile Concentration



MW06-10S

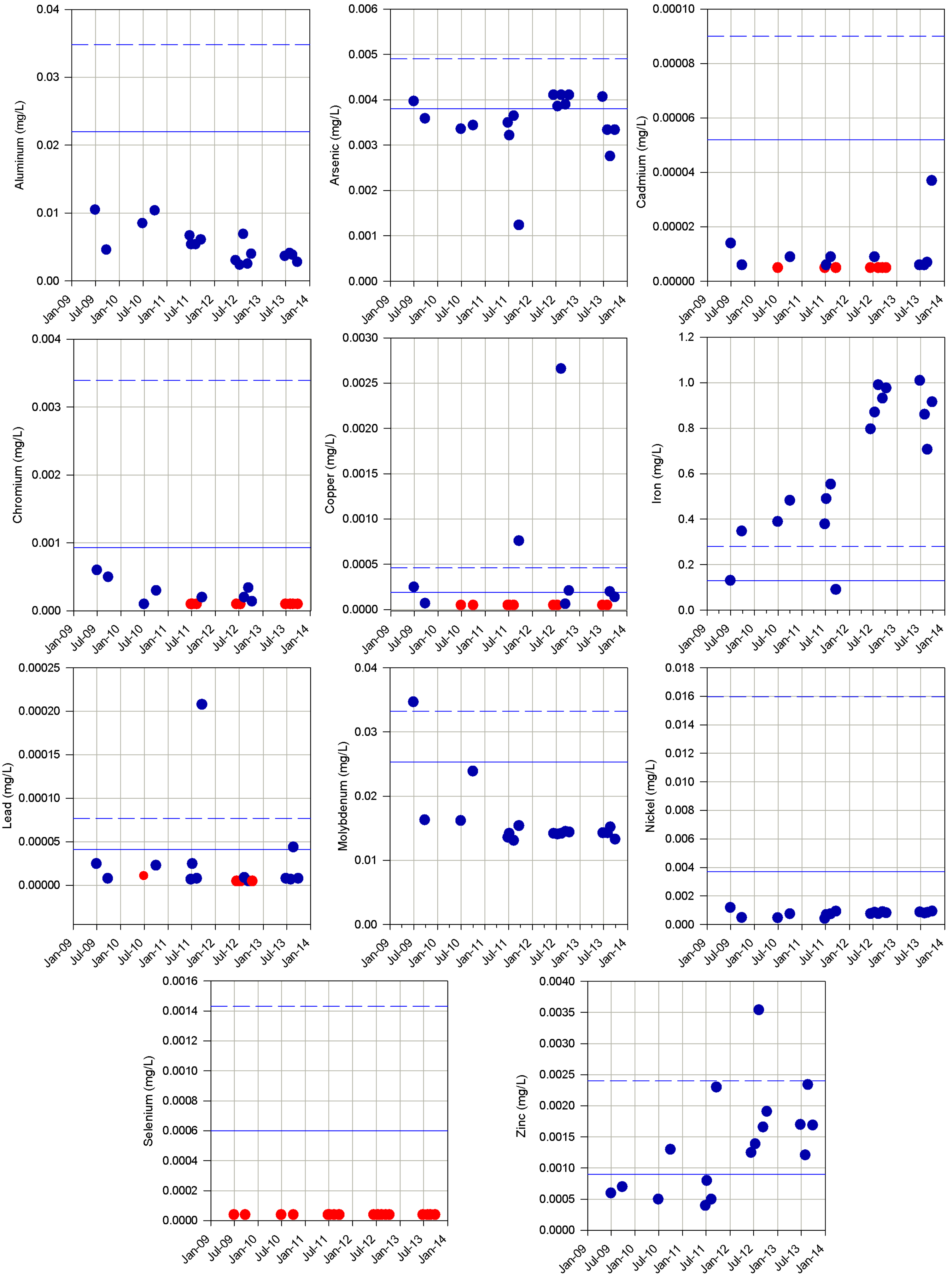

● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
Arsenic (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
0.006
Cadmium (mg/L)
0
1e-5
2e-5
3e-5
4e-5
5e-5
6e-5
Chromium (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
Copper (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
Iron (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
Lead (mg/L)
0.0000
0.0001
0.0002
0.0003
0.0004
Molybdenum (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
Nickel (mg/L)
0.000
0.002
0.004
0.006
0.008
Selenium (mg/L)
0.000
0.001
0.005
0.006
0.007
Zinc (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

MW06-10S

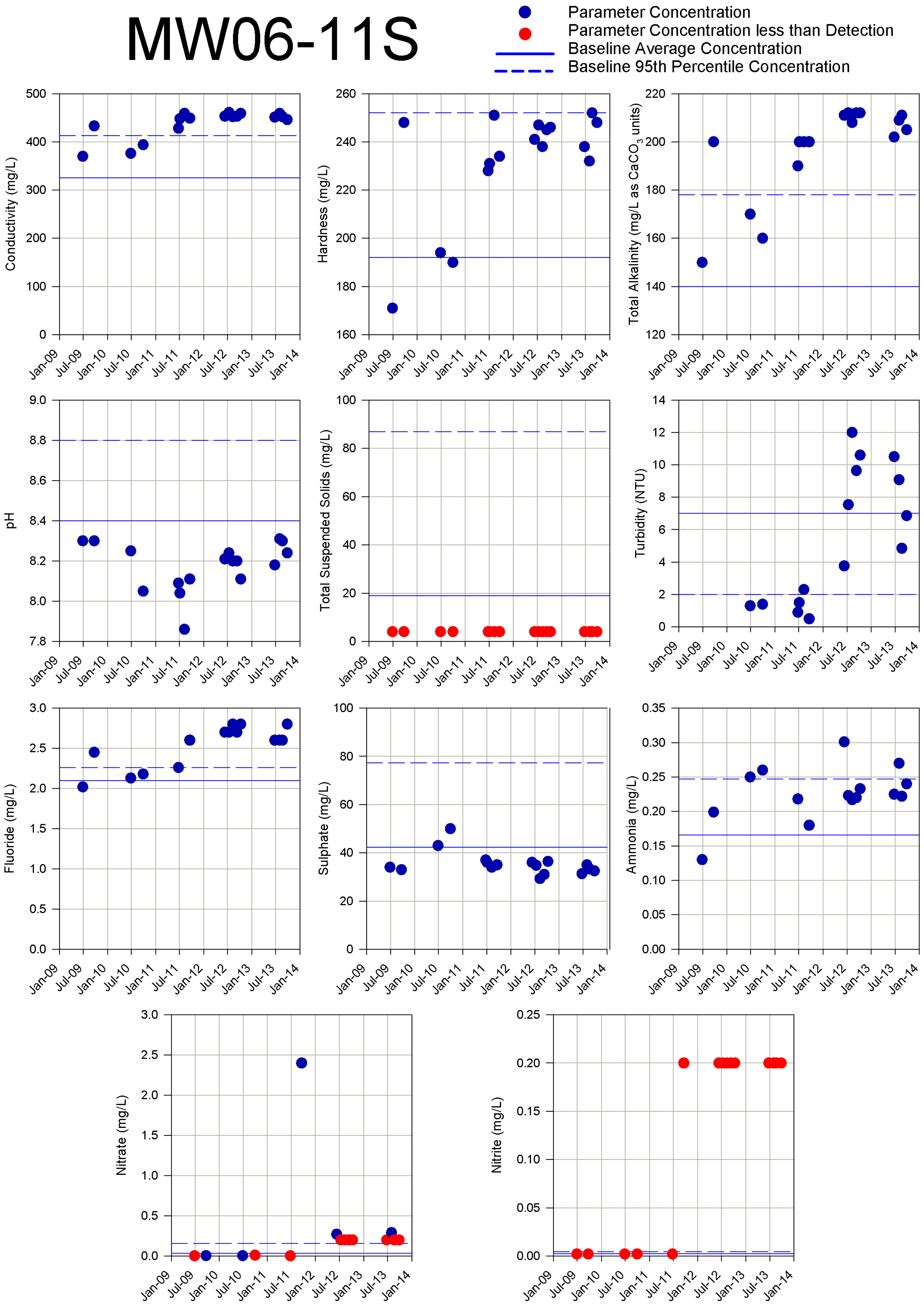

Parameter Concentration
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
0
50
100
150
200
250
300
350
Hardness (mg/L)
120
130
140
150
160
170
Total Alkalinity (mg/L as CaCO3 units)
95
100
105
110
115
120
125
130
pH
7.8
7.9
8.0
8.1
8.2
8.3
8.4
8.5
Total Suspended Solids (mg/L)
0
20
40
60
80
100
120
140
Turbidity (NTU)
0
1
2
3
4
5
Fluoride (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
Sulphate (mg/L)
0
10
20
30
40
50
Ammonia (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
0.18
Nitrate (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
Nitrite (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

MW06-11S

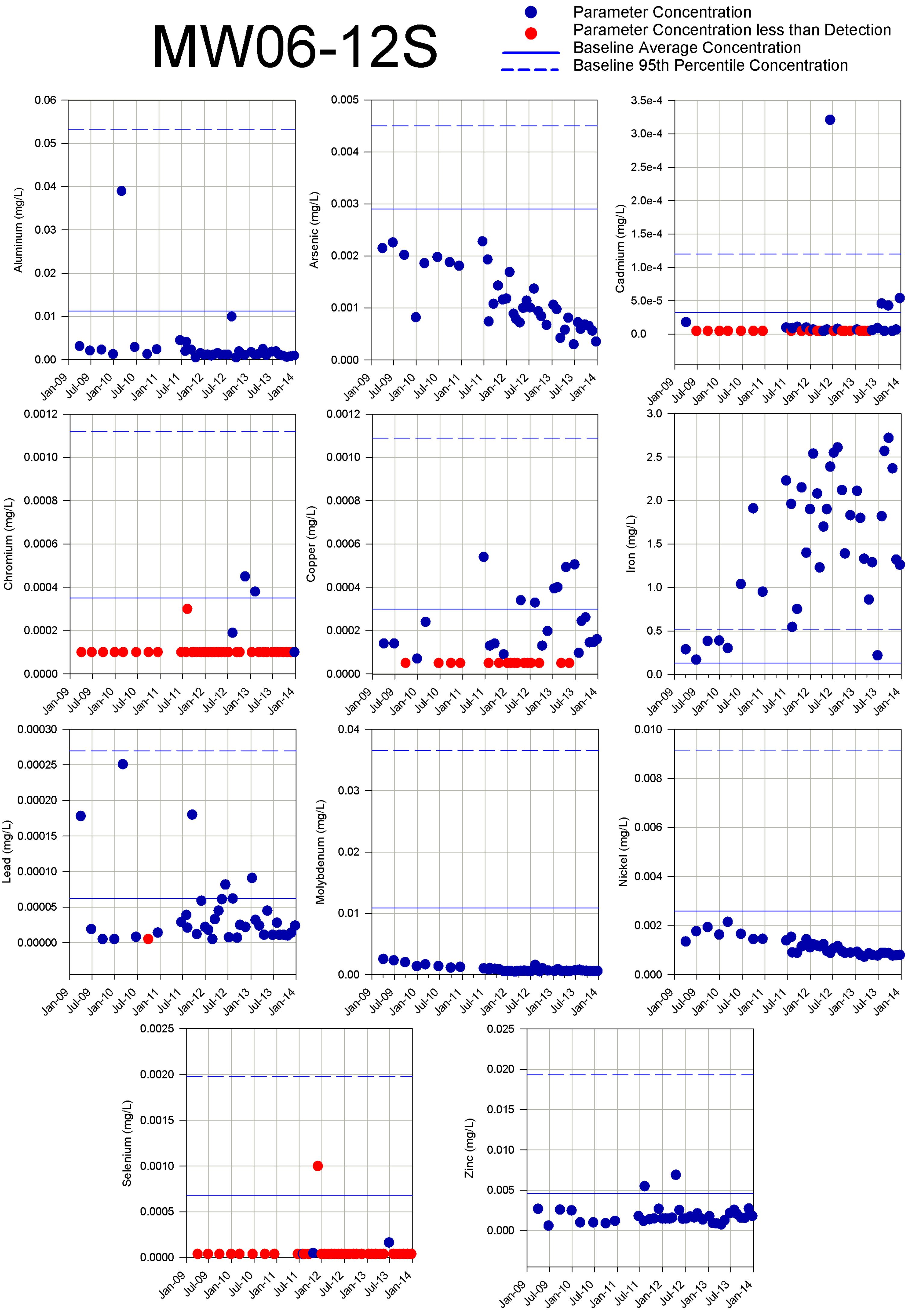
● Parameter Concentration
🔴 Parameter Concentration less than Detection
— Baseline Average Concentration
- - - Baseline 95th Percentile Concentration



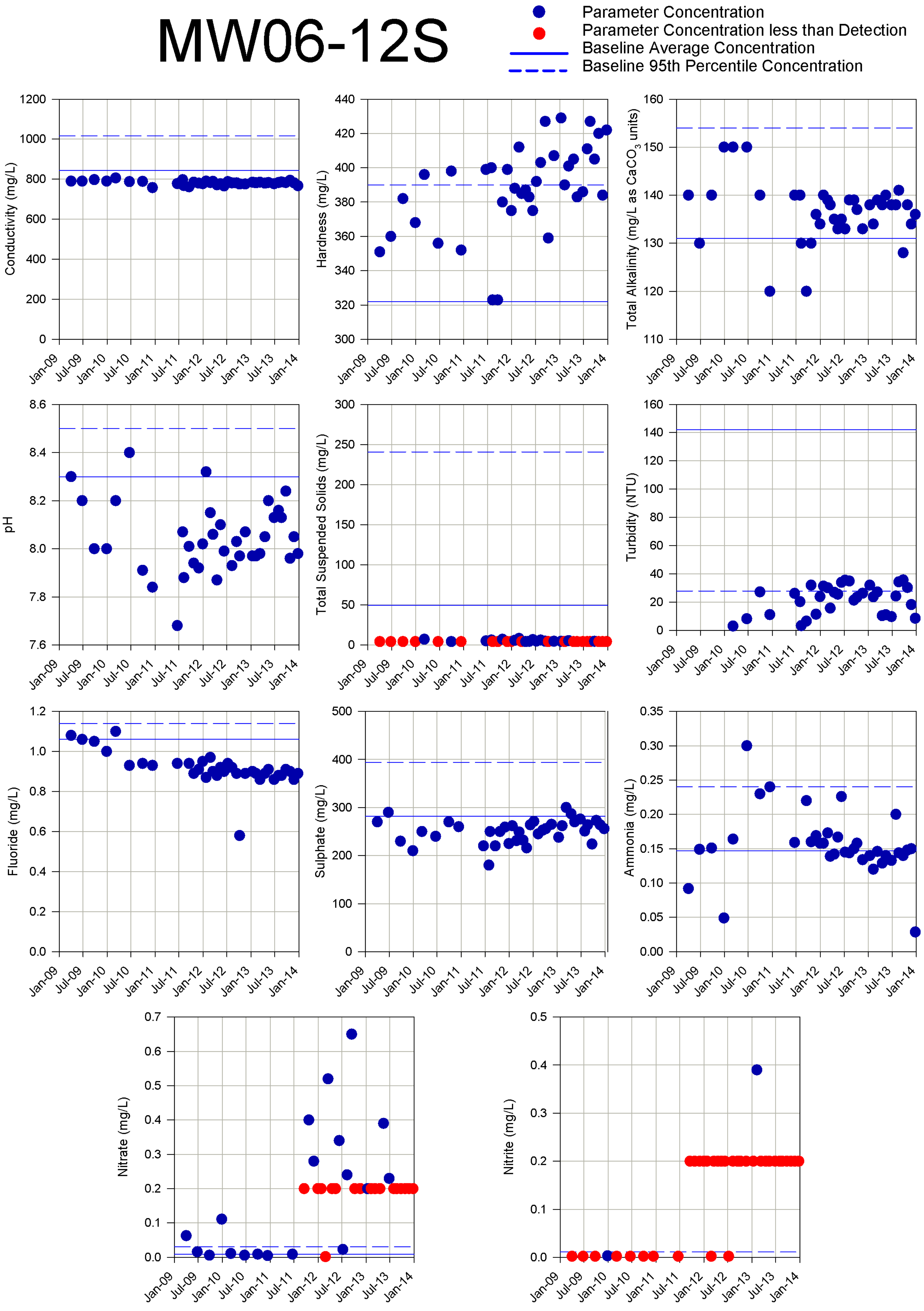
MW06-11S


Parameter Concentration
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
0
100
200
300
400
500
Hardness (mg/L)
160
180
200
220
240
260
Total Alkalinity (mg/L as $CaCO_3$ units)
120
140
160
180
200
220
pH
7.8
8.0
8.2
8.4
8.6
8.8
9.0
Total Suspended Solids (mg/L)
0
20
40
60
80
100
Turbidity (NTU)
0
2
4
6
8
10
12
14
Fluoride (mg/L)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Sulphate (mg/L)
0
20
40
60
80
100
Ammonia (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
Nitrate (mg/L)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Nitrite (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

MW06-12S

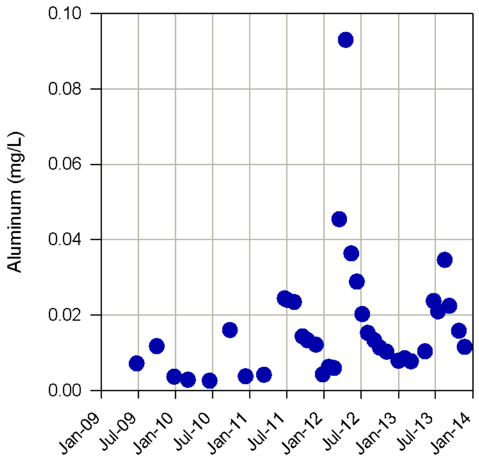

● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.00
0.01
0.02
0.03
0.04
0.05
0.06
Arsenic (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
Cadmium (mg/L)
0.0
5.0e-5
1.0e-4
1.5e-4
2.0e-4
2.5e-4
3.0e-4
3.5e-4
Chromium (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
Copper (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
Iron (mg/L)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Lead (mg/L)
0.00000
0.00005
0.00010
0.00015
0.00020
0.00025
0.00030
Molybdenum (mg/L)
0.00
0.01
0.02
0.03
0.04
Nickel (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
Selenium (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
Zinc (mg/L)
0.000
0.005
0.010
0.015
0.020
0.025
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

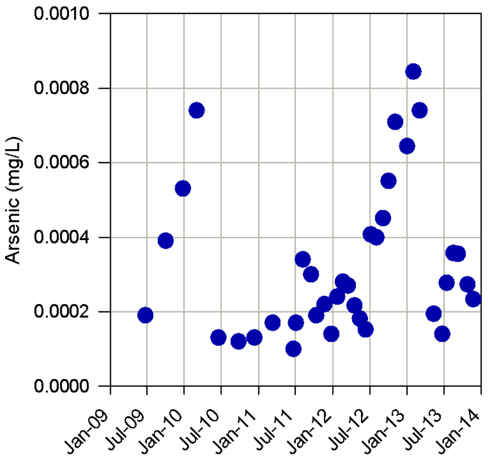
MW06-12S

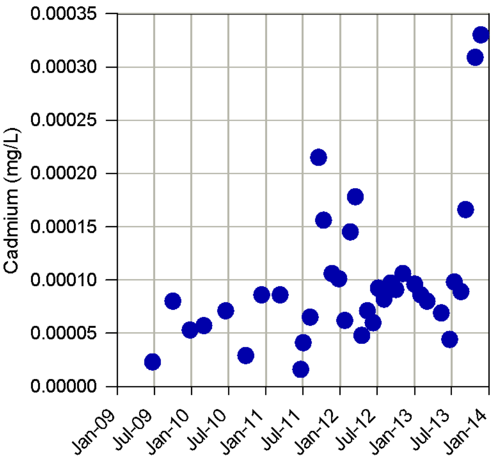

● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
0
200
400
600
800
1000
1200
Hardness (mg/L)
300
320
340
360
380
400
420
440
Total Alkalinity (mg/L as $CaCO_3$ units)
110
120
130
140
150
160
pH
7.6
7.8
8.0
8.2
8.4
8.6
Total Suspended Solids (mg/L)
0
50
100
150
200
250
300
Turbidity (NTU)
0
20
40
60
80
100
120
140
160
Fluoride (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Sulphate (mg/L)
0
100
200
300
400
500
Ammonia (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
Nitrate (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Nitrite (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

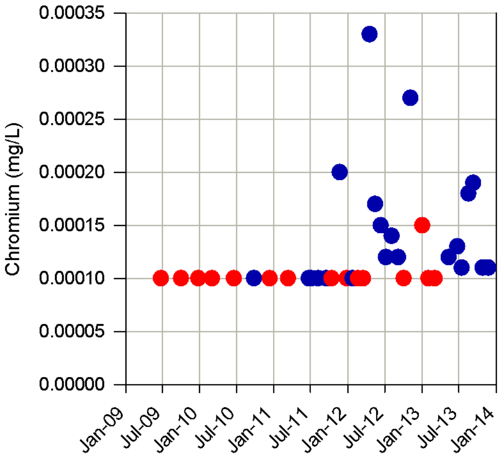
MW06-13

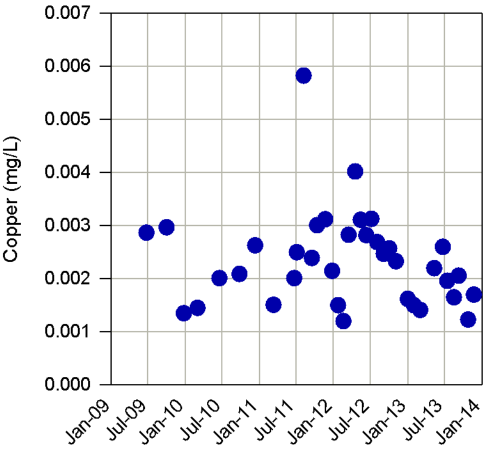
● Parameter Concentration
● Parameter Concentration less than Detection
── Baseline Average Concentration
- - - Baseline 95th Percentile Concentration

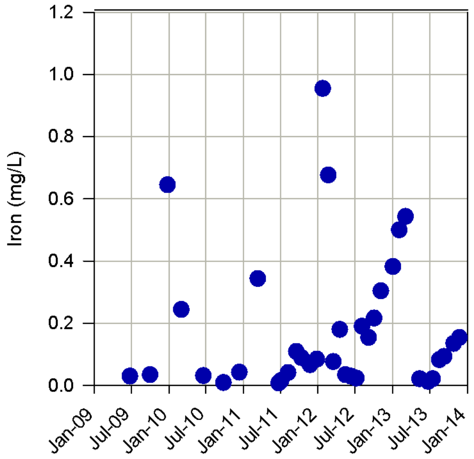


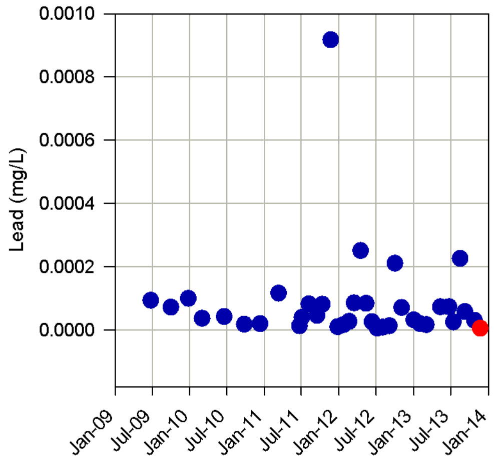


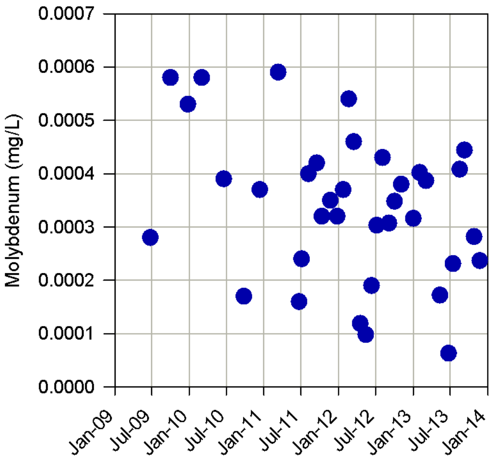


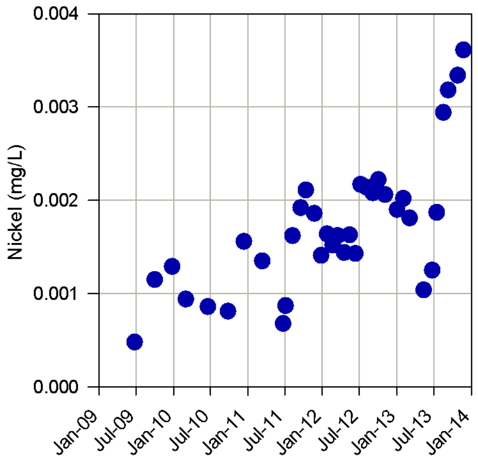


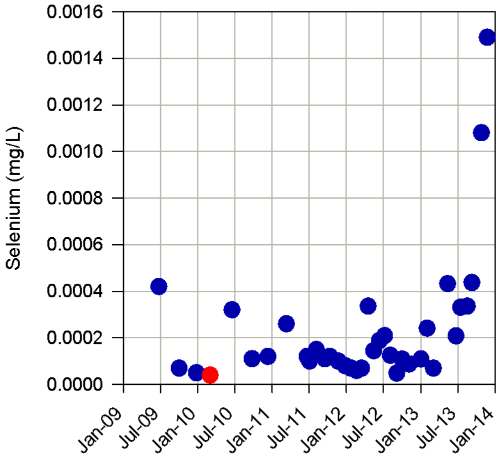


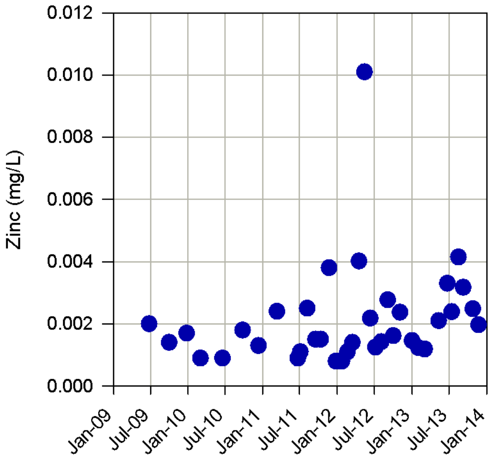






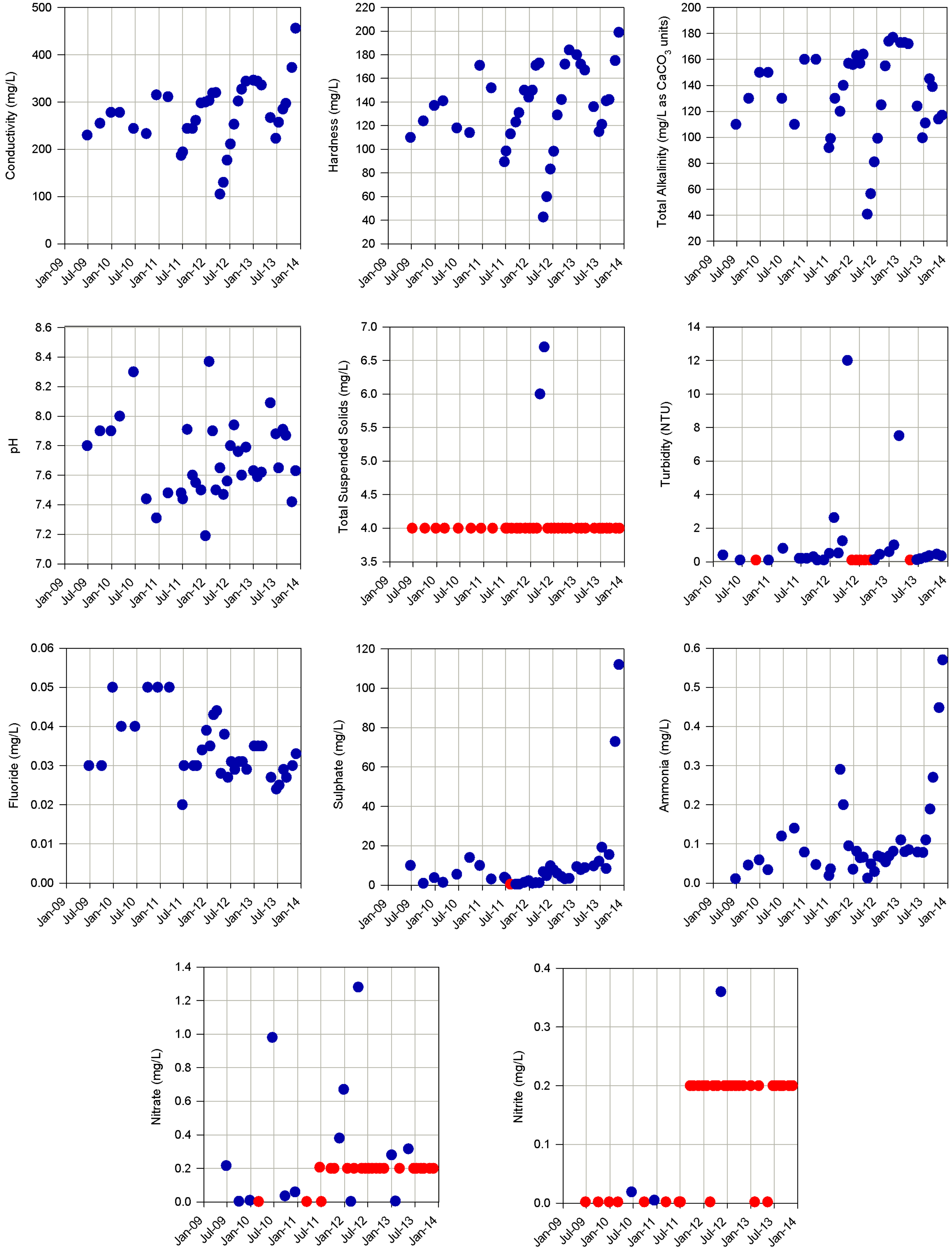






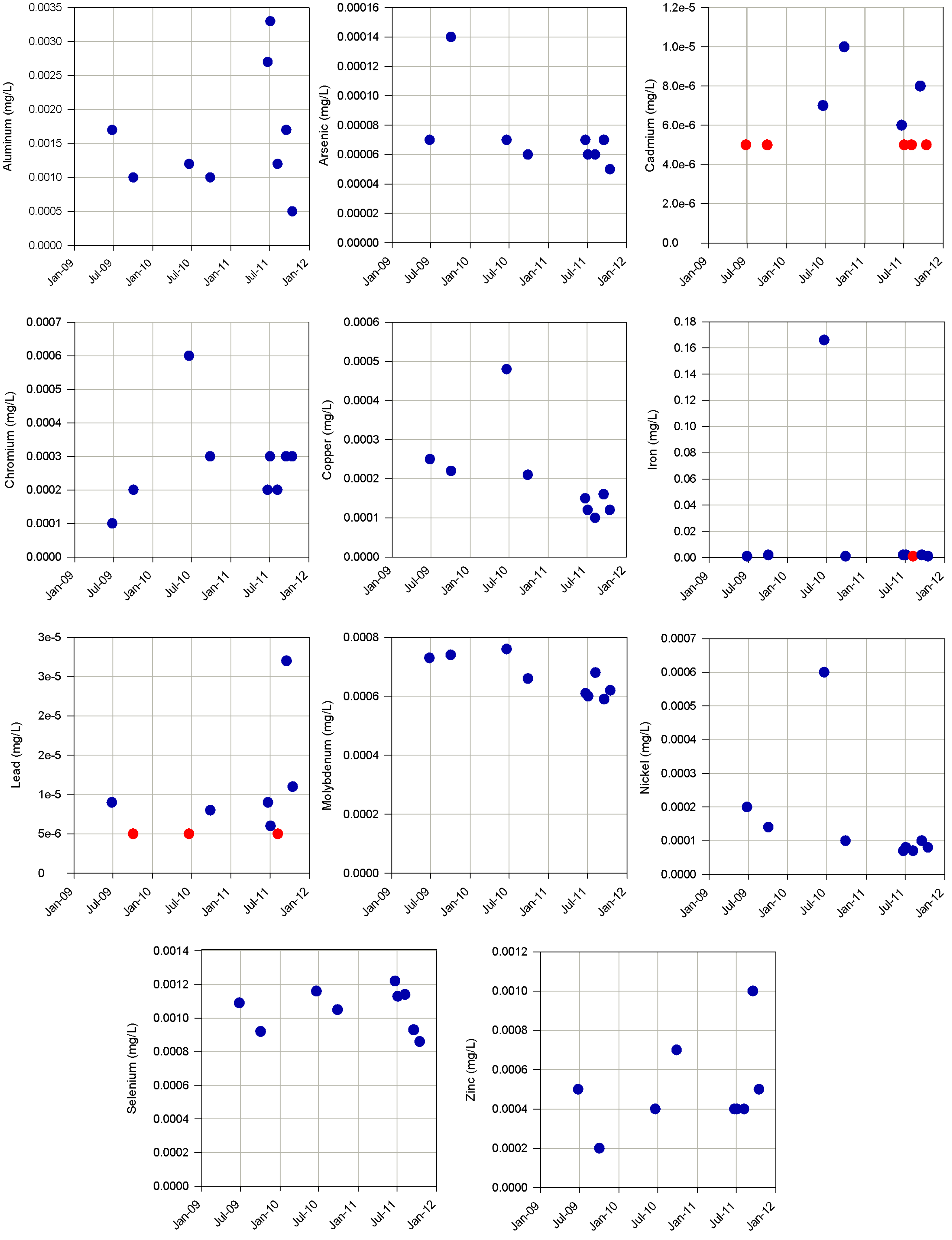
MW06-13

● Parameter Concentration
● Parameter Concentration less than Detection
── Baseline Average Concentration
- - - Baseline 95th Percentile Concentration



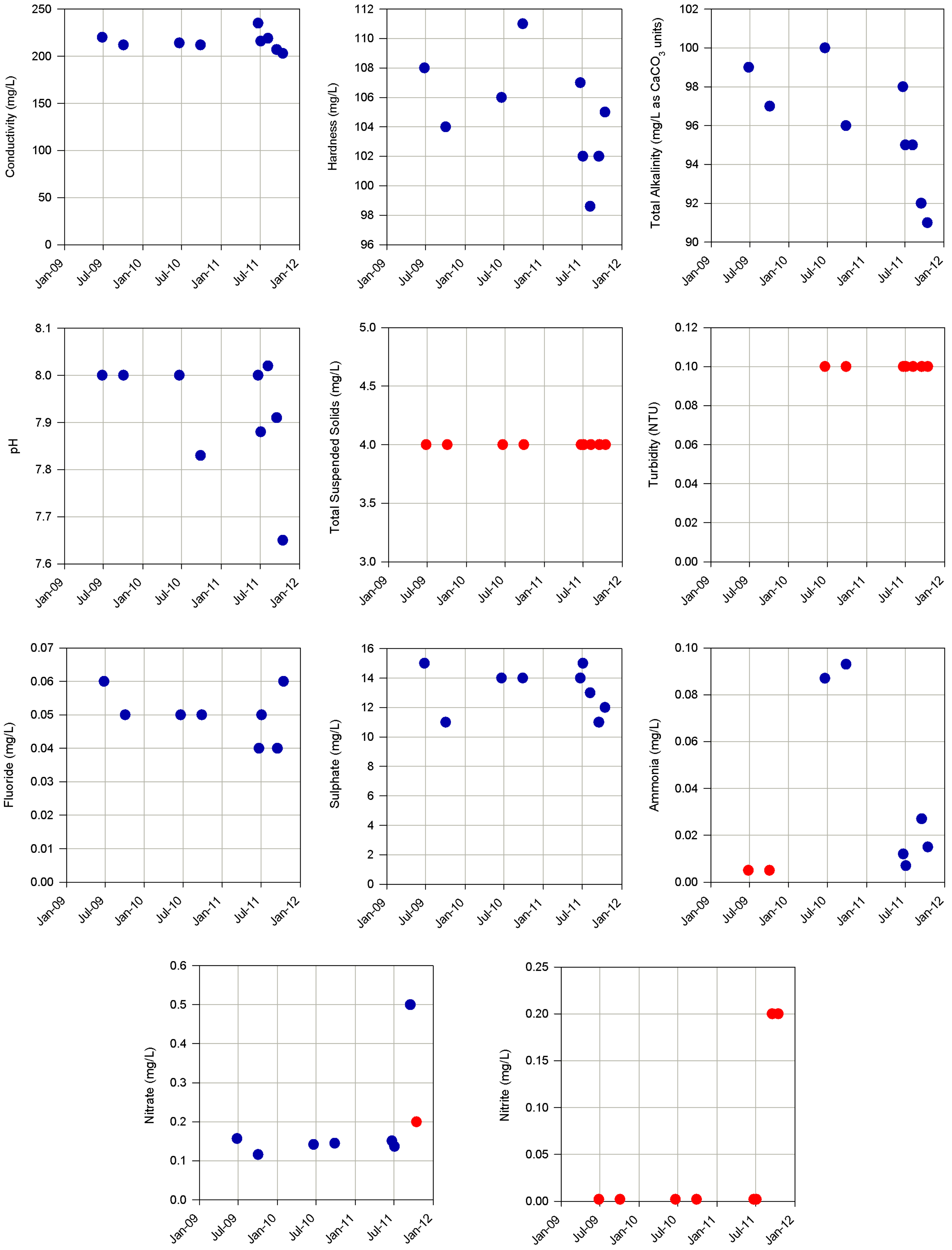
MW06-14

🔵 Parameter Concentration
🔴 Parameter Concentration less than Detection
— Baseline Average Concentration
- - - Baseline 95th Percentile Concentration



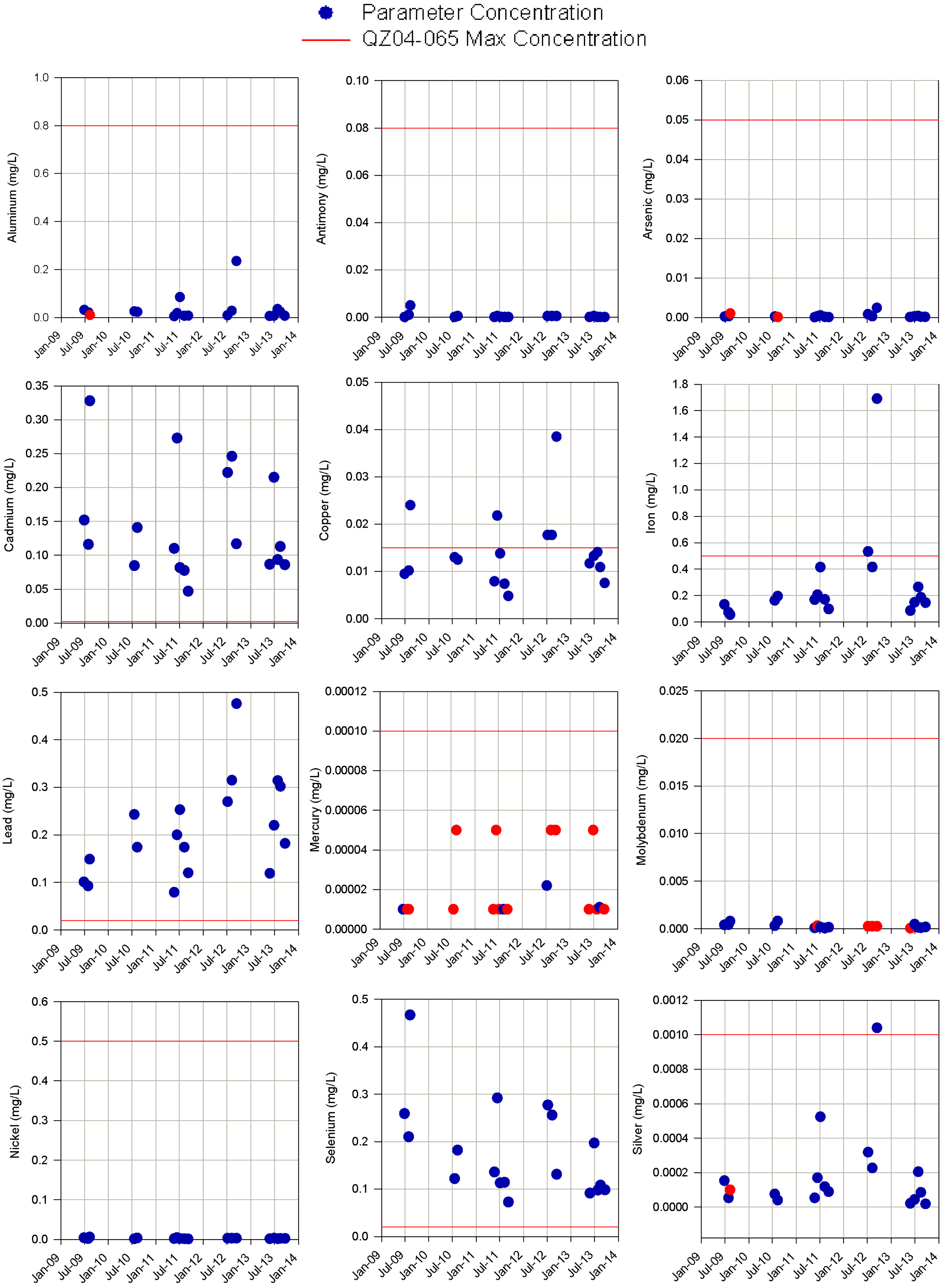
MW06-14

● Parameter Concentration
● Parameter Concentration less than Detection
— Baseline Average Concentration
– – Baseline 95th Percentile Concentration



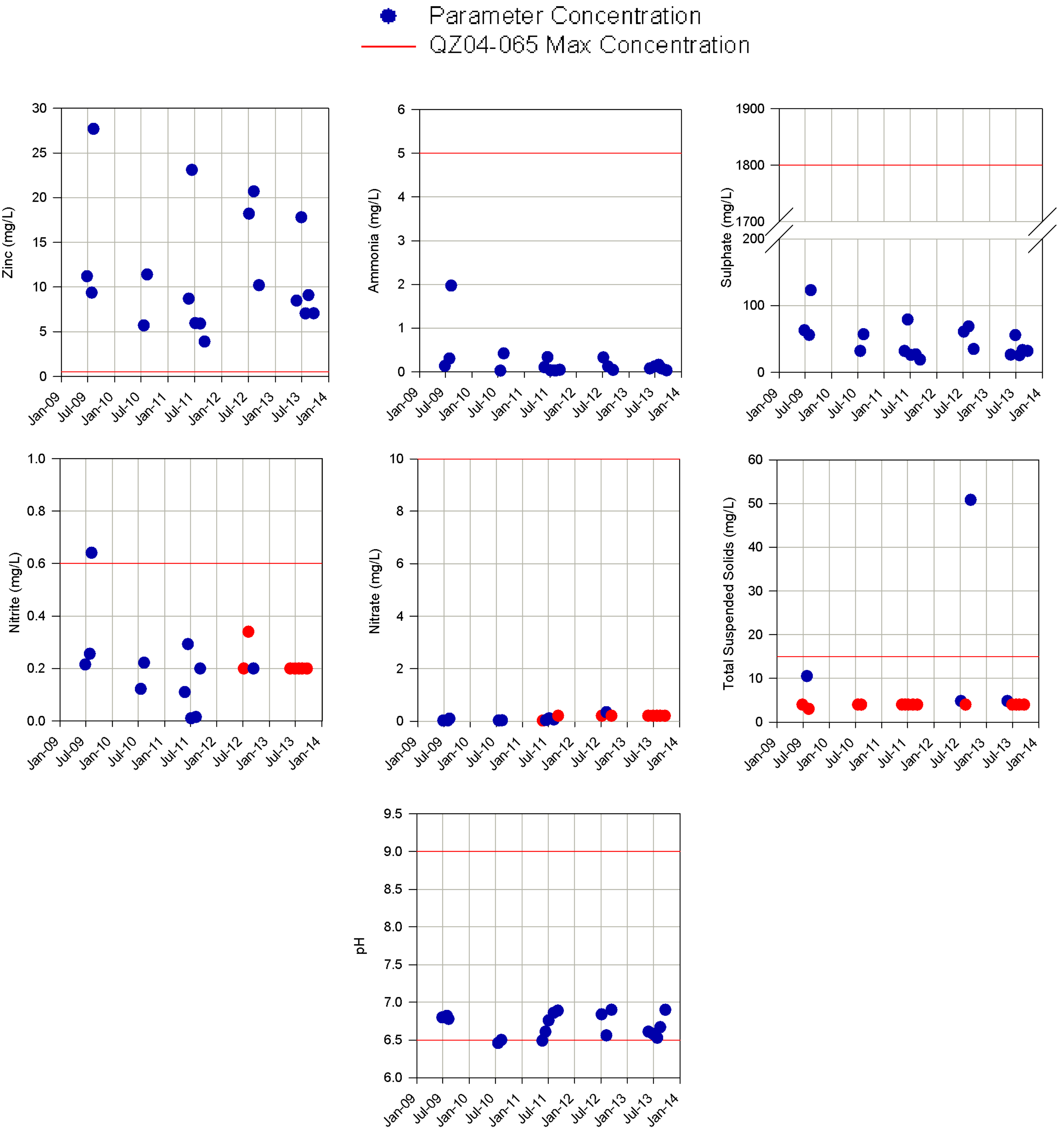
Appendix C: **In-situ Geochemical Test Pads (Lysimeters) – Graph**

Lysimeter A

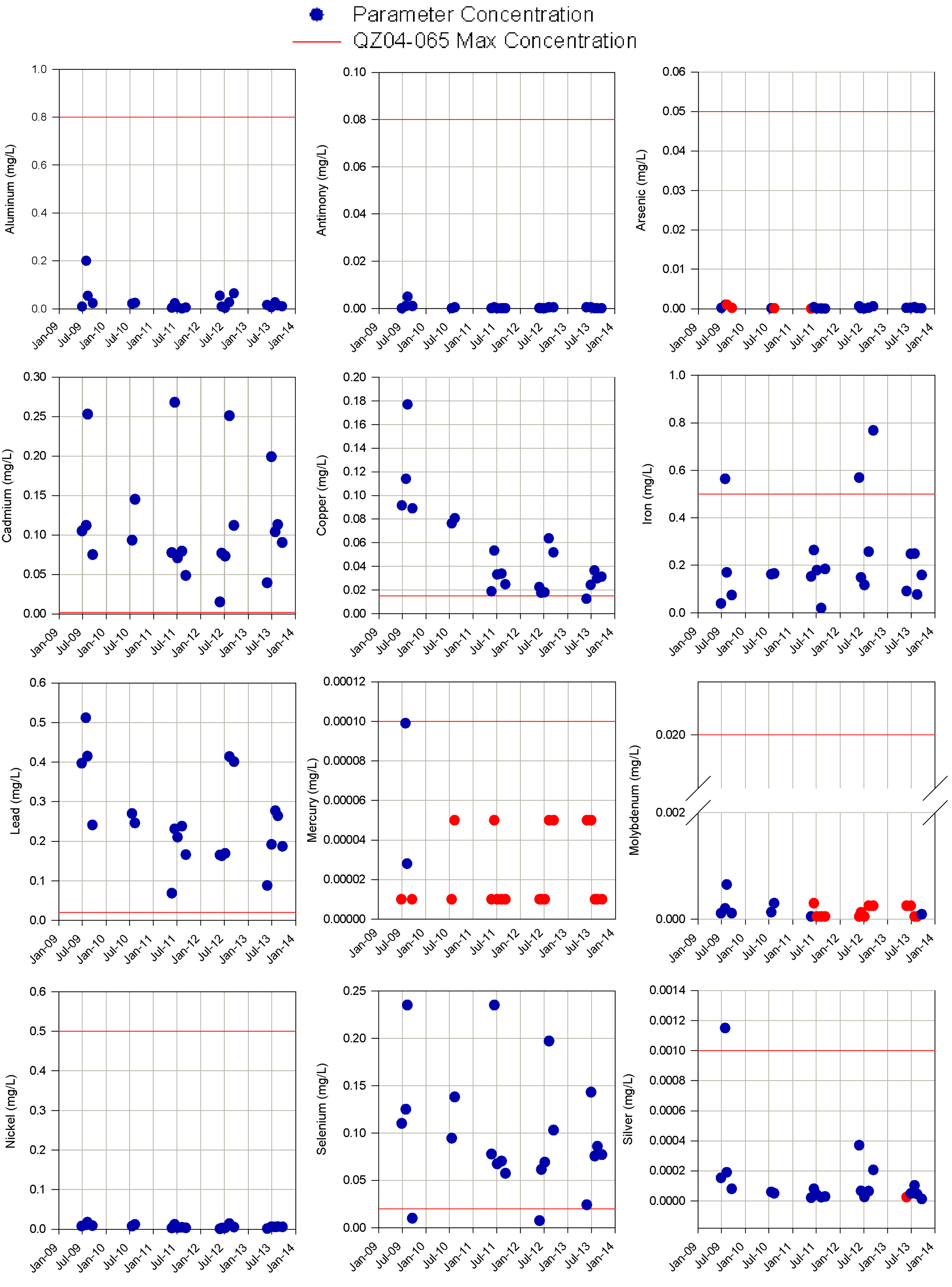


● Parameter Concentration
QZ04-065 Max Concentration
Aluminum (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
Antimony (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
Arsenic (mg/L)
0.00
0.01
0.02
0.03
0.04
0.05
0.06
Cadmium (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
Copper (mg/L)
0.00
0.01
0.02
0.03
0.04
0.05
Iron (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
Lead (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
Mercury (mg/L)
0.00000
0.00002
0.00004
0.00006
0.00008
0.00010
0.00012
Molybdenum (mg/L)
0.000
0.005
0.010
0.015
0.020
0.025
Nickel (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Selenium (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
Silver (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

Lysimeter A


●
Parameter Concentration
QZ04-065 Max Concentration
Zinc (mg/L)
0
5
10
15
20
25
30
Ammonia (mg/L)
0
1
2
3
4
5
6
Sulphate (mg/L)
0
100
200
1700
1800
1900
Nitrite (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
Nitrate (mg/L)
0
2
4
6
8
10
Total Suspended Solids (mg/L)
0
10
20
30
40
50
60
pH
6.0
6.5
7.0
7.5
8.0
8.5
9.0
9.5
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

Lysimeter B



Parameter Concentration
QZ04-065 Max Concentration
Aluminum (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
Antimony (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
Arsenic (mg/L)
0.00
0.01
0.02
0.03
0.04
0.05
0.06
Cadmium (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
Copper (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
0.18
0.20
Iron (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
Lead (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Mercury (mg/L)
0.00000
0.00002
0.00004
0.00006
0.00008
0.00010
0.00012
Molybdenum (mg/L)
0.000
0.002
0.020
Nickel (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Selenium (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
Silver (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
Jan-09
Jul-09
Jan-10
Jul-10
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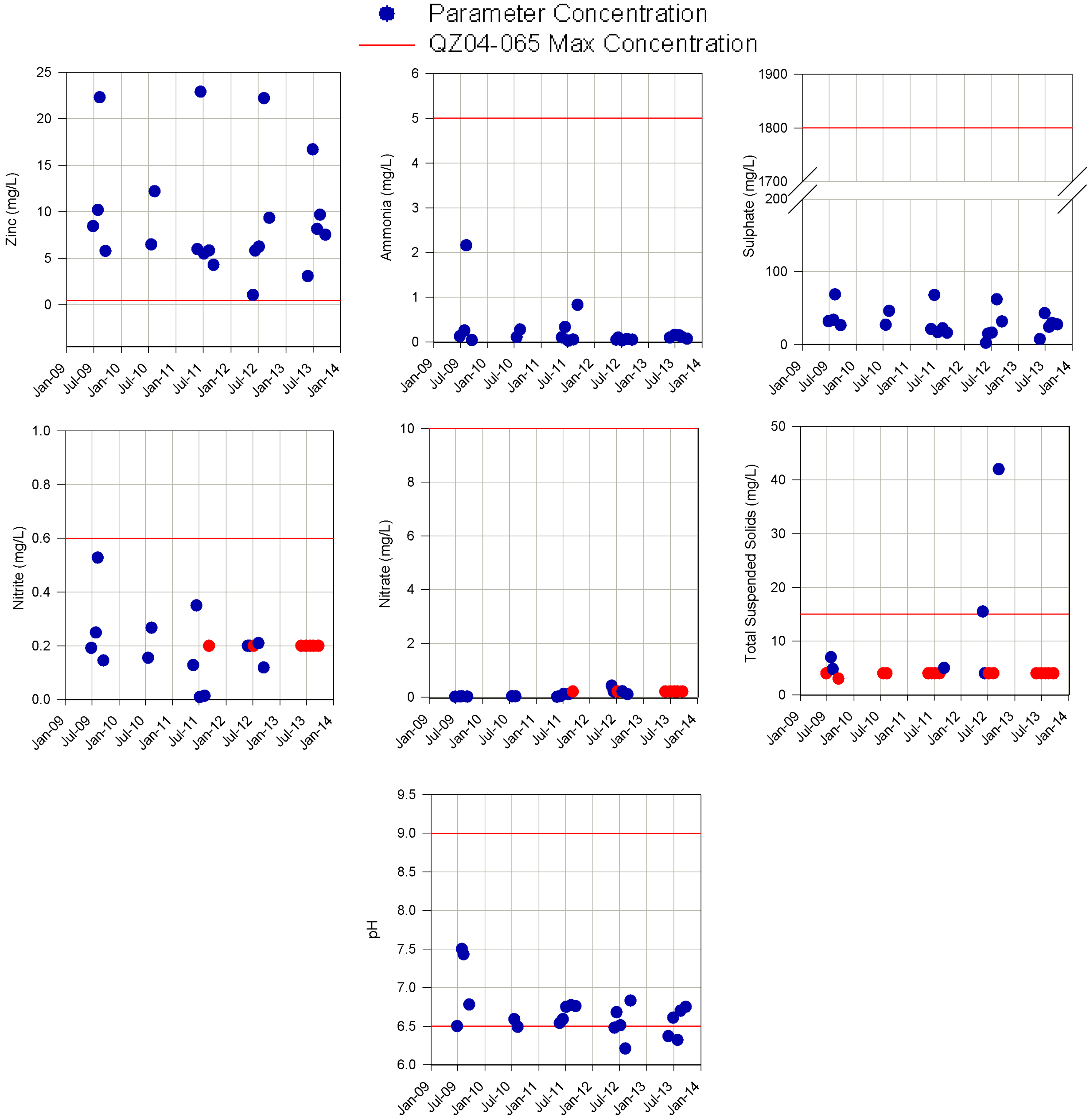
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

Lysimeter B



Parameter Concentration
QZ04-065 Max Concentration
Zinc (mg/L)
0
5
10
15
20
25
Ammonia (mg/L)
0
1
2
3
4
5
6
Sulphate (mg/L)
0
100
200
1700
1800
1900
Nitrite (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
Nitrate (mg/L)
0
2
4
6
8
10
Total Suspended Solids (mg/L)
0
10
20
30
40
50
pH
6.0
6.5
7.0
7.5
8.0
8.5
9.0
9.5
Jan-09
Jul-09
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Jul-10
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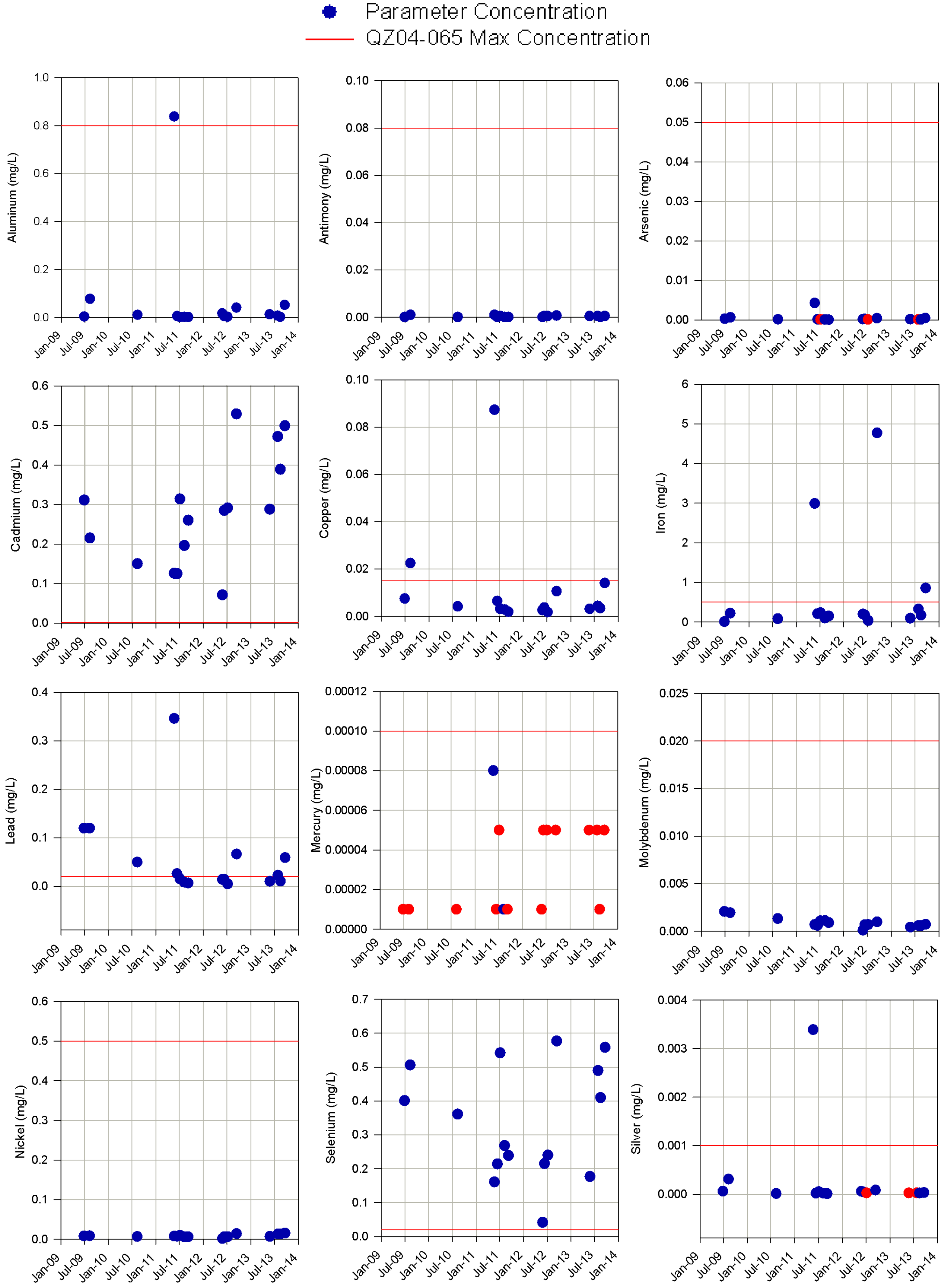
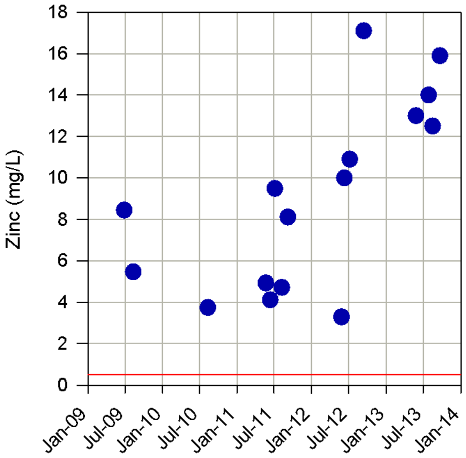
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

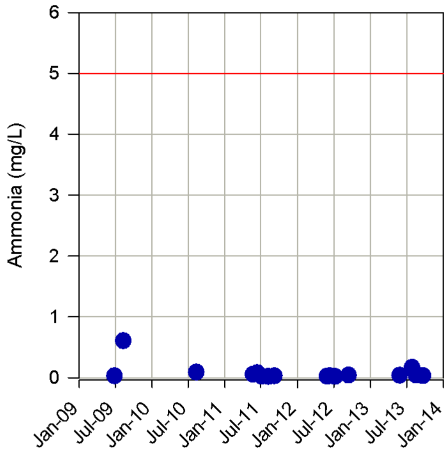
Lysimeter C

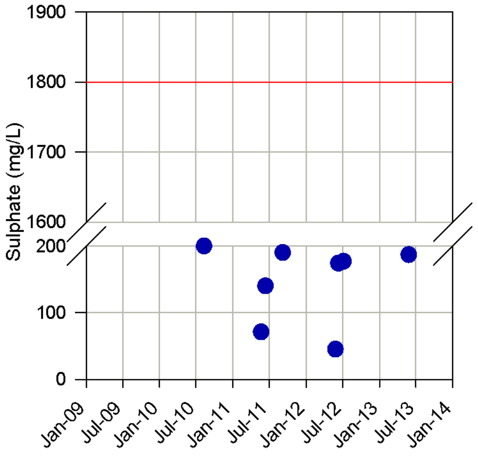

Parameter Concentration
QZ04-065 Max Concentration
Aluminum (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
Antimony (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
Arsenic (mg/L)
0.00
0.01
0.02
0.03
0.04
0.05
0.06
Cadmium (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Copper (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
Iron (mg/L)
0
1
2
3
4
5
6
Lead (mg/L)
0.0
0.1
0.2
0.3
0.4
Mercury (mg/L)
0.00000
0.00002
0.00004
0.00006
0.00008
0.00010
0.00012
Molybdenum (mg/L)
0.000
0.005
0.010
0.015
0.020
0.025
Nickel (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Selenium (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Silver (mg/L)
0.000
0.001
0.002
0.003
0.004
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

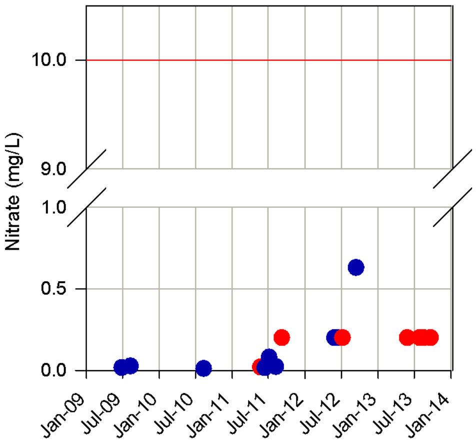
Lysimeter C

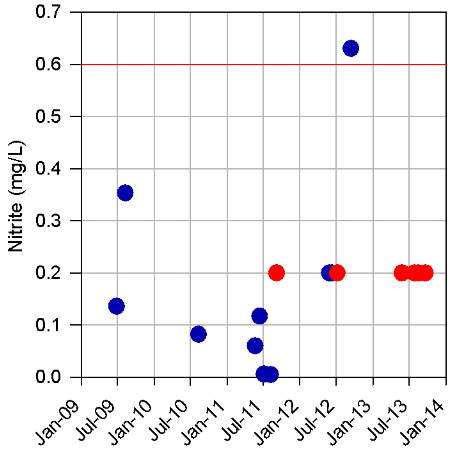
● Parameter Concentration
— QZ04-065 Max Concentration

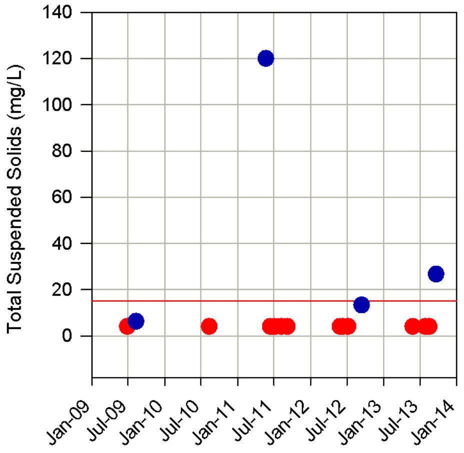


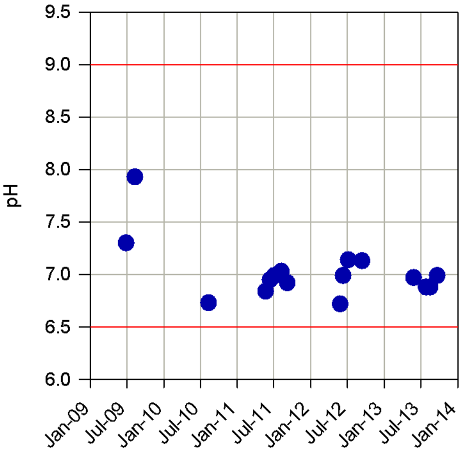




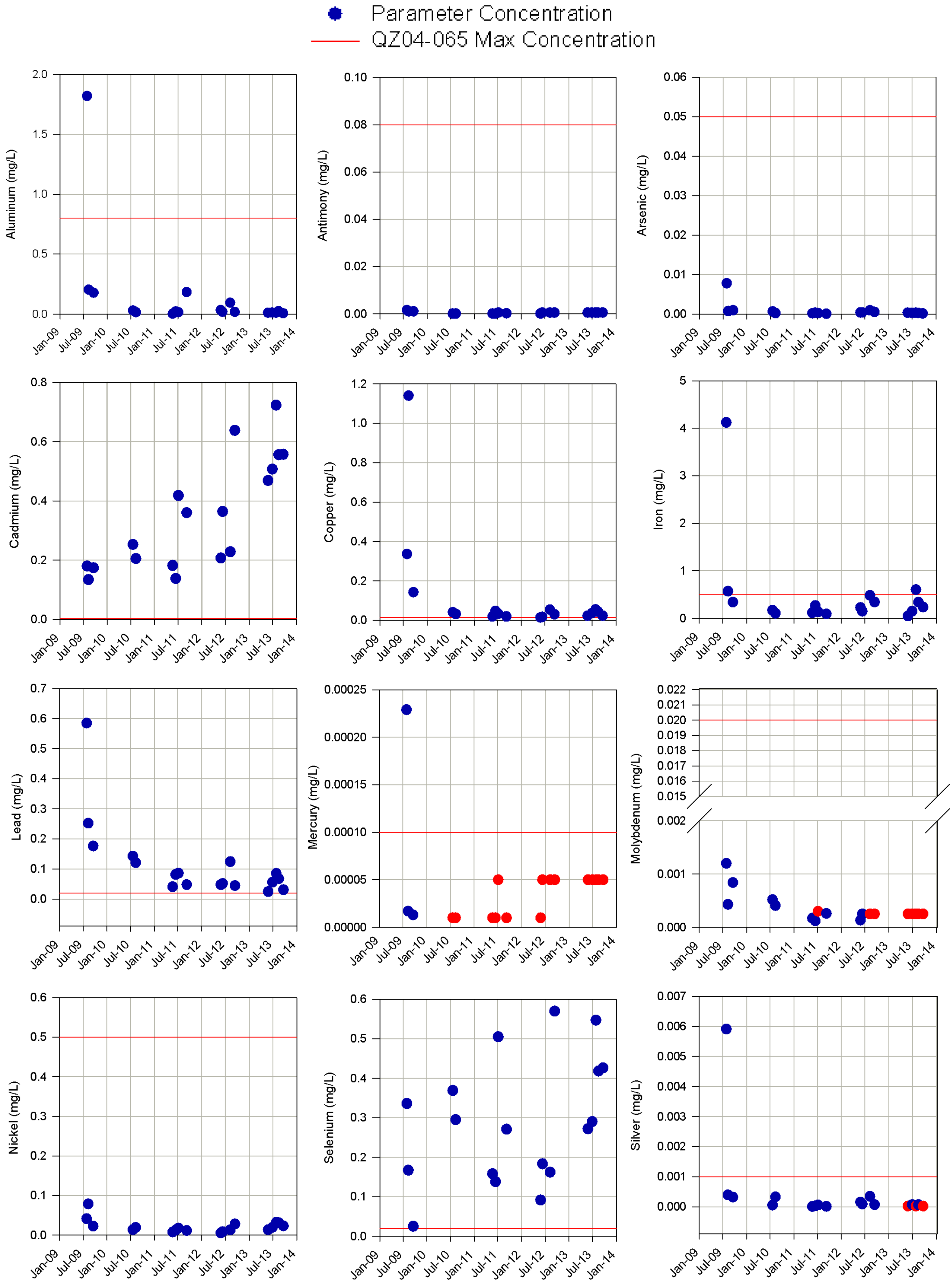




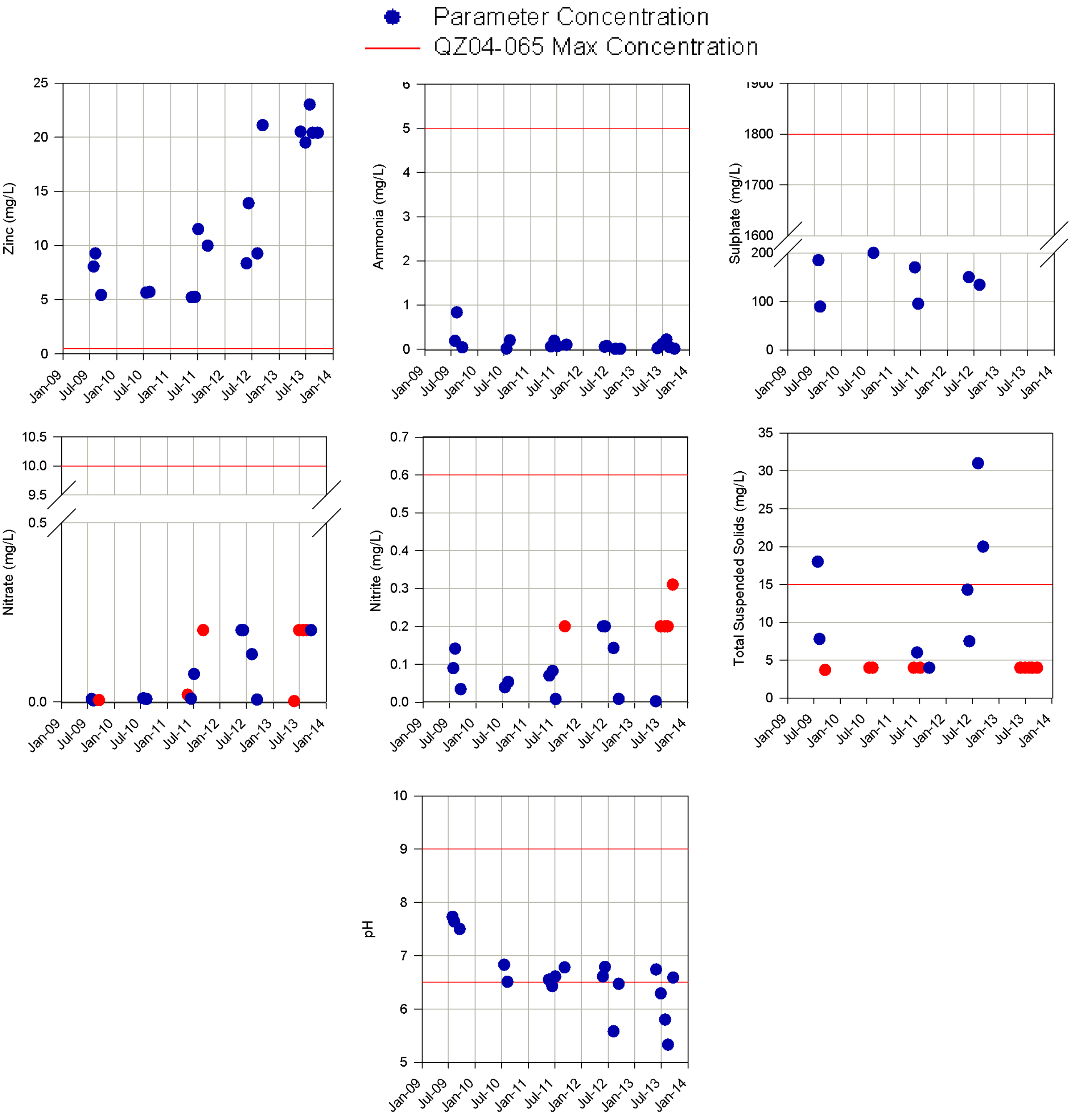




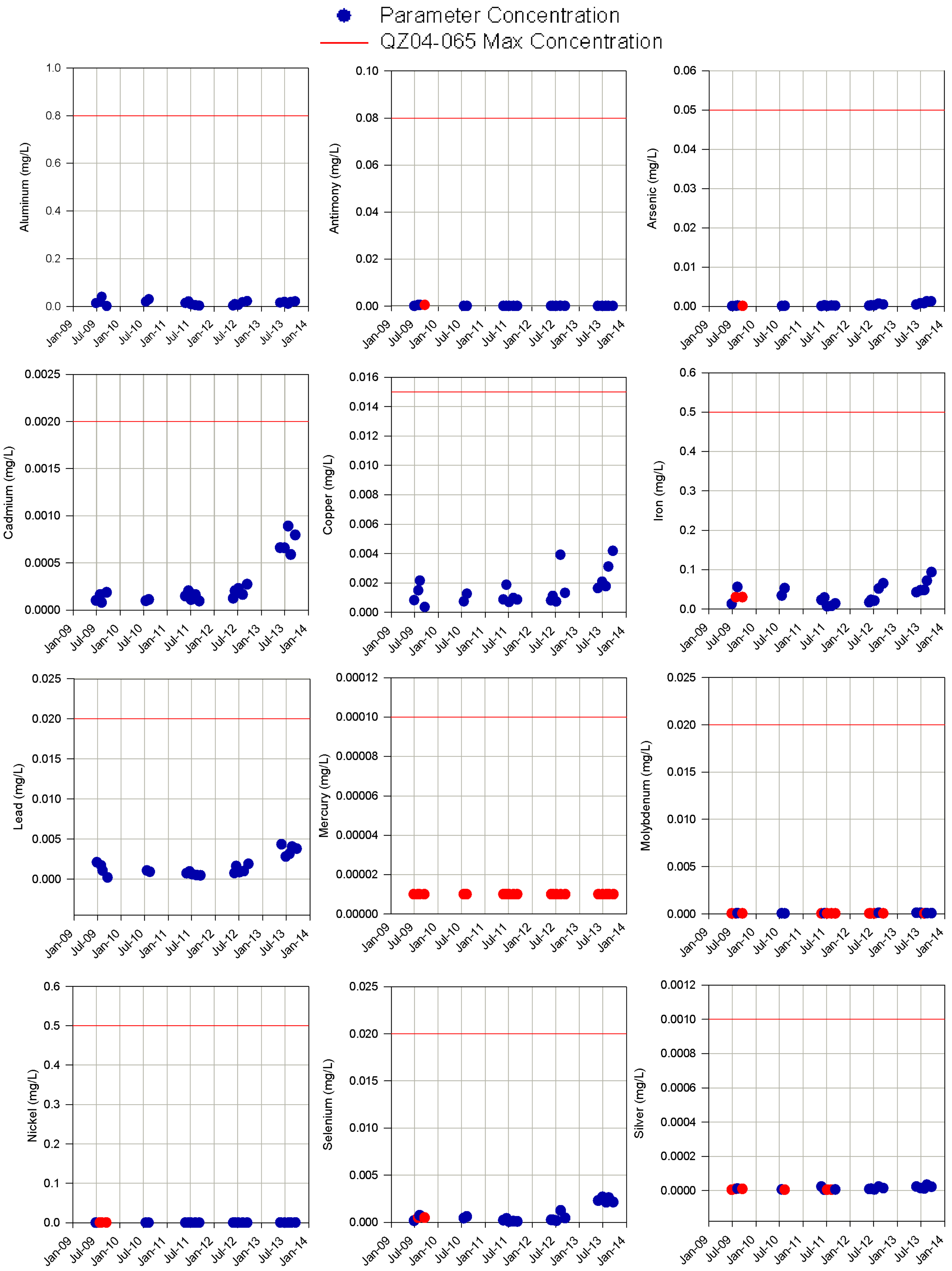
Lysimeter D


Parameter Concentration
QZ04-065 Max Concentration
Aluminum (mg/L)
Antimony (mg/L)
Arsenic (mg/L)
Cadmium (mg/L)
Copper (mg/L)
Iron (mg/L)
Lead (mg/L)
Mercury (mg/L)
Molybdenum (mg/L)
Nickel (mg/L)
Selenium (mg/L)
Silver (mg/L)
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

Lysimeter D


● Parameter Concentration
QZ04-065 Max Concentration
Zinc (mg/L)
0
5
10
15
20
25
Ammonia (mg/L)
0
1
2
3
4
5
6
Sulphate (mg/L)
0
100
200
1600
1700
1800
1900
Nitrate (mg/L)
0.0
0.5
9.5
10.0
10.5
Nitrite (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Total Suspended Solids (mg/L)
0
5
10
15
20
25
30
35
pH
5
6
7
8
9
10
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

Lysimeter E


Parameter Concentration
QZ04-065 Max Concentration
Aluminum (mg/L)
1.0
0.8
0.6
0.4
0.2
0.0
Antimony (mg/L)
0.10
0.08
0.06
0.04
0.02
0.00
Arsenic (mg/L)
0.06
0.05
0.04
0.03
0.02
0.01
0.00
Cadmium (mg/L)
0.0025
0.0020
0.0015
0.0010
0.0005
0.0000
Copper (mg/L)
0.016
0.014
0.012
0.010
0.008
0.006
0.004
0.002
0.000
Iron (mg/L)
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Lead (mg/L)
0.025
0.020
0.015
0.010
0.005
0.000
Mercury (mg/L)
0.00012
0.00010
0.00008
0.00006
0.00004
0.00002
0.00000
Molybdenum (mg/L)
0.025
0.020
0.015
0.010
0.005
0.000
Nickel (mg/L)
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Selenium (mg/L)
0.025
0.020
0.015
0.010
0.005
0.000
Silver (mg/L)
0.0012
0.0010
0.0008
0.0006
0.0004
0.0002
0.0000
Jan-09
Jul-09
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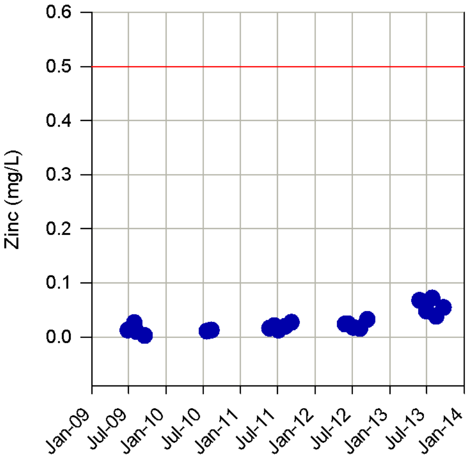
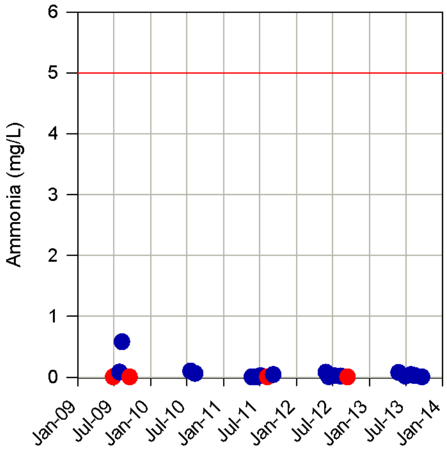
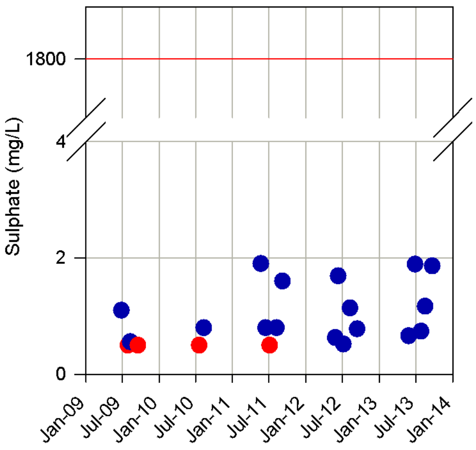
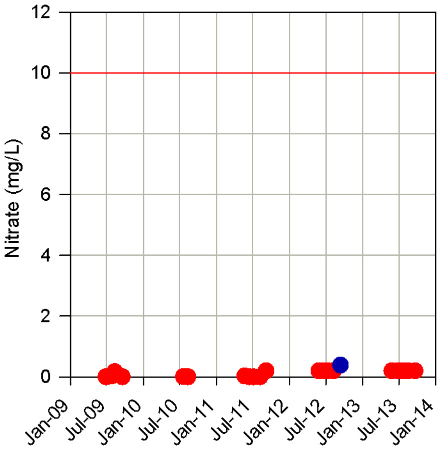
Lysimeter E

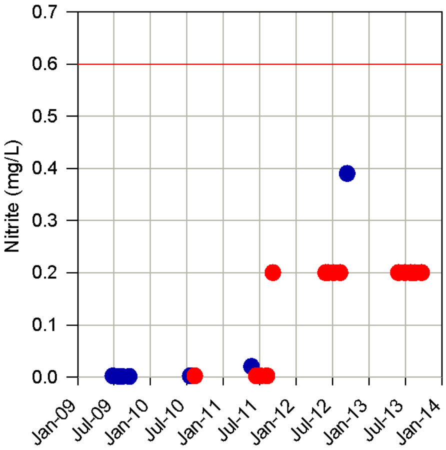
● Parameter Concentration
— QZ04-065 Max Concentration

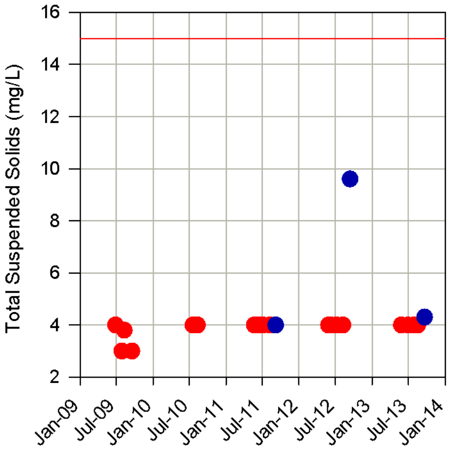


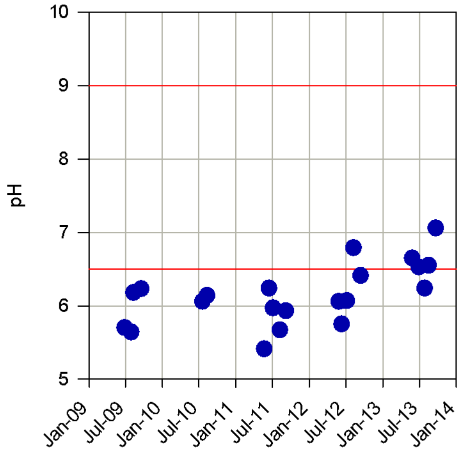












Appendix D: Geochemical Testwork – AMEC Report

March 20, 2013
TC53920

Robin McCall
Yukon Zinc Corporation
701-475 Howe Street
Vancouver BC
V6C 2B3

Dear Mr. McCall:

Re: Wolverine Project Update: Shutdown of Seven Remaining Humidity Cells

1.0 INTRODUCTION

This report summarizes the final leach data of the remaining seven humidity cells from the Wolverine Project humidity cell testing program. Results from the humidity cells were last reported in March 2011 (AMEC, 2011). Following recommendations made in November of 2008 (AMEC, 2008) 17 cells were shut down on February 19, 2009, and the operation of seven cells were continued up to January 2012 (Table 1).

The remaining seven humidity test cells consisted of four mine rock humidity cells (HC 4, HC 6, HC 7 and HC 10), one NP-depleted ore cell (HC 21) and two tailings paste backfill cells (T1 and T2).

Release rates were calculated based on the measured concentrations and volumes of leachate produced weekly by each cell. Long-term rates were determined for steady-state conditions that excluded the initial 20 weeks of data to account for the flushing of oxidation products in the samples that may have accumulated prior to testing.

Termination of the seven cells followed standard procedures as outlined in the document *Draft Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia* (Price, 1997). After the last cycle of the humidity cell testing, the closedown procedure involved a high volume final rinse to account for the retention and/or accumulation of weathering products over time. The detectable retained products of the final rinse were then distributed evenly over all weeks of testing; assuming the weekly amount of retained product was constant over the testing period.

Results for pH, and calculated loadings for sulphate, alkalinity, acidity and regulated metals, plus carbonate molar ratios for each material type are discussed in the following sections and shown in Figures 1 to 48.

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www.amec.com

2.0 HUMIDITY CELL SHUTDOWN RESULTS

2.1 Static Testing – ABA and Elemental Analysis

Initial acid-base accounting (ABA) analyses were conducted at the ALS Chemex laboratory in Burnaby, BC. Humidity cells were operated by SGS CEMI of Burnaby, BC. For consistency, after the final rinse of the humidity cells by SGS CEMI, subsamples of the humidity cell solids were sent to ALS Chemex for final ABA analyses and the results are provided in Table 2. The following section describes the results of the final ABA analyses in comparison to the initial test results.

Paste pH

The initial and final values for the paste pH of the HC 6 (Excp-3) sample were identical, with a value of 7.7. The paste pH of the waste rock samples HC 4 (Footwall Rhyolite-3) and HC 7 (Argillite-2) decreased by 2.8-3.6 pH units over the course of the testing period, with a final paste pH of 4.0 and 5.2 respectively. The paste pH of HC 10 increased from 7.9 at the commencement of testing, to 8.2 at the time of closeout.

The NP depleted ore sample (HC 21) had a paste pH of 3.6 following the decommissioning of the cell. The initial paste pH of HC 15 was used as a general comparison to the ore sample in HC 21, resulting in a decrease of 4.4 pH units (final paste pH of 3.6) over the testing period.

The initial measured paste pH of the tailings paste backfill samples T1 and T2 were 8.3 and 7.9, respectively, while the final measured paste pH of the humidity cell materials were both 7.8.

Forms of Sulphur

Total sulphur, sulphate sulphur and sulphide sulphur for both initial and final analyses are presented in Table 2. In general, total sulphur content decreased by 0.5 to 9.5% in all humidity cell material. The initial sulphide sulphur content was elevated relative to the final sulphide sulphur content for all waste rock humidity cell material.

Final sulphate content for material from HC 4, 6 and 7 were slightly higher than the initial values (0.03-0.07% increase) and sulphide content for the same cells declined relative to initial values (0.7 to 0.9% decrease), suggesting that sulphide oxidation may have occurred.

Values for total sulphur and sulphide sulphur content decreased by 9.5 and 10.8%, respectively for the NP depleted ore cell (HC 21) material. The sulphate values for the HC 21 material increased by 0.3% over the testing period relative to the initial values.

Total sulphur content in the backfill material (T1 and T2 cells) decreased by 1.25-2.25%, whereas initial and final sulphide sulphur content remained relatively similar. The initial concentrations of sulphate were 1.2% and 1.0%, and both decreased to 0.1% sulphate at the time of closeout. The backfill material had large proportions of pyrite, however evidence suggests that little sulphide oxidation occurred. The decline in sulphate content within the material may be related to the elevated sulphate loadings observed within the initial 100 weeks (ranged from 50-700 mg/kg/wk) (Figure 36).

The acid potential (AP) in the final humidity cell material was less than the initial AP values for all cells. The final AP values for humidity cell material from HC 4, 6, 7 and 10 were 9-29 kg $CaCO_3$/tonne lower than the initial material, and were likely a result of sulphide oxidation. The AP value for the NP depleted ore sample (HC 21) was initially 413 kg $CaCO_3$/tonne, while the final AP was 73 kg $CaCO_3$/tonne. The substantial loss in AP for the NP depleted cell is likely attributed to accelerated loss of sulphur after the onset of acidic conditions. The AP values for the backfill material in cells T1 and T2 decreased from 608 and 586 kg $CaCO_3$/tonne to 553 and 550 kg $CaCO_3$/tonne, respectively.

Forms of Neutralization Potential

In general the initial values for NP were significantly higher than the NP values for the final residues, and decreased by 13.5-112.5 kg $CaCO_3$/tonne for all materials.

The initial NP for HC 4 material decreased by 93%, from 19 kg/$CaCO_3$/tonne to 1.4 kg/$CaCO_3$/tonne. The NP depleted cell (HC 21) had a reported decrease in NP of 99.6%, with a final NP of 0.5 kg $CaCO_3$/tonne. The NP values of the tailings cells decrease by 66-68 kg $CaCO_3$/tonne.

At the onset of acidic conditions, approximately 10 kg $CaCO_3$/tonne NP was remaining for HC 4, 13 kg $CaCO_3$/tonne NP was remaining for HC 7, and 1.3 kg $CaCO_3$/tonne NP was remaining for HC 21.

Acid Base Accounting (ABA)

The ratio of NP to AP provides an estimate of the bulk available NP relative to AP, where a value of one indicates that NP content exactly balances AP content. Values less than one indicate AP exceeds NP and values greater than one indicates excess NP. Values of NP/AP much greater than one are preferable and allow for variability in rock composition.

Initial and final NP/AP ratios were compared in Table 2. The initial NP/AP ratios were less than 0.75 for all humidity cells, with the exception of HC 6 (2.52). In general, the final NP/AP ratios were less than the initial NP/AP ratios, and decreased by 0.02-0.34 for all humidity cell samples. All final NP/AP ratios were less than 0.4, with the exception of HC 6 (2.5).

The greatest differences in NP/AP were observed for HCs 4 and 21: HC 4 had an initial NP/AP ratio of 0.17 and a final NP/AP ratio of 0.02, and HC 21 had an initial NP/AP ratio of 0.27 and a final NP/AP ratio of 0.001. In general, the decrease in NP was greater than the decrease in AP for HCs 4, 7 and 21.

Elemental Analyses of Solids

The initial elemental content of the humidity cell material were compared to the elemental content of the humidity cell material after closeout, and are summarized in Table 3. Concentrations of major elements including aluminum, calcium, iron, magnesium and sodium were generally elevated in the initial analyses relative to the elemental content of samples following closeout.

Concentrations of calcium decreased by 2.3-3.3% for the NP depleted ore material (HC 21) and backfill materials (T1 and T2). The backfill materials had 2.5% calcium remaining following termination, which likely contributed to the elevated NP values for these materials. A large decline from initial to final elemental content was observed for cadmium, copper, manganese, zinc and magnesium for the acid generating humidity cell material (HC 4, 7 and 21).

Trace elemental content of the final samples were at times elevated relative to the initial content; the discrepancy is likely due heterogeneity within the soil sample and instrument sensitivity.

2.2 Kinetic Testing

Humidity cell testing was conducted at SGS CEMI (formerly Canadian Environmental and Metallurgical Inc.) according to standard humidity cell procedures outlined in Price (1997). Following the last cycle of the humidity cell operation, the closedown procedure included a high volume final rinse of the cells to remove any weathering products that may have been retained in the sample. Calculated loads of retained products in the final rinse were then distributed evenly over the testing period to revise the weekly loading rates. Humidity cell leachate chemistry was used to determine the release rate of metals and other parameters as a function of time, and to estimate the time to acid rock drainage (ARD) onset.

pH

Measured leachate pH values for HCs 6 and 10 remained fairly constant throughout the testing period and fluctuated around near-neutral pH values (~7). The pH values of HC 4 and HC 7 leachate behaved similarly. The pH values were near-neutral and decreased to 6.5 over approximately 50 weeks, followed by a rapidly decline (over 30-50 weeks) to values below 4. The final pH values measured for HC 4 and HC 7 were 3.8 and 2.8, respectively (Figure 1).

The pH values of the NP-depleted ore sample (HC 21) decreased to acidic conditions within 2.5 years; the last recorded pH value was 2.1 (Figure 16).

The pH values of the two paste backfill humidity cell samples remained circum-neutral throughout the testing period, ranging from 6.5 to 8.2 (Figure 33).

Alkalinity and Acidity

The alkalinity loadings from the mine rock samples HC 6 and HC 10 remained steady throughout the testing duration, and ranged from 12.1 to 51.3 mg/kg/wk (Figure 2). The acidity release rates for the mine rock leachate of the same cells ranged from 0.6 to 6.7 mg/kg/wk (Figure 3).

Alkalinity loadings from HC 4 and HC 7 decreased throughout the testing duration, reaching loads of 0.1 and 0.5 mg/kg/wk, respectively (Figure 2). The acidity release rates increased to 30.6 and 73.9 mg/kg/wk, respectively (Figure 3).

The alkalinity loads from the NP-depleted ore sample (HC 21) decreased to less than the Method Detection Limit (MDL) following 195 weeks (Figure 18). The acidity of HC 21 increased to a maximum loading rate of approximately 2200 mg/kg/wk at the time of termination (Figure 19).

Alkalinity release rates from the paste backfill samples increased slowly over time. After 150 weeks, the alkalinity concentrations stabilized and ranged from 11.1 to 41.2 mg/kg/wk (Figure 34). The acidity of the paste backfill humidity cell leachate rapidly declined from > 20 mg/kg/wk and stabilized between 0.7 and 4.3 mg/kg/wk until termination (Figure 35).

Sulphate

Sulphate loads from HC 6 and HC 10 remained relatively consistent throughout the testing period. After 50 weeks, the HC 6 sulphate loadings stabilized at 27.1 to 91.1 mg/kg/wk, and HC 10 stabilized at 5.5 to 22.4 mg/kg/wk. After 150 weeks, sulphate loadings for HC 4 and HC 7 increased slowly after the onset of acidic conditions. After 150 weeks, HC 4 ranged from 18.4 to 80.8 mg/kg/wk with a median of 33.1 mg/kg/wk, and HC 7 ranged from 12.9 to 198.3 mg/kg/wk with a median sulphate loading of 27.9 mg/kg/wk (Figure 4).

Sulphate release rates for the NP-depleted ore cell (HC 21) steadily increased from week 135. The final sulphate release rate from this cell was 2685.5 mg/kg/wk (Figure 20).

Sulphate loadings from the paste backfill humidity cells (T1 and T2) had decreased to below 100 mg/kg/wk at 91 and 101 weeks, respectively. With the exception of a few irregularities, sulphate release rates for these 2 cells ranged from 17.9 to 87.7 mg/kg/wk thereafter (Figure 36).

Carbonate Molar Ratio

The release rates of calcium and magnesium were compared to the release rates of sulphate, known as the carbonate molar ratio (CMR) to assess the relationship between acid generation and acid neutralization in a sample. Generally CMR values between 0.5 and 1.5 indicate carbonate dissolution in response to sulphide oxidation. Values above this range indicate additional carbonate dissolution due to other processes.

The CMR values for HC 10 were elevated relative to the other mine rock humidity leachates, and were commonly greater than 2 for the entirety of the test. The CMR values for HC 6 were relatively steady up to termination, and ranged from between 1 and 2 (Figure 16). Following 170 weeks, the CMR values for HC 4 and HC 7 steadily declined to ratios below 1, corresponding to decreases in the leachate pH to acidic values until the time of closeout.

The CMR for HC 21 decreased from values of 0.9 to1.7 prior to week 130, to less than one (Figure 36). At week 224, the ratio stabilized at approximately 0.3. The CMR for the paste backfill cells were approximately one for the initial 90 weeks, and increased to values between 1 and 2.6 thereafter (Figure 48). This change corresponded with a notable decrease in sulphate loadings, which were likely due to the flushing of sulphate content on the surface of the backfill tailings.

Metals

The average metal release rates for the waste rock cells HC 6 and HC 10 did not change notably over time (Figure 5 through 15). However, metal loading rates were observed to increase for acid generating cells HC 4 and HC 7. Loading rates for silver, aluminum, arsenic, cadmium, copper, iron, nickel, lead and zinc increased by approximately three orders of magnitude following the onset of acidic conditions in HC 4 and 7 (Figures 5 through 15).

Metals release rates for the NP depleted ore HC 21 generally increased by 2-3 orders of magnitude for most metals including aluminum, copper, iron, and lead (Figures 21 through 31). The release rates of some metals including arsenic, nickel, cadmium and zinc reached a minimum loading at 227 weeks, followed by a rapid increase for the remainder of the testing period.

Metal release rates from the paste backfill humidity cells generally decreased and reached steady state by approximately week 150 (Figures 37 through 47). Arsenic loads decreased significantly (to below method detection limit values) in the last few weeks of testing.

3.0 ESTIMATES OF SULPHIDE AND NP DEPLETION

Estimates of sulphide and NP depletion are used to assist in the prediction of the likelihood of a material to generate net acidity in the future. Net acid generation is assumed to begin once the available NP in a sample is exhausted. Results from humidity cell testing are used to determine the rates of depletion and time to exhaustion. Generally, extrapolation of these laboratory results to a mine setting cannot be done directly; laboratory testing tends to overestimate the rates of sulphide and NP depletion compared to the underground environment. However, the results of this exercise can be used to provide a general sense of the possible duration and relative time difference of sulphide and NP exhaustion.

Estimates of sulphide and NP exhaustion were calculated for all 7 remaining humidity cells (Table 4). Time to sulphide exhaustion was calculated using the sulphate release rates from each of the humidity cells and the amount of total sulphur as determined by the initial ABA static testing analyses. Time to sulphide exhaustion for the 7 terminated cells was calculated based on release rates for the period ending January, 2012. The measured loss of calcium and magnesium was used to estimate NP depletion, assuming the dominant forms of NP were calcium and magnesium carbonates. Estimates calculated for January 2012 include release rates for sulphate, calcium and magnesium incorporating the final rinse for the terminated cells.

Two of the waste rock humidity cells (HC 4 and HC 7) were acid generating. The NP remaining at the time of ARD on-set was approximately 10 kg $CaCO_3$/tonne for HC 4, at which time the humidity cell material had a calculated remaining total sulphur content of 3.4%. At the time of ARD on-set for HC7, approximately 13 kg $CaCO_3$/tonne of NP was remaining, corresponding to a remaining total sulphur content of 1.1%. These results suggest that unavailable NP present in the rock is approximately 10 kg $CaCO_3$/tonne.

The predicted NP exhaustion time of HC 10 was 5.1 years.

The HC 6 data predicted that the sulphide content would become depleted 37 years prior to NP depletion, suggesting the sample is not acid generating.

The NP-depleted ore sample (HC 21) reached acidic conditions at 146 weeks. The NP remaining at time of AP depletion was approximately 1.3 kg CaCO3/tonne. At the time of ARD on-set, the total sulphur content was approximately 12.6%.

The cemented tailings backfill cells (T1 and T2) have an estimated NP exhaustion period of approximately 16 and 8 years respectively.

4.0 SUMMARY

- Sulphate release rates for the mine rock HC 6 and HC 10 were generally constant after the initial 20 weeks of operation. Sulphate loadings increased for HC 4 and HC 7 and HC 21 after the onset of acidic conditions. Sulphate loadings decreased over time for the paste backfill tailings (T1 and T2).

- Elevated concentrations of metals were released as a result of acidic conditions, including aluminum, arsenic, cadmium, copper, iron, lead, nickel and zinc.

- Humidity cells HC 4, HC 7 and HC 21 were operating under acidic conditions. HC 10 and backfill tailings cells (T1 and T2) were estimated to exhaust their NP prior to the exhaustion of sulphide, suggesting that acidic conditions could occur over time. HC 6 was estimated to exhaust AP content prior to NP exhaustion.

- The Calcite-pyrite Exhalite mine rock humidity cell (HC 6) had a predicted NP exhaustion time of approximately 80 years.

- The Carbonaceous Argillite mine rock cell (HC 10) had a predicted NP exhaustion time of approximately 5 years.

- The cemented tailings backfill cells (T1 and T2) had an average estimated NP exhaustion period of approximately 12 years.

5.0 REFERENCES

AMEC, 2008a. Wolverine Project Humidity Cell Update. Prepared by AMEC Earth & Environmental, August 2008.

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AMEC, 2006. Wolverine Project. Acid Rock Drainage and Metal Leaching Assessment of Mine Rock and Predicted Water Quality of the Underground Workings at Closure. Prepared by AMEC Earth & Environmental, February 2006.

Price, W.A., 1997. Draft Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia.

6.0 CLOSURE

This memo was prepared exclusively for Yukon Zinc Corporation (Yukon Zinc) by AMEC Americas Limited (AMEC). The quality of information, conclusions and estimates contained herein are consistent with the level of effort involved in AMEC's services and based on: i) information available at the time of preparation, ii) data supplied by outside sources and iii) the assumptions, conditions and qualifications set forth in this memo. This memo is intended to be used by Yukon Zinc only, subject to the terms and conditions of its contract with AMEC. Any other use of, or reliance on, this report by any third party is at that party's sole risk.

Yours truly,
AMEC Environment & Infrastructure,
a Division of AMEC Americas Limited

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TABLES

Table 1: Waste Rock, Ore, and Tailing Paste Backfill Humidity Cell Descriptions

Cell #	Sample ID	Sample Type	Method Reference	Column Packing		Column Material	Initial Volume of Initial Flushings	Flushing Rate/Weekly Input*mL	Temp (oC)	Start-up Date	Status	Duration (weeks)
				Dry Wt. of Sample (kg)	Other Materials Used							
4	Footwall Rhyolite-3	wasterock	MEND	1	PVC perforated disk & nylon mesh	Plexiglas	750	500	20-22	22-Dec-05	Terminated	316
6	Excp-3	wasterock	MEND	1	PVC perforated disk & nylon mesh	Plexiglas	750	500	20-22	22-Dec-05	Terminated	316
7	Argillite-2	wasterock	MEND	0.9	PVC perforated disk & nylon mesh	Plexiglas	750	500	20-22	22-Dec-05	Terminated	316
10	A083529	wasterock	MEND	1	PVC perforated disk & nylon mesh	Plexiglas	750	500	20-22	12-Jan-06	Terminated	313
21	Hump Feed Ore NP Removed	ore	MEND	0.541	PVC perforated disk & nylon mesh	Plexiglas	410	270	20-22	23-May-06	Terminated	298
T1	Backfill A	paste backfill	MEND	1	PVC perforated disk & nylon mesh	Plexiglas	750	500	20-22	23-May-06	Terminated	297
T2	Backfill B	paste backfill	MEND	1	PVC perforated disk & nylon mesh	Plexiglas	750	500	20-22	23-May-06	Terminated	297

Table 2: Initial and Final ABA Summary

	Paste pH		Total Sulphur		Sulphate-S		Sulphide-S		AP		NP		NP/AP Ratio		MPA		Ca NP	
Sample			%		%		%		(kg CaCO3/tonne)		(kg CaCO3/tonne)				(kg CaCO3/tonne)		(kg CaCO3/tonne)	
	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final
HC 4	7.6	4.0	3.61	3.04	0.02	0.09	3.59	2.93	113	91.6	19.0	1.4	0.17	0.02	113	95		<0.8
HC 6	7.7	7.7	4.44	3.83	0.02	0.07	4.42	3.53	139	110	350	275.2	2.52	2.49	139	120		330.8
HC 7	8	5.2	1.2	0.52	0.01	0.04	1.19	0.4	37.5	12.5	18.0	4.5	0.48	0.36	38	16		<0.8
HC 10	7.9	8.2		0.73		0.01		0.68	29.7	21.3	22.0	8.5	0.74	0.40	30	23	25.02	9.2
HC 21	8	3.6	13.2	3.69	0.03	0.3	13.15	2.32	413	72.5	113	0.5	0.27	0.01	413	115		<0.8
T1	8.3	7.8	19.45	17.2	1.16	0.1	18.3	17.7	608	553	131	63.3	0.22	0.11	608	538		72.5
T2	7.9	7.8	18.75	17.5	1.01	0.1	17.75	17.6	586	550	131	65.0	0.22	0.12	586	547		72.5

Table 3: Initial and Final Elemental Content Summary

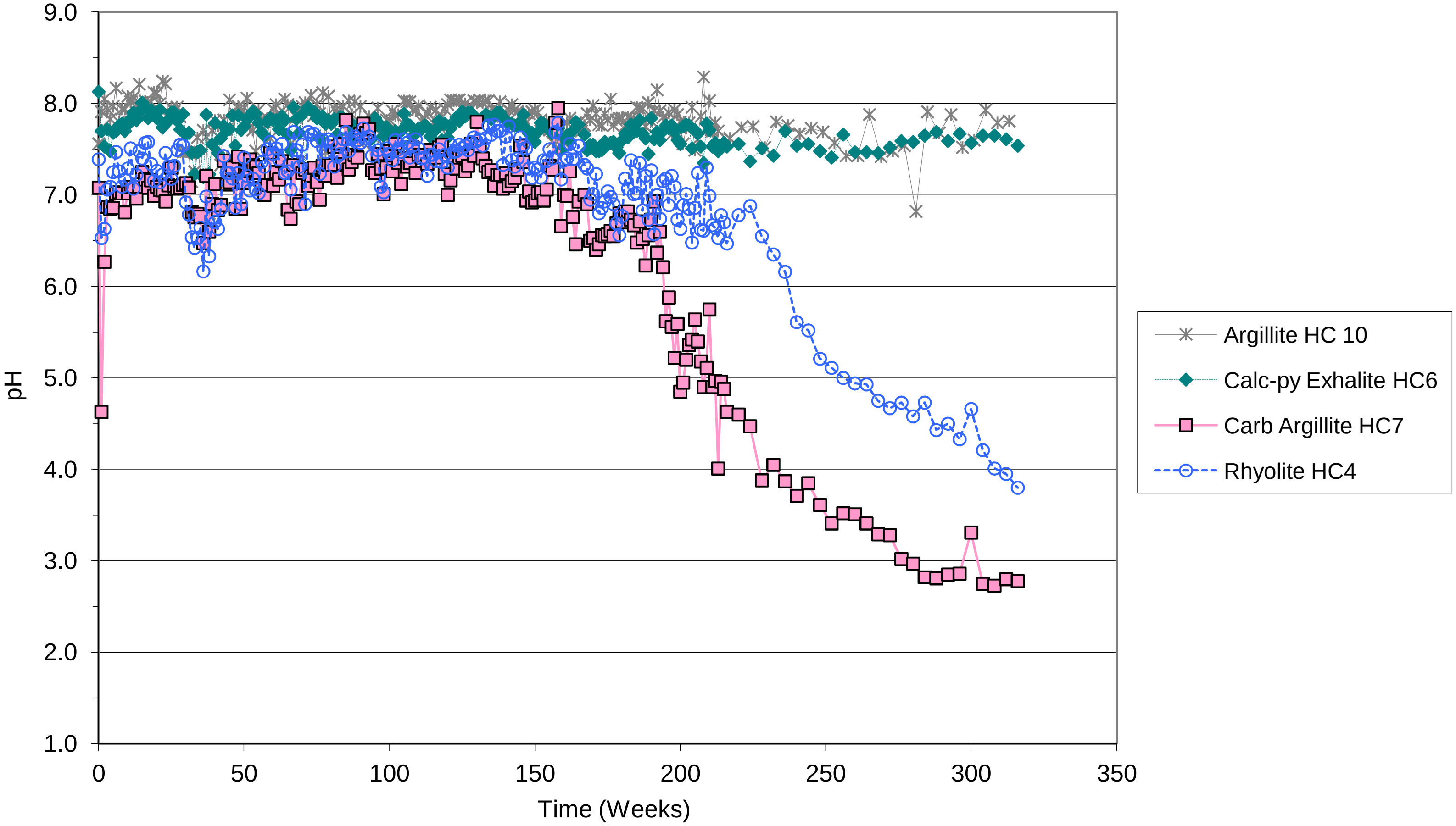
Concentration (ppm)	Ag		As		Cd		Co		Cr		Cu		Hg		Mn		Mo		Ni		Pb		Sb		Se		Zn	
MDL	0.01		1		0.01		0.1		1		0.5		0.01		2		0.05		0.5		0.2		0.05		1		1	
Sample ID	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final
HC 4	2.85		16.2	12	2.52	0.74	10	6.9	2	59	939	656	0.08	0.08	337	181	2.37	2.42	5.8	3.3	34	25.4	4.43	3.24	44.3	27	289	159
HC 6	0.36		17	14	0.09	0.12	4.6	4	10	53	55.1	67.9	0.02	0.01	4030	4360	5.81	6.06	19.6	17.1	139	163	2.19	1.46	2.3	2	31	34
HC 7	0.97		11.8	10	2.55	0.45	4.4	1.4	10	112	54.8	25.1	0.38	0.36	180	52	2.45	2.43	44.5	16.2	19.7	14.1	6.45	7.24	6	4	855	194
HC 10			8.4	7	0.34	0.33		3.9		110	62.5	66	0.06	0.06	222	247		1.69		36.2	29.2	29.3	3.15	3.08	2.4	2	192	195
HC 21	97		808	355	308	9.78	22.7	5.7	198	83	6430	6070	10.35	17.2	661	100	27	32.2	40.6	4.1	3760	1890	290	298	540	397	>10000	1180
T1	76.5		1250	1060	73.2	77.7	44.9	35.6	83	123	3130	2760	1	1.19	1150	1230	15.05	13.6	27.5	22	3030	3550	120	76.7	830	520	7320	7760
T2	79.3		1235	1040	76.3	87	43.7	36.2	80	119	3370	2990	1.03	1.21	1120	1170	15.35	14.2	27.1	21.1	2990	3440	121.5	73.7	830	532	7850	8000

Concentration %	Al		Ca		Fe		Mg		Na	
MDL	0.01		0.01		0.01		0.01		0.01	
Sample ID	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final
HC 4	2.05	1.81	0.41	0.1	5.75	6.15	1.54	1.44	0.01	0.02
HC 6	0.53	0.4	12	12.9	9	9.29	0.53	0.38	0.01	0.01
HC 7	0.36	0.25	0.79	0.47	1.52	1.42	0.06	0.03	<0.01	0.01
HC 10		0.38		0.38	1.76	1.84		0.11		0.01
HC 21	1.09	1.02	3.41	0.1	10.45	5.05	1.1	0.86	<0.01	0.01
T1	1.8	1.74	5.23	2.5	21.7	>15	1.43	1.49	0.04	0.01
T2	1.83	1.68	4.91	2.57	21.9	>15	1.43	1.43	0.04	0.01

Table 4: Estimates of Sulphide and Neutralization Potential Exhaustion

Cell	Sample ID	Rock Type	Years to Depletion		Years to Exhaustion		Years to Exhaustion		Status
			NP	Sulphide	NP	Sulphide	NP	Sulphide	
Continued Humidity Cells			**June 2008 Update**		**March 2009**		**Jan-12**		
HC4	Footwall Rhyolite-3	Rhyolite and Rhyolite Fragmental	8.6	97	5.5	78.1	4.3	68.8	Acidic after 240 weeks
HC6	EXCP-3	Calcite-pyrite exhalite	84	44	80.7	43.5	79.5	41.9	Expected to be non-acidic
HC7	Argillite-2	Carbonaceous argillites	14	45	8.7	24.5	9.1	18.4	Acidic after 198 weeks
HC10	A083529	Argillites	7.4	46	5.1	37.9	5.1	37.4	Potentially acid generating
HC21	Hump Ore	NP-Depleted Ore	0.8	88	0	2.3	0.0	0.5	Acidic after 146 weeks
T1	Backfill Tailings	Tailings Backfill	3.6	25	6.1	55.6	16.4	107.1	Potentially acid generating
T2	Backfill Tailings	Tailings Backfill	4.1	8.2	6.8	18.3	8.2	21.0	Potentially acid generating

FIGURES



pH
Operating Cells
Wolverine Mine, YK

Mine Rock

March 2013	FIGURE 1

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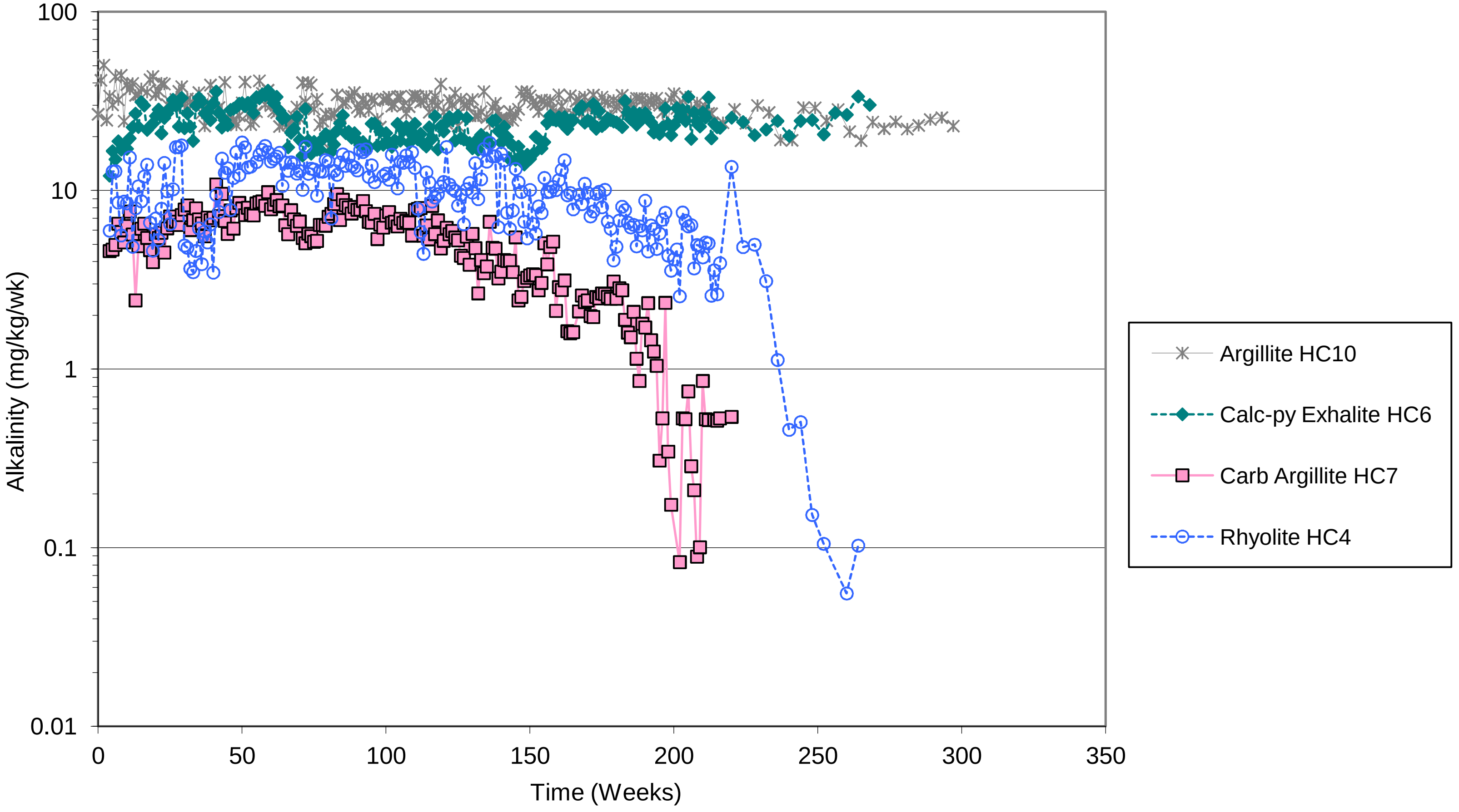
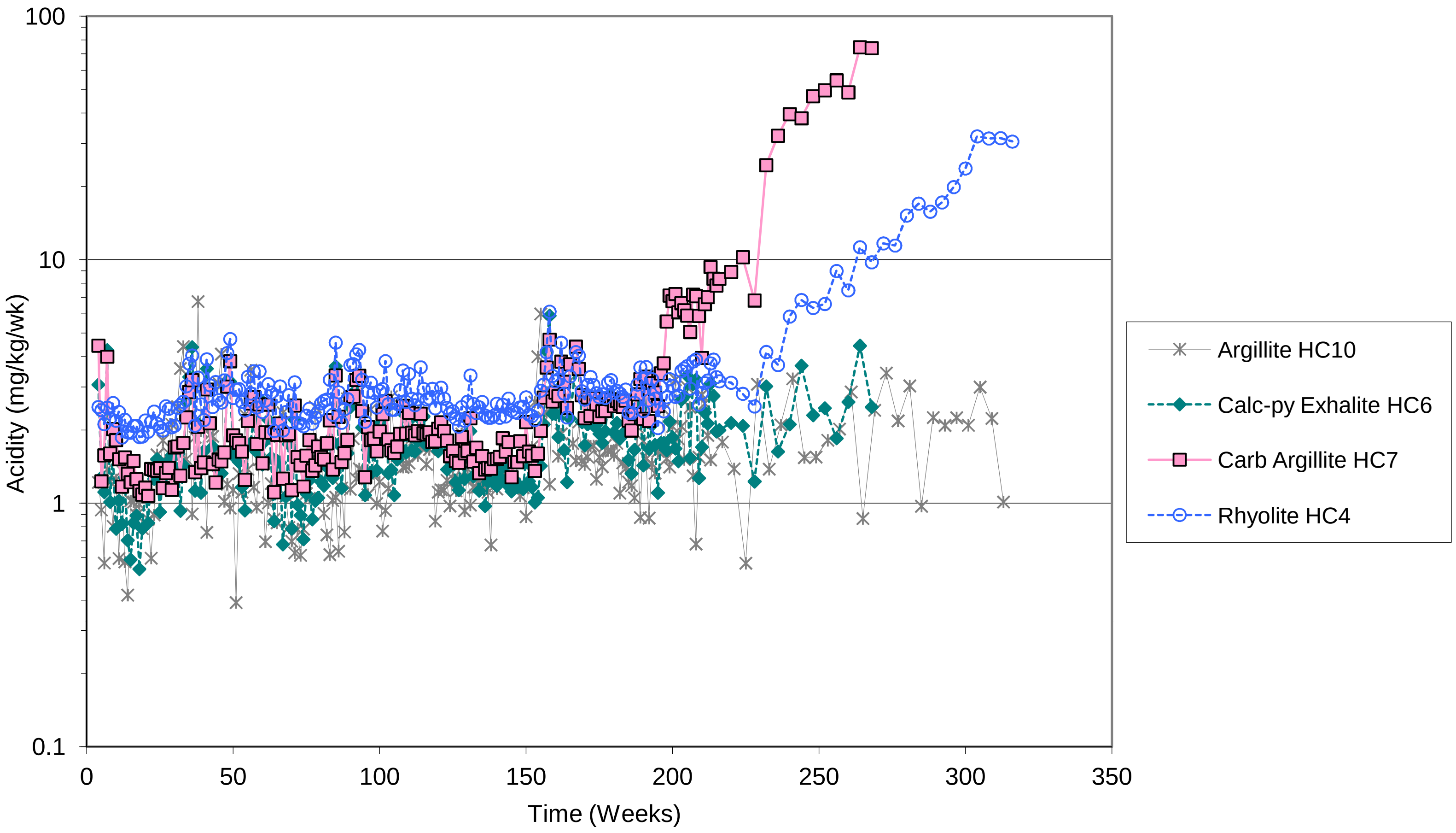


Determination of alkalinity is not valid
below pH values of pH 4.5

Alkalinity Load
Operating Cells
Wolverine Mine, YK

Mine Rock

March 2013	FIGURE 2



Acidity Load
Operating Cells
Wolverine Mine, YK

Mine Rock

March 2013	FIGURE 3

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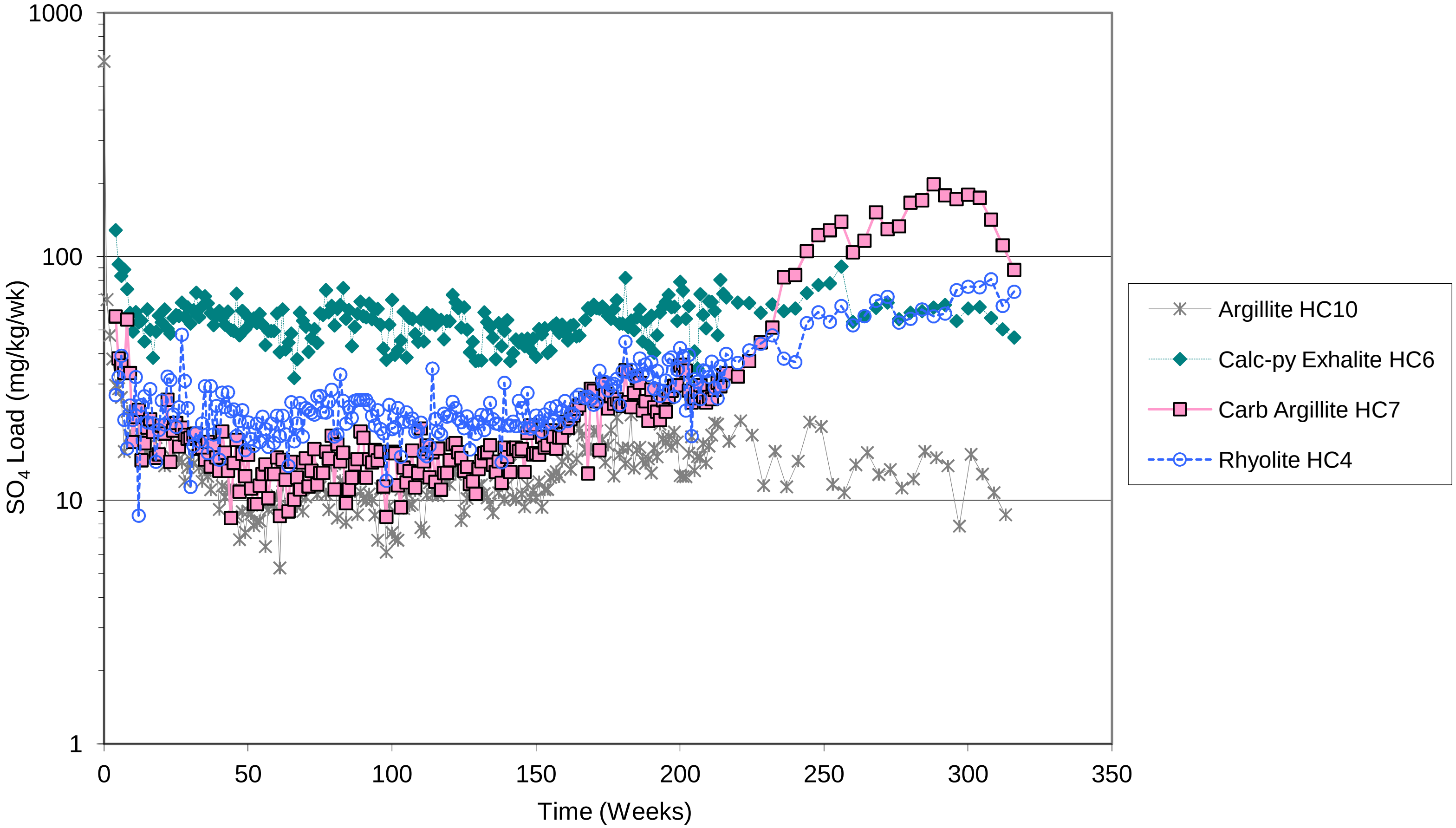

Sulphate Load
Operating Cells
Wolverine Mine, YK

Mine Rock

March 2013	FIGURE 4

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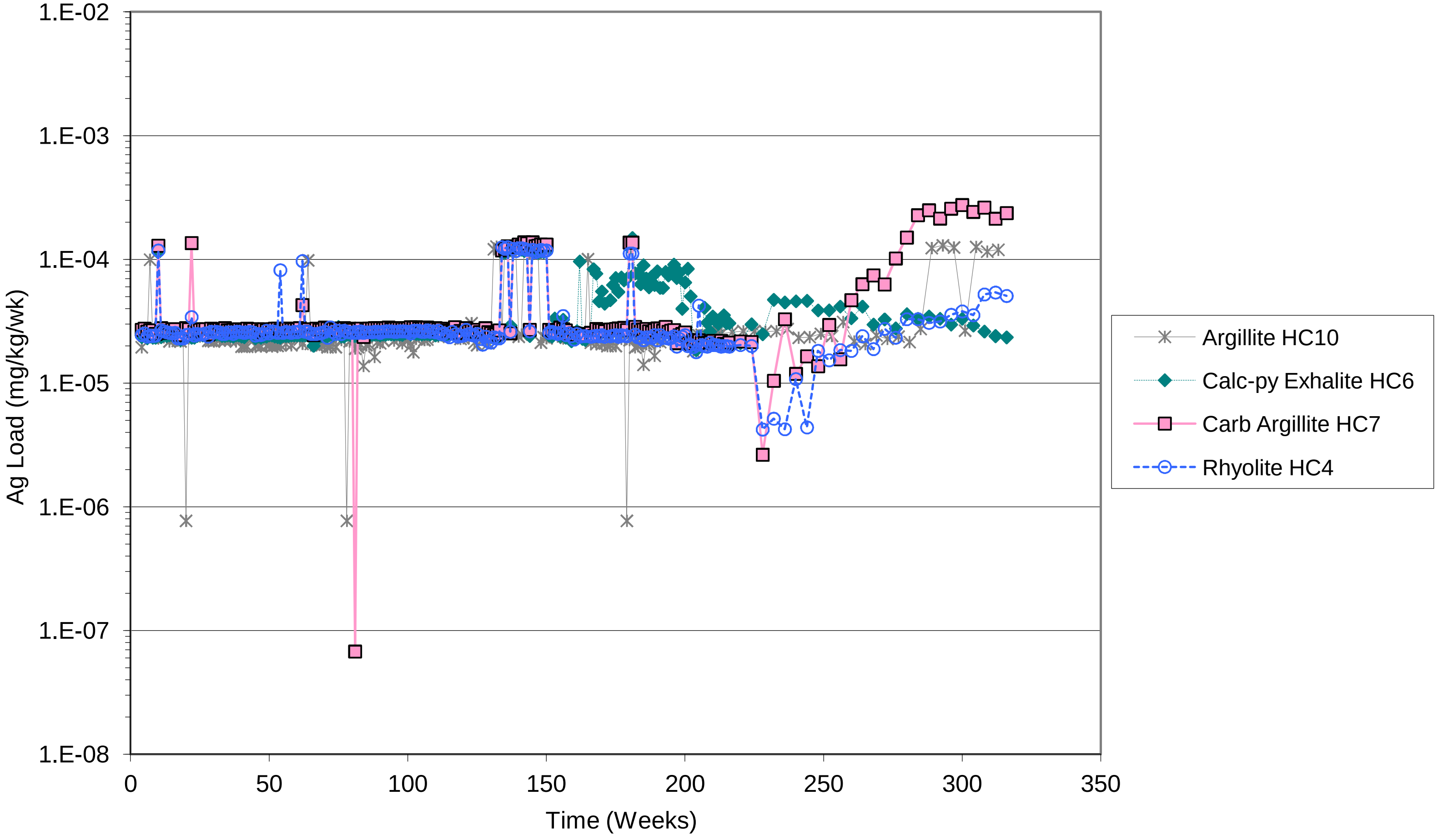
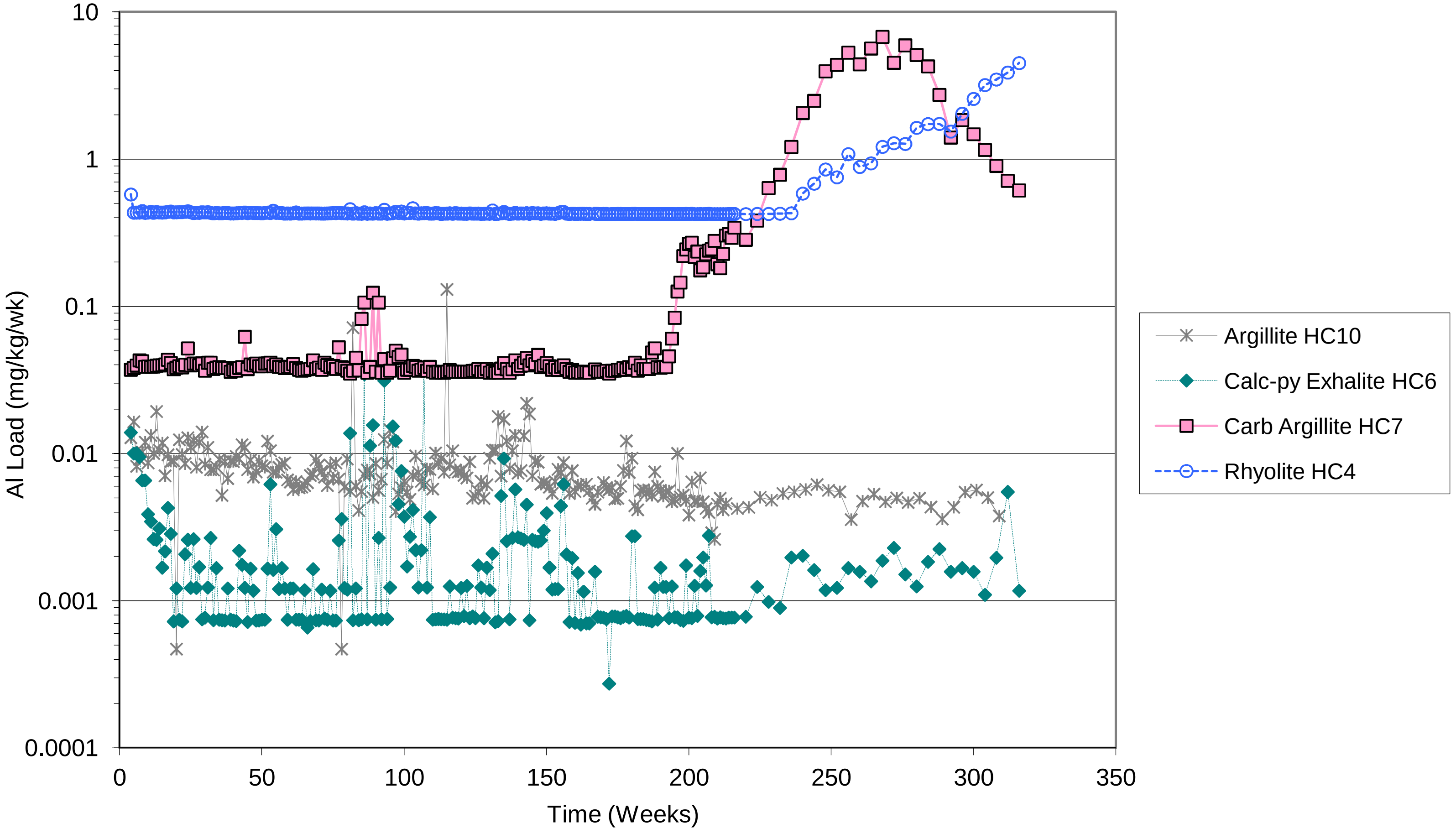


Silver Load Operating Cells Wolverine Mine, YK	
Mine Rock	
March 2013	FIGURE 5



Aluminium Load
Operating Cells
Wolverine Mine, YK

Mine Rock

March 2013	FIGURE 6

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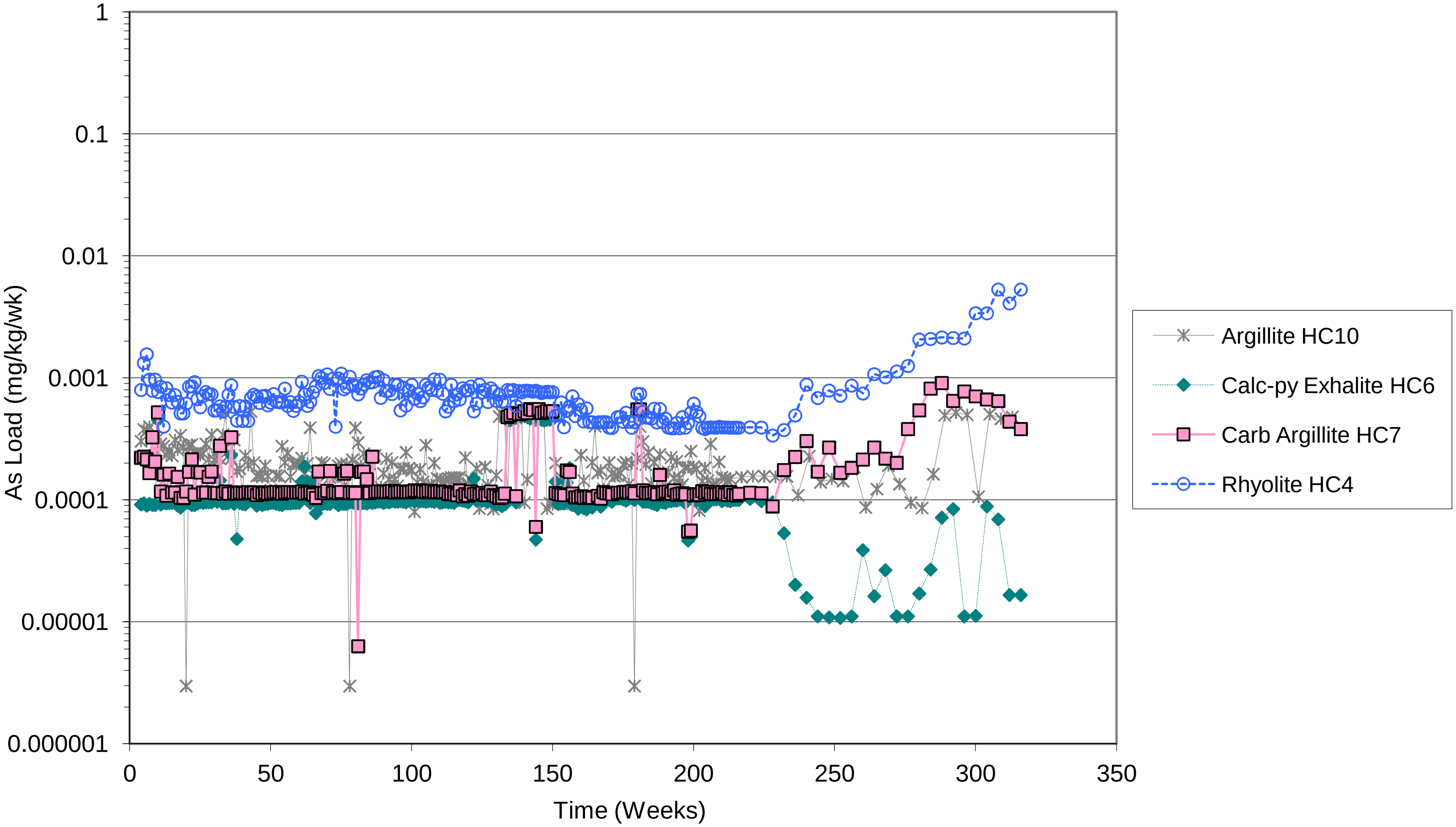
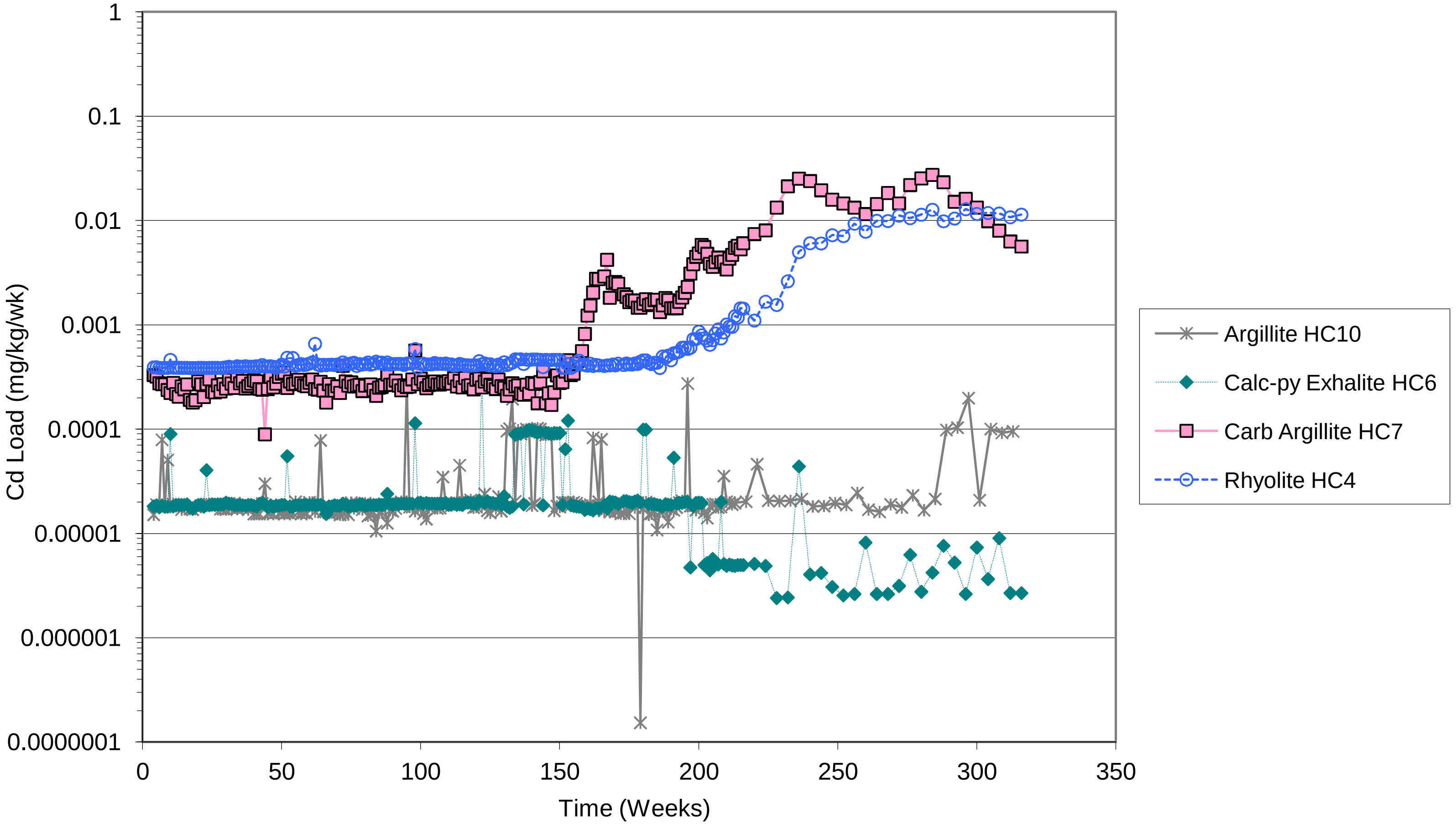


Arsenic Load
Operating Cells
Wolverine Mine, YK

Mine Rock	
March 2013	FIGURE 7



Cadmium Load
Operating Cells
Wolverine Mine, YK

Mine Rock

March 2013	FIGURE 8

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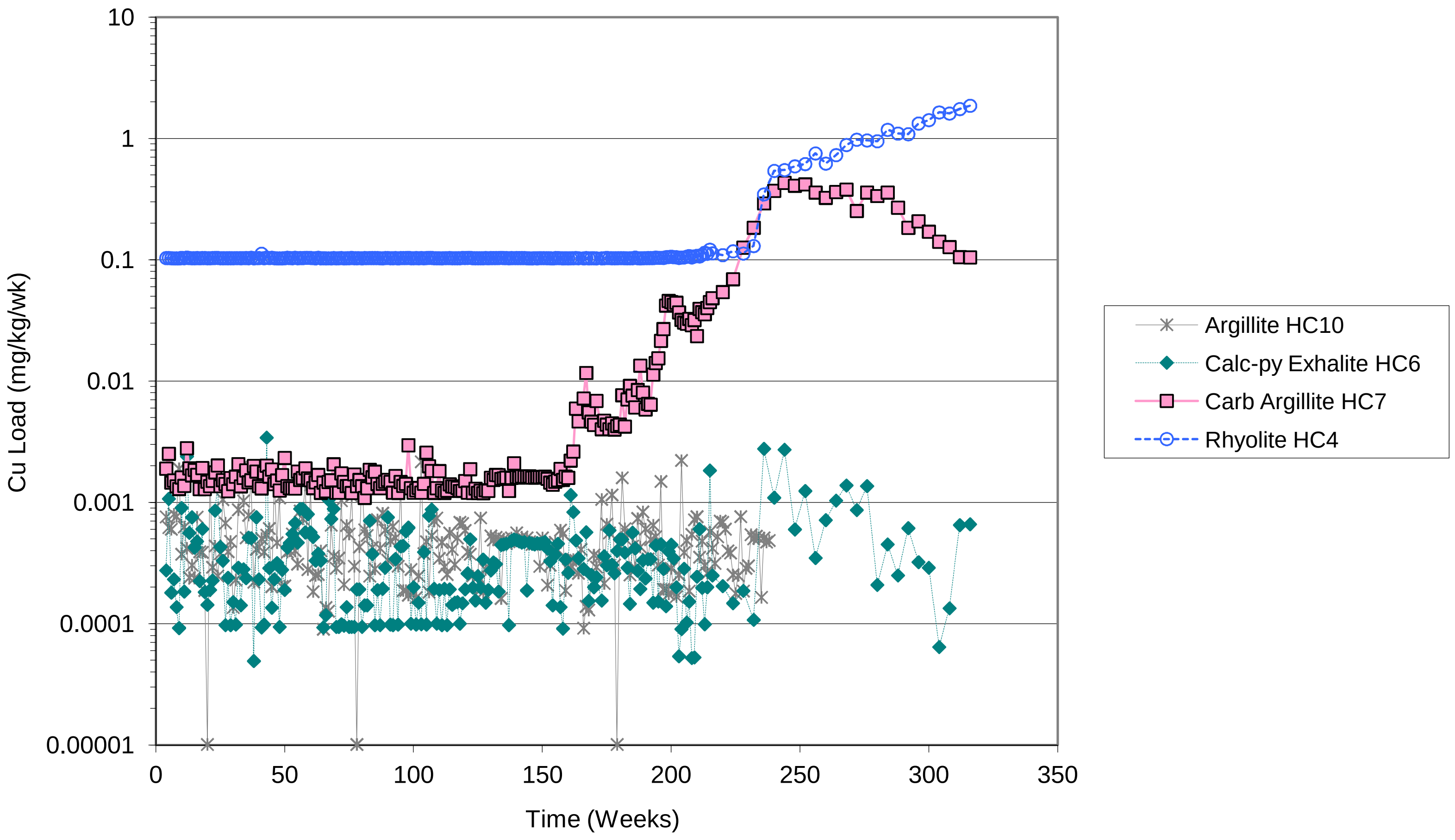
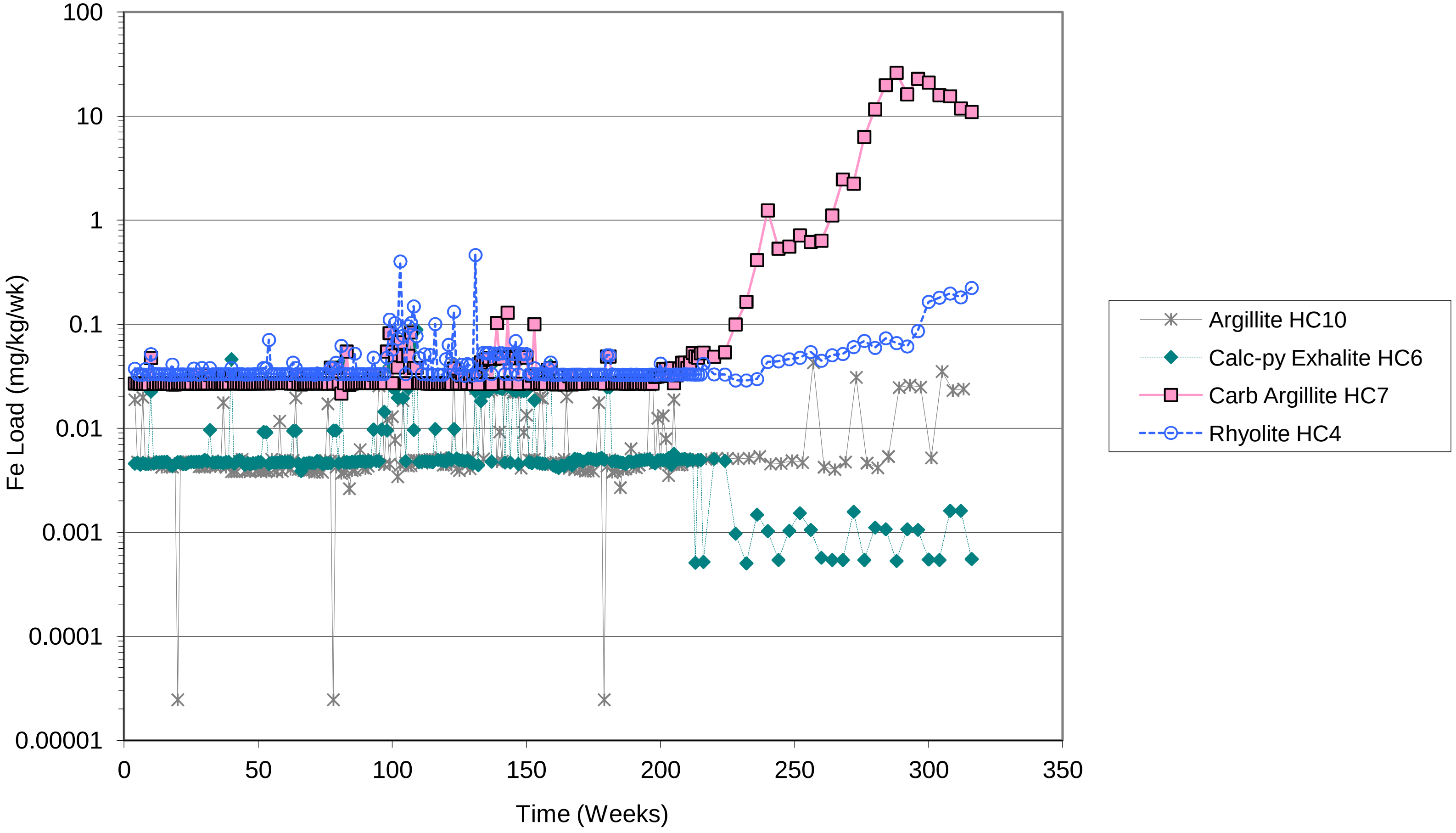


Copper Load
Operating Cells
Wolverine Mine, YK

Mine Rock

March 2013	FIGURE 9



Notes:

Instrument MDL lower for HC6 past 230 weeks

Iron Load
Operating Cells
Wolverine Mine, YK

Mine Rock

March 2013 | FIGURE 10

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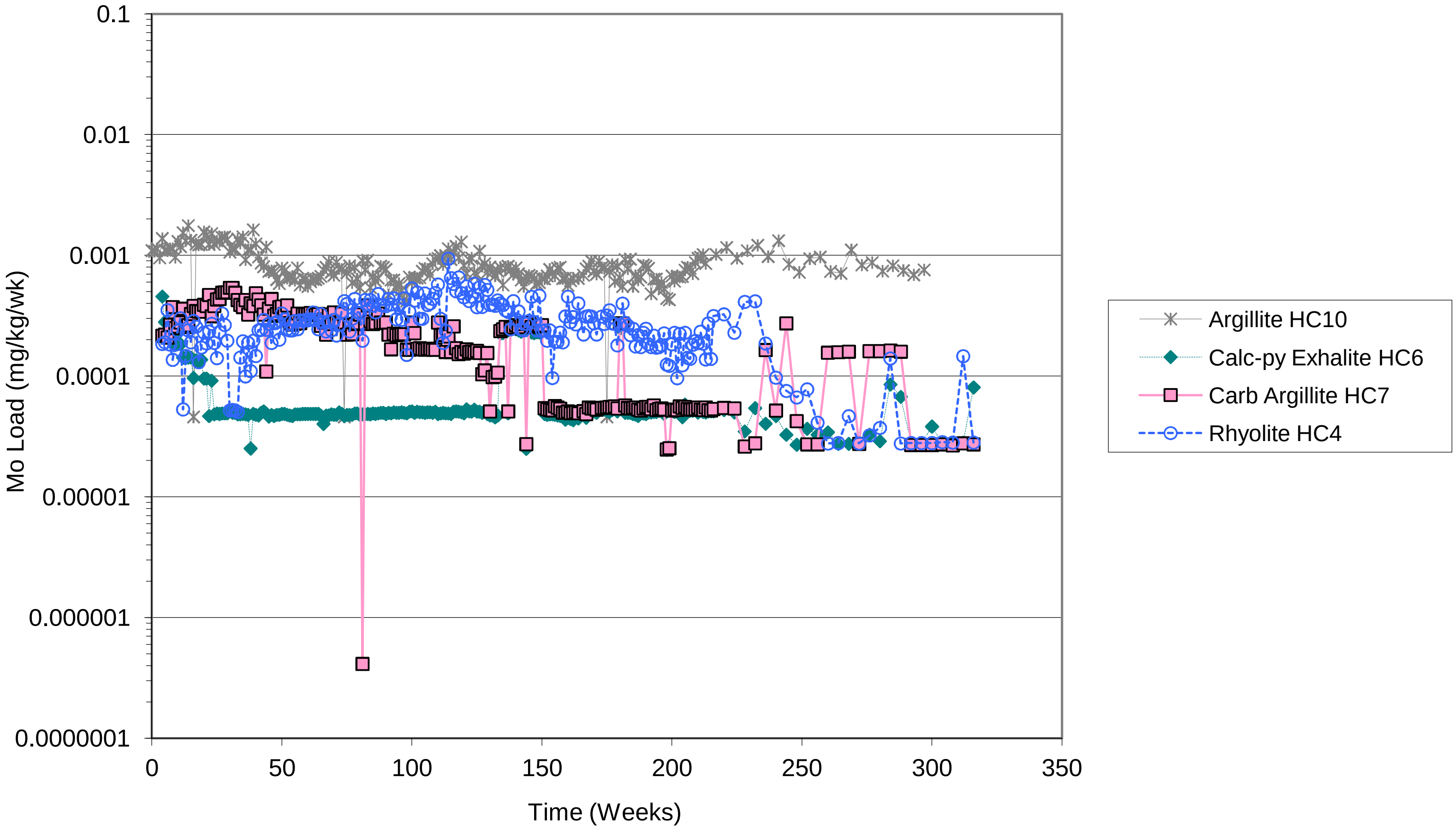

Molybdenum Load Operating Cells Wolverine Mine, YK	
Mine Rock	
March 2013	FIGURE 11

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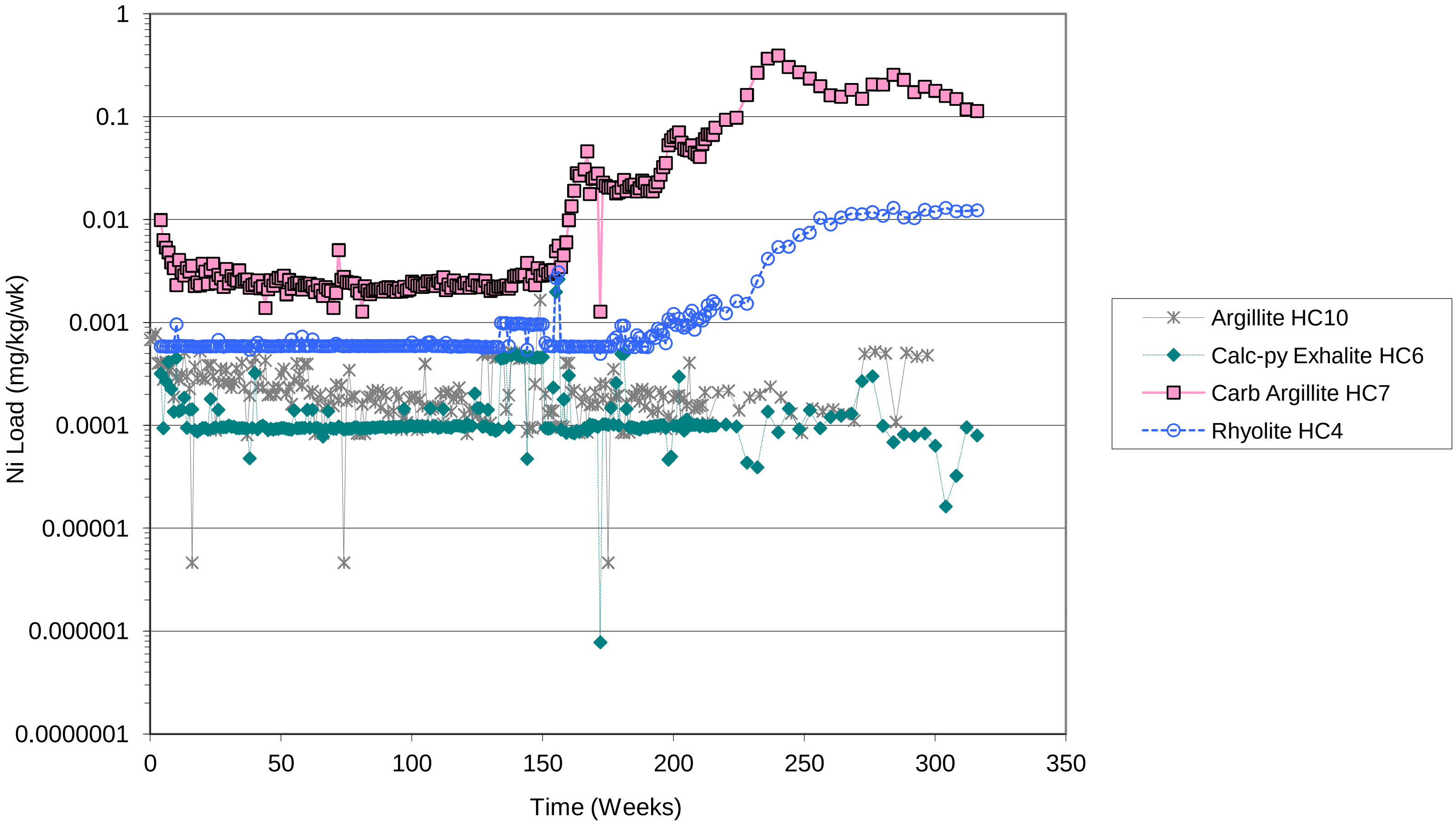

Nickel Load Operating Cells Wolverine Mine, YK	
Mine Rock	
March 2013	FIGURE 12

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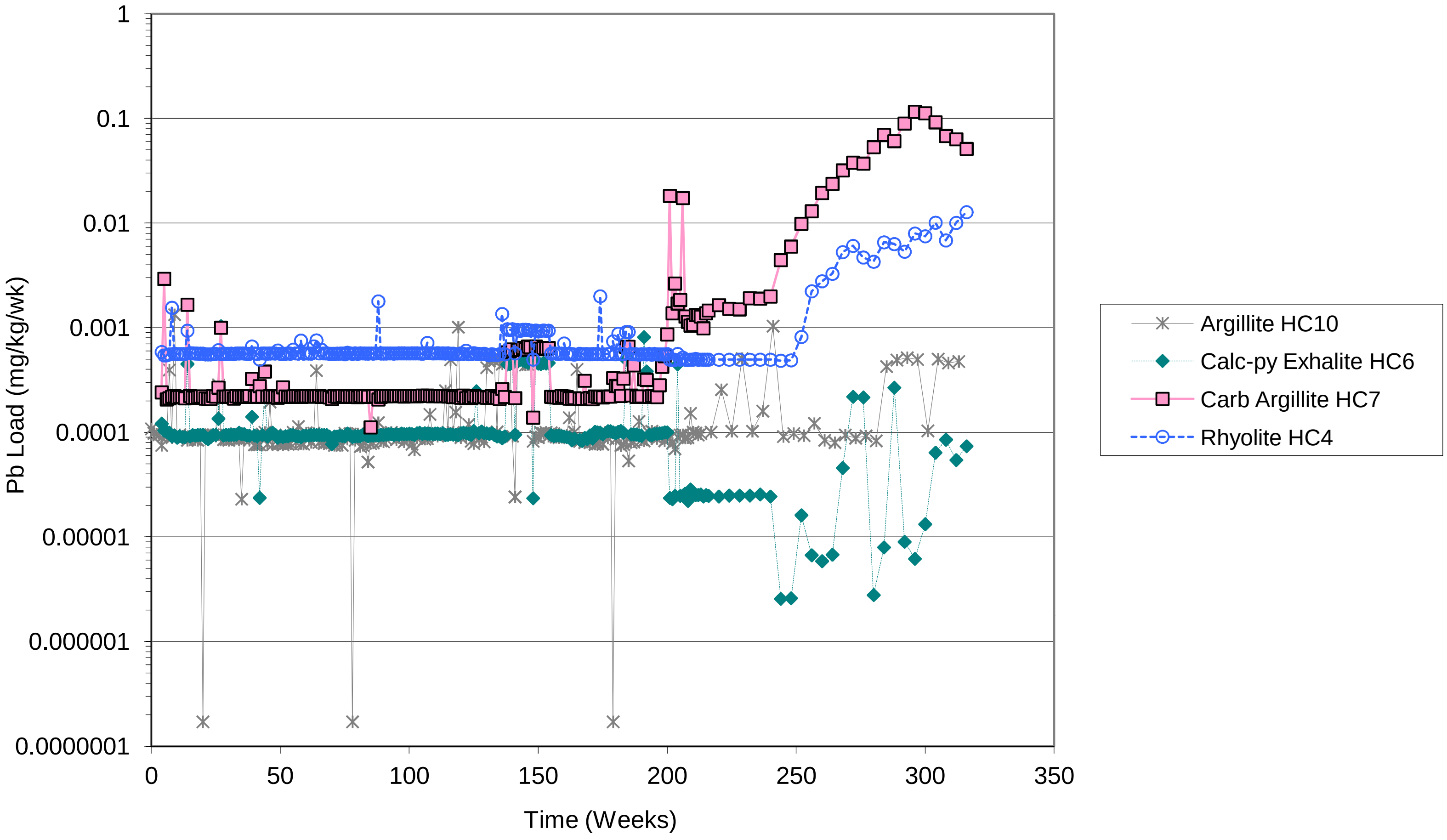

Lead Load
Operating Cells
Wolverine Mine, YK

Mine Rock

March 2013	FIGURE 13

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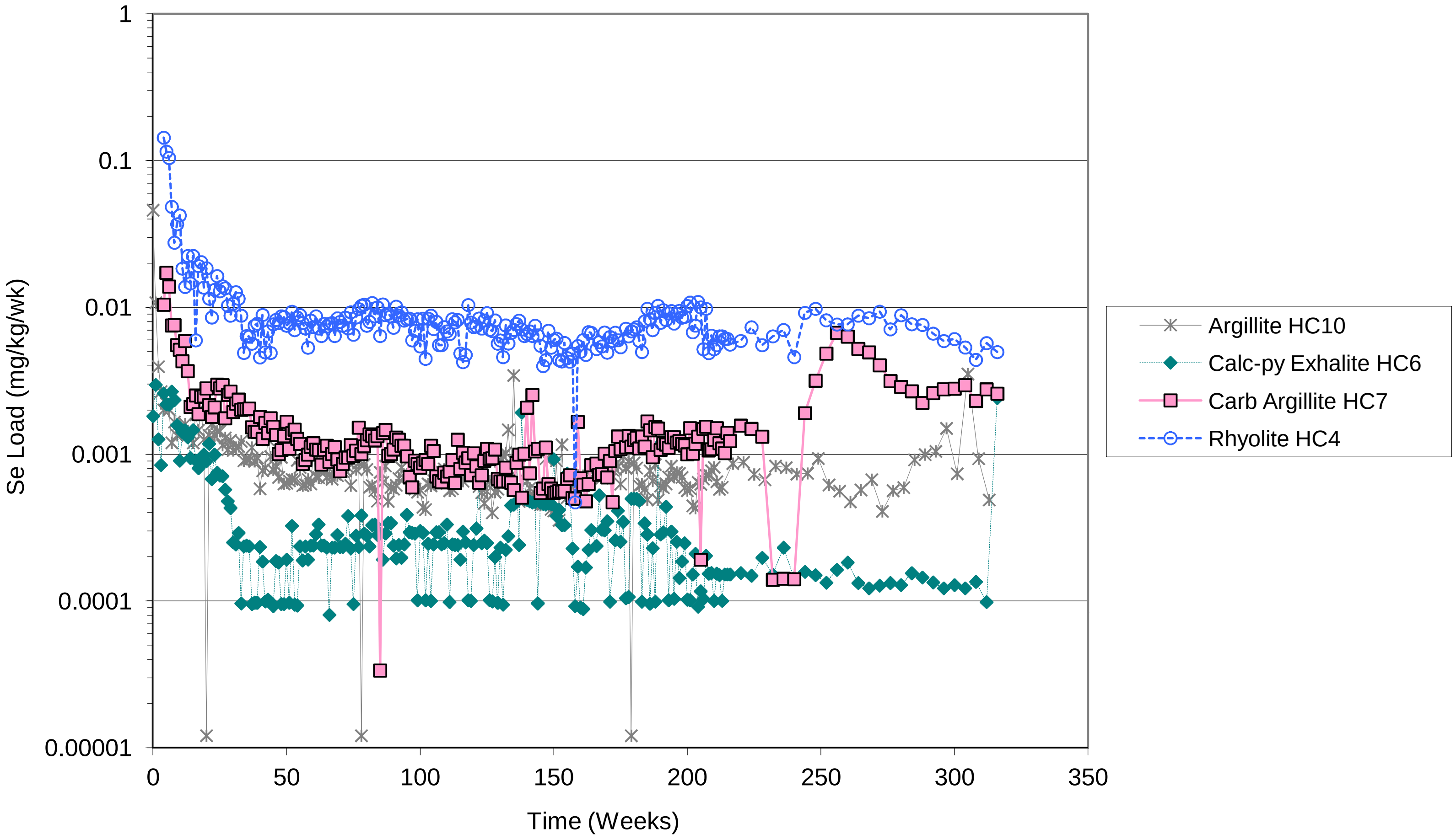

Selenium Load
Operating Cells
Wolverine Mine, YK

Mine Rock

March 2013 | FIGURE 14

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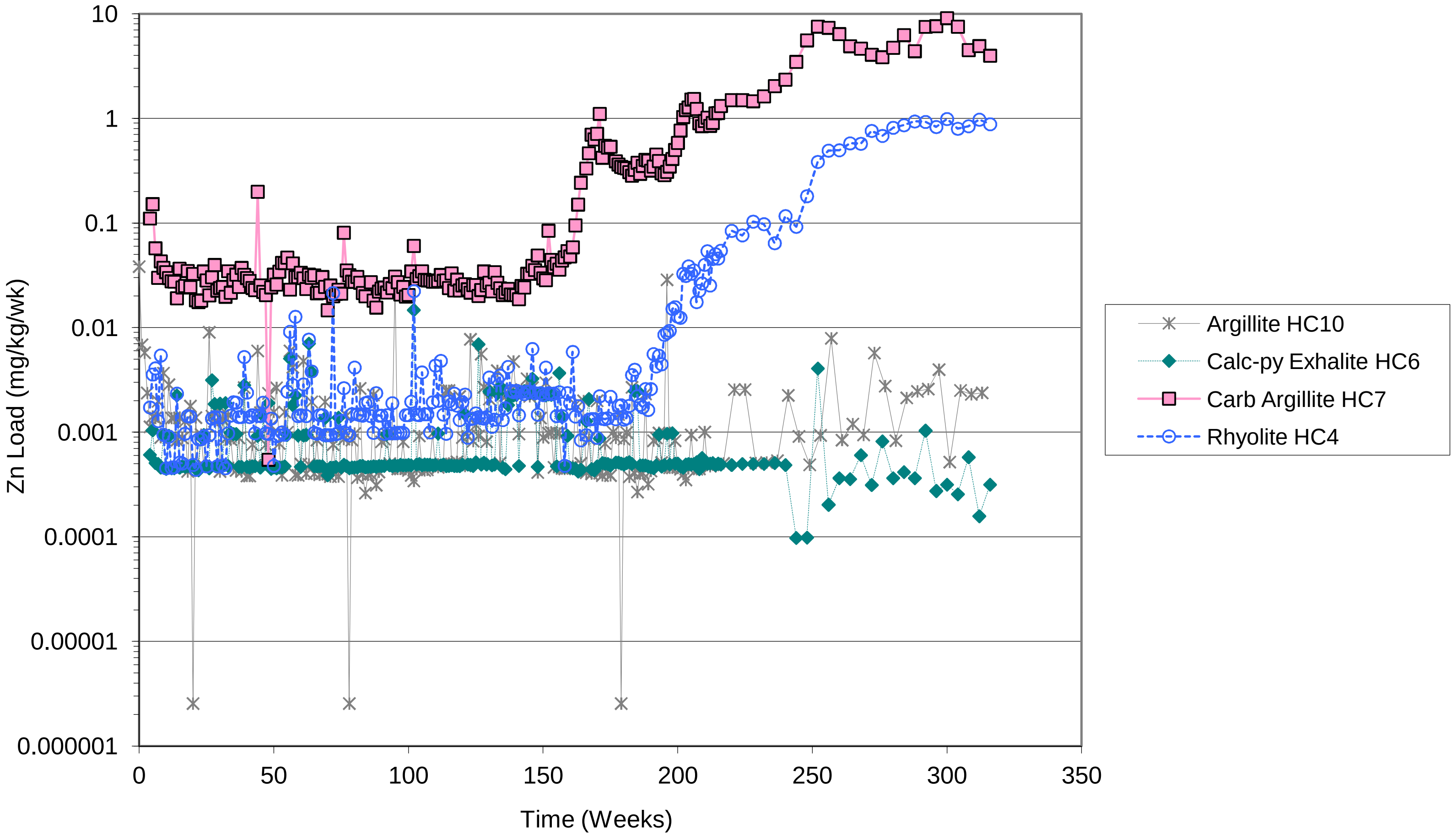

Zinc Load
Operating Cells
Wolverine Mine, YK

Mine Rock

March 2013	FIGURE 15

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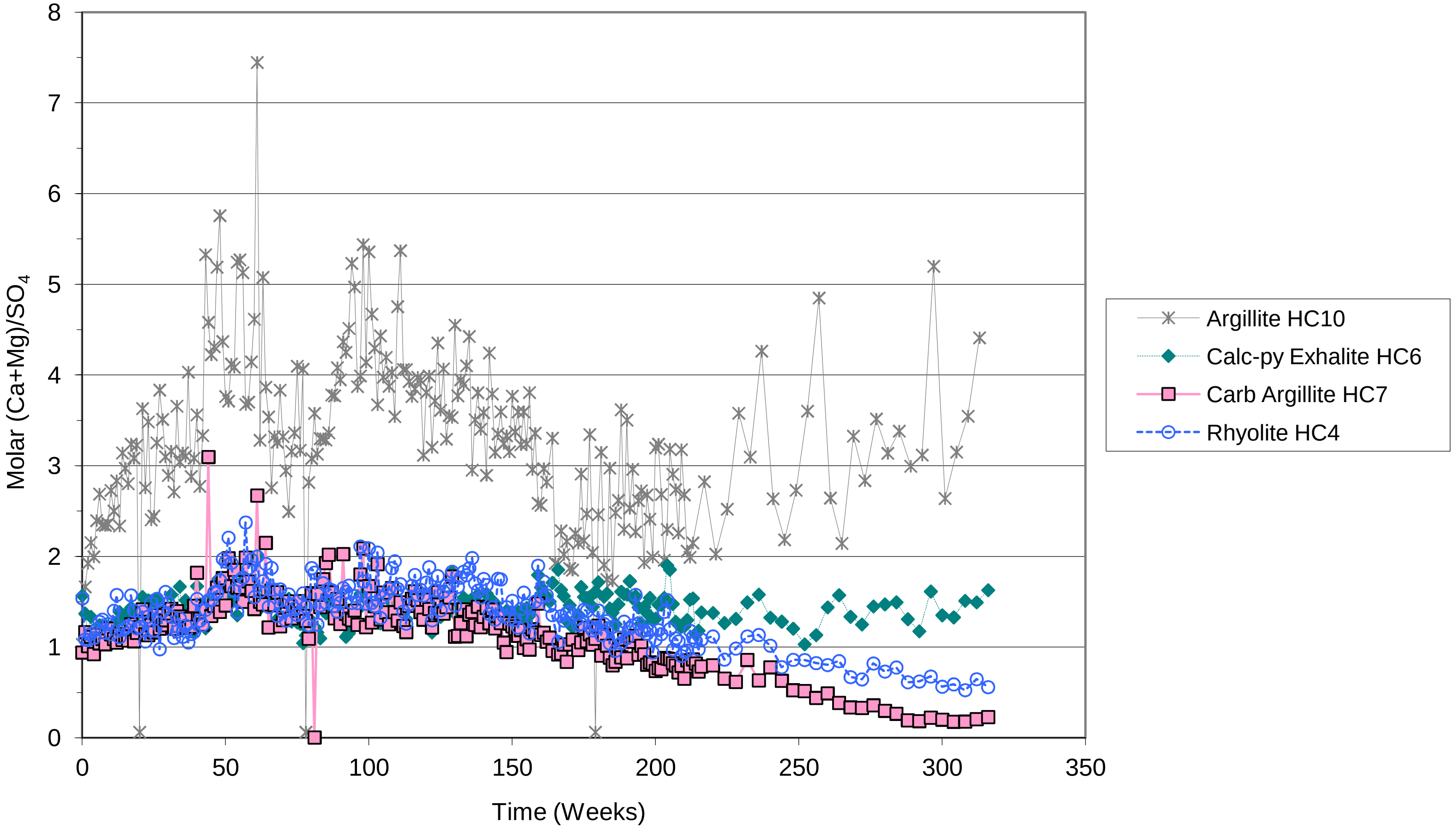

Molar (Ca+Mg)/SO_4 Load
Operating Cells
Wolverine Mine, YK

Mine Rock

March 2013	FIGURE 16

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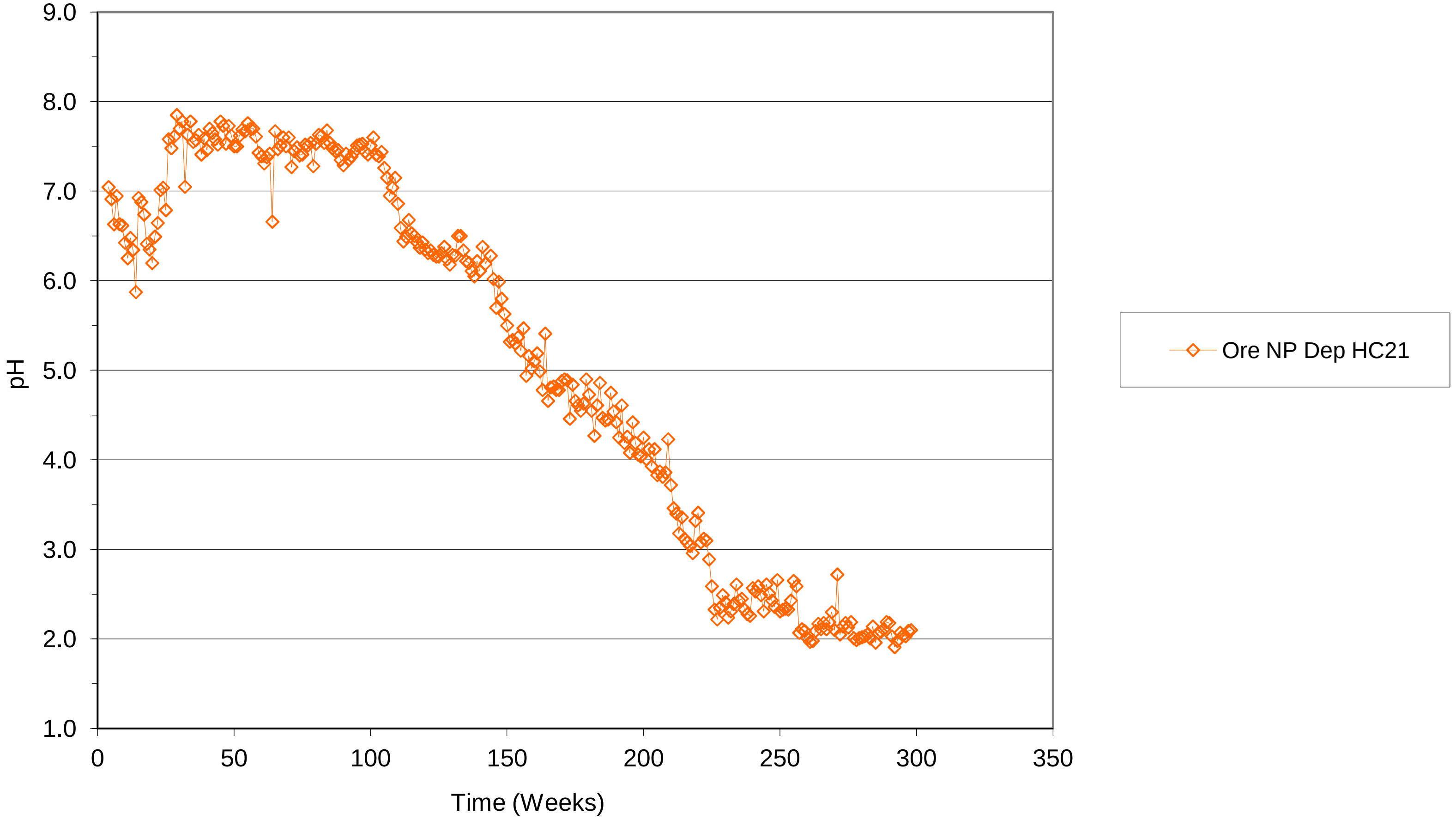

pH
Operating Cells
Wolverine Mine, YK

NP-Depleted Ore	
March 2013	FIGURE 17

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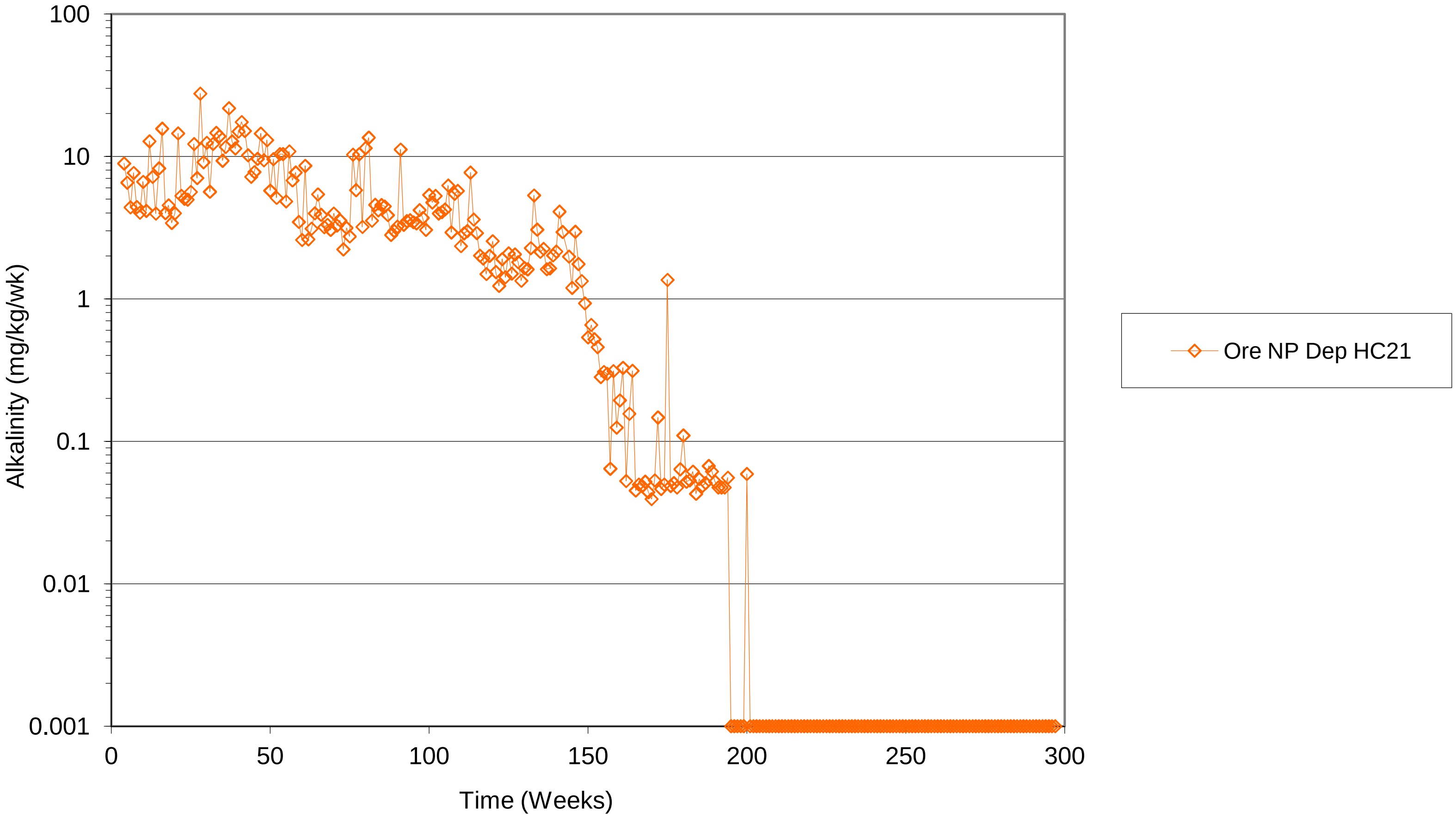
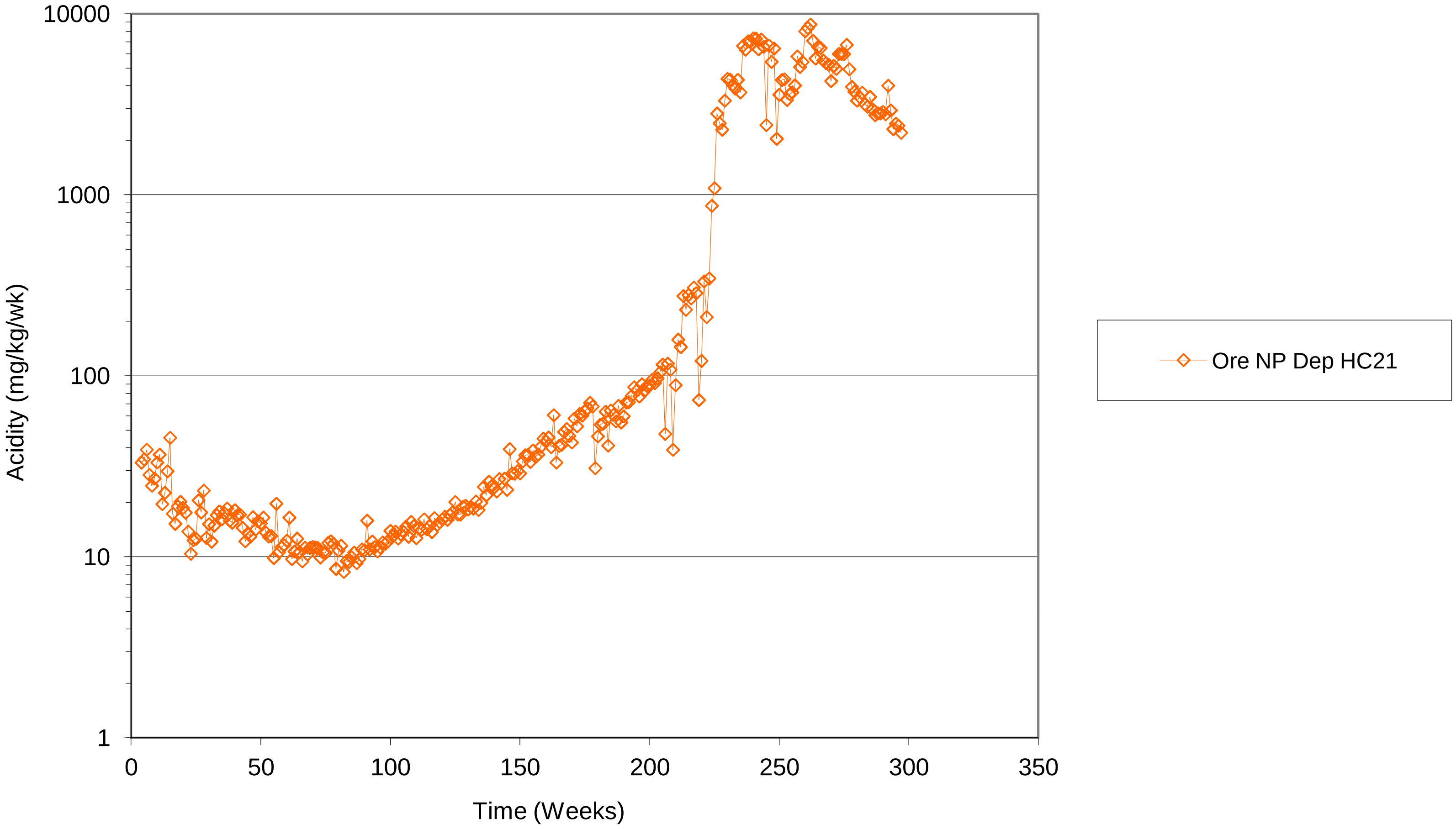


Determination of alkalinity is not valid
below pH values of pH 4.5

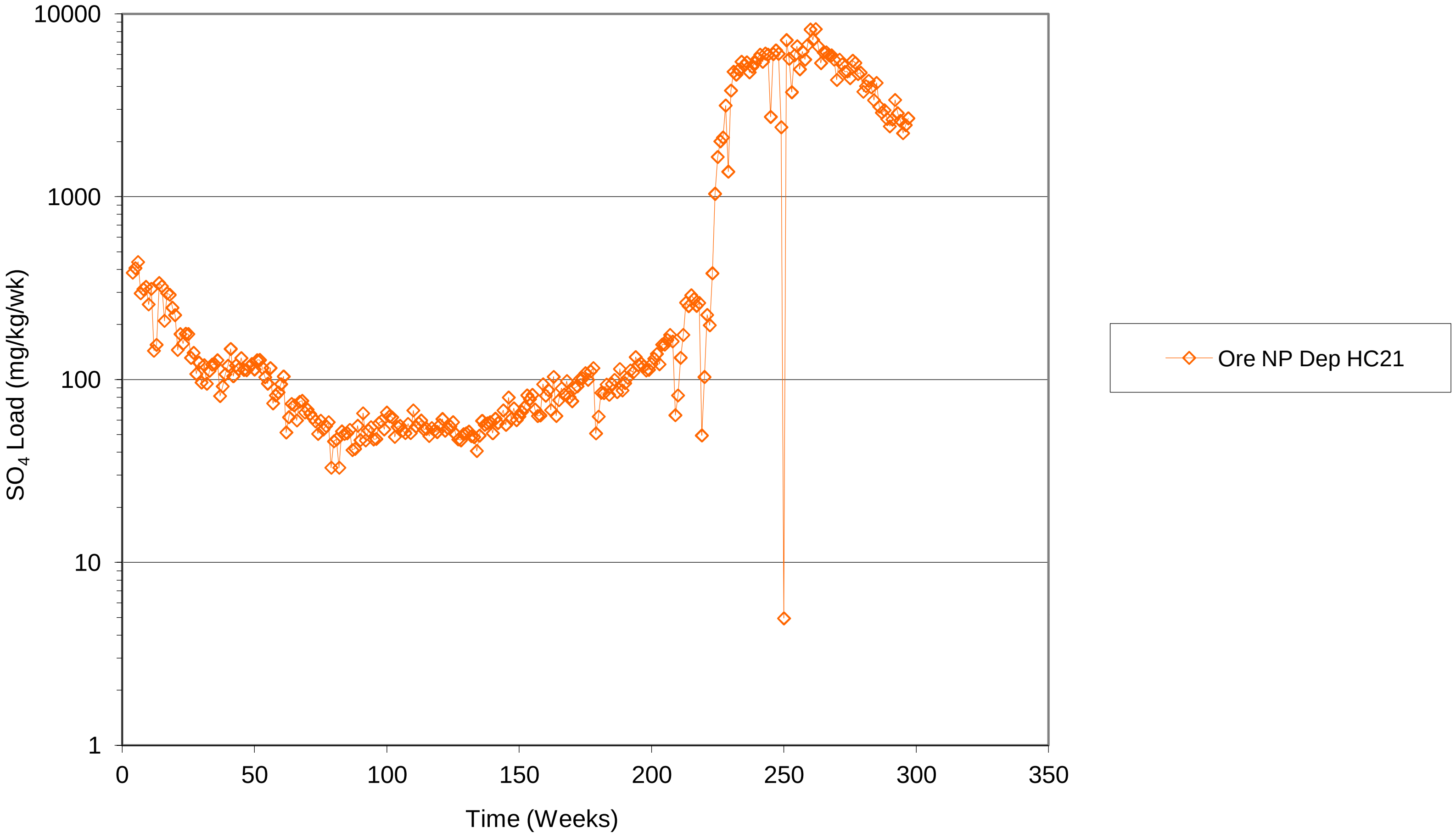
Alkalinity Load Operating Cells Wolverine Mine, YK	
NP-Depleted Ore	
March 2013	FIGURE 18



Acidity Load
Operating Cells
Wolverine Mine, YK

NP-Depleted Ore

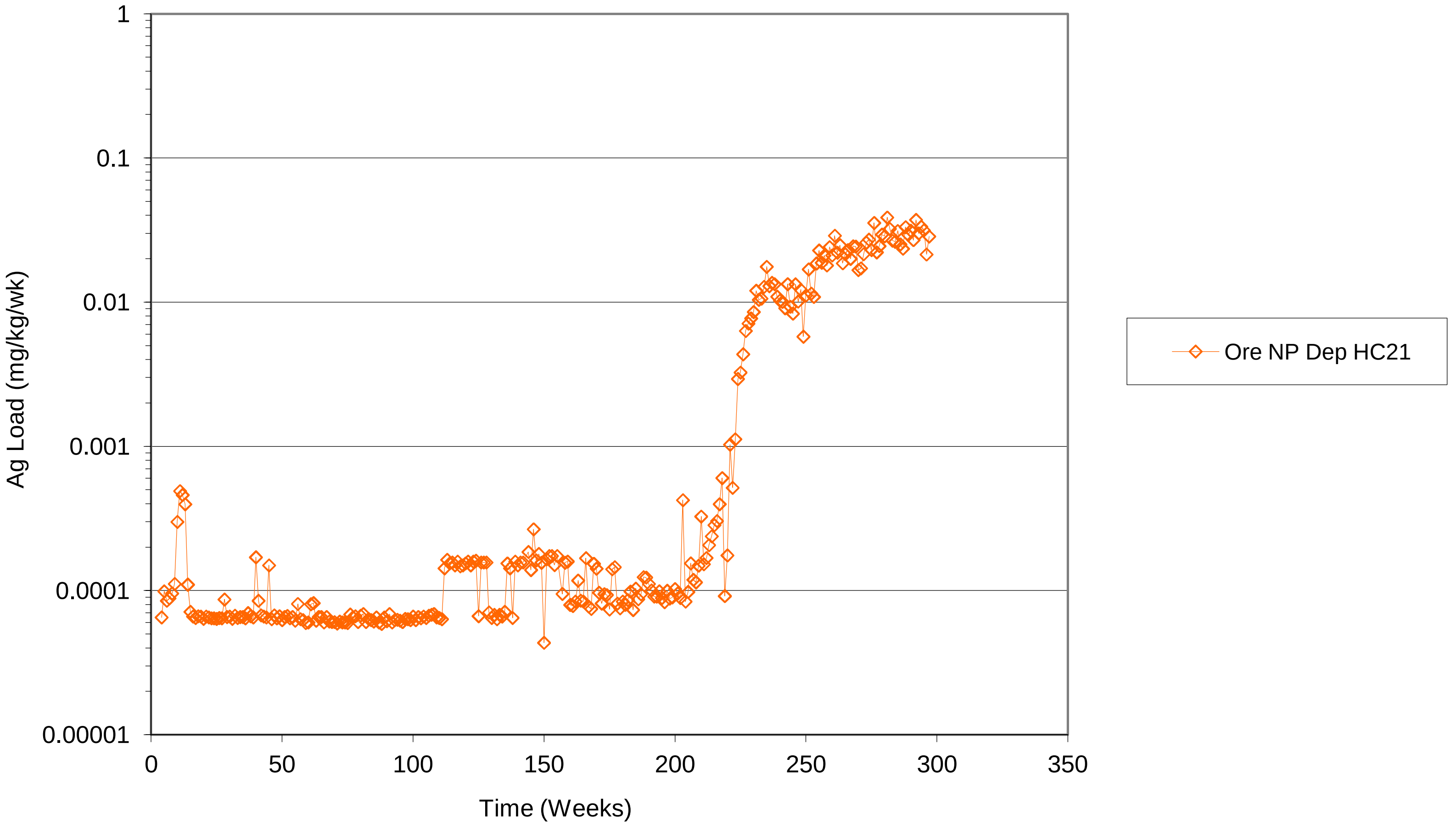
March 2013	FIGURE 19



Sulphate Load
Operating Cells
Wolverine Mine, YK

NP-Depleted Ore

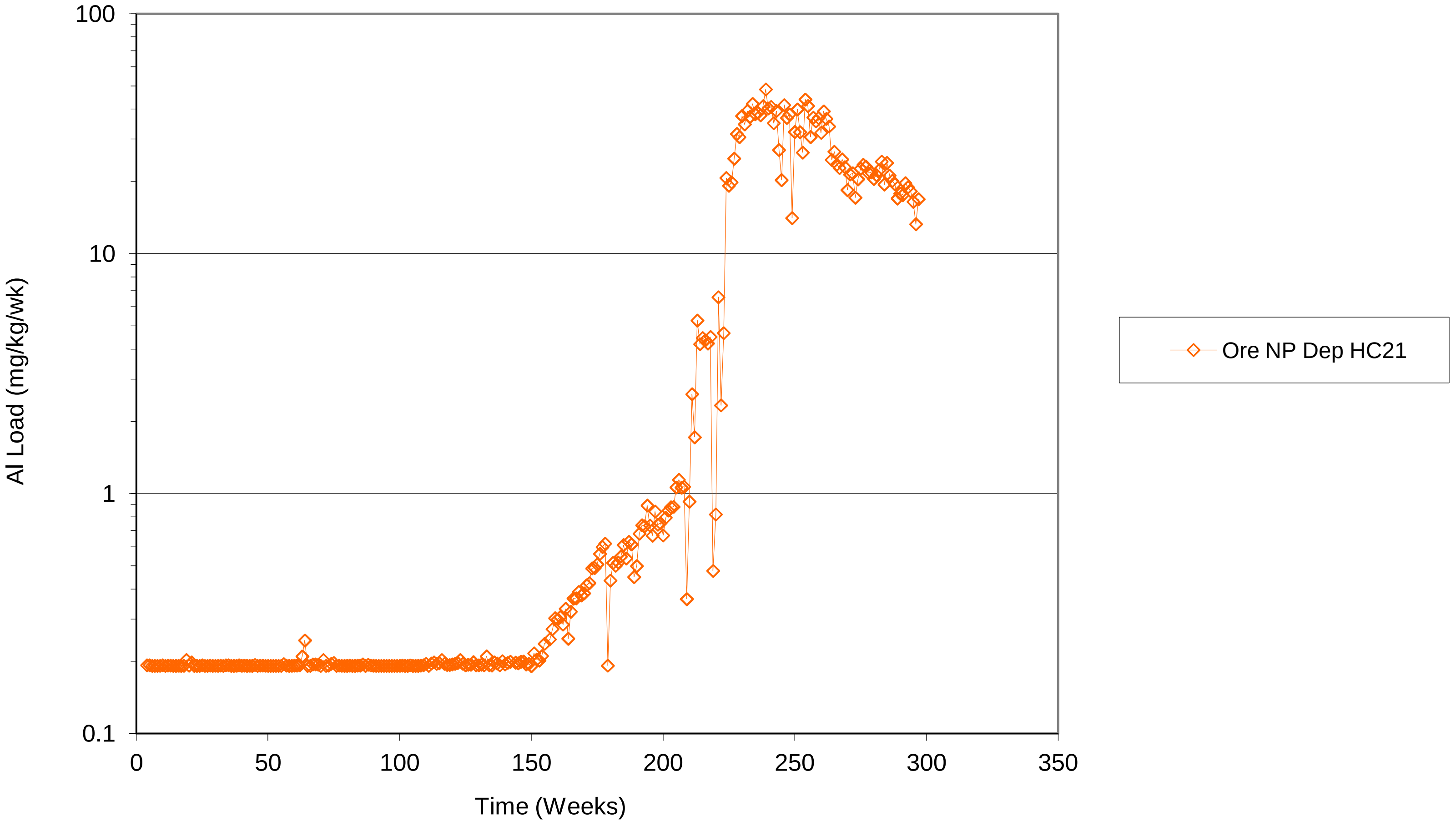
March 2013	FIGURE 20



Silver Load
Operating Cells
Wolverine Mine, YK

NP-Depleted Ore

March 2013	FIGURE 21

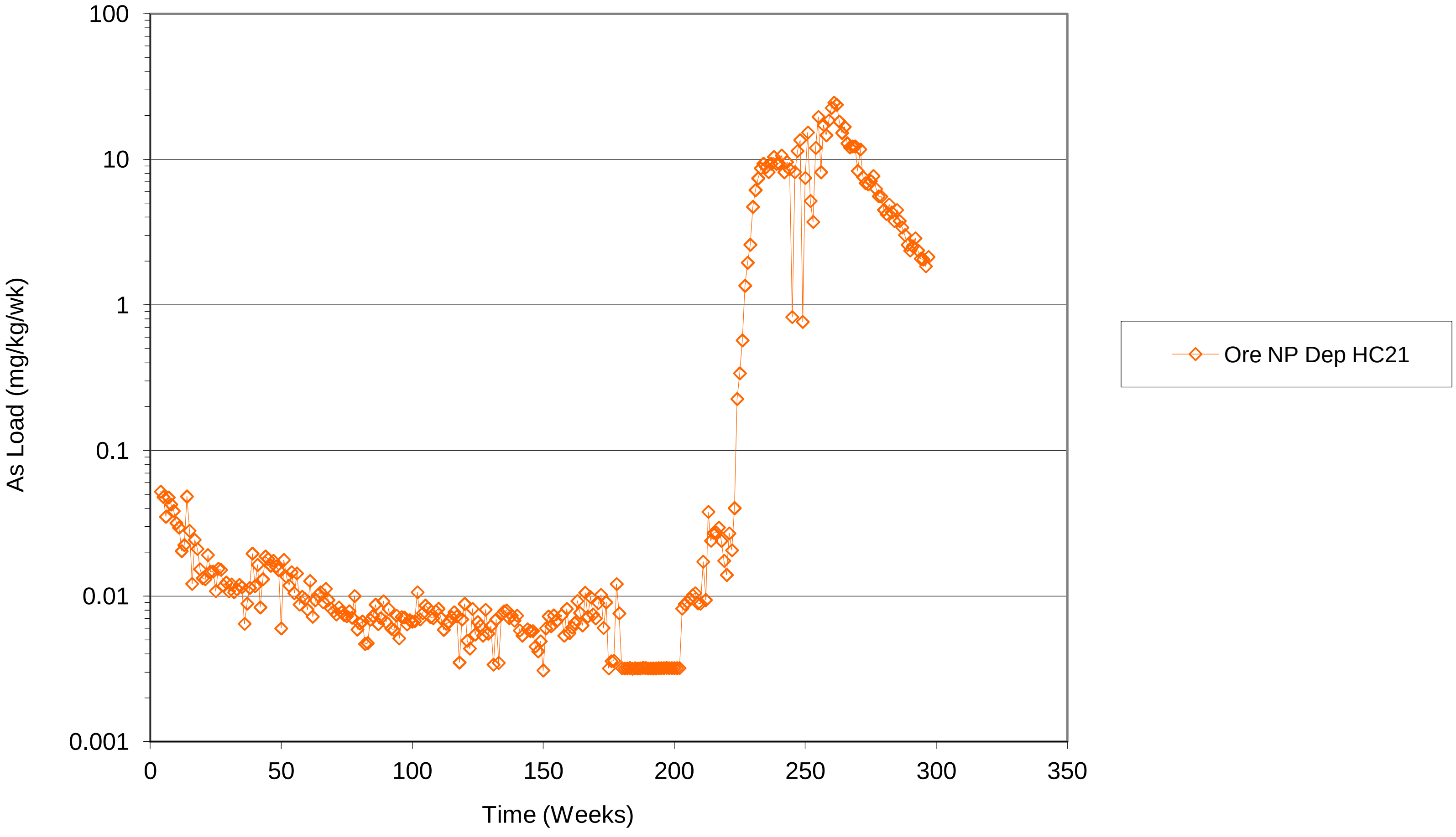


Aluminium Load
Operating Cells
Wolverine Mine, YK

NP-Depleted Ore

March 2013	FIGURE 22

TC 53920



Arsenic Load
Operating Cells
Wolverine Mine, YK

NP-Depleted Ore

March 2013	FIGURE 23

TC 53920

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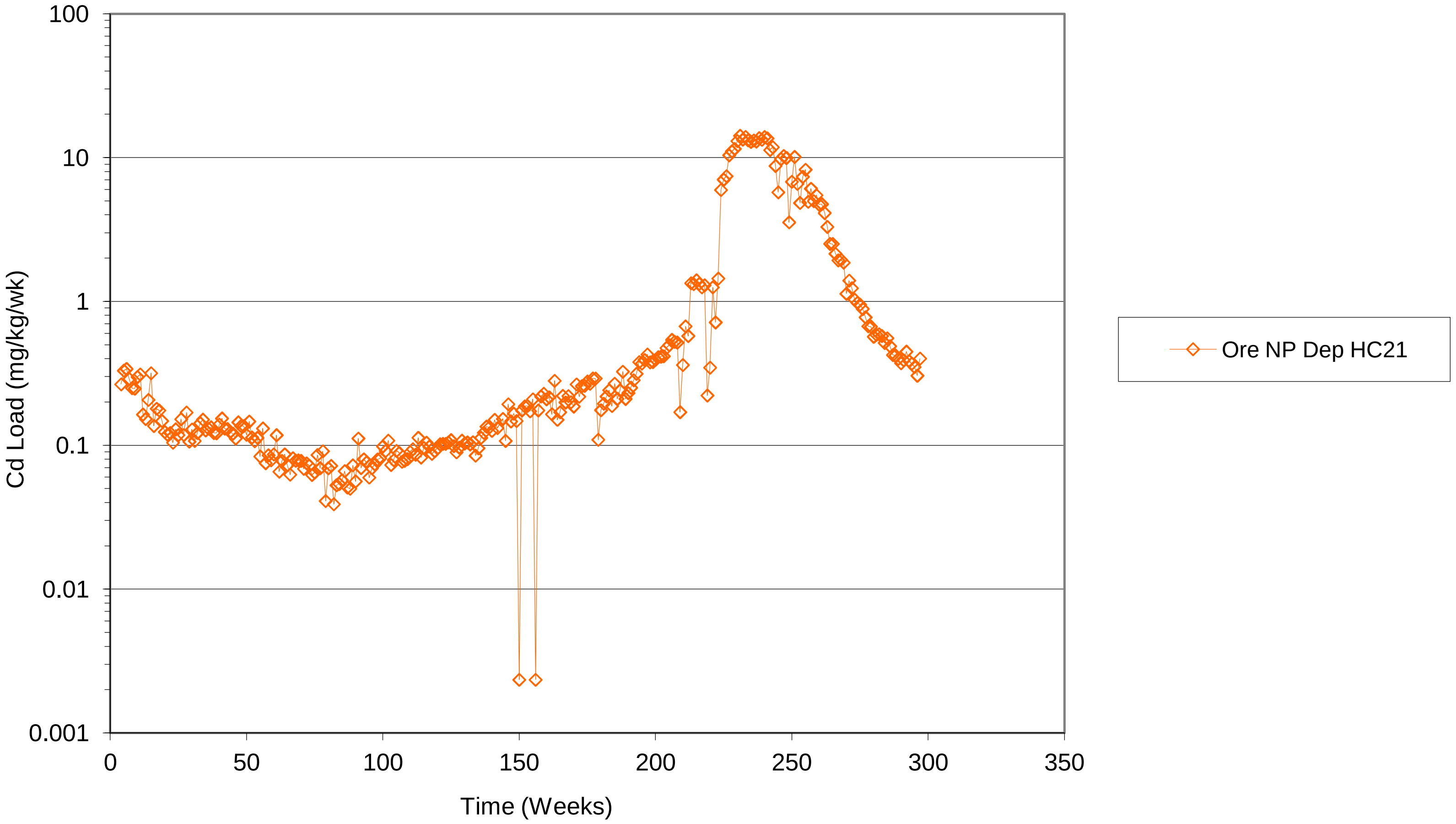
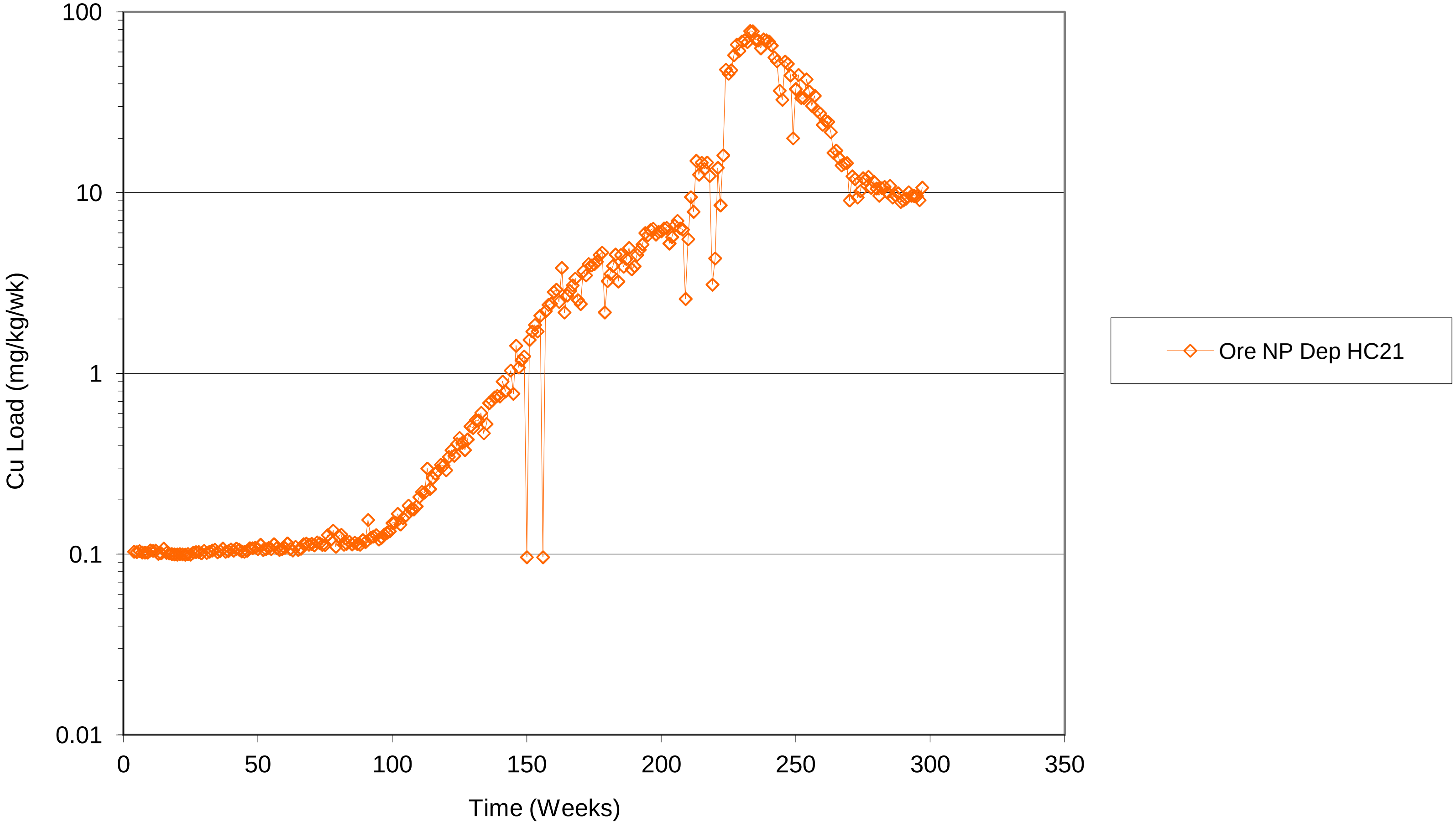


Cadmium Load
Operating Cells
Wolverine Mine, YK

NP-Depleted Ore

March 2013	FIGURE 24

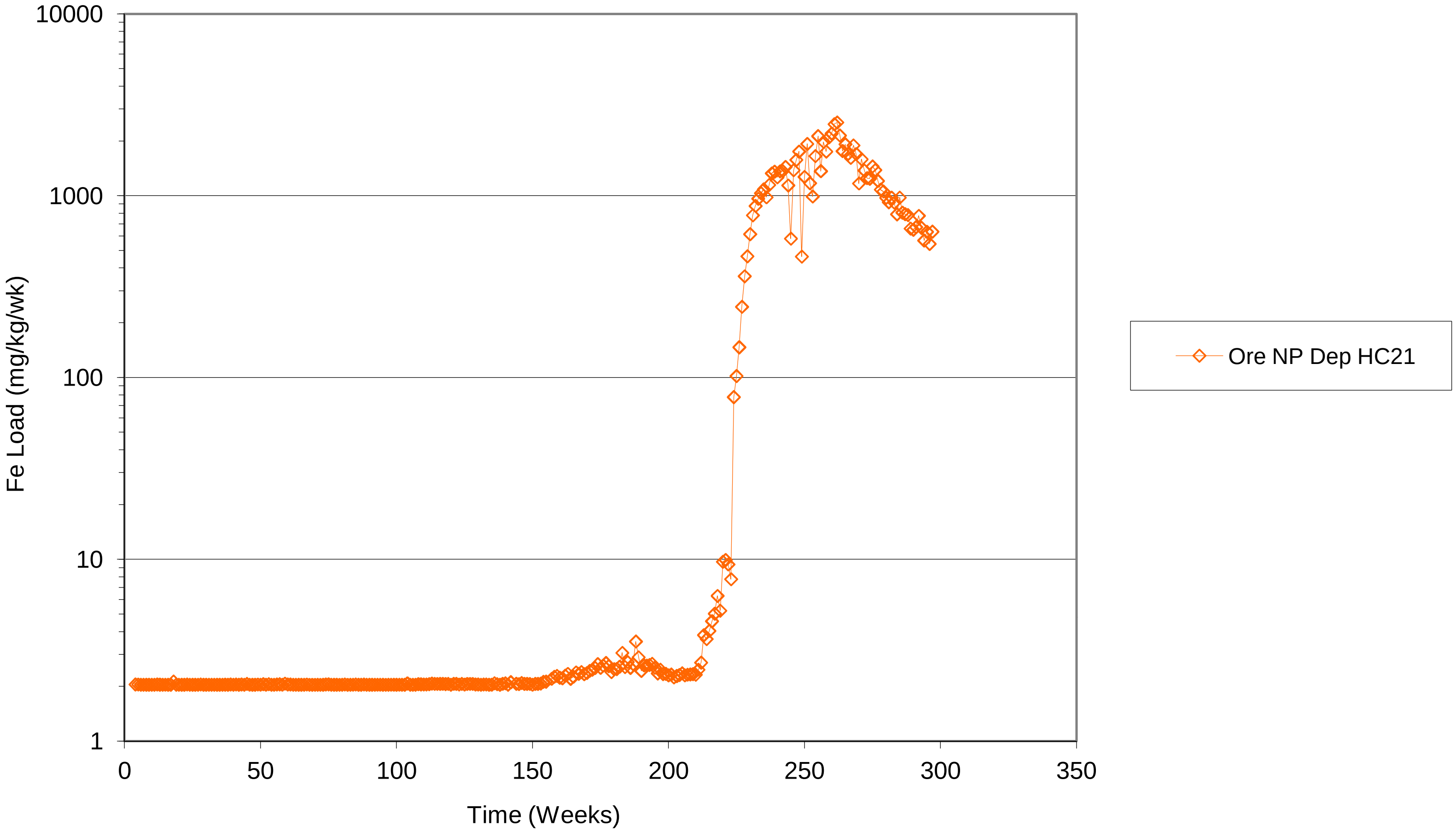
TC 53920



Copper Load
Operating Cells
Wolverine Mine, YK

NP-Depleted Ore

March 2013	FIGURE 25



Iron Load
Operating Cells
Wolverine Mine, YK

NP-Depleted Ore

March 2013	FIGURE 26

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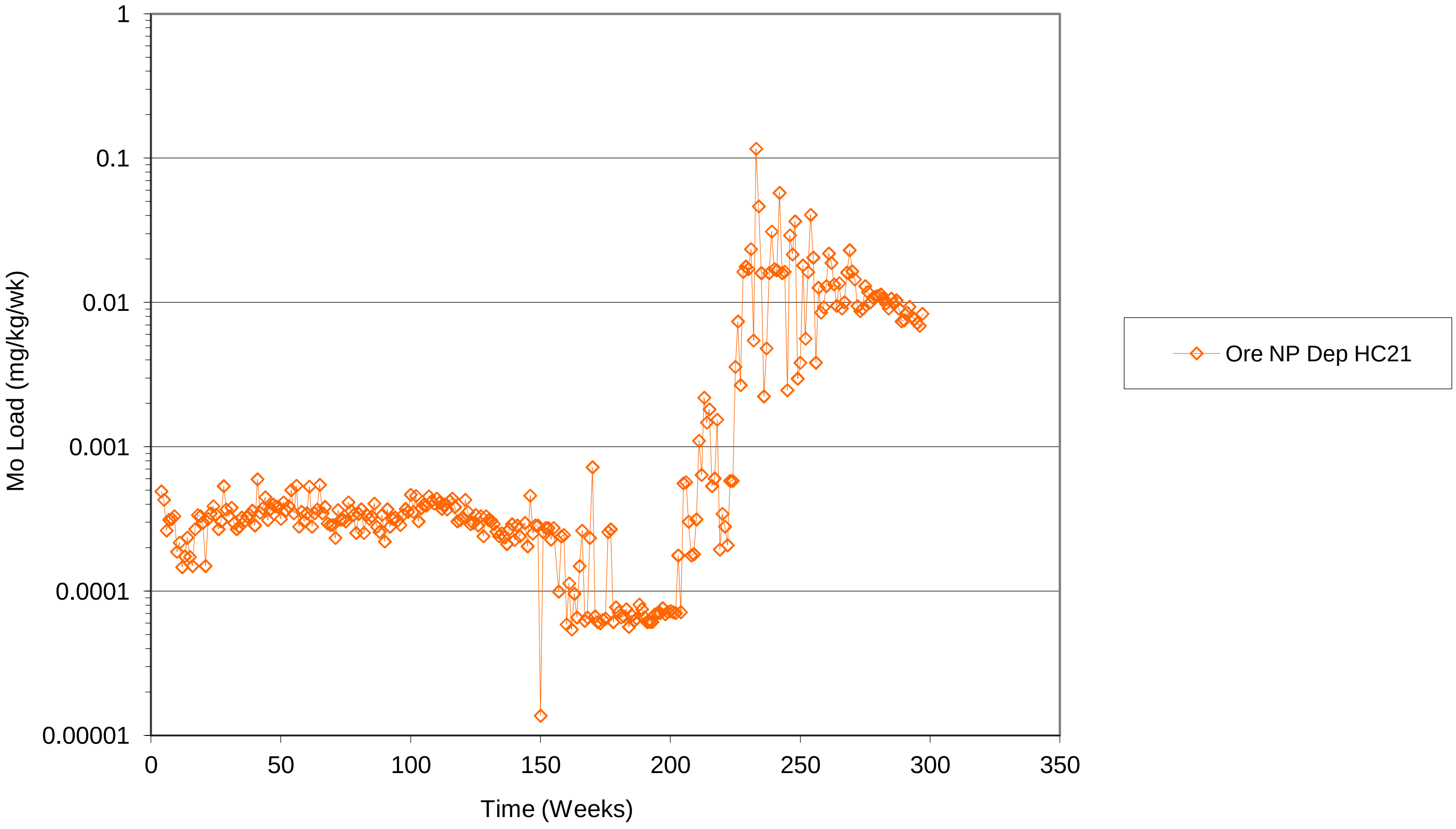
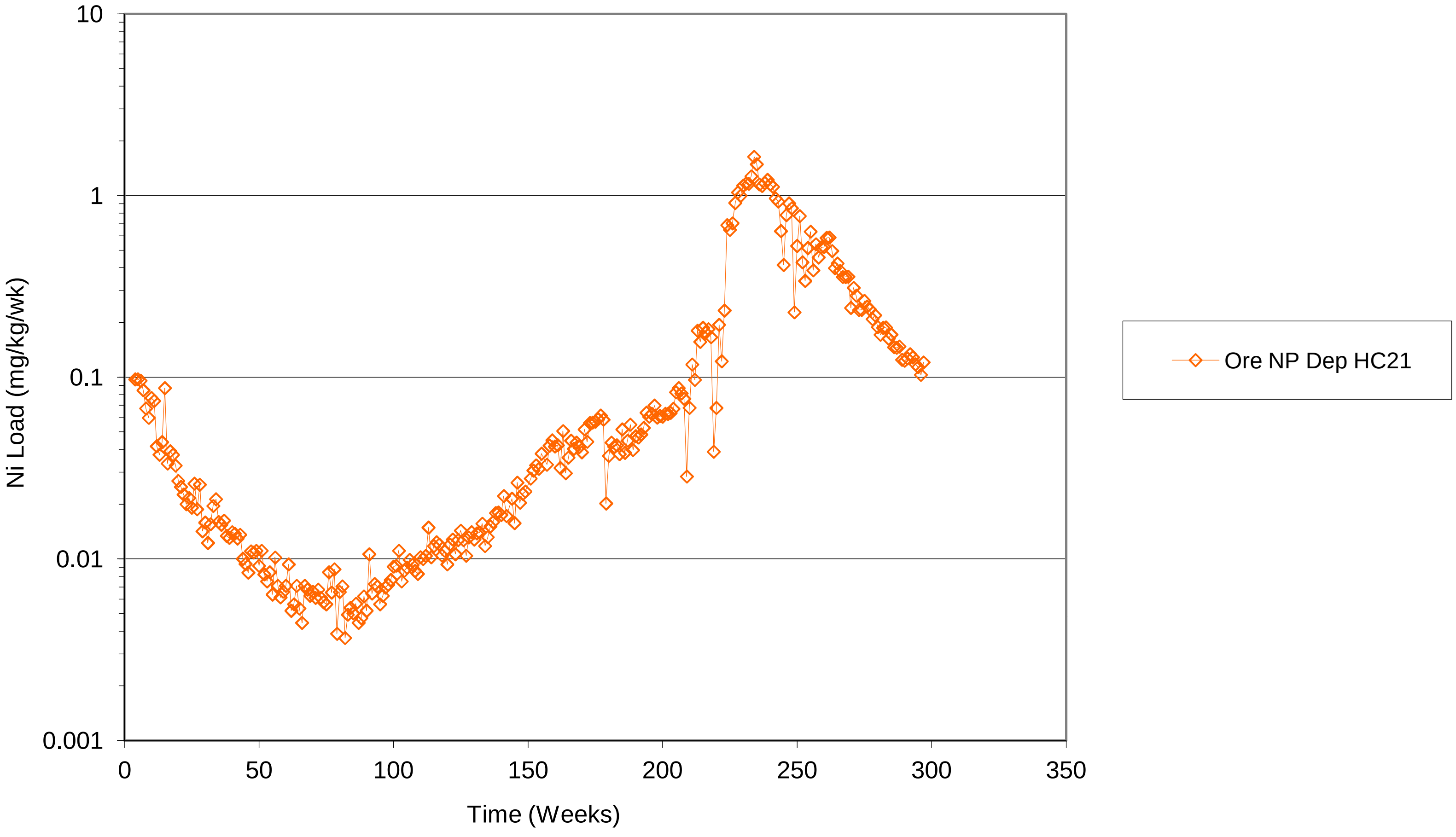


Molybdenum Load
Operating Cells
Wolverine Mine, YK

NP-Depleted Ore

March 2013	FIGURE 27

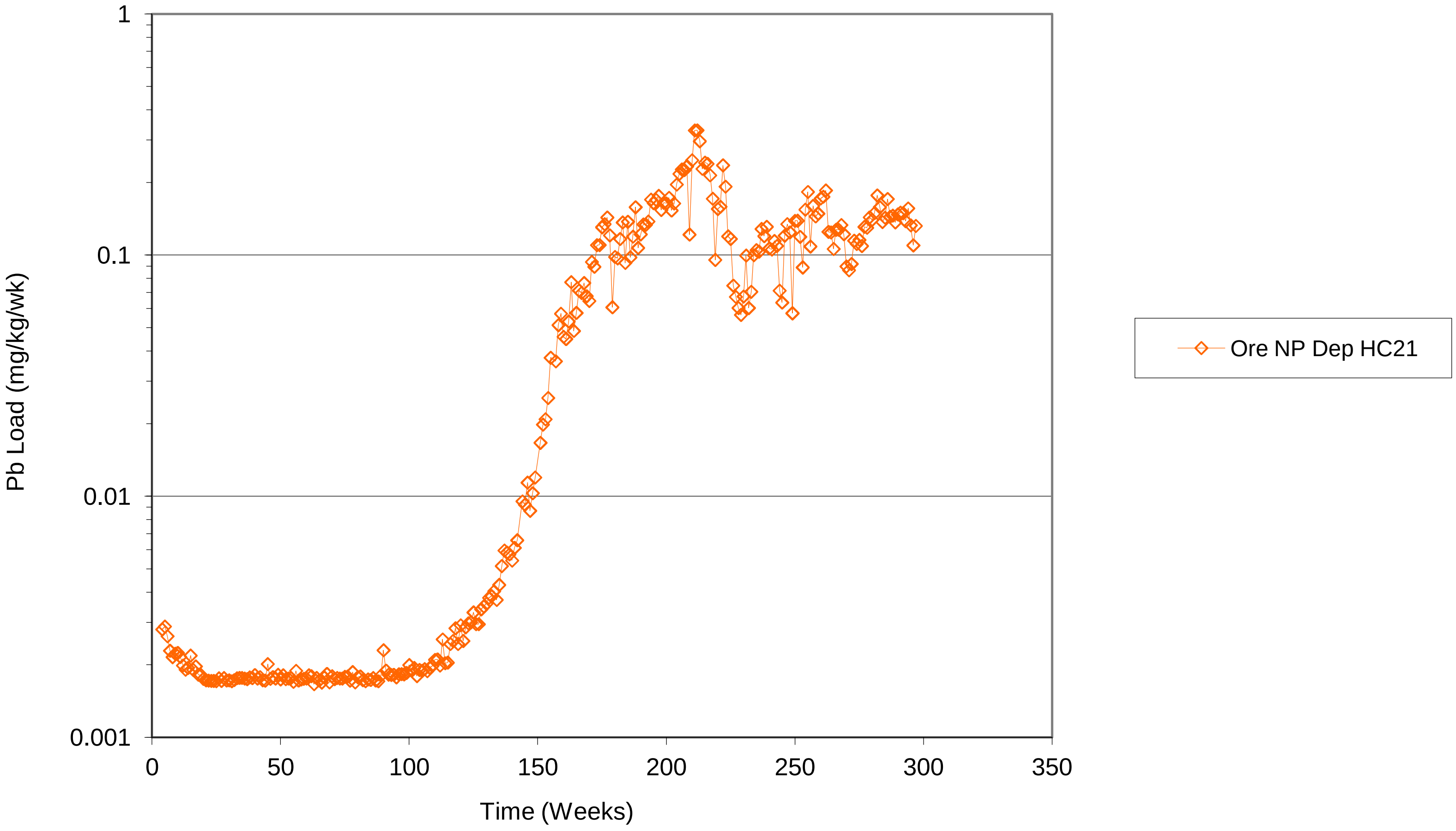


Nickel Load
Operating Cells
Wolverine Mine, YK

NP-Depleted Ore

March 2013	FIGURE 28

TC 53920

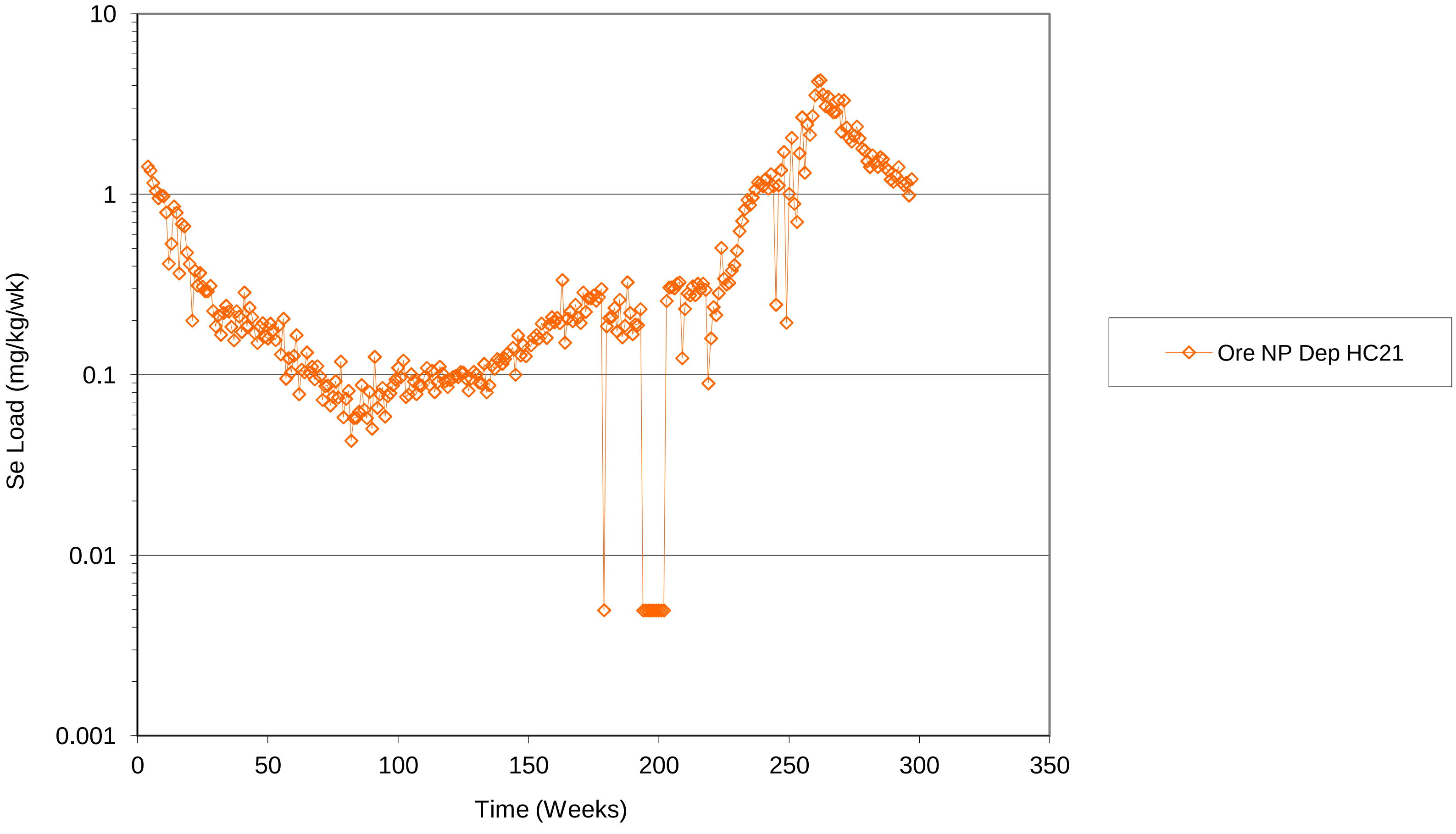


Lead Load
Operating Cells
Wolverine Mine, YK

NP-Depleted Ore

March 2013	FIGURE 29

TC 53920

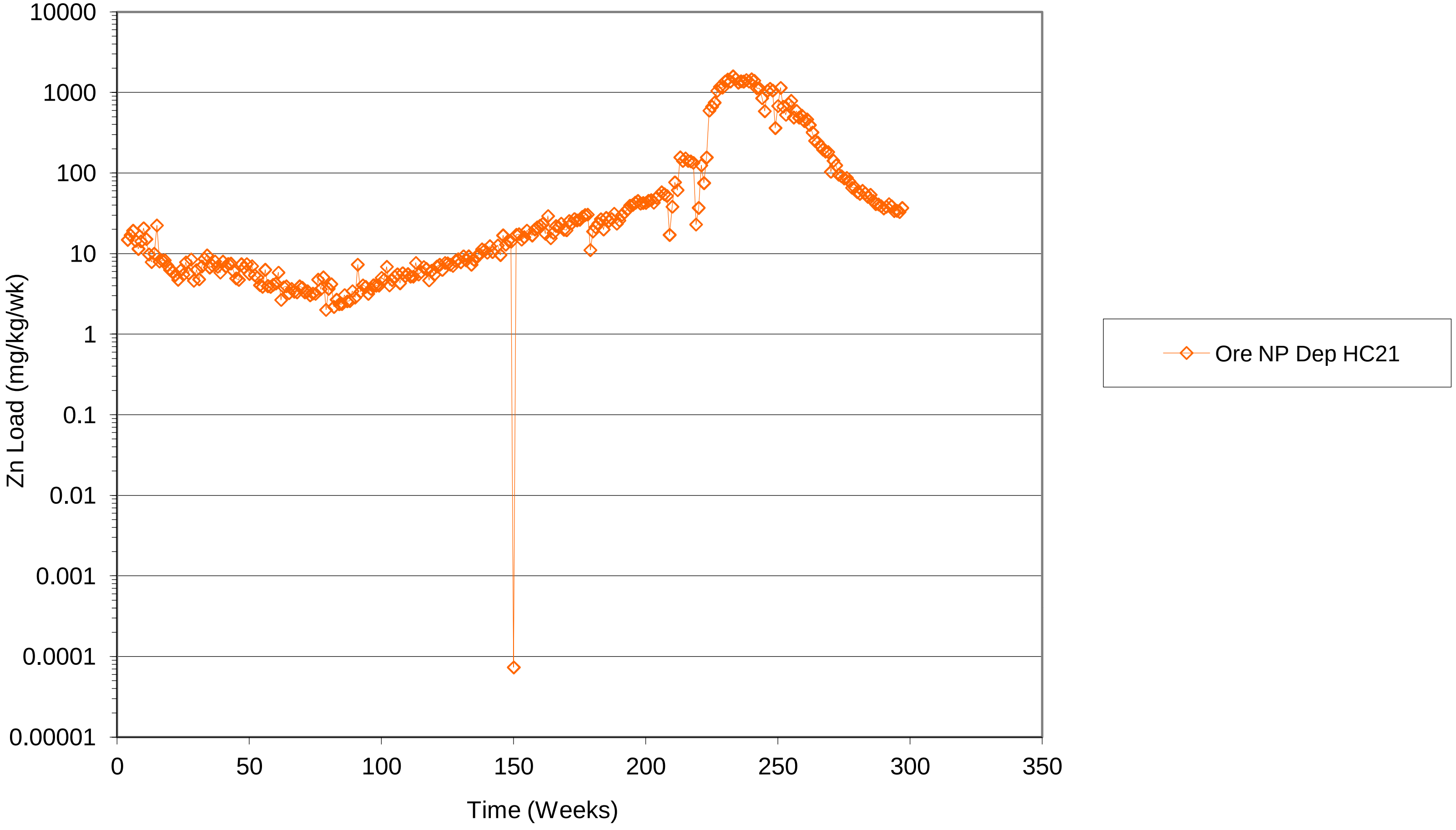


Selenium Load
Operating Cells
Wolverine Mine, YK

NP-Depleted Ore

March 2013	FIGURE 30

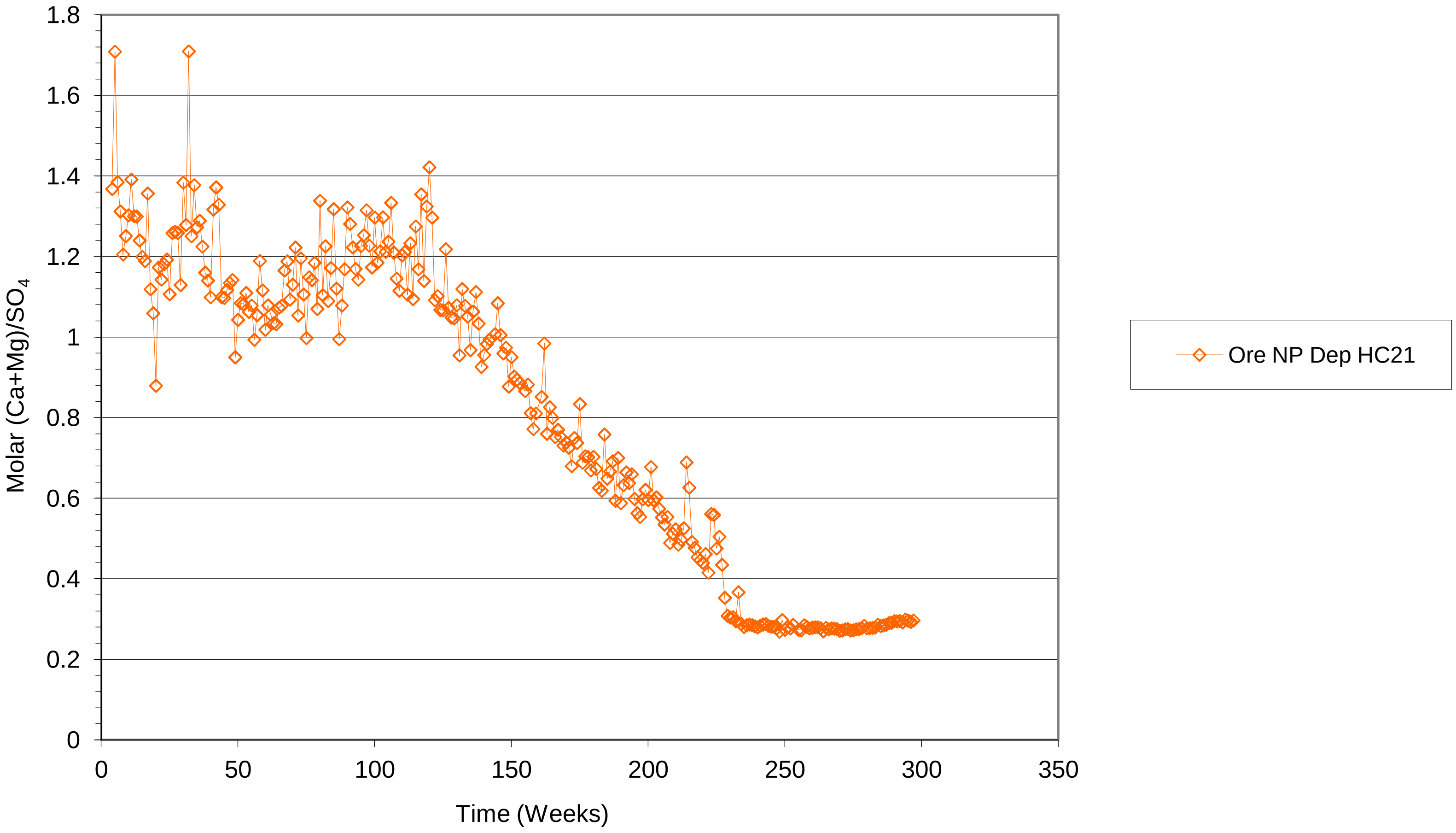
TC 53920



Zinc Load
Operating Cells
Wolverine Mine, YK

NP-Depleted Ore

March 2013	FIGURE 31



Molar (Ca+Mg)/SO_4 Ratio
Operating Cells
Wolverine Mine, YK

NP-Depleted Ore

March 2013	FIGURE 32

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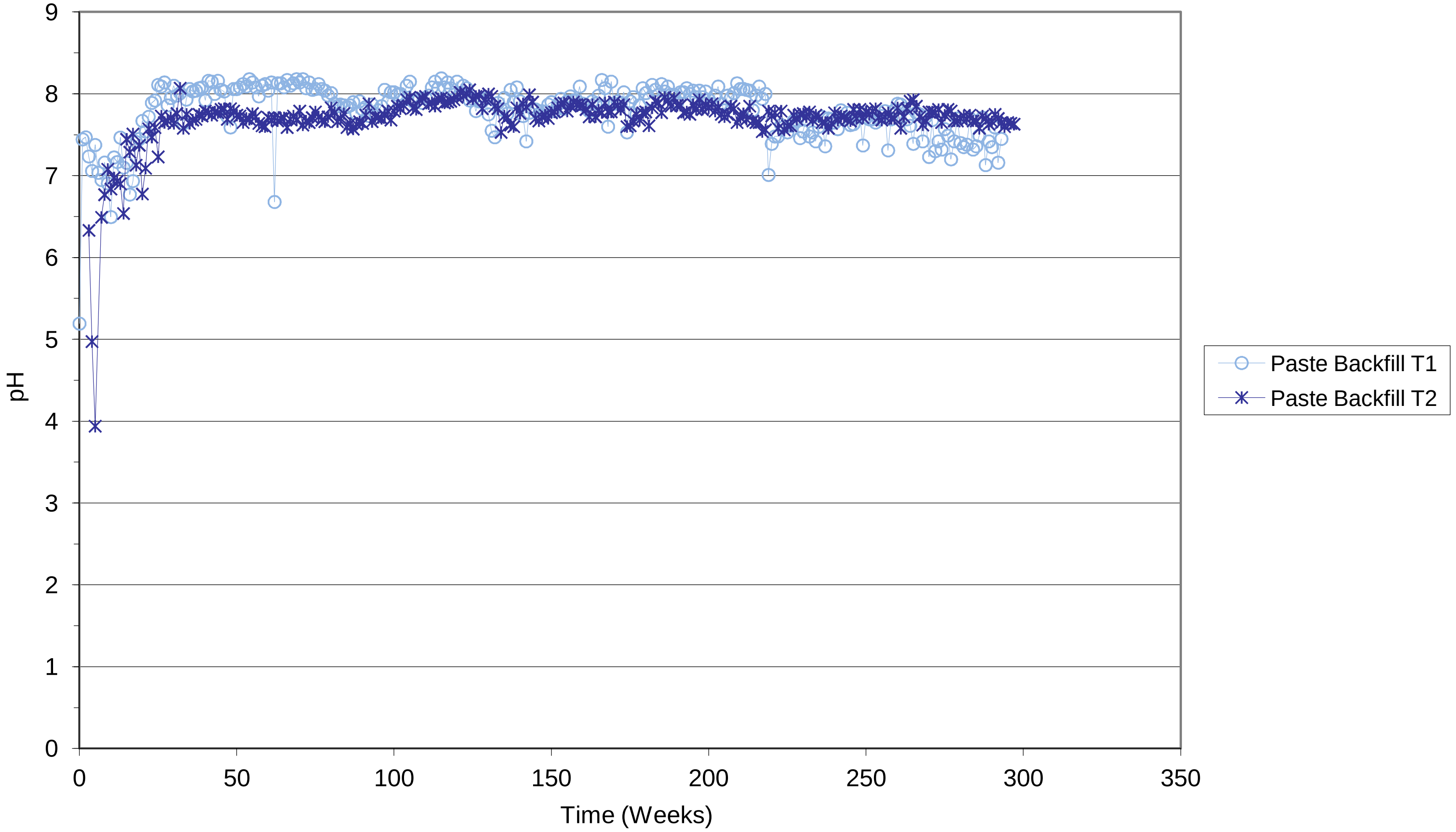

pH Load
Operating Cells
Wolverine Mine, YK

Paste Backfill

March 2013	FIGURE 33

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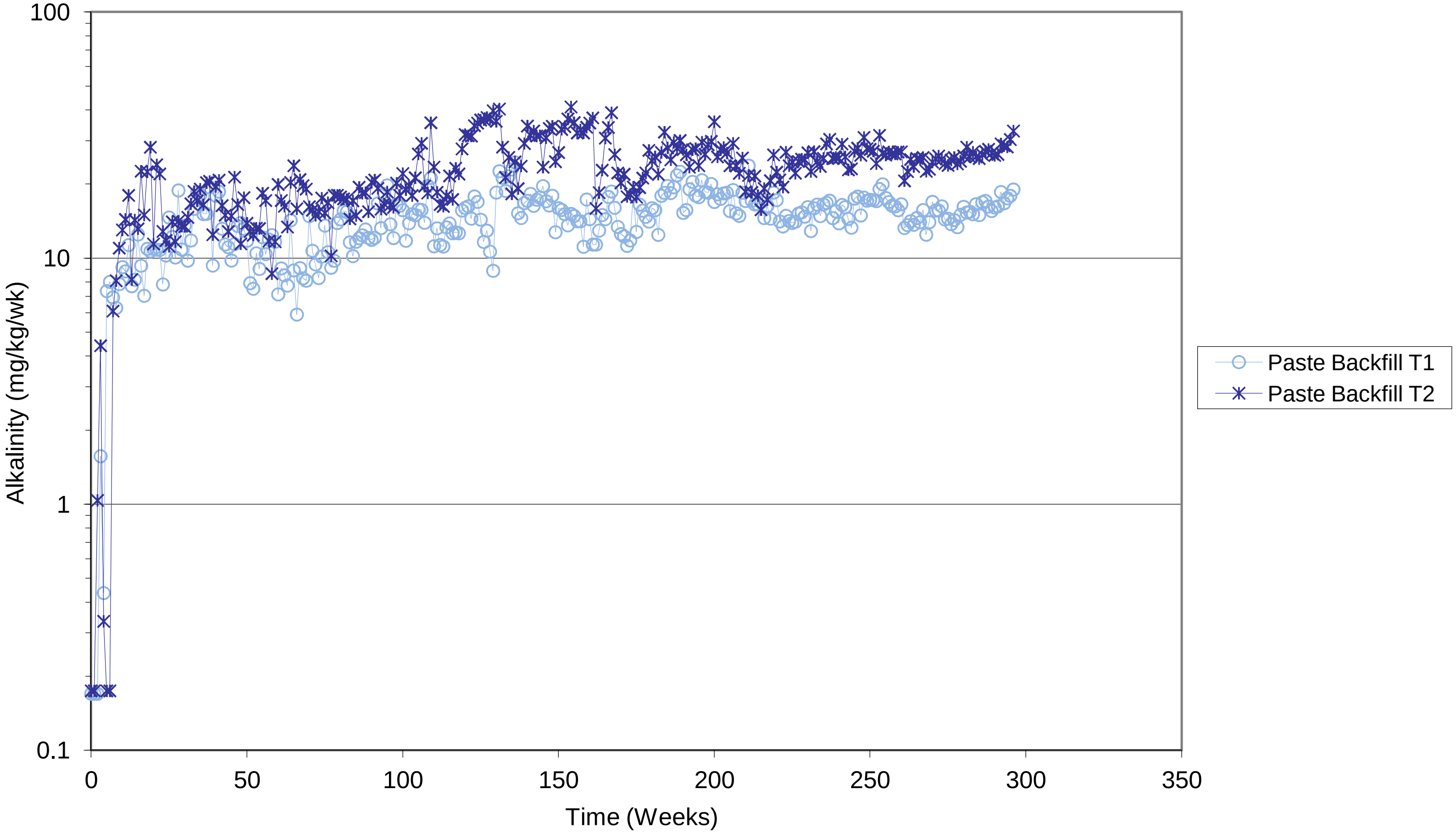

Alkalinity Load Operating Cells Wolverine Mine, YK	
Paste Backfill	
March 2013	FIGURE 34

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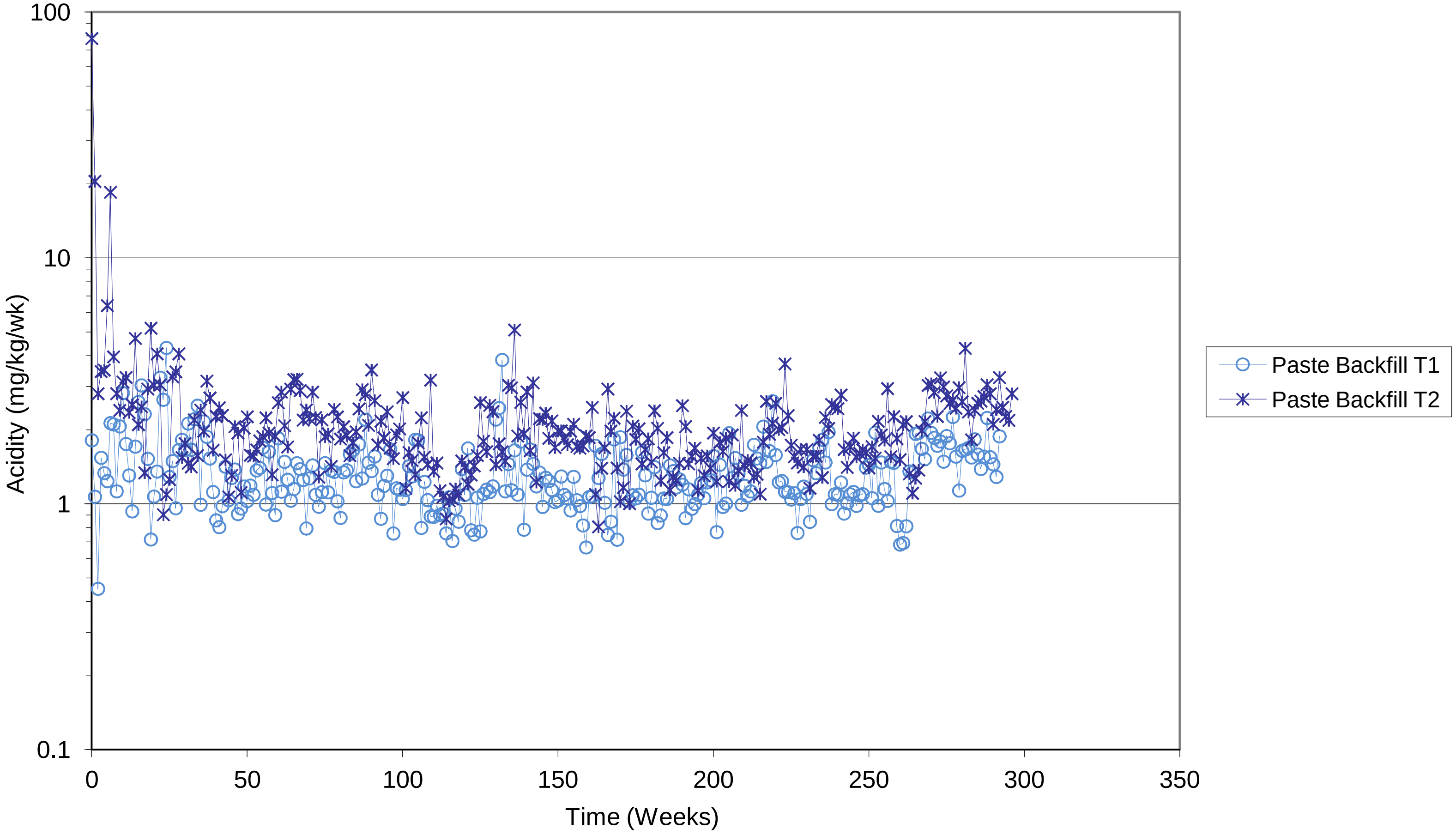

Acidity Load
Operating Cells
Wolverine Mine, YK

Paste Backfill

March 2013	FIGURE 35

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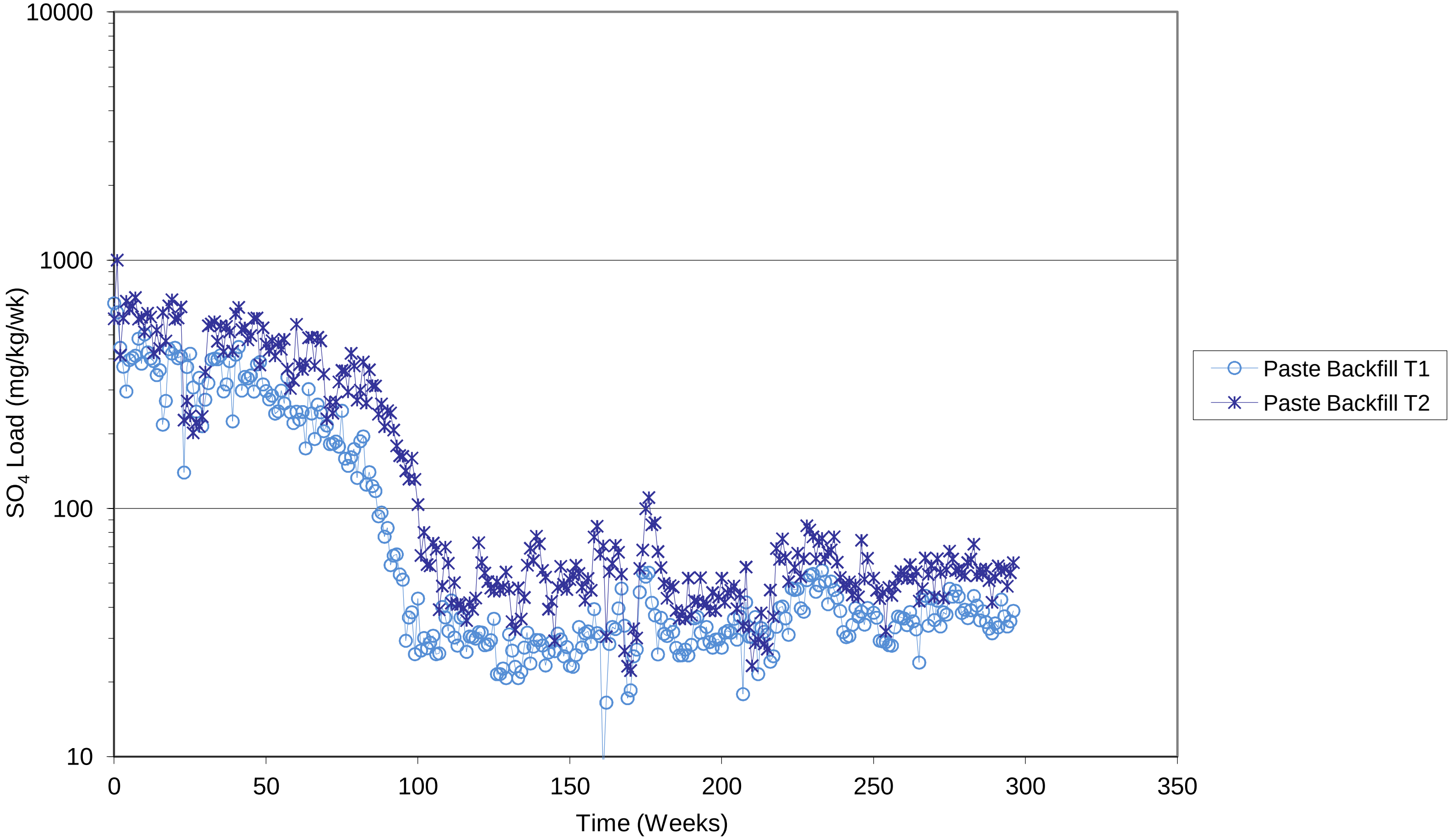

Sulphate
Operating Cells
Wolverine Mine, YK

Paste Backfill

March 2013	FIGURE 36

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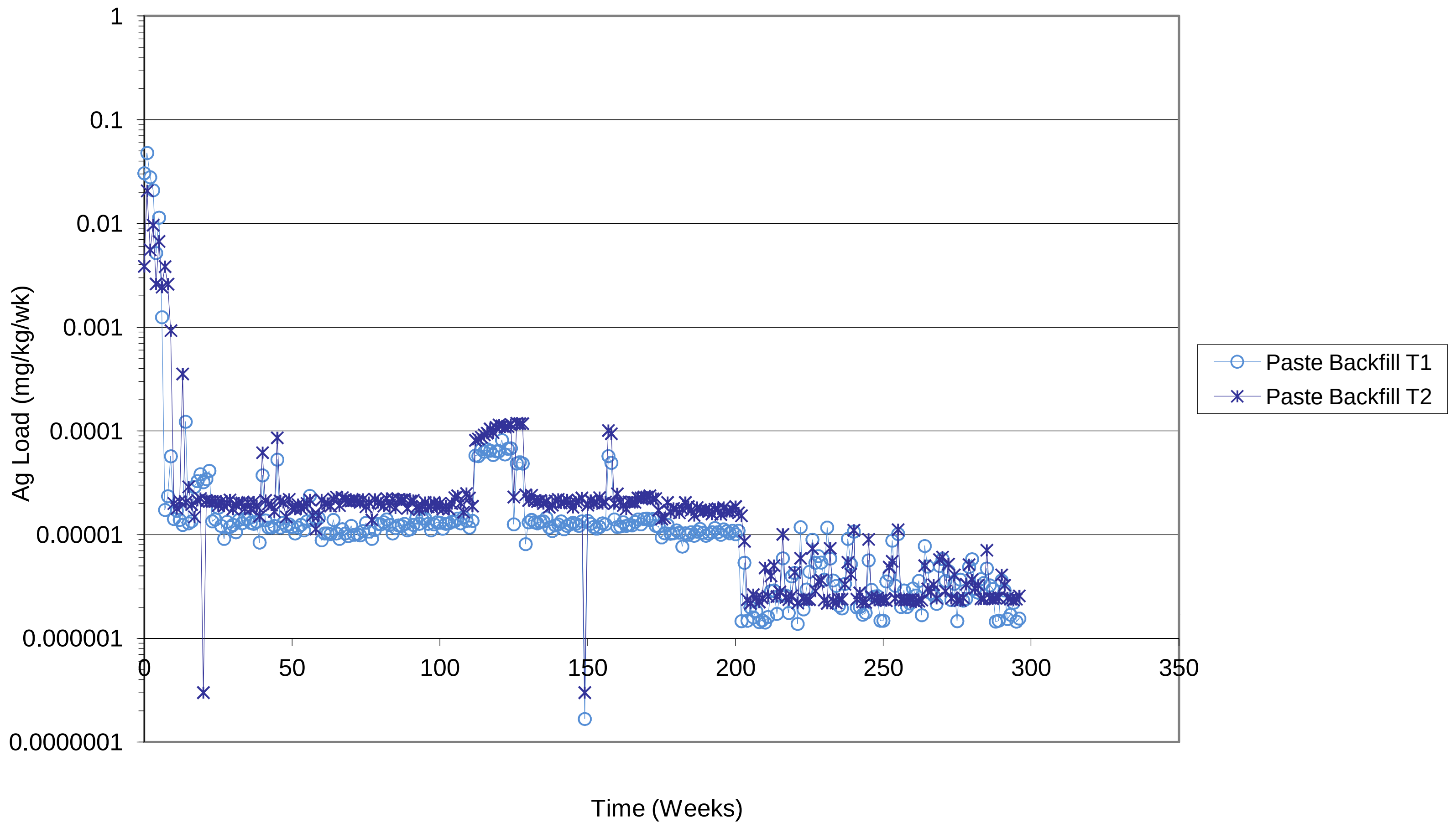

Silver Load
#REF!
Wolverine Mine, YK

Paste Backfill

March 2013	FIGURE 37

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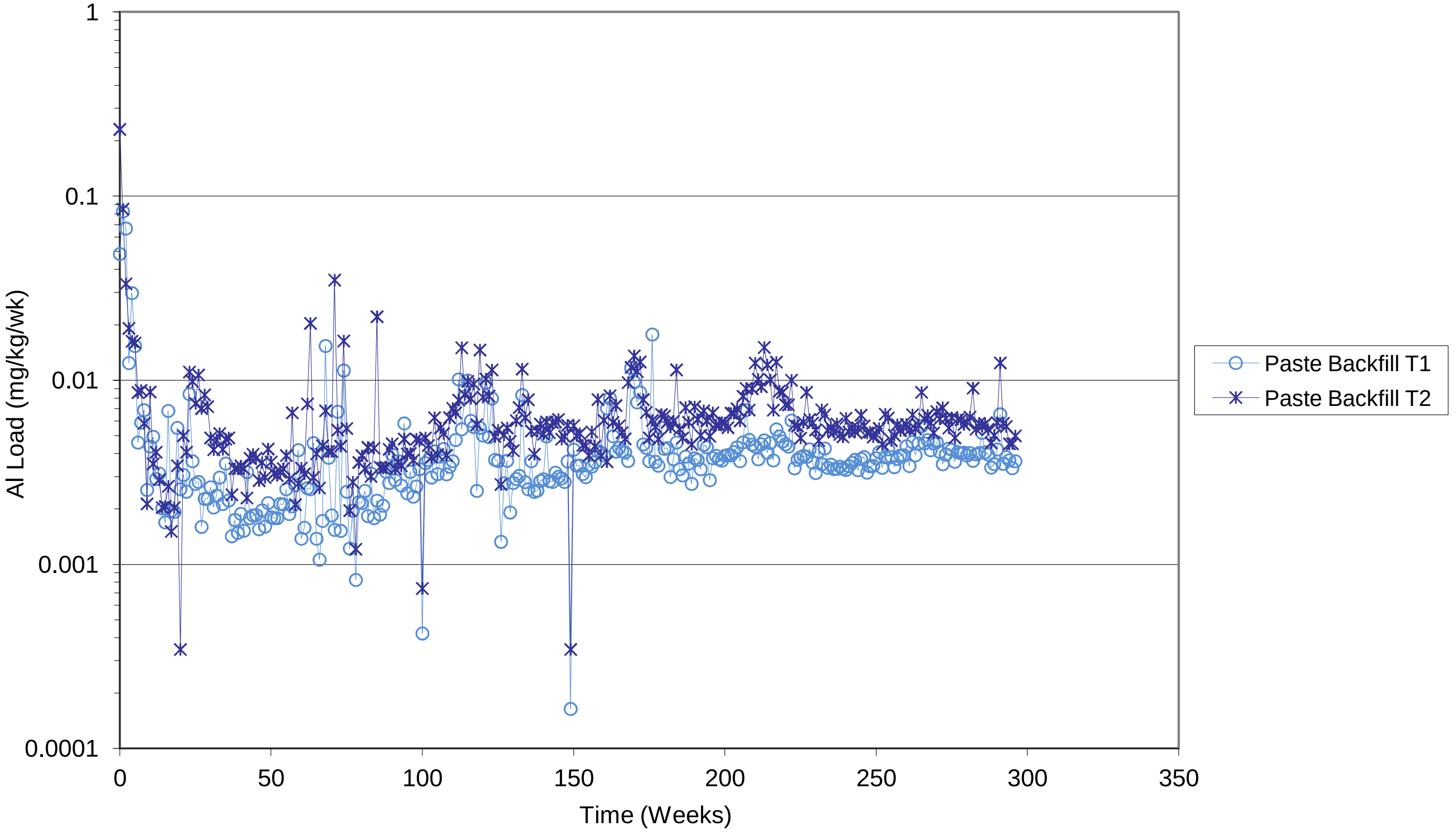

Aluminum Load Operating Cells Wolverine Mine, YK	
Paste Backfill	
March 2013	FIGURE 38

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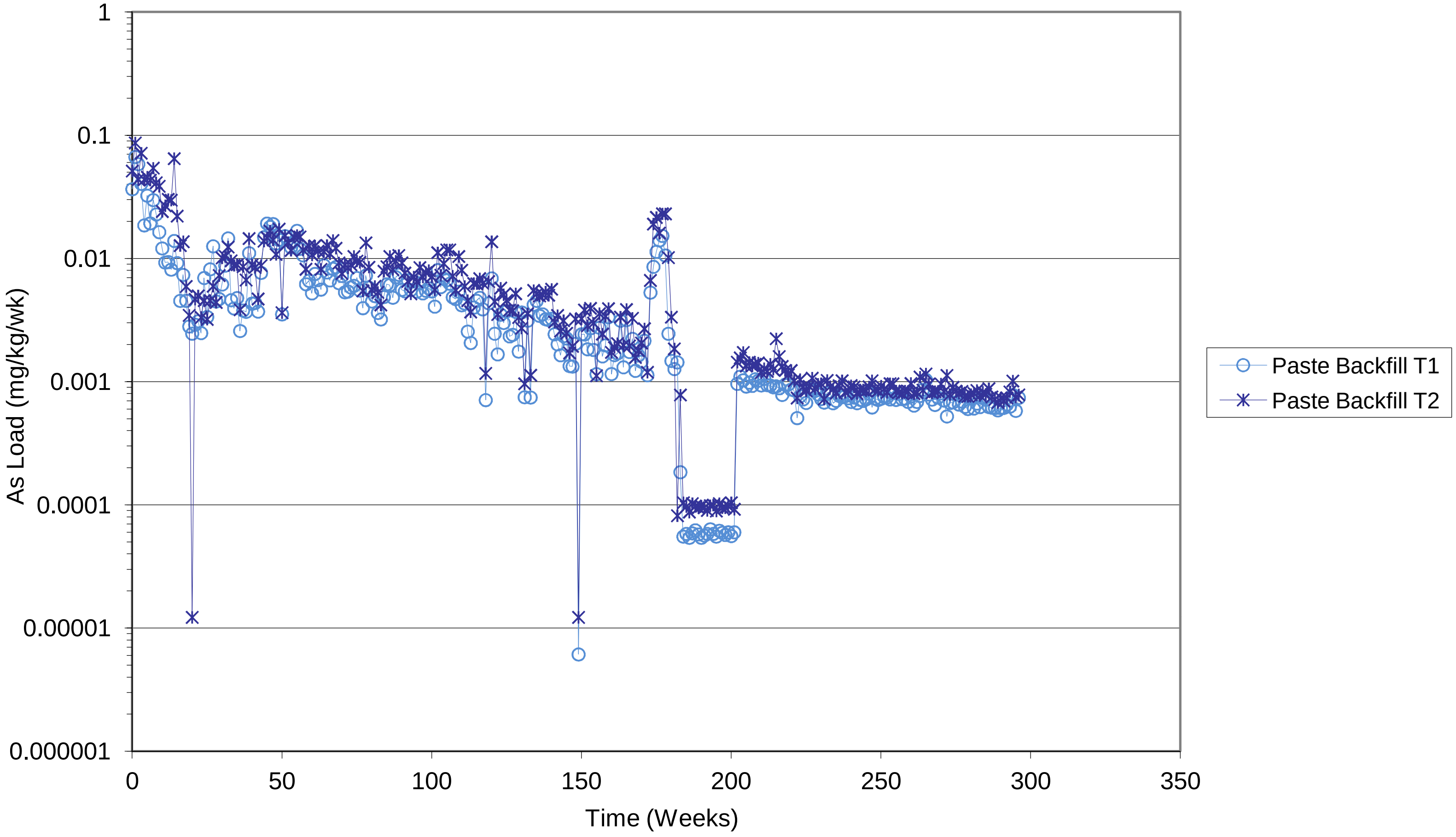

Arsenic Load
Operating Cells
Wolverine Mine, YK

Paste Backfill

March 2013	FIGURE 39

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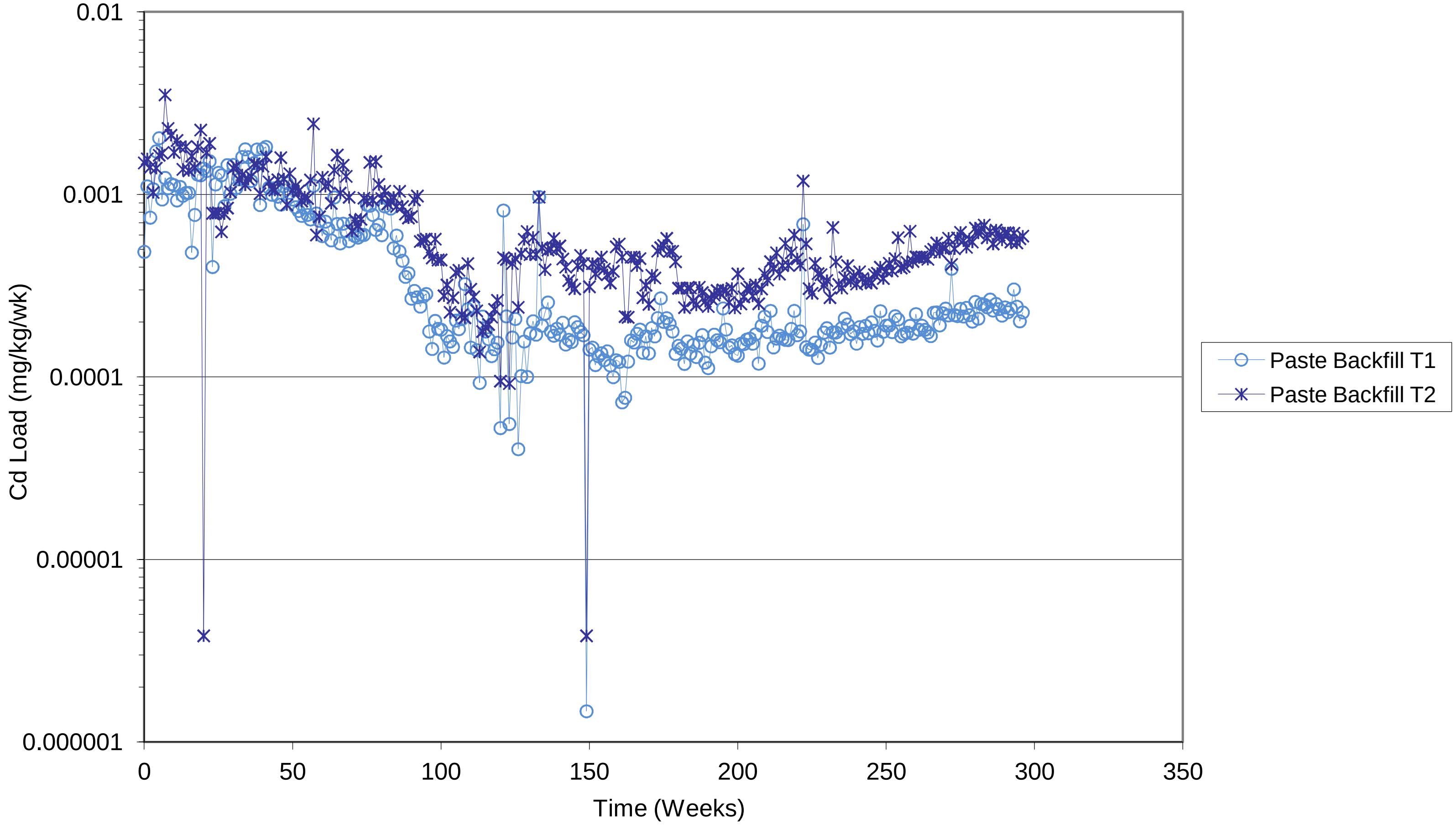
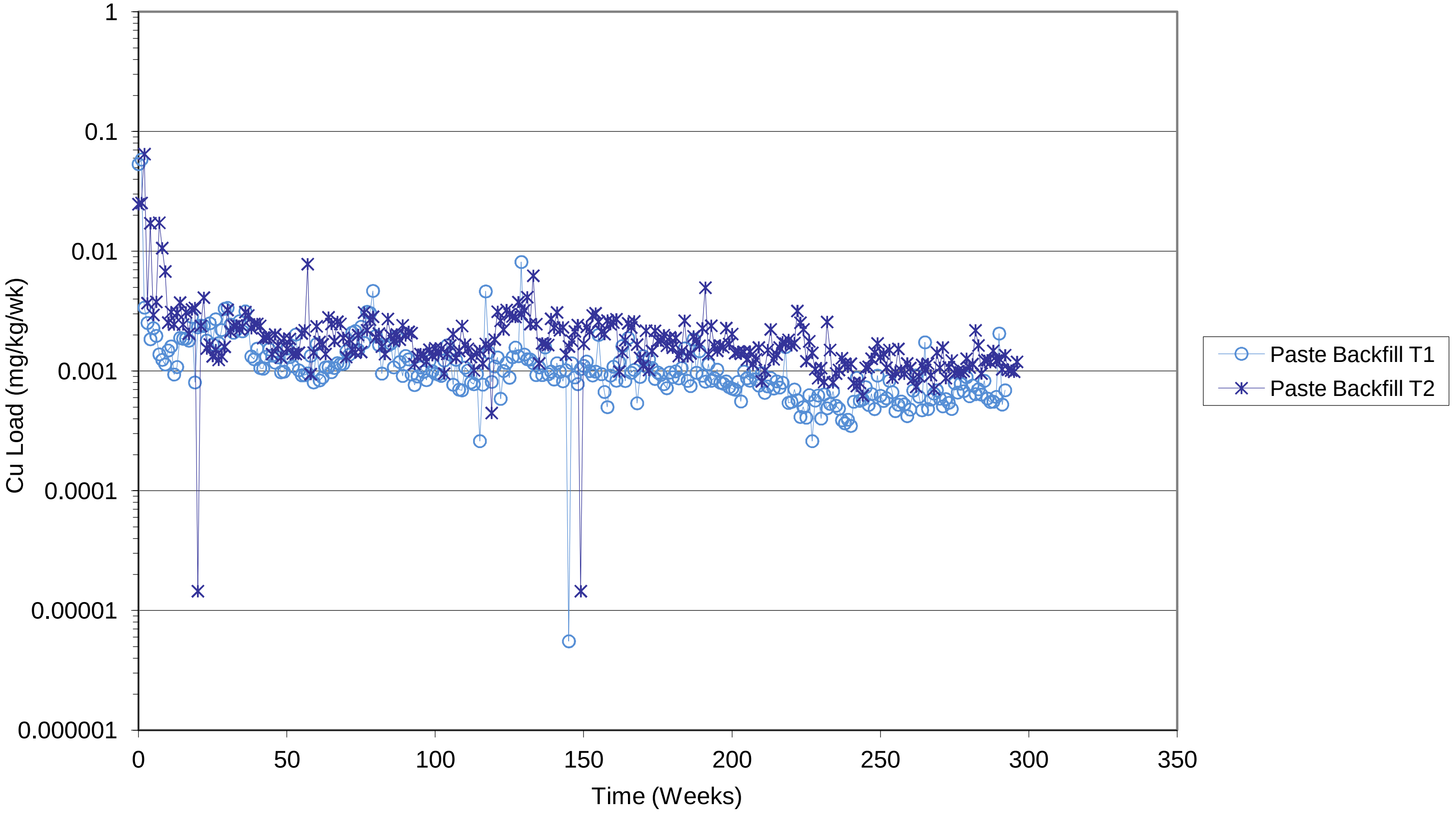


Cadmium Load
Operating Cells
Wolverine Mine, YK

Paste Backfill

March 2013	FIGURE 40



Copper Load
Operating Cells
Wolverine Mine, YK

Paste Backfill	
March 2013	FIGURE 41

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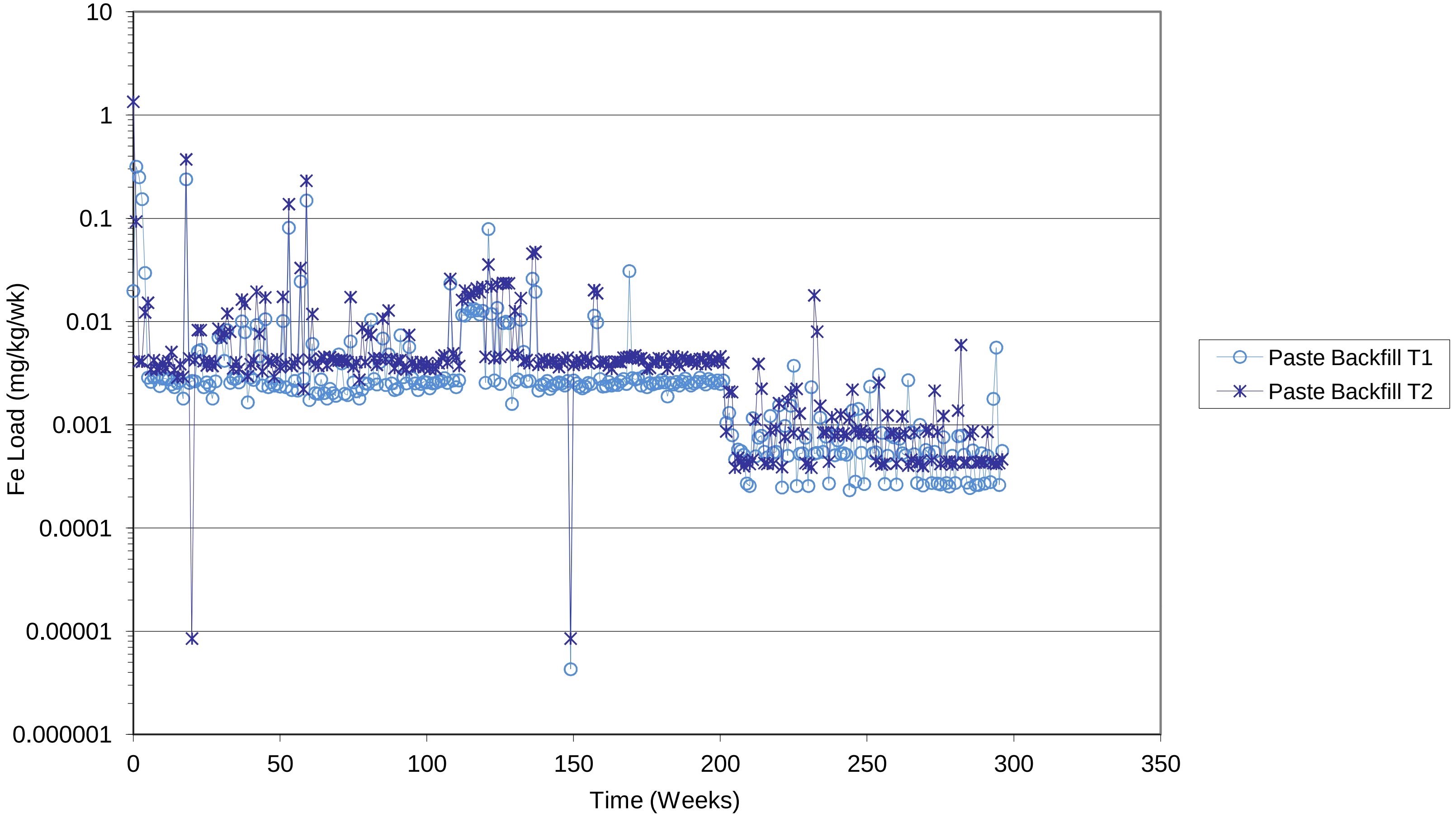
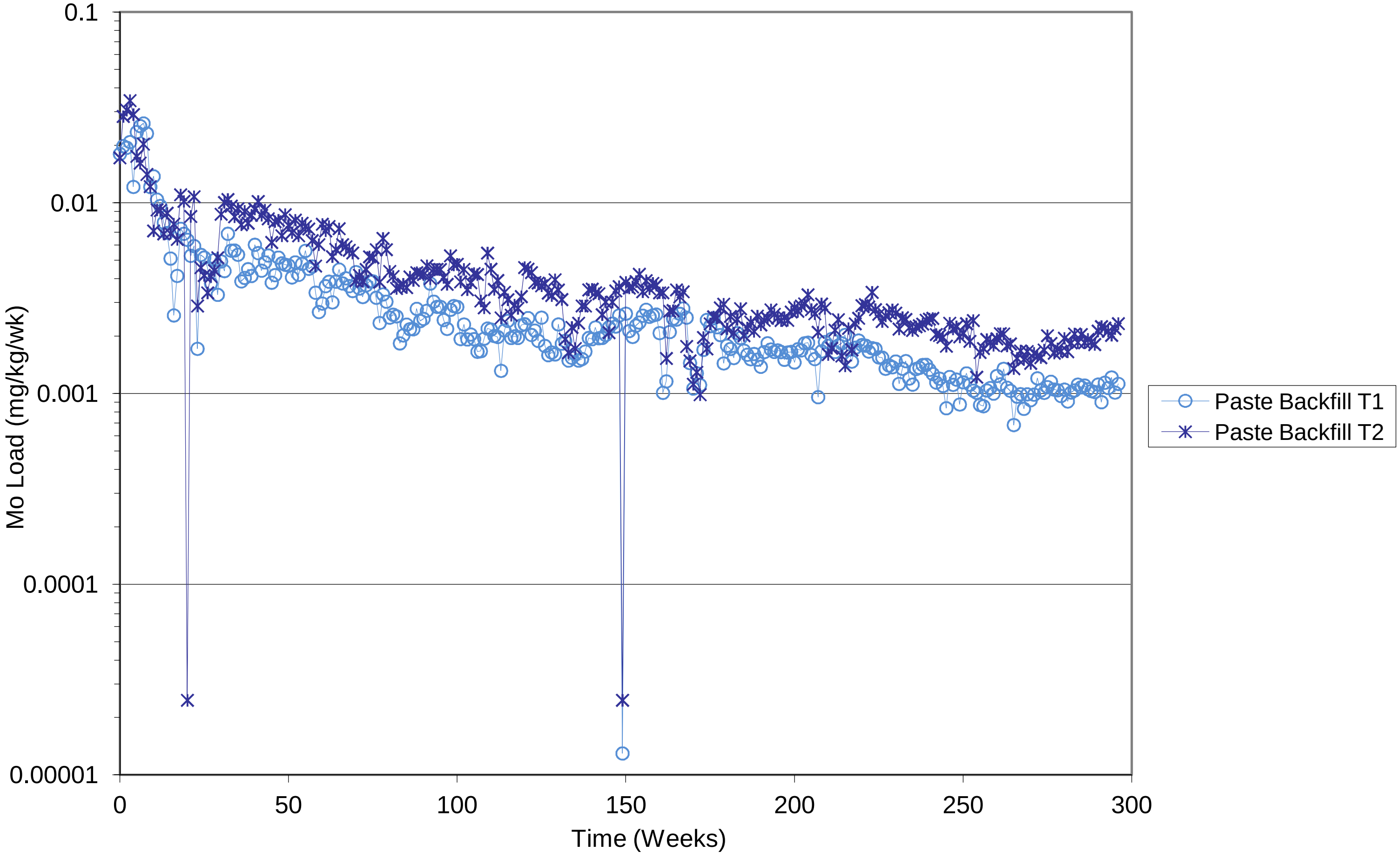


* Note change in method detection limit at week 200

Iron Load
Operating Cells
Wolverine Mine, YK

Paste Backfill	
March 2013	FIGURE 42



Molybdenum Load
Operating Cells
Wolverine Mine, YK

Paste Backfill

March 2013	FIGURE 43

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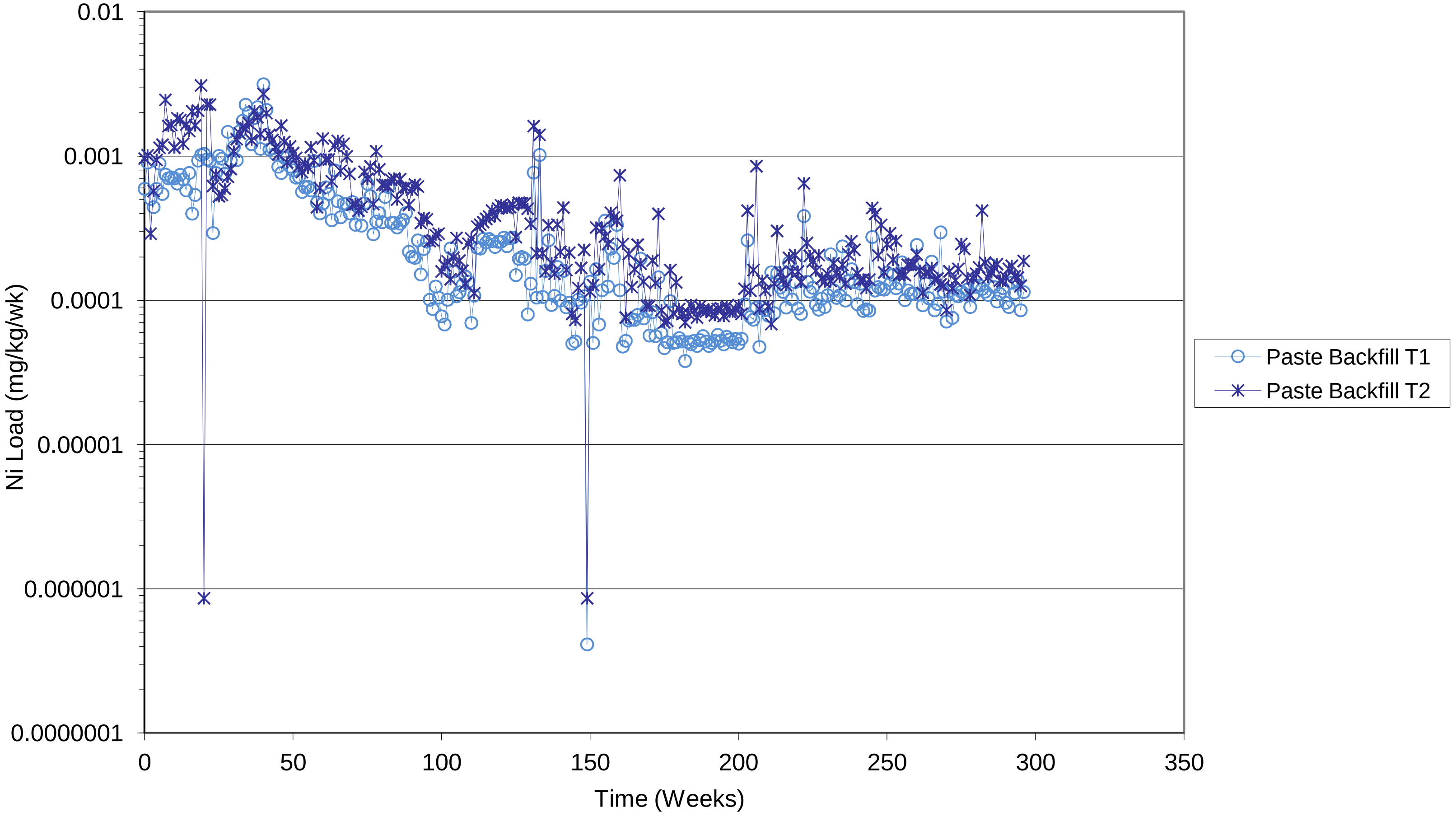

Nickel Load
Operating Cells
Wolverine Mine, YK

Paste Backfill

March 2013	FIGURE 44

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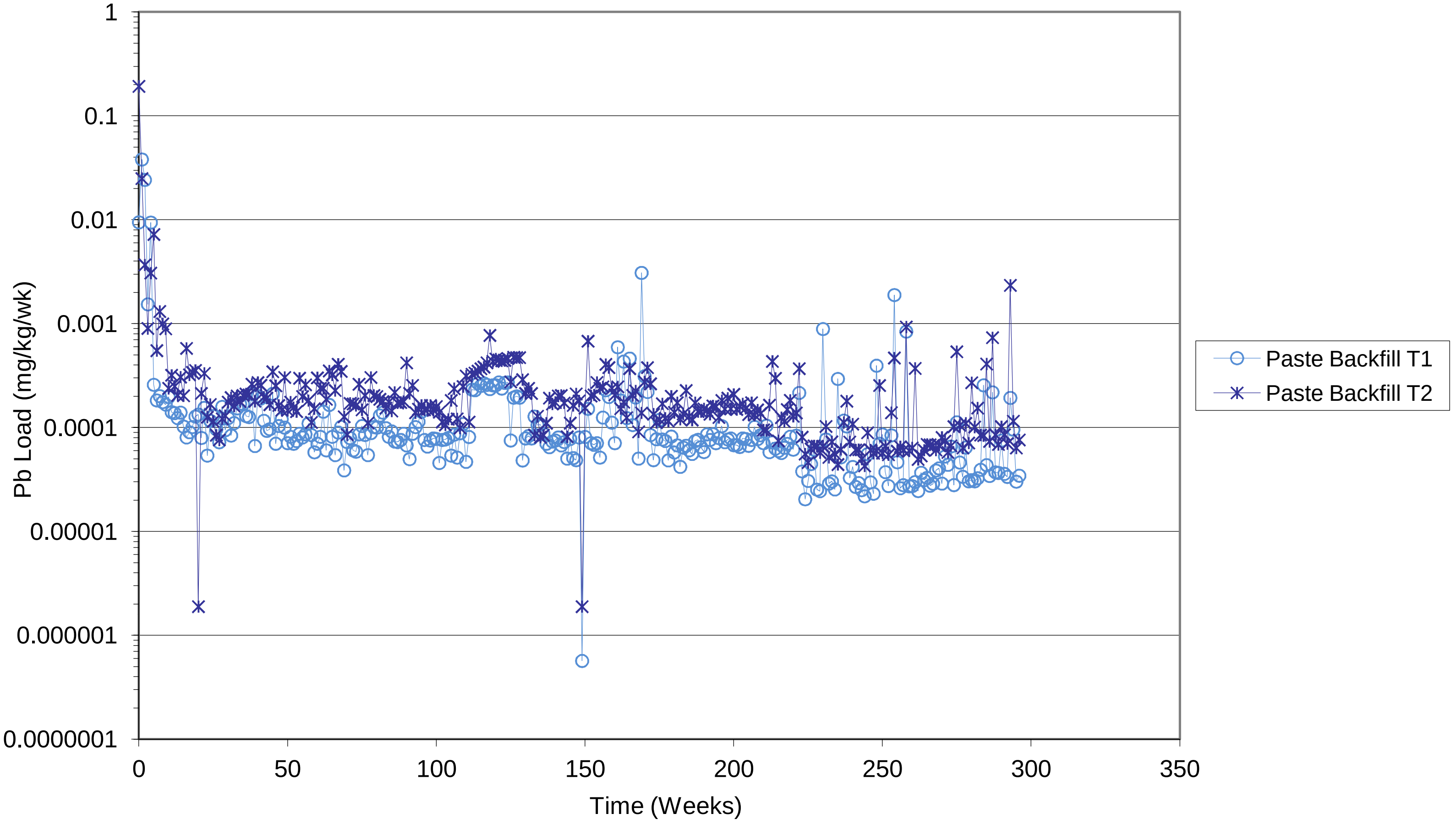

Lead Load
Operating Cells
Wolverine Mine, YK

Paste Backfill

March 2013	FIGURE 45

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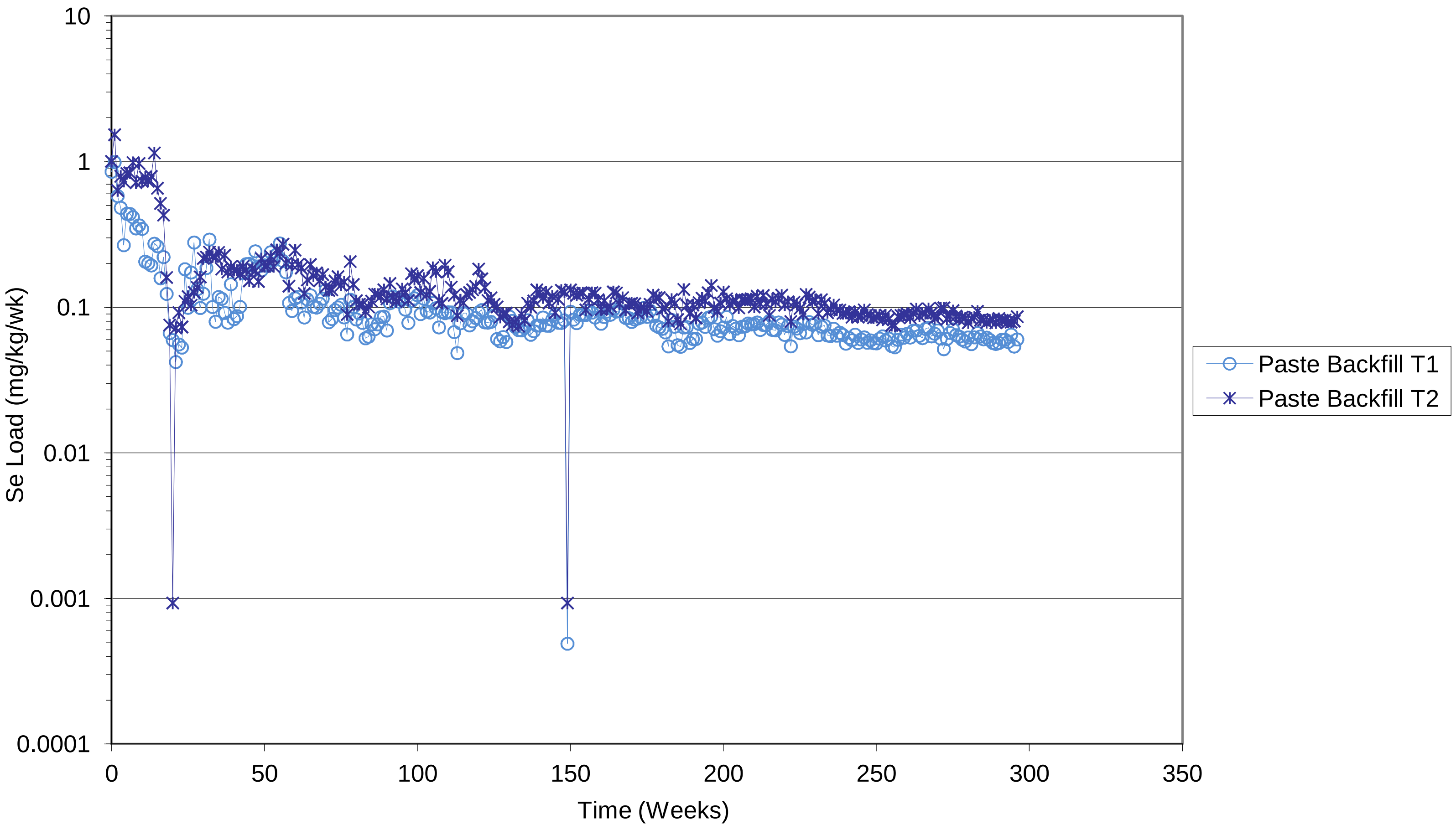

Selenium Load
Operating Cells
Wolverine Mine, YK

Paste Backfill

March 2013 | FIGURE 46

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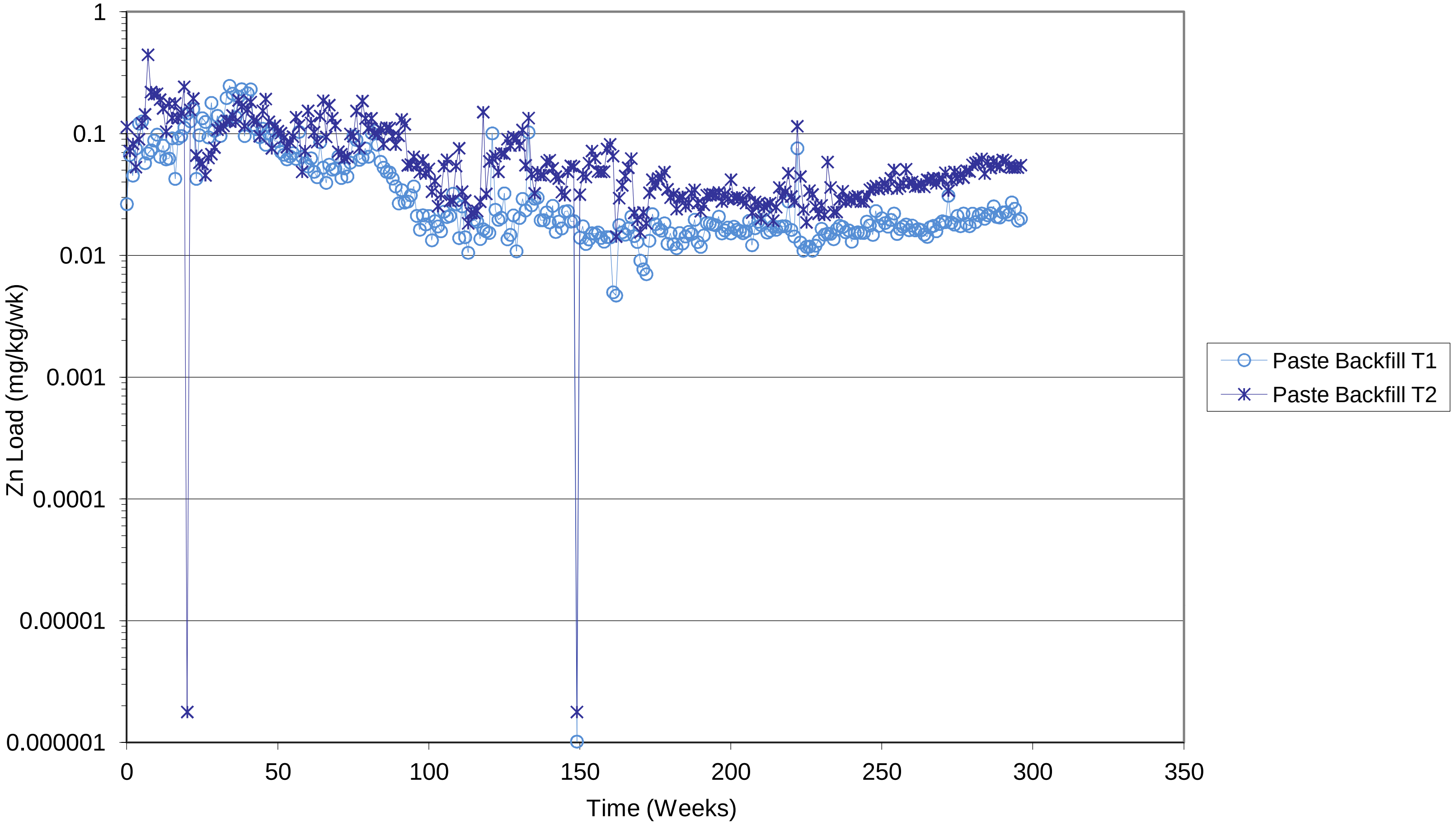

Zinc Load
Operating Cells
Wolverine Mine, YK

Paste Backfill

March 2013	FIGURE 47

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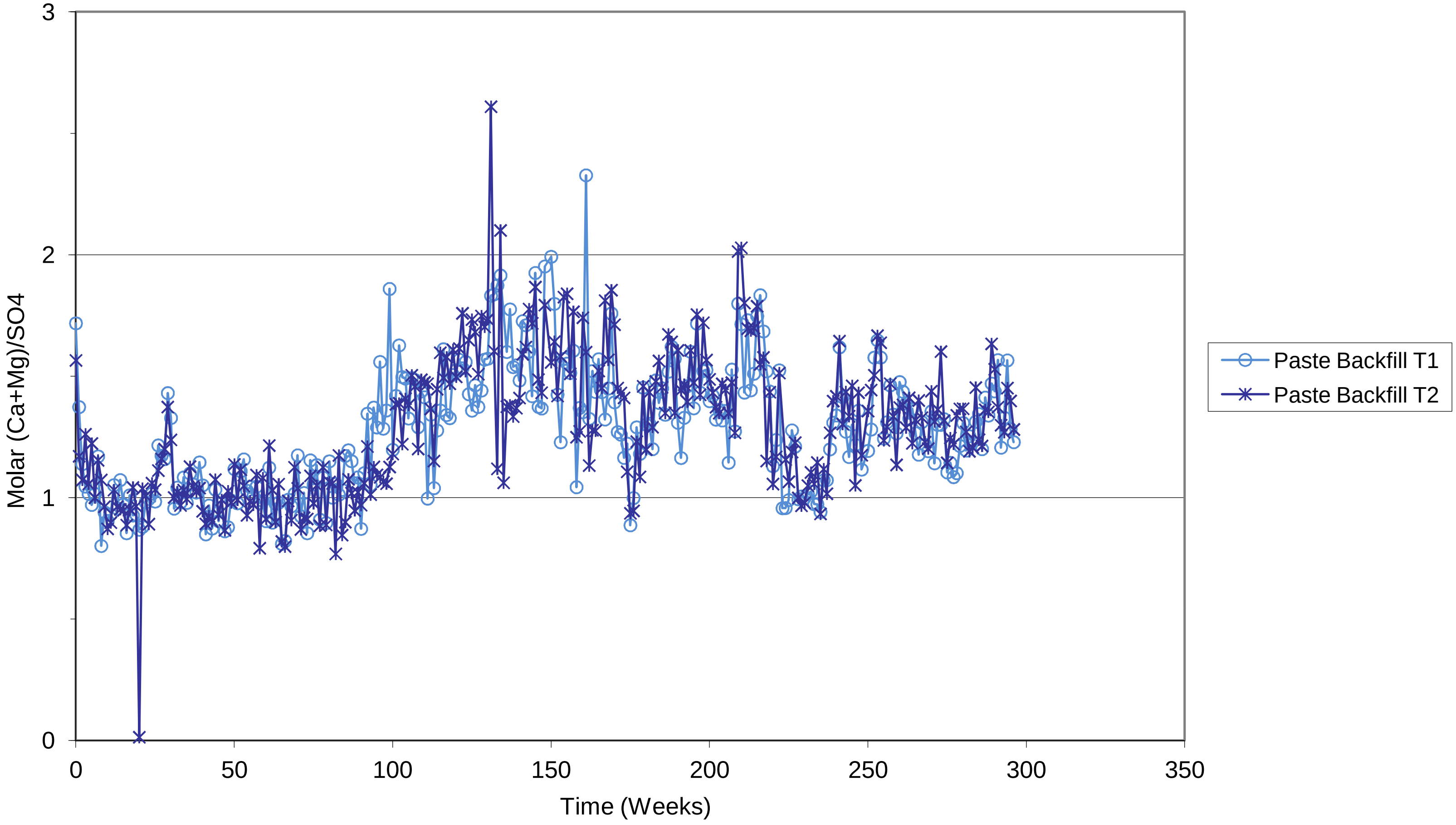

Molar $(Ca+Mg)/SO_4$ Ratio
Operating Cells
Wolverine Mine, YK

Paste Backfill

March 2013	FIGURE 48

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Appendix E: Geochemical Testwork – MEA Report

Wolverine Mine

Tailings Humidity Cells Decommissioning

Prepared for:

YukonZinc CORP

Prepared by:

Marsland
Environmental
Associates

February 2014

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1. Introduction

Environmental characterization of the Wolverine Mine tailings was initiated by Klohn Crippen in 2005 to support the Wolverine Mine environmental assessment. The purpose of the testing program was to identify the geochemical, metal leaching and acid rock drainage (ML/ARD) characteristics of tailings and waste rock materials. Both static and kinetic testing was employed in the characterization of samples. A detailed summary of the initial characterization work was provided in Appendix IV of the environmental assessment (KC, 2006).

Four tailings humidity cells were constructed in 2005 to assess the geochemical behaviour of unsaturated tailings under humid, aerobic conditions. The humidity cells were comprised of materials generated by experimental lock cycle testing using rock generated by bulk sampling conducted in 2005. Each of the four cells represented a likely tailings composition based on the best mine planning information available at the time.

Two samples, the Lynx Diluted Composite (Lynx) and Wolverine Diluted Composite (Wolv), ran for 63 weeks. The cells were decommissioned in 2006 once the mine plan and mineral processes were clearly defined, and it became apparent that these individual ore types did not behave significantly differently from the overall ore composites.

The Overall Ore Composite (OC) and Overall Diluted Ore Composite (OD) tailings humidity cells showed ML/ARD characteristics and were left running for several years to observe leachate chemistry and more conclusively determine the time required for Neutralization Potential depletion and the onset to acid generation. Beginning in 2010, the OD cell exhibited acidic leachate chemistry (after 250 weeks). The OC cell remained neutral throughout the testing program. The OC and OD cells ran a total of 345 and 339 weeks, respectively, until they were decommissioned in January 2012.

The following report provides a summary of the tailings sample selection, humidity cell set-up, operation, and decommissioning procedures. Pre-test and post-test geochemical characterization of the sample material is also included. Recommendations for further geochemical characterization test work are also provided.

2. Sample Selection and Preparation

Geochemical characterization was carried out on tailings samples representing possible tailings blends from the Wolverine Mine Project. To assess the geochemical characteristics of the tailings, four ore composite types were prepared and examined in 2005. The four samples were prepared with lock cycle tests (LCT) carried out to simulate the milling process. It was estimated at the time the process would produce three tailing sub-streams: ~2% pre-float concentrate tails (PFC), 88% rougher tails (Ro), and 10% cleaner scavenger tails (CS). The composite samples for kinetic testing included the following:

- **Combined Overall Diluted Ore Composite Tailings (OD).** Combined the three tailings streams generated by using ore and dilution rock from both Wolverine and Lynx ore zones.

- **Combined Overall Ore Composite Tailings (OC).** Combined the tailings generated from using only ore from the Wolverine and Lynx ore zones, and did not include any dilution rock. The sample was a composite of two lock cycle tests.

- **Combined Wolverine Composite Ore with Dilution Rock Tailings (Wolv)**. Combined all three tailings streams generated from ore samples prepared including dilution rock from the Wolverine ore zone.

- **Combined Lynx Ore with Dilution Rock Composite Tailings (Lynx).** Combined all three tailings streams generated from ore samples prepared that included dilution rock from the Lynx ore zone.

Subsequent to the testing program, the milling procedure was modified and the dense media separation (DMS), which produced a low specific gravity gravel sized by-product (DMS float), which mainly contained the dilution waste rock products, was dropped from the process. The implication of this change is that more dilution waste rock is milled through the overall process, and will be subsequently deposited in the tailings. Therefore, at this time, OD is considered to be the most representative tailings sample of the tailings that are presently being generated at the mine.

3. Pre-Test Characterization

The intent of pre-test characterization was to establish an understanding of the material composition of the test samples. Pre-test characterization of the humidity cell test material was carried out in 2005 under direction of Klohn Crippen and followed the Draft Guidelines and Recommendation Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Mine Sites in British Columbia (Price, 1997). Mineral composition, solid phase analysis, and acid-base accounting (ABA) were carried out on the samples. Test procedures and results are presented in the following sections.

3.1 Mineralogy Analysis

Mineral assemblage percentages were assessed using optical microscopy on the four samples and the results are summarized in Table 1. In addition, quantitative phase analysis using x-ray diffraction (XRD) with Rietveld refinement was carried out, which helped identify the carbonate and sulphide species. The following conclusions were reported by Klohn Crippen (2006a):

- Pyrite is the dominant sulphide, with moderate concentrations of quartz and muscovite. Minor sulphides (arsenopyrite and sphalerite) were not detected, although these were detected in the optical mineralogical analysis (<1.8%).
- The abundance of reactive carbonates and non-carbonate minerals (<10% total), relative to the high sulphide content indicated that the materials are likely acid generating.
- The abundance of reactive carbonates indicated that there would be a lag time of likely several years prior to onset of acid generation.
- Rietveld analyses identified the main carbonates as dolomite (5% to 7.4%), calcite (2.6% to 3.6%) and siderite (0.4% to 0.5%).

Trace element analyses by Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) were carried out on an *aqua regia* digest of the tailings samples, to quantify the solid-phase concentrations of various elements within the samples. When measured sample concentrations are compared to known crustal abundances, it can be determined which elements may be of environmental concern under neutral or acidic drainage conditions. At the time of the analyses, anomalous elemental concentrations were defined by Klohn Crippen as greater than five times the normal crustal abundance as listed in Appendix 3 of Price (1997). Thirteen trace elements

(Table 4) showed concentrations greater than five times crustal abundance in most of the samples. The results suggested that following the onset of acidic conditions, the release of metal(loid)s from mineral phases, particularly from the sulphide phases, may occur. Furthermore, elements that are mobile under neutral pH conditions may have the potential to be released prior to the onset of acidic conditions.

Table 1: Pre-test Mineral Assemblages and Modal Abundance

MINERAL	Tailings Sample			
	OD	OC	WOLV	LYNX
Pyrite	53.1	60.1	38.3	60.3
Quartz	20.9	17.1	26.7	16.7
Carbonate	10.5	10.6	14.2	11.6
Muscovite	11.9	5.2	14.3	8.9
Chlorite	1	1.1	0.9	0
Sphalerite	1.1	1.6	1.3	1.8
Pyrrhotite	0.5	1.6	2.1	0
Amphibole	0	0.6	0.5	0
Arsenopyrite	0.3	0.8	0	0.3
Pyroxene	0.2	0.3	1.5	0
Chalcopyrite	0.5	0.4	0.2	0
Galena	0	0.4	0	0.8
Biotite	0	0.2	0	0
Magnetite	0	0.1	0	0
Total	**100**	**100**	**100**	**100**

3.2 Acid Base Accounting (ABA)

Acidic drainage will only result when the rate of acid generation exceeds the rate of acid neutralization. Acid Base Accounting (ABA) is a series of analyses and calculations used to estimate the potential for mineral weathering to produce acidic drainage. ABA includes analysis for rinse and paste pH, sulphur species, acid generation potential (AP), and acid neutralization potential (NP). Laboratory ABA testing was carried out in 2005 under the direction of Klohn Crippen and results are presented in Table 2. Key observations as reported by Klohn Crippen (2006a) were:

- All samples had high sulphide content and a low NP and were likely to produce acid rock drainage.

- The samples had enough NP (carbonate neutralization potential of 52.3-106 kg $CaCO_3$/t) to remain at a near-neutral pH, when initially exposed to oxygen. This was further supported by the relatively high paste pH values of 7.27 to 7.42.

- Most samples indicated the presence of non-carbonate neutralization potential, possibly from the muscovite, clinochlore and kaolinite, indicated by the mineralogical analysis (Section 3.1).

Table 2: Pre-Test Tailings ABA Results

PARAMETER	UNITS	OD	OC	WOLV	LYNX
Paste pH	-	7.27	7.42	7.35	7.36
Fizz Rate	-	2	3	2	2
Total S	%S	26.6	29.2	19.7	31.2
Acid Leachable SO_4^{2-}	%S	2.04	2.51	1.74	0.74
Sulphide S	%S	22.9	25	15.7	27.8
Insoluble SO_4^{2-}	%S	0.005	0.005	0.005	0.005
Organic S	%S	1.67	1.73	2.34	2.68
AP	kg $CaCO_3$/t	715	781	489	869
Sobek NP	kg $CaCO_3$/t	82.5	72.8	94.6	49.4
Sobek NP/AP	-	0.12	0.09	0.19	0.06
Net NP	kg $CaCO_3$/t	-632	-708	-395	-820
C(t)	%C	1.56	1.48	2.14	1.27
TOC	%C	0.62	na	0.98	0.48
TIC	%C	0.94	na	1.2	0.79
Carb NP	kg $CaCO_3$/t	98.3	59.4	106	52.3
Carb NP/AP	-	0.14	0.08	0.22	0.06

Note: Red text indicates measured value less than detection limit and listed as one half of the method detection limit.

3.3 Metals Analysis

Trace element analyses by ICP-MS were carried out on the tailings samples in 2005 by SGS Lakefield, under the direction of Klohn Crippen. Solid samples were subjected to near-total digestion in a mixture of strong oxidizing acids (HNO_3 and HCl), known as *aqua regia*, in order to dissolve most mineral phases. Digests were then quantitatively analyzed for a suite of major, minor and trace elements. The elemental analyses by ICP-MS as reported by Klohn Crippen (2005b) are presented in Table 3.

Table 3: Pre-test ICP-MS Solid Phase Results

Element	Unit	Crustal Abundance[1]	Tailings Samples			
			OD	OC	WOLV	LYNX
Ag	mg/kg	0.080	55	59	82	54
Al	%	8.4	0.60	0.43	1.0	0.28
As	mg/kg	1.8	2,700	2,700	1,200	4,100
Ba	mg/kg	390	53	38	66	50
Be	mg/kg	2.0	0.17	0.10	0.24	0.12
Bi	mg/kg	0.0082	11	7.5	19	6.4
B	mg/kg	9.0	2.5	1.5	2.5	2.5
Ca	%	4.7	2.5	2.3	2.7	2.4
Cd	mg/kg	0.16	97	140	74	110
Co	mg/kg	29	43	37	48	39
Cr	mg/kg	122	200	120	160	210
Cu	mg/kg	68	820	1,100	1,100	820
Fe	%	6.2	23	28	18	27
Hg	mg/kg	0.086	3.6	3.2	4.0	3.2
K	%	1.8	0.17	0.21	0.25	0.11
Li	mg/kg	18	1.6	0.15	5.5	0.10
Mg	%	2.8	1.0	0.75	1.6	0.52
Mn	mg/kg	1,060	670	680	620	700
Mo	mg/kg	1.2	32	28	25	45
Na	%	2.3	0.014	0.011	0.015	0.010
Ni	mg/kg	99	60	65	56	63
P	mg/kg	1,120	320	290	520	190
Pb	mg/kg	13	3,900	3,500	5,100	5,600
Sb	mg/kg	0.20	170	220	310	180
Se	mg/kg	0.050	364	361	464	336
Sn	mg/kg	2.1	13	11	10	16
Sr	mg/kg	384	53	49	59	48
Ti	mg/kg	6,320	68	54	82	53
Tl	mg/kg	0.72	19	16	13	24
U	mg/kg	2.3	4.7	3.9	6.0	3.4
V	mg/kg	136	37	29	49	33
Zn	mg/kg	76	9,800	19,000	8,000	11,000

Note 1: Crust as a Whole in: Abundances of chemical elements in the Earth's Crust and chondrites in Appendix 3 of Price (1997).

Red text indicates measured value was less than detection limit and is presented as one half of the method detection limit.

Elemental analysis by XRF was also performed to provide a better estimate of elemental concentrations that are generally refractory to the *aqua regia* digest, including aluminosilicate minerals (Al, Si). The results of the Whole Rock Analyses, presented in elemental concentrations, are included in Table 4.

Table 4: Pre-test Elemental Concentrations Calculated from the Whole Rock Data

Element	Elemental Concentration (wt. %)			
	OD	OC	WOLV	LYNX
Si	12.53	11.31	16.5	9.63
Al	2.48	2.06	3.39	1.8
Fe	12.14	13.01	9.72	14.83
Mg	1.27	1.09	1.98	0.69
Ca	2.7	2.36	2.99	2.59
Na	0.18	0.19	0.14	0.17
K	0.5	0.4	0.68	0.38
Ti	0.07	0.05	0.09	0.05
P	0.02	0.02	0.03	0.01
Mn	0.07	0.09	0.06	0.08
Cr	0.02	0.02	0.02	0.02
V	0.02	0.02	0.04	0.02

4. Humidity Cell Testing

For sulphidic geologic materials, the humidity cell is the recommended kinetic test for predicting primary reaction rates under aerobic weathering conditions (Price, 2010). The resulting data provides a measure of rates of elemental release, acid generation and acid neutralization under the geochemical conditions encountered in the test. Humidity cell data can be used to estimate the time to mineral exhaustion, time to onset of acid generation, and waste rock and tailings drainge chemistry.

4.1 Set-up

The following description of humidity cell set-up was provided by Klohn Crippen (2006b). The humidity cells were constructed using acrylic tubing and base plate with an approximately 20 cm inside diameter and 10 cm height. The base plate was glued to the tube and threaded with a nylon hose adapter to which a length of tubing was attached allowing for leachate drainage into a collection container. A perforated PVC support plate was positioned inside the cell approximately 1.3 cm above the base plate and covered with six layers of nylon mesh. A nylon adapter was threaded into the side of the cell between the support plate, and the base plate and a length of tubing was connected from the side adapter to a humidifier to facilitate the inflow of humid air to the cell. A dry air line was also connected to each cell. Each cell was covered with a removable acrylic lid. The modifications made to the tailings flood leach humidity cell were adopted to facilitate the movement of water through the finer grained tailings. A saturated 1.0 kg sample of tailings was used to charge each cell. The overall depth of tailings within each humidity cell was approximately five centimetres. The OC humidity cell is depicted in Photo 1.

Photo 1: OC Humidity Cell (January 29, 2012)

4.2 Operation

At the end of each weekly cycle, the volume of leachate collected in the container for the tailings flood leach humidity cell was recorded. The leachate was filtered through a Gelman magnetic filter funnel fitted with a membrane filter of pore size 0.45 μm and analyzed by ICP-MS for a suite of elements as well as for pH, conductivity, acidity, alkalinity and sulphate.

4.3 Results

The primary objective of the humidity cell testing was to measure reaction rates under specific geochemical conditions and to calculate times for onset of acid generation. Weekly leachate volume, concentration, and sample mass were combined to calculate mass loading rates with units mg/kg/wk. The leachate chemistry and loading rates were compiled into a spreadsheet file titled “120724_Wolverine_Tailings_HC_database.xlsm”. A digital version of the data compilation file accompanies this report. The following sections provide a short summary of relevant analytical results for each of the four humidity cells.

4.3.1 pH

The pH values for all humidity cells over the duration of the testing program are presented graphically in Figure 1. The Wolv and Lynx cells began at neutral pH and then fell until week four, where they then returned to neutral pH and remained at nearly neutral levels for the remainder of the testing program.

The OC cell remained at nearly neutral pH levels for the duration of the testing program. The OC cell appeared to be undergoing a very slight decrease in pH from approximately week 200 (pH 6.8) until shutdown at week 345 (pH 6.4).

The OD cell had an initial pH of pH 7.0 (week 0), and pH dropped substantially over weeks 1-3 until recovering by week 4 when the pH rose to near neutral conditions and remained stable until approximately week 250 (4.8 years). This initial pH drop is believed to be associated with the relatively rapid oxidation of the thiosalts present in the tailings voids water. After week 250 the pH dropped steadily as a result of the onset of sulphide-oxidation induced acidic drainage conditions. At the end of the testing program, leachate pH of the OD cell had reached a minimum value of pH 3.1. The rate of drop in pH appeared to be slowing down between week 315 and shutdown of the cell (week 339). Although it is not possible to predict pH beyond the timeframe of the testing program by extrapolation, the pH might be expected to continue decrease and eventually stabilize at a lower, more acidic pH level. It is also possible that the pH could reach a minimum level and then rebound to a higher level before reaching a stable level.

4.3.2 Sulphate

Sulphate production rate is monitored in humidity cells to assess the depletion of sulphur species from the tailings samples because the process of oxidation of sulphides into sulphate can lead to acidic drainage conditions. Until the initial sulphate has been flushed from the humidity cell, the sulphate production rate does not necessarily reflect sulphate produced through the sulphide oxidation process. Prior to depletion of the original sulphate from the sample, it is likely that a majority of the sulphate measured is due to flushing of the original sulphate from the sample with only some sulphate produced due to sulphide oxidation. Therefore, in humidity cell testing, it is commonly assumed that sulphide oxidation is not taking place until flushing of all of the original sulphate measured during the pre-test ABA characterization is complete. A mass balance of the sulphur species for each cell is included in the ABA discussion in Section 6.1. Sulphate production rates are presented for each cell in Figure 2.

4.3.3 Metal Loading Rates

Each of the cells underwent an initial flush where metal loading rates were initially high for some parameters, but stabilized out at a lower level at a later date. Pre-test ICP-MS analysis showed that zinc (Zn) and selenium (Se) were present at elevated levels in the solid samples. Se and Zn are mobile under neutral drainage conditions, and loading rates for those metals were observed at elevated levels among all humidity cells, during, and following the initial flush. Zn and Se loading rates are presented in Figure 3 and Figure 4, respectively.

There has been an exponential growth trend in loading rates of various substances from the OD cell since the onset of acid generation conditions (week 232). The copper (Cu) loading rate has risen from around 0.0019 mg/kg/wk and reached as high as 4.1 mg/kg/wk (week 332). Cu loading at the final week (week 339) was 2.7 mg/kg/wk (Figure 5). The trend in Cu loadings is the most pronounced; the increase is ~1400-fold for Cu, ~50-fold for Zn and ~5-fold for Se. The exponential trends in metal loading rates appeared to be levelling off or decreasing between weeks 324 and 339, as the final data point was lower than the previous three.

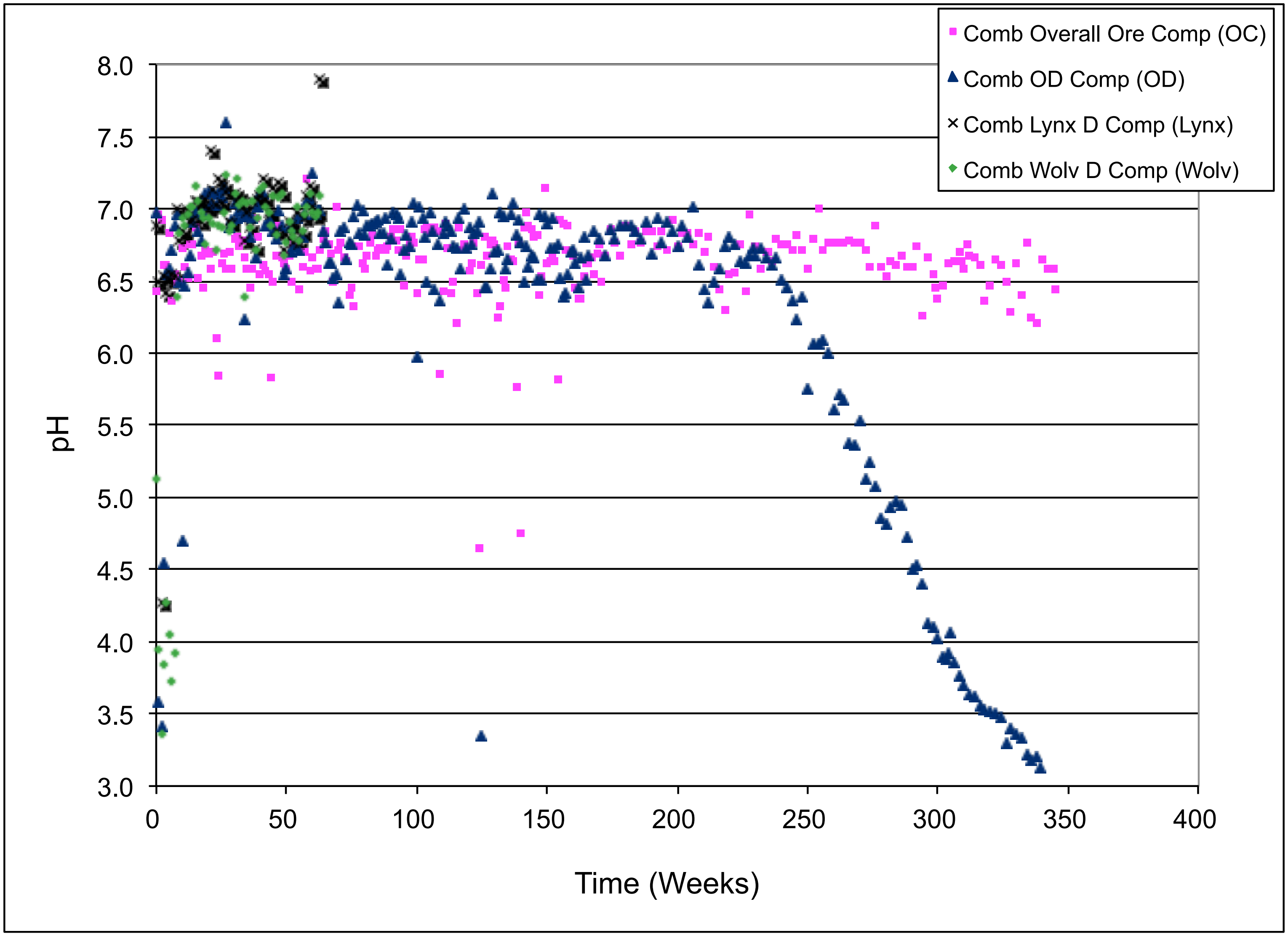

Figure 1: Wolverine Tailings Humidity Cells – pH

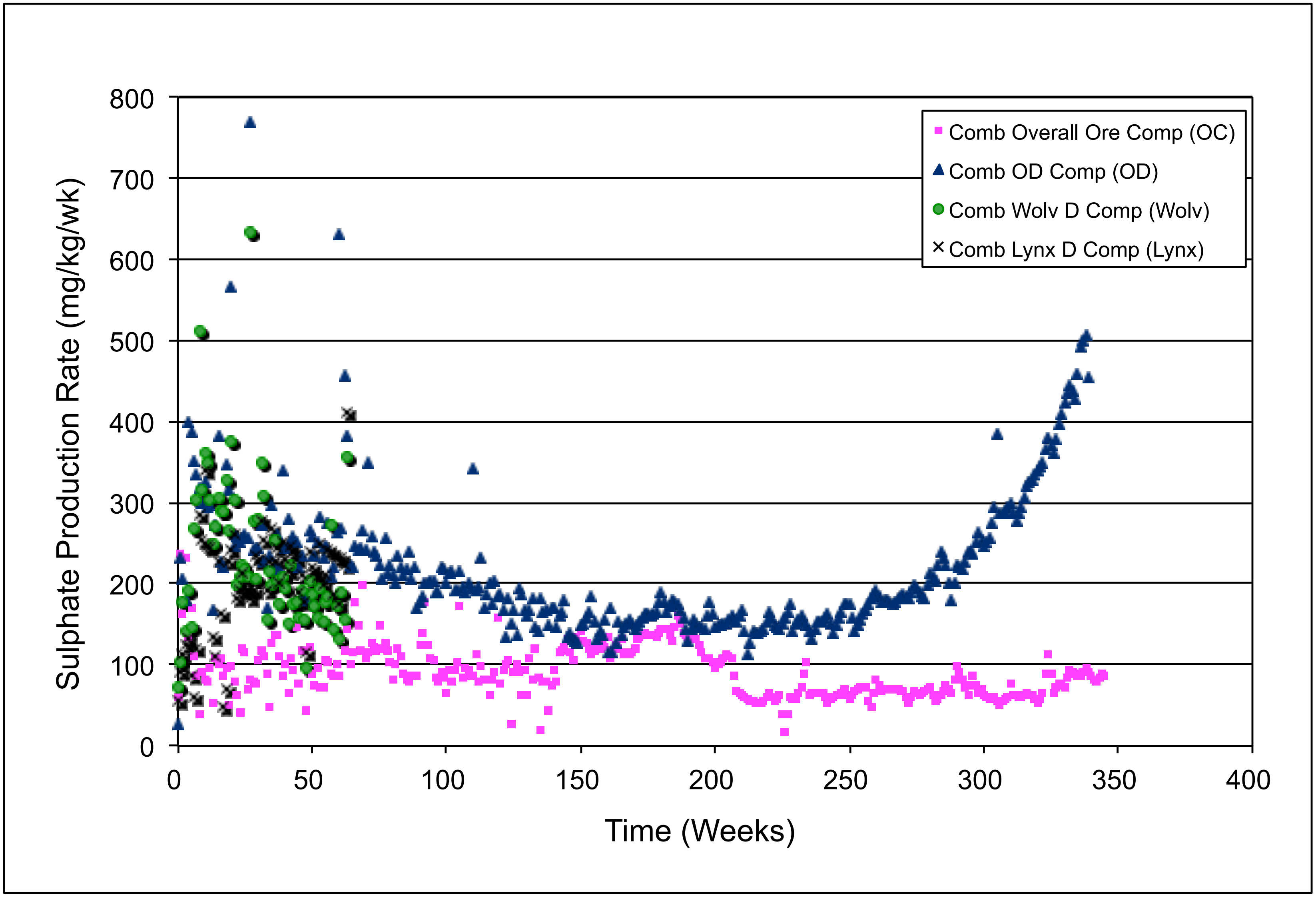

Figure 2: Wolverine Tailings Humidity Cells – Sulphate (SO_4) Production

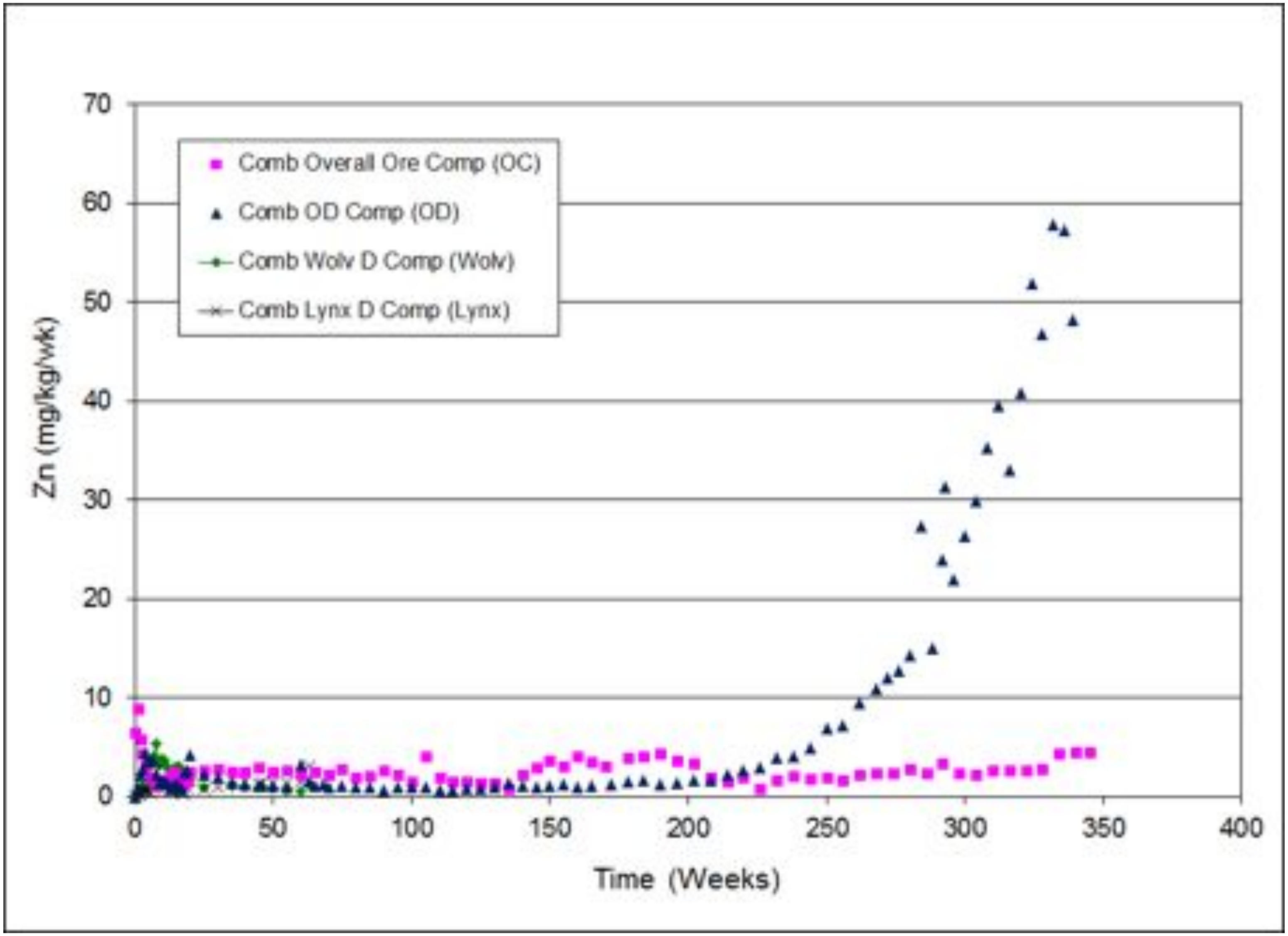

Figure 3: Wolverine Tailings Humidity Cells – Zinc (Zn) Loading Rates

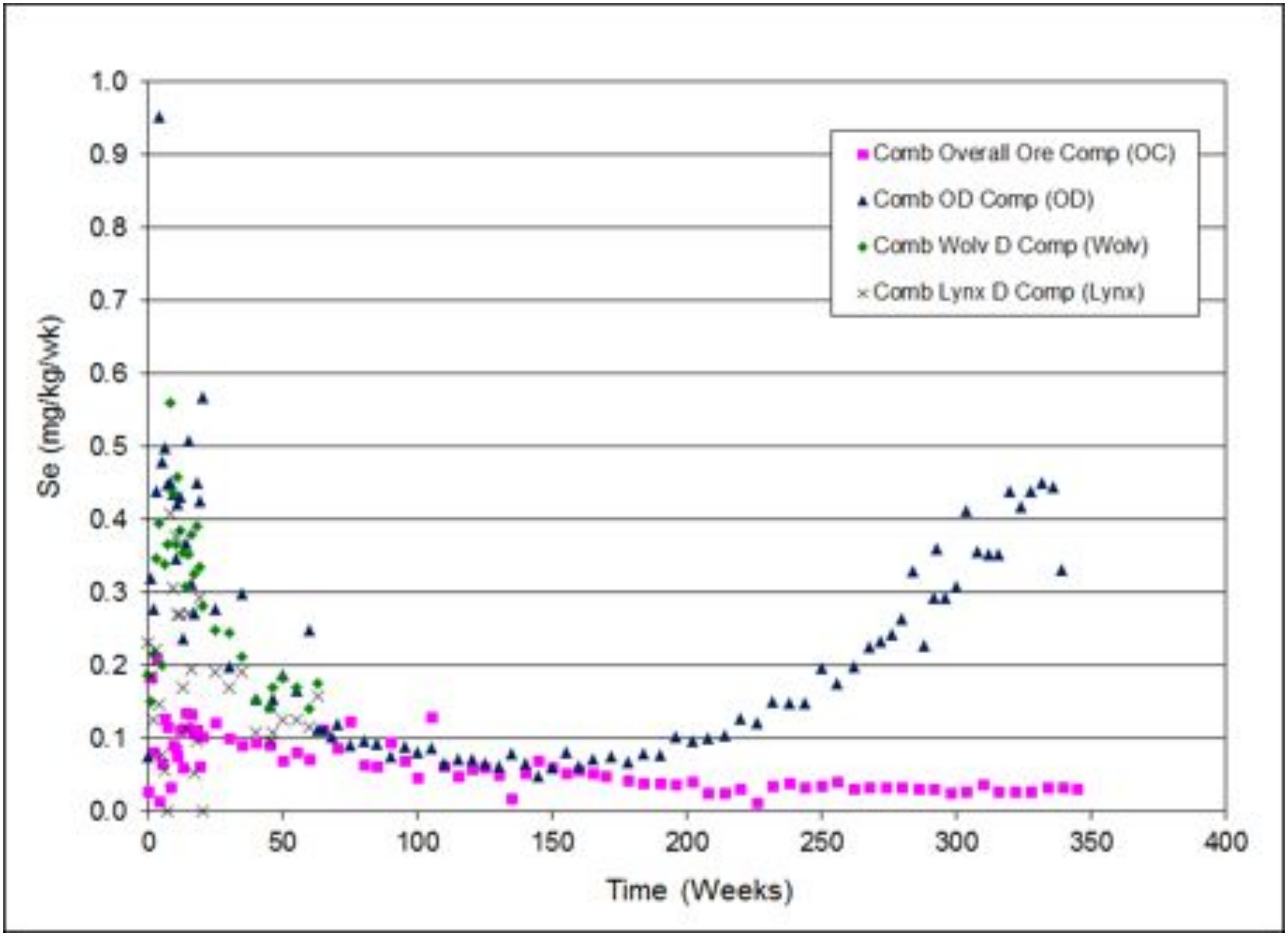

Figure 4: Wolverine Tailings Humidity Cells – Selenium (Se) Loading Rates

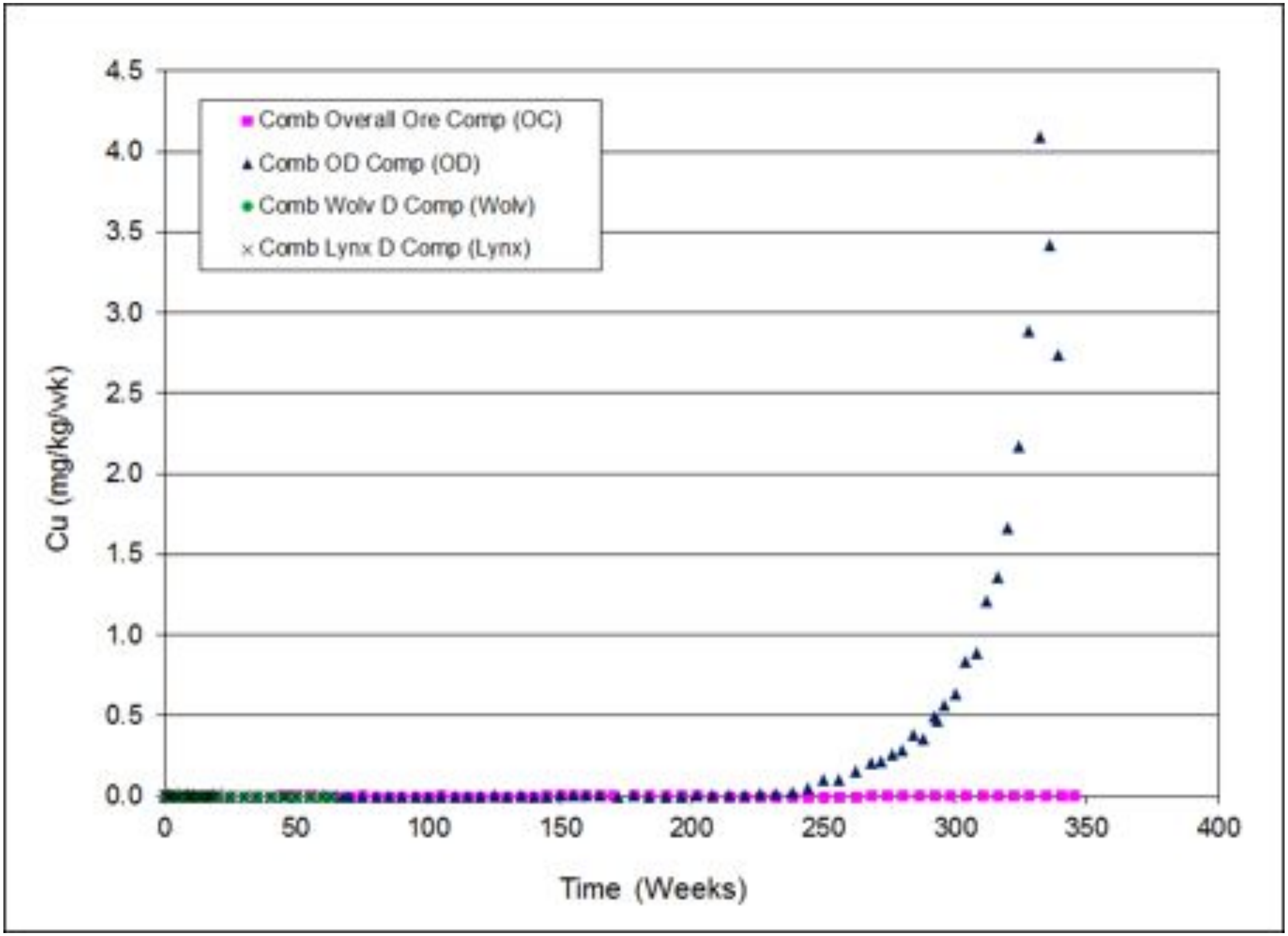

Figure 5: Wolverine Tailings Humidity Cells – Copper (Cu) Loading Rates

4.4 Humidity Cell Decommissioning (Shut-Down)

The Wolv and Lynx cells were each allowed to run for a total of 63 weeks. The cells were decommissioned in 2006 because it had become clear that the two ore types would be processed simultaneously and so separate humidity cells would not be representative of the tailings produced from the milling process. The Overall Ore Composites were continued as they were more suitable for the testing program.

The OC and OD cells were left to run a total of 345 and 339 weeks, respectively, until they were decommissioned in January 2012. Humidity cell closedown procedures were followed as outlined in the MEND Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials (Price, 2009). The following key items were undertaken during the shutdown procedure:

- After the final humidity cell cycle, collect the leachate as per the humidity cell operational procedures. Submit to lab for full suite of leachate water quality analyses.
- Remove the sample from the test cell and carry out a shake flask extraction test with minimum 3:1 (by mass) liquid to volume ratio. Following the procedure, collect the leachate, record leachate volume, and label the sample “final leach”. Carry out full suite of leachate water quality analysis on the “final leach” sample (pH, conductivity, acidity/alkalinity, sulphate, metals by ICP-MS including Hg, thiosalts, Cl, F, CNO, CNS, NO_3, and NH_3).
- Measure the mass of the wet solids. Dry the solids, then measure mass of dry solids.
- Take a representative split from the solid sample and label it “Final Residue”. Submit the split for comprehensive compositional analysis (petrographics, XRD, expanded ABA, ICP metals, Whole Rock Analyses by XRF, shake flask analyses (with pH, sulphate and metals)).

Photos of the Wolv and Lynx samples following decommissioning are provided in Photo 2 and Photo 3. Photos of the OD and OC samples during the decommissioning are presented in Photo 4 to Photo 7. Note the evidence of oxidation in the iron staining visible in the OD cell photos, which is also perhaps slightly evident in the OC cell but is certainly absent from the other cells, which had not been allowed to run for long enough for iron staining to become evident.

Photo 2: Wolverine Diluted Tailings in the Humidity Cell (October 6, 2006)

Photo 3: Lynx Diluted Tailings in the Humidity Cell (October 6, 2006)

Photo 4: OD Tailings in the Humidity Cell (January 29, 2012)

Photo 5: OD Tailings Sample Placed on Sheet for Drying (January 29, 2012)

Photo 6: OC Tailings in the Humidity Cell (January 29, 2012)

Photo 7: OC Tailings Sample Placed on Sheet for Drying (January 29, 2012)

5. Post-Test Characterization

Post-test characterization was carried out on the tailings samples following shutdown of the cells. Characterization work included mineralogy (optical microscopy and x-ray diffraction), ABA, metals analysis and shake flask testing. The results of the post-test characterization are presented below, and a comparison between pre-test and post-test characterization results is presented in Section 6.

5.1 Mineralogy Analysis

Mineral assemblage percentages of the post-test Wolv and Lynx tailings samples were assessed in 2007 by SGS using optical microscopy and the results are summarized in Table 5. In addition, quantitative phase analysis using x-ray diffraction (XRD) with Rietveld refinement was carried out, which helped identify the carbonate and sulphide species. The post-test mineral assemblages by QEMSCAN and subsequent quantitative phase analysis by Rietveld XRD of the OC and OD tailings samples were carried out in 2012 by SGS and are summarized in Table 6. The full analytical results are provided in Appendix A.

Table 5: Post-Test Mineral Assemblages for final Wolv and Lynx Samples

Mineral	QEMSCAN		Rietveld - XRD	
	WOLV	LYNX	WOLV	LYNX
Pyrite	40	67.6	36.1	64.7
Quartz	25.4	15.1	30.7	17.4
K-Feldspar	1.2	1.4		
Muscovite / Sericite	7	2.1	14.8	8.8
Biotite	3.3	0.8	1.3	1.2
Chlorite	5.9	0.3		
Pyriboles	0.9	0.2		
Plagioclase	0.1	0		
Talc	0.2	0		
Garnet	0	0		
Clay Minerals	4.4	3.9		
Calcite	0.5	0.4	0.5	
Ankerite	1.3	0.6		
Dolomite	4.5	1.6	6.8	3.2
Siderite	0.1	0		
Gypsum	0.3	0.5	3.2	4.9
Jarosite	1.9	2.6		
Rutile	0.2	0.1		
Fe-oxides	0.7	0.5		
Ilmenite	0.2	0.1		
Sphalerite	1	1		
Pyrrhotite	0.3	0.1	1.6	
Chalcopyrite	0.2	0.1		
Arsenopyrite	0.2	0.7		
Chlinochlore			4.9	
Other Trace (<0.05 wt.%)	0.3	0.2		
Total	**100**	**100**	**100**	**100**

Table 6: Post-Test Mineral Assemblages for final OC and OD samples

Mineral	QEMSCAN		Rietveld - XRD	
	OD	OC	OD	OC
Pyrite	60.0	69.0	57.3	62.3
Quartz	19.7	11.9	29.4	24.9
Muscovite	7.5	4.9	11.2	8.01
Biotite	3.5	1.8		
Ankerite/Dolomite	0.8	3.9	0.81	3.72
Sphalerite	0.8	3.0		
Chlorites	2.1	1.5	1.33	1.05
Clays	1.8	1.0		
Siderite	0.8	0.5		
Other Silicates	0.8	0.7		
Fe-Ti Oxides	0.7	0.2		
Arsenopyrite	0.2	0.6		
Apatite	0.3	0.2		
Zincite	0.2	0.3		
Chalcopyrite	0.1	0.3		
Pyrrhotite	0.1	0.1		
Galena	<0.1	<0.1		
Other/Accessory	0.4	0.1		
Total	**100**	**100**	**100**	**100**

5.2 Acid Base Accounting (ABA)

ABA testing was carried out on the post-test samples to measure the amount of sulphur species, acid generating potential (AP) and neutralizing potential (NP) remaining in the samples following the humidity cell testing procedure. Analyses on the Wolv and Lynx samples were carried out by SGS. OC and OD analyses were carried out in January 2012 and reported by SGS. Post-test ABA results for all four samples are presented in Table 7. The full analytical results are provided in Appendix B.

Table 7: Post-Test Tailings ABA Results

Parameter	Units	OD	OC	WOLV	LYNX
Paste pH	pH units	5.65	7.06	7.05	6.45
Fizz Rate	---	1	2	2	2
Total S	%	23.2	27.6	18.6	27.1
Acid Leachable SO_4^{2-}	%	0.005	0.005	0.005	0.005
Sulphide S	%	23.2	27.6	17.1	29.0
AP	kg $CaCO_3$/t	725	862	534	906
NP	kg $CaCO_3$/t	11.5	46.5	73.00	39.2
Net NP	kg $CaCO_3$/t	-714	-816	-461	-867
NP/AP	ratio	0.02	0.05	0.14	0.04
C(t)	%	0.727	1.22	1.912	0.865
CO_3	%	0.533	1.29	2.426	0.895

Red text indicates measured value less than detection limit and listed as one half of the method detection limit.

The absence of measurable sulphate reflects the lengthy flushing the cells had undergone, followed by the shake flask extraction prior to the post-test solid phase analyses. This combination removed all the soluble sulphate present in the samples prior to the test as well as any sulphate generated through oxidation of the material.

5.3 Metals Analysis

Metals analysis was carried out on the post-test solids to measure the metals remaining in the samples after the humidity cell testing procedure. Analyses on the Wolv and Lynx samples were carried out by SGS in 2007. OC and OD analyses were carried out in January 2012 and reported by SGS (2012c). Results are presented in Table 8 and the full analytical results are provided in Appendix C.

Table 8: Post-test ICP-MS Solid Phase Results

Element	Unit	Crustal Abundance[1]	Tailings Samples			
			OD	OC	WOLV	LYNX
Ag	mg/kg	0.080	56	63	86	59
Al	%	8.4	3.1	2.4	0.84	0.21
As	mg/kg	1.8	2,600	2,900	1,200	3,700
Ba	mg/kg	390	3,900	1,900	57	32
Be	mg/kg	2.0	1.4	1.2	0.20	0.05
Bi	mg/kg	0.0082	9.8	10	18	4.9
Ca	%	4.7	0.45	1.1	2.2	1.8
Cd	mg/kg	0.16	53	130	75	100
Co	mg/kg	29	29	33	40	32
Cr	mg/kg	122	440	430	91	110
Cu	mg/kg	68	640	960	1,100	850
Fe	%	6.2	35	35	20	30
Hg	mg/kg	0.086	3.9	5.5		
K	%	1.8	1.3	1.1	0.31	0.12
Li	mg/kg	18	29	23	4.2	0.10
Mg	%	2.8	0.86	1.0	1.4	0.37
Mn	mg/kg	1,060	470	730	600	590
Mo	mg/kg	1.2	36	36	28	47
Na	%	2.3	0.040	0.029	0.010	0.0055
Ni	mg/kg	99	45	54	60	66
P	mg/kg	1,120	410	330		
Pb	mg/kg	13	4,100	4,300	4,500	4,600
Sb	mg/kg	0.20	280	280	290	200
Se	mg/kg	0.050	370	470	530	430
Sn	mg/kg	2.1	21	20	9.0	14
Sr	mg/kg	384	37	49	52	36
Ti	mg/kg	6,320	550	450	62	39
Tl	mg/kg	0.72	36	34	12	23
U	mg/kg	2.3	6.4	6.5	6.5	3.9
V	mg/kg	136	240	200	34	26
Y	mg/kg		9.8	10	10	6.2
Zn	mg/kg	76	6,800	17,000	8,300	11,000

Note 1: Crust as a Whole in Abundances of chemical elements in the Earth's Crust and chondrites in Appendix 3 of Price (1997).

Red text indicates measured value less than detection limit and listed as one half of the method detection limit.

5.4 Shake Flask Extraction Test Analysis

Prior to mineralogy, ABA, and metals analyses, the final contents of the humidity cells underwent a shake flask extraction testing (shake flask test) procedure, as described in Section 4.4. The leachate (labelled “final leach”) water quality was analysed to determine the amount of soluble materials that remained on the tailings and in the pore water after the samples were removed from the cells. Analyses on the Wolv and Lynx samples were carried out by SGS in 2007. OC and OD analyses were carried out in January 2012 and reported by SGS, and results are summarized in Table 9 with the full analytical results are provided in Appendix D.

Table 9: Post-Test Tailings Shake Flask Test Results

Parameter	Units	Tailings Sample			
		OD	OC	WOLV	LYNX
Sample Mass	(g)	1,000	1,000	1,095	1,069
Volume D.I. Water Added	mL	3,000	3,000	3,000	3,000
Initial pH	units	5.3	6.5	6.7	6.7
Final pH	units	5.4	7.1	7.1	6.9
pH	units	6.5	6.9	7.1	7.2
Alkalinity	mg/L as $CaCO_3$	16	17	51	41
Acidity	mg/L as $CaCO_3$	522	37	116	40
Conductivity	µS/cm	2,960	2,050	2,300	2,260
F	mg/L	0.030	0.080	0.19	0.16
Cl	mg/L	1.0	1.0	3.6	1.0
SO4	mg/L	2,200	1,300	1,500	1,500
CN(T)	mg/L	0.005	0.005	0.005	0.005
CNO	mg/L	0.5	0.5	0.5	0.5
CNS	mg/L	0.1	0.1	1	1
Thiosalts (total)	as S_2O_3 mg/L	5	5	80	40
NH_3+NH_4	as N mg/L	0.10	0.20	0.10	0.05
NO3	as N mg/L	0.025	0.025	0.25	0.090
Ag	mg/L	0.00041	0.00005	0.00015	0.00015
Al	mg/L	0.0004	0.0008	0.0050	0.0050
As	mg/L	0.11	0.0064	0.0080	0.0025
Ba	mg/L	0.039	0.029	0.033	0.035
Be	mg/L	0.00001	0.00001	0.00080	0.00020
Bi	mg/L	0.000005	0.000005	0.000500	0.000300
B	mg/L	0.032	0.0086	0.020	0.023

Parameter	Units	Tailings Sample			
		OD	OC	WOLV	LYNX
Ca	mg/L	573	539	611	614
Cd	mg/L	2.1	1.2	0.36	0.29
Co	mg/L	0.14	0.0087	0.061	0.060
Cr	mg/L	0.00025	0.00025	0.00150	0.00150
Cu	mg/L	0.38	0.014	0.003	0.004
Fe	mg/L	0.012	0.0015	0.0050	0.0050
Hg	mg/L	0.00005	0.00030	0.00005	0.00005
Li	mg/L	0.0020	0.0005	0.0050	0.0040
K	mg/L	1.5	0.80	0.84	2.0
Mg	mg/L	62	4.4	21	23
Mn	mg/L	28	2.1	22	5.2
Mo	mg/L	0.00012	0.00330	0.00080	0.00080
Na	mg/L	5.2	4.0	0.42	0.72
Ni	mg/L	0.63	0.024	0.15	0.13
P	mg/L	0.0045	0.012	0.0050	0.030
Pb	mg/L	0.057	0.0097	0.053	0.017
Sb	mg/L			0.005	0.010
Se	mg/L	3.0	0.19	0.28	0.45
Si	mg/L	6.5	1.1	0.97	0.62
Sn	mg/L	0.00006	0.00035	0.0050	0.0040
Sr	mg/L	1.2	0.57	1.2	0.90
Ti	mg/L	0.0008	0.0003	0.0005	0.0005
Tl	mg/L	0.017	0.013	0.007	0.0005
U	mg/L	0.00016	0.000085	0.00080	0.00100
V	mg/L	0.00006	0.00014	0.0040	0.0040
Zn	mg/L	328	38	33	17

Red text indicates measured value less than detection limit and listed as one half of the method detection limit.

6. Mass Balance Assessment

The intent of humidity cell testing is to assess the rate of chemical leaching, time to onset of acid generation, and time until mineral exhaustion in the test material. Pre-test characterization results can be used in conjunction with the humidity cell results and post-test characterization results, to assess the amount of depletion of materials from the samples that occurred over the duration of the humidity cell testing program. The results can also provide insight as to which minerals in the test material did and did not react during kinetic testing. An ABA-based mass balance was carried out to assess the time to AP and NP depletion. Metal content mass balance was carried out to assess the rate of mineral exhaustion based on the humidity cell results.

6.1 ABA

ABA calculations are intended to track the amount of NP, AP, and sulphur species remaining in a sample by comparing the initial content that was measured during the pre-testing program, with the mass of substances released in the humidity cells. In some cases, the time to depletion of neutralizing potential (NP) and onset of acidic drainage conditions can be predicted from the calculations. Once the original sulphate is flushed from the tailings humidity cell, the sulphate measured in the leachate can be attributed to sulphide oxidation, and the time to sulphide depletion can then be estimated. If the time to sulphide depletion is shown to be longer than the time to NP depletion, the time to onset of acidic conditions can also be estimated. However, until all of the initial sulphate has been flushed from a cell, the time to sulphide depletion and subsequent acid generation cannot be estimated.

ABA calculations (Table 10) indicate that the initial sulphate had been depleted from the OD cell by approximately week 303 (5.8 years). Therefore, it was assumed that sulphate production subsequent to week 303 can be attributed to sulphide depletion. Based on the most recent five sulphate production rates for the OD cell, the time to depletion of initial sulphide from the sample was calculated to be 28 years following the depletion of initial sulphate from the sample. Because initial sulphate had not yet been depleted from the Wolv, Lynx, and OC cells prior to decommissioning, the time to depletion of sulphide from those samples could not be predicted. The calculated time to depletion of initial sulphate for Wolv, Lynx and OC and is presented in Table 10.

Mass balance calculations (Table 10) indicated that the OD cell had approximately 99% of initial NP remaining at the onset of acidic conditions (week 232), and 89% of the original NP remaining upon closure of the cell (week 339), indicating that the readily soluble calcite was consumed, and the remaining NP was not capable of buffering the leachate at a pH above pH 3.1. However, the small amount of reactive/available NP in the OD sample did keep the humidity cell pH in the neutral range for almost 5 years of weekly flushing at room temperature. Because initial sulphate depletion or onset of acidic conditions did not occur in the Lynx, Wolv, and OC cells, it was not possible to evaluate the time for NP depletion in those tailings samples. All that can be noted is that leachate pH remained near neutral at the end of the respective test periods. Mass balance results for sulphate, sulphide, and NP are presented Table 10.

Table 10: Depletion of Sulphur Species and NP from Humidity Cell Samples

		OD	OC	WOLV	LYNX
Sulphate and Sulphide Depletion					
Initial SO_4 - S	mg/kg	20,400	25,100	17,400	7,400
Initial S_2 - S	mg/kg	229,000	249,600	157,000	278,000
Cumulative SO_4 - S production to date	mg/kg	24,789	10,601	4,946	4,312
Remaining SO_4 – S (by difference)	mg/kg	0	14,499	12,454	3,088
Remaining S_2 – S (by sulphate removal)	mg/kg	224,604	249,600	157,000	278,000
SO_4 Production (5 sample average[1])	mg/kg/wk	465	87	210	255
SO_4 - S Production (5 sample average[1])	mg/kg/wk	155	29	70	85
Time to Initial SO_4 - S depletion[2]	years	5.8	16.3	4.6	1.9
Time to Initial S_2 - S depletion[3]	years	28	-	-	-
NP Depletion					
Initial NP	mg $CaCO_3$/kg	82,500	72,800	94,600	49,400
Cumulative Open System NP Consumption	mg $CaCO_3$/kg	9,135	153	0	0
Calculated Remaining NP	mg $CaCO_3$/kg	73,365	72,647	94,600	49,400
Open System NP Consumption Rate (5 sample average[1])	mg $CaCO_3$/kg/wk	268	0	0	0
Time to NP Depletion[2]	years	12	-	-	-

1. $S0_4$ and NP production rates were calculated based on the average value from the final five samples in order to reduce the effects of natural weekly variation in leachate water quality results.
2. From beginning of humidity cell testing.
3. From time at which initial sulphate becomes depleted from the sample.

6.2 Metals Analysis

A mass balance was carried out to assess the total mass of metals that was leached from the four tailings samples over the duration of the testing program. The following theoretical relationship represents conservation of mass of substances in the tailings samples following the humidity cell testing program:

$$m_i = m_{HC} + m_{SF} + m_f$$

where

m_i	is the initial metals content in the tailings sample (mg) calculated from the values reported in Table 3.
m_{HC}	is the total mass (mg) of solutes leached from the humidity cells. Calculated in the HC database, provided with this report.
m_{SF}	is the total mass (mg) of solutes washed from the tailings sample during the shake flask test procedure. Calculated from values in Table 9.
m_f	is the final metals content in the tailings sample (mg) calculated from the values reported in Table 8.

The fraction of the initial metals content that was depleted in the humidity cells over the duration of kinetic testing was calculated from the following relationship:

$$\text{Fraction Depleted (\%)} = \left(\frac{m_{HC}+m_{SF}}{m_i}\right)\times 100$$

Results for total mass leached, and fraction of initial content depleted over the testing program are presented in Table 11 to Table 14 for the four cells. Solid phase metals content (by ICP-MS) on the final sample is included in the summary tables for reference. In theory, the final metals content should equal the initial metals content minus the mass of metals leached from the samples. For some parameters and some tailings samples, final metal content results were either higher or lower than what would be calculated using the mass balance equation from the laboratory data. The following reasons are potential sources of error:

- ICP-MS should be regarded as accurate to +/- 25% for both the initial and final metals content analysis.

- The solid phase metals content results are based on ICP-MS analysis on a sub-sample (total mass of a few grams) taken from the tailings humidity cell sample (approximately 1 kg). There may be some heterogeneity among the humidity cell tailings sample from which the initial and final content sub-samples were taken, leaving potential for minerals to be present in different proportions among different sub-samples.

Therefore, it is often difficult to get convergence of the mass balance equation from the laboratory analytical results. However, the results and mass balance calculations do illustrate order of magnitude (months / years / decades) estimates for time to exhaustion of various metals that could be expected if laboratory loading rates were sustained in the tailings samples for an indefinite amount of time.

Some parameters were routinely below the laboratory detection limit during humidity cell testing. In this assessment, humidity cell leachate that was below detection limit was treated to be equal to half the laboratory detection limit. In some cases, this assumption could overestimate the actual concentration of a given substance by one or more orders of magnitude. Subsequently, the total mass leached during humidity cell testing could be overestimated as well. Parameters with all or most of their humidity cell leachate values below detection limit have been identified in the summary tables (Table 11 to Table 14).

Table 11: Wolv Humidity Cell Mass Metals Leached from a 1 kg Sample

Parameter		Initial Content (mg)	Final Content (mg)	Mass Extracted (mg)		Fraction Extracted (%)
				Humidity Cell	Shake Flask	
Silver	Ag	82	86	0.11	0.00045	0.14
Aluminum	Al	10,000	8,400	0.17	0.015	0.0019
Arsenic	As	1,200	1,200	0.18	0.024	0.017
Barium	Ba	66	57	0.74	0.099	1.3
Beryllium	Be	0.24	0.20	0.046	0.0024	20
Bismuth	Bi	19	18	0.0028	0.0015	0.023
Boron	B	2.5		0.14	0.060	7.9
Calcium	Ca	27,000	22,000	5,553	1,833	27
Cadmium	Cd	74	75	1.9	1.1	4.0
Cobalt	Co	48	40	0.43	0.18	1.3
Chromium	Cr	160	91	0.031	0.0045	0.022
Copper	Cu	1,100	1,100	0.080	0.0090	0.0081
Iron	Fe	180,000	200,000	0.23	0.015	0.00014
Mercury	Hg	4.0		0.0014	0.00015	0.038
Potassium	K	2,500	3,100	0.056	2.5	0.10
Lithium	Li	5.5	4.2	48	0.015	873
Magnesium	Mg	16,000	14,000	867	62	5.8
Manganese	Mn	620	600	38	67	17
Molybdenum	Mo	25	28	0.0097	0.0024	0.050
Sodium	Na	150	100	75	1.3	51
Nickel	Ni	56	60	0.86	0.45	2.4
Phosphorous	P	520		0.92	0.015	0.18
Lead	Pb	5,100	4,500	0.53	0.16	0.013
Antimony	Sb	310	290	0.47	0.015	0.16
Selenium	Se	464	530	16	0.84	3.6
Tin	Sn	10	9.0	0.10	0.015	1.2
Strontium	Sr	59	52	17	3.6	34
Titanium	Ti	82	62	0.050	0.0015	0.063
Thallium	Tl	13	12	0.16	0.021	1.3
Uranium	U	6.0	6.5	0.0027	0.0024	0.084
Vanadium	V	49	34	0.051	0.012	0.13
Zinc	Zn	8,000	8,300	99	100	2.5

Red text indicates that all or most of the input values were less than detection limit, and assumed to be one half of the method detection limit in mass loading calculations.

Table 12: Lynx Humidity Cell Mass Metals Leached from a 1 kg Sample

Parameter		Initial Content (mg)	Final Content (mg)	Mass Extracted (mg)		Fraction Extracted (%)
				Humidity Cell	Shake Flask	
Silver	Ag	54	59	0.069	0.00045	0.13
Aluminum	Al	2,800	2,100	0.14	0.015	0.0054
Arsenic	As	4,100	3,700	0.12	0.0075	0.0030
Barium	Ba	50	32	0.75	0.10	1.7
Beryllium	Be	0.12	0.050	0.042	0.00060	36
Bismuth	Bi	6.4	4.9	0.0026	0.00090	0.055
Boron	B	2.5		0.13	0.069	8.0
Calcium	Ca	24,000	18,000	4,354	1,842	26
Cadmium	Cd	110	100	1.5	0.86	2.1
Cobalt	Co	39	32	0.21	0.18	1.0
Chromium	Cr	210	110	0.011	0.0045	0.0073
Copper	Cu	820	850	0.10	0.012	0.014
Iron	Fe	270,000	300,000	0.22	0.015	0.000085
Mercury	Hg	3.2		0.0013	0.00015	0.045
Potassium	K	1,100	1,200	0.055	5.9	0.54
Lithium	Li	0.10	0.10	19	0.012	19,171
Magnesium	Mg	5,200	3,700	843	68	18
Manganese	Mn	700	590	47	16	9.0
Molybdenum	Mo	45	47	0.014	0.0024	0.036
Sodium	Na	100	55	51	2.2	54
Nickel	Ni	63	66	0.44	0.39	1.3
Phosphorous	P	190		0.83	0.090	0.48
Lead	Pb	5,600	4,600	0.28	0.050	0.0059
Antimony	Sb	180	200	0.44	0.030	0.26
Selenium	Se	336	430	9.5	1.4	3.2
Tin	Sn	16	14	0.16	0.012	1.1
Strontium	Sr	48	36	17	2.7	40
Titanium	Ti	53	39	0.046	0.0015	0.089
Thallium	Tl	24	23	0.26	0.0015	1.1
Uranium	U	3.4	3.9	0.0019	0.0030	0.15
Vanadium	V	33	26	0.029	0.012	0.12
Zinc	Zn	11,000	11,000	76	51	1.2

Red text indicates that all or most of the input values were less than detection limit, and assumed to be one half of the method detection limit in mass loading calculations.

Table 13: OC Humidity Cell Mass Metals Leached from a 1 kg Sample

Parameter		Initial Content (mg)	Final Content (mg)	Mass Extracted (mg)		Fraction Extracted (%)
				Humidity Cell	Shake Flask	
Silver	Ag	59	63	0.11	0.00015	0.18
Aluminum	Al	4,300	24,000	0.30	0.0024	0.0070
Arsenic	As	2,700	2,900	0.39	0.019	0.015
Barium	Ba	38	1,900	2.8	0.088	7.7
Beryllium	Be	0.10	1.2	0.048	0.000030	48
Bismuth	Bi	7.5	10	0.0039	0.000015	0.052
Boron	B	1.5		0.33	0.026	23
Calcium	Ca	23,000	11,000	11,450	1,617	57
Cadmium	Cd	140	130	24	3.6	20
Cobalt	Co	37	33	0.44	0.026	1.2
Chromium	Cr	120	430	0.054	0.00075	0.046
Copper	Cu	1,100	960	0.69	0.041	0.066
Iron	Fe	280,000	350,000	0.92	0.0045	0.00033
Mercury	Hg	3.2	5.5	0.0074	0.00090	0.26
Potassium	K	2,100	11,000	2.0	2.4	0.21
Lithium	Li	0.15	23	43	0.0015	28,576
Magnesium	Mg	7,500	10,000	945	13	13
Manganese	Mn	680	730	106	6.2	17
Molybdenum	Mo	28	36	0.14	0.0099	0.52
Sodium	Na	110	290	38	12	46
Nickel	Ni	65	54	0.54	0.071	0.95
Phosphorous	P	290	330	2.0	0.036	0.70
Lead	Pb	3,500	4,300	2.4	0.029	0.069
Antimony	Sb	220	280	0.72	0	0.33
Selenium	Se	361	470	19	0.58	5.4
Tin	Sn	11	20	0.077	0.0011	0.71
Strontium	Sr	49	49	27	1.7	58
Titanium	Ti	54	450	0.078	0.00090	0.15
Thallium	Tl	16	34	0.51	0.039	3.4
Uranium	U	3.9	6.5	0.058	0.00026	1.5
Vanadium	V	29	200	0.035	0.00042	0.12
Zinc	Zn	19,000	17,000	886	113	5.3

Red text indicates that all or most of the input values were less than detection limit, and assumed to be one half of the method detection limit in mass loading calculations.

Table 14: OD Humidity Cell Mass Metals Leached from a 1 kg Sample

Parameter		Initial Content (mg)	Final Content (mg)	Mass Extracted (mg)		Fraction Extracted (%)
				Humidity Cell	Shake Flask	
Silver	Ag	55	56	0.12	0.0012	0.23
Aluminum	Al	6,000	31,000	61	0.0012	1.0
Arsenic	As	2,700	2,600	2.0	0.34	0.085
Barium	Ba	53	3,900	3.1	0.12	6.0
Beryllium	Be	0.17	1.4	0.051	0.000030	30
Bismuth	Bi	11	9.8	0.0040	0.000015	0.036
Boron	B	2.5		0.35	0.097	18
Calcium	Ca	25,000	4,500	21,057	1,719	91
Cadmium	Cd	97	53	35	6.3	42
Cobalt	Co	43	29	2.9	0.41	7.8
Chromium	Cr	200	440	0.99	0.00075	0.49
Copper	Cu	820	640	91	1.1	11
Iron	Fe	230,000	350,000	953	0.036	0.41
Mercury	Hg	3.6	3.9	0.0014	0.00015	0.042
Potassium	K	1,700	13,000	10	4.5	0.86
Lithium	Li	1.6	29	79	0.0060	4,963
Magnesium	Mg	10,000	8,600	4,475	187	47
Manganese	Mn	670	470	276	83	54
Molybdenum	Mo	32	36	0.13	0.00036	0.42
Sodium	Na	140	400	59	16	53
Nickel	Ni	60	45	7.8	1.9	16
Phosphorous	P	320	410	2.7	0.014	0.85
Lead	Pb	3,900	4,100	10	0.17	0.26
Antimony	Sb	170	280	0.66	0	0.39
Selenium	Se	364	370	64	8.9	20
Tin	Sn	13	21	0.15	0.00018	1.1
Strontium	Sr	53	37	47	3.6	96
Titanium	Ti	68	550	0.10	0.0024	0.16
Thallium	Tl	19	36	0.68	0.050	3.8
Uranium	U	4.7	6.4	0.44	0.00048	9.3
Vanadium	V	37	240	0.086	0.00018	0.23
Zinc	Zn	9,800	6,800	2,801	984	39

Red text indicates that all or most of the input values were less than detection limit, and assumed to be one half of the method detection limit in mass loading calculations.

An overall metals mass balance of the OD cell was conducted for all parameters analyzed, and the results are summarized in Table 15 for parameters of interest: Ca, Cd, Cu, Mg, Se and Zn. The initial content for Ca and Mg were taken from Table 4 to better reflect the solid phase concentration. Mass balances for the other three cells were not conducted as the Wolv and Lynx cells did not run for long enough to release enough contaminants to conduct a mass balance, and as the OC cell did not achieve acidic conditions, the total quantity of metals leached were also inadequate to perform an accurate mass balance.

To evaluate the results of the humidity cell mass balance, the following relationship (from the equation above) should exist:

$$m_i - m_f = m_{HC} + m_{SF}$$

Total Removed = Total Flushed

A very good correlation exists between the total removed (initial – final content) and the total flushed (humidity cell leachate + shake flask extract) for Ca, Cd, Mg and Zn (Table 15). The selenium final content was greater than the initial content; however, as discussed above, each analytical result is only accurate to +/- 25%, meaning the actual initial value could range from 273 – 455 mg and the final value could range from 277 – 462 mg. Additionally, the analytical method for selenium has been greatly improved from 2005 (when initial analysis was conducted), to 2012, with current methods having less interference from other parameters. For copper, the total flushed value was half that of the total removed, however, these values are still within the limits of analytical uncertainty. Overall, the mass balance results confirm the validity of the laboratory humidity cell test program.

Table 15: OD Humidity Cell Metals Mass Balance

Parameter		Initial Content (mg)	Final Content (mg)	Total Removed (mg)	Mass Flushed (mg)		Total Flushed (mg)
					Humidity Cell	Shake Flask	
Calcium	Ca	*27,000*	4,500	22,500	21,057	1,719	22,776
Cadmium	Cd	97	53	44	35	6	41
Copper	Cu	820	640	180	91	1	92
Magnesium	Mg	*12,700*	8,600	4,100	4,475	187	4,662
Selenium	Se	364	370	-6	64	9	73
Zinc	Zn	9,800	6,800	3,000	2,801	984	3,785

NOTE: Values in italics were taken from Table 4 instead of Table 3, to better reflect the true solid phase concentration.

7. Conclusions

While stable long term leaching rates had not been achieved in the four tailings humidity cells prior to decommissioning, the tests illustrated the following characteristics about the samples:

- The tests have indicated that the onset of acid generation in lab conditions could take approximately 5 years for tailings comparable to the OD sample. It was not possible to predict time to onset of acid generation for the Wolv, Lynx and OC cells.
- The majority of the NP in the OD cell was not capable of buffering the leachate to a pH above pH 3.1 However, the relatively small amount of reactive/available NP did keep the OD humidity cell pH in the neutral range for almost 5 years of weekly flushing at room temperature. The time to onset of acidic drainage under site conditions, for tailings comparable to those in the OD sample, would be expected to be considerably longer than that experienced in the laboratory humidity cell.
- Initial flush and neutral pH drainage leaching rates that could be expected given controlled laboratory conditions:
    - All samples showed elevated rates of leaching for Se and Zn for neutral pH drainage. When the drainage became acidic, as in the OD cell, the leaching rates for Cu, Se, and Zn increased exponentially over time, in response to the drop in pH.

A mass balance for the OD cell was carried out to assess the total mass of metals that were leached from the tailings samples over the duration of the testing program. A very good correlation was seen for Ca, Cd, Mg, and Zn. This finding confirms the validity of the laboratory humidity cell test program.

8. Closure

We trust this humidity cell decommissioning report meets your requirements for the Wolverine tailings kinetic testing program. If you have any questions, please contact the undersigned.

Yours truly,
Marsland Environmental Associates Ltd.

Rob Griffith, P.Eng.	Rob Marsland, P.Eng.
Project Engineer	Senior Environmental Engineer

/attach – digital version only of data compilation spreadsheet

9. References

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Appendix A: Final Mineralogy Analysis

QUANTITATIVE PHASE ANALYSIS OF TWO POWDER SAMPLES USING THE RIETVELD METHOD AND X-RAY POWDER DIFFRACTION DATA.

(Project 10961-002 - P.O. 18042)

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February 27, 2007

EXPERIMENTAL METHOD

The two samples “**Combined Wolverine D Composite Tails Final Washed Solids**” and “**Combined Lynx D Composite Tails Final Washed Solids**” were reduced into fine powder to the optimum grain-size range for X-ray analysis (<10μm) grinding under ethanol in a vibratory McCrone Micronising Mill for 7 minutes. Step-scan X-ray powder-diffraction data were collected over a range 3-80°2θ with CoKα radiation on a standard Siemens (Bruker) D5000 Bragg-Brentano diffractometer equipped with an Fe monochromator foil, 0.6 mm (0.3°) divergence slit, incident- and diffracted-beam Sollers slits and a Vantec-1 strip detector. The long fine-focus Co X-ray tube was operated at 35 kV and 40 mA, using a take-off angle of 6°.

RESULTS AND DISCUSSION

The X-ray diffractograms were analyzed using the International Centre for Diffraction Database PDF-4 using Search-Match software by Siemens (Bruker). X-ray powder-diffraction data were refined with Rietveld Topas 3 (Bruker AXS).

The results of quantitative phase analysis by Rietveld refinement are given in Table 1. These amounts represent the relative amounts of crystalline phases normalized to 100%. The Rietveld refinement plots for the samples are shown in Figures 1-2.

Table 1. Results of quantitative phase analysis (wt. %)

Mineral	**Ideal formula**	**Combined Lynx D**	**Combined Wolverine D**
Quartz	SiO_2	17.4	30.7
Muscovite	$KAl_2AlSi_3O_{10}(OH)_2$	8.8	14.8
Biotite	$K(Mg,Fe^{2+})_3AlSi_3O_{10}(OH)_2$	1.2	1.3
Clinochlore	$(Mg,Fe^{2+})_5Al(Si_3Al)O_{10}(OH)_8$		4.9
Calcite	$CaCO_3$		0.5
Gypsum	$CaSO_4{\cdot}2H_2O$	4.9	3.2
Dolomite	$CaMg(CO_3)_2$	3.2	6.8
Pyrite	FeS_2	64.7	36.1
Pyrrhotite	$Fe_{1-x}S$		1.6
Total		100.0	100.0

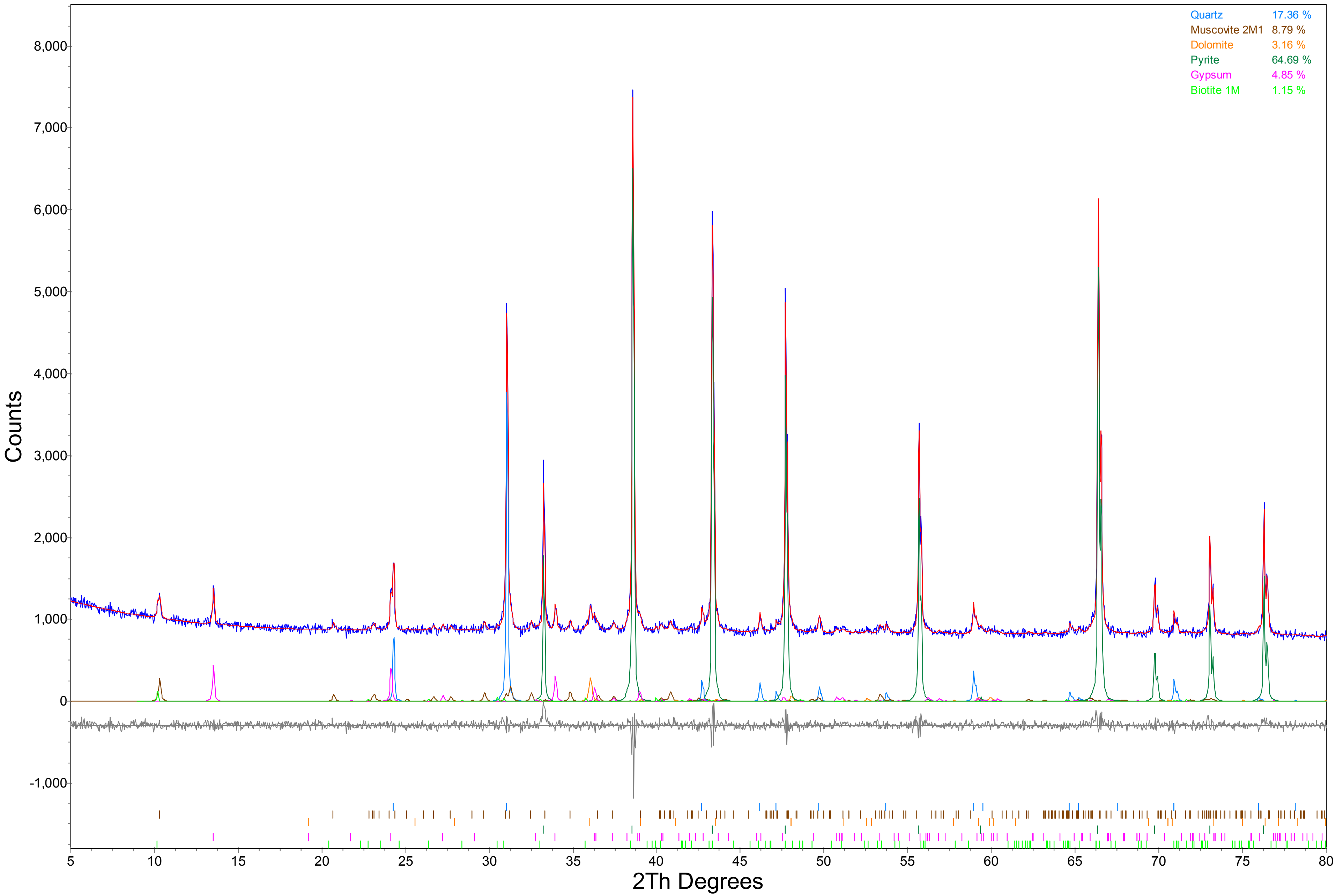

Figure 1. Rietveld refinement plot of sample **SGS Combined Lynx D** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars, positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

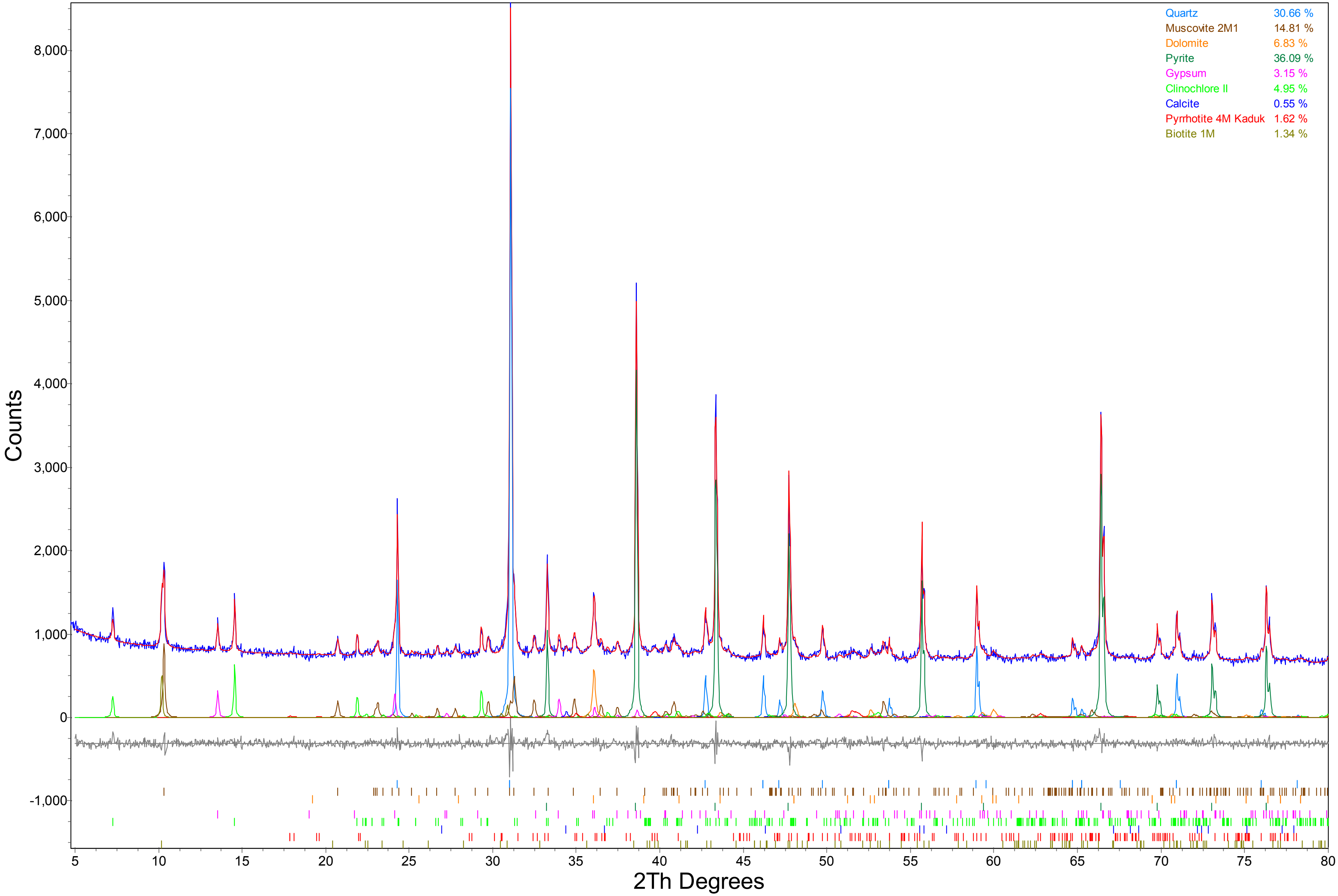

Figure 2. Rietveld refinement plot of sample **SGS Combined Wolverine D** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars, positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

An Investigation into

MINERALOGICAL CHARACTERIZATION OF TWO HUMIDITY CELL FINAL WASHED SOLIDS

prepared for

YUKON ZINC CORPORATION

LR 10961-002 – MI5015-FEB07
April 2, 2007

NOTE:
This report refers to the samples as received.

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Introduction

Two humidity cell final washed solids (labelled as Comb. Wolverine D Comp Tail and Comb. Lynx D Comp Tail) were submitted to SGS Mineral Technologies for mineralogical examination. The purpose of the investigation was to determine the bulk mineral assemblage and textural characteristics of the mineral species within the tailings. The proportions of sulphides and carbonates were particularly noteworthy, due to the environmental implications of the relative stability of the tailings. A bulk modal analysis (by QEMSCAN technology) and optical examination were performed on each sample. X-ray diffraction (XRD) analysis was also performed to determine the bulk crystalline mineral assemblage as well as any water soluble phases. Carbonate grains were examined using scanning electron microscopy (SEM) equipped with an energy dispersive X-ray spectrometer (EDS).

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Summary

1. Procedures

Each as-received sample was initially air-dried and micro-riffled to ensure sub-sample representivity for analyses. A representative sub-sample of material was pulverized and submitted for X-ray diffraction (XRD) analysis, in order to determine the bulk crystalline mineral assemblage (Appendix 1). A sub-sample of this material was also pulverized and submitted for whole rock analysis (WRA) by XRF using borate fusion (Appendix 2).

One polished section and one polished thin section per sample were prepared from representative micro-riffled sub-samples. Each polished section was examined optically with a petrographic microscope under incident (reflected) and transmitted light at 50x to 500x magnifications. The mineral assemblage and modal abundance of each sample were determined by compiling both optical data from manual point counting with a bulk mineral analysis (BMA) generated by QEMSCAN technology. The modal analyses and mineral grain size data are presented in Tables 1 and 3. Weight percentages of minerals were calculated from volume percentage using standard grain densities and documented mineral chemistries. A summary of the major calculated elemental oxides for each sample by mineralogical analysis is compared to the whole rock analysis (WRA) of each sample in assay reconciliation tables (Tables 2 and 4).

2. Mineralogical Results

2.1. Modal Analyses

2.1.1. Comb. Wolverine D Comp. Tail Final Washed Solids

Combined microscopic and SEM examination of the Comb. Wolverine D Comp Tail Final Washed Solids indicates that the sample is composed primarily of sulphides (42 wt. % of sample) and silicates (48.4 wt. % of sample) with minor amounts of carbonates (6.4 wt. % of sample), sulphates (2.2 wt. % of sample), and Fe-Ti oxides (1.1 wt. % of sample). A summary of the bulk mineralogy is presented below in Table 1.

Table 1. Summary Modal Analysis for Comb. Wolverine D Comp. Tail

Comb Wolverine D Comp Tail Final Wash Sol.	Formula or chemical composition	Wt.%	Typical Grain Size (µm)
Mineral			
Quartz	SiO_2	25.4	3 to 50
K-Feldspar	$KAlSi_3O_8$	1.2	1 to 15
Muscovite/Sericite	$KAl_2(Si_3Al)O_{10}(OH,F)_2$	7.0	2 to 35
Biotite	$K(Mg,Fe)_3AlSi_3O_{10}(OH,F)_2$	3.3	2 to 25
Chlorite	$(Mg,Al,Fe)_{12}[(Si,Al)_8O_{20}](OH)_{16}$	5.9	1 to 15
Pyriboles	$Ca_2(Mg,Fe)_5(Si_8O_{22})(OH)_2$	0.9	1 to 14
Plagioclase	$(Ca,Na)(Si,Al)_4O_8$	0.1	2 to 30
Talc	$Mg_3Si_4O_{10}(OH)_2$	0.2	1 to 15
Garnet	$Ca_3Al_2(SiO_4)_3$	0.0	1 to 15
Clay Minerals	$Al_2Si_2O_5(OH)_4$	4.4	1 to 15
Calcite	$CaCO_3$	0.5	1 to 20
Ankerite	$Ca(Fe,Mg)(CO_3)_2$	1.3	1 to 16
Dolomite	$CaMg(CO_3)_2$	4.5	2 to 30
Siderite	$FeCO_3$	0.1	1 to 20
Gypsum	$CaSO_4 \cdot 2(H_2O)$	0.3	1 to 15
Jarosite	$KFe_3(SO_4)_2(OH)_6$	1.9	1 to 15
Rutile	TiO_2	0.2	2 to 32
Fe-oxides	Fe_2O_3	0.7	2 to 35
Ilmenite	$FeTiO_3$	0.2	1 to 15
Sphalerite	ZnS	1.0	1 to 18
Pyrite	FeS_2	40.0	2 to 30
Pyrrhotite	$Fe_{1-x}S$	0.3	1 to 20
Chalcopyrite	$CuFeS_2$	0.2	1 to 20
Arsenopyrite	FeAsS	0.2	1 to 20
Other trace (< 0.05)	variable	0.3	1 to 15
Total		**100.0**	

Table 2 presents assay reconciliation of the Comb. Wolverine D Comp. Tail sample. In general, reconciliation of calculated mineralogical assay versus direct chemical assay is good, demonstrating confidence in mineralogical results. Due to the variable density of the minerals (pyrite denser than silicates), a slight over-estimation of sulphur and iron by calculated mineralogical assay may occur. In order to minimize this effect, the polished sections were prepared with graphite impregnation which separates particles and reduces density segregation. Documented mineral chemistries are used for mineralogical assay reconciliation tables for all minerals; therefore actual mineral chemistries will vary slightly from calculated ‘book’ values.

Table 2. Assay Reconciliation for Comb. Wolverine D Comp. Tail

Comb. Wolverine D Comp Tail Mineral	**Wt.%**	**SiO2**	**Al2O3**	**Fe2O3**	**MgO**	**CaO**	**Na2O**	**K2O**	**TiO2**	**MnO**	**Cr2O3**	**C**	**S_T %**	**LOI**
Quartz	25.4	25.4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
K-Feldspar	1.20	0.78	0.22	0.00	0.00	0.00	0.02	0.20	0.00	0.00	0.00	0.00	0.00	0.00
Muscovite/Sericite	7.00	3.16	2.69	0.00	0.00	0.00	0.00	0.83	0.00	0.00	0.00	0.00	0.00	0.28
Biotite	3.29	1.37	0.39	0.49	0.07	0.00	0.00	0.36	0.00	0.03	0.00	0.00	0.00	0.16
Chlorite	5.95	1.61	1.13	1.49	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48
Pyriboles	0.88	0.35	0.03	0.25	0.14	0.13	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.02
Plagioclase	0.06	0.03	0.02	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Talc	0.19	0.12	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
Garnet	0.03	0.01	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Clay Minerals	4.40	2.05	1.54	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.61
Calcite	0.50	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.16
Ankerite	1.30	0.00	0.00	0.20	0.13	0.48	0.00	0.00	0.00	0.04	0.00	0.15	0.00	0.40
Dolomite	4.50	0.00	0.00	0.18	1.44	0.99	0.00	0.00	0.00	0.00	0.00	0.60	0.00	1.56
Siderite	0.09	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.02
Gypsum	0.32	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.07
Jarosite	1.89	0.00	0.00	0.90	0.00	1.04	0.09	0.09	0.00	0.00	0.00	0.00	0.24	0.20
Rutile	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00
Fe-oxides	0.71	0.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ilmenite	0.17	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00
Sphalerite	0.98	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.32	0.63
Pyrite	40.0	0.00	0.00	26.6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	21.4	0.00
Pyrrhotite	0.34	0.00	0.00	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00
Chalcopyrite	0.18	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.06
Arsenopyrite	0.19	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.09
Other trace (< 0.05)	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.10
Total (calc'd)	**100.0**	**34.9**	**6.01**	**33.0**	**2.79**	**3.04**	**0.14**	**1.48**	**0.27**	**0.07**	**0.00**	**0.82**	**22.3**	**4.87**
WRA (by XRF)		**35.3**	**6.13**	**27.1**	**3.09**	**3.13**	**0.29**	**1.57**	**0.13**	**0.09**	**0.04**	**1.91**	**18.6**	**8.99**

2.1.2. Comb. Lynx D Comp. Tail Final Washed Solids

Combined microscopic and SEM examination of the Comb. Lynx D Comp Tail Final Washed Solids indicates that the sample is composed primarily of sulphides (69.7 wt. % of sample) and silicates (23.8 wt. % of sample) with minor amounts of carbonates (2.7 wt. % of sample), sulphates (3.1 wt. % of sample), and Fe-Ti oxides (0.7 wt. % of sample). A summary of the bulk mineralogy is presented below in Table 3.

Table 3. Summary Modal Analyses for Comb. Lynx D Comp. Tail

Comb Lynx D Comp Tail Final Wash Sol.	Formula or chemical composition	Wt.%	Typical Grain Size (µm)
Quartz	SiO_2	15.1	2 to 40
K-Feldspar	$KAlSi_3O_8$	1.4	1 to 30
Muscovite/Sericite	$KAl_2(Si_3Al)O_{10}(OH,F)_2$	2.1	1 to 25
Biotite	$K(Mg,Fe)_3AlSi_3O_{10}(OH,F)_2$	0.8	1 to 20
Chlorite	$(Mg,Al,Fe)_{12}[(Si,Al)_8O_{20}](OH)_{16}$	0.3	1 to 15
Pyriboles	$Ca_2(Mg,Fe)_5(Si_8O_{22})(OH)_2$	0.2	1 to 15
Plagioclase	$(Ca,Na)(Si,Al)_4O_8$	0.0	1 to 15
Talc	$Mg_3Si_4O_{10}(OH)_2$	0.0	1 to 15
Garnet	$Ca_3Al_2(SiO_4)_3$	0.0	---
Clay Minerals	$Al_2Si_2O_5(OH)_4$	3.9	1 to 15
Calcite	$CaCO_3$	0.4	1 to 25
Ankerite	$Ca(Fe,Mg)(CO_3)_2$	0.6	1 to 20
Dolomite	$CaMg(CO_3)_2$	1.6	1 to 20
Siderite	$FeCO_3$	0.0	1 to 15
Gypsum	$CaSO_4 \cdot 2(H_2O)$	0.5	1 to 15
Jarosite	$KFe_3(SO_4)_2(OH)_6$	2.6	1 to 15
Rutile	TiO_2	0.1	2 to 40
Fe-oxides	Fe_2O_3	0.5	2 to 35
Ilmenite	$FeTiO_3$	0.1	1 to 22
Sphalerite	ZnS	1.0	1 to 20
Pyrite	FeS_2	67.6	2 to 35
Pyrrhotite	$Fe_{1-x}S$	0.1	1 to 15
Chalcopyrite	$CuFeS_2$	0.1	1 to 20
Arsenopyrite	$FeAsS$	0.7	1 to 20
Other trace (< 0.05)	variable	0.2	1 to 15
Total		**100.0**	

Table 4 presents assay reconciliation of the Comb. Lynx D Comp. Tail sample In general, reconciliation of calculated mineralogical assay versus direct chemical assay is good, demonstrating confidence in mineralogical results. As with the previous sample, due to the variable density of the minerals (pyrite denser than silicates), a slight over-estimation of sulphur and iron by calculated mineralogical assay may occur. In order to minimize this effect, the polished sections were prepared with graphite impregnation which separates particles and reduces density segregation. Documented mineral chemistries are used for mineralogical assay reconciliation tables for all minerals; therefore actual mineral chemistries will vary slightly from calculated ‘book’ values.

Table 4. Assay Reconciliation for Comb. Lynx D Comp. Tail

Comb. Lynx D Comp Tail Mineral	Wt.%	SiO2	Al2O3	Fe2O3	MgO	CaO	Na2O	K2O	TiO2	MnO	Cr2O3	C	S_T %	LOI
Quartz	15.1	15.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
K-Feldspar	1.40	0.91	0.26	0.00	0.00	0.00	0.03	0.24	0.00	0.00	0.00	0.00	0.00	0.00
Muscovite/Sericite	2.10	0.95	0.81	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.09
Biotite	0.80	0.33	0.09	0.12	0.02	0.00	0.00	0.09	0.00	0.01	0.00	0.00	0.00	0.04
Chlorite	0.30	0.08	0.06	0.08	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
Pyriboles	0.20	0.08	0.01	0.06	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Plagioclase	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Talc	0.02	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Garnet	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Clay Minerals	3.90	1.82	1.37	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.54
Calcite	0.40	0.00	0.00	0.00	0.00	0.22	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.13
Ankerite	0.60	0.00	0.00	0.09	0.06	0.22	0.00	0.00	0.00	0.02	0.00	0.07	0.00	0.19
Dolomite	1.60	0.00	0.00	0.06	0.48	0.40	0.00	0.00	0.00	0.00	0.00	0.21	0.00	0.56
Siderite	0.05	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01
Gypsum	0.50	0.00	0.00	0.00	0.00	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.10
Jarosite	2.60	0.00	0.00	1.24	0.00	1.43	0.13	0.24	0.00	0.00	0.00	0.00	0.33	0.28
Rutile	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00
Fe-oxides	0.48	0.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ilmenite	0.14	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00
Sphalerite	1.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.64
Pyrite	67.6	0.00	0.00	45.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	36.1	0.00
Pyrrhotite	0.11	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00
Chalcopyrite	0.15	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.05
Arsenopyrite	0.69	0.00	0.00	0.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.32
Other trace (< 0.05)	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.07
Total (calc'd)	**100.0**	**19.3**	**2.58**	**49.4**	**0.64**	**2.47**	**0.16**	**0.82**	**0.12**	**0.03**	**0.00**	**0.34**	**37.2**	**3.04**
WRA (by XRF)		**20.6**	**3.26**	**42.6**	**1.02**	**2.66**	**0.53**	**0.91**	**0.08**	**0.08**	**0.05**	**0.87**	**27.1**	**8.99**

2.2. Summary and Mineralogical Overview

Pyrite is the main sulphide mineral among both samples and typically occurs as liberated grains ranging from 1 to 35 µm. Sphalerite (~1 wt. % of each sample) occurs in minor amounts typically as inclusions (1 to 20 µm) in pyrite and other non-opaque gangue minerals. Trace amounts of chalcopyrite (typically as inclusions 1 to 20 µm) and arsenopyrite (typically liberated 1 to 20 µm) account for the remaining sulphides.

Carbonates (typically 1 to 30 µm) are present mainly as ferroan dolomite and ankerite with trace to rare occurrences of calcite and siderite. The distribution of both sulphide and carbonate minerals by composition is presented below in Table 5.

Table 5. Summary of Carbonate and Sulphide Minerals by Sample

Mineral	Formula	Comb Wolverine D Comp Tail		Comb Lynx D Comp Tail	
		wt. %	**% dist'n**	**wt. %**	**% dist'n**
Calcite	$CaCO_3$	0.5	7.8	0.4	15.1
Ankerite	$Ca(Fe,Mg)(CO_3)_2$	1.3	20.3	0.6	22.7
Dolomite	$CaMg(CO_3)_2$	4.5	70.4	1.6	60.4
Siderite	$FeCO_3$	0.1	1.4	0.0	1.8
Total carbonate		**6.4**	**100.0**	**2.6**	**100.0**
Sphalerite	ZnS	1.0	2.4	1.0	1.5
Pyrite	FeS_2	40.0	96.4	67.6	98.2
Pyrrhotite	$Fe_{1-x}S$	0.3	0.8	0.1	0.2
Chalcopyrite	$CuFeS_2$	0.2	0.4	0.1	0.2
Arsenopyrite	$FeAsS$	0.2	0.5	0.7	1.0
Total sulphide		**41.5**	**100.0**	**68.9**	**100.0**

Minor sulphates (typically as Ca-sulphate and Fe-sulphate) are present in both samples. These occur as rims on pyrite as well as liberated particles (ranging from 1 to 15 µm).

The main silicate minerals among the samples consist of quartz, muscovite/sericite and clay minerals. Minor to trace amounts of feldspars, biotite, chlorite, amphiboles and talc are also present.

Fe-Ti oxides consist of rutile, magnetite, rare goethite, and ilmenite (ranging from 1 to 40 µm).

Appendix 1

X-ray Diffraction Results

Summary of Qualitative X-ray Diffraction Results

Sample	Crystalline Mineral Assemblage (relative proportions based on peak height)			
	Major	**Moderate**	**Minor**	**Trace**
1. Comb Wolverine D Comp Tail Final Washed Sol	quartz	pyrite, mica	dolomite, bassanite, chlorite	*potassium-feldspar, *calcite
2. Comb Lynx D Comp Tail Final Washed Sol	pyrite	quartz	mica, bassanite, potassium-feldspar	*calcite, *dolomite, *jarosite

*Tentative identification due to low concentrations, diffraction line overlap or poor crystallinity

Instrument:	Siemens D5000 diffractometer
Scan Conditions:	Co radiation, graphite monochromator, 40 kV, 30 mA, Step:0.02°, Step time:1s
Interpretations:	JCPDS / ICDD powder diffraction files. Siemens Search / Match software.
Detection Limit:	0.5-2%. Strongly dependent on crystallinity.

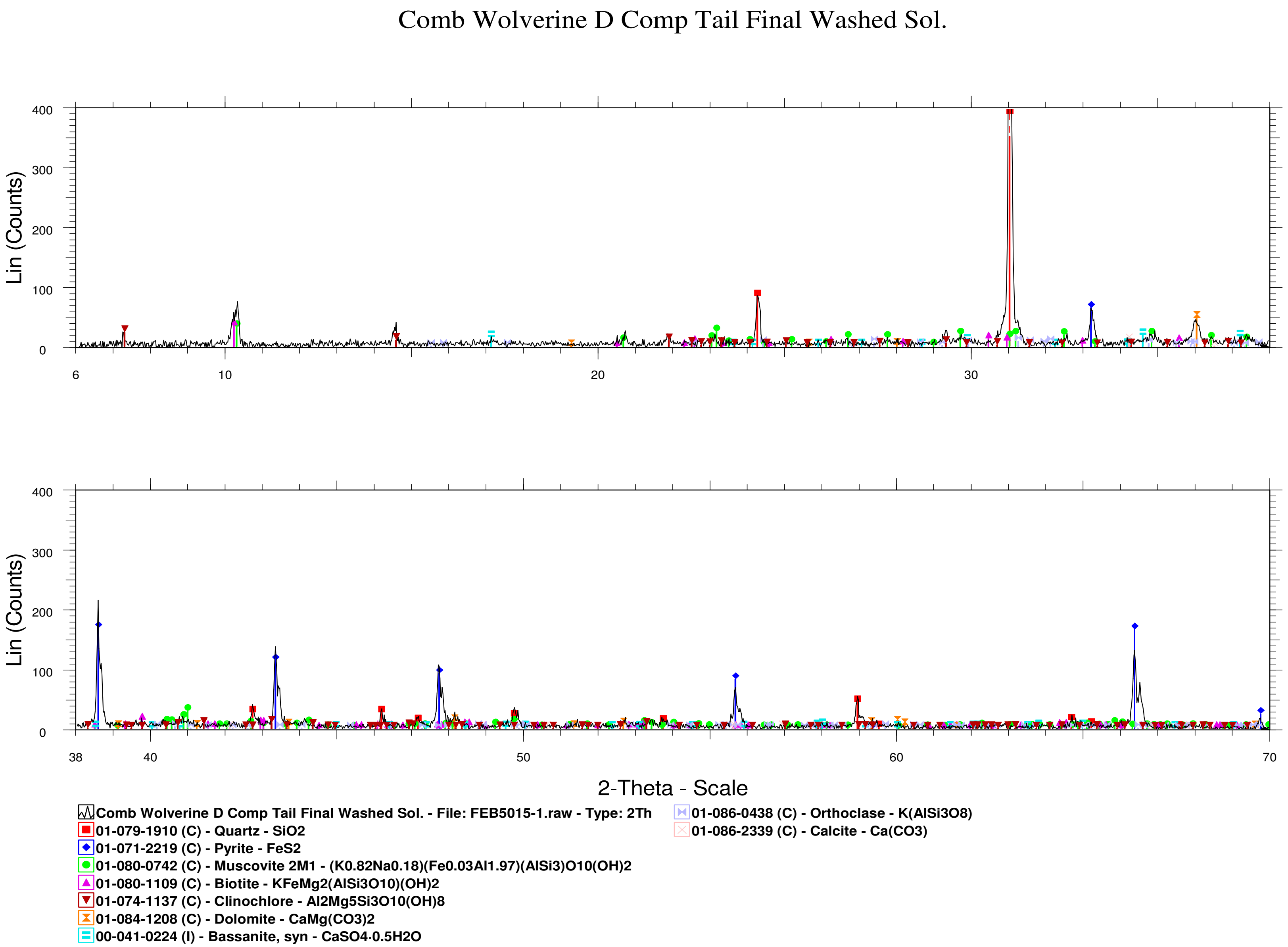
Interpretations do not reflect the presence of non-crystalline / amorphous compounds. Mineral proportions are based on relative peak heights and may be strongly influenced by crystallinity, structural group or preferred orientations. Interpretations and relative proportions should be accompanied by supporting petrographic and geochemical data (WRA, ICP-OES).

Mineral	**Composition**
Bassanite	$CaSO_4 \cdot 0.5H_2O$
Calcite	$CaCO_3$
Chlorite	$(Fe,(Mg,Mn)_5,Al)(Si_3Al)O_{10}(OH)_8$
Dolomite	$CaMg(CO_3)_2$
Jarosite	$(K)_2Fe_3(SO_4)_2(OH)_6$
Mica	$K(Mg,Fe)Al_2Si_3AlO_{10}(OH)_2$
Potassium-Feldspar	$K(AlSi_3O_8)$
Pyrite	FeS_2
Quartz	SiO_2

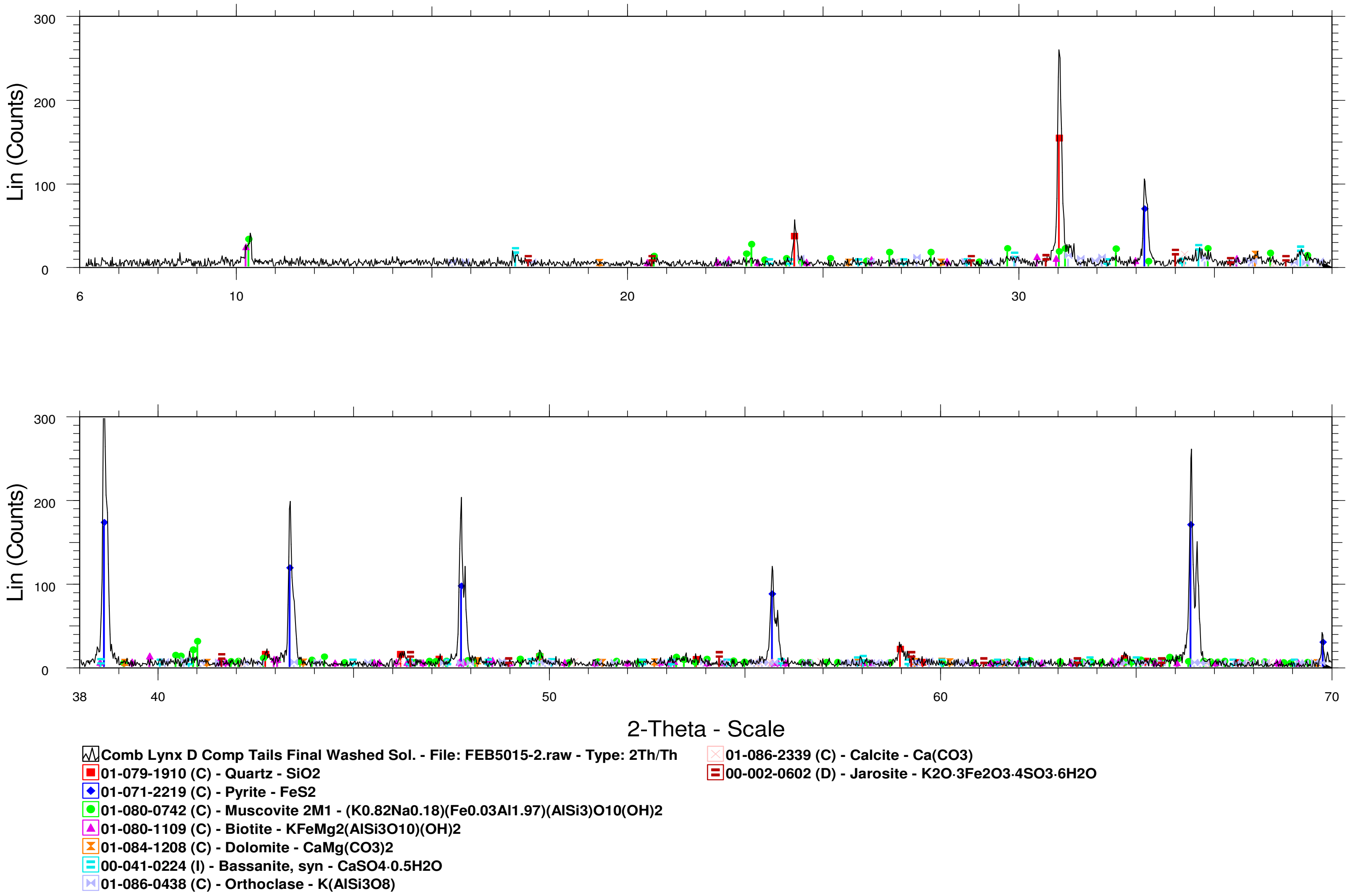
Note:
N/A

Huyun Zhou, Ph.D.
Project Mineralogist, XRD

Stephanie Downing, M. Sc.
Senior Mineralogist


Comb Wolverine D Comp Tail Final Washed Sol.
Lin (Counts)
400
300
200
100
0
6
10
20
30
38
40
50
60
70
2-Theta - Scale
Comb Wolverine D Comp Tail Final Washed Sol. - File: FEB5015-1.raw - Type: 2Th
01-079-1910 (C) - Quartz - SiO2
01-071-2219 (C) - Pyrite - FeS2
01-080-0742 (C) - Muscovite 2M1 - (K0.82Na0.18)(Fe0.03Al1.97)(AlSi3)O10(OH)2
01-080-1109 (C) - Biotite - KFeMg2(AlSi3O10)(OH)2
01-074-1137 (C) - Clinochlore - Al2Mg5Si3O10(OH)8
01-084-1208 (C) - Dolomite - CaMg(CO3)2
00-041-0224 (I) - Bassanite, syn - CaSO4·0.5H2O
01-086-0438 (C) - Orthoclase - K(AlSi3O8)
01-086-2339 (C) - Calcite - Ca(CO3)

Comb Lynx D Comp Tails Final Washed Sol.



Appendix 2
Chemical Analyses

SGS

SGS Lakefield Research Limited
P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - K0L 2H0
Phone: 705-652-2038 FAX: 705-652-6441

LR Internal Dept 14
Attn : Stephanie Downing

---, ---

Phone: ---
Fax: ---

Monday, March 26, 2007

Date Rec. : 20 March 2007
LR Report : CA80467-MAR07
Project : CALR-10961-002
Client Ref : MI5015-Feb07 Wolverine

CERTIFICATE OF ANALYSIS

Final Report

Sample ID	SiO2 %	Al2O3 %	Fe2O3 %	MgO %	CaO %	Na2O %	K2O %	TiO2 %	P2O5 %	MnO %	Cr2O3 %	V2O5 %	LOI %	Sum %
1: Comb Wolverine D Comp Tail Final Washed Sol.	35.3	6.13	27.1	3.09	3.12	0.29	1.57	0.13	0.15	0.09	0.04	0.06	17.3	94.4
2: Comb Lynx D Comp Tail Final Washed Sol.	20.8	3.28	42.6	1.02	2.66	0.53	0.91	0.38	0.06	0.08	0.05	0.04	24.7	96.6

Debbie Waldon
Debbie Waldon
Project Coordinator,
Minerals Services, Analytical

Page 1 of 1

SGS

Quantitative X-Ray Diffraction by Rietveld Refinement

Report Prepared for: *Environmental -Analytical*

Project Number/ LIMS No. *Mineralogy/MI5037-MAR12*

Reporting Date: *March 27, 2012*

Instrument: BRUKER AXS D8 Advance Diffractometer

Test Conditions: Co radiation, 40 kV, 35 mA
Regular Scanning: Step: 0.02°, Step time: 1s, 2θ range: 3-80°

Interpretations : PDF2/PDF4 powder diffraction databases issued by the International Center for Diffraction Data (ICDD). DiffracPlus Eva and Topas software.

Detection Limit : 0.5-2%. Strongly dependent on crystallinity.

Contents:

1) Method Summary
2) Summary of Mineral Asemblages
3) Semi-Quantitative XRD Results
4) Chemical Balance(s)
5) XRD Pattern(s)

Bernie C. Yeung, B. Sc.
Mineralogist

Huyun Zhou
Huyun Zhou, Ph.D., P.Geo.
Senior Mineralogist

Method Summary

Mineral Identification and Interpretation:

Mineral identification and interpretation involve matching the diffraction pattern of an unknown material to patterns of single-phase reference materials. The reference patterns are compiled by the Joint Committee on Powder Diffraction Standards - International Center for Diffraction Data (JCPDS-ICDD) database and released on software as Powder Diffraction Files (PDF).

Interpretations do not reflect the presence of non-crystalline and/or amorphous compounds, except when internal standards added by request. Mineral proportions may be strongly influenced by crystallinity, crystal structure and preferred orientations. Minerals or compounds identification and quantitative analysis results should be accompanied by supporting chemical assay data or other tests.

Rietveld Method Quantitative Analysis:

Whole-pattern Rietveld Method Quantitative Analysis is performed by using Topas 4.1 (Bruker AXS), a graphics based profile analysis program built around a general non-linear least squares fitting system, to determine the amount of different phases in a multicomponent sample. Whole pattern analyses are predicated by the fact that the X-ray diffraction pattern is a total sum of both instrumental factors and specimen. Unlike other peak intensity-based methods, the Rietveld method uses a least square approach to refine a theoretical line profile until it matches the obtained experimental patterns.

Rietveld refinement is completed with a set of minerals specifically identified for the sample(s). Zero values indicate that the mineral was included in the refinement calculations, but the calculated concentration was less than 0.05wt%. Minerals not identified by the analyst are not included in refinement calculations for specific samples and are indicated with a dash.

Summary of Rietveld Quantitative Analysis X-ray Diffraction Results

Quantitative X-ray Diffraction Results

Mineral/Compound	June 28/05 Combined OD Composite Tails Pulv 7-3 Riet (wt %)	Combined RO Cl Sc Tailings Solids Pulv 7-4 Riet (wt %)
Chlorite	1.33	1.05
Dolomite	0.81	3.72
Muscovite	11.2	8.01
Pyrite	57.3	62.3
Quartz	29.4	24.9
TOTAL	100.0	100.0

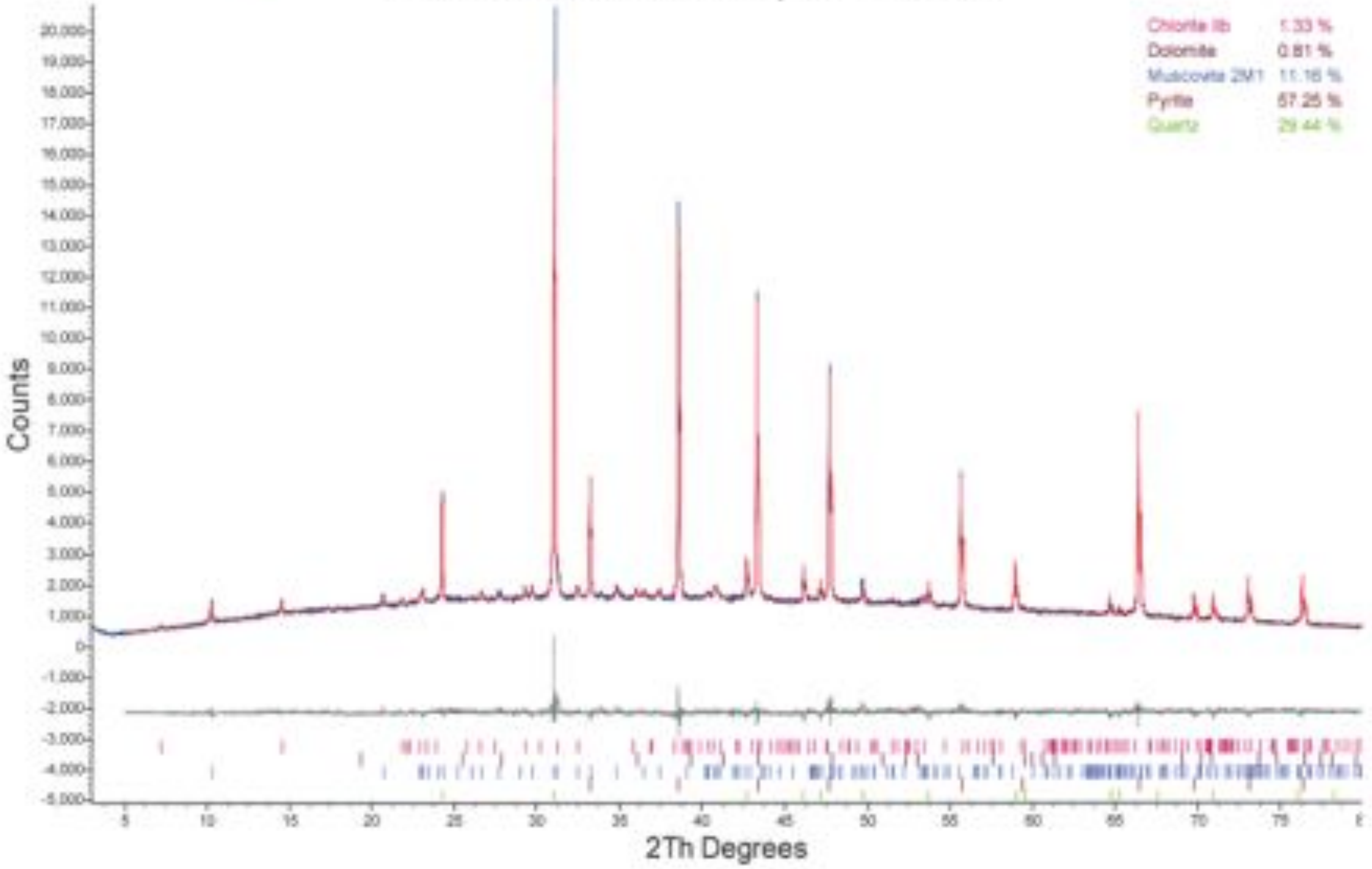
Zero values indicate that the mineral was included in the refinement, but the calculated concentration is below a measurable value.

Dashes indicate that the mineral was not identified by the analyst and not included in the refinement calculation for the sample.

Mineral/Compound	Formula
Chlorite	$(Mg,Fe)_3(Si,Al)_4O_{10}$
Dolomite	$CaMg(CO_3)_2$
Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$
Pyrite	FeS_2
Quartz	SiO_2

Enviromental - Analytical
Custum XRD/M4511-SEP10
10/28/2010

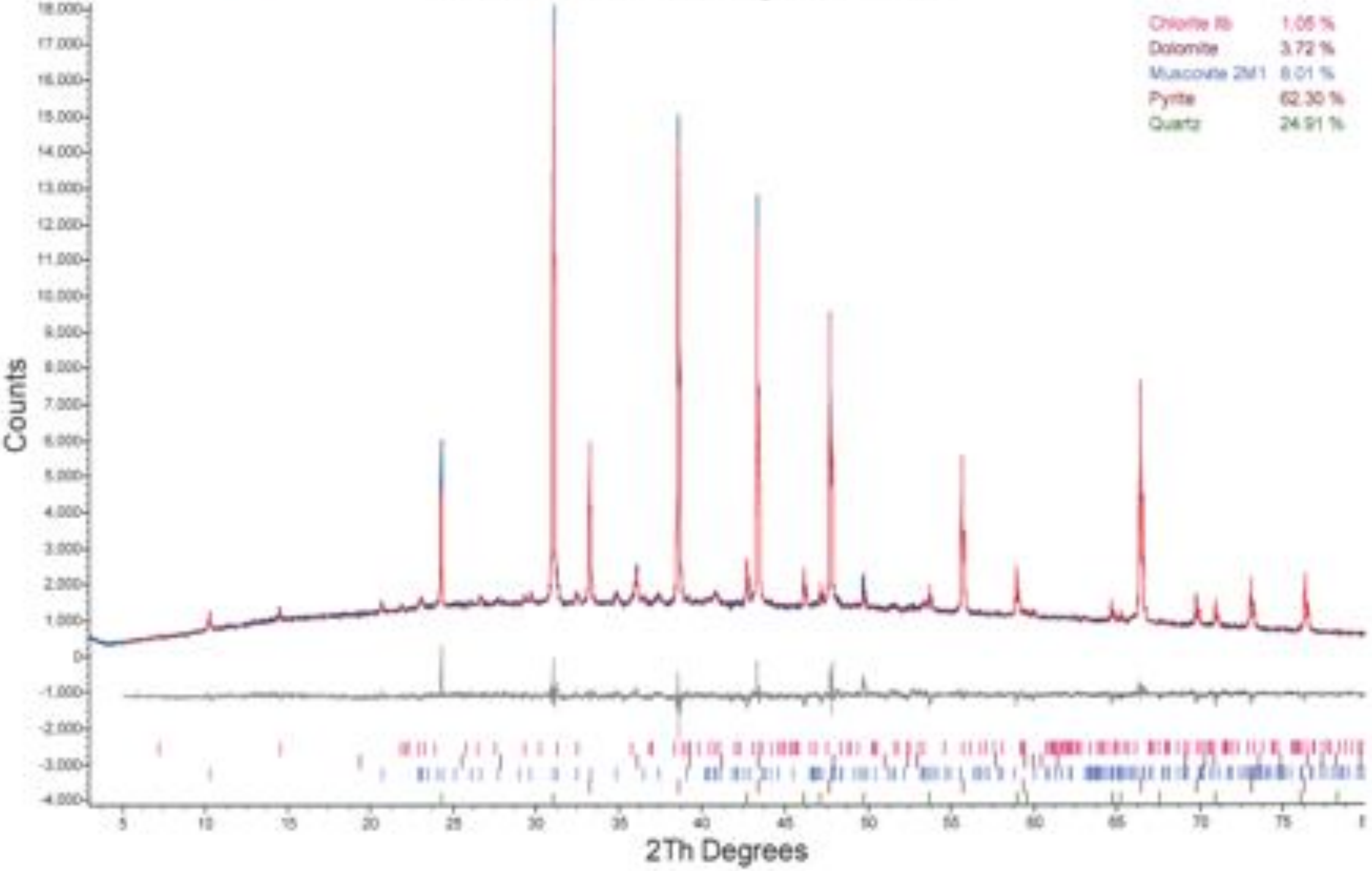
June 29/05 Combined OD Composite Tails Pulv



The Qualitative XRD method (METH # 8-8-1) used by SGS Minerals Services, P.O. Box 4300, 185 Concession Street, Lakefield, Ontario, Canada K0L 2H0. Tel: (705) 652-2000 Fax: (705) 652-6365. Mini-method available upon request.

Environmental - Analytical
Custum XRD/MI4511-SEP10
10/28/2010

Combined RO Cl Sc Tailings Solids Pulv



The Qualitative XRD method (METH # 8-8-1) used by SGS Minerals Services, P.O. Box 4300, 185 Concession Street, Lakefield, Ontario, Canada K0L 2H0.
Tel: (705) 652-2000 Fax: (705) 652-6365. Mini-method available upon request.

A Petrography Report on

TWO TAILINGS SAMPLES

prepared for

YUKON ZINC

Project: Custom-Min MI5037-MAR12 – Draft Report
June 13, 2012

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Member of the SGS Group (SGS SA)

Introduction

This report describes a High Definition Mineralogy test program based on QEMSCAN technology (Quantitative Evaluation of Materials by Scanning Electron Microscopy) and optical microscopy to examine the mineralogical characteristics of two tailings samples. The two samples, labelled "June 29/05 Combined OD Composite Tails" and "Combined Ro Cl Sc Tailings Solids", were submitted by Brian Graham of the SGS Environmental Analytical Department on behalf of Yukon Zinc and were given the LIMS number MI5037-MAR12.

Two de-agglomerated graphite-impregnated polished epoxy grain mounts were prepared and submitted for mineralogical analyses using QEMSCAN technology. As well, two polished thin sections were prepared from grain mounts for optical microscopy.

The purpose of this test program was to provide semi-quantitative modal mineralogy, general grain size information, assess the degree of oxidation of pyrite and to comment on the textures and the associative nature of the sulphide minerals.

Kathryn Sheridan

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Report preparation: Kathryn Sheridan and Stephanie Downing
Reviewed by: Stephanie Downing

Mineralogical Characterization

1.1. Mineral Abundance

The mineral distributions of the samples are presented below in Table 1. The samples are mainly composed of pyrite (60% and 69%), quartz (20% and 12%) and micas/clays (15% and 9%, respectively). The other main mineralogical differences between the samples are sphalerite content (0.8% and 3.0%) and ankerite/dolomite content (0.8% and 3.9%, respectively).

Table 1: Mineral Distribution (by QEMSCAN)

Sample	**Mineral**	**June 29/05 Combined OD Composite Tails**	**Combined Ro Cl Sc Tailings Solids**
Avg. Particle Size (µm)		20	26
Mineral Mass(%)	Chalcopyrite	0.1	0.3
	Pyrite	60.0	69.0
	Pyrrhotite	0.1	0.1
	Arsenopyrite	0.2	0.6
	Galena	<0.1	<0.1
	Sphalerite	0.8	3.0
	Zincite	0.2	0.3
	Fe-Ti-Oxides	0.7	0.2
	Quartz	19.7	11.9
	Muscovite	7.5	4.9
	Biotite	3.5	1.8
	Chlorites	2.1	1.5
	Clays	1.8	1.0
	Other Silicates	0.8	0.7
	Ankerite/Dolomite	0.8	3.9
	Siderite	0.8	0.5
	Apatite	0.3	0.2
	Other/Accesssory	0.4	0.1
Calculated Grain Size by Frequency (µm)	Chalcopyrite	7	12
	Pyrite	15	21
	Pyrrhotite	11	14
	Arsenopyrite	10	13
	Galena	5	8
	Sphalerite	9	11
	Zincite	7	8
	Fe-Ti-Oxides	7	7
	Quartz	24	24
	Muscovite	13	15
	Biotite	8	10
	Chlorites	11	14
	Clays	8	8
	Other Silicates	10	9
	Ankerite/Dolomite	16	24
	Siderite	8	12
	Apatite	18	13
	Other/Accesssory	7	7

1.2. Observations from Optical Petrography

1.2.1. June 29/05 Combined OD Composite Tails

This sample is mainly fine-grained (<200 µm). Pyrite typically occurs as liberated grains with an average grain size of 15 µm (by frequency), although some pyrite is found up to 120 µm in size. Quartz tends to be coarse with an average size of 24 µm and maximum size of 240 µm. Micas are found up to 240 µm in length. An overview photomicrograph of the sample is shown in Figure 3.

Sphalerite occurs as fine liberated grains, in binary particles with pyrite (Figure 10), and in complex particles with pyrite and silicates (Figure 9).

Of the two samples, this sample shows the most evidence of sulphide oxidation, although the relative proportion of oxidized grains found is low (<5% of total sulphides). This sample tends to have numerous agglomerations (Figure 5) which are cemented by goethite, an oxidation product of pyrite. Some pyrite grains show oxidation rims of goethite (Figure 6 and Figure 8). Goethite is also found in cracks in the pyrite (Figure 7 and Figure 8). Arsenopyrite also shows signs of oxidation.

1.2.2. Combined Ro Cl Sc Tailings Solids

This sample is coarser-grained than the OD Composite Tails. Most of the pyrite is fine-grained and liberated with an average size of 21 µm, and maximum size of 200 µm, slightly coarser than the OD Composite Tails. Quartz occurs up to 400 µm in size and micas occur up to 680 µm in length. An overview photomicrograph of the sample is shown in Figure 4.

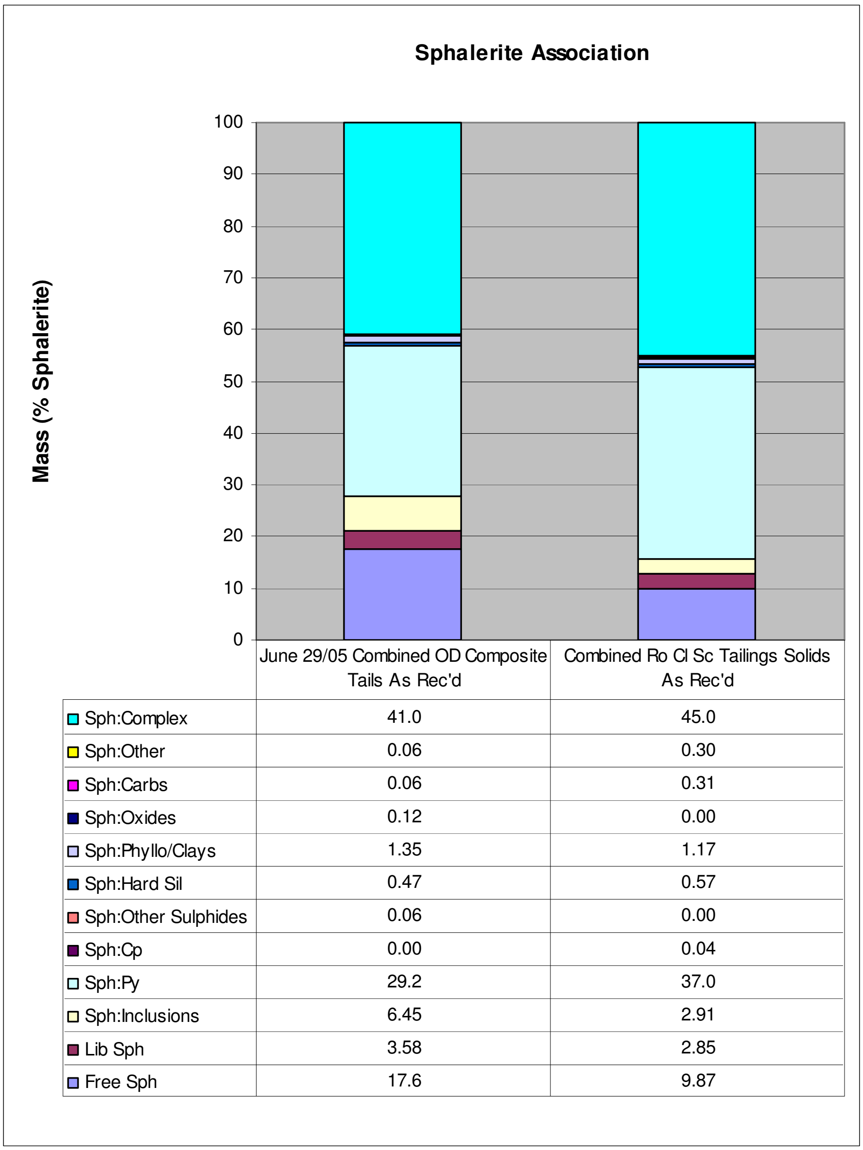
Most of the sphalerite in this sample occurs as attachments with pyrite and complex association (Figure 17), lesser occurs liberated.

There is some evidence of pyrite oxidation as shown in Figure 14 but overall less than 3% of the pyrite shows signs of oxidation. Approximately ten percent of the pyrite is in granular (Figure 15) or porous (Figure 16) form.

1.3. Mineral Associations and Grain Size (by QEMSCAN)

1.3.1. Sphalerite Association and Grain Size

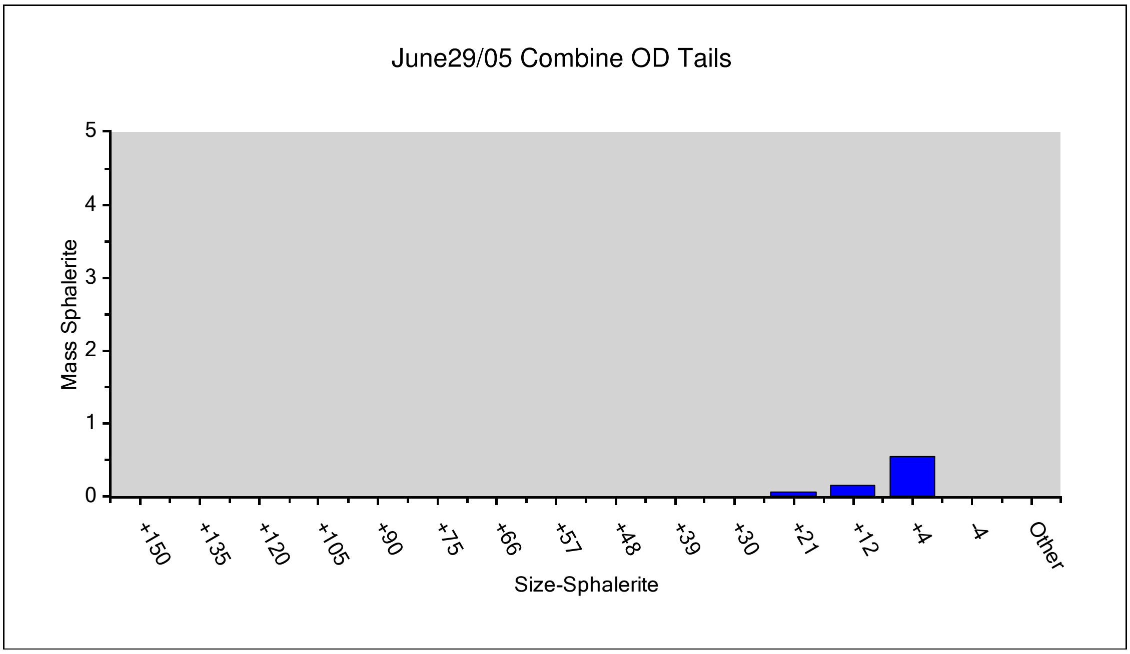
Based on particle mapping mode of QEMSCAN analysis, the main associations of sphalerite in the Tailings are as inclusions and attachments with pyrite (29% and 37%) and in complex association as ternary or greater particles (41% and 45%) for the June29/05 Combine OD Tails and the Combined Ro Cl Sc Tailings Solids, respectively. A lesser proportion occurs as liberated grains (21% and 12%), respectively.

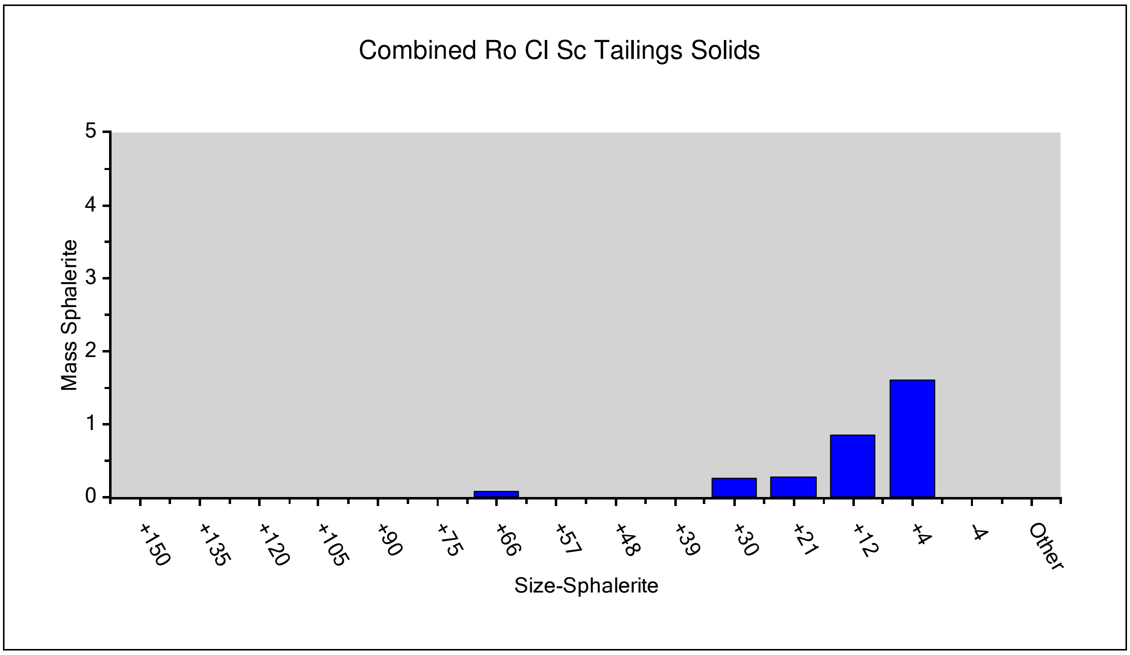


	June 29/05 Combined OD Composite Tails As Rec'd	Combined Ro Cl Sc Tailings Solids As Rec'd
■ Sph:Complex	41.0	45.0
■ Sph:Other	0.06	0.30
■ Sph:Carbs	0.06	0.31
■ Sph:Oxides	0.12	0.00
■ Sph:Phyllo/Clays	1.35	1.17
■ Sph:Hard Sil	0.47	0.57
■ Sph:Other Sulphides	0.06	0.00
■ Sph:Cp	0.00	0.04
■ Sph:Py	29.2	37.0
■ Sph:Inclusions	6.45	2.91
■ Lib Sph	3.58	2.85
■ Free Sph	17.6	9.87

Table 2. Sphalerite Association (by QEMSCAN, Normalized %)

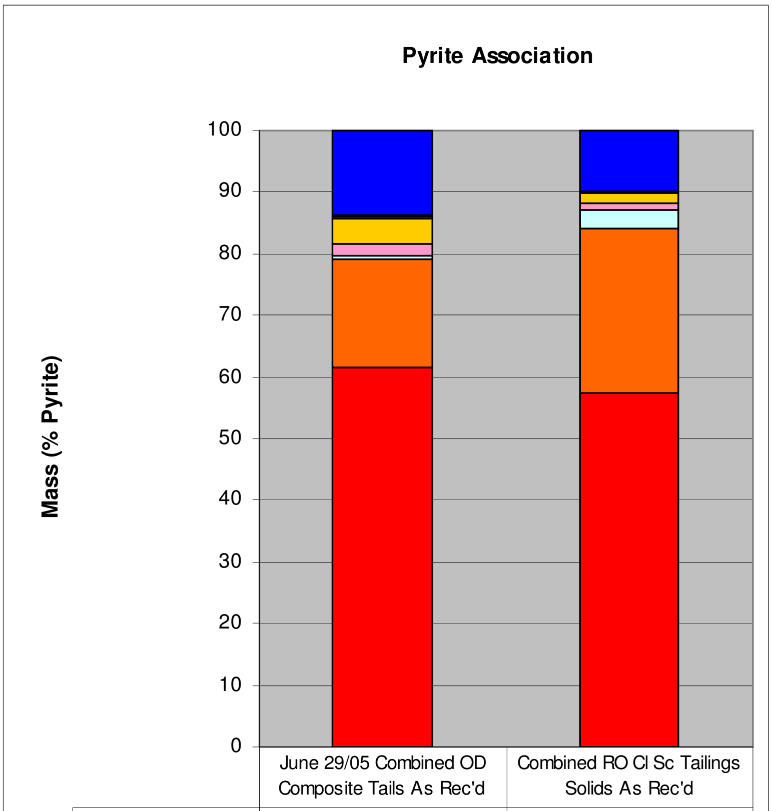
Figure 1. Sphalerite Grain Size by Mass (by QEMSCAN)





1.3.2. Pyrite Association and Grain Size

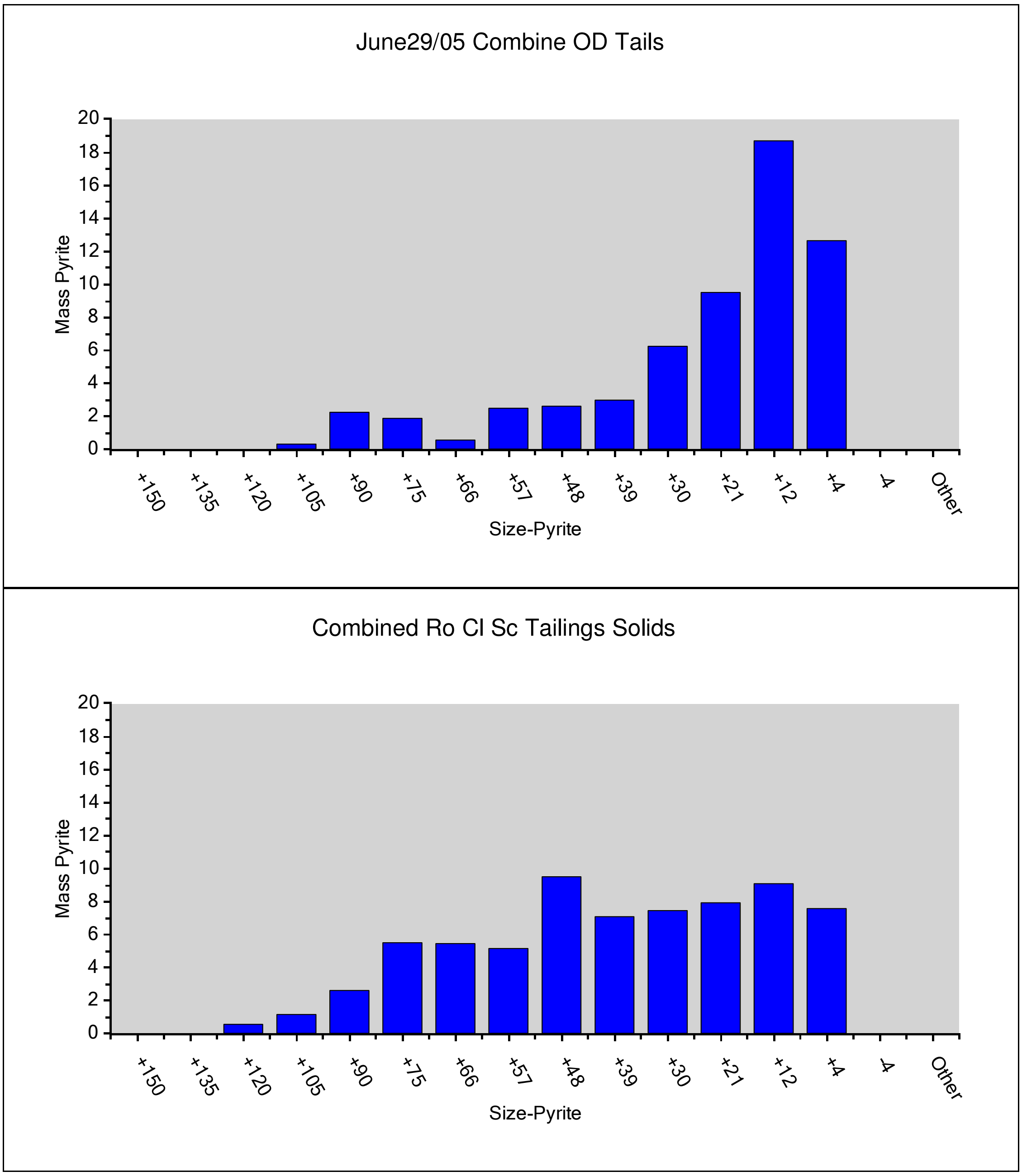
Based on particle mapping mode of QEMSCAN analysis, the main association of pyrite in the Tailings are as free and liberated grains (79% and 84%) and lesser amounts in complex association as ternary or greater particles (14% and 10%) for the June29/05 Combine OD Tails and the Combined Ro Cl Sc Tailings Solids, respectively.



	June 29/05 Combined OD Composite Tails As Rec'd	Combined RO Cl Sc Tailings Solids As Rec'd
■ Barren	0.00	0.00
🟦 Py:Complex	13.8	9.86
■ Py:Other	0.19	0.02
🟪 Py:Carbs	0.16	0.31
▨ Py:Oxides	0.06	0.02
🟨 Py:Phyllo/Clays	4.35	1.67
▨ Py:Hard Sil	1.75	0.93
🟩 Py:Other Sulphides	0.02	0.05
🟨 Py:CuS	0.02	0.07
☐ Py:Sph	0.58	3.01
🟧 Py:Inclusions	0.03	0.03
🟧 Lib Py	17.4	26.5
🟥 Free Py	61.7	57.5

Table 3. Pyrite Association (by QEMSCAN, Normalized %)

Figure 2. Pyrite Grain Size by Mass (by QEMSCAN)



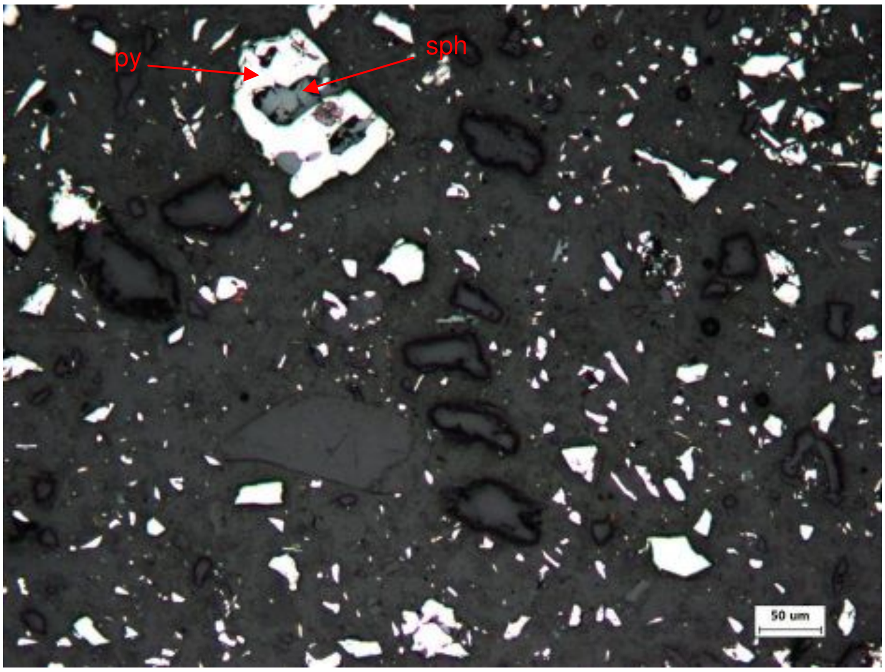


Figure 3: Overview of June 29/05 Combined OD Composite Tails

Plane-polarized reflected light (PPRL) photomicrograph showing bimodal size distribution of pyrite (py) and a sphalerite (sph)-pyrite binary grain (red arrows).

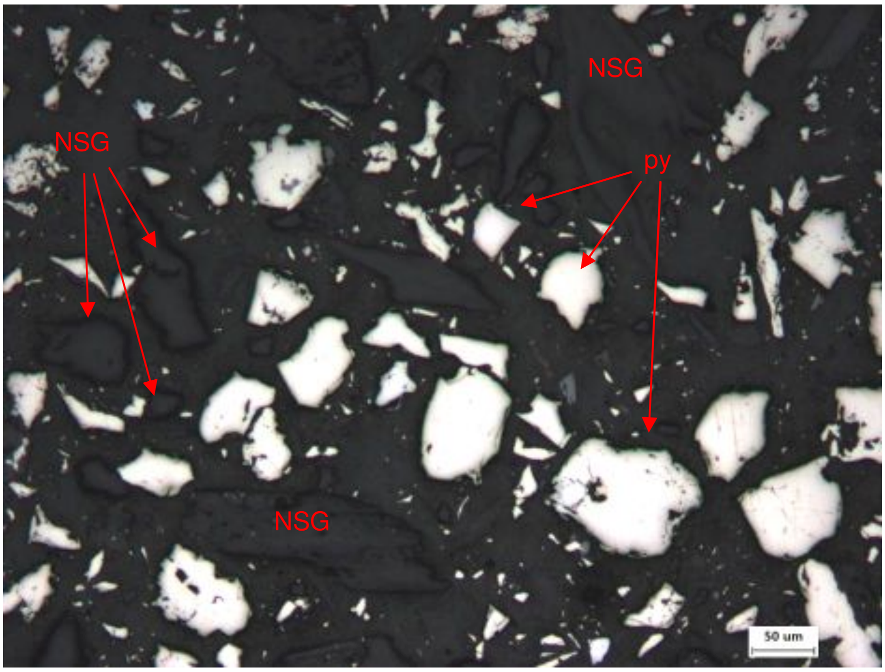


Figure 4: Overview of Combined Ro Cl Sc Tailings Solids

PPRL photomicrograph showing relatively coarse-grained pyrite (py) and non-sulphide gangue (NSG).

Appendix A – Photomicrographs June 29/05 Combined OD Composite Tails

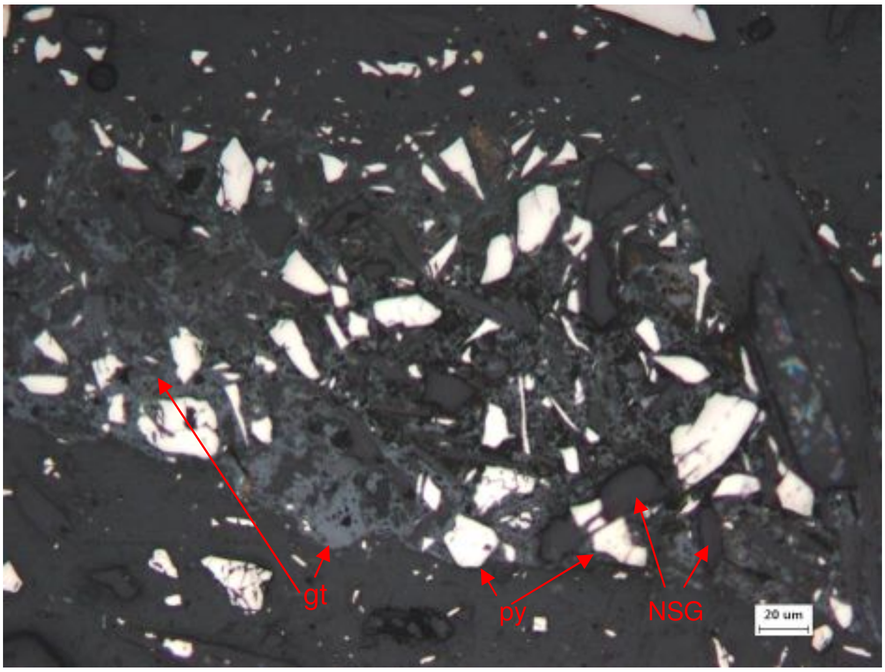


Figure 5: June 29/05 Combined OD Composite Tails

PPRL photomicrograph showing an agglomeration of pyrite (py) and non-sulphide gangue (NSG) cemented together by goethite (gt).

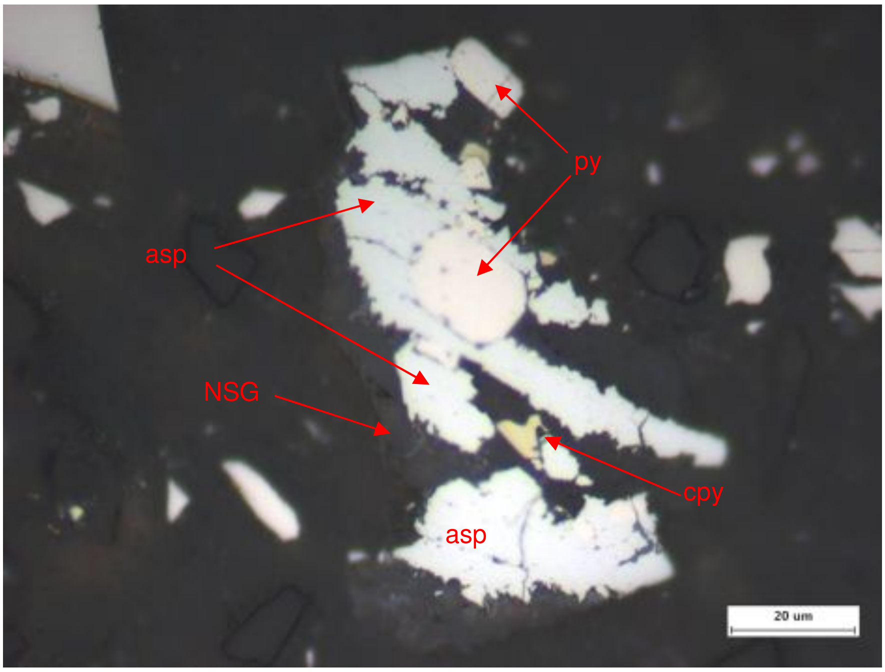


Figure 6: June 29/05 Combined OD Composite Tails

PPRL photomicrograph showing a complex particle of pyrite (py) and chalcopyrite (cpy) surrounded by a rim of non-sulphide gangue (NSG).

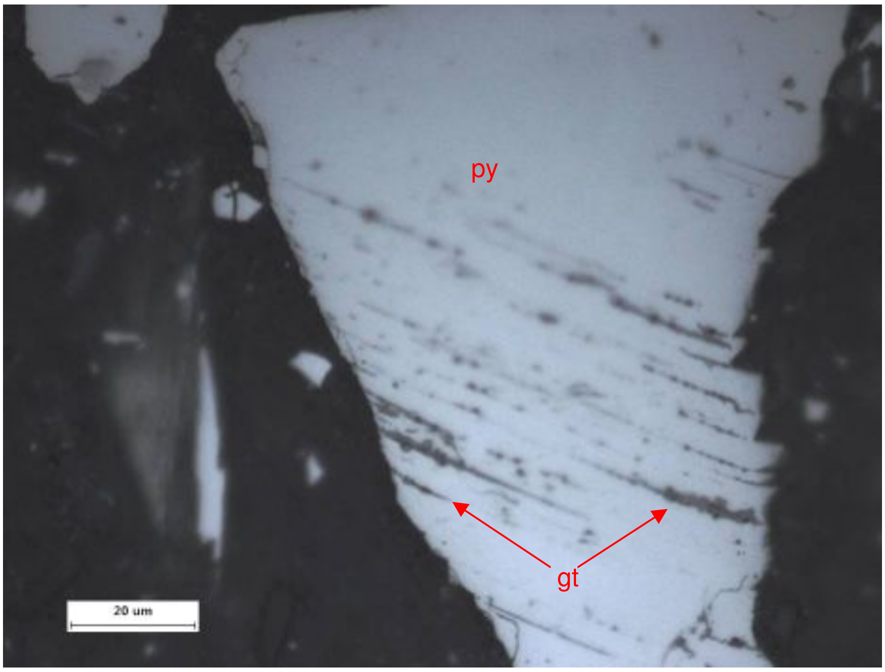


Figure 7: June 29/05 Combined OD Composite Tails

PPRL photomicrograph showing goethite (gt) forming along crystallographic planes in pyrite (py) due to oxidation.

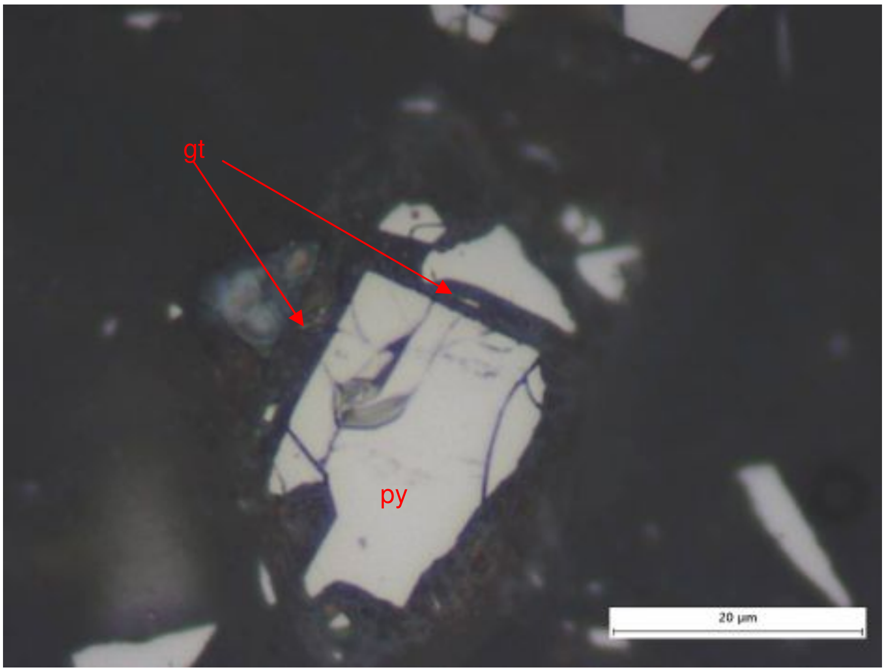


Figure 8: June 29/05 Combined OD Composite Tails

PPRL photomicrograph showing goethite (gt) forming along oxidized cracks in pyrite (py) and on the outer edges of the pyrite.

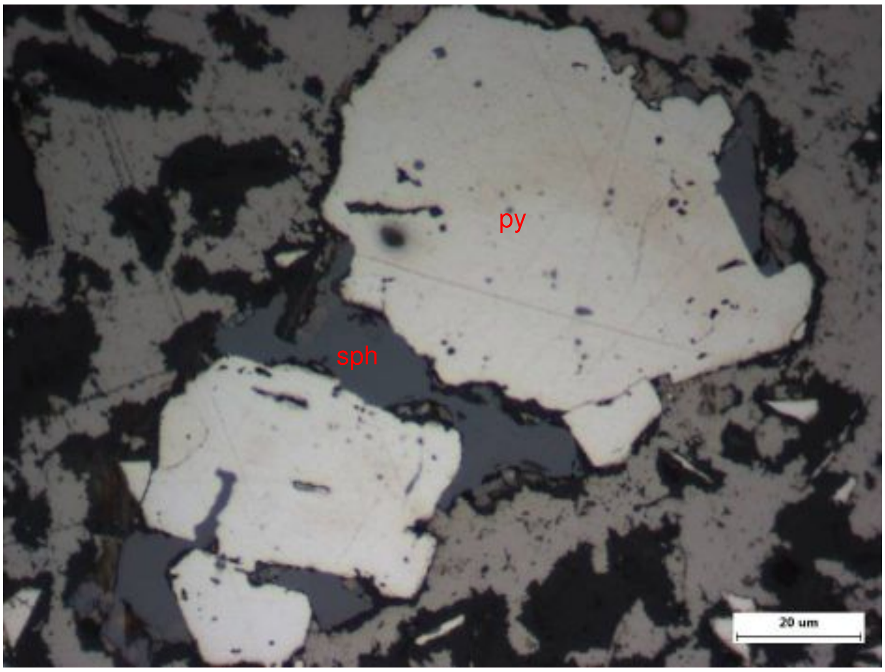


Figure 9: June 29/05 Combined OD Composite Tails

PPRL photomicrograph showing binary particle of pyrite (py) and sphalerite (sph).

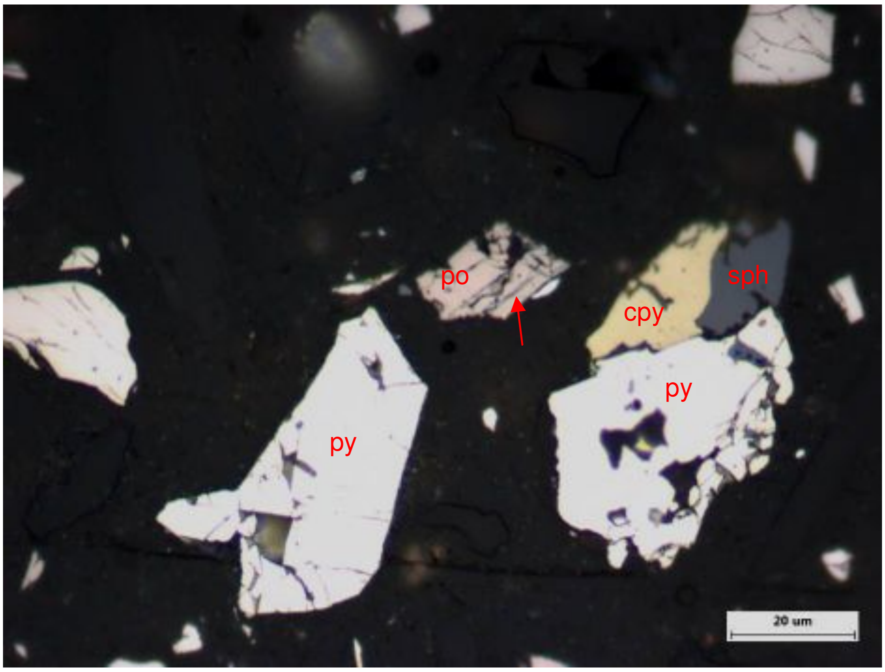


Figure 10: June 29/05 Combined OD Composite Tails

PPRL photomicrograph showing a ternary particle of pyrite (py), chalcopyrite (cp) and sphalerite (sph); and liberated grains of pyrrhotite (po) and pyrite (py). Note that pyrrhotite shows signs of oxidation along crystallographic grain boundaries to goethite (indicated by red arrow).

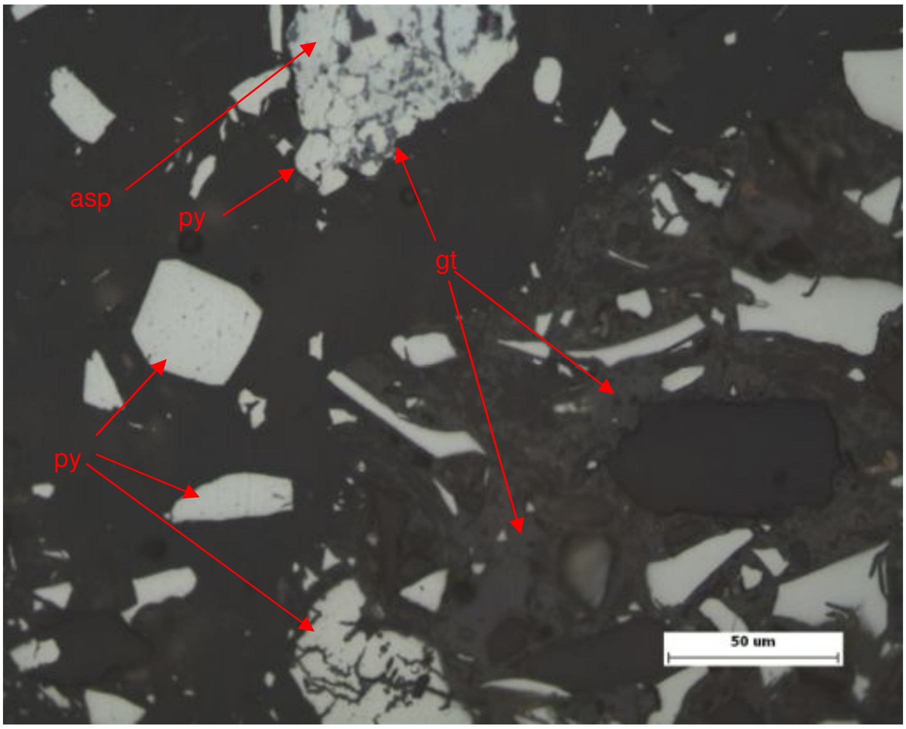


Figure 11. June 29/05 Combined OD Composite Tails

PPRL photomicrograph showing a binary pyrite-arsenopyrite (asp) particle (top, centre) showing oxidation to goethite (gt). Goethite agglomerate enclosing oxidized pyrite grains (bottom, right).

Appendix B – Photomicrographs Combined Ro Cl Sc Tailings Solids

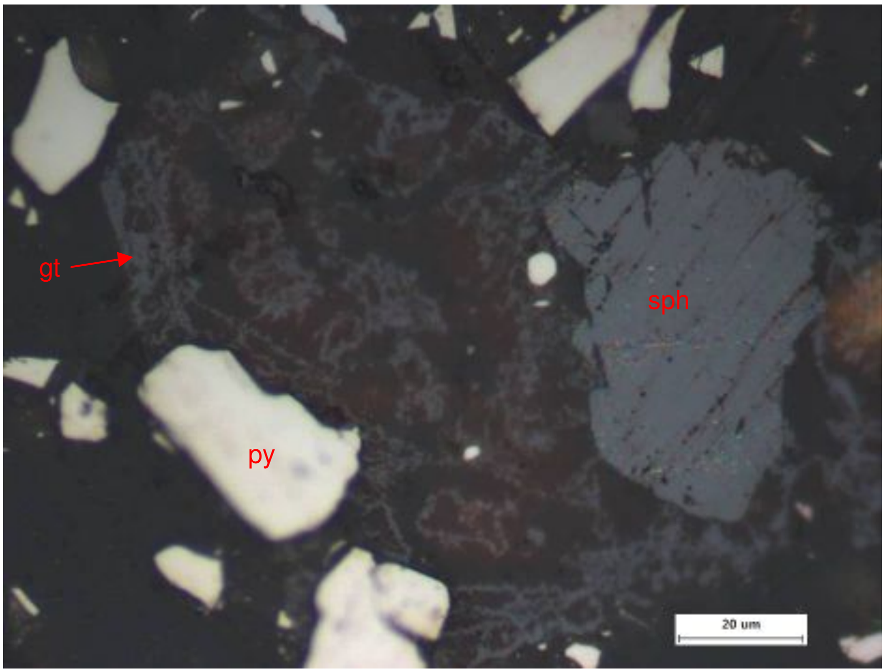


Figure 12: Combined Ro Cl Sc Tailings Solids

PPRL photomicrograph of complex particle containing sphalerite (sph), pyrite (py) and goethite (gt).

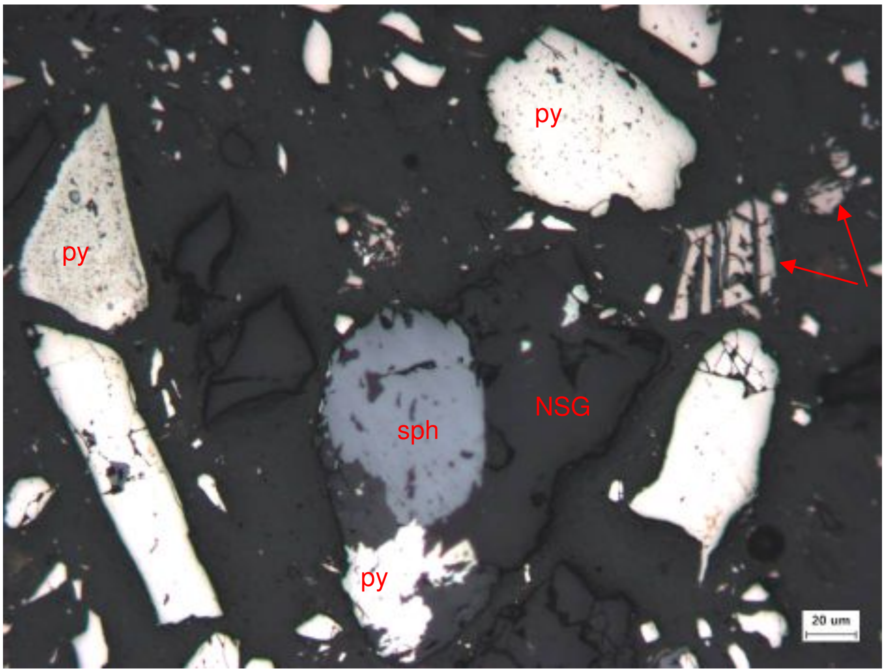


Figure 13: Combined Ro Cl Sc Tailings Solids

PPRL photomicrograph showing ternary particle of sphalerite (sph), pyrite (py) and non-sulphide gangue (NSG) surrounded by liberated pyrite and porous pyrite (py). The red arrows denote oxidized pyrrhotite which is also shown in high magnification below.

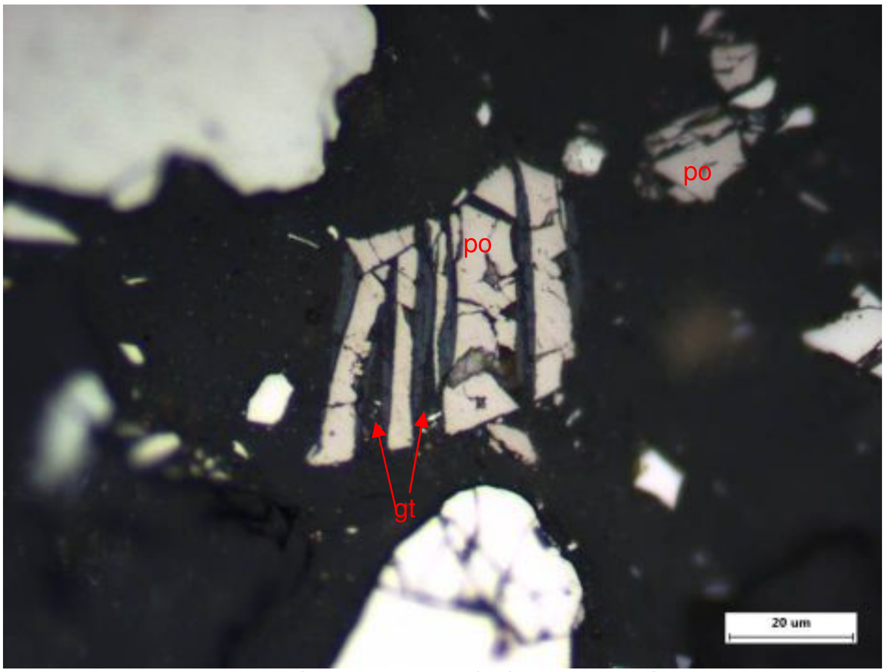


Figure 14: Combined Ro Cl Sc Tailings Solids

PPRL photomicrograph of a fractured grain of pyrrhotite (po) with goethite (gt) oxidation along the crystallographic grain boundaries.

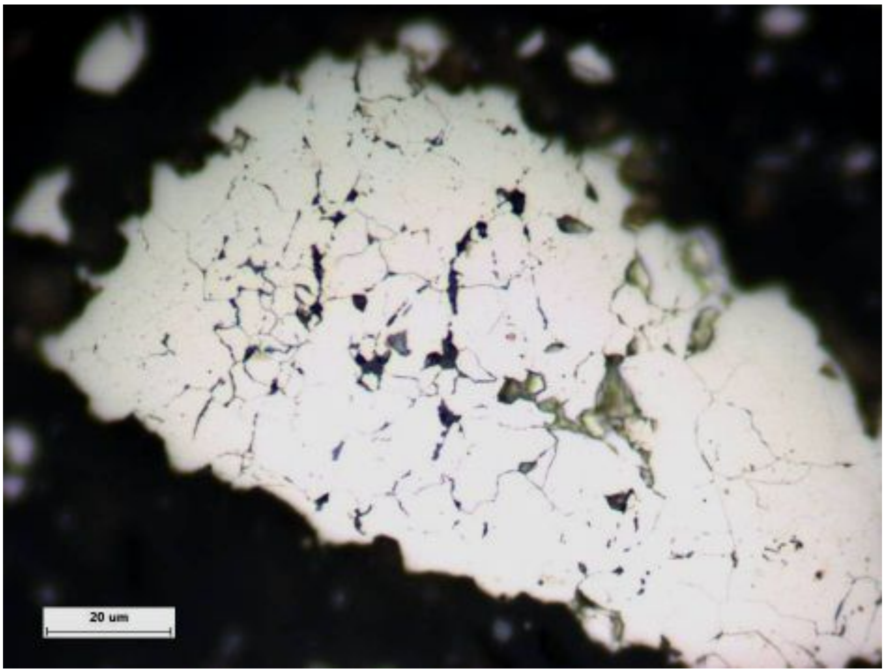


Figure 15: Combined Ro Cl Sc Tailings Solids

PPRL photomicrograph of granular pyrite which will be more susceptible to oxidation due to its high surface area.

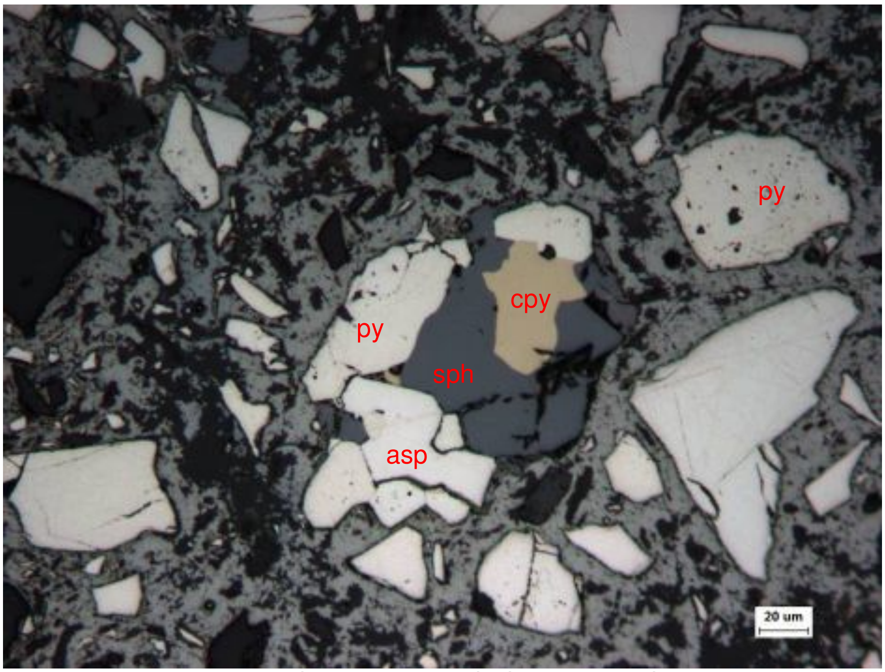


Figure 16: Combined Ro Cl Sc Tailings Solids

PPRL photomicrograph showing quaternary particle comprised of sphalerite (sph), chalcopyrite (cpy), pyrite (py) and arsenopyrite (asp). A porous grain of pyrite (py) lies to the upper right.

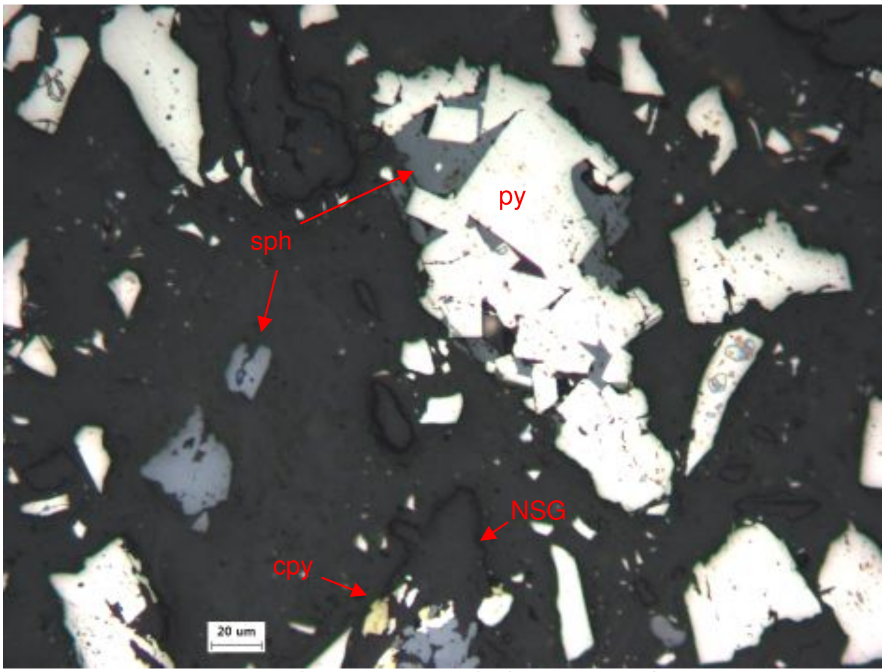


Figure 17: Combined Ro Cl Sc Tailings Solids

PPRL photomicrograph showing various associations of sphalerite.

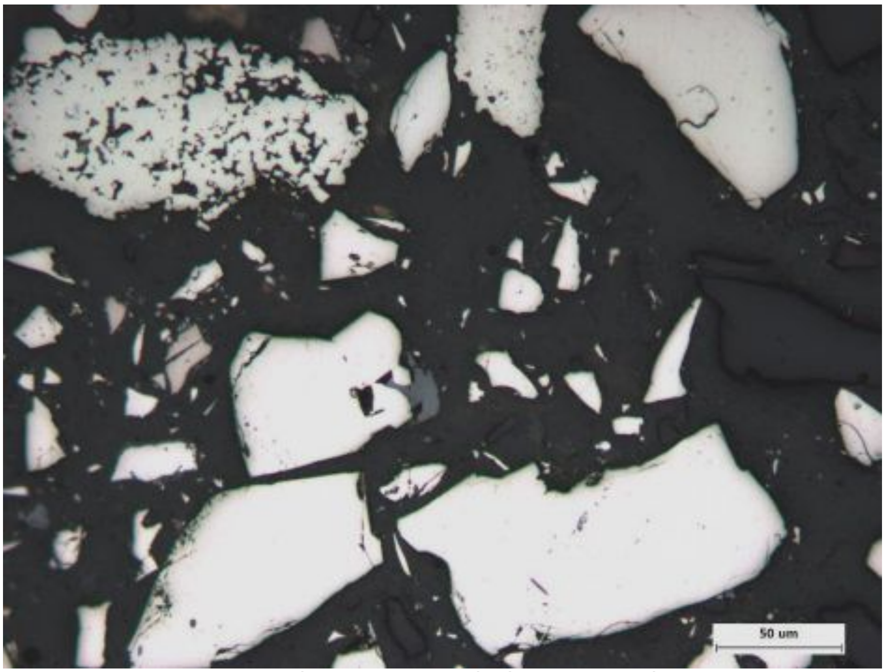


Figure 18: Combined Ro Cl Sc Tailings Solids

PPRL photomicrograph showing typical occurrences of pyrite in this sample.

Appendix B: Final Acid Base Accounting Results

Mod ABA
(Price 1997)

Parameter	**Units**	**Combined Wolverine D Composite Tails Final Washed Solids**	**Combined Lynx D Composite Tails Final Washed Solids**
Paste pH	units	7.05	6.45
Fizz Rate	---	2	2
Sample	weight(g)	1.96	2.00
HCl added	mL	62.00	44.00
HCl	Normality	0.10	0.10
NaOH	Normality	0.10	0.10
NaOH to	pH=8.3 mL	33.40	28.30
Final pH	units	1.65	1.77
NP	t $CaCO_3$/1000 t	73.00	39.2
AP	t $CaCO_3$/1000 t	534	906
Net NP	t $CaCO_3$/1000 t	-461	-867
NP/AP	ratio	0.14	0.04
S	%	18.6	27.1
Insoluble SO_4	%	< 0.01	< 0.01
$S^=$	%	17.1	29.0
C(t)	%	1.912	0.865
CO_3	%	2.426	0.895

LIMS #10480-NOV06

SGS Canada Inc.
P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - KOL 2HO
Phone: 705-652-2000 FAX: 705-652-6365

Modified ABA

Project : PO#100453

February-24-12

Yukon Zinc Corporation
Attn : Mary Mioska

Suite 701-475 Howe Street
Vancouver, Ontario
V6C 2B3, Canada

Phone: 604-682-5474 ext246
Fax:pdf, excel

Date Rec. : 23 January 2012
LR Report: **CA11273-JAN12**
Reference: Hum Cell Shutdown - Washed Solids

Copy: #1

CERTIFICATE OF ANALYSIS

Final Report

Analysis	**3: Analysis Approval Date**	**4: Analysis Approval Time**	**5: June 29/05 Combined OD Composite Tails**	**6: Combined RO + Cl Sc Tailings Solids**
Paste pH [units]	14-Feb-12	13:38	5.65	7.06
Fizz Rate [---]	14-Feb-12	13:38	1	2
Sample weight [g]	14-Feb-12	13:38	2.04	2.05
HCl added [mL]	14-Feb-12	13:38	24.30	48.90
HCl [Normality]	14-Feb-12	13:38	0.10	0.10
NaOH [Normality]	14-Feb-12	13:38	0.10	0.10
NaOH to [pH=8.3 mL]	14-Feb-12	13:38	19.63	29.82
Final pH [units]	14-Feb-12	13:38	1.65	1.62
NP [t CaCO3/1000 t]	14-Feb-12	13:38	11.5	46.5
AP [t CaCO3/1000 t]	23-Feb-12	09:51	725	862
Net NP [t CaCO3/1000 t]	23-Feb-12	09:51	-714	-816
NP/AP [ratio]	23-Feb-12	09:51	0.02	0.05
Sulphur (total) [%]	17-Feb-12	14:37	23.2	27.6
Acid Leachable SO4-S [%]	23-Feb-12	09:50	< 0.01	< 0.01
Sulphide [%]	23-Feb-12	09:50	23.2	27.6
Carbon (total) [%]	17-Feb-12	14:37	0.727	1.22
Carbonate [%]	22-Feb-12	14:12	0.533	1.29

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Project Specialist
Environmental Services, Analytical

Appendix C: Final ICP-MS Results

Solids ICP-MS by Aqua Regia

Parameter	Units	Combined Wolverine D Composite Tails Final Washed Solids	Combined Lynx D Composite Tails Final Washed Solids
Hg	g/t	---	---
Ag	µg/g	86	59
Al	µg/g	8400	2100
As	µg/g	1200	3700
Ba	µg/g	57	32
Be	µg/g	0.2	< 0.1
Bi	µg/g	18	4.9
B	µg/g		
Ca	µg/g	22000	18000
Cd	µg/g	75	100
Co	µg/g	40	32
Cr	µg/g	91	110
Cu	µg/g	1100	850
Fe	µg/g	200000	300000
K	µg/g	3100	1200
Li	µg/g	4.2	0.1
Mg	µg/g	14000	3700
Mn	µg/g	600	590
Mo	µg/g	28	47
Na	µg/g	100	55
Ni	µg/g	60	66
Pb	µg/g	4500	4600
P	µg/g		
Sb	µg/g	290	200
Se	µg/g	530	430
Sn	µg/g	9	14
Sr	µg/g	52	36
Ti	µg/g	62	39
Tl	µg/g	12	23
U	µg/g	6.5	3.9
V	µg/g	34	26
Y	µg/g	10	6.2
Zn	µg/g	8300	11000

LIMS #10481-NOV06

SGS Canada Inc.
P.O. Box 4300 - 185 Concession St.
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Project : Metals - on wahsed solids

Monday, February 20, 2012

Yukon Zinc Corporation
Attn : Mary Mioska

Suite 701-475 Howe Street
Vancouver, Ontario
V6C 2B3, Canada

Phone: 604-682-5474 ext246
Fax:pdf, excel

Date Rec. : 23 January 2012
LR Report: **CA11275-JAN12**
Reference: Hum Cell Shutdown

Copy: #1

CERTIFICATE OF ANALYSIS

Final Report

Analysis	**3: Analysis Approval Date**	**4: Analysis Approval Time**	**5: June 29/05 Combined OD Composite Tails**	**6: Combined RO + Cl Sc Tailings Solids**
Sample Date & Time			Date:N/A	Date:N/A
Mercury [µg/g]	14-Feb-12	10:19	3.9	5.5
Silver [µg/g]	15-Feb-12	13:42	56	63
Aluminum [µg/g]	14-Feb-12	14:31	31000	24000
Arsenic [µg/g]	15-Feb-12	13:42	2600	2900
Barium [µg/g]	15-Feb-12	13:42	3900	1900
Beryllium [µg/g]	15-Feb-12	13:42	1.4	1.2
Bismuth [µg/g]	15-Feb-12	13:42	9.8	10
Calcium [µg/g]	14-Feb-12	14:31	4500	11000
Cadmium [µg/g]	15-Feb-12	13:42	53	130
Cobalt [µg/g]	15-Feb-12	13:42	29	33
Chromium [µg/g]	15-Feb-12	13:42	440	430
Copper [µg/g]	15-Feb-12	13:42	640	960
Iron [µg/g]	14-Feb-12	14:31	350000	350000
Potassium [µg/g]	14-Feb-12	14:31	13000	11000
Lithium [µg/g]	15-Feb-12	13:42	29	23
Magnesium [µg/g]	14-Feb-12	14:31	8600	10000
Manganese [µg/g]	15-Feb-12	13:42	470	730
Molybdenum [µg/g]	15-Feb-12	13:42	36	36
Sodium [µg/g]	14-Feb-12	14:31	400	290
Nickel [µg/g]	15-Feb-12	13:42	45	54
Phosphorus [µg/g]	14-Feb-12	14:32	410	330
Lead [µg/g]	15-Feb-12	13:42	4100	4300
Antimony [µg/g]	15-Feb-12	13:42	280	280
Selenium [µg/g]	15-Feb-12	13:42	370	470
Tin [µg/g]	15-Feb-12	13:42	21	20
Strontium [µg/g]	15-Feb-12	13:42	37	49
Titanium [µg/g]	14-Feb-12	14:32	550	450
Thallium [µg/g]	15-Feb-12	13:42	36	34
Uranium [µg/g]	15-Feb-12	13:43	6.4	6.5
Vanadium [µg/g]	15-Feb-12	13:43	240	200
Yttrium [µg/g]	15-Feb-12	13:43	9.8	10
Zinc [µg/g]	15-Feb-12	13:43	6800	17000

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Appendix D: Final Shake Flask Extraction Test Results

Final Wash - DI Leach 3:1 Ratio as per Price (1997)

Sample ID	Units	MMER[1]	Combined Wolverine D Composite Tails - Final Solids	Combined Lynx D Composite Tails - Final Solids
Sample	weight(g)		1095	1069
Volume mL	D.I. H_2O		3000	3000
Initial pH	units	6.0 to 9.5	6.7	6.7
Final pH	units	6.0 to 9.5	7.09	6.94
F	mg/L		0.19	0.16
pH	units	6.0 to 9.5	7.05	7.24
Alkalinity	mg/L as $CaCO_3$		51	41
Acidity	mg/L as $CaCO_3$		116	40
Conductivity	uS/cm		2300	2260
Cl	mg/L		3.6	< 2
SO_4	mg/L		1500	1500
NO_3	as N mg/L		< 0.5	0.09
NH_3+NH_4	as N mg/L		0.1	< 0.1
Thiosalts	as S_2O_3 mg/L		80	40
CN(T)	mg/L	1.00	< 0.01	< 0.01
CNO	mg/L		< 1	< 1
CNS	mg/L		< 2	< 2
Hg	µg/L		< 0.1	< 0.1
Ag	mg/L		< 0.0003	< 0.0003
Al	mg/L		< 0.01	< 0.01
As	mg/L	0.50	0.008	< 0.005
Ba	mg/L		0.0331	0.0345
Be	mg/L		0.0008	< 0.0004
Bi	mg/L		0.0005	0.0003
B	mg/L		0.020	0.023
Ca	mg/L		611	614
Cd	mg/L		0.361	0.288
Co	mg/L		0.0614	0.0602
Cr	mg/L		< 0.003	< 0.003
Cu	mg/L	0.30	0.003	0.004
Fe	mg/L		< 0.01	< 0.01
Li	mg/L		0.005	0.004
K	mg/L		0.84	1.97
Mg	mg/L		20.7	22.7
Mn	mg/L		22.3	5.20
Mo	mg/L		0.0008	0.0008
Na	mg/L		0.42	0.72
Ni	mg/L	0.50	0.151	0.131
P	mg/L		< 0.01	0.03
Pb	mg/L	0.20	0.0530	0.0167
Sb	mg/L		< 0.01	0.01
Se	mg/L		0.28	0.45
Si	mg/L		0.97	0.62
Sn	mg/L		0.005	0.004
Sr	mg/L		1.19	0.896
Ti	mg/L		< 0.001	< 0.001
Tl	mg/L		0.007	< 0.001
U	mg/L		0.0008	0.0010
V	mg/L		0.004	0.004
Zn	mg/L	0.50	**33.2**	**17.0**

LIMS #10080-NOV06

SGS Canada Inc.
P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - KOL 2HO
Phone: 705-652-2000 FAX: 705-652-6365

Monday, February 20, 2012

Yukon Zinc Corporation
Attn : Mary Mioska

Suite 701-475 Howe Street, Vancouver
Canada, V6C 2B3
Phone: 604-682-5474 ext246, Fax:pdf, excel

Date Rec. : 23 January 2012
LR Report: **CA11274-JAN12**
Reference: Hum Cell Shutdown - Final Wash

Copy: #1

CERTIFICATE OF ANALYSIS

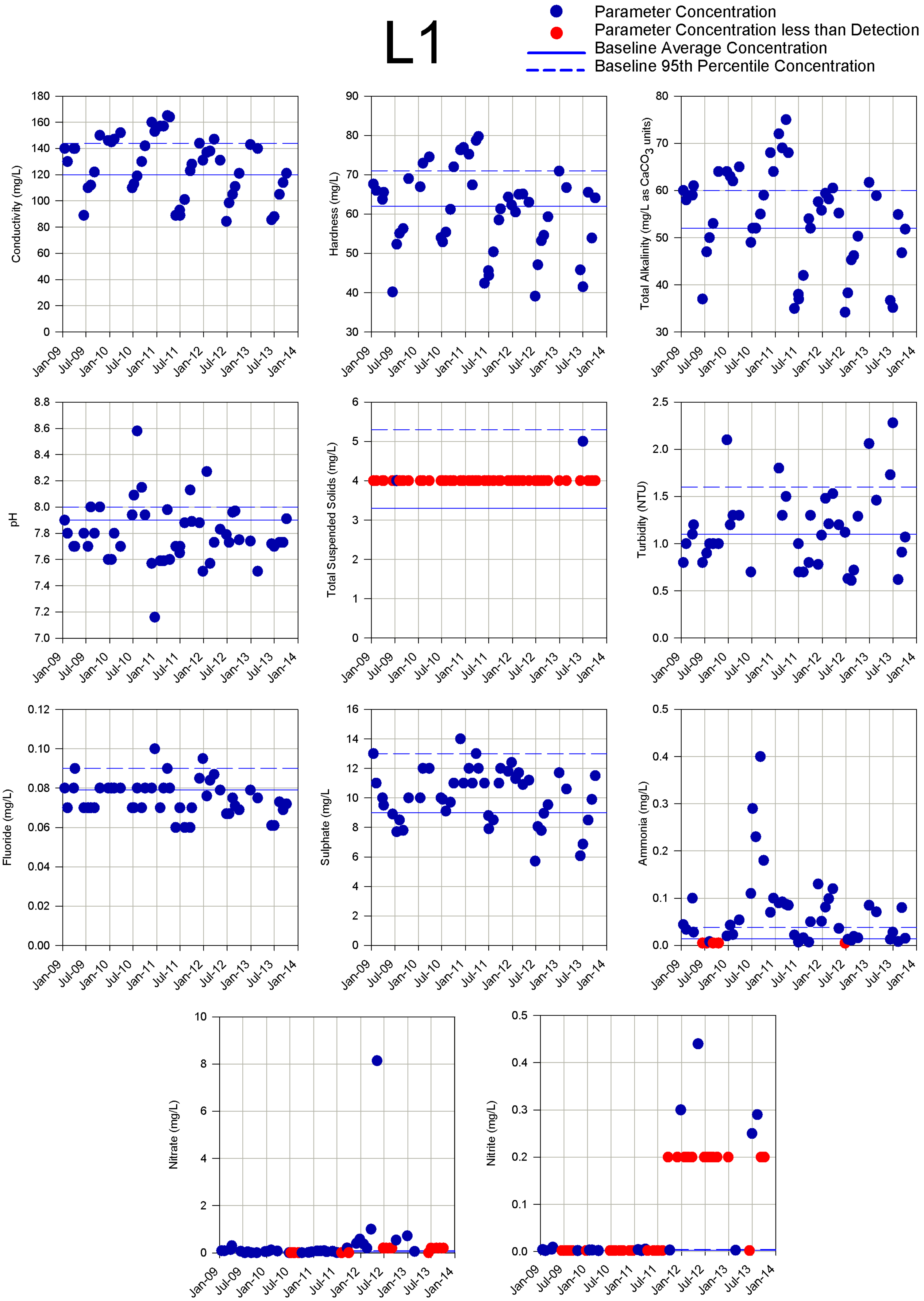
Final Report

Analysis	3: Analysis Approval Date	4: Analysis Approval Time	5: June 29/05 Combined OD Composite Tails Final Wash	6: Combined RO + Cl Sc Tailings Solids Final Wash
Sample [weight(g)]	03-Feb-12	11:24	1000	1000
Volume D.I. Water [mL]	03-Feb-12	11:24	3000	3000
Initial pH [units]	03-Feb-12	11:24	5.29	6.53
Final pH [units]	03-Feb-12	11:24	5.41	7.05
pH [no unit]	06-Feb-12	14:21	6.51	6.94
Alkalinity [mg/L as CaCO3]	06-Feb-12	14:21	16	17
Acidity [mg/L as CaCO3]	06-Feb-12	14:21	522	37
Conductivity [µS/cm]	06-Feb-12	14:21	2960	2050
Fluoride [mg/L]	07-Feb-12	10:37	< 0.06	0.08
Chloride [mg/L]	03-Feb-12	15:56	< 2	< 2
Sulphate [mg/L]	03-Feb-12	15:56	2200	1300
Cyanide (total) [mg/L]	03-Feb-12	14:50	< 0.01	< 0.01
Cyanate [mg/L]	03-Feb-12	09:52	< 1	< 1
Thiocyanate [mg/L]	06-Feb-12	11:19	< 0.2	< 0.2
Thiosalts (total) [as S2O3 mg/L]	15-Feb-12	21:40	<10	<10
Ammonia+Ammonium (N) [mg/L]	02-Feb-12	13:55	0.1	0.2
Nitrate (as N) [mg/L]	03-Feb-12	16:22	< 0.05	< 0.05
Mercury [mg/L]	02-Feb-12	17:16	< 0.0001	0.0003
Silver [mg/L]	07-Feb-12	13:54	0.00041	0.00005
Aluminum [mg/L]	07-Feb-12	13:54	0.0004	0.0008
Arsenic [mg/L]	07-Feb-12	13:54	0.112	0.0064
Barium [mg/L]	07-Feb-12	13:54	0.0387	0.0293
Beryllium [mg/L]	07-Feb-12	13:54	< 0.00002	< 0.00002
Bismuth [mg/L]	07-Feb-12	13:54	< 0.00001	< 0.00001
Boron [mg/L]	07-Feb-12	13:54	0.0323	0.0086
Calcium [mg/L]	03-Feb-12	14:53	573	539
Cadmium [mg/L]	07-Feb-12	13:54	2.10	1.21
Cobalt [mg/L]	07-Feb-12	13:54	0.136	0.00872
Chromium [mg/L]	07-Feb-12	13:54	< 0.0005	< 0.0005
Copper [mg/L]	07-Feb-12	13:54	0.376	0.0136
Iron [mg/L]	03-Feb-12	14:53	0.012	< 0.003
Lithium [mg/L]	07-Feb-12	13:54	0.002	< 0.001

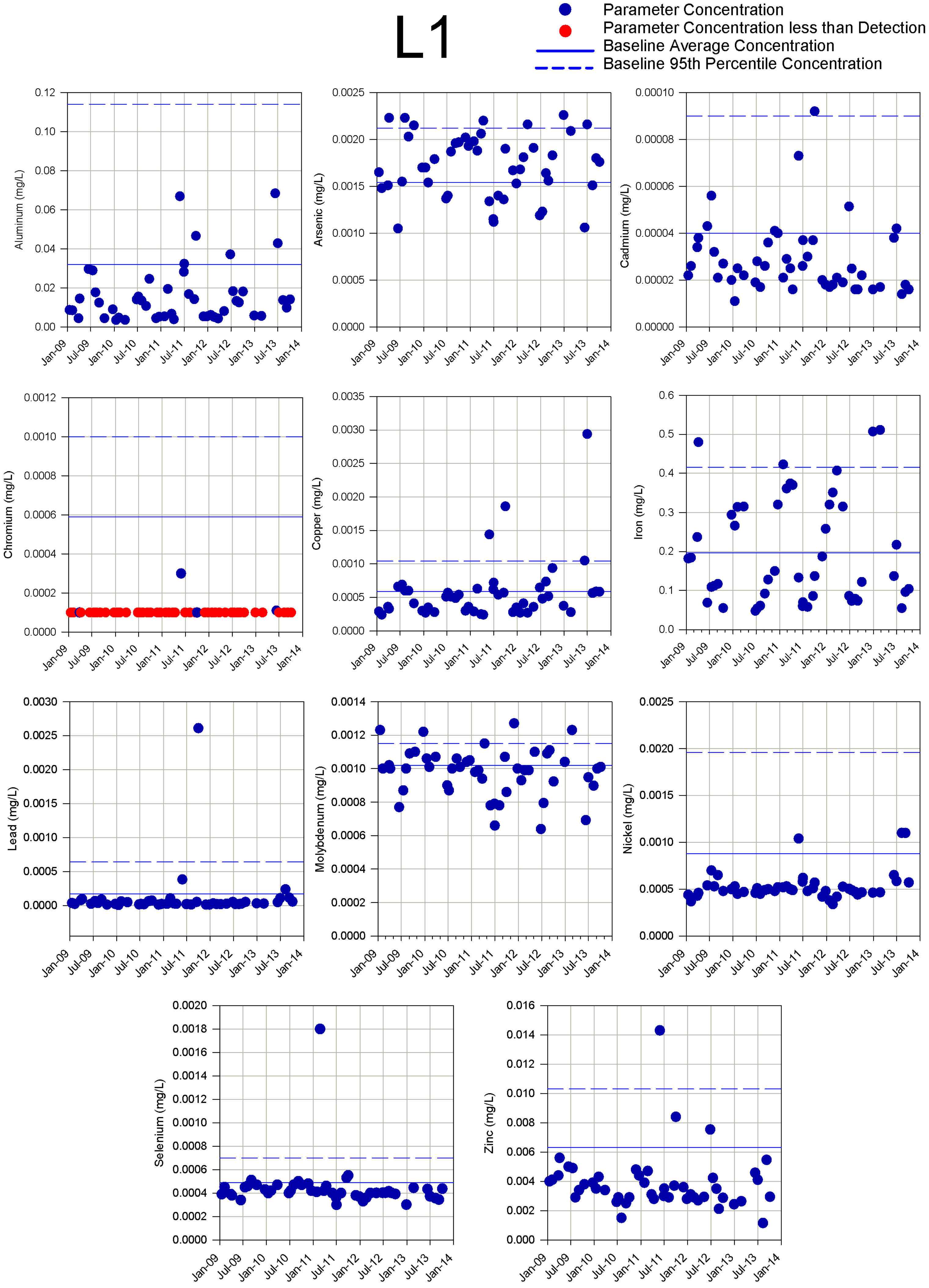
Analysis	**3: Analysis Approval Date**	**4: Analysis Approval Time**	**5: June 29/05 Combined OD Composite Tails Final Wash**	**6: Combined RO + Cl Sc Tailings Solids Final Wash**
Potassium [mg/L]	03-Feb-12	14:53	1.50	0.798
Magnesium [mg/L]	03-Feb-12	14:53	62.4	4.38
Manganese [mg/L]	07-Feb-12	13:54	27.7	2.08
Molybdenum [mg/L]	07-Feb-12	13:54	0.00012	0.00329
Sodium [mg/L]	03-Feb-12	14:53	5.17	4.01
Nickel [mg/L]	07-Feb-12	13:54	0.630	0.0237
Phosphorus [mg/L]	03-Feb-12	14:53	< 0.009	0.012
Lead [mg/L]	07-Feb-12	13:54	0.0569	0.00965
Selenium [mg/L]	07-Feb-12	13:54	2.95	0.193
Silicon [mg/L]	03-Feb-12	14:53	6.51	1.06
Tin [mg/L]	07-Feb-12	13:54	0.00006	0.00035
Strontium [mg/L]	03-Feb-12	14:53	1.21	0.568
Titanium [mg/L]	07-Feb-12	13:54	0.0008	0.0003
Thallium [mg/L]	07-Feb-12	13:54	0.0165	0.0129
Uranium [mg/L]	07-Feb-12	13:54	0.000159	0.000085
Vanadium [mg/L]	07-Feb-12	13:54	0.00006	0.00014
Zinc [mg/L]	03-Feb-12	14:53	328	37.7

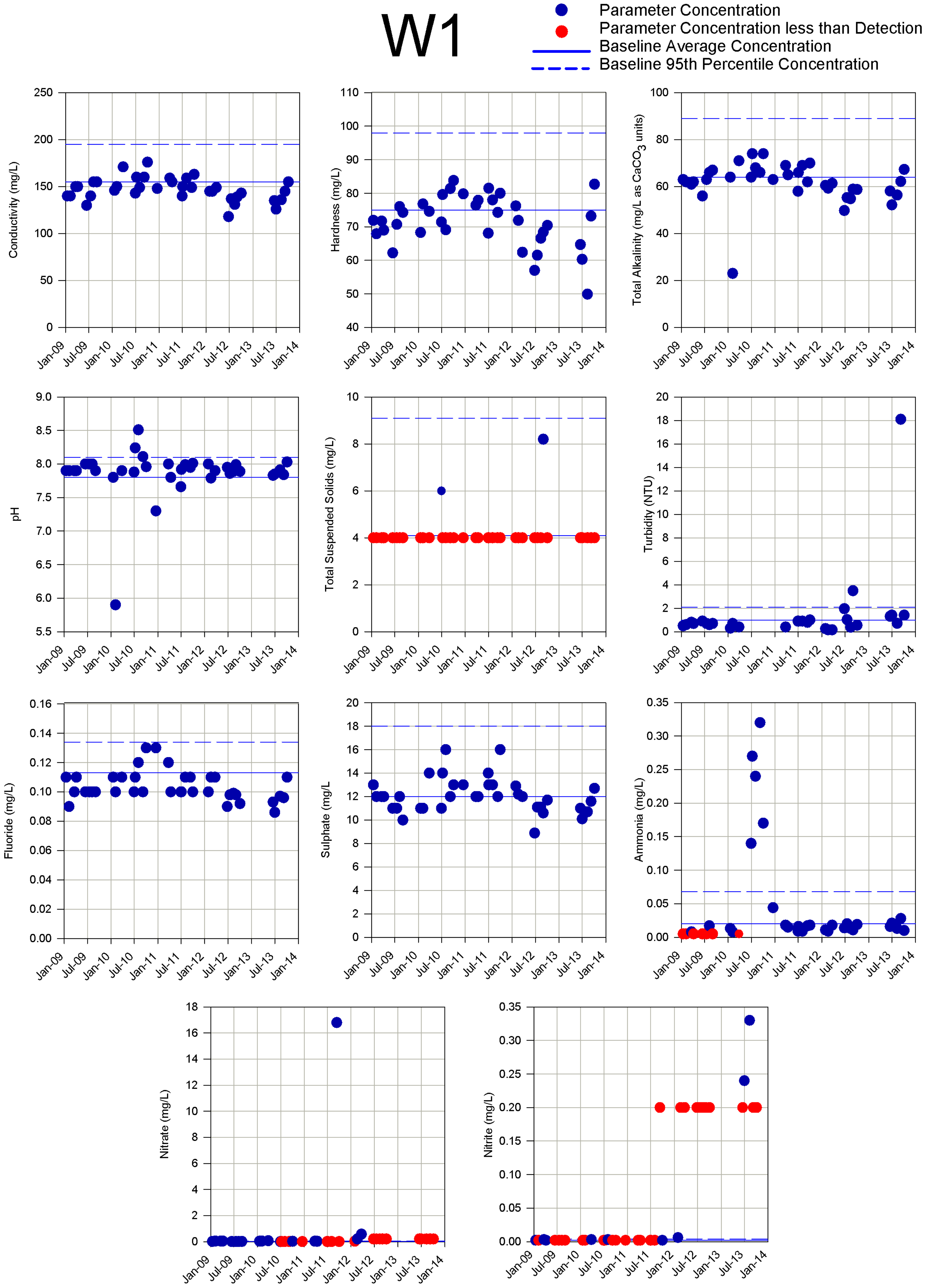
Brian Graham B.Sc.
Project Specialist
Environmental Services, Analytical

L1


Parameter Concentration
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
0
20
40
60
80
100
120
140
160
180
Hardness (mg/L)
30
40
50
60
70
80
90
Total Alkalinity (mg/L as $CaCO_3$ units)
30
40
50
60
70
80
pH
7.0
7.2
7.4
7.6
7.8
8.0
8.2
8.4
8.6
8.8
Total Suspended Solids (mg/L)
0
1
2
3
4
5
6
Turbidity (NTU)
0.0
0.5
1.0
1.5
2.0
2.5
Fluoride (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
0.12
Sulphate (mg/L
0
2
4
6
8
10
12
14
16
Ammonia (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
Nitrate (mg/L)
0
2
4
6
8
10
Nitrite (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

L1


Parameter Concentration
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
0.12
Arsenic (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
Cadmium (mg/L)
0.00000
0.00002
0.00004
0.00006
0.00008
0.00010
Chromium (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
Copper (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
0.0030
0.0035
Iron (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Lead (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
0.0030
Molybdenum (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
Nickel (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
Selenium (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
0.0016
0.0018
0.0020
Zinc (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0.014
0.016
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14


W1
Parameter Concentration
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
0
50
100
150
200
250
Hardness (mg/L)
40
50
60
70
80
90
100
110
Total Alkalinity (mg/L as $CaCO_3$ units)
0
20
40
60
80
100
pH
5.5
6.0
6.5
7.0
7.5
8.0
8.5
9.0
Total Suspended Solids (mg/L)
0
2
4
6
8
10
Turbidity (NTU)
0
2
4
6
8
10
12
14
16
18
20
Fluoride (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
Sulphate (mg/L
0
2
4
6
8
10
12
14
16
18
20
Ammonia (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
Nitrate (mg/L)
0
2
4
6
8
10
12
14
16
18
Nitrite (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
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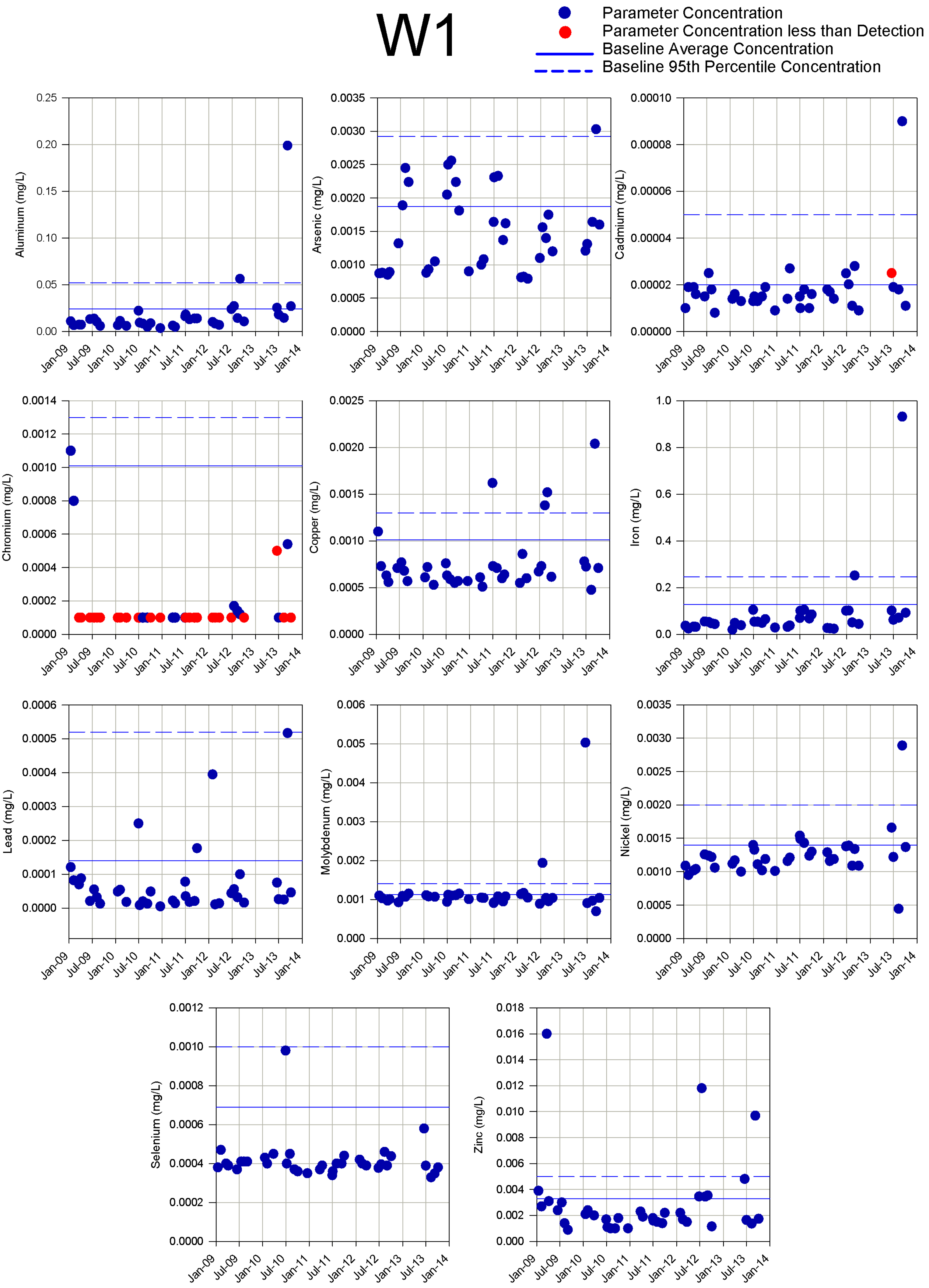
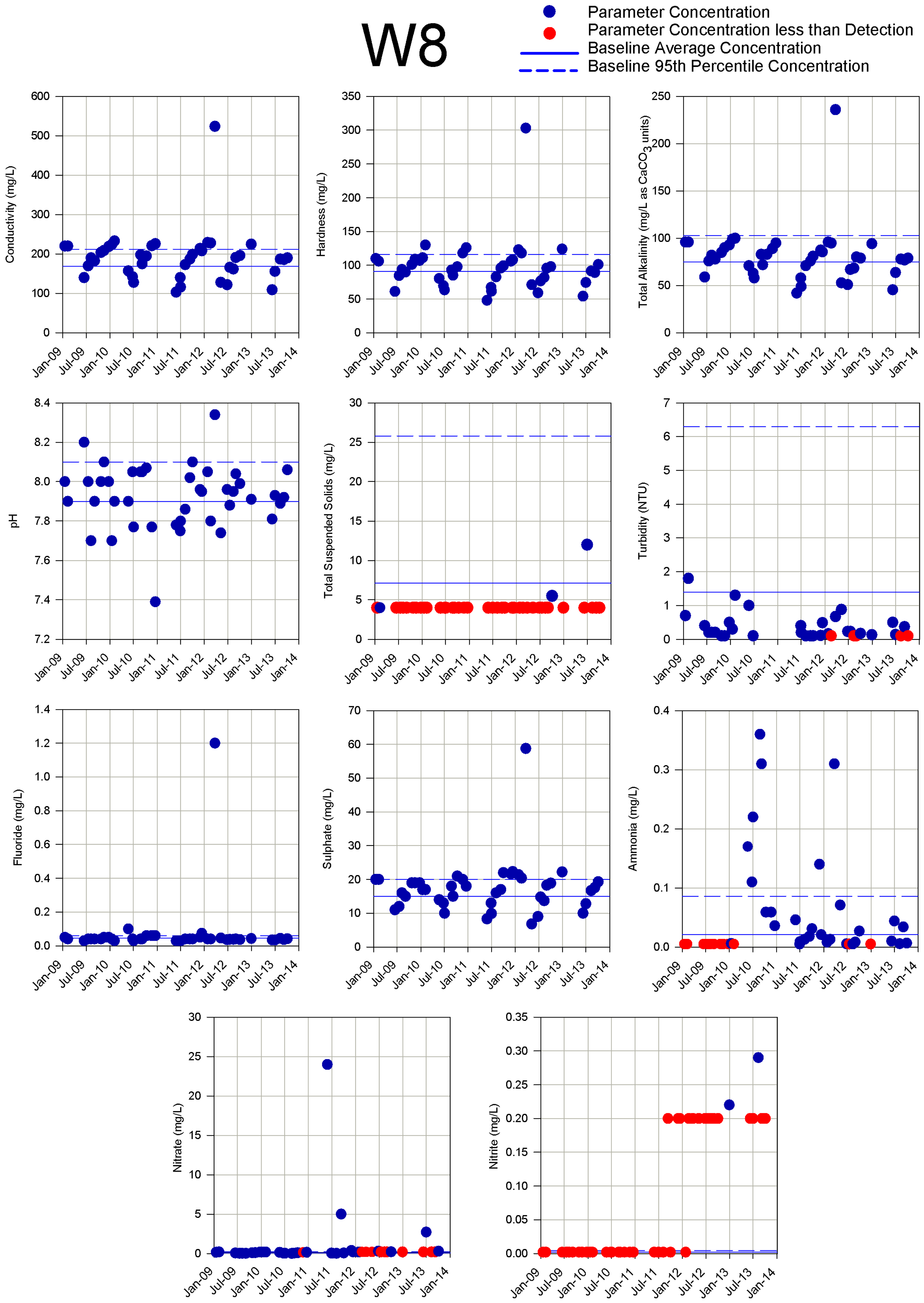
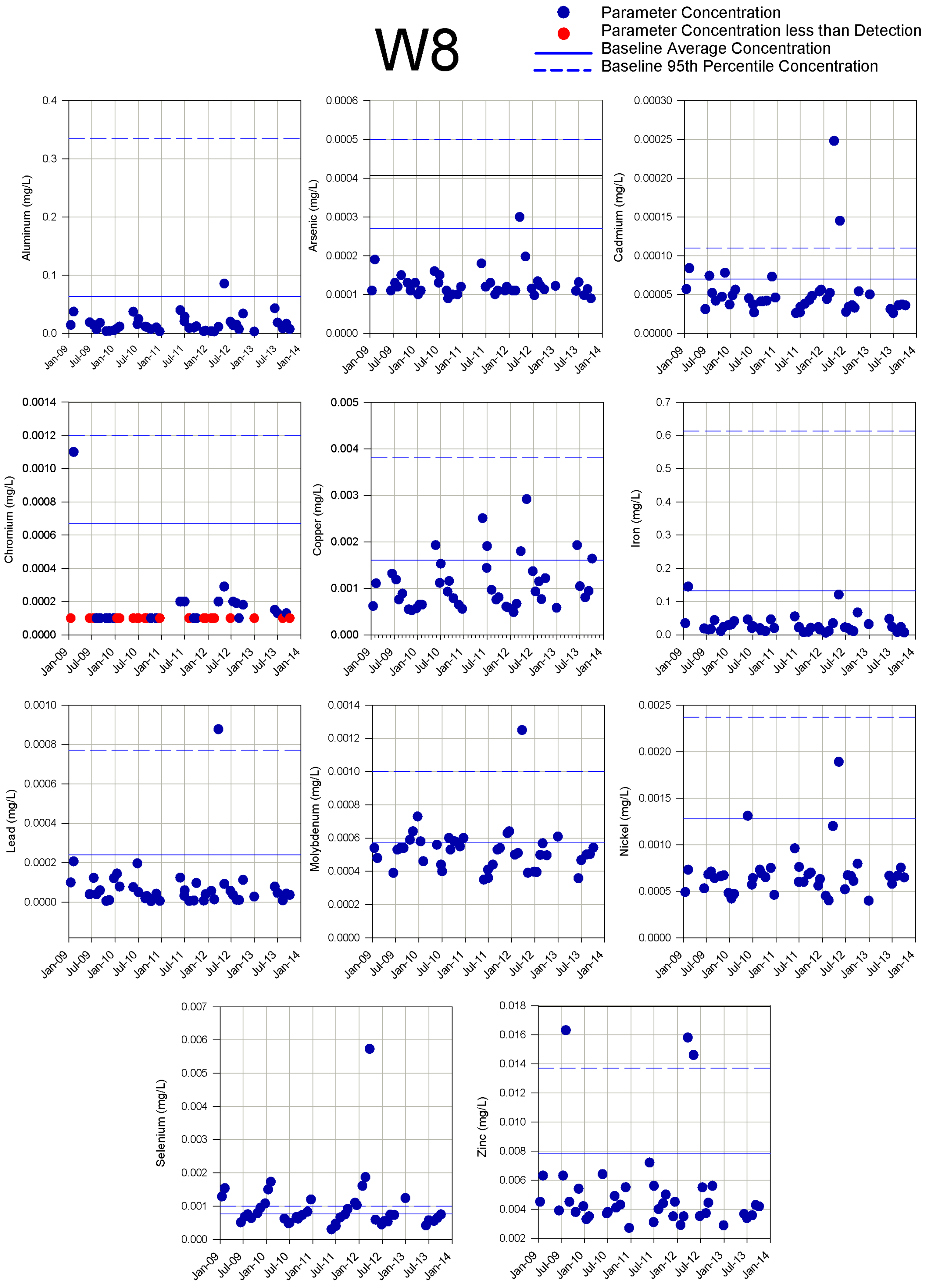
Jul-12
Jan-13
Jul-13
Jan-14

W1

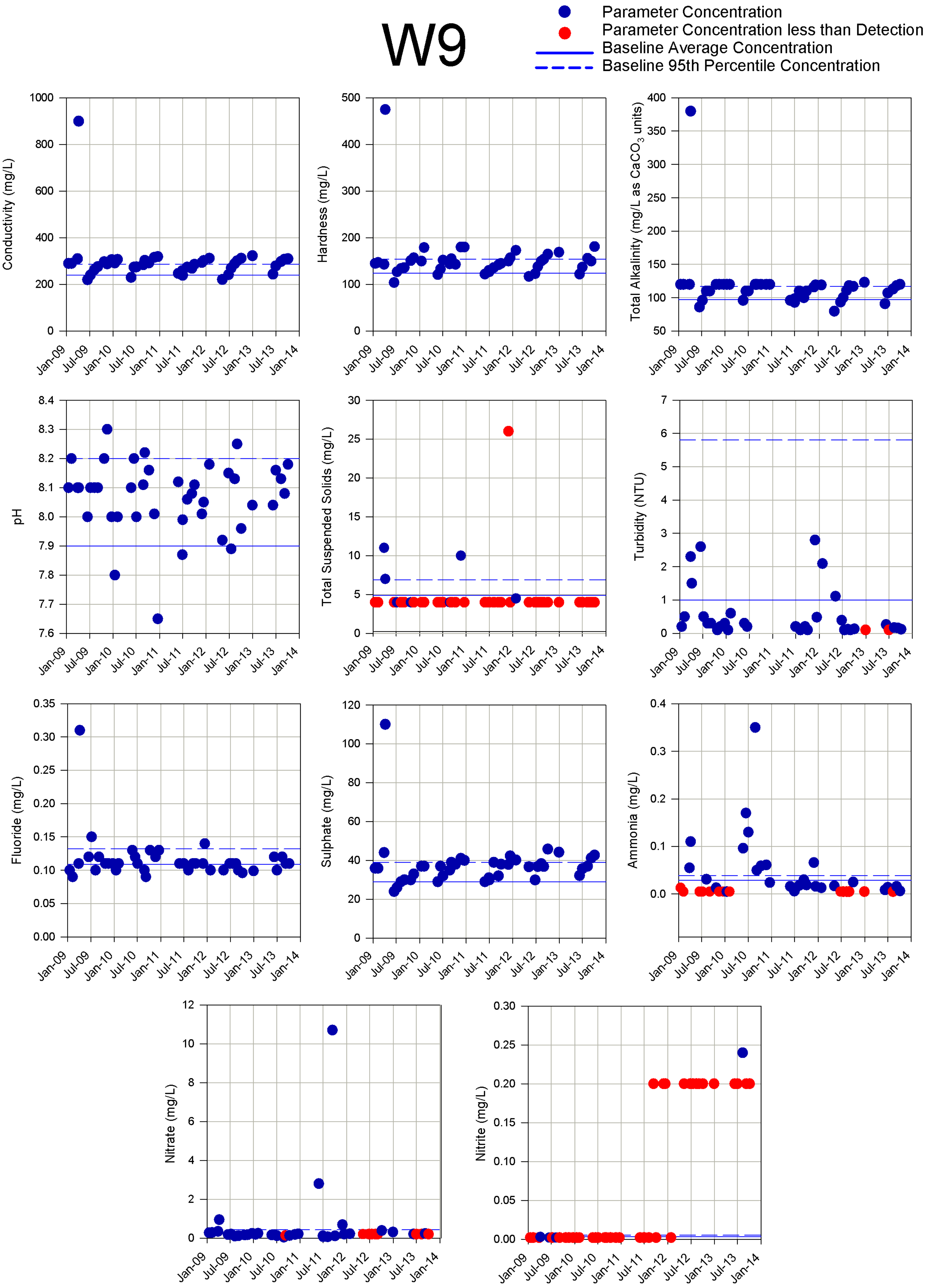

Parameter Concentration
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
Arsenic (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
0.0030
0.0035
Cadmium (mg/L)
0.00000
0.00002
0.00004
0.00006
0.00008
0.00010
Chromium (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
Copper (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
Iron (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
Lead (mg/L)
0.0000
0.0001
0.0002
0.0003
0.0004
0.0005
0.0006
Molybdenum (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
0.006
Nickel (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
0.0030
0.0035
Selenium (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
Zinc (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0.014
0.016
0.018
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14


W8
● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
0
100
200
300
400
500
600
Hardness (mg/L)
0
50
100
150
200
250
300
350
Total Alkalinity (mg/L as $CaCO_3$ units)
0
50
100
150
200
250
pH
7.2
7.4
7.6
7.8
8.0
8.2
8.4
Total Suspended Solids (mg/L)
0
5
10
15
20
25
30
Turbidity (NTU)
0
1
2
3
4
5
6
7
Fluoride (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
Sulphate (mg/L)
0
10
20
30
40
50
60
70
Ammonia (mg/L)
0.0
0.1
0.2
0.3
0.4
Nitrate (mg/L)
0
5
10
15
20
25
30
Nitrite (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

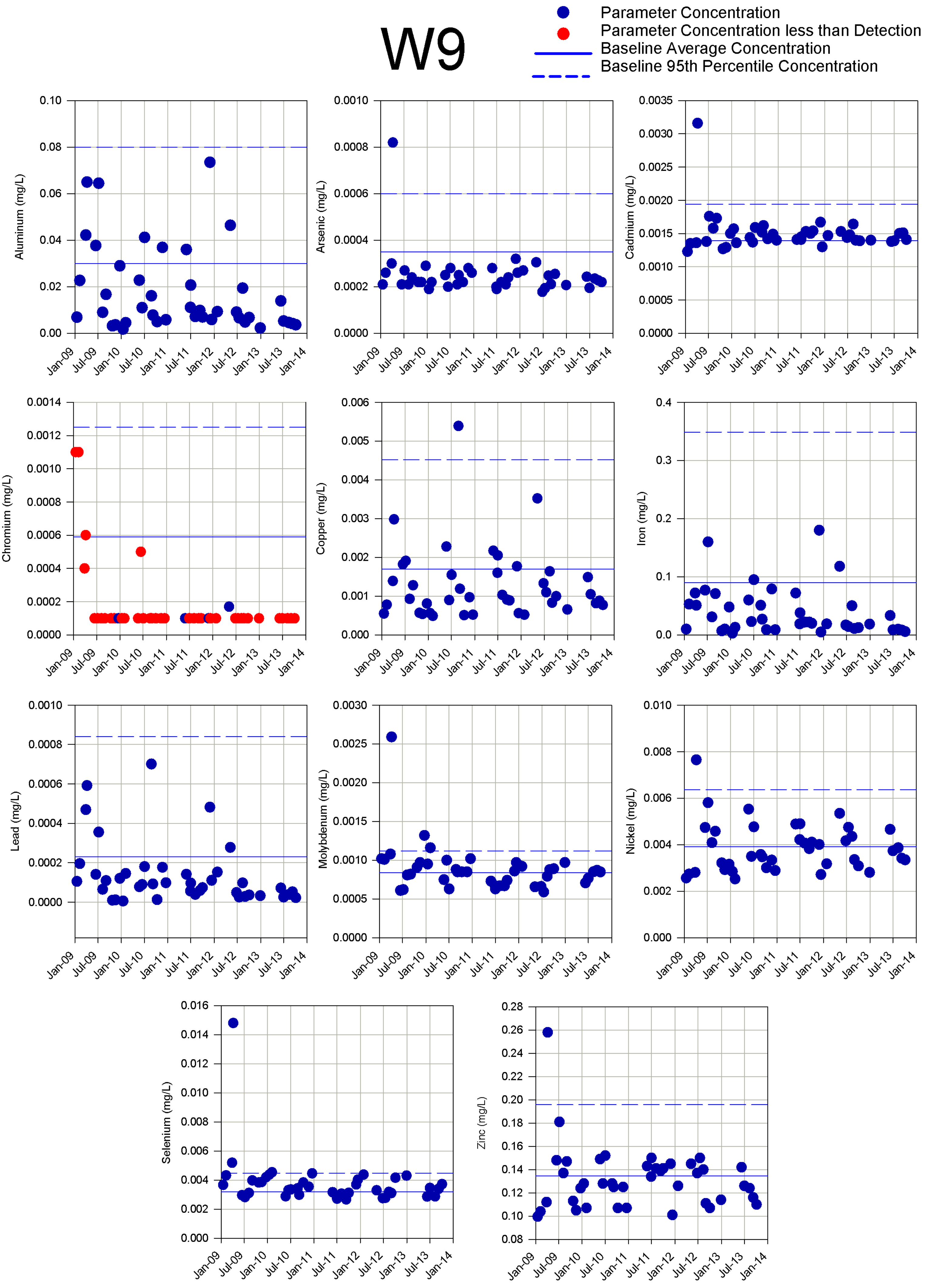
W8

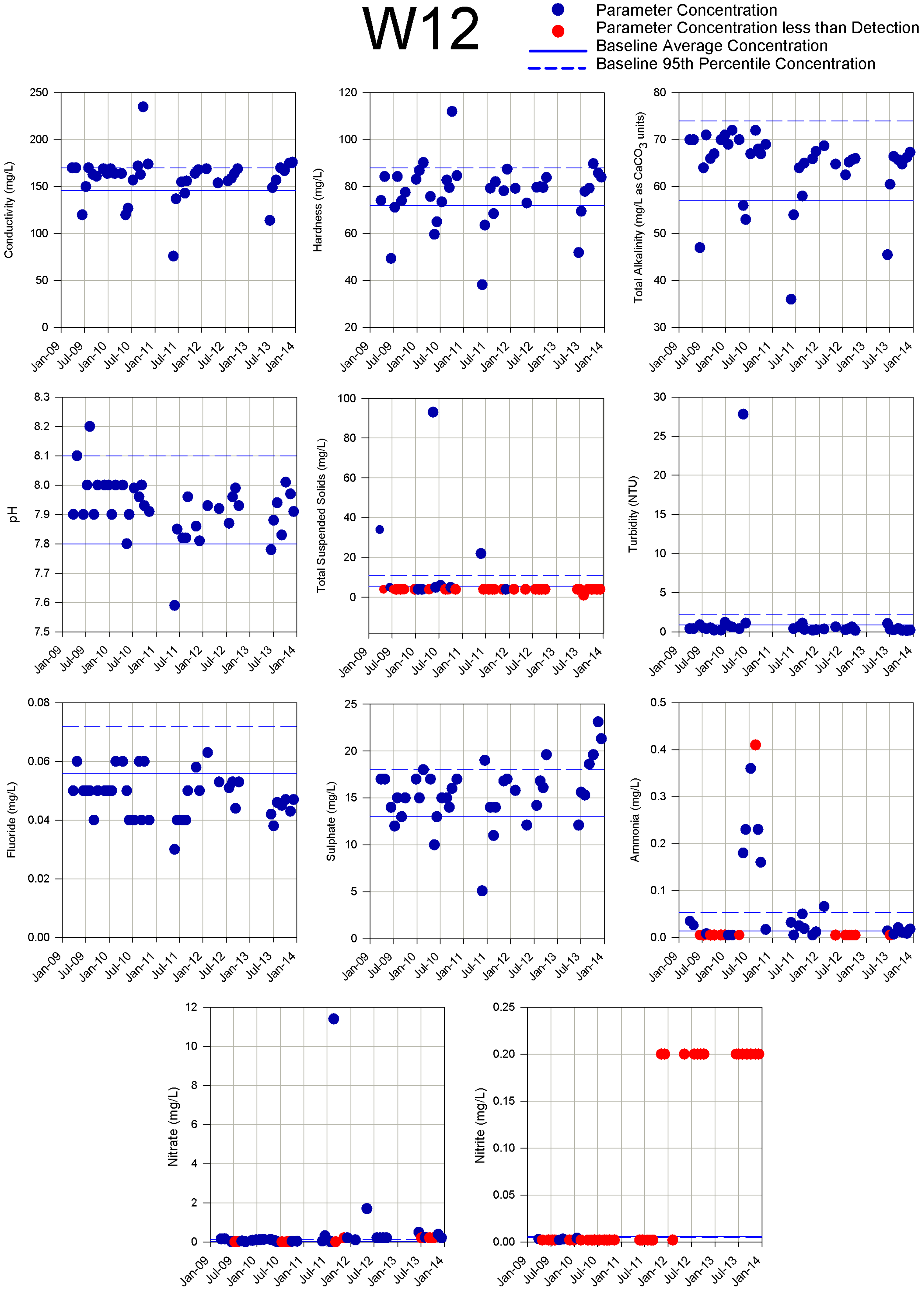


● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.0
0.1
0.2
0.3
0.4
Arsenic (mg/L)
0.0000
0.0001
0.0002
0.0003
0.0004
0.0005
0.0006
Cadmium (mg/L)
0.00000
0.00005
0.00010
0.00015
0.00020
0.00025
0.00030
Chromium (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
Copper (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
Iron (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Lead (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
Molybdenum (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
Nickel (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
Selenium (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
0.006
0.007
Zinc (mg/L)
0.002
0.004
0.006
0.008
0.010
0.012
0.014
0.016
0.018
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

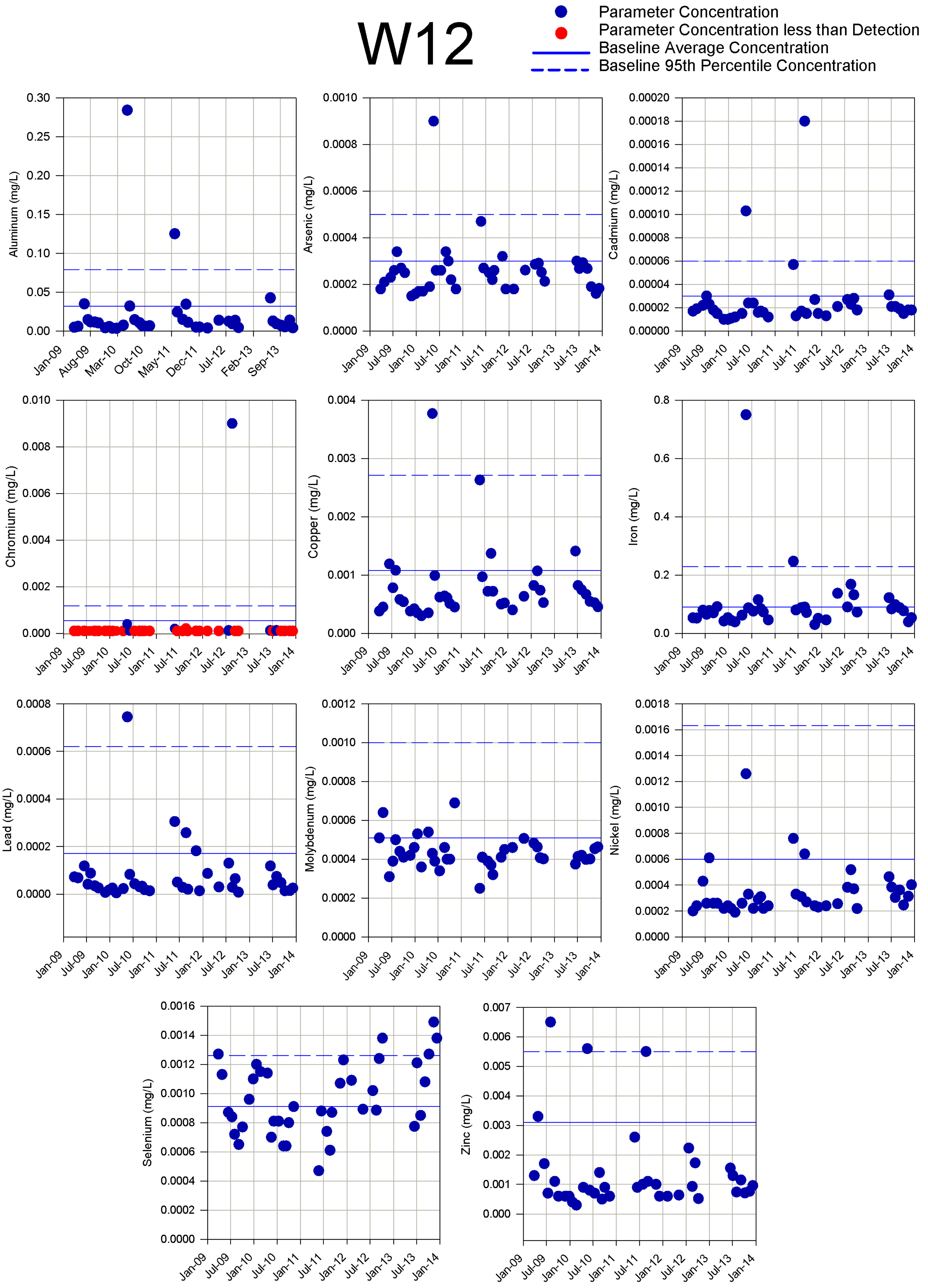

W9
Parameter Concentration
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
0
200
400
600
800
1000
Hardness (mg/L)
0
100
200
300
400
500
Total Alkalinity (mg/L as $CaCO_3$ units)
50
100
150
200
250
300
350
400
pH
7.6
7.7
7.8
7.9
8.0
8.1
8.2
8.3
8.4
Total Suspended Solids (mg/L)
0
5
10
15
20
25
30
Turbidity (NTU)
0
1
2
3
4
5
6
7
Fluoride (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
Sulphate (mg/L)
0
20
40
60
80
100
120
Ammonia (mg/L)
0.0
0.1
0.2
0.3
0.4
Nitrate (mg/L)
0
2
4
6
8
10
12
Nitrite (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

W9


Parameter Concentration
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
Arsenic (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
Cadmium (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
0.0030
0.0035
Chromium (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
Copper (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
0.006
Iron (mg/L)
0.0
0.1
0.2
0.3
0.4
Lead (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
Molybdenum (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
0.0030
Nickel (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
Selenium (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0.014
0.016
Zinc (mg/L)
0.08
0.10
0.12
0.14
0.16
0.18
0.20
0.22
0.24
0.26
0.28
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

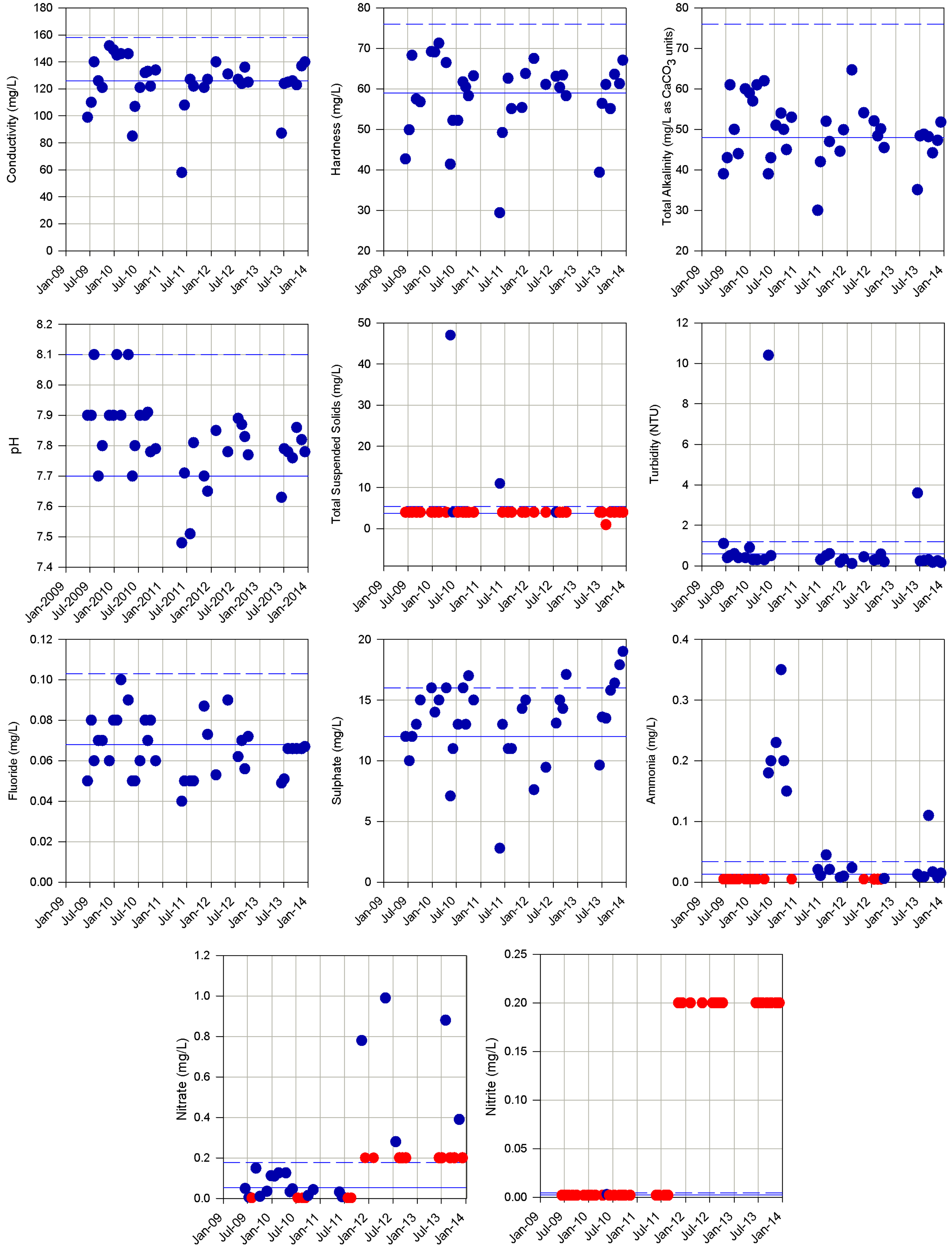

W12
Parameter Concentration
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
0
50
100
150
200
250
Hardness (mg/L)
20
40
60
80
100
120
Total Alkalinity (mg/L as CaCO3 units)
30
40
50
60
70
80
pH
7.5
7.6
7.7
7.8
7.9
8.0
8.1
8.2
8.3
Total Suspended Solids (mg/L)
0
20
40
60
80
100
Turbidity (NTU)
0
5
10
15
20
25
30
Fluoride (mg/L)
0.00
0.02
0.04
0.06
0.08
Sulphate (mg/L)
0
5
10
15
20
25
Ammonia (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
Nitrate (mg/L)
0
2
4
6
8
10
12
Nitrite (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

W12

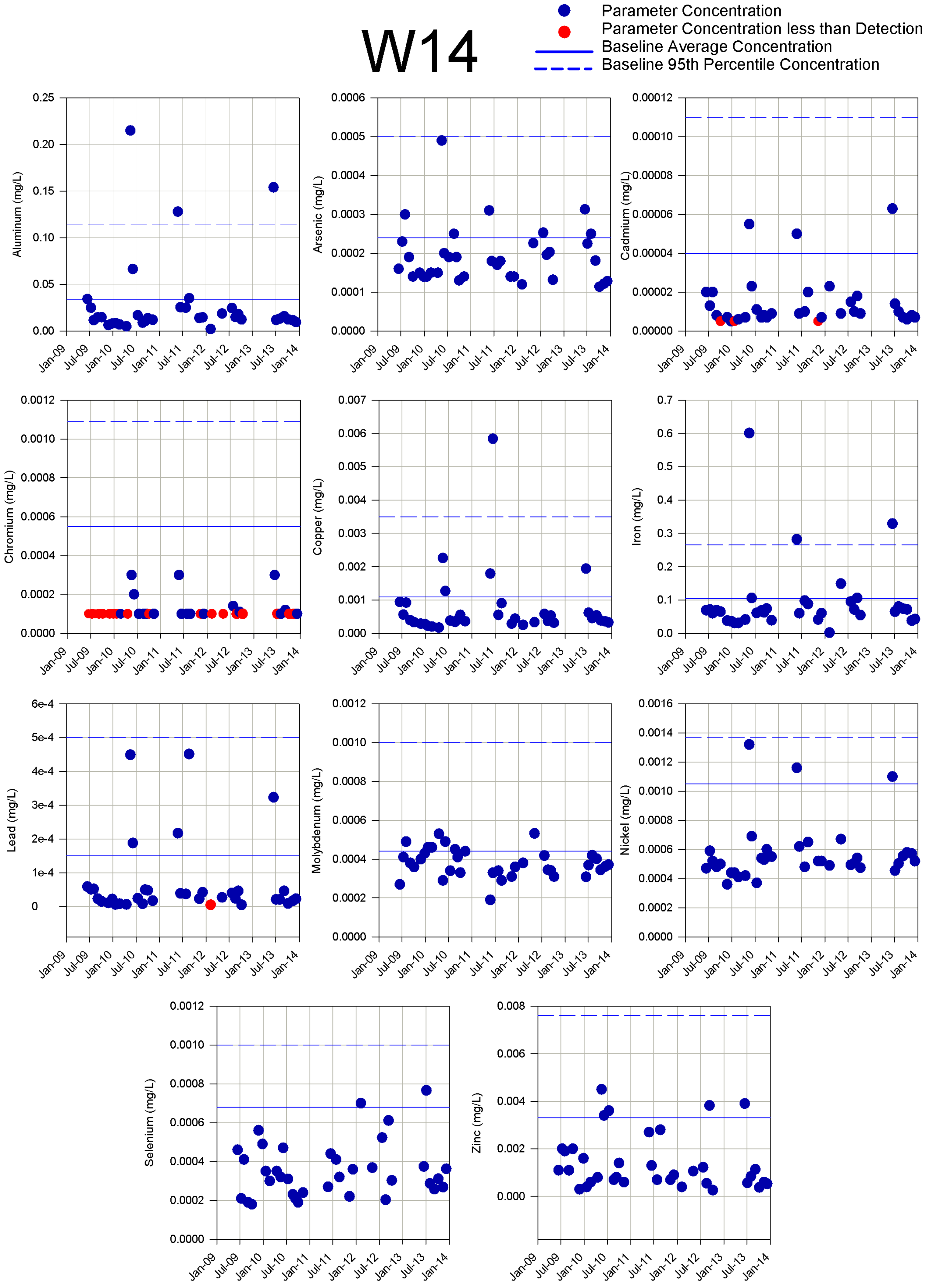

● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Jan-09
Aug-09
Mar-10
Oct-10
May-11
Dec-11
Jul-12
Feb-13
Sep-13
Arsenic (mg/L)
0.0010
0.0008
0.0006
0.0004
0.0002
0.0000
Cadmium (mg/L)
0.00020
0.00018
0.00016
0.00014
0.00012
0.00010
0.00008
0.00006
0.00004
0.00002
0.00000
Chromium (mg/L)
0.010
0.008
0.006
0.004
0.002
0.000
Copper (mg/L)
0.004
0.003
0.002
0.001
0.000
Iron (mg/L)
0.8
0.6
0.4
0.2
0.0
Lead (mg/L)
0.0008
0.0006
0.0004
0.0002
0.0000
Molybdenum (mg/L)
0.0012
0.0010
0.0008
0.0006
0.0004
0.0002
0.0000
Nickel (mg/L)
0.0018
0.0016
0.0014
0.0012
0.0010
0.0008
0.0006
0.0004
0.0002
0.0000
Selenium (mg/L)
0.0016
0.0014
0.0012
0.0010
0.0008
0.0006
0.0004
0.0002
0.0000
Zinc (mg/L)
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0.000
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

W14

● Parameter Concentration
● Parameter Concentration less than Detection
— Baseline Average Concentration
– – Baseline 95th Percentile Concentration

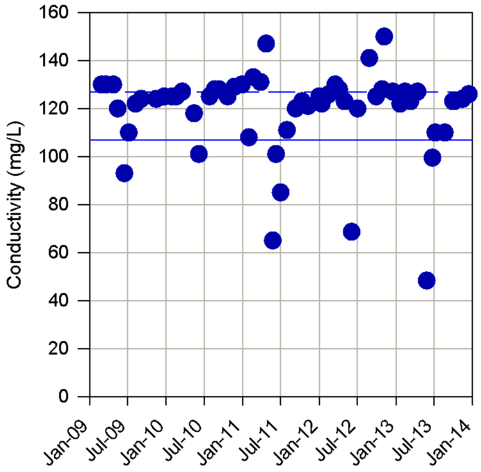


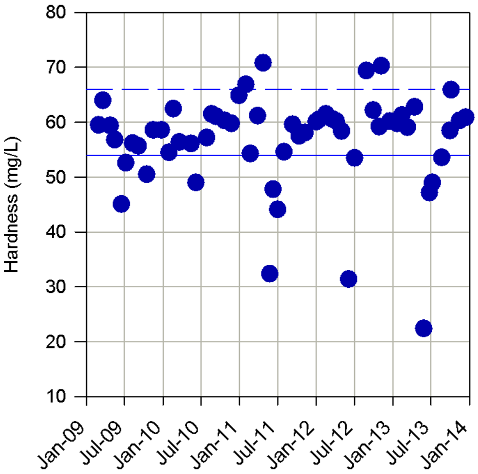
W14

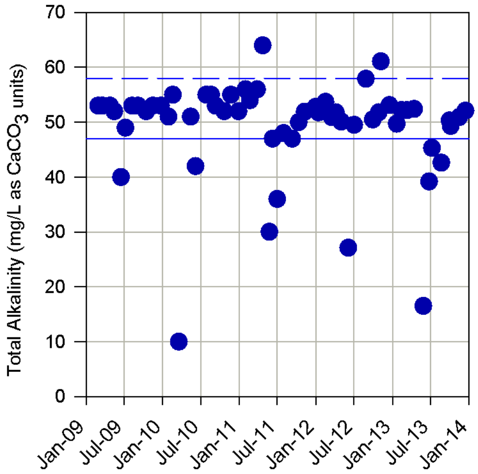

Parameter Concentration
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
Arsenic (mg/L)
0.0000
0.0001
0.0002
0.0003
0.0004
0.0005
0.0006
Cadmium (mg/L)
0.00000
0.00002
0.00004
0.00006
0.00008
0.00010
0.00012
Chromium (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
Copper (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
0.006
0.007
Iron (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Lead (mg/L)
0
1e-4
2e-4
3e-4
4e-4
5e-4
6e-4
Molybdenum (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
Nickel (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
0.0016
Selenium (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
Zinc (mg/L)
0.000
0.002
0.004
0.006
0.008
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

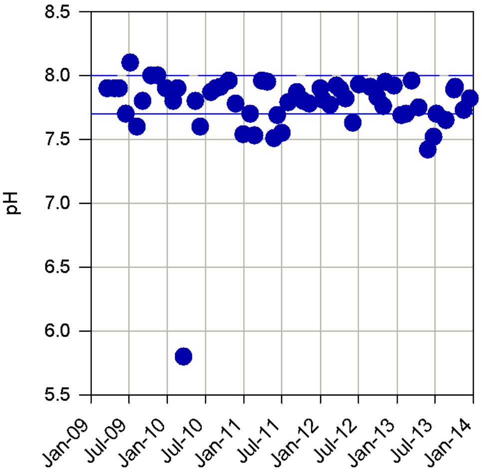
W15

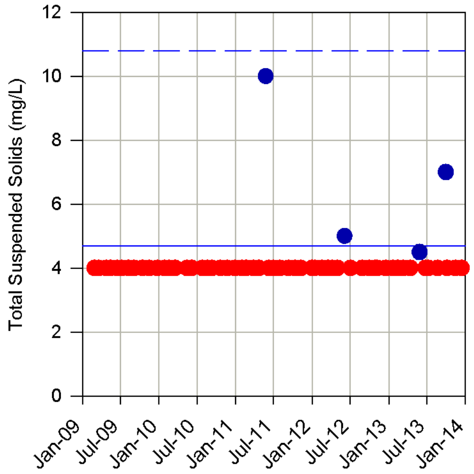
● Parameter Concentration
● Parameter Concentration less than Detection
— Baseline Average Concentration
– – Baseline 95th Percentile Concentration

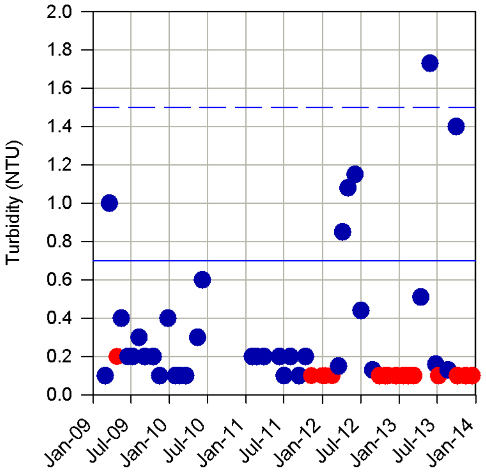


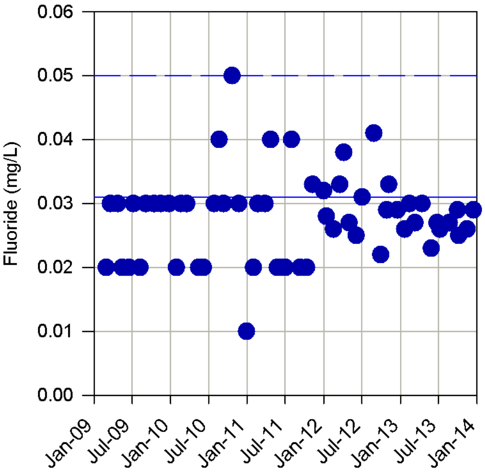


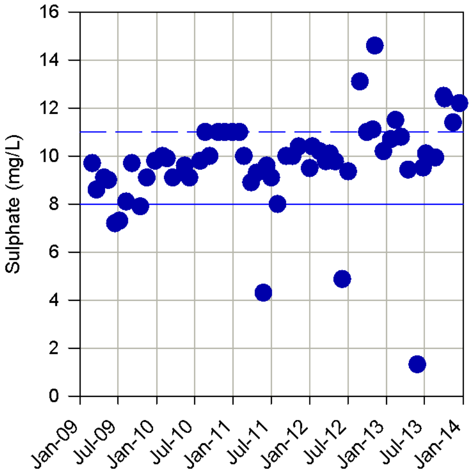


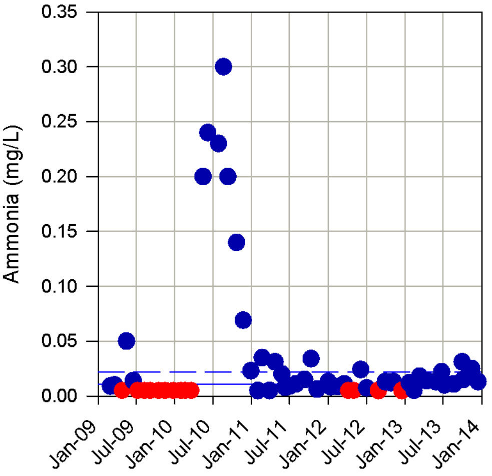


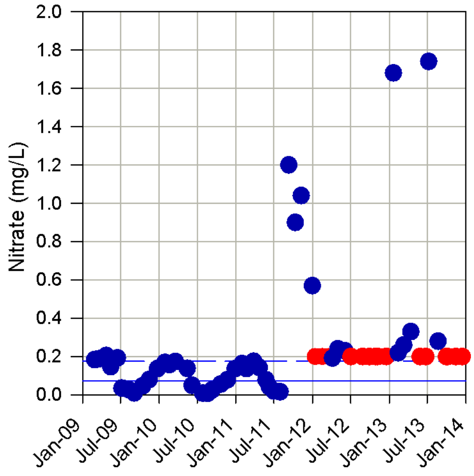


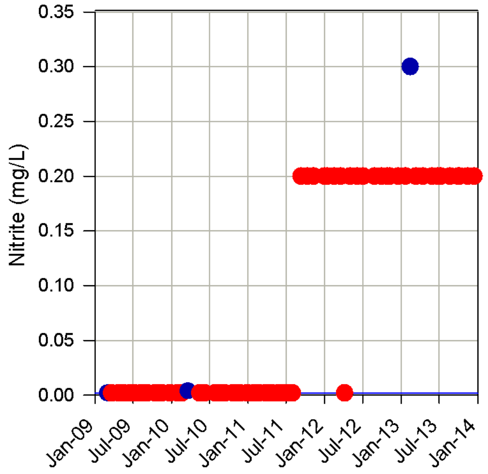


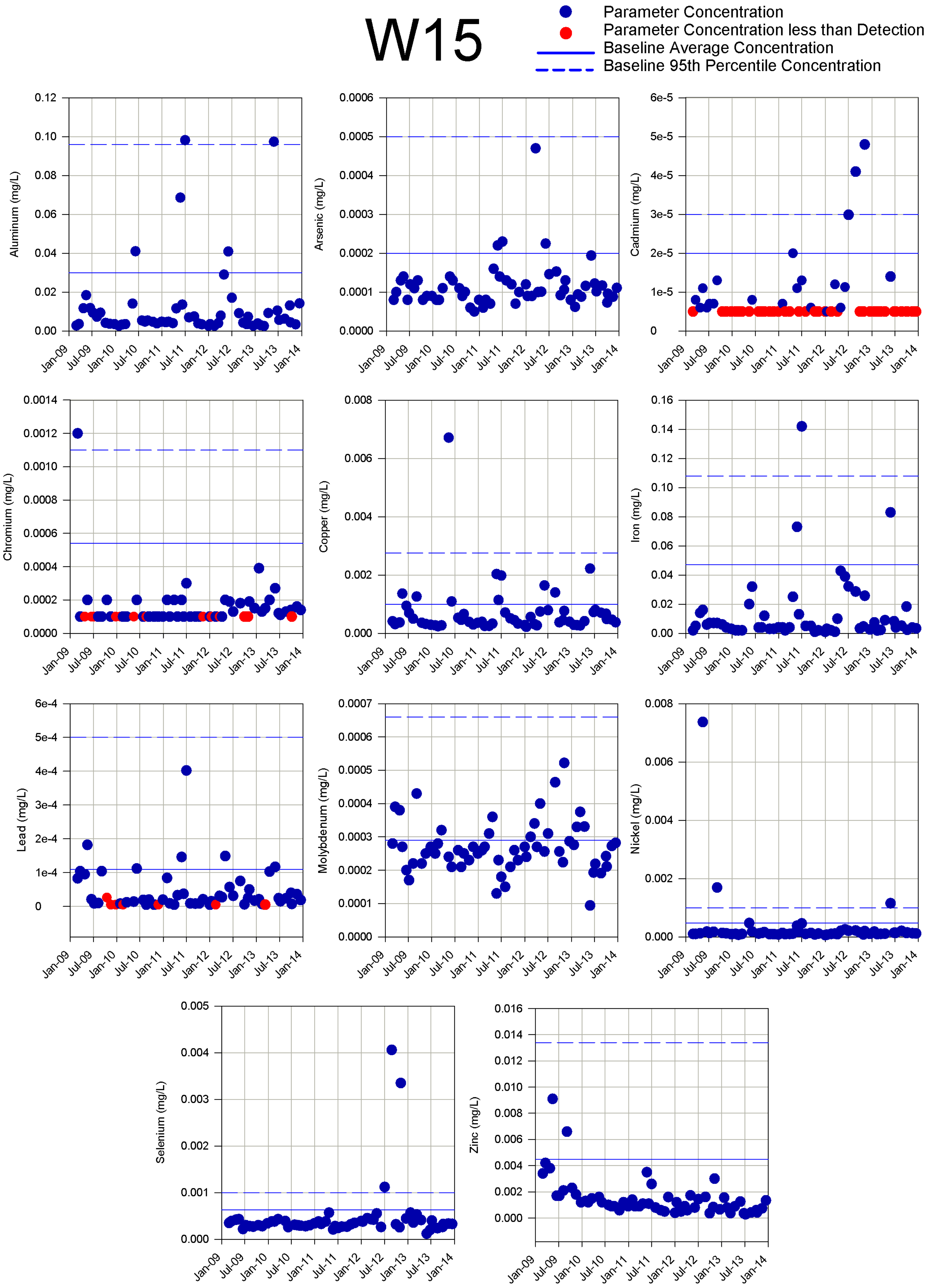




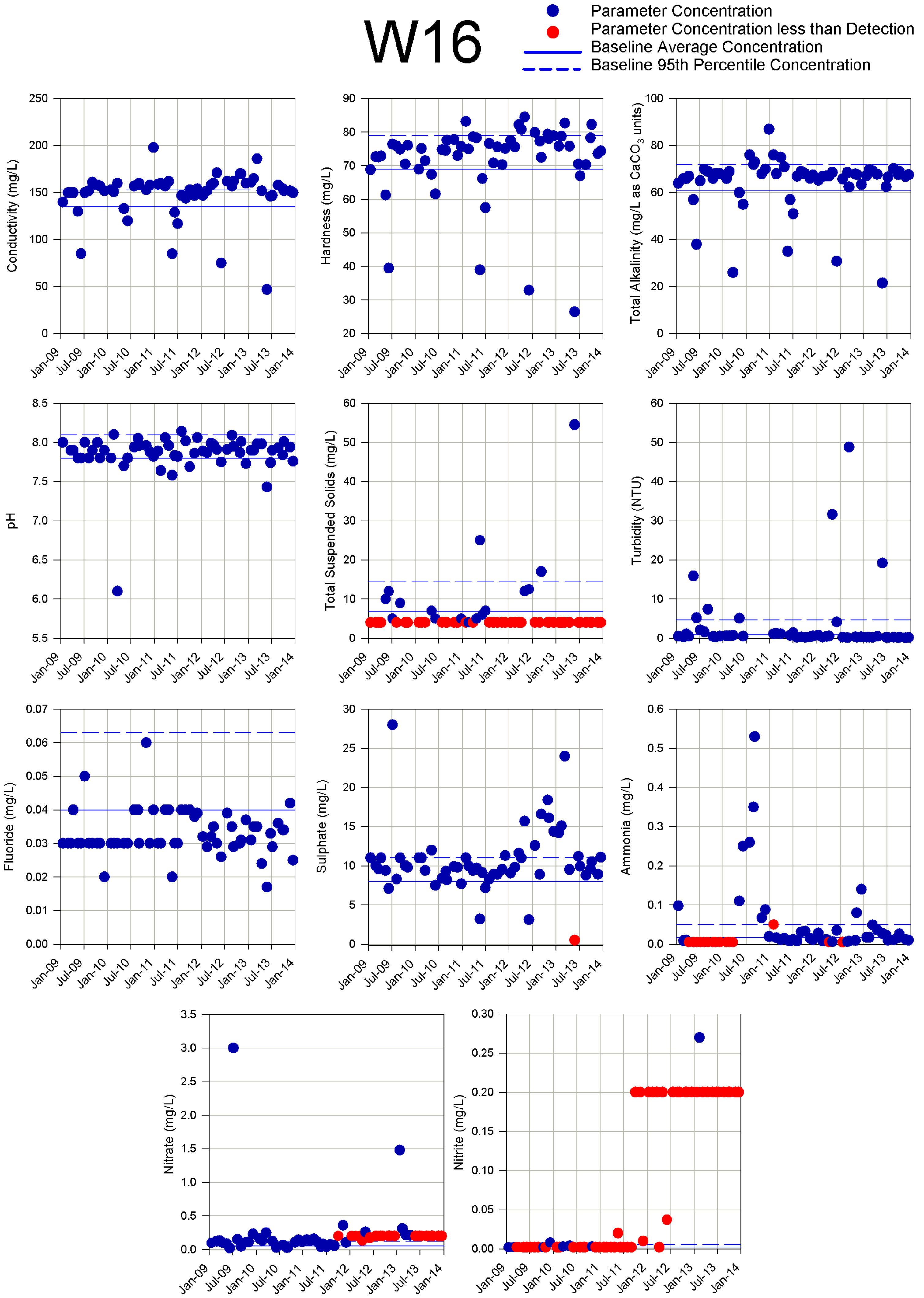






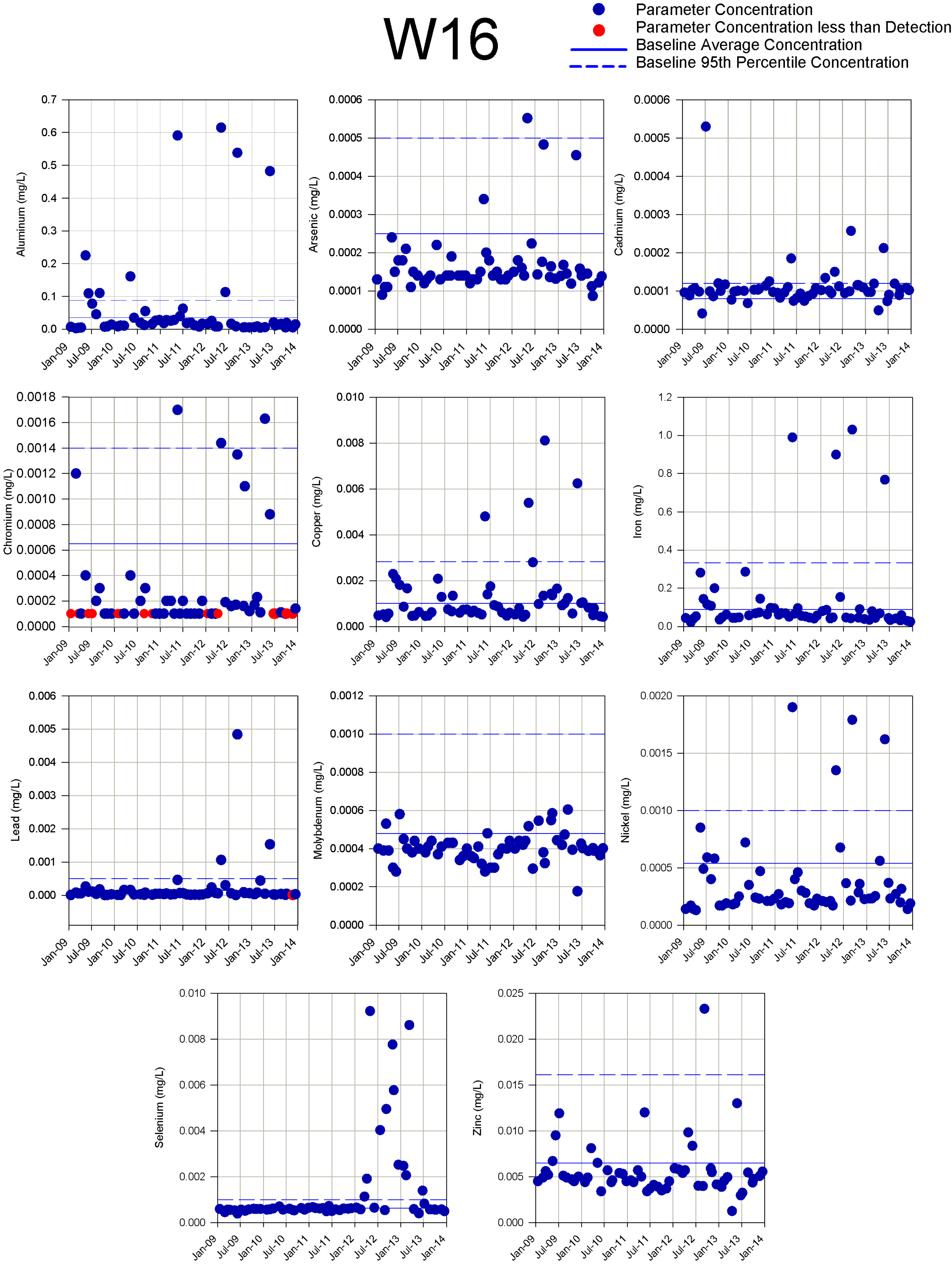

W15
Parameter Concentration
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
Arsenic (mg/L)
Cadmium (mg/L)
Chromium (mg/L)
Copper (mg/L)
Iron (mg/L)
Lead (mg/L)
Molybdenum (mg/L)
Nickel (mg/L)
Selenium (mg/L)
Zinc (mg/L)
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.0000
0.0001
0.0002
0.0003
0.0004
0.0005
0.0006
0
1e-5
2e-5
3e-5
4e-5
5e-5
6e-5
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
0.000
0.002
0.004
0.006
0.008
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
0
1e-4
2e-4
3e-4
4e-4
5e-4
6e-4
0.0000
0.0001
0.0002
0.0003
0.0004
0.0005
0.0006
0.0007
0.000
0.002
0.004
0.006
0.008
0.000
0.001
0.002
0.003
0.004
0.005
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0.014
0.016

W16

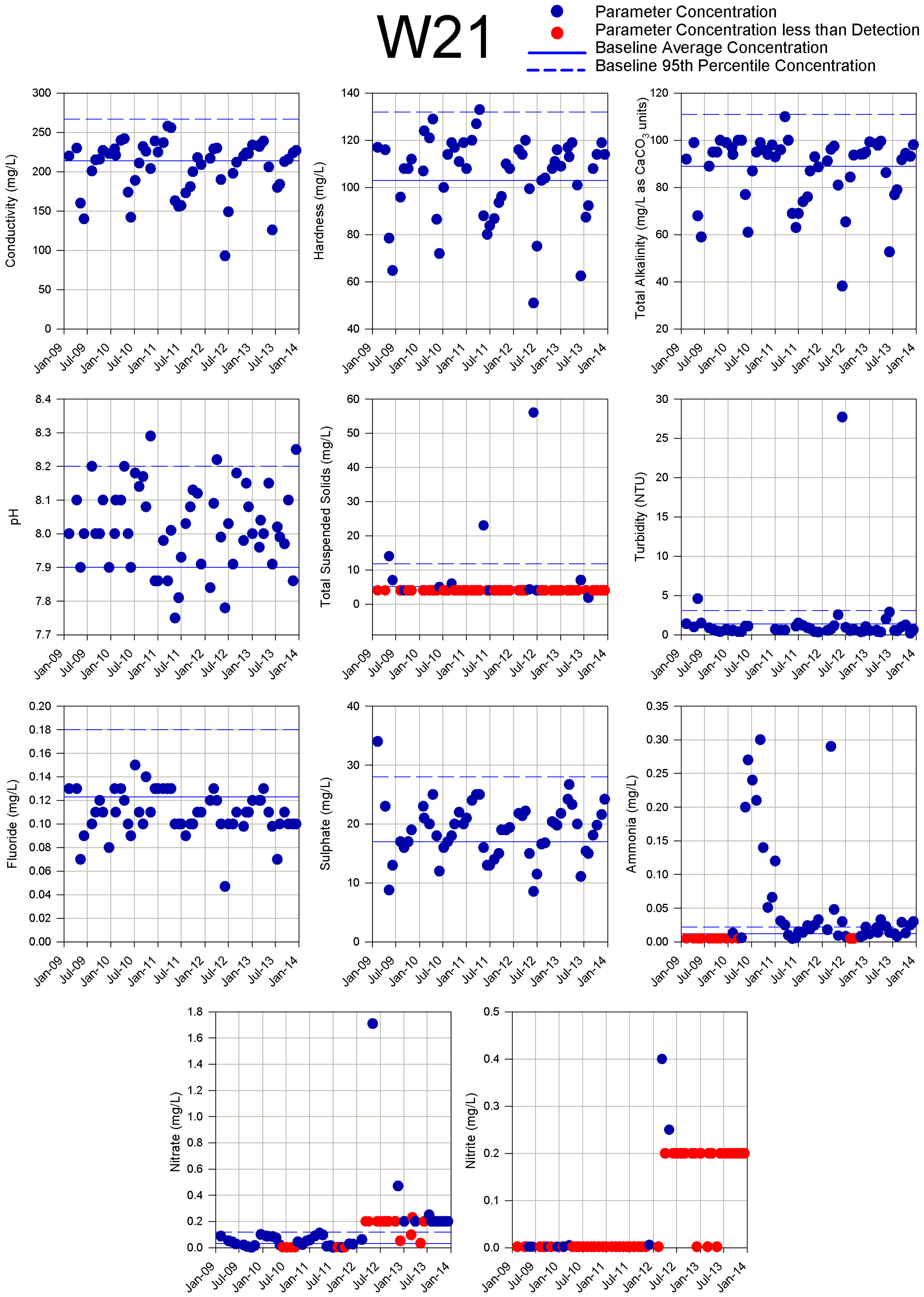


● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
0
50
100
150
200
250
Hardness (mg/L)
20
30
40
50
60
70
80
90
Total Alkalinity (mg/L as CaCO3 units)
0
20
40
60
80
100
pH
5.5
6.0
6.5
7.0
7.5
8.0
8.5
Total Suspended Solids (mg/L)
0
10
20
30
40
50
60
Turbidity (NTU)
0
10
20
30
40
50
60
Fluoride (mg/L)
0.00
0.01
0.02
0.03
0.04
0.05
0.06
0.07
Sulphate (mg/L)
0
5
10
15
20
25
30
Ammonia (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Nitrate (mg/L)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
Nitrite (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

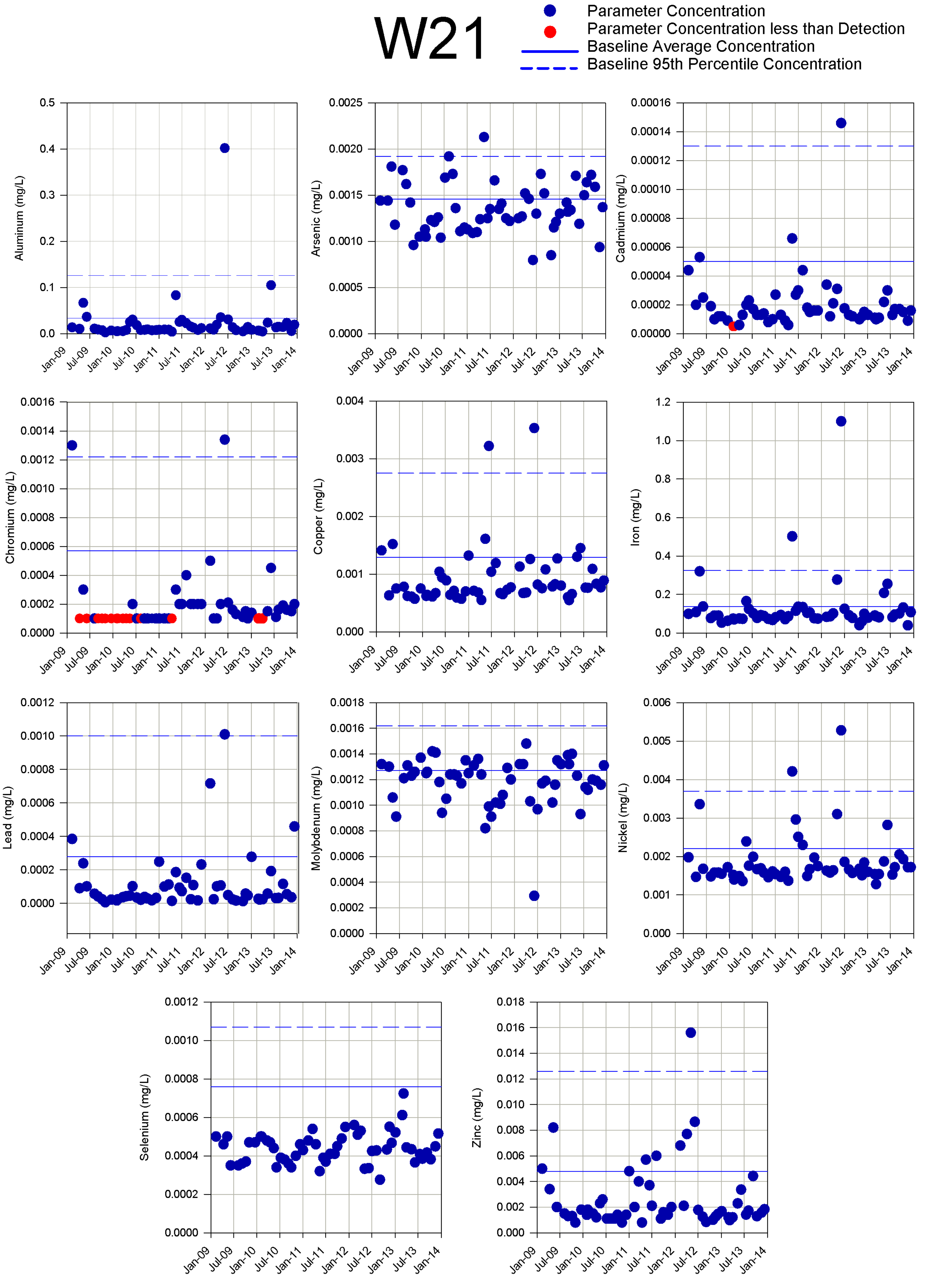
W16



Parameter Concentration
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Arsenic (mg/L)
0.0000
0.0001
0.0002
0.0003
0.0004
0.0005
0.0006
Cadmium (mg/L)
0.0000
0.0001
0.0002
0.0003
0.0004
0.0005
0.0006
Chromium (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
0.0016
0.0018
Copper (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
Iron (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Lead (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
0.006
Molybdenum (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
Nickel (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
Selenium (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
Zinc (mg/L)
0.000
0.005
0.010
0.015
0.020
0.025
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

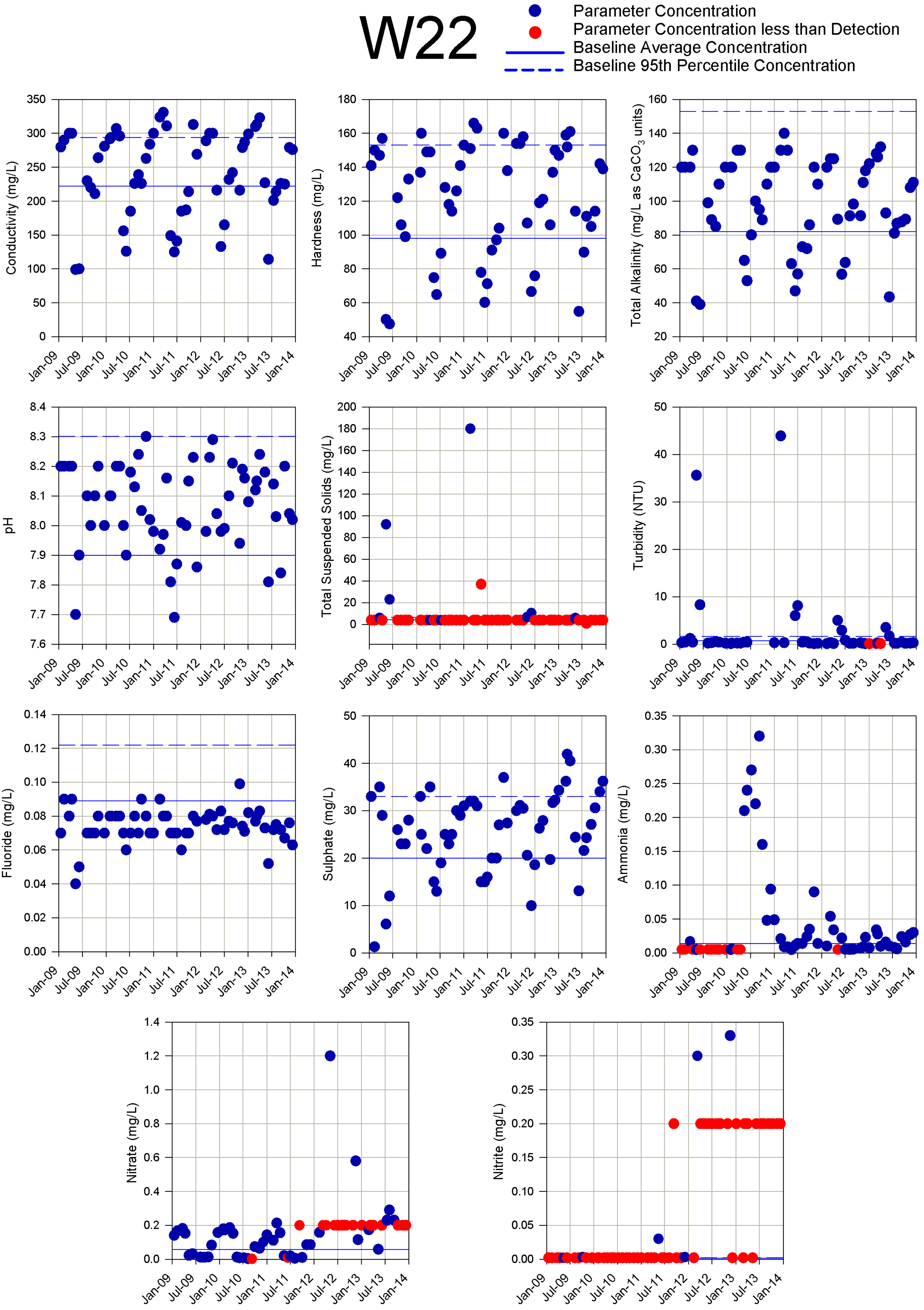

W21
Parameter Concentration
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
0
50
100
150
200
250
300
Hardness (mg/L)
40
60
80
100
120
140
Total Alkalinity (mg/L as $CaCO_3$ units)
20
40
60
80
100
120
pH
7.7
7.8
7.9
8.0
8.1
8.2
8.3
8.4
Total Suspended Solids (mg/L)
0
10
20
30
40
50
60
Turbidity (NTU)
0
5
10
15
20
25
30
Fluoride (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
0.18
0.20
Sulphate (mg/L)
0
10
20
30
40
Ammonia (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
Nitrate (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
Nitrite (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

W21

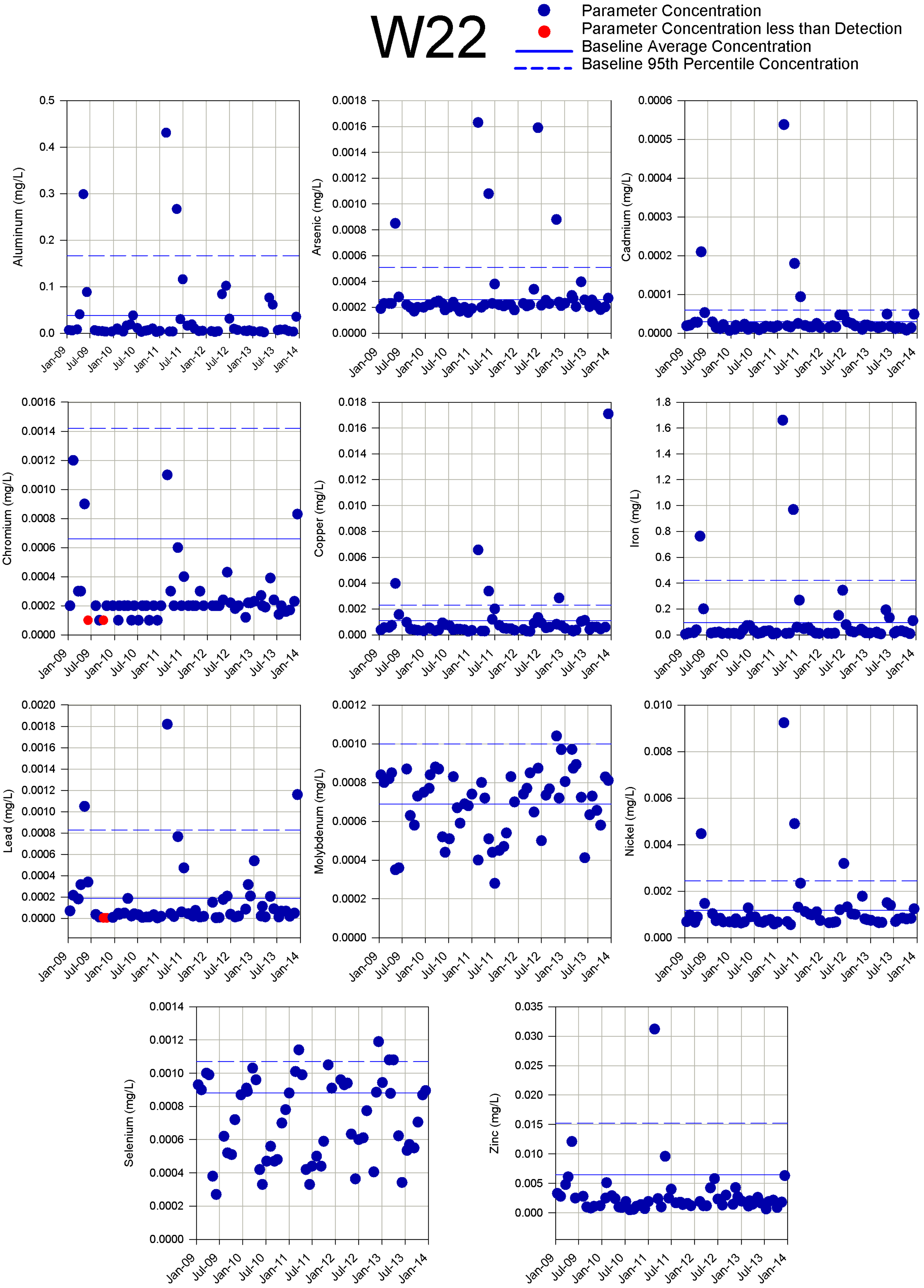


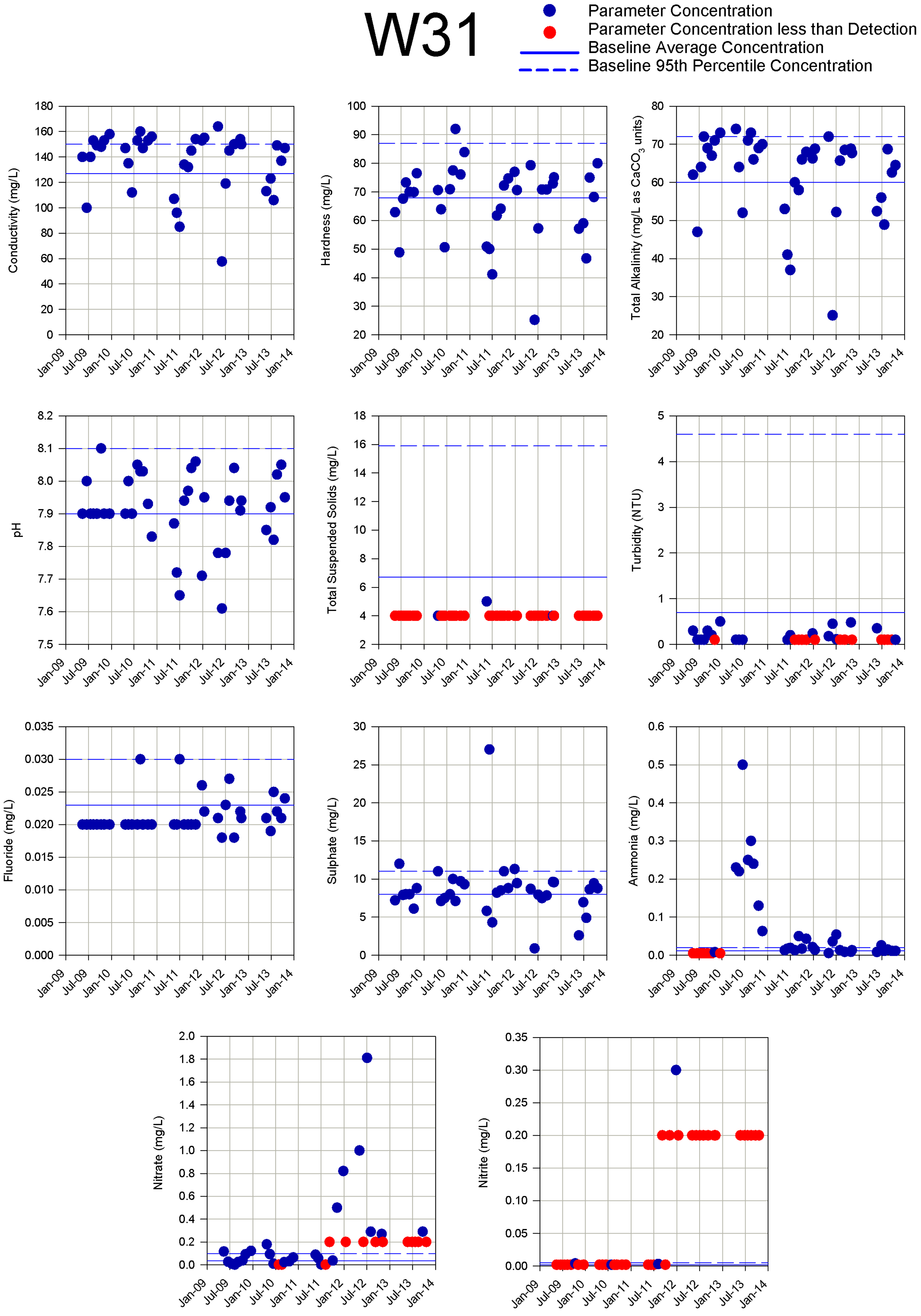
● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
Arsenic (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
Cadmium (mg/L)
0.00000
0.00002
0.00004
0.00006
0.00008
0.00010
0.00012
0.00014
0.00016
Chromium (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
0.0016
Copper (mg/L)
0.000
0.001
0.002
0.003
0.004
Iron (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Lead (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
Molybdenum (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
0.0016
0.0018
Nickel (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
0.006
Selenium (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
Zinc (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0.014
0.016
0.018
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

W22

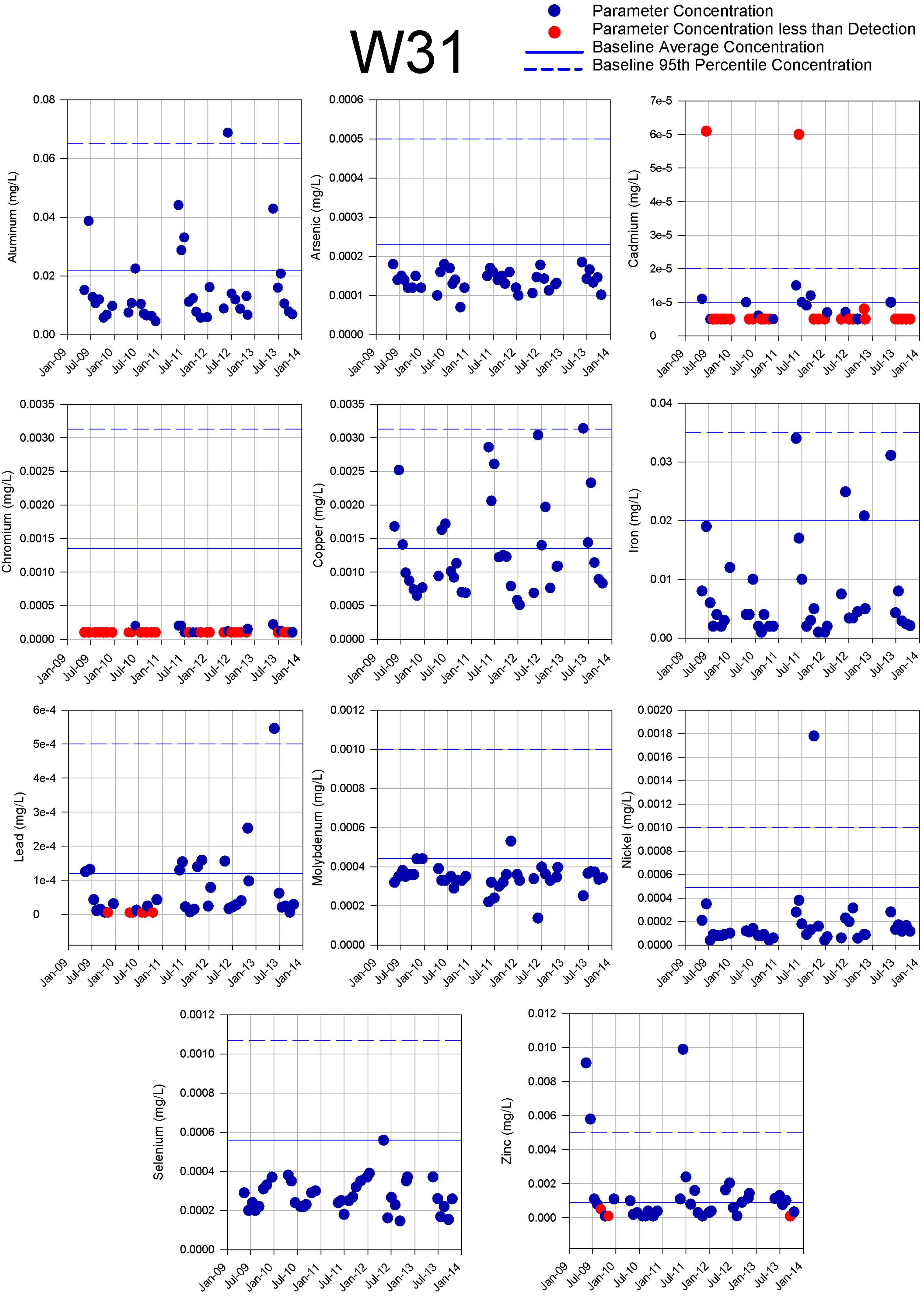

Parameter Concentration
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
0
50
100
150
200
250
300
350
Hardness (mg/L)
40
60
80
100
120
140
160
180
Total Alkalinity (mg/L as CaCO3 units)
20
40
60
80
100
120
140
160
pH
7.6
7.7
7.8
7.9
8.0
8.1
8.2
8.3
8.4
Total Suspended Solids (mg/L)
0
20
40
60
80
100
120
140
160
180
200
Turbidity (NTU)
0
10
20
30
40
50
Fluoride (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
Sulphate (mg/L)
0
10
20
30
40
50
Ammonia (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
Nitrate (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
Nitrite (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

W22

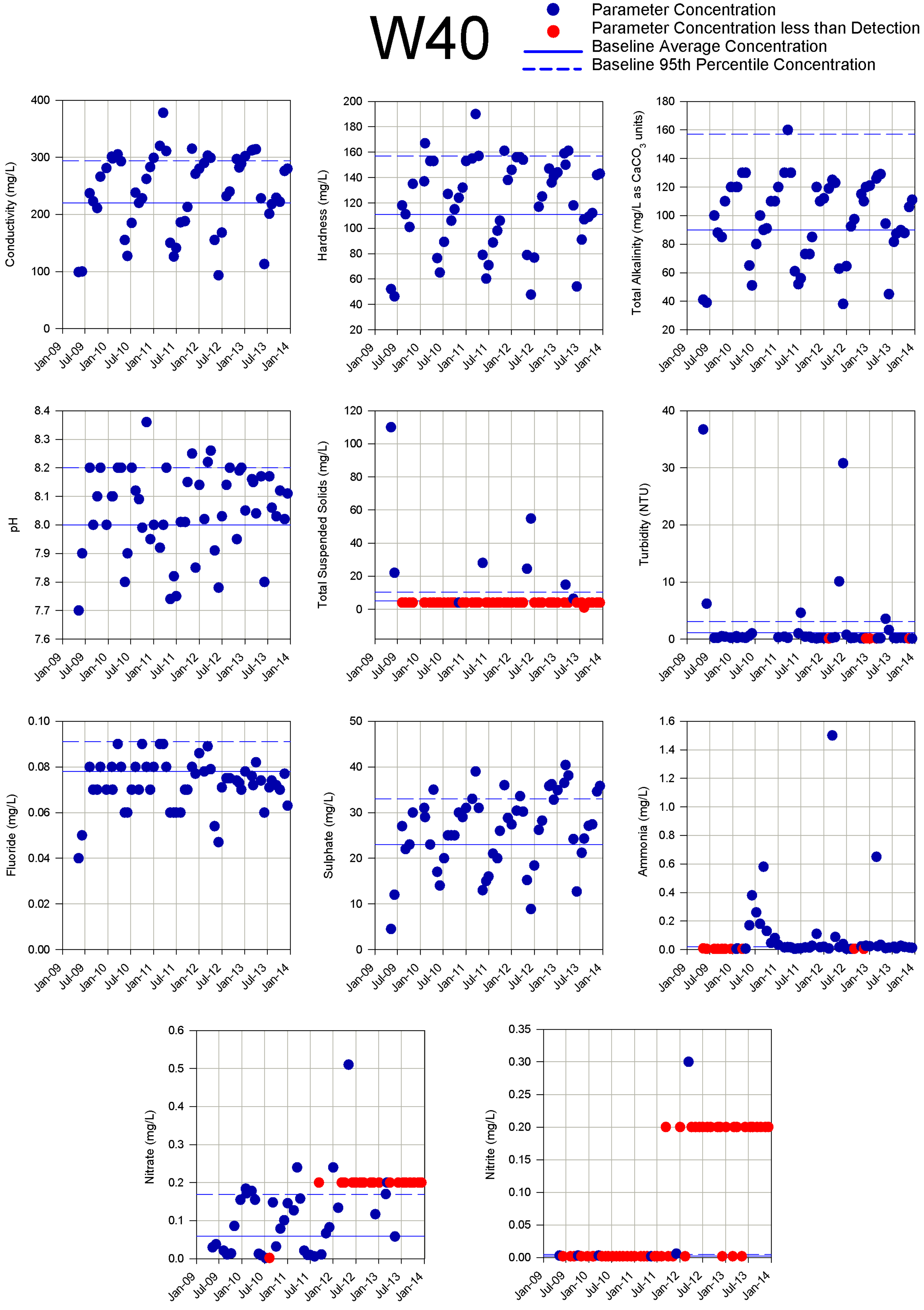

● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.0 0.1 0.2 0.3 0.4 0.5
Arsenic (mg/L)
0.0000 0.0002 0.0004 0.0006 0.0008 0.0010 0.0012 0.0014 0.0016 0.0018
Cadmium (mg/L)
0.0000 0.0001 0.0002 0.0003 0.0004 0.0005 0.0006
Chromium (mg/L)
0.0000 0.0002 0.0004 0.0006 0.0008 0.0010 0.0012 0.0014 0.0016
Copper (mg/L)
0.000 0.002 0.004 0.006 0.008 0.010 0.012 0.014 0.016 0.018
Iron (mg/L)
0.0 0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8
Lead (mg/L)
0.0000 0.0002 0.0004 0.0006 0.0008 0.0010 0.0012 0.0014 0.0016 0.0018 0.0020
Molybdenum (mg/L)
0.0000 0.0002 0.0004 0.0006 0.0008 0.0010 0.0012
Nickel (mg/L)
0.000 0.002 0.004 0.006 0.008 0.010
Selenium (mg/L)
0.0000 0.0002 0.0004 0.0006 0.0008 0.0010 0.0012 0.0014
Zinc (mg/L)
0.000 0.005 0.010 0.015 0.020 0.025 0.030 0.035
Jan-09 Jul-09 Jan-10 Jul-10 Jan-11 Jul-11 Jan-12 Jul-12 Jan-13 Jul-13 Jan-14


W31
● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
Hardness (mg/L)
Total Alkalinity (mg/L as $CaCO_3$ units)
pH
Total Suspended Solids (mg/L)
Turbidity (NTU)
Fluoride (mg/L)
Sulphate (mg/L)
Ammonia (mg/L)
Nitrate (mg/L)
Nitrite (mg/L)
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

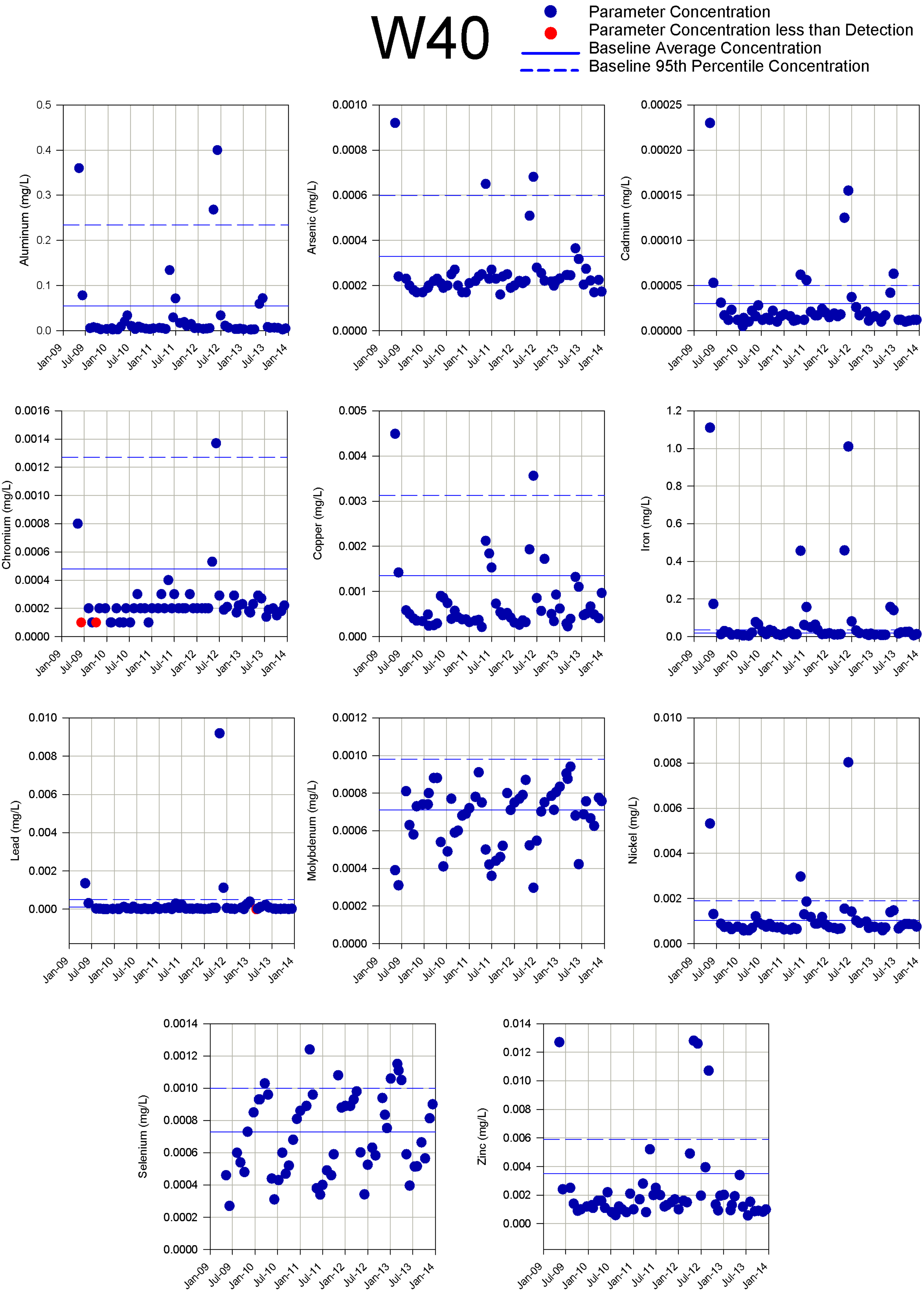
W31



● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.00
0.02
0.04
0.06
0.08
Arsenic (mg/L)
0.0000
0.0001
0.0002
0.0003
0.0004
0.0005
0.0006
Cadmium (mg/L)
0
1e-5
2e-5
3e-5
4e-5
5e-5
6e-5
7e-5
Chromium (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
0.0030
0.0035
Copper (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
0.0030
0.0035
Iron (mg/L)
0.00
0.01
0.02
0.03
0.04
Lead (mg/L)
0
1e-4
2e-4
3e-4
4e-4
5e-4
6e-4
Molybdenum (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
Nickel (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
0.0016
0.0018
0.0020
Selenium (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
Zinc (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

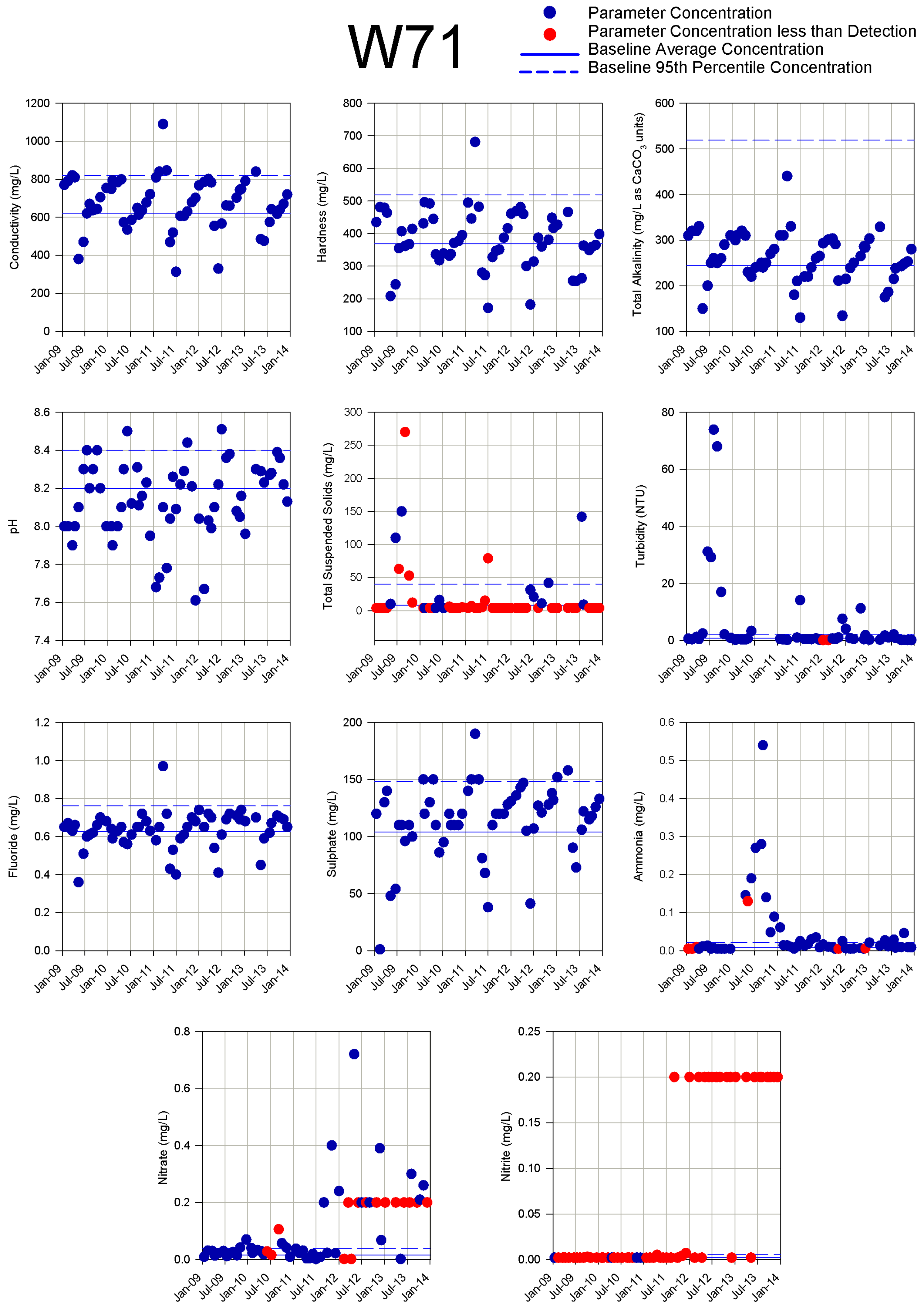

W40
Parameter Concentration
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
0
100
200
300
400
Hardness (mg/L)
20
40
60
80
100
120
140
160
180
200
Total Alkalinity (mg/L as $CaCO_3$ units)
20
40
60
80
100
120
140
160
180
pH
7.6
7.7
7.8
7.9
8.0
8.1
8.2
8.3
8.4
Total Suspended Solids (mg/L)
0
20
40
60
80
100
120
Turbidity (NTU)
0
10
20
30
40
Fluoride (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
Sulphate (mg/L)
0
10
20
30
40
50
Ammonia (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
Nitrate (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Nitrite (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

W40

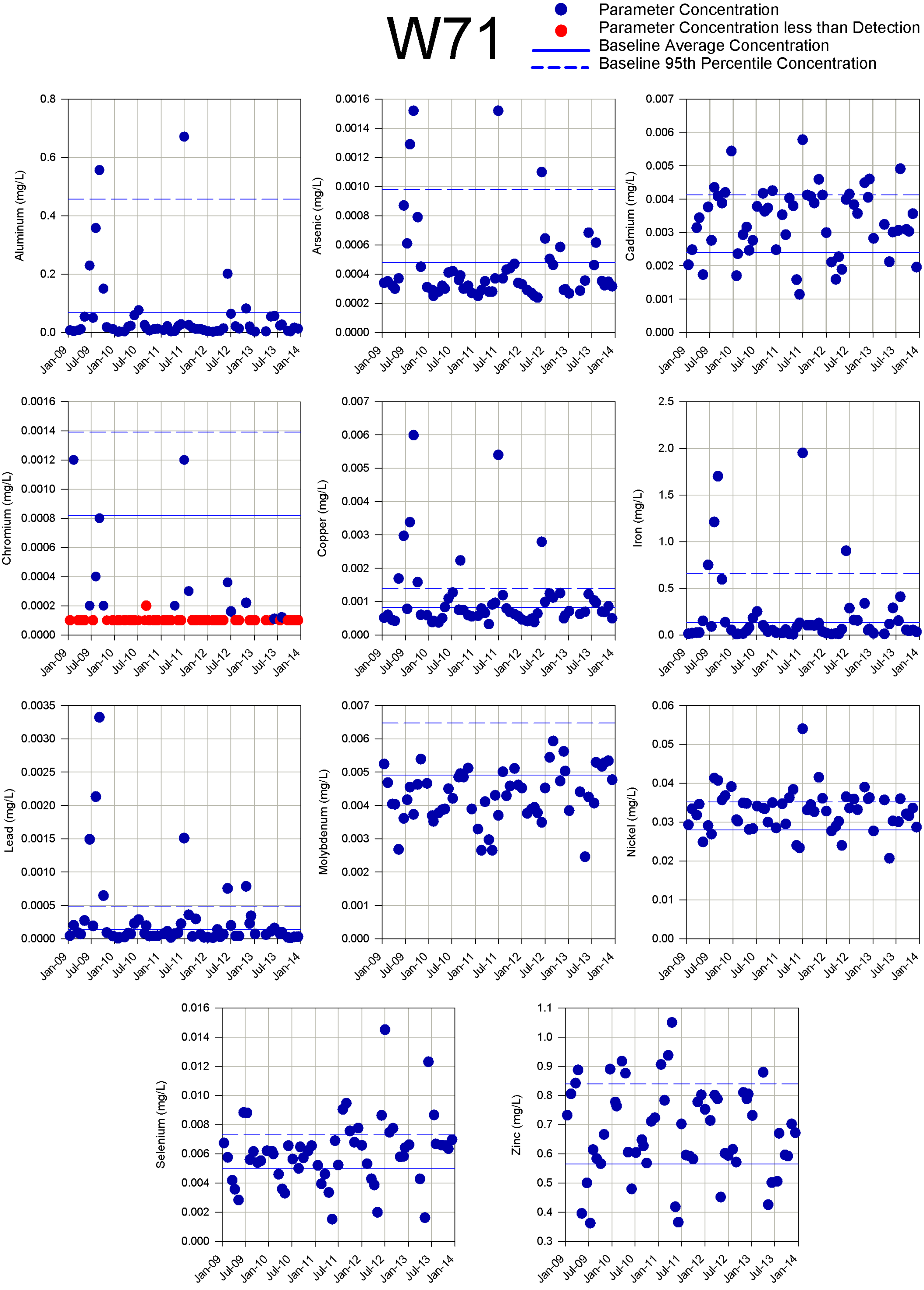


● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
Arsenic (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
Cadmium (mg/L)
0.00000
0.00005
0.00010
0.00015
0.00020
0.00025
Chromium (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
0.0016
Copper (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
Iron (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Lead (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
Molybdenum (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
Nickel (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
Selenium (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
Zinc (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0.014
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

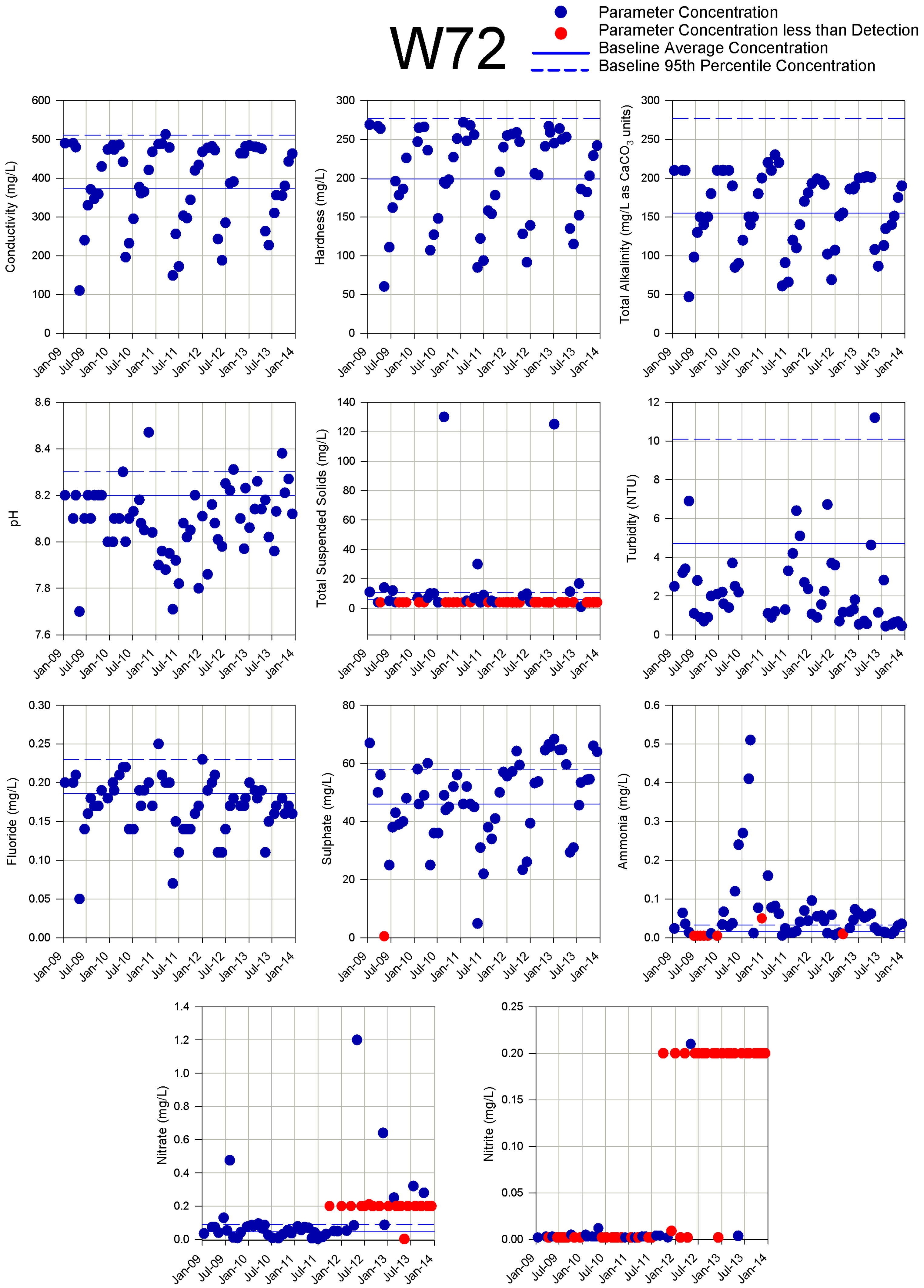
W71

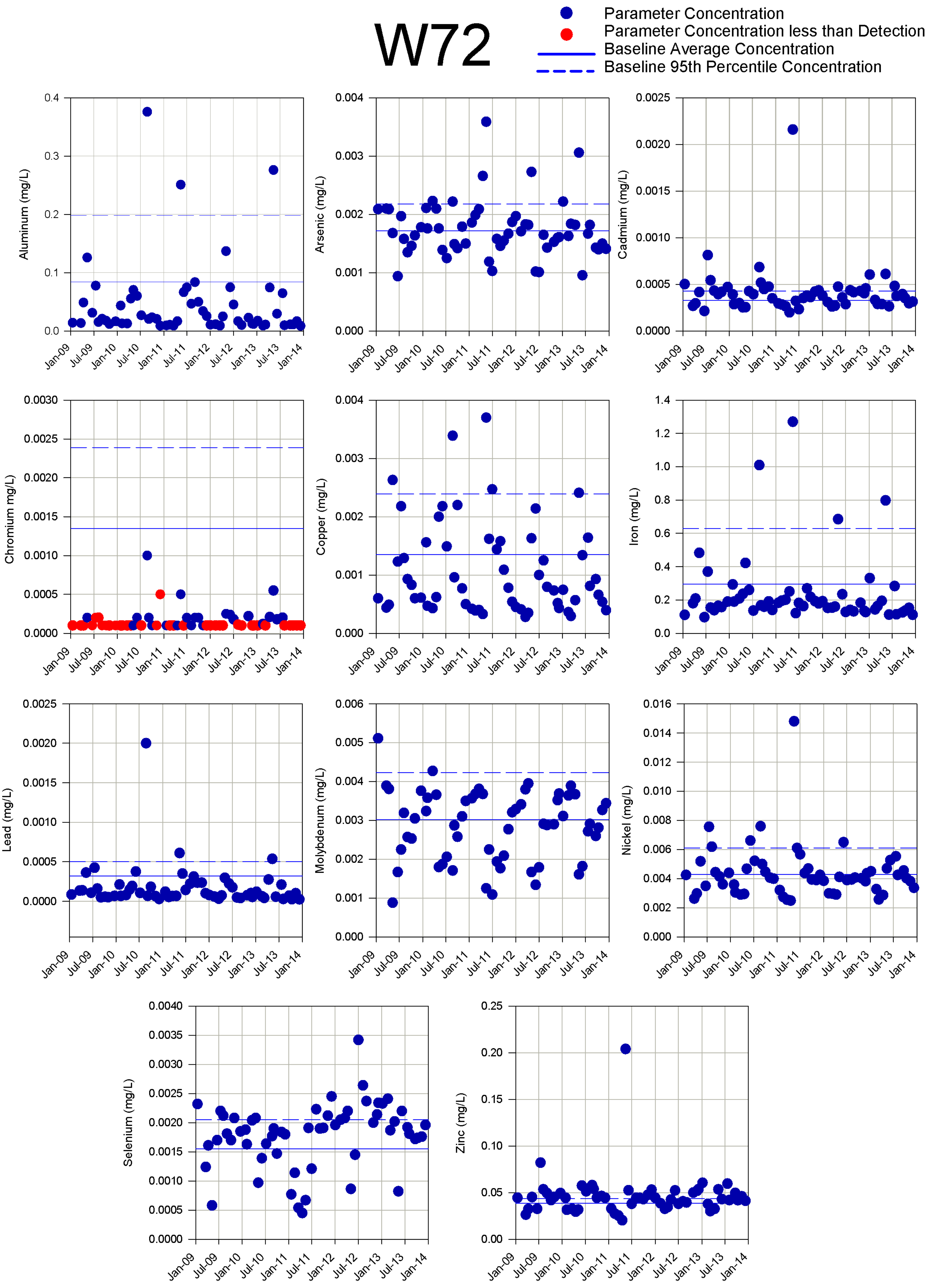

Parameter Concentration
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
0
200
400
600
800
1000
1200
Hardness (mg/L)
100
200
300
400
500
600
700
800
Total Alkalinity (mg/L as $CaCO_3$ units)
100
200
300
400
500
600
pH
7.4
7.6
7.8
8.0
8.2
8.4
8.6
Total Suspended Solids (mg/L)
0
50
100
150
200
250
300
Turbidity (NTU)
0
20
40
60
80
Fluoride (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Sulphate (mg/L)
0
50
100
150
200
Ammonia (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Nitrate (mg/L)
0.0
0.2
0.4
0.6
0.8
Nitrite (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

W71

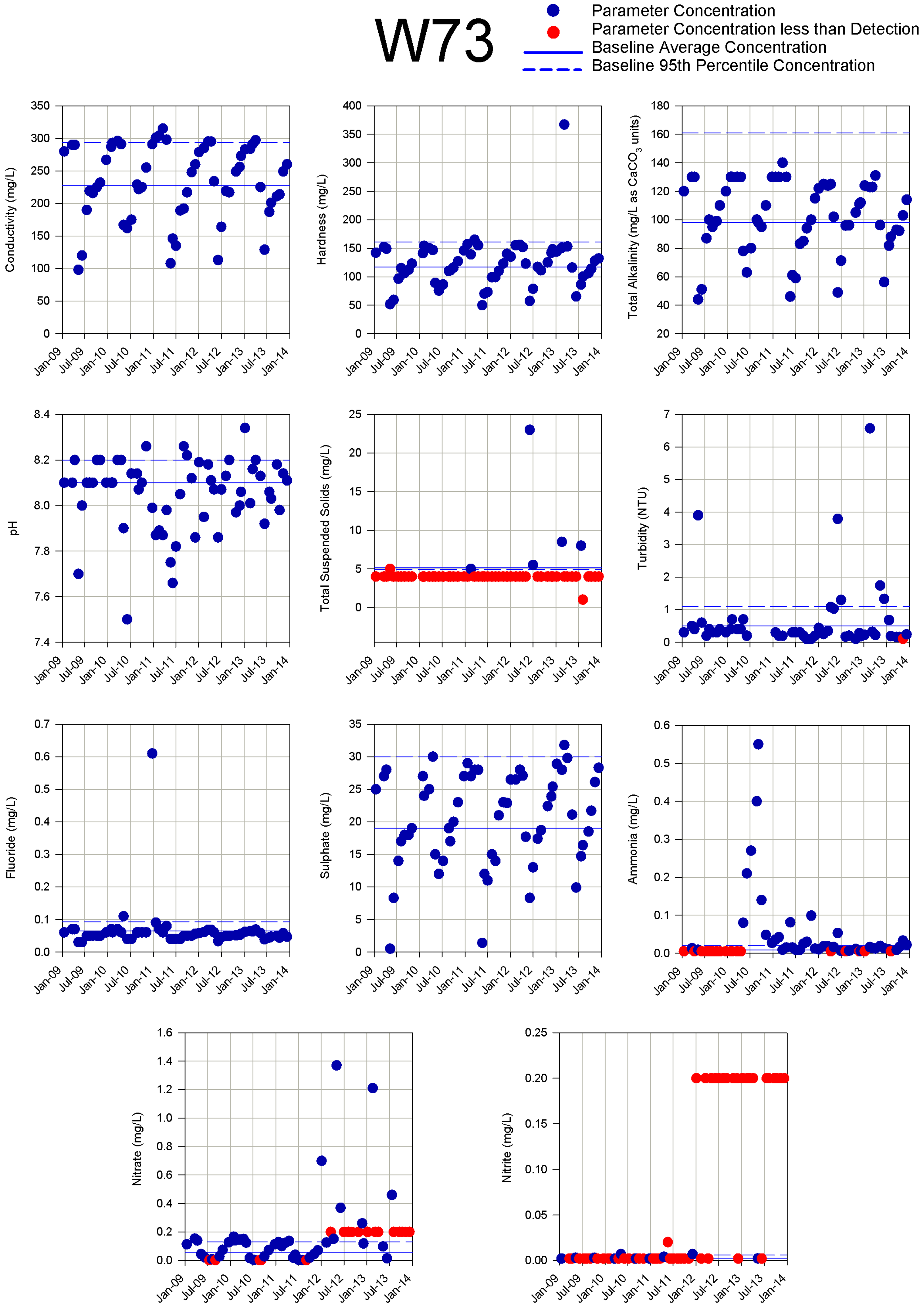


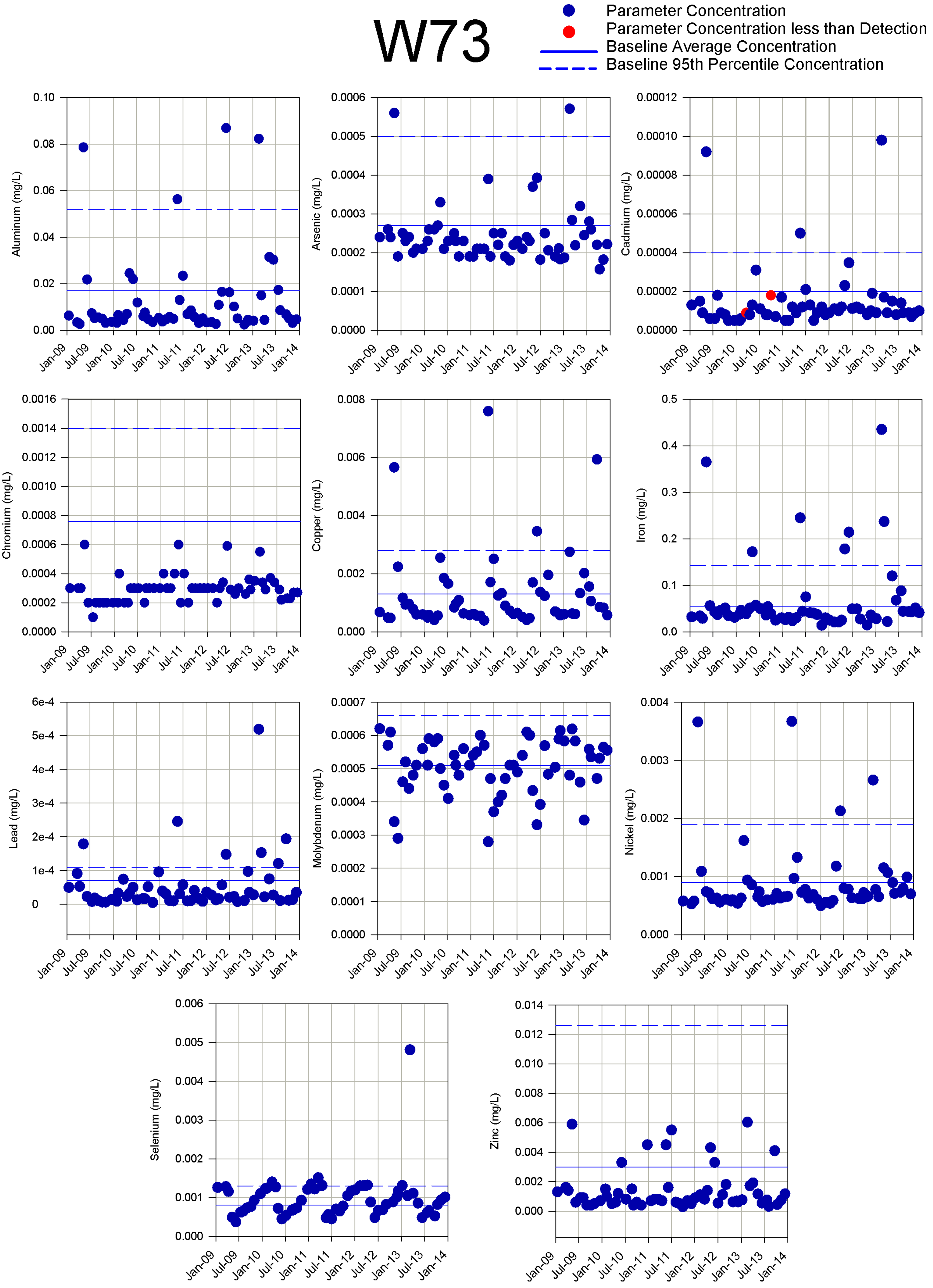
● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.0
0.2
0.4
0.6
0.8
Arsenic (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
0.0016
Cadmium (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
0.006
0.007
Chromium (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
0.0016
Copper (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
0.006
0.007
Iron (mg/L)
0.0
0.5
1.0
1.5
2.0
2.5
Lead (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
0.0030
0.0035
Molybdenum (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
0.006
0.007
Nickel (mg/L)
0.00
0.01
0.02
0.03
0.04
0.05
0.06
Selenium (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0.014
0.016
Zinc (mg/L)
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

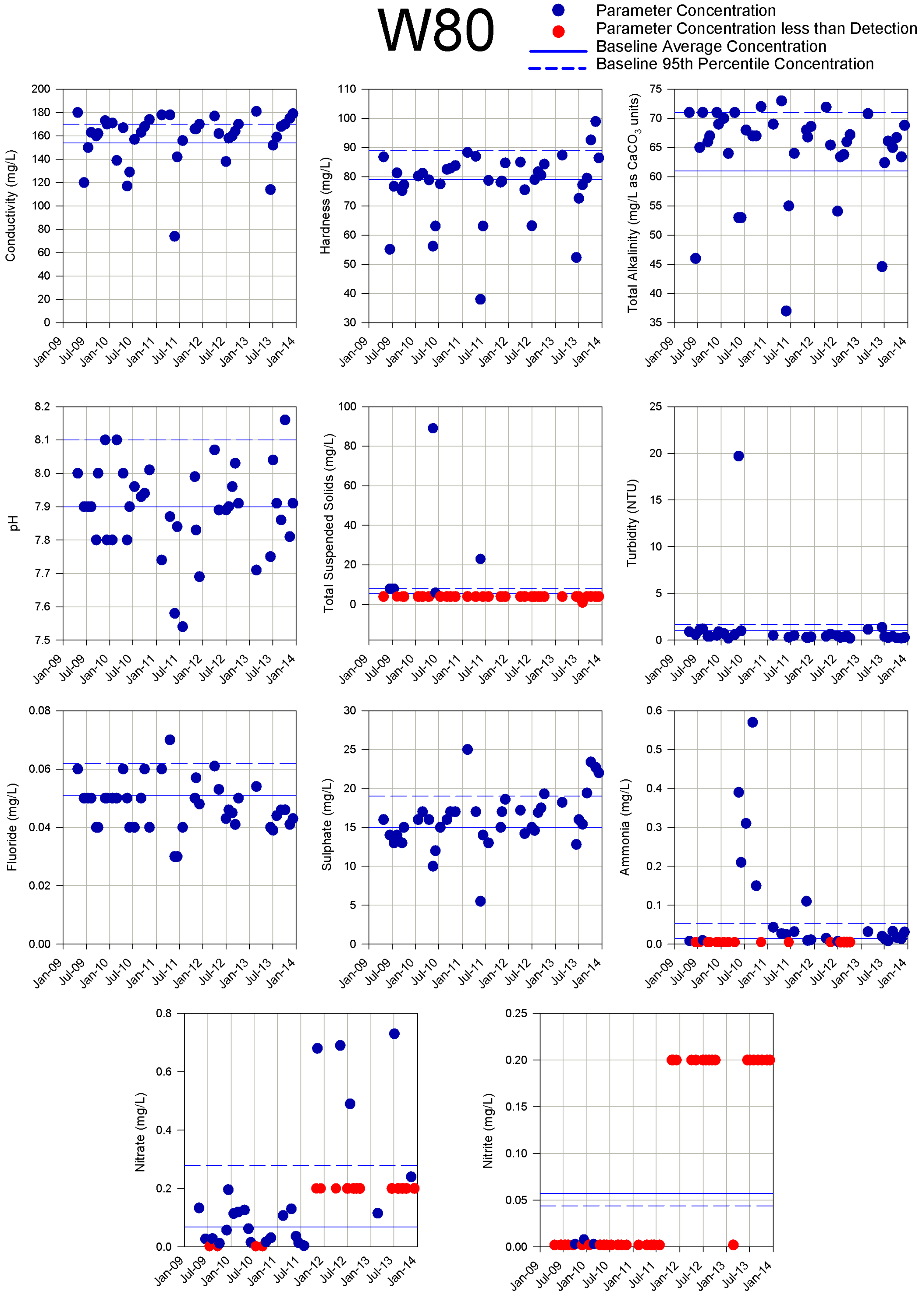

W72
● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
0
100
200
300
400
500
600
Hardness (mg/L)
0
50
100
150
200
250
300
Total Alkalinity (mg/L as CaCO3 units)
pH
7.6
7.8
8.0
8.2
8.4
8.6
Total Suspended Solids (mg/L)
0
20
40
60
80
100
120
140
Turbidity (NTU)
0
2
4
6
8
10
12
Fluoride (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
Sulphate (mg/L)
0
20
40
60
80
Ammonia (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Nitrate (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
Nitrite (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14


W72
Parameter Concentration
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.0
0.1
0.2
0.3
0.4
Arsenic (mg/L)
0.000
0.001
0.002
0.003
0.004
Cadmium (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
Chromium mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
0.0030
Copper (mg/L)
0.000
0.001
0.002
0.003
0.004
Iron (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
Lead (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
Molybdenum (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
0.006
Nickel (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0.014
0.016
Selenium (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
0.0030
0.0035
0.0040
Zinc (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

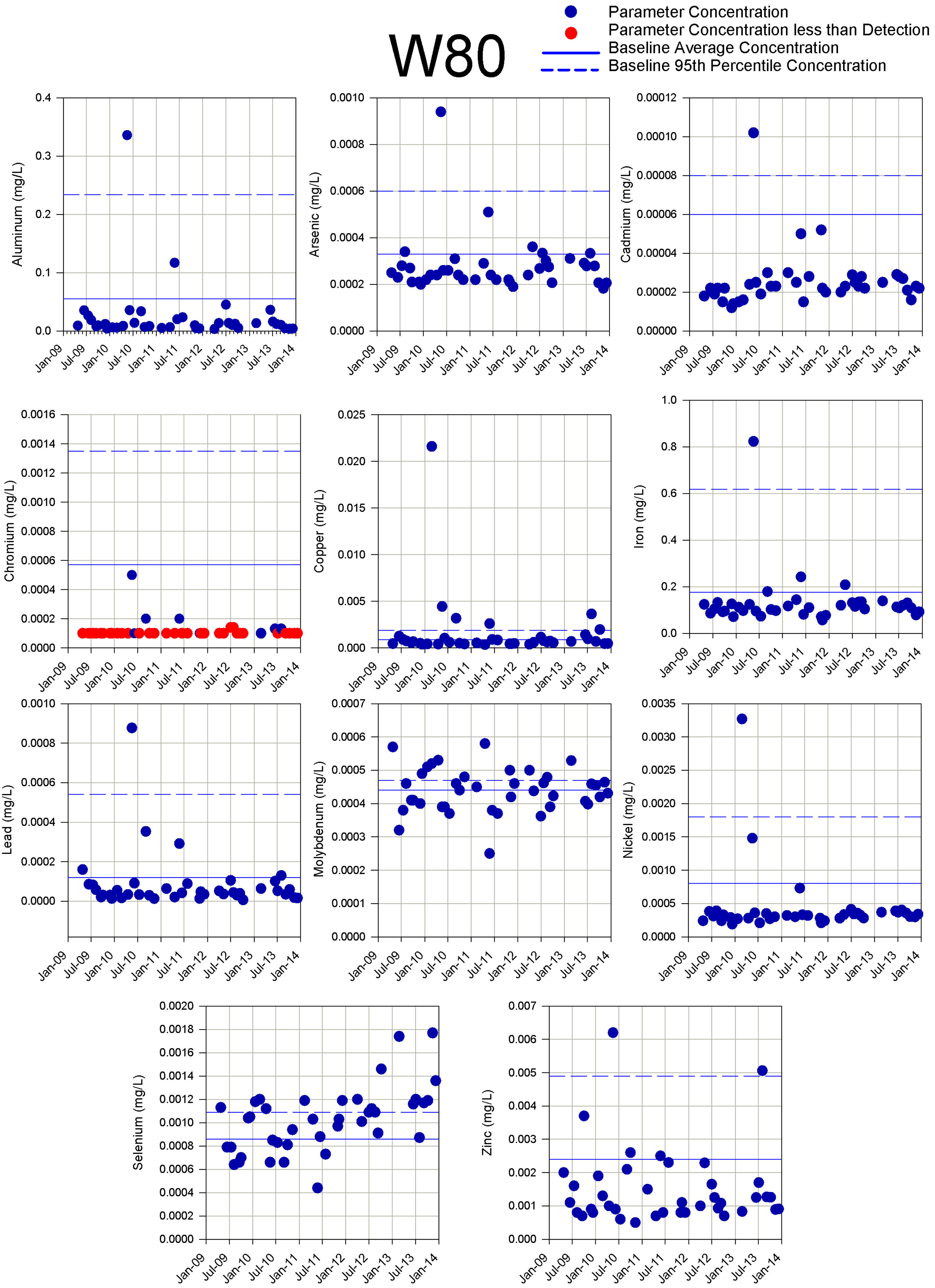
W73

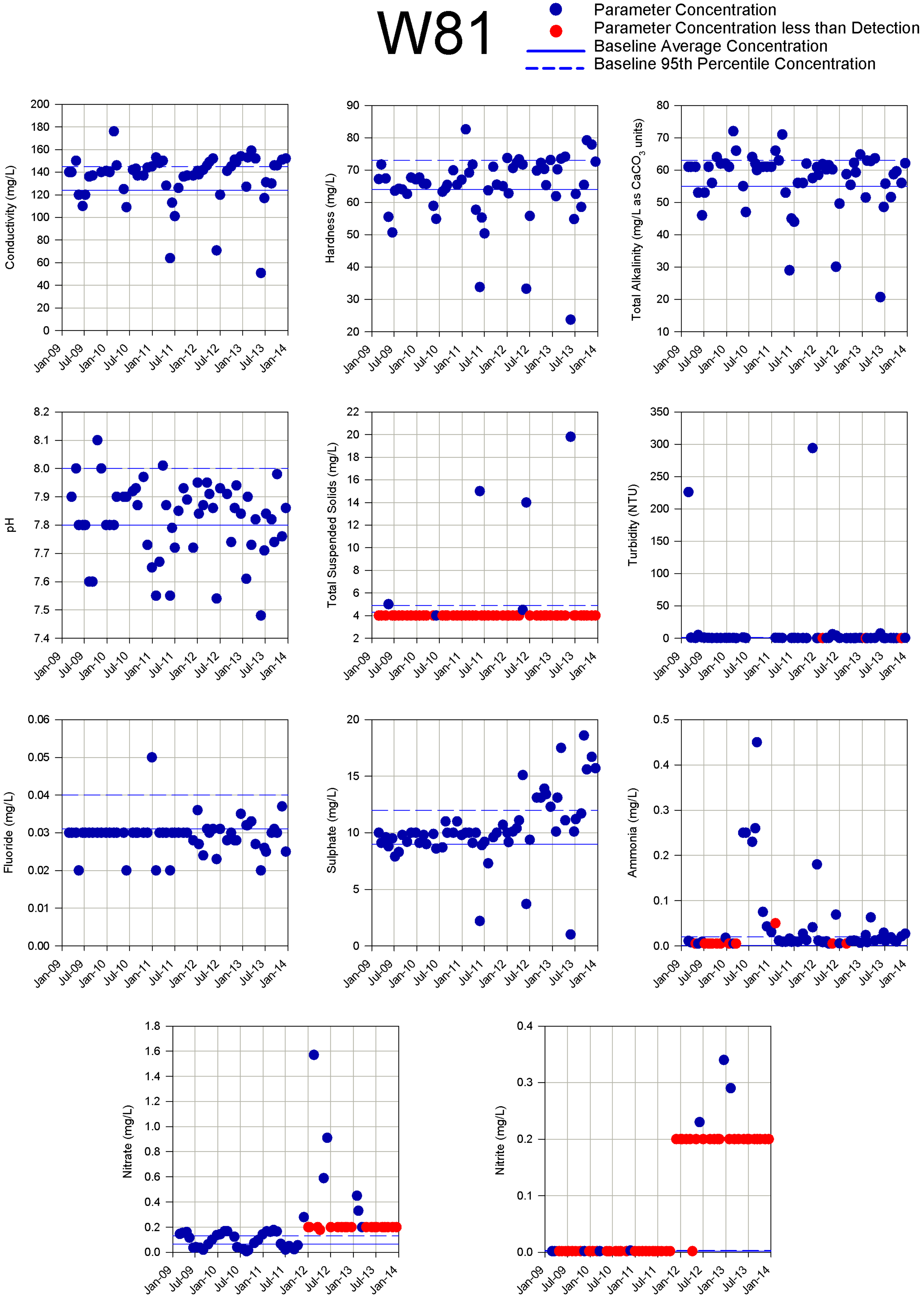

Parameter Concentration
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
0
50
100
150
200
250
300
350
Hardness (mg/L)
0
50
100
150
200
250
300
350
400
Total Alkalinity (mg/L as $CaCO_3$ units)
20
40
60
80
100
120
140
160
180
pH
7.4
7.6
7.8
8.0
8.2
8.4
Total Suspended Solids (mg/L)
0
5
10
15
20
25
Turbidity (NTU)
0
1
2
3
4
5
6
7
Fluoride (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Sulphate (mg/L)
0
5
10
15
20
25
30
35
Ammonia (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Nitrate (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
Nitrite (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14


W73
● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.00 0.02 0.04 0.06 0.08 0.10
Arsenic (mg/L)
0.0000 0.0001 0.0002 0.0003 0.0004 0.0005 0.0006
Cadmium (mg/L)
0.00000 0.00002 0.00004 0.00006 0.00008 0.00010 0.00012
Chromium (mg/L)
0.0000 0.0002 0.0004 0.0006 0.0008 0.0010 0.0012 0.0014 0.0016
Copper (mg/L)
0.000 0.002 0.004 0.006 0.008
Iron (mg/L)
0.0 0.1 0.2 0.3 0.4 0.5
Lead (mg/L)
0 1e-4 2e-4 3e-4 4e-4 5e-4 6e-4
Molybdenum (mg/L)
0.0000 0.0001 0.0002 0.0003 0.0004 0.0005 0.0006 0.0007
Nickel (mg/L)
0.000 0.001 0.002 0.003 0.004
Selenium (mg/L)
0.000 0.001 0.002 0.003 0.004 0.005 0.006
Zinc (mg/L)
0.000 0.002 0.004 0.006 0.008 0.010 0.012 0.014
Jan-09 Jul-09 Jan-10 Jul-10 Jan-11 Jul-11 Jan-12 Jul-12 Jan-13 Jul-13 Jan-14

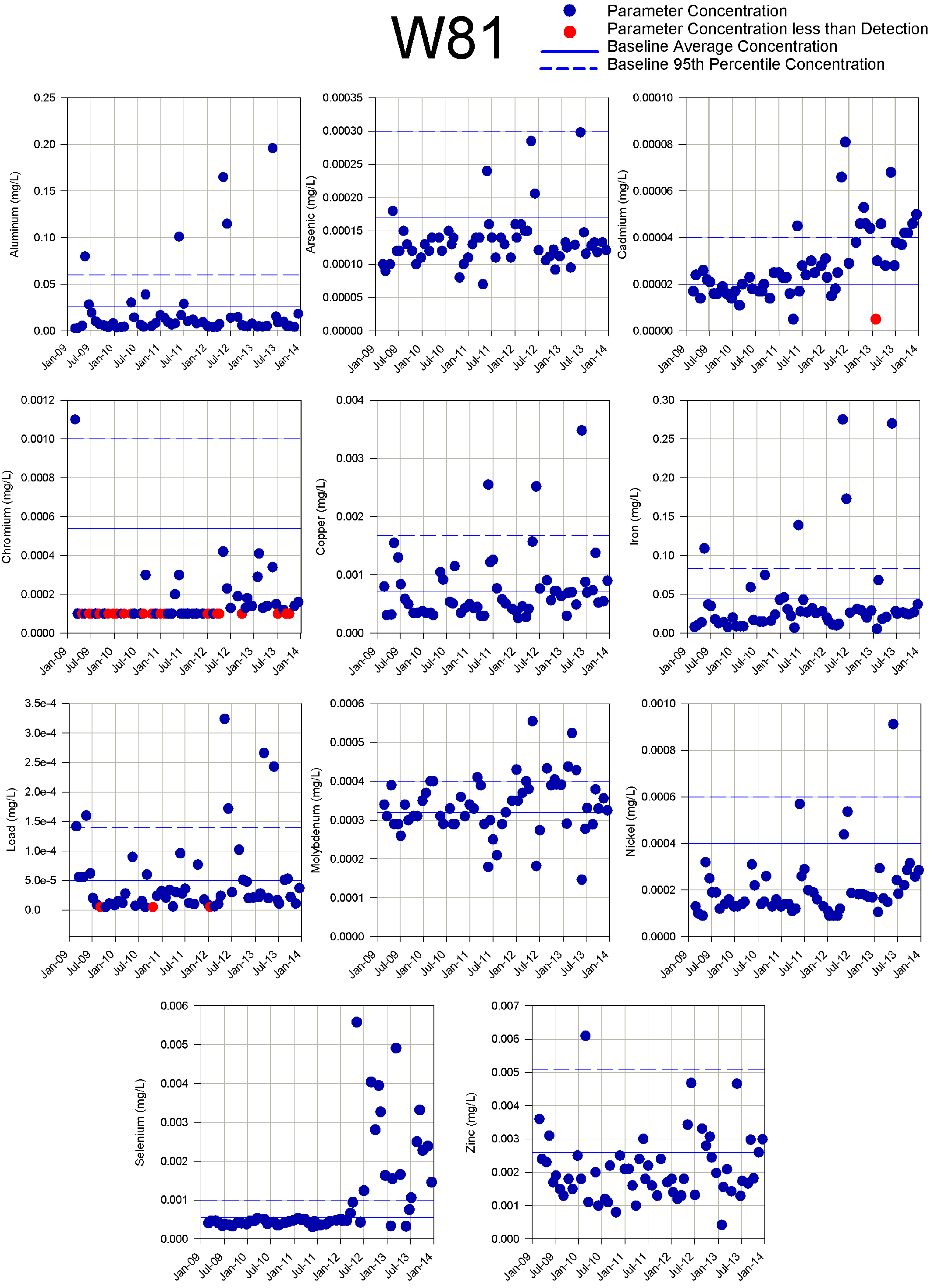

W80
Parameter Concentration
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
0 20 40 60 80 100 120 140 160 180 200
Hardness (mg/L)
30 40 50 60 70 80 90 100 110
Total Alkalinity (mg/L as $CaCO_3$ units)
35 40 45 50 55 60 65 70 75
pH
7.5 7.6 7.7 7.8 7.9 8.0 8.1 8.2
Total Suspended Solids (mg/L)
0 20 40 60 80 100
Turbidity (NTU)
0 5 10 15 20 25
Fluoride (mg/L)
0.00 0.02 0.04 0.06 0.08
Sulphate (mg/L)
0 5 10 15 20 25 30
Ammonia (mg/L)
0.0 0.1 0.2 0.3 0.4 0.5 0.6
Nitrate (mg/L)
0.0 0.2 0.4 0.6 0.8
Nitrite (mg/L)
0.00 0.05 0.10 0.15 0.20 0.25
Jan-09 Jul-09 Jan-10 Jul-10 Jan-11 Jul-11 Jan-12 Jul-12 Jan-13 Jul-13 Jan-14

W80


Parameter Concentration
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.0
0.1
0.2
0.3
0.4
Arsenic (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
Cadmium (mg/L)
0.00000
0.00002
0.00004
0.00006
0.00008
0.00010
0.00012
Chromium (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
0.0016
Copper (mg/L)
0.000
0.005
0.010
0.015
0.020
0.025
Iron (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
Lead (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
Molybdenum (mg/L)
0.0000
0.0001
0.0002
0.0003
0.0004
0.0005
0.0006
0.0007
Nickel (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
0.0030
0.0035
Selenium (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
0.0016
0.0018
0.0020
Zinc (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
0.006
0.007
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

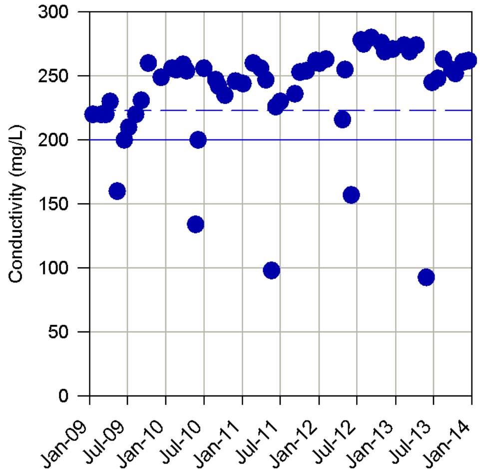

W81
Parameter Concentration
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
0
20
40
60
80
100
120
140
160
180
200
Hardness (mg/L)
20
30
40
50
60
70
80
90
Total Alkalinity (mg/L as CaCO3 units)
10
20
30
40
50
60
70
80
pH
7.4
7.5
7.6
7.7
7.8
7.9
8.0
8.1
8.2
Total Suspended Solids (mg/L)
2
4
6
8
10
12
14
16
18
20
22
Turbidity (NTU)
0
50
100
150
200
250
300
350
Fluoride (mg/L)
0.00
0.01
0.02
0.03
0.04
0.05
0.06
Sulphate (mg/L)
0
5
10
15
20
Ammonia (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
Nitrate (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
Nitrite (mg/L)
0.0
0.1
0.2
0.3
0.4
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

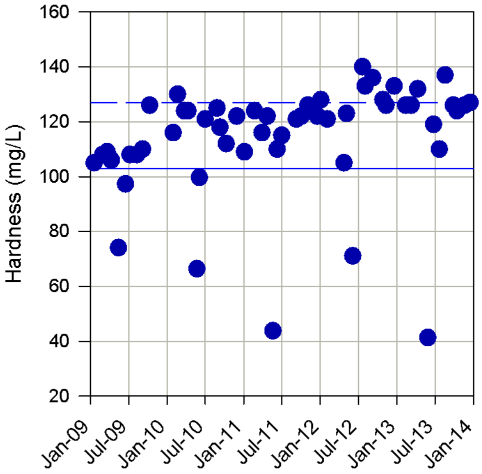
W81

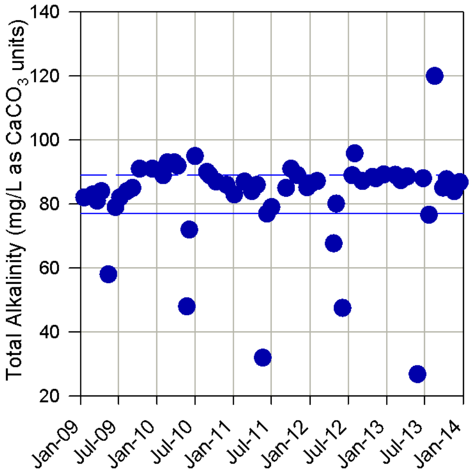

Parameter Concentration
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.25
0.20
0.15
0.10
0.05
0.00
Arsenic (mg/L)
0.00035
0.00030
0.00025
0.00020
0.00015
0.00010
0.00005
0.00000
Cadmium (mg/L)
0.00010
0.00008
0.00006
0.00004
0.00002
0.00000
Chromium (mg/L)
0.0012
0.0010
0.0008
0.0006
0.0004
0.0002
0.0000
Copper (mg/L)
0.004
0.003
0.002
0.001
0.000
Iron (mg/L)
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Lead (mg/L)
3.5e-4
3.0e-4
2.5e-4
2.0e-4
1.5e-4
1.0e-4
5.0e-5
0.0
Molybdenum (mg/L)
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0.0000
Nickel (mg/L)
0.0010
0.0008
0.0006
0.0004
0.0002
0.0000
Selenium (mg/L)
0.006
0.005
0.004
0.003
0.002
0.001
0.000
Zinc (mg/L)
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0.000
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

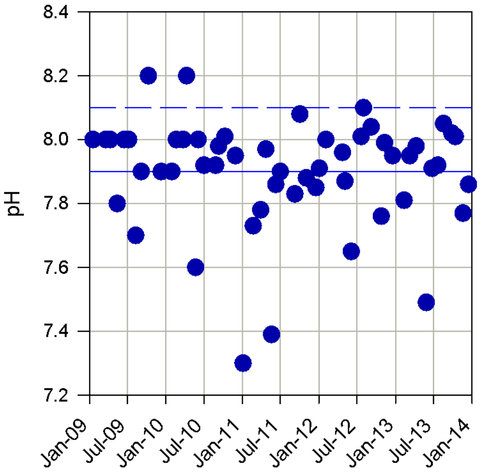
W82

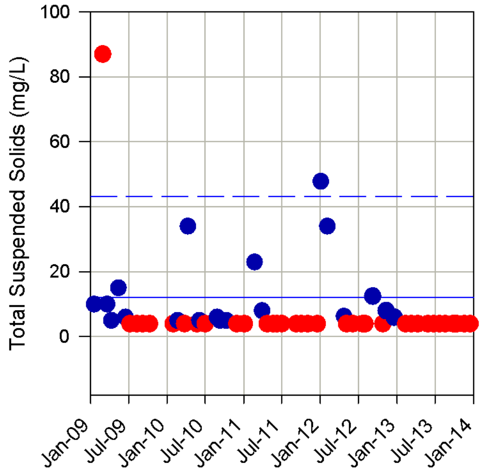
● Parameter Concentration
● Parameter Concentration less than Detection
— Baseline Average Concentration
- - - Baseline 95th Percentile Concentration

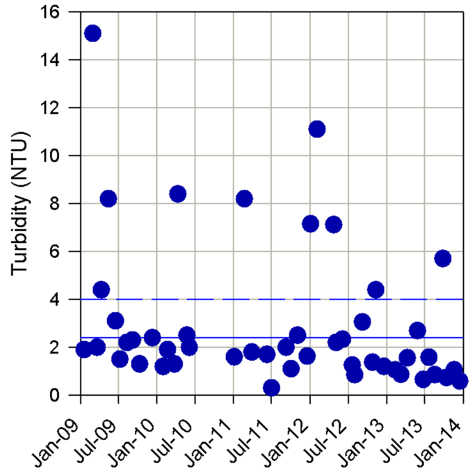


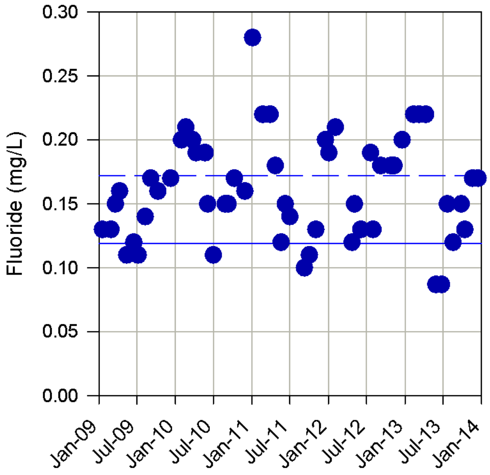


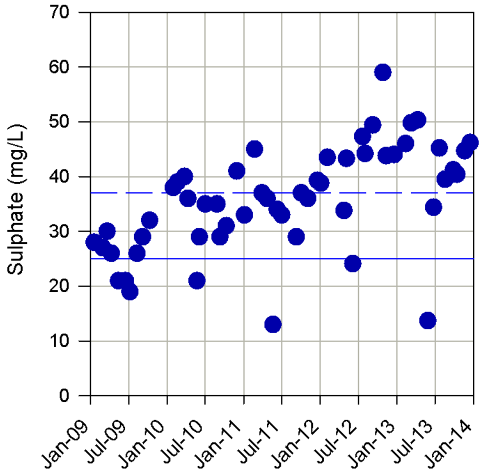


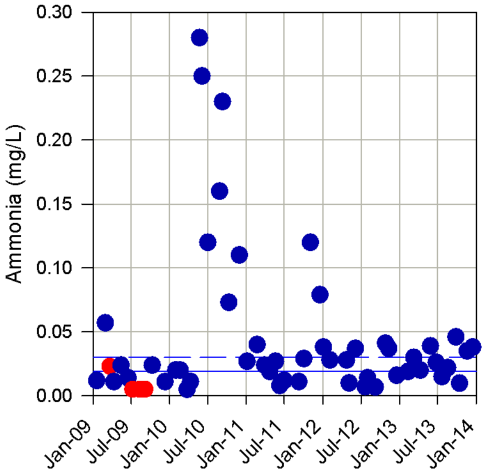


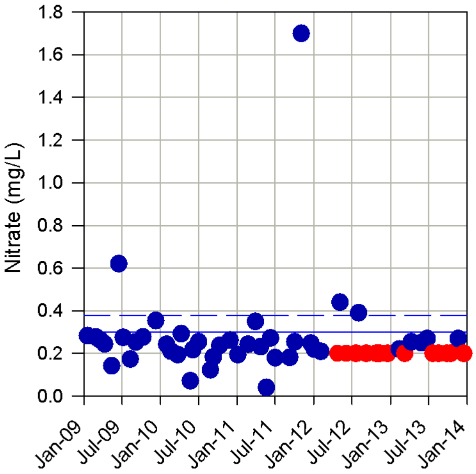


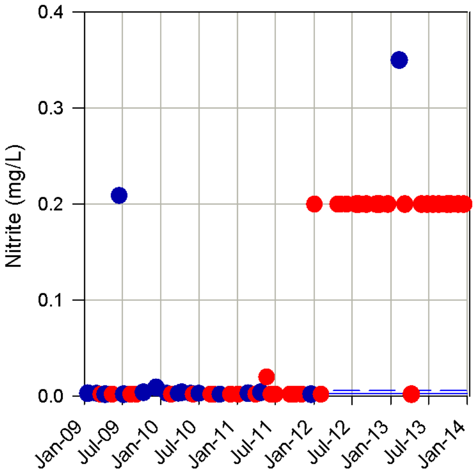






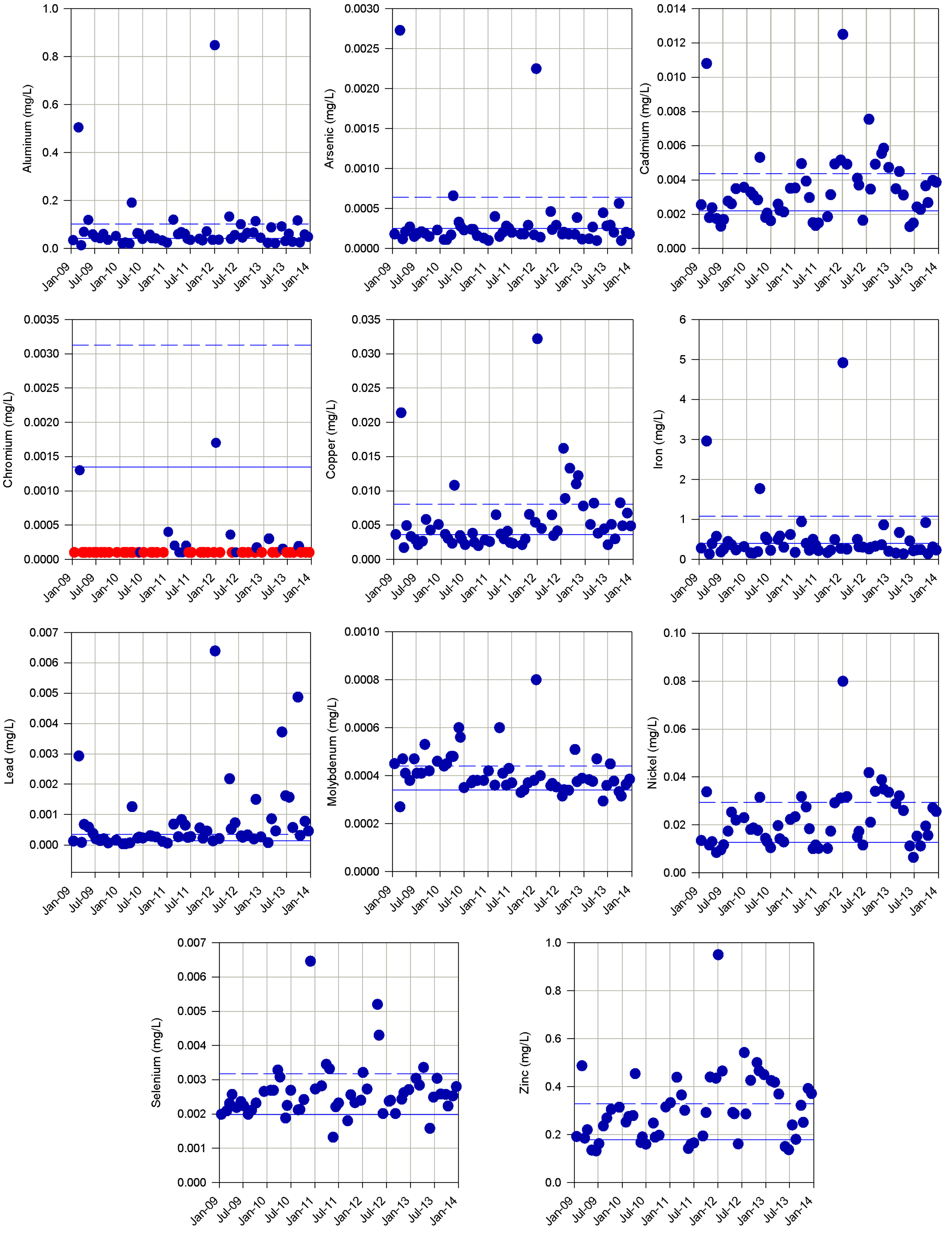




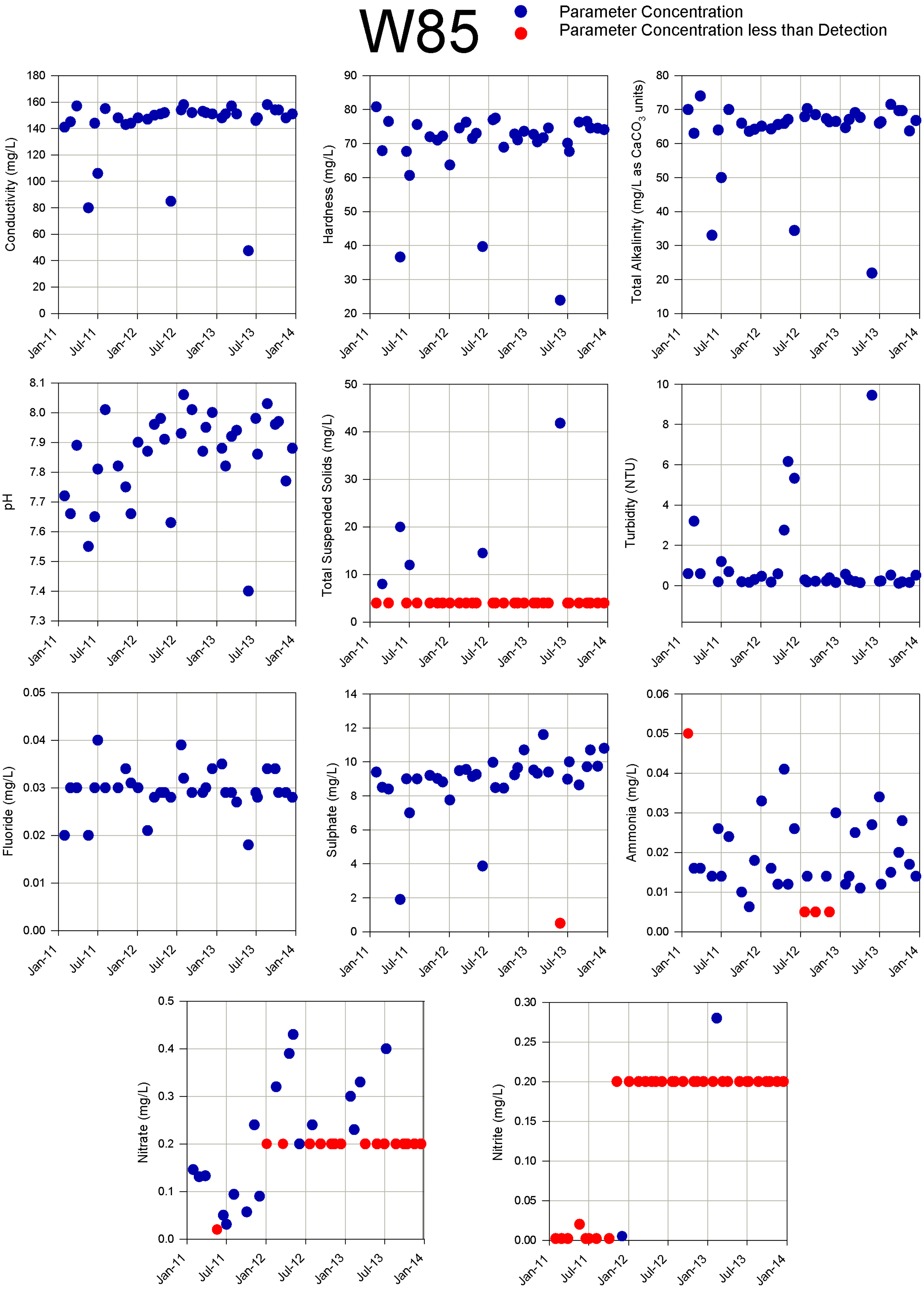


W82

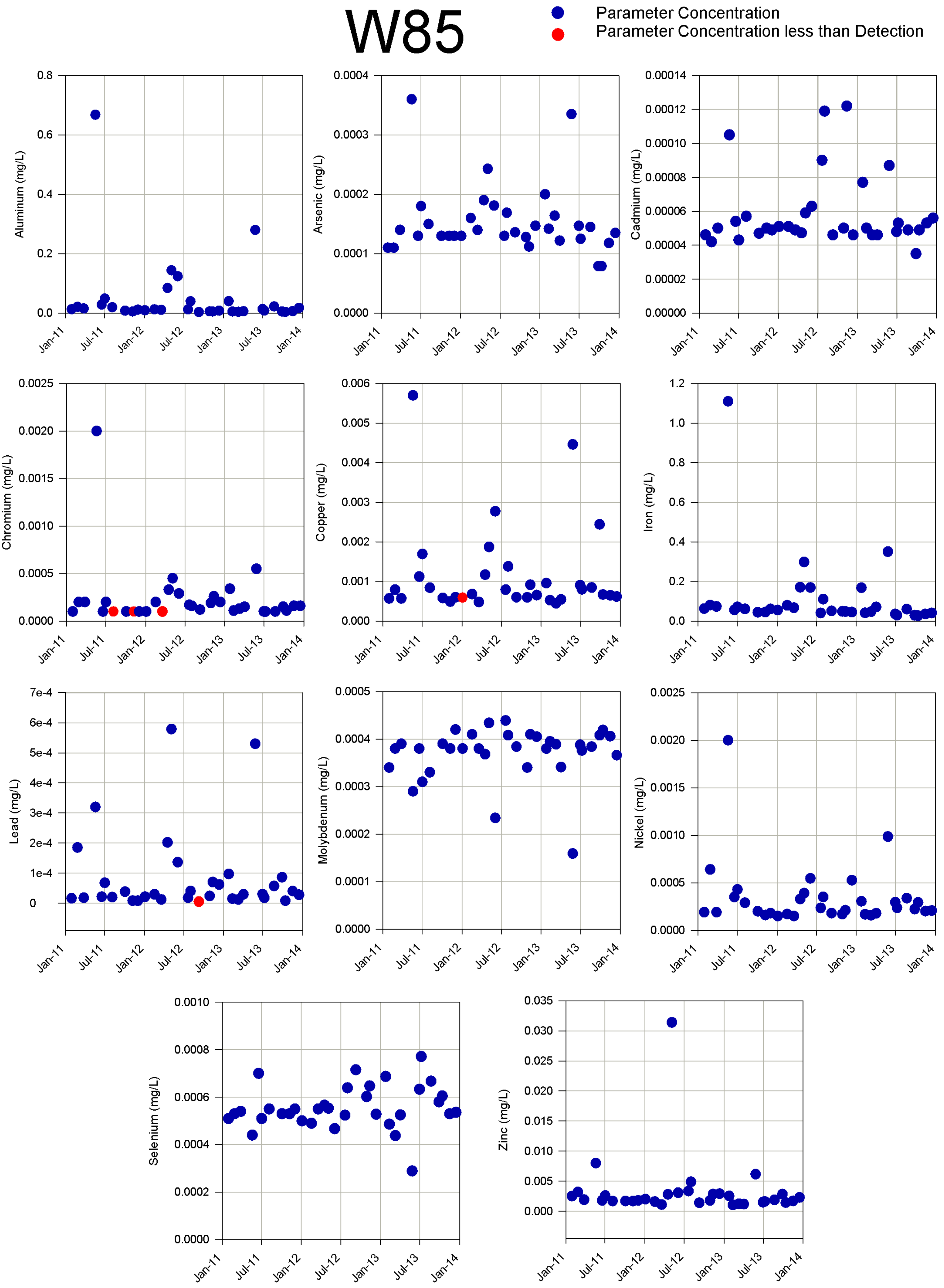
● Parameter Concentration
● Parameter Concentration less than Detection
— Baseline Average Concentration
- - - Baseline 95th Percentile Concentration

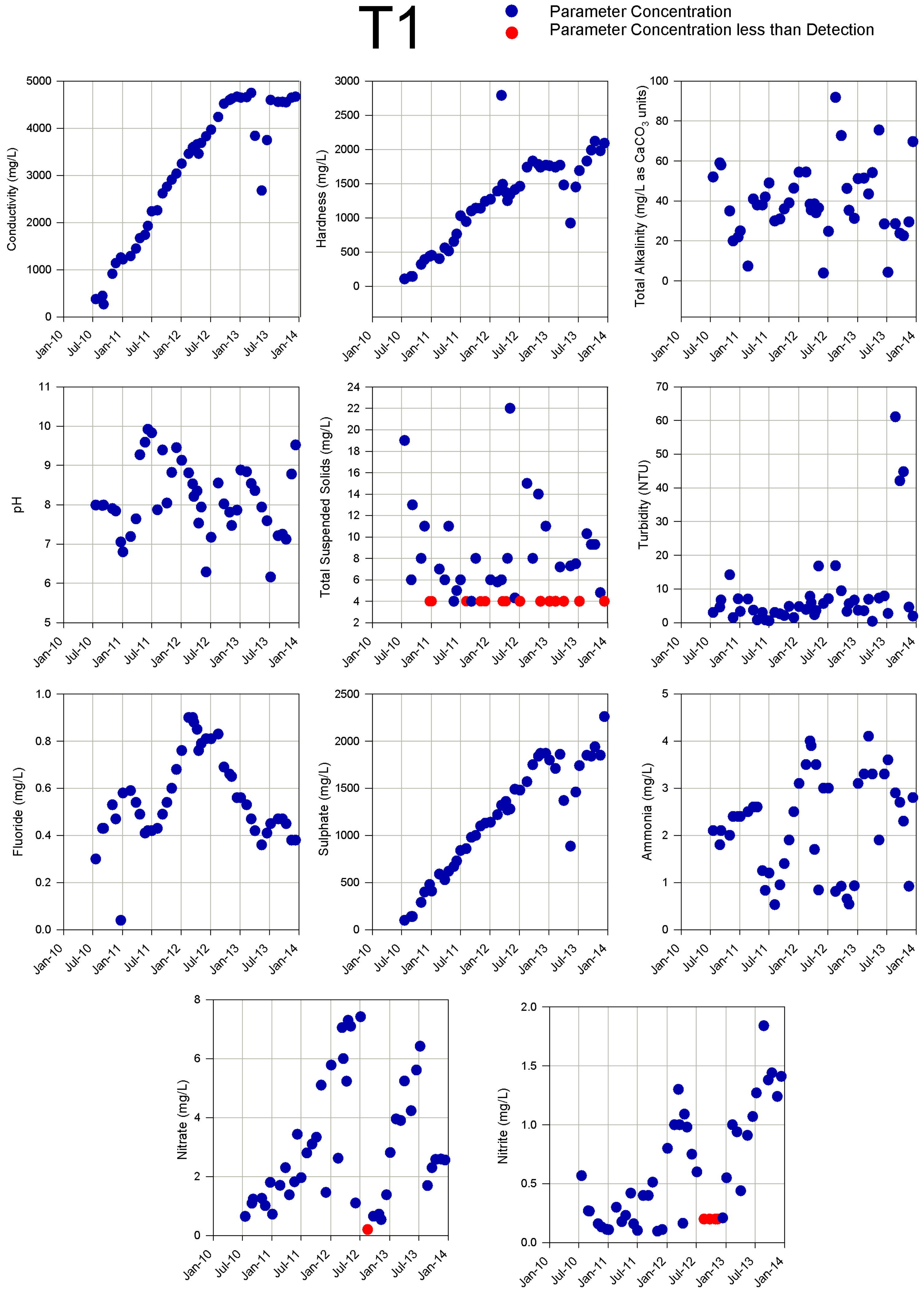


W85

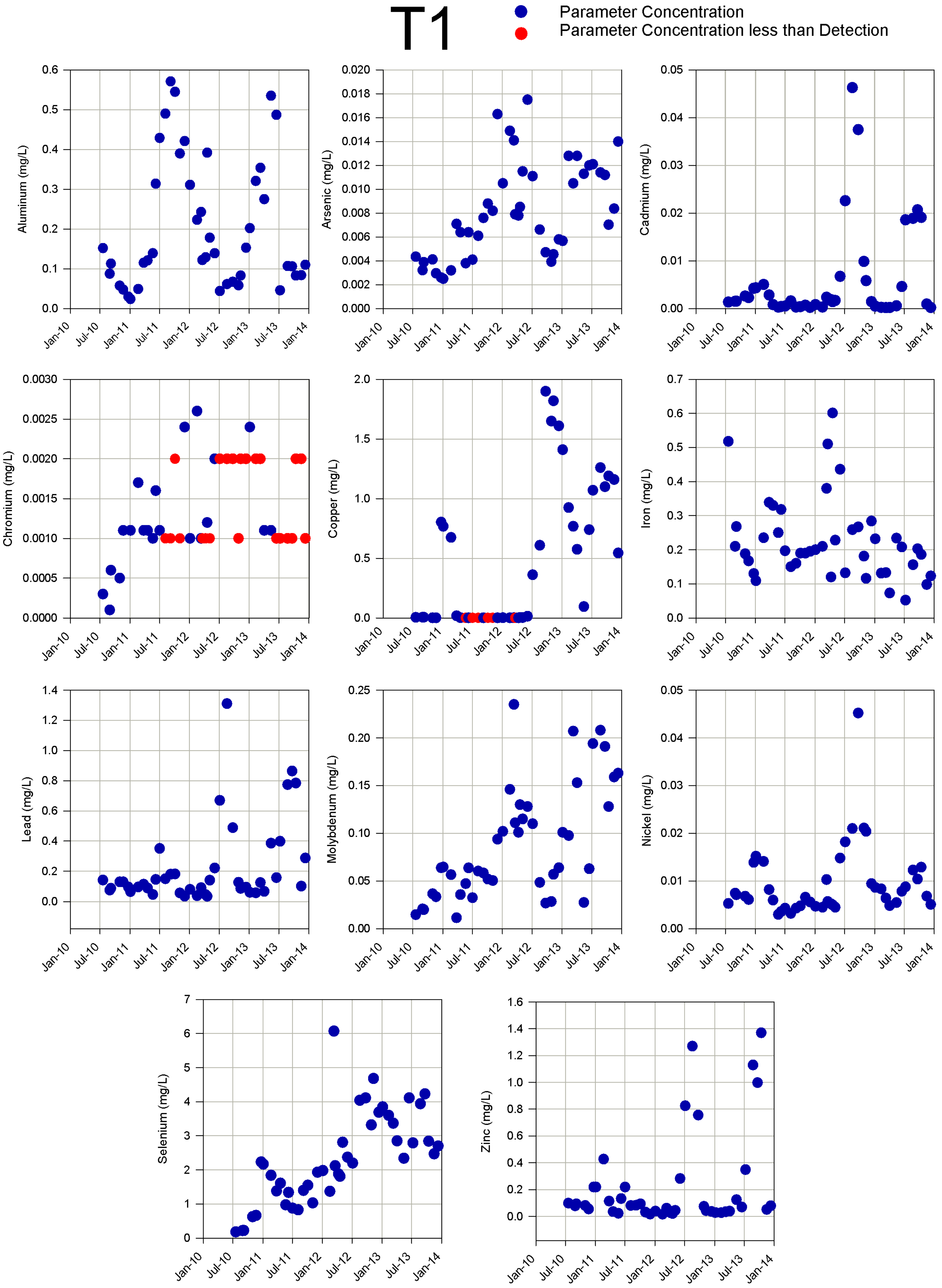

● Parameter Concentration
● Parameter Concentration less than Detection
Conductivity (mg/L)
0 20 40 60 80 100 120 140 160 180
Hardness (mg/L)
20 30 40 50 60 70 80 90
Total Alkalinity (mg/L as $CaCO_3$ units)
10 20 30 40 50 60 70 80
pH
7.3 7.4 7.5 7.6 7.7 7.8 7.9 8.0 8.1
Total Suspended Solids (mg/L)
0 10 20 30 40 50
Turbidity (NTU)
0 2 4 6 8 10
Fluoride (mg/L)
0.00 0.01 0.02 0.03 0.04 0.05
Sulphate (mg/L)
0 2 4 6 8 10 12 14
Ammonia (mg/L)
0.00 0.01 0.02 0.03 0.04 0.05 0.06
Nitrate (mg/L)
0.0 0.1 0.2 0.3 0.4 0.5
Nitrite (mg/L)
0.00 0.05 0.10 0.15 0.20 0.25 0.30
Jan-11 Jul-11 Jan-12 Jul-12 Jan-13 Jul-13 Jan-14

W85


Parameter Concentration
Parameter Concentration less than Detection
Aluminum (mg/L)
0.0
0.2
0.4
0.6
0.8
Arsenic (mg/L)
0.0000
0.0001
0.0002
0.0003
0.0004
Cadmium (mg/L)
0.00000
0.00002
0.00004
0.00006
0.00008
0.00010
0.00012
0.00014
Chromium (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
Copper (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
0.006
Iron (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Lead (mg/L)
0
1e-4
2e-4
3e-4
4e-4
5e-4
6e-4
7e-4
Molybdenum (mg/L)
0.0000
0.0001
0.0002
0.0003
0.0004
0.0005
Nickel (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
Selenium (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
Zinc (mg/L)
0.000
0.005
0.010
0.015
0.020
0.025
0.030
0.035
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14


T1
● Parameter Concentration
● Parameter Concentration less than Detection
Conductivity (mg/L)
0
1000
2000
3000
4000
5000
Hardness (mg/L)
0
500
1000
1500
2000
2500
3000
Total Alkalinity (mg/L as $CaCO_3$ units)
0
20
40
60
80
100
pH
5
6
7
8
9
10
11
Total Suspended Solids (mg/L)
2
4
6
8
10
12
14
16
18
20
22
24
Turbidity (NTU)
0
10
20
30
40
50
60
70
Fluoride (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
Sulphate (mg/L)
0
500
1000
1500
2000
2500
Ammonia (mg/L)
0
1
2
3
4
5
Nitrate (mg/L)
0
2
4
6
8
Nitrite (mg/L)
0.0
0.5
1.0
1.5
2.0
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

T1

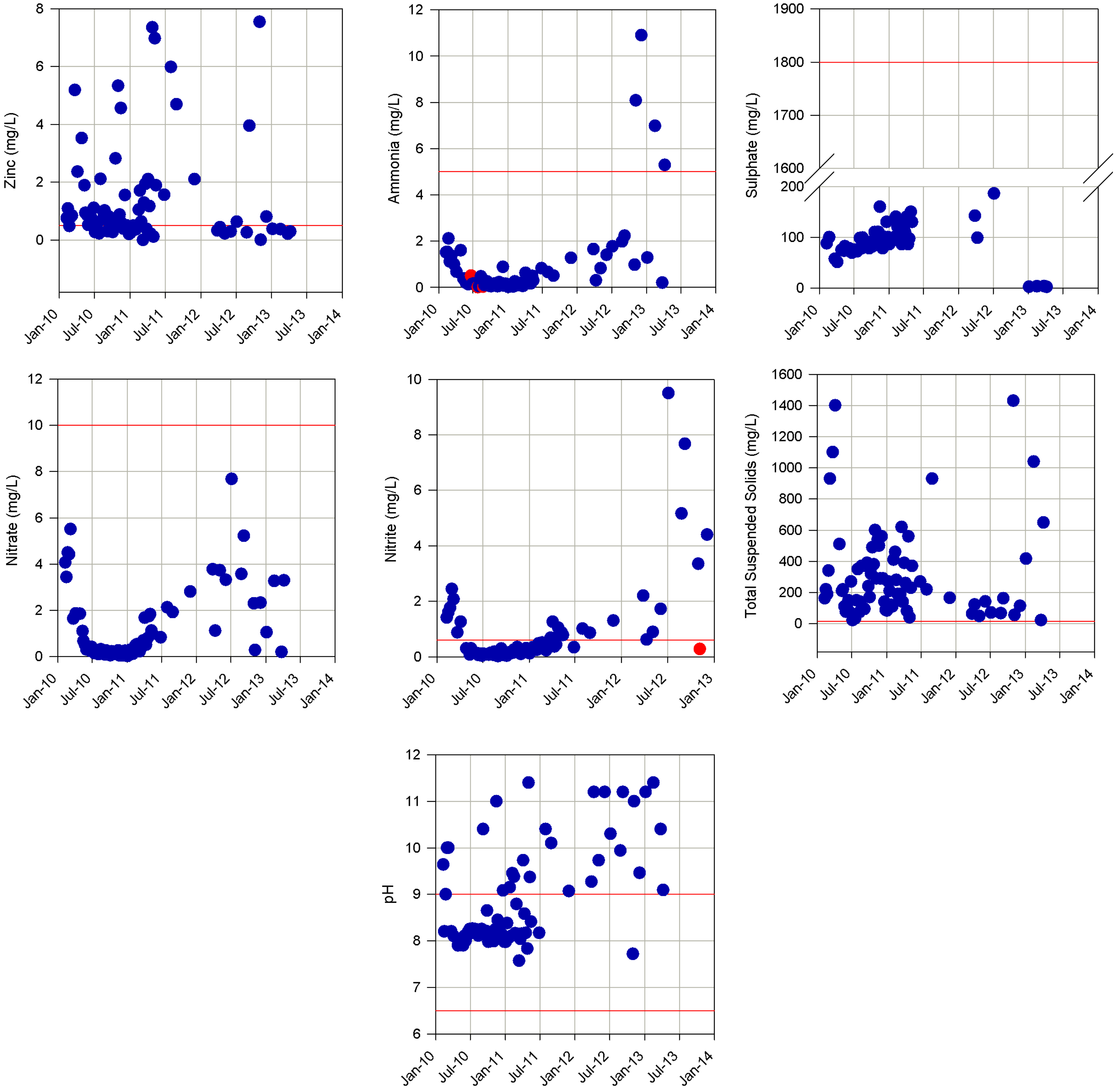

● Parameter Concentration
● Parameter Concentration less than Detection
Aluminum (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Arsenic (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0.014
0.016
0.018
0.020
Cadmium (mg/L)
0.00
0.01
0.02
0.03
0.04
0.05
Chromium (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
0.0030
Copper (mg/L)
0.0
0.5
1.0
1.5
2.0
Iron (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Lead (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
Molybdenum (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
Nickel (mg/L)
0.00
0.01
0.02
0.03
0.04
0.05
Selenium (mg/L)
0
1
2
3
4
5
6
7
Zinc (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

UTMD

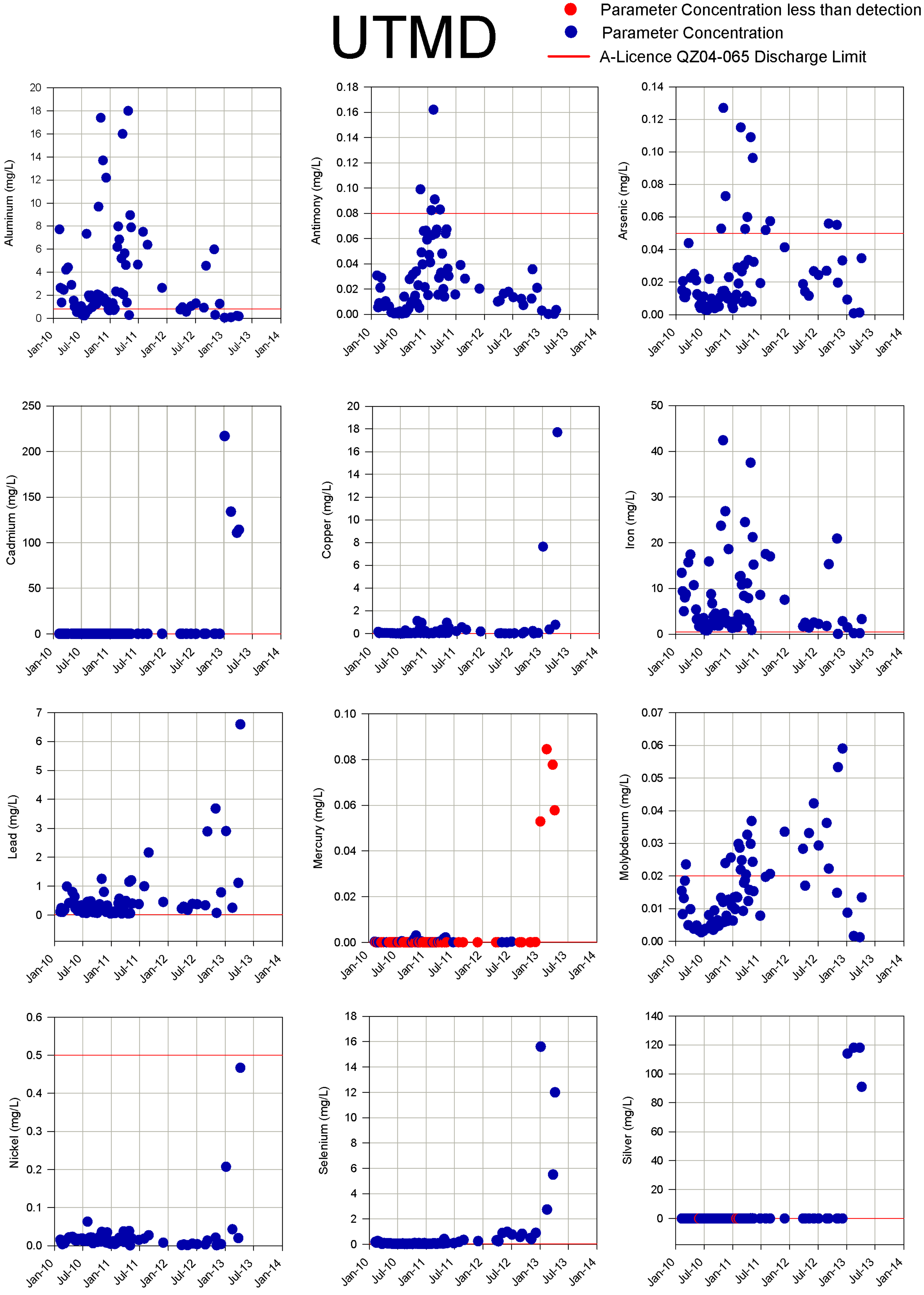
● Parameter Concentration less than detection

● Parameter Concentration

— A-Licence QZ04-065 Discharge Limit



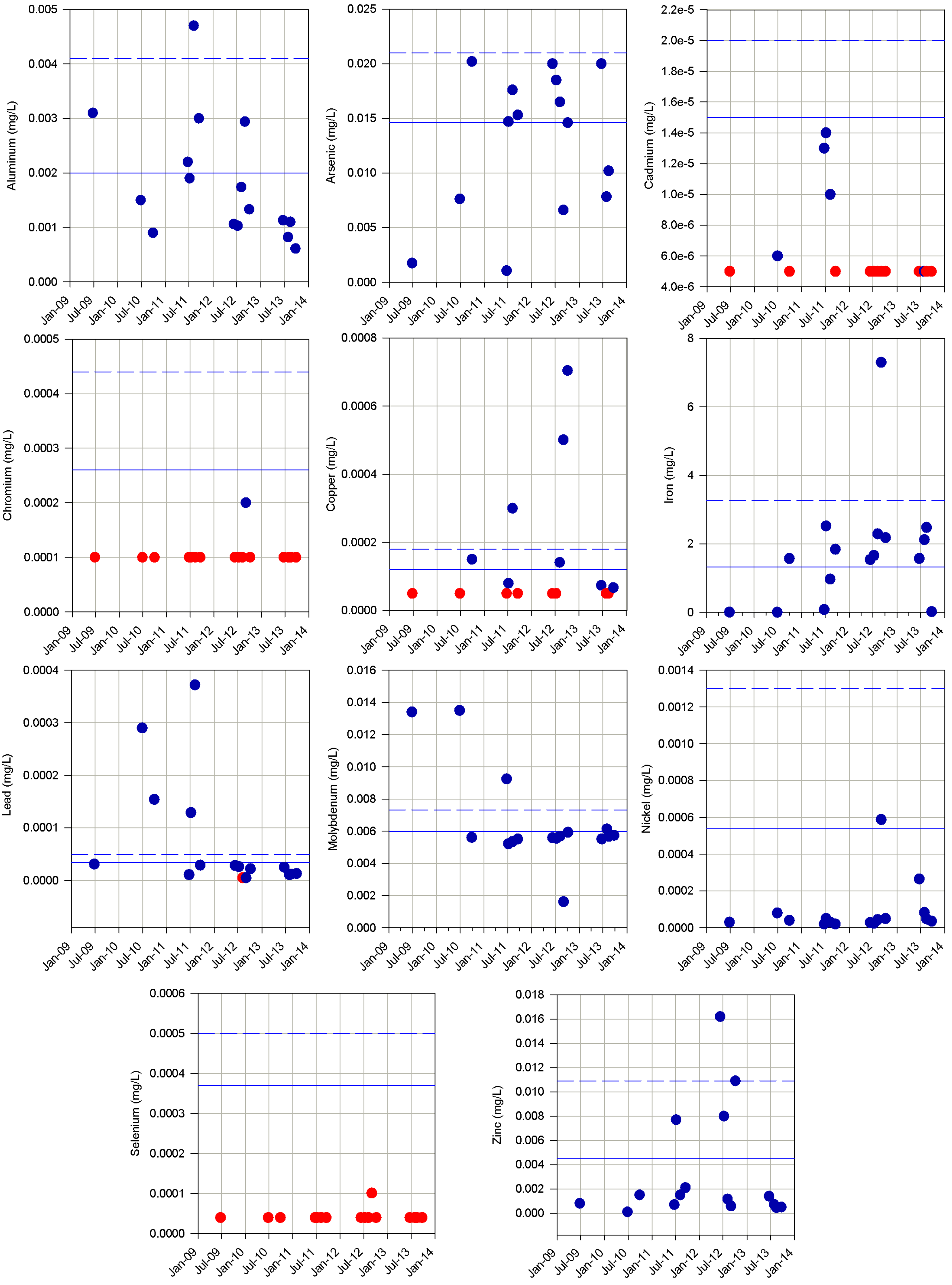
UTMD



● Parameter Concentration less than detection
● Parameter Concentration
A-Licence QZ04-065 Discharge Limit
Aluminum (mg/L)
0
2
4
6
8
10
12
14
16
18
20
Antimony (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
0.18
Arsenic (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
Cadmium (mg/L)
0
50
100
150
200
250
Copper (mg/L)
0
2
4
6
8
10
12
14
16
18
20
Iron (mg/L)
0
10
20
30
40
50
Lead (mg/L)
0
1
2
3
4
5
6
7
Mercury (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
Molybdenum (mg/L)
0.00
0.01
0.02
0.03
0.04
0.05
0.06
0.07
Nickel (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Selenium (mg/L)
0
2
4
6
8
10
12
14
16
18
Silver (mg/L)
0
20
40
60
80
100
120
140
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

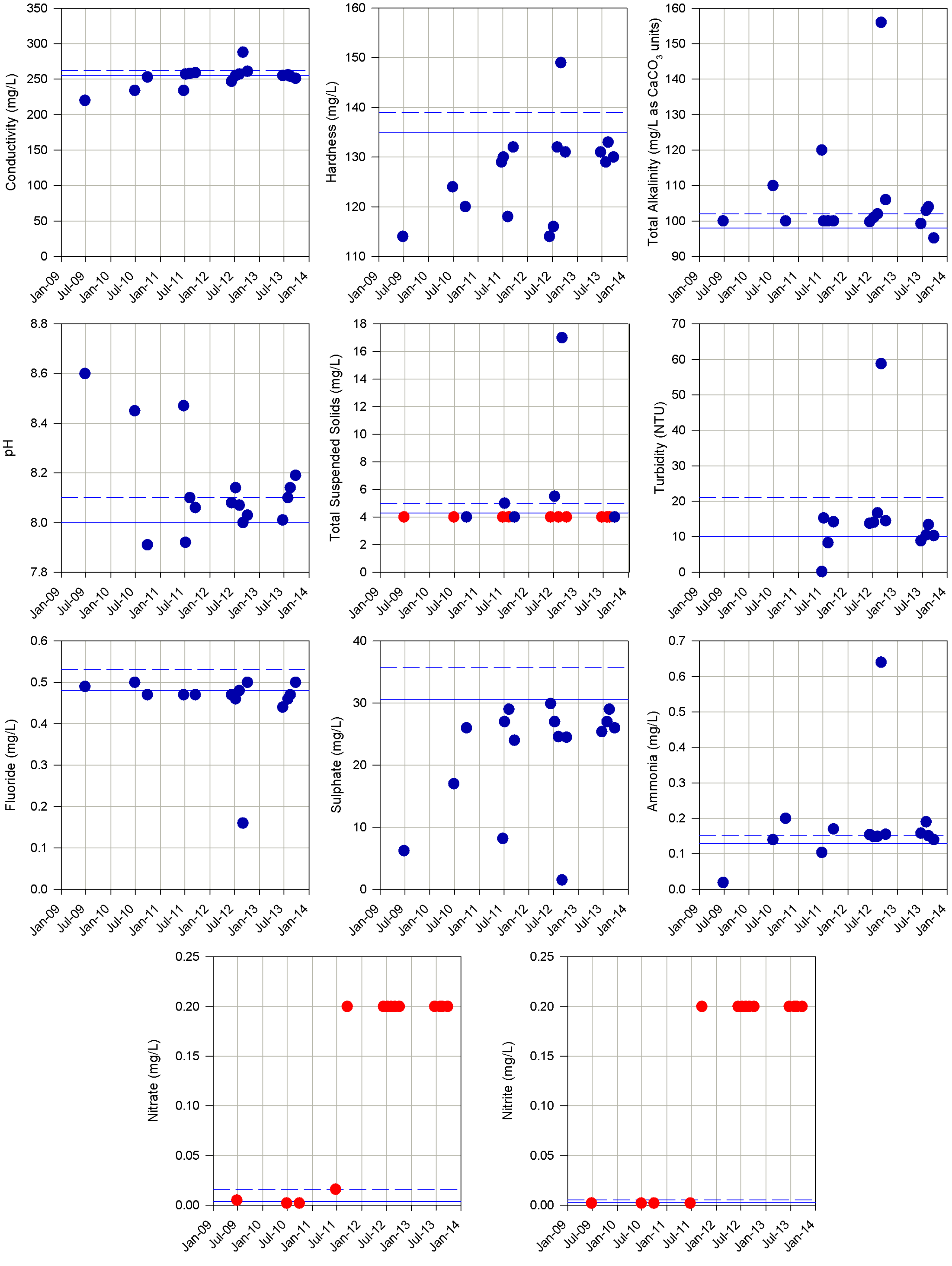
MW05-1A

● Parameter Concentration
● Parameter Concentration less than Detection
— Baseline Average Concentration
- - Baseline 95th Percentile Concentration

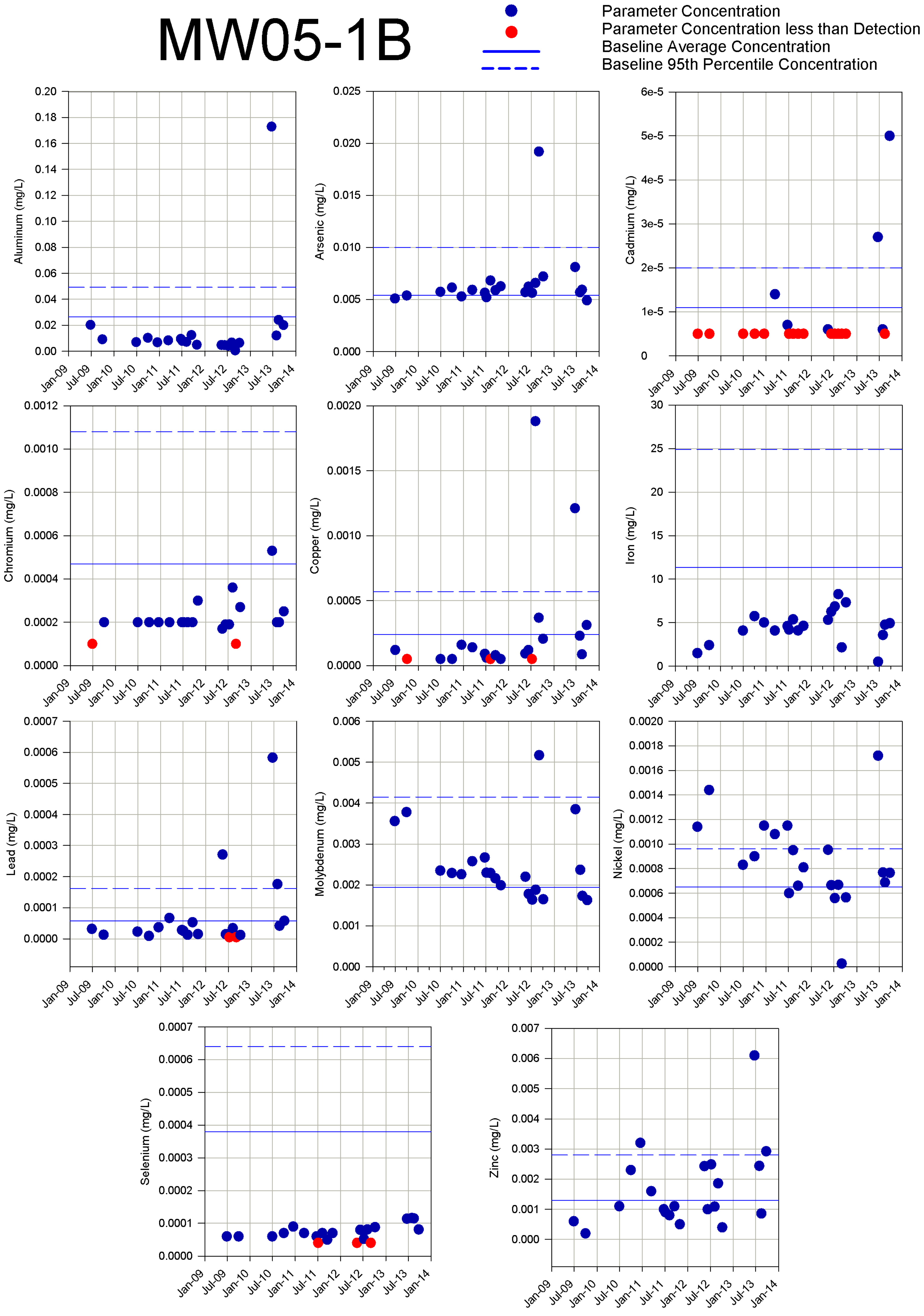


MW05-1A

● Parameter Concentration
● Parameter Concentration less than Detection
── Baseline Average Concentration
– – Baseline 95th Percentile Concentration

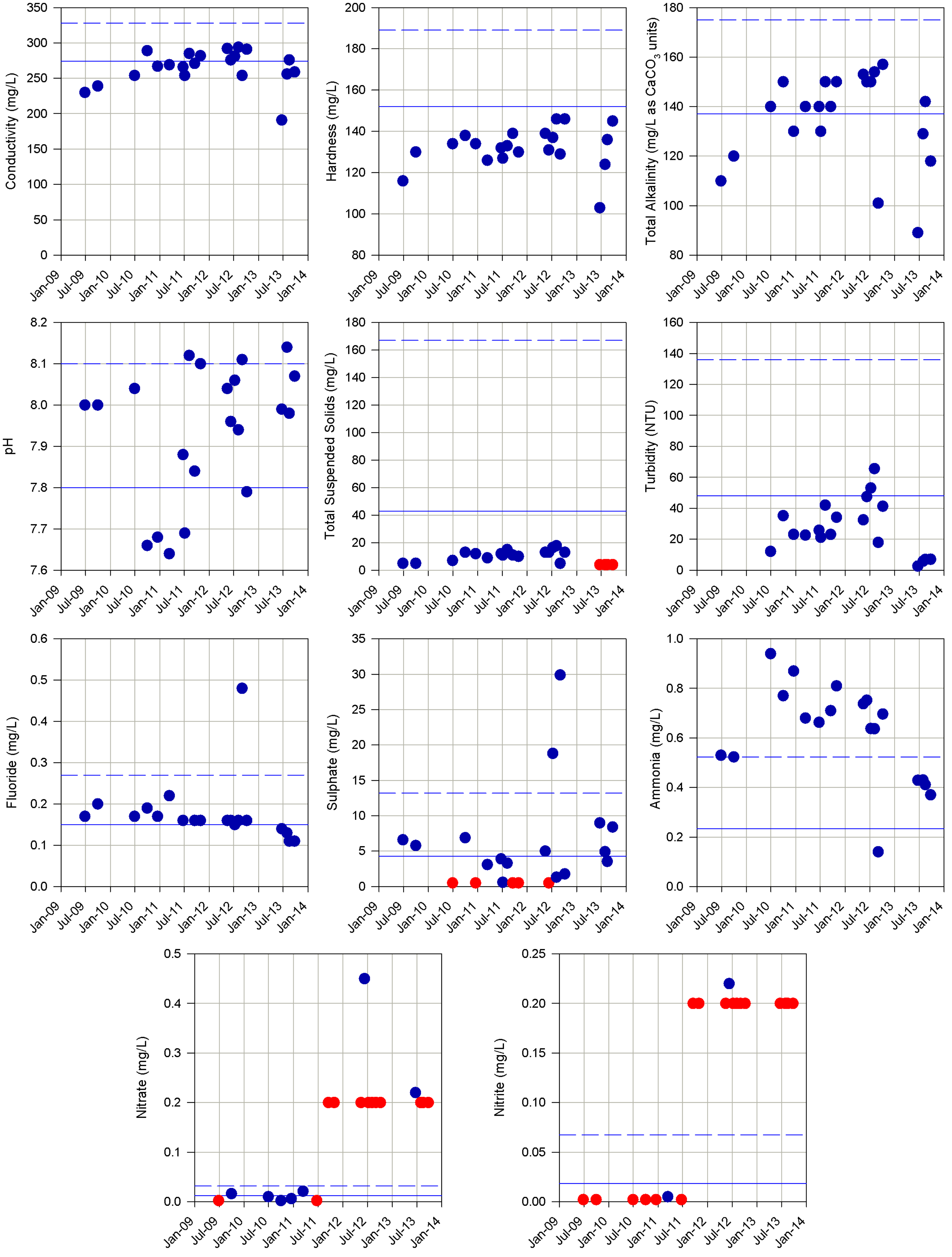


MW05-1B


● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.00 0.02 0.04 0.06 0.08 0.10 0.12 0.14 0.16 0.18 0.20
Arsenic (mg/L)
0.000 0.005 0.010 0.015 0.020 0.025
Cadmium (mg/L)
0 1e-5 2e-5 3e-5 4e-5 5e-5 6e-5
Chromium (mg/L)
0.0000 0.0002 0.0004 0.0006 0.0008 0.0010 0.0012
Copper (mg/L)
0.0000 0.0005 0.0010 0.0015 0.0020
Iron (mg/L)
0 5 10 15 20 25 30
Lead (mg/L)
0.0000 0.0001 0.0002 0.0003 0.0004 0.0005 0.0006 0.0007
Molybdenum (mg/L)
0.000 0.001 0.002 0.003 0.004 0.005 0.006
Nickel (mg/L)
0.0000 0.0002 0.0004 0.0006 0.0008 0.0010 0.0012 0.0014 0.0016 0.0018 0.0020
Selenium (mg/L)
0.0000 0.0001 0.0002 0.0003 0.0004 0.0005 0.0006 0.0007
Zinc (mg/L)
0.000 0.001 0.002 0.003 0.004 0.005 0.006 0.007
Jan-09 Jul-09 Jan-10 Jul-10 Jan-11 Jul-11 Jan-12 Jul-12 Jan-13 Jul-13 Jan-14

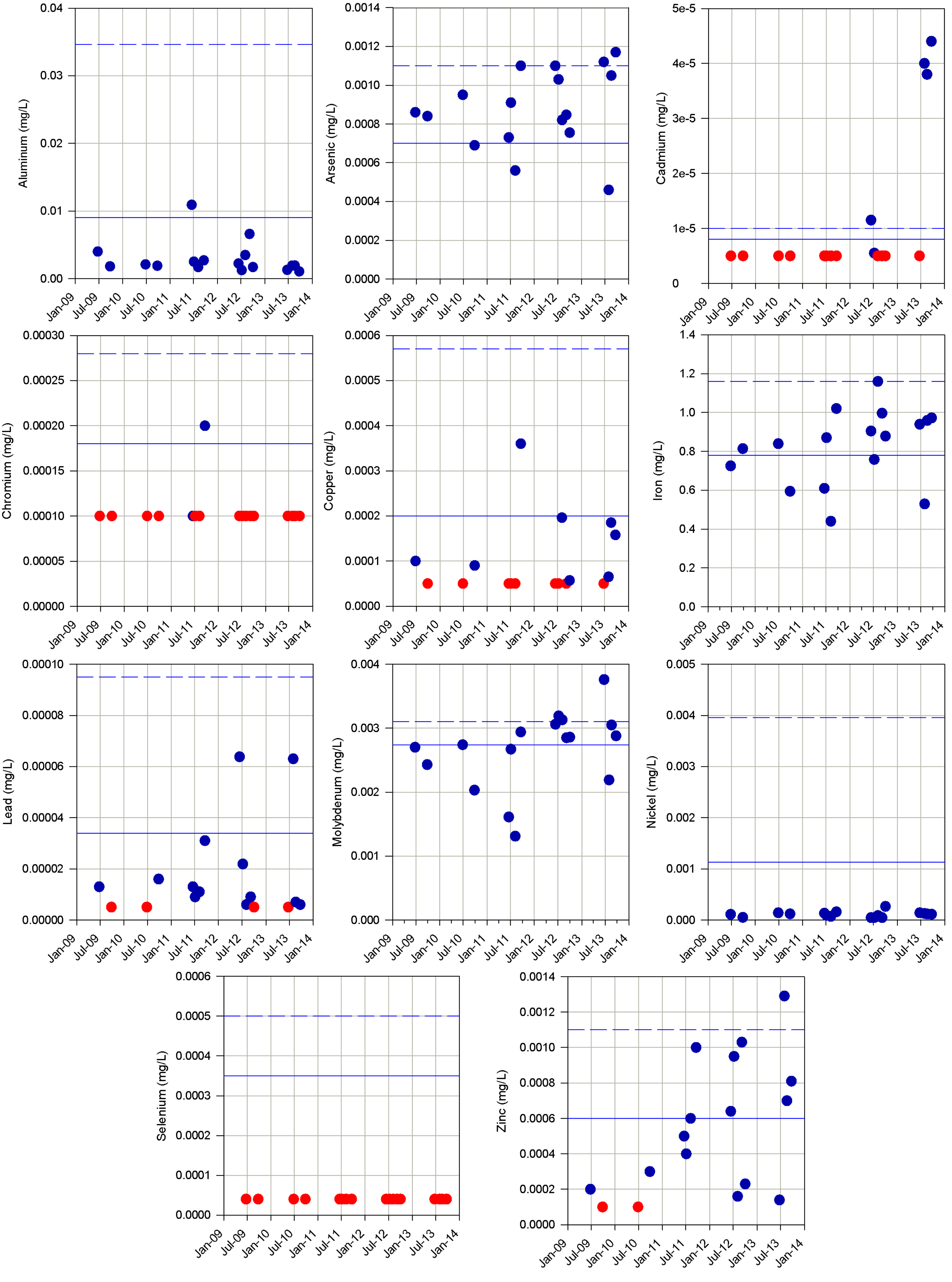
MW05-1B

● Parameter Concentration
● Parameter Concentration less than Detection
― Baseline Average Concentration
- - - Baseline 95th Percentile Concentration

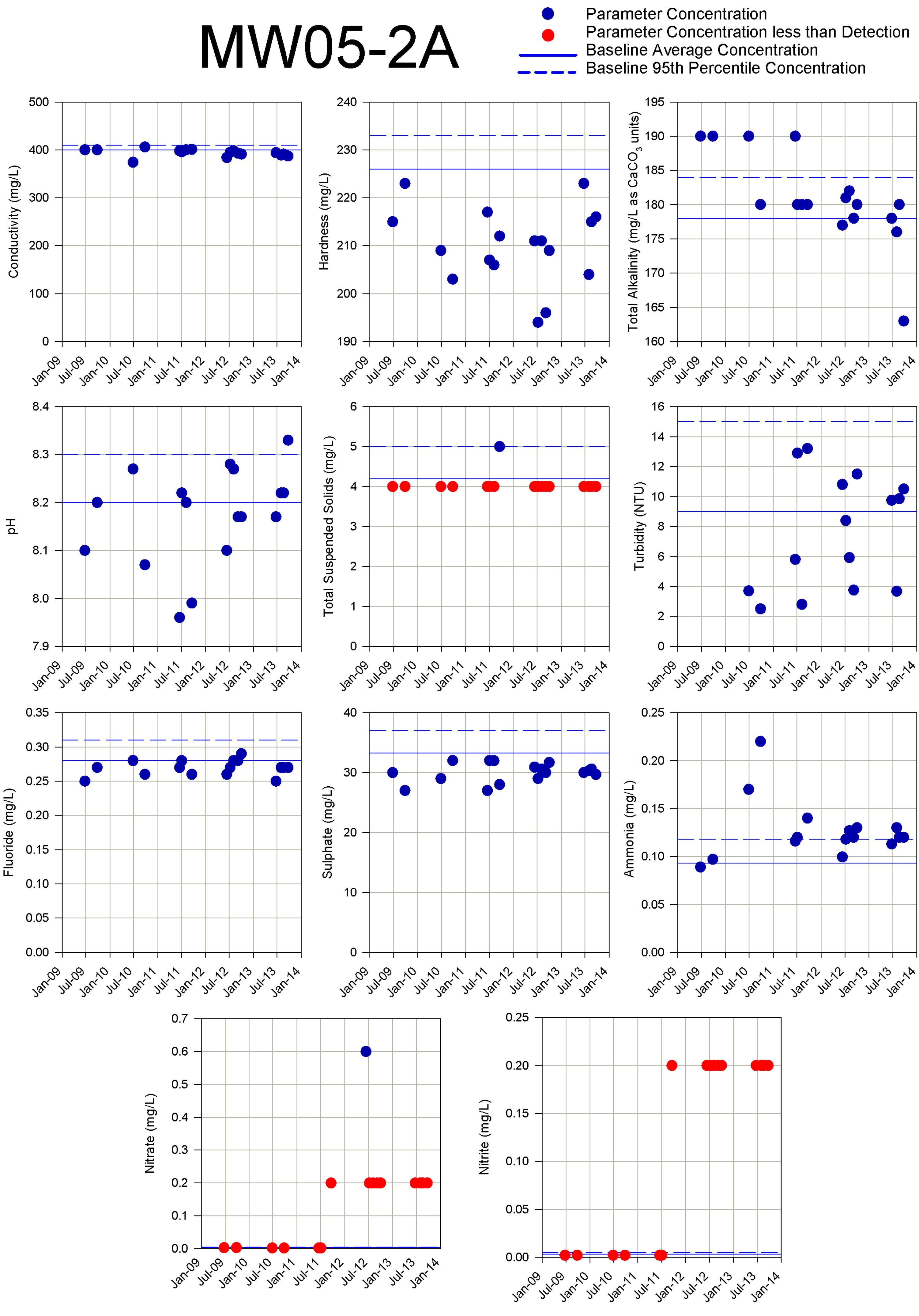


MW05-2A

● Parameter Concentration
🔴 Parameter Concentration less than Detection
━━ Baseline Average Concentration
‒ ‒ ‒ Baseline 95th Percentile Concentration

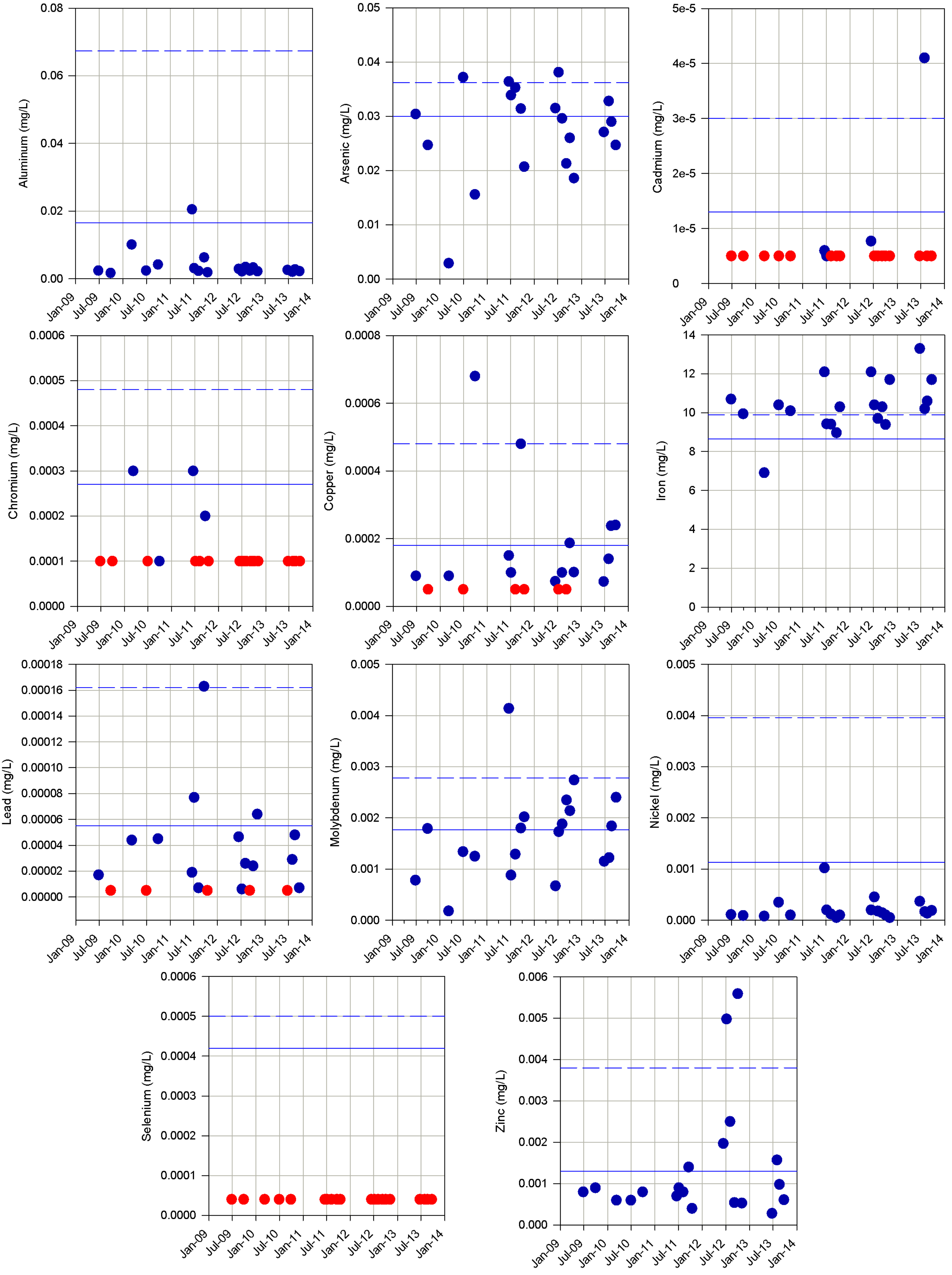


MW05-2A

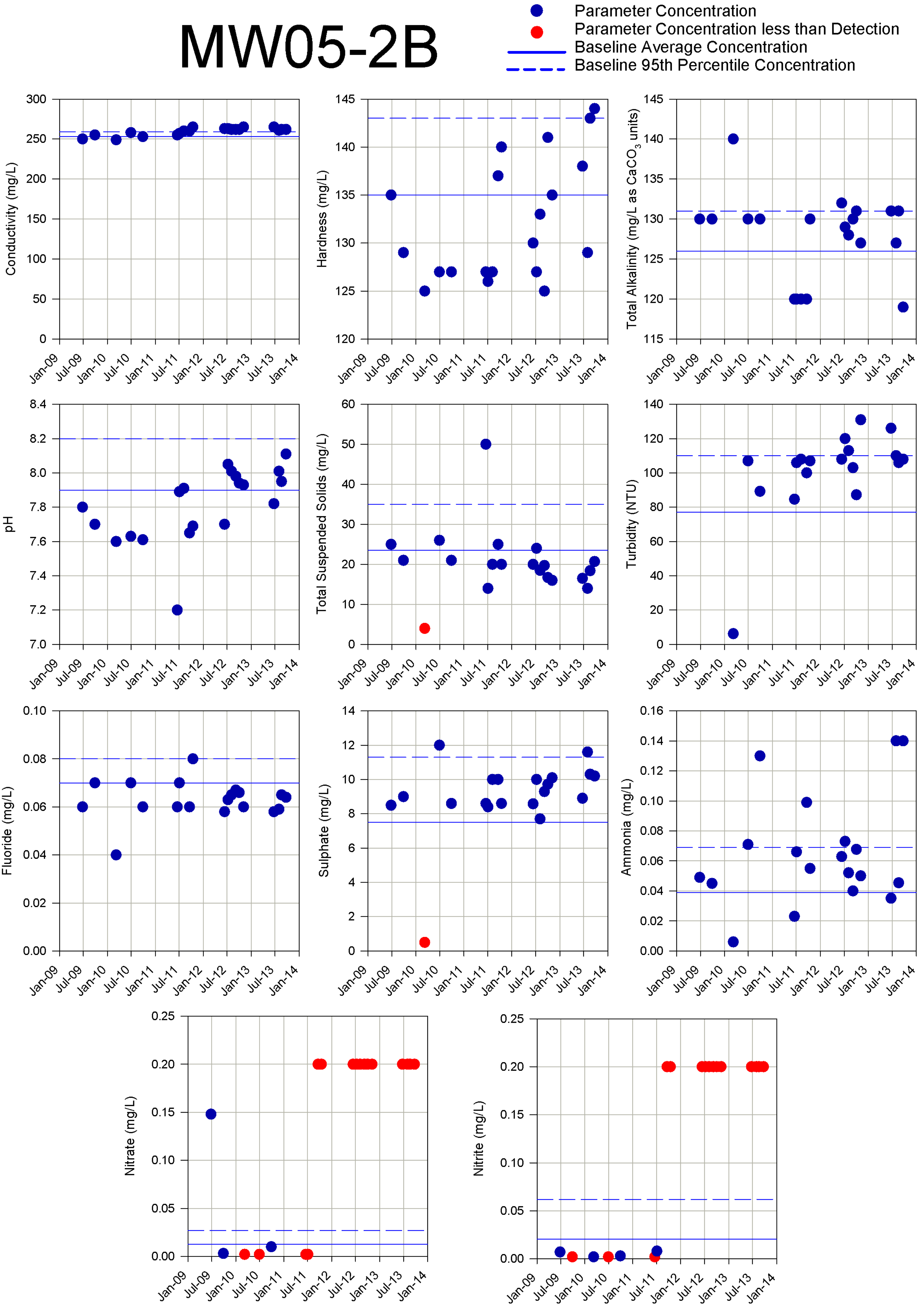

Parameter Concentration
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
0
100
200
300
400
500
Hardness (mg/L)
190
200
210
220
230
240
Total Alkalinity (mg/L as $CaCO_3$ units)
160
165
170
175
180
185
190
195
pH
7.9
8.0
8.1
8.2
8.3
8.4
Total Suspended Solids (mg/L)
0
1
2
3
4
5
6
Turbidity (NTU)
0
2
4
6
8
10
12
14
16
Fluoride (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
Sulphate (mg/L)
0
10
20
30
40
Ammonia (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
Nitrate (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Nitrite (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

MW05-2B

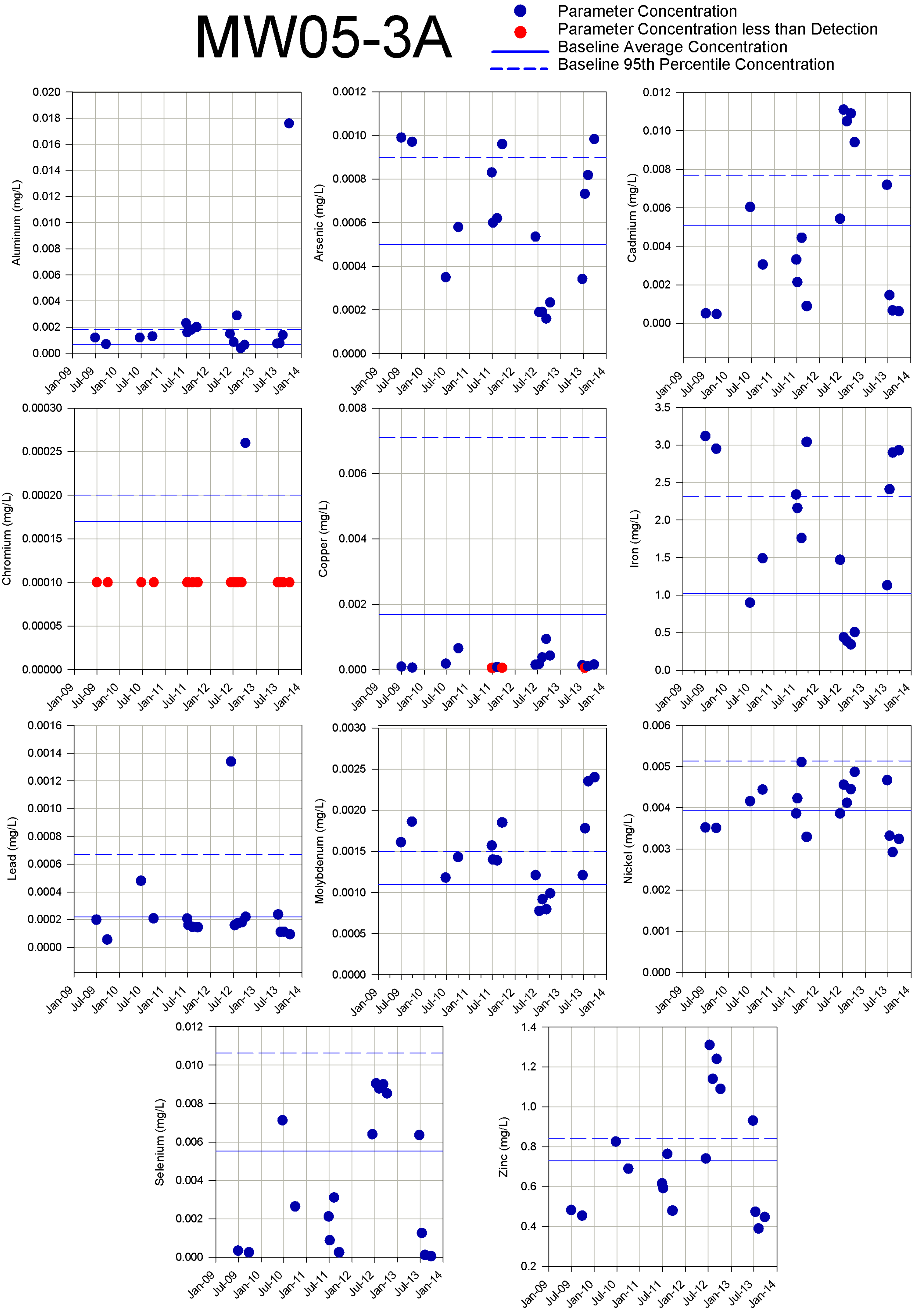
● Parameter Concentration
● Parameter Concentration less than Detection
— Baseline Average Concentration
– – Baseline 95th Percentile Concentration



MW05-2B


● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
0
50
100
150
200
250
300
Hardness (mg/L)
120
125
130
135
140
145
Total Alkalinity (mg/L as $CaCO_3$ units)
115
120
125
130
135
140
145
pH
7.0
7.2
7.4
7.6
7.8
8.0
8.2
8.4
Total Suspended Solids (mg/L)
0
10
20
30
40
50
60
Turbidity (NTU)
0
20
40
60
80
100
120
140
Fluoride (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
Sulphate (mg/L)
0
2
4
6
8
10
12
14
Ammonia (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
Nitrate (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
Nitrite (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

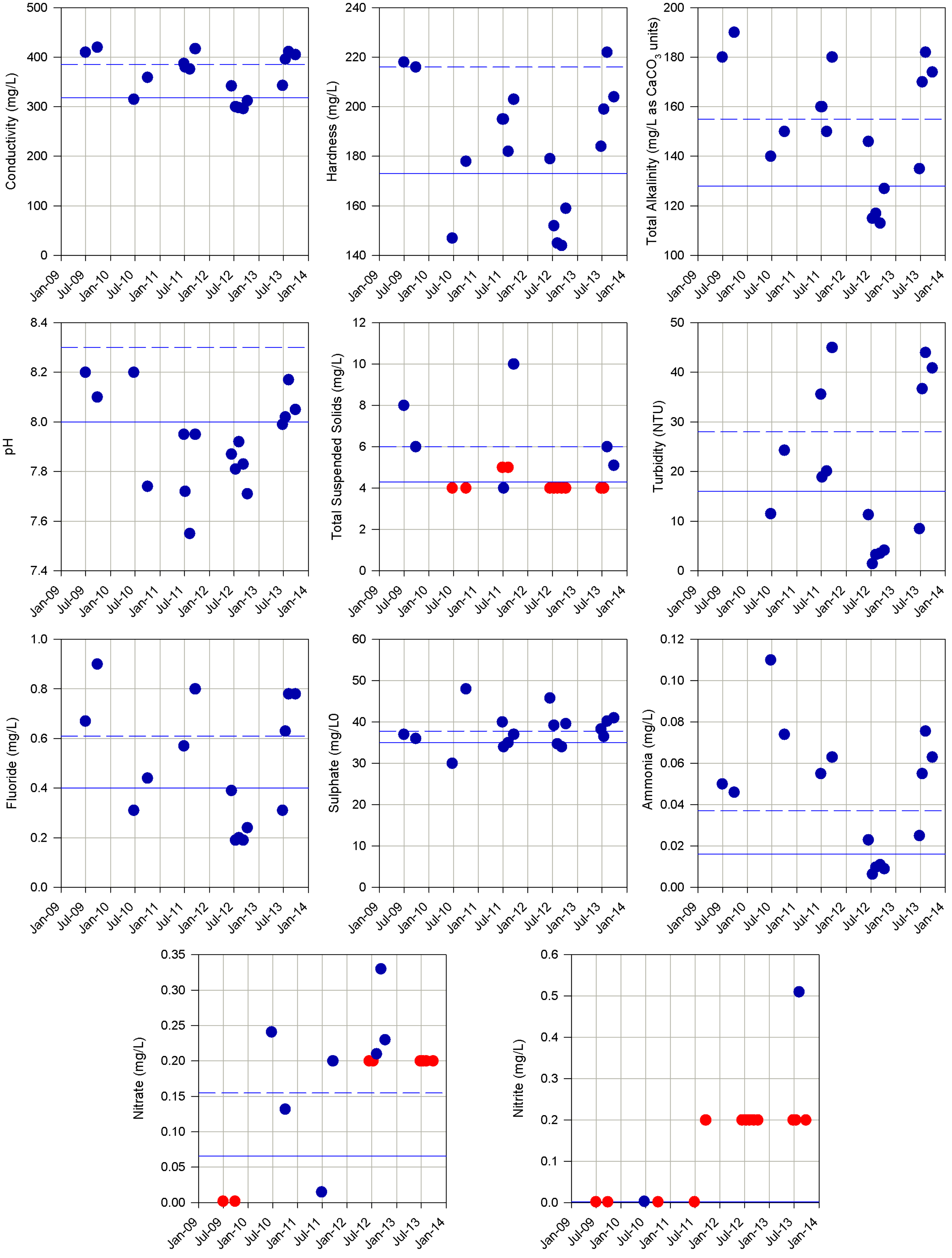
MW05-3A



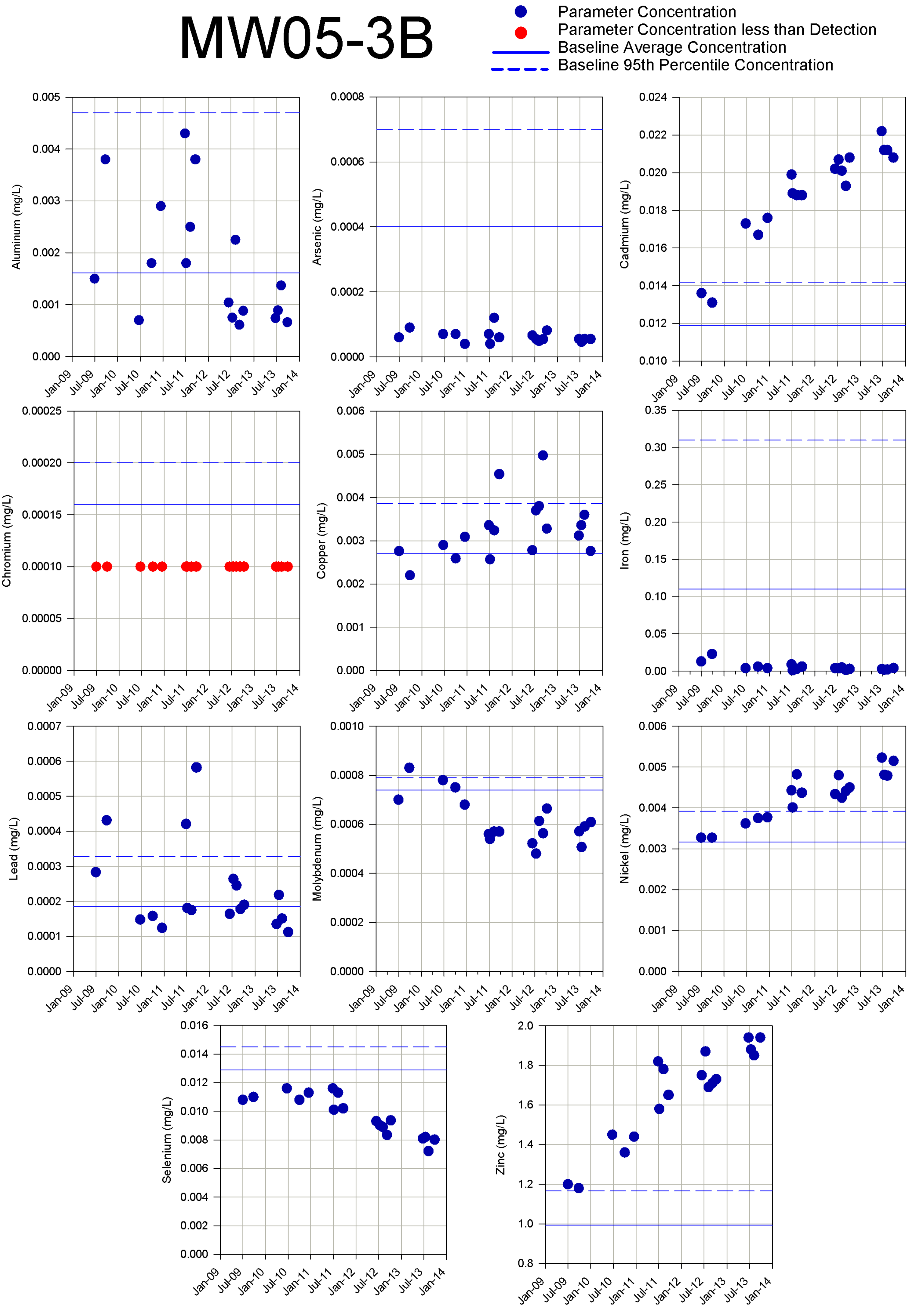
● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0.014
0.016
0.018
0.020
Arsenic (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
Cadmium (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
Chromium (mg/L)
0.00000
0.00005
0.00010
0.00015
0.00020
0.00025
0.00030
Copper (mg/L)
0.000
0.002
0.004
0.006
0.008
Iron (mg/L)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
Lead (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
0.0016
Molybdenum (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
0.0030
Nickel (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
0.006
Selenium (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
Zinc (mg/L)
0.2
0.4
0.6
0.8
1.0
1.2
1.4
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

MW05-3A

● Parameter Concentration
● Parameter Concentration less than Detection
— Baseline Average Concentration
– – Baseline 95th Percentile Concentration

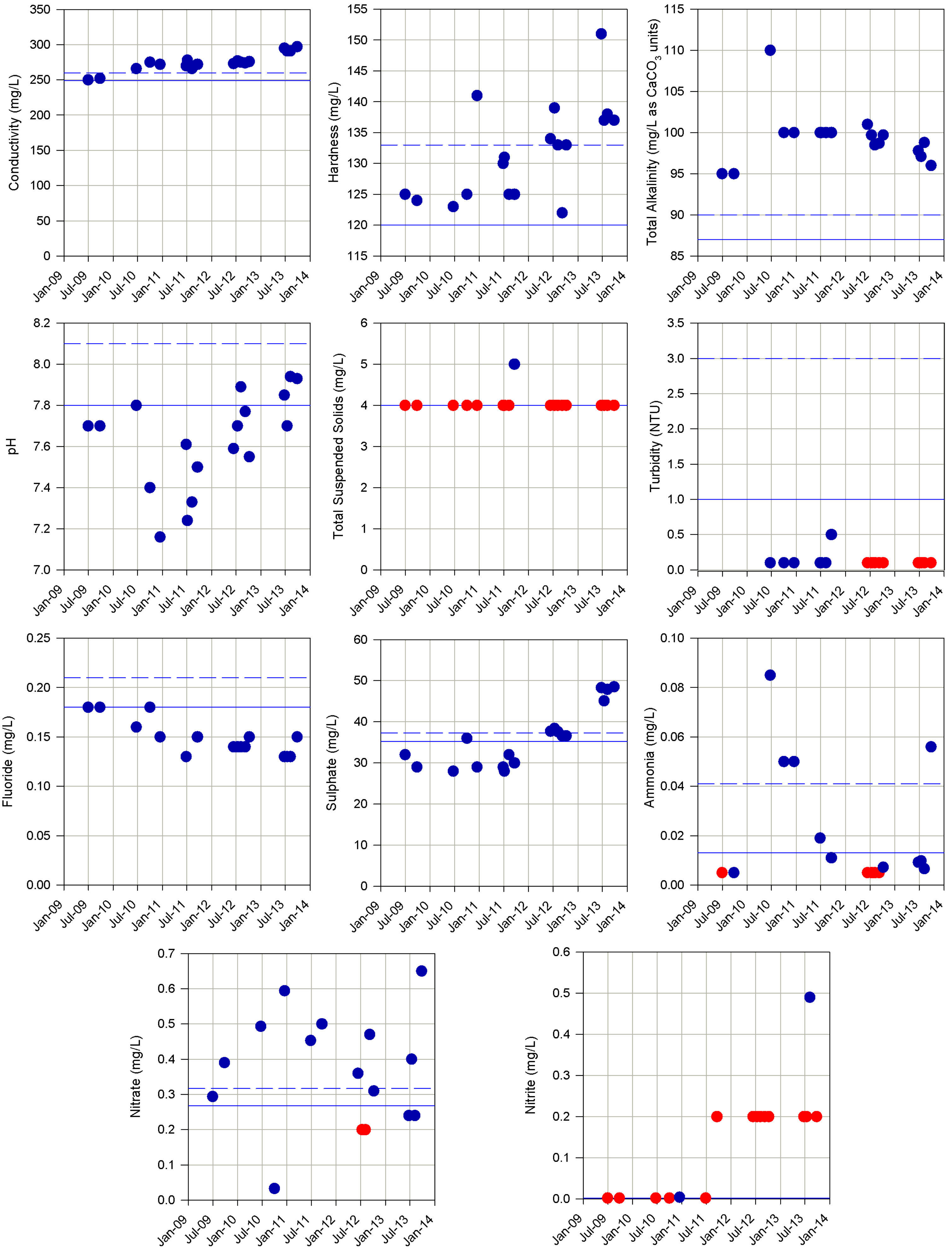


MW05-3B

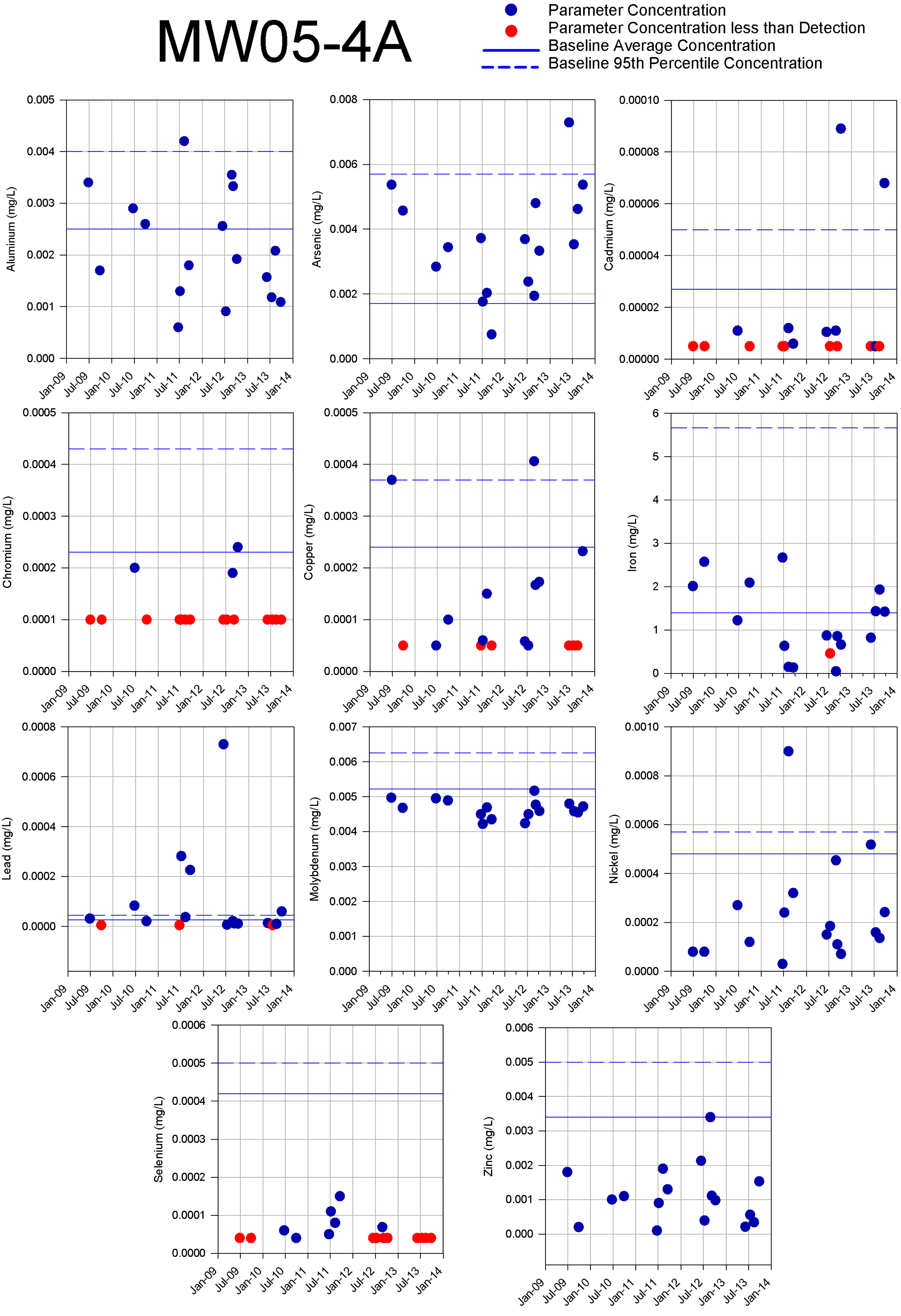


● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
Arsenic (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
Cadmium (mg/L)
0.010
0.012
0.014
0.016
0.018
0.020
0.022
0.024
Chromium (mg/L)
0.00000
0.00005
0.00010
0.00015
0.00020
0.00025
Copper (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
0.006
Iron (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
Lead (mg/L)
0.0000
0.0001
0.0002
0.0003
0.0004
0.0005
0.0006
0.0007
Molybdenum (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
Nickel (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
0.006
Selenium (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0.014
0.016
Zinc (mg/L)
0.8
1.0
1.2
1.4
1.6
1.8
2.0
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

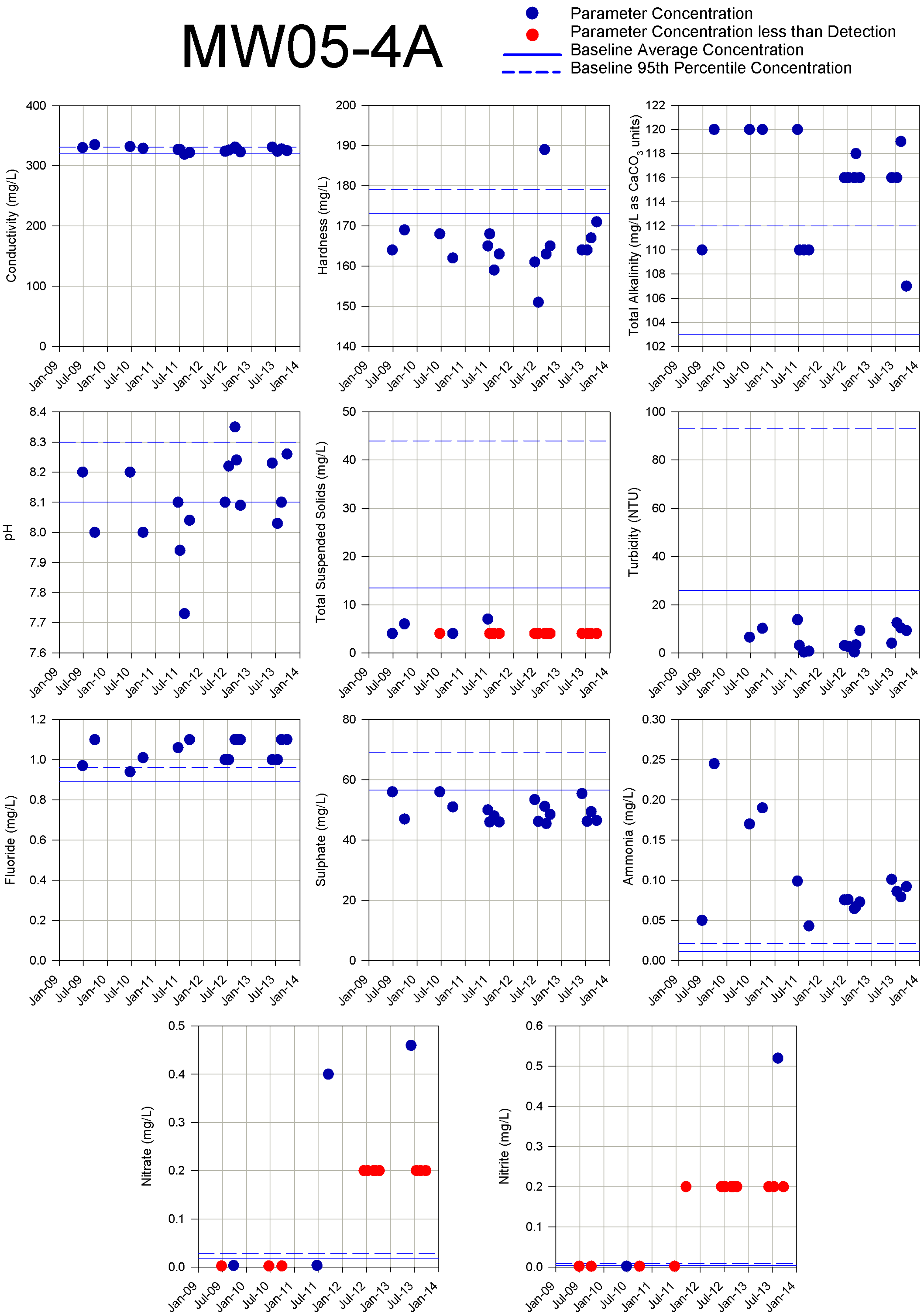
MW05-3B


● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
0
50
100
150
200
250
300
350
Hardness (mg/L)
115
120
125
130
135
140
145
150
155
Total Alkalinity (mg/L as $CaCO_3$ units)
85
90
95
100
105
110
115
pH
7.0
7.2
7.4
7.6
7.8
8.0
8.2
Total Suspended Solids (mg/L)
0
1
2
3
4
5
6
Turbidity (NTU)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
Fluoride (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
Sulphate (mg/L)
0
10
20
30
40
50
60
Ammonia (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
Nitrate (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Nitrite (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

MW05-4A


● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
Arsenic (mg/L)
0.000
0.002
0.004
0.006
0.008
Cadmium (mg/L)
0.00000
0.00002
0.00004
0.00006
0.00008
0.00010
Chromium (mg/L)
0.0000
0.0001
0.0002
0.0003
0.0004
0.0005
Copper (mg/L)
0.0000
0.0001
0.0002
0.0003
0.0004
0.0005
Iron (mg/L)
0
1
2
3
4
5
6
Lead (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
Molybdenum (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
0.006
0.007
Nickel (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
Selenium (mg/L)
0.0000
0.0001
0.0002
0.0003
0.0004
0.0005
0.0006
Zinc (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
0.006
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

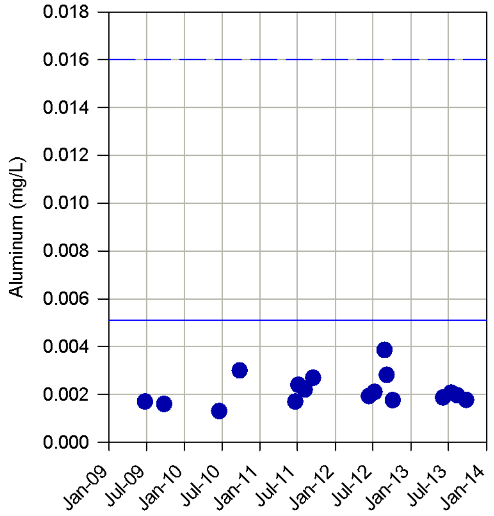
MW05-4A

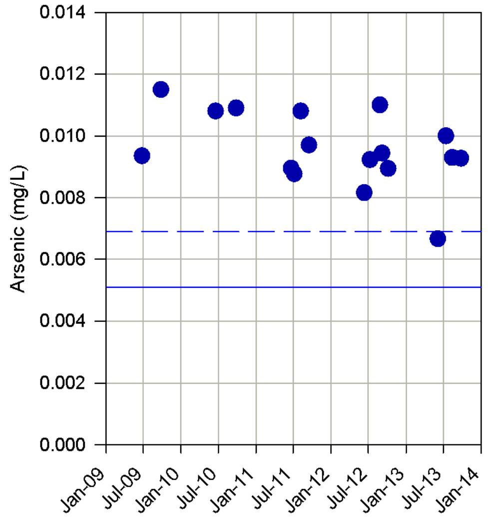


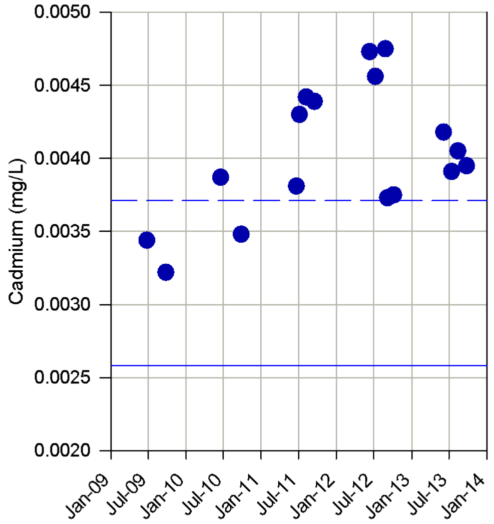
● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
0
100
200
300
400
Hardness (mg/L)
140
150
160
170
180
190
200
Total Alkalinity (mg/L as $CaCO_3$ units)
102
104
106
108
110
112
114
116
118
120
122
pH
7.6
7.7
7.8
7.9
8.0
8.1
8.2
8.3
8.4
Total Suspended Solids (mg/L)
0
10
20
30
40
50
Turbidity (NTU)
0
20
40
60
80
100
Fluoride (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Sulphate (mg/L)
0
20
40
60
80
Ammonia (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
Nitrate (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
Nitrite (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

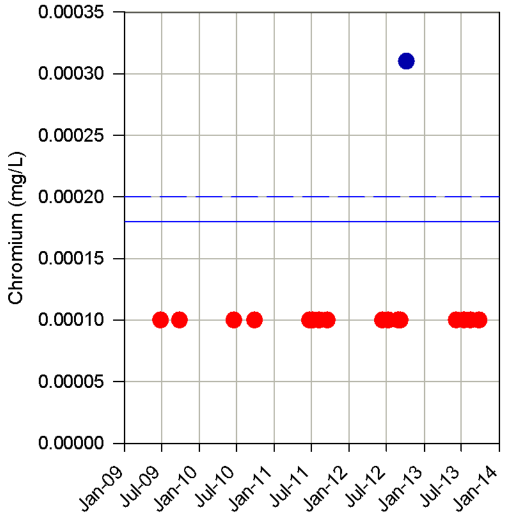
MW05-4B

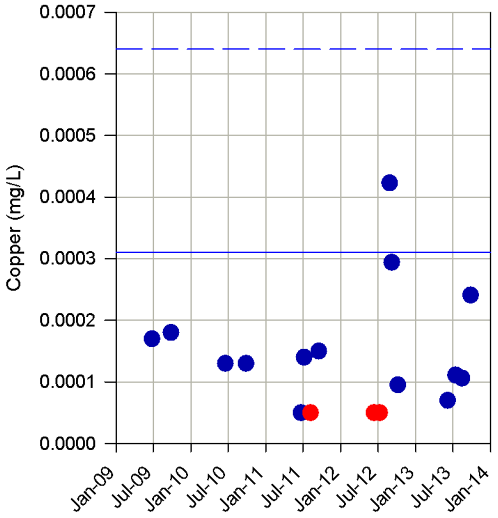
● Parameter Concentration
● Parameter Concentration less than Detection
— Baseline Average Concentration
– – Baseline 95th Percentile Concentration

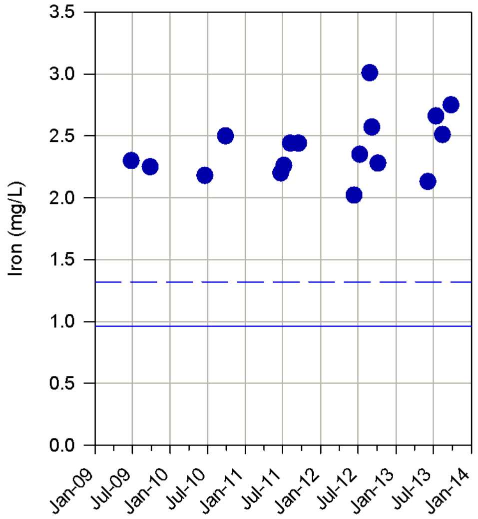


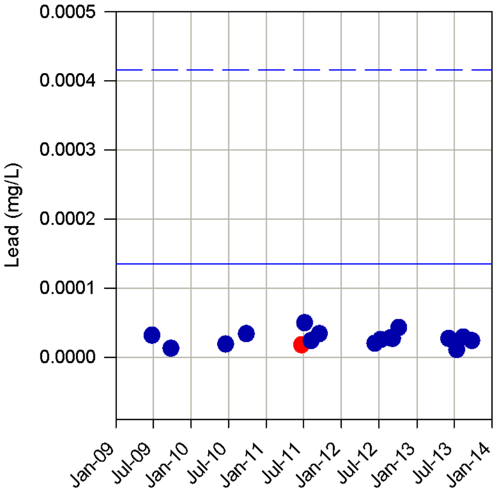


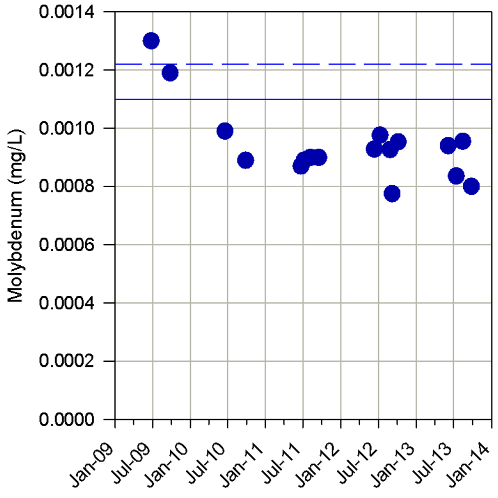


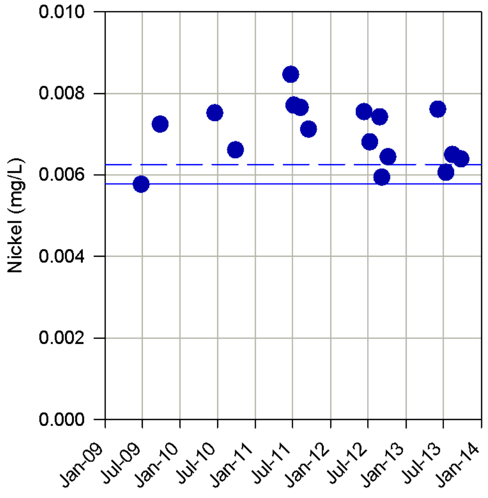


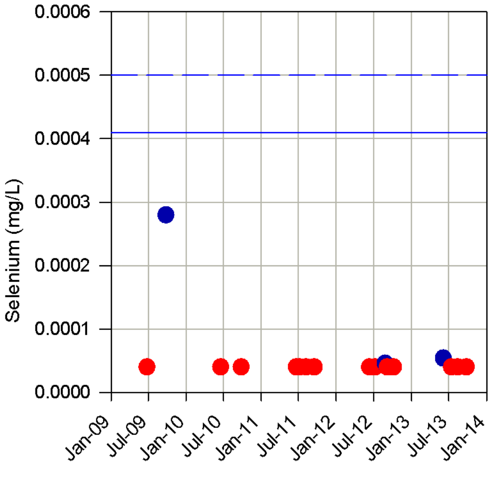


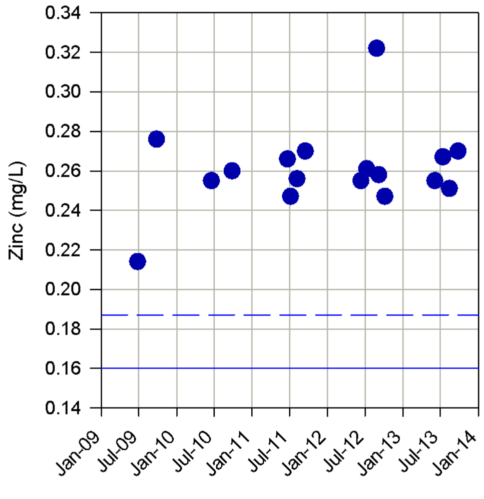




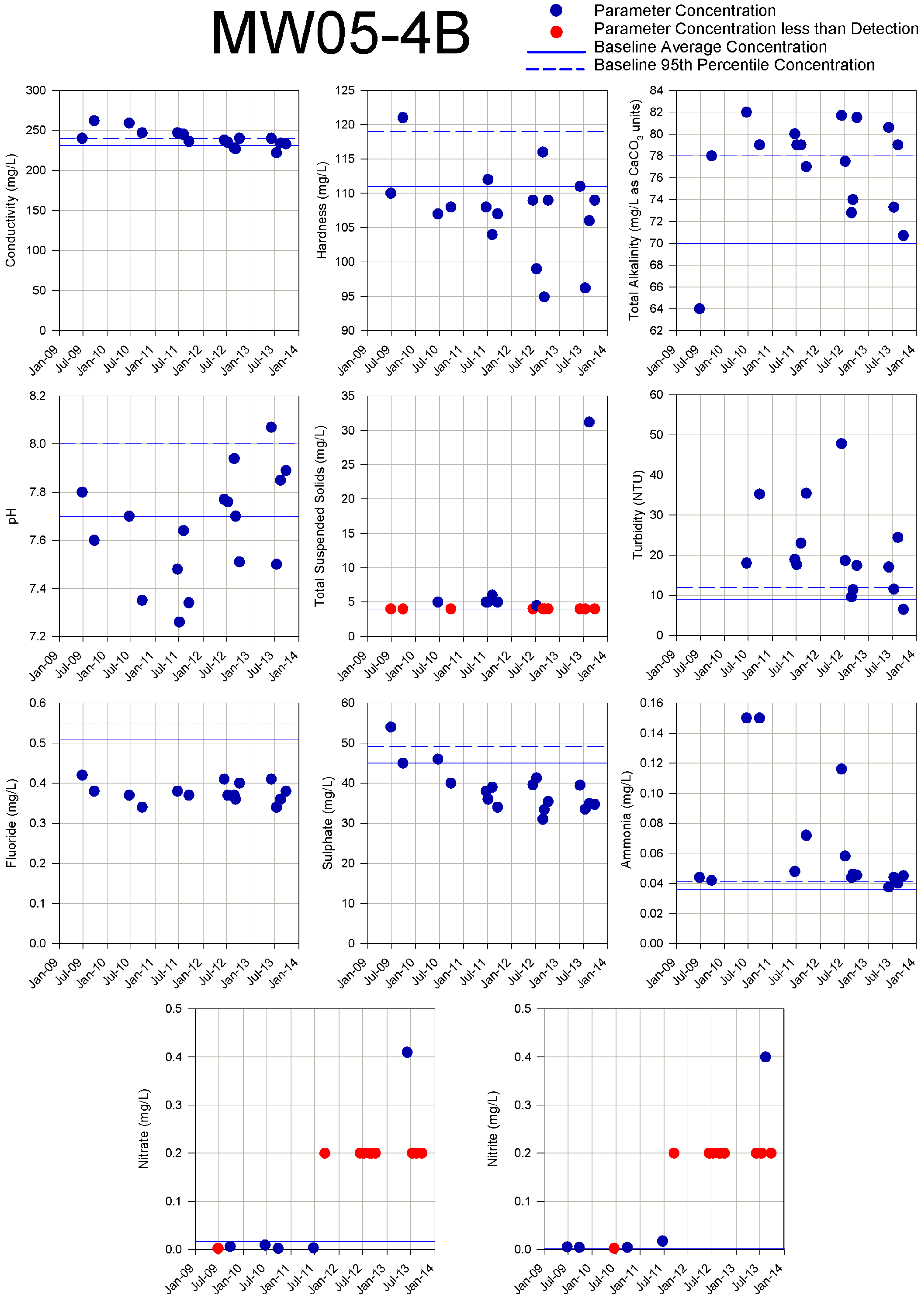








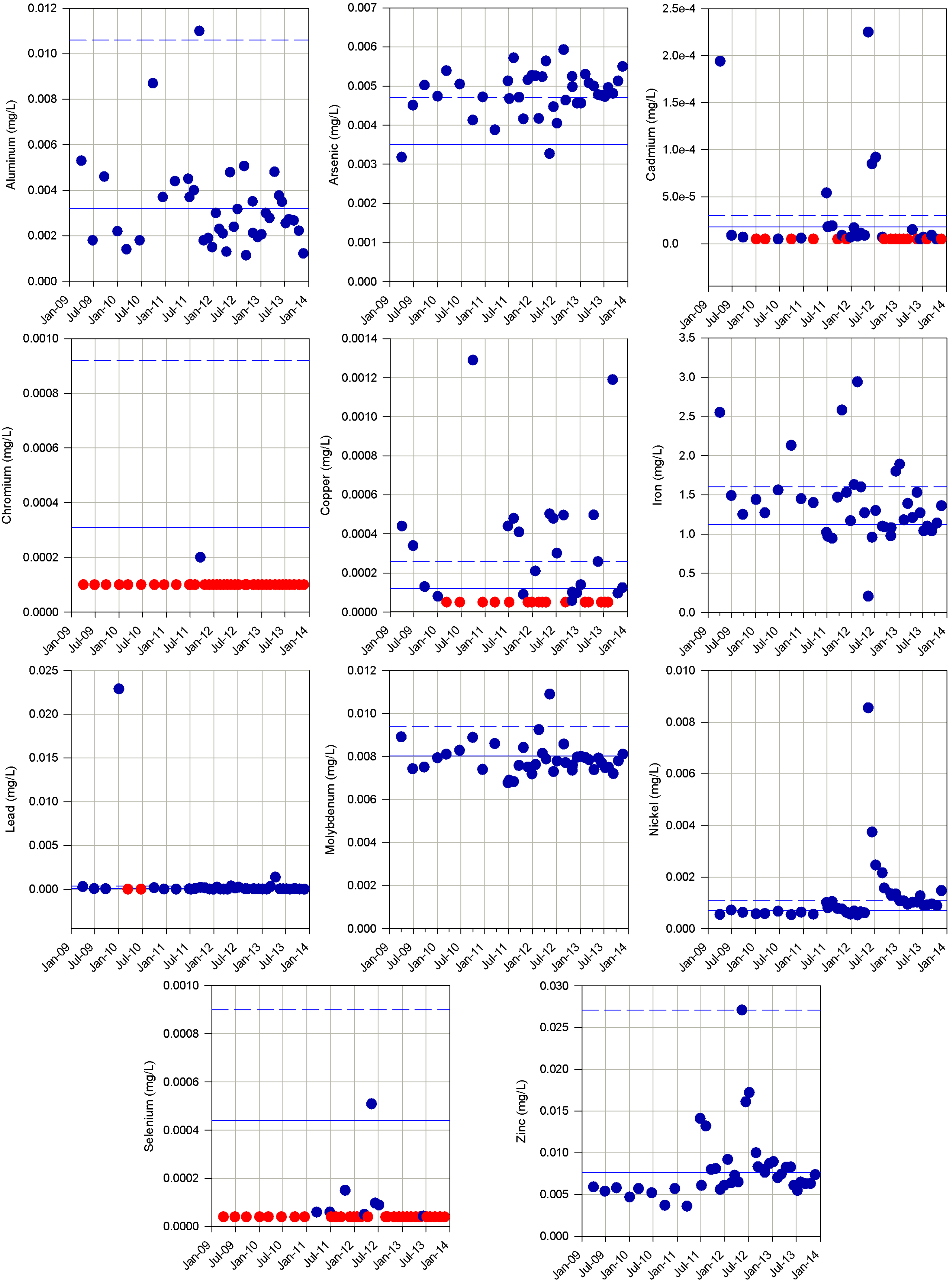
MW05-4B



● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
0
50
100
150
200
250
300
Hardness (mg/L)
90
95
100
105
110
115
120
125
Total Alkalinity (mg/L as $CaCO_3$ units)
62
64
66
68
70
72
74
76
78
80
82
84
pH
7.2
7.4
7.6
7.8
8.0
8.2
Total Suspended Solids (mg/L)
0
5
10
15
20
25
30
35
Turbidity (NTU)
0
10
20
30
40
50
60
Fluoride (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Sulphate (mg/L)
0
10
20
30
40
50
60
Ammonia (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
Nitrate (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
Nitrite (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

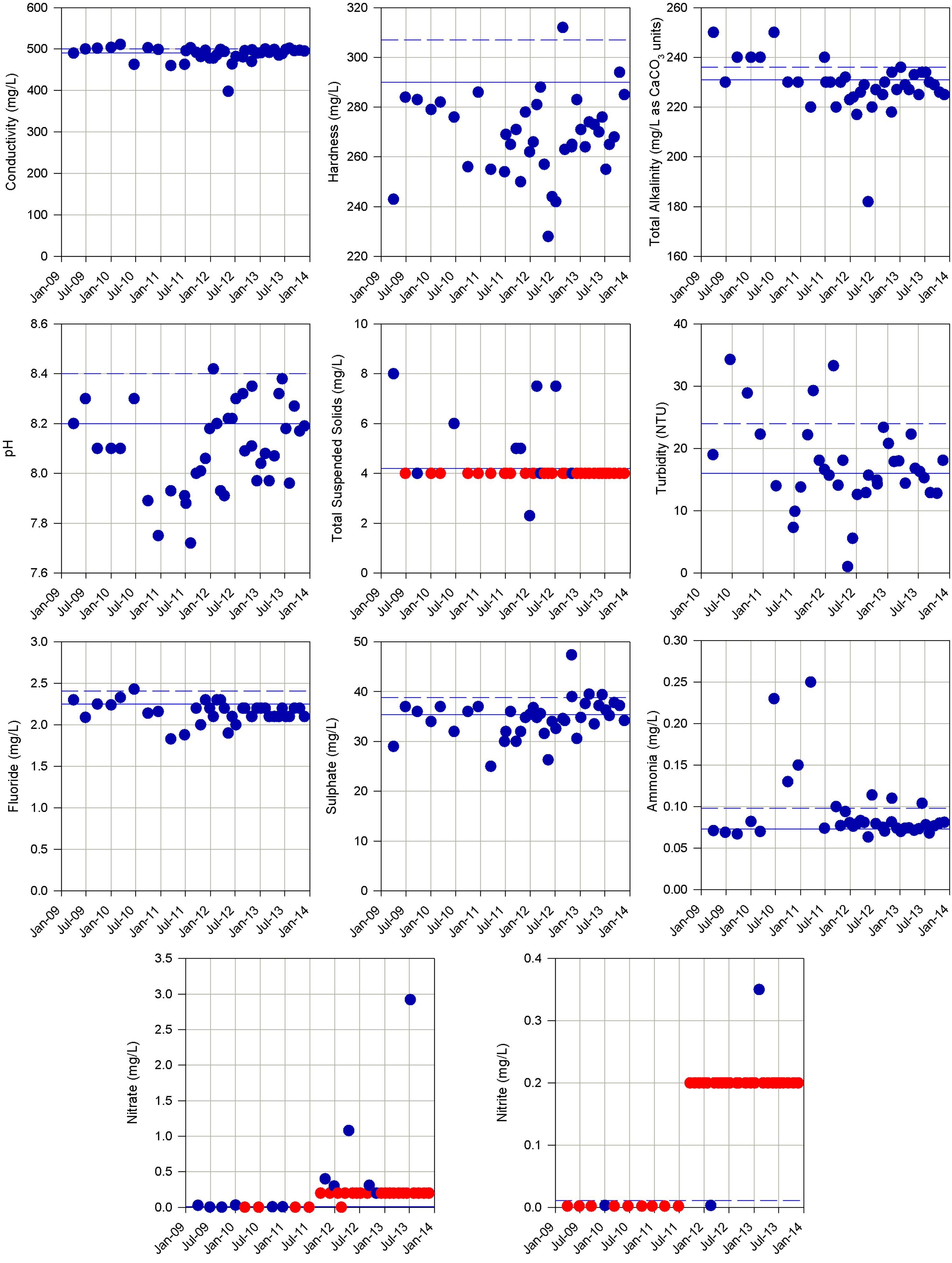
MW05-5A

● Parameter Concentration
● Parameter Concentration less than Detection
— Baseline Average Concentration
- - Baseline 95th Percentile Concentration

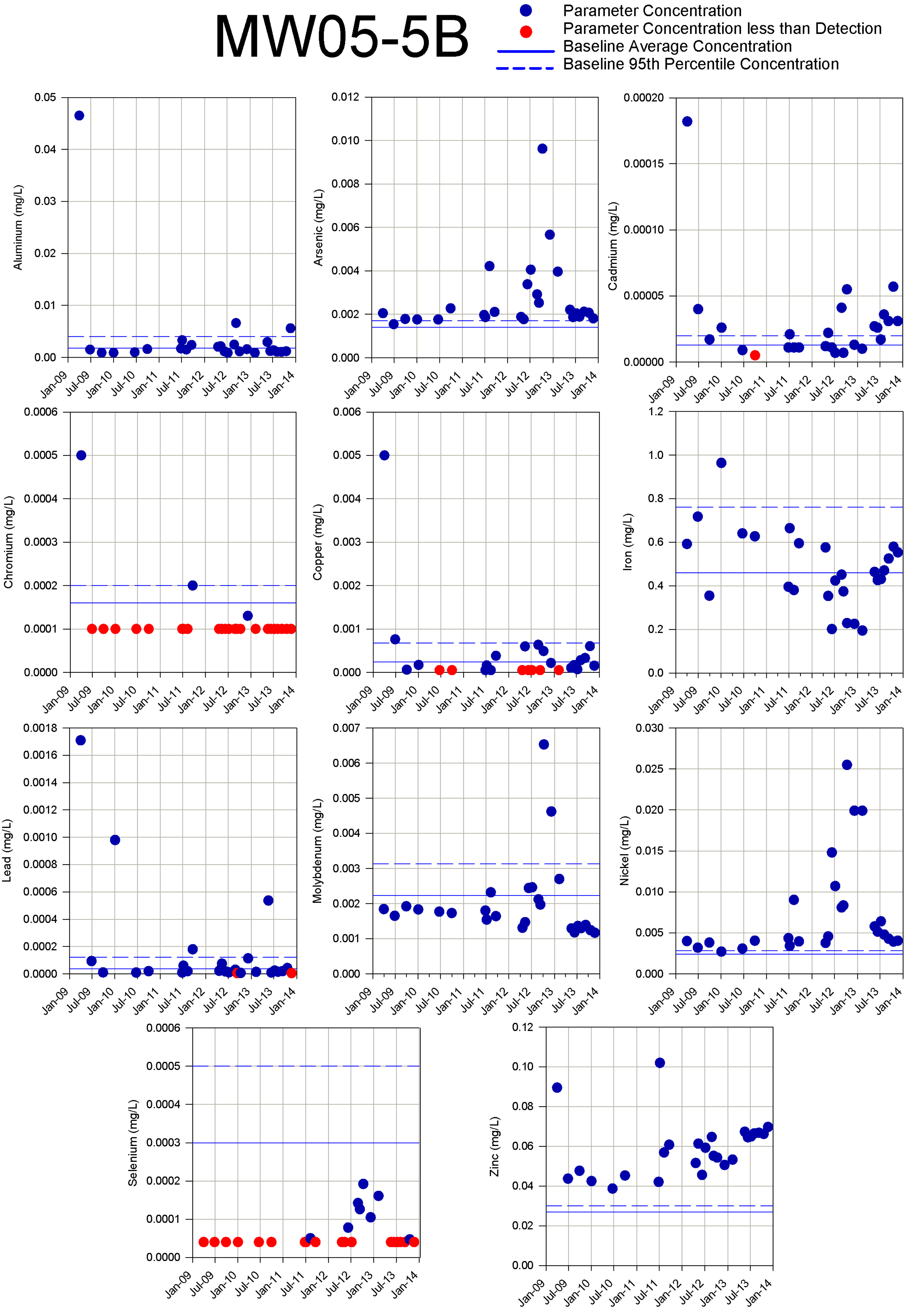


MW05-5A

● Parameter Concentration
● Parameter Concentration less than Detection
— Baseline Average Concentration
– – Baseline 95th Percentile Concentration

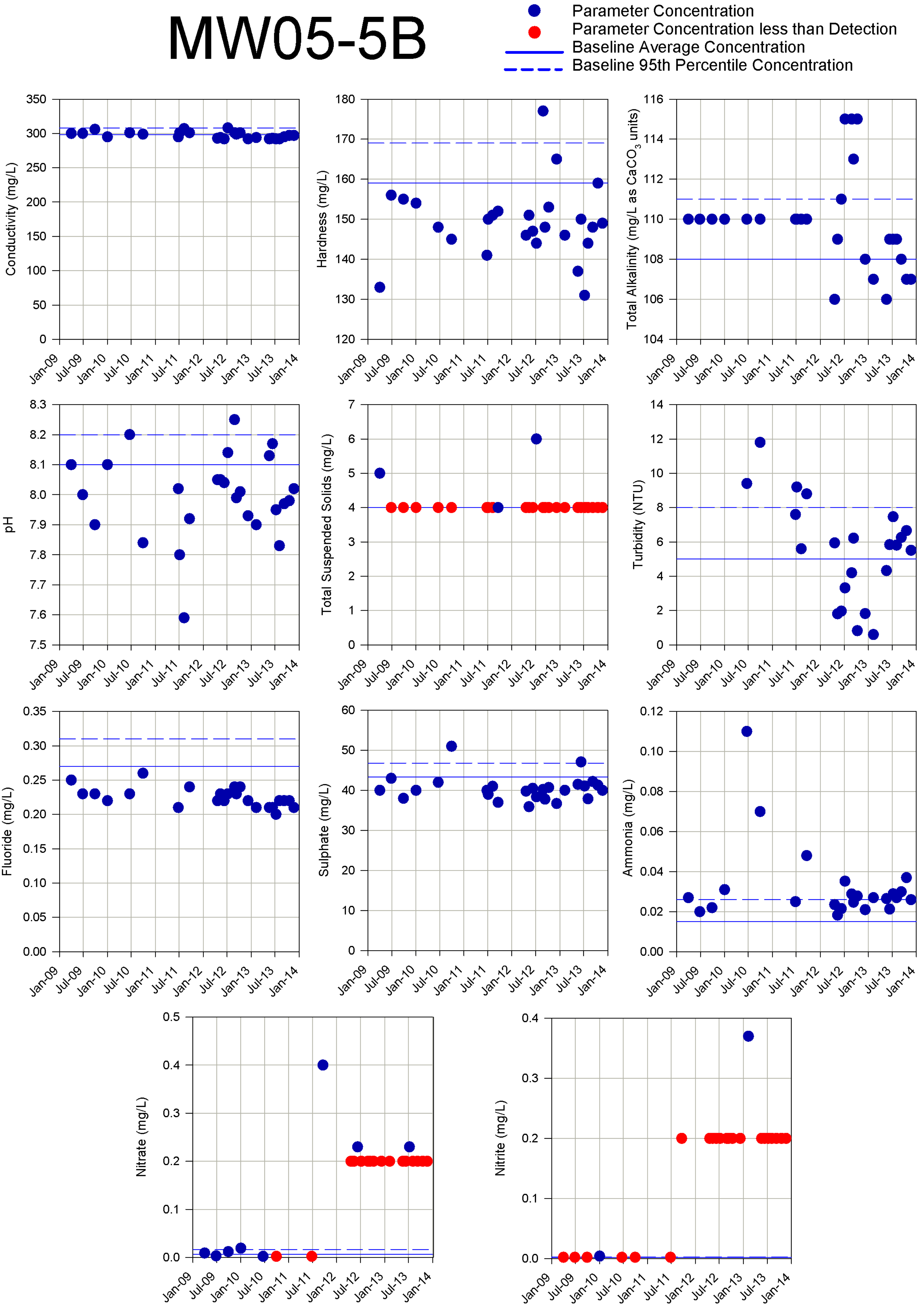


MW05-5B

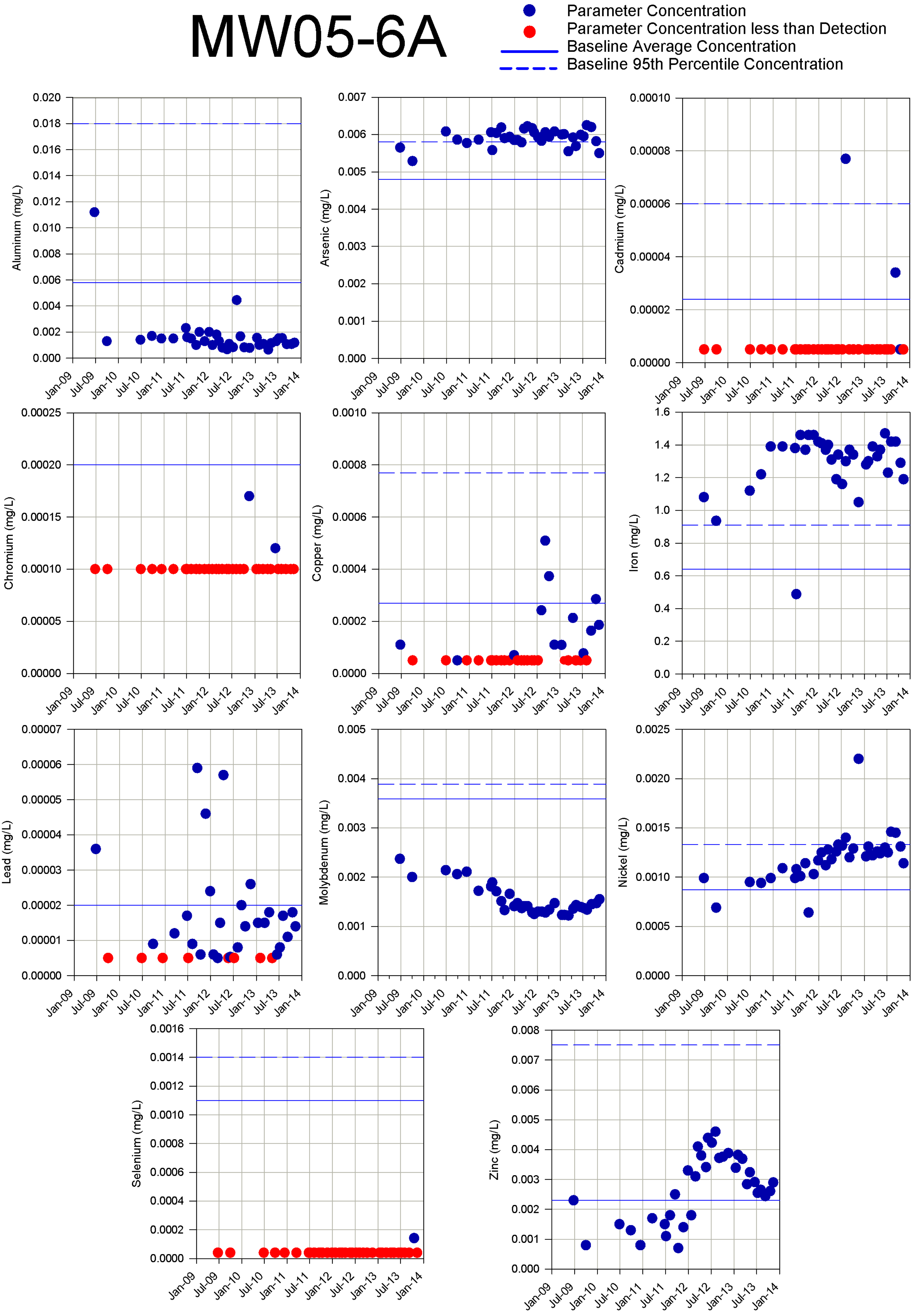


● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.00
0.01
0.02
0.03
0.04
0.05
Arsenic (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
Cadmium (mg/L)
0.00000
0.00005
0.00010
0.00015
0.00020
Chromium (mg/L)
0.0000
0.0001
0.0002
0.0003
0.0004
0.0005
0.0006
Copper (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
0.006
Iron (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Lead (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
0.0016
0.0018
Molybdenum (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
0.006
0.007
Nickel (mg/L)
0.000
0.005
0.010
0.015
0.020
0.025
0.030
Selenium (mg/L)
0.0000
0.0001
0.0002
0.0003
0.0004
0.0005
0.0006
Zinc (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
0.12
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

MW05-5B

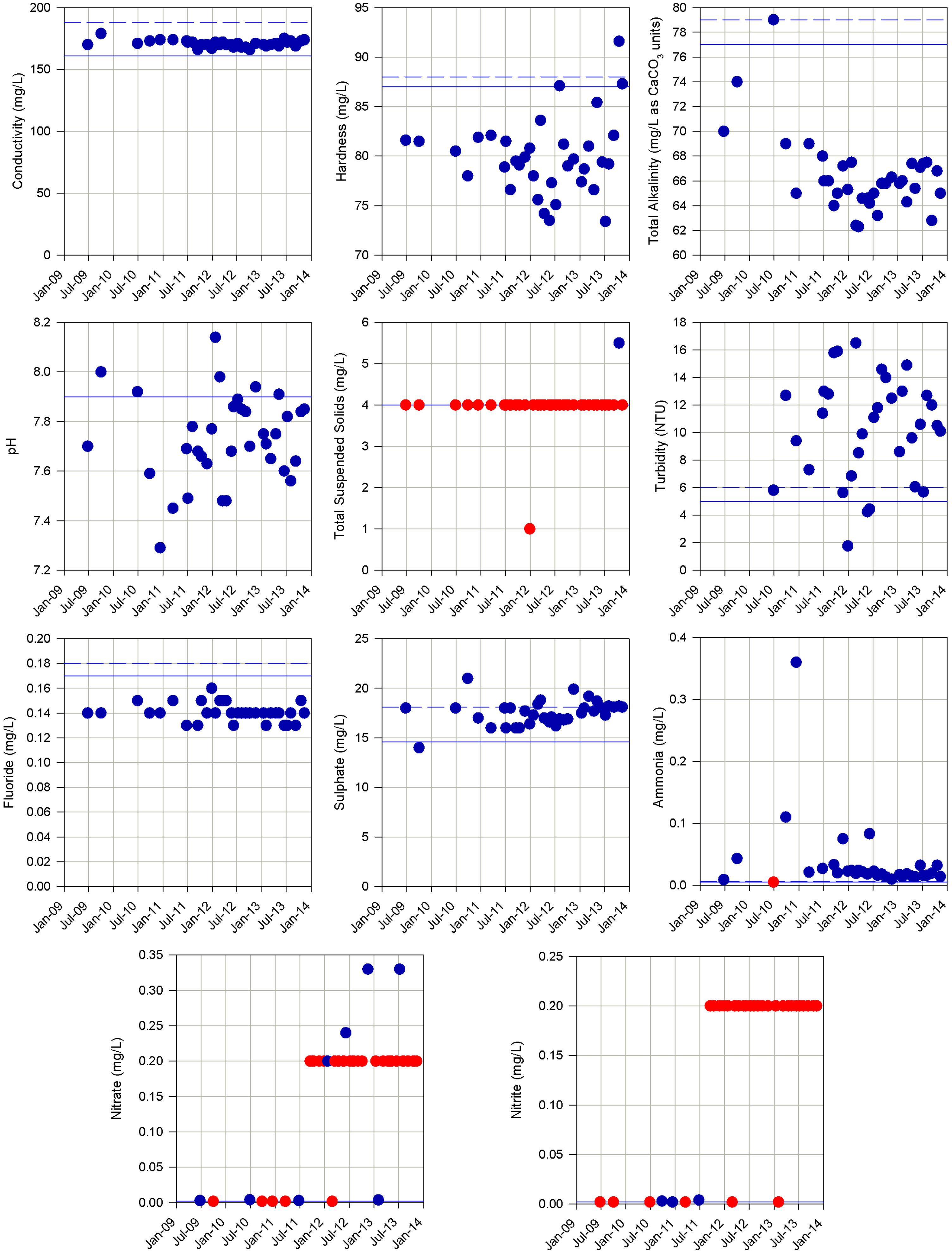

Parameter Concentration
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
0
50
100
150
200
250
300
350
Hardness (mg/L)
120
130
140
150
160
170
180
Total Alkalinity (mg/L as CaCO3 units)
104
106
108
110
112
114
116
pH
7.5
7.6
7.7
7.8
7.9
8.0
8.1
8.2
8.3
Total Suspended Solids (mg/L)
0
1
2
3
4
5
6
7
Turbidity (NTU)
0
2
4
6
8
10
12
14
Fluoride (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
Sulphate (mg/L)
0
10
20
30
40
50
60
Ammonia (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
0.12
Nitrate (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
Nitrite (mg/L)
0.0
0.1
0.2
0.3
0.4
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

MW05-6A

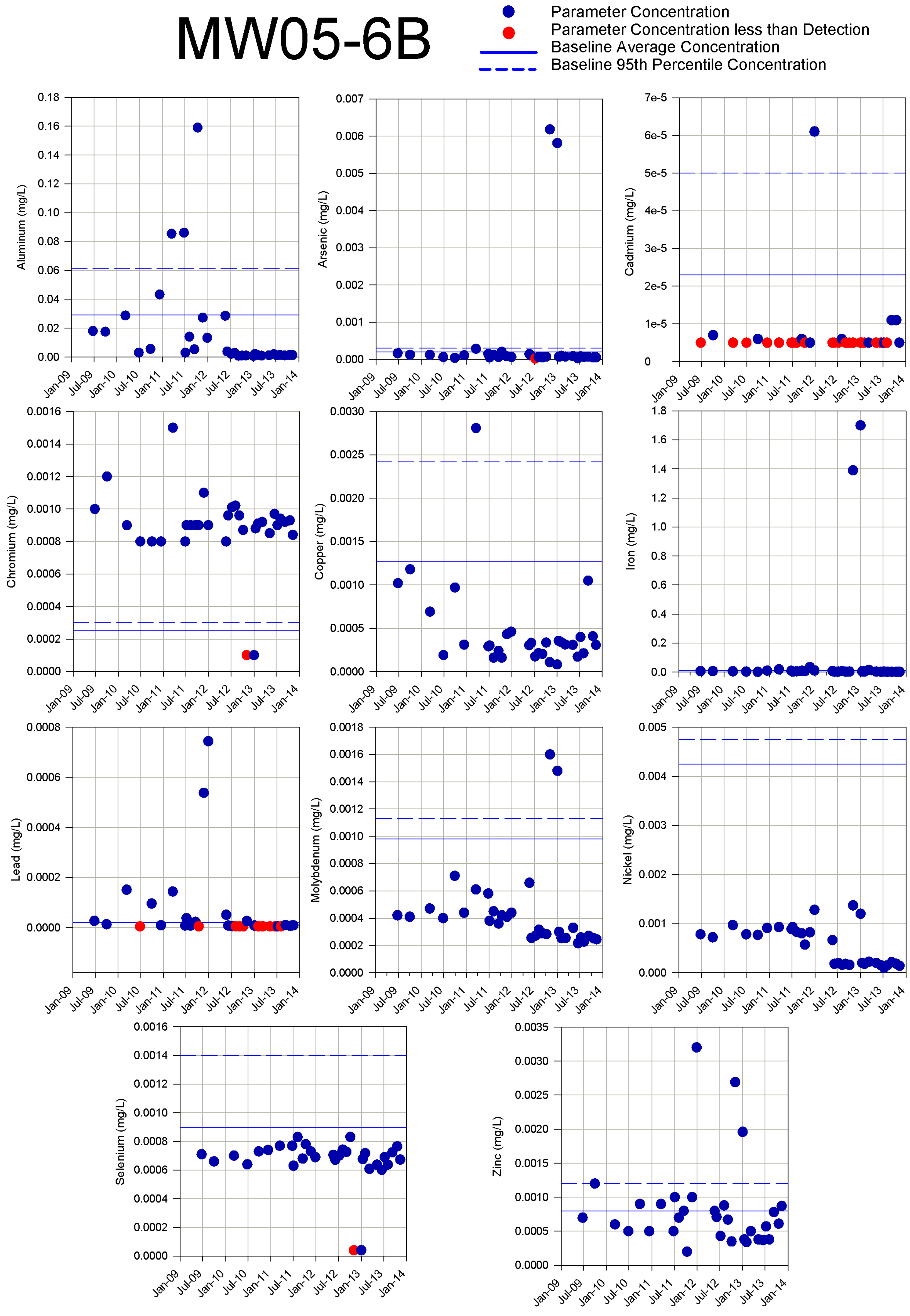

● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0.014
0.016
0.018
0.020
Arsenic (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
0.006
0.007
Cadmium (mg/L)
0.00000
0.00002
0.00004
0.00006
0.00008
0.00010
Chromium (mg/L)
0.00000
0.00005
0.00010
0.00015
0.00020
0.00025
Copper (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
Iron (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
Lead (mg/L)
0.00000
0.00001
0.00002
0.00003
0.00004
0.00005
0.00006
0.00007
Molybdenum (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
Nickel (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
Selenium (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
0.0016
Zinc (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
0.006
0.007
0.008
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

MW05-6A

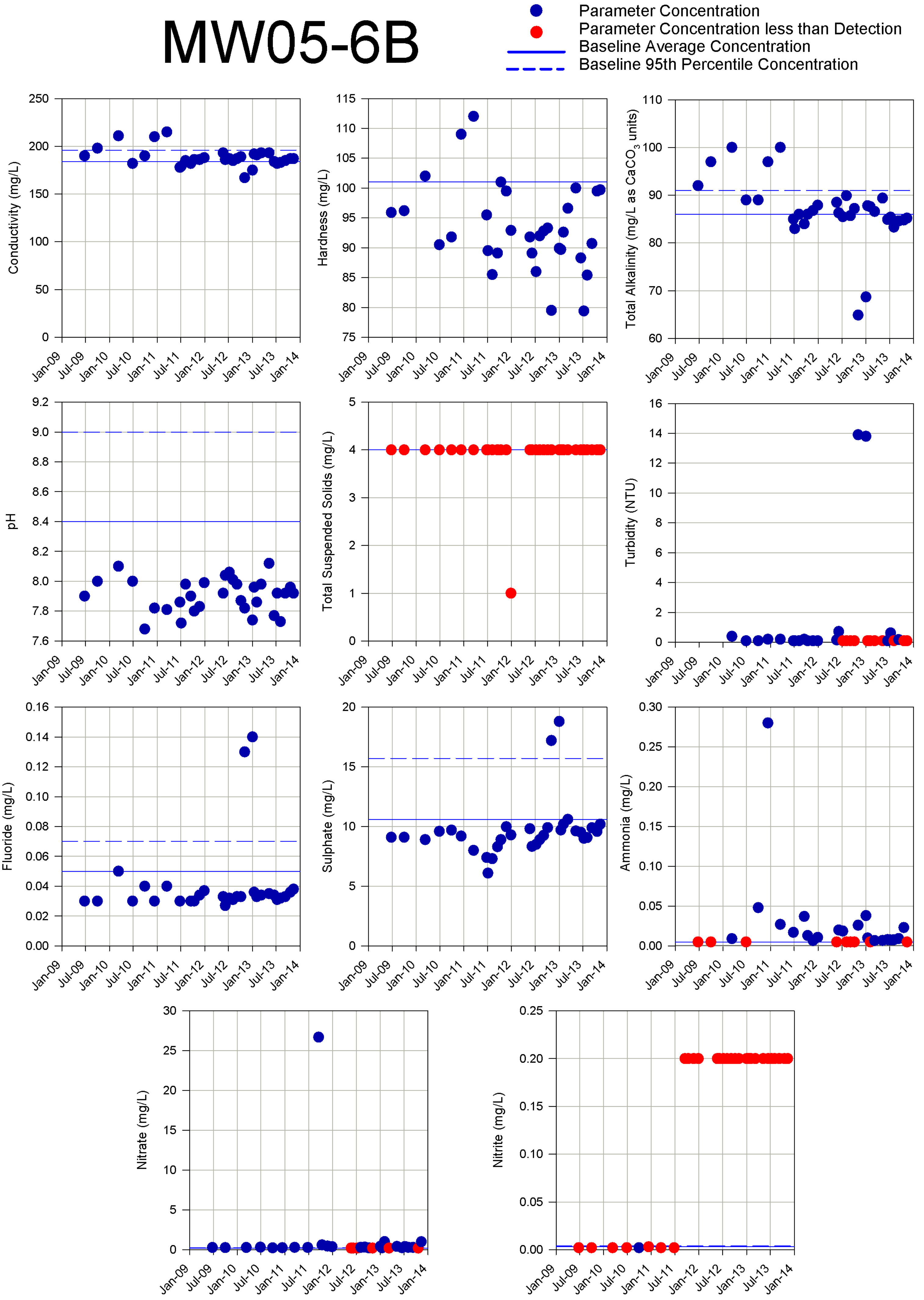
● Parameter Concentration
● Parameter Concentration less than Detection
— Baseline Average Concentration
– – Baseline 95th Percentile Concentration



MW05-6B

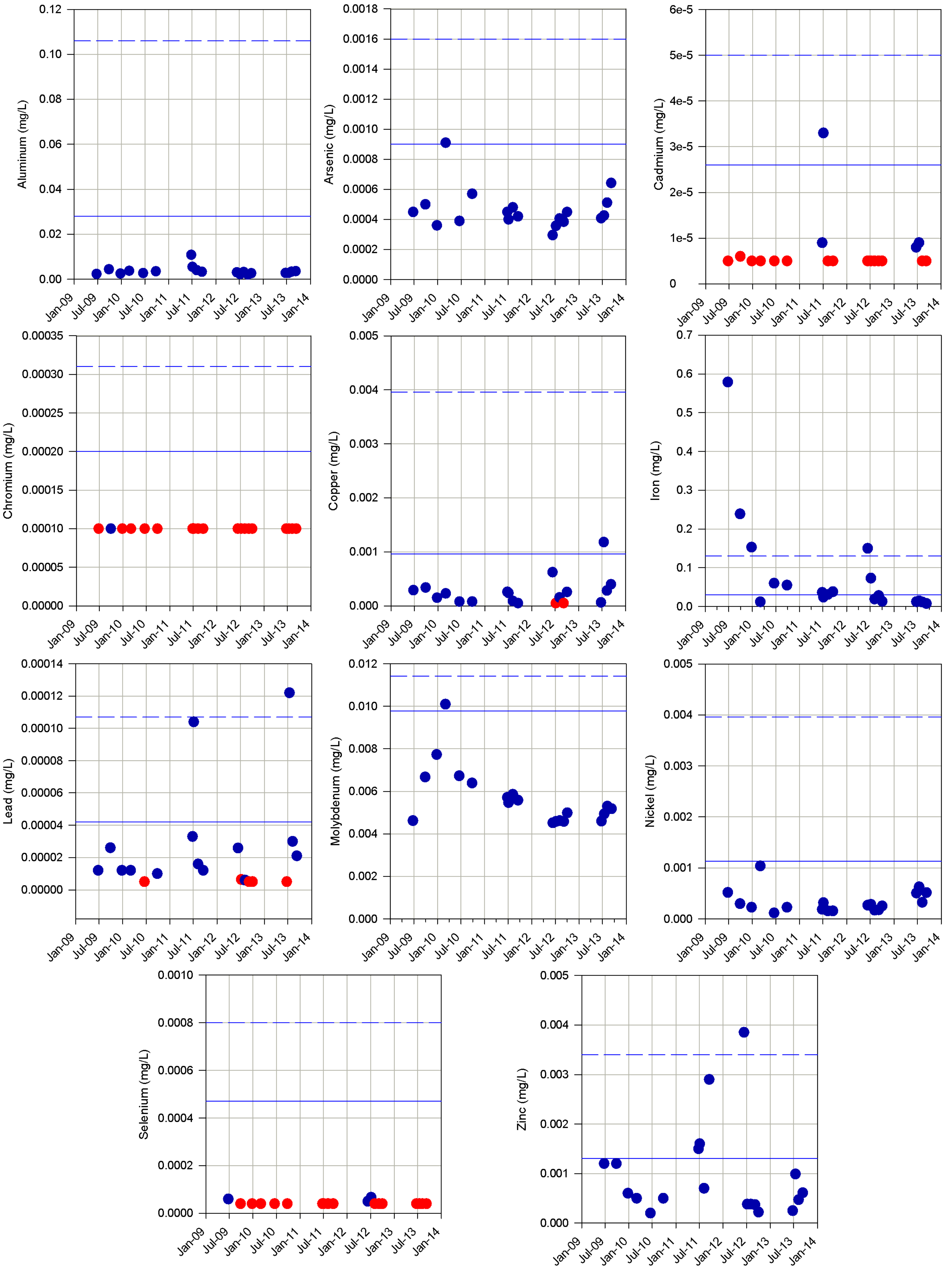

● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.00 0.02 0.04 0.06 0.08 0.10 0.12 0.14 0.16 0.18
Arsenic (mg/L)
0.000 0.001 0.002 0.003 0.004 0.005 0.006 0.007
Cadmium (mg/L)
0 1e-5 2e-5 3e-5 4e-5 5e-5 6e-5 7e-5
Chromium (mg/L)
0.0000 0.0002 0.0004 0.0006 0.0008 0.0010 0.0012 0.0014 0.0016
Copper (mg/L)
0.0000 0.0005 0.0010 0.0015 0.0020 0.0025 0.0030
Iron (mg/L)
0.0 0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8
Lead (mg/L)
0.0000 0.0002 0.0004 0.0006 0.0008
Molybdenum (mg/L)
0.0000 0.0002 0.0004 0.0006 0.0008 0.0010 0.0012 0.0014 0.0016 0.0018
Nickel (mg/L)
0.000 0.001 0.002 0.003 0.004 0.005
Selenium (mg/L)
0.0000 0.0002 0.0004 0.0006 0.0008 0.0010 0.0012 0.0014 0.0016
Zinc (mg/L)
0.0000 0.0005 0.0010 0.0015 0.0020 0.0025 0.0030 0.0035
Jan-09 Jul-09 Jan-10 Jul-10 Jan-11 Jul-11 Jan-12 Jul-12 Jan-13 Jul-13 Jan-14

MW05-6B


● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
0
50
100
150
200
250
Hardness (mg/L)
75
80
85
90
95
100
105
110
115
Total Alkalinity (mg/L as $CaCO_3$ units)
60
70
80
90
100
110
pH
7.6
7.8
8.0
8.2
8.4
8.6
8.8
9.0
9.2
Total Suspended Solids (mg/L)
0
1
2
3
4
5
Turbidity (NTU)
0
2
4
6
8
10
12
14
16
Fluoride (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
Sulphate (mg/L)
0
5
10
15
20
Ammonia (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
Nitrate (mg/L)
0
5
10
15
20
25
30
Nitrite (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

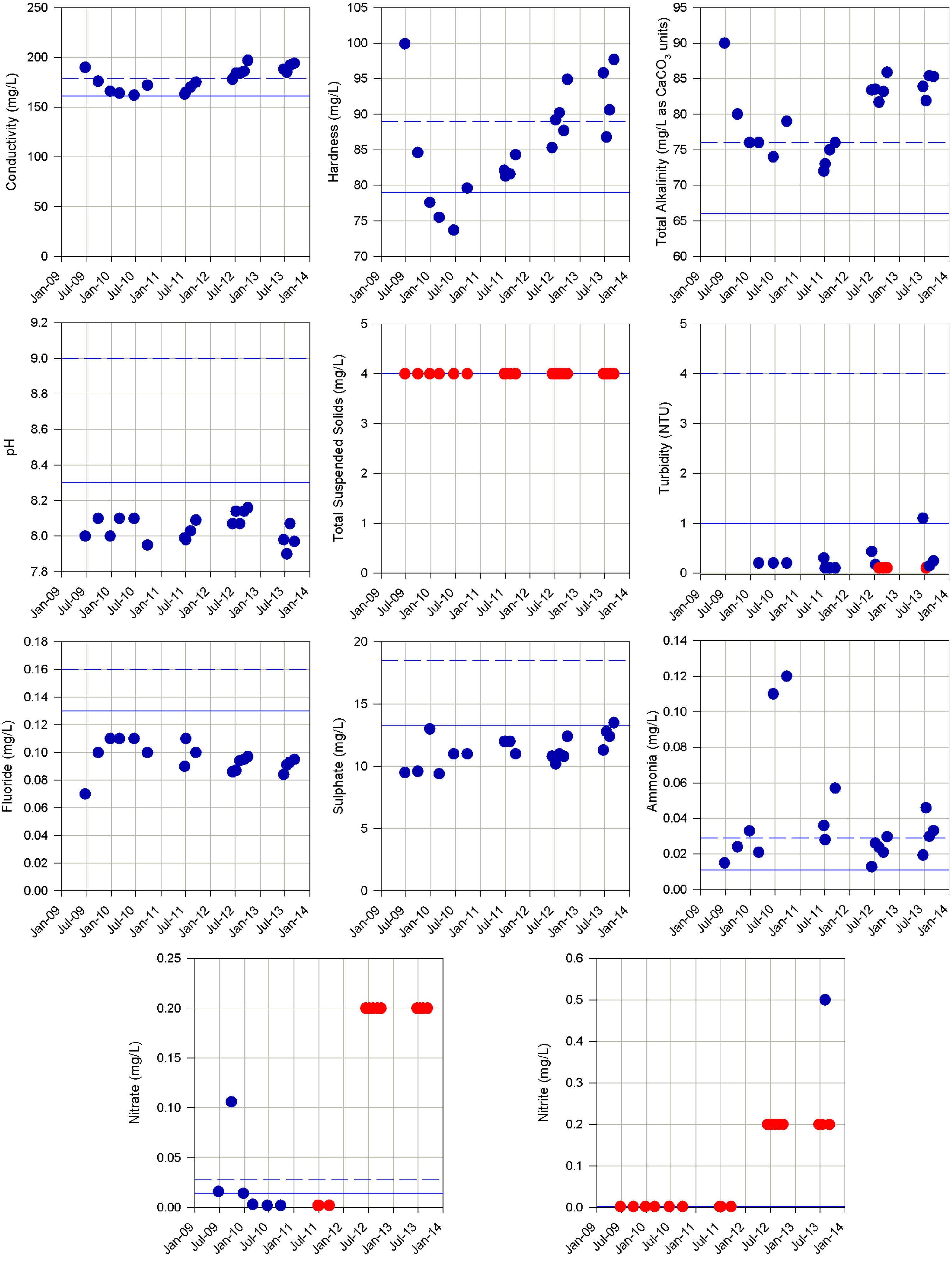
MW05-7B

● Parameter Concentration
● Parameter Concentration less than Detection
— Baseline Average Concentration
- - - Baseline 95th Percentile Concentration

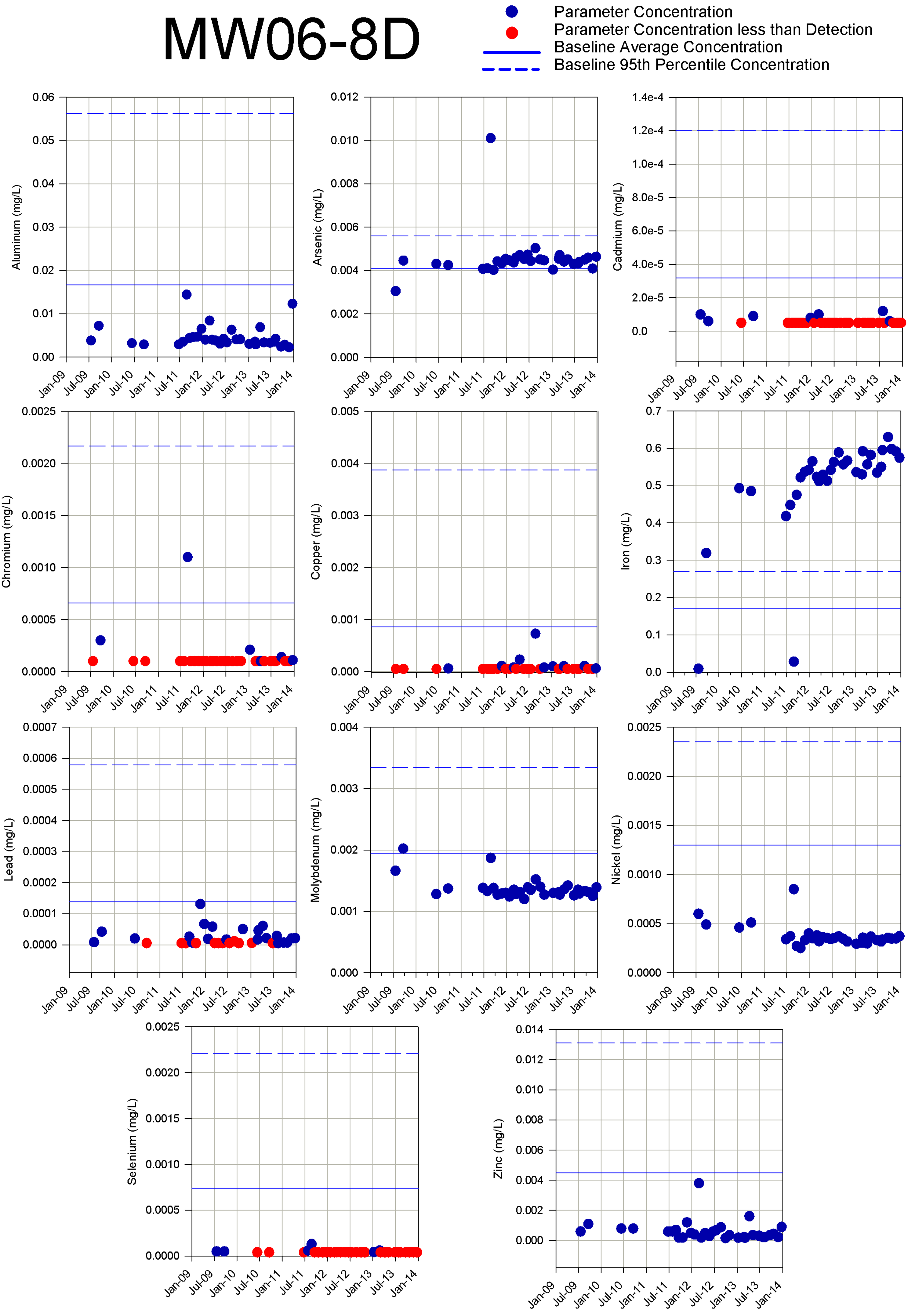


MW05-7B

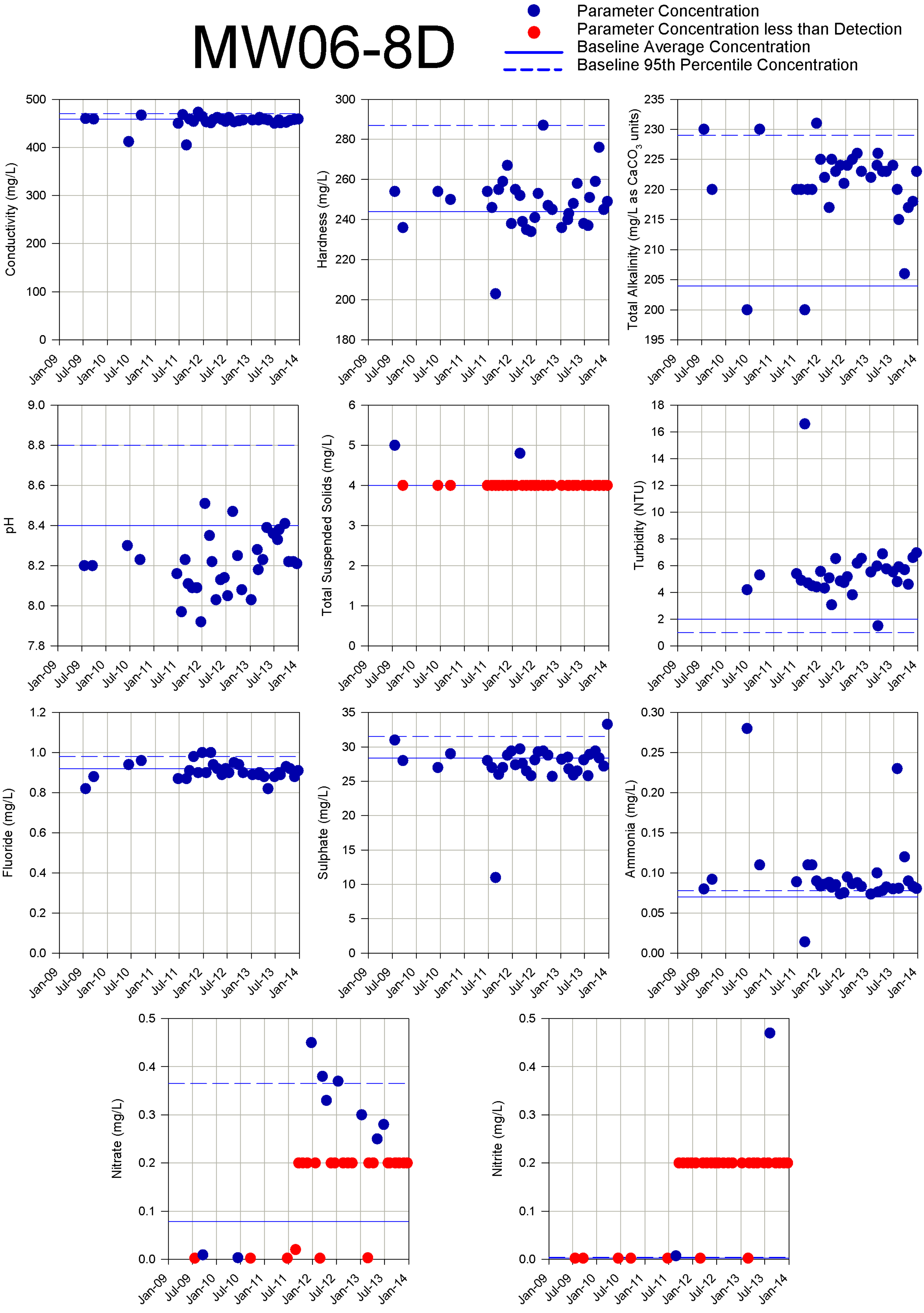
● Parameter Concentration
● Parameter Concentration less than Detection
— Baseline Average Concentration
- - Baseline 95th Percentile Concentration



MW06-8D


● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.00
0.01
0.02
0.03
0.04
0.05
0.06
Arsenic (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
Cadmium (mg/L)
0.0
2.0e-5
4.0e-5
6.0e-5
8.0e-5
1.0e-4
1.2e-4
1.4e-4
Chromium (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
Copper (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
Iron (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Lead (mg/L)
0.0000
0.0001
0.0002
0.0003
0.0004
0.0005
0.0006
0.0007
Molybdenum (mg/L)
0.000
0.001
0.002
0.003
0.004
Nickel (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
Selenium (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
Zinc (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0.014
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

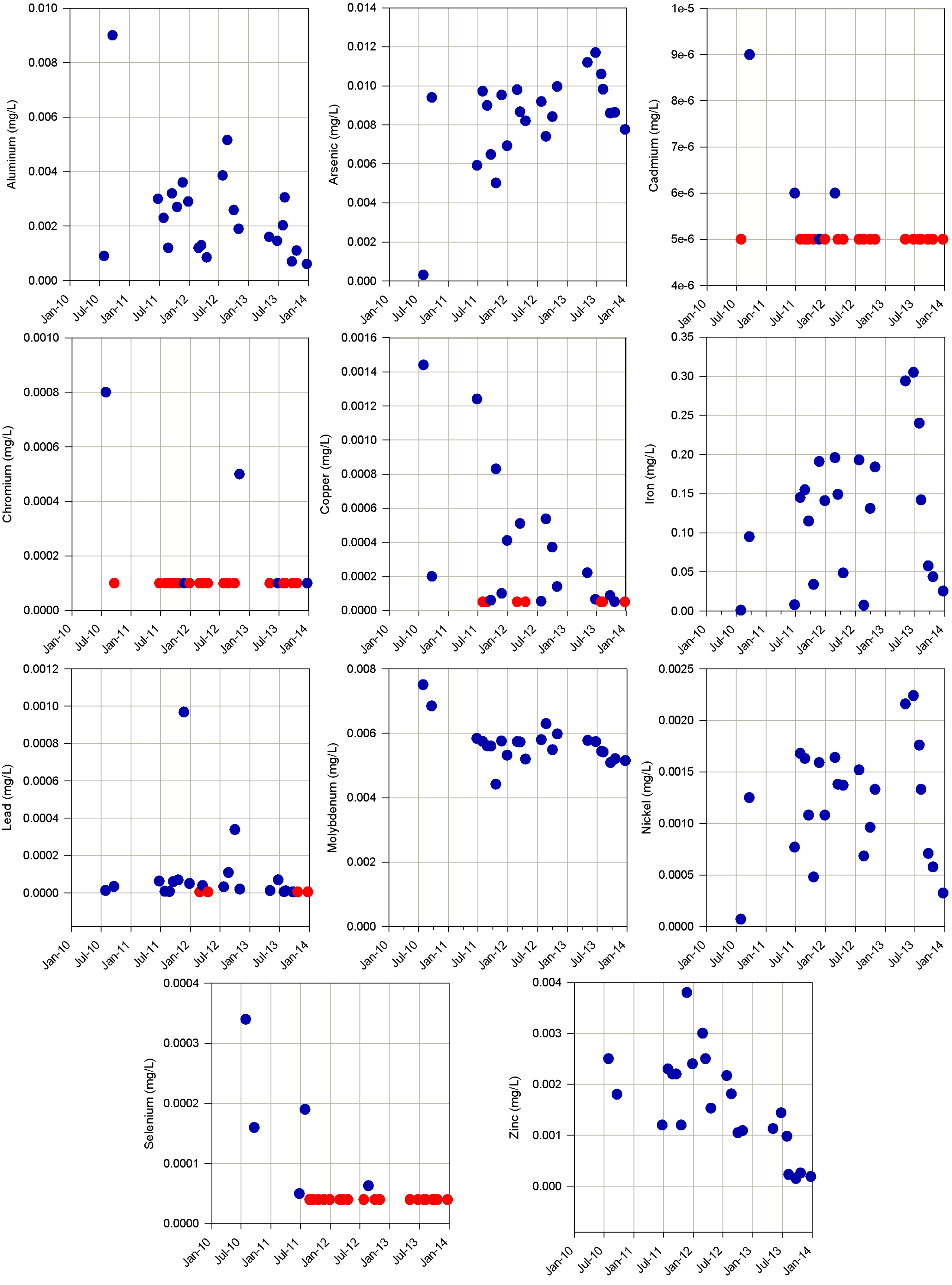
MW06-8D



● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
0
100
200
300
400
500
Hardness (mg/L)
180
200
220
240
260
280
300
Total Alkalinity (mg/L as $CaCO_3$ units)
195
200
205
210
215
220
225
230
235
pH
7.8
8.0
8.2
8.4
8.6
8.8
9.0
Total Suspended Solids (mg/L)
0
1
2
3
4
5
6
Turbidity (NTU)
0
2
4
6
8
10
12
14
16
18
Fluoride (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Sulphate (mg/L)
0
5
10
15
20
25
30
35
Ammonia (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
Nitrate (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
Nitrite (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

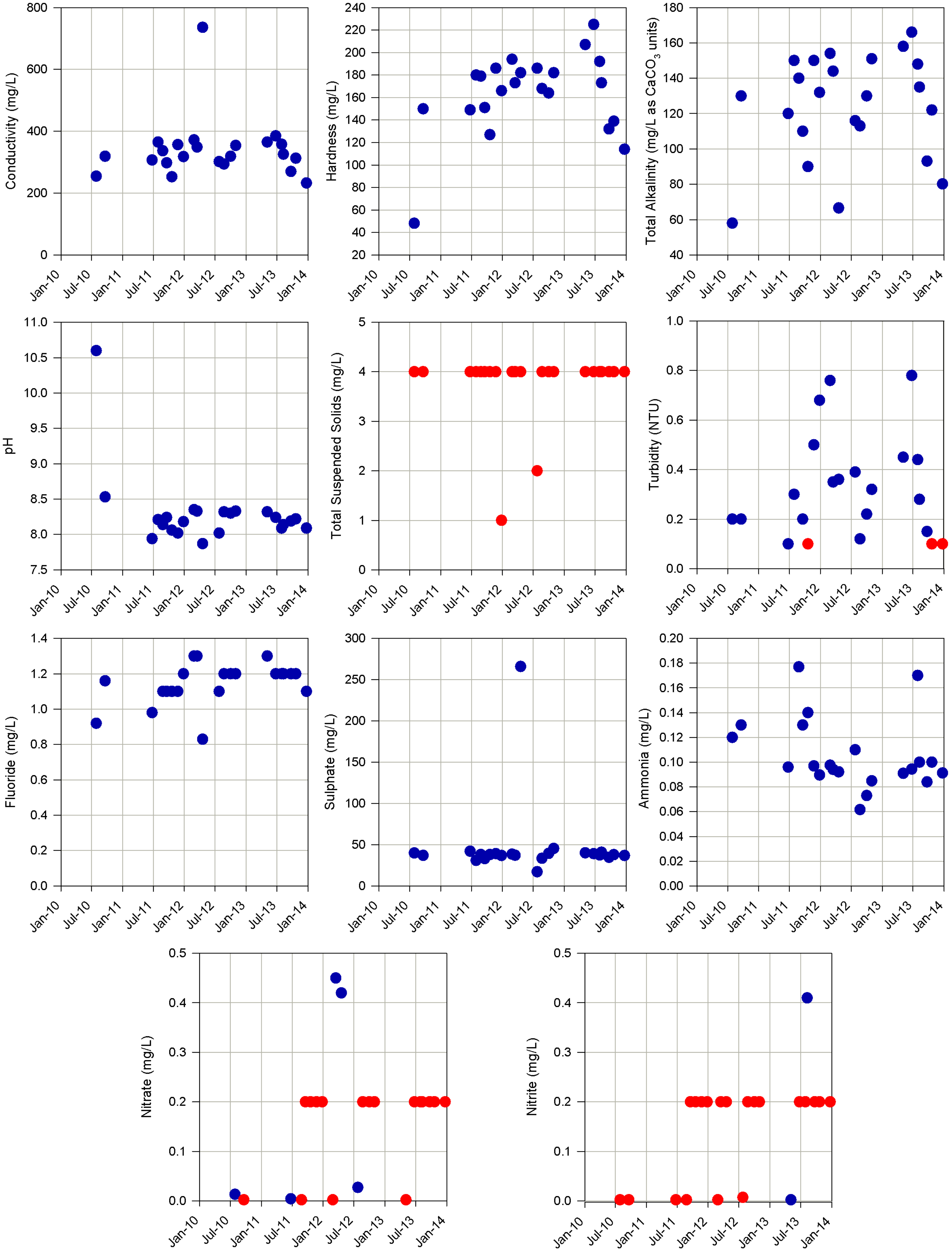
MW06-8M

● Parameter Concentration
● Parameter Concentration less than Detection
— Baseline Average Concentration
- - - Baseline 95th Percentile Concentration

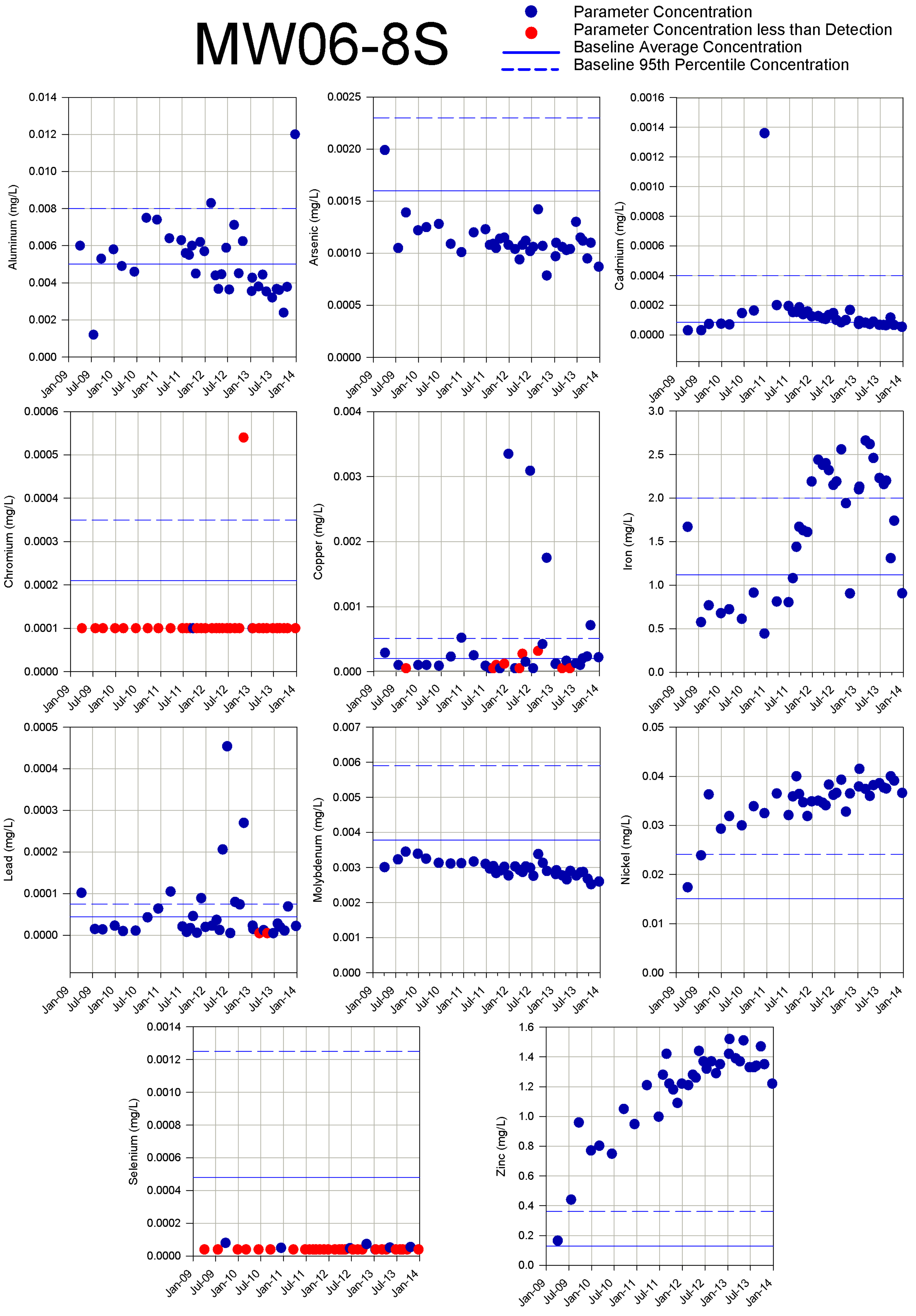


MW06-8M

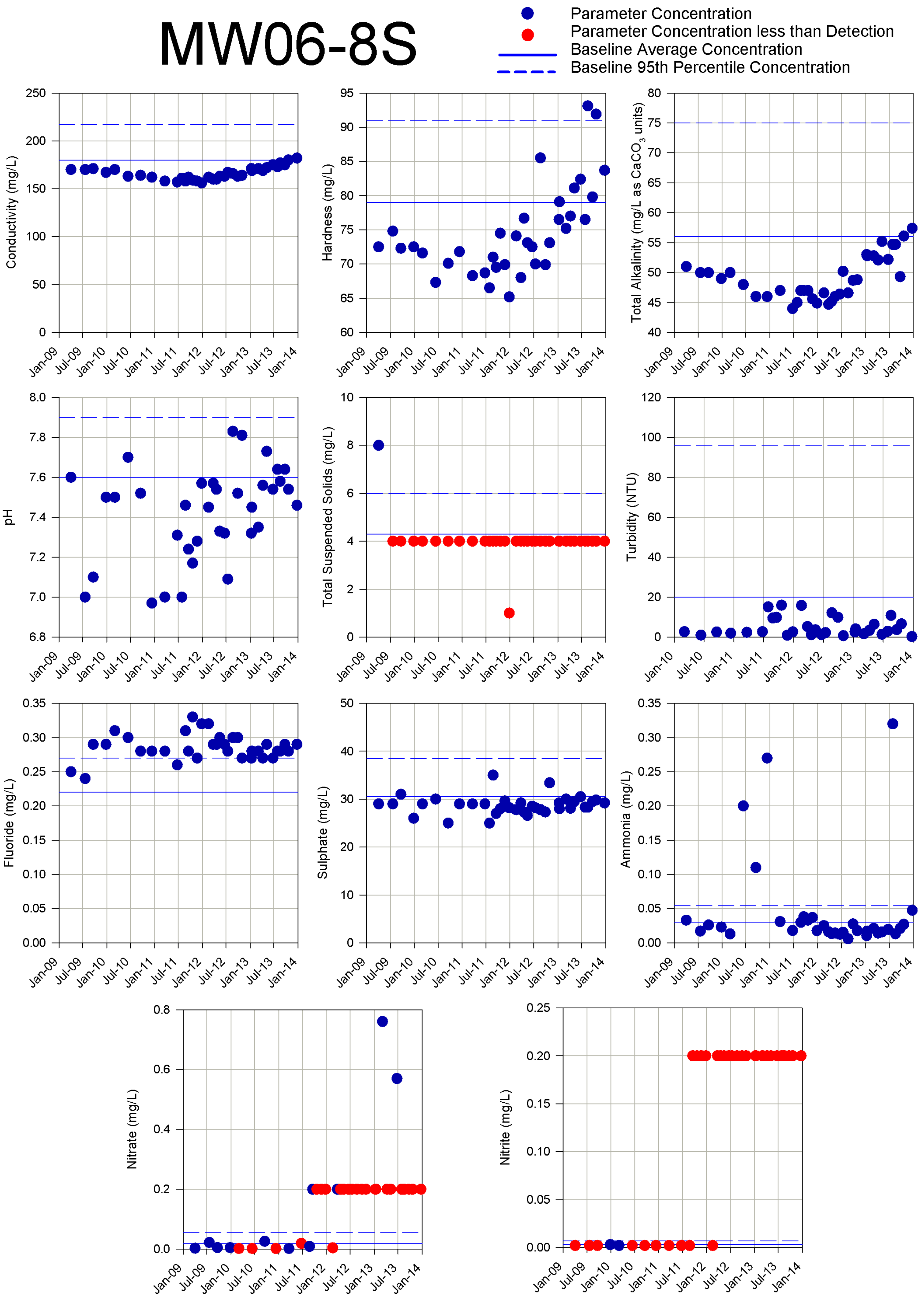
● Parameter Concentration
● Parameter Concentration less than Detection
— Baseline Average Concentration
– – Baseline 95th Percentile Concentration



MW06-8S


Parameter Concentration
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0.014
Arsenic (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
Cadmium (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
0.0016
Chromium (mg/L)
0.0000
0.0001
0.0002
0.0003
0.0004
0.0005
0.0006
Copper (mg/L)
0.000
0.001
0.002
0.003
0.004
Iron (mg/L)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Lead (mg/L)
0.0000
0.0001
0.0002
0.0003
0.0004
0.0005
Molybdenum (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
0.006
0.007
Nickel (mg/L)
0.00
0.01
0.02
0.03
0.04
0.05
Selenium (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
Zinc (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

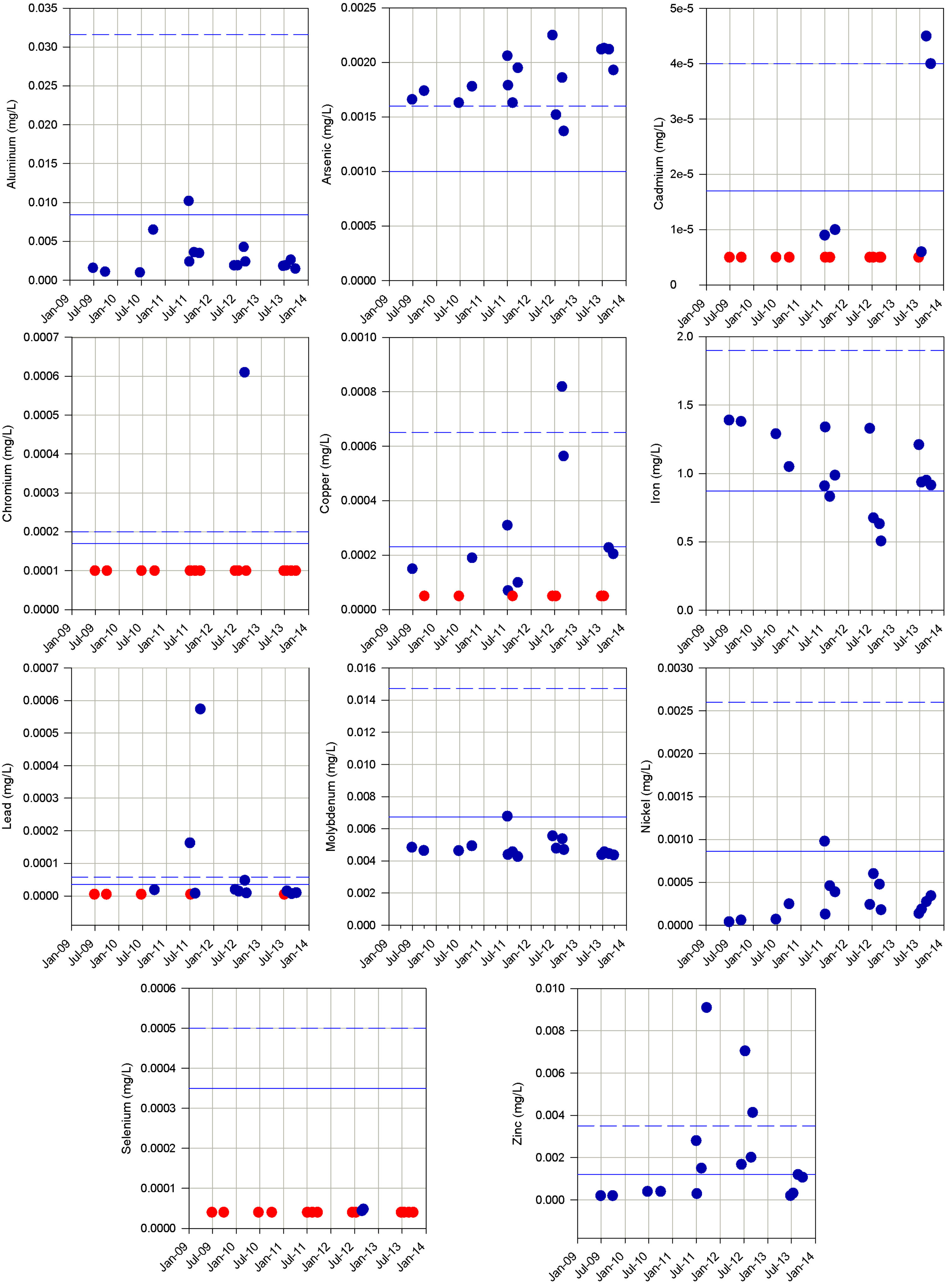
MW06-8S



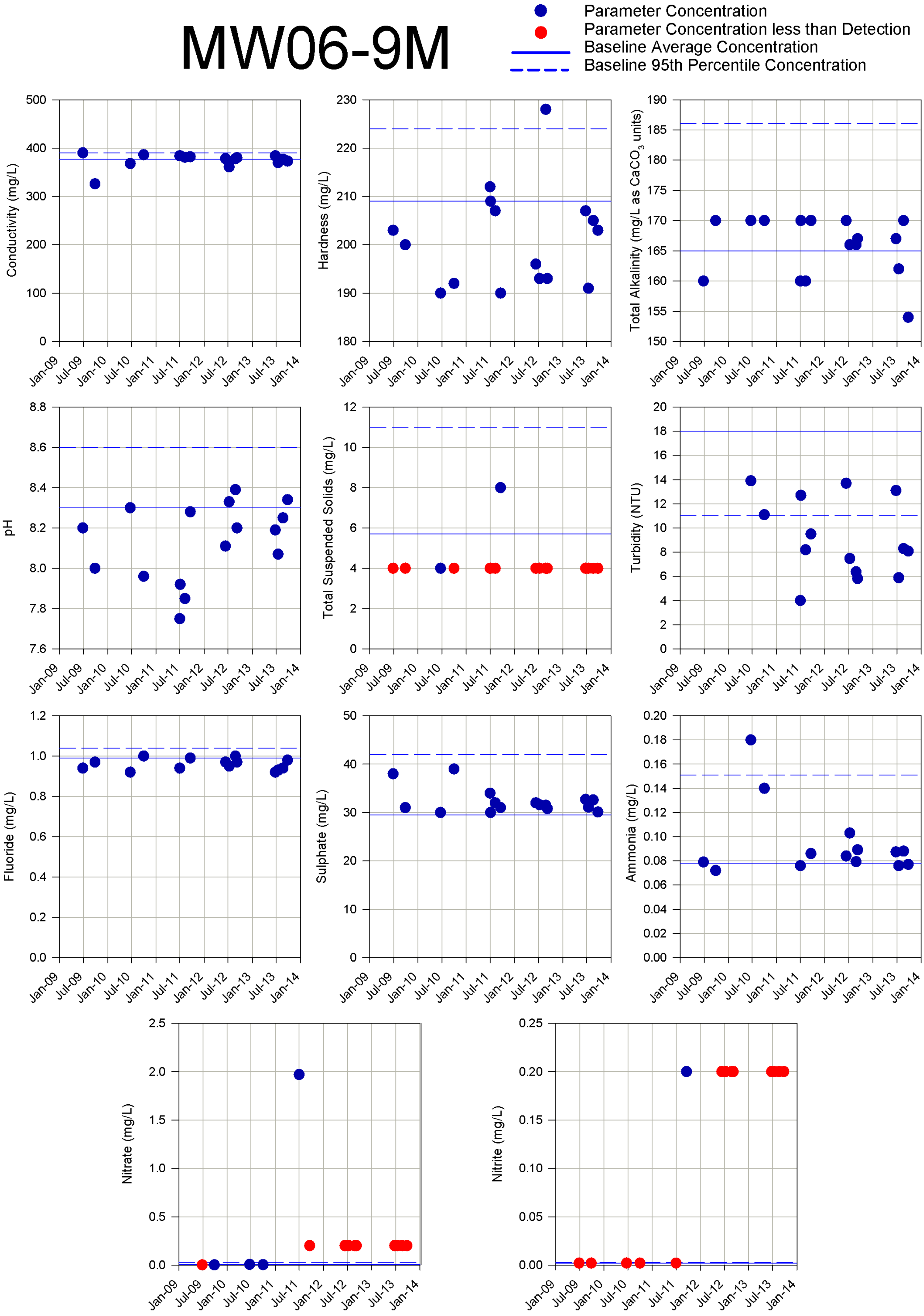
● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
0
50
100
150
200
250
Hardness (mg/L)
60
65
70
75
80
85
90
95
Total Alkalinity (mg/L as $CaCO_3$ units)
40
45
50
55
60
65
70
75
80
pH
6.8
7.0
7.2
7.4
7.6
7.8
8.0
Total Suspended Solids (mg/L)
0
2
4
6
8
10
Turbidity (NTU)
0
20
40
60
80
100
120
Fluoride (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
Sulphate (mg/L)
0
10
20
30
40
50
Ammonia (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
Nitrate (mg/L)
0.0
0.2
0.4
0.6
0.8
Nitrite (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

MW06-9M

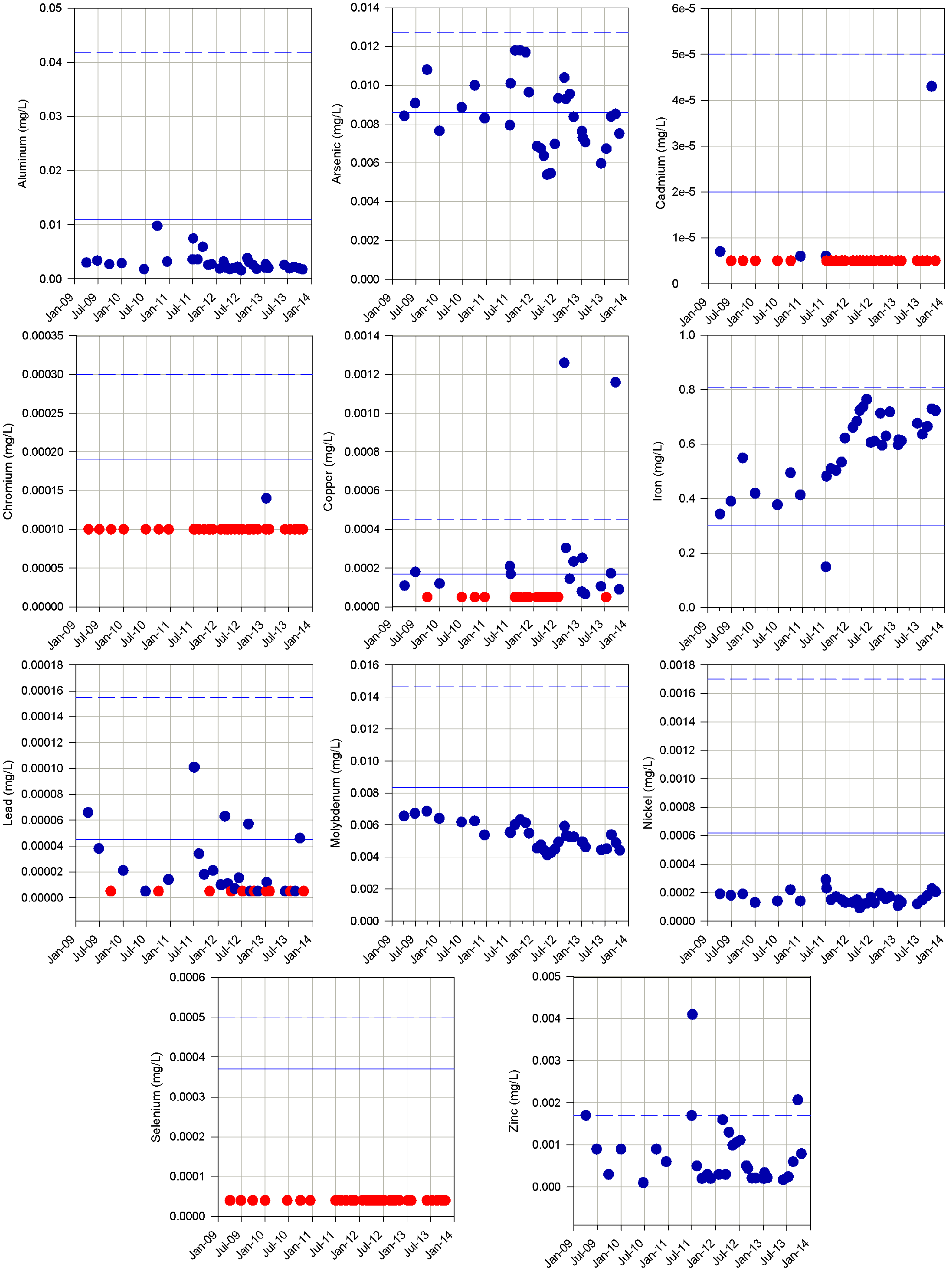
● Parameter Concentration
● Parameter Concentration less than Detection
— Baseline Average Concentration
- - Baseline 95th Percentile Concentration



MW06-9M


● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
0
100
200
300
400
500
Hardness (mg/L)
180
190
200
210
220
230
Total Alkalinity (mg/L as $CaCO_3$ units)
150
155
160
165
170
175
180
185
190
pH
7.6
7.8
8.0
8.2
8.4
8.6
8.8
Total Suspended Solids (mg/L)
0
2
4
6
8
10
12
Turbidity (NTU)
0
2
4
6
8
10
12
14
16
18
20
Fluoride (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Sulphate (mg/L)
0
10
20
30
40
50
Ammonia (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
0.18
0.20
Nitrate (mg/L)
0.0
0.5
1.0
1.5
2.0
2.5
Nitrite (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

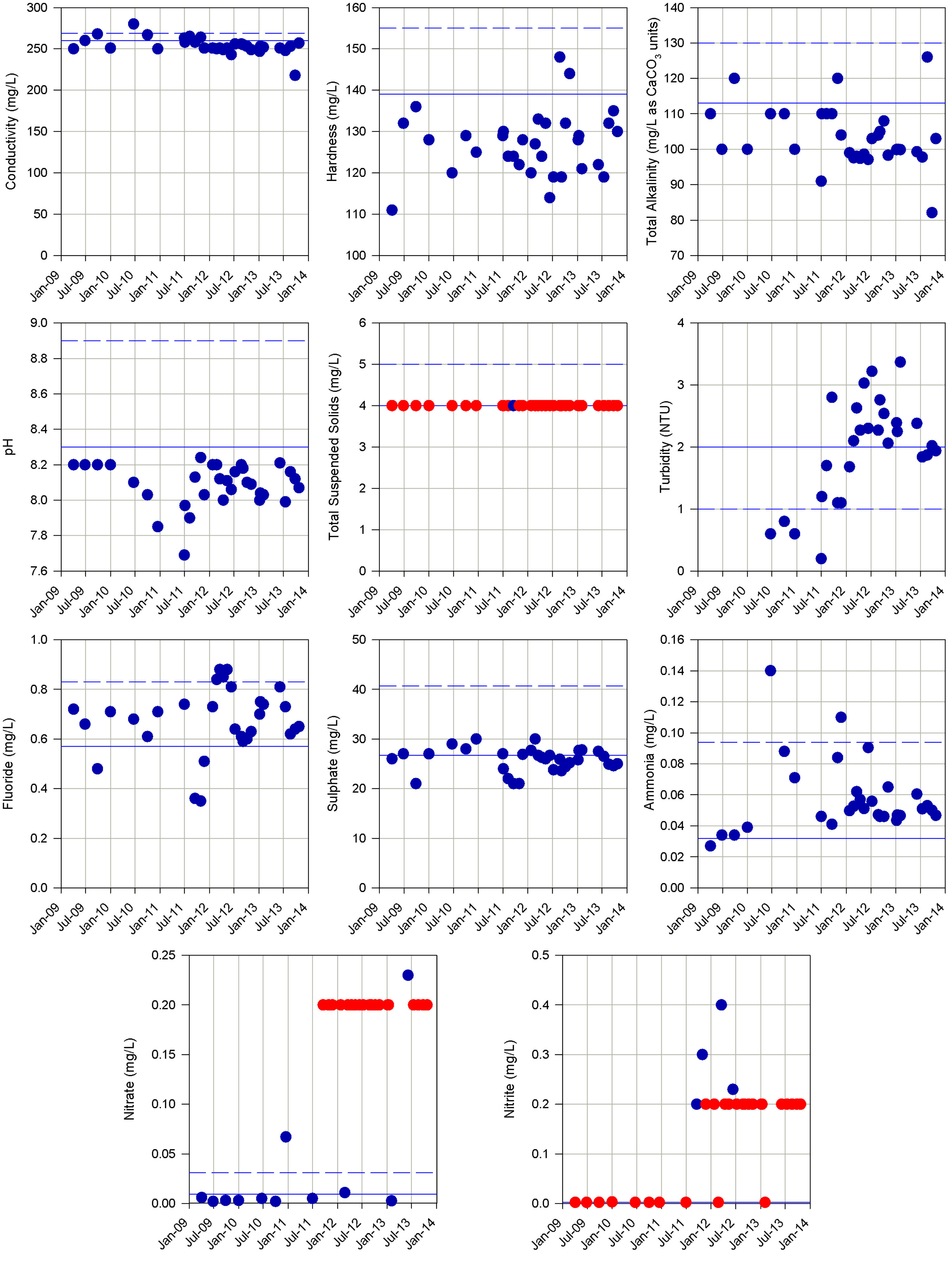
MW06-9S



● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.00
0.01
0.02
0.03
0.04
0.05
Arsenic (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0.014
Cadmium (mg/L)
0
1e-5
2e-5
3e-5
4e-5
5e-5
6e-5
Chromium (mg/L)
0.00000
0.00005
0.00010
0.00015
0.00020
0.00025
0.00030
0.00035
Copper (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
Iron (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
Lead (mg/L)
0.00000
0.00002
0.00004
0.00006
0.00008
0.00010
0.00012
0.00014
0.00016
0.00018
Molybdenum (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0.014
0.016
Nickel (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
0.0016
0.0018
Selenium (mg/L)
0.0000
0.0001
0.0002
0.0003
0.0004
0.0005
0.0006
Zinc (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

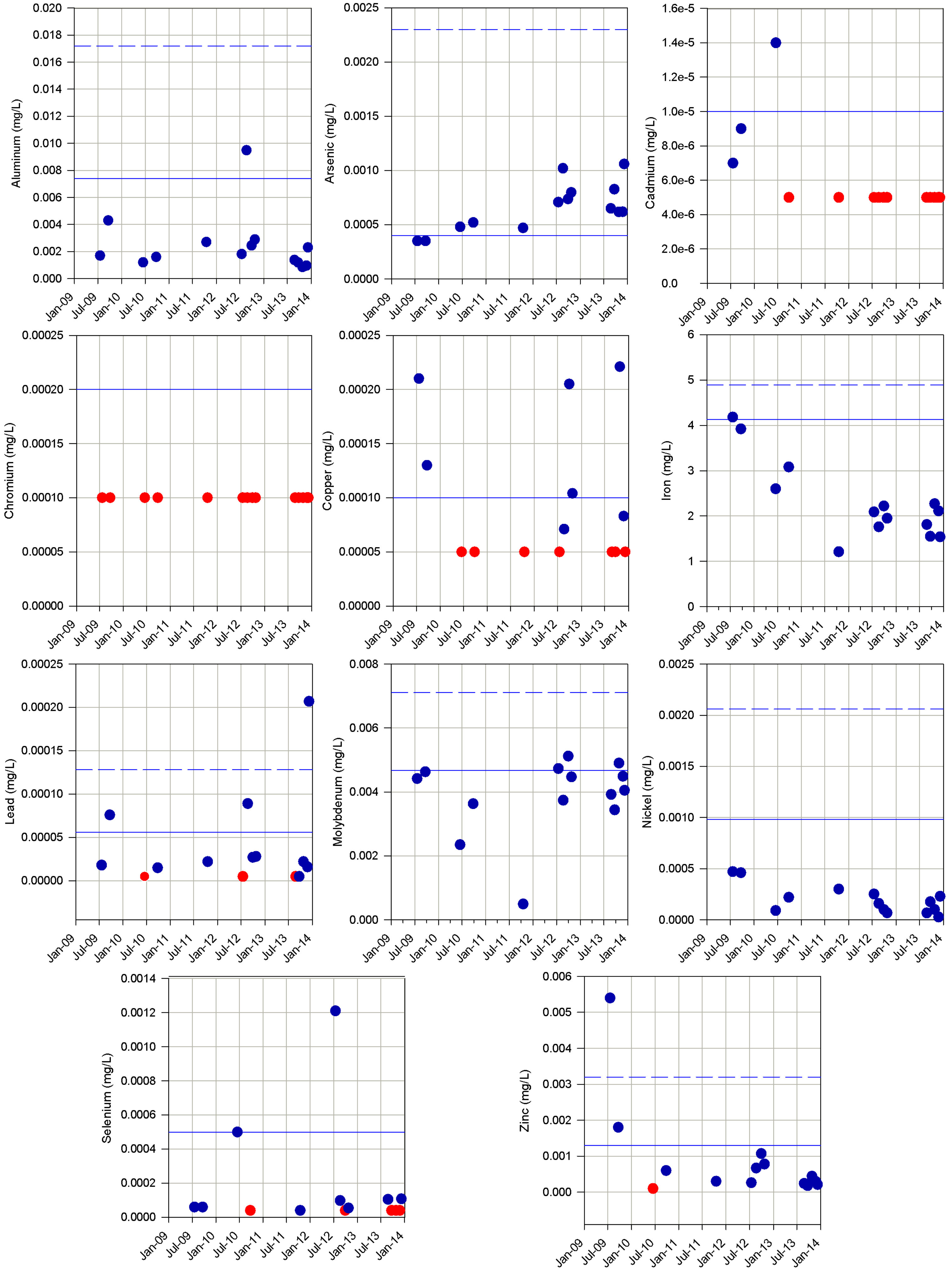
MW06-9S

● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration



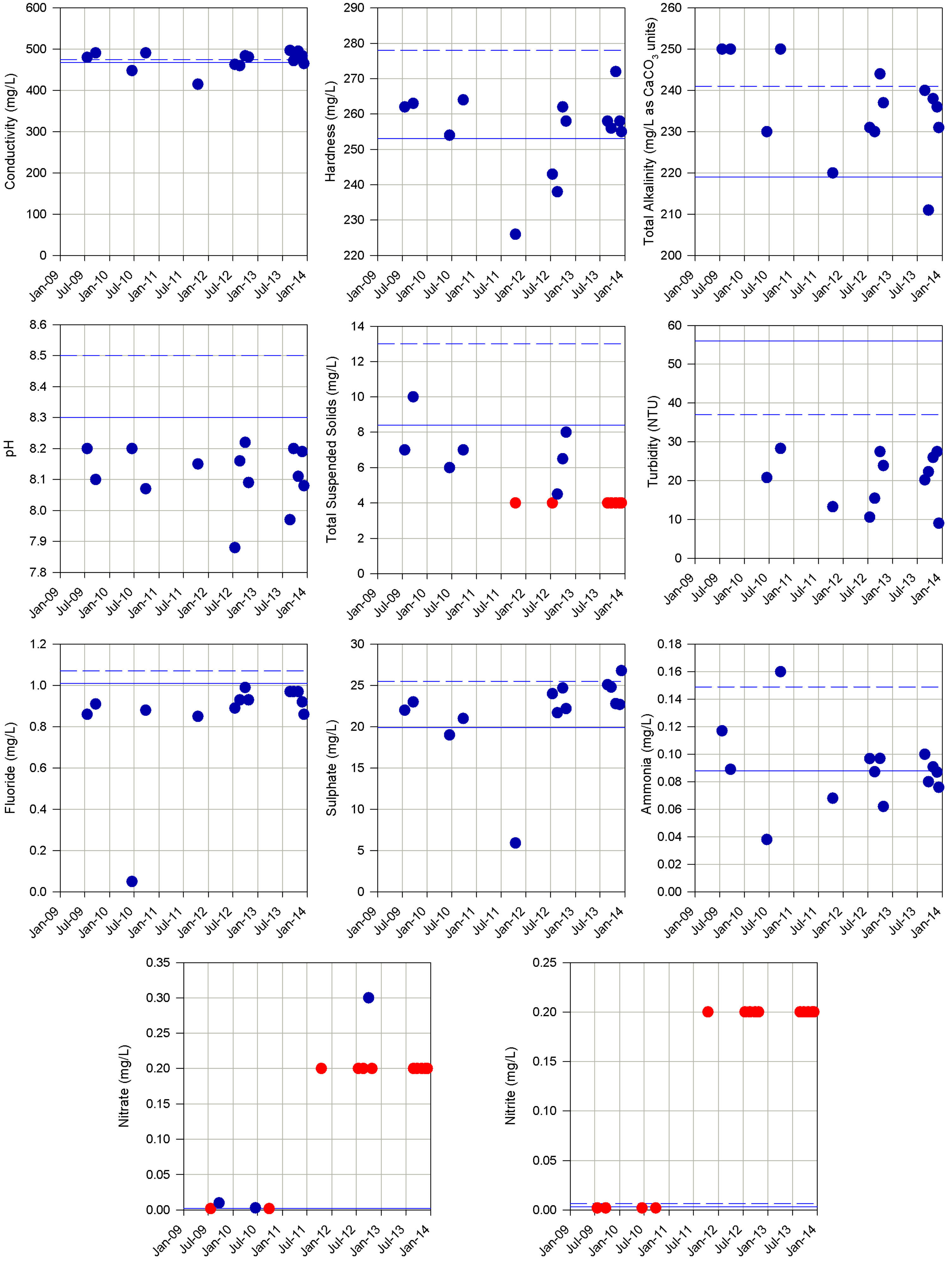
MW06-10D

● Parameter Concentration
● Parameter Concentration less than Detection
— Baseline Average Concentration
- - Baseline 95th Percentile Concentration

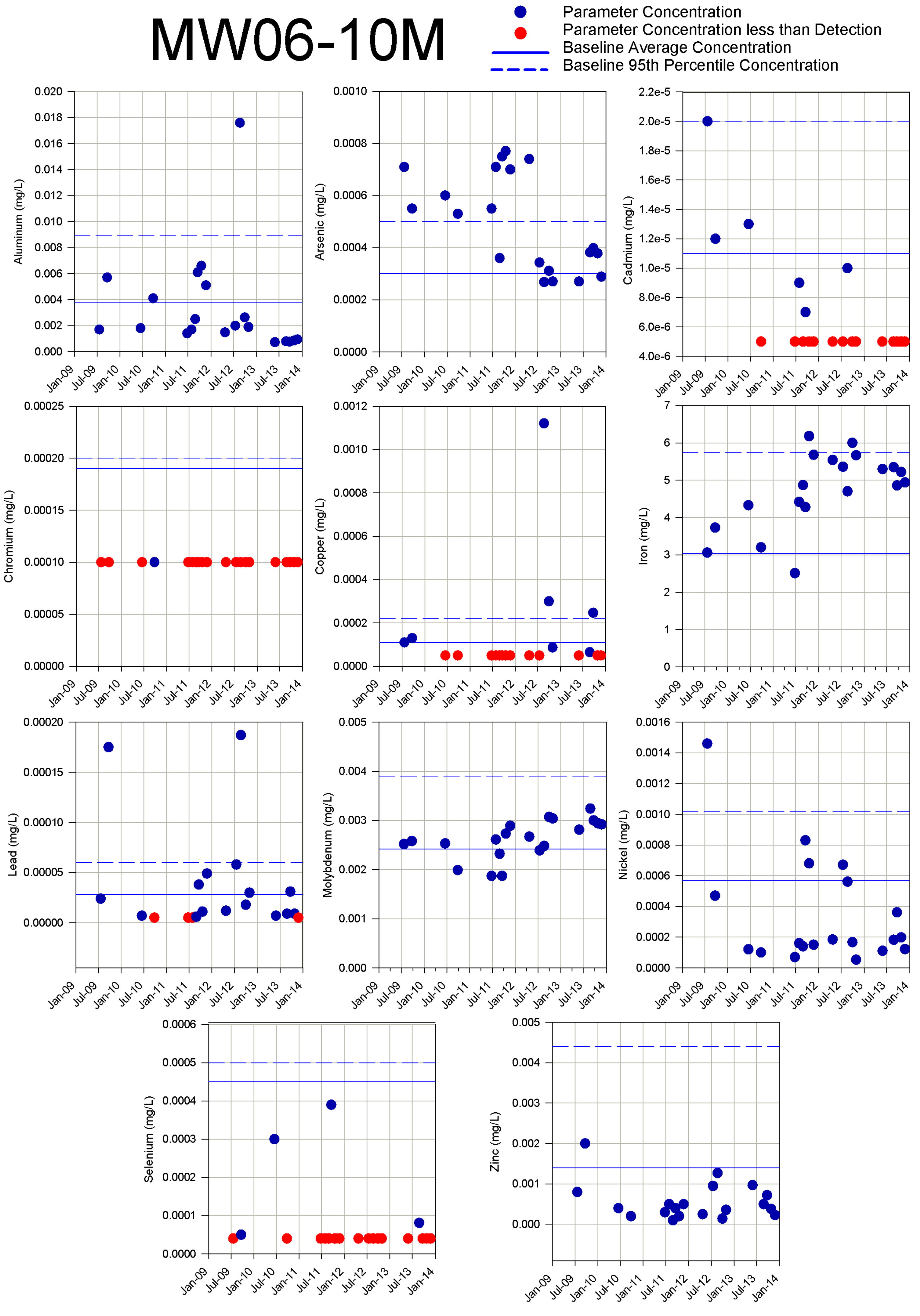


MW06-10D

● Parameter Concentration
🔴 Parameter Concentration less than Detection
— Baseline Average Concentration
- - - Baseline 95th Percentile Concentration

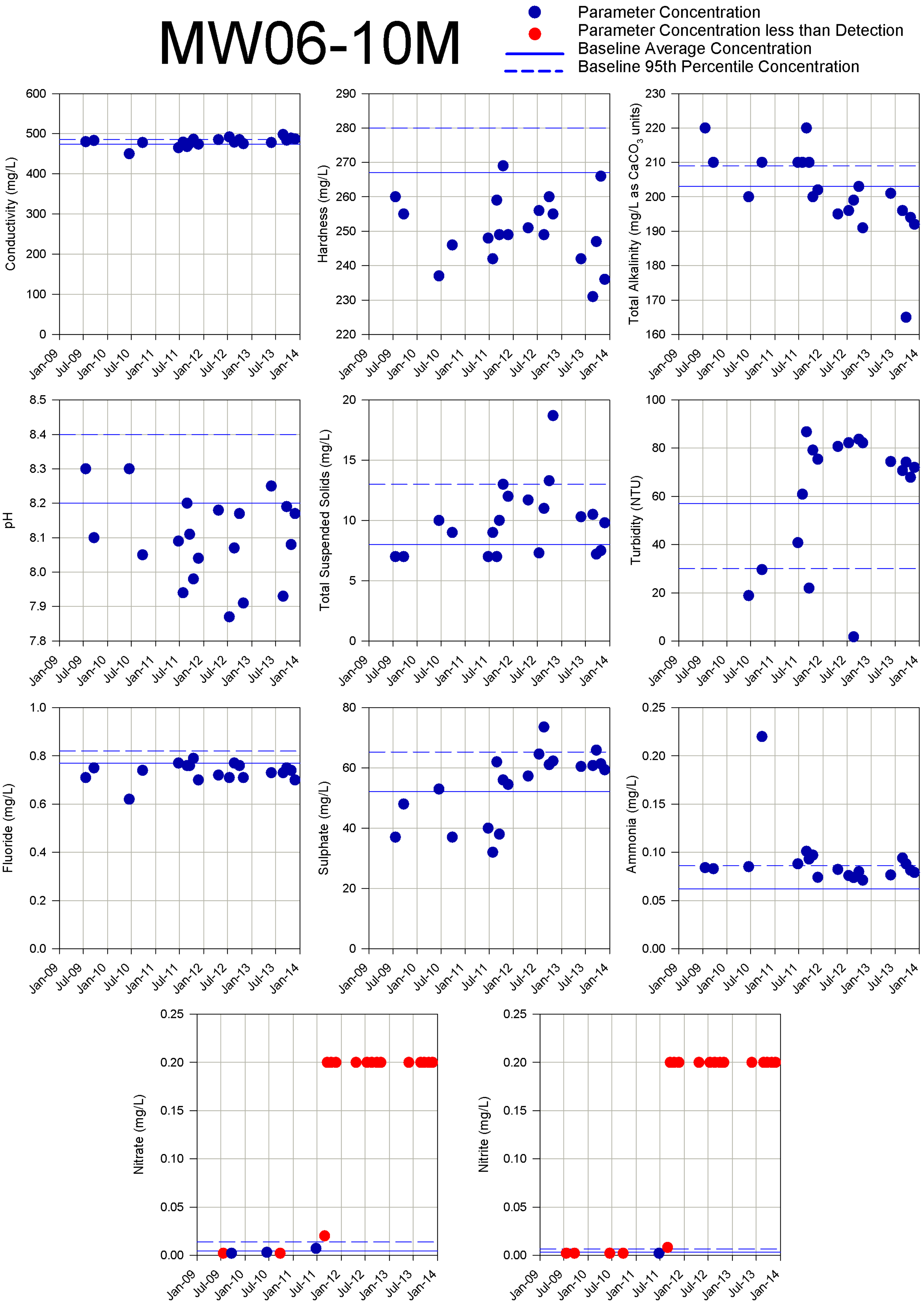


MW06-10M



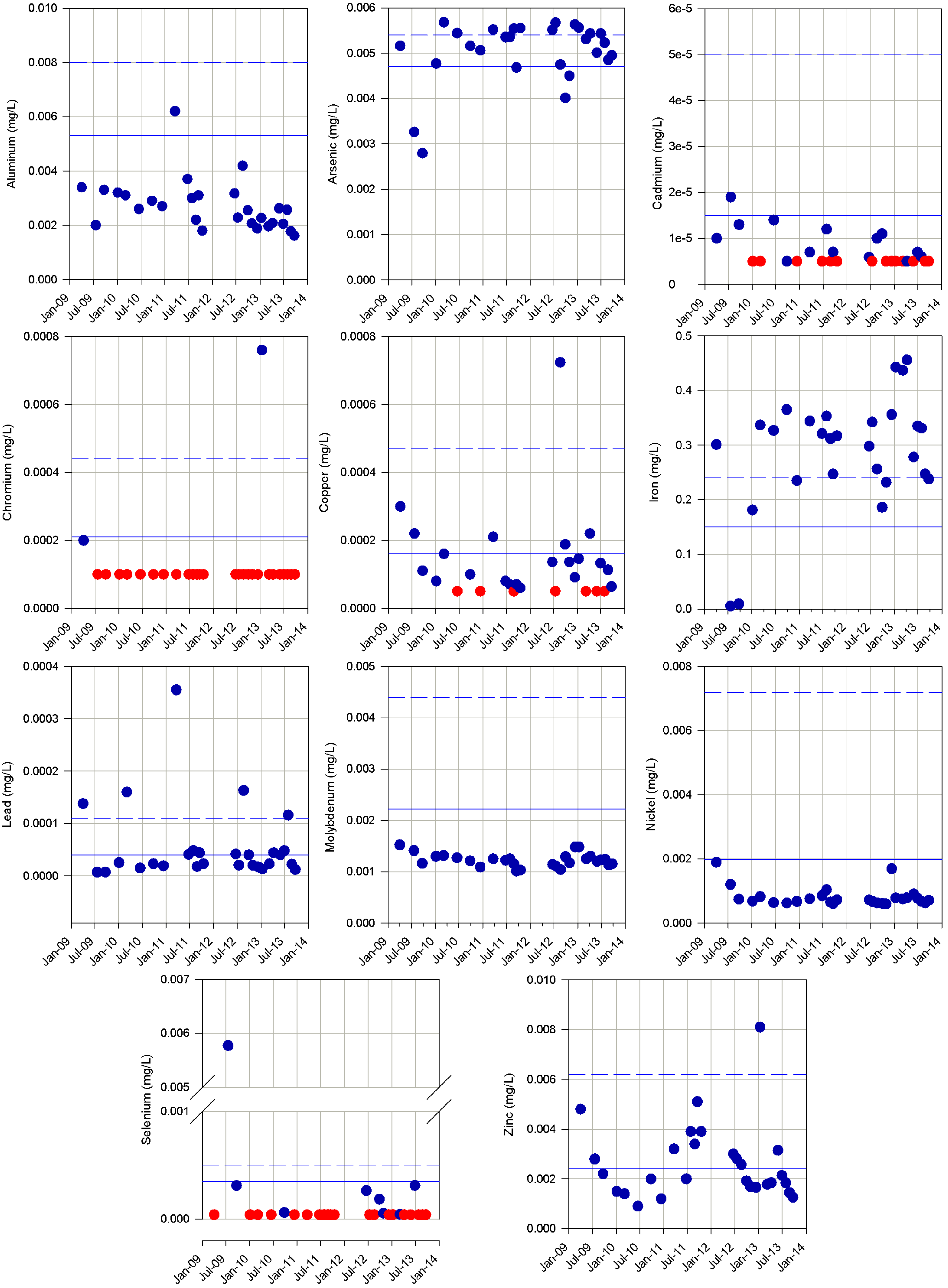
●
Parameter Concentration
●
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.000 0.002 0.004 0.006 0.008 0.010 0.012 0.014 0.016 0.018 0.020
Arsenic (mg/L)
0.0000 0.0002 0.0004 0.0006 0.0008 0.0010
Cadmium (mg/L)
4.0e-6 6.0e-6 8.0e-6 1.0e-5 1.2e-5 1.4e-5 1.6e-5 1.8e-5 2.0e-5 2.2e-5
Chromium (mg/L)
0.00000 0.00005 0.00010 0.00015 0.00020 0.00025
Copper (mg/L)
0.0000 0.0002 0.0004 0.0006 0.0008 0.0010 0.0012
Iron (mg/L)
0 1 2 3 4 5 6 7
Lead (mg/L)
0.00000 0.00005 0.00010 0.00015 0.00020
Molybdenum (mg/L)
0.000 0.001 0.002 0.003 0.004 0.005
Nickel (mg/L)
0.0000 0.0002 0.0004 0.0006 0.0008 0.0010 0.0012 0.0014 0.0016
Selenium (mg/L)
0.0000 0.0001 0.0002 0.0003 0.0004 0.0005 0.0006
Zinc (mg/L)
0.000 0.001 0.002 0.003 0.004 0.005
Jan-09 Jul-09 Jan-10 Jul-10 Jan-11 Jul-11 Jan-12 Jul-12 Jan-13 Jul-13 Jan-14

MW06-10M

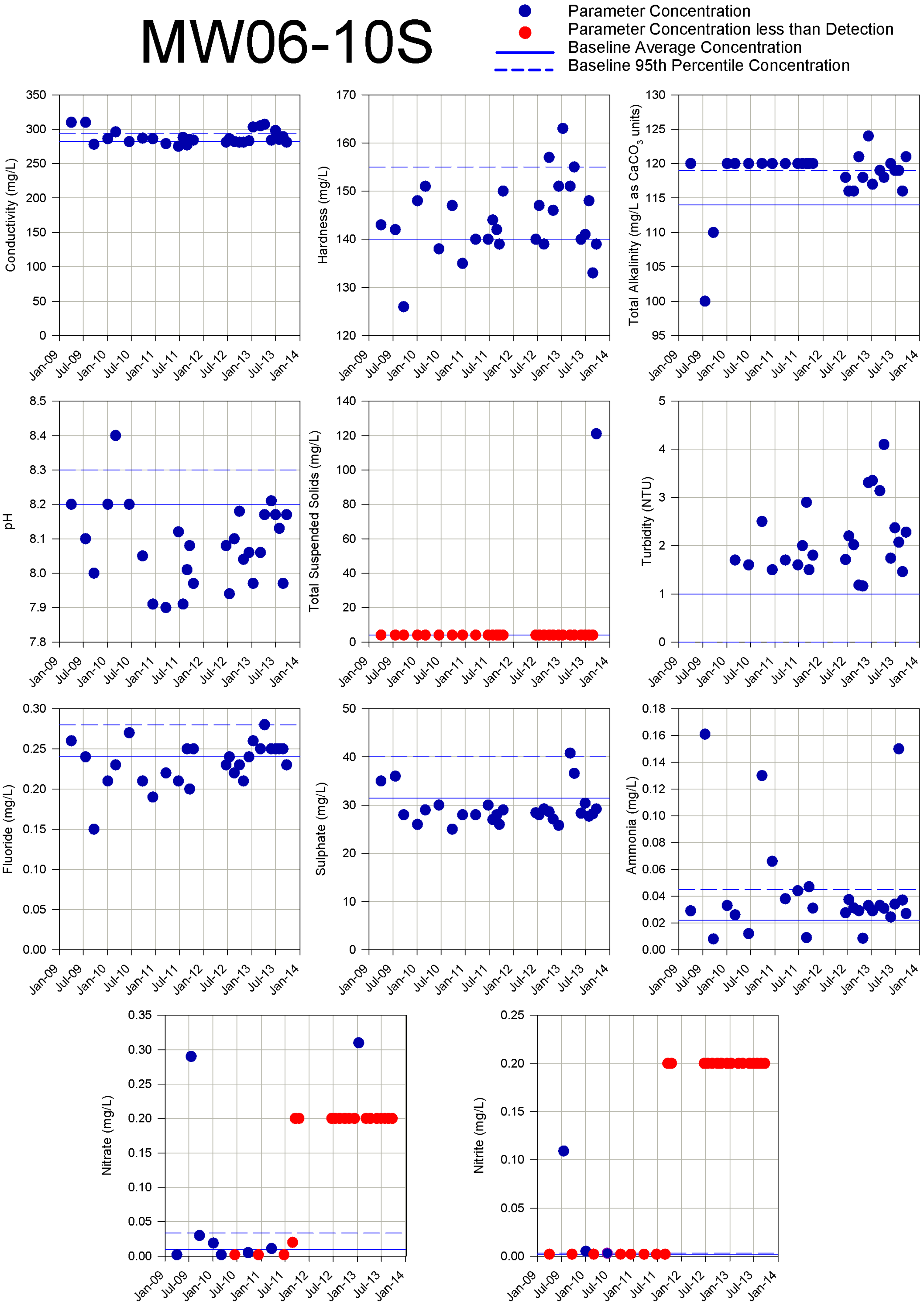

● Parameter Concentration
● Parameter Concentration less than Detection
— Baseline Average Concentration
- - Baseline 95th Percentile Concentration
Conductivity (mg/L)
0
100
200
300
400
500
600
Hardness (mg/L)
220
230
240
250
260
270
280
290
Total Alkalinity (mg/L as $CaCO_3$ units)
160
170
180
190
200
210
220
230
pH
7.8
7.9
8.0
8.1
8.2
8.3
8.4
8.5
Total Suspended Solids (mg/L)
0
5
10
15
20
Turbidity (NTU)
0
20
40
60
80
100
Fluoride (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
Sulphate (mg/L)
0
20
40
60
80
Ammonia (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
Nitrate (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
Nitrite (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

MW06-10S

● Parameter Concentration
● Parameter Concentration less than Detection
── Baseline Average Concentration
– – Baseline 95th Percentile Concentration

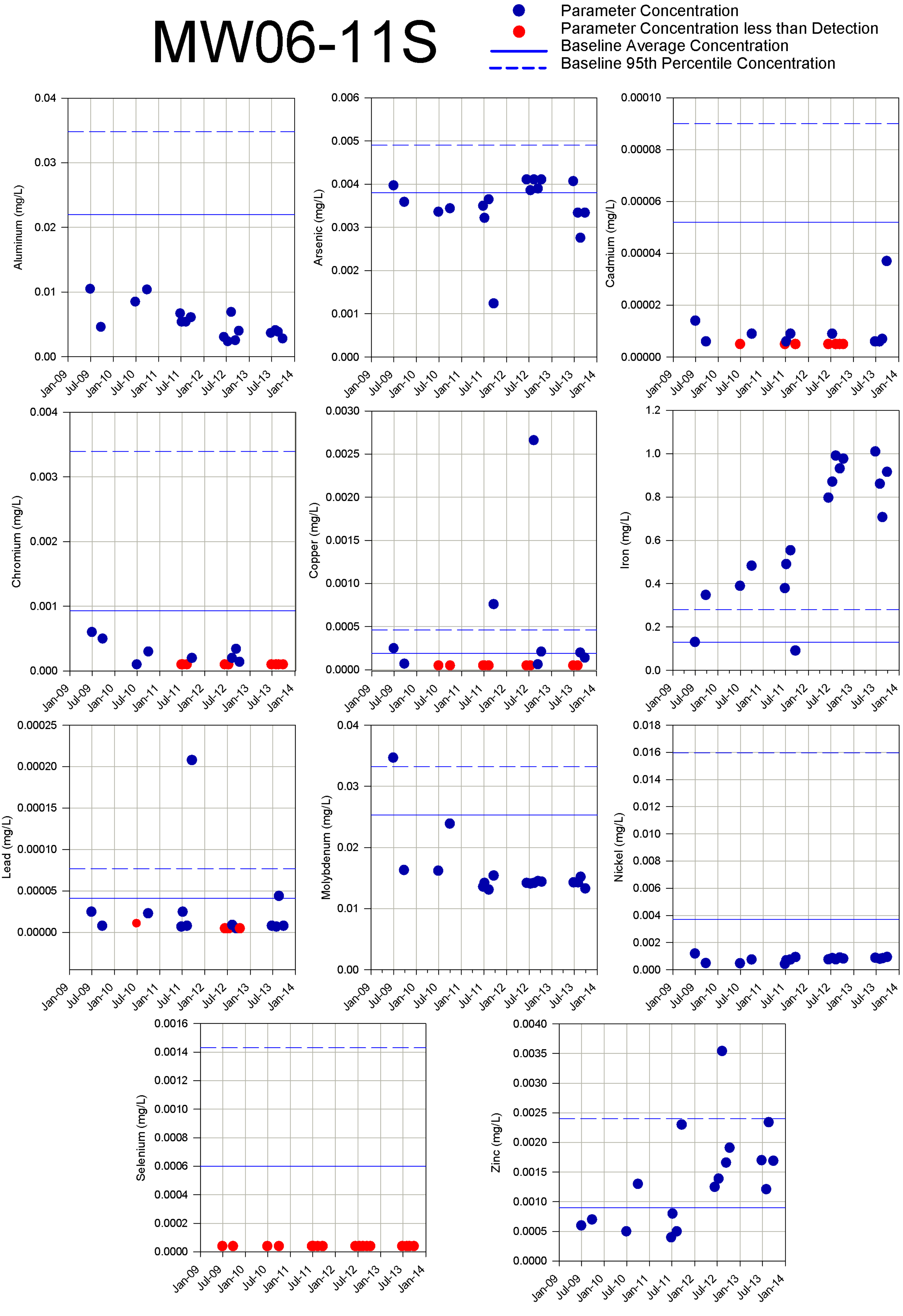


MW06-10S



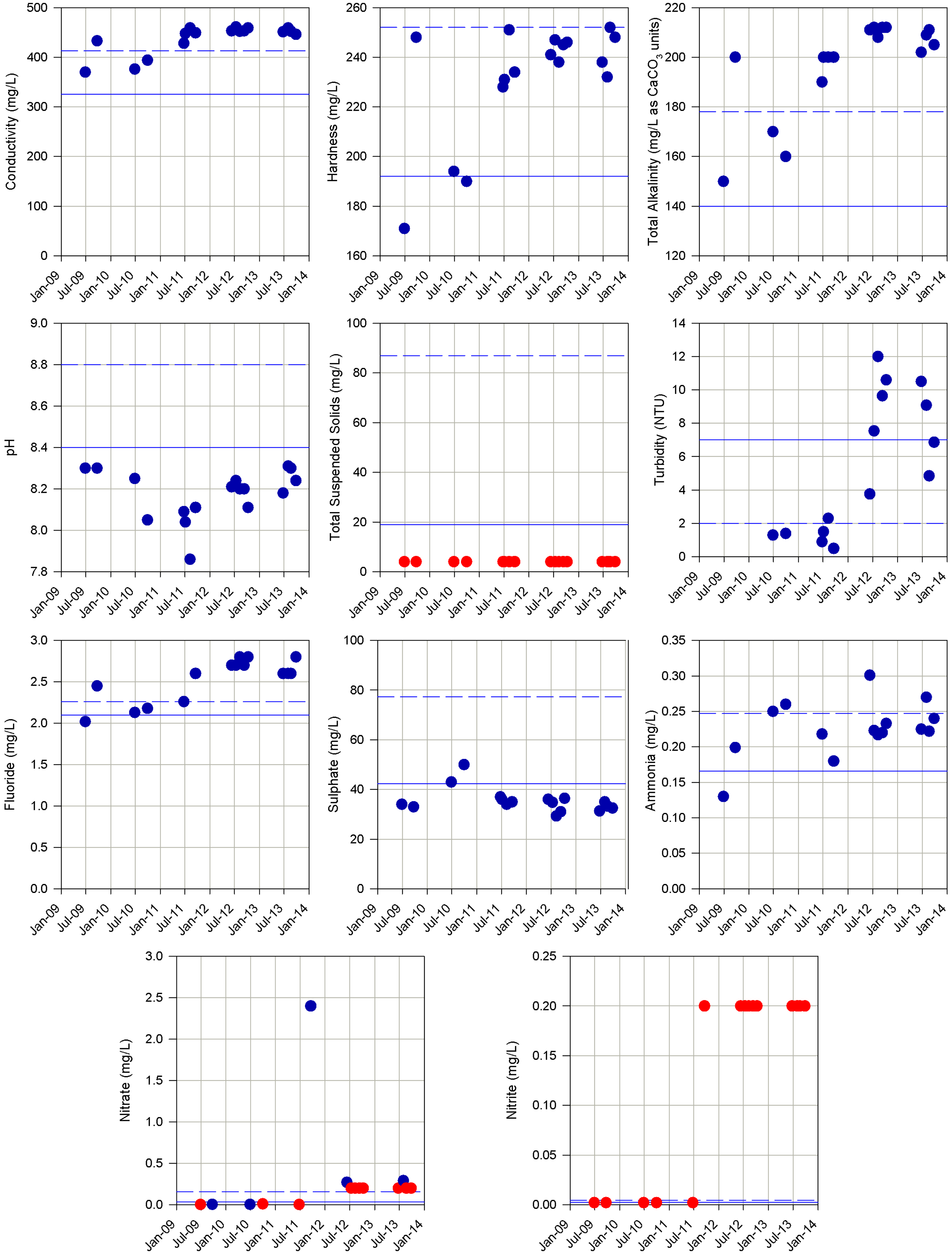
Parameter Concentration
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
0
50
100
150
200
250
300
350
Hardness (mg/L)
120
130
140
150
160
170
Total Alkalinity (mg/L as $CaCO_3$ units)
95
100
105
110
115
120
125
130
pH
7.8
7.9
8.0
8.1
8.2
8.3
8.4
8.5
Total Suspended Solids (mg/L)
0
20
40
60
80
100
120
140
Turbidity (NTU)
0
1
2
3
4
5
Fluoride (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
Sulphate (mg/L)
0
10
20
30
40
50
Ammonia (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
0.18
Nitrate (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
Nitrite (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

MW06-11S

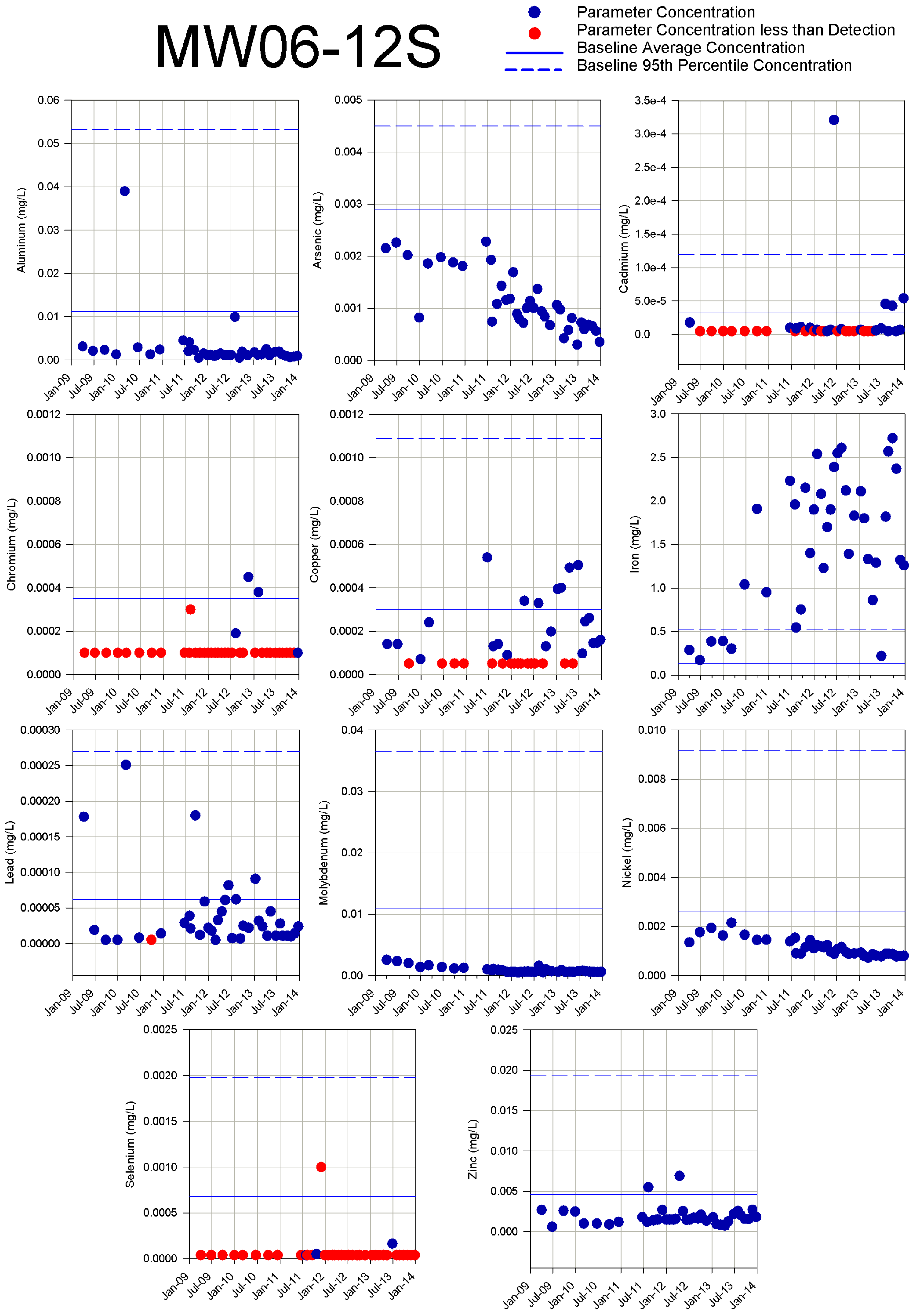

● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.00
0.01
0.02
0.03
0.04
Arsenic (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
0.006
Cadmium (mg/L)
0.00000
0.00002
0.00004
0.00006
0.00008
0.00010
Chromium (mg/L)
0.000
0.001
0.002
0.003
0.004
Copper (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
0.0030
Iron (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Lead (mg/L)
0.00000
0.00005
0.00010
0.00015
0.00020
0.00025
Molybdenum (mg/L)
0.00
0.01
0.02
0.03
0.04
Nickel (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0.014
0.016
0.018
Selenium (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
0.0014
0.0016
Zinc (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
0.0030
0.0035
0.0040
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

MW06-11S

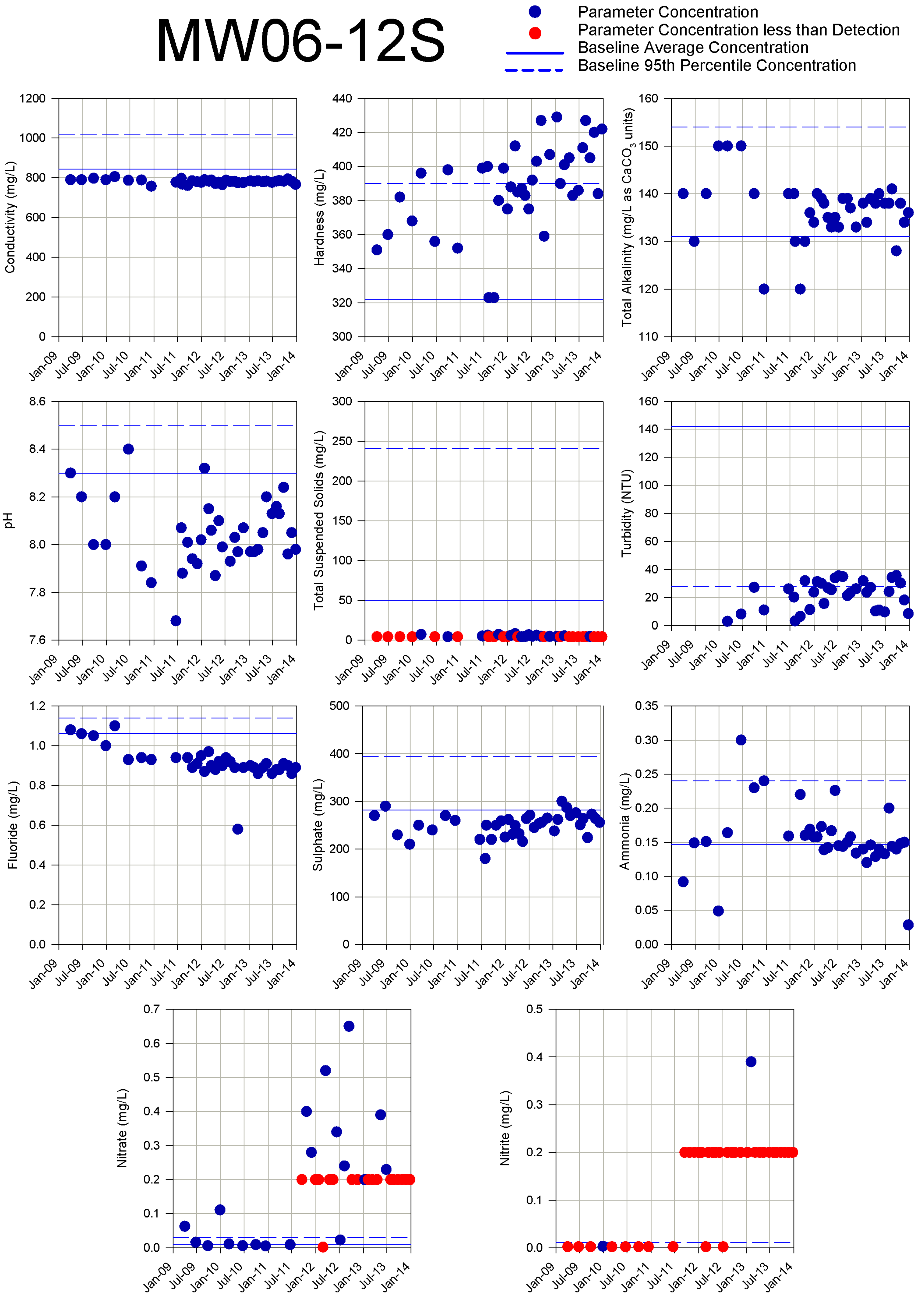
● Parameter Concentration
● Parameter Concentration less than Detection
— Baseline Average Concentration
– – Baseline 95th Percentile Concentration



MW06-12S

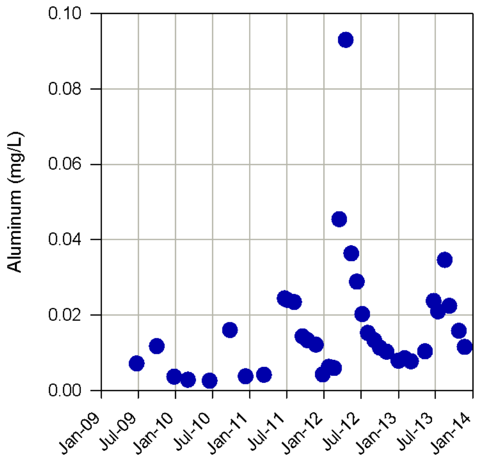

● Parameter Concentration
● Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Aluminum (mg/L)
0.00
0.01
0.02
0.03
0.04
0.05
0.06
Arsenic (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
Cadmium (mg/L)
0.0
5.0e-5
1.0e-4
1.5e-4
2.0e-4
2.5e-4
3.0e-4
3.5e-4
Chromium (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
Copper (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
Iron (mg/L)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Lead (mg/L)
0.00000
0.00005
0.00010
0.00015
0.00020
0.00025
0.00030
Molybdenum (mg/L)
0.00
0.01
0.02
0.03
0.04
Nickel (mg/L)
0.000
0.002
0.004
0.006
0.008
0.010
Selenium (mg/L)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
Zinc (mg/L)
0.000
0.005
0.010
0.015
0.020
0.025
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

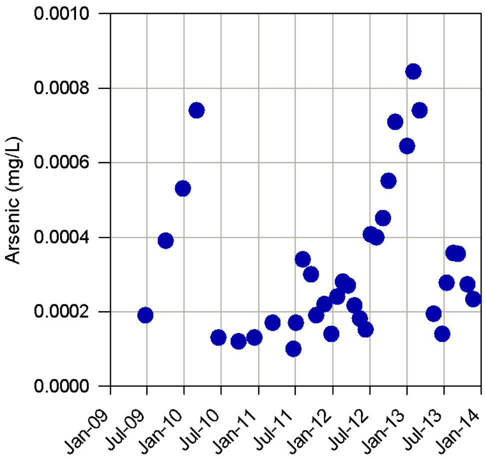
MW06-12S

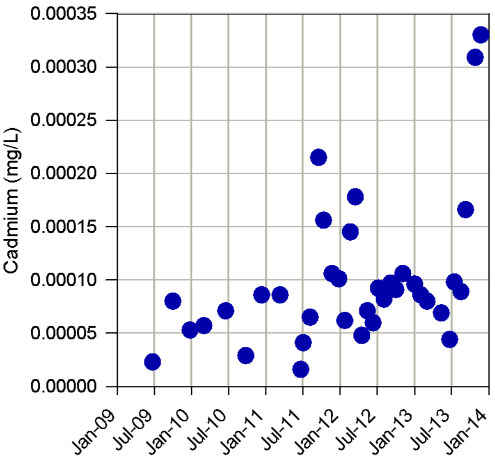

Parameter Concentration
Parameter Concentration less than Detection
Baseline Average Concentration
Baseline 95th Percentile Concentration
Conductivity (mg/L)
0
200
400
600
800
1000
1200
Hardness (mg/L)
300
320
340
360
380
400
420
440
Total Alkalinity (mg/L as $CaCO_3$ units)
110
120
130
140
150
160
pH
7.6
7.8
8.0
8.2
8.4
8.6
Total Suspended Solids (mg/L)
0
50
100
150
200
250
300
Turbidity (NTU)
0
20
40
60
80
100
120
140
160
Fluoride (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Sulphate (mg/L)
0
100
200
300
400
500
Ammonia (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
Nitrate (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Nitrite (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

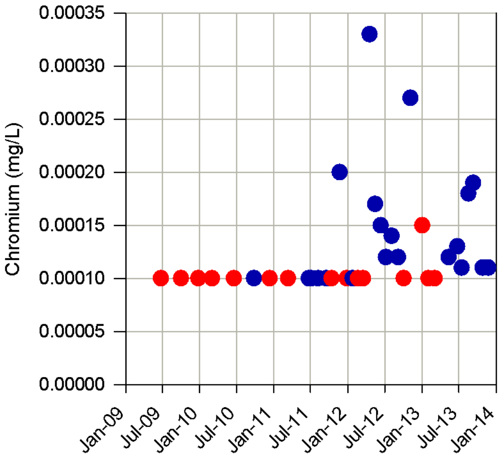
MW06-13

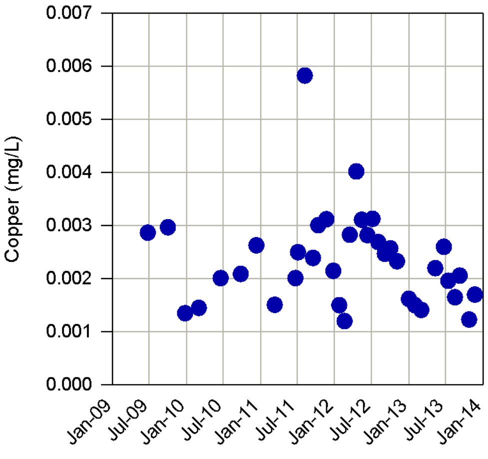
● Parameter Concentration
🔴 Parameter Concentration less than Detection
— Baseline Average Concentration
- - - Baseline 95th Percentile Concentration

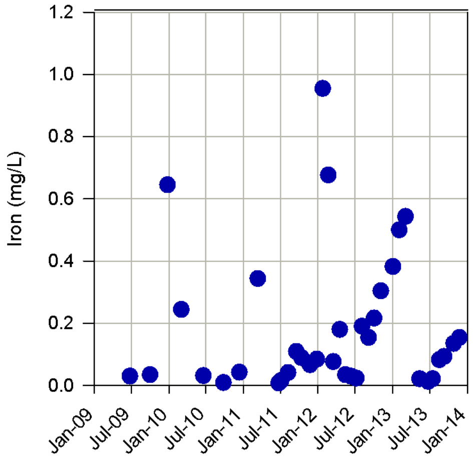


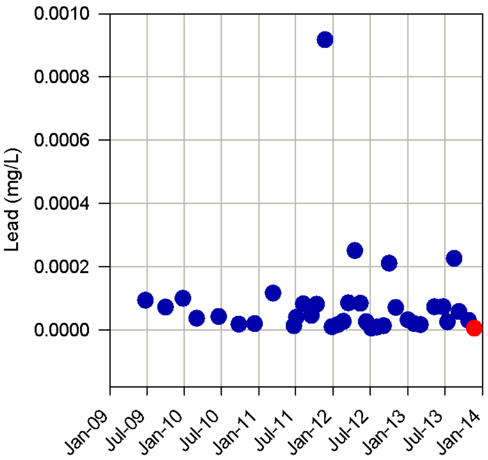


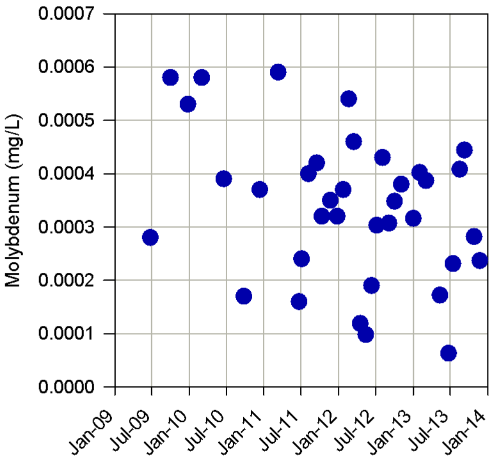


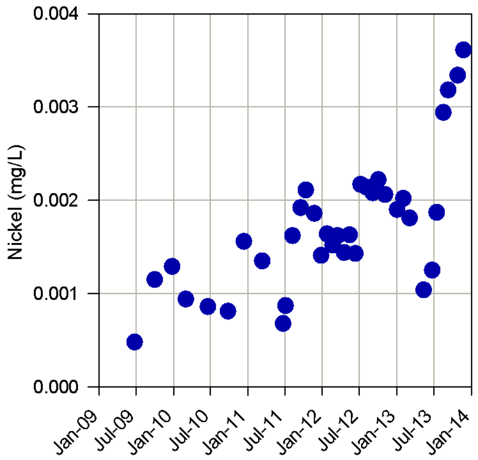


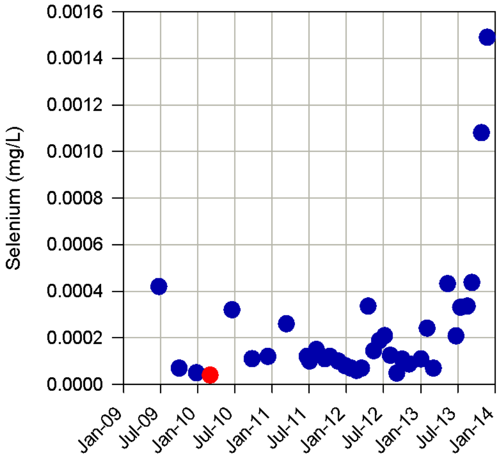


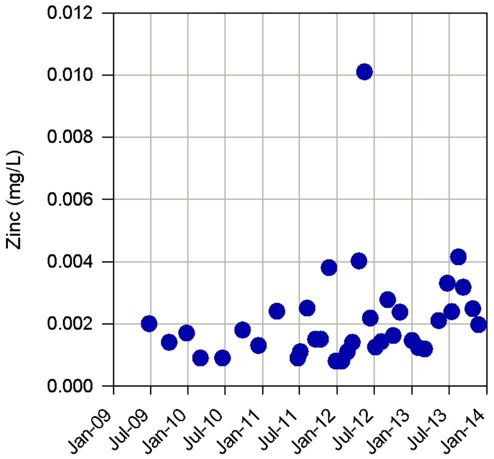






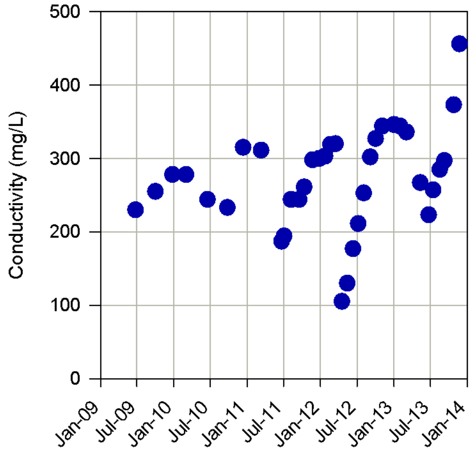


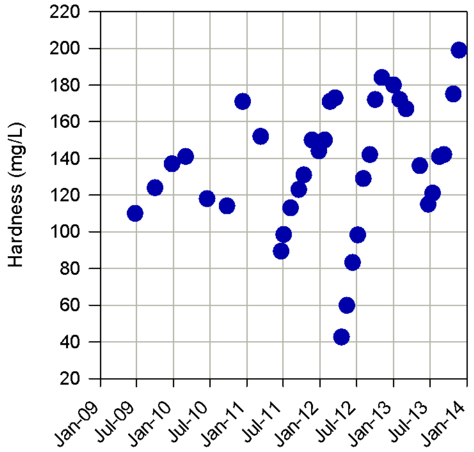


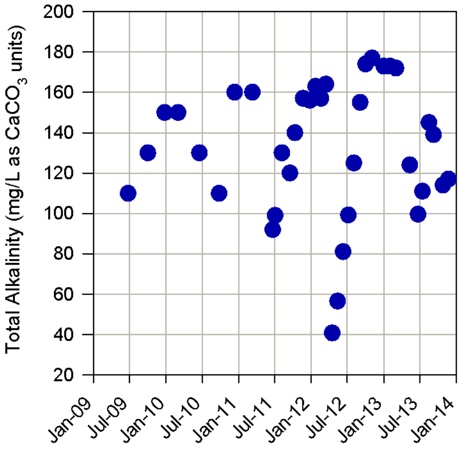


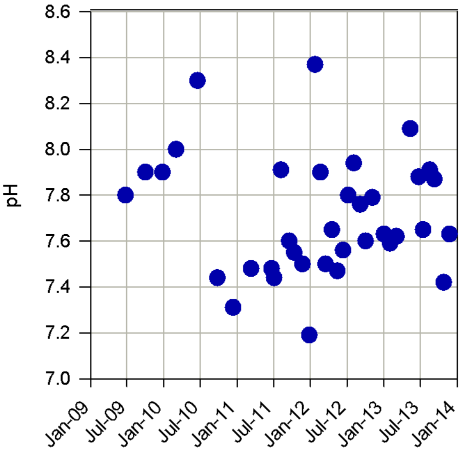
MW06-13

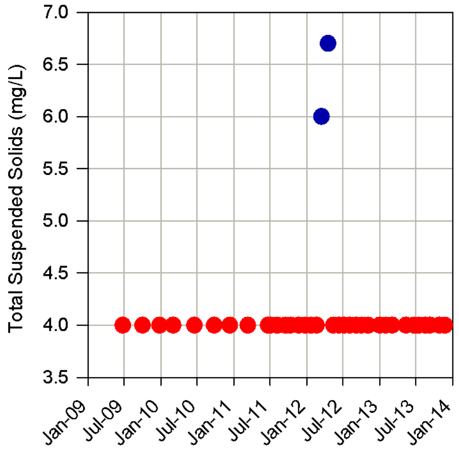
● Parameter Concentration
● Parameter Concentration less than Detection
— Baseline Average Concentration
- - - Baseline 95th Percentile Concentration

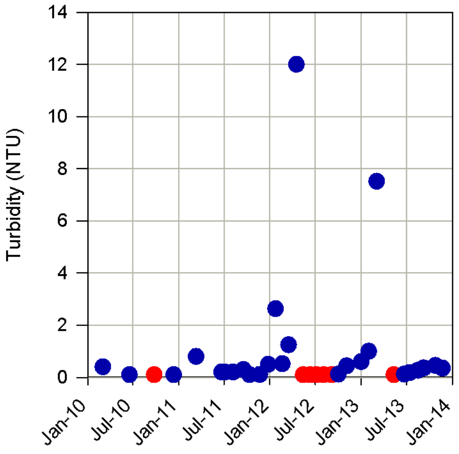


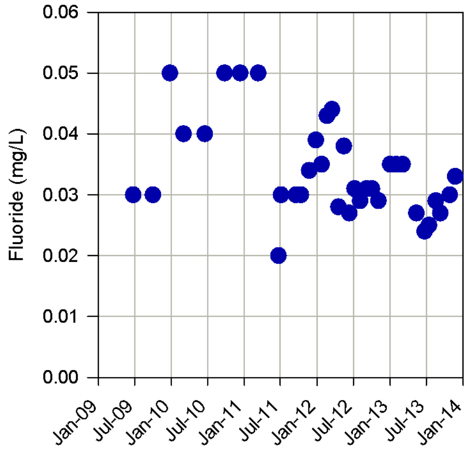


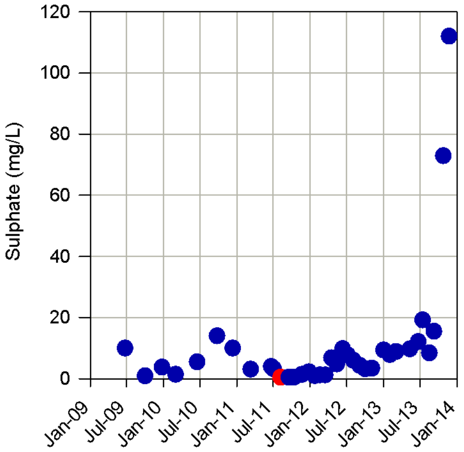


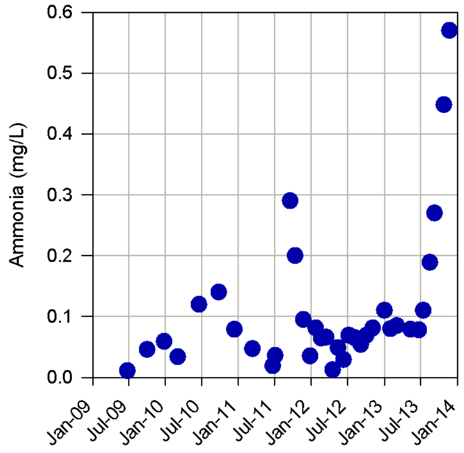


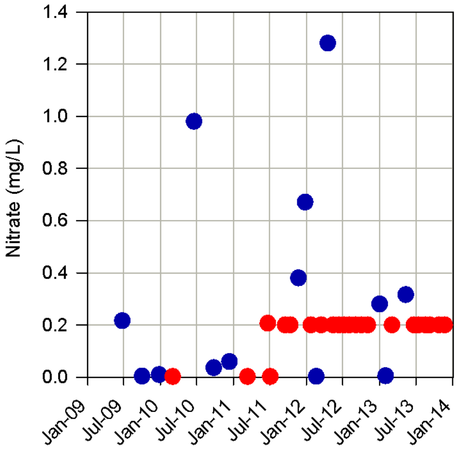


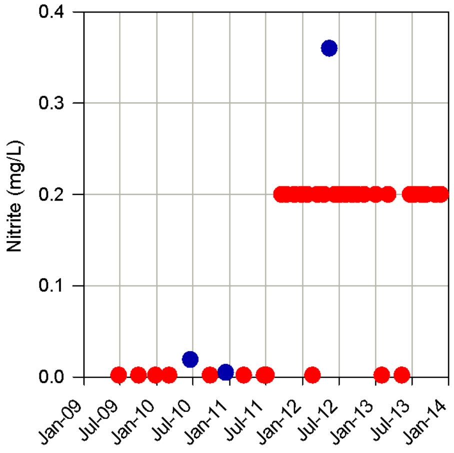






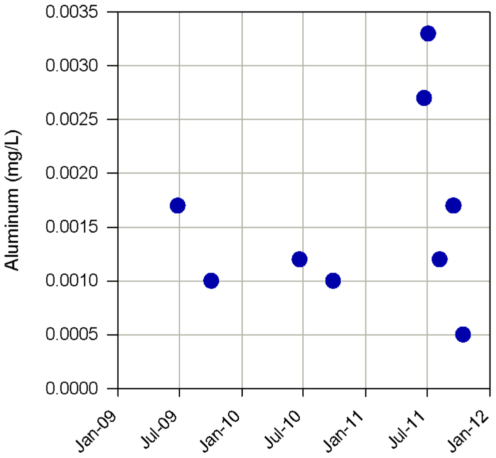


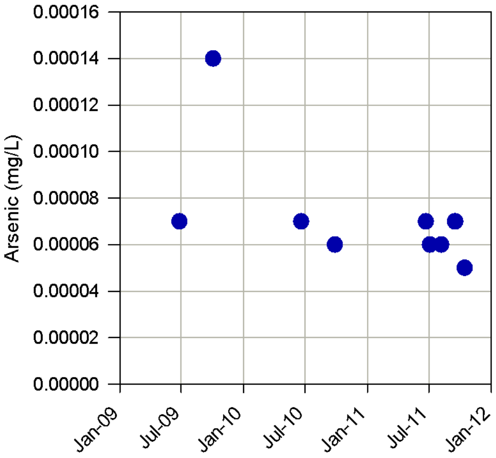


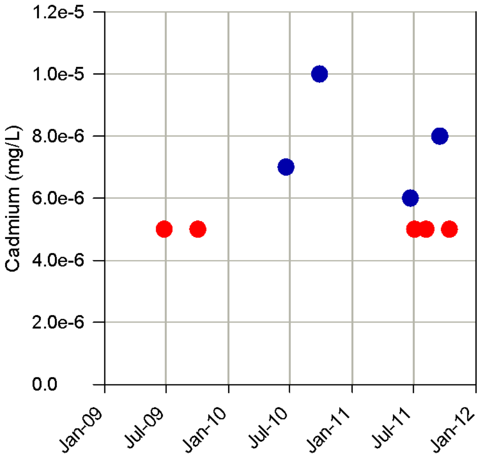


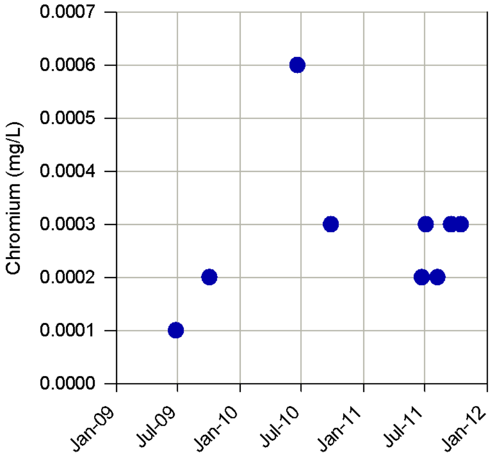
MW06-14

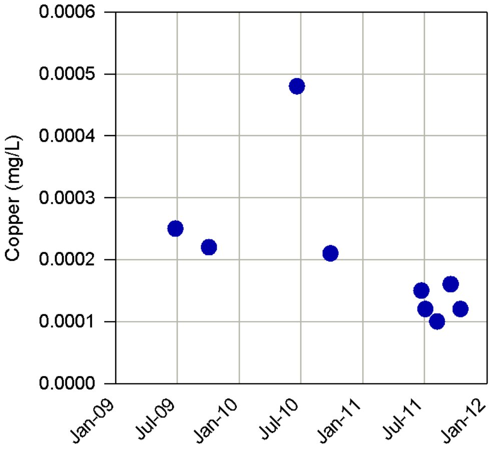
● Parameter Concentration
● Parameter Concentration less than Detection
— Baseline Average Concentration
- - - Baseline 95th Percentile Concentration

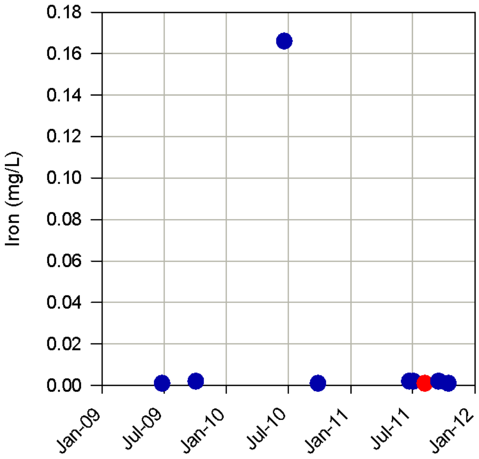


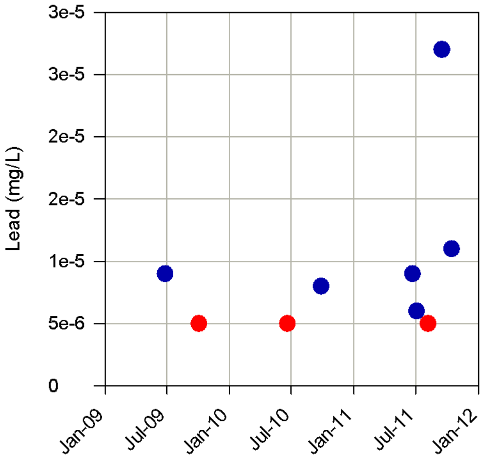


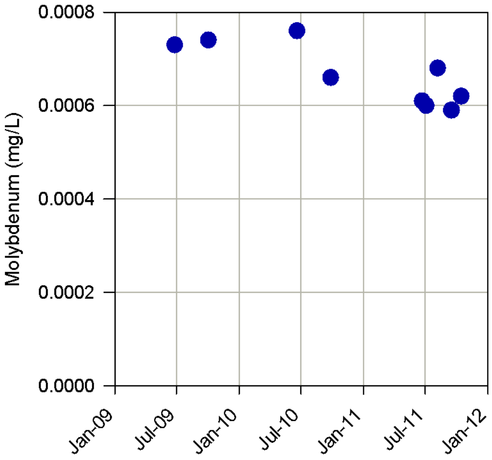


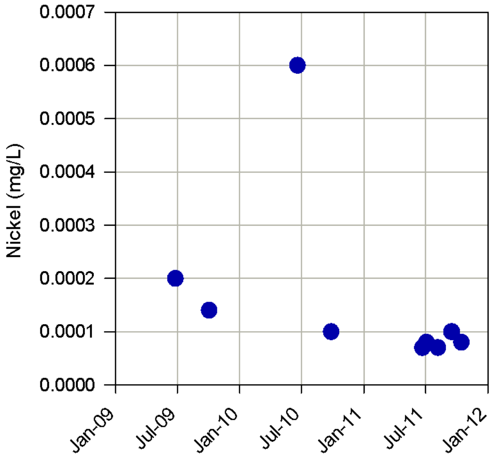


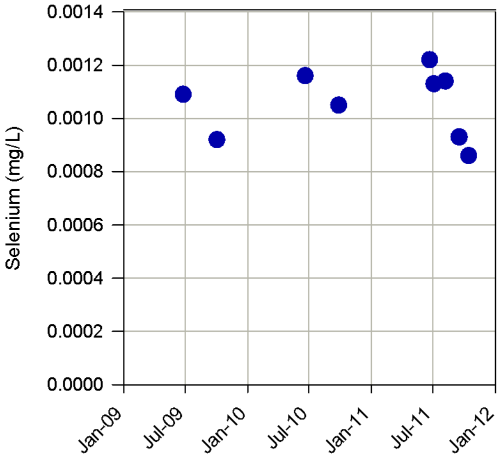


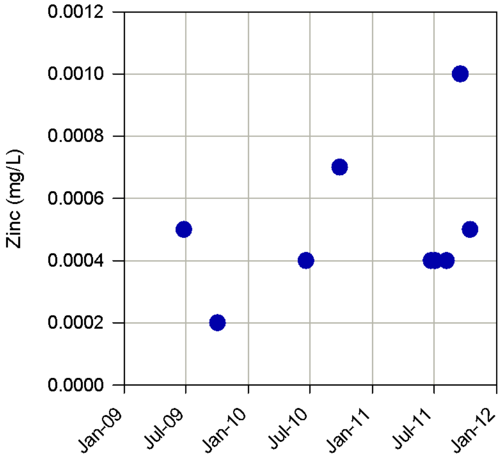






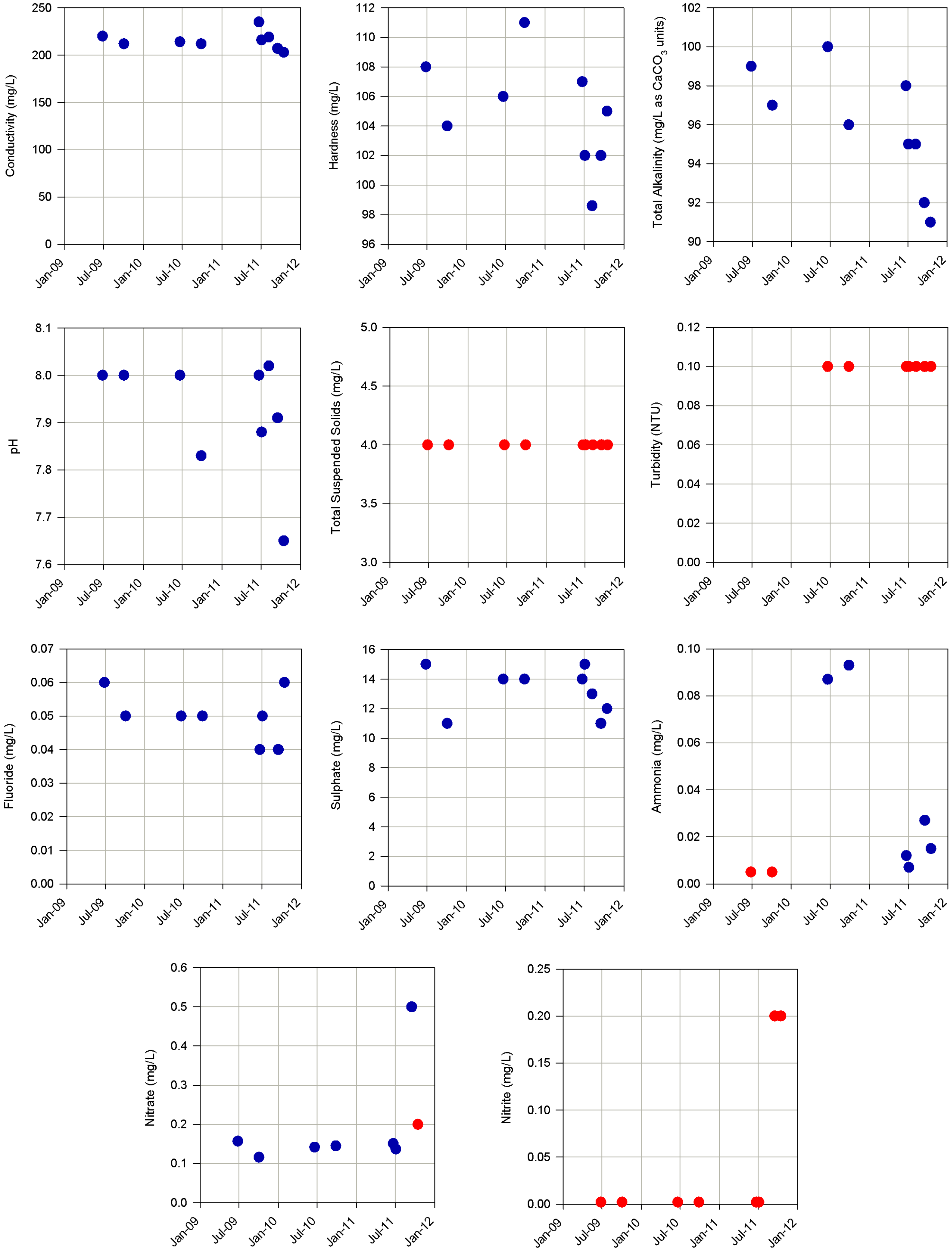




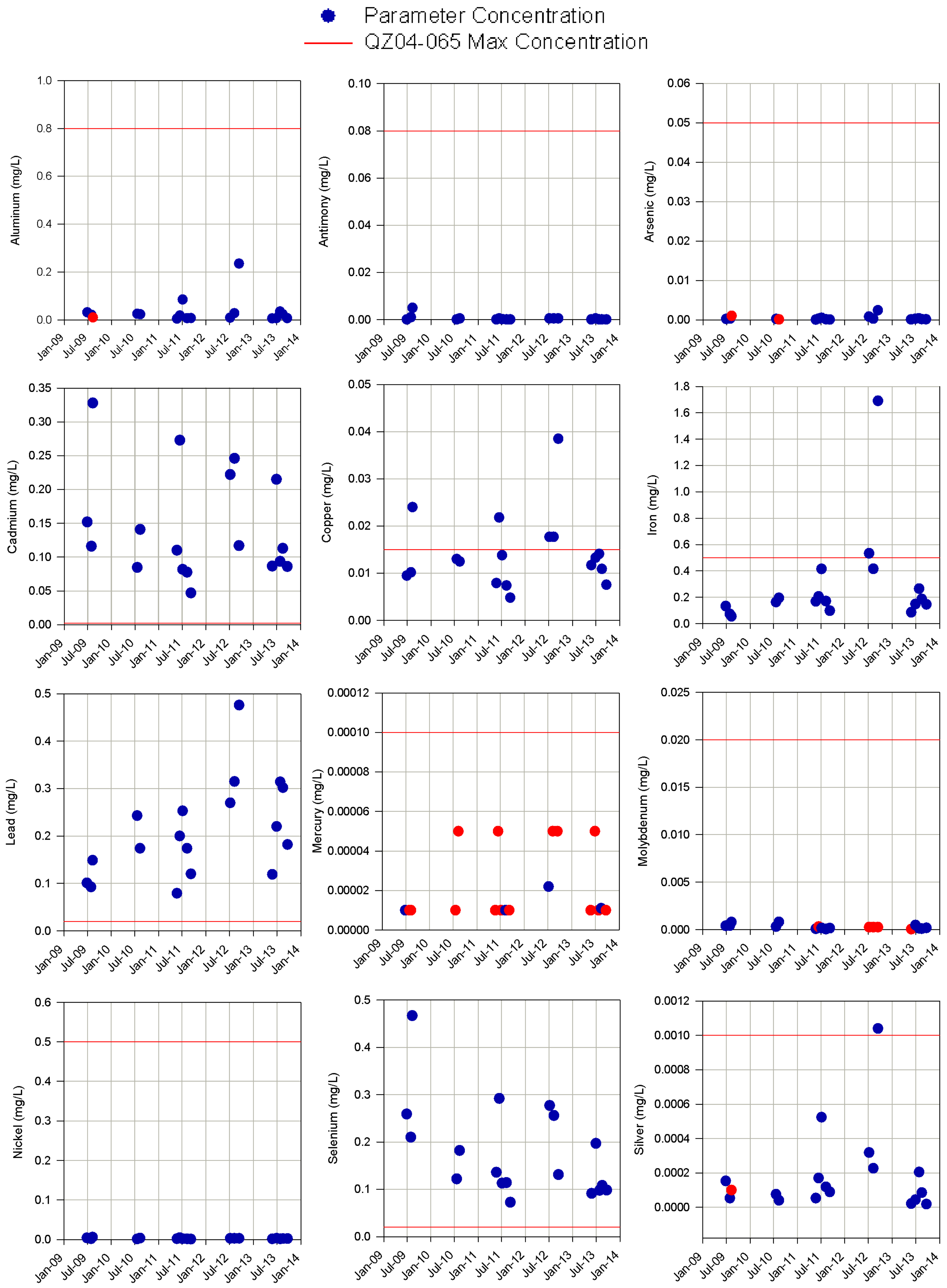


MW06-14

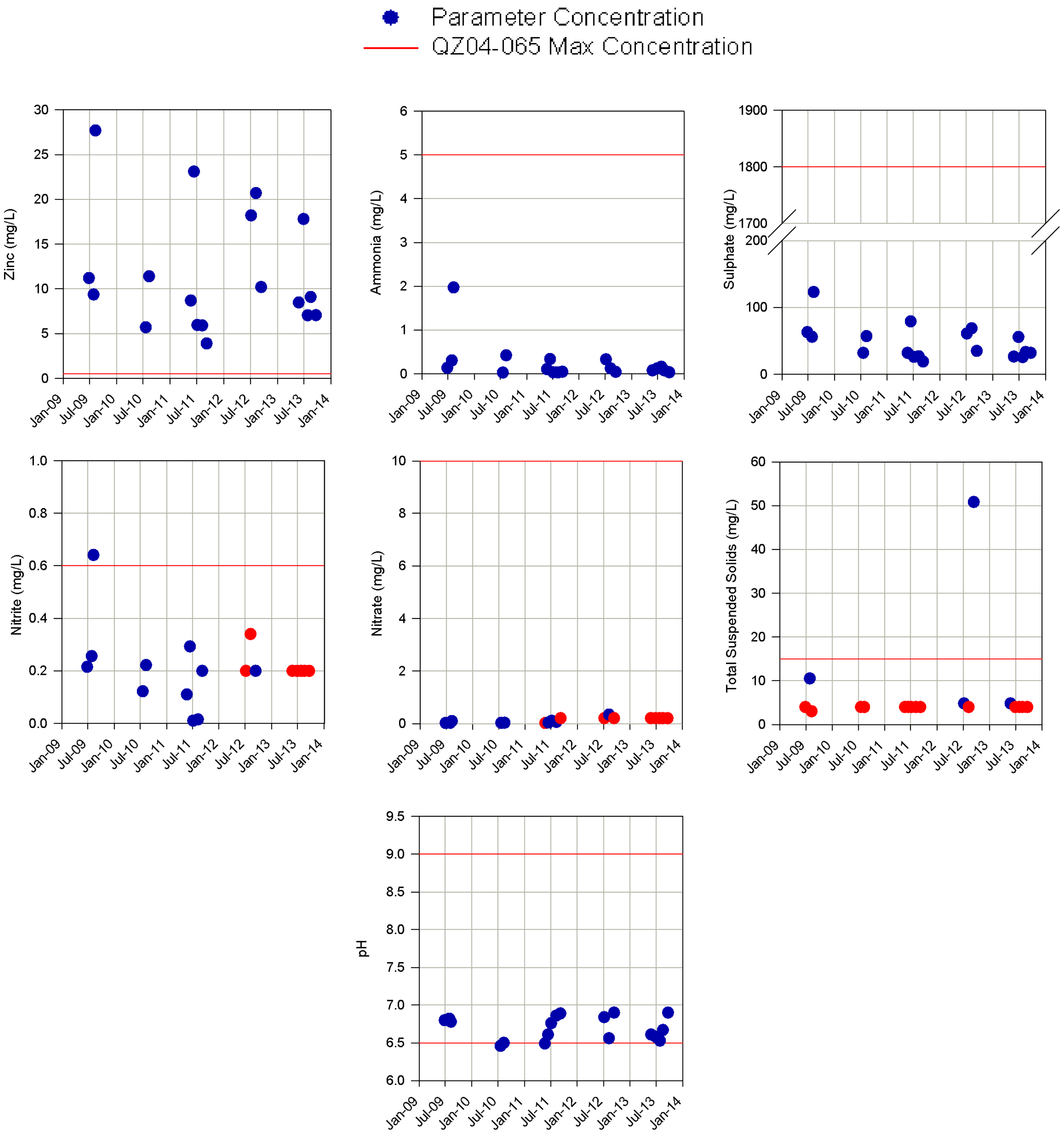
🔵 Parameter Concentration
🔴 Parameter Concentration less than Detection
— Baseline Average Concentration
- - - Baseline 95th Percentile Concentration



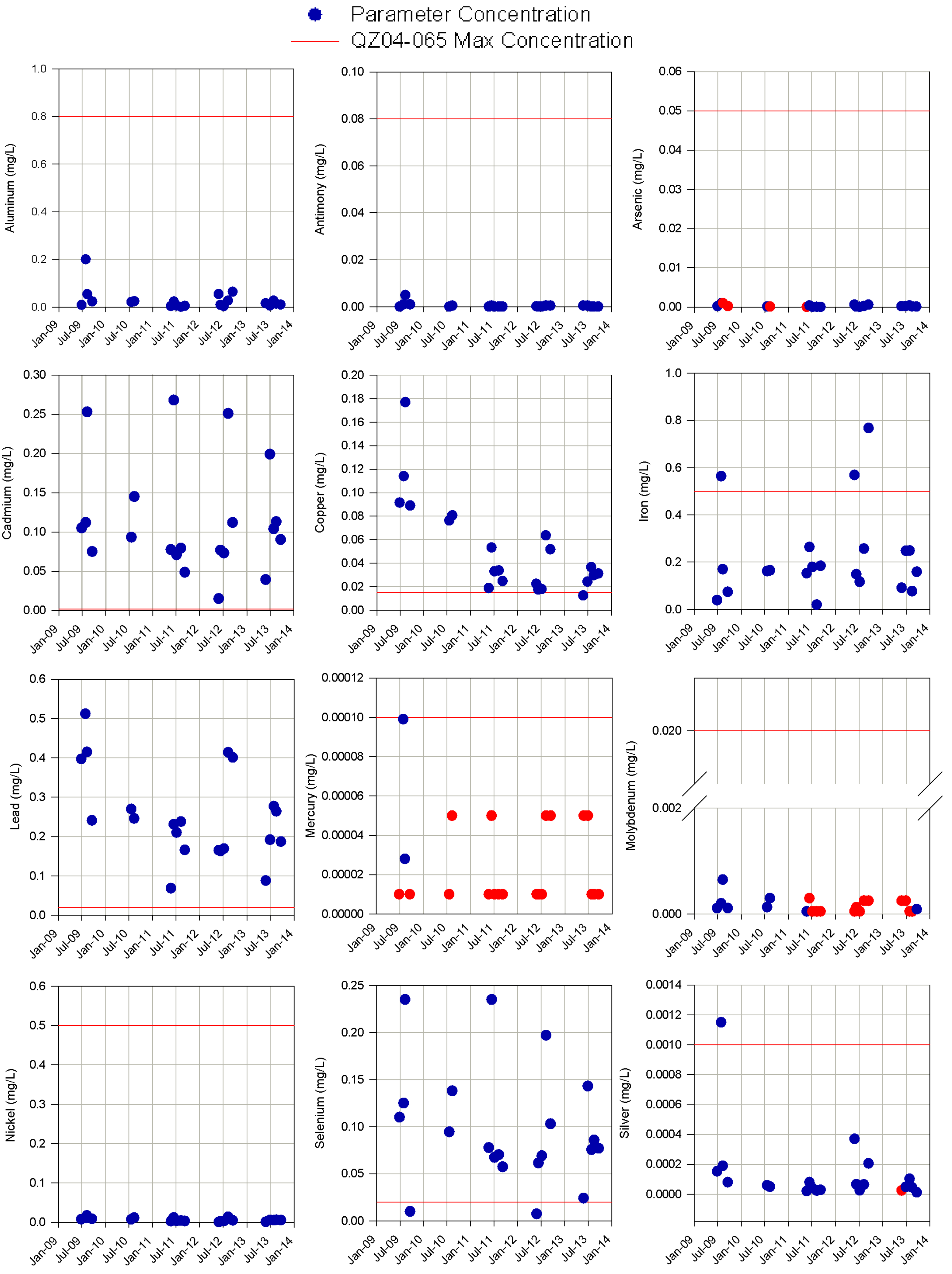
Lysimeter A


Parameter Concentration
QZ04-065 Max Concentration
Aluminum (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
Antimony (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
Arsenic (mg/L)
0.00
0.01
0.02
0.03
0.04
0.05
0.06
Cadmium (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
Copper (mg/L)
0.00
0.01
0.02
0.03
0.04
0.05
Iron (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
Lead (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
Mercury (mg/L)
0.00000
0.00002
0.00004
0.00006
0.00008
0.00010
0.00012
Molybdenum (mg/L)
0.000
0.005
0.010
0.015
0.020
0.025
Nickel (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Selenium (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
Silver (mg/L)
0.0000
0.0002
0.0004
0.0006
0.0008
0.0010
0.0012
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

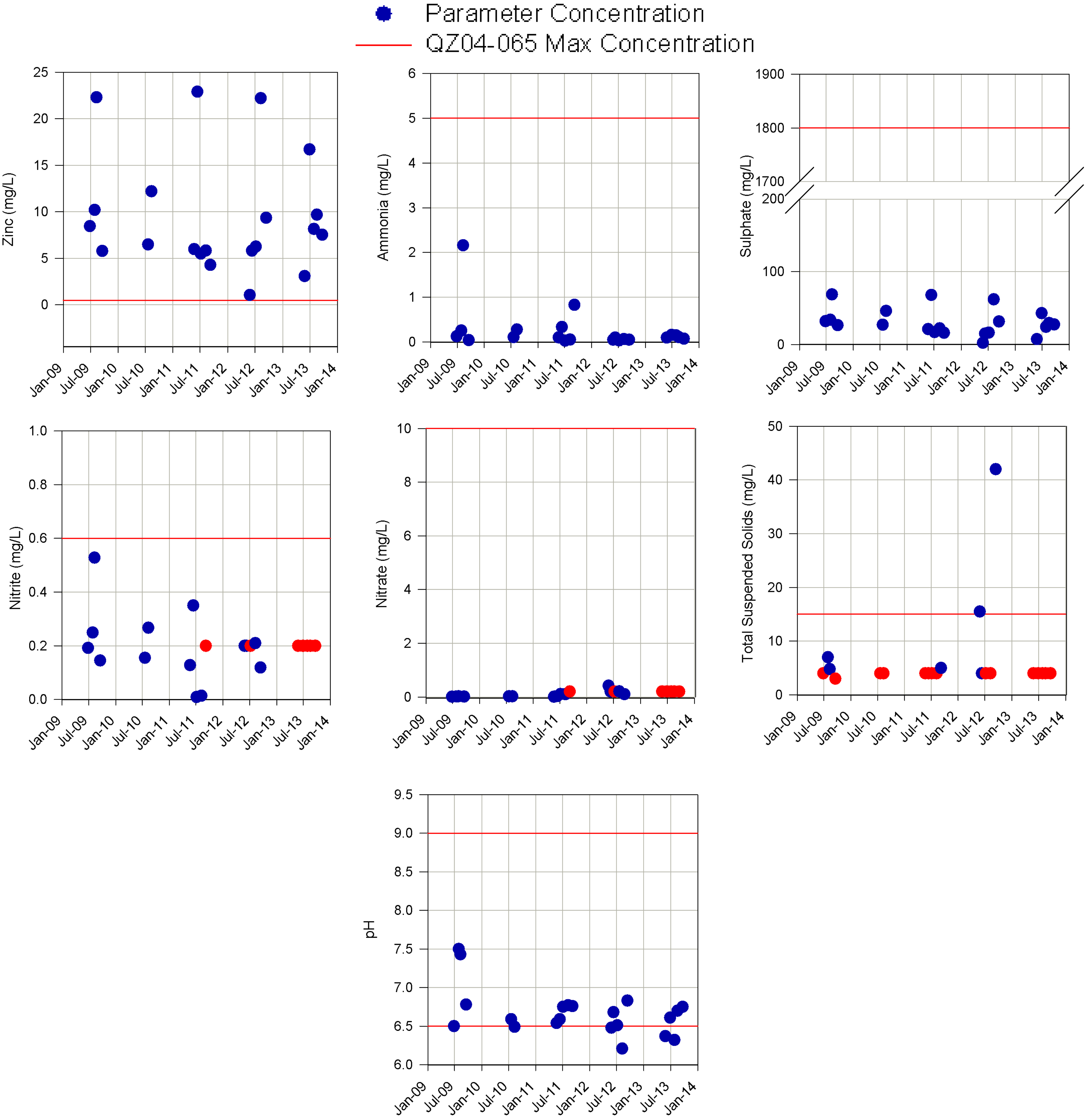
Lysimeter A


● Parameter Concentration
QZ04-065 Max Concentration
Zinc (mg/L)
0
5
10
15
20
25
30
Ammonia (mg/L)
0
1
2
3
4
5
6
Sulphate (mg/L)
0
100
200
1700
1800
1900
Nitrite (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
Nitrate (mg/L)
0
2
4
6
8
10
Total Suspended Solids (mg/L)
0
10
20
30
40
50
60
pH
6.0
6.5
7.0
7.5
8.0
8.5
9.0
9.5
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

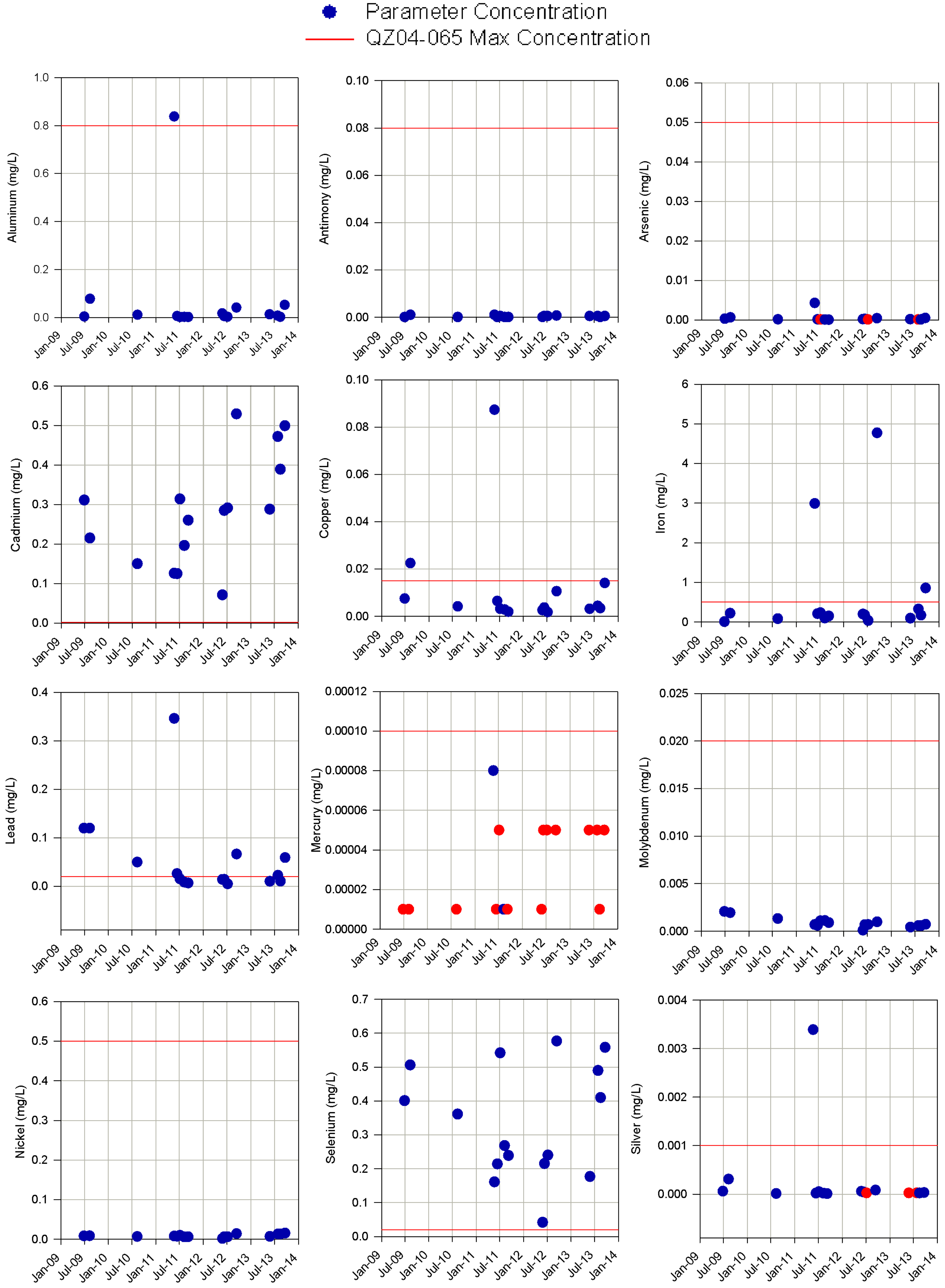
Lysimeter B


● Parameter Concentration
QZ04-065 Max Concentration
Aluminum (mg/L)
1.0
0.8
0.6
0.4
0.2
0.0
Antimony (mg/L)
0.10
0.08
0.06
0.04
0.02
0.00
Arsenic (mg/L)
0.06
0.05
0.04
0.03
0.02
0.01
0.00
Cadmium (mg/L)
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Copper (mg/L)
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
Iron (mg/L)
1.0
0.8
0.6
0.4
0.2
0.0
Lead (mg/L)
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Mercury (mg/L)
0.00012
0.00010
0.00008
0.00006
0.00004
0.00002
0.00000
Molybdenum (mg/L)
0.020
0.002
0.000
Nickel (mg/L)
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Selenium (mg/L)
0.25
0.20
0.15
0.10
0.05
0.00
Silver (mg/L)
0.0014
0.0012
0.0010
0.0008
0.0006
0.0004
0.0002
0.0000
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

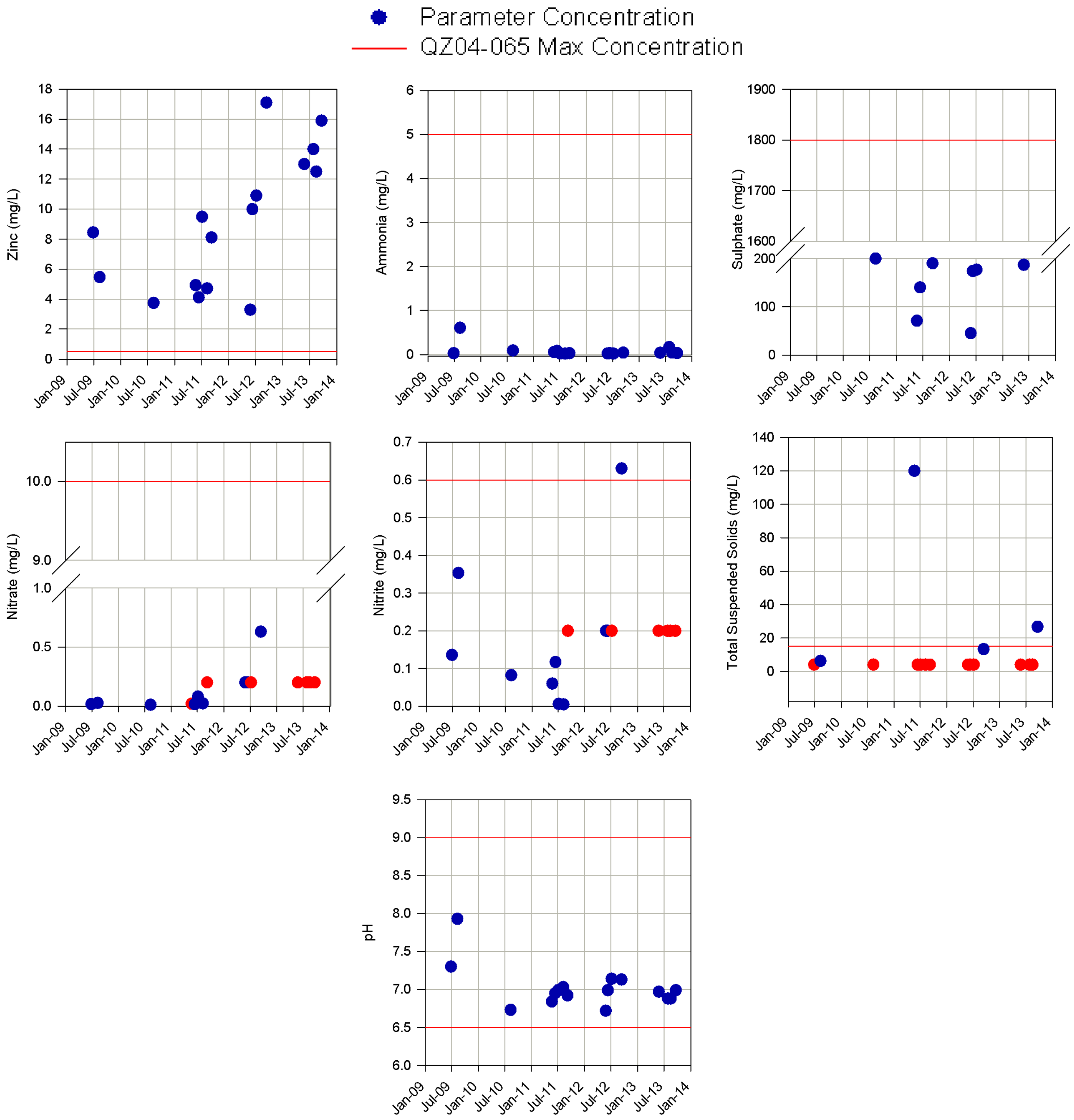
Lysimeter B


● Parameter Concentration
QZ04-065 Max Concentration
Zinc (mg/L)
0
5
10
15
20
25
Ammonia (mg/L)
0
1
2
3
4
5
6
Sulphate (mg/L)
0
100
200
1700
1800
1900
Nitrite (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
Nitrate (mg/L)
0
2
4
6
8
10
Total Suspended Solids (mg/L)
0
10
20
30
40
50
pH
6.0
6.5
7.0
7.5
8.0
8.5
9.0
9.5
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

Lysimeter C


Parameter Concentration
QZ04-065 Max Concentration
Aluminum (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
Antimony (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
Arsenic (mg/L)
0.00
0.01
0.02
0.03
0.04
0.05
0.06
Cadmium (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Copper (mg/L)
0.00
0.02
0.04
0.06
0.08
0.10
Iron (mg/L)
0
1
2
3
4
5
6
Lead (mg/L)
0.0
0.1
0.2
0.3
0.4
Mercury (mg/L)
0.00000
0.00002
0.00004
0.00006
0.00008
0.00010
0.00012
Molybdenum (mg/L)
0.000
0.005
0.010
0.015
0.020
0.025
Nickel (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Selenium (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Silver (mg/L)
0.000
0.001
0.002
0.003
0.004
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

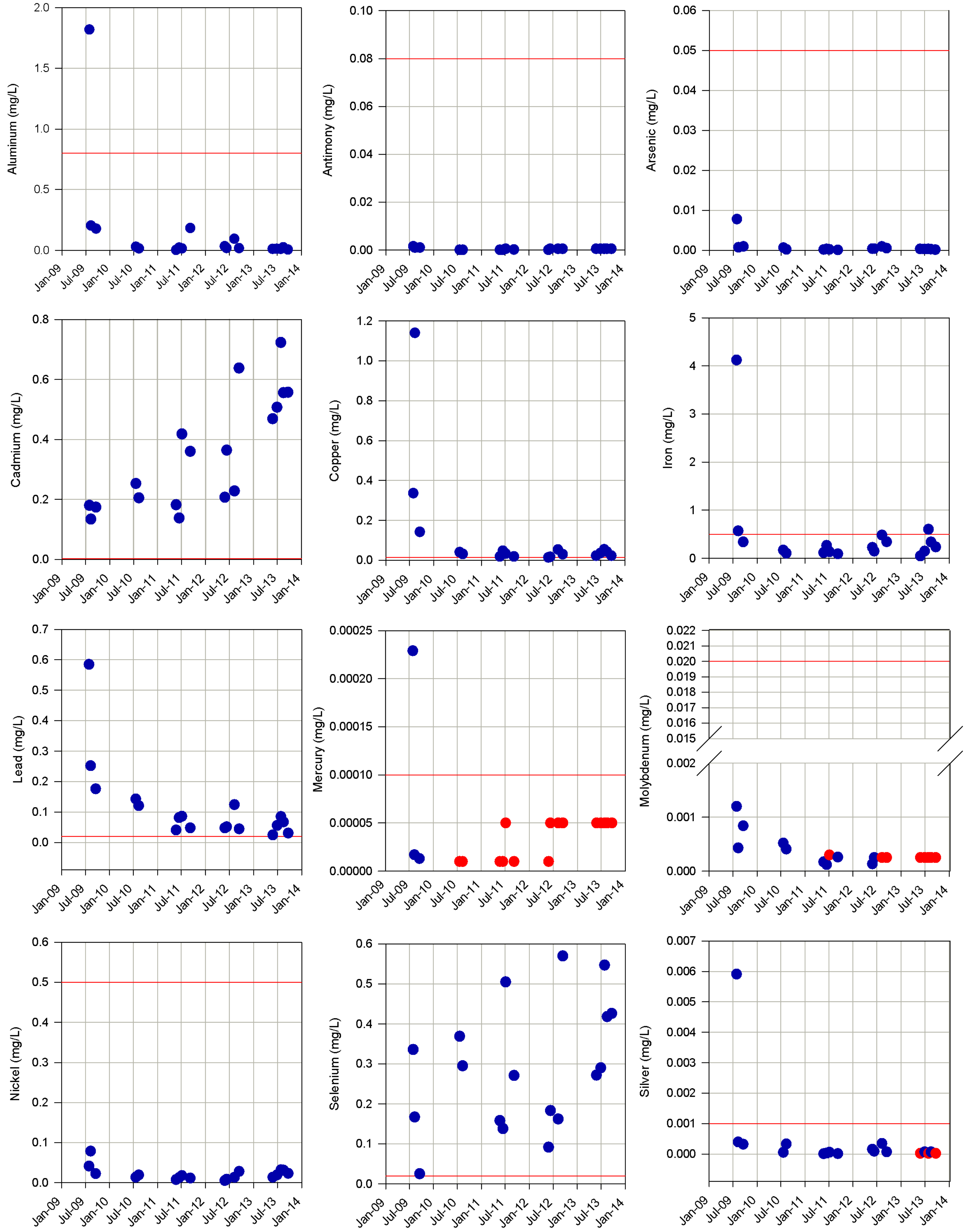
Lysimeter C


● Parameter Concentration
QZ04-065 Max Concentration
Zinc (mg/L)
0
2
4
6
8
10
12
14
16
18
Ammonia (mg/L)
0
1
2
3
4
5
6
Sulphate (mg/L)
0
100
200
1600
1700
1800
1900
Nitrate (mg/L)
0.0
0.5
1.0
9.0
10.0
Nitrite (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Total Suspended Solids (mg/L)
0
20
40
60
80
100
120
140
pH
6.0
6.5
7.0
7.5
8.0
8.5
9.0
9.5
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

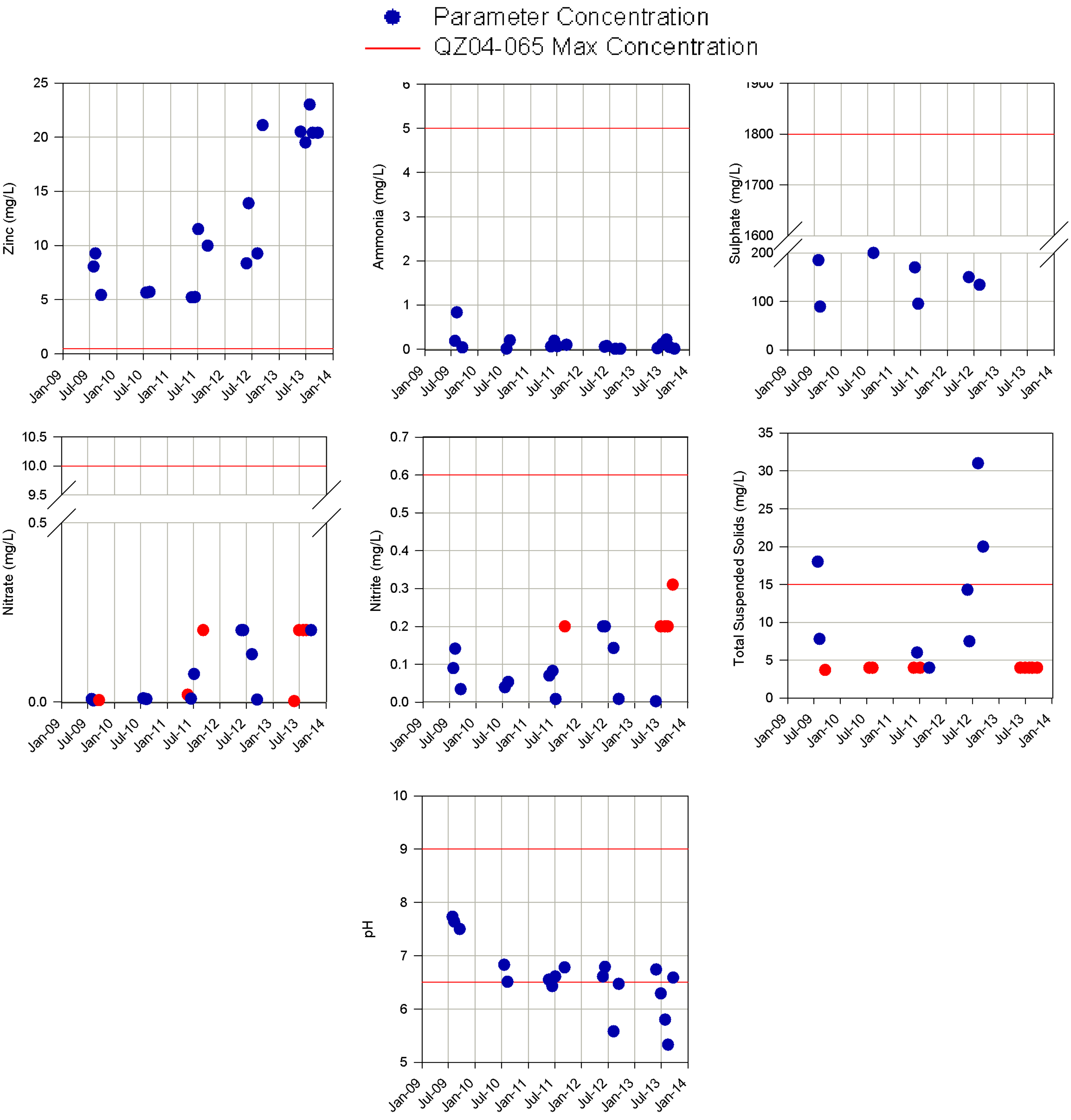
Lysimeter D

● Parameter Concentration

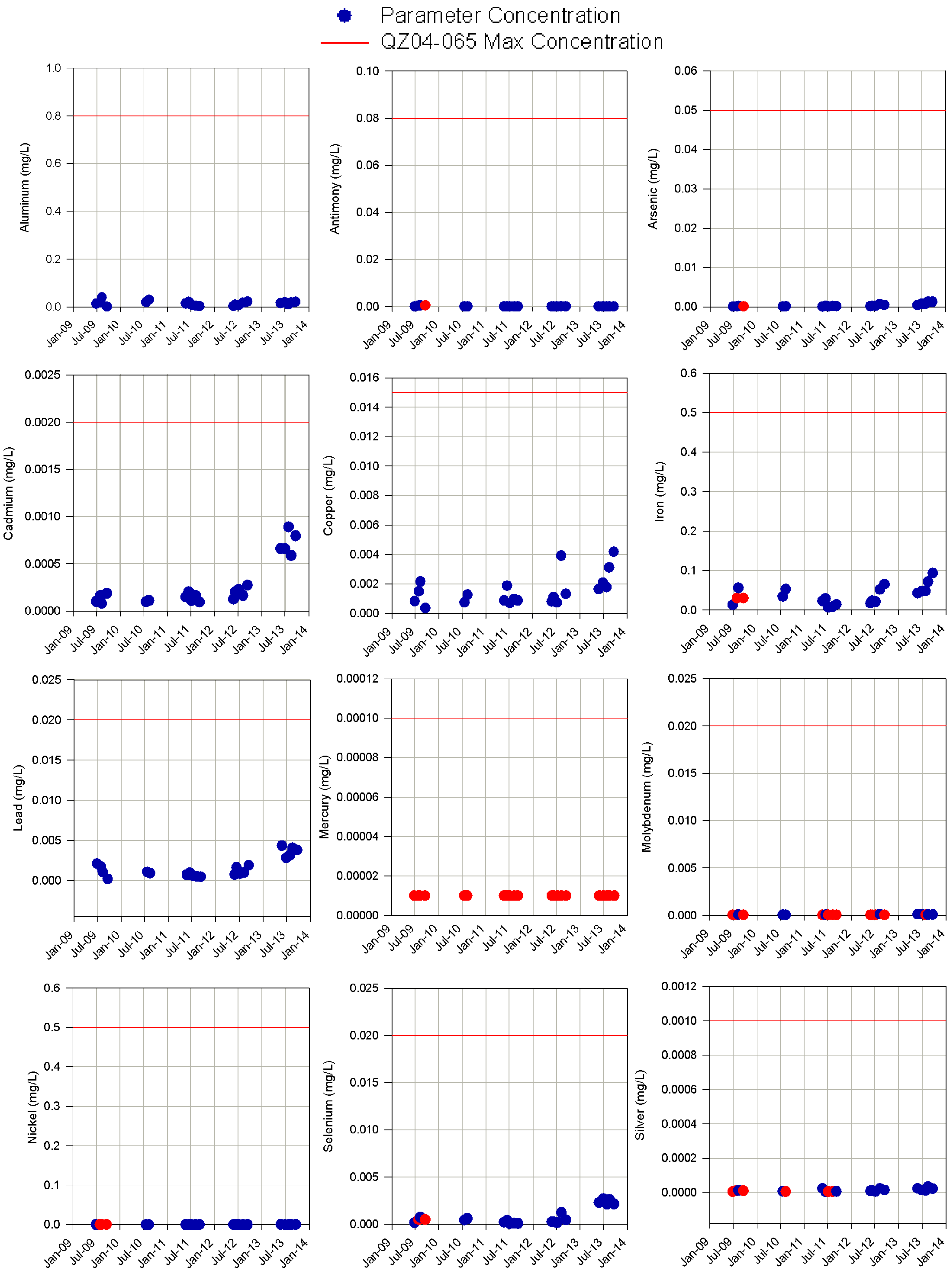
— QZ04-065 Max Concentration



Lysimeter D


Parameter Concentration
QZ04-065 Max Concentration
Zinc (mg/L)
0
5
10
15
20
25
Ammonia (mg/L)
0
1
2
3
4
5
6
Sulphate (mg/L)
0
100
200
1600
1700
1800
1900
Nitrate (mg/L)
0.0
0.5
9.5
10.0
10.5
Nitrite (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Total Suspended Solids (mg/L)
0
5
10
15
20
25
30
35
pH
5
6
7
8
9
10
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

Lysimeter E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0.8
0.6
0.4
0.2
0.0
Antimony (mg/L)
0.10
0.08
0.06
0.04
0.02
0.00
Arsenic (mg/L)
0.06
0.05
0.04
0.03
0.02
0.01
0.00
Cadmium (mg/L)
0.0025
0.0020
0.0015
0.0010
0.0005
0.0000
Copper (mg/L)
0.016
0.014
0.012
0.010
0.008
0.006
0.004
0.002
0.000
Iron (mg/L)
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Lead (mg/L)
0.025
0.020
0.015
0.010
0.005
0.000
Mercury (mg/L)
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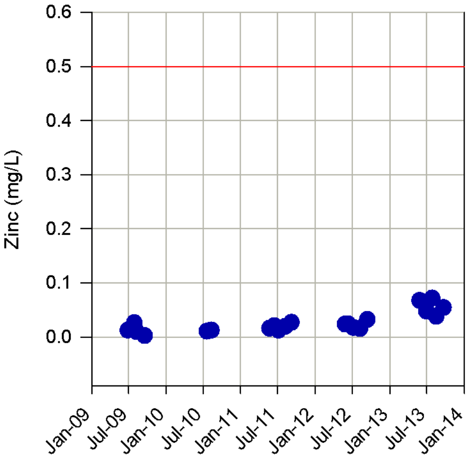
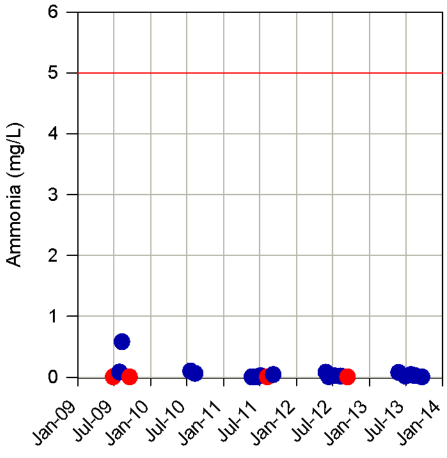
0.00010
0.00008
0.00006
0.00004
0.00002
0.00000
Molybdenum (mg/L)
0.025
0.020
0.015
0.010
0.005
0.000
Nickel (mg/L)
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Selenium (mg/L)
0.025
0.020
0.015
0.010
0.005
0.000
Silver (mg/L)
0.0012
0.0010
0.0008
0.0006
0.0004
0.0002
0.0000
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14

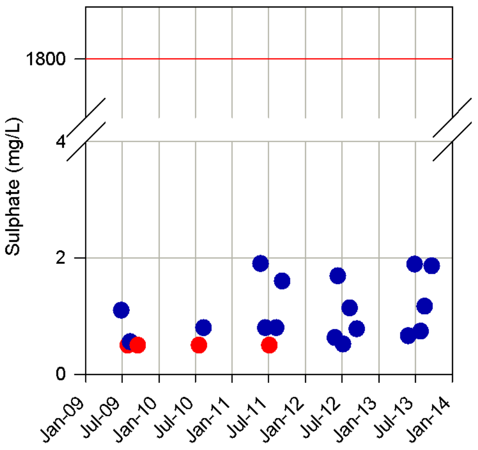
Lysimeter E

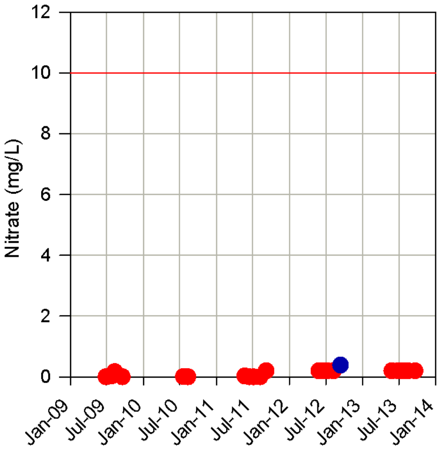
● Parameter Concentration

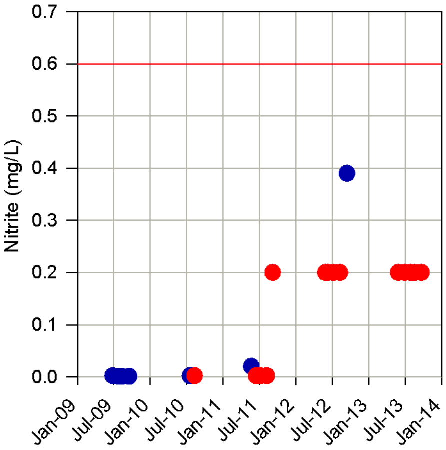
QZ04-065 Max Concentration

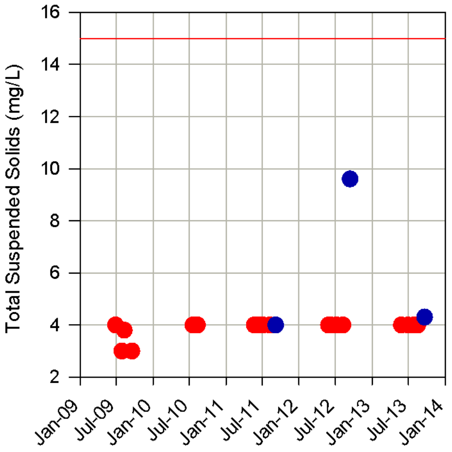


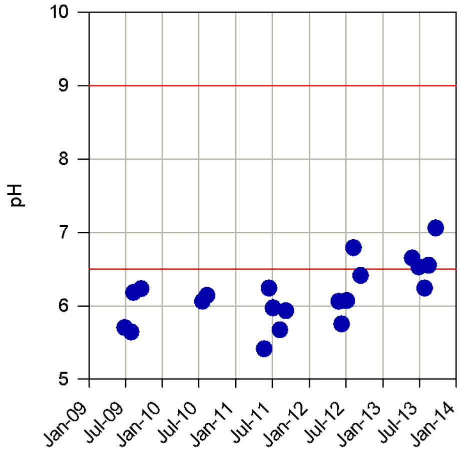












March 20, 2013
TC53920

Robin McCall
Yukon Zinc Corporation
701-475 Howe Street
Vancouver BC
V6C 2B3

Dear Mr. McCall:

Re: Wolverine Project Update: Shutdown of Seven Remaining Humidity Cells

1.0 INTRODUCTION

This report summarizes the final leach data of the remaining seven humidity cells from the Wolverine Project humidity cell testing program. Results from the humidity cells were last reported in March 2011 (AMEC, 2011). Following recommendations made in November of 2008 (AMEC, 2008) 17 cells were shut down on February 19, 2009, and the operation of seven cells were continued up to January 2012 (Table 1).

The remaining seven humidity test cells consisted of four mine rock humidity cells (HC 4, HC 6, HC 7 and HC 10), one NP-depleted ore cell (HC 21) and two tailings paste backfill cells (T1 and T2).

Release rates were calculated based on the measured concentrations and volumes of leachate produced weekly by each cell. Long-term rates were determined for steady-state conditions that excluded the initial 20 weeks of data to account for the flushing of oxidation products in the samples that may have accumulated prior to testing.

Termination of the seven cells followed standard procedures as outlined in the document *Draft Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia* (Price, 1997). After the last cycle of the humidity cell testing, the closedown procedure involved a high volume final rinse to account for the retention and/or accumulation of weathering products over time. The detectable retained products of the final rinse were then distributed evenly over all weeks of testing; assuming the weekly amount of retained product was constant over the testing period.

Results for pH, and calculated loadings for sulphate, alkalinity, acidity and regulated metals, plus carbonate molar ratios for each material type are discussed in the following sections and shown in Figures 1 to 48.

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2.0 HUMIDITY CELL SHUTDOWN RESULTS

2.1 Static Testing – ABA and Elemental Analysis

Initial acid-base accounting (ABA) analyses were conducted at the ALS Chemex laboratory in Burnaby, BC. Humidity cells were operated by SGS CEMI of Burnaby, BC. For consistency, after the final rinse of the humidity cells by SGS CEMI, subsamples of the humidity cell solids were sent to ALS Chemex for final ABA analyses and the results are provided in Table 2. The following section describes the results of the final ABA analyses in comparison to the initial test results.

Paste pH

The initial and final values for the paste pH of the HC 6 (Excp-3) sample were identical, with a value of 7.7. The paste pH of the waste rock samples HC 4 (Footwall Rhyolite-3) and HC 7 (Argillite-2) decreased by 2.8-3.6 pH units over the course of the testing period, with a final paste pH of 4.0 and 5.2 respectively. The paste pH of HC 10 increased from 7.9 at the commencement of testing, to 8.2 at the time of closeout.

The NP depleted ore sample (HC 21) had a paste pH of 3.6 following the decommissioning of the cell. The initial paste pH of HC 15 was used as a general comparison to the ore sample in HC 21, resulting in a decrease of 4.4 pH units (final paste pH of 3.6) over the testing period.

The initial measured paste pH of the tailings paste backfill samples T1 and T2 were 8.3 and 7.9, respectively, while the final measured paste pH of the humidity cell materials were both 7.8.

Forms of Sulphur

Total sulphur, sulphate sulphur and sulphide sulphur for both initial and final analyses are presented in Table 2. In general, total sulphur content decreased by 0.5 to 9.5% in all humidity cell material. The initial sulphide sulphur content was elevated relative to the final sulphide sulphur content for all waste rock humidity cell material.

Final sulphate content for material from HC 4, 6 and 7 were slightly higher than the initial values (0.03-0.07% increase) and sulphide content for the same cells declined relative to initial values (0.7 to 0.9% decrease), suggesting that sulphide oxidation may have occurred.

Values for total sulphur and sulphide sulphur content decreased by 9.5 and 10.8%, respectively for the NP depleted ore cell (HC 21) material. The sulphate values for the HC 21 material increased by 0.3% over the testing period relative to the initial values.

Total sulphur content in the backfill material (T1 and T2 cells) decreased by 1.25-2.25%, whereas initial and final sulphide sulphur content remained relatively similar. The initial concentrations of sulphate were 1.2% and 1.0%, and both decreased to 0.1% sulphate at the time of closeout. The backfill material had large proportions of pyrite, however evidence suggests that little sulphide oxidation occurred. The decline in sulphate content within the material may be related to the elevated sulphate loadings observed within the initial 100 weeks (ranged from 50-700 mg/kg/wk) (Figure 36).

The acid potential (AP) in the final humidity cell material was less than the initial AP values for all cells. The final AP values for humidity cell material from HC 4, 6, 7 and 10 were 9-29 kg $CaCO_3$/tonne lower than the initial material, and were likely a result of sulphide oxidation. The AP value for the NP depleted ore sample (HC 21) was initially 413 kg $CaCO_3$/tonne, while the final AP was 73 kg $CaCO_3$/tonne. The substantial loss in AP for the NP depleted cell is likely attributed to accelerated loss of sulphur after the onset of acidic conditions. The AP values for the backfill material in cells T1 and T2 decreased from 608 and 586 kg $CaCO_3$/tonne to 553 and 550 kg $CaCO_3$/tonne, respectively.

Forms of Neutralization Potential

In general the initial values for NP were significantly higher than the NP values for the final residues, and decreased by 13.5-112.5 kg $CaCO_3$/tonne for all materials.

The initial NP for HC 4 material decreased by 93%, from 19 kg/$CaCO_3$/tonne to 1.4 kg/$CaCO_3$/tonne. The NP depleted cell (HC 21) had a reported decrease in NP of 99.6%, with a final NP of 0.5 kg $CaCO_3$/tonne. The NP values of the tailings cells decrease by 66-68 kg $CaCO_3$/tonne.

At the onset of acidic conditions, approximately 10 kg $CaCO_3$/tonne NP was remaining for HC 4, 13 kg $CaCO_3$/tonne NP was remaining for HC 7, and 1.3 kg $CaCO_3$/tonne NP was remaining for HC 21.

Acid Base Accounting (ABA)

The ratio of NP to AP provides an estimate of the bulk available NP relative to AP, where a value of one indicates that NP content exactly balances AP content. Values less than one indicate AP exceeds NP and values greater than one indicates excess NP. Values of NP/AP much greater than one are preferable and allow for variability in rock composition.

Initial and final NP/AP ratios were compared in Table 2. The initial NP/AP ratios were less than 0.75 for all humidity cells, with the exception of HC 6 (2.52). In general, the final NP/AP ratios were less than the initial NP/AP ratios, and decreased by 0.02-0.34 for all humidity cell samples. All final NP/AP ratios were less than 0.4, with the exception of HC 6 (2.5).

The greatest differences in NP/AP were observed for HCs 4 and 21: HC 4 had an initial NP/AP ratio of 0.17 and a final NP/AP ratio of 0.02, and HC 21 had an initial NP/AP ratio of 0.27 and a final NP/AP ratio of 0.001. In general, the decrease in NP was greater than the decrease in AP for HCs 4, 7 and 21.

Elemental Analyses of Solids

The initial elemental content of the humidity cell material were compared to the elemental content of the humidity cell material after closeout, and are summarized in Table 3. Concentrations of major elements including aluminum, calcium, iron, magnesium and sodium were generally elevated in the initial analyses relative to the elemental content of samples following closeout.

Concentrations of calcium decreased by 2.3-3.3% for the NP depleted ore material (HC 21) and backfill materials (T1 and T2). The backfill materials had 2.5% calcium remaining following termination, which likely contributed to the elevated NP values for these materials. A large decline from initial to final elemental content was observed for cadmium, copper, manganese, zinc and magnesium for the acid generating humidity cell material (HC 4, 7 and 21).

Trace elemental content of the final samples were at times elevated relative to the initial content; the discrepancy is likely due heterogeneity within the soil sample and instrument sensitivity.

2.2 Kinetic Testing

Humidity cell testing was conducted at SGS CEMI (formerly Canadian Environmental and Metallurgical Inc.) according to standard humidity cell procedures outlined in Price (1997). Following the last cycle of the humidity cell operation, the closedown procedure included a high volume final rinse of the cells to remove any weathering products that may have been retained in the sample. Calculated loads of retained products in the final rinse were then distributed evenly over the testing period to revise the weekly loading rates. Humidity cell leachate chemistry was used to determine the release rate of metals and other parameters as a function of time, and to estimate the time to acid rock drainage (ARD) onset.

pH

Measured leachate pH values for HCs 6 and 10 remained fairly constant throughout the testing period and fluctuated around near-neutral pH values (~7). The pH values of HC 4 and HC 7 leachate behaved similarly. The pH values were near-neutral and decreased to 6.5 over approximately 50 weeks, followed by a rapidly decline (over 30-50 weeks) to values below 4. The final pH values measured for HC 4 and HC 7 were 3.8 and 2.8, respectively (Figure 1).

The pH values of the NP-depleted ore sample (HC 21) decreased to acidic conditions within 2.5 years; the last recorded pH value was 2.1 (Figure 16).

The pH values of the two paste backfill humidity cell samples remained circum-neutral throughout the testing period, ranging from 6.5 to 8.2 (Figure 33).

Alkalinity and Acidity

The alkalinity loadings from the mine rock samples HC 6 and HC 10 remained steady throughout the testing duration, and ranged from 12.1 to 51.3 mg/kg/wk (Figure 2). The acidity release rates for the mine rock leachate of the same cells ranged from 0.6 to 6.7 mg/kg/wk (Figure 3).

Alkalinity loadings from HC 4 and HC 7 decreased throughout the testing duration, reaching loads of 0.1 and 0.5 mg/kg/wk, respectively (Figure 2). The acidity release rates increased to 30.6 and 73.9 mg/kg/wk, respectively (Figure 3).

The alkalinity loads from the NP-depleted ore sample (HC 21) decreased to less than the Method Detection Limit (MDL) following 195 weeks (Figure 18). The acidity of HC 21 increased to a maximum loading rate of approximately 2200 mg/kg/wk at the time of termination (Figure 19).

Alkalinity release rates from the paste backfill samples increased slowly over time. After 150 weeks, the alkalinity concentrations stabilized and ranged from 11.1 to 41.2 mg/kg/wk (Figure 34). The acidity of the paste backfill humidity cell leachate rapidly declined from > 20 mg/kg/wk and stabilized between 0.7 and 4.3 mg/kg/wk until termination (Figure 35).

Sulphate

Sulphate loads from HC 6 and HC 10 remained relatively consistent throughout the testing period. After 50 weeks, the HC 6 sulphate loadings stabilized at 27.1 to 91.1 mg/kg/wk, and HC 10 stabilized at 5.5 to 22.4 mg/kg/wk. After 150 weeks, sulphate loadings for HC 4 and HC 7 increased slowly after the onset of acidic conditions. After 150 weeks, HC 4 ranged from 18.4 to 80.8 mg/kg/wk with a median of 33.1 mg/kg/wk, and HC 7 ranged from 12.9 to 198.3 mg/kg/wk with a median sulphate loading of 27.9 mg/kg/wk (Figure 4).

Sulphate release rates for the NP-depleted ore cell (HC 21) steadily increased from week 135. The final sulphate release rate from this cell was 2685.5 mg/kg/wk (Figure 20).

Sulphate loadings from the paste backfill humidity cells (T1 and T2) had decreased to below 100 mg/kg/wk at 91 and 101 weeks, respectively. With the exception of a few irregularities, sulphate release rates for these 2 cells ranged from 17.9 to 87.7 mg/kg/wk thereafter (Figure 36).

Carbonate Molar Ratio

The release rates of calcium and magnesium were compared to the release rates of sulphate, known as the carbonate molar ratio (CMR) to assess the relationship between acid generation and acid neutralization in a sample. Generally CMR values between 0.5 and 1.5 indicate carbonate dissolution in response to sulphide oxidation. Values above this range indicate additional carbonate dissolution due to other processes.

The CMR values for HC 10 were elevated relative to the other mine rock humidity leachates, and were commonly greater than 2 for the entirety of the test. The CMR values for HC 6 were relatively steady up to termination, and ranged from between 1 and 2 (Figure 16). Following 170 weeks, the CMR values for HC 4 and HC 7 steadily declined to ratios below 1, corresponding to decreases in the leachate pH to acidic values until the time of closeout.

The CMR for HC 21 decreased from values of 0.9 to1.7 prior to week 130, to less than one (Figure 36). At week 224, the ratio stabilized at approximately 0.3. The CMR for the paste backfill cells were approximately one for the initial 90 weeks, and increased to values between 1 and 2.6 thereafter (Figure 48). This change corresponded with a notable decrease in sulphate loadings, which were likely due to the flushing of sulphate content on the surface of the backfill tailings.

Metals

The average metal release rates for the waste rock cells HC 6 and HC 10 did not change notably over time (Figure 5 through 15). However, metal loading rates were observed to increase for acid generating cells HC 4 and HC 7. Loading rates for silver, aluminum, arsenic, cadmium, copper, iron, nickel, lead and zinc increased by approximately three orders of magnitude following the onset of acidic conditions in HC 4 and 7 (Figures 5 through 15).

Metals release rates for the NP depleted ore HC 21 generally increased by 2-3 orders of magnitude for most metals including aluminum, copper, iron, and lead (Figures 21 through 31). The release rates of some metals including arsenic, nickel, cadmium and zinc reached a minimum loading at 227 weeks, followed by a rapid increase for the remainder of the testing period.

Metal release rates from the paste backfill humidity cells generally decreased and reached steady state by approximately week 150 (Figures 37 through 47). Arsenic loads decreased significantly (to below method detection limit values) in the last few weeks of testing.

3.0 ESTIMATES OF SULPHIDE AND NP DEPLETION

Estimates of sulphide and NP depletion are used to assist in the prediction of the likelihood of a material to generate net acidity in the future. Net acid generation is assumed to begin once the available NP in a sample is exhausted. Results from humidity cell testing are used to determine the rates of depletion and time to exhaustion. Generally, extrapolation of these laboratory results to a mine setting cannot be done directly; laboratory testing tends to overestimate the rates of sulphide and NP depletion compared to the underground environment. However, the results of this exercise can be used to provide a general sense of the possible duration and relative time difference of sulphide and NP exhaustion.

Estimates of sulphide and NP exhaustion were calculated for all 7 remaining humidity cells (Table 4). Time to sulphide exhaustion was calculated using the sulphate release rates from each of the humidity cells and the amount of total sulphur as determined by the initial ABA static testing analyses. Time to sulphide exhaustion for the 7 terminated cells was calculated based on release rates for the period ending January, 2012. The measured loss of calcium and magnesium was used to estimate NP depletion, assuming the dominant forms of NP were calcium and magnesium carbonates. Estimates calculated for January 2012 include release rates for sulphate, calcium and magnesium incorporating the final rinse for the terminated cells.

Two of the waste rock humidity cells (HC 4 and HC 7) were acid generating. The NP remaining at the time of ARD on-set was approximately 10 kg $CaCO_3$/tonne for HC 4, at which time the humidity cell material had a calculated remaining total sulphur content of 3.4%. At the time of ARD on-set for HC7, approximately 13 kg $CaCO_3$/tonne of NP was remaining, corresponding to a remaining total sulphur content of 1.1%. These results suggest that unavailable NP present in the rock is approximately 10 kg $CaCO_3$/tonne.

The predicted NP exhaustion time of HC 10 was 5.1 years.

The HC 6 data predicted that the sulphide content would become depleted 37 years prior to NP depletion, suggesting the sample is not acid generating.

The NP-depleted ore sample (HC 21) reached acidic conditions at 146 weeks. The NP remaining at time of AP depletion was approximately 1.3 kg CaCO3/tonne. At the time of ARD on-set, the total sulphur content was approximately 12.6%.

The cemented tailings backfill cells (T1 and T2) have an estimated NP exhaustion period of approximately 16 and 8 years respectively.

4.0 SUMMARY

- Sulphate release rates for the mine rock HC 6 and HC 10 were generally constant after the initial 20 weeks of operation. Sulphate loadings increased for HC 4 and HC 7 and HC 21 after the onset of acidic conditions. Sulphate loadings decreased over time for the paste backfill tailings (T1 and T2).

- Elevated concentrations of metals were released as a result of acidic conditions, including aluminum, arsenic, cadmium, copper, iron, lead, nickel and zinc.

- Humidity cells HC 4, HC 7 and HC 21 were operating under acidic conditions. HC 10 and backfill tailings cells (T1 and T2) were estimated to exhaust their NP prior to the exhaustion of sulphide, suggesting that acidic conditions could occur over time. HC 6 was estimated to exhaust AP content prior to NP exhaustion.

- The Calcite-pyrite Exhalite mine rock humidity cell (HC 6) had a predicted NP exhaustion time of approximately 80 years.

- The Carbonaceous Argillite mine rock cell (HC 10) had a predicted NP exhaustion time of approximately 5 years.

- The cemented tailings backfill cells (T1 and T2) had an average estimated NP exhaustion period of approximately 12 years.

5.0 REFERENCES

AMEC, 2008a. Wolverine Project Humidity Cell Update. Prepared by AMEC Earth & Environmental, August 2008.

AMEC, 2008b. Wolverine Project: Recommendations for Continued Humidity Cell Testing. Prepared by AMEC Earth & Environmental, November 2008.

AMEC, 2006. Wolverine Project. Acid Rock Drainage and Metal Leaching Assessment of Mine Rock and Predicted Water Quality of the Underground Workings at Closure. Prepared by AMEC Earth & Environmental, February 2006.

Price, W.A., 1997. Draft Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia.

6.0 CLOSURE

This memo was prepared exclusively for Yukon Zinc Corporation (Yukon Zinc) by AMEC Americas Limited (AMEC). The quality of information, conclusions and estimates contained herein are consistent with the level of effort involved in AMEC's services and based on: i) information available at the time of preparation, ii) data supplied by outside sources and iii) the assumptions, conditions and qualifications set forth in this memo. This memo is intended to be used by Yukon Zinc only, subject to the terms and conditions of its contract with AMEC. Any other use of, or reliance on, this report by any third party is at that party's sole risk.

Yours truly,
AMEC Environment & Infrastructure,
a Division of AMEC Americas Limited

K Stevenson

Krista Stevenson, M.E.S.	Steve Sibbick, M.Sc., P. Geol.
Environmental Geochemist	Principal Geochemist

TABLES

Table 1: Waste Rock, Ore, and Tailing Paste Backfill Humidity Cell Descriptions

Cell #	Sample ID	Sample Type	Method Reference	Column Packing		Column Material	Initial Volume of Initial Flushings	Flushing Rate/Weekly Input*mL	Temp (oC)	Start-up Date	Status	Duration (weeks)
				Dry Wt. of Sample (kg)	Other Materials Used							
4	Footwall Rhyolite-3	wasterock	MEND	1	PVC perforated disk & nylon mesh	Plexiglas	750	500	20-22	22-Dec-05	Terminated	316
6	Excp-3	wasterock	MEND	1	PVC perforated disk & nylon mesh	Plexiglas	750	500	20-22	22-Dec-05	Terminated	316
7	Argillite-2	wasterock	MEND	0.9	PVC perforated disk & nylon mesh	Plexiglas	750	500	20-22	22-Dec-05	Terminated	316
10	A083529	wasterock	MEND	1	PVC perforated disk & nylon mesh	Plexiglas	750	500	20-22	12-Jan-06	Terminated	313
21	Hump Feed Ore NP Removed	ore	MEND	0.541	PVC perforated disk & nylon mesh	Plexiglas	410	270	20-22	23-May-06	Terminated	298
T1	Backfill A	paste backfill	MEND	1	PVC perforated disk & nylon mesh	Plexiglas	750	500	20-22	23-May-06	Terminated	297
T2	Backfill B	paste backfill	MEND	1	PVC perforated disk & nylon mesh	Plexiglas	750	500	20-22	23-May-06	Terminated	297

Table 2: Initial and Final ABA Summary

	Paste pH		Total Sulphur		Sulphate-S		Sulphide-S		AP		NP		NP/AP Ratio		MPA		Ca NP	
Sample			%		%		%		(kg CaCO3/tonne)		(kg CaCO3/tonne)				(kg CaCO3/tonne)		(kg CaCO3/tonne)	
	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final
HC 4	7.6	4.0	3.61	3.04	0.02	0.09	3.59	2.93	113	91.6	19.0	1.4	0.17	0.02	113	95		<0.8
HC 6	7.7	7.7	4.44	3.83	0.02	0.07	4.42	3.53	139	110	350	275.2	2.52	2.49	139	120		330.8
HC 7	8	5.2	1.2	0.52	0.01	0.04	1.19	0.4	37.5	12.5	18.0	4.5	0.48	0.36	38	16		<0.8
HC 10	7.9	8.2		0.73		0.01		0.68	29.7	21.3	22.0	8.5	0.74	0.40	30	23	25.02	9.2
HC 21	8	3.6	13.2	3.69	0.03	0.3	13.15	2.32	413	72.5	113	0.5	0.27	0.01	413	115		<0.8
T1	8.3	7.8	19.45	17.2	1.16	0.1	18.3	17.7	608	553	131	63.3	0.22	0.11	608	538		72.5
T2	7.9	7.8	18.75	17.5	1.01	0.1	17.75	17.6	586	550	131	65.0	0.22	0.12	586	547		72.5

Table 3: Initial and Final Elemental Content Summary

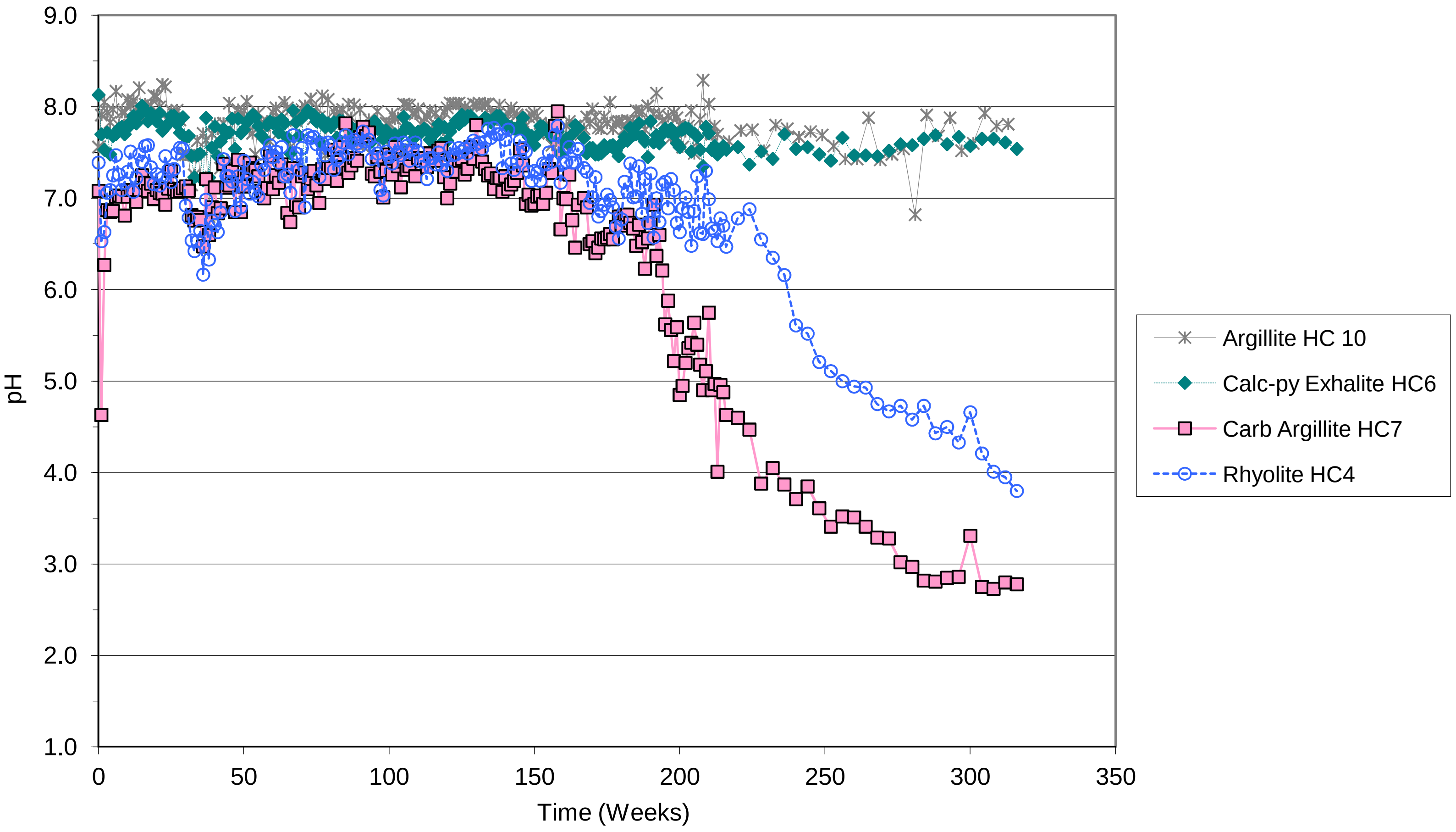
Concentration (ppm)	Ag		As		Cd		Co		Cr		Cu		Hg		Mn		Mo		Ni		Pb		Sb		Se		Zn	
MDL	0.01		1		0.01		0.1		1		0.5		0.01		2		0.05		0.5		0.2		0.05		1		1	
Sample ID	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final
HC 4	2.85		16.2	12	2.52	0.74	10	6.9	2	59	939	656	0.08	0.08	337	181	2.37	2.42	5.8	3.3	34	25.4	4.43	3.24	44.3	27	289	159
HC 6	0.36		17	14	0.09	0.12	4.6	4	10	53	55.1	67.9	0.02	0.01	4030	4360	5.81	6.06	19.6	17.1	139	163	2.19	1.46	2.3	2	31	34
HC 7	0.97		11.8	10	2.55	0.45	4.4	1.4	10	112	54.8	25.1	0.38	0.36	180	52	2.45	2.43	44.5	16.2	19.7	14.1	6.45	7.24	6	4	855	194
HC 10			8.4	7	0.34	0.33		3.9		110	62.5	66	0.06	0.06	222	247		1.69		36.2	29.2	29.3	3.15	3.08	2.4	2	192	195
HC 21	97		808	355	308	9.78	22.7	5.7	198	83	6430	6070	10.35	17.2	661	100	27	32.2	40.6	4.1	3760	1890	290	298	540	397	>10000	1180
T1	76.5		1250	1060	73.2	77.7	44.9	35.6	83	123	3130	2760	1	1.19	1150	1230	15.05	13.6	27.5	22	3030	3550	120	76.7	830	520	7320	7760
T2	79.3		1235	1040	76.3	87	43.7	36.2	80	119	3370	2990	1.03	1.21	1120	1170	15.35	14.2	27.1	21.1	2990	3440	121.5	73.7	830	532	7850	8000

Concentration %	Al		Ca		Fe		Mg		Na	
MDL	0.01		0.01		0.01		0.01		0.01	
Sample ID	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final
HC 4	2.05	1.81	0.41	0.1	5.75	6.15	1.54	1.44	0.01	0.02
HC 6	0.53	0.4	12	12.9	9	9.29	0.53	0.38	0.01	0.01
HC 7	0.36	0.25	0.79	0.47	1.52	1.42	0.06	0.03	<0.01	0.01
HC 10		0.38		0.38	1.76	1.84		0.11		0.01
HC 21	1.09	1.02	3.41	0.1	10.45	5.05	1.1	0.86	<0.01	0.01
T1	1.8	1.74	5.23	2.5	21.7	>15	1.43	1.49	0.04	0.01
T2	1.83	1.68	4.91	2.57	21.9	>15	1.43	1.43	0.04	0.01

Table 4: Estimates of Sulphide and Neutralization Potential Exhaustion

Cell	Sample ID	Rock Type	Years to Depletion		Years to Exhaustion		Years to Exhaustion		Status
			NP	Sulphide	NP	Sulphide	NP	Sulphide	
Continued Humidity Cells			**June 2008 Update**		**March 2009**		**Jan-12**		
HC4	Footwall Rhyolite-3	Rhyolite and Rhyolite Fragmental	8.6	97	5.5	78.1	4.3	68.8	Acidic after 240 weeks
HC6	EXCP-3	Calcite-pyrite exhalite	84	44	80.7	43.5	79.5	41.9	Expected to be non-acidic
HC7	Argillite-2	Carbonaceous argillites	14	45	8.7	24.5	9.1	18.4	Acidic after 198 weeks
HC10	A083529	Argillites	7.4	46	5.1	37.9	5.1	37.4	Potentially acid generating
HC21	Hump Ore	NP-Depleted Ore	0.8	88	0	2.3	0.0	0.5	Acidic after 146 weeks
T1	Backfill Tailings	Tailings Backfill	3.6	25	6.1	55.6	16.4	107.1	Potentially acid generating
T2	Backfill Tailings	Tailings Backfill	4.1	8.2	6.8	18.3	8.2	21.0	Potentially acid generating

FIGURES

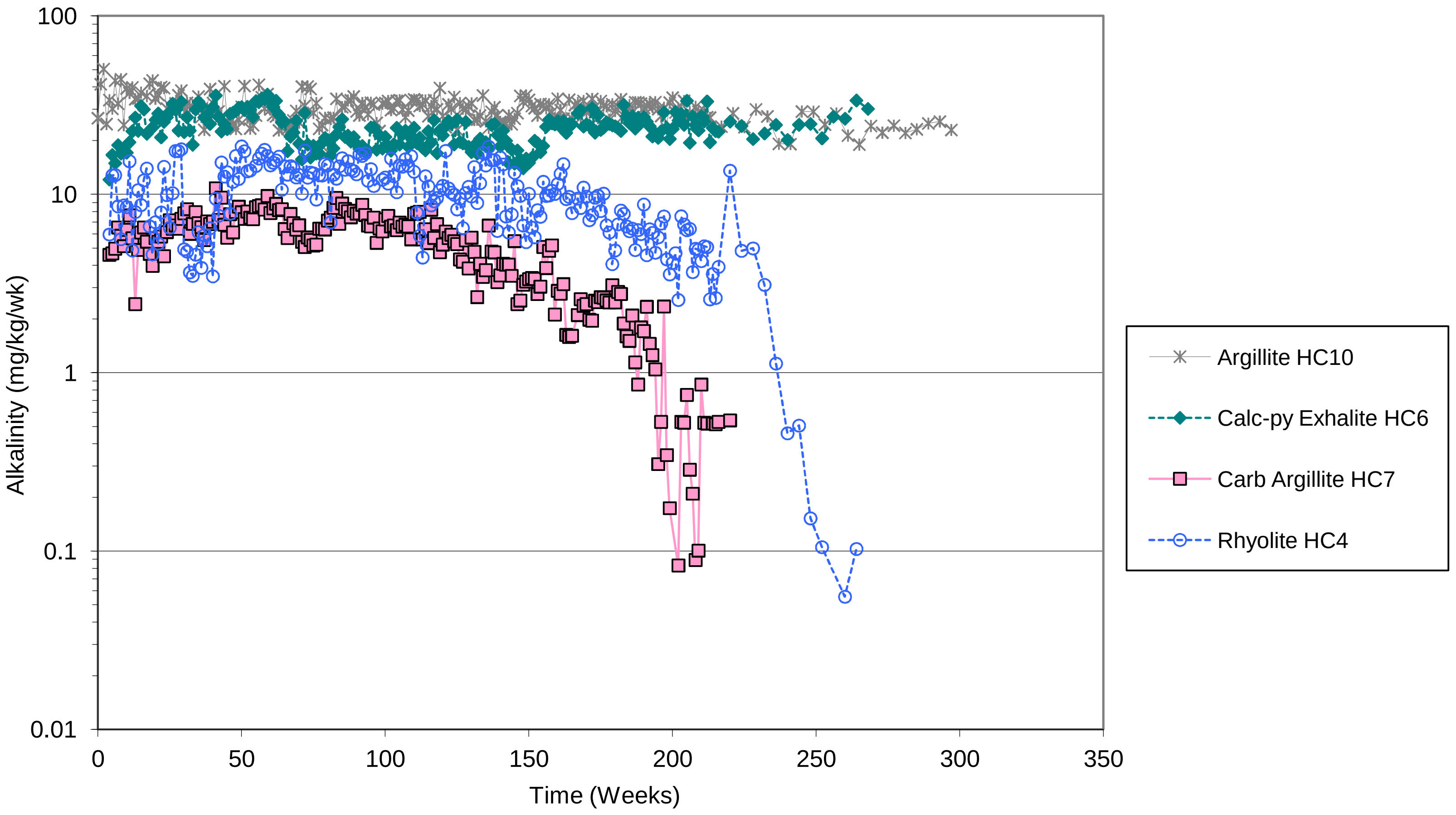


pH
Operating Cells
Wolverine Mine, YK

Mine Rock

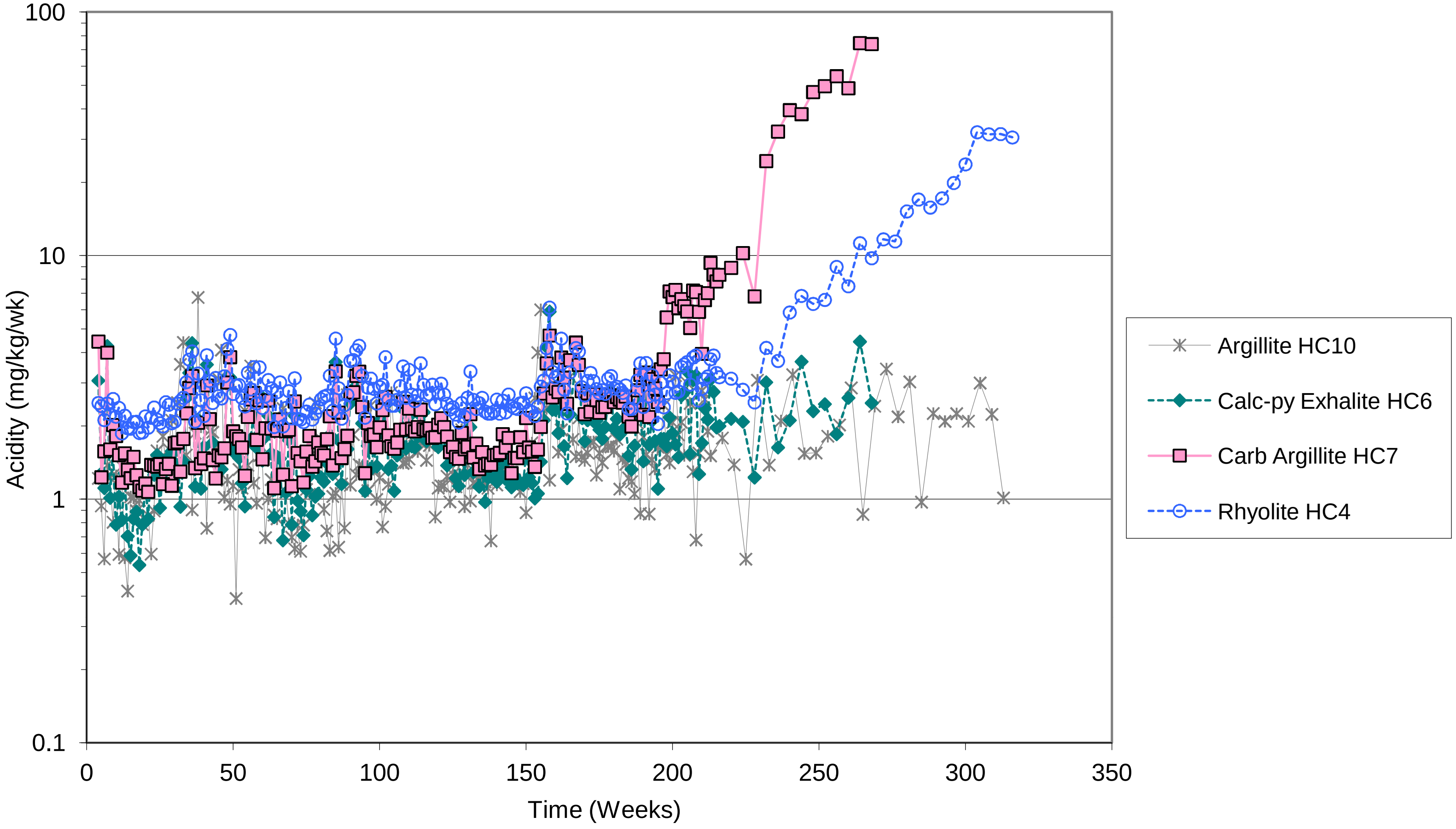
March 2013	FIGURE 1

amec



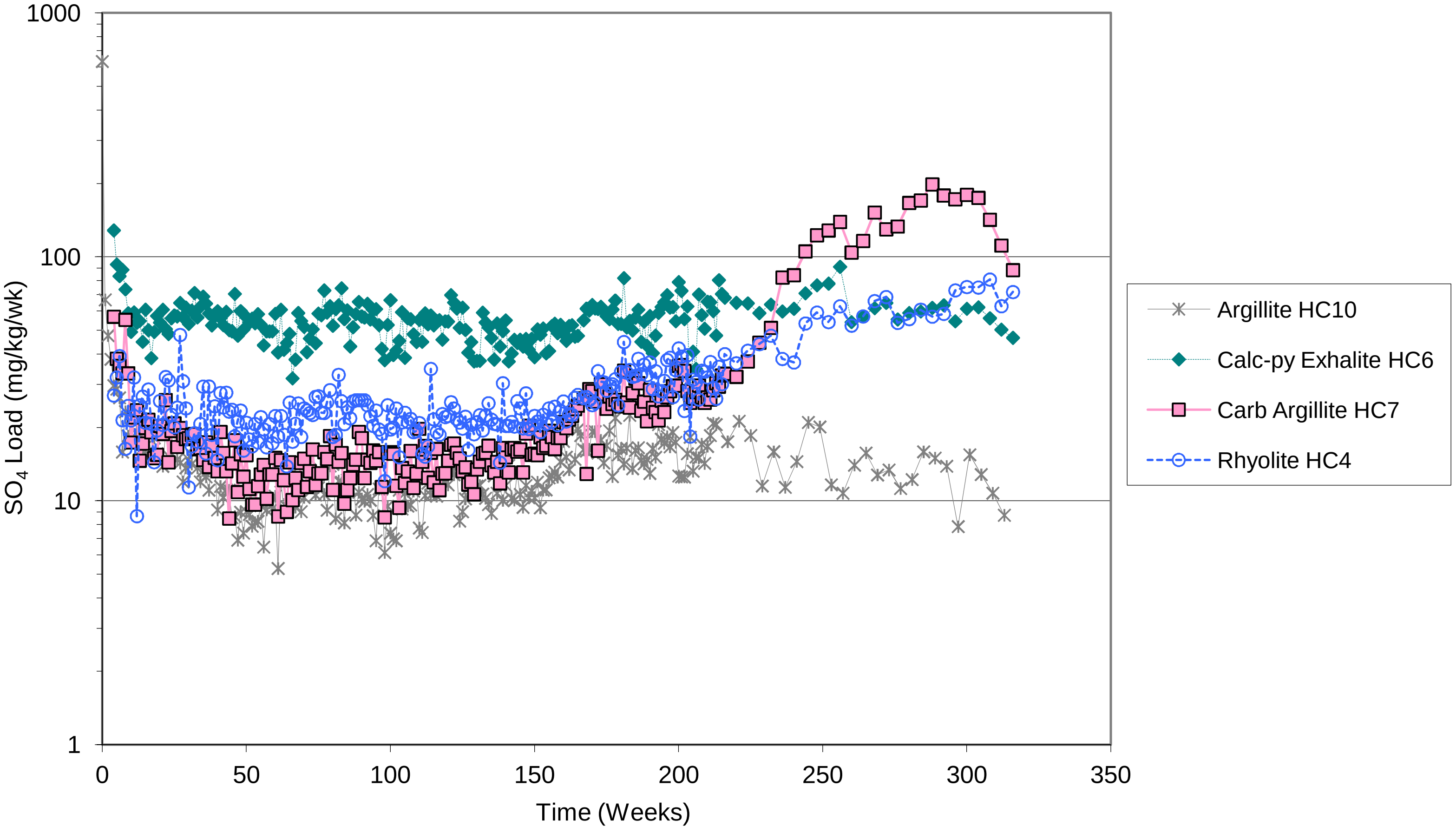
Determination of alkalinity is not valid
below pH values of pH 4.5

Alkalinity Load Operating Cells Wolverine Mine, YK	
Mine Rock	
March 2013	FIGURE 2



Acidity Load Operating Cells Wolverine Mine, YK	
Mine Rock	
March 2013	FIGURE 3

amec



Sulphate Load
Operating Cells
Wolverine Mine, YK

Mine Rock	
March 2013	FIGURE 4

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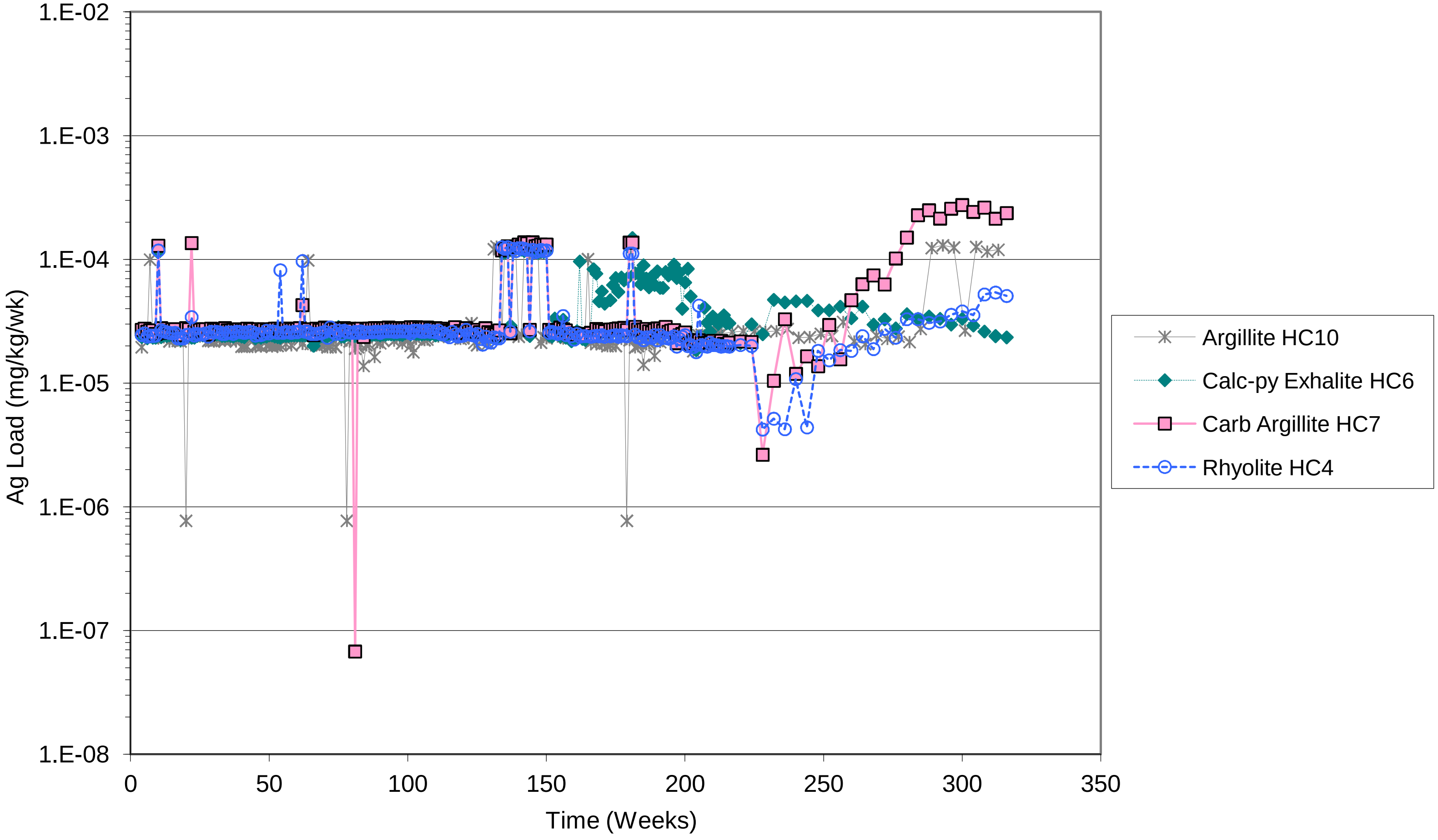
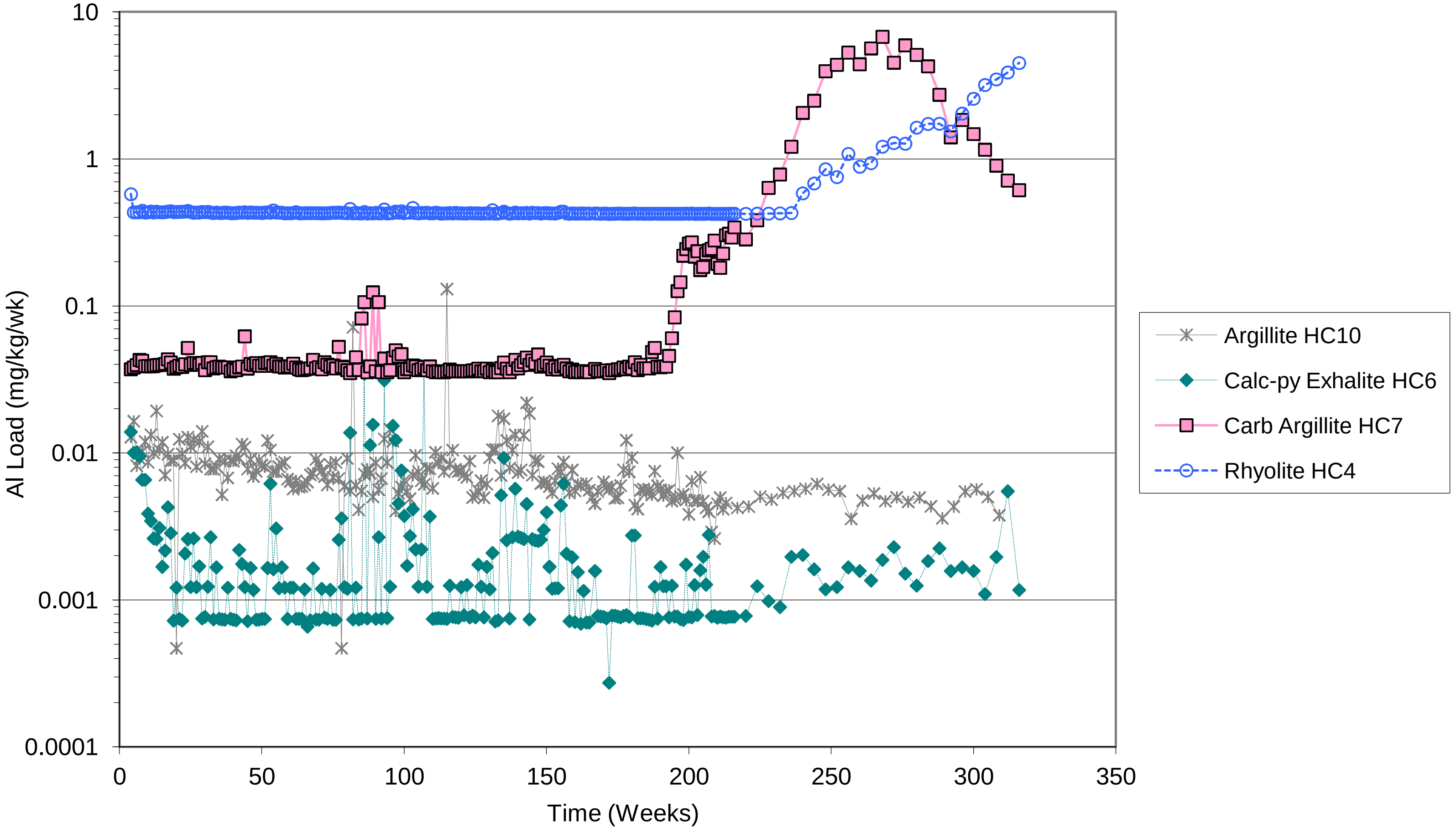
amec

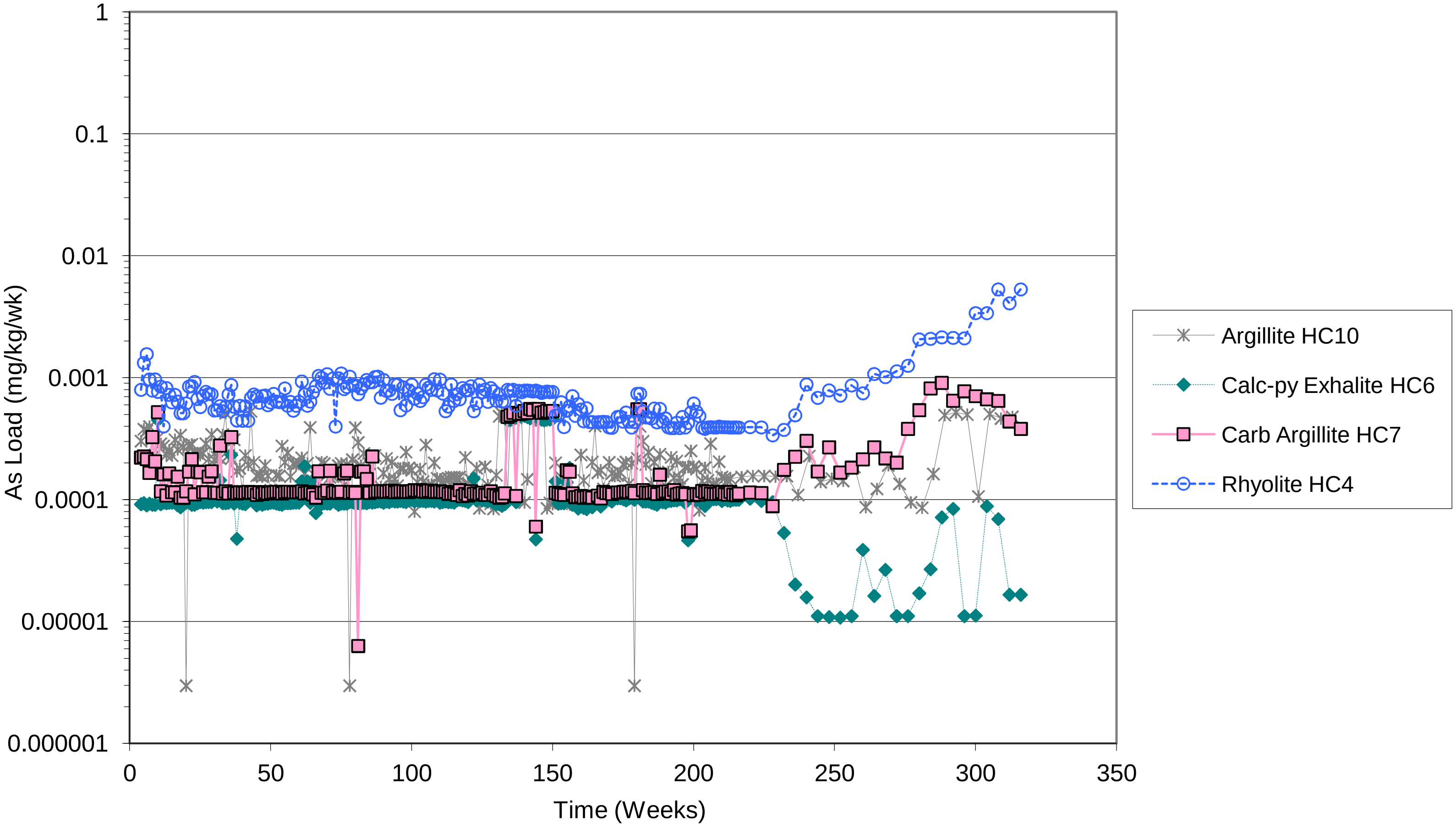


Silver Load Operating Cells Wolverine Mine, YK	
Mine Rock	
March 2013	FIGURE 5

TC 53920



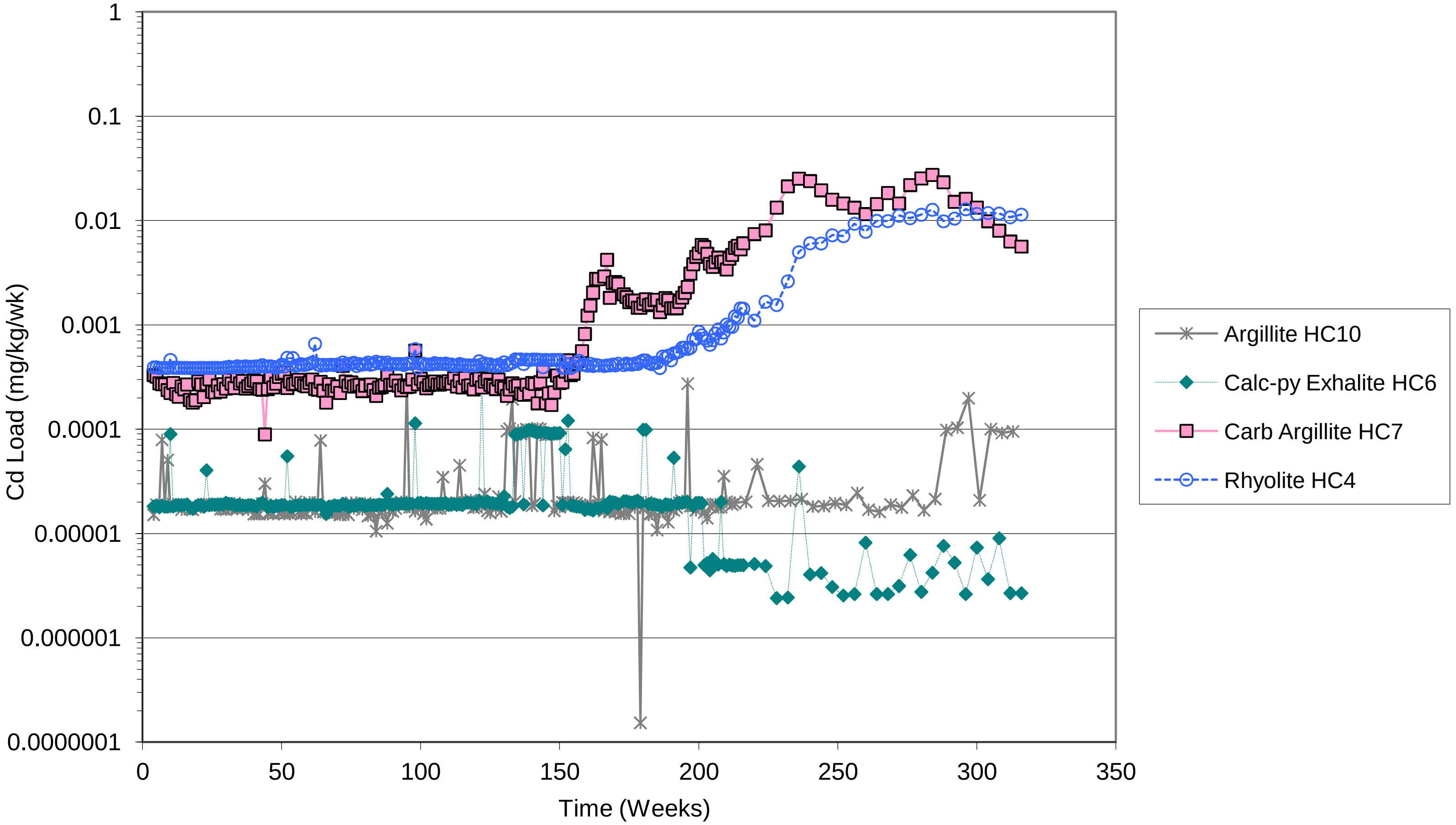
Aluminium Load Operating Cells Wolverine Mine, YK	
Mine Rock	
March 2013	FIGURE 6



Arsenic Load
Operating Cells
Wolverine Mine, YK

Mine Rock	
March 2013	FIGURE 7

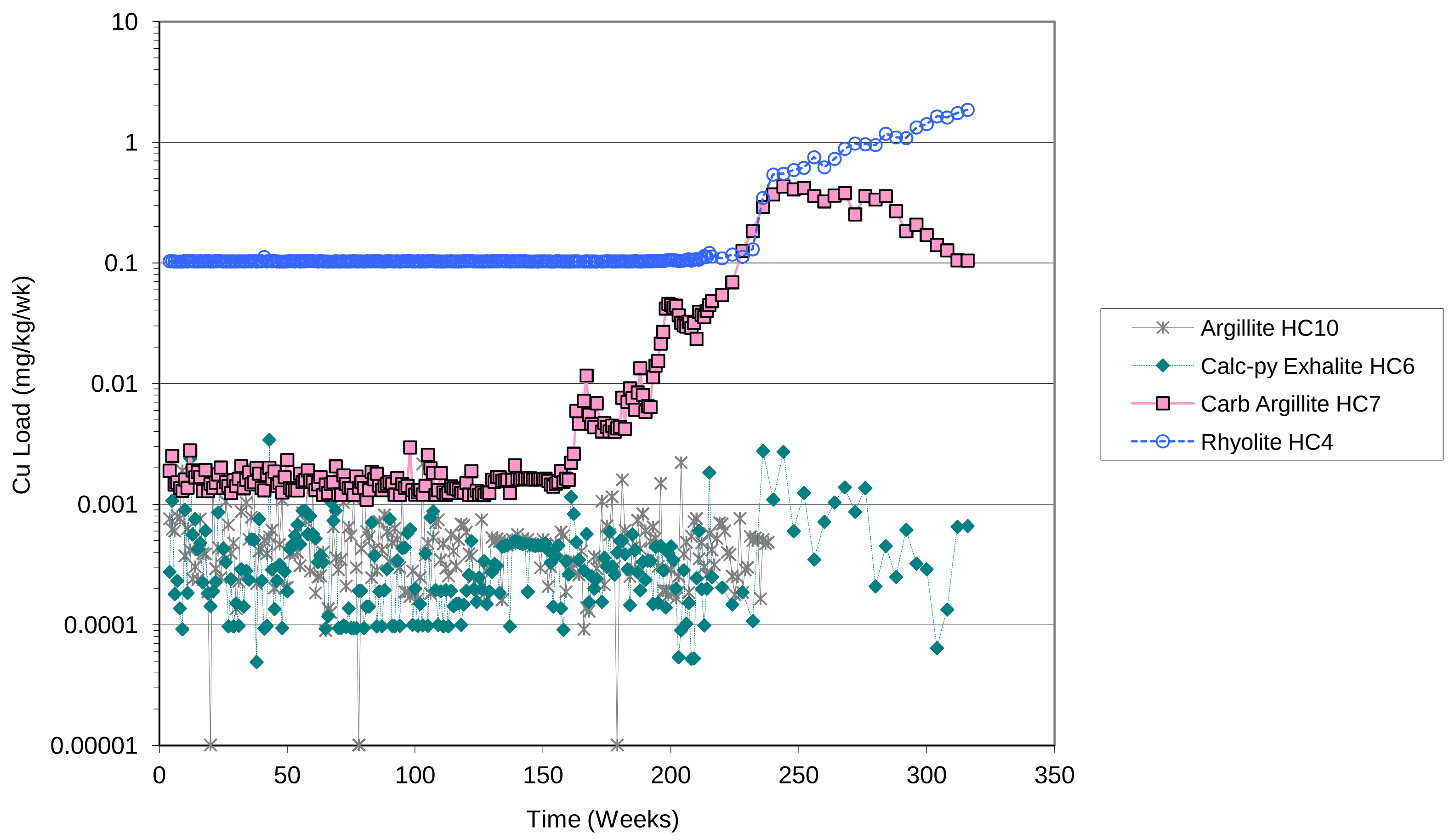
amec



Cadmium Load
Operating Cells
Wolverine Mine, YK

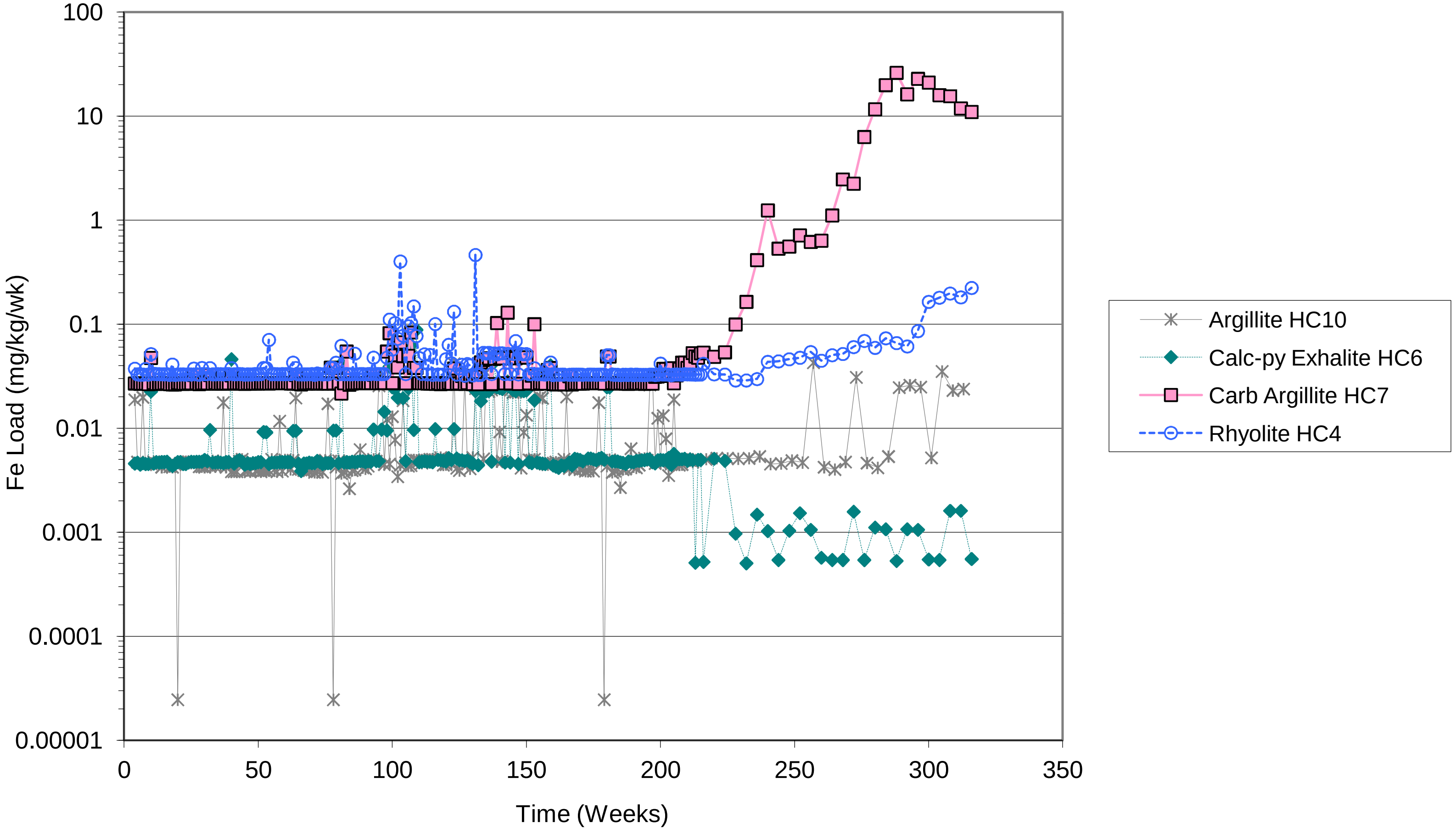
Mine Rock	
March 2013	FIGURE 8

TC 53920



Copper Load Operating Cells Wolverine Mine, YK
Mine Rock

March 2013	FIGURE 9



Notes:

Instrument MDL lower for HC6 past 230 weeks

Iron Load Operating Cells Wolverine Mine, YK	
Mine Rock	
March 2013	FIGURE 10

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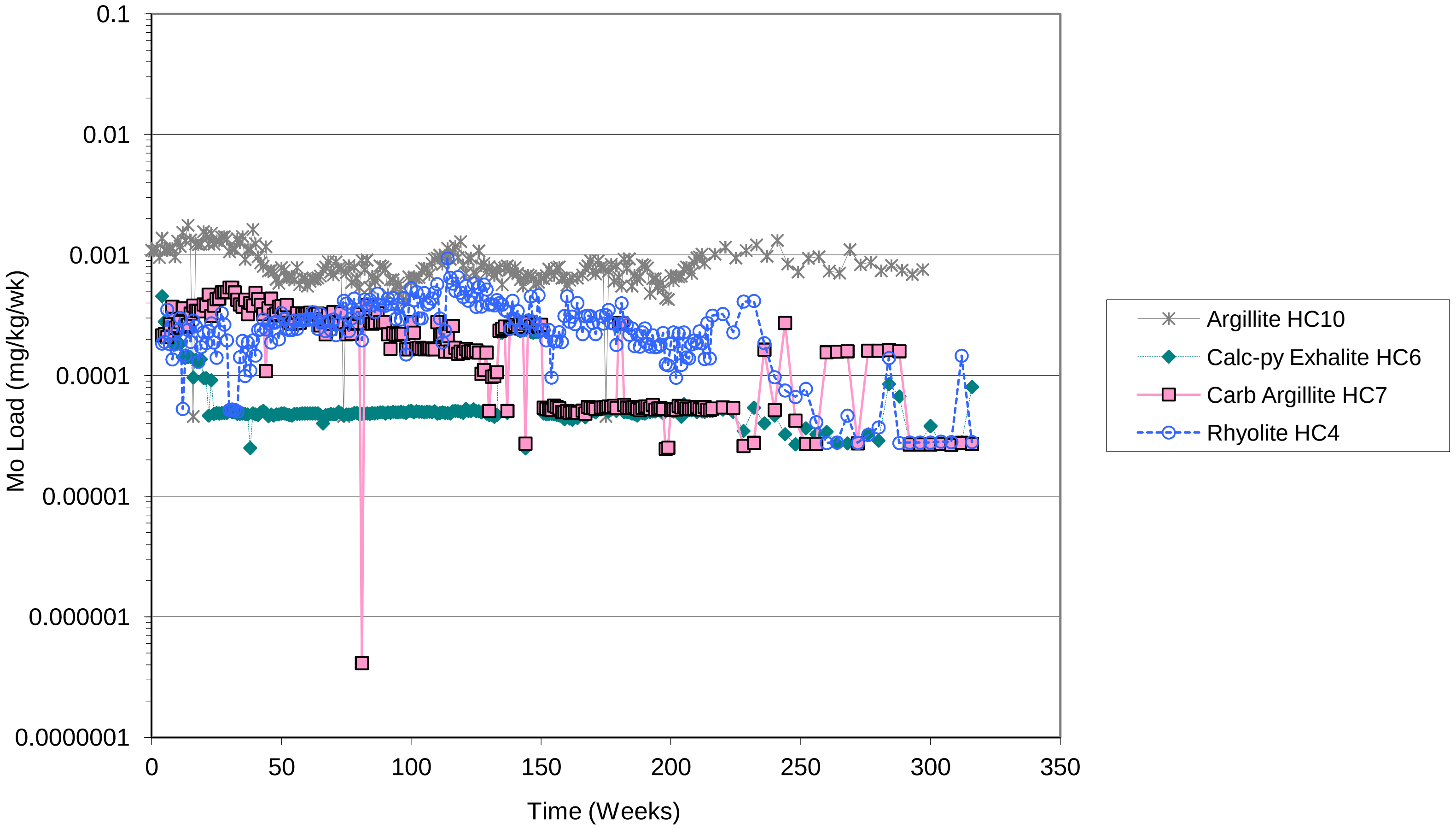
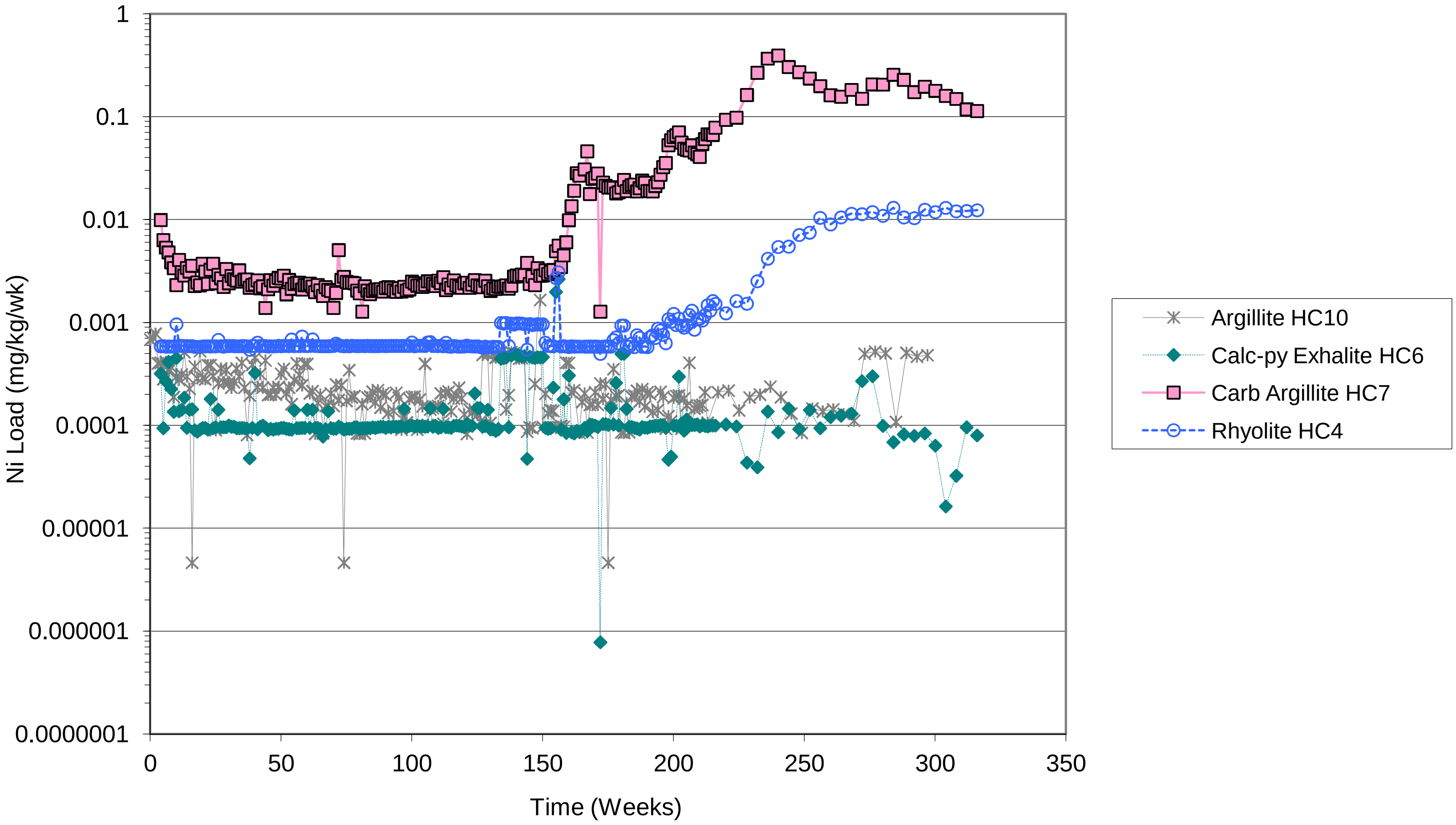
amec



Molybdenum Load Operating Cells Wolverine Mine, YK	
Mine Rock	
March 2013	FIGURE 11

TC 53920

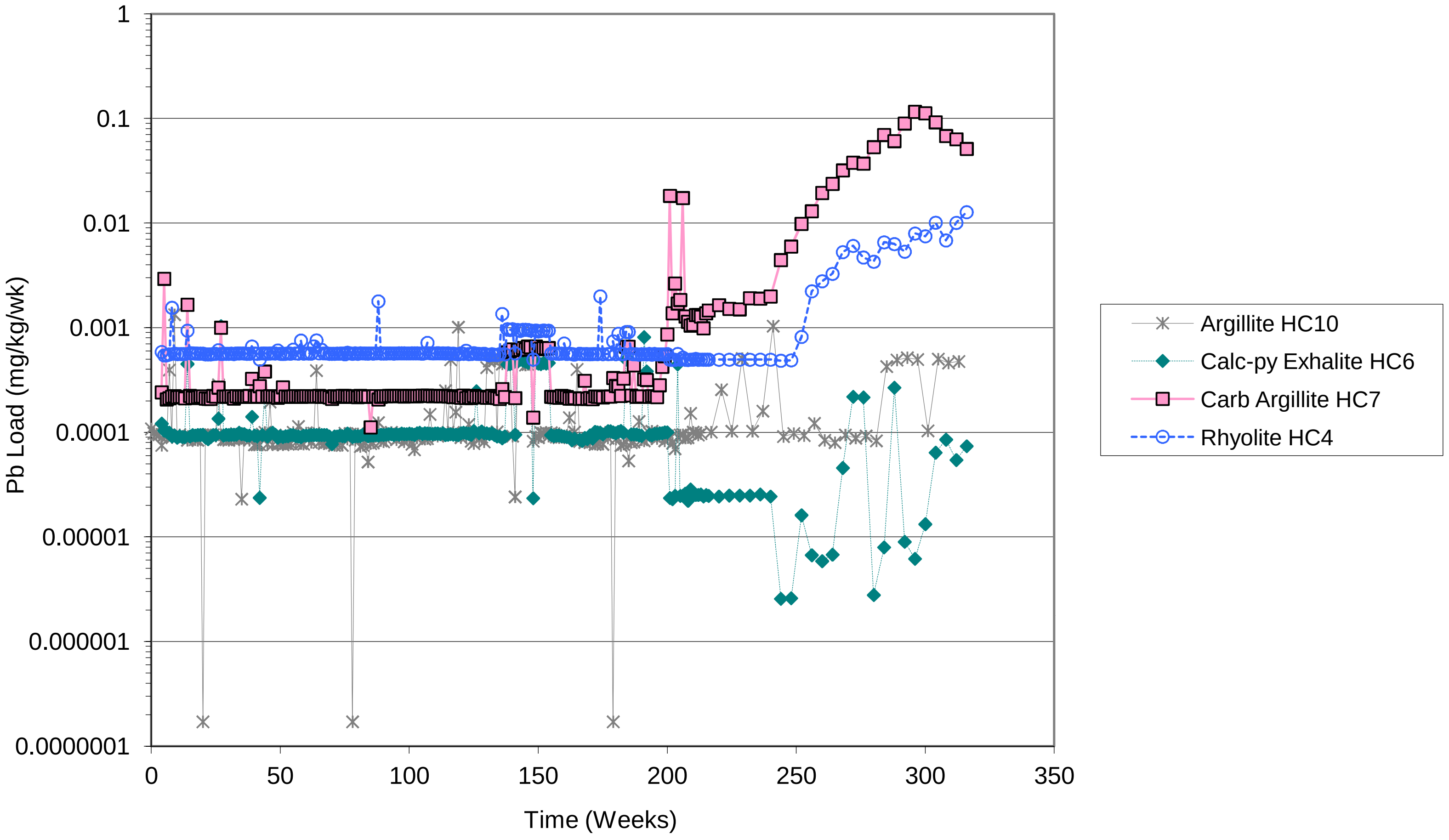


Nickel Load
Operating Cells
Wolverine Mine, YK

Mine Rock

March 2013	FIGURE 12

amec

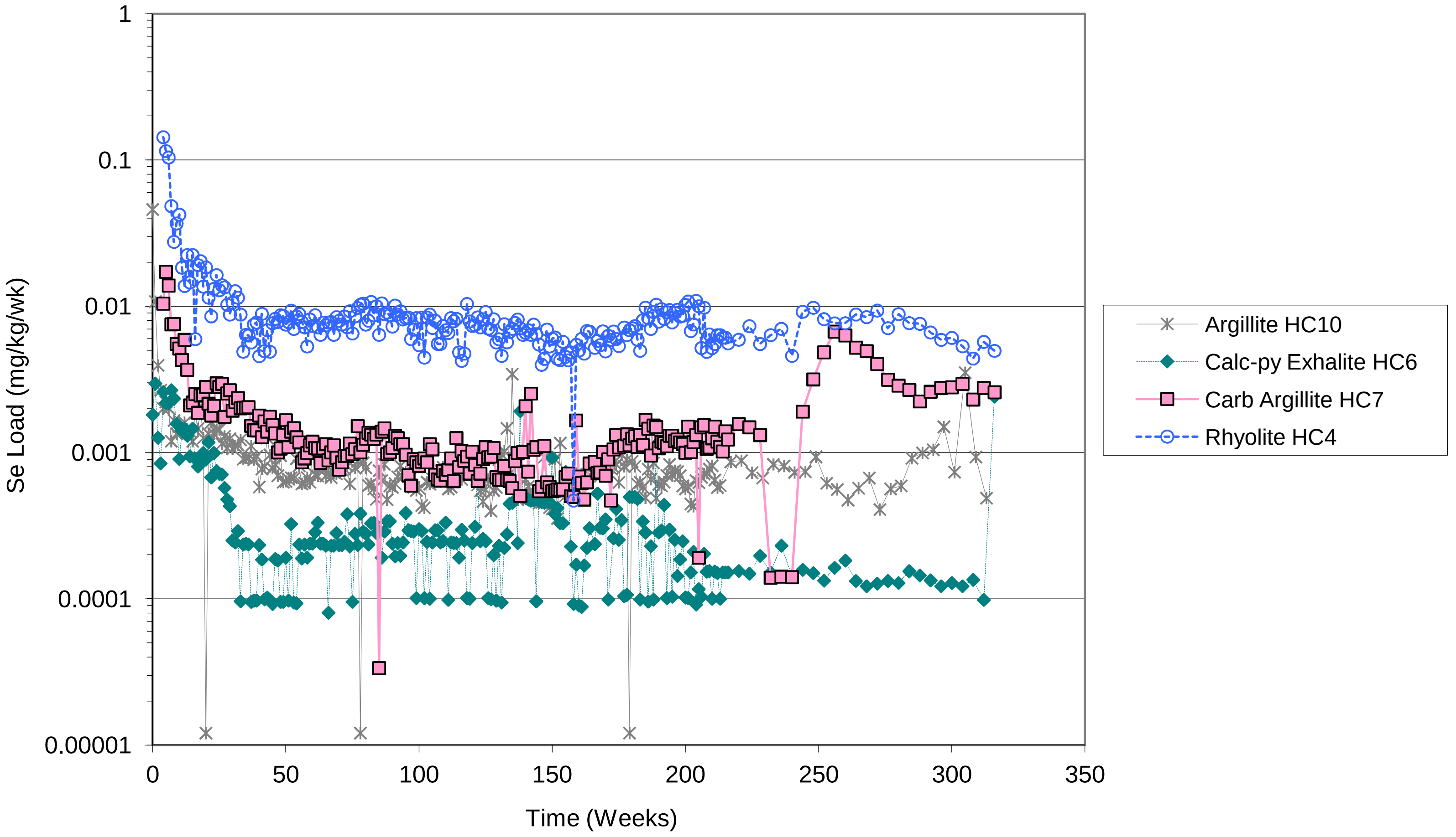


Lead Load
Operating Cells
Wolverine Mine, YK

Mine Rock

March 2013	FIGURE 13

TC 53920

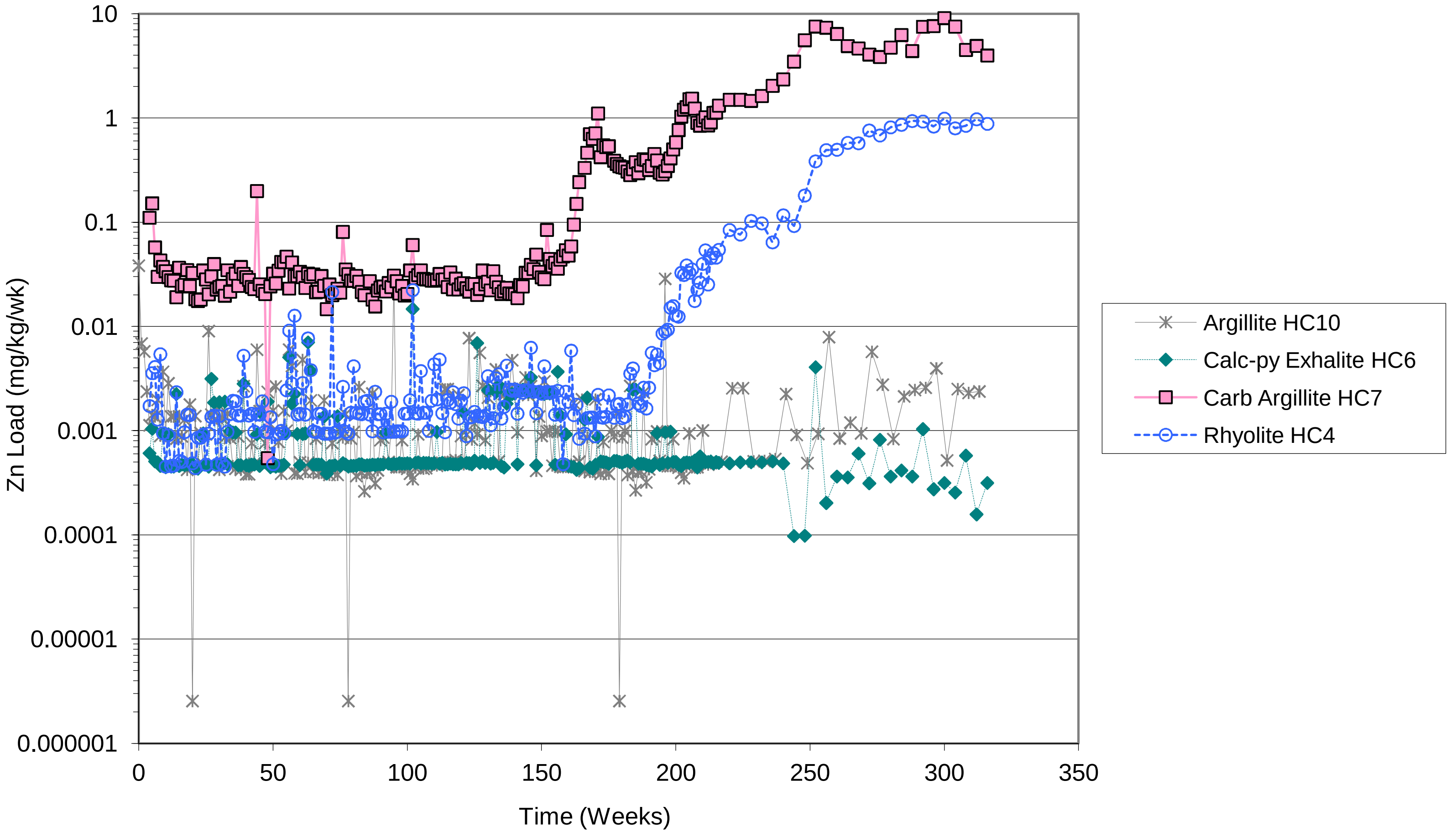


Selenium Load
Operating Cells
Wolverine Mine, YK

Mine Rock	
March 2013	FIGURE 14

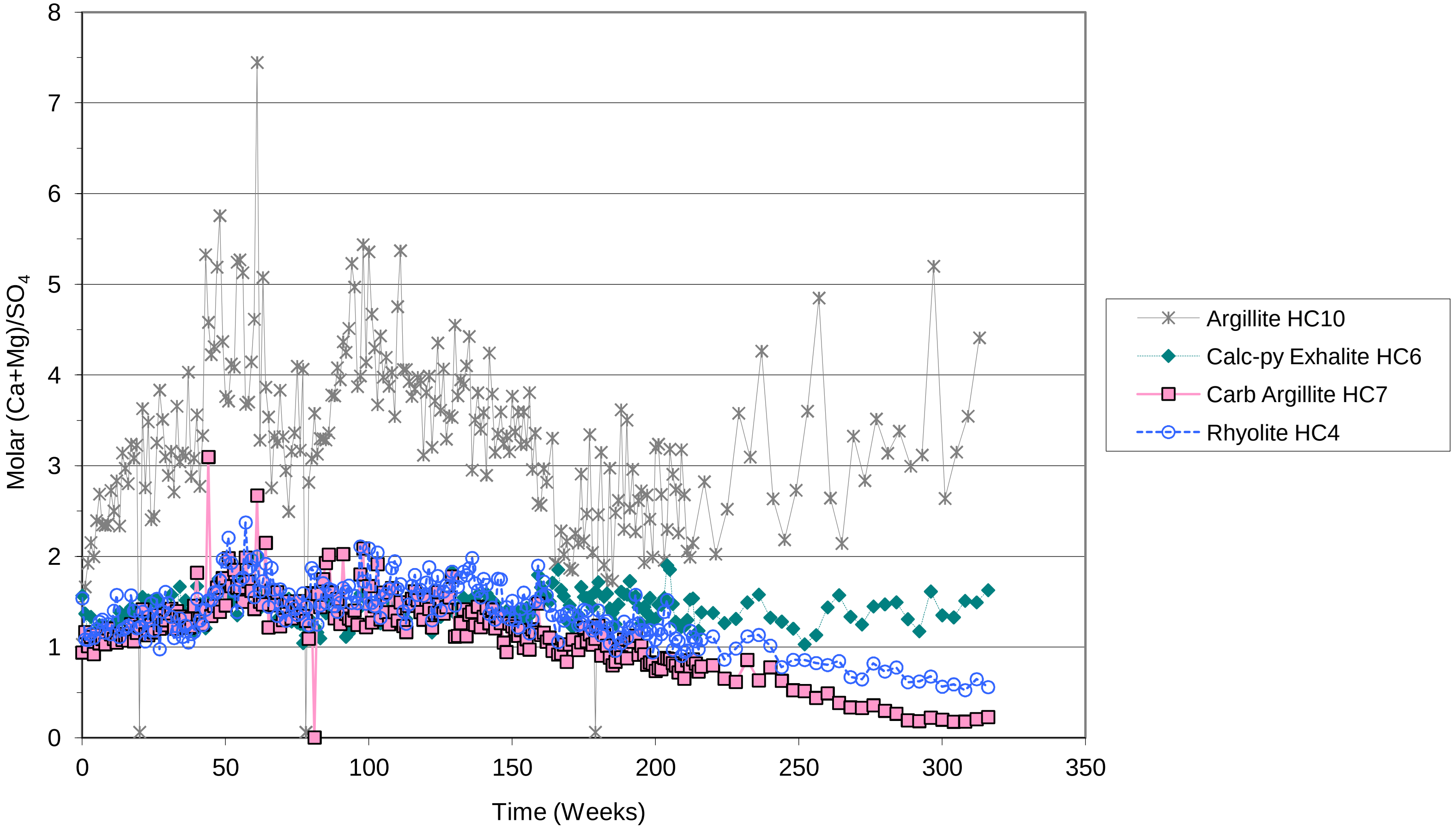
TC 53920

amec



Zinc Load Operating Cells Wolverine Mine, YK	
Mine Rock	
March 2013	FIGURE 15

TC 53920

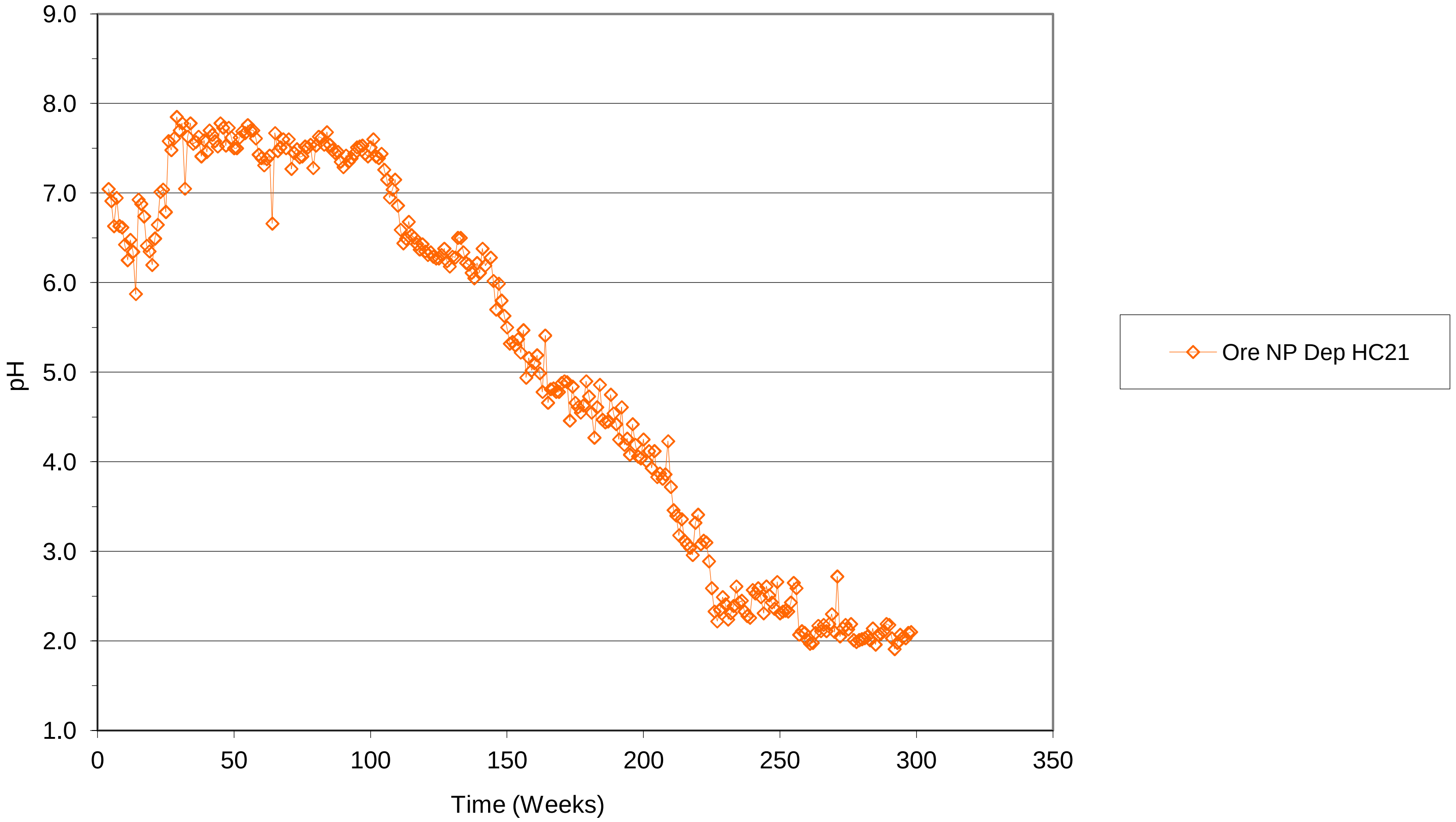


Molar (Ca+Mg)/SO$_4$ Load
Operating Cells
Wolverine Mine, YK

Mine Rock	
March 2013	FIGURE 16

TC 53920

amec



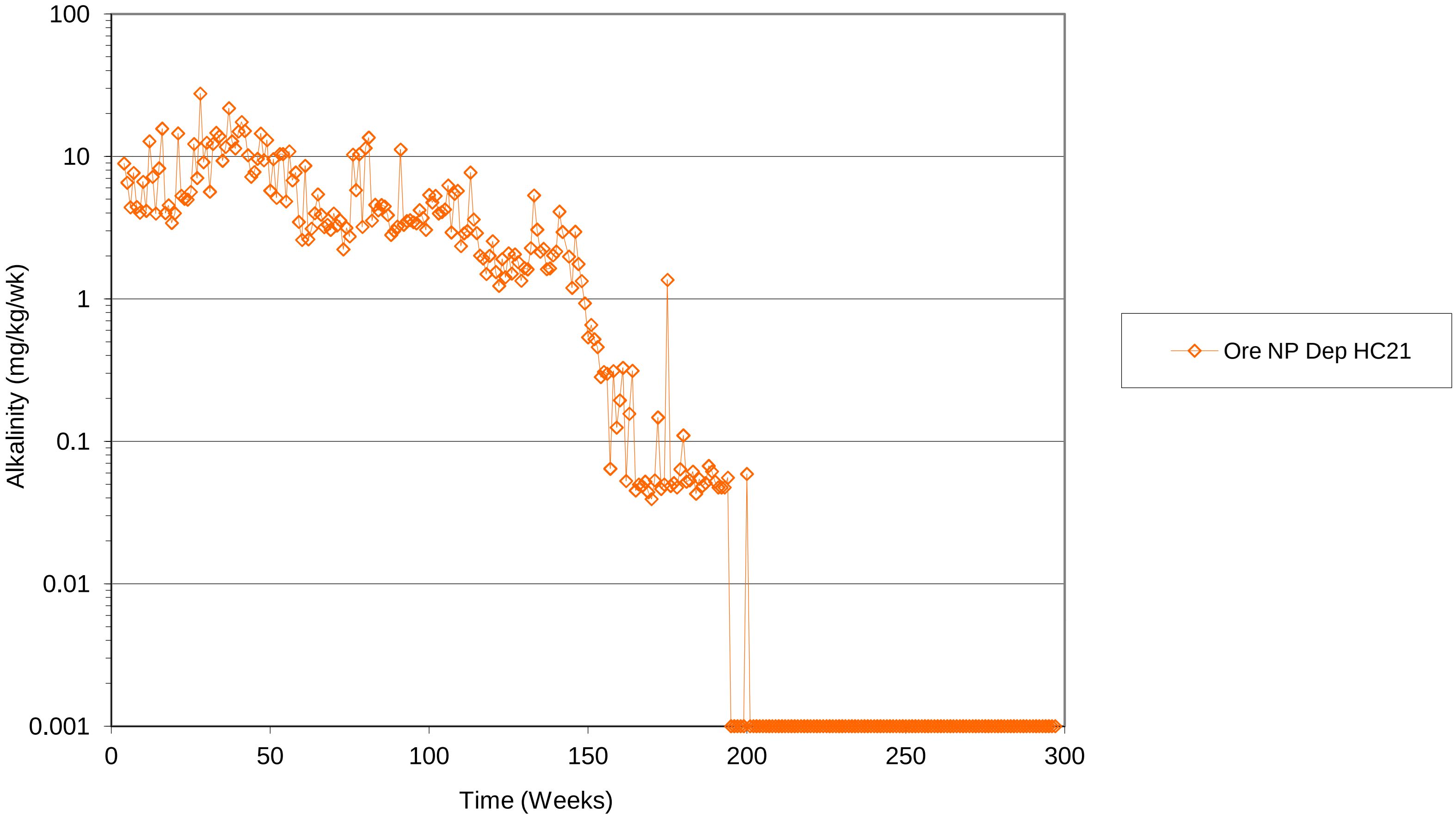
pH
Operating Cells
Wolverine Mine, YK

NP-Depleted Ore

March 2013	FIGURE 17

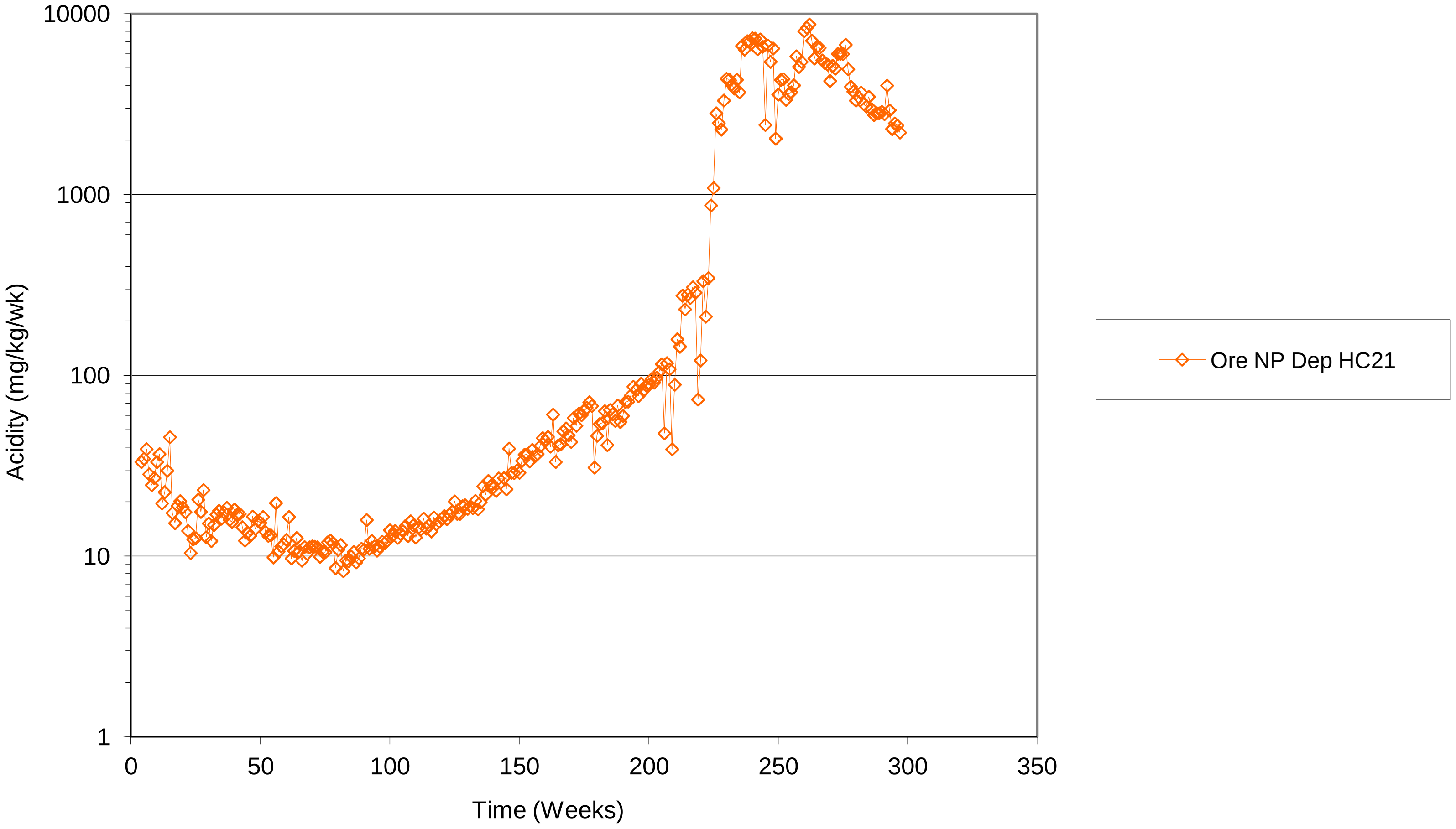
TC 53920

amec



Determination of alkalinity is not valid
below pH values of pH 4.5

Alkalinity Load Operating Cells Wolverine Mine, YK	
NP-Depleted Ore	
March 2013	FIGURE 18

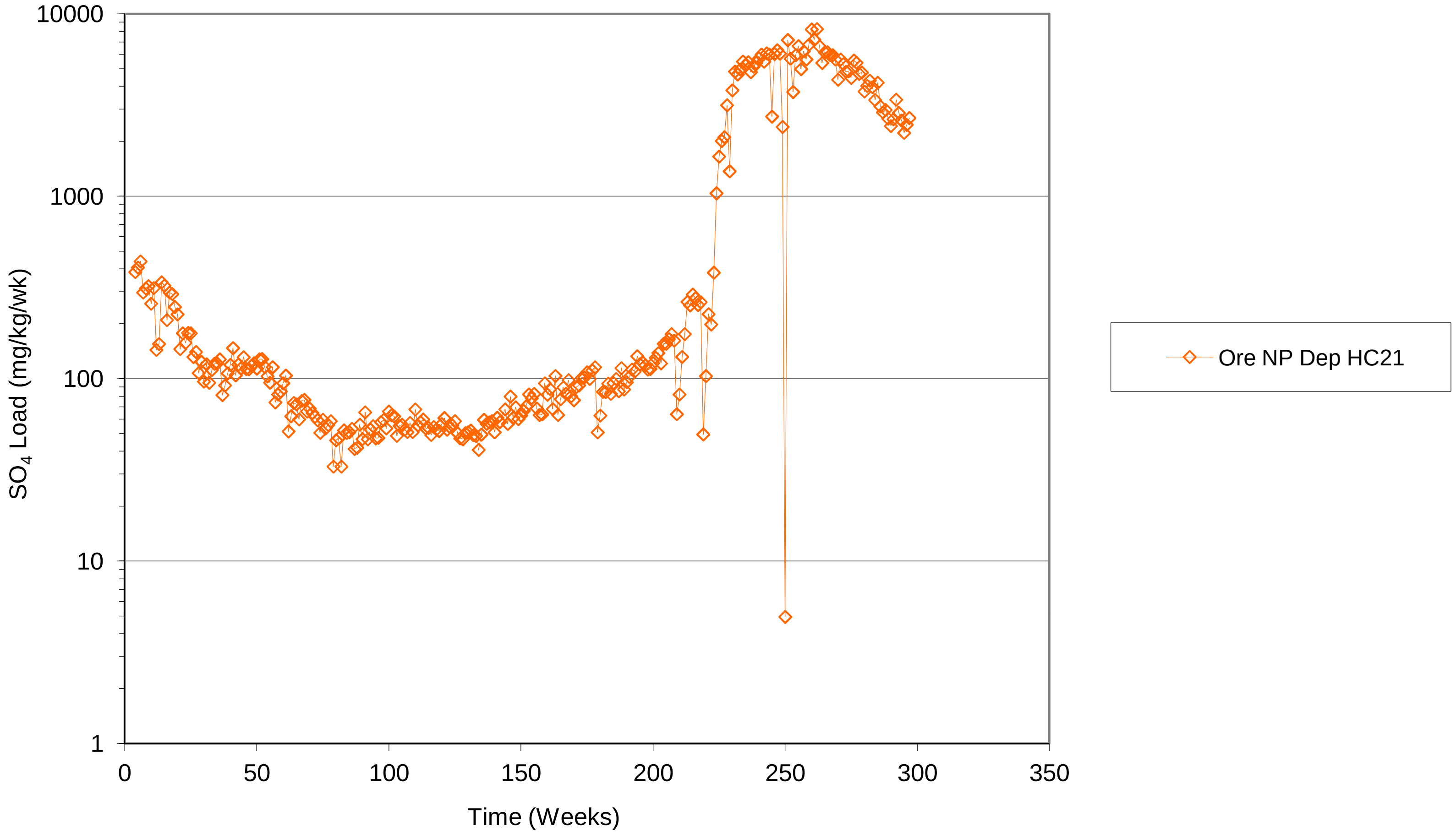


Acidity Load
Operating Cells
Wolverine Mine, YK

NP-Depleted Ore

March 2013	FIGURE 19

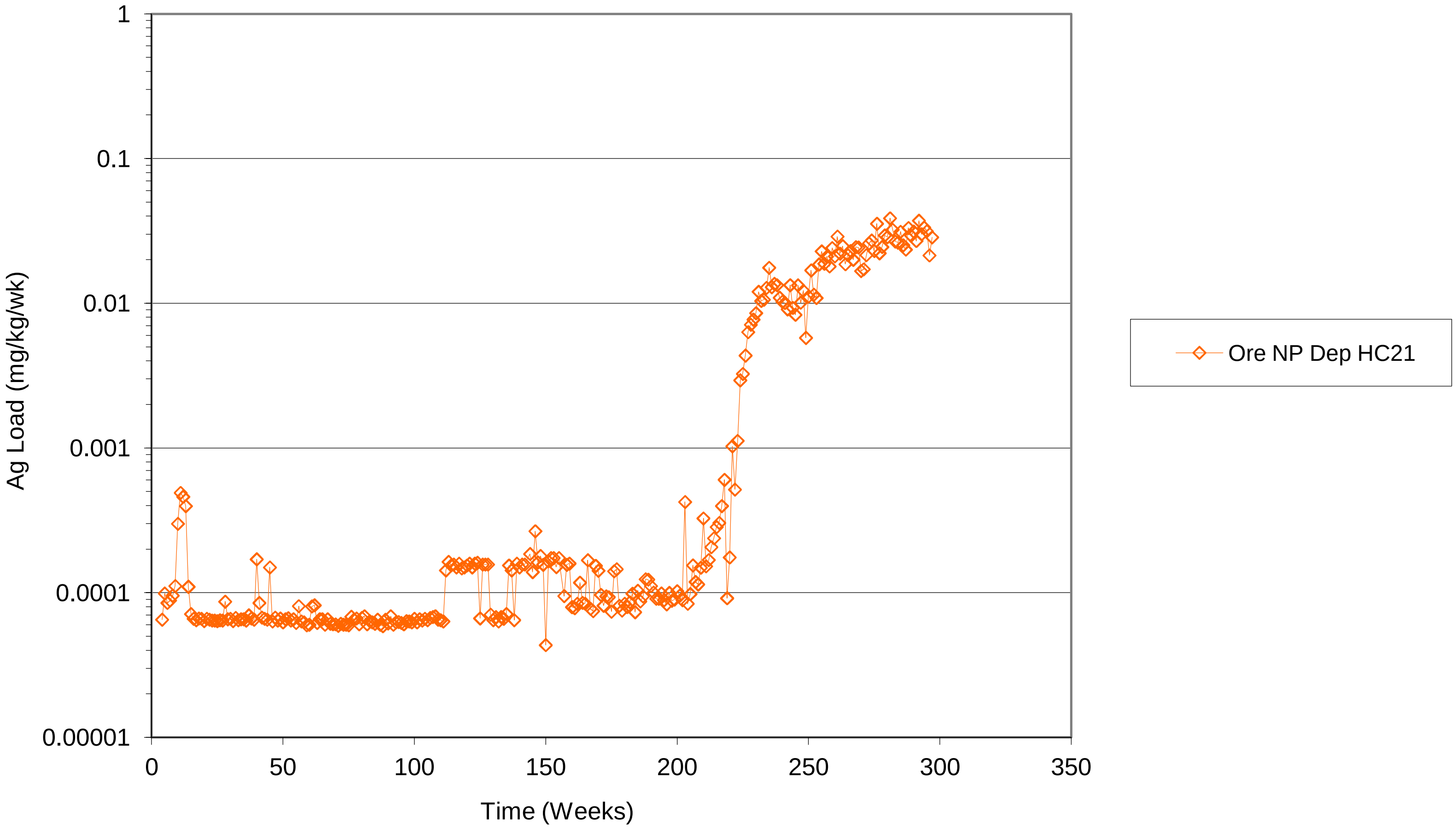
TC 53920



Sulphate Load
Operating Cells
Wolverine Mine, YK

NP-Depleted Ore

March 2013	FIGURE 20



Silver Load
Operating Cells
Wolverine Mine, YK

NP-Depleted Ore

March 2013	FIGURE 21

TC 53920

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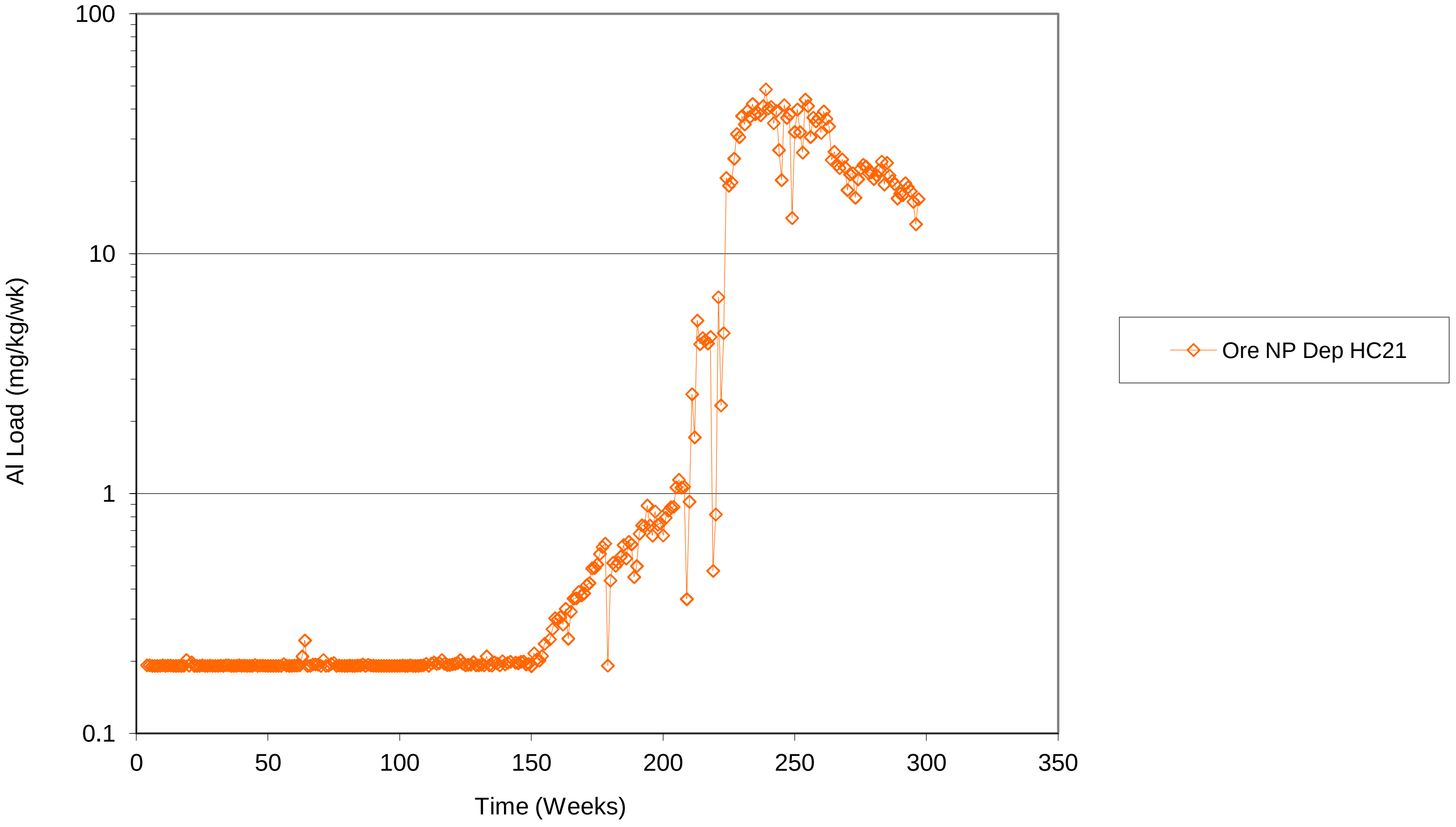
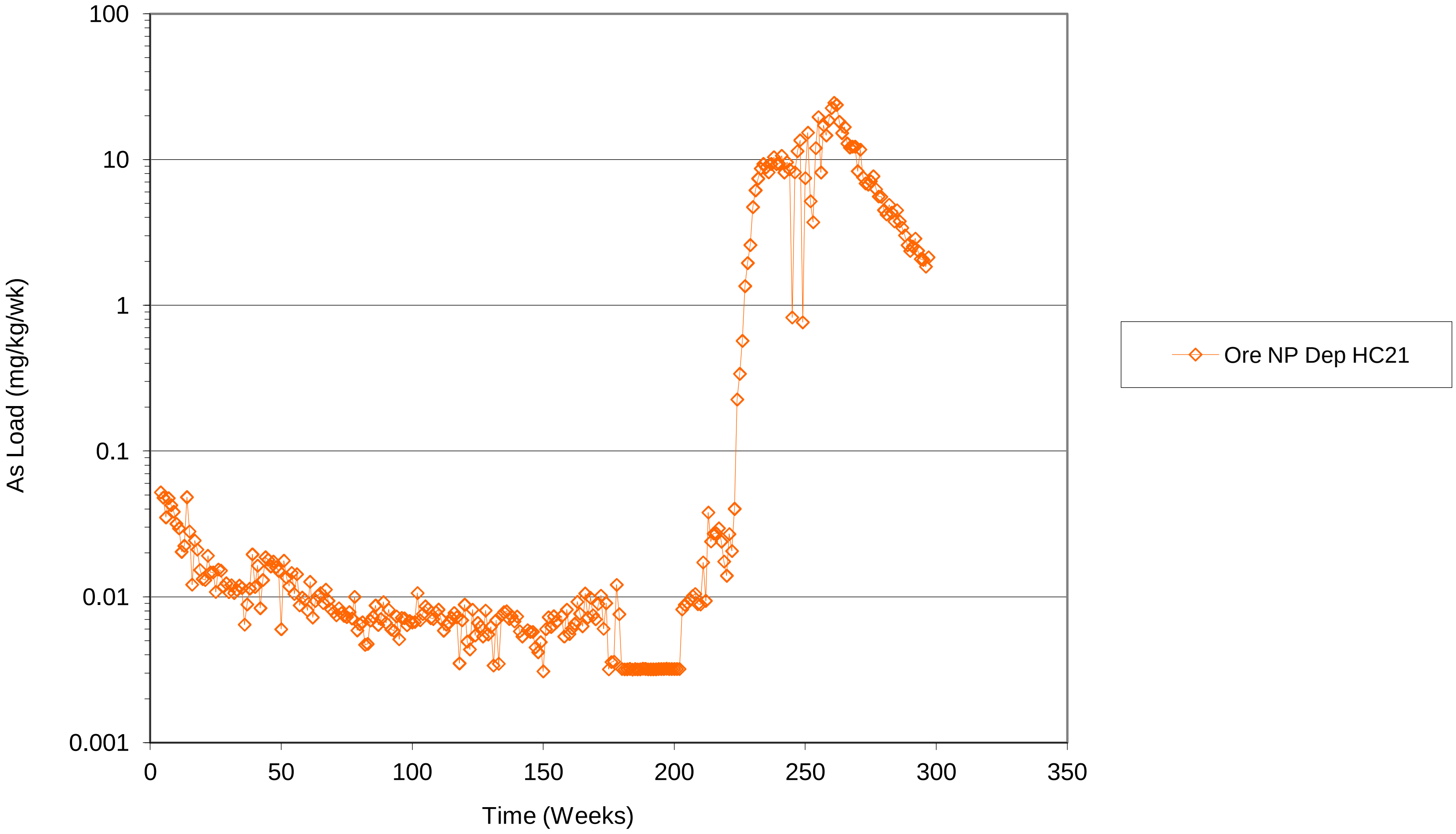


Aluminium Load
Operating Cells
Wolverine Mine, YK

NP-Depleted Ore

March 2013	FIGURE 22



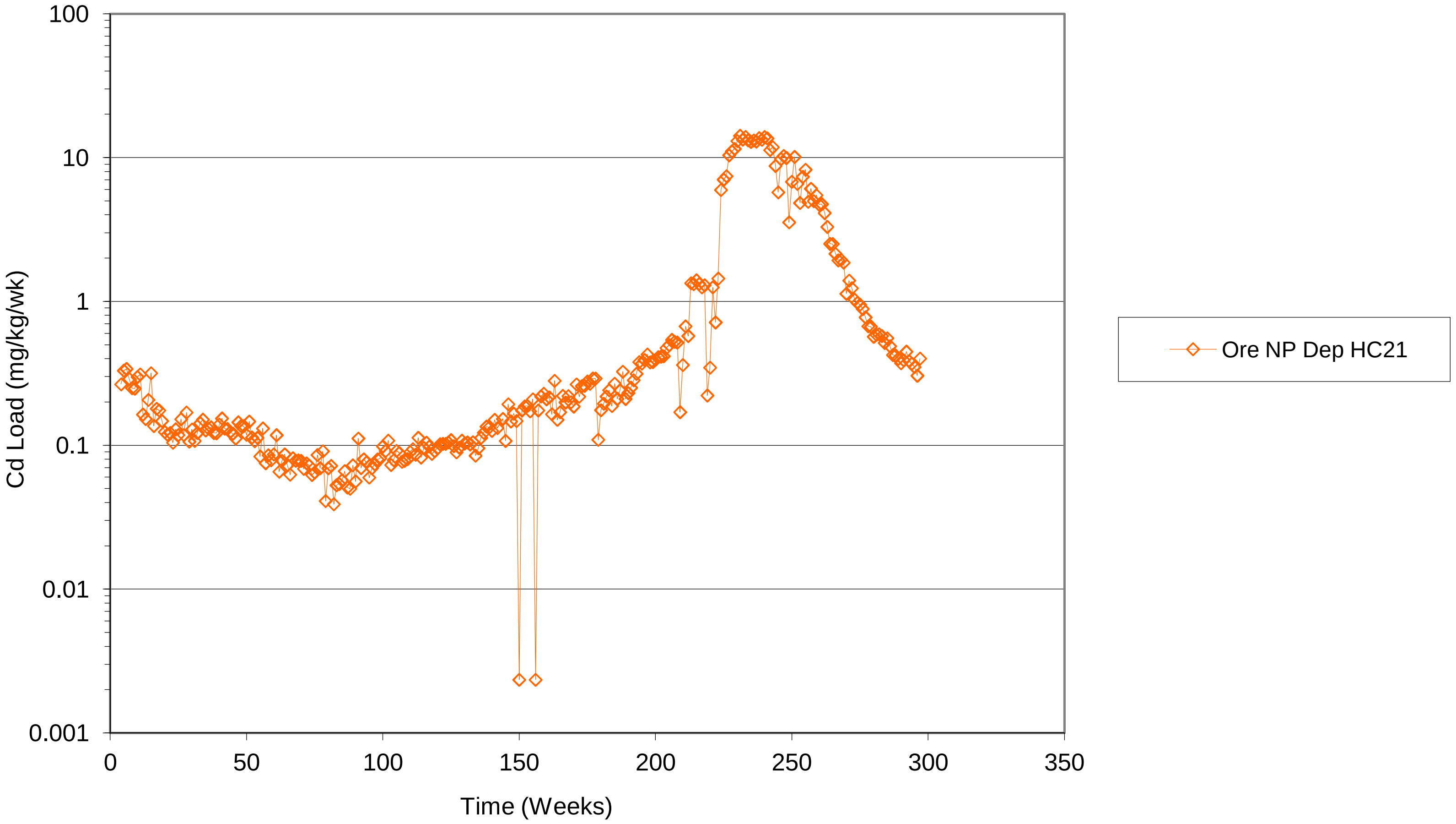
Arsenic Load
Operating Cells
Wolverine Mine, YK

NP-Depleted Ore

March 2013	FIGURE 23

TC 53920

amec



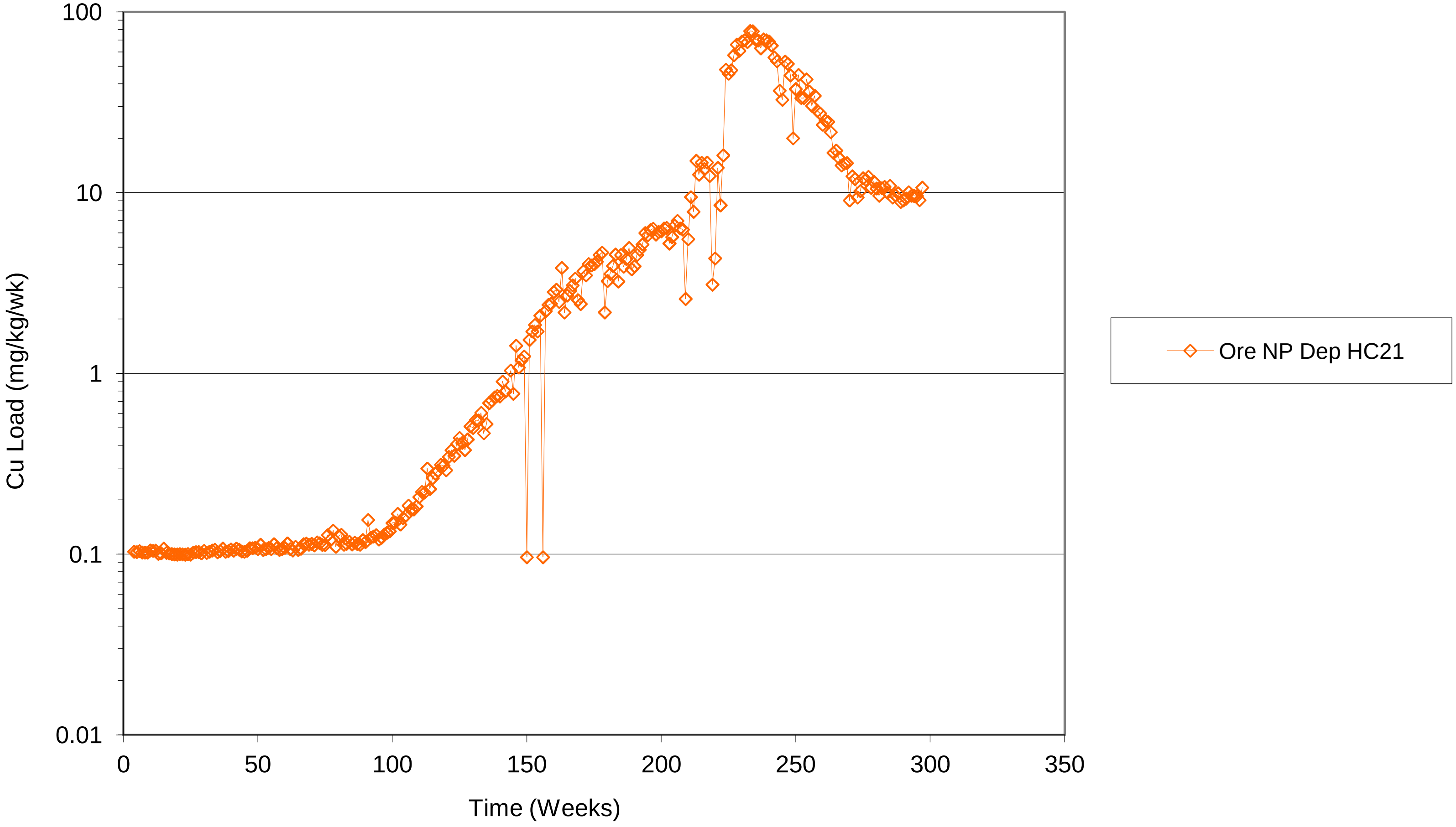
Cadmium Load
Operating Cells
Wolverine Mine, YK

NP-Depleted Ore

March 2013	FIGURE 24

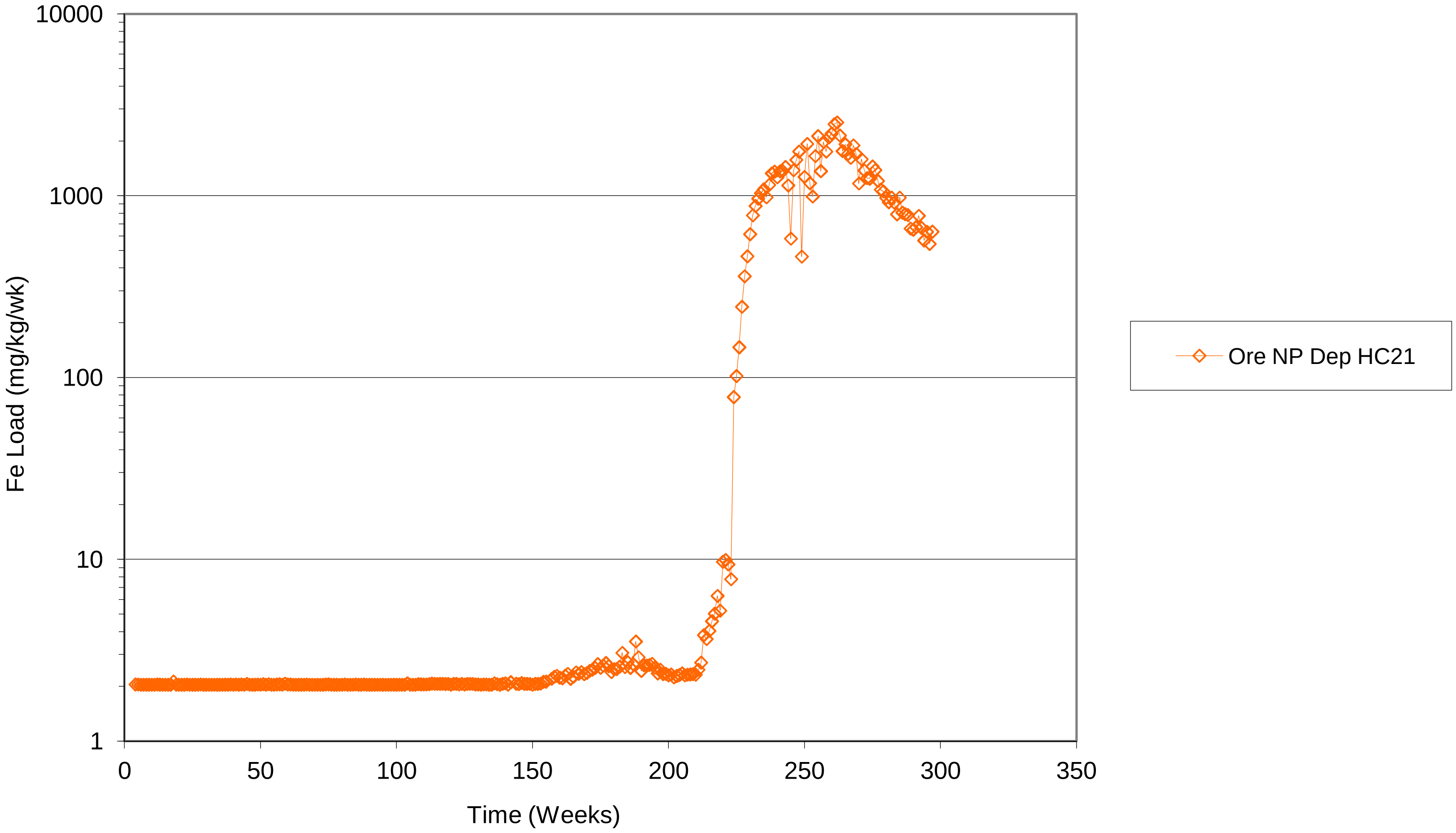
TC 53920

amec



Copper Load Operating Cells Wolverine Mine, YK	
NP-Depleted Ore	
March 2013	FIGURE 25

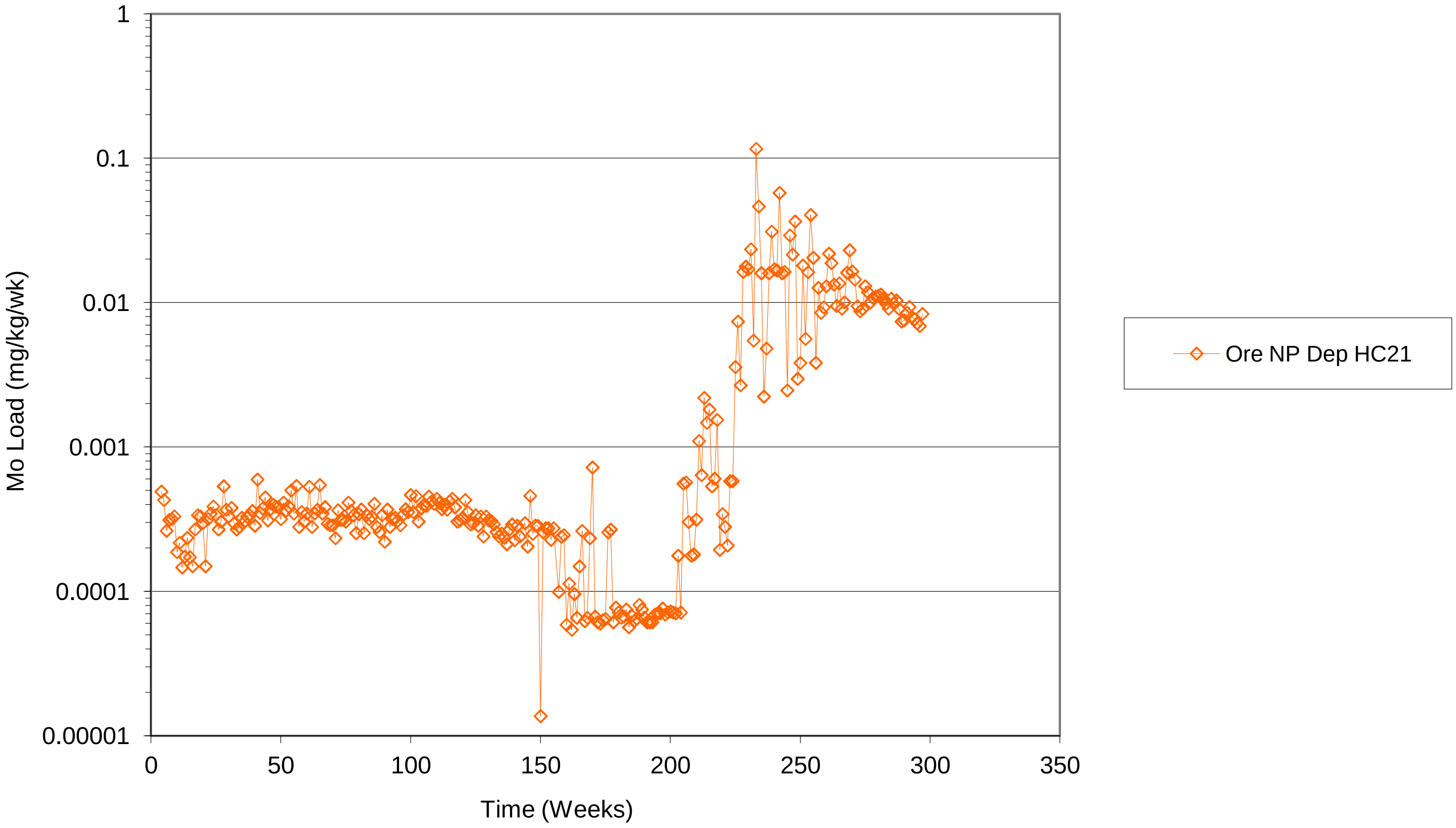
TC 53920



Iron Load
Operating Cells
Wolverine Mine, YK

NP-Depleted Ore

March 2013	FIGURE 26

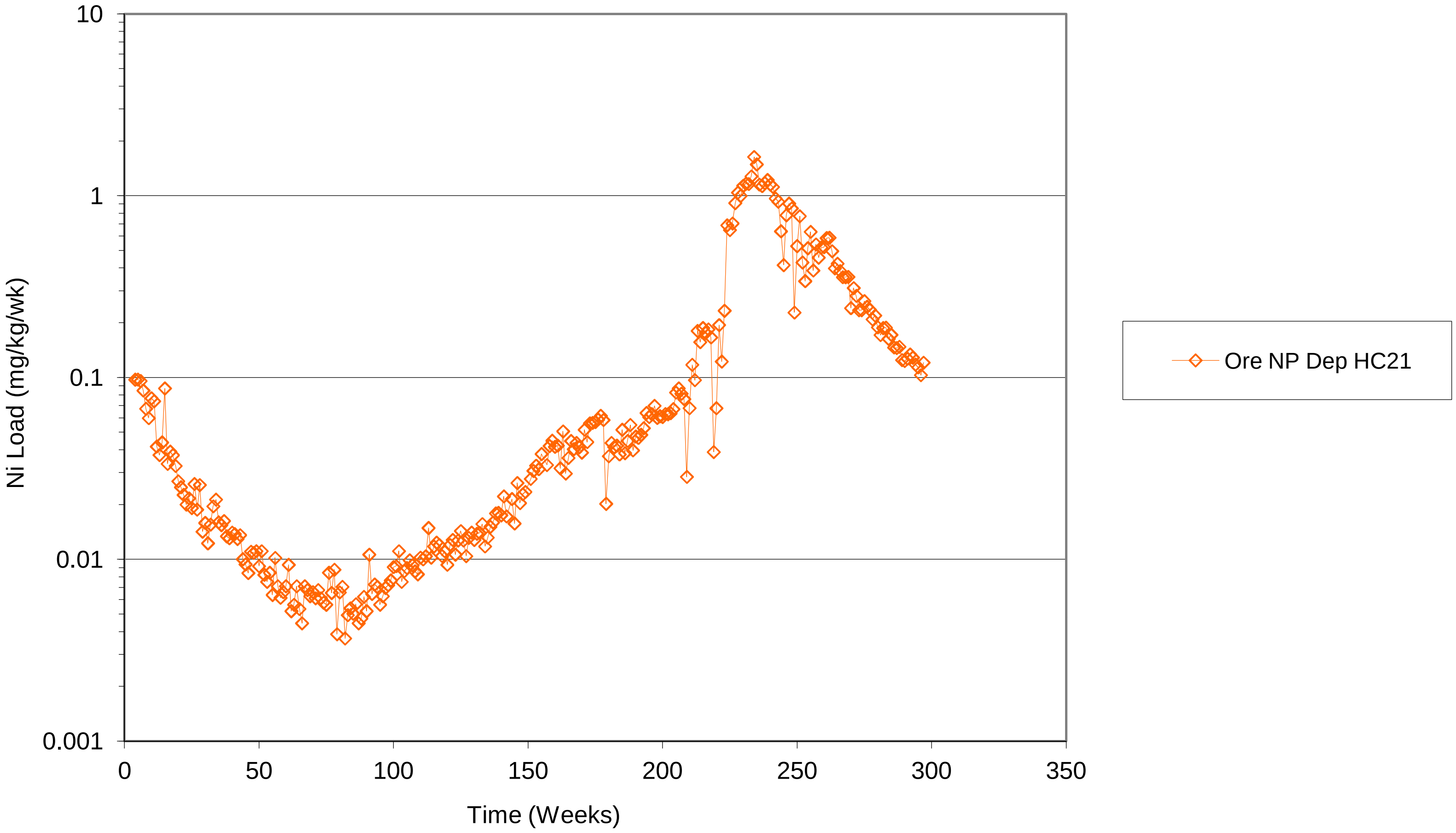


Molybdenum Load
Operating Cells
Wolverine Mine, YK

NP-Depleted Ore

March 2013	FIGURE 27

TC 53920

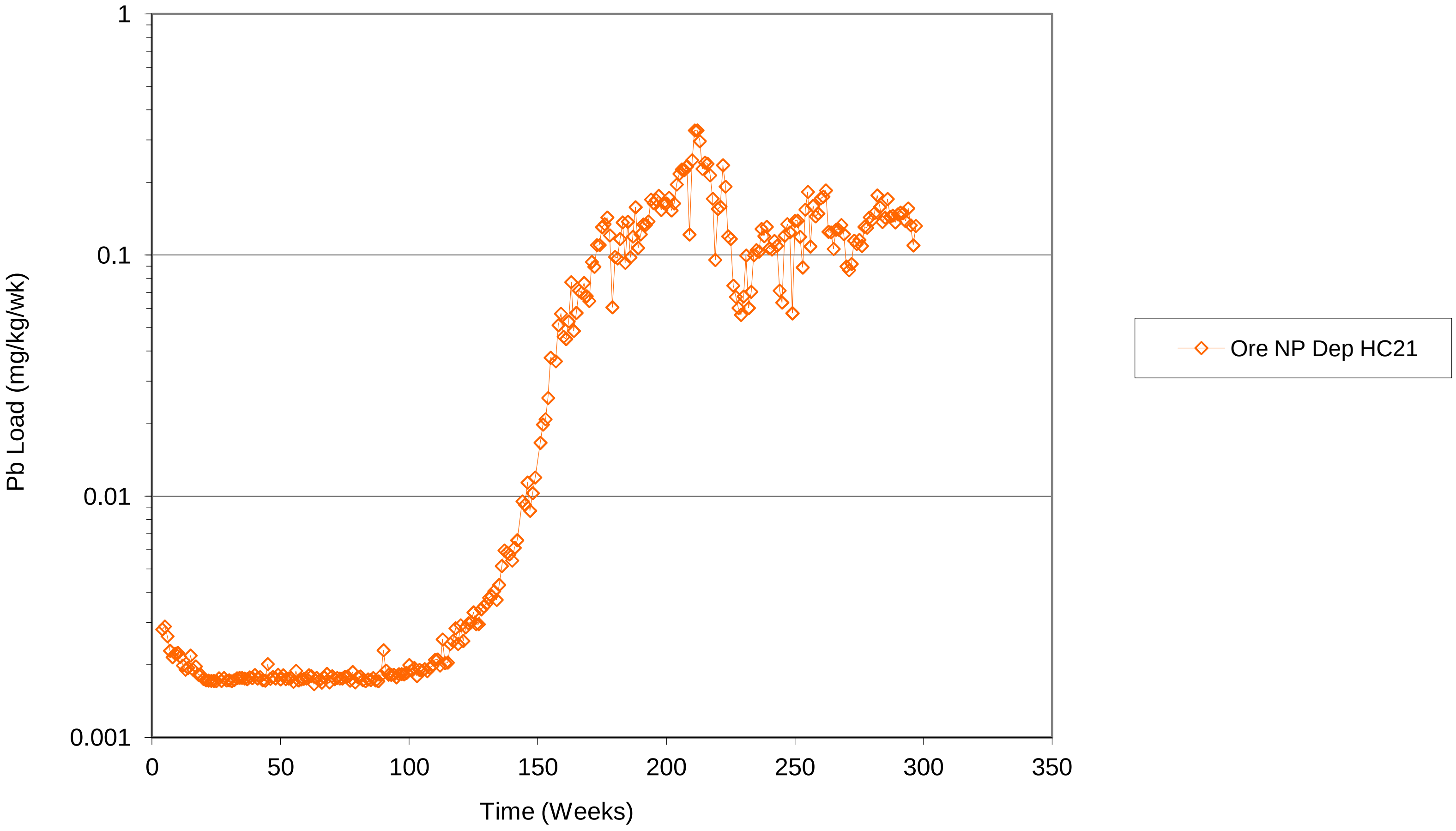


Nickel Load
Operating Cells
Wolverine Mine, YK

NP-Depleted Ore

March 2013	FIGURE 28

TC 53920

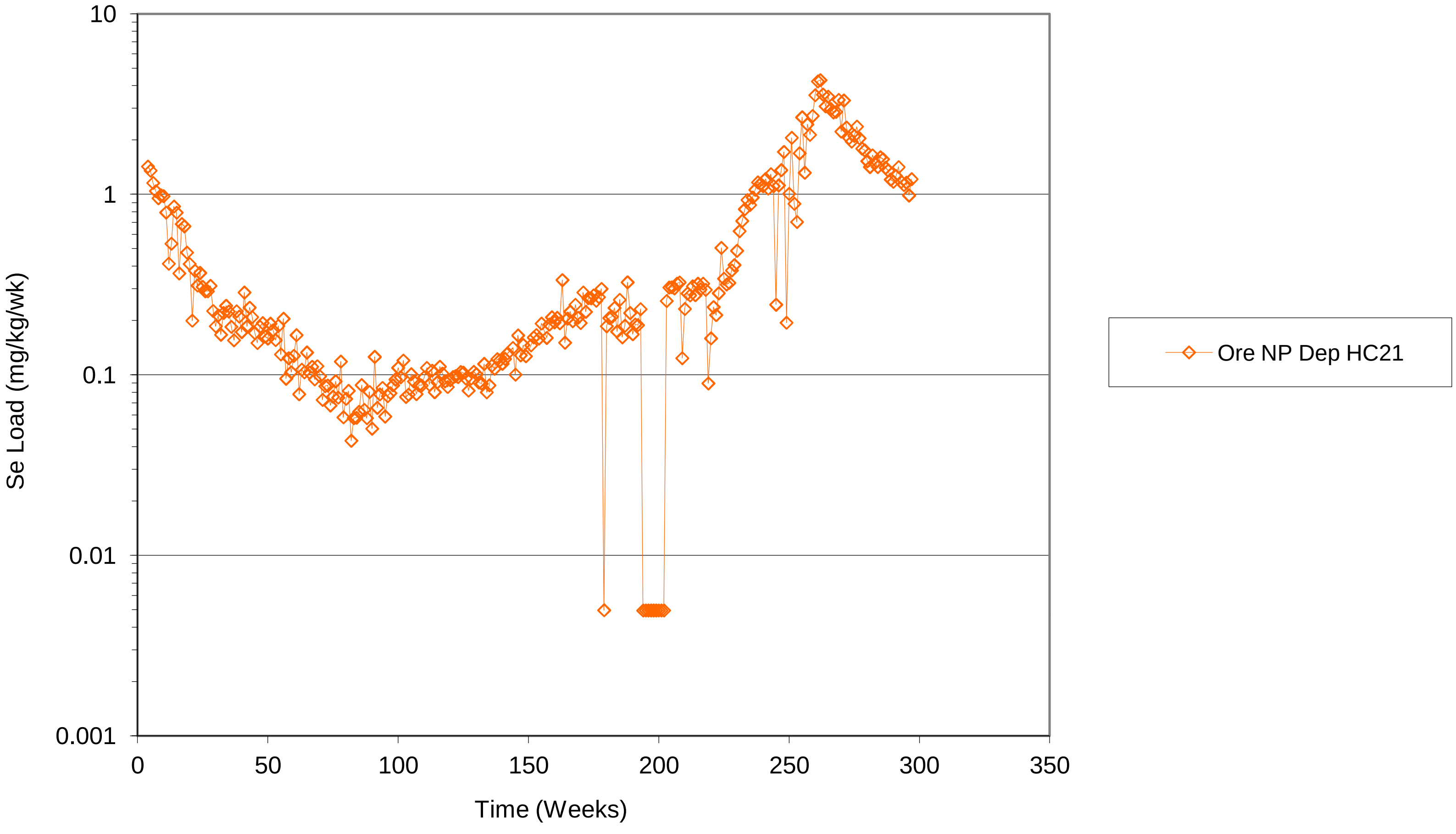


Lead Load
Operating Cells
Wolverine Mine, YK

NP-Depleted Ore

March 2013	FIGURE 29

TC 53920

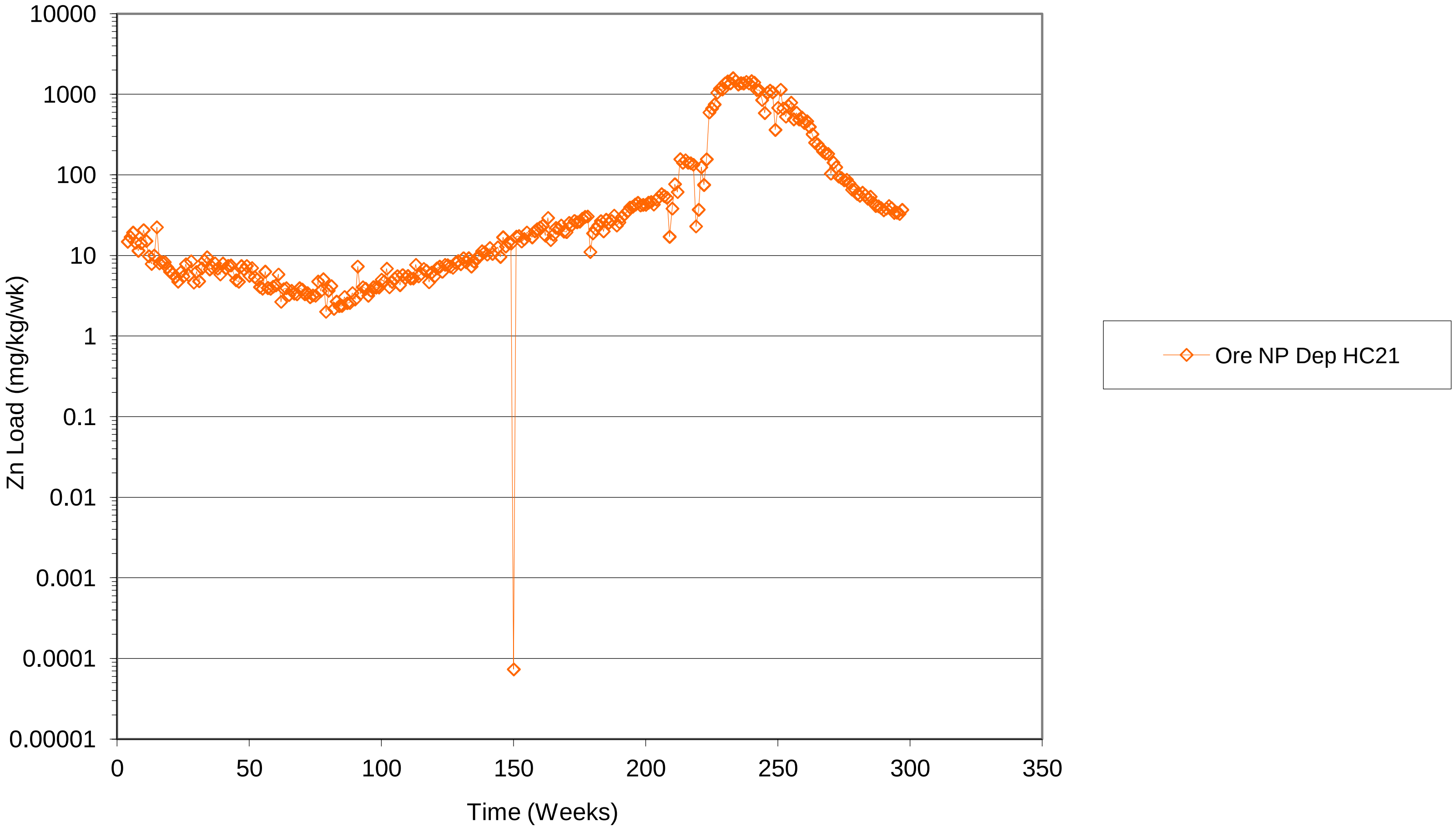


Selenium Load
Operating Cells
Wolverine Mine, YK

NP-Depleted Ore

March 2013	FIGURE 30

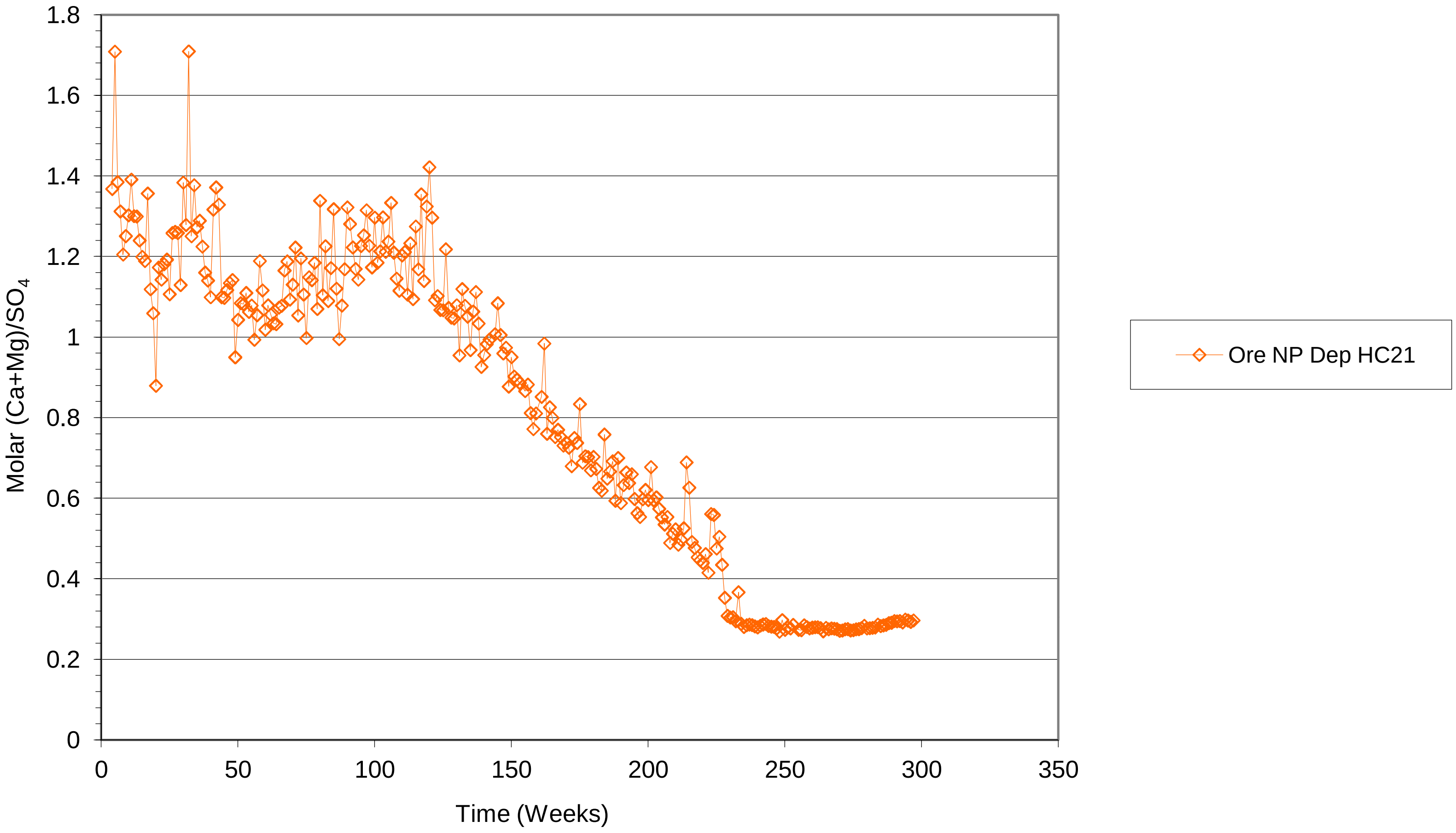
TC 53920



Zinc Load
Operating Cells
Wolverine Mine, YK

NP-Depleted Ore

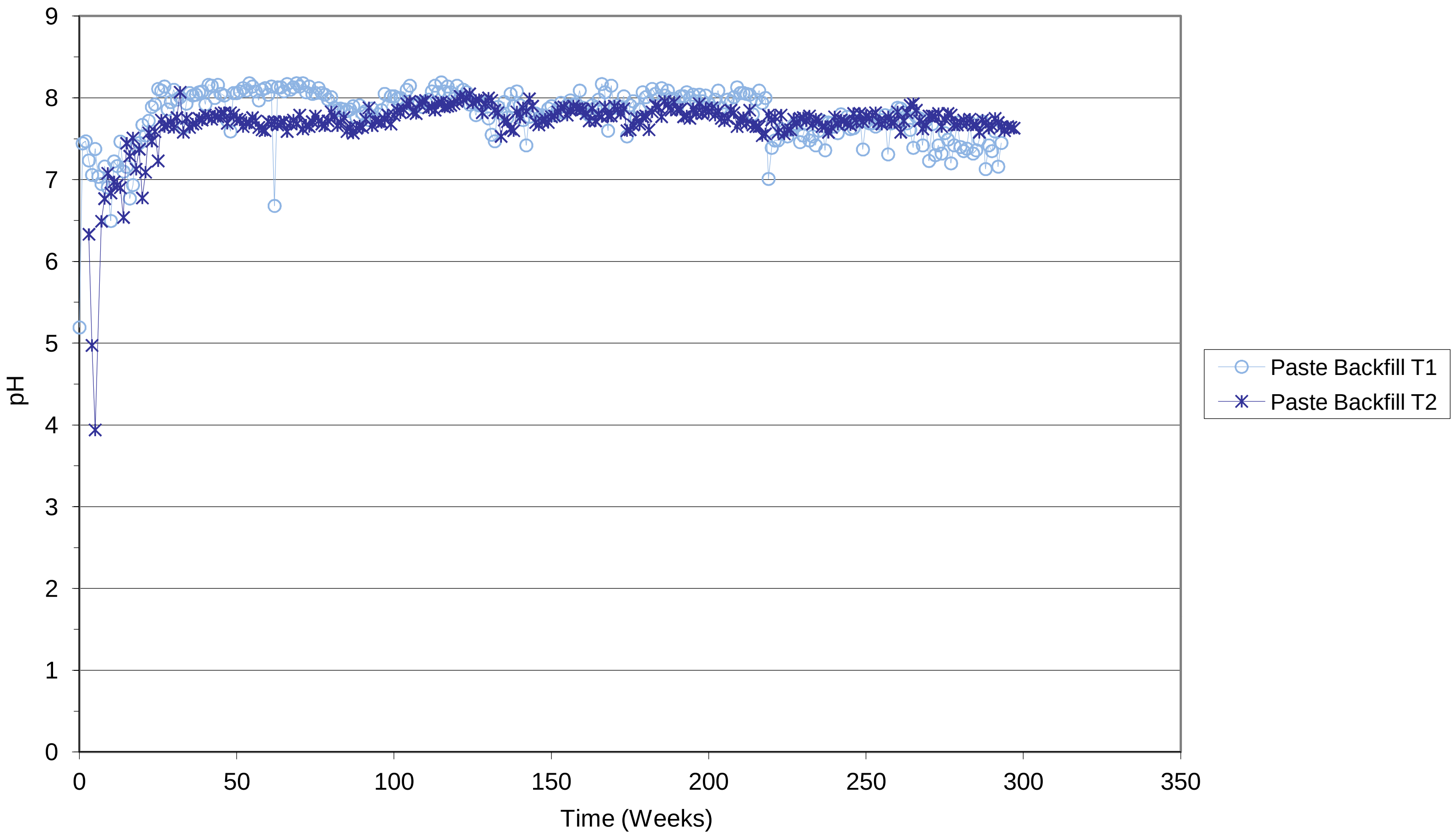
March 2013	FIGURE 31



Molar (Ca+Mg)/SO_4 Ratio
Operating Cells
Wolverine Mine, YK

NP-Depleted Ore

March 2013	FIGURE 32

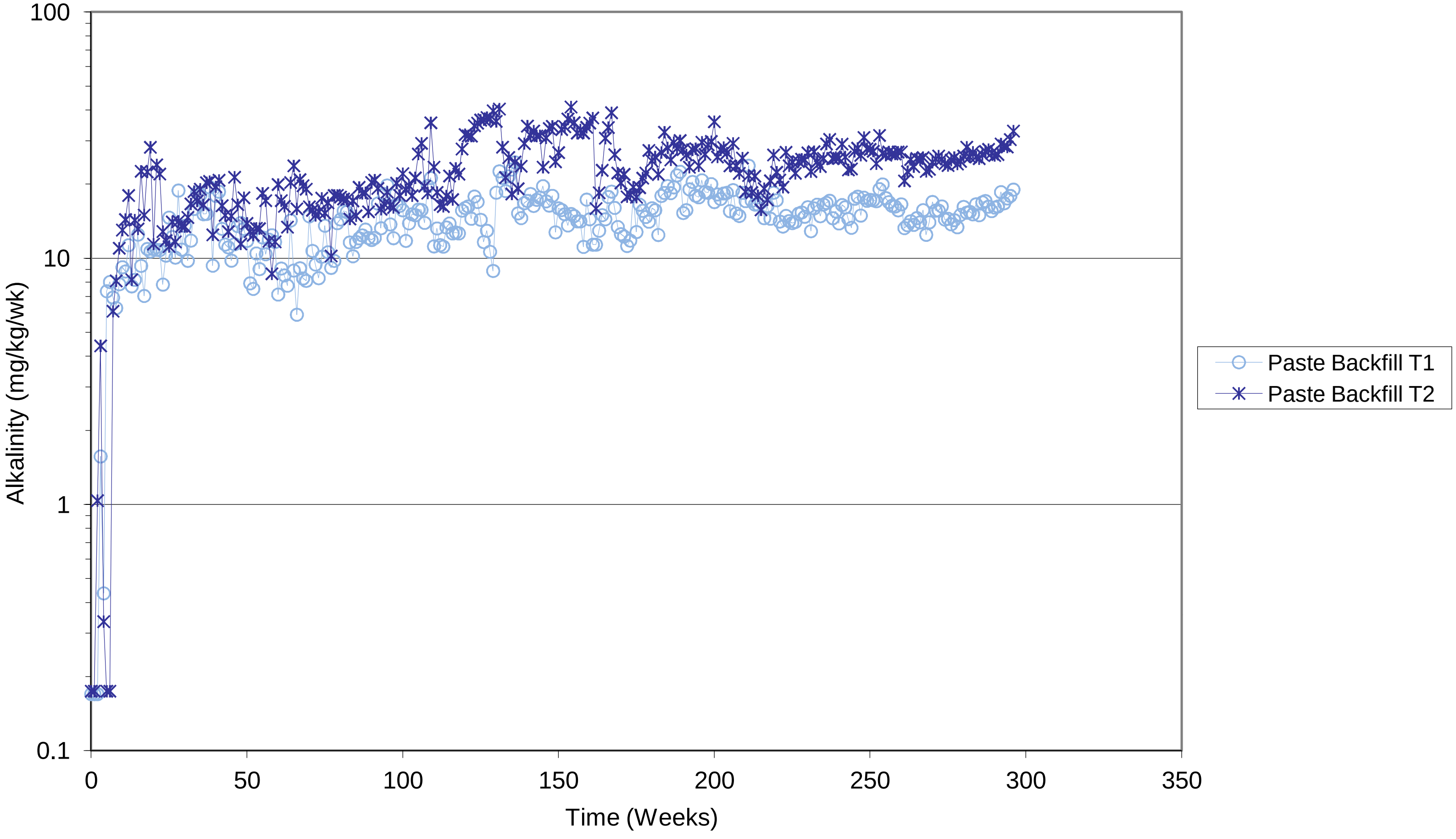


pH Load
Operating Cells
Wolverine Mine, YK

Paste Backfill

March 2013	FIGURE 33

amec



Alkalinity Load
Operating Cells
Wolverine Mine, YK

Paste Backfill

March 2013	FIGURE 34

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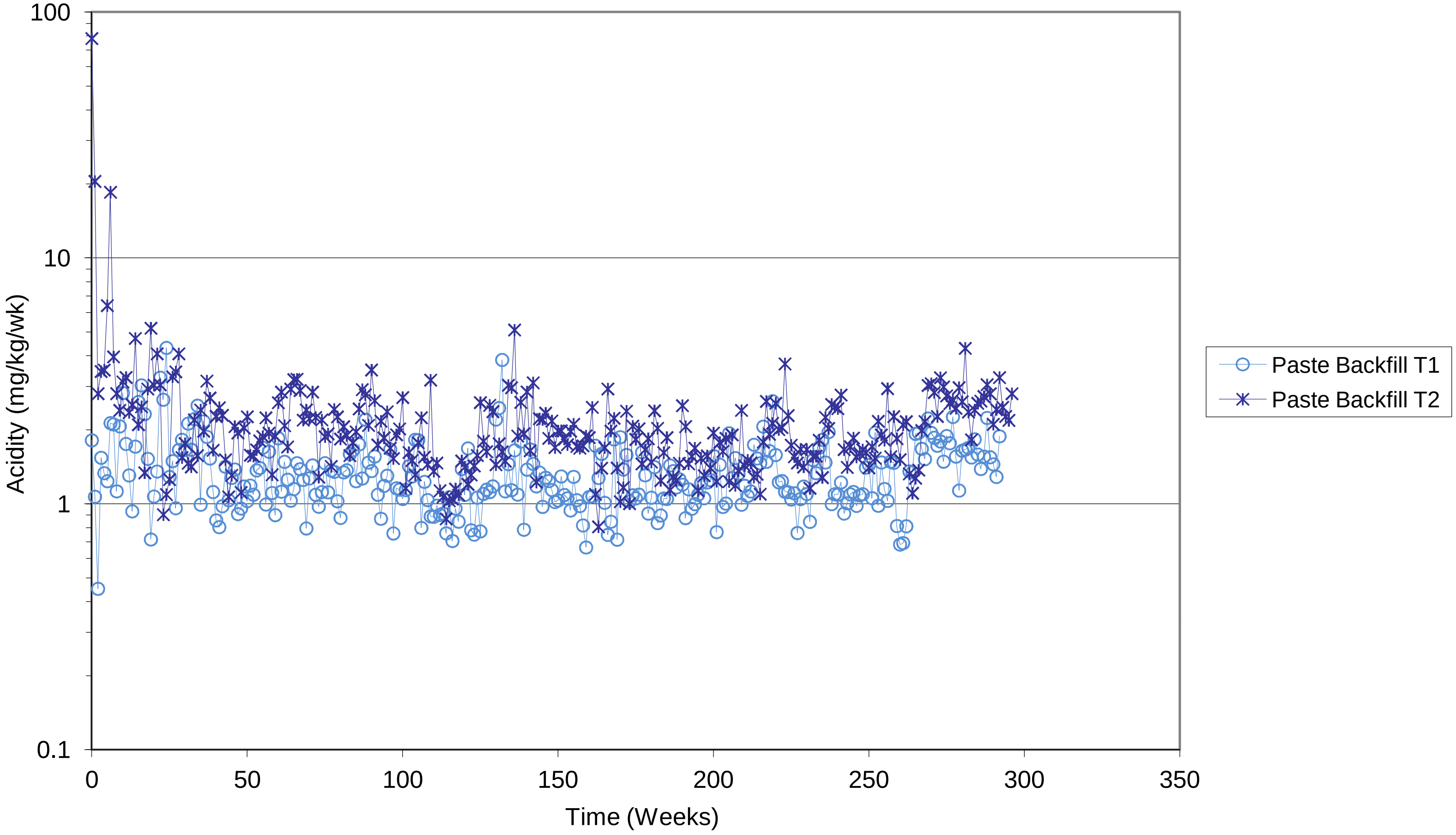
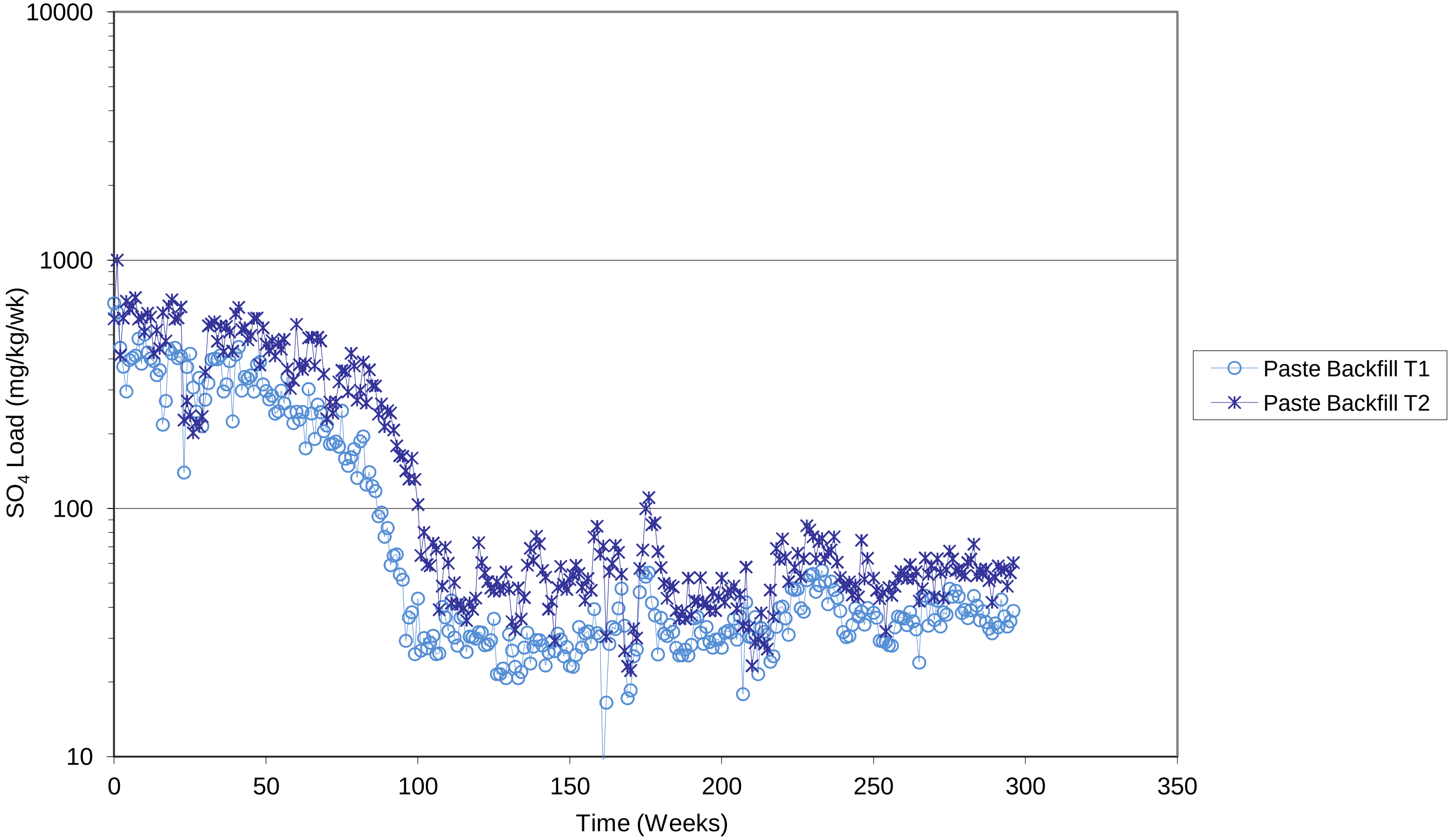


Acidity Load
Operating Cells
Wolverine Mine, YK

Paste Backfill

March 2013	FIGURE 35

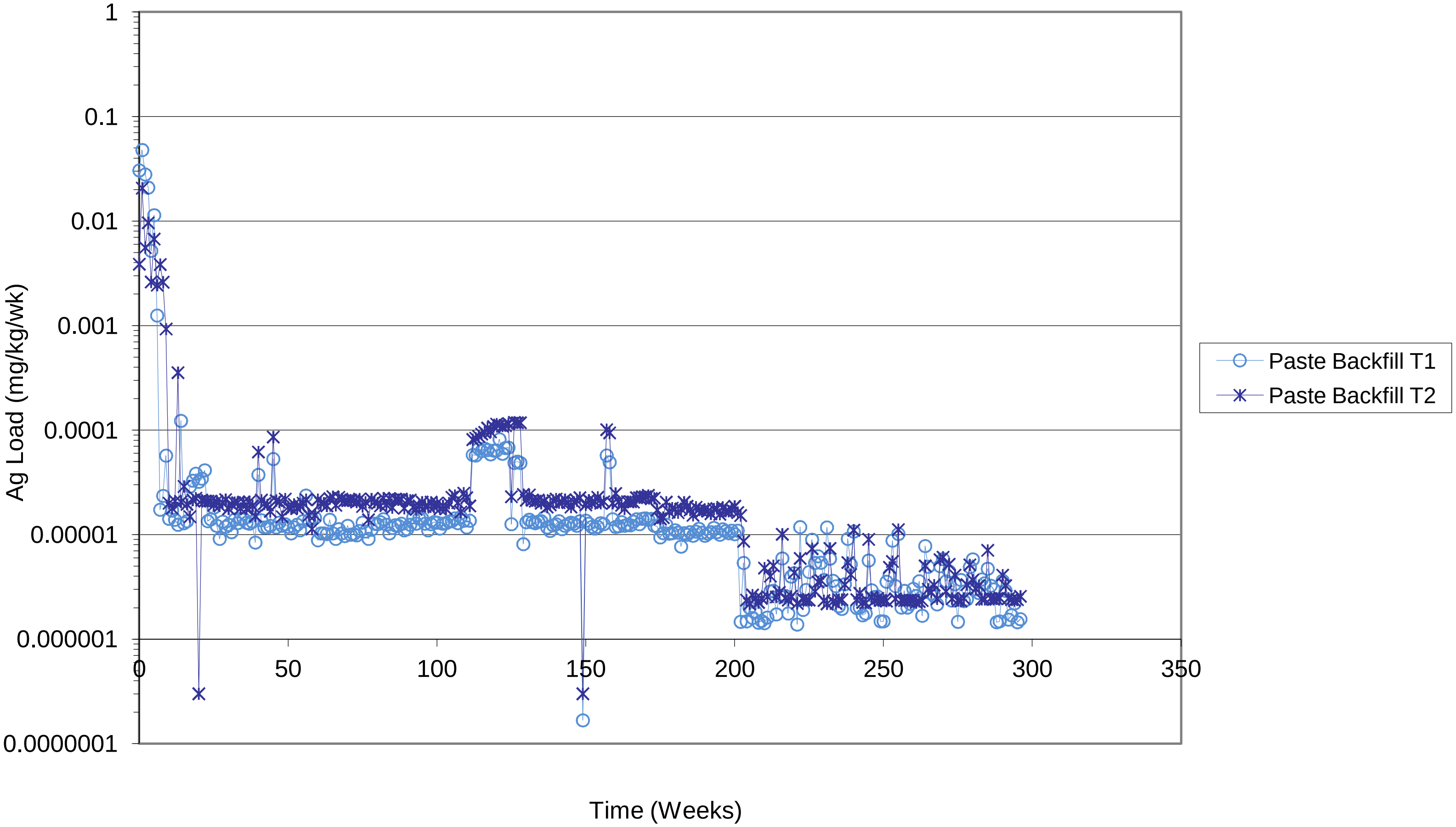


Sulphate
Operating Cells
Wolverine Mine, YK

Paste Backfill

March 2013	FIGURE 36

TC 53920

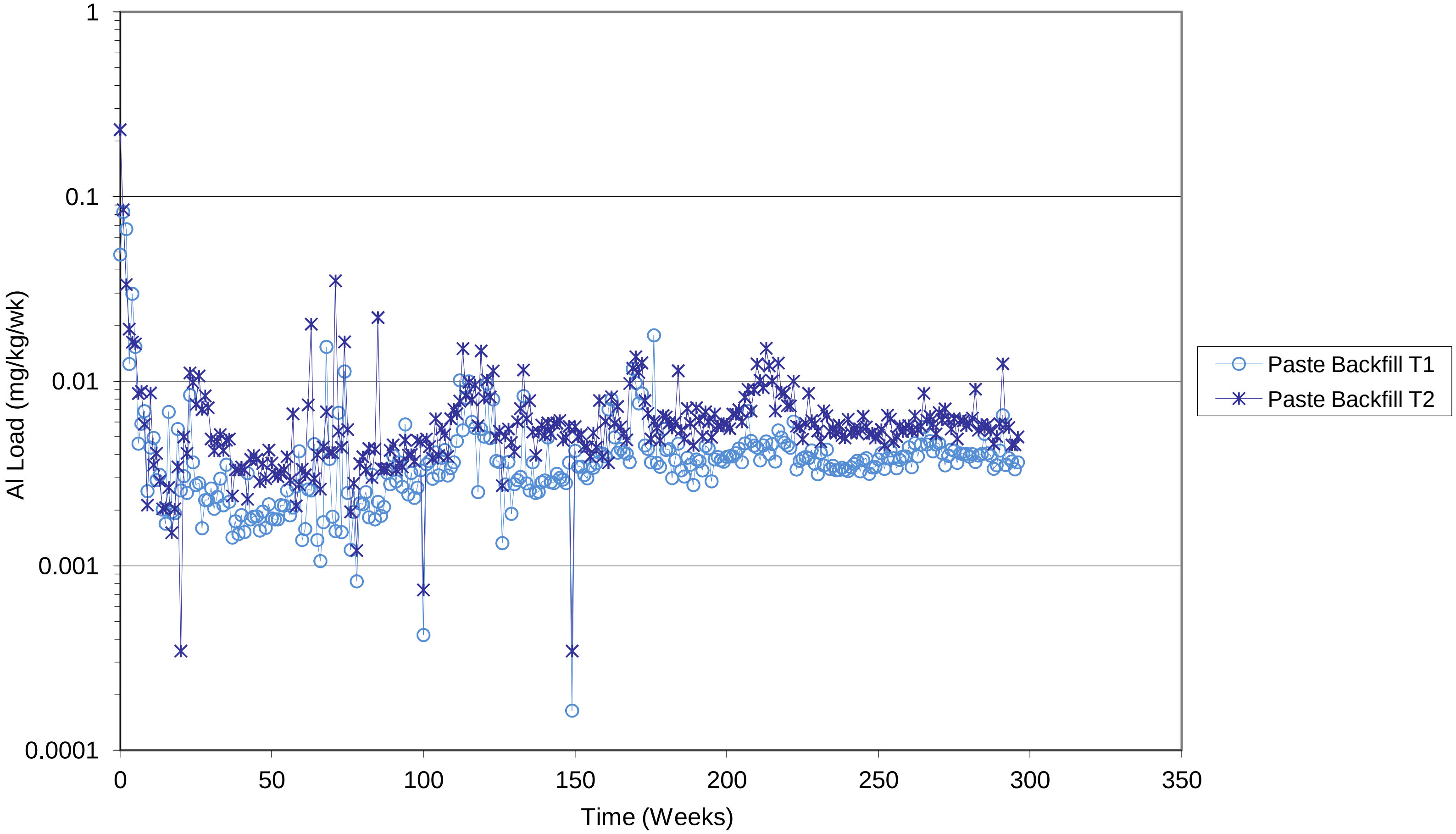


Silver Load
#REF!
Wolverine Mine, YK

Paste Backfill

March 2013	FIGURE 37

TC 53920

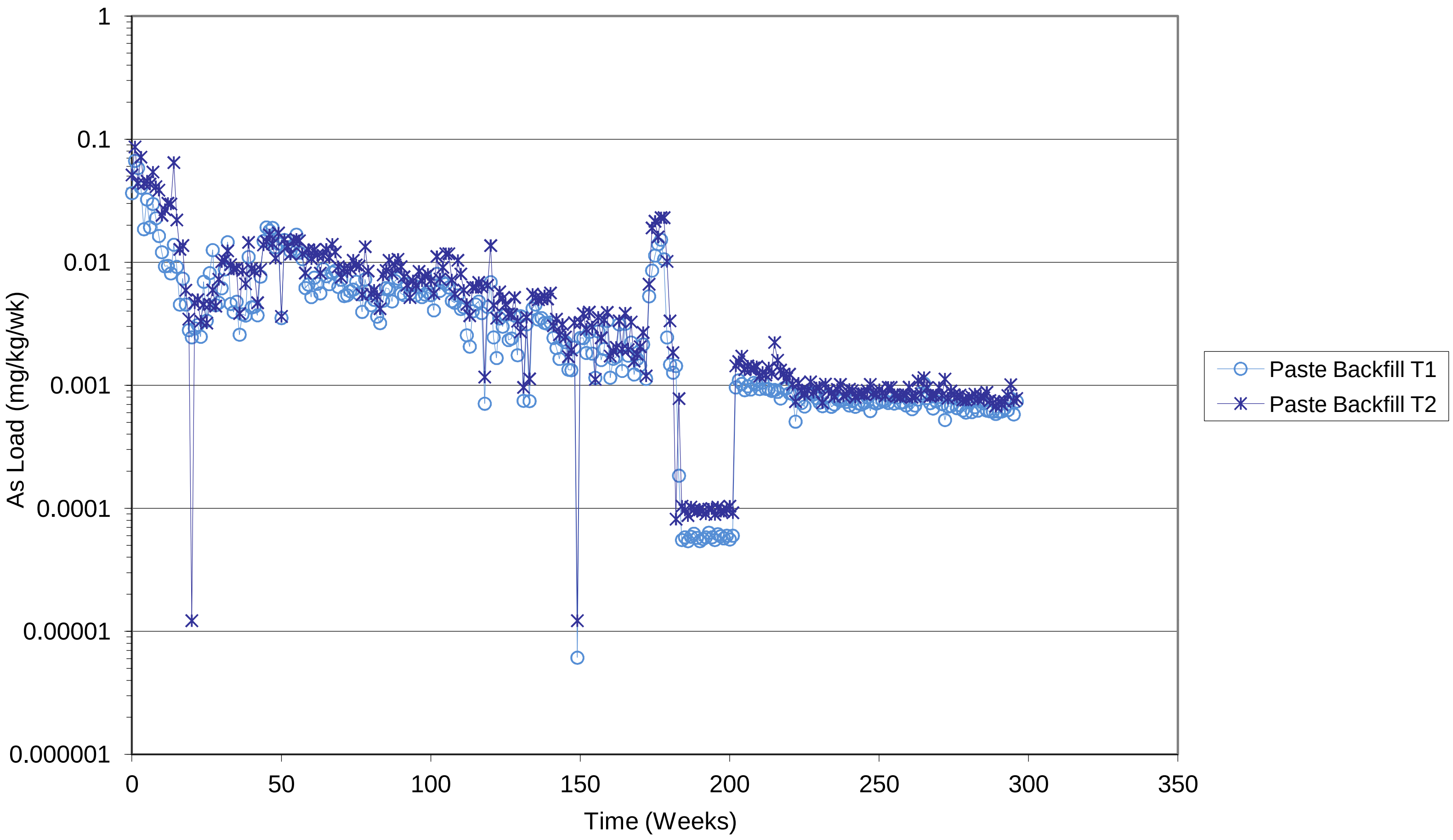


Aluminum Load
Operating Cells
Wolverine Mine, YK

Paste Backfill

March 2013	FIGURE 38

amec

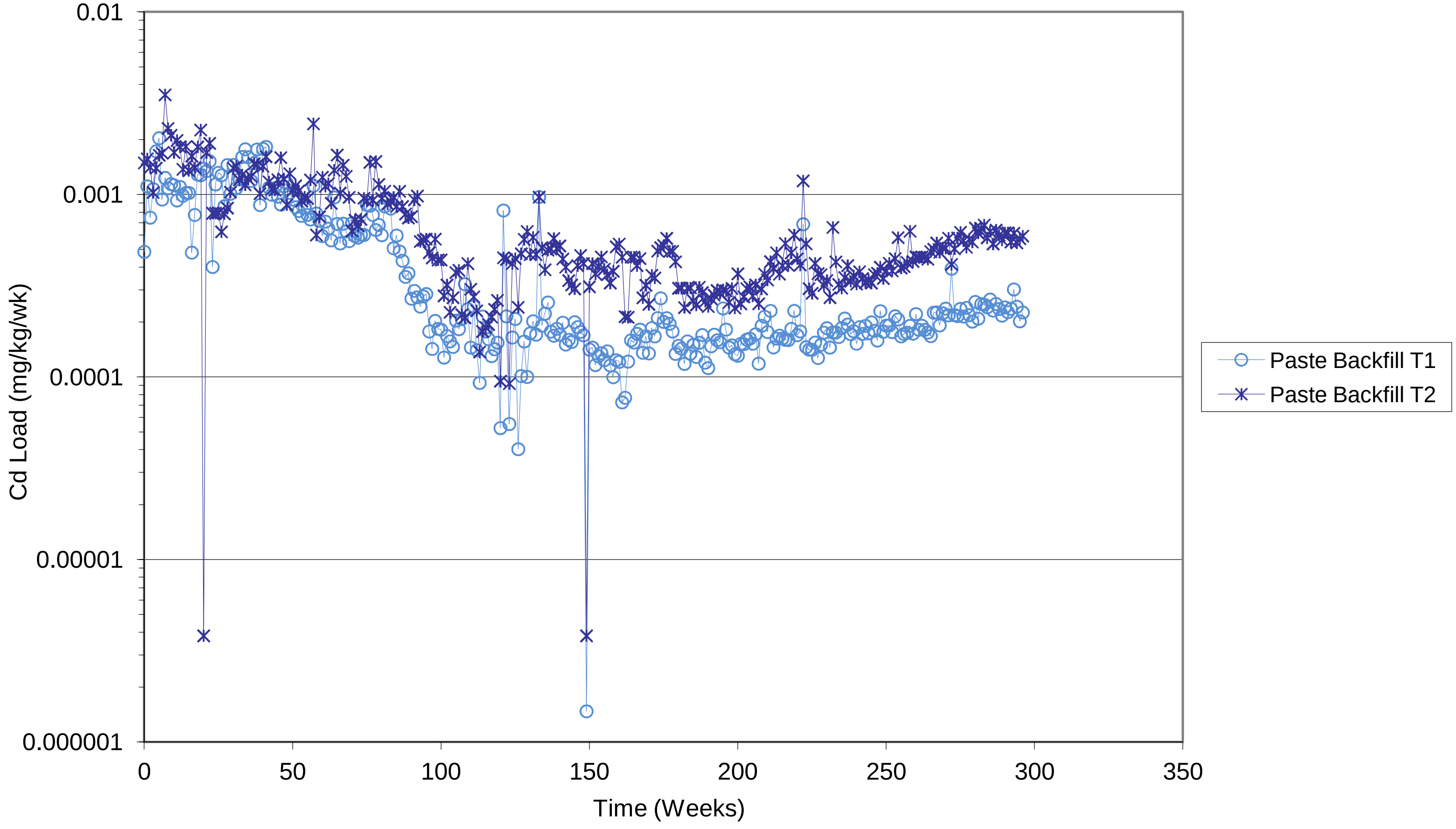


Arsenic Load
Operating Cells
Wolverine Mine, YK

Paste Backfill

March 2013	FIGURE 39

TC 53920



Cadmium Load Operating Cells Wolverine Mine, YK
Paste Backfill

March 2013	FIGURE 40

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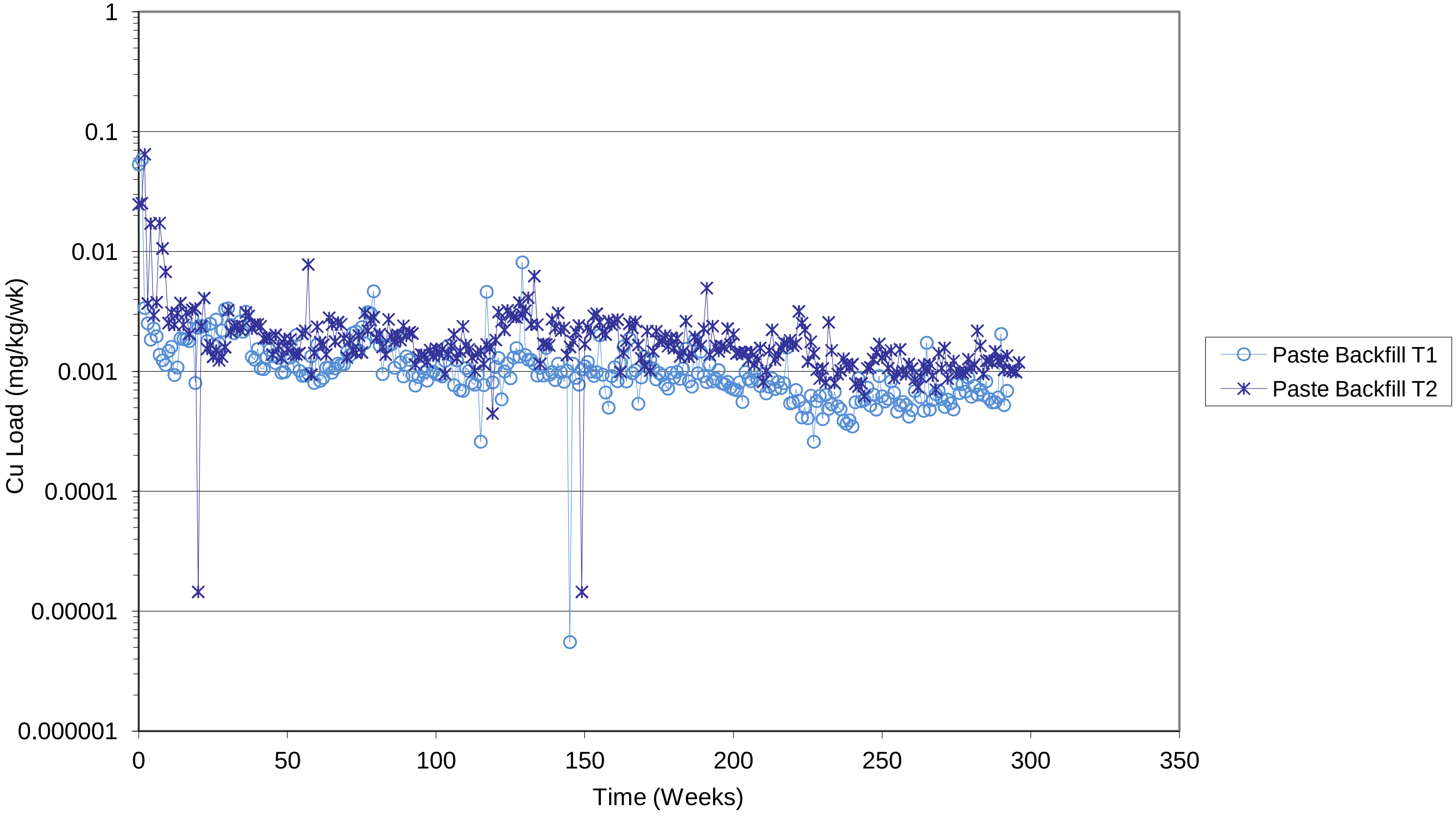
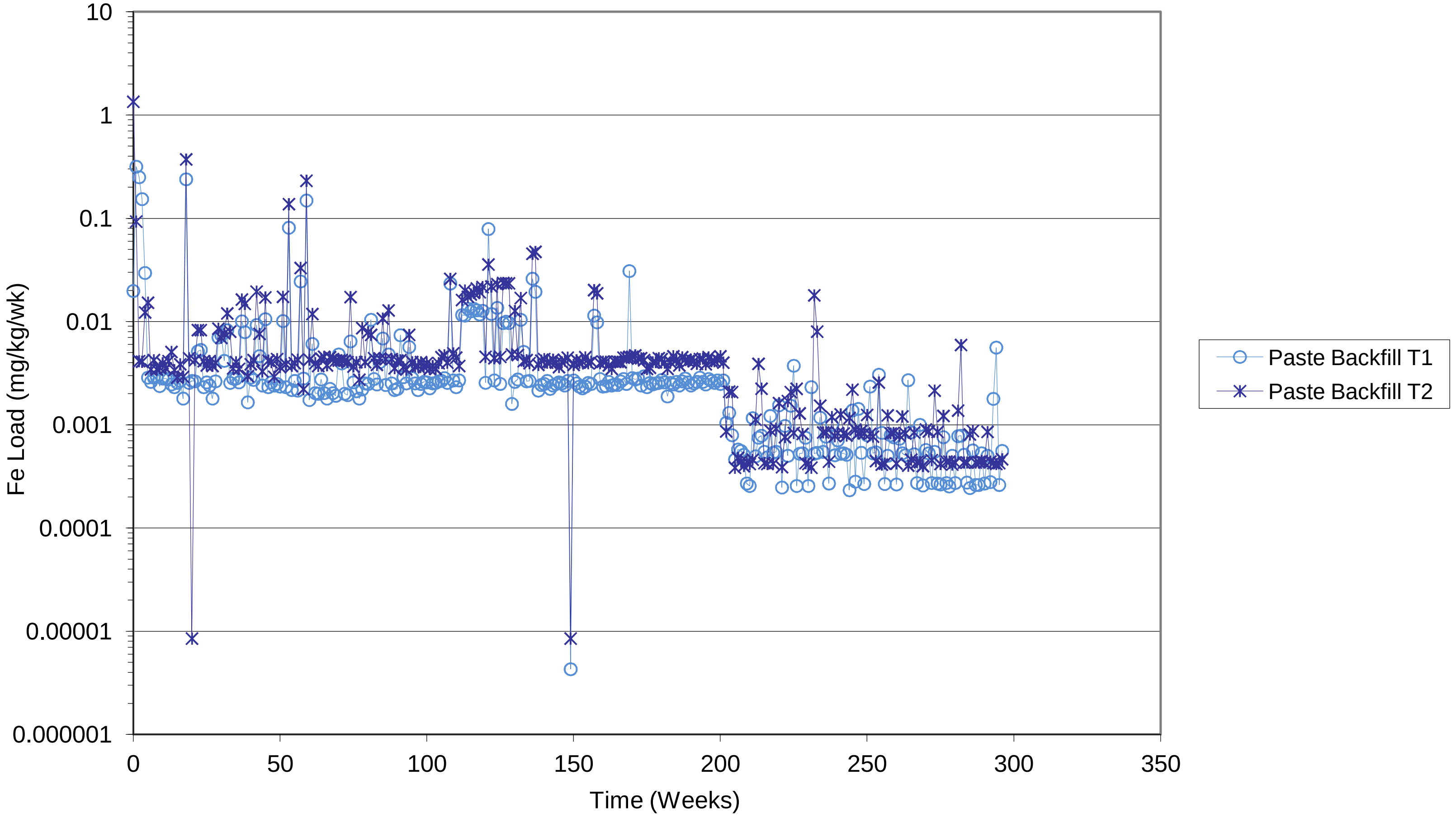


Copper Load
Operating Cells
Wolverine Mine, YK

Paste Backfill

March 2013	FIGURE 41

TC 53920



* Note change in method detection limit at week 200

Iron Load
Operating Cells
Wolverine Mine, YK

Paste Backfill

March 2013	FIGURE 42

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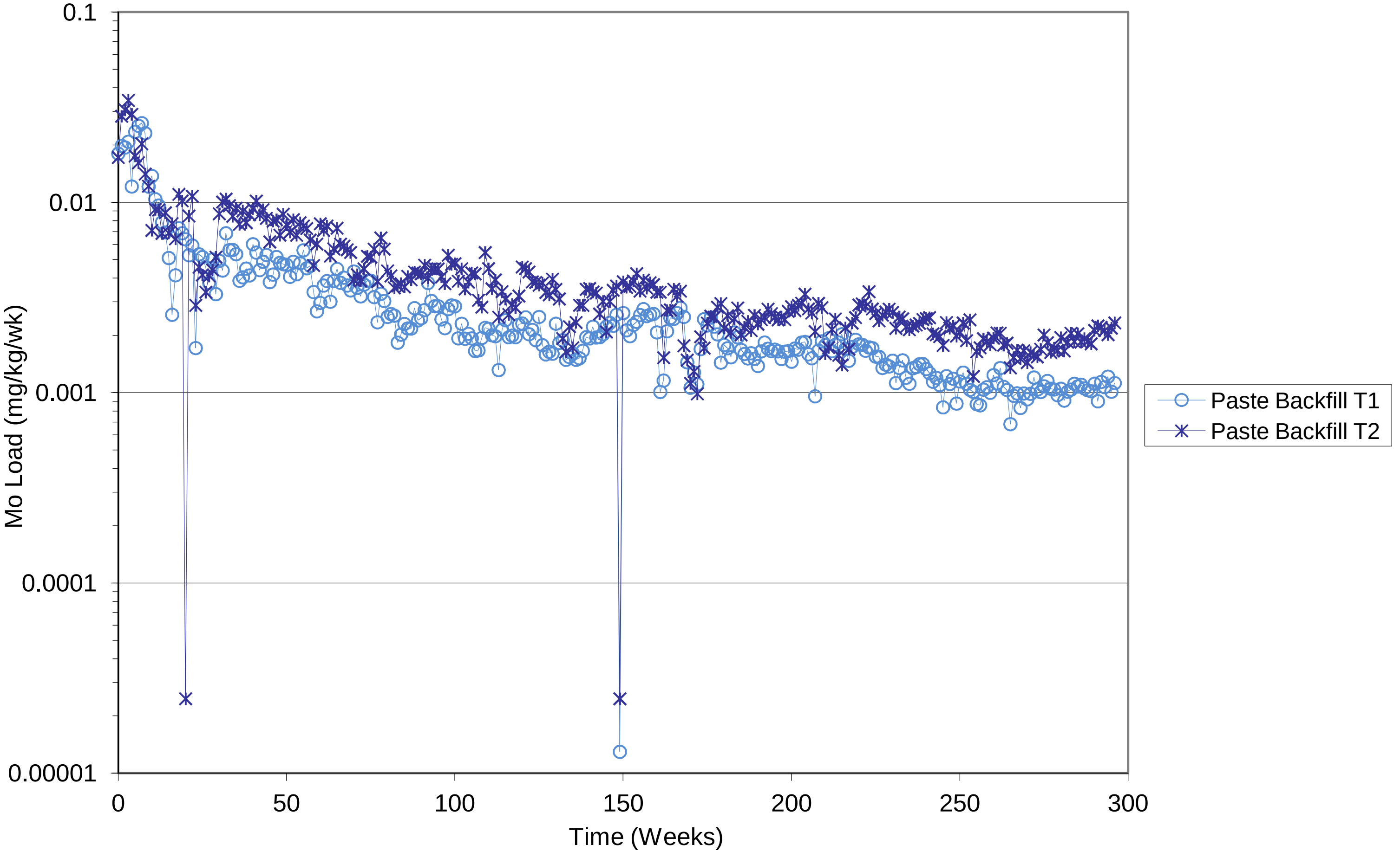


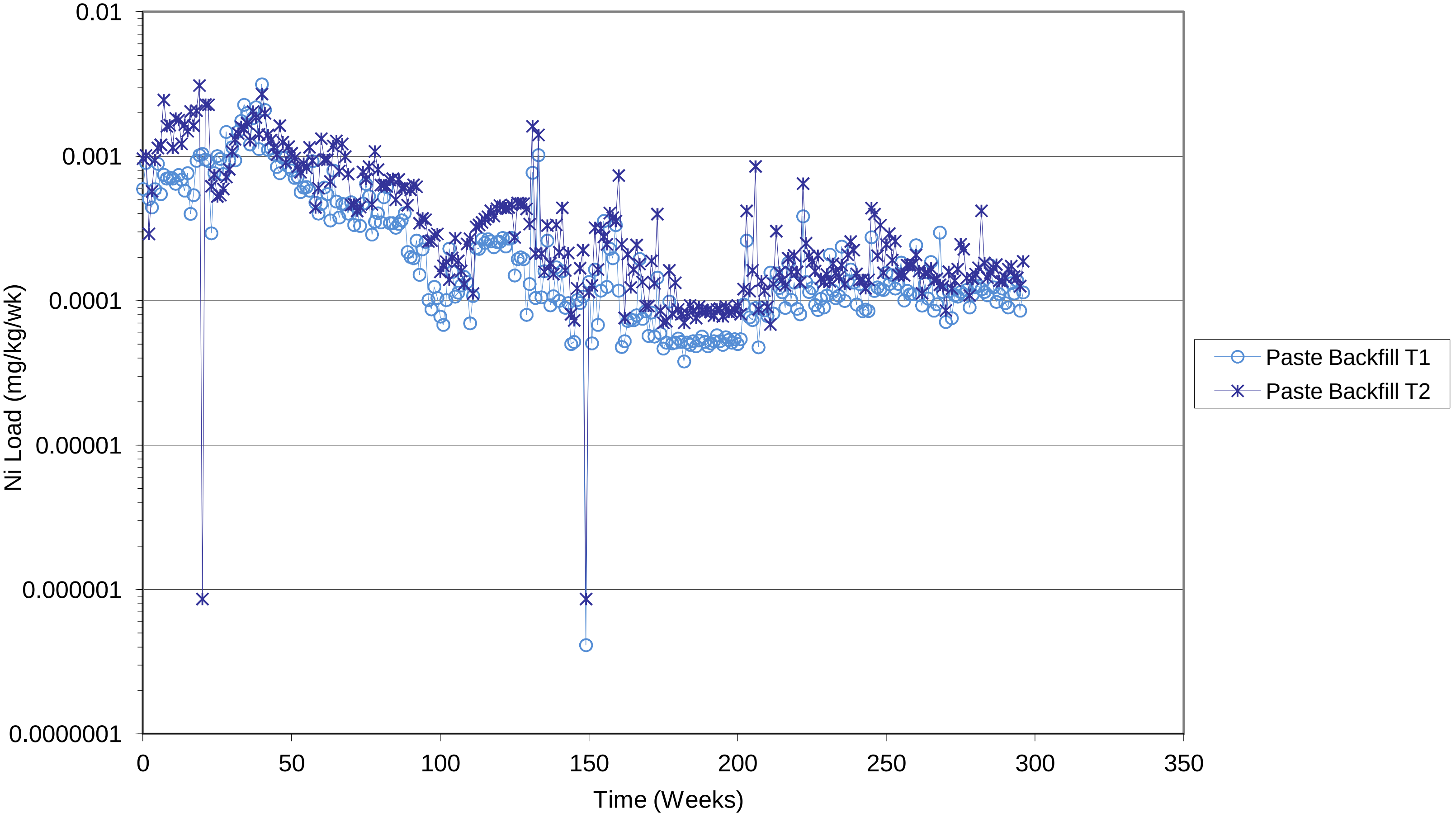
Molybdenum Load
Operating Cells
Wolverine Mine, YK

Paste Backfill

March 2013	FIGURE 43

TC 53920

amec

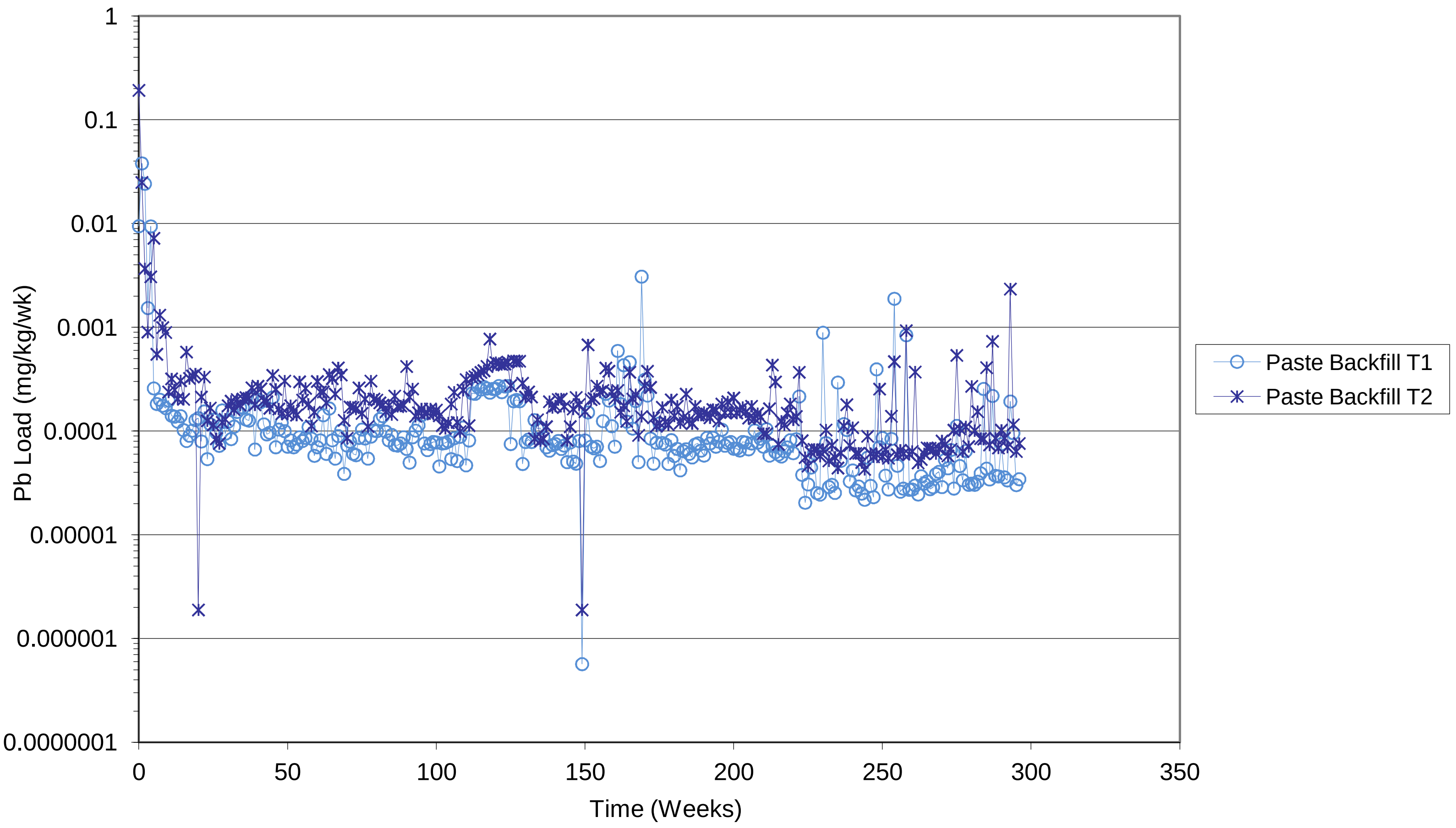


Nickel Load
Operating Cells
Wolverine Mine, YK

Paste Backfill

March 2013	FIGURE 44

TC 53920



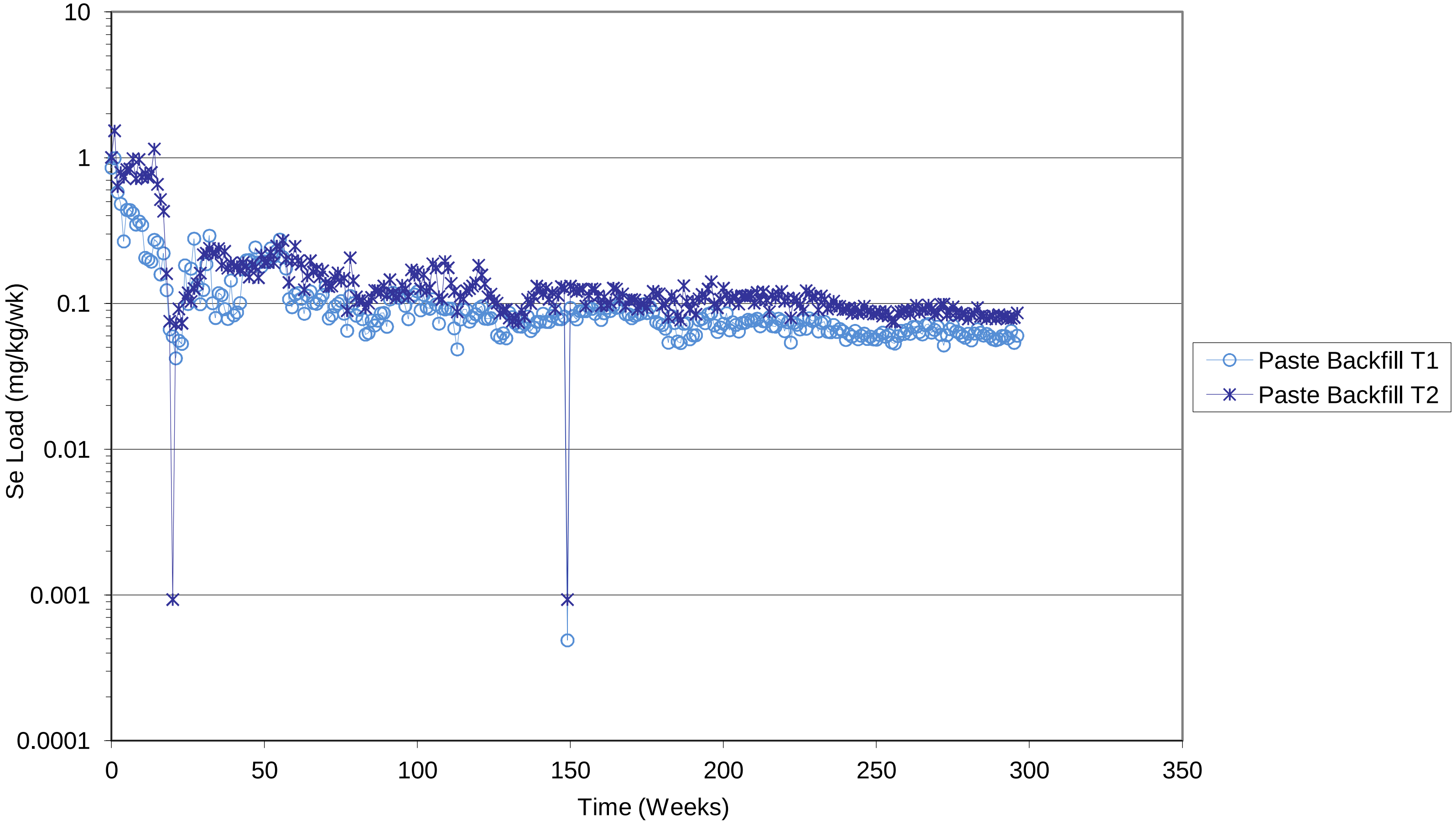
Lead Load
Operating Cells
Wolverine Mine, YK

Paste Backfill

March 2013	FIGURE 45

TC 53920

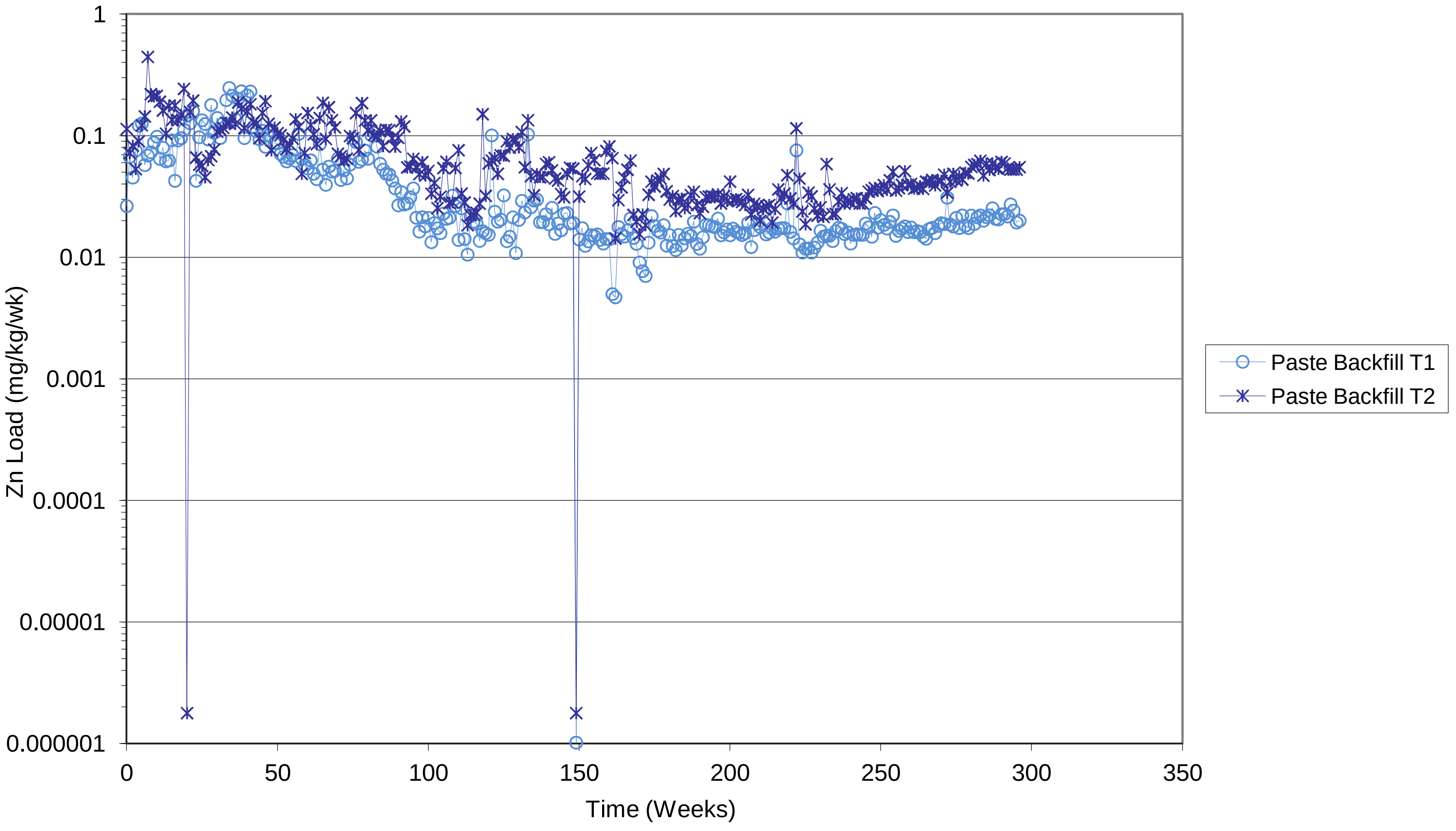
amec



Selenium Load Operating Cells Wolverine Mine, YK
Paste Backfill
March 2013 | FIGURE 46

TC 53920

amec



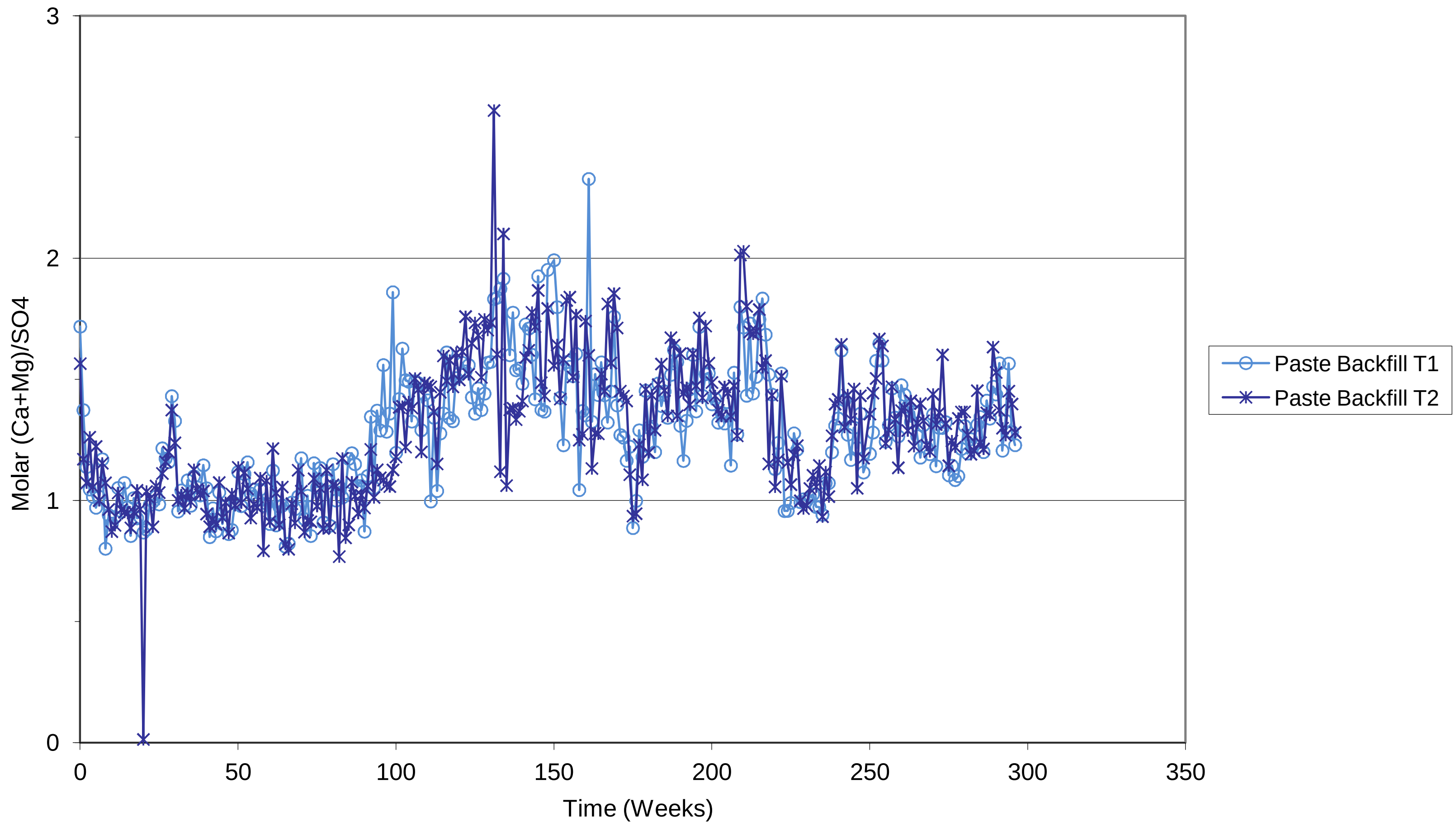
Zinc Load
Operating Cells
Wolverine Mine, YK

Paste Backfill

March 2013	FIGURE 47

TC 53920

amec



Molar $(Ca+Mg)/SO_4$ Ratio
Operating Cells
Wolverine Mine, YK

Paste Backfill

March 2013	FIGURE 48

TC 53920

Wolverine Mine

Tailings Humidity Cells Decommissioning

Prepared for:

YukonZinc CORP

Prepared by:

Marsland
Environmental
Associates

February 2014

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1. Introduction

Environmental characterization of the Wolverine Mine tailings was initiated by Klohn Crippen in 2005 to support the Wolverine Mine environmental assessment. The purpose of the testing program was to identify the geochemical, metal leaching and acid rock drainage (ML/ARD) characteristics of tailings and waste rock materials. Both static and kinetic testing was employed in the characterization of samples. A detailed summary of the initial characterization work was provided in Appendix IV of the environmental assessment (KC, 2006).

Four tailings humidity cells were constructed in 2005 to assess the geochemical behaviour of unsaturated tailings under humid, aerobic conditions. The humidity cells were comprised of materials generated by experimental lock cycle testing using rock generated by bulk sampling conducted in 2005. Each of the four cells represented a likely tailings composition based on the best mine planning information available at the time.

Two samples, the Lynx Diluted Composite (Lynx) and Wolverine Diluted Composite (Wolv), ran for 63 weeks. The cells were decommissioned in 2006 once the mine plan and mineral processes were clearly defined, and it became apparent that these individual ore types did not behave significantly differently from the overall ore composites.

The Overall Ore Composite (OC) and Overall Diluted Ore Composite (OD) tailings humidity cells showed ML/ARD characteristics and were left running for several years to observe leachate chemistry and more conclusively determine the time required for Neutralization Potential depletion and the onset to acid generation. Beginning in 2010, the OD cell exhibited acidic leachate chemistry (after 250 weeks). The OC cell remained neutral throughout the testing program. The OC and OD cells ran a total of 345 and 339 weeks, respectively, until they were decommissioned in January 2012.

The following report provides a summary of the tailings sample selection, humidity cell set-up, operation, and decommissioning procedures. Pre-test and post-test geochemical characterization of the sample material is also included. Recommendations for further geochemical characterization test work are also provided.

2. Sample Selection and Preparation

Geochemical characterization was carried out on tailings samples representing possible tailings blends from the Wolverine Mine Project. To assess the geochemical characteristics of the tailings, four ore composite types were prepared and examined in 2005. The four samples were prepared with lock cycle tests (LCT) carried out to simulate the milling process. It was estimated at the time the process would produce three tailing sub-streams: ~2% pre-float concentrate tails (PFC), 88% rougher tails (Ro), and 10% cleaner scavenger tails (CS). The composite samples for kinetic testing included the following:

- **Combined Overall Diluted Ore Composite Tailings (OD).** Combined the three tailings streams generated by using ore and dilution rock from both Wolverine and Lynx ore zones.

- **Combined Overall Ore Composite Tailings (OC).** Combined the tailings generated from using only ore from the Wolverine and Lynx ore zones, and did not include any dilution rock. The sample was a composite of two lock cycle tests.

- **Combined Wolverine Composite Ore with Dilution Rock Tailings (Wolv)**. Combined all three tailings streams generated from ore samples prepared including dilution rock from the Wolverine ore zone.

- **Combined Lynx Ore with Dilution Rock Composite Tailings (Lynx).** Combined all three tailings streams generated from ore samples prepared that included dilution rock from the Lynx ore zone.

Subsequent to the testing program, the milling procedure was modified and the dense media separation (DMS), which produced a low specific gravity gravel sized by-product (DMS float), which mainly contained the dilution waste rock products, was dropped from the process. The implication of this change is that more dilution waste rock is milled through the overall process, and will be subsequently deposited in the tailings. Therefore, at this time, OD is considered to be the most representative tailings sample of the tailings that are presently being generated at the mine.

3. Pre-Test Characterization

The intent of pre-test characterization was to establish an understanding of the material composition of the test samples. Pre-test characterization of the humidity cell test material was carried out in 2005 under direction of Klohn Crippen and followed the Draft Guidelines and Recommendation Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Mine Sites in British Columbia (Price, 1997). Mineral composition, solid phase analysis, and acid-base accounting (ABA) were carried out on the samples. Test procedures and results are presented in the following sections.

3.1 Mineralogy Analysis

Mineral assemblage percentages were assessed using optical microscopy on the four samples and the results are summarized in Table 1. In addition, quantitative phase analysis using x-ray diffraction (XRD) with Rietveld refinement was carried out, which helped identify the carbonate and sulphide species. The following conclusions were reported by Klohn Crippen (2006a):

- Pyrite is the dominant sulphide, with moderate concentrations of quartz and muscovite. Minor sulphides (arsenopyrite and sphalerite) were not detected, although these were detected in the optical mineralogical analysis (<1.8%).
- The abundance of reactive carbonates and non-carbonate minerals (<10% total), relative to the high sulphide content indicated that the materials are likely acid generating.
- The abundance of reactive carbonates indicated that there would be a lag time of likely several years prior to onset of acid generation.
- Rietveld analyses identified the main carbonates as dolomite (5% to 7.4%), calcite (2.6% to 3.6%) and siderite (0.4% to 0.5%).

Trace element analyses by Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) were carried out on an *aqua regia* digest of the tailings samples, to quantify the solid-phase concentrations of various elements within the samples. When measured sample concentrations are compared to known crustal abundances, it can be determined which elements may be of environmental concern under neutral or acidic drainage conditions. At the time of the analyses, anomalous elemental concentrations were defined by Klohn Crippen as greater than five times the normal crustal abundance as listed in Appendix 3 of Price (1997). Thirteen trace elements

(Table 4) showed concentrations greater than five times crustal abundance in most of the samples. The results suggested that following the onset of acidic conditions, the release of metal(loid)s from mineral phases, particularly from the sulphide phases, may occur. Furthermore, elements that are mobile under neutral pH conditions may have the potential to be released prior to the onset of acidic conditions.

Table 1: Pre-test Mineral Assemblages and Modal Abundance

MINERAL	Tailings Sample			
	OD	OC	WOLV	LYNX
Pyrite	53.1	60.1	38.3	60.3
Quartz	20.9	17.1	26.7	16.7
Carbonate	10.5	10.6	14.2	11.6
Muscovite	11.9	5.2	14.3	8.9
Chlorite	1	1.1	0.9	0
Sphalerite	1.1	1.6	1.3	1.8
Pyrrhotite	0.5	1.6	2.1	0
Amphibole	0	0.6	0.5	0
Arsenopyrite	0.3	0.8	0	0.3
Pyroxene	0.2	0.3	1.5	0
Chalcopyrite	0.5	0.4	0.2	0
Galena	0	0.4	0	0.8
Biotite	0	0.2	0	0
Magnetite	0	0.1	0	0
Total	**100**	**100**	**100**	**100**

3.2 Acid Base Accounting (ABA)

Acidic drainage will only result when the rate of acid generation exceeds the rate of acid neutralization. Acid Base Accounting (ABA) is a series of analyses and calculations used to estimate the potential for mineral weathering to produce acidic drainage. ABA includes analysis for rinse and paste pH, sulphur species, acid generation potential (AP), and acid neutralization potential (NP). Laboratory ABA testing was carried out in 2005 under the direction of Klohn Crippen and results are presented in Table 2. Key observations as reported by Klohn Crippen (2006a) were:

- All samples had high sulphide content and a low NP and were likely to produce acid rock drainage.

- The samples had enough NP (carbonate neutralization potential of 52.3-106 kg $CaCO_3$/t) to remain at a near-neutral pH, when initially exposed to oxygen. This was further supported by the relatively high paste pH values of 7.27 to 7.42.
- Most samples indicated the presence of non-carbonate neutralization potential, possibly from the muscovite, clinochlore and kaolinite, indicated by the mineralogical analysis (Section 3.1).

Table 2: Pre-Test Tailings ABA Results

PARAMETER	UNITS	OD	OC	WOLV	LYNX
Paste pH	-	7.27	7.42	7.35	7.36
Fizz Rate	-	2	3	2	2
Total S	%S	26.6	29.2	19.7	31.2
Acid Leachable SO_4^{2-}	%S	2.04	2.51	1.74	0.74
Sulphide S	%S	22.9	25	15.7	27.8
Insoluble SO_4^{2-}	%S	0.005	0.005	0.005	0.005
Organic S	%S	1.67	1.73	2.34	2.68
AP	kg $CaCO_3$/t	715	781	489	869
Sobek NP	kg $CaCO_3$/t	82.5	72.8	94.6	49.4
Sobek NP/AP	-	0.12	0.09	0.19	0.06
Net NP	kg $CaCO_3$/t	-632	-708	-395	-820
C(t)	%C	1.56	1.48	2.14	1.27
TOC	%C	0.62	na	0.98	0.48
TIC	%C	0.94	na	1.2	0.79
Carb NP	kg $CaCO_3$/t	98.3	59.4	106	52.3
Carb NP/AP	-	0.14	0.08	0.22	0.06

Note: Red text indicates measured value less than detection limit and listed as one half of the method detection limit.

3.3 Metals Analysis

Trace element analyses by ICP-MS were carried out on the tailings samples in 2005 by SGS Lakefield, under the direction of Klohn Crippen. Solid samples were subjected to near-total digestion in a mixture of strong oxidizing acids (HNO_3 and HCl), known as *aqua regia*, in order to dissolve most mineral phases. Digests were then quantitatively analyzed for a suite of major, minor and trace elements. The elemental analyses by ICP-MS as reported by Klohn Crippen (2005b) are presented in Table 3.

Table 3: Pre-test ICP-MS Solid Phase Results

Element	Unit	Crustal Abundance[1]	Tailings Samples			
			OD	OC	WOLV	LYNX
Ag	mg/kg	0.080	55	59	82	54
Al	%	8.4	0.60	0.43	1.0	0.28
As	mg/kg	1.8	2,700	2,700	1,200	4,100
Ba	mg/kg	390	53	38	66	50
Be	mg/kg	2.0	0.17	0.10	0.24	0.12
Bi	mg/kg	0.0082	11	7.5	19	6.4
B	mg/kg	9.0	2.5	1.5	2.5	2.5
Ca	%	4.7	2.5	2.3	2.7	2.4
Cd	mg/kg	0.16	97	140	74	110
Co	mg/kg	29	43	37	48	39
Cr	mg/kg	122	200	120	160	210
Cu	mg/kg	68	820	1,100	1,100	820
Fe	%	6.2	23	28	18	27
Hg	mg/kg	0.086	3.6	3.2	4.0	3.2
K	%	1.8	0.17	0.21	0.25	0.11
Li	mg/kg	18	1.6	0.15	5.5	0.10
Mg	%	2.8	1.0	0.75	1.6	0.52
Mn	mg/kg	1,060	670	680	620	700
Mo	mg/kg	1.2	32	28	25	45
Na	%	2.3	0.014	0.011	0.015	0.010
Ni	mg/kg	99	60	65	56	63
P	mg/kg	1,120	320	290	520	190
Pb	mg/kg	13	3,900	3,500	5,100	5,600
Sb	mg/kg	0.20	170	220	310	180
Se	mg/kg	0.050	364	361	464	336
Sn	mg/kg	2.1	13	11	10	16
Sr	mg/kg	384	53	49	59	48
Ti	mg/kg	6,320	68	54	82	53
Tl	mg/kg	0.72	19	16	13	24
U	mg/kg	2.3	4.7	3.9	6.0	3.4
V	mg/kg	136	37	29	49	33
Zn	mg/kg	76	9,800	19,000	8,000	11,000

Note 1: Crust as a Whole in: Abundances of chemical elements in the Earth's Crust and chondrites in Appendix 3 of Price (1997).

Red text indicates measured value was less than detection limit and is presented as one half of the method detection limit.

Elemental analysis by XRF was also performed to provide a better estimate of elemental concentrations that are generally refractory to the *aqua regia* digest, including aluminosilicate minerals (Al, Si). The results of the Whole Rock Analyses, presented in elemental concentrations, are included in Table 4.

Table 4: Pre-test Elemental Concentrations Calculated from the Whole Rock Data

Element	Elemental Concentration (wt. %)			
	OD	OC	WOLV	LYNX
Si	12.53	11.31	16.5	9.63
Al	2.48	2.06	3.39	1.8
Fe	12.14	13.01	9.72	14.83
Mg	1.27	1.09	1.98	0.69
Ca	2.7	2.36	2.99	2.59
Na	0.18	0.19	0.14	0.17
K	0.5	0.4	0.68	0.38
Ti	0.07	0.05	0.09	0.05
P	0.02	0.02	0.03	0.01
Mn	0.07	0.09	0.06	0.08
Cr	0.02	0.02	0.02	0.02
V	0.02	0.02	0.04	0.02

4. Humidity Cell Testing

For sulphidic geologic materials, the humidity cell is the recommended kinetic test for predicting primary reaction rates under aerobic weathering conditions (Price, 2010). The resulting data provides a measure of rates of elemental release, acid generation and acid neutralization under the geochemical conditions encountered in the test. Humidity cell data can be used to estimate the time to mineral exhaustion, time to onset of acid generation, and waste rock and tailings drainge chemistry.

4.1 Set-up

The following description of humidity cell set-up was provided by Klohn Crippen (2006b). The humidity cells were constructed using acrylic tubing and base plate with an approximately 20 cm inside diameter and 10 cm height. The base plate was glued to the tube and threaded with a nylon hose adapter to which a length of tubing was attached allowing for leachate drainage into a collection container. A perforated PVC support plate was positioned inside the cell approximately 1.3 cm above the base plate and covered with six layers of nylon mesh. A nylon adapter was threaded into the side of the cell between the support plate, and the base plate and a length of tubing was connected from the side adapter to a humidifier to facilitate the inflow of humid air to the cell. A dry air line was also connected to each cell. Each cell was covered with a removable acrylic lid. The modifications made to the tailings flood leach humidity cell were adopted to facilitate the movement of water through the finer grained tailings. A saturated 1.0 kg sample of tailings was used to charge each cell. The overall depth of tailings within each humidity cell was approximately five centimetres. The OC humidity cell is depicted in Photo 1.

Photo 1: OC Humidity Cell (January 29, 2012)

4.2 Operation

At the end of each weekly cycle, the volume of leachate collected in the container for the tailings flood leach humidity cell was recorded. The leachate was filtered through a Gelman magnetic filter funnel fitted with a membrane filter of pore size 0.45 µm and analyzed by ICP-MS for a suite of elements as well as for pH, conductivity, acidity, alkalinity and sulphate.

4.3 Results

The primary objective of the humidity cell testing was to measure reaction rates under specific geochemical conditions and to calculate times for onset of acid generation. Weekly leachate volume, concentration, and sample mass were combined to calculate mass loading rates with units mg/kg/wk. The leachate chemistry and loading rates were compiled into a spreadsheet file titled “120724_Wolverine_Tailings_HC_database.xlsm”. A digital version of the data compilation file accompanies this report. The following sections provide a short summary of relevant analytical results for each of the four humidity cells.

4.3.1 pH

The pH values for all humidity cells over the duration of the testing program are presented graphically in Figure 1. The Wolv and Lynx cells began at neutral pH and then fell until week four, where they then returned to neutral pH and remained at nearly neutral levels for the remainder of the testing program.

The OC cell remained at nearly neutral pH levels for the duration of the testing program. The OC cell appeared to be undergoing a very slight decrease in pH from approximately week 200 (pH 6.8) until shutdown at week 345 (pH 6.4).

The OD cell had an initial pH of pH 7.0 (week 0), and pH dropped substantially over weeks 1-3 until recovering by week 4 when the pH rose to near neutral conditions and remained stable until approximately week 250 (4.8 years). This initial pH drop is believed to be associated with the relatively rapid oxidation of the thiosalts present in the tailings voids water. After week 250 the pH dropped steadily as a result of the onset of sulphide-oxidation induced acidic drainage conditions. At the end of the testing program, leachate pH of the OD cell had reached a minimum value of pH 3.1. The rate of drop in pH appeared to be slowing down between week 315 and shutdown of the cell (week 339). Although it is not possible to predict pH beyond the timeframe of the testing program by extrapolation, the pH might be expected to continue decrease and eventually stabilize at a lower, more acidic pH level. It is also possible that the pH could reach a minimum level and then rebound to a higher level before reaching a stable level.

4.3.2 Sulphate

Sulphate production rate is monitored in humidity cells to assess the depletion of sulphur species from the tailings samples because the process of oxidation of sulphides into sulphate can lead to acidic drainage conditions. Until the initial sulphate has been flushed from the humidity cell, the sulphate production rate does not necessarily reflect sulphate produced through the sulphide oxidation process. Prior to depletion of the original sulphate from the sample, it is likely that a majority of the sulphate measured is due to flushing of the original sulphate from the sample with only some sulphate produced due to sulphide oxidation. Therefore, in humidity cell testing, it is commonly assumed that sulphide oxidation is not taking place until flushing of all of the original sulphate measured during the pre-test ABA characterization is complete. A mass balance of the sulphur species for each cell is included in the ABA discussion in Section 6.1. Sulphate production rates are presented for each cell in Figure 2.

4.3.3 Metal Loading Rates

Each of the cells underwent an initial flush where metal loading rates were initially high for some parameters, but stabilized out at a lower level at a later date. Pre-test ICP-MS analysis showed that zinc (Zn) and selenium (Se) were present at elevated levels in the solid samples. Se and Zn are mobile under neutral drainage conditions, and loading rates for those metals were observed at elevated levels among all humidity cells, during, and following the initial flush. Zn and Se loading rates are presented in Figure 3 and Figure 4, respectively.

There has been an exponential growth trend in loading rates of various substances from the OD cell since the onset of acid generation conditions (week 232). The copper (Cu) loading rate has risen from around 0.0019 mg/kg/wk and reached as high as 4.1 mg/kg/wk (week 332). Cu loading at the final week (week 339) was 2.7 mg/kg/wk (Figure 5). The trend in Cu loadings is the most pronounced; the increase is ~1400-fold for Cu, ~50-fold for Zn and ~5-fold for Se. The exponential trends in metal loading rates appeared to be levelling off or decreasing between weeks 324 and 339, as the final data point was lower than the previous three.

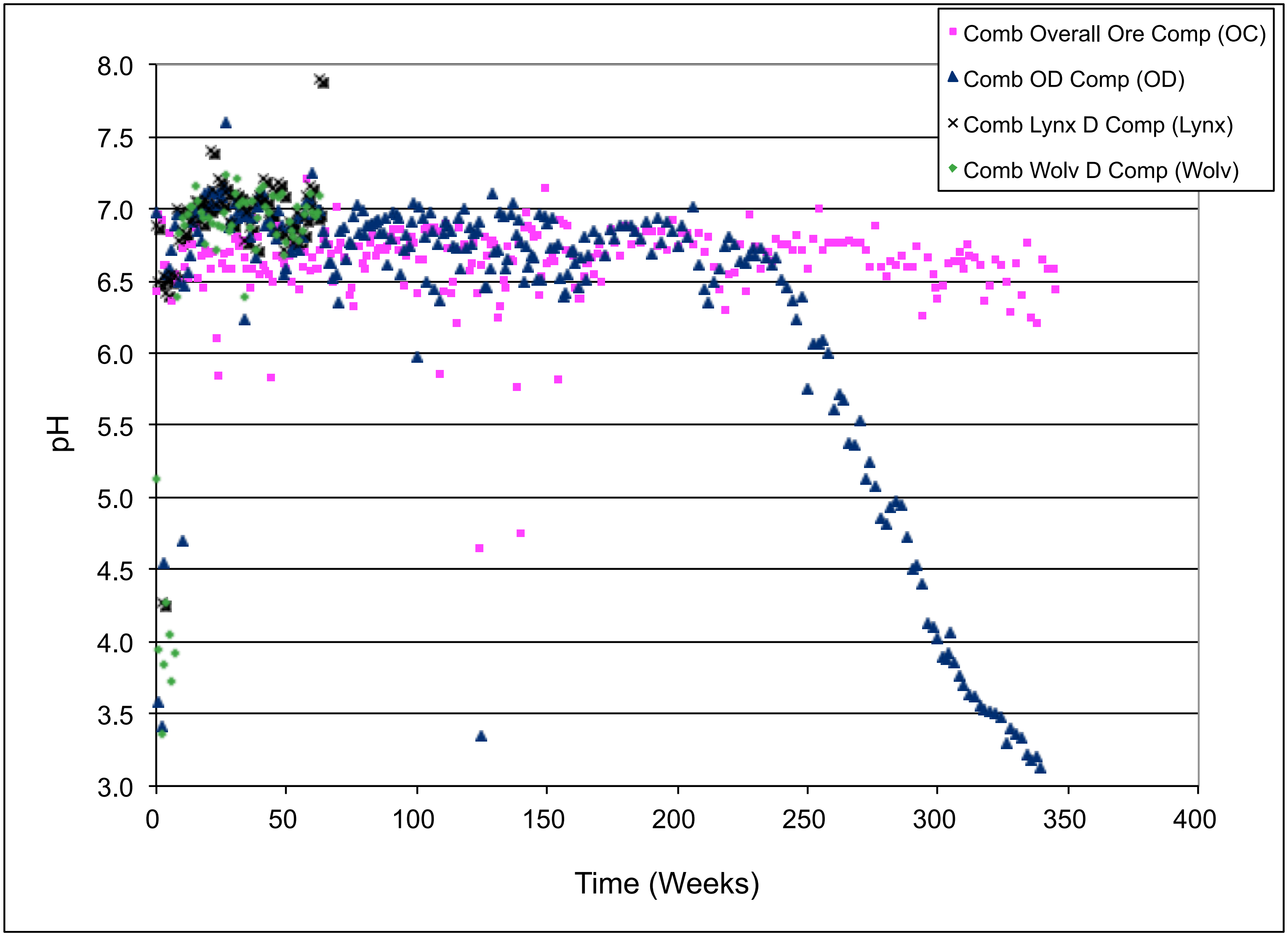

Figure 1: Wolverine Tailings Humidity Cells – pH

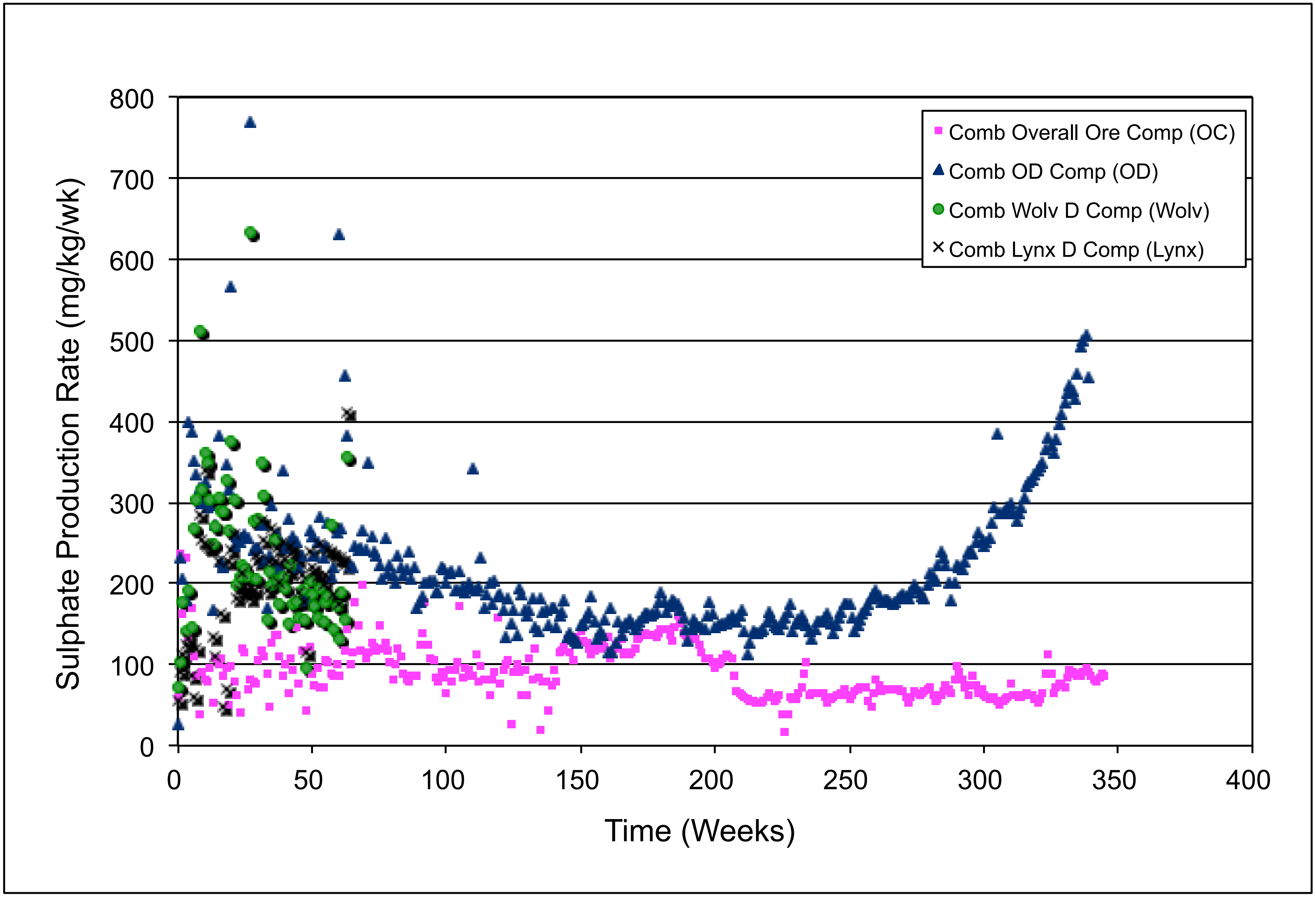

Figure 2: Wolverine Tailings Humidity Cells – Sulphate (SO_4) Production

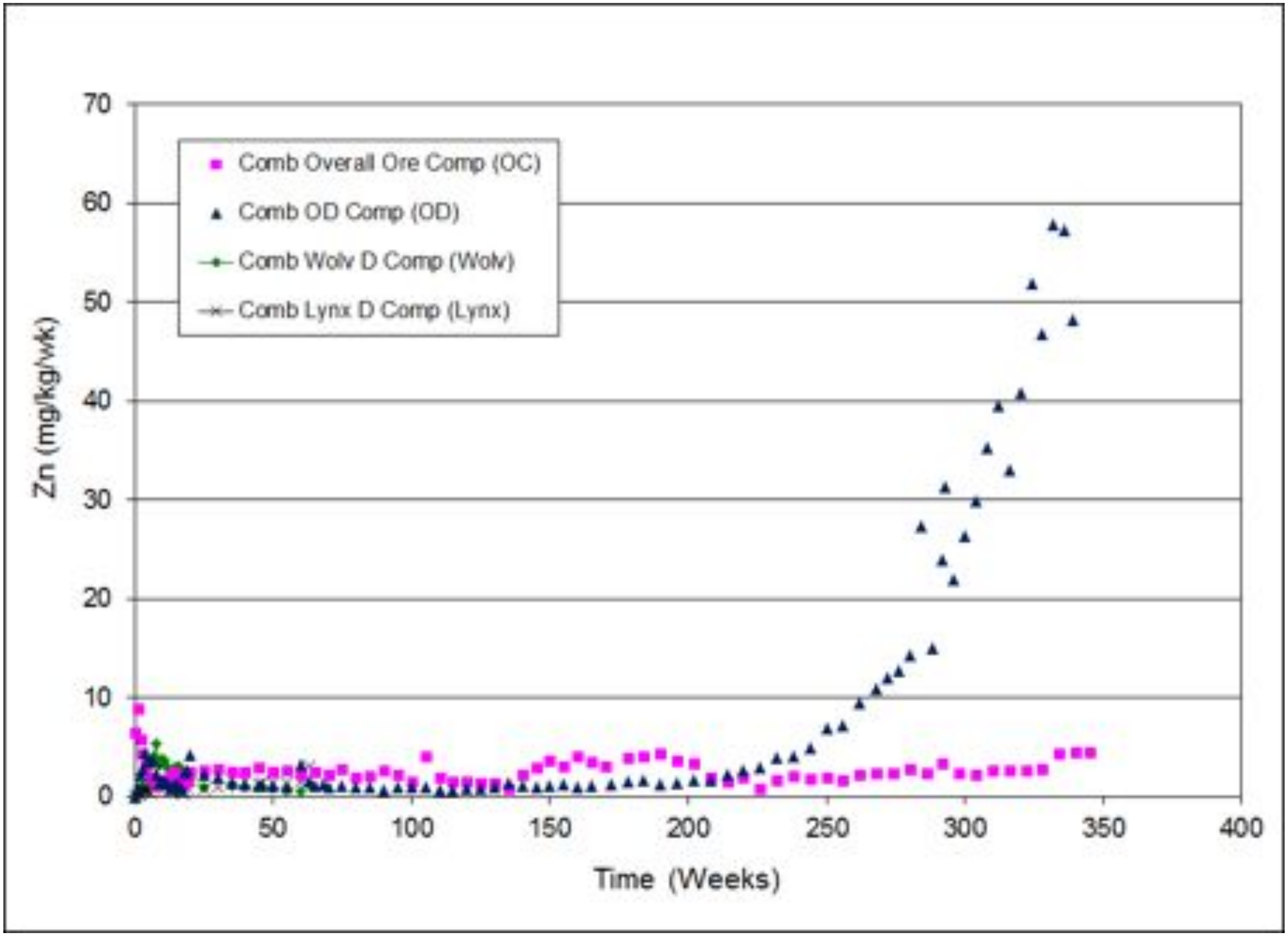

Figure 3: Wolverine Tailings Humidity Cells – Zinc (Zn) Loading Rates

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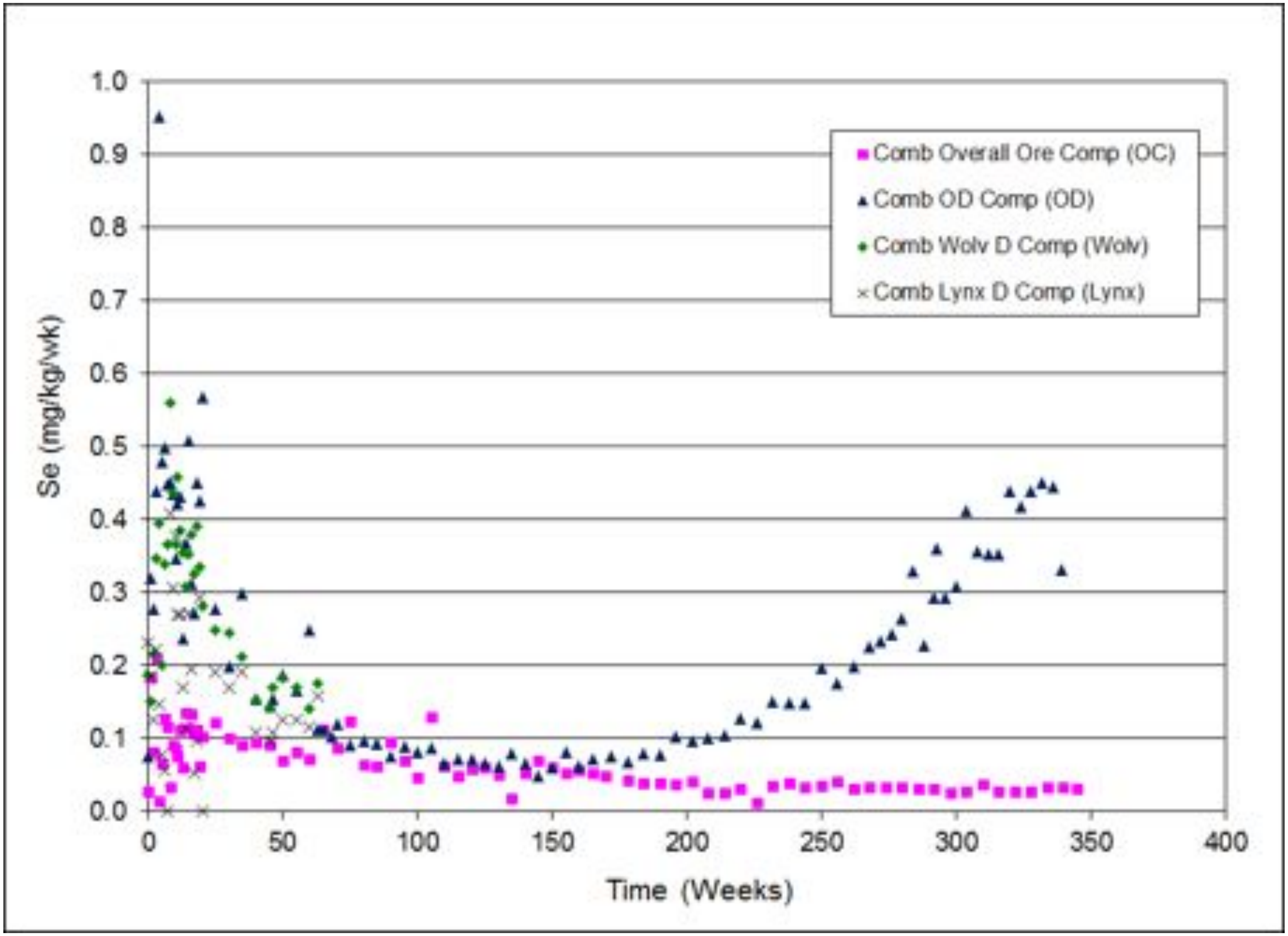

Figure 4: Wolverine Tailings Humidity Cells – Selenium (Se) Loading Rates

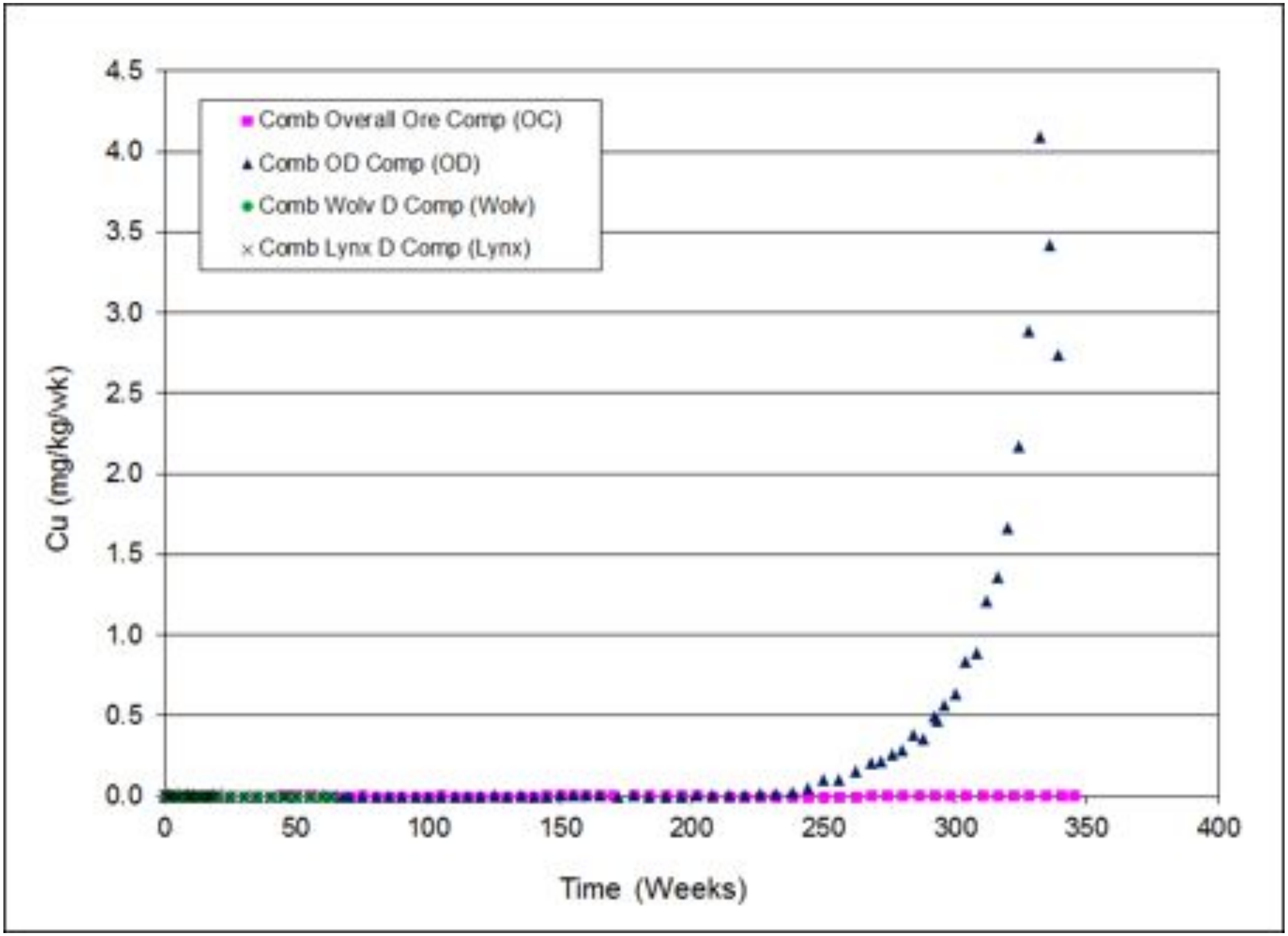

Figure 5: Wolverine Tailings Humidity Cells – Copper (Cu) Loading Rates

4.4 Humidity Cell Decommissioning (Shut-Down)

The Wolv and Lynx cells were each allowed to run for a total of 63 weeks. The cells were decommissioned in 2006 because it had become clear that the two ore types would be processed simultaneously and so separate humidity cells would not be representative of the tailings produced from the milling process. The Overall Ore Composites were continued as they were more suitable for the testing program.

The OC and OD cells were left to run a total of 345 and 339 weeks, respectively, until they were decommissioned in January 2012. Humidity cell closedown procedures were followed as outlined in the MEND Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials (Price, 2009). The following key items were undertaken during the shutdown procedure:

- After the final humidity cell cycle, collect the leachate as per the humidity cell operational procedures. Submit to lab for full suite of leachate water quality analyses.
- Remove the sample from the test cell and carry out a shake flask extraction test with minimum 3:1 (by mass) liquid to volume ratio. Following the procedure, collect the leachate, record leachate volume, and label the sample “final leach”. Carry out full suite of leachate water quality analysis on the “final leach” sample (pH, conductivity, acidity/alkalinity, sulphate, metals by ICP-MS including Hg, thiosalts, Cl, F, CNO, CNS, NO_3, and NH_3).
- Measure the mass of the wet solids. Dry the solids, then measure mass of dry solids.
- Take a representative split from the solid sample and label it “Final Residue”. Submit the split for comprehensive compositional analysis (petrographics, XRD, expanded ABA, ICP metals, Whole Rock Analyses by XRF, shake flask analyses (with pH, sulphate and metals)).

Photos of the Wolv and Lynx samples following decommissioning are provided in Photo 2 and Photo 3. Photos of the OD and OC samples during the decommissioning are presented in Photo 4 to Photo 7. Note the evidence of oxidation in the iron staining visible in the OD cell photos, which is also perhaps slightly evident in the OC cell but is certainly absent from the other cells, which had not been allowed to run for long enough for iron staining to become evident.

Photo 2: Wolverine Diluted Tailings in the Humidity Cell (October 6, 2006)

Photo 3: Lynx Diluted Tailings in the Humidity Cell (October 6, 2006)

Photo 4: OD Tailings in the Humidity Cell (January 29, 2012)

Photo 5: OD Tailings Sample Placed on Sheet for Drying (January 29, 2012)

Photo 6: OC Tailings in the Humidity Cell (January 29, 2012)

Photo 7: OC Tailings Sample Placed on Sheet for Drying (January 29, 2012)

5. Post-Test Characterization

Post-test characterization was carried out on the tailings samples following shutdown of the cells. Characterization work included mineralogy (optical microscopy and x-ray diffraction), ABA, metals analysis and shake flask testing. The results of the post-test characterization are presented below, and a comparison between pre-test and post-test characterization results is presented in Section 6.

5.1 Mineralogy Analysis

Mineral assemblage percentages of the post-test Wolv and Lynx tailings samples were assessed in 2007 by SGS using optical microscopy and the results are summarized in Table 5. In addition, quantitative phase analysis using x-ray diffraction (XRD) with Rietveld refinement was carried out, which helped identify the carbonate and sulphide species. The post-test mineral assemblages by QEMSCAN and subsequent quantitative phase analysis by Rietveld XRD of the OC and OD tailings samples were carried out in 2012 by SGS and are summarized in Table 6. The full analytical results are provided in Appendix A.

Table 5: Post-Test Mineral Assemblages for final Wolv and Lynx Samples

Mineral	QEMSCAN		Rietveld - XRD	
	WOLV	LYNX	WOLV	LYNX
Pyrite	40	67.6	36.1	64.7
Quartz	25.4	15.1	30.7	17.4
K-Feldspar	1.2	1.4		
Muscovite / Sericite	7	2.1	14.8	8.8
Biotite	3.3	0.8	1.3	1.2
Chlorite	5.9	0.3		
Pyriboles	0.9	0.2		
Plagioclase	0.1	0		
Talc	0.2	0		
Garnet	0	0		
Clay Minerals	4.4	3.9		
Calcite	0.5	0.4	0.5	
Ankerite	1.3	0.6		
Dolomite	4.5	1.6	6.8	3.2
Siderite	0.1	0		
Gypsum	0.3	0.5	3.2	4.9
Jarosite	1.9	2.6		
Rutile	0.2	0.1		
Fe-oxides	0.7	0.5		
Ilmenite	0.2	0.1		
Sphalerite	1	1		
Pyrrhotite	0.3	0.1	1.6	
Chalcopyrite	0.2	0.1		
Arsenopyrite	0.2	0.7		
Chlinochlore			4.9	
Other Trace (<0.05 wt.%)	0.3	0.2		
Total	**100**	**100**	**100**	**100**

Table 6: Post-Test Mineral Assemblages for final OC and OD samples

Mineral	QEMSCAN		Rietveld - XRD	
	OD	OC	OD	OC
Pyrite	60.0	69.0	57.3	62.3
Quartz	19.7	11.9	29.4	24.9
Muscovite	7.5	4.9	11.2	8.01
Biotite	3.5	1.8		
Ankerite/Dolomite	0.8	3.9	0.81	3.72
Sphalerite	0.8	3.0		
Chlorites	2.1	1.5	1.33	1.05
Clays	1.8	1.0		
Siderite	0.8	0.5		
Other Silicates	0.8	0.7		
Fe-Ti Oxides	0.7	0.2		
Arsenopyrite	0.2	0.6		
Apatite	0.3	0.2		
Zincite	0.2	0.3		
Chalcopyrite	0.1	0.3		
Pyrrhotite	0.1	0.1		
Galena	<0.1	<0.1		
Other/Accessory	0.4	0.1		
Total	**100**	**100**	**100**	**100**

5.2 Acid Base Accounting (ABA)

ABA testing was carried out on the post-test samples to measure the amount of sulphur species, acid generating potential (AP) and neutralizing potential (NP) remaining in the samples following the humidity cell testing procedure. Analyses on the Wolv and Lynx samples were carried out by SGS. OC and OD analyses were carried out in January 2012 and reported by SGS. Post-test ABA results for all four samples are presented in Table 7. The full analytical results are provided in Appendix B.

Table 7: Post-Test Tailings ABA Results

Parameter	Units	OD	OC	WOLV	LYNX
Paste pH	pH units	5.65	7.06	7.05	6.45
Fizz Rate	---	1	2	2	2
Total S	%	23.2	27.6	18.6	27.1
Acid Leachable SO_4^{2-}	%	0.005	0.005	0.005	0.005
Sulphide S	%	23.2	27.6	17.1	29.0
AP	kg $CaCO_3$/t	725	862	534	906
NP	kg $CaCO_3$/t	11.5	46.5	73.00	39.2
Net NP	kg $CaCO_3$/t	-714	-816	-461	-867
NP/AP	ratio	0.02	0.05	0.14	0.04
C(t)	%	0.727	1.22	1.912	0.865
CO_3	%	0.533	1.29	2.426	0.895

Red text indicates measured value less than detection limit and listed as one half of the method detection limit.

The absence of measurable sulphate reflects the lengthy flushing the cells had undergone, followed by the shake flask extraction prior to the post-test solid phase analyses. This combination removed all the soluble sulphate present in the samples prior to the test as well as any sulphate generated through oxidation of the material.

5.3 Metals Analysis

Metals analysis was carried out on the post-test solids to measure the metals remaining in the samples after the humidity cell testing procedure. Analyses on the Wolv and Lynx samples were carried out by SGS in 2007. OC and OD analyses were carried out in January 2012 and reported by SGS (2012c). Results are presented in Table 8 and the full analytical results are provided in Appendix C.

Table 8: Post-test ICP-MS Solid Phase Results

Element	Unit	Crustal Abundance[1]	Tailings Samples			
			OD	OC	WOLV	LYNX
Ag	mg/kg	0.080	56	63	86	59
Al	%	8.4	3.1	2.4	0.84	0.21
As	mg/kg	1.8	2,600	2,900	1,200	3,700
Ba	mg/kg	390	3,900	1,900	57	32
Be	mg/kg	2.0	1.4	1.2	0.20	0.05
Bi	mg/kg	0.0082	9.8	10	18	4.9
Ca	%	4.7	0.45	1.1	2.2	1.8
Cd	mg/kg	0.16	53	130	75	100
Co	mg/kg	29	29	33	40	32
Cr	mg/kg	122	440	430	91	110
Cu	mg/kg	68	640	960	1,100	850
Fe	%	6.2	35	35	20	30
Hg	mg/kg	0.086	3.9	5.5		
K	%	1.8	1.3	1.1	0.31	0.12
Li	mg/kg	18	29	23	4.2	0.10
Mg	%	2.8	0.86	1.0	1.4	0.37
Mn	mg/kg	1,060	470	730	600	590
Mo	mg/kg	1.2	36	36	28	47
Na	%	2.3	0.040	0.029	0.010	0.0055
Ni	mg/kg	99	45	54	60	66
P	mg/kg	1,120	410	330		
Pb	mg/kg	13	4,100	4,300	4,500	4,600
Sb	mg/kg	0.20	280	280	290	200
Se	mg/kg	0.050	370	470	530	430
Sn	mg/kg	2.1	21	20	9.0	14
Sr	mg/kg	384	37	49	52	36
Ti	mg/kg	6,320	550	450	62	39
Tl	mg/kg	0.72	36	34	12	23
U	mg/kg	2.3	6.4	6.5	6.5	3.9
V	mg/kg	136	240	200	34	26
Y	mg/kg		9.8	10	10	6.2
Zn	mg/kg	76	6,800	17,000	8,300	11,000

Note 1: Crust as a Whole in Abundances of chemical elements in the Earth's Crust and chondrites in Appendix 3 of Price (1997).

Red text indicates measured value less than detection limit and listed as one half of the method detection limit.

5.4 Shake Flask Extraction Test Analysis

Prior to mineralogy, ABA, and metals analyses, the final contents of the humidity cells underwent a shake flask extraction testing (shake flask test) procedure, as described in Section 4.4. The leachate (labelled "final leach") water quality was analysed to determine the amount of soluble materials that remained on the tailings and in the pore water after the samples were removed from the cells. Analyses on the Wolv and Lynx samples were carried out by SGS in 2007. OC and OD analyses were carried out in January 2012 and reported by SGS, and results are summarized in Table 9 with the full analytical results are provided in Appendix D.

Table 9: Post-Test Tailings Shake Flask Test Results

Parameter	Units	Tailings Sample			
		OD	OC	WOLV	LYNX
Sample Mass	(g)	1,000	1,000	1,095	1,069
Volume D.I. Water Added	mL	3,000	3,000	3,000	3,000
Initial pH	units	5.3	6.5	6.7	6.7
Final pH	units	5.4	7.1	7.1	6.9
pH	units	6.5	6.9	7.1	7.2
Alkalinity	mg/L as $CaCO_3$	16	17	51	41
Acidity	mg/L as $CaCO_3$	522	37	116	40
Conductivity	µS/cm	2,960	2,050	2,300	2,260
F	mg/L	0.030	0.080	0.19	0.16
Cl	mg/L	1.0	1.0	3.6	1.0
SO4	mg/L	2,200	1,300	1,500	1,500
CN(T)	mg/L	0.005	0.005	0.005	0.005
CNO	mg/L	0.5	0.5	0.5	0.5
CNS	mg/L	0.1	0.1	1	1
Thiosalts (total)	as S_2O_3 mg/L	5	5	80	40
NH_3+NH_4	as N mg/L	0.10	0.20	0.10	0.05
NO3	as N mg/L	0.025	0.025	0.25	0.090
Ag	mg/L	0.00041	0.00005	0.00015	0.00015
Al	mg/L	0.0004	0.0008	0.0050	0.0050
As	mg/L	0.11	0.0064	0.0080	0.0025
Ba	mg/L	0.039	0.029	0.033	0.035
Be	mg/L	0.00001	0.00001	0.00080	0.00020
Bi	mg/L	0.000005	0.000005	0.000500	0.000300
B	mg/L	0.032	0.0086	0.020	0.023

Parameter	Units	Tailings Sample			
		OD	OC	WOLV	LYNX
Ca	mg/L	573	539	611	614
Cd	mg/L	2.1	1.2	0.36	0.29
Co	mg/L	0.14	0.0087	0.061	0.060
Cr	mg/L	0.00025	0.00025	0.00150	0.00150
Cu	mg/L	0.38	0.014	0.003	0.004
Fe	mg/L	0.012	0.0015	0.0050	0.0050
Hg	mg/L	0.00005	0.00030	0.00005	0.00005
Li	mg/L	0.0020	0.0005	0.0050	0.0040
K	mg/L	1.5	0.80	0.84	2.0
Mg	mg/L	62	4.4	21	23
Mn	mg/L	28	2.1	22	5.2
Mo	mg/L	0.00012	0.00330	0.00080	0.00080
Na	mg/L	5.2	4.0	0.42	0.72
Ni	mg/L	0.63	0.024	0.15	0.13
P	mg/L	0.0045	0.012	0.0050	0.030
Pb	mg/L	0.057	0.0097	0.053	0.017
Sb	mg/L			0.005	0.010
Se	mg/L	3.0	0.19	0.28	0.45
Si	mg/L	6.5	1.1	0.97	0.62
Sn	mg/L	0.00006	0.00035	0.0050	0.0040
Sr	mg/L	1.2	0.57	1.2	0.90
Ti	mg/L	0.0008	0.0003	0.0005	0.0005
Tl	mg/L	0.017	0.013	0.007	0.0005
U	mg/L	0.00016	0.000085	0.00080	0.00100
V	mg/L	0.00006	0.00014	0.0040	0.0040
Zn	mg/L	328	38	33	17

Red text indicates measured value less than detection limit and listed as one half of the method detection limit.

6. Mass Balance Assessment

The intent of humidity cell testing is to assess the rate of chemical leaching, time to onset of acid generation, and time until mineral exhaustion in the test material. Pre-test characterization results can be used in conjunction with the humidity cell results and post-test characterization results, to assess the amount of depletion of materials from the samples that occurred over the duration of the humidity cell testing program. The results can also provide insight as to which minerals in the test material did and did not react during kinetic testing. An ABA-based mass balance was carried out to assess the time to AP and NP depletion. Metal content mass balance was carried out to assess the rate of mineral exhaustion based on the humidity cell results.

6.1 ABA

ABA calculations are intended to track the amount of NP, AP, and sulphur species remaining in a sample by comparing the initial content that was measured during the pre-testing program, with the mass of substances released in the humidity cells. In some cases, the time to depletion of neutralizing potential (NP) and onset of acidic drainage conditions can be predicted from the calculations. Once the original sulphate is flushed from the tailings humidity cell, the sulphate measured in the leachate can be attributed to sulphide oxidation, and the time to sulphide depletion can then be estimated. If the time to sulphide depletion is shown to be longer than the time to NP depletion, the time to onset of acidic conditions can also be estimated. However, until all of the initial sulphate has been flushed from a cell, the time to sulphide depletion and subsequent acid generation cannot be estimated.

ABA calculations (Table 10) indicate that the initial sulphate had been depleted from the OD cell by approximately week 303 (5.8 years). Therefore, it was assumed that sulphate production subsequent to week 303 can be attributed to sulphide depletion. Based on the most recent five sulphate production rates for the OD cell, the time to depletion of initial sulphide from the sample was calculated to be 28 years following the depletion of initial sulphate from the sample. Because initial sulphate had not yet been depleted from the Wolv, Lynx, and OC cells prior to decommissioning, the time to depletion of sulphide from those samples could not be predicted. The calculated time to depletion of initial sulphate for Wolv, Lynx and OC and is presented in Table 10.

Mass balance calculations (Table 10) indicated that the OD cell had approximately 99% of initial NP remaining at the onset of acidic conditions (week 232), and 89% of the original NP remaining upon closure of the cell (week 339), indicating that the readily soluble calcite was consumed, and the remaining NP was not capable of buffering the leachate at a pH above pH 3.1. However, the small amount of reactive/available NP in the OD sample did keep the humidity cell pH in the neutral range for almost 5 years of weekly flushing at room temperature. Because initial sulphate depletion or onset of acidic conditions did not occur in the Lynx, Wolv, and OC cells, it was not possible to evaluate the time for NP depletion in those tailings samples. All that can be noted is that leachate pH remained near neutral at the end of the respective test periods. Mass balance results for sulphate, sulphide, and NP are presented Table 10.

Table 10: Depletion of Sulphur Species and NP from Humidity Cell Samples

		OD	OC	WOLV	LYNX
Sulphate and Sulphide Depletion					
Initial SO_4 - S	mg/kg	20,400	25,100	17,400	7,400
Initial S_2 - S	mg/kg	229,000	249,600	157,000	278,000
Cumulative SO_4 - S production to date	mg/kg	24,789	10,601	4,946	4,312
Remaining SO_4 – S (by difference)	mg/kg	0	14,499	12,454	3,088
Remaining S_2 – S (by sulphate removal)	mg/kg	224,604	249,600	157,000	278,000
SO_4 Production (5 sample average[1])	mg/kg/wk	465	87	210	255
SO_4 - S Production (5 sample average[1])	mg/kg/wk	155	29	70	85
Time to Initial SO_4 - S depletion[2]	years	5.8	16.3	4.6	1.9
Time to Initial S_2 - S depletion[3]	years	28	-	-	-
NP Depletion					
Initial NP	mg $CaCO_3$/kg	82,500	72,800	94,600	49,400
Cumulative Open System NP Consumption	mg $CaCO_3$/kg	9,135	153	0	0
Calculated Remaining NP	mg $CaCO_3$/kg	73,365	72,647	94,600	49,400
Open System NP Consumption Rate (5 sample average[1])	mg $CaCO_3$/kg/wk	268	0	0	0
Time to NP Depletion[2]	years	12	-	-	-

1. $S0_4$ and NP production rates were calculated based on the average value from the final five samples in order to reduce the effects of natural weekly variation in leachate water quality results.
2. From beginning of humidity cell testing.
3. From time at which initial sulphate becomes depleted from the sample.

6.2 Metals Analysis

A mass balance was carried out to assess the total mass of metals that was leached from the four tailings samples over the duration of the testing program. The following theoretical relationship represents conservation of mass of substances in the tailings samples following the humidity cell testing program:

$$m_i = m_{HC} + m_{SF} + m_f$$

where

m_i	is the initial metals content in the tailings sample (mg) calculated from the values reported in Table 3.
m_{HC}	is the total mass (mg) of solutes leached from the humidity cells. Calculated in the HC database, provided with this report.
m_{SF}	is the total mass (mg) of solutes washed from the tailings sample during the shake flask test procedure. Calculated from values in Table 9.
m_f	is the final metals content in the tailings sample (mg) calculated from the values reported in Table 8.

The fraction of the initial metals content that was depleted in the humidity cells over the duration of kinetic testing was calculated from the following relationship:

$$\text{Fraction Depleted (\%)} = \left(\frac{m_{HC}+m_{SF}}{m_i}\right)\times 100$$

Results for total mass leached, and fraction of initial content depleted over the testing program are presented in Table 11 to Table 14 for the four cells. Solid phase metals content (by ICP-MS) on the final sample is included in the summary tables for reference. In theory, the final metals content should equal the initial metals content minus the mass of metals leached from the samples. For some parameters and some tailings samples, final metal content results were either higher or lower than what would be calculated using the mass balance equation from the laboratory data. The following reasons are potential sources of error:

- ICP-MS should be regarded as accurate to +/- 25% for both the initial and final metals content analysis.

- The solid phase metals content results are based on ICP-MS analysis on a sub-sample (total mass of a few grams) taken from the tailings humidity cell sample (approximately 1 kg). There may be some heterogeneity among the humidity cell tailings sample from which the initial and final content sub-samples were taken, leaving potential for minerals to be present in different proportions among different sub-samples.

Therefore, it is often difficult to get convergence of the mass balance equation from the laboratory analytical results. However, the results and mass balance calculations do illustrate order of magnitude (months / years / decades) estimates for time to exhaustion of various metals that could be expected if laboratory loading rates were sustained in the tailings samples for an indefinite amount of time.

Some parameters were routinely below the laboratory detection limit during humidity cell testing. In this assessment, humidity cell leachate that was below detection limit was treated to be equal to half the laboratory detection limit. In some cases, this assumption could overestimate the actual concentration of a given substance by one or more orders of magnitude. Subsequently, the total mass leached during humidity cell testing could be overestimated as well. Parameters with all or most of their humidity cell leachate values below detection limit have been identified in the summary tables (Table 11 to Table 14).

Table 11: Wolv Humidity Cell Mass Metals Leached from a 1 kg Sample

Parameter		Initial Content (mg)	Final Content (mg)	Mass Extracted (mg)		Fraction Extracted (%)
				Humidity Cell	Shake Flask	
Silver	Ag	82	86	0.11	0.00045	0.14
Aluminum	Al	10,000	8,400	0.17	0.015	0.0019
Arsenic	As	1,200	1,200	0.18	0.024	0.017
Barium	Ba	66	57	0.74	0.099	1.3
Beryllium	Be	0.24	0.20	0.046	0.0024	20
Bismuth	Bi	19	18	0.0028	0.0015	0.023
Boron	B	2.5		0.14	0.060	7.9
Calcium	Ca	27,000	22,000	5,553	1,833	27
Cadmium	Cd	74	75	1.9	1.1	4.0
Cobalt	Co	48	40	0.43	0.18	1.3
Chromium	Cr	160	91	0.031	0.0045	0.022
Copper	Cu	1,100	1,100	0.080	0.0090	0.0081
Iron	Fe	180,000	200,000	0.23	0.015	0.00014
Mercury	Hg	4.0		0.0014	0.00015	0.038
Potassium	K	2,500	3,100	0.056	2.5	0.10
Lithium	Li	5.5	4.2	48	0.015	873
Magnesium	Mg	16,000	14,000	867	62	5.8
Manganese	Mn	620	600	38	67	17
Molybdenum	Mo	25	28	0.0097	0.0024	0.050
Sodium	Na	150	100	75	1.3	51
Nickel	Ni	56	60	0.86	0.45	2.4
Phosphorous	P	520		0.92	0.015	0.18
Lead	Pb	5,100	4,500	0.53	0.16	0.013
Antimony	Sb	310	290	0.47	0.015	0.16
Selenium	Se	464	530	16	0.84	3.6
Tin	Sn	10	9.0	0.10	0.015	1.2
Strontium	Sr	59	52	17	3.6	34
Titanium	Ti	82	62	0.050	0.0015	0.063
Thallium	Tl	13	12	0.16	0.021	1.3
Uranium	U	6.0	6.5	0.0027	0.0024	0.084
Vanadium	V	49	34	0.051	0.012	0.13
Zinc	Zn	8,000	8,300	99	100	2.5

Red text indicates that all or most of the input values were less than detection limit, and assumed to be one half of the method detection limit in mass loading calculations.

Table 12: Lynx Humidity Cell Mass Metals Leached from a 1 kg Sample

Parameter		Initial Content (mg)	Final Content (mg)	Mass Extracted (mg)		Fraction Extracted (%)
				Humidity Cell	Shake Flask	
Silver	Ag	54	59	0.069	0.00045	0.13
Aluminum	Al	2,800	2,100	0.14	0.015	0.0054
Arsenic	As	4,100	3,700	0.12	0.0075	0.0030
Barium	Ba	50	32	0.75	0.10	1.7
Beryllium	Be	0.12	0.050	0.042	0.00060	36
Bismuth	Bi	6.4	4.9	0.0026	0.00090	0.055
Boron	B	2.5		0.13	0.069	8.0
Calcium	Ca	24,000	18,000	4,354	1,842	26
Cadmium	Cd	110	100	1.5	0.86	2.1
Cobalt	Co	39	32	0.21	0.18	1.0
Chromium	Cr	210	110	0.011	0.0045	0.0073
Copper	Cu	820	850	0.10	0.012	0.014
Iron	Fe	270,000	300,000	0.22	0.015	0.000085
Mercury	Hg	3.2		0.0013	0.00015	0.045
Potassium	K	1,100	1,200	0.055	5.9	0.54
Lithium	Li	0.10	0.10	19	0.012	19,171
Magnesium	Mg	5,200	3,700	843	68	18
Manganese	Mn	700	590	47	16	9.0
Molybdenum	Mo	45	47	0.014	0.0024	0.036
Sodium	Na	100	55	51	2.2	54
Nickel	Ni	63	66	0.44	0.39	1.3
Phosphorous	P	190		0.83	0.090	0.48
Lead	Pb	5,600	4,600	0.28	0.050	0.0059
Antimony	Sb	180	200	0.44	0.030	0.26
Selenium	Se	336	430	9.5	1.4	3.2
Tin	Sn	16	14	0.16	0.012	1.1
Strontium	Sr	48	36	17	2.7	40
Titanium	Ti	53	39	0.046	0.0015	0.089
Thallium	Tl	24	23	0.26	0.0015	1.1
Uranium	U	3.4	3.9	0.0019	0.0030	0.15
Vanadium	V	33	26	0.029	0.012	0.12
Zinc	Zn	11,000	11,000	76	51	1.2

Red text indicates that all or most of the input values were less than detection limit, and assumed to be one half of the method detection limit in mass loading calculations.

Table 13: OC Humidity Cell Mass Metals Leached from a 1 kg Sample

Parameter		Initial Content (mg)	Final Content (mg)	Mass Extracted (mg)		Fraction Extracted (%)
				Humidity Cell	Shake Flask	
Silver	Ag	59	63	0.11	0.00015	0.18
Aluminum	Al	4,300	24,000	0.30	0.0024	0.0070
Arsenic	As	2,700	2,900	0.39	0.019	0.015
Barium	Ba	38	1,900	2.8	0.088	7.7
Beryllium	Be	0.10	1.2	0.048	0.000030	48
Bismuth	Bi	7.5	10	0.0039	0.000015	0.052
Boron	B	1.5		0.33	0.026	23
Calcium	Ca	23,000	11,000	11,450	1,617	57
Cadmium	Cd	140	130	24	3.6	20
Cobalt	Co	37	33	0.44	0.026	1.2
Chromium	Cr	120	430	0.054	0.00075	0.046
Copper	Cu	1,100	960	0.69	0.041	0.066
Iron	Fe	280,000	350,000	0.92	0.0045	0.00033
Mercury	Hg	3.2	5.5	0.0074	0.00090	0.26
Potassium	K	2,100	11,000	2.0	2.4	0.21
Lithium	Li	0.15	23	43	0.0015	28,576
Magnesium	Mg	7,500	10,000	945	13	13
Manganese	Mn	680	730	106	6.2	17
Molybdenum	Mo	28	36	0.14	0.0099	0.52
Sodium	Na	110	290	38	12	46
Nickel	Ni	65	54	0.54	0.071	0.95
Phosphorous	P	290	330	2.0	0.036	0.70
Lead	Pb	3,500	4,300	2.4	0.029	0.069
Antimony	Sb	220	280	0.72	0	0.33
Selenium	Se	361	470	19	0.58	5.4
Tin	Sn	11	20	0.077	0.0011	0.71
Strontium	Sr	49	49	27	1.7	58
Titanium	Ti	54	450	0.078	0.00090	0.15
Thallium	Tl	16	34	0.51	0.039	3.4
Uranium	U	3.9	6.5	0.058	0.00026	1.5
Vanadium	V	29	200	0.035	0.00042	0.12
Zinc	Zn	19,000	17,000	886	113	5.3

Red text indicates that all or most of the input values were less than detection limit, and assumed to be one half of the method detection limit in mass loading calculations.

Table 14: OD Humidity Cell Mass Metals Leached from a 1 kg Sample

Parameter		Initial Content (mg)	Final Content (mg)	Mass Extracted (mg)		Fraction Extracted (%)
				Humidity Cell	Shake Flask	
Silver	Ag	55	56	0.12	0.0012	0.23
Aluminum	Al	6,000	31,000	61	0.0012	1.0
Arsenic	As	2,700	2,600	2.0	0.34	0.085
Barium	Ba	53	3,900	3.1	0.12	6.0
Beryllium	Be	0.17	1.4	0.051	0.000030	30
Bismuth	Bi	11	9.8	0.0040	0.000015	0.036
Boron	B	2.5		0.35	0.097	18
Calcium	Ca	25,000	4,500	21,057	1,719	91
Cadmium	Cd	97	53	35	6.3	42
Cobalt	Co	43	29	2.9	0.41	7.8
Chromium	Cr	200	440	0.99	0.00075	0.49
Copper	Cu	820	640	91	1.1	11
Iron	Fe	230,000	350,000	953	0.036	0.41
Mercury	Hg	3.6	3.9	0.0014	0.00015	0.042
Potassium	K	1,700	13,000	10	4.5	0.86
Lithium	Li	1.6	29	79	0.0060	4,963
Magnesium	Mg	10,000	8,600	4,475	187	47
Manganese	Mn	670	470	276	83	54
Molybdenum	Mo	32	36	0.13	0.00036	0.42
Sodium	Na	140	400	59	16	53
Nickel	Ni	60	45	7.8	1.9	16
Phosphorous	P	320	410	2.7	0.014	0.85
Lead	Pb	3,900	4,100	10	0.17	0.26
Antimony	Sb	170	280	0.66	0	0.39
Selenium	Se	364	370	64	8.9	20
Tin	Sn	13	21	0.15	0.00018	1.1
Strontium	Sr	53	37	47	3.6	96
Titanium	Ti	68	550	0.10	0.0024	0.16
Thallium	Tl	19	36	0.68	0.050	3.8
Uranium	U	4.7	6.4	0.44	0.00048	9.3
Vanadium	V	37	240	0.086	0.00018	0.23
Zinc	Zn	9,800	6,800	2,801	984	39

Red text indicates that all or most of the input values were less than detection limit, and assumed to be one half of the method detection limit in mass loading calculations.

An overall metals mass balance of the OD cell was conducted for all parameters analyzed, and the results are summarized in Table 15 for parameters of interest: Ca, Cd, Cu, Mg, Se and Zn. The initial content for Ca and Mg were taken from Table 4 to better reflect the solid phase concentration. Mass balances for the other three cells were not conducted as the Wolv and Lynx cells did not run for long enough to release enough contaminants to conduct a mass balance, and as the OC cell did not achieve acidic conditions, the total quantity of metals leached were also inadequate to perform an accurate mass balance.

To evaluate the results of the humidity cell mass balance, the following relationship (from the equation above) should exist:

$$m_i - m_f = m_{HC} + m_{SF}$$

Total Removed = Total Flushed

A very good correlation exists between the total removed (initial – final content) and the total flushed (humidity cell leachate + shake flask extract) for Ca, Cd, Mg and Zn (Table 15). The selenium final content was greater than the initial content; however, as discussed above, each analytical result is only accurate to +/- 25%, meaning the actual initial value could range from 273 – 455 mg and the final value could range from 277 – 462 mg. Additionally, the analytical method for selenium has been greatly improved from 2005 (when initial analysis was conducted), to 2012, with current methods having less interference from other parameters. For copper, the total flushed value was half that of the total removed, however, these values are still within the limits of analytical uncertainty. Overall, the mass balance results confirm the validity of the laboratory humidity cell test program.

Table 15: OD Humidity Cell Metals Mass Balance

Parameter		Initial Content (mg)	Final Content (mg)	Total Removed (mg)	Mass Flushed (mg)		Total Flushed (mg)
					Humidity Cell	Shake Flask	
Calcium	Ca	*27,000*	4,500	22,500	21,057	1,719	22,776
Cadmium	Cd	97	53	44	35	6	41
Copper	Cu	820	640	180	91	1	92
Magnesium	Mg	*12,700*	8,600	4,100	4,475	187	4,662
Selenium	Se	364	370	-6	64	9	73
Zinc	Zn	9,800	6,800	3,000	2,801	984	3,785

NOTE: Values in italics were taken from Table 4 instead of Table 3, to better reflect the true solid phase concentration.

7. Conclusions

While stable long term leaching rates had not been achieved in the four tailings humidity cells prior to decommissioning, the tests illustrated the following characteristics about the samples:

- The tests have indicated that the onset of acid generation in lab conditions could take approximately 5 years for tailings comparable to the OD sample. It was not possible to predict time to onset of acid generation for the Wolv, Lynx and OC cells.
- The majority of the NP in the OD cell was not capable of buffering the leachate to a pH above pH 3.1 However, the relatively small amount of reactive/available NP did keep the OD humidity cell pH in the neutral range for almost 5 years of weekly flushing at room temperature. The time to onset of acidic drainage under site conditions, for tailings comparable to those in the OD sample, would be expected to be considerably longer than that experienced in the laboratory humidity cell.
- Initial flush and neutral pH drainage leaching rates that could be expected given controlled laboratory conditions:
  - All samples showed elevated rates of leaching for Se and Zn for neutral pH drainage. When the drainage became acidic, as in the OD cell, the leaching rates for Cu, Se, and Zn increased exponentially over time, in response to the drop in pH.

A mass balance for the OD cell was carried out to assess the total mass of metals that were leached from the tailings samples over the duration of the testing program. A very good correlation was seen for Ca, Cd, Mg, and Zn. This finding confirms the validity of the laboratory humidity cell test program.

8. Closure

We trust this humidity cell decommissioning report meets your requirements for the Wolverine tailings kinetic testing program. If you have any questions, please contact the undersigned.

Yours truly,

Marsland Environmental Associates Ltd.

Rob Griffith

Rob Griffith, P.Eng.
Project Engineer

Rob Marsland, P.Eng.
Senior Environmental Engineer

/attach – digital version only of data compilation spreadsheet

9. References

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Appendix A: Final Mineralogy Analysis

QUANTITATIVE PHASE ANALYSIS OF TWO POWDER SAMPLES USING THE RIETVELD METHOD AND X-RAY POWDER DIFFRACTION DATA.

(Project 10961-002 - P.O. 18042)

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February 27, 2007

EXPERIMENTAL METHOD

The two samples “**Combined Wolverine D Composite Tails Final Washed Solids**” and “**Combined Lynx D Composite Tails Final Washed Solids**” were reduced into fine powder to the optimum grain-size range for X-ray analysis (<10μm) grinding under ethanol in a vibratory McCrone Micronising Mill for 7 minutes. Step-scan X-ray powder-diffraction data were collected over a range 3-80°2θ with CoKα radiation on a standard Siemens (Bruker) D5000 Bragg-Brentano diffractometer equipped with an Fe monochromator foil, 0.6 mm (0.3°) divergence slit, incident- and diffracted-beam Sollers slits and a Vantec-1 strip detector. The long fine-focus Co X-ray tube was operated at 35 kV and 40 mA, using a take-off angle of 6°.

RESULTS AND DISCUSSION

The X-ray diffractograms were analyzed using the International Centre for Diffraction Database PDF-4 using Search-Match software by Siemens (Bruker). X-ray powder-diffraction data were refined with Rietveld Topas 3 (Bruker AXS).

The results of quantitative phase analysis by Rietveld refinement are given in Table 1. These amounts represent the relative amounts of crystalline phases normalized to 100%. The Rietveld refinement plots for the samples are shown in Figures 1-2.

Table 1. Results of quantitative phase analysis (wt. %)

Mineral	**Ideal formula**	**Combined Lynx D**	**Combined Wolverine D**
Quartz	SiO_2	17.4	30.7
Muscovite	$KAl_2AlSi_3O_{10}(OH)_2$	8.8	14.8
Biotite	$K(Mg,Fe^{2+})_3AlSi_3O_{10}(OH)_2$	1.2	1.3
Clinochlore	$(Mg,Fe^{2+})_5Al(Si_3Al)O_{10}(OH)_8$		4.9
Calcite	$CaCO_3$		0.5
Gypsum	$CaSO_4 \cdot 2H_2O$	4.9	3.2
Dolomite	$CaMg(CO_3)_2$	3.2	6.8
Pyrite	FeS_2	64.7	36.1
Pyrrhotite	$Fe_{1-x}S$		1.6
Total		100.0	100.0

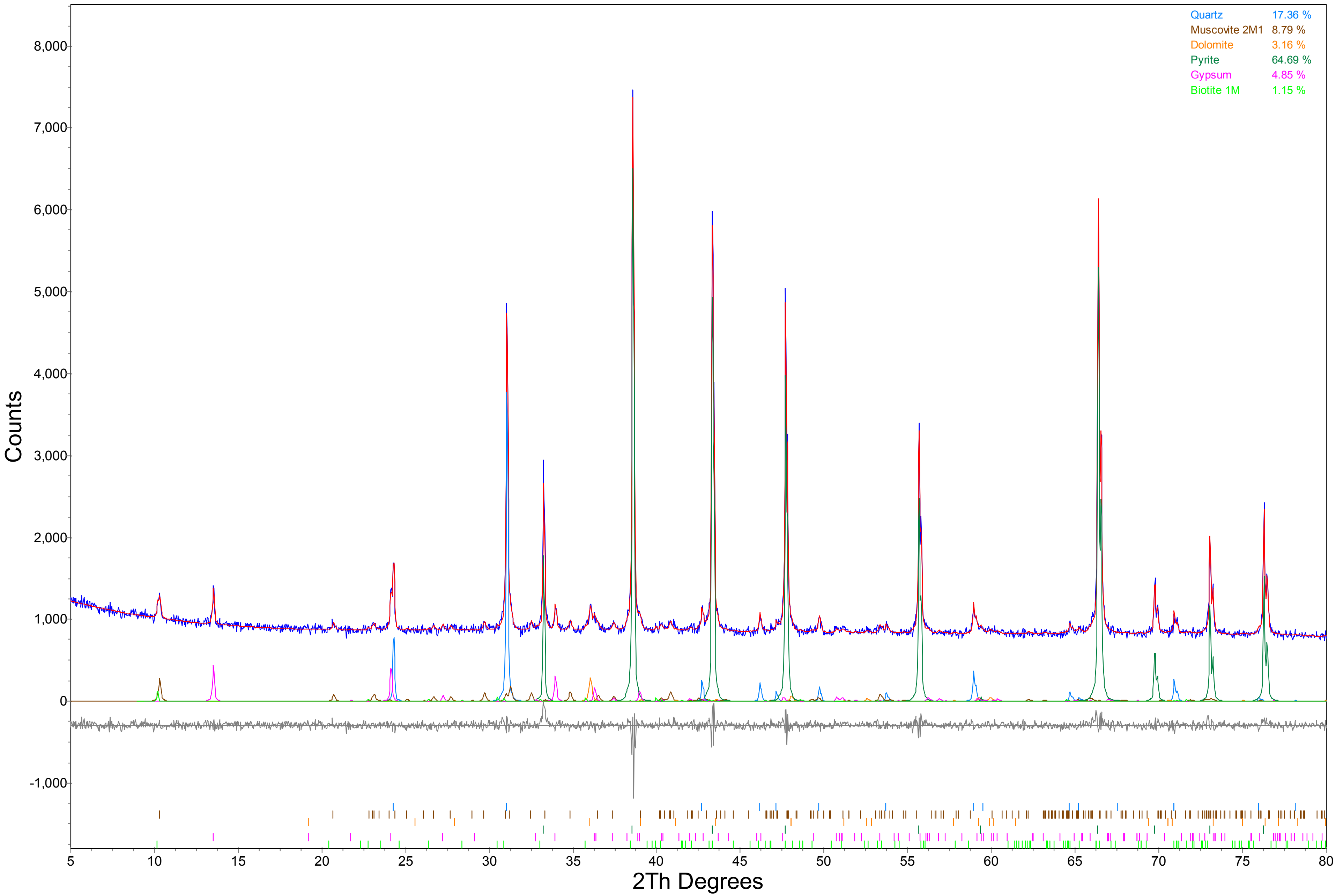

Figure 1. Rietveld refinement plot of sample **SGS Combined Lynx D** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars, positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

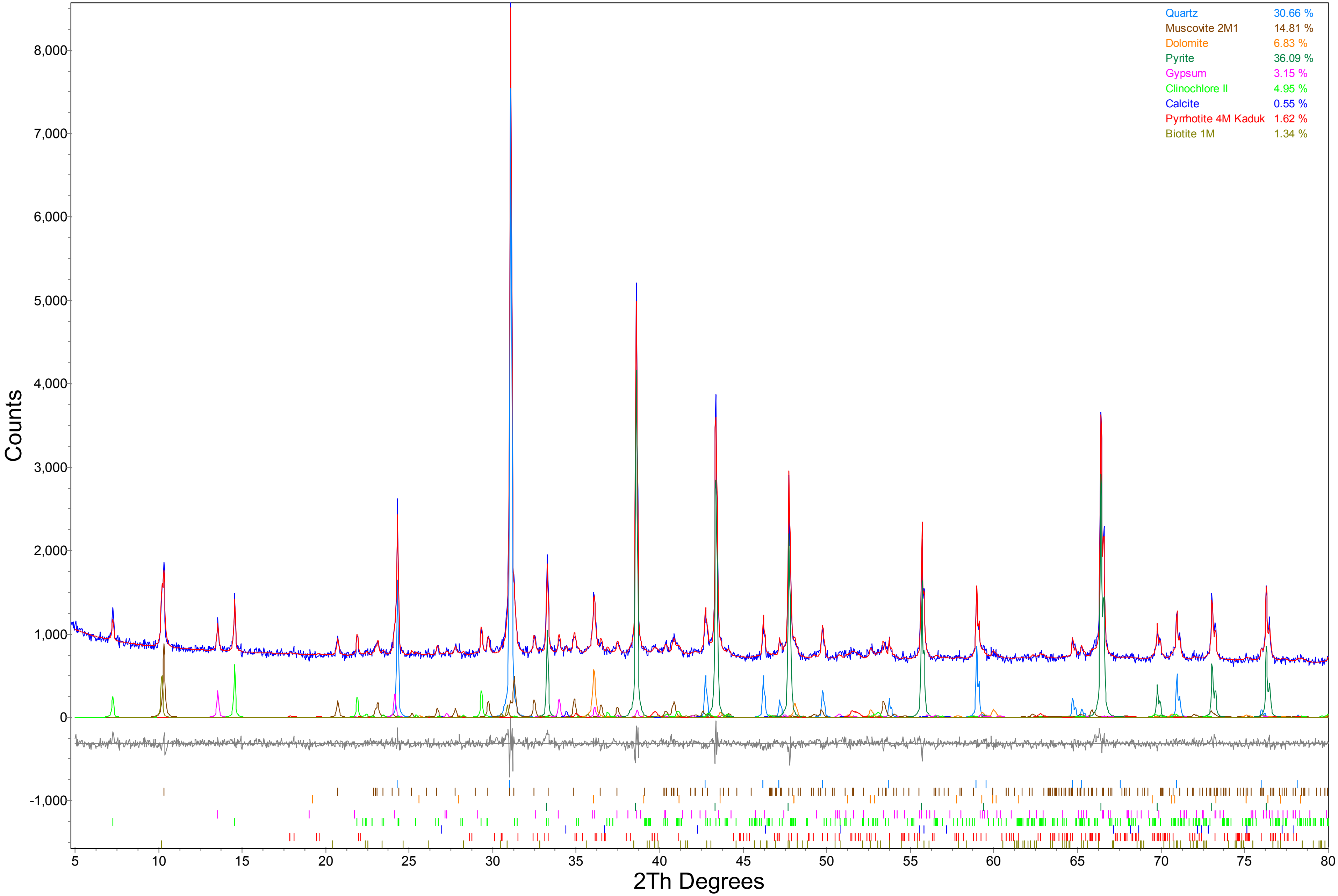

Figure 2. Rietveld refinement plot of sample **SGS Combined Wolverine D** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars, positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

An Investigation into

MINERALOGICAL CHARACTERIZATION OF TWO HUMIDITY CELL FINAL WASHED SOLIDS

prepared for

YUKON ZINC CORPORATION

LR 10961-002 – MI5015-FEB07
April 2, 2007

NOTE:
This report refers to the samples as received.

The practice of this Company in issuing reports of this nature is to require the recipient not to publish the report or any part thereof without the written consent of SGS Minerals Services.

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Introduction

Two humidity cell final washed solids (labelled as Comb. Wolverine D Comp Tail and Comb. Lynx D Comp Tail) were submitted to SGS Mineral Technologies for mineralogical examination. The purpose of the investigation was to determine the bulk mineral assemblage and textural characteristics of the mineral species within the tailings. The proportions of sulphides and carbonates were particularly noteworthy, due to the environmental implications of the relative stability of the tailings. A bulk modal analysis (by QEMSCAN technology) and optical examination were performed on each sample. X-ray diffraction (XRD) analysis was also performed to determine the bulk crystalline mineral assemblage as well as any water soluble phases. Carbonate grains were examined using scanning electron microscopy (SEM) equipped with an energy dispersive X-ray spectrometer (EDS).

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Jou Zhou, M.Sc., P.Geo.
Group Leader, Mineral Technologies

Experimental work by:	*Jennifer Glover, Section Preparation* *Huyun Zhou, Ph.D., XRD Mineralogist* *Stephanie Downing, M.Sc., Optical Microscopy*
Report preparation by:	*Stephanie Downing, M.Sc., Project Mineralogist*

Summary

1. Procedures

Each as-received sample was initially air-dried and micro-riffled to ensure sub-sample representivity for analyses. A representative sub-sample of material was pulverized and submitted for X-ray diffraction (XRD) analysis, in order to determine the bulk crystalline mineral assemblage (Appendix 1). A sub-sample of this material was also pulverized and submitted for whole rock analysis (WRA) by XRF using borate fusion (Appendix 2).

One polished section and one polished thin section per sample were prepared from representative micro-riffled sub-samples. Each polished section was examined optically with a petrographic microscope under incident (reflected) and transmitted light at 50x to 500x magnifications. The mineral assemblage and modal abundance of each sample were determined by compiling both optical data from manual point counting with a bulk mineral analysis (BMA) generated by QEMSCAN technology. The modal analyses and mineral grain size data are presented in Tables 1 and 3. Weight percentages of minerals were calculated from volume percentage using standard grain densities and documented mineral chemistries. A summary of the major calculated elemental oxides for each sample by mineralogical analysis is compared to the whole rock analysis (WRA) of each sample in assay reconciliation tables (Tables 2 and 4).

2. Mineralogical Results

2.1. Modal Analyses

2.1.1. Comb. Wolverine D Comp. Tail Final Washed Solids

Combined microscopic and SEM examination of the Comb. Wolverine D Comp Tail Final Washed Solids indicates that the sample is composed primarily of sulphides (42 wt. % of sample) and silicates (48.4 wt. % of sample) with minor amounts of carbonates (6.4 wt. % of sample), sulphates (2.2 wt. % of sample), and Fe-Ti oxides (1.1 wt. % of sample). A summary of the bulk mineralogy is presented below in Table 1.

Table 1. Summary Modal Analysis for Comb. Wolverine D Comp. Tail

Comb Wolverine D Comp Tail Final Wash Sol.	Formula or chemical composition	Wt.%	Typical Grain Size (µm)
Mineral			
Quartz	SiO_2	25.4	3 to 50
K-Feldspar	$KAlSi_3O_8$	1.2	1 to 15
Muscovite/Sericite	$KAl_2(Si_3Al)O_{10}(OH,F)_2$	7.0	2 to 35
Biotite	$K(Mg,Fe)_3AlSi_3O_{10}(OH,F)_2$	3.3	2 to 25
Chlorite	$(Mg,Al,Fe)_{12}[(Si,Al)_8O_{20}](OH)_{16}$	5.9	1 to 15
Pyriboles	$Ca_2(Mg,Fe)_5(Si_8O_{22})(OH)_2$	0.9	1 to 14
Plagioclase	$(Ca,Na)(Si,Al)_4O_8$	0.1	2 to 30
Talc	$Mg_3Si_4O_{10}(OH)_2$	0.2	1 to 15
Garnet	$Ca_3Al_2(SiO_4)_3$	0.0	1 to 15
Clay Minerals	$Al_2Si_2O_5(OH)_4$	4.4	1 to 15
Calcite	$CaCO_3$	0.5	1 to 20
Ankerite	$Ca(Fe,Mg)(CO_3)_2$	1.3	1 to 16
Dolomite	$CaMg(CO_3)_2$	4.5	2 to 30
Siderite	$FeCO_3$	0.1	1 to 20
Gypsum	$CaSO_4 \cdot 2(H_2O)$	0.3	1 to 15
Jarosite	$KFe_3(SO_4)_2(OH)_6$	1.9	1 to 15
Rutile	TiO_2	0.2	2 to 32
Fe-oxides	Fe_2O_3	0.7	2 to 35
Ilmenite	$FeTiO_3$	0.2	1 to 15
Sphalerite	ZnS	1.0	1 to 18
Pyrite	FeS_2	40.0	2 to 30
Pyrrhotite	$Fe_{1-x}S$	0.3	1 to 20
Chalcopyrite	$CuFeS_2$	0.2	1 to 20
Arsenopyrite	FeAsS	0.2	1 to 20
Other trace (< 0.05)	variable	0.3	1 to 15
Total		**100.0**	

Table 2 presents assay reconciliation of the Comb. Wolverine D Comp. Tail sample. In general, reconciliation of calculated mineralogical assay versus direct chemical assay is good, demonstrating confidence in mineralogical results. Due to the variable density of the minerals (pyrite denser than silicates), a slight over-estimation of sulphur and iron by calculated mineralogical assay may occur. In order to minimize this effect, the polished sections were prepared with graphite impregnation which separates particles and reduces density segregation. Documented mineral chemistries are used for mineralogical assay reconciliation tables for all minerals; therefore actual mineral chemistries will vary slightly from calculated ‘book’ values.

Table 2. Assay Reconciliation for Comb. Wolverine D Comp. Tail

Comb. Wolverine D Comp Tail Mineral	Wt.%	SiO2	Al2O3	Fe2O3	MgO	CaO	Na2O	K2O	TiO2	MnO	Cr2O3	C	S_T %	LOI
Quartz	25.4	25.4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
K-Feldspar	1.20	0.78	0.22	0.00	0.00	0.00	0.02	0.20	0.00	0.00	0.00	0.00	0.00	0.00
Muscovite/Sericite	7.00	3.16	2.69	0.00	0.00	0.00	0.00	0.83	0.00	0.00	0.00	0.00	0.00	0.28
Biotite	3.29	1.37	0.39	0.49	0.07	0.00	0.00	0.36	0.00	0.03	0.00	0.00	0.00	0.16
Chlorite	5.95	1.61	1.13	1.49	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48
Pyriboles	0.88	0.35	0.03	0.25	0.14	0.13	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.02
Plagioclase	0.06	0.03	0.02	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Talc	0.19	0.12	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
Garnet	0.03	0.01	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Clay Minerals	4.40	2.05	1.54	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.61
Calcite	0.50	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.16
Ankerite	1.30	0.00	0.00	0.20	0.13	0.48	0.00	0.00	0.00	0.04	0.00	0.15	0.00	0.40
Dolomite	4.50	0.00	0.00	0.18	1.44	0.99	0.00	0.00	0.00	0.00	0.00	0.60	0.00	1.56
Siderite	0.09	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.02
Gypsum	0.32	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.07
Jarosite	1.89	0.00	0.00	0.90	0.00	1.04	0.09	0.09	0.00	0.00	0.00	0.00	0.24	0.20
Rutile	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00
Fe-oxides	0.71	0.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ilmenite	0.17	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00
Sphalerite	0.98	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.32	0.63
Pyrite	40.0	0.00	0.00	26.6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	21.4	0.00
Pyrrhotite	0.34	0.00	0.00	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00
Chalcopyrite	0.18	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.06
Arsenopyrite	0.19	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.09
Other trace (< 0.05)	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.10
Total (calc'd)	**100.0**	**34.9**	**6.01**	**33.0**	**2.79**	**3.04**	**0.14**	**1.48**	**0.27**	**0.07**	**0.00**	**0.82**	**22.3**	**4.87**
WRA (by XRF)		**35.3**	**6.13**	**27.1**	**3.09**	**3.13**	**0.29**	**1.57**	**0.13**	**0.09**	**0.04**	**1.91**	**18.6**	**8.99**

2.1.2. Comb. Lynx D Comp. Tail Final Washed Solids

Combined microscopic and SEM examination of the Comb. Lynx D Comp Tail Final Washed Solids indicates that the sample is composed primarily of sulphides (69.7 wt. % of sample) and silicates (23.8 wt. % of sample) with minor amounts of carbonates (2.7 wt. % of sample), sulphates (3.1 wt. % of sample), and Fe-Ti oxides (0.7 wt. % of sample). A summary of the bulk mineralogy is presented below in Table 3.

Table 3. Summary Modal Analyses for Comb. Lynx D Comp. Tail

Comb Lynx D Comp Tail Final Wash Sol.	Formula or chemical composition	Wt.%	Typical Grain Size (μm)
Quartz	SiO_2	15.1	2 to 40
K-Feldspar	$KAlSi_3O_8$	1.4	1 to 30
Muscovite/Sericite	$KAl_2(Si_3Al)O_{10}(OH,F)_2$	2.1	1 to 25
Biotite	$K(Mg,Fe)_3AlSi_3O_{10}(OH,F)_2$	0.8	1 to 20
Chlorite	$(Mg,Al,Fe)_{12}[(Si,Al)_8O_{20}](OH)_{16}$	0.3	1 to 15
Pyriboles	$Ca_2(Mg,Fe)_5(Si_8O_{22})(OH)_2$	0.2	1 to 15
Plagioclase	$(Ca,Na)(Si,Al)_4O_8$	0.0	1 to 15
Talc	$Mg_3Si_4O_{10}(OH)_2$	0.0	1 to 15
Garnet	$Ca_3Al_2(SiO_4)_3$	0.0	---
Clay Minerals	$Al_2Si_2O_5(OH)_4$	3.9	1 to 15
Calcite	$CaCO_3$	0.4	1 to 25
Ankerite	$Ca(Fe,Mg)(CO_3)_2$	0.6	1 to 20
Dolomite	$CaMg(CO_3)_2$	1.6	1 to 20
Siderite	$FeCO_3$	0.0	1 to 15
Gypsum	$CaSO_4 \cdot 2(H_2O)$	0.5	1 to 15
Jarosite	$KFe_3(SO_4)_2(OH)_6$	2.6	1 to 15
Rutile	TiO_2	0.1	2 to 40
Fe-oxides	Fe_2O_3	0.5	2 to 35
Ilmenite	$FeTiO_3$	0.1	1 to 22
Sphalerite	ZnS	1.0	1 to 20
Pyrite	FeS_2	67.6	2 to 35
Pyrrhotite	$Fe_{1-x}S$	0.1	1 to 15
Chalcopyrite	$CuFeS_2$	0.1	1 to 20
Arsenopyrite	FeAsS	0.7	1 to 20
Other trace (< 0.05)	variable	0.2	1 to 15
Total		**100.0**	

Table 4 presents assay reconciliation of the Comb. Lynx D Comp. Tail sample In general, reconciliation of calculated mineralogical assay versus direct chemical assay is good, demonstrating confidence in mineralogical results. As with the previous sample, due to the variable density of the minerals (pyrite denser than silicates), a slight over-estimation of sulphur and iron by calculated mineralogical assay may occur. In order to minimize this effect, the polished sections were prepared with graphite impregnation which separates particles and reduces density segregation. Documented mineral chemistries are used for mineralogical assay reconciliation tables for all minerals; therefore actual mineral chemistries will vary slightly from calculated 'book' values.

Table 4. Assay Reconciliation for Comb. Lynx D Comp. Tail

Comb. Lynx D Comp Tail Mineral	Wt.%	SiO2	Al2O3	Fe2O3	MgO	CaO	Na2O	K2O	TiO2	MnO	Cr2O3	C	S_T %	LOI
Quartz	15.1	15.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
K-Feldspar	1.40	0.91	0.26	0.00	0.00	0.00	0.03	0.24	0.00	0.00	0.00	0.00	0.00	0.00
Muscovite/Sericite	2.10	0.95	0.81	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.09
Biotite	0.80	0.33	0.09	0.12	0.02	0.00	0.00	0.09	0.00	0.01	0.00	0.00	0.00	0.04
Chlorite	0.30	0.08	0.06	0.08	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
Pyriboles	0.20	0.08	0.01	0.06	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Plagioclase	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Talc	0.02	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Garnet	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Clay Minerals	3.90	1.82	1.37	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.54
Calcite	0.40	0.00	0.00	0.00	0.00	0.22	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.13
Ankerite	0.60	0.00	0.00	0.09	0.06	0.22	0.00	0.00	0.00	0.02	0.00	0.07	0.00	0.19
Dolomite	1.60	0.00	0.00	0.06	0.48	0.40	0.00	0.00	0.00	0.00	0.00	0.21	0.00	0.56
Siderite	0.05	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01
Gypsum	0.50	0.00	0.00	0.00	0.00	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.10
Jarosite	2.60	0.00	0.00	1.24	0.00	1.43	0.13	0.24	0.00	0.00	0.00	0.00	0.33	0.28
Rutile	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00
Fe-oxides	0.48	0.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ilmenite	0.14	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00
Sphalerite	1.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.64
Pyrite	67.6	0.00	0.00	45.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	36.1	0.00
Pyrrhotite	0.11	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00
Chalcopyrite	0.15	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.05
Arsenopyrite	0.69	0.00	0.00	0.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.32
Other trace (< 0.05)	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.07
Total (calc'd)	**100.0**	**19.3**	**2.58**	**49.4**	**0.64**	**2.47**	**0.16**	**0.82**	**0.12**	**0.03**	**0.00**	**0.34**	**37.2**	**3.04**
WRA (by XRF)		**20.6**	**3.26**	**42.6**	**1.02**	**2.66**	**0.53**	**0.91**	**0.08**	**0.08**	**0.05**	**0.87**	**27.1**	**8.99**

2.2. Summary and Mineralogical Overview

Pyrite is the main sulphide mineral among both samples and typically occurs as liberated grains ranging from 1 to 35 µm. Sphalerite (~1 wt. % of each sample) occurs in minor amounts typically as inclusions (1 to 20 µm) in pyrite and other non-opaque gangue minerals. Trace amounts of chalcopyrite (typically as inclusions 1 to 20 µm) and arsenopyrite (typically liberated 1 to 20 µm) account for the remaining sulphides.

Carbonates (typically 1 to 30 µm) are present mainly as ferroan dolomite and ankerite with trace to rare occurrences of calcite and siderite. The distribution of both sulphide and carbonate minerals by composition is presented below in Table 5.

Table 5. Summary of Carbonate and Sulphide Minerals by Sample

Mineral	Formula	Comb Wolverine D Comp Tail		Comb Lynx D Comp Tail	
		wt. %	**% dist'n**	**wt. %**	**% dist'n**
Calcite	$CaCO_3$	0.5	7.8	0.4	15.1
Ankerite	$Ca(Fe,Mg)(CO_3)_2$	1.3	20.3	0.6	22.7
Dolomite	$CaMg(CO_3)_2$	4.5	70.4	1.6	60.4
Siderite	$FeCO_3$	0.1	1.4	0.0	1.8
Total carbonate		**6.4**	**100.0**	**2.6**	**100.0**
Sphalerite	ZnS	1.0	2.4	1.0	1.5
Pyrite	FeS_2	40.0	96.4	67.6	98.2
Pyrrhotite	$Fe_{1-x}S$	0.3	0.8	0.1	0.2
Chalcopyrite	$CuFeS_2$	0.2	0.4	0.1	0.2
Arsenopyrite	FeAsS	0.2	0.5	0.7	1.0
Total sulphide		**41.5**	**100.0**	**68.9**	**100.0**

Minor sulphates (typically as Ca-sulphate and Fe-sulphate) are present in both samples. These occur as rims on pyrite as well as liberated particles (ranging from 1 to 15 µm).

The main silicate minerals among the samples consist of quartz, muscovite/sericite and clay minerals. Minor to trace amounts of feldspars, biotite, chlorite, amphiboles and talc are also present.

Fe-Ti oxides consist of rutile, magnetite, rare goethite, and ilmenite (ranging from 1 to 40 µm).

Appendix 1

X-ray Diffraction Results

Summary of Qualitative X-ray Diffraction Results

Sample	Crystalline Mineral Assemblage (relative proportions based on peak height)			
	Major	**Moderate**	**Minor**	**Trace**
1. Comb Wolverine D Comp Tail Final Washed Sol	quartz	pyrite, mica	dolomite, bassanite, chlorite	*potassium-feldspar, *calcite
2. Comb Lynx D Comp Tail Final Washed Sol	pyrite	quartz	mica, bassanite, potassium-feldspar	*calcite, *dolomite, *jarosite

*Tentative identification due to low concentrations, diffraction line overlap or poor crystallinity

Instrument:	Siemens D5000 diffractometer
Scan Conditions:	Co radiation, graphite monochromator, 40 kV, 30 mA, Step:0.02°, Step time:1s
Interpretations:	JCPDS / ICDD powder diffraction files. Siemens Search / Match software.
Detection Limit:	0.5-2%. Strongly dependent on crystallinity.

Interpretations do not reflect the presence of non-crystalline / amorphous compounds. Mineral proportions are based on relative peak heights and may be strongly influenced by crystallinity, structural group or preferred orientations. Interpretations and relative proportions should be accompanied by supporting petrographic and geochemical data (WRA, ICP-OES).

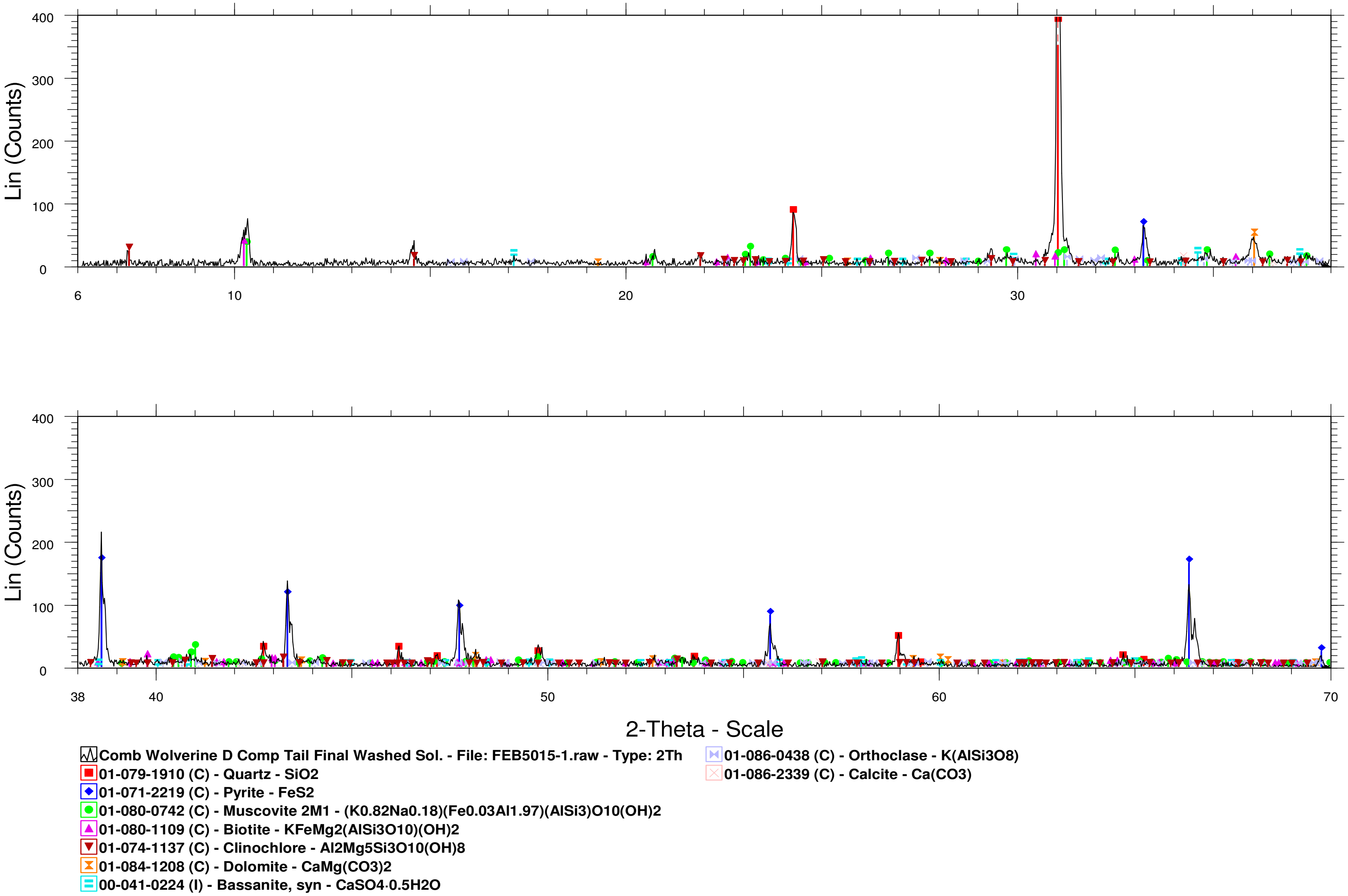
Mineral	**Composition**
Bassanite	$CaSO_4 \cdot 0.5H_2O$
Calcite	$CaCO_3$
Chlorite	$(Fe,(Mg,Mn)_5,Al)(Si_3Al)O_{10}(OH)_8$
Dolomite	$CaMg(CO_3)_2$
Jarosite	$(K)_2Fe_3(SO_4)_2(OH)_6$
Mica	$K(Mg,Fe)Al_2Si_3AlO_{10}(OH)_2$
Potassium-Feldspar	$K(AlSi_3O_8)$
Pyrite	FeS_2
Quartz	SiO_2

Note:
N/A

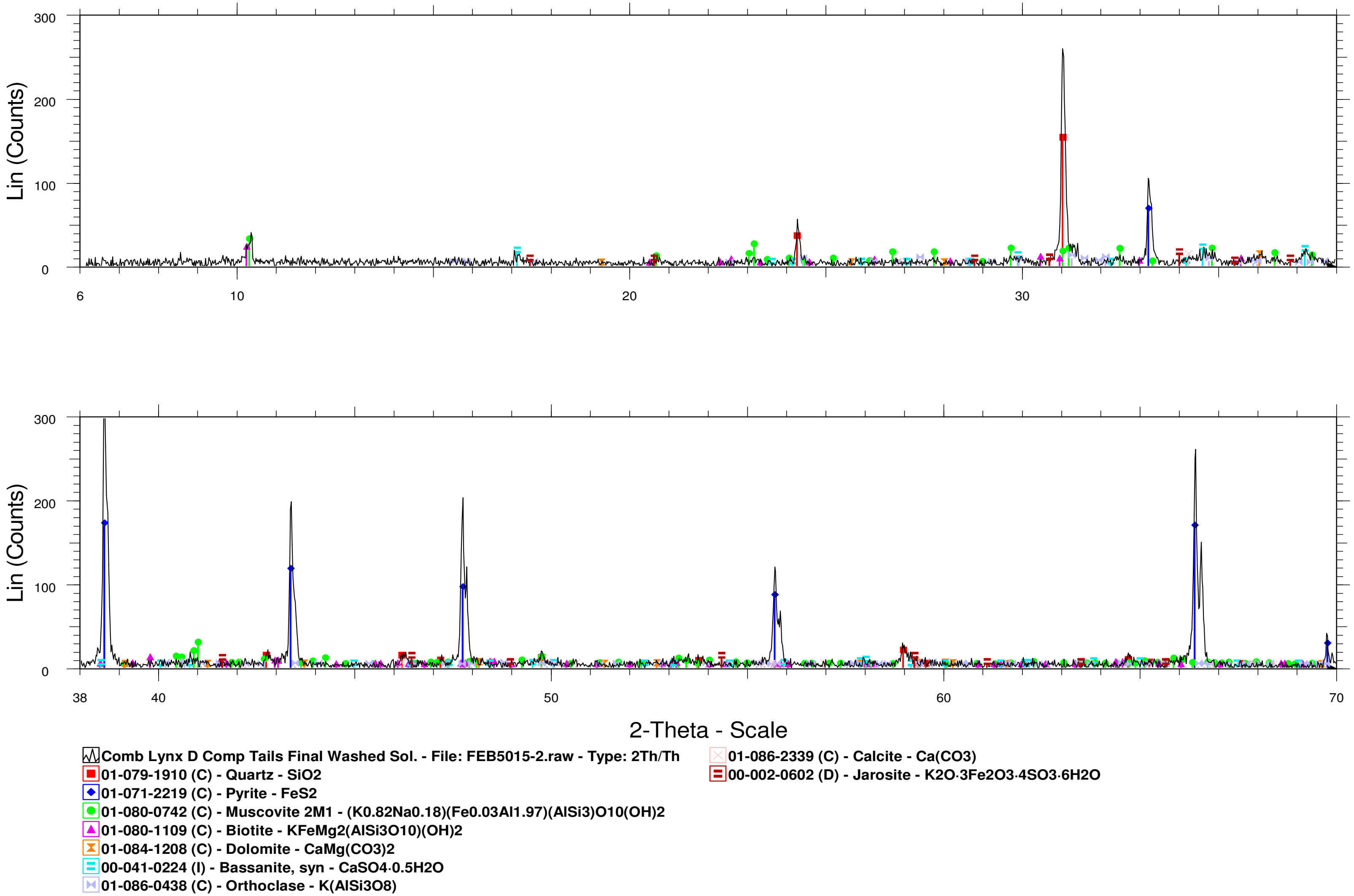
Huyun Zhou, Ph.D.
Project Mineralogist, XRD

Stephanie Downing, M. Sc.
Senior Mineralogist

Comb Wolverine D Comp Tail Final Washed Sol.



Comb Lynx D Comp Tails Final Washed Sol.



Appendix 2

Chemical Analyses

SGS Lakefield Research Limited
P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - K0L 2H0
Phone: 705-652-2038 FAX: 705-652-6441

LR Internal Dept 14
Attn : Stephanie Downing

---, ---

Phone: ---
Fax: ---

Monday, March 26, 2007

Date Rec. : 20 March 2007
LR Report : CA80467-MAR07
Project : CALR-10961-002
Client Ref : MI5015-Feb07 Wolverine

CERTIFICATE OF ANALYSIS

Final Report

Sample ID	SiO2 %	Al2O3 %	Fe2O3 %	MgO %	CaO %	Na2O %	K2O %	TiO2 %	P2O5 %	MnO %	Cr2O3 %	V2O5 %	LOI %	Sum %
1: Comb Wolverine D Comp Tail Final Washed Sol.	35.3	6.13	27.1	3.09	3.13	0.29	1.57	0.13	0.15	0.09	0.04	0.06	17.3	94.4
2: Comb Lynx D Comp Tail Final Washed Sol.	20.6	3.28	42.6	1.02	2.66	0.53	0.91	0.38	0.06	0.08	0.05	0.04	24.7	96.8

Debbie Waldon
Project Coordinator,
Minerals Services, Analytical

Page 1 of 1

Quantitative X-Ray Diffraction by Rietveld Refinement

Report Prepared for:	*Environmental -Analytical*
Project Number/ LIMS No.	*Mineralogy/MI5037-MAR12*
Reporting Date:	*March 27, 2012*

Instrument:	BRUKER AXS D8 Advance Diffractometer
Test Conditions:	Co radiation, 40 kV, 35 mA Regular Scanning: Step: 0.02°, Step time: 1s, 2θ range: 3-80°
Interpretations :	PDF2/PDF4 powder diffraction databases issued by the International Center for Diffraction Data (ICDD). DiffracPlus Eva and Topas software.
Detection Limit :	0.5-2%. Strongly dependent on crystallinity.

Contents:

1) Method Summary
2) Summary of Mineral Asemblages
3) Semi-Quantitative XRD Results
4) Chemical Balance(s)
5) XRD Pattern(s)

Bernie C. Yeung, B. Sc.
Mineralogist

Huyun Zhou

Huyun Zhou, Ph.D., P.Geo.
Senior Mineralogist

Method Summary

Mineral Identification and Interpretation:

Mineral identification and interpretation involve matching the diffraction pattern of an unknown material to patterns of single-phase reference materials. The reference patterns are compiled by the Joint Committee on Powder Diffraction Standards - International Center for Diffraction Data (JCPDS-ICDD) database and released on software as Powder Diffraction Files (PDF).

Interpretations do not reflect the presence of non-crystalline and/or amorphous compounds, except when internal standards added by request. Mineral proportions may be strongly influenced by crystallinity, crystal structure and preferred orientations. Minerals or compounds identification and quantitative analysis results should be accompanied by supporting chemical assay data or other tests.

Rietveld Method Quantitative Analysis:

Whole-pattern Rietveld Method Quantitative Analysis is performed by using Topas 4.1 (Bruker AXS), a graphics based profile analysis program built around a general non-linear least squares fitting system, to determine the amount of different phases in a multicomponent sample. Whole pattern analyses are predicated by the fact that the X-ray diffraction pattern is a total sum of both instrumental factors and specimen. Unlike other peak intensity-based methods, the Rietveld method uses a least square approach to refine a theoretical line profile until it matches the obtained experimental patterns.

Rietveld refinement is completed with a set of minerals specifically identified for the sample(s). Zero values indicate that the mineral was included in the refinement calculations, but the calculated concentration was less than 0.05wt%. Minerals not identified by the analyst are not included in refinement calculations for specific samples and are indicated with a dash.

SGS

Enviromental - Analytical
Custum XRD/MI4511-SEP10
10/28/2010

Summary of Rietveld Quantitative Analysis X-ray Diffraction Results

Quantitative X-ray Diffraction Results

Mineral/Compound	June 29/05 Combined OD Composite Tails Pulv 7-3 Riet (wt %)	Combined RO Cl Sc Tailings Solids Pulv 7-4 Riet (wt %)
Chlorite	1.33	1.05
Dolomite	0.81	3.72
Muscovite	11.2	8.01
Pyrite	57.3	62.3
Quartz	29.4	24.9
TOTAL	100.0	100.0

Zero values indicate that the mineral was included in the refinement, but the calculated concentration is below a measurable value.

Dashes indicate that the mineral was not identified by the analyst and not included in the refinement calculation for the sample.

Mineral/Compound	Formula
Chlorite	$(Mg,Fe)_3(Si,Al)_4O_{10}$
Dolomite	$CaMg(CO_3)_2$
Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$
Pyrite	FeS_2
Quartz	SiO_2

The Qualitative XRD method (METH # 8-8-1) used by SGS Minerals Services, P.O. Box 4300, 185 Concession Street, Lakefield, Ontario, Canada K0L 2H0
Tel: (705) 652-2000 Fax: (705) 652-6365. Mini-method available upon request.

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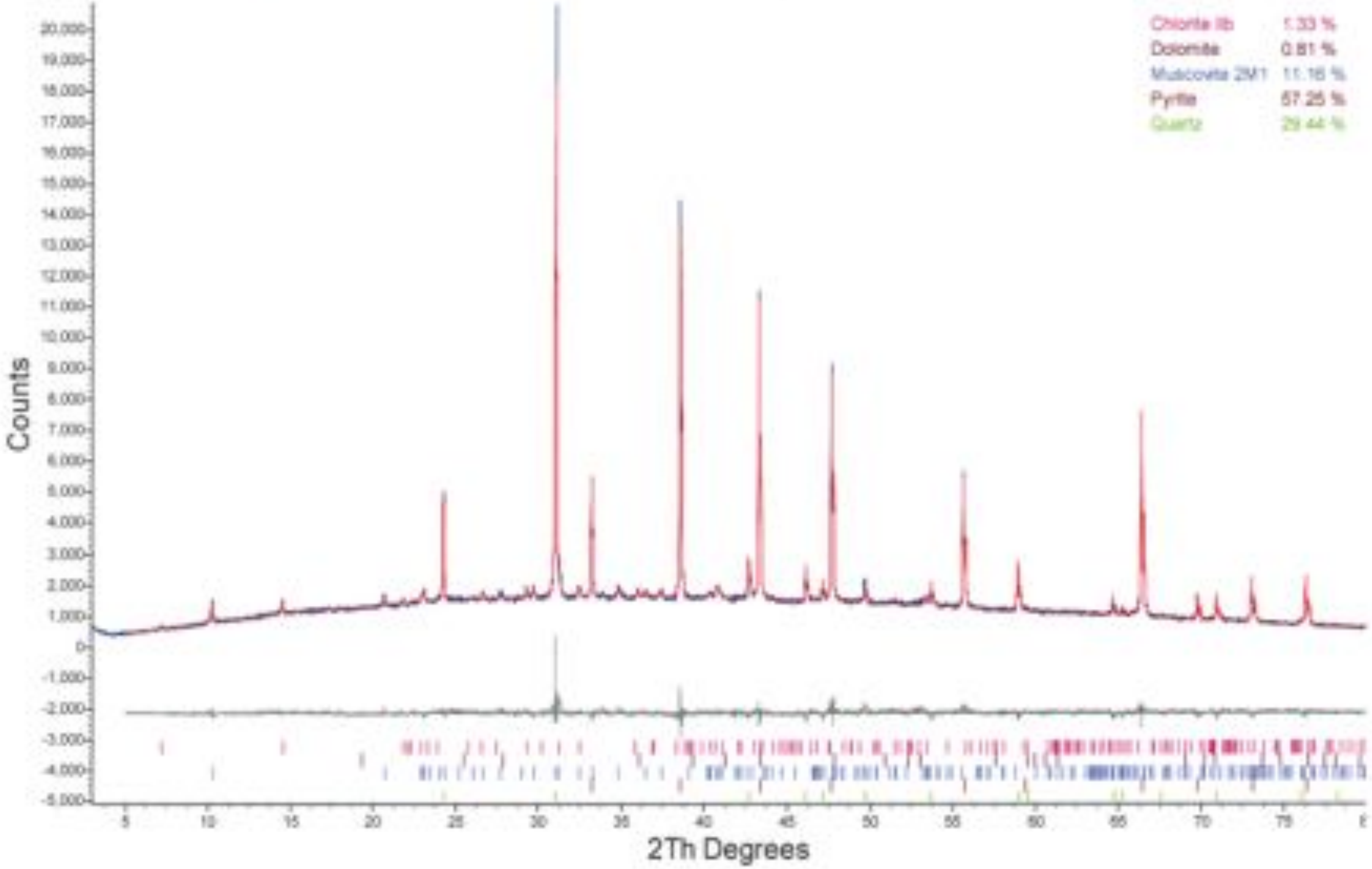
Custum XRD/M04511-SEP10
10/28/2010

June 29/05 Combined OD Composite Tails Pulv



The Qualitative XRD method (METH # 8-8-1) used by SGS Minerals Services, P.O. Box 4300, 185 Concession Street, Lakefield, Ontario, Canada K0L 2H0.
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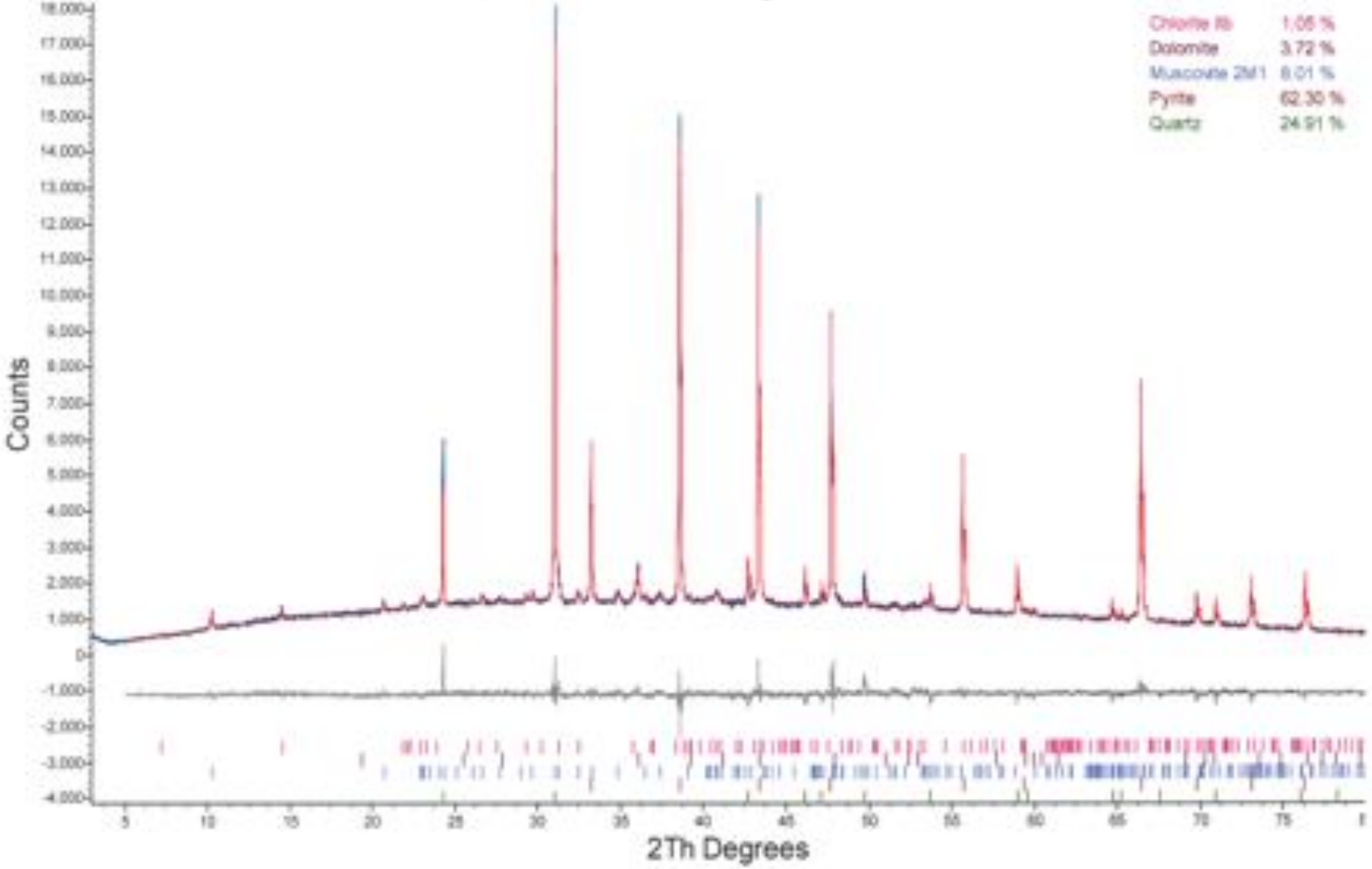
Custum XRD/MI4511-SEP10
10/28/2010

Combined RO Cl Sc Tailings Solids Pulv



The Qualitative XRD method (METH # 8-8-1) used by SGS Minerals Services, P.O. Box 4300, 185 Concession Street, Lakefield, Ontario, Canada K0L 2H0
Tel: (705) 652-2000 Fax: (705) 652-6365. Mini-method available upon request.

A Petrography Report on

TWO TAILINGS SAMPLES

prepared for

YUKON ZINC

Project: Custom-Min MI5037-MAR12 – Draft Report
June 13, 2012

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Member of the SGS Group (SGS SA)

Introduction

This report describes a High Definition Mineralogy test program based on QEMSCAN technology (Quantitative Evaluation of Materials by Scanning Electron Microscopy) and optical microscopy to examine the mineralogical characteristics of two tailings samples. The two samples, labelled “June 29/05 Combined OD Composite Tails” and “Combined Ro Cl Sc Tailings Solids”, were submitted by Brian Graham of the SGS Environmental Analytical Department on behalf of Yukon Zinc and were given the LIMS number MI5037-MAR12.

Two de-agglomerated graphite-impregnated polished epoxy grain mounts were prepared and submitted for mineralogical analyses using QEMSCAN technology. As well, two polished thin sections were prepared from grain mounts for optical microscopy.

The purpose of this test program was to provide semi-quantitative modal mineralogy, general grain size information, assess the degree of oxidation of pyrite and to comment on the textures and the associative nature of the sulphide minerals.

Kathryn Sheridan

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Mineralogist - Advanced Mineralogy Facility

Stephanie Downing

Stephanie Downing, M.Sc.
Senior Mineralogist - Advanced Mineralogy Facility

Section Preparation by: Scott Young
QEMSCAN Operation by: Amie Brock
Petrography by: Kathryn Sheridan and Stephanie Downing
Report preparation: Kathryn Sheridan and Stephanie Downing
Reviewed by: Stephanie Downing

Mineralogical Characterization

1.1. Mineral Abundance

The mineral distributions of the samples are presented below in Table 1. The samples are mainly composed of pyrite (60% and 69%), quartz (20% and 12%) and micas/clays (15% and 9%, respectively). The other main mineralogical differences between the samples are sphalerite content (0.8% and 3.0%) and ankerite/dolomite content (0.8% and 3.9%, respectively).

Table 1: Mineral Distribution (by QEMSCAN)

Sample	**Mineral**	**June 29/05 Combined OD Composite Tails**	**Combined Ro Cl Sc Tailings Solids**
Avg. Particle Size (µm)		20	26
Mineral Mass(%)	Chalcopyrite	0.1	0.3
	Pyrite	60.0	69.0
	Pyrrhotite	0.1	0.1
	Arsenopyrite	0.2	0.6
	Galena	<0.1	<0.1
	Sphalerite	0.8	3.0
	Zincite	0.2	0.3
	Fe-Ti-Oxides	0.7	0.2
	Quartz	19.7	11.9
	Muscovite	7.5	4.9
	Biotite	3.5	1.8
	Chlorites	2.1	1.5
	Clays	1.8	1.0
	Other Silicates	0.8	0.7
	Ankerite/Dolomite	0.8	3.9
	Siderite	0.8	0.5
	Apatite	0.3	0.2
	Other/Accesssory	0.4	0.1
Calculated Grain Size by Frequency (µm)	Chalcopyrite	7	12
	Pyrite	15	21
	Pyrrhotite	11	14
	Arsenopyrite	10	13
	Galena	5	8
	Sphalerite	9	11
	Zincite	7	8
	Fe-Ti-Oxides	7	7
	Quartz	24	24
	Muscovite	13	15
	Biotite	8	10
	Chlorites	11	14
	Clays	8	8
	Other Silicates	10	9
	Ankerite/Dolomite	16	24
	Siderite	8	12
	Apatite	18	13
	Other/Accesssory	7	7

1.2. Observations from Optical Petrography

1.2.1. June 29/05 Combined OD Composite Tails

This sample is mainly fine-grained (<200 µm). Pyrite typically occurs as liberated grains with an average grain size of 15 µm (by frequency), although some pyrite is found up to 120 µm in size. Quartz tends to be coarse with an average size of 24 µm and maximum size of 240 µm. Micas are found up to 240 µm in length. An overview photomicrograph of the sample is shown in Figure 3.

Sphalerite occurs as fine liberated grains, in binary particles with pyrite (Figure 10), and in complex particles with pyrite and silicates (Figure 9).

Of the two samples, this sample shows the most evidence of sulphide oxidation, although the relative proportion of oxidized grains found is low (<5% of total sulphides). This sample tends to have numerous agglomerations (Figure 5) which are cemented by goethite, an oxidation product of pyrite. Some pyrite grains show oxidation rims of goethite (Figure 6 and Figure 8). Goethite is also found in cracks in the pyrite (Figure 7 and Figure 8). Arsenopyrite also shows signs of oxidation.

1.2.2. Combined Ro Cl Sc Tailings Solids

This sample is coarser-grained than the OD Composite Tails. Most of the pyrite is fine-grained and liberated with an average size of 21 µm, and maximum size of 200 µm, slightly coarser than the OD Composite Tails. Quartz occurs up to 400 µm in size and micas occur up to 680 µm in length. An overview photomicrograph of the sample is shown in Figure 4.

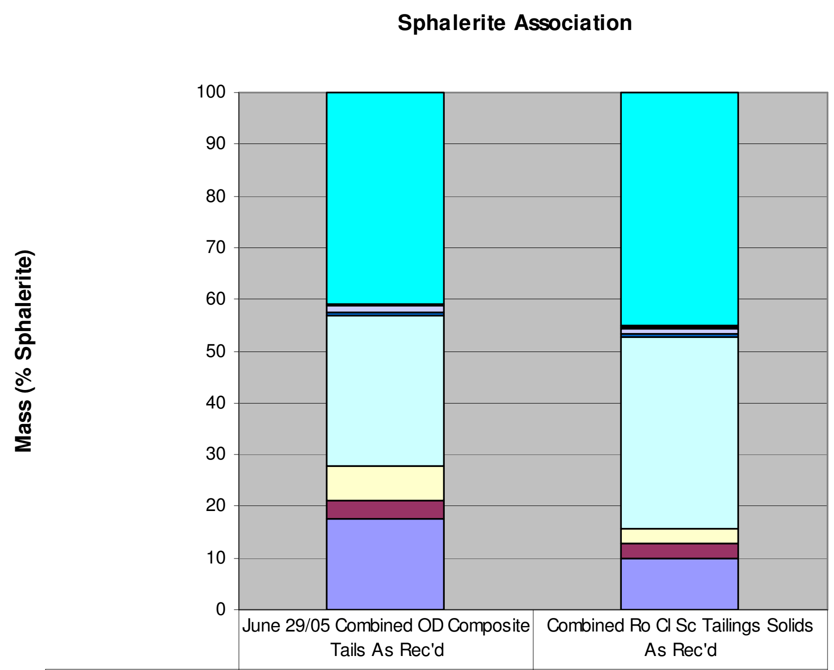
Most of the sphalerite in this sample occurs as attachments with pyrite and complex association (Figure 17), lesser occurs liberated.

There is some evidence of pyrite oxidation as shown in Figure 14 but overall less than 3% of the pyrite shows signs of oxidation. Approximately ten percent of the pyrite is in granular (Figure 15) or porous (Figure 16) form.

1.3. Mineral Associations and Grain Size (by QEMSCAN)

1.3.1. Sphalerite Association and Grain Size

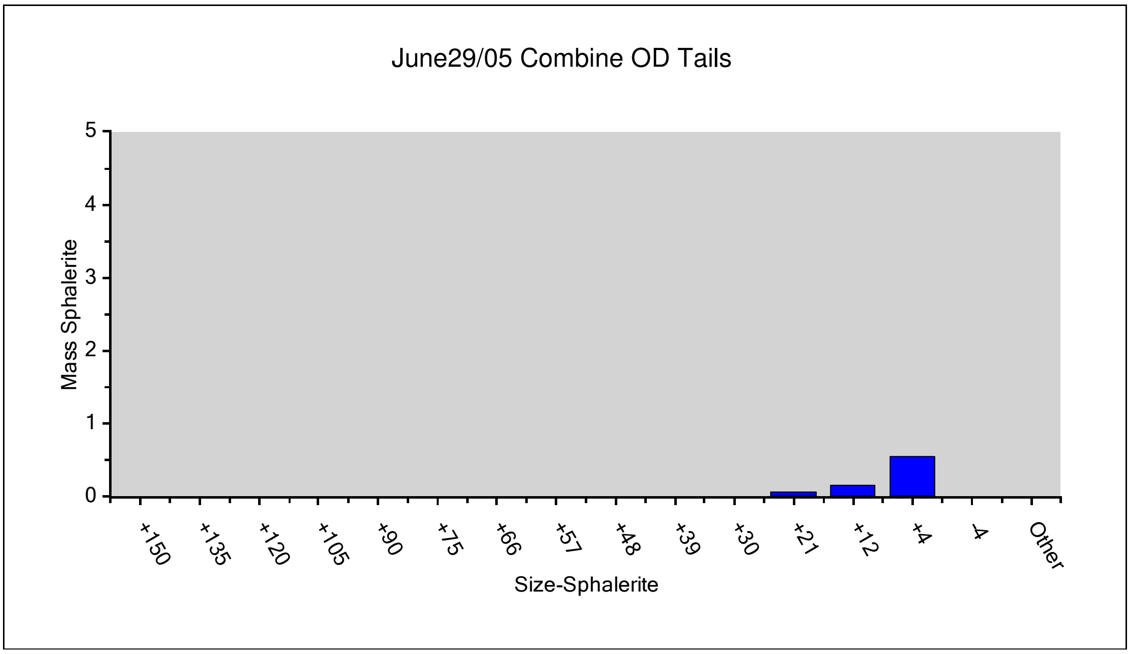
Based on particle mapping mode of QEMSCAN analysis, the main associations of sphalerite in the Tailings are as inclusions and attachments with pyrite (29% and 37%) and in complex association as ternary or greater particles (41% and 45%) for the June29/05 Combine OD Tails and the Combined Ro Cl Sc Tailings Solids, respectively. A lesser proportion occurs as liberated grains (21% and 12%), respectively.

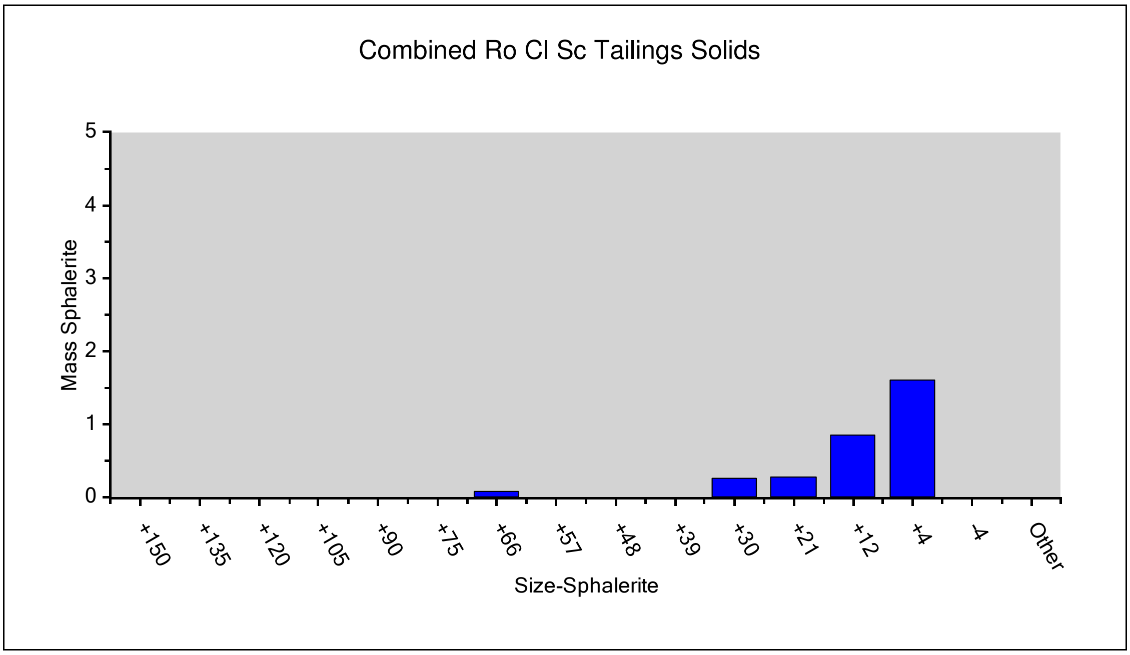


	June 29/05 Combined OD Composite Tails As Rec'd	Combined Ro Cl Sc Tailings Solids As Rec'd
■ Sph:Complex	41.0	45.0
■ Sph:Other	0.06	0.30
■ Sph:Carbs	0.06	0.31
■ Sph:Oxides	0.12	0.00
■ Sph:Phyllo/Clays	1.35	1.17
■ Sph:Hard Sil	0.47	0.57
■ Sph:Other Sulphides	0.06	0.00
■ Sph:Cp	0.00	0.04
■ Sph:Py	29.2	37.0
■ Sph:Inclusions	6.45	2.91
■ Lib Sph	3.58	2.85
■ Free Sph	17.6	9.87

Table 2. Sphalerite Association (by QEMSCAN, Normalized %)

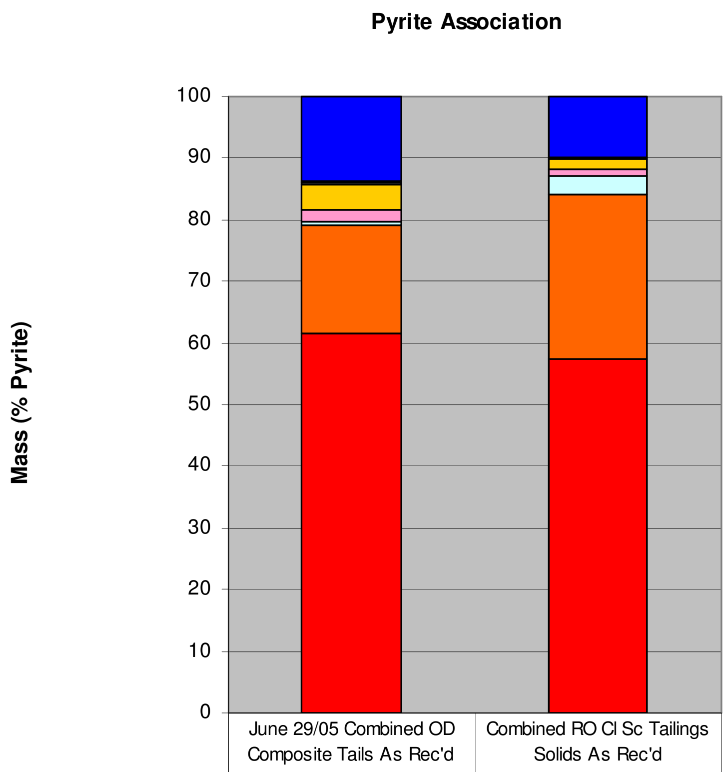
Figure 1. Sphalerite Grain Size by Mass (by QEMSCAN)





1.3.2. Pyrite Association and Grain Size

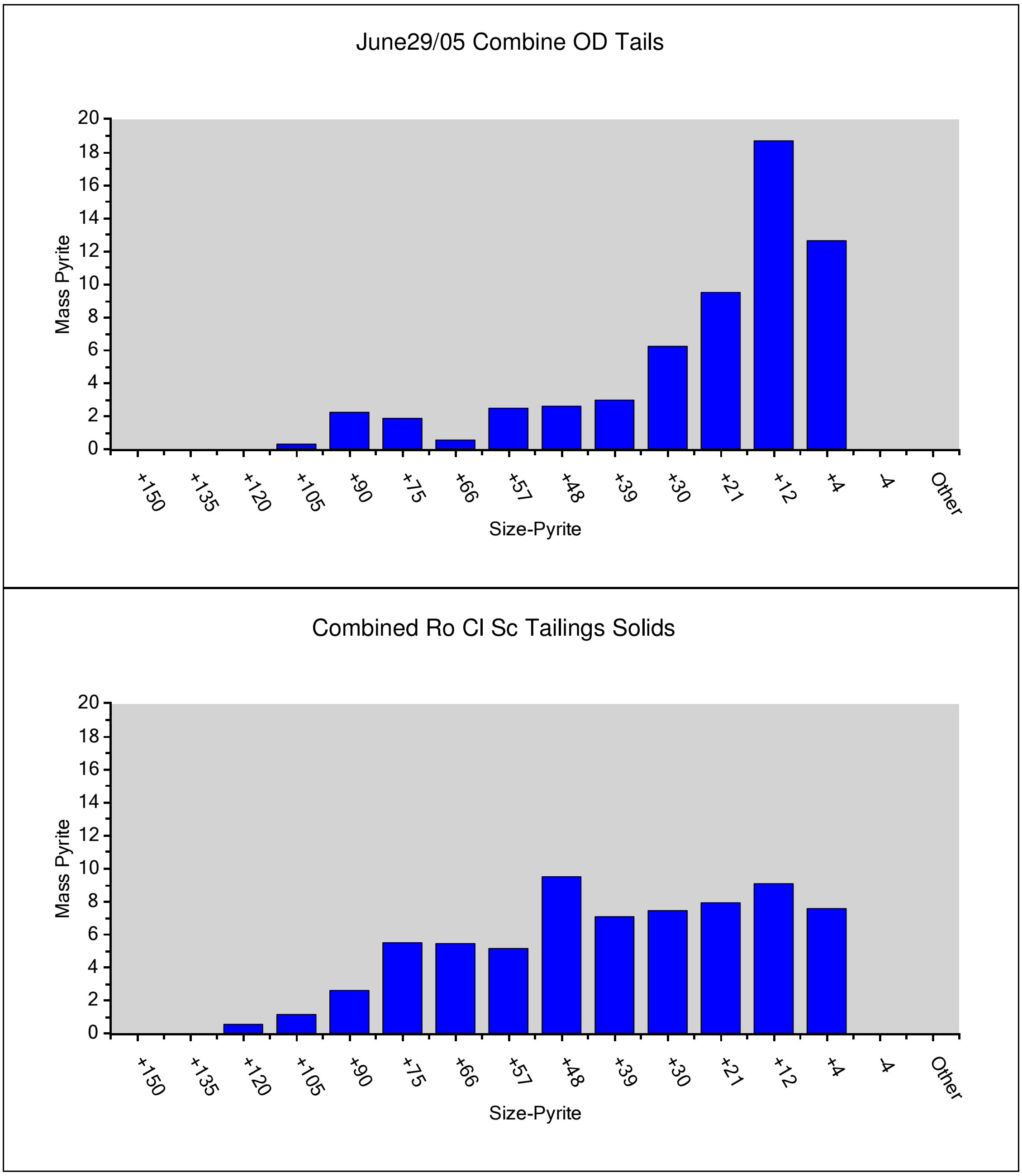
Based on particle mapping mode of QEMSCAN analysis, the main association of pyrite in the Tailings are as free and liberated grains (79% and 84%) and lesser amounts in complex association as ternary or greater particles (14% and 10%) for the June29/05 Combine OD Tails and the Combined Ro Cl Sc Tailings Solids, respectively.



	June 29/05 Combined OD Composite Tails As Rec'd	Combined RO Cl Sc Tailings Solids As Rec'd
■ Barren	0.00	0.00
🟦 Py:Complex	13.8	9.86
■ Py:Other	0.19	0.02
🟪 Py:Carbs	0.16	0.31
▨ Py:Oxides	0.06	0.02
🟨 Py:Phyllo/Clays	4.35	1.67
■ Py:Hard Sil	1.75	0.93
🟩 Py:Other Sulphides	0.02	0.05
🟨 Py:CuS	0.02	0.07
☐ Py:Sph	0.58	3.01
🟧 Py:Inclusions	0.03	0.03
🟧 Lib Py	17.4	26.5
🟥 Free Py	61.7	57.5

Table 3. Pyrite Association (by QEMSCAN, Normalized %)

Figure 2. Pyrite Grain Size by Mass (by QEMSCAN)



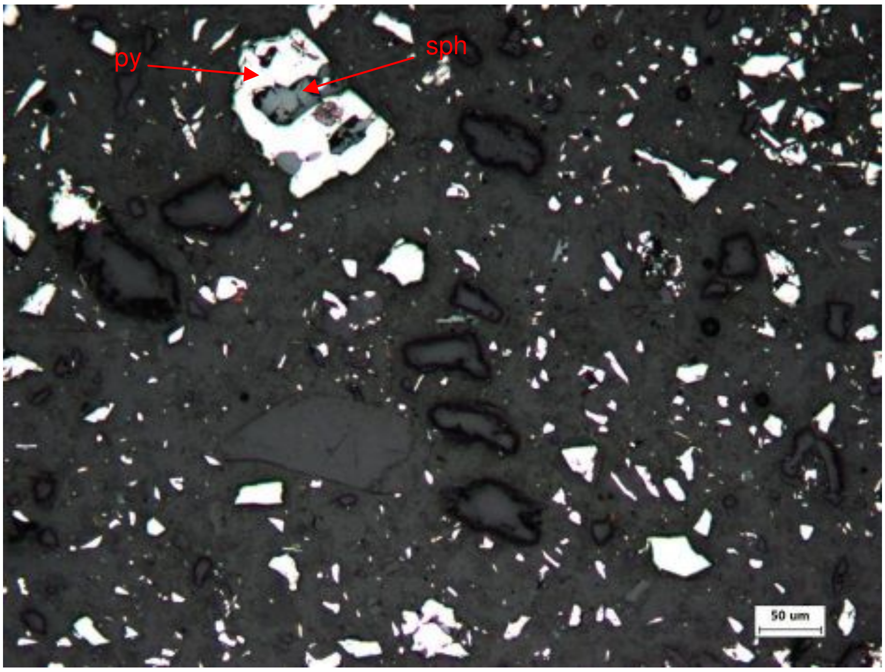


Figure 3: Overview of June 29/05 Combined OD Composite Tails

Plane-polarized reflected light (PPRL) photomicrograph showing bimodal size distribution of pyrite (py) and a sphalerite (sph)-pyrite binary grain (red arrows).

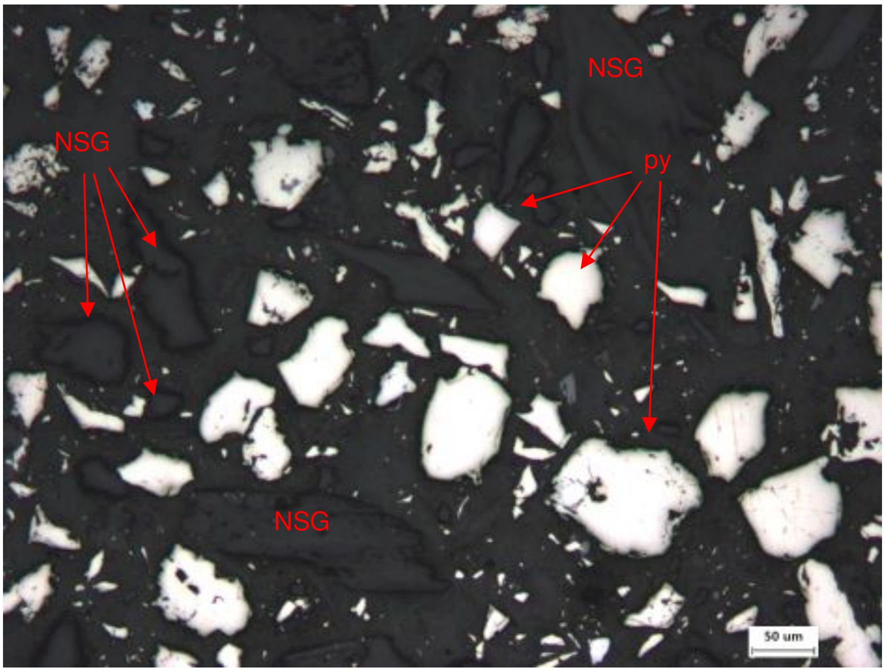


Figure 4: Overview of Combined Ro Cl Sc Tailings Solids

PPRL photomicrograph showing relatively coarse-grained pyrite (py) and non-sulphide gangue (NSG).

Appendix A – Photomicrographs June 29/05 Combined OD Composite Tails

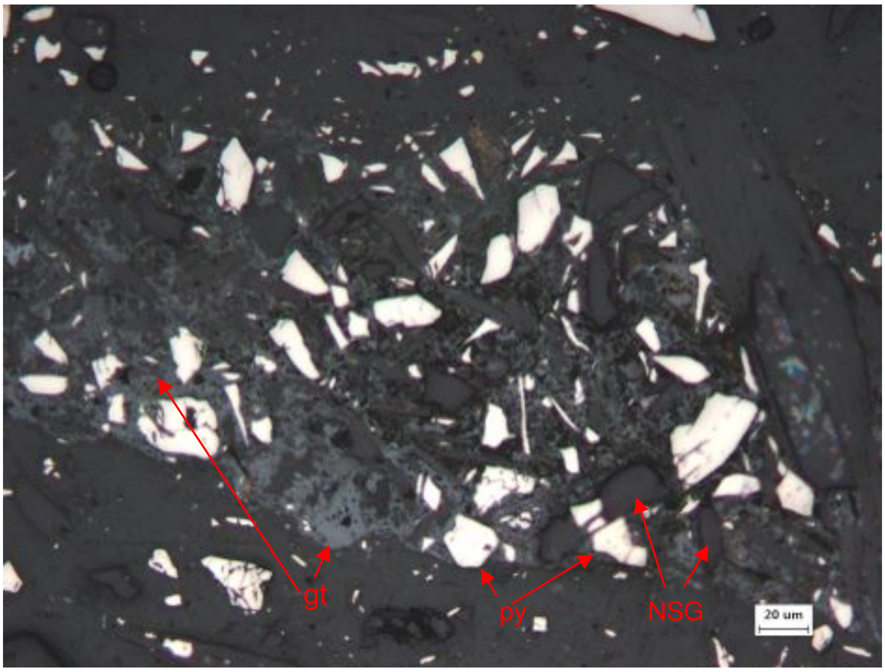


Figure 5: June 29/05 Combined OD Composite Tails

PPRL photomicrograph showing an agglomeration of pyrite (py) and non-sulphide gangue (NSG) cemented together by goethite (gt).

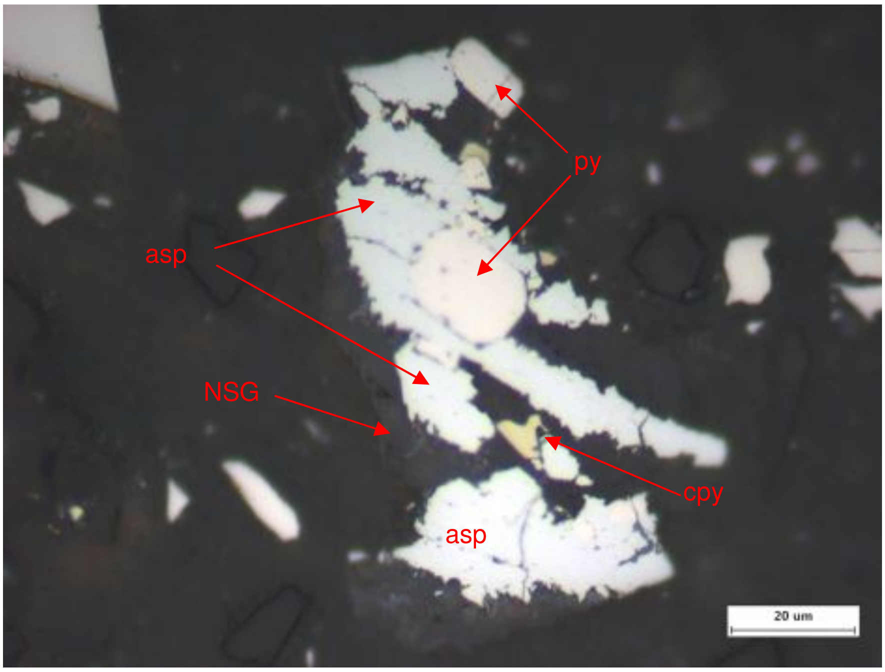


Figure 6: June 29/05 Combined OD Composite Tails

PPRL photomicrograph showing a complex particle of pyrite (py) and chalcopyrite (cpy) surrounded by a rim of non-sulphide gangue (NSG).

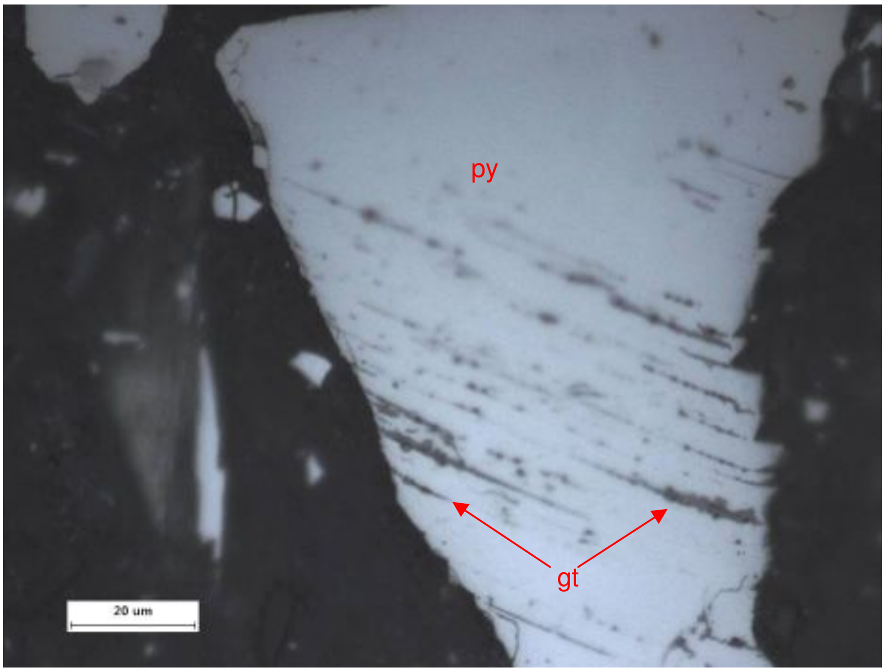


Figure 7: June 29/05 Combined OD Composite Tails

PPRL photomicrograph showing goethite (gt) forming along crystallographic planes in pyrite (py) due to oxidation.

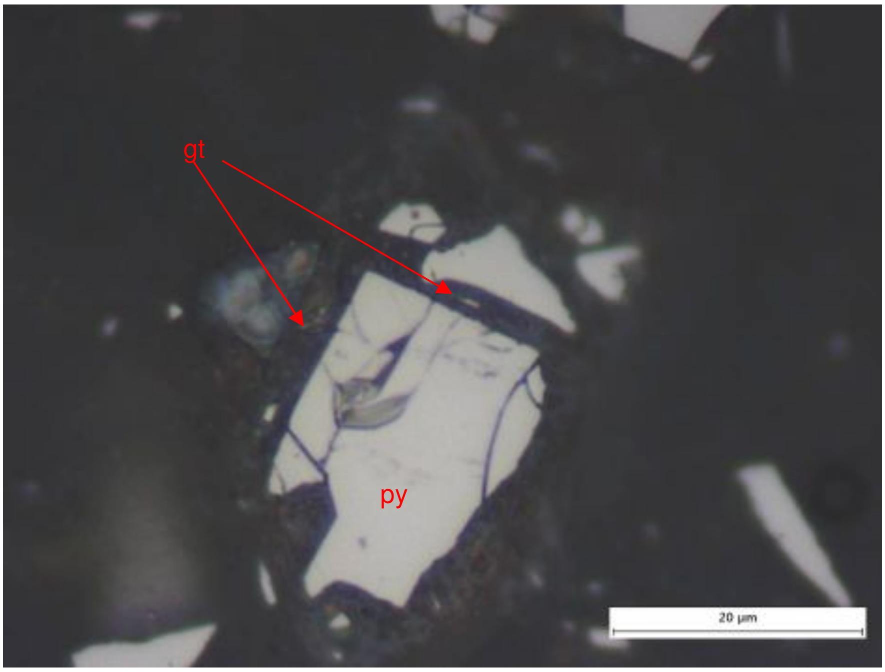


Figure 8: June 29/05 Combined OD Composite Tails

PPRL photomicrograph showing goethite (gt) forming along oxidized cracks in pyrite (py) and on the outer edges of the pyrite.

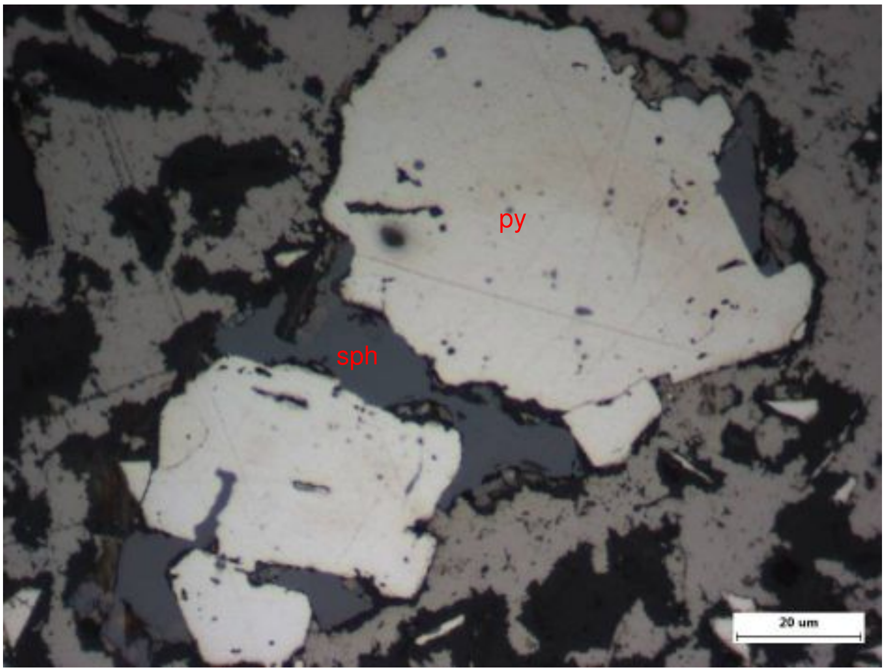


Figure 9: June 29/05 Combined OD Composite Tails

PPRL photomicrograph showing binary particle of pyrite (py) and sphalerite (sph).

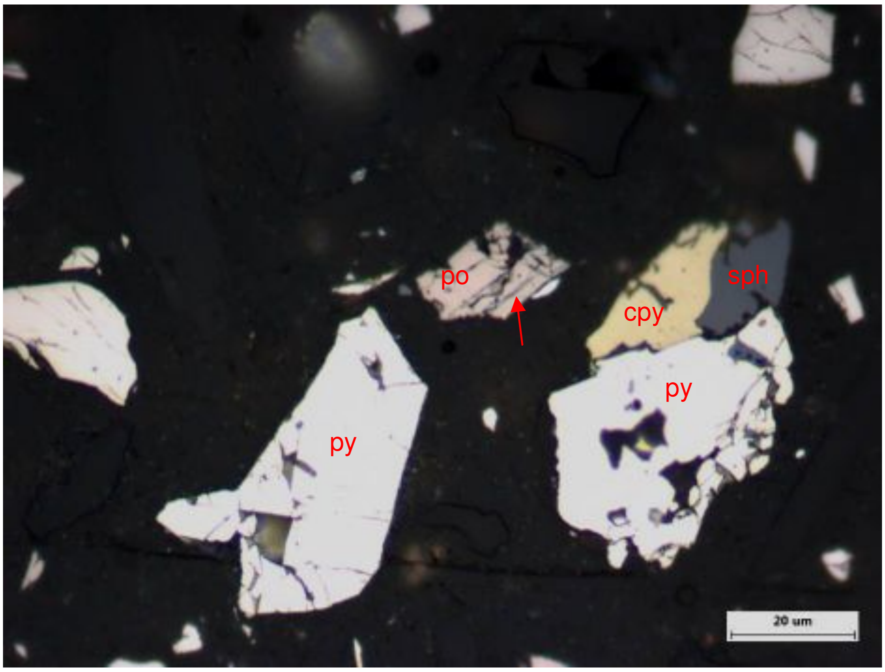


Figure 10: June 29/05 Combined OD Composite Tails

PPRL photomicrograph showing a ternary particle of pyrite (py), chalcopyrite (cp) and sphalerite (sph); and liberated grains of pyrrhotite (po) and pyrite (py). Note that pyrrhotite shows signs of oxidation along crystallographic grain boundaries to goethite (indicated by red arrow).

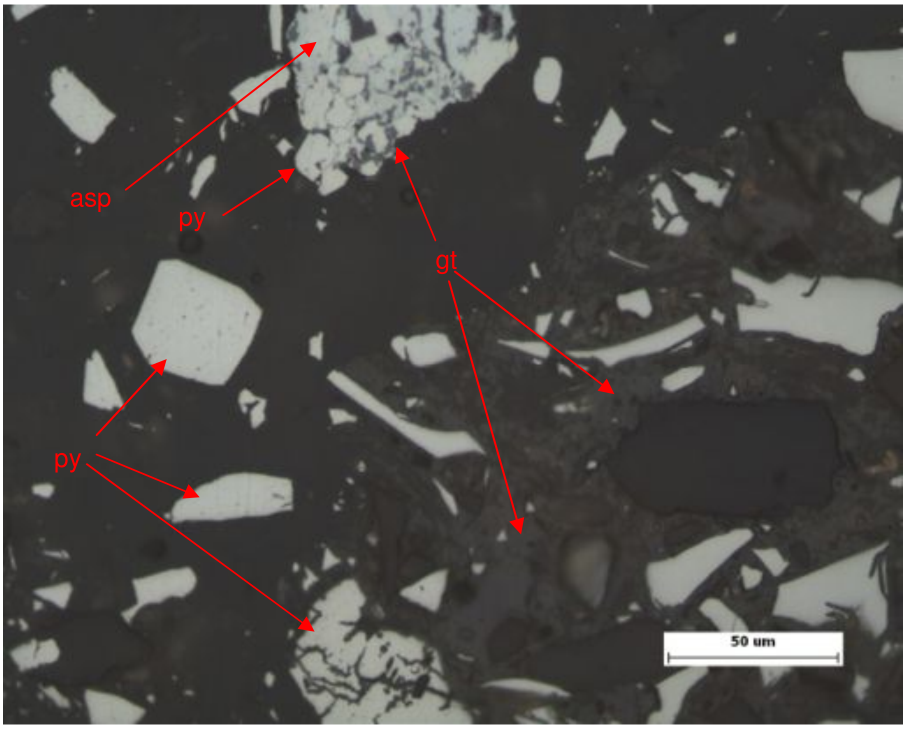


Figure 11. June 29/05 Combined OD Composite Tails

PPRL photomicrograph showing a binary pyrite-arsenopyrite (asp) particle (top, centre) showing oxidation to goethite (gt). Goethite agglomerate enclosing oxidized pyrite grains (bottom, right).

Appendix B – Photomicrographs Combined Ro Cl Sc Tailings Solids

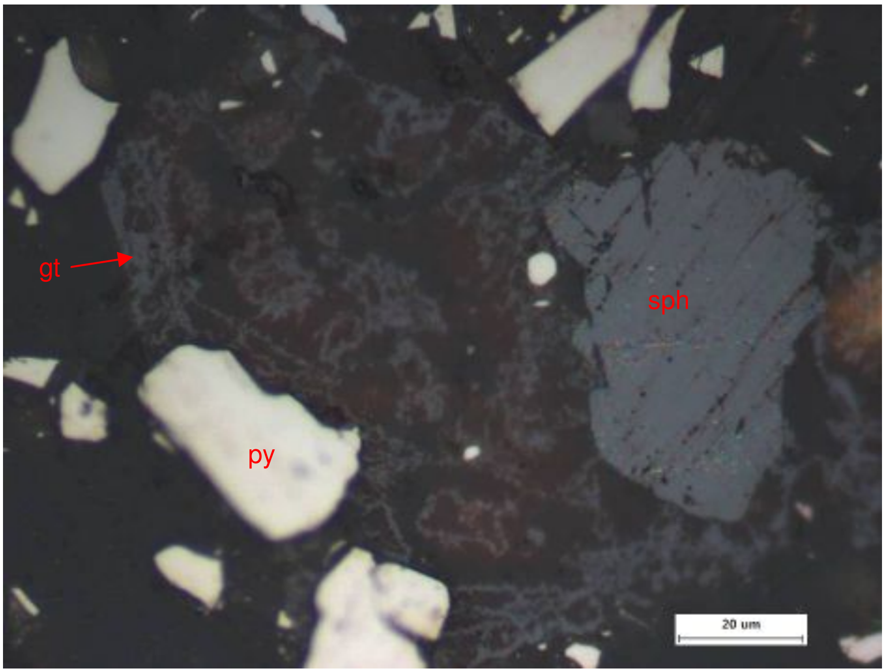


Figure 12: Combined Ro Cl Sc Tailings Solids

PPRL photomicrograph of complex particle containing sphalerite (sph), pyrite (py) and goethite (gt).

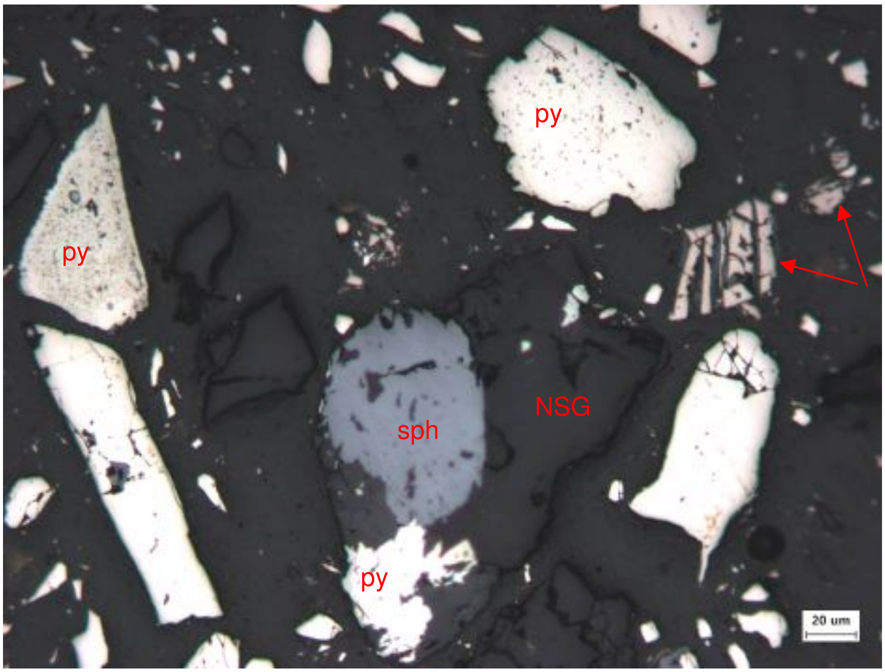


Figure 13: Combined Ro Cl Sc Tailings Solids

PPRL photomicrograph showing ternary particle of sphalerite (sph), pyrite (py) and non-sulphide gangue (NSG) surrounded by liberated pyrite and porous pyrite (py). The red arrows denote oxidized pyrrhotite which is also shown in high magnification below.

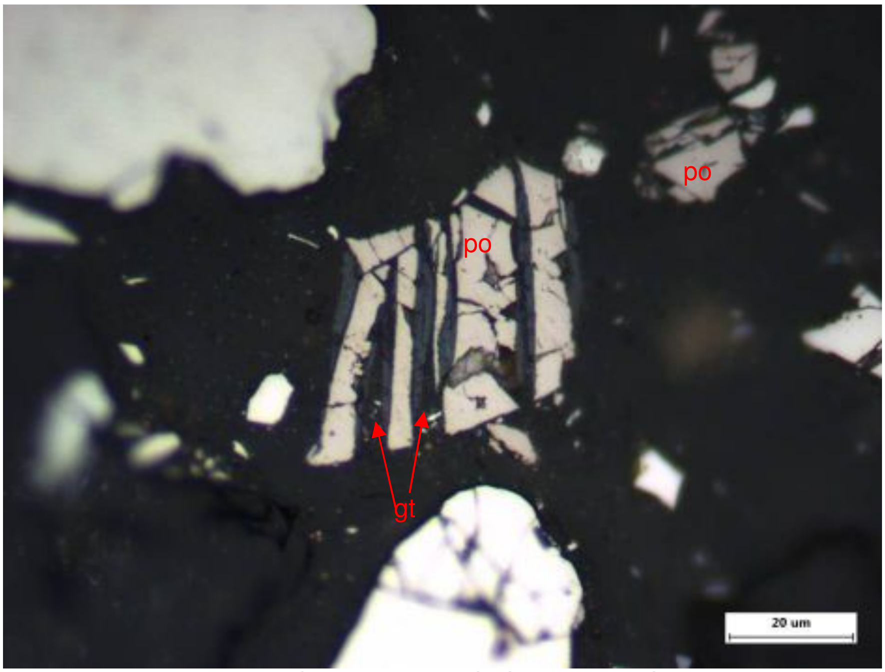


Figure 14: Combined Ro Cl Sc Tailings Solids

PPRL photomicrograph of a fractured grain of pyrrhotite (po) with goethite (gt) oxidation along the crystallographic grain boundaries.

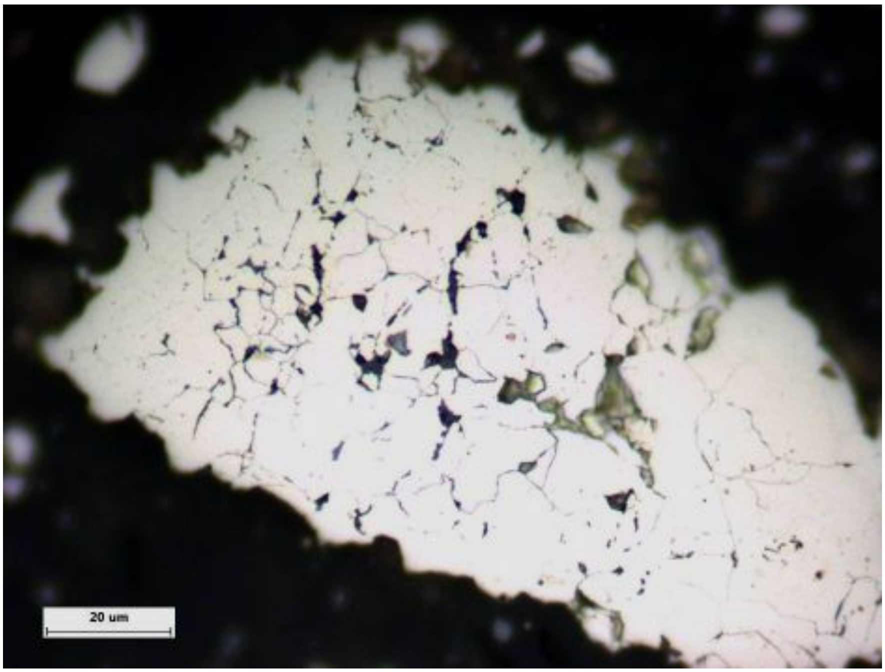


Figure 15: Combined Ro Cl Sc Tailings Solids

PPRL photomicrograph of granular pyrite which will be more susceptible to oxidation due to its high surface area.

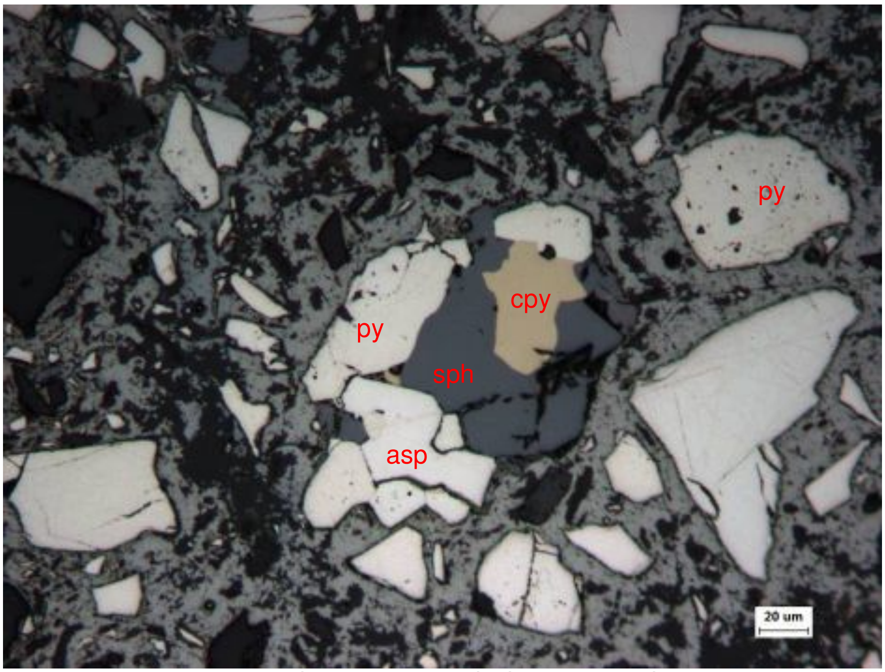


Figure 16: Combined Ro Cl Sc Tailings Solids

PPRL photomicrograph showing quaternary particle comprised of sphalerite (sph), chalcopyrite (cpy), pyrite (py) and arsenopyrite (asp). A porous grain of pyrite (py) lies to the upper right.

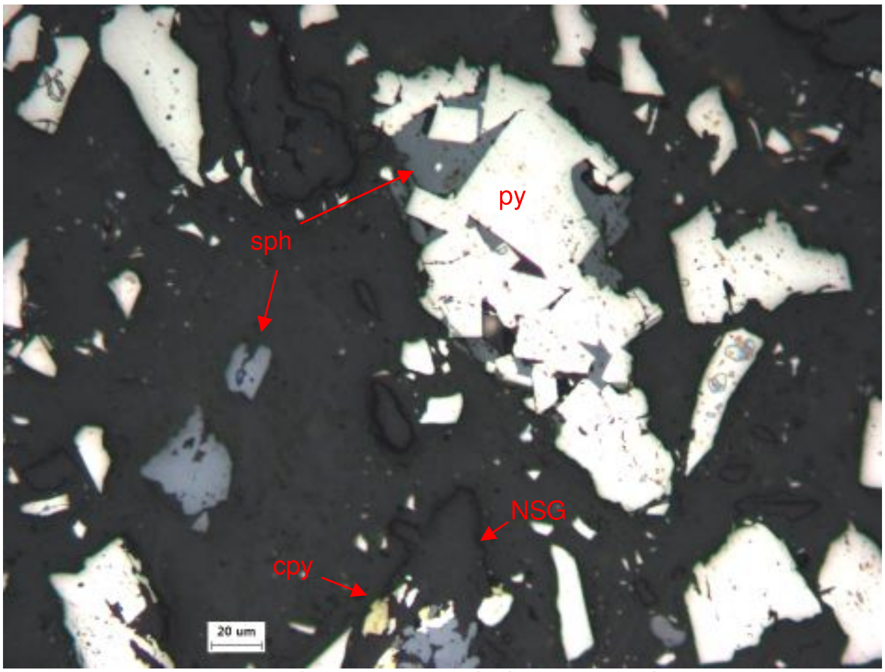


Figure 17: Combined Ro Cl Sc Tailings Solids

PPRL photomicrograph showing various associations of sphalerite.

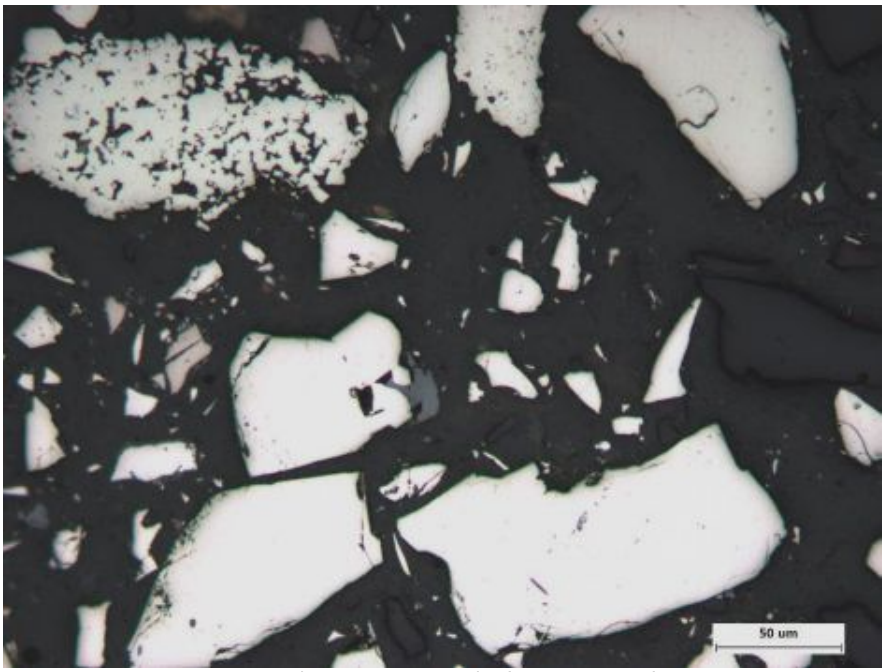


Figure 18: Combined Ro Cl Sc Tailings Solids

PPRL photomicrograph showing typical occurrences of pyrite in this sample.

Appendix B: Final Acid Base Accounting Results

Mod ABA
(Price 1997)

Parameter	**Units**	**Combined Wolverine D Composite Tails Final Washed Solids**	**Combined Lynx D Composite Tails Final Washed Solids**
Paste pH	units	7.05	6.45
Fizz Rate	---	2	2
Sample	weight(g)	1.96	2.00
HCl added	mL	62.00	44.00
HCl	Normality	0.10	0.10
NaOH	Normality	0.10	0.10
NaOH to	pH=8.3 mL	33.40	28.30
Final pH	units	1.65	1.77
NP	t $CaCO_3$/1000 t	73.00	39.2
AP	t $CaCO_3$/1000 t	534	906
Net NP	t $CaCO_3$/1000 t	-461	-867
NP/AP	ratio	0.14	0.04
S	%	18.6	27.1
Insoluble SO_4	%	< 0.01	< 0.01
$S^{=}$	%	17.1	29.0
C(t)	%	1.912	0.865
CO_3	%	2.426	0.895

LIMS #10480-NOV06

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Modified ABA

Project : PO#100453

February-24-12

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Phone: 604-682-5474 ext246
Fax:pdf, excel

Date Rec. : 23 January 2012
LR Report: **CA11273-JAN12**
Reference: Hum Cell Shutdown - Washed Solids

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CERTIFICATE OF ANALYSIS

Final Report

Analysis	**3: Analysis Approval Date**	**4: Analysis Approval Time**	**5: June 29/05 Combined OD Composite Tails**	**6: Combined RO + Cl Sc Tailings Solids**
Paste pH [units]	14-Feb-12	13:38	5.65	7.06
Fizz Rate [---]	14-Feb-12	13:38	1	2
Sample weight [g]	14-Feb-12	13:38	2.04	2.05
HCl added [mL]	14-Feb-12	13:38	24.30	48.90
HCl [Normality]	14-Feb-12	13:38	0.10	0.10
NaOH [Normality]	14-Feb-12	13:38	0.10	0.10
NaOH to [pH=8.3 mL]	14-Feb-12	13:38	19.63	29.82
Final pH [units]	14-Feb-12	13:38	1.65	1.62
NP [t CaCO3/1000 t]	14-Feb-12	13:38	11.5	46.5
AP [t CaCO3/1000 t]	23-Feb-12	09:51	725	862
Net NP [t CaCO3/1000 t]	23-Feb-12	09:51	-714	-816
NP/AP [ratio]	23-Feb-12	09:51	0.02	0.05
Sulphur (total) [%]	17-Feb-12	14:37	23.2	27.6
Acid Leachable SO4-S [%]	23-Feb-12	09:50	< 0.01	< 0.01
Sulphide [%]	23-Feb-12	09:50	23.2	27.6
Carbon (total) [%]	17-Feb-12	14:37	0.727	1.22
Carbonate [%]	22-Feb-12	14:12	0.533	1.29

Brian Graham B.Sc.
Project Specialist
Environmental Services, Analytical

OnLine LIMS

Appendix C: Final ICP-MS Results

Solids ICP-MS by Aqua Regia

Parameter	**Units**	**Combined Wolverine D Composite Tails Final Washed Solids**	**Combined Lynx D Composite Tails Final Washed Solids**
Hg	g/t	---	---
Ag	µg/g	86	59
Al	µg/g	8400	2100
As	µg/g	1200	3700
Ba	µg/g	57	32
Be	µg/g	0.2	< 0.1
Bi	µg/g	18	4.9
B	µg/g		
Ca	µg/g	22000	18000
Cd	µg/g	75	100
Co	µg/g	40	32
Cr	µg/g	91	110
Cu	µg/g	1100	850
Fe	µg/g	200000	300000
K	µg/g	3100	1200
Li	µg/g	4.2	0.1
Mg	µg/g	14000	3700
Mn	µg/g	600	590
Mo	µg/g	28	47
Na	µg/g	100	55
Ni	µg/g	60	66
Pb	µg/g	4500	4600
P	µg/g		
Sb	µg/g	290	200
Se	µg/g	530	430
Sn	µg/g	9	14
Sr	µg/g	52	36
Ti	µg/g	62	39
Tl	µg/g	12	23
U	µg/g	6.5	3.9
V	µg/g	34	26
Y	µg/g	10	6.2
Zn	µg/g	8300	11000

LIMS #10481-NOV06

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Project : Metals - on wahsed solids

Monday, February 20, 2012

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Fax:pdf, excel

Date Rec. : 23 January 2012
LR Report: **CA11275-JAN12**
Reference: Hum Cell Shutdown

Copy: #1

CERTIFICATE OF ANALYSIS

Final Report

Analysis	**3: Analysis Approval Date**	**4: Analysis Approval Time**	**5: June 29/05 Combined OD Composite Tails**	**6: Combined RO + Cl Sc Tailings Solids**
Sample Date & Time			Date:N/A	Date:N/A
Mercury [μg/g]	14-Feb-12	10:19	3.9	5.5
Silver [μg/g]	15-Feb-12	13:42	56	63
Aluminum [μg/g]	14-Feb-12	14:31	31000	24000
Arsenic [μg/g]	15-Feb-12	13:42	2600	2900
Barium [μg/g]	15-Feb-12	13:42	3900	1900
Beryllium [μg/g]	15-Feb-12	13:42	1.4	1.2
Bismuth [μg/g]	15-Feb-12	13:42	9.8	10
Calcium [μg/g]	14-Feb-12	14:31	4500	11000
Cadmium [μg/g]	15-Feb-12	13:42	53	130
Cobalt [μg/g]	15-Feb-12	13:42	29	33
Chromium [μg/g]	15-Feb-12	13:42	440	430
Copper [μg/g]	15-Feb-12	13:42	640	960
Iron [μg/g]	14-Feb-12	14:31	350000	350000
Potassium [μg/g]	14-Feb-12	14:31	13000	11000
Lithium [μg/g]	15-Feb-12	13:42	29	23
Magnesium [μg/g]	14-Feb-12	14:31	8600	10000
Manganese [μg/g]	15-Feb-12	13:42	470	730
Molybdenum [μg/g]	15-Feb-12	13:42	36	36
Sodium [μg/g]	14-Feb-12	14:31	400	290
Nickel [μg/g]	15-Feb-12	13:42	45	54
Phosphorus [μg/g]	14-Feb-12	14:32	410	330
Lead [μg/g]	15-Feb-12	13:42	4100	4300
Antimony [μg/g]	15-Feb-12	13:42	280	280
Selenium [μg/g]	15-Feb-12	13:42	370	470
Tin [μg/g]	15-Feb-12	13:42	21	20
Strontium [μg/g]	15-Feb-12	13:42	37	49
Titanium [μg/g]	14-Feb-12	14:32	550	450
Thallium [μg/g]	15-Feb-12	13:42	36	34
Uranium [μg/g]	15-Feb-12	13:43	6.4	6.5
Vanadium [μg/g]	15-Feb-12	13:43	240	200
Yttrium [μg/g]	15-Feb-12	13:43	9.8	10
Zinc [μg/g]	15-Feb-12	13:43	6800	17000

Brian Graham B.Sc.
Project Specialist
Environmental Services, Analytical

Appendix D: Final Shake Flask Extraction Test Results

Final Wash - DI Leach 3:1 Ratio as per Price (1997)

Sample ID	**Units**	**MMER[1]**	**Combined Wolverine D Composite Tails - Final Solids**	**Combined Lynx D Composite Tails - Final Solids**
Sample	weight(g)		1095	1069
Volume mL	D.I. H_2O		3000	3000
Initial pH	units	6.0 to 9.5	6.7	6.7
Final pH	units	6.0 to 9.5	7.09	6.94
F	mg/L		0.19	0.16
pH	units	6.0 to 9.5	7.05	7.24
Alkalinity	mg/L as $CaCO_3$		51	41
Acidity	mg/L as $CaCO_3$		116	40
Conductivity	uS/cm		2300	2260
Cl	mg/L		3.6	< 2
SO_4	mg/L		1500	1500
NO_3	as N mg/L		< 0.5	0.09
NH_3+NH_4	as N mg/L		0.1	< 0.1
Thiosalts	as S_2O_3 mg/L		80	40
CN(T)	mg/L	1.00	< 0.01	< 0.01
CNO	mg/L		< 1	< 1
CNS	mg/L		< 2	< 2
Hg	µg/L		< 0.1	< 0.1
Ag	mg/L		< 0.0003	< 0.0003
Al	mg/L		< 0.01	< 0.01
As	mg/L	0.50	0.008	< 0.005
Ba	mg/L		0.0331	0.0345
Be	mg/L		0.0008	< 0.0004
Bi	mg/L		0.0005	0.0003
B	mg/L		0.020	0.023
Ca	mg/L		611	614
Cd	mg/L		0.361	0.288
Co	mg/L		0.0614	0.0602
Cr	mg/L		< 0.003	< 0.003
Cu	mg/L	0.30	0.003	0.004
Fe	mg/L		< 0.01	< 0.01
Li	mg/L		0.005	0.004
K	mg/L		0.84	1.97
Mg	mg/L		20.7	22.7
Mn	mg/L		22.3	5.20
Mo	mg/L		0.0008	0.0008
Na	mg/L		0.42	0.72
Ni	mg/L	0.50	0.151	0.131
P	mg/L		< 0.01	0.03
Pb	mg/L	0.20	0.0530	0.0167
Sb	mg/L		< 0.01	0.01
Se	mg/L		0.28	0.45
Si	mg/L		0.97	0.62
Sn	mg/L		0.005	0.004
Sr	mg/L		1.19	0.896
Ti	mg/L		< 0.001	< 0.001
Tl	mg/L		0.007	< 0.001
U	mg/L		0.0008	0.0010
V	mg/L		0.004	0.004
Zn	mg/L	0.50	**33.2**	**17.0**

LIMS #10080-NOV06

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Monday, February 20, 2012

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Phone: 604-682-5474 ext246, Fax:pdf, excel

Date Rec. : 23 January 2012
LR Report: **CA11274-JAN12**
Reference: Hum Cell Shutdown - Final Wash

Copy: #1

CERTIFICATE OF ANALYSIS

Final Report

Analysis	**3: Analysis Approval Date**	**4: Analysis Approval Time**	**5: June 29/05 Combined OD Composite Tails Final Wash**	**6: Combined RO + Cl Sc Tailings Solids Final Wash**
Sample [weight(g)]	03-Feb-12	11:24	1000	1000
Volume D.I. Water [mL]	03-Feb-12	11:24	3000	3000
Initial pH [units]	03-Feb-12	11:24	5.29	6.53
Final pH [units]	03-Feb-12	11:24	5.41	7.05
pH [no unit]	06-Feb-12	14:21	6.51	6.94
Alkalinity [mg/L as CaCO3]	06-Feb-12	14:21	16	17
Acidity [mg/L as CaCO3]	06-Feb-12	14:21	522	37
Conductivity [µS/cm]	06-Feb-12	14:21	2960	2050
Fluoride [mg/L]	07-Feb-12	10:37	< 0.06	0.08
Chloride [mg/L]	03-Feb-12	15:56	< 2	< 2
Sulphate [mg/L]	03-Feb-12	15:56	2200	1300
Cyanide (total) [mg/L]	03-Feb-12	14:50	< 0.01	< 0.01
Cyanate [mg/L]	03-Feb-12	09:52	< 1	< 1
Thiocyanate [mg/L]	06-Feb-12	11:19	< 0.2	< 0.2
Thiosalts (total) [as S2O3 mg/L]	15-Feb-12	21:40	<10	<10
Ammonia+Ammonium (N) [mg/L]	02-Feb-12	13:55	0.1	0.2
Nitrate (as N) [mg/L]	03-Feb-12	16:22	< 0.05	< 0.05
Mercury [mg/L]	02-Feb-12	17:16	< 0.0001	0.0003
Silver [mg/L]	07-Feb-12	13:54	0.00041	0.00005
Aluminum [mg/L]	07-Feb-12	13:54	0.0004	0.0008
Arsenic [mg/L]	07-Feb-12	13:54	0.112	0.0064
Barium [mg/L]	07-Feb-12	13:54	0.0387	0.0293
Beryllium [mg/L]	07-Feb-12	13:54	< 0.00002	< 0.00002
Bismuth [mg/L]	07-Feb-12	13:54	< 0.00001	< 0.00001
Boron [mg/L]	07-Feb-12	13:54	0.0323	0.0086
Calcium [mg/L]	03-Feb-12	14:53	573	539
Cadmium [mg/L]	07-Feb-12	13:54	2.10	1.21
Cobalt [mg/L]	07-Feb-12	13:54	0.136	0.00872
Chromium [mg/L]	07-Feb-12	13:54	< 0.0005	< 0.0005
Copper [mg/L]	07-Feb-12	13:54	0.376	0.0136
Iron [mg/L]	03-Feb-12	14:53	0.012	< 0.003
Lithium [mg/L]	07-Feb-12	13:54	0.002	< 0.001

Analysis	3: Analysis Approval Date	4: Analysis Approval Time	5: June 29/05 Combined OD Composite Tails Final Wash	6: Combined RO + Cl Sc Tailings Solids Final Wash
Potassium [mg/L]	03-Feb-12	14:53	1.50	0.798
Magnesium [mg/L]	03-Feb-12	14:53	62.4	4.38
Manganese [mg/L]	07-Feb-12	13:54	27.7	2.08
Molybdenum [mg/L]	07-Feb-12	13:54	0.00012	0.00329
Sodium [mg/L]	03-Feb-12	14:53	5.17	4.01
Nickel [mg/L]	07-Feb-12	13:54	0.630	0.0237
Phosphorus [mg/L]	03-Feb-12	14:53	< 0.009	0.012
Lead [mg/L]	07-Feb-12	13:54	0.0569	0.00965
Selenium [mg/L]	07-Feb-12	13:54	2.95	0.193
Silicon [mg/L]	03-Feb-12	14:53	6.51	1.06
Tin [mg/L]	07-Feb-12	13:54	0.00006	0.00035
Strontium [mg/L]	03-Feb-12	14:53	1.21	0.568
Titanium [mg/L]	07-Feb-12	13:54	0.0008	0.0003
Thallium [mg/L]	07-Feb-12	13:54	0.0165	0.0129
Uranium [mg/L]	07-Feb-12	13:54	0.000159	0.000085
Vanadium [mg/L]	07-Feb-12	13:54	0.00006	0.00014
Zinc [mg/L]	03-Feb-12	14:53	328	37.7

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