# FRESH WATER MONITORING PROGRAM
# ANNUAL REPORT

# WATER YEAR 2014

(October 1, 2013 through September 30, 2014)

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# EXECUTIVE SUMMARY

This annual report has been prepared by Hecla Greens Creek Mining Company (HGCMC) in accordance with the Fresh Water Monitoring Program (FWMP) contained in the mine's General Plan of Operations Appendix 1: Integrated Monitoring Plan (IMP). Monitoring data interpretative reports are presented for thirteen surface water and four groundwater monitoring sites.

Each site's interpretative report summarizes the annual dataset with respect to several goals and objectives outlined in the FWMP. Each report contains a list of any exceptions, omissions or errors that occurred during data collection. The report lists a comparison of each site's annual dataset to all appropriate applicable Alaska Water Quality Standards (AWQS). Finally, a series of summary tables and X-Y graphs have been generated to meet the specific statistical goals for each site.

This was the second full year of sampling under the recently approved FWMP sampling schedule. All required sampling, except for the December sampling of Site 62 was accomplished as specified in the monitoring schedule and for each site the specified analytic suite (P or Q) was performed on the collected samples. Applicable holding times were achieved for all analytes, except pH, which for three of the twelve sample events were not within the applicable hold time. Furthermore, no data points were qualified as outliers.

No exceedances of Alaska Water Quality Standards (AWQS) occurred along Greens Creek at the four monitoring points (Site 48, Site 6, Site 54, and Site 62) during Water Year 2014. Four exceedances (dissolved cadmium, dissolved mercury, dissolved selenium, and dissolved zinc) were recorded in May 2013 at the new surface water location Site 61, however the downgradient site (Site 62), which receives this drainage, during the same sample period was well within AWQS. To further investigate HGCMC switched the sampling frequency at Site 61 from quarterly to monthly during Water Year 2014. There were no exceedances measured at Site 61 since the four from May 2013, HGCMC plans to reduce the sampling frequency back to quarterly.

Site 13 was in exceedance twice for total sulfate, dissolved cadmium and dissolved zinc. HGCMC removed 11,200 bank cubic yards of material from the 1350 during the 2014 summer season. It is after this disturbance that these exceedances occurred. This has been seen before with other reclamation projects and with those the increased concentrations were short lived. It is HGCMC's intention to remove a small amount of material, from the 1350, in the access to the raised bore ventilation shafts during the 2015 summer season.

Exceedances in the tailings area were noted for low pH, low alkalinity, and elevated levels of lead. The shallow wells (Site 27, Site 29, and Site 32) continued to express the natural condition of low pH and low alkalinity that characterize these sites located in organic rich peat sediments. Seven exceedances for dissolved lead occurred between two of the three down gradient shallow wells (Site 29 and Site 32). These exceedances continue the recent history of low to moderate levels of lead that may in part be due to minor amounts of tailings escaping the facility due to fugitive dust or tracking. HGCMC has been and will continue to improve best management practices to minimize fugitive dust and tracking.

Site 60 had exceedances for low alkalinity, low pH, and elevated mercury. This site's watershed was disturbed when the construction of Pond 7 began in 2004,resulting in a change from naturally acidic to alkaline conditions. HGCMC believes that the increase in pH and alkalinity increases the potential for adsorption of mercury on sediments and soil particles in the drainage. The pH of the Site 60 drainage now fluctuates seasonally and from year to year and may control the storage and release of mercury from the adsorbed fraction. Dissolution of tailings dust particles, which contain small amounts of mercury, and atmospheric deposition of mercury from natural (e.g. volcanoes) and anthropogenic sources (e.g. coal fired power plants in Asia) are potential sources of this metal in the drainage area. Two of the four samples collected during the current water year were within AWQS, the other two were only slightly above the AWQS (0.0174 µg/L and 0.0162 µg/L).Sampling in adjacent drainages during water year 2009 and water year 2013 showed that this issue was isolated to only the Site 60 watershed.

The final two sites in the tailings facility, Site 9 and Site 609, both had exceedances for low alkalinity. The low alkalinity values are expected given the naturally occurring acidic muskeg conditions in the headwaters near Site 27 and Site 29. Site 609 had an exceedance for total sulfate (252 mg/L), however this was only slightly above the AWQS and the other 5 samples taken at the site, over the past 2 years, have not been in exceedance.

Graphical and non-parametric analyses for trends in the data were performed for all sites when sufficient data was available. It takes six years of monitoring a new site (Site 609, Site 711, Site 712, Site 61, and 62) before the statistical analyses can be performed. Statistically significant trends were identified for eleven sites: Site 48, increasing trend in total alkalinity and pH; Site 6, upward trend in total alkalinity and pH; Site 54, upward trend in total alkalinity and pH; Site 57, increasing trends in pH and dissolved zinc, decreasing trend in conductivity; Site 60, upward trend in dissolved zinc; Site 27, decreasing trend in dissolved zinc and an upward trend in total alkalinity; Site 32, a downward trend in dissolved zinc and an increasing trend in total alkalinity; Site 13, decreasing trend in conductivity; Site 9, increasing trend in pH and decreasing trend in dissolved zinc; Site 46, increasing trend in pH; Site 49, increasing trend in pH and total alkalinity;
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Site 48, Site 49, and Site 57 are considered up-gradient control sites and thus the trends are likely due to natural variation. Two of Greens Creek sites (Site 48, Site 6,.and Site 54) had similar low magnitude increasing trends in total alkalinity and pH. Though this is an increasing trend, Site 48 indicates that a portion of the increase is natural variation.

Downward trends in dissolved zinc at Site 27 and Site 32 may indicate a decrease in loading from fugitive dust. Also, the upward trends in total alkalinity at Site 27 and Site 32 are still within historical ranges.

A non-parametric comparison of medians was performed for all the appropriately paired surface sites (48-6, 6-54, 54-62). Significant differences were noted for the paired datasets from Greens Creek (48-6) for conductivity, total sulfate, and dissolved zinc. These differences have all been noted in previous annual reports and do not appear to be increasing in magnitude. There were significant differences for the paired dataset (6-54) from Greens Creek for conductivity, but not for total sulfate, total alkalinity, or dissolved zinc data. Also, significant differences were noted between the paired Greens Creeks sites 54-62 for conductivity, pH, and total sulfate.

With the reduction in the sampling frequency for the Bruin Creek sites (49 and 46) a statistical analysis of median values cannot be calculated, instead the data from Site 46 is analyzed on a intra-site basis using the combined Shewhart-CUSUM control charts. An analysis using these charts reached the same conclusion as in previous reports that HGCMC is not having a measurable effect on Site 46.

With the removal of the Site 58 and Site 59 form the FWMP, it is not possible to perform inter-well comparison with the down gradient sites Site 27, Site 29, and Site 32. These sites are now also analyzed using the combined Shewhart-CUSUM control charts also. From this evaluation it is recognized that Site 27 has seen some recent changes. Primarily the specific conductance and total sulfate charts begin to go out of control early 2008. This is attributed to the building of the pad west of Pond 7. Both of these parameters are trending towards pre-pad disturbance levels. The other control chart for dissolved zinc first went out of control during water year 2007, a high fugitive dust year. Twice since zinc concentrations have been above the control limits, also associated with fugitive dust loading. However, after each of these events the values return to the historical range.

# INTRODUCTION

This annual report for Water Year 2014 (October 1, 2013 through September 30, 2014) provides the information required by the Fresh Water Monitoring Program (FWMP). It is separated into several sections, the first of which provides general information applicable to the entire program, followed by a comprehensive analysis of the data for each specific site.

To avoid confusion data values reported by the laboratory as being below the Method Detection Limit (MDL) are assigned a value of zero for plotting purposes. This is done so that the values below MDL are visually distinct and thus can be properly interpreted. On several of the graphs presented, changes have occurred in MDL over the period shown. This leads to the visual impression that an upward trend exists when in fact the older analysis had MDL greater than ambient background levels. For the current Water Year's data the actual MDLs for non-detect values are listed in each site's table of results in the interpretative discussion of this report. For prior Water Year's historic MDLs please refer to GPO Appendix 1, Table 8-2.

The monitoring schedule varies from site to site and different sites are monitored for different analytes on different months of the year. Occasionally, sites scheduled for sampling may not be available due to weather or more rarely operational reasons. A copy of the Water Year 2014 sampling log is included in this section and any variations from scheduled sampling events are noted on each site's table of results presented in the interpretive section.

The following table outlines the Statistical Information Goals for each site sampled during the Water Year 2014.

| | | Trend | | | |
|---|---|---|---|---|---|
| Site | AWQS Comparison | Visual | Calc | Median Comparison | Control Chart |
| 48 | x | x | x | | |
| 6 | x | x | x | 6 vs 48 | |
| 54 | x | x | x | 54 vs 6 | |
| 62 | x | x | x | 62 vs 54 | |
| 46 | x | x | x | | x |
| 49 | x | x | x | | x |
| 61 | x | x | x | | |
| 13 | x | x | x | | |
| 57 | x | x | x | | x |
| 27 | x | x | x | | x |
| 29 | x | x | x | | x |
| 32 | x | x | x | | x |
| 9 | x | x | x | | |
| 60 | x | x | x | | |
| 609 | x | x | x | | |
| 711 | x | x | x | | |
| 712 | x | x | x | | |

A comparison to Alaska Water Quality Standards (AWQS) is required for all sites. In Appendix A the specific water quality criteria used for each comparison are summarized. Trend analysis is carried out by two different methods. The first method is a visual trend analysis for each analyte. For each site sampled a series of time-concentration graphs are constructed for the previous five years of data collected. The second method is a non-parametric statistical method, Kendall seasonal trend analysis that is routinely done for conductivity, pH, alkalinity, and dissolved zinc. These are the key parameters along with sulfate that can be strongly affected by Acid Mine Drainage (AMD). Sulfate was added back into the required list of analytes in the 2002 Water Year. Median calculations are shown in the annual table of results for each site. Finally, for all down gradient sites that are paired with an upgradient reference site, which are monitored with a frequency greater than 4 times per year, a comparison of medians is presented for each specific site. These down gradient sites (upgradient site in parenthesis) include Site 6 (Site 48), Site 54 (Site 6), and Site 62 (Site 54). For each of these sites, a comparison of medians was performed for total alkalinity, pH, conductivity, total sulfate and dissolved zinc. The statistical test utilized is a non-parametric, Wilcoxon signed-rank test. A brief summary of the two main statistical procedures, the Wilcoxon-Mann-Whitney rank sum test and the Mann-Kendall seasonal trend are given below.

With the approved decrease in the sampling frequency at Site 46 and Site 49 the statistical procedures previously discussed are no longer useable. More recently the analysis of data for Site 46 has been conducted using intra-site methodologies instead of an inter-site comparison. In the interpretive section of Site 46 is a discussion of this new methodology. This technique was also applied to Site 57, Site 27, Site 29, and Site 32. Much of the development and understanding of the new technique used has come from Resource Conservation and Recovery Act (RCRA) documents concerning ground water monitoring at waste sites.

## Statistical Tests

The Mann-Kendall seasonal trend test is a non-parametric test for zero slope of a linear regression of time-ordered data verse time. Briefly the test consists of tabulating the Mann-Kendall statistic $S_k$ (k=1 to 12, for each month) and its variance VAR(S) for data from each season (month). The $S_k$ statistic is simply the sum of the number of positive differences minus the number of negative differences for time ordered data pairs. Any seasonal trend is removed by only considering data pairs taken within the same month. The individual monthly Mann-Kendall statistics ($S_k$) are tested for homogeneity of trend which is used to determine if it is reasonable to combine the monthly $S_k$ statistics into an overall annual statistic ($\Sigma S_k$). If the test for monthly homogeneity is rejected the annualize statistic is not meaningful. However, the individual monthly Mann-Kendall statistics can still be tested for trend and a Sen's slope estimator can be calculated for each month (noted as $Q_m$ in the interpretive section) with a significant trend.

The advantages of the Seasonal Kendall trend test is that it is a rank-based procedure especially suitable for non-normally distributed data, censored data, data containing outliers and non-linear trends. The null hypothesis ($H_0$) states that the data($x_1$, ., $x_n$) are a sample of n independent and identically distributed random variables. The trend test statistic Z is used as a measure of trend magnitude, or of its significance. A positive Z value indicates an upward trend while a negative value indicates a downward trend. However, the Z statistic is not a direct quantification of trend magnitude. For trend of significant magnitude a separate statistic, Sen's slope estimator, is calculated by computing the seasonally adjusted (monthly) median value for the slope. For datasets which fail the homogeneity test, individual monthly $S_k$ statistics are compared to a theoretical probability distribution of S derived by Mann and Kendall (Table A18 in Gilbert, 1987). Further guidance and background on these statistical methods can be found in Gilbert (1987) or Helsel and Hirsch (1992).

The Wilcoxon signed-rank test is used to determine if the median difference between paired data points is equal to zero. In general terms the signed-rank is used to determine if a set of paired data observations, x's and y's, come from the same population (i.e. have the same median) or as the alternative hypothesis differ only in the location of the central value (median). If the data are from the same population then the differences of the paired data should be equally distributed around 0, or about half the differences should be greater than 0 and half should be less than 0. Computationally the test is straight forward. First the differences $D_i=x_i-y_i$ ,i=1…N are computed for each pair. The absolute values of the differences $|D_i|$, i=1…N are ranked from smallest to largest and data pairs that are tied, thus having differences of zero, are ignored. The ranks of the absolute differences are assigned the sign of the actual differences. For example, negative differences have negative-signed ranks and positive differences have positive-signed ranks thus the term "signed-rank" in the method name. The test statistic $W^+$ is the sum of all positively signed ranks. The statistic $W^+$ is then compared to tabled values that vary based on N. The one-tailed version of the signed-rank test has been applied to the key indicator analytes of conductivity, pH, total alkalinity, sulfate, and dissolved zinc as listed in the table below.

| **Analyte** | **Rationale** | **median \|D\|** | **Tail** | **Reject $H_0$ if:** |
|---|---|---|---|---|
| Specific Conductance | Conductivity, as a proxy for total dissolved solids, **increases** due to sulfide oxidation. | <0 | X's **<** Y's | $W^+(calc)<W(table)_{\alpha,n}$ |
| Lab-pH | pH **decreases** though the addition of $H^+$ generated by pyrite oxidation. | >0 | X's **>** Y's | $W^+(calc)>W(table)_{\alpha,n}$ |
| Total Alkalinity | Total alkalinity **decreases** by consumption of buffing capacity due to $H^+$ produced by pyrite oxidation, associated with waste rock. | >0 | X's **>** Y's | $W^+(calc)>W(table)_{\alpha,n}$ |
| Total Alkalinity | Total alkalinity **increase** by the weathering of carbonate mineralogy, associated with tailings | <0 | X's **<** Y's | $W^+(calc)<W(table)_{\alpha,n}$ |
| Total Sulfate | Total sulfate **increases** due to oxidation of sulfides | <0 | X's **<** Y's | $W^+(calc)<W(table)_{\alpha,n}$ |
| Dissolved Zinc | Dissolved zinc **increases** due to sulfide oxidation and is more readily soluble at neutral pH than other metals. | <0 | X's **<** Y's | $W^+(calc)<W(table)_{\alpha,n}$ |

X: Upgradient Site

Y: Downgradient Site

Further guidance and background on the statistical methods utilized in this report can be found in one of the following references: Helsel and Hirsch (1992), Gilbert (1987), or Section 3.3.3.1 of the EPA document "Guidance for Data Quality Assessment" EPA/600/R-96/084.

**Qualified Data by QA Reviewer -** QA reports provide a summary for each site section of data limitations found in the monthly QA reviews. They list all data for that site that was qualified by the QA Reviewer for Water Year 2014 along with the reason for qualification. These data are all included in the data analyses, unless also identified as an outlier in the Qualified Data Summary.

# INTERVENTIONS

This section identifies any procedural changes, natural phenomena, mine operational changes, or other interventions that could have affected data during Water Year 2014. Results of any visual data analyses to detect effects of these interventions are also indicated.

Prior interventions (and negotiated mid-year program modifications such as changes to laboratories, methods, detection limits, and reporting limits), and anything else which may affect data comparability and quality which occurred during previous Water Years, are documented in the “General History” section of the FWMP and in previous annual reports.

## MID-YEAR MODIFICATIONS

Sampling frequency at Site 61 was increased to monthly in June.

## GENERAL HISTORY

There has been an error in the graphical labeling found in the 2004-2009 annual reports. It was noticed, a few years ago, that on most of the graphs, the line indicating the AWQS is labeled as ‘total’. Most of the analytes in this report are dissolved and HGCMC is held to the dissolved AWQS. All analyses have been dissolved during this timeframe, so the graphs were mislabeled and should read ‘dissolved’. After reviewing the yearly files it appears that HGCMC was using total standards prior to 2003 when the change was made to using the dissolved standards. This change resulted in modifying the limits and also the graph labels, both of which were correctly done in 2003. Unfortunately, in 2004-2009 both of these modifications were not carried forward. This error in labeling was first corrected in the 2010 FWMP Report.

It was noted, during the annual meeting in 2012, that the units on the conductivity graphs were expressed as ‘NTU’ and not ‘µS/cm’. This error was corrected in the 2012 FWMP Report.

For several years the graphing and statistical analysis has been carried out in several Excel spreadsheets. The 2012 FWMP report broke from using Excel with the majority of the graphing and the statistical analysis being carried out in an R system. R is a system for statistical computation and graphics. It provides, among other things, a programming language, high level graphics, interfaces to other languages and debugging facilities.

All of the statistical analysis was also carried out in the Excel files and a comparison was made with the new system (‘R’), to ensure that there was continuity in the calculations. Both of the systems were in agreement with the statistical analysis. Also, the layout of the x-y plots has changed. Most of the plots are now composed of two graphs: the top smaller graph has y axis limits that encompass the whole data range, whereas the larger bottom graph has fixed limits that allow for comparison between sites. Also, note that the limits are not always shown if in doing so improves the visual interpretation of the graph.

A number of modifications were made to the FWMP with regards to sample sites and frequency. These modifications were discussed during the 2012 annual meeting and the discussion was followed up with two formal request letters in January 2013 and October 2013. Approval for these changes was granted in late October 2013. See the 2013 FWMP report for a thorough analysis of these changes.

# FWMP SAMPLE LOG

## 2014 Water Year October 2013 Through September 2014
## Annual Water Quality Monitoring Schedule-Laboratory Samples

| Site Number | Sample Identifier | Site Name | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 | 006FMS | Middle Greens Creek | P | P | Q | P | Q | P | P | P | P | P | P | P |
| 9 | 009FMS | Tributary Creek- Lower | | Q | | | | | | Q | | Q | | Q |
| 13 | 013FMS | Mine Adit Discharge East | | Q | | | | | | Q | | | Q | |
| 27 | 027FMG | Monitoring Well 2S | | Q | | | | | | Q | | Q | | Q |
| 29 | 029FMG | Monitoring Well 3S | | Q | | | | | | Q | | Q | | Q |
| 32 | 032FMG | Monitoring Well 5S | | Q | | | | | | Q | | Q | | Q |
| 46 | 046FMS | Lower Bruin Creek | | Q | | | Q | | | P | | | P | |
| 48 | 048FMS | Upper Greens Creek | P | P | Q | P | Q | P | P | P | P | P | P | P |
| 49 | 049FMS | Control Site Upper Bruin Creek | | Q | | | Q | | | P | | | P | |
| 54 | 054FMS | Greens Creek below D-Pond | P | P | Q | P | Q | P | P | P | P | P | P | P |
| 57 | 057FMG | Monitoring Well -23-00-03 | | Q | | | Q | | | Q | | | Q | |
| 60 | 060FMS | Althea Creek - Lower | | Q | | | | | | Q | | Q | | Q |
| 61 | 061FMS | Greens Creek Floodplain | | Q | | | Q | | Q | Q | Q | Q | Q | Q |
| 62 | 062FMS | Greens Creek Lower Than 54 | P | P | Q | P | Q | P | P | P | P | P | P | P |
| 609 | 609FMS | Further Creek Lower | | Q | | | | | | Q | | Q | | Q |
| 711 | 711FMS | Greens Creek Above Site E | | | | | | | | Q | | | | P |
| 712 | 712FMS | Greens Creek Below Site E | | | | | | | | Q | | | | P |
| 1067 | 1067 | TRIP BLANK | | | | | | | | Q | | | | Q |
| 1068 | 1068 | FIELD BLANK @ SITE | **54** | **46** | **6** | **48** | **49** | **54** | **6** | **60** | **48** | **59** | **57** | **9** |

| | |
|---|---|
| (yellow) | Sample not taken |
| (blue) | Increased sample frequency |
| (white) | Regular sample |

# SAMPLE SUITES

## Suite P
(Surface water only)

Conductivity
pH
Temperature
Hardness
Sulfate
Total Alkalinity
Dissolved Arsenic
Dissolved Cadmium
Dissolved Copper
Dissolved Lead
Dissolved Mercury
Dissolved Zinc

## Suite Q
(Groundwater and surface water)

Conductivity
pH
Temperature
Hardness
Sulfate
Total Alkalinity
Dissolved Arsenic
Dissolved Barium
Dissolved Cadmium
Dissolved Chromium
Dissolved Copper
Dissolved Lead
Dissolved Mercury
Dissolved Nickel
Dissolved Selenium
Dissolved Silver
Dissolved Zinc

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# SITE COORDINATES

| Site | Site Name | Latitude | Longitude |
|---|---|---|---|
| 6 | Greens Creek – Middle | 58°04’47.424” N | 134°38’25.849” W |
| 9 | Tributary Creek - Lower | 58°06’22.040” N | 134°44’44.100” W |
| 13 | East Mine Drainage Upper | 58°04’47.685” N | 134°37’39.951” W |
| 27 | Monitoring Well-2S | 58°06’48.546” N | 134°44’38.365” W |
| 29 | Monitoring Well-3S | 58°06’59.860” N | 134°44’51.821” W |
| 32 | Monitoring Well-5S | 58°06’57.732” N | 134°44’51.225’ W |
| 46 | Bruin Creek – Lower | 58°04’46.450” N | 134°38’32.580” W |
| 48 | Greens Creek – Upper | 58°05’01.350” N | 134°37’33.590” W |
| 49 | Bruin Creek – Upper | 58°05’04.070” N | 134°38’30.410” W |
| 54 | Greens Creek - Lower | 58°04’41.681” N | 134°38’46.529” W |
| 57 | Monitoring Well-23-00-03 | 58°04’59.933” N | 134°38’39.881” W |
| 60 | Althea Creek - Lower | 58°04’41.770” N | 134°45’08.432” W |
| 609 | Further Creek – Lower | 58°07’05.707” N | 134°45’06.332” W |
| 61 | Greens Creek Floodplain | 58°04’43.480” N | 134°38’52.910” W |
| 62 | Greens Creek Lower Than 54 | 58°04’38.650” N | 134°39’06.000” W |
| 711 | Greens Creek Above Site E | 58°04’08.425” N | 134°43’27.181” W |
| 712 | Greens Creek Below Site E | 58°04’13.858” N | 134°43’42.438” W |

# PROPOSED PROGRAM MODIFICATIONS

HGCMC is not proposing changes to the FWMP during the 2015 Water Year.

## BIBLIOGRAPHY

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Gilbert, Richard O. (1987). *Statistical Methods for Environmental Pollution Monitoring.* Van Nostrand Reinhold, New York. 320 pp.

Helsel, D.R., and Hirsch, R.M. (1992). *Statistical methods in water resource.* Elsevier Publishers, Amsterdam. 510 pp.

# INTERPRETIVE REPORT
# SITE 48

The data collected during the current water year are listed in the following "Table of Results for Water Year 2014" report. The table includes all the required FWMP analyte data (field and laboratory) collected for the current water year and a series of flags keyed to the summary report "Qualified Data by QA Reviewer". The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of ½ MDL for the purpose of median calculation.

All data collected at this site for the past six years are included in the data analyses with the exception of the outliers shown in the table below. During the current year no new data points were flagged as outliers, after review by HGCMC.

| Sample Date | Parameter | Value | Qualifier | Notes |
|---|---|---|---|---|
| 01/13/2009 | Conductivity Field, µmho | 52.00 | | Field and laboratory values not comparable |
| 01/13/2009 | Total Alkalinity, mg/L | 16.2 | | Suspected sample contamination |

The data for Water Year 2014 have been compared to the strictest fresh water quality criterion for each applicable analyte. One result exceeded these criteria.

**Table of Exceedance for Water Year 2014**

| | | | Limits | | |
|---|---|---|---|---|---|
| Sample Date | Parameter | Value | Lower | Upper | Hardness |
| 14-Jan-14 | Alkalinity | 16 mg/L | 20 | 0 | |

X-Y plots have been generated to graphically present the data for each of the analytes requested in the Statistical Information Goals for this site. These plots have been visually analyzed for the appearance of trends in concentration. The only obvious visual trend is in field pH that has had a gradual upward trend of the past 5 years.

A non-parametric statistical analysis for trend was performed for specific conductivity, field pH, total alkalinity, total sulfate, and dissolved zinc. Calculation details of the Seasonal Kendall analyses are presented in detail on the pages following this interpretive section. The following table summarizes the results on the data collected between Oct-08 and Sep-14(WY2009-WY2014).

**Table of Summary Statistics for Trend Analysis**

| | Mann-Kendall test statistics | | | Sen's slope estimate | |
|---|---|---|---|---|---|
| **Parameter** | **n*** | **p**** | **Trend** | **Q** | **Q(%)** |
| Conductivity Field | 6 | 0.05 | | | |
| pH Field | 6 | <0.01 | + | 0.112 | 1.453 |
| Alkalinity, Total | 6 | <0.01 | + | 1.025 | 2.389 |
| Sulfate, Total | 6 | 0.22 | | | |
| Zinc, Dissolved | 6 | 0.04 | | | |

* Number of Years  ** Significance level

For datasets with a statistically significant trend ($\alpha/2=2.5\%$) a Seasonal-Sen's Slope estimate statistic has also been calculated. For the current water year (2014), total alkalinity has a slope estimate of 1.025 mg/L/yr and field pH has a slope estimate of 0.112 su/yr.

## Table of Results for Water Year 2014

| Site 048FMS - 'Upper Greens Creek' | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Date/Parameter | Oct 2013 | Nov 2013 | Dec 2013 | Jan 2014 | Feb 2014 | Mar 2014 | Apr 2014 | May 2014 | Jun 2014 | Jul 2014 | Aug 2014 | Sep 2014 | **Median** |
| Water Temp (°C) | 5.4 | 0.96 | 1.18 | 0.13 | 0.03 | 0.73 | 0.93 | 3.48 | 4.32 | 9.54 | 9.35 | 8.7 | 2.33 |
| Conductivity-Field(μmho) | 106 | 139 | 144 | 44 | 151 | 147 | 180 | 95 | 94 | 111 | 117 | 131.2 | 124.1 |
| Conductivity-Lab (μmho) | 93 | 106 | 142 | 44 | 141 | 136 | 165 | 95 | 95 | 110 | 112 | 131 | 111 |
| pH Lab (standard units) | 7.73 | 7.68 | 7.79 | 7.25 | 7.56 | 7.68 | 7.54 | 7.4 | 7.87 | 7.78 | 7.69 | 7.77 | 7.69 |
| pH Field (standard units) | 7.87 | 7.91 | 7.85 | 7.31 | 7.66 | 7.82 | 7.82 | 7.7 | 7.75 | 7.85 | 7.9 | 8.12 | 7.84 |
| Total Alkalinity (mg/L) | 39.4 | 49.5 | 51.2 | 16 | 51.1 | 50 | 56.1 | 34.4 | 35.9 | 39.9 | 42.9 | 49.5 | 46.2 |
| Total Sulfate (mg/L) | 9.5 | 16.3 | 17.6 | 3.4 | 18.9 | 19.7 | 22 | 8.7 | 8.9 | 11.1 | 10.7 | 14.6 | 12.9 |
| Hardness (mg/L) | 48.3 | 65 | 67.2 | 18.4 | 66.2 | 67.8 | 77.1 | 43.1 | 42.4 | 49.6 | 53.8 | 65 | 59.4 |
| Dissolved As (ug/L) | 0.203 | 0.18 | 0.201 | 0.194 | 0.173 | 0.202 | 0.167 | 0.177 | 0.187 | 0.238 | 0.241 | 0.256 | 0.198 |
| Dissolved Ba (ug/L) | | | 31.2 | | 31.9 | | | | | | | | 31.6 |
| Dissolved Cd (ug/L) | 0.0352 | 0.0383 | 0.0349 | 0.0741 | 0.0404 | 0.0379 | 0.0346 | 0.0245 | 0.0259 | 0.0316 | 0.035 | 0.0411 | 0.0351 |
| Dissolved Cr (ug/L) | | | 0.575 | | 0.664 | | | | | | | | 0.620 |
| Dissolved Cu (ug/L) | 0.51 | 0.286 | 0.35 | 1.23 | 0.332 | 0.436 | 0.256 | 0.469 | 0.253 | 0.294 | 0.403 | 0.752 | 0.377 |
| Dissolved Pb (ug/L) | 0.0069 | 0.0015 | 0.0051 | 0.19 | 0.0015 | 0.0114 | 0.004 | 0.0067 | 0.0059 | 0.0015 | 0.0015 | 0.0015 | 0.0046 |
| Dissolved Ni (ug/L) | | | 0.562 | | 0.633 | | | | | | | | 0.598 |
| Dissolved Ag (ug/L) | | | 0.002 | | 0.002 | | | | | | | | 0.002 |
| Dissolved Zn (ug/L) | 2.9 | 4.18 | 3.53 | 9.27 | 3.92 | 4.5 | 2.97 | 2.39 | 2.46 | 2.06 | 2.73 | 3 | 2.99 |
| Dissolved Se (ug/L) | | | 0.953 | | 1.11 | | | | | | | | 1.032 |
| Dissolved Hg (ug/L) | 0.00101 | 0.000493 | 0.000431 | 0.00369 | 0.000455 | 0.000804 | 0.000443 | 0.00798 | 0.000642 | 0.000409 | 0.000715 | 0.000619 | 0.000631 |

For individual sample/analyte qualifier descriptions see "Qualified Data by QA Reviewer" table.

Values reported as less than MDL are replaced by 1/2 MDL for median calculation purposes.

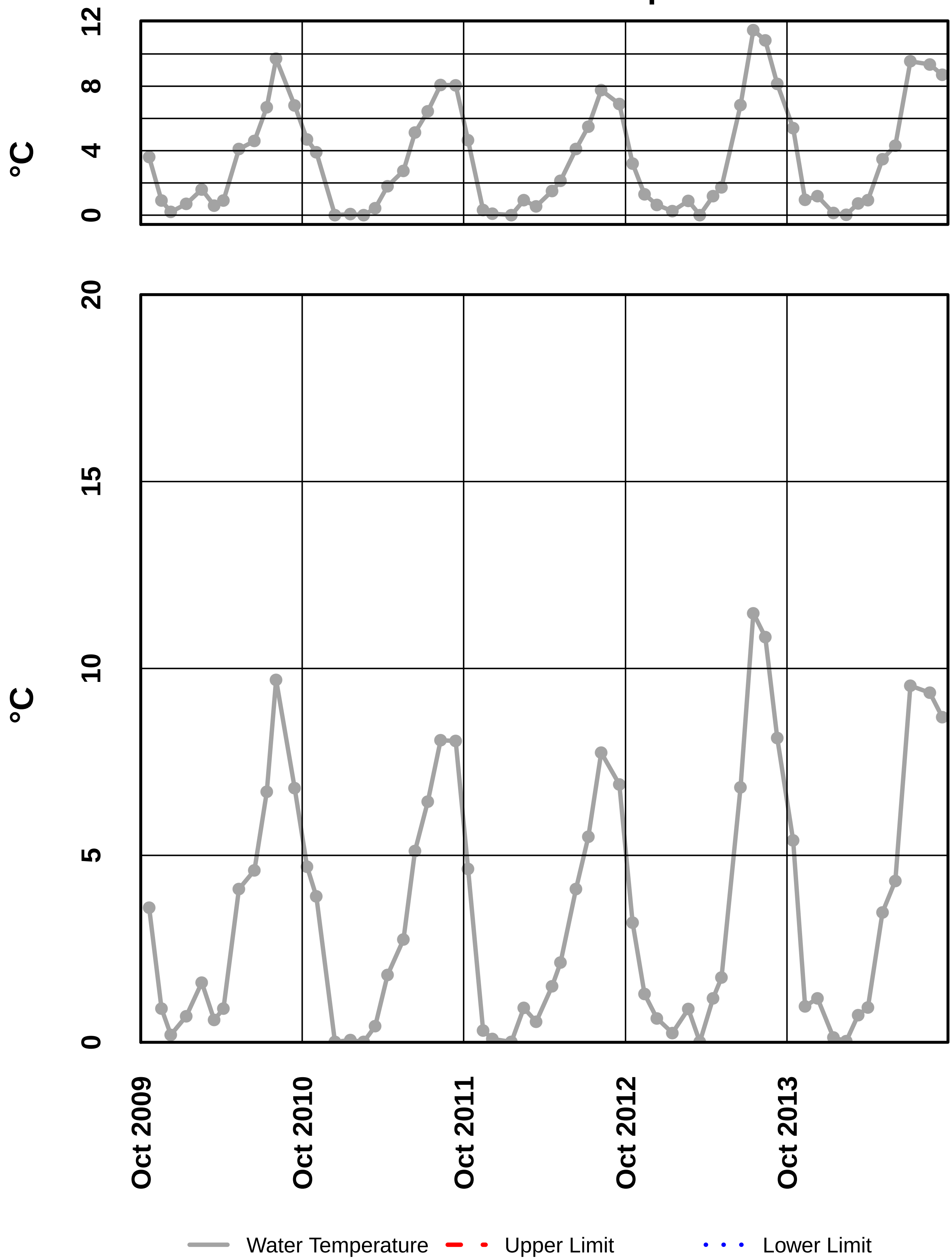
Shaded data has been qualified as an outlier by HGCMC and removed from any further analysis and is not included into the calculation of the median

# Qualified Data by QA Reviewer

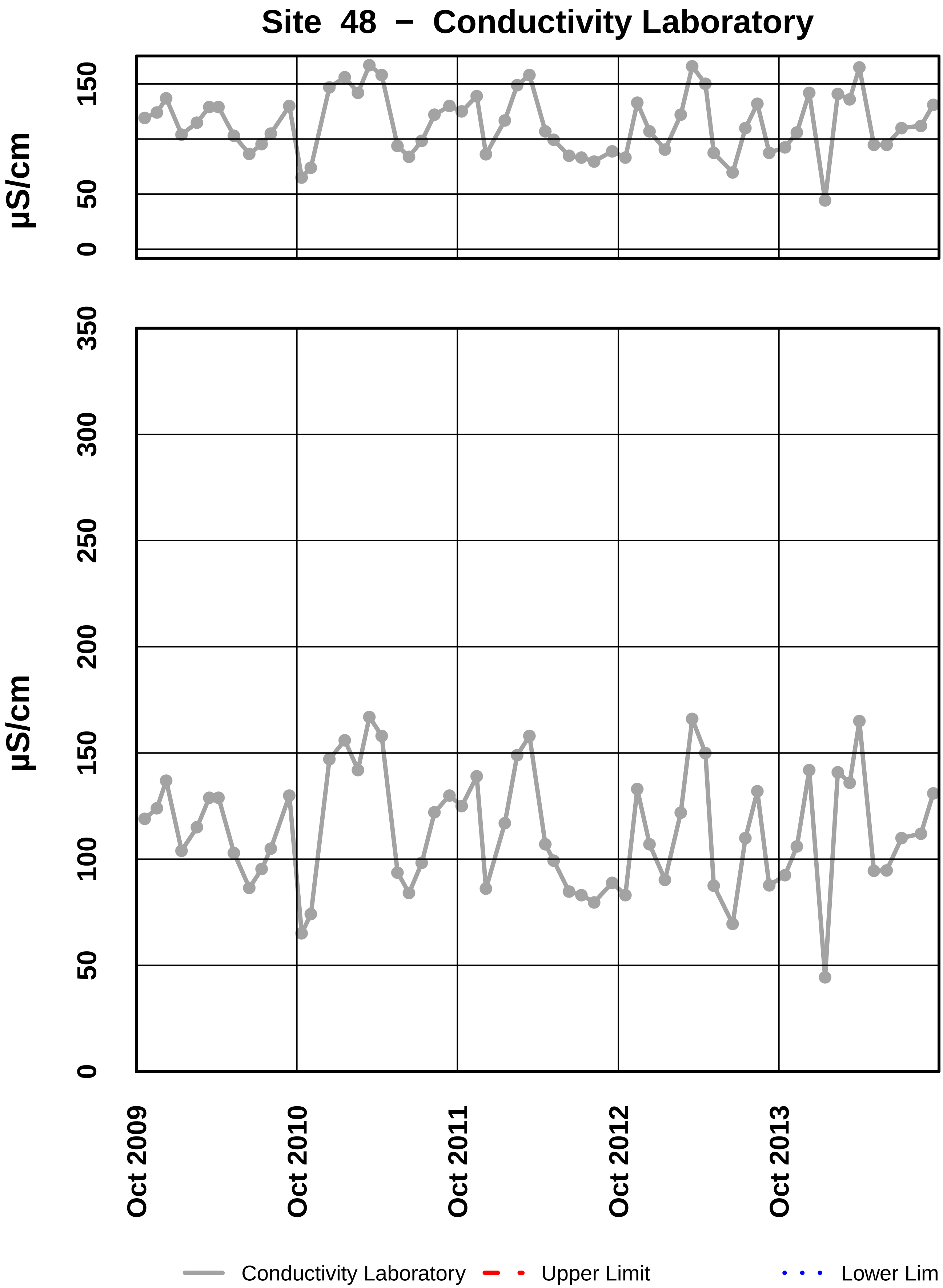
**Date Range: 10/01/2013 to 09/30/2014**

| Site No. | Sample Date | Sample Time | Parameter | Value | Qualifier | Reason for Qualifier |
|---|---|---|---|---|---|---|
| 048FMS | 10/15/2013 | 12:00 PM | Diss. Pb-ICP/MS | 0.00693 | J | Below Quantitative Range |
| 048FMS | 11/11/2013 | 12:00 PM | pH | 7.68 | J | Hold Time Violation |
| 048FMS | 12/9/2013 | 12:00 PM | Diss. Cu-ICP/MS | 0.35 | U | Field Blank Contamination |
| | | | Diss. Ni-ICP/MS | 0.56 | U | Field Blank Contamination |
| | | | Diss. Pb-ICP/MS | 0.00508 | U | Field Blank Contamination |
| | | | Diss. Zn-ICP/MS | 3.53 | U | Field Blank Contamination |
| 048FMS | 1/14/2014 | 12:00 PM | pH | 7.25 | J | Hold Time Violation |
| 048FMS | 2/12/2014 | 12:00 PM | Diss. Cu-ICP/MS | 0.33 | J | LCS Recovery |
| | | | Sulfate | 18.9 | J | Sample Receipt Temperature |
| 048FMS | 4/2/2014 | 12:00 PM | Diss. Pb-ICP/MS | 0.00398 | J | Below Quantitative Range |
| | | | pH | 7.54 | J | Hold Time Violation |
| 048FMS | 5/5/2014 | 12:00 PM | Diss. Pb-ICP/MS | 0.00667 | J | Below Quantitative Range |
| 048FMS | 6/3/2014 | 12:00 PM | Diss. Pb-ICP/MS | 0.00593 | J | Below Quantitative Range |
| | | | Diss. Zn-ICP/MS | 2.46 | U | Field Blank Contamination |
| 048FMS | 7/7/2014 | 12:00 PM | Sulfate | 11.1 | J | Sample Receipt Temperature |

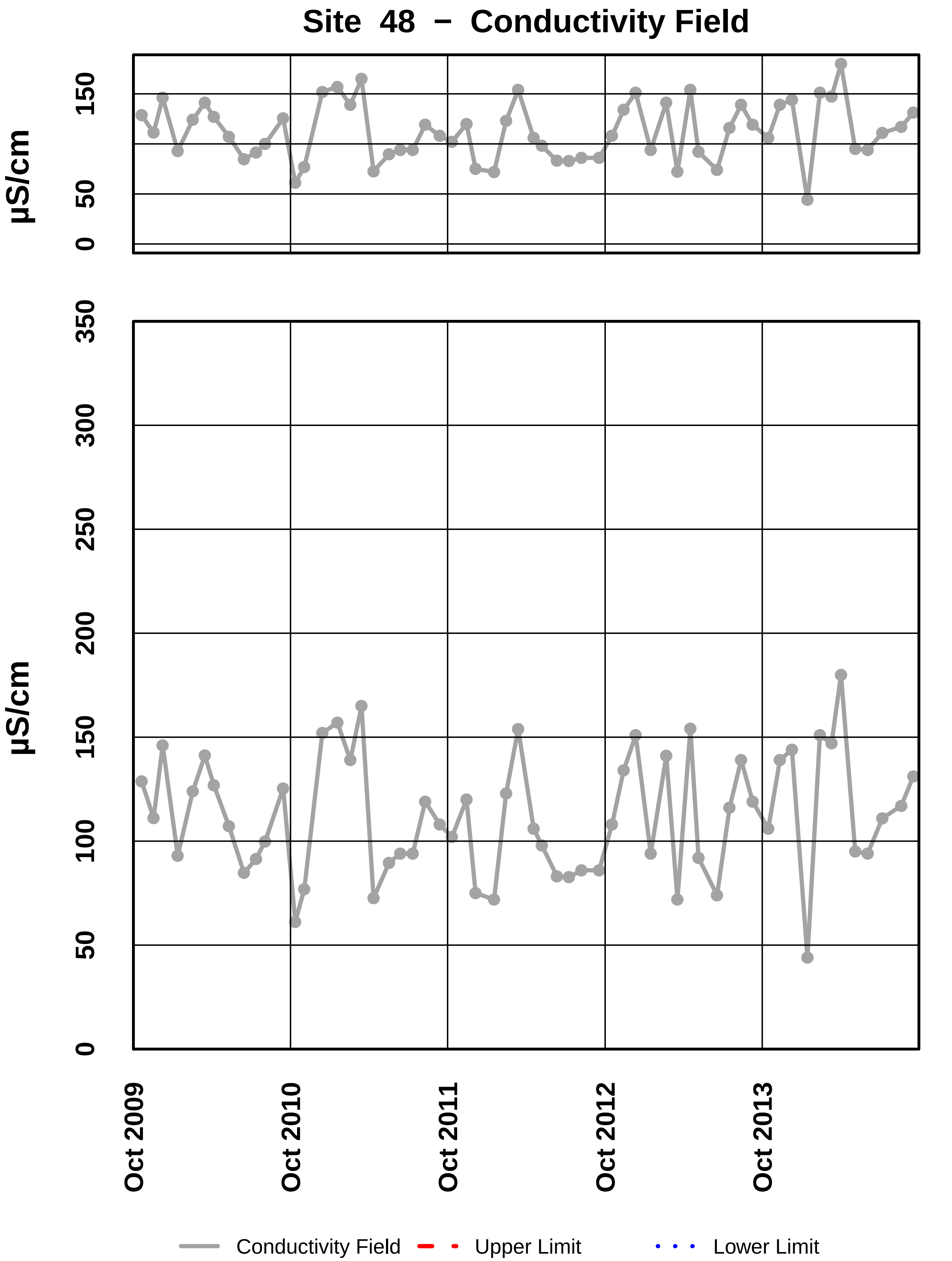
## Site 48 – Water Temperature



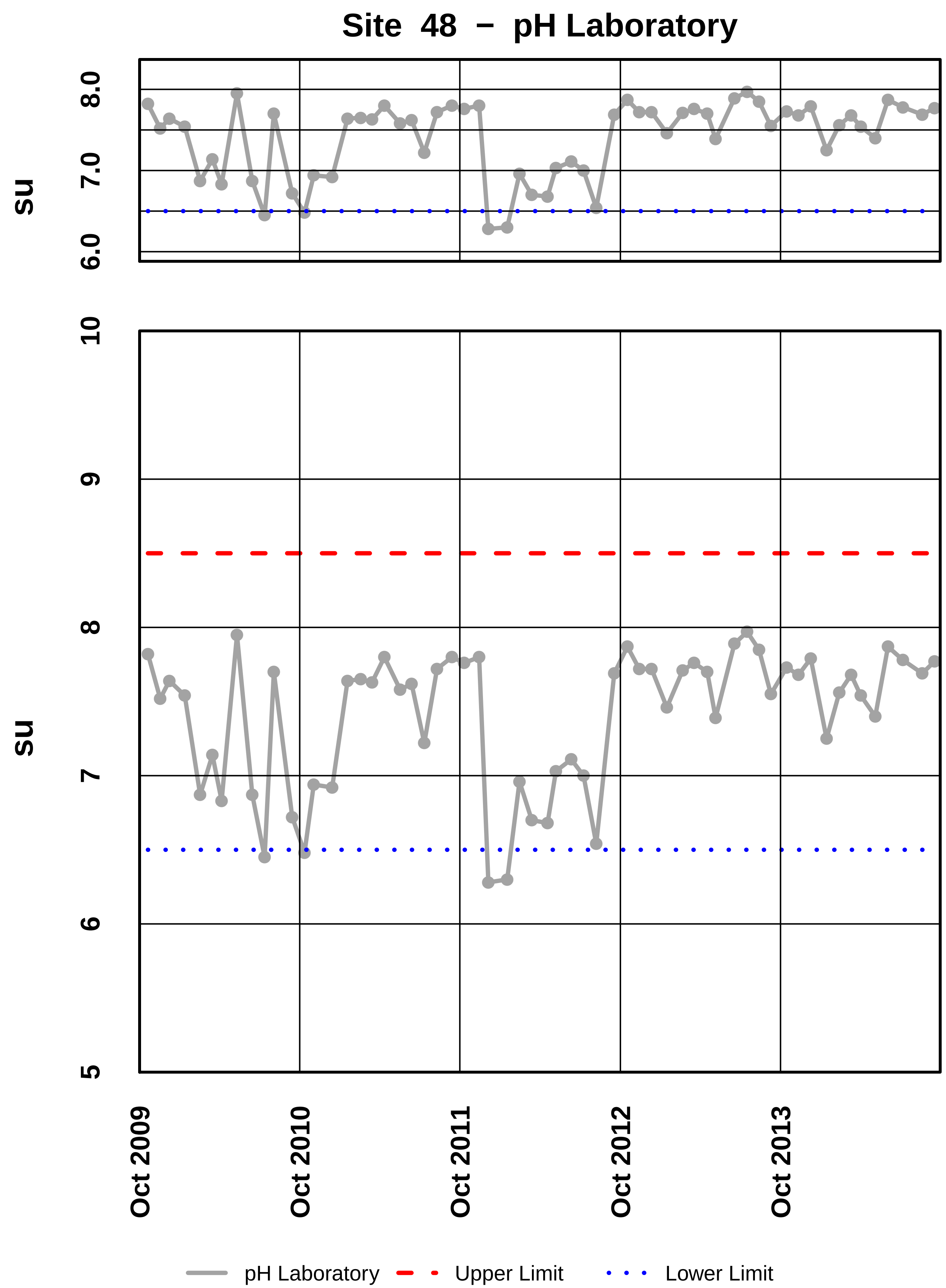

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

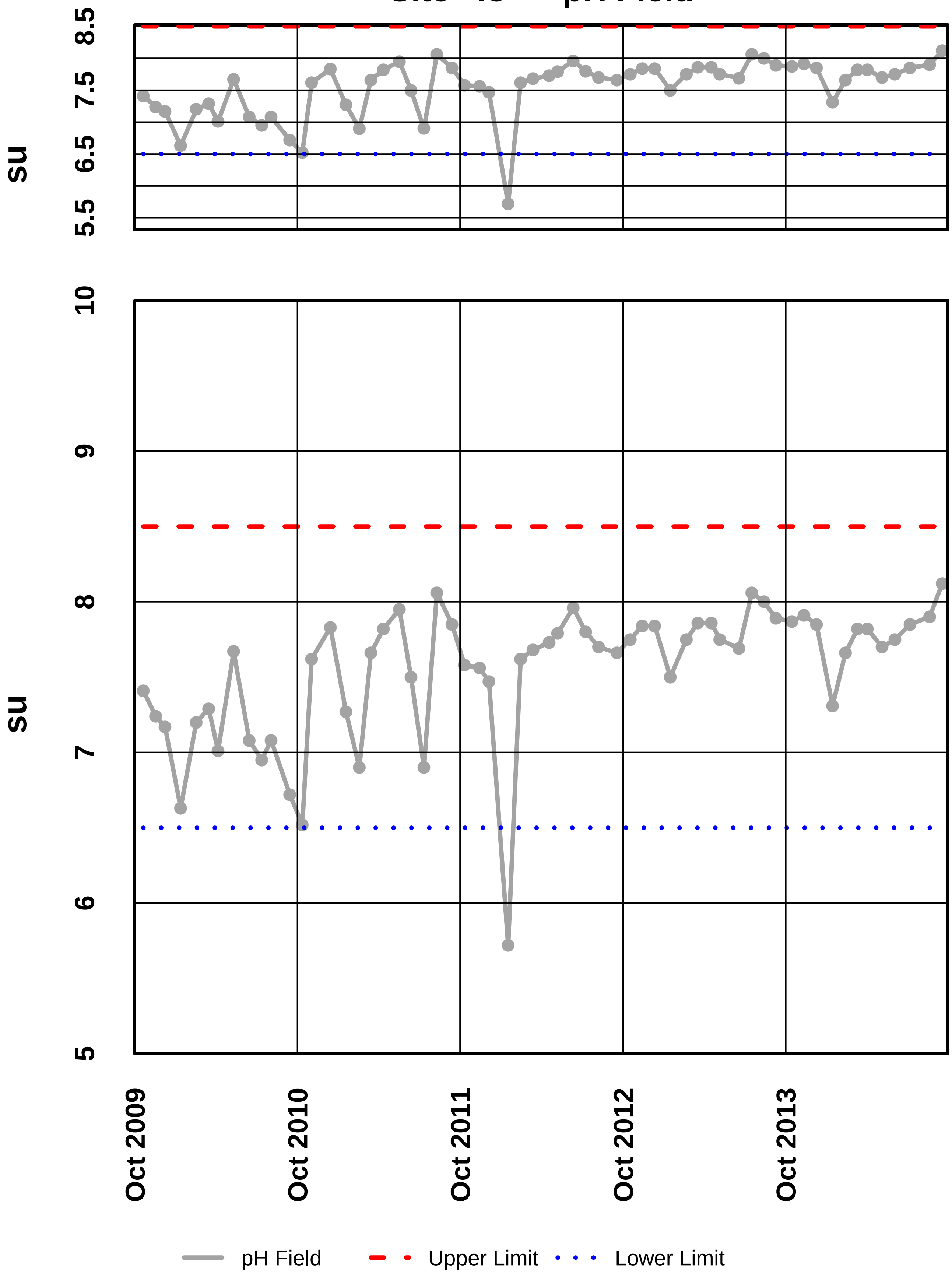



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

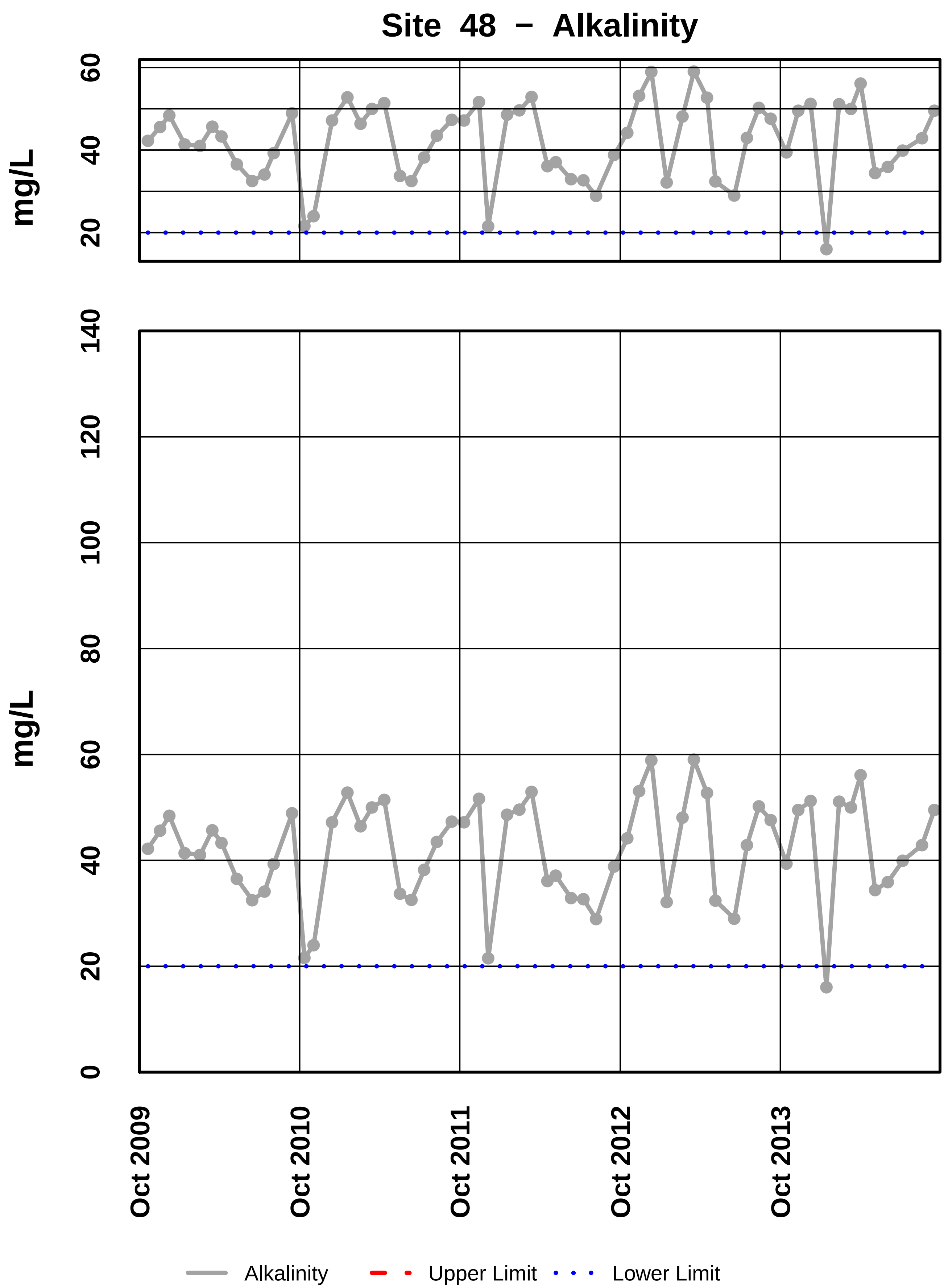



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

## Site 48 – pH Field

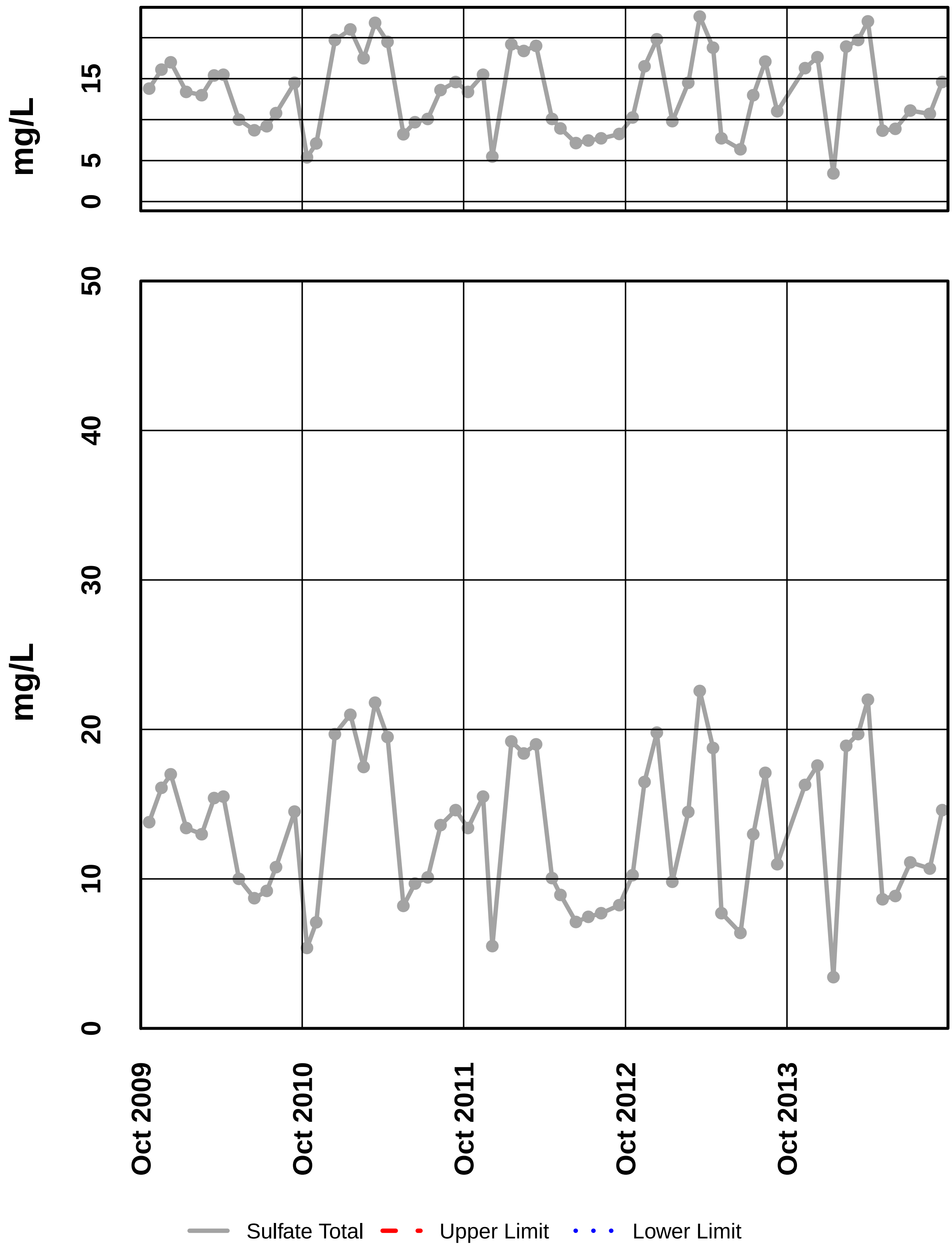



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

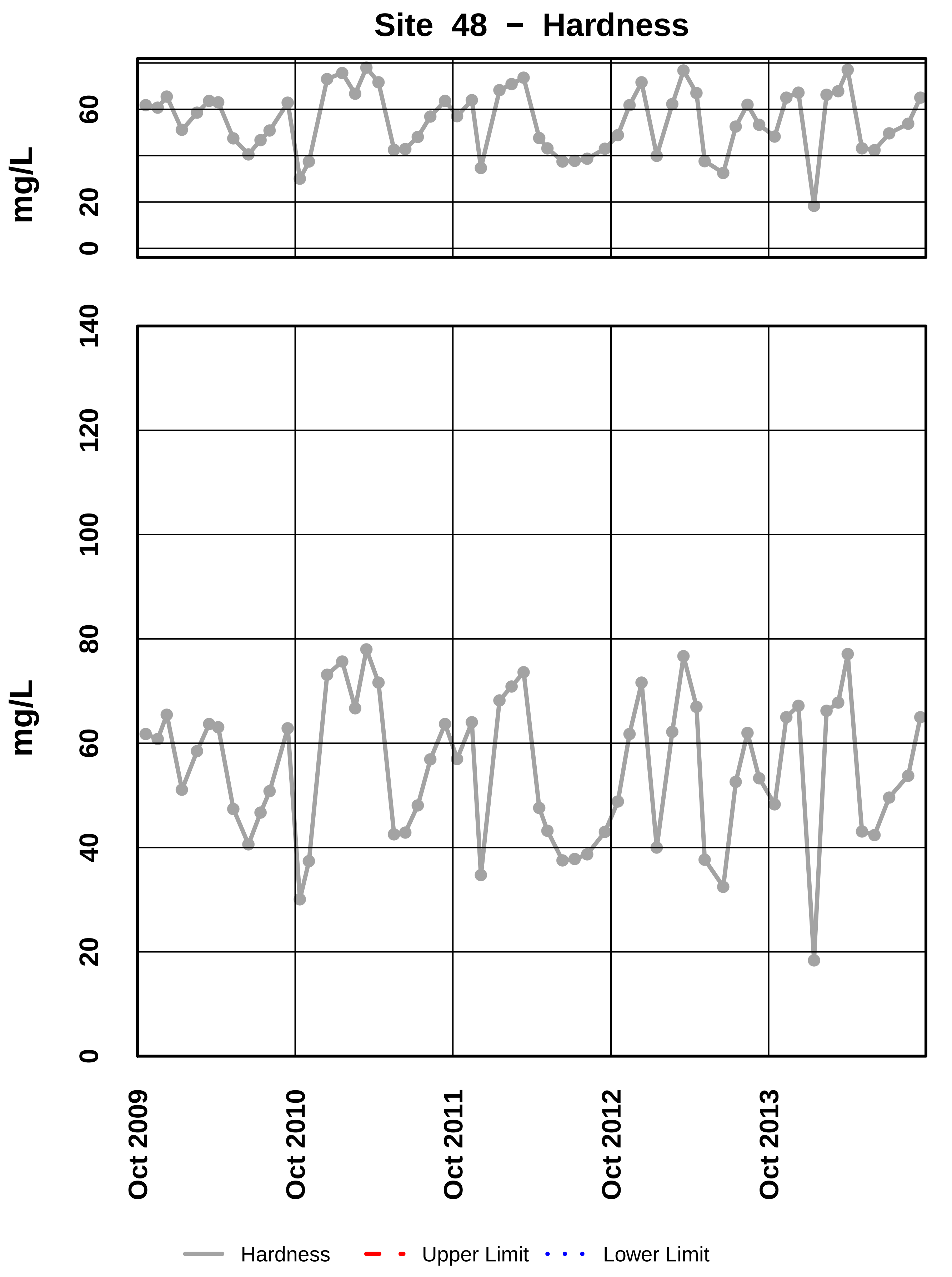



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

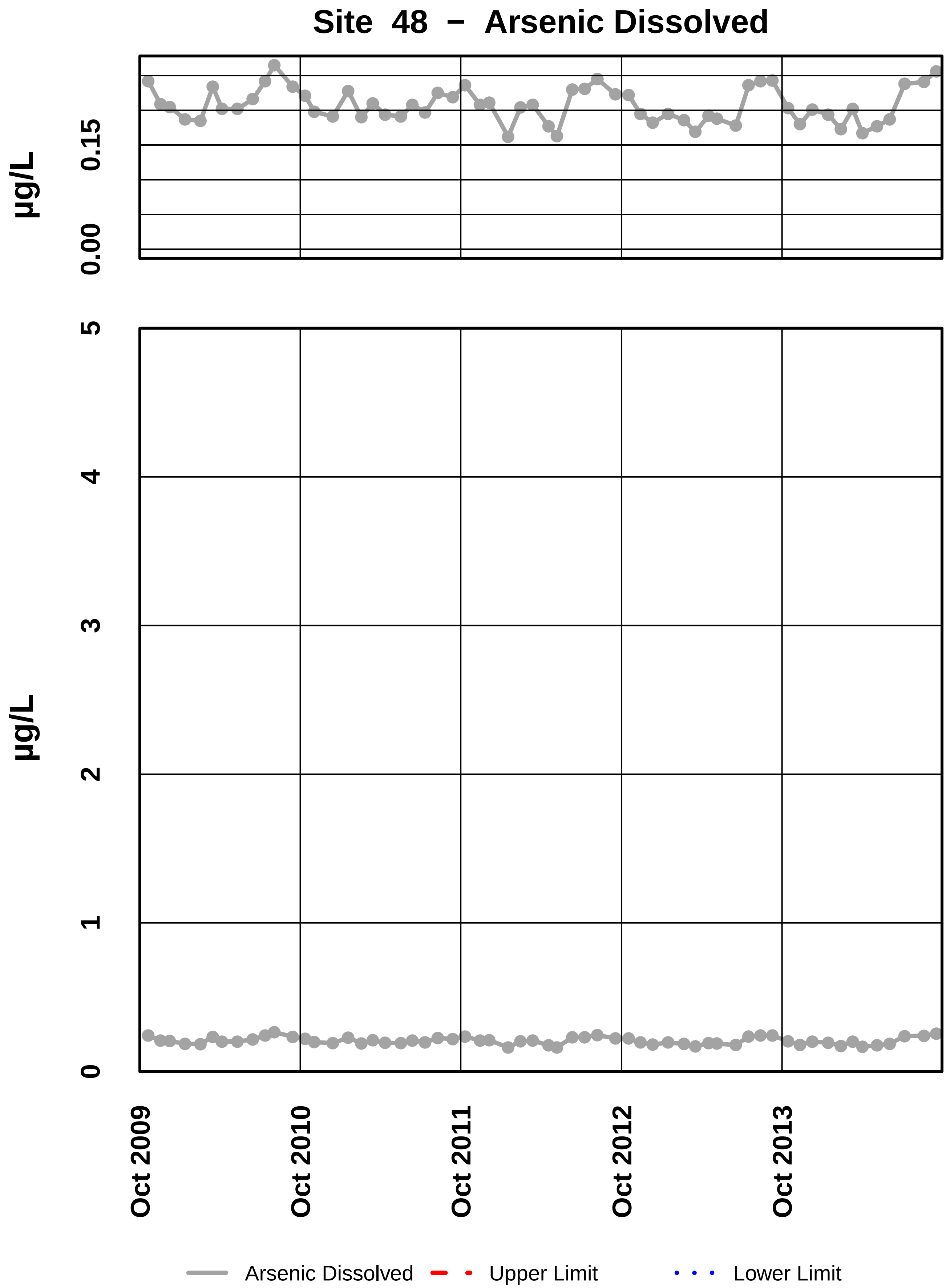
## Site 48 – Sulfate Total




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

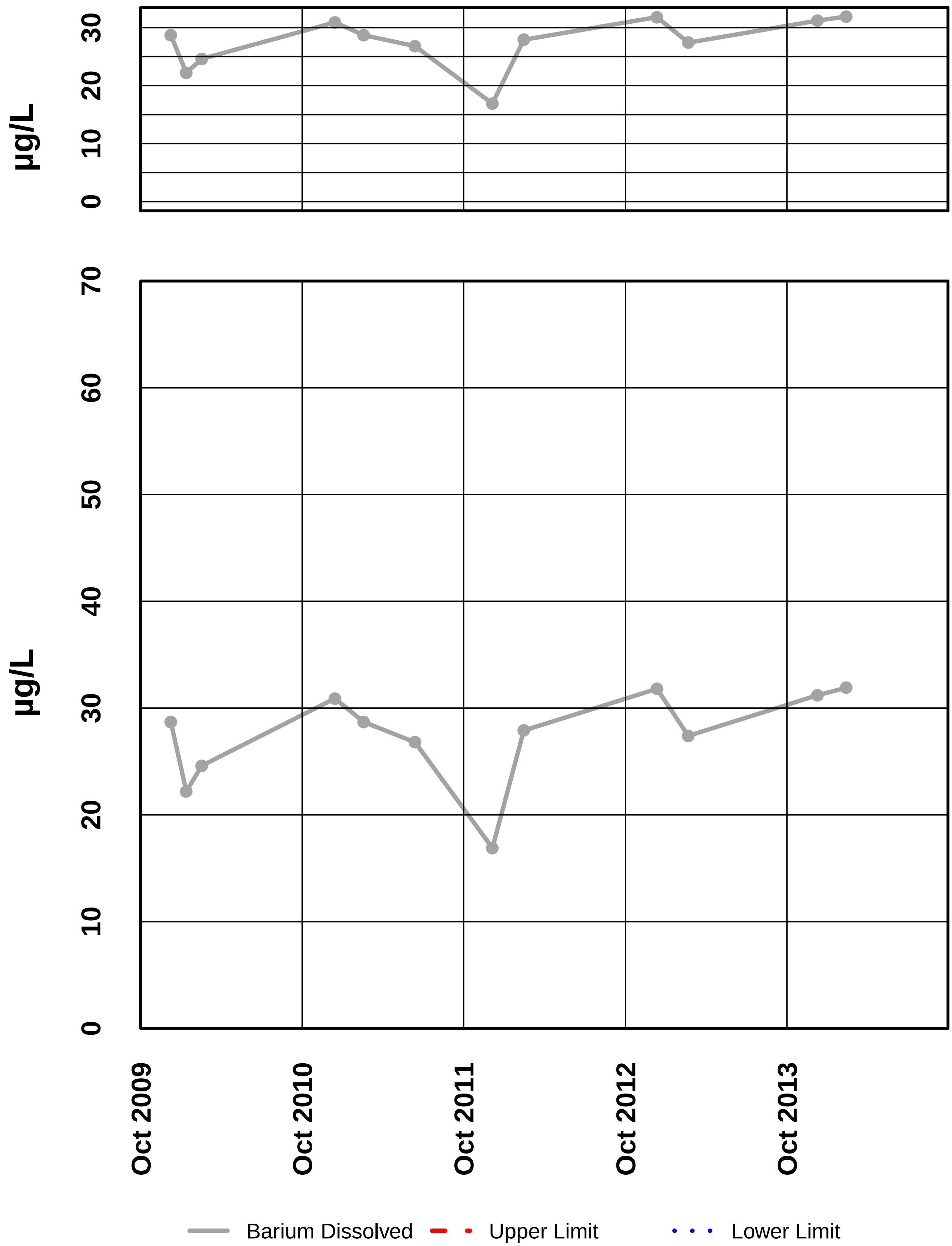



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

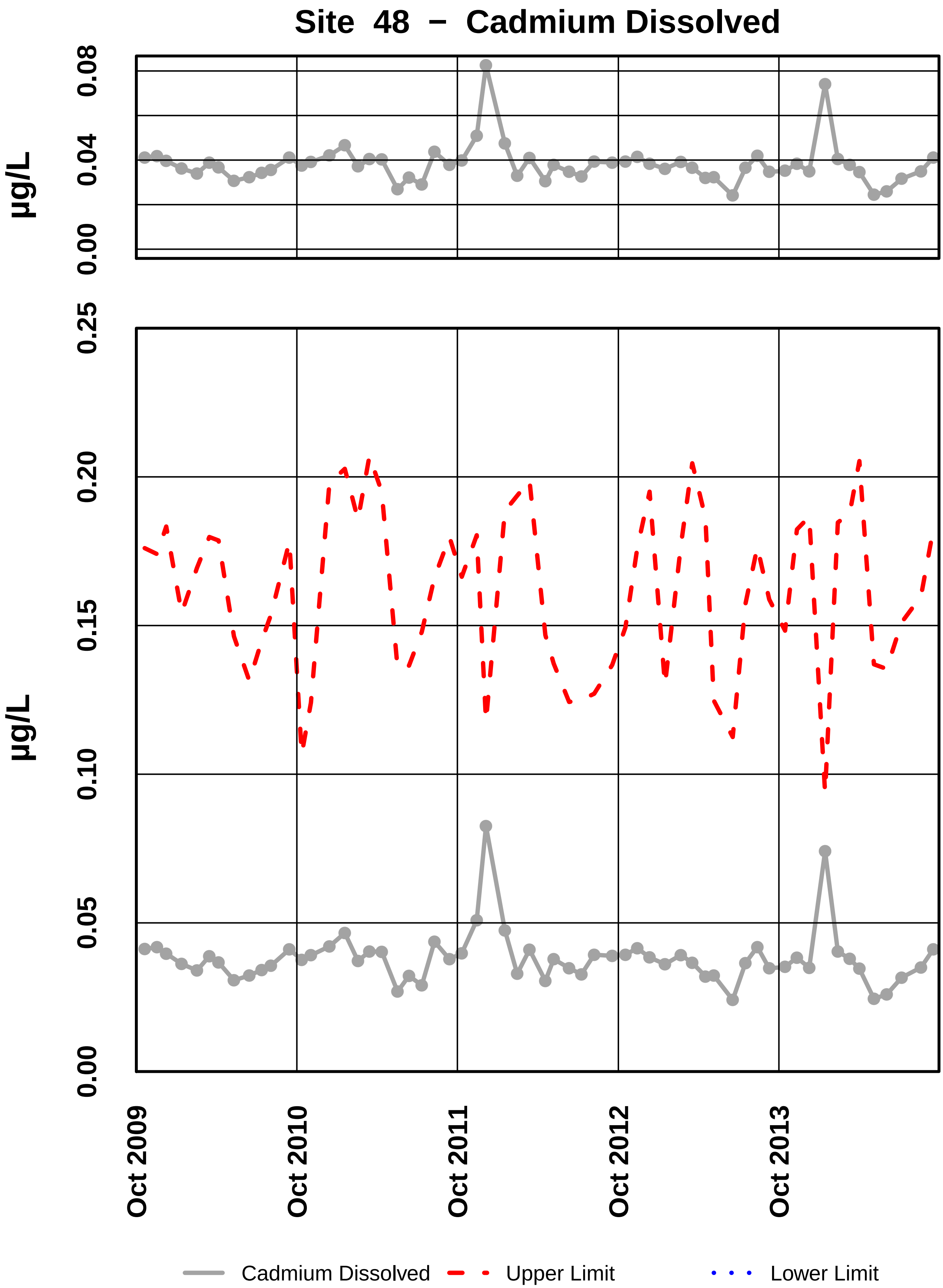



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

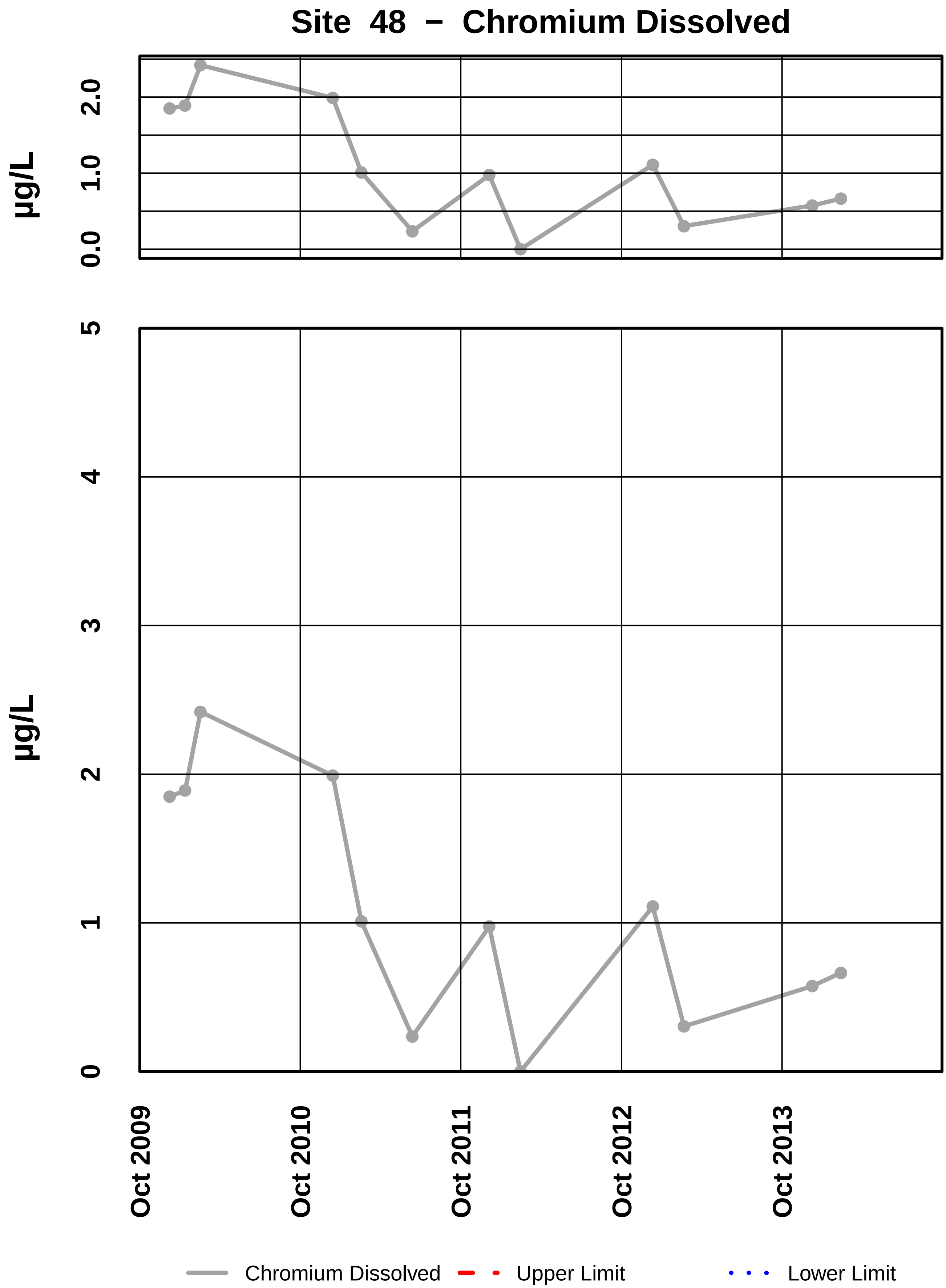
## Site 48 – Barium Dissolved




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

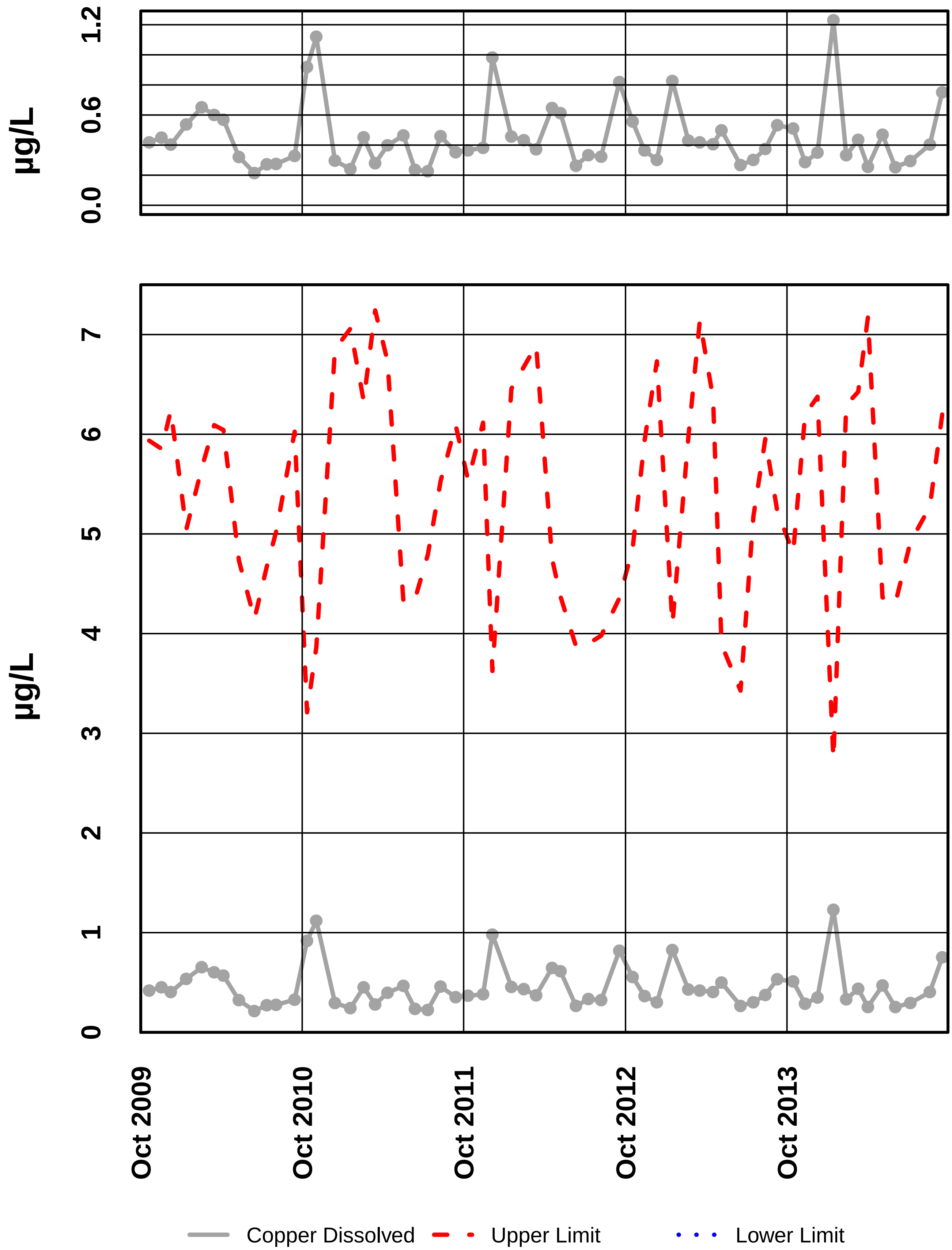



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



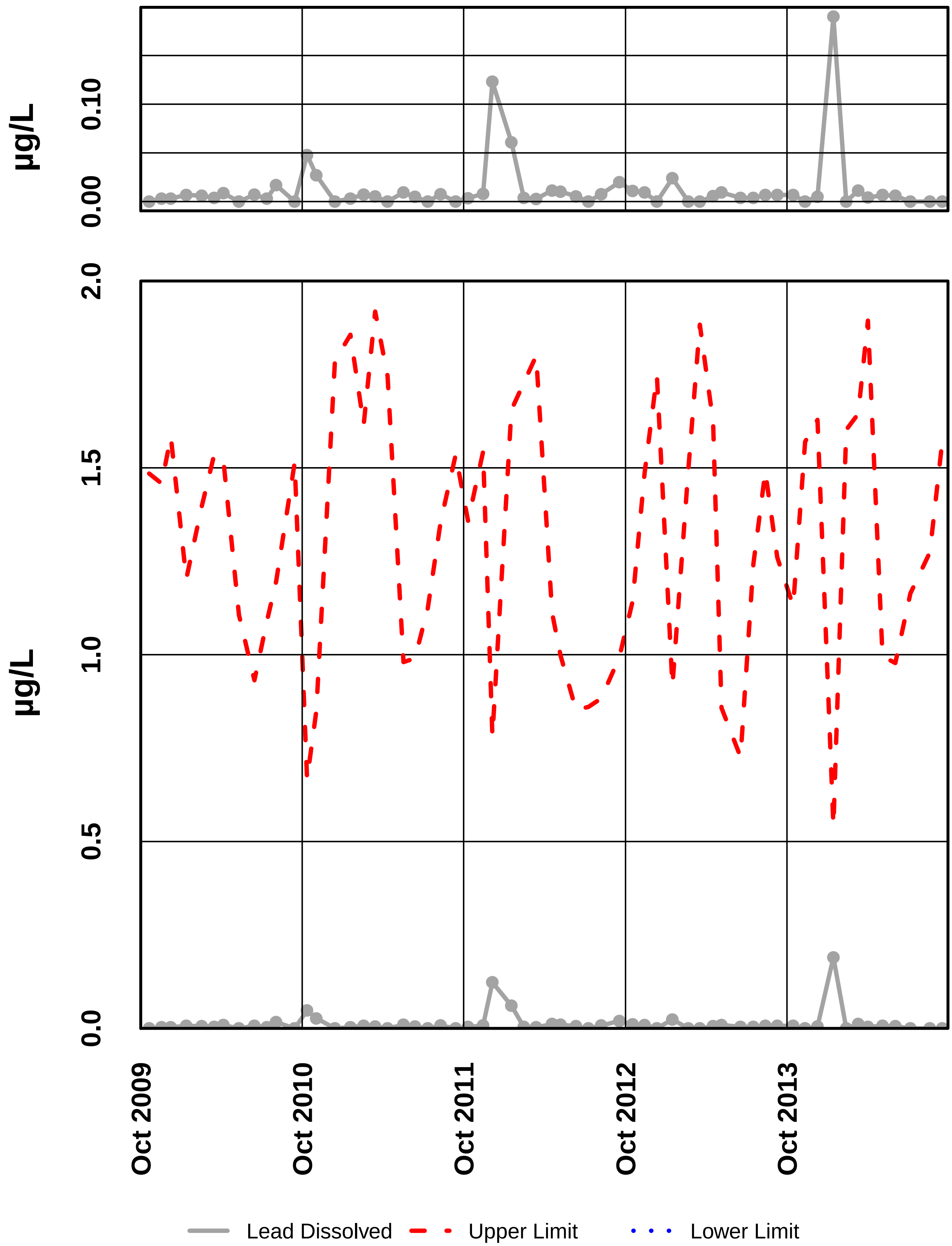

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

## Site 48 – Copper Dissolved



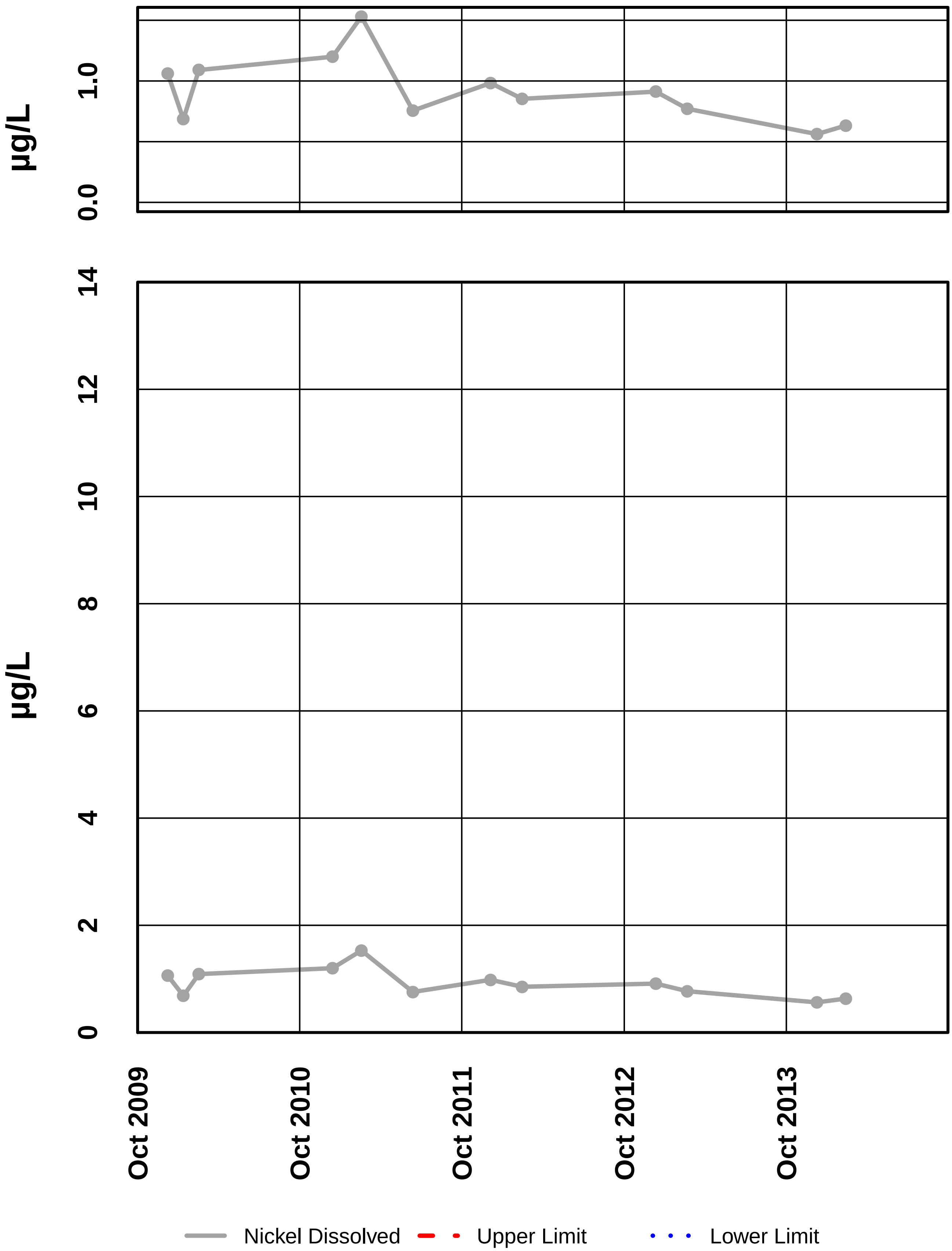

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# Site 48 – Lead Dissolved

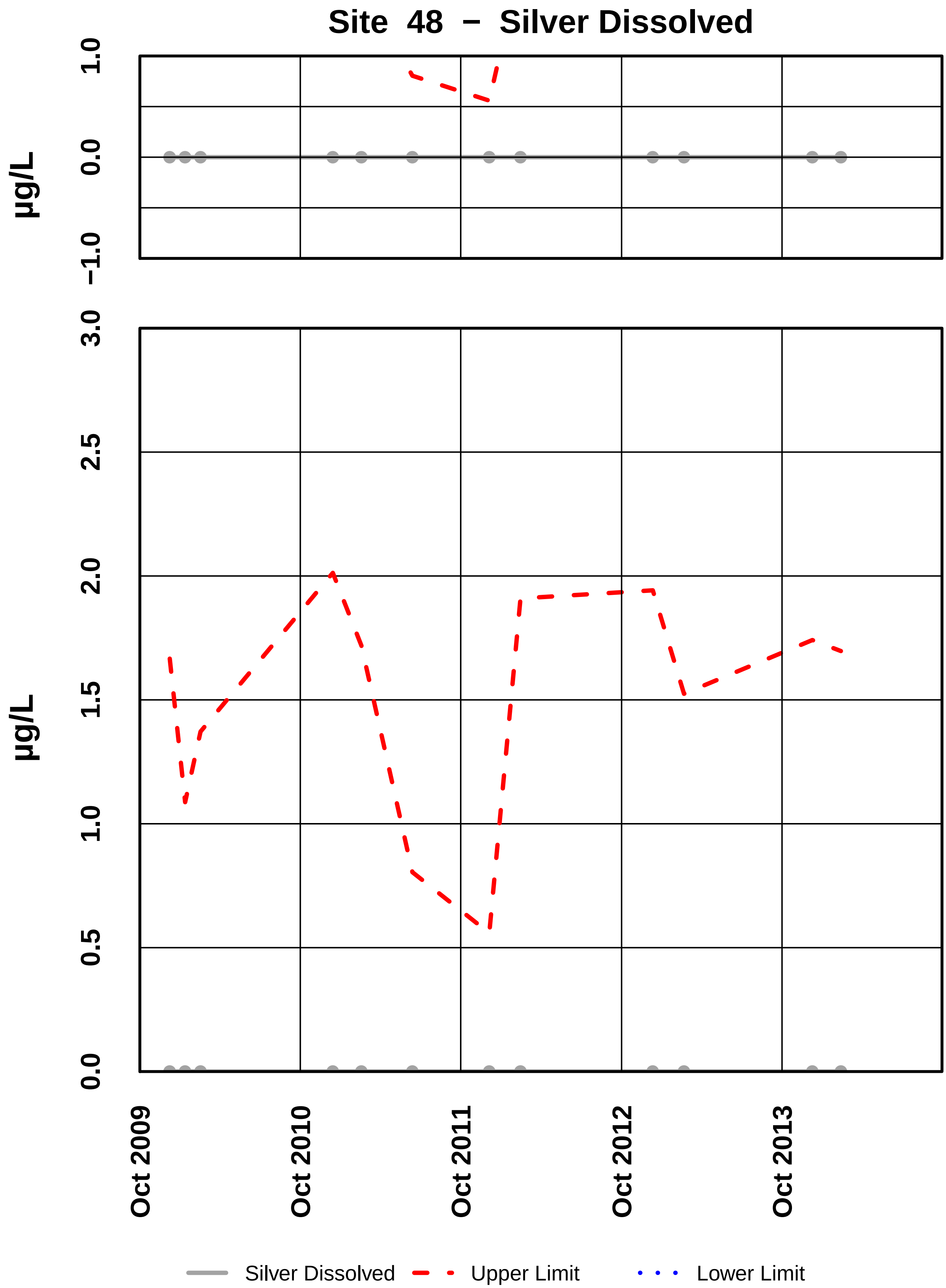



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

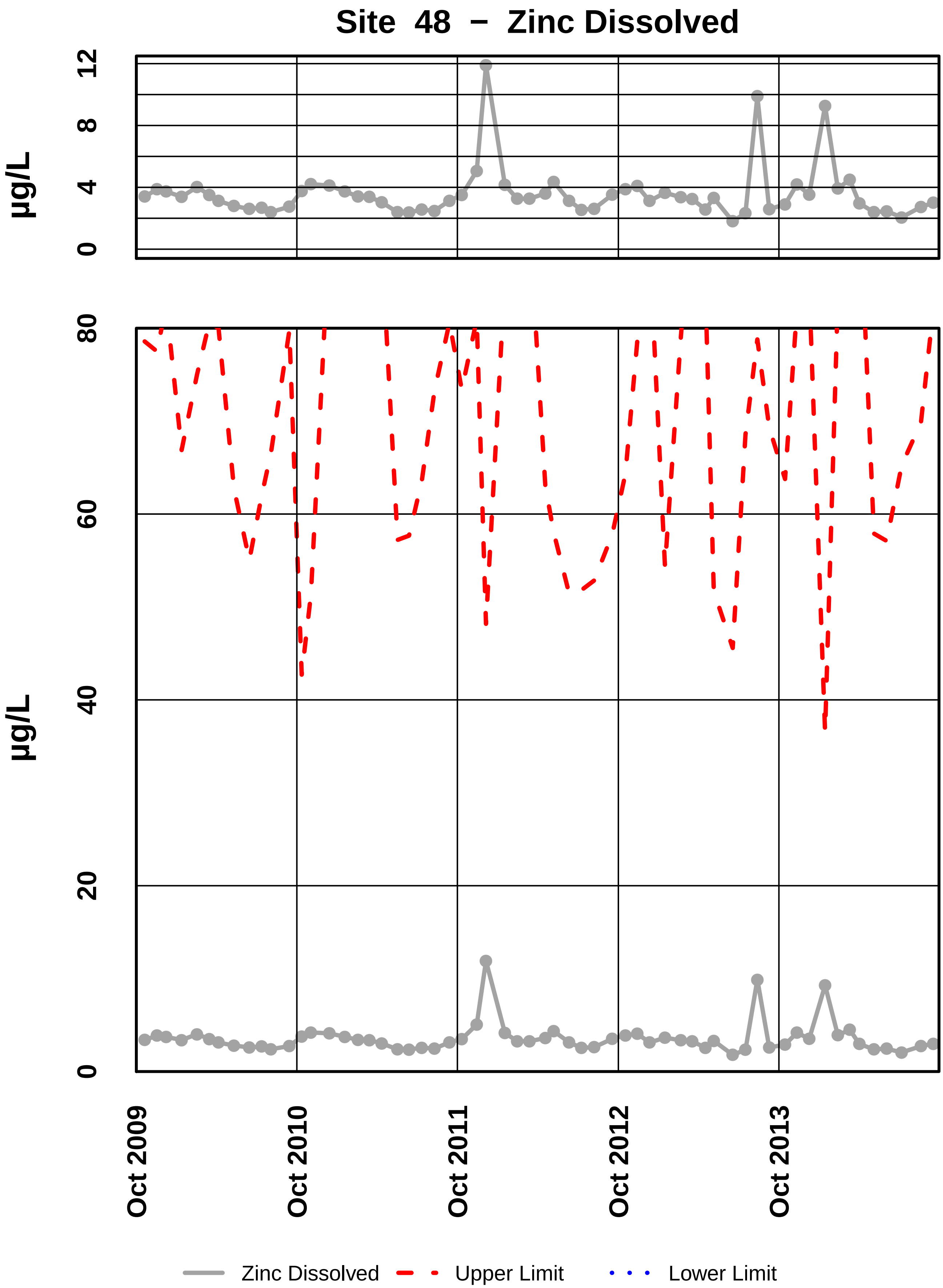
# Site 48 – Nickel Dissolved



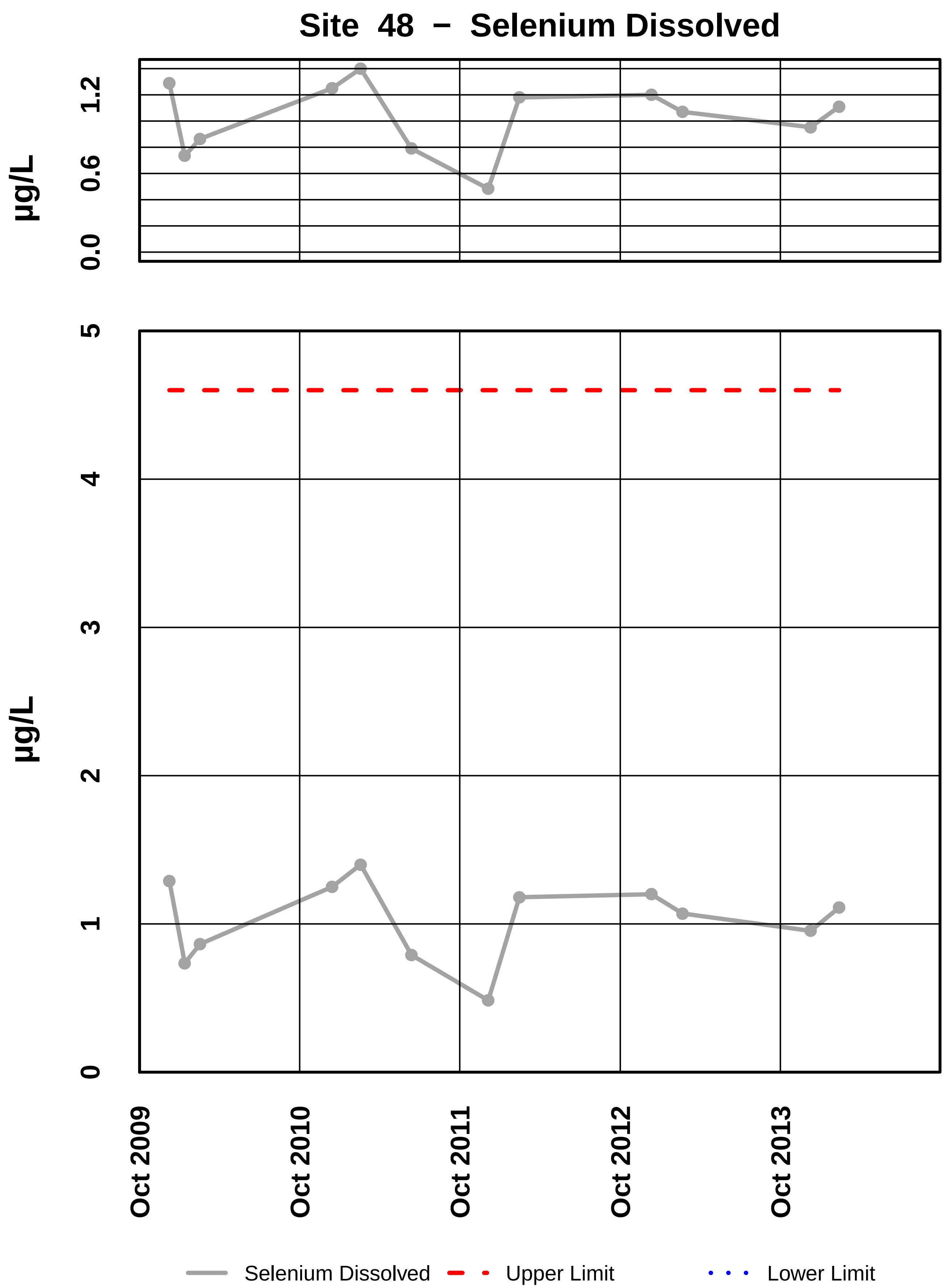

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

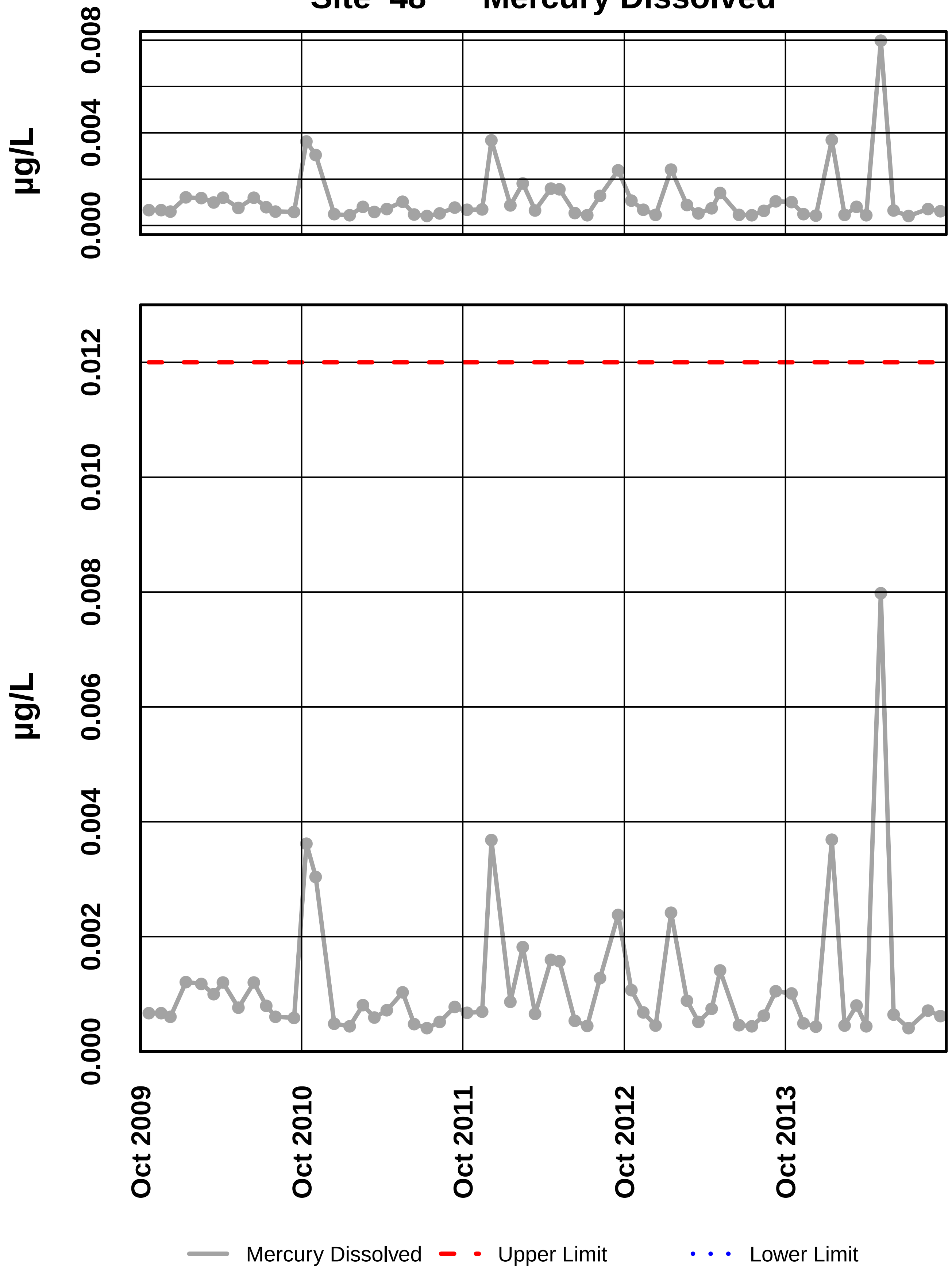



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

## Site 48 – Mercury Dissolved




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# INTERPRETIVE REPORT
# SITE 6

The data collected during the current water year are listed in the following “Table of Results for Water Year 2014” report. The table includes all the required FWMP analyte data (field and laboratory) collected for the current water year and a series of flags keyed to the summary report “Qualified Data by QA Reviewer”. The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of ½ MDL for the purpose of median calculation.

All data collected at this site for the past six years are included in the data analyses with the exception of the outliers shown in the table below. During the current year no new data points were flagged as outliers after review by HGCMC.

| Sample Date | Parameter | Value | Qualifier | Notes |
|---|---|---|---|---|
| No outliers have been identified by HGCMC for the period of October 2009 through September 2014. | | | | |

The data for Water Year 2014 have been compared to the strictest fresh water quality criterion for each applicable analyte. One result, total alkalinity, exceeded these criteria, however the measured value is similar to the upgradient background site (Site 48) that was also in exceedance, and thus is considered natural variation.

**Table of Exceedance for Water Year 2014**

| | | | Limits | | |
|---|---|---|---|---|---|
| **Sample Date** | **Parameter** | **Value** | **Lower** | **Upper** | **Hardness** |
| 14-Jan-14 | Alkalinity | 18.5 mg/L | 20 | 0 | |

X-Y plots have been generated to graphically present the data for each of the analytes requested in the Statistical Information Goals for this site. These plots have been visually analyzed for the appearance of any trend in concentration. The only obvious visual trend is in field pH that has had a gradual upward trend for the past 5 years.

A non-parametric statistical analysis for trend was performed for specific conductivity, field pH, total alkalinity, total sulfate, and dissolved zinc. Calculation details of the Seasonal Kendall analyses are presented in detail on the pages following this interpretive section. The following table summarizes the results of the data collected between Oct-08 and Sep-14 (WY2009-WY2014).

**Table of Summary Statistics for Trend Analysis**

| | Mann-Kendall test statistics | | | Sen's slope estimate | |
|---|---|---|---|---|---|
| **Parameter** | **n*** | **p**** | **Trend** | **Q** | **Q(%)** |
| Conductivity Field | 6 | 0.02 | + | 2.55 | 2.151 |
| pH Field | 6 | <0.01 | + | 0.09 | 1.2 |
| Alkalinity, Total | 6 | <0.01 | + | 1.08 | 2.5 |
| Sulfate, Total | 6 | 0.25 | | | |
| Zinc, Dissolved | 6 | 0.46 | | | |

* Number of Years ** Significance level

Total alkalinity, pH field, and conductivity field all have statistically significant positive slopes of 2.55 µS/cm/yr, 0.09 su/yr, and 1.08 mg/L/yr respectively. The pH field and total alkalinity are similar to the values for Site 48. Currently, HGCMC does not feel that this increasing trend is a significant indication of changes in water chemistry.

A comparison of median values for alkalinity, laboratory pH, lab conductivity, total sulfate, and dissolved zinc between Site 6 and Site 48 has been conducted as specified in the Statistical Information Goals for Site 6. Additionally, X-Y plots have been generated for total alkalinity, field pH, specific conductance, total sulfate, and dissolved zinc that co-plot data from Site 6 and Site 48, the upstream control site, to aid in the comparison between those sites. Calculation details of the non-parametric signed-rank tests are presented in detail on the pages following this interpretive section. The table below summarizes the results of the signed-rank test as performed on the Water Year 2014 dataset.

**Table of Summary Statistics for Median Analysis**

**Site 6 vs Site 48**

| **Parameter** | **Signed Ranks p-value** | **Site 48 median** | **Site 6 median** | **Median Differences** |
|---|---|---|---|---|
| Conductivity Field | <0.01 | 124.1 | 128.1 | -5 |
| pH Field | 0.449 | 7.84 | 7.85 | -0.01 |
| Alkalinity, Total | <0.01 | 46.2 | 46.7 | -0.6 |
| Sulfate, Total | <0.01 | 12.9 | 14.10 | -1.60 |
| Zinc, Dissolved | <0.01 | 2.99 | 6.79 | 2.71 |

Field pH does not have a statistically significant difference between measured median values at a significance level of $\alpha$=0.05 for a one-tailed test. The median values for field pH for Site 48 and Site 6 are 7.84 mg/L and 7.85 mg/L respectively and the median of differences, Site 48 minus Site 6, is -0.01 mg/L.

The median values for field conductivity for Site 48 and Site 6 are 124.1 µS/cm and 128.1 µS/cm respectively. Median values for total alkalinity for Site 48 and Site 6 are 46.2 mg/L su and 46.7

mg/L respectively. The median values for total sulfate for Site 48 and Site 6 are 14.6 mg/L and 15.90 mg/L respectively.

Dissolved zinc results follow along in a similar manner where the median values for Site 48 and Site 6 are 2.99 µg/L and 6.79 µg/L respectively. Signed-rank test results for prior datasets for Water Years 2000 – 2013 show similar statistically significant differences with a median difference ranging from -1.7 µg/L to -4.77 µg/L dissolved zinc.

The magnitudes of these differences appear to have been relatively consistent over the past several years and do not appear to be increasing. Also, the magnitude of the relative differences is small with respect to field conductivity and well below the applicable AWQS in the case of total sulfate and dissolved zinc. Taking into consideration the small magnitude of the differences that are measurable between the two sites, the current FWMP program is sufficient to monitor future increases at Site 6. Thus, if an upward trend in total sulfate, or dissolved zinc at Site 6 is occurring, the current program is sufficient for identifying the change before any water quality values are impaired.

## Table of Results for Water Year 2014

### Site 006FMS - 'Greens Creek Middle'

| Sample Date/Parameter | Oct 2013 | Nov 2013 | Dec 2013 | Jan 2014 | Feb 2014 | Mar 2014 | Apr 2014 | May 2014 | Jun 2014 | Jul 2014 | Aug 2014 | Sep 2014 | **Median** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Water Temp (°C) | 5.4 | 1 | 1.1 | 0.2 | 0.0 | 0.9 | 0.9 | 2.9 | 4.4 | 9.4 | 8.4 | 8.7 | 2.0 |
| Conductivity-Field(μmho) | 110 | 146 | 150 | 52 | 157 | 159 | 189 | 98 | 97 | 115 | 121 | 135.2 | 128.1 |
| Conductivity-Lab (μmho) | 94 | 116 | 148 | 53 | 150 | 145 | 173 | 97 | 98 | 114 | 113 | 136 | 115 |
| pH Lab (standard units) | 7.78 | 7.78 | 7.79 | 7.16 | 7.38 | 7.58 | 7.69 | 7.24 | 7.81 | 7.74 | 7.5 | 7.78 | 7.72 |
| pH Field (standard units) | 7.84 | 7.88 | 7.88 | 7.34 | 7.68 | 7.81 | 7.85 | 7.59 | 7.77 | 7.85 | 7.87 | 8.13 | 7.85 |
| Total Alkalinity (mg/L) | 39.6 | 50.1 | 52 | 18.5 | 52.6 | 51.6 | 55.7 | 34.7 | 36.1 | 40.4 | 43.3 | 50.2 | 46.7 |
| Total Sulfate (mg/L) | 10.7 | 17.9 | 20.2 | 5.2 | 21.7 | 23.1 | 25.6 | 9.3 | 9.5 | 12.1 | 12.3 | 15.9 | 14.1 |
| Hardness (mg/L) | 50.4 | 67.4 | 69.3 | 21.9 | 69.5 | 72.1 | 80.8 | 43.8 | 43.2 | 51.3 | 55.1 | 66.1 | 60.6 |
| Dissolved As (ug/L) | 0.22 | 0.189 | 0.195 | 0.242 | 0.174 | 0.183 | 0.171 | 0.195 | 0.198 | 0.23 | 0.221 | 0.247 | 0.197 |
| Dissolved Ba (ug/L) | | | 30.5 | | 32.7 | | 32.1 | | | | | | 32.1 |
| Dissolved Cd (ug/L) | 0.0512 | 0.0504 | 0.0479 | 0.0828 | 0.0621 | 0.0523 | 0.0471 | 0.0342 | 0.0316 | 0.0372 | 0.043 | 0.047 | 0.0475 |
| Dissolved Cr (ug/L) | | | 0.248 | | 1.11 | | 0.218 | | | | | | 0.248 |
| Dissolved Cu (ug/L) | 0.652 | 0.34 | 0.399 | 1.67 | 0.411 | 0.517 | 0.311 | 0.51 | 0.267 | 0.302 | 0.493 | 0.397 | 0.405 |
| Dissolved Pb (ug/L) | 0.0172 | 0.0066 | 0.0054 | 0.406 | 0.0175 | 0.0397 | 0.0073 | 0.0092 | 0.0145 | 0.0056 | 0.0093 | 0.006 | 0.0093 |
| Dissolved Ni (ug/L) | | | 0.625 | | 0.719 | | 0.663 | | | | | | 0.663 |
| Dissolved Ag (ug/L) | | | 0.002 | | 0.002 | | 0.002 | | | | | | 0.002 |
| Dissolved Zn (ug/L) | 6.53 | 7.05 | 7.12 | 11.4 | 9.78 | 9.69 | 7.61 | 4.77 | 3.3 | 3.38 | 5.13 | 5.54 | 6.79 |
| Dissolved Se (ug/L) | | | 1.08 | | 1.48 | | 1.46 | | | | | | 1.460 |
| Dissolved Hg (ug/L) | 0.00129 | 0.000522 | 0.000475 | 0.00442 | 0.000506 | 0.000768 | 0.000605 | 0.00782 | 0.00055 | 0.000462 | 0.000819 | 0.000667 | 0.000636 |

For individual sample/analyte qualifier descriptions see "Qualified Data by QA Reviewer" table.

Values reported as less than MDL are replaced by 1/2 MDL for median calculation purposes.

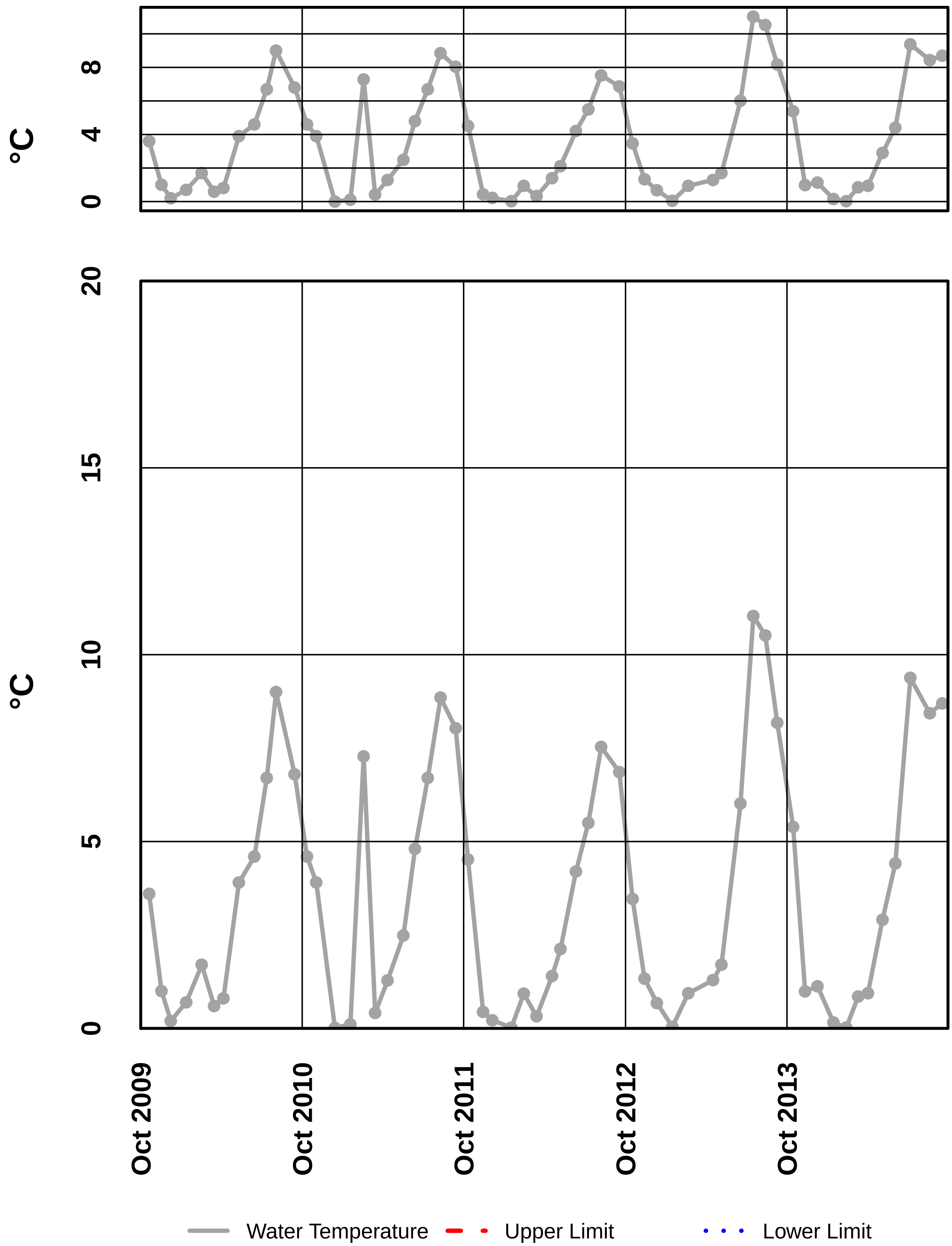
Shaded data has been qualified as an outlier by HGCMC and removed from any further analysis and is not included into the calculation of the median

# Qualified Data by QA Reviewer

## Date Range: 10/01/2013 to 09/30/2014

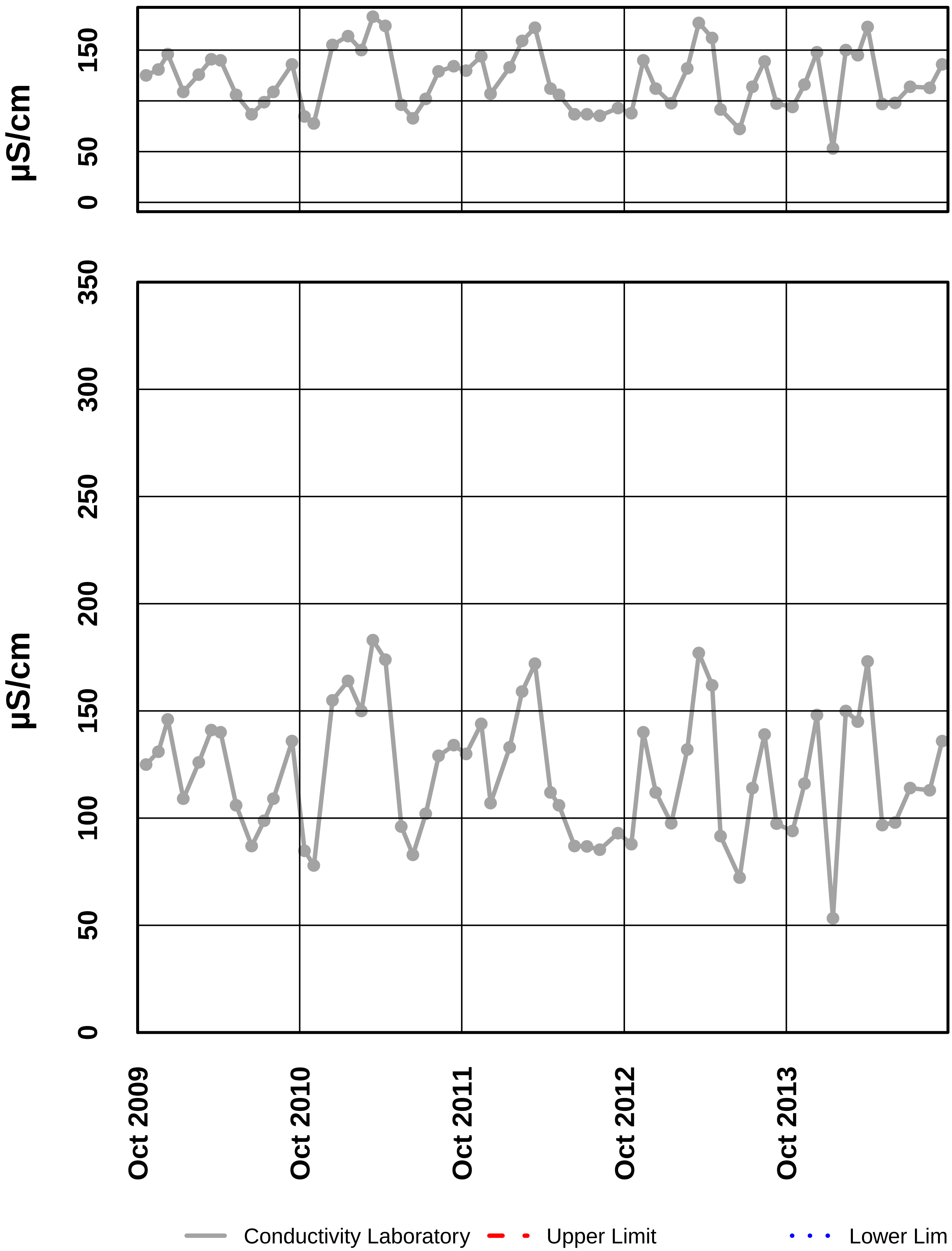
| Site No. | Sample Date | Sample Time | Parameter | Value | Qualifier | Reason for Qualifier |
|---|---|---|---|---|---|---|
| 006FMS | 11/11/2013 | 12:00 PM | Diss. Pb-ICP/MS | 0.00655 | J | Below Quantitative Range |
| | | | pH | 7.78 | J | Hold Time Violation |
| 006FMS | 12/9/2013 | 12:00 PM | Diss. Ni-ICP/MS | 0.62 | U | Field Blank Contamination |
| | | | Diss. Pb-ICP/MS | 0.00537 | U | Field Blank Contamination |
| 006FMS | 1/14/2014 | 12:00 PM | pH | 7.16 | J | Hold Time Violation |
| 006FMS | 2/12/2014 | 12:00 PM | Diss. Cu-ICP/MS | 0.41 | J | LCS Recovery |
| | | | Sulfate | 21.7 | J | Sample Receipt Temperature |
| 006FMS | 4/2/2014 | 12:00 PM | Diss. Pb-ICP/MS | 0.0073 | J | Below Quantitative Range |
| | | | Diss. Se-ICP/MS | 1.46 | J | Duplicate RPD |
| | | | pH | 7.69 | J | Hold Time Violation |
| 006FMS | 6/3/2014 | 12:00 PM | Diss. Zn-ICP/MS | 3.3 | U | Field Blank Contamination |
| 006FMS | 7/7/2014 | 12:00 PM | Diss. Pb-ICP/MS | 0.00556 | J | Below Quantitative Range |
| | | | Sulfate | 12.1 | J | Sample Receipt Temperature |
| 006FMS | 9/17/2014 | 12:00 PM | Diss. Pb-ICP/MS | 0.00597 | J | Below Quantitative Range |

# Site 6 – Water Temperature

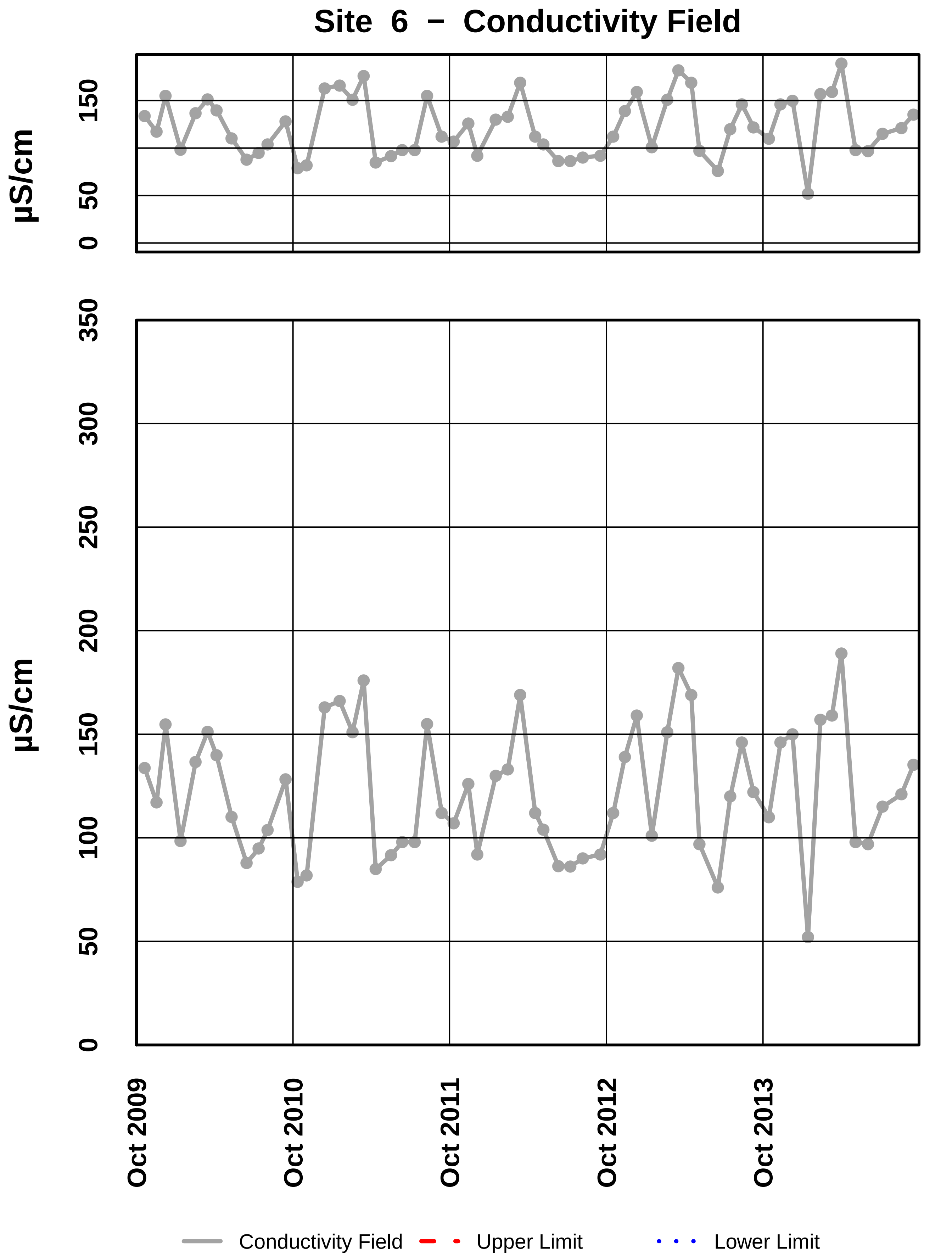



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

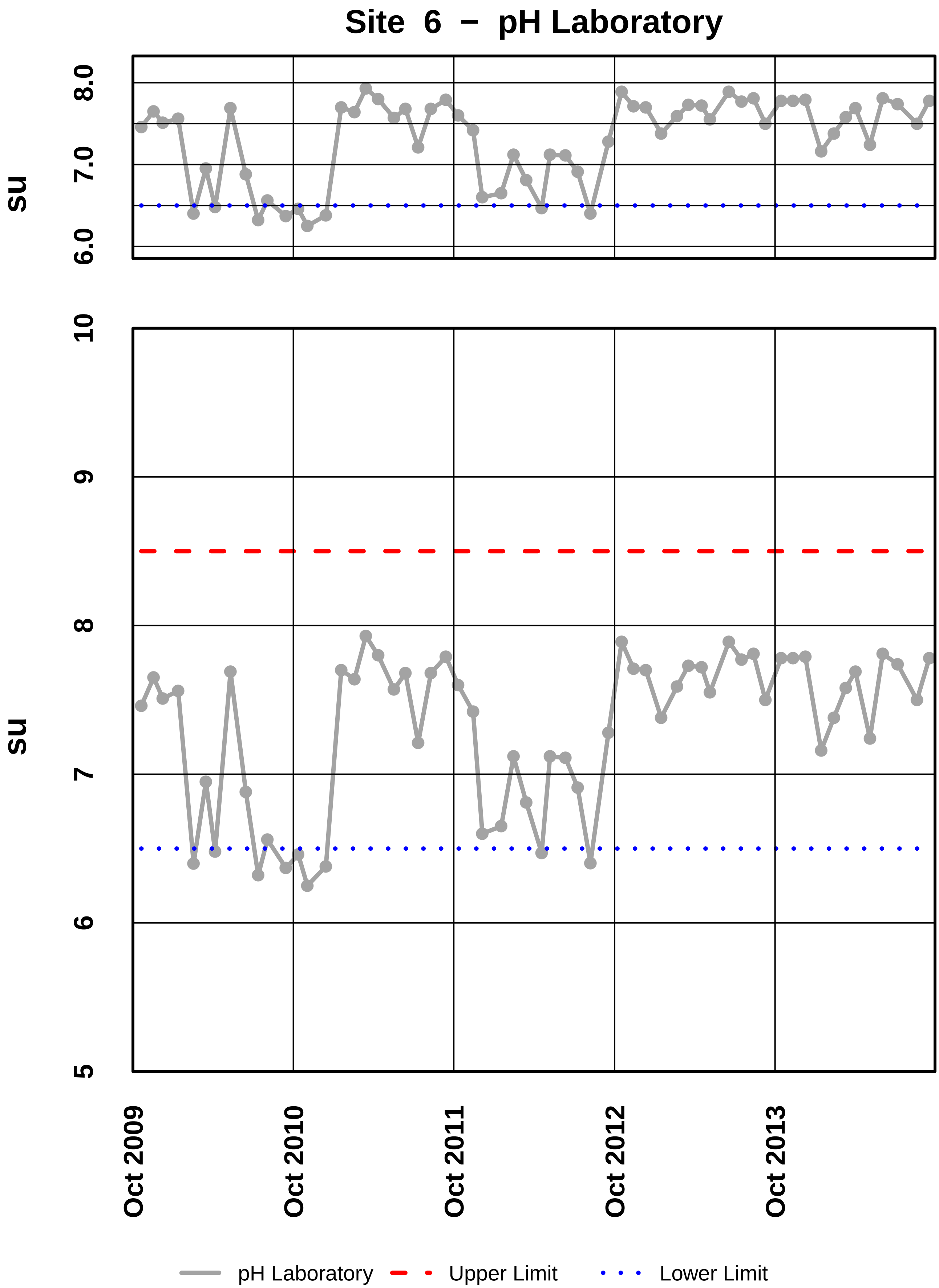
## Site 6 – Conductivity Laboratory




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

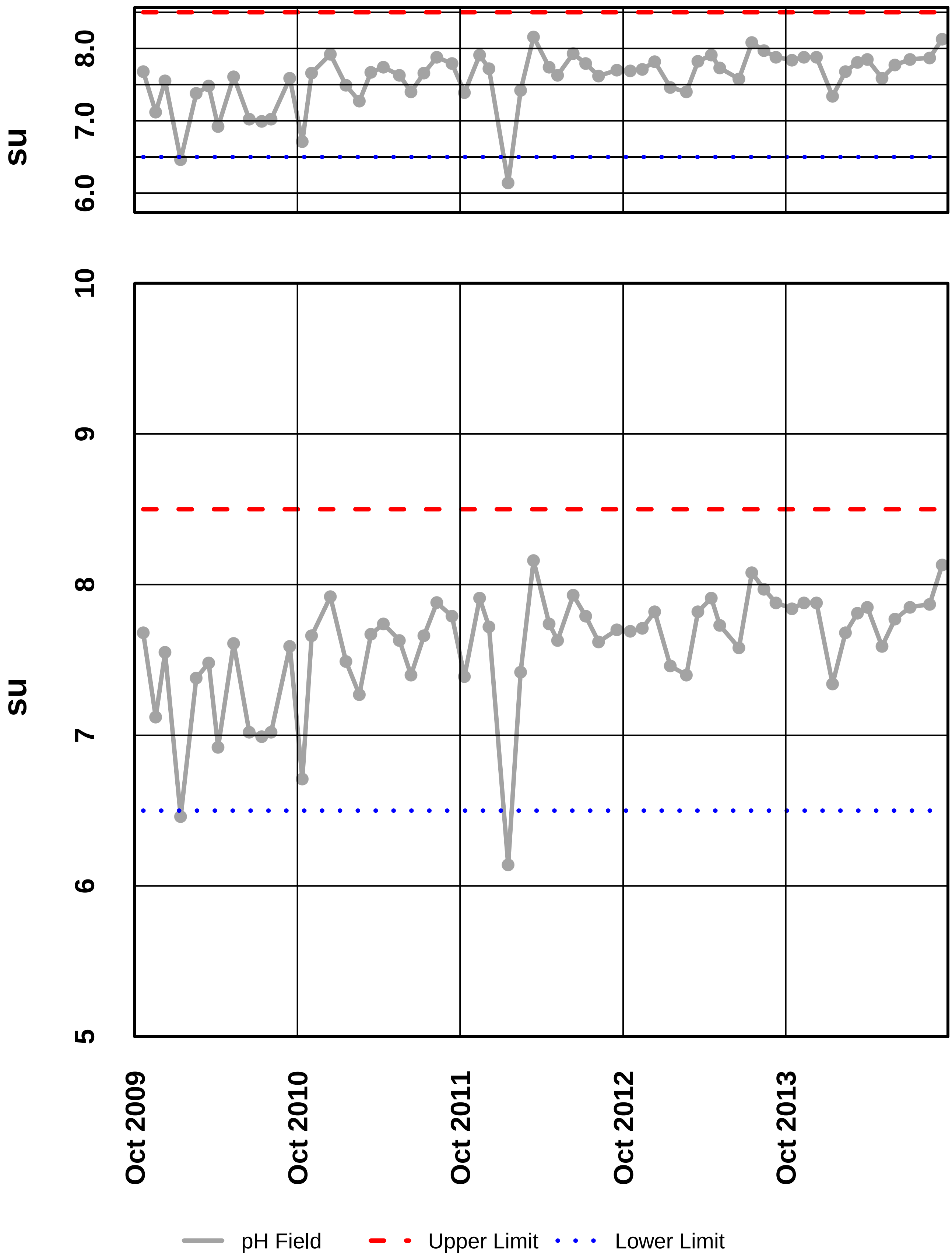



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

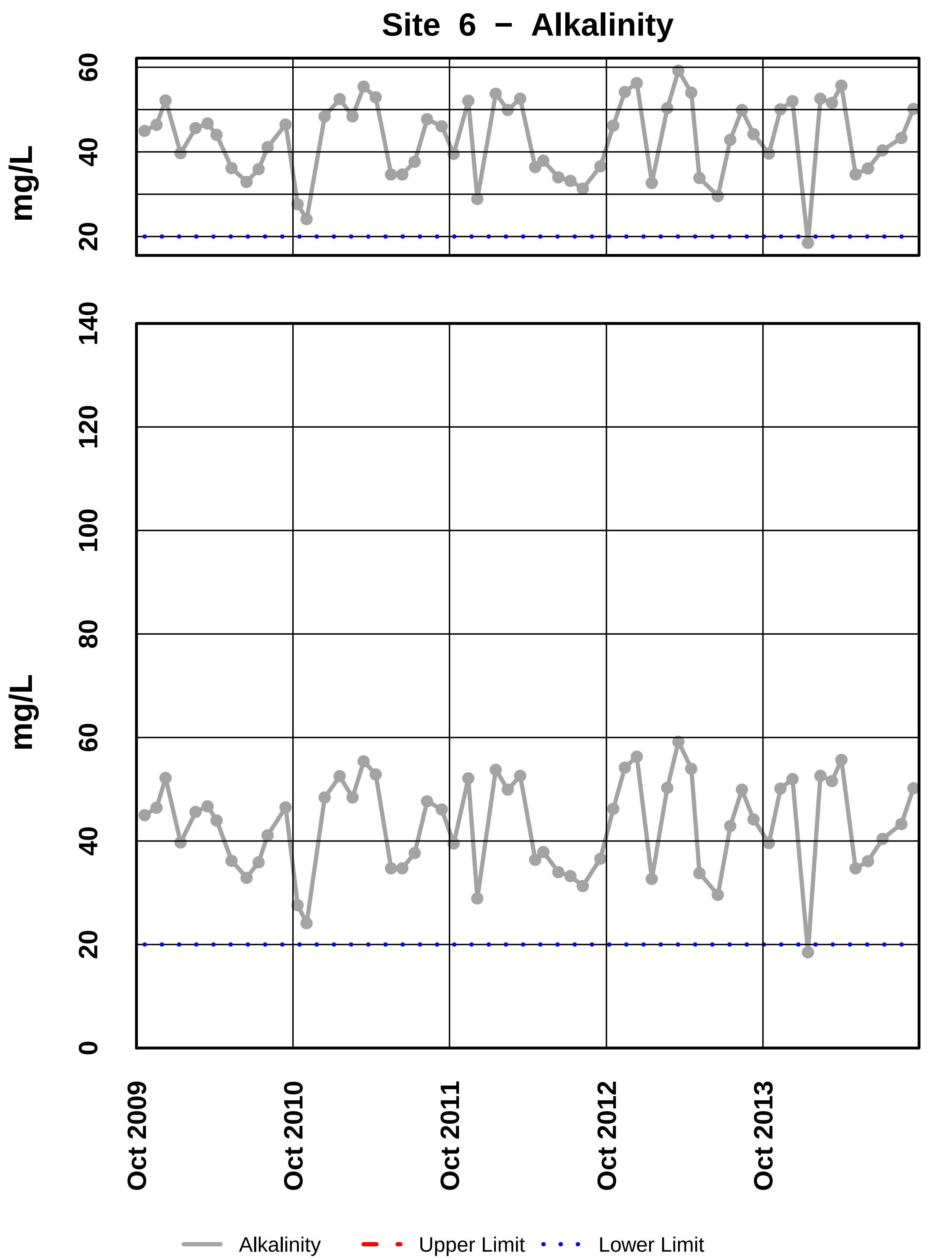



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

## Site 6 – pH Field

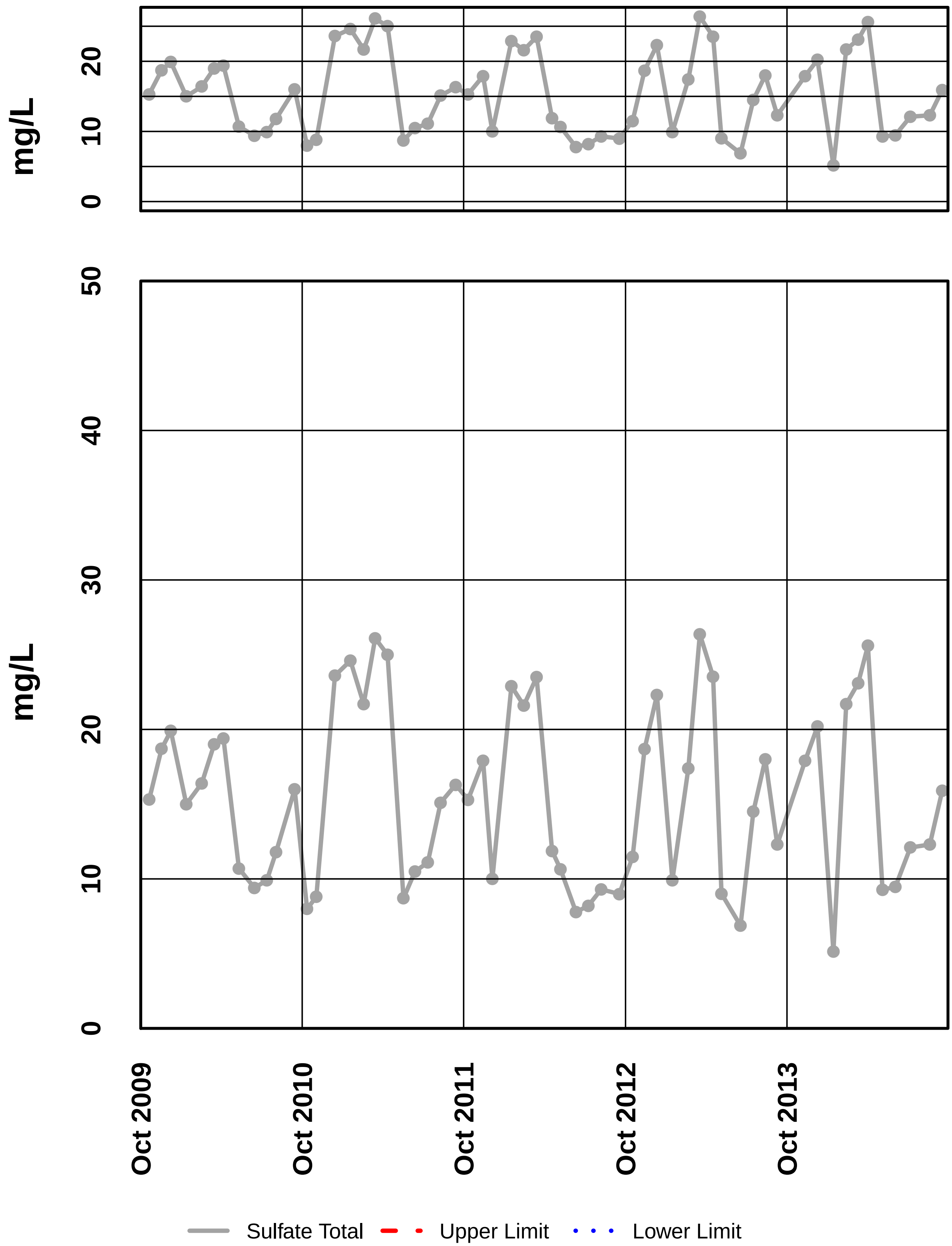



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



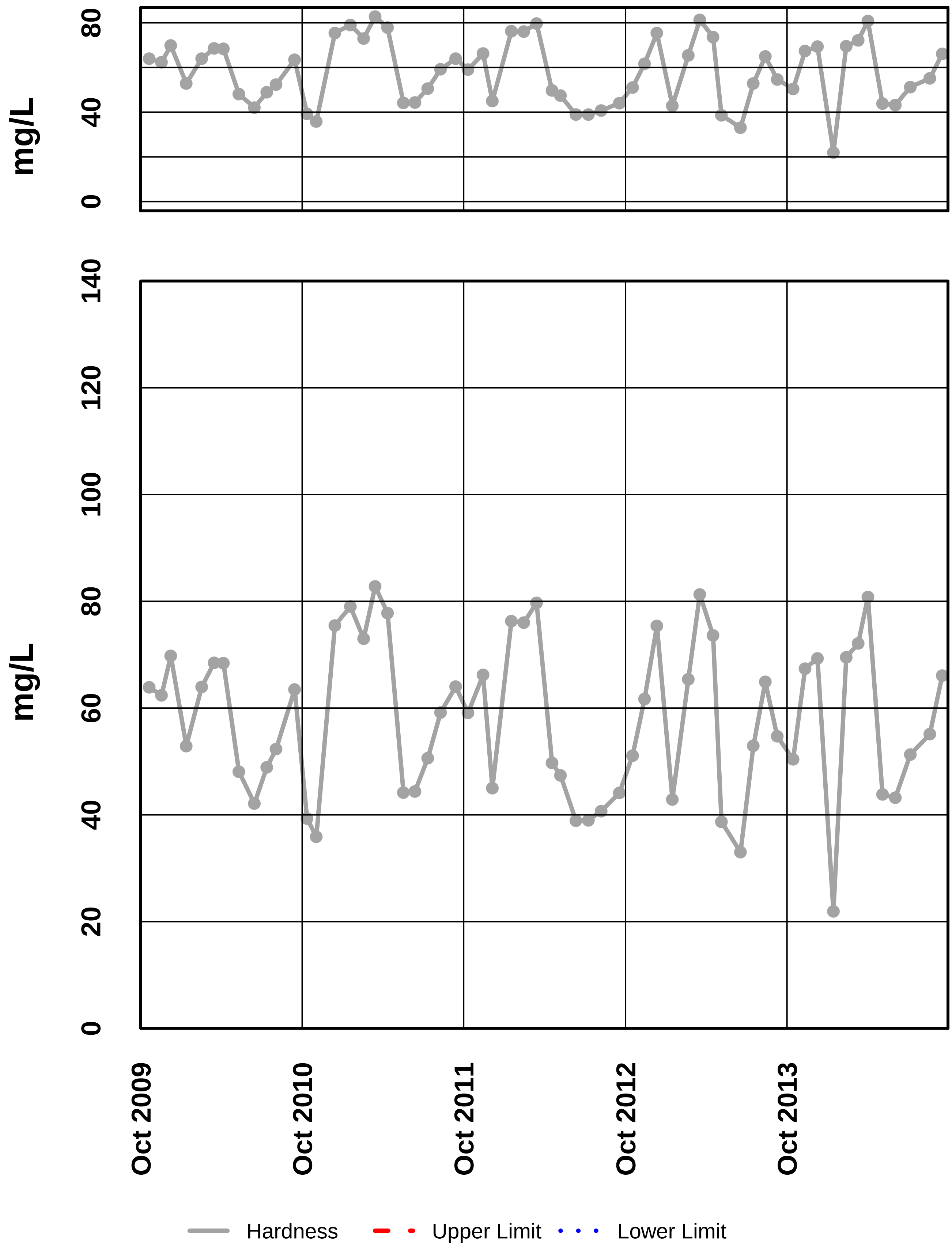

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

## Site 6 – Sulfate Total



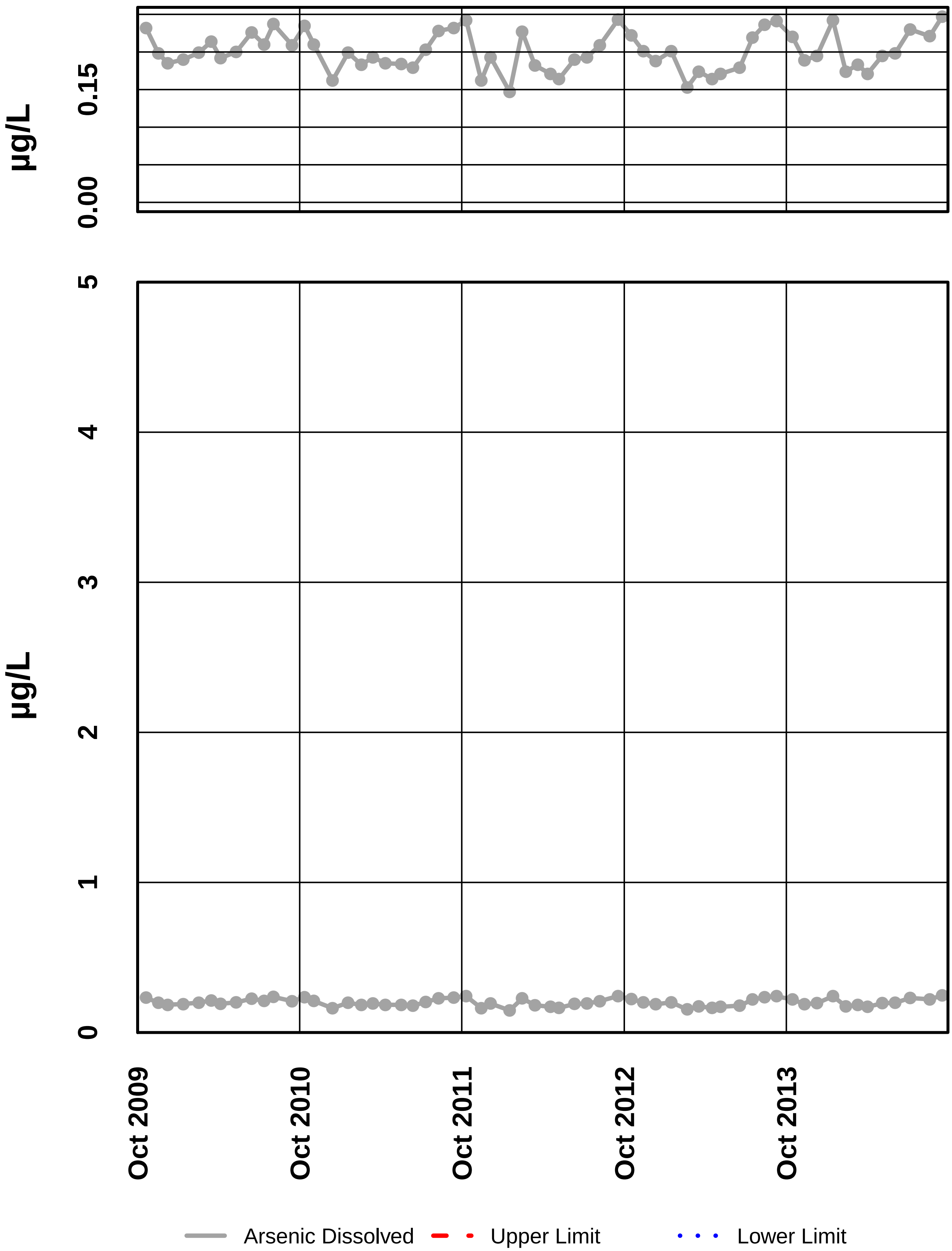

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# Site 6 − Hardness

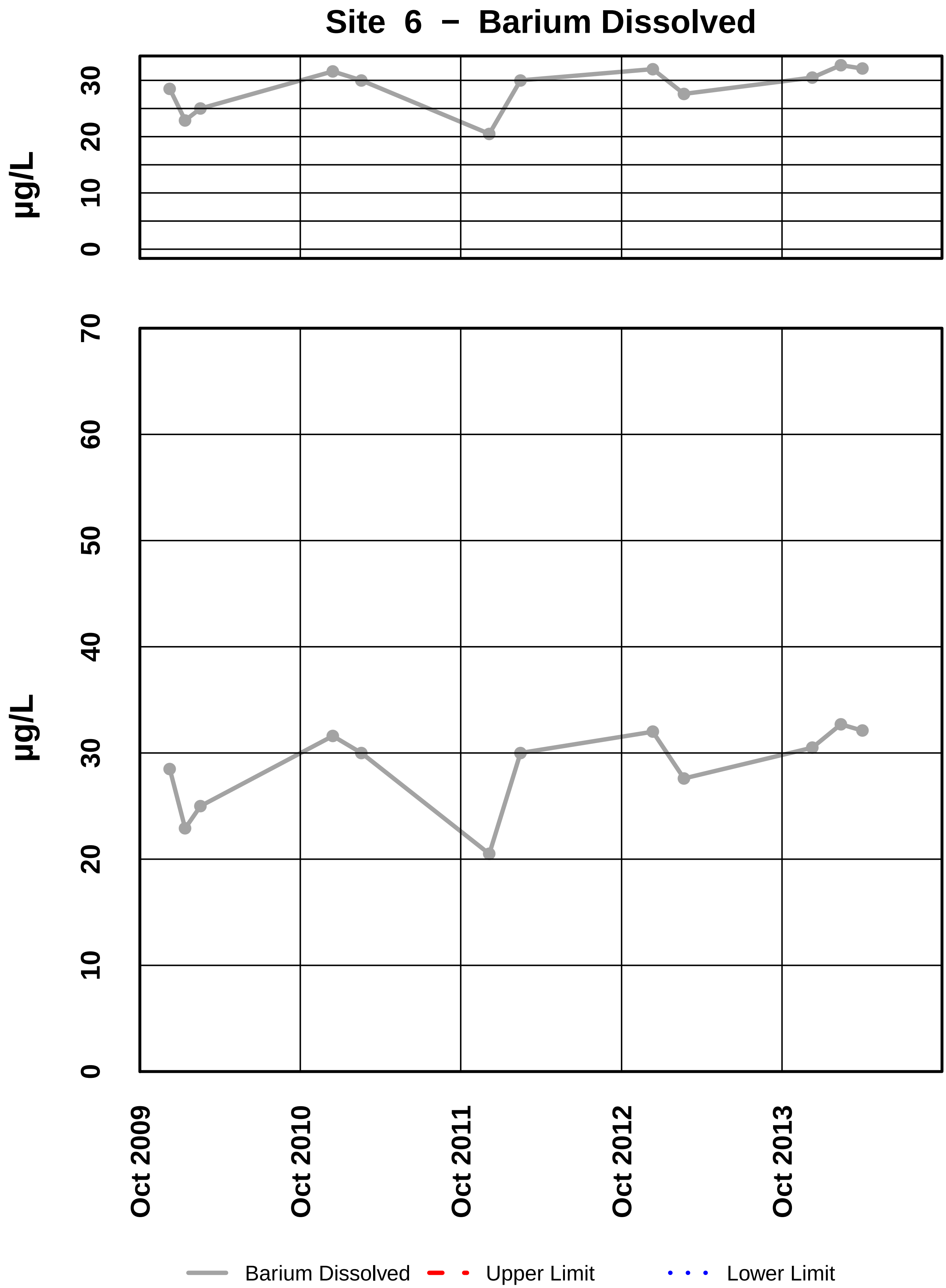



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# Site 6 – Arsenic Dissolved

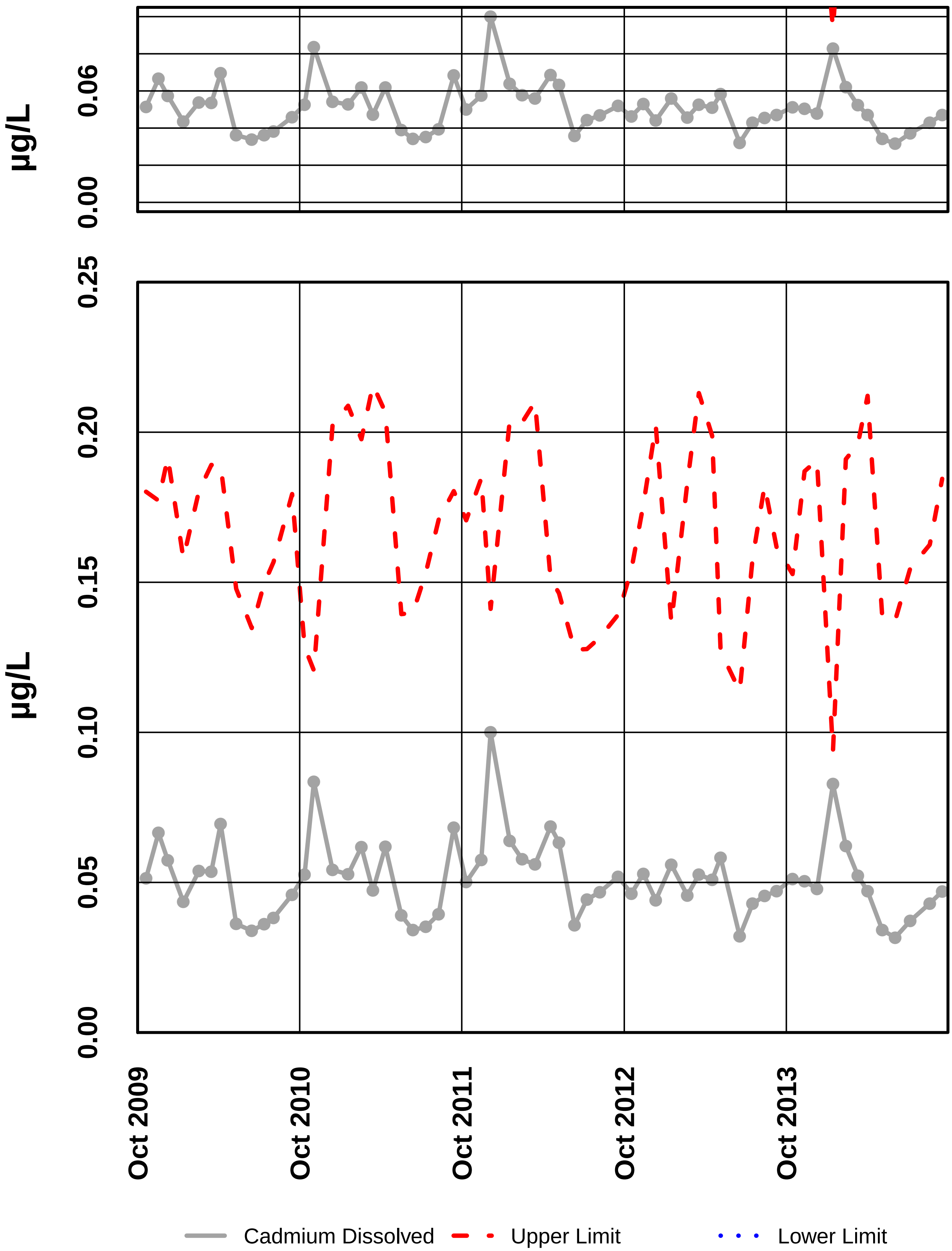



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



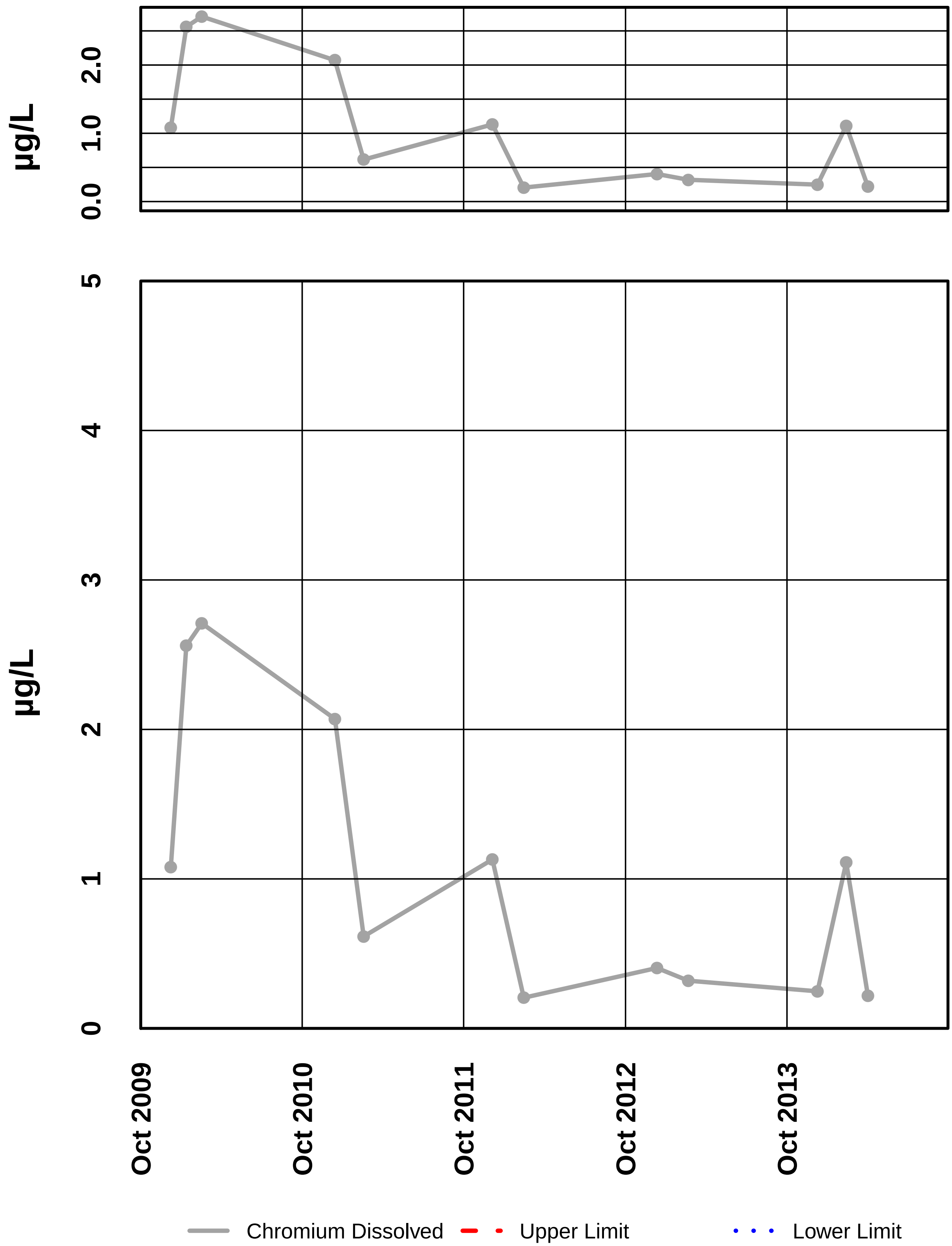

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# Site 6 – Cadmium Dissolved

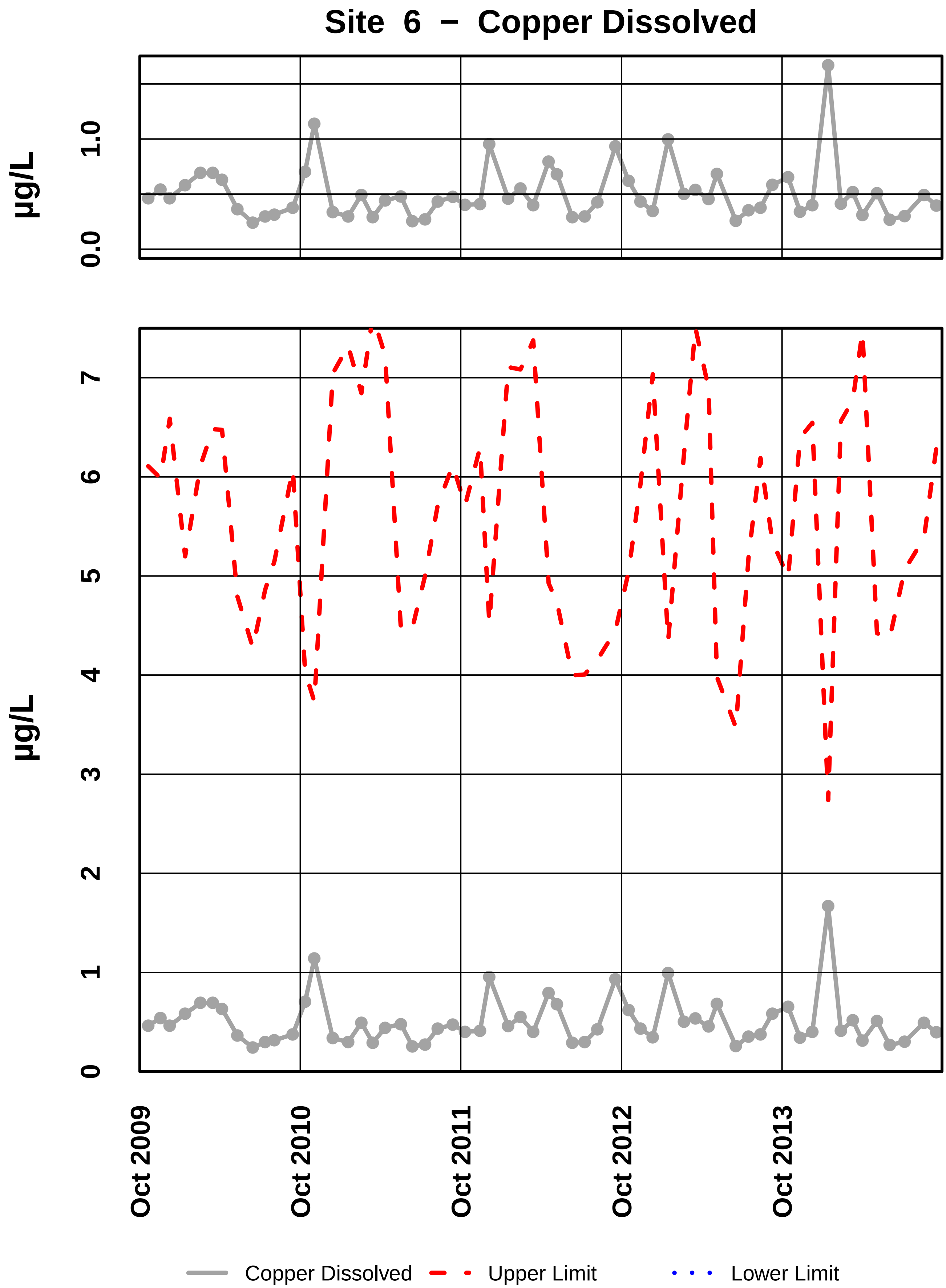



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

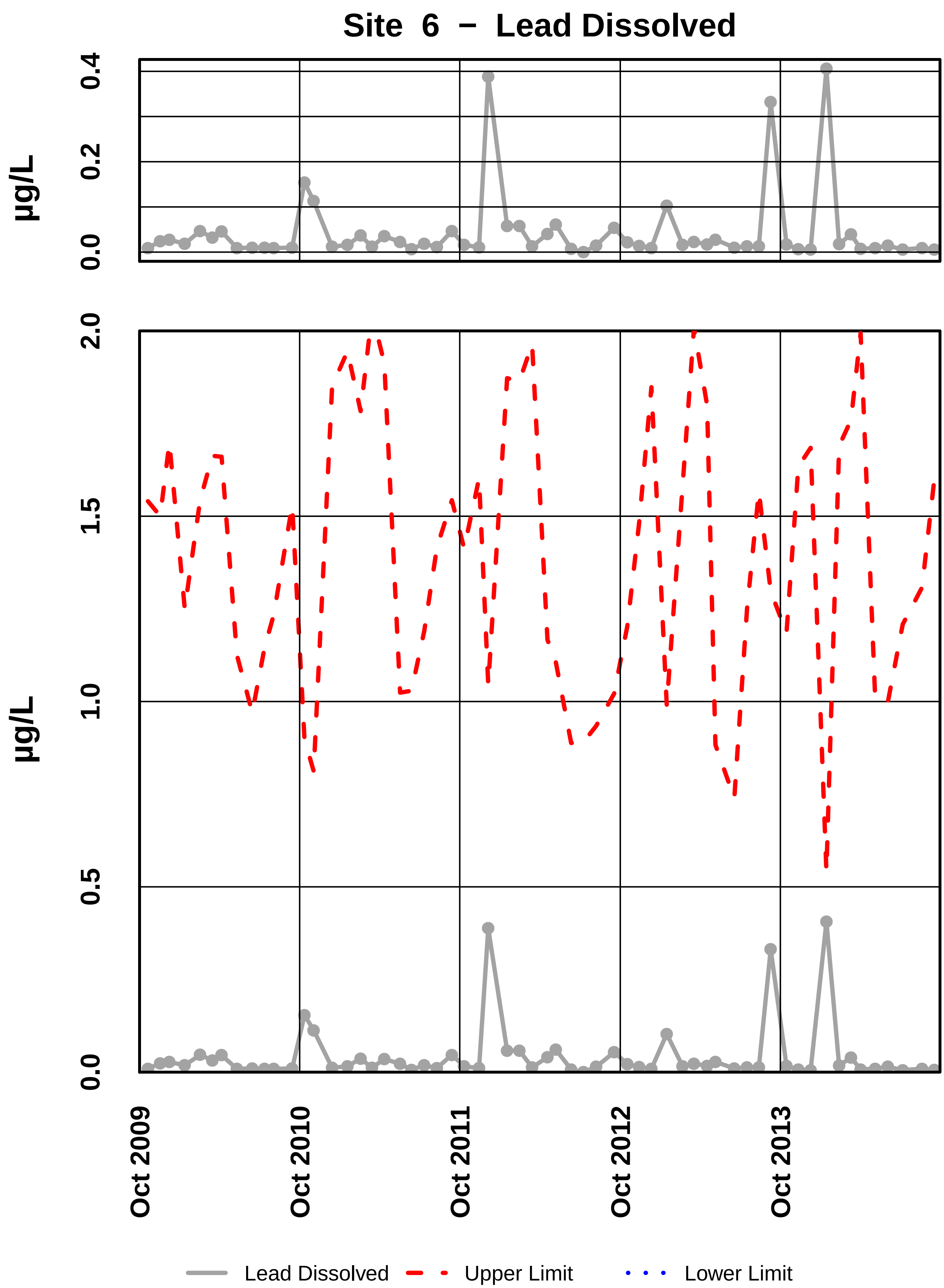
Site 6 − Chromium Dissolved



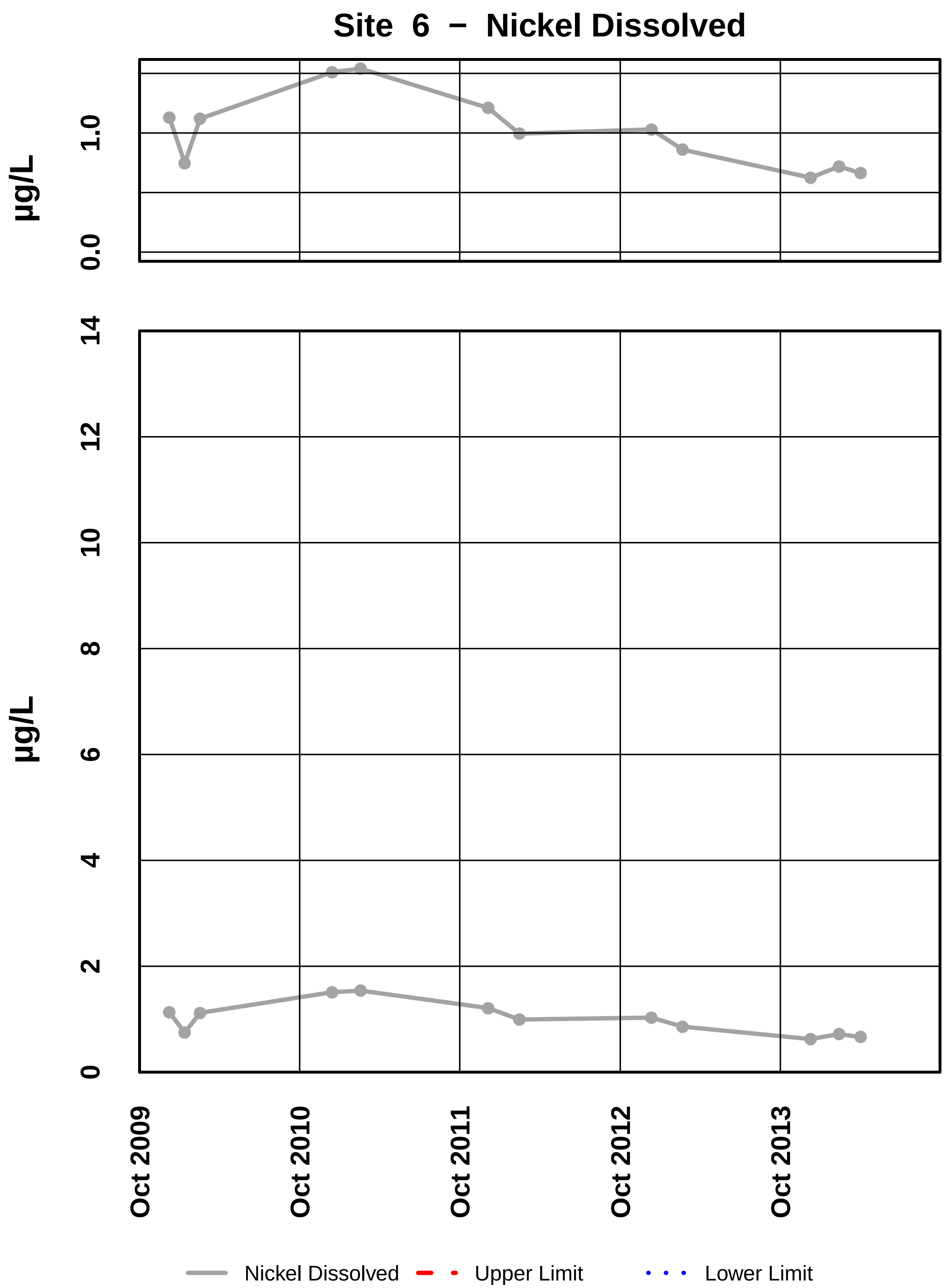

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



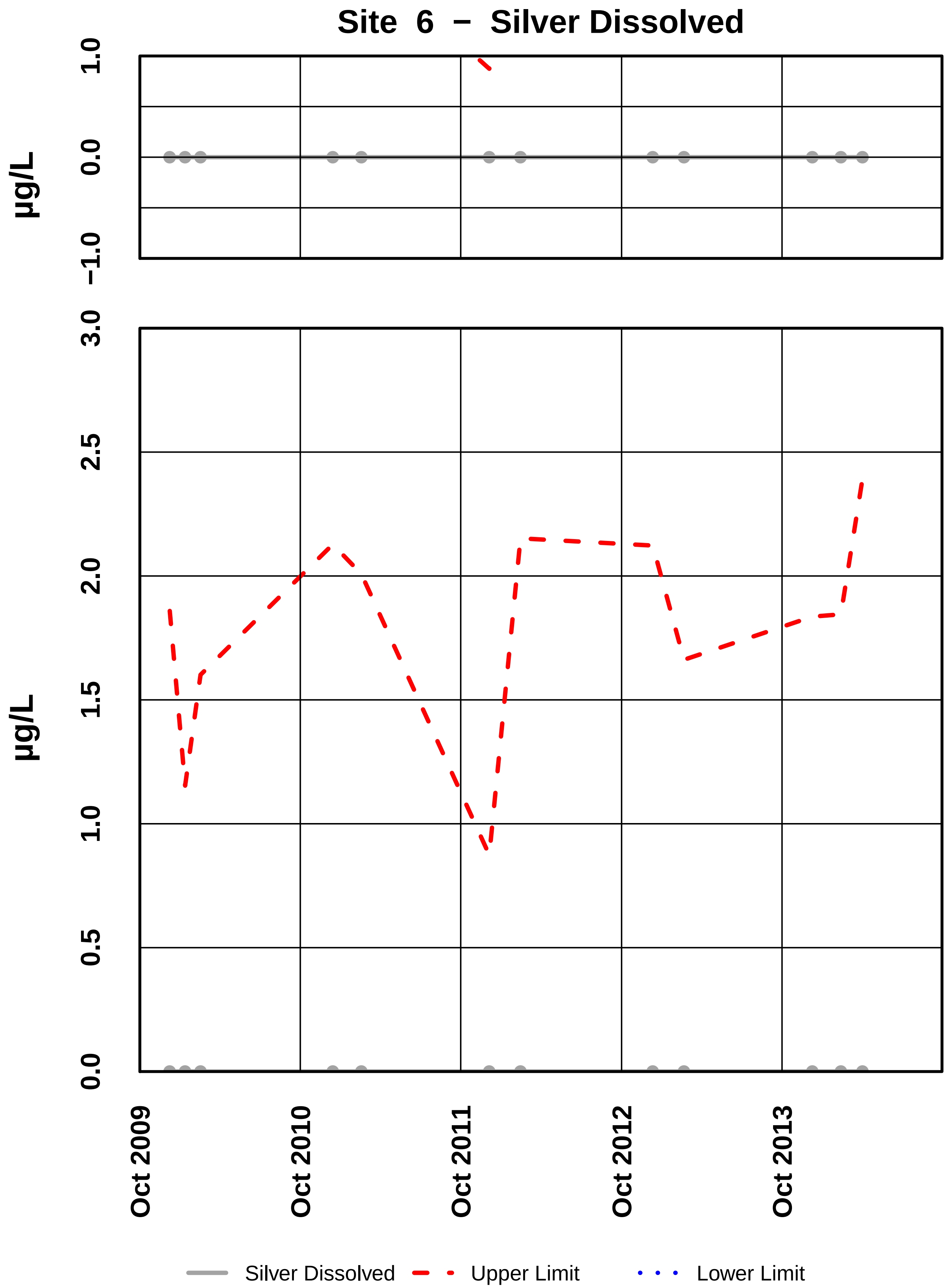

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



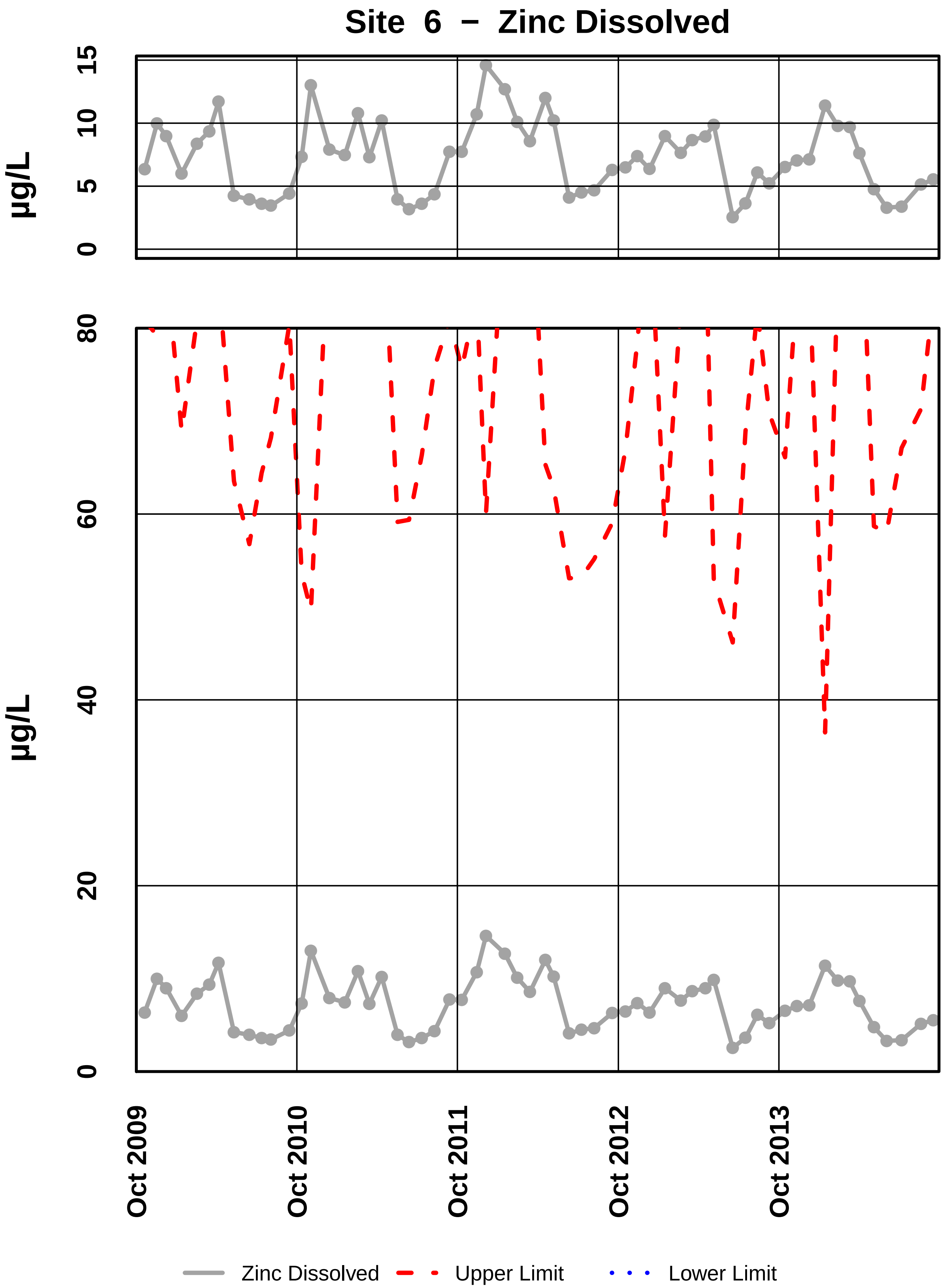

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



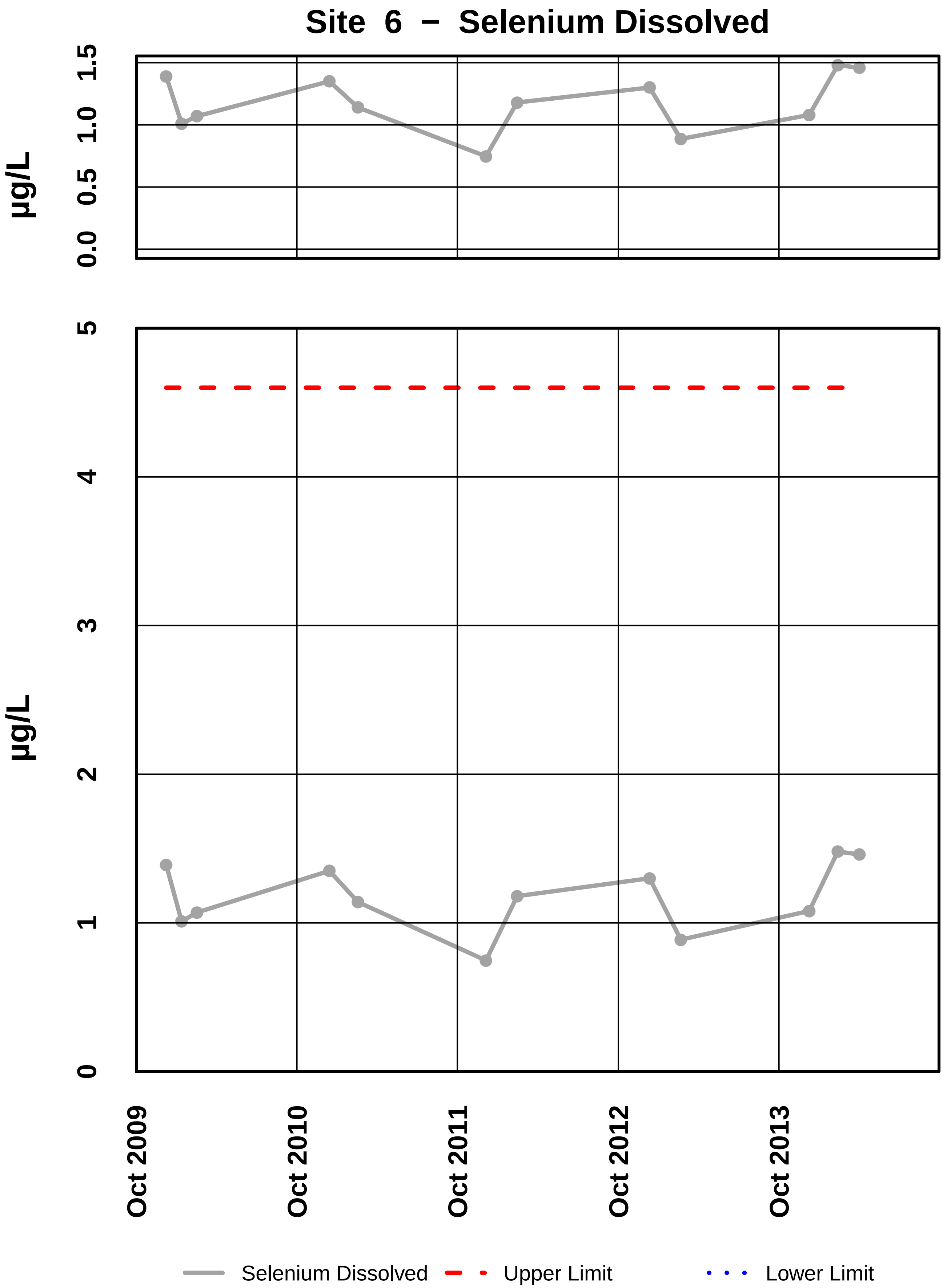

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



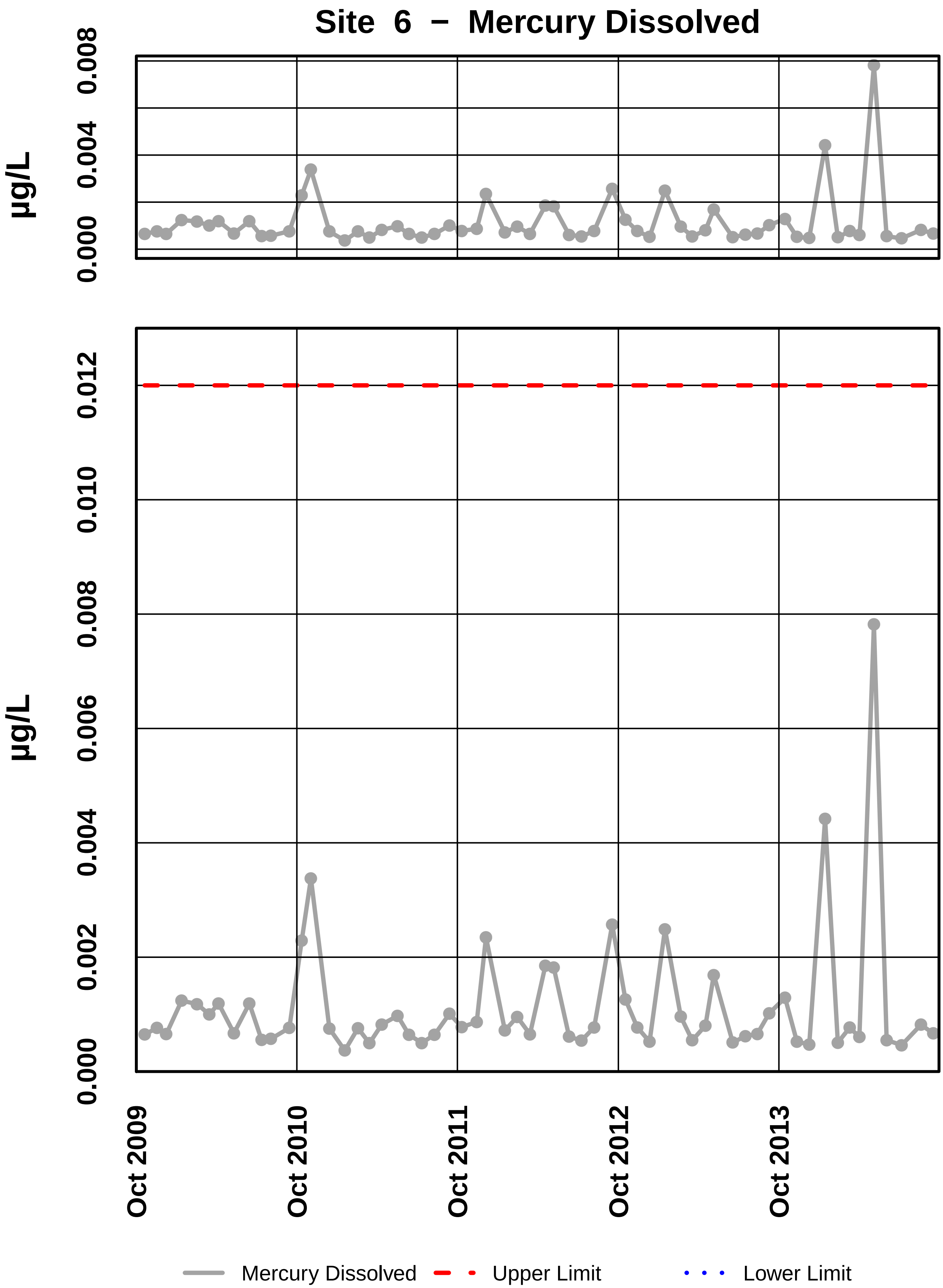

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



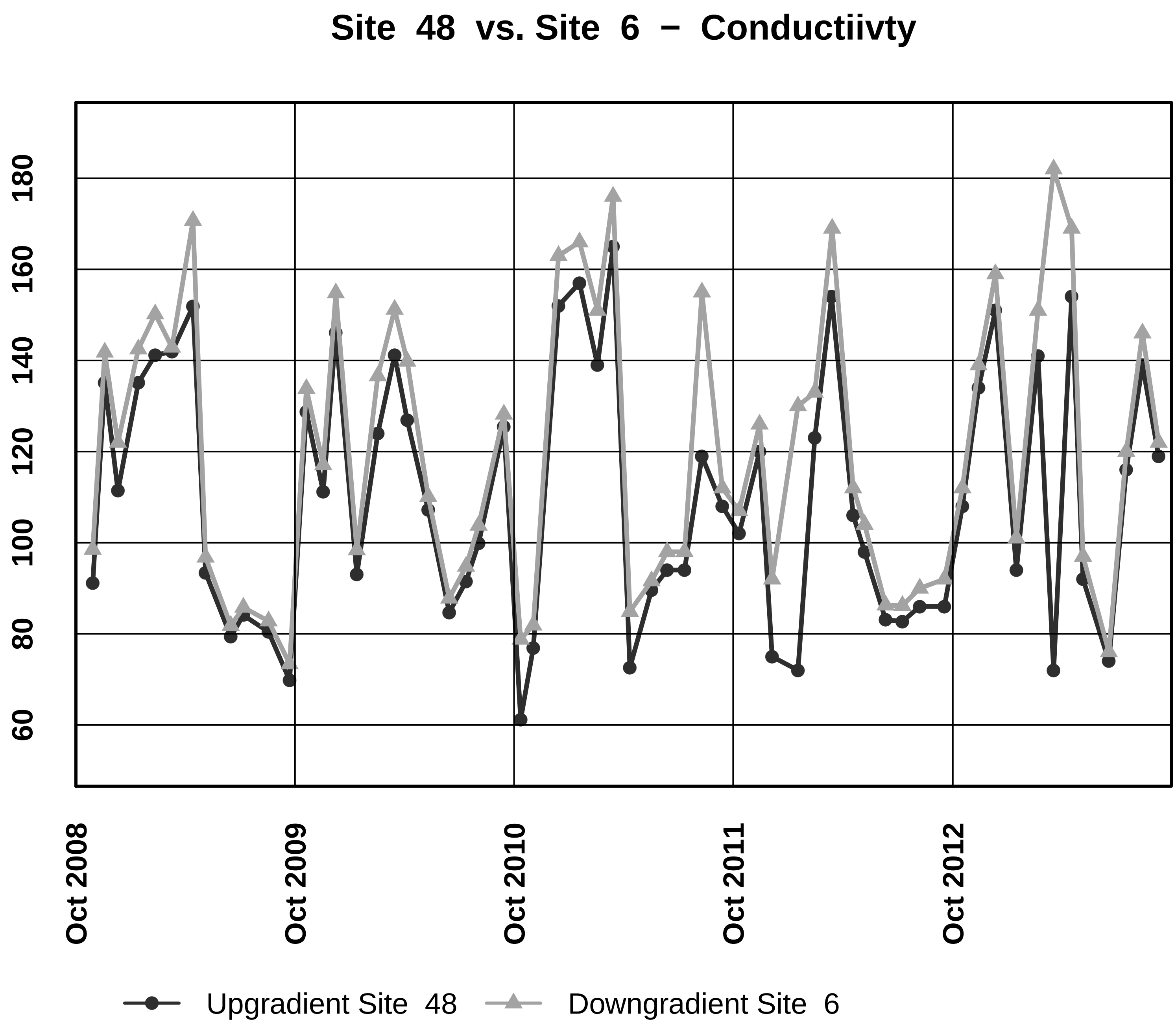

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

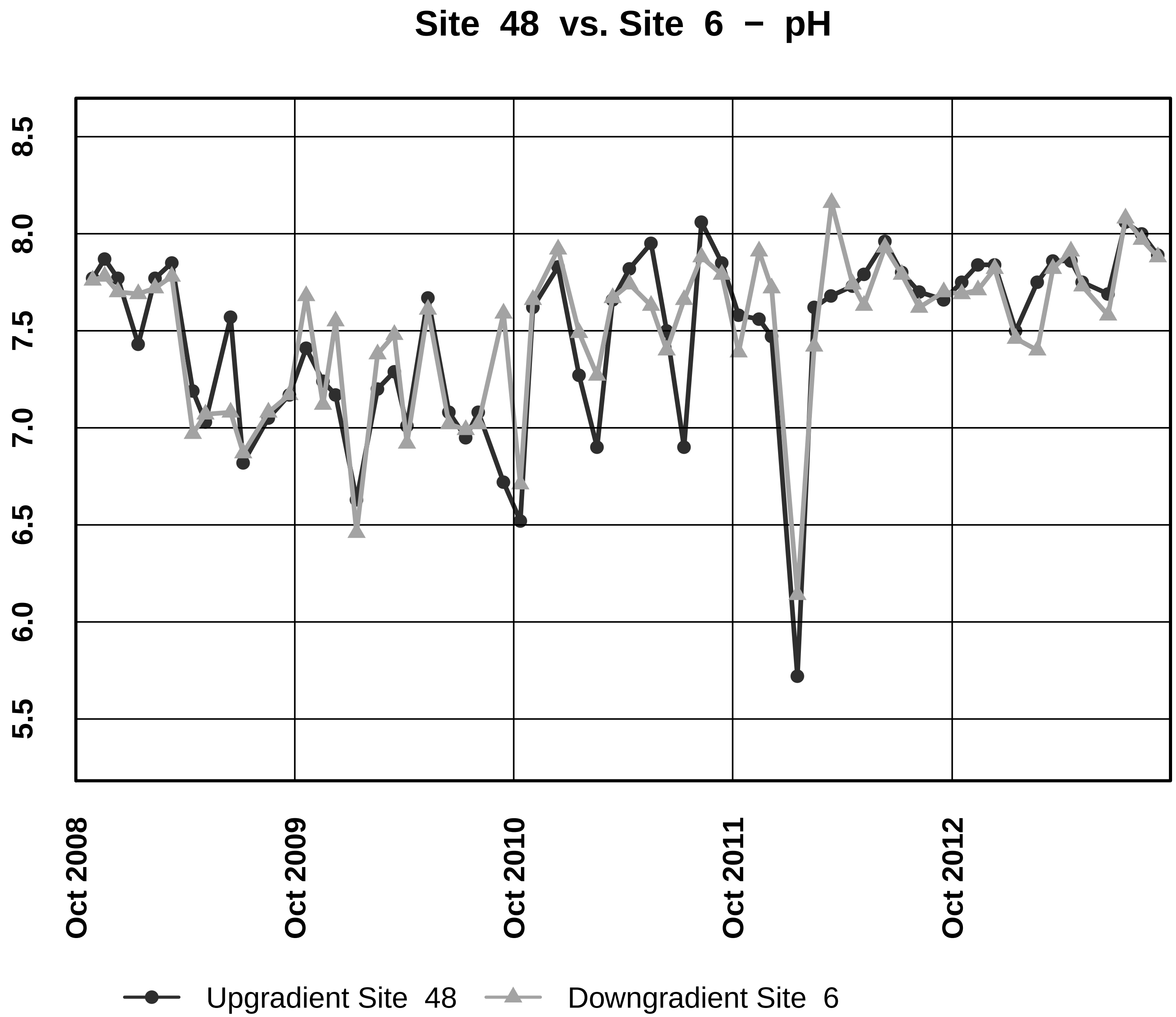



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

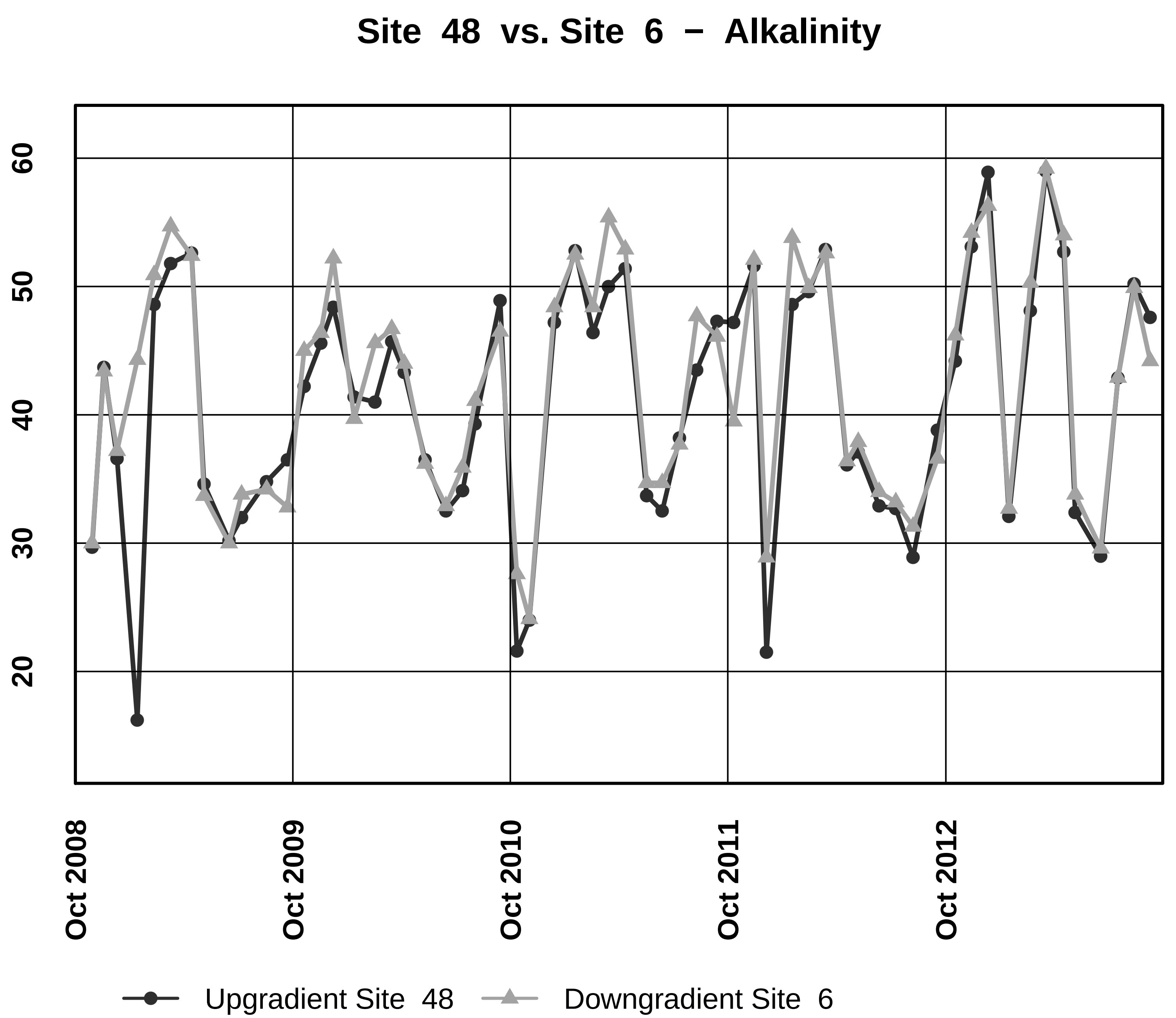



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis


Site 48 vs. Site 6 − Conductiivty
60
80
100
120
140
160
180
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Oct 2012
Upgradient Site 48
Downgradient Site 6

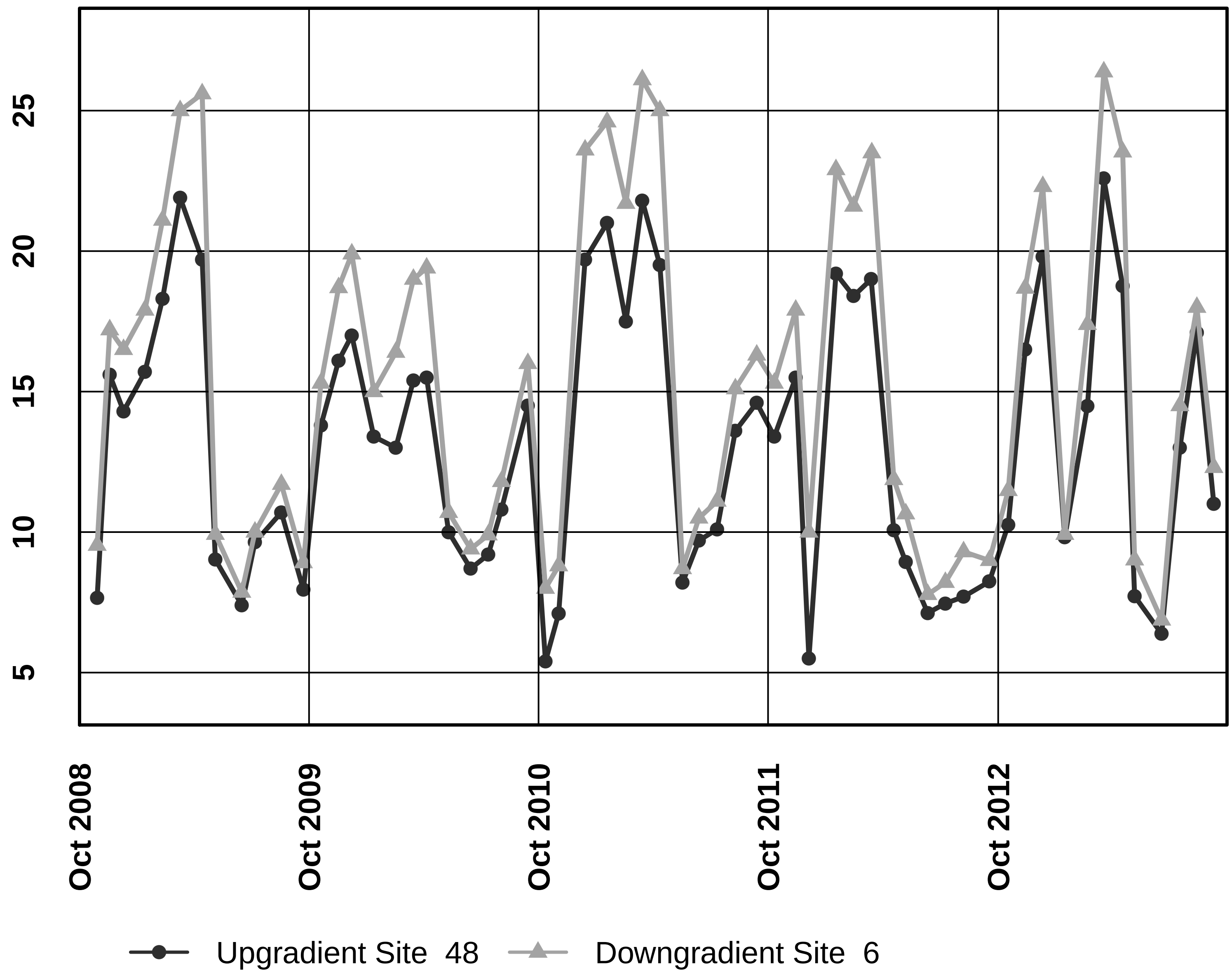


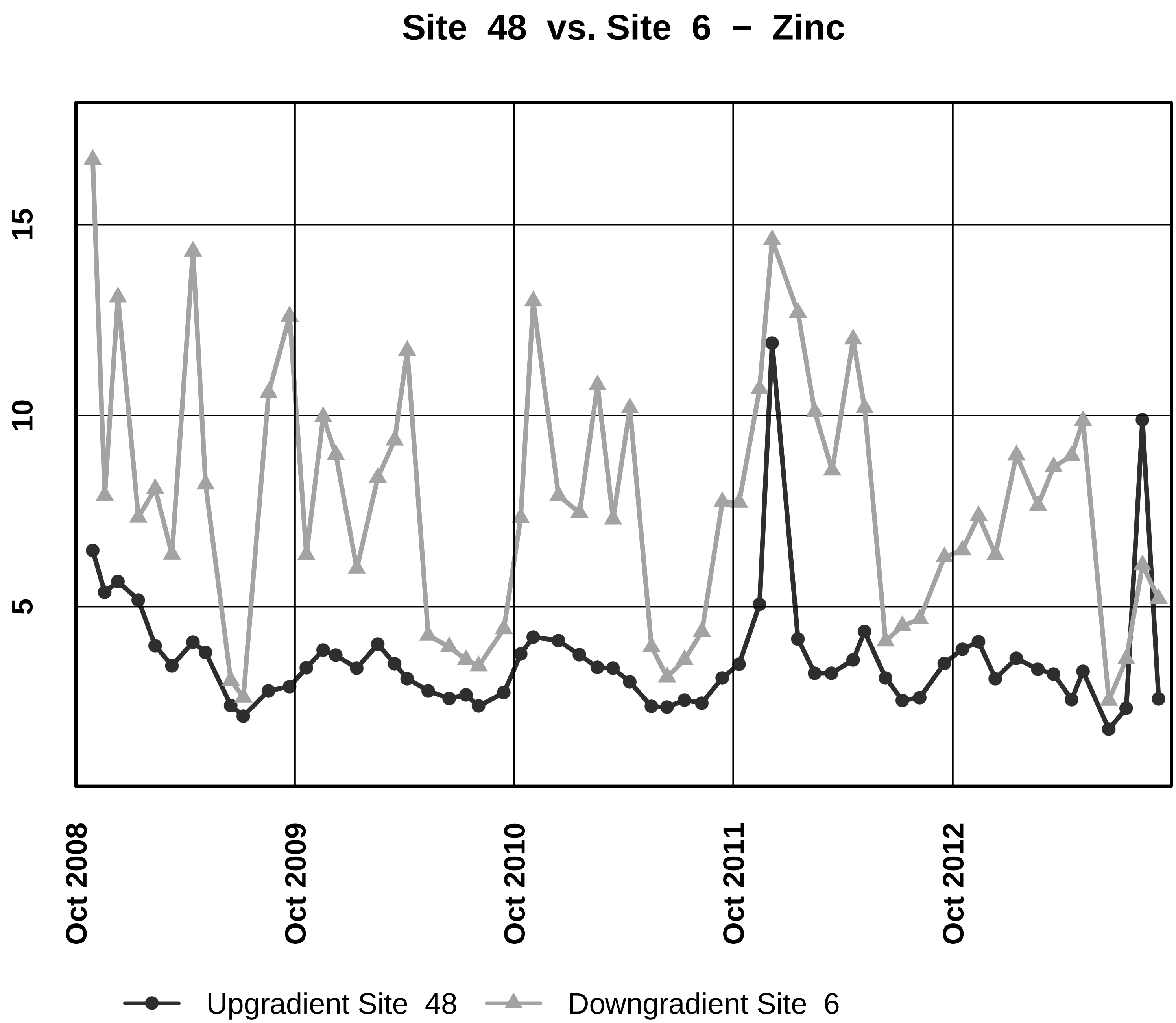
Site 48 vs. Site 6 − pH
8.5
8.0
7.5
7.0
6.5
6.0
5.5
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Oct 2012
Upgradient Site 48
Downgradient Site 6



Site 48 vs. Site 6 − Alkalinity
20
30
40
50
60
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Oct 2012
Upgradient Site 48
Downgradient Site 6

## Site 48 vs. Site 6 − Sulfate





Site 48 vs. Site 6 − Zinc
15
10
5
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Oct 2012
Upgradient Site 48
Downgradient Site 6

**Wilcoxon-signed-ranks test**
**Exact Form**

Variable: **Specific Conductance, Field (µS/cm)**

| Site | X #48 | Y #6 | Differences | | |
|---|---|---|---|---|---|
| Year | WY2014 | WY2014 | **D** | **\|D\|** | **Rank** |
| Oct | 106.0 | 110.0 | -4.0 | 4.0 | -4.5 |
| Nov | 139.0 | 146.0 | -7.0 | 7.0 | -9 |
| Dec | 144.0 | 150.0 | -6.0 | 6.0 | -7.5 |
| Jan | 44.0 | 52.0 | -8.0 | 8.0 | -10 |
| Feb | 151.0 | 157.0 | -6.0 | 6.0 | -7.5 |
| Mar | 147.0 | 159.0 | -12.0 | 12.0 | -12 |
| Apr | 180.0 | 189.0 | -9.0 | 9.0 | -11 |
| May | 95.0 | 98.0 | -3.0 | 3.0 | -1.5 |
| Jun | 94.0 | 97.0 | -3.0 | 3.0 | -1.5 |
| Jul | 111.0 | 115.0 | -4.0 | 4.0 | -4.5 |
| Aug | 117.0 | 121.0 | -4.0 | 4.0 | -4.5 |
| Sep | 131.2 | 135.2 | -4.0 | 4.0 | -4.5 |
| Median | 124.1 | 128.1 | -5.0 | 5.0 | |

| n | m |
|---|---|
| 12 | 12 |

**N**= 12

$\Sigma$R= -78

| $\alpha$ |
|---|
| 0.05 |
| **W'**$\alpha$,n |
| 17 |

| $W^+$= |
|---|
| **0** |
| p-test |
| 0.000 |

| | | |
|---|---|---|
| $H_0$ | median [D]=0 | **REJECT** |
| $H_1$ | median [D]<0 | **ACCEPT** |

**Wilcoxon-signed-ranks test**
**Exact Form**

Variable: **pH, Field, Standard Units**

| | **X** | **Y** | | | |
|---|---|---|---|---|---|
| Site | #48 | #6 | Differences | | |
| Year | WY2014 | WY2014 | **D** | **\|D\|** | **Rank** |
| Oct | 7.87 | 7.84 | 0.03 | 0.03 | 6.5 |
| Nov | 7.91 | 7.88 | 0.03 | 0.03 | 6.5 |
| Dec | 7.85 | 7.88 | -0.03 | 0.03 | -9.5 |
| Jan | 7.31 | 7.34 | -0.03 | 0.03 | -9.5 |
| Feb | 7.66 | 7.68 | -0.02 | 0.02 | -3.5 |
| Mar | 7.82 | 7.81 | 0.01 | 0.01 | 1 |
| Apr | 7.82 | 7.85 | -0.03 | 0.03 | -6.5 |
| May | 7.70 | 7.59 | 0.11 | 0.11 | 11 |
| Jun | 7.75 | 7.77 | -0.02 | 0.02 | -3.5 |
| Jul | 7.85 | 7.85 | 0.00 | | |
| Aug | 7.90 | 7.87 | 0.03 | 0.03 | 6.5 |
| Sep | 8.12 | 8.13 | -0.01 | 0.01 | -2 |
| Median | 7.84 | 7.85 | -0.01 | 0.03 | |

| **n** | **m** |
|---|---|
| 12 | 11 |

**N**= 11

$\Sigma$R= -3

| $\alpha$ |
|---|
| 0.05 |
| **W'**$\alpha$,n |
| 13 |

| $W^+$= |
|---|
| **31.5** |
| p-test |
| 0.449 |

| | | |
|---|---|---|
| $H_0$ | median [D]=0 | ACCEPT |
| $H_1$ | median [D]>0 | |

**Wilcoxon-signed-ranks test**

**Exact Form**

Variable: **Total Alk, (mg/l)**

| | **X** | **Y** | | | |
|---|---|---|---|---|---|
| Site | #48 | #6 | Differences | | |
| Year | WY2014 | WY2014 | **D** | **\|D\|** | **Rank** |
| Oct | 39.4 | 39.6 | -0.2 | 0.2 | -1.5 |
| Nov | 49.5 | 50.1 | -0.6 | 0.6 | -7 |
| Dec | 51.2 | 52.0 | -0.8 | 0.8 | -9 |
| Jan | 16.0 | 18.5 | -2.5 | 2.5 | -12 |
| Feb | 51.1 | 52.6 | -1.5 | 1.5 | -10 |
| Mar | 50.0 | 51.6 | -1.6 | 1.6 | -11 |
| Apr | 56.1 | 55.7 | 0.4 | 0.4 | 4.00 |
| May | 34.4 | 34.7 | -0.3 | 0.3 | -3 |
| Jun | 35.9 | 36.1 | -0.2 | 0.2 | -1.5 |
| Jul | 39.9 | 40.4 | -0.5 | 0.5 | -6 |
| Aug | 42.9 | 43.3 | -0.4 | 0.4 | -5.00 |
| Sep | 49.5 | 50.2 | -0.7 | 0.7 | -8 |
| Median | 46.2 | 46.7 | -0.6 | 0.6 | |

| **n** | **m** |
|---|---|
| 12 | 12 |

**N=** 12

$\Sigma R=$ -70

| $\alpha$ |
|---|
| 0.05 |
| **W'**$\alpha$,n |
| 17 |

| $W^{+}=$ |
|---|
| **4.00** |
| p-test |
| 0.002 |

| | | |
|---|---|---|
| $H_0$ | median [D]=0 | **REJECT** |
| $H_1$ | median [D]>0 | **ACCEPT** |

**Wilcoxon-signed-ranks test**
**Exact Form**

Variable: **Sulfate, Total (mg/l)**

| | **X** | **Y** | | | |
|---|---|---|---|---|---|
| Site | #48 | #6 | Differences | | |
| Year | WY2014 | WY2014 | **D** | **\|D\|** | **Rank** |
| Oct | 9.5 | 10.7 | -1.2 | 1.2 | -4 |
| Nov | 16.3 | 17.9 | -1.6 | 1.6 | -6.5 |
| Dec | 17.6 | 20.2 | -2.6 | 2.6 | -9 |
| Jan | 3.4 | 5.2 | -1.7 | 1.7 | -8 |
| Feb | 18.9 | 21.7 | -2.8 | 2.8 | -10 |
| Mar | 19.7 | 23.1 | -3.4 | 3.4 | -11 |
| Apr | 22.0 | 25.6 | -3.6 | 3.6 | -12 |
| May | 8.7 | 9.3 | -0.6 | 0.6 | -2 |
| Jun | 8.9 | 9.5 | -0.6 | 0.6 | -1 |
| Jul | 11.1 | 12.1 | -1.0 | 1.0 | -3 |
| Aug | 10.7 | 12.3 | -1.6 | 1.6 | -6.5 |
| Sep | 14.6 | 15.9 | -1.3 | 1.3 | -5 |
| Median | 12.9 | 14.1 | -1.6 | 1.6 | |

| **n** | **m** |
|---|---|
| 12 | 12 |

**N**= 12
$\Sigma R$= -78

| $\alpha$ |
|---|
| 0.05 |
| **W'**$_{\alpha,n}$ |
| 17 |

| $W^{+}$= |
|---|
| **0** |
| p-test |
| 0.000 |

| | | |
|---|---|---|
| $H_0$ | median [D]=0 | **REJECT** |
| $H_1$ | median [D]<0 | **ACCEPT** |

**Wilcoxon-signed-ranks test**
**Exact Form**

Variable: **Zinc, Dissolved (ug/l)**

| | X | Y | Differences | | |
|---|---|---|---|---|---|
| Site | #48 | #6 | | | |
| Year | WY2014 | WY2014 | D | \|D\| | Rank |
| Oct | 2.90 | 6.53 | -3.63 | 3.63 | -9 |
| Nov | 4.18 | 7.05 | -2.87 | 2.87 | -7 |
| Dec | 3.53 | 7.12 | -3.59 | 3.59 | -8 |
| Jan | 9.27 | 11.40 | -2.13 | 2.13 | -3 |
| Feb | 3.92 | 9.78 | -5.86 | 5.86 | -12 |
| Mar | 4.50 | 9.69 | -5.19 | 5.19 | -11 |
| Apr | 2.97 | 7.61 | -4.64 | 4.64 | -10 |
| May | 2.39 | 4.77 | -2.38 | 2.38 | -4 |
| Jun | 2.46 | 3.30 | -0.84 | 0.84 | -1 |
| Jul | 2.06 | 3.38 | -1.32 | 1.32 | -2 |
| Aug | 2.73 | 5.13 | -2.40 | 2.40 | -5 |
| Sep | 3.00 | 5.54 | -2.54 | 2.54 | -6 |
| Median | 2.99 | 6.79 | -2.71 | 2.71 | |

| n | m |
|---|---|
| 12 | 12 |

N= 12

$\Sigma$R= -78

| $\alpha$ |
|---|
| 0.05 |
| **W'**$\alpha$,n |
| 17 |

| $W^+$= |
|---|
| **0** |
| p-test |
| 0.000 |

| | | |
|---|---|---|
| $H_0$ | median [D]=0 | **REJECT** |
| $H_1$ | median [D]<0 | **ACCEPT** |

# INTERPRETIVE REPORT
# SITE 54

The data collected during the current water year are listed in the following “Table of Results for Water Year 2014” report. The table includes all the required FWMP analyte data (field and laboratory) collected for the current water year and a series of flags keyed to the summary report “Qualified Data by QA Reviewer”. The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of ½ MDL for the purpose of median calculation.

All data collected at this site for the past six years are included in the data analyses with the exception of the outliers shown in the table below. During the current year no new data points were flagged as outliers after review by HGCMC.

| Sample Date | Parameter | Value | Qualifier | Notes |
|---|---|---|---|---|
| No outliers have been identified by HGCMC for the period of October 2008 through September 2014. | | | | |

The data for Water Year 2014 have been compared to the strictest fresh water quality criterion for each applicable analyte. No results exceeded these criteria.

**Table of Exceedance for Water Year 2014**

| | | | Limits | | |
|---|---|---|---|---|---|
| **Sample Date** | **Parameter** | **Value** | **Lower** | **Upper** | **Hardness** |
| No exceedances have been identified by HGCMC for the period of October 2013 through September 2014. | | | | | |

X-Y plots have been generated to graphically present the data for each of the analytes requested in the Statistical Information Goals for this site. These plots have been visually analyzed for the appearance of any trend in concentration. The only obvious visual trend is in field pH that has had a gradual upward trend for the past 5 years.

A non-parametric statistical analysis for trend was performed for specific conductivity, field pH, total alkalinity, total sulfate, and dissolved zinc. Calculation details of the Seasonal Kendall analyses are presented in detail on the pages following this interpretive section. The following table summarizes the results on the data collected between Oct-08 and Sep-14 (WY2009-WY2014).

**Table of Summary Statistics for Trend Analysis**

| | Mann-Kendall test statistics | | | Sen's slope estimate | |
|---|---|---|---|---|---|
| **Parameter** | **n*** | **p**** | **Trend** | **Q** | **Q(%)** |
| Conductivity Field | 6 | 0.05 | | | |
| pH Field | 6 | <0.01 | + | 0.12 | 1.6 |
| Alkalinity, Total | 6 | <0.01 | + | 0.85 | 1.9 |
| Sulfate, Total | 6 | 0.22 | | | |
| Zinc, Dissolved | 6 | 0.16 | | | |

* Number of Years ** Significance level

Field pH had a statistically significant ($p<0.01$) trend with a slope estimate of 0.12 su/yr or 1.6% increase. Total alkalinity had a statistically significant ($p<0.01$) trend with a Sen's slope estimate of 0.85 mg/L/yr. However given the low magnitude and similar trend noted at Site 6 and Site 48, HGCMC does not feel that these trends are a significant indication of changes in water chemistry at Site 54.

A comparison of median values for total alkalinity, field pH, field conductivity, total sulfate, and dissolved zinc between Site 54 and Site 6 has been conducted as specified in the Statistical Information Goals for Site 54. Additionally, X-Y plots have been generated for total alkalinity, field pH, specific conductance, total sulfate, and dissolved zinc that co-plot data from Site 54 and Site 6, the upstream control site, to aid in the comparison between those sites. Calculation details of the non-parametric signed-rank tests are presented in detail on the pages following this interpretive section. The table below summarizes the results of the signed-rank test as performed on the Water Year 2014 dataset.

**Table of Summary Statistics for Median Analysis**

**Site 54 vs Site 6**

| **Parameter** | **Signed Ranks p-value** | **Site 6 median** | **Site 54 median** | **Median Differences** |
|---|---|---|---|---|
| Conductivity Field | <0.01 | 128.1 | 128.9 | -1.8 |
| pH Field | <0.01 | 7.85 | 7.73 | 0.03 |
| Alkalinity, Total | <0.01 | 46.7 | 47.7 | -1.3 |
| Sulfate, Total | 0.285 | 14.10 | 14.00 | 0.00 |
| Zinc, Dissolved | <0.01 | 6.79 | 6.25 | 0.55 |

The median values for pH for Site 6 and Site 54 are 7.85 su and 7.73 su respectively and the median of differences, Site 6 minus Site 54, is 0.03 su. Site 54 has intermittently (8 out of 12) had statistically significantly lower pH readings for water years (WY2002 and WY2013). This difference may in part be due to inflow of Bruin Creek which typically has a slightly lower pH than Greens Creek.

The median values for total alkalinity for Site 6 and Site 54 are 46.7 mg/L and 47.7 mg/L respectively. The median of the differences, Site 6 minus Site 54, is -1.3 mg/L total alkalinity. Again similar results are obtained using the signed-rank test on the WY2004 - WY2013 total alkalinity datasets.

Along with the significant difference in total alkalinity there was a significant difference in field conductivity. Upgradient the median conductivity value was 128.1 µs/cm and the downgradient median value was 128.9 µs/cm, resulting in a -1.8 µs/cm median difference. Datasets from WY2002 – WY2013 yield similar significant results with similar magnitudes. In general, the trend in conductivity is similar to differences measured between Site 48 and Site 6, although of a smaller magnitude. HGCMC feels the current FWMP program is adequate to measure and quantify future changes that may occur between Site 6 and Site 54, given the small magnitude of the differences and the consistency of the variations over the past several years.

## Table of Results for Water Year 2014

### Site 054FMS - 'Greens Creek Below D-Pond'

| Sample Date/Parameter | Oct 2013 | Nov 2013 | Dec 2013 | Jan 2014 | Feb 2014 | Mar 2014 | Apr 2014 | May 2014 | Jun 2014 | Jul 2014 | Aug 2014 | Sep 2014 | **Median** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Water Temp (°C) | 5.4 | 1.1 | 1.1 | 0.2 | 0.0 | 0.8 | 0.8 | 2.7 | 4.4 | 9.3 | 8.3 | 8.7 | 1.9 |
| Conductivity-Field(μmho) | 112 | 147 | 154 | 56 | 160 | 163 | 191 | 99 | 97 | 116 | 121 | 136.8 | 128.9 |
| Conductivity-Lab (μmho) | 97 | 113 | 152 | 56 | 151 | 148 | 176 | 98 | 99 | 116 | 114 | 138 | 115 |
| pH Lab (standard units) | 7.69 | 7.73 | 7.73 | 7.51 | 7.56 | 7.73 | 7.58 | 7.38 | 7.88 | 7.8 | 7.62 | 7.34 | 7.66 |
| pH Field (standard units) | 7.79 | 7.85 | 7.8 | 7.38 | 7.66 | 7.61 | 7.66 | 7.6 | 7.66 | 7.88 | 7.84 | 8.14 | 7.73 |
| Total Alkalinity (mg/L) | 40.4 | 51.5 | 53.6 | 21.7 | 53.1 | 53.7 | 58.1 | 36.5 | 36 | 41.6 | 44.5 | 50.9 | 47.7 |
| Total Sulfate (mg/L) | 10.7 | 18.1 | 20.2 | 5.3 | 21.7 | 24.7 | 25.8 | 9.2 | 9.5 | 12.2 | 11.5 | 15.7 | 14.0 |
| Hardness (mg/L) | 50.8 | 68.6 | 71.3 | 23.5 | 70.8 | 75.4 | 81.6 | 44.5 | 43.8 | 51.4 | 56.3 | 66.8 | 61.6 |
| Dissolved As (ug/L) | 0.2 | 0.194 | 0.177 | 0.263 | 0.172 | 0.159 | 0.156 | 0.183 | 0.19 | 0.239 | 0.233 | 0.252 | 0.192 |
| Dissolved Ba (ug/L) | | | 30.4 | | 32.3 | | | | | | | | 31.4 |
| Dissolved Cd (ug/L) | 0.0441 | 0.0514 | 0.0489 | 0.0844 | 0.0553 | 0.0488 | 0.0483 | 0.0347 | 0.0337 | 0.0371 | 0.0456 | 0.0428 | 0.0470 |
| Dissolved Cr (ug/L) | | | 0.66 | | 1.12 | | | | | | | | 0.890 |
| Dissolved Cu (ug/L) | 0.632 | 0.349 | 0.401 | 1.76 | 0.418 | 0.496 | 0.316 | 0.525 | 0.314 | 0.452 | 0.489 | 0.397 | 0.435 |
| Dissolved Pb (ug/L) | 0.0222 | 0.0122 | 0.0113 | 0.431 | 0.0145 | 0.0336 | 0.0056 | 0.0085 | 0.0055 | 0.0063 | 0.0084 | 0.0081 | 0.0099 |
| Dissolved Ni (ug/L) | | | 0.617 | | 0.736 | | | | | | | | 0.677 |
| Dissolved Ag (ug/L) | | | 0.002 | | 0.002 | | | | | | | | 0.002 |
| Dissolved Zn (ug/L) | 5.92 | 7.12 | 6.58 | 10.2 | 8.68 | 8.77 | 6.73 | 4.62 | 3.25 | 3.45 | 4.86 | 4.99 | 6.25 |
| Dissolved Se (ug/L) | | | 1.1 | | 1.5 | | | | | | | | 1.300 |
| Dissolved Hg (ug/L) | 0.00125 | 0.00058 | 0.000479 | 0.00478 | 0.000505 | 0.000752 | 0.000528 | 0.000894 | 0.000542 | 0.000501 | 0.000863 | 0.000684 | 0.000632 |

For individual sample/analyte qualifier descriptions see "Qualified Data by QA Reviewer" table.

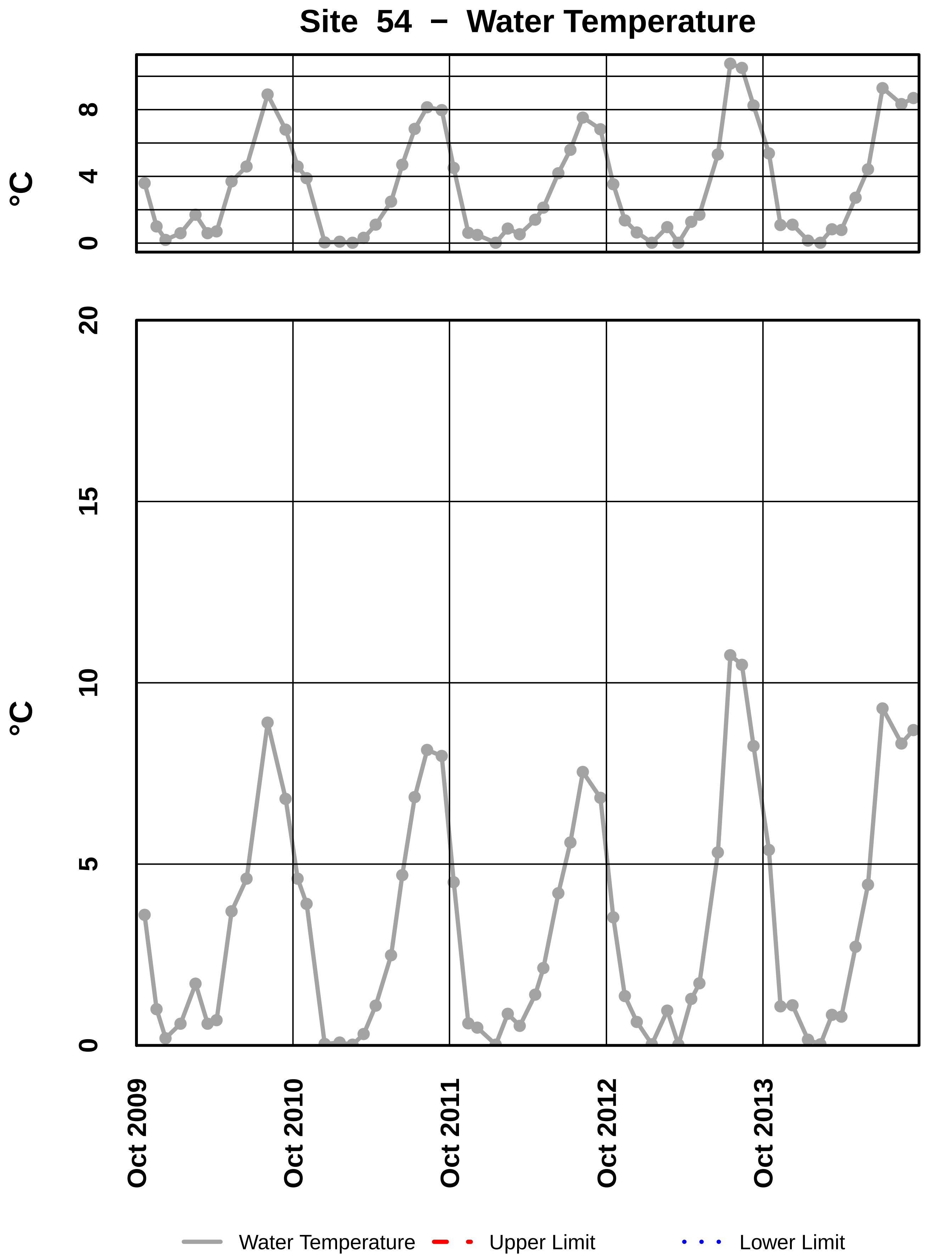
Values reported as less than MDL are replaced by 1/2 MDL for median calculation purposes.

Shaded data has been qualified as an outlier by HGCMC and removed from any further analysis and is not included into the calculation of the median

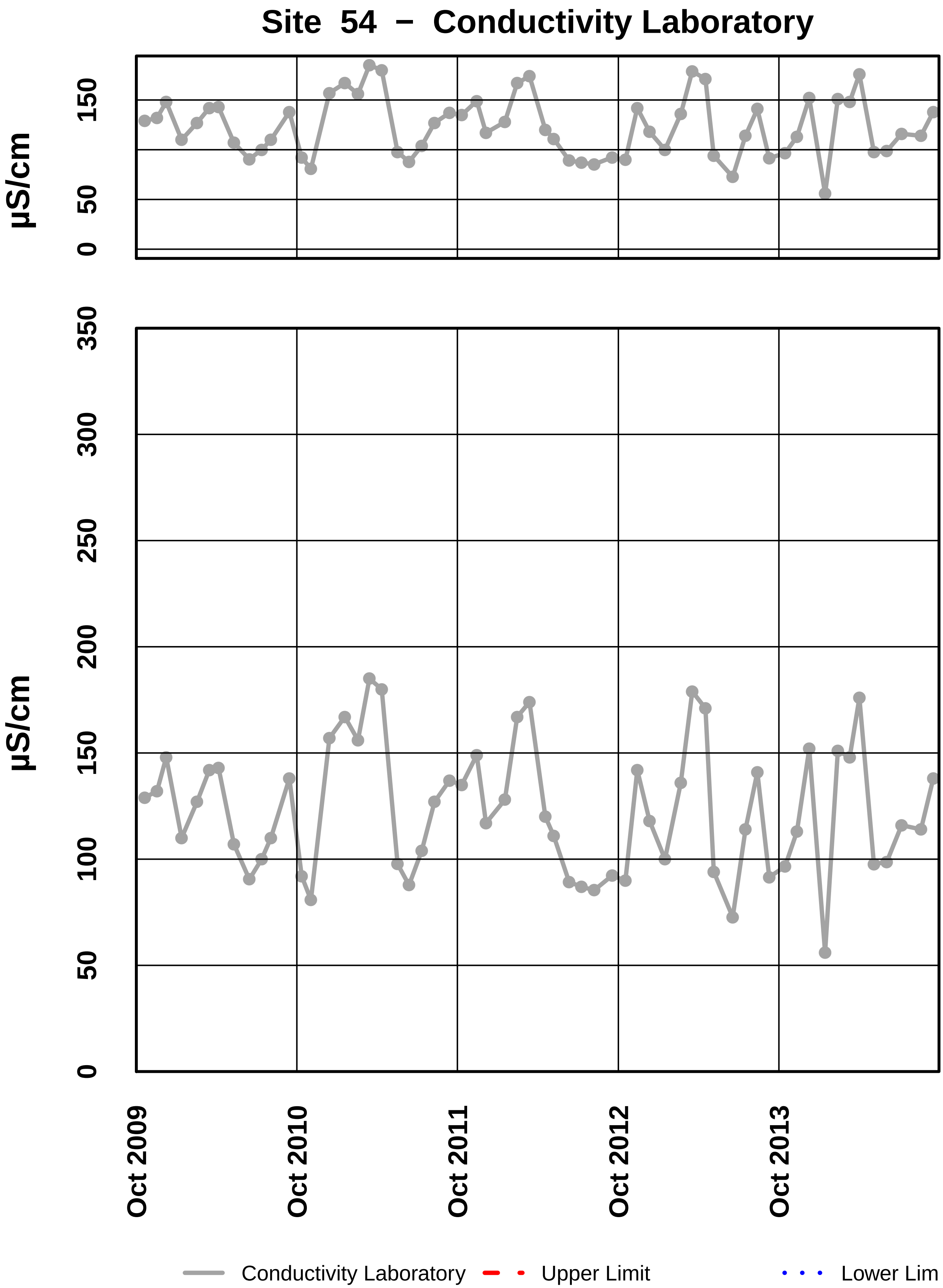
# Qualified Data by QA Reviewer

## Date Range: 10/01/2013 to 09/30/2014

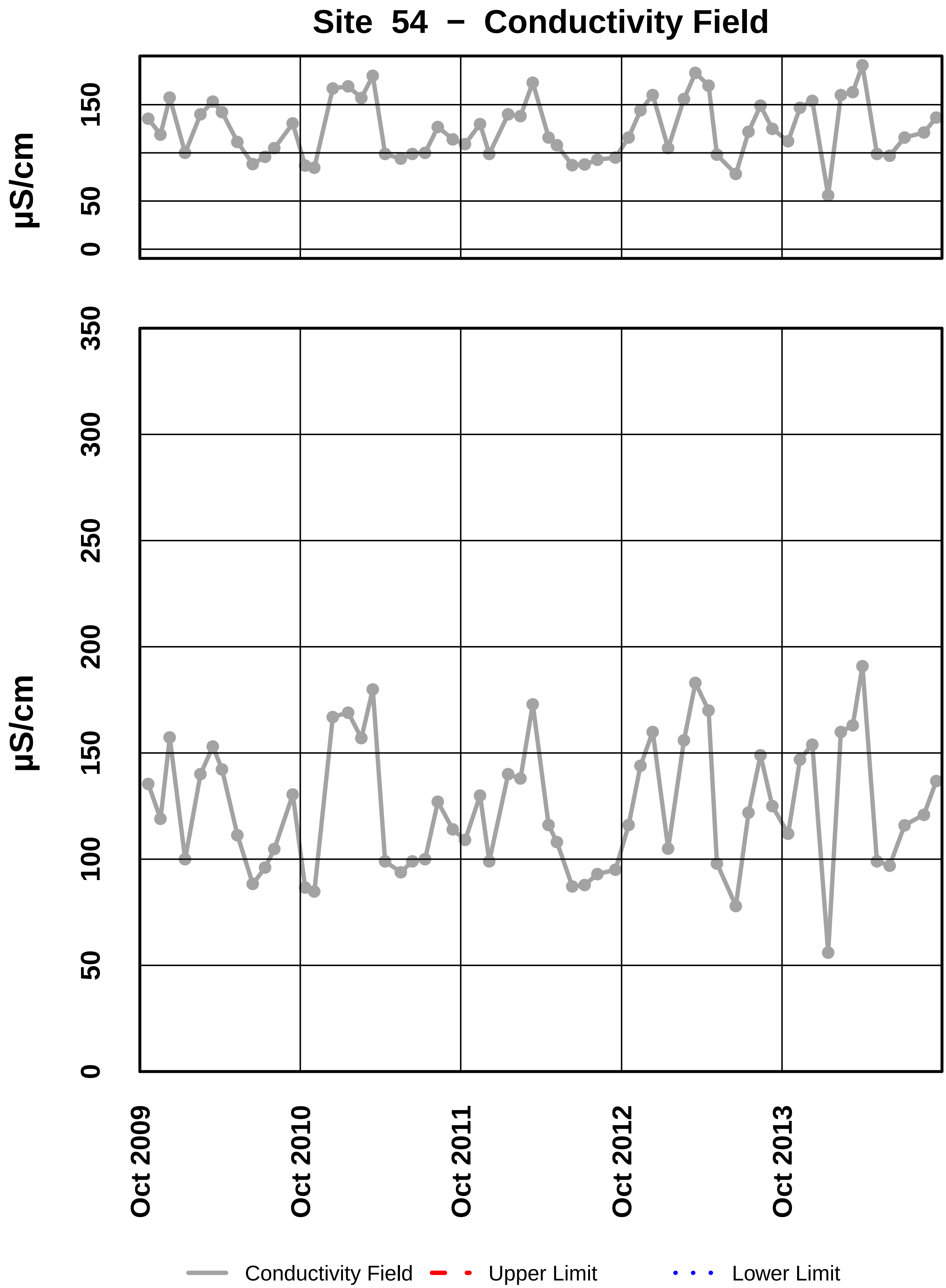
| Site No. | Sample Date | Sample Time | Parameter | Value | Qualifier | Reason for Qualifier |
|---|---|---|---|---|---|---|
| 054FMS | 11/11/2013 | 12:00 PM | pH | 7.73 | J | Hold Time Violation |
| 054FMS | 12/9/2013 | 12:00 PM | Diss. Ni-ICP/MS | 0.61 | U | Field Blank Contamination |
| | | | Diss. Pb-ICP/MS | 0.01 | U | Field Blank Contamination |
| 054FMS | 1/14/2014 | 12:00 PM | pH | 7.51 | J | Hold Time Violation |
| 054FMS | 2/12/2014 | 12:00 PM | Diss. Cu-ICP/MS | 0.41 | J | LCS Recovery |
| | | | Sulfate | 21.7 | J | Sample Receipt Temperature |
| 054FMS | 4/2/2014 | 12:00 PM | Diss. Pb-ICP/MS | 0.00559 | J | Below Quantitative Range |
| | | | pH | 7.58 | J | Hold Time Violation |
| 054FMS | 5/5/2014 | 12:00 PM | Diss. Pb-ICP/MS | 0.0085 | J | Below Quantitative Range |
| 054FMS | 6/3/2014 | 12:00 PM | Diss. Pb-ICP/MS | 0.00549 | J | Below Quantitative Range |
| | | | Diss. Zn-ICP/MS | 3.25 | U | Field Blank Contamination |
| 054FMS | 7/7/2014 | 12:00 PM | Diss. Pb-ICP/MS | 0.00625 | J | Below Quantitative Range |
| | | | Sulfate | 12.2 | J | Sample Receipt Temperature |
| 054FMS | 8/20/2014 | 12:00 PM | Diss. Pb-ICP/MS | 0.00843 | J | Below Quantitative Range |
| 054FMS | 9/17/2014 | 12:00 PM | Diss. Pb-ICP/MS | 0.00812 | J | Below Quantitative Range |



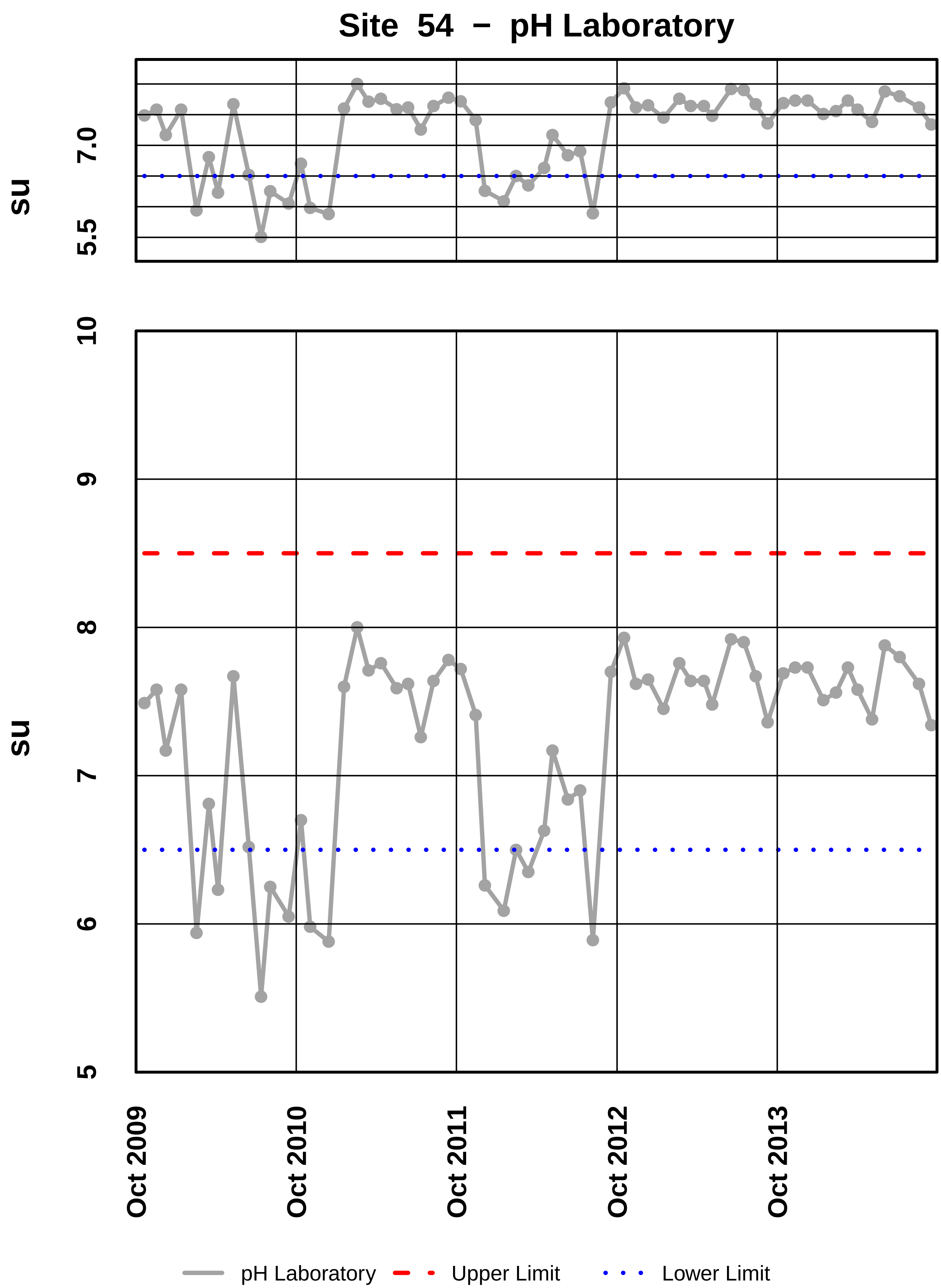

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



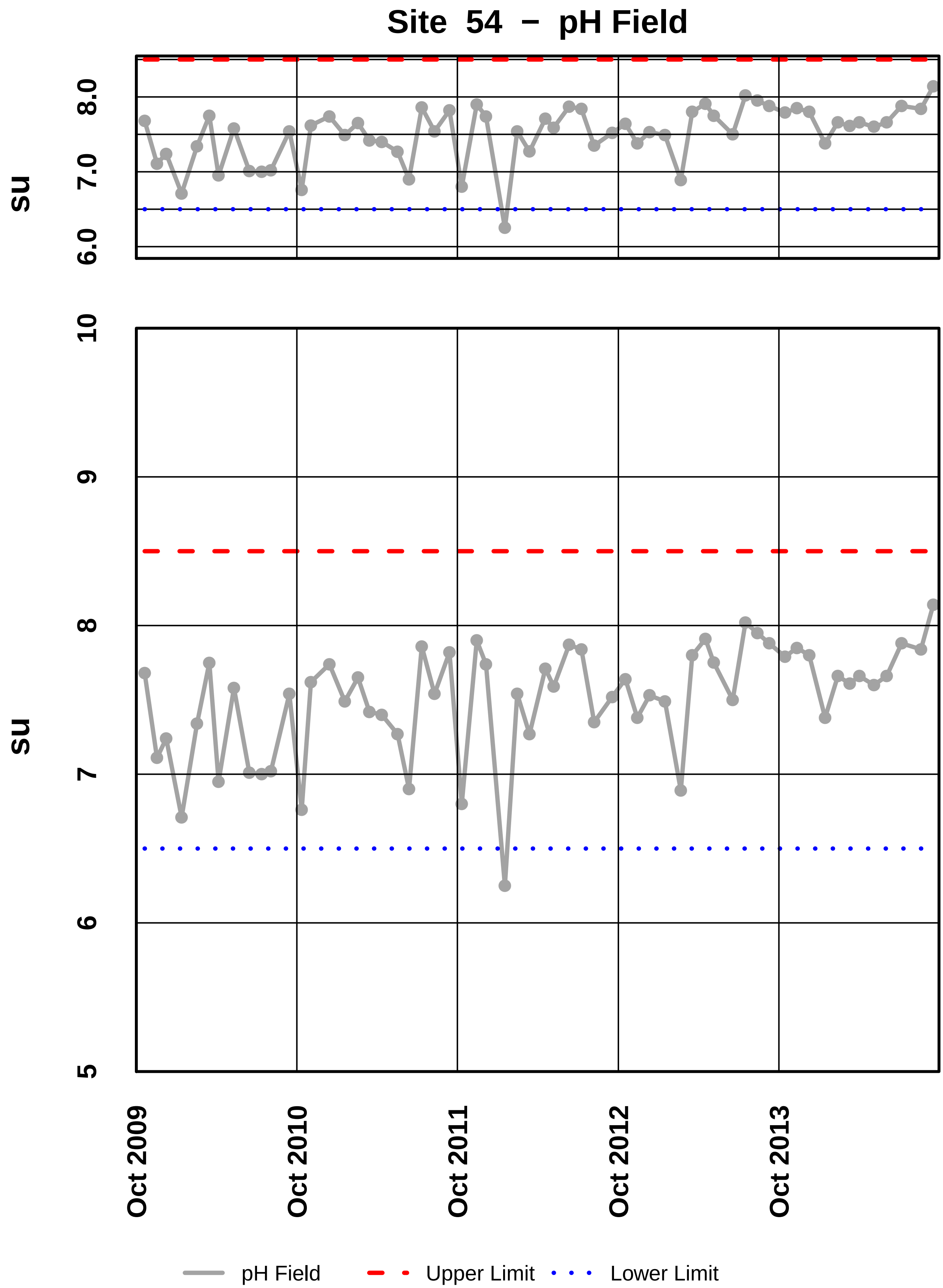

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

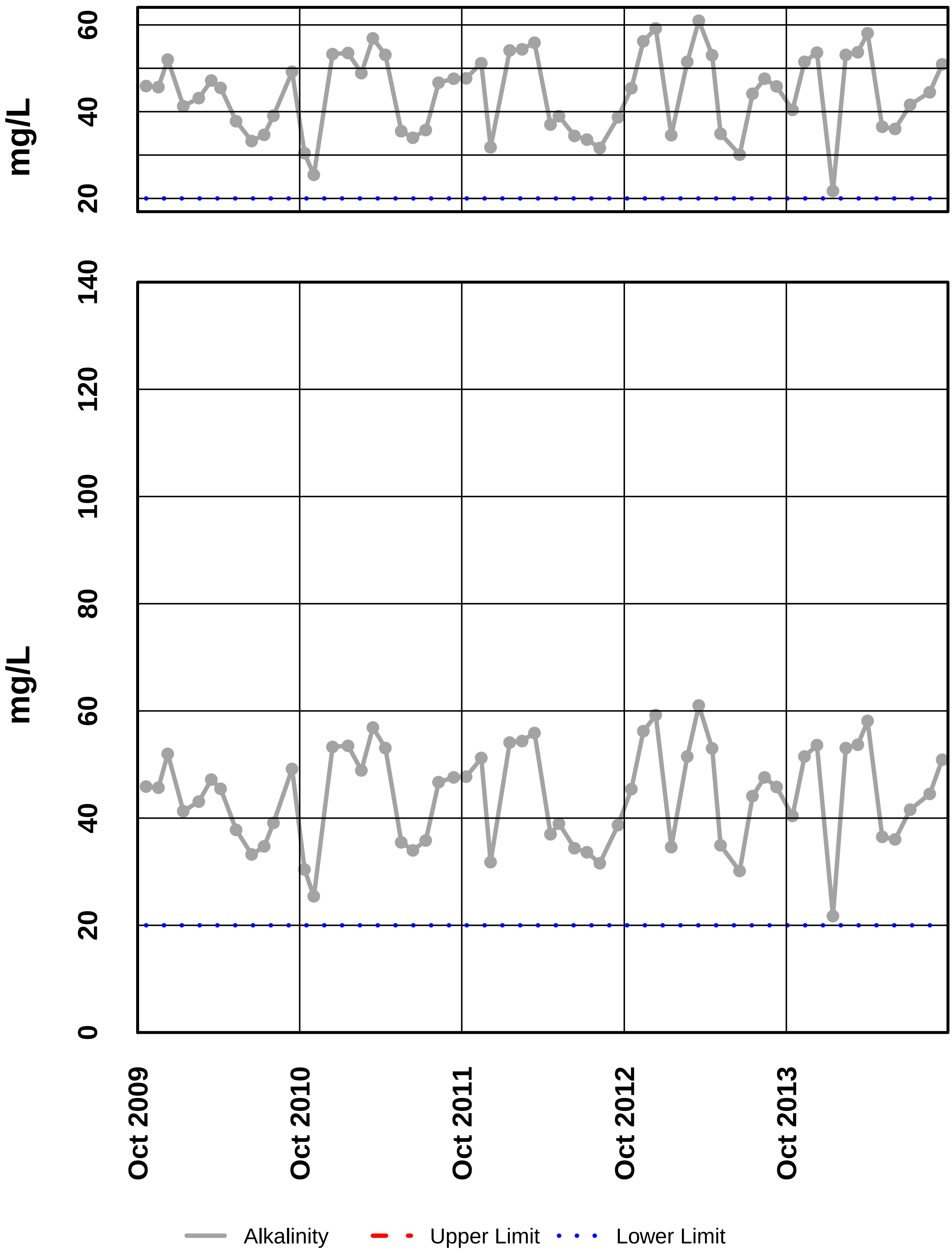



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



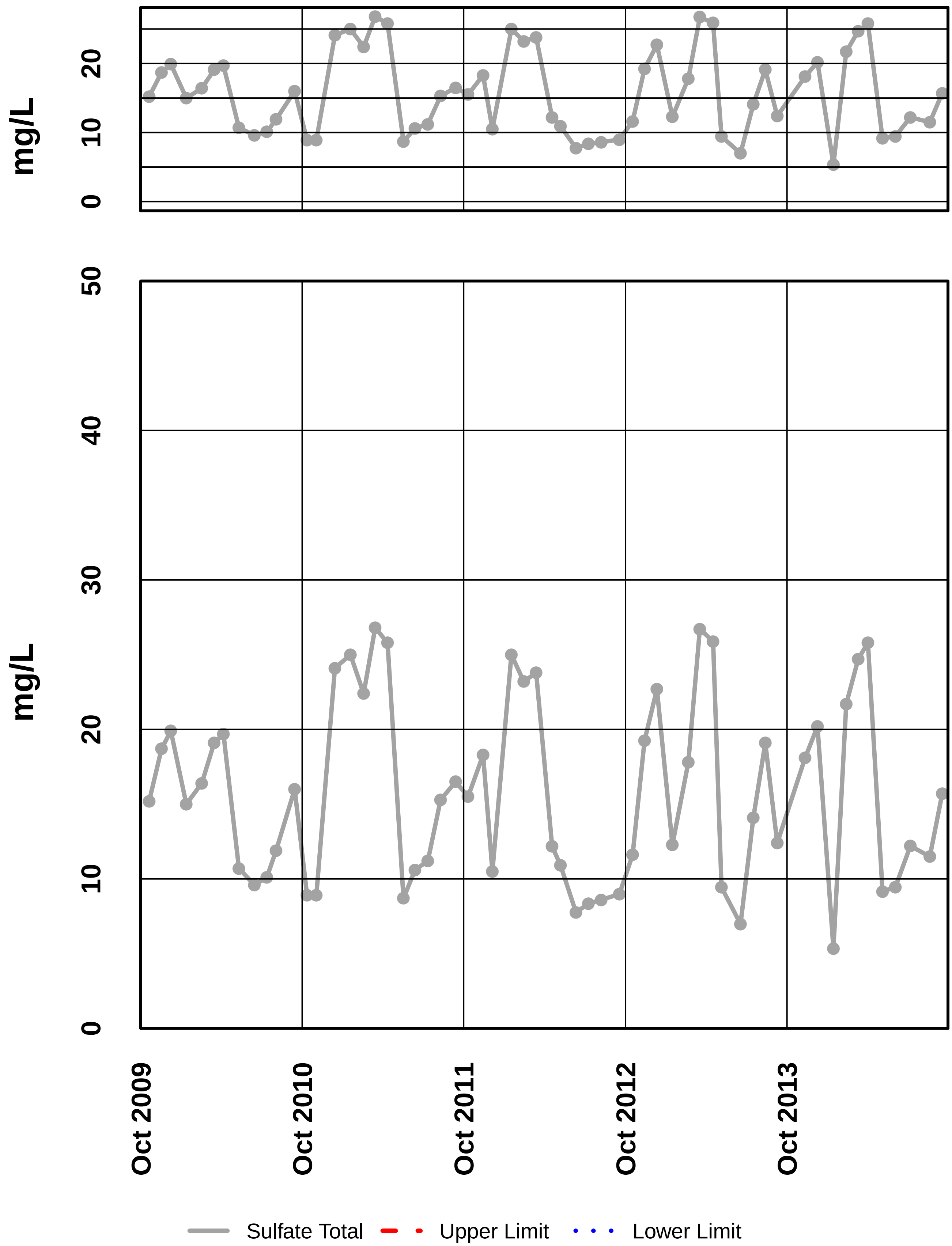

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# Site 54 − Alkalinity

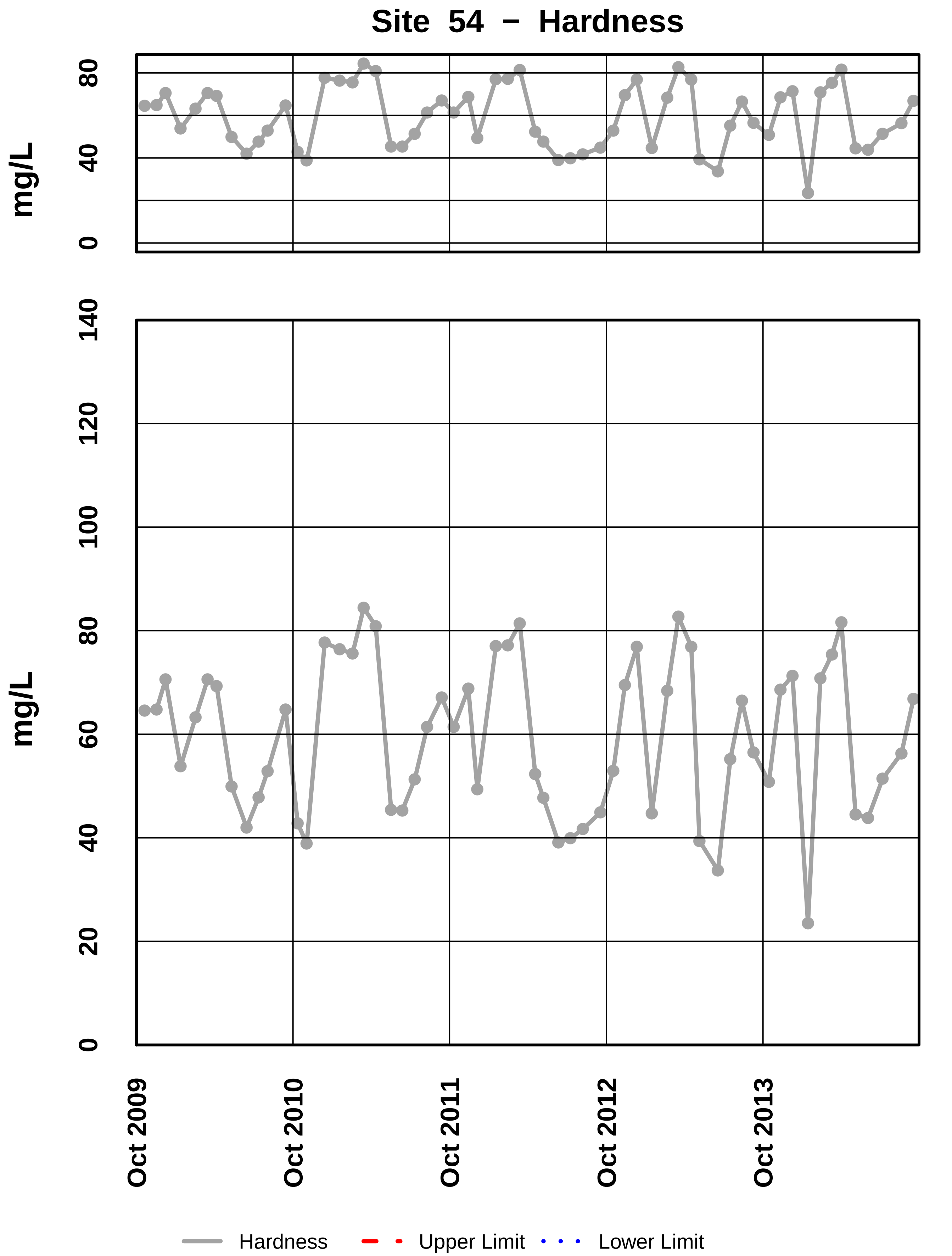



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

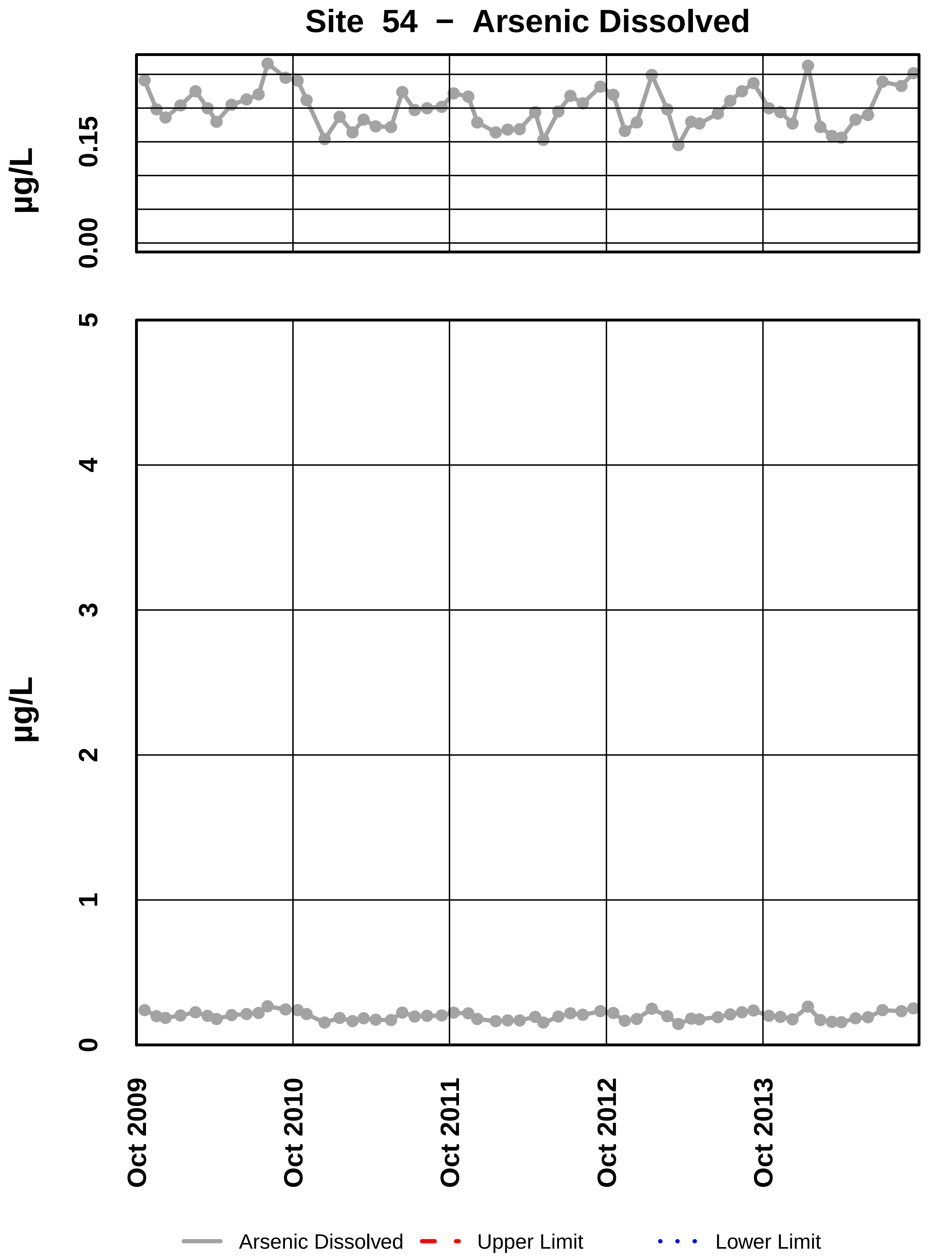
## Site 54 − Sulfate Total



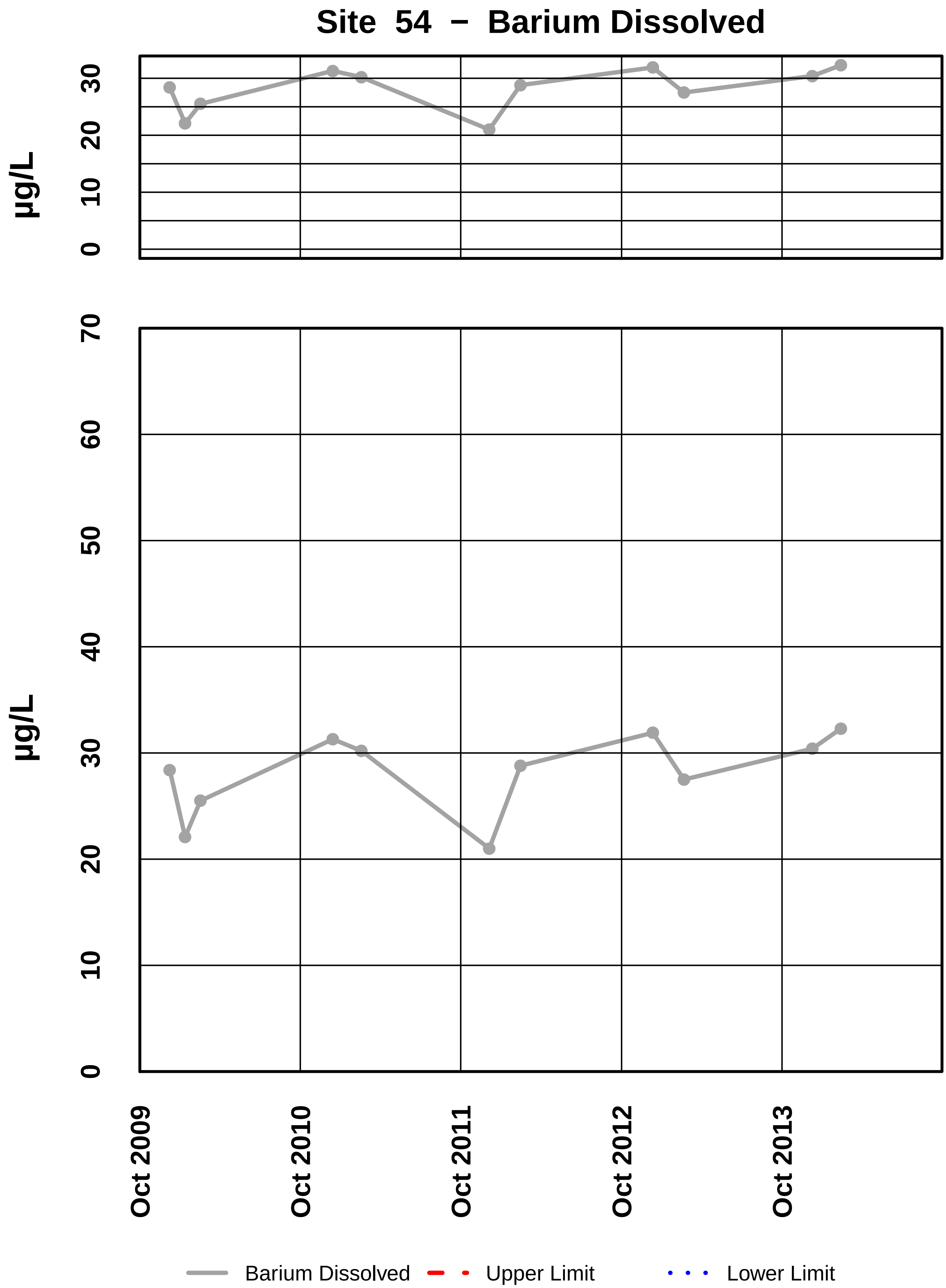

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



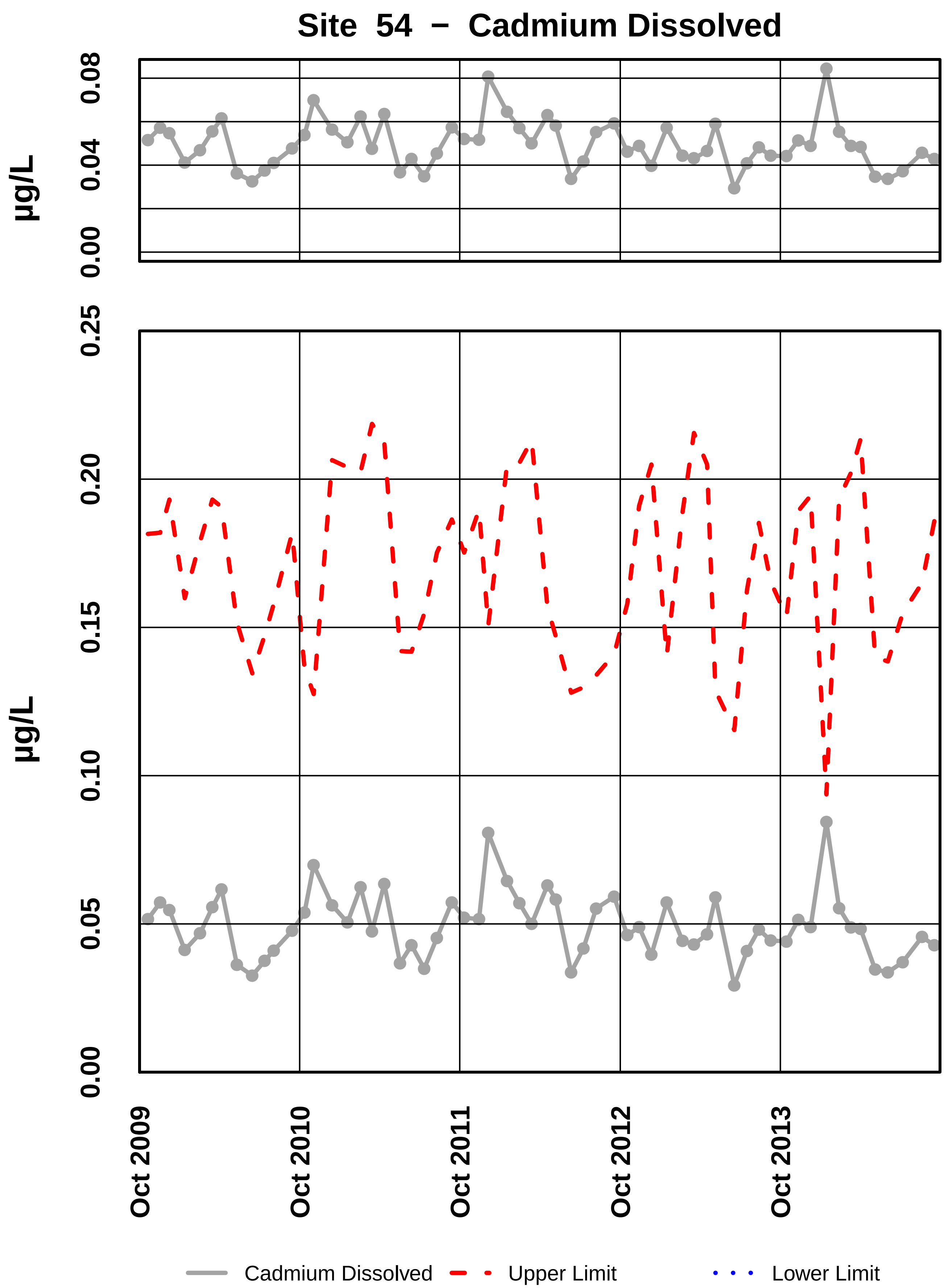

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

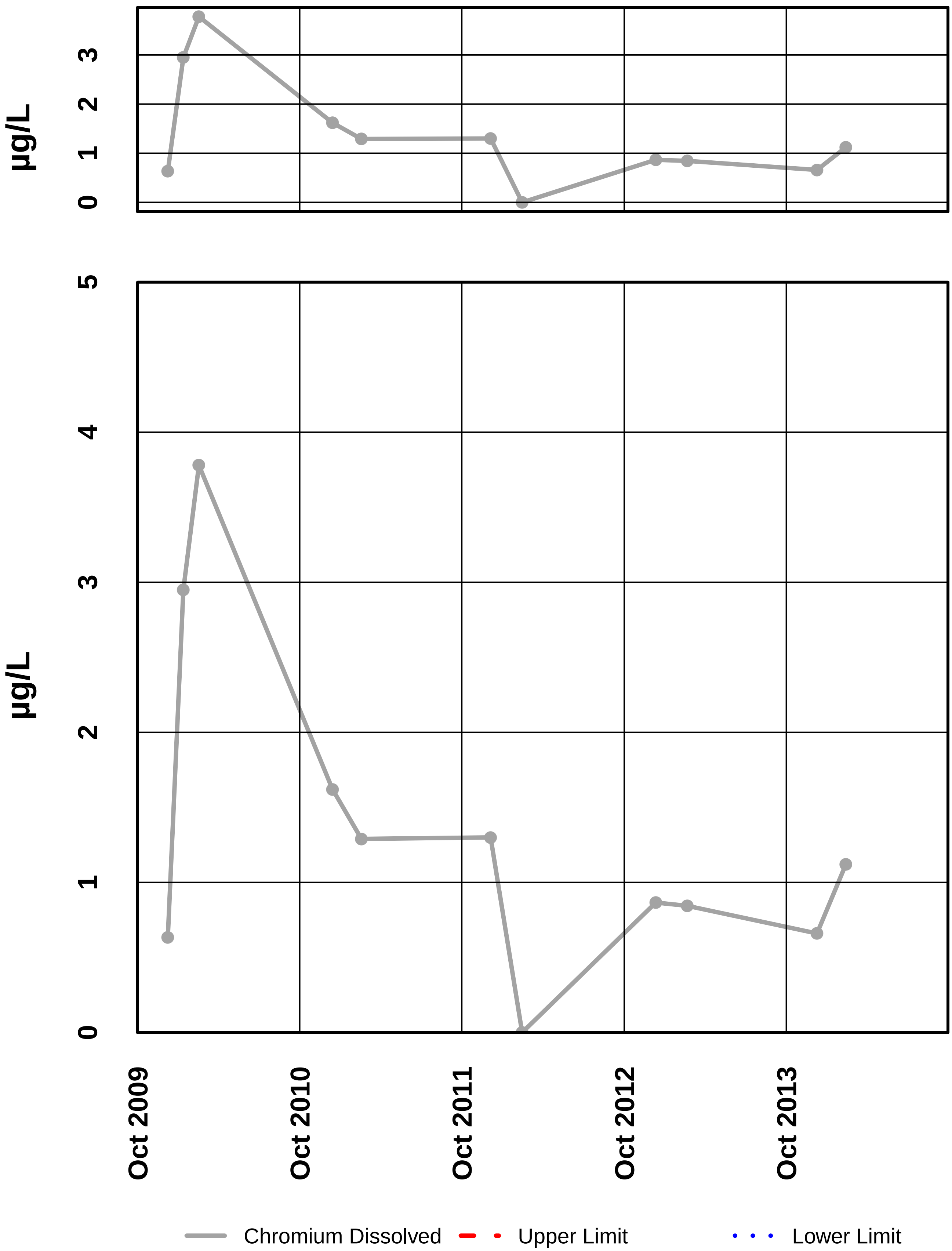



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

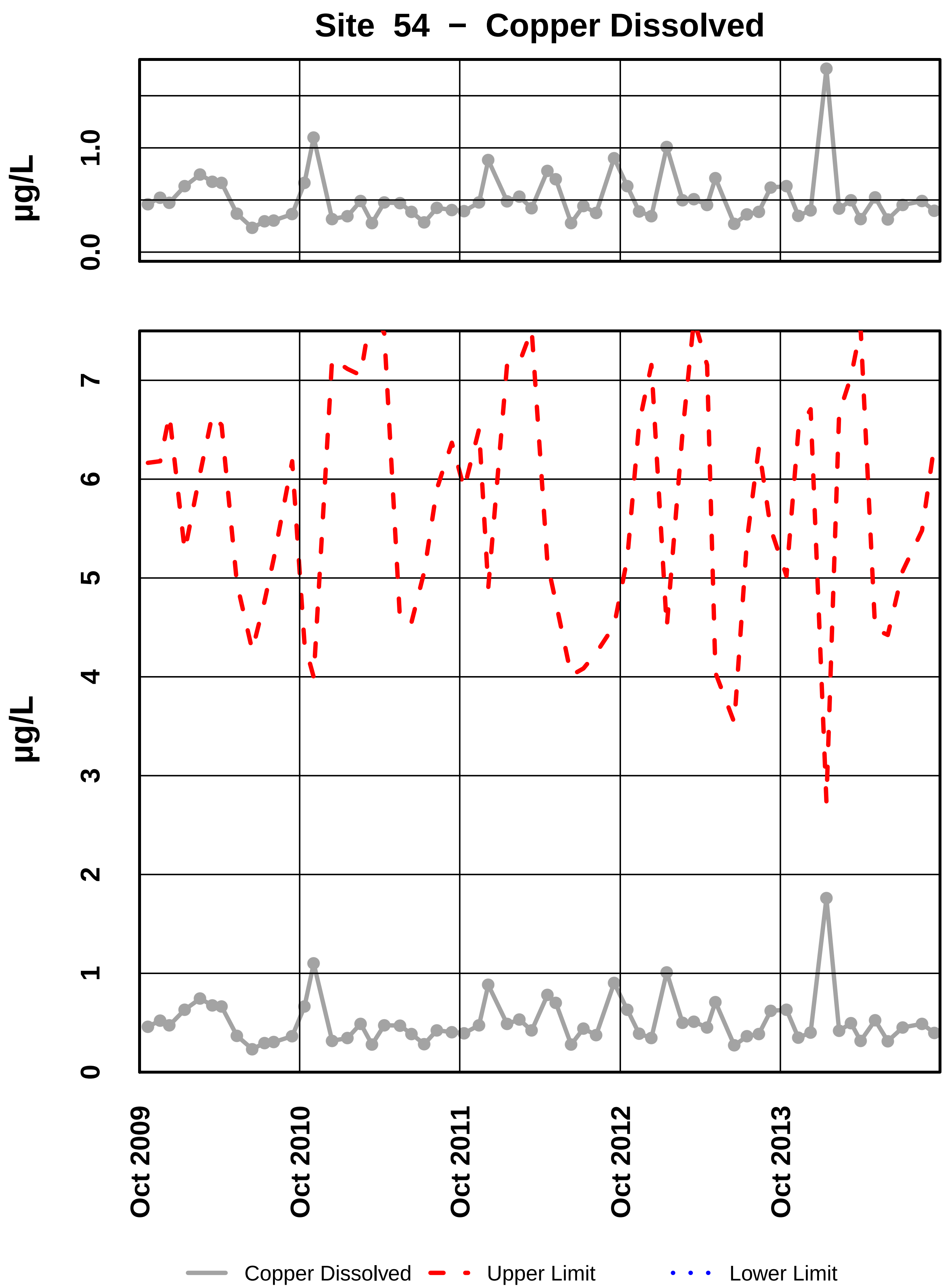



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

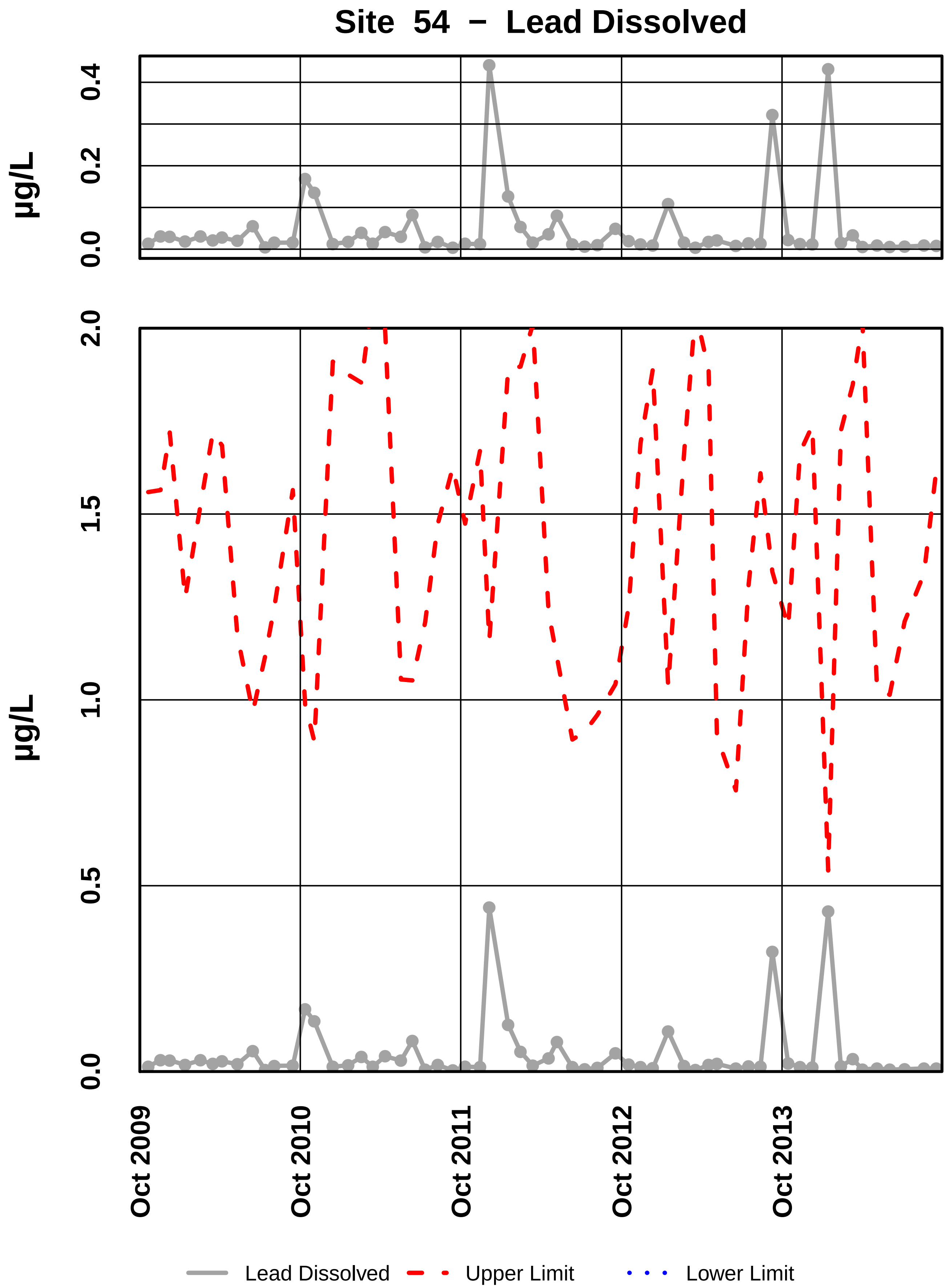
## Site 54 − Chromium Dissolved



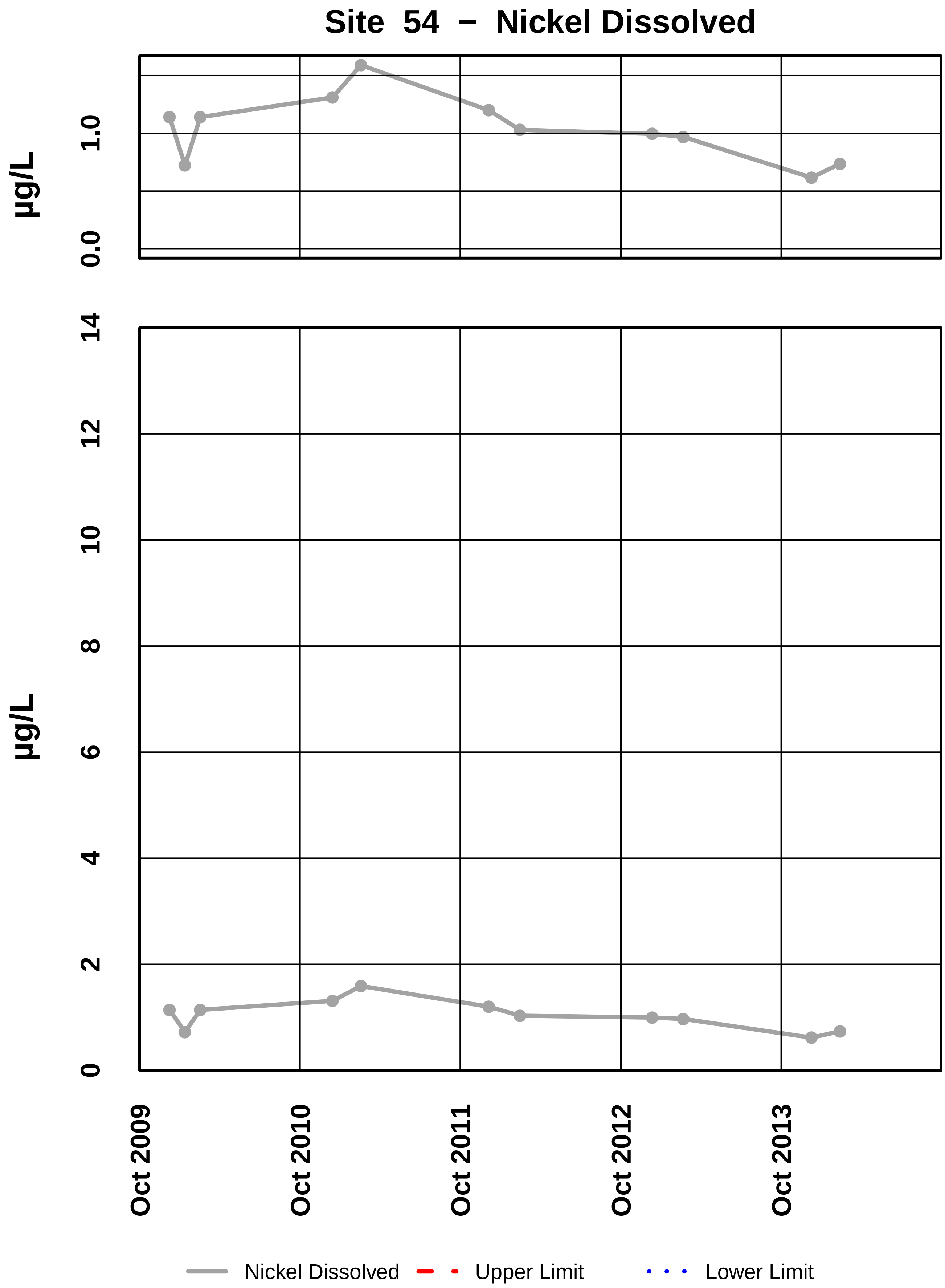

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



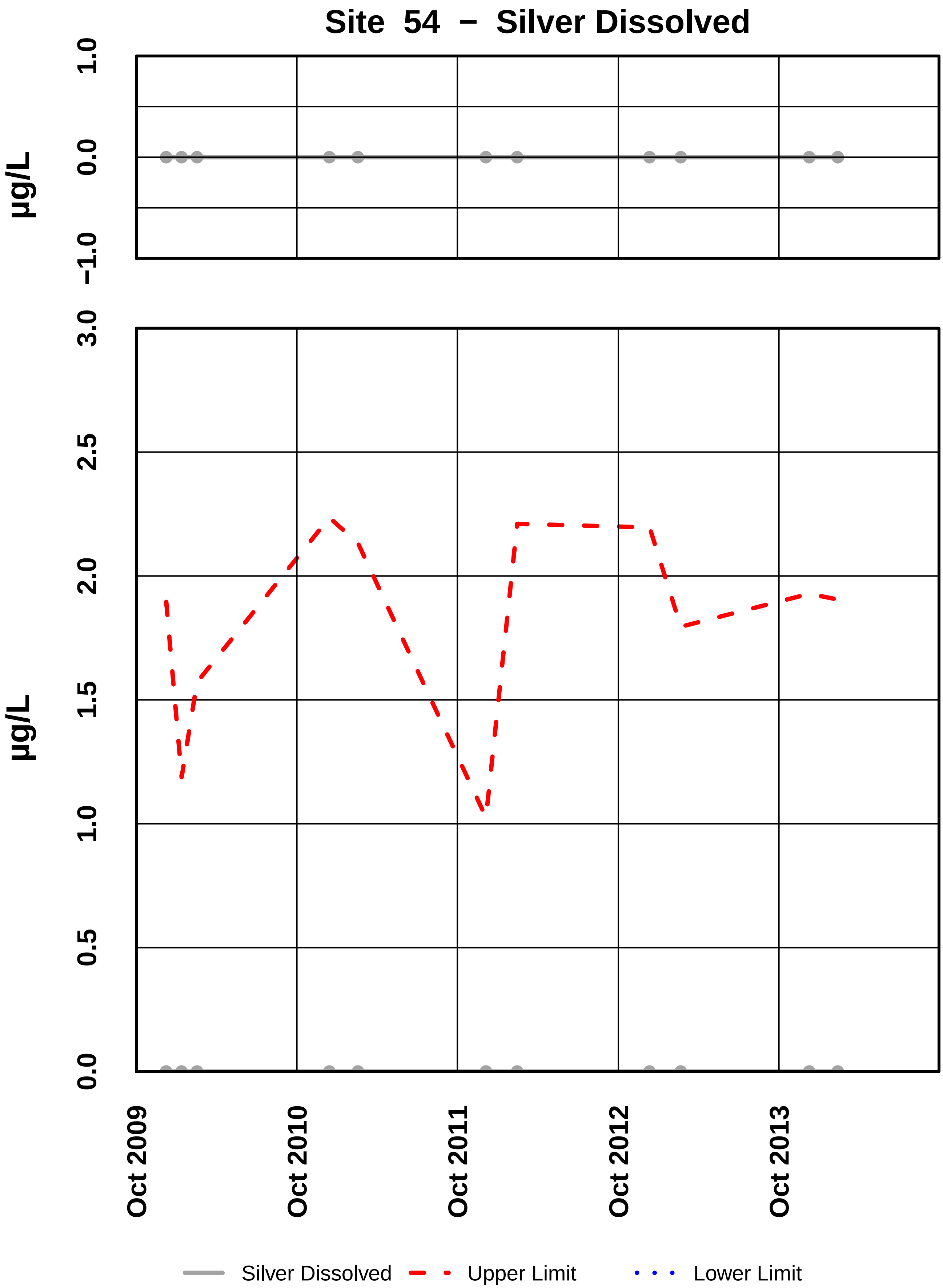

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

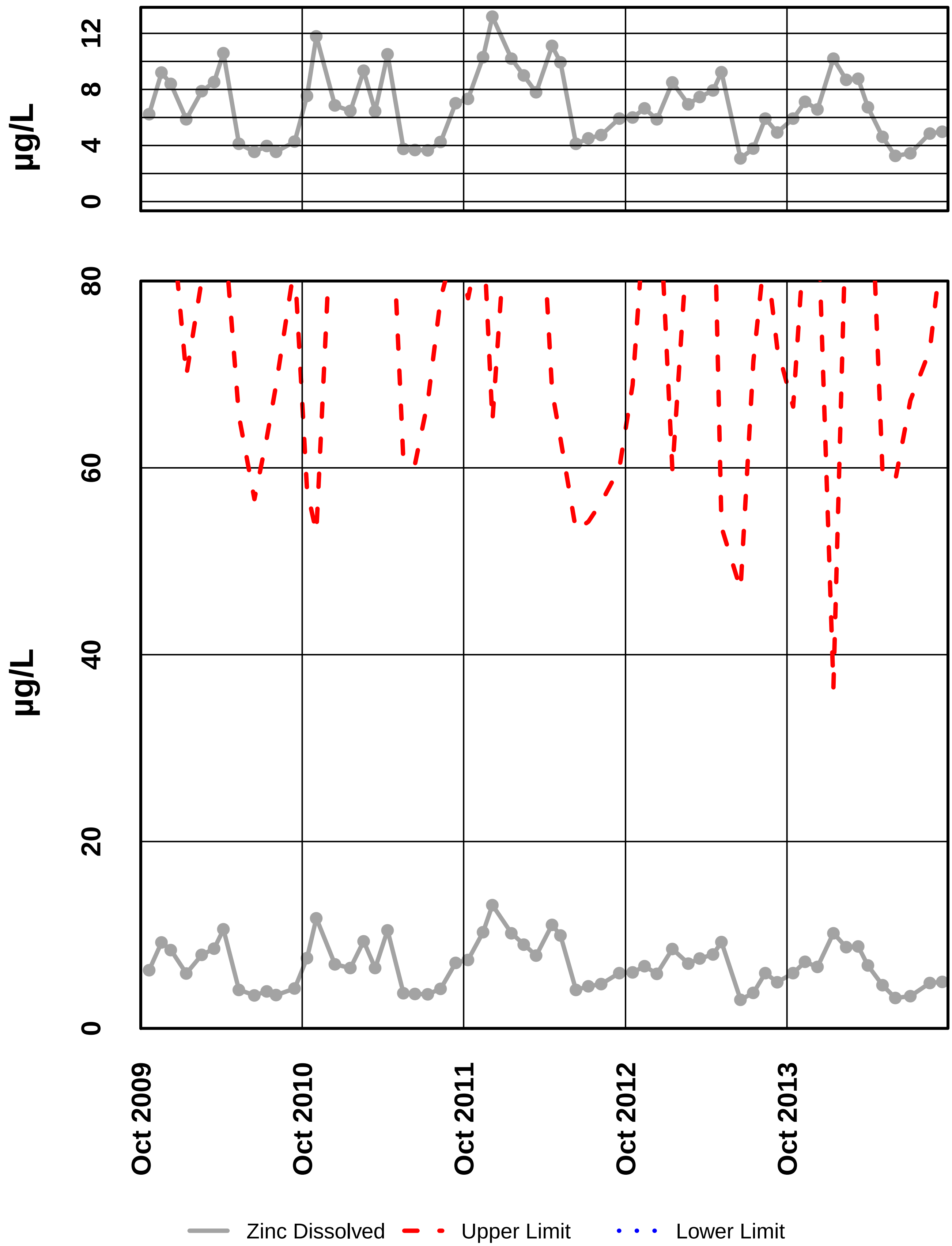



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



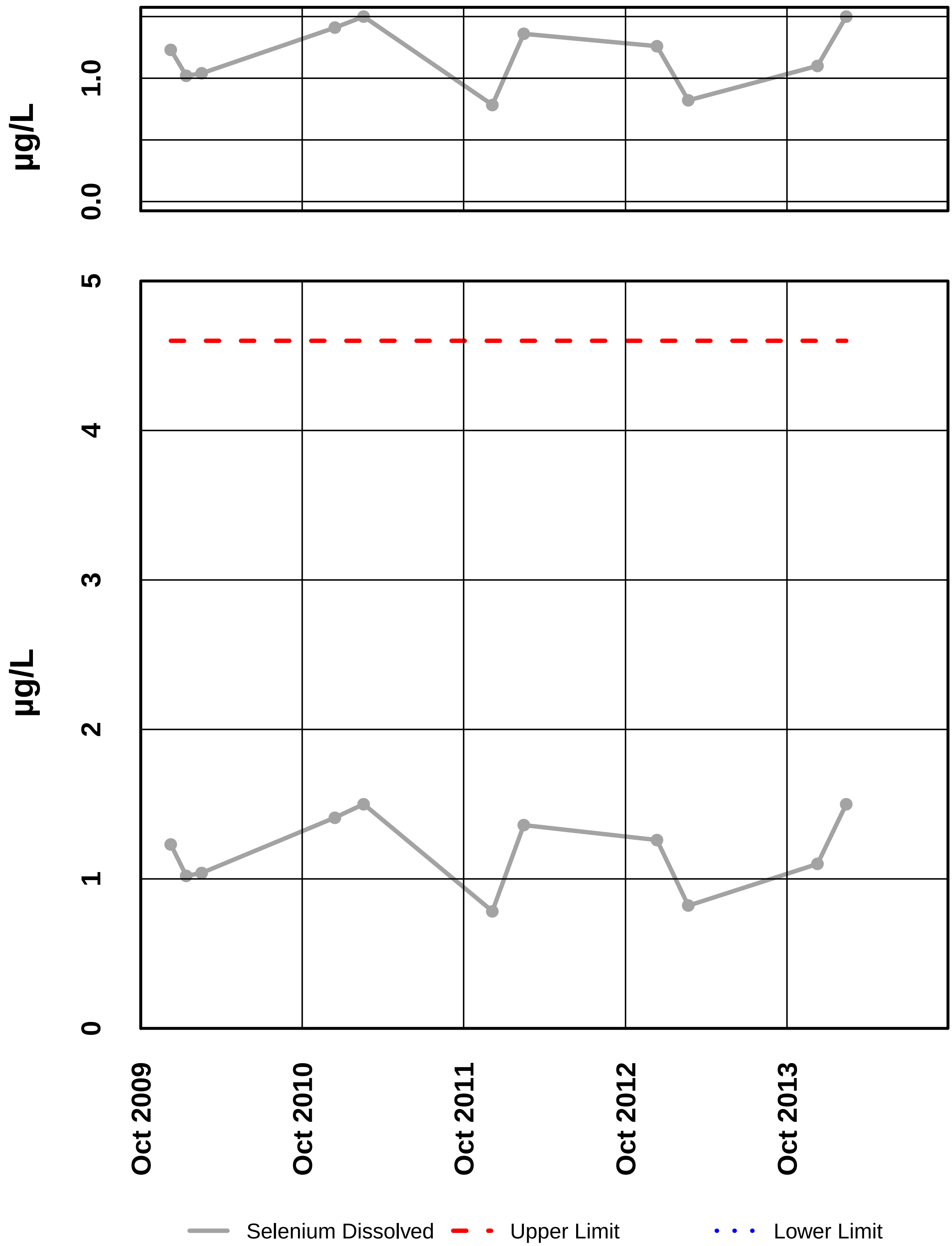

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# Site 54 – Zinc Dissolved

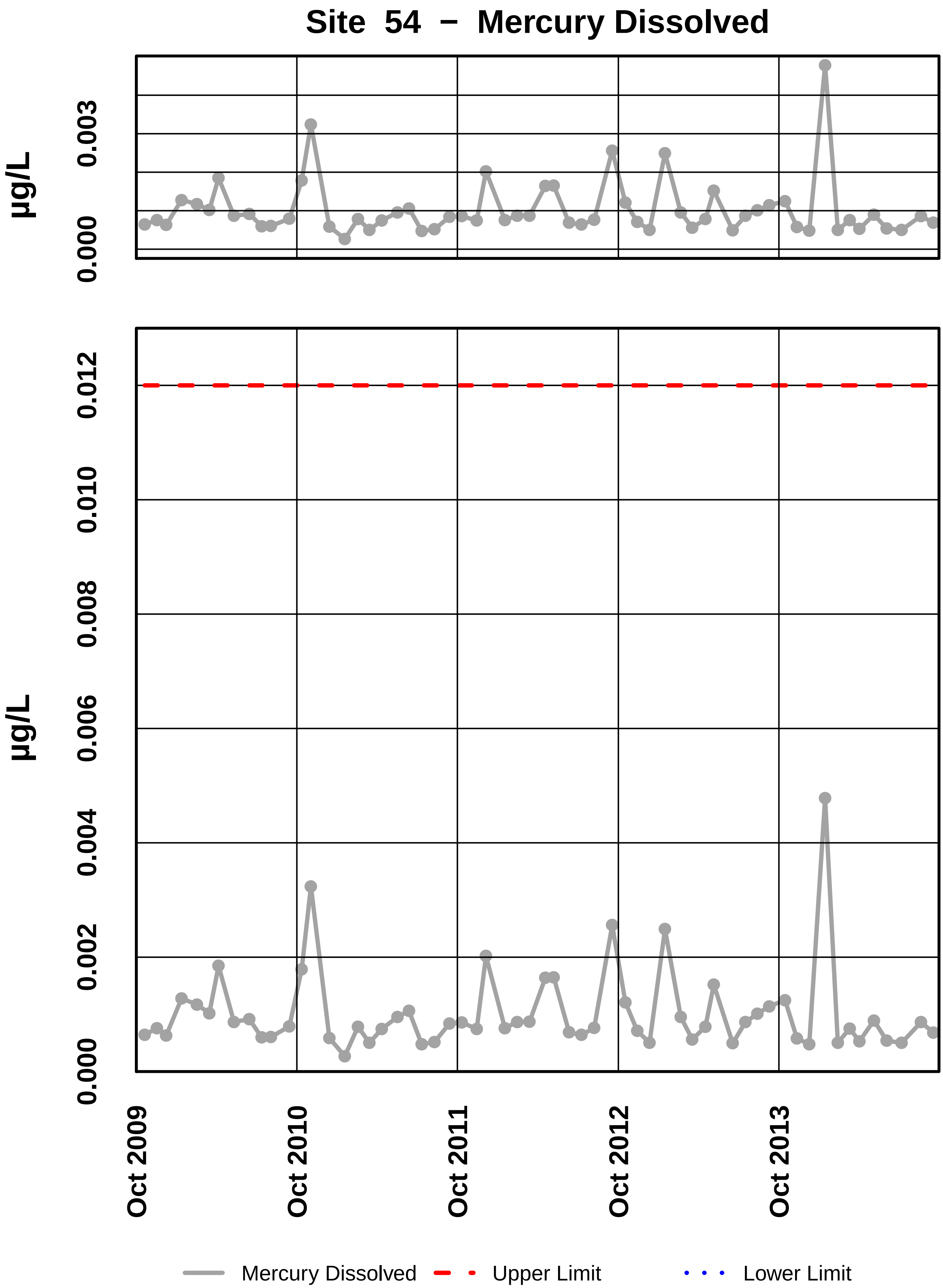



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

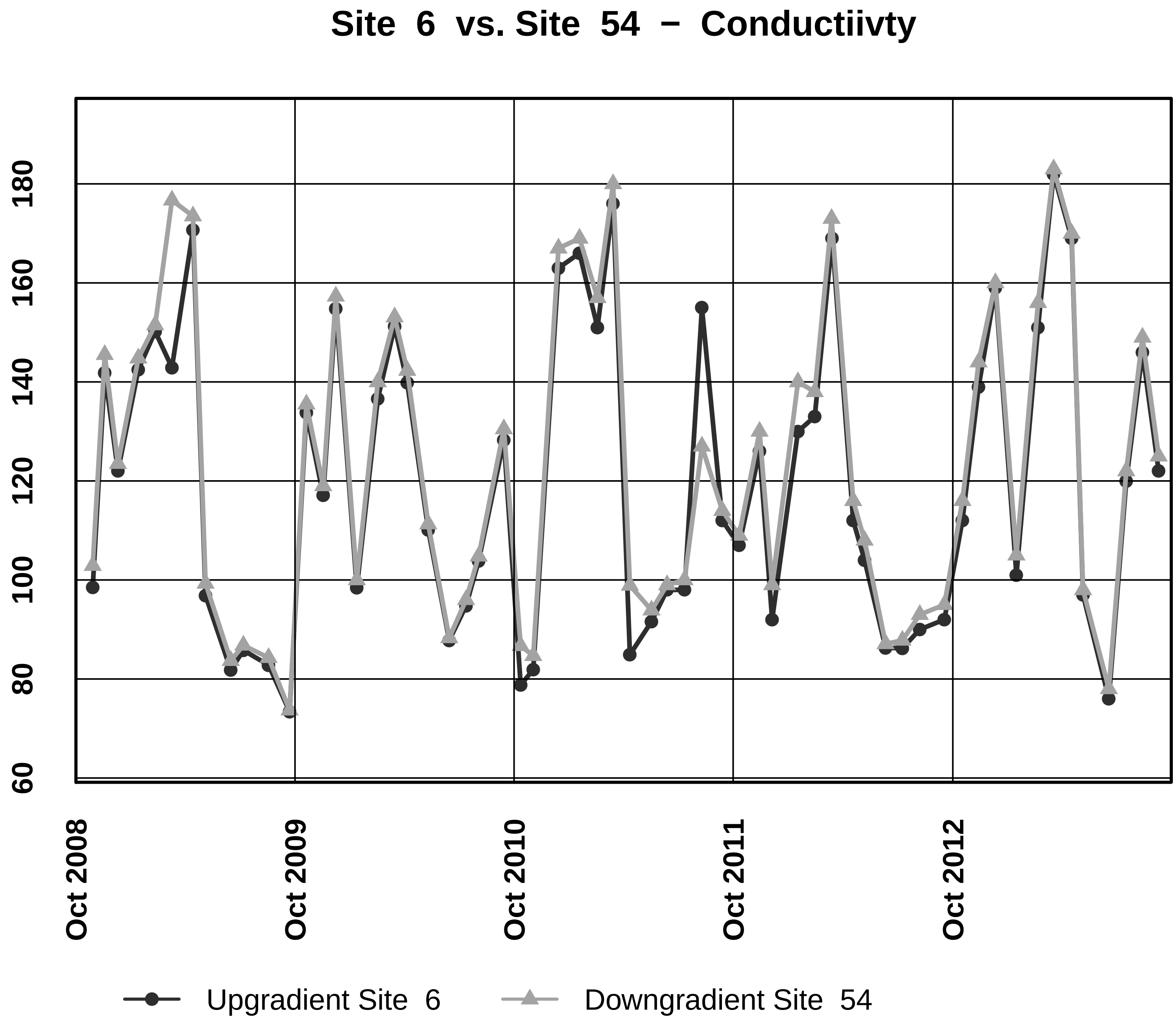
# Site 54 − Selenium Dissolved

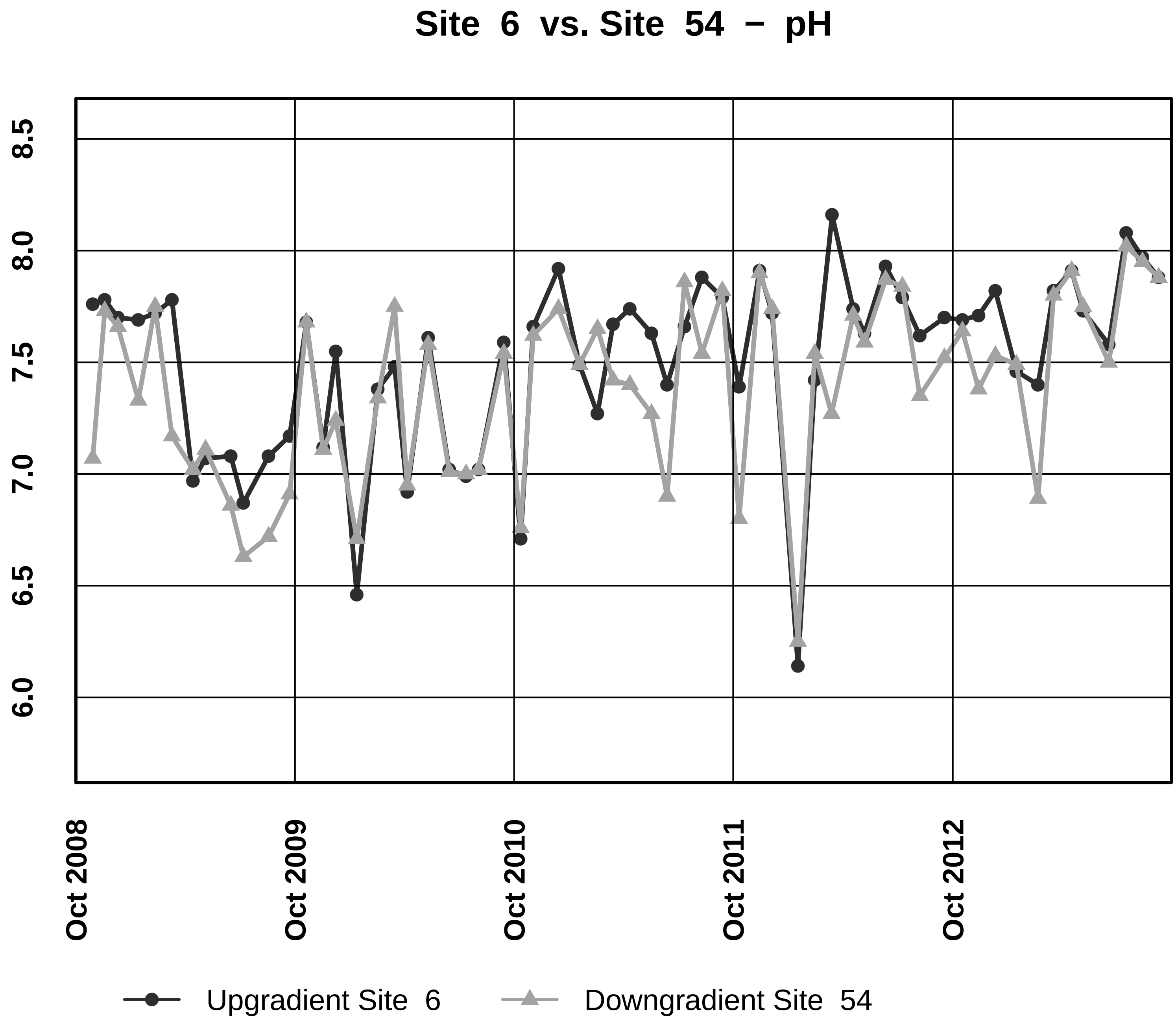


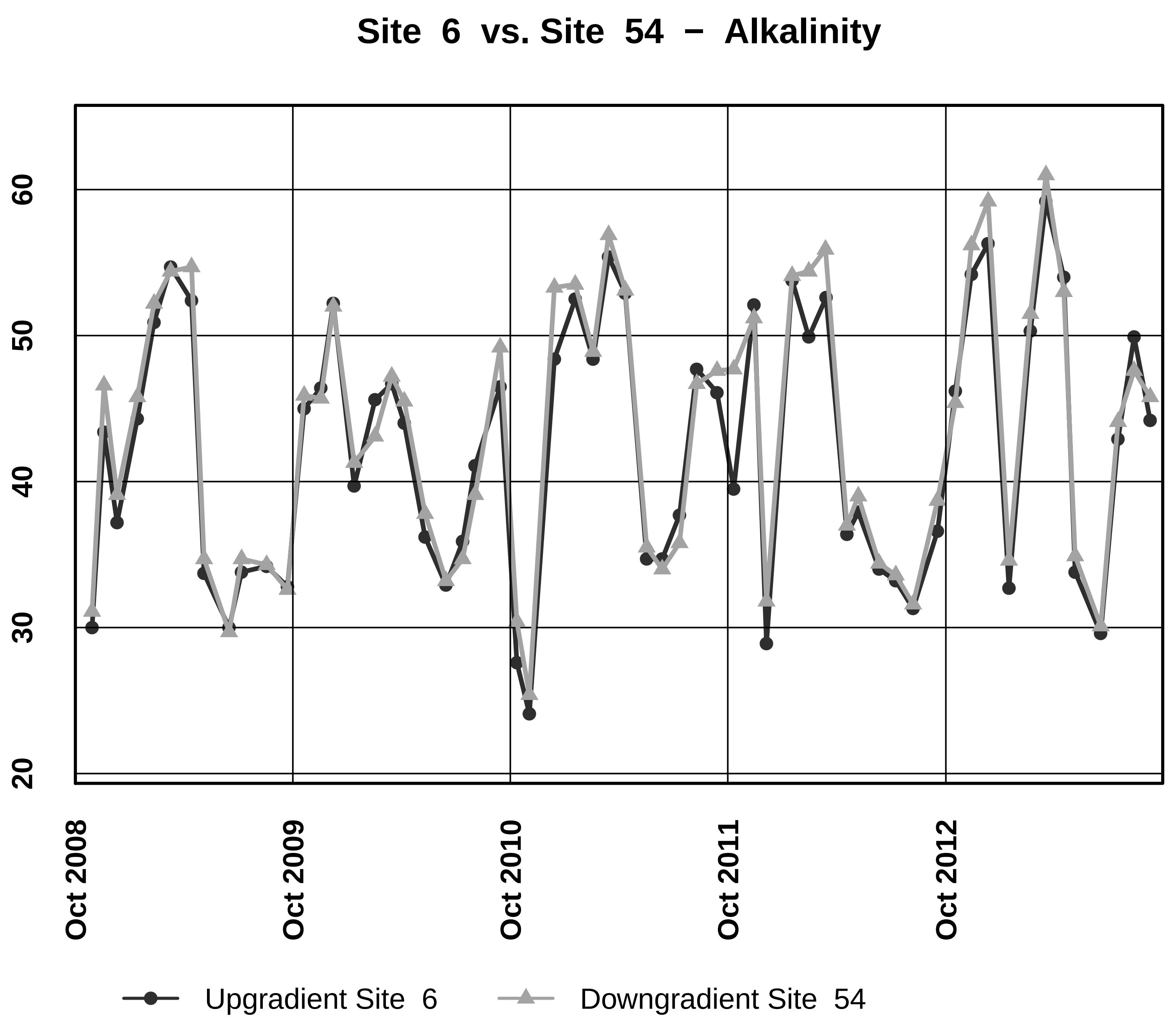

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



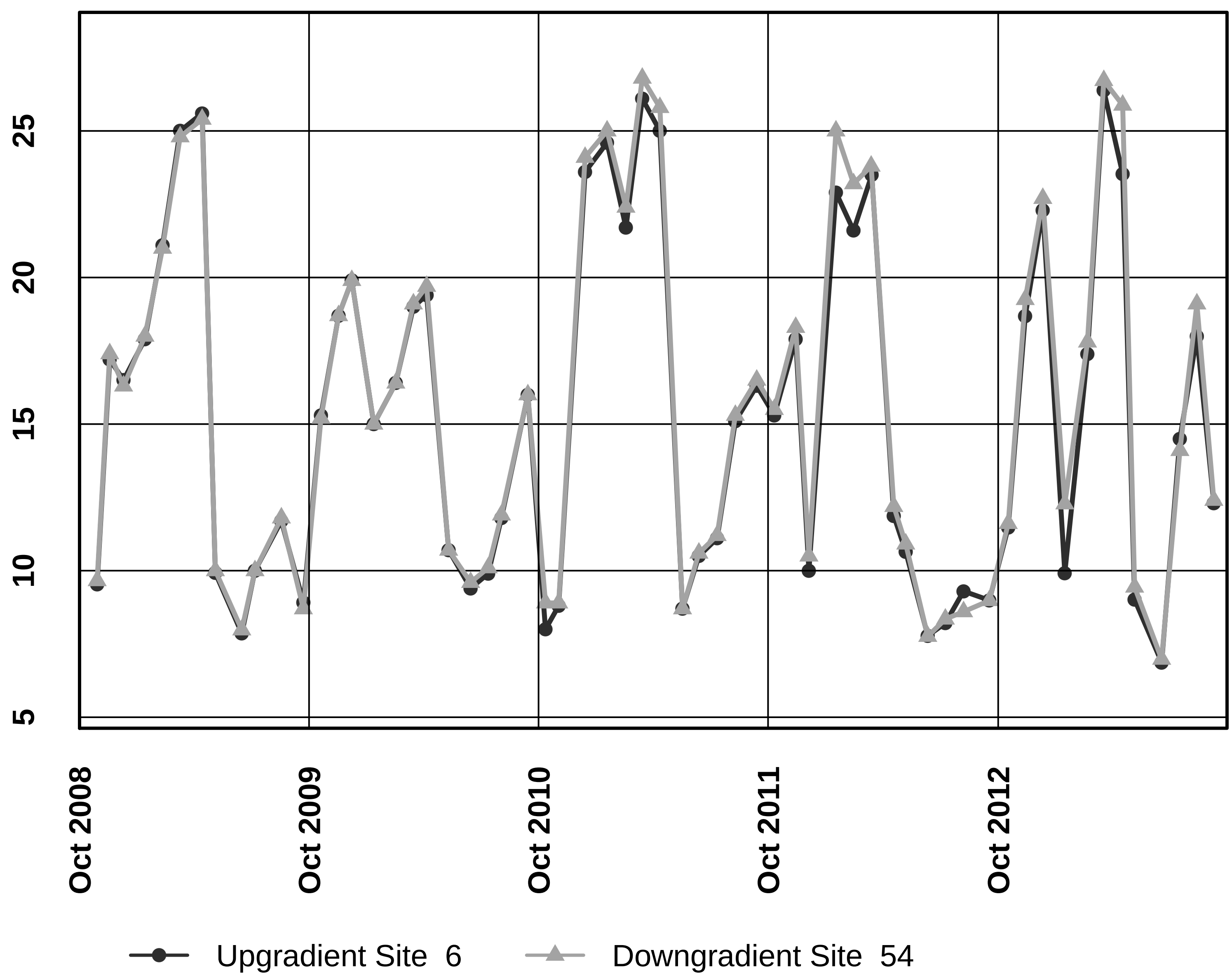

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

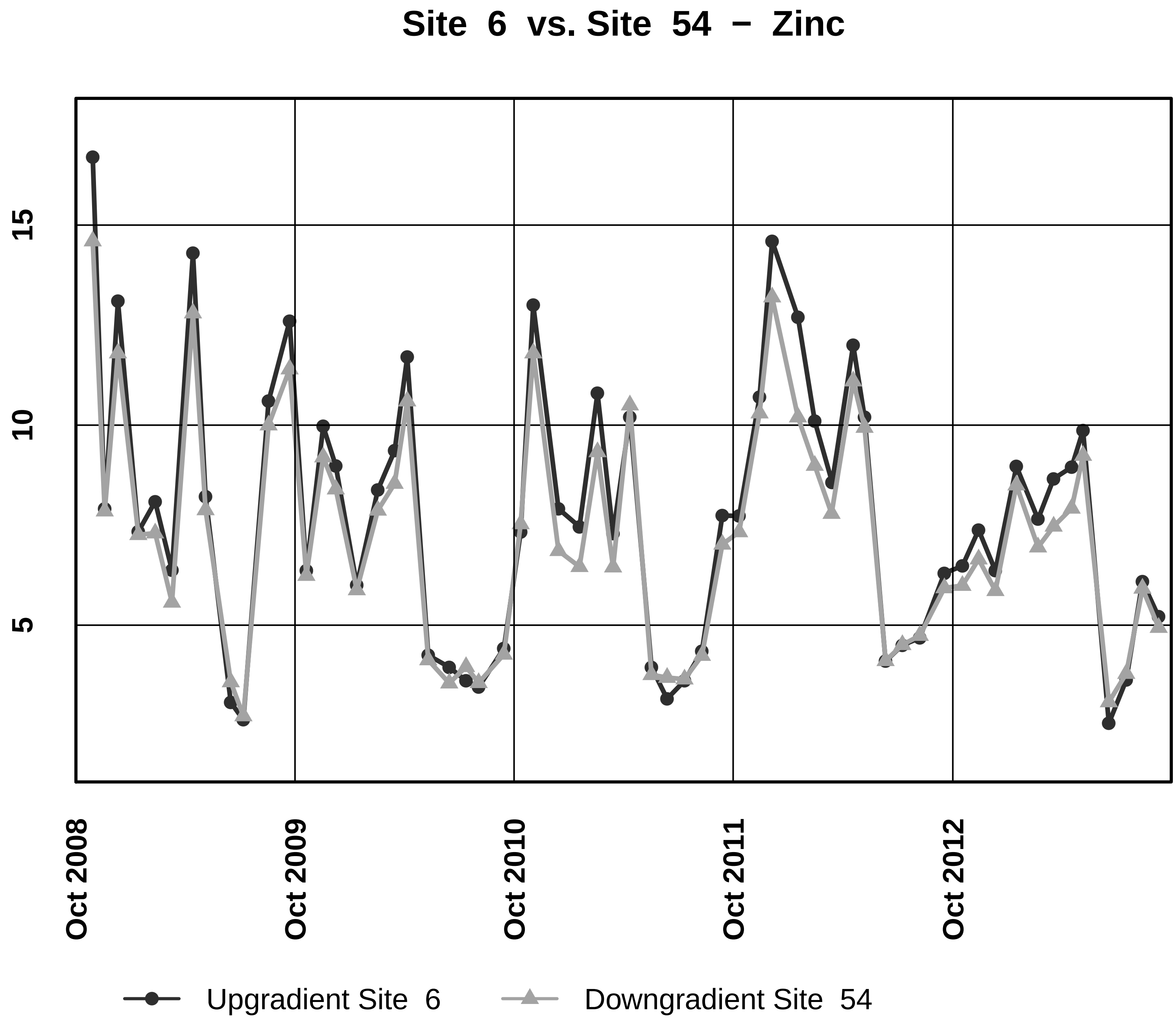

Site 6 vs. Site 54 − Conductiivty
180
160
140
120
100
80
60
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Oct 2012
Upgradient Site 6
Downgradient Site 54


Site 6 vs. Site 54 − pH
8.5
8.0
7.5
7.0
6.5
6.0
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Oct 2012
Upgradient Site 6
Downgradient Site 54


Site 6 vs. Site 54 − Alkalinity
20
30
40
50
60
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Oct 2012
Upgradient Site 6
Downgradient Site 54

## Site 6 vs. Site 54 − Sulfate




Site 6 vs. Site 54 − Zinc
15
10
5
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Oct 2012
Upgradient Site 6
Downgradient Site 54

**Wilcoxon-signed-ranks test**
**Exact Form**

Variable: **Specific Conductance, Field (µS/cm)**

| | **X** | **Y** | | | |
|---|---|---|---|---|---|
| Site | #6 | #54 | Differences | | |
| Year | WY2014 | WY2014 | **D** | **\|D\|** | **Rank** |
| Oct | 110.0 | 112.0 | -2.0 | 2.0 | -5.5 |
| Nov | 146.0 | 147.0 | -1.0 | 1.0 | -2 |
| Dec | 150.0 | 154.0 | -4.0 | 4.0 | -9 |
| Jan | 52.0 | 56.0 | -4.0 | 4.0 | -9 |
| Feb | 157.0 | 160.0 | -3.0 | 3.0 | -7 |
| Mar | 159.0 | 163.0 | -4.0 | 4.0 | -9 |
| Apr | 189.0 | 191.0 | -2.0 | 2.0 | -5.5 |
| May | 98.0 | 99.0 | -1.0 | 1.0 | -2 |
| Jun | 97.0 | 97.0 | 0.0 | | |
| Jul | 115.0 | 116.0 | -1.0 | 1.0 | -2 |
| Aug | 121.0 | 121.0 | 0.0 | | |
| Sep | 135.2 | 136.8 | -1.6 | 1.6 | -4 |
| Median | 128.1 | 128.9 | -1.8 | 2.0 | |

| **n** | **m** |
|---|---|
| 12 | 10 |

**N=** 10

$\Sigma R=$ -55

| $\alpha$ |
|---|
| 0.05 |
| **W'**$\alpha$,n |
| 10 |

| $W^+=$ |
|---|
| **0** |
| p-test |
| 0.001 |

| | | |
|---|---|---|
| $H_0$ | median [D]=0 | **REJECT** |
| $H_1$ | median [D]<0 | **ACCEPT** |

**Wilcoxon-signed-ranks test**
**Exact Form**

Variable: **pH, Field, Standard Units**

| | **X** | **Y** | | | |
|---|---|---|---|---|---|
| Site | #6 | #54 | Differences | | |
| Year | WY2014 | WY2014 | **D** | **\|D\|** | **Rank** |
| Oct | 7.84 | 7.79 | 0.05 | 0.05 | 8 |
| Nov | 7.88 | 7.85 | 0.03 | 0.03 | 4.5 |
| Dec | 7.88 | 7.80 | 0.08 | 0.08 | 9 |
| Jan | 7.34 | 7.38 | -0.04 | 0.04 | -7 |
| Feb | 7.68 | 7.66 | 0.02 | 0.02 | 3 |
| Mar | 7.81 | 7.61 | 0.20 | 0.20 | 12 |
| Apr | 7.85 | 7.66 | 0.19 | 0.19 | 11 |
| May | 7.59 | 7.60 | -0.01 | 0.01 | -1.5 |
| Jun | 7.77 | 7.66 | 0.11 | 0.11 | 10 |
| Jul | 7.85 | 7.88 | -0.03 | 0.03 | -6 |
| Aug | 7.87 | 7.84 | 0.03 | 0.03 | 4.5 |
| Sep | 8.13 | 8.14 | -0.01 | 0.01 | -1.5 |
| Median | 7.85 | 7.73 | 0.03 | 0.04 | |

| **n** | **m** |
|---|---|
| 12 | 12 |

**N=** 12
$\Sigma R=$ 46

| $\alpha$ |
|---|
| 0.05 |
| **W'**$\alpha$,n |
| 17 |

| $W^{+}=$ |
|---|
| **16** |
| p-test |
| 0.039 |

| | | |
|---|---|---|
| $H_0$ | median [D]=0 | **REJECT** |
| $H_1$ | median [D]>0 | **ACCEPT** |

**Wilcoxon-signed-ranks test**
**Exact Form**

Variable: **Total Alk, (mg/l)**

| | **X** | **Y** | Differences | | |
|---|---|---|---|---|---|
| Site | #6 | #54 | | | |
| Year | WY2014 | WY2014 | **D** | **\|D\|** | **Rank** |
| Oct | 39.6 | 40.4 | -0.8 | 0.8 | -4 |
| Nov | 50.1 | 51.5 | -1.4 | 1.4 | -7 |
| Dec | 52.0 | 53.6 | -1.6 | 1.6 | -8 |
| Jan | 18.5 | 21.7 | -3.2 | 3.2 | -12 |
| Feb | 52.6 | 53.1 | -0.5 | 0.5 | -2 |
| Mar | 51.6 | 53.7 | -2.1 | 2.1 | -10 |
| Apr | 55.7 | 58.1 | -2.4 | 2.4 | -11.00 |
| May | 34.7 | 36.5 | -1.8 | 1.8 | -9 |
| Jun | 36.1 | 36.0 | 0.1 | 0.1 | 1 |
| Jul | 40.4 | 41.6 | -1.2 | 1.2 | -5.5 |
| Aug | 43.3 | 44.5 | -1.2 | 1.2 | -5.50 |
| Sep | 50.2 | 50.9 | -0.7 | 0.7 | -3 |
| Median | 46.7 | 47.7 | -1.3 | 1.3 | |

| **n** | **m** |
|---|---|
| 12 | 12 |

**N=** 12
$\Sigma R=$ -76

| $\alpha$ |
|---|
| 0.05 |
| **W'**$_{\alpha,n}$ |
| 17 |

| $W^{+}=$ |
|---|
| **1.00** |
| p-test |
| 0.000 |

| | | |
|---|---|---|
| $H_0$ | median [D]=0 | **REJECT** |
| $H_1$ | median [D]>0 | **ACCEPT** |

**Wilcoxon-signed-ranks test**
**Exact Form**

Variable: **Sulfate, Total (mg/l)**

| | **X** | **Y** | | | |
|---|---|---|---|---|---|
| Site | #6 | #54 | Differences | | |
| Year | WY2014 | WY2014 | **D** | **\|D\|** | **Rank** |
| Oct | 10.7 | 10.7 | 0.0 | | |
| Nov | 17.9 | 18.1 | -0.2 | 0.2 | -7 |
| Dec | 20.2 | 20.2 | 0.0 | | |
| Jan | 5.2 | 5.3 | -0.2 | 0.2 | -4 |
| Feb | 21.7 | 21.7 | 0.0 | | |
| Mar | 23.1 | 24.7 | -1.6 | 1.6 | -9 |
| Apr | 25.6 | 25.8 | -0.2 | 0.2 | -5.5 |
| May | 9.3 | 9.2 | 0.1 | 0.1 | 3 |
| Jun | 9.5 | 9.5 | 0.0 | 0.0 | 1 |
| Jul | 12.1 | 12.2 | -0.1 | 0.1 | -2 |
| Aug | 12.3 | 11.5 | 0.8 | 0.8 | 8 |
| Sep | 15.9 | 15.7 | 0.2 | 0.2 | 5.5 |
| Median | 14.1 | 14.0 | 0.0 | 0.2 | |

| **n** | **m** |
|---|---|
| 12 | 9 |

**N=** 9

$\Sigma R=$ -10

| $\alpha$ |
|---|
| 0.05 |
| **W'**$\alpha$,n |
| 8 |

| $W^+=$ |
|---|
| **17.5** |
| p-test |
| 0.285 |

| | | |
|---|---|---|
| $H_0$ | median [D]=0 | ACCEPT |
| $H_1$ | median [D]<0 | |

**Wilcoxon-signed-ranks test**
**Exact Form**

Variable: **Zinc, Dissolved (ug/l)**

| | X | Y | Differences | | |
|---|---|---|---|---|---|
| Site | #6 | #54 | | | |
| Year | WY2014 | WY2014 | D | \|D\| | Rank |
| Oct | 6.53 | 5.92 | 0.61 | 0.61 | 8 |
| Nov | 7.05 | 7.12 | -0.07 | 0.07 | -2.5 |
| Dec | 7.12 | 6.58 | 0.54 | 0.54 | 6 |
| Jan | 11.40 | 10.20 | 1.20 | 1.20 | 12 |
| Feb | 9.78 | 8.68 | 1.10 | 1.10 | 11 |
| Mar | 9.69 | 8.77 | 0.92 | 0.92 | 10 |
| Apr | 7.61 | 6.73 | 0.88 | 0.88 | 9 |
| May | 4.77 | 4.62 | 0.15 | 0.15 | 4 |
| Jun | 3.30 | 3.25 | 0.05 | 0.05 | 1 |
| Jul | 3.38 | 3.45 | -0.07 | 0.07 | -2.5 |
| Aug | 5.13 | 4.86 | 0.27 | 0.27 | 5 |
| Sep | 5.54 | 4.99 | 0.55 | 0.55 | 7 |
| Median | 6.79 | 6.25 | 0.55 | 0.55 | |

| n | m |
|---|---|
| 12 | 12 |

**N**= 12
$\Sigma$R= 68

| $\alpha$ |
|---|
| 0.05 |
| **W'**$\alpha$,n |
| 17 |

| $W^{+}$= |
|---|
| **5** |
| p-test |
| 0.002 |

| | | |
|---|---|---|
| $H_0$ | median [D]=0 | **REJECT** |
| $H_1$ | median [D]<0 | **ACCEPT** |

# INTERPRETIVE REPORT
# SITE 62

Sampling at this site was initiated during the spring of the Water Year 2013. Site 62 is located approximately 1,000 feet downstream from Site 54, and therefore is downstream of Site 23 and Inactive Site D. Sampling is on a monthly basis in conjunction with the other routine monthly sampling along Greens Creek.

The data collected during the current water year are listed in the following “Table of Results for Water Year 2014” report. The table includes all the required FWMP analyte data (field and laboratory) collected for the current water year and a series of flags keyed to the summary report “Qualified Data by QA Reviewer”. The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of ½ MDL for the purpose of median calculation.

All data collected at this site for the past year is included in the report. As shown in the table below, there were no data outliers.

| Sample Date | Parameter | Value | Qualifier | Notes |
|---|---|---|---|---|
| No outliers have been identified by HGCMC for the period of October 2012 through September 2014. | | | | |

The data for Water Year 2014 have been compared to the strictest fresh water quality criterion for each applicable analyte. No results exceeding these criteria have been identified as listed in the table below.

**Table of Exceedance for Water Year 2014**

| | | | Limits | | |
|---|---|---|---|---|---|
| Sample Date | Parameter | Value | Lower | Upper | Hardness |
| No exceedances have been identified by HGCMC for the period of October 2013 through September 2014. | | | | | |

X-Y plots have been generated to graphically present the data for each of the analytes requested in the Statistical Information Goals for this site. Because of the limited amount of data, visual trend analysis and statistical analysis of the data was not performed.

A comparison of median values for total alkalinity, field pH, field conductivity, total sulfate, and dissolved zinc between Site 62 and Site 54 has been conducted. Additionally, X-Y plots have been generated for total alkalinity, field pH, specific conductance, total sulfate, and dissolved zinc that co-plot data from Site 62 and Site 54, the upstream control site, to aid in the comparison between those sites. Calculation details of the non-parametric signed-rank tests are presented in detail on the pages following this interpretive section. The table below summarizes the results of the signed-rank test as performed on the Water Year 2014 dataset.

**Table of Summary Statistics for Median Analysis**

| Site 62 vs Site 54 | | | | |
|---|---|---|---|---|
| **Parameter** | **Signed Ranks p-value** | **Site 54 median** | **Site 62 median** | **Median Differences** |
| Conductivity Field | <0.01 | 128.9 | 130.00 | -9.0 |
| pH Field | <0.01 | 7.73 | 7.48 | 0.23 |
| Alkalinity, Total | 0.016 | 47.7 | 46.0 | -2.2 |
| Sulfate, Total | <0.01 | 14 | 12.7 | 2.0 |
| Zinc, Dissolved | 0.087 | 6.25 | 5.82 | -0.2 |

The median values for pH for Site 6 and Site 54 are 7.73 su and 7.48 su respectively and the median of differences, Site 54 minus Site 62, is 0.23 su. The median values for total alkalinity for Site 54 and Site 62 are 47.7 mg/L and 46.0 mg/L respectively, with a median difference of -2.2 mg/L total alkalinity. Field conductivity was also a statistically significant with a median difference of -9 µS/cm. Similar results to these were obtained when comparing other paired (48-6 and 6-54) sites along Greens Creek.

HGCMC feels the current FWMP program is adequate to measure and quantify future changes that may occur between Site 54 and Site 62, given that this is the first year of comparison.

## Table of Results for Water Year 2014

### Site 062FMS - 'Greens Creek Below Site 54'

| Sample Date/Parameter | Oct 2013 | Nov 2013 | Dec 2013 | Jan 2014 | Feb 2014 | Mar 2014 | Apr 2014 | May 2014 | Jun 2014 | Jul 2014 | Aug 2014 | Sep 2014 | **Median** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Water Temp (°C) | 5.4 | 4 | | 0.2 | 0.2 | 1 | 0.9 | 2.4 | 4.3 | 9 | 8.1 | 8.6 | 4.0 |
| Conductivity-Field(μmho) | 116 | 347 | | 63 | 174 | 173 | 210 | 106 | 100 | 122 | 130 | 146.7 | 130.0 |
| Conductivity-Lab (μmho) | 103 | 122 | | 65 | 166 | 157 | 186 | 105 | 98 | 121 | 124 | 148 | 122 |
| pH Lab (standard units) | 7.73 | 7.78 | | 7.49 | 7.56 | 7.75 | 7.7 | 7.4 | 7.34 | 7.72 | 7.68 | 7.71 | 7.70 |
| pH Field (standard units) | 7.77 | 7.76 | | 7.02 | 7.33 | 7.48 | 7.42 | 7.37 | 6.82 | 7.81 | 7.55 | 8.06 | 7.48 |
| Total Alkalinity (mg/L) | 42 | 46 | | 23.9 | 59.2 | 60.2 | 62.2 | 38.7 | 38 | 43.1 | 47.8 | 54.7 | 46.0 |
| Total Sulfate (mg/L) | 11 | 18.4 | | 6.7 | 22.6 | 24.3 | 27.6 | 10 | 9.5 | 12.7 | 12.2 | 16.8 | 12.7 |
| Hardness (mg/L) | 54.2 | 73 | | 27.7 | 78 | 78.7 | 88.4 | 47.5 | 45.2 | 55.4 | 59.8 | 72.8 | 59.8 |
| Dissolved As (ug/L) | 0.21 | 0.189 | | 0.257 | 0.207 | 0.188 | 0.176 | 0.185 | 0.195 | 0.183 | 0.231 | 0.241 | 0.195 |
| Dissolved Ba (ug/L) | | 30.6 | | | 32.3 | | | | | | | | 31.5 |
| Dissolved Cd (ug/L) | 0.0466 | 0.0517 | | 0.0884 | 0.0587 | 0.0559 | 0.0502 | 0.0377 | 0.0314 | 0.0324 | 0.0457 | 0.0489 | 0.0489 |
| Dissolved Cr (ug/L) | | 0.377 | | | 1.21 | | | | | | | | 0.794 |
| Dissolved Cu (ug/L) | 0.594 | 0.339 | | 1.73 | 1.99 | 0.483 | 0.293 | 0.513 | 0.278 | 0.357 | 0.497 | 0.384 | 0.483 |
| Dissolved Pb (ug/L) | 0.0173 | 0.0105 | | 0.593 | 0.0726 | 0.037 | 0.0078 | 0.0085 | 0.004 | 0.0078 | 0.0122 | 0.011 | 0.0110 |
| Dissolved Ni (ug/L) | | 0.669 | | | 0.73 | | | | | | | | 0.700 |
| Dissolved Ag (ug/L) | | 0.002 | | | 0.002 | | | | | | | | 0.002 |
| Dissolved Zn (ug/L) | 5.82 | 6.75 | | 11.1 | 9.85 | 8.97 | 7.11 | 4.47 | 3.16 | 3.46 | 5.22 | 5.32 | 5.82 |
| Dissolved Se (ug/L) | | 1.24 | | | 1.54 | | | | | | | | 1.390 |
| Dissolved Hg (ug/L) | 0.00111 | 0.000422 | | 0.005 | 0.000543 | 0.000659 | 0.00048 | 0.000845 | 0.0004 | 0.000442 | 0.00134 | 0.000663 | 0.000659 |

For individual sample/analyte qualifier descriptions see "Qualified Data by QA Reviewer" table.

Values reported as less than MDL are replaced by 1/2 MDL for median calculation purposes.

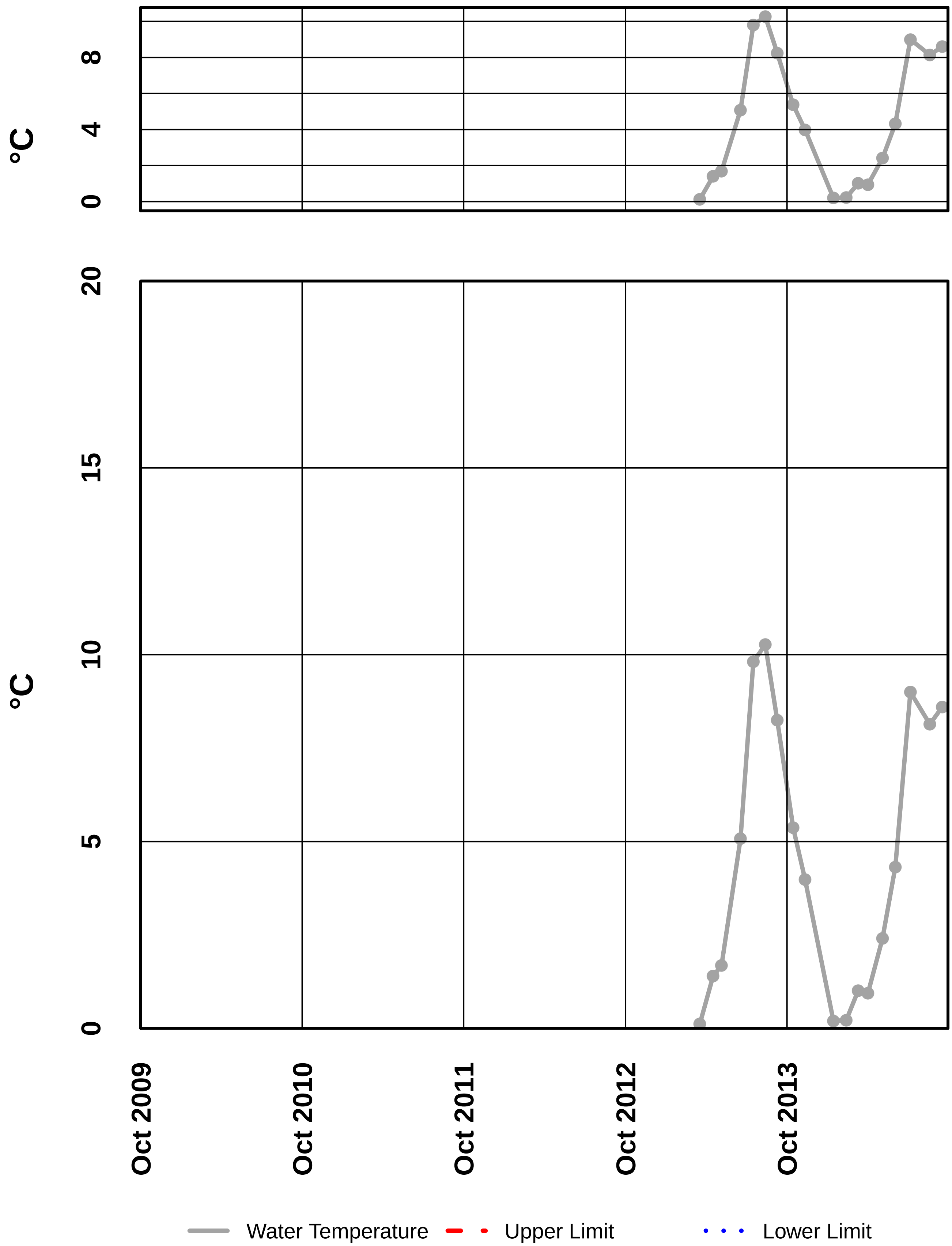
Shaded data has been qualified as an outlier by HGCMC and removed from any further analysis and is not included into the calculation of the median

# Qualified Data by QA Reviewer

## Date Range: 10/01/2013 to 09/30/2014

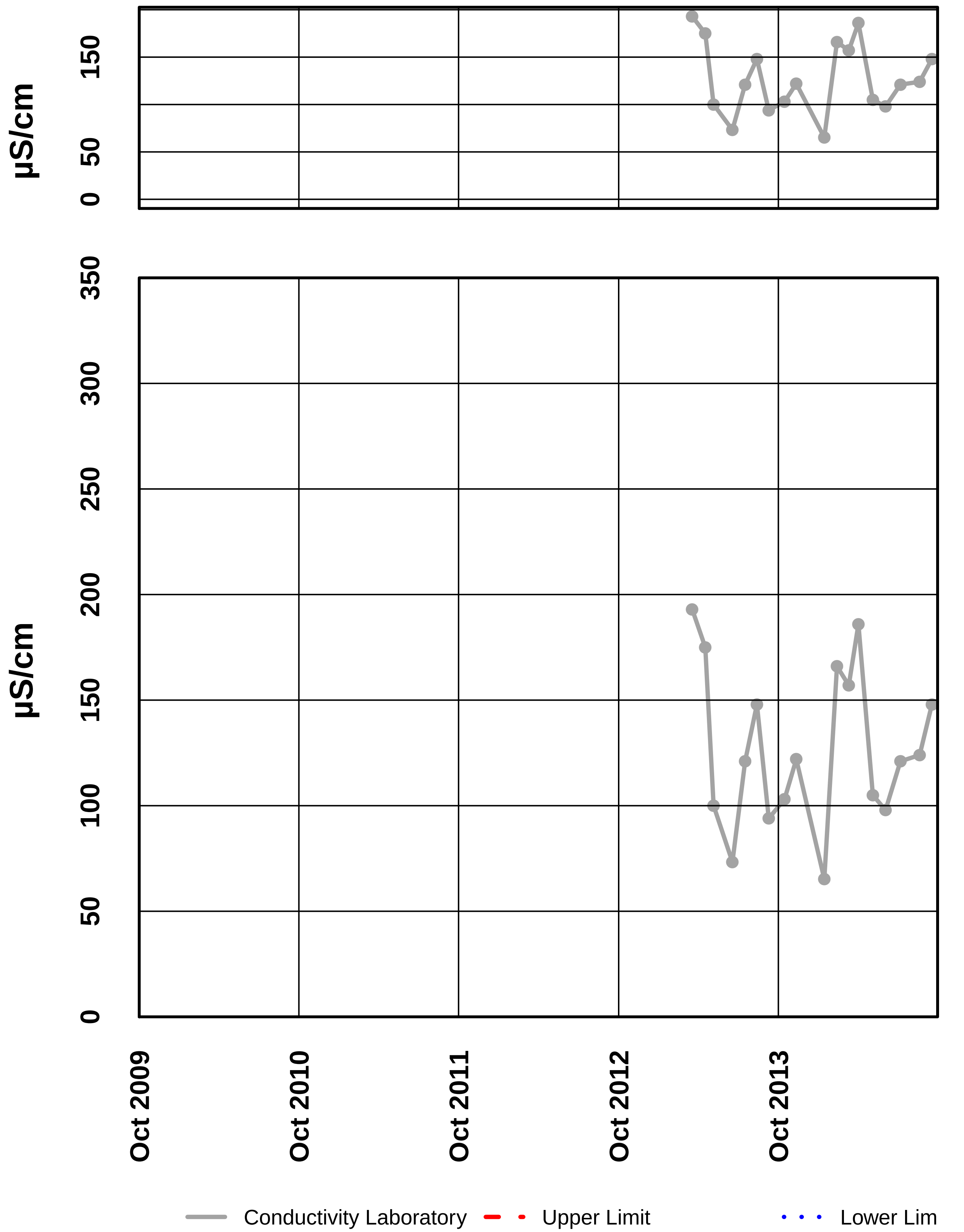
| Site No. | Sample Date | Sample Time | Parameter | Value | Qualifier | Reason for Qualifier |
|---|---|---|---|---|---|---|
| 062FMS | 11/11/2013 | 12:00 PM | Diss. Hg-CVAF | 0.000114 | J | Below Quantitative Range |
| | | | pH | 7.67 | J | Hold Time Violation |
| 062FMS | 1/14/2014 | 12:00 PM | pH | 7.49 | J | Hold Time Violation |
| 062FMS | 2/12/2014 | 12:00 PM | Diss. Cu-ICP/MS | 1.99 | J | LCS Recovery |
| | | | Sulfate | 22.6 | J | Sample Receipt Temperature |
| 062FMS | 4/2/2014 | 12:00 PM | Diss. Pb-ICP/MS | 0.00776 | J | Below Quantitative Range |
| | | | pH | 7.7 | J | Hold Time Violation |
| 062FMS | 5/5/2014 | 12:00 PM | Diss. Pb-ICP/MS | 0.0085 | J | Below Quantitative Range |
| 062FMS | 6/3/2014 | 12:00 PM | Diss. Pb-ICP/MS | 0.00398 | J | Below Quantitative Range |
| | | | Diss. Zn-ICP/MS | 3.16 | U | Field Blank Contamination |
| 062FMS | 7/7/2014 | 12:00 PM | Diss. Pb-ICP/MS | 0.00778 | J | Below Quantitative Range |
| | | | Sulfate | 12.7 | J | Sample Receipt Temperature |

## Site 62 – Water Temperature



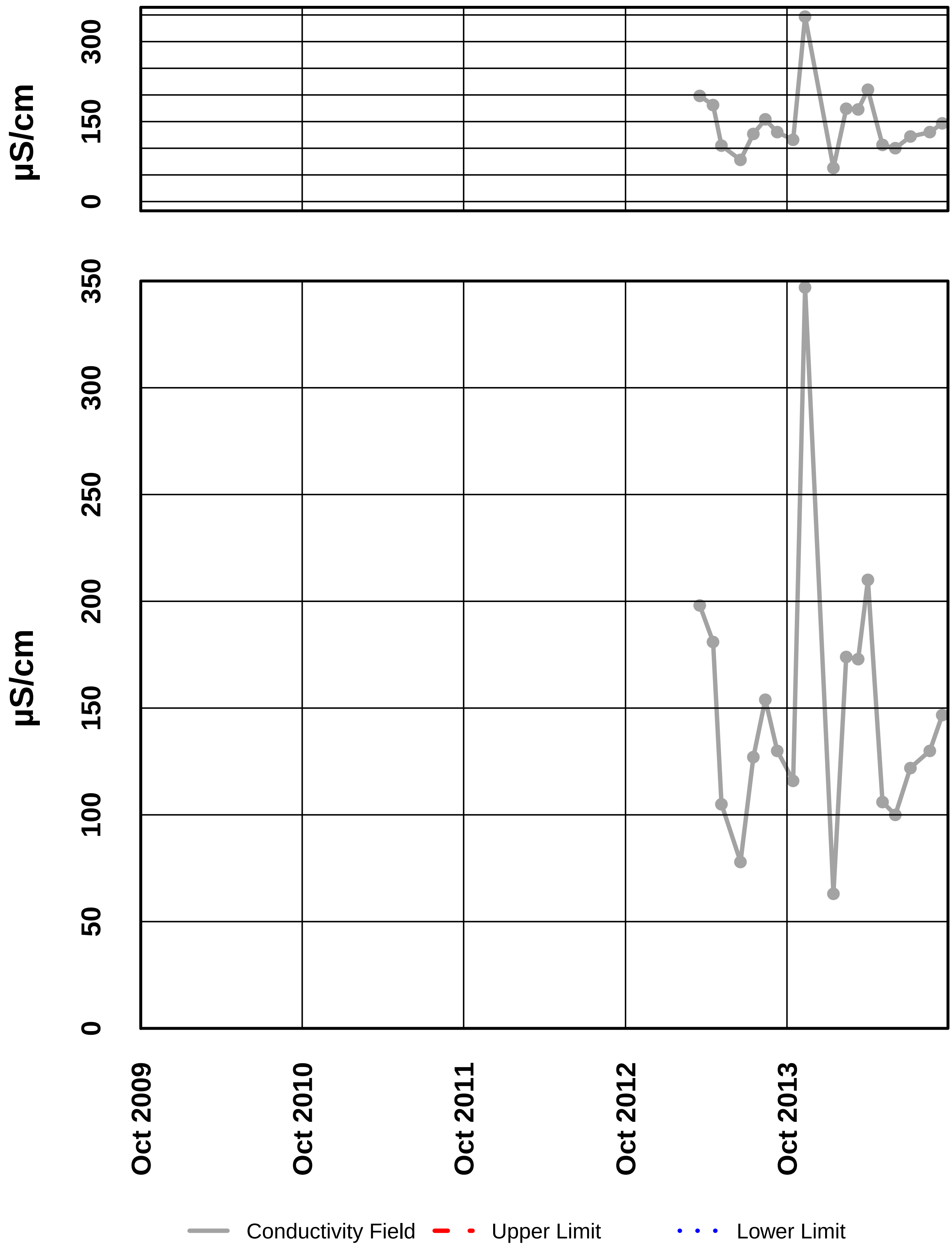

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

## Site 62 − Conductivity Laboratory

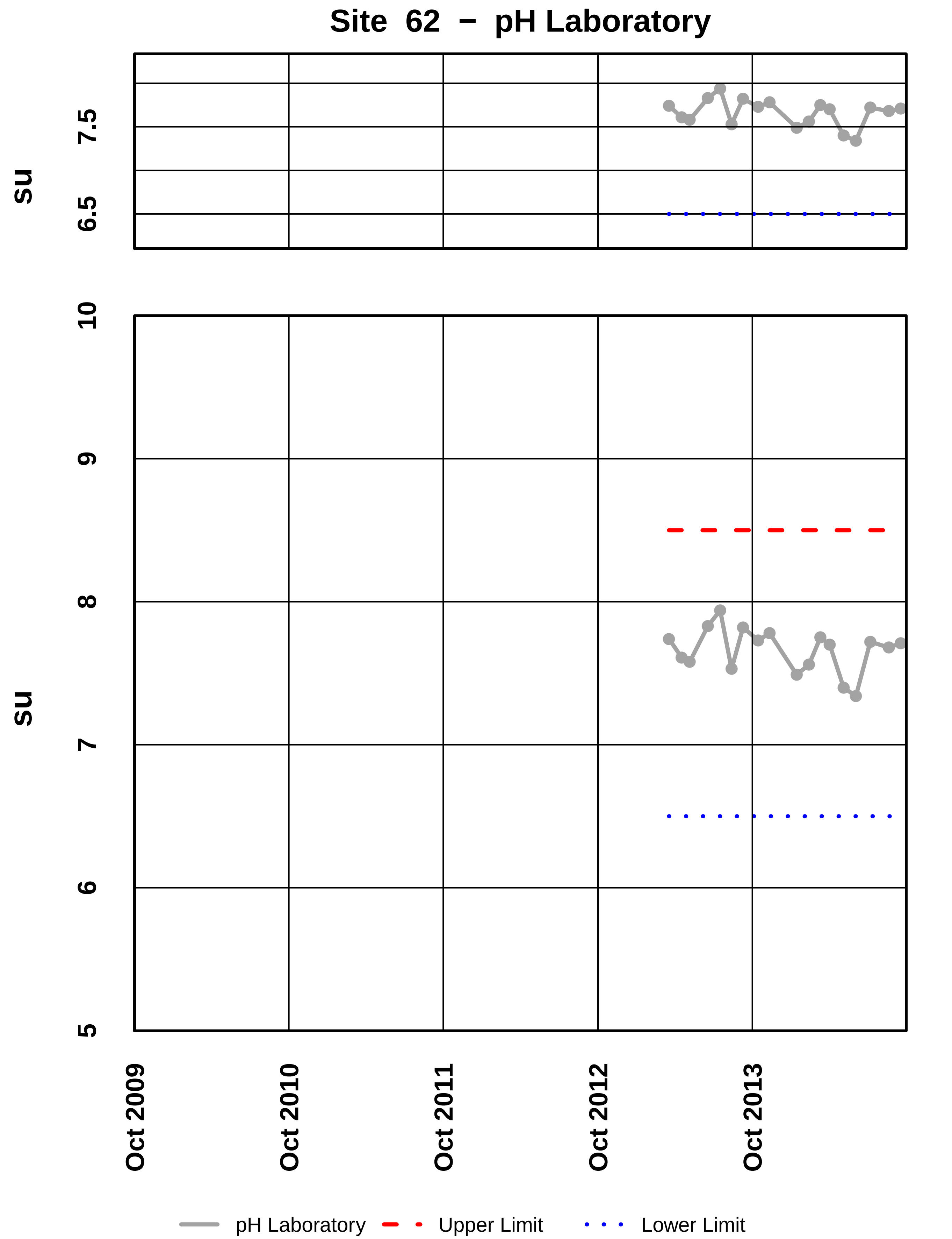



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

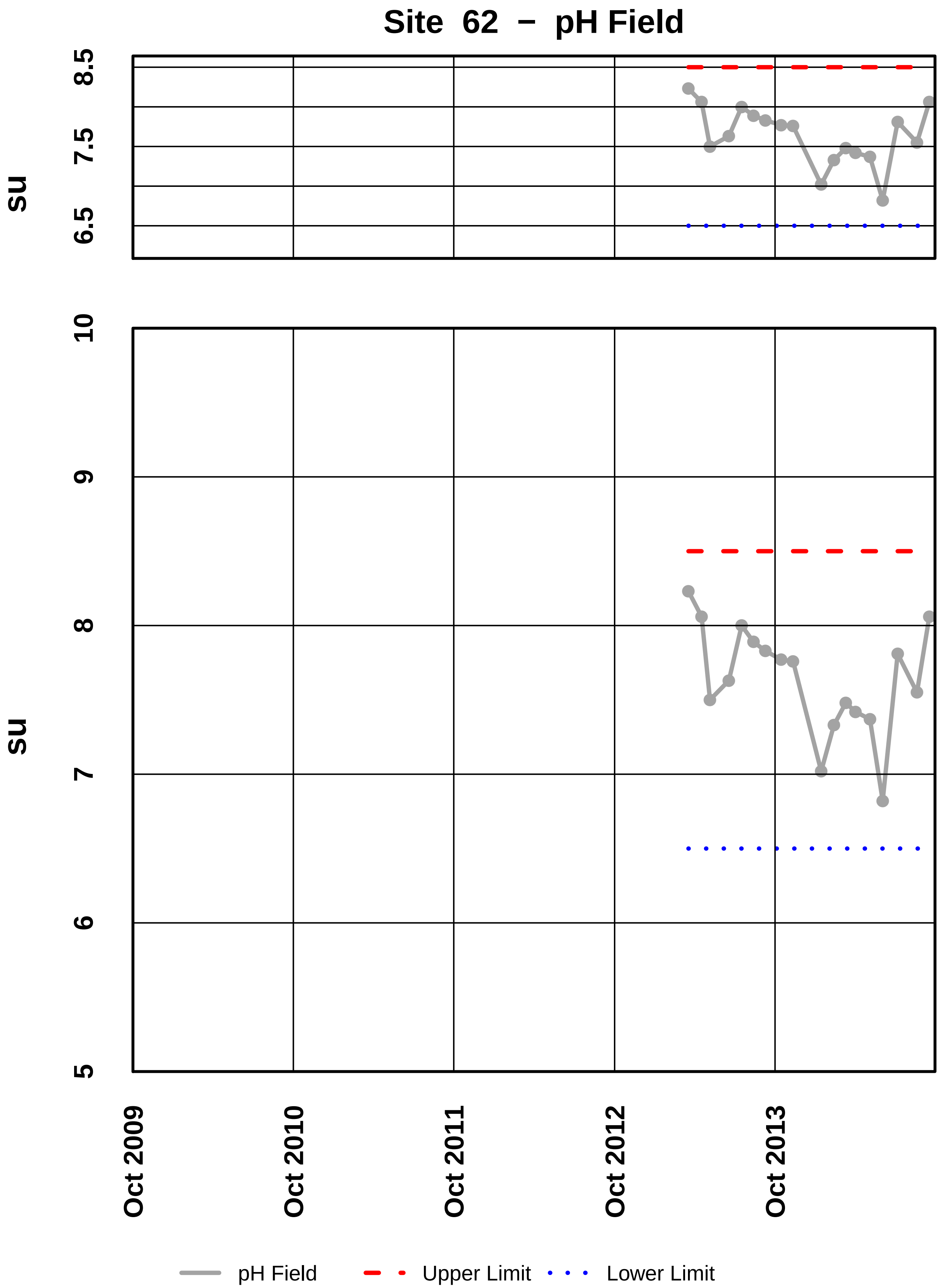
## Site 62 − Conductivity Field



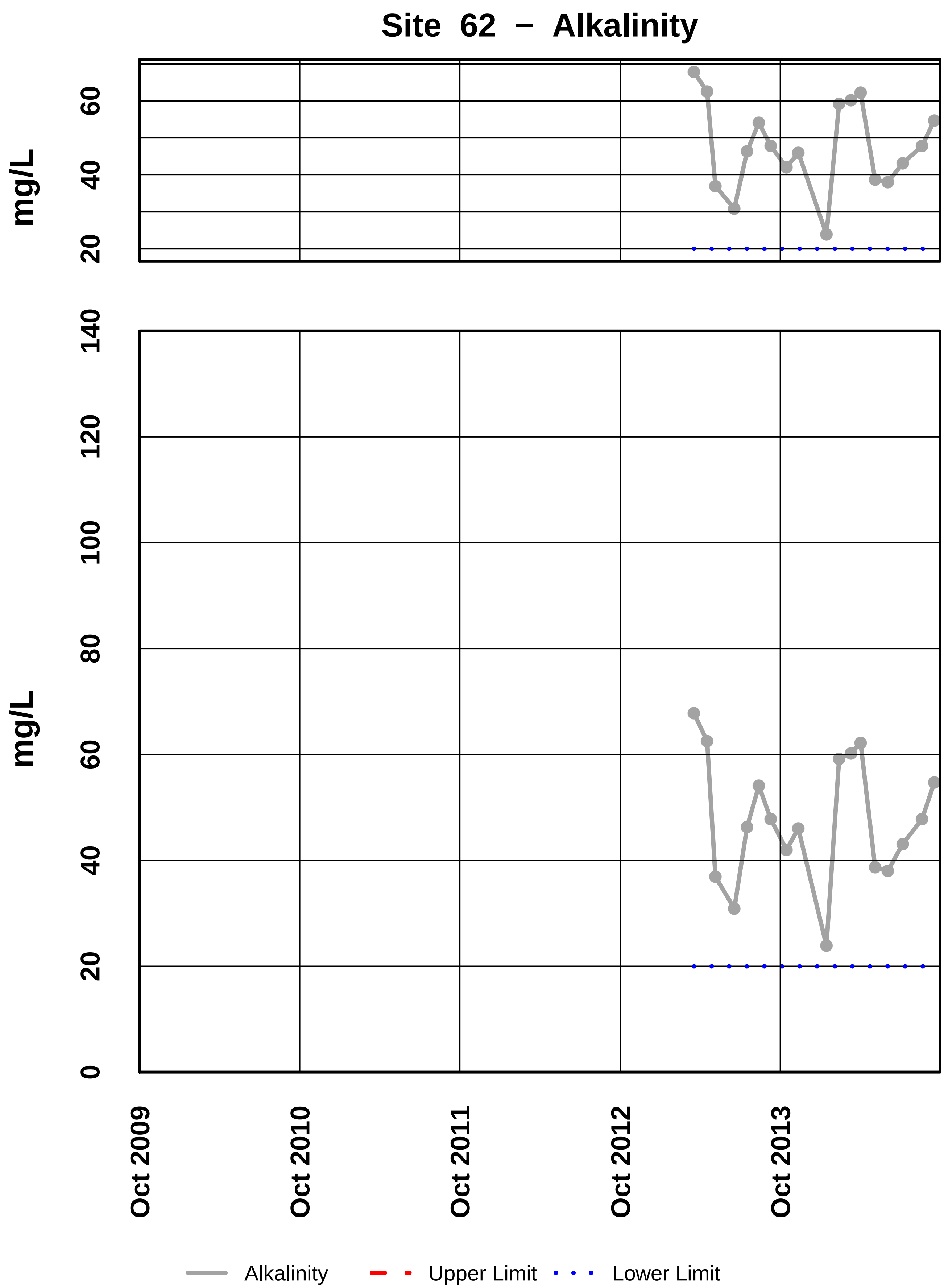

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



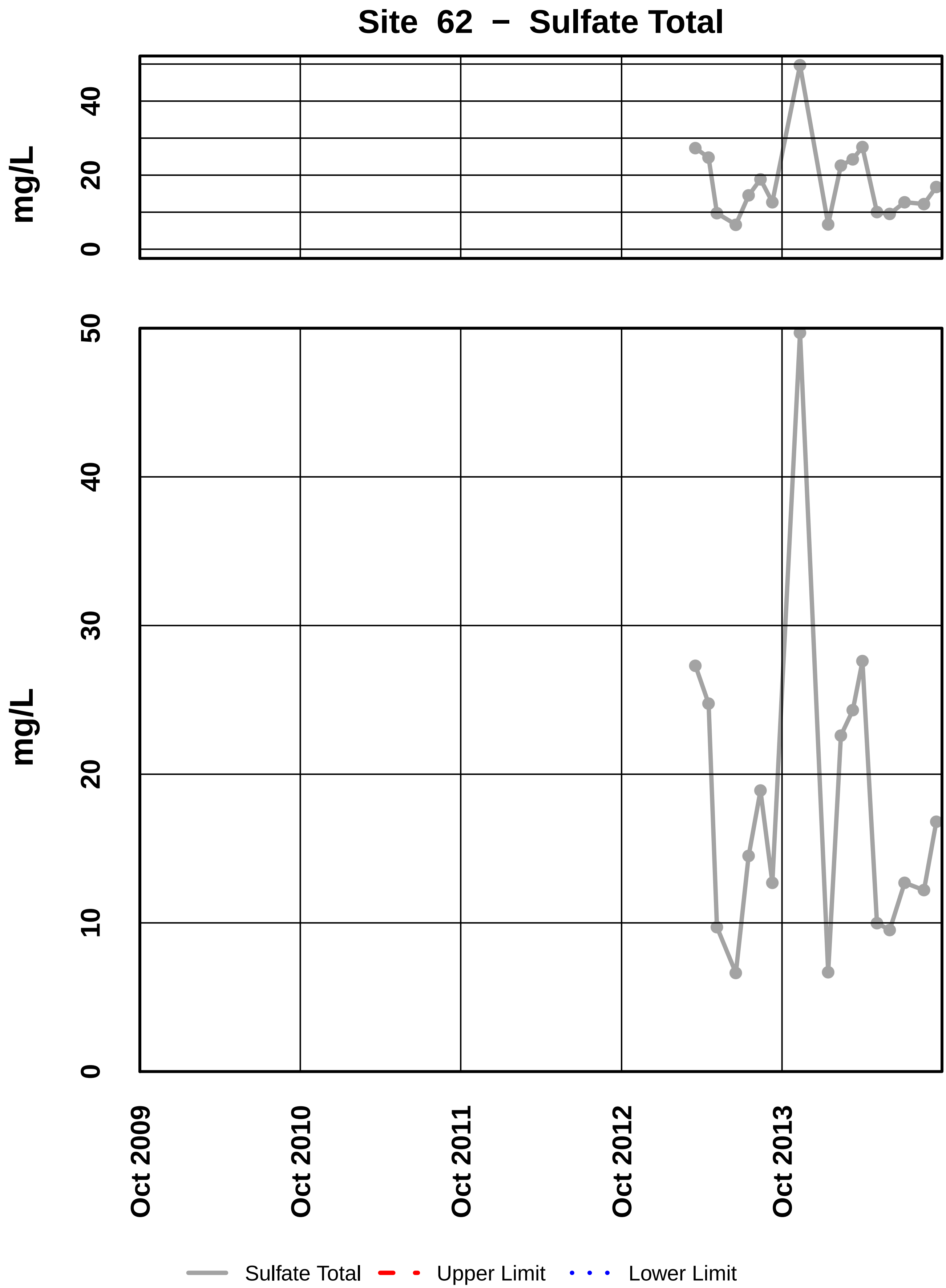

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



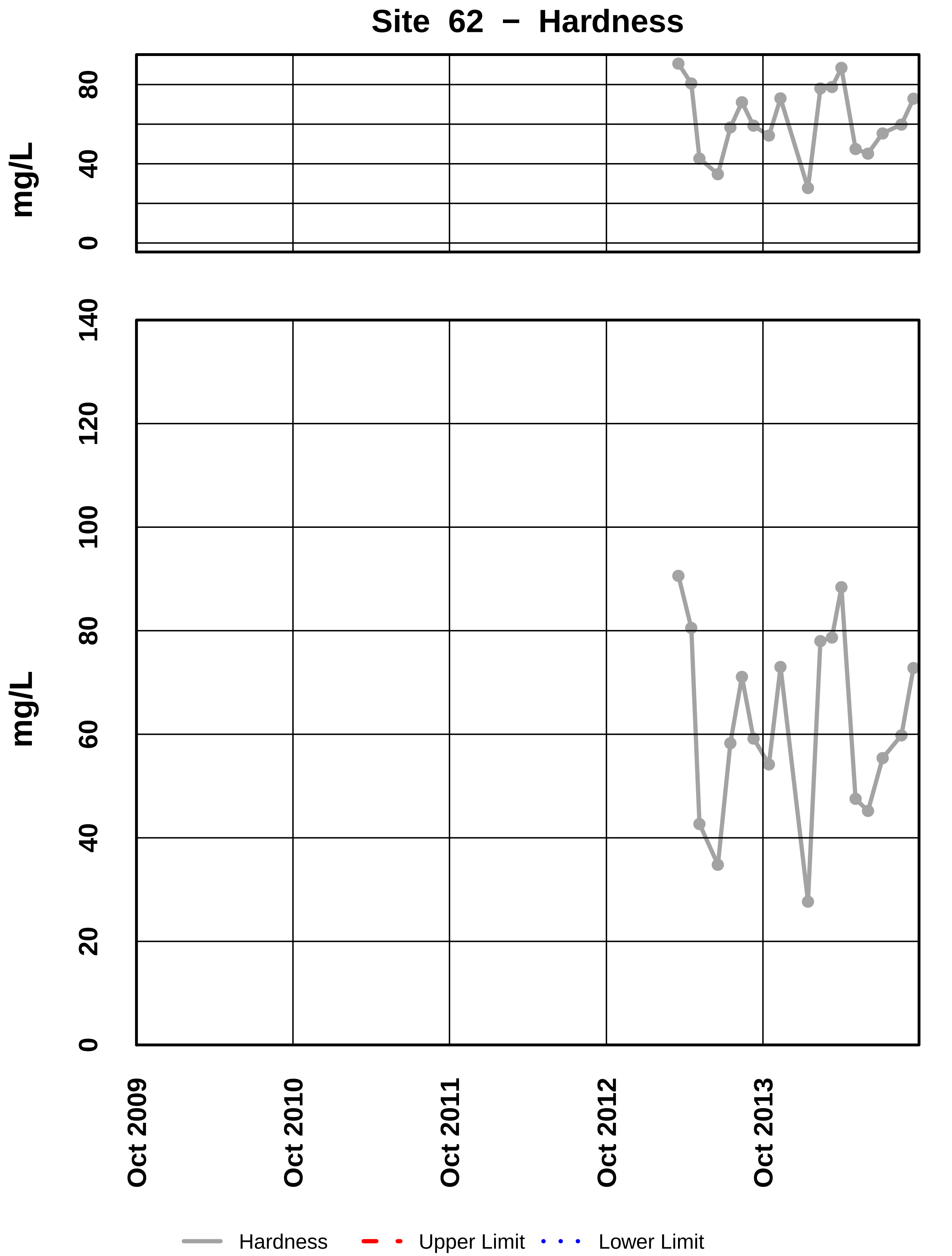

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

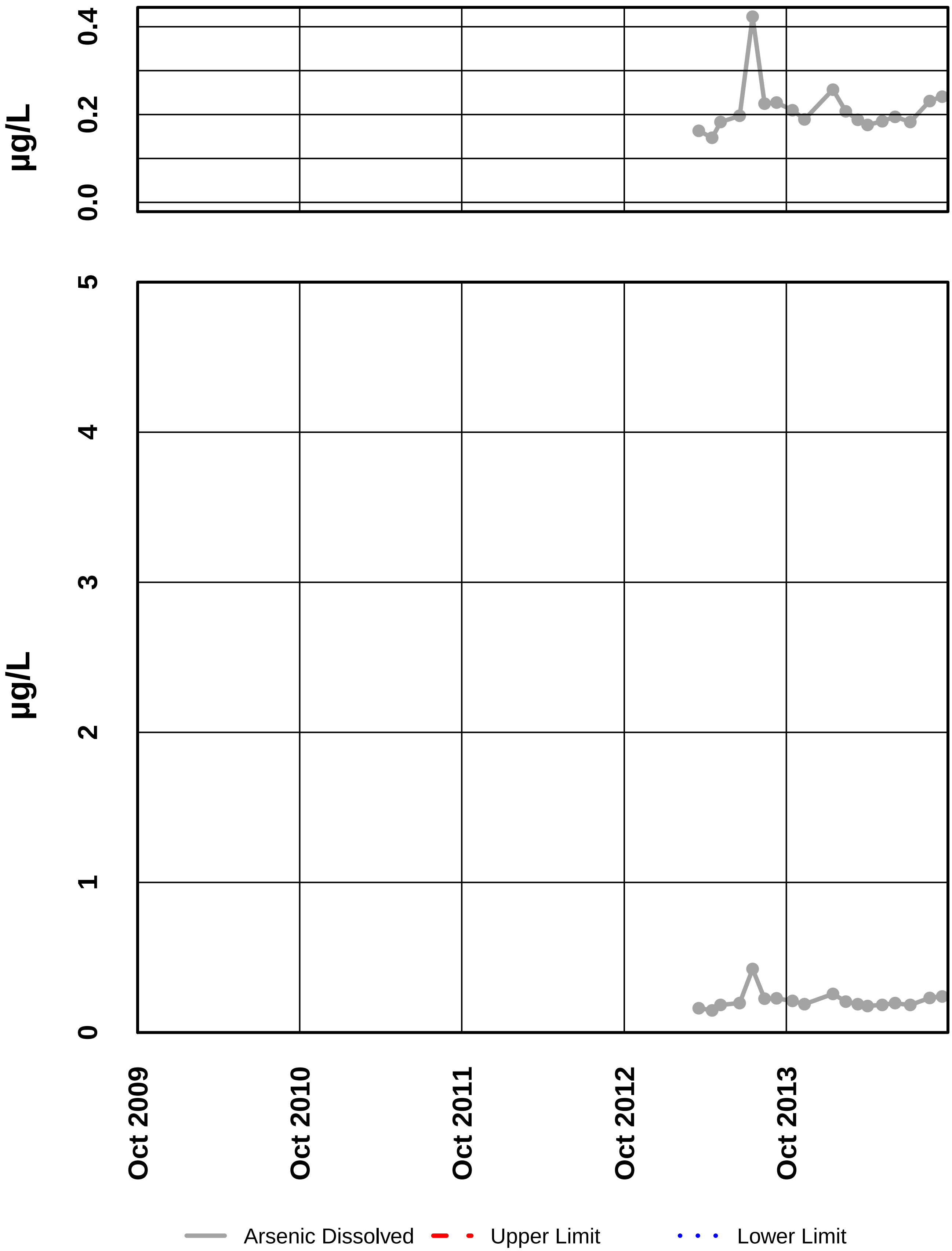



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



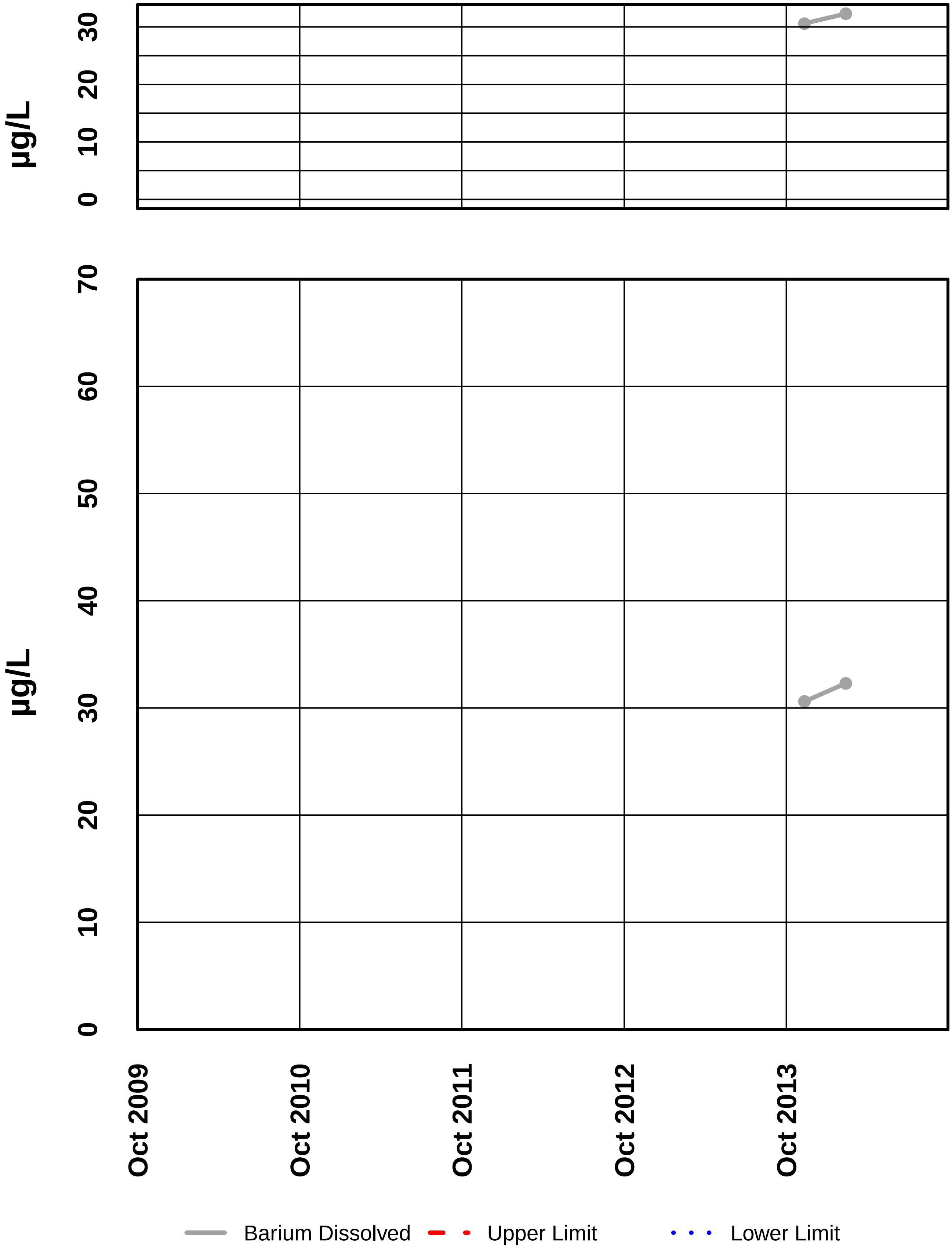

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# Site 62 – Arsenic Dissolved



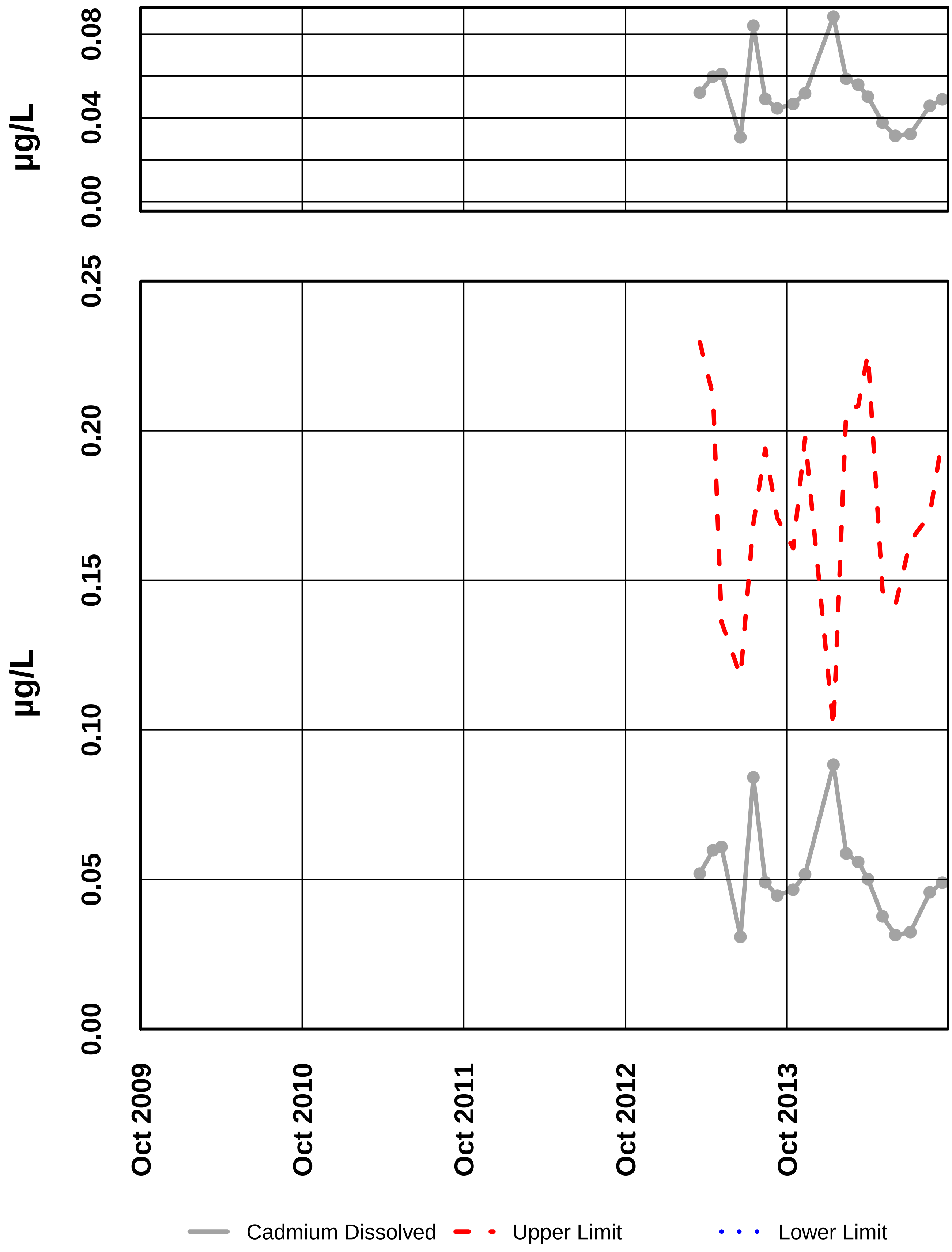

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# Site 62 – Barium Dissolved

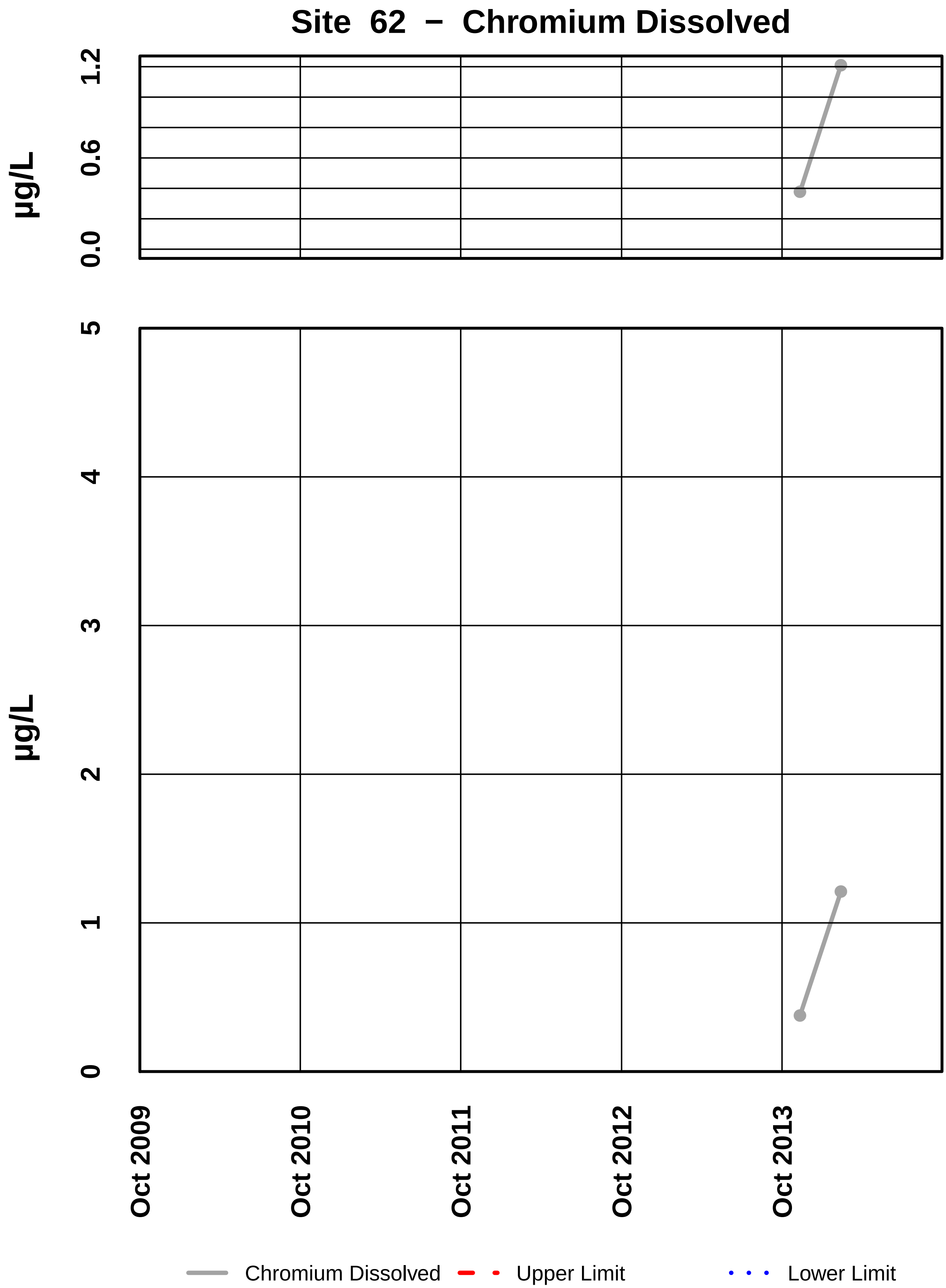



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

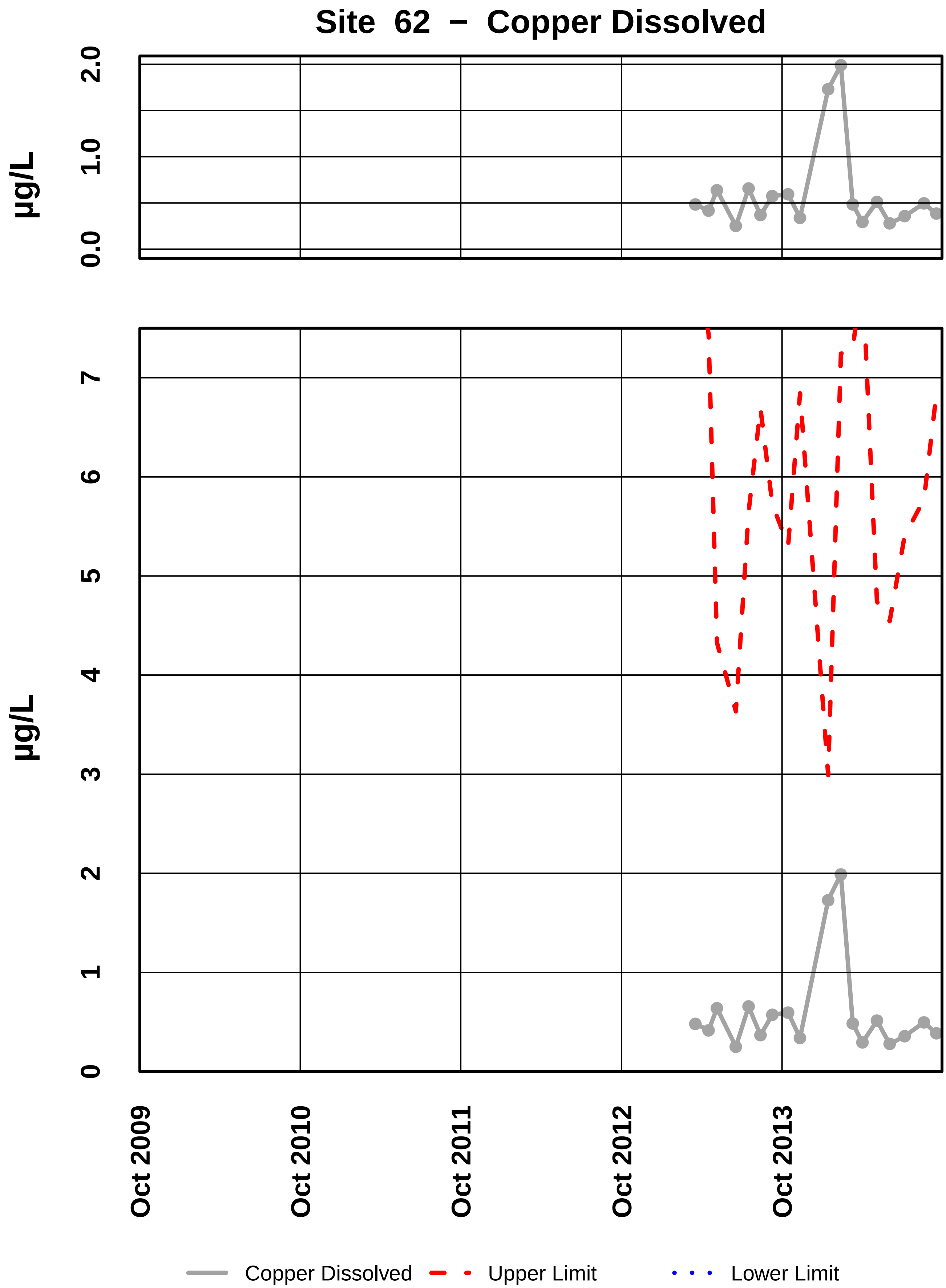
## Site 62 − Cadmium Dissolved



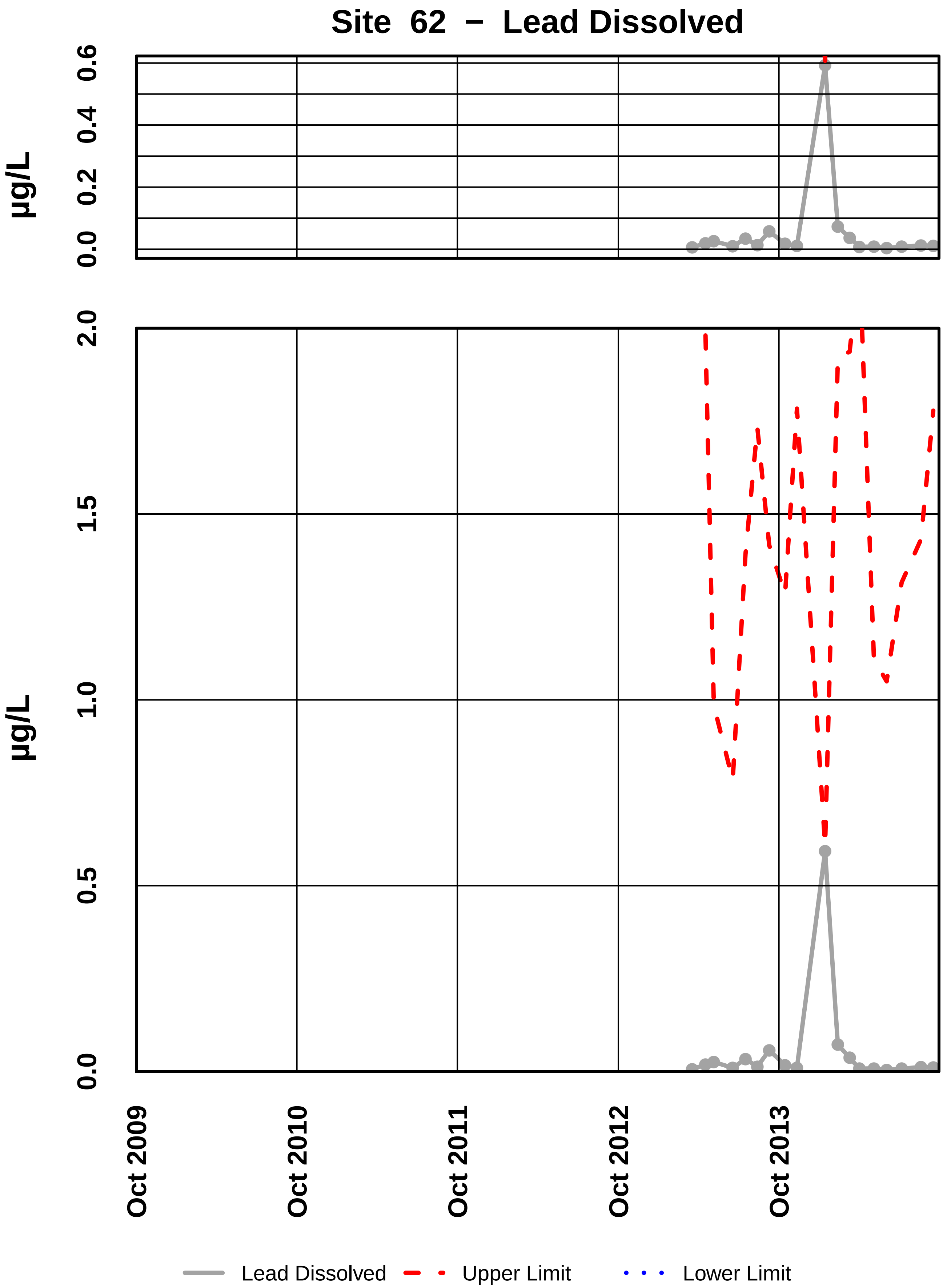

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

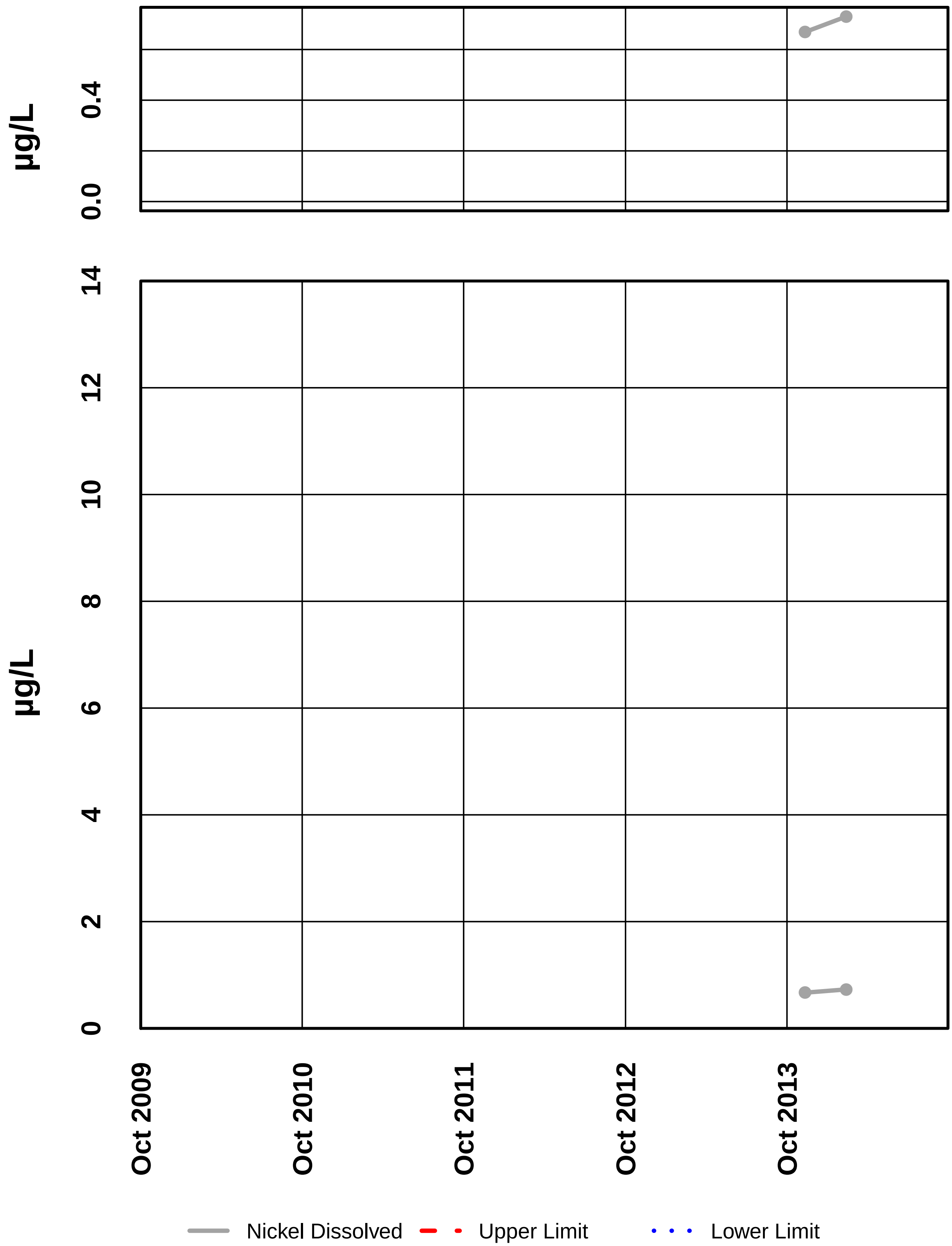



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

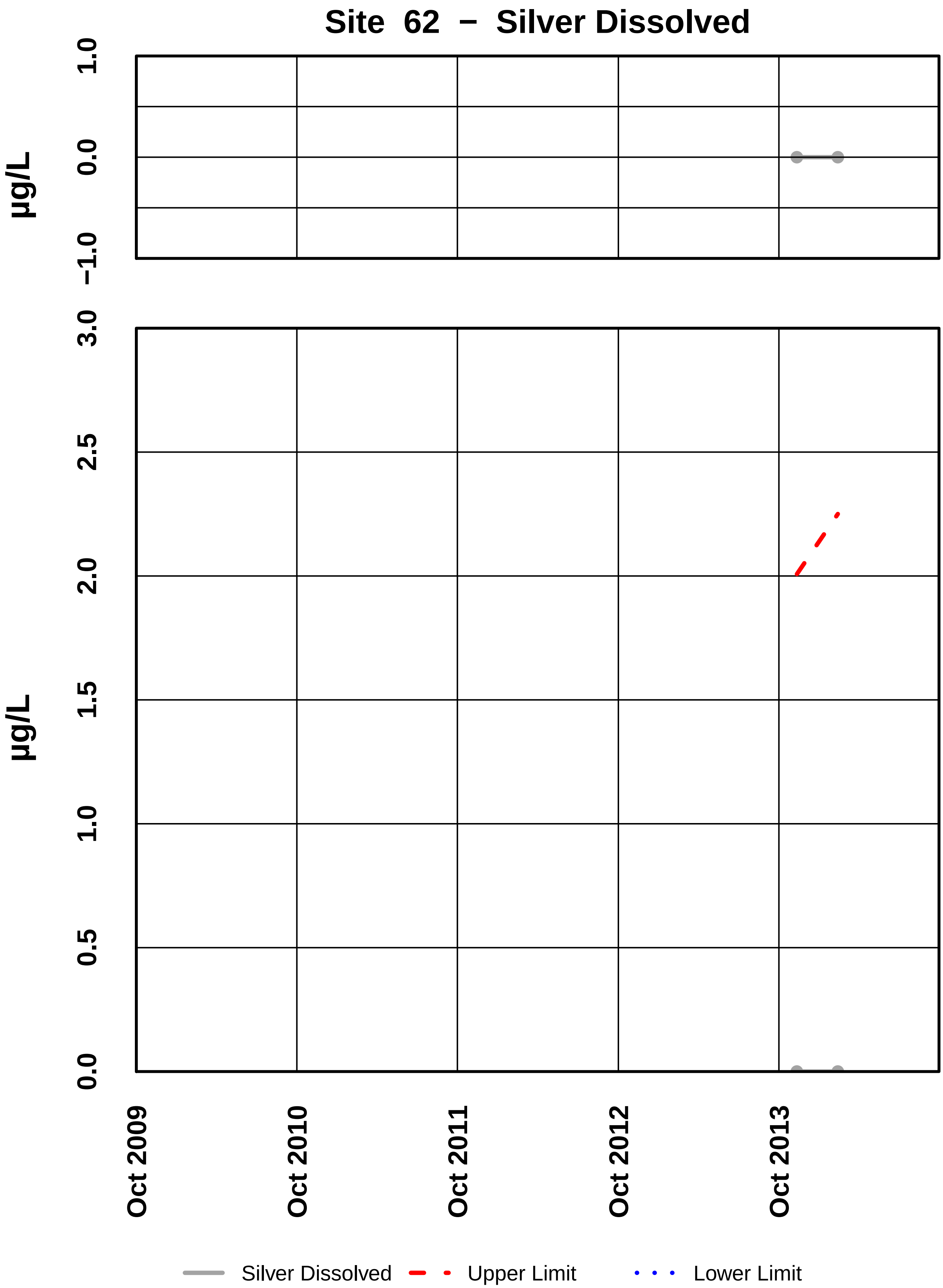



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

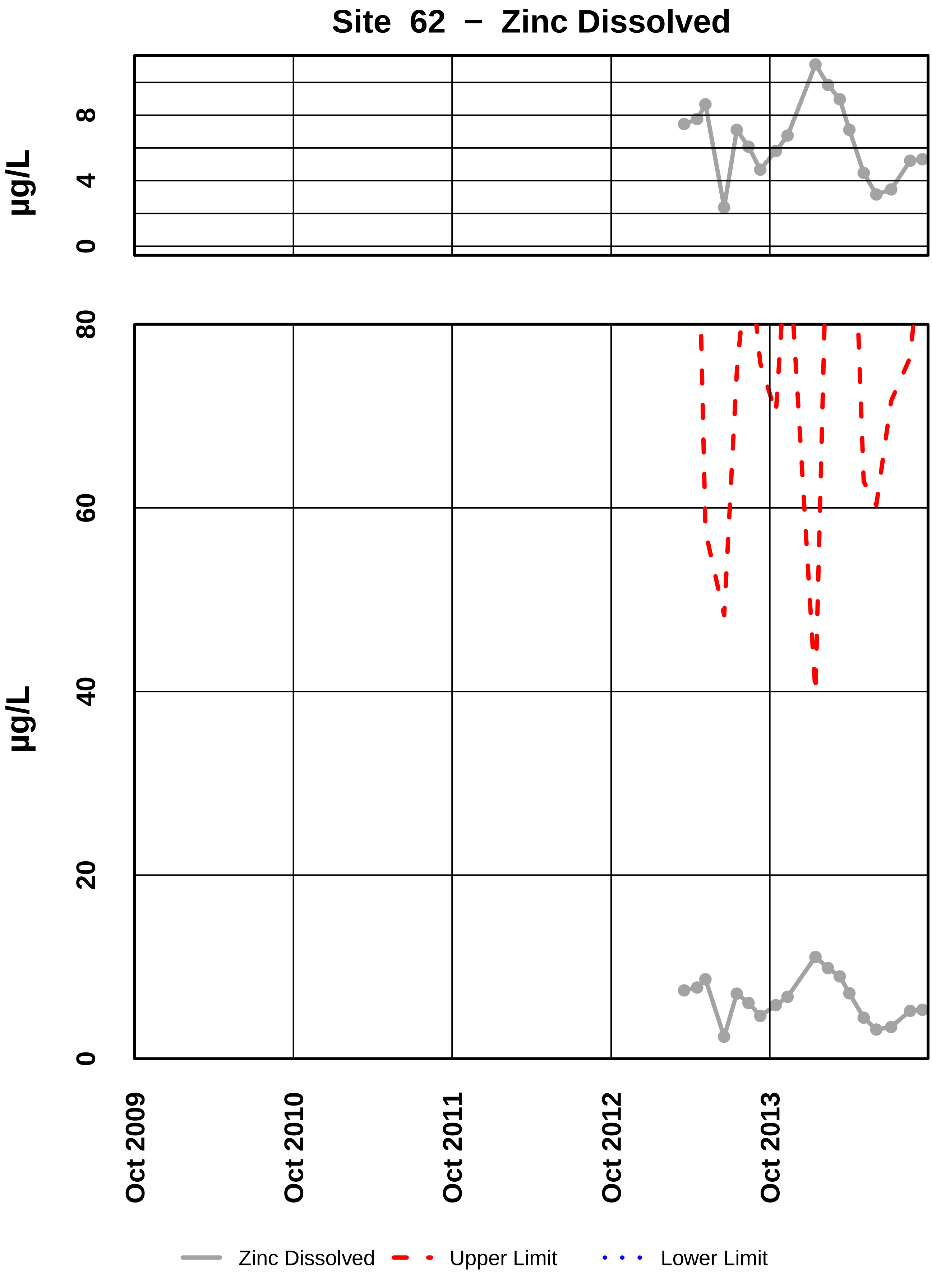
## Site 62 – Nickel Dissolved



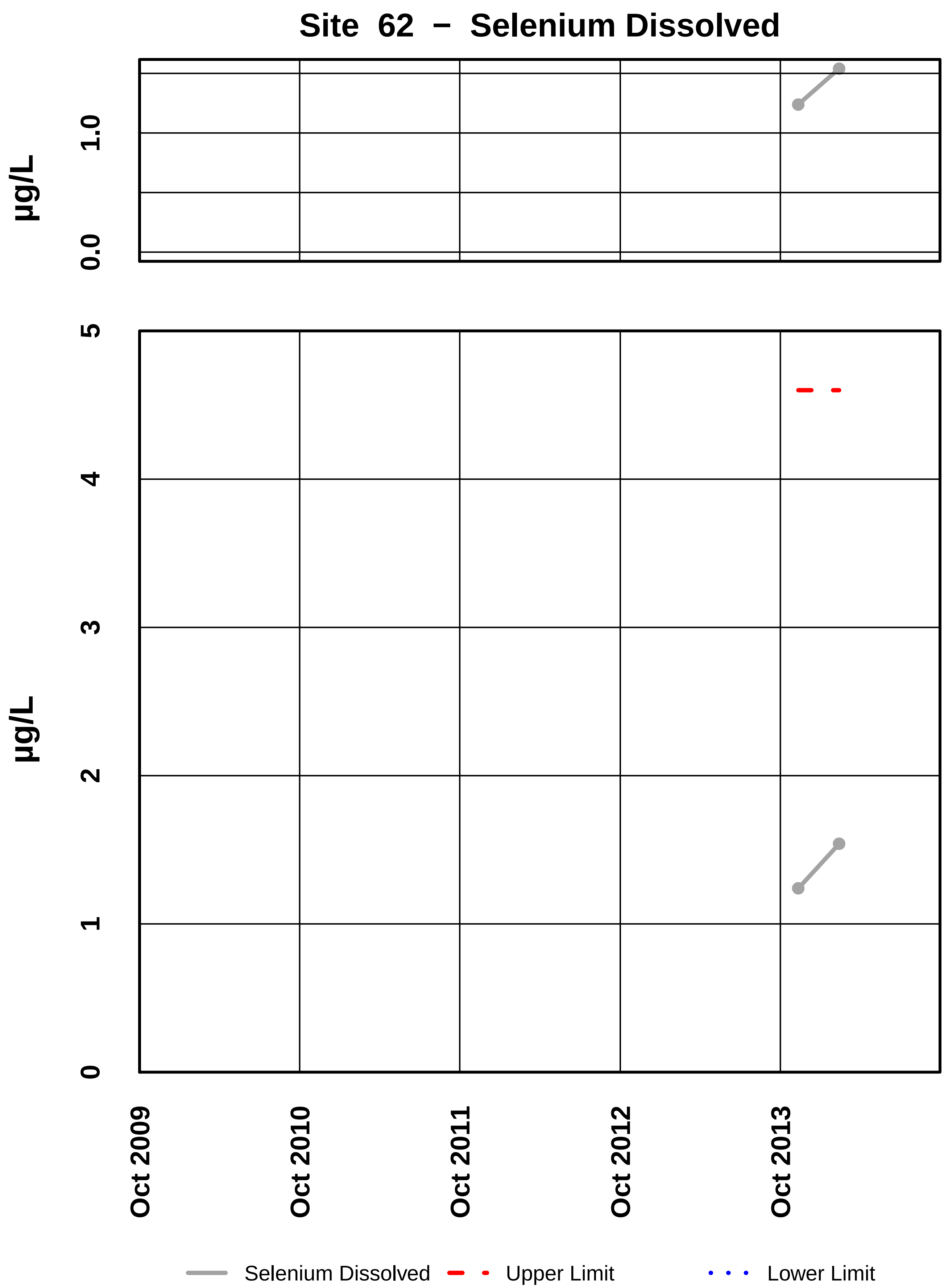

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

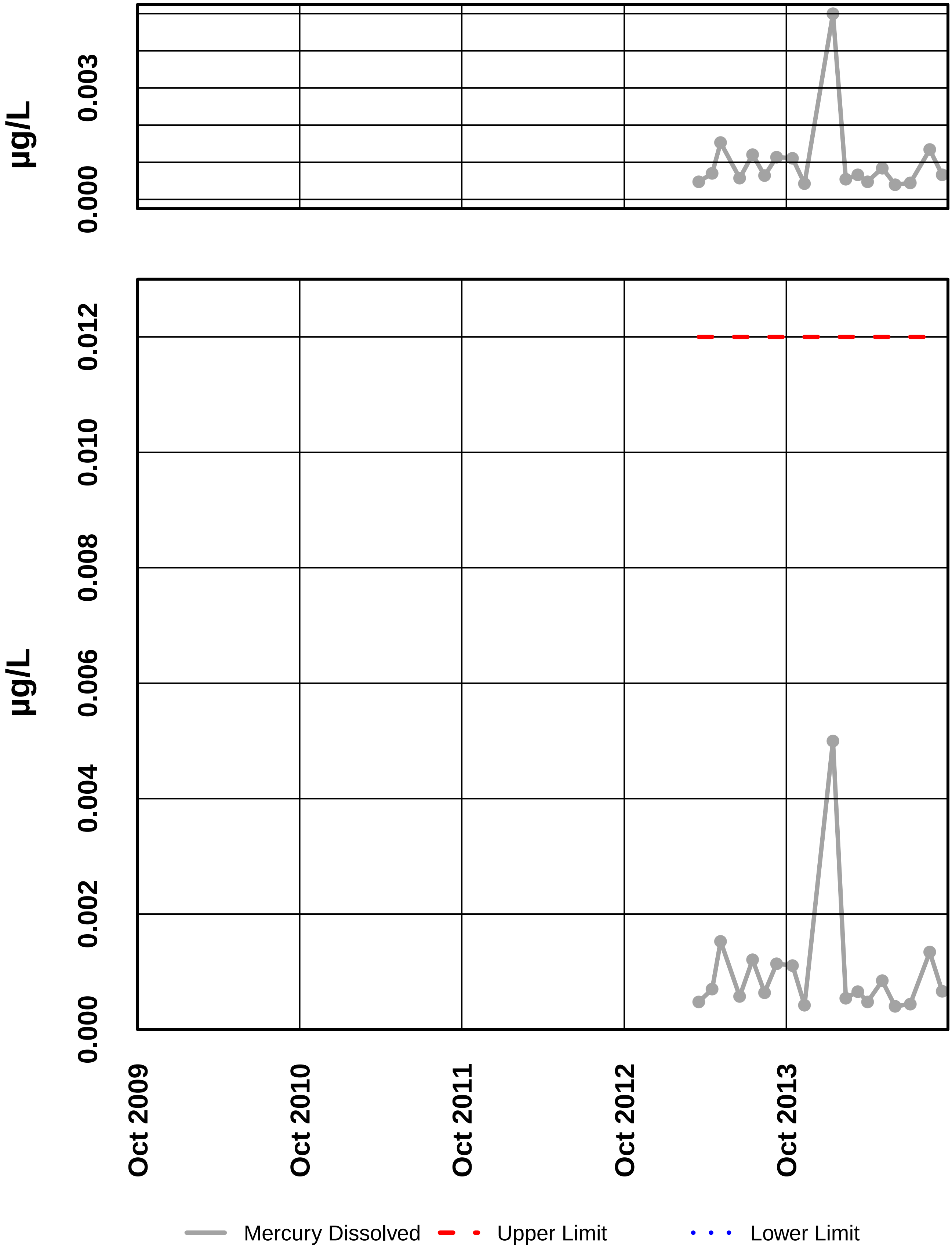



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

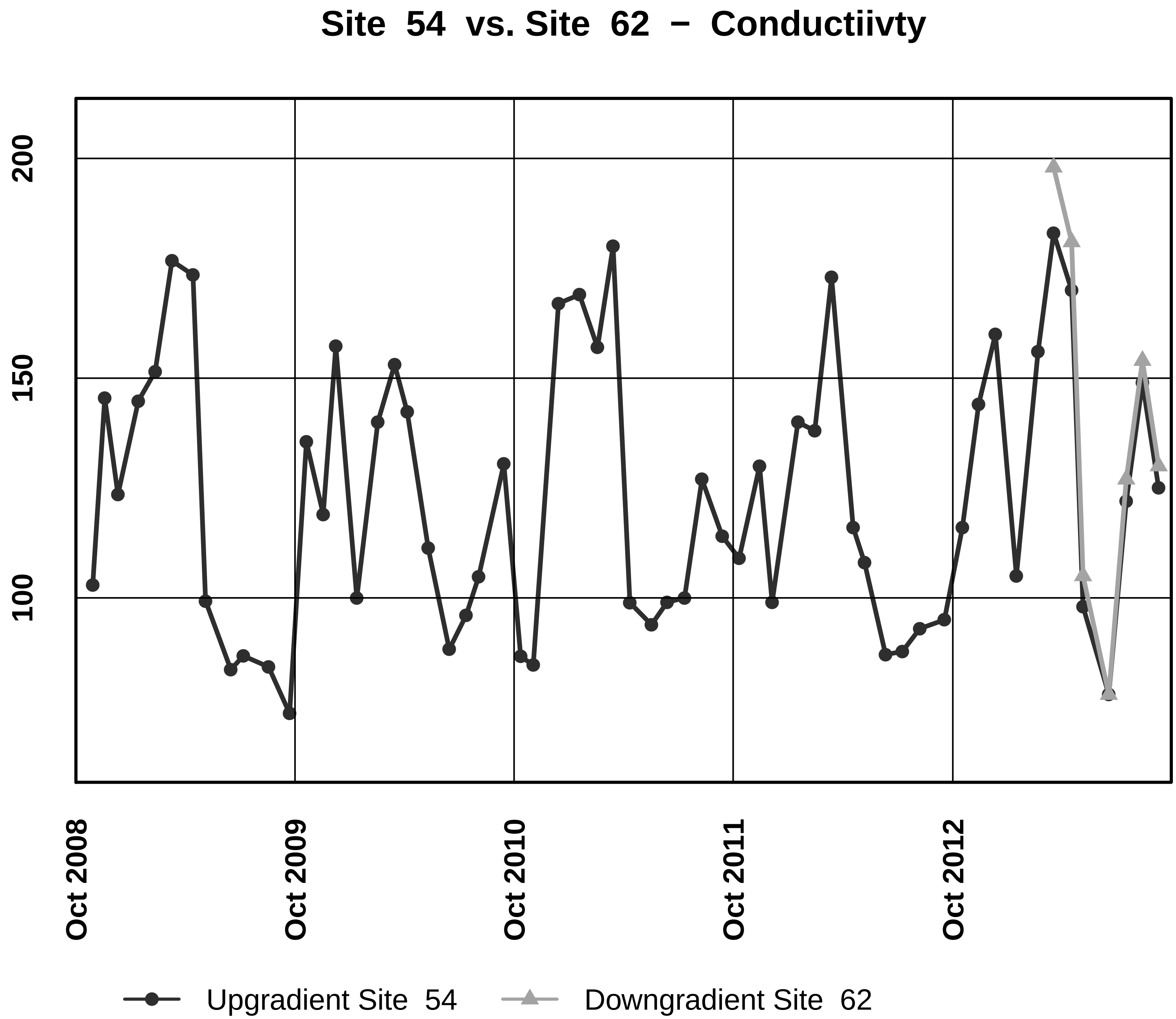


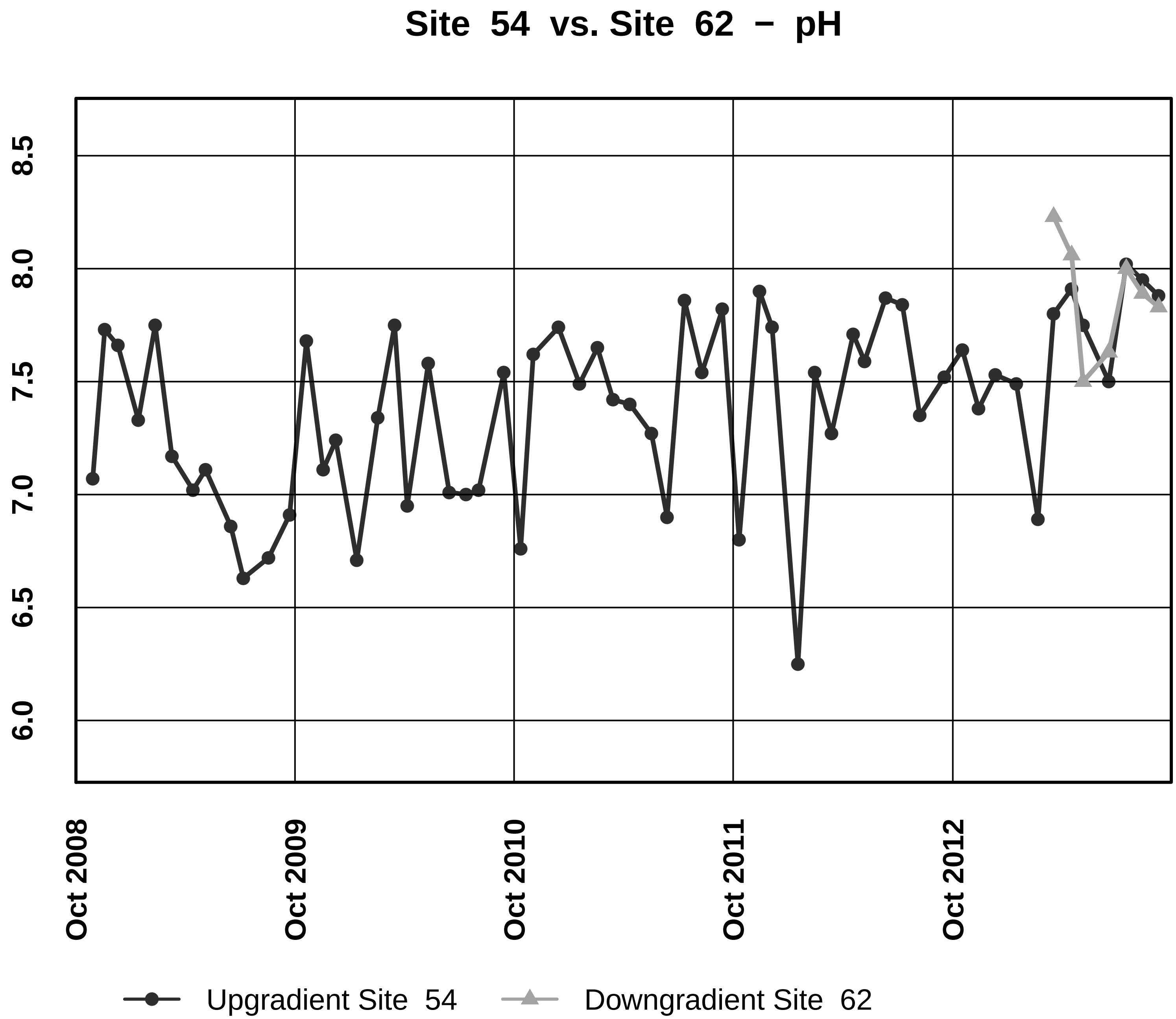

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

## Site 62 − Mercury Dissolved

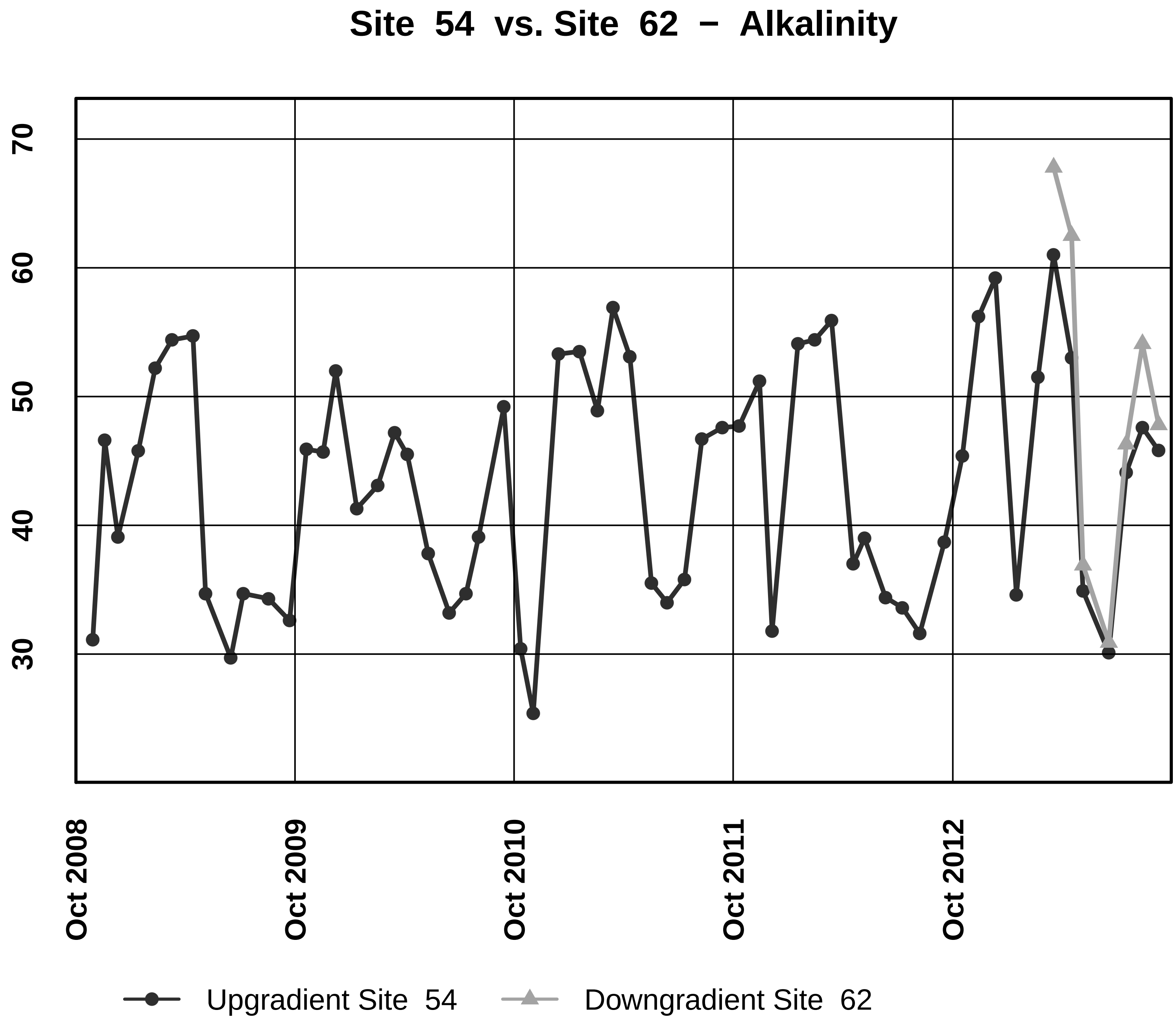


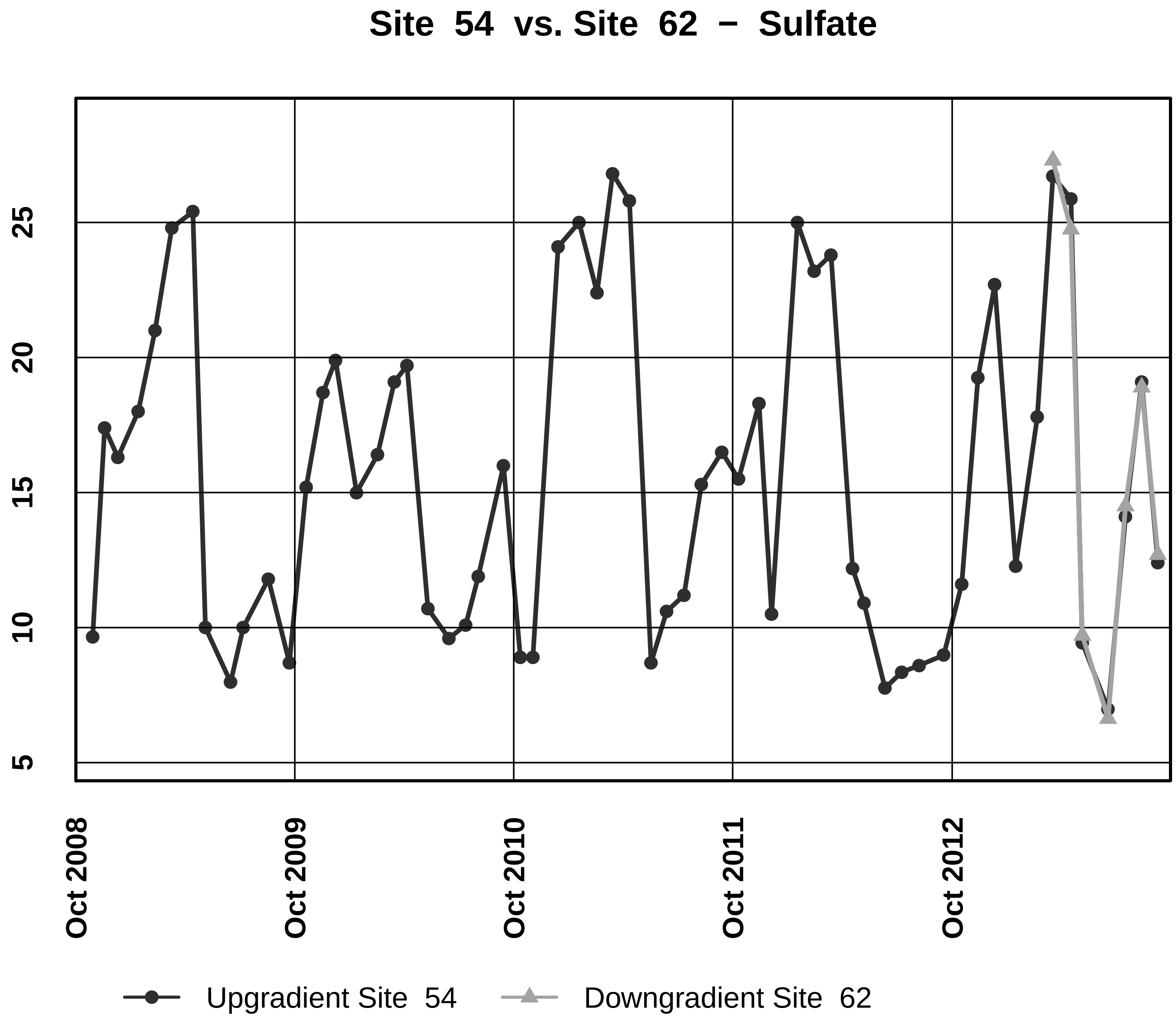

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

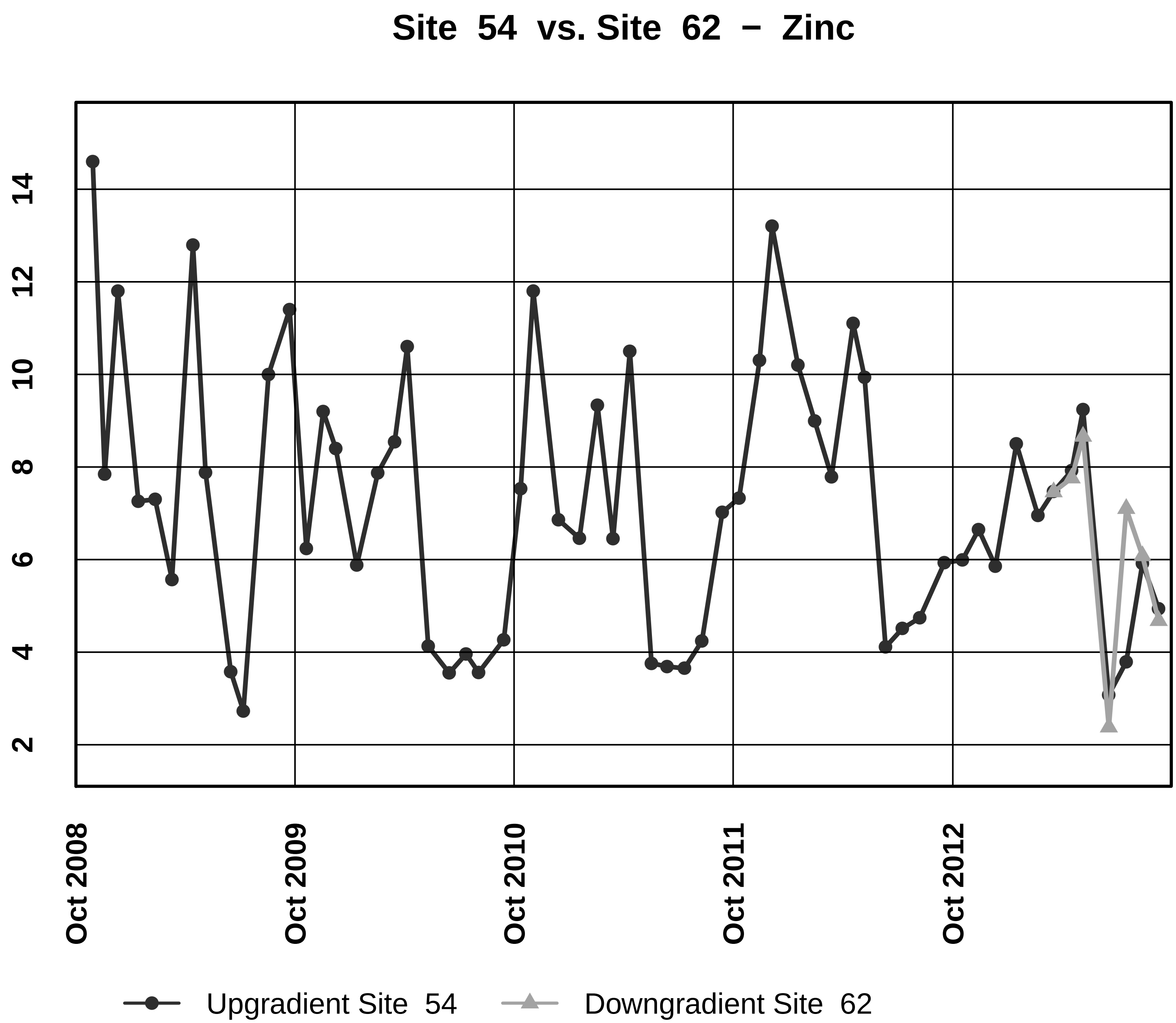

Site 54 vs. Site 62 − Conductiivty
200
150
100
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Oct 2012
Upgradient Site 54
Downgradient Site 62



Site 54 vs. Site 62 − pH
8.5
8.0
7.5
7.0
6.5
6.0
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Oct 2012
Upgradient Site 54
Downgradient Site 62


Site 54 vs. Site 62 − Alkalinity
70
60
50
40
30
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Oct 2012
Upgradient Site 54
Downgradient Site 62


Site 54 vs. Site 62 − Sulfate
5
10
15
20
25
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Oct 2012
Upgradient Site 54
Downgradient Site 62


Site 54 vs. Site 62 − Zinc
14
12
10
8
6
4
2
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Oct 2012
Upgradient Site 54
Downgradient Site 62

**Wilcoxon-signed-ranks test**

**Exact Form**

Variable: **Specific Conductance, Field (µS/cm)**

| | X | Y | | | |
|---|---|---|---|---|---|
| Site | #54 | #62 | Differences | | |
| Year | WY2014 | WY2014 | D | \|D\| | Rank |
| Oct | 112.0 | 116.0 | -4.0 | 4.0 | -2 |
| Nov | 147.0 | 156.0 | -9.0 | 9.0 | -6.5 |
| Dec | 154.0 | | | | |
| Jan | 56.0 | 63.0 | -7.0 | 7.0 | -4.5 |
| Feb | 160.0 | 174.0 | -14.0 | 14.0 | -10 |
| Mar | 163.0 | 173.0 | -10.0 | 10.0 | -9 |
| Apr | 191.0 | 210.0 | -19.0 | 19.0 | -11 |
| May | 99.0 | 106.0 | -7.0 | 7.0 | -4.5 |
| Jun | 97.0 | 100.0 | -3.0 | 3.0 | -1 |
| Jul | 116.0 | 122.0 | -6.0 | 6.0 | -3 |
| Aug | 121.0 | 130.0 | -9.0 | 9.0 | -6.5 |
| Sep | 136.8 | 146.7 | -9.9 | 9.9 | -8 |
| Median | 128.9 | 130.0 | -9.0 | 9.0 | |

| n | m |
|---|---|
| 11 | 11 |

N= 11

$\Sigma R=$ -66

| $\alpha$ |
|---|
| 0.05 |
| **W'**$\alpha$,n |
| 13 |

| $W^{+}=$ |
|---|
| **0** |
| p-test |
| 0.000 |

| | | |
|---|---|---|
| $H_0$ | median [D]=0 | **REJECT** |
| $H_1$ | median [D]<0 | **ACCEPT** |

**Wilcoxon-signed-ranks test**
**Exact Form**

Variable: **pH, Field, Standard Units**

| | X | Y | Differences | | |
|---|---|---|---|---|---|
| Site | #54 | #62 | | | |
| Year | WY2014 | WY2014 | D | \|D\| | Rank |
| Oct | 7.79 | 7.77 | 0.02 | 0.02 | 1 |
| Nov | 7.85 | 7.76 | 0.09 | 0.09 | 4 |
| Dec | 7.80 | | | | |
| Jan | 7.38 | 7.02 | 0.36 | 0.36 | 10 |
| Feb | 7.66 | 7.33 | 0.33 | 0.33 | 9 |
| Mar | 7.61 | 7.48 | 0.13 | 0.13 | 5 |
| Apr | 7.66 | 7.42 | 0.24 | 0.24 | 7 |
| May | 7.60 | 7.37 | 0.23 | 0.23 | 6 |
| Jun | 7.66 | 6.82 | 0.84 | 0.84 | 11 |
| Jul | 7.88 | 7.81 | 0.07 | 0.07 | 2 |
| Aug | 7.84 | 7.55 | 0.29 | 0.29 | 8 |
| Sep | 8.14 | 8.06 | 0.08 | 0.08 | 3 |
| Median | 7.73 | 7.48 | 0.23 | 0.23 | |

| n | m |
|---|---|
| 11 | 11 |

N= 11
$\Sigma$R= 66

| $\alpha$ |
|---|
| 0.05 |
| **W'**$\alpha$,n |
| 13 |

| $W^+$= |
|---|
| **0** |
| p-test |
| 0.000 |

| | | |
|---|---|---|
| $H_0$ | median [D]=0 | **REJECT** |
| $H_1$ | median [D]>0 | **ACCEPT** |

**Wilcoxon-signed-ranks test**
**Exact Form**

Variable: **Total Alk, (mg/l)**

| | **X** | **Y** | | | |
|---|---|---|---|---|---|
| Site | #54 | #62 | Differences | | |
| Year | WY2014 | WY2014 | **D** | **\|D\|** | **Rank** |
| Oct | 40.4 | 42.0 | -1.6 | 1.6 | -2 |
| Nov | 51.5 | 46.0 | 5.5 | 5.5 | 9 |
| Dec | 53.6 | | | | |
| Jan | 21.7 | 23.9 | -2.2 | 2.2 | -4.5 |
| Feb | 53.1 | 59.2 | -6.1 | 6.1 | -10 |
| Mar | 53.7 | 60.2 | -6.5 | 6.5 | -11 |
| Apr | 58.1 | 62.2 | -4.1 | 4.1 | -8.00 |
| May | 36.5 | 38.7 | -2.2 | 2.2 | -4.5 |
| Jun | 36.0 | 38.0 | -2.0 | 2.0 | -3 |
| Jul | 41.6 | 43.1 | -1.5 | 1.5 | -1 |
| Aug | 44.5 | 47.8 | -3.3 | 3.3 | -6.00 |
| Sep | 50.9 | 54.7 | -3.8 | 3.8 | -7 |
| Median | 47.7 | 46.0 | -2.2 | 3.3 | |

| **n** | **m** |
|---|---|
| 11 | 11 |

**N**= 11

$\Sigma$R= -48

| $\alpha$ |
|---|
| 0.05 |
| **W'**$\alpha$,n |
| 13 |

| $W^{+}$= |
|---|
| **9.00** |
| p-test |
| 0.016 |

| | | |
|---|---|---|
| $H_0$ | median [D]=0 | **REJECT** |
| $H_1$ | median [D]>0 | **ACCEPT** |

**Wilcoxon-signed-ranks test**
**Exact Form**
Variable: **Sulfate, Total (mg/l)**

| | X | Y | Differences | | |
|---|---|---|---|---|---|
| Site | #54 | #62 | | | |
| Year | WY2014 | WY2014 | **D** | **\|D\|** | **Rank** |
| Oct | 10.7 | 11.0 | -0.3 | 0.3 | -3 |
| Nov | 18.1 | 18.4 | -0.3 | 0.3 | -2 |
| Dec | 20.2 | | | | |
| Jan | 5.3 | 6.7 | -1.4 | 1.4 | -10 |
| Feb | 21.7 | 22.6 | -0.9 | 0.9 | -8 |
| Mar | 24.7 | 24.3 | 0.4 | 0.4 | 4 |
| Apr | 25.8 | 27.6 | -1.8 | 1.8 | -11 |
| May | 9.2 | 10.0 | -0.8 | 0.8 | -7 |
| Jun | 9.5 | 9.5 | -0.1 | 0.1 | -1 |
| Jul | 12.2 | 12.7 | -0.5 | 0.5 | -5 |
| Aug | 11.5 | 12.2 | -0.7 | 0.7 | -6 |
| Sep | 15.7 | 16.8 | -1.1 | 1.1 | -9 |
| Median | 14.0 | 12.7 | -0.7 | 0.7 | |

| n | m |
|---|---|
| 11 | 11 |

**N=** 11
$\Sigma$R= -58

| $\alpha$ |
|---|
| 0.05 |
| **W'**$\alpha$,n |
| 13 |

| $W^+$= |
|---|
| **4** |
| p-test |
| 0.003 |

| | | |
|---|---|---|
| $H_0$ | median [D]=0 | **REJECT** |
| $H_1$ | median [D]<0 | **ACCEPT** |

**Wilcoxon-signed-ranks test**
**Exact Form**

Variable: **Zinc, Dissolved (ug/l)**

| | X | Y | Differences | | |
|---|---|---|---|---|---|
| Site | #54 | #62 | | | |
| Year | WY2014 | WY2014 | **D** | **\|D\|** | **Rank** |
| Oct | 5.92 | 5.82 | 0.10 | 0.10 | 3 |
| Nov | 7.12 | 6.75 | 0.37 | 0.37 | 8 |
| Dec | 6.58 | | | | |
| Jan | 10.20 | 11.10 | -0.90 | 0.90 | -10 |
| Feb | 8.68 | 9.85 | -1.17 | 1.17 | -11 |
| Mar | 8.77 | 8.97 | -0.20 | 0.20 | -5 |
| Apr | 6.73 | 7.11 | -0.38 | 0.38 | -9 |
| May | 4.62 | 4.47 | 0.15 | 0.15 | 4 |
| Jun | 3.25 | 3.16 | 0.09 | 0.09 | 2 |
| Jul | 3.45 | 3.46 | -0.01 | 0.01 | -1 |
| Aug | 4.86 | 5.22 | -0.36 | 0.36 | -7 |
| Sep | 4.99 | 5.32 | -0.33 | 0.33 | -6 |
| Median | 6.25 | 5.82 | -0.20 | 0.33 | |

| **n** | **m** |
|---|---|
| 11 | 11 |

**N**= 11

$\Sigma R=$ -32

| $\alpha$ |
|---|
| 0.05 |
| **W'**$\alpha$,n |
| 13 |

| $W^{+}=$ |
|---|
| **17** |
| p-test |
| 0.087 |

| | | |
|---|---|---|
| $H_0$ | median [D]=0 | ACCEPT |
| $H_1$ | median [D]<0 | |

# INTERPRETIVE REPORT
# SITE 61

Sampling at this site was initiated during the spring of Water Year 2013. This site was added to the FWMP at the request of the state and federal regulators. Site 61 is located in a floodplain of Greens Creek, approximately 250 feet down gradient of D Pond. The sampling location is at just past the confluence of two drainages, one of which originates from the north and the other from the east. Sampling began in May 2013 and will occur on quarterly basis

The data collected during the current water year are listed in the following "Table of Results for Water Year 2014" report. The table includes all the required FWMP analyte data (field and laboratory) collected for the current water year and a series of flags keyed to the summary report "Qualified Data by QA Reviewer". The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of ½ MDL for the purpose of median calculation.

All data collected at this site for the past year is included in the report. As shown in the table below, there were no data outliers.

| Sample Date | Parameter | Value | Qualifier | Notes |
|---|---|---|---|---|
| No outliers have been identified by HGCMC for the period of October 2012 through September 2014. | | | | |

The data for Water Year 2014 have been compared to the strictest fresh water quality criterion for each applicable analyte. No results exceeding these criteria have been identified as listed in the table below.

**Table of Exceedance for Water Year 2014**

| | | | Limits | | |
|---|---|---|---|---|---|
| **Sample Date** | **Parameter** | **Value** | **Lower** | **Upper** | **Hardness** |
| No exceedances have been identified by HGCMC for the period of October 2013 through September 2014. | | | | | |

As a result of the monitoring and reporting for Water Year 2013, HGCMC increased the sample frequency to monthly at for Site 62. The first sample collected at Site 62 (6 May 2013) was in exceedance for cadmium, mercury, selenium, and zinc. Since that sampling there have been no other water quality exceedances. HGCMC plans to return to sampling Site 62 on a quarterly basis after the May 2015 sampling event.

X-Y plots have been generated to graphically present the data for each of the analytes requested in the Statistical Information Goals for this site. Because of the limited amount of data, visual trend analysis and statistical analysis of the data was not performed.

## Table of Results for Water Year 2014

### Site 061FMS - 'Greens Creek Floodplain'

| Sample Date/Parameter | Oct 2013 | Nov 2013 | Dec 2013 | Jan 2014 | Feb 2014 | Mar 2014 | Apr 2014 | May 2014 | Jun 2014 | Jul 2014 | Aug 2014 | Sep 2014 | **Median** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Water Temp (°C) | | 1.2 | | | 2.5 | | | 6.5 | 6.5 | 8.7 | 8.2 | 7.3 | 6.5 |
| Conductivity-Field(µmho) | | 156 | | | 386 | | | 516 | 452 | 511 | 524 | 516 | 511.0 |
| Conductivity-Lab (µmho) | | 267 | | | 370 | | | 506 | 448 | 515 | 502 | 478 | 478 |
| pH Lab (standard units) | | 7.67 | | | 7.44 | | | 7.38 | 7.59 | 7.55 | 7.44 | 7.41 | 7.44 |
| pH Field (standard units) | | 7.8 | | | 7.62 | | | 7.49 | 7.18 | 7.51 | 7.53 | 7.77 | 7.53 |
| Total Alkalinity (mg/L) | | 116 | | | 115 | | | 116 | 117 | 122 | 115 | 124 | 116.0 |
| Total Sulfate (mg/L) | | 49.7 | | | 64.6 | | | 118 | 89.9 | 110 | 120 | 102 | 102.0 |
| Hardness (mg/L) | | 171 | | | 178 | | | 251 | 218 | 248 | 258 | 246 | 246.0 |
| Dissolved As (ug/L) | | 0.212 | | | 0.255 | | | 0.191 | 0.225 | 0.249 | 0.23 | 0.254 | 0.230 |
| Dissolved Ba (ug/L) | | | | | 40.9 | | | 49.2 | | 52.2 | 54.7 | 49.9 | 49.9 |
| Dissolved Cd (ug/L) | | 0.304 | | | 0.286 | | | 0.294 | 0.221 | 0.258 | 0.369 | 0.298 | 0.2940 |
| Dissolved Cr (ug/L) | | | | | 2.03 | | | 0.774 | | 0.476 | 1.19 | 1.67 | 1.190 |
| Dissolved Cu (ug/L) | | 0.195 | | | 0.343 | | | 0.698 | 0.528 | 0.539 | 0.308 | 0.26 | 0.343 |
| Dissolved Pb (ug/L) | | 0.0486 | | | 0.0308 | | | 0.022 | 0.0113 | 0.0137 | 0.01 | 0.0119 | 0.0137 |
| Dissolved Ni (ug/L) | | | | | 1.87 | | | 2.16 | | 2.53 | 3.43 | 3.33 | 2.530 |
| Dissolved Ag (ug/L) | | | | | 0.002 | | | 0.002 | | 0.002 | 0.007 | 0.002 | 0.002 |
| Dissolved Zn (ug/L) | | 85.9 | | | 63.9 | | | 65.5 | 48.9 | 57.4 | 118 | 78.4 | 65.50 |
| Dissolved Se (ug/L) | | | | | 1.51 | | | 1.77 | | 1.25 | 1.52 | 1.27 | 1.510 |
| Dissolved Hg (ug/L) | | 0.000114 | | | 0.000203 | | | 0.000261 | 0.00029 | 0.000209 | 0.000188 | 0.000198 | 0.000203 |

For individual sample/analyte qualifier descriptions see "Qualified Data by QA Reviewer" table.

Values reported as less than MDL are replaced by 1/2 MDL for median calculation purposes.

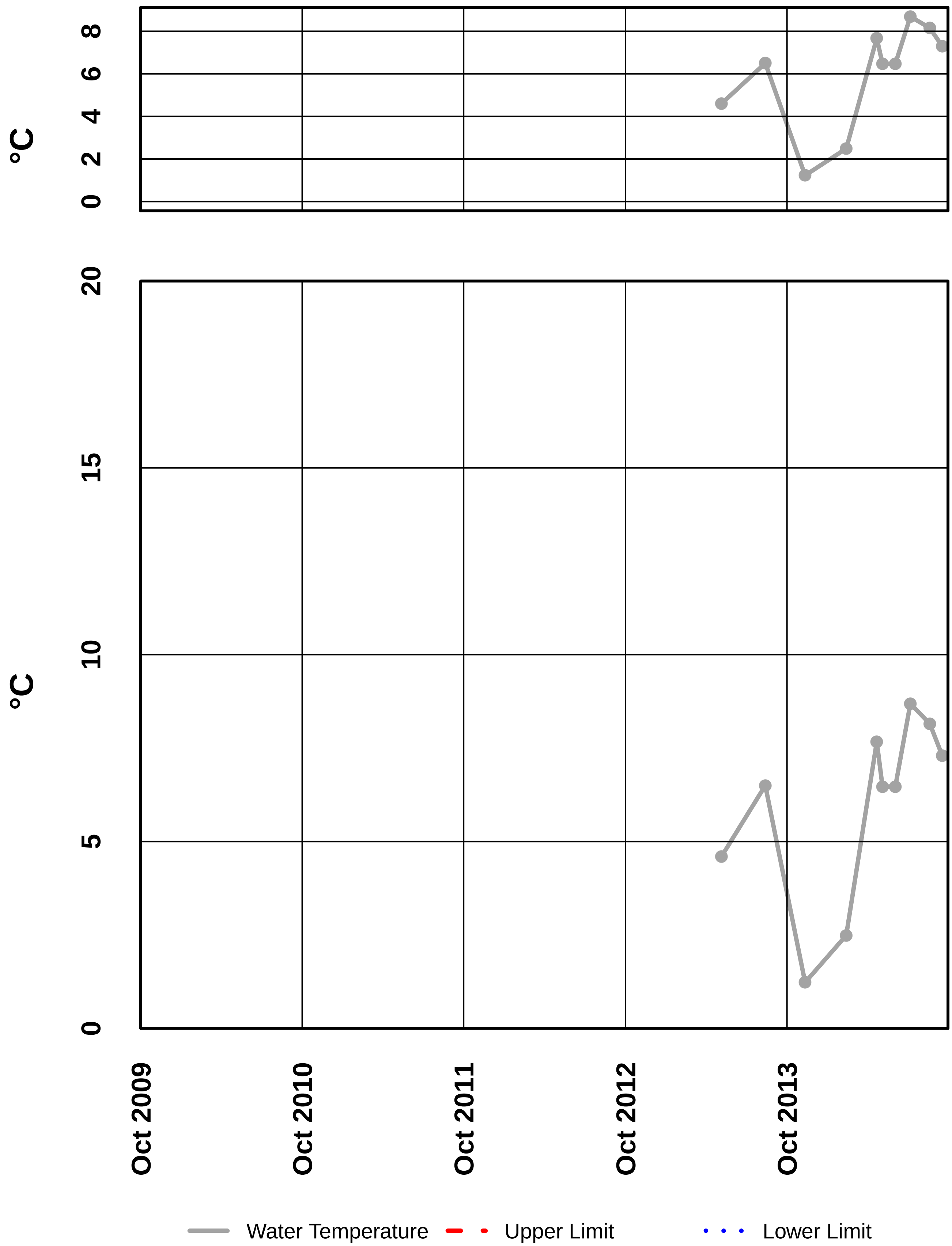
Shaded data has been qualified as an outlier by HGCMC and removed from any further analysis and is not included into the calculation of the median

# Qualified Data by QA Reviewer

## Date Range: 10/01/2013 to 09/30/2014

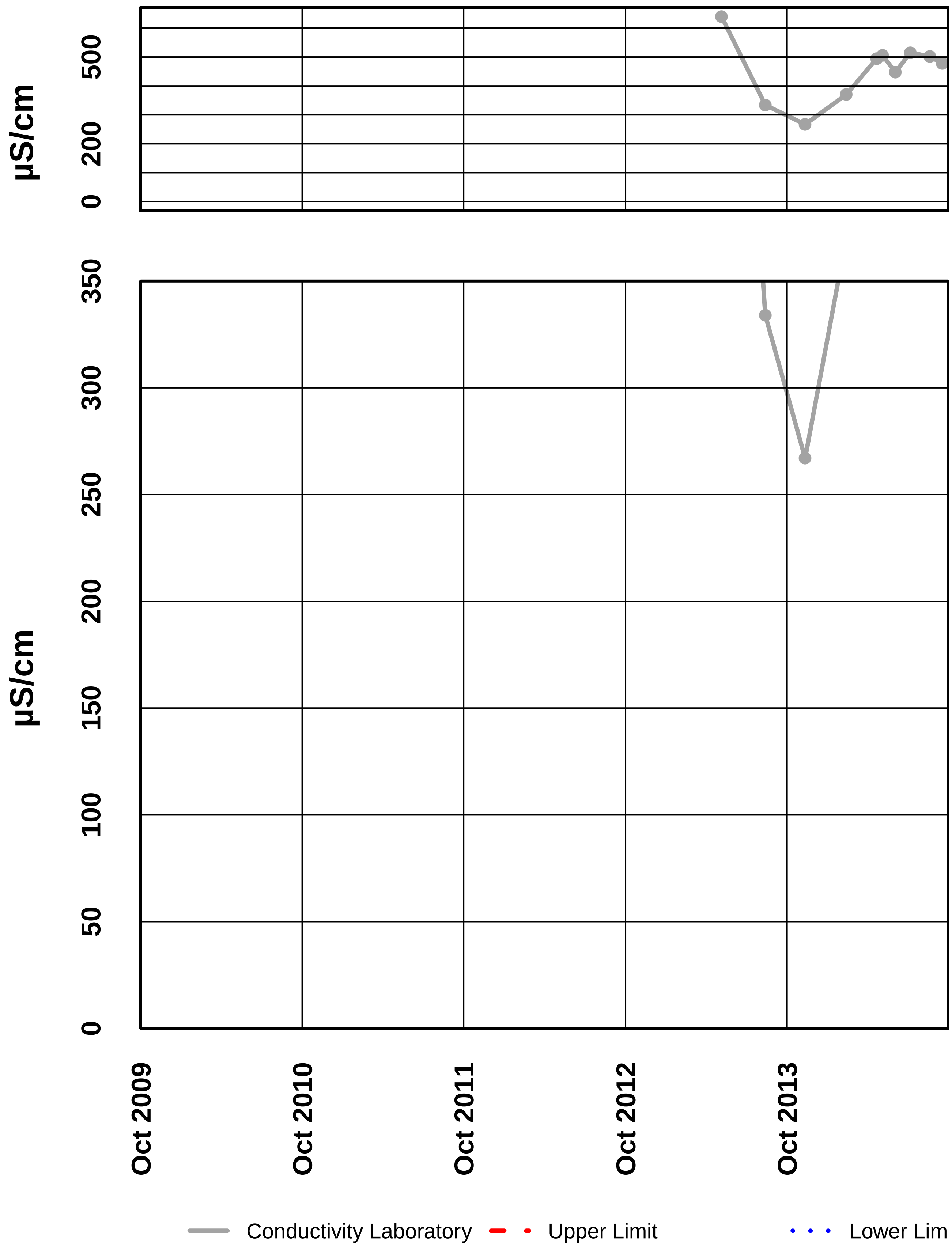
| Site No. | Sample Date | Sample Time | Parameter | Value | Qualifier | Reason for Qualifier |
|---|---|---|---|---|---|---|
| 061FMS | 11/11/2013 | 12:00 PM | pH | 7.78 | J | Hold Time Violation |
| 061FMS | 2/12/2014 | 12:00 PM | Diss. Cu-ICP/MS | 0.34 | J | LCS Recovery |
| | | | Diss. Hg-CVAF | 0.000203 | J | Below Quantitative Range |
| | | | Sulfate | 64.6 | J | Sample Receipt Temperature |
| 061FMS | 5/5/2014 | 12:00 PM | Diss. Hg-CVAF | 0.000261 | J | Below Quantitative Range |
| 061FMS | 6/3/2014 | 12:00 PM | Diss. Hg-CVAF | 0.00029 | J | Below Quantitative Range |
| 061FMS | 7/7/2014 | 12:00 PM | Diss. Hg-CVAF | 0.000209 | J | Below Quantitative Range |
| | | | Sulfate | 110 | J | Sample Receipt Temperature |
| 061FMS | 8/20/2014 | 12:00 PM | Diss. Ag-ICP/MS | 0.00737 | U | Field Blank Contamination |
| | | | Diss. Cu-ICP/MS | 0.3 | U | Field Blank Contamination |
| | | | Diss. Hg-CVAF | 0.000188 | J | Below Quantitative Range |
| 061FMS | 9/17/2014 | 12:00 PM | Diss. Hg-CVAF | 0.000198 | J | Below Quantitative Range |

## Site 61 – Water Temperature



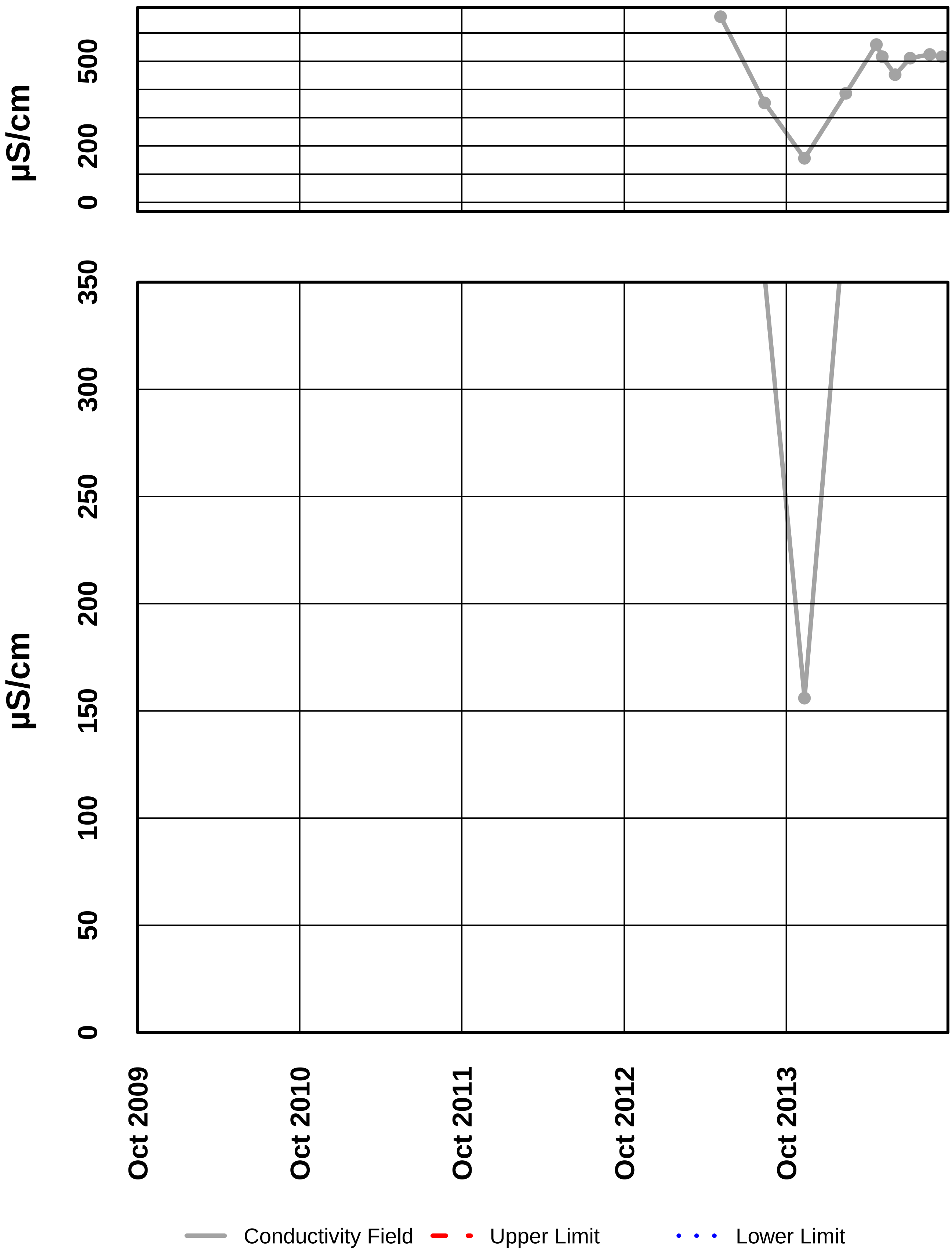

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

## Site 61 − Conductivity Laboratory



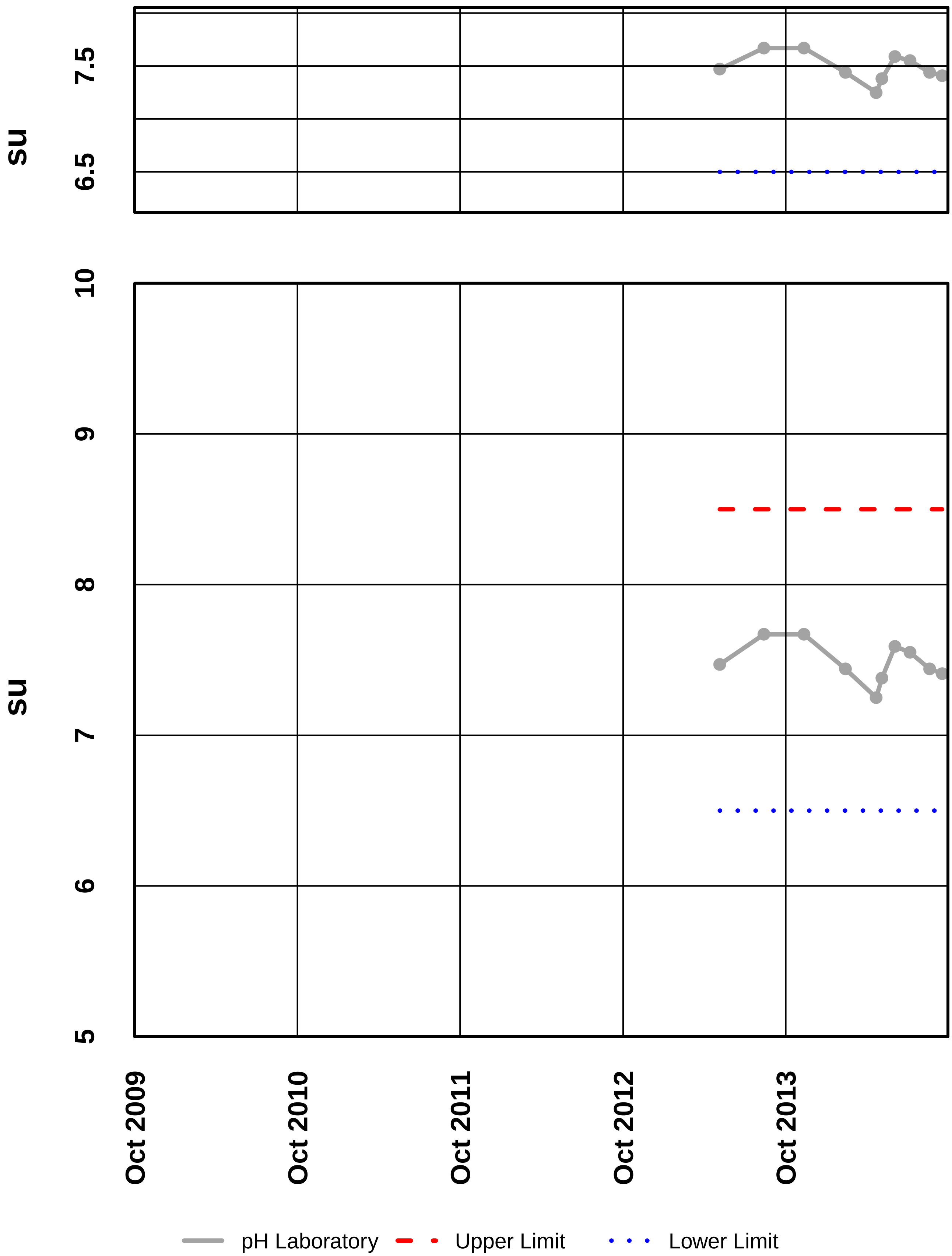

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# Site 61 – Conductivity Field

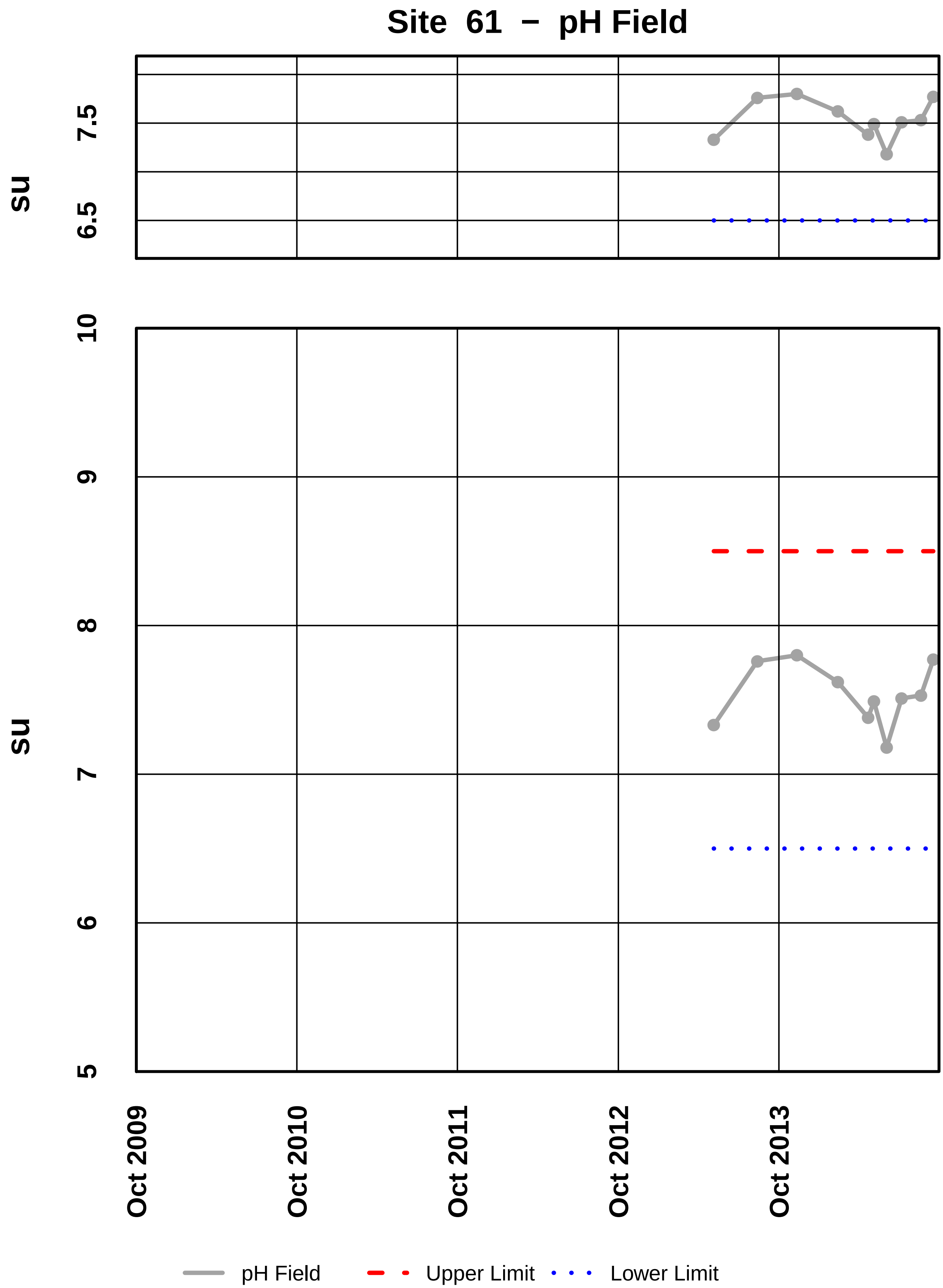



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

## Site 61 – pH Laboratory

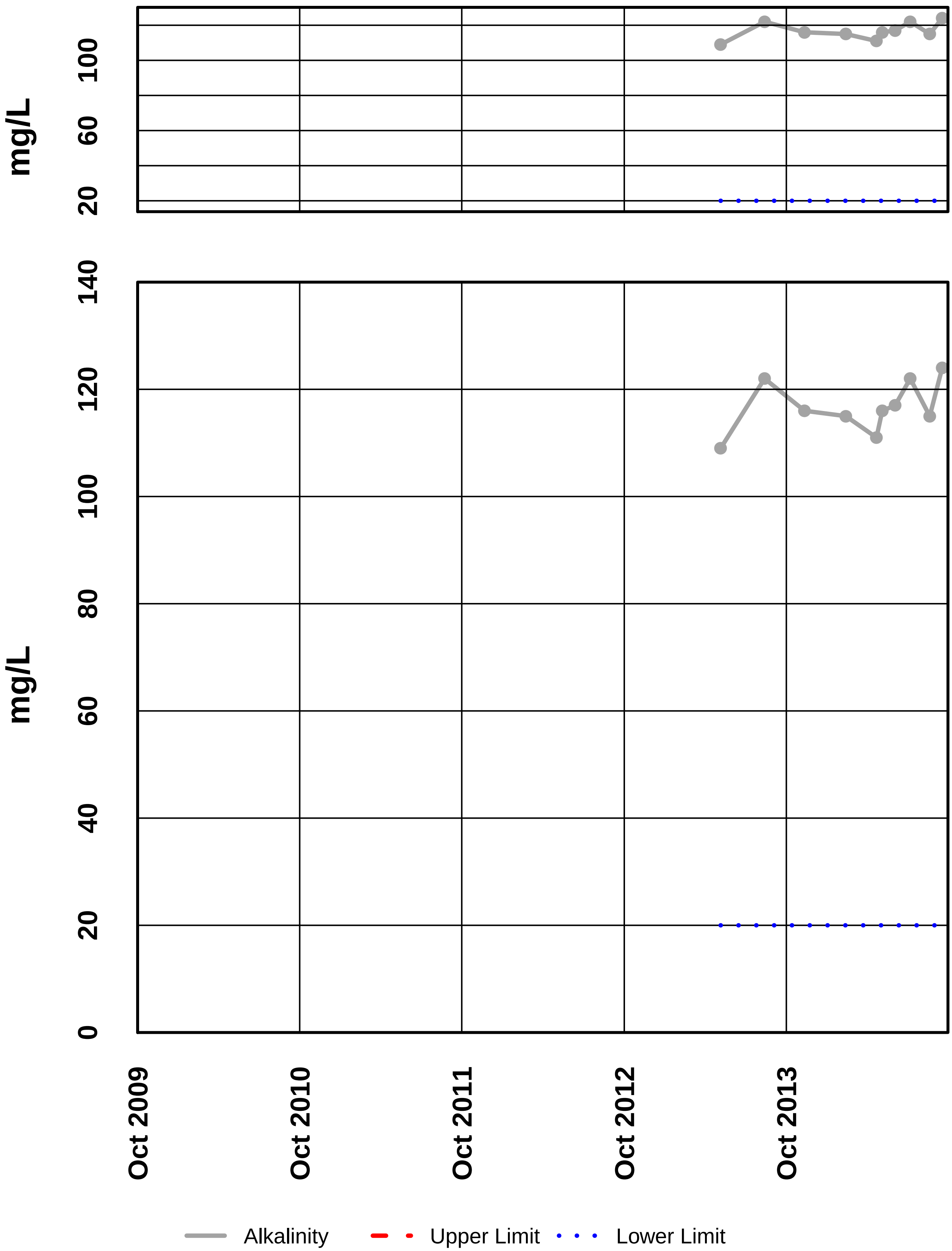



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



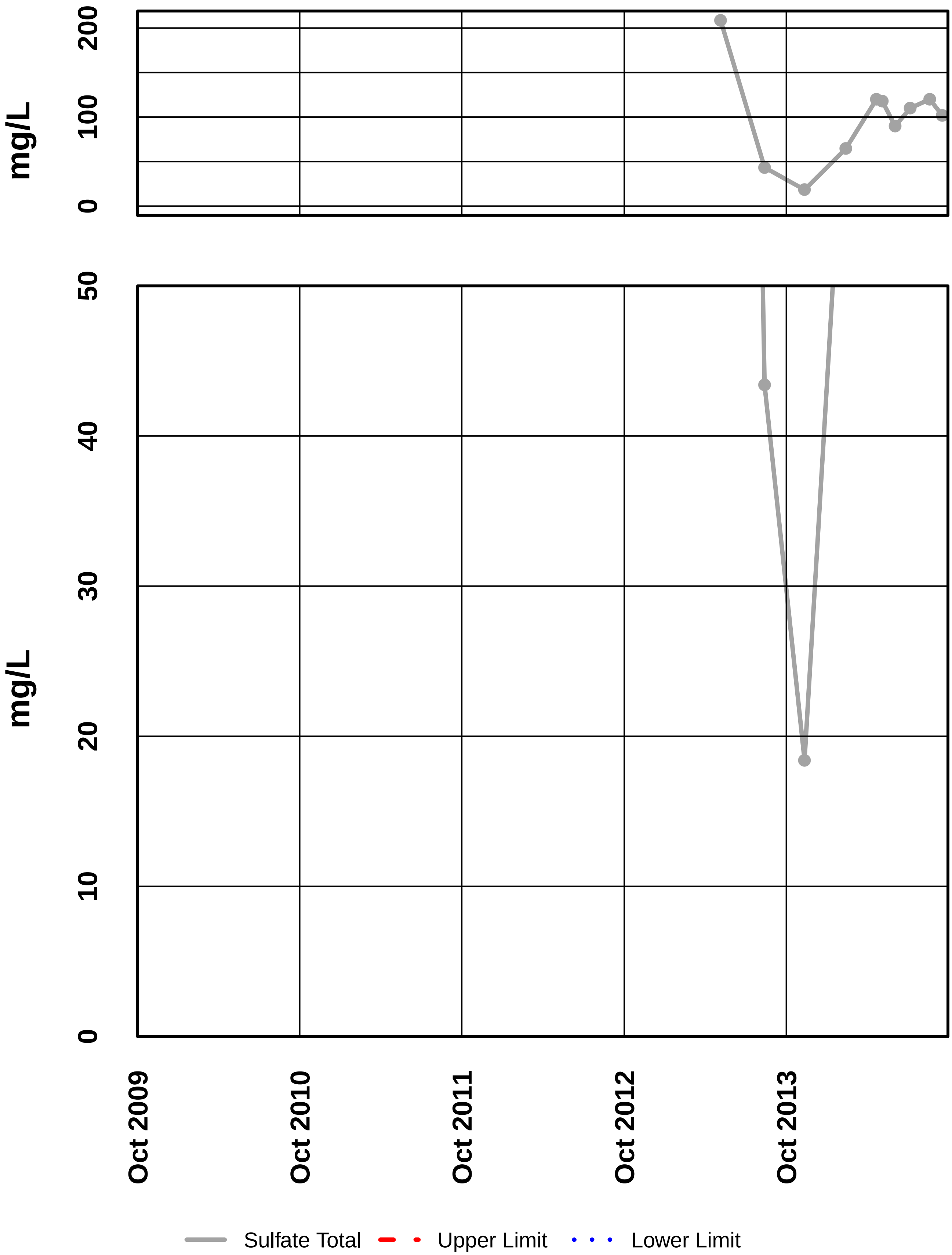

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# Site 61 − Alkalinity



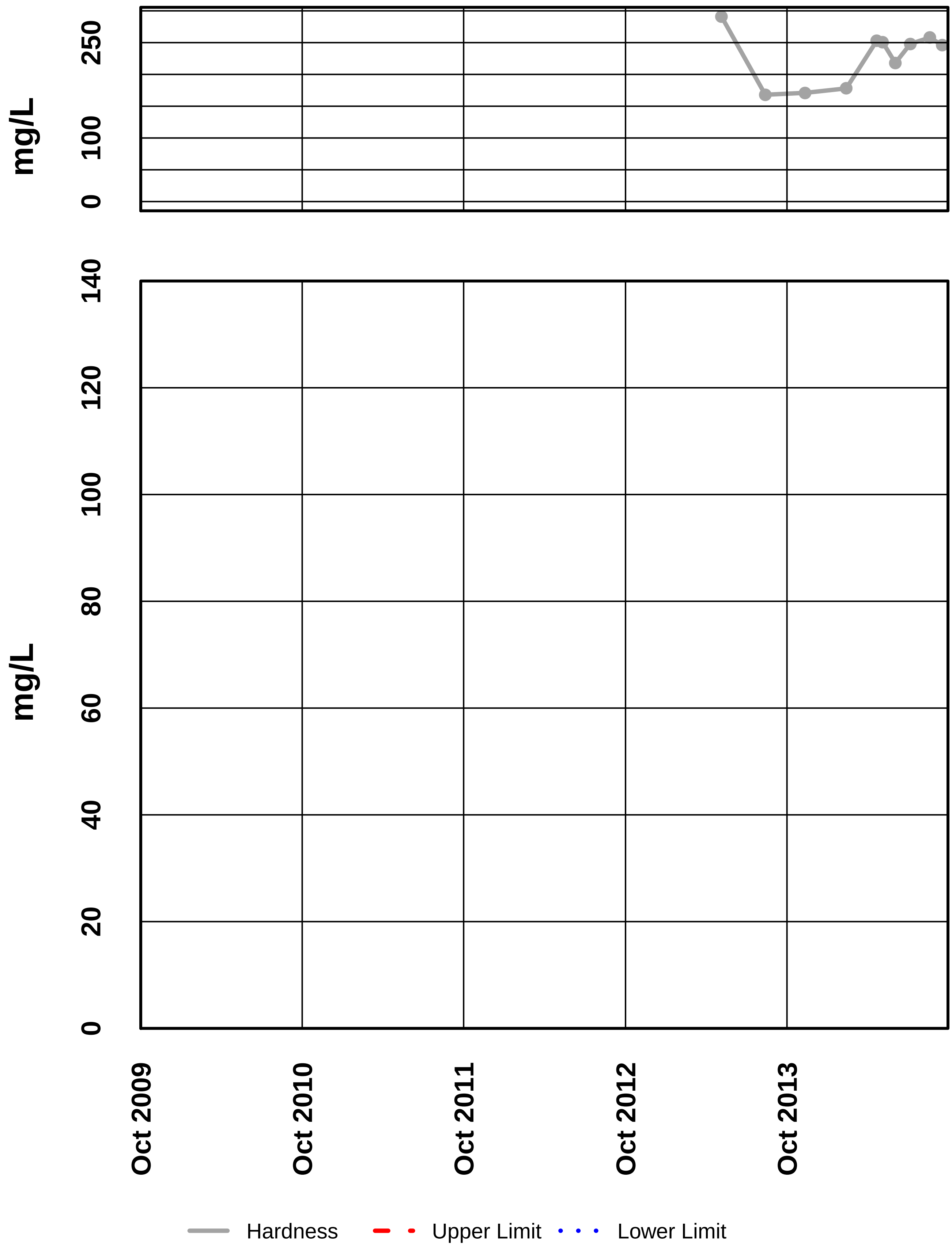

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# Site 61 – Sulfate Total



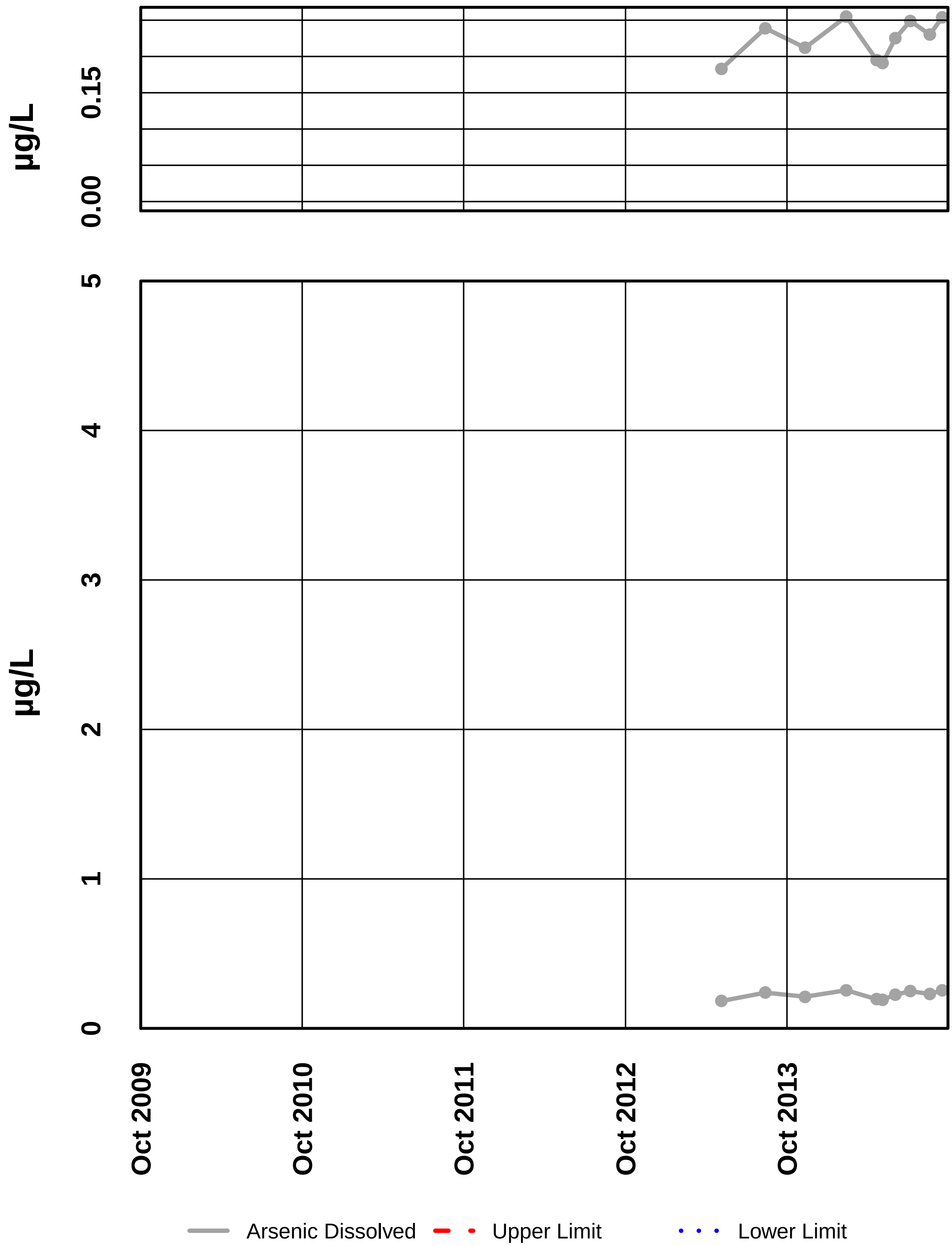

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# Site 61 – Hardness

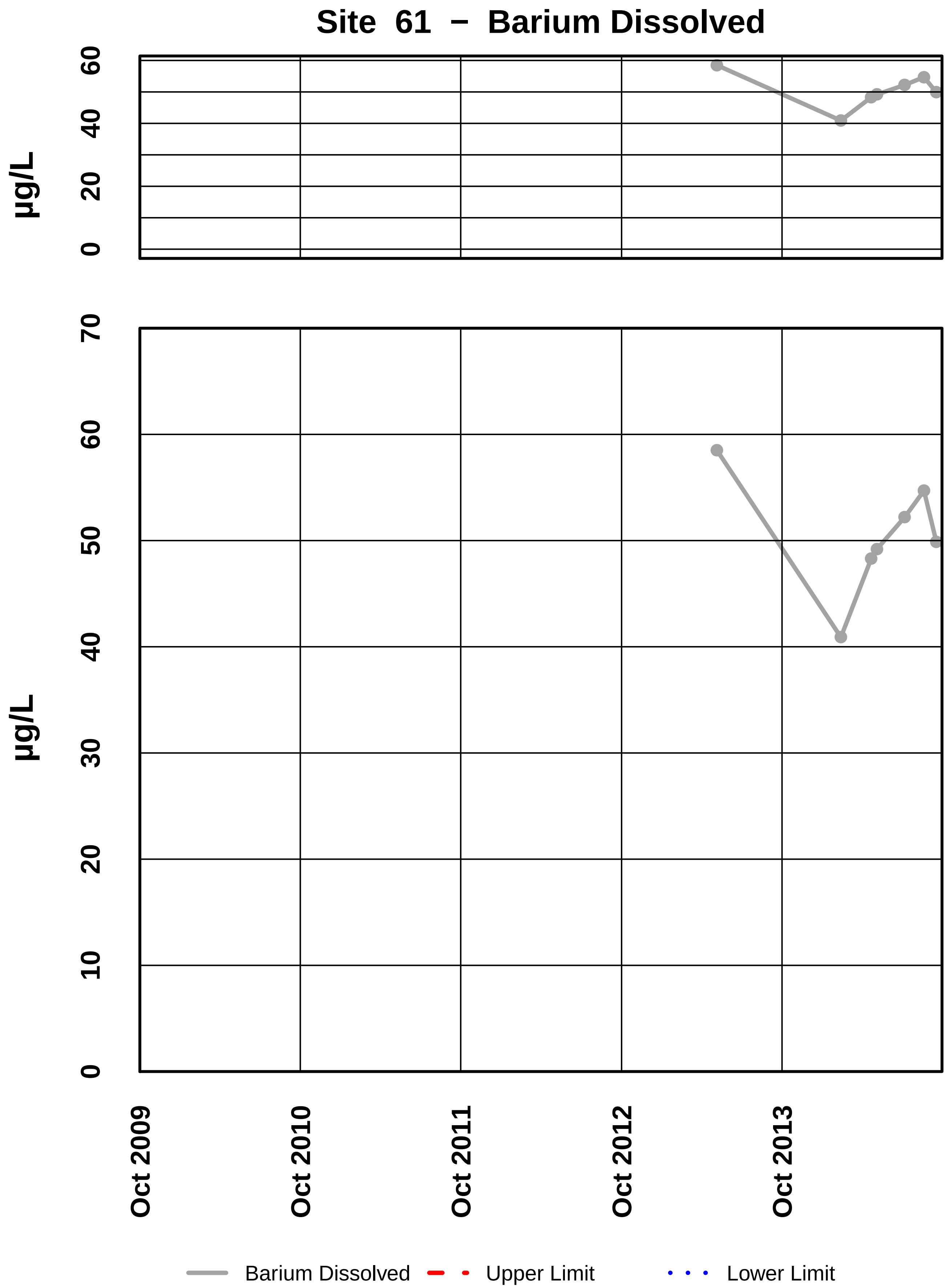



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# Site 61 – Arsenic Dissolved

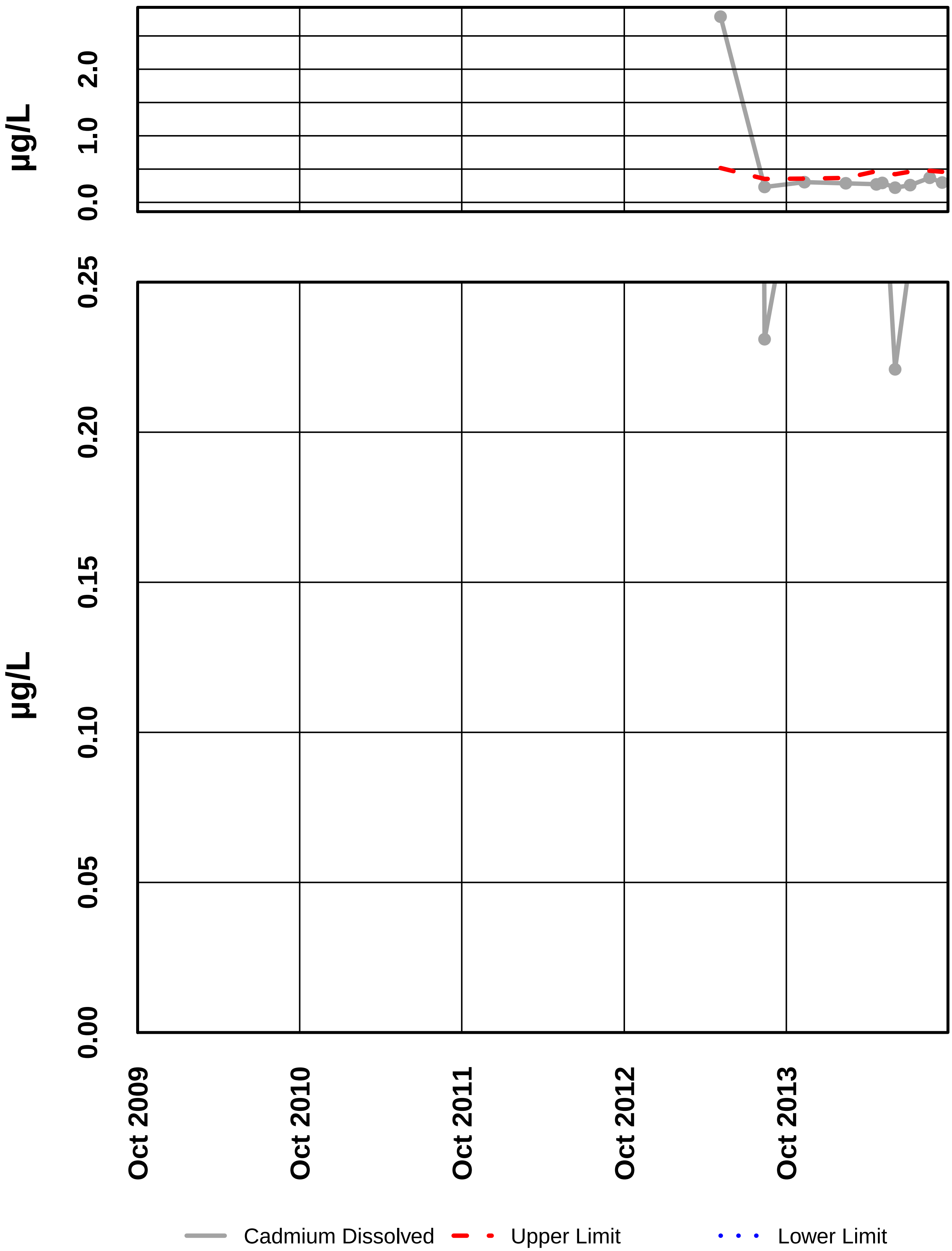



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

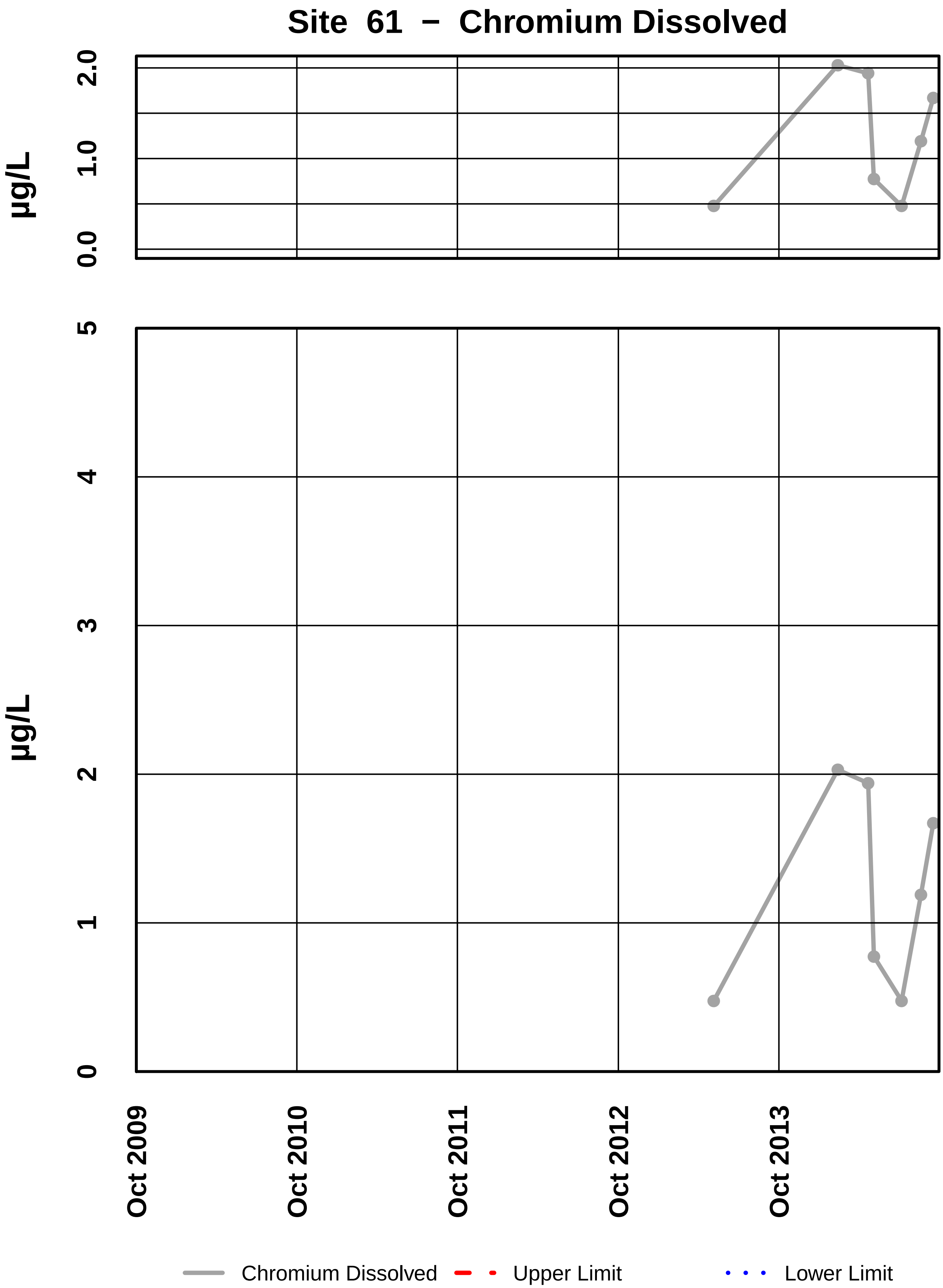



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

## Site 61 – Cadmium Dissolved

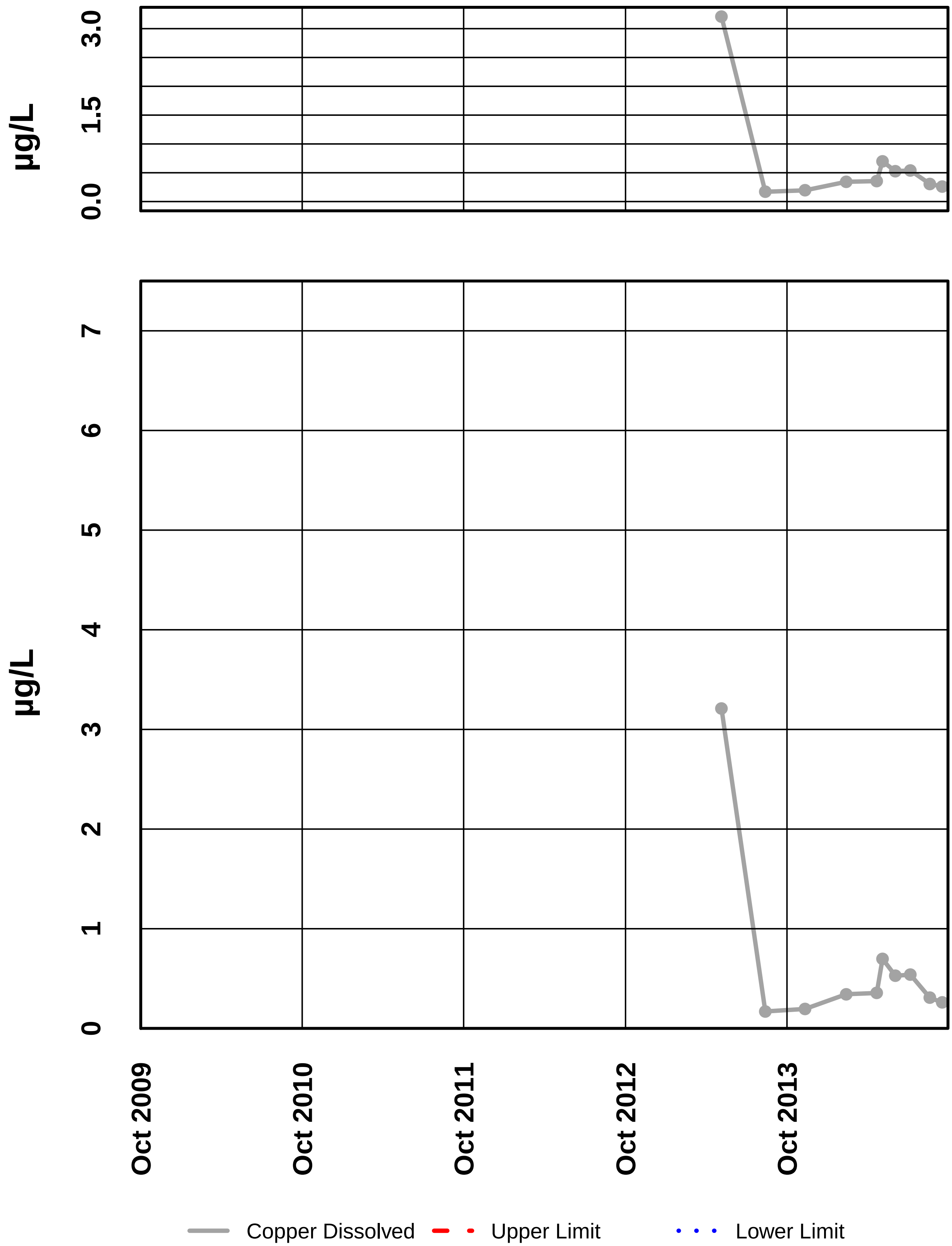



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

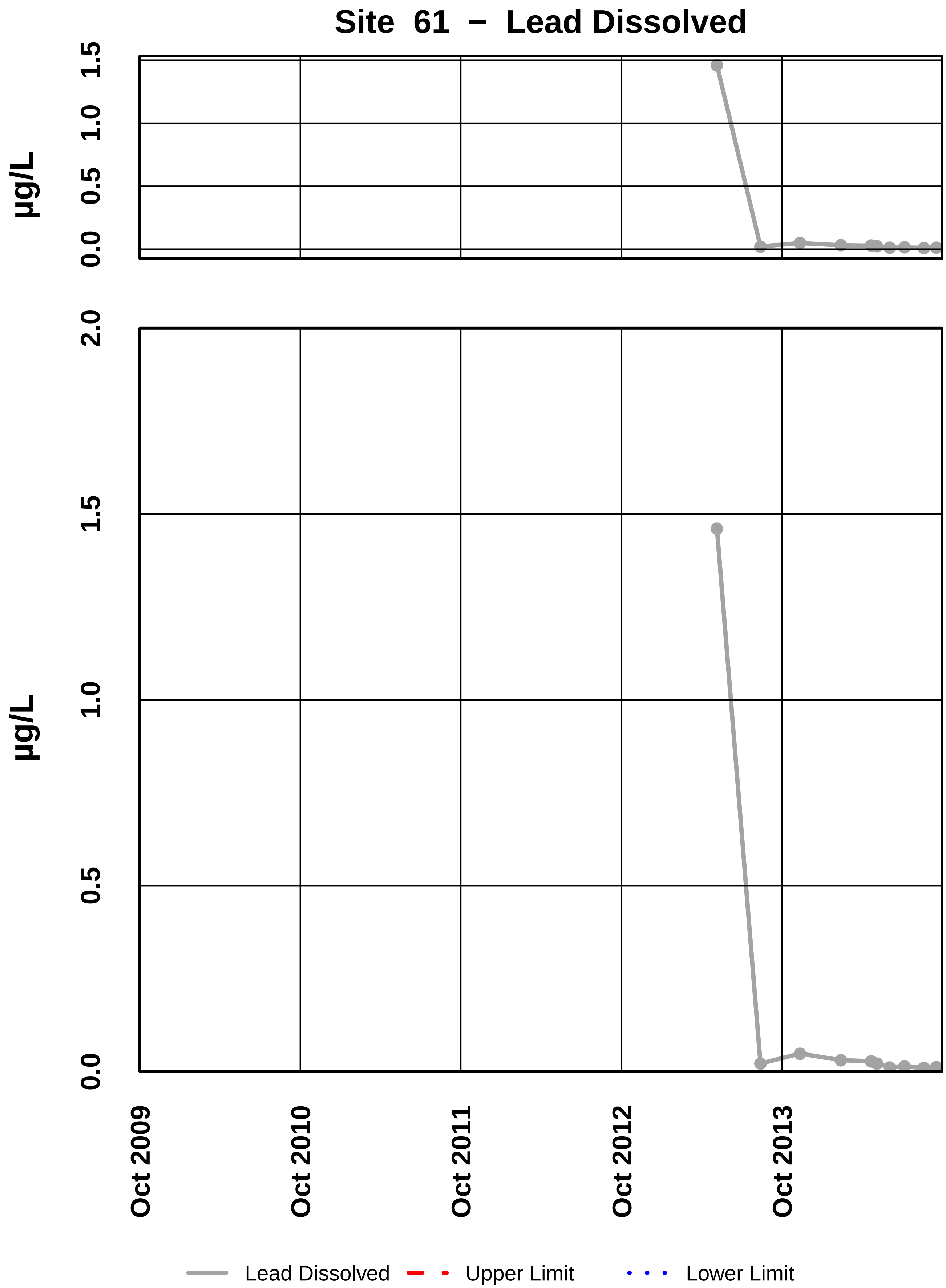



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

## Site 61 – Copper Dissolved

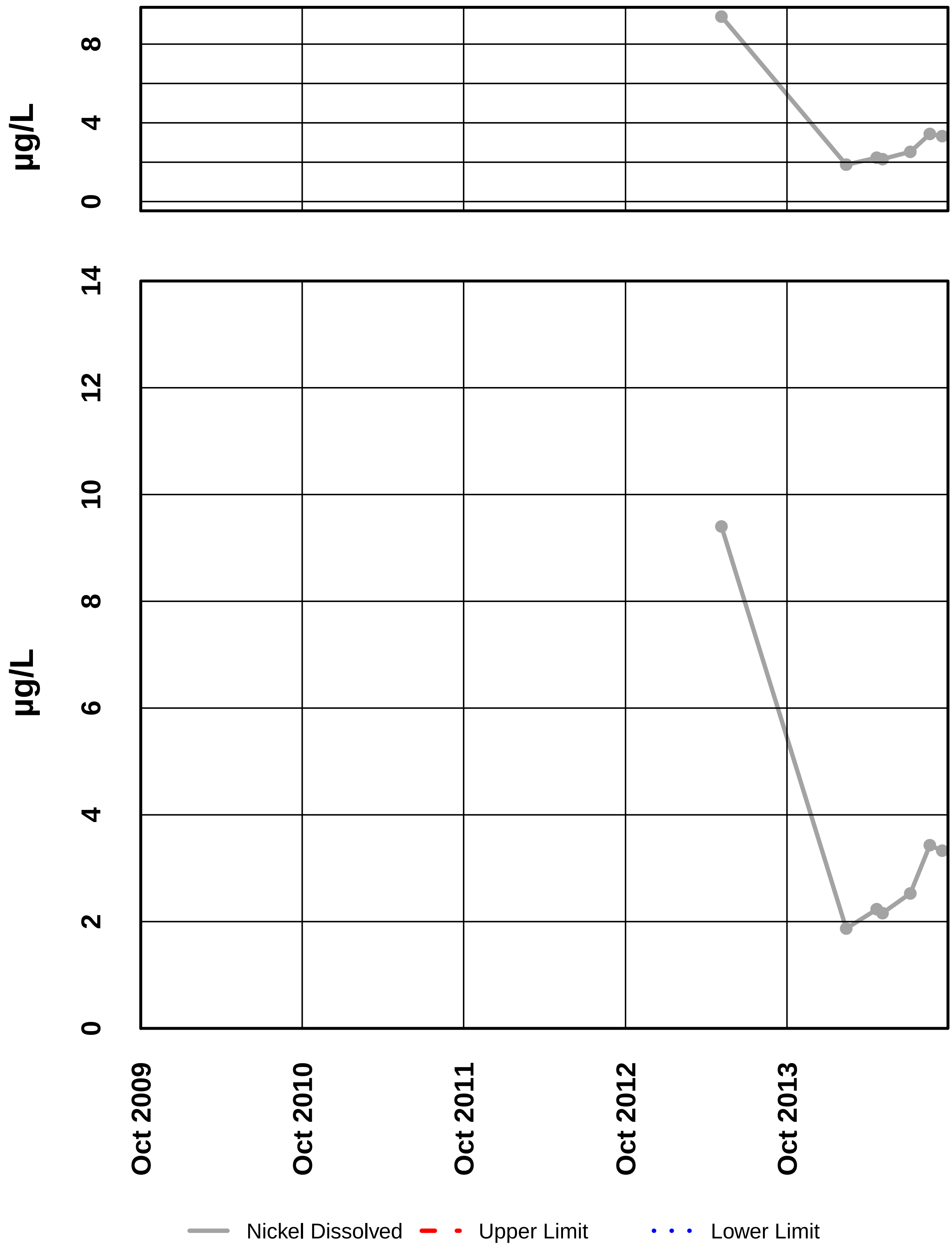



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

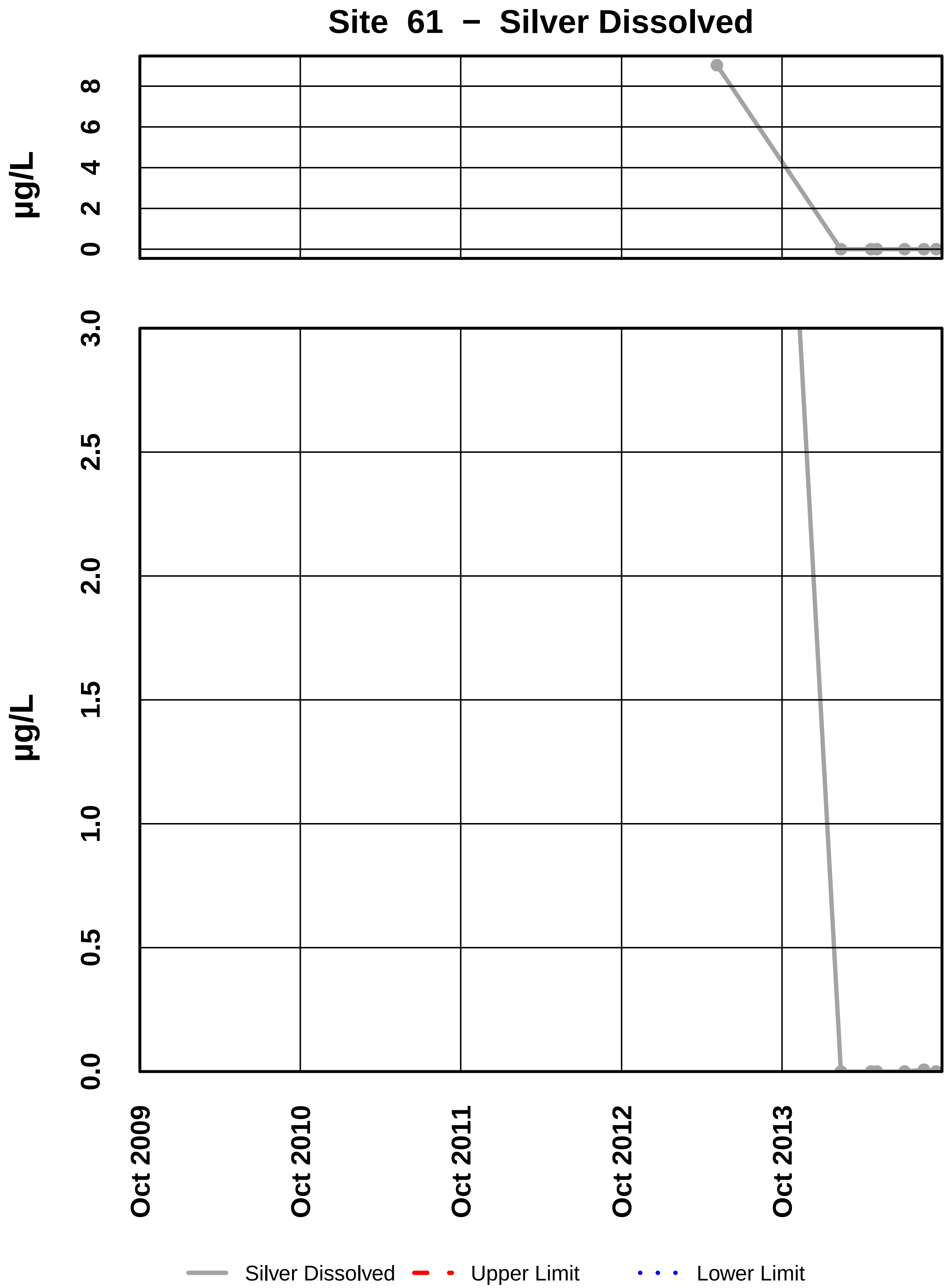



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

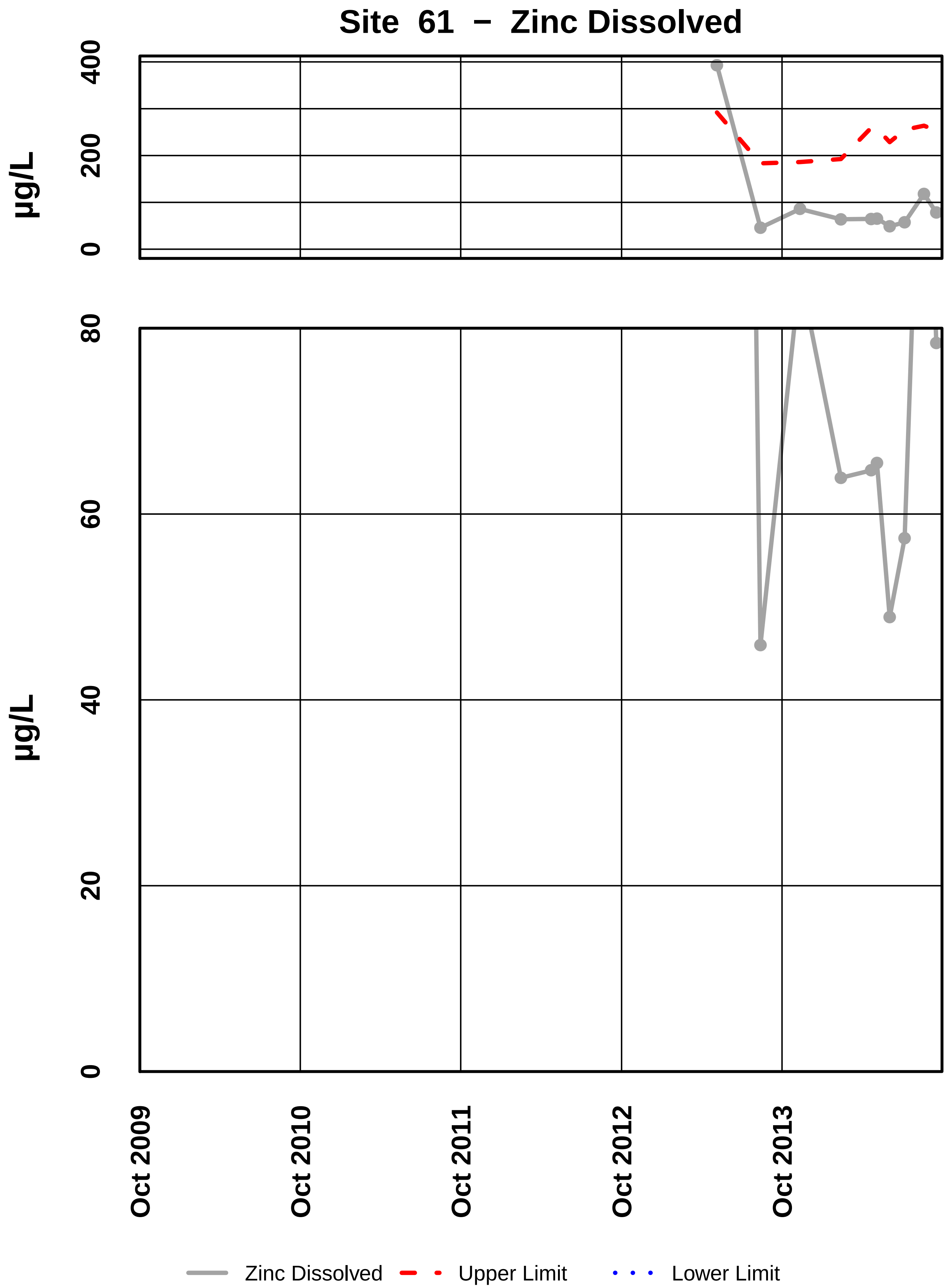
# Site 61 – Nickel Dissolved



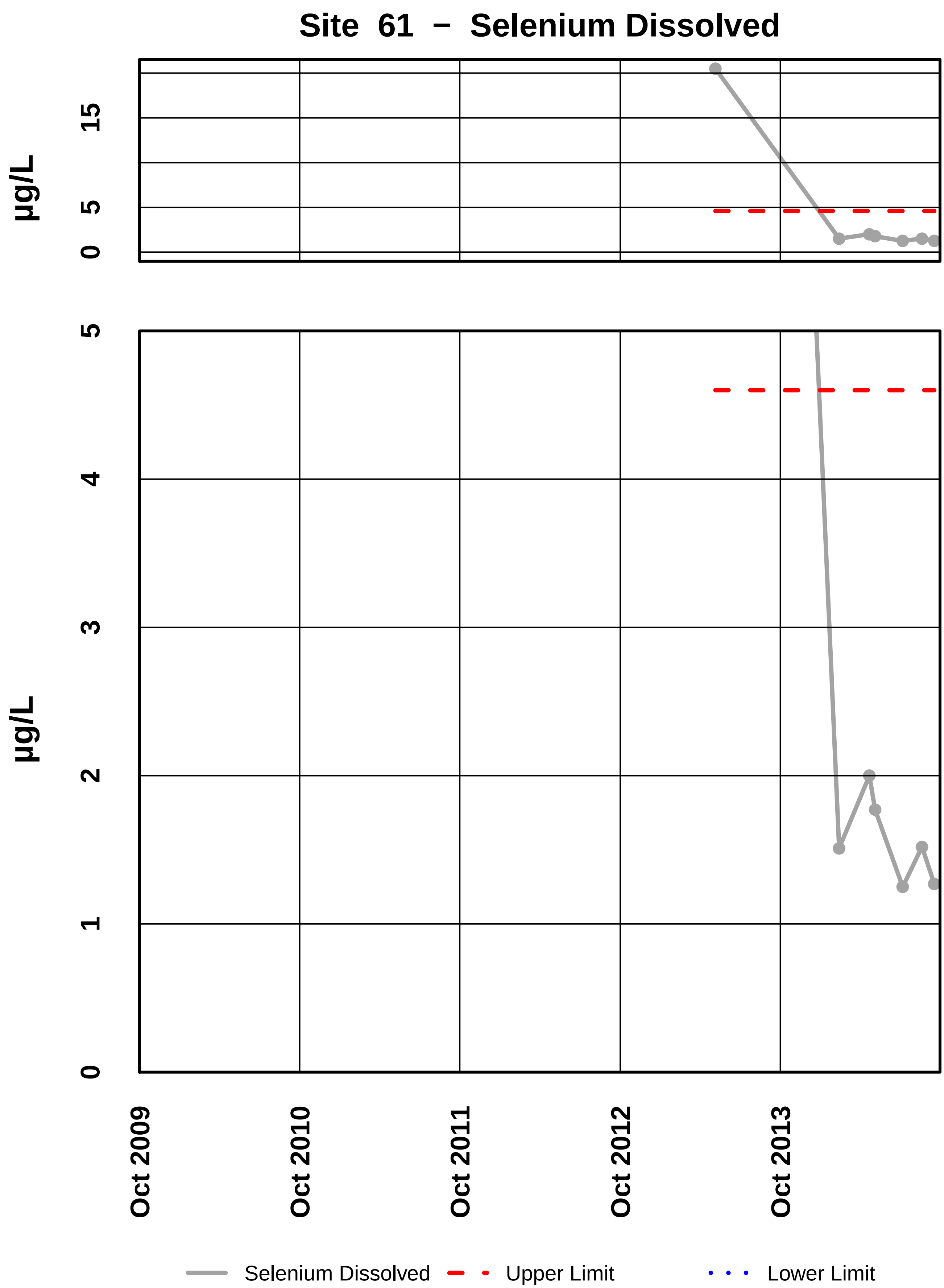

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



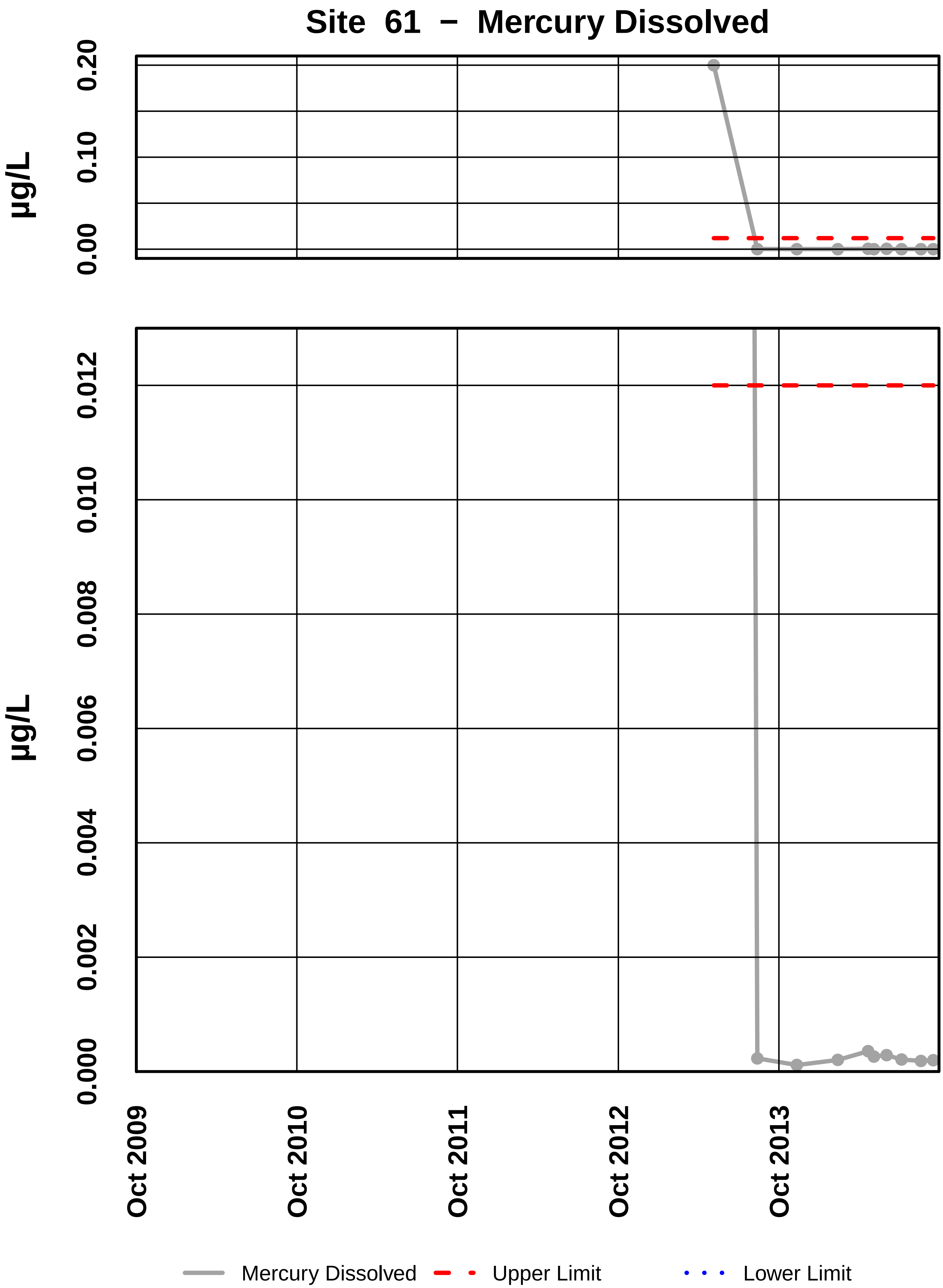

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# INTERPRETIVE REPORT
# SITE 49

The data collected during the current water year are listed in the following “Table of Results for Water Year 2014” report. The table includes all the required FWMP analyte data (field and laboratory) collected for the current water year and a series of flags keyed to the summary report “Qualified Data by QA Reviewer”. The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of ½ MDL for the purpose of median calculation.

All data collected at this site for the past six years are included in the data analyses. As shown in the table below, there were no data outliers.

| Sample Date | Parameter | Value | Qualifier | Notes |
|---|---|---|---|---|
| No outliers have been identified by HGCMC for the period of October 2008 through September 2014. | | | | |

The data for Water Year 2014 have been compared to the strictest fresh water quality criterion for each applicable analyte. No results exceeding these criteria have been identified as listed in the table below.

**Table of Exceedance for Water Year 2014**

| | | | Limits | | |
|---|---|---|---|---|---|
| **Sample Date** | **Parameter** | **Value** | **Lower** | **Upper** | **Hardness** |
| No exceedances have been identified by HGCMC for the period of October 2013 through September 2014. | | | | | |

X-Y plots have been generated to graphically present the data for each of the analytes requested in the Statistical Information Goals for this site. These plots have been visually analyzed for the appearance of any trend in concentration. There were no visually identifiable trends noted for the current water year.

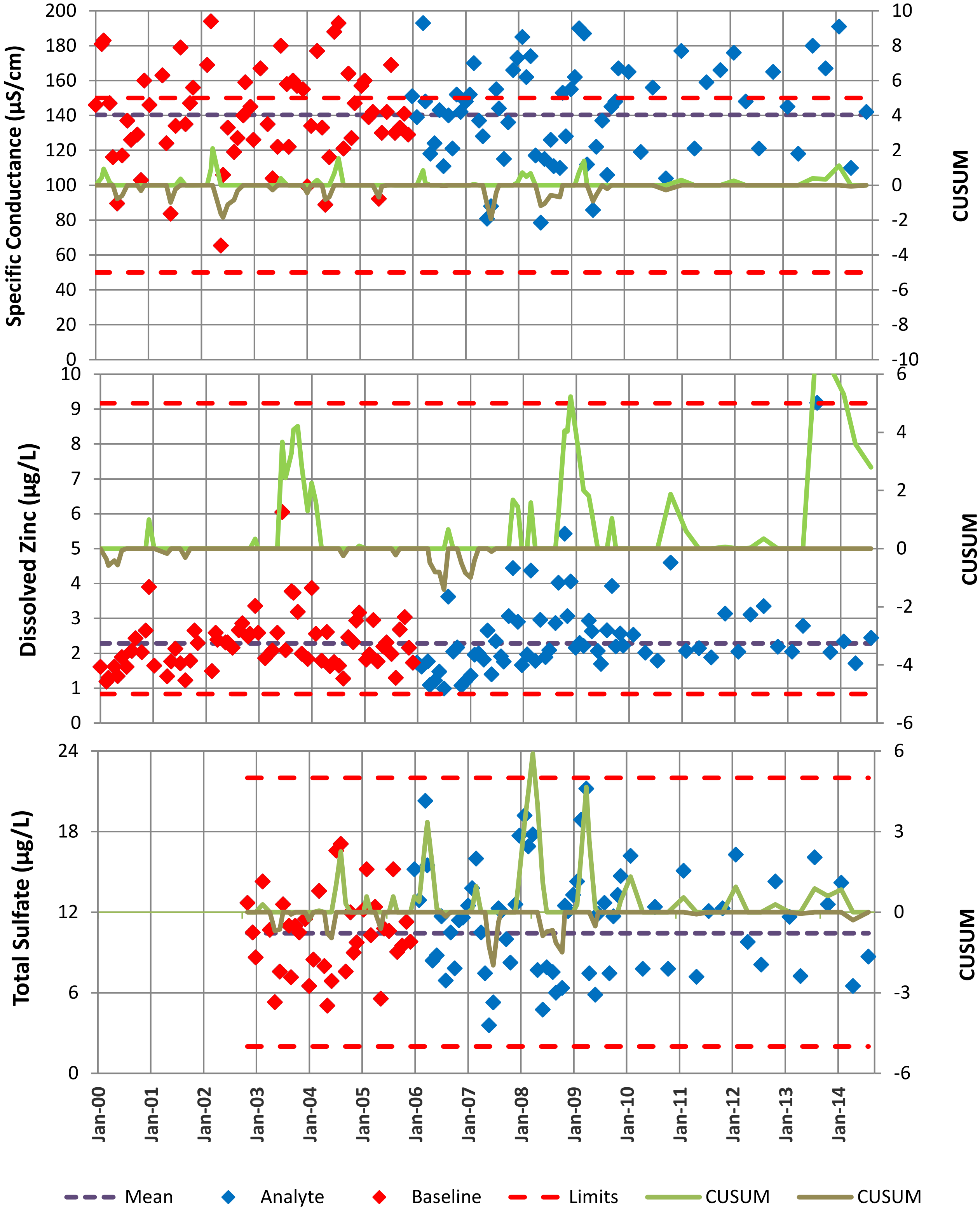
A non-parametric statistical analysis for trend was performed for specific conductivity, field pH, total alkalinity, total sulfate, and dissolved zinc. Calculation details of the Seasonal Kendall analyses are presented in detail on the pages following this interpretive section. The below table summarizes the results on the data collected between Oct-08 and Sep-14(WY2009-WY2014). For datasets with a statistically significant trend ($\alpha/2=2.5\%$) a Seasonal-Sen’s Slope estimate statistic has also been calculated. Two statistically significant trends were detected for field pH and total alkalinity, during the current water year. These trends were similar as those noted for Site 48.

**Table of Summary Statistics for Trend Analysis**

| | Mann-Kendall test statistics | | | Sen's slope estimate | |
|---|---|---|---|---|---|
| **Parameter** | **n*** | **p**** | **Trend** | **Q** | **Q(%)** |
| Conductivity Field | 6 | 0.13 | | | |
| pH Field | 6 | <0.01 | + | 0.07 | 0.9 |
| Alkalinity, Total | 6 | 0.02 | + | 2.10 | 3.5 |
| Sulfate, Total | 6 | 0.26 | | | |
| Zinc, Dissolved | 6 | 0.23 | | | |

* Number of Years ** Significance level

**Figure 1.** **Observed Measurements for Specific Conductance, Dissolved Zinc, and Total Sulfate from Site 49 Compared to the Shewhart-CUSUM Control Limits From Table 1**



## Table of Results for Water Year 2014

### Site 049FMS - 'Upper Bruin Creek'

| Sample Date/Parameter | Oct 2013 | Nov 2013 | Dec 2013 | Jan 2014 | Feb 2014 | Mar 2014 | Apr 2014 | May 2014 | Jun 2014 | Jul 2014 | Aug 2014 | Sep 2014 | **Median** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Water Temp (°C) | | 1.4 | | | 0.0 | | | 4.6 | | | 9.9 | | 3.0 |
| Conductivity-Field(μmho) | | 167 | | | 191 | | | 110 | | | 142 | | 154.5 |
| Conductivity-Lab (μmho) | | 135 | | | 182 | | | 109 | | | 135 | | 135 |
| pH Lab (standard units) | | 7.82 | | | 7.68 | | | 7.49 | | | 7.76 | | 7.72 |
| pH Field (standard units) | | 8.03 | | | 7.92 | | | 7.72 | | | 8.02 | | 7.97 |
| Total Alkalinity (mg/L) | | 67.5 | | | 77.5 | | | 43.9 | | | 58 | | 62.8 |
| Total Sulfate (mg/L) | | 12.6 | | | 14.2 | | | 6.5 | | | 8.7 | | 10.7 |
| Hardness (mg/L) | | 82.7 | | | 88.1 | | | 50.9 | | | 68 | | 75.4 |
| Dissolved As (ug/L) | | 0.171 | | | 0.164 | | | 0.169 | | | 0.197 | | 0.170 |
| Dissolved Ba (ug/L) | | 10.1 | | | 11.9 | | | | | | | | 11.0 |
| Dissolved Cd (ug/L) | | 0.0292 | | | 0.0292 | | | 0.0221 | | | 0.0329 | | 0.0292 |
| Dissolved Cr (ug/L) | | 0.692 | | | 1.17 | | | | | | | | 0.931 |
| Dissolved Cu (ug/L) | | 0.371 | | | 0.334 | | | 0.46 | | | 0.598 | | 0.416 |
| Dissolved Pb (ug/L) | | 0.0056 | | | 0.0096 | | | 0.0059 | | | 0.0032 | | 0.0058 |
| Dissolved Ni (ug/L) | | 0.928 | | | 0.952 | | | | | | | | 0.940 |
| Dissolved Ag (ug/L) | | 0.002 | | | 0.002 | | | | | | | | 0.002 |
| Dissolved Zn (ug/L) | | 2.03 | | | 2.34 | | | 1.71 | | | 2.45 | | 2.19 |
| Dissolved Se (ug/L) | | 0.772 | | | 0.783 | | | | | | | | 0.778 |
| Dissolved Hg (ug/L) | | 0.000827 | | | 0.000695 | | | 0.00131 | | | 0.00177 | | 0.001069 |

For individual sample/analyte qualifier descriptions see "Qualified Data by QA Reviewer" table.

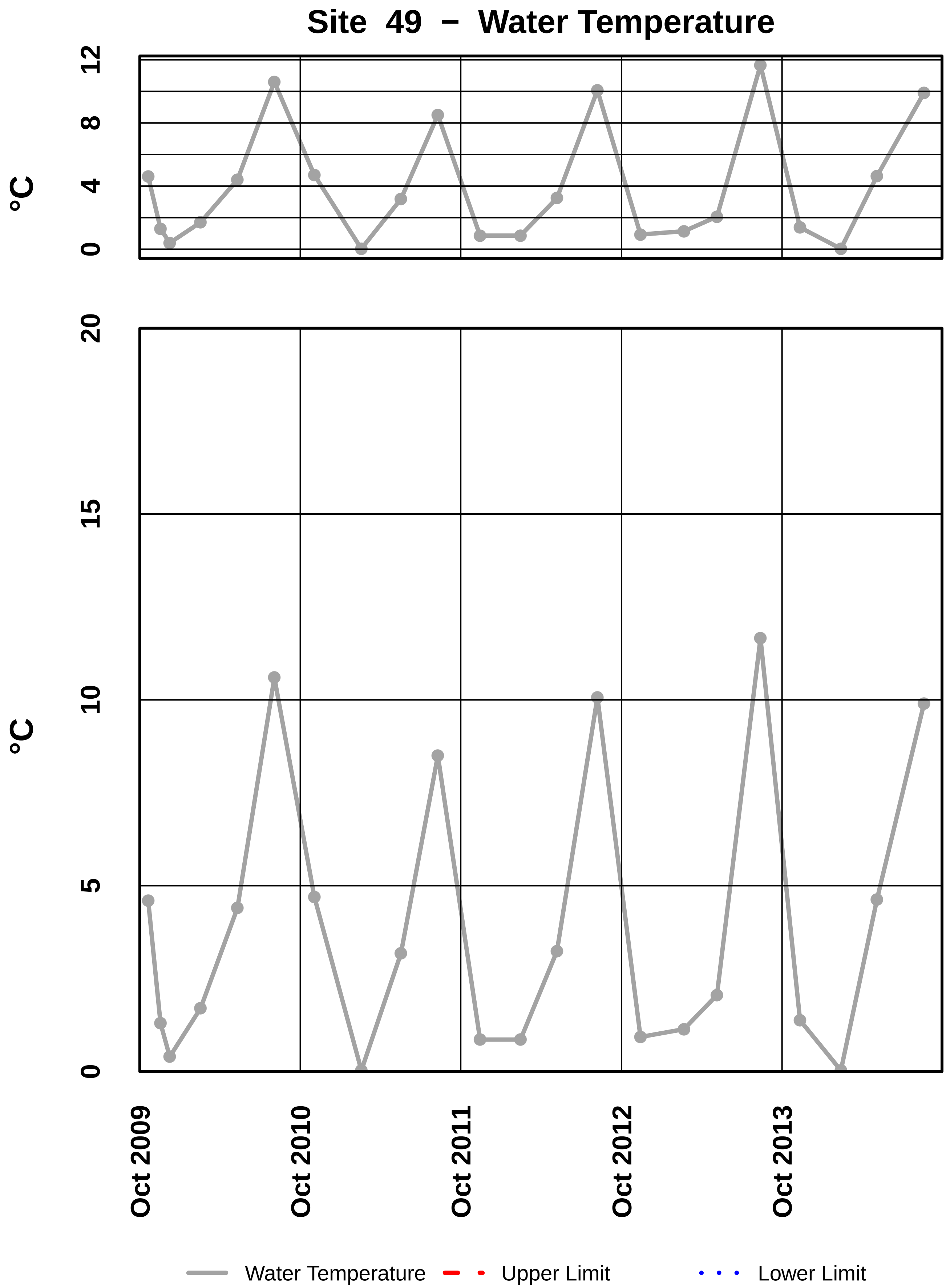
Values reported as less than MDL are replaced by 1/2 MDL for median calculation purposes.

Shaded data has been qualified as an outlier by HGCMC and removed from any further analysis and is not included into the calculation of the median

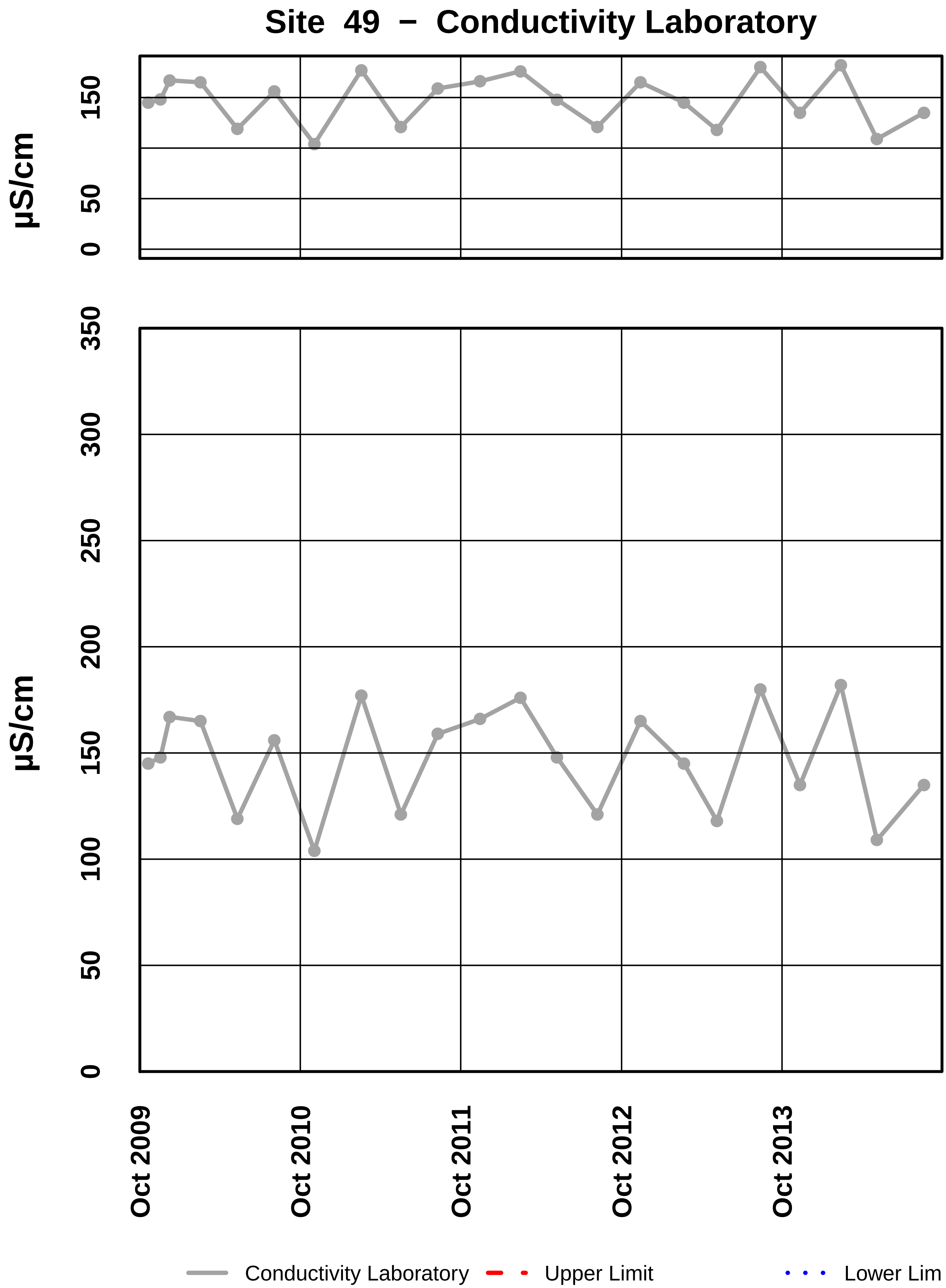
# Qualified Data by QA Reviewer

**Date Range: 10/01/2013 to 09/30/2014**

| Site No. | Sample Date | Sample Time | Parameter | Value | Qualifier | Reason for Qualifier |
|---|---|---|---|---|---|---|
| 049FMS | 11/11/2013 | 12:00 PM | Diss. Pb-ICP/MS | 0.00559 | J | Below Quantitative Range |
| | | | pH | 7.82 | J | Hold Time Violation |
| 049FMS | 2/12/2014 | 12:00 PM | Diss. Cu-ICP/MS | 0.33 | J | LCS Recovery |
| | | | Sulfate | 14.2 | J | Sample Receipt Temperature |
| 049FMS | 5/5/2014 | 12:00 PM | Diss. Pb-ICP/MS | 0.00586 | J | Below Quantitative Range |
| 049FMS | 8/20/2014 | 12:00 PM | Diss. Pb-ICP/MS | 0.00317 | J | Below Quantitative Range |

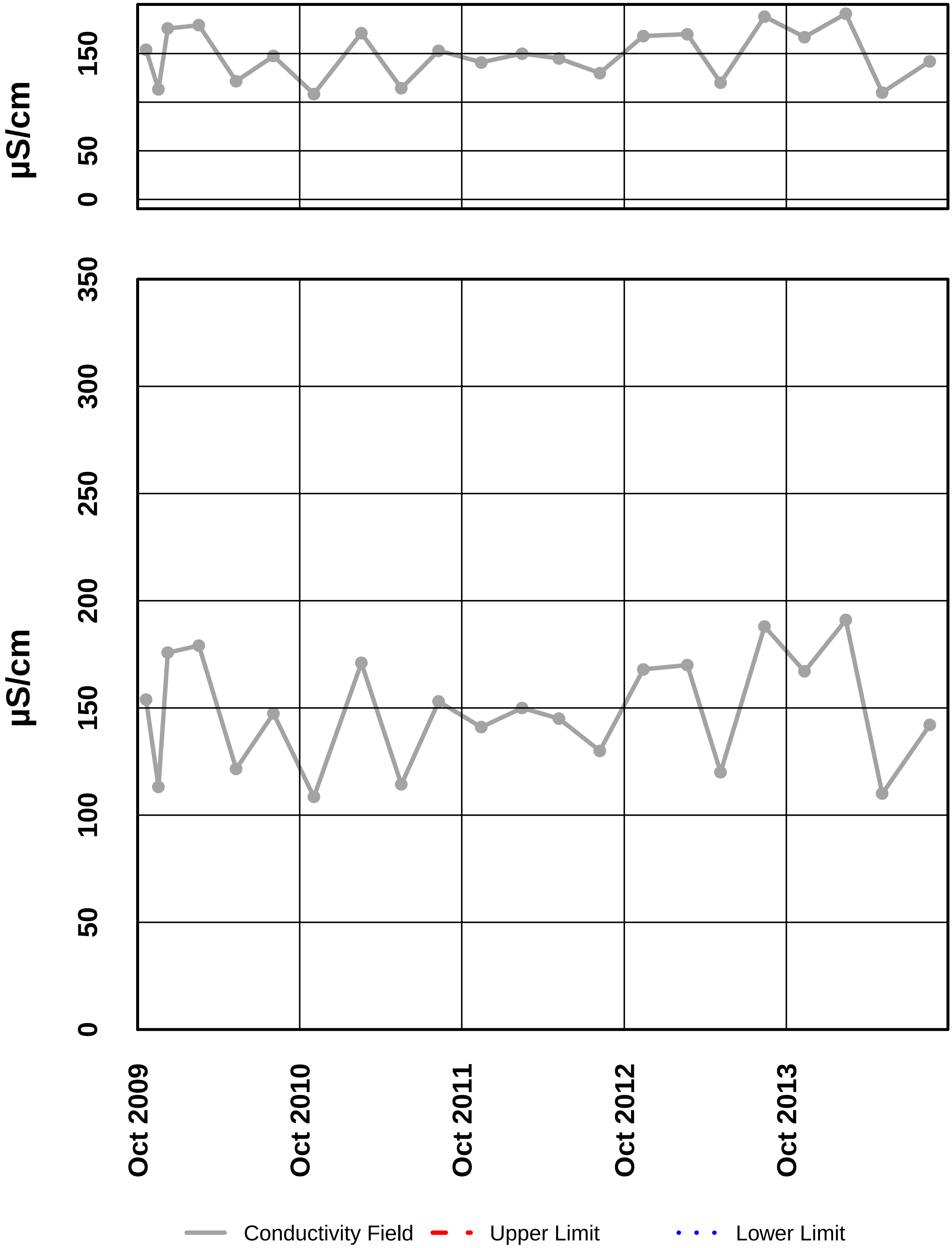



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

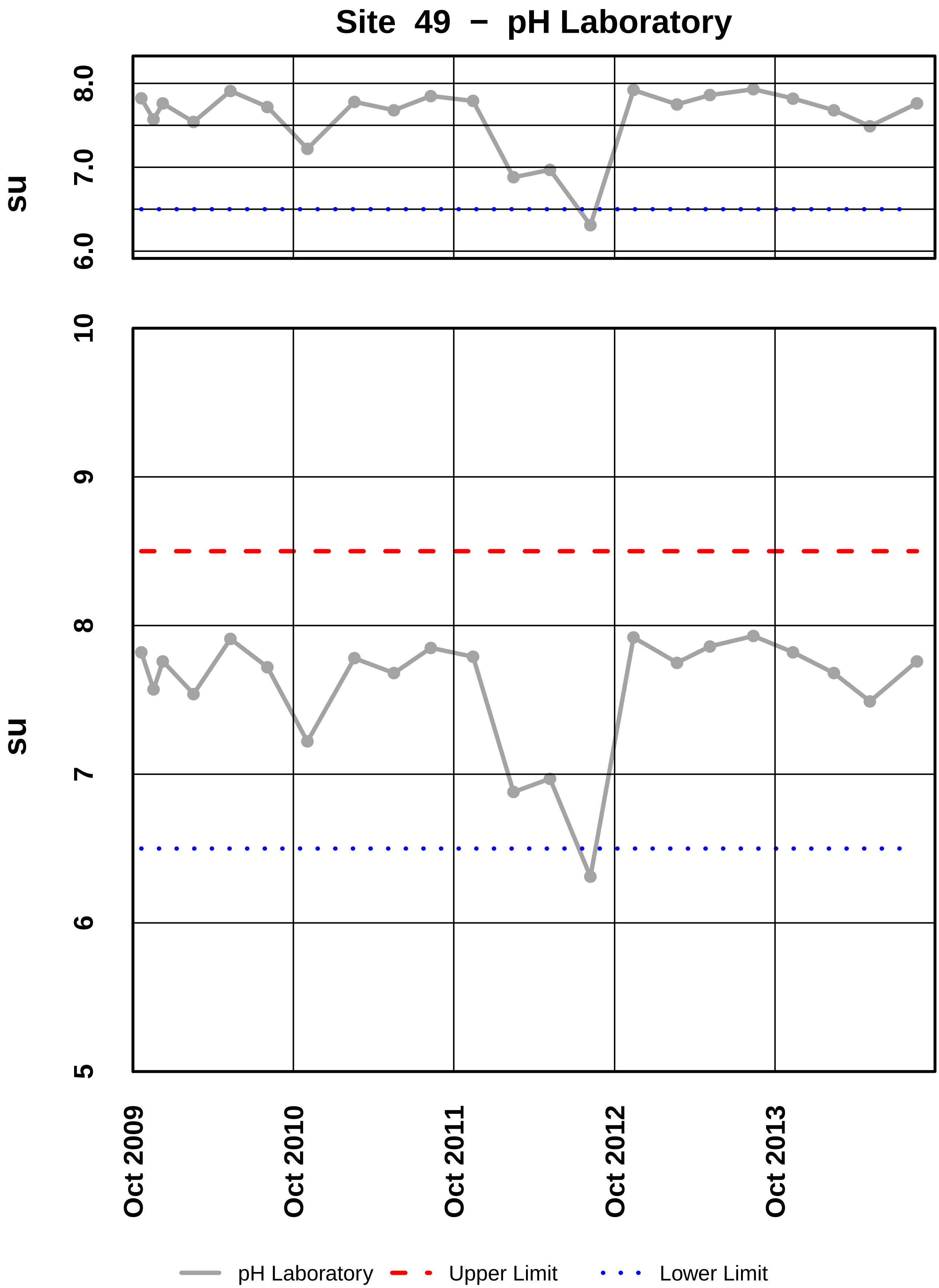



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

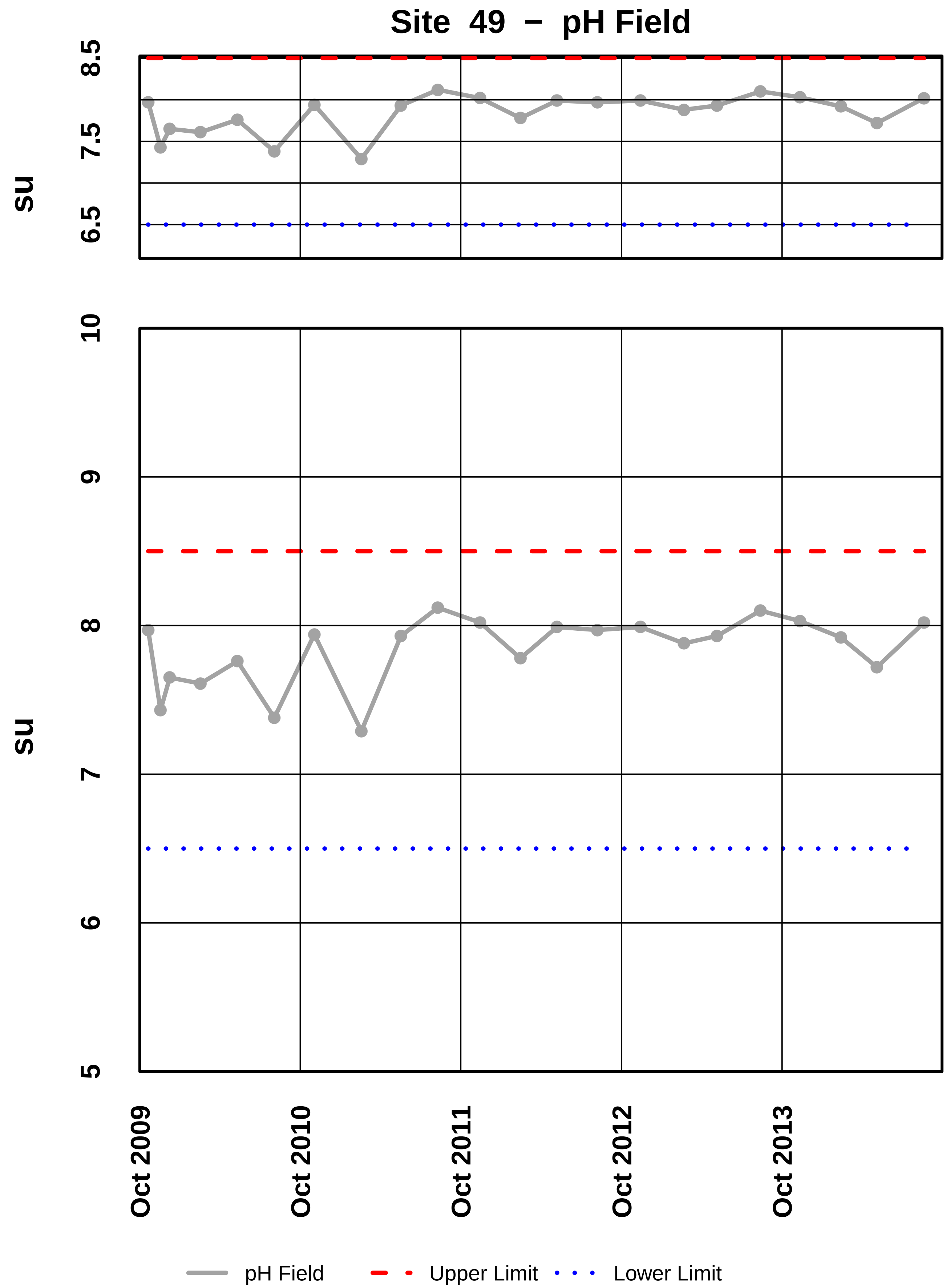
# Site 49 – Conductivity Field



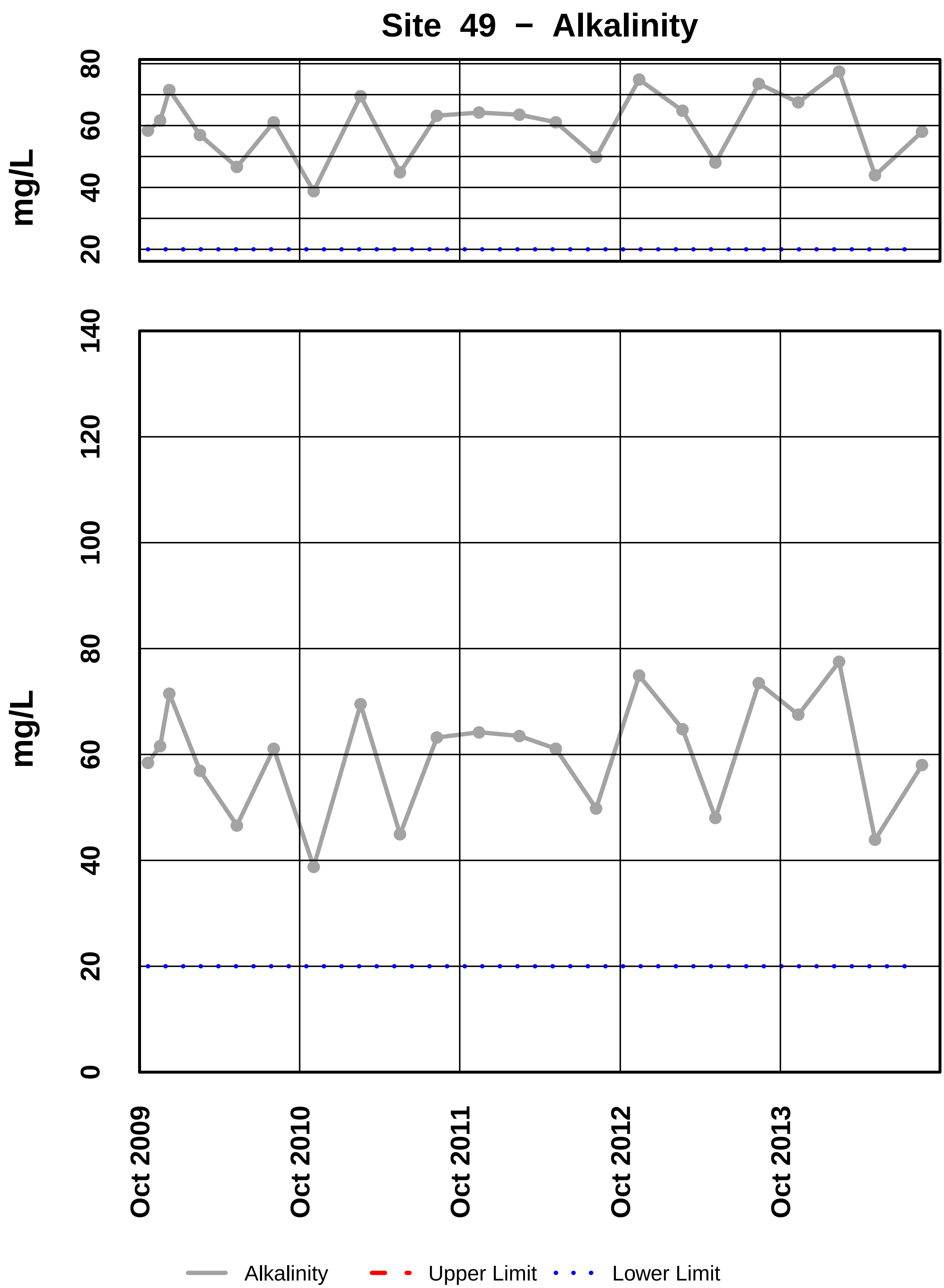

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



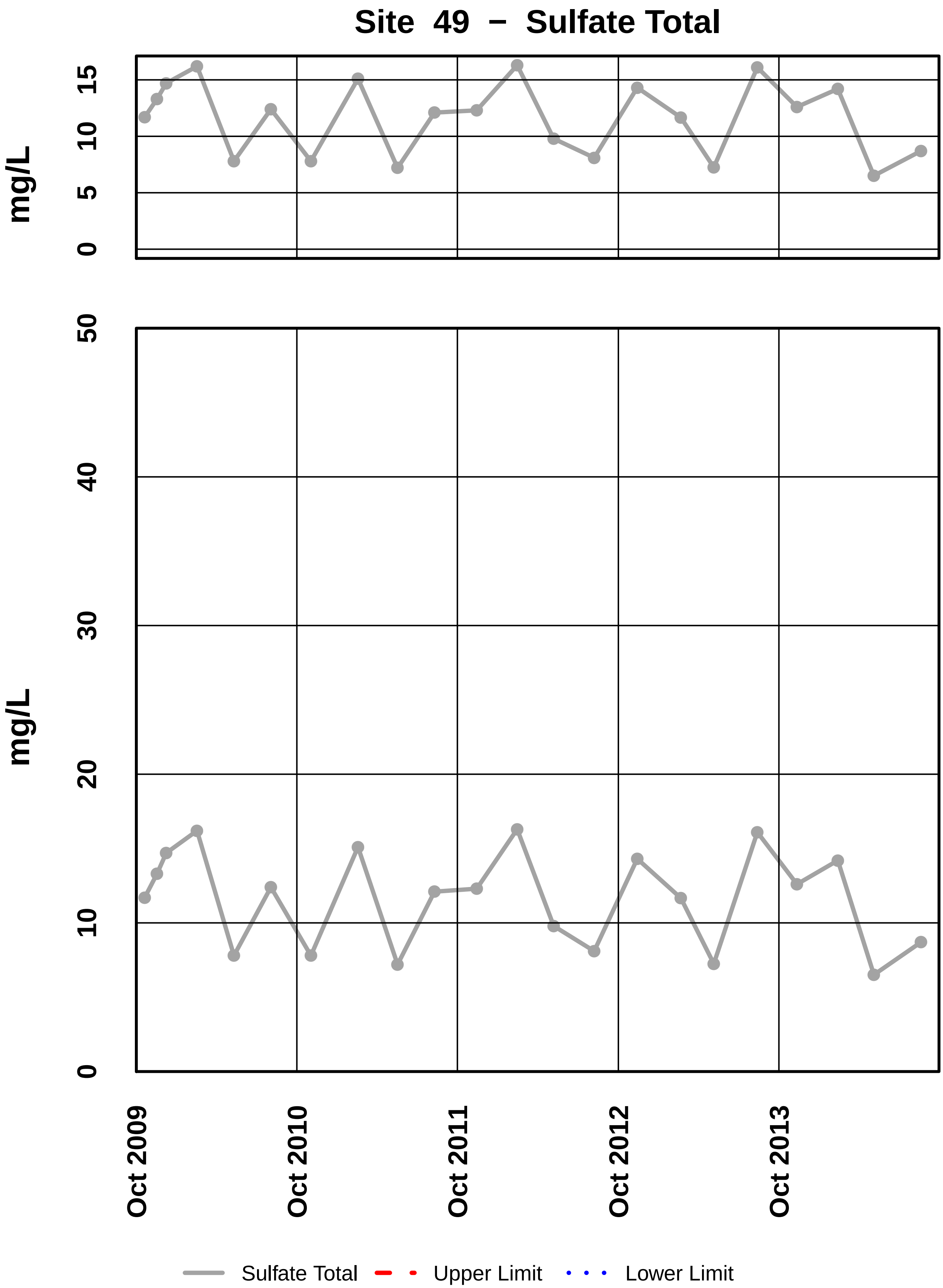

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



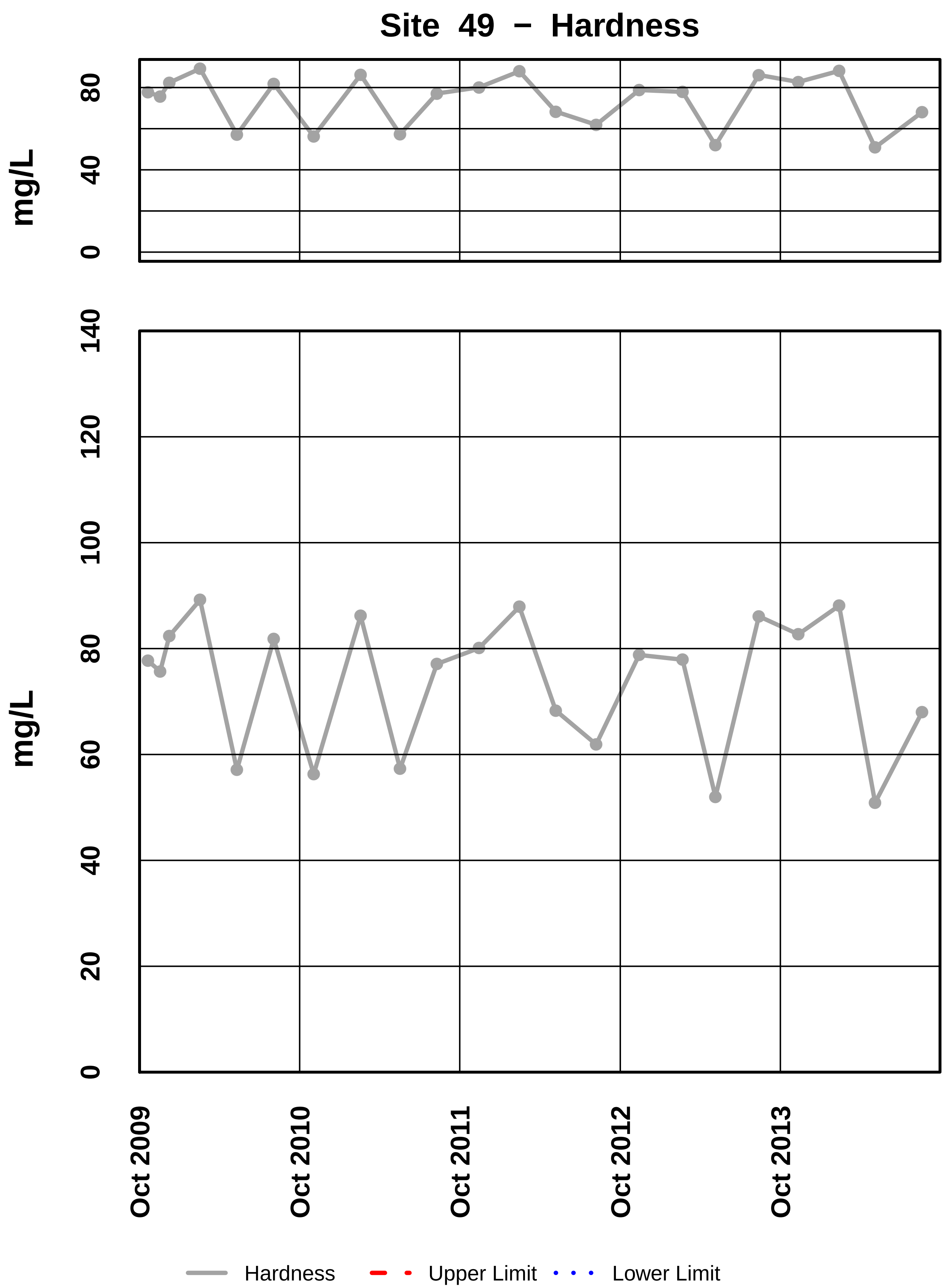

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



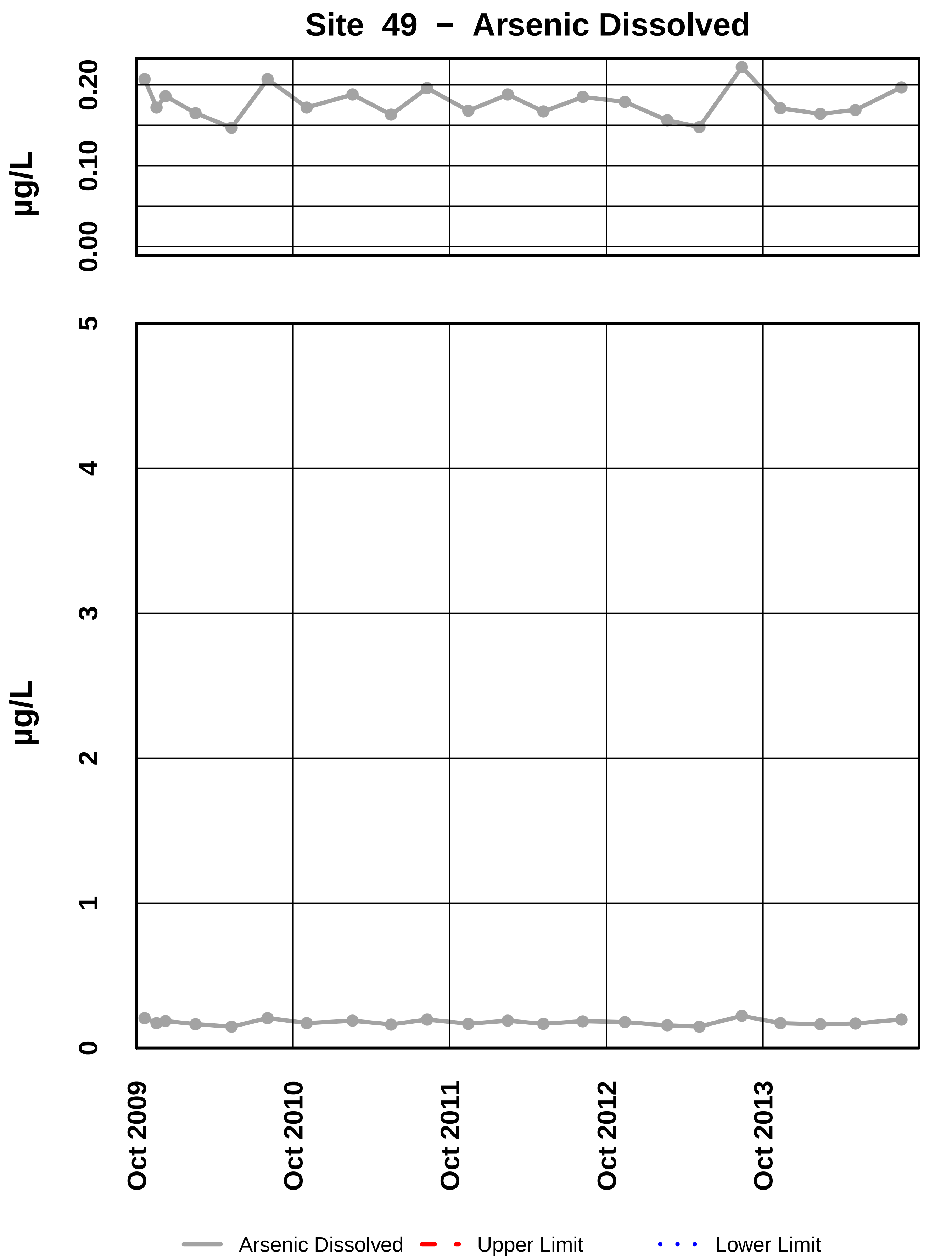

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



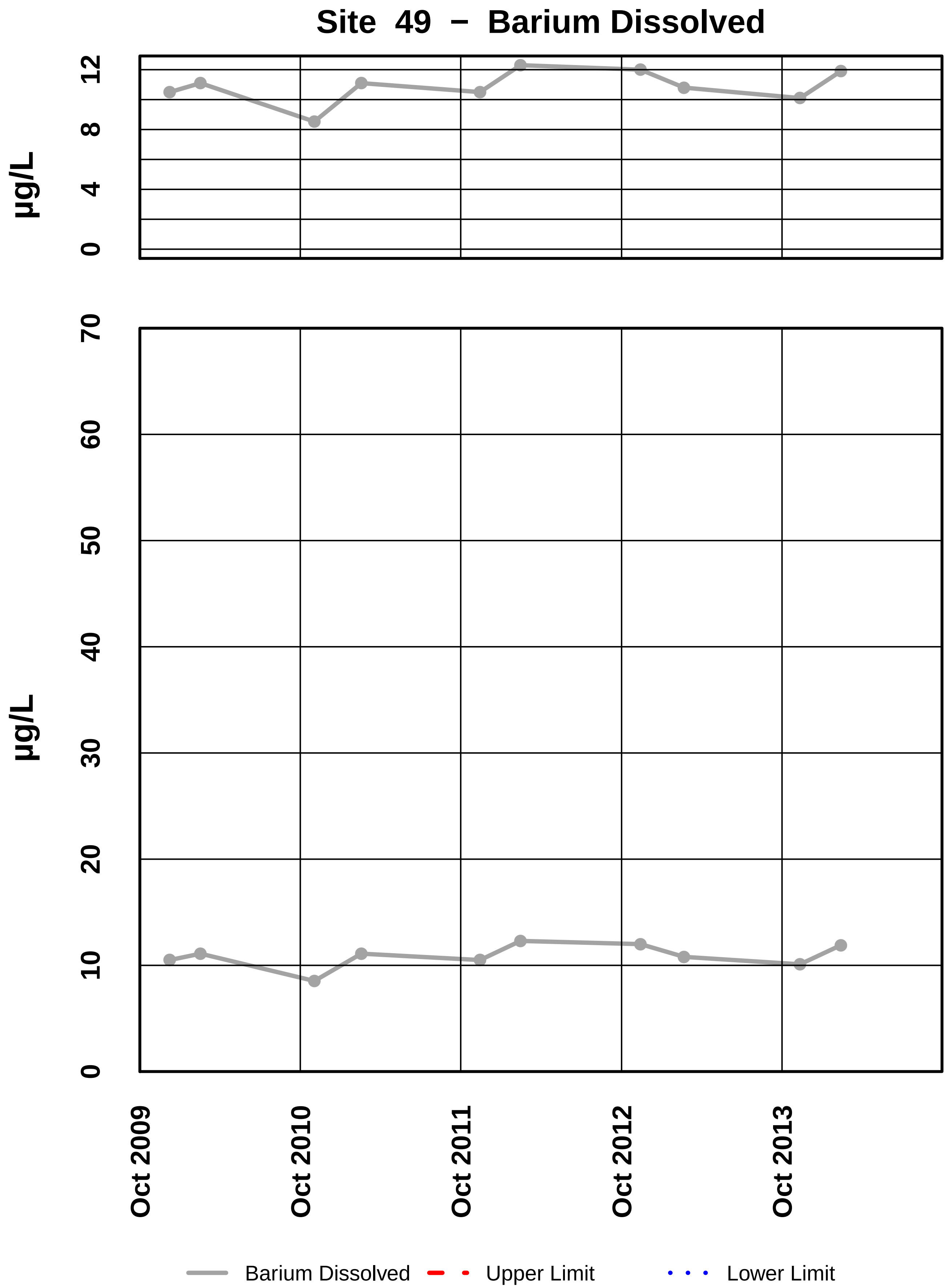

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

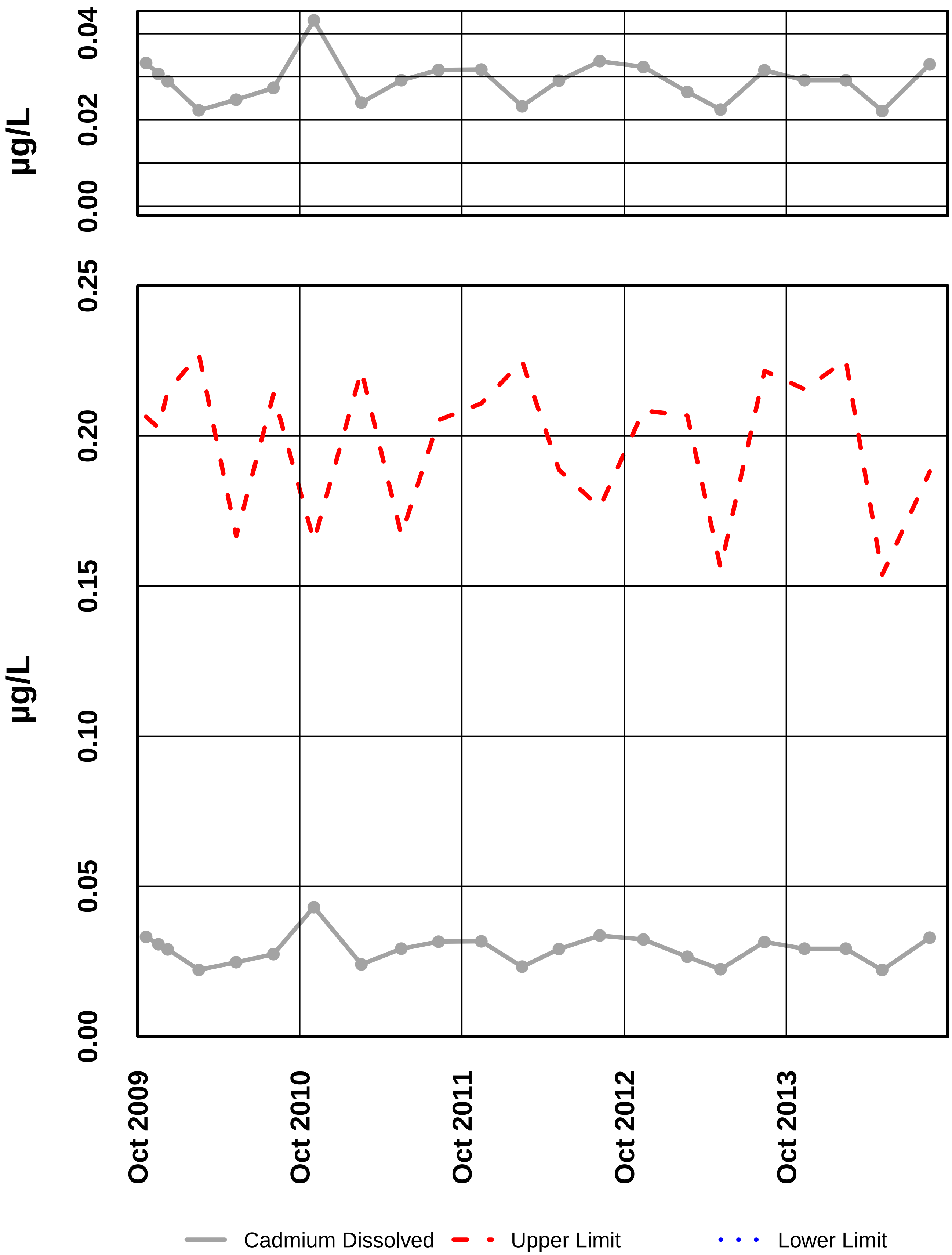



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



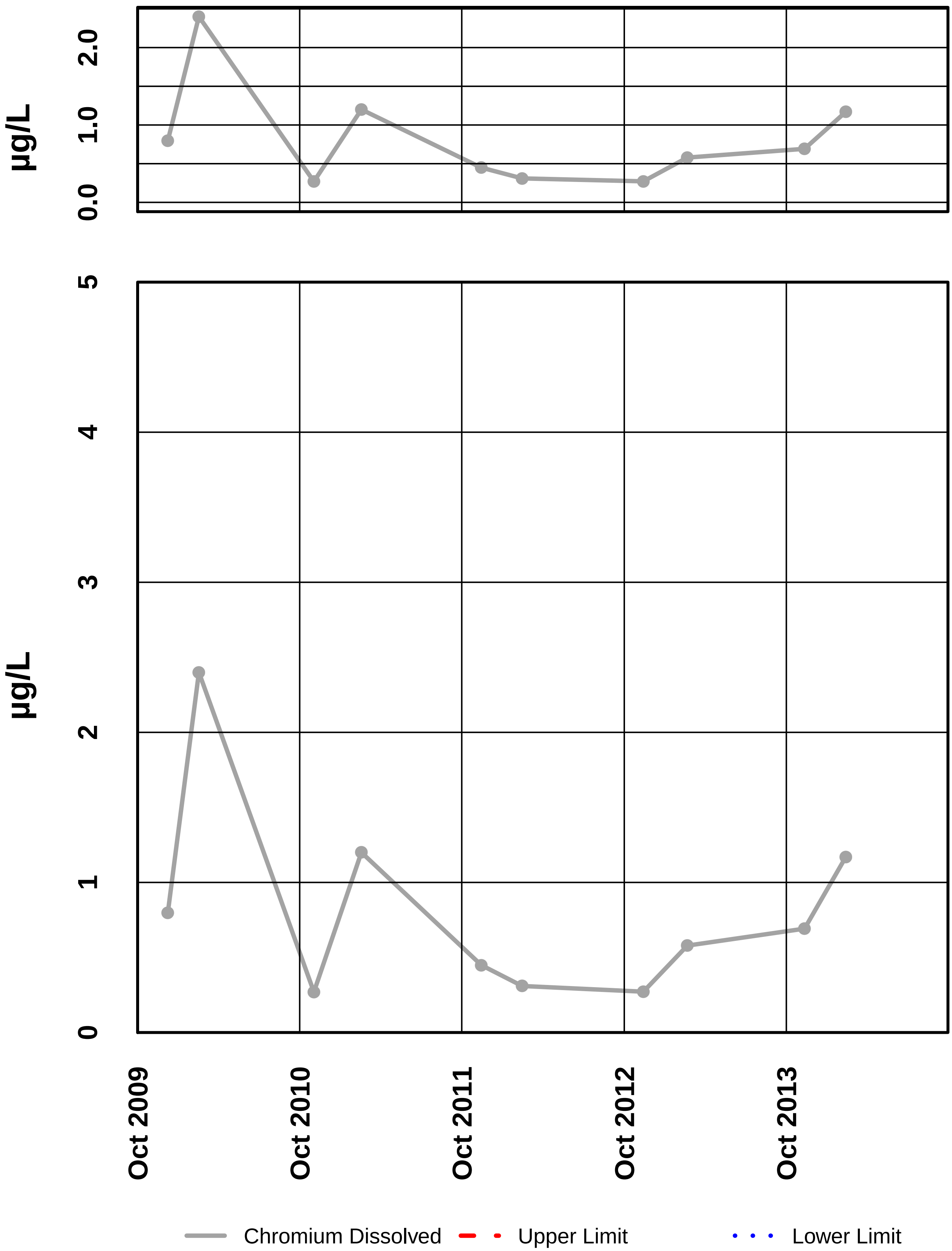

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# Site 49 – Cadmium Dissolved



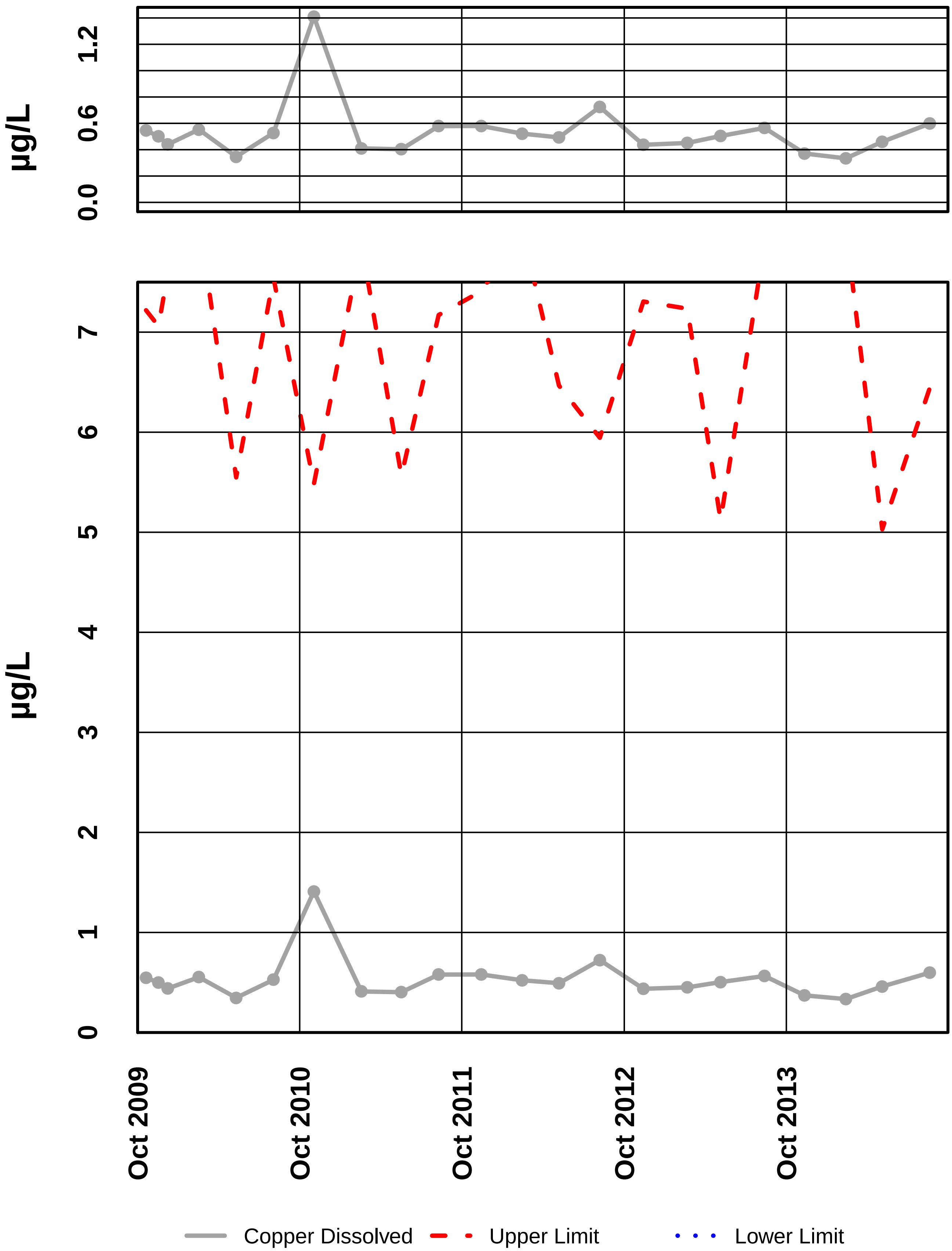

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# Site 49 – Chromium Dissolved

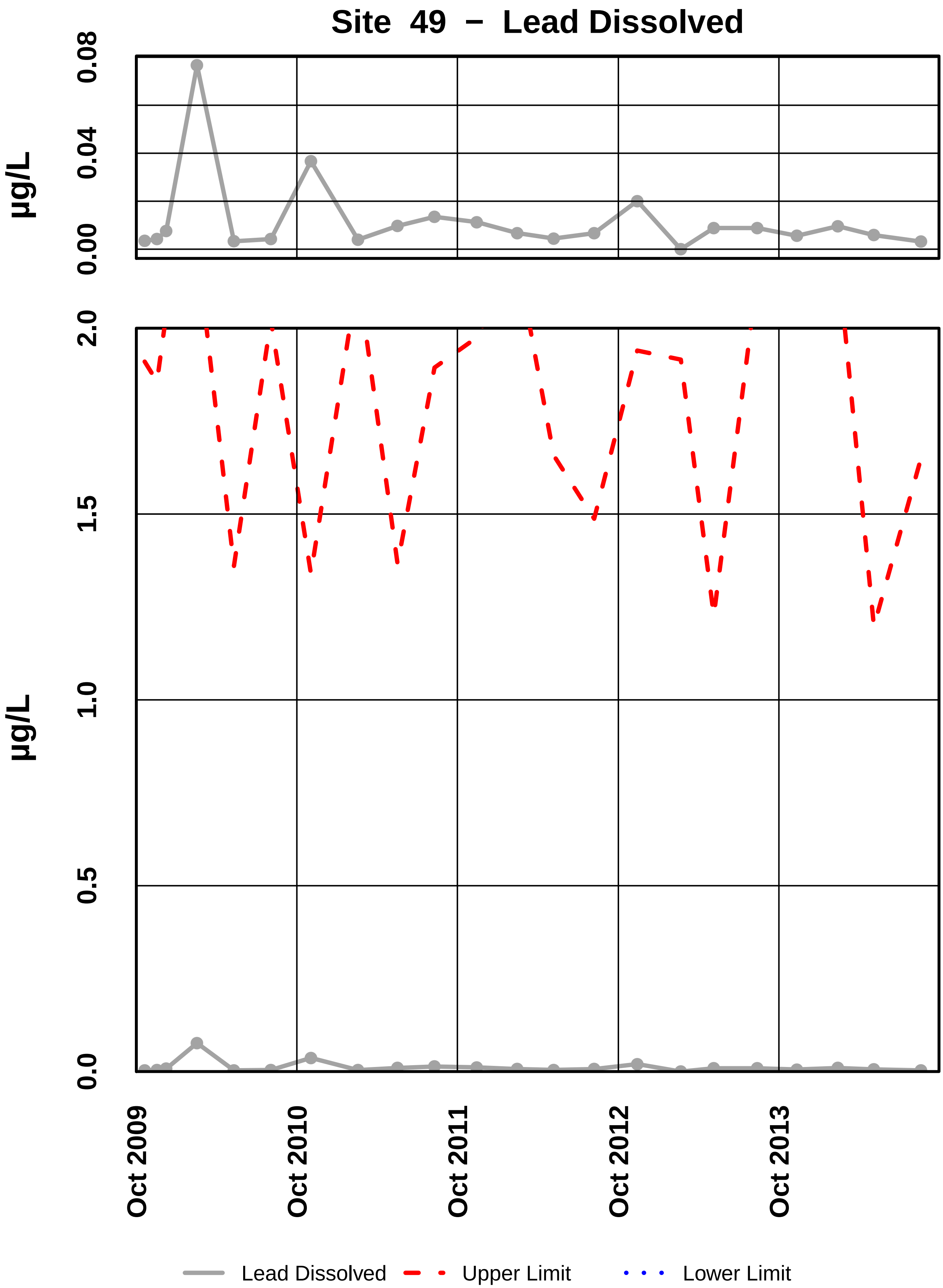



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

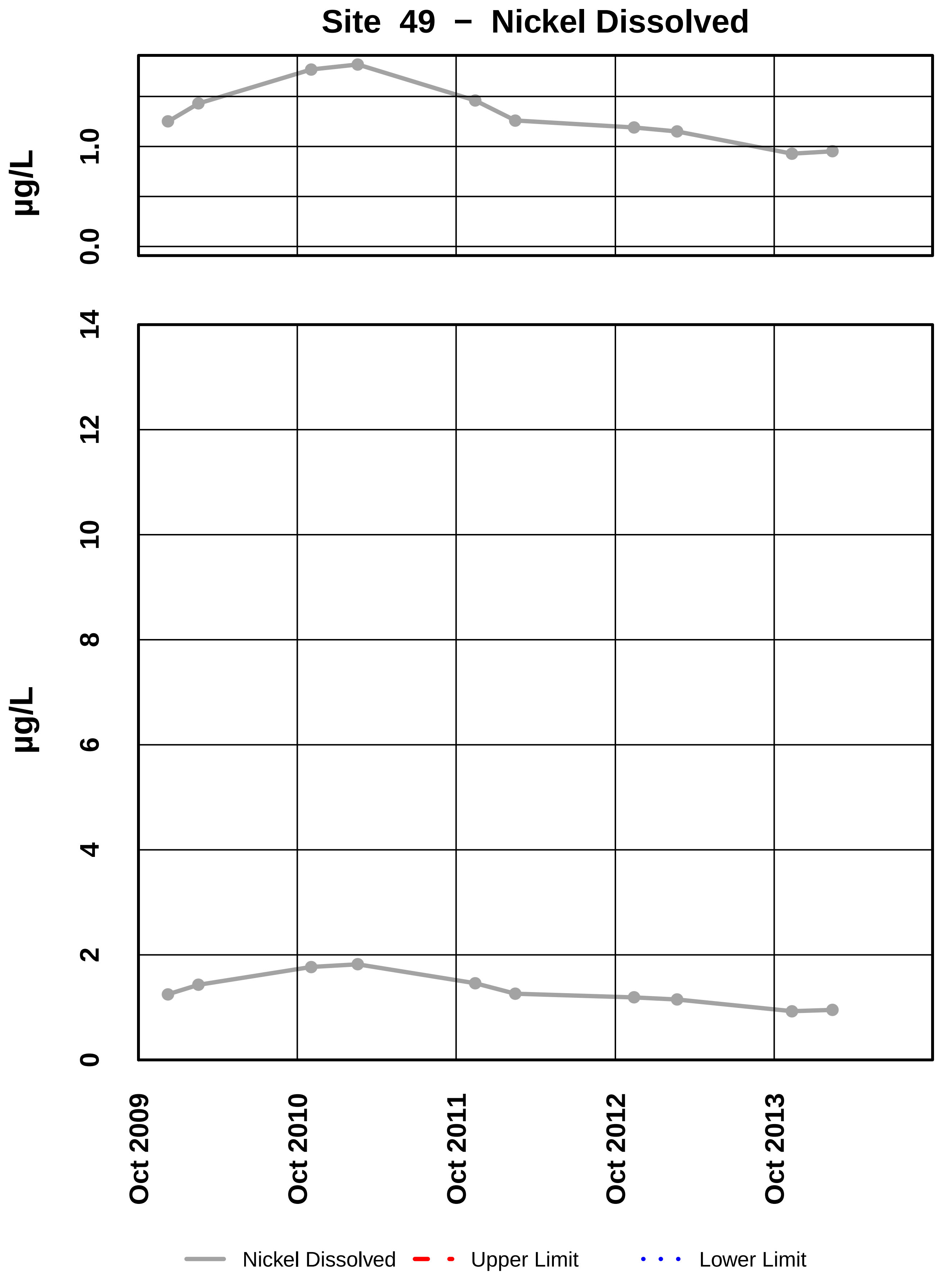
## Site 49 – Copper Dissolved



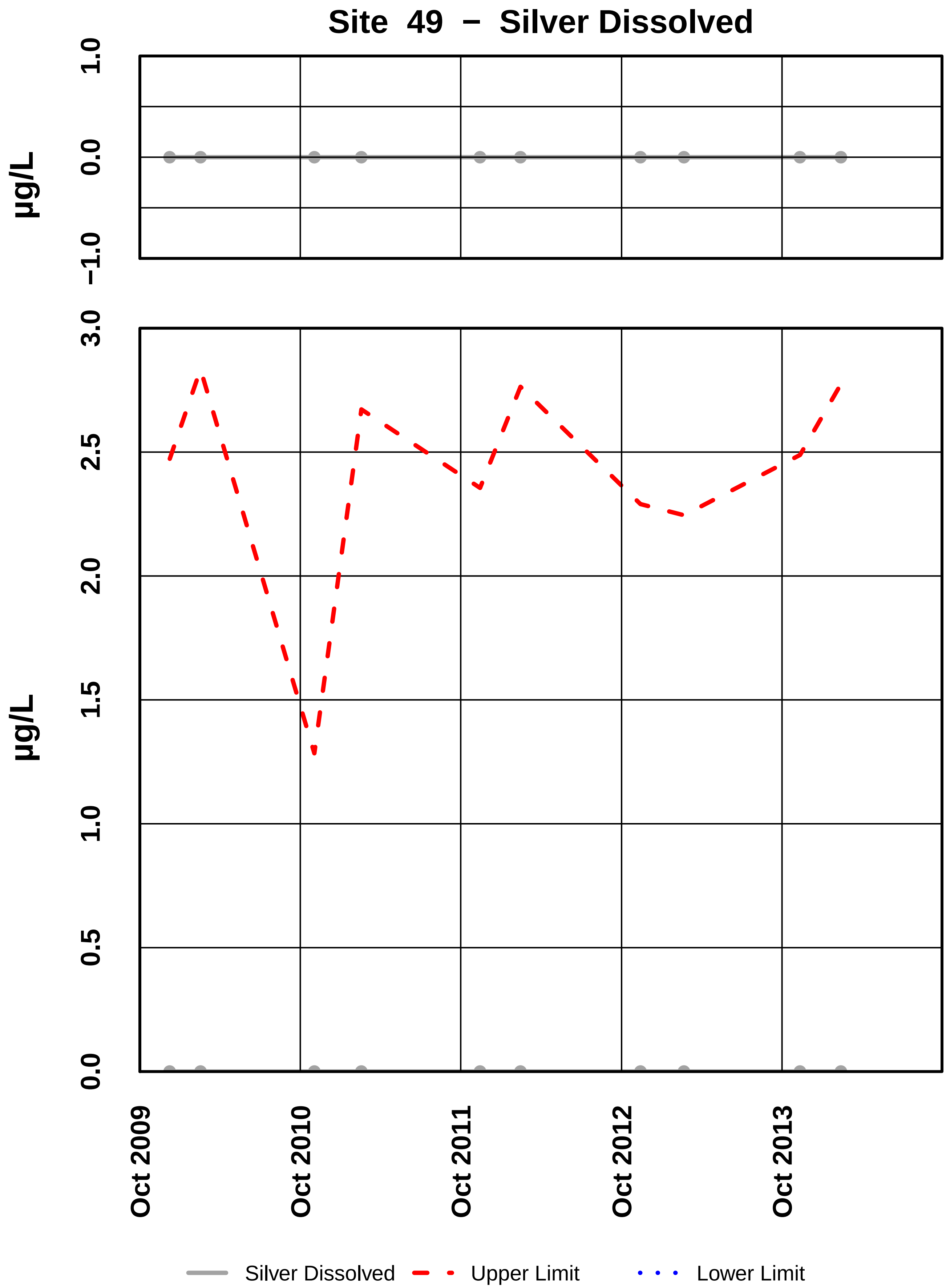

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



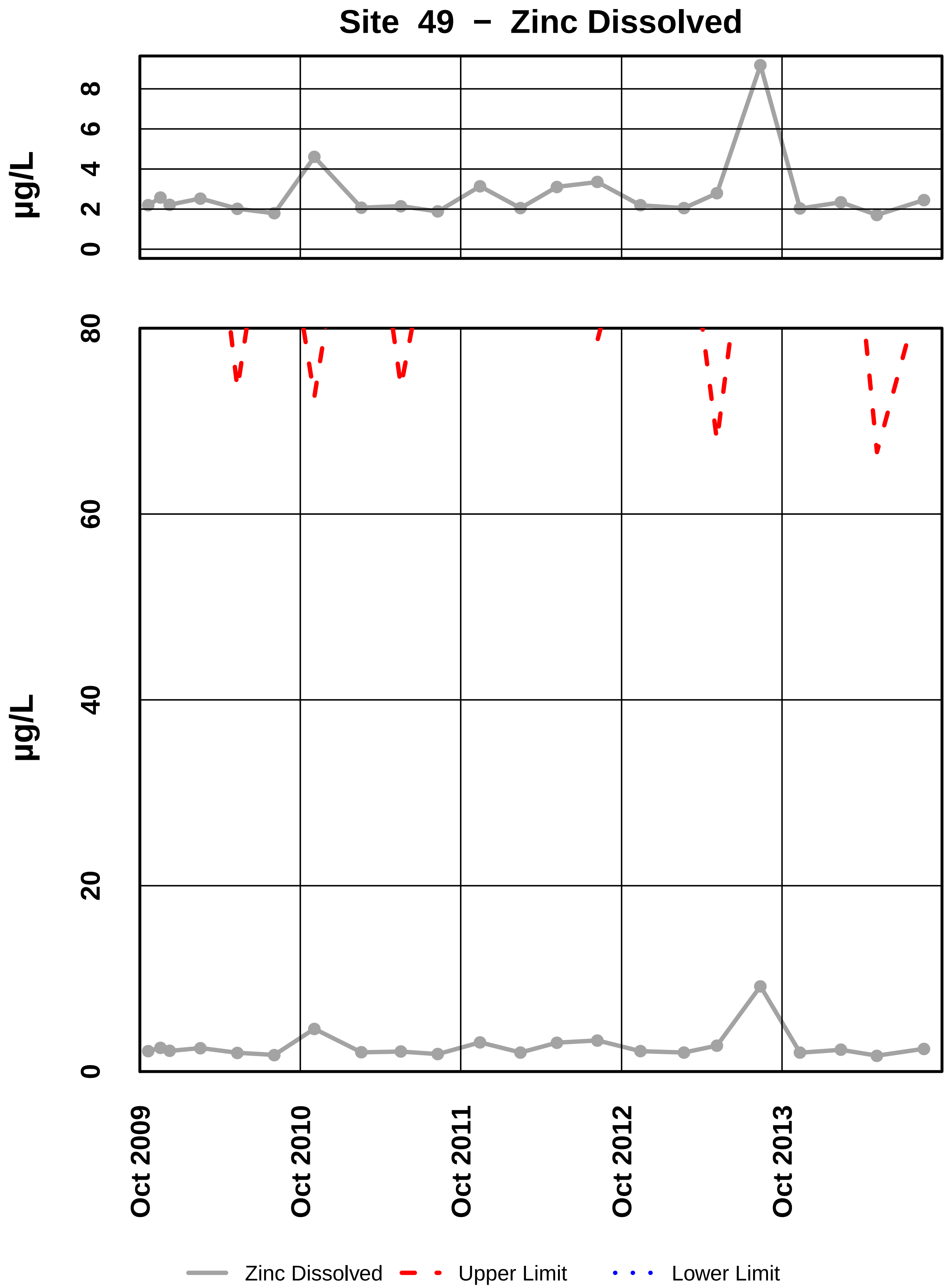

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

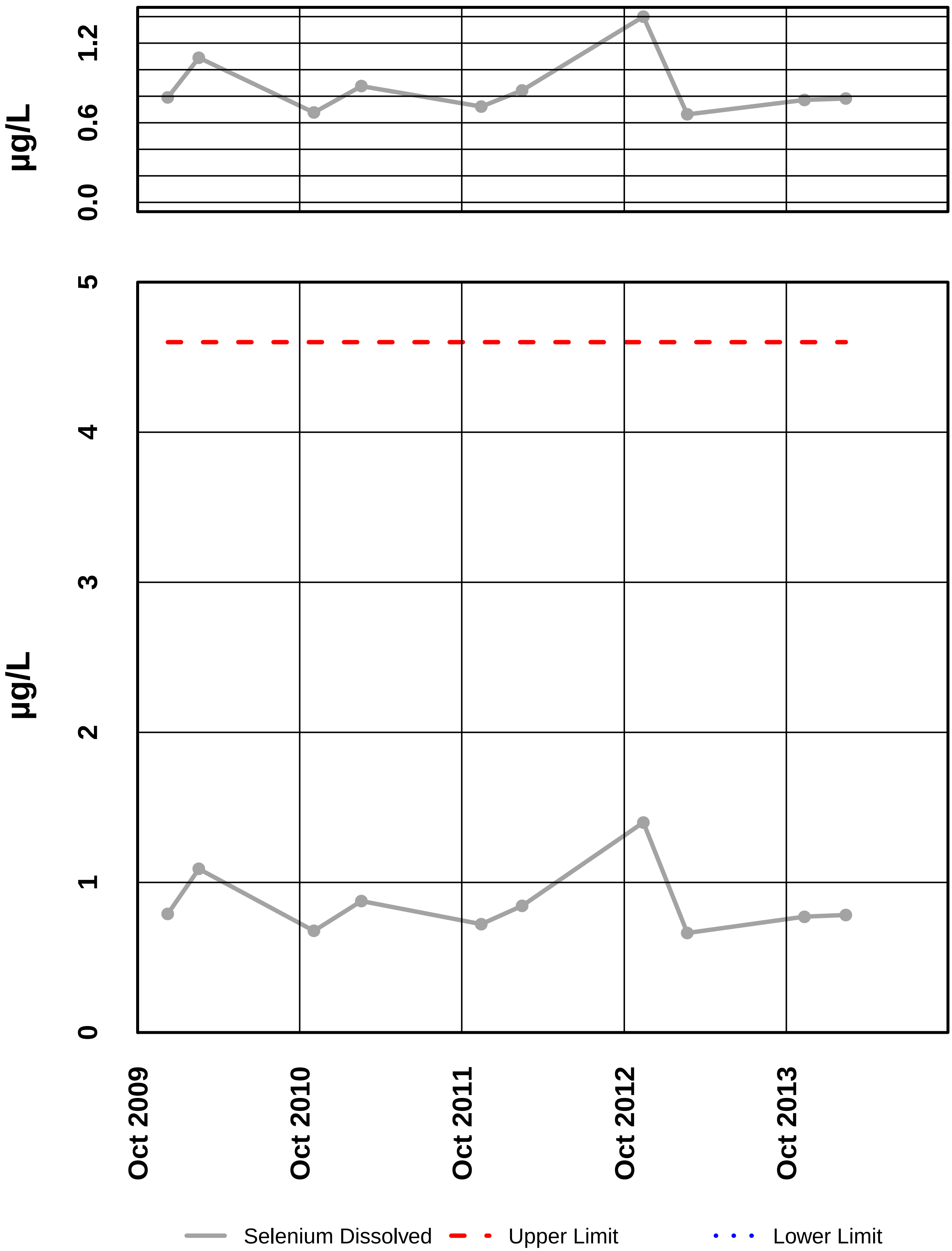



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



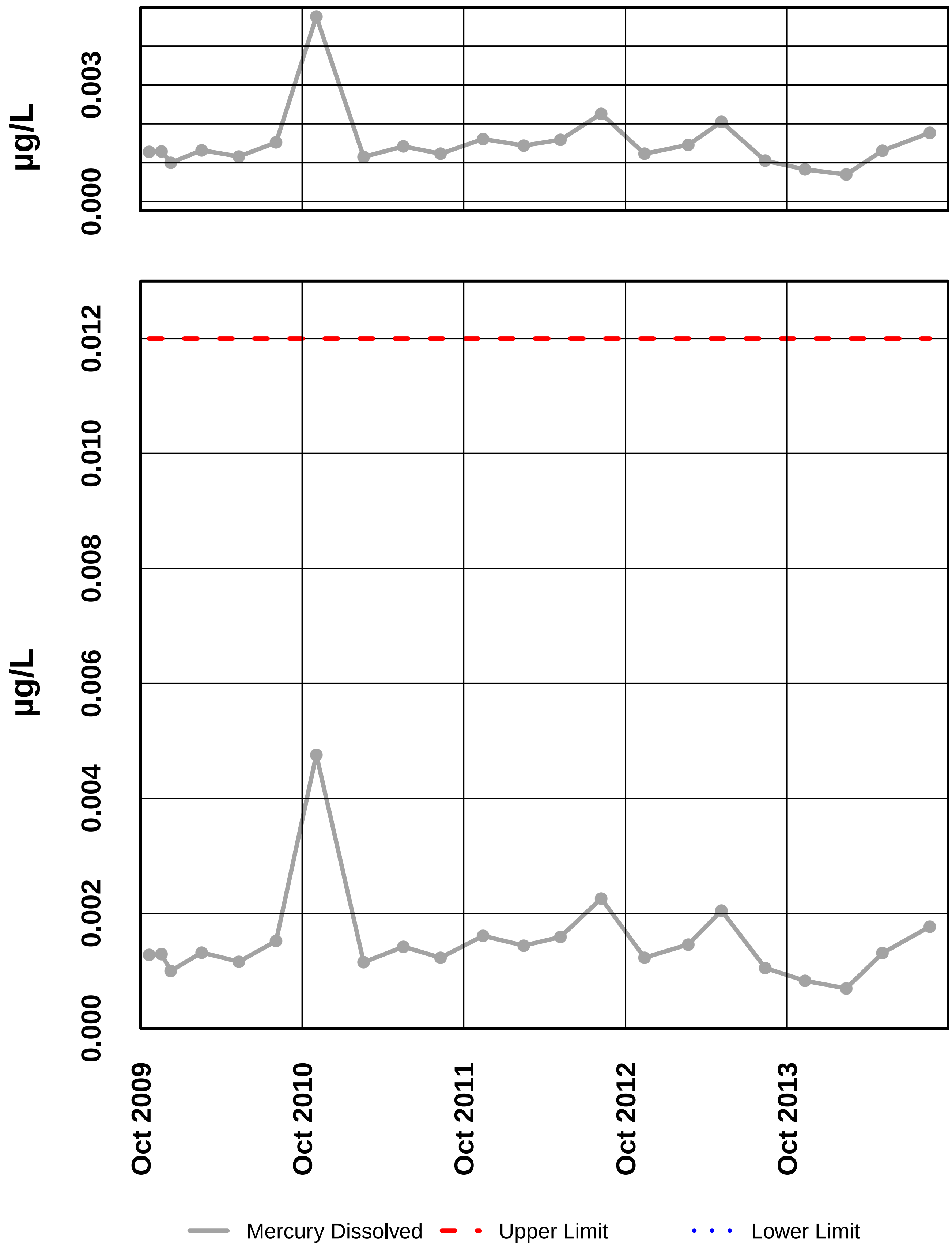

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# Site 49 – Selenium Dissolved




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

## Site 49 – Mercury Dissolved




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# INTERPRETIVE REPORT
# SITE 46

The data collected during the current water year are listed in the following “Table of Results for Water Year 2014” report. The table includes all the required FWMP analyte data (field and laboratory) collected for the current water year and a series of flags keyed to the summary report “Qualified Data by QA Reviewer”. The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of ½ MDL for the purpose of median calculation.

All data collected at this site for the past six years are included in the data analyses. As shown in the table below, there were no data outliers.

| Sample Date | Parameter | Value | Qualifier | Notes |
|---|---|---|---|---|
| No outliers have been identified by HGCMC for the period of October 2008 through September 2014. | | | | |

The data for Water Year 2014 have been compared to the strictest fresh water quality criterion for each applicable analyte. No results exceeding these criteria have been identified as listed in the table below.

**Table of Exceedance for Water Year 2014**

| | | | Limits | | |
|---|---|---|---|---|---|
| Sample Date | Parameter | Value | Lower | Upper | Hardness |
| No exceedances have been identified by HGCMC for the period of October 2013 through September 2014. | | | | | |

X-Y plots have been generated to graphically present the data for each of the analytes requested in the Statistical Information Goals for this site. These plots have been visually analyzed for the appearance of any trend in concentration. No visually obvious trends are apparent.

A non-parametric statistical analysis for trend was performed for field conductivity, field pH, total alkalinity, total sulfate, and dissolved zinc. Calculation details of the Seasonal Kendall analyses are presented on the pages following this interpretive section. The following table summarizes the results on the data collected between Oct-08 and Sep-14(WY2009-WY2014). Datasets with a statistically significant trend ($\alpha/2=2.5\%$) a Seasonal-Sen’s Slope estimate statistic has also been calculated. There was one statistically significant trend detected for pH, during the current water year, which was similar in magnitude and direction as the trend noted for the upgradient background site.

**Table of Summary Statistics for Trend Analysis**

| | Mann-Kendall test statistics | | | Sen's slope estimate | |
|---|---|---|---|---|---|
| **Parameter** | **n*** | **p**** | **Trend** | **Q** | **Q(%)** |
| Conductivity Field | 6 | 0.12 | | | |
| pH Field | 6 | <0.01 | + | 0.07 | 0.9 |
| Alkalinity, Total | 6 | 0.22 | | | |
| Sulfate, Total | 6 | 0.38 | | | |
| Zinc, Dissolved | 6 | 0.22 | | | |

* Number of Years ** Significance level

In previous years a comparison of median values for alkalinity, laboratory pH, field conductivity, sulfate, and dissolved zinc between Site 49 and Site 46 has been conducted. With the change in the sampling frequency at Site 46 and Site 49 the resulting small sample size (N=4) eliminates the possibility of using the Wilcoxon Signed Ranks (WSR) test as a methodology for comparing median values. This is the same reason this technique (WSR) has not been used with the wells at the tailings facility.

Analytical results from Site 46 were analyzed using combined Shewhart-CUSUM charts. The Shewhart-CUSUM is a sequential analysis technique to determine changes in a variable. The methodology involves the calculation of a standardized difference $z_i$ for each measurement at time $t_i$ as $x_i$:

$$Z_i = (x_i - x) / s$$

At each time $t_i$, the cumulative sum is computed as:

$$S_0 = 0$$
$$S_i = \max[0,(z_i - d) + (S_i - 1)]$$

Setting $S_0 = 0$ ensures that only cumulative changes from background are monitored. When the value of $S$ exceeds a certain threshold value, a change in value has been found. The above formula only detects changes in the positive direction. Plot the values $S_i$ (y-axis) versus $t_i$ (x-axis) on time plot for visual purposes. A process (analyte) is considered 'out of control' when the cumulative increase in the parameter over background $S_i >= h$ (e.g. h=5) or a standardized increase $z_i >= SCL$ (e.g. SCL = 4.5 standard deviations units over background).

For this year's FWMP report the combined Shewhart-CUSUM control chart statistical analysis was carried out on the specific conductance, dissolved zinc, and total sulfate data from Site 46. In order to use the analysis background values were calculated for each of the analytes. Without a true background record the first year of sampling was chosen for this calculation. Results of these calculations are summarized in the Table 1.

The visual representations of these calculations are graphed in Figure 1. All three of the analytes reached the lowest control limit (SCL=2) and only total sulfate reached the control limit of

SCL=4.  Each of the sites were below the EPA recommend control limit of SCL=4.5. Values for the CUSUM statistic ranged from a low of 0, observed in each analysis to a high of 3.4 recorded for dissolved zinc. None of the analyses exceed the established limit of h=5. In order for a process to be considered ‘out of control’ both metrics (Shewhart & CUSUM) need to be ‘out of control’. With these analyses the only analyte that neared both these limits was total sulfate.

Once a background value is established the proceeding years that are not ‘out of control’, can be used to recalculate the background values. It is suggested that these calculations be carried out every two years. In order to prevent the incorporation of a gradual trend into the background data, it is important to test for background trends on a routine basis.  Currently, HGCMC is using the Mann-Kendall test for seasonal trends for trend analysis. Of the three analytes used, for the combined Shewhart-CUSUM control charts, none of them had a significant seasonal trend. Therefore, it should be possible to incorporate more of the measurements into the calculation of the baseline statistics.

To use these charts an average value and standard deviation first needs to be calculated for the each analyte of interest. These could be calculated from the historical process data or the background data collected prior to disturbance. Tables 1 and 2 summarize the baseline statistics for Site 46, differing in the number of samples (N) used in the calculation. From previous FWMP reports it is known that Site 46 is similar in chemistry as the background Site 49. Furthermore, it then can be inferred that changes in chemistry at Site 46 are a result of natural variation and not from HGCMC activities in the area. Therefore Site 46 is an ideal dataset for testing the effects of incorporating a larger set of values into the baseline statistics.

When comparing the baseline statistics for the two sample periods it is noted that the mean values are similar and the standard deviation increased for two of the three analytes. The increase in the standard deviation shows that with an increase in the number of samples the range also increased (greater variability). Also, the corollary decrease in standard deviation would mean a decreased range (less variability).   The similarity in the mean values with a change in the standard deviation signifies that the additional values were equally distributed about the previous calculated mean. A longer baseline period would incorporate greater natural variation. Regardless of the length of the baseline period each analyte that goes out of control needs to be evaluated on an individual basis.  Figures 1is the combined Shewhart-CUSUM charts for field conductivity, dissolved zinc, and total sulfate; using the baseline statistics from Tables 1.

**Table 1.** **Specific Conductance, Dissolved Zinc, and Total Sulfate Baseline Periods, Summary Statistics and Various Control Limits**

| | Site 46 Conductivity (µS/cm) | Site 46 Diss. Zinc (µg/L) | Site 46 Total Sulfate (mg/L) |
|---|---|---|---|
| **Baseline Statistics** | | | |
| Baseline Period | 01/12/00-11/15/01 | 01/12/00-11/15/01 | 11/12/02-10/09/03 |
| Number of Samples | 19 | 19 | 9 |
| Mean (x) | 136.4 | 1.9 | 9.39 |
| Standard Deviation | 24.5 | 0.8 | 2.20 |
| **Shewhart-CUSUM Control Limits (SCL)** | | | |
| Control Limit (mean x+ 2s) | 185.3 | 3.5 | 13.8 |
| Control Limit (mean x + 3s) | 209.8 | 4.3 | 16.0 |
| Control Limit (mean x + 4s) | 234.3 | 5.2 | 18.2 |
| Control Limit (mean x + 4.5s) | 246.5 | 5.6 | 19.3 |
| **CUSUM Control Limits** | | | |
| Cumulative increase – h | 5 | 5 | 5 |

**Table 1.** **Specific Conductance, Dissolved Zinc, and Total Sulfate Baseline Periods, Summary Statistics and Various Control Limits**

| | Site 46 Conductivity (µS/cm) | Site 46 Diss. Zinc (µg/L) | Site 46 Total Sulfate (mg/L) |
|---|---|---|---|
| **Baseline Statistics** | | | |
| Baseline Period | 12/1/00–12/14/05 | 12/1/00–12/14/05 | 11/12/02–12/14/05 |
| Number of Samples | 58 | 58 | 33 |
| Mean (x) | 135.5 | 2.3 | 10.0 |
| Standard Deviation | 22.9 | 1.6 | 2.86 |
| **Shewhart-CUSUM Control Limits (SCL)** | | | |
| Control Limit (mean x+ 2s) | 181.4 | 5.6 | 15.7 |
| Control Limit (mean x + 3s) | 204.4 | 7.3 | 18.6 |
| Control Limit (mean x + 4s) | 227.3 | 8.9 | 21.5 |
| Control Limit (mean x + 4.5s) | 238.8 | 9.7 | 22.9 |
| **CUSUM Control Limits** | | | |
| Cumulative increase – h | 5 | 5 | 5 |

From figure 1 it can be seen that specific conductance remained in control while dissolved zinc and total sulfate went of control multiple times and one time respectively. A value is out of control when it exceeds the CUSUM control limit (h) value of five. Also, based on the Shewhart-CUSUM control limit (SCL) for total sulfate the process was out of control twice when the total sulfate concentration exceeded 19.3 µg/L. It is important to remember that the corresponding up-gradient background site Site 49 exhibited the same variation in concentration, which is natural variation. If the CUSUM technique was being used during water year 2003 it would have been concluded that the dissolved zinc was going out of control and an evaluation of each out of control data point would have been undertaken. This evaluation would have involved an analysis of the background sites to establish whether this was occurring naturally. Furthermore, a larger suite of analytes would be analyzed to determine if the shift is in a single analyte or multiple analytes and whether the shift in analytes matches known signatures from the various mineralogies that HGCMC encounters.

It is recommended that every couple years a revaluation of the baseline statistics is made. This will allow for the incorporation of data points that appeared out of control, but were a greater part of the variability. Figure 2 are the control charts after the data was recalculated using a greater baseline period. Notice that during the 2003 water year that dissolved zinc remained in control when the longer baseline dataset was used. With these charts it is noted that none of the analytes went out of control during the monitoring period. This supports the conclusion drawn in the previous FWMP reports that HGCMC activities in the Site23 / D Pile area are not having a measurable effect on Bruin Creek.

**Figure 1.** **Observed Measurements for Specific Conductance, Dissolved Zinc, and Total Sulfate from Site 46 Compared to the Shewhart-CUSUM Control Limits From Table 1**

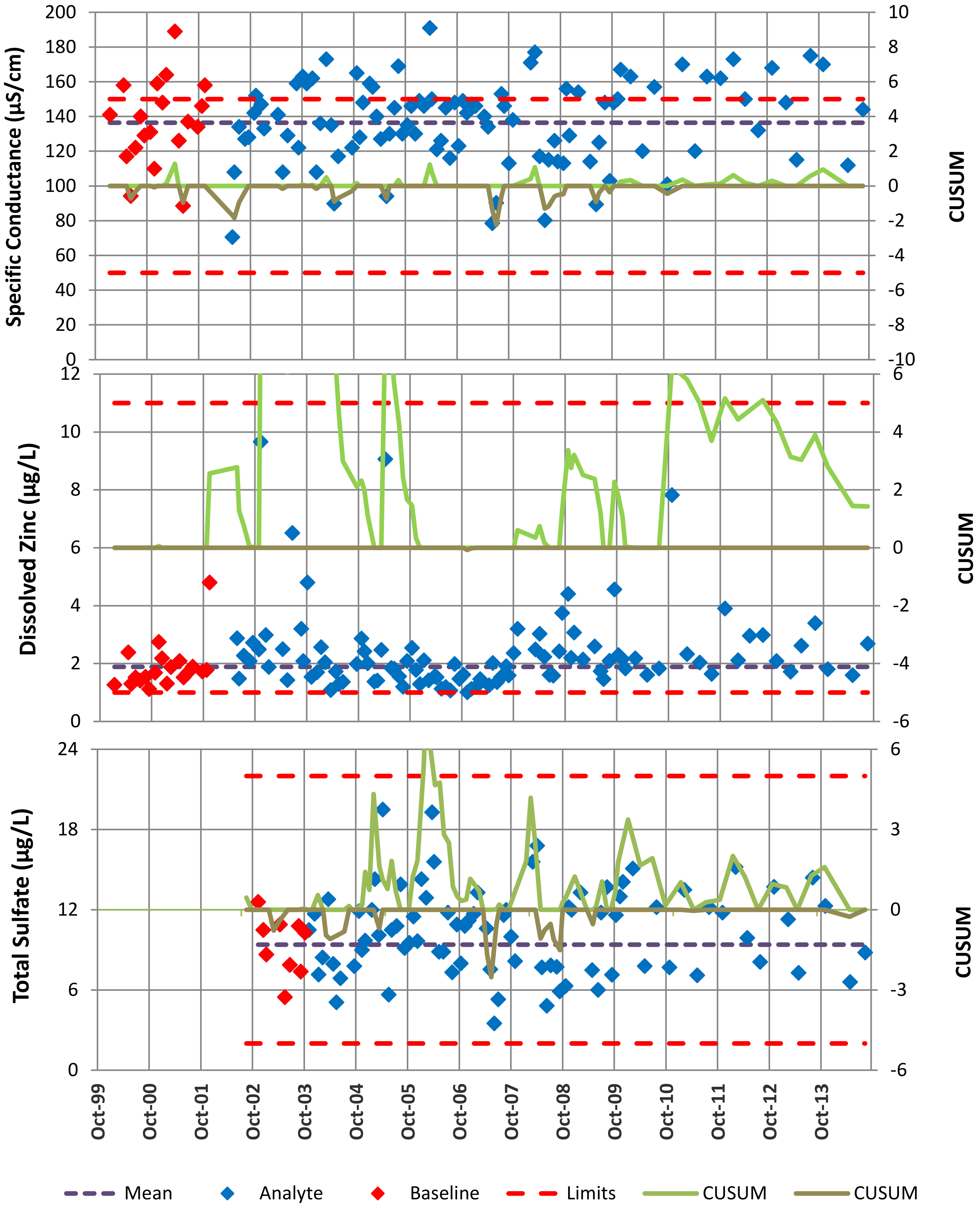
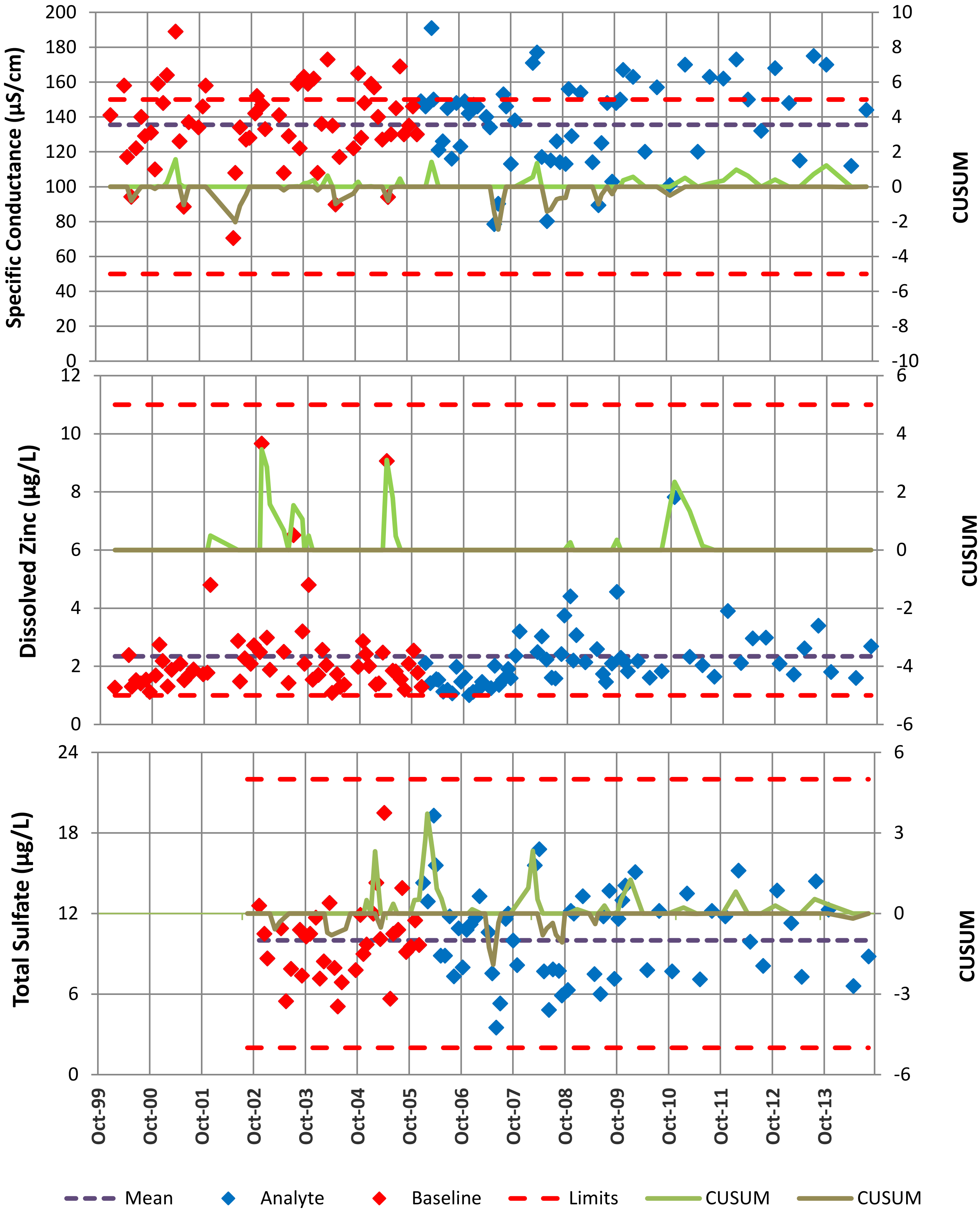


**Figure 2.** **Observed Measurements for Specific Conductance, Dissolved Zinc, and Total Sulfate from Site 46 Compared to the Shewhart-CUSUM Control Limits From Table 2**



## Table of Results for Water Year 2014

### Site 046FMS - 'Lower Bruin Creek'

| Sample Date/Parameter | Oct 2013 | Nov 2013 | Dec 2013 | Jan 2014 | Feb 2014 | Mar 2014 | Apr 2014 | May 2014 | Jun 2014 | Jul 2014 | Aug 2014 | Sep 2014 | **Median** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Water Temp (°C) | | 1.1 | | | | | | 3.8 | | | 9.3 | | 3.8 |
| Conductivity-Field(µmho) | | 170 | | | | | | 112 | | | 144 | | 144.0 |
| Conductivity-Lab (µmho) | | 139 | | | | | | 111 | | | 139 | | 139 |
| pH Lab (standard units) | | 7.86 | | | | | | 7.28 | | | 7.74 | | 7.74 |
| pH Field (standard units) | | 8.05 | | | | | | 7.89 | | | 8.06 | | 8.05 |
| Total Alkalinity (mg/L) | | 67.9 | | | | | | 44.4 | | | 58.4 | | 58.4 |
| Total Sulfate (mg/L) | | 12.3 | | | | | | 6.6 | | | 8.8 | | 8.8 |
| Hardness (mg/L) | | 81.9 | | | | | | 51.8 | | | 68.1 | | 68.1 |
| Dissolved As (ug/L) | | 0.269 | | | | | | 0.177 | | | 0.301 | | 0.269 |
| Dissolved Ba (ug/L) | | 11.2 | | | | | | | | | | | 11.2 |
| Dissolved Cd (ug/L) | | 0.0237 | | | | | | 0.0186 | | | 0.0304 | | 0.0237 |
| Dissolved Cr (ug/L) | | 0.471 | | | | | | | | | | | 0.471 |
| Dissolved Cu (ug/L) | | 0.405 | | | | | | 0.458 | | | 0.68 | | 0.458 |
| Dissolved Pb (ug/L) | | 0.0091 | | | | | | 0.0106 | | | 0.0127 | | 0.0106 |
| Dissolved Ni (ug/L) | | 0.849 | | | | | | | | | | | 0.849 |
| Dissolved Ag (ug/L) | | 0.002 | | | | | | | | | | | 0.002 |
| Dissolved Zn (ug/L) | | 1.81 | | | | | | 1.6 | | | 2.69 | | 1.81 |
| Dissolved Se (ug/L) | | 0.729 | | | | | | | | | | | 0.729 |
| Dissolved Hg (ug/L) | | 0.00102 | | | | | | 0.00132 | | | 0.00181 | | 0.001320 |

For individual sample/analyte qualifier descriptions see "Qualified Data by QA Reviewer" table.

Values reported as less than MDL are replaced by 1/2 MDL for median calculation purposes.

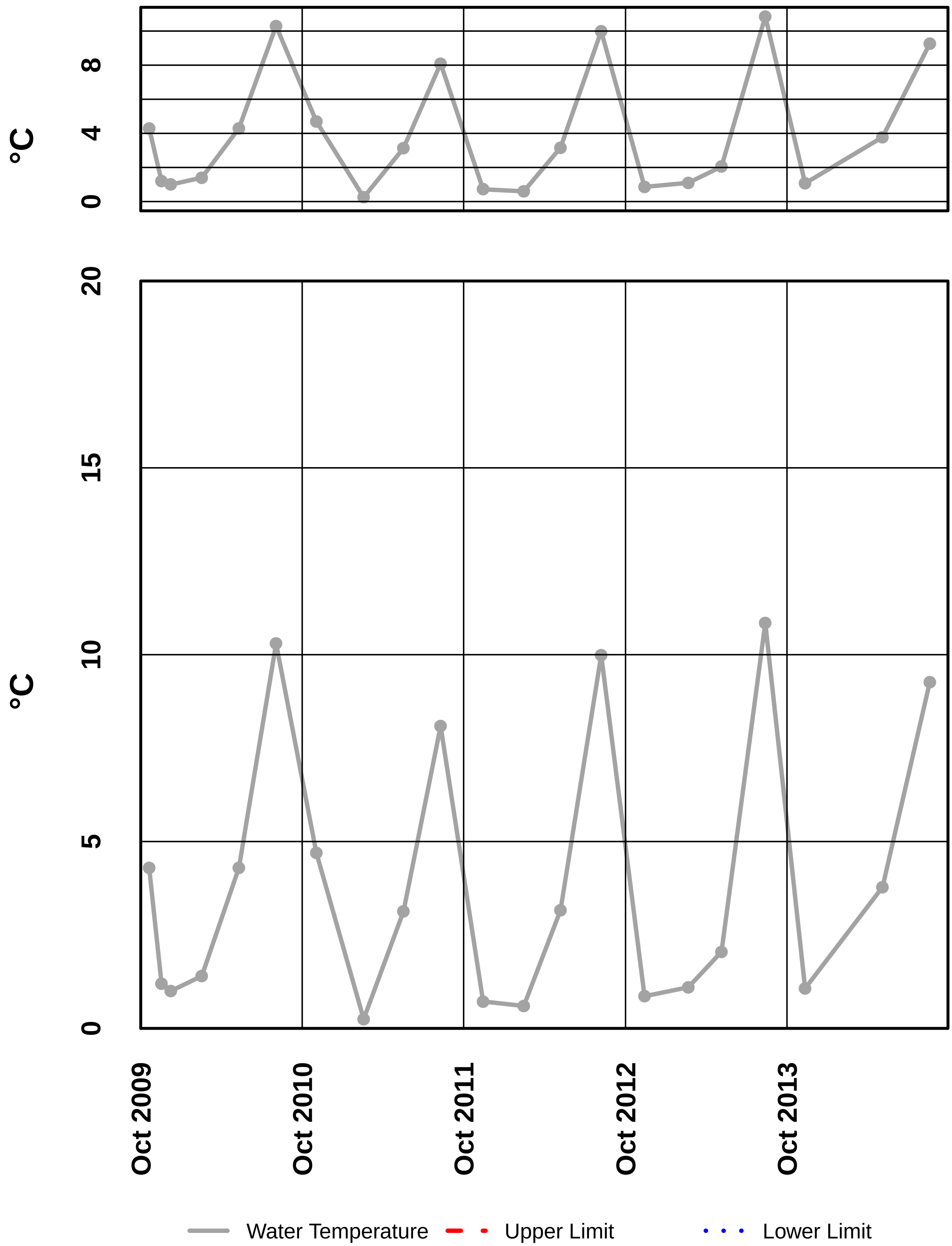
Shaded data has been qualified as an outlier by HGCMC and removed from any further analysis and is not included into the calculation of the median

# Qualified Data by QA Reviewer

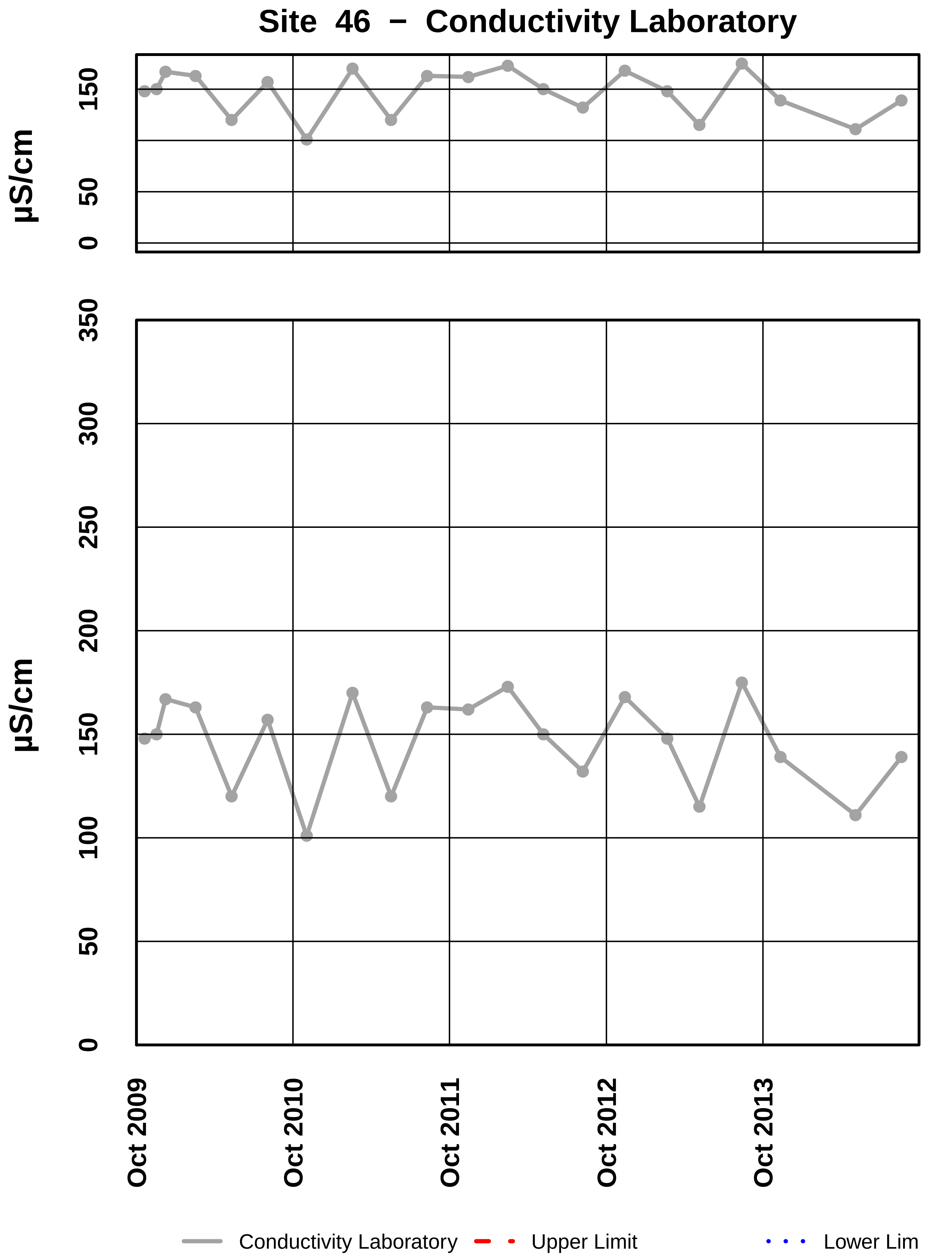
**Date Range: 10/01/2013  to 09/30/2014**

| Site No. | Sample Date | Sample Time | Parameter | Value | Qualifier | Reason for Qualifier |
|---|---|---|---|---|---|---|
| 046FMS | 11/11/2013 | 12:00 PM | pH | 7.86 | J | Hold Time Violation |

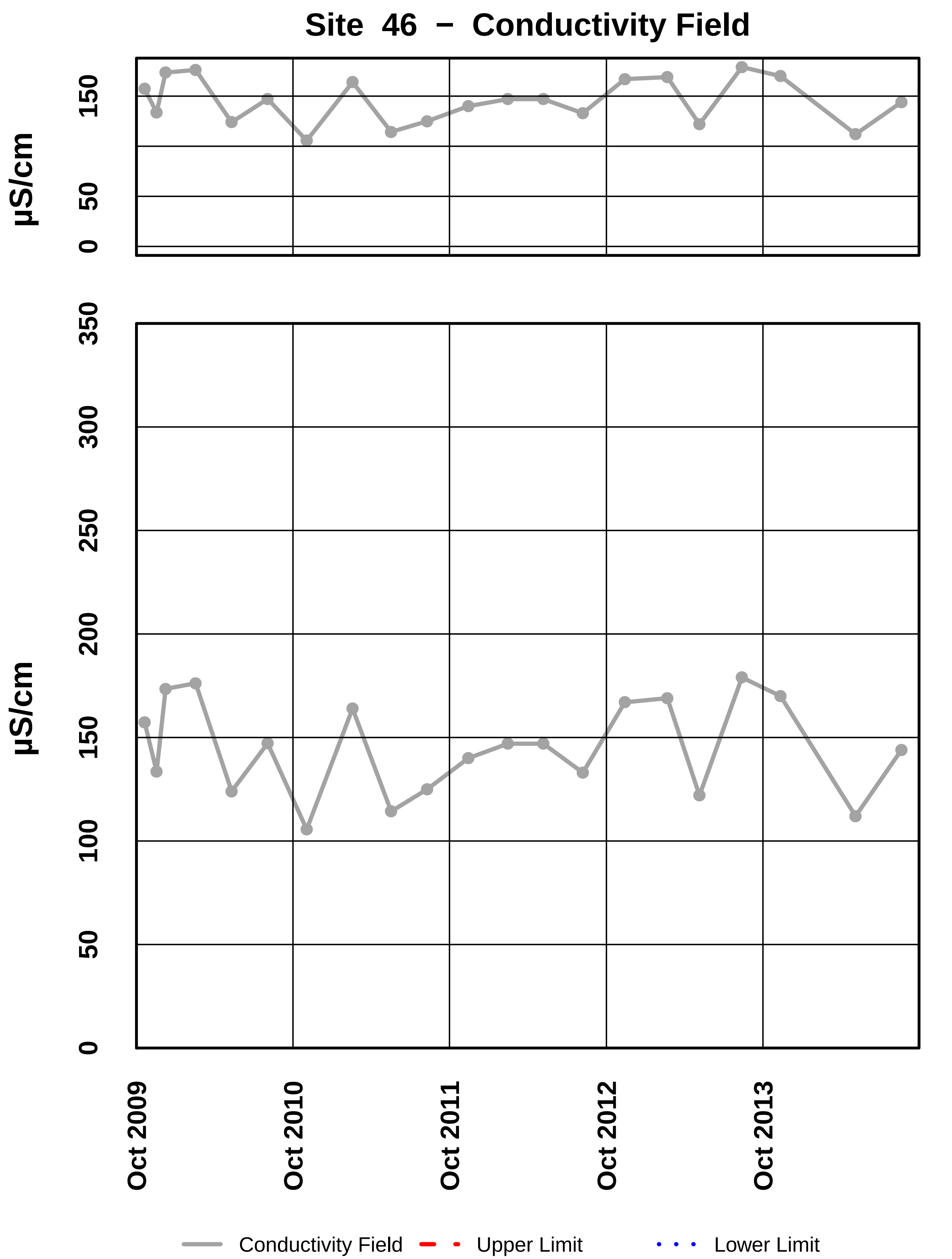
## Site 46 – Water Temperature




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

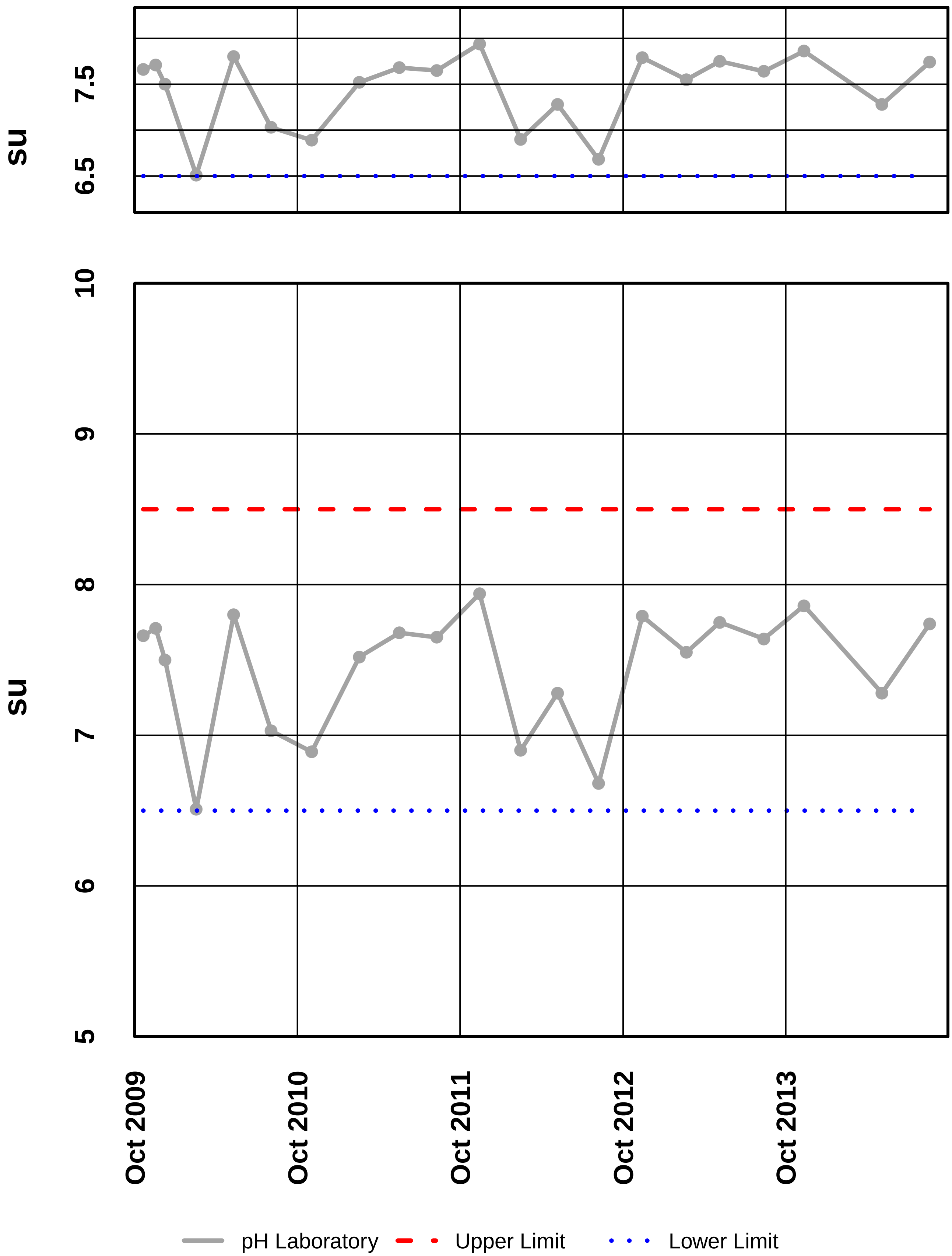



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

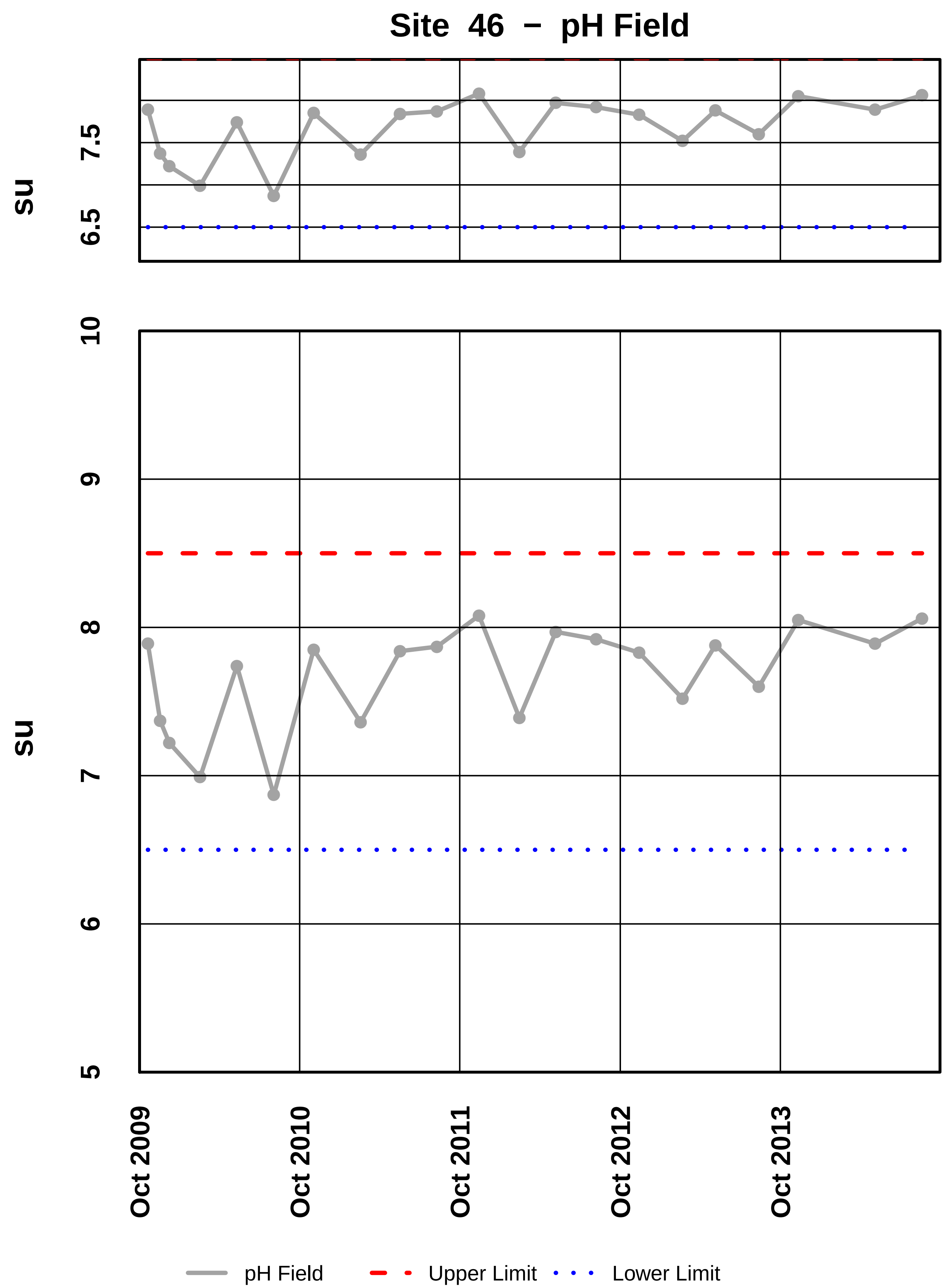



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

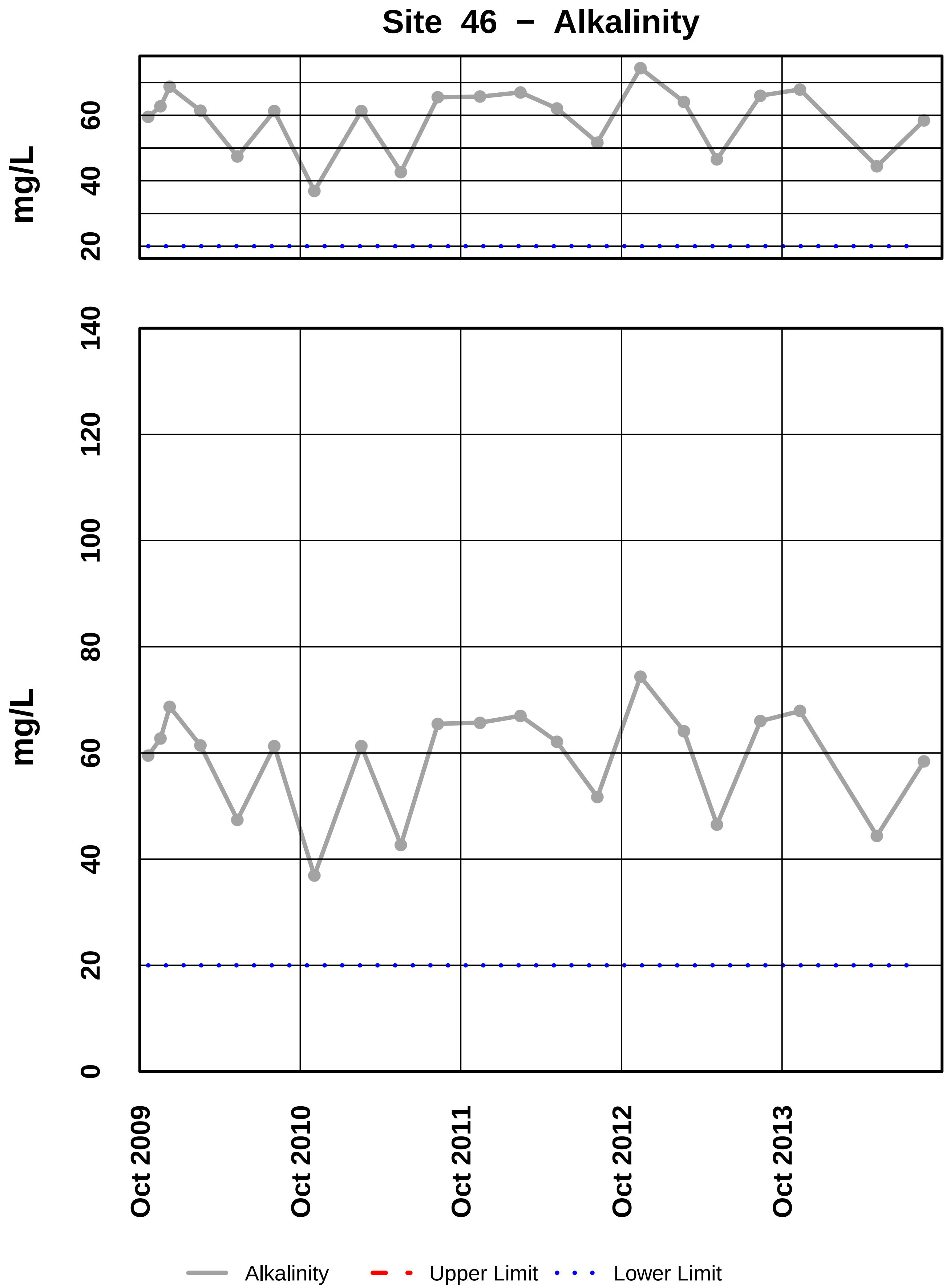
# Site 46 – pH Laboratory




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

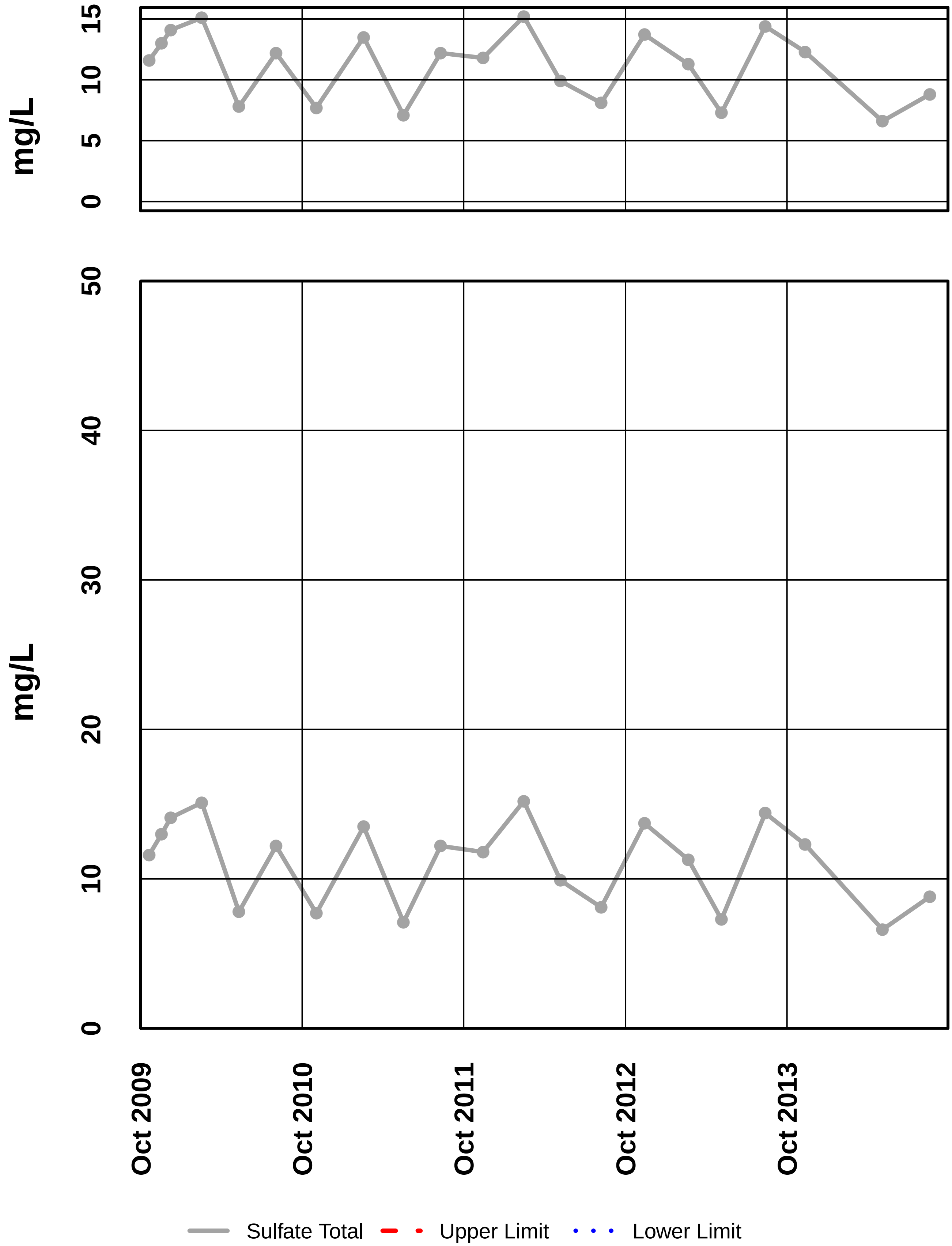



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

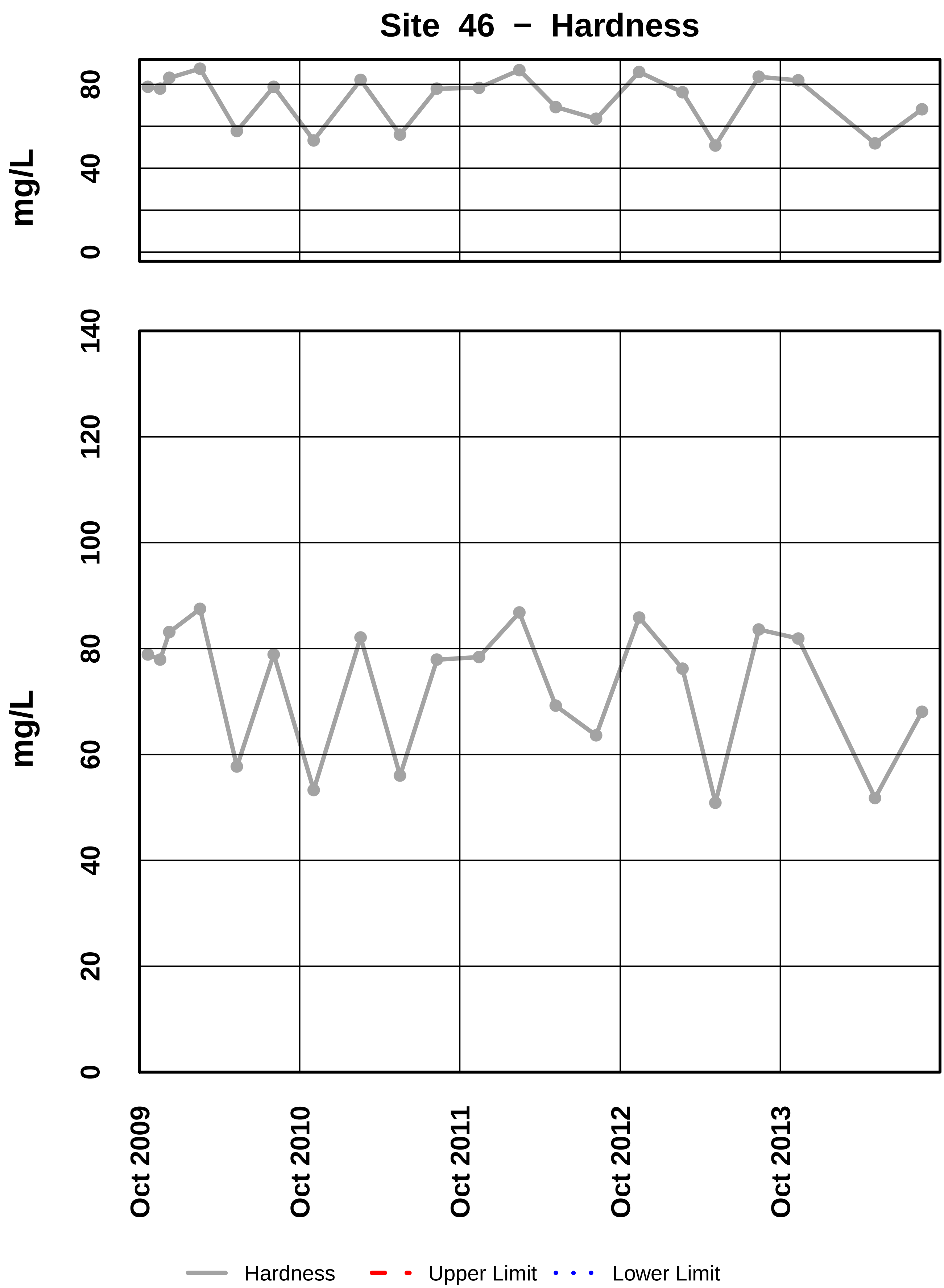



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# Site 46 − Sulfate Total

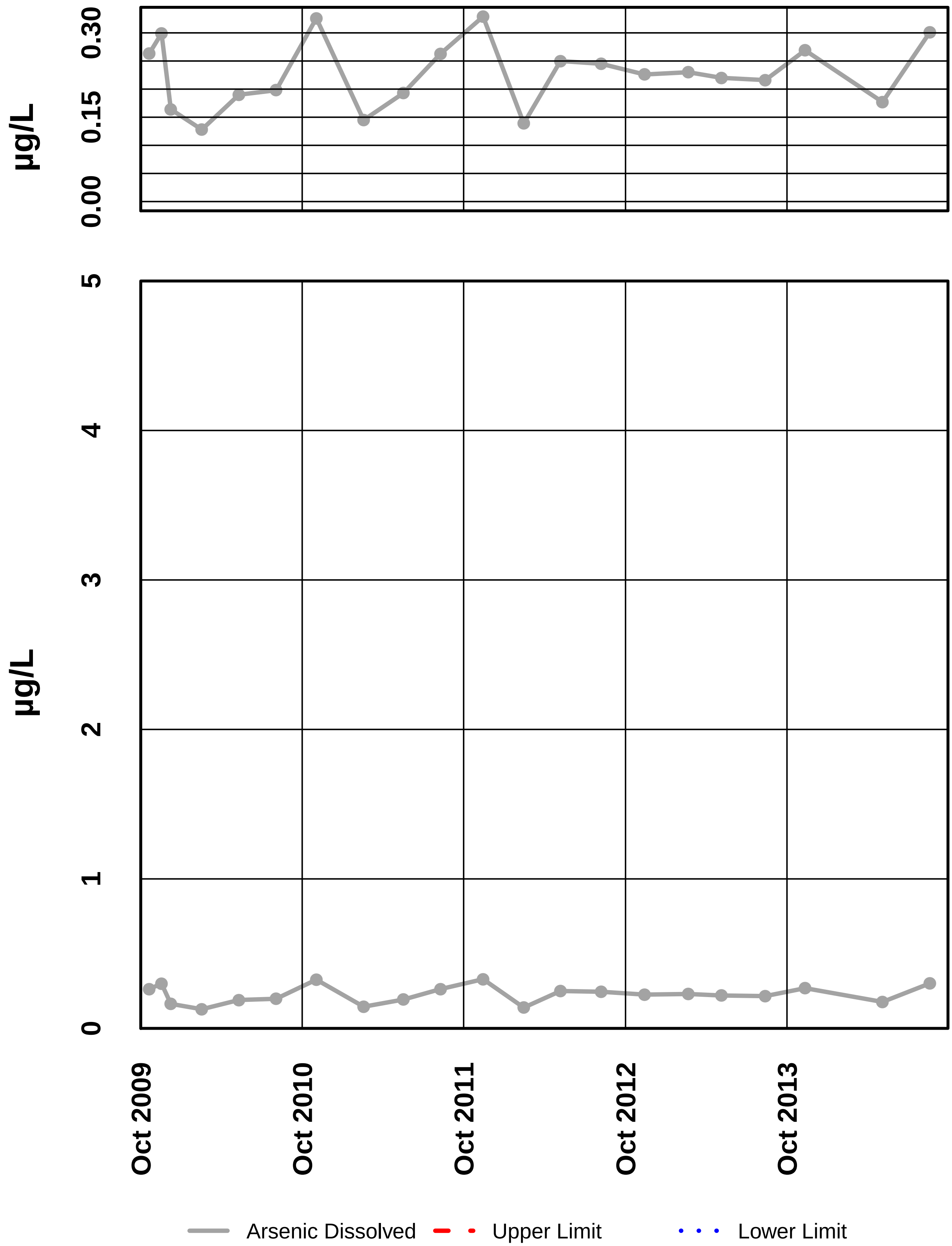



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

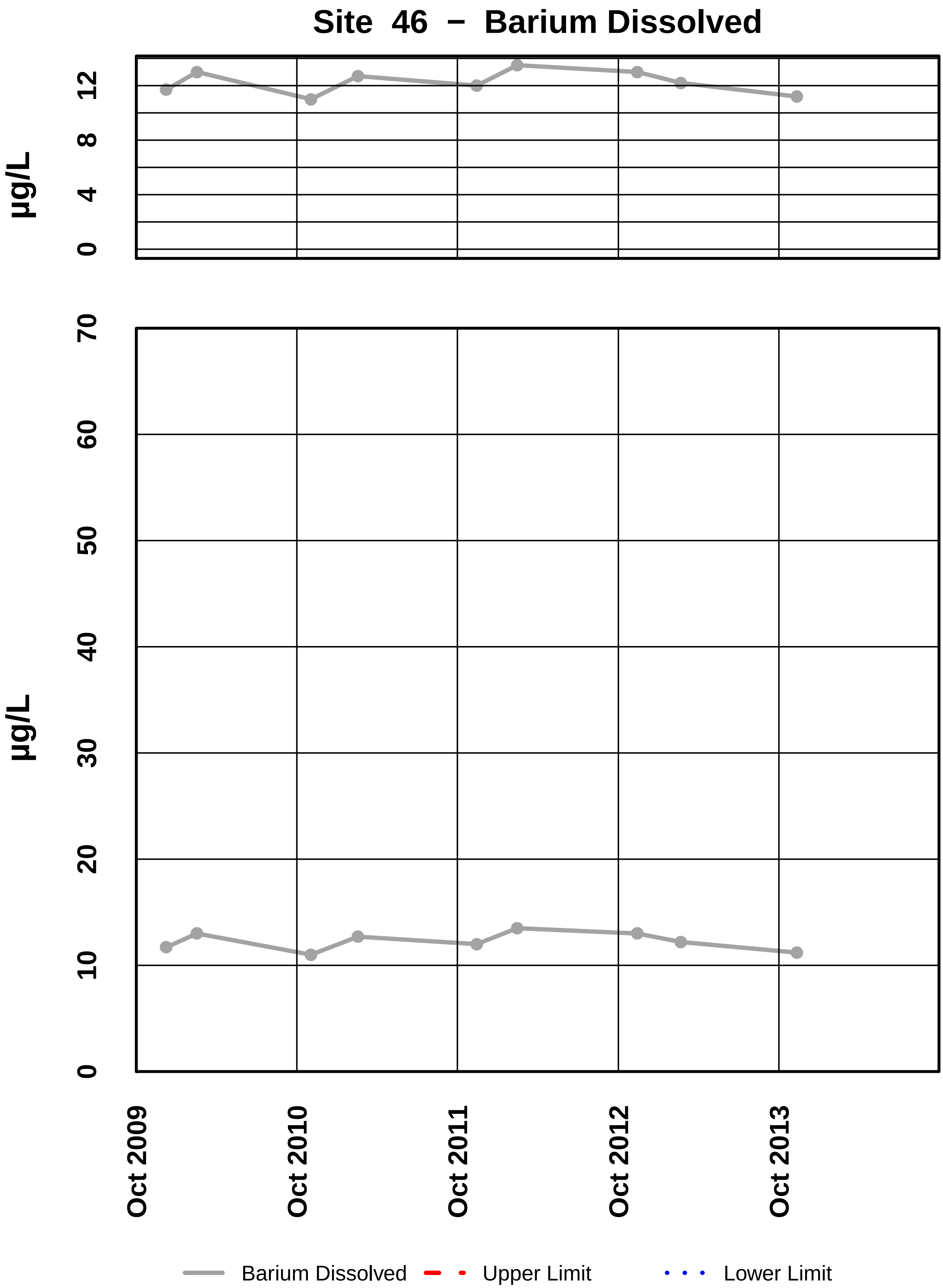



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

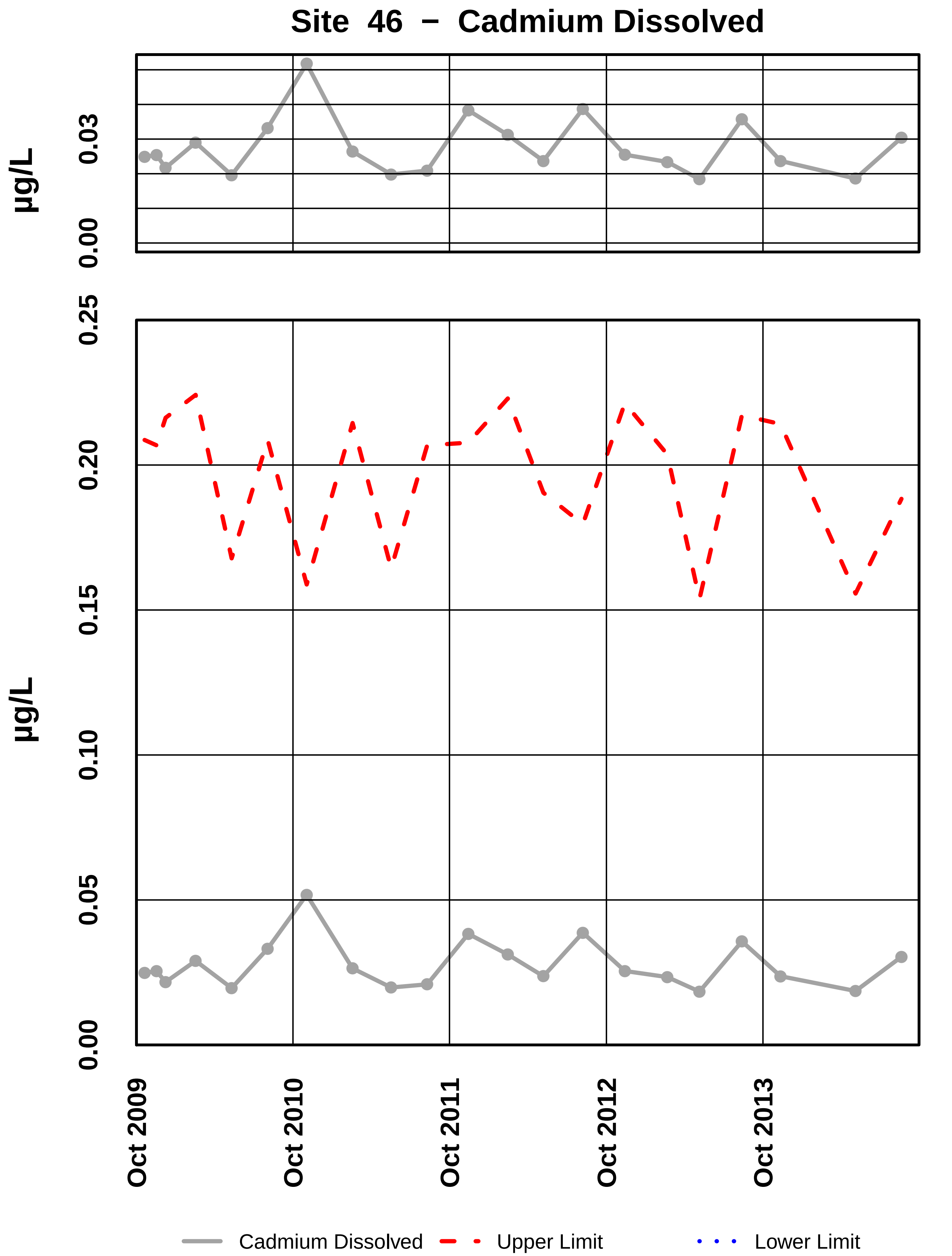
# Site 46 – Arsenic Dissolved




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

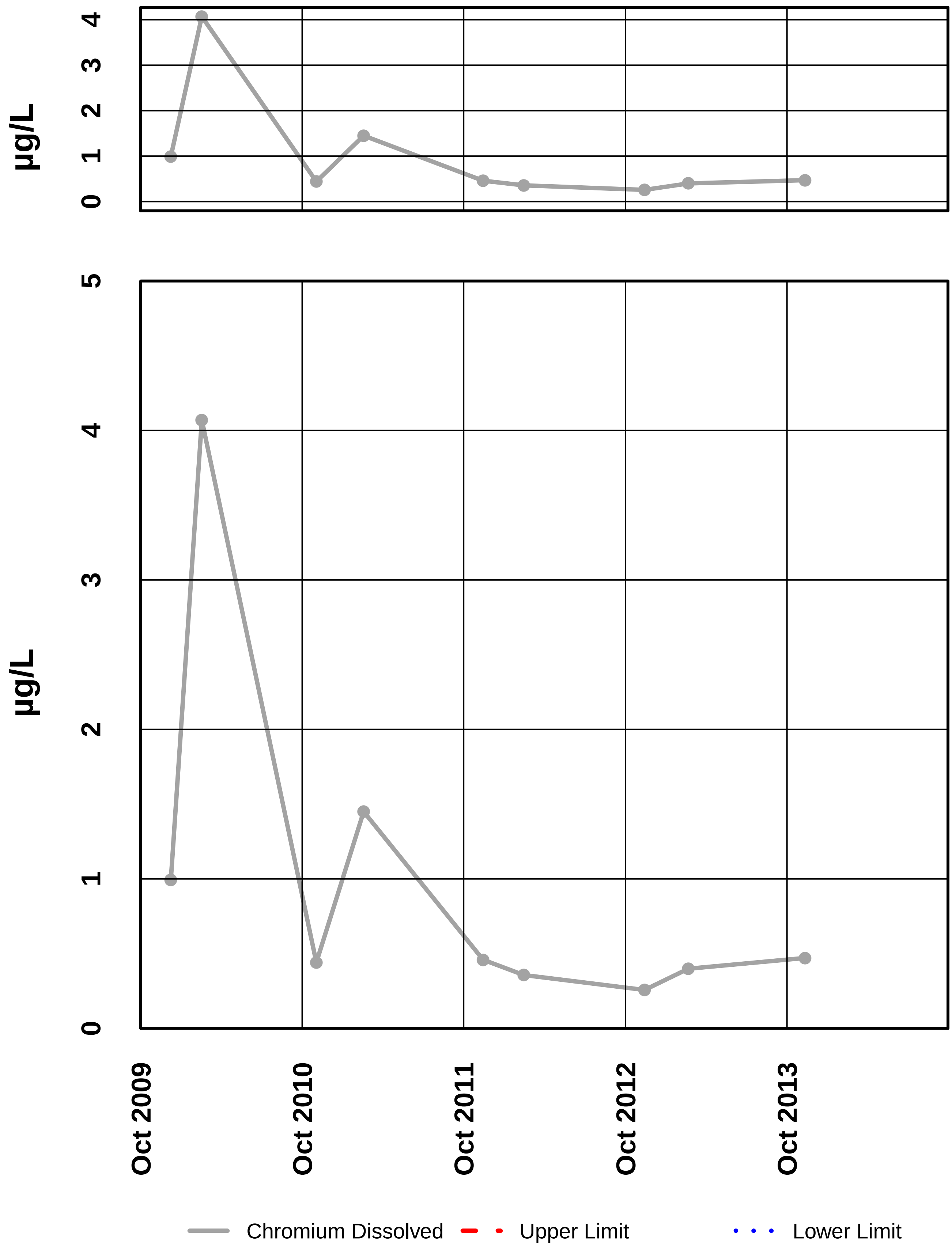



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



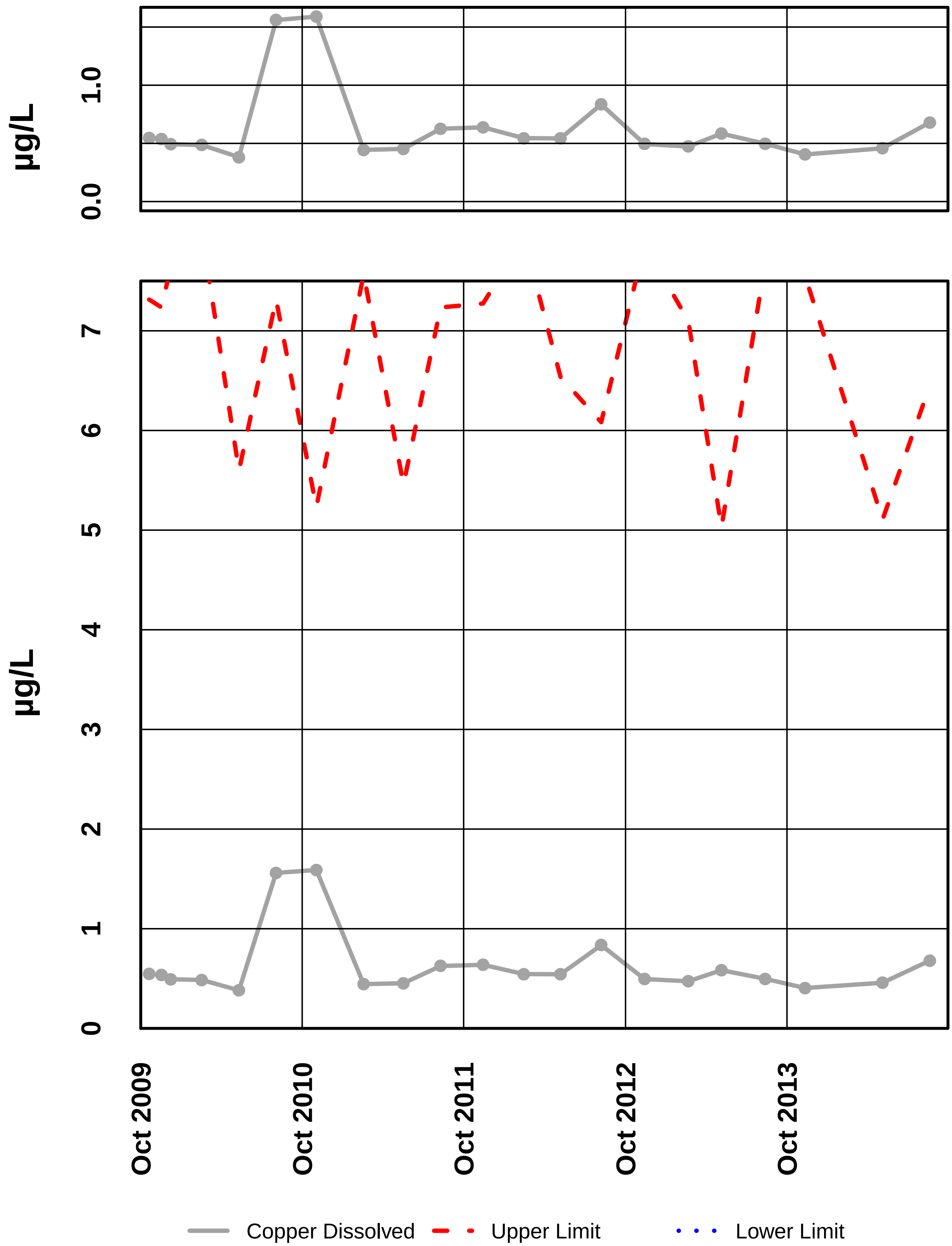

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# Site 46 − Chromium Dissolved

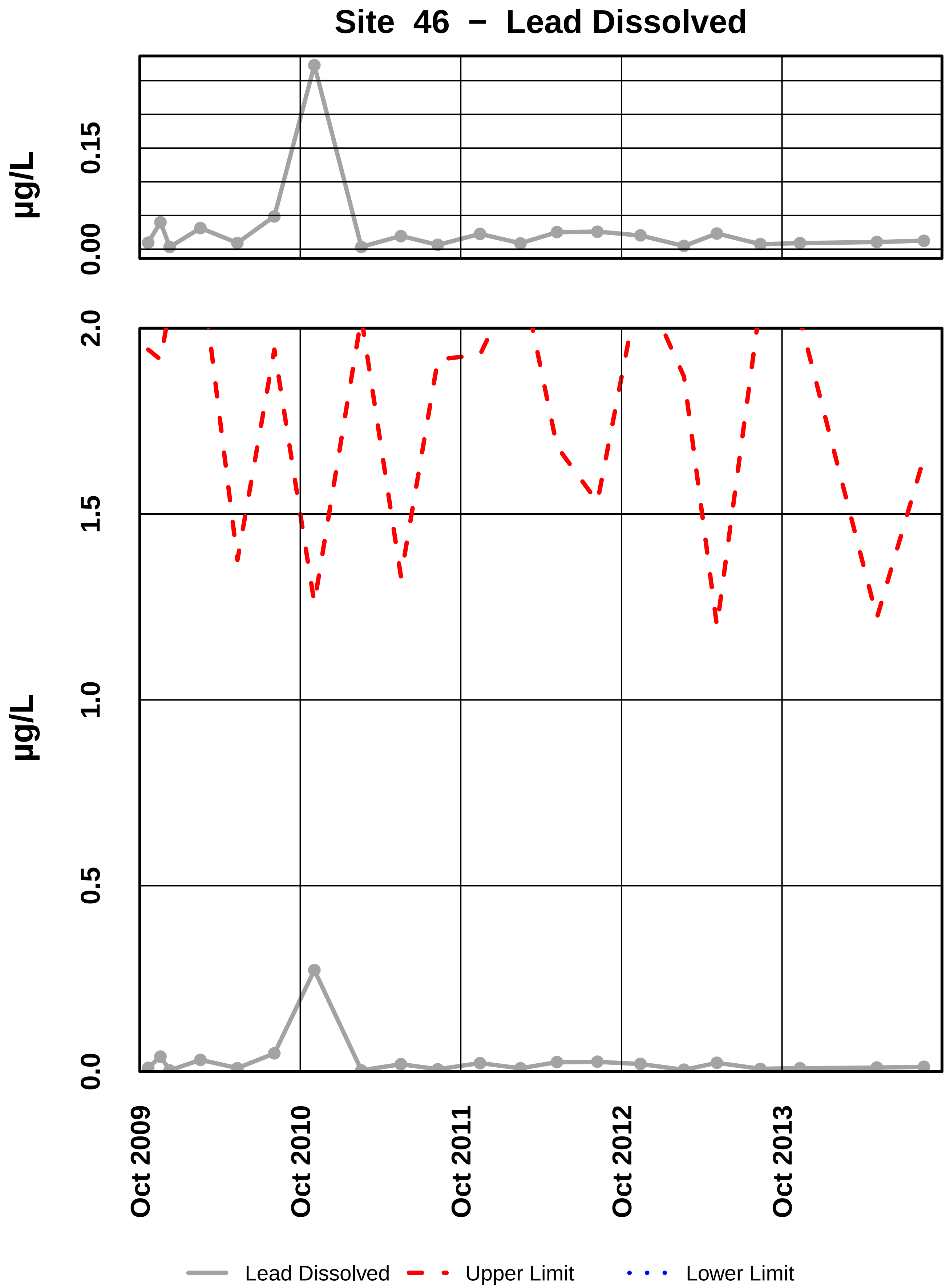



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

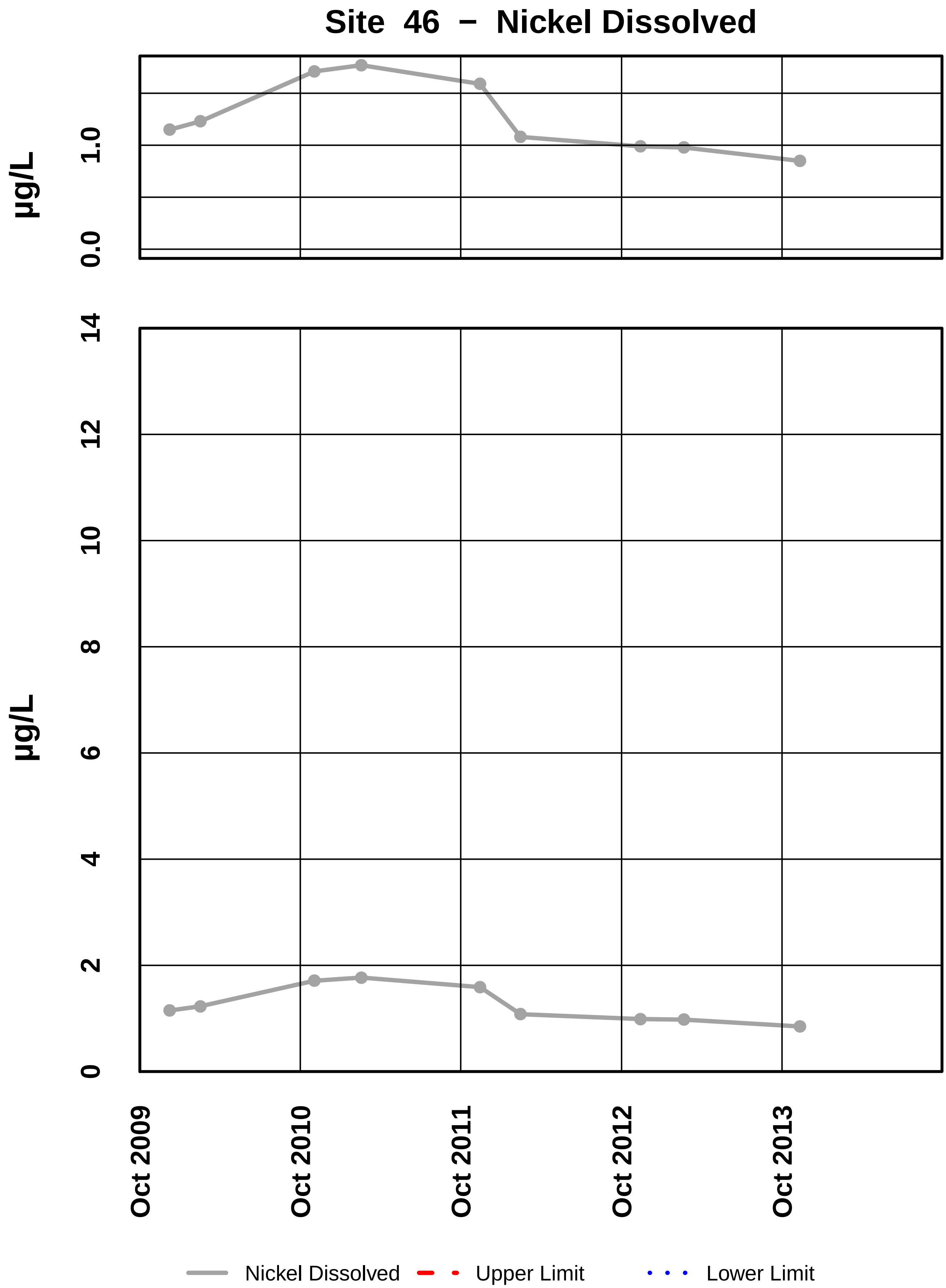
# Site 46 – Copper Dissolved



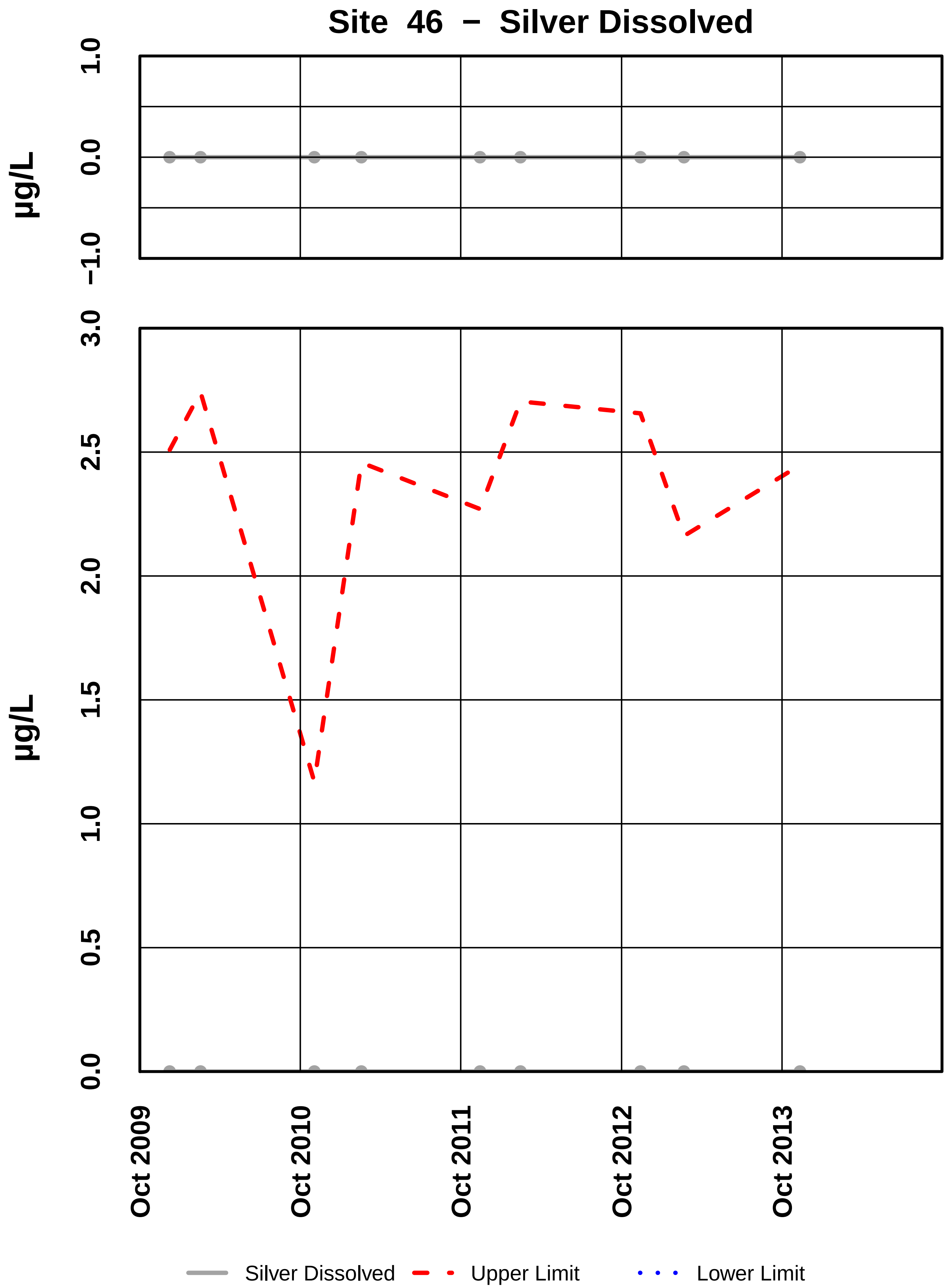

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



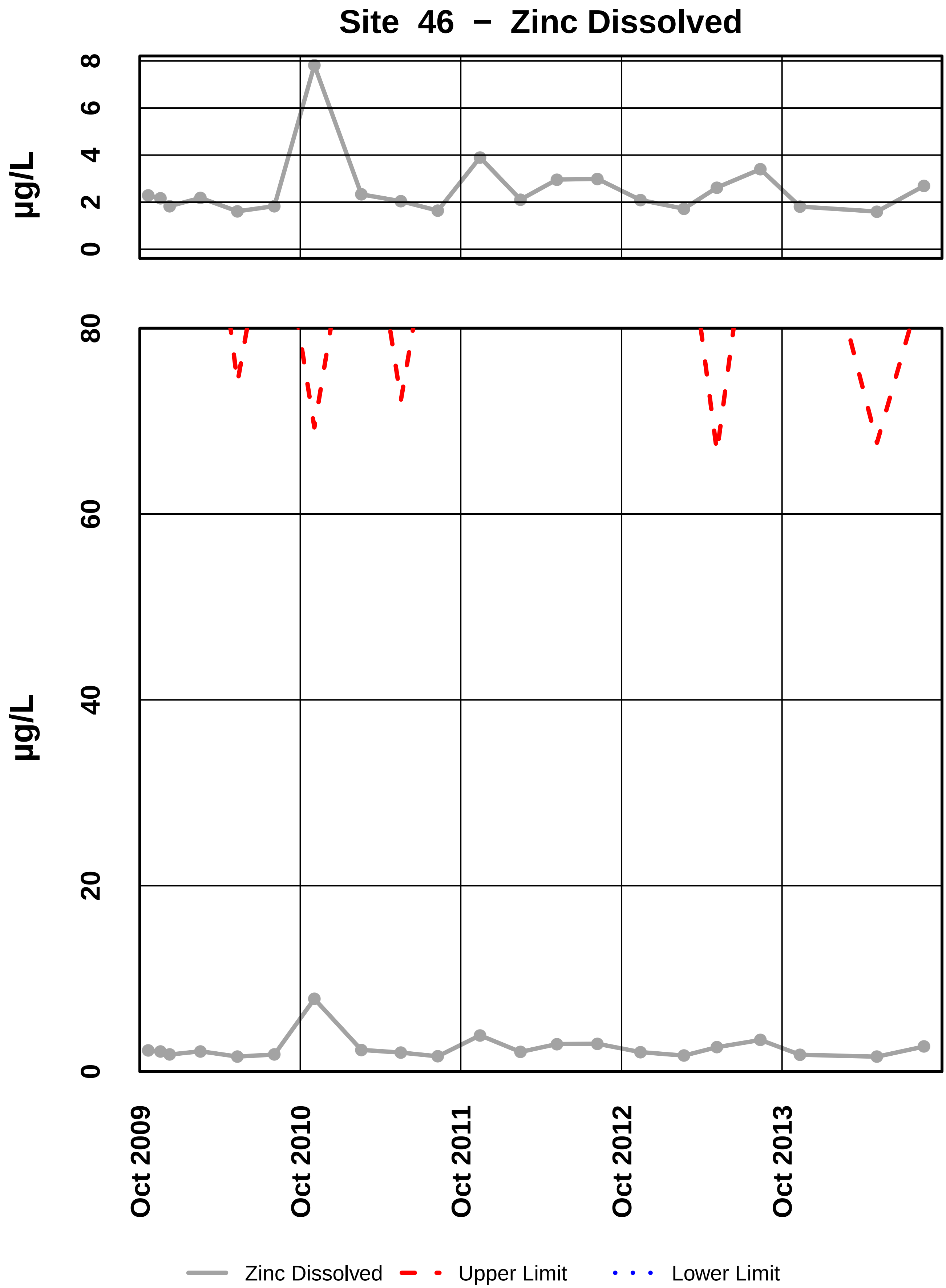

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

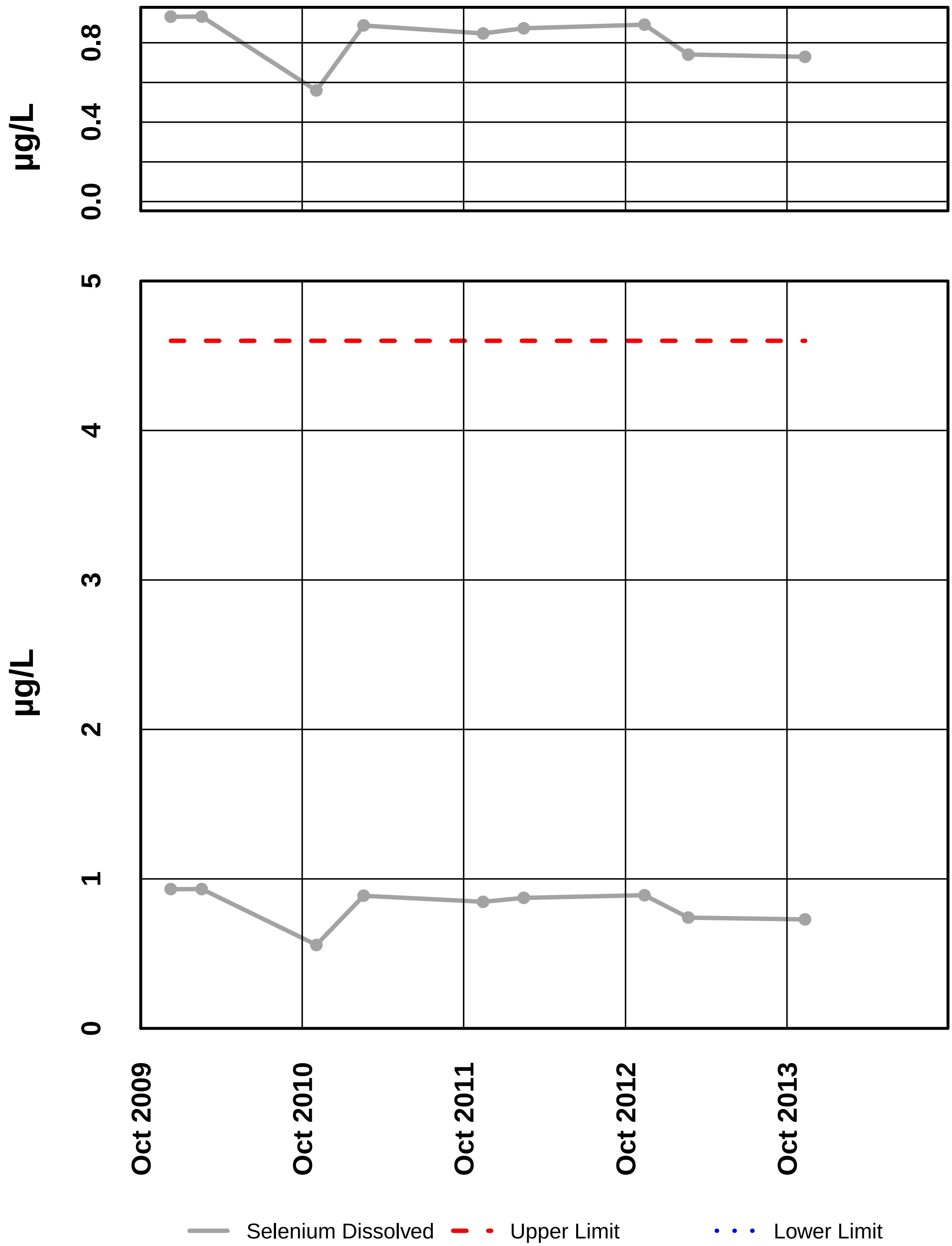



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



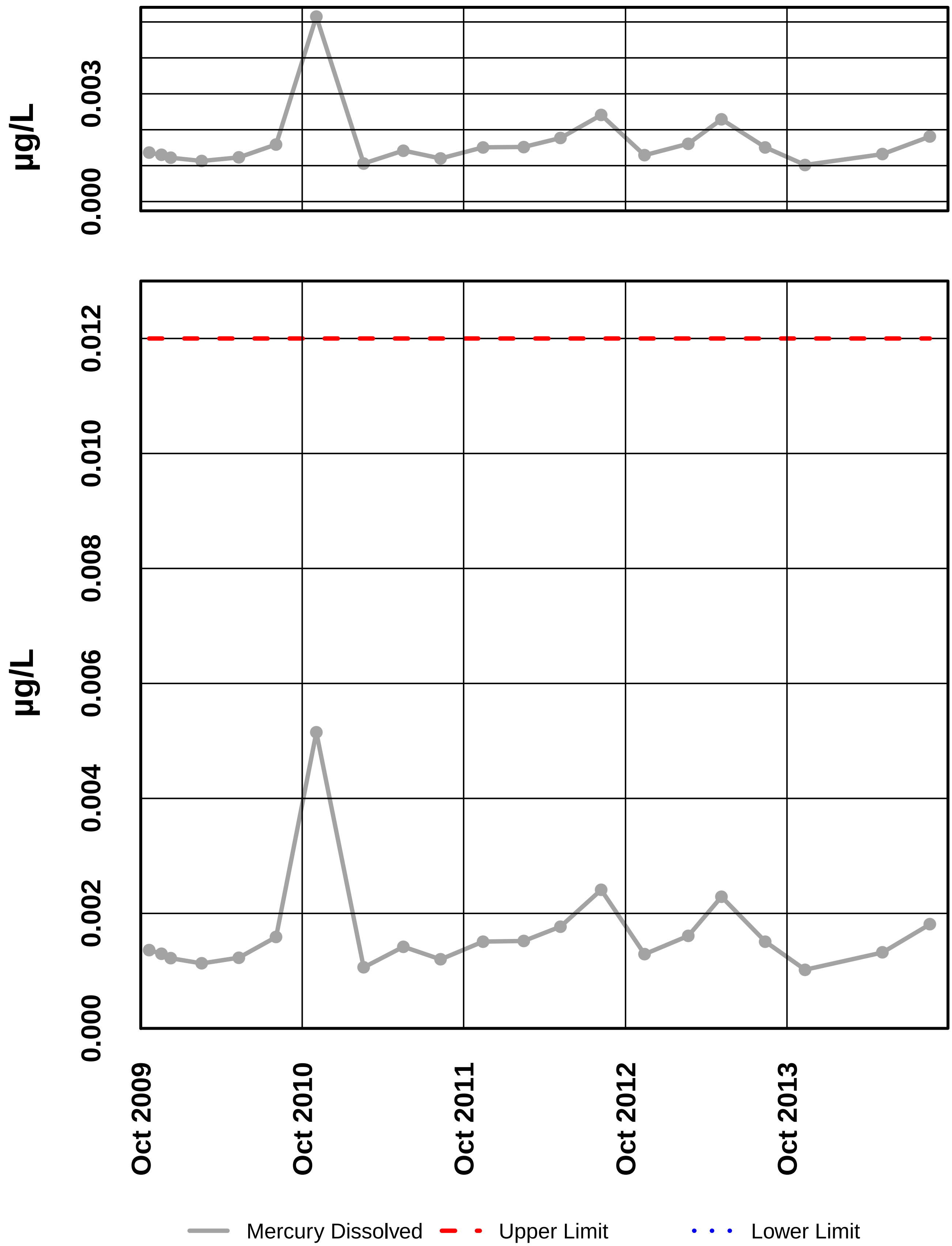

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# Site 46 – Selenium Dissolved




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# Site 46 – Mercury Dissolved




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

## INTERPRETIVE REPORT
## SITE 57

The data collected during the current water year are listed in the following "Table of Results for Water Year 2014" report. The table includes all the required FWMP analyte data (field and laboratory) collected for the current water year and a series of flags keyed to the summary report "Qualified Data by QA Reviewer". The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of ½ MDL for the purpose of median calculation.

All data collected at this site for the past six years are included in the data analyses. As shown in the table below, there were no data outliers.

| Sample Date | Parameter | Value | Qualifier | Notes |
|---|---|---|---|---|
| No outliers have been identified by HGCMC for the period of October 2008 through September 2014. | | | | |

The data for Water Year 2014 have been compared to the strictest fresh water quality criterion for each applicable analyte. No results exceeding these criteria have been identified as listed in the table below.

**Table of Exceedance for Water Year 2014**

| | | | Limits | | |
|---|---|---|---|---|---|
| Sample Date | Parameter | Value | Lower | Upper | Hardness |
| No exceedances have been identified by HGCMC for the period of October 2013 through September 2014. | | | | | |

X-Y plots have been generated to graphically present the data for each of the analytes requested in the Statistical Information Goals for this site. These plots have been visually analyzed for the appearance of any trend in concentration. Though values for dissolved cadmium, dissolved lead, and dissolved zinc had shown a large variation in the past, the current water year's data continues the trend from water year 2009 of these analytes leveling out. Also, there appears to be a gradual increase in dissolved nickel over the past few years, however the values are within the historical range,

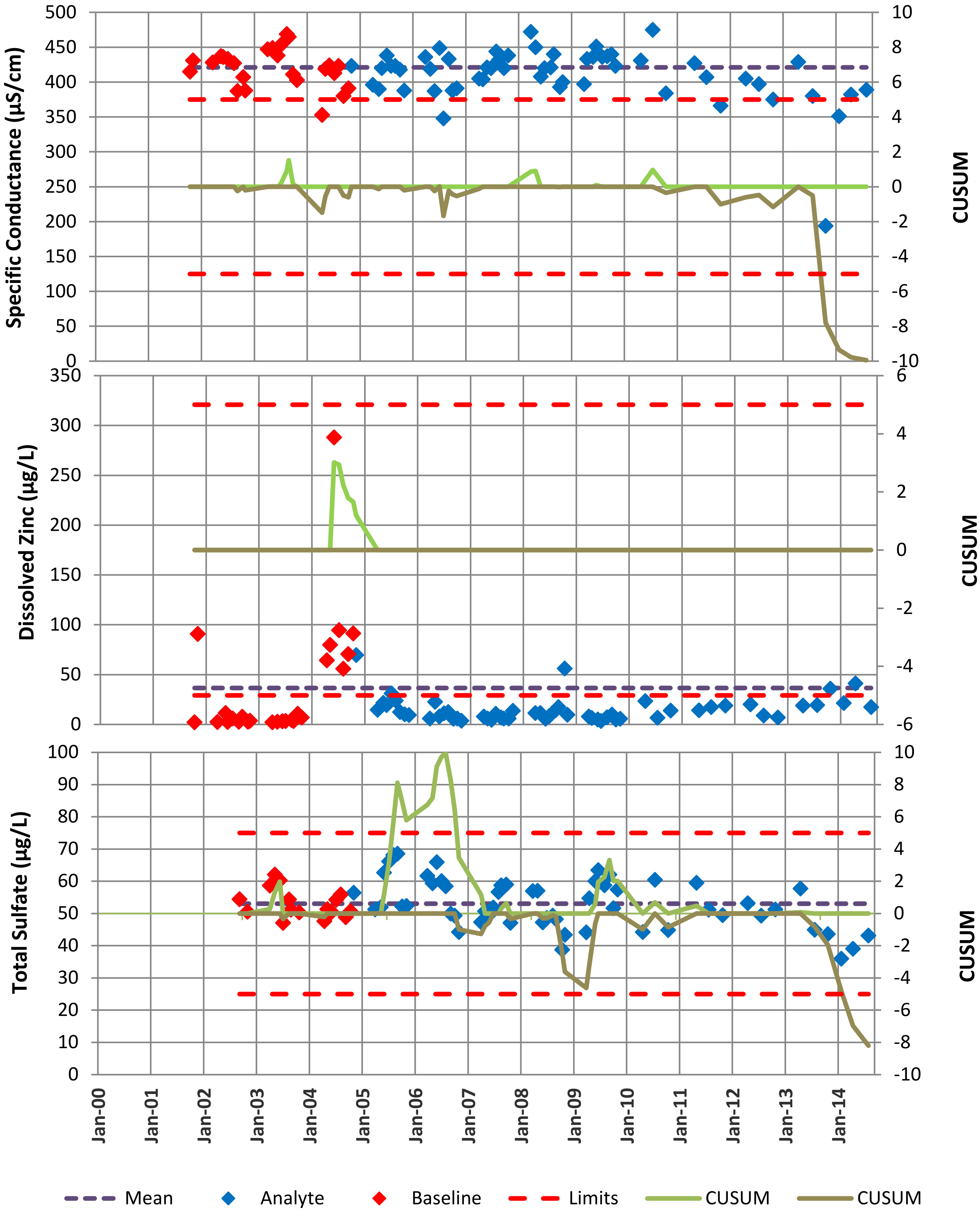
A non-parametric statistical analysis for trend was performed for specific conductivity, field pH, total alkalinity, total sulfate, and dissolved zinc. Calculation details of the Seasonal Kendall analyses are presented on the pages following this interpretive section. The following table summarizes the results on the data collected between Oct-08 and Sep-14 (WY2009-WY2014). Datasets with a statistically significant trend ($\alpha/2$=2.5%) a Seasonal-Sen's Slope estimate statistic has also been calculated. There were three statistically significant trends calculated for these parameters this water year. Of note is the increasing trend in dissolved zinc, with a Sen's slope estimate of 3.13 mg/L/yr. Site 57 is an upgradient background site and this trend is an example of the natural variability of the system.

**Table of Summary Statistics for Trend Analysis**

| | Mann-Kendall test statistics | | | Sen's slope estimate | |
|---|---|---|---|---|---|
| **Parameter** | **n*** | **p**** | **Trend** | **Q** | **Q(%)** |
| Conductivity Field | 6 | <0.01 | - | -11.875 | -2.932 |
| pH Field | 6 | <0.01 | + | 0.023 | 0.307 |
| Alkalinity, Total | 6 | 0.41 | | | |
| Sulfate, Total | 6 | 0.08 | | | |
| Zinc, Dissolved | 6 | 0.02 | + | 3.127 | 22.339 |

* Number of Years  ** Significance level

**Figure 1.** **Observed Measurements for Specific Conductance, Dissolved Zinc, and Total Sulfate from Site 57 Compared to the Shewhart-CUSUM Control Limits From Table 1**



## Table of Results for Water Year 2014

| Site 057FMG - 'Monitoring Well -23-00-03' | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Date/Parameter | Oct 2013 | Nov 2013 | Dec 2013 | Jan 2014 | Feb 2014 | Mar 2014 | Apr 2014 | May 2014 | Jun 2014 | Jul 2014 | Aug 2014 | Sep 2014 | **Median** |
| Water Temp (°C) | | 5.3 | | | 4.0 | | | 11 | | | 9.7 | | 7.5 |
| Conductivity-Field(µmho) | | 194 | | | 351 | | | 382 | | | 389 | | 366.5 |
| Conductivity-Lab (µmho) | | 295 | | | 316 | | | 352 | | | 362 | | 334 |
| pH Lab (standard units) | | 7.58 | | | 7.62 | | | 7.48 | | | 7.56 | | 7.57 |
| pH Field (standard units) | | 7.73 | | | 7.76 | | | 7.68 | | | 7.7 | | 7.72 |
| Total Alkalinity (mg/L) | | 136 | | | 129 | | | 124 | | | 129 | | 129.0 |
| Total Sulfate (mg/L) | | 43.7 | | | 36 | | | 39.1 | | | 43.2 | | 41.2 |
| Hardness (mg/L) | | 186 | | | 161 | | | 171 | | | 185 | | 178.0 |
| Dissolved As (ug/L) | | 0.679 | | | 0.769 | | | 0.673 | | | 0.685 | | 0.682 |
| Dissolved Ba (ug/L) | | 29.3 | | | 31 | | | 29.6 | | | 30.5 | | 30.1 |
| Dissolved Cd (ug/L) | | 0.149 | | | 0.157 | | | 0.2 | | | 0.158 | | 0.1575 |
| Dissolved Cr (ug/L) | | 1.67 | | | 2.65 | | | 1.37 | | | 1.19 | | 1.520 |
| Dissolved Cu (ug/L) | | 0.682 | | | 1.92 | | | 1.99 | | | 1.47 | | 1.695 |
| Dissolved Pb (ug/L) | | 0.688 | | | 0.251 | | | 0.574 | | | 0.363 | | 0.4685 |
| Dissolved Ni (ug/L) | | 1.39 | | | 1.12 | | | 1.41 | | | 1.7 | | 1.400 |
| Dissolved Ag (ug/L) | | 0.002 | | | 0.002 | | | 0.002 | | | 0.002 | | 0.002 |
| Dissolved Zn (ug/L) | | 36 | | | 21.4 | | | 41.3 | | | 17.5 | | 28.70 |
| Dissolved Se (ug/L) | | 0.847 | | | 0.719 | | | 0.856 | | | 0.985 | | 0.852 |
| Dissolved Hg (ug/L) | | 0.000283 | | | 0.000247 | | | 0.00493 | | | 0.000833 | | 0.000558 |

For individual sample/analyte qualifier descriptions see "Qualified Data by QA Reviewer" table.

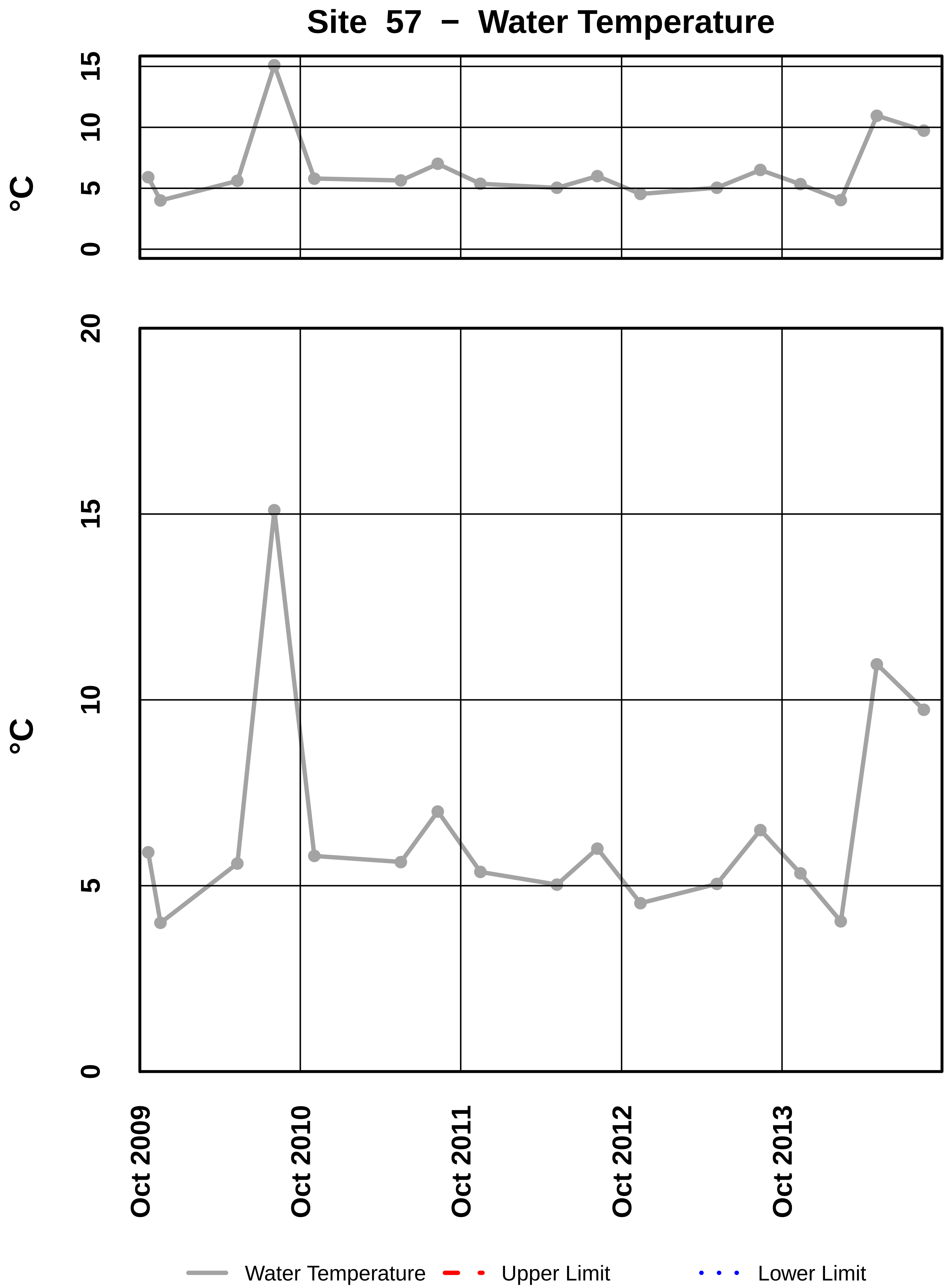
Values reported as less than MDL are replaced by 1/2 MDL for median calculation purposes.

Shaded data has been qualified as an outlier by HGCMC and removed from any further analysis and is not included into the calculation of the median

# Qualified Data by QA Reviewer

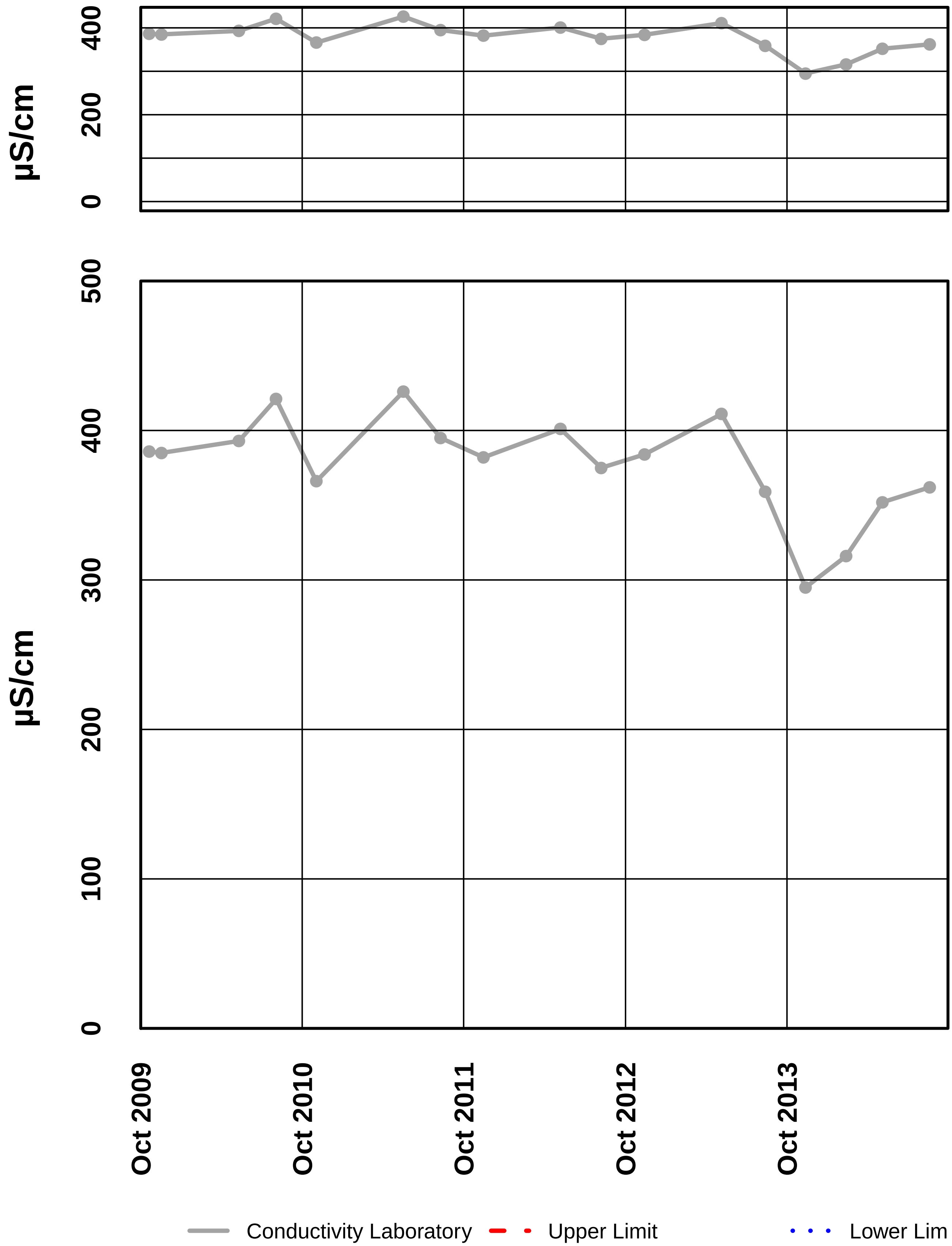
## Date Range: 10/01/2013 to 09/30/2014

| Site No. | Sample Date | Sample Time | Parameter | Value | Qualifier | Reason for Qualifier |
|---|---|---|---|---|---|---|
| 057FMS | 2/12/2014 | 12:00 PM | Diss. Cu-ICP/MS | 1.92 | J | LCS Recovery |
| | | | Diss. Hg-CVAF | 0.000247 | J | Below Quantitative Range |
| | | | Sulfate | 36 | J | Sample Receipt Temperature |

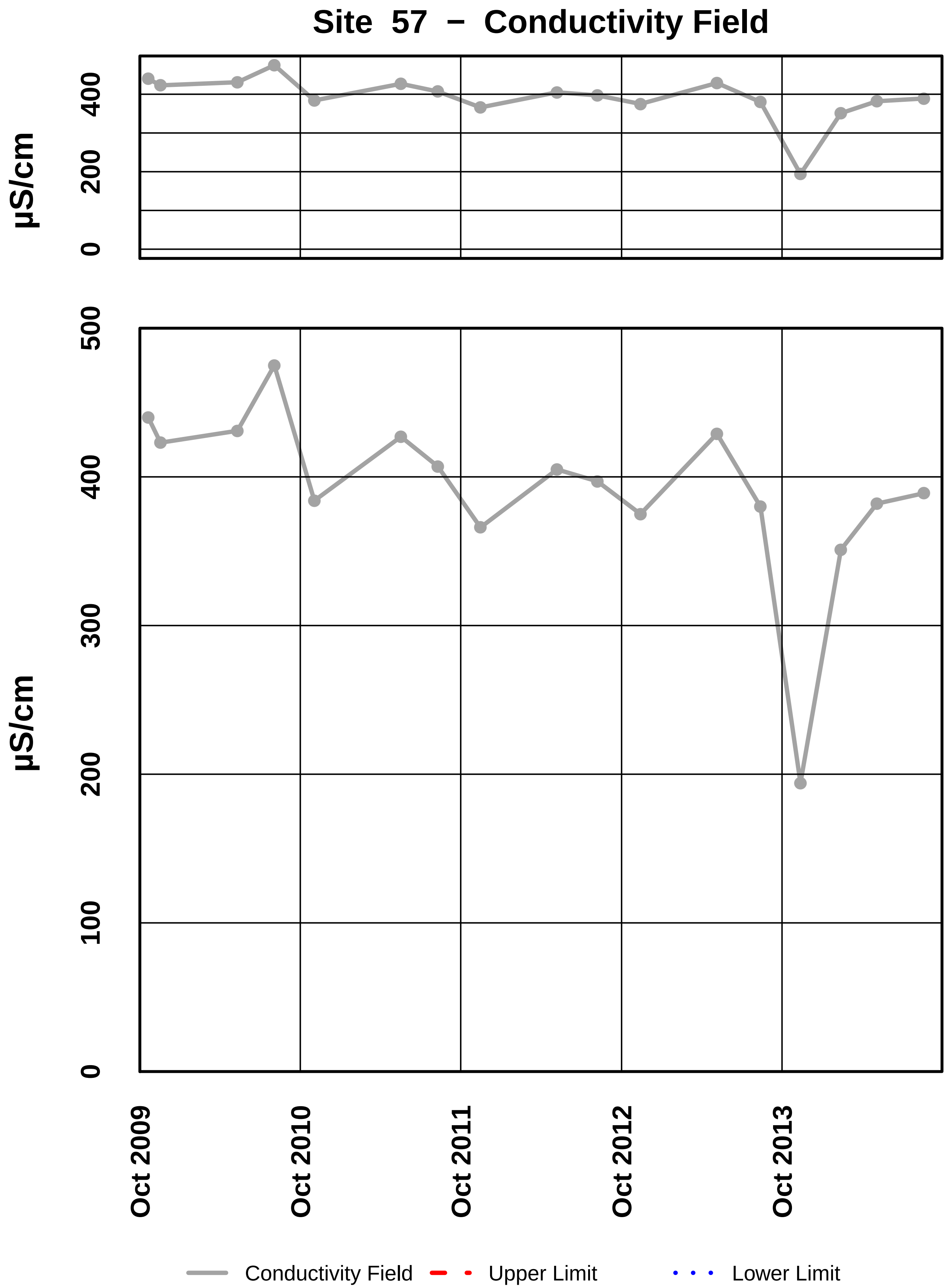



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

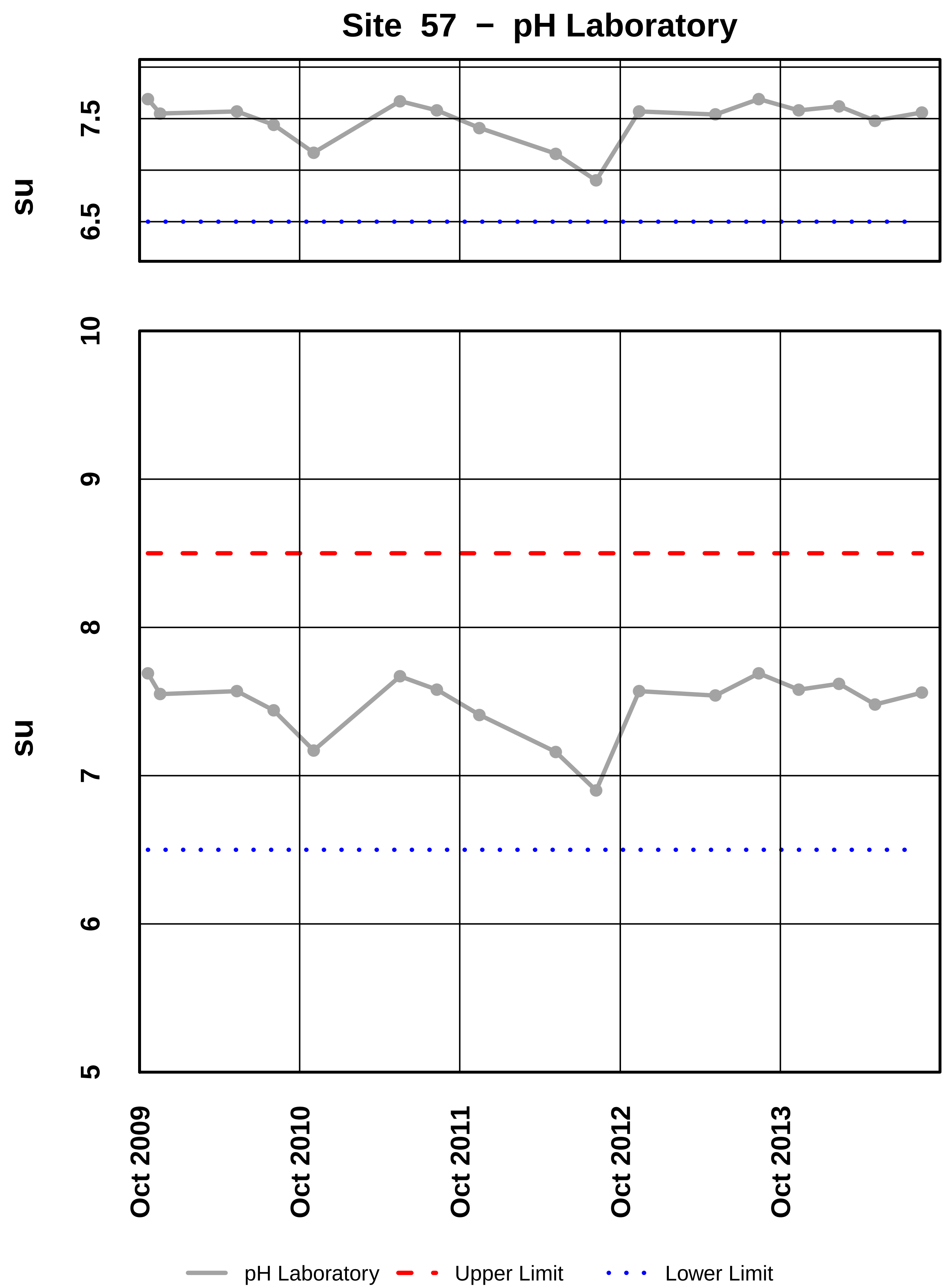
## Site 57 – Conductivity Laboratory




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

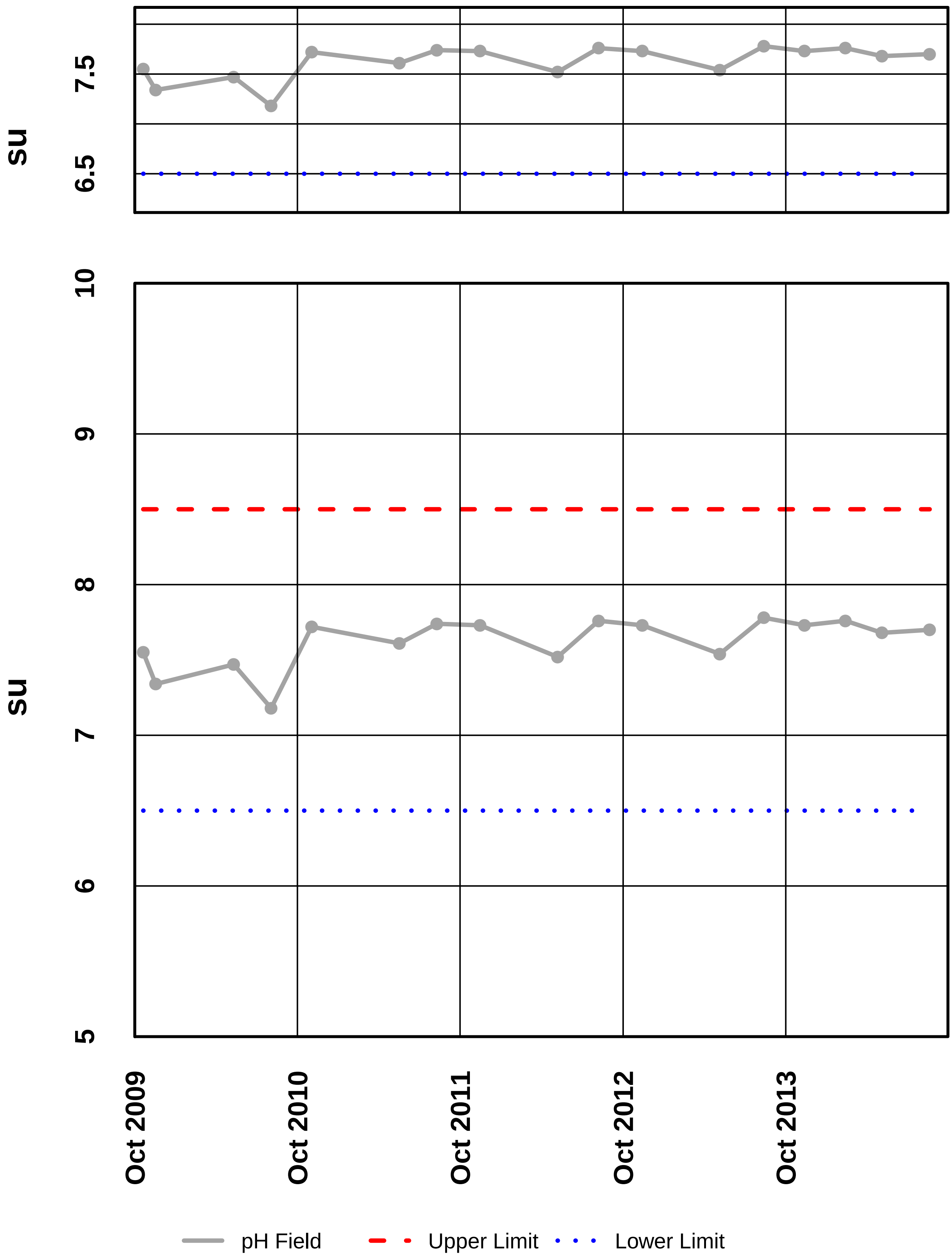



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

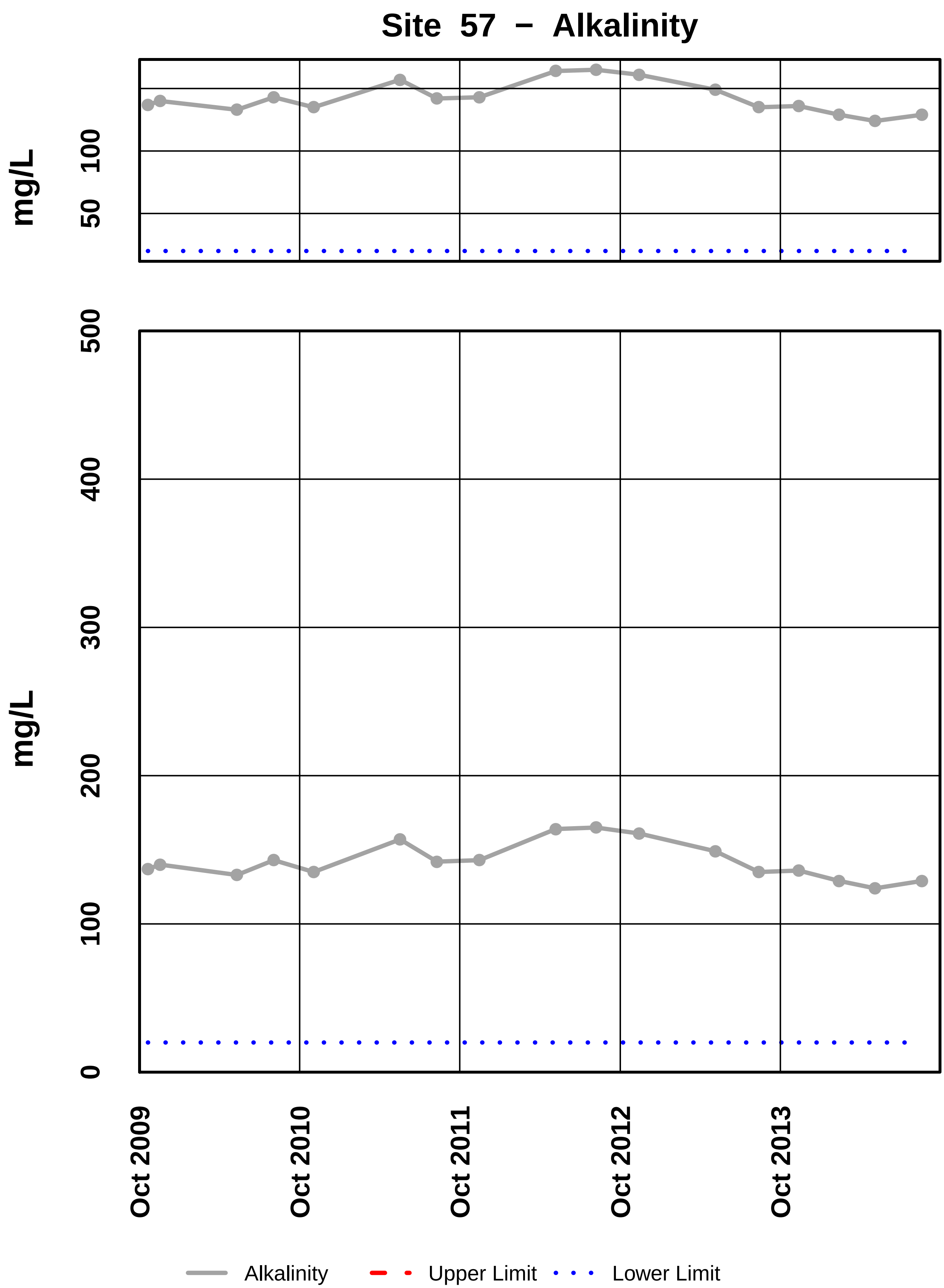



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

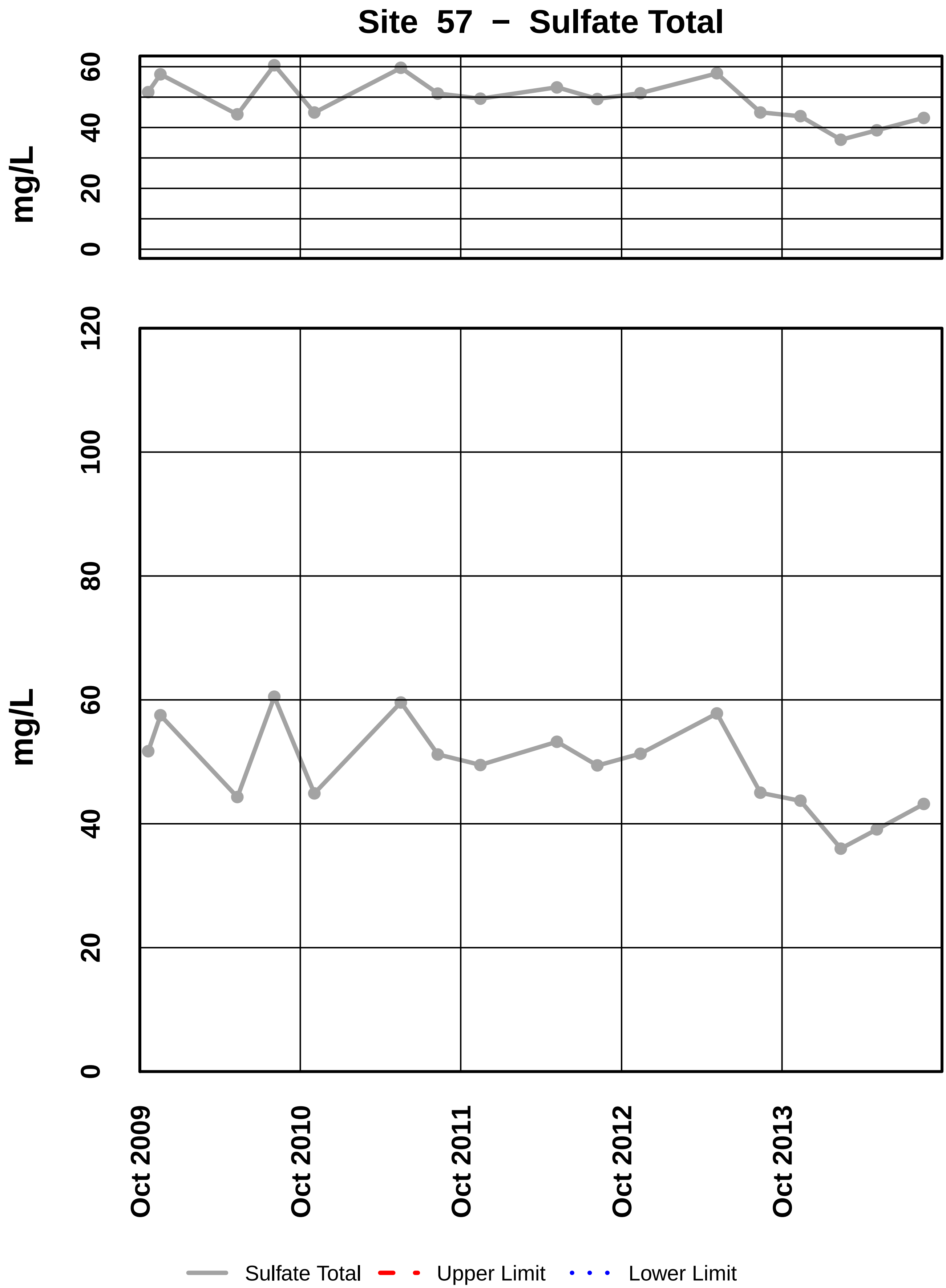
## Site 57 – pH Field




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

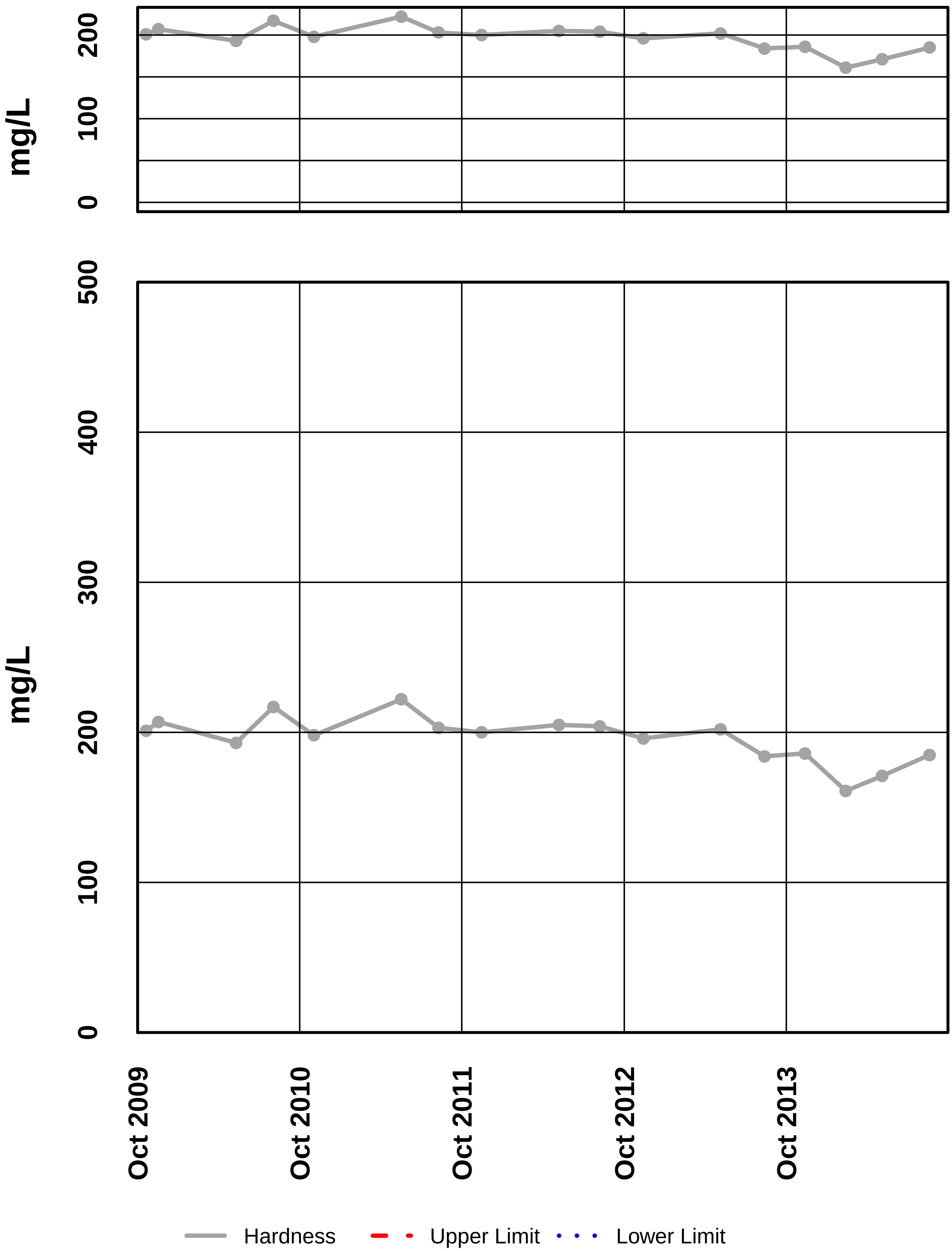



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



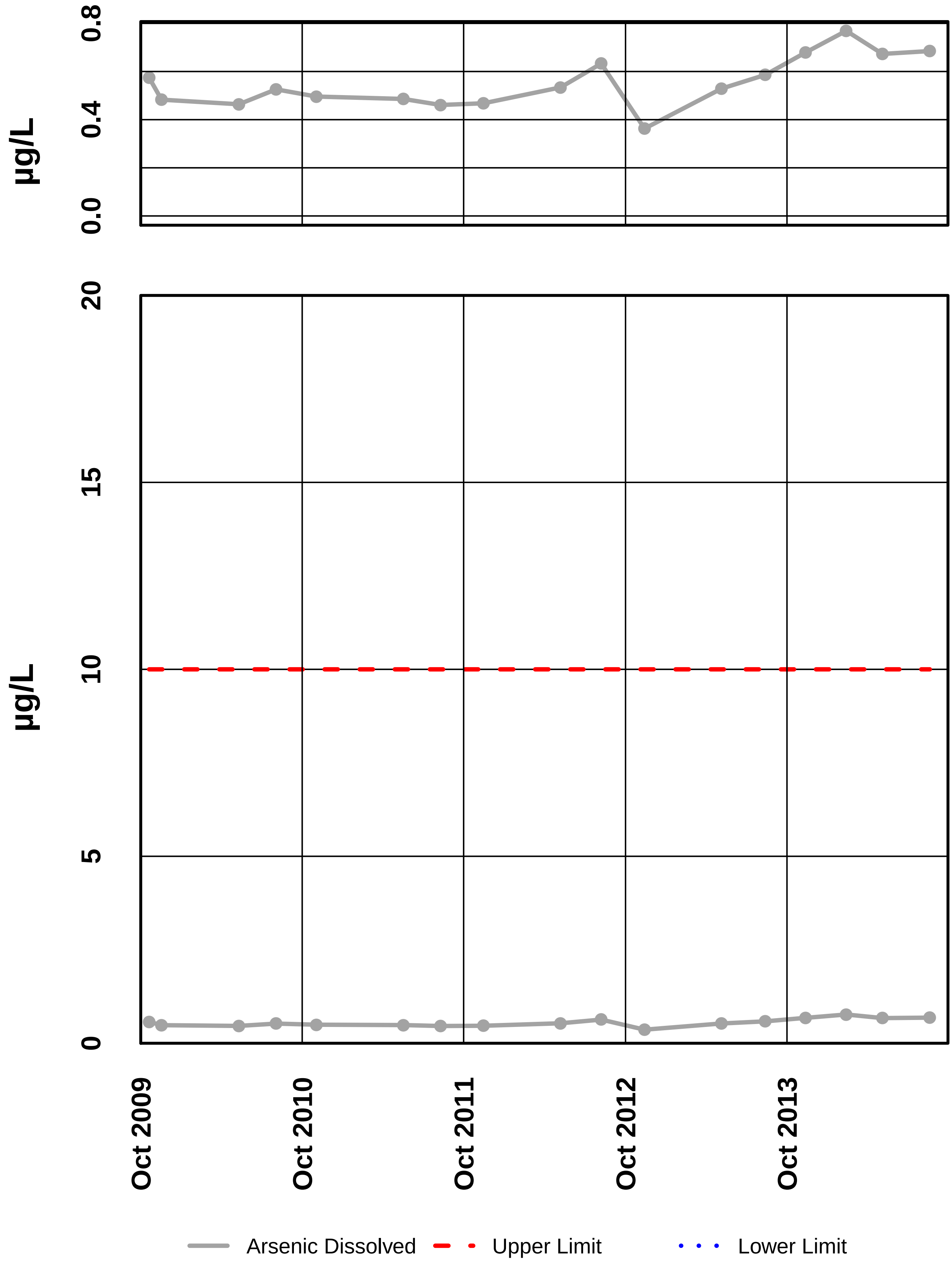

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# Site 57 – Hardness

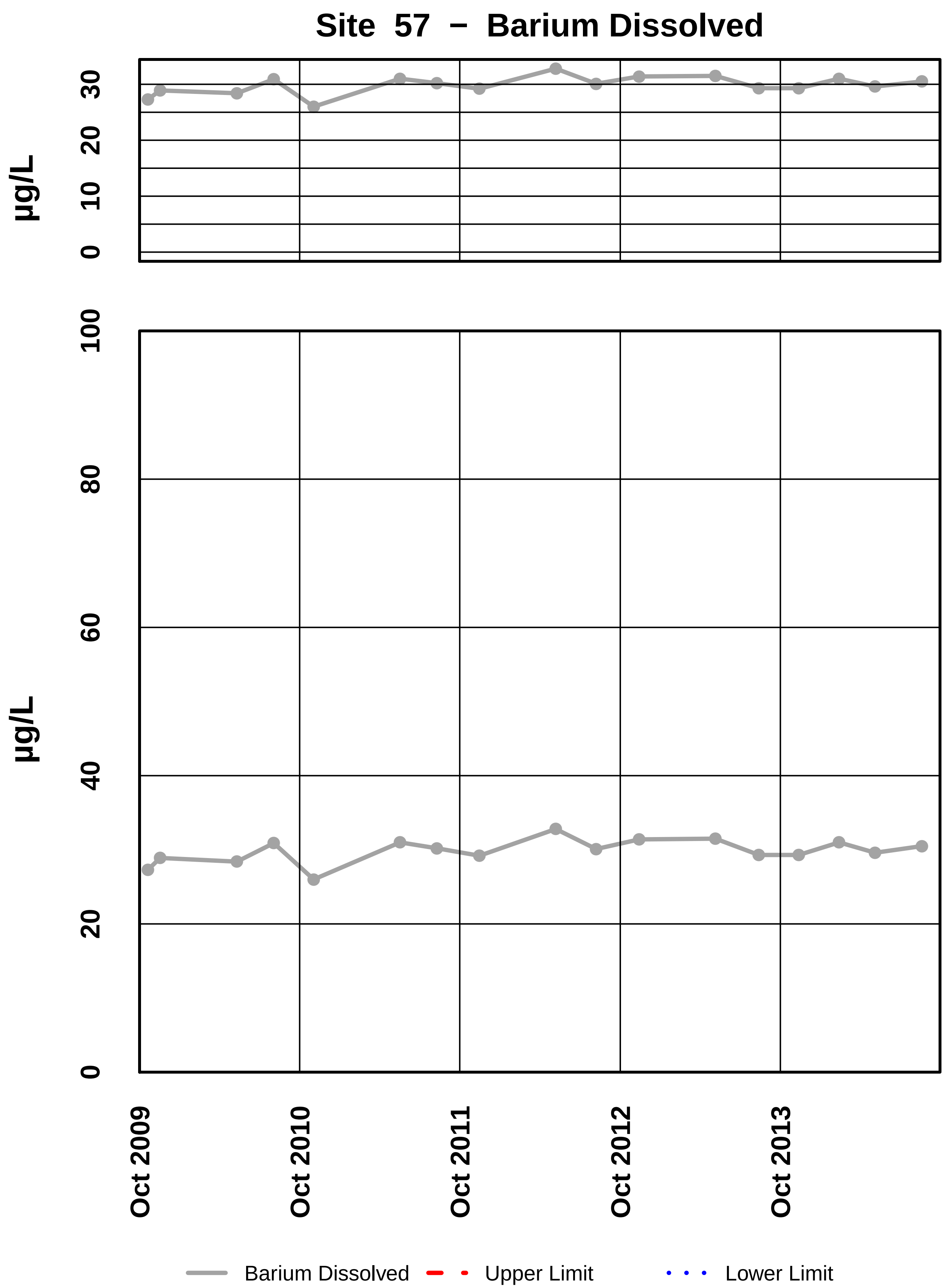



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

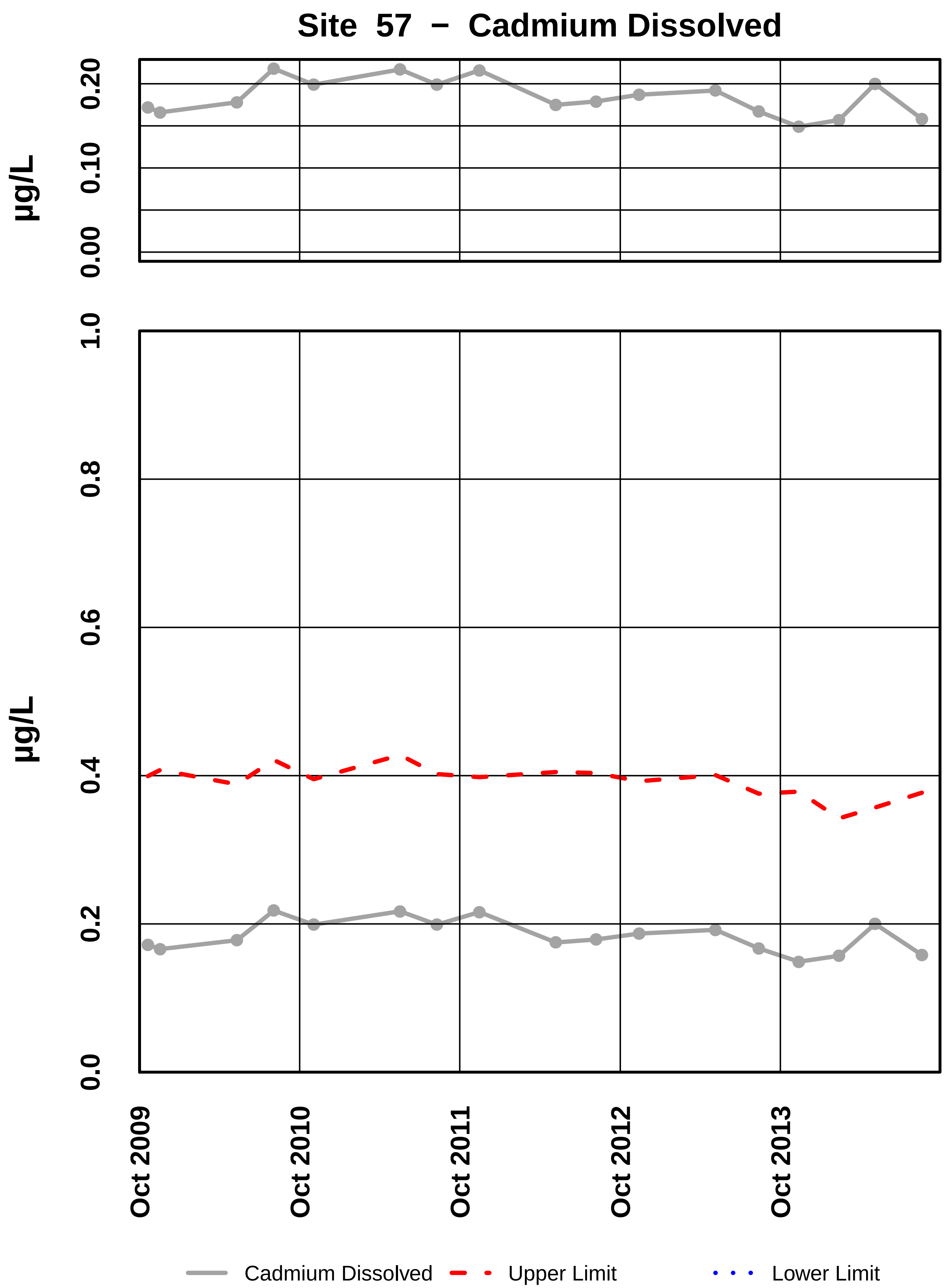
# Site 57 – Arsenic Dissolved




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

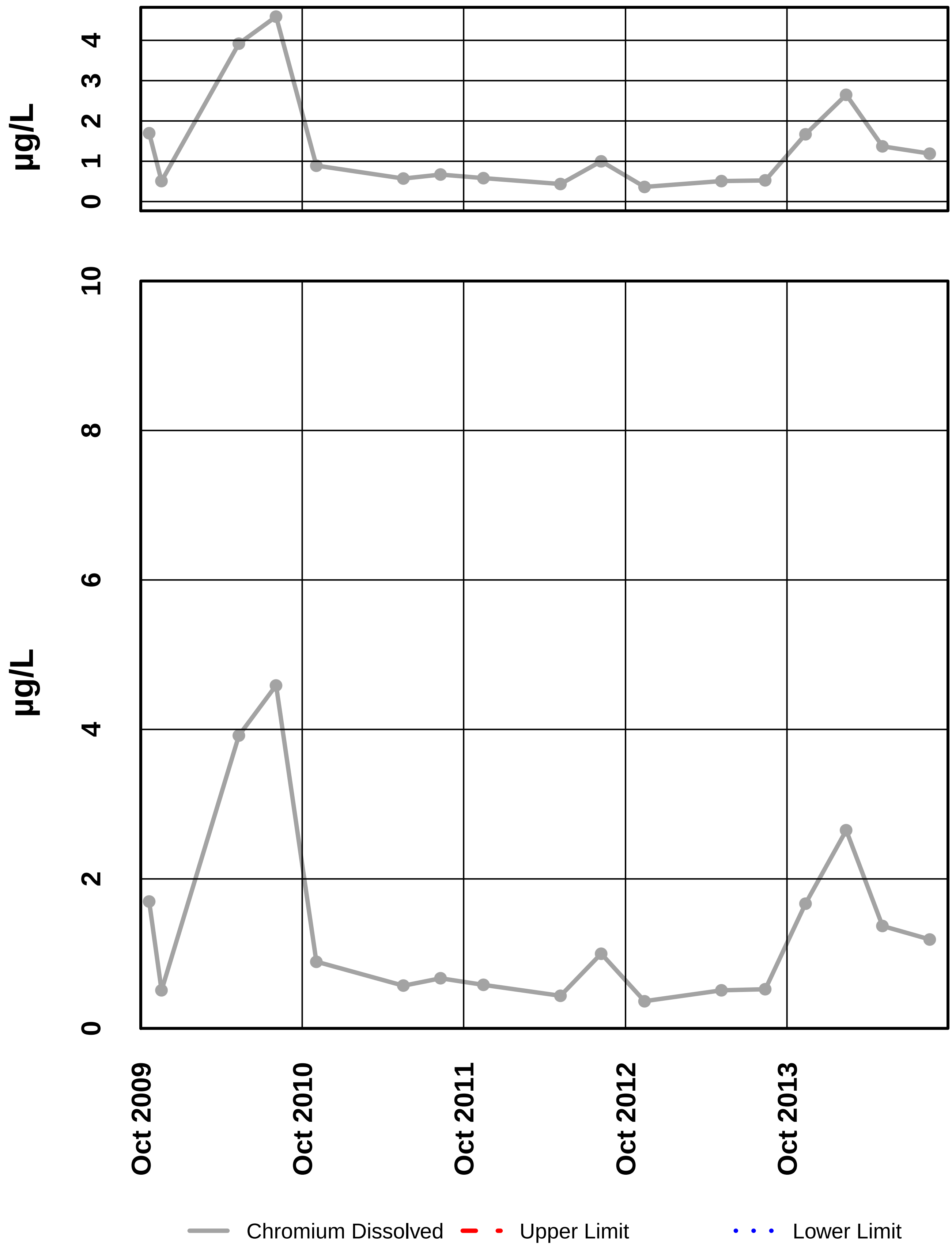



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



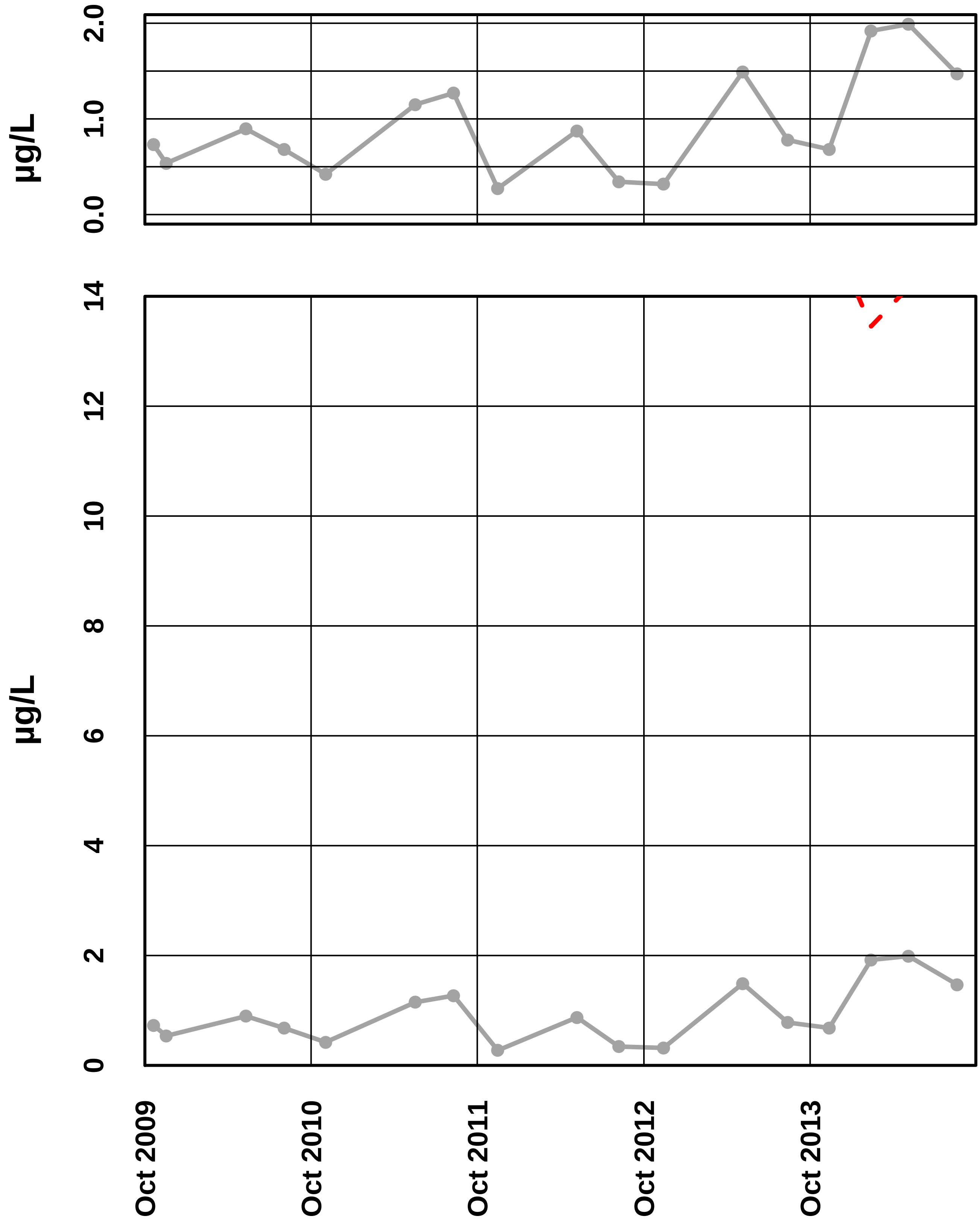

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# Site 57 – Chromium Dissolved



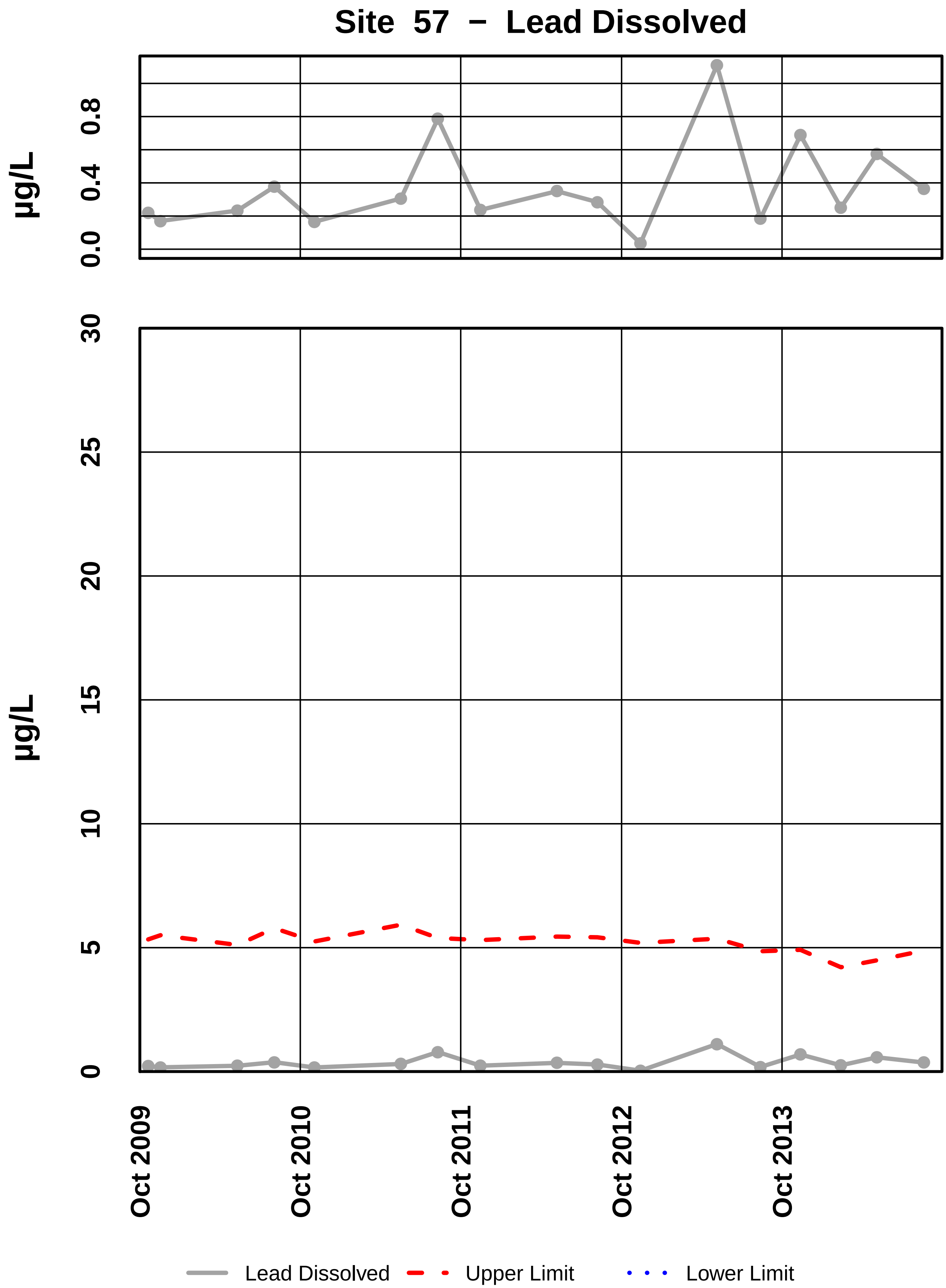

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# Site 57 − Copper Dissolved



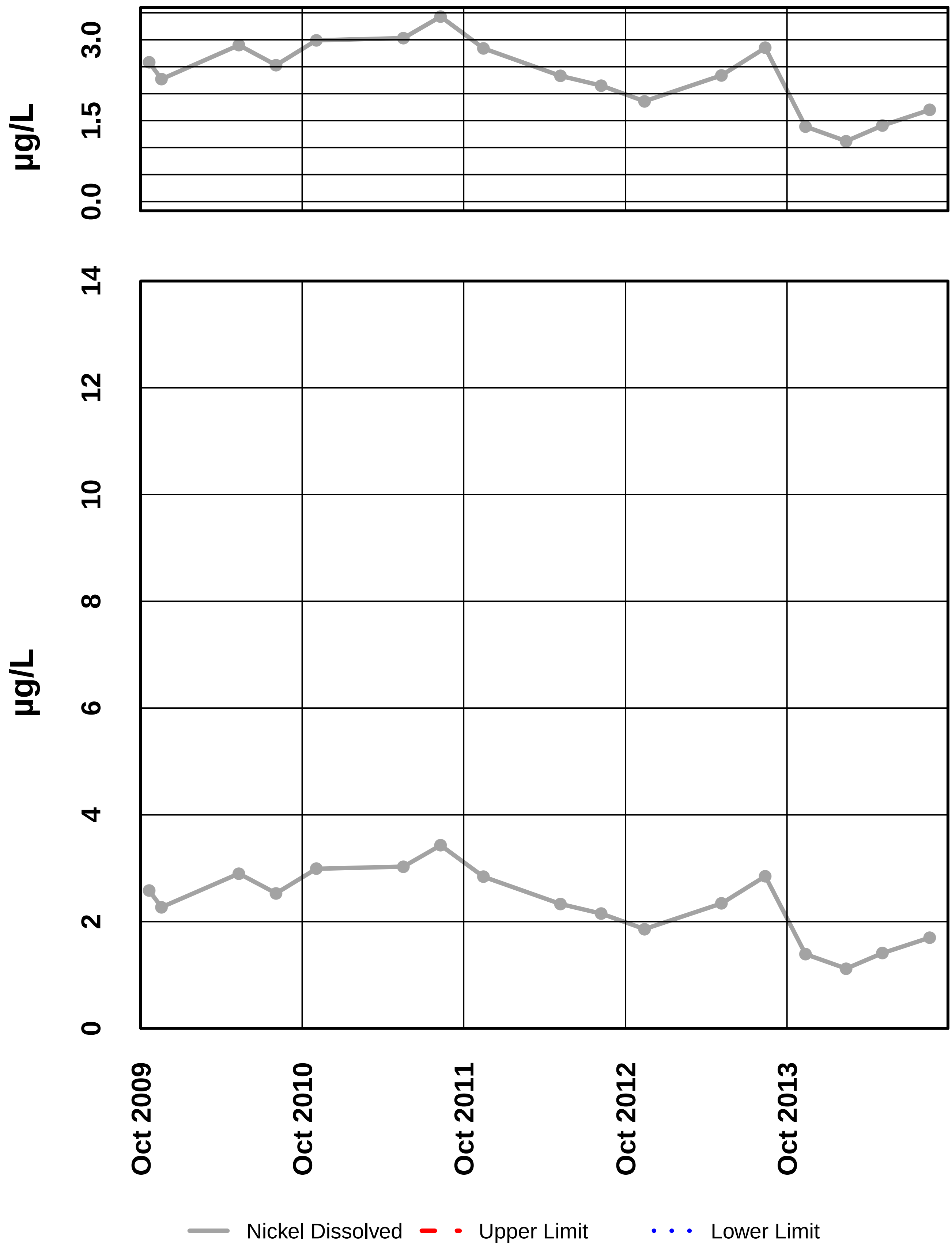

Copper Dissolved   Upper Limit   Lower Limit

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



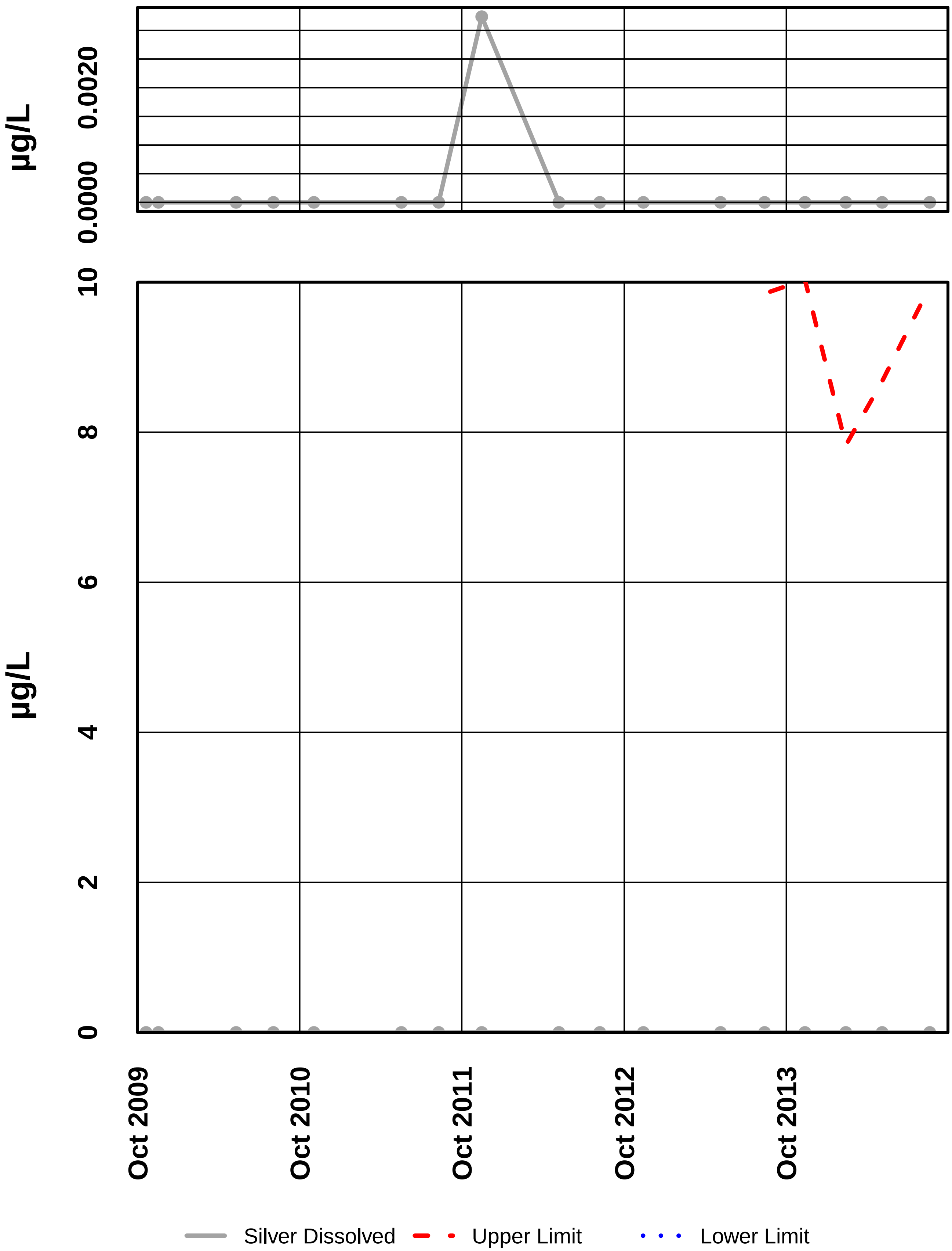

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

## Site 57 − Nickel Dissolved

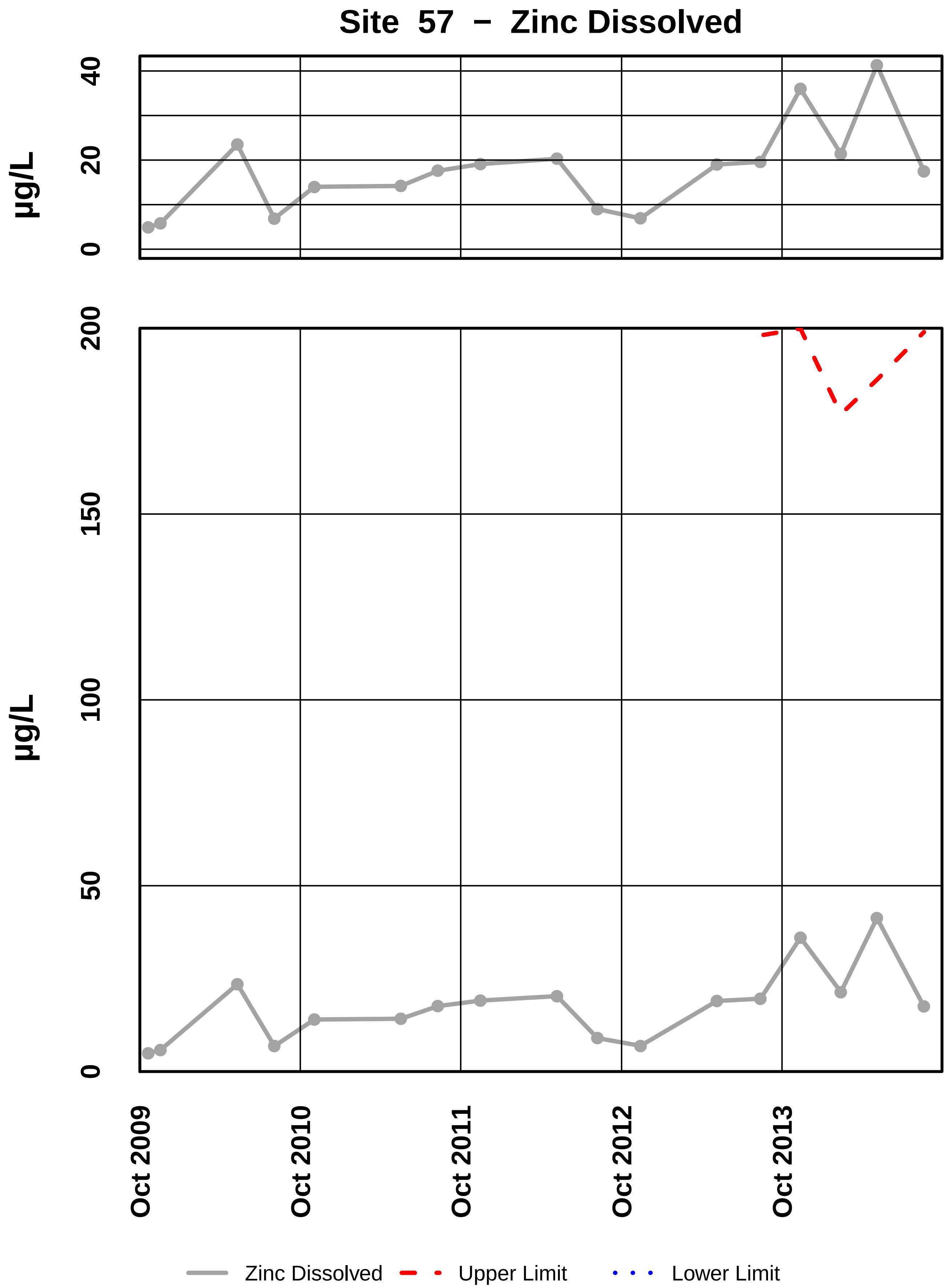



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

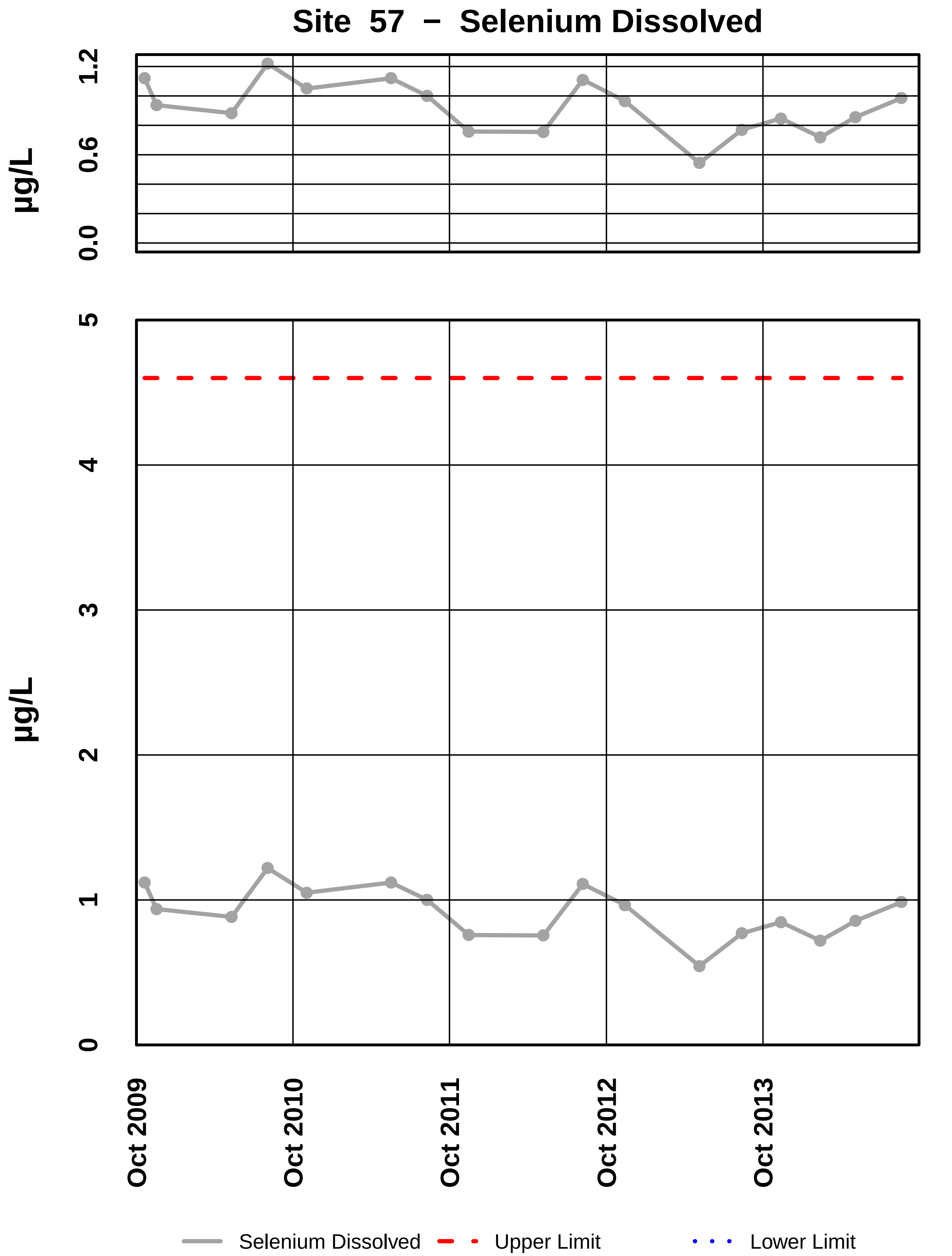
## Site 57 – Silver Dissolved



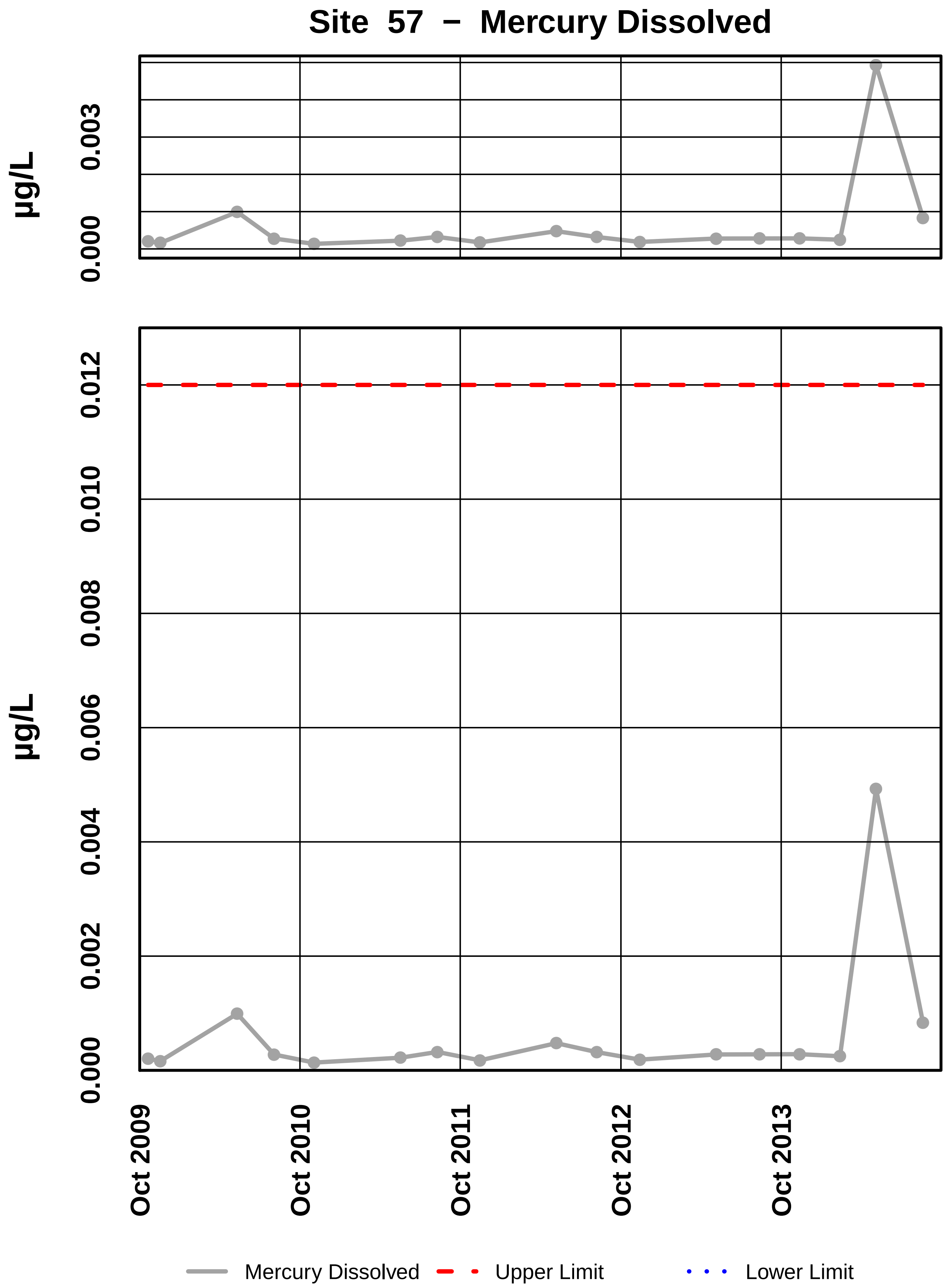

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# INTERPRETIVE REPORT
# SITE 13

The data collected during the current water year are listed in the following “Table of Results for Water Year 2014” report. The table includes all the required FWMP analyte data (field and laboratory) collected for the current water year and a series of flags keyed to the summary report “Qualified Data by QA Reviewer”. The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of ½ MDL for the purpose of median calculation.

All data collected at this site for the past six years are included in the data analyses. As shown in the table below, there were no data outliers.

| Sample Date | Parameter | Value | Qualifier | Notes |
|---|---|---|---|---|
| No outliers have been identified by HGCMC for the period of October 2008 through September 2014. | | | | |

The data for Water Year 2014 have been compared to the strictest fresh water quality criterion for each applicable analyte.  Six results exceeding these criteria have been identified as listed in the table below.

**Table of Exceedance for Water Year 2014**

| | | | Limits | | |
|---|---|---|---|---|---|
| **Sample Date** | **Parameter** | **Value** | **Lower** | **Upper** | **Hardness** |
| 20-Aug-14 | Cadmium Dissolved | 5.68 µg/L | 0 | 0.429 | 223 mg/L |
| 23-Sep-14 | Cadmium Dissolved | 10.9 µg/L | 0 | 0.427 | 221 mg/L |
| 11-Nov-13 | Sulfate Total | 363 mg/L | 0 | 250 | |
| 22-May-14 | Sulfate Total | 258 mg/L | 0 | 250 | |
| 20-Aug-14 | Zinc Dissolved | 1460 µg/L | 0 | 233 | 223 mg/L |
| 23-Sep-14 | Zinc Dissolved | 2660 µg/L | 0 | 231 | 221 mg/L |

Over several years waste rock material has been removed from the 1350 Area. It was not until 2011 that any material was removed from the Eastern Lobe, the area that contributes to the Site 13 drainage; however the material removed was not in the direct drain path for Site 13. During 2012 no material was removed, a limited amount was removed in 2013, HGCMC removed most of the remaining material in 2014, only the material that is needed for road access was left. This material will be removed during final reclamation.

X-Y plots have been generated to graphically present the data for each of the analytes requested in the Statistical Information Goals for this site.  Cadmium, nickel, lead, and zinc all sharply increased at Site 13 after waste rock material was removed in 2014. As seen with other reclamation projects (e.g. the 960) there is usually an initial increase in metals concentration. It is HGCMC expectation that these increased values are transient in nature and will be attenuate throughout Water Year 2015.

**Table of Summary Statistics for Trend Analysis**

| | Mann-Kendall test statistics | | | Sen's slope estimate | |
|---|---|---|---|---|---|
| **Parameter** | **n*** | **p**** | **Trend** | **Q** | **Q(%)** |
| Conductivity Field | 6 | 0.02 | - | -41 | -5.64 |
| pH Field | 6 | 0.38 | | | |
| Alkalinity, Total | 6 | 0.38 | | | |
| Sulfate, Total | 6 | 0.38 | | | |
| Zinc, Dissolved | 6 | 0.27 | | | |

* Number of Years ** Significance level

A non-parametric statistical analysis for trend was performed for specific conductivity, field pH, total alkalinity, total sulfate, and dissolved zinc. Calculation details of the Seasonal Kendall analyses are presented in detail on the pages following this interpretive section. The following table summarizes the results on the data collected between Oct-08 and Sep-14(WY2009-WY2014). For datasets with a statistically significant trend a Seasonal-Sen’s Slope estimate statistic has also been calculated. There was one statistically significant decreasing trend ($\alpha/2=2.5\%$) for conductivity at Site 13, this is potentially a result of the material removal. HGCMC feels the current FWMP program is sufficient to monitor current and future changes at Site 13 before water quality values are impaired long term.

## Table of Results for Water Year 2014

### Site 013FMS - '1350 East Drainage'

| Sample Date/Parameter | Oct 2013 | Nov 2013 | Dec 2013 | Jan 2014 | Feb 2014 | Mar 2014 | Apr 2014 | May 2014 | Jun 2014 | Jul 2014 | Aug 2014 | Sep 2014 | **Median** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Water Temp (°C) | | 1.3 | | | | | | 4.5 | | | 10.7 | 8.8 | 6.7 |
| Conductivity-Field(µmho) | | 959 | | | | | | 721 | | | 453 | 463 | 592.0 |
| Conductivity-Lab (µmho) | | 768 | | | | | | 612 | | | 441 | 424 | 527 |
| pH Lab (standard units) | | 7.82 | | | | | | 7.72 | | | 7.33 | 7.29 | 7.53 |
| pH Field (standard units) | | 8.1 | | | | | | 8.08 | | | 7.51 | 6.97 | 7.80 |
| Total Alkalinity (mg/L) | | 160 | | | | | | 125 | | | 53.5 | 41.5 | 89.3 |
| Total Sulfate (mg/L) | | 363 | | | | | | 258 | | | 158 | 164 | 211.0 |
| Hardness (mg/L) | | 573 | | | | | | 404 | | | 223 | 221 | 313.5 |
| Dissolved As (ug/L) | | 0.111 | | | | | | 0.116 | | | 0.243 | 0.203 | 0.160 |
| Dissolved Ba (ug/L) | | 19.2 | | | | | | 15.9 | | | 19.9 | 20.1 | 19.6 |
| Dissolved Cd (ug/L) | | 0.0087 | | | | | | 0.0083 | | | 5.68 | 10.9 | 2.8444 |
| Dissolved Cr (ug/L) | | 0.736 | | | | | | 2.33 | | | 0.95 | 0.651 | 0.843 |
| Dissolved Cu (ug/L) | | 0.298 | | | | | | 1.31 | | | 1.08 | 1.17 | 1.125 |
| Dissolved Pb (ug/L) | | 0.006 | | | | | | 0.0057 | | | 2.87 | 5.63 | 1.4380 |
| Dissolved Ni (ug/L) | | 1.68 | | | | | | 1.03 | | | 9.92 | 12.9 | 5.800 |
| Dissolved Ag (ug/L) | | 0.002 | | | | | | 0.002 | | | 0.004 | 0.002 | 0.002 |
| Dissolved Zn (ug/L) | | 8.48 | | | | | | 6.98 | | | 1460 | 2660 | 734.24 |
| Dissolved Se (ug/L) | | 0.205 | | | | | | 0.395 | | | 0.147 | 0.447 | 0.300 |
| Dissolved Hg (ug/L) | | 0.000575 | | | | | | 0.000664 | | | 0.00149 | 0.0017 | 0.001077 |

For individual sample/analyte qualifier descriptions see "Qualified Data by QA Reviewer" table.

Values reported as less than MDL are replaced by 1/2 MDL for median calculation purposes.

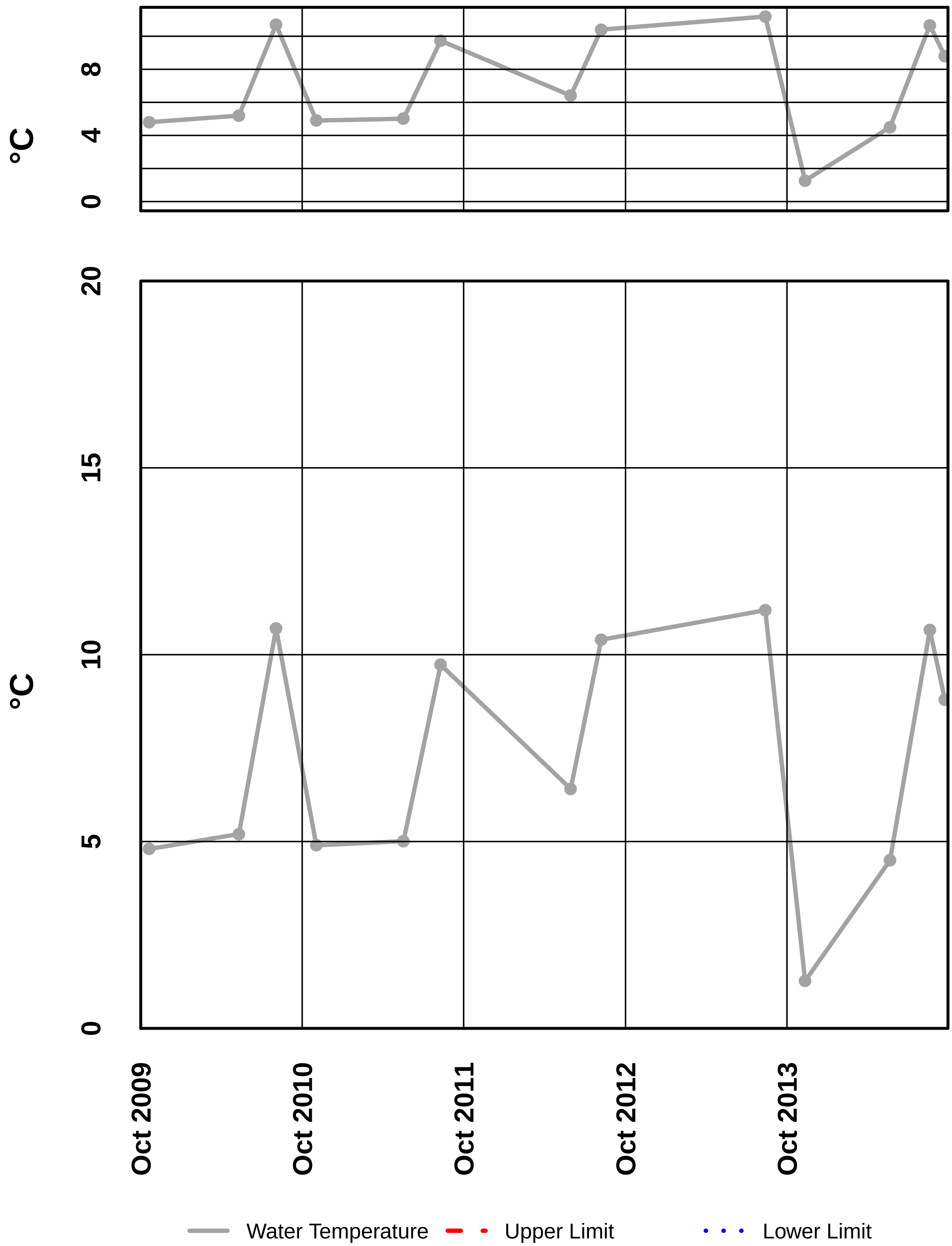
Shaded data has been qualified as an outlier by HGCMC and removed from any further analysis and is not included into the calculation of the median

# Qualified Data by QA Reviewer

**Date Range: 10/01/2013 to 09/30/2014**

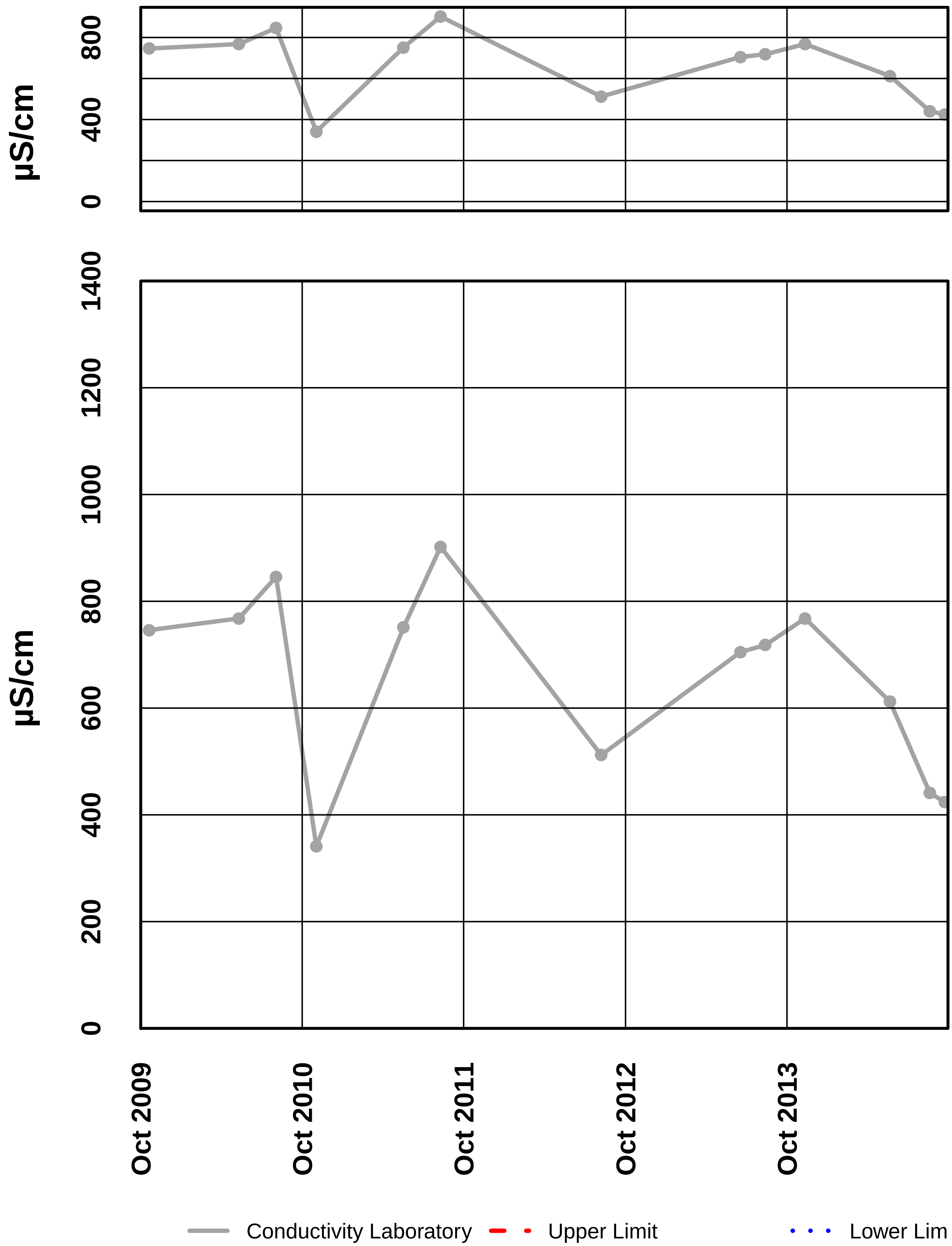
| Site No. | Sample Date | Sample Time | Parameter | Value | Qualifier | Reason for Qualifier |
|---|---|---|---|---|---|---|
| 013FMS | 11/11/2013 | 12:00 PM | Diss. Cd-ICP/MS | 0.0087 | J | Below Quantitative Range |
| | | | Diss. Pb-ICP/MS | 0.00597 | J | Below Quantitative Range |
| | | | Diss. Se-ICP/MS | 0.2 | J | Below Quantitative Range |
| | | | pH | 7.82 | J | Hold Time Violation |
| 013FMS | 5/22/2014 | 12:00 PM | Diss. Cd-ICP/MS | 0.00834 | J | Below Quantitative Range |
| | | | Diss. Hg-CVAF | 0.000664 | J | LCS Recovery |
| | | | Diss. Pb-ICP/MS | 0.00574 | J | Below Quantitative Range |
| | | | Sulfate | 258 | J | Sample Receipt Temperature |
| 013FMS | 8/20/2014 | 12:00 PM | Diss. Ag-ICP/MS | 0.00387 | U | Field Blank Contamination |
| | | | Diss. Se-ICP/MS | 0.14 | J | Below Quantitative Range |

## Site 13 – Water Temperature

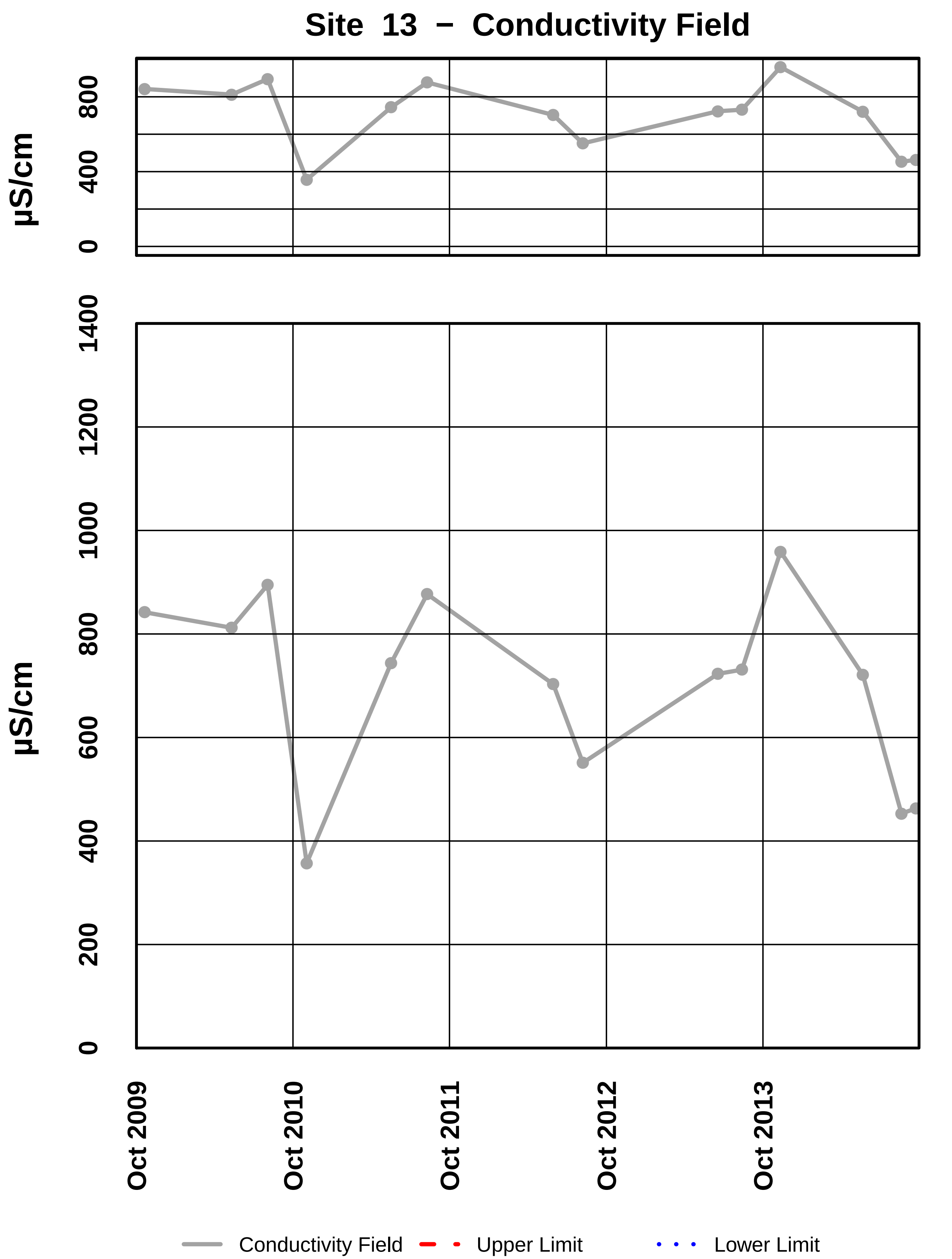



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

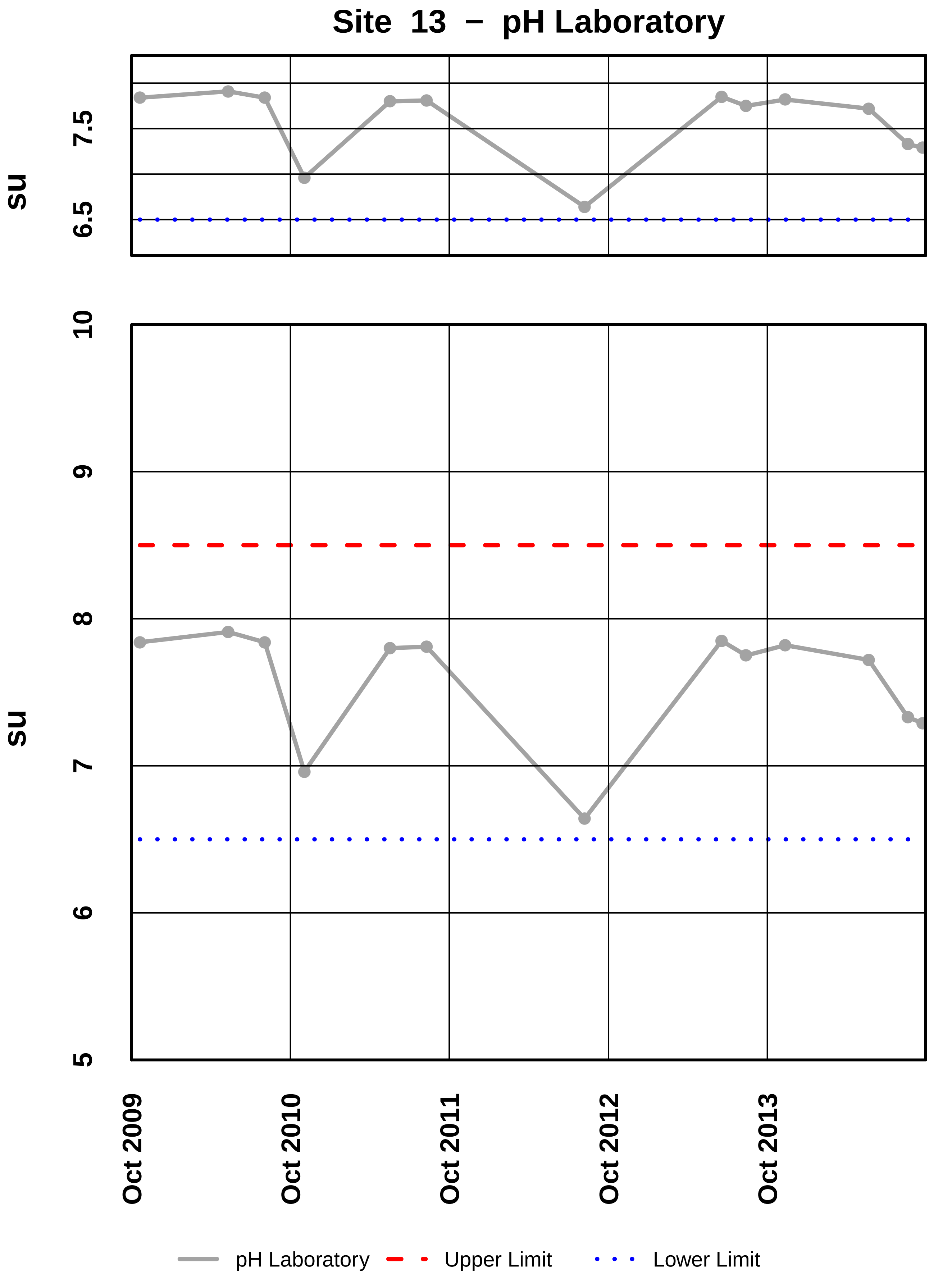
## Site 13 − Conductivity Laboratory



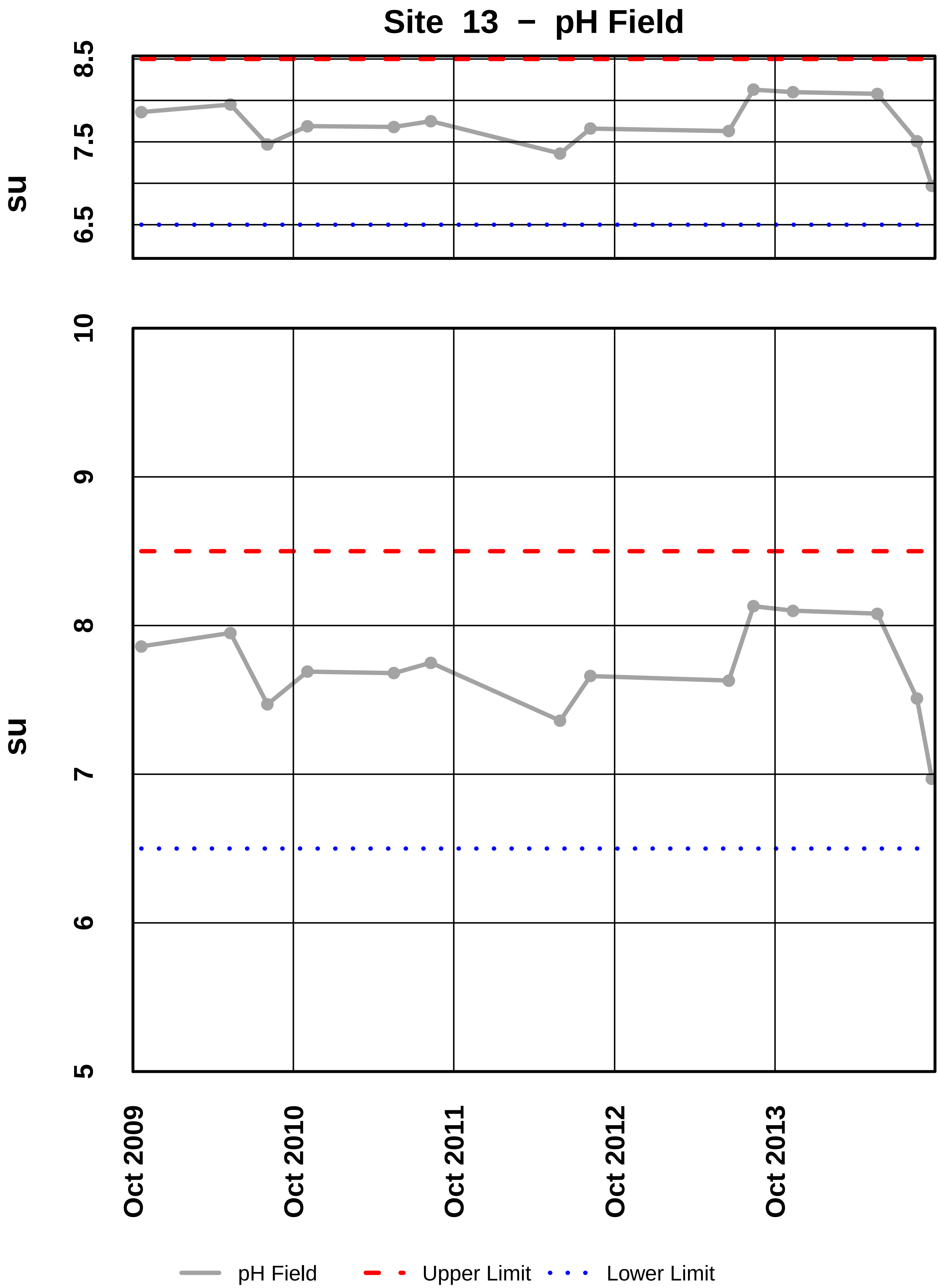

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



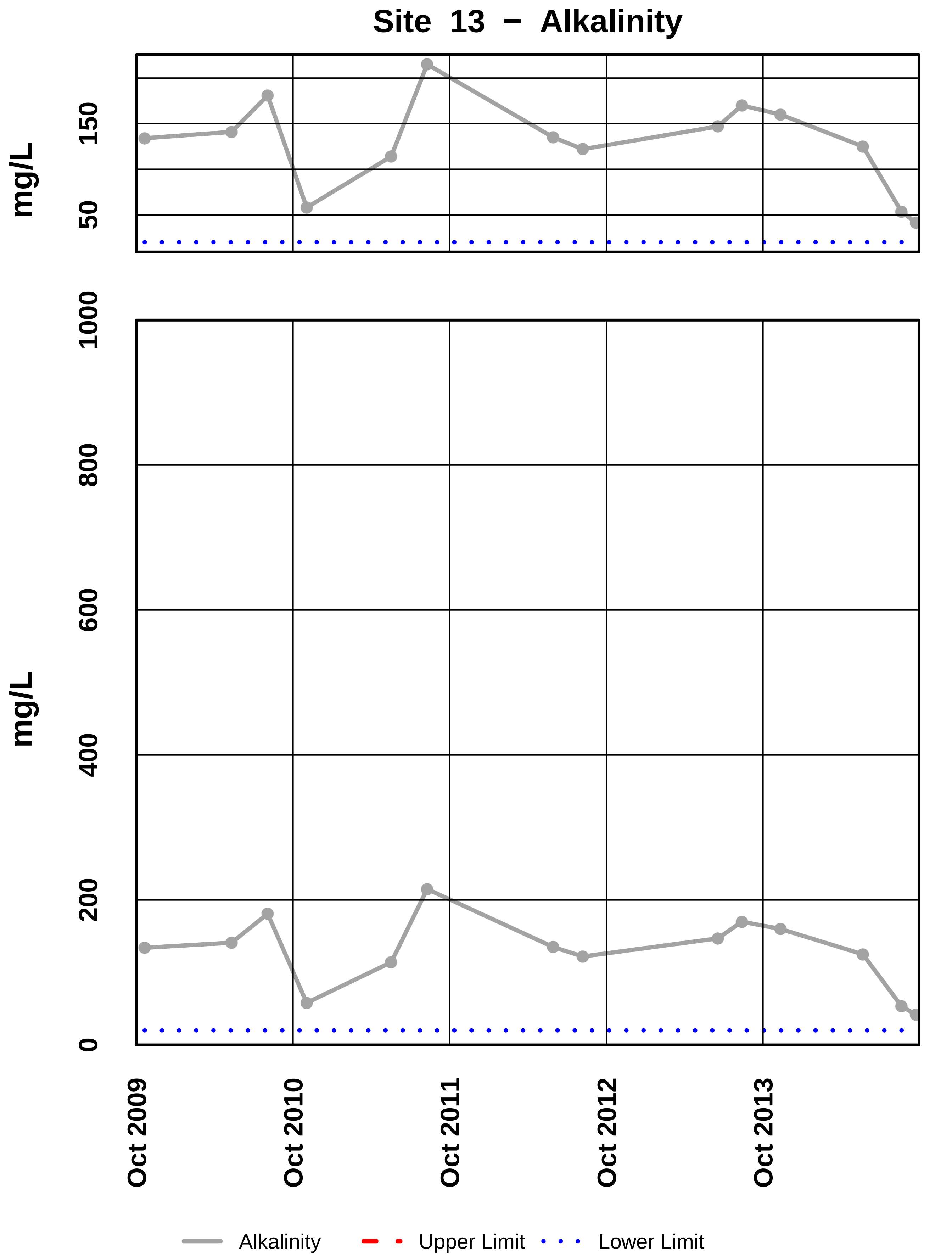

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

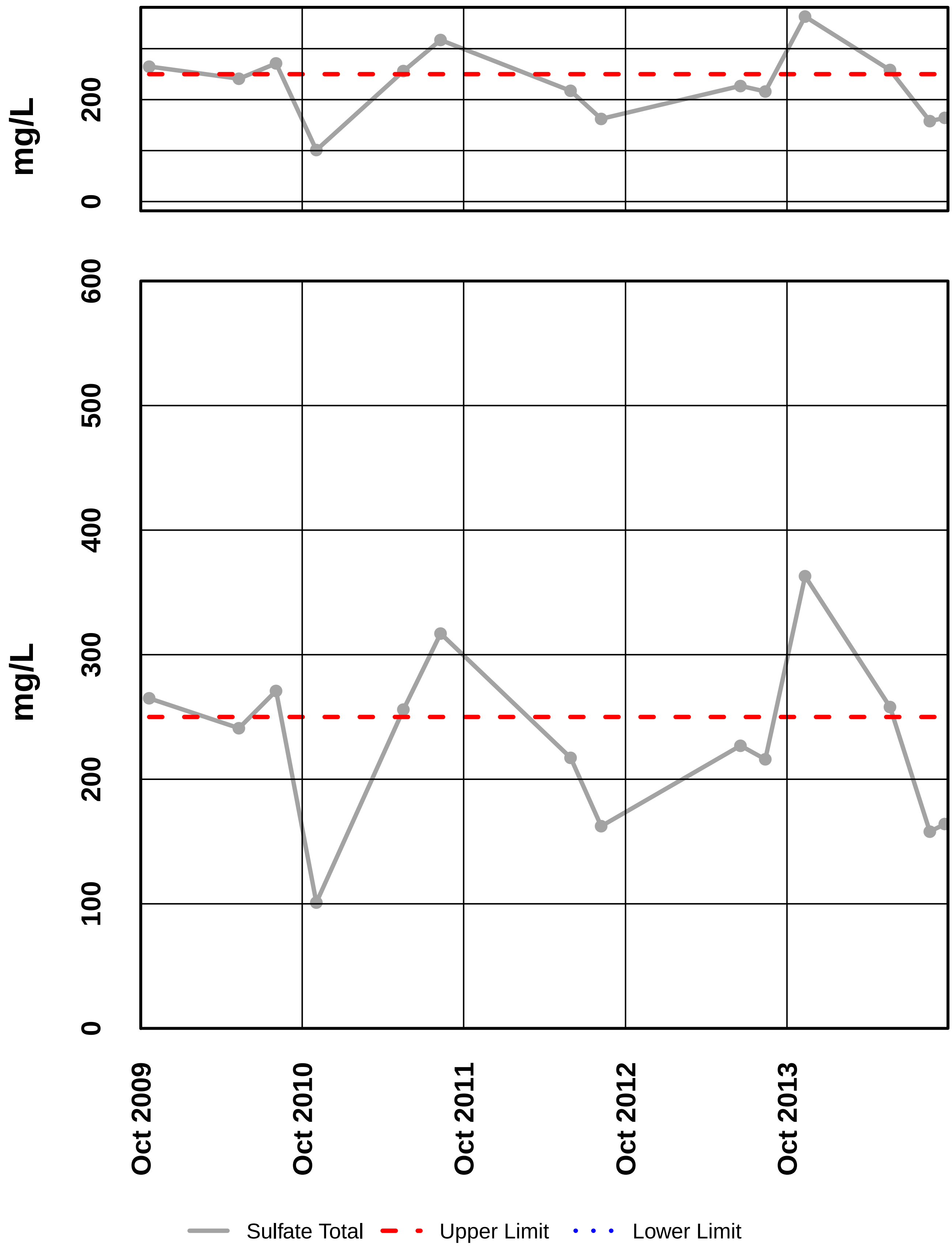



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



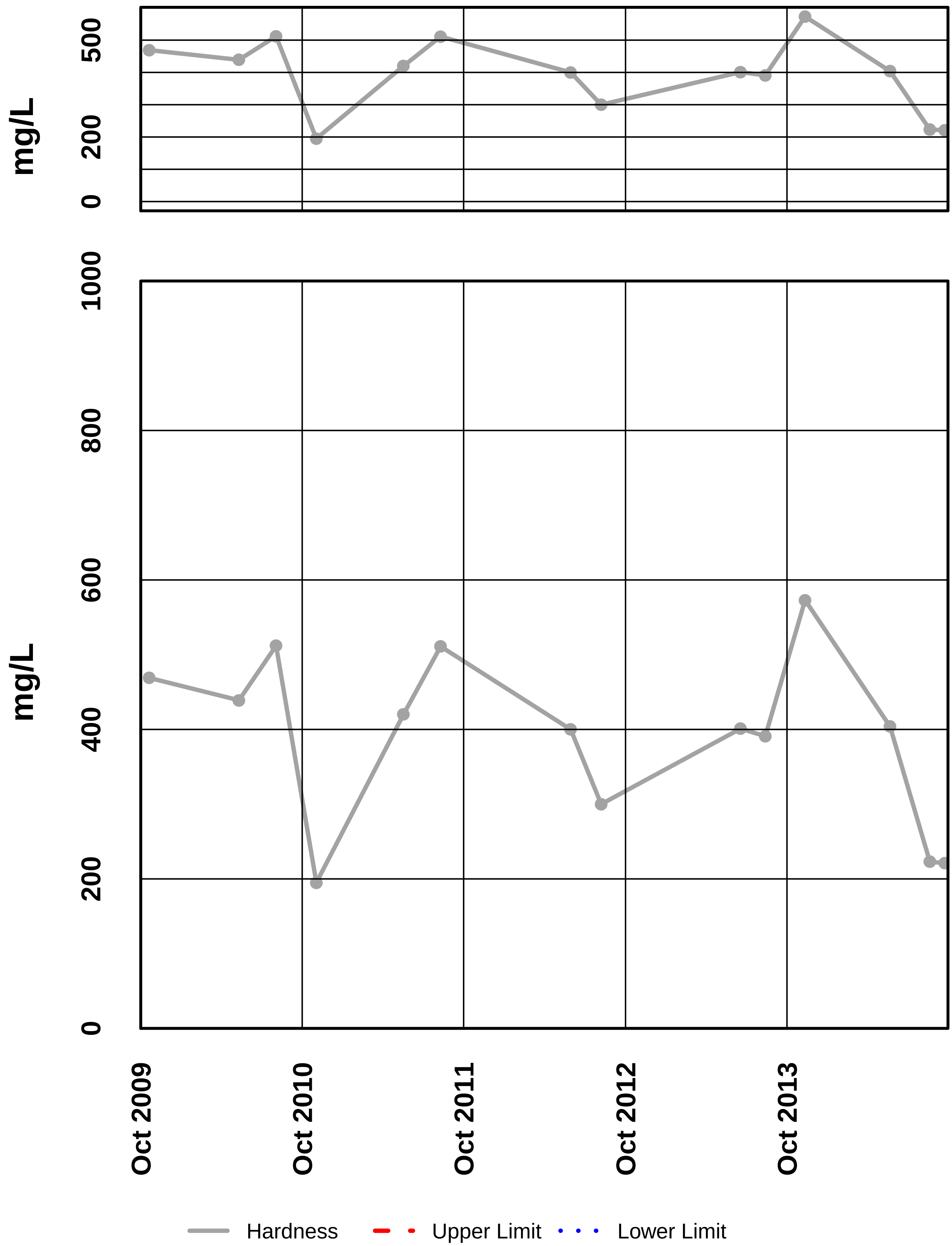

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

## Site 13 – Sulfate Total

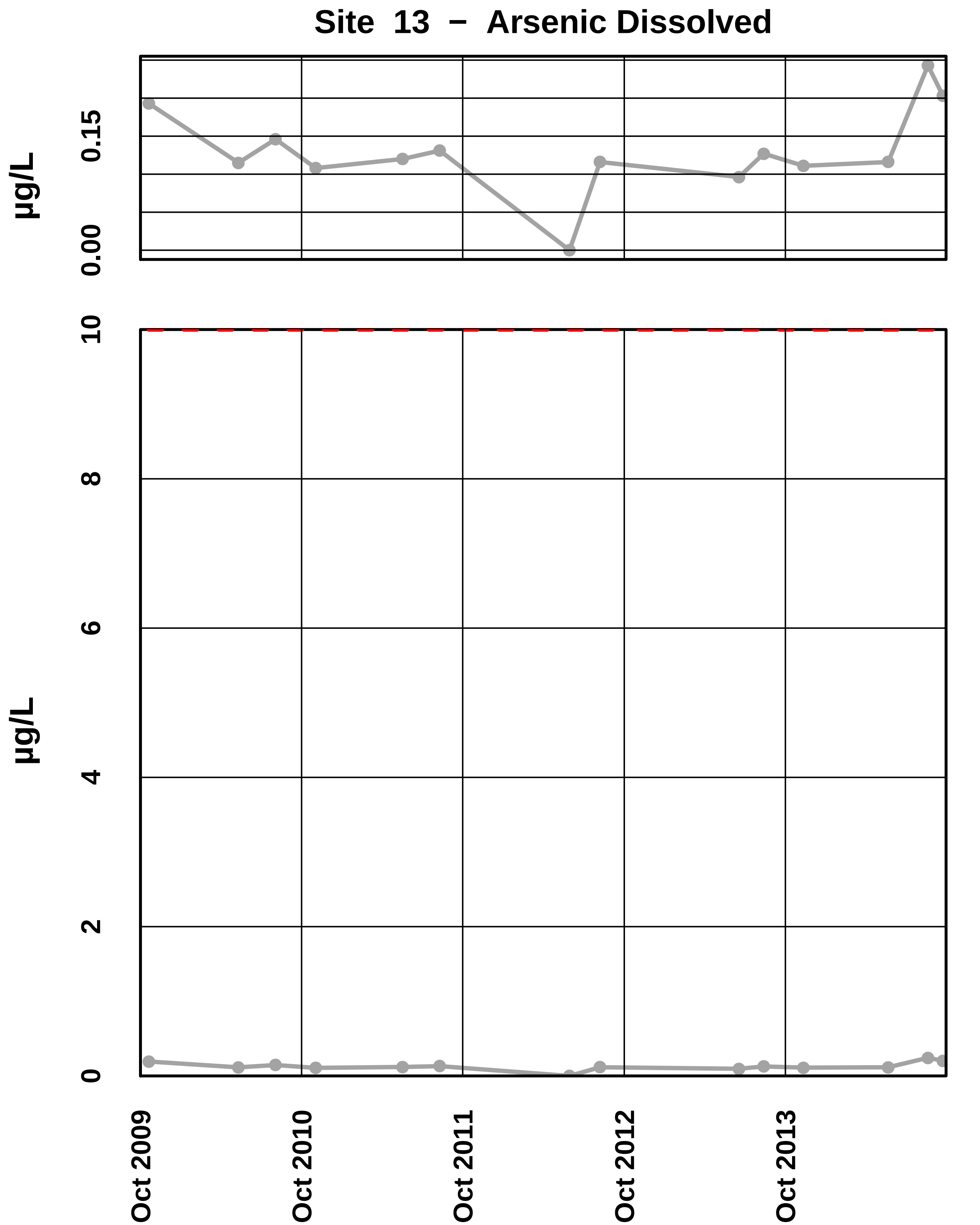



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# Site 13 – Hardness

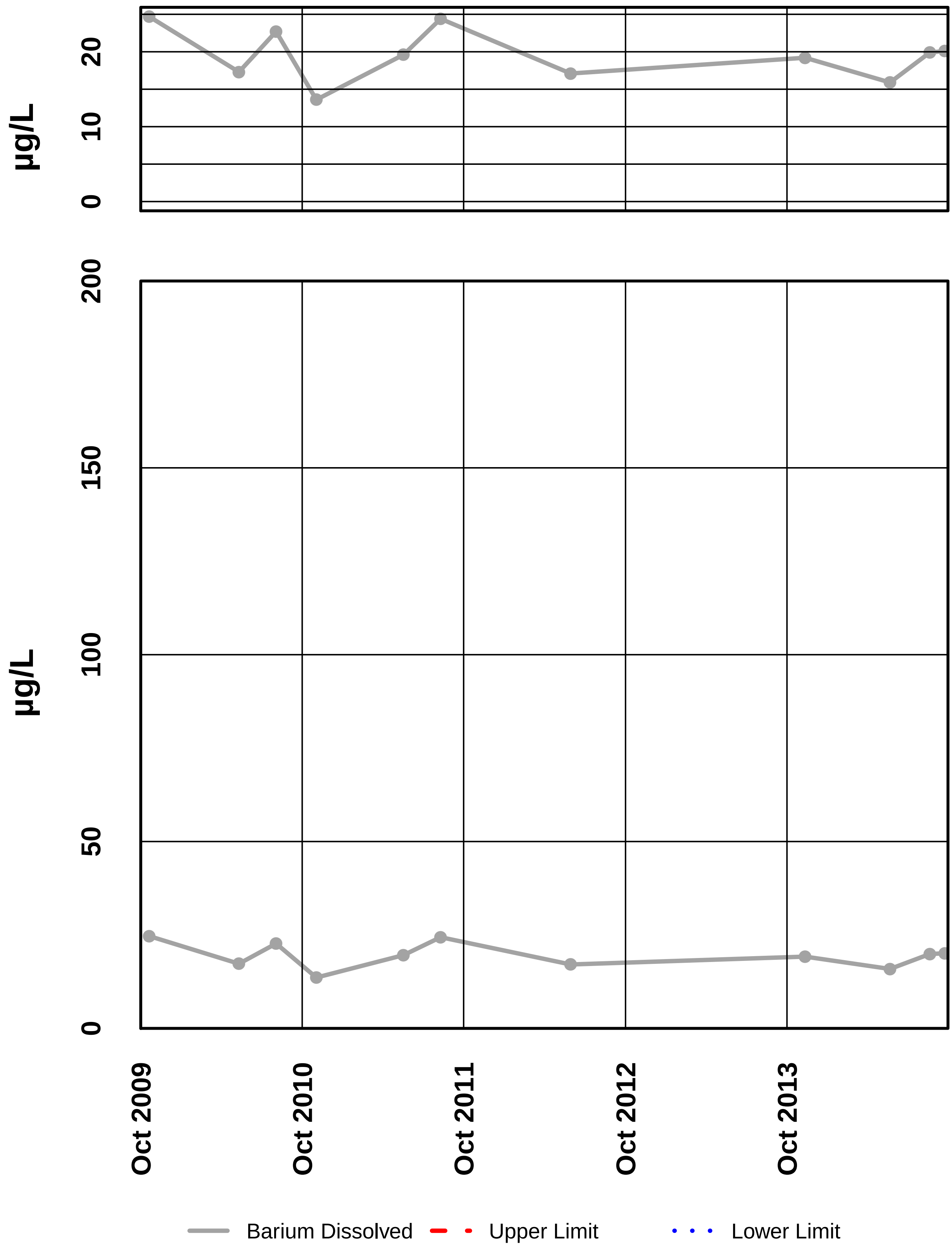



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

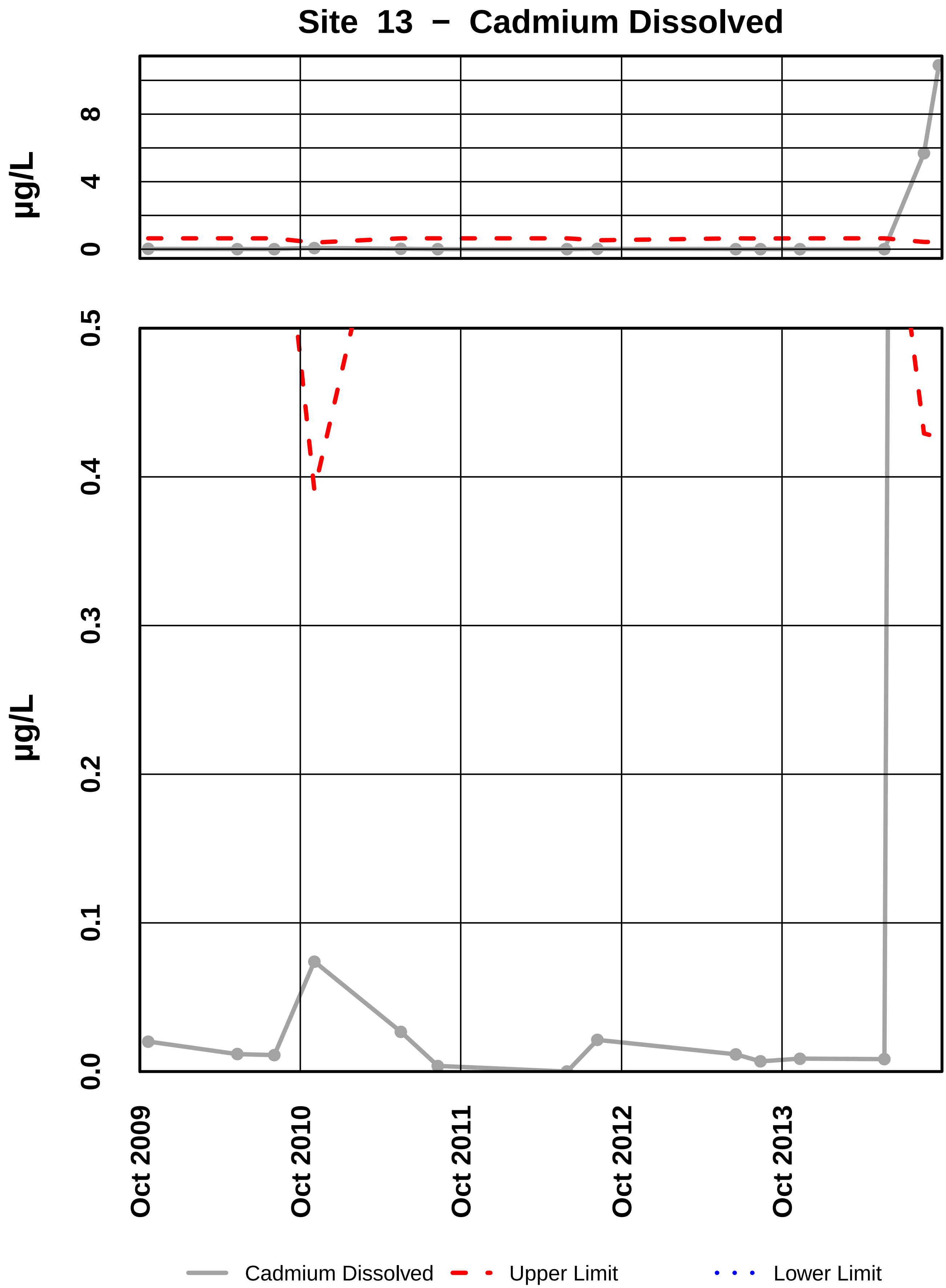



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 13 – Barium Dissolved

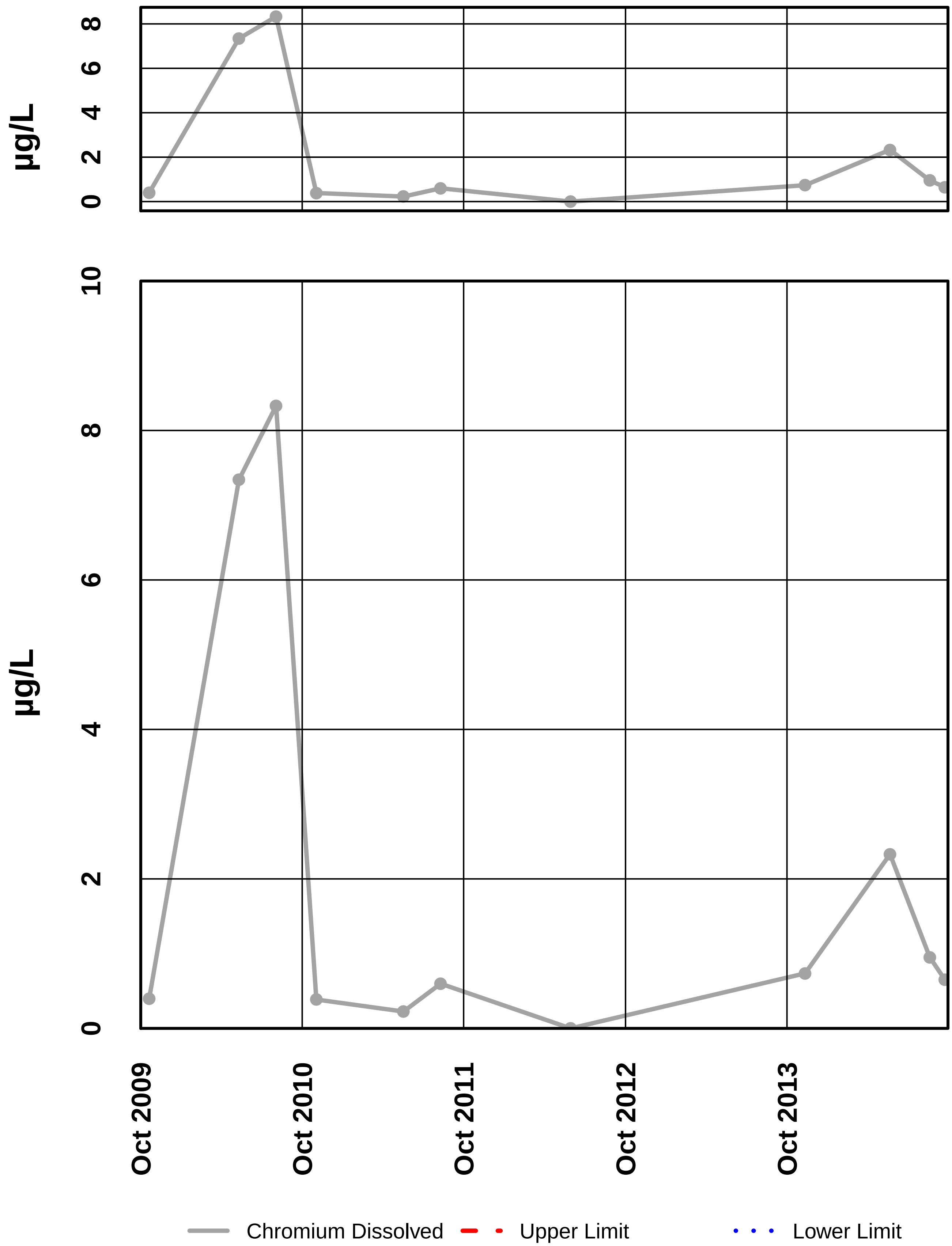



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



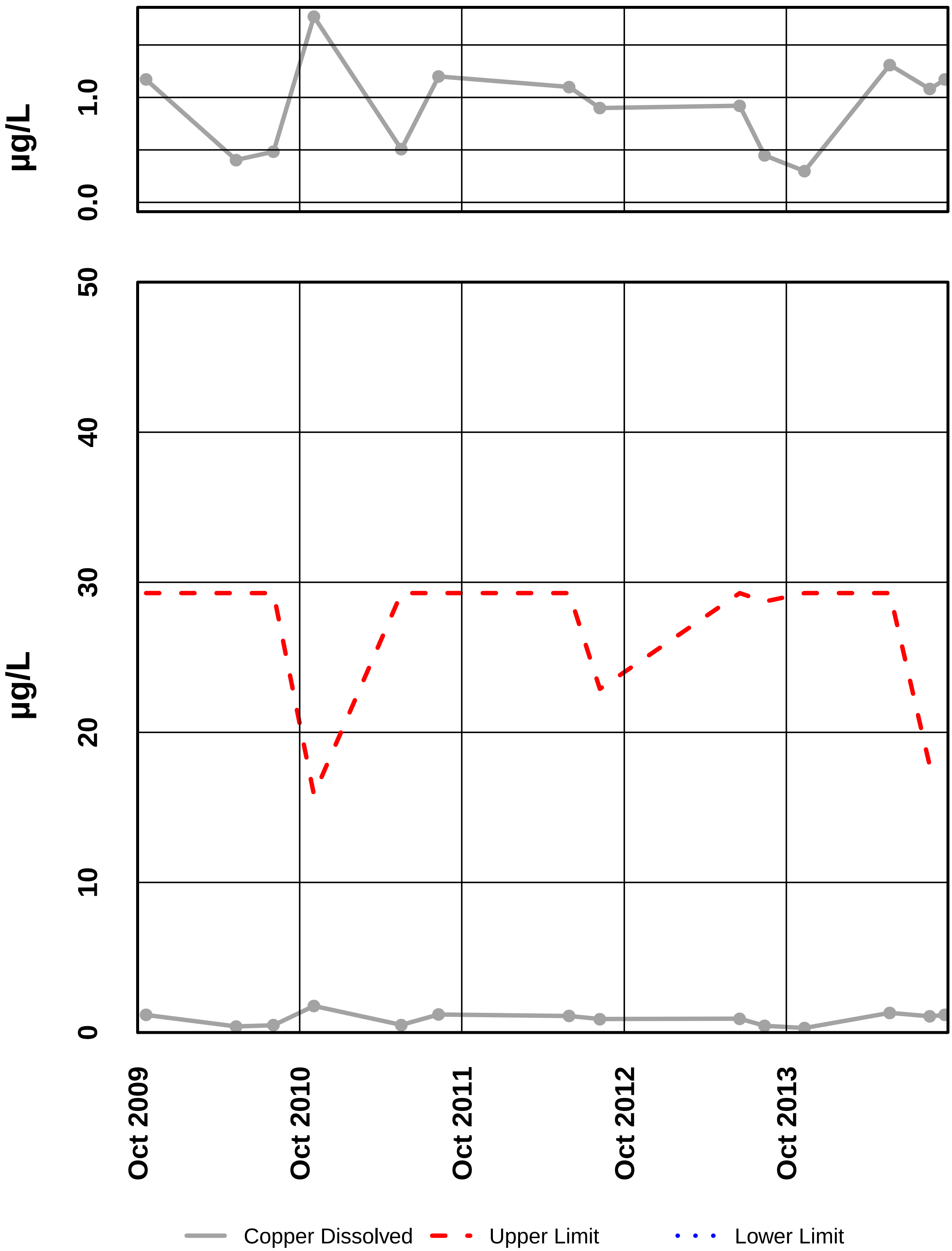

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

## Site 13 – Chromium Dissolved



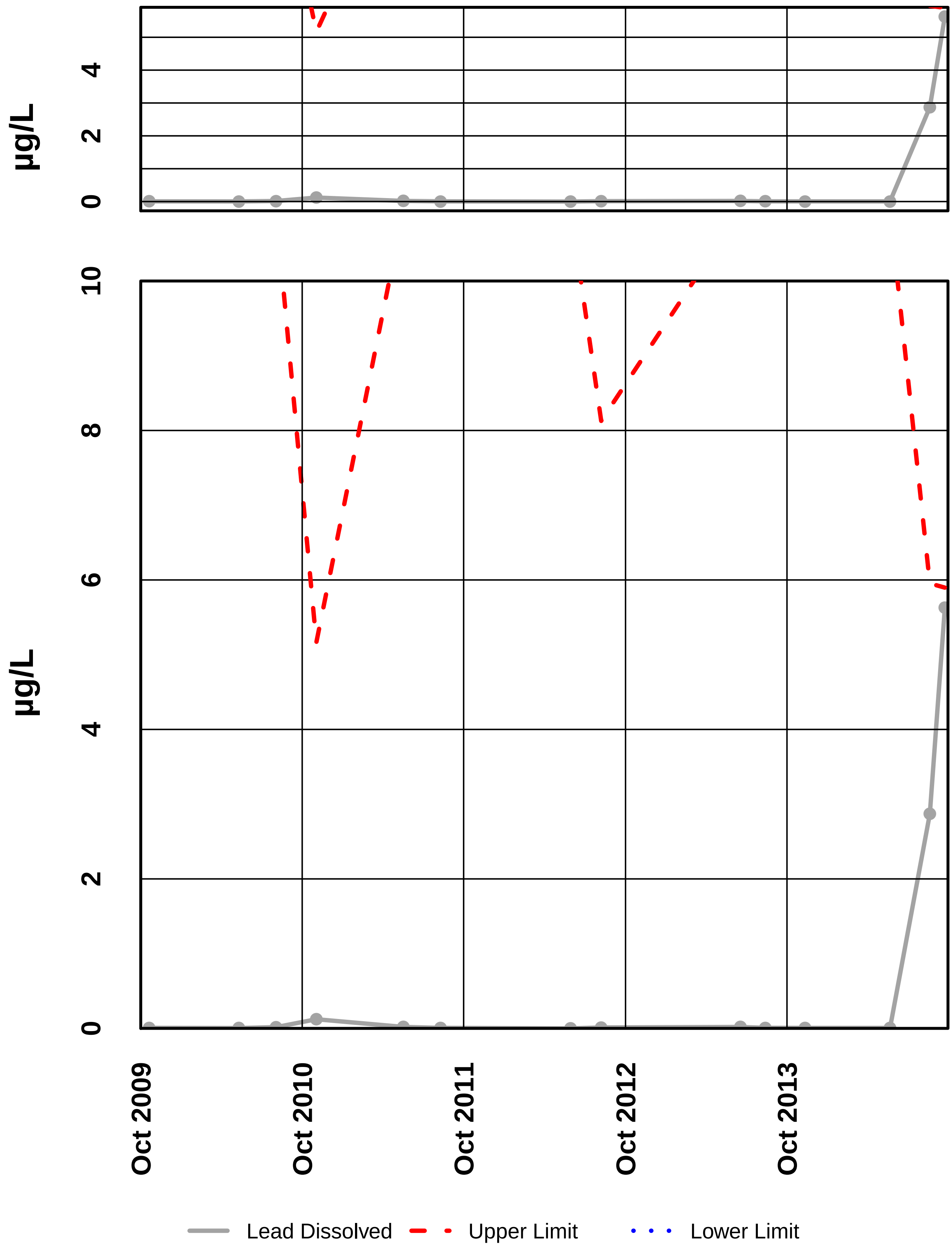

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# Site 13 − Copper Dissolved



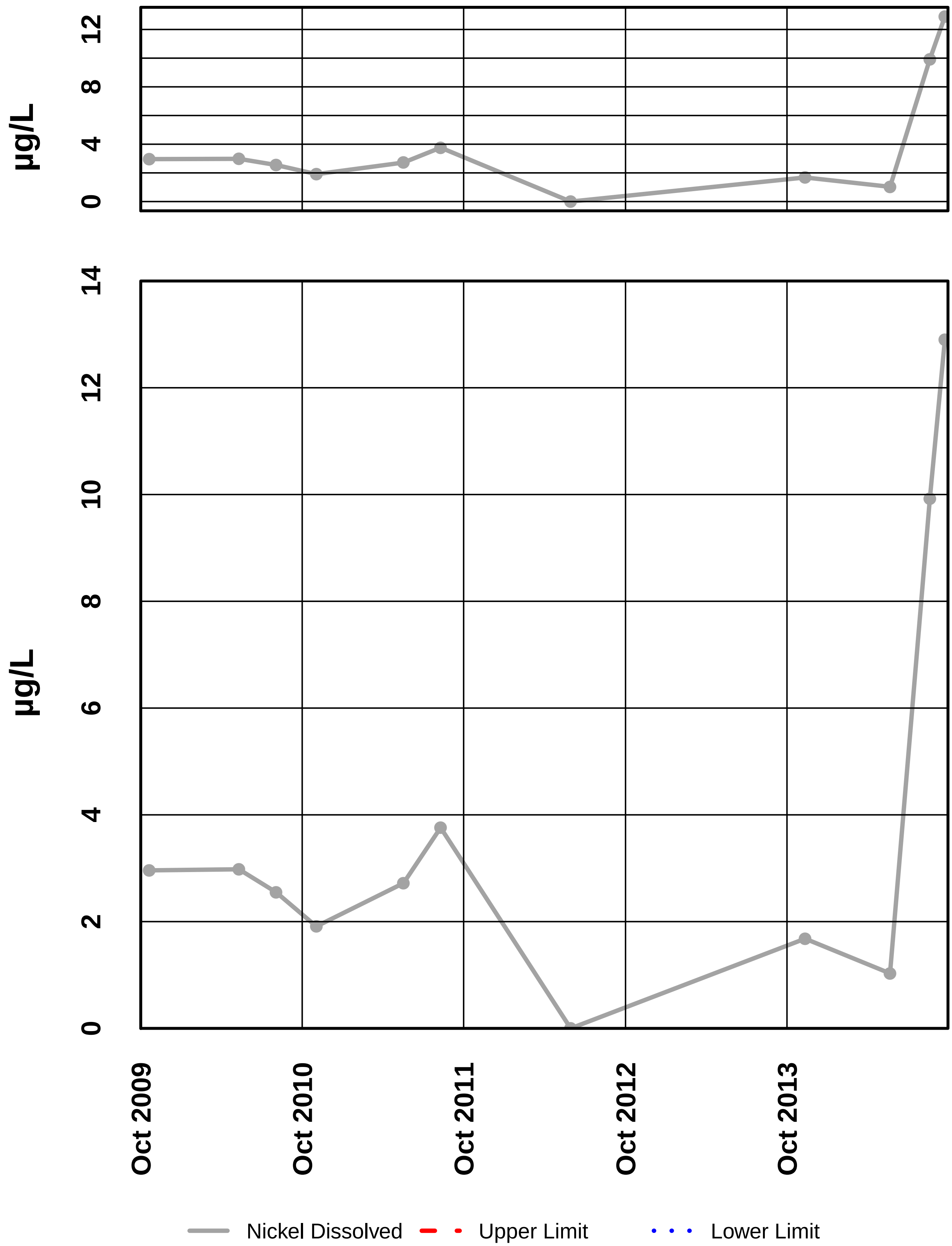

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

## Site 13 − Lead Dissolved

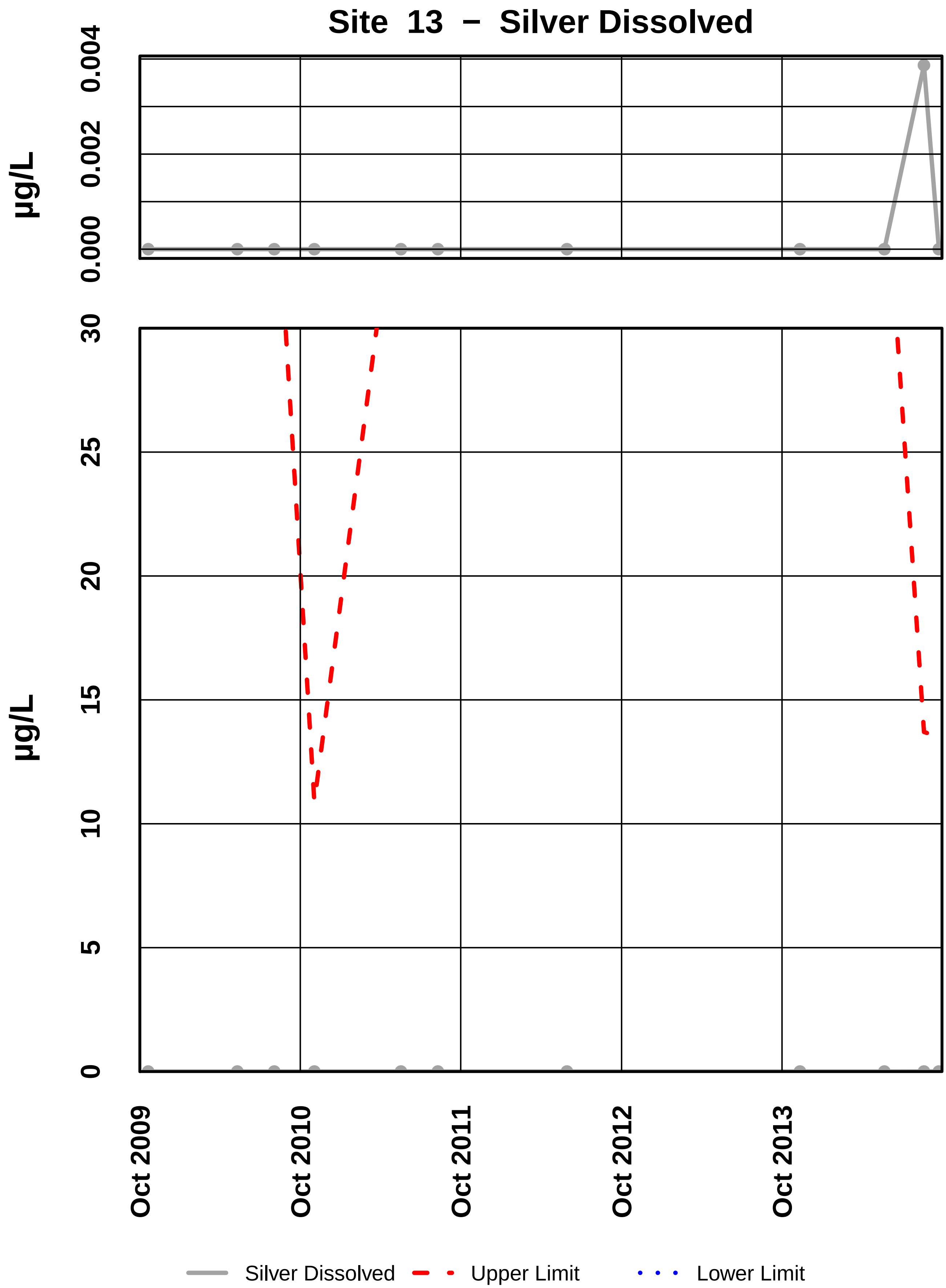



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

## Site 13 – Nickel Dissolved




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

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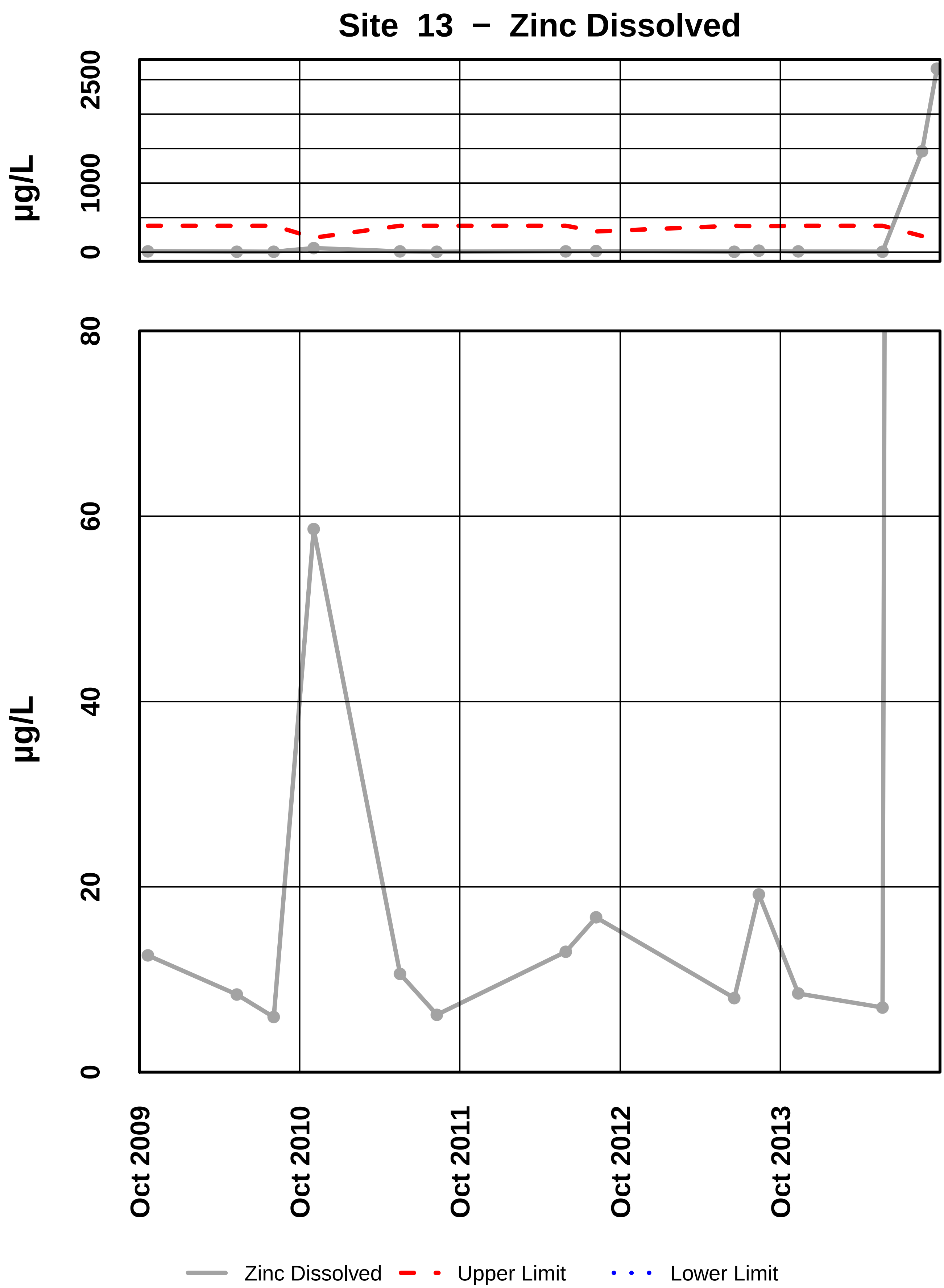
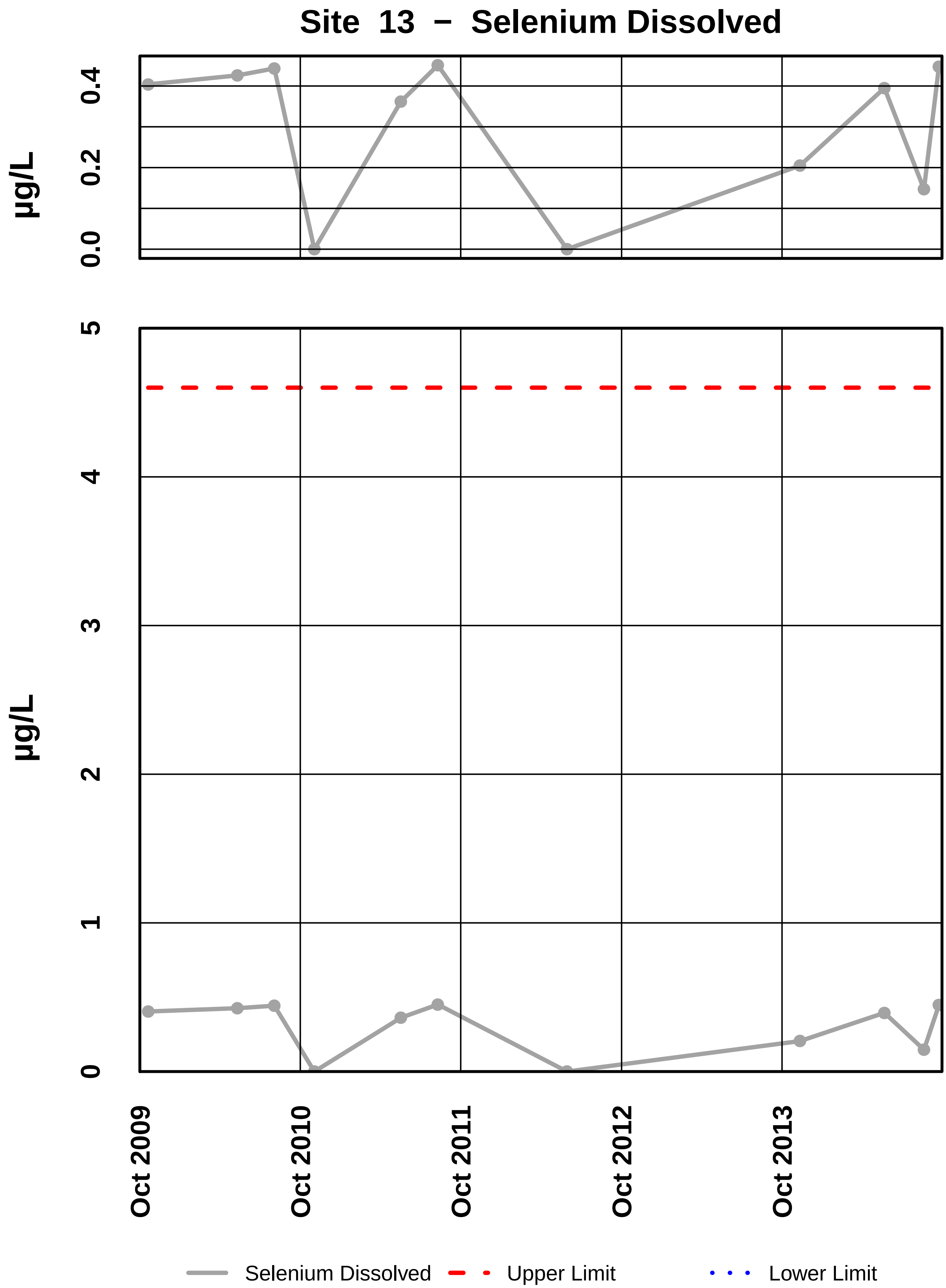
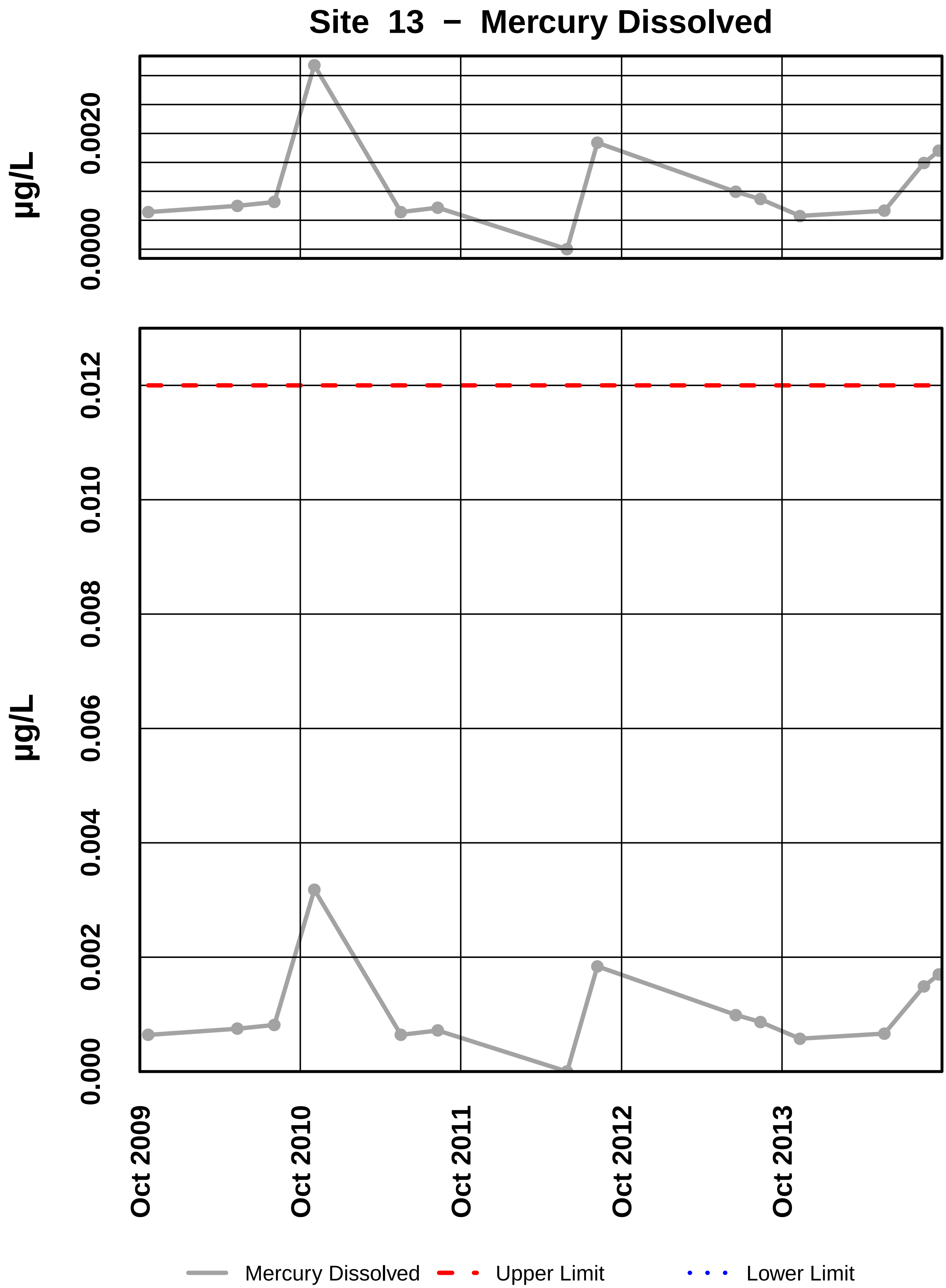



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# INTERPRETIVE REPORT
# SITE 27

The data collected during the current water year are listed in the following “Table of Results for Water Year 2014” report. The table includes all the required FWMP analyte data (field and laboratory) collected for the current water year and a series of flags keyed to the summary report “Qualified Data by QA Reviewer”. The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of ½ MDL for the purpose of median calculation.

All data collected at this site for the past six years are included in the data analyses. As shown in the table below, there were no data outliers.

| Sample Date | Parameter | Value | Qualifier | Notes |
|---|---|---|---|---|
| No outliers have been identified by HGCMC for the period of October 2008 through September 2014. | | | | |

The data for Water Year 2014 have been compared to the strictest fresh water quality criterion for each applicable analyte.  Three samples exceeding these criteria have been identified, as listed in the table below. The exceedances were for field pH values which are below the lower limit of 6.5 su listed in the AWQS. Values for field pH from other wells completed into organic rich peat sediments similar to Site 27 have historically resulted in pH values ranging from 5 to 6 su (*e.g.* Sites 58, 29, and 32).  All of the other analytes were within AWQS for the current water year.

**Table of Exceedance for Water Year 2014**

| | | | Limits | | |
|---|---|---|---|---|---|
| Sample Date | Parameter | Value | Lower | Upper | Hardness |
| 12-May-14 | pH Field | 5.87 su | 6.5 | 8.5 | |
| 15-Jul-14 | pH Field | 6.1 su | 6.5 | 8.5 | |
| 17-Sep-14 | pH Field | 6.21 su | 6.5 | 8.5 | |

X-Y plots have been generated to graphically present the data for each of the analytes requested in the Statistical Information Goals for this site. These plots have been visually analyzed for the appearance of any trend in concentration. Visually the increasing trend in total sulfate values, which started in 2008, has since ‘leveled’ off. The maximum value recorded was 34.8mg/L in October 2009, during the current water year the mean value recorded was 9.2 µg/L which is slightly more than doubled from the 2006 through 2008 water years.

Non-parametric statistical analyses were performed for specific conductivity, field pH, total alkalinity, total sulfate, and dissolved zinc. Calculation details of the Seasonal Kendall analyses are presented in detail on the pages following this interpretive section. The below table summarizes the results on the data collected between Oct-08 and Sep-14(WY2009-WY2014).

**Table of Summary Statistics for Trend Analysis**

| | Mann-Kendall test statistics | | | Sen's slope estimate | |
|---|---|---|---|---|---|
| **Parameter** | **n*** | **p**** | **Trend** | **Q** | **Q(%)** |
| Conductivity Field | 6 | 0.50 | | | |
| pH Field | 6 | 0.16 | | | |
| Alkalinity, Total | 6 | <0.01 | + | 3.067 | 9.9 |
| Sulfate, Total | 6 | 0.08 | | | |
| Zinc, Dissolved | 6 | 0.01 | - | -0.477 | -29.8 |

* Number of Years ** Significance level

For datasets with a statistically significant trend ($\alpha/2=2.5\%$) a Seasonal-Sen's Slope estimate statistic has also been calculated. The dataset for total alkalinity has a statistically significant (p <0.01) trend with a slope estimate of 3.07mg/L/yr or a 9.9% increase over the last 6 years. Over the same period dissolved the statistically significant trend with dissolved zinc was decreasing by 0.48 mg/L /yr. With the changes that were made to the FWMP monitoring schedule (*i.e.* increase sampling frequency), HGCMC feels that the FWMP program is sufficient to monitor further changes, before the AWQS are exceeded.

An intra-well analysis was performed using combined Shewhart-CUSUM charts for conductivity, dissolved zinc, and total sulfate. Table 1 contains a summary of the baseline statistics along with the control limits used.

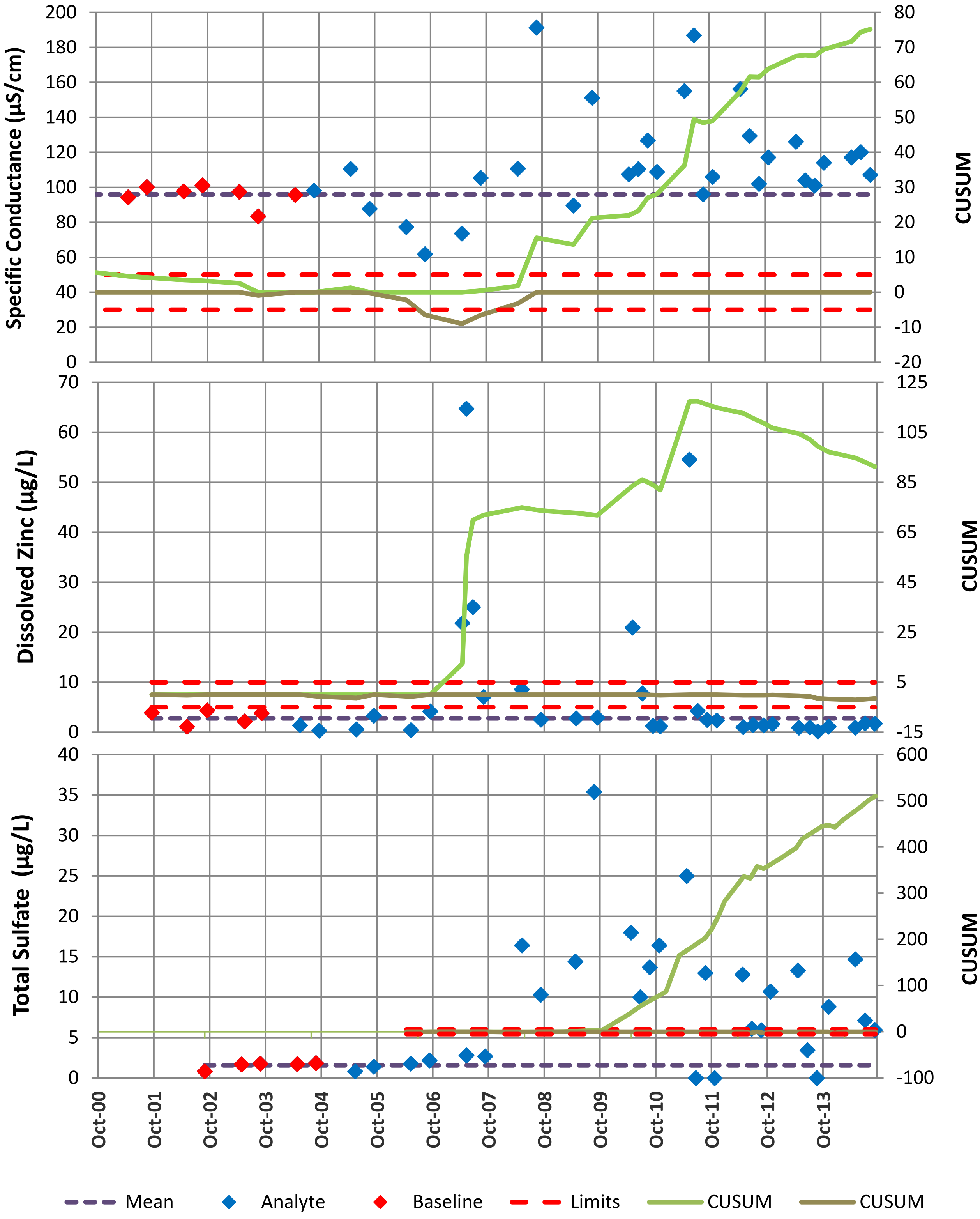
**Table 1.** **Specific Conductance, Dissolved Zinc, and Total Sulfate Baseline Periods, Summary Statistics and Various Control Limits**

| | Site 27 Conductivity (µS/cm) | Site 27 Diss. Zinc (µg/L) | Site 27 Total Sulfate (mg/L) |
|---|---|---|---|
| **Baseline Statistics** | | | |
| Baseline Period | 09/18/01-05/18/04 | 09/18/01-05/18/04 | 09/17/02-09/21/04 |
| Number of Samples | 6 | 6 | 5 |
| Mean (x) | 95.88 | 2.78 | 1.56 |
| Standard Deviation | 6.43 | 1.42 | 0.43 |
| **Shewhart-CUSUM Control Limits (SCL)** | | | |
| Control Limit (mean x+ 2s) | 108.6 | 5.6 | 2.4 |
| Control Limit (mean x + 3s) | 115.5 | 7.0 | 2.8 |
| Control Limit (mean x + 4s) | 122.3 | 8.4 | 3.3 |
| Control Limit (mean x + 4.5s) | 125.7 | 9.2 | 3.5 |
| **CUSUM Control Limits** | | | |
| Cumulative increase – h | 5 | 5 | 5 |

Figure 1 shows the three analytes examined eventually went out of control. Total sulfate went out of control during the water year 2008. This has been discussed in previous reports and is related to the material that was placed to the east of Pond 7 to form a pad. The fill material originated from the North End expansion of the tailings facility and from the figure it appears that there was some easily weathered sulfide mineralogy in the freshly blasted material. Total sulfate concentration initially continued to rise, but now are trending downward. This is captured in the decreasing slope of the CUSUM values; as the values return to pre-disturbance conditions the CUSUM value will flatten off. As discussed with other sites it can take a long time to bring the value back below the limit. Specific conductance also went out of control in water 2008 as would be expected with the increase in total sulfate driving the increase in conductivity.

Dissolved zinc went out of control beginning in water year 2007. After the first increase in water year 2007 concentrations returned to near baseline levels resulting in the flattening of the CUSUM values. Then water years 2010 and 2011 each had dissolved zinc concentrations that further increased the CUSUM value. Since the fall of 2011 the CUSUM measurement has been trending downward indicating that the concentrations are around the baseline mean.

**Figure 1.** **Observed Measurements for Specific Conductance, Dissolved Zinc, and Total Sulfate from Site 27 Compared to the Shewhart-CUSUM Control Limits From Table 1**



## Table of Results for Water Year 2014

### Site 027FMG - 'Monitoring Well - 2S'

| Sample Date/Parameter | Oct 2013 | Nov 2013 | Dec 2013 | Jan 2014 | Feb 2014 | Mar 2014 | Apr 2014 | May 2014 | Jun 2014 | Jul 2014 | Aug 2014 | Sep 2014 | **Median** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Water Temp (°C) | | 5.1 | | | | | | 7.9 | | 13.2 | | 11.1 | 9.5 |
| Conductivity-Field(μmho) | | 114 | | | | | | 117 | | 120 | | 107.1 | 115.5 |
| Conductivity-Lab (μmho) | | 105 | | | | | | 112 | | 101 | | 94 | 103 |
| pH Lab (standard units) | | 5.98 | | | | | | 5.74 | | 5.87 | | 6.01 | 5.93 |
| pH Field (standard units) | | 6.58 | | | | | | 5.87 | | 6.1 | | 6.21 | 6.16 |
| Total Alkalinity (mg/L) | | 36.5 | | | | | | 31.1 | | 37.1 | | 35.6 | 36.1 |
| Total Sulfate (mg/L) | | 8.8 | | | | | | 14.7 | | 7.1 | | 6 | 8.0 |
| Hardness (mg/L) | | 29.6 | | | | | | 29.9 | | 29 | | 28.2 | 29.3 |
| Dissolved As (ug/L) | | 3.16 | | | | | | 4.1 | | 4.3 | | 3.88 | 3.990 |
| Dissolved Ba (ug/L) | | 32.7 | | | | | | 40.1 | | 34.1 | | 38.2 | 36.2 |
| Dissolved Cd (ug/L) | | 0.0018 | | | | | | 0.0018 | | 0.0018 | | 0.0018 | 0.0018 |
| Dissolved Cr (ug/L) | | 0.987 | | | | | | 1.21 | | 1.45 | | 1.4 | 1.305 |
| Dissolved Cu (ug/L) | | 0.096 | | | | | | 0.098 | | 0.108 | | 0.106 | 0.102 |
| Dissolved Pb (ug/L) | | 0.0545 | | | | | | 0.115 | | 0.207 | | 0.124 | 0.1195 |
| Dissolved Ni (ug/L) | | 0.592 | | | | | | 0.618 | | 0.632 | | 0.58 | 0.605 |
| Dissolved Ag (ug/L) | | 0.002 | | | | | | 0.002 | | 0.002 | | 0.002 | 0.002 |
| Dissolved Zn (ug/L) | | 1.1 | | | | | | 0.89 | | 1.75 | | 1.69 | 1.40 |
| Dissolved Se (ug/L) | | 0.227 | | | | | | 0.083 | | 0.223 | | 0.133 | 0.178 |
| Dissolved Hg (ug/L) | | 0.000561 | | | | | | 0.00034 | | 0.000505 | | 0.000648 | 0.000533 |

For individual sample/analyte qualifier descriptions see "Qualified Data by QA Reviewer" table.

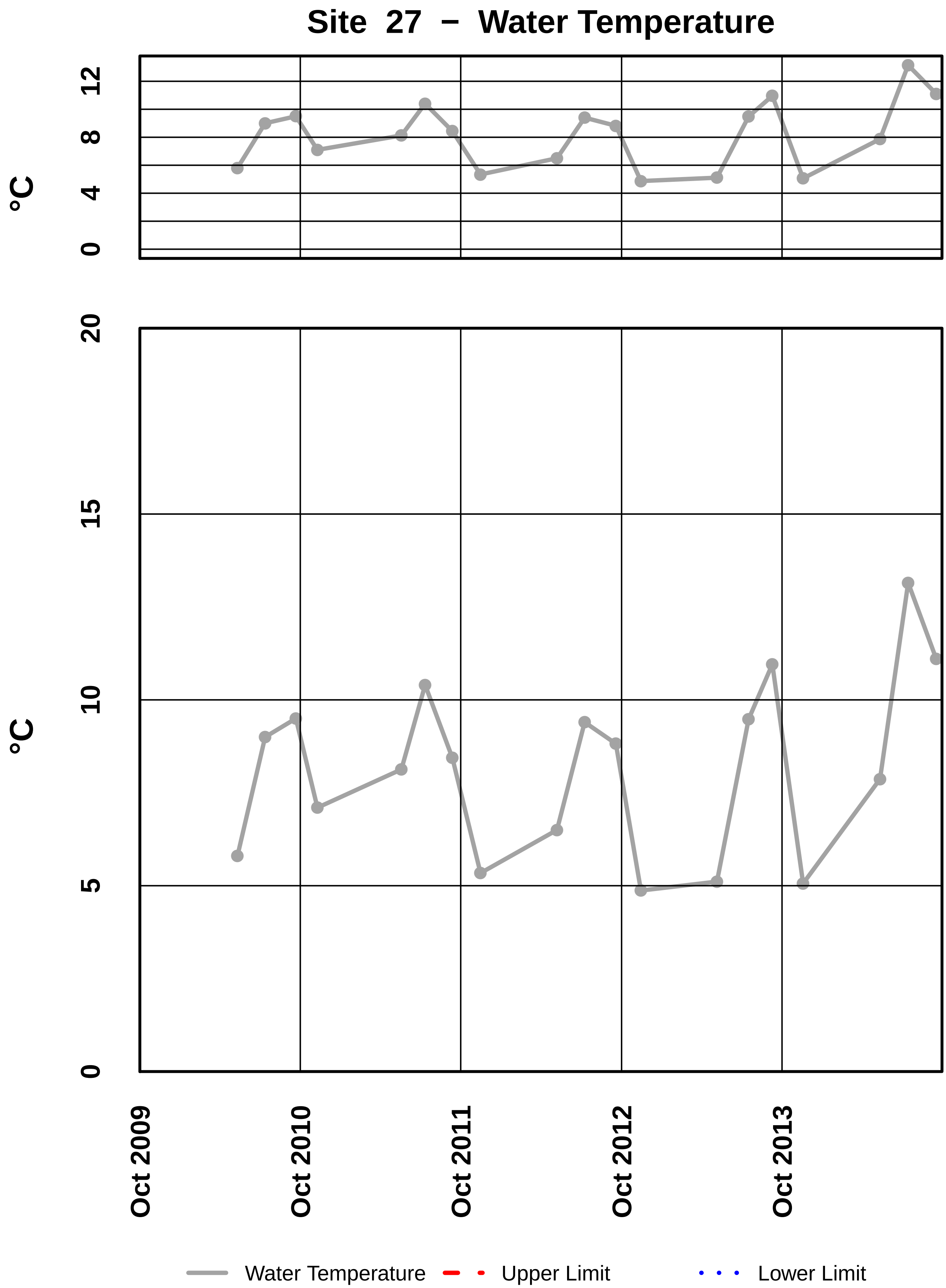
Values reported as less than MDL are replaced by 1/2 MDL for median calculation purposes.

Shaded data has been qualified as an outlier by HGCMC and removed from any further analysis and is not included into the calculation of the median

# Qualified Data by QA Reviewer

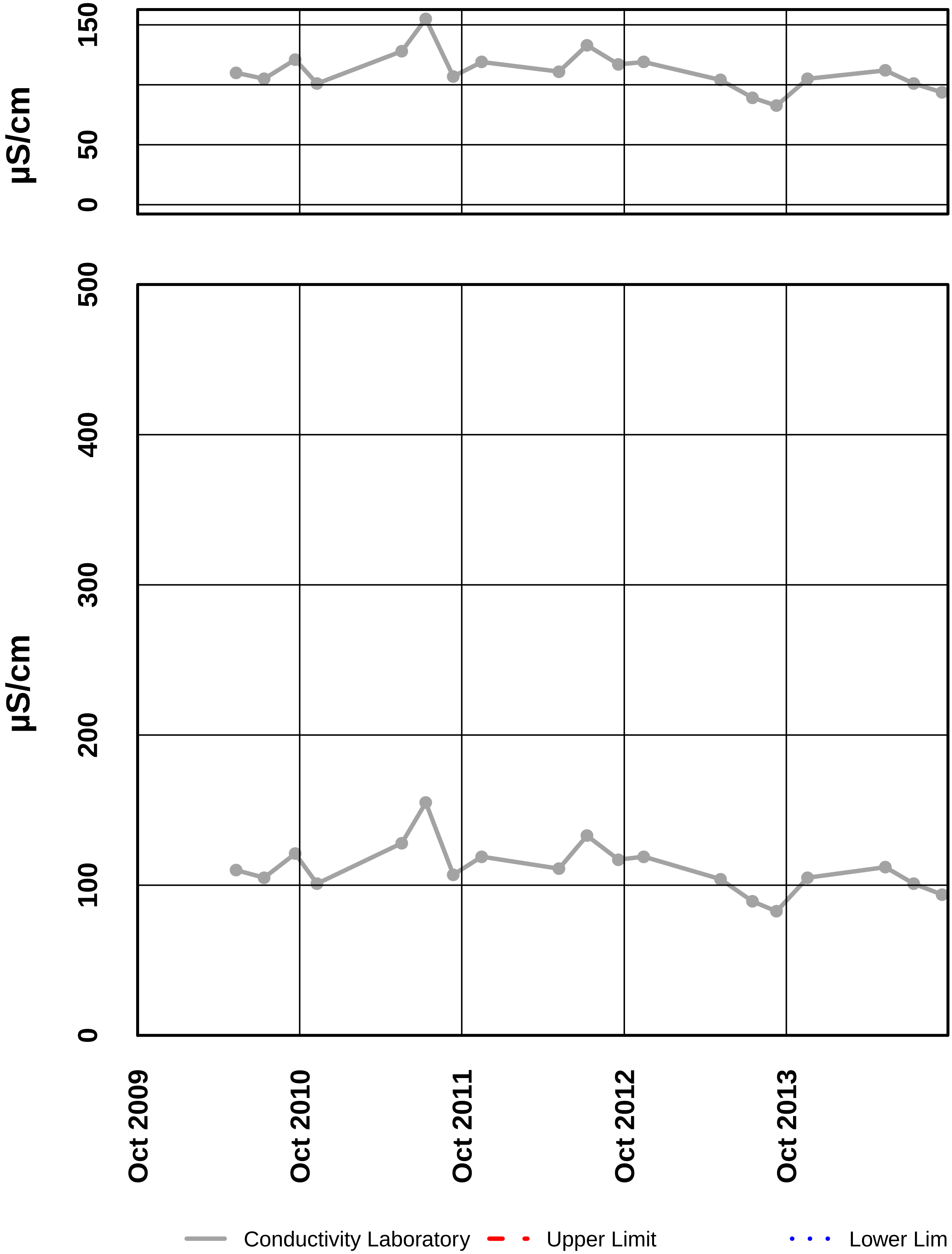
## Date Range: 10/01/2013 to 09/30/2014

| Site No. | Sample Date | Sample Time | Parameter | Value | Qualifier | Reason for Qualifier |
|---|---|---|---|---|---|---|
| 027FMG | 11/11/2013 | 12:00 PM | Diss. Hg-CVAF | 0.000283 | J | Below Quantitative Range |
| | | | pH | 7.58 | J | Hold Time Violation |
| 027FMG | 11/18/2013 | 12:00 PM | Diss. Se-ICP/MS | 0.22 | J | Below Quantitative Range |
| 027FMG | 5/12/2014 | 12:00 PM | Alkalinity | 31.1 | U | Trip Blank Contamination |
| | | | Conductivity | 112 | U | Trip Blank Contamination |
| | | | Diss. Se-ICP/MS | 0.08 | J | Below Quantitative Range |
| | | | Sulfate | 14.7 | J | Sample Receipt Temperature |
| 027FMG | 7/15/2014 | 12:00 PM | Diss. Se-ICP/MS | 0.22 | J | Below Quantitative Range |
| 027FMG | 9/17/2014 | 12:00 PM | Diss. Se-ICP/MS | 0.13 | J | Below Quantitative Range |



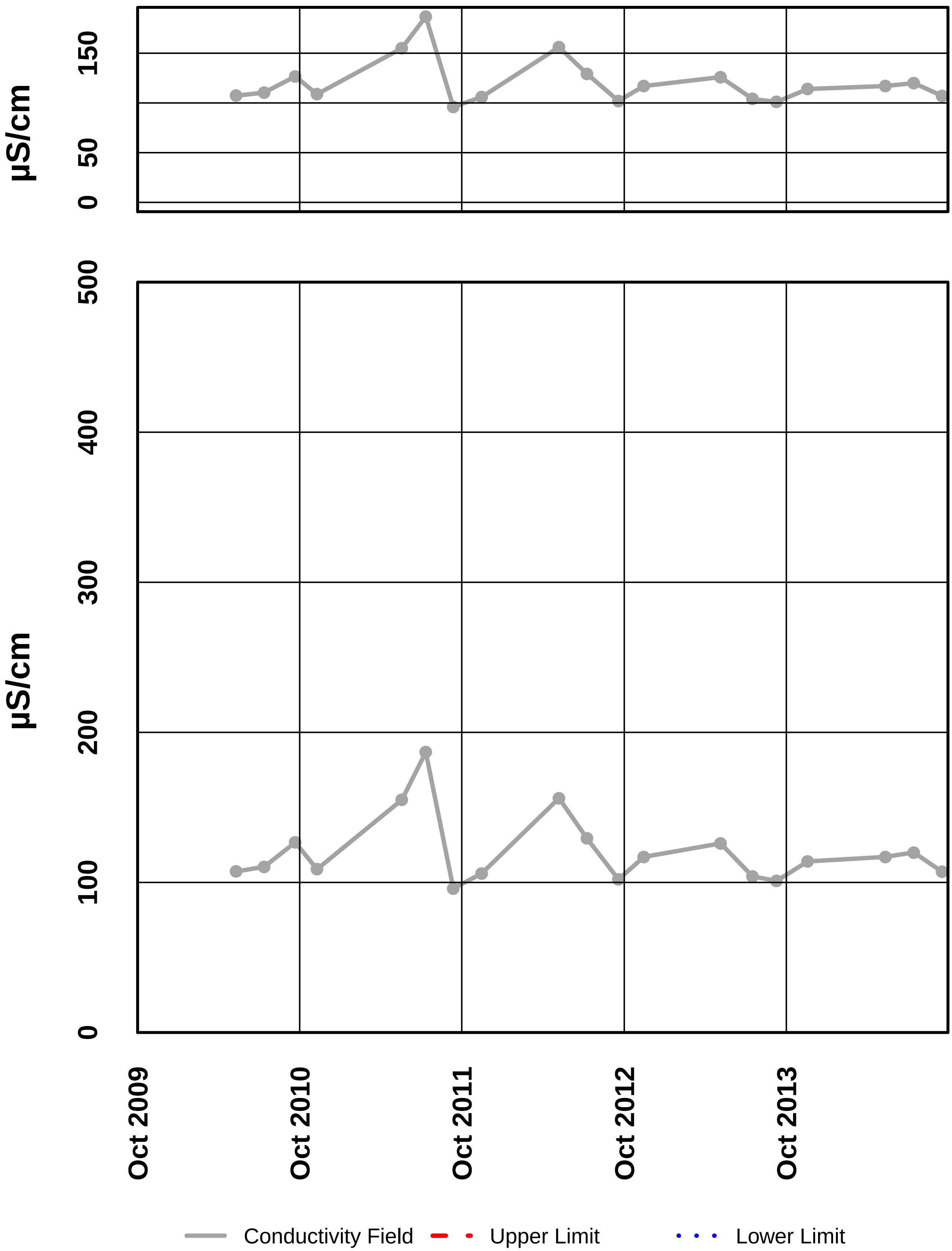

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

## Site 27 − Conductivity Laboratory



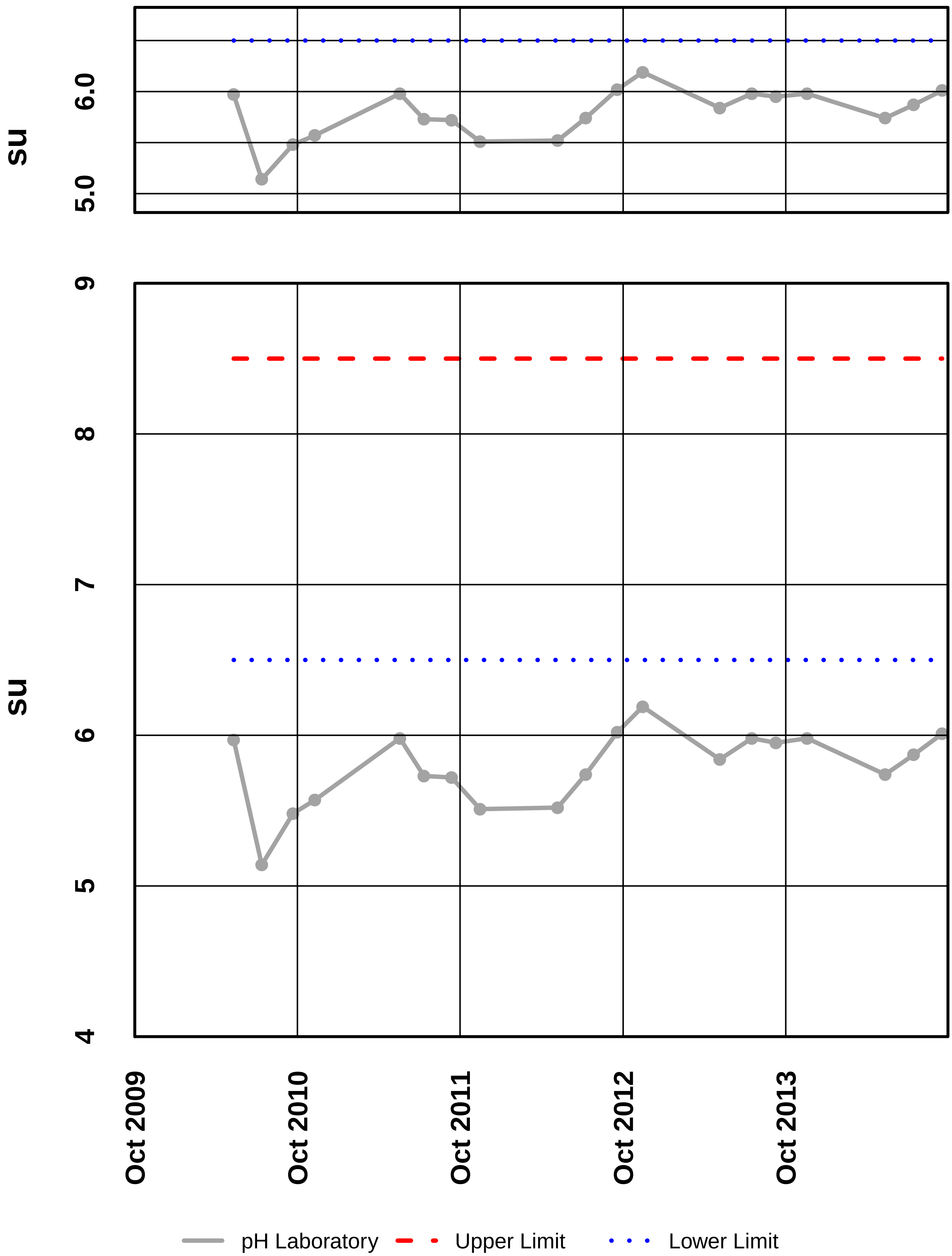

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# Site 27 – Conductivity Field

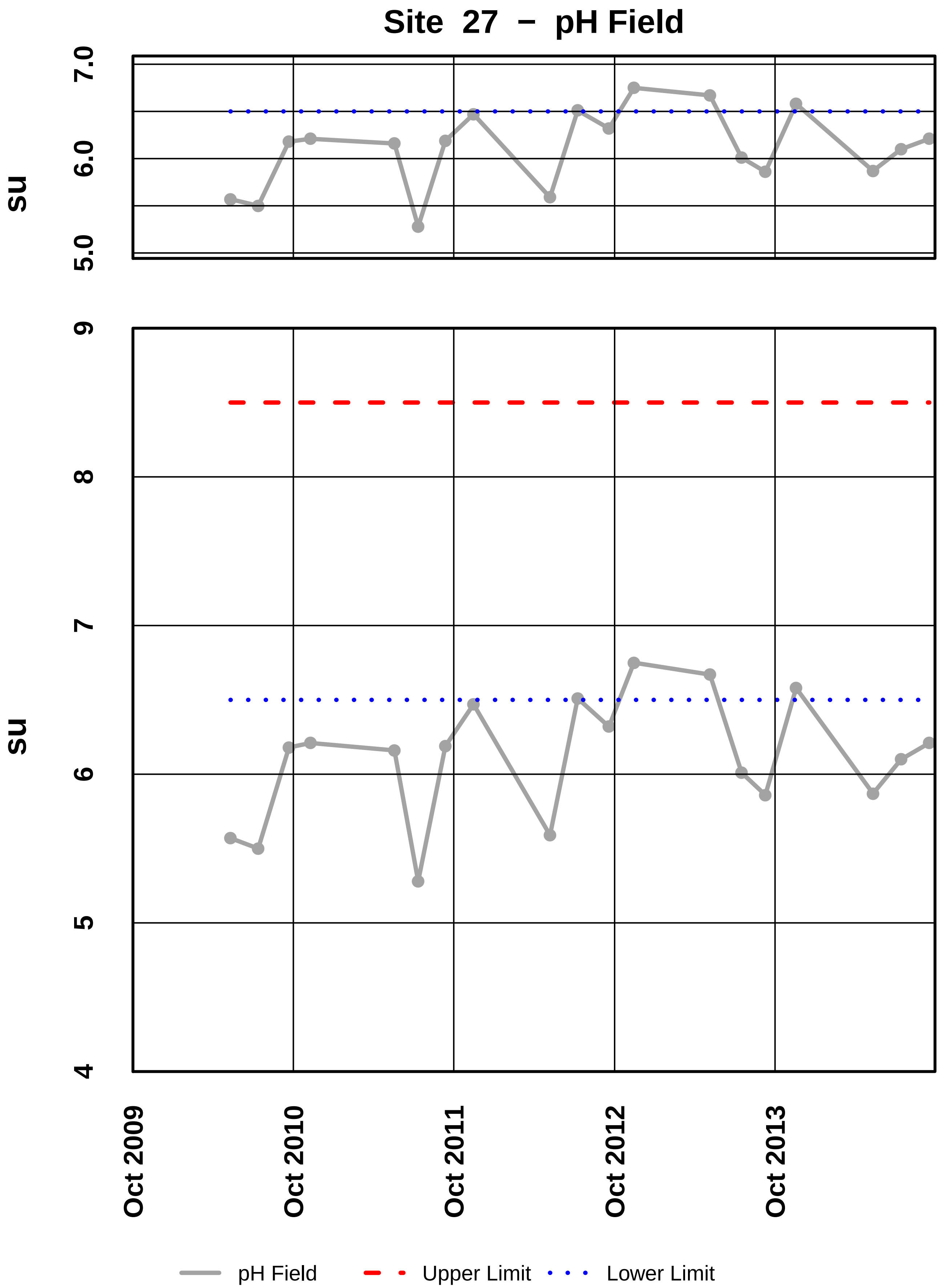



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

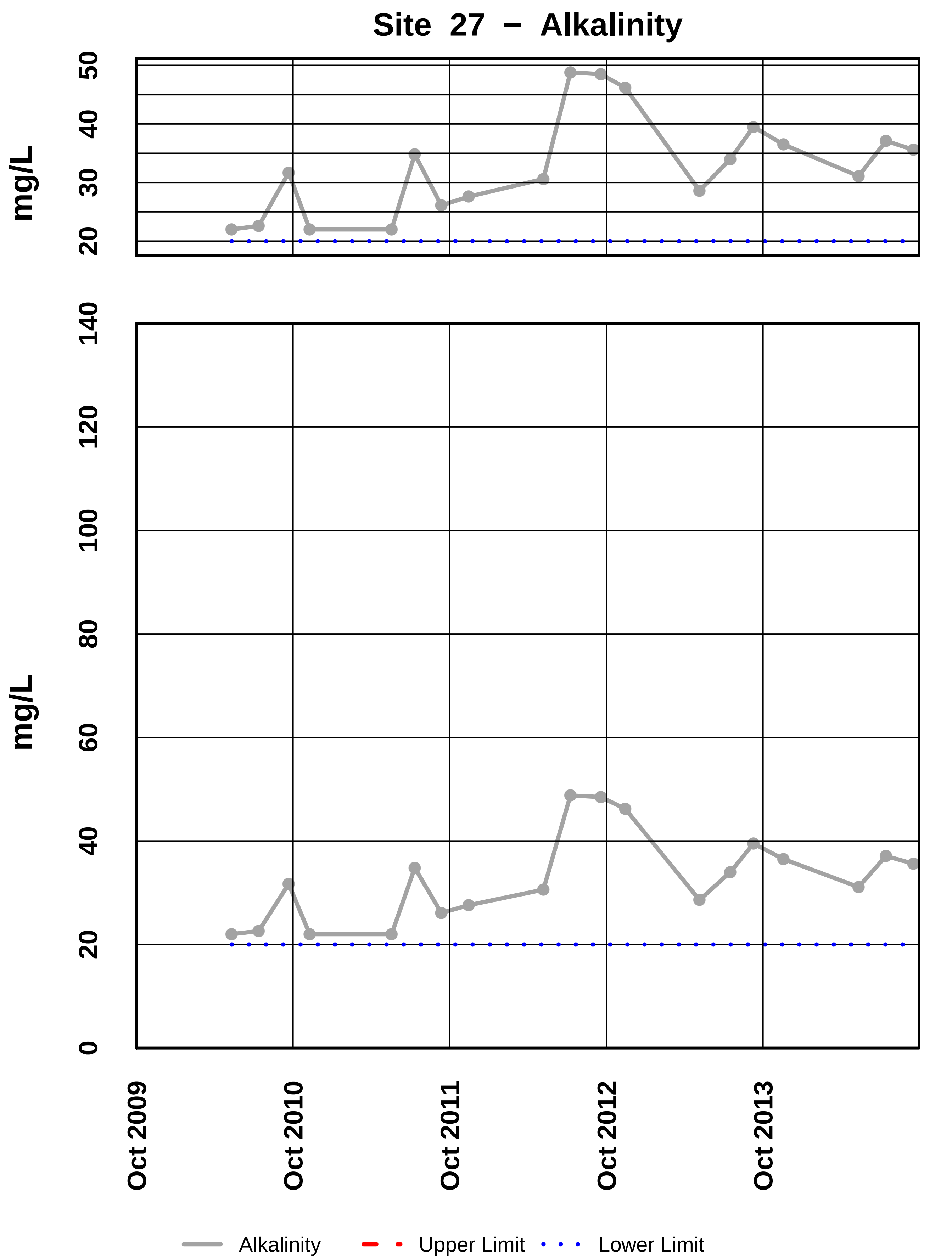
## Site 27 – pH Laboratory



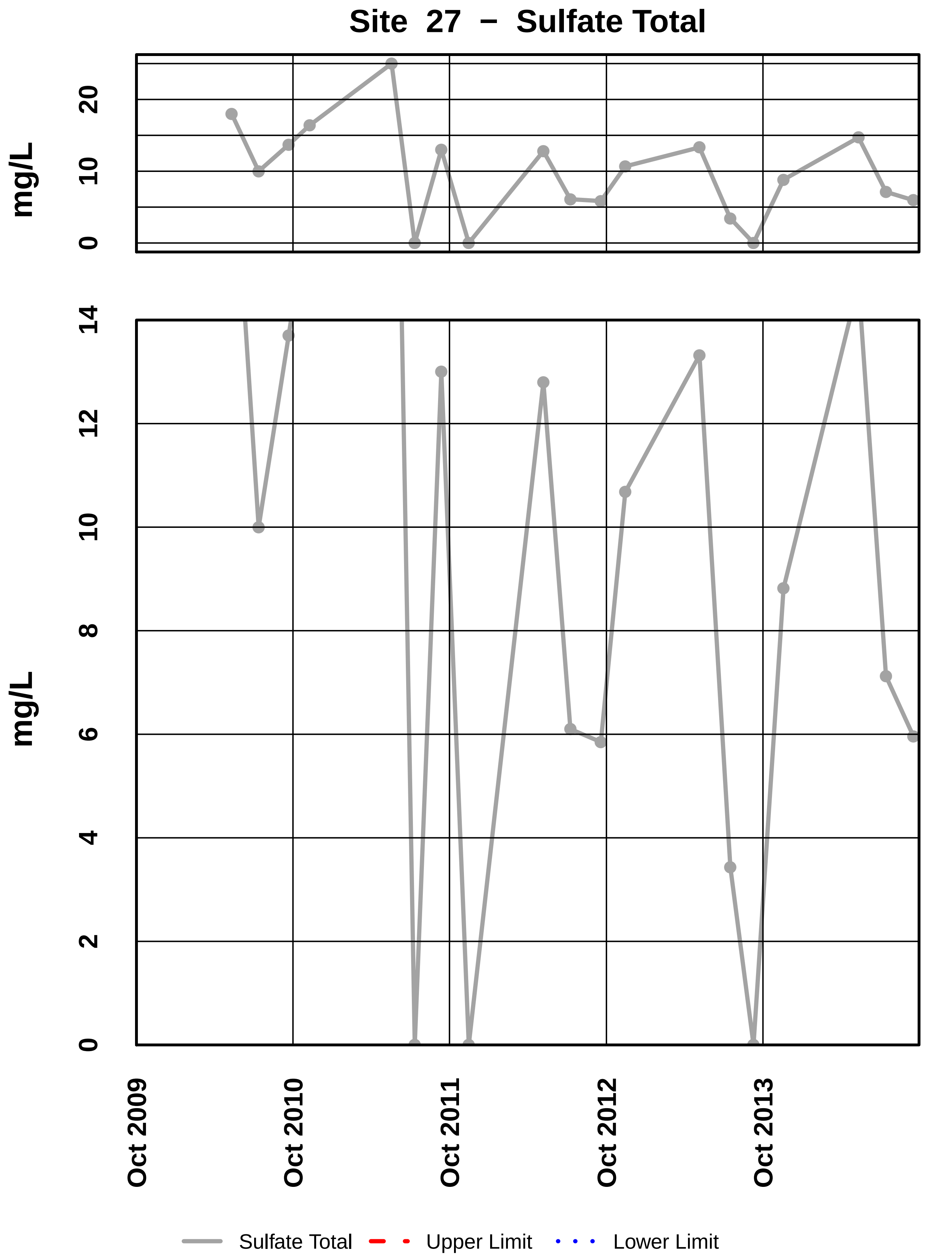

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

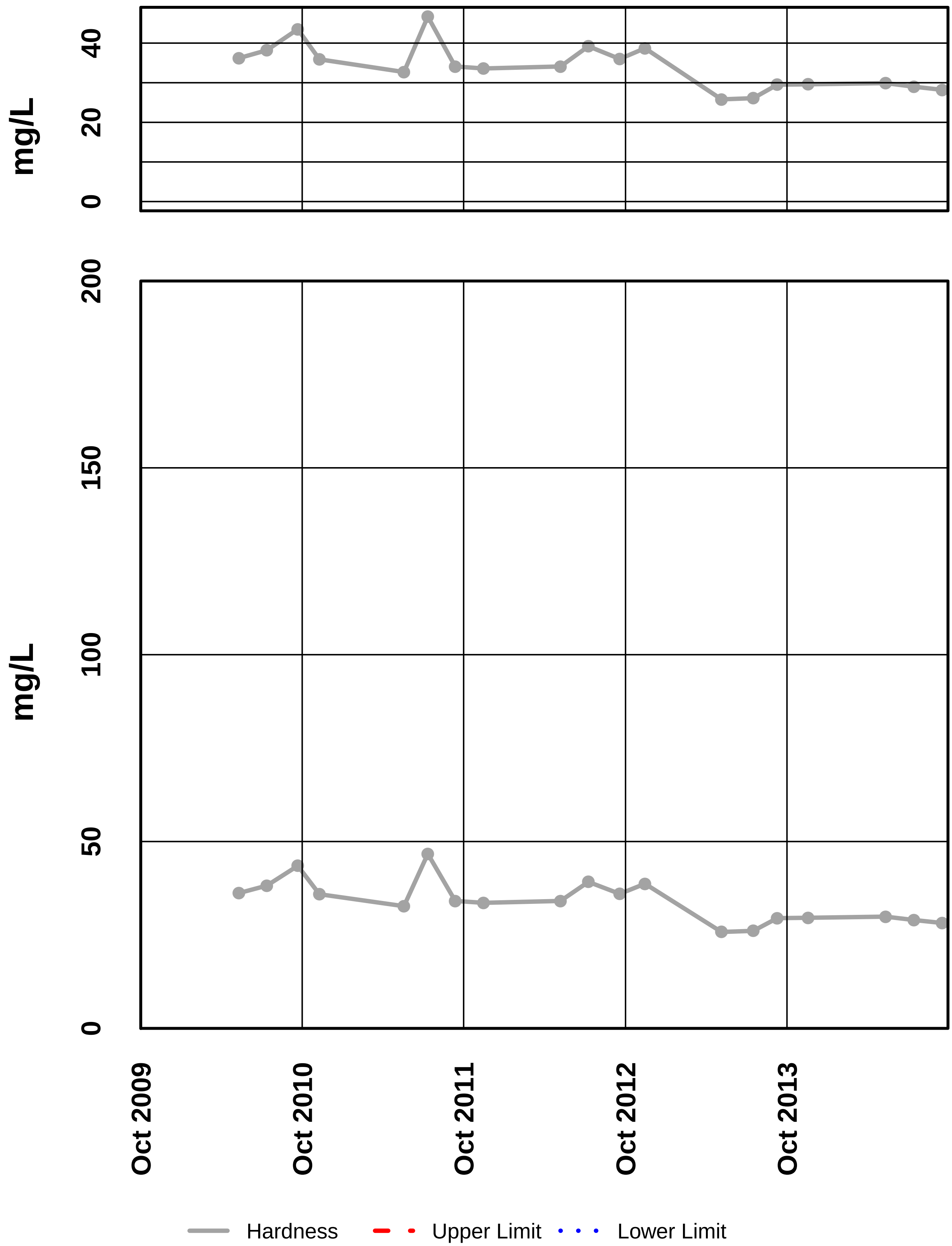



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

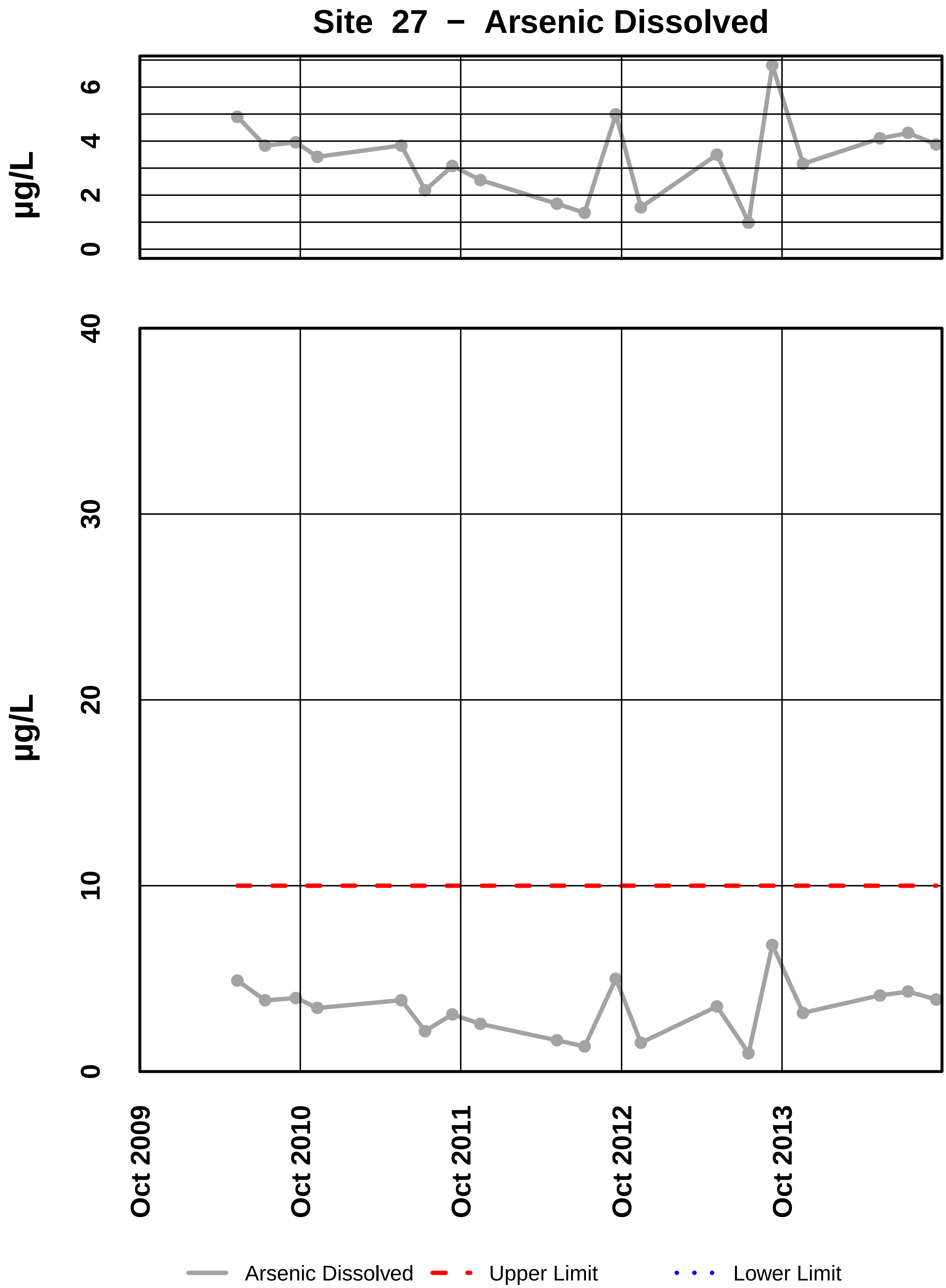



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

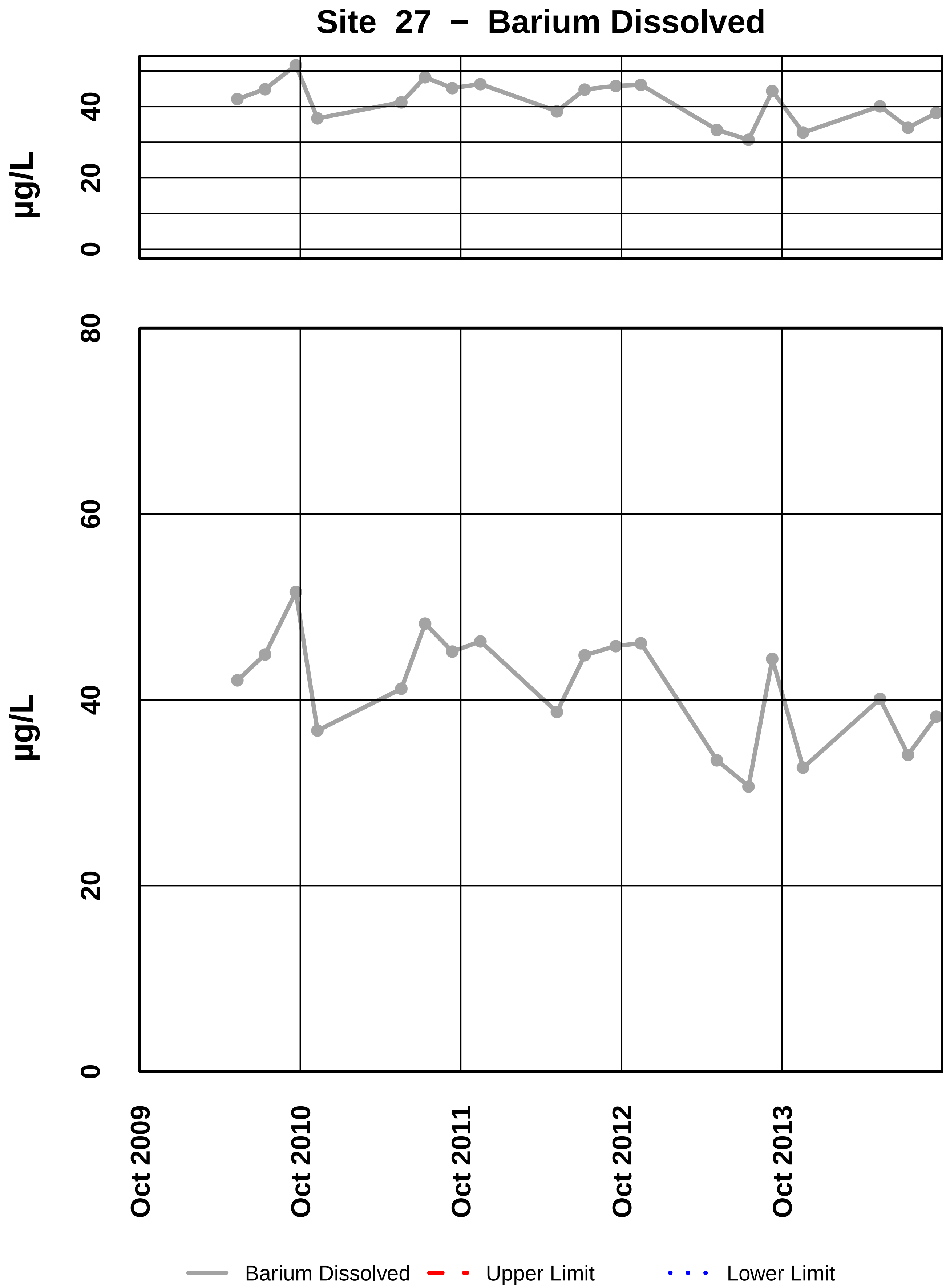
Site 27 − Hardness



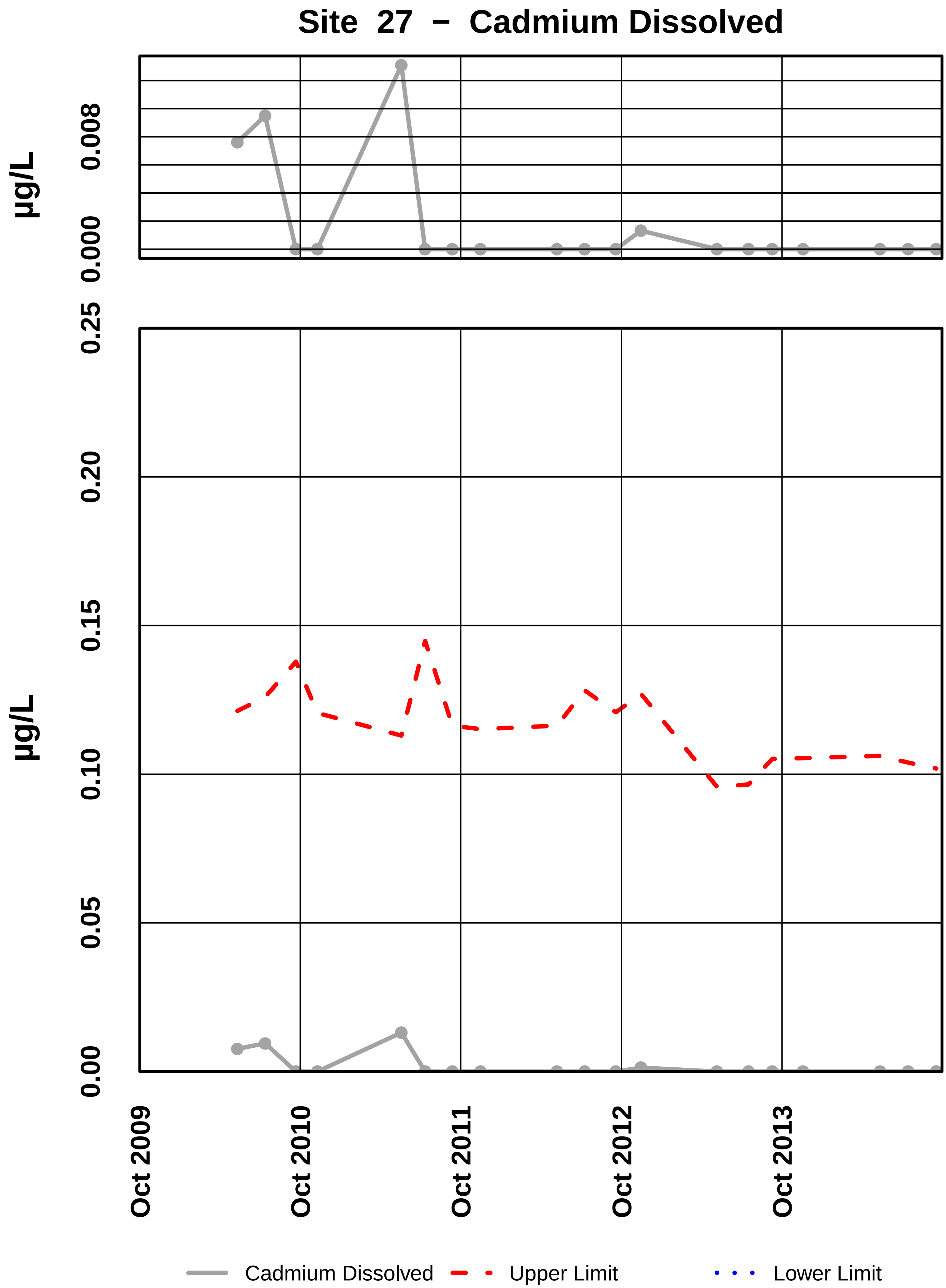

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

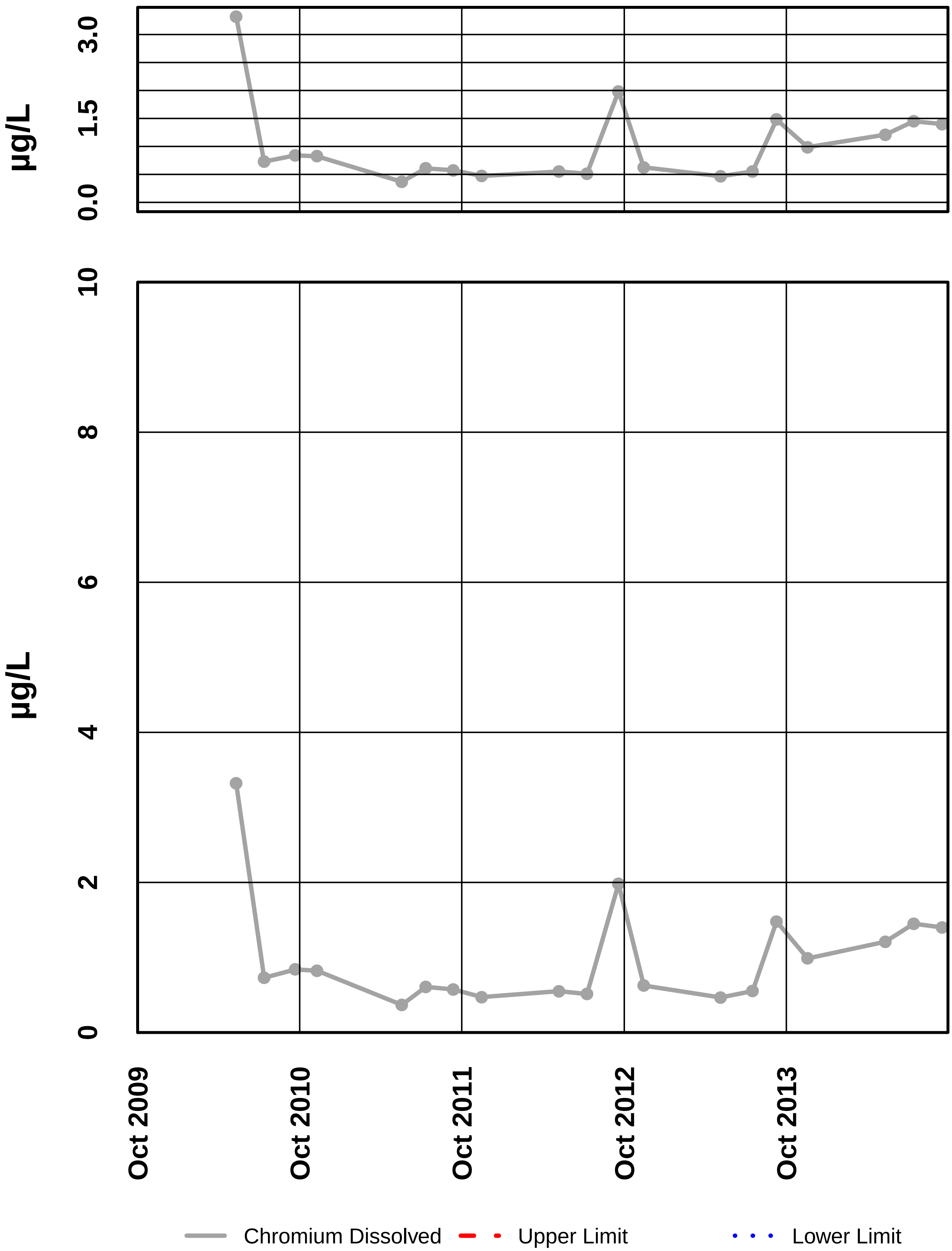



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

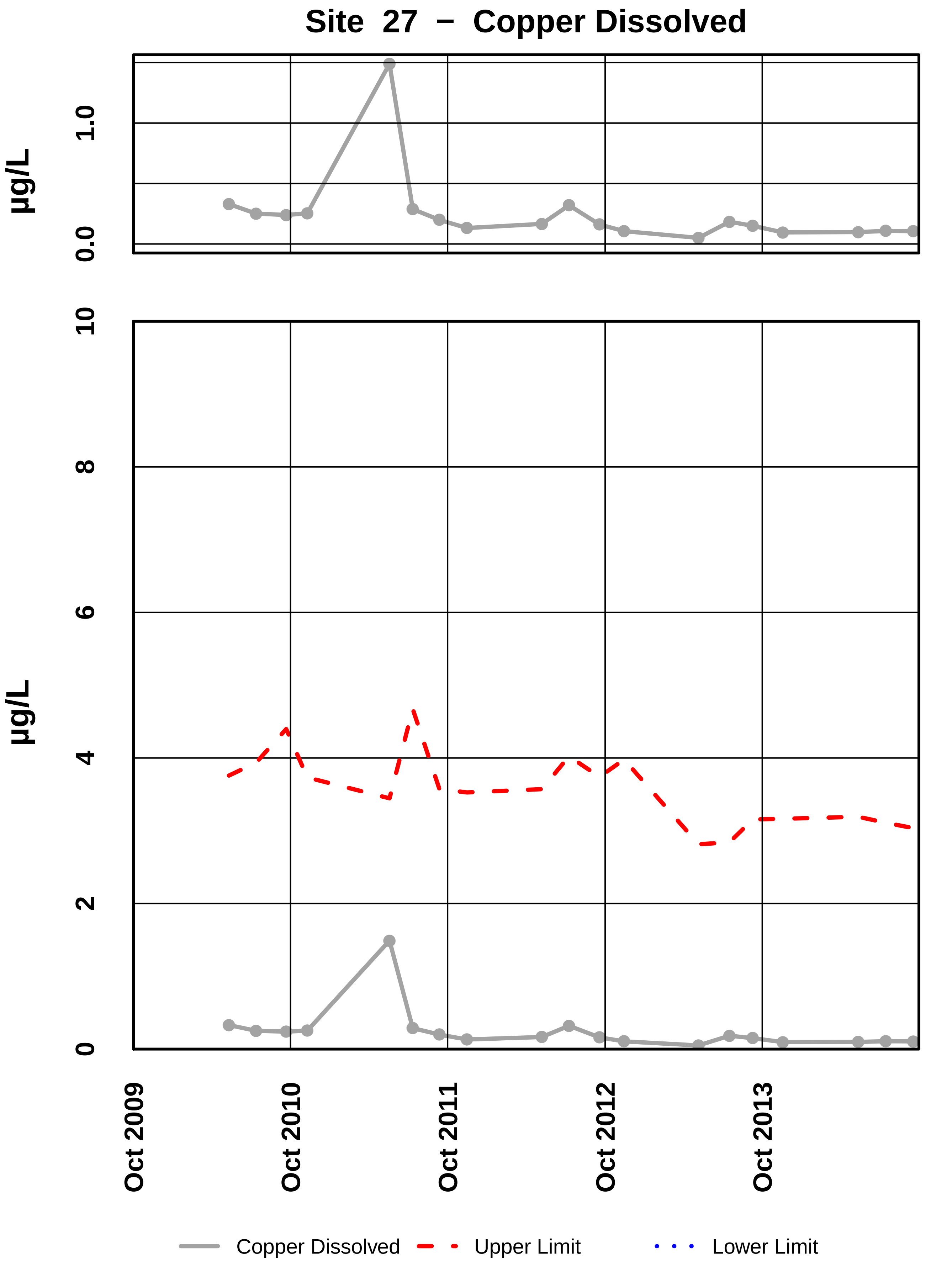



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

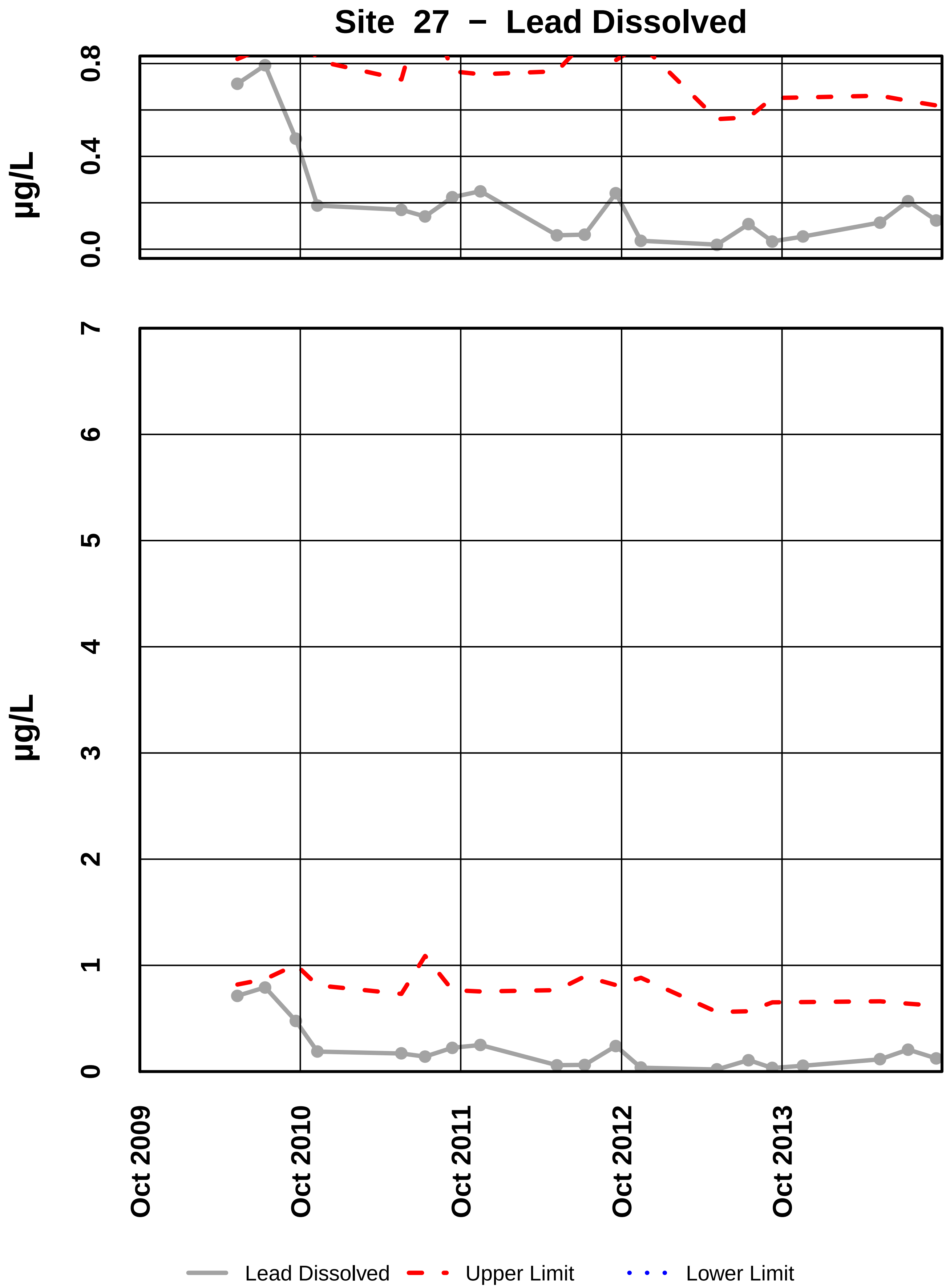
# Site 27 – Chromium Dissolved



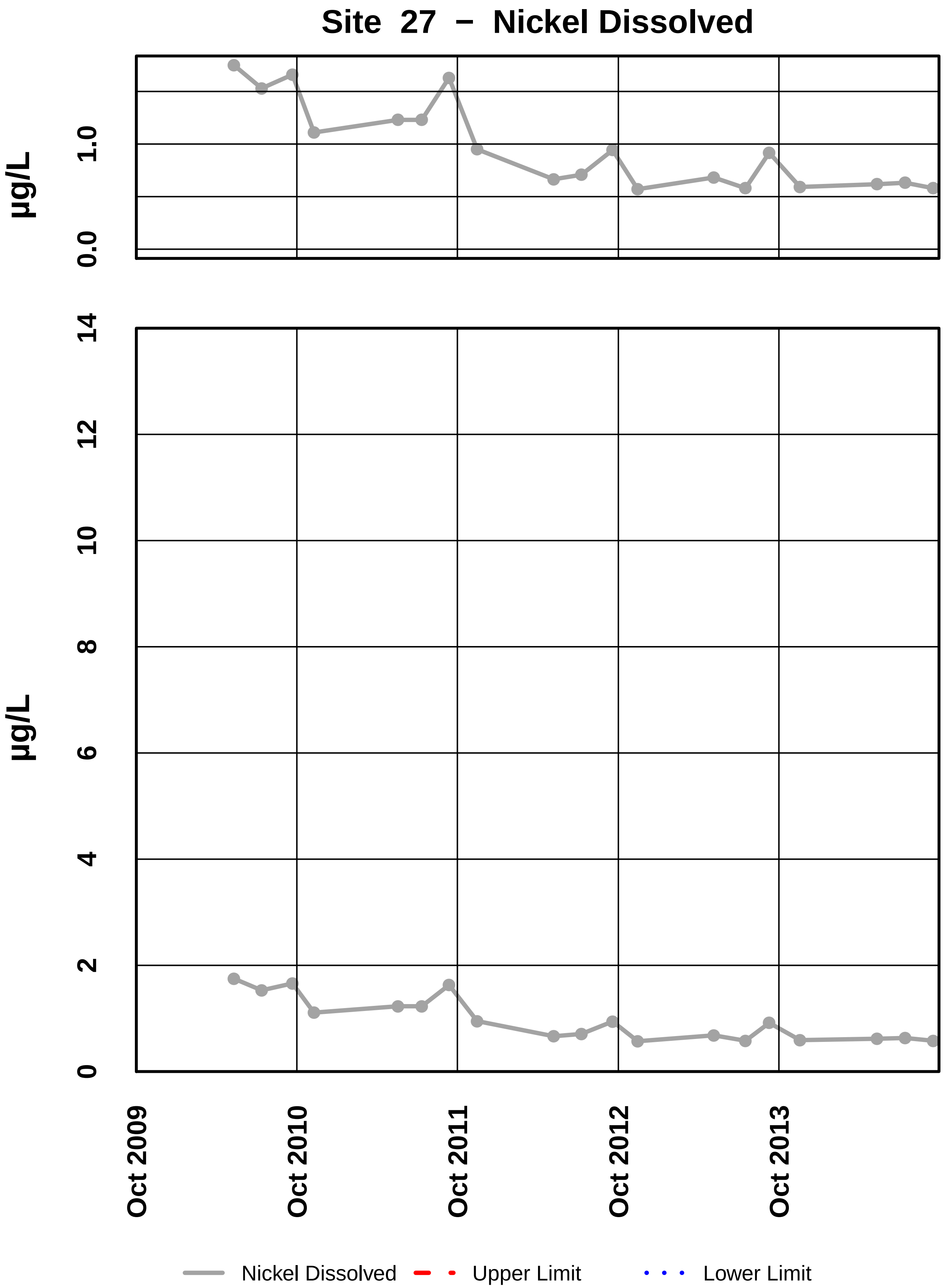

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



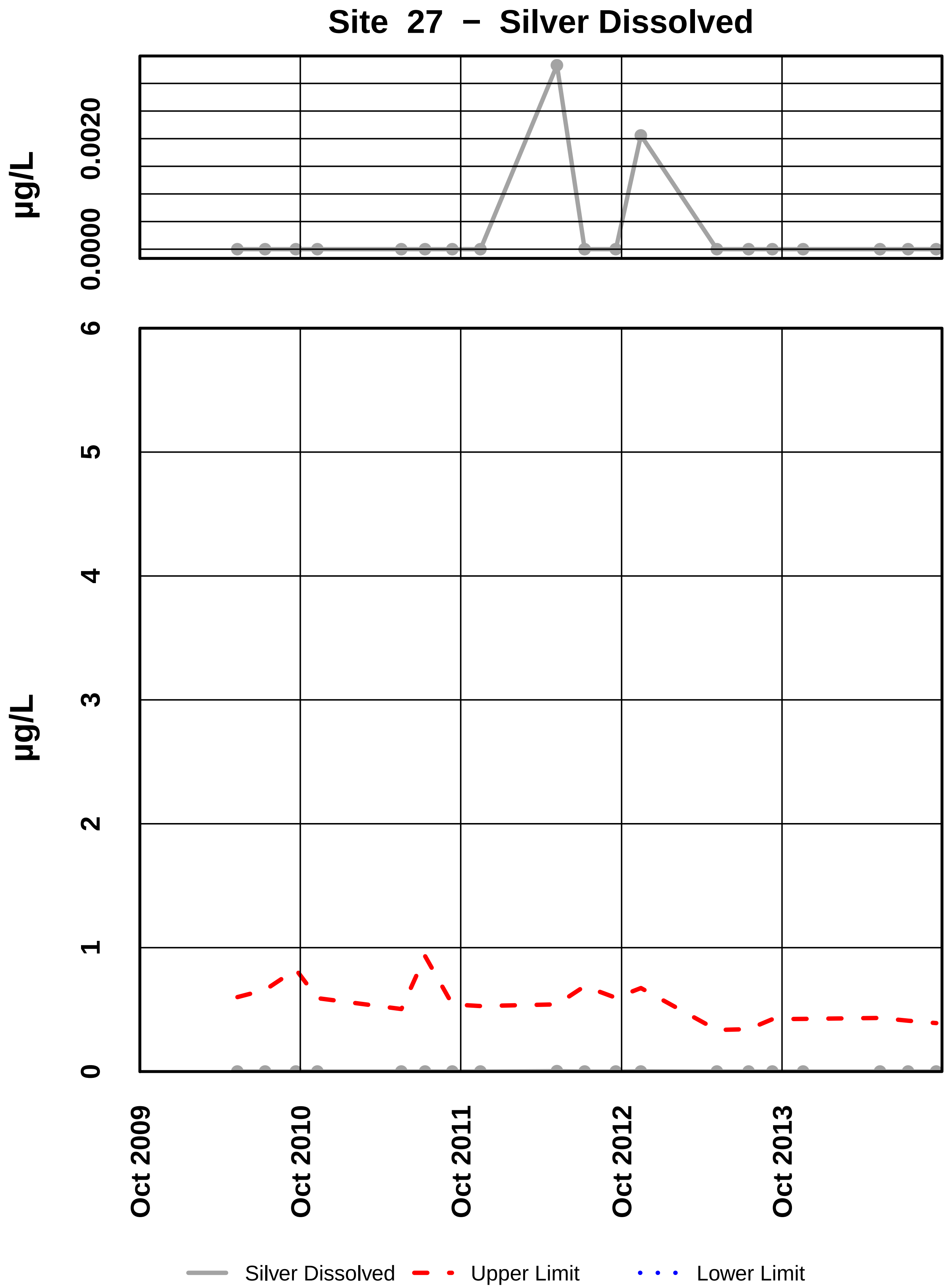

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

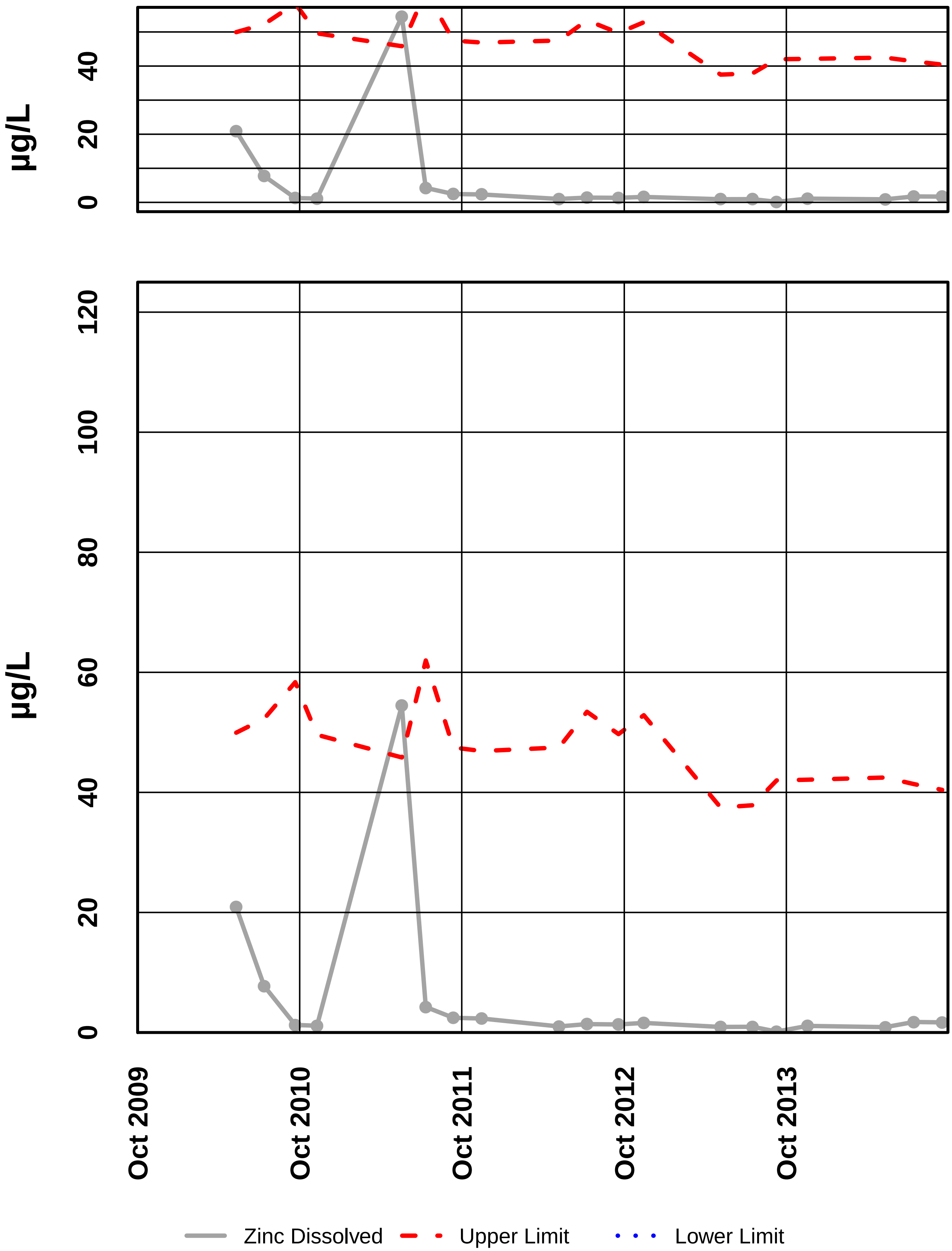



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

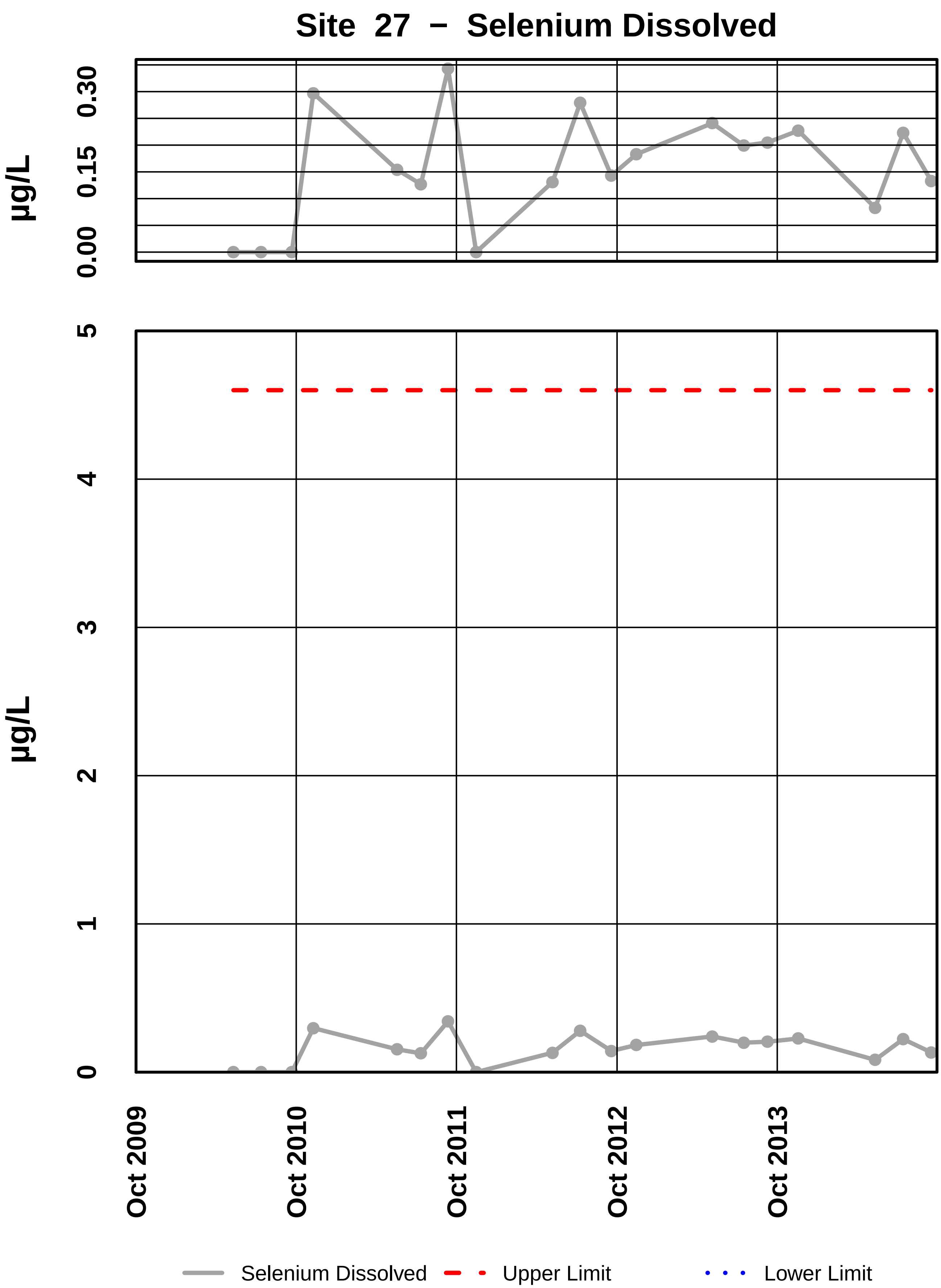



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# Site 27 − Zinc Dissolved

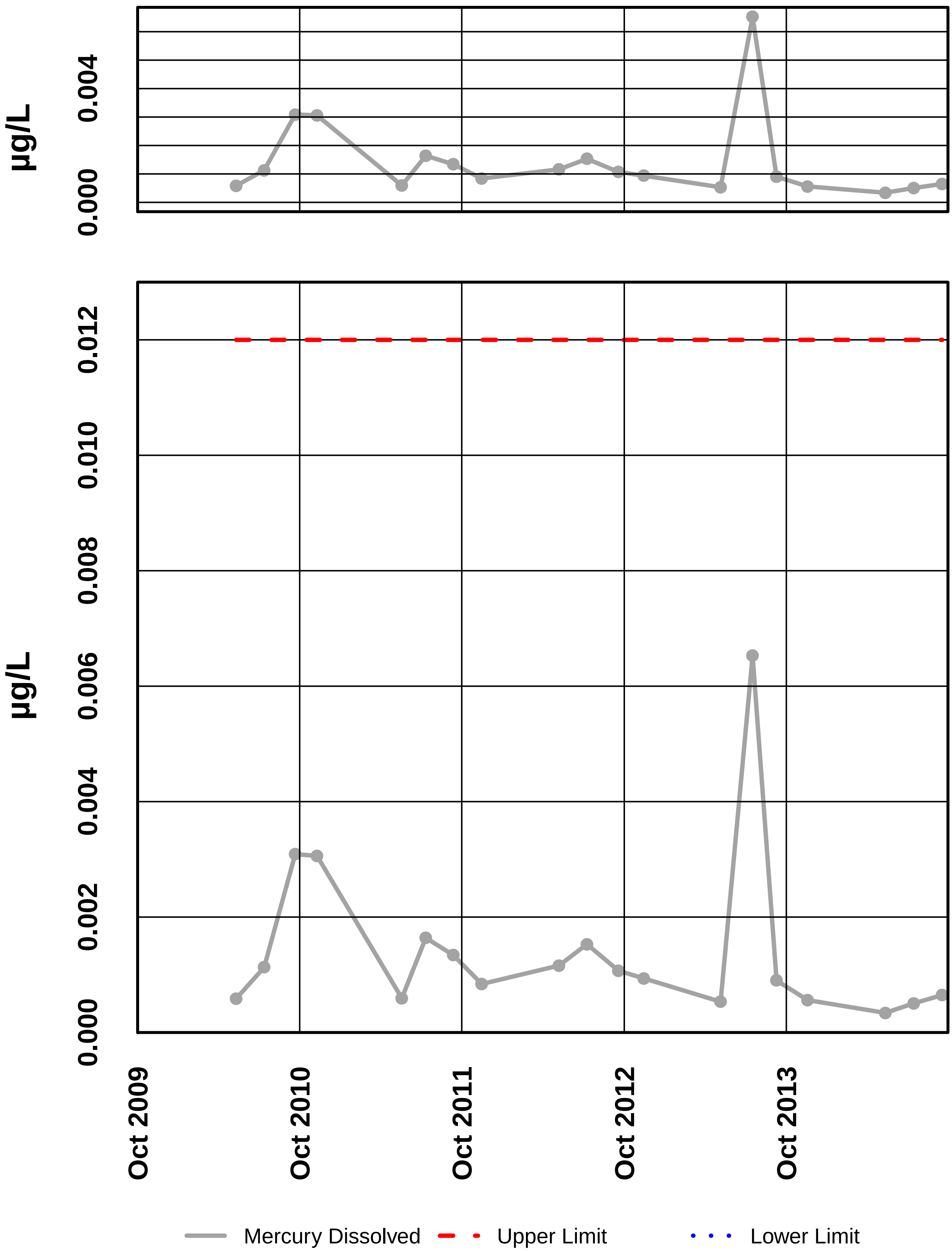



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

## Site 27 – Mercury Dissolved




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# INTERPRETIVE REPORT
# SITE 29

The data collected during the current water year are listed in the following “Table of Results for Water Year 2014” report. The table includes all the required FWMP analyte data (field and laboratory) collected for the current water year and a series of flags keyed to the summary report “Qualified Data by QA Reviewer”. The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of ½ MDL for the purpose of median calculation.

All data collected at this site for the past six years are included in the data analyses. As shown in the table below, there were no data outliers.

| Sample Date | Parameter | Value | Qualifier | Notes |
|---|---|---|---|---|
| No outliers have been identified by HGCMC for the period of October 2008 through September 2014. | | | | |

The data for Water Year 2014 have been compared to the strictest fresh water quality criterion for each applicable analyte. Several results exceeding these criteria have been identified, as listed in the table below.

**Table of Exceedance for Water Year 2014**

| | | | Limits | | |
|---|---|---|---|---|---|
| Sample Date | Parameter | Value | Lower | Upper | Hardness |
| 12-Nov-13 | Alkalinity | 16.2 mg/L | 20 | 0 | |
| 12-May-14 | Alkalinity | 17.7 mg/L | 20 | 0 | |
| 15-Jul-14 | Alkalinity | 16.8 mg/L | 20 | 0 | |
| 17-Sep-14 | Alkalinity | 15.8 mg/L | 20 | 0 | |
| 15-Jul-14 | Arsenic Dissolved | 18.1 µg/L | 0 | 10.0 | |
| 12-Nov-13 | Lead Dissolved | 0.798 µg/L | 0 | 0.5 | 19.3 mg/L |
| 15-Jul-14 | Lead Dissolved | 0.787 µg/L | 0 | 0.5 | 18.7 mg/L |
| 17-Sep-14 | Lead Dissolved | 0.574 µg/L | 0 | 0.5 | 19 mg/L |
| 12-Nov-13 | pH Field | 5.3 su | 6.5 | 8.5 | |
| 12-May-14 | pH Field | 5.18 su | 6.5 | 8.5 | |
| 15-Jul-14 | pH Field | 5.42 su | 6.5 | 8.5 | |
| 17-Sep-14 | pH Field | 5.37 su | 6.5 | 8.5 | |

Four of these records are for field pH with values below the lower limit of 6.5 su listed in AWQS. Field pH from other wells completed in organic rich peat sediments similar to Site 29 have historically resulted in pH values ranging from 5 to 6 su (*e.g.* Sites 58, 27, and 32). Four other exceedances were for total alkalinity below the lower limit of 20 mg/L.

Though dissolved lead had dropped below the AWQS in Water Year 2013, three of the four samples this water year were in exceedance. Dissolved zinc also increased however it remained below the AWQS limit. The most probable mechanism for dispersal of the lead, zinc, and potentially other metals away from the tailings pile would be as fugitive tailings dust transported during cold, descanting winds during winter or due to dust induced by truck traffic during dry summer conditions.

The changes in these analytes may reflect the changing topography of the tails dry stack facility. After the northeast expansion was completed in 2008 HGCMC commenced to place the majority of the tailings in the northeast region. For a couple of years the northeast was mostly bowl shaped and below the tree line. During the last couple of years this area stopped being a bowl and has been brought up in elevation. With the increase in elevation this area is not as protected from the winds that predominantly prevail from the northeast. Dispersal of fugitive dust from this region would be to the southwest towards Site 29 and Site 32. In Water Year 2014 tailings were not only placed in the northwest, but also in central western portion of the facility. This area is more directly upwind from the monitoring site.

In 2011 HGCMC implemented a biweekly dust monitoring program to support the snow monitoring program. This program has continued into 2013 and the results from this monitoring are summarized in the 2014 Tailings and Waste Rock Annual Report and will also be presented at the annual meeting in July 2015.

The July sample for arsenic was also in exceedance. Arsenic values over the past five years have ranged from ~3 µg/L to ~10 µg/L. This exceedance for 18.1 µg/L appears anomalous and could be associated with underlining marine sediments.

X-Y plots have been generated to graphically present the data for each of the analytes requested in the Statistical Information Goals for this site. These plots have been visually analyzed for the appearance of any trend in concentration. There appears to be no obvious visually trends.

A non-parametric statistical analysis for trend was performed for specific conductivity, field pH, total alkalinity, total sulfate, and dissolved zinc. Calculation details of the Seasonal Kendall analyses are presented in detail on the pages following this interpretive section. The following table summarizes the results on the data collected between Oct-08 and Sep-14(WY2009-WY2014). No statistically significant trends were found with the trend analysis.

**Table of Summary Statistics for Trend Analysis**

| | Mann-Kendall test statistics | | | Sen's slope estimate | |
|---|---|---|---|---|---|
| **Parameter** | **n*** | **p**** | **Trend** | **Q** | **Q(%)** |
| Conductivity Field | 6 | 0.16 | | | |
| pH Field | 6 | 0.29 | | | |
| Alkalinity, Total | 6 | 0.46 | | | |
| Sulfate, Total | 6 | Inconsistent detection limits | | | |
| Zinc, Dissolved | 6 | 0.05 | | | |

* Number of Years  ** Significance level

Trend analysis was not performed on the total sulfate dataset because of a change in the method detection limit used by the analytical laboratories. A primary assumption of the Mann-Kendall test is "… only one censoring threshold exists. When more than one detection limit exists, the Mann-Kendall test cannot be performed without further censoring the data." In order to prevent this from occurring HGCMC has worked to establish a consistent MDL for sulfate from the laboratory.

With the discontinuation of sampling at Site 58 during Water Year 2013, an inter-well comparison is no longer feasible. Instead an intra-well analysis was performed using combined Shewhart-CUSUM charts for conductivity, dissolved zinc, and alkalinity. Table 1 contains a summary of the baseline statistics along with the control limits used.

**Table 1. Specific Conductance, Dissolved Zinc, and Total Sulfate Baseline Periods, Summary Statistics and Various Control Limits**

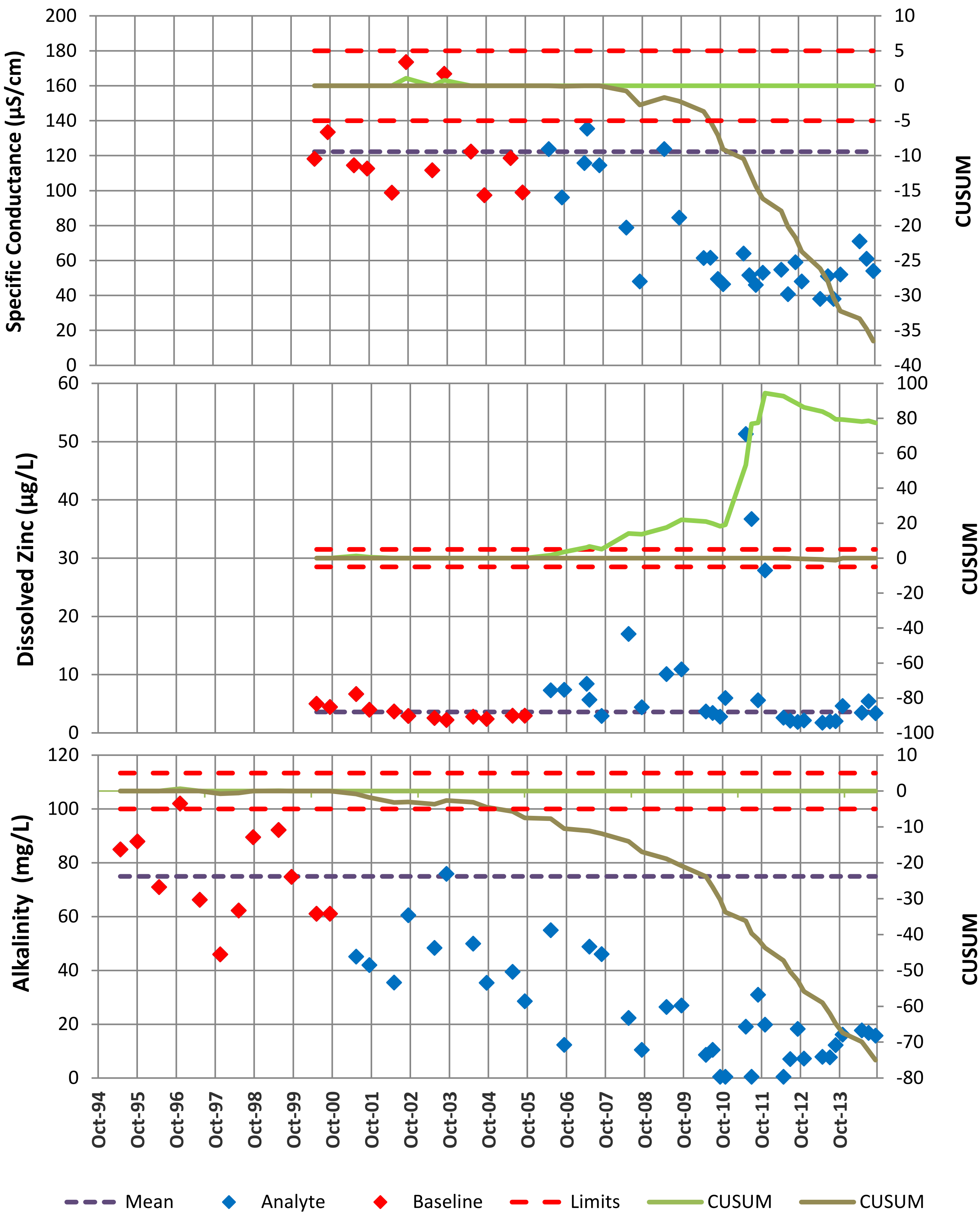
| | Site 29 Conductivity (µS/cm) | Site 29 Diss. Zinc (µg/L) | Site 29 Alkalinity (mg/L) |
|---|---|---|---|
| **Baseline Statistics** | | | |
| Baseline Period | 05/11/00-09/15/05 | 05/11/00-09/15/05 | 04/27/95-09/13/00 |
| Number of Samples | 12 | 12 | 5 |
| Mean (x) | 122.27 | 3.60 | 1.56 |
| Standard Deviation | 24.8 | 1.35 | 0.43 |
| **Shewhart-CUSUM Control Limits (SCL)** | | | |
| Control Limit (mean x+ 2s) | 171.9 | 6.3 | 2.4 |
| Control Limit (mean x + 3s) | 196.7 | 7.6 | 2.8 |
| Control Limit (mean x + 4s) | 221.4 | 9.0 | 3.3 |
| Control Limit (mean x + 4.5s) | 233.8 | 9.7 | 3.5 |
| **CUSUM Control Limits** | | | |
| Cumulative increase – h | 5 | 5 | 5 |

Site 29 was installed in 1988 and has an extensive sampling history, however establishing a baseline has been difficult. Since the installation of the well a number of the monitored parameters (*i.e.* alkalinity, specific conductance, total sulfate, and etc…) have been in constant flux. Because the CUSUM process compares the mean and standard deviation of the chosen baseline to the collected data it is possible to detect continual changes in the analytes without having a background data set. After reviewing the data for the three parameters, data periods were chosen based upon the data having a period of minimal flux. This period was then used for the calculation of the baseline statistics.

All three of the parameters examined (Figure 1) eventually went out of control with respects to the chosen baseline data statistics. If the pore/contact water from inside the facility was not contained, the well water would have high conductivity, high dissolved zinc, and high alkalinity. Two of the three charts in figure 1 have long term decreasing trends; it is dissolved zinc that has periodically had higher values. As previously discussed it is hypothesized that the increase in dissolved zinc results from the accumulation of fugitive dust in the snow pack during the winter. In the spring when the snow pack melts this material is released as a pulse. Most years the deposited material is not present by the fall sampling. With the implementation of additional best management practices, HGCMC expects to decrease the amount of fugitive dust leaving the tailings disposal facility.

The long term decreasing trends in specific conductance and alkalinity are potentially the result of the weathering of the rock originally used to build the tailings facility. In recent years HGCMC has reported on water chemistry changes in the FWMP directly related to construction activities in the tailings facility. As previously discussed in the report, with regards to Site 27, there was an increase in total sulfate and conductivity after the pad was built east of Pond 7. In the 5-6years after this pad was built the values for these parameters are still elevated though trending towards pre–disturbance conditions. A similar sort of change was also recorded at Site 60 after the construction of Pond 7. Until the pump back collection system was brought online there were substantial increases for specific conductivity and alkalinity at Site 60. These are two examples of where the construction of the improvement has resulted in changes to the water chemistry. Therefore, the decreasing trends in alkalinity and specific conductance seen at Site 29 are potentially the result of weathering of the initial improvements made in the area for tailings disposal.

**Figure 1.** **Observed Measurements for Specific Conductance, Dissolved Zinc, and Alkalinity from Site 29 Compared to the Shewhart-CUSUM Control Limits From Table 1**



## Table of Results for Water Year 2014

### Site 029FMG - 'Monitoring Well - 3S'

| Sample Date/Parameter | Oct 2013 | Nov 2013 | Dec 2013 | Jan 2014 | Feb 2014 | Mar 2014 | Apr 2014 | May 2014 | Jun 2014 | Jul 2014 | Aug 2014 | Sep 2014 | **Median** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Water Temp (°C) | | 6.7 | | | | | | 6.9 | | 8.9 | | 8.3 | 7.6 |
| Conductivity-Field(μmho) | | 52 | | | | | | 71 | | 61 | | 54 | 57.5 |
| Conductivity-Lab (μmho) | | 39 | | | | | | 53 | | 50 | | 45 | 48 |
| pH Lab (standard units) | | 5.22 | | | | | | 5.09 | | 5.04 | | 5.17 | 5.13 |
| pH Field (standard units) | | 5.3 | | | | | | 5.18 | | 5.42 | | 5.37 | 5.34 |
| Total Alkalinity (mg/L) | | 16.2 | | | | | | 17.7 | | 16.8 | | 15.8 | 16.5 |
| Total Sulfate (mg/L) | | 2.5 | | | | | | 2.5 | | 0.3 | | 1.3 | 1.9 |
| Hardness (mg/L) | | 19.3 | | | | | | 20.6 | | 18.7 | | 19 | 19.2 |
| Dissolved As (ug/L) | | 7.04 | | | | | | 8.57 | | 18.1 | | 7.85 | 8.210 |
| Dissolved Ba (ug/L) | | 8.3 | | | | | | 7.5 | | 13.7 | | 7.4 | 7.9 |
| Dissolved Cd (ug/L) | | 0.0051 | | | | | | 0.0018 | | 0.0018 | | 0.0052 | 0.0035 |
| Dissolved Cr (ug/L) | | 1.1 | | | | | | 3.7 | | 10.2 | | 2.03 | 2.865 |
| Dissolved Cu (ug/L) | | 0.43 | | | | | | 0.18 | | 0.499 | | 0.242 | 0.336 |
| Dissolved Pb (ug/L) | | 0.798 | | | | | | 0.376 | | 0.787 | | 0.574 | 0.6805 |
| Dissolved Ni (ug/L) | | 1.27 | | | | | | 1.27 | | 2.62 | | 1.27 | 1.270 |
| Dissolved Ag (ug/L) | | 0.002 | | | | | | 0.006 | | 0.002 | | 0.002 | 0.002 |
| Dissolved Zn (ug/L) | | 4.64 | | | | | | 3.48 | | 5.44 | | 3.38 | 4.06 |
| Dissolved Se (ug/L) | | 0.057 | | | | | | 0.187 | | 0.203 | | 0.057 | 0.122 |
| Dissolved Hg (ug/L) | | 0.000499 | | | | | | 0.000762 | | 0.000613 | | 0.000712 | 0.000663 |

For individual sample/analyte qualifier descriptions see "Qualified Data by QA Reviewer" table.

Values reported as less than MDL are replaced by 1/2 MDL for median calculation purposes.

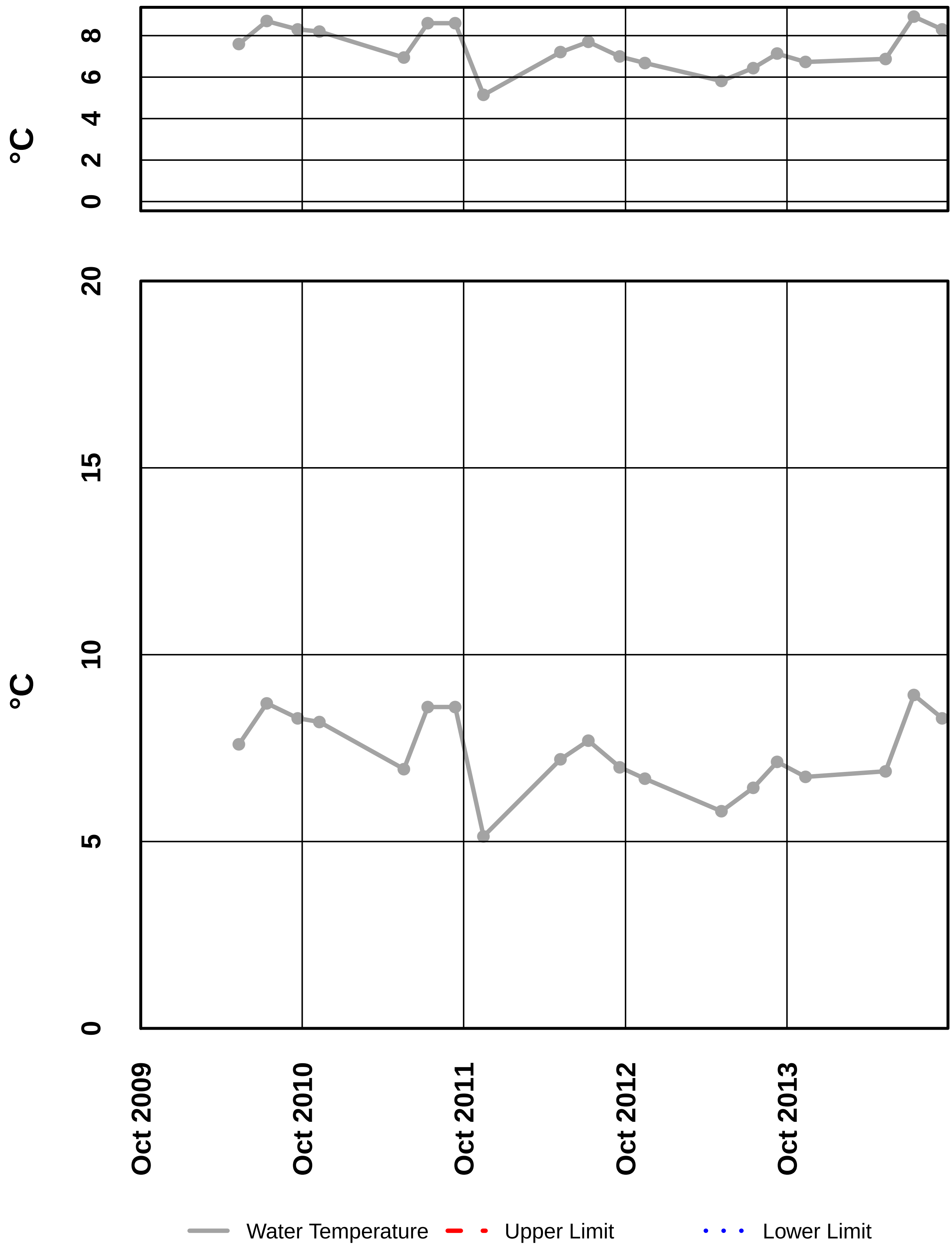
Shaded data has been qualified as an outlier by HGCMC and removed from any further analysis and is not included into the calculation of the median

# Qualified Data by QA Reviewer

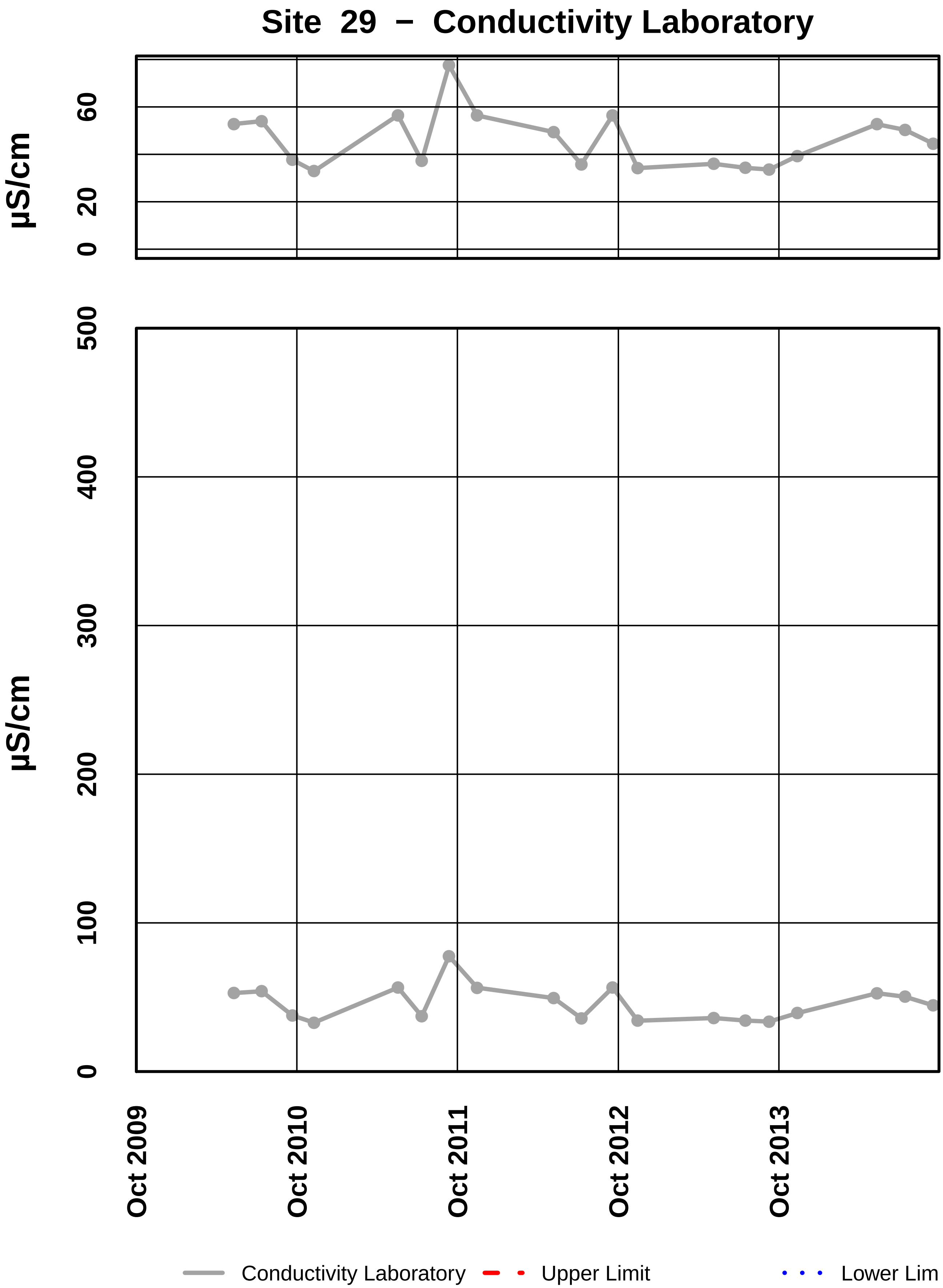
## Date Range: 10/01/2013 to 09/30/2014

| Site No. | Sample Date | Sample Time | Parameter | Value | Qualifier | Reason for Qualifier |
|---|---|---|---|---|---|---|
| 029FMG | 11/12/2013 | 12:00 PM | Diss. Cd-ICP/MS | 0.0051 | J | Below Quantitative Range |
| 029FMG | 5/12/2014 | 12:00 PM | Alkalinity | 17.7 | U | Trip Blank Contamination |
| | | | Conductivity | 52.7 | U | Trip Blank Contamination |
| | | | Diss. Ag-ICP/MS | 0.00576 | J | Below Quantitative Range |
| | | | Diss. Se-ICP/MS | 0.18 | J | Below Quantitative Range |
| | | | Sulfate | -5 | UJ | Sample Receipt Temperature |
| 029FMG | 7/15/2014 | 12:00 PM | Diss. Se-ICP/MS | 0.2 | J | Below Quantitative Range |
| 029FMG | 9/17/2014 | 12:00 PM | Diss. Cd-ICP/MS | 0.00517 | J | Below Quantitative Range |

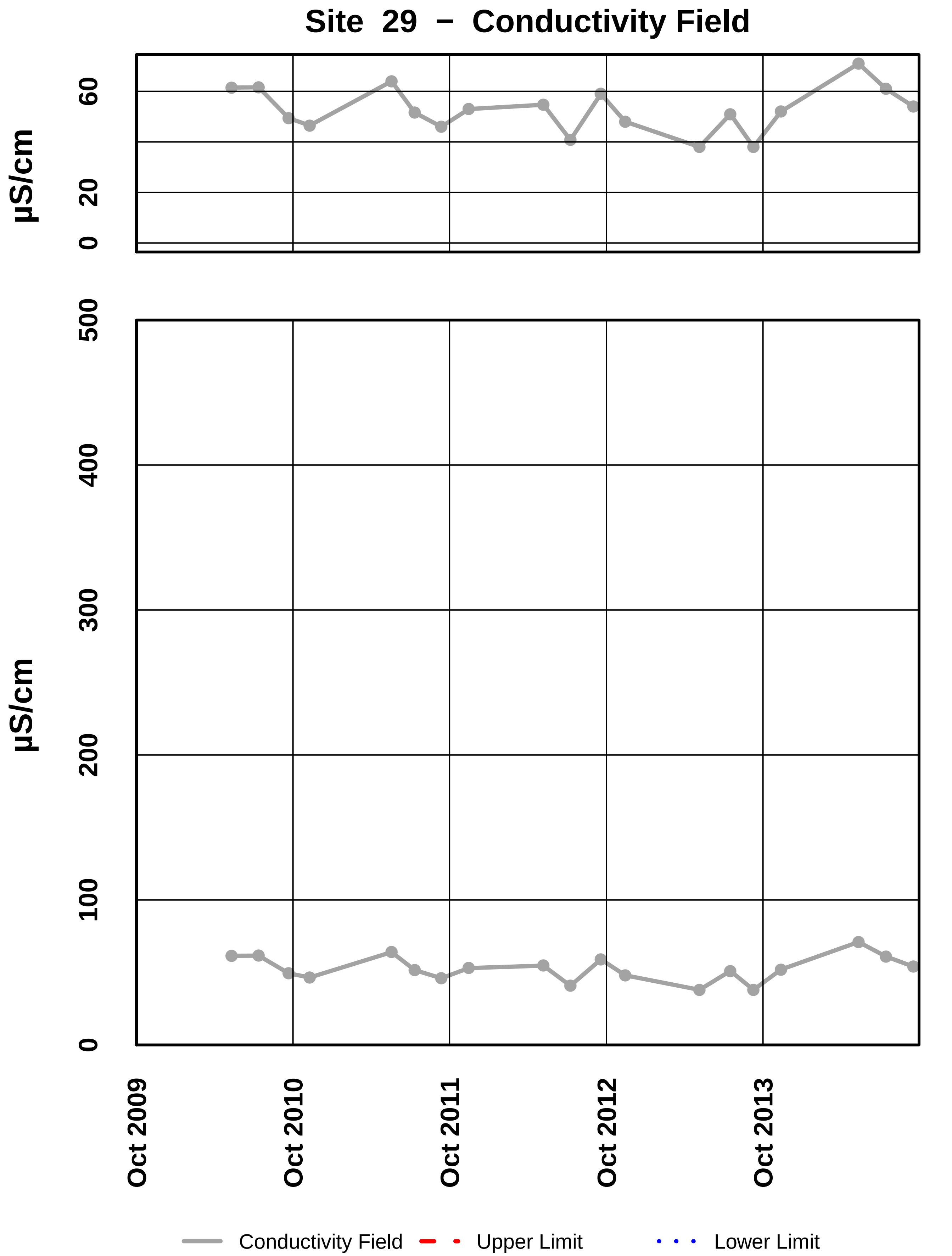
## Site 29 – Water Temperature




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

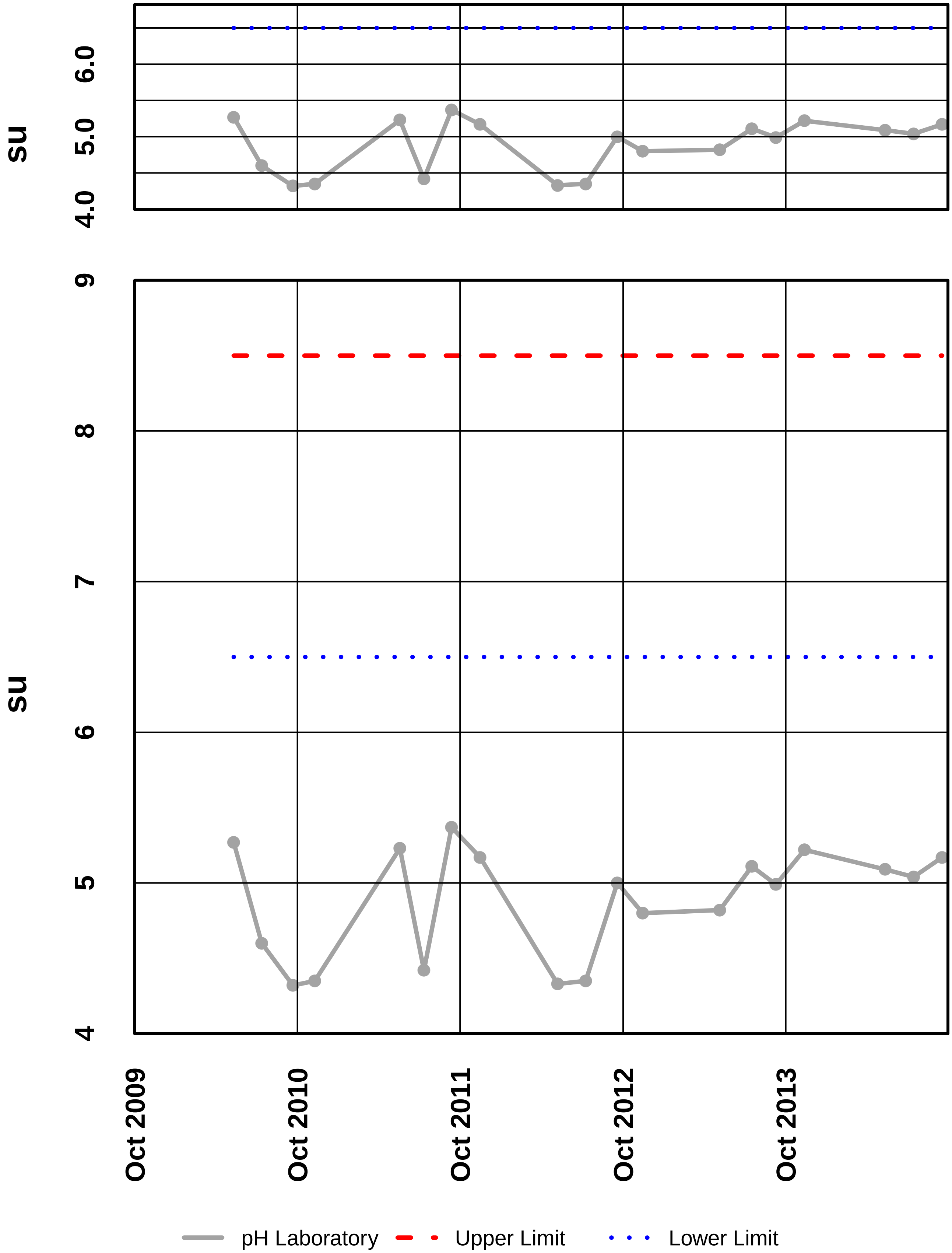



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



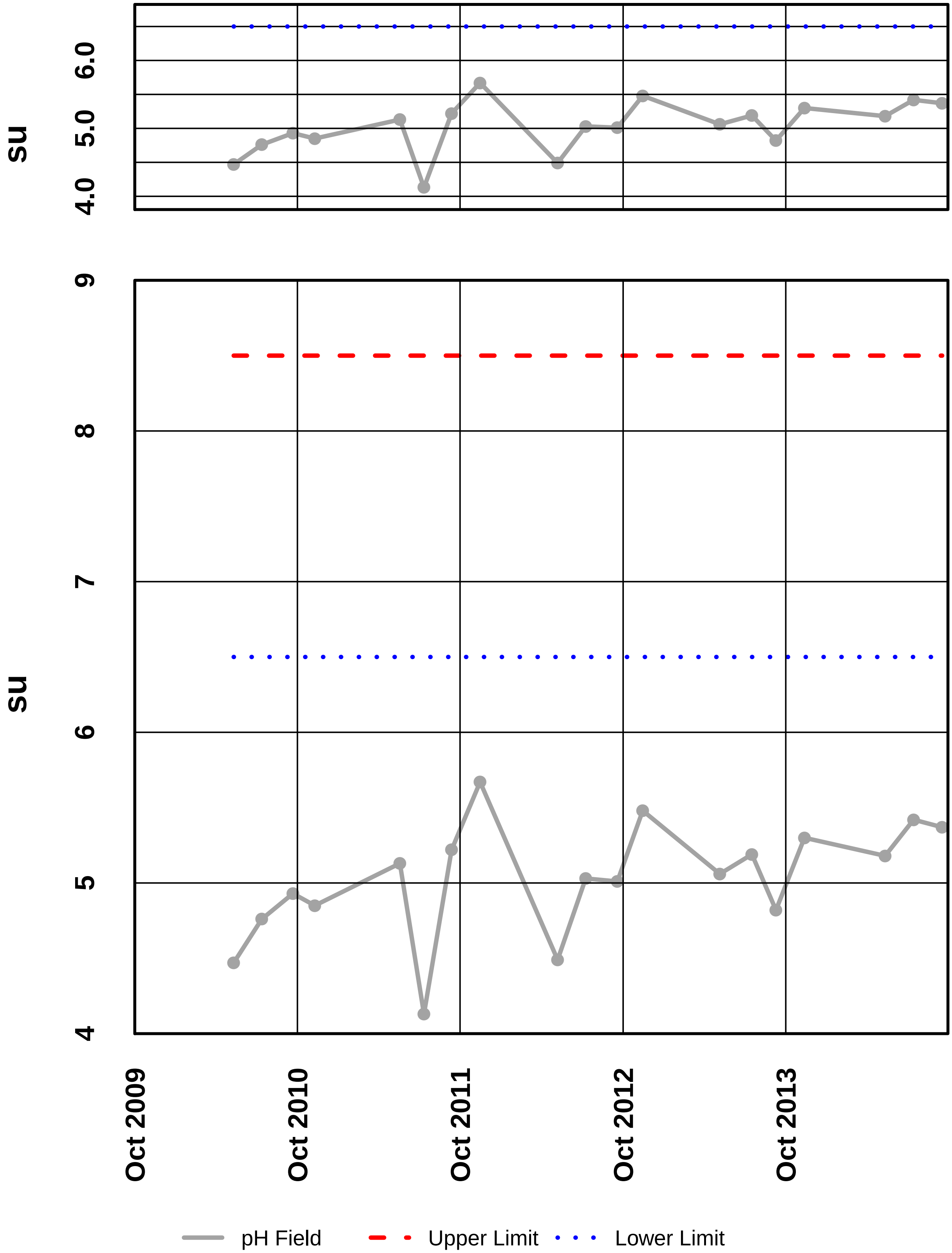

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# Site 29 – pH Laboratory

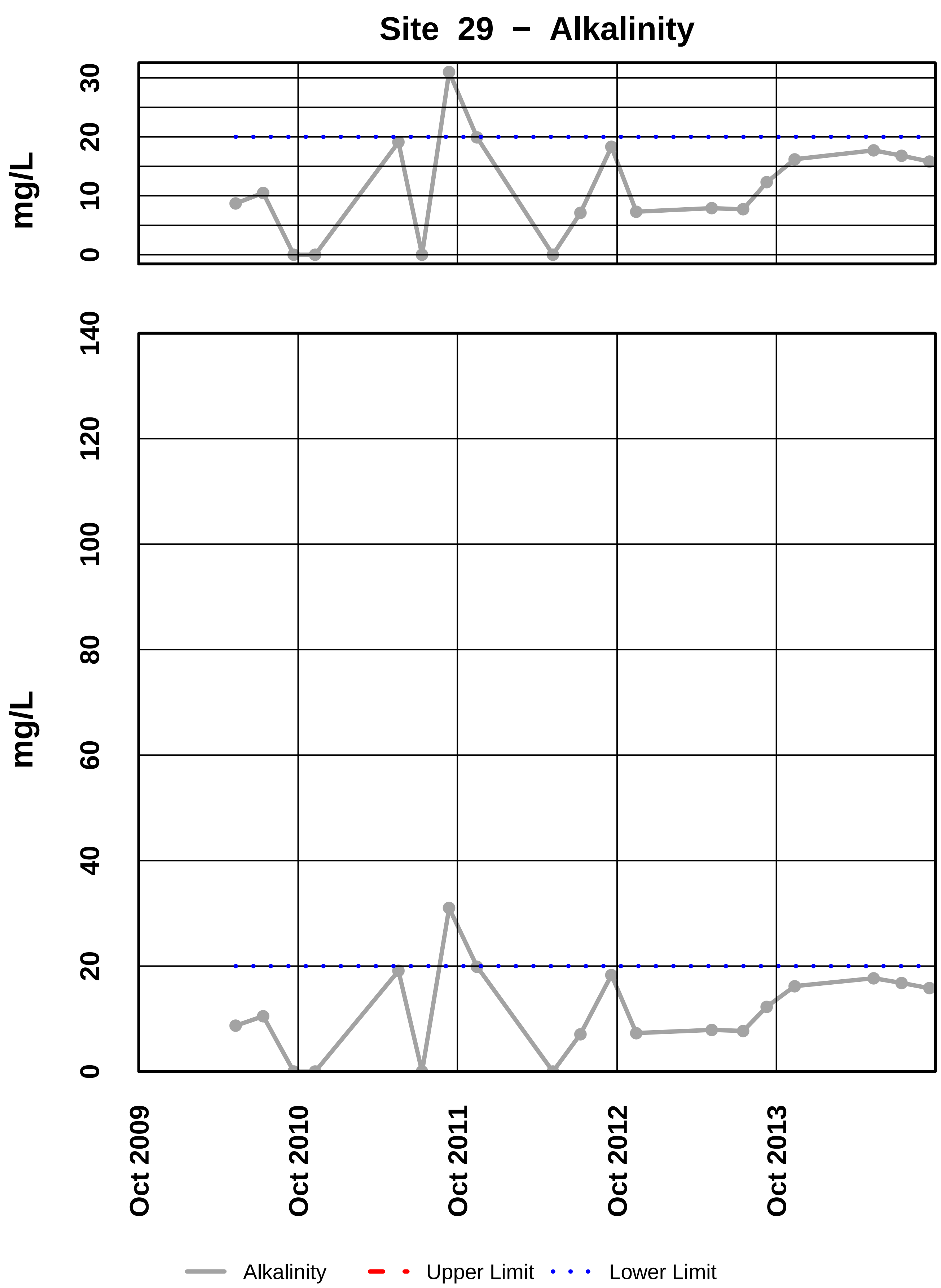



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

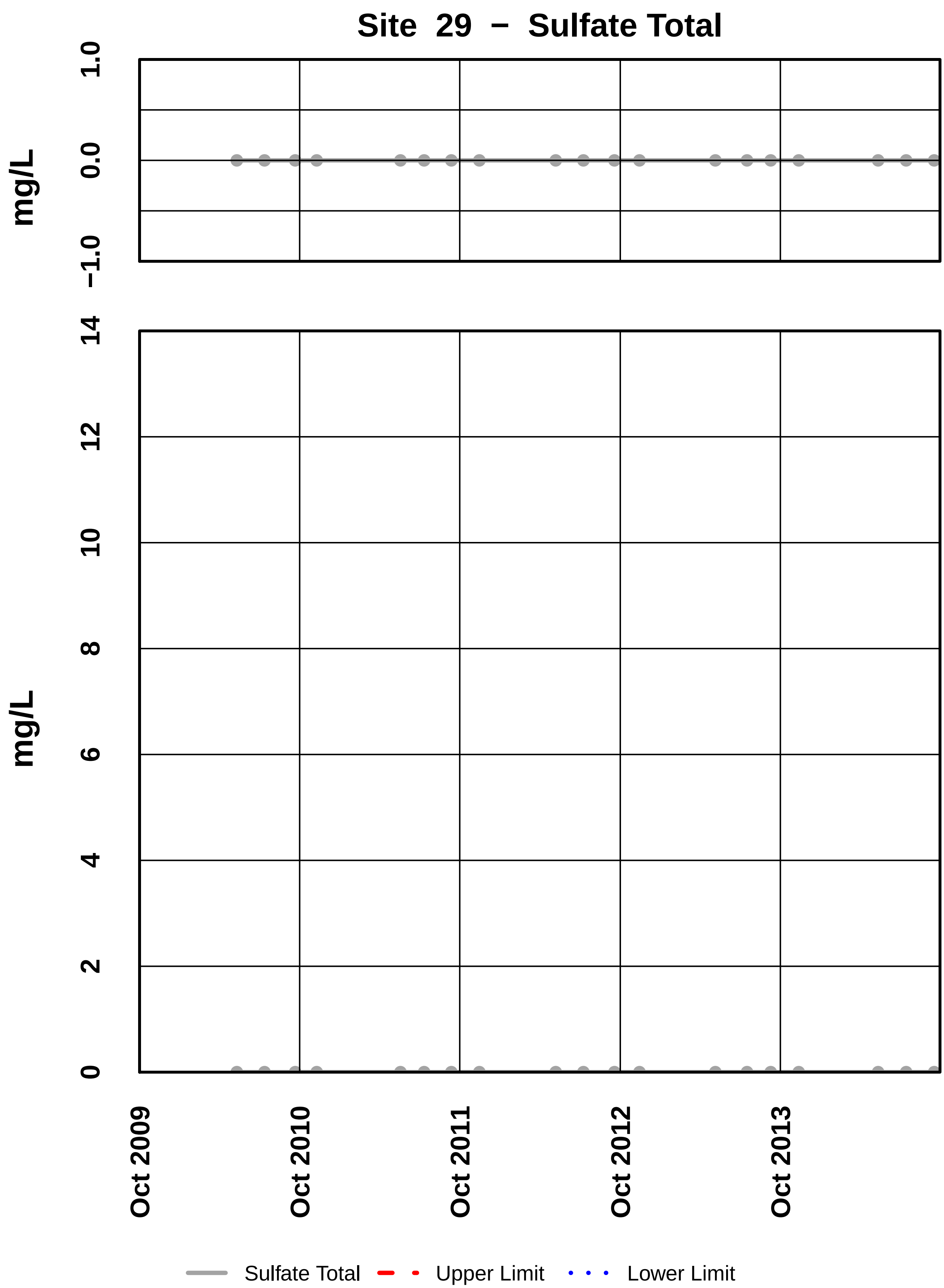
# Site 29 – pH Field



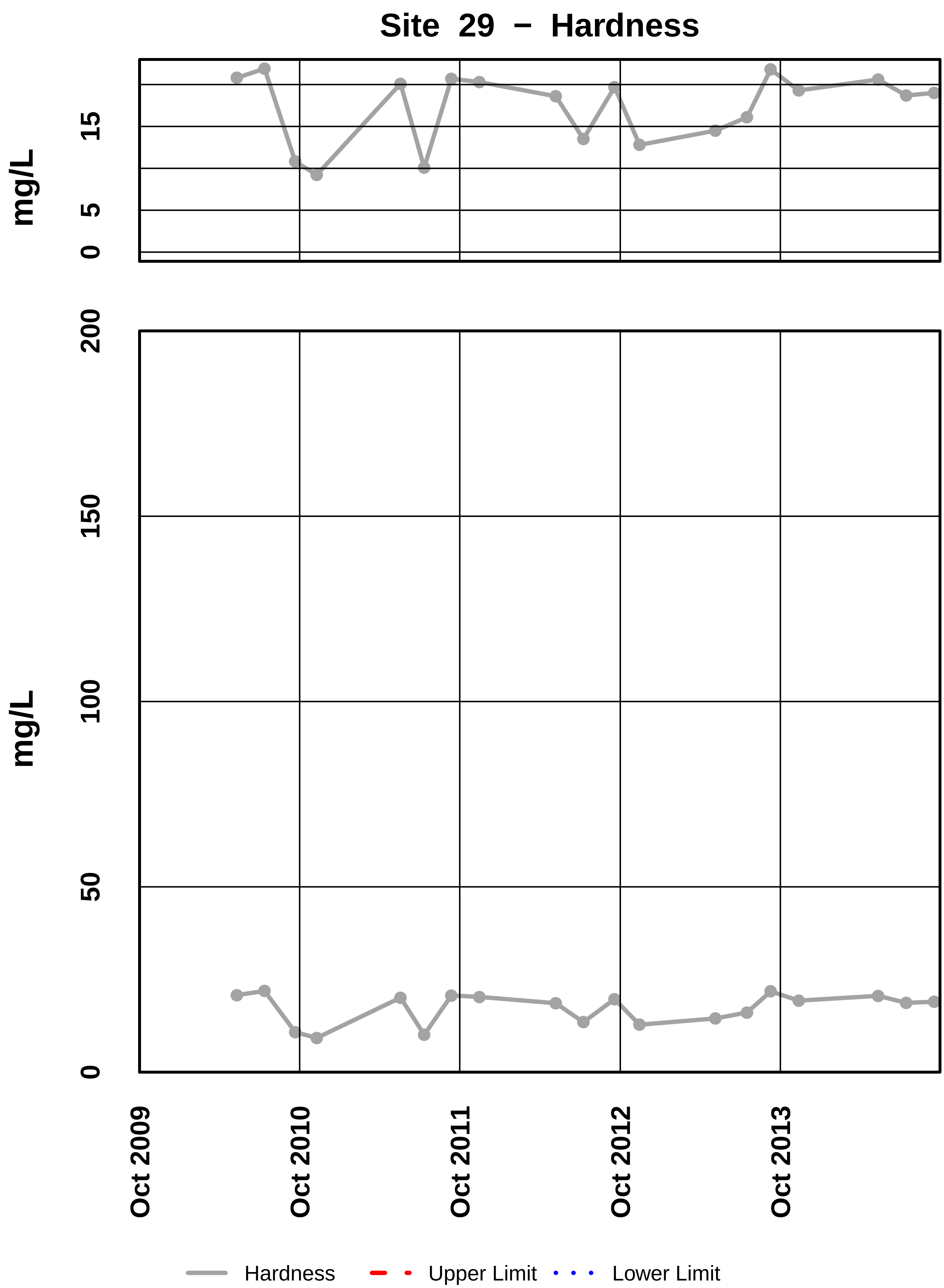

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

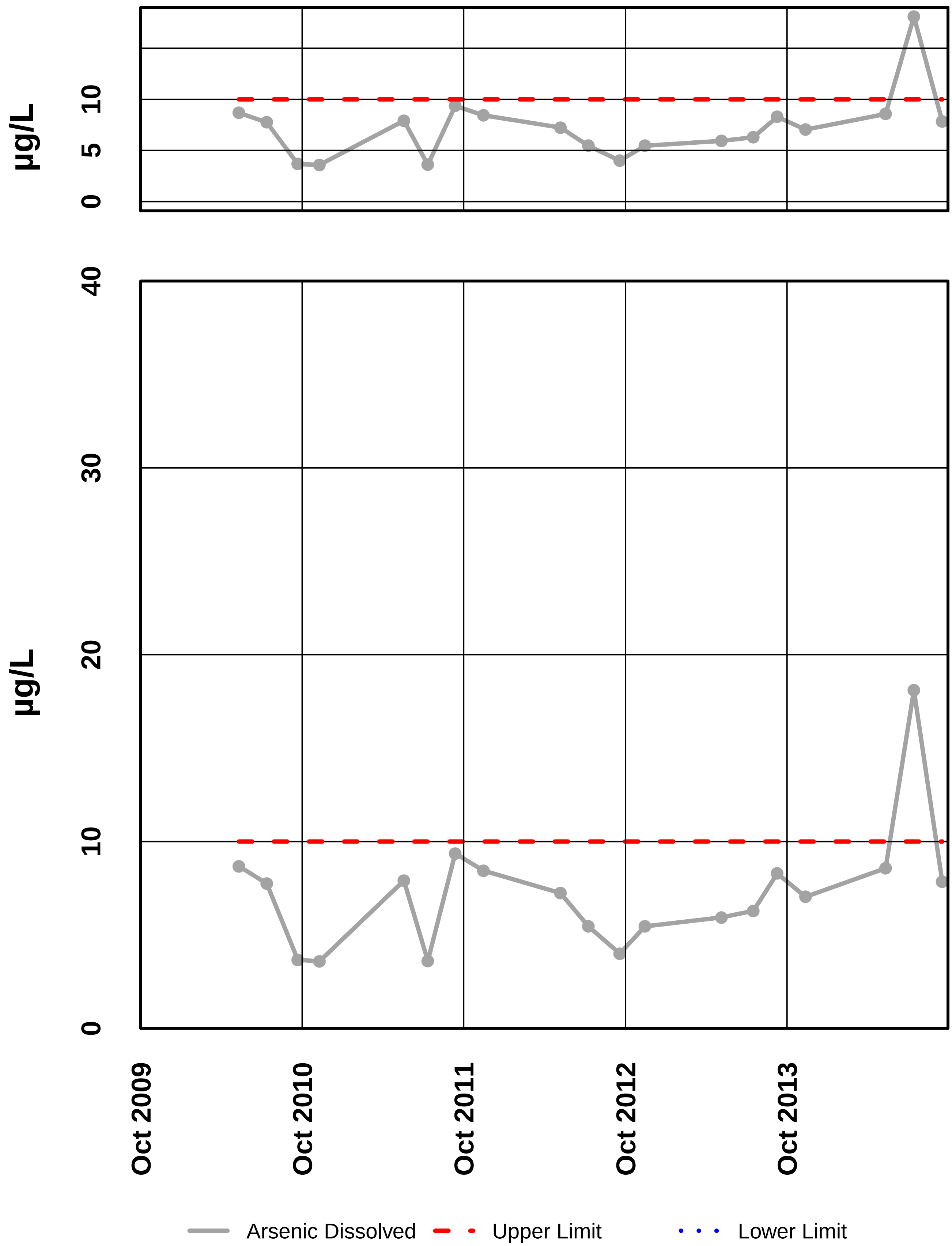



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

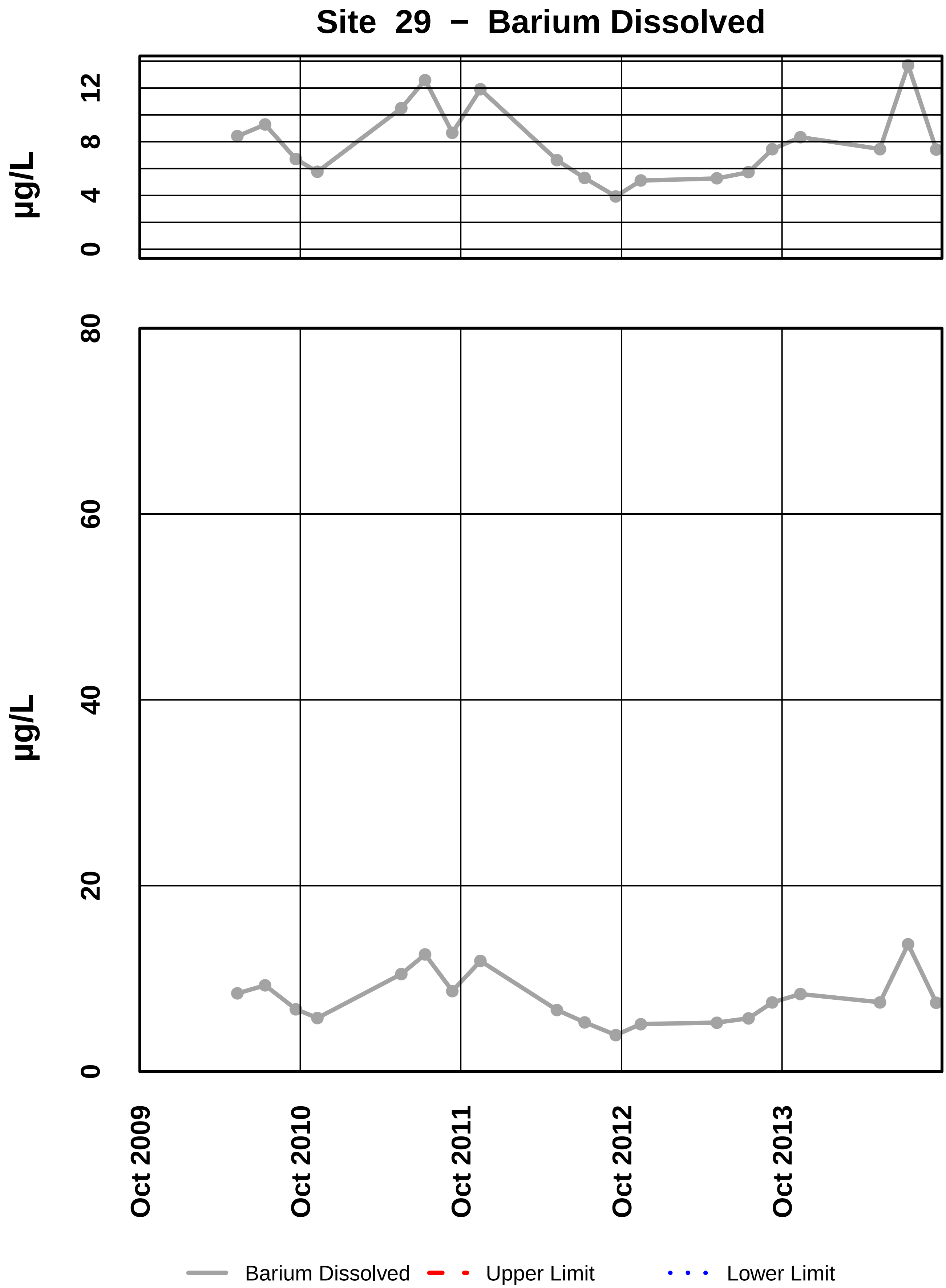



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# Site 29 – Arsenic Dissolved

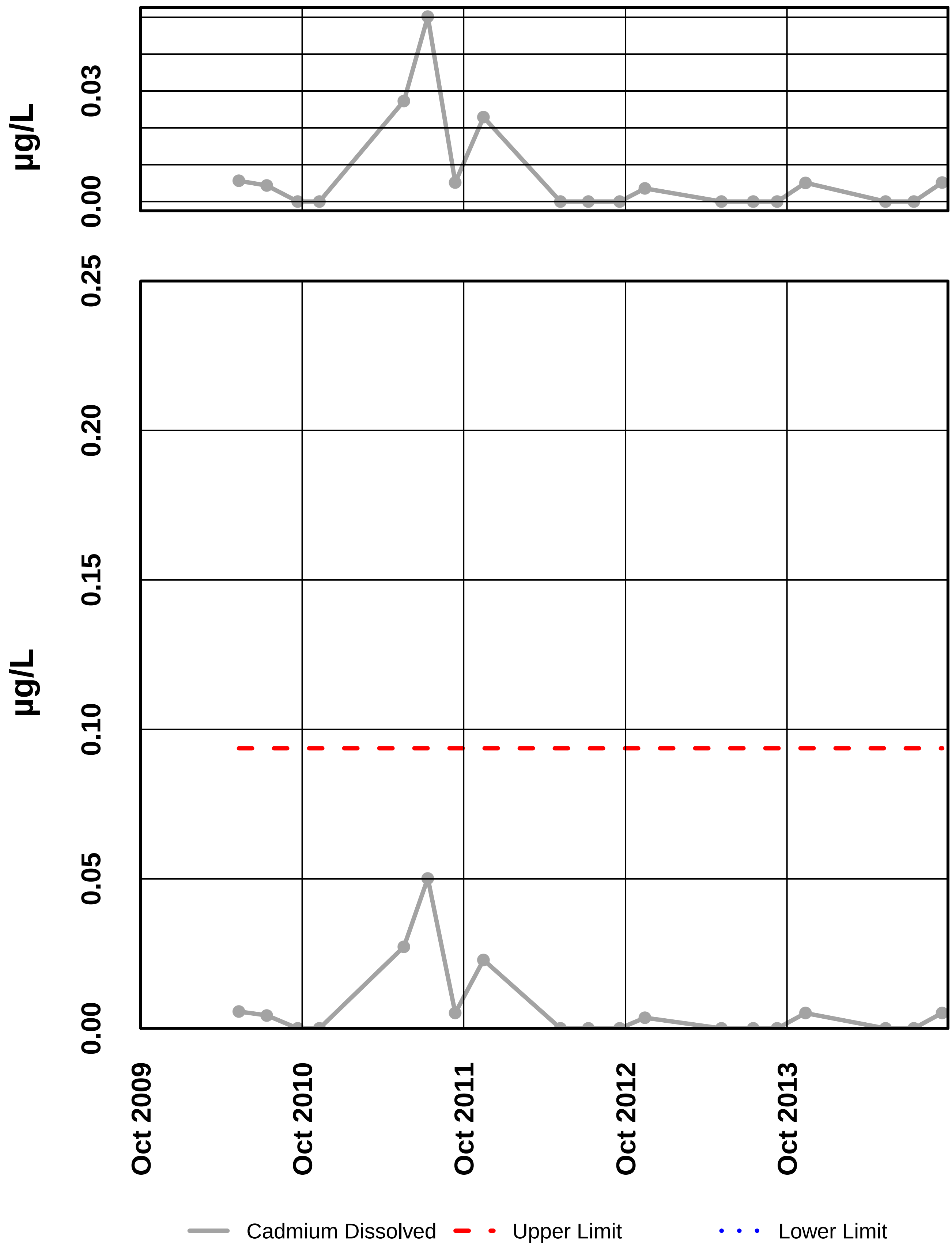



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

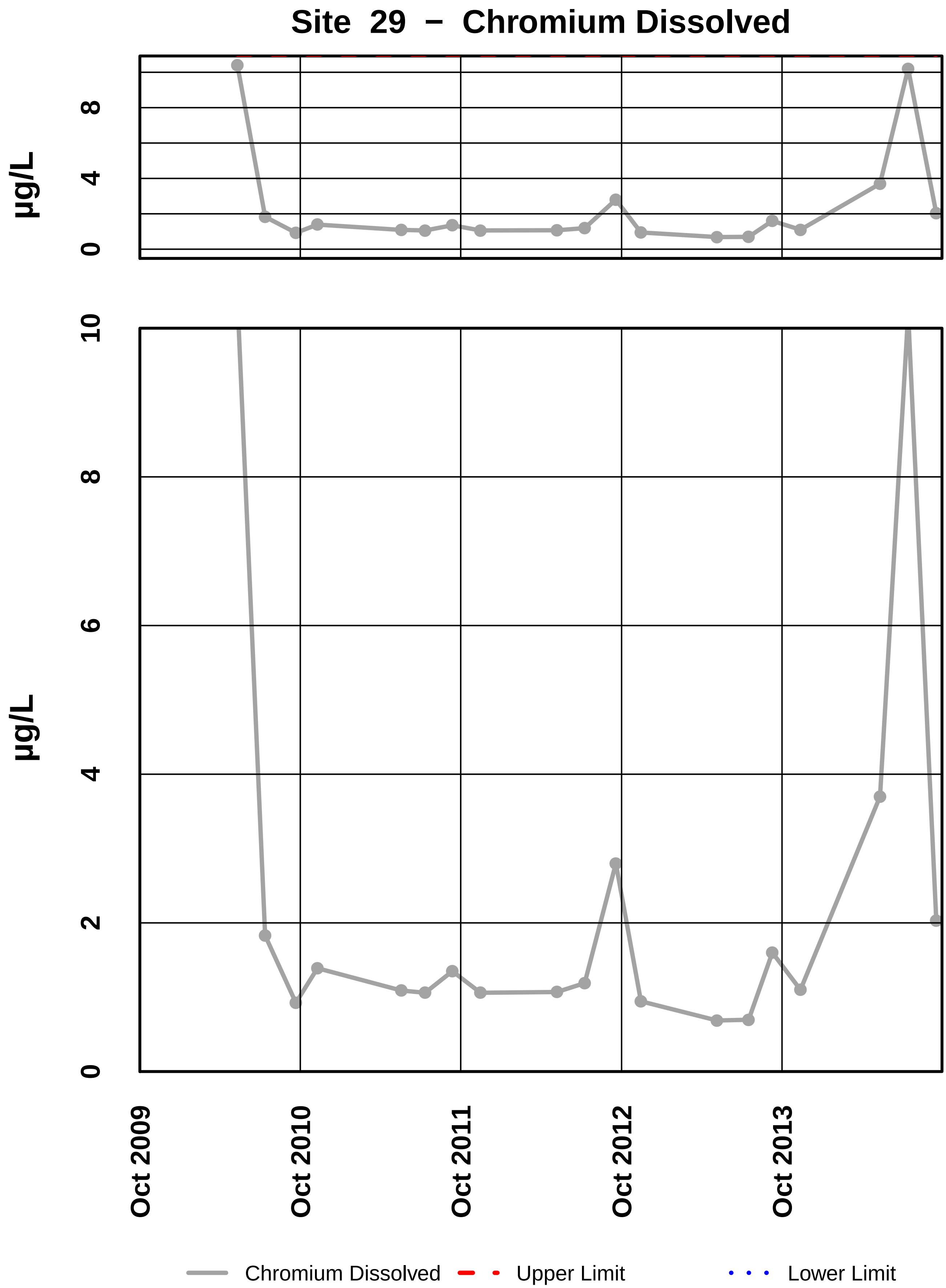



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# Site 29 – Cadmium Dissolved

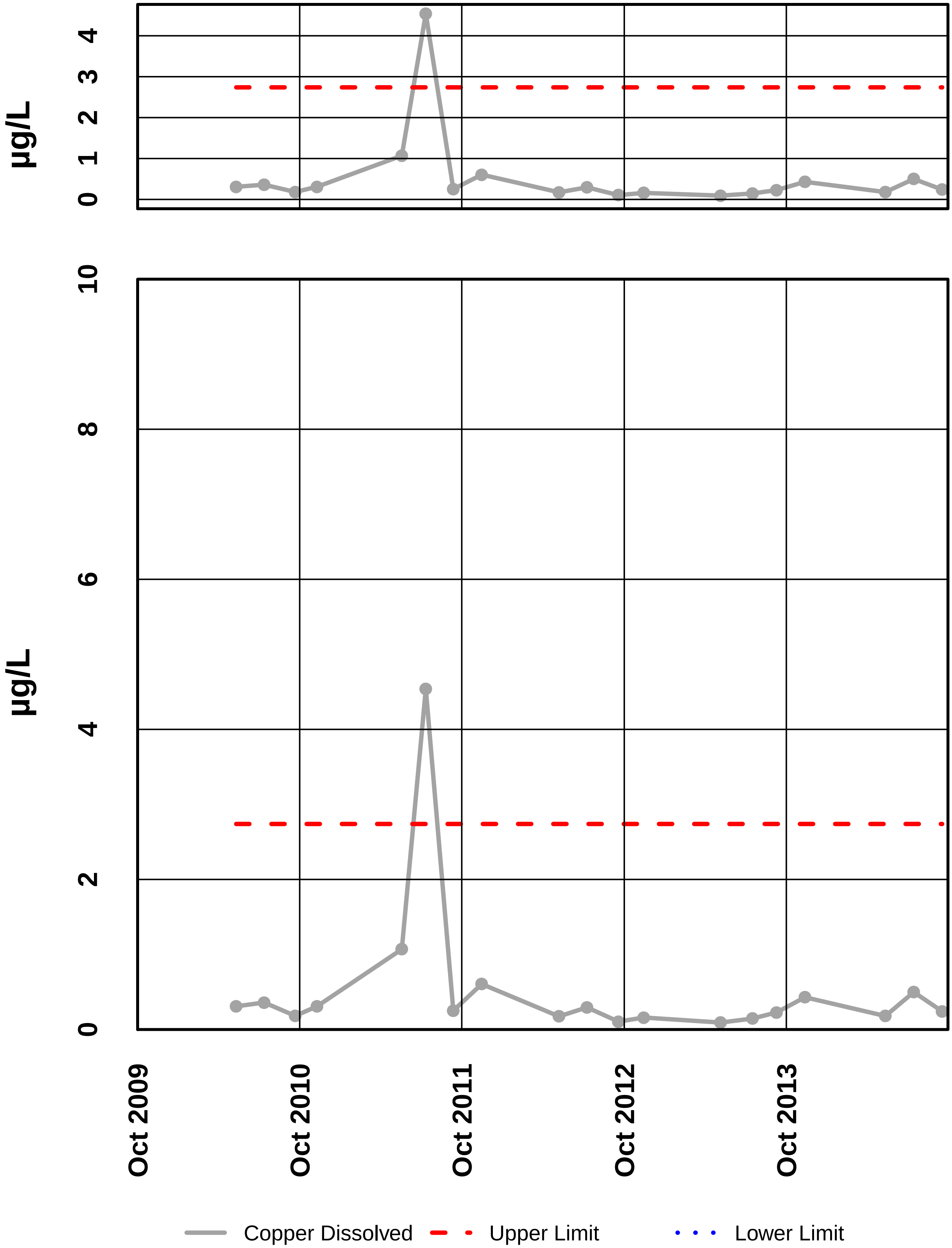



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

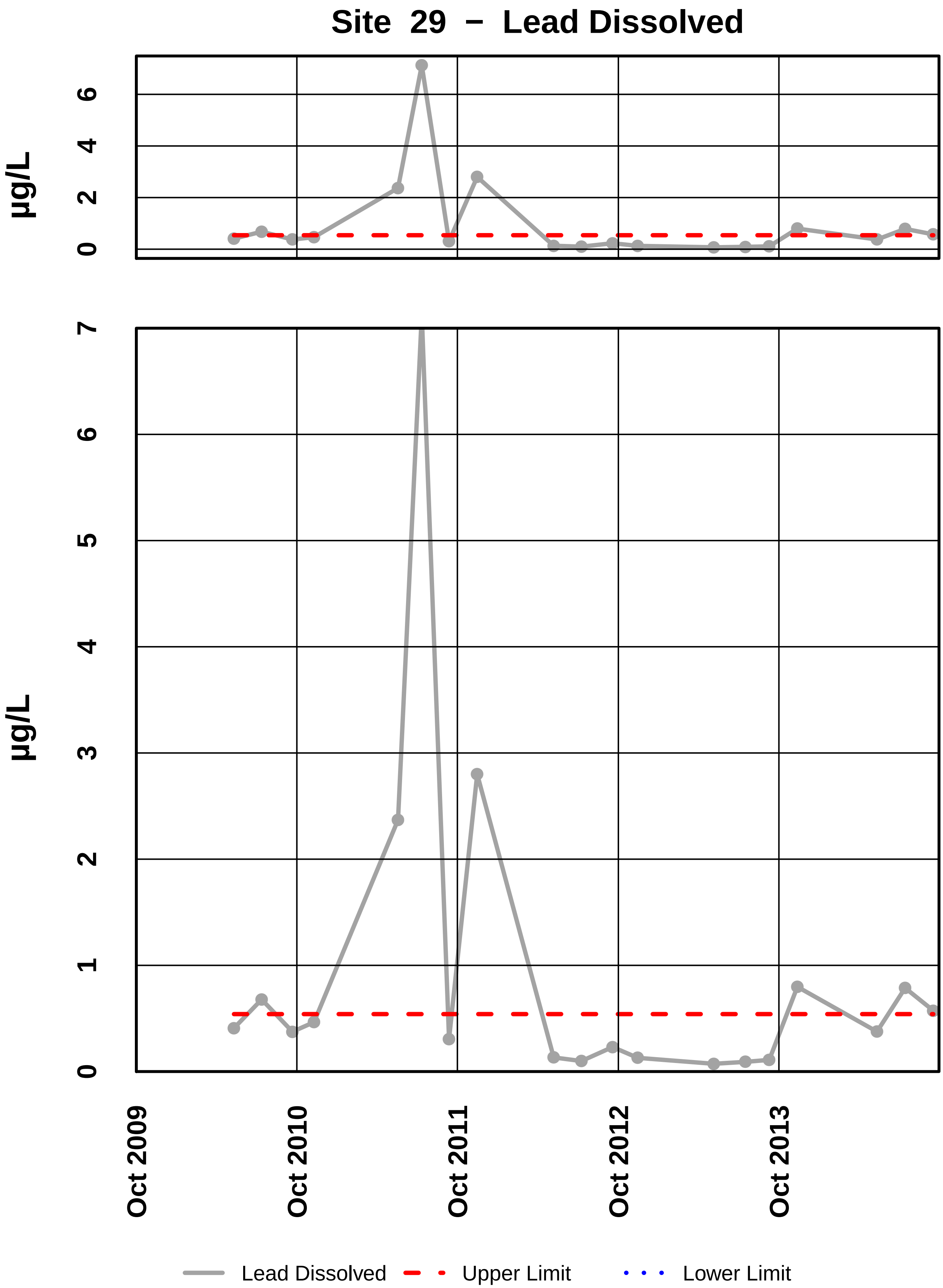



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

## Site 29 – Copper Dissolved

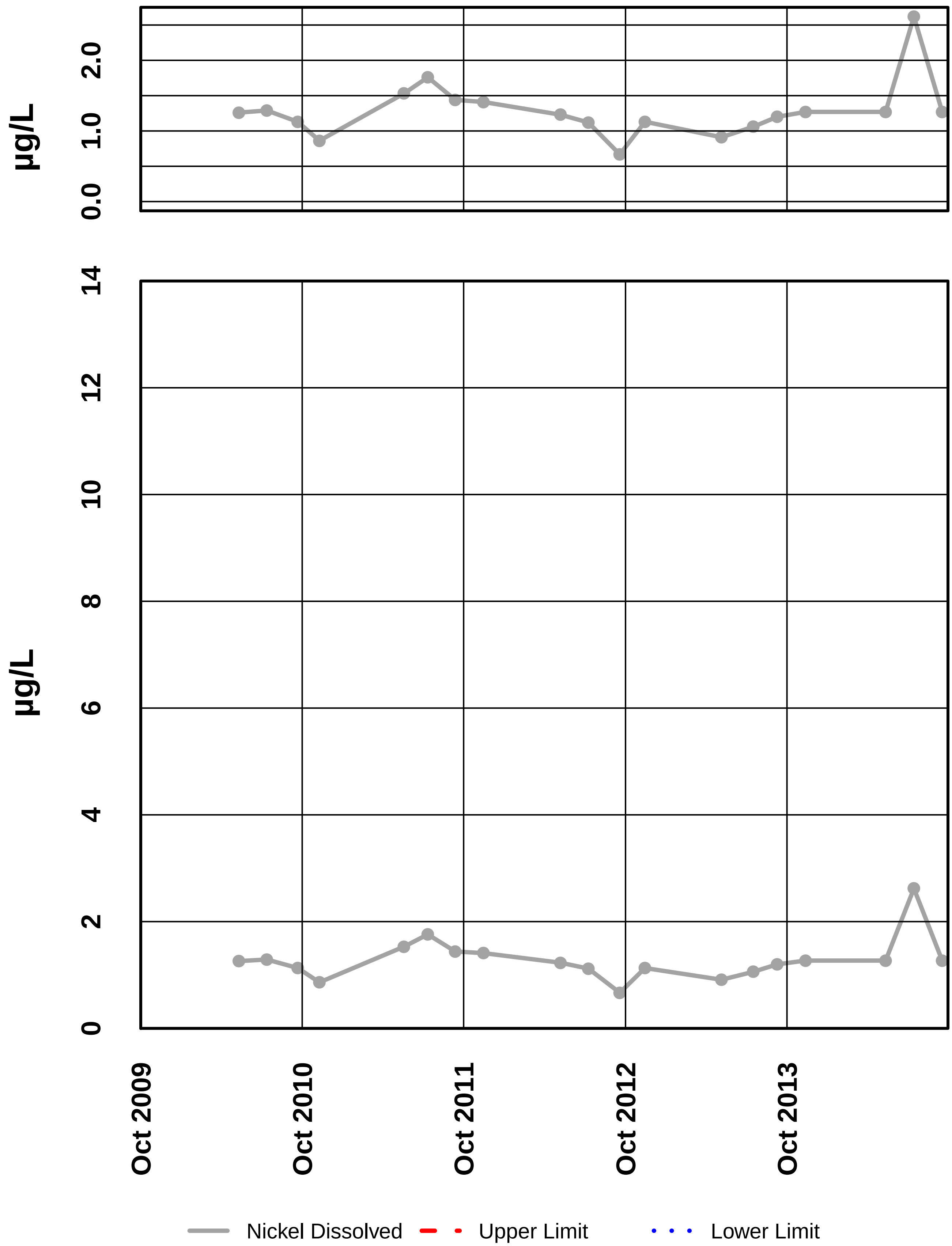



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

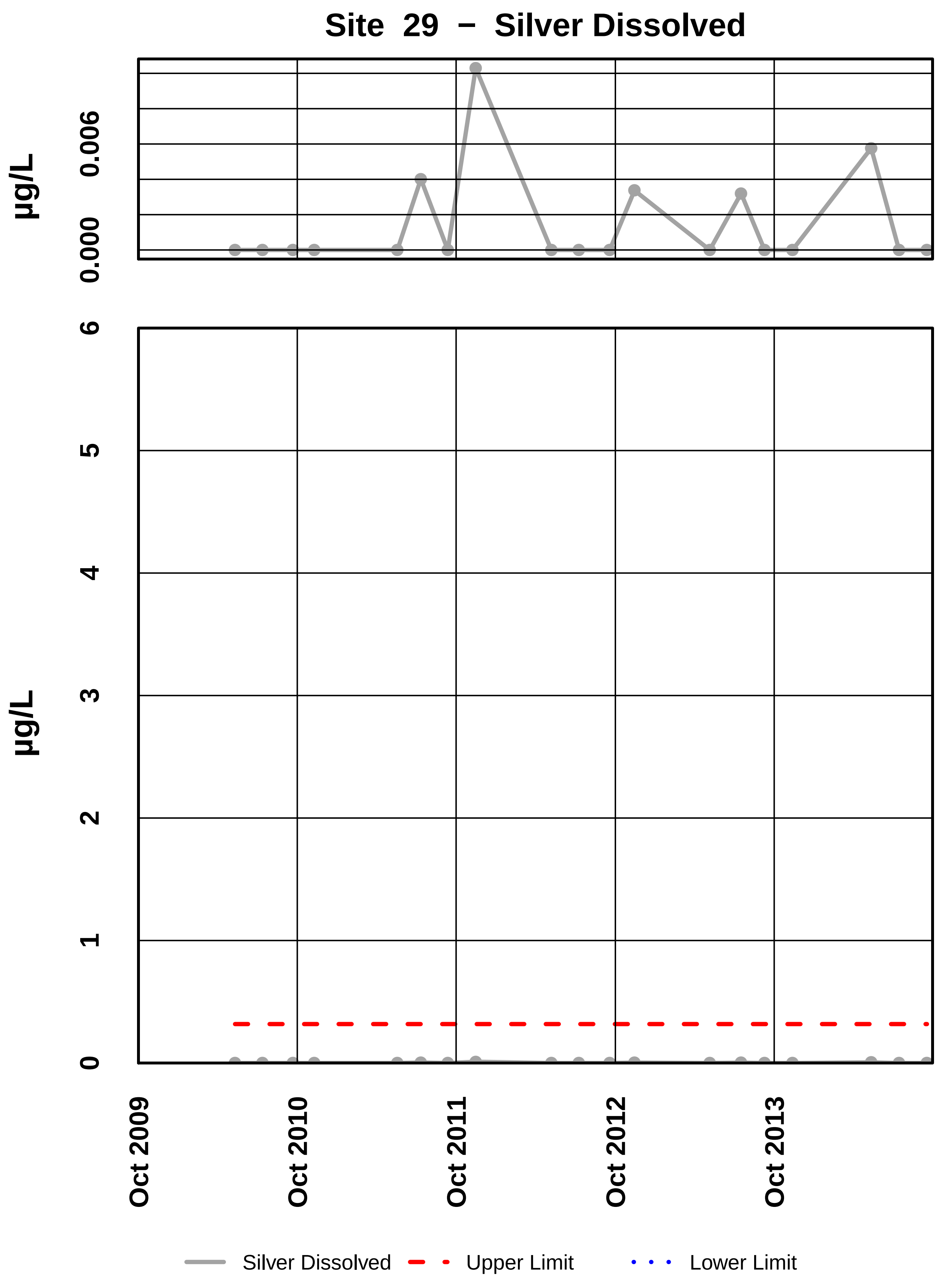



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# Site 29 – Nickel Dissolved

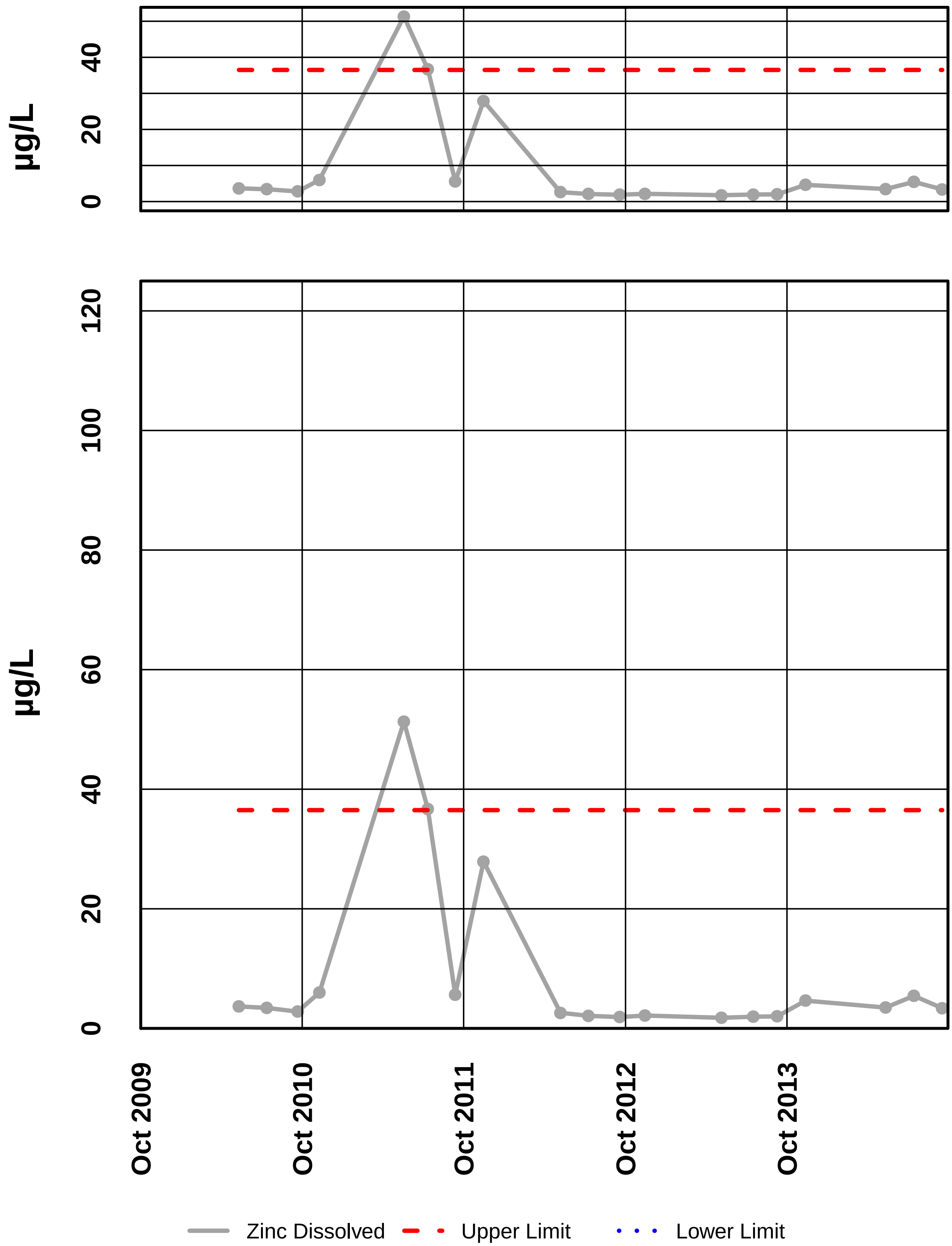



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



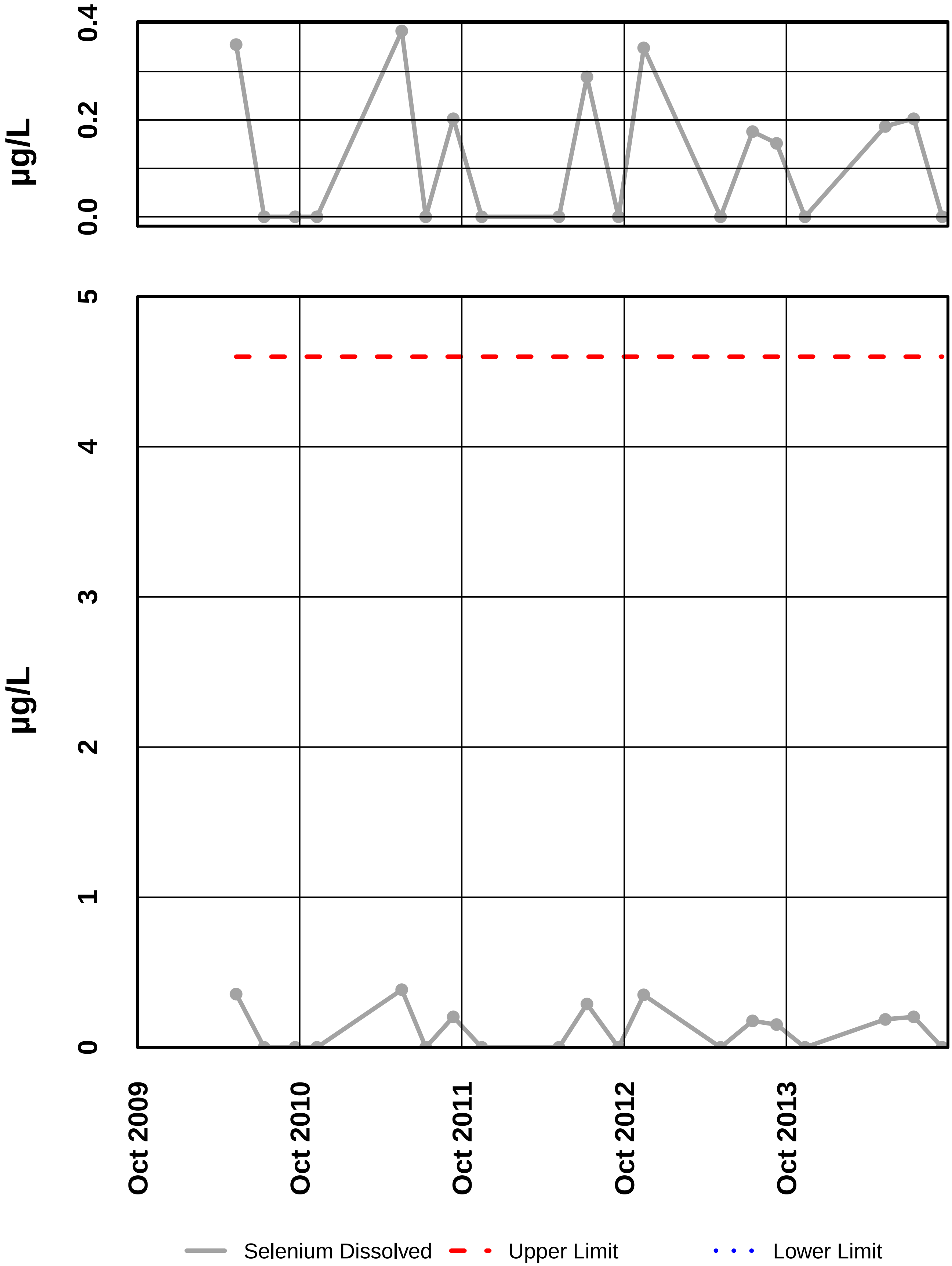

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# Site 29 − Zinc Dissolved



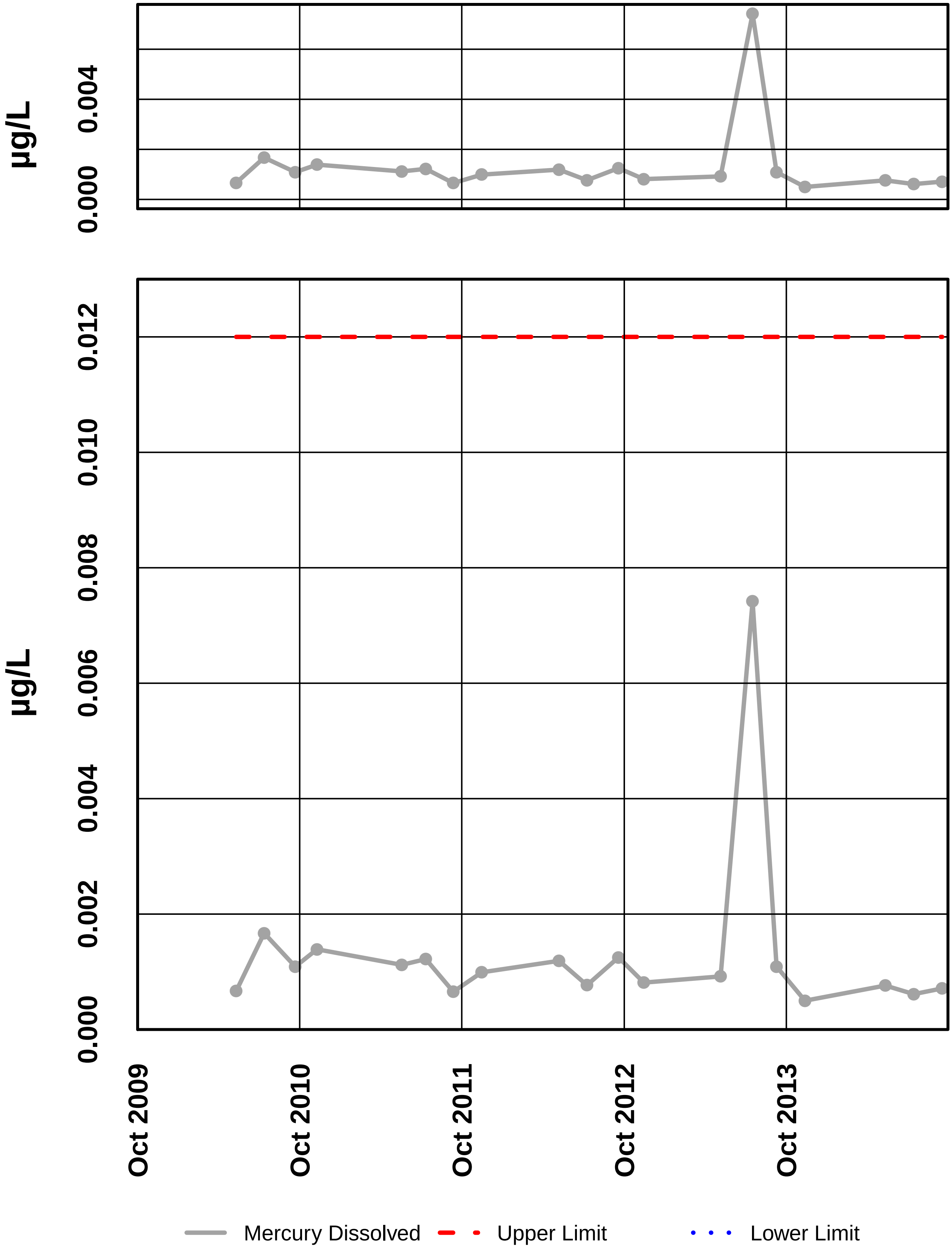

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# Site 29 – Selenium Dissolved




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# Site 29 − Mercury Dissolved




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# INTERPRETIVE REPORT
# SITE 32

The data collected during the current water year are listed in the following "Table of Results for Water Year 2014" report. The table includes all the required FWMP analyte data (field and laboratory) collected for the current water year and a series of flags keyed to the summary report "Qualified Data by QA Reviewer". The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of ½ MDL for the purpose of median calculation.

All data collected at this site for the past six years are included in the data analyses. As shown in the table below, there were no data outliers.

| Sample Date | Parameter | Value | Qualifier | Notes |
|---|---|---|---|---|
| No outliers have been identified by HGCMC for the period of October 2008 through September 2014. | | | | |

The data for Water Year 2014 have been compared to the strictest fresh water quality criterion for each applicable analyte. Twelve results exceeding these criteria have been identified as listed in the table below.

**Table of Exceedance for Water Year 2014**

| | | | Limits | | |
|---|---|---|---|---|---|
| Sample Date | Parameter | Value | Lower | Upper | Hardness |
| 12-Nov-13 | Alkalinity | 19.2 mg/L | 20 | 0 | |
| 12-May-14 | Alkalinity | 17.2 mg/L | 20 | 0 | |
| 15-Jul-14 | Alkalinity | 15.8 mg/L | 20 | 0 | |
| 17-Sep-14 | Alkalinity | 16.9 mg/L | 20 | 0 | |
| 12-Nov-13 | Lead Dissolved | 1.42 µg/L | 0 | 0.541 | 9.53 mg/L |
| 12-May-14 | Lead Dissolved | 1.26 µg/L | 0 | 0.541 | 8.35 mg/L |
| 15-Jul-14 | Lead Dissolved | 1.48 µg/L | 0 | 0.541 | 8.12 mg/L |
| 17-Sep-14 | Lead Dissolved | 1.38 µg/L | 0 | 0.541 | 8.42 mg/L |
| 12-Nov-13 | pH Field | 5.19 su | 6.5 | 8.5 | |
| 12-May-14 | pH Field | 5.23 su | 6.5 | 8.5 | |
| 15-Jul-14 | pH Field | 5.28 su | 6.5 | 8.5 | |
| 17-Sep-14 | pH Field | 5.31 su | 6.5 | 8.5 | |

All four of the annual sampling events were in exceedance for total alkalinity, dissolved lead, and field pH. Due to the low hardness for this site, 46 of the past 47 samples have returned lead values higher than the AWQS. As noted in the interpretive section for Site 29 fugitive tailings dust may be contributing to the elevated lead levels monitored at Site 32.

Dissolved chromium concentrations for the current water year, which were in exceedance during the May 2009 and May 2010 sampling, were well below the AWQS limit. A mechanism has yet to be established to explain the two elevated chromium results in those years.

X-Y plots have been generated to graphically present the data for each of the analytes requested in the Statistical Information Goals for this site. These plots have been visually analyzed for the appearance of any trend in concentration. No obvious trends are apparent except for dissolved lead which has generally decreased the last several water years from a peak in water year 2006.

A non-parametric statistical analysis for trend was performed for specific conductivity, field pH, total alkalinity, total sulfate, and dissolved zinc. Calculation details of the Seasonal Kendall analyses are presented in detail on the pages following this interpretive section. The adjacent table summarizes the results on the data collected between Oct-08 and Sep-14(WY2009-WY2014).

**Table of Summary Statistics for Trend Analysis**

| | Mann-Kendall test statistics | | | Sen's slope estimate | |
|---|---|---|---|---|---|
| **Parameter** | **n*** | **p**** | **Trend** | **Q** | **Q(%)** |
| Conductivity Field | 6 | 0.16 | | | |
| pH Field | 6 | 0.29 | | | |
| Alkalinity, Total | 6 | <0.01 | + | 1.825 | 11.774 |
| Sulfate, Total | 6 | Inconsistent detection limits | | | |
| Zinc, Dissolved | 6 | 0.01 | - | -1.143 | -13.451 |

* Number of Years ** Significance level

There was a significant negative (p=0.01) trend in dissolved zinc (slope of -1.14 su/yr) and a significant positive trend with total alkalinity (slope of 1.82 mg/L/yr). Trend analysis was not performed on the total sulfate dataset because of a change in the method detection limit used by Analytica Laboratories. A primary assumption of the Mann-Kendall test is "… only one censoring threshold exists. When more than one detection limit exists, the Mann-Kendall test cannot be performed without further censoring the data." In order to prevent this from occurring HGCMC has worked to establish a consistent MDL for sulfate from the laboratory.

With the discontinuation of sampling at Site 58 during Water Year 2013, an inter-well comparison is no longer feasible. Instead an intra-well analysis was performed using combined Shewhart-CUSUM charts for conductivity, dissolved zinc, and alkalinity. Table 1 contains a summary of the baseline statistics along with the control limits used.

Site 32 was installed in 1988 and has an extensive sampling history, however establishing a baseline has been difficult. Since the installation of the well a number of the monitored parameters (*i.e.* alkalinity, specific conductance, total sulfate, and etc…) have been in constant flux. Because the CUSUM process compares the mean and standard deviation of the chosen baseline to the collected data it is possible to detect continual changes in the analytes without having a background data set. After reviewing the data for the three parameters, data periods were chosen based upon the data having a period of minimal flux. This period was then used for the calculation of the baseline statistics.

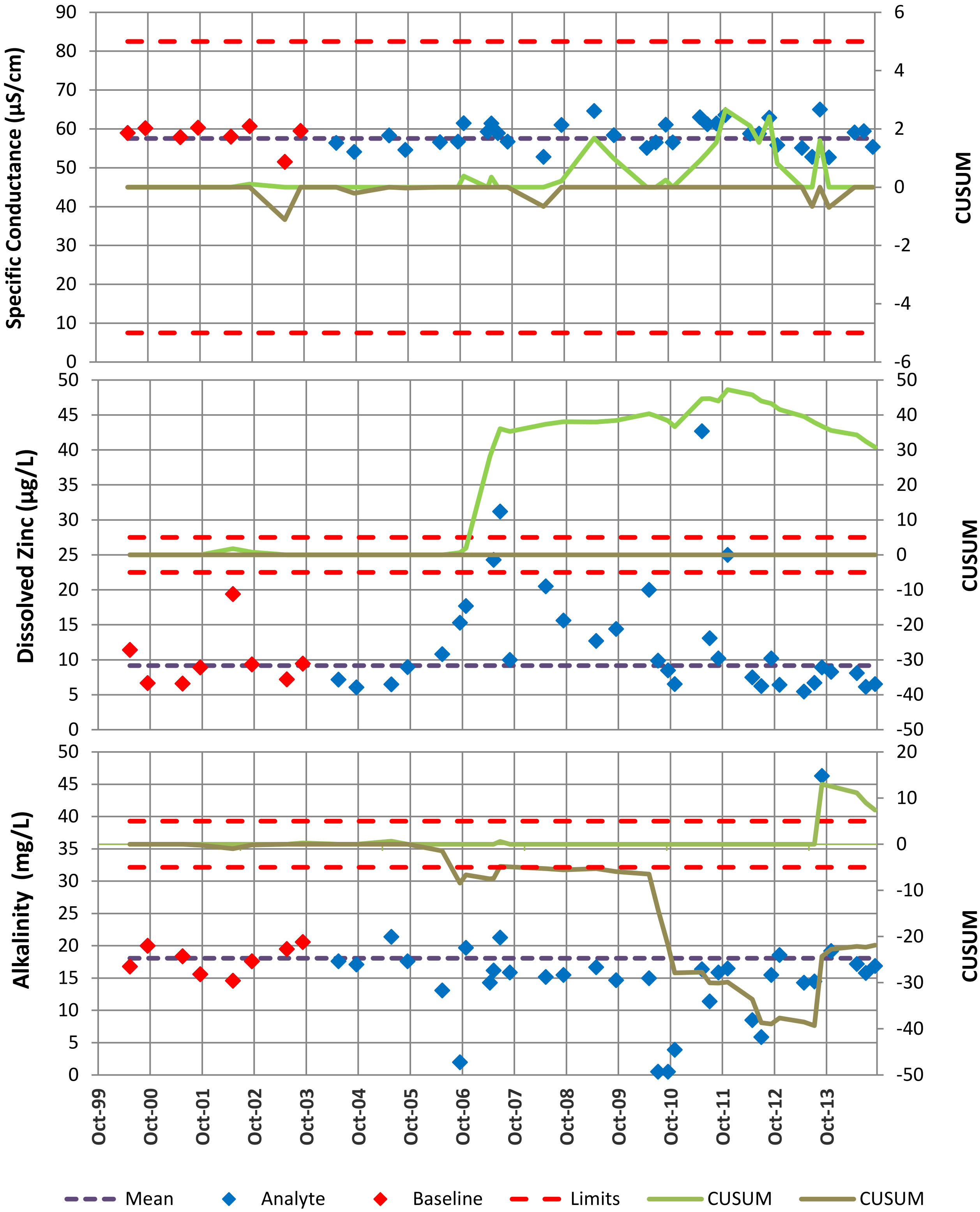
**Table 1. Specific Conductance, Dissolved Zinc, and Total Sulfate Baseline Periods, Summary Statistics and Various Control Limits**

| | Site 32 Conductivity (µS/cm) | Site 32 Diss. Zinc (µg/L) | Site 32 Alkalinity (mg/L) |
|---|---|---|---|
| **Baseline Statistics** | | | |
| Baseline Period | 09/18/95-09/10/03 | 05/11/00-09/15/05 | 04/27/95-09/13/00 |
| Number of Samples | 12 | 12 | 12 |
| Mean (x) | 57.5 | 9.17 | 18.7 |
| Standard Deviation | 2.86 | 3.72 | 2.02 |
| **Shewhart-CUSUM Control Limits (SCL)** | | | |
| Control Limit (mean x+ 2s) | 63.3 | 16.6 | 22.1 |
| Control Limit (mean x + 3s) | 66.1 | 20.3 | 24.1 |
| Control Limit (mean x + 4s) | 69.0 | 24.0 | 26.1 |
| Control Limit (mean x + 4.5s) | 70.4 | 25.9 | 27.1 |
| **CUSUM Control Limits** | | | |
| Cumulative increase – h | 5 | 5 | 5 |

Site 32 was installed in 1988 and has an extensive sampling history; though this well has similar completion as Site 29, there has not been an analogous long term flux in these parameters. This makes establishing the baseline less difficult. Because the CUSUM process compares the mean and standard deviation of the chosen baseline to the collected data it possible to detect continual changes in the analytes without having a background data set. After reviewing the data for the three parameters, data periods were chosen based upon the data having a period of stability. This period was then used for the calculation of the baseline statistics.

Two of the three parameters examined (Figure 1) eventually went out of control with respects to the chosen baseline data statistics. If the pore/contact water from inside the facility was not contained, the well water would have high conductivity, high dissolved zinc, and high alkalinity. Specific conductance has shown the least amount of variability, never going out of control. Total alkalinity went out of control because there has been a minor decrease in the parameter concentration. Because alkalinity and specific conductance do not have a similar pattern to going out of control as compared to dissolved zinc, it is not thought that these changes are a result of contact water leaching from containment. Dissolved zinc has periodically had higher values than the mean. As previous discussed it is hypothesized that the increase in dissolved zinc results from the accumulation of fugitive dust in the snow pack during the winter. In the spring when the snow pack melts this material is released as a pulse. Most years the deposited material is not present by the fall sampling. With the implementation of additional best management practices, HGCMC expects to decrease the amount of fugitive dust leaving the tailings disposal facility.

**Figure 1.** **Observed Measurements for Specific Conductance, Dissolved Zinc, and Alkalinity from Site 32 Compared to the Shewhart-CUSUM Control Limits From Table 1**



## Table of Results for Water Year 2014

### Site 032FMG - 'Monitoring Well - 5S'

| Sample Date/Parameter | Oct 2013 | Nov 2013 | Dec 2013 | Jan 2014 | Feb 2014 | Mar 2014 | Apr 2014 | May 2014 | Jun 2014 | Jul 2014 | Aug 2014 | Sep 2014 | **Median** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Water Temp (°C) | | 7.3 | | | | | | 10.2 | | 10.3 | | 8.8 | 9.5 |
| Conductivity-Field(µmho) | | 64 | | | | | | 67 | | 69 | | 62.3 | 65.5 |
| Conductivity-Lab (µmho) | | 53 | | | | | | 59 | | 59 | | 55 | 57 |
| pH Lab (standard units) | | 5.15 | | | | | | 5.11 | | 5.05 | | 5.17 | 5.13 |
| pH Field (standard units) | | 5.19 | | | | | | 5.23 | | 5.28 | | 5.31 | 5.26 |
| Total Alkalinity (mg/L) | | 19.2 | | | | | | 17.2 | | 15.8 | | 16.9 | 17.1 |
| Total Sulfate (mg/L) | | 5 | | | | | | 2.5 | | 0.3 | | 1.3 | 1.9 |
| Hardness (mg/L) | | 9.5 | | | | | | 8.4 | | 8.1 | | 8.4 | 8.4 |
| Dissolved As (ug/L) | | 4.33 | | | | | | 5.18 | | 4.46 | | 4.86 | 4.660 |
| Dissolved Ba (ug/L) | | 17.5 | | | | | | 17.7 | | 14.3 | | 13.5 | 15.9 |
| Dissolved Cd (ug/L) | | 0.0068 | | | | | | 0.0121 | | 0.0086 | | 0.0105 | 0.0096 |
| Dissolved Cr (ug/L) | | 1.78 | | | | | | 3.56 | | 2.99 | | 4.7 | 3.275 |
| Dissolved Cu (ug/L) | | 0.727 | | | | | | 0.435 | | 0.875 | | 0.563 | 0.645 |
| Dissolved Pb (ug/L) | | 1.42 | | | | | | 1.26 | | 1.48 | | 1.38 | 1.4000 |
| Dissolved Ni (ug/L) | | 3.65 | | | | | | 3.23 | | 3.25 | | 2.94 | 3.240 |
| Dissolved Ag (ug/L) | | 0.002 | | | | | | 0.007 | | 0.002 | | 0.002 | 0.002 |
| Dissolved Zn (ug/L) | | 8.26 | | | | | | 8.1 | | 6.14 | | 6.53 | 7.32 |
| Dissolved Se (ug/L) | | 0.287 | | | | | | 0.198 | | 0.581 | | 0.287 | 0.287 |
| Dissolved Hg (ug/L) | | 0.00119 | | | | | | 0.000816 | | 0.00104 | | 0.00094 | 0.000990 |

For individual sample/analyte qualifier descriptions see "Qualified Data by QA Reviewer" table.

Values reported as less than MDL are replaced by 1/2 MDL for median calculation purposes.

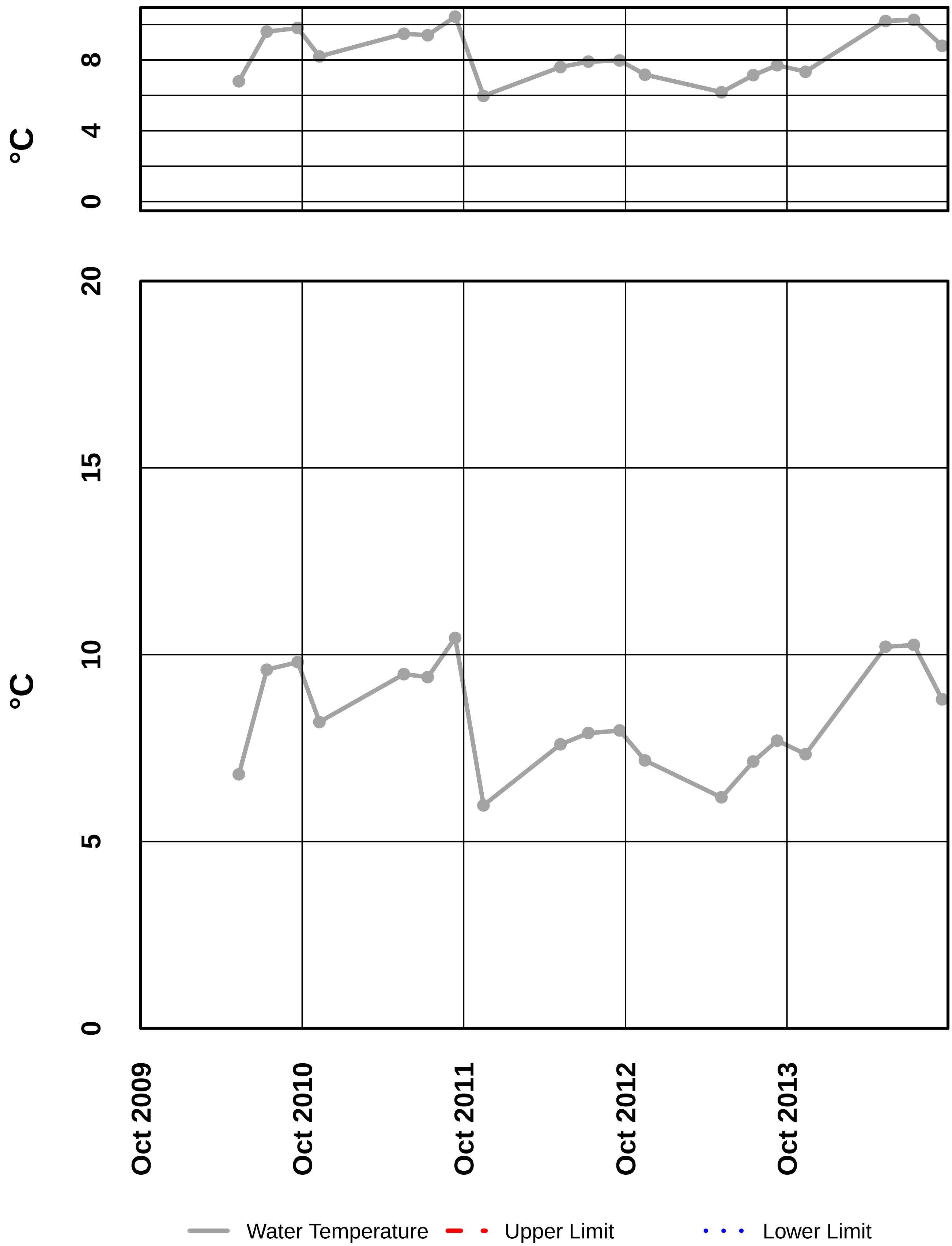
Shaded data has been qualified as an outlier by HGCMC and removed from any further analysis and is not included into the calculation of the median

# Qualified Data by QA Reviewer

## Date Range: 10/01/2013 to 09/30/2014

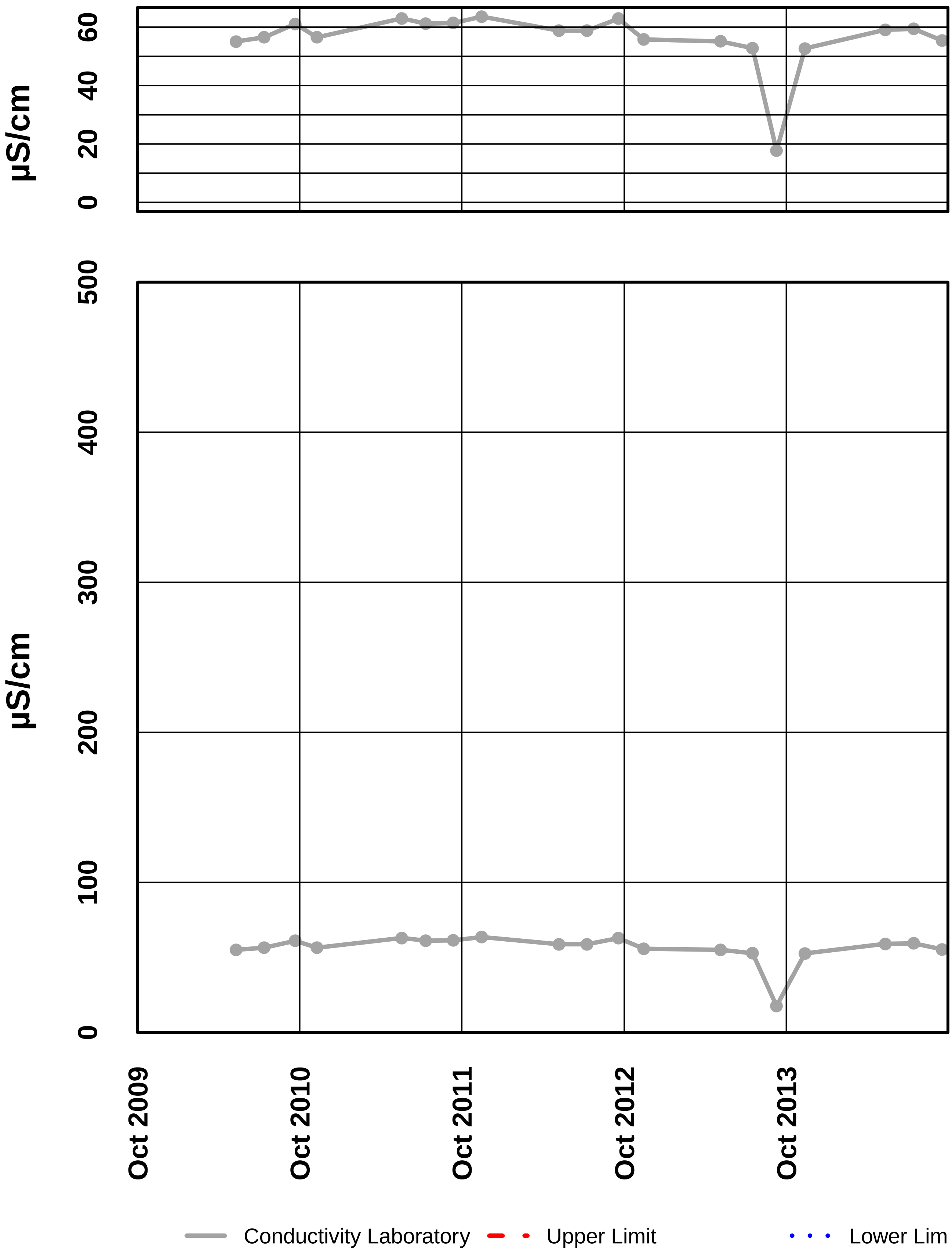
| Site No. | Sample Date | Sample Time | Parameter | Value | Qualifier | Reason for Qualifier |
|---|---|---|---|---|---|---|
| 032FMG | 11/12/2013 | 12:00 PM | Diss. Cd-ICP/MS | 0.00681 | J | Below Quantitative Range |
| 032FMG | 11/12/2013 | 12:00 PM | Diss. Se-ICP/MS | 0.28 | J | Below Quantitative Range |
| 032FMG | 5/12/2014 | 12:00 PM | Alkalinity | 17.2 | U | Trip Blank Contamination |
| | | | Conductivity | 59.1 | U | Trip Blank Contamination |
| | | | Diss. Ag-ICP/MS | 0.00691 | J | Below Quantitative Range |
| | | | Diss. Se-ICP/MS | 0.19 | J | Below Quantitative Range |
| | | | Sulfate | -5 | UJ | Sample Receipt Temperature |
| 032FMG | 7/15/2014 | 12:00 PM | Diss. Cd-ICP/MS | 0.0086 | J | Below Quantitative Range |
| 032FMG | 9/17/2014 | 12:00 PM | Diss. Cd-ICP/MS | 0.01 | J | Below Quantitative Range |
| | | | Diss. Se-ICP/MS | 0.28 | J | Below Quantitative Range |

# Site 32 − Water Temperature

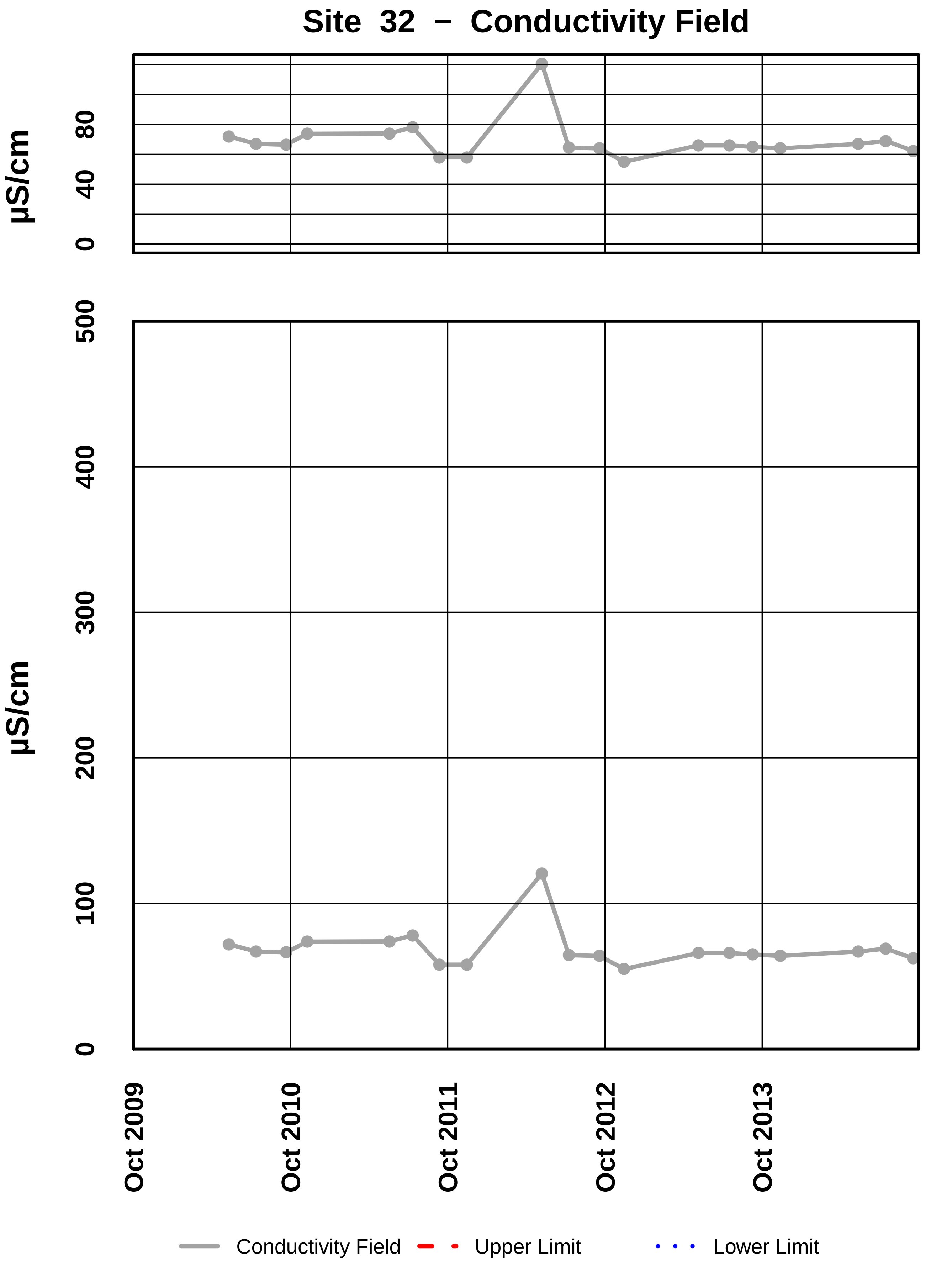



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

## Site 32 – Conductivity Laboratory

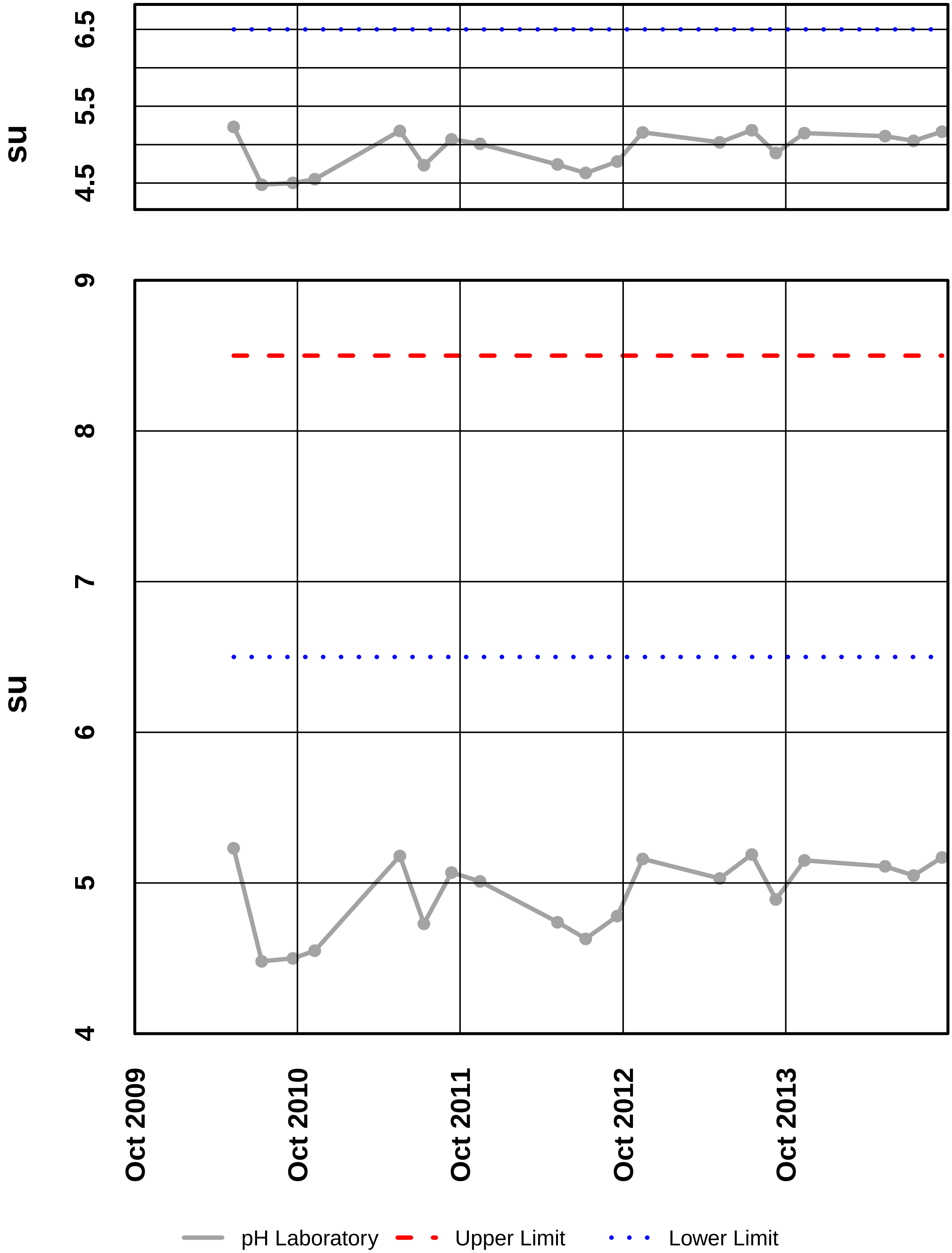



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

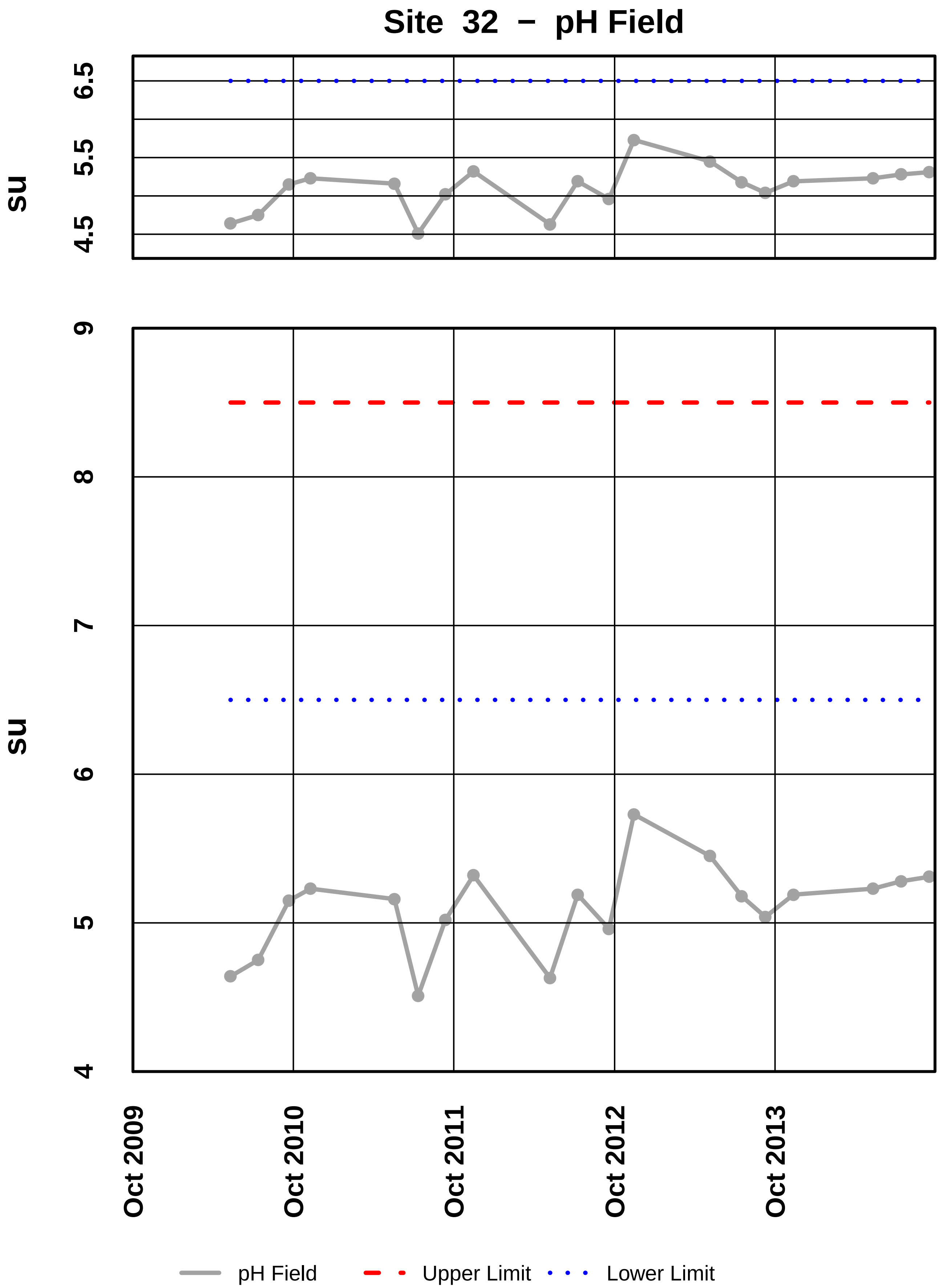



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

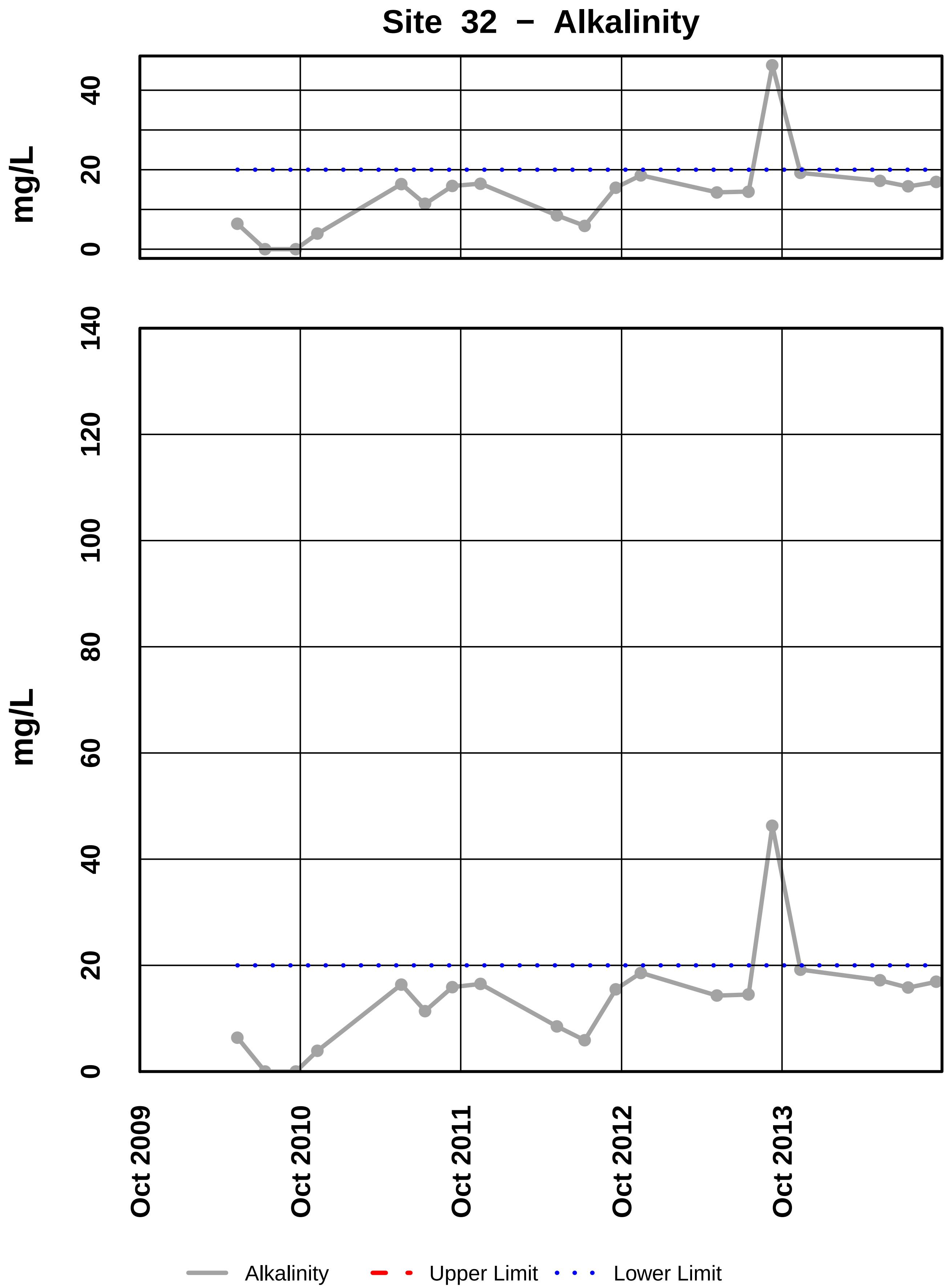
## Site 32 – pH Laboratory



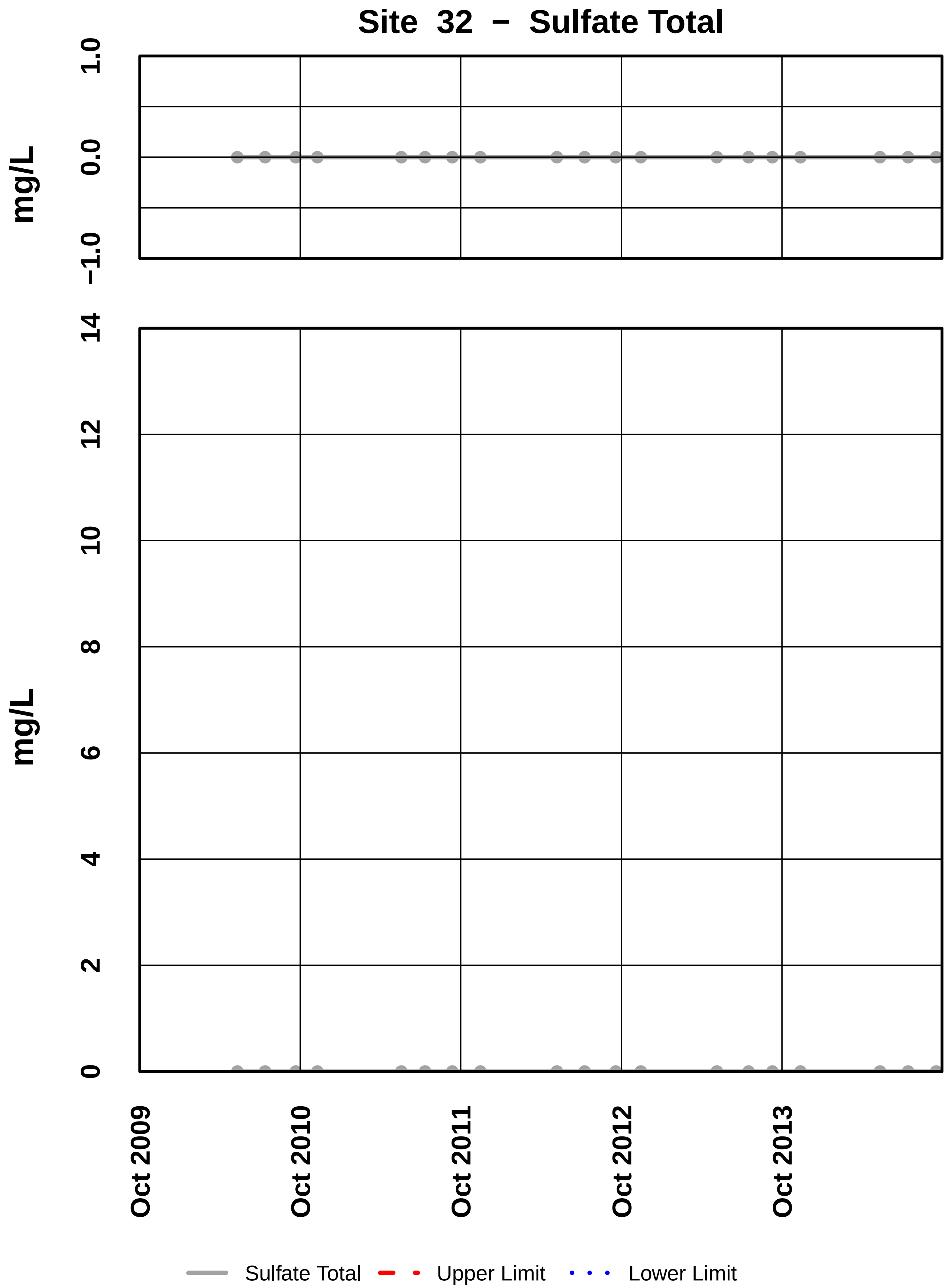

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

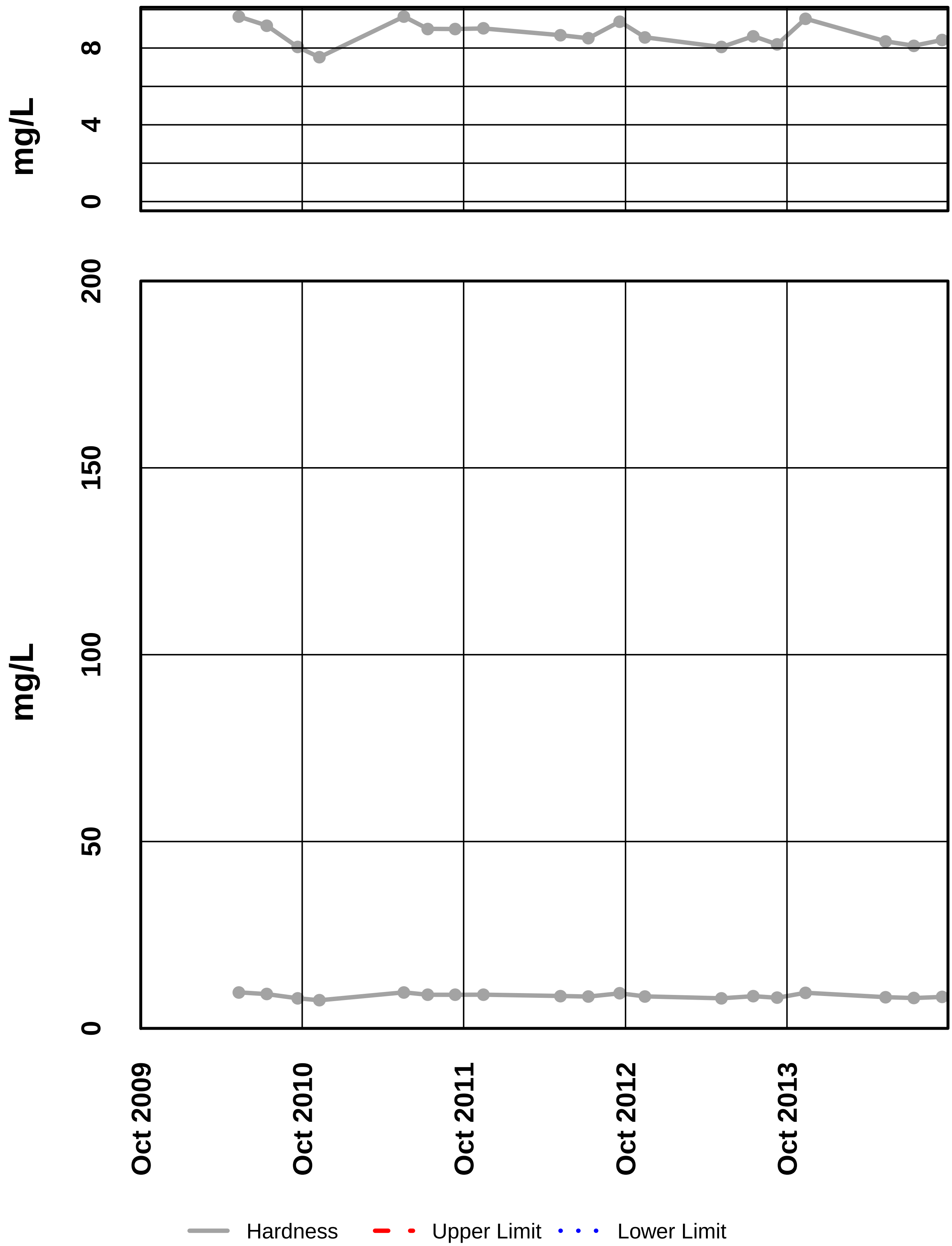



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



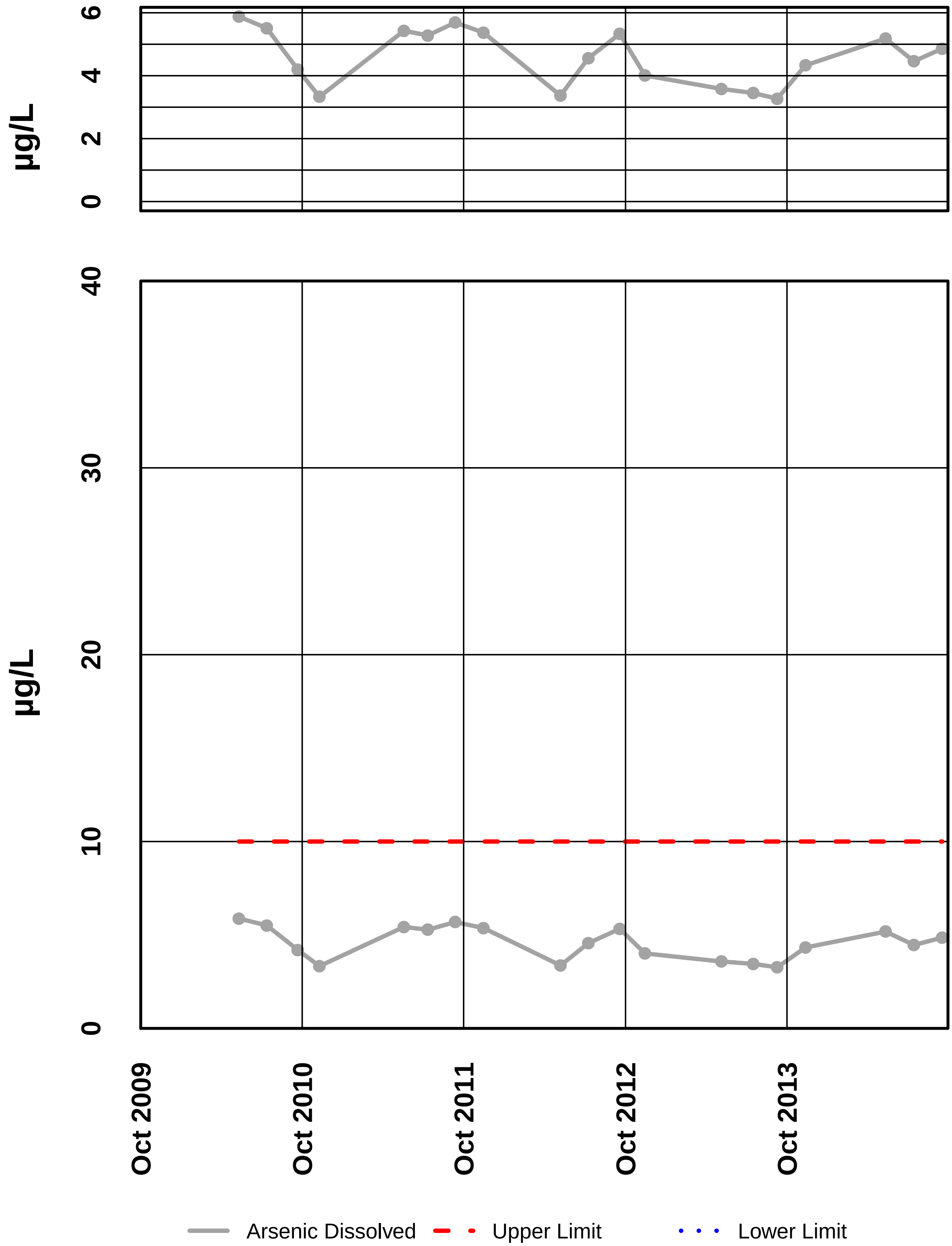

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# Site 32 − Hardness

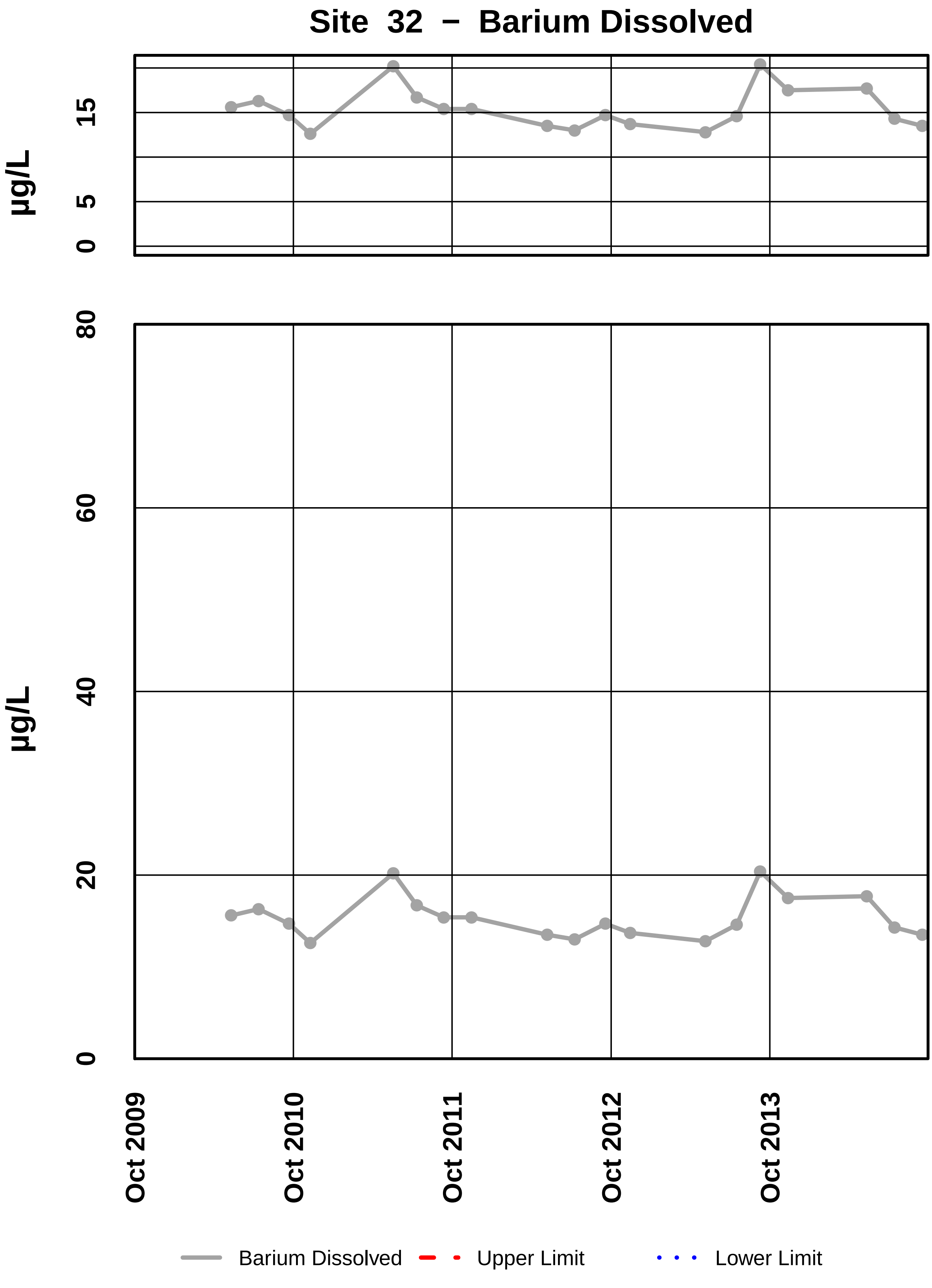



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

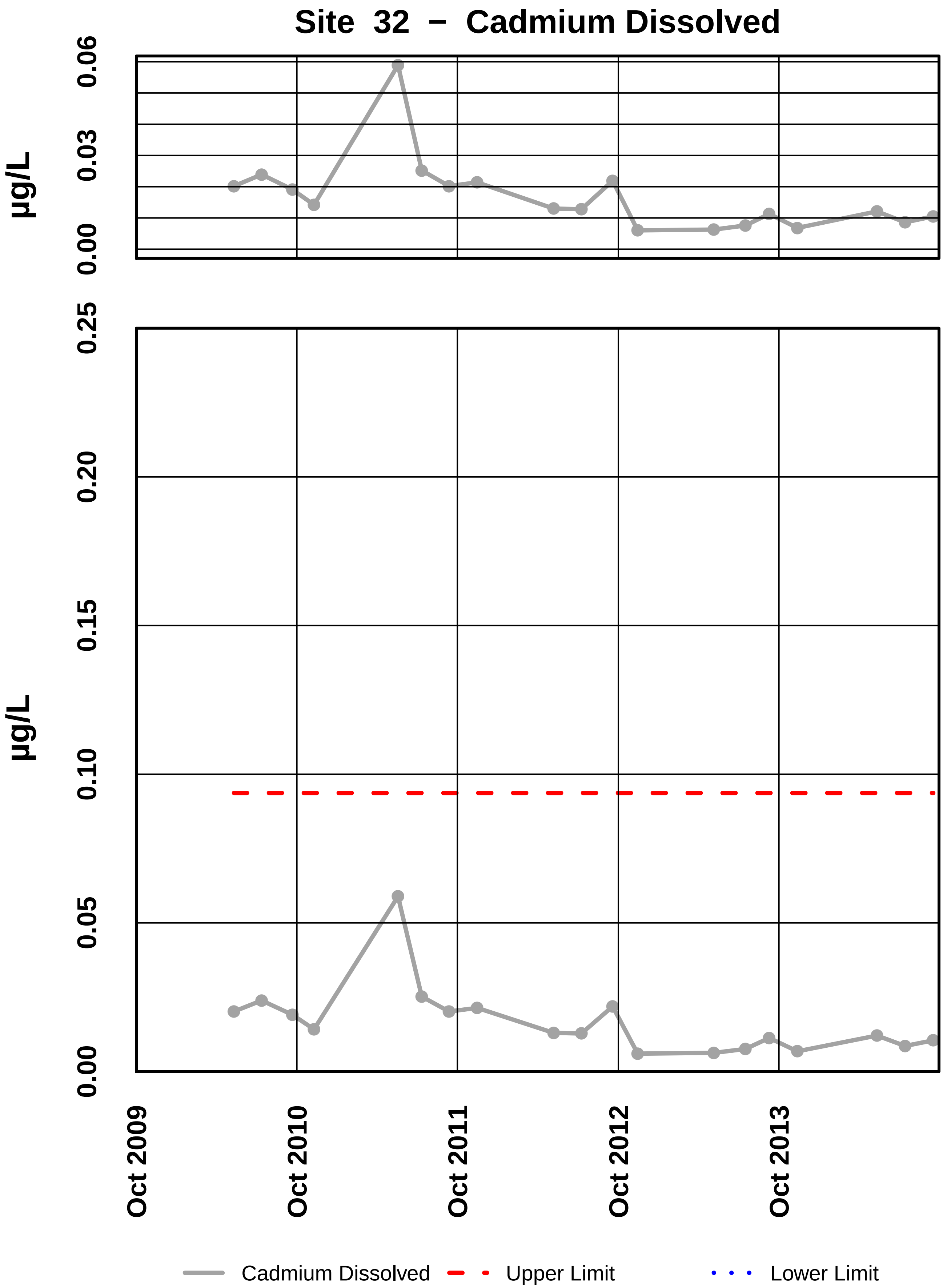
# Site 32 – Arsenic Dissolved



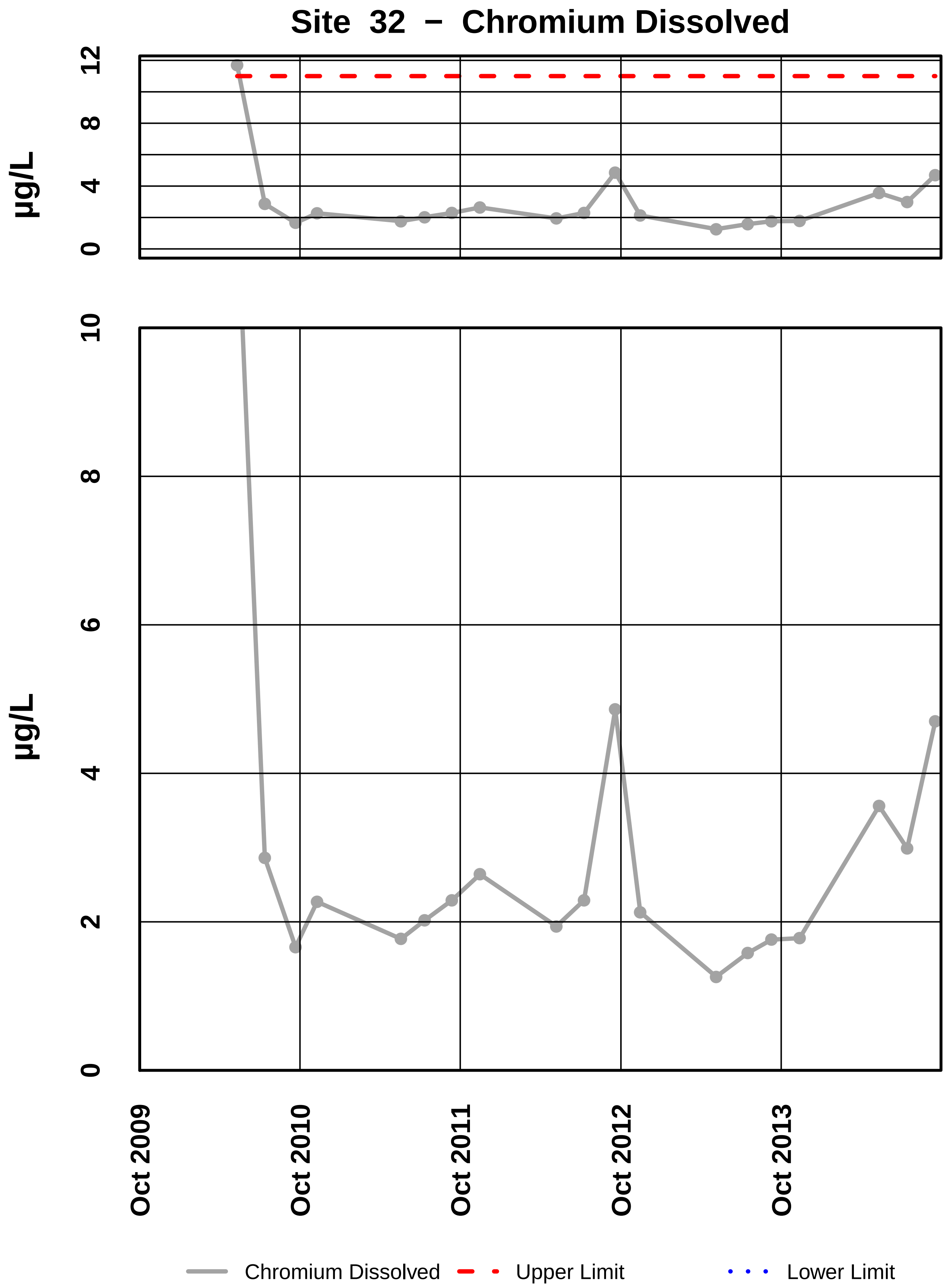

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



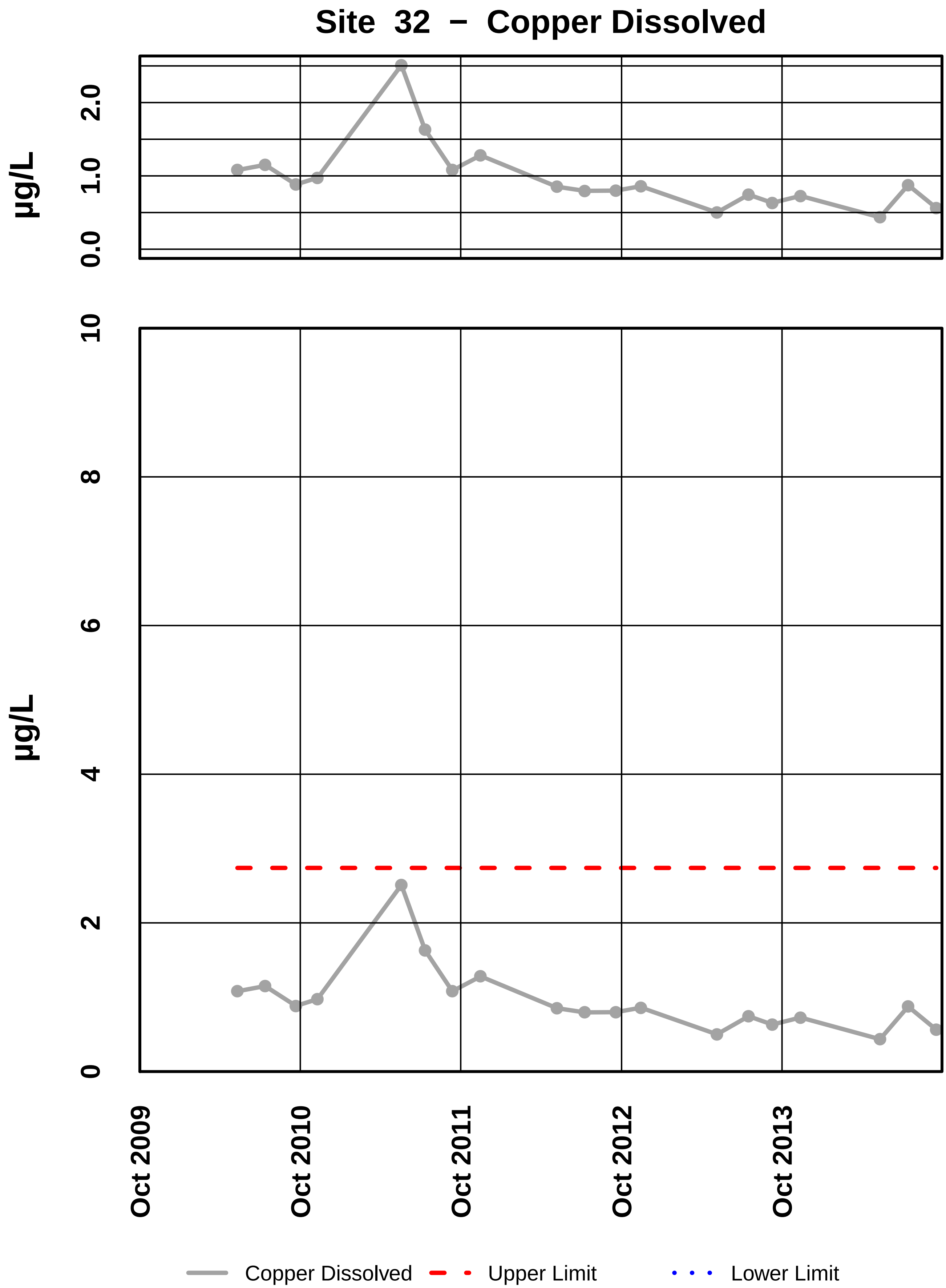

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



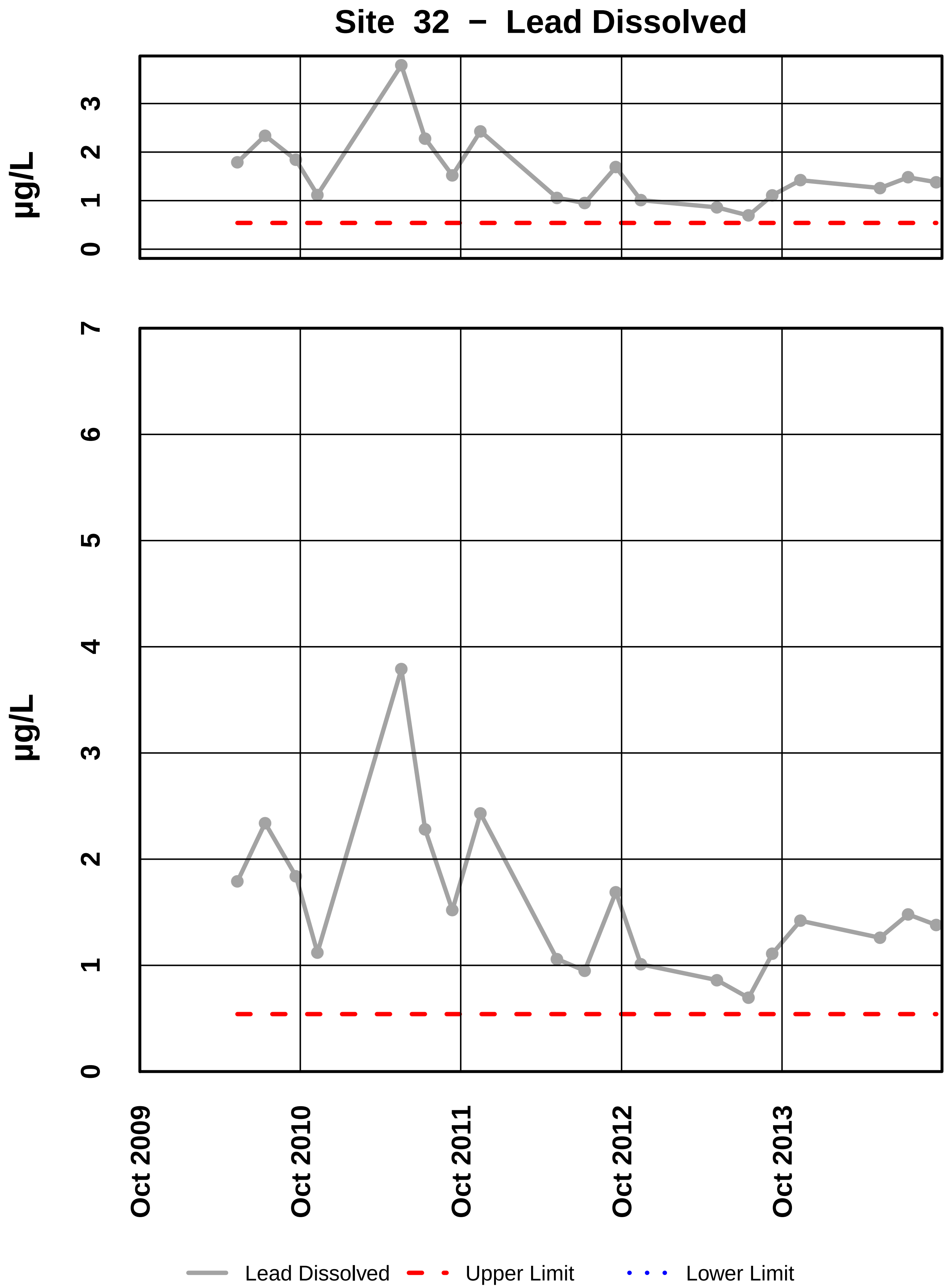

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



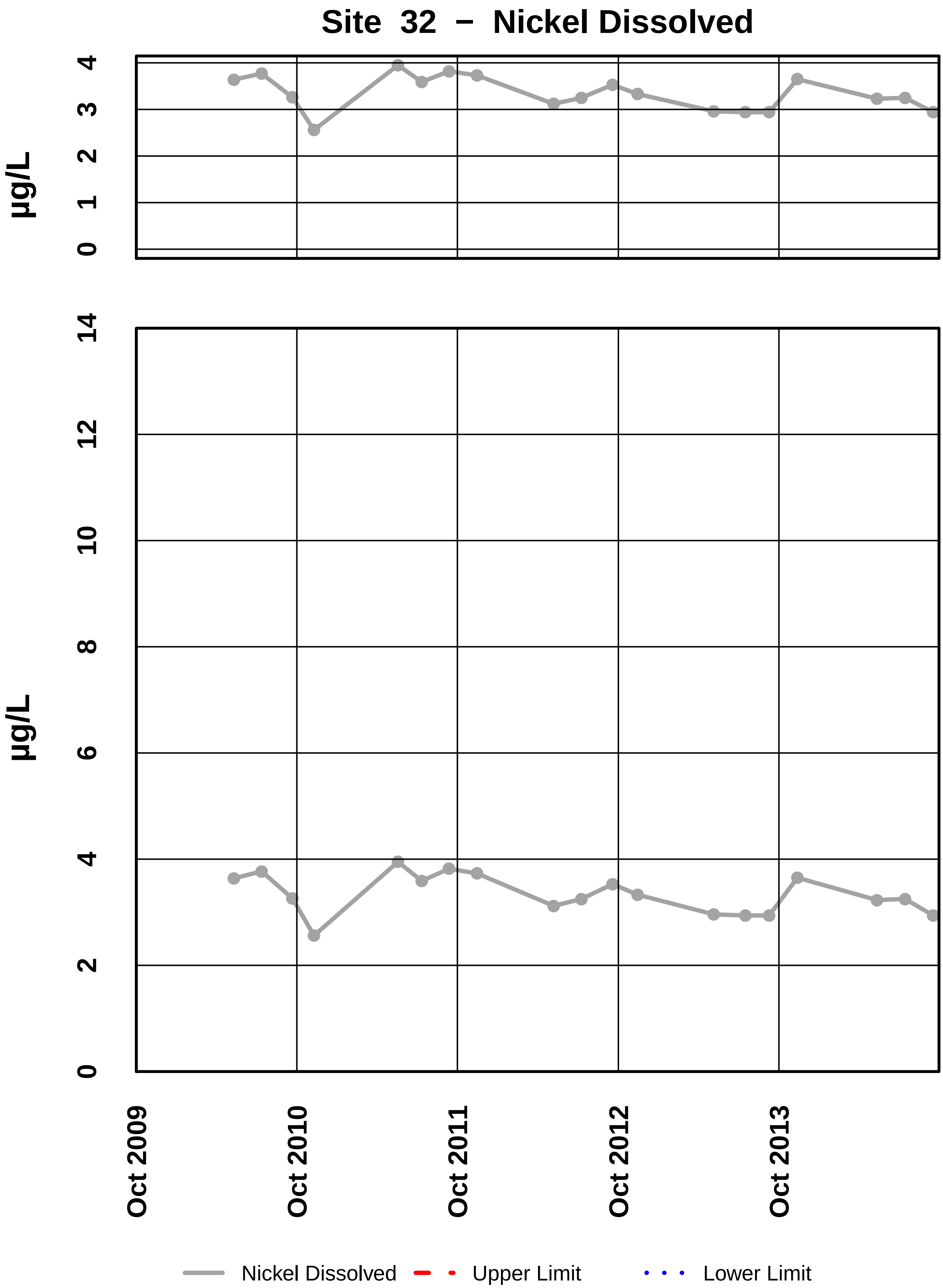

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

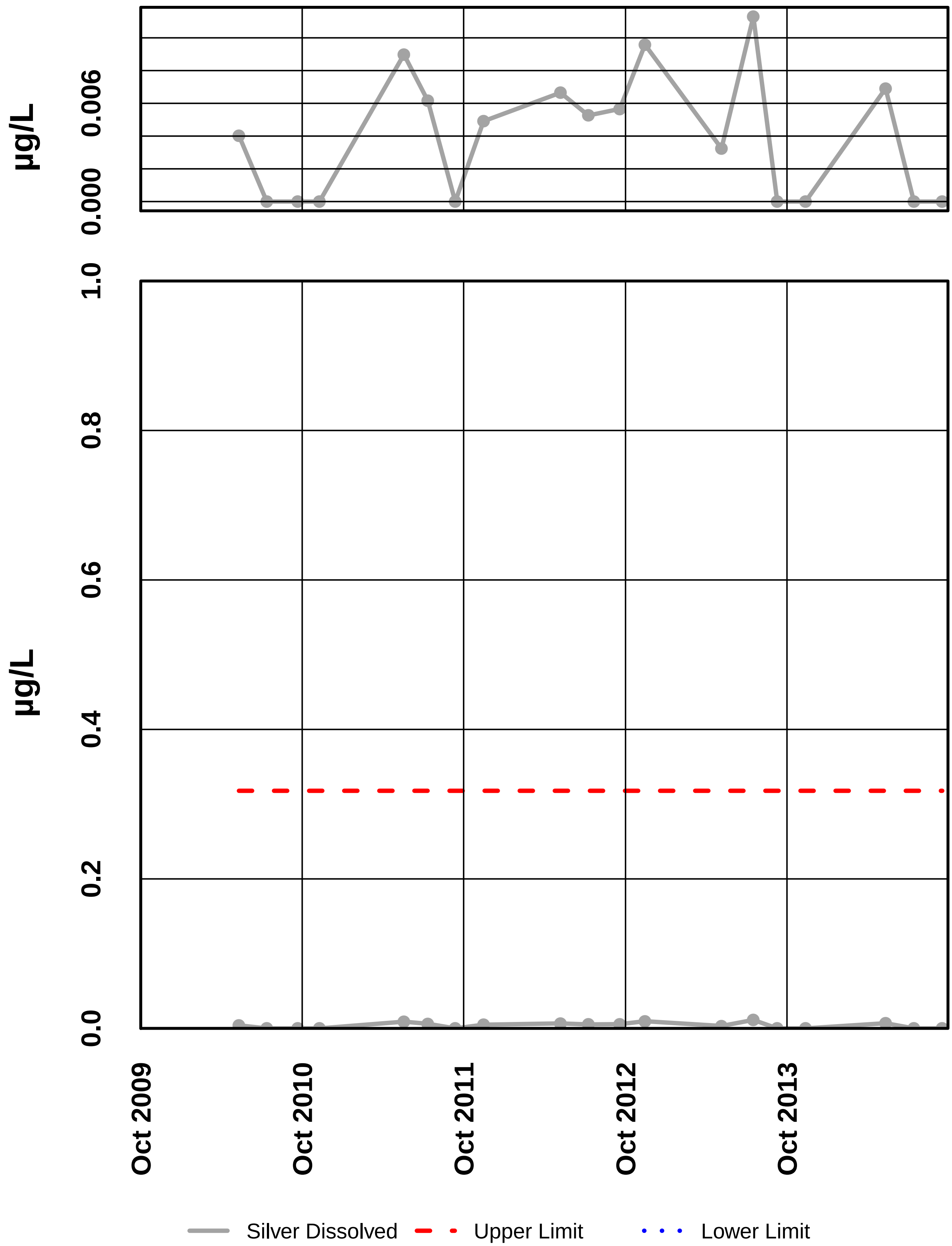



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



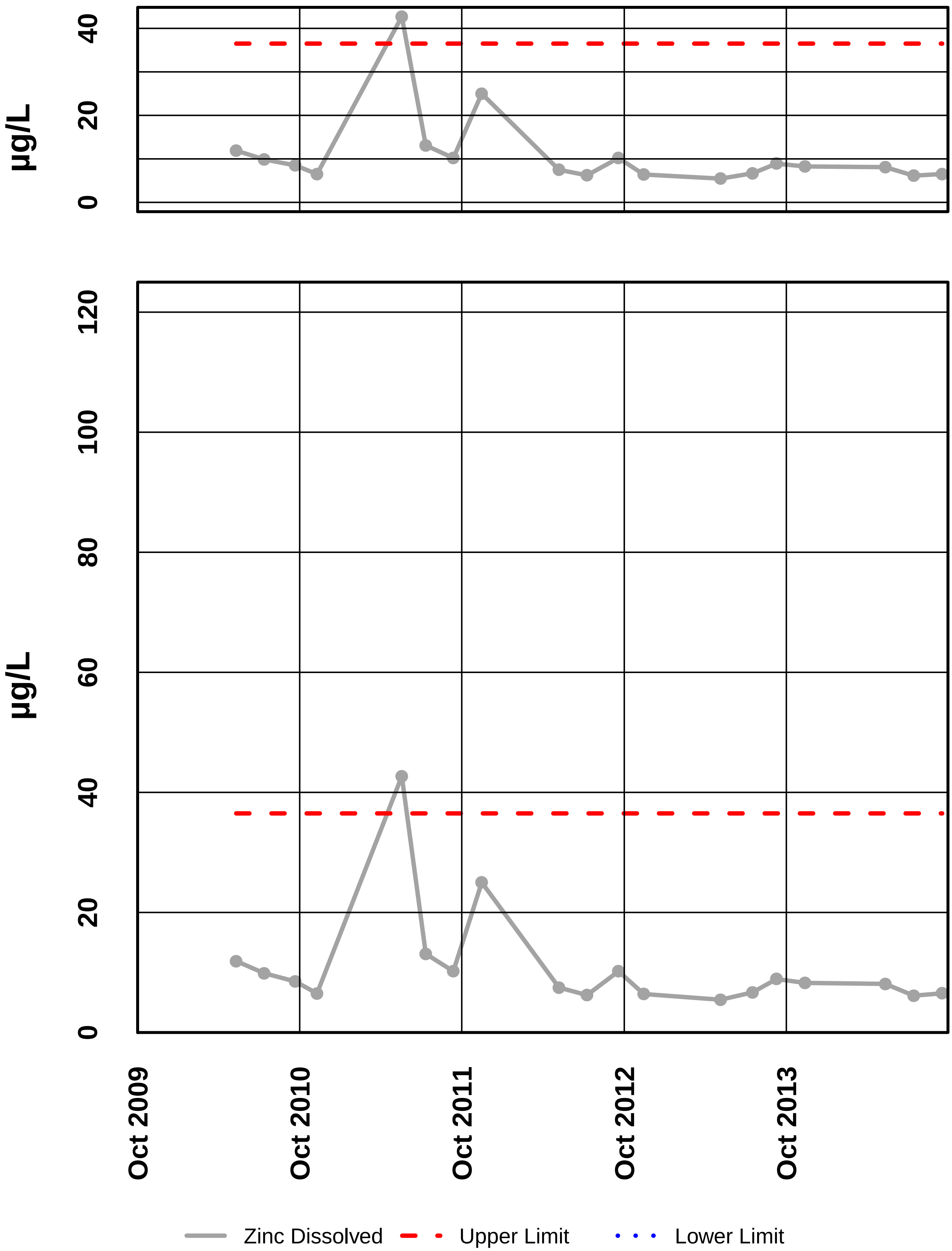

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# Site 32 − Silver Dissolved

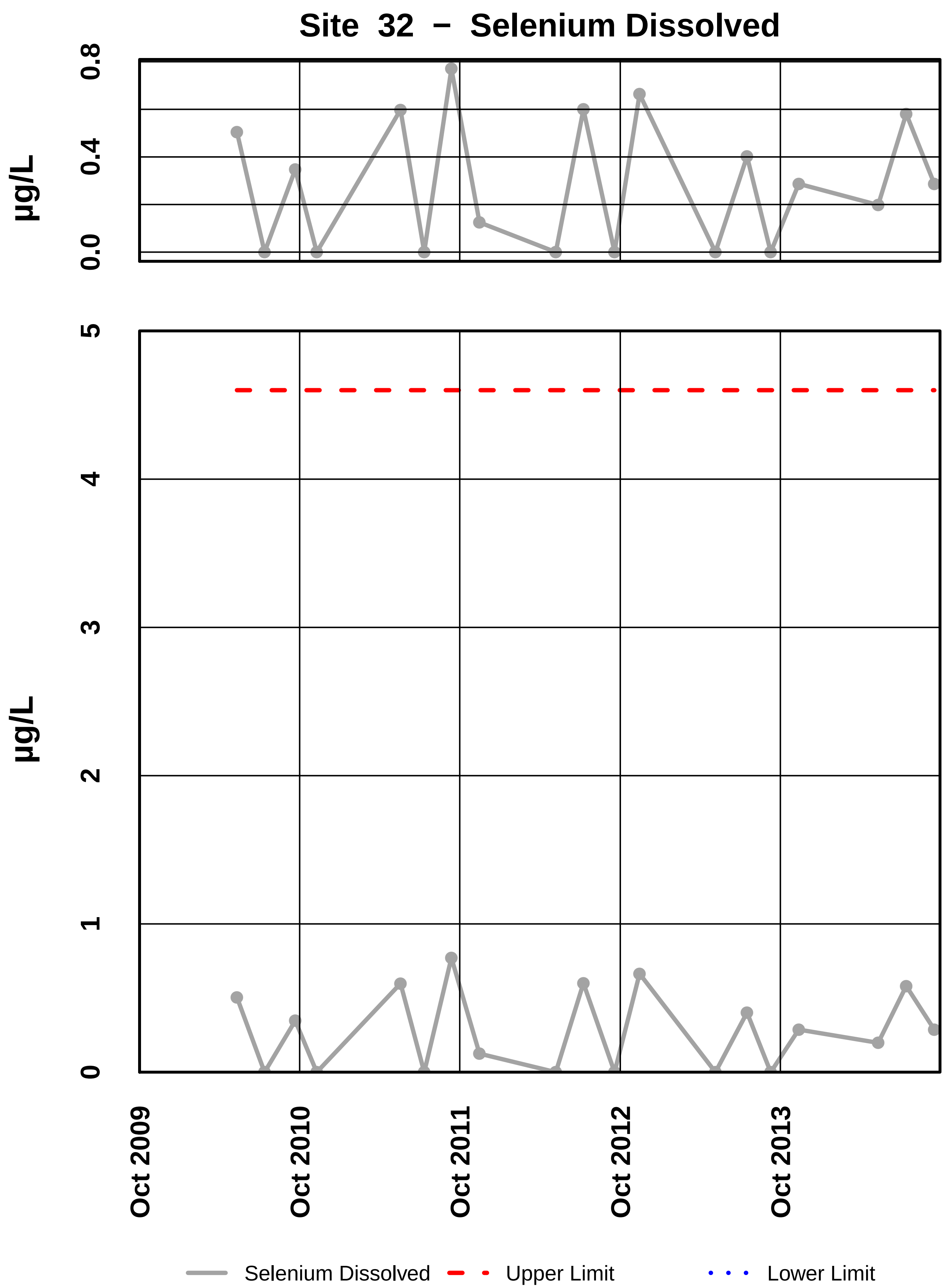



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

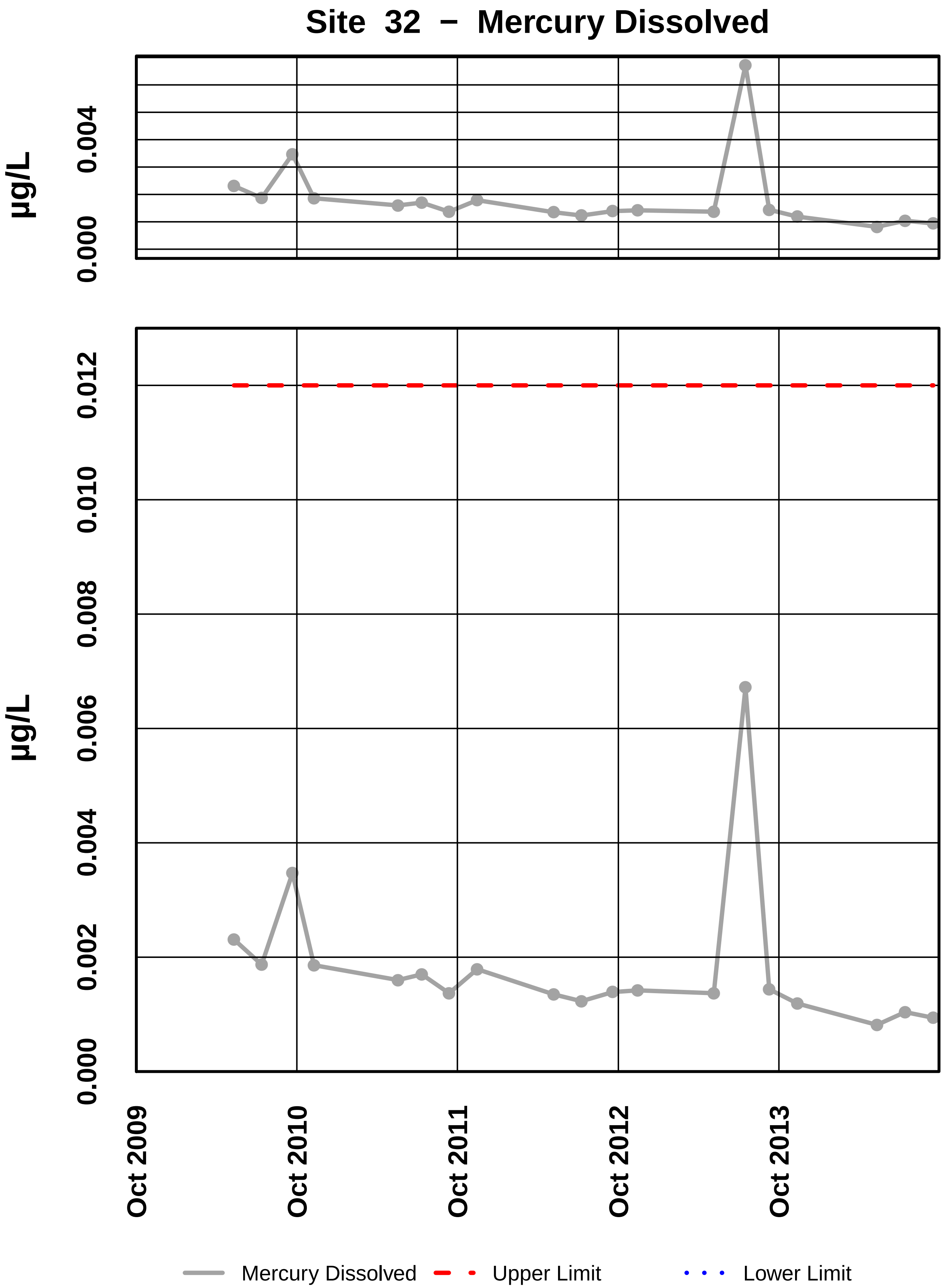
## Site 32 – Zinc Dissolved




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# INTERPRETIVE REPORT
# SITE 9

The Tributary Creek site was initially chosen to monitor the effects on water quality caused by the originally planned, larger slurry tailings impoundment. It is approximately one mile downstream from the present dry stack tailings site. The site was monitored from 1981 – 1993 when it was temporarily suspended by administrative agreement with the USFS. The site was re-activated in 2001 as a biological monitoring site for the Tailings Pile. HGCMC recommenced collection of water chemistry samples after receiving a suggestion to do so from ADNR personnel. It was noted that should the required annual biomonitoring show significant changes, an understanding of any related water chemistry variations would enhance the interpretation of those results. During the 2013 water year, samples were collected in conjunction with the normal monthly FWMP sampling run during the months of November, May, July, and September and analyzed for Suite Q analytes.

The data collected during the current water year are listed in the following "Table of Results for Water Year 2014" report. The table includes all the FWMP analyte data (field and laboratory) collected for the current water year and a series of flags keyed to the summary report "Qualified Data by QA Reviewer". The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of ½ MDL for the purpose of median calculation.

Routine water chemistry data collection was reinstated May 2006. All data collected at the site since then are included in the data analyses. As shown in the table below, there were no data outliers.

| Sample Date | Parameter | Value | Qualifier | Notes |
|---|---|---|---|---|
| No outliers have been identified by HGCMC for the period of October 2008 through September 2014. | | | | |

The data for Water Year 2014 have been compared to the strictest fresh water quality criterion for each applicable analyte. Two results exceeding these criteria have been identified, and listed in the table below. The results were for total alkalinity values of 17.6 mg/L, and 12.6 mg/L for the May 2014 and July 2014 sampling events respectively, which exceed the AWQS lower limit of 20 mg/L.

**Table of Exceedance for Water Year 2014**

| | | | Limits | | |
|---|---|---|---|---|---|
| **Sample Date** | **Parameter** | **Value** | **Lower** | **Upper** | **Hardness** |
| 12-May-14 | Alkalinity | 17.6 mg/L | 20 | 0 | |
| 15-Jul-14 | Alkalinity | 12.6 mg/L | 20 | 0 | |

X-Y plots have been generated to graphically present the data for each of the analytes that are listed in Suite Q. Given the short record, no clear determination can be made as to if any trends are present. Comparisons made between the current dataset and an analysis of data from the prior monitoring period from 1981 to 1993 indicates that no major changes in water chemistry for the listed analytes appears to have occurred.

A non-parametric statistical analysis for trend was performed for specific conductivity, field pH, total alkalinity, total sulfate, and dissolved zinc. Calculation details of the Seasonal Kendall analyses are presented in detail on the pages following this interpretive section. The following table summarizes the results on the data collected between Oct-08 and Sep-14 (WY2009-WY2014). There were no statistically significant ($\alpha/2=2.5\%$) trends identified for the current water year. This is the second year that there was a sufficient number years (n=6) of data for conducting these calculations.  Trend analysis revealed statistically significant trends in field pH and dissolved zinc. Field pH has a positive slope of 0.147 su/yr and dissolved zinc has a negative slope of 0.71 µg/L/yr.

**Table of Summary Statistics for Trend Analysis**

| | Mann-Kendall test statistics | | | Sen's slope estimate | |
|---|---|---|---|---|---|
| **Parameter** | **n*** | **p**** | **Trend** | **Q** | **Q(%)** |
| Conductivity Field | 6 | 0.46 | | | |
| pH Field | 6 | 0.01 | + | 0.147 | 2.164 |
| Alkalinity, Total | 6 | 0.15 | | | |
| Sulfate, Total | 6 | 0.05 | | | |
| Zinc, Dissolved | 6 | <0.01 | - | -0.71 | -11.823 |

* Number of Years  ** Significance level

HGCMC will continue to monitor Site 9 during May, July, September, and November for the Suite Q analytes. This sampling is in addition to the already scheduled July biomonitoring. HGCMC feels that this schedule will adequately characterize the water quality parameters while addressing safety concerns associated with winter access down the steep slope that leads to the site and the increased potential for bear encounters during salmon spawning season.

## Table of Results for Water Year 2014

### Site 009FMS - 'Lower Tributary Creek'

| Sample Date/Parameter | Oct 2013 | Nov 2013 | Dec 2013 | Jan 2014 | Feb 2014 | Mar 2014 | Apr 2014 | May 2014 | Jun 2014 | Jul 2014 | Aug 2014 | Sep 2014 | **Median** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Water Temp (°C) | | 2.3 | | | | | | 8.9 | | 11.5 | | 10.8 | 9.9 |
| Conductivity-Field(μmho) | | 103 | | | | | | 77 | | 77 | | 87.8 | 82.4 |
| Conductivity-Lab (μmho) | | 82 | | | | | | 76 | | 76 | | 85 | 79 |
| pH Lab (standard units) | | 6.88 | | | | | | 7.16 | | 7.12 | | 7.08 | 7.10 |
| pH Field (standard units) | | 7.16 | | | | | | 6.79 | | 6.9 | | 7.45 | 7.03 |
| Total Alkalinity (mg/L) | | 23.6 | | | | | | 17.6 | | 12.6 | | 23.9 | 20.6 |
| Total Sulfate (mg/L) | | 12.5 | | | | | | 12.5 | | 11.8 | | 11 | 12.2 |
| Hardness (mg/L) | | 42.7 | | | | | | 29.4 | | 32.3 | | 38.8 | 35.6 |
| Dissolved As (ug/L) | | 0.855 | | | | | | 0.666 | | 0.979 | | 1.28 | 0.917 |
| Dissolved Ba (ug/L) | | 37.8 | | | | | | 32.3 | | 40.7 | | 45.2 | 39.3 |
| Dissolved Cd (ug/L) | | 0.0265 | | | | | | 0.0177 | | 0.0317 | | 0.0318 | 0.0291 |
| Dissolved Cr (ug/L) | | 0.779 | | | | | | 0.704 | | 0.902 | | 0.768 | 0.774 |
| Dissolved Cu (ug/L) | | 1.23 | | | | | | 1.7 | | 2.36 | | 1.67 | 1.685 |
| Dissolved Pb (ug/L) | | 0.428 | | | | | | 0.232 | | 0.521 | | 0.417 | 0.4225 |
| Dissolved Ni (ug/L) | | 2.35 | | | | | | 1.73 | | 2.53 | | 2.74 | 2.440 |
| Dissolved Ag (ug/L) | | 0.006 | | | | | | 0.008 | | 0.011 | | 0.011 | 0.010 |
| Dissolved Zn (ug/L) | | 4.22 | | | | | | 3.13 | | 5.59 | | 4.27 | 4.25 |
| Dissolved Se (ug/L) | | 0.337 | | | | | | 0.116 | | 0.158 | | 0.22 | 0.189 |
| Dissolved Hg (ug/L) | | 0.00282 | | | | | | 0.00308 | | 0.00532 | | 0.00422 | 0.003650 |

For individual sample/analyte qualifier descriptions see "Qualified Data by QA Reviewer" table.

Values reported as less than MDL are replaced by 1/2 MDL for median calculation purposes.

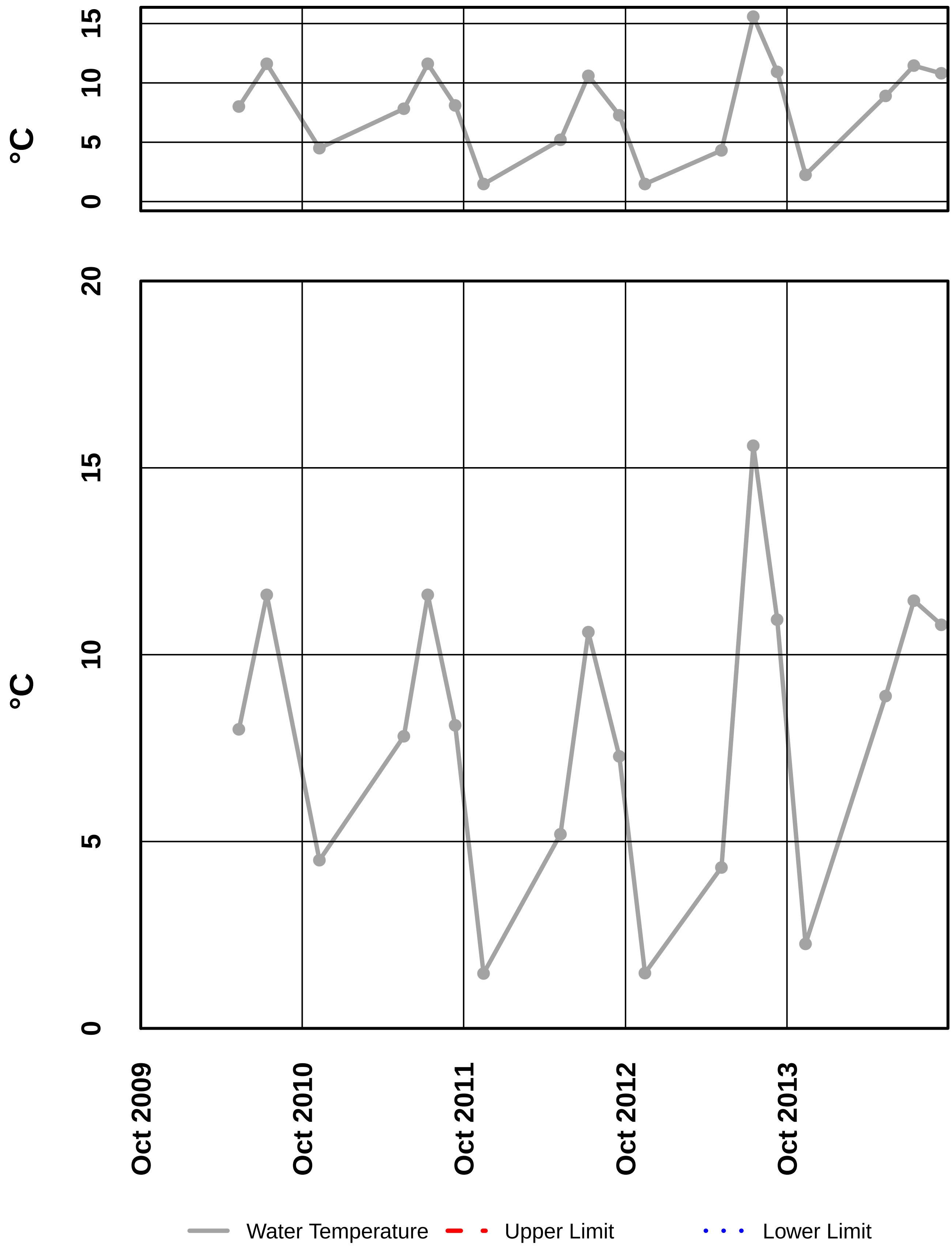
Shaded data has been qualified as an outlier by HGCMC and removed from any further analysis and is not included into the calculation of the median

# Qualified Data by QA Reviewer

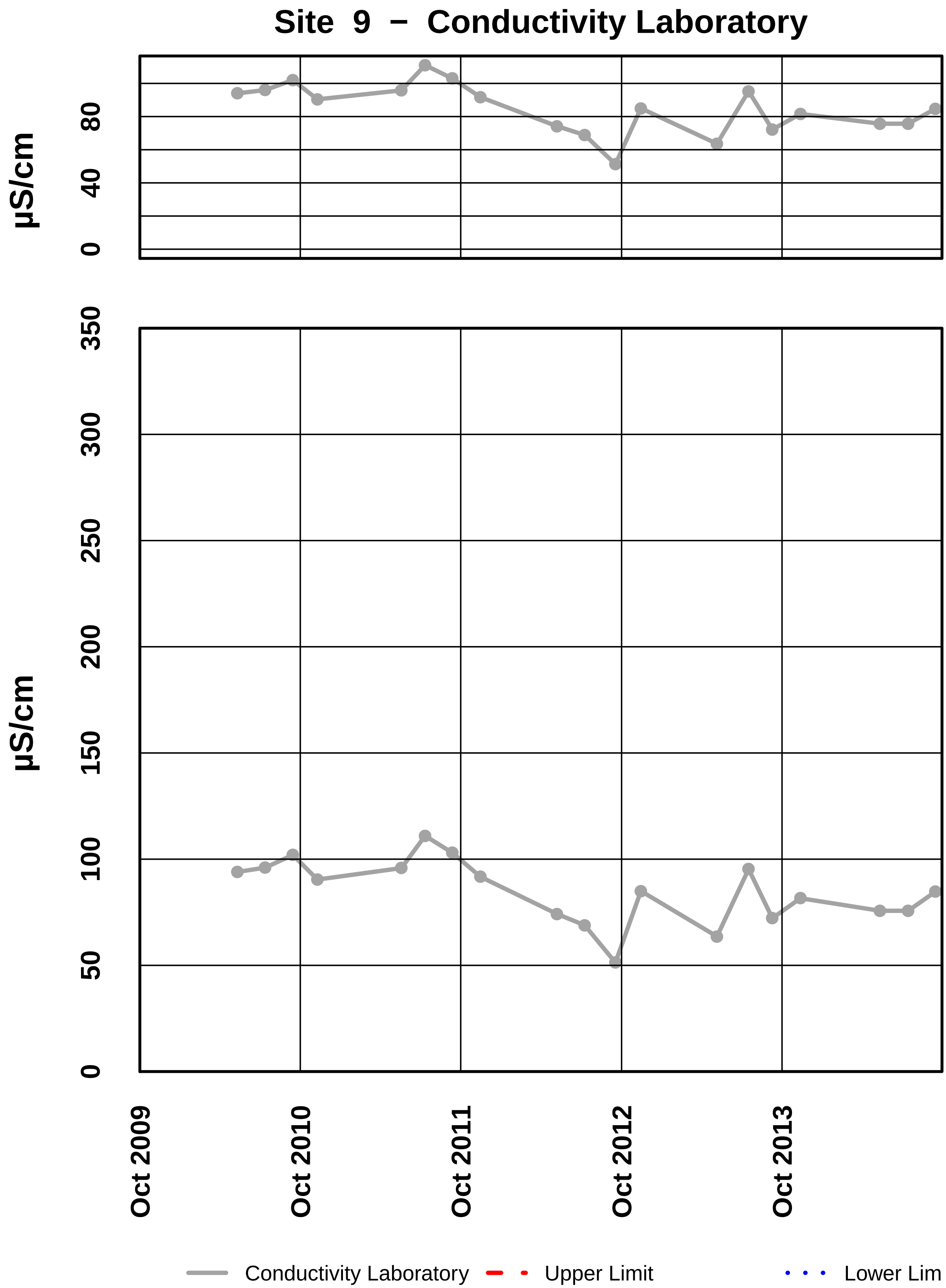
**Date Range: 10/01/2013 to 09/30/2014**

| Site No. | Sample Date | Sample Time | Parameter | Value | Qualifier | Reason for Qualifier |
|---|---|---|---|---|---|---|
| 009FMS | 11/12/2013 | 12:00 PM | Diss. Ag-ICP/MS | 0.00634 | J | Below Quantitative Range |
| | | | Diss. Se-ICP/MS | 0.33 | J | Below Quantitative Range |
| | | | Sulfate | 12.5 | J | Below Quantitative Range |
| 009FMS | 5/12/2014 | 12:00 PM | Alkalinity | 17.6 | U | Trip Blank Contamination |
| | | | Conductivity | 75.7 | U | Trip Blank Contamination |
| | | | Diss. Ag-ICP/MS | 0.00804 | J | Below Quantitative Range |
| | | | Diss. Se-ICP/MS | 0.11 | J | Below Quantitative Range |
| | | | Sulfate | 12.5 | J | Sample Receipt Temperature |
| 009FMS | 7/15/2014 | 12:00 PM | Diss. Se-ICP/MS | 0.15 | J | Below Quantitative Range |
| 009FMS | 9/15/2014 | 12:00 PM | Diss. Ag-ICP/MS | 0.01 | J | Matrix Spike Recovery |
| | | | Diss. Se-ICP/MS | 0.22 | J | Below Quantitative Range |

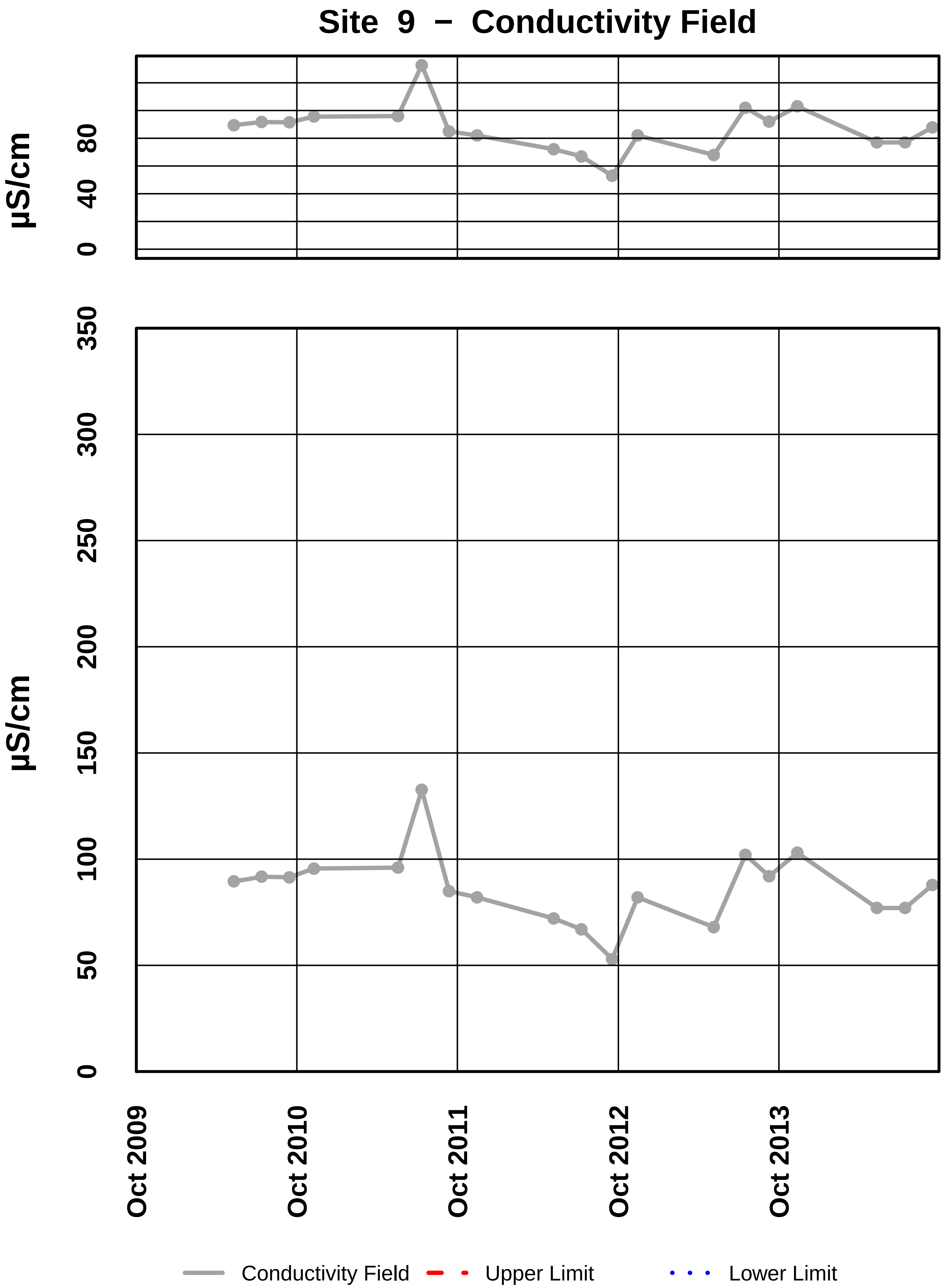
## Site 9 – Water Temperature



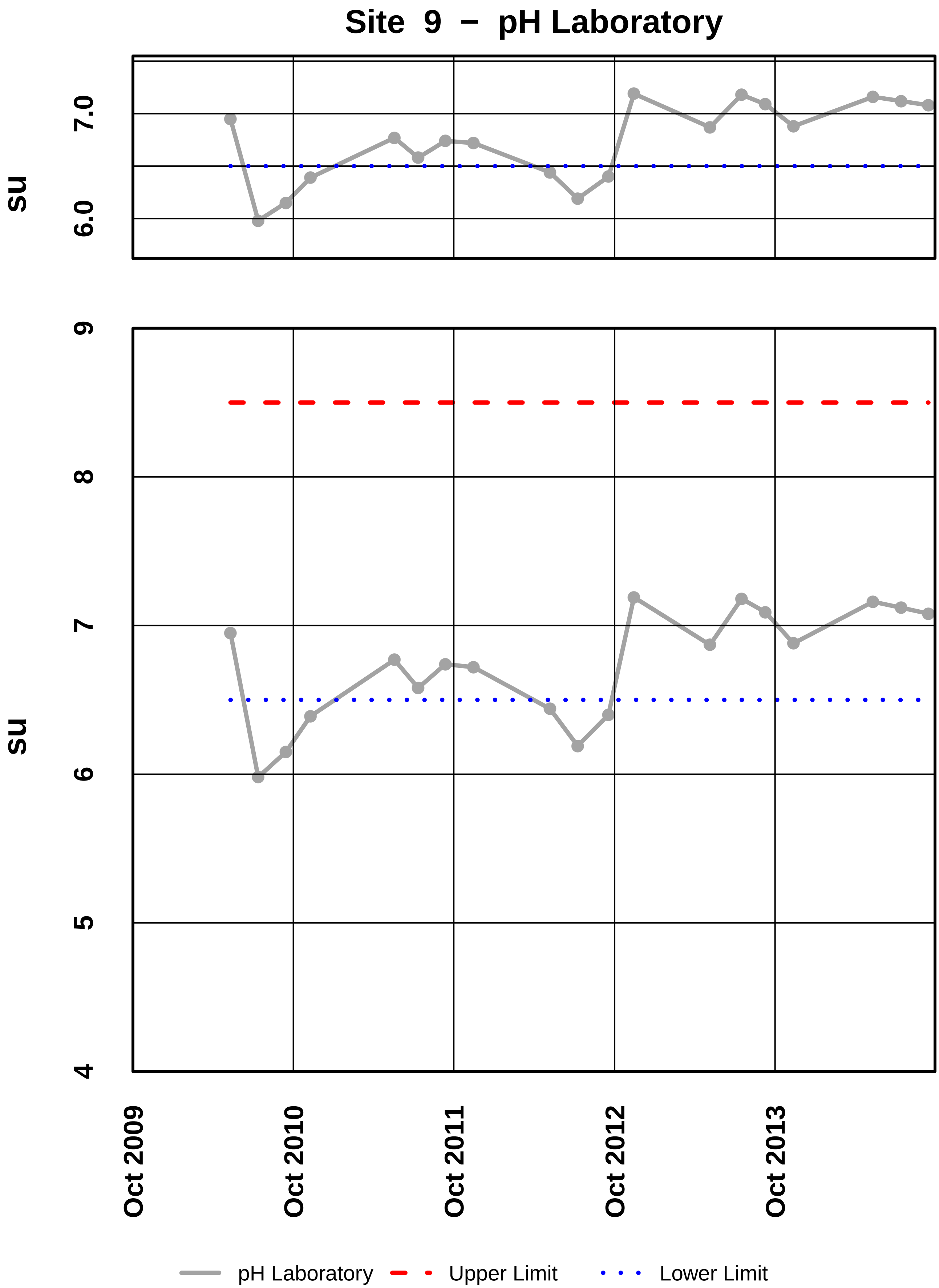

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



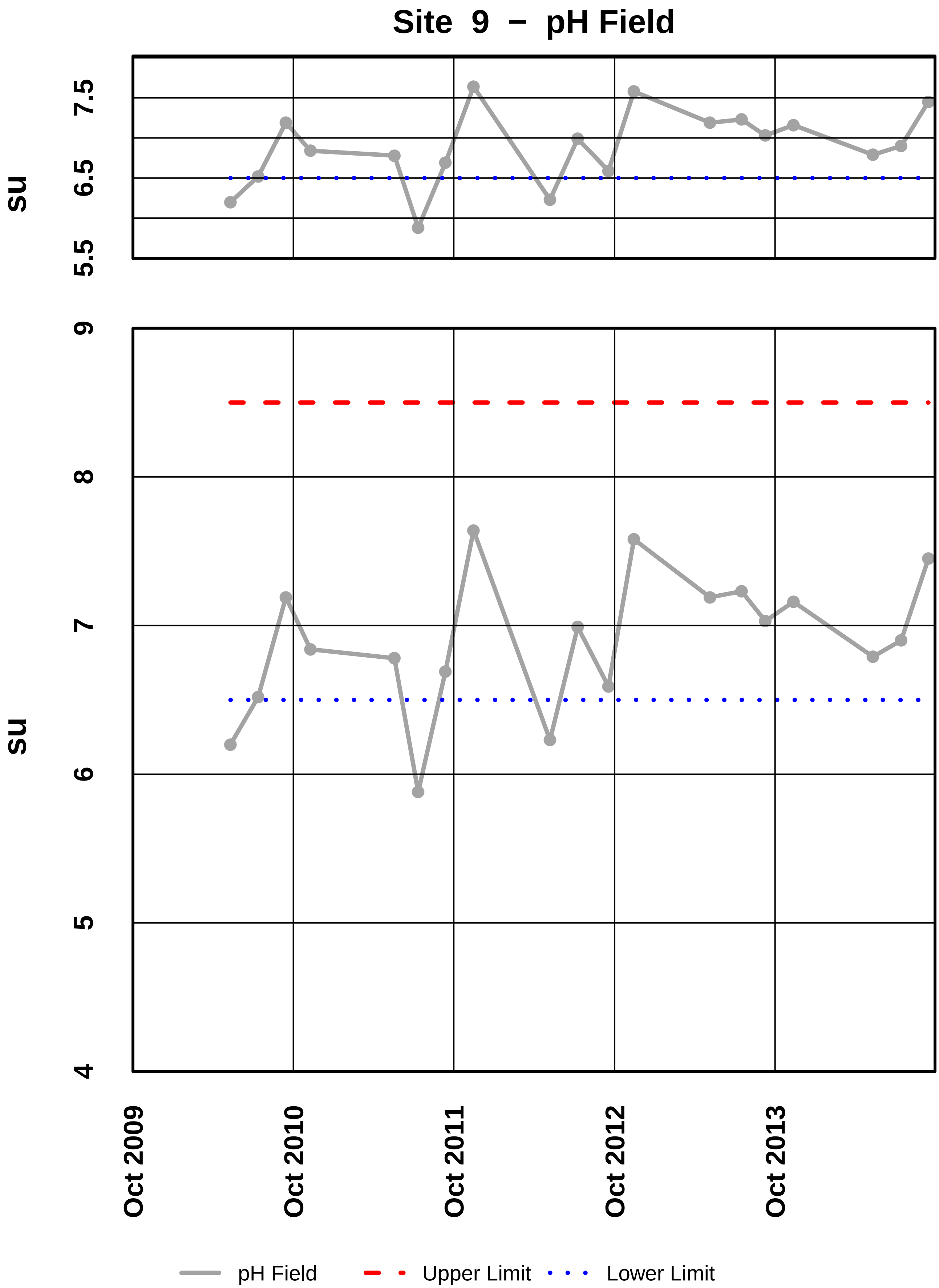

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



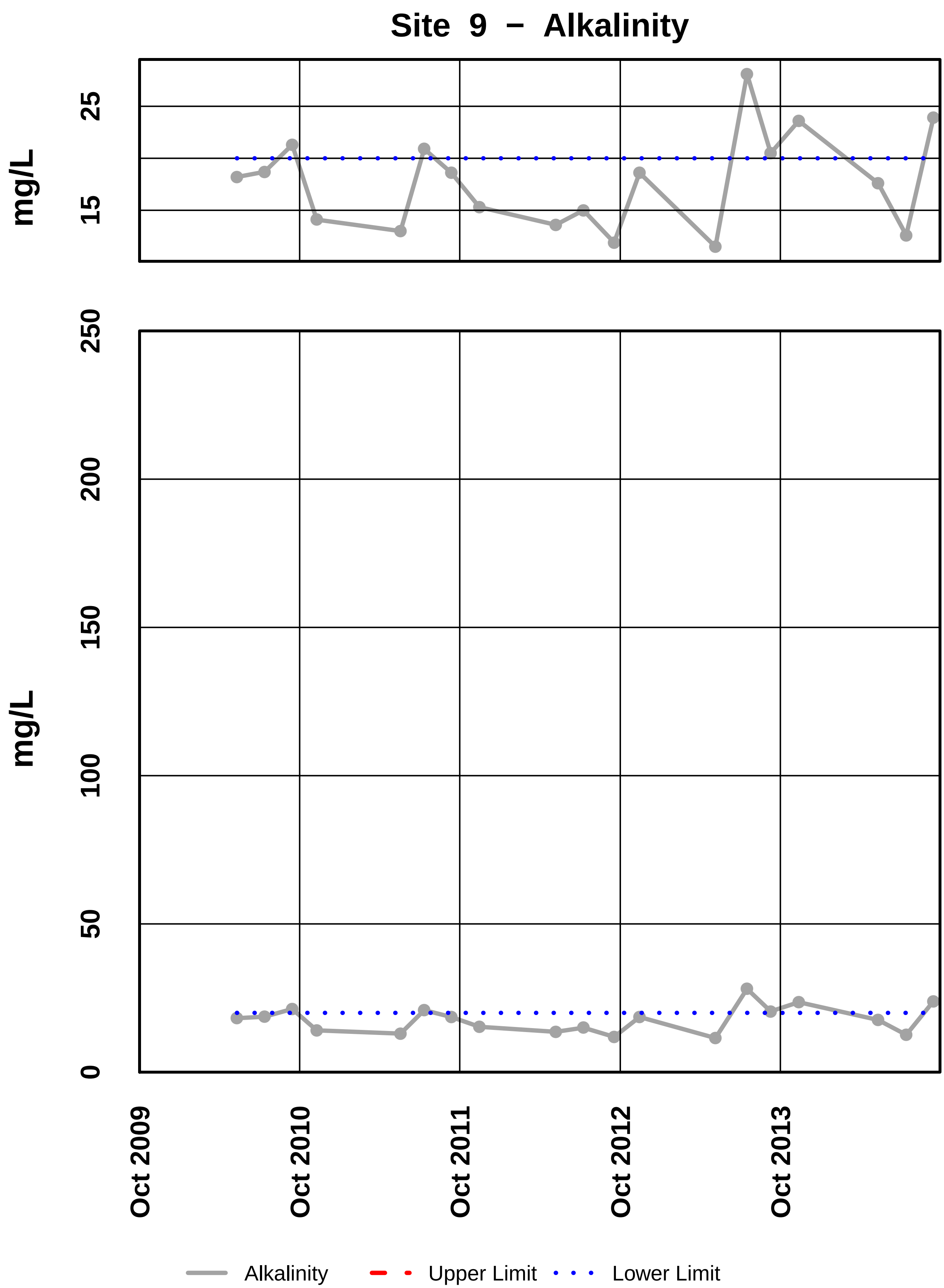

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

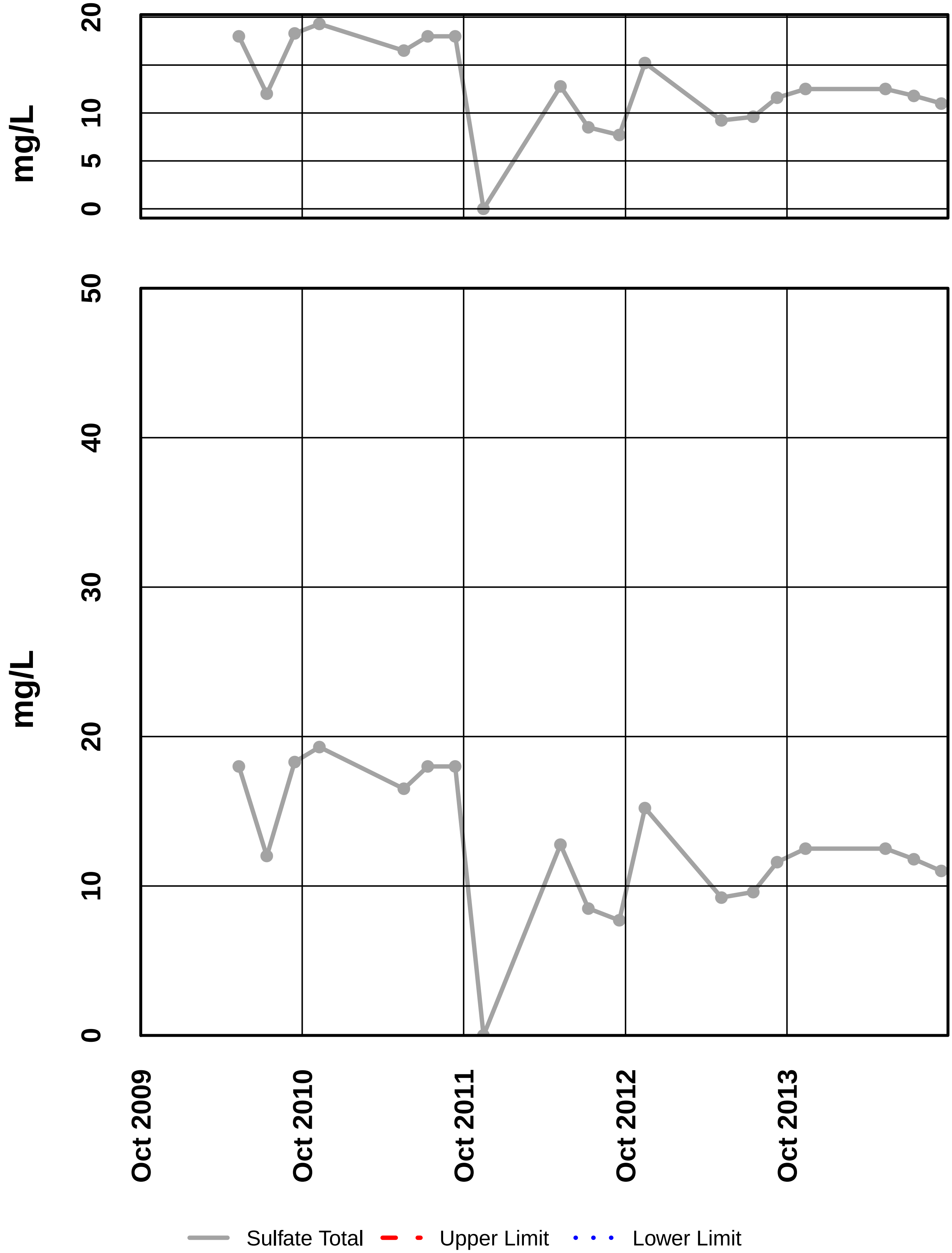



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

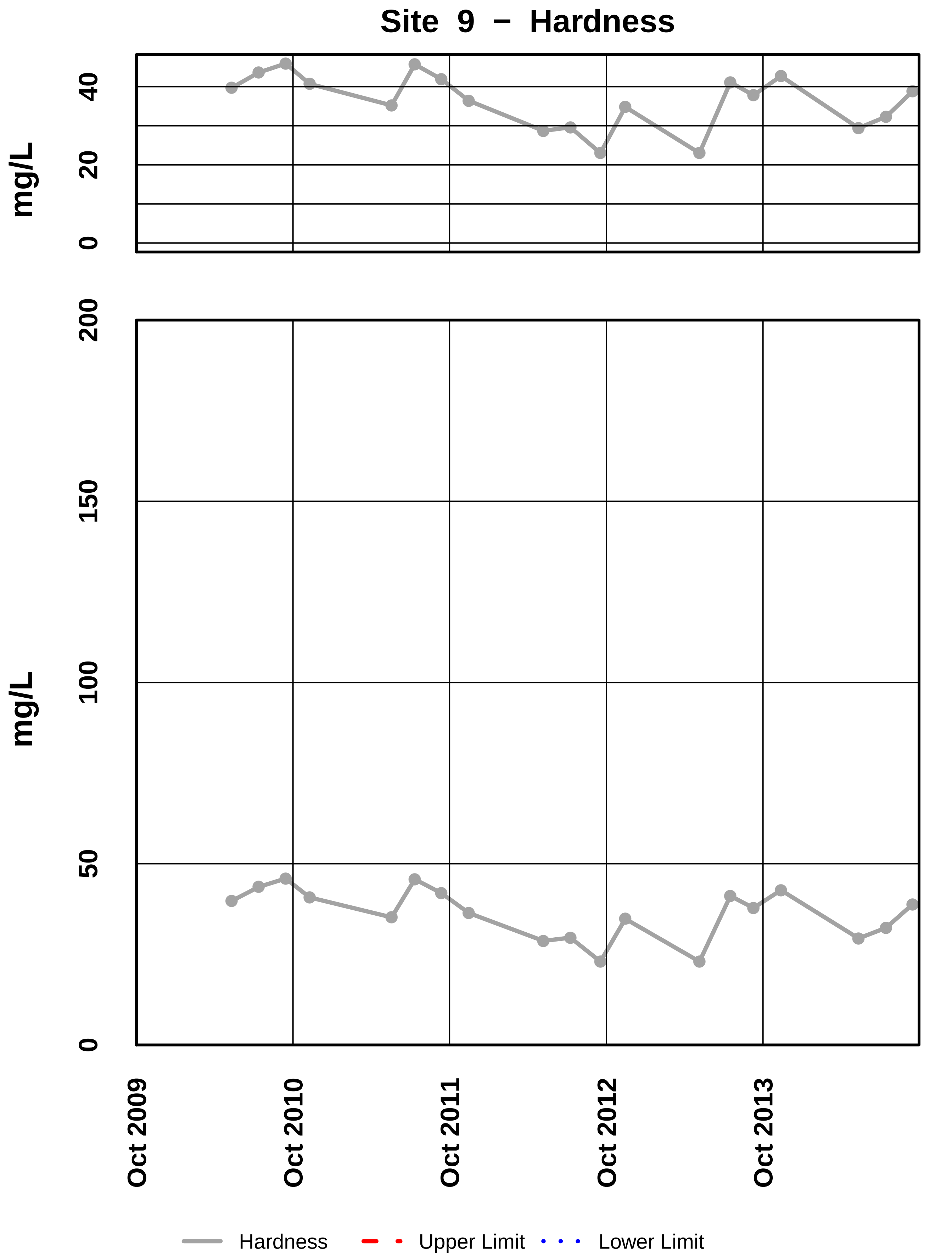



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

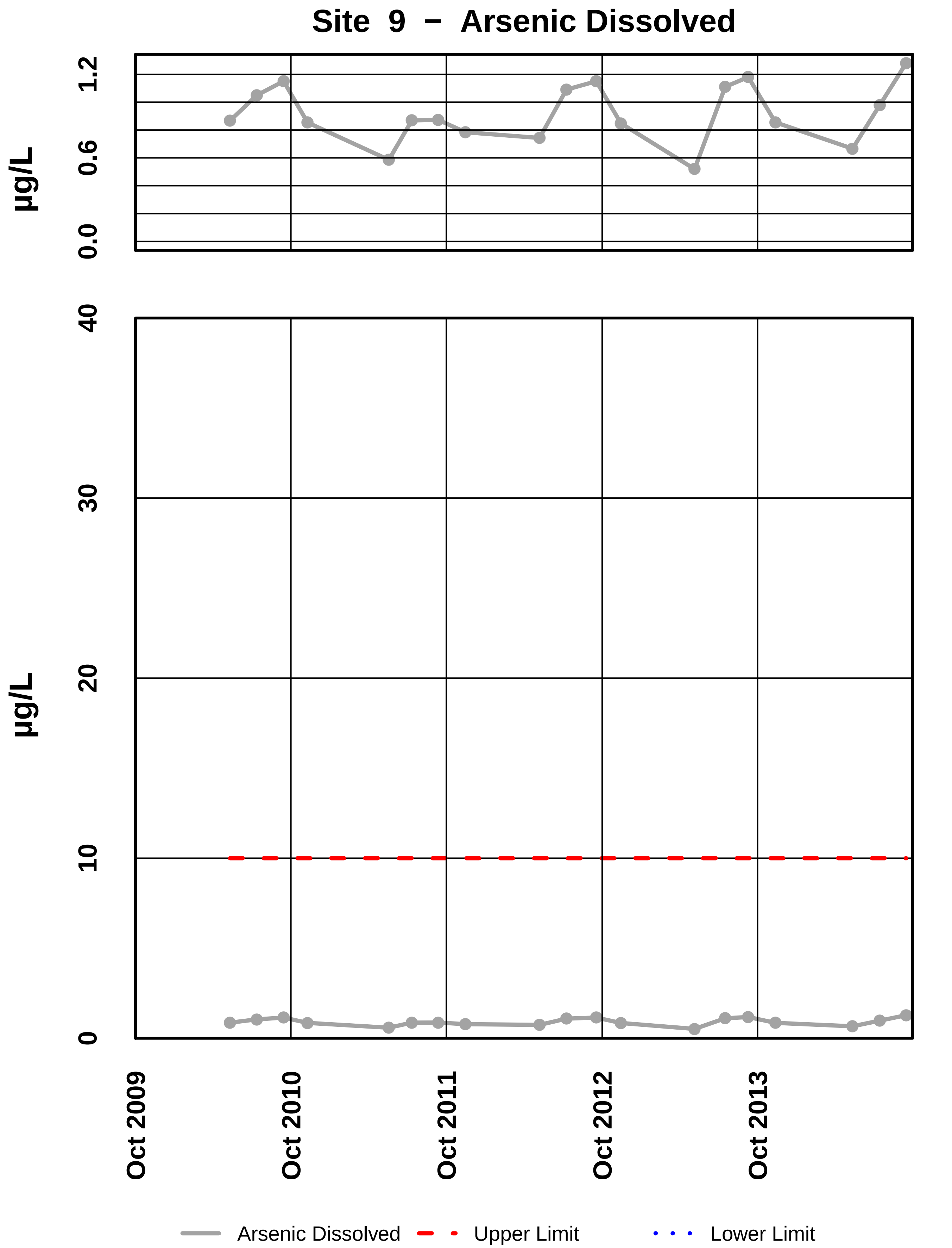
# Site 9 – Sulfate Total



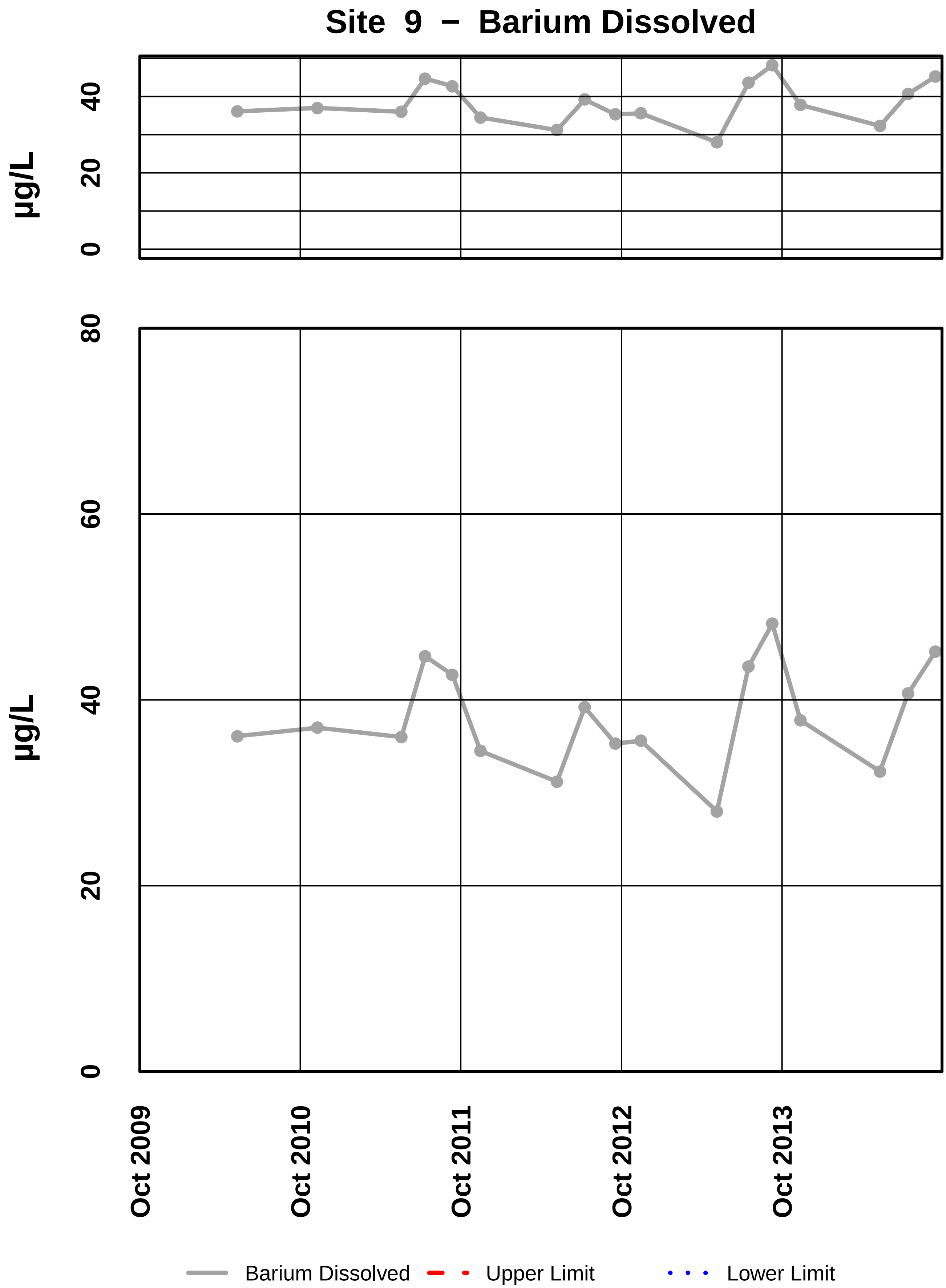

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

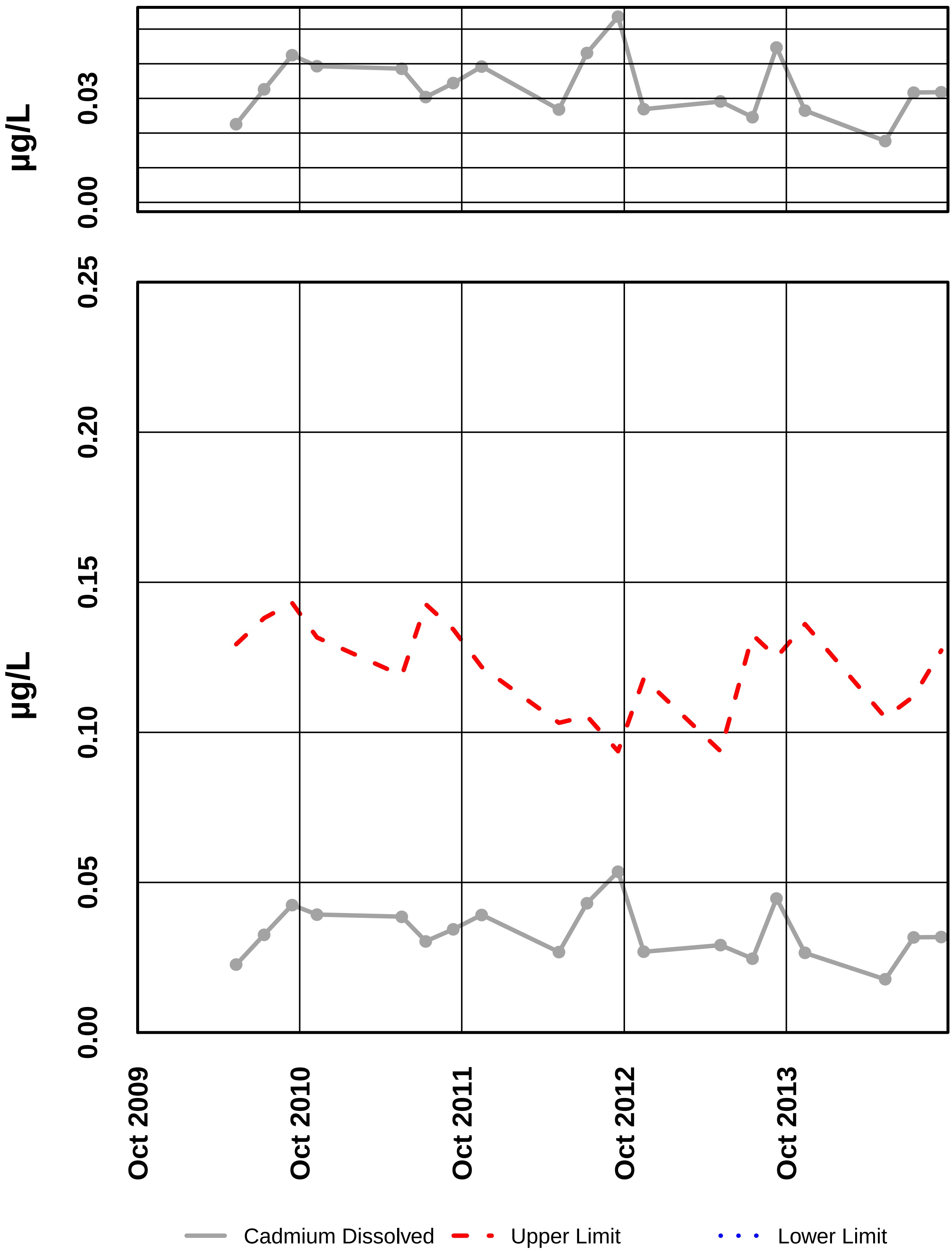



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

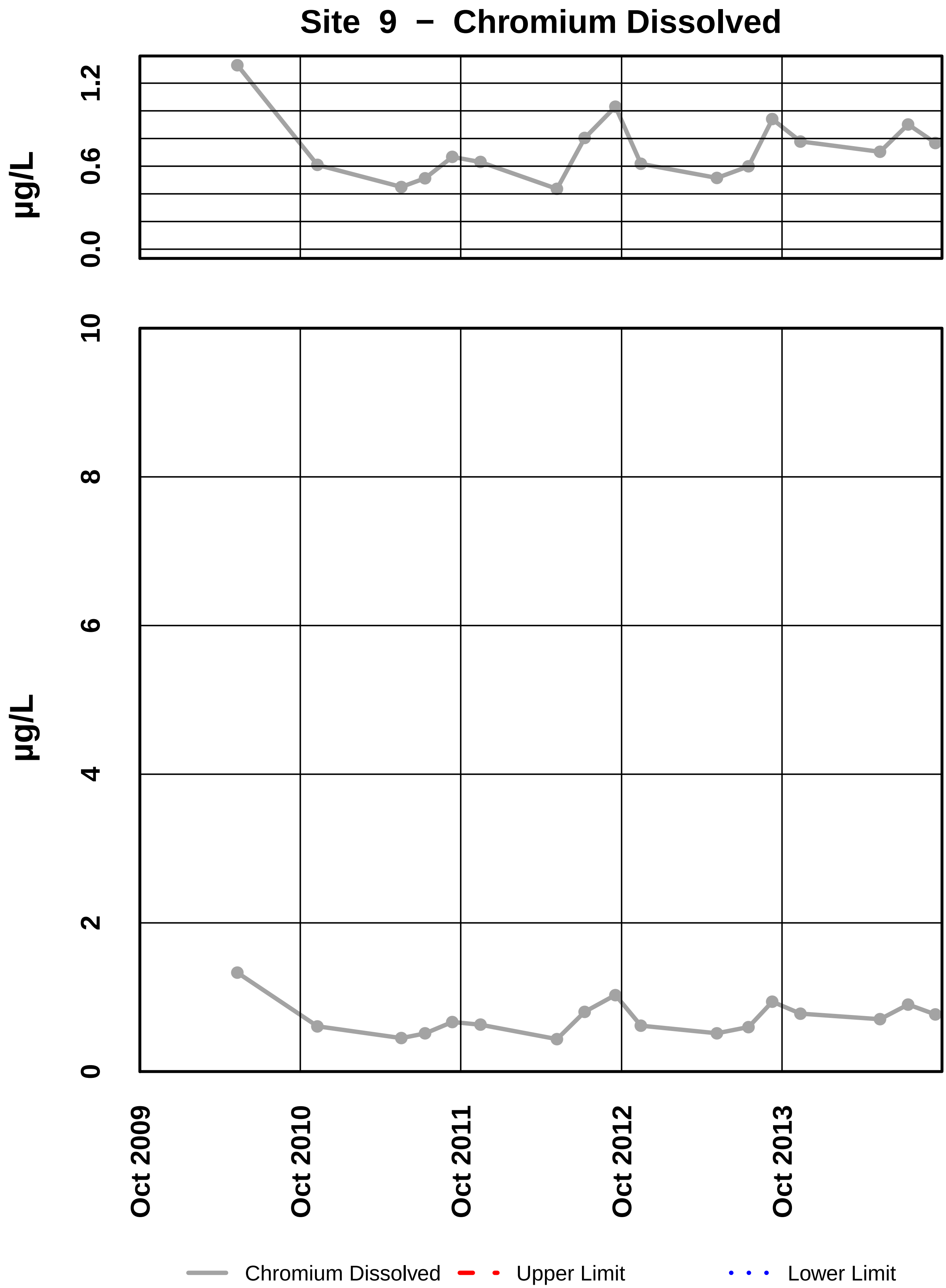



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

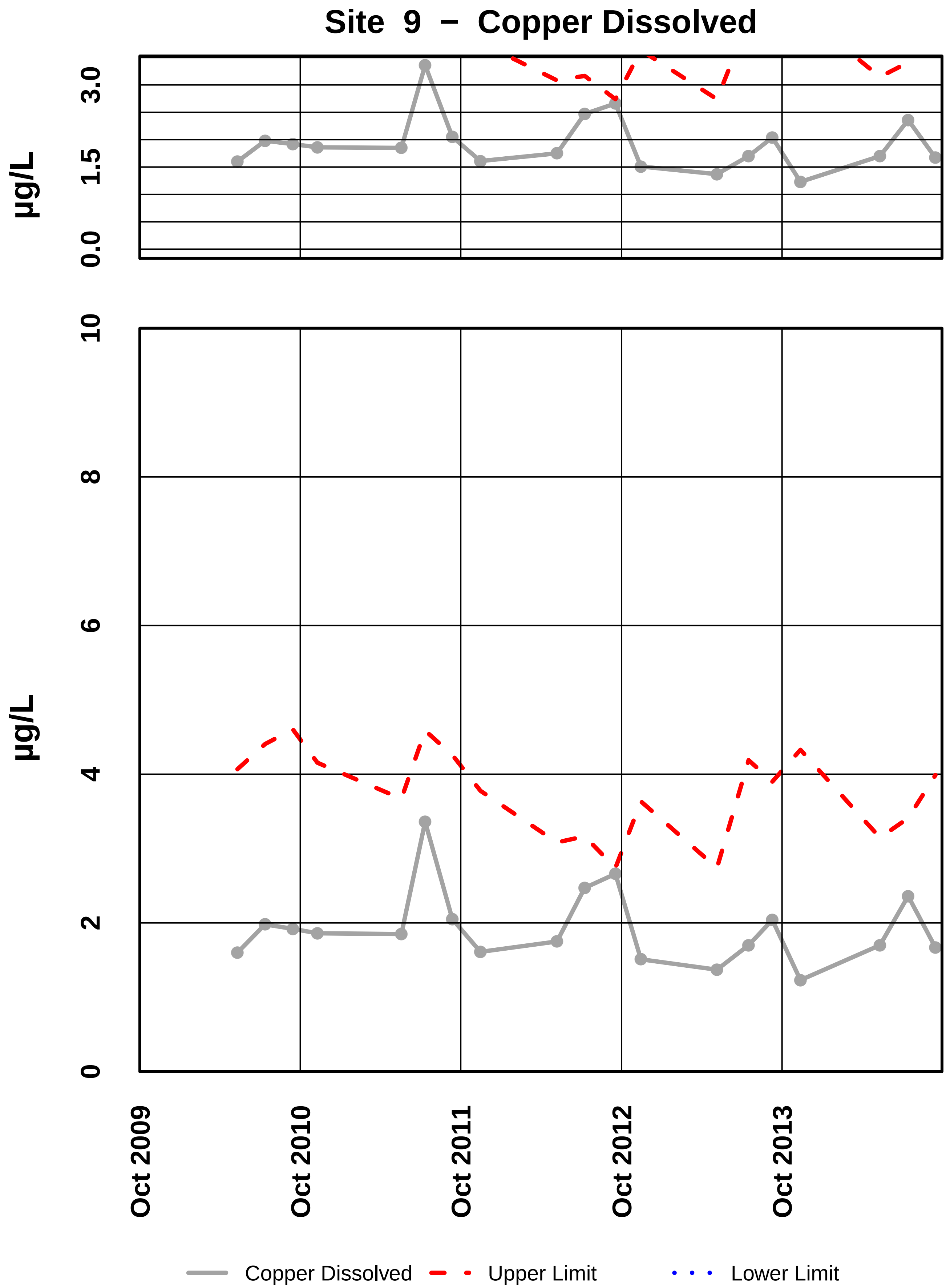
## Site 9 – Cadmium Dissolved




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

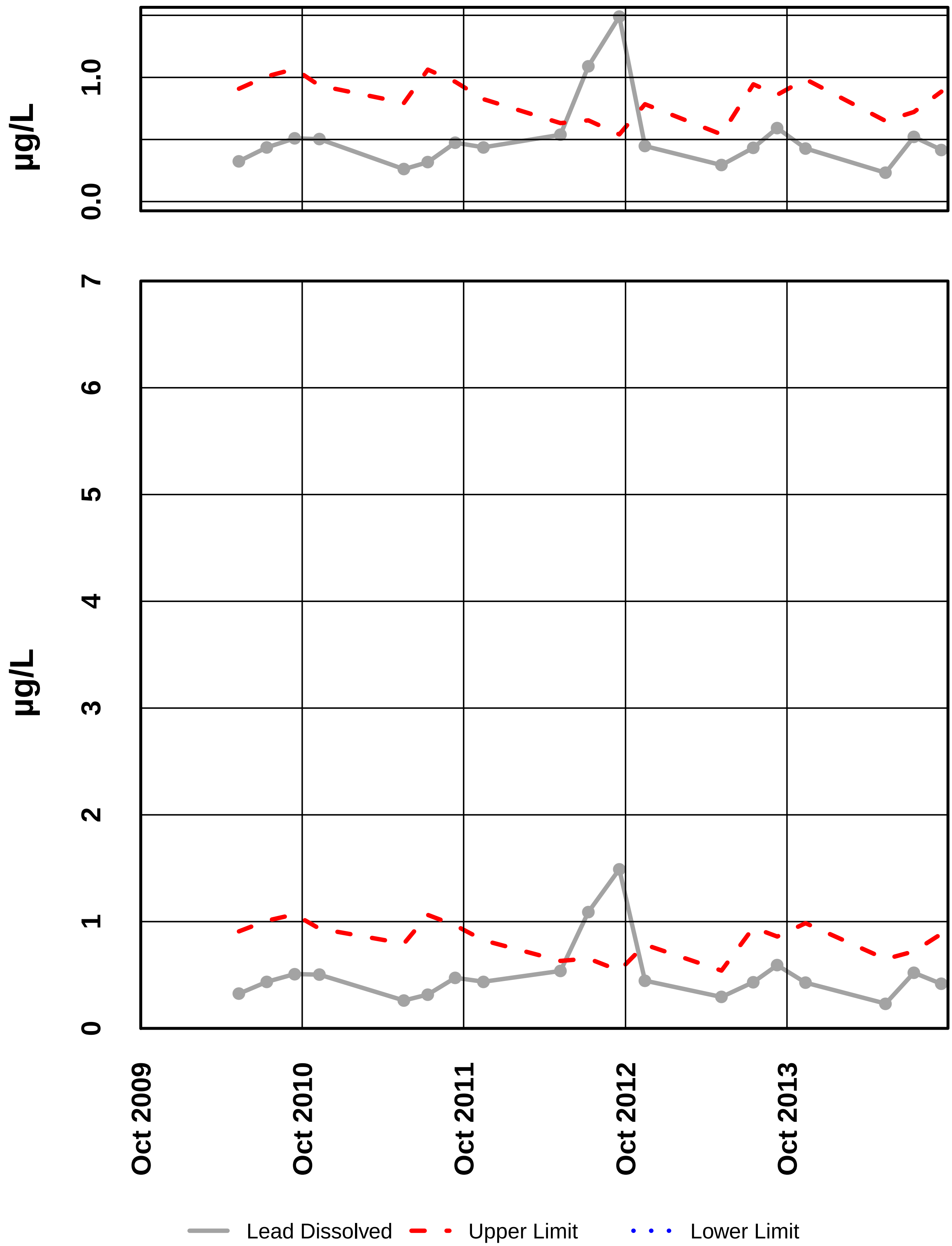



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

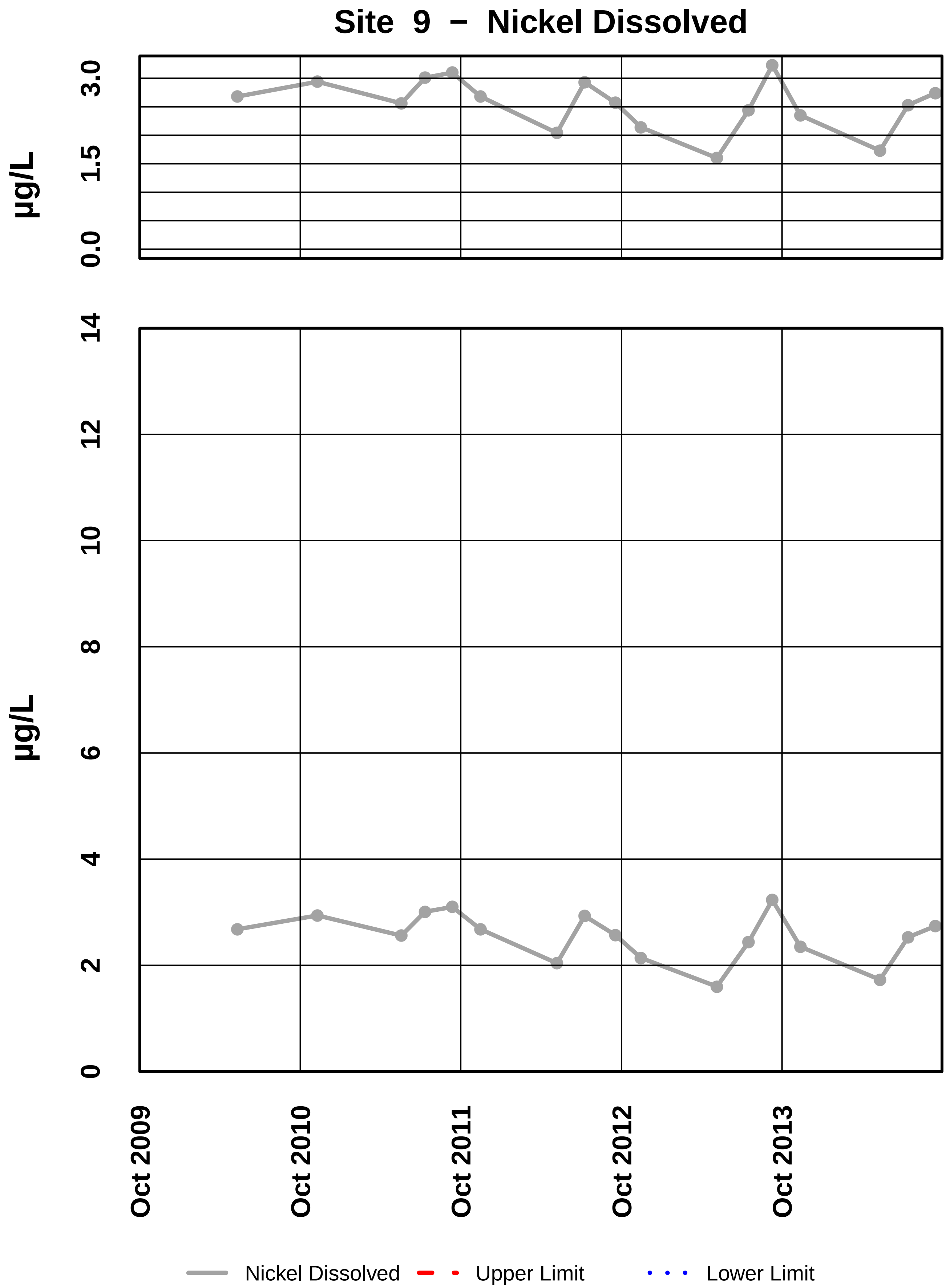



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

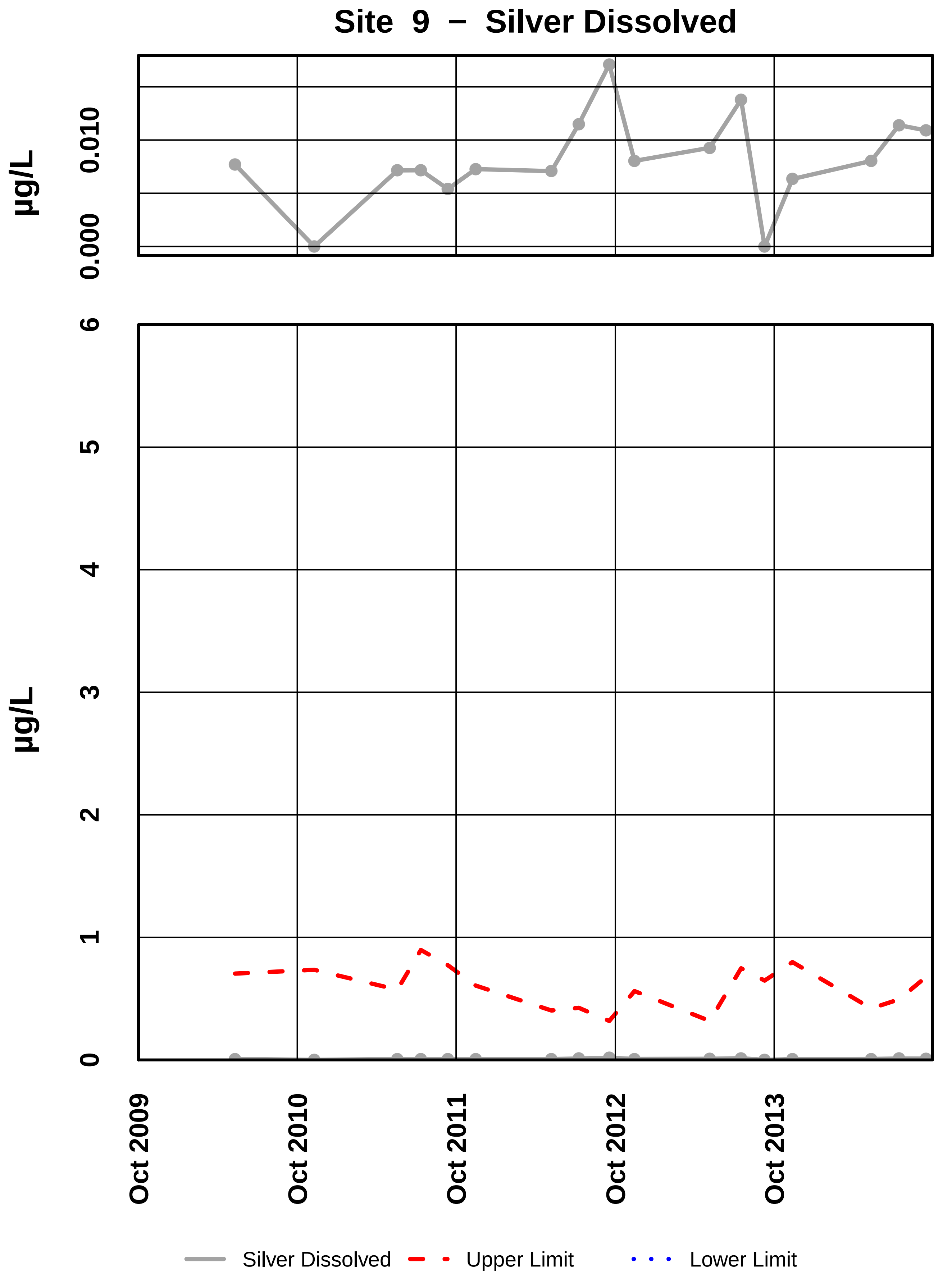
## Site 9 – Lead Dissolved



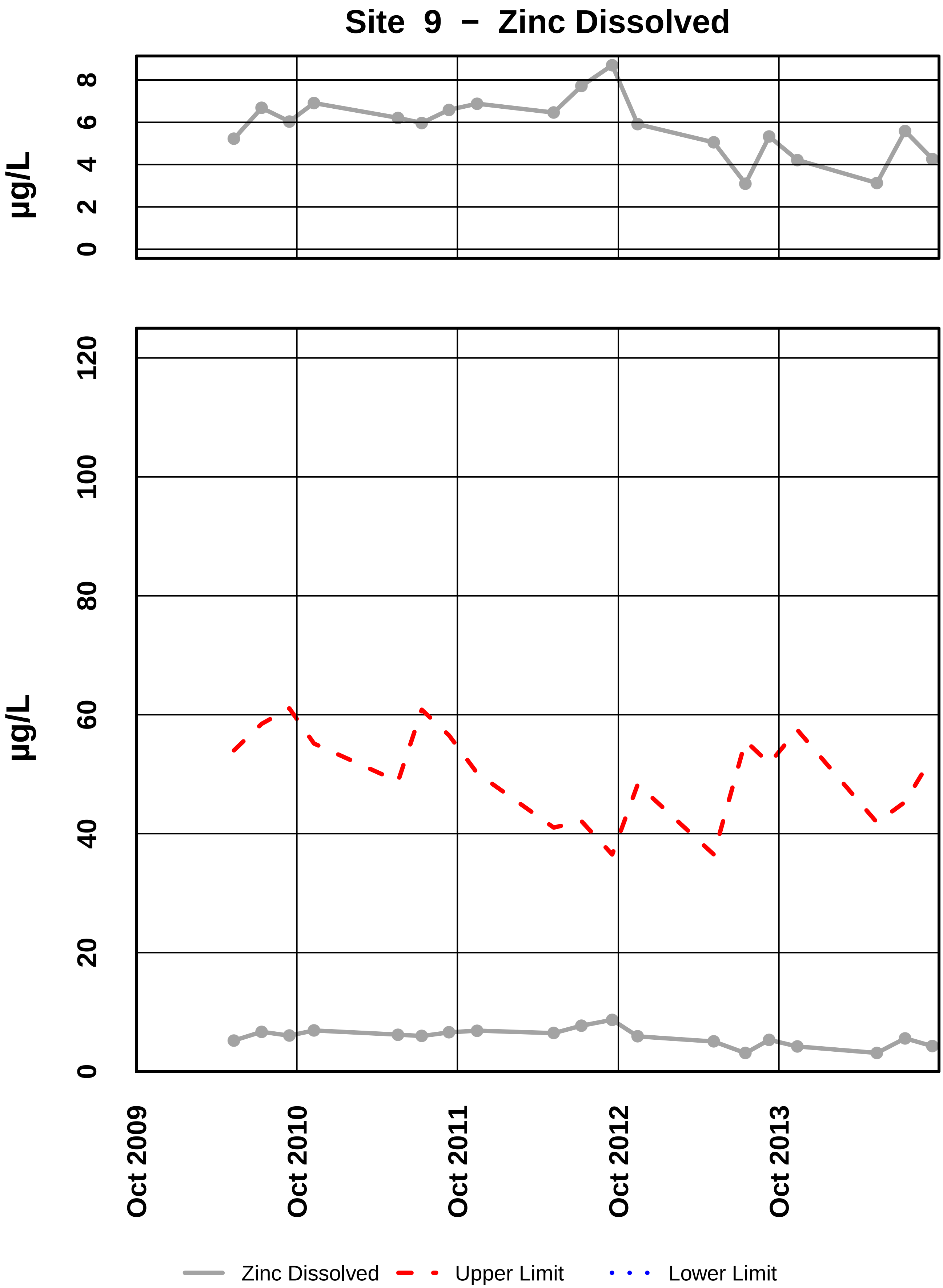

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

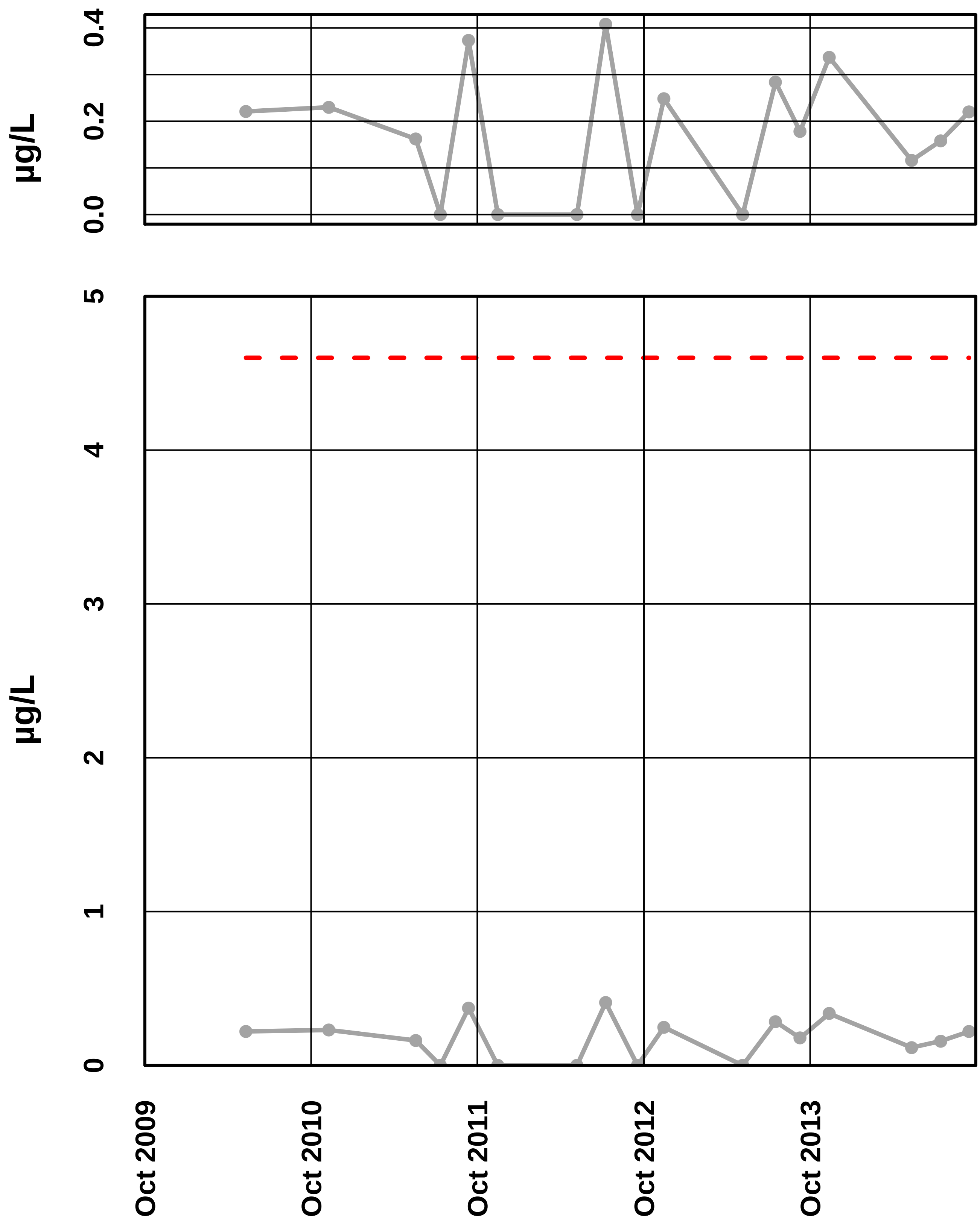



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



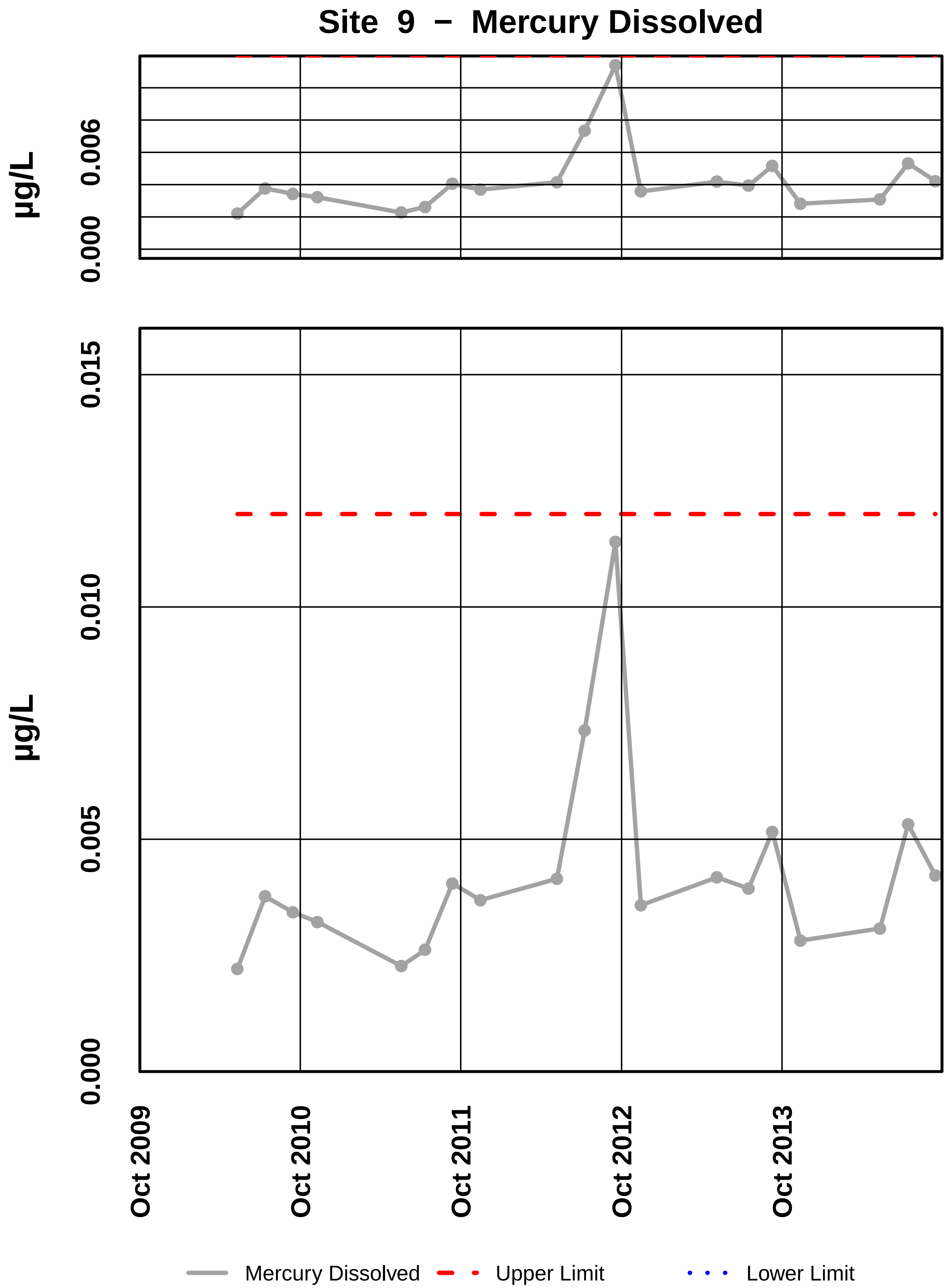

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

## Site 9 – Selenium Dissolved




Selenium Dissolved — Upper Limit ··· Lower Limit

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# INTERPRETIVE REPORT
# SITE 60

Sampling at this site was initiated during background investigations conducted by HGCMC for the Stage II Tailings EIS. The two sampling events that occurred in 2003 were submitted to Analytica Alaska Laboratories for analysis and subject to standard QAQC procedures. The detection limits achieved during this analysis were slightly higher for some analytes than are currently achieved under FWMP sampling protocols. The two sample events that occurred in the 2006 water year were analyzed in parallel with standard FWMP samples and thus subject to the same analytical procedures.

The data collected during the current water year are listed in the following "Table of Results for Water Year 2014" report. The table includes all the required FWMP analyte data (field and laboratory) collected for the current water year and a series of flags keyed to the summary report "Qualified Data by QA Reviewer". The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of ½ MDL for the purpose of median calculation.

Both ADEC and the USFS requested during the WY2006 annual meeting that an additional monitoring point be added to monitor potential impacts from Pond 7 on the western, downgradient drainage. Greens Creek proposed the current site on lower Althea, and after review by ADEC and USFS during a site visit (June 2, 2007 – USFS Inspection #259) the new site was added to the routine monitoring schedule.

As shown in the table below, there were no data outliers.

| Sample Date | Parameter | Value | Qualifier | Notes |
|---|---|---|---|---|
| No outliers have been identified by HGCMC for the period of October 2008 through September 2014. | | | | |

The data for Water Year 2014 have been compared to the strictest fresh water quality criterion for each applicable analyte. Seven results exceeding these criteria have been identified, as listed in the table below. One of the exceedances is for field pH with value of 6.48 su (September 2013), this was below the AWQS limit of 6.50 su. Historical sampling for this site in 2003, prior to any disturbance that would directly impact Althea Creek, indicates that the natural background pH ranged from 4.1 su to 4.8 su. Also, for all four sampling events total alkalinity was in exceedance at Site 60, however these values are similar to those recorded for prior to disturbance values.  The two exceedances were for dissolved mercury, see discussion below.

**Table of Exceedance for Water Year 2014**

| Sample Date | Parameter | Value | Limits Lower | Limits Upper | Hardness |
|---|---|---|---|---|---|
| 18-Nov-13 | Alkalinity | 14.3 mg/L | 20 | 0 | |
| 12-May-14 | Alkalinity | 9.2 mg/L | 20 | 0 | |
| 15-Jul-14 | Alkalinity | 9 mg/L | 20 | 0 | |
| 15-Sep-14 | Alkalinity | 11.9 mg/L | 20 | 0 | |
| 15-Jul-14 | Mercury Dissolved | 0.0162 µg/L | 0 | 0.012 | |
| 15-Sep-14 | Mercury Dissolved | 0.0174 µg/L | 0 | 0.012 | |
| 12-May-14 | pH Field | 6.45 su | 6.5 | 8.50 | |

X-Y plots have been generated to graphically present the data for each of the analytes requested in the Statistical Information Goals for this site. Site 60 was added to the FWMP as a monitoring point for potential impacts from Pond 7. Some analytes (*e.g.* sulfate, barium) and measurements (*e.g.* pH, conductivity, hardness, and alkalinity) have similar decreasing visual trends over water years 2007 – 2012. Initially, after the construction of Pond 7 there was a spike in these analytes and measurements. With the completion of the Pond 7 under drain caisson pump back system, these values have begun to decrease and normalize.

The notable exception to this is the elevated dissolved mercury levels seen in the past several years. Alkalinity and pH at Site 60 increased when fill for Pond 7 was placed in the drainage area. HGCMC believes that the increase in pH and alkalinity increases the potential for adsorption of mercury on sediments and soil particles in the drainage. The pH of the Site 60 drainage now fluctuates seasonally and from year to year and may control the storage and release of mercury from the adsorbed fraction. Dissolution of tailings dust particles, which contain small amounts of mercury, and atmospheric deposition of mercury from natural (e.g. volcanoes) and anthropogenic sources (e.g. coal fired power plants in Asia) are potential sources of this metal in the drainage area. Additional sampling in adjacent drainages during water year 2009 and Water Year 2012 showed that this issue was isolated to only the Site 60 watershed.

A non-parametric statistical analysis for trend was performed for specific conductivity, field pH, total alkalinity, total sulfate, and dissolved zinc. Calculation details of the Seasonal Kendall analyses are presented in detail on the pages following this interpretive section. The following table summarizes the results on the data collected between Oct-08 and Sep-14 (WY2009-WY2014). This is the second time that there were a sufficient number of years (n=6) of data for conducting these calculations.

**Table of Summary Statistics for Trend Analysis**

| Parameter | n* | p** | Trend | Q | Q(%) |
|---|---|---|---|---|---|
| | Mann-Kendall test statistics | | | Sen's slope estimate | |
| Conductivity Field | 6 | 0.24 | | | |
| pH Field | 6 | 0.24 | | | |
| Alkalinity, Total | 6 | 0.14 | | | |
| Sulfate, Total | 6 | 0.39 | | | |
| Zinc, Dissolved | 6 | 0.02 | + | 0.25 | 4.5 |

* Number of Years  ** Significance level

There was one statistically significant (α/2=2.5%) trend identified for the current water year, associated with an increasing trend in dissolved zinc with a Sen's slope estimate of 0.25 µg/L/yr. The current zinc values are approximately 15% of the AWQS. HGCMC feels that the current sampling schedule adequately characterizes the water quality parameters at this site.

# Table of Results for Water Year 2014

## Site 060FMS - 'Lower Althea creek'

| Sample Date/Parameter | Oct 2013 | Nov 2013 | Dec 2013 | Jan 2014 | Feb 2014 | Mar 2014 | Apr 2014 | May 2014 | Jun 2014 | Jul 2014 | Aug 2014 | Sep 2014 | **Median** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Water Temp (°C) | | 0 | | | | | | 10.3 | | 10.8 | | 10.5 | 10.4 |
| Conductivity-Field(μmho) | | 61 | | | | | | 56 | | 51 | | 47.6 | 53.5 |
| Conductivity-Lab (μmho) | | 57 | | | | | | 51 | | 49 | | 46 | 50 |
| pH Lab (standard units) | | 6.47 | | | | | | 6.29 | | 6.2 | | 6.46 | 6.38 |
| pH Field (standard units) | | 6.73 | | | | | | 6.45 | | 6.72 | | 6.79 | 6.73 |
| Total Alkalinity (mg/L) | | 14.3 | | | | | | 9.2 | | 9 | | 11.9 | 10.6 |
| Total Sulfate (mg/L) | | 2.5 | | | | | | 5.5 | | 4.7 | | 2.1 | 3.6 |
| Hardness (mg/L) | | 26.4 | | | | | | 19.8 | | 22.6 | | 24.4 | 23.5 |
| Dissolved As (ug/L) | | 2.09 | | | | | | 1.51 | | 3.19 | | 3.14 | 2.615 |
| Dissolved Ba (ug/L) | | 20.7 | | | | | | 17.3 | | 25.6 | | 26.6 | 23.2 |
| Dissolved Cd (ug/L) | | 0.0174 | | | | | | 0.0122 | | 0.011 | | 0.0237 | 0.0148 |
| Dissolved Cr (ug/L) | | 1.72 | | | | | | 1.57 | | 1.54 | | 2.05 | 1.645 |
| Dissolved Cu (ug/L) | | 0.851 | | | | | | 1.08 | | 1.59 | | 1.32 | 1.200 |
| Dissolved Pb (ug/L) | | 0.291 | | | | | | 0.168 | | 0.401 | | 0.336 | 0.3135 |
| Dissolved Ni (ug/L) | | 1.27 | | | | | | 1.01 | | 1.51 | | 1.67 | 1.390 |
| Dissolved Ag (ug/L) | | 0.005 | | | | | | 0.005 | | 0.007 | | 0.014 | 0.006 |
| Dissolved Zn (ug/L) | | 5.13 | | | | | | 5.18 | | 7.06 | | 7.13 | 6.12 |
| Dissolved Se (ug/L) | | 0.253 | | | | | | 0.176 | | 0.216 | | 0.176 | 0.196 |
| Dissolved Hg (ug/L) | | 0.00704 | | | | | | 0.0116 | | 0.0162 | | 0.0174 | 0.013900 |

For individual sample/analyte qualifier descriptions see "Qualified Data by QA Reviewer" table.

Values reported as less than MDL are replaced by 1/2 MDL for median calculation purposes.

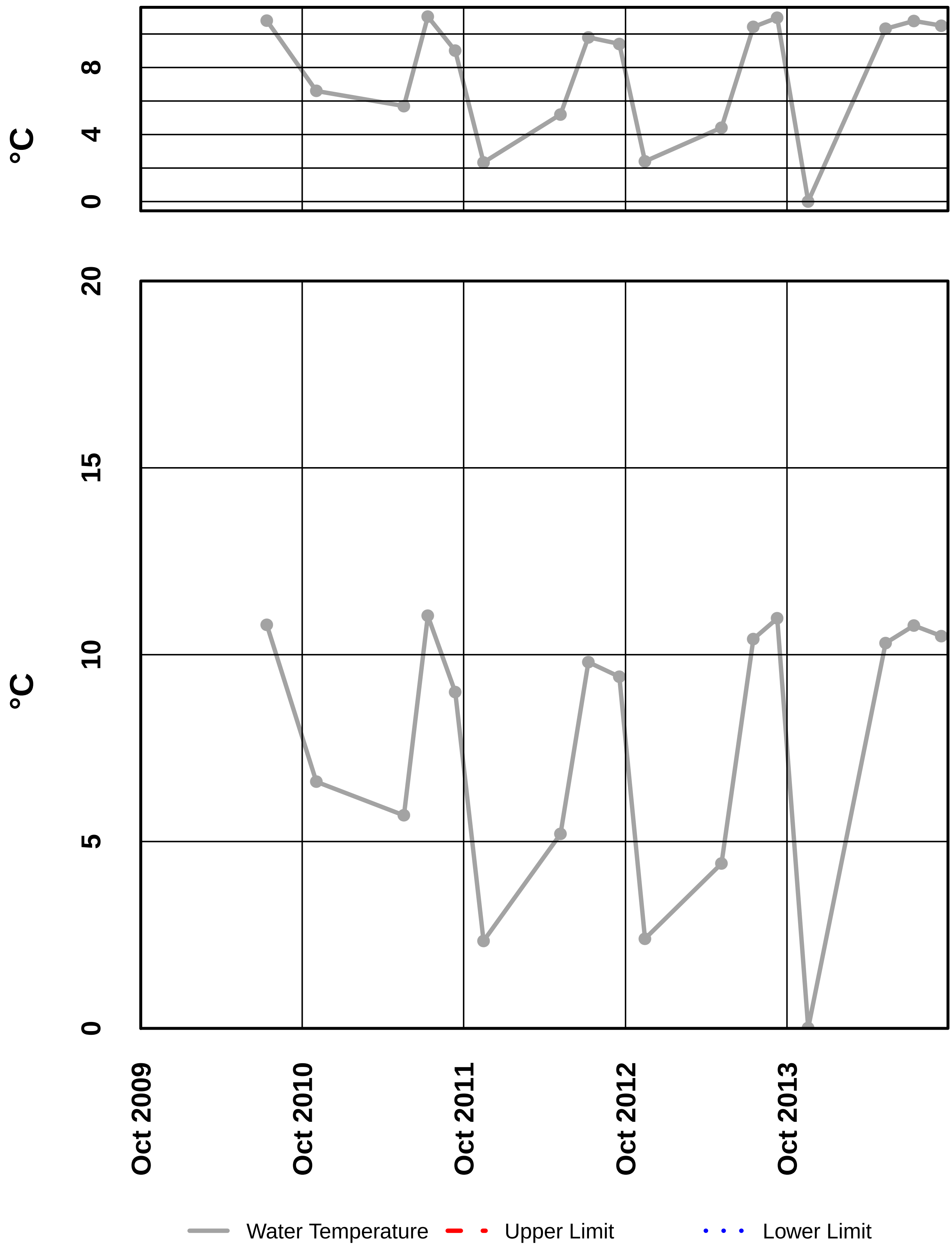
Shaded data has been qualified as an outlier by HGCMC and removed from any further analysis and is not included into the calculation of the median

# Qualified Data by QA Reviewer

**Date Range: 10/01/2013 to 09/30/2014**

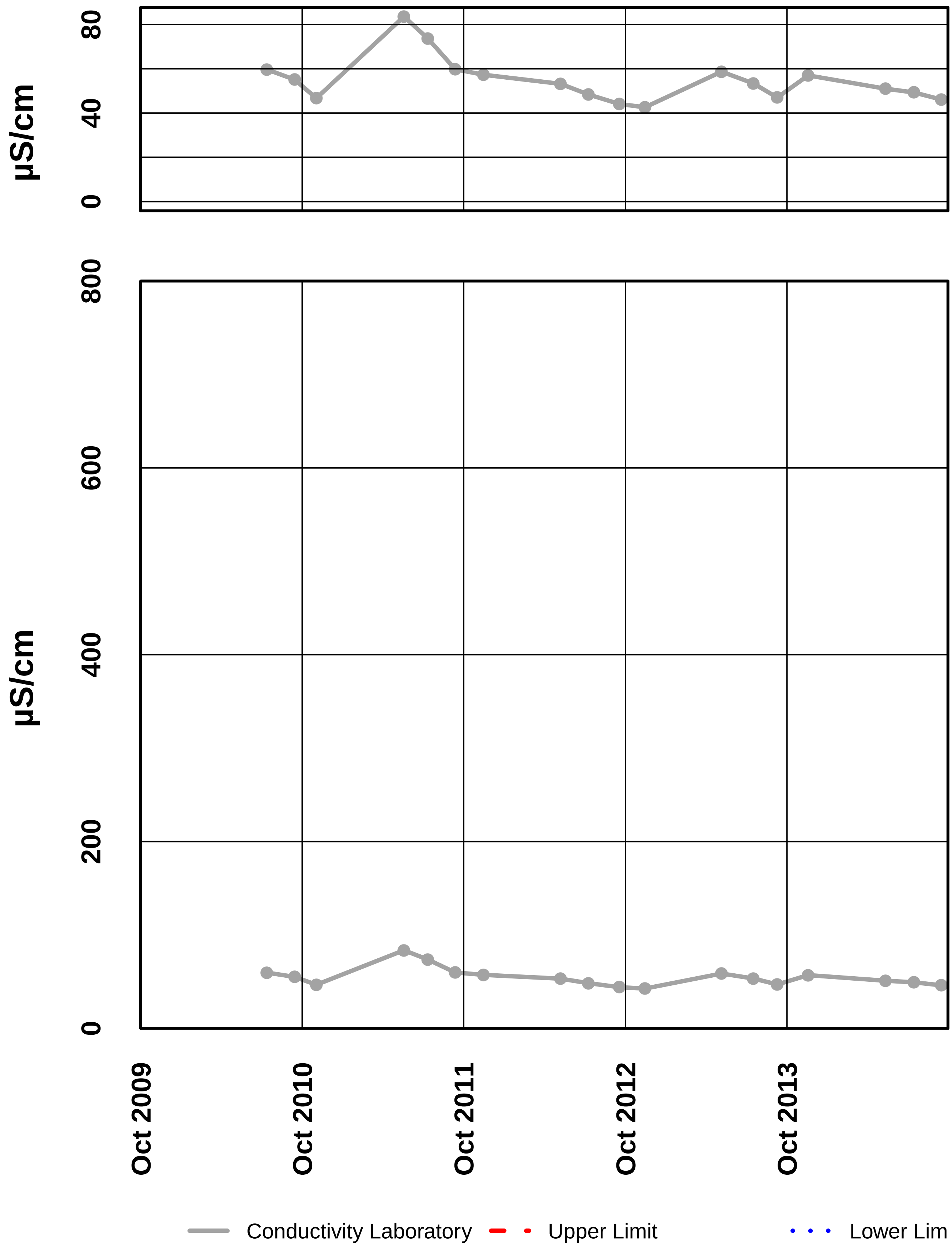
| Site No. | Sample Date | Sample Time | Parameter | Value | Qualifier | Reason for Qualifier |
|---|---|---|---|---|---|---|
| 060FMS | 11/18/2013 | 12:00 PM | Diss. Ag-ICP/MS | 0.0049 | J | Below Quantitative Range |
| | | | Diss. Se-ICP/MS | 0.25 | J | Below Quantitative Range |
| 060FMS | 5/12/2014 | 12:00 PM | Alkalinity | 9.2 | U | Trip Blank Contamination |
| | | | Conductivity | 51 | U | Trip Blank Contamination |
| | | | Diss. Ag-ICP/MS | 0.00533 | J | Below Quantitative Range, Duplicate RPD |
| | | | Diss. Se-ICP/MS | 0.17 | J | Below Quantitative Range |
| | | | Sulfate | 5.47 | J | Below Quantitative Range, Sample Receipt T |
| 060FMS | 7/15/2014 | 12:00 PM | Diss. Ag-ICP/MS | 0.00712 | J | Below Quantitative Range |
| | | | Diss. Se-ICP/MS | 0.21 | J | Below Quantitative Range |
| 060FMS | 9/15/2014 | 12:00 PM | Diss. Se-ICP/MS | 0.17 | J | Below Quantitative Range |

# Site 60 – Water Temperature

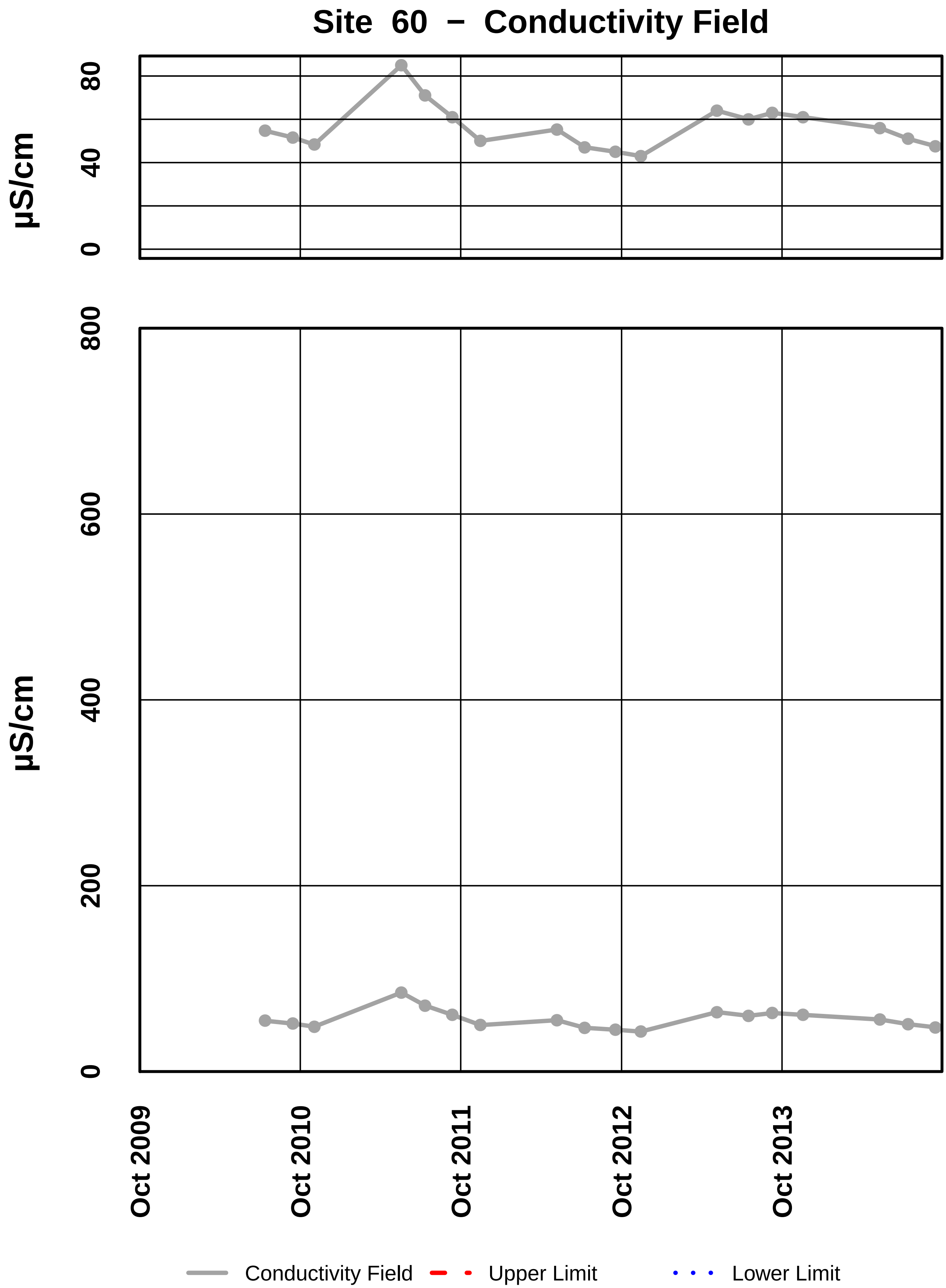



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# Site 60 – Conductivity Laboratory

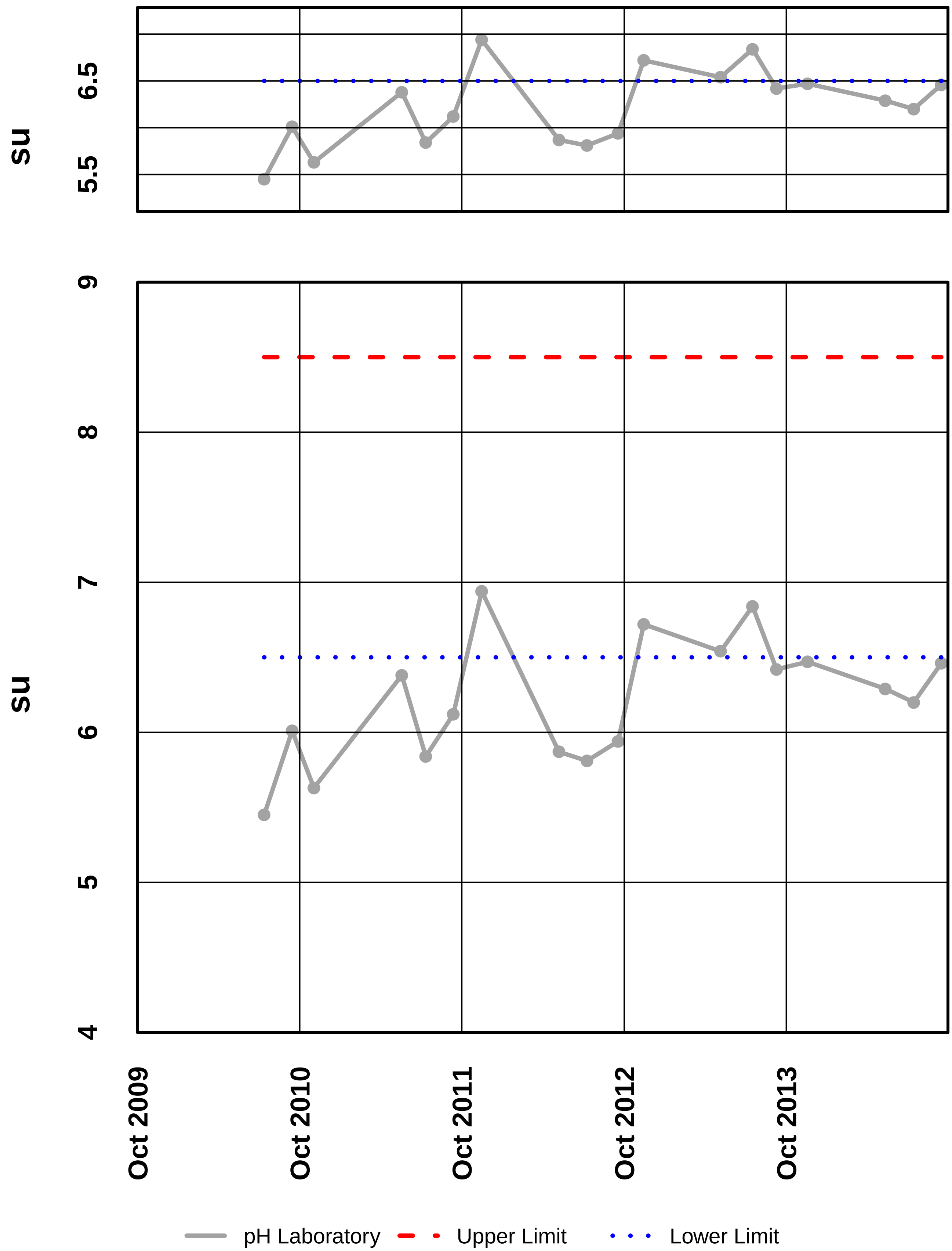



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

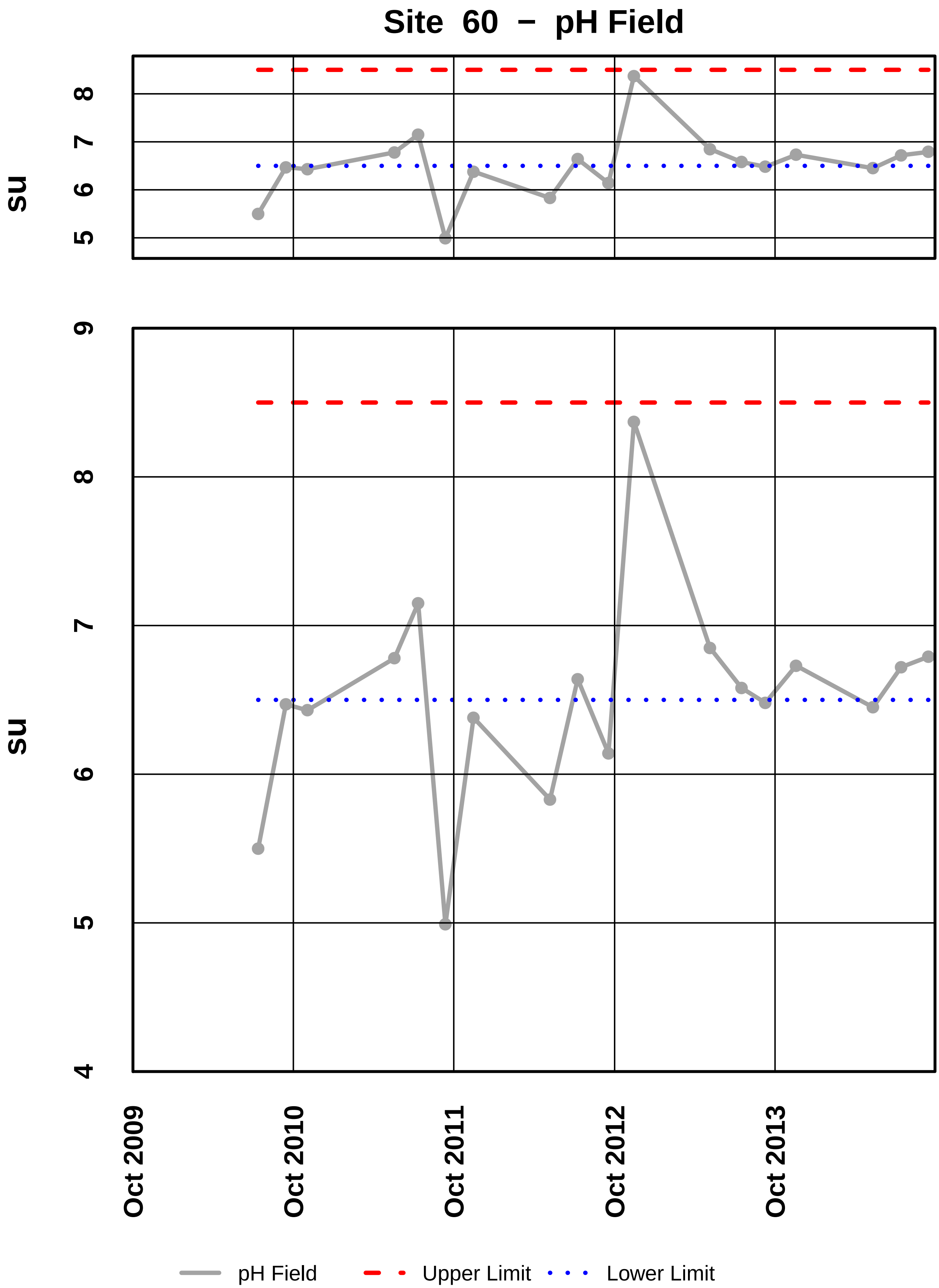



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

## Site 60 – pH Laboratory

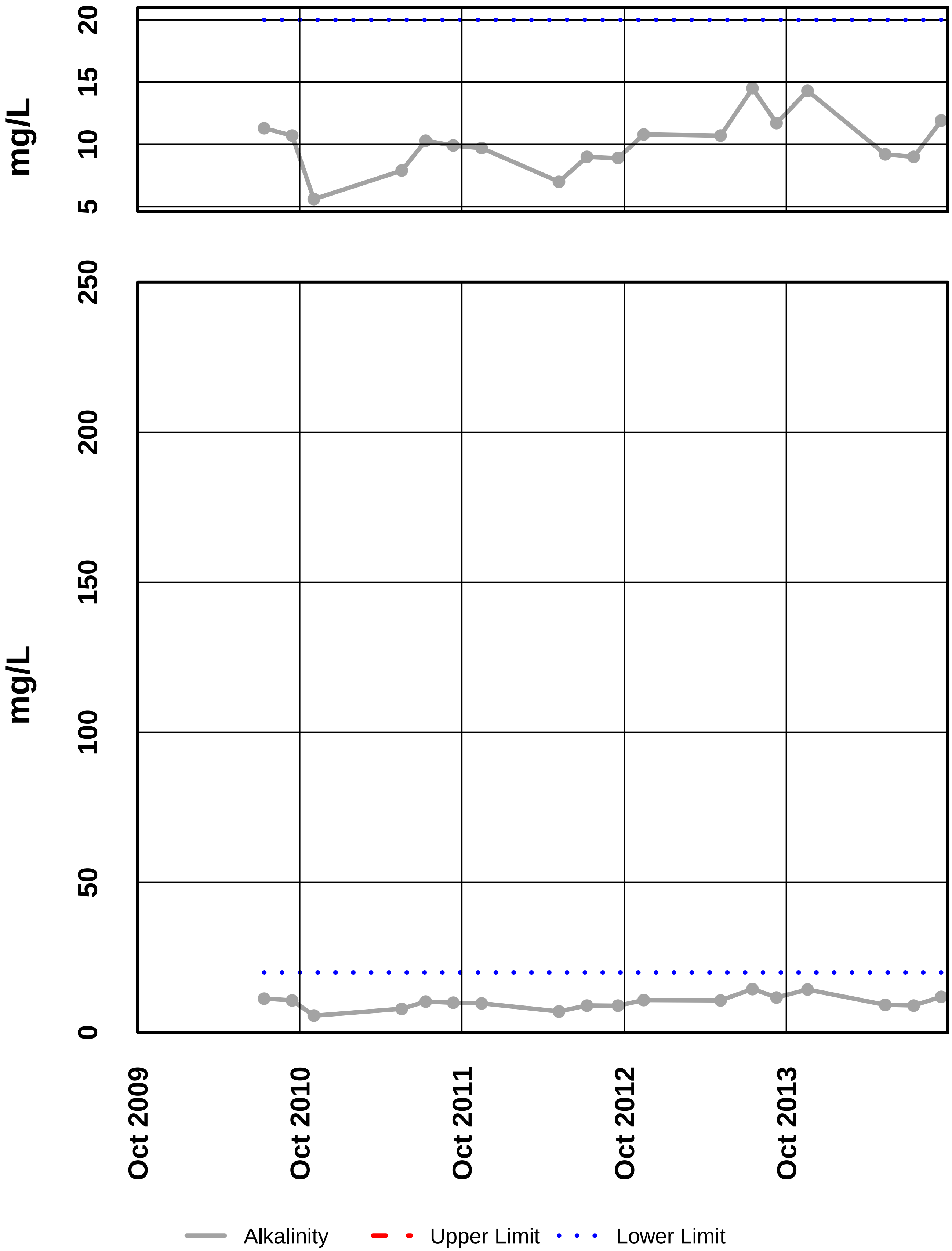



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

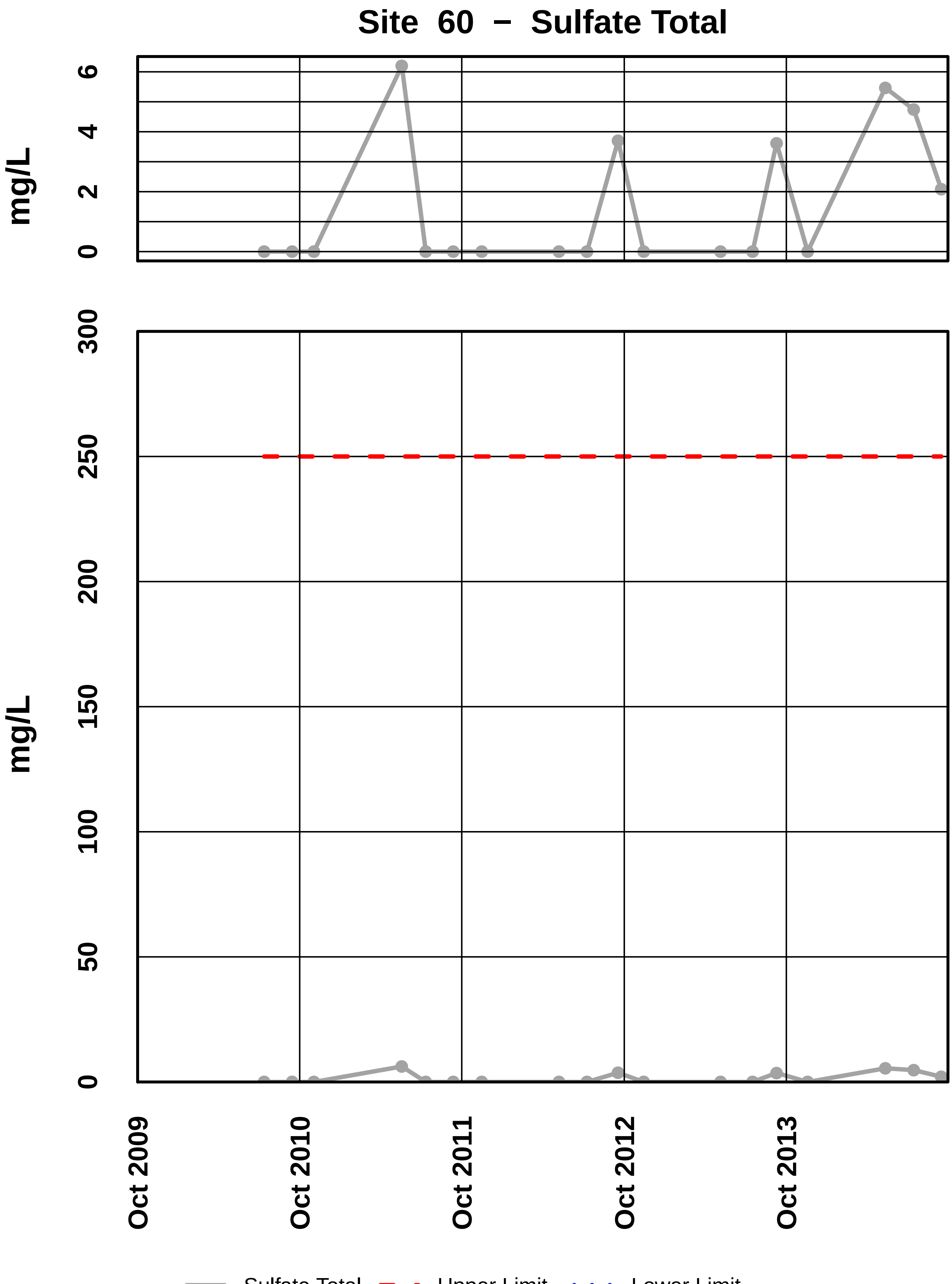



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

## Site 60 − Alkalinity

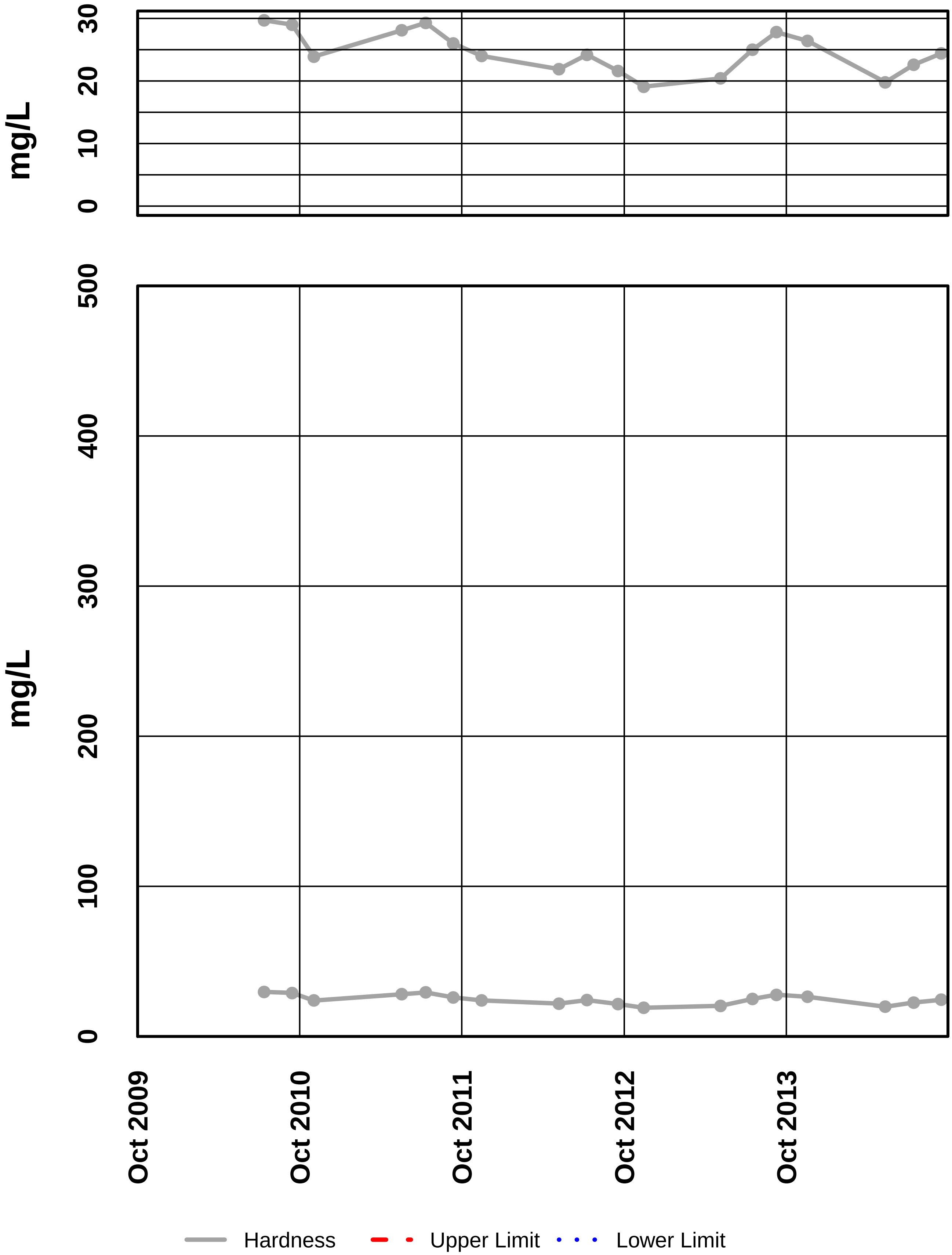



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



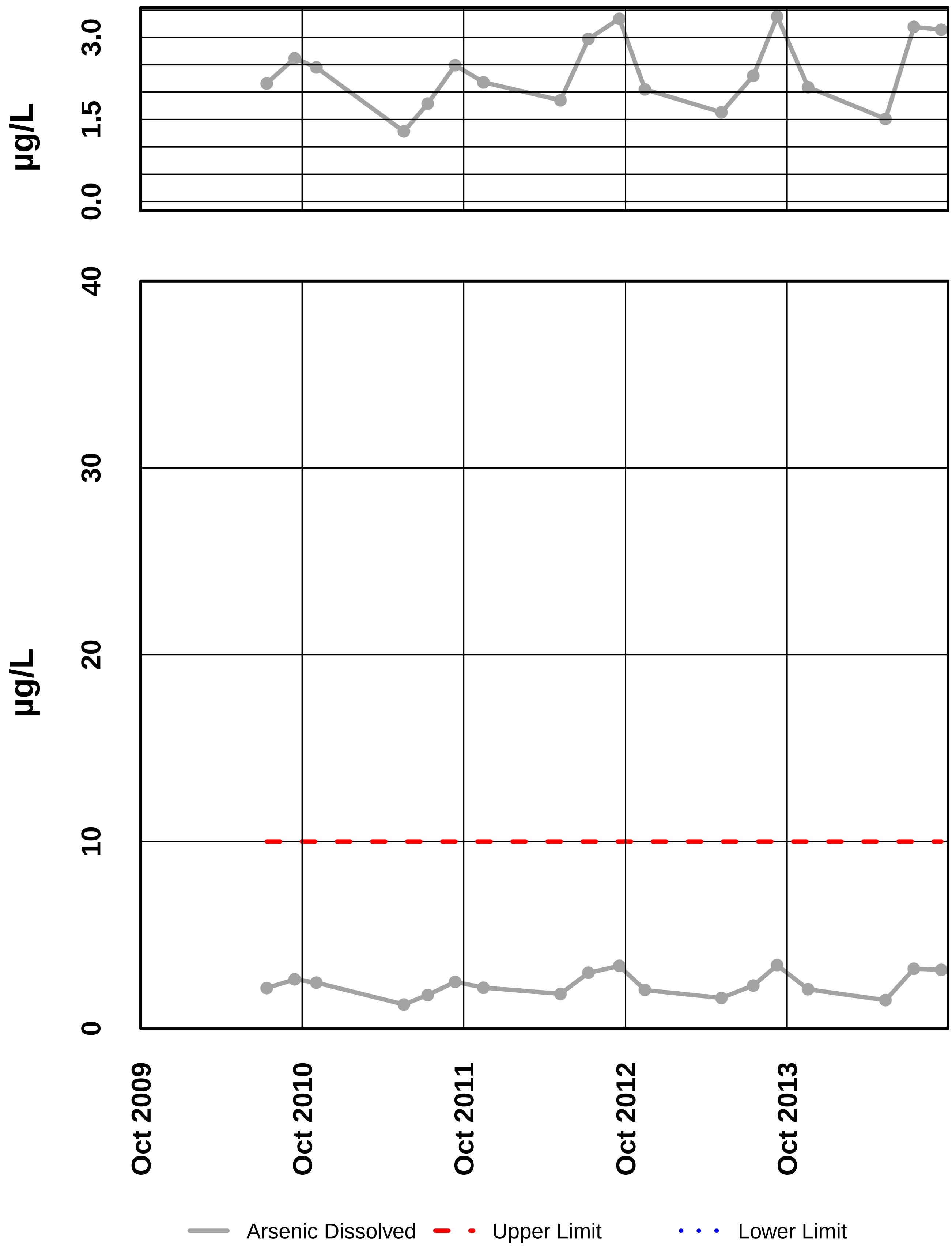

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# Site 60 − Hardness

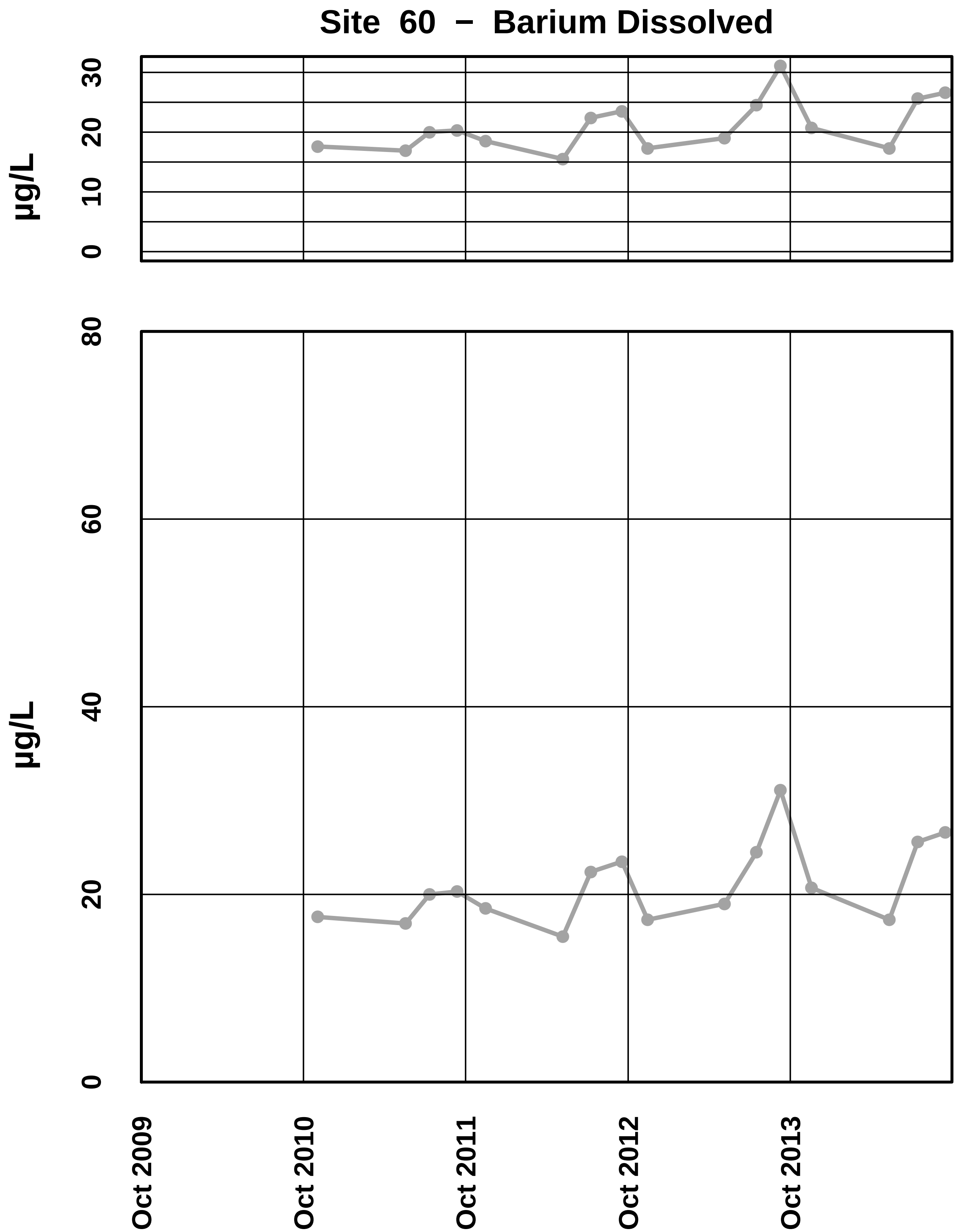



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

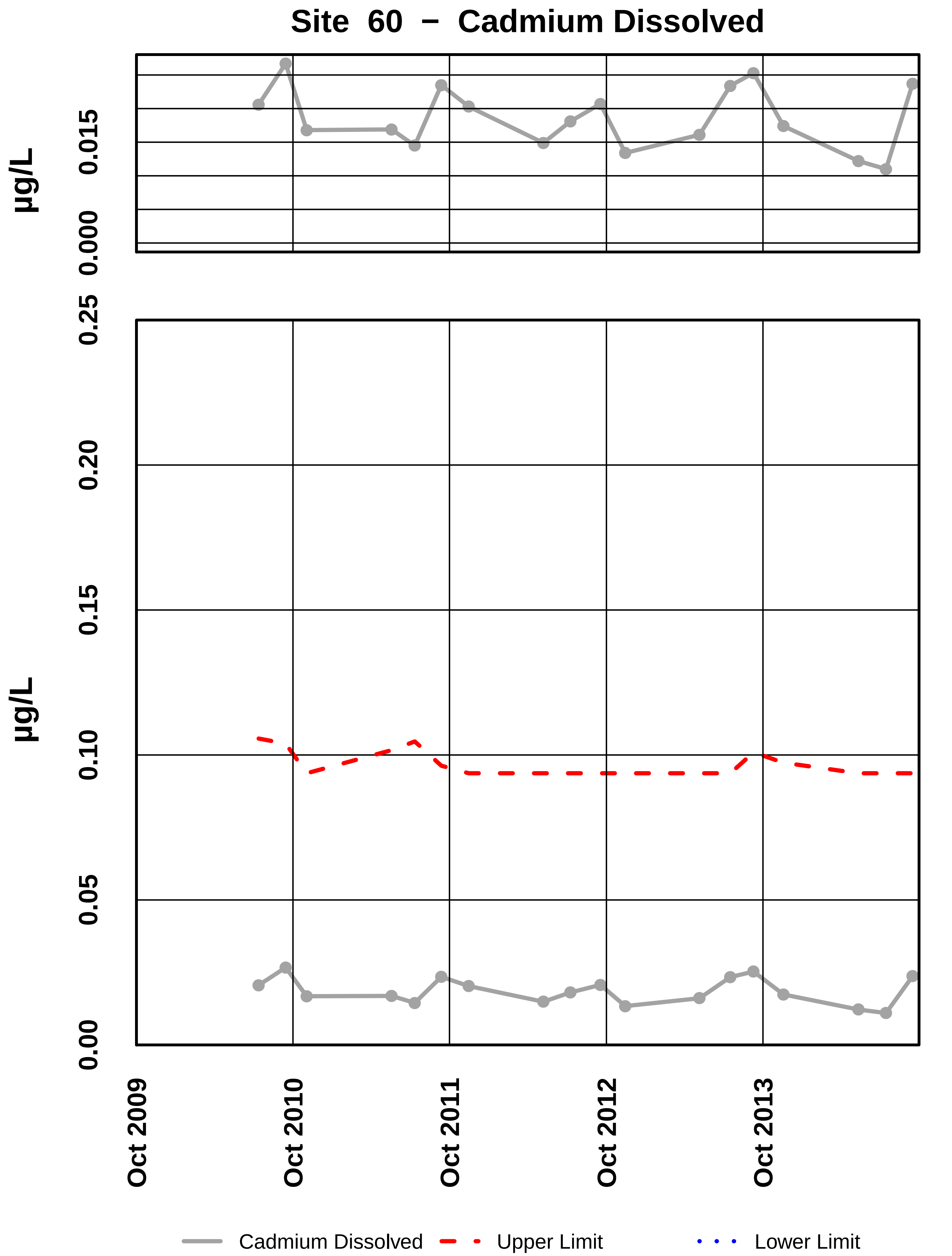
# Site 60 – Arsenic Dissolved




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

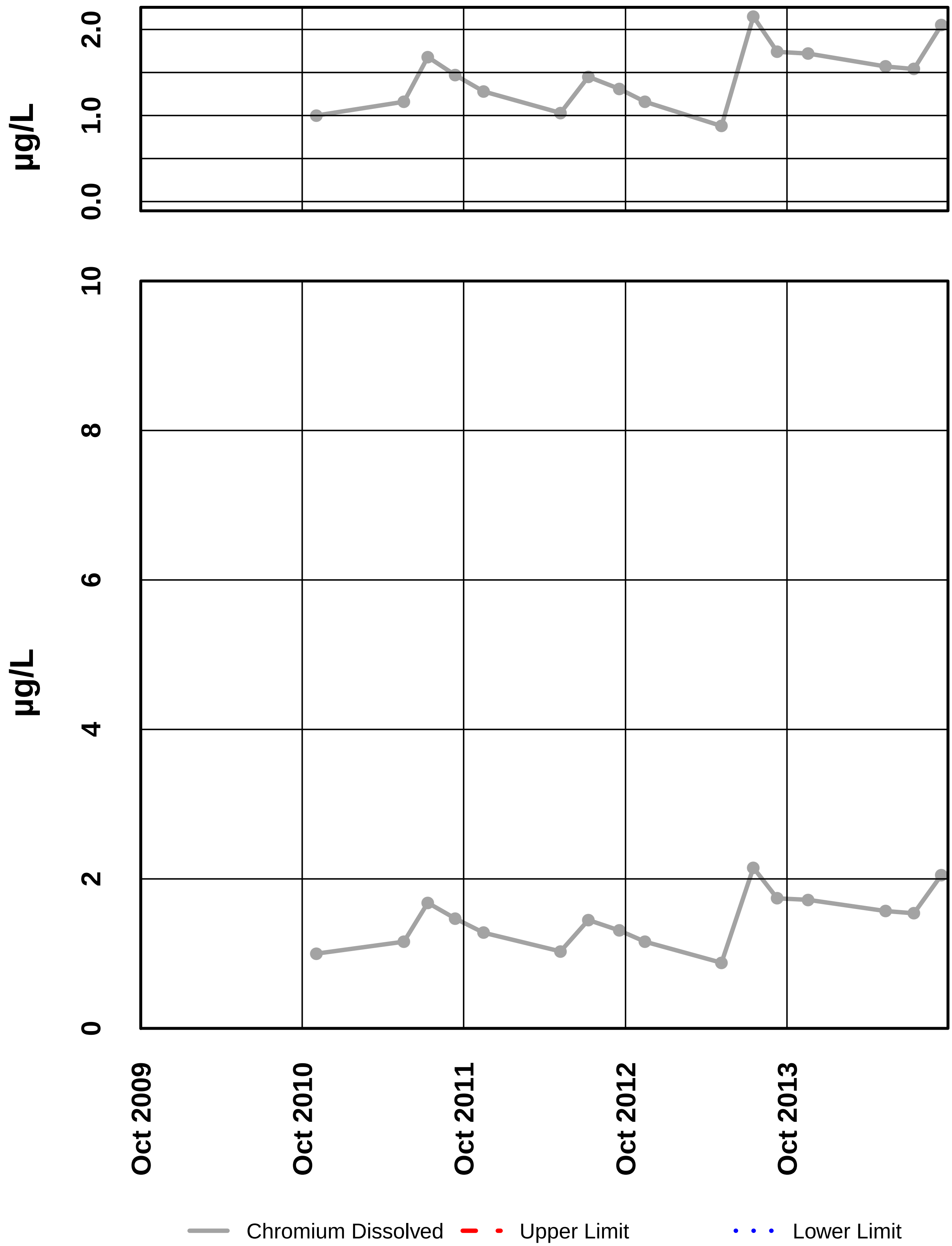



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

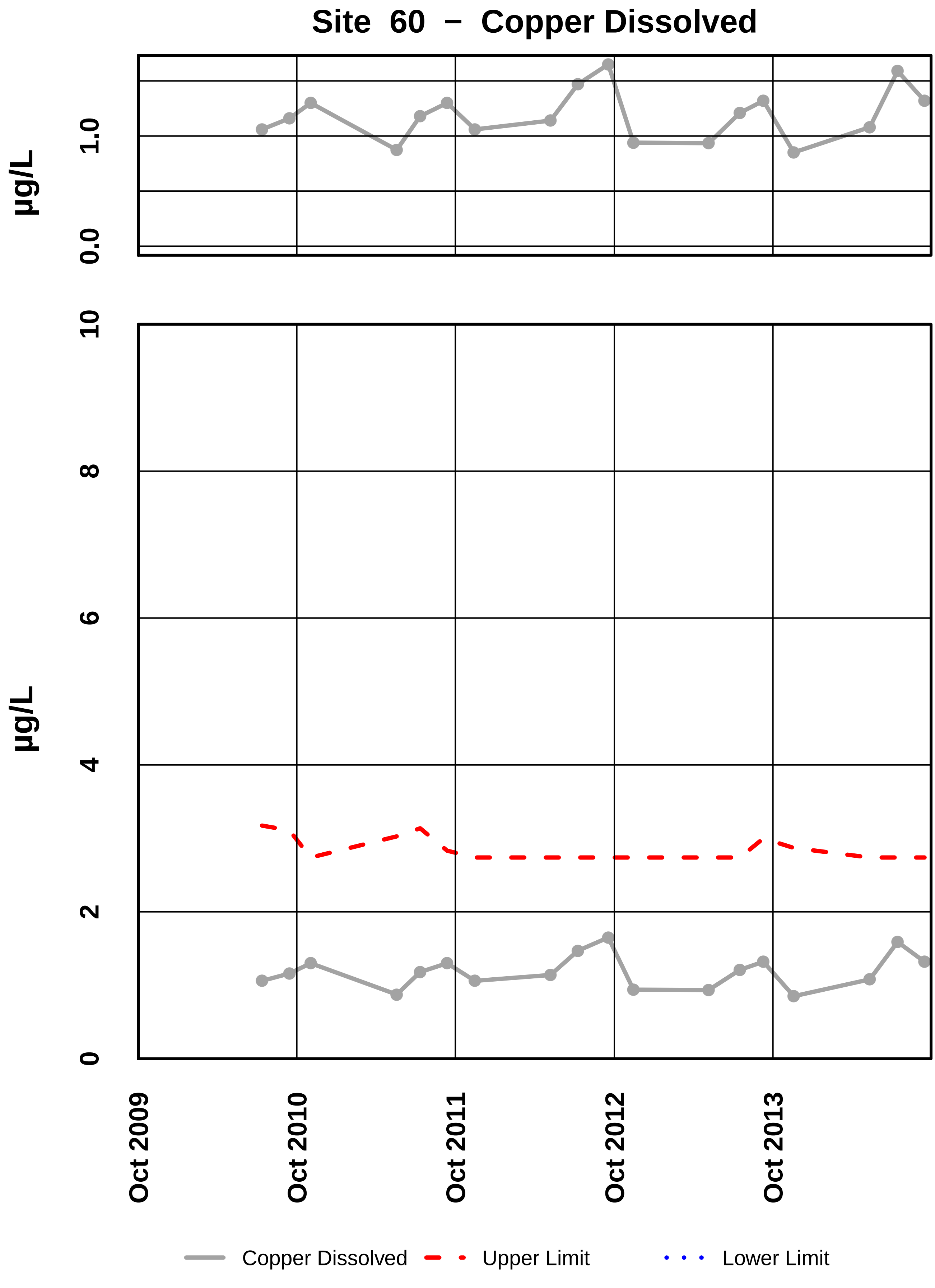



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

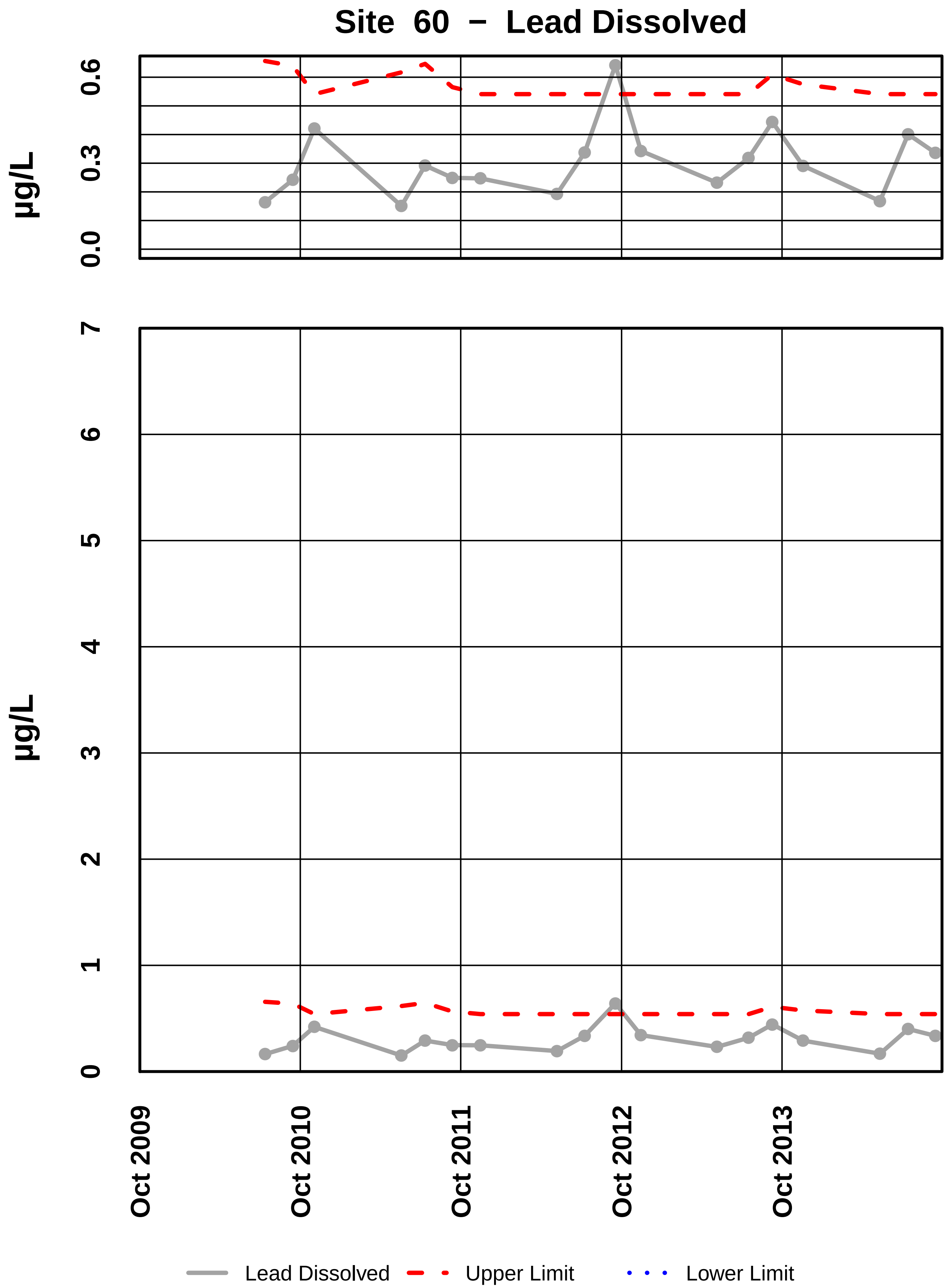
# Site 60 – Chromium Dissolved



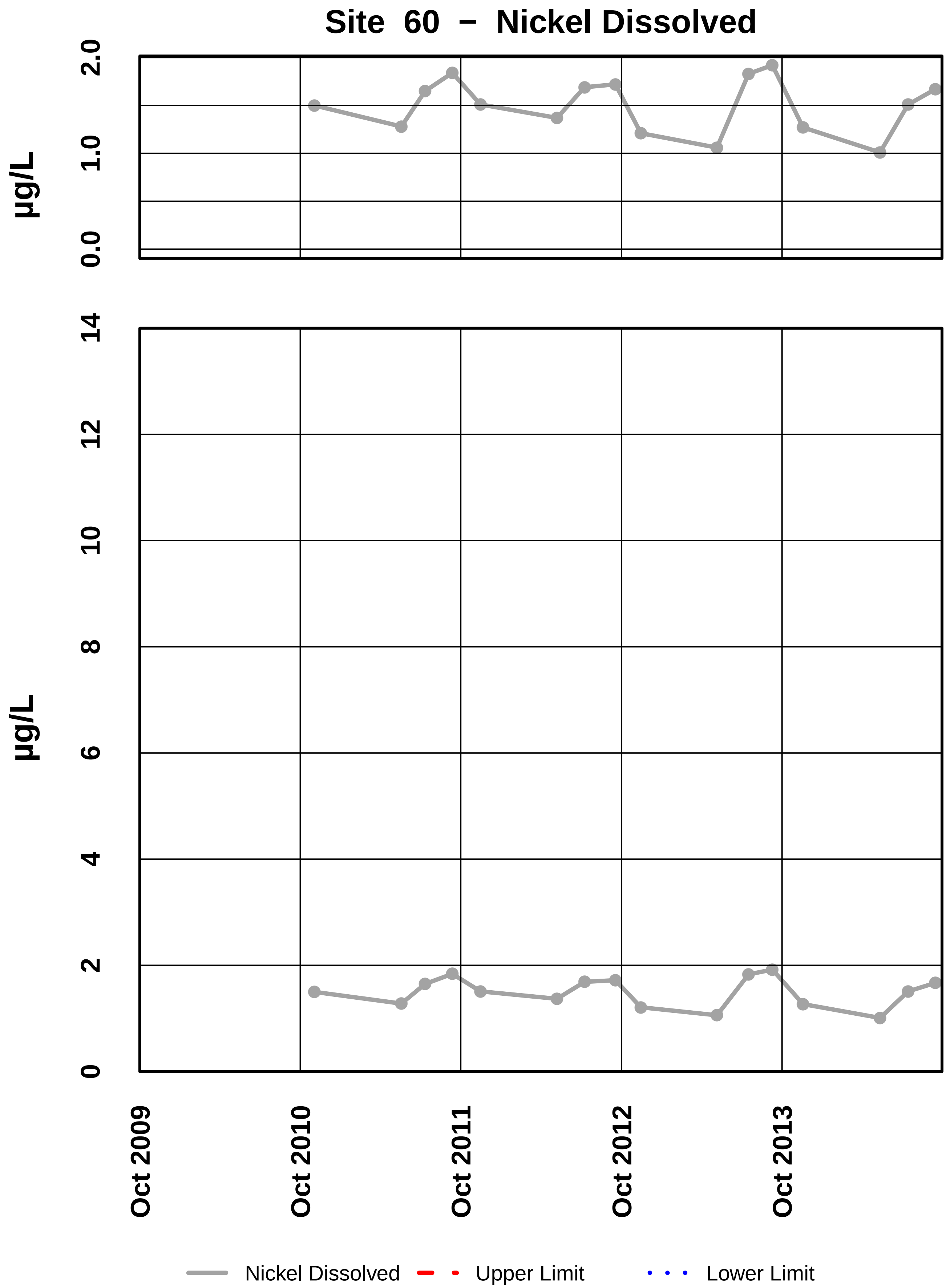

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



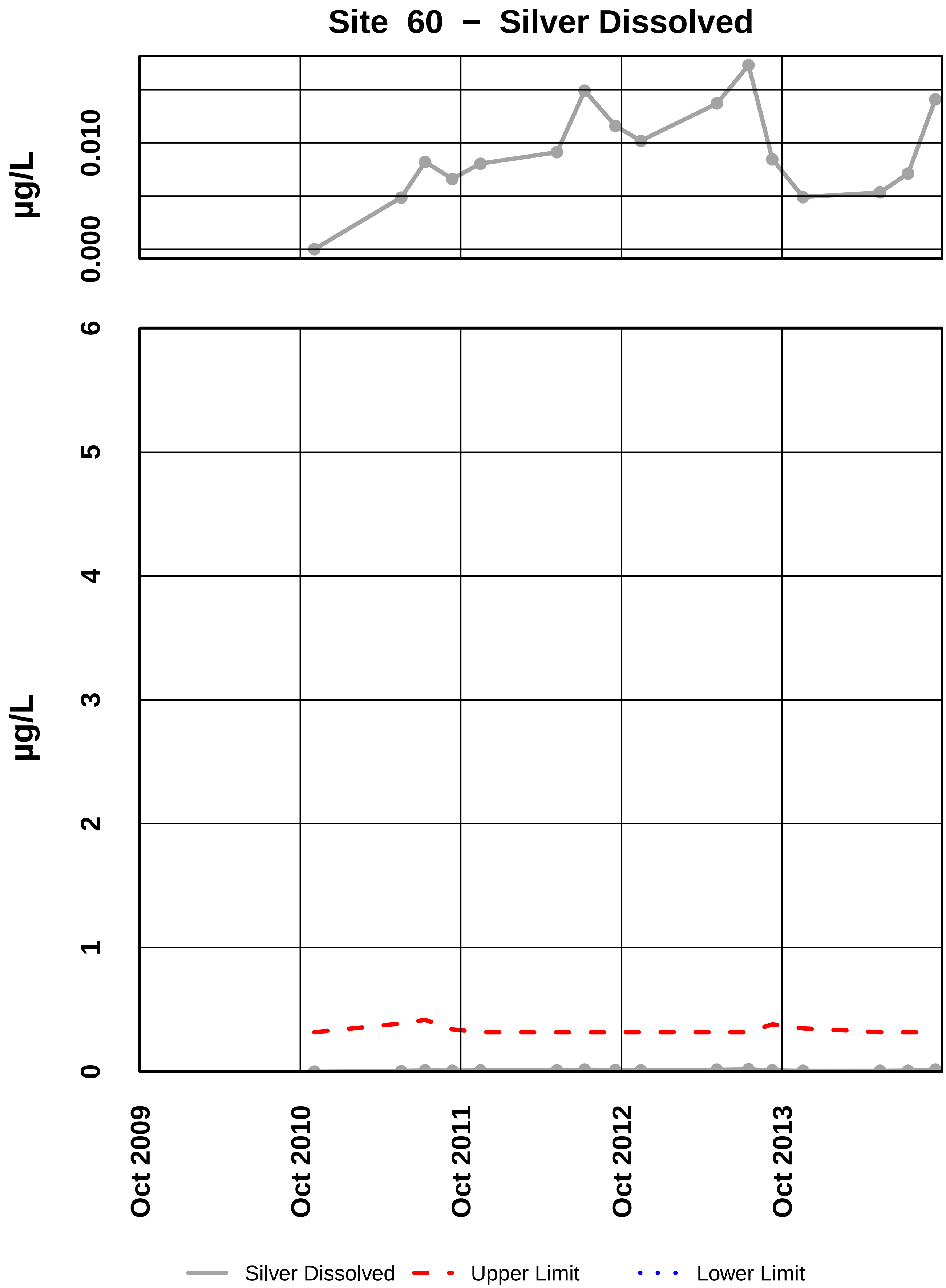

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



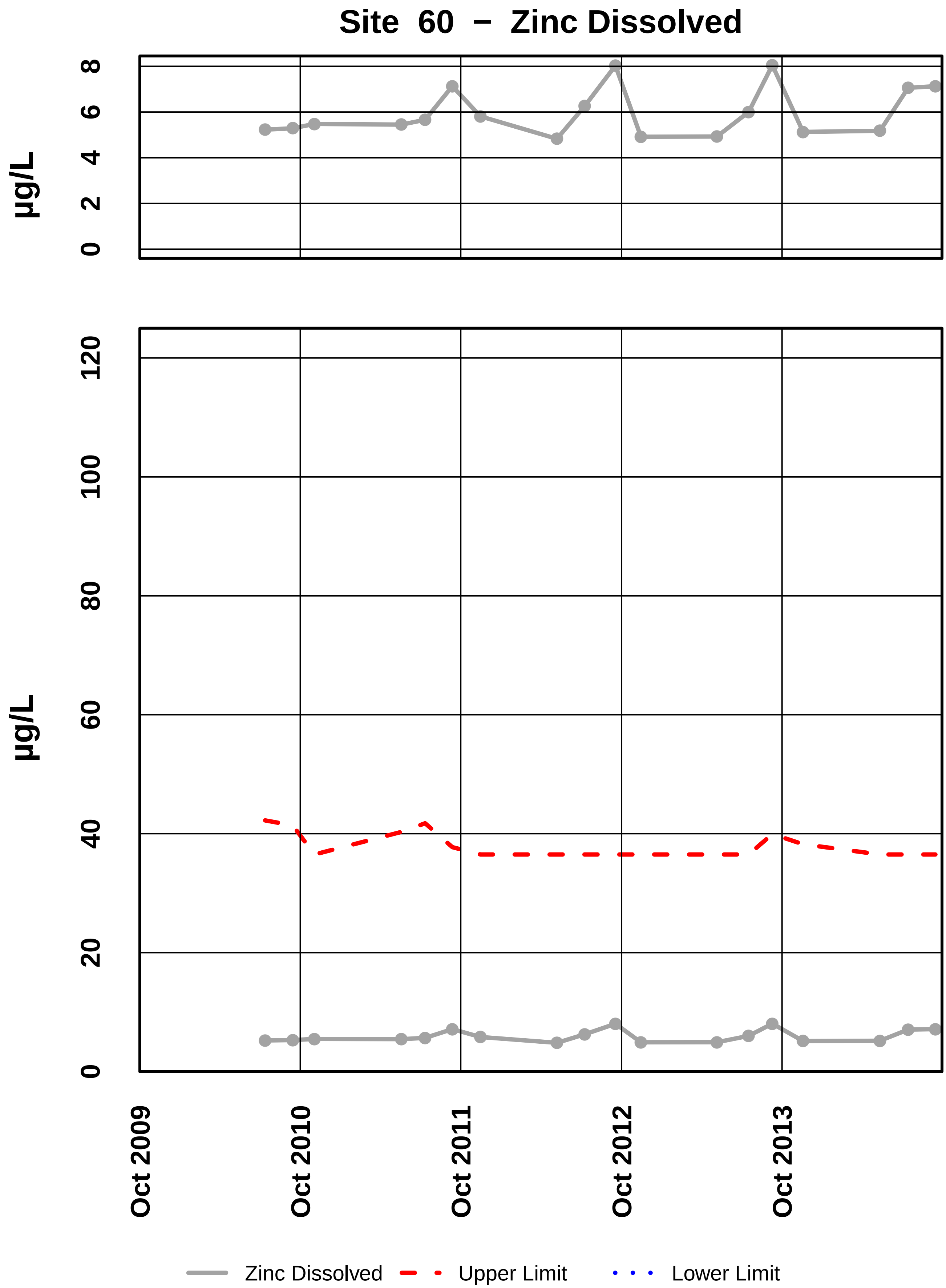

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

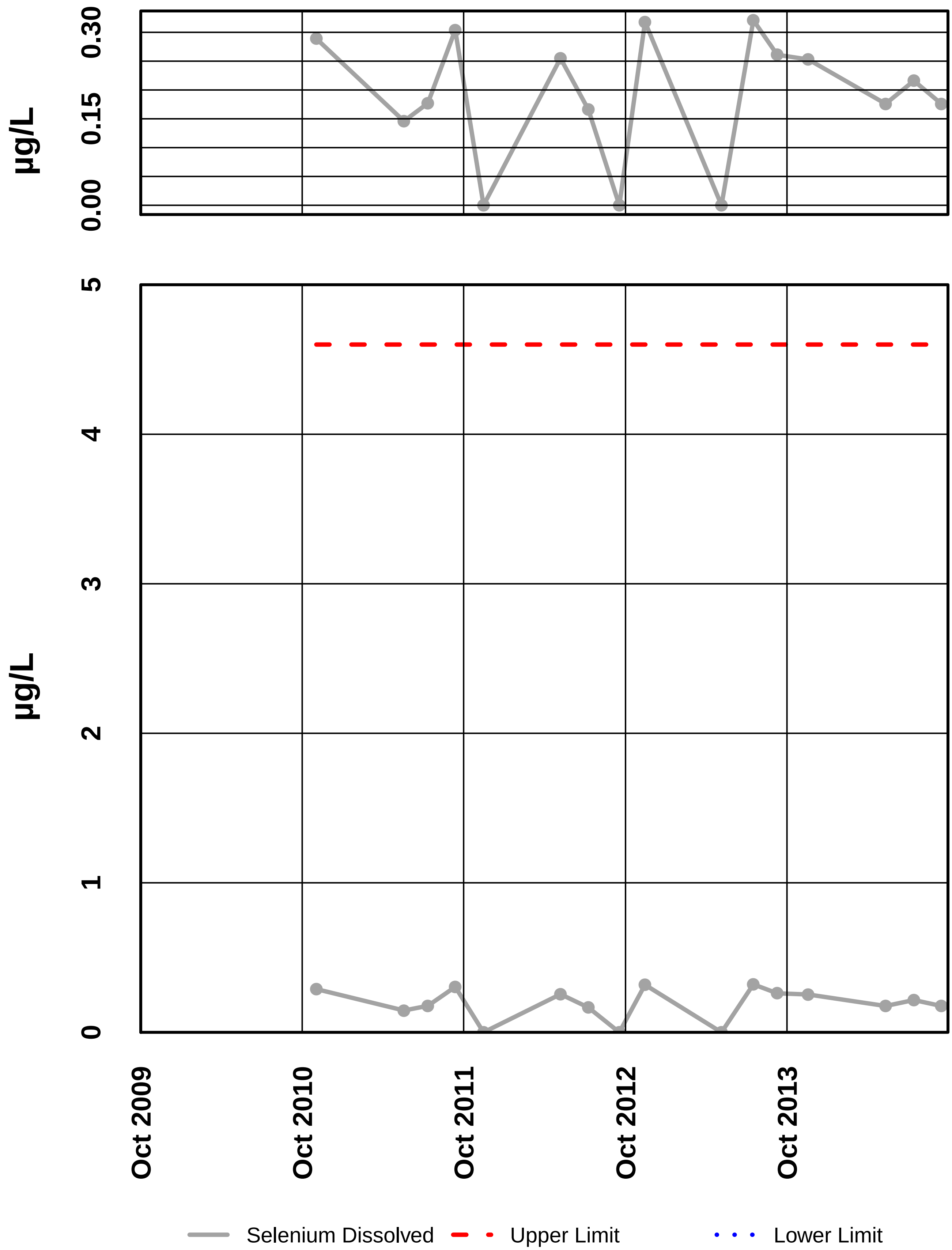



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

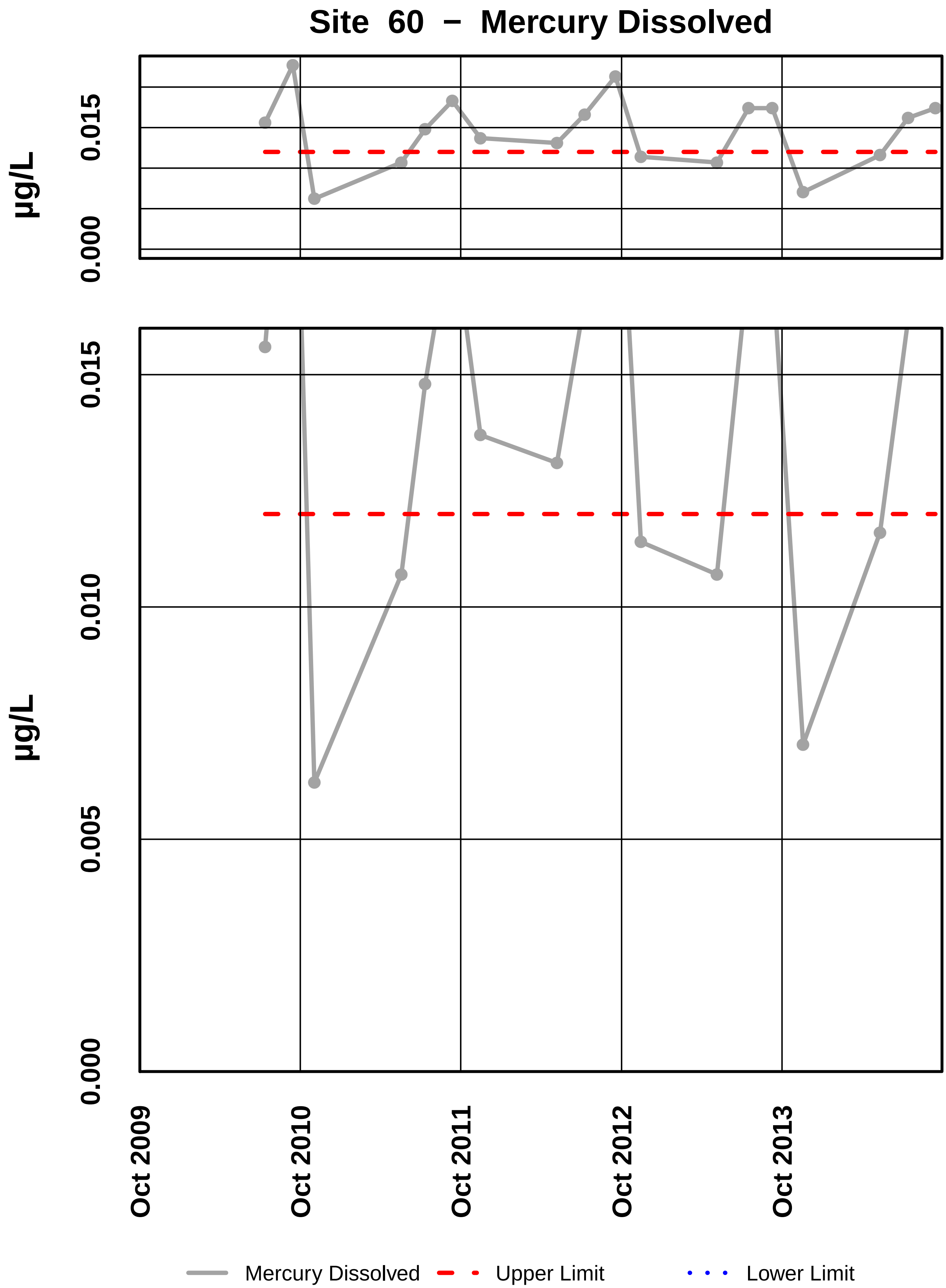



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# Site 60 – Selenium Dissolved




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# INTERPRETIVE REPORT
# SITE 609

Sampling at this site was initiated during the spring of Water Year 2013. This site was added to the FWMP at the request of the state and federal regulators. Site 609 is located west of the tailings disposal facility on a small surface drainage. The sampling location is near the bottom of the drainage, therefore monitoring a larger expanse upgradient from the site.

The data collected during the current water year are listed in the following "Table of Results for Water Year 2014" report. The table includes all the required FWMP analyte data (field and laboratory) collected for the current water year and a series of flags keyed to the summary report "Qualified Data by QA Reviewer". The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of ½ MDL for the purpose of median calculation.

All data collected at this site for the past year is included in the data analyses. As shown in the table below, there were no data outliers.

| Sample Date | Parameter | Value | Qualifier | Notes |
|---|---|---|---|---|
| No outliers have been identified by HGCMC for the period of October 2012 through September 2014. | | | | |

The data for Water Year 2014 have been compared to the strictest fresh water quality criterion for each applicable analyte. Two results exceeding these criteria were identified as listed in the table below.

**Table of Exceedance for Water Year 2014**

| | | | Limits | | |
|---|---|---|---|---|---|
| **Sample Date** | **Parameter** | **Value** | **Lower** | **Upper** | **Hardness** |
| 18-Nov-13 | Alkalinity | 17.5 mg/L | 20 | 0 | |
| 12-May-14 | Alkalinity | 16 mg/L | 20 | 0 | |
| 12-May-14 | pH Field | 6.32 su | 6.5 | 8.5 | |
| 15-Jul-14 | Sulfate Total | 252 mg/L | 0 | 250 | |

Though two of the four samples were below the minimal limit for alkalinity, the other two samples were above the lower limit. Low alkalinity/pH values are expected, because a portion of the drainage through the site consists of waters originating in the low alkalinity/pH muskeg areas, such as those being monitored at Site 29. Total sulfate was slightly above the AWQS in July and by the September sample was below the AWQS. The other four sulfate samples taken at the site have all been below the AWQS. HGCMC will continue to monitor the site to determine if this increase was transient in nature.

## Table of Results for Water Year 2014

### Site 609FMS - 'Further Creek Lower'

| Sample Date/Parameter | Oct 2013 | Nov 2013 | Dec 2013 | Jan 2014 | Feb 2014 | Mar 2014 | Apr 2014 | May 2014 | Jun 2014 | Jul 2014 | Aug 2014 | Sep 2014 | **Median** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Water Temp (°C) | | 0.1 | | | | | | 6.9 | | 10.4 | | 10.5 | 8.7 |
| Conductivity-Field(µmho) | | 430 | | | | | | 276 | | 614 | | 556 | 493.0 |
| Conductivity-Lab (µmho) | | 416 | | | | | | 277 | | 562 | | 528 | 472 |
| pH Lab (standard units) | | 6.76 | | | | | | 6.44 | | 7 | | 6.95 | 6.86 |
| pH Field (standard units) | | 6.77 | | | | | | 6.32 | | 6.6 | | 7.05 | 6.69 |
| Total Alkalinity (mg/L) | | 17.5 | | | | | | 16 | | 22.5 | | 22.5 | 20.0 |
| Total Sulfate (mg/L) | | 172 | | | | | | 103 | | 252 | | 246 | 209.0 |
| Hardness (mg/L) | | 203 | | | | | | 119 | | 293 | | 268 | 235.5 |
| Dissolved As (ug/L) | | 1.1 | | | | | | 0.782 | | 1.36 | | 1.46 | 1.230 |
| Dissolved Ba (ug/L) | | 35.8 | | | | | | 33 | | 70.5 | | 55.9 | 45.9 |
| Dissolved Cd (ug/L) | | 0.121 | | | | | | 0.119 | | 0.241 | | 0.155 | 0.1380 |
| Dissolved Cr (ug/L) | | 1.39 | | | | | | 1.41 | | 1.22 | | 1.62 | 1.400 |
| Dissolved Cu (ug/L) | | 0.578 | | | | | | 1.09 | | 1.42 | | 0.708 | 0.899 |
| Dissolved Pb (ug/L) | | 0.363 | | | | | | 0.346 | | 0.435 | | 0.388 | 0.3755 |
| Dissolved Ni (ug/L) | | 4.12 | | | | | | 2.7 | | 6.65 | | 6.15 | 5.135 |
| Dissolved Ag (ug/L) | | 0.002 | | | | | | 0.005 | | 0.002 | | 0.002 | 0.002 |
| Dissolved Zn (ug/L) | | 78.7 | | | | | | 51.9 | | 110 | | 83.5 | 81.10 |
| Dissolved Se (ug/L) | | 0.64 | | | | | | 0.164 | | 1.46 | | 0.686 | 0.663 |
| Dissolved Hg (ug/L) | | 0.00299 | | | | | | 0.00273 | | 0.003 | | 0.00453 | 0.002995 |

For individual sample/analyte qualifier descriptions see "Qualified Data by QA Reviewer" table.

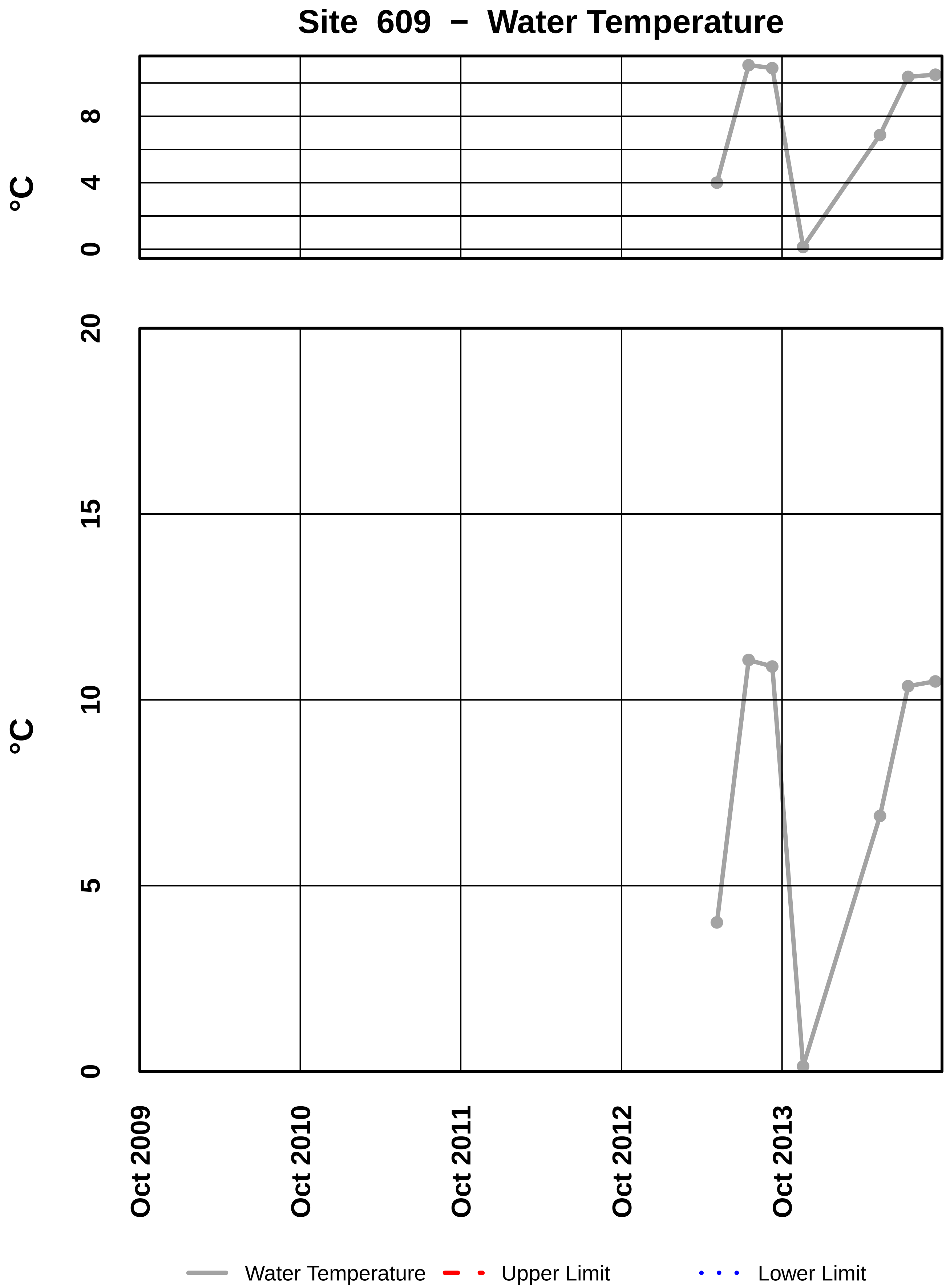
Values reported as less than MDL are replaced by 1/2 MDL for median calculation purposes.

Shaded data has been qualified as an outlier by HGCMC and removed from any further analysis and is not included into the calculation of the median

# Qualified Data by QA Reviewer

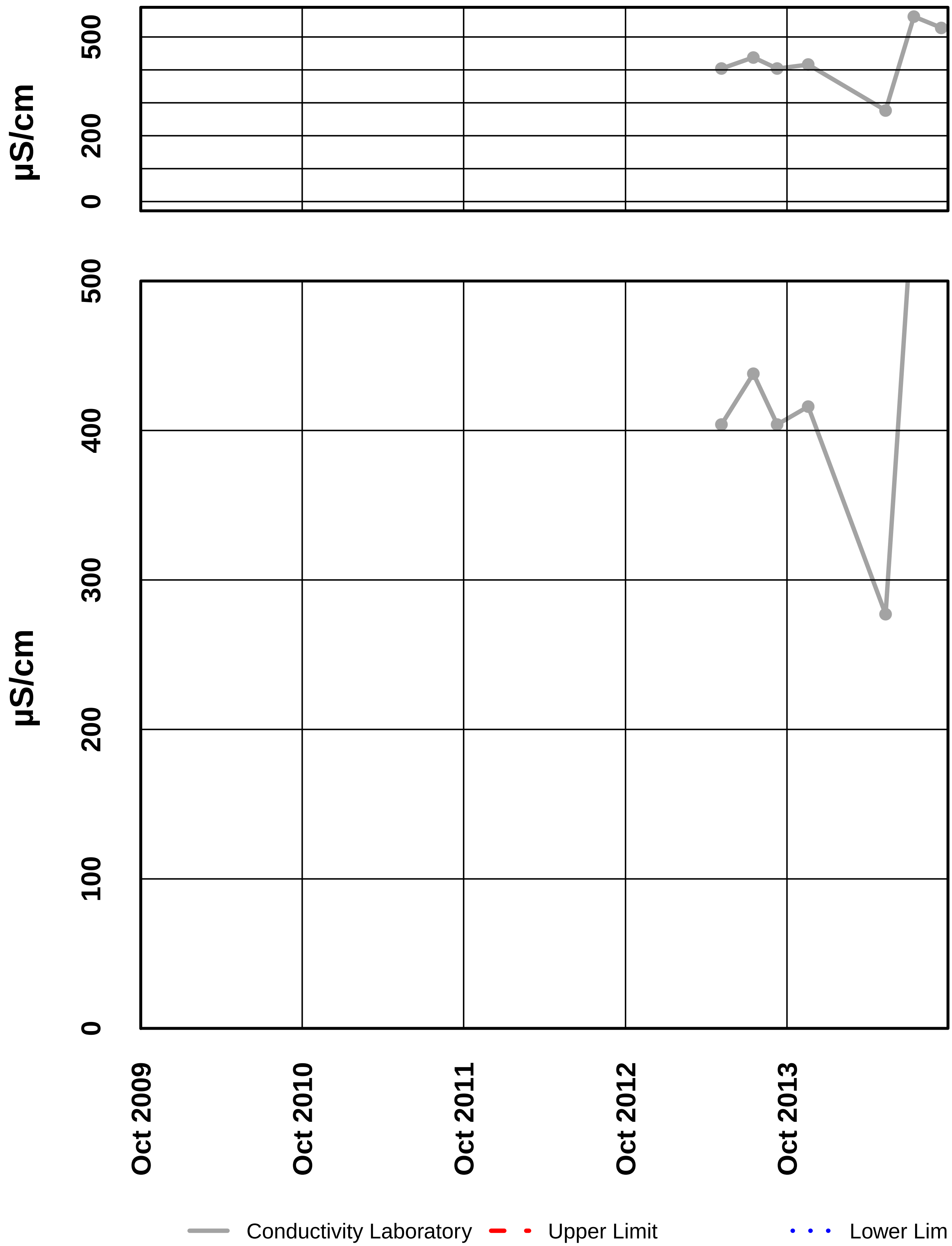
**Date Range: 10/01/2013 to 09/30/2014**

| Site No. | Sample Date | Sample Time | Parameter | Value | Qualifier | Reason for Qualifier |
|---|---|---|---|---|---|---|
| 609FMS | 5/12/2014 | 12:00 PM | Alkalinity | 16 | U | Trip Blank Contamination |
| | | | Diss. Ag-ICP/MS | 0.0045 | J | Below Quantitative Range |
| | | | Diss. Se-ICP/MS | 0.16 | J | Below Quantitative Range |
| | | | Sulfate | 103 | J | Sample Receipt Temperature |



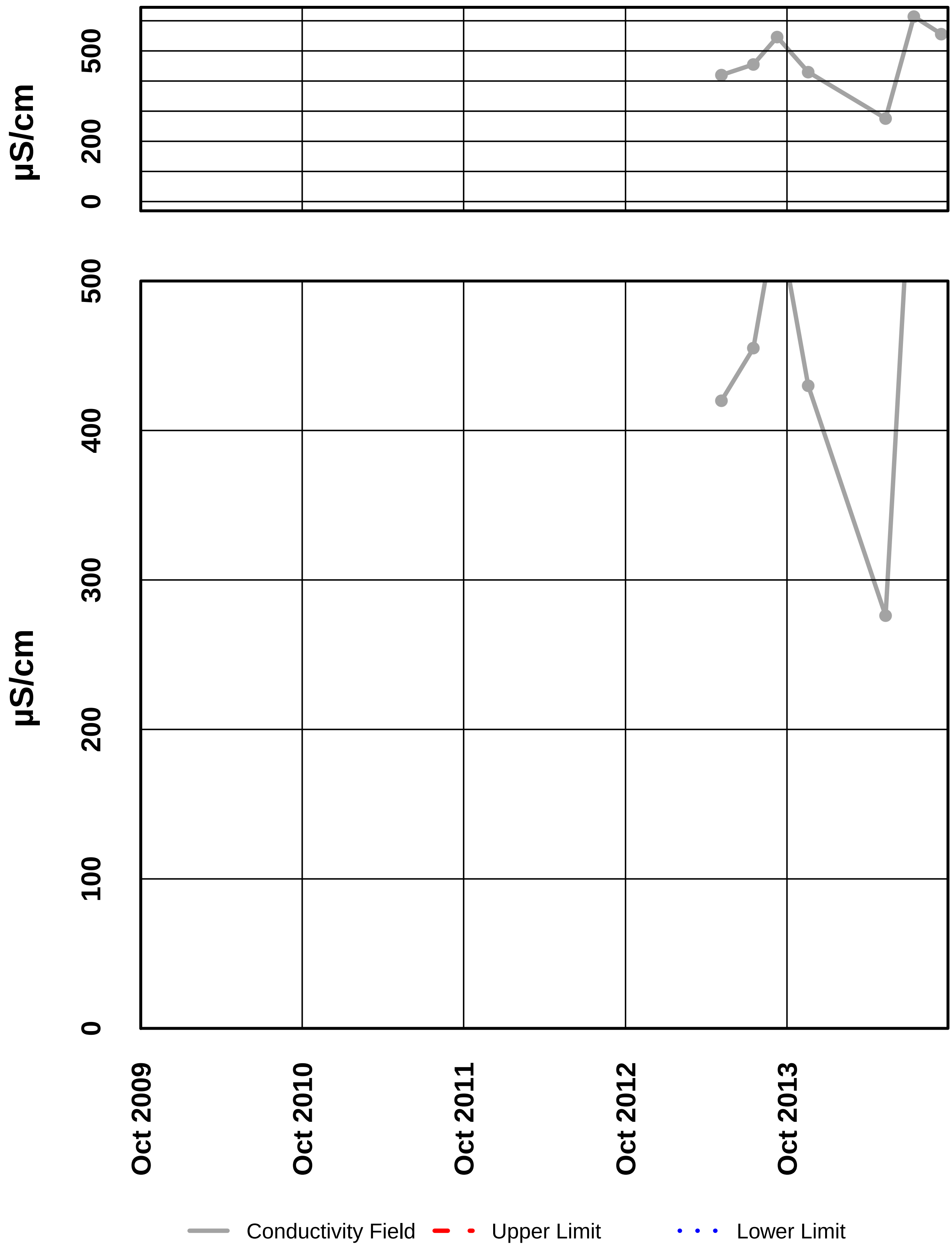

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

## Site 609 – Conductivity Laboratory



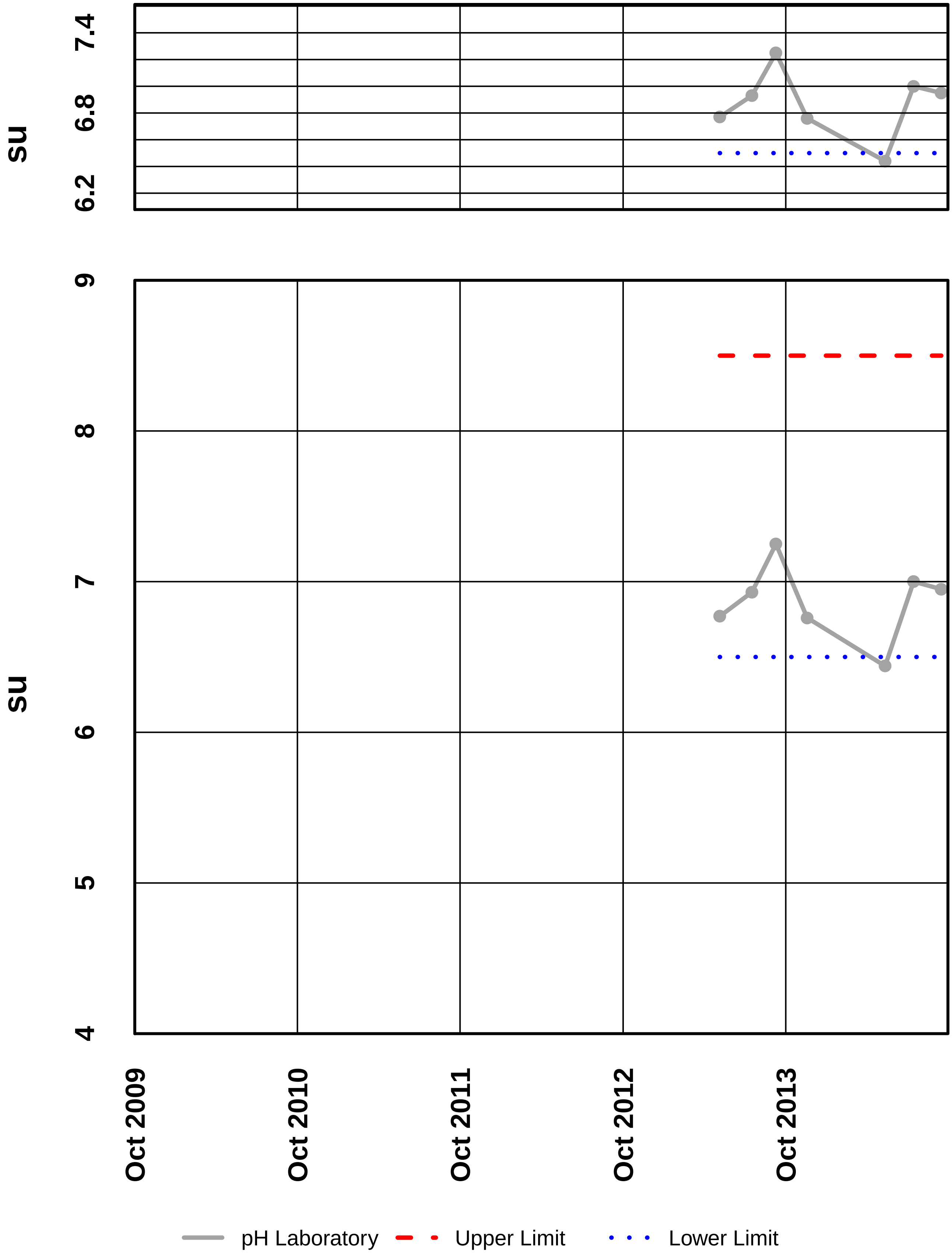

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# Site 609 − Conductivity Field

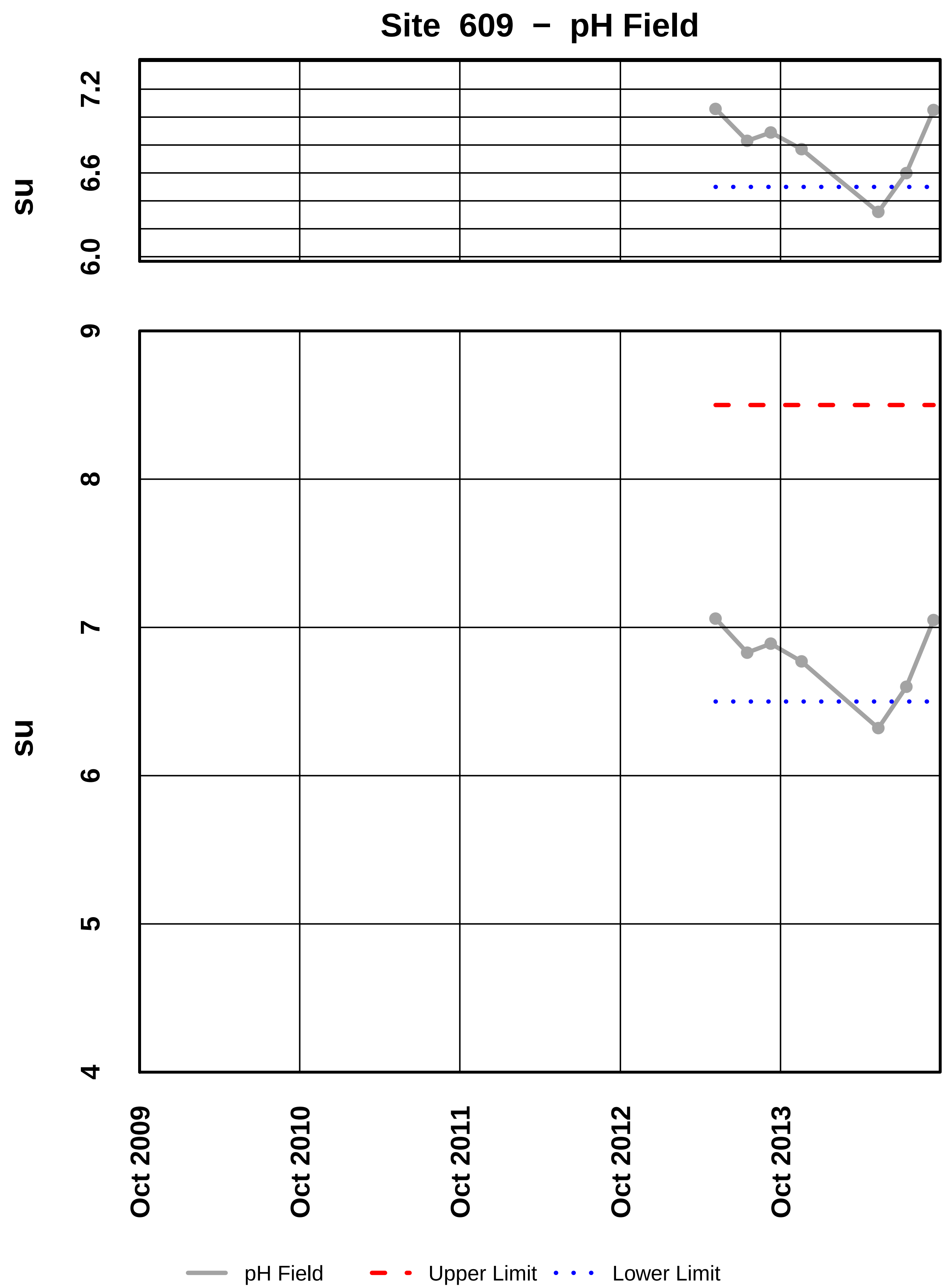



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

## Site 609 – pH Laboratory

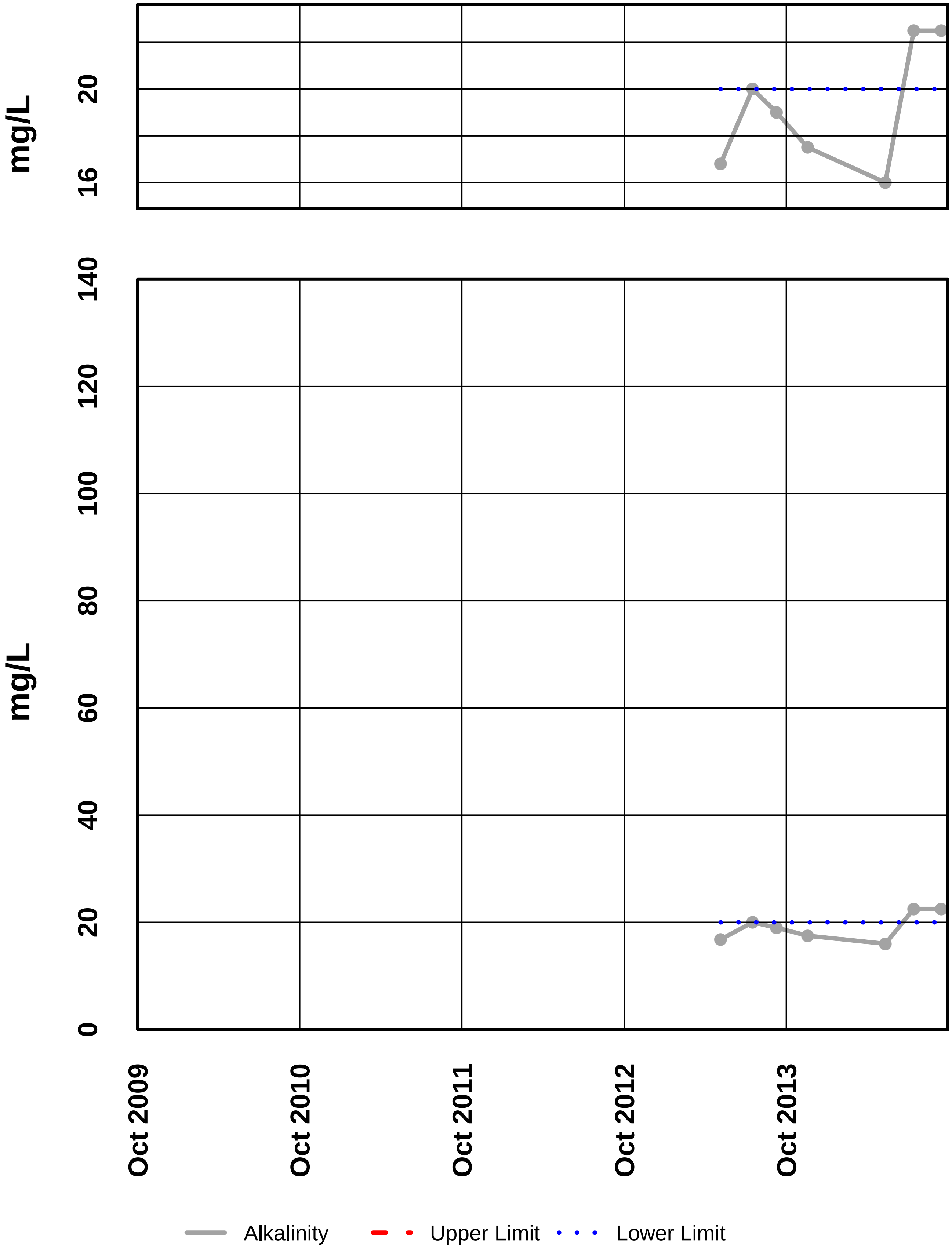



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



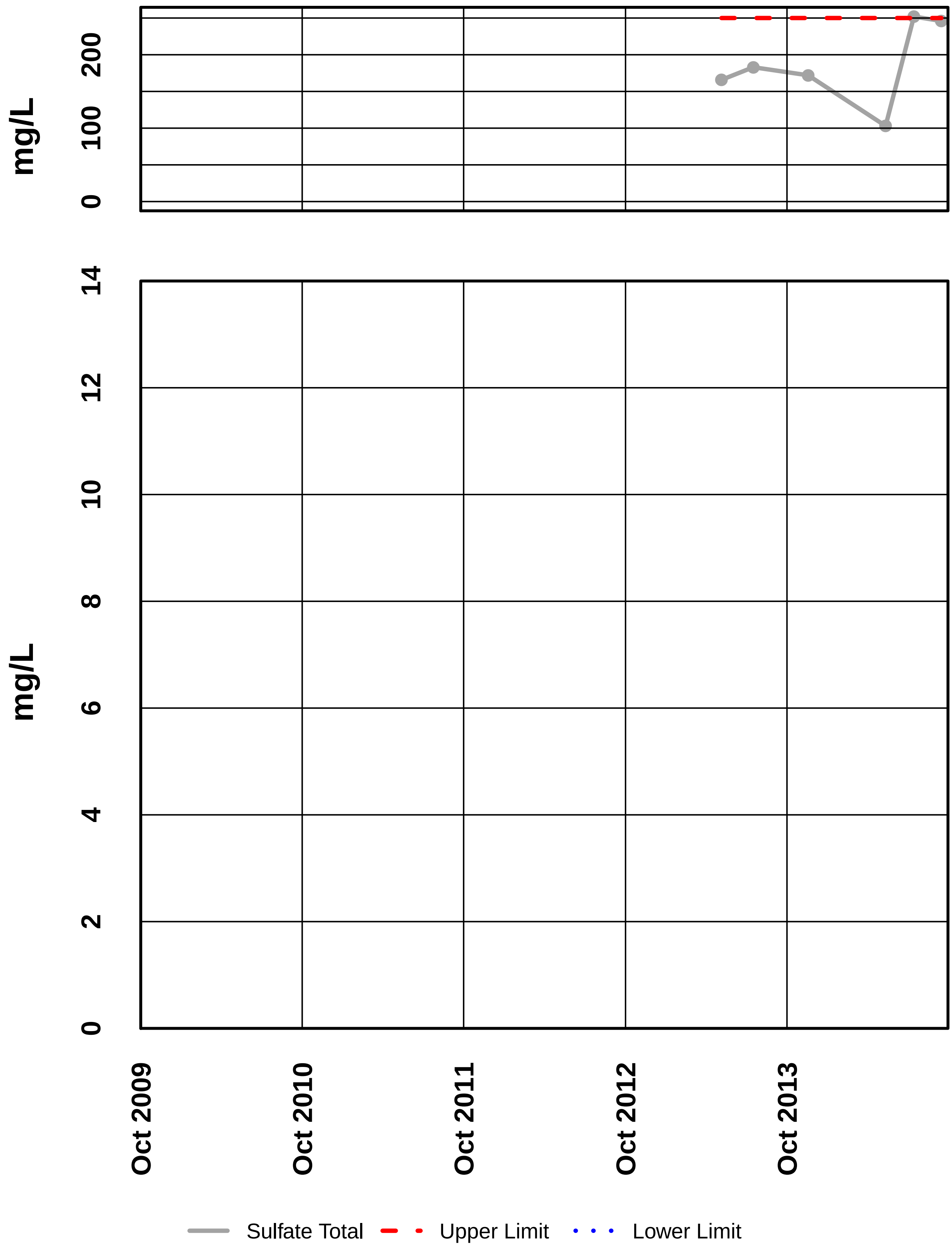

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

## Site 609 – Alkalinity



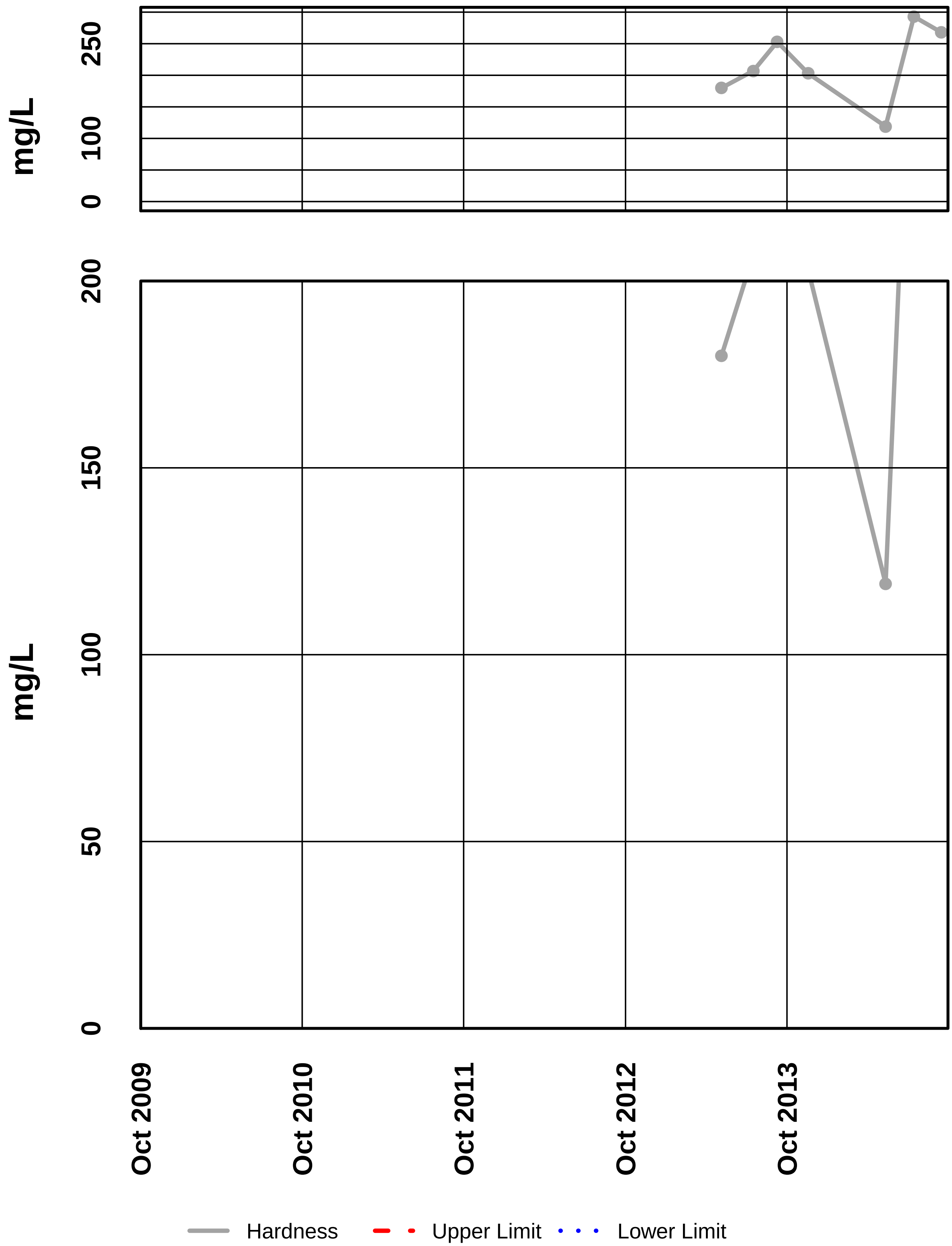

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# Site 609 – Sulfate Total

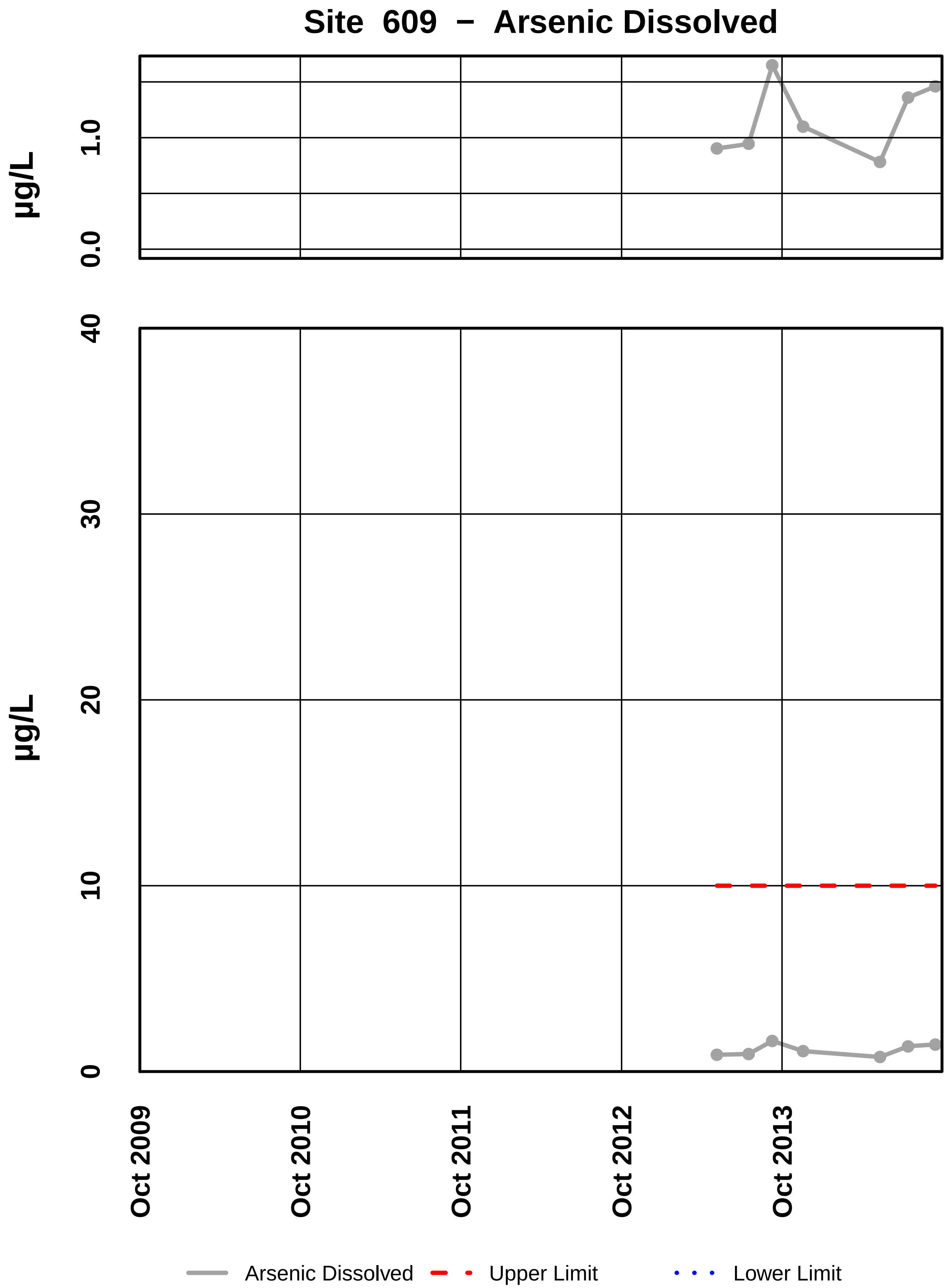



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

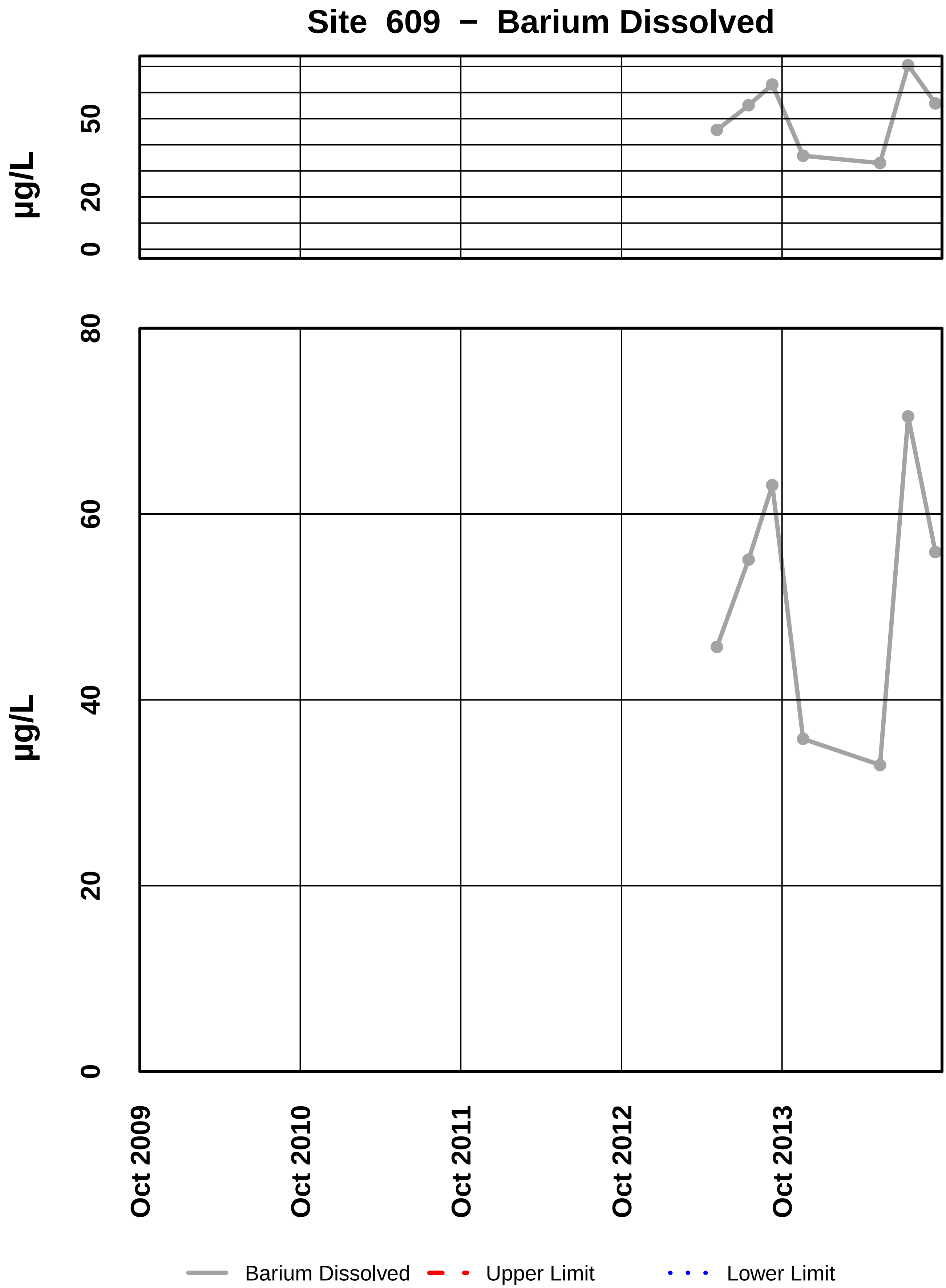
## Site 609 – Hardness




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

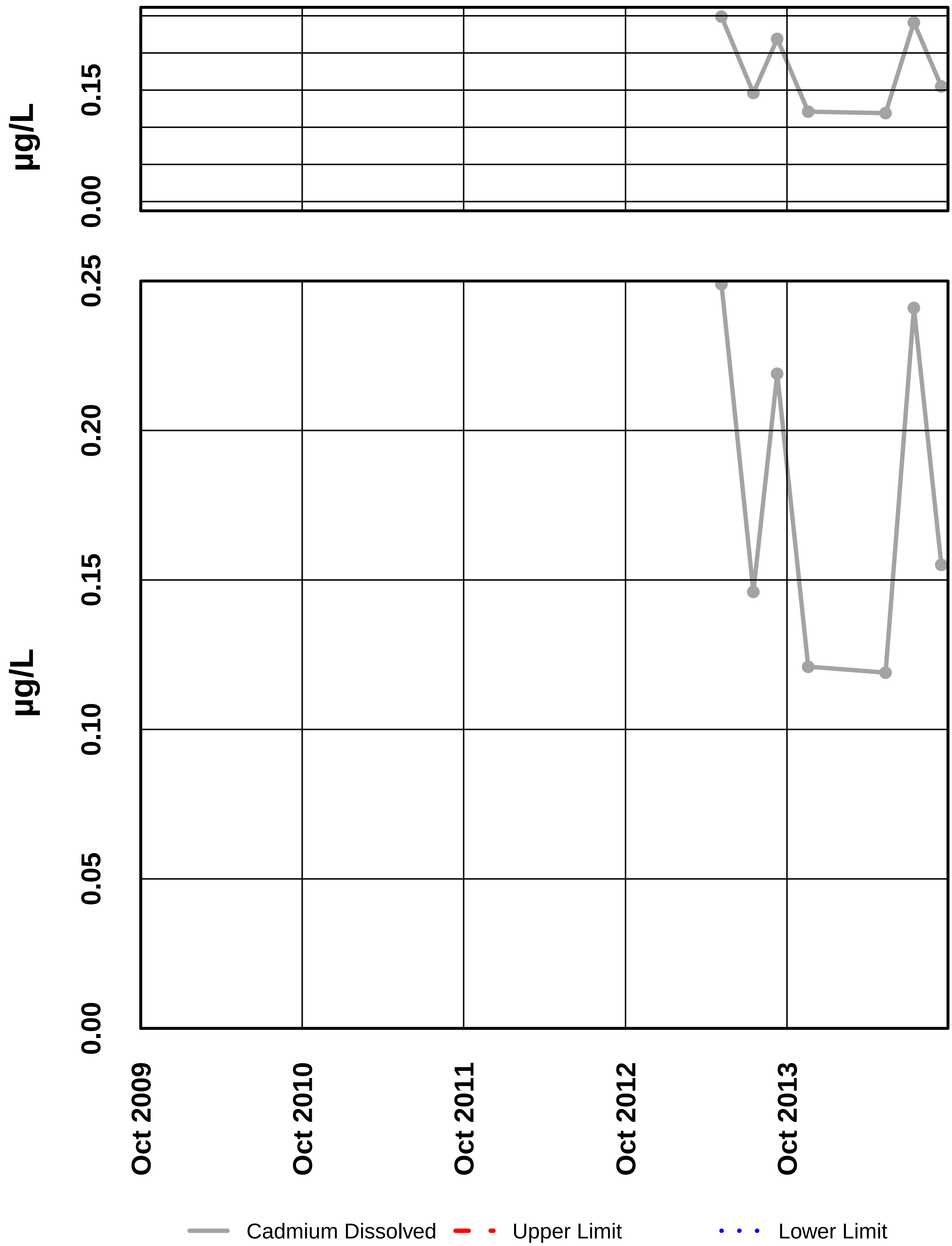



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

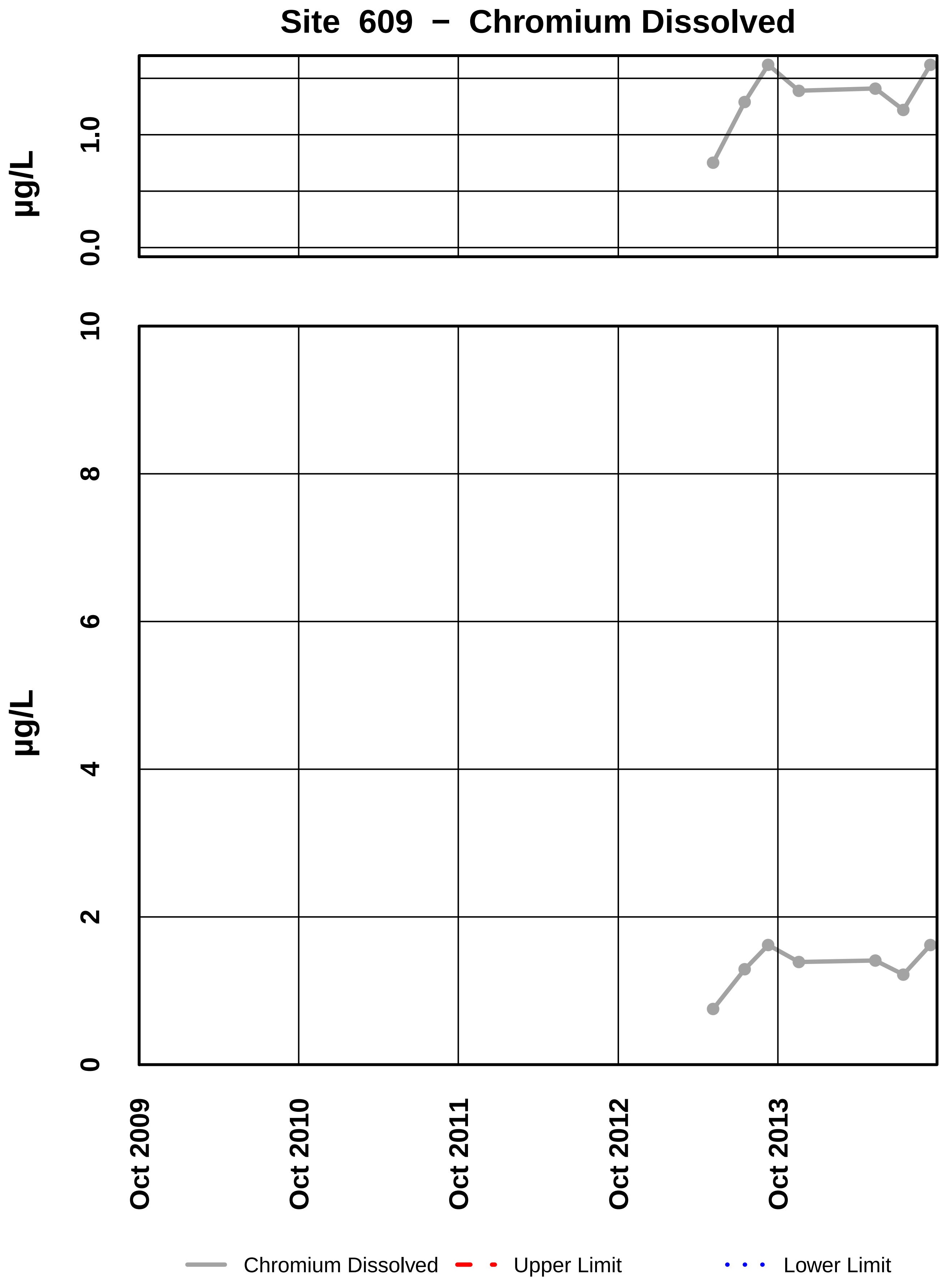



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# Site 609 − Cadmium Dissolved

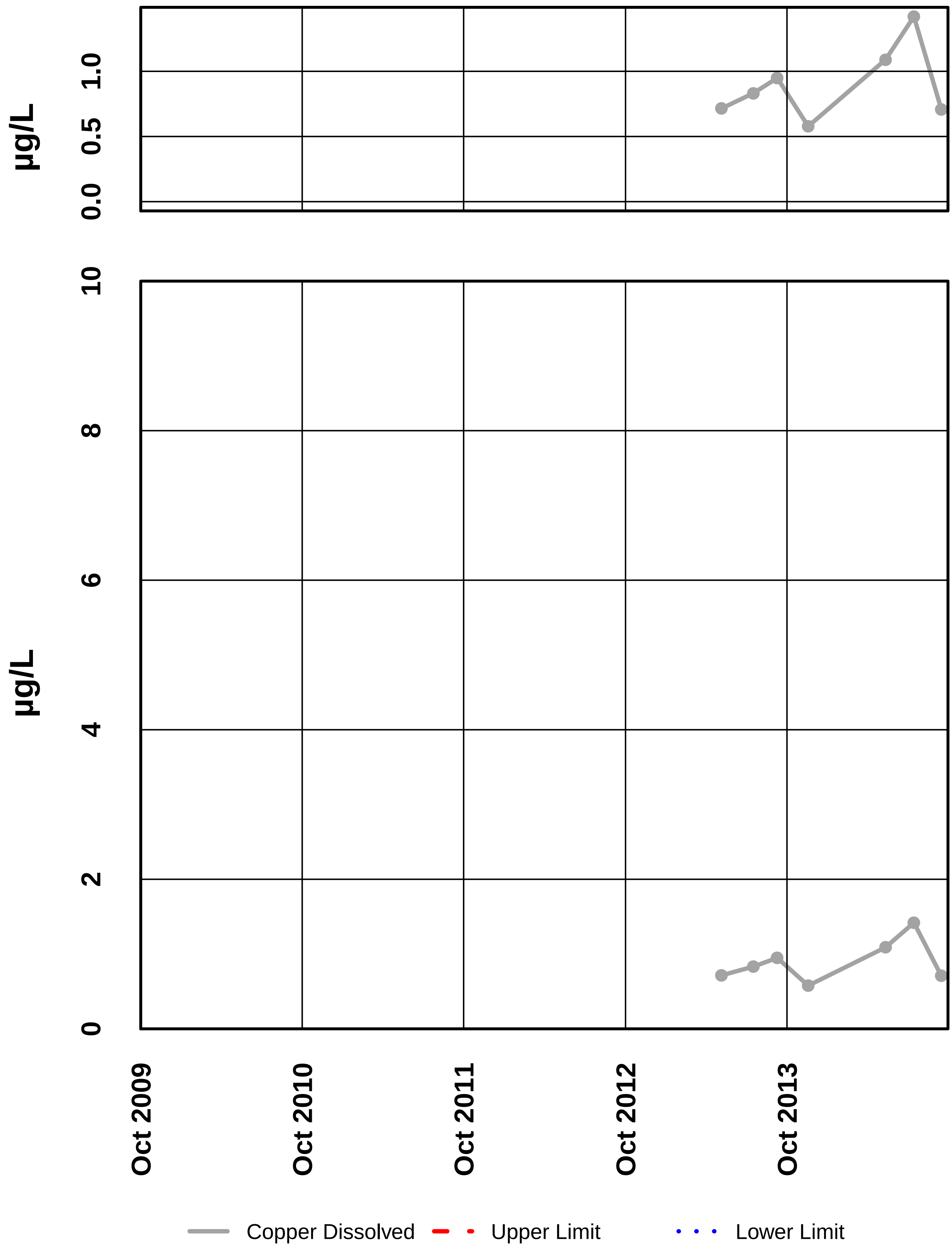



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

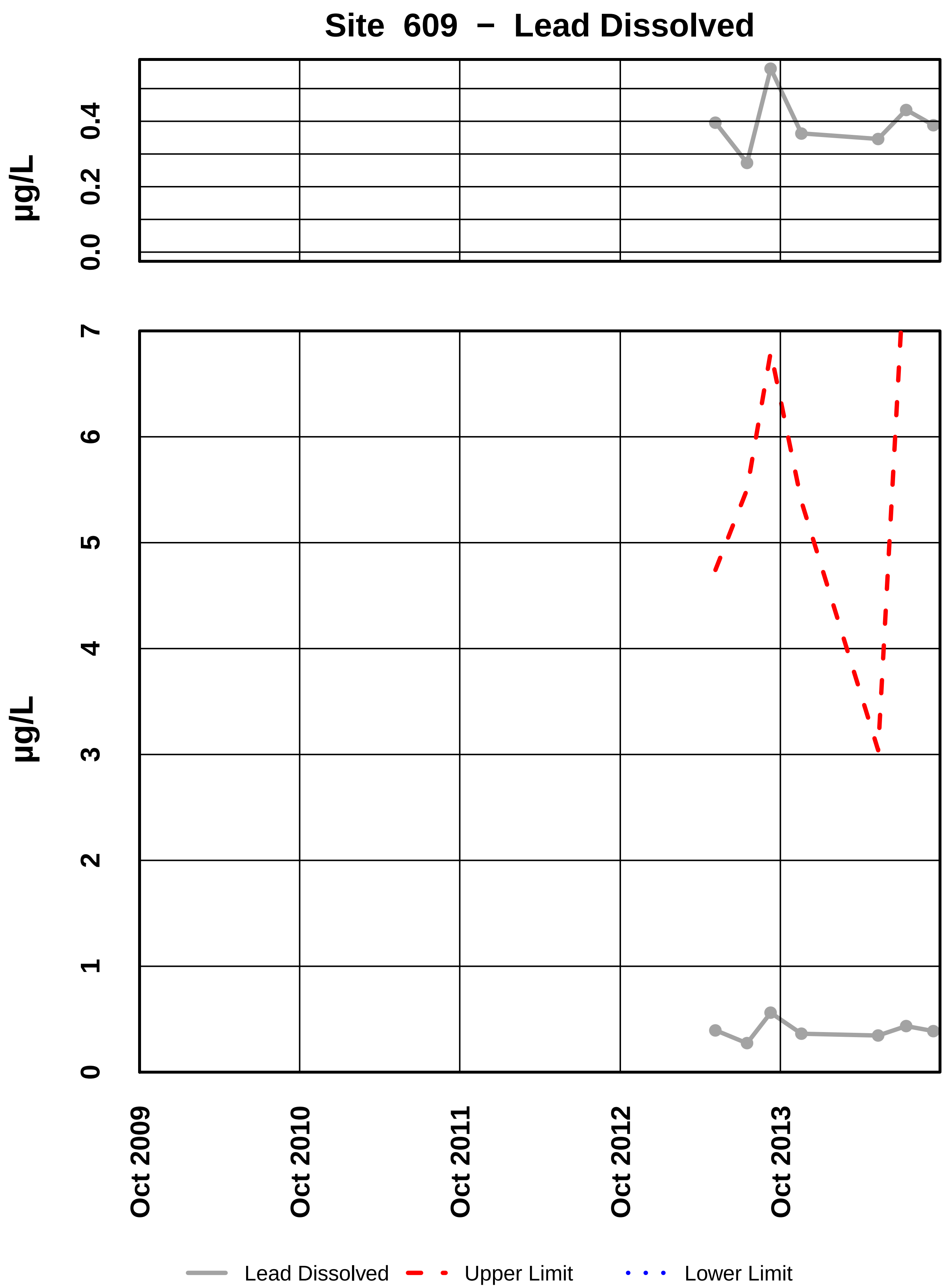



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

## Site 609 – Copper Dissolved

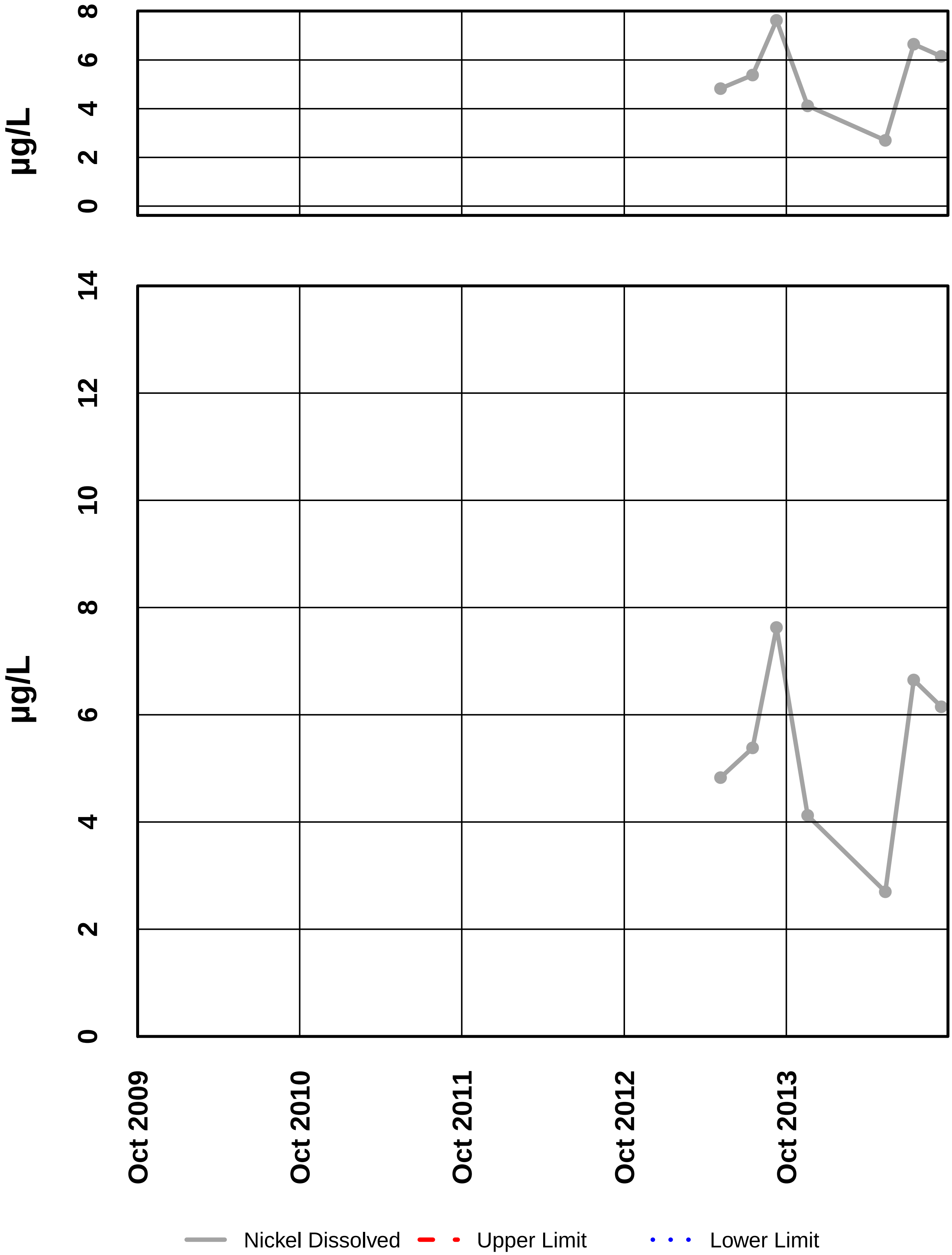



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



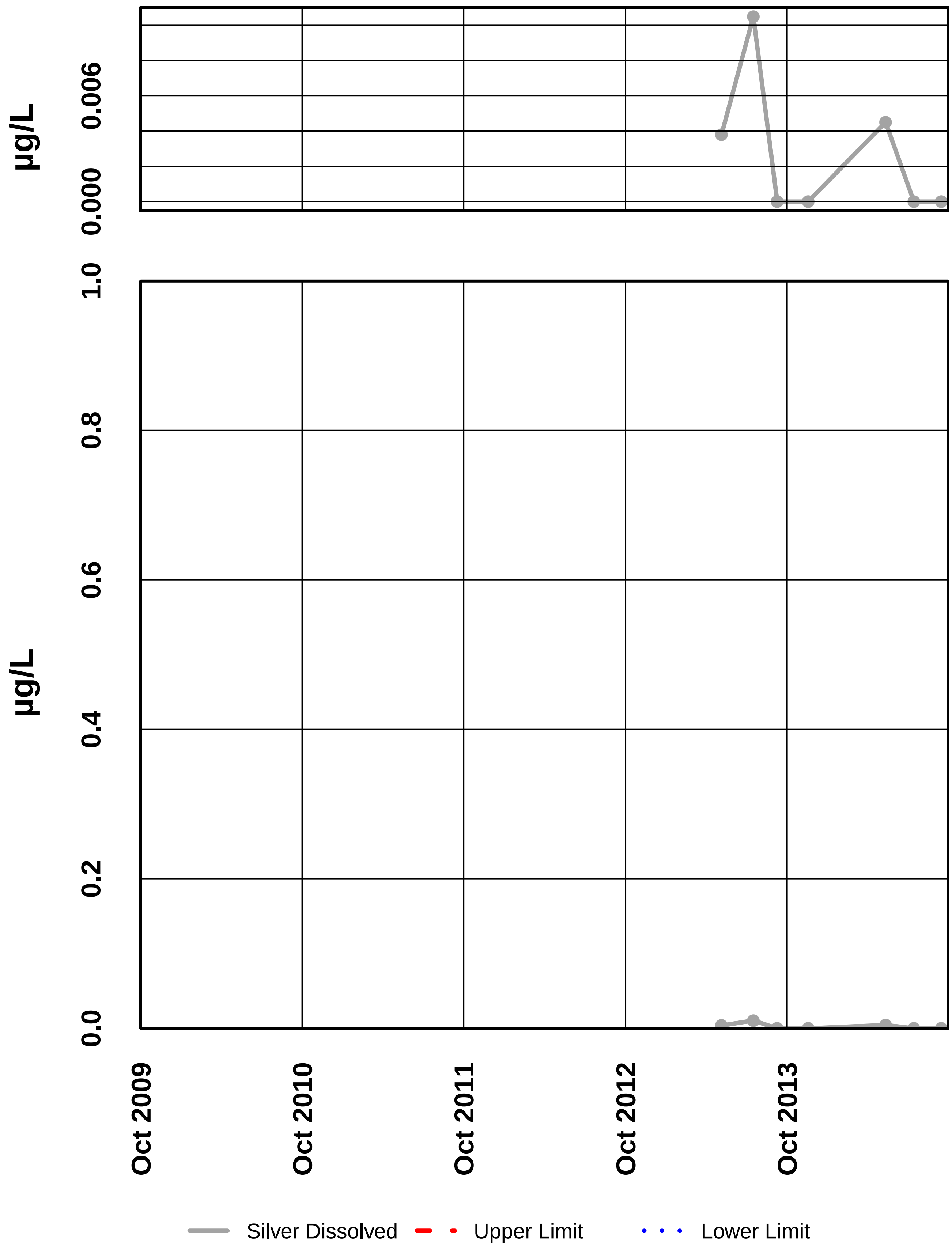

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

## Site 609 − Nickel Dissolved

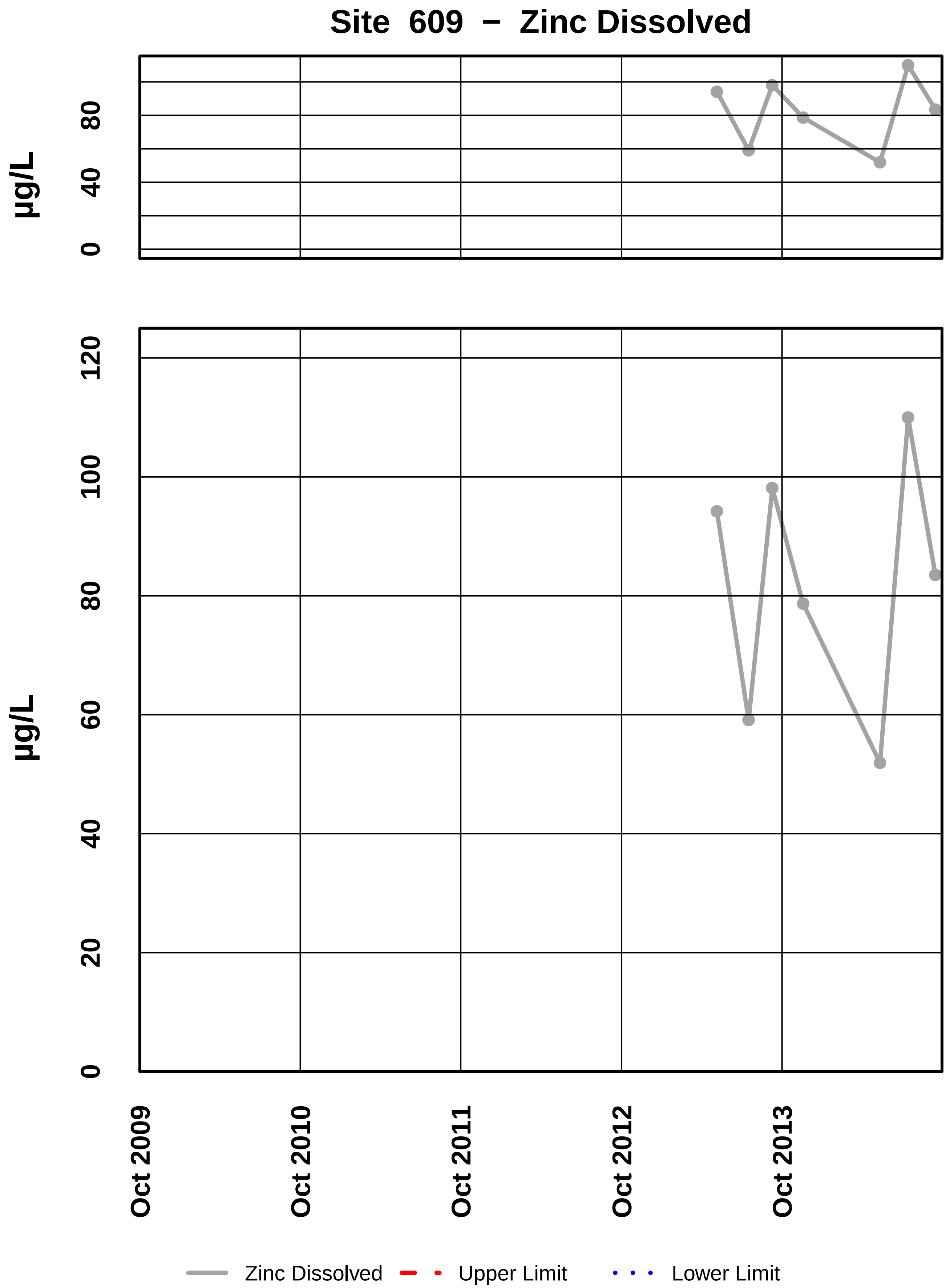



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

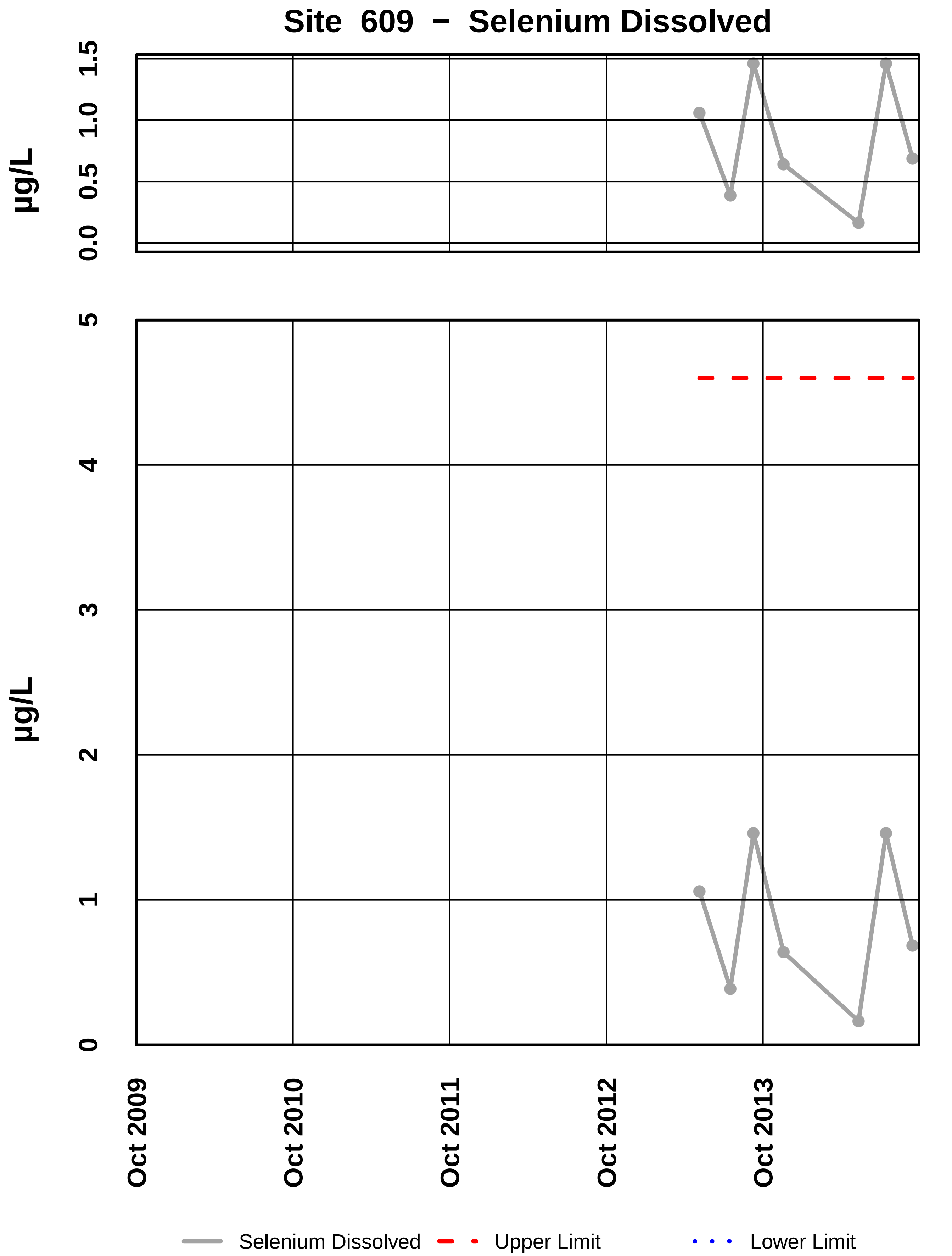
# Site 609 − Silver Dissolved




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

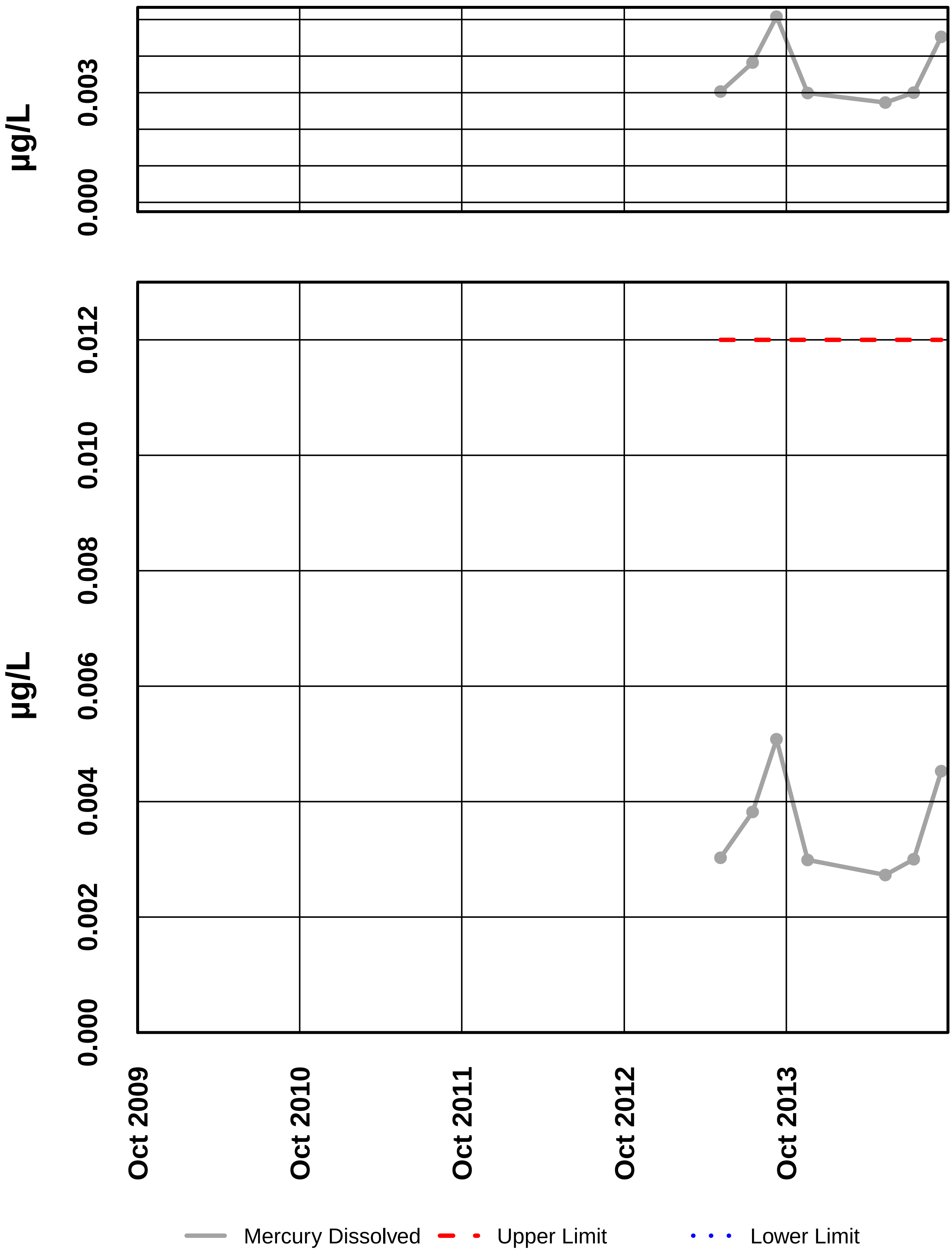



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# Site 609 – Mercury Dissolved




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# INTERPRETIVE REPORT
# SITE 711

Sampling at this site was initiated during the spring of Water Year 2014. This site was added to the FWMP at the request of the Forest Service. Site 711is located on Greens Creek upgradient to any drainage from Site E, a waste rock disposal area.

The data collected during the current water year are listed in the following "Table of Results for Water Year 2014" report. The table includes all the required FWMP analyte data (field and laboratory) collected for the current water year and a series of flags keyed to the summary report "Qualified Data by QA Reviewer". The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of ½ MDL for the purpose of median calculation.

All data collected at this site for the past year is included in the data analyses. As shown in the table below, there were no data outliers.

| Sample Date | Parameter | Value | Qualifier | Notes |
|---|---|---|---|---|
| No outliers have been identified by HGCMC for the period of October 2013 through September 2014. | | | | |

The data for Water Year 2014 have been compared to the strictest fresh water quality criterion for each applicable analyte. No results exceeding these criteria were identified as listed in the table below.

**Table of Exceedance for Water Year 2014**

| | | | Limits | | |
|---|---|---|---|---|---|
| Sample Date | Parameter | Value | Lower | Upper | Hardness |
| No exceedances have been identified by HGCMC for the period of October 2013 through September 2014. | | | | | |

X-Y plots have been generated to graphically present the data for each of the analytes requested in the Statistical Information Goals for this site. Because of the limited amount of data, visual trend analysis and statistical analysis of the data was not performed

## Table of Results for Water Year 2014

### Site 711FMS - 'Greens Creek Above Site E'

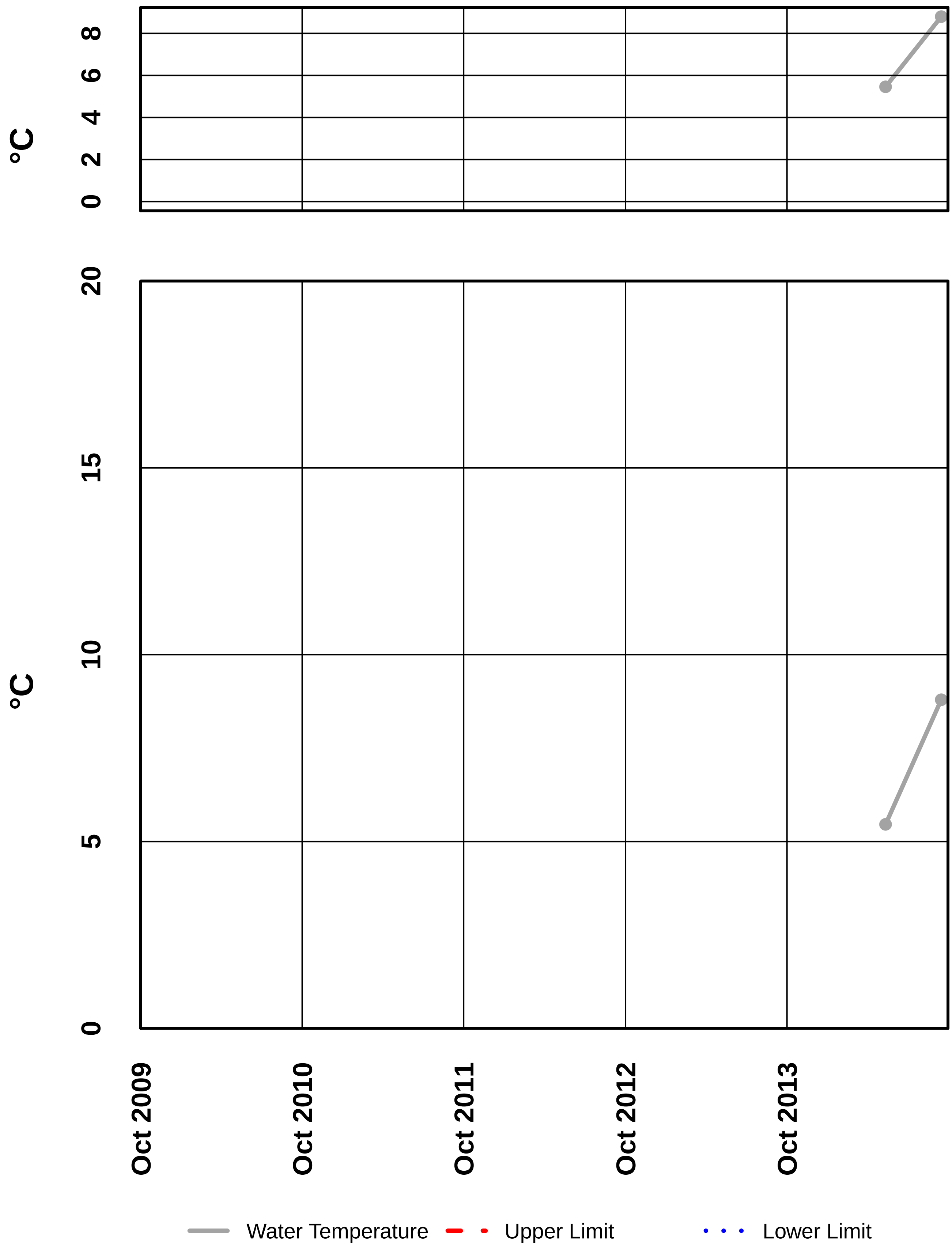
| Sample Date/Parameter | Oct 2013 | Nov 2013 | Dec 2013 | Jan 2014 | Feb 2014 | Mar 2014 | Apr 2014 | May 2014 | Jun 2014 | Jul 2014 | Aug 2014 | Sep 2014 | **Median** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Water Temp (°C) | | | | | | | | 5.5 | | | | 8.8 | 7.2 |
| Conductivity-Field(µmho) | | | | | | | | 98 | | | | 157.6 | 127.8 |
| Conductivity-Lab (µmho) | | | | | | | | 97 | | | | 153 | 125 |
| pH Lab (standard units) | | | | | | | | 7.63 | | | | 7.72 | 7.68 |
| pH Field (standard units) | | | | | | | | 7.83 | | | | 8.28 | 8.06 |
| Total Alkalinity (mg/L) | | | | | | | | 36.3 | | | | 58.9 | 47.6 |
| Total Sulfate (mg/L) | | | | | | | | 8.3 | | | | 15.7 | 12.0 |
| Hardness (mg/L) | | | | | | | | 44.9 | | | | 74.9 | 59.9 |
| Dissolved As (ug/L) | | | | | | | | 0.186 | | | | 0.284 | 0.235 |
| Dissolved Ba (ug/L) | | | | | | | | 23.6 | | | | | 23.6 |
| Dissolved Cd (ug/L) | | | | | | | | 0.0232 | | | | 0.0341 | 0.0287 |
| Dissolved Cr (ug/L) | | | | | | | | 0.466 | | | | | 0.466 |
| Dissolved Cu (ug/L) | | | | | | | | 0.466 | | | | 0.525 | 0.496 |
| Dissolved Pb (ug/L) | | | | | | | | 0.0093 | | | | 0.0143 | 0.0118 |
| Dissolved Ni (ug/L) | | | | | | | | 0.479 | | | | | 0.479 |
| Dissolved Ag (ug/L) | | | | | | | | 0.002 | | | | | 0.002 |
| Dissolved Zn (ug/L) | | | | | | | | 1.88 | | | | 2.94 | 2.41 |
| Dissolved Se (ug/L) | | | | | | | | 0.688 | | | | | 0.688 |
| Dissolved Hg (ug/L) | | | | | | | | 0.000843 | | | | 0.000737 | 0.000790 |

For individual sample/analyte qualifier descriptions see "Qualified Data by QA Reviewer" table.

Values reported as less than MDL are replaced by 1/2 MDL for median calculation purposes.

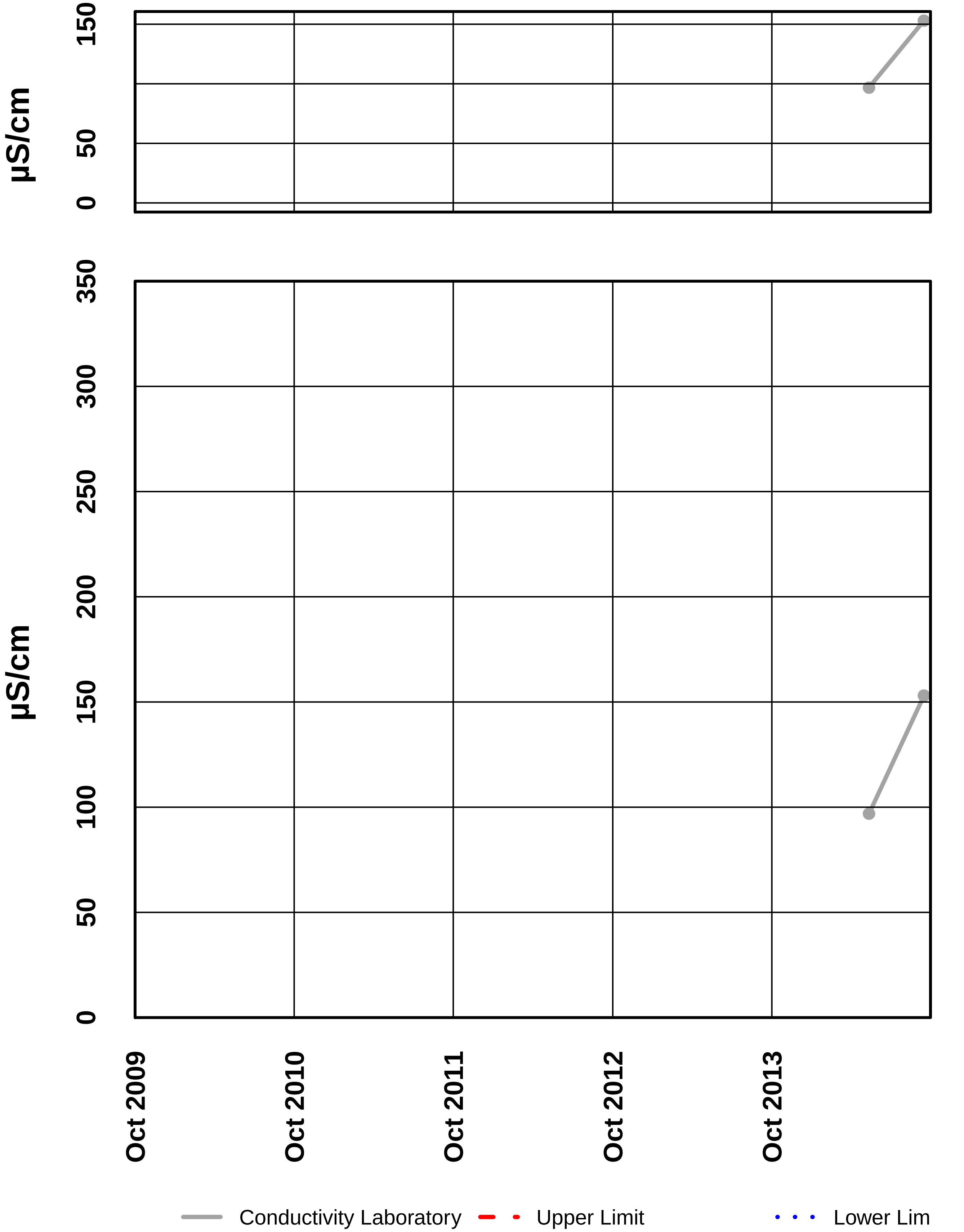
Shaded data has been qualified as an outlier by HGCMC and removed from any further analysis and is not included into the calculation of the median

# Site 711 – Water Temperature



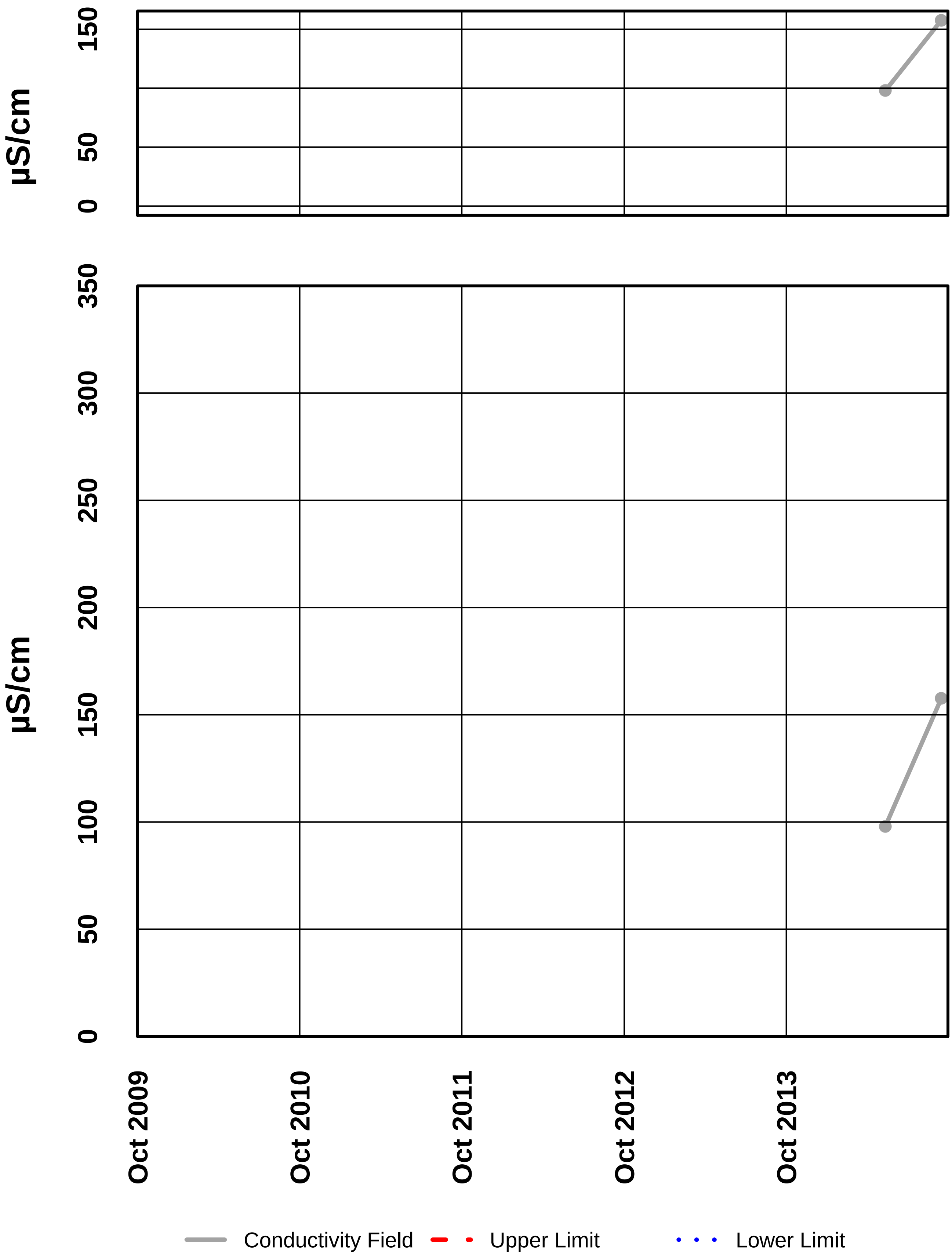

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# Site 711 – Conductivity Laboratory



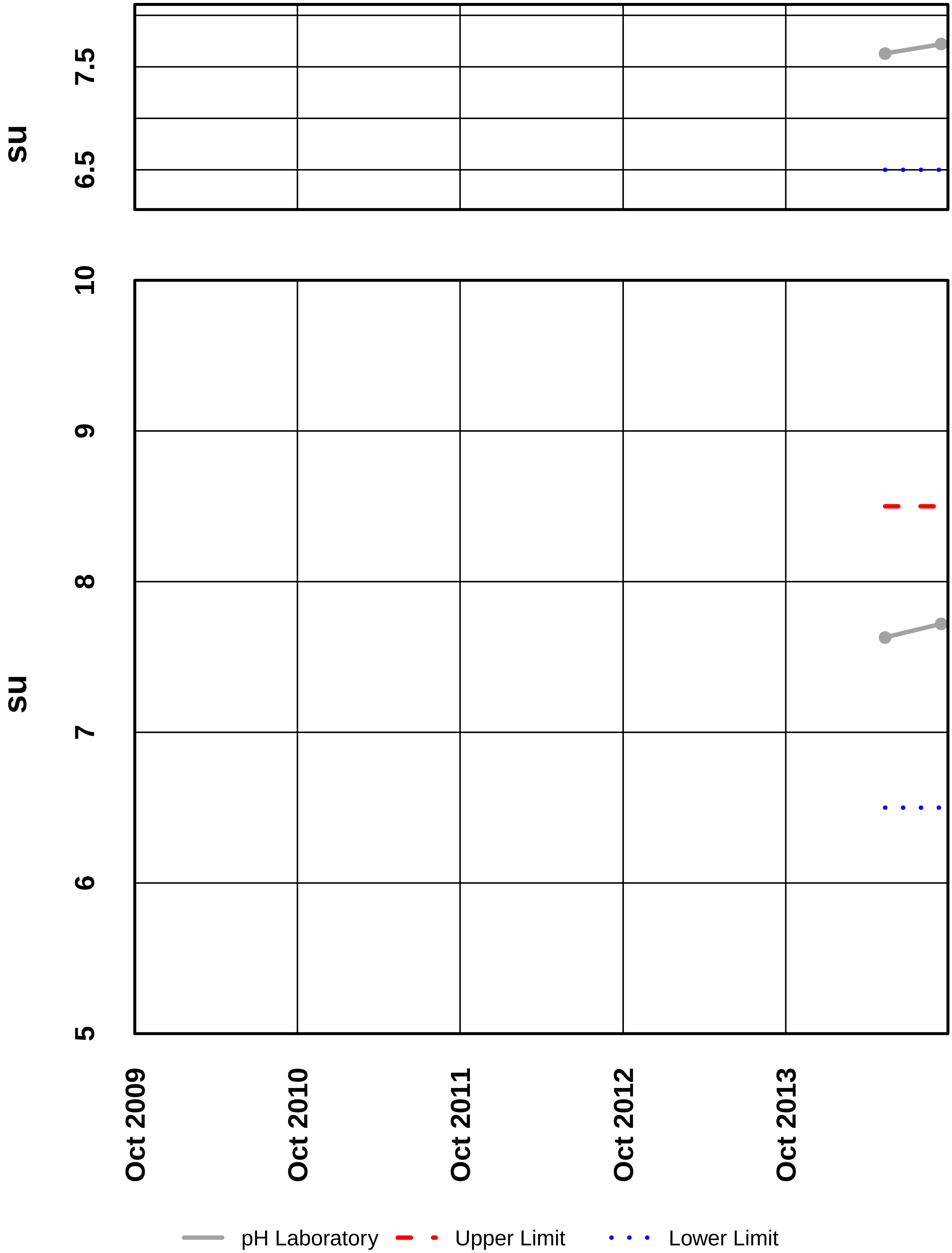

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# Site 711 – Conductivity Field



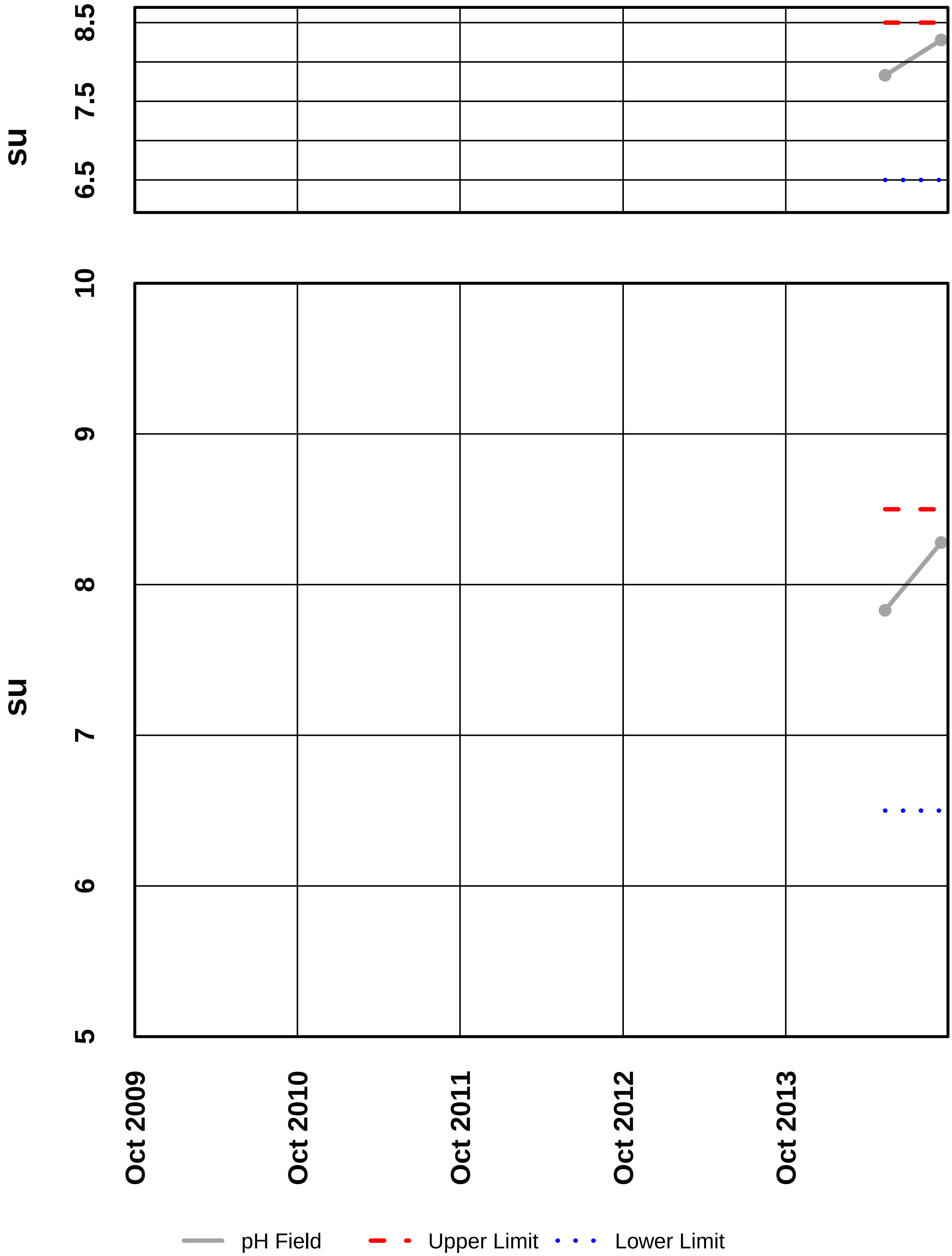

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

## Site 711 − pH Laboratory



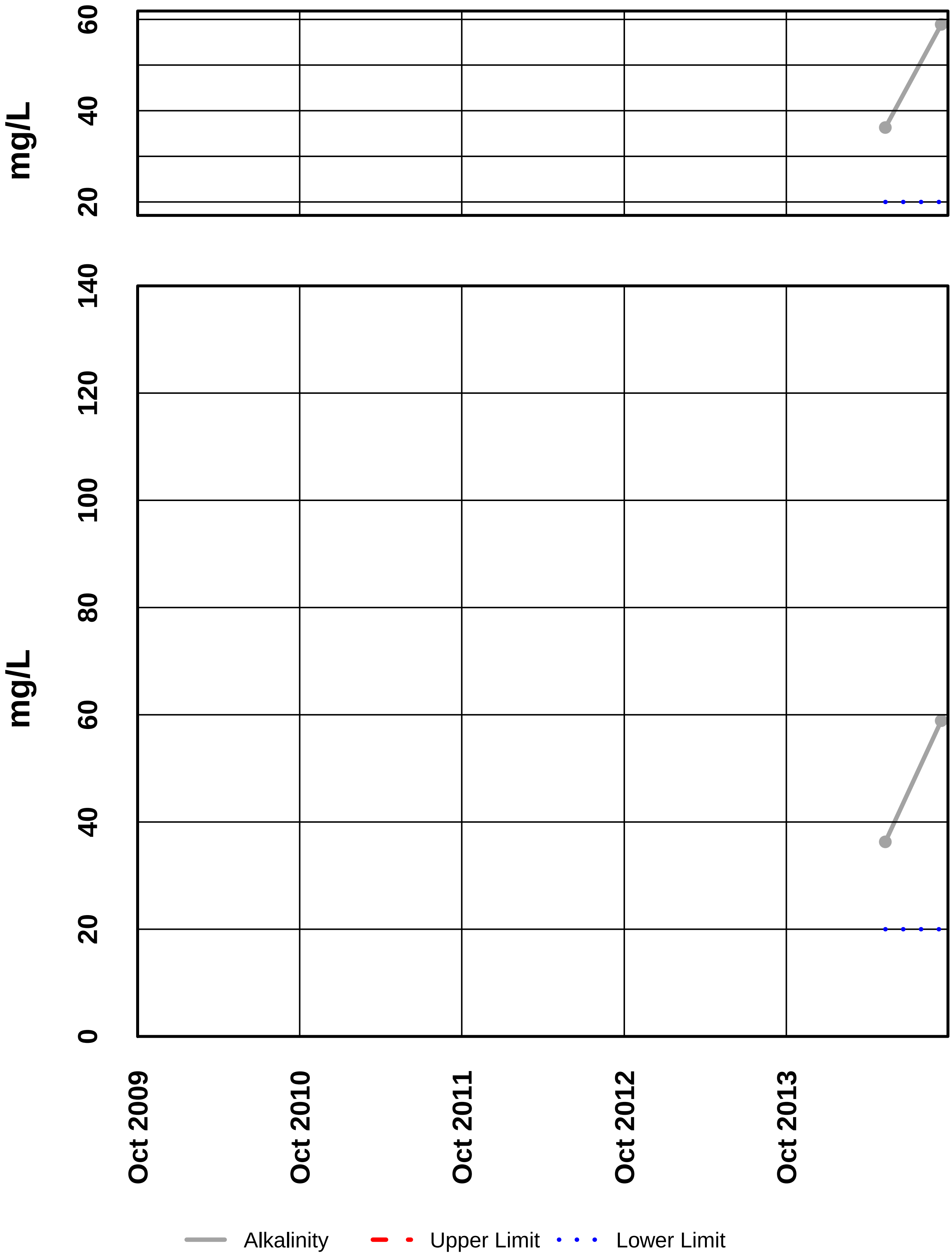

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

## Site 711 – pH Field



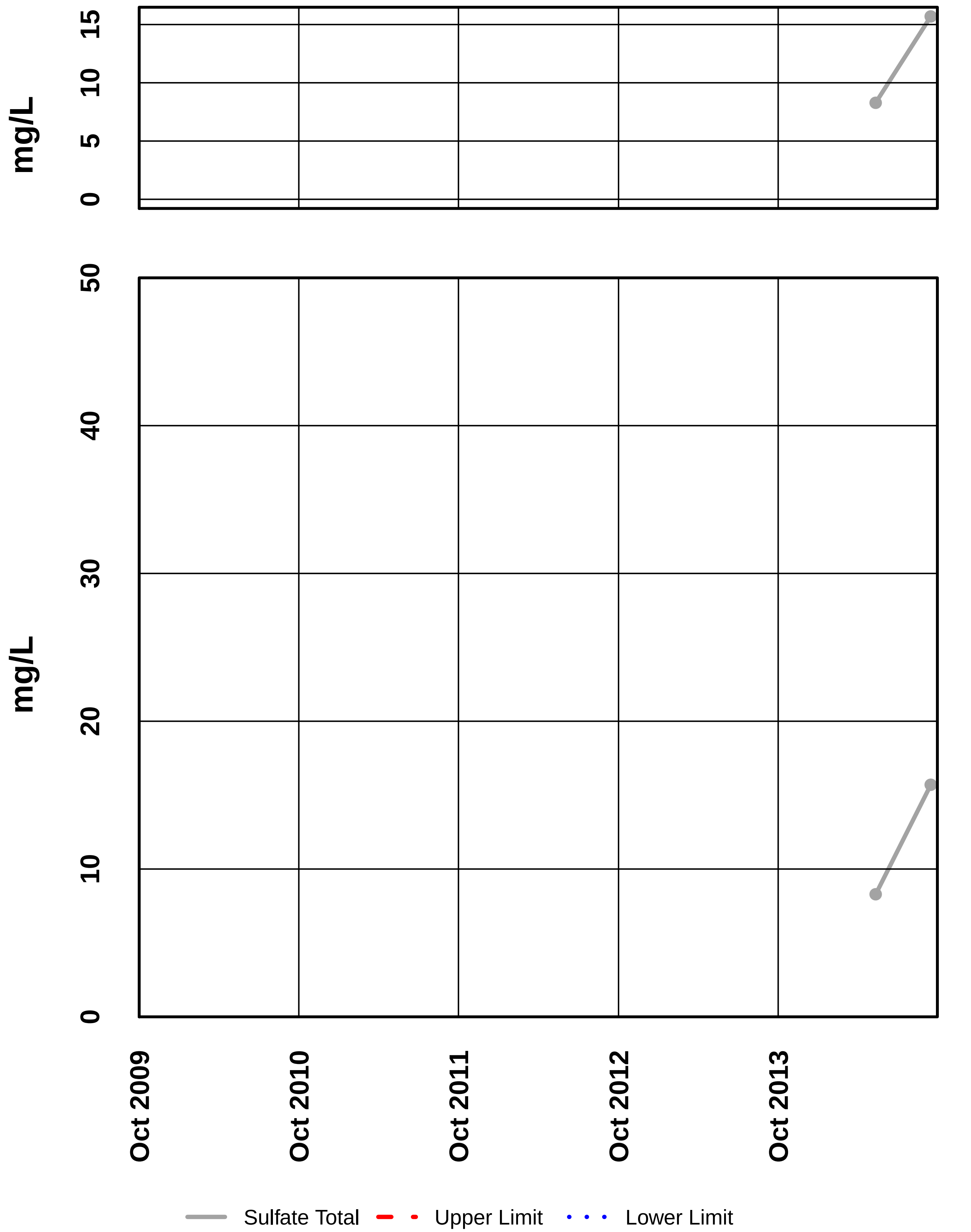

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# Site 711 − Alkalinity

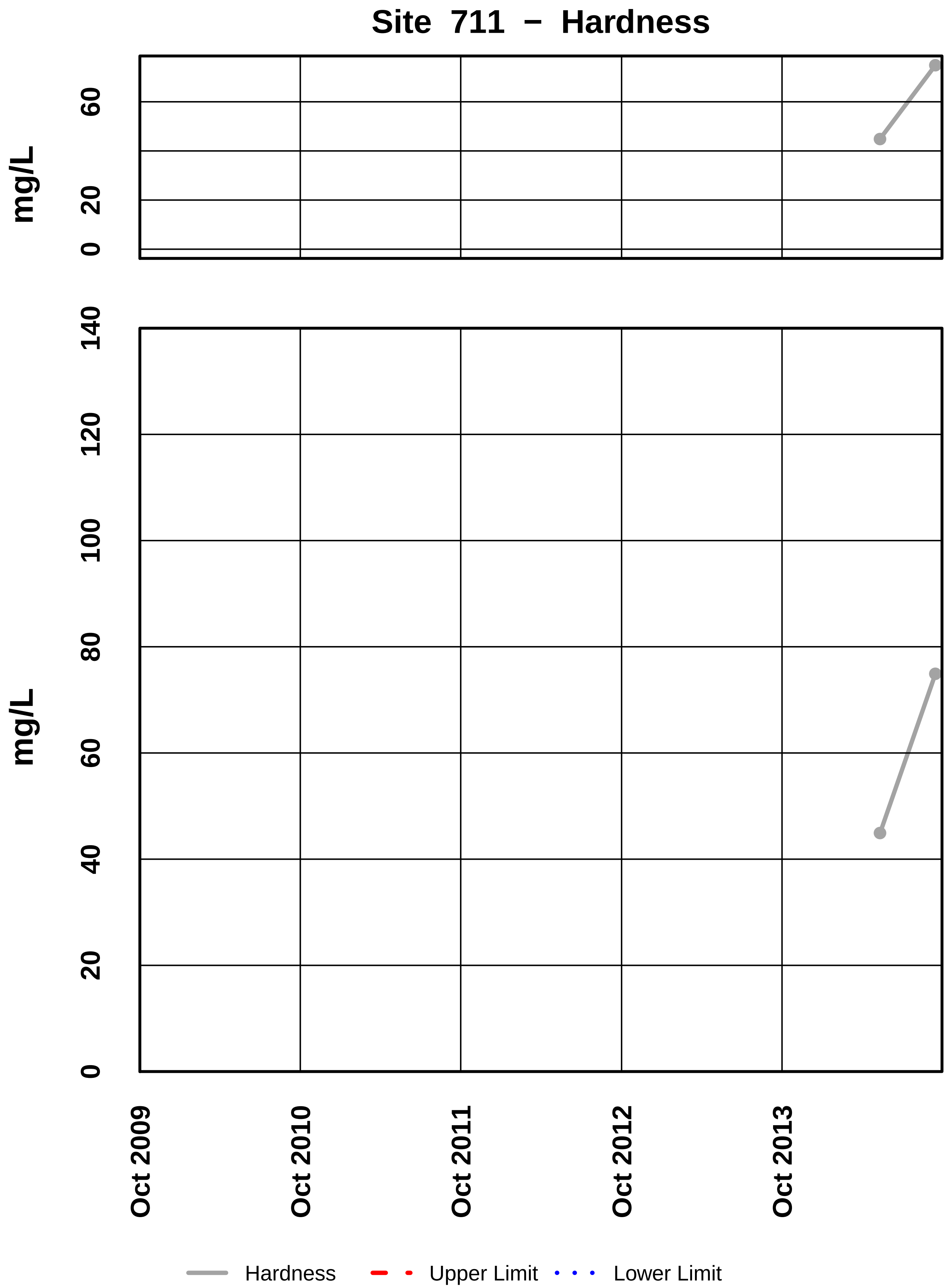



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

## Site 711 – Sulfate Total

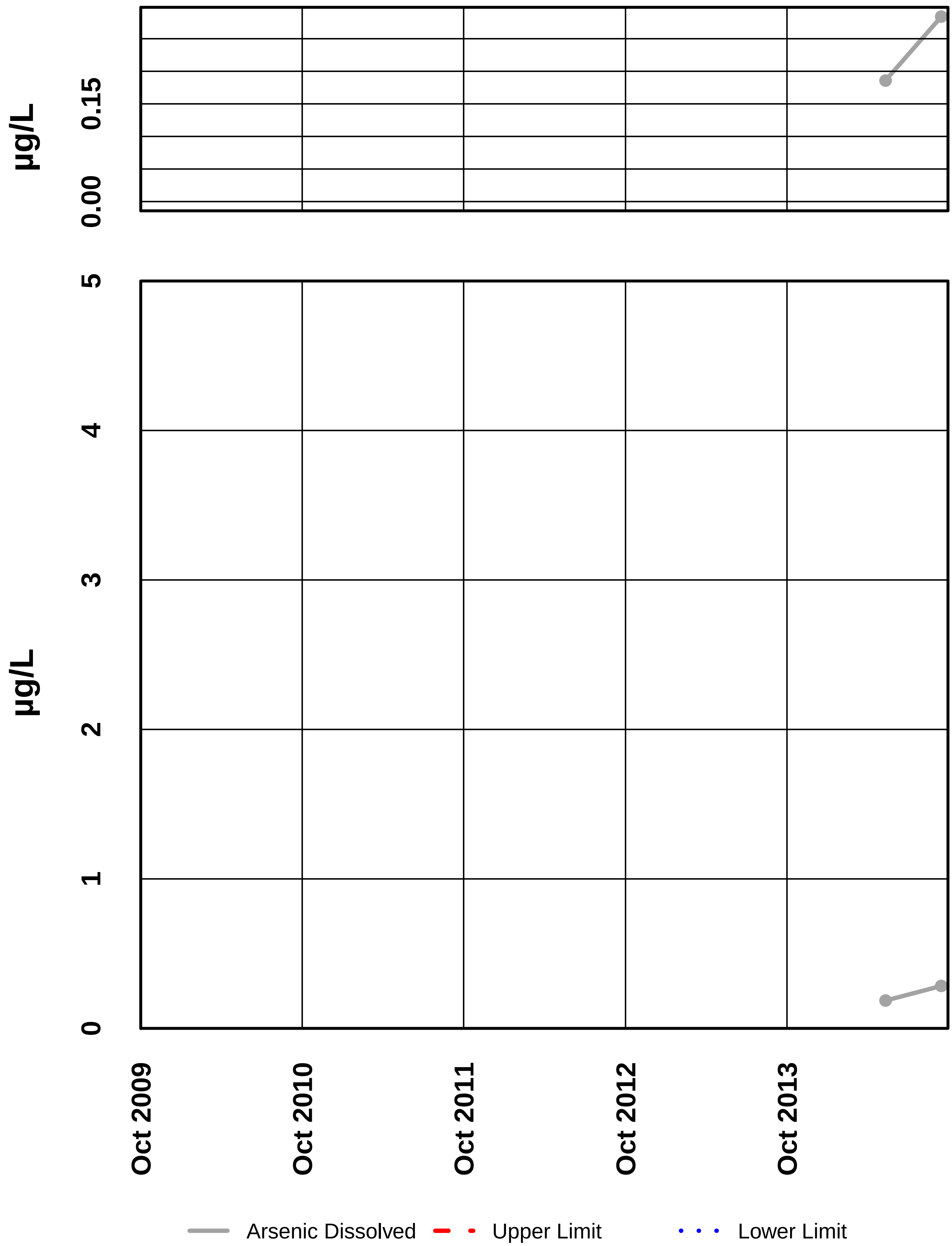



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

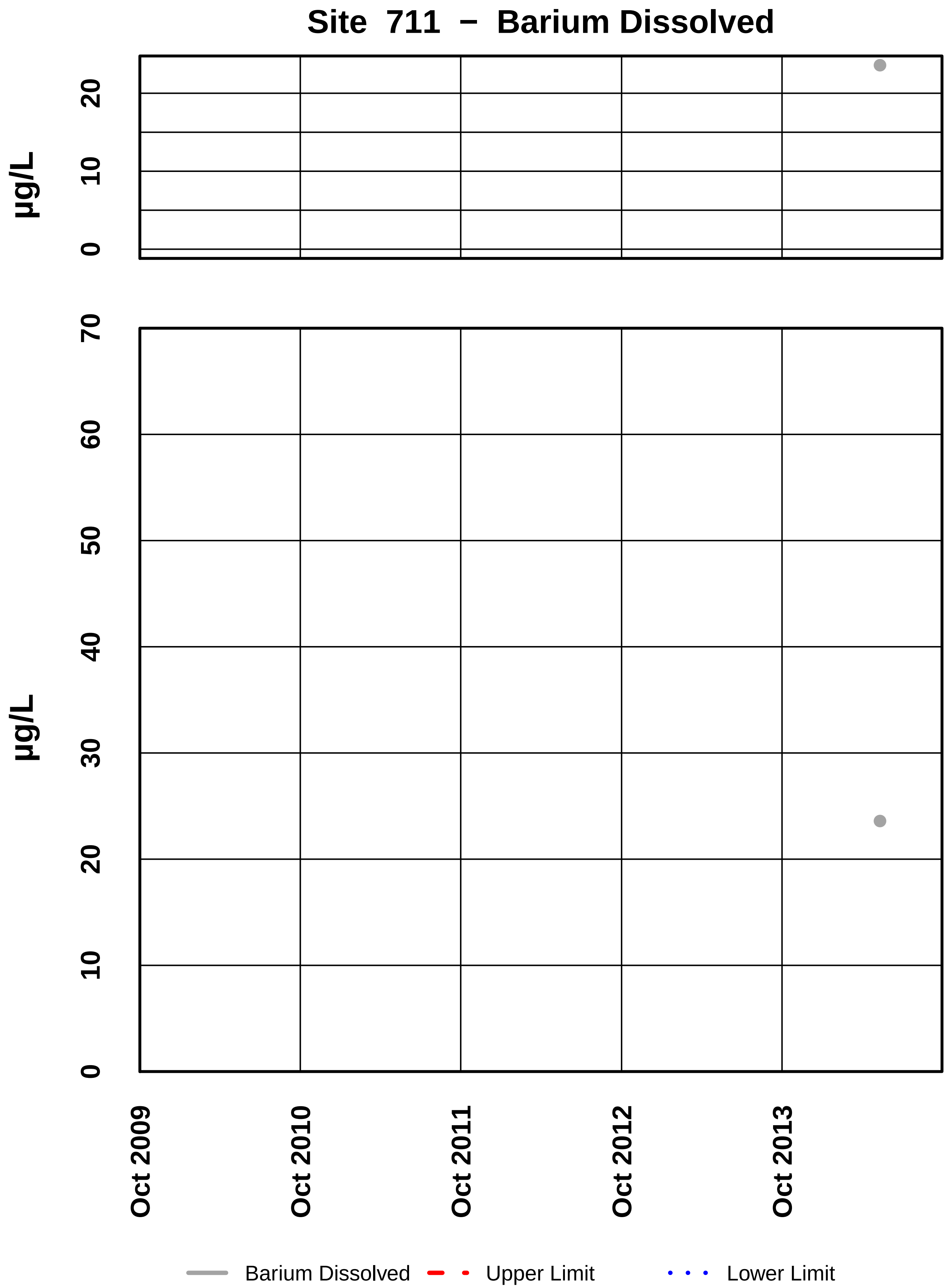



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

## Site 711 – Arsenic Dissolved

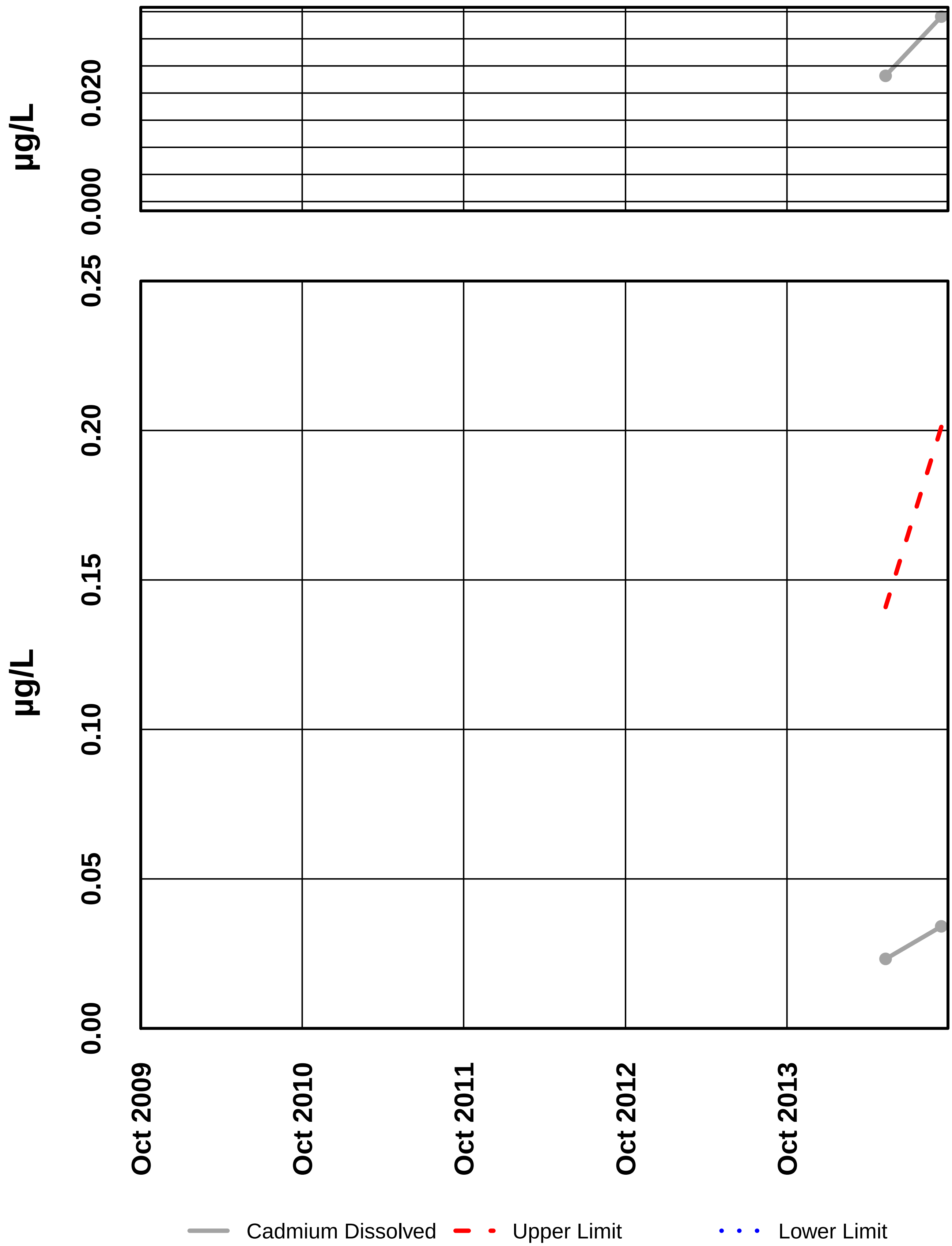



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



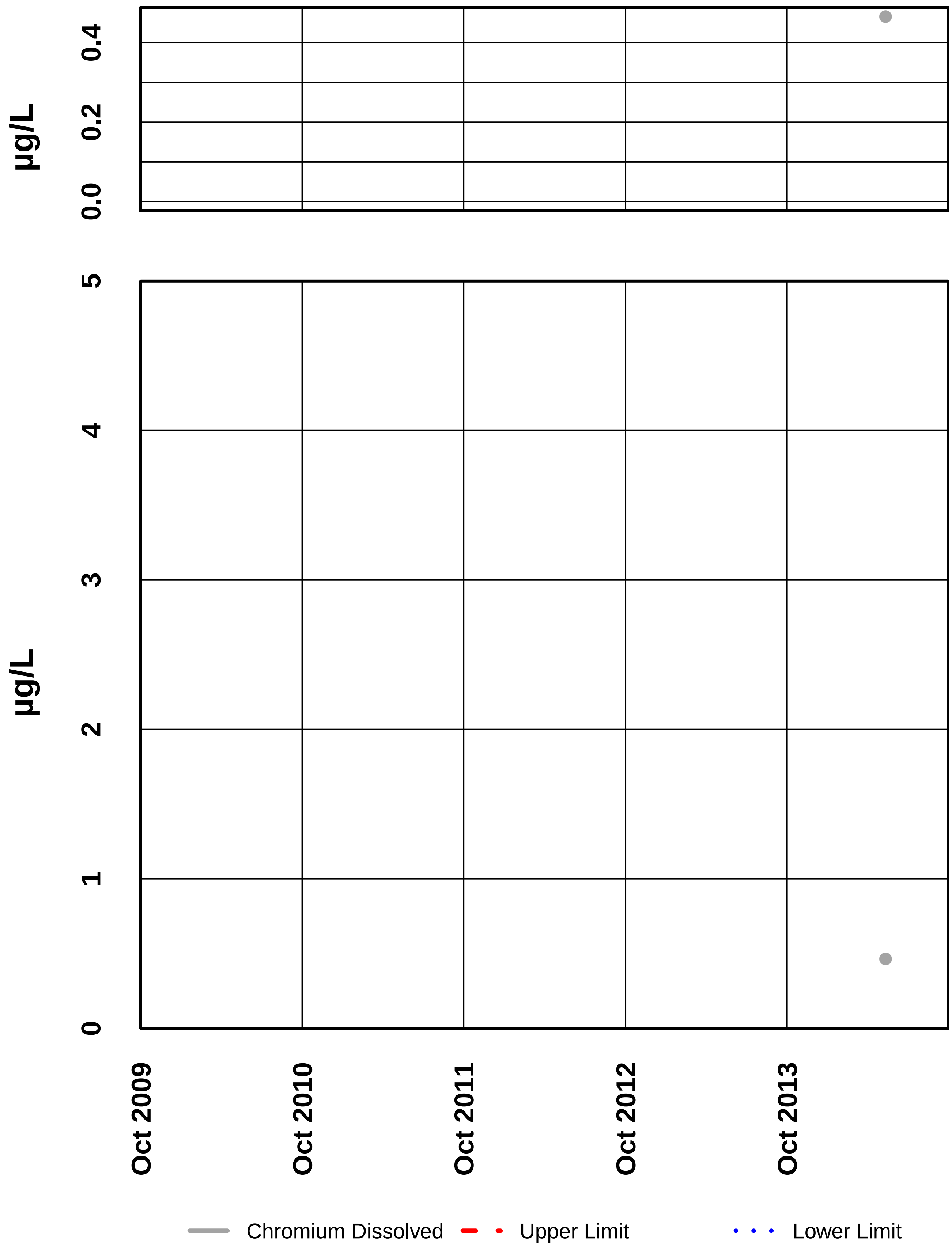

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

## Site 711 – Cadmium Dissolved



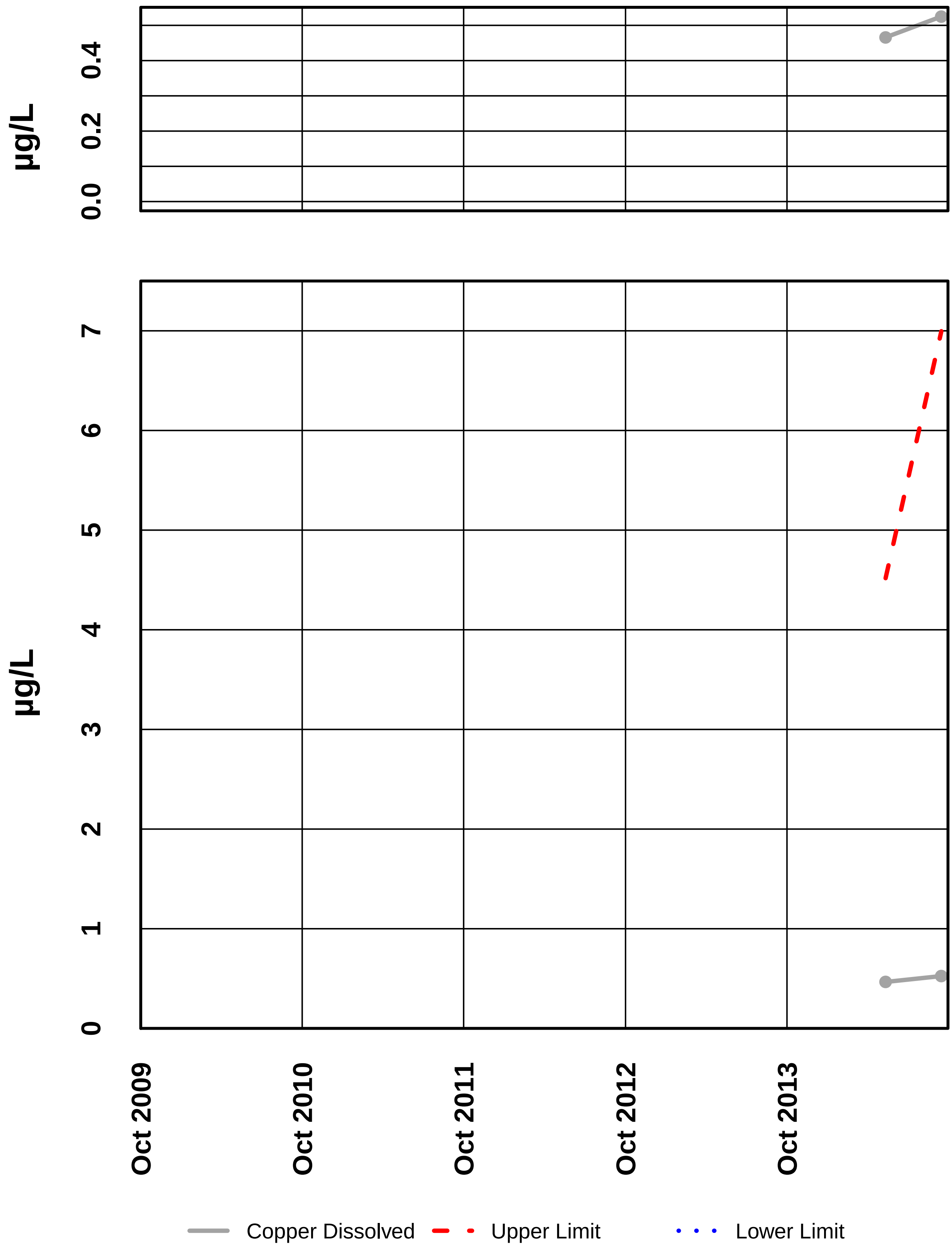

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

## Site 711 – Chromium Dissolved

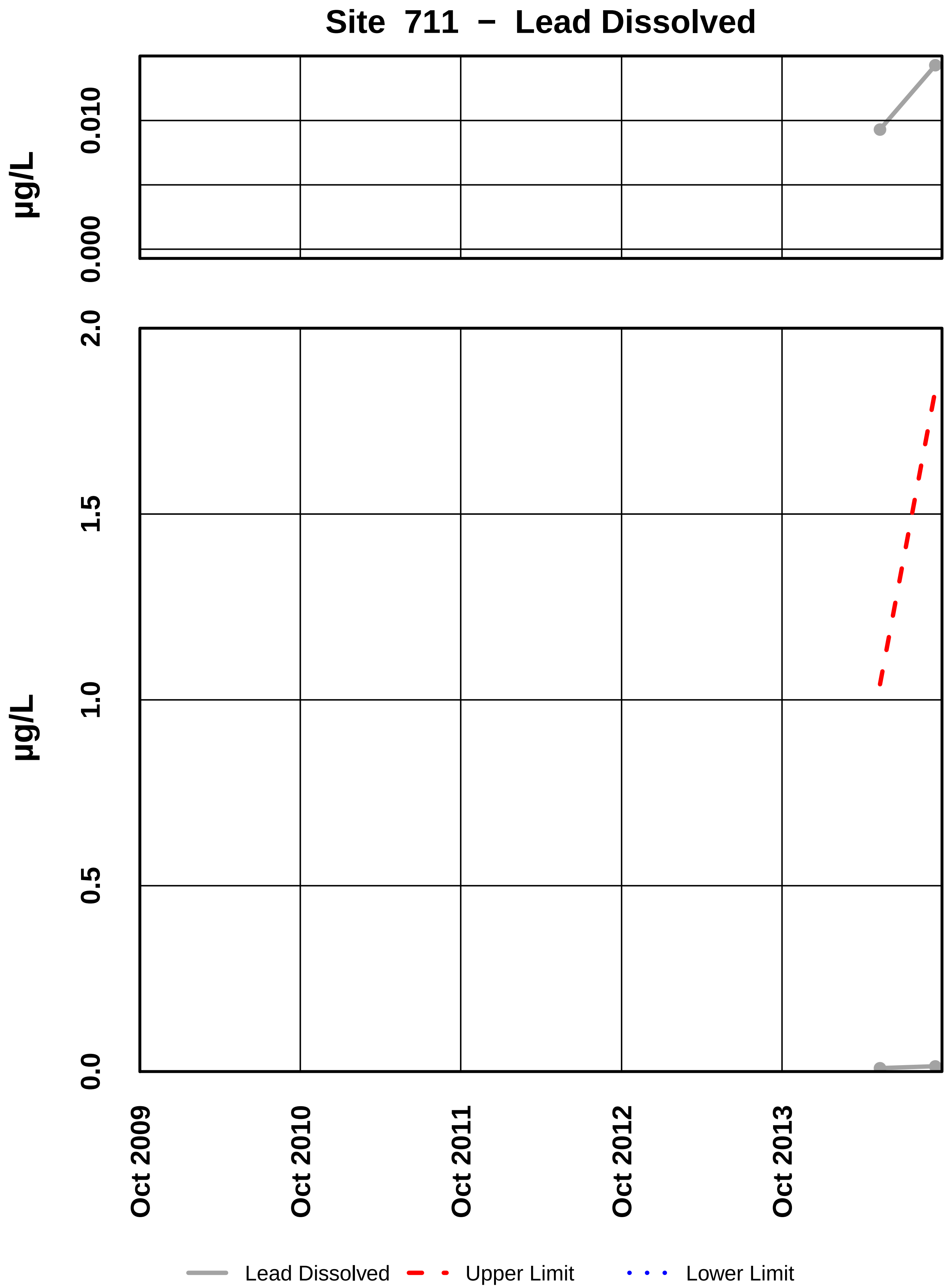



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

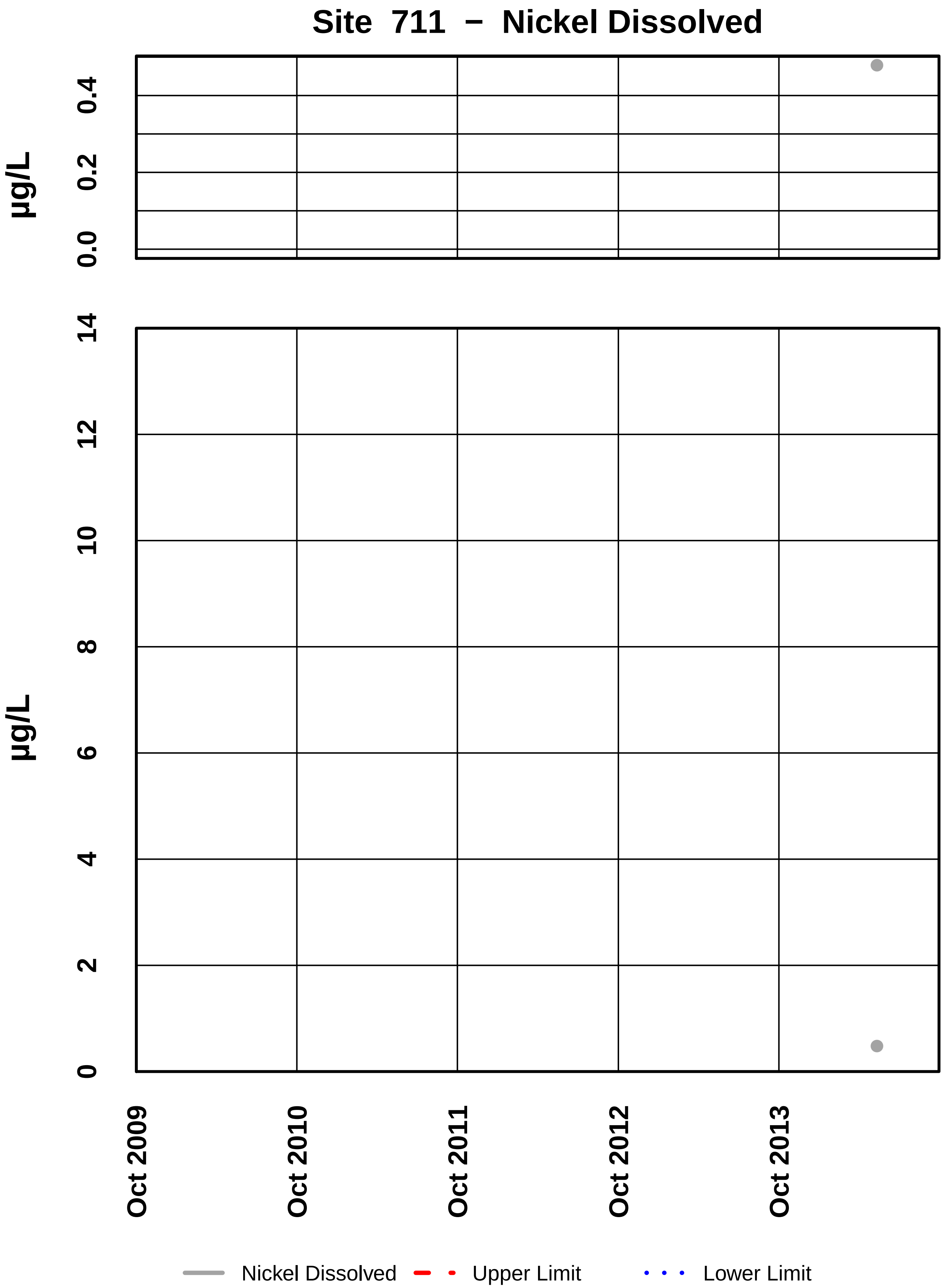
# Site 711 – Copper Dissolved



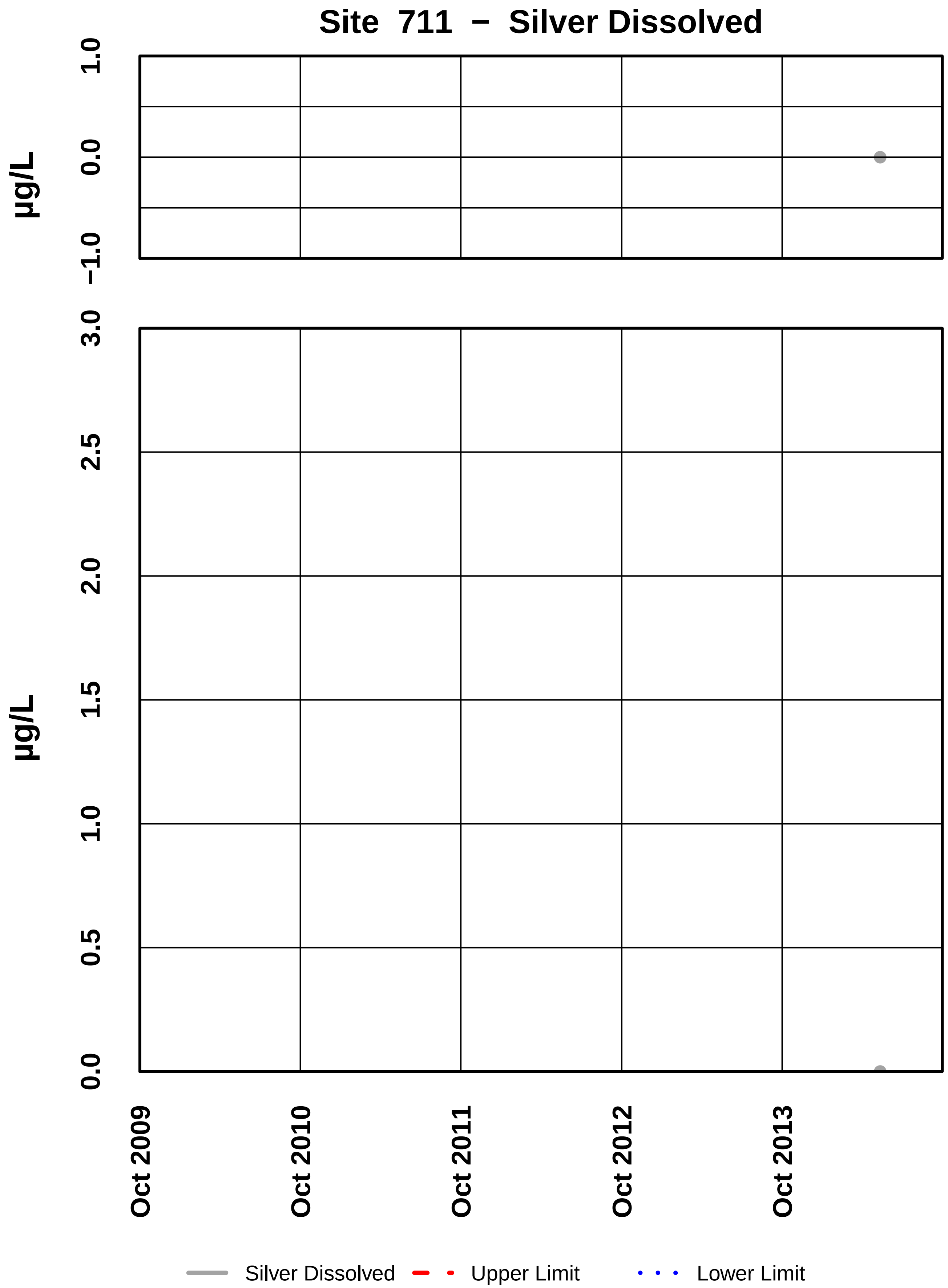

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



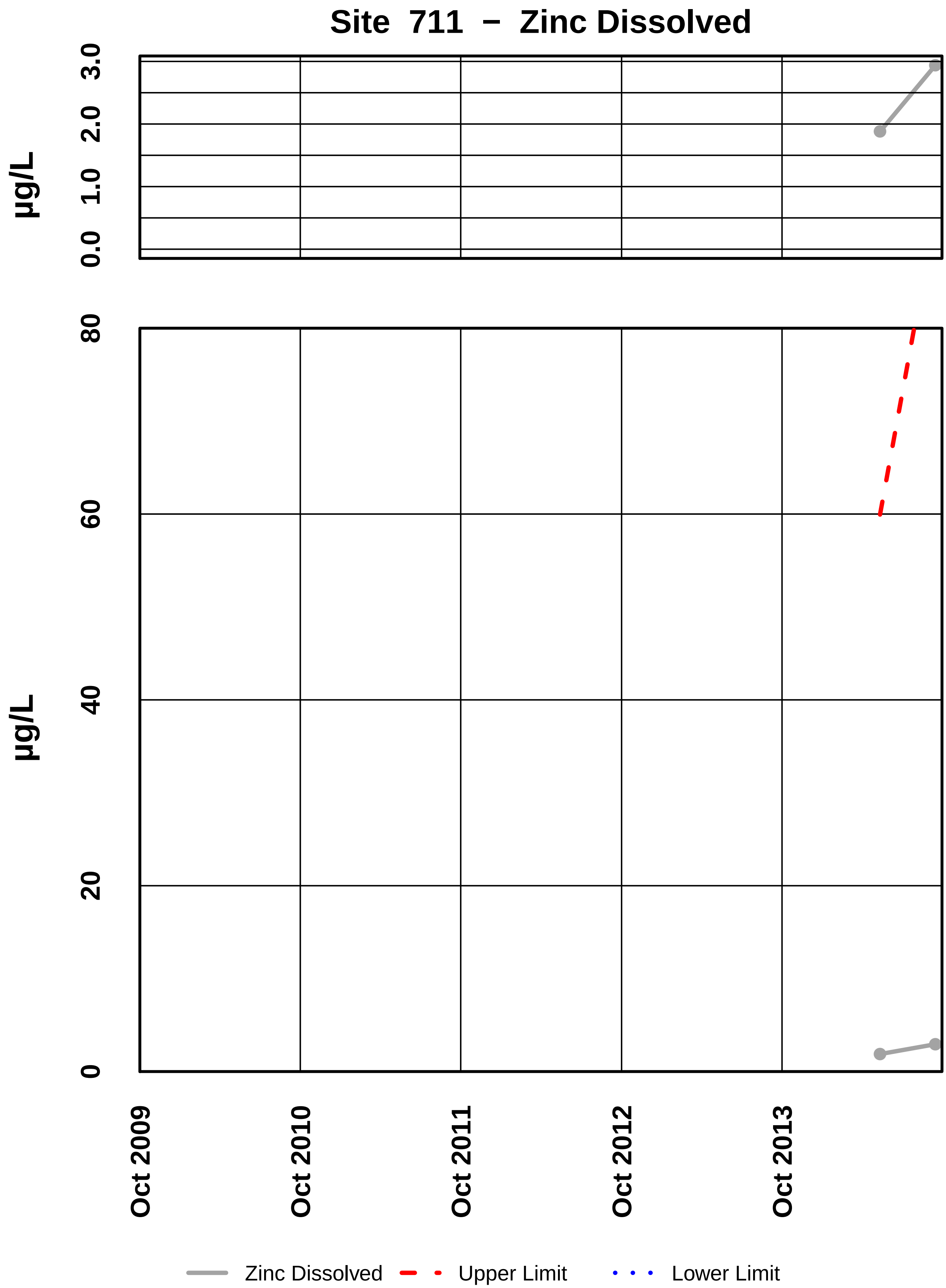

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

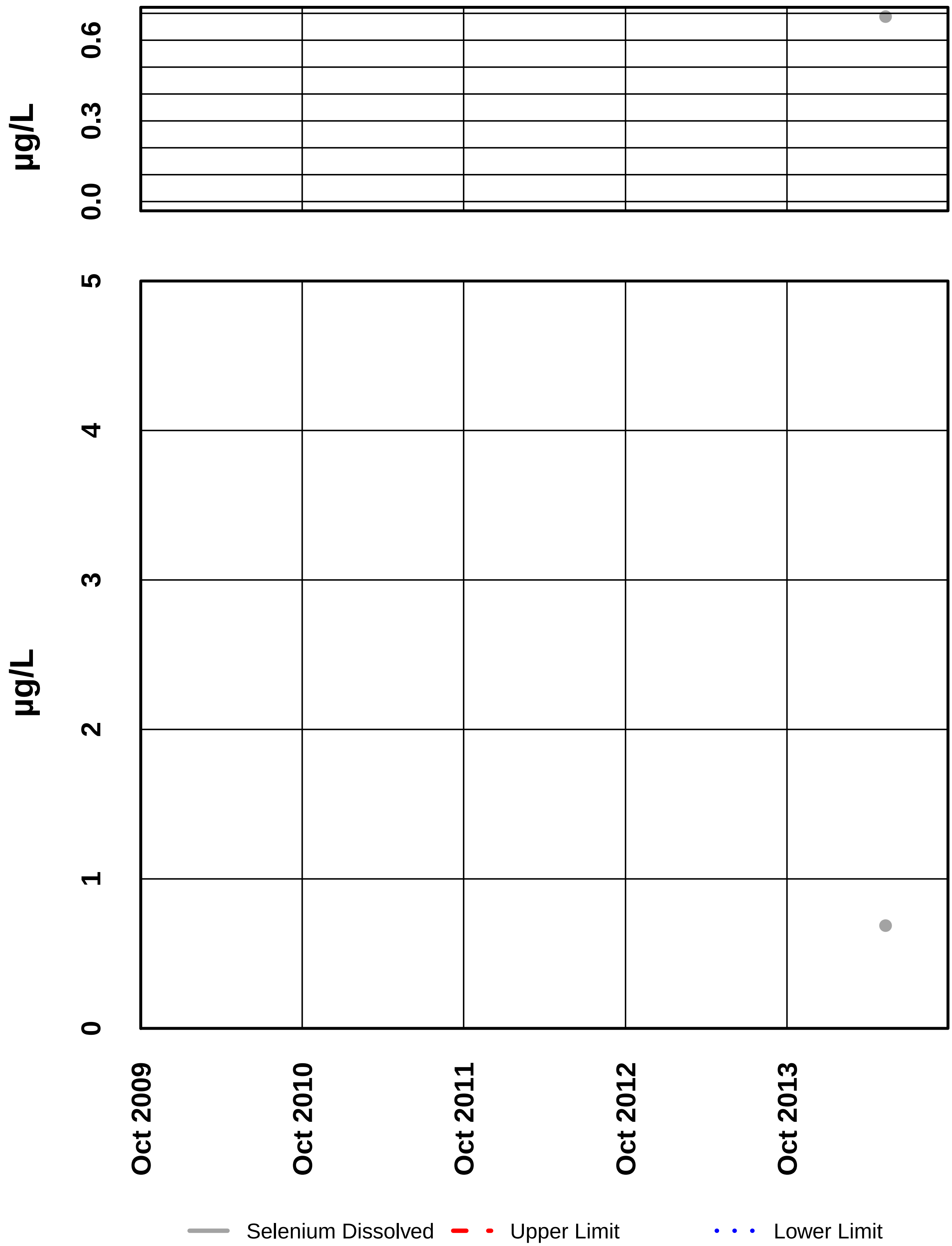



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



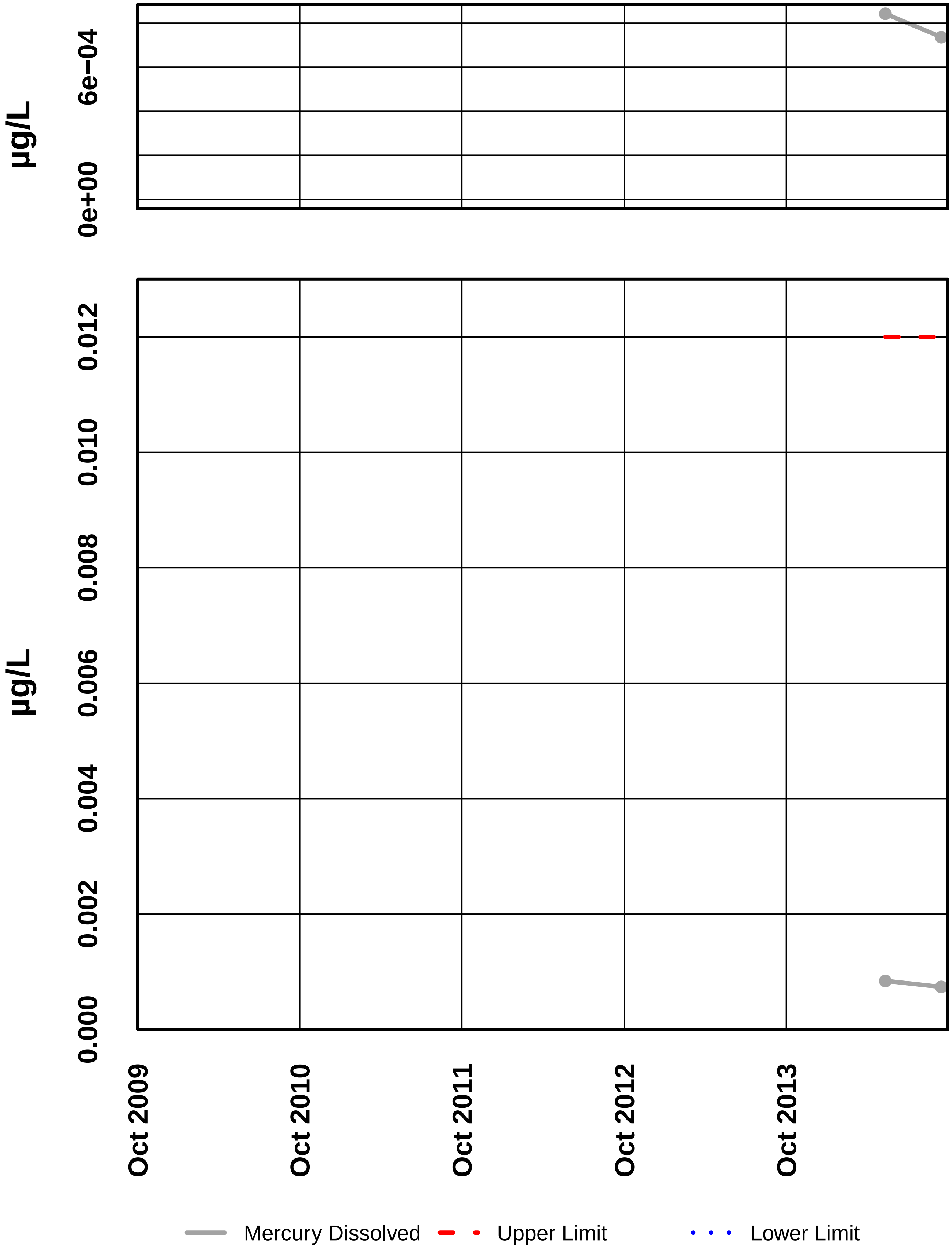

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

## Site 711 – Selenium Dissolved




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# Site 711 − Mercury Dissolved




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# INTERPRETIVE REPORT
# SITE 712

Sampling at this site was initiated during the spring of Water Year 2014. This site was added to the FWMP at the request of the Forest Service. Site 712 is located on Greens Creek down gradient to any drainage from Site E, a waste rock disposal area.

The data collected during the current water year are listed in the following "Table of Results for Water Year 2014" report. The table includes all the required FWMP analyte data (field and laboratory) collected for the current water year and a series of flags keyed to the summary report "Qualified Data by QA Reviewer". The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of ½ MDL for the purpose of median calculation.

All data collected at this site for the past year is included in the data analyses. As shown in the table below, there were no data outliers.

| Sample Date | Parameter | Value | Qualifier | Notes |
|---|---|---|---|---|
| No outliers have been identified by HGCMC for the period of October 2013 through September 2014. | | | | |

The data for Water Year 2014 have been compared to the strictest fresh water quality criterion for each applicable analyte. No results exceeding these criteria were identified as listed in the table below.

**Table of Exceedance for Water Year 2014**

| | | | Limits | | |
|---|---|---|---|---|---|
| Sample Date | Parameter | Value | Lower | Upper | Hardness |
| No exceedances have been identified by HGCMC for the period of October 2013 through September 2014. | | | | | |

X-Y plots have been generated to graphically present the data for each of the analytes requested in the Statistical Information Goals for this site. Because of the limited amount of data, visual trend analysis and statistical analysis of the data was not performed

## Table of Results for Water Year 2014

### Site 712FMS - 'Greens Creek Below Site E'

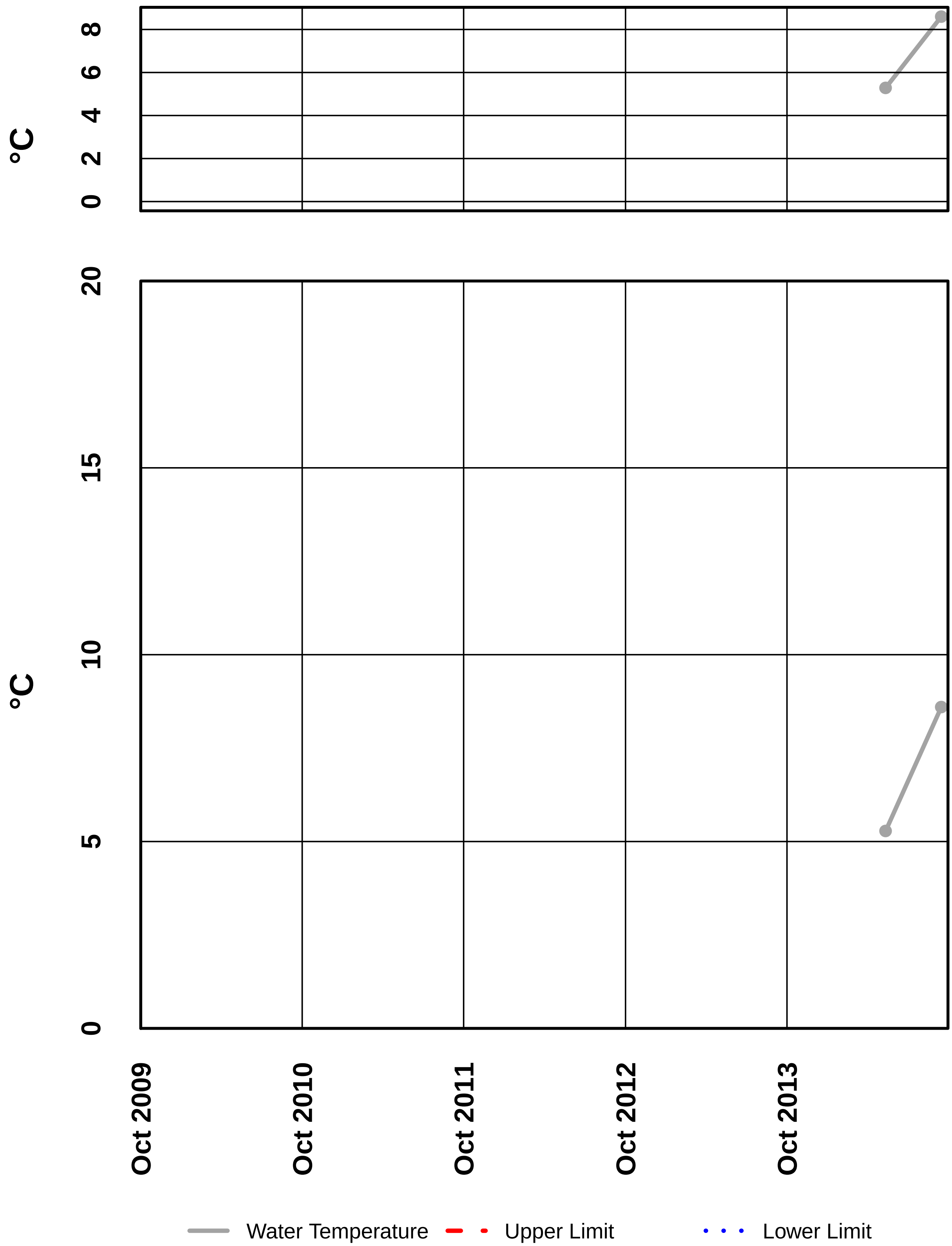
| Sample Date/Parameter | Oct 2013 | Nov 2013 | Dec 2013 | Jan 2014 | Feb 2014 | Mar 2014 | Apr 2014 | May 2014 | Jun 2014 | Jul 2014 | Aug 2014 | Sep 2014 | **Median** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Water Temp (°C) | | | | | | | | 5.3 | | | | 8.6 | 7.0 |
| Conductivity-Field(μmho) | | | | | | | | 98 | | | | 159.1 | 128.6 |
| Conductivity-Lab (μmho) | | | | | | | | 98 | | | | 157 | 128 |
| pH Lab (standard units) | | | | | | | | 7.65 | | | | 7.71 | 7.68 |
| pH Field (standard units) | | | | | | | | 7.8 | | | | 8.15 | 7.98 |
| Total Alkalinity (mg/L) | | | | | | | | 36.9 | | | | 59.7 | 48.3 |
| Total Sulfate (mg/L) | | | | | | | | 8.7 | | | | 16.3 | 12.5 |
| Hardness (mg/L) | | | | | | | | 45.5 | | | | 75.8 | 60.7 |
| Dissolved As (ug/L) | | | | | | | | 0.185 | | | | 0.277 | 0.231 |
| Dissolved Ba (ug/L) | | | | | | | | 23.7 | | | | | 23.7 |
| Dissolved Cd (ug/L) | | | | | | | | 0.0225 | | | | 0.0367 | 0.0296 |
| Dissolved Cr (ug/L) | | | | | | | | 0.519 | | | | | 0.519 |
| Dissolved Cu (ug/L) | | | | | | | | 0.482 | | | | 0.515 | 0.499 |
| Dissolved Pb (ug/L) | | | | | | | | 0.0098 | | | | 0.0109 | 0.0104 |
| Dissolved Ni (ug/L) | | | | | | | | 0.487 | | | | | 0.487 |
| Dissolved Ag (ug/L) | | | | | | | | 0.006 | | | | | 0.006 |
| Dissolved Zn (ug/L) | | | | | | | | 2.09 | | | | 3.69 | 2.89 |
| Dissolved Se (ug/L) | | | | | | | | 0.633 | | | | | 0.633 |
| Dissolved Hg (ug/L) | | | | | | | | 0.000779 | | | | 0.000745 | 0.000762 |

For individual sample/analyte qualifier descriptions see "Qualified Data by QA Reviewer" table.

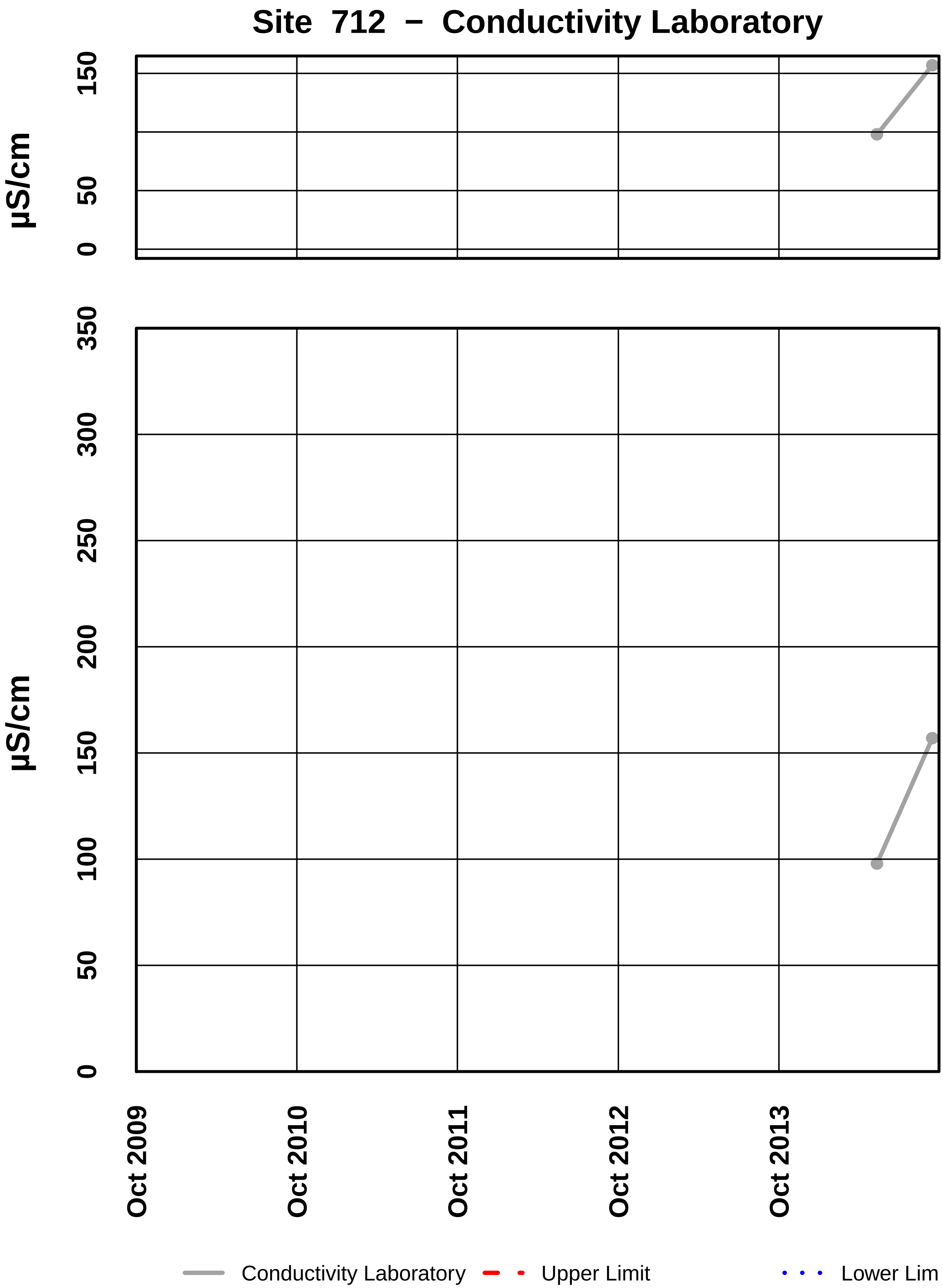
Values reported as less than MDL are replaced by 1/2 MDL for median calculation purposes.

Shaded data has been qualified as an outlier by HGCMC and removed from any further analysis and is not included into the calculation of the median

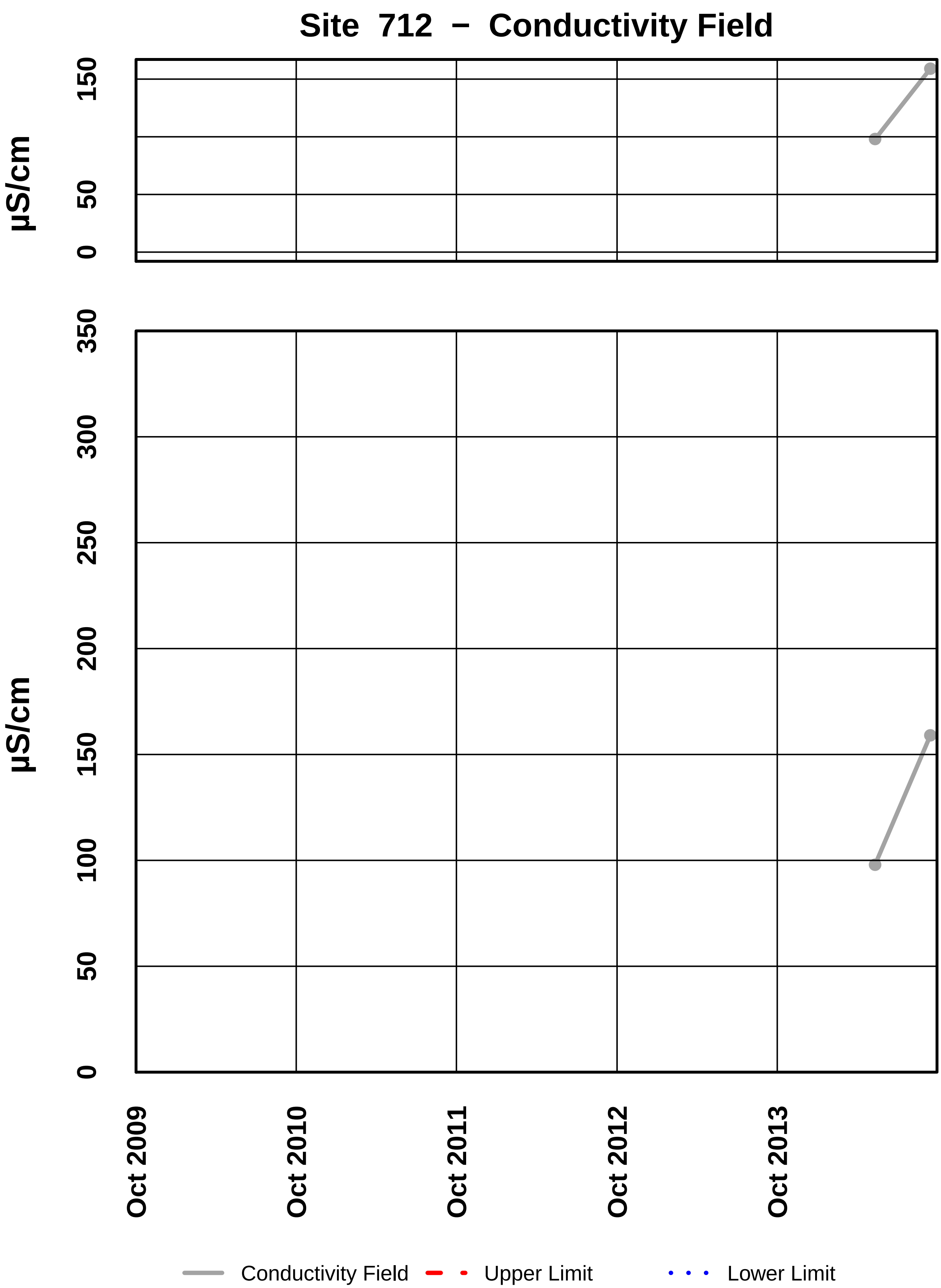
## Site 712 – Water Temperature



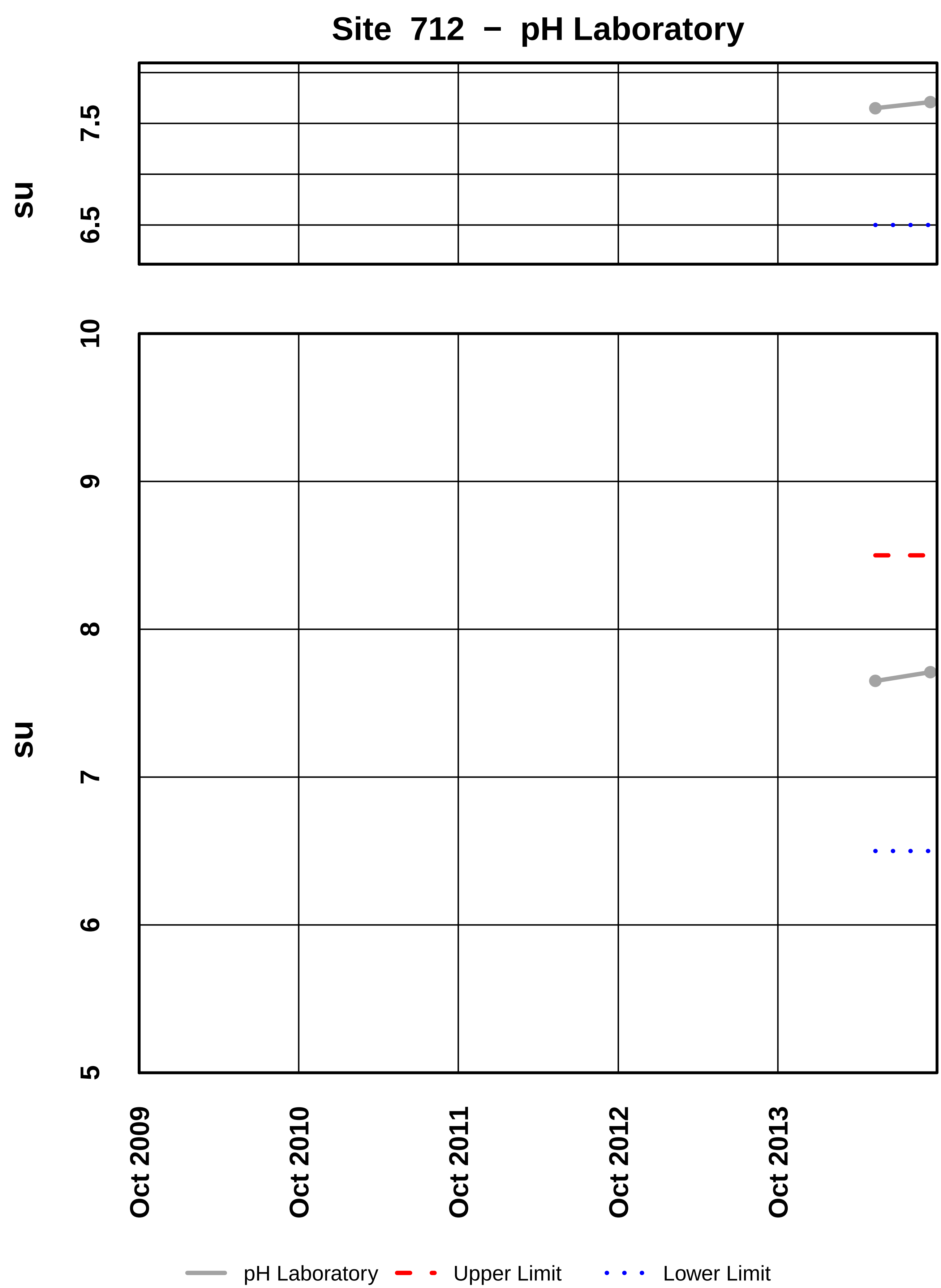

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



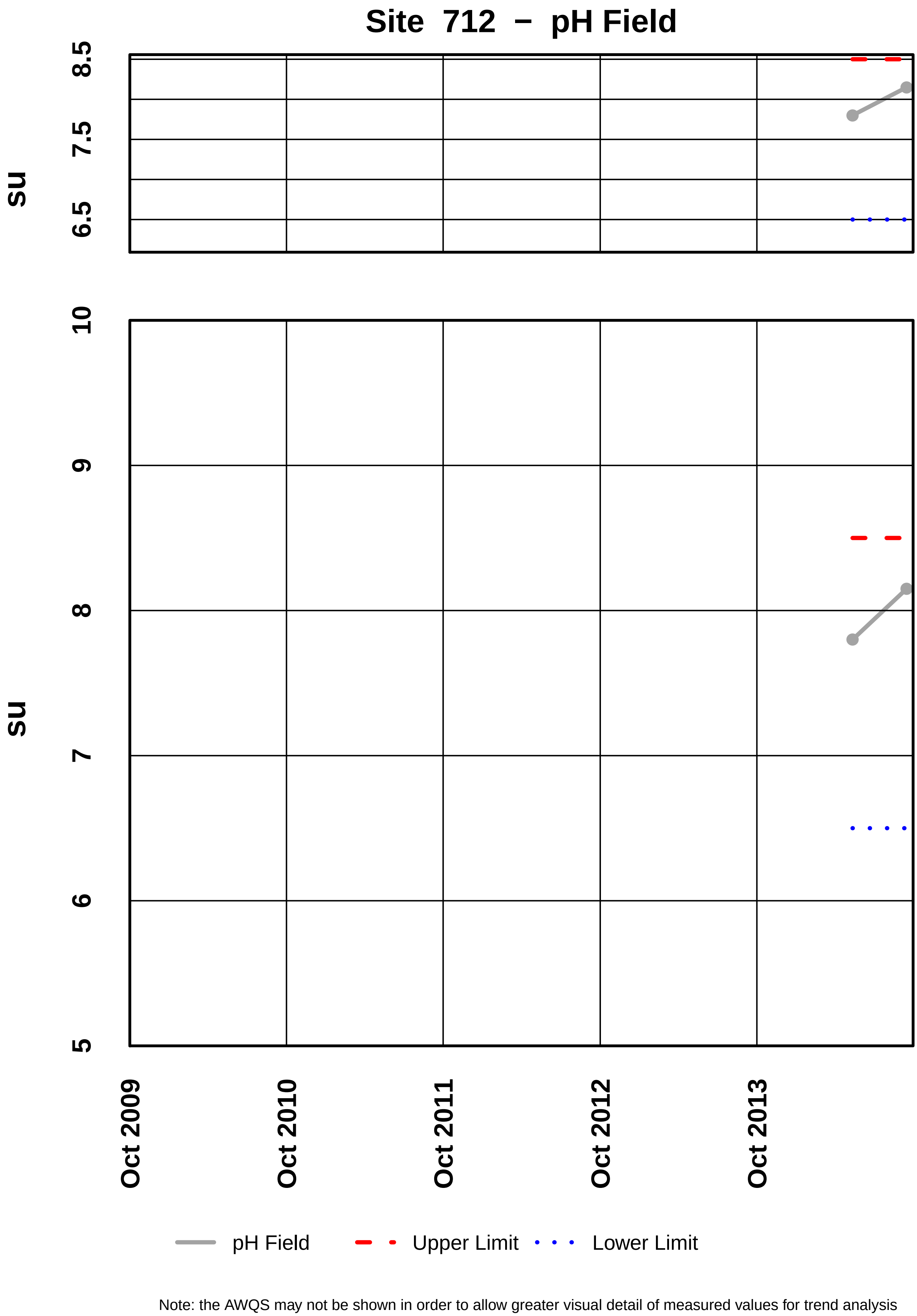

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

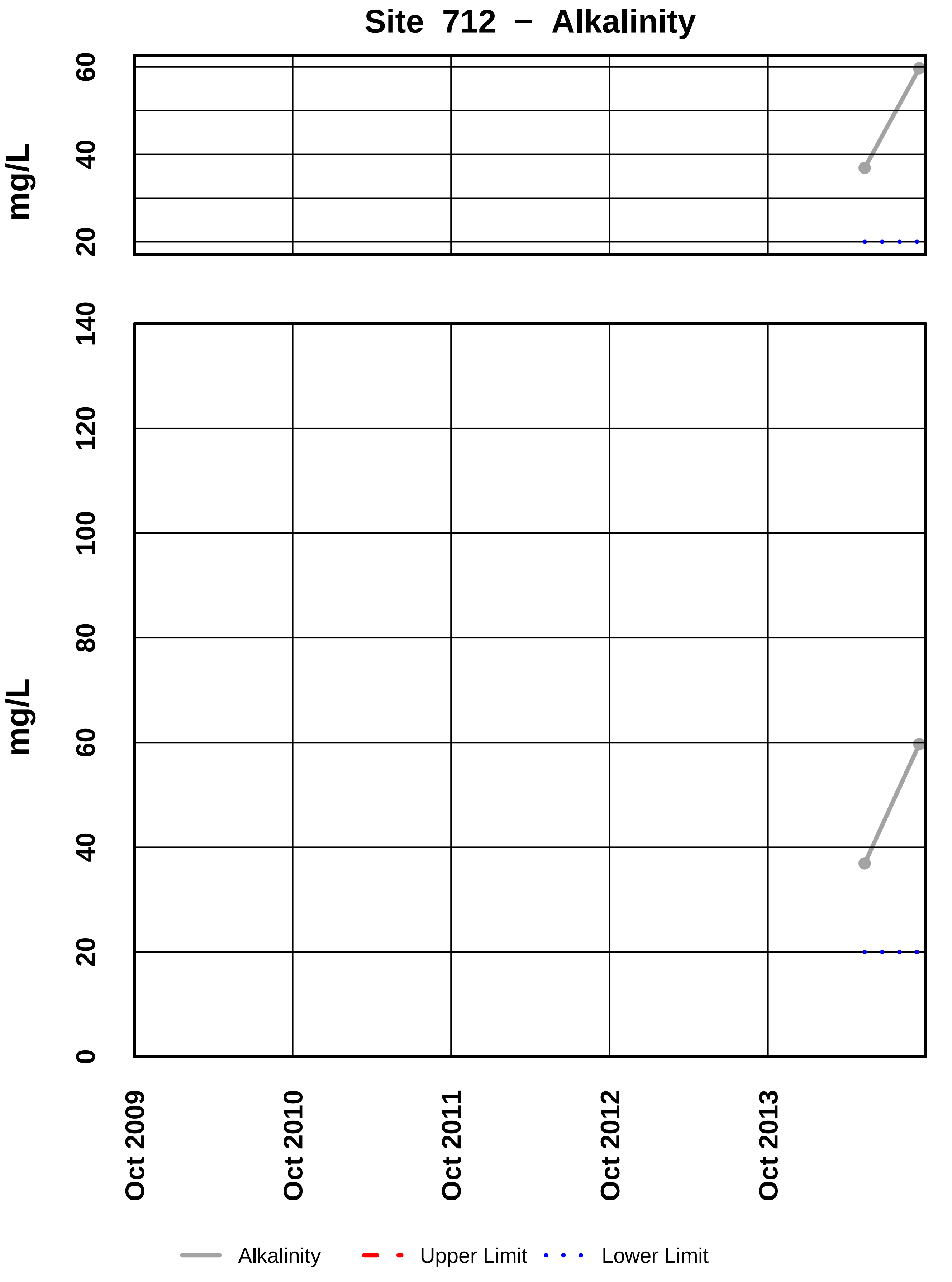



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



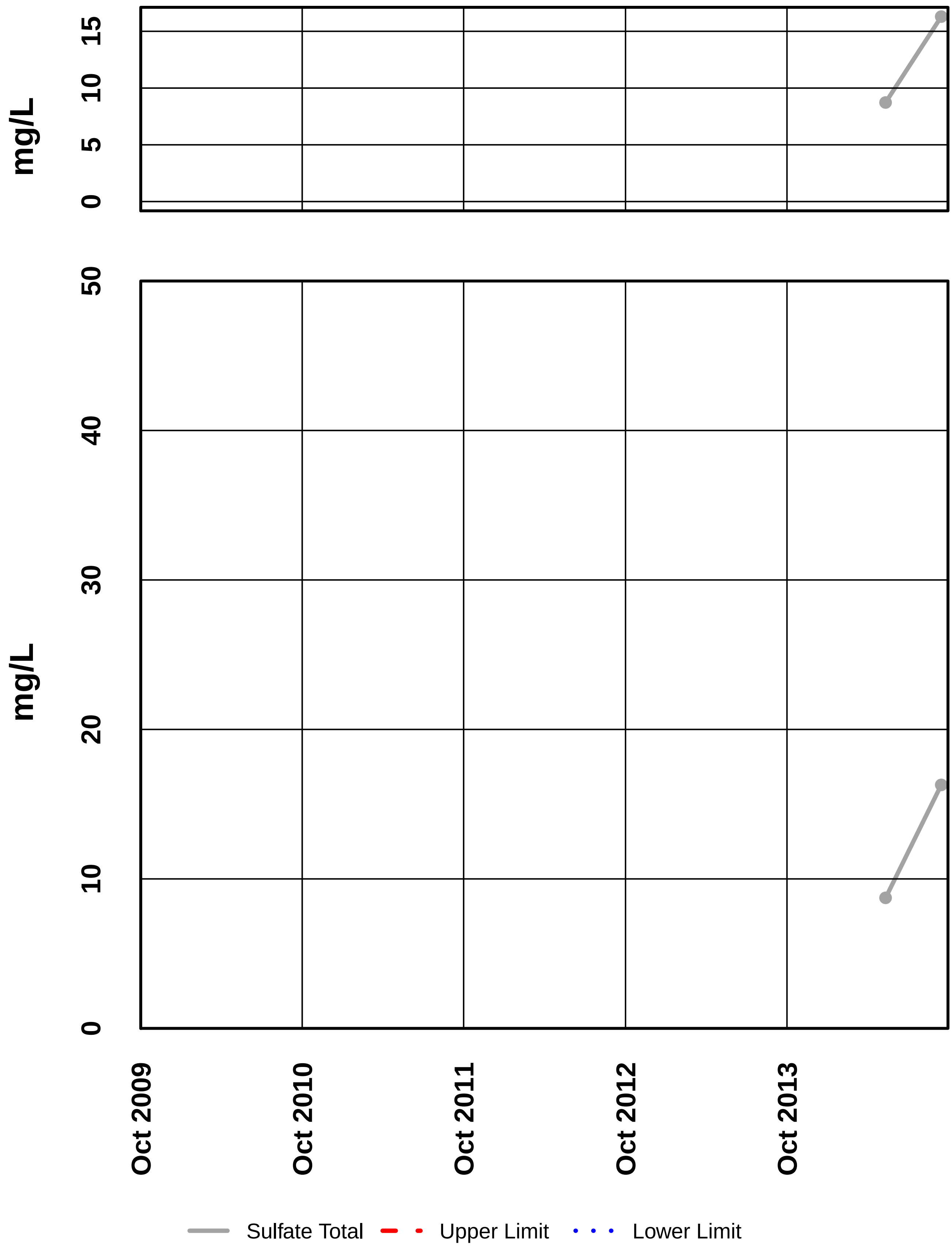

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis


Site 712 – pH Field
su
8.5
7.5
6.5
su
10
9
8
7
6
5
Oct 2009
Oct 2010
Oct 2011
Oct 2012
Oct 2013
pH Field
Upper Limit
Lower Limit
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



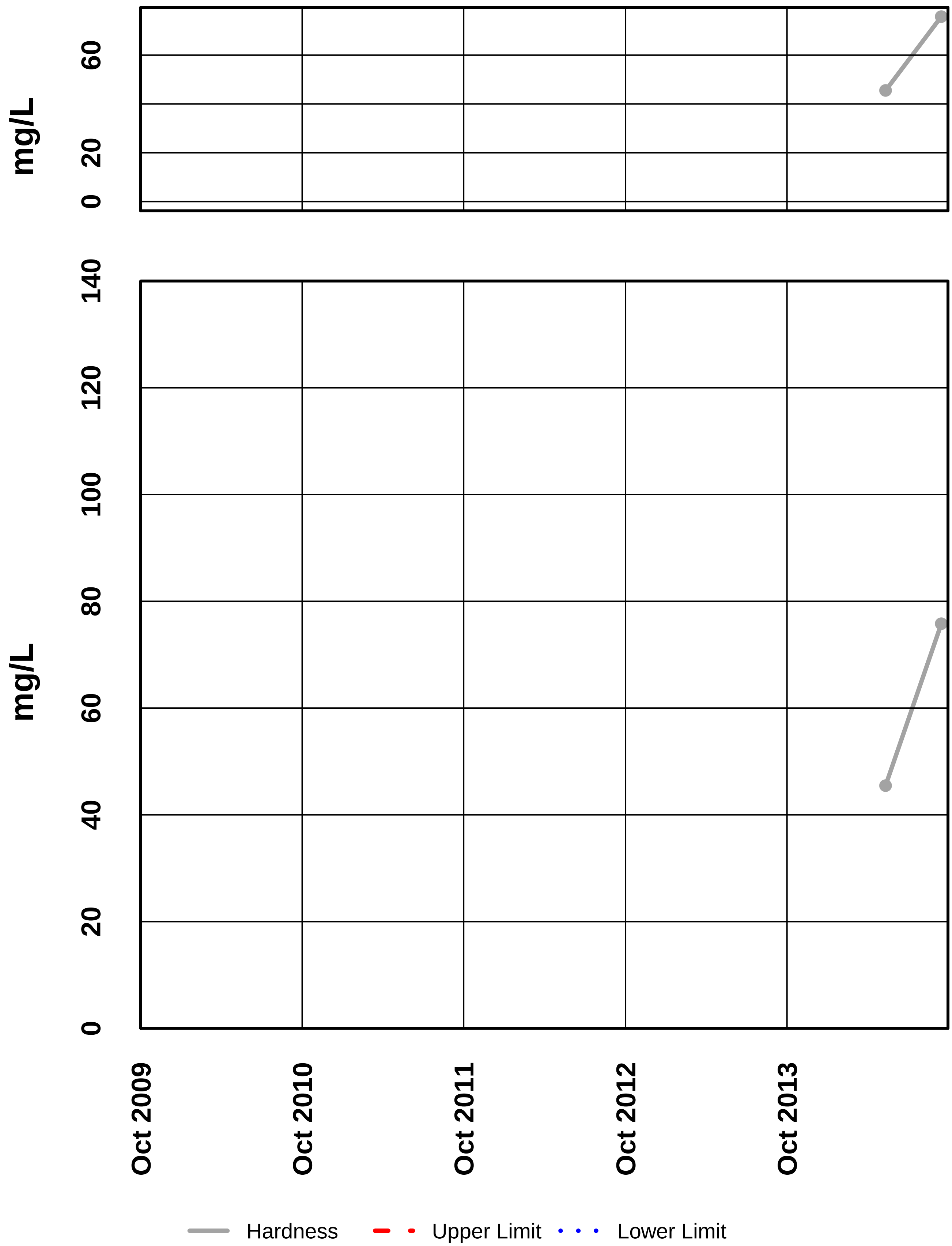

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

## Site 712 – Sulfate Total

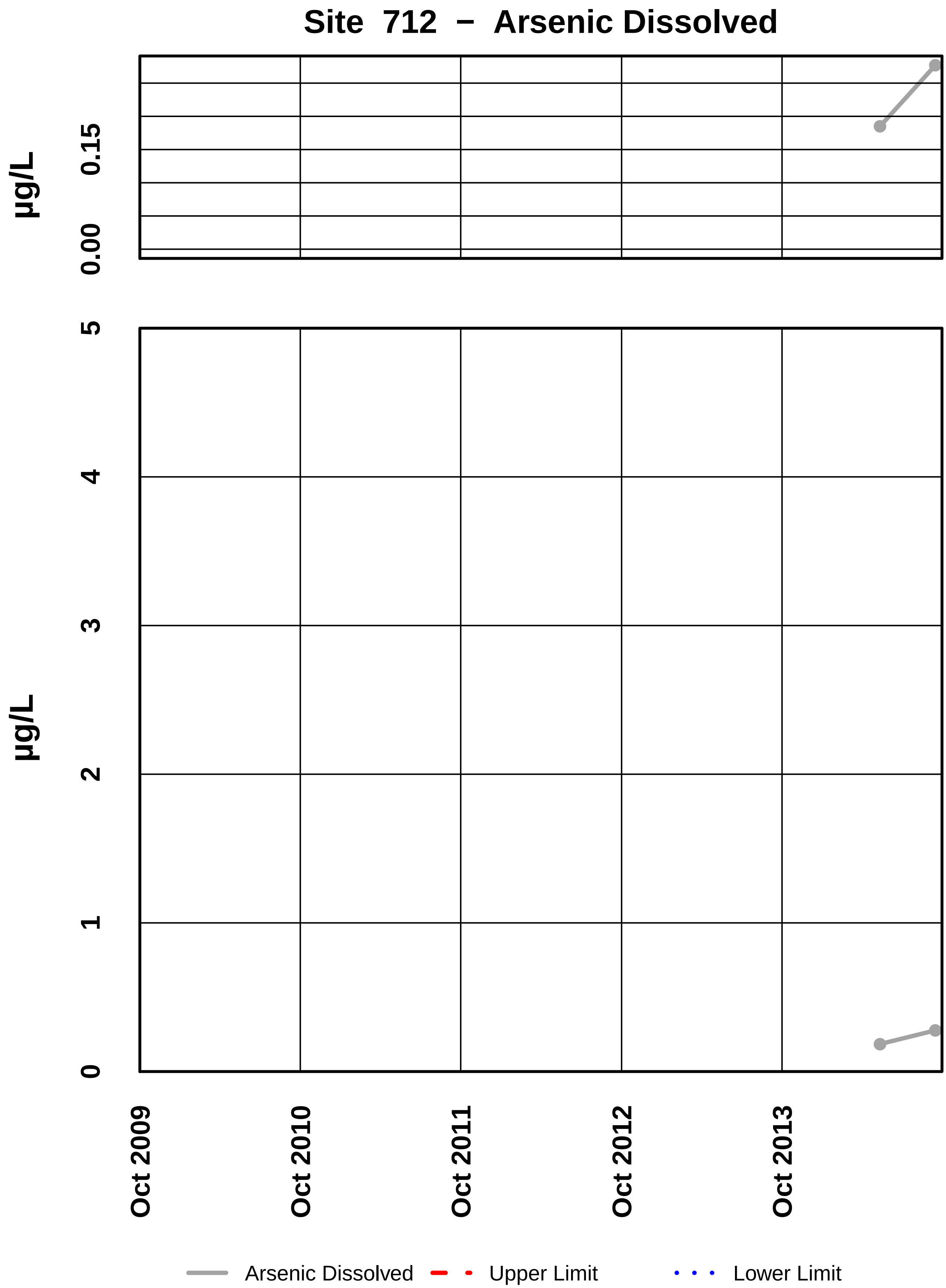



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

## Site 712 − Hardness

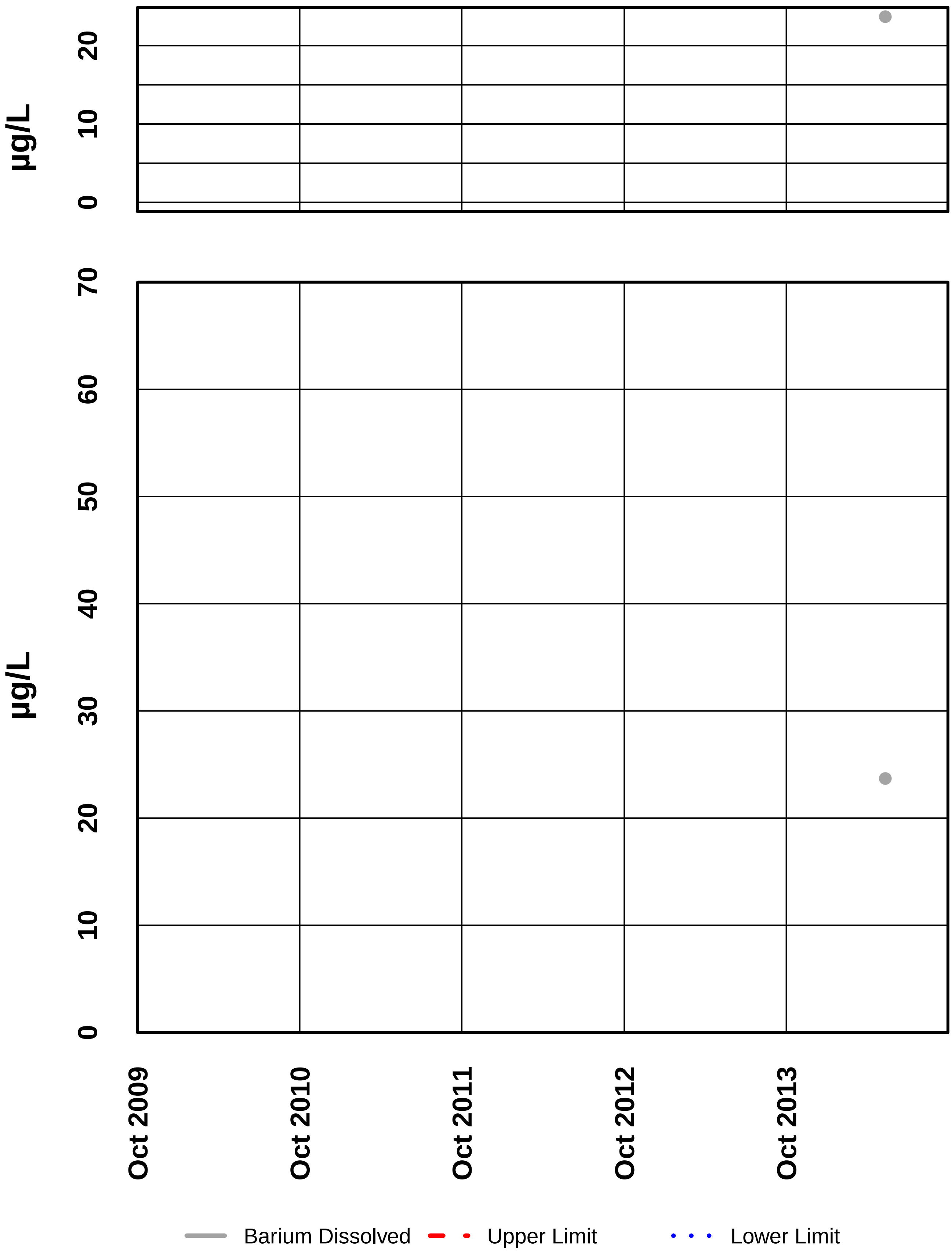



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



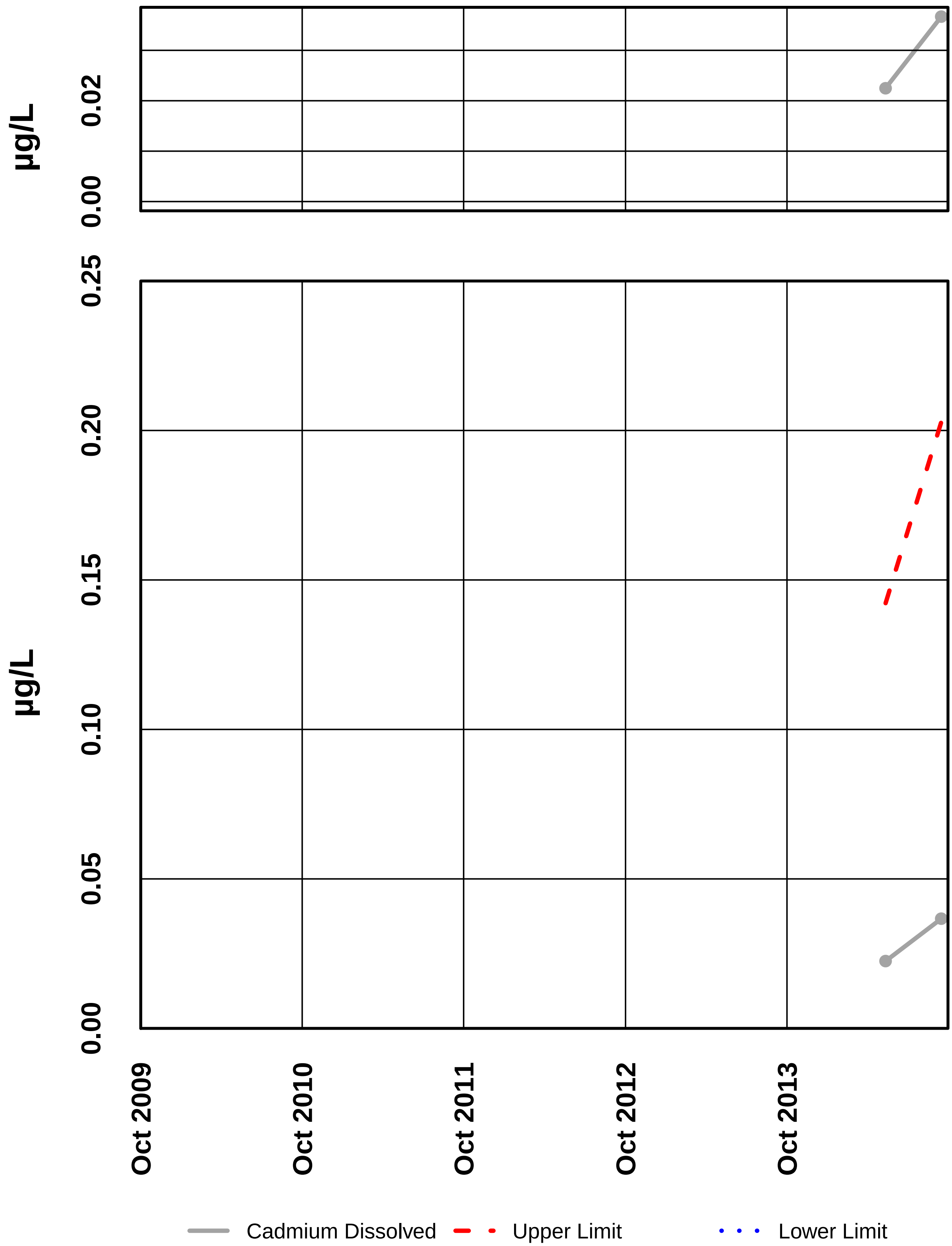

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# Site 712 − Barium Dissolved

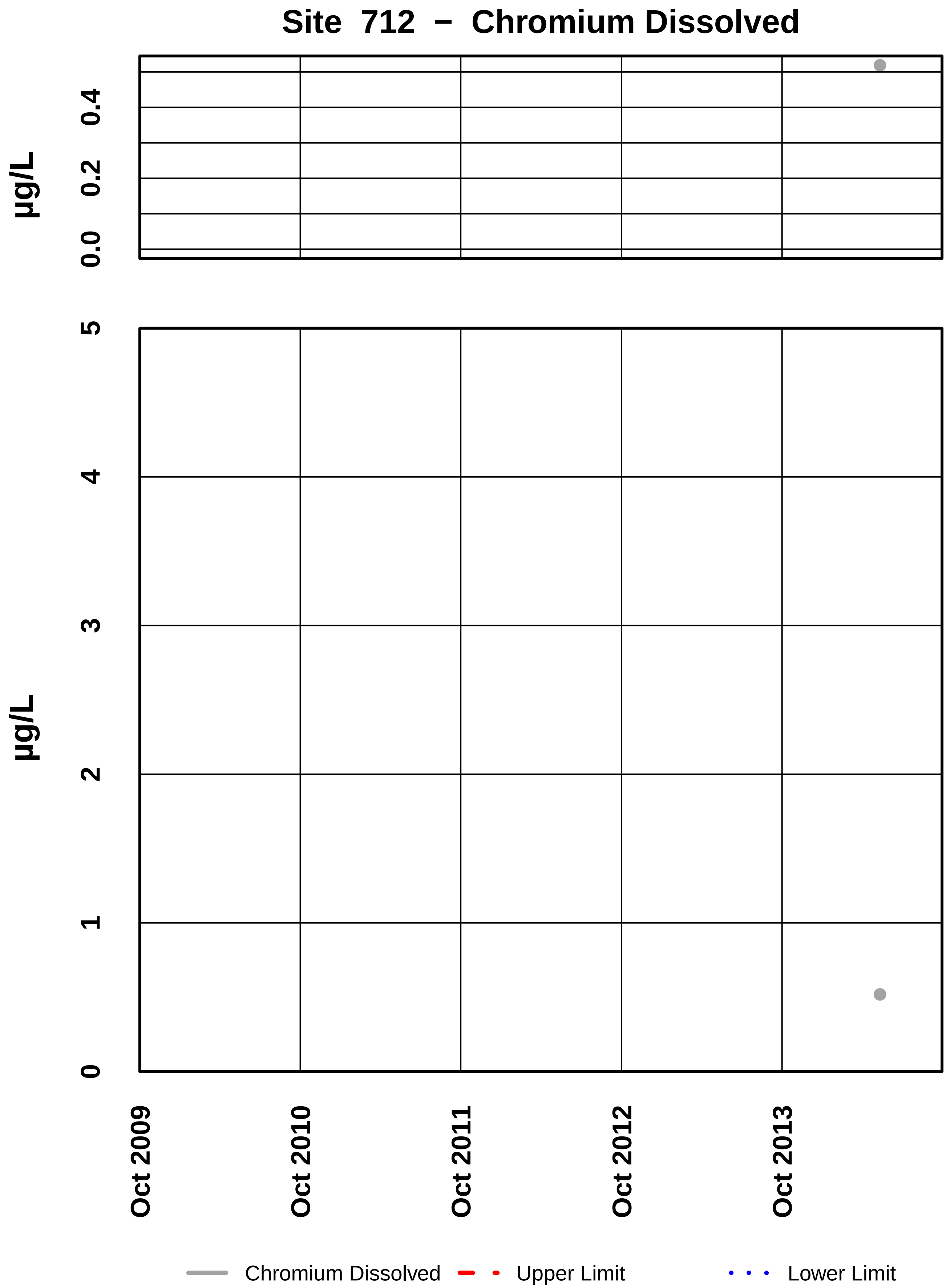



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

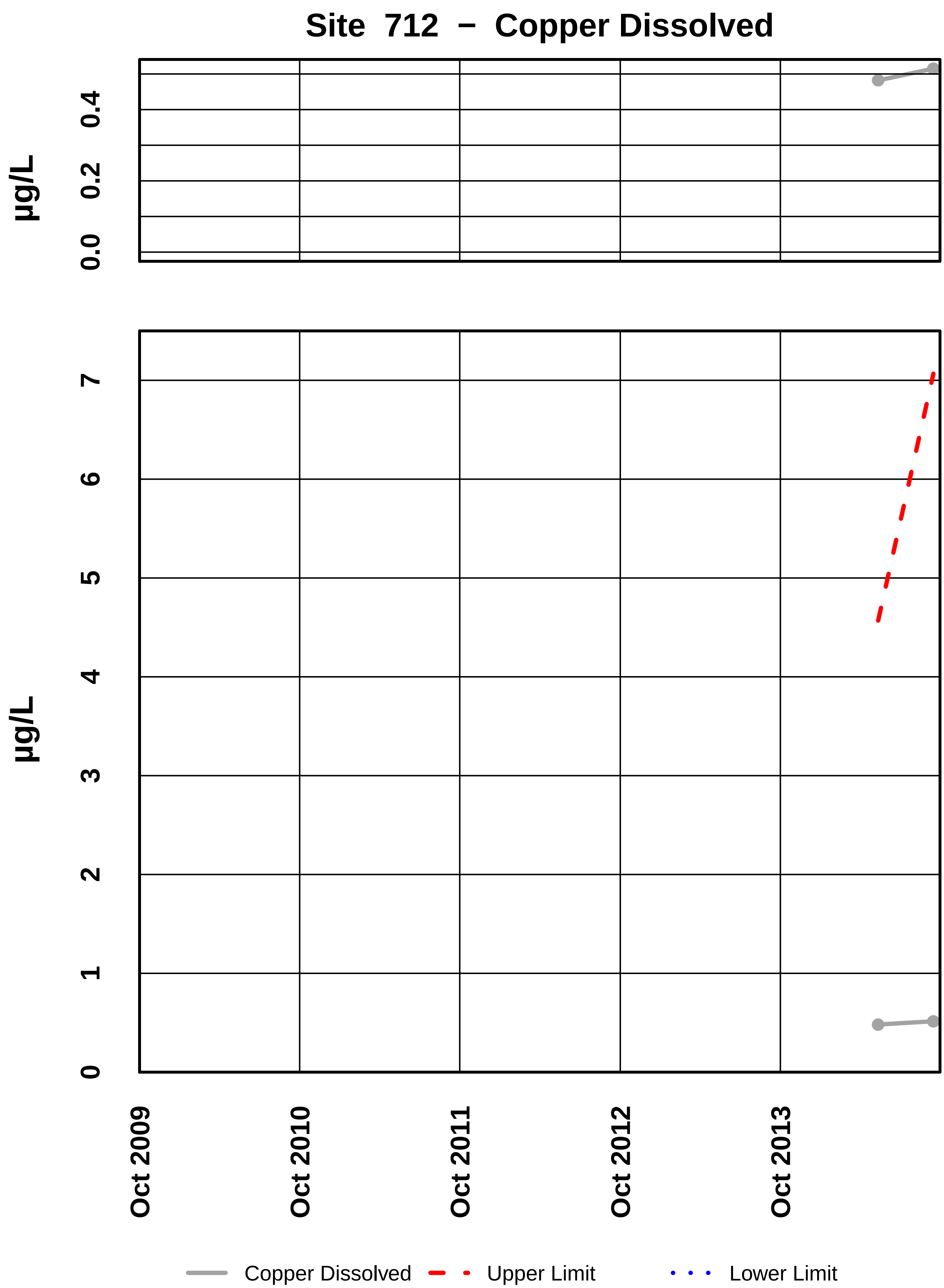
# Site 712 – Cadmium Dissolved



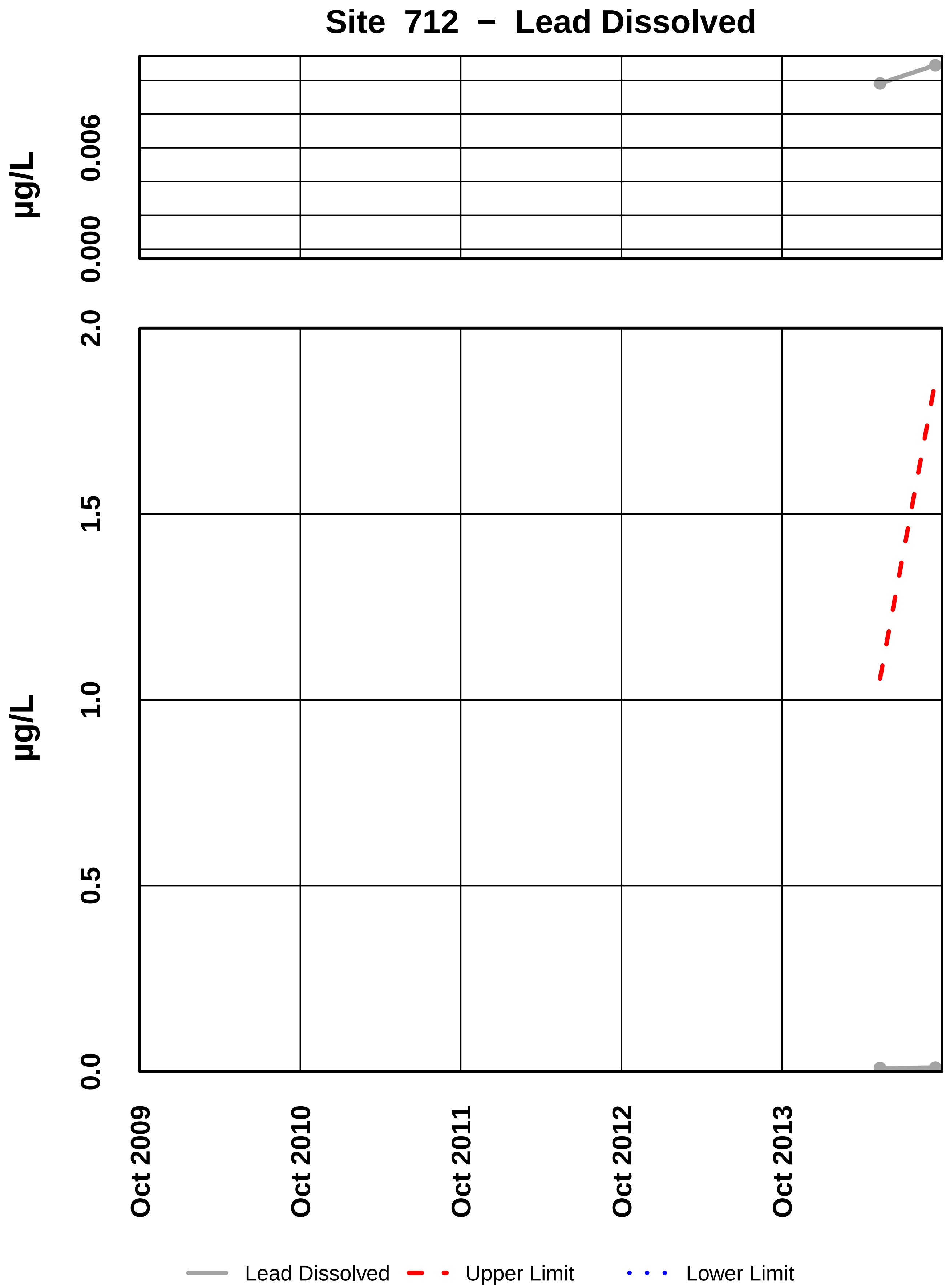

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

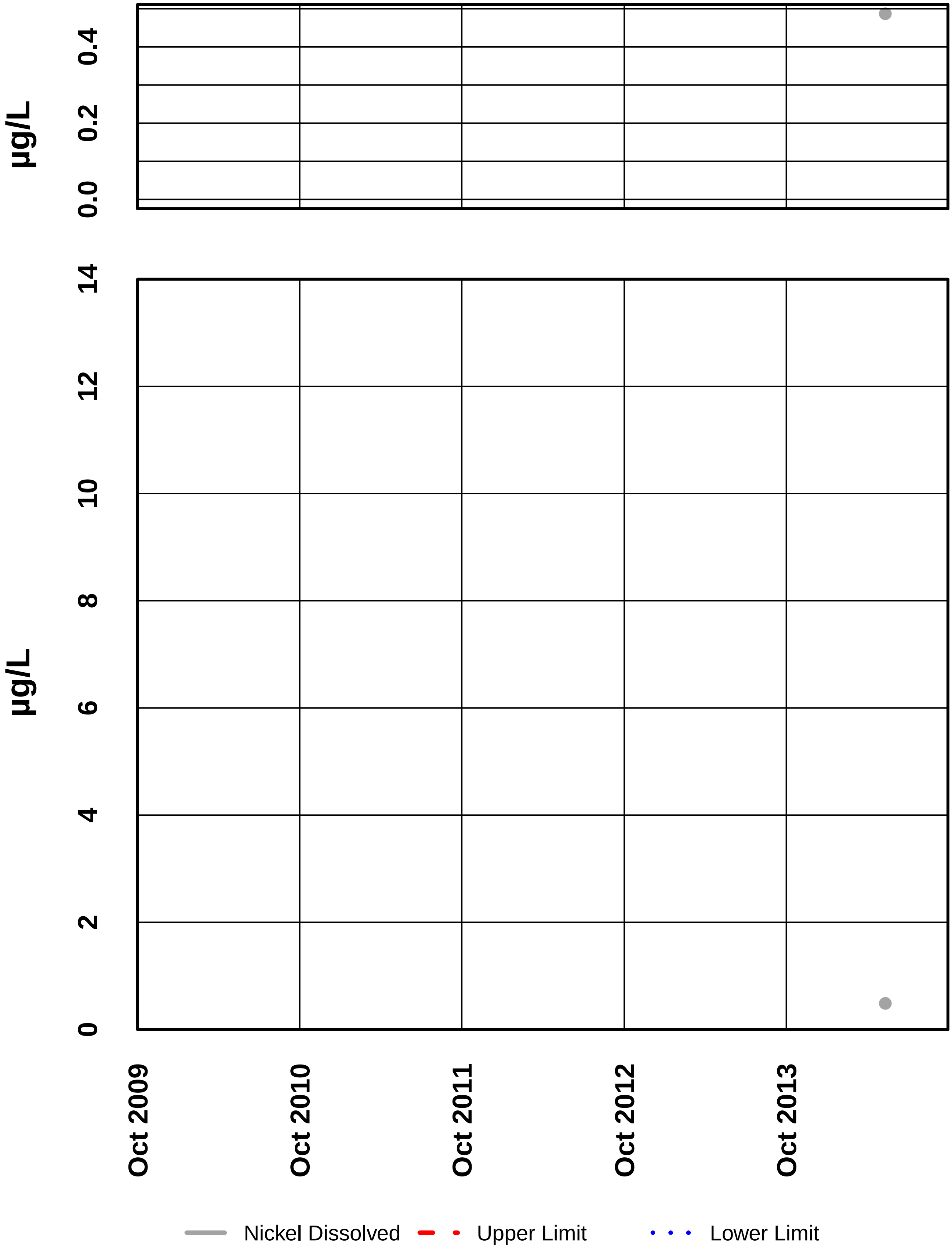



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



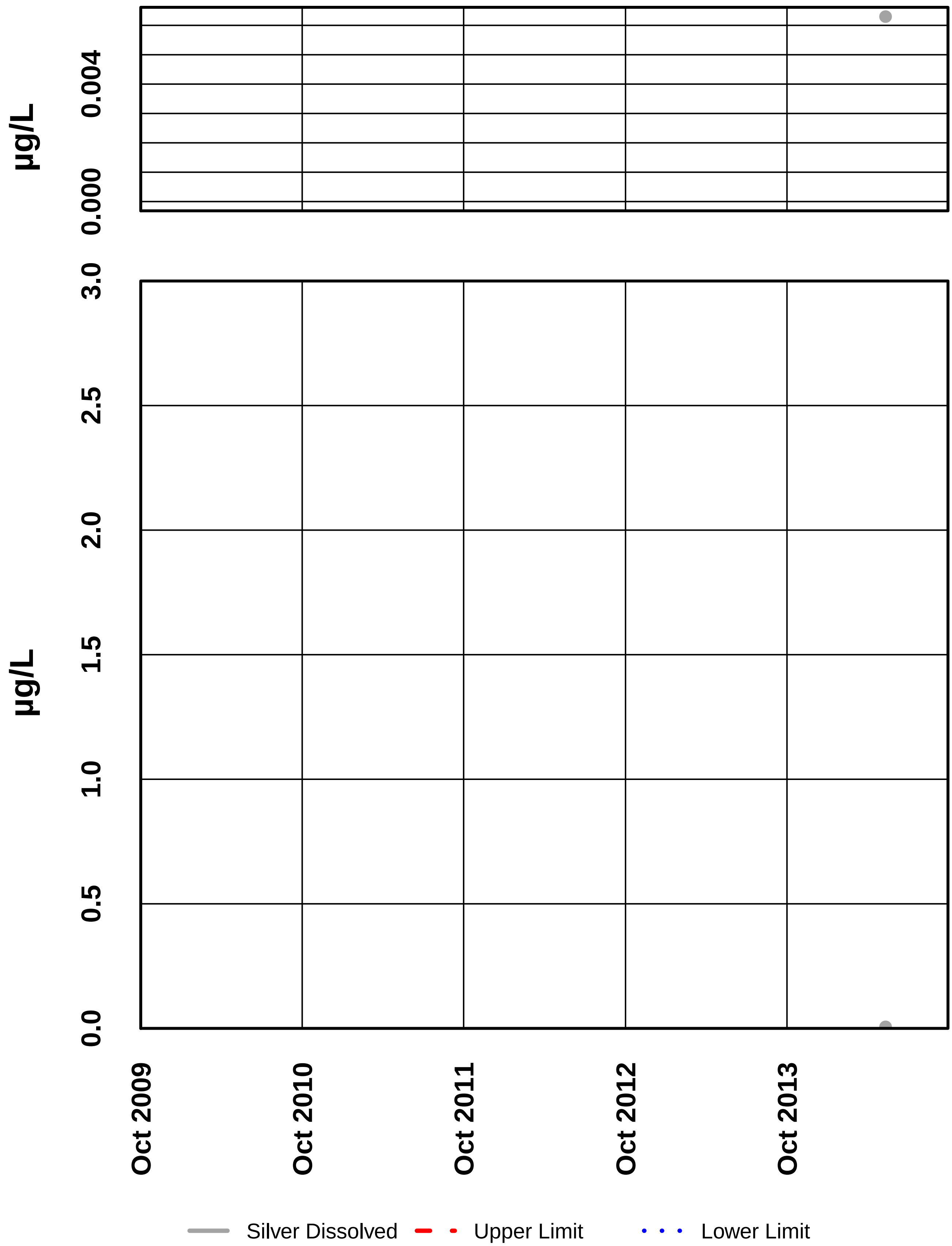

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# Site 712 – Nickel Dissolved

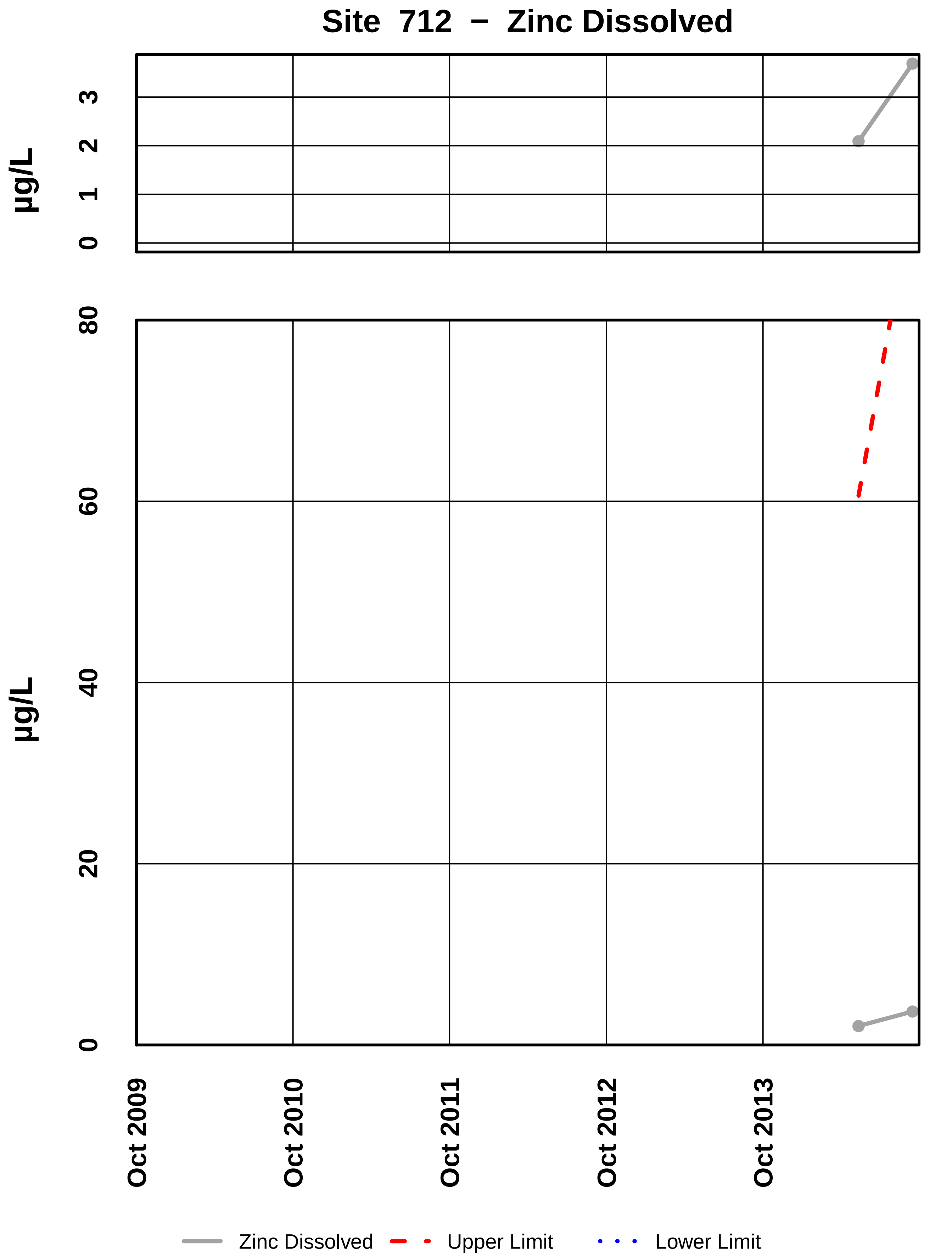



Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

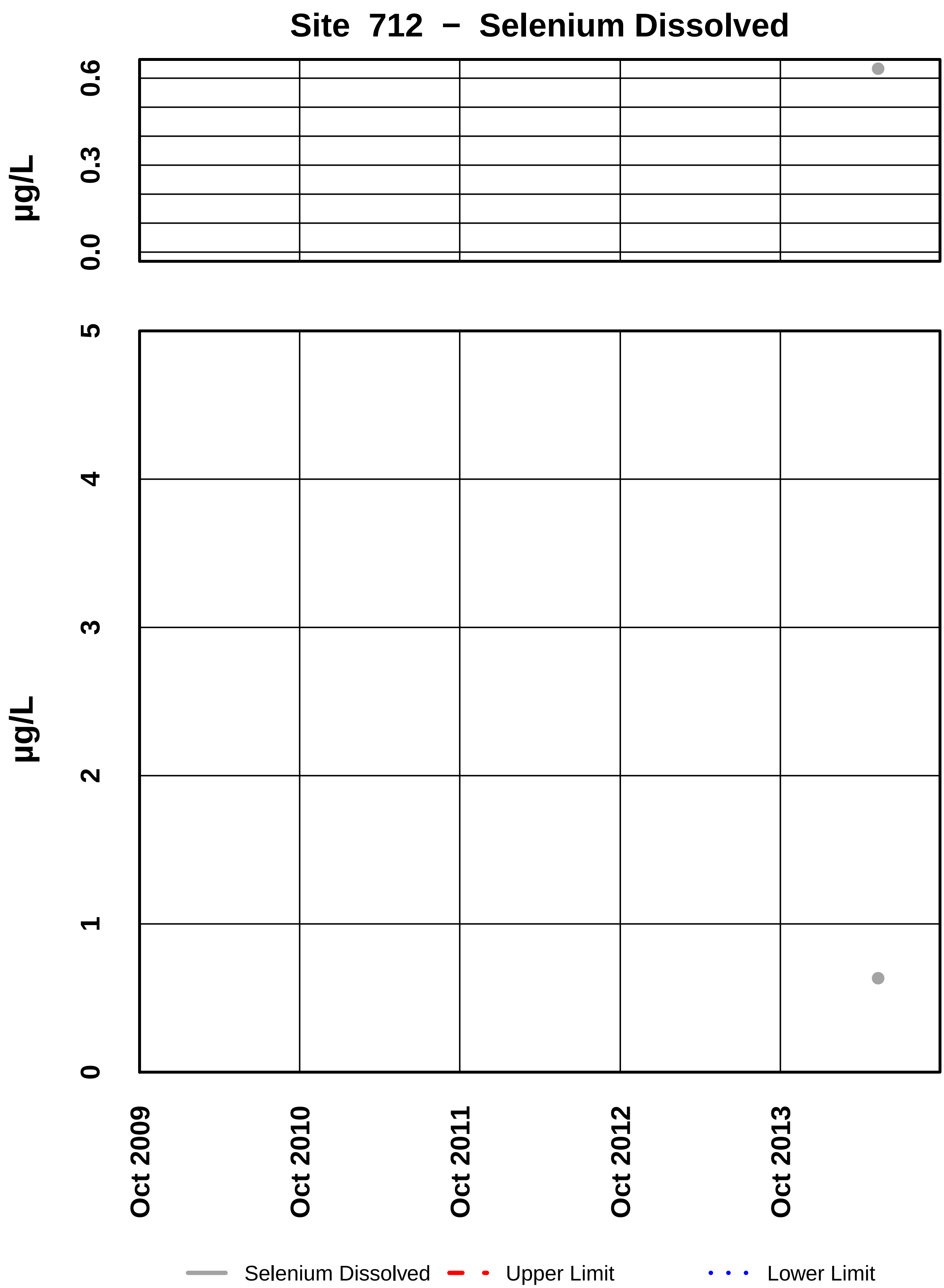
## Site 712 – Silver Dissolved



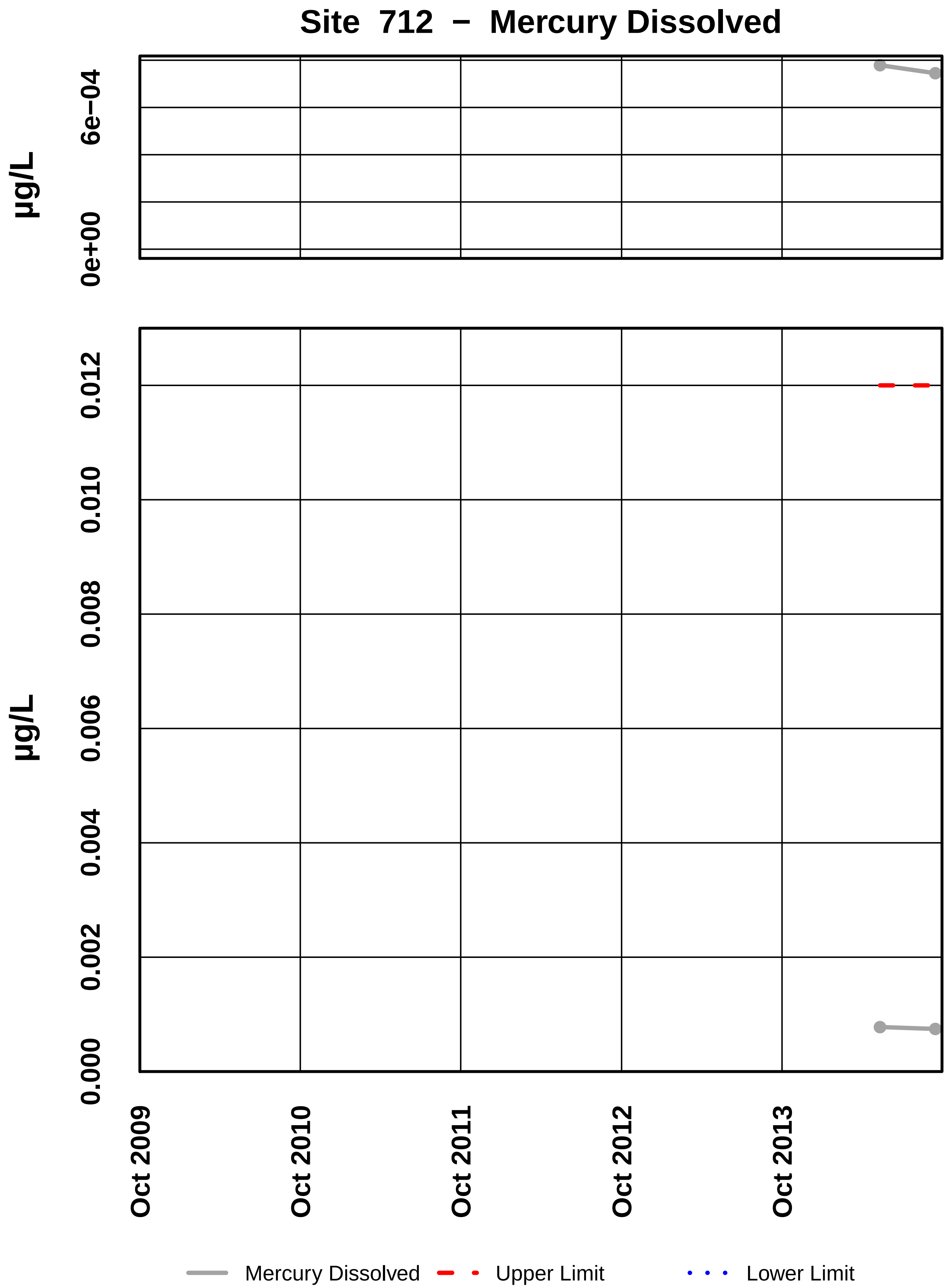

Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis




Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

# APPENDIX B

**Map Sheets**

Map 1-920 Area FWMP Sites
Map 2-Tailings Area FWMP Sites
Map 3-Site 9, Tributary Creek

APPENDIX A

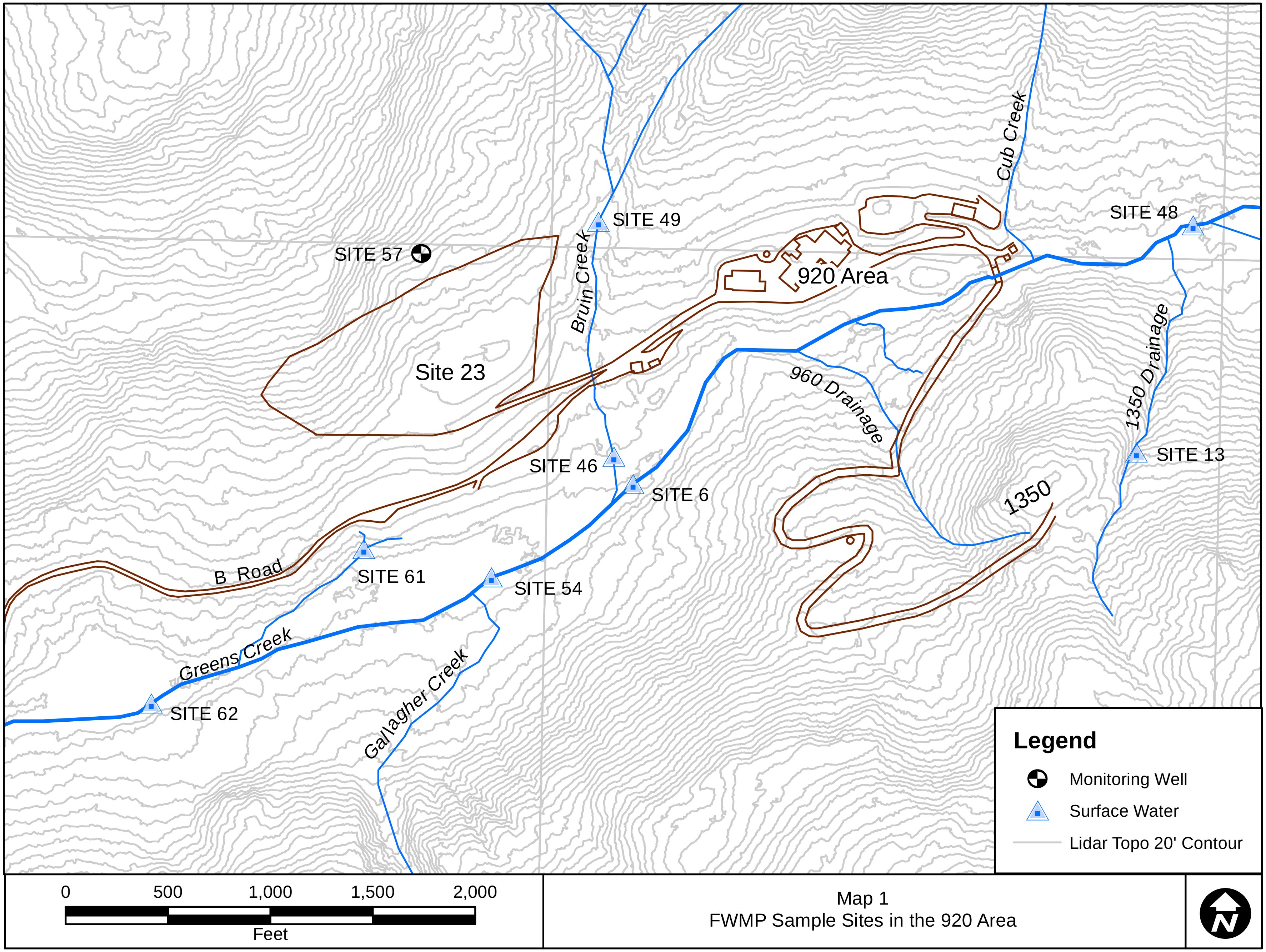
| Parameter | Drinking Water | Stockwater | Irrigation Water | Aquatic Life-Fresh Water | | | | | | | | Human Health Criteria for NonCarcinogens | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Acute | | | | Chronic | | | | | |
| | | | | criteria | as | multilply by conversion factor | to convert to | criteria | as | multiply by conversion factor | to convert to | Water + Aquatic Organisms | Aquatic Organisms Only |
| alkalinity | | | | | | | | **20,000 minimum** | | | | | |
| As | **10** | 50 | 100 | 340 | TR | 1 | D | 150 | TR | 1 | D | | |
| Ba | **2,000** | | | | | | | | | | | | |
| Cd | 5 | 10 | 10 | e^1.0166(ln hardness)-3.924 | TR | 1.136672-[(ln hardness)(0.041838)] | D | e^0.7409(ln hardness)-4.719 | TR | 1.101672-[(ln hardness)(0.041838)] | **D** | | |
| Cr | 100 | | | | | | | | | | | | |
| Cr(total) | | | 100 | | | | | | | | | | |
| Cr(III) | | | | e^0.819(ln hardness)+3.7256 | TR | 0.316 | D | e^0.819(ln hardness)+0.6848 | TR | 0.860 | D | | |
| Cr(VI) | | 50 | | 16 | D | | | **11** | **D** | | | | |
| Cu | | | 200 | e^0.9422(ln hardness)-1.700 | TR | 0.960 | D | e^0.8545(ln hardness)-1.702 | TR | **0.960** | **D** | 1,300 | |
| Pb | | 50 | 5,000 | e^1.273(ln hardness)-1.460 | TR | 1.46203-[(ln hardness)(0.145712)] | D | e^1.273(ln hardness)-4.705 | TR | 1.46203-[(ln hardness)(0.145712)] | **D** | | |
| Hg | 2 | | | 1.4 | D | | | **0.012** | TR | | | 0.05 | 0.051 |
| Ni | 100 | | 200 | e^0.846(ln hardness)+2.255 | TR | 0.998 | D | e^0.846(ln hardness)+0.0584 | TR | 0.997 | D | 610 | 4,600 |
| Se | 50 | 10 | 20 | 1/[([selenite]/185.9)+ ([selenate]/12.83] | TR | 0.922 | D | **5** | **TR** | **0.922** | **D** | 170 | 11,000 |
| Ag | | | | **e^1.72(ln hardness)-6.52** | **TR** | **0.850** | **D** | | | | | | |
| Zn | | | 2,000 | e^0.8473(ln hardness)+0.884 | TR | 0.978 | D | e^0.8473(ln hardness)+0.884 | TR | **0.986** | **D** | 9,100 | 69,000 |

all units in micrograms per liter (ug/L)

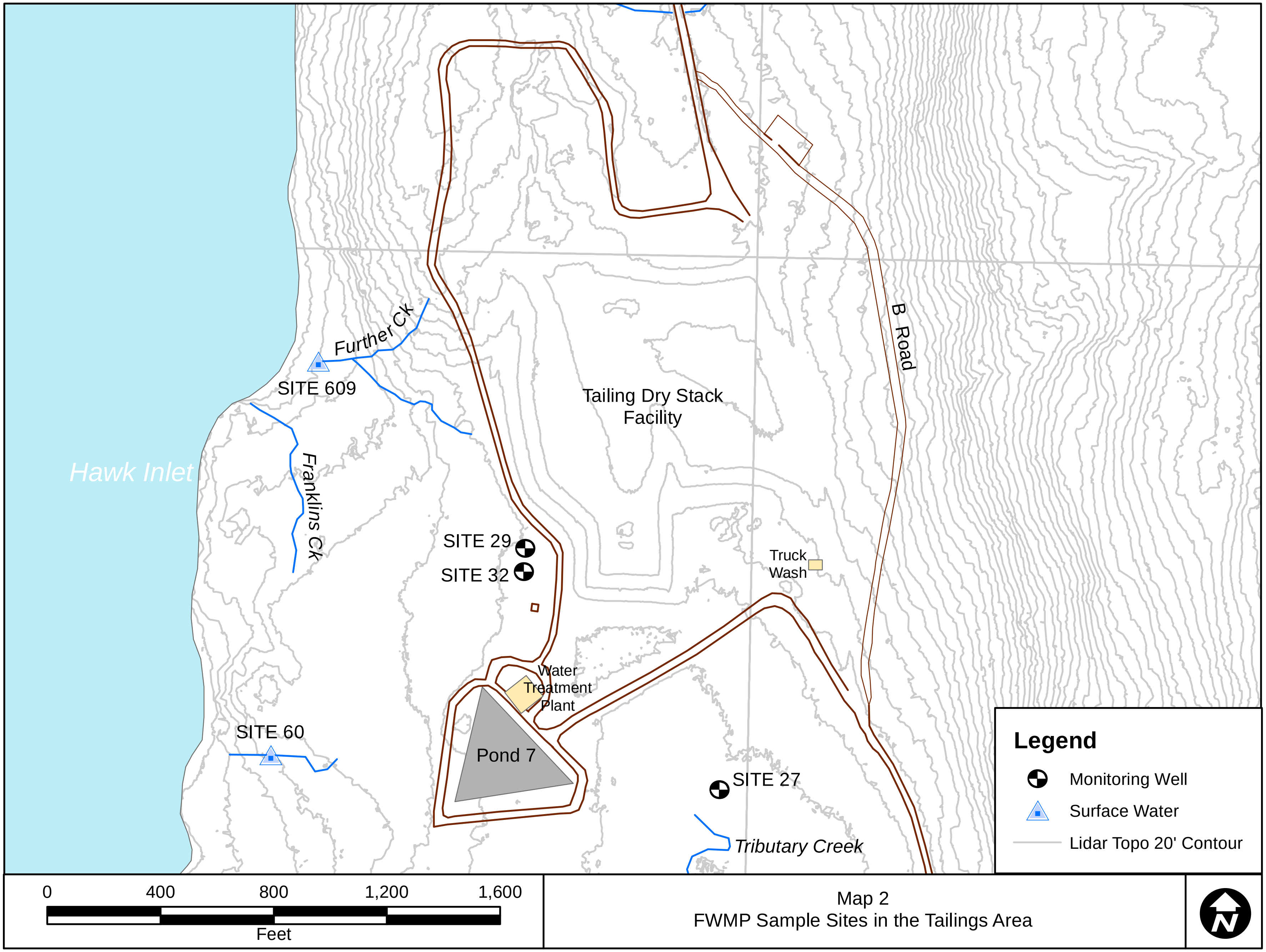
DENOTES STRICTEST CRITERIA

TR total recoverable
D dissolved
H some of the criteria for this parameter are hardness dependant
FWA Fresh Water Acute
FWC Fresh Water Chronic

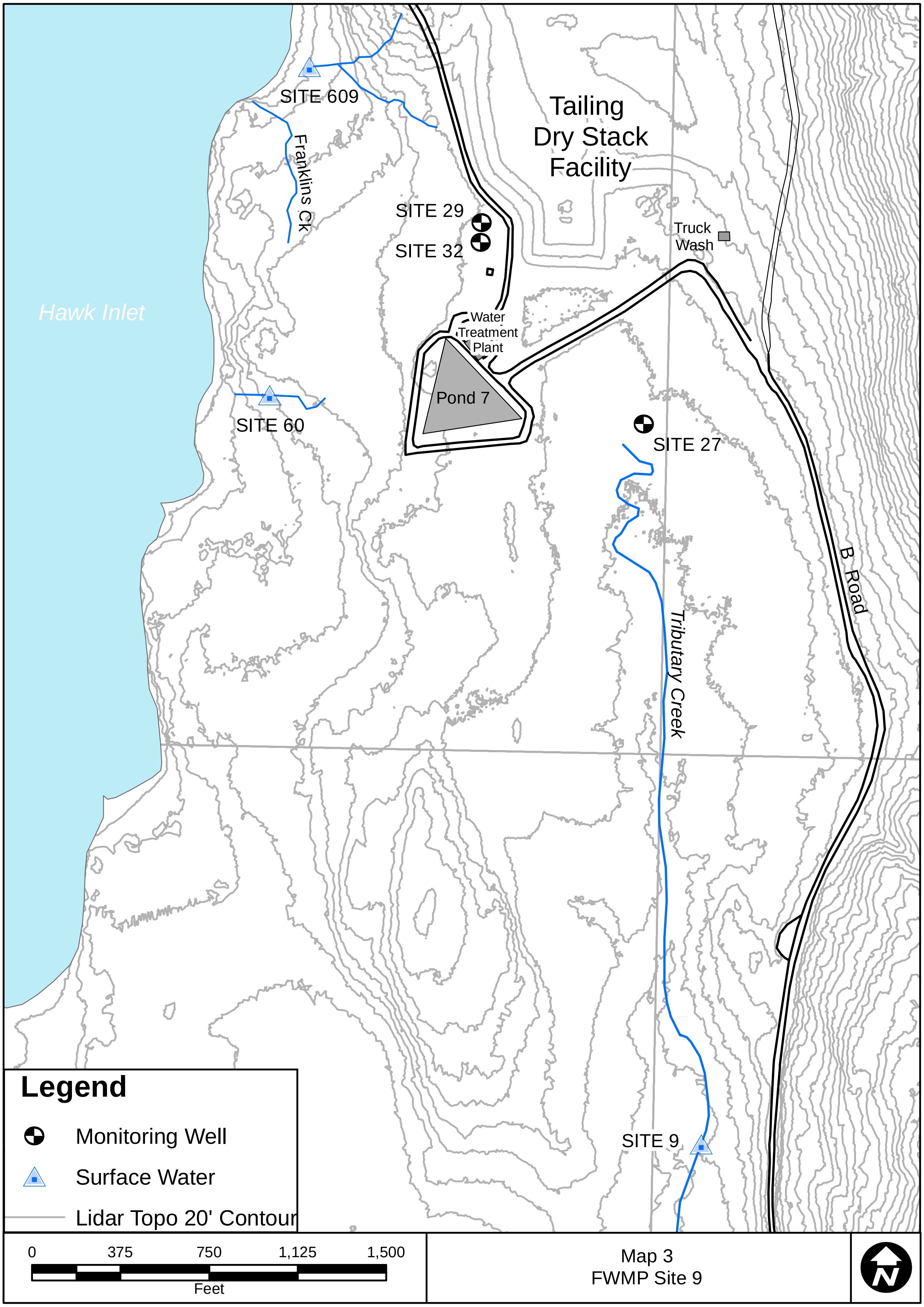
**Source:** http://www.dec.state.ak.us/water/wqsar/wqs/toxicsbook.xls
Table formatting was modified by HGCMC to include only parameters include in Suite P and Q and to highlight the strictest standard.




Map 1
FWMP Sample Sites in the 920 Area




Map 2
FWMP Sample Sites in the Tailings Area


Hawk Inlet
SITE 609
Franklins Ck
Tailing
Dry Stack
Facility
SITE 29
SITE 32
Truck
Wash
Water
Treatment
Plant
Pond 7
SITE 60
SITE 27
B Road
Tributary Creek
SITE 9
Legend
Monitoring Well
Surface Water
Lidar Topo 20' Contour
0
375
750
1,125
1,500
Feet
Map 3
FWMP Site 9