Hecla
GREENS CREEK

FRESH WATER MONITORING PROGRAM
ANNUAL REPORT

WATER YEAR 2013

(October 1, 2012 through September 30, 2013)

Hecla Greens Creek Mining Company

April 15, 2014

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EXECUTIVE SUMMARY

This annual report has been prepared by Hecla Greens Creek Mining Company (HGCMC) in accordance with the mine's General Plan of Operations Appendix 1: Fresh Water Monitoring Program (FWMP). Monitoring data interpretative reports are presented for eleven 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 November sampling of Site 13 and the February sampling of Site 57, 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 two 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). Four exceedances (dissolved cadmium, dissolved mercury, dissolved selenium, and dissolved zinc) were recorded in May 2013 at the new surface water location Site 61. Though this sampling had these constituents above AWQS the down gradient site (Site 62), which receives this drainage, during the same sample period was well within AWQS. To further understand the issues HGCMC has switched the sampling frequency at Site 61 from quarterly to monthly.

Though there are typically exceedances of AWQS at Site 13 for total sulfate, there were none this year. HGCMC removed an additional 5,645 cubic yards of material from the 1350 during the 2013 summer season. It is HGCMC's intention to remove the accessible remaining material from the 1350 during the 2014 summer season. There will be some material left in the access road to the 1350 until final reclamation.

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 display a long history of exceedances due to the low pH and low alkalinity that characterize these sites located in organic rich peat sediments. Four exceedances for dissolved lead occurred at one of the three down gradient shallow wells (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. Though lead is above AWQS at Site 32 there has been a continual decrease in the concentration since the high values recorded during the 2006 and 2007 water years.

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: as the area recovers the water is returning to the naturally low pH and low alkalinity characteristic of the area. It has been theorized that the disturbance resulted in the watershed changing from naturally acidic to alkaline conditions. This change in fundamental chemistry is thought to have caused the naturally occurring, low level, dissolved mercury to adsorb onto soil particles. Now as the area reverts to the natural state of low pH and low alkalinity, this abundance of adsorbed mercury may be dissolving back into solution, resulting in the temporary mercury increase. After this disturbance mercury concentrations had continued to increase yearly until water year 2009, which showed a decrease in concentration. In water year 2010, the highest mercury measurement recorded (0.0227µg/L) occurred in September 2010. Then the concentration initially decreased and was below AWQS at the beginning of water year 2011, but by September 2011 the concentration was again in exceedance (0.0183 µg/L). After an initial decrease in concentration mercury concentrations rose to the second highest value (0.0213 µg/L) by the end of water year 2012.Two of the four samples collected during the current water year were within AWQS, the other two were only slightly above the AWQS at 0.0174 µg/L each.

As a result of data collected in the previous water year the above hypothesis was revised slightly. It is still HGCMC hypothesis that the issue is being driven by the adsorption and desorption of mercury with the change in pH. However, instead of creating a 'pool' of adsorbed mercury once and depleting it, this process has occurred several times. Though overall the pH of the system is trending towards lower values there has been great fluctuations. It is believed that these fluctuations 'see saw' about the equilibrium point of the adsorption desorption mechanism. Additional sampling in adjacent drainages during water year 2009 and water year 2012 showed that this issue was isolated to only the Althea watershed. In the last annual report HGCMC proposed to conduct a pH survey of the muskeg region to the west of Pond 7 and also the drainage above Site 60, in order to better understand the pH dynamics of the system. Along with this work an evaluation of the catchment and pump back system at Pond 7 was also proposed. This work was delayed and was not conducted in the previous water year. It is now HGCMC intention to conduct this work during the spring/summer of 2014.

The final two sites in the tailings facility, Site 9 and Site 609, only 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.

Graphical and non-parametric analyses for trends in the data were performed for all sites monitored. Statistically significant trends were identified for eleven sites: Site 48, increasing trend in total alkalinity; Site 6, upward trend in total alkalinity; Site 54, upward trend in total sulfate; Site 57, increasing trends in pH and total alkalinity, 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 29, decreasing trend in conductivity and dissolved zinc; Site 32, a downward trend in dissolved zinc.

Site 48 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 and Site 6) had similar low magnitude increasing trends in total alkalinity. Though this is an increasing trend, Site 48 indicates that a portion of the increase is natural variation. The increasing trend recorded at Site 54 for total sulfate is minor and total sulfate at the site remains well below the AWQS. Conductivity at Site 29 has been trending downward for several years. Downward trends in dissolved zinc at Site 29 and Site 32 may indicate a decrease in loading from fugitive dust. Also, the upward trend in total alkalinity at Site 27 is still well within the historical range. And the increasing trend at Site 60 for dissolved zinc is low in magnitude.

A non-parametric comparison of medians was performed for all the appropriately paired surface (48-6 and 6-54). 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. Also, there were significant differences for the paired dataset (6-54) from Greens Creek for conductivity and total sulfate. There were no trends for the total alkalinity, total sulfate, or dissolved zinc data.

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 theses 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 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 2013 (October 1, 2012 through September 30, 2013) provides the information required by the Fresh Water Monitoring Program (FWMP) for the Hecla Greens Creek Mining Company (HGCMC). 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 2013 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 (SIGs) for each site sampled during the Water Year 2013.

		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		
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		

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) and Site 54 (Site 6). For each of these sites, the statistical information goals requested a comparison of medians 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 (ΣS_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 **increases** by the weathering of carbonate mineralology, 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 2013 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 2013. 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

There were no mid-year modifications made.

GENERAL HISTORY

There has been an error in the graphical labeling found in the 2004-2009 annual reports. It was recently noticed 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.

FWMP Sample Log

2013 Water Year October 2012 Through September 2013

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	
62	062FMS	Greens Creek Lower Than 54						P	P	P	P	P	P	P
609	609FMS	Further Creek Lower								Q		Q		Q
1067	1067	TRIP BLANK								Q				Q
1068	1068	FIELD BLANK @ SITE	**54**	**46**	**6**	**48**	**49**	**54**	**6**	**60**	**48**	**59**	**57**	**9**

No sample taken, lack of access (i.e. snow)

Regular monthly 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

PERSONNEL INVOLVED

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Chad Van Ormer
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Sarah Samuelson
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Jessica Lopez-Pierce

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Sue Weber, Project Manager
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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
56	Monitoring Well-D-00-01	58°04’48.140” N	134°38’32.580” 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

Since the last revision of the FWMP in October 6, 2000 several changes have been made to the program, not all of which were accurately documented. Also, there are discrepancies within the FWMP as to which sites were to be monitored. During the most recent annual meeting HGCMC was asked to address the changes to the FWMP that need to be made. The following letter addressing these changes was submitted to the USFS and ADEC on 9 January 2013. Approval of the modifications was granted on 23 January 2013 and included these three statements:

1. The approved modifications should be implemented as soon as practical.
2. The date the modifications go into effect must be stated in the next annual report.
3. The modifications must be incorporated into the General Plan of Operations Appendix 1, the Fresh Water Monitoring Program (FWMP), and into the Integrated Waste Management Monitoring Plan (IWMMP) since this is scheduled to replace the FWMP.

The approved modifications were implemented with the March 2013 FWMP sampling event.

Hecla GREENS CREEK

9 January 2013

David Schmerge
USFS Tongass National Forest
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Juneau, AK 99801

Ed Emswiler
ADEC – Solid Waste Program
410 Willoughby Ave #303
Juneau, AK 99801

The following is a proposal by Hecla Greens Creek Mining Company (HGCMC) for the modification of the Freshwater Monitoring Program (FWMP). This proposal supersedes the letter that was sent on 22 October 2012, which only dealt with the sampling schedule and did not fully address the requirements for modification set out in section 13.2 of the FWMP. These changes were proposed during a meeting with the United States Forest Service (USFS), Alaska Department of Fish and Game (ADFG), Alaska Department of Environmental Conservation (ADEC) and HGCMC personnel on 3 October 2012. One other modification, addition of Site 609 (Further Creek Lower Reach), was requested by the USFS and ADEC during a subsequent phone call with HGCMC on 19 November 2012.

After the 2000 revision of the FWMP there were a few modifications made that lacked proper documentation. Though there was not proper documentation for changes made to the FWMP the following sites have been monitored now for several years as part of the FWMP.

- Added Lower Althea Creek (Site 60) to the sampling schedule.
- Changed the sampling regime at Tributary Creek (Site 9) to include water quality analysis along with the yearly biomonitoring.

The results of this monitoring have been reported in the annual FWMP reports and presented at the annual meetings.

The following is a summary of the modifications being proposed as a direct result of the above mentioned meeting and phone call with the agencies. After this summary there is a detailed discussion of each of these changes.

1. Change the status of Site 28 (MW-2D) to inactive.
2. Change the status of Site 30 (MW-3D) to inactive.
3. Change the status of Site 58 (MW-T-00-01C) to inactive.
4. Change the status of Site 59 (MW-T-00-01A) to inactive.

5. Change the status of Site 56 (MW-D-00-01) to inactive.
6. Change the status of Site 32 (MW-5S) to active
7. Add and activate Site 609 (Further Creek Lower Reach) to the FWMP.
8. Add and activate a new site at the confluence of the two streams west of D pile in the Greens Creek floodplain (New Site #1).
9. Add and activate a new site on Greens Creek, ¼ mile downstream of Site 54, and adjacent to 7.7 mile along the B road (New site #2).

Attachments to this letter

To aid in the understanding of the topics discussed in the following section there are several attachments with this letter. These attachments include maps of the current and proposed FWMP sites along with a table of the site coordinates. Tables are also included for the current and proposed FWMP schedules. Lastly drill logs for all the monitoring well sites have also been included.

Inactivation of Site 28 (MW-2D) and Site 30 (MW-3D)

- Both of these wells (map 1) were completed in the silt layer that underlies the tailings facility and do not monitor the upper most aquifer (drill log MW-2D and MW-3D) in which tailings associated water would likely be seen. Which is not in accordance with 18 AAC 60.825 (a)(2)(c)(3), which states that monitoring 'must ensure detection of groundwater pollution in the uppermost aquifer'.
- Though Site 30 (MW-3D) is being made inactive it has not been sampled as part of the FWMP since the last revision. There were conflicting requirements with the FWMP as to which sites were to be sampled.
- There are no expected changes to the effectiveness of the current FWMP ability to monitor the potential impact the tailings storage facility is having on the surrounding environment.

Inactivation of the Site 58 (MW-T-00-01C) and Site 59 (MW-T-00-01A)

- Both of these wells were installed in 2000 as a direct result of suggestions in the Shepherd-Miller report that had been commissioned by an Inter-Agency FWMP Review Team.
- These wells were installed northeast of the tailings storage facility as upgradient wells for inter-well statistical analysis with the associated downgradient wells (Site 27 (MW-2S), Site 28 (MW-2D), Site 29 (MW-3S), and Site 32 (MW-5S).
- With the eastern expansion of the tailings facility in 2011 these wells are no longer in an upgradient position and are now influenced by changes in hydrology associated with the expansion (map 1).
- Without these wells for inter-well comparison the statistical analysis for the downgradient shallow wells will now use intra-well analysis methodology.

Inactivation of Site 56 (MW-D-00-01)

- Site 56 (MW-D-00-01) was established in 2000 as a direct result of suggestions in the Shepherd-Miller report that had been commissioned by an Inter-Agency FWMP Review Team.
- This well was the downgradient component of a pair of wells for monitoring Site 23 and D pile, and is located to the southeast of D Pile (map 3). The corresponding upgradient well 57 (MW-23-00-03) is located to the north of Site 23 (map 3).
- After years of sampling it has been established that the water chemistry at Site 56 (MW-D-00-01) is not reflective of facility related drainage, but is heavily influenced by the Greens Creek flood plain.
- There are no expected changes to the effectiveness of the current FWMP ability to monitor the potential impact that Site 23 / D Pile facility is having on the surrounding environment.
- Statistical analysis for the upgradient Site 57 (MW-23-00-03) will now use intra-well analysis methodology.

Activation of Site 32 (MW-5S)

- HGCMC has been monitoring this site since the 2000 revision of the FWMP; however there was some confusion with the current FWMP whether or not this was an active monitoring site.

- Site 32 (MW-5S) is located to the west of the tailings storage facility (map 1), and completed in the peat strata in which tailings associated water would likely be seen (drill log MW-5S).
- Statistical analysis will now be conducted using intra-well methodology and not inter-well methodology, because of the proposed inactivation of Site 58 (MW-T-00- 01C).
- There are no expected changes to the effectiveness of the current FWMP ability to monitor the potential impact the tailings storage facility is having on the surrounding environment.

Addition and Activation of Site 609 (Further Creek Lower Reach)

- Further Creek Lower Reach is a surface water site located to the west of the tailings storage facility (map 1) and has been used as an internal monitoring point for several years. This monitoring is documented in the annual report and presented during the annual meeting with the agencies.
- It is at the request of the agencies that HGCMC is proposing to add and activate Site 609 as part of the FWMP.
- It is expected that the effectiveness of the current FWMP ability to monitor the potential impact the tailings storage facility is having on the surrounding environment, will be strengthened with the addition of this site.
- This site is to remain numbered 609 and named Further Creek Lower Reach to avoid the confusion that is generated when the same site is given multiple names / numbers.
- Without an upgradient background site, statistical analysis will be conducted on an intra-site basis.

Addition and Activation of New Site #1

- HGCMC is proposing to add and activate a surface water monitoring site at the confluence of the two streams west of Site 23 / D pile in the Greens Creek floodplain (map 3). The confluence of these two streams is within 100 feet of the Site 23 / D pile facility boundary. Whereas the course of the streams vary from only a few feet from the boundary up to a maximum of a 100 feet at the confluence.
- The addition of this site to the FWMP is to monitor for the potential impact that Site 23 / D Pile may have on the Greens Creek flood plain and potentially Greens Creek.
- After acceptance of this proposed site it will be numbered 61 and named Site 61.
- Without an upgradient background site, statistical analysis will be conducted on an intra-site basis.

Addition and Activation of New Site #2

- HGCMC is proposing to add and activate a surface water monitoring site below the confluence of Greens Creek and the stream now monitored at the proposed New Site #1 (map 3). This site will be approximately ¼ mile downstream from the current FWMP Site 54 (Greens Creek Lower).
- The addition of this site to the FWMP is to monitor for the potential impact that Site 23 / D Pile may have on Greens Creek.
- After acceptance of this proposed site it will be numbered 62 and named Site 62.
- As with the current FWMP there will be an inter-site statistical comparison made between this new downgradient site and Site 54 (Lower Greens Creek).

Current and Previous Sampling Schedule Changes

Table 1 represents the current sampling schedule; this includes the last modifications proposed in 2009 to the sampling frequency at Site 46 (Bruin Creek Lower), Site 49 (Bruin Creek Upper), Site 56 (MW-D-00-01), Site 57 (MW-23-00-03), Site 58 (MW-T-00-01C), Site 59 (MW-T-00-01A), Site 27 (MW-2S), Site 28 (MW-2D), Site 29 (MW-3S), and Site 32 (MW-5). The frequency of sampling was decreased at Site 46 (Bruin Creek Lower), Site 49 (Bruin Creek Upper), Site 56 (MW-D-00-01), and Site 57 (MW-23-00-03) to a quarterly sampling schedule; based on the analysis of the data collected that has shown that HGCMC activities have not had an impact on the water quality monitored by these sites. At the same time the sampling frequency was decreased at these four sites HGCMC increased the frequency of sampling of the six wells located at the tailings storage facility, Site 58 (MW-T-00-01C), Site 59 (MW-T-00-01A), Site 27 (MW-2S), Site 28 (MW-2D), Site 29 (MW-3S), and Site 32 (MW-5). The frequency was increased from biannual sampling to quarterly sampling to improve the ability of the FWMP to monitor the potential impact the tailings storage facility could have on the surrounding environment.

These modifications to the FWMP program were approved by the ADEC in a letter dated September 2, 2009. Also the proposal to change the July and September samplings at Site 60 (Althea Creek) from Suite P to Suite Q were approved by the ADEC in a letter dated July 12, 2011.Until these changes were made the schedule had remained mostly unchanged from the 6 October 2000 FWMP revision.

Changes HGCMC are proposing to make to the sampling schedule are summarized in Table 2. Ideally the implementation of these proposed modifications would take place within 90 days after the acceptance of the modifications has been acknowledged by the USFS and ADEC. However, if approval of these changes is received after the May 2013 sampling HGCMC would recommend not implementing them until the 2014 water year (beginning October 2013), for report writing and statistical reasons.

Should you have any questions regarding these proposed changes, please feel free to contact me at 790-8473.

Sincerely,

Christopher Wallace

Christopher Wallace
Environmental Engineer

After the submittal of last year's annual reports HGCMC was asked to include an existing site on Greens Creek, below Site E, into the FWMP. The following letter addressing these changes was submitted to the USFS and ADEC on 21 October 2013. Approval of the modifications was granted on 22 October 2013 from ADEC and 31 October 2013 from the USFS. These modifications were implemented with the water year 2014 FWMP.

Hecla GREENS CREEK

21 October 2013

David Schmerge
USFS Tongass National Forest
8510 Mendenhall Loop Road
Juneau, AK 99801

Doug Buetyn
ADEC – Solid Waste Program
410 Willoughby Ave #303
Juneau, AK 99801

RE: Addition of sites 711 and 712 to the Freshwater Monitoring Program

The following is a proposal by Hecla Greens Creek Mining Company (HGCMC) for the modification of the Freshwater Monitoring Program (FWMP). This proposal for the addition of two surface water sites is based on a request made by the United States Forest Service (USFS). After the submittal of the annual reports it was noted by the USFS that HGCMC does not have a monitoring point on Greens Creek that is below the furthest most point of operations, as part of the FWMP. The area of interest is the inactive waste rock facility, Site E, located at 4.6 mile B road. Site E is routinely monitored and the results are reported yearly in the inactive waste report along with being presented at the annual meeting. The USFS recognizes that the monitoring is occurring; however they want to incorporate it into the FWMP.

Historically Greens Creek had been monitored approximately one mile upstream from the mouth of the creek, below all points of operations. This monitoring was conducted at Site 7, Lower Greens Creek was discontinued from a safety standpoint, potential for bear human interactions, not from a need for monitoring. At the time the USFS did not request that HGCMC reestablish monitoring at another location along the creek, therefore official downstream monitoring ended. However, HGCMC has been internally monitoring downstream of operations at Site E for several years.

Site E is an inactive waste rock facility that HGCMC has been removing from a geo- chemical perspective. In order to monitor water quality around Site E, HGCMC has established a number of sites (surface water and ground water) in the area. One of the sites (712) is located down gradient of Site E in Greens Creek. It is Site 712 that the USFS has requested to have added to the annual FWMP. This site is currently visited 1-2 times per year based upon the removal activity associated with Site E. It was proposed that HGCMC could monitor Site 712 for the FWMP when other routine monitoring is taking place. This is considered an acceptable request from the USFS. HGCMC will also monitor the upstream site, Site 711, to establish analyte concentrations in Greens Creek prior to any potential influence from Site E, for comparison analysis.

The following is a summary of the modifications being proposed as a direct result of the above mentioned request. After this summary there is a detailed discussion of each of these changes.

1. Add and activate Site 711 (Greens Creek above Site E) to the FWMP.
2. Add and activate Site 712 (Greens Creek below Site E) to the FWMP.

Attachments to this letter

To aid in the understanding of the topics discussed in the following section there are several attachments with this letter. These attachments include a map of the proposed FWMP sites along with a table of all FWMP site coordinates. Tables are also included for the current and proposed FWMP schedules.

Addition and Activation of Site 711 (Greens Creek above Site E)

- Greens Creek above Site E is a surface water site located to the northwest of the inactive waste rock facility (map 1) and has been used as an internal monitoring point for several years. This monitoring is documented in the annual report and presented during the annual meeting with the agencies.

- It is a result of the request from the USFS that HGCMC is proposing to add and activate Site 711 as part of the FWMP.

- Sampling at the site will occur twice yearly once in April or May and once in September or October. The two month windows allow for coordinating with other yearly sampling events in the area.

- It is expected that the effectiveness of the current FWMP ability to monitor the potential impact the Site E waste rock facility is having on the surrounding environment, will be strengthened with the addition of this site.

- This site is to remain numbered 711 and named Greens Creek above Site E to avoid the confusion that is generated when the same site is given multiple names / numbers.

- This site will serve as an up gradient site to the down gradient Site 712, for comparison analysis.

Addition and Activation of Site 712 (Greens Creek below Site E)

- Greens Creek below Site E is a surface water site located to the southwest of the inactive waste rock facility (map 1) and has been used as an internal monitoring point for several years. This monitoring is documented in the annual report and presented during the annual meeting with the agencies.

- It is a result of the request from the USFS that HGCMC is proposing to add and activate Site 712 as part of the FWMP.

- Sampling at the site will occur twice yearly once in April or May and once in September or October. The two month windows allow for coordinating with other yearly sampling events in the area.

- It is expected that the effectiveness of the current FWMP ability to monitor the potential impact the Site E waste rock facility is having on the surrounding environment, will be strengthened with the addition of this site.

- This site is to remain numbered 712 and named Greens Creek below Site E to avoid the confusion that is generated when the same site is given multiple names / numbers.

- Site 712 will serve as a down gradient site on Greens Creek for the monitoring of the potential impact from Site E.

Table 1 summarizes the current sampling schedule and the changes HGCMC are proposing to make are summarized in Table 2. Ideally the implementation of these proposed modifications will take place in the spring of 2014, after the acceptance of the modifications has been acknowledged by the USFS and ADEC.

Should you have any questions regarding these proposed changes, please feel free to contact me at 790-8473.

Sincerely,

Christopher Wallace
Environmental Manager


B Road
Site E
Greens Creek
712
700
Site
Map 1
Proposed FWMP Sites
0
250
500
750
1,000
Feet
N

Site Number	Site Name	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
6	Middle Greens Creek	P	P	Q	P	Q	P	P	P	P	P	P	P
9	Tributary Creek-Lower		Q						Q		Q		Q
13	Mine Adit Discharge East		Q						Q			Q	
27	Monitoring Well 2S		Q						Q		Q		Q
29	Monitoring Well 3S		Q						Q		Q		Q
32	Monitoring Well 5S		Q						Q		Q		Q
46	Lower Bruin Creek		Q			Q			P			P	
48	Upper Greens Creek	P	P	Q	P	Q	P	P	P	P	P	P	P
49	Control Site Upper Bruin Creek		Q			Q			P			P	
54	Greens Creek below D-Pond	P	P	Q	P	Q	P	P	P	P	P	P	P
57	Monitoring Well -23-00-03		Q			Q			Q			Q	
60	Althea Creek - Lower		Q						Q		Q		Q
61	Greens Creek Floodplain		Q			Q			Q			Q	
62	Greens Creek Lower Than 54	P	P	Q	P	Q	P	P	P	P	P	P	P
609	Further Creek Lower		Q						Q		Q		Q

Table 2 – Proposed FWMP Water Year Monitoring Schedule

Site Number	Site Name	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
6	Middle Greens Creek	P	P	Q	P	Q	P	P	P	P	P	P	P
9	Tributary Creek-Lower		Q						Q		Q		Q
13	Mine Adit Discharge East		Q						Q			Q	
27	Monitoring Well 2S		Q						Q		Q		Q
29	Monitoring Well 3S		Q						Q		Q		Q
32	Monitoring Well 5S		Q						Q		Q		Q
46	Lower Bruin Creek		Q			Q			P			P	
48	Upper Greens Creek	P	P	Q	P	Q	P	P	P	P	P	P	P
49	Control Site Upper Bruin Creek		Q			Q			P			P	
54	Greens Creek below D-Pond	P	P	Q	P	Q	P	P	P	P	P	P	P
57	Monitoring Well -23-00-03		Q			Q			Q			Q	
60	Althea Creek - Lower		Q						Q		Q		Q
61	Greens Creek Floodplain		Q			Q			Q			Q	
62	Greens Creek Lower Than 54	P	P	Q	P	Q	P	P	P	P	P	P	P
609	Further Creek Lower		Q						Q		Q		Q
711	Greens Creek Above Site E	Q						Q					
712	Greens Creek Below Site E	Q						Q					

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
28	Monitoring Well-2D	58°06’48.600” N	134°44’37.344” W
29	Monitoring Well-3S	58°06’59.860” N	134°44’51.821” W
30	Monitoring Well-3D	58°06’58.654” N	134°44’54.846” 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
56	Monitoring Well-D-00-01	58°04’48.140” N	134°38’32.580” W
57	Monitoring Well-23-00-03	58°04’59.933” N	134°38’39.881” W
58	Monitoring Well-T-00-01C	58°07’12.758” N	134°44’38.252” W
59	Monitoring Well-T-00-01A	59°07’12.919” N	134°44’38.411” 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

Table 1 – Current FWMP Water Year Monitoring Schedule

BIBLIOGRAPHY

Environmental Protection Agency (1998). *EPA Guidance for Data Quality Assessment.* EPA QA/G-9, EPA/600-R-96/084. U.S. Environmental Protection Agency, Office of Research and Development, Washington, D.C. 219 pp.

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 2013" 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 2013 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 2013

			Limits		
Sample Date	**Parameter**	**Value**	**Lower**	**Upper**	**Hardness**
No exceedances have been identified by HGCMC for the period of October 2012 through September 2013.					

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. No obvious visual trends were apparent.

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-07 and Sep-13(WY2008-WY2013).

Table of Summary Statistics for Trend Analysis

	Mann-Kendall test statistics			Sen's slope estimate	
Parameter	**n***	**p****	**Trend**	**Q**	**Q(%)**
Conductivity Field	6	0.28			
pH Field	6	0.35			
Alkalinity, Total	6	0.01	+	0.817	1.919
Sulfate, Total	6	0.06			
Zinc, Dissolved	6	0.09			

* 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 (2013), total alkalinity has a slope estimate of 0.817 mg/L/yr.

Table of Results for Water Year 2013

Site 048FMS - 'Upper Greens Creek'

Sample Date/Parameter	Oct 2012	Nov 2012	Dec 2012	Jan 2013	Feb 2013	Mar 2013	Apr 2013	May 2013	Jun 2013	Jul 2013	Aug 2013	Sep 2013	**Median**
Water Temp (°C)	3.2	1.29	0.64	0.25	0.89	0.01	1.18	1.73	6.82	11.48	10.84	8.14	1.51
Conductivity-Field(μmho)	108	134	151	94	141	72	154	92	74	116	139	119	117.5
Conductivity-Lab (μmho)	83	133	107	90	122	166	150	88	70	110	132	88	109
pH Lab (standard units)	7.87	7.72	7.72	7.46	7.71	7.76	7.7	7.39	7.89	7.97	7.85	7.55	7.72
pH Field (standard units)	7.75	7.84	7.84	7.5	7.75	7.86	7.86	7.75	7.69	8.06	8	7.89	7.84
Total Alkalinity (mg/L)	44.2	53.1	58.9	32.1	48.1	59	52.7	32.4	29	42.9	50.2	47.6	47.9
Total Sulfate (mg/L)	10.3	16.5	19.8	9.8	14.5	22.6	18.8	7.7	6.4	13	17.1	11	13.8
Hardness (mg/L)	48.8	61.8	71.6	40	62.2	76.7	67	37.7	32.5	52.6	62	53.3	57.6
Dissolved As (ug/L)	0.222	0.195	0.182	0.195	0.186	0.169	0.192	0.188	0.178	0.236	0.242	0.243	0.194
Dissolved Ba (ug/L)			31.8		27.4								29.6
Dissolved Cd (ug/L)	0.0393	0.0415	0.0384	0.0361	0.0392	0.0366	0.032	0.0323	0.0241	0.0365	0.0419	0.0347	0.0366
Dissolved Cr (ug/L)			1.11		0.304								0.707
Dissolved Cu (ug/L)	0.556	0.364	0.301	0.827	0.431	0.418	0.406	0.499	0.267	0.301	0.375	0.532	0.412
Dissolved Pb (ug/L)	0.011	0.0093	0.0015	0.0239	0.0015	0.0015	0.0056	0.0093	0.0039	0.0036	0.0068	0.0067	0.0062
Dissolved Ni (ug/L)			0.912		0.771								0.842
Dissolved Ag (ug/L)			0.002		0.002								0.002
Dissolved Zn (ug/L)	3.89	4.08	3.12	3.65	3.36	3.24	2.57	3.31	1.8	2.34	9.89	2.59	3.28
Dissolved Se (ug/L)			1.2		1.07								1.135
Dissolved Hg (ug/L)	0.00107	0.00068	0.000453	0.00242	0.000886	0.000516	0.000743	0.00141	0.000459	0.000443	0.000625	0.00105	0.000712

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.

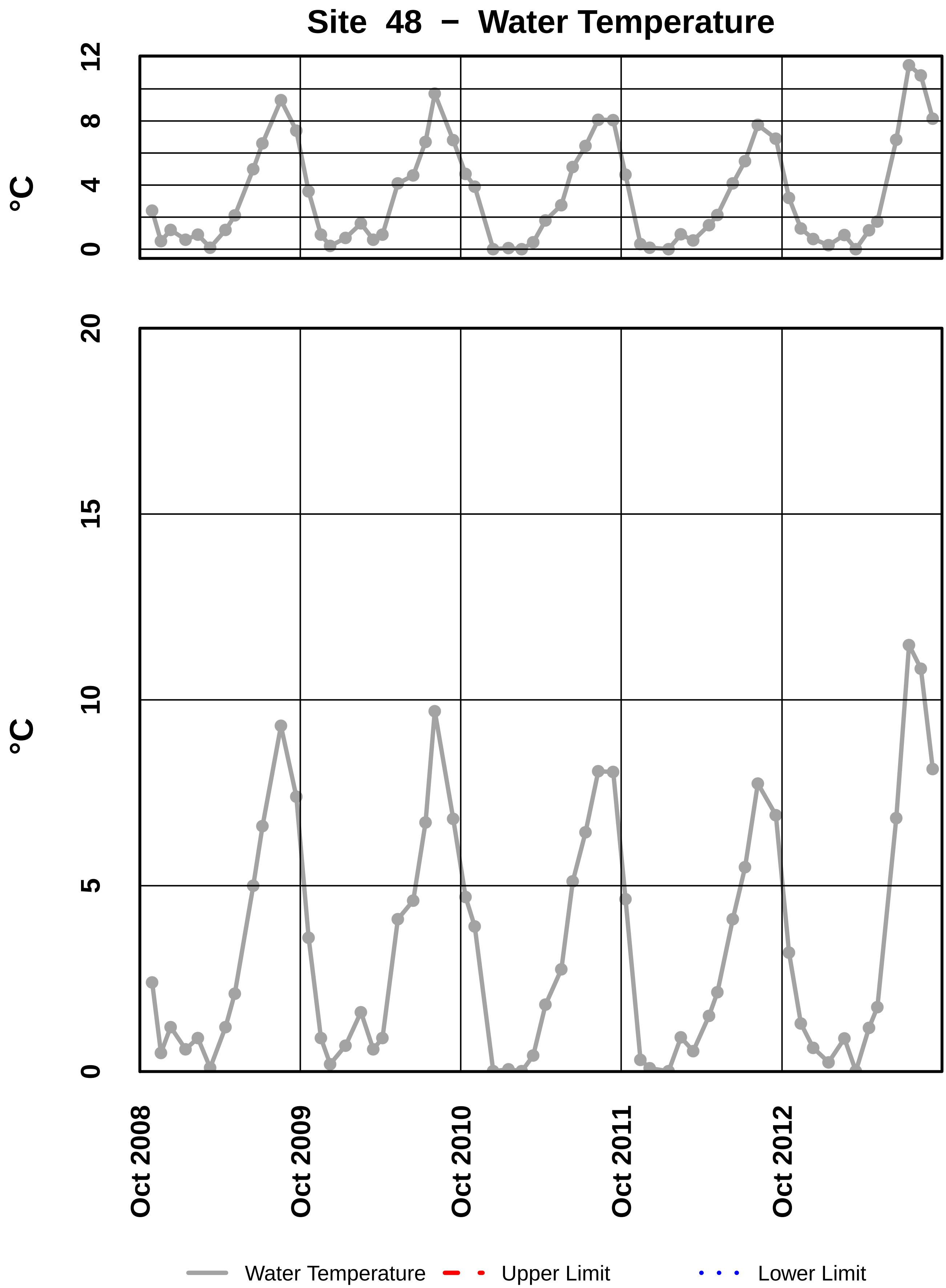
Shaded data has been qualified as an outlier by HGCMC and removed from any further analysis and is not included into the calculation of the median

Qualified Data by QA Reviewer

Date Range: 10/01/2012 to 09/30/2013

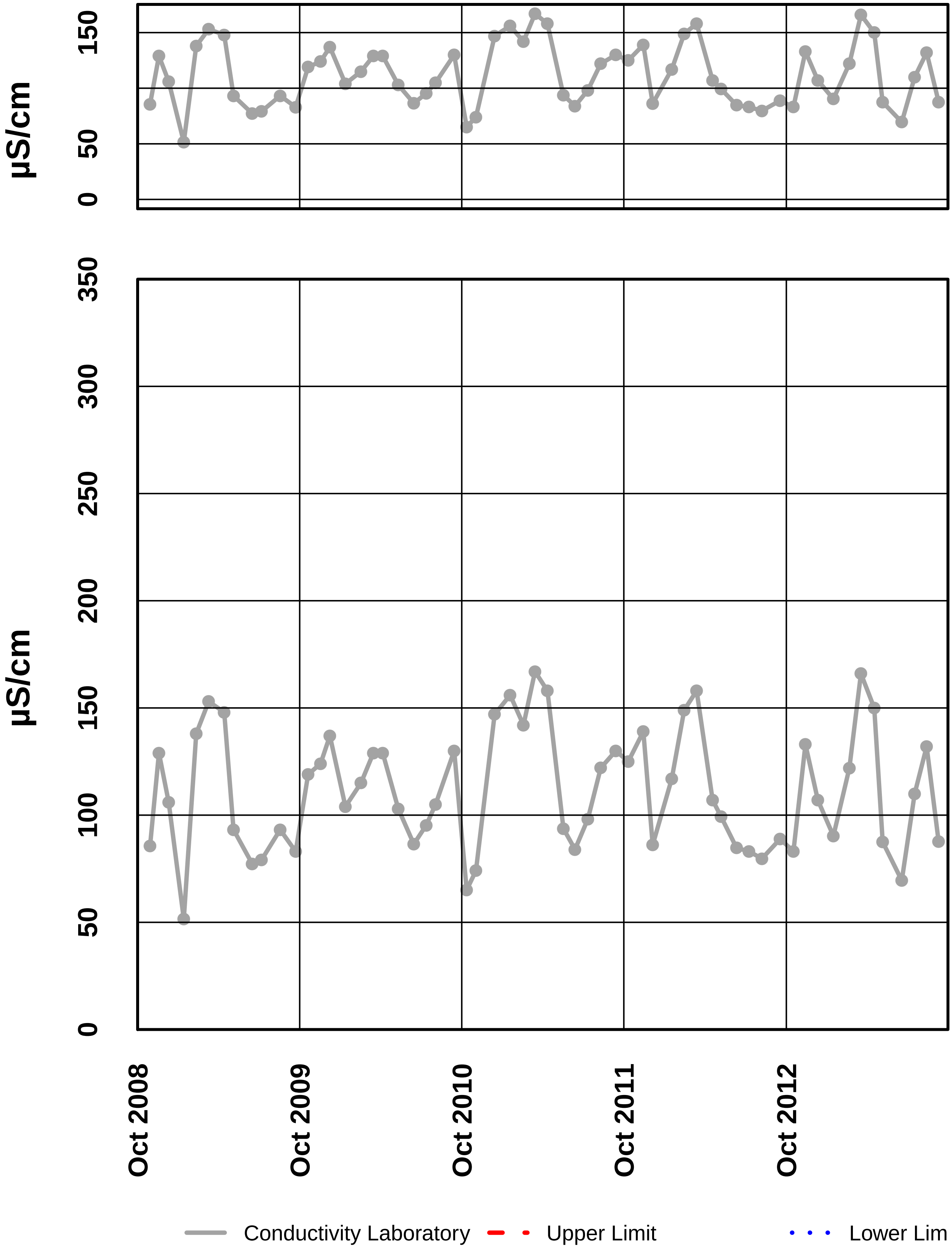
Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
48	10/17/2012	12:00 AM	SO4 Tot, mg/l	10.26	J	Sample Temperature
			Zn diss, µg/l	3.89	U	Field Blank Contamination
48	11/13/2012	12:00 AM	pH Lab, su	7.72	J	Hold Time Violation
			Zn diss, µg/l	4.08	U	Field Blank Contamination
			Hg diss, µg/l	0.00068	U	Field Blank Contamination
48	12/11/2012	12:00 AM	Hg diss, µg/l	0.000453	U	Field Blank Contamination
48	1/15/2013	12:00 AM	Hg diss, µg/l	0.00242	J	LCS Recovery
			Zn diss, µg/l	3.65	U	Field Blank Contamination
48	3/18/2013	12:00 AM	Hg diss, µg/l	0.000516	U	Field Blank Contamination
48	4/17/2013	12:00 AM	Pb diss, µg/l	0.00556	J	Below Quantitative Range
48	5/6/2013	12:00 AM	pH Lab, su	7.39	J	Hold Time Violation
			Alk, mg/L	32.4	U	Field Blank Contamination
48	6/18/2013	12:00 AM	Pb diss, µg/l	0.00392	J	Below Quantitative Range
			Hg diss, µg/l	0.000459	U	Field Blank Contamination
48	7/17/2013	12:00 AM	SO4 Tot, mg/l	13	J	Sample Receipt Temperature
			Pb diss, µg/l	0.0036	J	Below Quantitative Range
			Hg diss, µg/l	0.000443	U	Field Blank Contamination
48	8/13/2013	12:00 AM	Cond, µmhos	132	J	Sample receipt temperature
			Alk, mg/L	50.2	J	Sample receipt temperature
			SO4 Tot, mg/l	17.1	J	Sample receipt temperature
			Pb diss, µg/l	0.00678	U	Field Blank Contamination
			Hg diss, µg/l	0.000625	U	Field Blank Contamination
48	9/9/2013	12:00 AM	Pb diss, µg/l	0.0067	J	Below Quantitative Range
			SO4 Tot, mg/l	11	J	Sample receipt temperature
			Hg diss, µg/l	0.00105	U	Field Blank Contamination

Qualifier	Description
J	Positively Identified - Approximate concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit



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

Site 48 − Conductivity Laboratory



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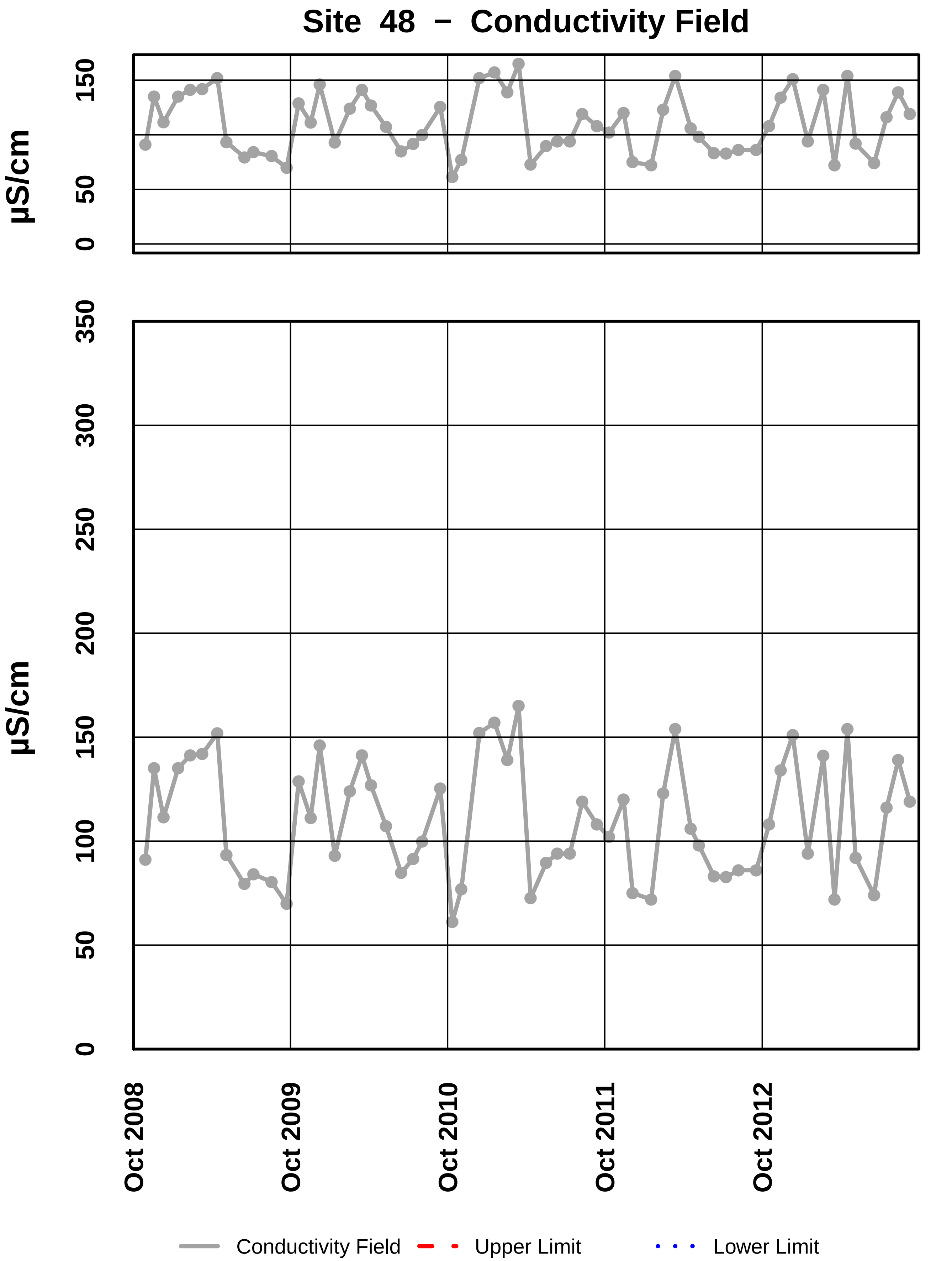

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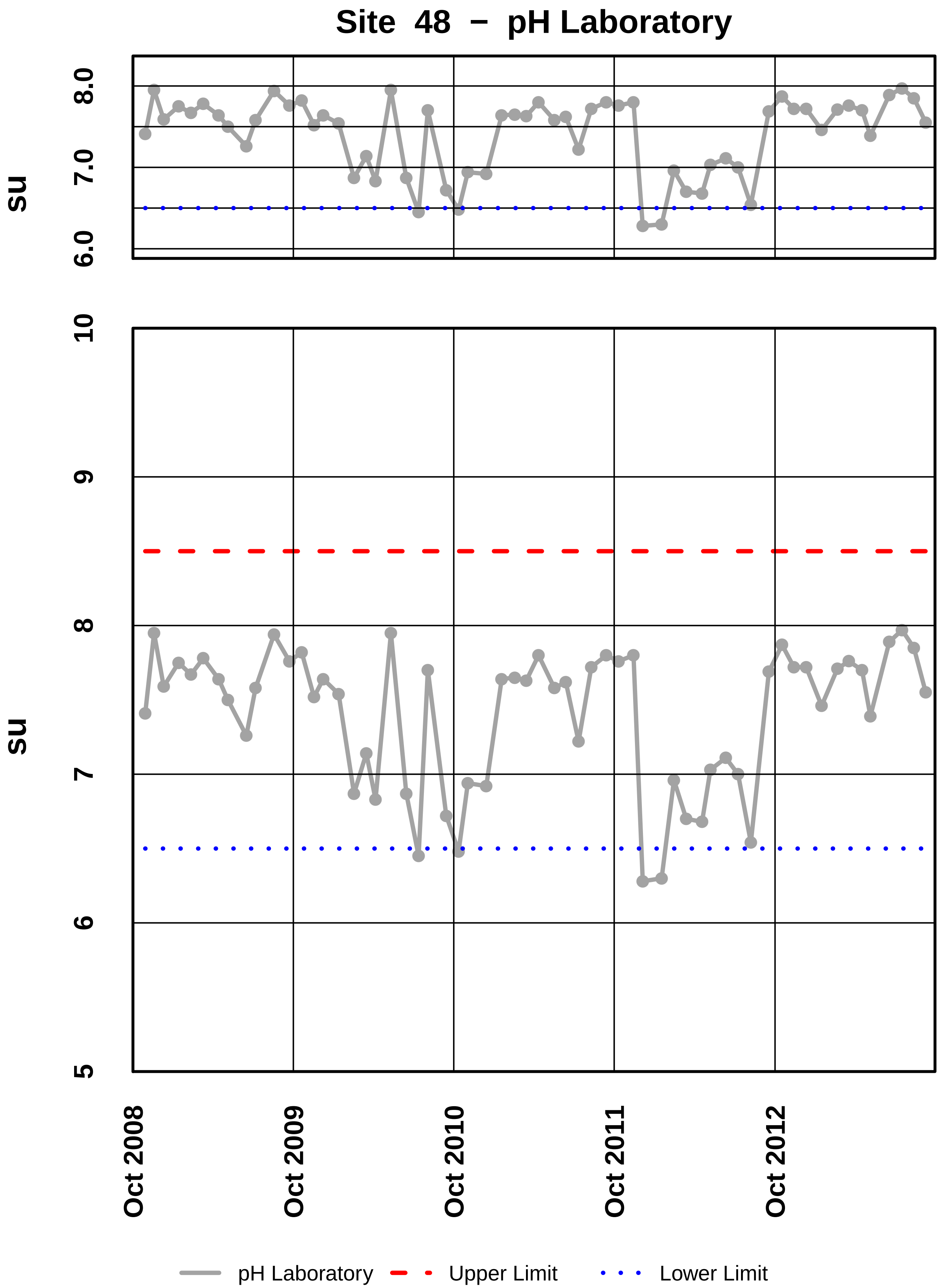
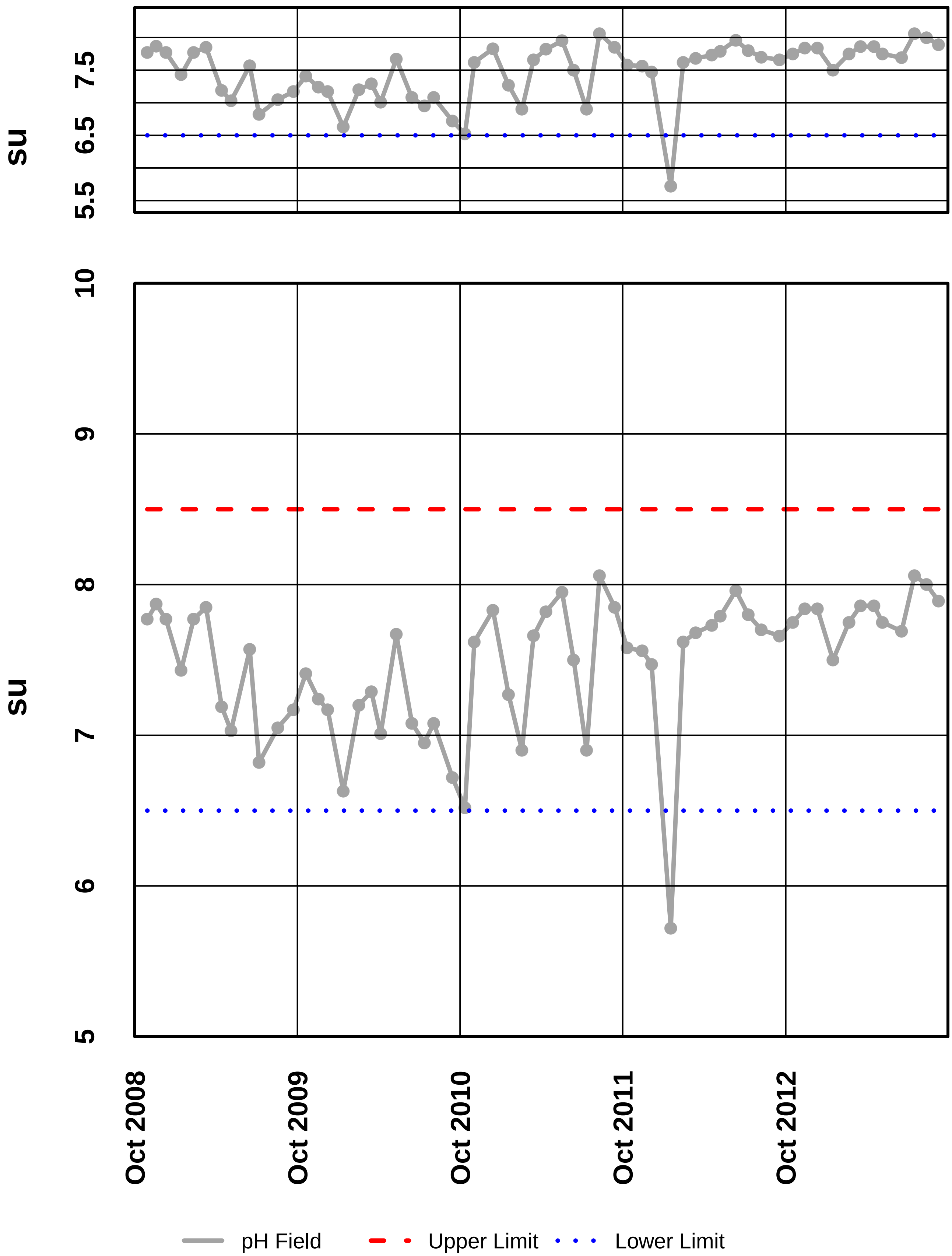
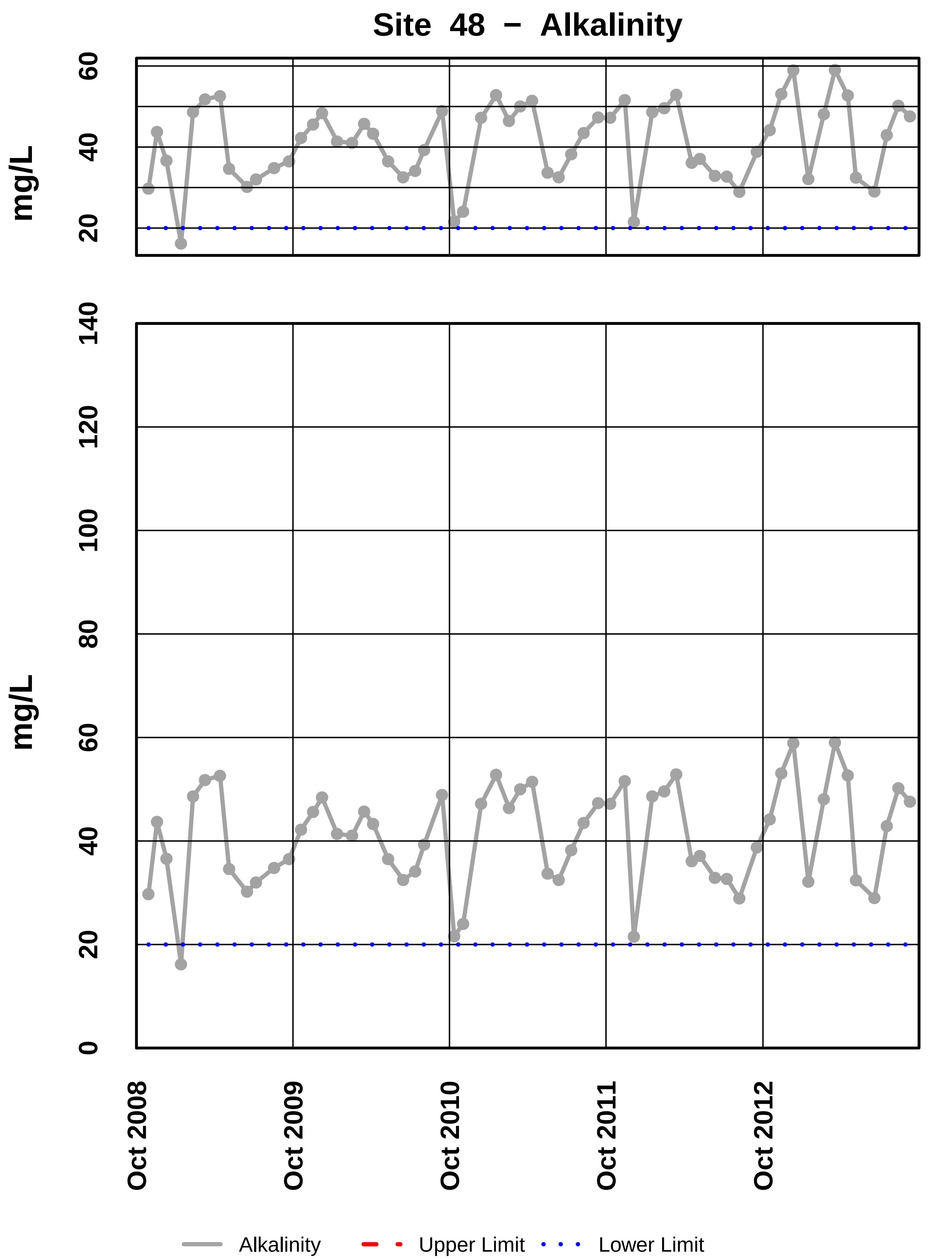


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 48 – pH Field

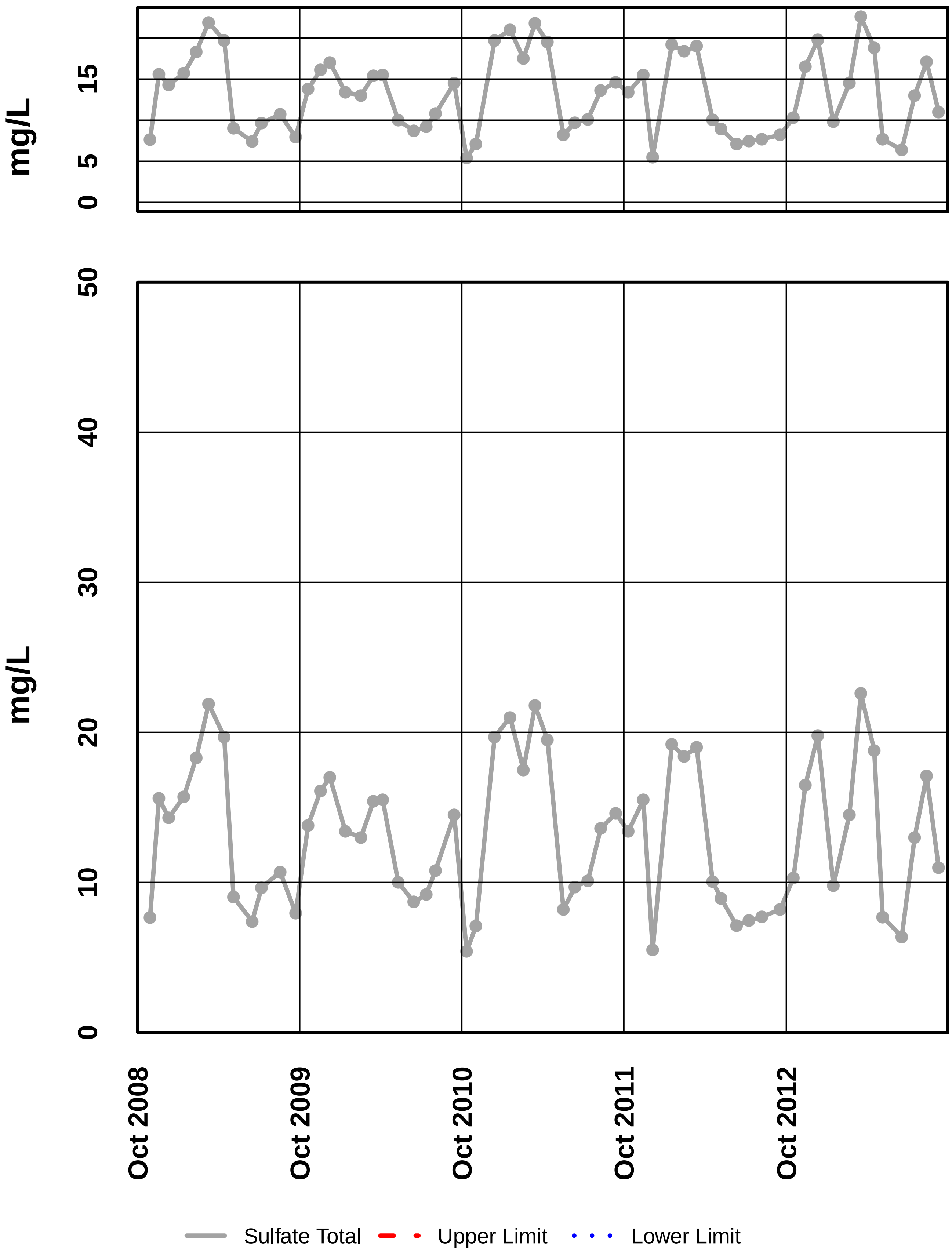


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

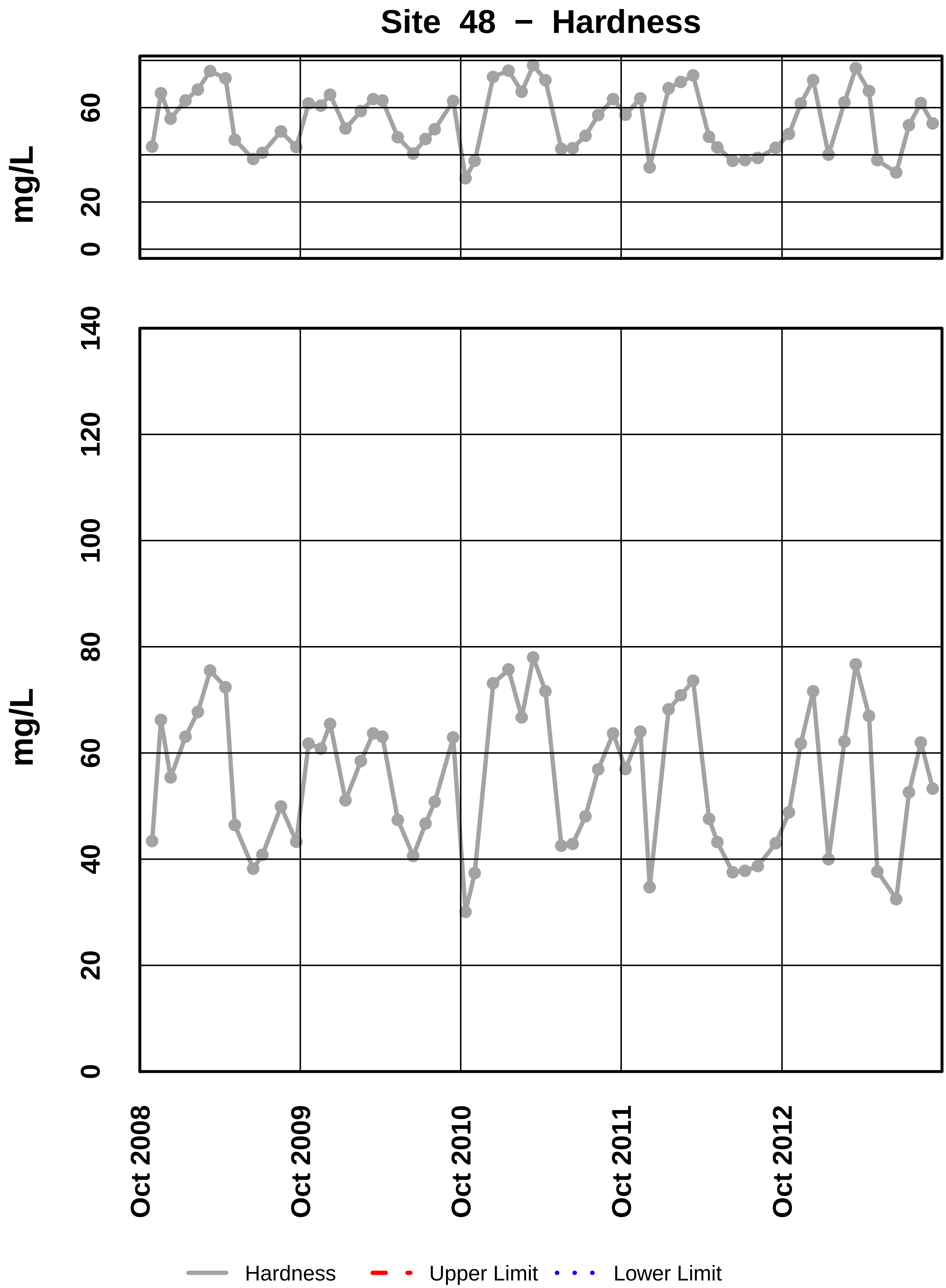


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

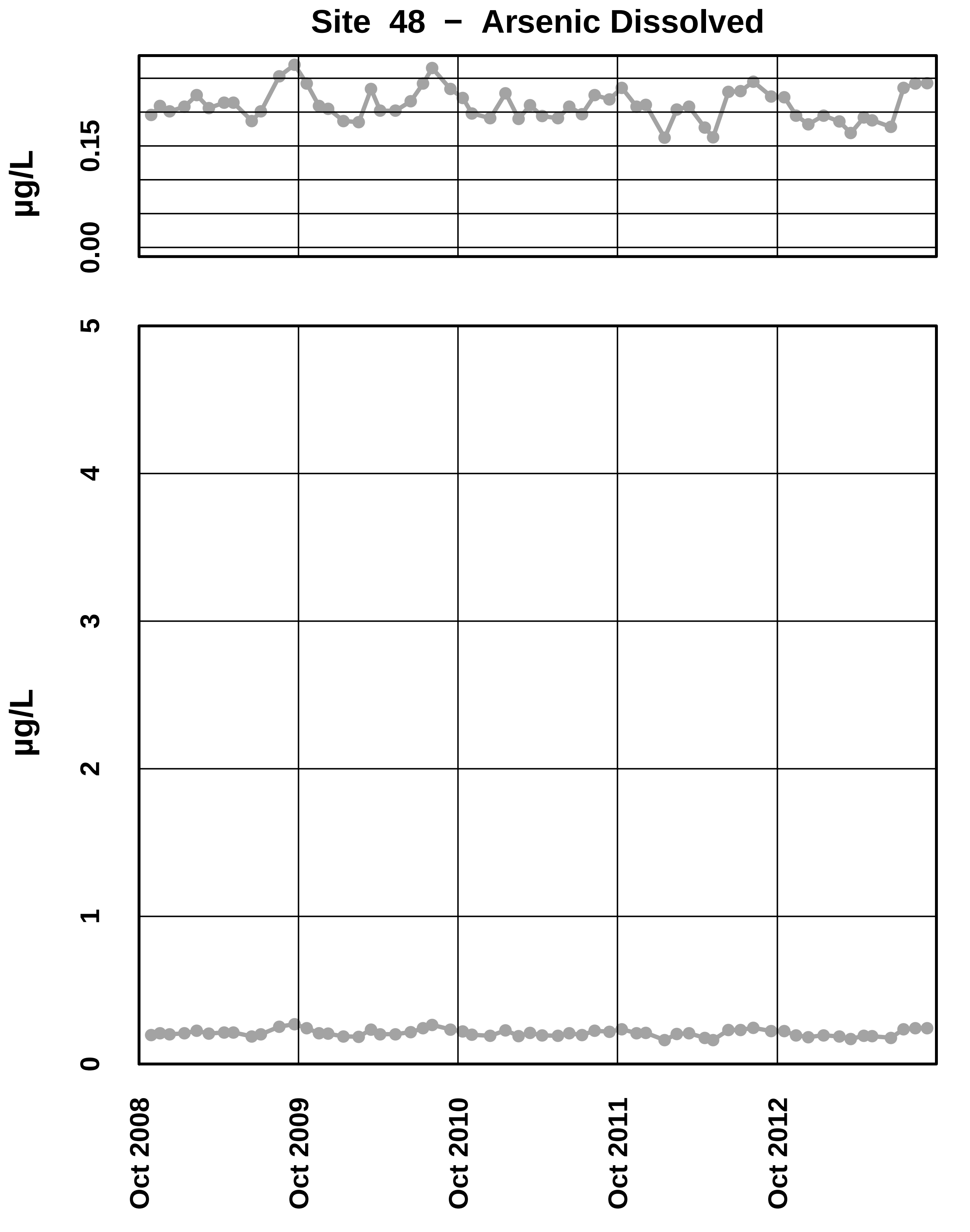
Site 48 − Sulfate Total



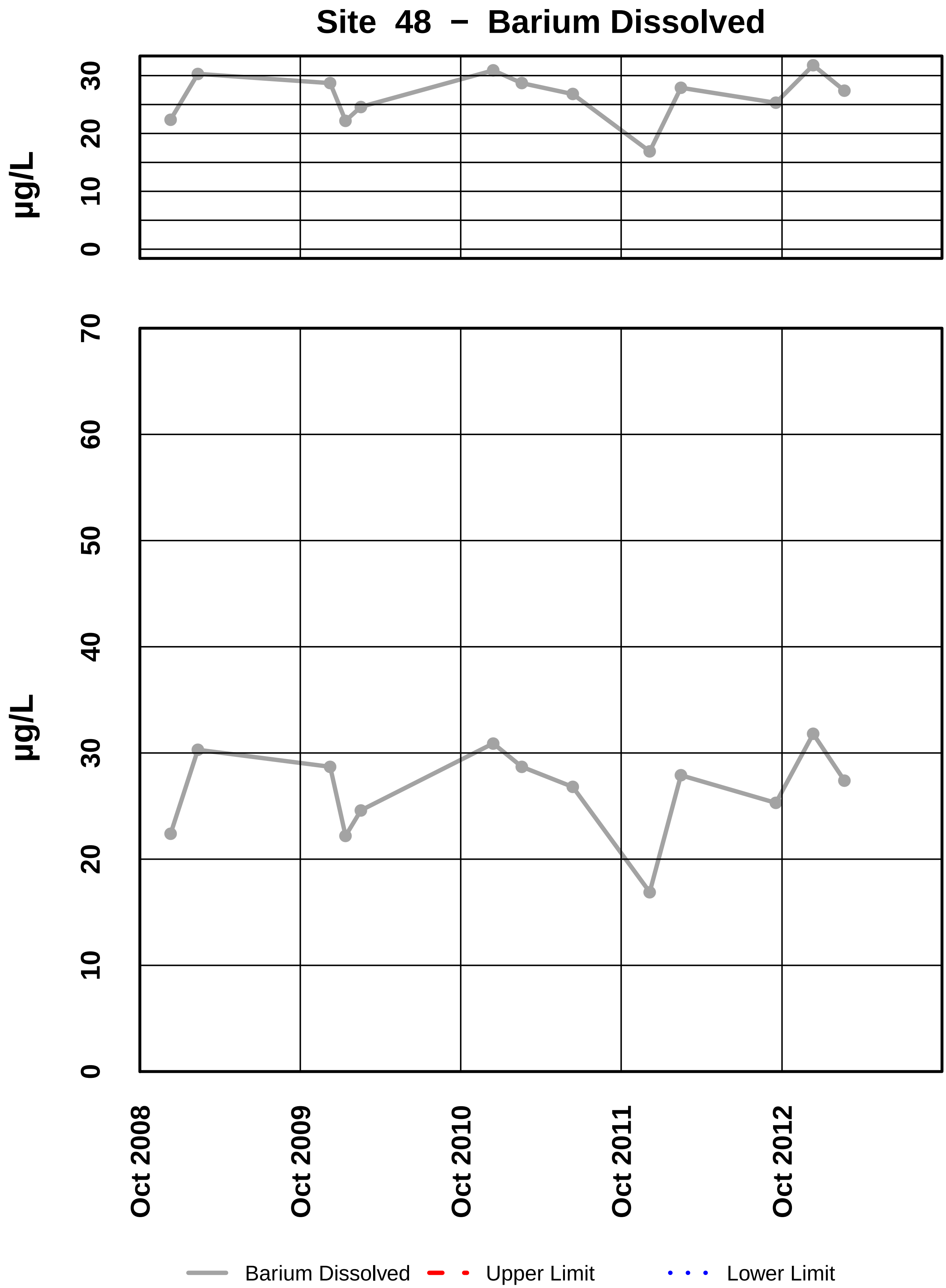
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

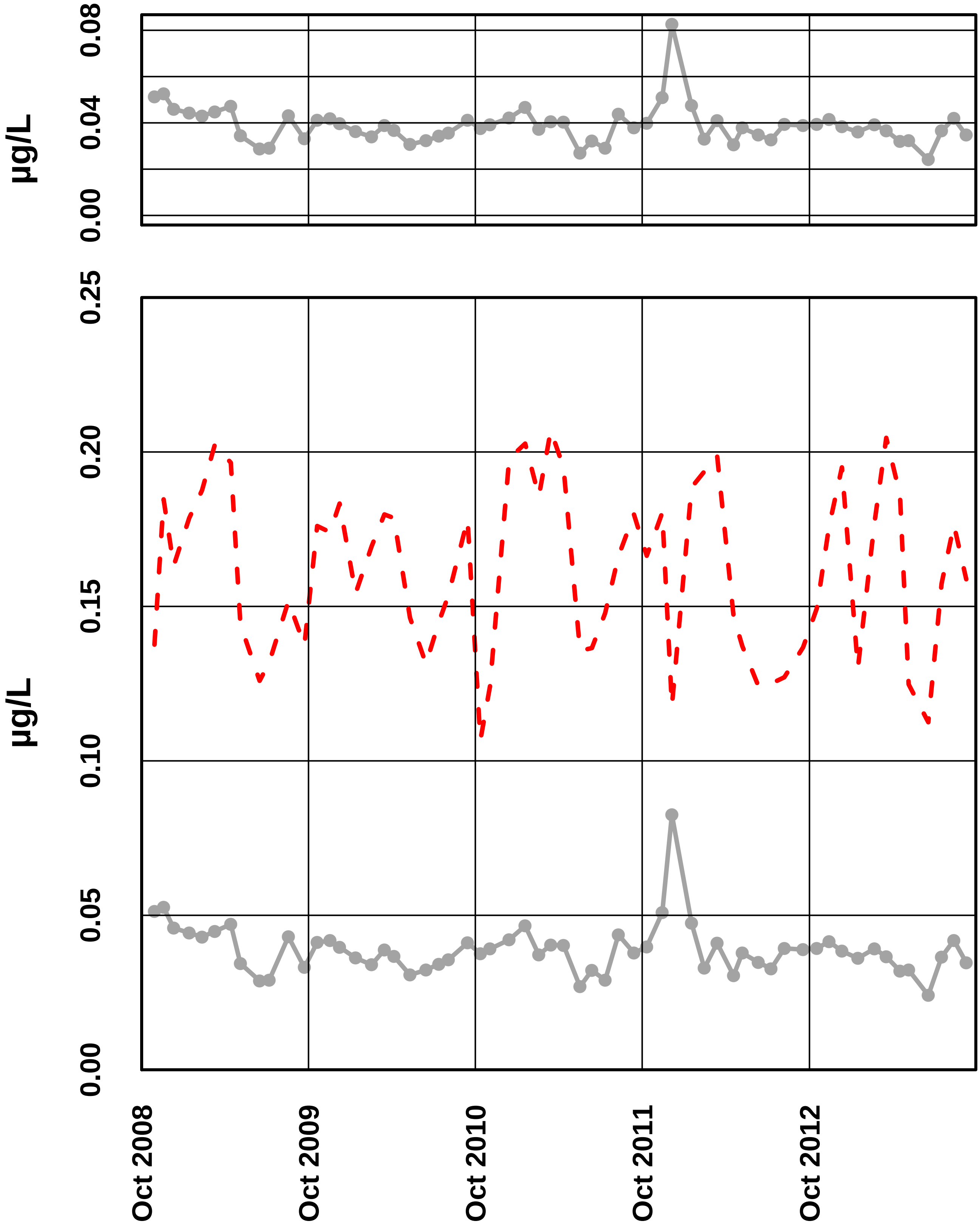


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



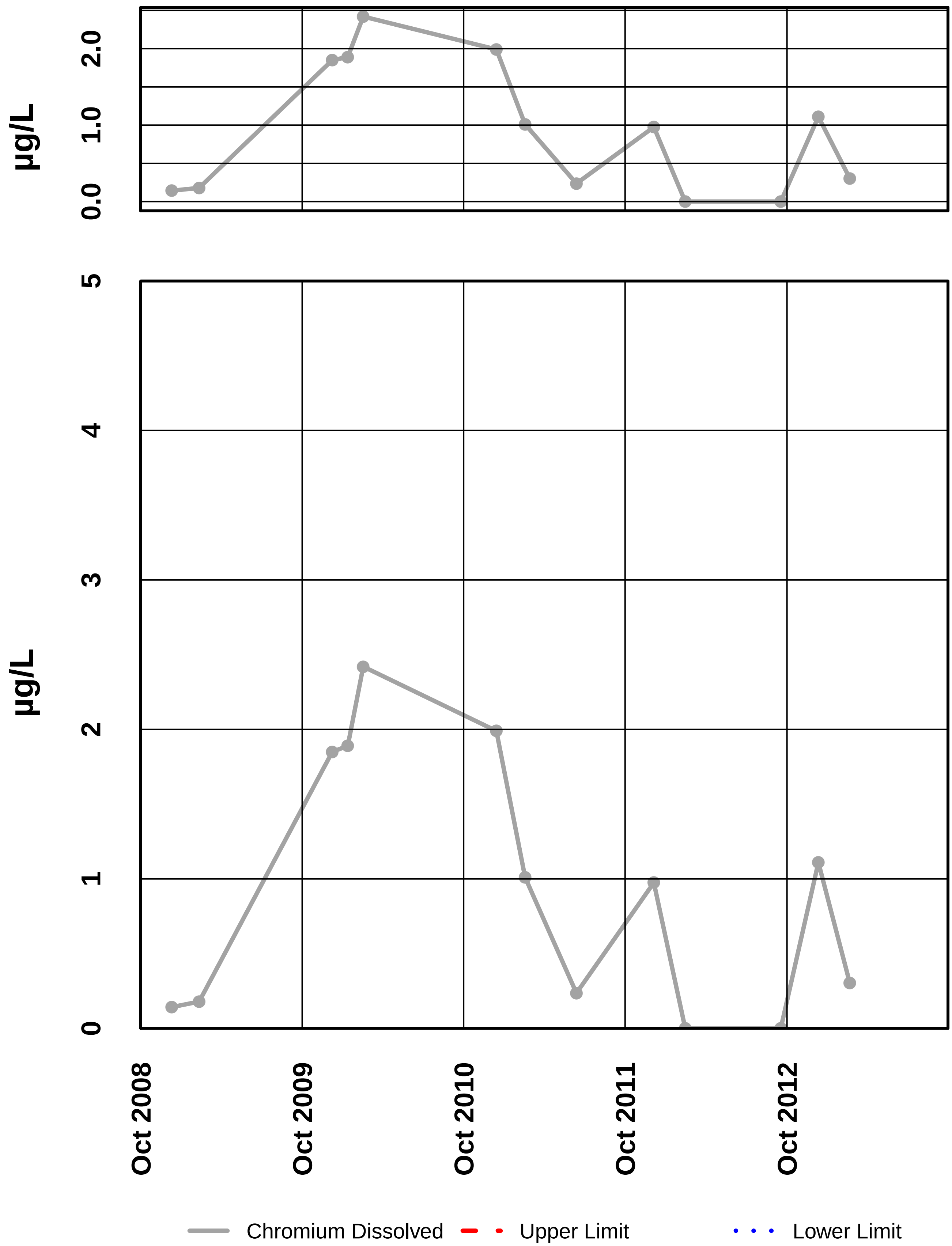
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 48 – Cadmium Dissolved



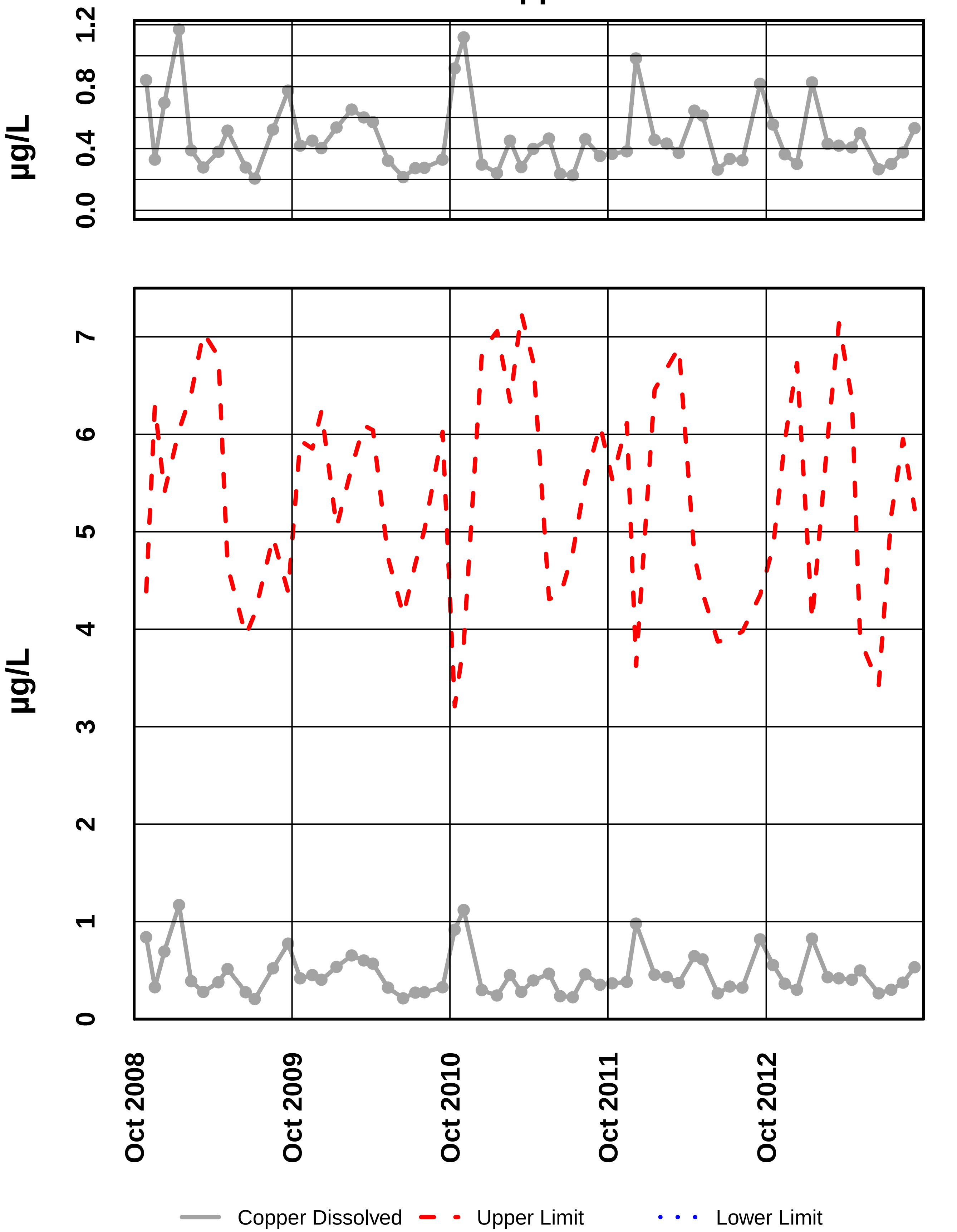
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 48 – Chromium Dissolved



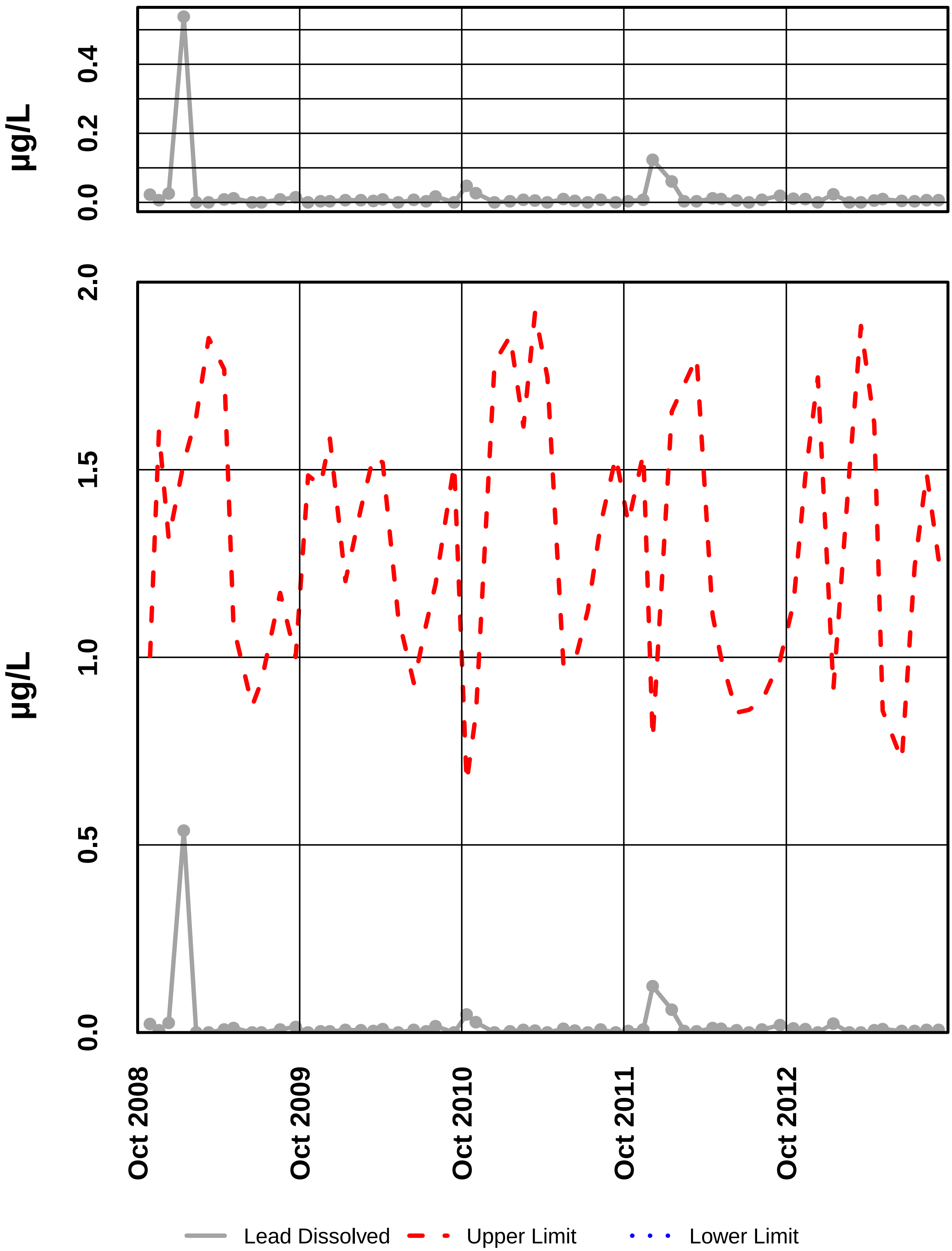
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 48 – Copper Dissolved



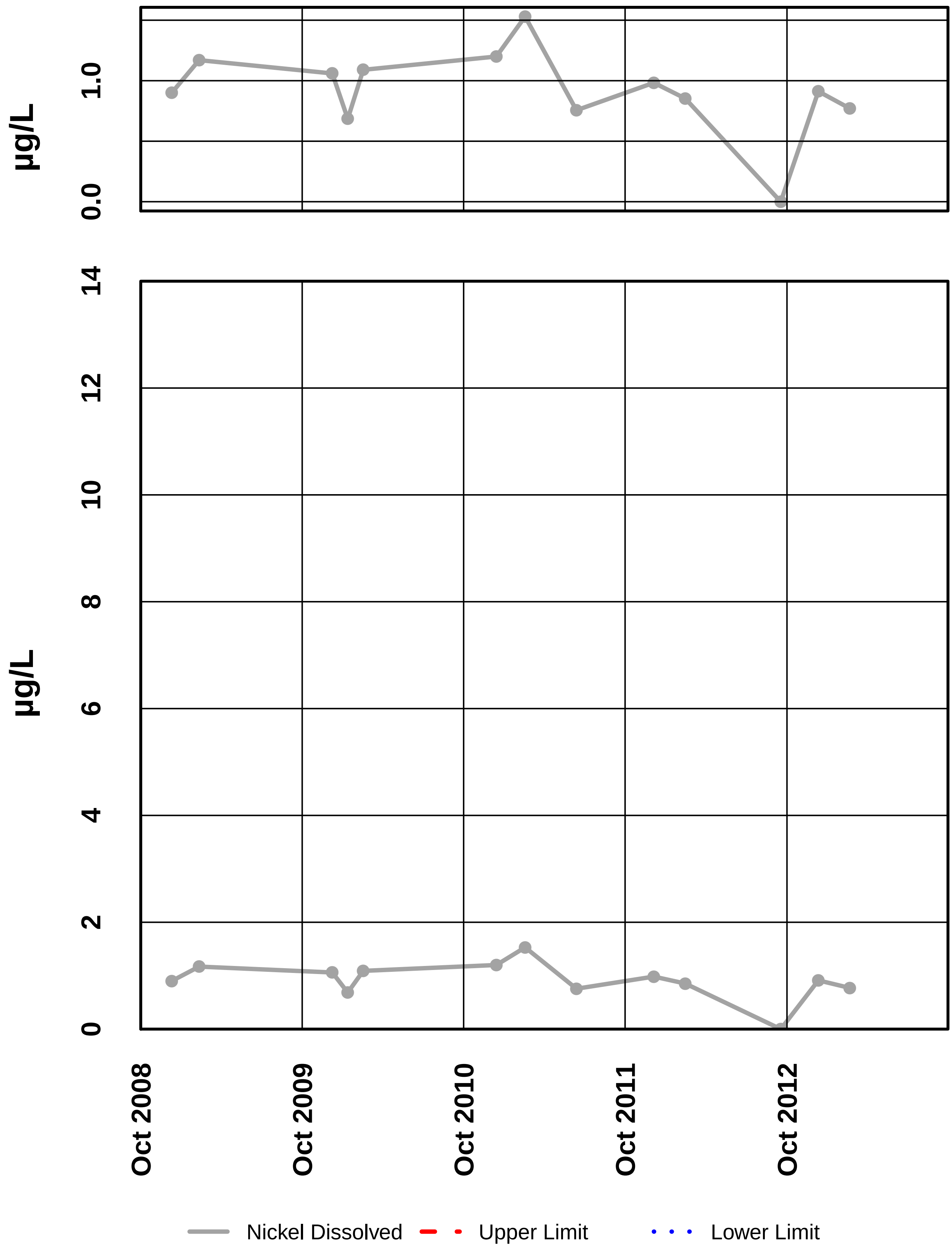
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 48 − Lead Dissolved

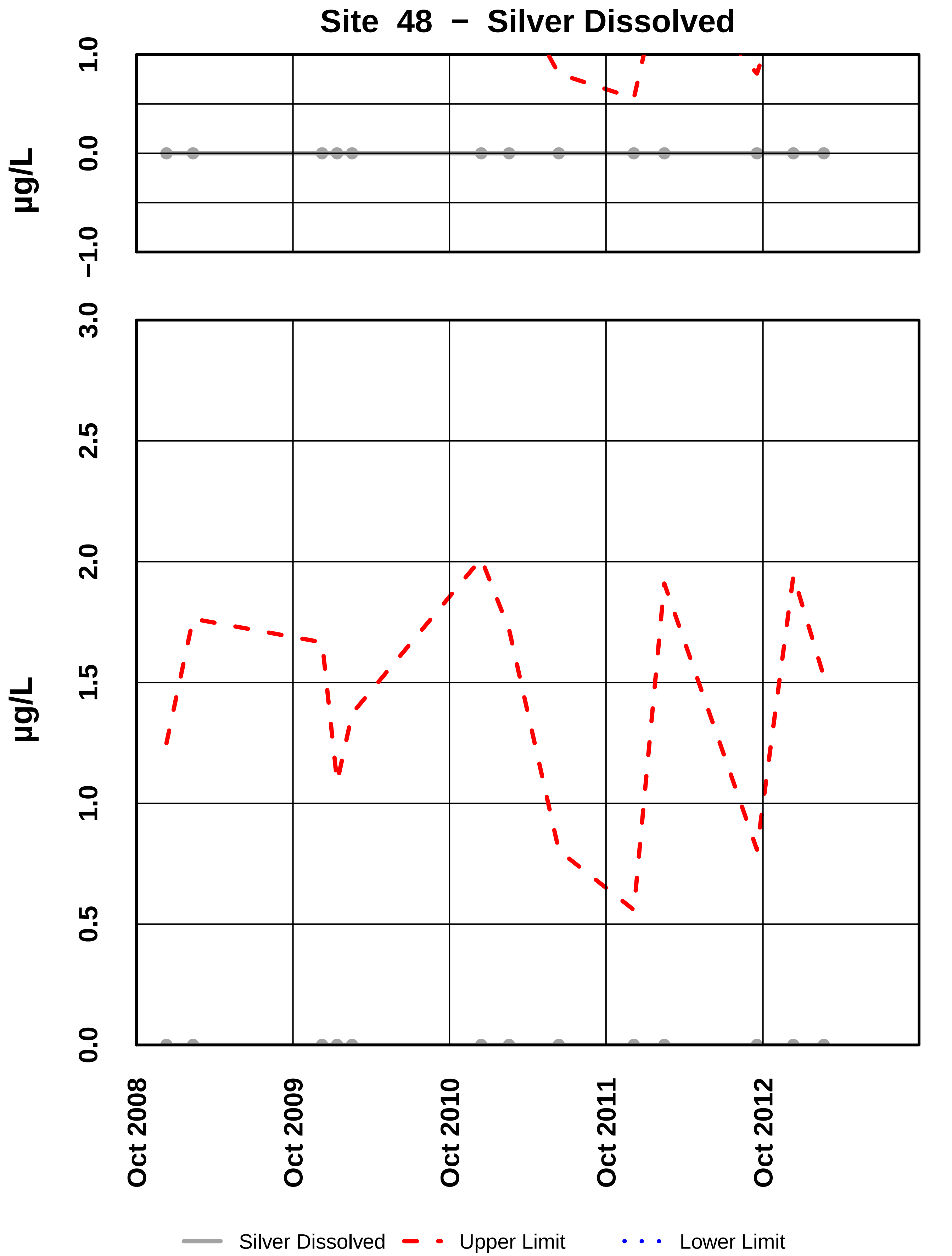


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

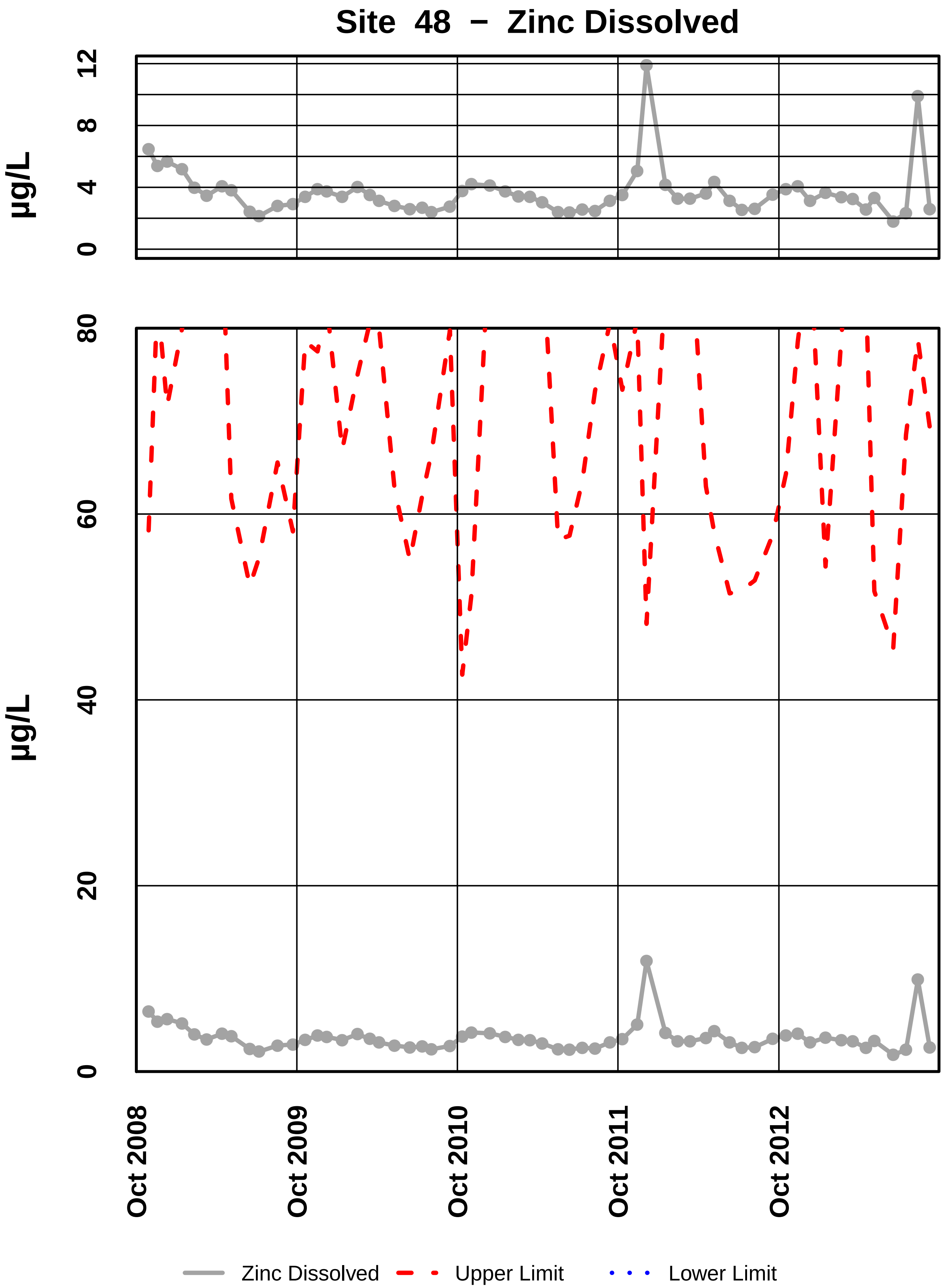
Site 48 − Nickel Dissolved



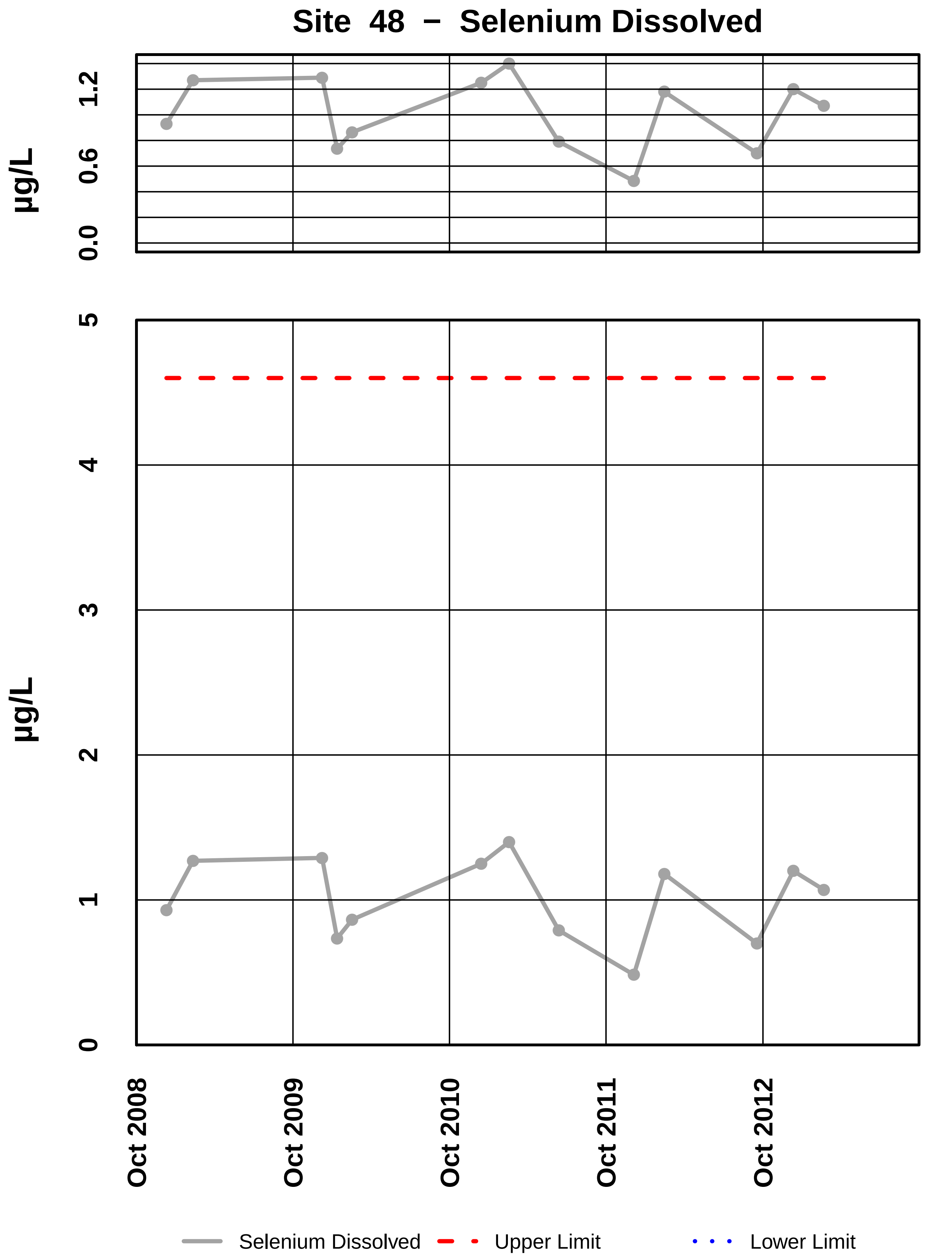
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

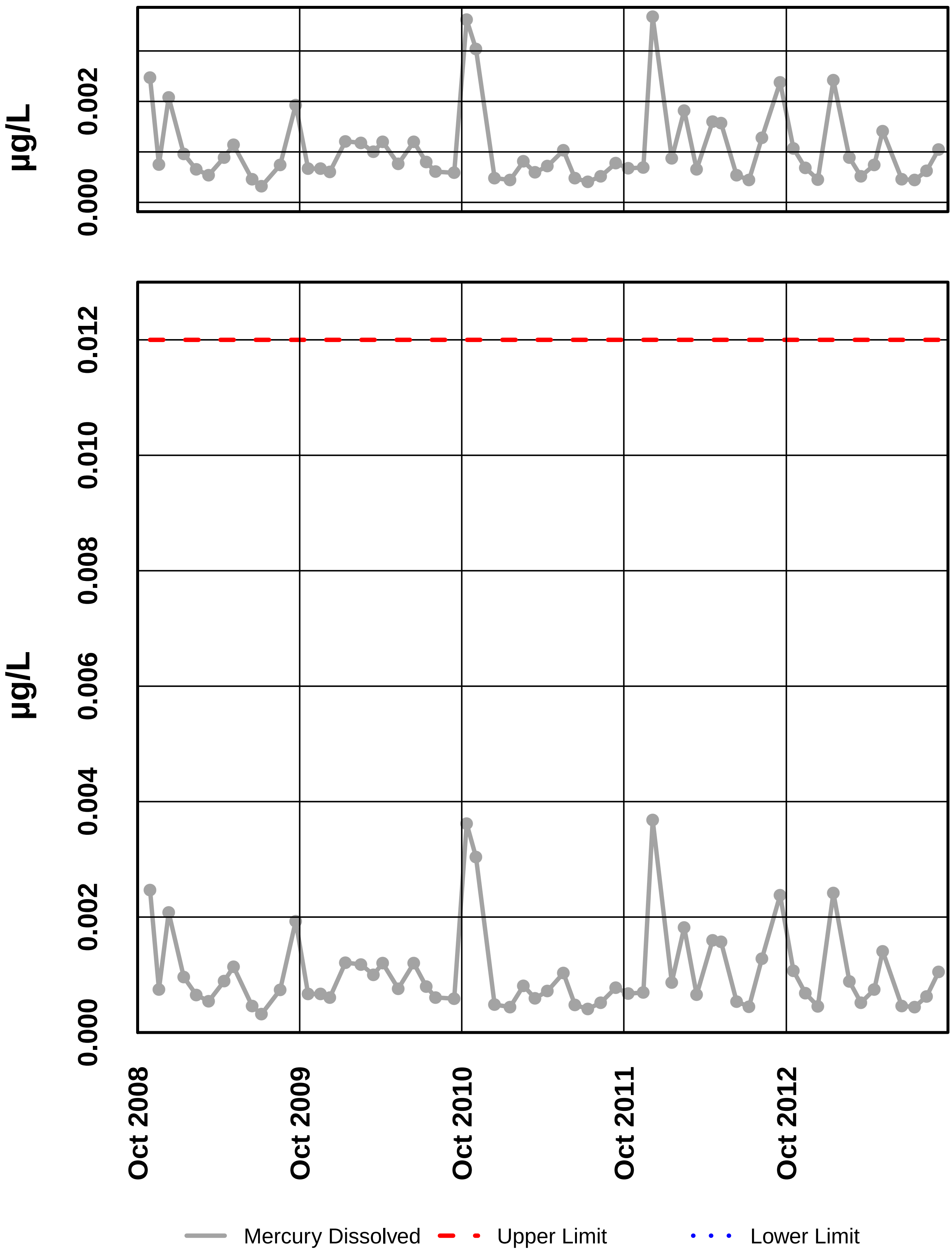


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

Site **#48** Seasonal Kendall analysis for Specific Conductance, Field (µS/cm)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**	106.4	129.6	145.7	151.9	139.5	144.5	132.2	88.8	87.2	82.2	83.9	83.5
b	**WY2009**	91.1	135.1	111.4	135.1	141.2	141.9	151.9	93.4	79.4	84.1	80.4	69.8
c	**WY2010**	128.7	111.2	146.1	93	124	141.2	126.9	107.2	84.7	91.5	99.9	125.4
d	**WY2011**	61.2	76.9	152	157	139	165	72.6	89.6	94	94	119	108
e	**WY2012**	102	120	75	72	123	154	106	98	83.1	82.7	86	86
f	**WY2013**	108	134	151	94	141	72	154	92	74	116	139	119
	n	6	6	6	6	6	6	6	6	6	6	6	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	6	6	6	6	6	6	6	6	6	6	6	6
t_2	0	0	0	0	0	0	0	0	0	0	0	0
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a	-1	1	-1	-1	1	-1	1	1	-1	1	-1	-1
c-a	1	-1	1	-1	-1	-1	-1	1	-1	1	1	1
d-a	-1	-1	1	1	-1	1	-1	1	1	1	1	1
e-a	-1	-1	-1	-1	-1	1	-1	1	-1	1	1	1
f-a	1	1	1	-1	1	-1	1	1	-1	1	1	1
c-b	1	-1	1	-1	-1	-1	-1	1	1	1	1	1
d-b	-1	-1	1	1	-1	1	-1	-1	1	1	1	1
e-b	1	-1	-1	-1	-1	1	-1	1	1	-1	1	1
f-b	1	-1	1	-1	-1	-1	1	-1	-1	1	1	1
d-c	-1	-1	1	1	1	1	-1	-1	1	1	1	-1
e-c	-1	1	-1	-1	-1	1	-1	-1	-1	-1	-1	-1
f-c	-1	1	1	1	1	-1	1	-1	-1	1	1	-1
e-d	1	1	-1	-1	-1	-1	1	1	-1	-1	-1	-1
f-d	1	1	-1	-1	1	-1	1	1	-1	1	1	1
f-e	1	1	1	1	1	-1	1	-1	-1	1	1	1
S_k	1	-1	3	-5	-3	-3	-1	3	-5	9	9	5

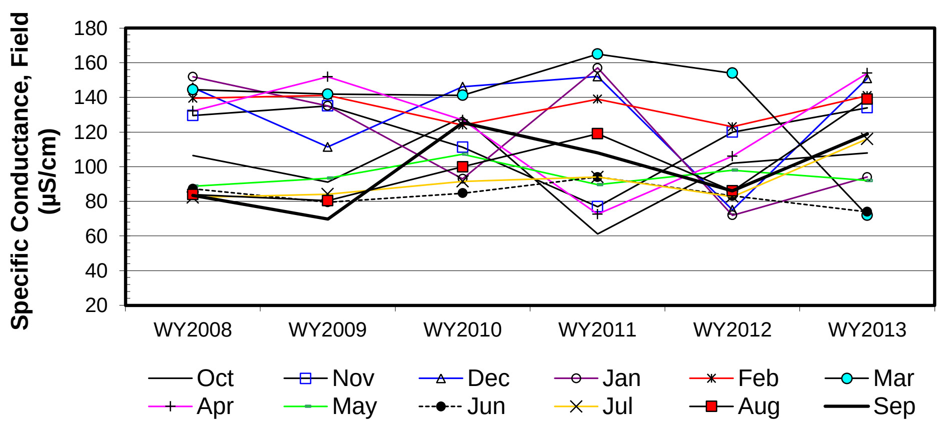
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33
$Z_k = S_k/\sigma_S$	0.19	-0.19	0.56	-0.94	-0.56	-0.56	-0.19	0.56	-0.94	1.69	1.69	0.94
Z^2_k	0.04	0.04	0.32	0.88	0.32	0.32	0.04	0.32	0.88	2.86	2.86	0.88

ΣZ_k= 2.25
ΣZ^2_k= 9.74
Z-bar=ΣZ_k/K= 0.19

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	72	0	0	0	0

Σn 72
ΣS_k 12

$\chi^2_h=\Sigma Z^2_k$-K(Z-bar)^2=	9.32	@α=5% $\chi^2_{(K-1)}$=	19.68	Test for station homogeneity	
p	**0.593**			$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k) Z_{calc}	0.60	@α/2=2.5% Z=	1.96	**H_0** (No trend)	ACCEPT
340.00 p	**0.725**			**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-2.00		3.77
0.050	-1.04	**0.43**	1.93
0.100	-0.50		1.69
0.200	-0.25		1.17

Site **#48** Seasonal Kendall analysis for pH, Field, Standard Units

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**	7.8	7.7	8.0	7.9	7.9	7.9	7.9	7.8	7.9	7.6	7.7	7.4
b	**WY2009**	7.8	7.9	7.8	7.4	7.8	7.9	7.2	7.0	7.6	6.8	7.1	7.2
c	**WY2010**	7.4	7.2	7.2	6.6	7.2	7.3	7.0	7.7	7.1	7.0	7.1	6.7
d	**WY2011**	6.5	7.6	7.8	7.3	6.9	7.7	7.8	8.0	7.5	6.9	8.1	7.9
e	**WY2012**	7.6	7.6	7.5	5.7	7.6	7.7	7.7	7.8	8.0	7.8	7.7	7.7
f	**WY2013**	7.8	7.8	7.8	7.5	7.8	7.9	7.9	7.8	7.7	8.1	8.0	7.9
	n	6	6	6	6	6	6	6	6	6	6	6	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	6	6	6	6	6	6	6	4	6	6	4	6
t_2	0	0	0	0	0	0	0	1	0	0	1	0
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a	-1	1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
c-a	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
d-a	-1	-1	-1	-1	-1	-1	-1	1	-1	-1	1	1
e-a	-1	-1	-1	-1	-1	-1	-1	1	1	1	0	1
f-a	-1	1	-1	-1	-1	-1	-1	0	-1	1	1	1
c-b	-1	-1	-1	-1	-1	-1	-1	1	-1	1	1	-1
d-b	-1	-1	1	-1	-1	-1	1	1	-1	1	1	1
e-b	-1	-1	-1	-1	-1	-1	1	1	1	1	1	1
f-b	-1	-1	1	1	-1	1	1	1	1	1	1	1
d-c	-1	1	1	1	-1	1	1	1	1	-1	1	1
e-c	1	1	1	-1	1	1	1	1	1	1	1	1
f-c	1	1	1	1	1	1	1	1	1	1	1	1
e-d	1	-1	-1	-1	1	1	-1	-1	1	1	-1	-1
f-d	1	1	1	1	1	1	1	-1	1	1	-1	1
f-e	1	1	1	1	1	1	1	-1	-1	1	1	1
S_k	-5	-1	-1	-5	-5	-1	1	4	1	7	6	7

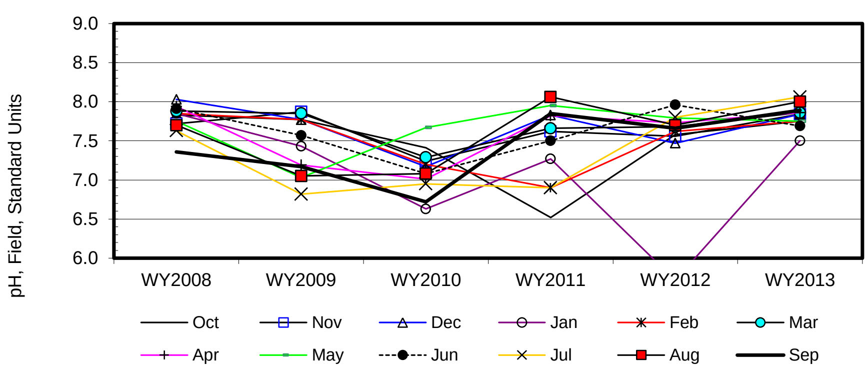
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	28.33	28.33	28.33	28.33	28.33	28.33	28.33	27.33	28.33	28.33	27.33	28.33
$Z_k = S_k/\sigma_S$	-0.94	-0.19	-0.19	-0.94	-0.94	-0.19	0.19	0.77	0.19	1.32	1.15	1.32
Z^2_k	0.88	0.04	0.04	0.88	0.88	0.04	0.04	0.59	0.04	1.73	1.32	1.73

ΣZ_k=	1.54
ΣZ^2_k=	8.18
Z-bar=ΣZ_k/K=	0.13

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	68	2	0	0	0

Σn	72
ΣS_k	8

$\chi^2_h=\Sigma Z^2_k - K(\text{Z-bar})^2$=	7.99	@α=5% $\chi^2_{(K-1)}$= 19.68	Test for station homogeneity	
p	**0.714**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc} 0.38	@α/2=2.5% Z= 1.96	H_0 (No trend)	ACCEPT
338.00	**p** **0.648**		H_A (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.05		0.10
0.050	-0.04	**0.01**	0.06
0.100	-0.03		0.04
0.200	-0.01		0.03

Site **#48** Seasonal Kendall analysis for Total Alk, (mg/l)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**	37.7	44.2	51.9	54.5	48.1	46.8	52.4	35.3	29.7	30.6	33.1	31.4
b	**WY2009**	29.7	43.7	36.6		48.6	51.8	52.6	34.6	30.2	32.0	34.8	36.5
c	**WY2010**	42.2	45.6	48.4	41.4	41.0	45.7	43.3	36.5	32.5	34.1	39.3	48.9
d	**WY2011**	21.6	24.0	47.2	52.8	46.4	50.0	51.4	33.7	32.5	38.2	43.5	47.3
e	**WY2012**	47.2	51.6	21.5	48.6	49.6	52.9	36.1	37.1	32.9	32.7	28.9	38.8
f	**WY2013**	44.2	53.1	58.9	32.1	48.1	59.0	52.7	32.4	29.0	42.9	50.2	47.6
	n	6	6	6	5	6	6	6	6	6	6	6	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	6	6	6	5	4	6	6	6	4	6	6	6
t_2	0	0	0	0	1	0	0	0	1	0	0	0
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a	-1	-1	-1		1	1	1	-1	1	1	1	1
c-a	1	1	-1	-1	-1	-1	-1	1	1	1	1	1
d-a	-1	-1	-1	-1	-1	1	-1	-1	1	1	1	1
e-a	1	1	-1	-1	1	1	-1	1	1	1	-1	1
f-a	1	1	1	-1	0	1	1	-1	-1	1	1	1
c-b	1	1	1		-1	-1	-1	1	1	1	1	1
d-b	-1	-1	1		-1	-1	-1	-1	1	1	1	1
e-b	1	1	-1		1	1	-1	1	1	1	-1	1
f-b	1	1	1		-1	1	1	-1	-1	1	1	1
d-c	-1	-1	-1	1	1	1	1	-1	0	1	1	-1
e-c	1	1	-1	1	1	1	-1	1	1	-1	-1	-1
f-c	1	1	1	-1	1	1	1	-1	-1	1	1	-1
e-d	1	1	-1	-1	1	1	-1	1	1	-1	-1	-1
f-d	1	1	1	-1	1	1	1	-1	-1	1	1	1
f-e	-1	1	1	-1	-1	1	1	-1	-1	1	1	1
S_k	5	7	-1	-6	2	9	-1	-3	4	11	7	7

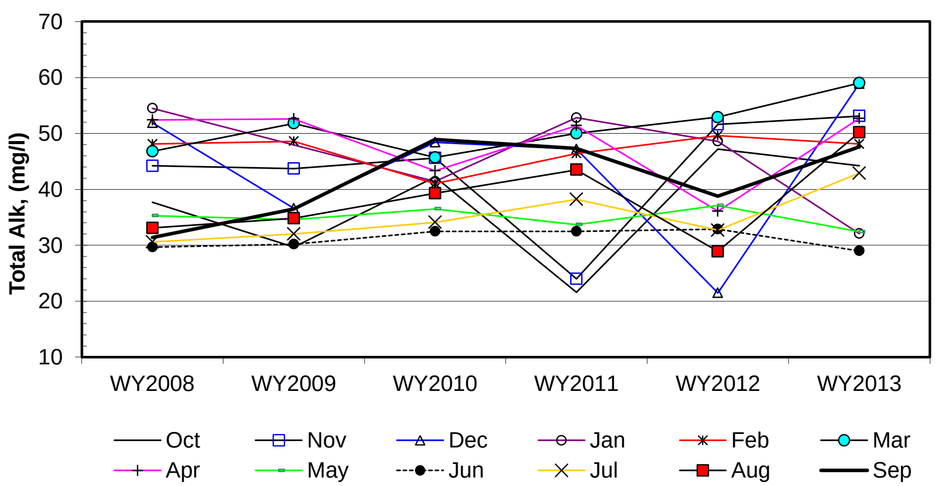
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	28.33	28.33	28.33	16.67	27.33	28.33	28.33	28.33	27.33	28.33	28.33	28.33
$Z_k = S_k/\sigma_S$	0.94	1.32	-0.19	-1.47	0.38	1.69	-0.19	-0.56	0.77	2.07	1.32	1.32
Z^2_k	0.88	1.73	0.04	2.16	0.15	2.86	0.04	0.32	0.59	4.27	1.73	1.73

ΣZ_k= 7.38
ΣZ^2_k= 16.48
Z-bar=ΣZ_k/K= 0.62

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	67	2	0	0	0

Σn 71
ΣS_k 41

$\chi^2_h=\Sigma Z^2_k$-K(Z-bar)^2=	11.94	@α=5% $\chi^2_{(K-1)}$=	19.68	Test for station homogeneity	
p	**0.368**			$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
$\Sigma VAR(S_k)$	Z_{calc} 2.21	@α/2=2.5% Z=	1.96	H_0 (No trend)	REJECT
326.33	p **0.987**			H_A (± trend)	ACCEPT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.06		1.90
0.050	0.20	**0.77**	1.72
0.100	0.33		1.41
0.200	0.44		1.17

1.8%

Site #48 — Seasonal Kendall analysis for Sulfate, Total (mg/l)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**	12.0	11.5	15.1	18.5	17.4	14.2	16.0	6.9	6.8	7.8	7.6	6.6
b	**WY2009**	7.7	15.6	14.3	15.7	18.3	21.9	19.7	9.0	7.4	9.6	10.7	8.0
c	**WY2010**	13.8	16.1	17.0	13.4	13.0	15.4	15.5	10.0	8.7	9.2	10.8	14.5
d	**WY2011**	5.4	7.1	19.7	21.0	17.5	21.8	19.5	8.2	9.7	10.1	13.6	14.6
e	**WY2012**	13.4	15.5	5.5	19.2	18.4	19.0	10.1	8.9	7.1	7.5	7.7	8.2
f	**WY2013**	10.3	16.5	19.8	9.8	14.5	22.6	18.8	7.7	6.4	13.0	17.1	11.0
	n	6	6	6	6	6	6	6	6	6	6	6	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	6	6	6	6	6	6	6	6	6	6	6	6
t_2	0	0	0	0	0	0	0	0	0	0	0	0
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a	-1	1	-1	-1	1	1	1	1	1	1	1	1
c-a	1	1	1	-1	-1	1	-1	1	1	1	1	1
d-a	-1	-1	1	1	1	1	1	1	1	1	1	1
e-a	1	1	-1	1	1	1	-1	1	1	-1	1	1
f-a	-1	1	1	-1	-1	1	1	1	-1	1	1	1
c-b	1	1	1	-1	-1	-1	-1	1	1	-1	1	1
d-b	-1	-1	1	1	-1	-1	-1	-1	1	1	1	1
e-b	1	-1	-1	1	1	-1	-1	-1	-1	-1	-1	1
f-b	1	1	1	-1	-1	1	-1	-1	-1	1	1	1
d-c	-1	-1	1	1	1	1	1	-1	1	1	1	1
e-c	-1	-1	-1	1	1	1	-1	-1	-1	-1	-1	-1
f-c	-1	1	1	-1	1	1	1	-1	-1	1	1	-1
e-d	1	1	-1	-1	1	-1	-1	1	-1	-1	-1	-1
f-d	1	1	1	-1	-1	1	-1	-1	-1	1	1	-1
f-e	-1	1	1	-1	-1	1	1	-1	-1	1	1	1
S_k	-1	5	5	-3	1	7	-3	-1	-1	5	9	7

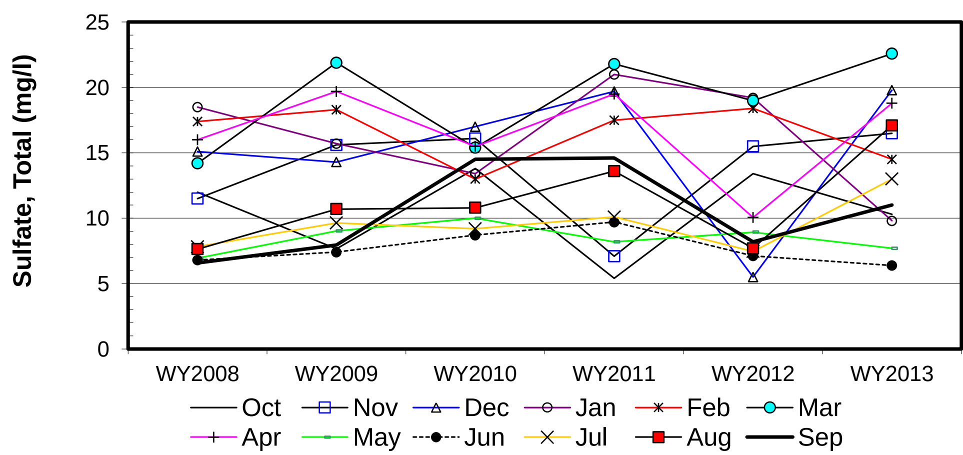
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33
$Z_k = S_k/\sigma_S$	-0.19	0.94	0.94	-0.56	0.19	1.32	-0.56	-0.19	-0.19	0.94	1.69	1.32
Z^2_k	0.04	0.88	0.88	0.32	0.04	1.73	0.32	0.04	0.04	0.88	2.86	1.73

ΣZ_k= 5.64
ΣZ^2_k= 9.74
Z-bar=$\Sigma Z_k/K$= 0.47

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	72	0	0	0	0

Σn 72
ΣS_k 30

$\chi^2_h = \Sigma Z^2_k - K(\text{Z-bar})^2$=	7.09	@α=5% $\chi^2_{(K-1)}$=	19.68	Test for station homogeneity	
p	**0.791**			$\chi^2_h < \chi^2_{(K-1)}$	ACCEPT
$\Sigma VAR(S_k)$	Z_{calc} 1.57	@α=2.5% Z=	1.96	**H_0** (No trend)	ACCEPT
340.00	p **0.942**			**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.14		0.90
0.050	-0.03	**0.30**	0.77
0.100	0.04		0.68
0.200	0.10		0.55

Site #48 Seasonal Kendall analysis for Zinc, Dissolved (ug/l)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**	3.7	6.8	4.3	3.5	3.2	3.2	3.1	3.7	2.6	2.3	3.2	3.9
b	**WY2009**	6.5	5.4	5.7	5.2	4.0	3.5	4.1	3.8	2.4	2.1	2.8	2.9
c	**WY2010**	3.4	3.9	3.7	3.4	4.0	3.5	3.1	2.8	2.6	2.7	2.4	2.8
d	**WY2011**	3.8	4.2	4.1	3.7	3.4	3.4	3.0	2.4	2.4	2.6	2.5	3.1
e	**WY2012**	3.5	5.1	11.9	4.2	3.3	3.3	3.6	4.4	3.1	2.6	2.6	3.5
f	**WY2013**	3.9	4.1	3.1	3.7	3.4	3.2	2.6	3.3	1.8	2.3	9.9	2.6
	n	6	6	6	6	6	6	6	6	6	6	6	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	6	6	6	6	6	6	6	6	6	6	6	6
t_2	0	0	0	0	0	0	0	0	0	0	0	0
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a	1	-1	1	1	1	1	1	1	-1	-1	-1	-1
c-a	-1	-1	-1	-1	1	1	1	-1	-1	1	-1	-1
d-a	1	-1	-1	1	1	1	-1	-1	-1	1	-1	-1
e-a	-1	-1	1	1	1	1	1	1	1	1	-1	-1
f-a	1	-1	-1	1	1	1	-1	-1	-1	1	1	-1
c-b	-1	-1	-1	-1	1	1	-1	-1	1	1	-1	-1
d-b	-1	-1	-1	-1	-1	-1	-1	-1	-1	1	-1	1
e-b	-1	-1	1	-1	-1	-1	-1	1	1	1	-1	1
f-b	-1	-1	-1	-1	-1	-1	-1	-1	-1	1	1	-1
d-c	1	1	1	1	-1	-1	-1	-1	-1	-1	1	1
e-c	1	1	1	1	-1	-1	1	1	1	-1	1	1
f-c	1	1	-1	1	-1	-1	-1	1	-1	-1	1	-1
e-d	-1	1	1	1	-1	-1	1	1	1	-1	1	1
f-d	1	-1	-1	-1	-1	-1	-1	1	-1	-1	1	-1
f-e	1	-1	-1	-1	1	-1	-1	-1	-1	-1	1	-1
S_k	1	-7	-3	1	-1	-3	-5	-1	-5	1	1	-5

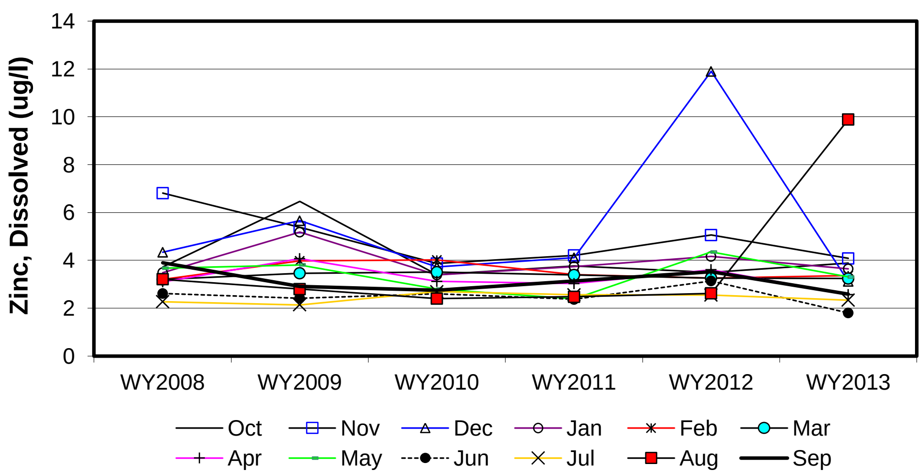
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33
$Z_k = S_k/\sigma_S$	0.19	-1.32	-0.56	0.19	-0.19	-0.56	-0.94	-0.19	-0.94	0.19	0.19	-0.94
Z^2_k	0.04	1.73	0.32	0.04	0.04	0.32	0.88	0.04	0.88	0.04	0.04	0.88

ΣZ_k= -4.88
ΣZ^2_k= 5.22
Z-bar=ΣZ_k/K= -0.41

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	72	0	0	0	0

Σn 72
ΣS_k -26

$\chi^2_h=\Sigma Z^2_k$-K(Z-bar)^2= 3.24	@α=5% $\chi^2_{(K-1)}$= 19.68	Test for station homogeneity	
p 0.987		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k) 340.00	Z_{calc} -1.36	@α/2=2.5% Z= 1.96	**H_0** (No trend)	ACCEPT
	p 0.088		**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.15		0.03
0.050	-0.12	**-0.06**	0.01
0.100	-0.11		-0.01
0.200	-0.09		-0.03

INTERPRETIVE REPORT
SITE 6

The data collected during the current water year are listed in the following "Table of Results for Water Year 2013" 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 2013.				

The data for Water Year 2013 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 2013

			Limits		
Sample Date	Parameter	Value	Lower	Upper	Hardness
No exceedances have been identified by HGCMC for the period of October 2012 through September 2013.					

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 apparent visual trends identified.

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-07 and Sep-13 (WY2008-WY2013).

Table of Summary Statistics for Trend Analysis

Parameter	Mann-Kendall test statistics n*	p**	Trend	Sen's slope estimate Q	Q(%)
Conductivity Field	6	0.19			
pH Field	6	0.11			
Alkalinity, Total	6	0.02	+	0.83	1.9
Sulfate, Total	6	0.04			
Zinc, Dissolved	6	0.46			

* Number of Years ** Significance level

Total alkalinity had a statistically significant positive slope of 0.83 mg/L/yr, which is similar to the value 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 2013 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	117.5	130.5	-6
pH Field	0.987	7.84	7.78	0.04
Alkalinity, Total	0.207	47.9	48.1	0.06
Sulfate, Total	<0.01	13.8	16.00	-1.40
Zinc, Dissolved	0.005	3.28	6.93	-3.27

Total alkalinity does not have a statistically significant difference between measured median values at a significance level of α=0.05 for a one-tailed test. The median values for total alkalinity for Site 48 and Site 6 are 47.9 mg/L and 48.1 mg/L respectively and the median of differences, Site 48 minus Site 6, is 0.06 mg/L.

The median values for field conductivity for Site 48 and Site 6 are 117.5 µS/cm and 130.5 µS/cm respectively. Median values for field pH for Site 48 and Site 6 are 7.84 su and 7.78 su respectively. The median values for total sulfate for Site 48 and Site 6 are 13.8 mg/L and 16.0 mg/L respectively.

Dissolved zinc results follow along in a similar manner where the median values for Site 48 and Site 6 are 3.28 µg/L and 6.93 µg/L respectively. Signed-rank test results for prior datasets for Water Years 2000 – 2012 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 any 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 2013

Site 006FMS - 'Greens Creek Middle'

Sample Date/Parameter	Oct 2012	Nov 2012	Dec 2012	Jan 2013	Feb 2013	Mar 2013	Apr 2013	May 2013	Jun 2013	Jul 2013	Aug 2013	Sep 2013	**Median**
Water Temp (°C)	3.5	1.3	0.7	0	0.9		1.3	1.7	6	11	10.5	8.2	1.7
Conductivity-Field(µmho)	112	139	159	101	151	182	169	97	76	120	146	122	130.5
Conductivity-Lab (µmho)	88	140	112	98	132	177	162	92	72	114	139	97	113
pH Lab (standard units)	7.89	7.7	7.7	7.38	7.59	7.73	7.72	7.55	7.89	7.77	7.81	7.5	7.71
pH Field (standard units)	7.69	7.71	7.82	7.46	7.4	7.82	7.91	7.73	7.58	8.08	7.97	7.88	7.78
Total Alkalinity (mg/L)	46.2	54.2	56.3	32.7	50.3	59.2	54	33.8	29.6	42.9	49.9	44.2	48.1
Total Sulfate (mg/L)	11.5	18.7	22.3	9.9	17.4	26.4	23.5	9	6.9	14.5	18	12.3	16.0
Hardness (mg/L)	51.1	61.7	75.4	42.9	65.4	81.3	73.6	38.7	33	52.9	64.9	54.7	58.2
Dissolved As (ug/L)	0.222	0.201	0.188	0.201	0.153	0.174	0.164	0.171	0.179	0.219	0.236	0.241	0.195
Dissolved Ba (ug/L)			32		27.6								29.8
Dissolved Cd (ug/L)	0.0463	0.0529	0.0441	0.0559	0.0457	0.0526	0.0509	0.0583	0.0321	0.0429	0.0455	0.0471	0.0467
Dissolved Cr (ug/L)			0.404		0.319								0.362
Dissolved Cu (ug/L)	0.619	0.434	0.346	0.995	0.502	0.537	0.454	0.683	0.258	0.353	0.375	0.584	0.478
Dissolved Pb (ug/L)	0.0219	0.0139	0.009	0.103	0.0163	0.0228	0.0173	0.0277	0.0101	0.0129	0.0129	0.332	0.0168
Dissolved Ni (ug/L)			1.03		0.86								0.945
Dissolved Ag (ug/L)			0.002		0.002								0.002
Dissolved Zn (ug/L)	6.48	7.38	6.36	8.97	7.65	8.66	8.95	9.87	2.55	3.63	6.09	5.21	6.93
Dissolved Se (ug/L)			1.3		0.887								1.094
Dissolved Hg (ug/L)	0.00126	0.000774	0.000522	0.00249	0.000959	0.000546	0.000804	0.00169	0.00051	0.000618	0.00066	0.00102	0.000789

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

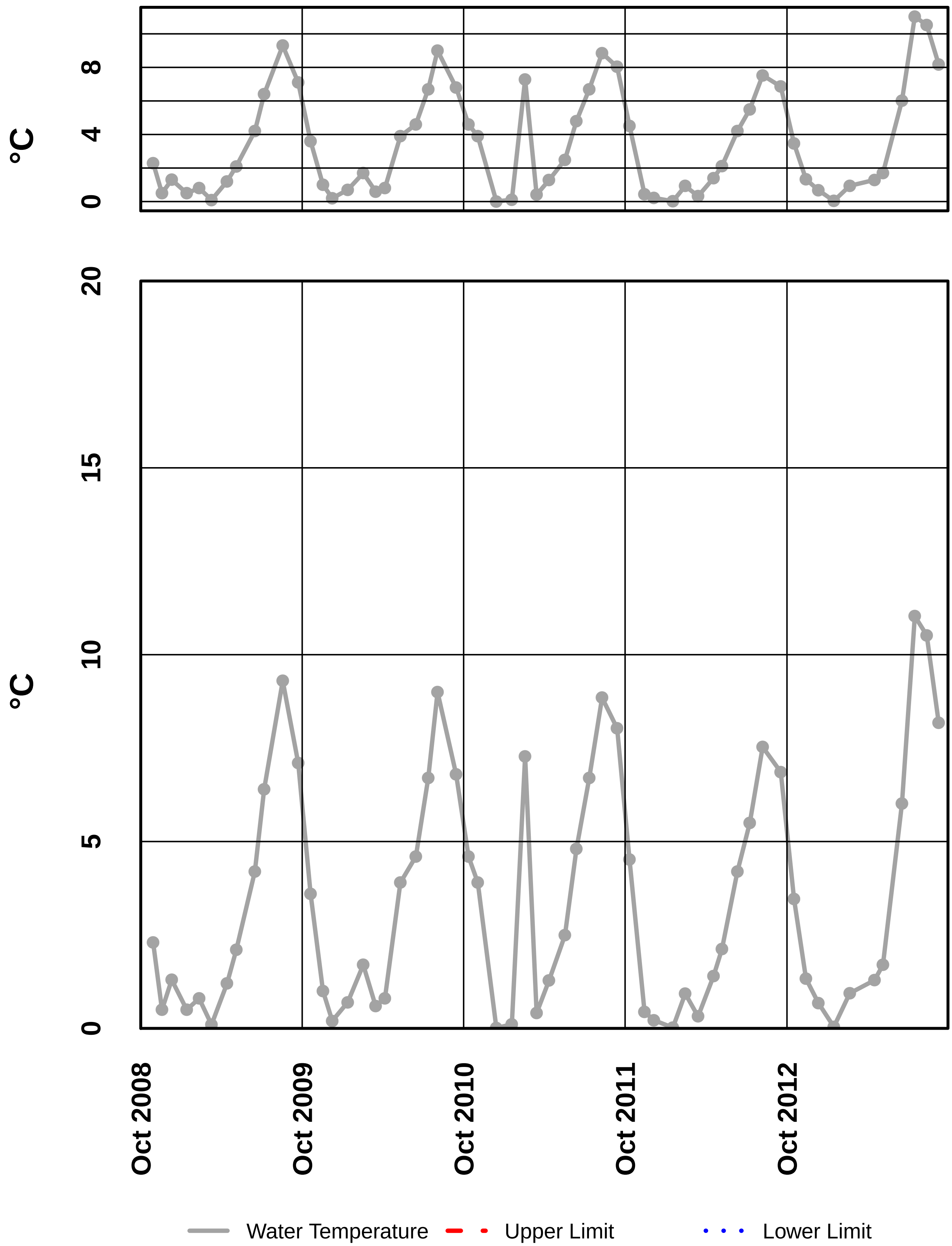
Qualified Data by QA Reviewer

Date Range: 10/01/2012 to 09/30/2013

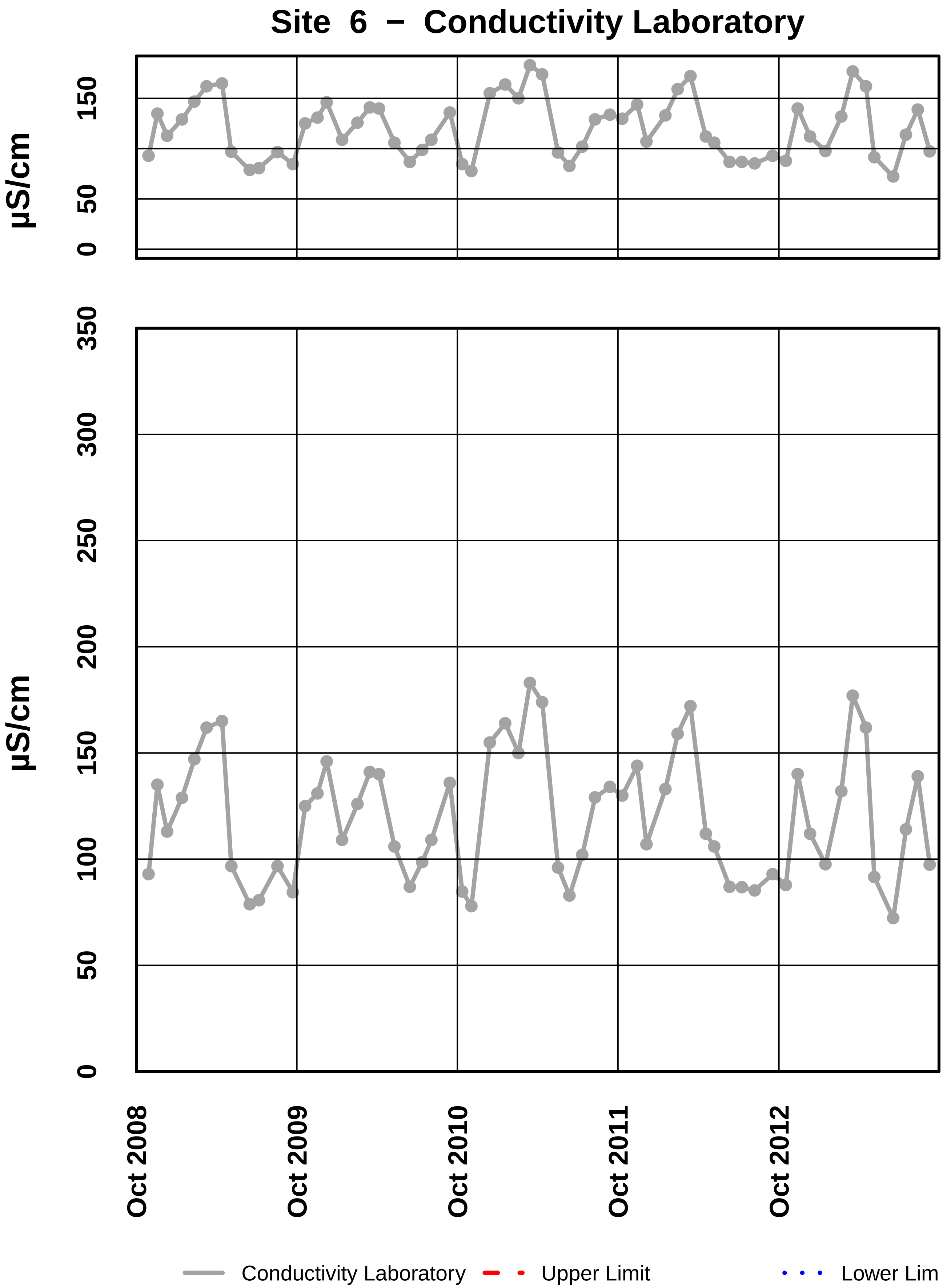
Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
6	10/17/2012	12:00 AM	SO4 Tot, mg/l	11.48	J	Sample Temperature
			Zn diss, µg/l	6.48	U	Field Blank Contamination
6	11/13/2012	12:00 AM	Hg diss, µg/l	0.000774	U	Field Blank Contamination
6	12/11/2012	12:00 AM	Hg diss, µg/l	0.000522	U	Field Blank Contamination
6	1/15/2013	12:00 AM	Hg diss, µg/l	0.00249	J	LCS Recovery
6	5/6/2013	12:00 AM	pH Lab, su	7.55	J	Hold Time Violation
			Alk, mg/L	33.8	U	Field Blank Contamination
6	6/18/2013	12:00 AM	Hg diss, µg/l	0.00051	U	Field Blank Contamination
6	7/17/2013	12:00 AM	SO4 Tot, mg/l	14.5	J	Sample Receipt Temperature
			Hg diss, µg/l	0.000618	U	Field Blank Contamination
6	8/13/2013	12:00 AM	Cond, µmhos	139	J	Sample receipt temperature
			Alk, mg/L	49.9	J	Sample receipt temperature
			SO4 Tot, mg/l	18	J	Sample receipt temperature
			Pb diss, µg/l	0.01	U	Field Blank Contamination
			Hg diss, µg/l	0.00066	U	Field Blank Contamination
6	9/9/2013	12:00 AM	SO4 Tot, mg/l	12.3	J	Sample receipt temperature
			Hg diss, µg/l	0.00102	U	Field Blank Contamination

Qualifier	Description
J	Positively Identified - Approximate concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit

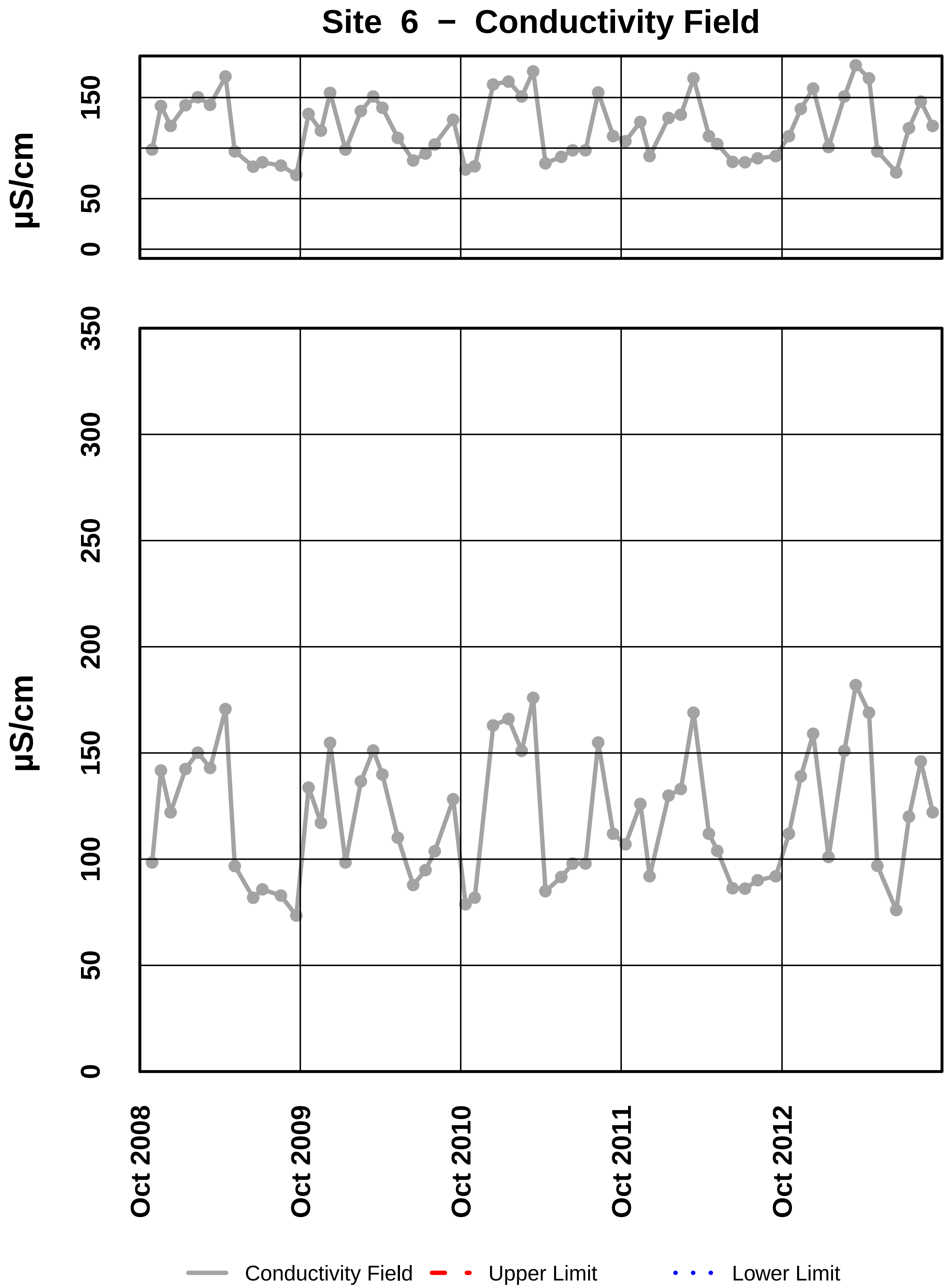
Site 6 – Water Temperature



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

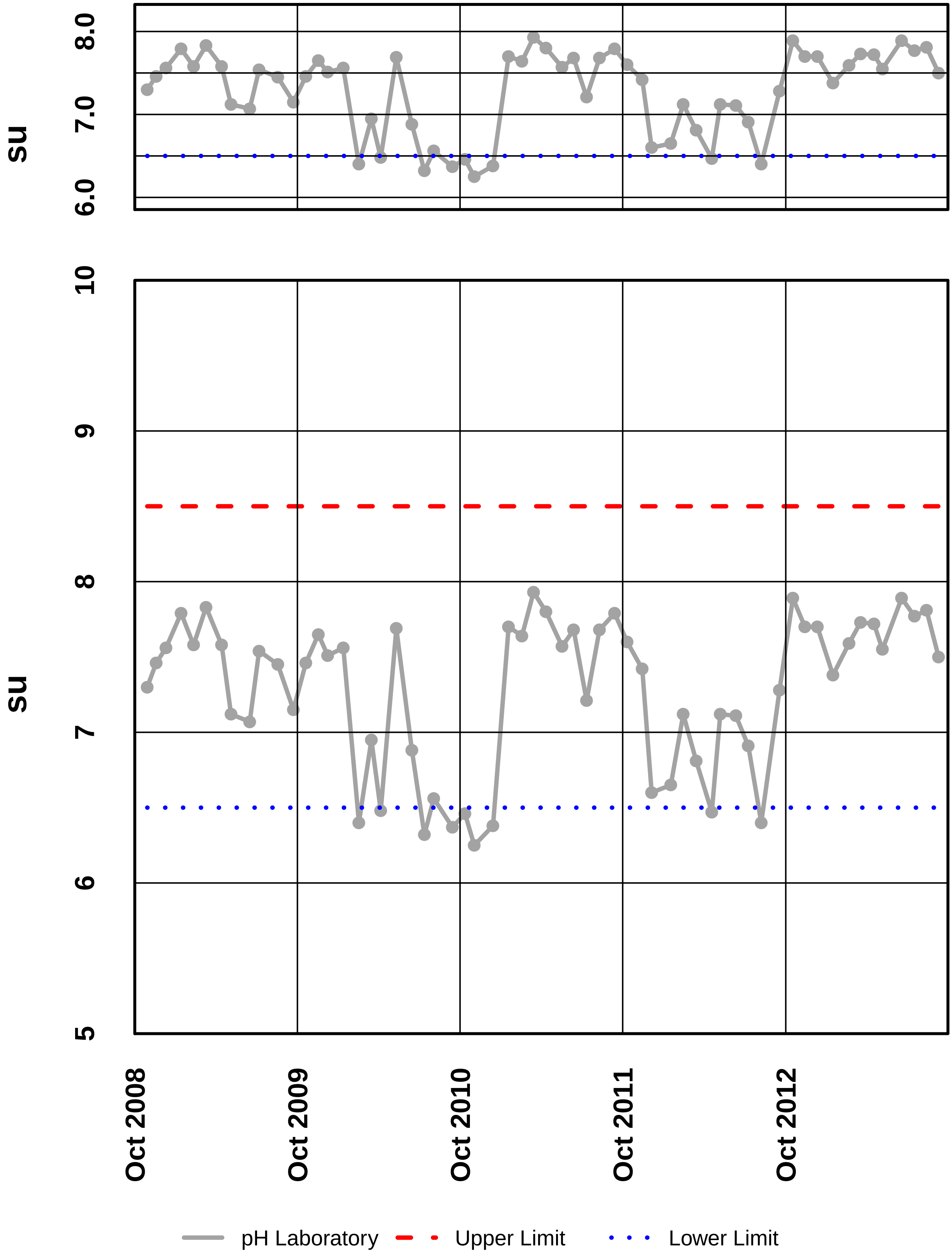


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



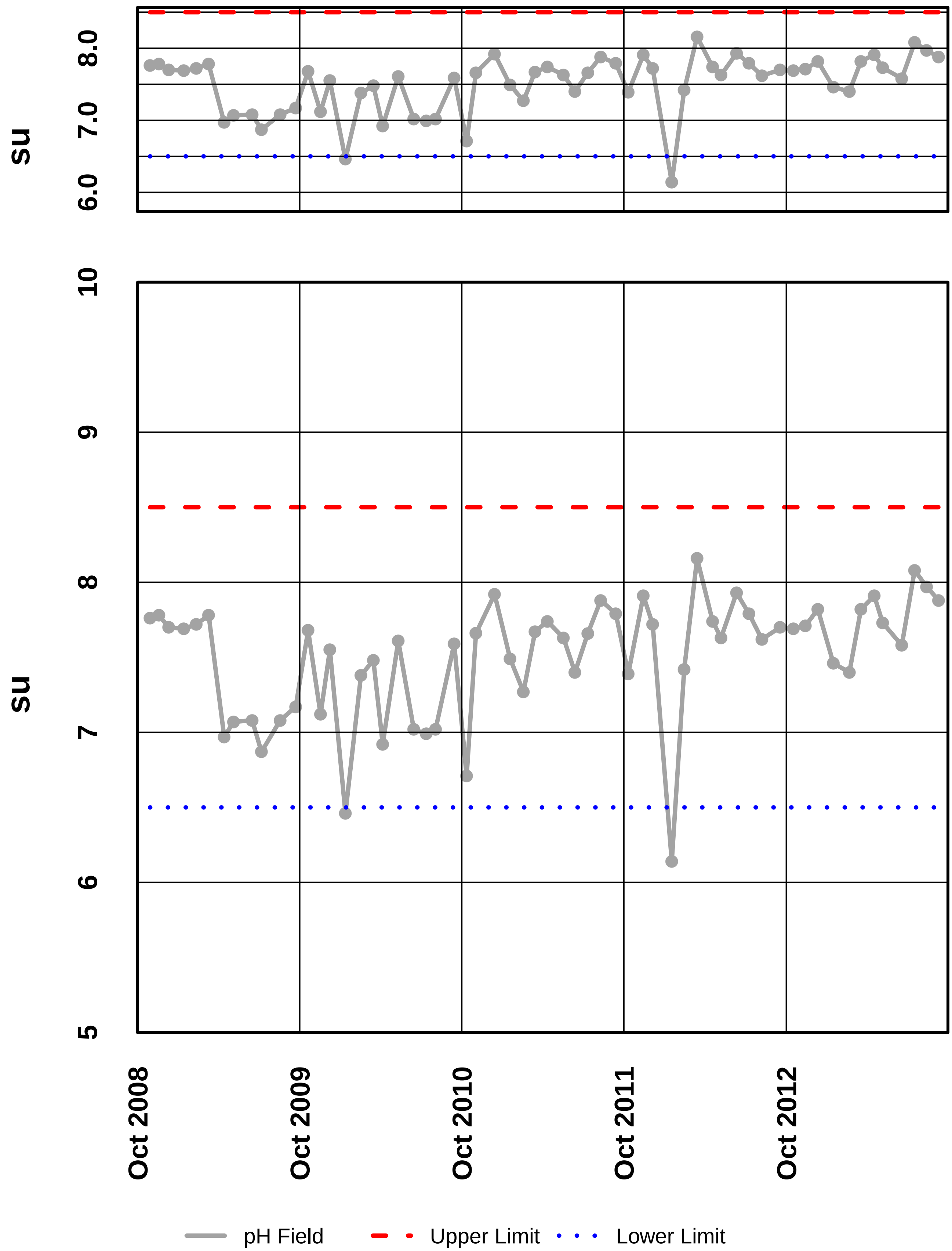
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 6 – pH Laboratory



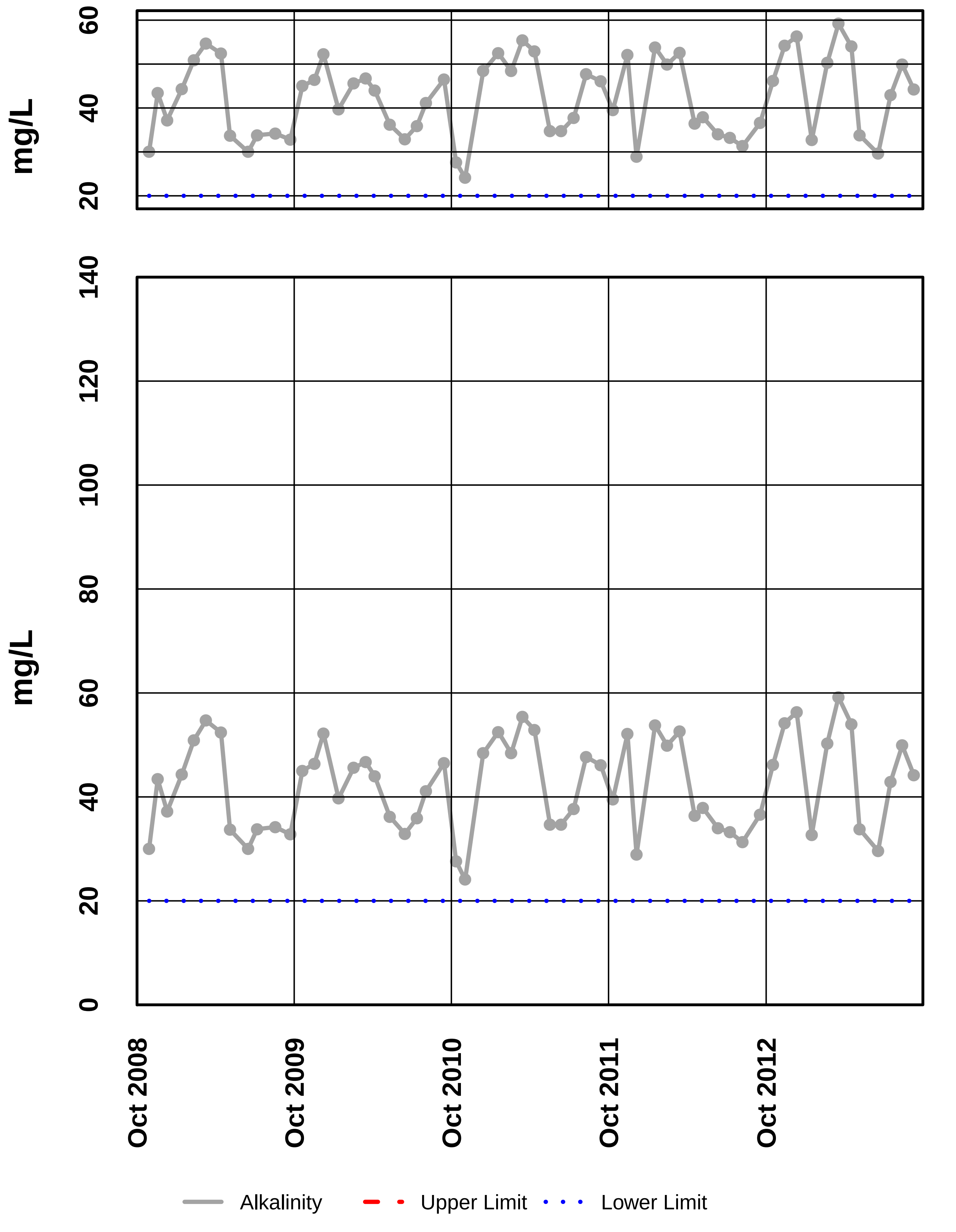
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 6 – pH Field



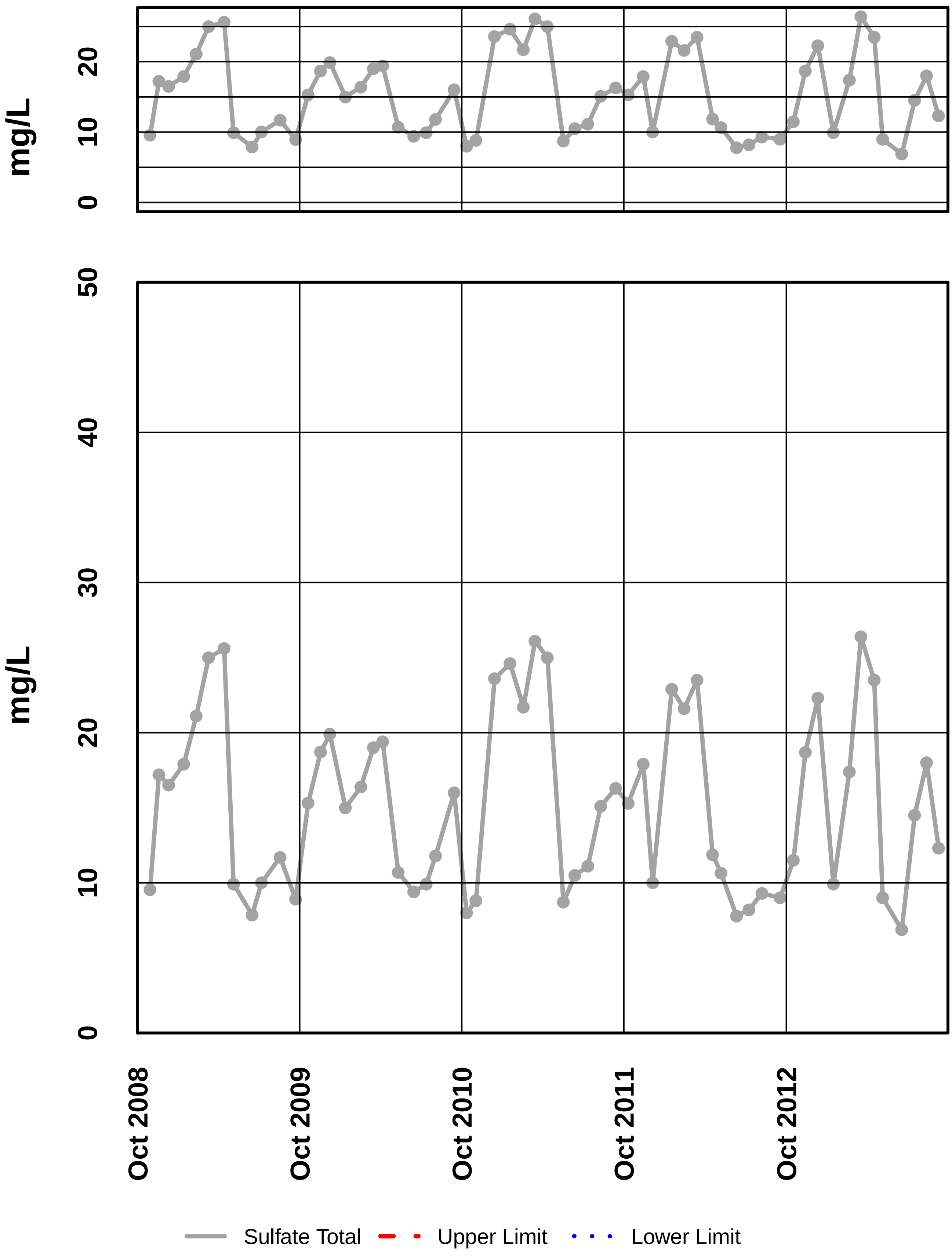
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 6 − Alkalinity

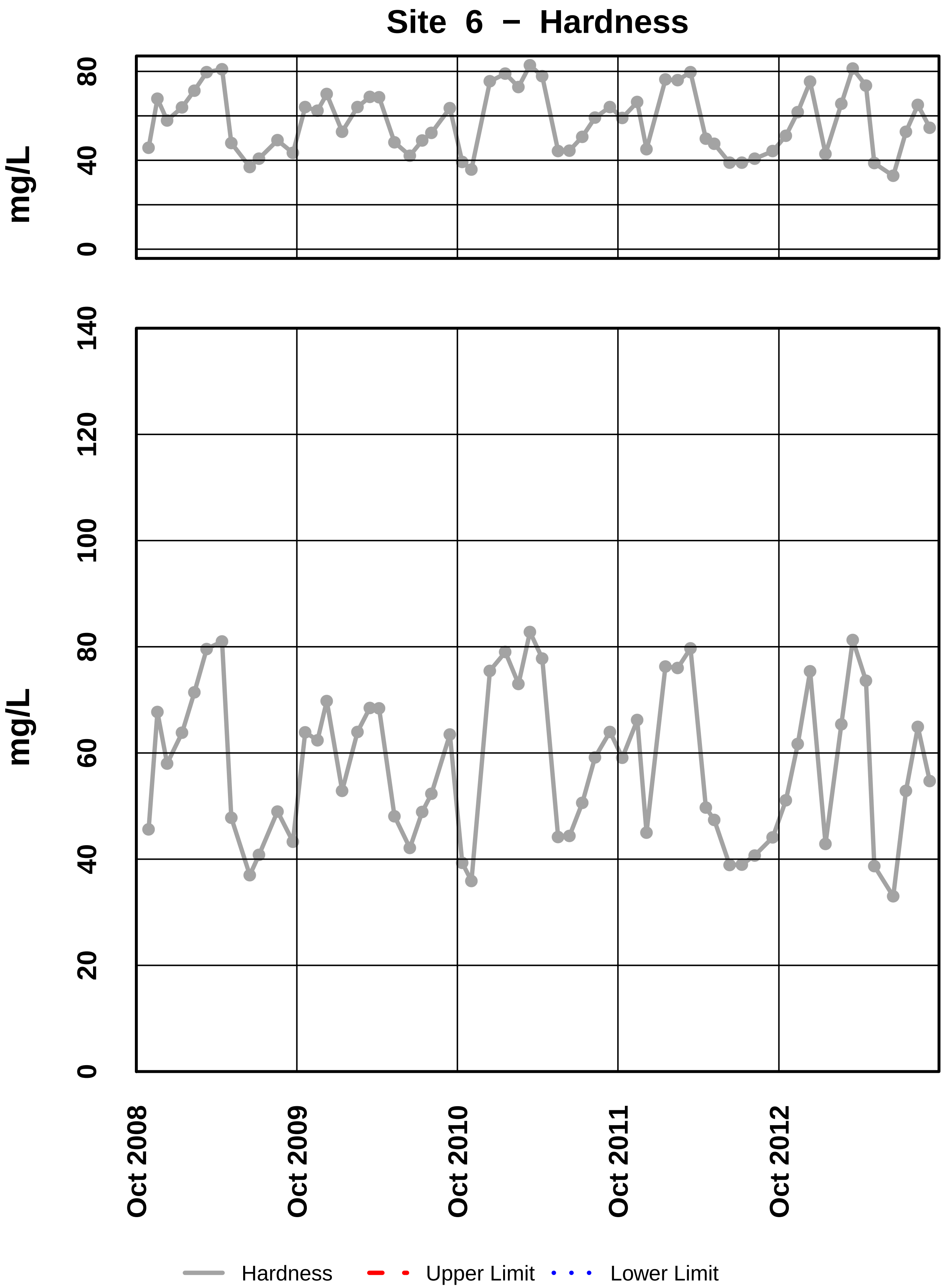


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 6 – Sulfate Total

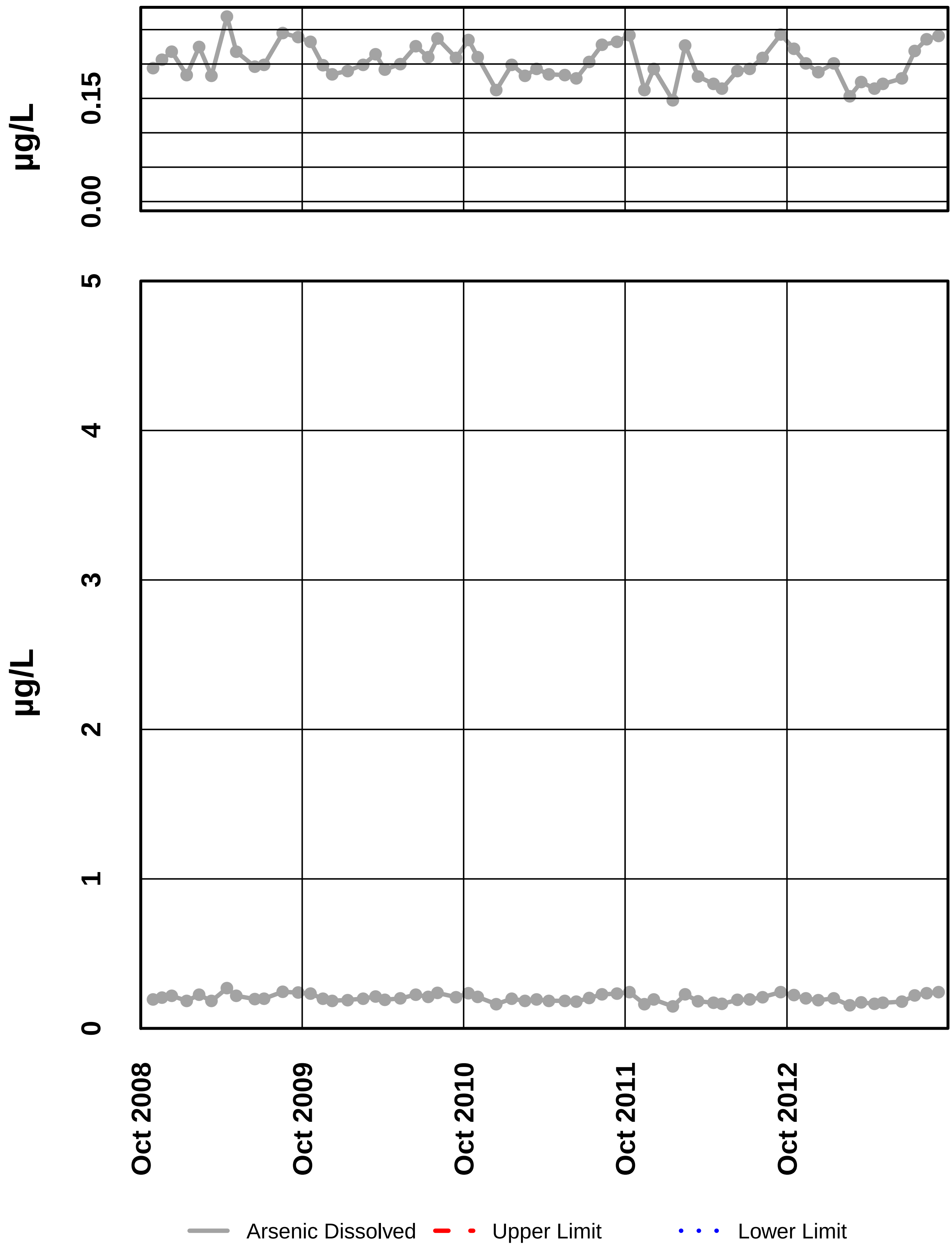


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



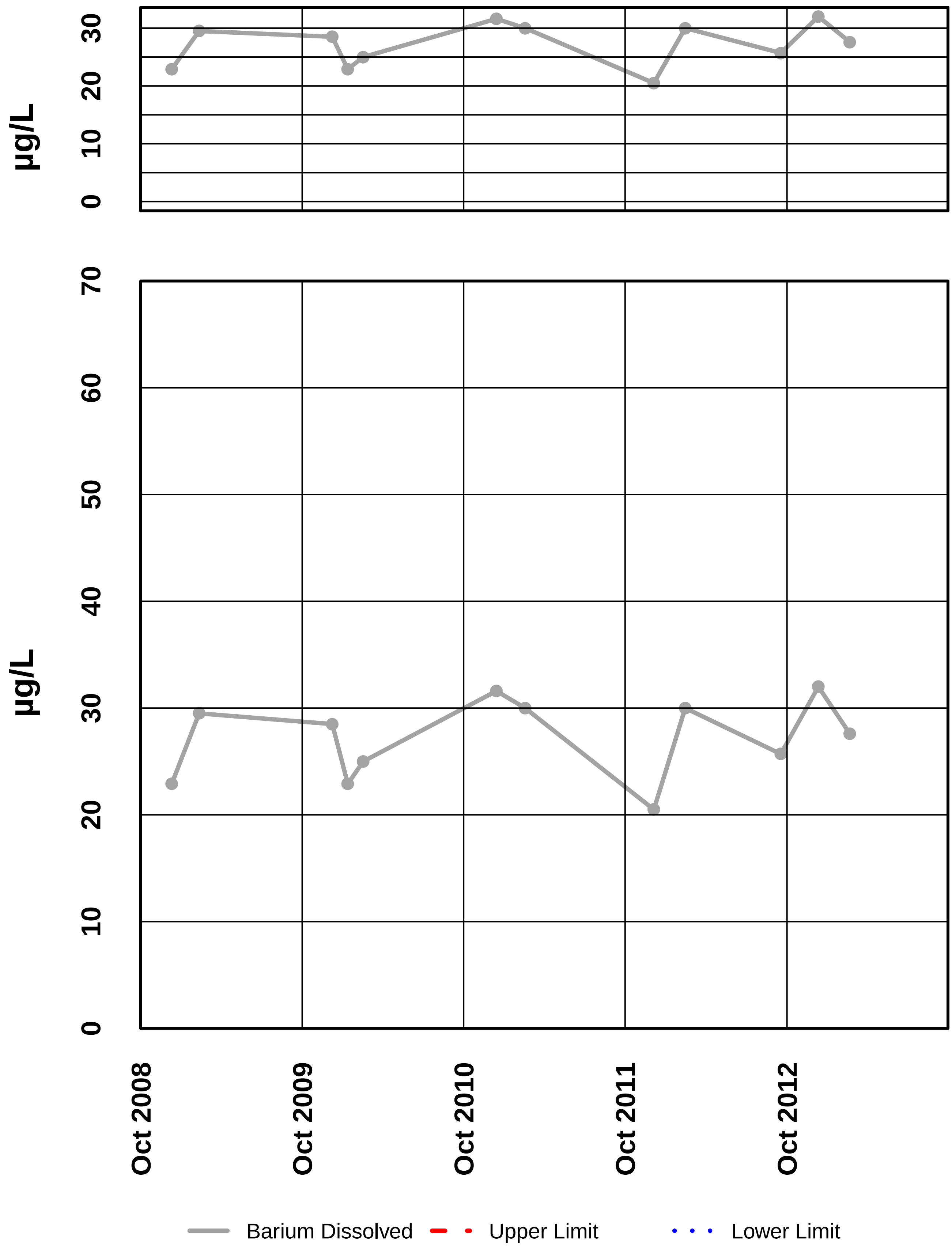
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 6 – Arsenic Dissolved



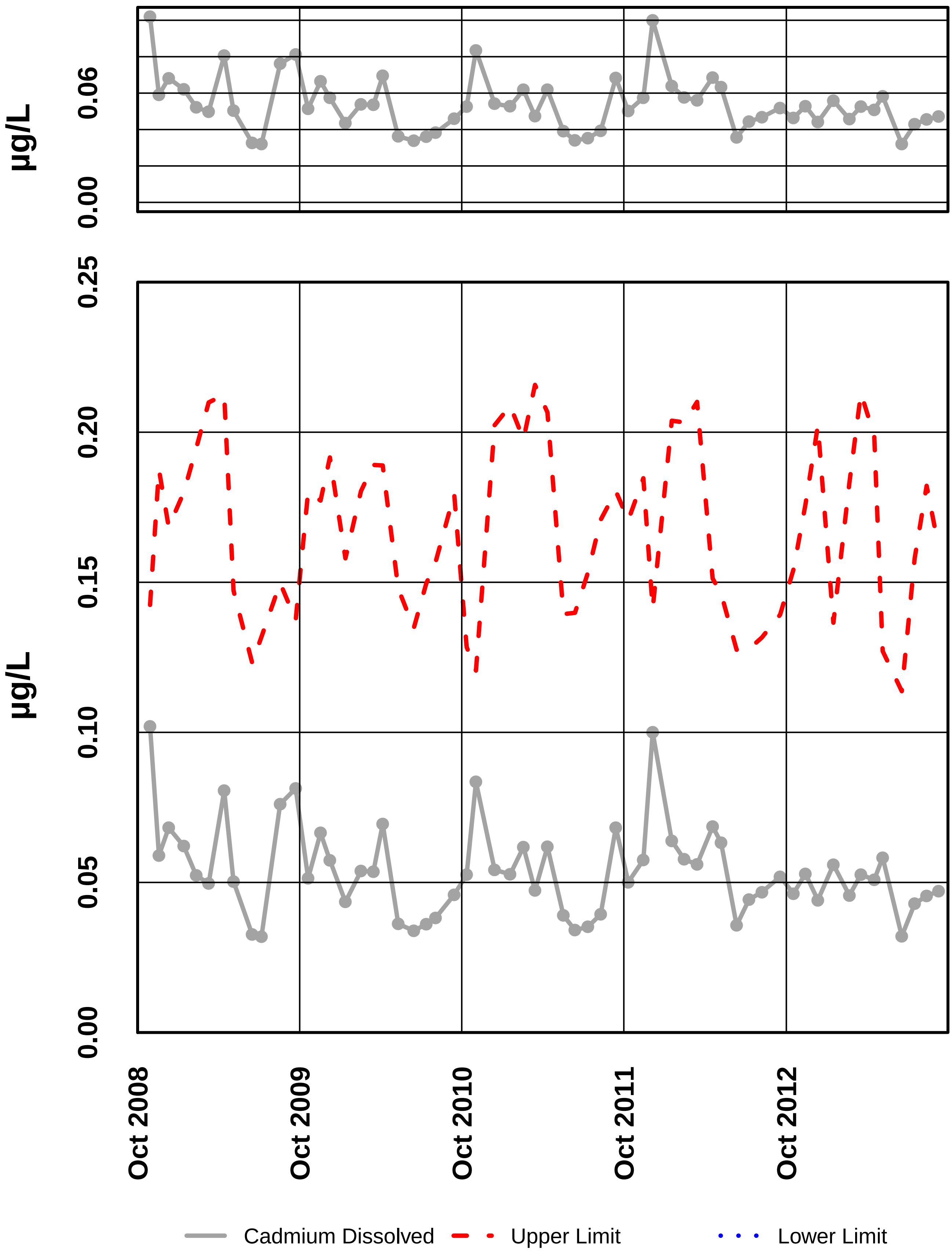
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 6 – Barium Dissolved

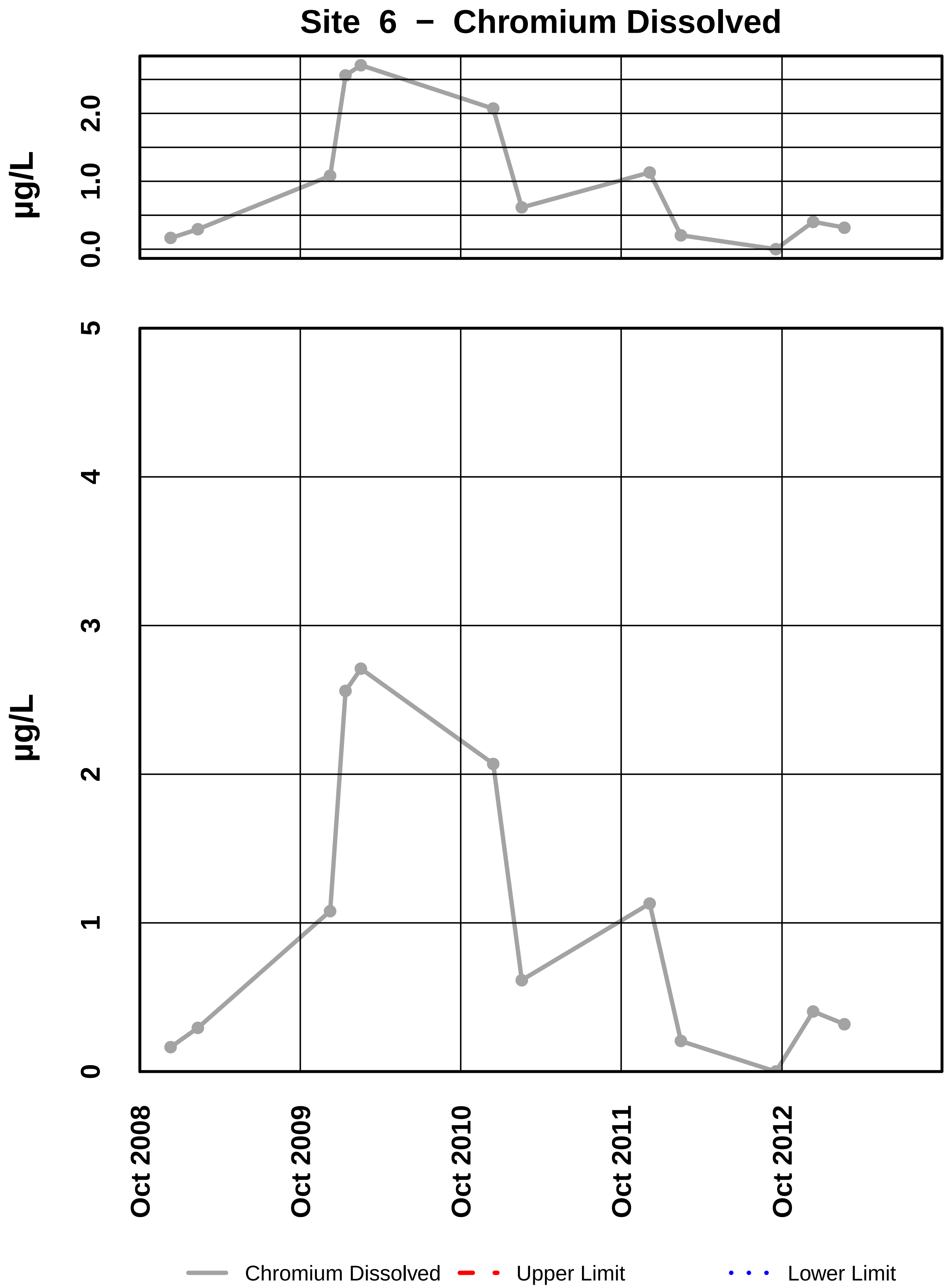


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 6 – Cadmium Dissolved

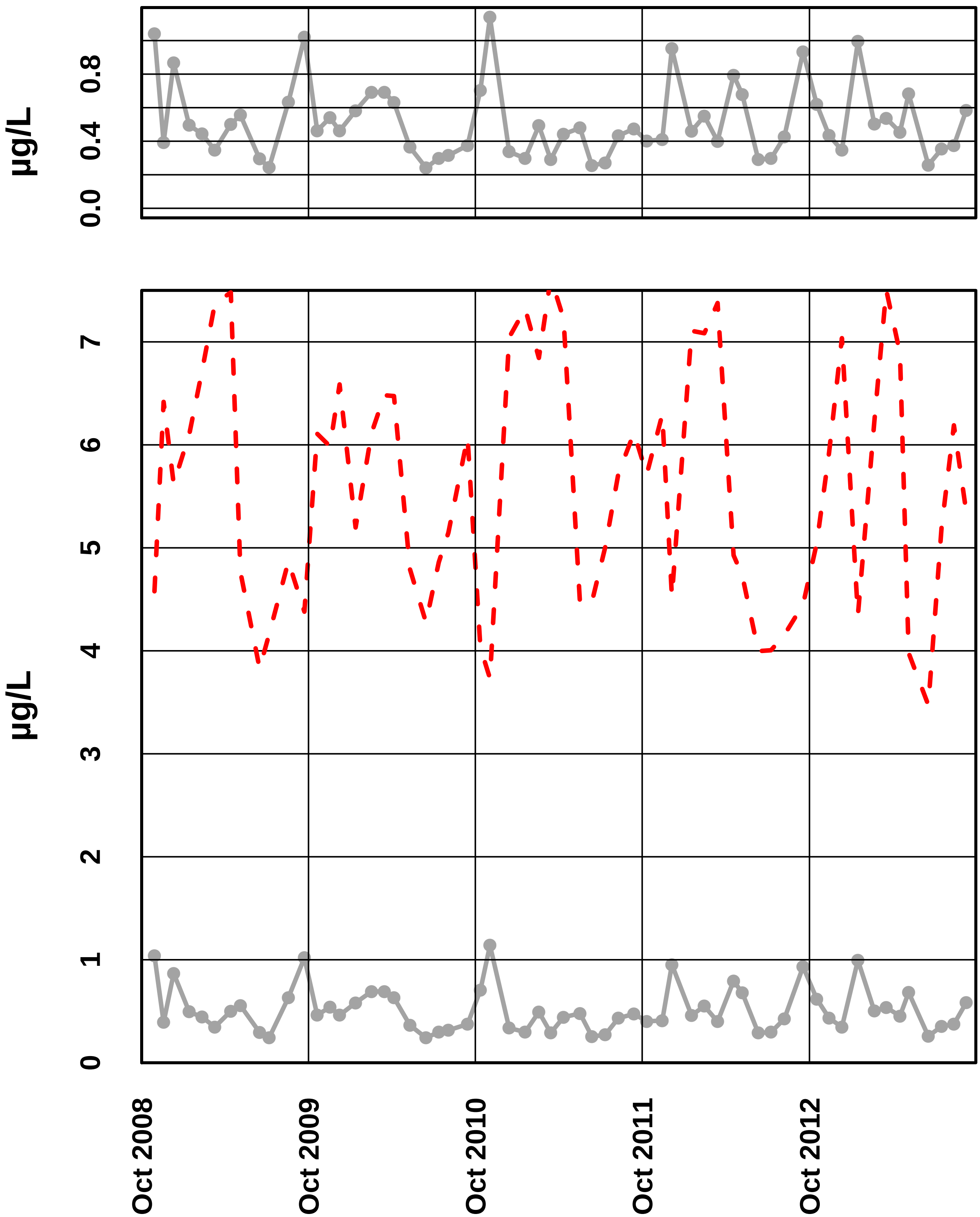


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

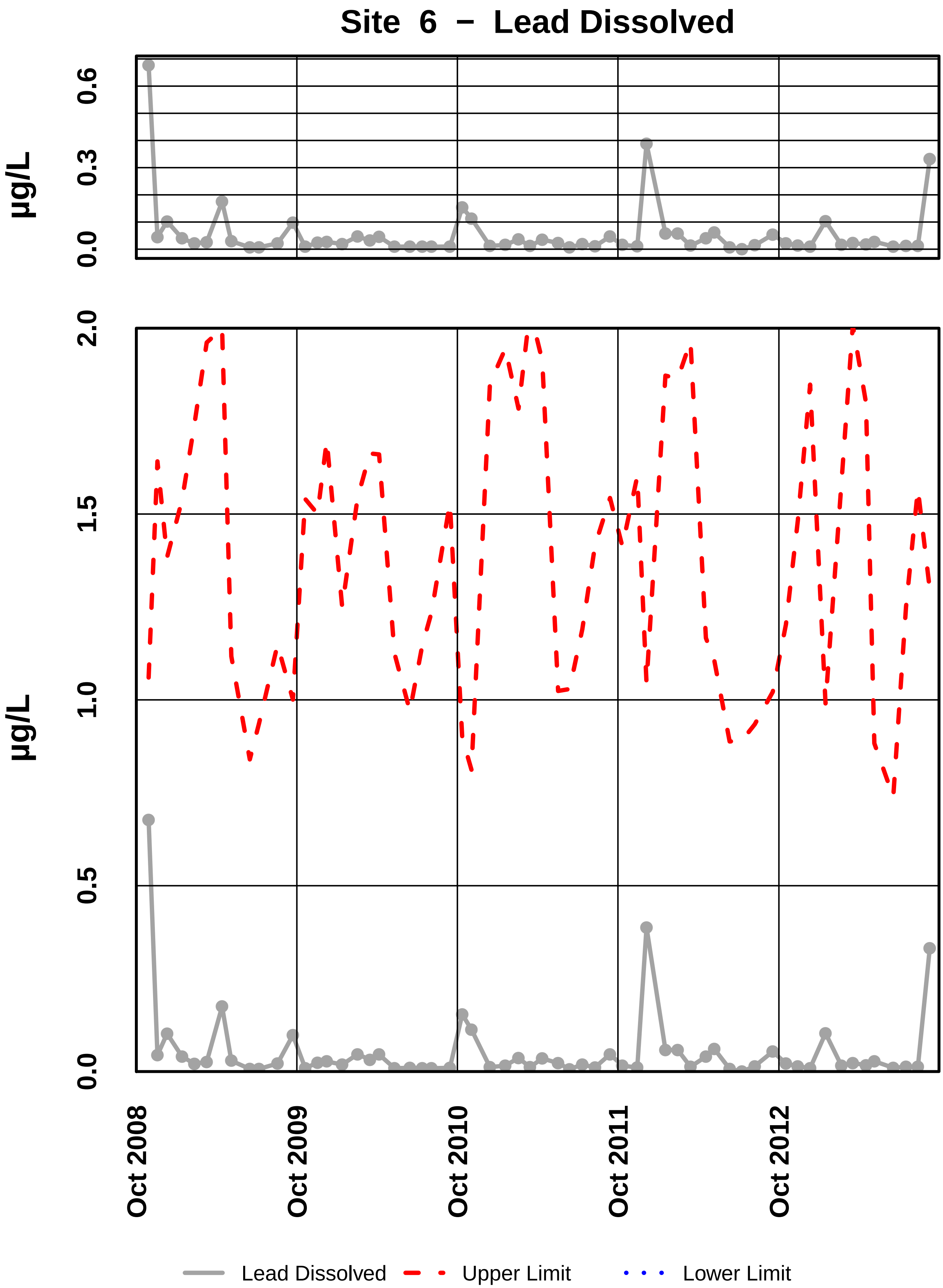


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 6 – Copper Dissolved

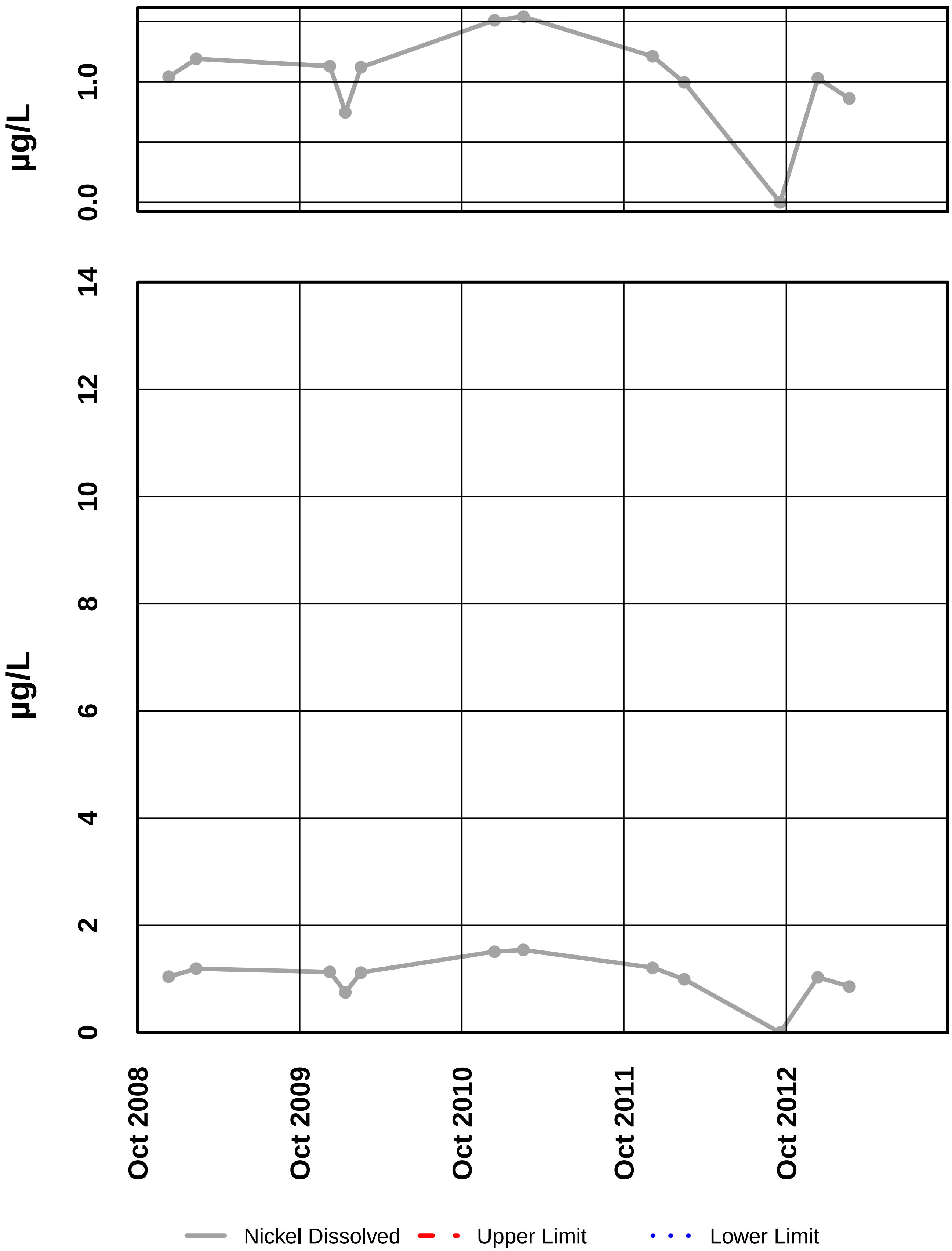


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

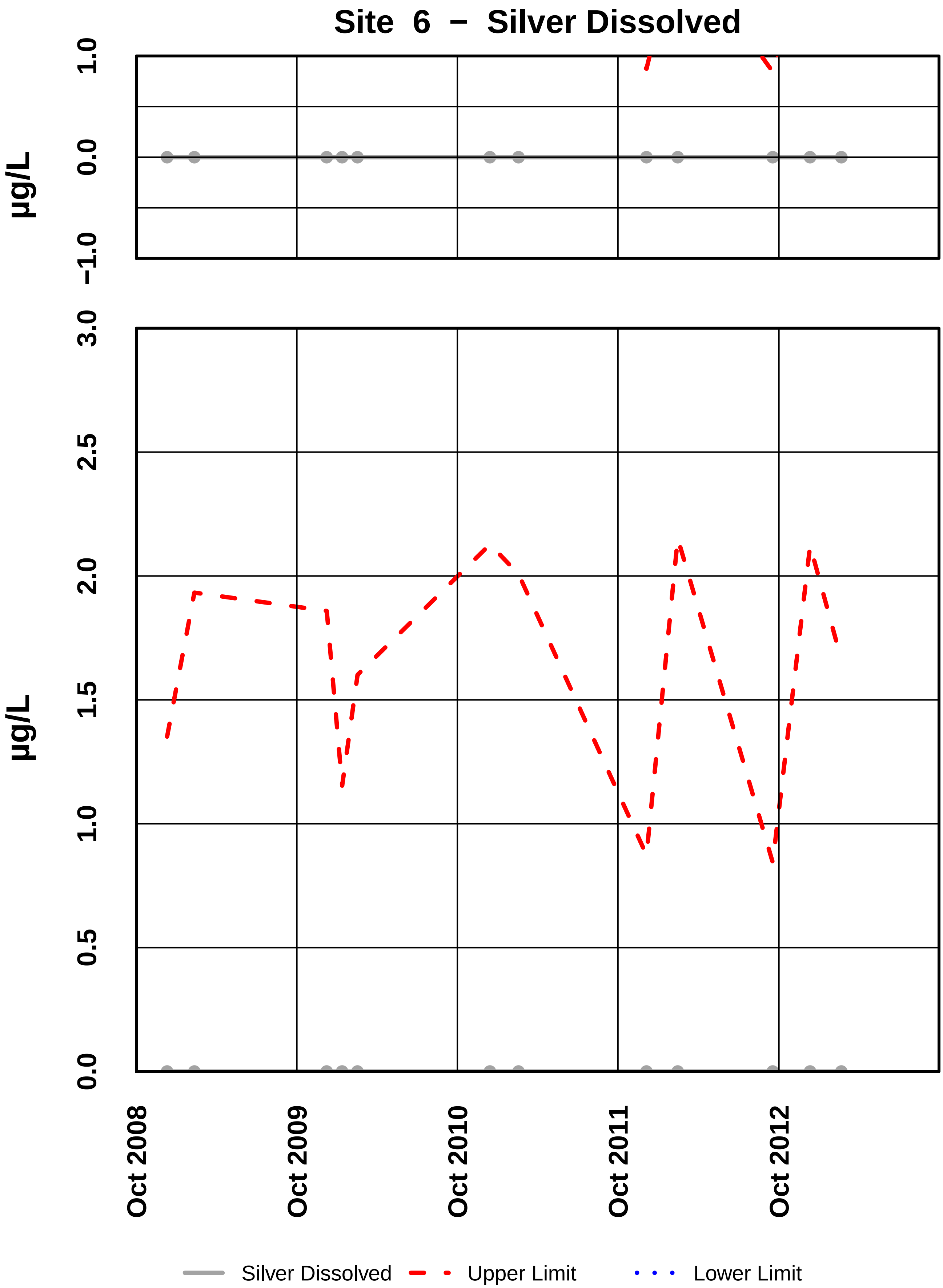


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

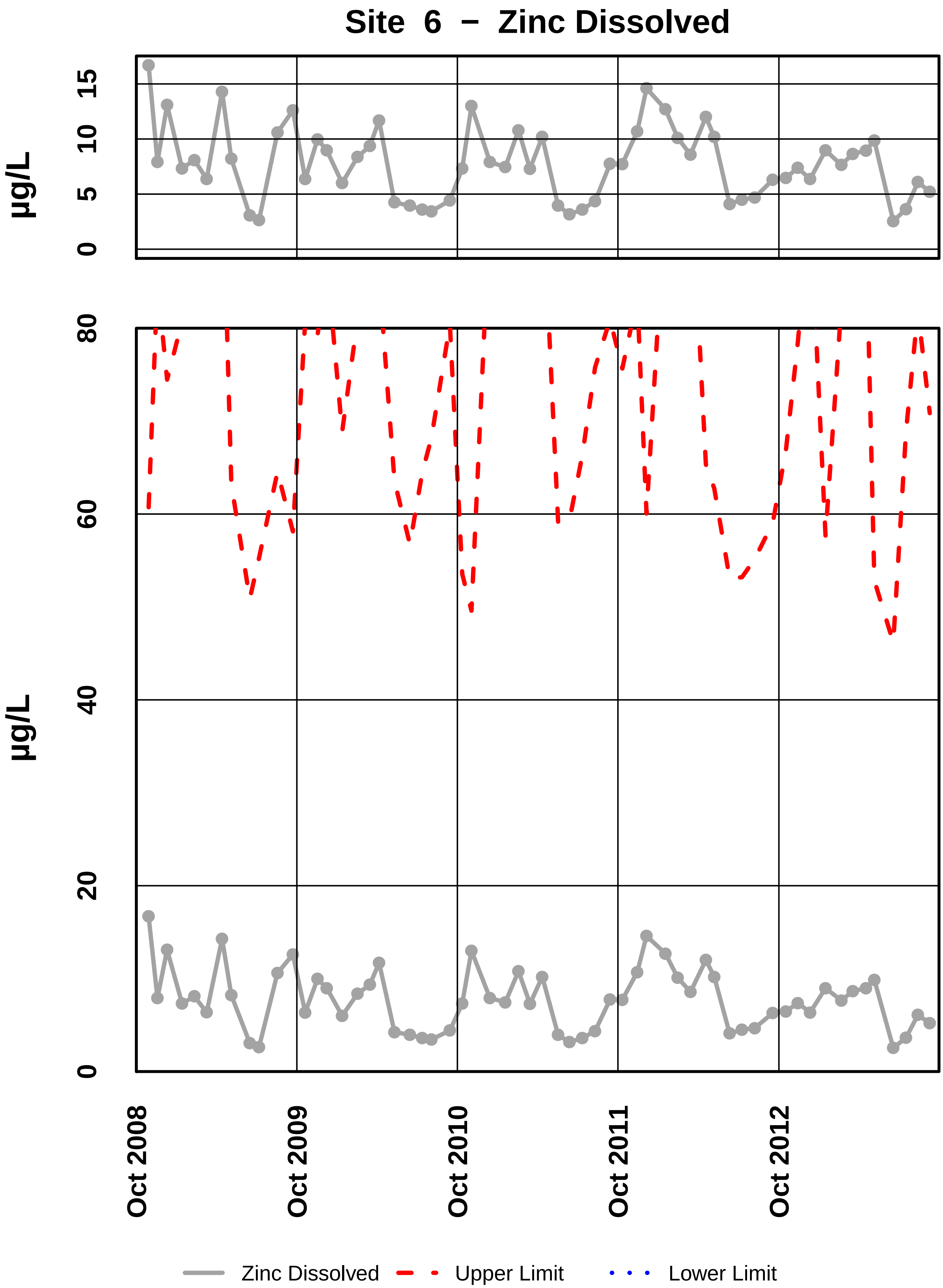
Site 6 − Nickel Dissolved



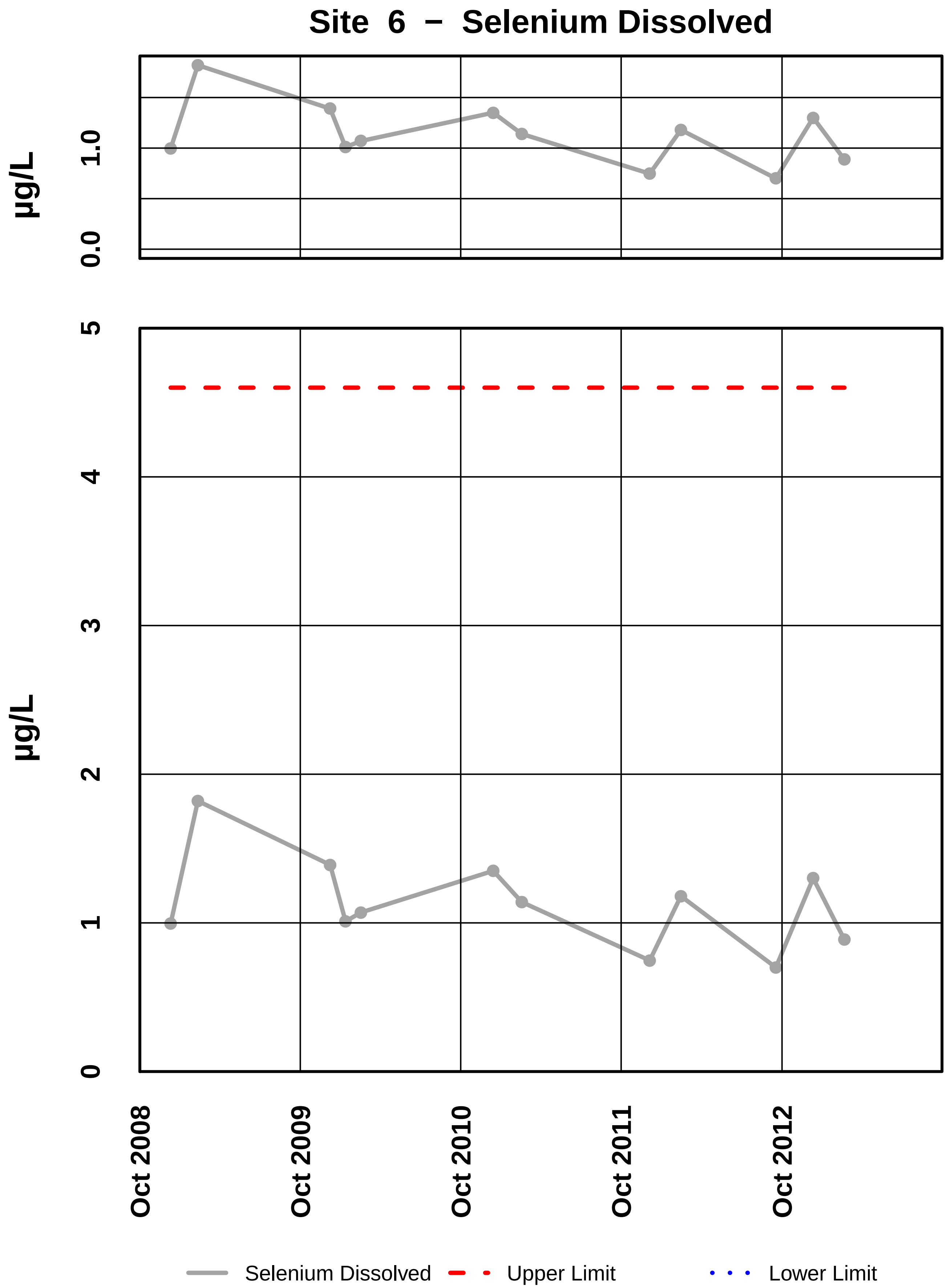
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

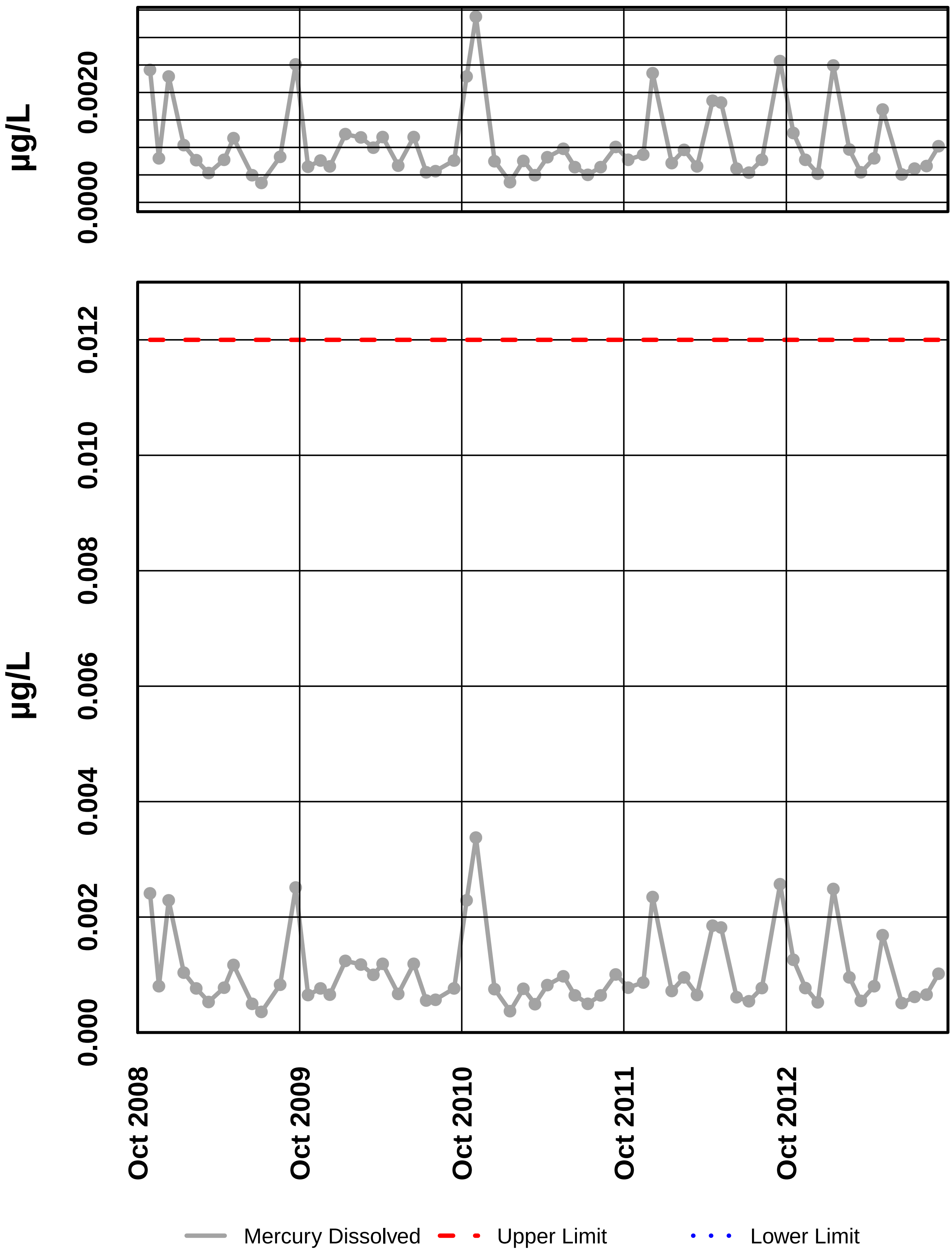


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

Site 6 – Mercury Dissolved



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

Site **#6** Seasonal Kendall analysis for Specific Conductance, Field (µS/cm)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**	110.8	135.3	155.1	162.9	150.4	161.9	149.6	92.5	89.4	87.2	90.8	89.5
b	**WY2009**	98.5	141.8	122	142.5	150.2	142.9	170.7	96.8	81.8	85.8	82.8	73.4
c	**WY2010**	133.8	117.1	154.8	98.4	136.6	151.2	139.8	110.1	87.8	94.8	103.8	128.2
d	**WY2011**	78.8	81.9	163	166	151	176	84.9	91.6	98	98	155	112
e	**WY2012**	107	126	92	130	133	169	112	104	86.3	86.2	90	92
f	**WY2013**	112	139	159	101	151	182	169	97	76	120	146	122
	n	6	6	6	6	6	6	6	6	6	6	6	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	6	6	6	6	4	6	6	6	6	6	6	6
t_2	0	0	0	0	1	0	0	0	0	0	0	0
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a	-1	1	-1	-1	-1	-1	1	1	-1	-1	-1	-1
c-a	1	-1	-1	-1	-1	-1	-1	1	-1	1	1	1
d-a	-1	-1	1	1	1	1	-1	-1	1	1	1	1
e-a	-1	-1	-1	-1	-1	1	-1	1	-1	-1	-1	1
f-a	1	1	1	-1	1	1	1	1	-1	1	1	1
c-b	1	-1	1	-1	-1	1	-1	1	1	1	1	1
d-b	-1	-1	1	1	1	1	-1	-1	1	1	1	1
e-b	1	-1	-1	-1	-1	1	-1	1	1	1	1	1
f-b	1	-1	1	-1	1	1	-1	1	-1	1	1	1
d-c	-1	-1	1	1	1	1	-1	-1	1	1	1	-1
e-c	-1	1	-1	1	-1	1	-1	-1	-1	-1	-1	-1
f-c	-1	1	1	1	1	1	1	-1	-1	1	1	-1
e-d	1	1	-1	-1	-1	-1	1	1	-1	-1	-1	-1
f-d	1	1	-1	-1	0	1	1	1	-1	1	-1	1
f-e	1	1	1	-1	1	1	1	-1	-1	1	1	1
S_k	1	-1	1	-5	0	9	-3	3	-5	7	5	5

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	28.33	28.33	28.33	28.33	27.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33
$Z_k = S_k/\sigma_S$	0.19	-0.19	0.19	-0.94	0.00	1.69	-0.56	0.56	-0.94	1.32	0.94	0.94
Z^2_k	0.04	0.04	0.04	0.88	0.00	2.86	0.32	0.32	0.88	1.73	0.88	0.88

ΣZ_k= 3.19

ΣZ^2_k= 8.86

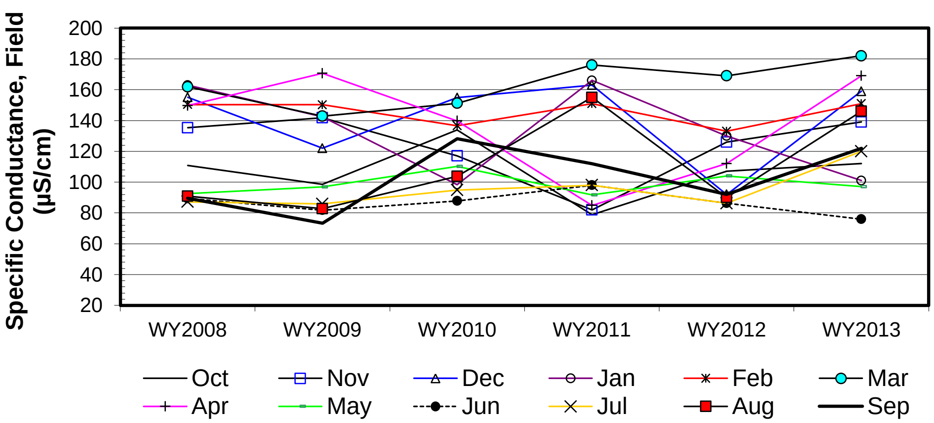
Z-bar=$\Sigma Z_k/K$= 0.27

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	70	1	0	0	0

Σn 72

ΣS_k 17

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=		8.01	@α=5% $\chi^2_{(K-1)}$=	19.68	Test for station homogeneity
	p	**0.713**			$\chi^2_h<\chi^2_{(K-1)}$ ACCEPT
ΣVAR(S_k)	Z_{calc}	0.87	@α/2=2.5% Z=	1.96	**H_0** (No trend) ACCEPT
339.00	**p**	**0.808**			**H_A** (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-1.60		3.94
0.050	-0.71	**0.68**	2.89
0.100	-0.24		2.69
0.200	0.01		1.71

Site **#6** Seasonal Kendall analysis for pH, Field, Standard Units

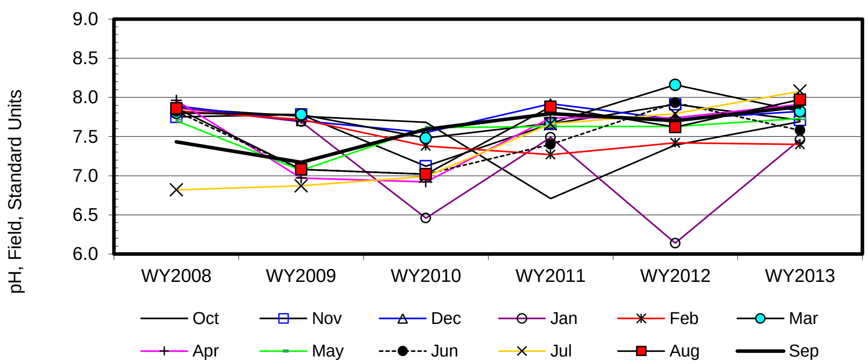
Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**	7.9	7.8	7.9	7.9	7.8	7.8	8.0	7.7	7.8	6.8	7.9	7.4
b	**WY2009**	7.8	7.8	7.7	7.7	7.7	7.8	7.0	7.1	7.1	6.9	7.1	7.2
c	**WY2010**	7.7	7.1	7.6	6.5	7.4	7.5	6.9	7.6	7.0	7.0	7.0	7.6
d	**WY2011**	6.7	7.7	7.9	7.5	7.3	7.7	7.7	7.6	7.4	7.7	7.9	7.8
e	**WY2012**	7.4	7.9	7.7	6.1	7.4	8.2	7.7	7.6	7.9	7.8	7.6	7.7
f	**WY2013**	7.7	7.7	7.8	7.5	7.4	7.8	7.9	7.7	7.6	8.1	8.0	7.9
	n	6	6	6	6	6	6	6	6	6	6	6	6
	t_1	6	6	6	6	6	6	4	4	6	6	6	6
	t_2	0	0	0	0	0	0	1	1	0	0	0	0
	t_3	0	0	0	0	0	0	0	0	0	0	0	0
	t_4	0	0	0	0	0	0	0	0	0	0	0	0
	t_5	0	0	0	0	0	0	0	0	0	0	0	0
	b-a	-1	1	-1	-1	-1	-1	-1	-1	-1	1	-1	-1
	c-a	-1	-1	-1	-1	-1	-1	-1	-1	-1	1	-1	1
	d-a	-1	-1	1	-1	-1	-1	-1	-1	-1	1	1	1
	e-a	-1	1	-1	-1	-1	1	-1	-1	1	1	-1	1
	f-a	-1	-1	-1	-1	-1	1	-1	1	-1	1	1	1
	c-b	-1	-1	-1	-1	-1	-1	-1	1	-1	1	-1	1
	d-b	-1	-1	1	-1	-1	-1	1	1	1	1	1	1
	e-b	-1	1	1	-1	-1	1	1	1	1	1	1	1
	f-b	-1	-1	1	-1	-1	1	1	1	1	1	1	1
	d-c	-1	1	1	1	-1	1	1	1	1	1	1	1
	e-c	-1	1	1	-1	1	1	1	1	1	1	1	1
	f-c	1	1	1	1	1	1	1	1	1	1	1	1
	e-d	1	1	-1	-1	1	1	0	0	1	1	-1	-1
	f-d	1	1	-1	-1	1	1	1	1	1	1	1	1
	f-e	1	-1	1	1	-1	-1	1	1	-1	1	1	1
	S_k	-7	1	1	-9	-7	3	2	6	3	15	5	11
	Qm										0.28		0.10
	σ^2_S=	28.33	28.33	28.33	28.33	28.33	28.33	27.33	27.33	28.33	28.33	28.33	28.33
	$Z_k = S_k/\sigma_S$	-1.32	0.19	0.19	-1.69	-1.32	0.56	0.38	1.15	0.56	2.82	0.94	2.07
	Z^2_k	1.73	0.04	0.04	2.86	1.73	0.32	0.15	1.32	0.32	7.94	0.88	4.27

ΣZ_k=	4.54
ΣZ^2_k=	21.58
Z-bar=ΣZ_k/K=	0.38

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	68	2	0	0	0

Σn	72
ΣS_k	24

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=		19.87	@α=5% $\chi^2_{(K-1)}$=	19.68	Test for station homogeneity
	p	**0.047**			$\chi^2_h<\chi^2_{(K-1)}$ **REJECT**
ΣVAR(S_k)	Z_{calc}	1.25	@α/2=2.5% Z=	1.96	**H_0** (No trend) NA
338.00	**p**	**0.895**			**H_A** ($\pm$ trend) NA



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.02		0.09
0.050	-0.01	**0.02**	0.07
0.100	0.00		0.05
0.200	0.01		0.04

Site #6 — Seasonal Kendall analysis for Total Alk, (mg/l)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**	39.2	44.9	53.0	54.1	49.8	47.7	53.8	32.3	33.8	31.2	35.1	31.7
b	**WY2009**	30.0	43.4	37.2	44.3	50.9	54.7	52.4	33.7	30.0	33.8	34.2	32.8
c	**WY2010**	45.0	46.4	52.2	39.7	45.6	46.7	44.0	36.2	32.9	35.9	41.1	46.5
d	**WY2011**	27.6	24.1	48.4	52.5	48.4	55.4	52.9	34.7	34.7	37.7	47.7	46.1
e	**WY2012**	39.5	52.1	28.9	53.8	49.9	52.6	36.4	37.9	34.0	33.2	31.3	36.6
f	**WY2013**	46.2	54.2	56.3	32.7	50.3	59.2	54.0	33.8	29.6	42.9	49.9	44.2
	n	6	6	6	6	6	6	6	6	6	6	6	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	6	6	6	6	6	6	6	6	6	6	6	6
t_2	0	0	0	0	0	0	0	0	0	0	0	0
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a	-1	-1	-1	-1	1	1	-1	1	-1	1	-1	1
c-a	1	1	-1	-1	-1	-1	-1	1	-1	1	1	1
d-a	-1	-1	-1	-1	-1	1	-1	1	1	1	1	1
e-a	1	1	-1	-1	1	1	-1	1	1	1	-1	1
f-a	1	1	1	-1	1	1	1	1	-1	1	1	1
c-b	1	1	1	-1	-1	-1	-1	1	1	1	1	1
d-b	-1	-1	1	1	-1	1	1	1	1	1	1	1
e-b	1	1	-1	1	-1	-1	-1	1	1	-1	-1	1
f-b	1	1	1	-1	-1	1	1	1	-1	1	1	1
d-c	-1	-1	-1	1	1	1	1	-1	1	1	1	-1
e-c	-1	1	-1	1	1	1	-1	1	1	-1	-1	-1
f-c	1	1	1	-1	1	1	1	-1	-1	1	1	-1
e-d	1	1	-1	1	1	-1	-1	1	-1	-1	-1	-1
f-d	1	1	1	-1	1	1	1	-1	-1	1	1	-1
f-e	1	1	1	-1	1	1	1	-1	-1	1	1	1
S_k	5	7	-1	-5	3	7	-1	7	-1	9	5	5

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33
$Z_k = S_k/\sigma_S$	0.94	1.32	-0.19	-0.94	0.56	1.32	-0.19	1.32	-0.19	1.69	0.94	0.94
Z^2_k	0.88	1.73	0.04	0.88	0.32	1.73	0.04	1.73	0.04	2.86	0.88	0.88

ΣZ_k= 7.51

ΣZ^2_k= 12.00

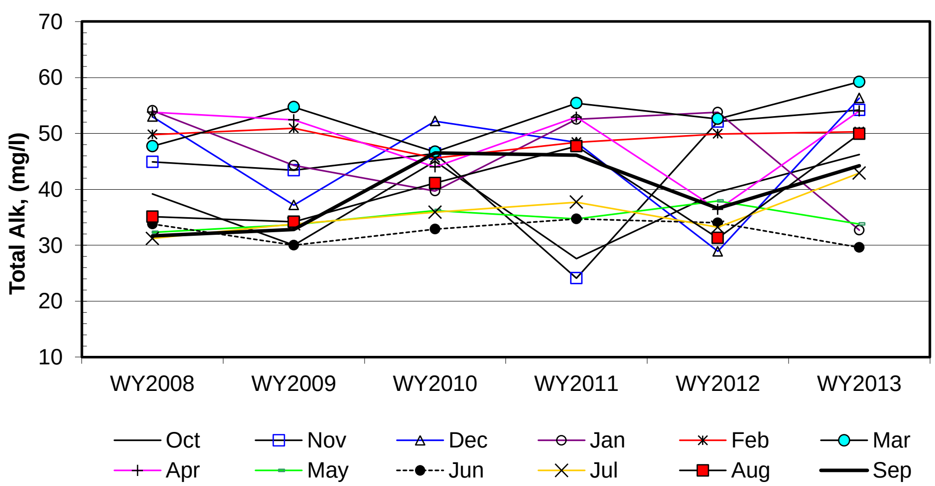
Z-bar=ΣZ_k/K= 0.63

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	72	0	0	0	0

Σn 72

ΣS_k 40

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$= 7.29	@α=5% $\chi^2_{(K-1)}$= 19.68	Test for station homogeneity	
p **0.775**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
$\Sigma VAR(S_k)$ **Z_{calc}** 2.12	@α/2=2.5% **Z**= 1.96	**H_0** (No trend)	REJECT
340.00 **p** **0.983**		**H_A** (± trend)	ACCEPT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.12		1.83
0.050	0.07	**0.83**	1.40
0.100	0.30		1.36
0.200	0.40		1.23

1.9%

Site **#6** Seasonal Kendall analysis for Sulfate, Total (mg/l)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**	13.0	13.4	18.0	22.4	21.5	19.3	22.3	7.6	7.4	8.2	8.7	7.5
b	**WY2009**	9.5	17.2	16.5	17.9	21.1	25.0	25.6	9.9	7.9	10.0	11.7	8.9
c	**WY2010**	15.3	18.7	19.9	15.0	16.4	19.0	19.4	10.7	9.4	9.9	11.8	16.0
d	**WY2011**	8.0	8.8	23.6	24.6	21.7	26.1	25.0	8.7	10.5	11.1	15.1	16.3
e	**WY2012**	15.3	17.9	10.0	22.9	21.6	23.5	11.9	10.7	7.8	8.2	9.3	9.0
f	**WY2013**	11.5	18.7	22.3	9.9	17.4	26.4	23.5	9.0	6.9	14.5	18.0	12.3
	n	6	6	6	6	6	6	6	6	6	6	6	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	4	4	6	6	6	6	6	6	6	6	6	6
t_2	1	1	0	0	0	0	0	0	0	0	0	0
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a	-1	1	-1	-1	-1	1	1	1	1	1	1	1
c-a	1	1	1	-1	-1	-1	-1	1	1	1	1	1
d-a	-1	-1	1	1	1	1	1	1	1	1	1	1
e-a	1	1	-1	1	1	1	-1	1	1	1	1	1
f-a	-1	1	1	-1	-1	1	1	1	-1	1	1	1
c-b	1	1	1	-1	-1	-1	-1	1	1	-1	1	1
d-b	-1	-1	1	1	1	1	-1	-1	1	1	1	1
e-b	1	1	-1	1	1	-1	-1	1	-1	-1	-1	1
f-b	1	1	1	-1	-1	1	-1	-1	-1	1	1	1
d-c	-1	-1	1	1	1	1	1	-1	1	1	1	1
e-c	0	-1	-1	1	1	1	-1	-1	-1	-1	-1	-1
f-c	-1	0	1	-1	1	1	1	-1	-1	1	1	-1
e-d	1	1	-1	-1	-1	-1	-1	1	-1	-1	-1	-1
f-d	1	1	-1	-1	-1	1	-1	1	-1	1	1	-1
f-e	-1	1	1	-1	-1	1	1	-1	-1	1	1	1
S_k	0	6	3	-3	-1	7	-3	3	-1	7	9	7

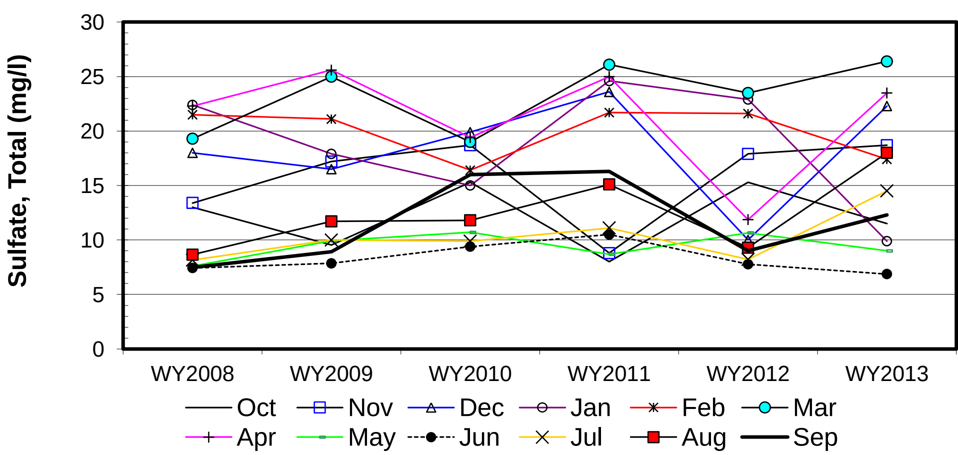
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	27.33	27.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33
$Z_k = S_k/\sigma_S$	0.00	1.15	0.56	-0.56	-0.19	1.32	-0.56	0.56	-0.19	1.32	1.69	1.32
Z^2_k	0.00	1.32	0.32	0.32	0.04	1.73	0.32	0.32	0.04	1.73	2.86	1.73

ΣZ_k= 6.41
ΣZ^2_k= 10.71
Z-bar=ΣZ_k/K= 0.53

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	68	2	0	0	0

Σn 72
ΣS_k 34

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	7.28	@α=5% $\chi^2_{(K-1)}$= 19.68	Test for station homogeneity	
p	**0.776**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k) Z_{calc}	1.79	@α=2.5% Z= 1.96	H_0 (No trend)	ACCEPT
338.00 p	**0.964**		H_A (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.10		0.96
0.050	0.01	**0.30**	0.80
0.100	0.07		0.70
0.200	0.15		0.48

Site #6 Seasonal Kendall analysis for Zinc, Dissolved (ug/l)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**	9.9	10.6	7.6	6.4	7.5	12.4	16.6	8.7	3.2	3.3	7.3	12.2
b	**WY2009**	16.7	7.9	13.1	7.3	8.1	6.4	14.3	8.2	3.1	2.6	10.6	12.6
c	**WY2010**	6.4	10.0	9.0	6.0	8.4	9.4	11.7	4.3	4.0	3.6	3.5	4.4
d	**WY2011**	7.3	13.0	7.9	7.5	10.8	7.3	10.2	4.0	3.2	3.6	4.4	7.7
e	**WY2012**	7.7	10.7	14.6	12.7	10.1	8.6	12.0	10.2	4.1	4.5	4.7	6.3
f	**WY2013**	6.5	7.4	6.4	9.0	7.7	8.7	9.0	9.9	2.6	3.6	6.1	5.2
	n	6	6	6	6	6	6	6	6	6	6	6	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	6	6	6	6	6	6	6	6	6	4	6	6
t_2	0	0	0	0	0	0	0	0	0	1	0	0
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a	1	-1	1	1	1	-1	-1	-1	-1	-1	1	1
c-a	-1	-1	1	-1	1	-1	-1	-1	1	1	-1	-1
d-a	-1	1	1	1	1	-1	-1	-1	-1	1	-1	-1
e-a	-1	1	1	1	1	-1	-1	1	1	1	-1	-1
f-a	-1	-1	-1	1	1	-1	-1	1	-1	1	-1	-1
c-b	-1	1	-1	-1	1	1	-1	-1	1	1	-1	-1
d-b	-1	1	-1	1	1	1	-1	-1	1	1	-1	-1
e-b	-1	1	1	1	1	1	-1	1	1	1	-1	-1
f-b	-1	-1	-1	1	-1	1	-1	1	-1	1	-1	-1
d-c	1	1	-1	1	1	-1	-1	-1	-1	0	1	1
e-c	1	1	1	1	1	-1	1	1	1	1	1	1
f-c	1	-1	-1	1	-1	-1	-1	1	-1	1	1	1
e-d	1	-1	1	1	-1	1	1	1	1	1	1	-1
f-d	-1	-1	-1	1	-1	1	-1	1	-1	1	1	-1
f-e	-1	-1	-1	-1	-1	1	-1	-1	-1	-1	1	-1
S_k	-5	-1	-1	9	5	-1	-11	1	-1	10	-1	-7

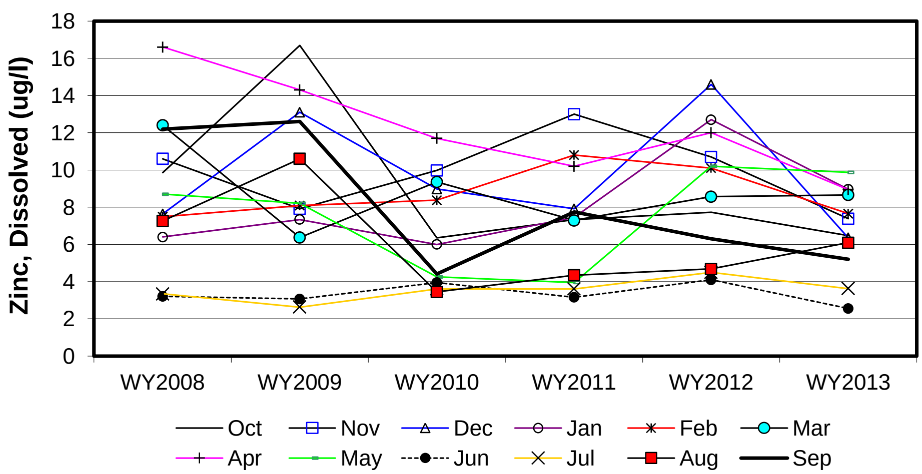
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	27.33	28.33	28.33
$Z_k = S_k/\sigma_S$	-0.94	-0.19	-0.19	1.69	0.94	-0.19	-2.07	0.19	-0.19	1.91	-0.19	-1.32
Z^2_k	0.88	0.04	0.04	2.86	0.88	0.04	4.27	0.04	0.04	3.66	0.04	1.73

ΣZ_k= -0.53
ΣZ^2_k= 14.49
Z-bar=ΣZ_k/K= -0.04

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	70	1	0	0	0

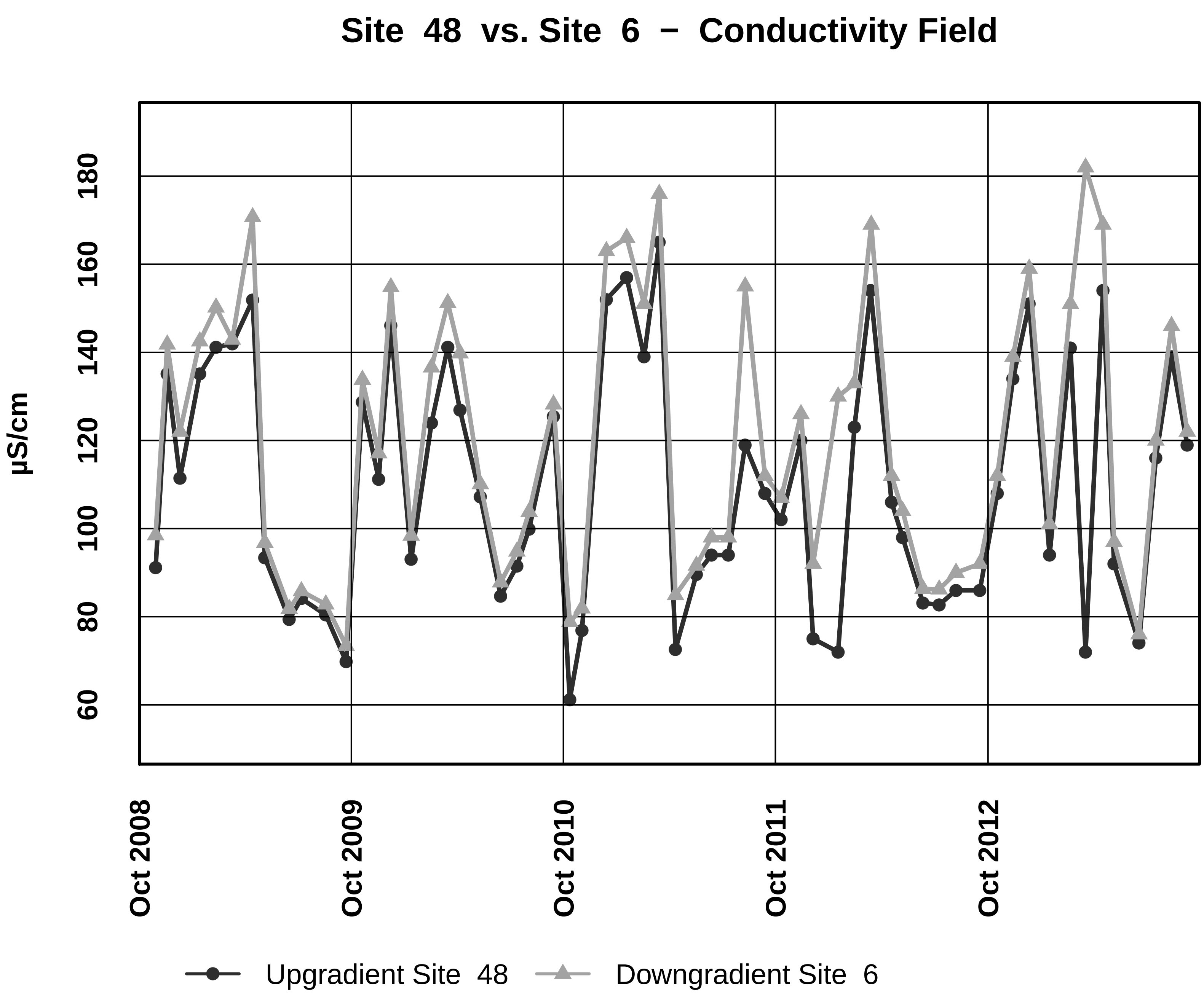
Σn 72
ΣS_k -3

$\chi^2_h=\Sigma Z^2_k$-K(Z-bar)^2=	14.47	@α=5% $\chi^2_{(K-1)}$= 19.68	Test for station homogeneity
p	**0.208**		$\chi^2_h<\chi^2_{(K-1)}$ ACCEPT
ΣVAR(S_k)	Z_{calc} -0.11	@α/2=2.5% Z= 1.96	H_0 (No trend) ACCEPT
339.00	**p** **0.457**		H_A (± trend) REJECT

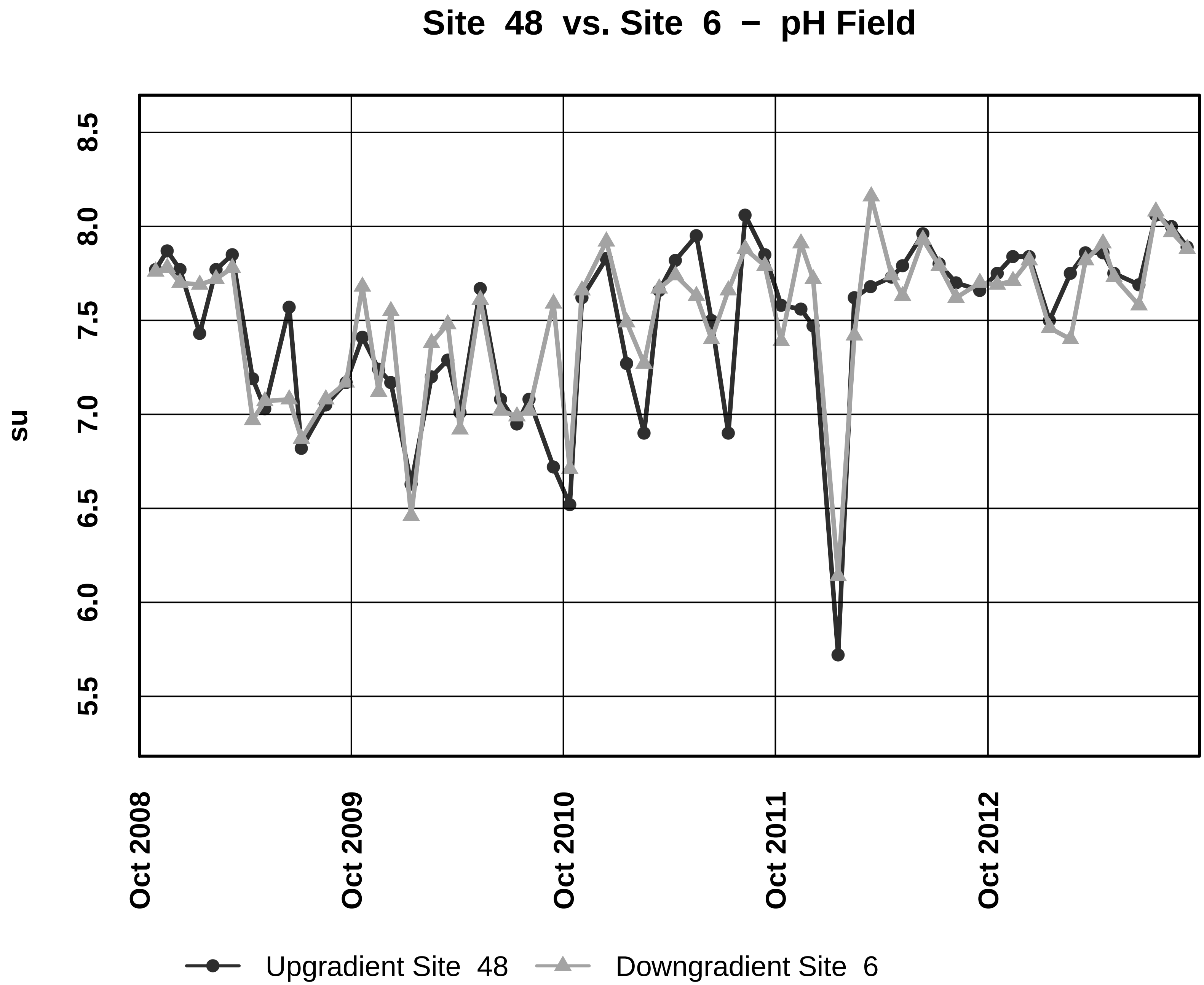


Seasonal-Kendall Slope Confidence Intervals

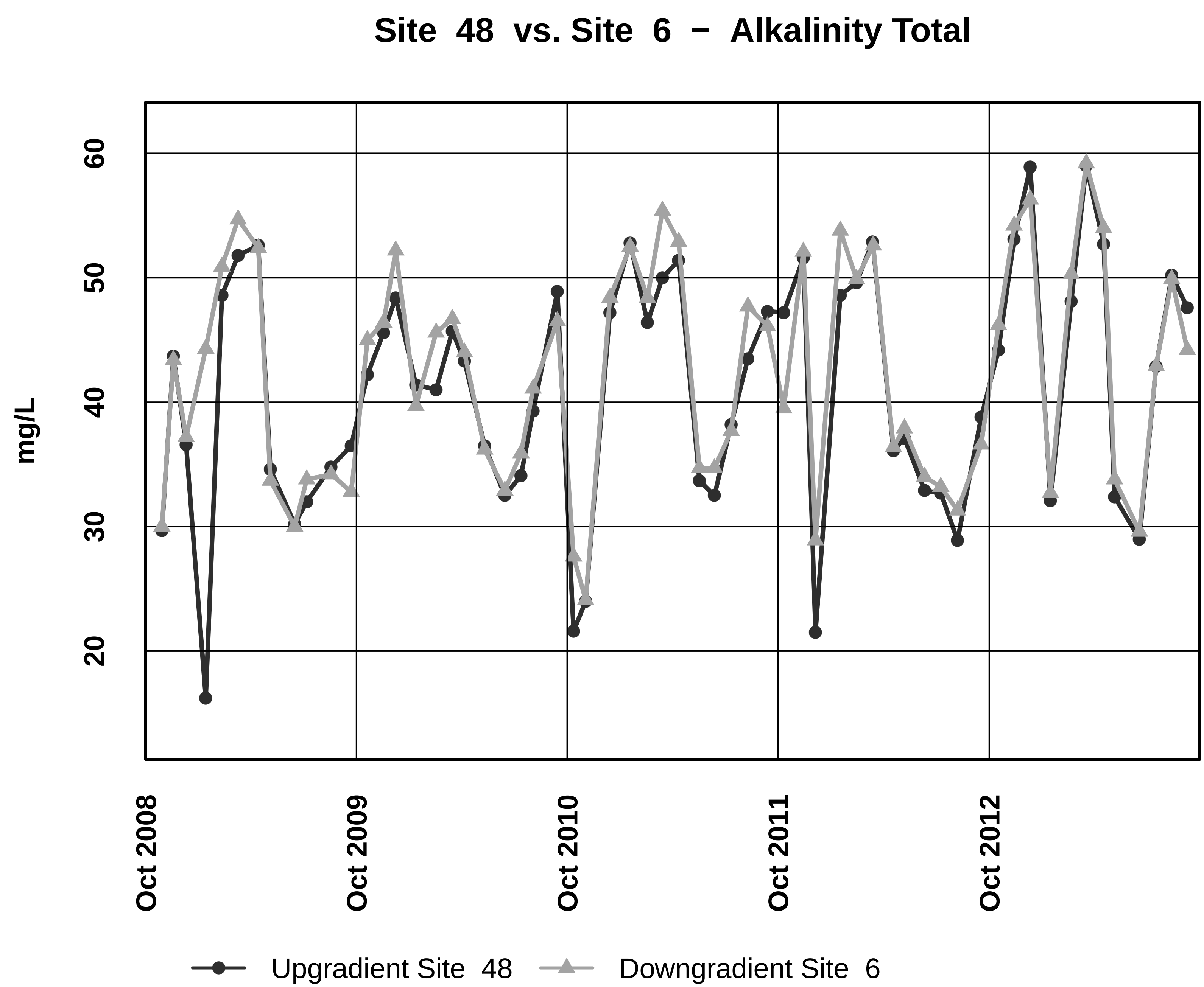
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.66		0.29
0.050	-0.43	**-0.06**	0.14
0.100	-0.31		0.09
0.200	-0.24		0.04

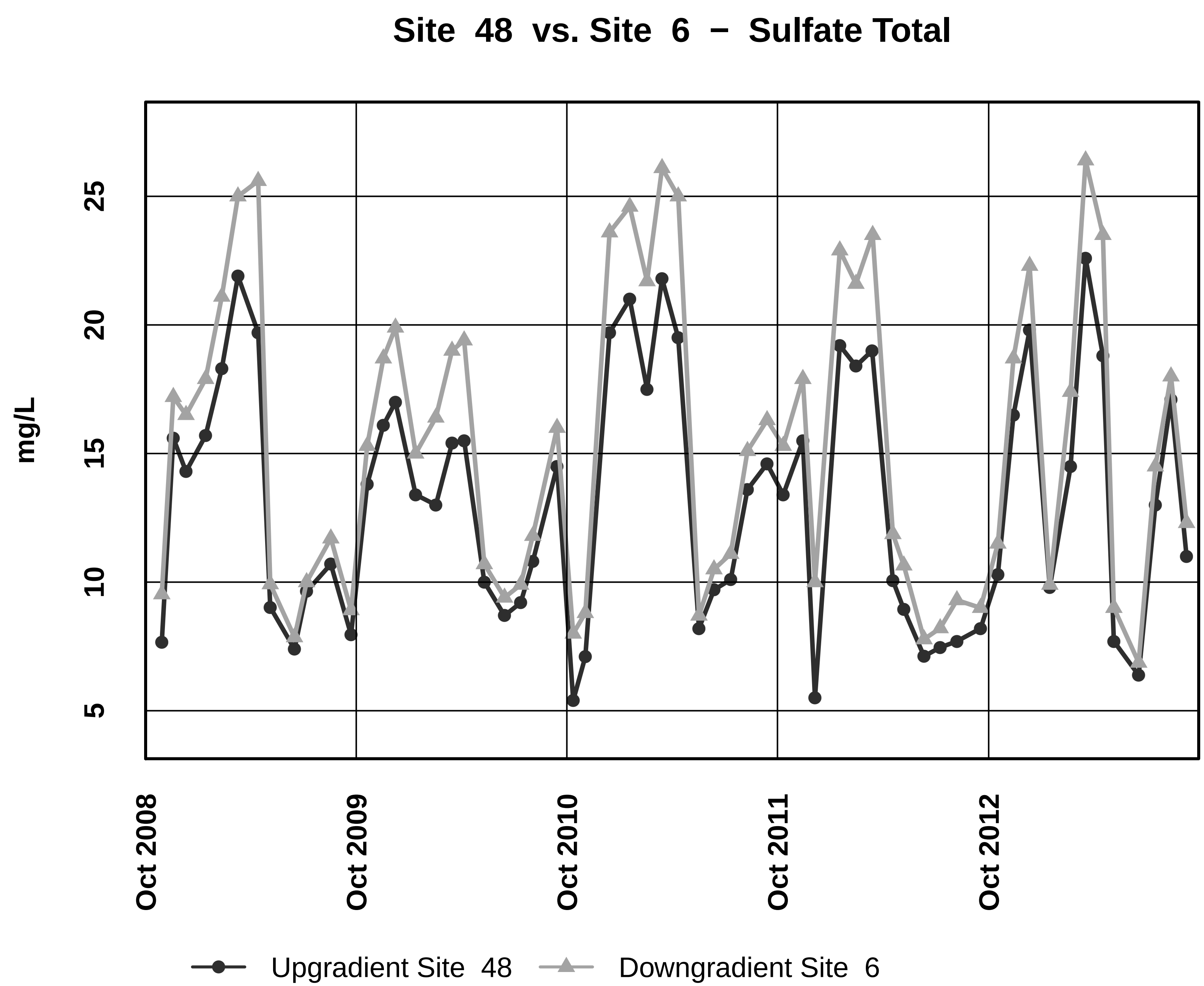


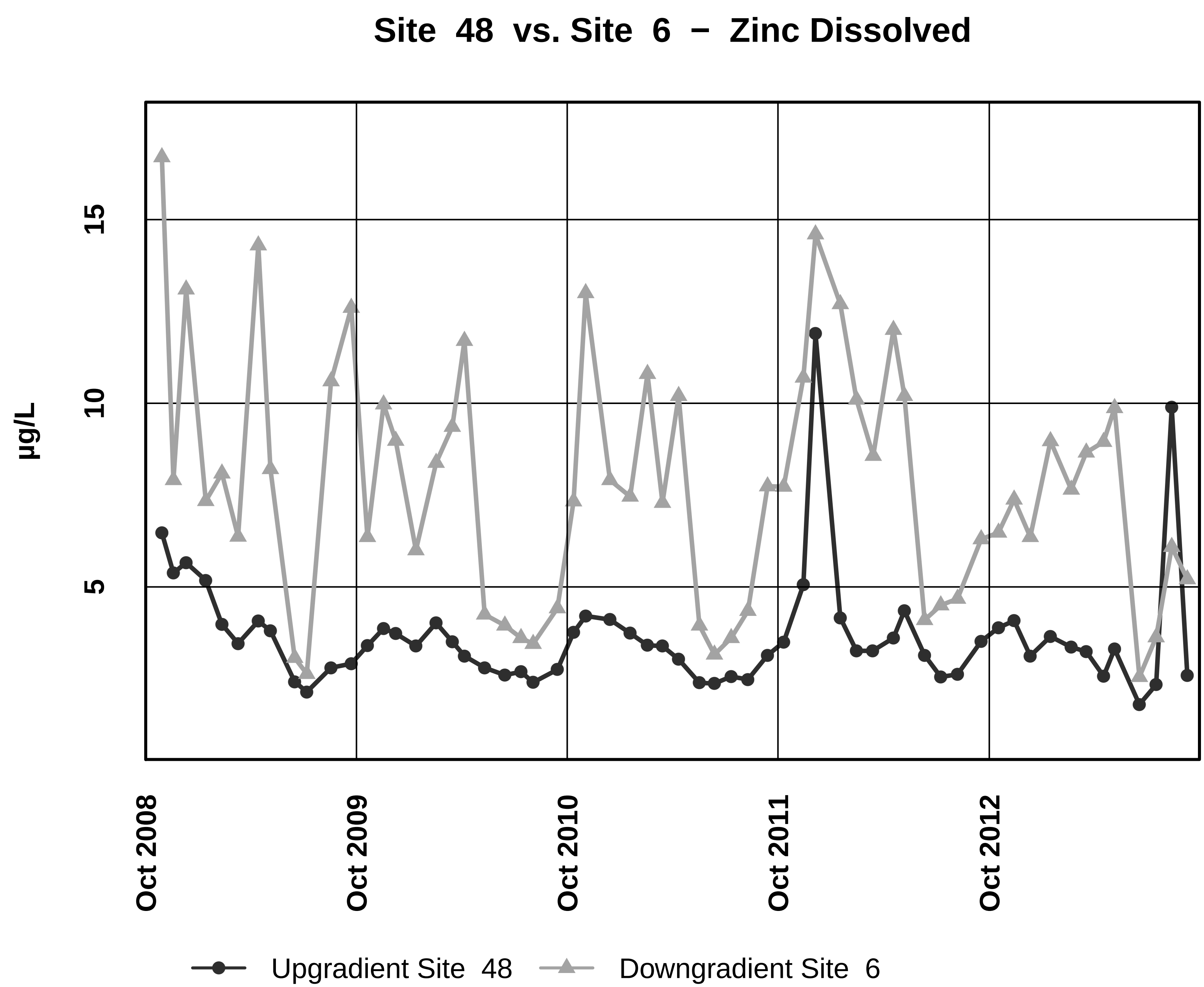
Site 48 vs. Site 6 − Conductivity Field
µS/cm
60
80
100
120
140
160
180
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Oct 2012
Upgradient Site 48
Downgradient Site 6



Site 48 vs. Site 6 − pH Field
su
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 Total
mg/L
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 Total
mg/L
5
10
15
20
25
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Oct 2012
Upgradient Site 48
Downgradient Site 6


Site 48 vs. Site 6 − Zinc Dissolved
µg/L
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)**

	X	Y	Differences		
Site	#48	#6			
Year	WY2013	WY2013	**D**	**|D|**	**Rank**
Oct	108.0	112.0	-4.0	4.0	-3.5
Nov	134.0	139.0	-5.0	5.0	-5.5
Dec	151.0	159.0	-8.0	8.0	-9
Jan	94.0	101.0	-7.0	7.0	-7.5
Feb	141.0	151.0	-10.0	10.0	-10
Mar	72.0	182.0	-110.0	110.0	-12
Apr	154.0	169.0	-15.0	15.0	-11
May	92.0	97.0	-5.0	5.0	-5.5
Jun	74.0	76.0	-2.0	2.0	-1
Jul	116.0	120.0	-4.0	4.0	-3.5
Aug	139.0	146.0	-7.0	7.0	-7.5
Sep	119.0	122.0	-3.0	3.0	-2
Median	117.5	130.5	-6.0	6.0	

n	m
12	12

N= 12

ΣR= -78

α
5.0%
W'α,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	Differences		
Site	#48	#6			
Year	WY2013	WY2013	**D**	**|D|**	**Rank**
Oct	7.75	7.69	0.06	0.06	9
Nov	7.84	7.71	0.13	0.13	11
Dec	7.84	7.82	0.02	0.02	2.5
Jan	7.50	7.46	0.04	0.04	6.5
Feb	7.75	7.40	0.35	0.35	12
Mar	7.86	7.82	0.04	0.04	6.5
Apr	7.86	7.91	-0.05	0.05	-8
May	7.75	7.73	0.02	0.02	2.5
Jun	7.69	7.58	0.11	0.11	10
Jul	8.06	8.08	-0.02	0.02	-4
Aug	8.00	7.97	0.03	0.03	5
Sep	7.89	7.88	0.01	0.01	1
Median	7.84	7.78	0.04	0.04	

n	m
12	12

N= 12
ΣR= 54

α
95.0%
W'α,n
59

W^+=
66
p-test
0.987

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	#48	#6	Differences		
Year	WY2013	WY2013	**D**	**|D|**	**Rank**
Oct	44.2	46.2	-2.0	2.0	-8
Nov	53.1	54.2	-1.1	1.1	-5
Dec	58.9	56.3	2.6	2.6	10
Jan	32.1	32.7	-0.6	0.6	-3.5
Feb	48.1	50.3	-2.2	2.2	-9
Mar	59.0	59.2	-0.2	0.2	-1
Apr	52.7	54.0	-1.3	1.3	-6
May	32.4	33.8	-1.4	1.4	-7
Jun	29.0	29.6	-0.6	0.6	-3.5
Jul	42.9	42.9	0.0		
Aug	50.2	49.9	0.3	0.3	2
Sep	47.6	44.2	3.4	3.4	11
Median	47.9	48.1	-0.6	1.3	

n	**m**
12	11

N= 11
ΣR= -20

α
95.0%
W'α,n
51

W^+=
23
p-test
0.207

H_0	median [D]=0	ACCEPT
H_1	median [D]>0	

Wilcoxon-signed-ranks test
Exact Form

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

	X	Y	Differences		
Site	#48	#6			
Year	WY2013	WY2013	**D**	**|D|**	**Rank**
Oct	10.3	11.5	-1.2	1.2	-4
Nov	16.5	18.7	-2.2	2.2	-8
Dec	19.8	22.3	-2.5	2.5	-9
Jan	9.8	9.9	-0.1	0.1	-1
Feb	14.5	17.4	-2.9	2.9	-10
Mar	22.6	26.4	-3.8	3.8	-11
Apr	18.8	23.5	-4.7	4.7	-12
May	7.7	9.0	-1.3	1.3	-5.5
Jun	6.4	6.9	-0.5	0.5	-2
Jul	13.0	14.5	-1.5	1.5	-7
Aug	17.1	18.0	-0.9	0.9	-3
Sep	11.0	12.3	-1.3	1.3	-5.5
Median	13.8	16.0	-1.4	1.4	

n	m
12	12

N= 12

$\Sigma R =$ -78

α
5.0%
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	WY2013	WY2013	D	|D|	Rank
Oct	3.89	6.48	-2.59	2.59	-3
Nov	4.08	7.38	-3.30	3.30	-6
Dec	3.12	6.36	-3.24	3.24	-5
Jan	3.65	8.97	-5.32	5.32	-9
Feb	3.36	7.65	-4.29	4.29	-8
Mar	3.24	8.66	-5.42	5.42	-10
Apr	2.57	8.95	-6.38	6.38	-11
May	3.31	9.87	-6.56	6.56	-12
Jun	1.80	2.55	-0.75	0.75	-1
Jul	2.34	3.63	-1.29	1.29	-2
Aug	9.89	6.09	3.80	3.80	7
Sep	2.59	5.21	-2.62	2.62	-4
Median	3.28	6.93	-3.27	3.55	

n	m
12	12

N= 12

$\Sigma R =$ -64

α
5.0%
W'α,n
17

$W^+=$
7
p-test
0.005

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 2013" 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 2007 through September 2013.				

The data for Water Year 2013 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 2013

			Limits		
Sample Date	Parameter	Value	Lower	Upper	Hardness
No exceedances have been identified by HGCMC for the period of October 2012 through September 2013.					

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 apparent visual trends identified.

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-07 and Sep-13 (WY2008-WY2013).

Table of Summary Statistics for Trend Analysis

	Mann-Kendall test statistics			Sen's slope estimate	
Parameter	**n***	**p****	**Trend**	**Q**	**Q(%)**
Conductivity Field	6	0.24			
pH Field	6	0.26			
Alkalinity, Total	6	0.04			
Sulfate, Total	6	0.01	+	0.48	3.1
Zinc, Dissolved	6	0.28			

* Number of Years ** Significance level

Total sulfate had a statistically significant (p<0.01) trend with a slope estimate of 0.48 µg/L/yr or 3.1% increase. However given the low magnitude and similar trend noted at Site 6, 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 2013 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	130.5	134.5	-2.5
pH Field	0.986	7.78	7.7	0.04
Alkalinity, Total	0.039	48.1	46.7	-1.2
Sulfate, Total	<0.01	16.00	16.00	-0.40
Zinc, Dissolved	0.995	6.93	6.32	0.5

The median values for pH for Site 6 and Site 54 are 7.78 su and 7.7 su respectively and the median of differences, Site 6 minus Site 54, is 0.04 su. Site 54 has intermittently (7 out of 11) had statistically significantly lower pH readings for water years (WY2002 and WY2012). 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 sulfate for Site 6 and Site 54 are 16.0 mg/L and 16.0 mg/L respectively. The median of the differences, Site 6 minus Site 54, is -0.40 mg/L total sulfate.

Again similar results are obtained using the signed-rank test on the WY2004 - WY2012 total sulfate datasets.

Along with the significant difference in total sulfate there was a significant difference in field conductivity. Upgradient the median conductivity value was 130.5 µs/cm and the downgradient median value was 134.5 µs/cm, resulting in a -2.5 µs/cm median difference. Datasets from WY2002 – WY2012 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 any 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 2013

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

Sample Date/Parameter	Oct 2012	Nov 2012	Dec 2012	Jan 2013	Feb 2013	Mar 2013	Apr 2013	May 2013	Jun 2013	Jul 2013	Aug 2013	Sep 2013	**Median**
Water Temp (°C)	3.5	1.4	0.7	0	1.0	0	1.3	1.7	5.3	10.8	10.5	8.3	1.6
Conductivity-Field(µmho)	116	144	160	105	156	183	170	98	78	122	149	125	134.5
Conductivity-Lab (µmho)	90	142	118	100	136	179	171	94	73	114	141	92	116
pH Lab (standard units)	7.93	7.62	7.65	7.45	7.76	7.64	7.64	7.48	7.92	7.9	7.67	7.36	7.65
pH Field (standard units)	7.64	7.38	7.53	7.49	6.89	7.8	7.91	7.75	7.5	8.02	7.95	7.88	7.70
Total Alkalinity (mg/L)	45.4	56.2	59.2	34.6	51.5	61	53	34.9	30.1	44.1	47.6	45.8	46.7
Total Sulfate (mg/L)	11.6	19.3	22.7	12.3	17.8	26.7	25.9	9.4	7	14.1	19.1	12.4	16.0
Hardness (mg/L)	52.9	69.5	76.9	44.7	68.4	82.7	76.9	39.4	33.7	55.2	66.5	56.5	61.5
Dissolved As (ug/L)	0.22	0.166	0.179	0.249	0.198	0.145	0.18	0.177	0.192	0.211	0.225	0.237	0.195
Dissolved Ba (ug/L)			31.9		27.5								29.7
Dissolved Cd (ug/L)	0.0462	0.0489	0.0396	0.0572	0.0443	0.0431	0.0465	0.059	0.0293	0.0409	0.0481	0.0444	0.0453
Dissolved Cr (ug/L)			0.866		0.844								0.855
Dissolved Cu (ug/L)	0.632	0.389	0.346	1.01	0.499	0.509	0.453	0.71	0.271	0.362	0.387	0.62	0.476
Dissolved Pb (ug/L)	0.0189	0.0116	0.0087	0.108	0.0154	0.0038	0.0178	0.0207	0.0081	0.014	0.0128	0.322	0.0147
Dissolved Ni (ug/L)			0.996		0.969								0.983
Dissolved Ag (ug/L)			0.002		0.002								0.002
Dissolved Zn (ug/L)	5.99	6.65	5.86	8.5	6.95	7.47	7.92	9.24	3.08	3.79	5.92	4.94	6.32
Dissolved Se (ug/L)			1.26		0.821								1.041
Dissolved Hg (ug/L)	0.00121	0.00071	0.000504	0.00249	0.000953	0.000561	0.000785	0.00152	0.000494	0.000865	0.00101	0.00114	0.000909

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.

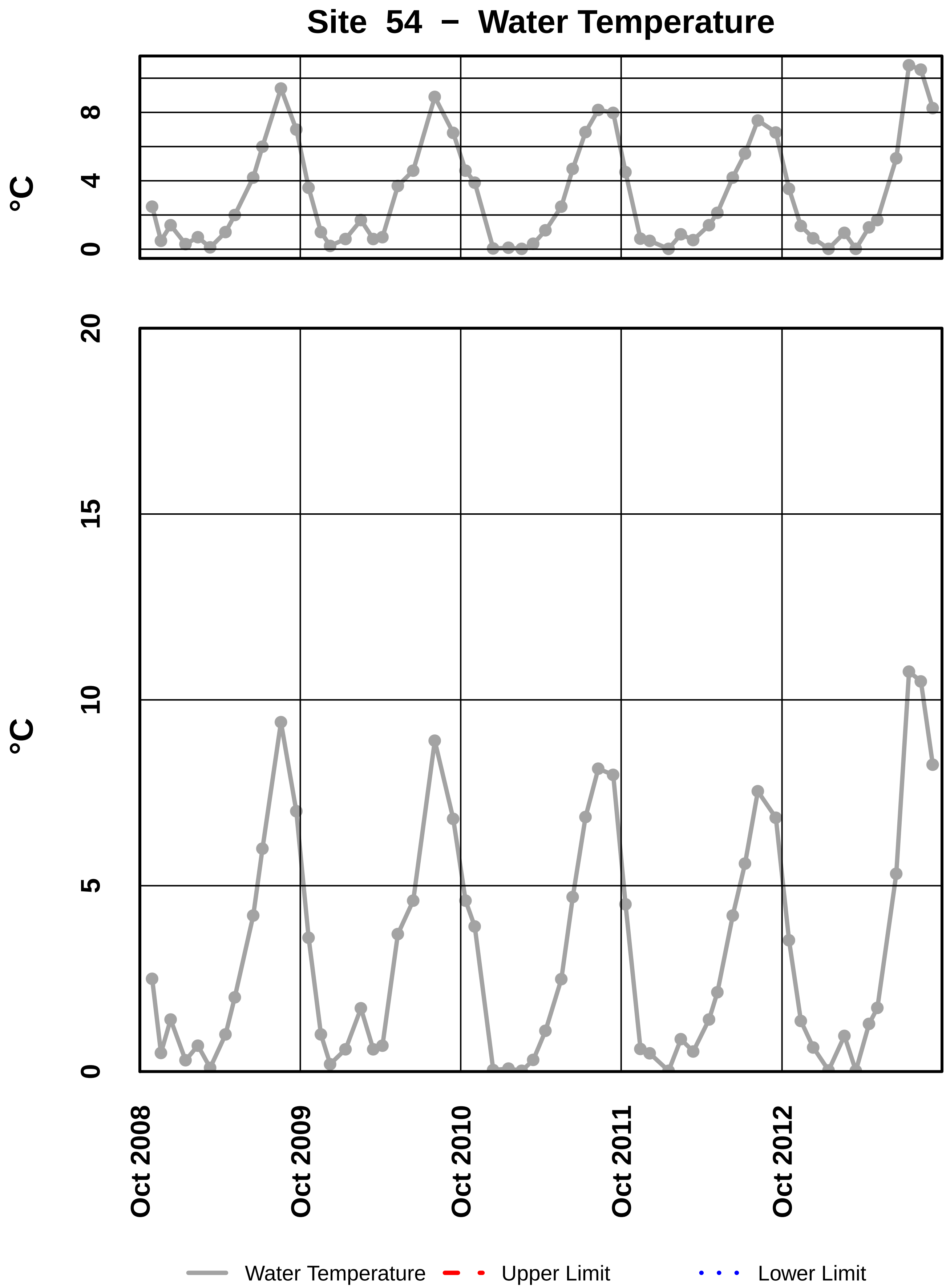
Shaded data has been qualified as an outlier by HGCMC and removed from any further analysis and is not included into the calculation of the median

Qualified Data by QA Reviewer

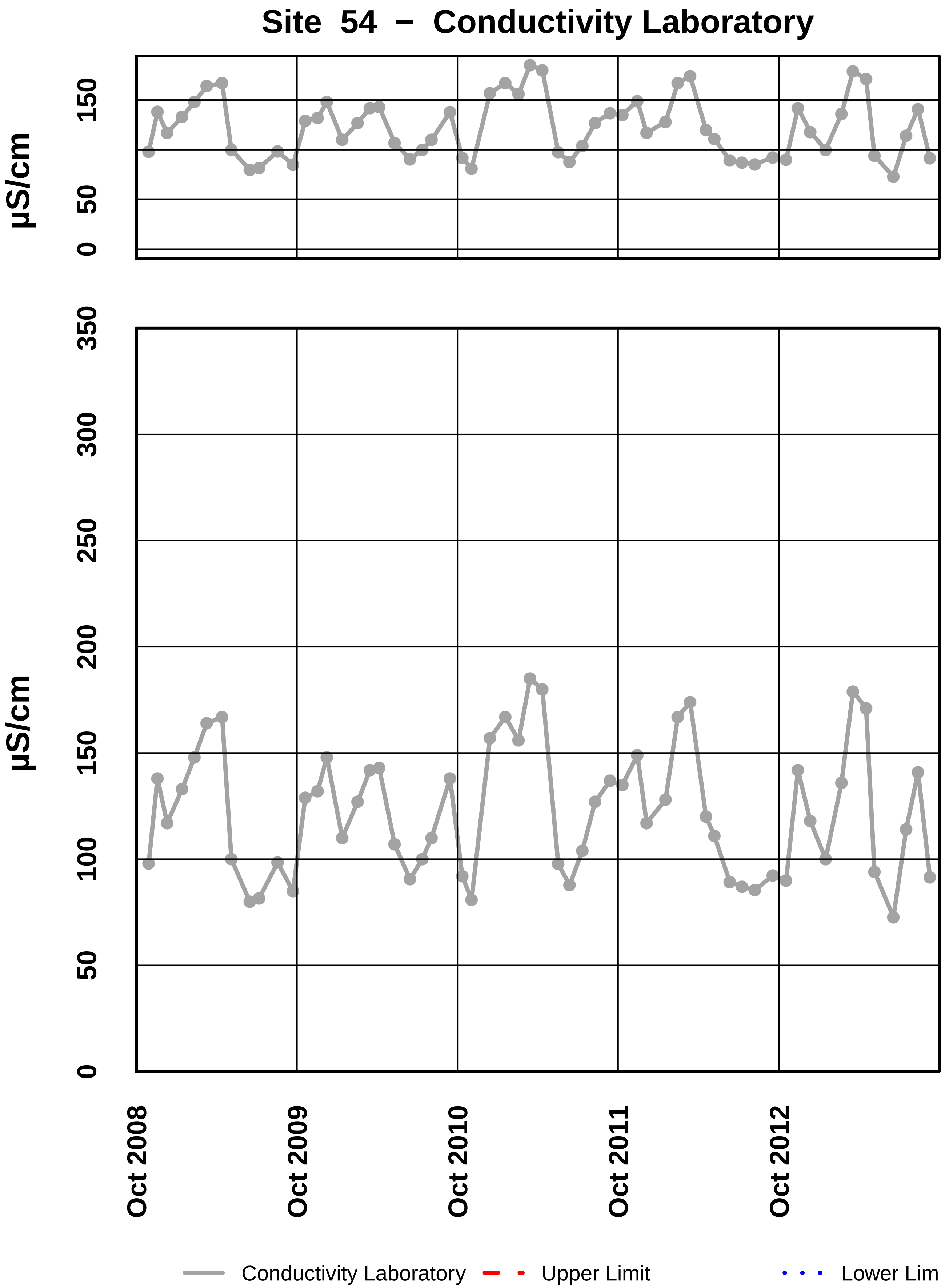
Date Range: 10/01/2012 to 09/30/2013

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
54	10/17/2012	12:00 AM	SO4 Tot, mg/l	11.61	J	Sample Temperature
			Zn diss, µg/l	5.99	U	Field Blank Contamination
54	11/13/2012	12:00 AM	pH Lab, su	7.62	J	Hold Time Violation
			Zn diss, µg/l	6.65	U	Field Blank Contamination
			Hg diss, µg/l	0.00071	U	Field Blank Contamination
54	12/11/2012	12:00 AM	Pb diss, µg/l	0.00872	J	Below Quantitative Range
			Hg diss, µg/l	0.000504	U	Field Blank Contamination
54	1/15/2013	12:00 AM	Hg diss, µg/l	0.00249	J	LCS Recovery
54	3/18/2013	12:00 AM	Pb diss, µg/l	0.0038	J	Below Quantitative Range
54	5/6/2013	12:00 AM	pH Lab, su	7.48	J	Hold Time Violation
54	6/18/2013	12:00 AM	Pb diss, µg/l	0.00811	J	Below Quantitative Range
			Hg diss, µg/l	0.000494	U	Field Blank Contamination
54	7/17/2013	12:00 AM	SO4 Tot, mg/l	14.1	J	Sample Receipt Temperature
			Hg diss, µg/l	0.000865	U	Field Blank Contamination
54	8/13/2013	12:00 AM	Cond, µmhos	141	J	Sample receipt temperature
			Alk, mg/L	47.6	J	Sample receipt temperature
			SO4 Tot, mg/l	19.1	J	Sample receipt temperature
			Pb diss, µg/l	0.01	U	Field Blank Contamination
54	9/9/2013	12:00 AM	SO4 Tot, mg/l	12.4	J	Sample receipt temperature

Qualifier	Description
J	Positively Identified - Approximate concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit

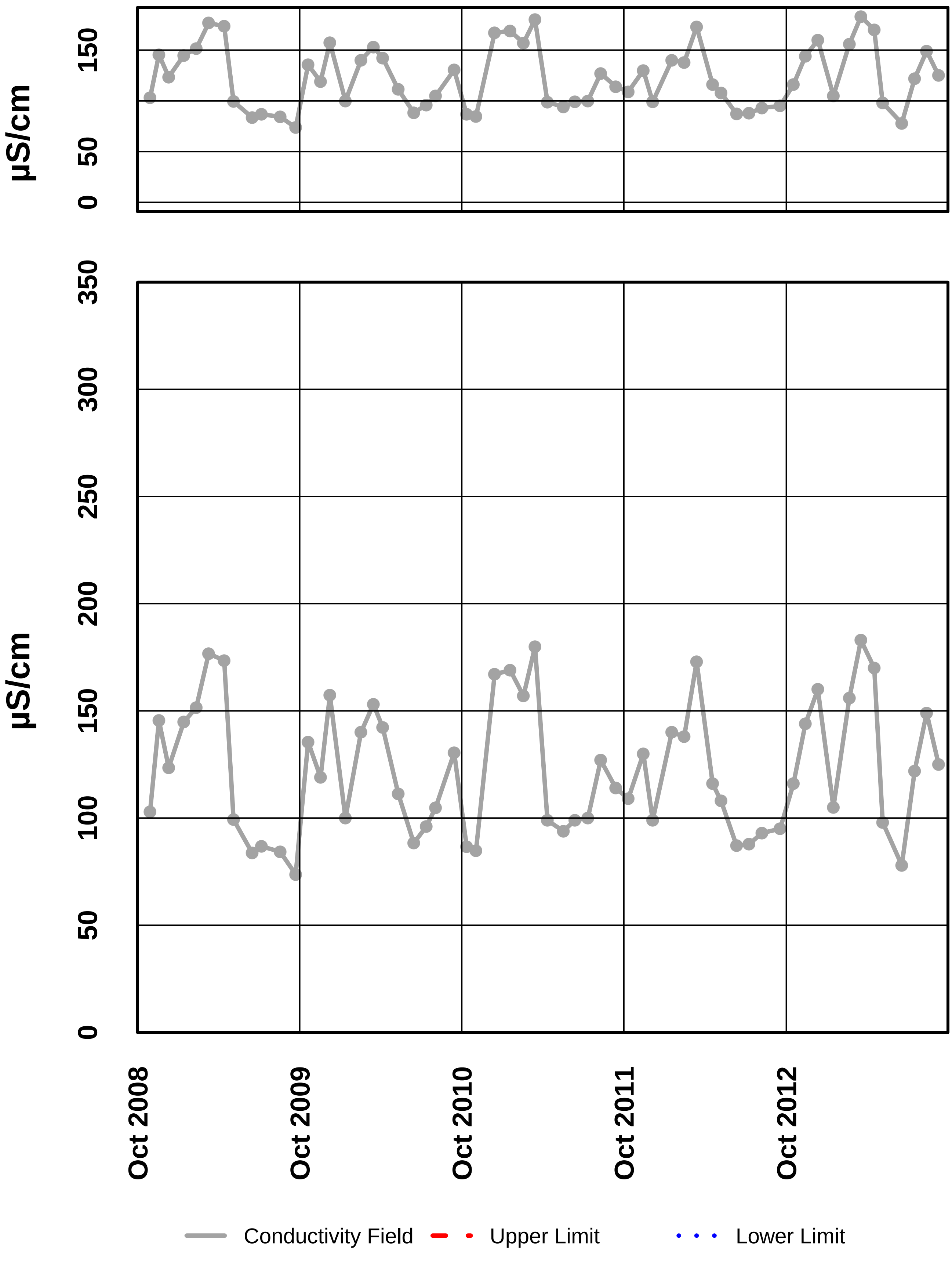


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



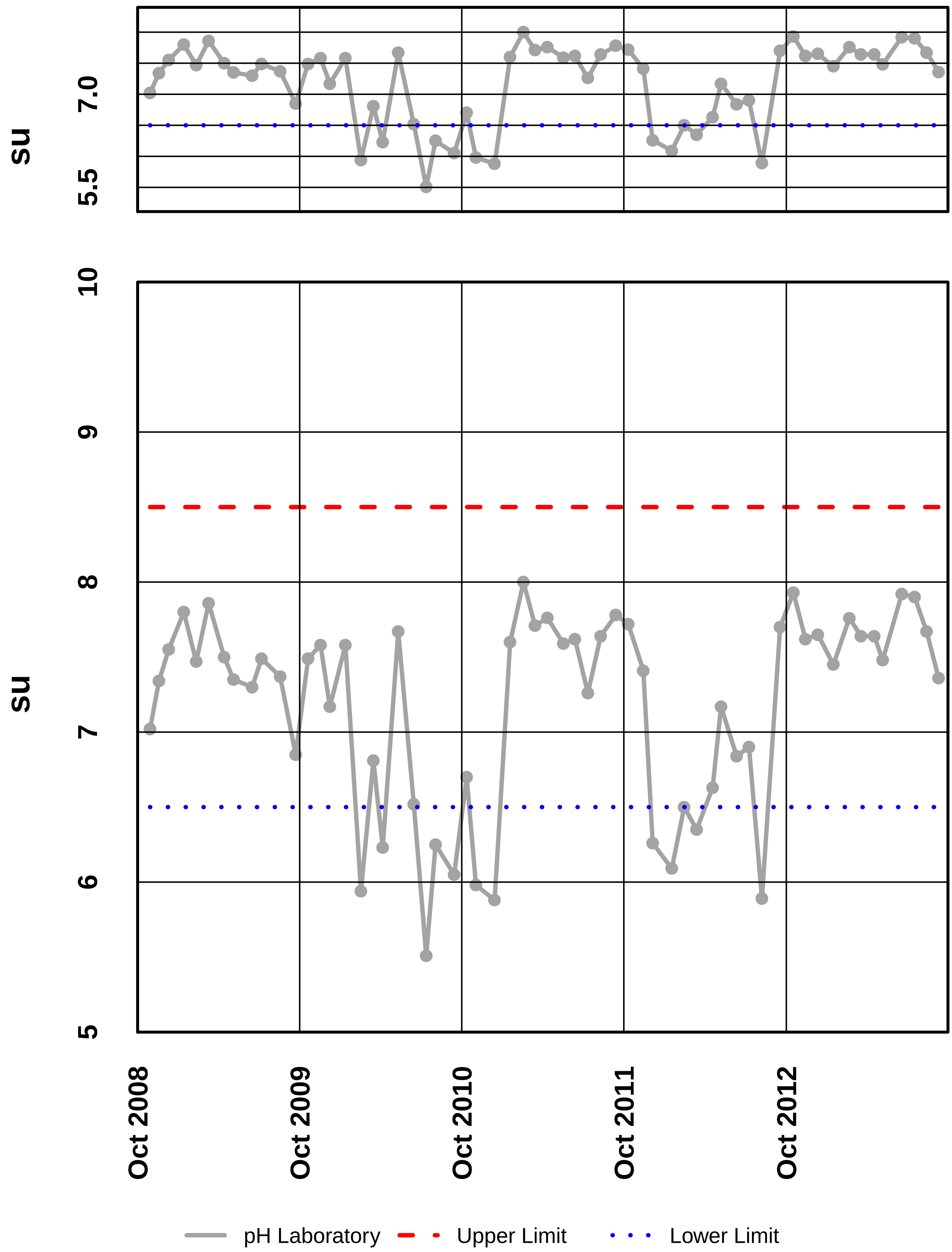
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 54 – Conductivity Field



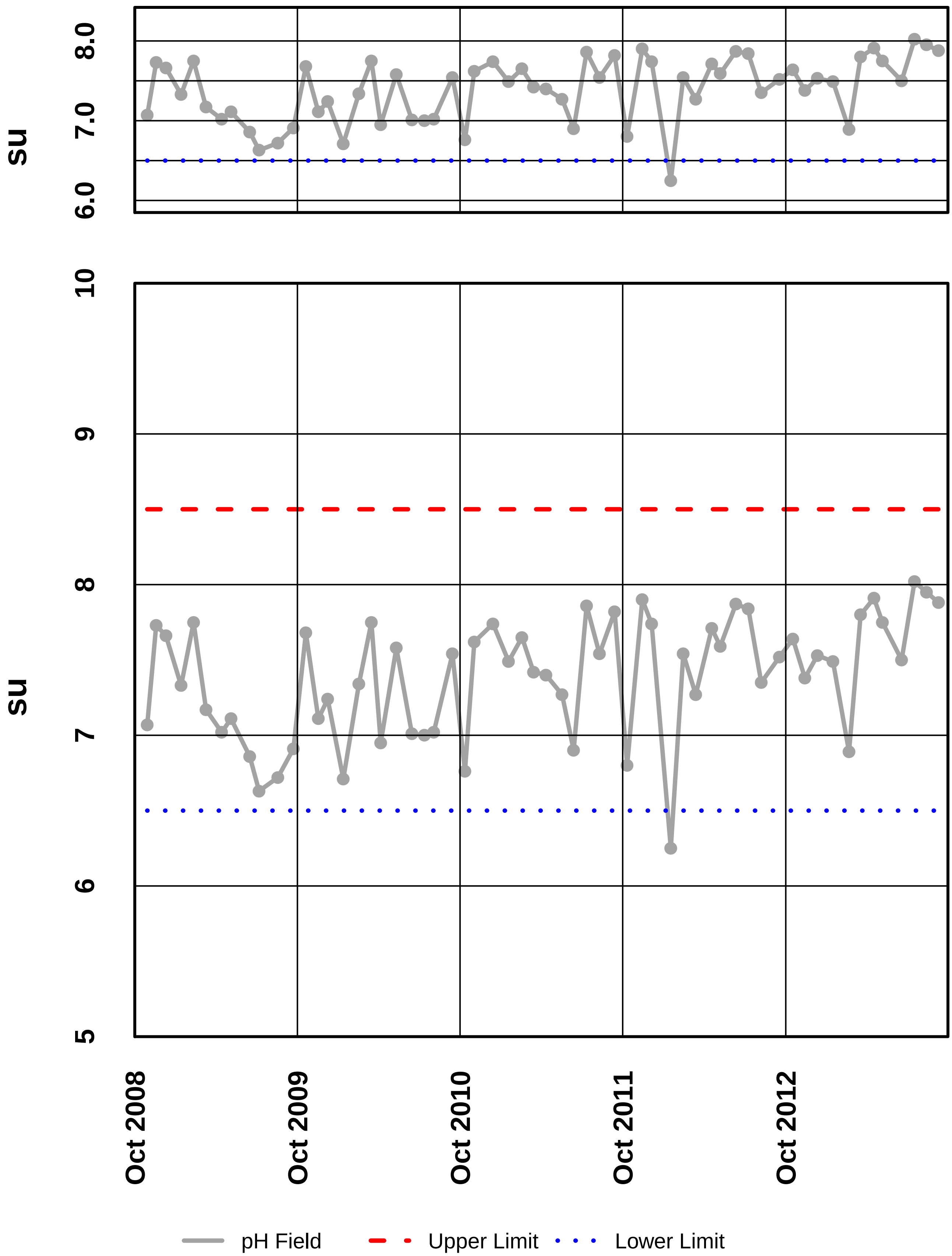
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 54 – pH Laboratory



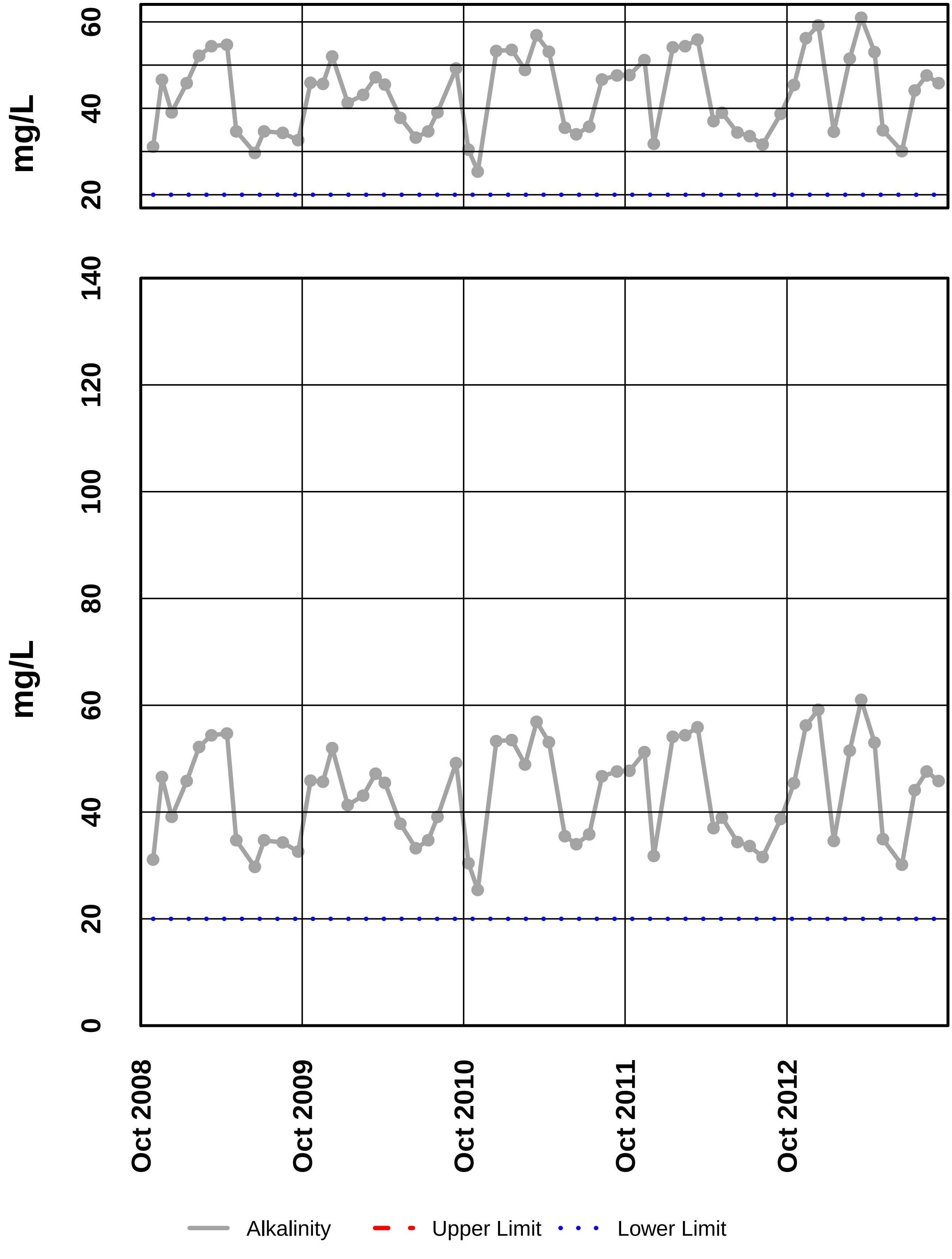
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 54 – pH Field



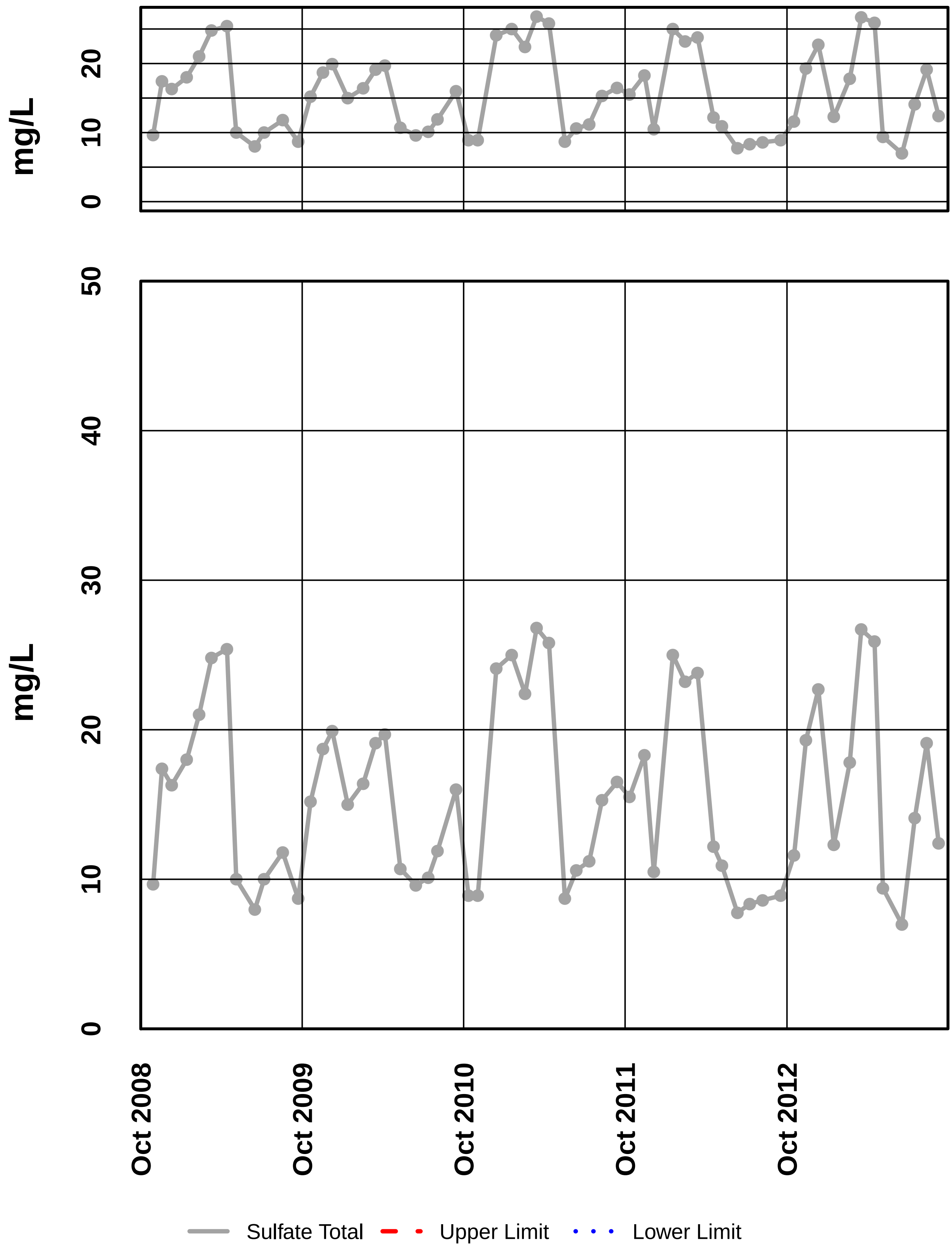
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 54 – Alkalinity



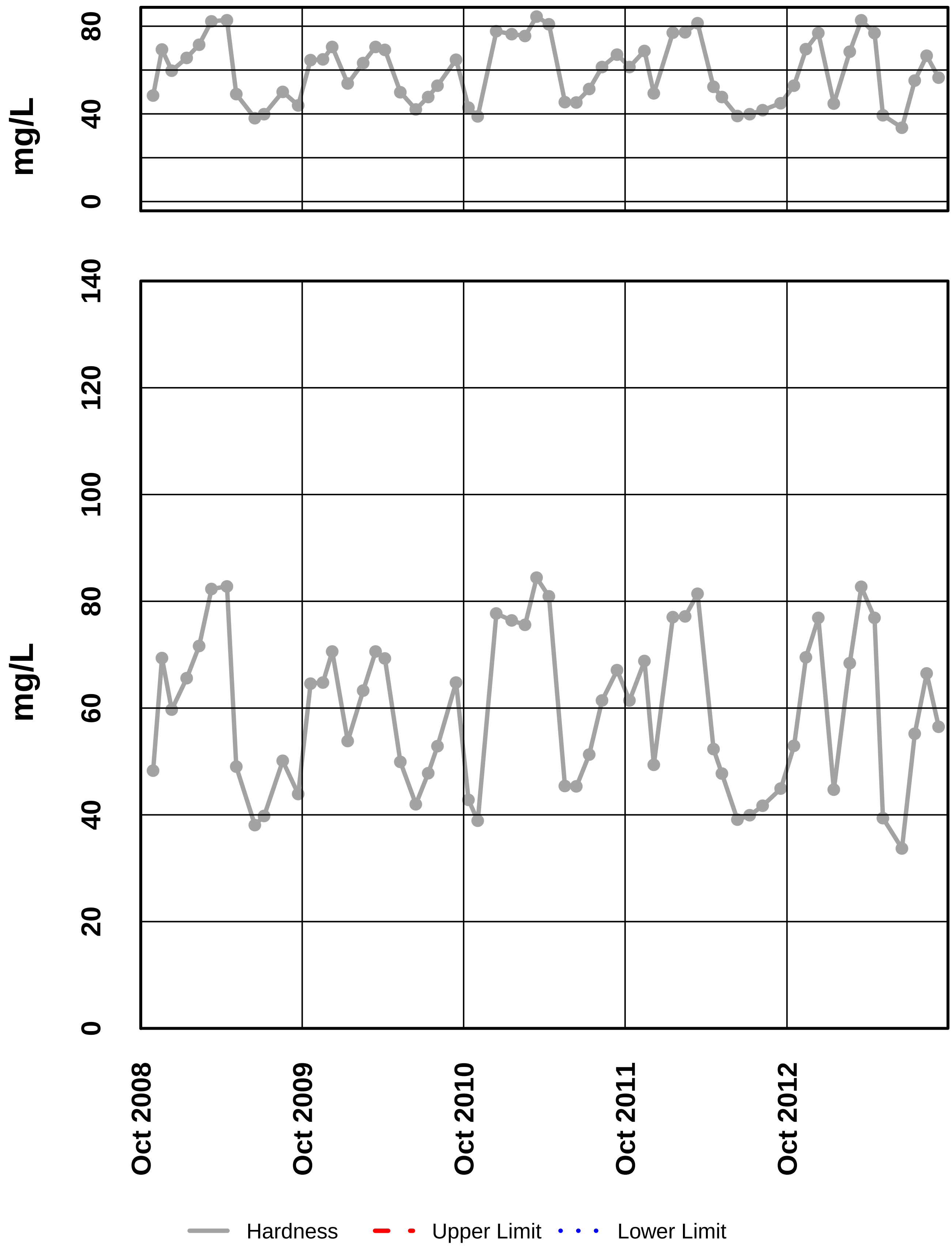
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 54 – Sulfate Total

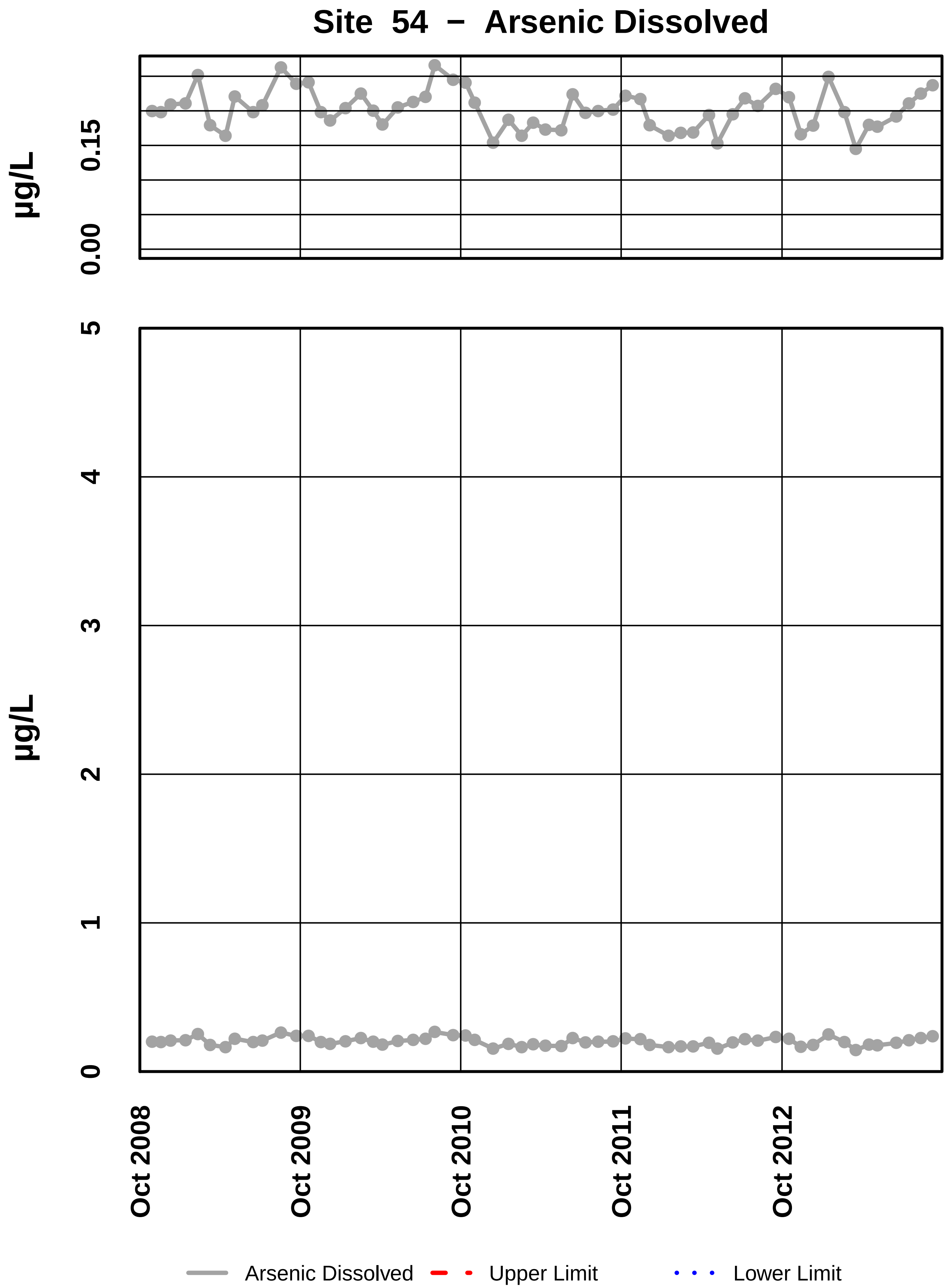


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 54 − Hardness

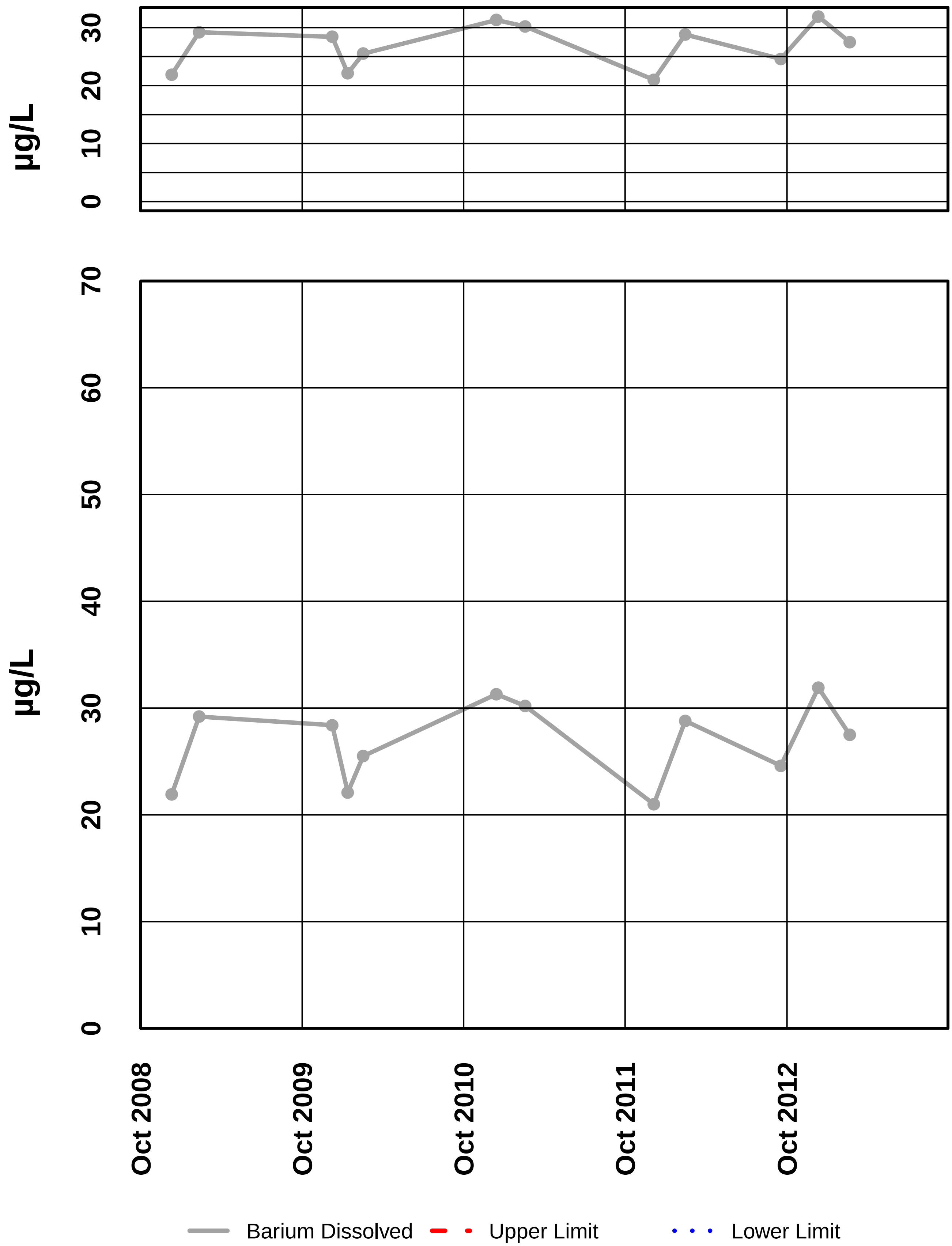


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

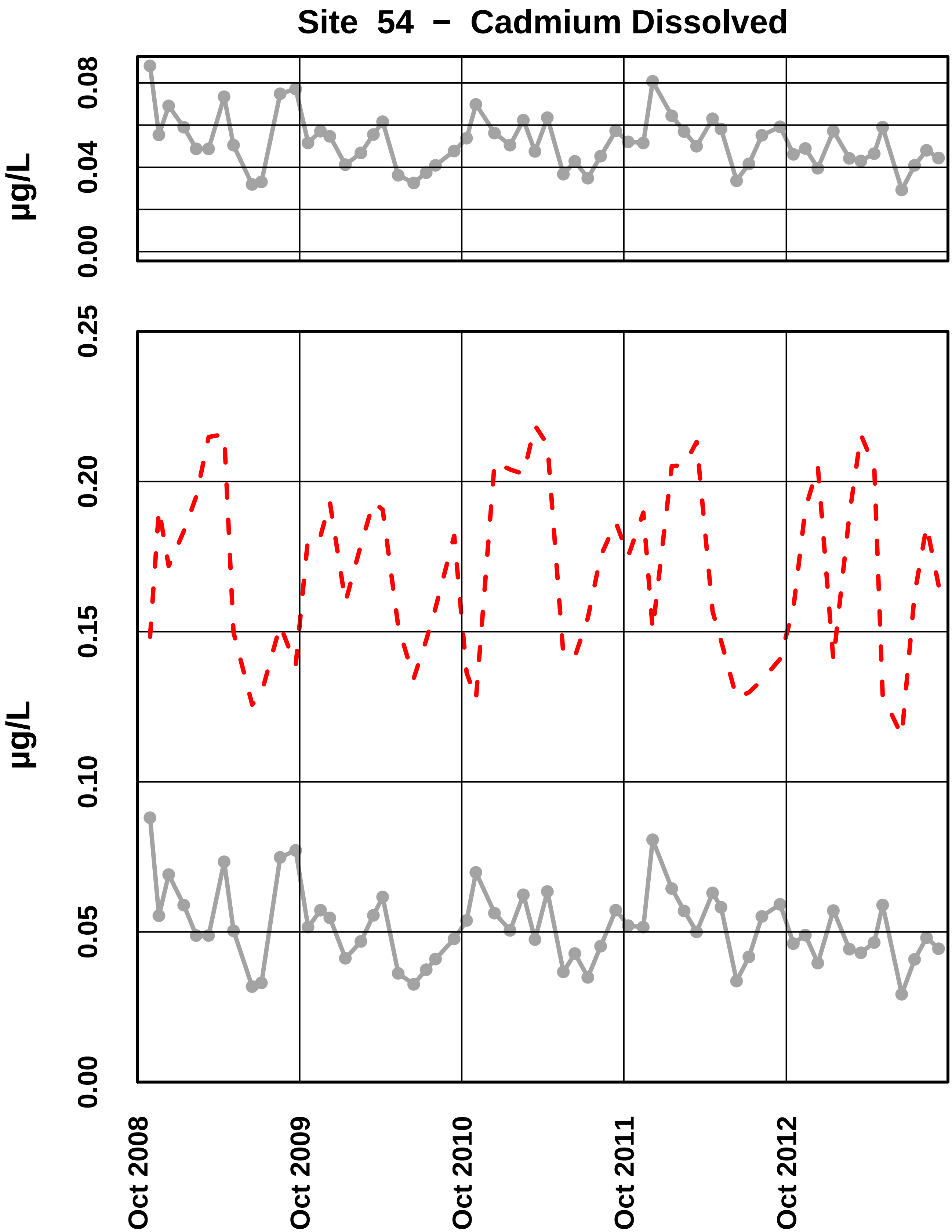


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 54 – Barium Dissolved

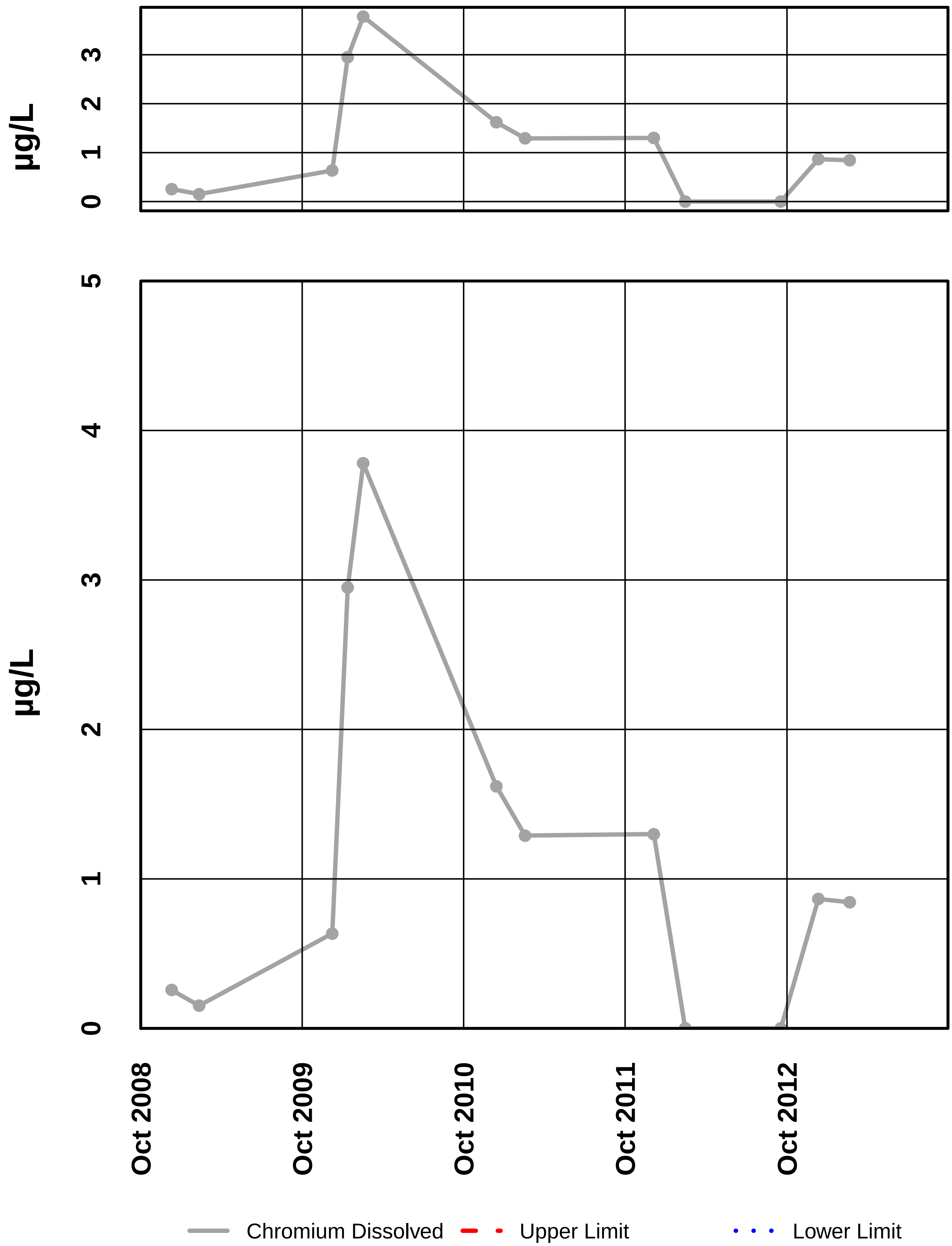


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



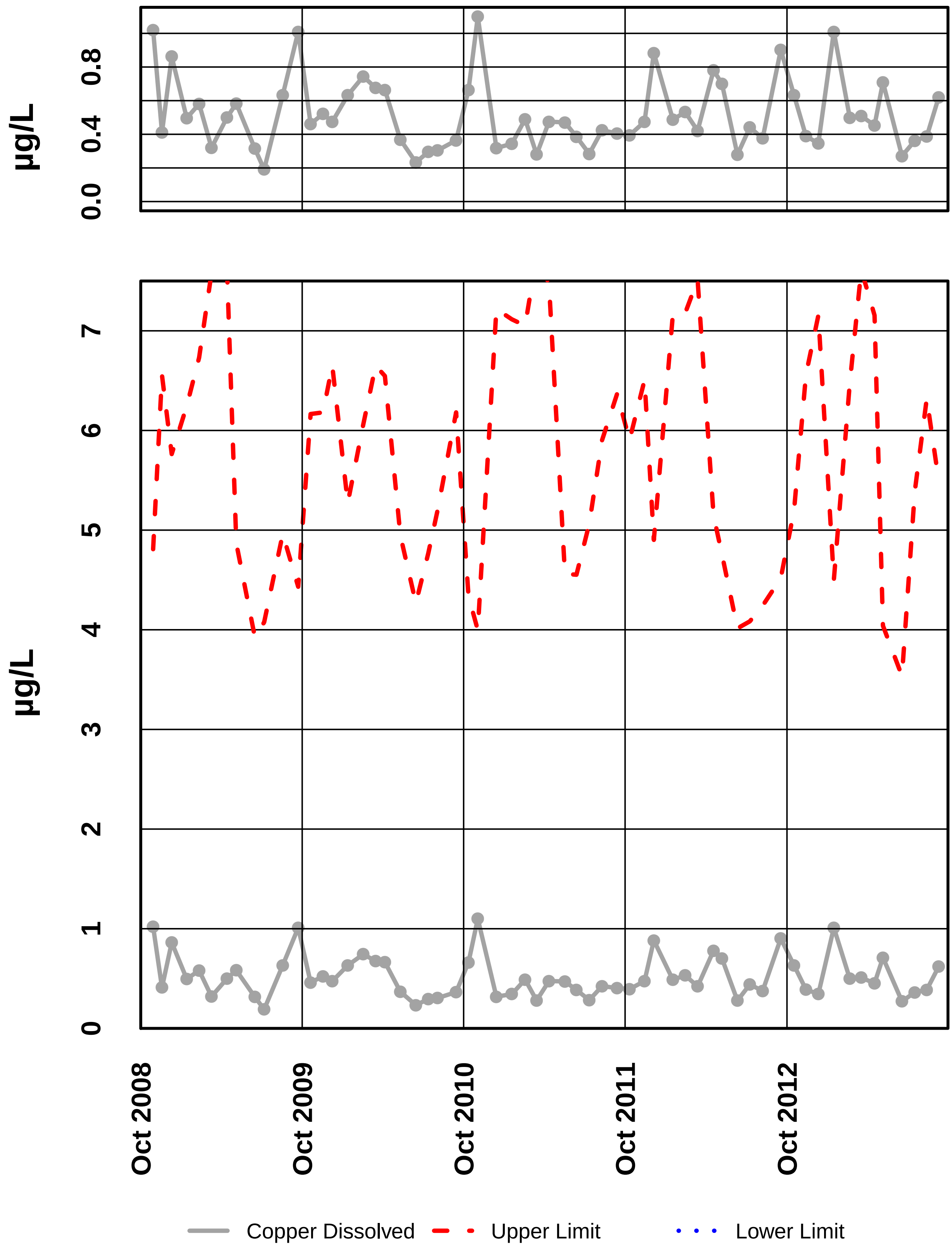
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 54 − Chromium Dissolved



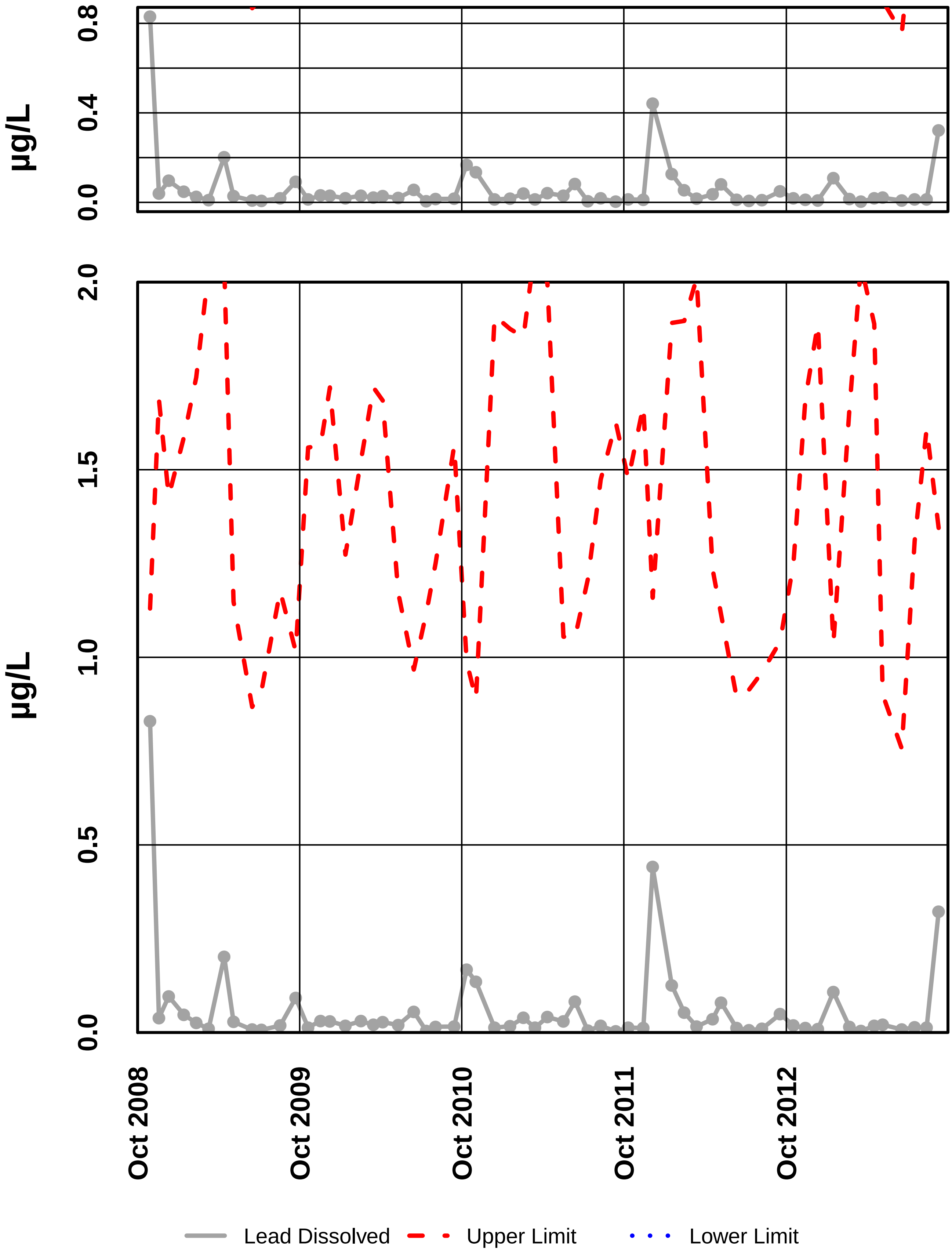
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 54 − Copper Dissolved

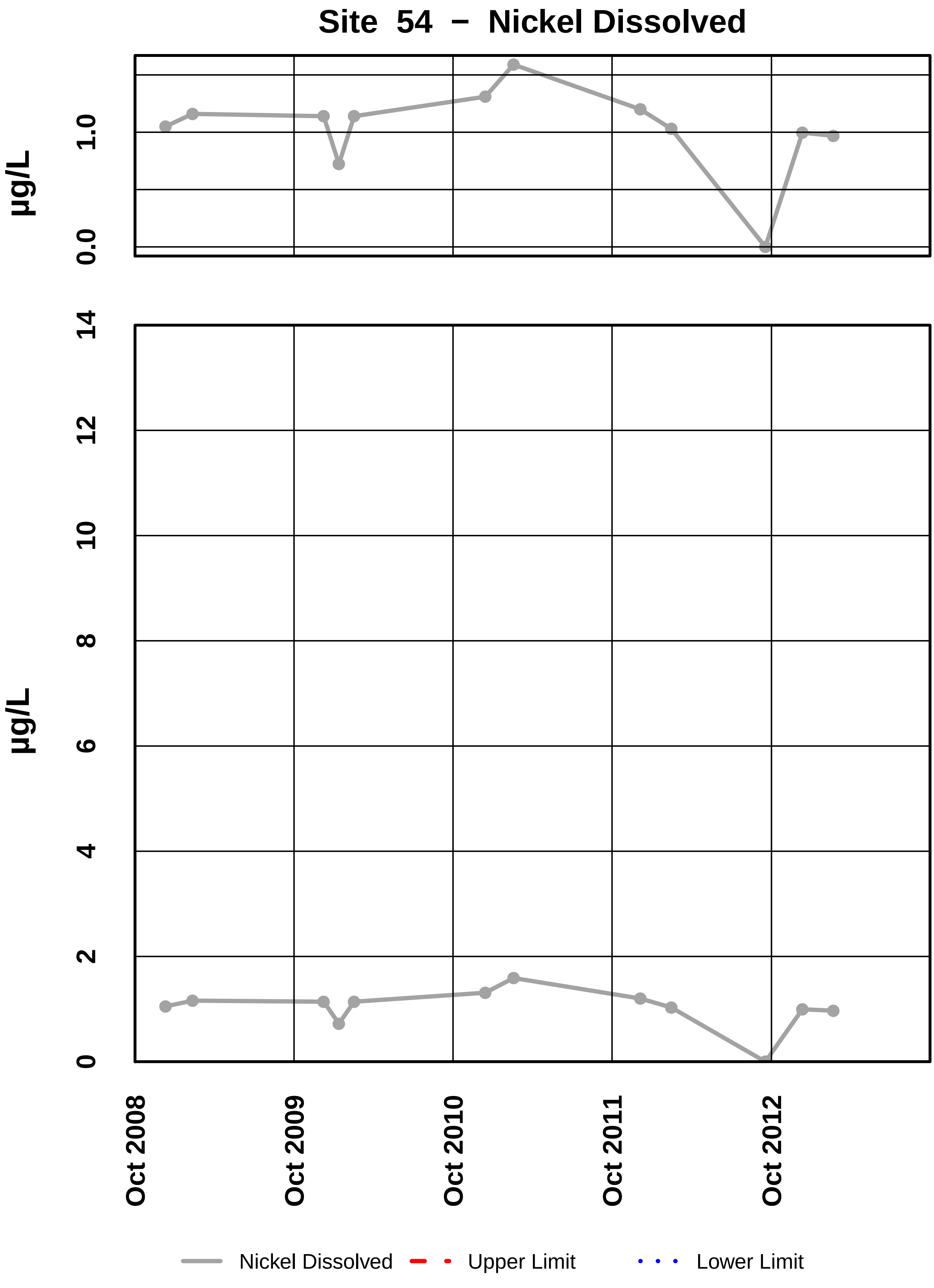


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

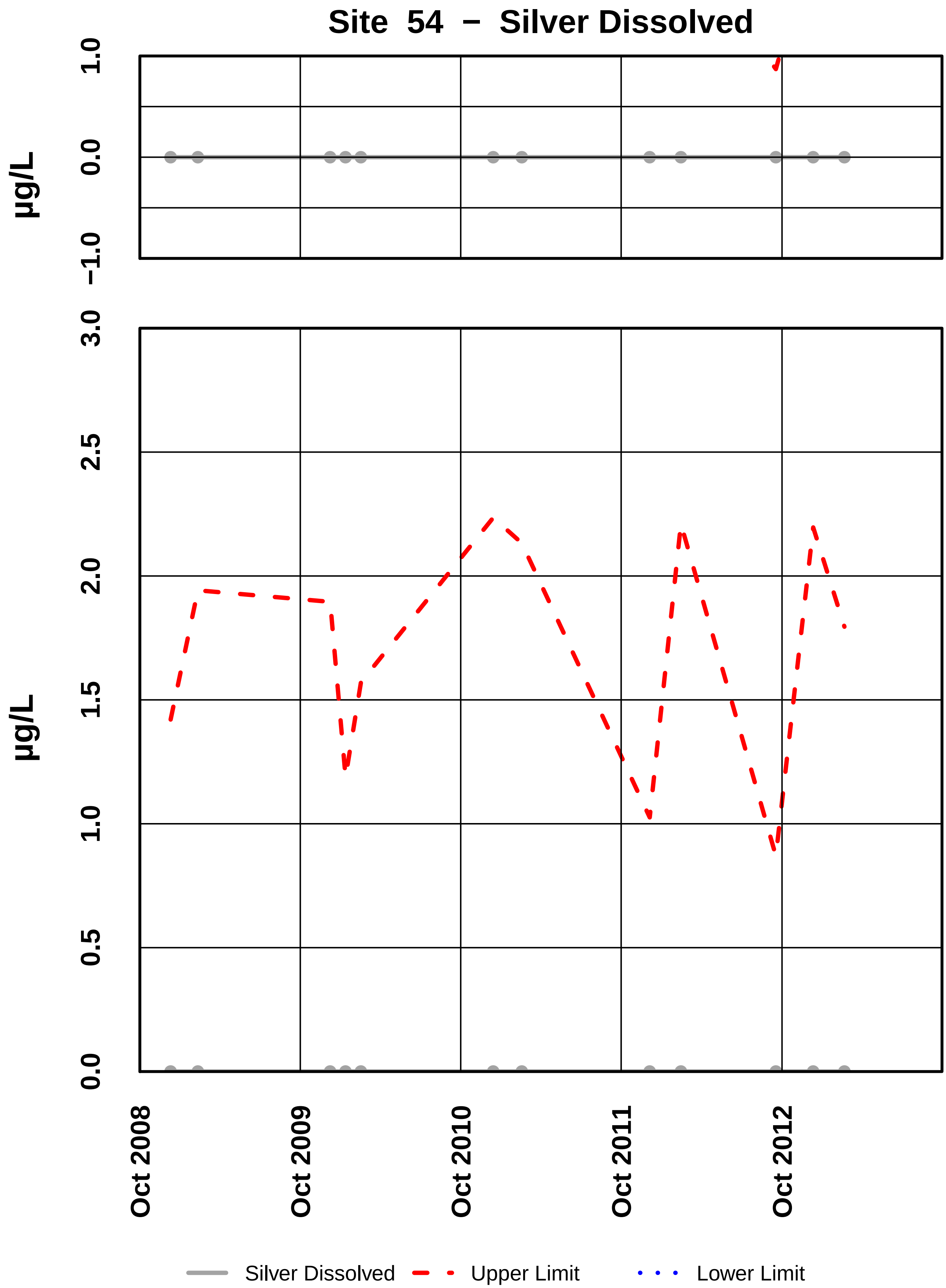
Site 54 − Lead Dissolved



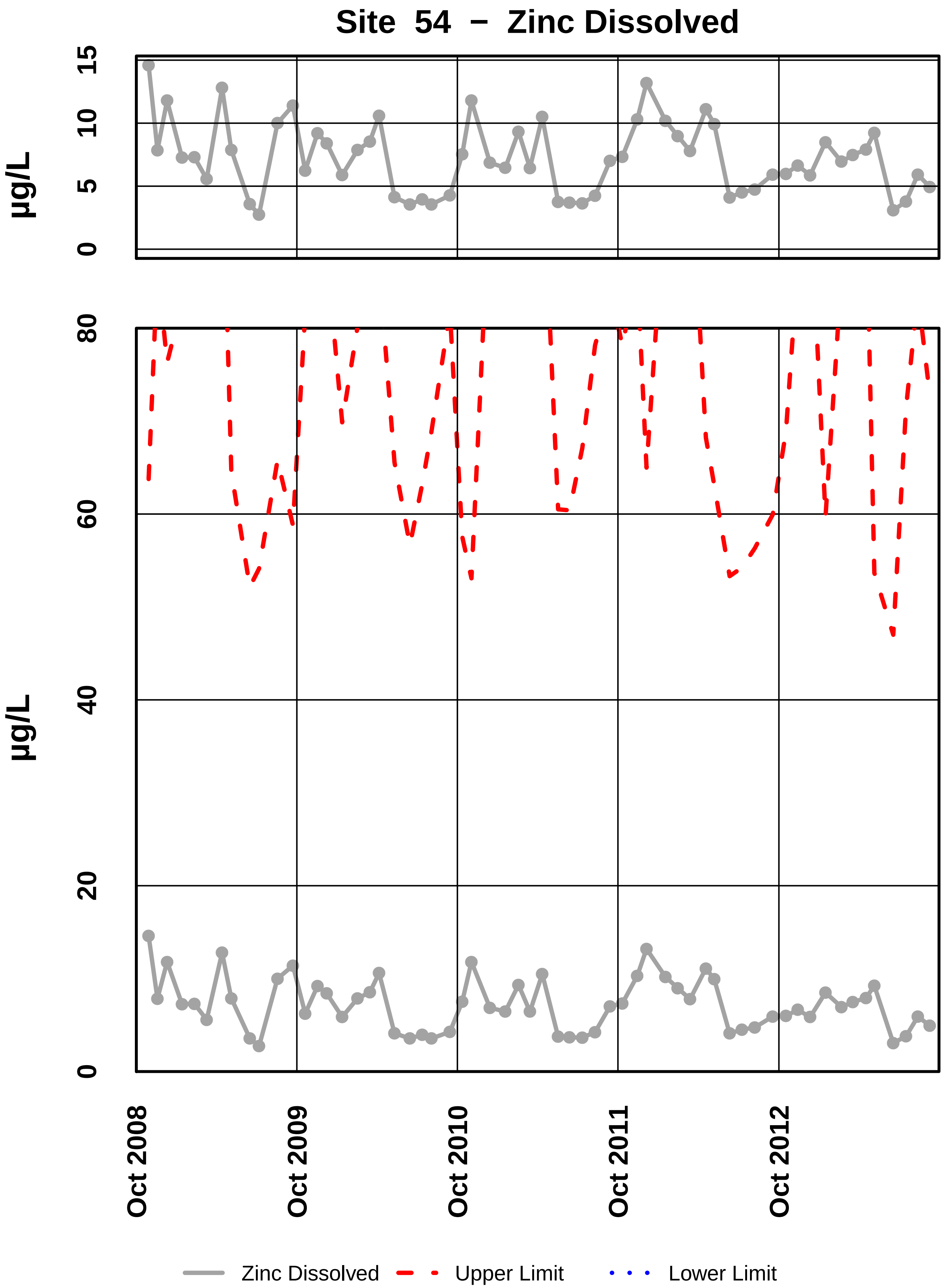
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



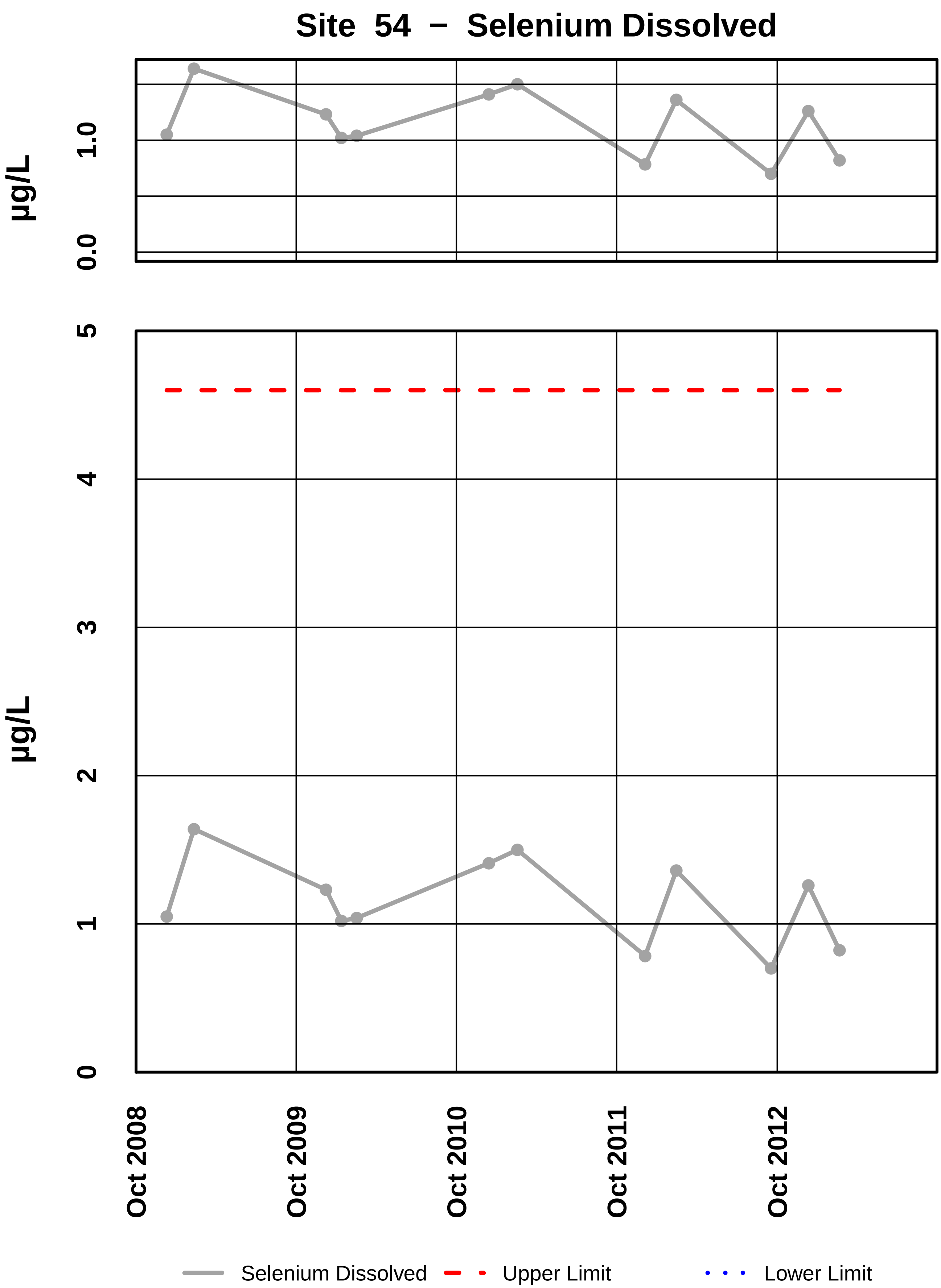
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

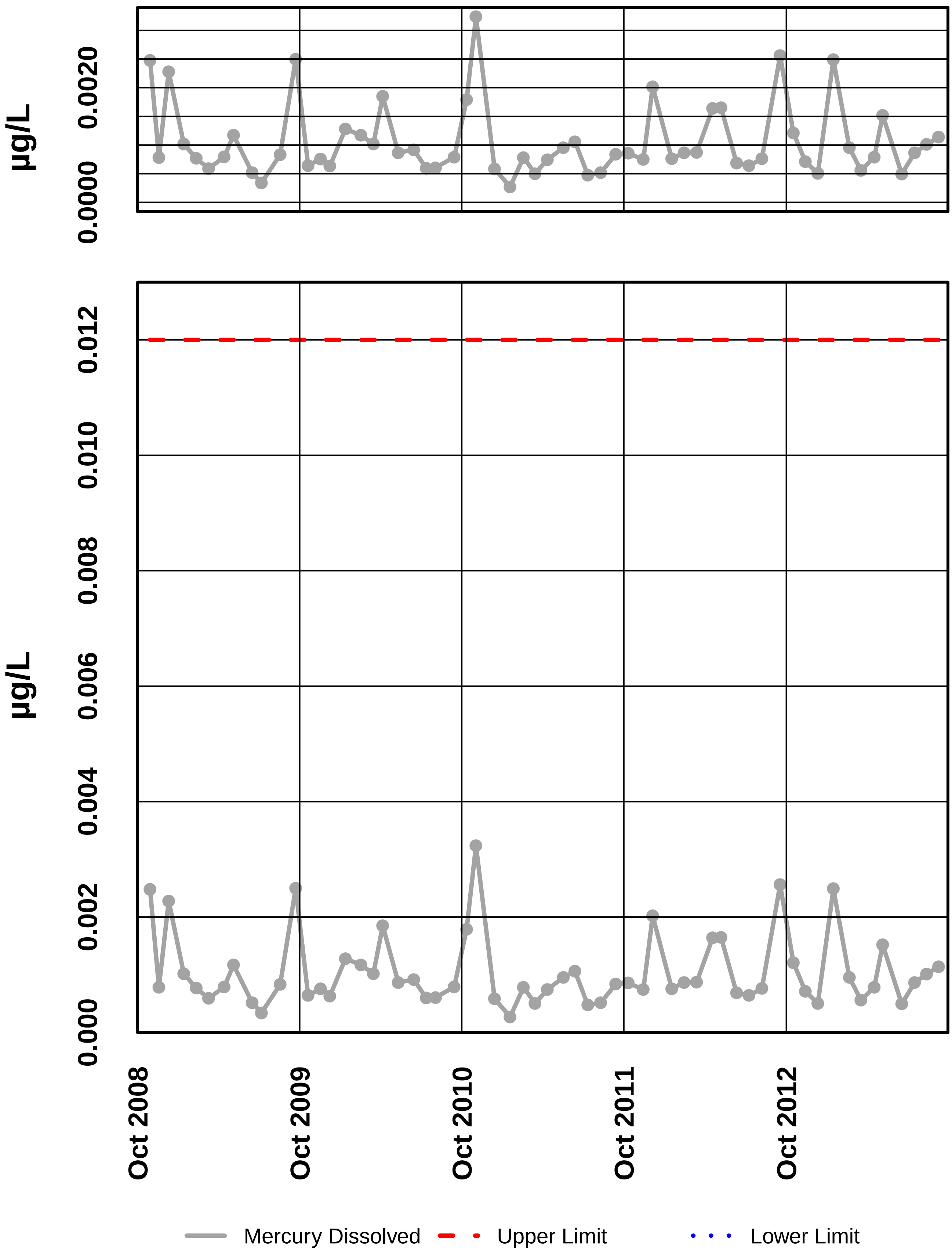


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

Site 54 – Mercury Dissolved



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

Site **#54** Seasonal Kendall analysis for Specific Conductance, Field (µS/cm)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**	113.4	138	158.8	164.3	153.7	170.6	152.3	91.6	90.6	89.1	93.2	92.5
b	**WY2009**	102.9	145.5	123.5	144.8	151.5	176.7	173.5	99.3	83.7	86.8	84.3	73.7
c	**WY2010**	135.5	119	157.3	100	140	153.1	142.3	111.3	88.3	96	104.8	130.5
d	**WY2011**	86.7	84.7	167	169	157	180	98.9	93.9	99	100	127	114
e	**WY2012**	109	130	99	140	138	173	116	108	87.1	87.8	93	95
f	**WY2013**	116	144	160	105	156	183	170	98	78	122	149	125
	n	6	6	6	6	6	6	6	6	6	6	6	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	6	6	6	6	6	6	6	6	6	6	6	6
t_2	0	0	0	0	0	0	0	0	0	0	0	0
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a	-1	1	-1	-1	-1	1	1	1	-1	-1	-1	-1
c-a	1	-1	-1	-1	-1	-1	-1	1	-1	1	1	1
d-a	-1	-1	1	1	1	1	-1	1	1	1	1	1
e-a	-1	-1	-1	-1	-1	1	-1	1	-1	-1	-1	1
f-a	1	1	1	-1	1	1	1	1	-1	1	1	1
c-b	1	-1	1	-1	-1	-1	-1	1	1	1	1	1
d-b	-1	-1	1	1	1	1	-1	-1	1	1	1	1
e-b	1	-1	-1	-1	-1	-1	-1	1	1	1	1	1
f-b	1	-1	1	-1	1	1	-1	-1	-1	1	1	1
d-c	-1	-1	1	1	1	1	-1	-1	1	1	1	-1
e-c	-1	1	-1	1	-1	1	-1	-1	-1	-1	-1	-1
f-c	-1	1	1	1	1	1	1	-1	-1	1	1	-1
e-d	1	1	-1	-1	-1	-1	1	1	-1	-1	-1	-1
f-d	1	1	-1	-1	-1	1	1	1	-1	1	1	1
f-e	1	1	1	-1	1	1	1	-1	-1	1	1	1
S_k	1	-1	1	-5	-1	7	-3	3	-5	7	7	5

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33
$Z_k = S_k/\sigma_S$	0.19	-0.19	0.19	-0.94	-0.19	1.32	-0.56	0.56	-0.94	1.32	1.32	0.94
Z^2_k	0.04	0.04	0.04	0.88	0.04	1.73	0.32	0.32	0.88	1.73	1.73	0.88

ΣZ_k= 3.01

ΣZ^2_k= 8.61

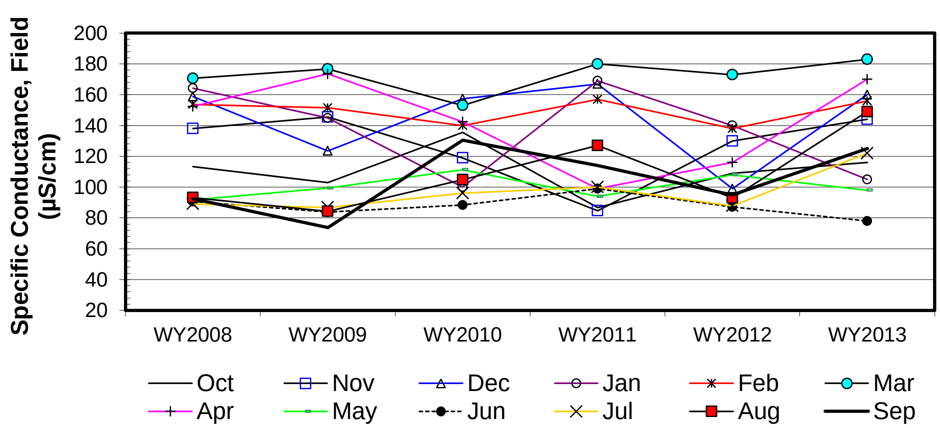
Z-bar=ΣZ_k/K= 0.25

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	72	0	0	0	0

Σn 72

ΣS_k 16

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=		7.86	@α=5% $\chi^2_{(K-1)}$= 19.68	Test for station homogeneity	
	p	**0.726**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc}	0.81	@α/2=2.5% Z= 1.96	**H_0** (No trend)	ACCEPT
340.00	**p**	**0.792**		**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-1.50		3.49
0.050	-0.88	1.00	2.76
0.100	-0.48		2.05
0.200	0.02		1.57

Site **#54** Seasonal Kendall analysis for pH, Field, Standard Units

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**	7.8	7.7	7.7	7.8	7.9	7.7	7.9	7.5	7.9	7.4	7.8	7.5
b	**WY2009**	7.1	7.7	7.7	7.3	7.8	7.2	7.0	7.1	6.9	6.6	6.7	6.9
c	**WY2010**	7.7	7.1	7.2	6.7	7.3	7.8	7.0	7.6	7.0	7.0	7.0	7.5
d	**WY2011**	6.8	7.6	7.7	7.5	7.7	7.4	7.4	7.3	6.9	7.9	7.5	7.8
e	**WY2012**	6.8	7.9	7.7	6.3	7.5	7.3	7.7	7.6	7.9	7.8	7.4	7.5
f	**WY2013**	7.6	7.4	7.5	7.5	6.9	7.8	7.9	7.8	7.5	8.0	8.0	7.9
	n	6	6	6	6	6	6	6	6	6	6	6	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	6	6	4	4	6	6	6	6	6	6	6	4
t_2	0	0	1	1	0	0	0	0	0	0	0	1
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a	-1	1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
c-a	-1	-1	-1	-1	-1	1	-1	1	-1	-1	-1	0
d-a	-1	-1	1	-1	-1	-1	-1	-1	-1	1	-1	1
e-a	-1	1	1	-1	-1	-1	-1	1	-1	1	-1	-1
f-a	-1	-1	-1	-1	-1	1	1	1	-1	1	1	1
c-b	1	-1	-1	-1	-1	1	-1	1	1	1	1	1
d-b	-1	-1	1	1	-1	1	1	1	1	1	1	1
e-b	-1	1	1	-1	-1	1	1	1	1	1	1	1
f-b	1	-1	-1	1	-1	1	1	1	1	1	1	1
d-c	-1	1	1	1	1	-1	1	-1	-1	1	1	1
e-c	-1	1	1	-1	1	-1	1	1	1	1	1	-1
f-c	-1	1	1	1	-1	1	1	1	1	1	1	1
e-d	1	1	0	-1	-1	-1	1	1	1	-1	-1	-1
f-d	1	-1	-1	0	-1	1	1	1	1	1	1	1
f-e	1	-1	-1	1	-1	1	1	1	-1	1	1	1
S_k	-5	-1	0	-4	-11	3	5	9	1	9	5	6

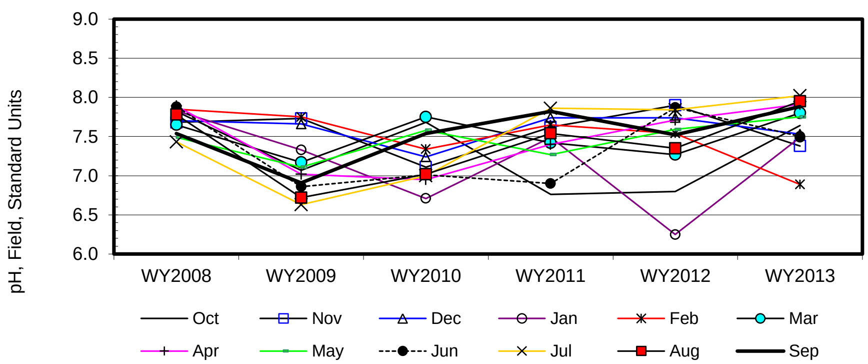
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	28.33	28.33	27.33	27.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	27.33
$Z_k = S_k/\sigma_S$	-0.94	-0.19	0.00	-0.77	-2.07	0.56	0.94	1.69	0.19	1.69	0.94	1.15
Z^2_k	0.88	0.04	0.00	0.59	4.27	0.32	0.88	2.86	0.04	2.86	0.88	1.32

ΣZ_k= 3.20
ΣZ^2_k= 14.93
Z-bar=$\Sigma Z_k/K$= 0.27

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	66	3	0	0	0

Σn 72
ΣS_k 17

$\chi^2_h=\Sigma Z^2_k - K(\text{Z-bar})^2$=	14.07	@α=5% $\chi^2_{(K-1)}$= 19.68	Test for station homogeneity	
p	**0.229**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc} 0.87	@α/2=2.5% Z= 1.96	H_0 (No trend)	ACCEPT
337.00	**p** **0.808**		H_A (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.05		0.09
0.050	-0.02	**0.03**	0.06
0.100	-0.01		0.05
0.200	0.00		0.04

Site **#54** Seasonal Kendall analysis for Total Alk, (mg/l)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**	40.6	45.9	52.4	55.5	49.6	51.6	54.6	33.8	33.1	33.0	59.5	34.6
b	**WY2009**	31.1	46.6	39.1	45.8	52.2	54.4	54.7	34.7	29.7	34.7	34.3	32.6
c	**WY2010**	45.9	45.7	52.0	41.3	43.1	47.2	45.5	37.8	33.2	34.7	39.1	49.2
d	**WY2011**	30.4	25.4	53.3	53.5	48.9	56.9	53.1	35.5	34.0	35.8	46.7	47.6
e	**WY2012**	47.7	51.2	31.8	54.1	54.4	55.9	37.0	39.0	34.4	33.6	31.6	38.7
f	**WY2013**	45.4	56.2	59.2	34.6	51.5	61.0	53.0	34.9	30.1	44.1	47.6	45.8
	n	6	6	6	6	6	6	6	6	6	6	6	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	6	6	6	6	6	6	6	6	6	4	6	6
t_2	0	0	0	0	0	0	0	0	0	1	0	0
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a	-1	1	-1	-1	1	1	1	1	-1	1	-1	-1
c-a	1	-1	-1	-1	-1	-1	-1	1	1	1	-1	1
d-a	-1	-1	1	-1	-1	1	-1	1	1	1	-1	1
e-a	1	1	-1	-1	1	1	-1	1	1	1	-1	1
f-a	1	1	1	-1	1	1	-1	1	-1	1	-1	1
c-b	1	-1	1	-1	-1	-1	-1	1	1	0	1	1
d-b	-1	-1	1	1	-1	1	-1	1	1	1	1	1
e-b	1	1	-1	1	1	1	-1	1	1	-1	-1	1
f-b	1	1	1	-1	-1	1	-1	1	1	1	1	1
d-c	-1	-1	1	1	1	1	1	-1	1	1	1	-1
e-c	1	1	-1	1	1	1	-1	1	1	-1	-1	-1
f-c	-1	1	1	-1	1	1	1	-1	-1	1	1	-1
e-d	1	1	-1	1	1	-1	-1	1	1	-1	-1	-1
f-d	1	1	1	-1	1	1	-1	-1	-1	1	1	-1
f-e	-1	1	1	-1	-1	1	1	-1	-1	1	1	1
S_k	3	5	3	-5	3	9	-7	7	5	8	-1	3

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	27.33	28.33	28.33
$Z_k = S_k/\sigma_S$	0.56	0.94	0.56	-0.94	0.56	1.69	-1.32	1.32	0.94	1.53	-0.19	0.56
Z^2_k	0.32	0.88	0.32	0.88	0.32	2.86	1.73	1.73	0.88	2.34	0.04	0.32

ΣZ_k= 6.23

ΣZ^2_k= 12.61

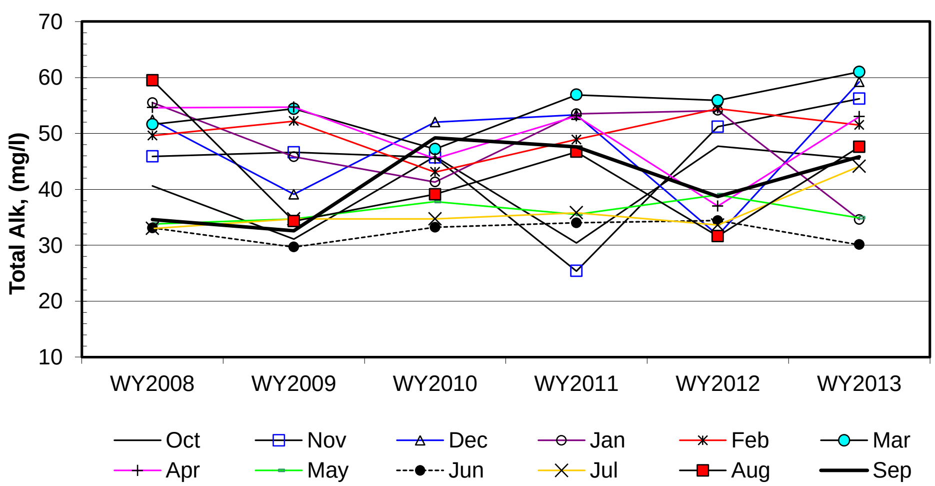
Z-bar=ΣZ_k/K= 0.52

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	70	1	0	0	0

Σn 72

ΣS_k 33

$\chi^2_h=\Sigma Z^2_k$-K(Z-bar)^2=	9.38	@α=5% $\chi^2_{(K-1)}$=	19.68	Test for station homogeneity
p	**0.587**			$\chi^2_h<\chi^2_{(K-1)}$ ACCEPT
ΣVAR(S_k)	Z_{calc} 1.74	@α/2=2.5% **Z**=	1.96	**H_0** (No trend) ACCEPT
339.00	**p** **0.959**			**H_A** ($\pm$ trend) REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.21		1.39
0.050	0.04	**0.58**	1.21
0.100	0.11		1.01
0.200	0.31		0.89

Site #54 — Seasonal Kendall analysis for Sulfate, Total (mg/l)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**	13.0	13.3	18.2	23.0	21.5	20.1	22.7	8.5	7.6	8.4	8.8	7.7
b	**WY2009**	9.7	17.4	16.3	18.0	21.0	24.8	25.4	10.0	8.0	10.0	11.8	8.7
c	**WY2010**	15.2	18.7	19.9	15.0	16.4	19.1	19.7	10.7	9.6	10.1	11.9	16.0
d	**WY2011**	8.9	8.9	24.1	25.0	22.4	26.8	25.8	8.7	10.6	11.2	15.3	16.5
e	**WY2012**	15.5	18.3	10.5	25.0	23.2	23.8	12.2	10.9	7.8	8.4	8.6	9.0
f	**WY2013**	11.6	19.3	22.7	12.3	17.8	26.7	25.9	9.4	7.0	14.1	19.1	12.4
	n	6	6	6	6	6	6	6	6	6	6	6	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	6	6	6	4	6	6	6	6	6	6	6	6
t_2	0	0	0	1	0	0	0	0	0	0	0	0
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a	-1	1	-1	-1	-1	1	1	1	1	1	1	1
c-a	1	1	1	-1	-1	-1	-1	1	1	1	1	1
d-a	-1	-1	1	1	1	1	1	1	1	1	1	1
e-a	1	1	-1	1	1	1	-1	1	1	-1	-1	1
f-a	-1	1	1	-1	-1	1	1	1	-1	1	1	1
c-b	1	1	1	-1	-1	-1	-1	1	1	1	1	1
d-b	-1	-1	1	1	1	1	1	-1	1	1	1	1
e-b	1	1	-1	1	1	-1	-1	1	-1	-1	-1	1
f-b	1	1	1	-1	-1	1	1	-1	-1	1	1	1
d-c	-1	-1	1	1	1	1	1	-1	1	1	1	1
e-c	1	-1	-1	1	1	1	-1	1	-1	-1	-1	-1
f-c	-1	1	1	-1	1	1	1	-1	-1	1	1	-1
e-d	1	1	-1	0	1	-1	-1	1	-1	-1	-1	-1
f-d	1	1	-1	-1	-1	-1	1	1	-1	1	1	-1
f-e	-1	1	1	-1	-1	1	1	-1	-1	1	1	1
S_k	1	7	3	-2	1	5	3	5	-1	7	7	7

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	28.33	28.33	28.33	27.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33
$Z_k = S_k/\sigma_S$	0.19	1.32	0.56	-0.38	0.19	0.94	0.56	0.94	-0.19	1.32	1.32	1.32
Z^2_k	0.04	1.73	0.32	0.15	0.04	0.88	0.32	0.88	0.04	1.73	1.73	1.73

ΣZ_k= 8.07

ΣZ^2_k= 9.57

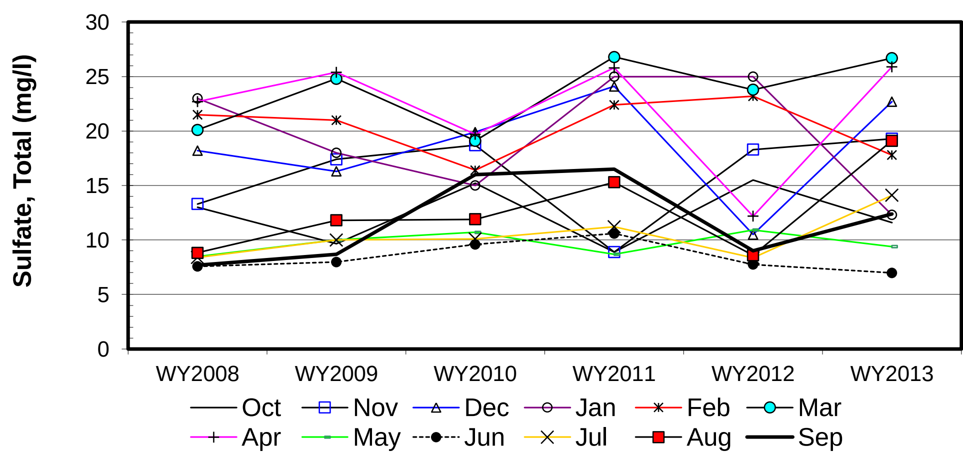
Z-bar=$\Sigma Z_k/K$= 0.67

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	70	1	0	0	0

Σn 72

ΣS_k 43

$\chi^2_h=\Sigma Z^2_k - K(\text{Z-bar})^2$=	4.14	@α=5% $\chi^2_{(K-1)}$=	19.68	Test for station homogeneity	
p	**0.966**			$\chi^2_h < \chi^2_{(K-1)}$	ACCEPT
$\Sigma VAR(S_k)$	Z_{calc} 2.28	@α=2.5% **Z**=	1.96	**H_0** (No trend)	REJECT
339.00	**p** **0.989**			**H_A** (± trend)	ACCEPT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.01		0.97
0.050	0.10	0.48	0.86
0.100	0.16		0.73
0.200	0.30		0.64
		3.1%	

Site #54 — Seasonal Kendall analysis for Zinc, Dissolved (ug/l)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**	9.7	9.3	7.1	5.7	7.0	11.0	15.0	8.4	3.3	3.4	7.3	11.3
b	**WY2009**	14.6	7.9	11.8	7.3	7.3	5.6	12.8	7.9	3.6	2.7	10.0	11.4
c	**WY2010**	6.2	9.2	8.4	5.9	7.9	8.5	10.6	4.1	3.6	4.0	3.6	4.3
d	**WY2011**	7.5	11.8	6.9	6.5	9.3	6.5	10.5	3.8	3.7	3.7	4.2	7.0
e	**WY2012**	7.3	10.3	13.2	10.2	9.0	7.8	11.1	9.9	4.1	4.5	4.7	5.9
f	**WY2013**	6.0	6.7	5.9	8.5	7.0	7.5	7.9	9.2	3.1	3.8	5.9	4.9
	n	6	6	6	6	6	6	6	6	6	6	6	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	6	6	6	6	6	6	6	6	6	6	6	6
t_2	0	0	0	0	0	0	0	0	0	0	0	0
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a	1	-1	1	1	1	-1	-1	-1	1	-1	1	1
c-a	-1	-1	1	1	1	-1	-1	-1	1	1	-1	-1
d-a	-1	1	-1	1	1	-1	-1	-1	1	1	-1	-1
e-a	-1	1	1	1	1	-1	-1	1	1	1	-1	-1
f-a	-1	-1	-1	1	-1	-1	-1	1	-1	1	-1	-1
c-b	-1	1	-1	-1	1	1	-1	-1	-1	1	-1	-1
d-b	-1	1	-1	-1	1	1	-1	-1	1	1	-1	-1
e-b	-1	1	1	1	1	1	-1	1	1	1	-1	-1
f-b	-1	-1	-1	1	-1	1	-1	1	-1	1	-1	-1
d-c	1	1	-1	1	1	-1	-1	-1	1	-1	1	1
e-c	1	1	1	1	1	-1	1	1	1	1	1	1
f-c	-1	-1	-1	1	-1	-1	-1	1	-1	-1	1	1
e-d	-1	-1	1	1	-1	1	1	1	1	1	1	-1
f-d	-1	-1	-1	1	-1	1	-1	1	-1	1	1	-1
f-e	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	1	-1
S_k	-9	-1	-3	9	3	-3	-11	1	3	7	-1	-7

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33
$Z_k = S_k/\sigma_S$	-1.69	-0.19	-0.56	1.69	0.56	-0.56	-2.07	0.19	0.56	1.32	-0.19	-1.32
Z^2_k	2.86	0.04	0.32	2.86	0.32	0.32	4.27	0.04	0.32	1.73	0.04	1.73

ΣZ_k= -2.25

ΣZ^2_k= 14.82

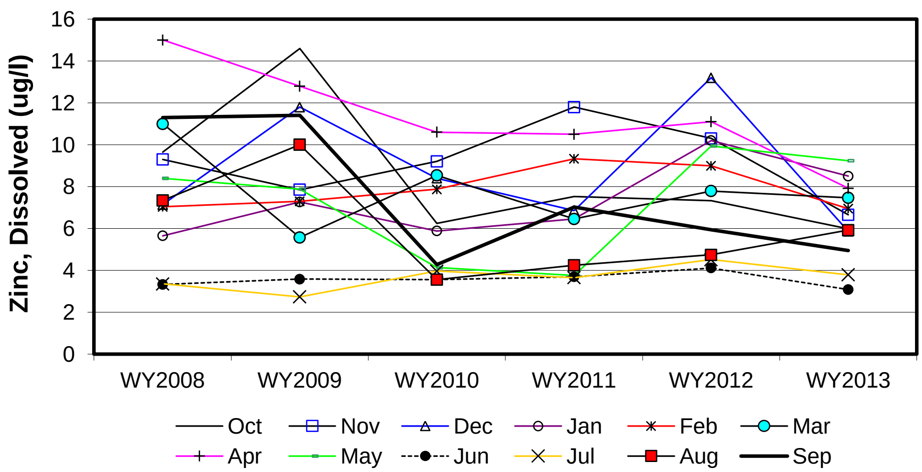
Z-bar=$\Sigma Z_k/K$= -0.19

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	72	0	0	0	0

Σn 72

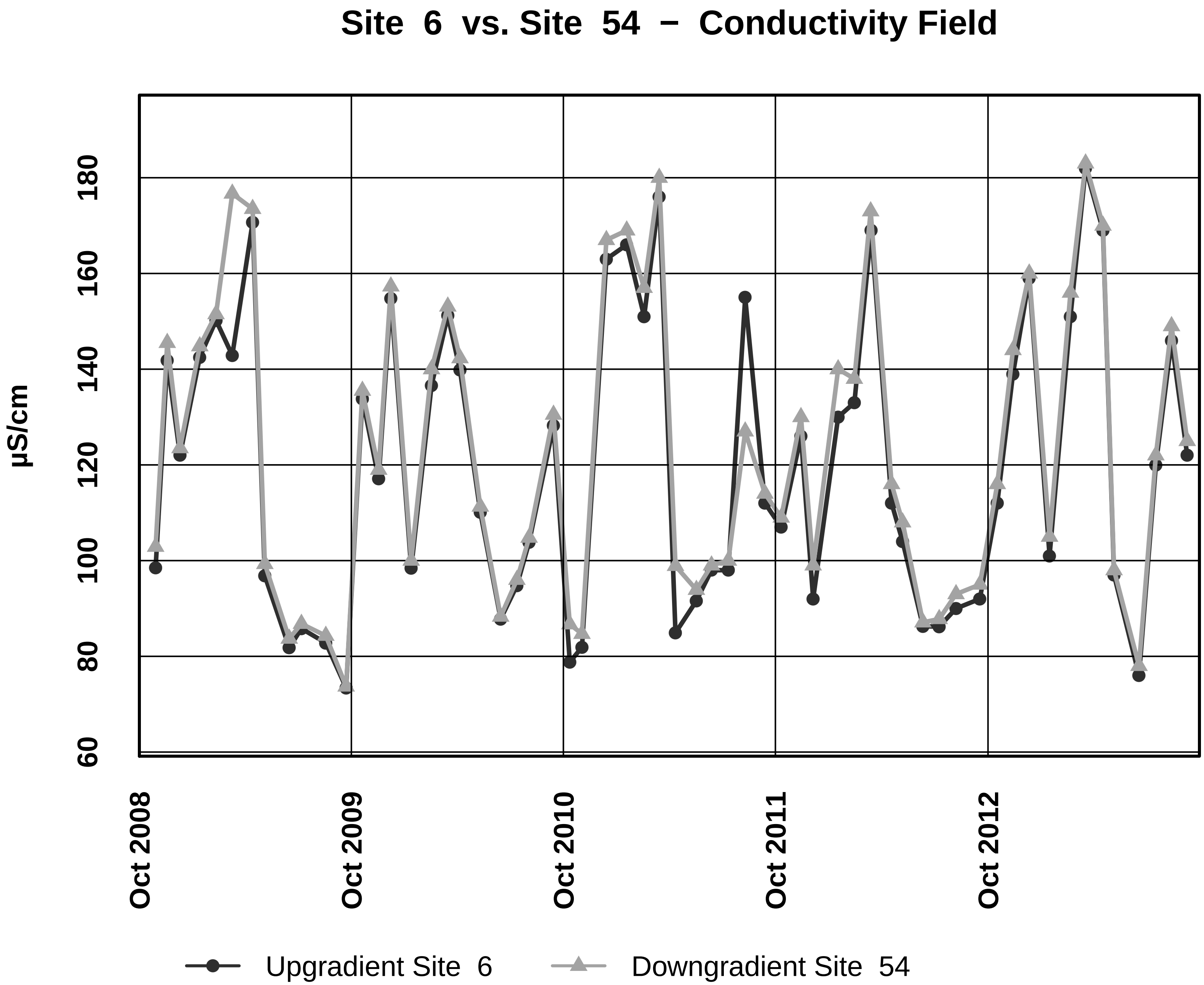
ΣS_k -12

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$= 14.40	@α=5% $\chi^2_{(K-1)}$= 19.68	Test for station homogeneity	
p **0.212**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k) 340.00 / Z_{calc} -0.60	@α/2=2.5% Z= 1.96	**H_0** (No trend)	ACCEPT
p **0.275**		**H_A** (± trend)	REJECT



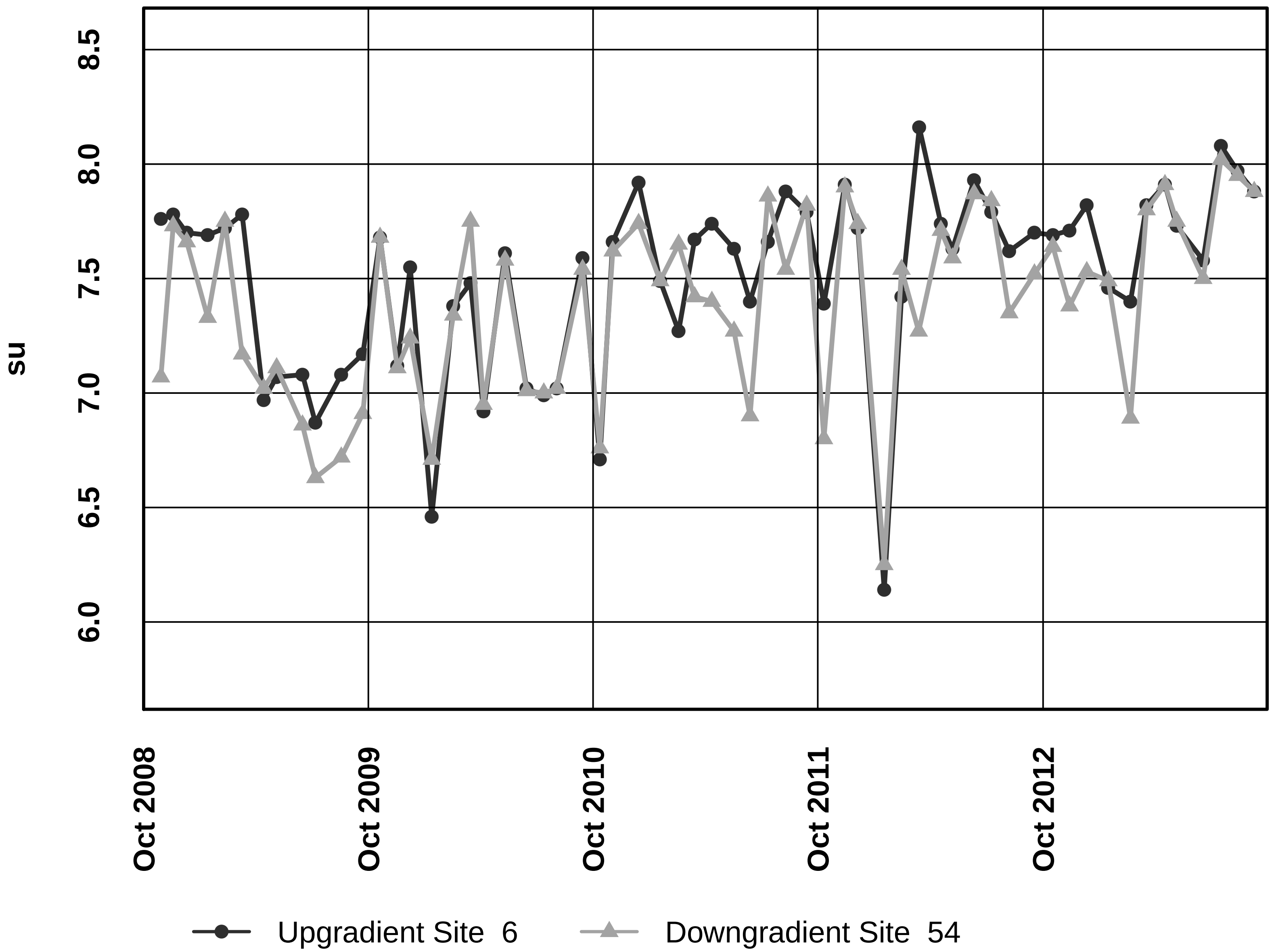
Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.57		0.25
0.050	-0.37	**-0.09**	0.14
0.100	-0.32		0.11
0.200	-0.30		0.07

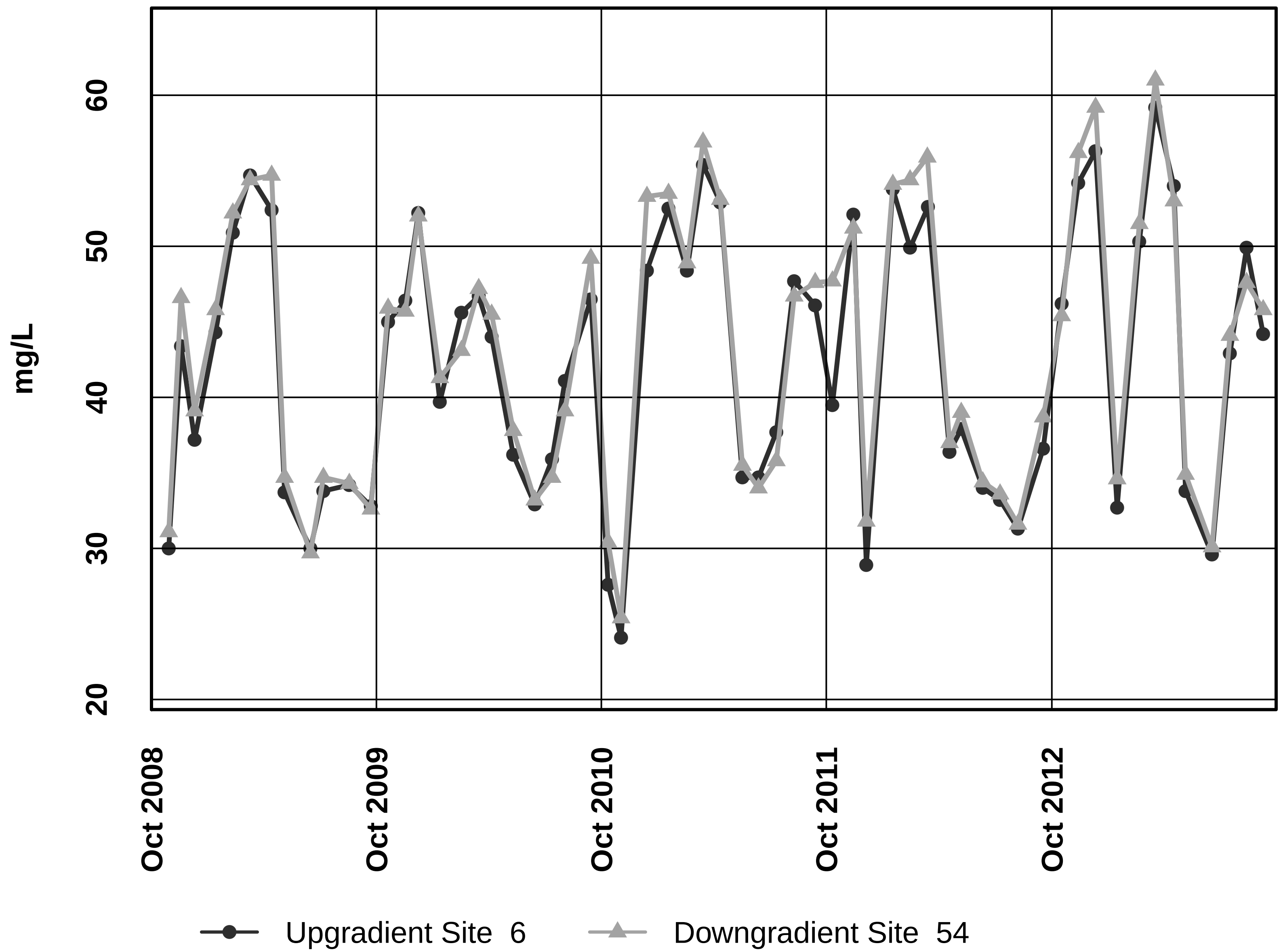


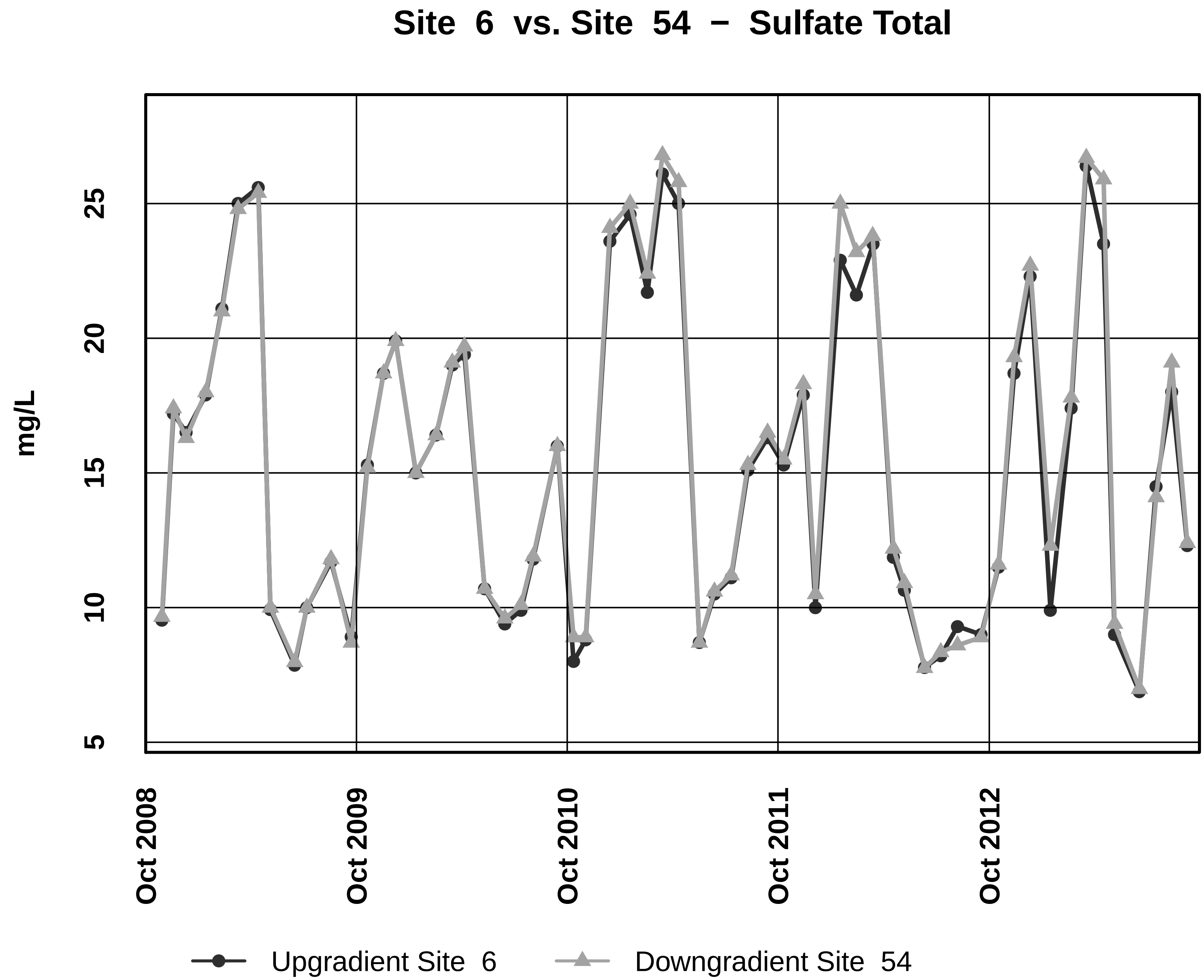
Site 6 vs. Site 54 − Conductivity Field
µS/cm
60
80
100
120
140
160
180
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Oct 2012
Upgradient Site 6
Downgradient Site 54

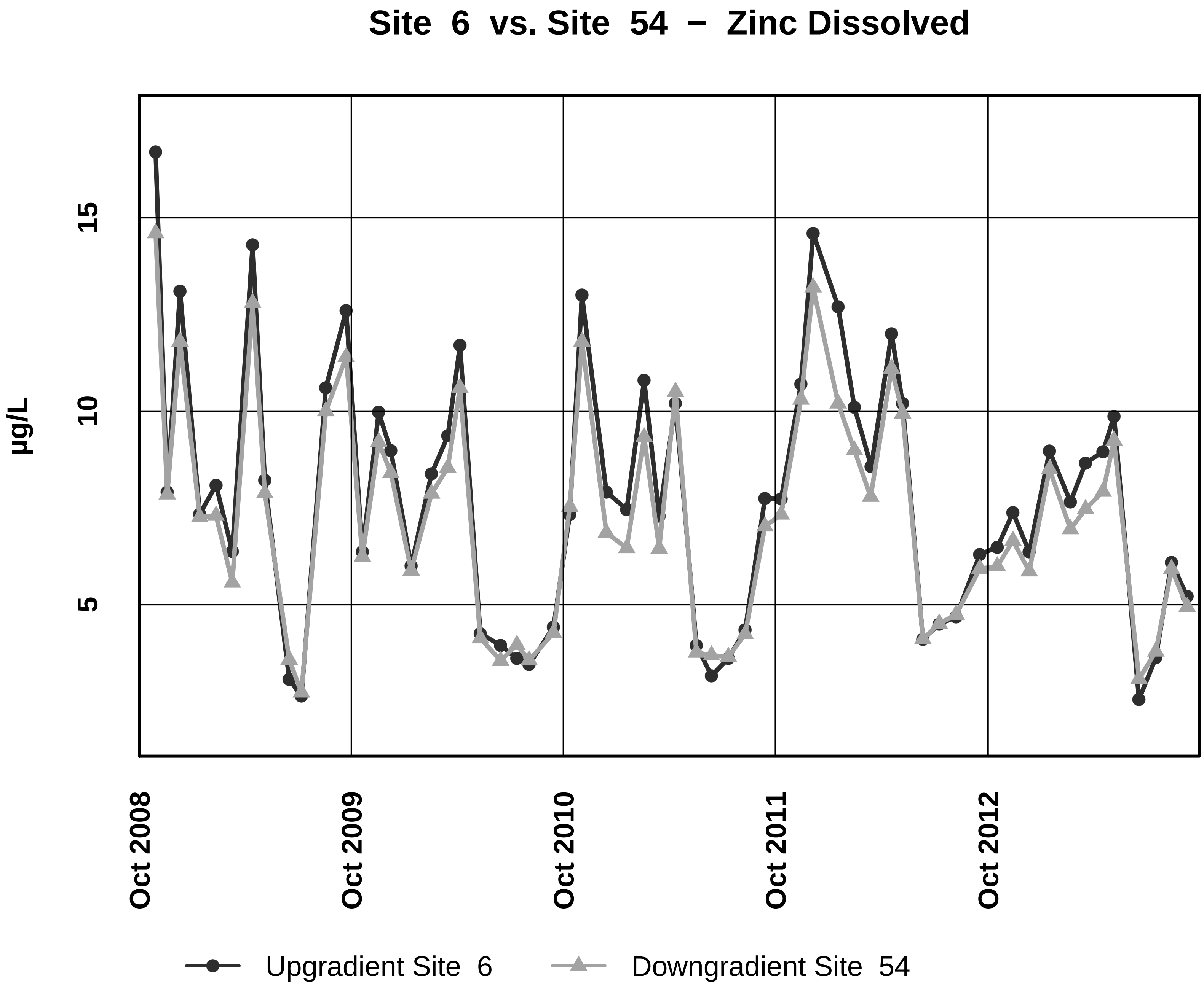
Site 6 vs. Site 54 − pH Field



Site 6 vs. Site 54 − Alkalinity Total




Site 6 vs. Site 54 − Sulfate Total
mg/L
5
10
15
20
25
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Oct 2012
Upgradient Site 6
Downgradient Site 54


Site 6 vs. Site 54 − Zinc Dissolved
µg/L
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	WY2013	WY2013	**D**	**|D|**	**Rank**
Oct	112.0	116.0	-4.0	4.0	-9.5
Nov	139.0	144.0	-5.0	5.0	-11.5
Dec	159.0	160.0	-1.0	1.0	-2.5
Jan	101.0	105.0	-4.0	4.0	-9.5
Feb	151.0	156.0	-5.0	5.0	-11.5
Mar	182.0	183.0	-1.0	1.0	-2.5
Apr	169.0	170.0	-1.0	1.0	-2.5
May	97.0	98.0	-1.0	1.0	-2.5
Jun	76.0	78.0	-2.0	2.0	-5.5
Jul	120.0	122.0	-2.0	2.0	-5.5
Aug	146.0	149.0	-3.0	3.0	-7.5
Sep	122.0	125.0	-3.0	3.0	-7.5
Median	130.5	134.5	-2.5	2.5	

n	**m**
12	12

N= 12
ΣR= -78

α
5.0%
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	Differences		
Site	#6	#54			
Year	WY2013	WY2013	D	|D|	Rank
Oct	7.69	7.64	0.05	0.05	5
Nov	7.71	7.38	0.33	0.33	9
Dec	7.82	7.53	0.29	0.29	8
Jan	7.46	7.49	-0.03	0.03	-4
Feb	7.40	6.89	0.51	0.51	10
Mar	7.82	7.80	0.02	0.02	2.5
Apr	7.91	7.91	0.00		
May	7.73	7.75	-0.02	0.02	-2.5
Jun	7.58	7.50	0.08	0.08	7
Jul	8.08	8.02	0.06	0.06	6
Aug	7.97	7.95	0.02	0.02	1
Sep	7.88	7.88	0.00		
Median	7.78	7.70	0.04	0.06	

n	m
12	10

N= 10

ΣR= 42

α
95.0%
W'$_{\alpha,n}$
43

W^+=
48.5
p-test
0.986

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	WY2013	WY2013	D	|D|	Rank
Oct	46.2	45.4	0.8	0.8	2
Nov	54.2	56.2	-2.0	2.0	-10
Dec	56.3	59.2	-2.9	2.9	-12
Jan	32.7	34.6	-1.9	1.9	-9
Feb	50.3	51.5	-1.2	1.2	-5.5
Mar	59.2	61.0	-1.8	1.8	-8
Apr	54.0	53.0	1.0	1.0	3
May	33.8	34.9	-1.1	1.1	-4
Jun	29.6	30.1	-0.5	0.5	-1
Jul	42.9	44.1	-1.2	1.2	-5.5
Aug	49.9	47.6	2.3	2.3	11
Sep	44.2	45.8	-1.6	1.6	-7
Median	48.1	46.7	-1.2	1.4	

n	m
12	12

N= 12

ΣR= -46

α
95.0%
W'α,n
59

W^+=
16
p-test
0.039

H_0	median [D]=0	ACCEPT
H_1	median [D]>0	

Wilcoxon-signed-ranks test
Exact Form

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

	X	**Y**			
Site	#6	#54	Differences		
Year	WY2013	WY2013	**D**	**|D|**	**Rank**
Oct	11.5	11.6	-0.1	0.1	-1.5
Nov	18.7	19.3	-0.6	0.6	-9
Dec	22.3	22.7	-0.4	0.4	-6
Jan	9.9	12.3	-2.4	2.4	-11.5
Feb	17.4	17.8	-0.4	0.4	-8
Mar	26.4	26.7	-0.3	0.3	-4
Apr	23.5	25.9	-2.4	2.4	-11.5
May	9.0	9.4	-0.4	0.4	-6
Jun	6.9	7.0	-0.1	0.1	-3
Jul	14.5	14.1	0.4	0.4	6
Aug	18.0	19.1	-1.1	1.1	-10
Sep	12.3	12.4	-0.1	0.1	-1.5
Median	16.0	16.0	-0.4	0.4	

n	**m**
12	12

N= 12

$\Sigma R=$ -66

α
5.0%
W'α,n
17

$W^+=$
6
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	#6	#54			
Year	WY2013	WY2013	D	|D|	Rank
Oct	6.48	5.99	0.49	0.49	5
Nov	7.38	6.65	0.73	0.73	10
Dec	6.36	5.86	0.50	0.50	6
Jan	8.97	8.50	0.47	0.47	4
Feb	7.65	6.95	0.70	0.70	9
Mar	8.66	7.47	1.19	1.19	12
Apr	8.95	7.92	1.03	1.03	11
May	9.87	9.24	0.63	0.63	8
Jun	2.55	3.08	-0.53	0.53	-7
Jul	3.63	3.79	-0.16	0.16	-1
Aug	6.09	5.92	0.17	0.17	2
Sep	5.21	4.94	0.27	0.27	3
Median	6.93	6.32	0.50	0.52	

n	m
12	12

N= 12

ΣR= 62

α
5.0%
W' α,n
17

W^+=
70
p-test
0.995

H_0	median [D]=0	ACCEPT
H_1	median [D]<0	

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 2013” 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 2013.				

The data for Water Year 2013 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 2013

			Limits		
Sample Date	Parameter	Value	Lower	Upper	Hardness
No exceedances have been identified by HGCMC for the period of October 2012 through September 2013.					

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 2013

Site 062FMS - 'Greens Creek Below Site 54'

Sample Date/Parameter	Oct 2012	Nov 2012	Dec 2012	Jan 2013	Feb 2013	Mar 2013	Apr 2013	May 2013	Jun 2013	Jul 2013	Aug 2013	Sep 2013	**Median**
Water Temp (°C)						0.1	1.4	1.7	5.1	9.8	10.3	8.3	5.1
Conductivity-Field(μmho)						198	181	105	78	127	154	130	130.0
Conductivity-Lab (μmho)						193	175	100	73	121	148	94	121
pH Lab (standard units)						7.74	7.61	7.58	7.83	7.94	7.53	7.82	7.74
pH Field (standard units)						8.23	8.06	7.5	7.63	8	7.89	7.83	7.89
Total Alkalinity (mg/L)						67.8	62.5	36.9	30.9	46.3	54.1	47.8	47.8
Total Sulfate (mg/L)						27.3	24.8	9.7	6.6	14.5	18.9	12.7	14.5
Hardness (mg/L)						90.6	80.5	42.7	34.8	58.3	71.1	59.2	59.2
Dissolved As (ug/L)						0.163	0.147	0.183	0.197	0.423	0.225	0.227	0.197
Dissolved Ba (ug/L)													
Dissolved Cd (ug/L)						0.052	0.0598	0.0609	0.0308	0.0841	0.049	0.0446	0.0520
Dissolved Cr (ug/L)													
Dissolved Cu (ug/L)						0.483	0.416	0.639	0.251	0.656	0.368	0.574	0.483
Dissolved Pb (ug/L)						0.0064	0.0186	0.0257	0.01	0.0338	0.0133	0.0572	0.0186
Dissolved Ni (ug/L)													
Dissolved Ag (ug/L)													
Dissolved Zn (ug/L)						7.46	7.76	8.66	2.38	7.1	6.08	4.68	7.10
Dissolved Se (ug/L)													
Dissolved Hg (ug/L)						0.00048	0.000699	0.00153	0.000573	0.00121	0.00064	0.00114	0.000699

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.

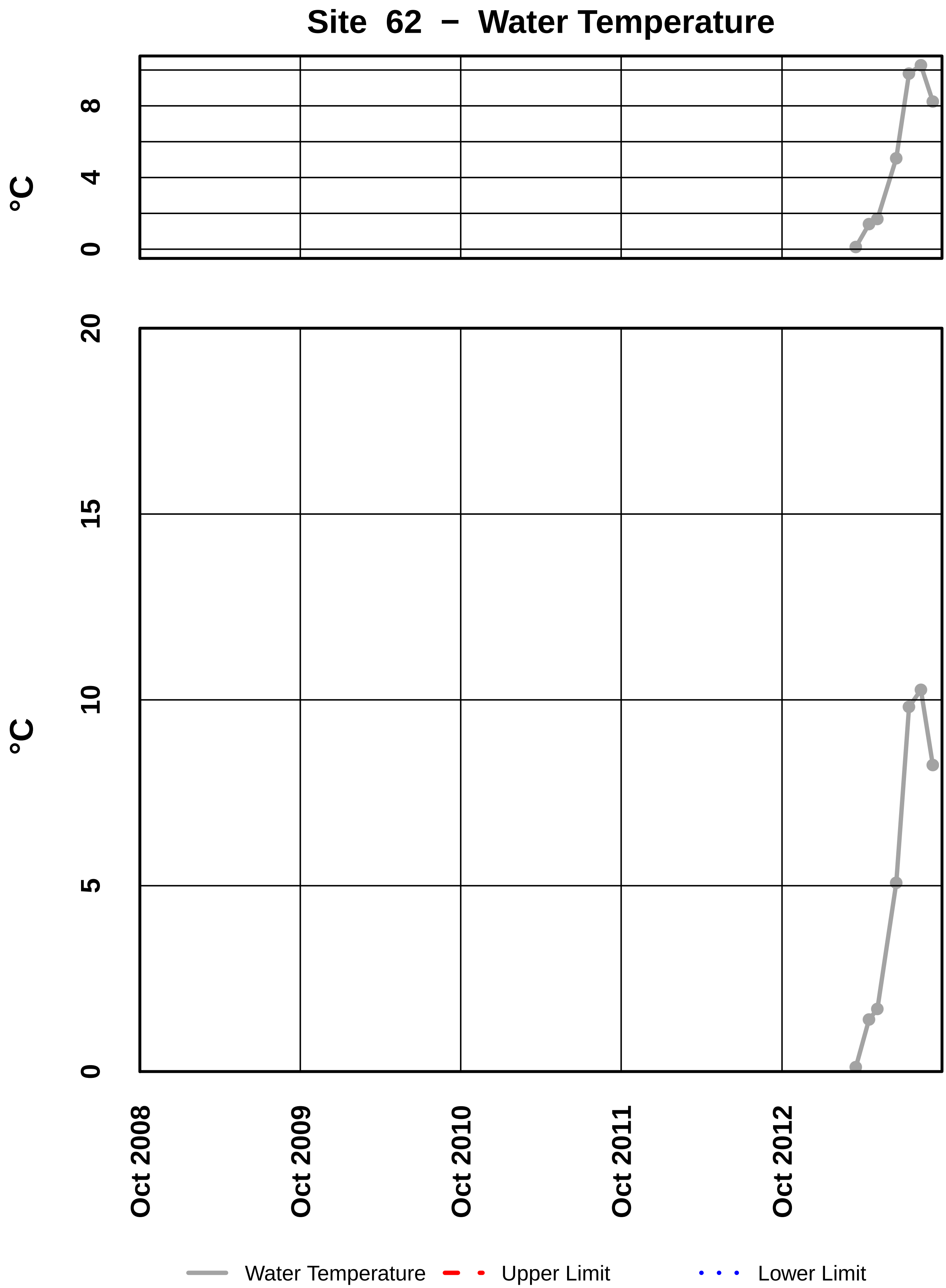
Shaded data has been qualified as an outlier by HGCMC and removed from any further analysis and is not included into the calculation of the median

Qualified Data by QA Reviewer

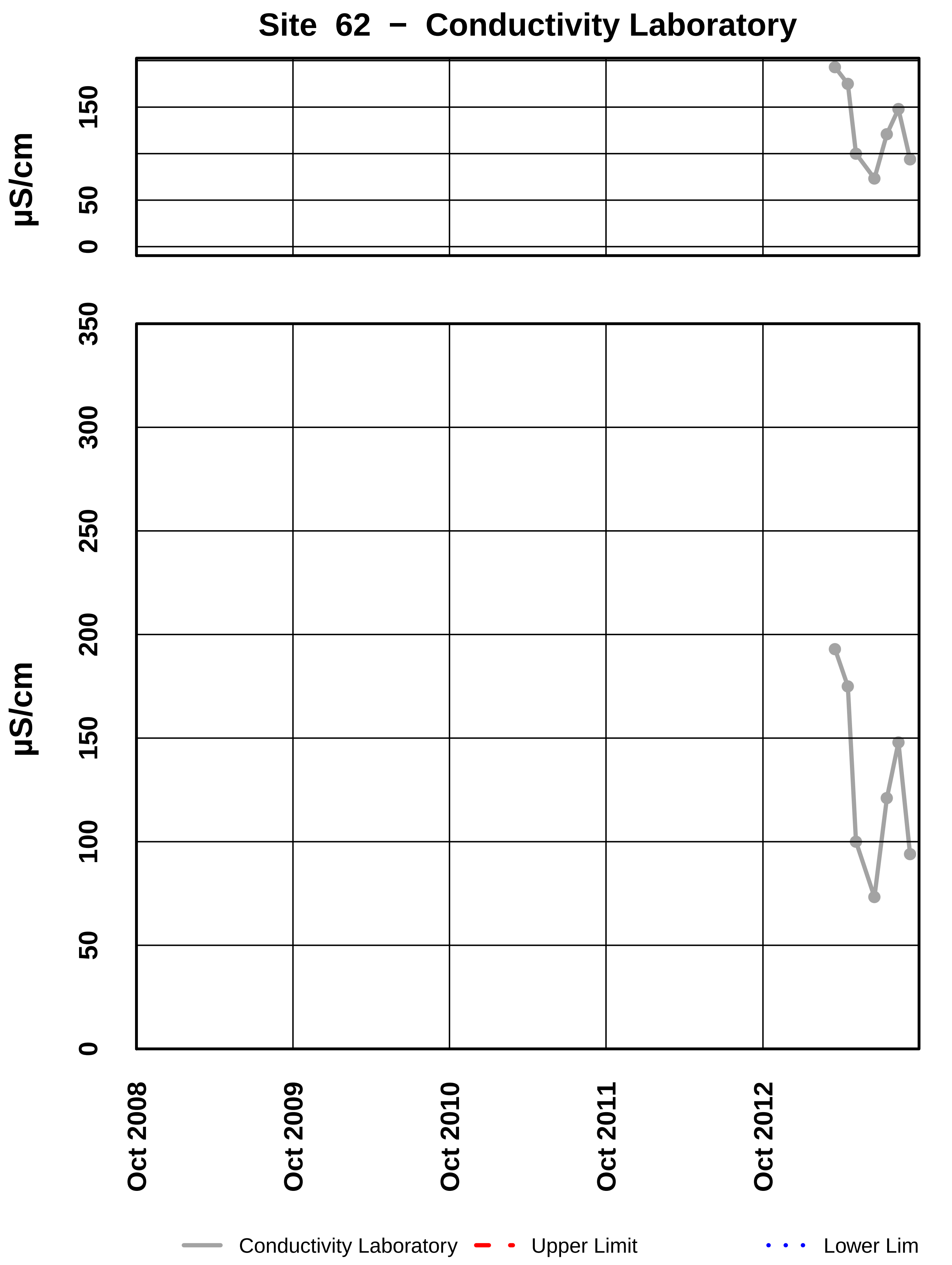
Date Range: 10/01/2012 to 09/30/2013

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
62	3/18/2013	12:00 AM	Pb diss, µg/l	0.00642	J	Below Quantitative Range
			Hg diss, µg/l	0.00048	U	Field Blank Contamination
62	5/6/2013	12:00 AM	pH Lab, su	7.58	J	Hold Time Violation
62	6/18/2013	12:00 AM	Hg diss, µg/l	0.000573	U	Field Blank Contamination
62	7/17/2013	12:00 AM	SO4 Tot, mg/l	14.5	J	Sample Receipt Temperature
62	8/13/2013	12:00 AM	Cond, µmhos	148	J	Sample receipt temperature
			Alk, mg/L	54.1	J	Sample receipt temperature
			SO4 Tot, mg/l	18.9	J	Sample receipt temperature
			Pb diss, µg/l	0.01	U	Field Blank Contamination
			Hg diss, µg/l	0.00064	U	Field Blank Contamination
62	9/9/2013	12:00 AM	SO4 Tot, mg/l	12.7	J	Sample receipt temperature

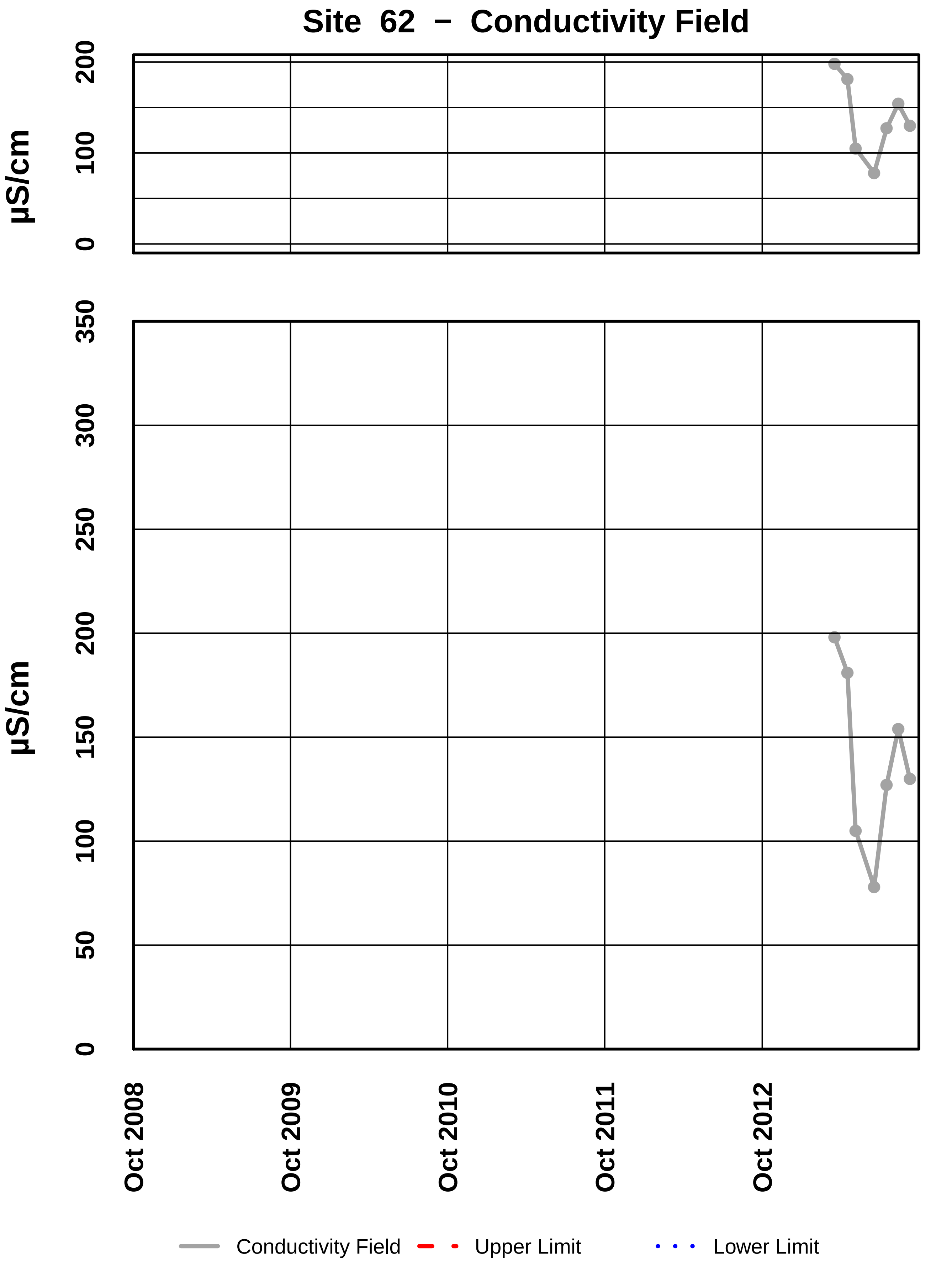
Qualifier	Description
J	Positively Identified - Approximate concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit



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

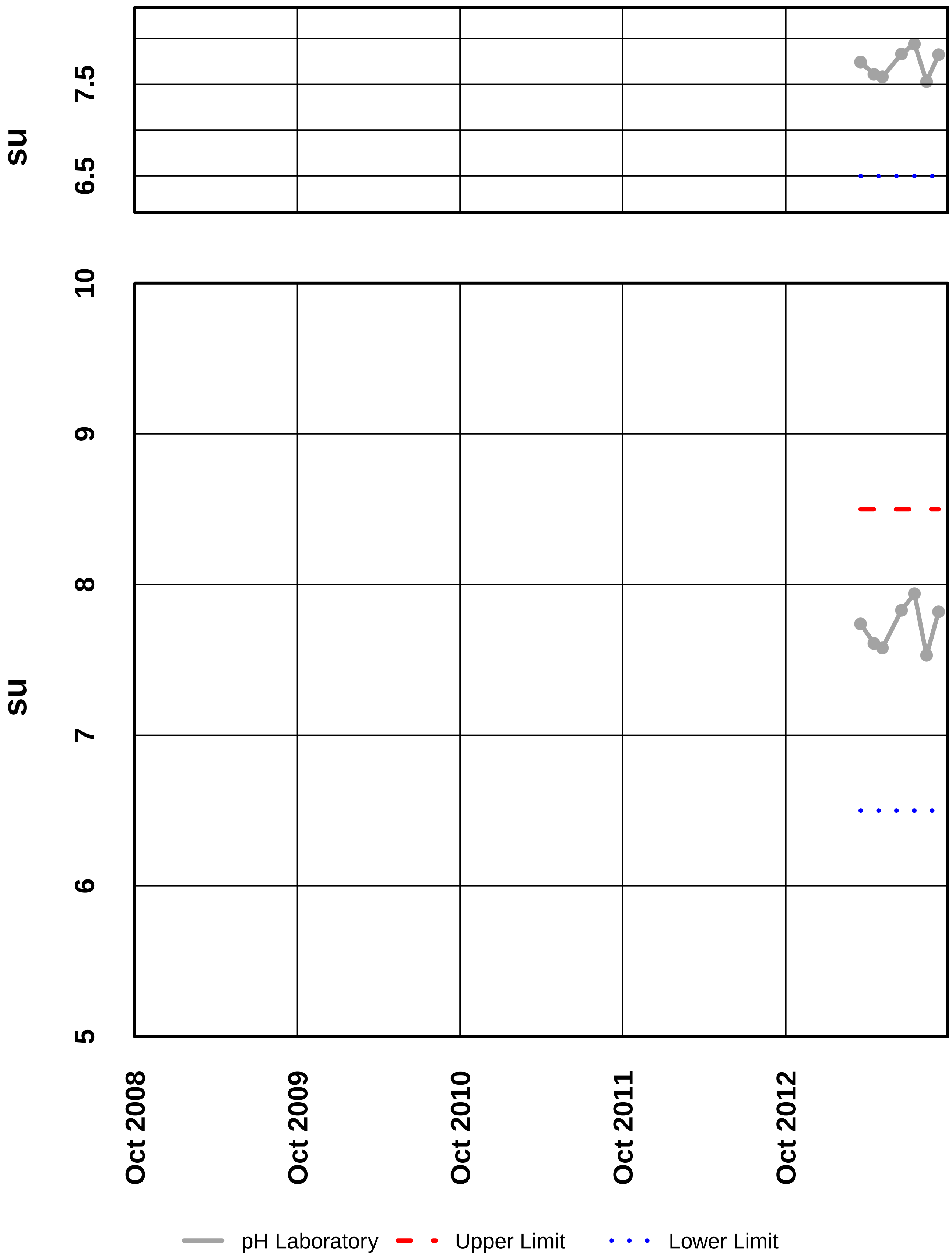


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



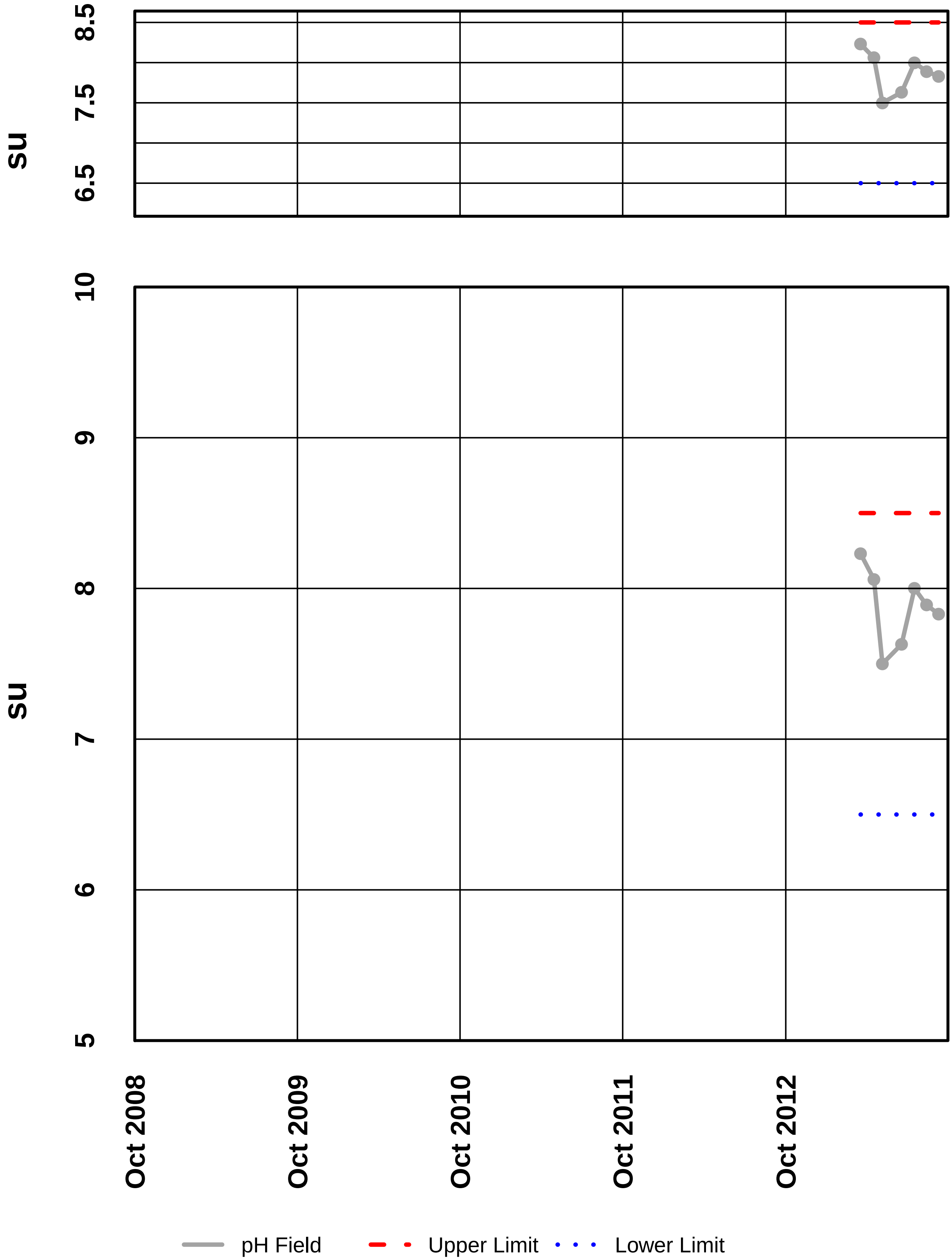
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 62 – pH Laboratory

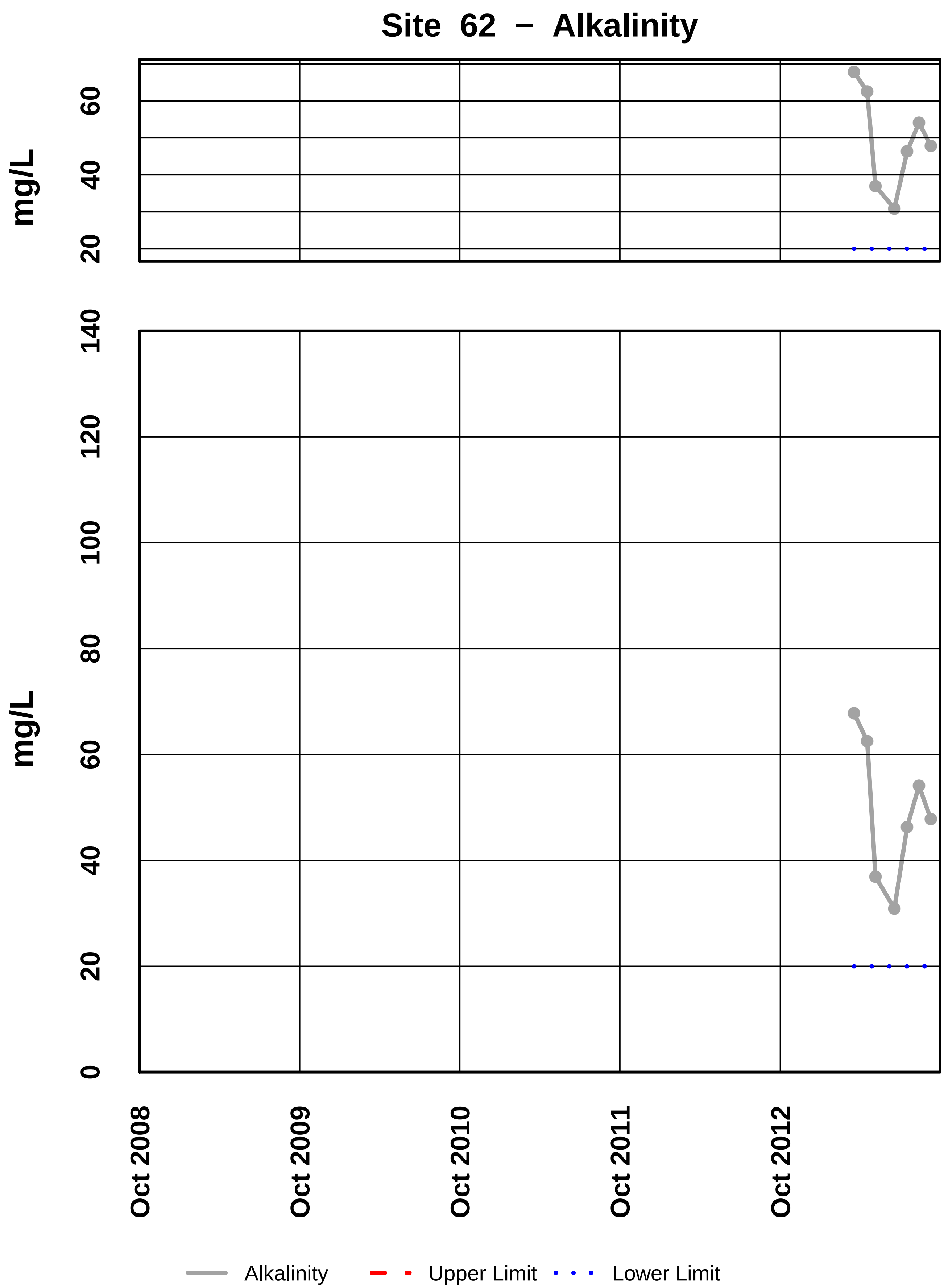


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 62 – pH Field

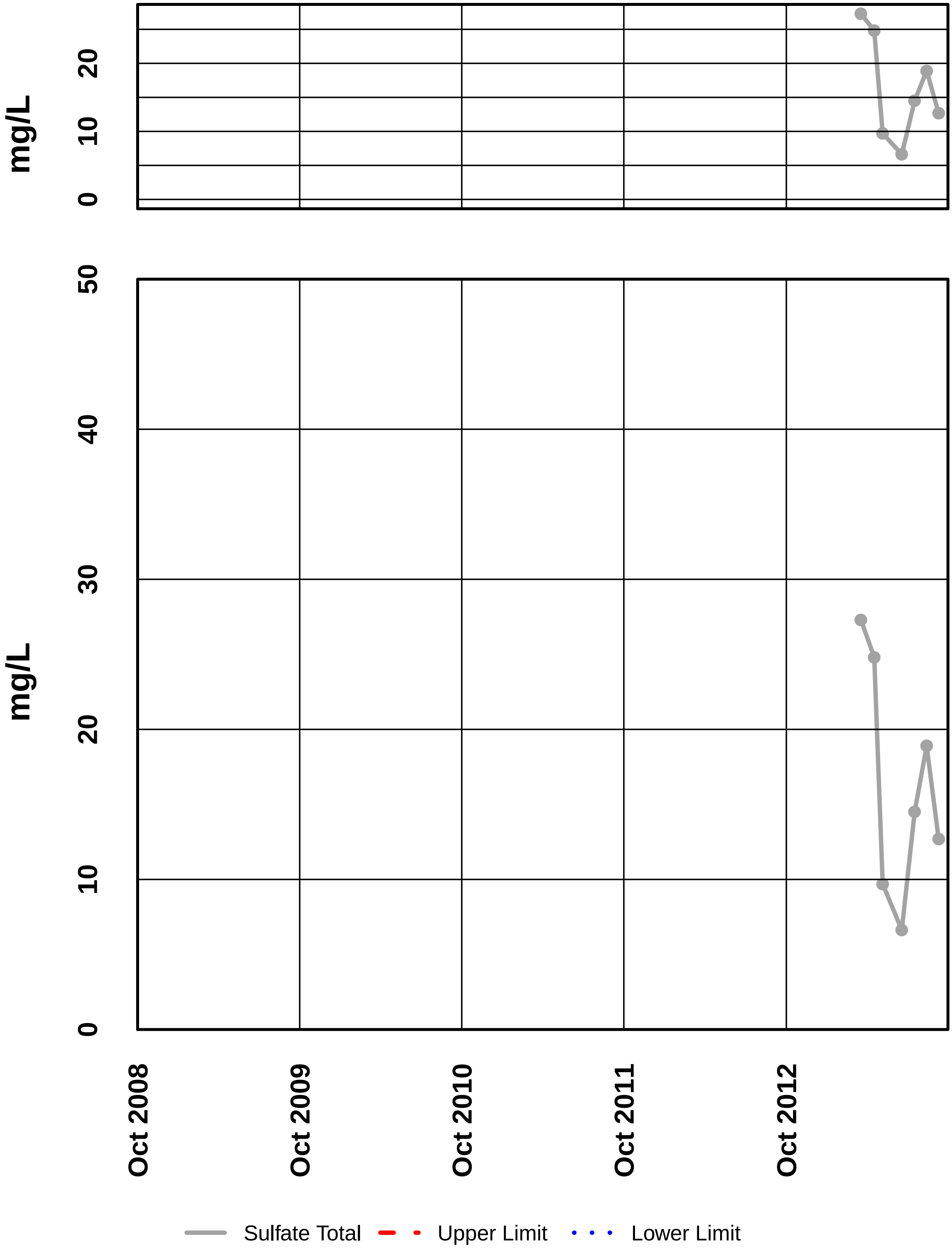


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



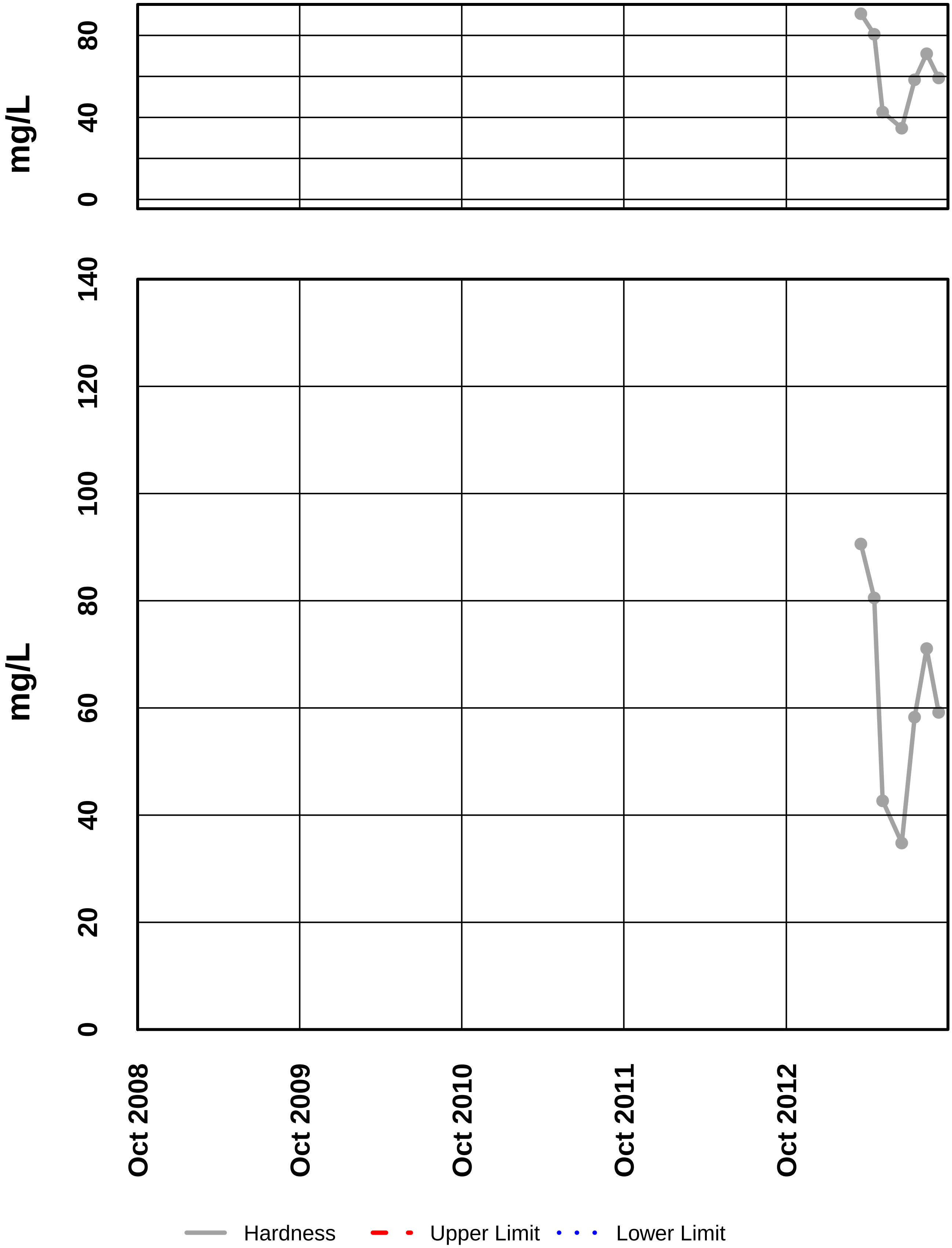
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 62 − Sulfate Total



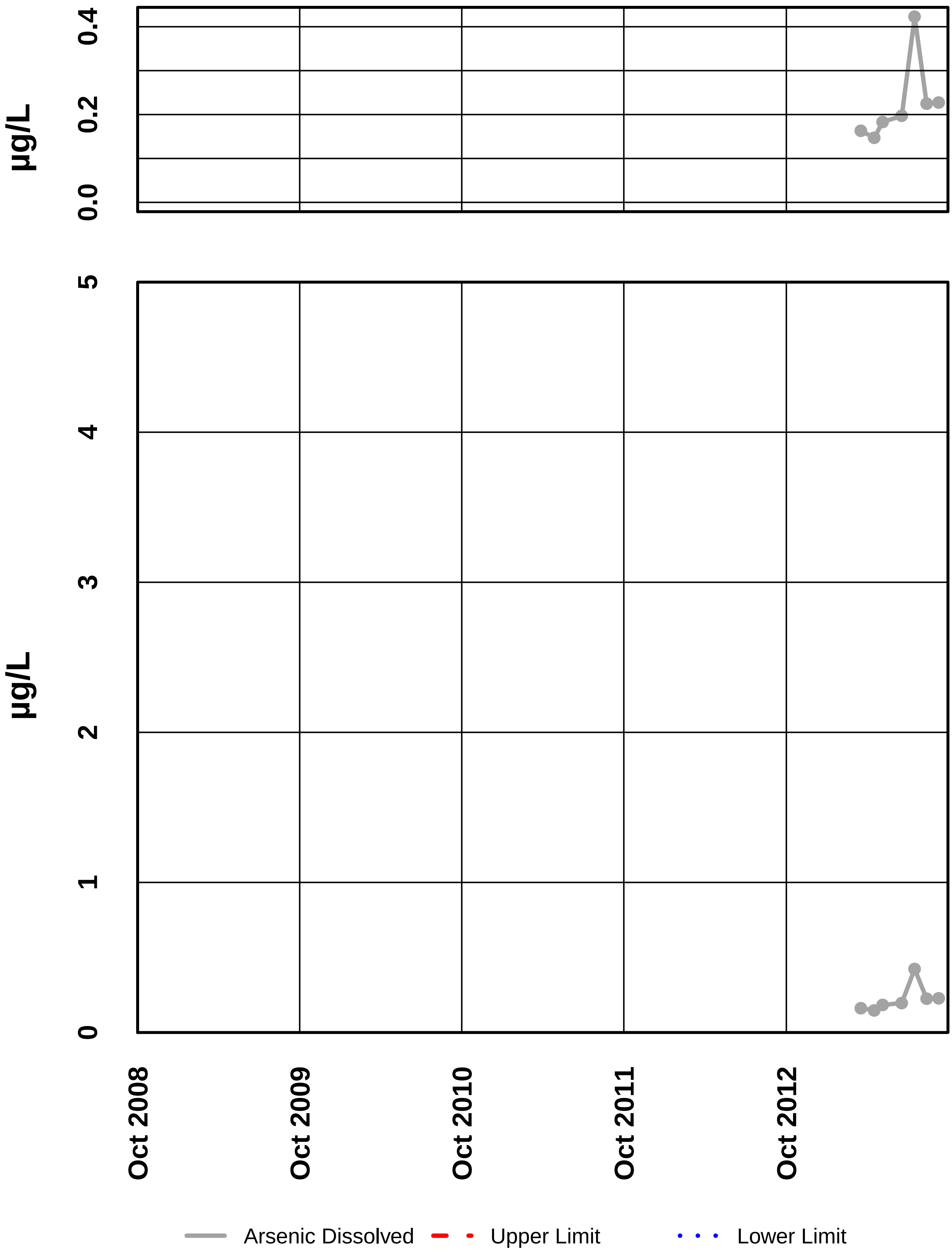
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 62 – Hardness



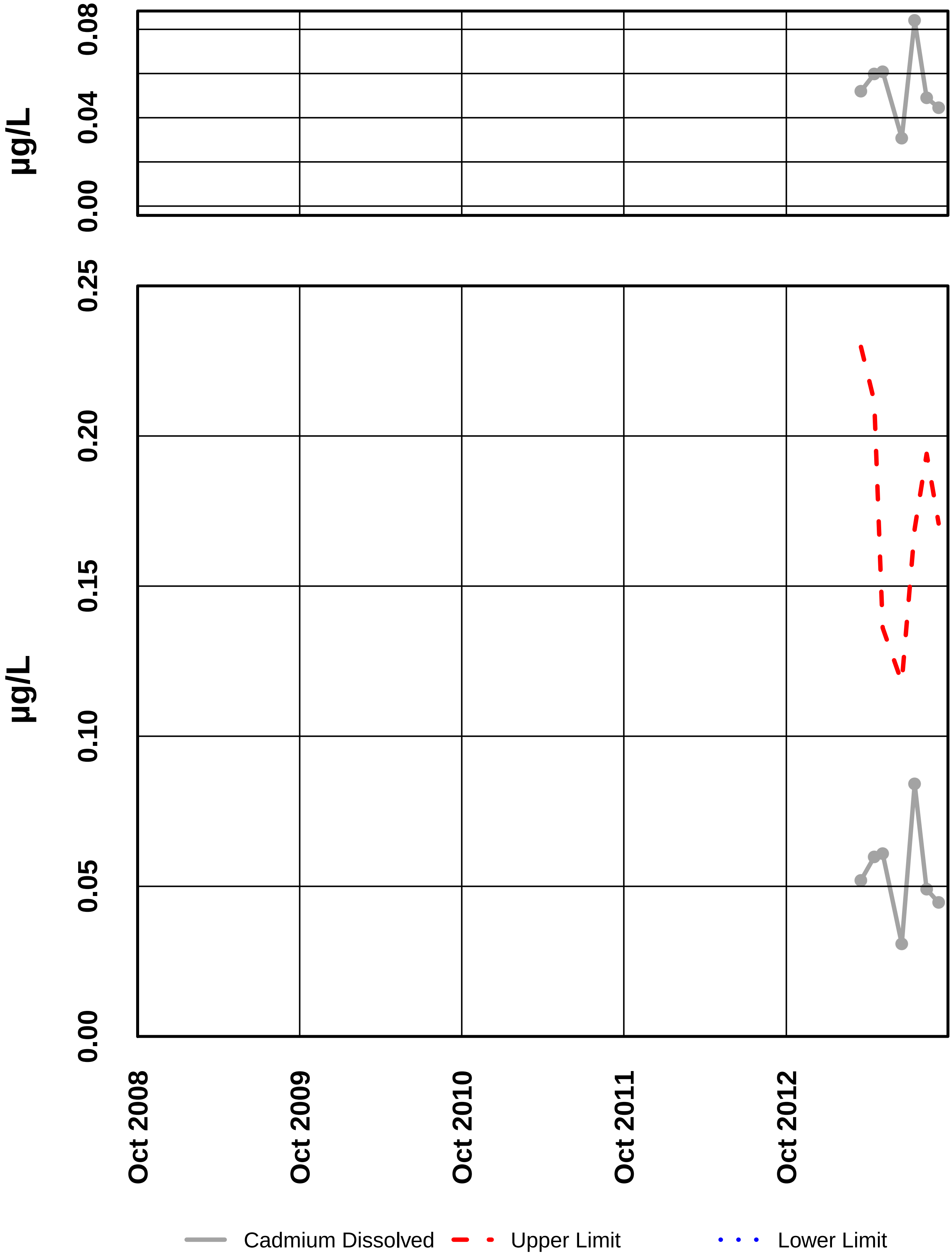
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 62 – Arsenic Dissolved



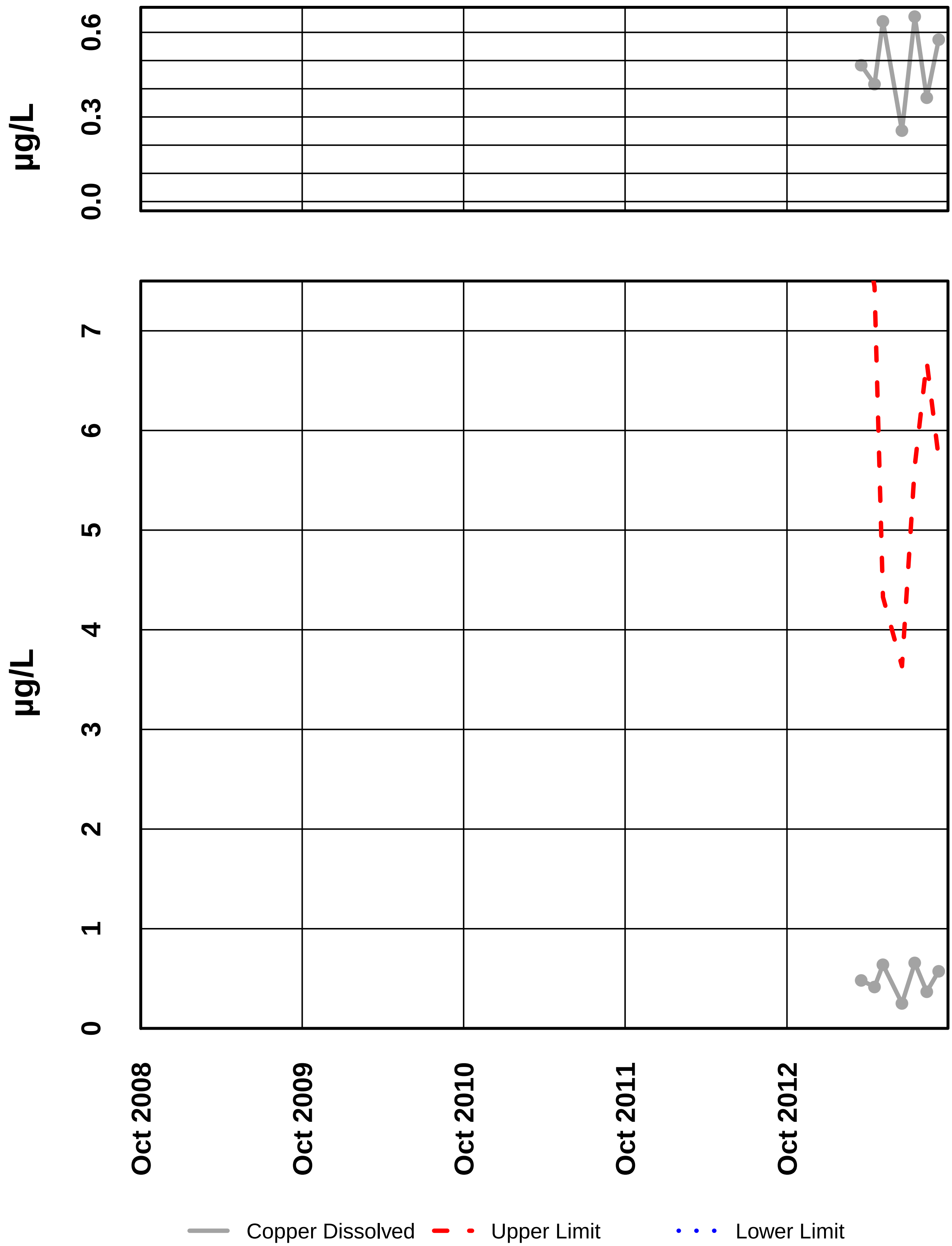
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 62 − Cadmium Dissolved

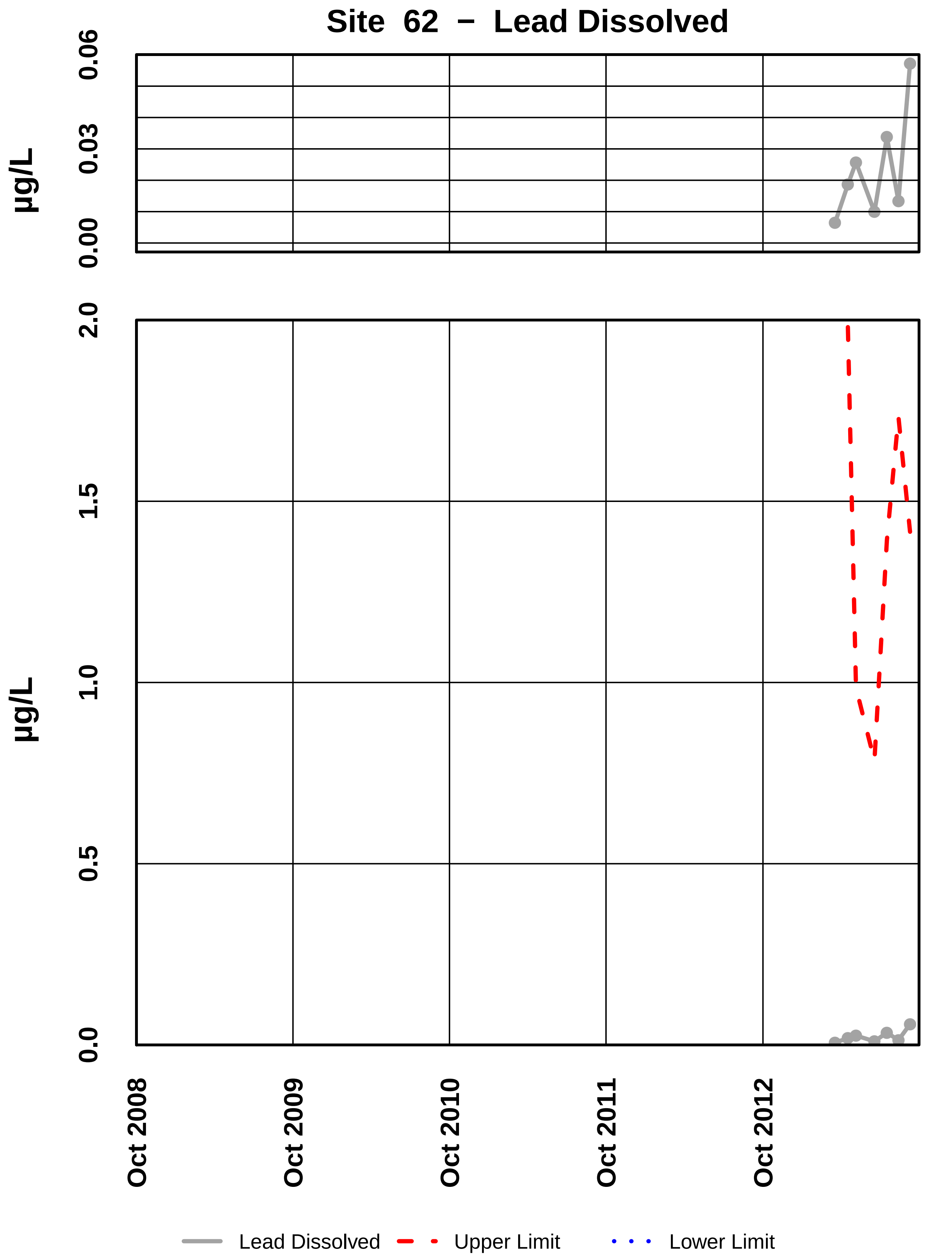


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 62 − Copper Dissolved

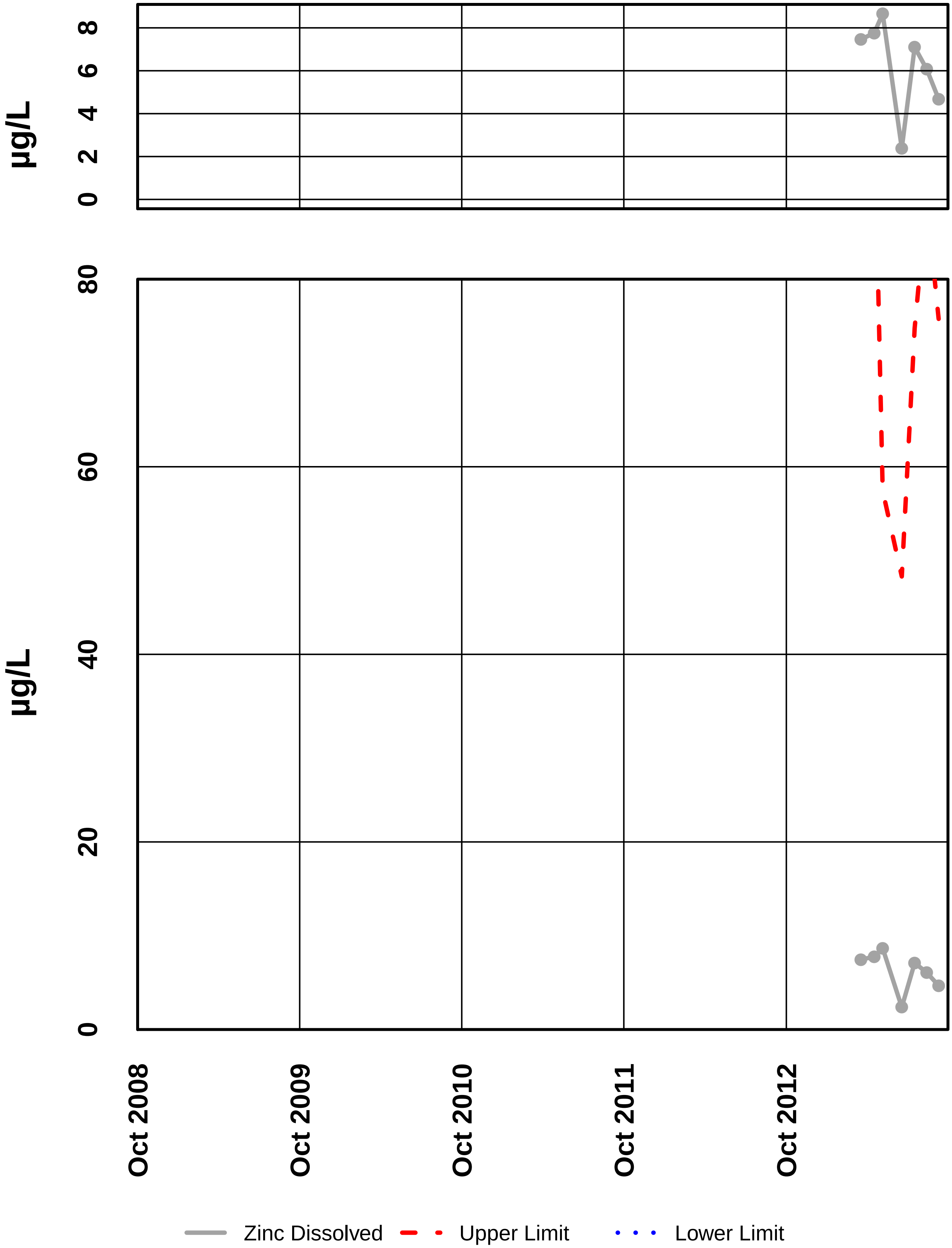


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



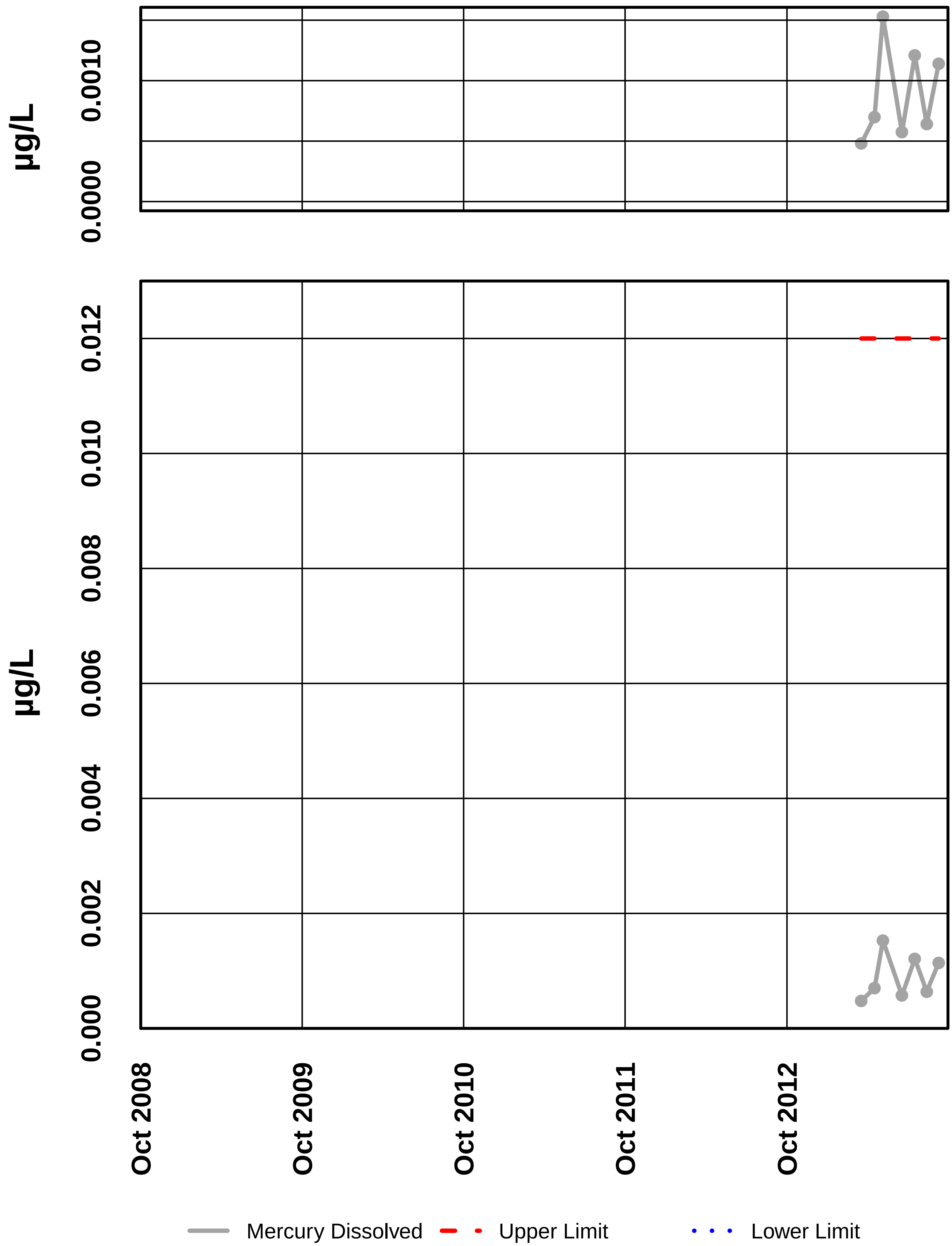
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 62 − Zinc Dissolved



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

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 2013" 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 2013.				

The data for Water Year 2013 have been compared to the strictest fresh water quality criterion for each applicable analyte. Four results exceeding these criteria have been identified as listed in the table below.

Table of Exceedance for Water Year 2013

			Limits		
Sample Date	Parameter	Value	Lower	Upper	Hardness
6-May-13	Cadmium Dissolved	2.79 µg/L		0.52	291 mg/L
6-May-13	Mercury Dissolved	0.2 µg/L		0.012	
6-May-13	Selenium Dissolved	20.5 µg/L		4.60	
6-May-13	Zinc Dissolved	393 µg/L		292	291 mg/L

Though these four exceedances were greatly above the upper limit of the AWQS, the down gradient monitoring point Site 62 had no exceedances. Site 61 has been sampled on a quarterly basis since May 2013, and the other sampling was not in exceedance for these analytes. After a review of this data HGCMC will increase the sampling frequency to monthly, to determine if this is a seasonal trend or an intermittent pulse.

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 2013

Site 061FMS - 'Greens Creek Floodplain'

Sample Date/Parameter	Oct 2012	Nov 2012	Dec 2012	Jan 2013	Feb 2013	Mar 2013	Apr 2013	May 2013	Jun 2013	Jul 2013	Aug 2013	Sep 2013	**Median**
Water Temp (°C)								4.6			6.5		5.6
Conductivity-Field(µmho)								658			353		505.5
Conductivity-Lab (µmho)								640			334		487
pH Lab (standard units)								7.47			7.67		7.57
pH Field (standard units)								7.33			7.76		7.55
Total Alkalinity (mg/L)								109			122		115.5
Total Sulfate (mg/L)								208.7			43.4		126.1
Hardness (mg/L)								291			168		229.5
Dissolved As (ug/L)								0.183			0.239		0.211
Dissolved Ba (ug/L)								58.5					58.5
Dissolved Cd (ug/L)								2.79			0.231		1.5105
Dissolved Cr (ug/L)								0.476					0.476
Dissolved Cu (ug/L)								3.21			0.17		1.690
Dissolved Pb (ug/L)								1.46			0.0217		0.7409
Dissolved Ni (ug/L)								9.4					9.400
Dissolved Ag (ug/L)								9.03					9.030
Dissolved Zn (ug/L)								393			45.9		219.45
Dissolved Se (ug/L)								20.5					20.500
Dissolved Hg (ug/L)								0.2			0.000231		0.100116

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

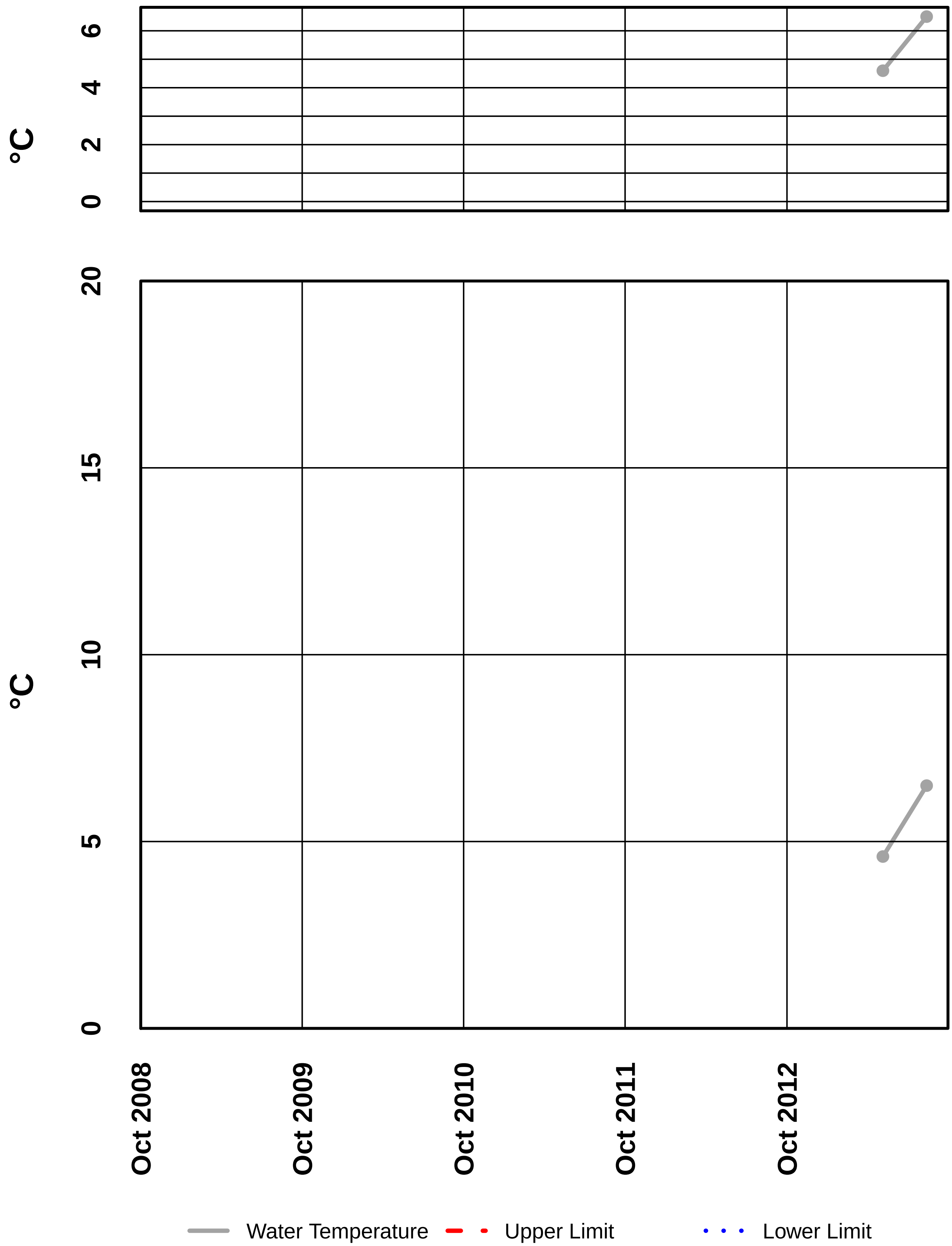
Qualified Data by QA Reviewer

Date Range: 10/01/2012 to 09/30/2013

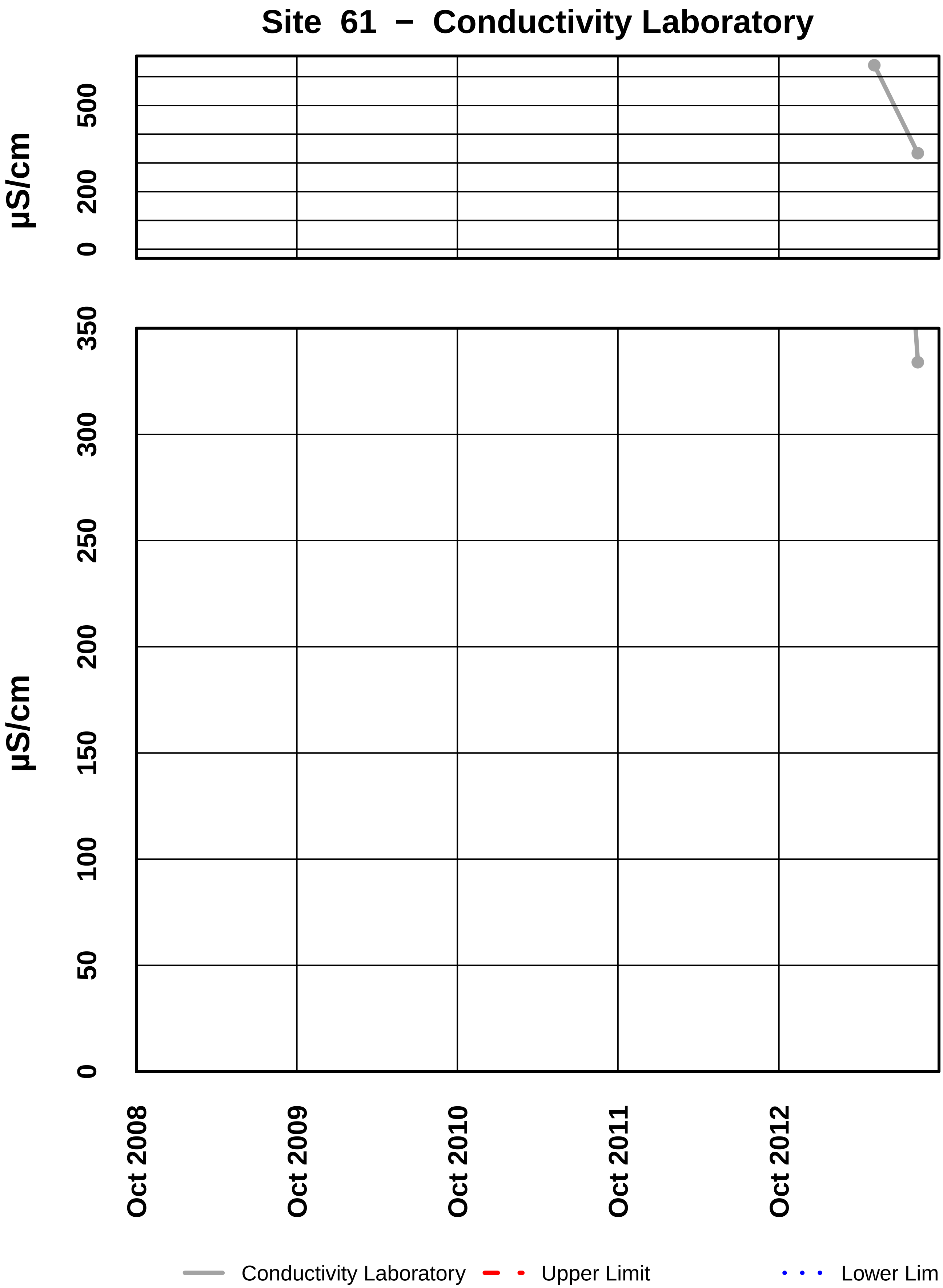
Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
61	5/6/2013	12:00 AM	pH Lab, su	7.47	J	Hold Time Violation
61	8/13/2013	12:00 AM	Cond, µmhos	334	J	Sample receipt temperature
			Alk, mg/L	122	J	Sample receipt temperature
			SO4 Tot, mg/l	43.4	J	Sample receipt temperature
			Pb diss, µg/l	0.02	U	Field Blank Contamination
			Hg diss, µg/l	0.000231	U	Field Blank Contamination

Qualifier	Description
J	Positively Identified - Approximate concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit

Site 61 – Water Temperature

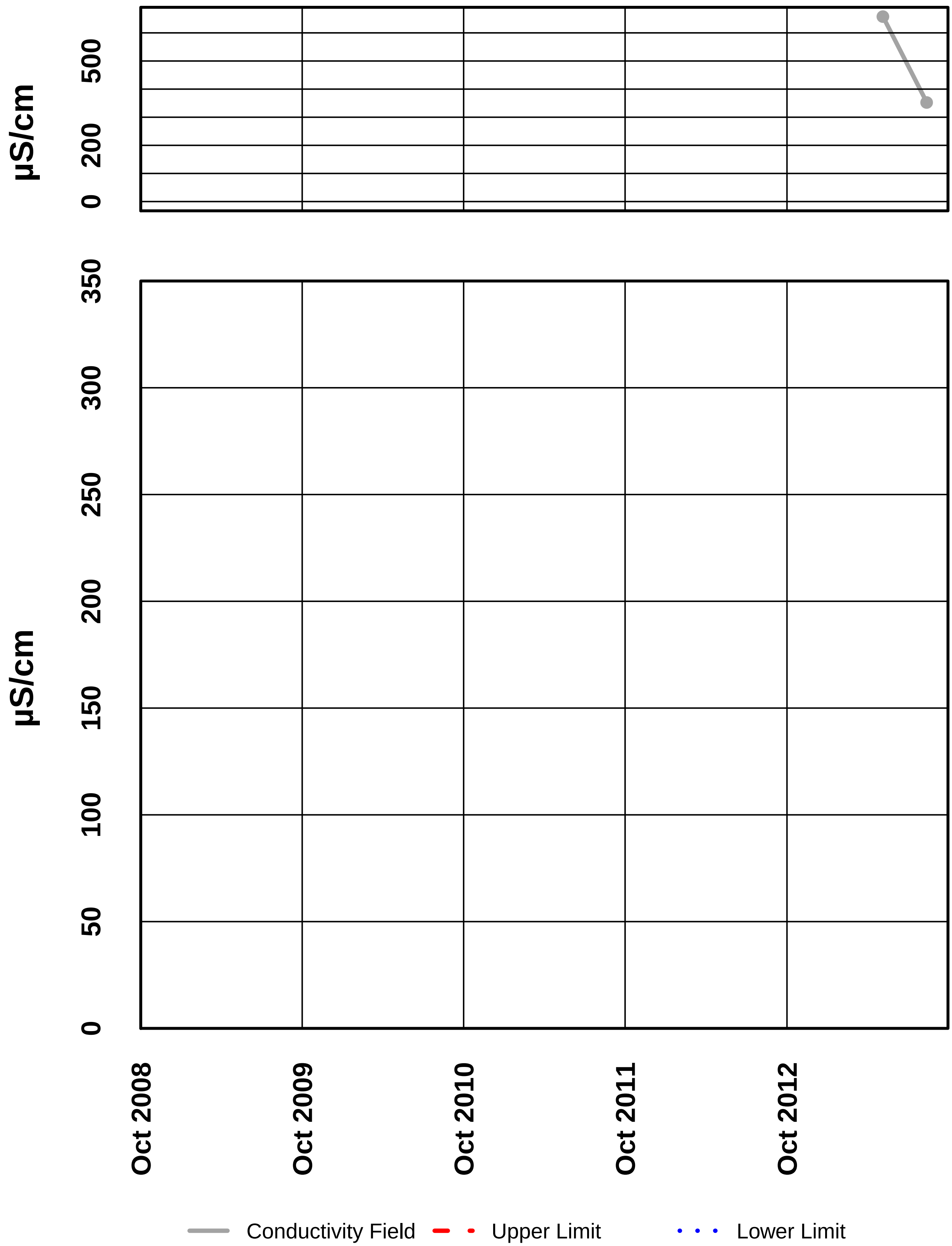


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



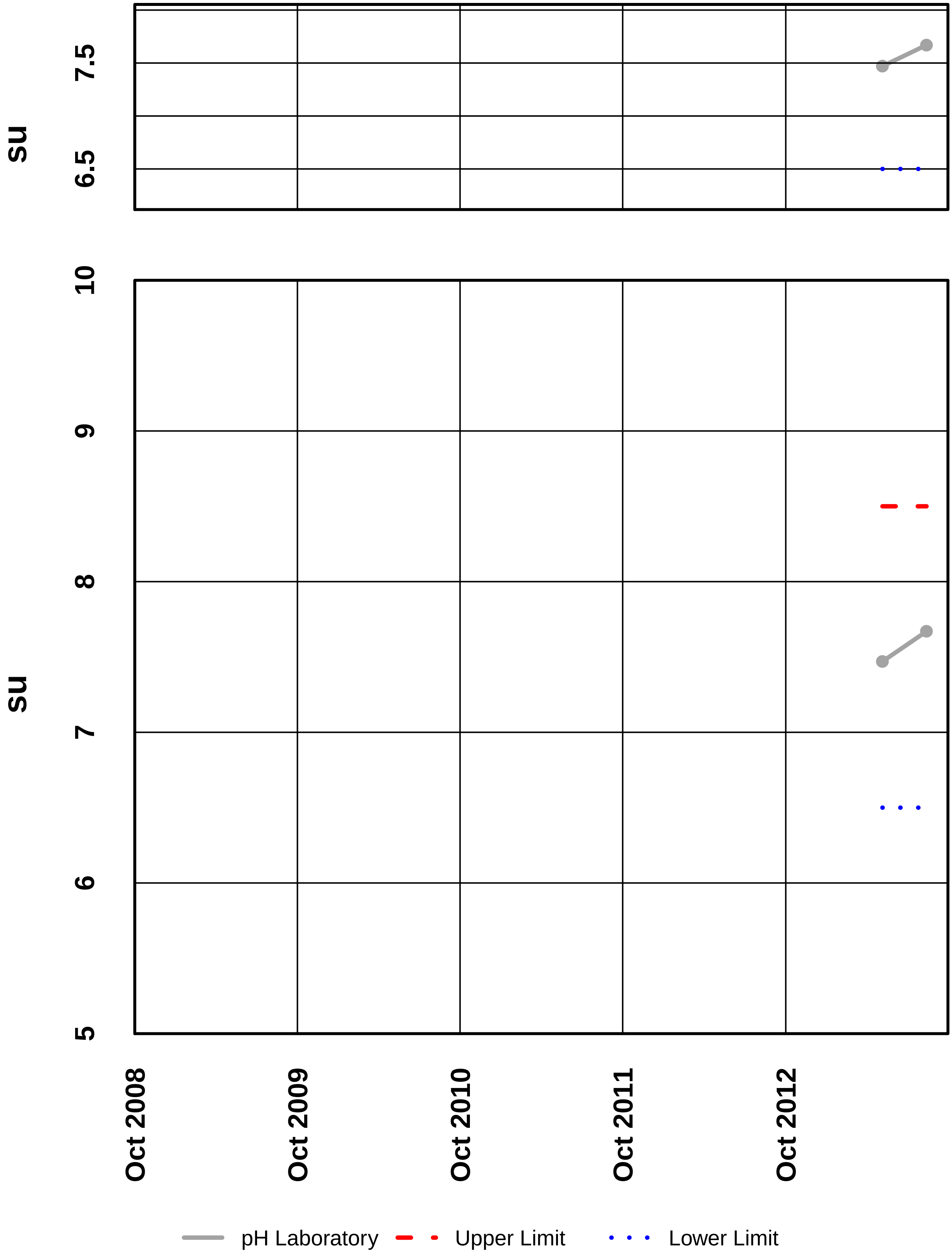
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 61 – Conductivity Field



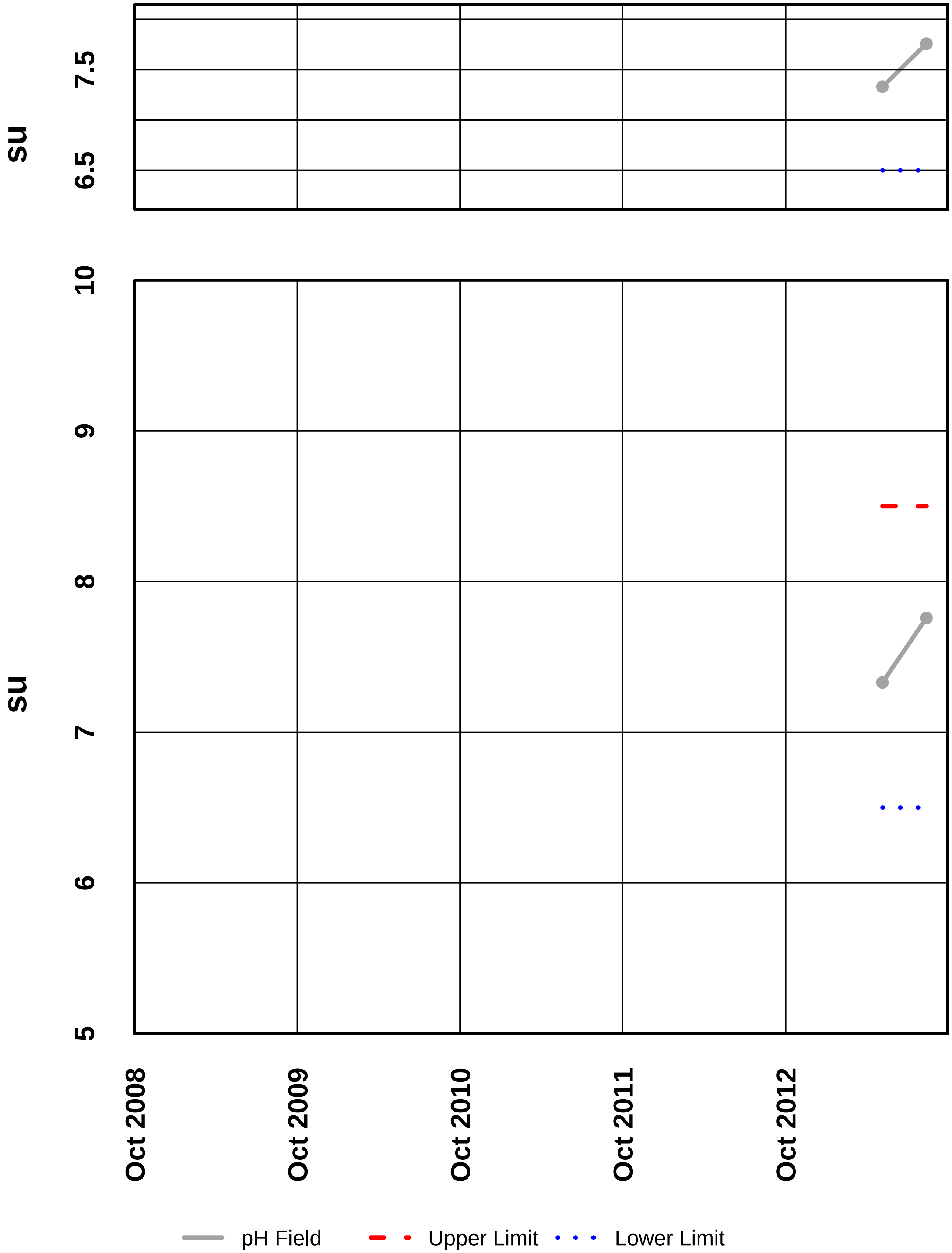
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 61 – pH Laboratory



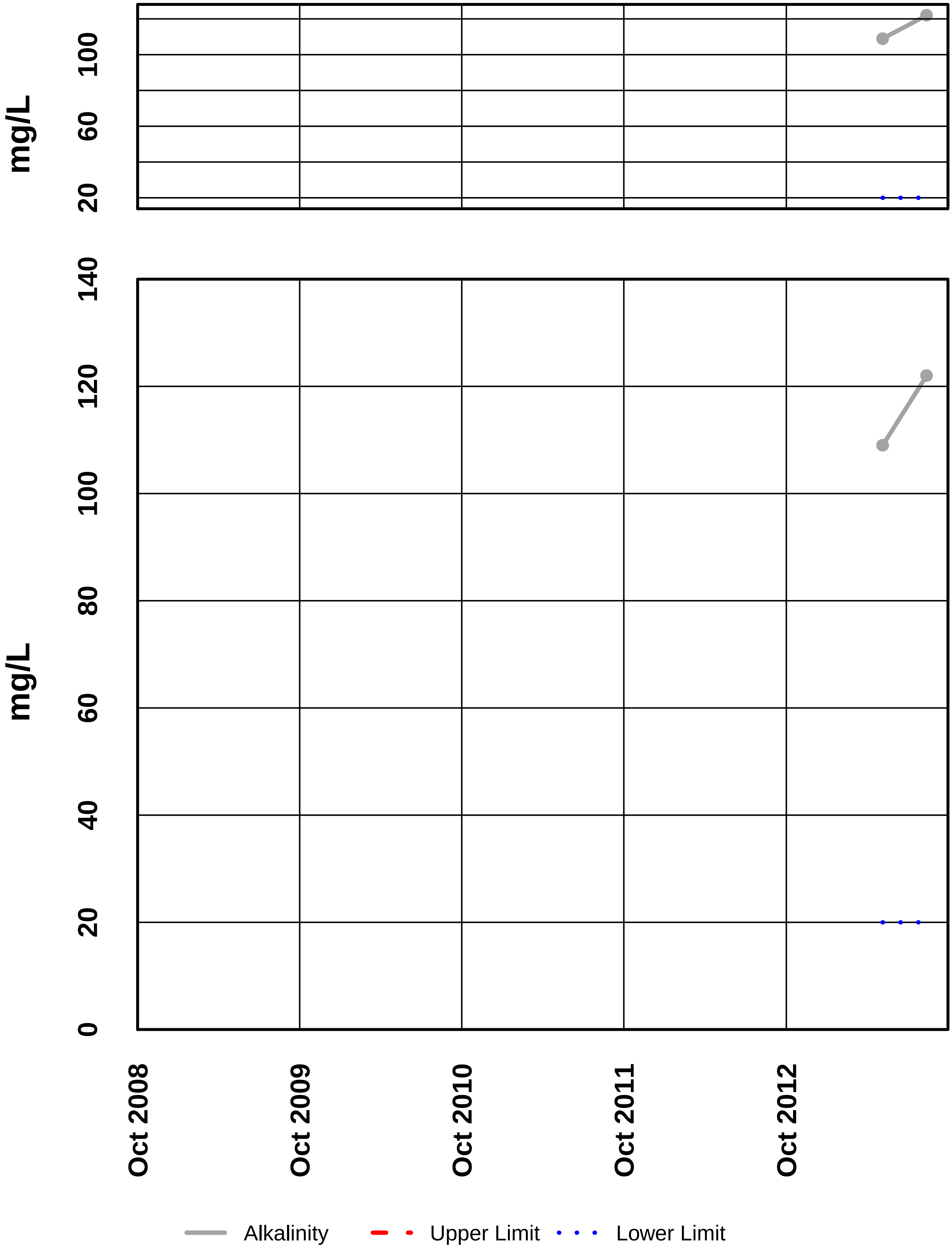
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 61 – pH Field

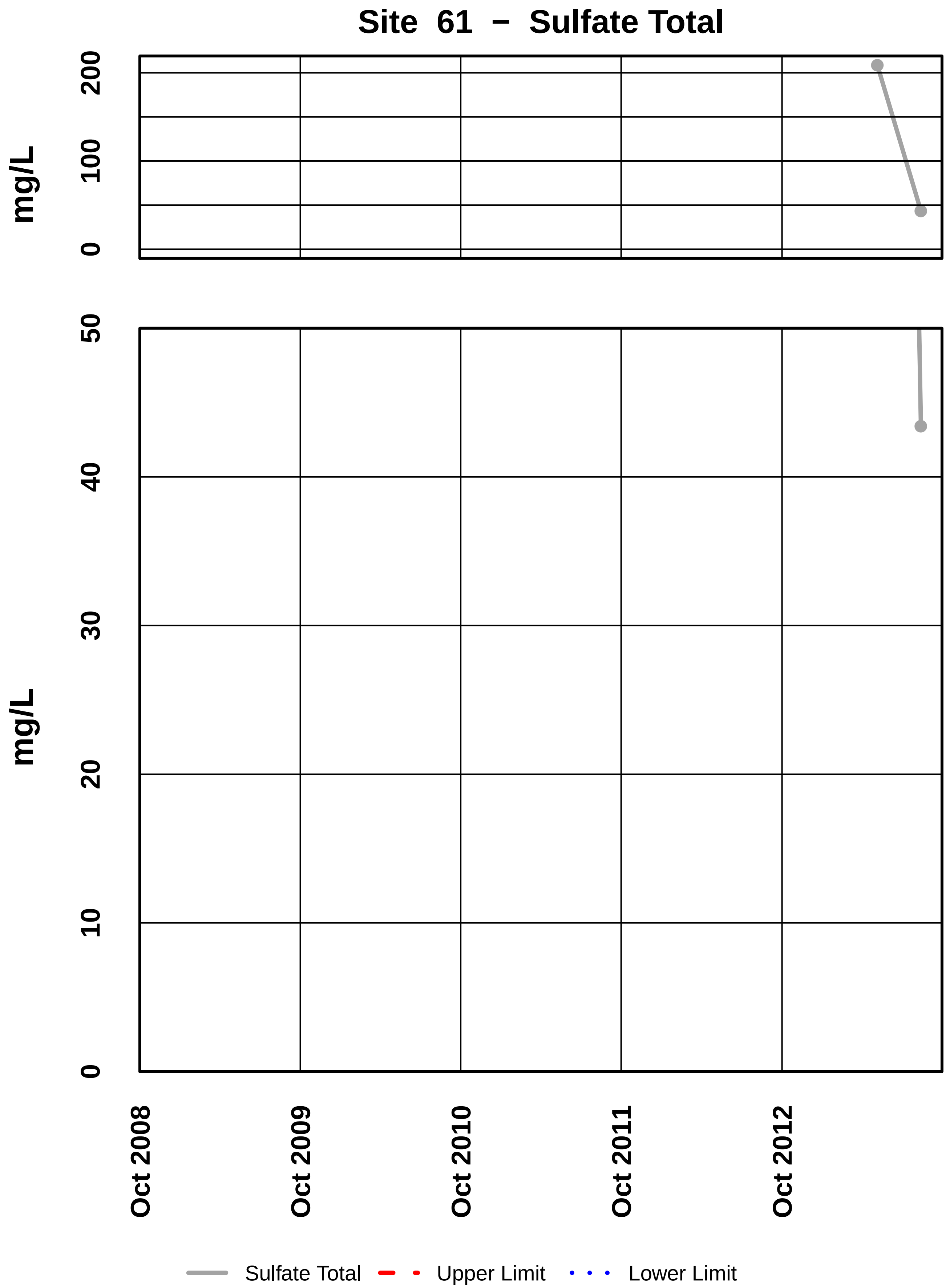


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 61 − Alkalinity

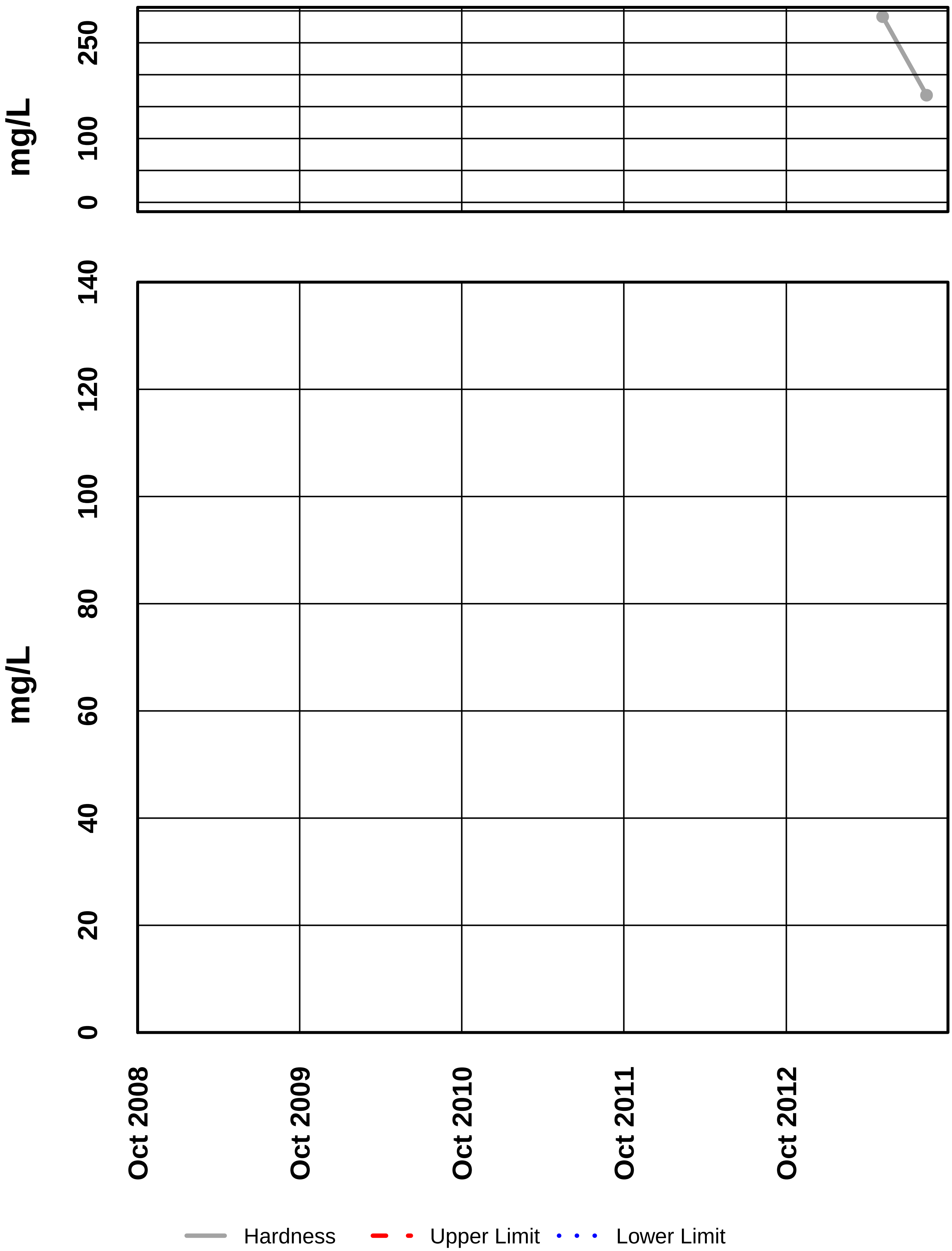


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



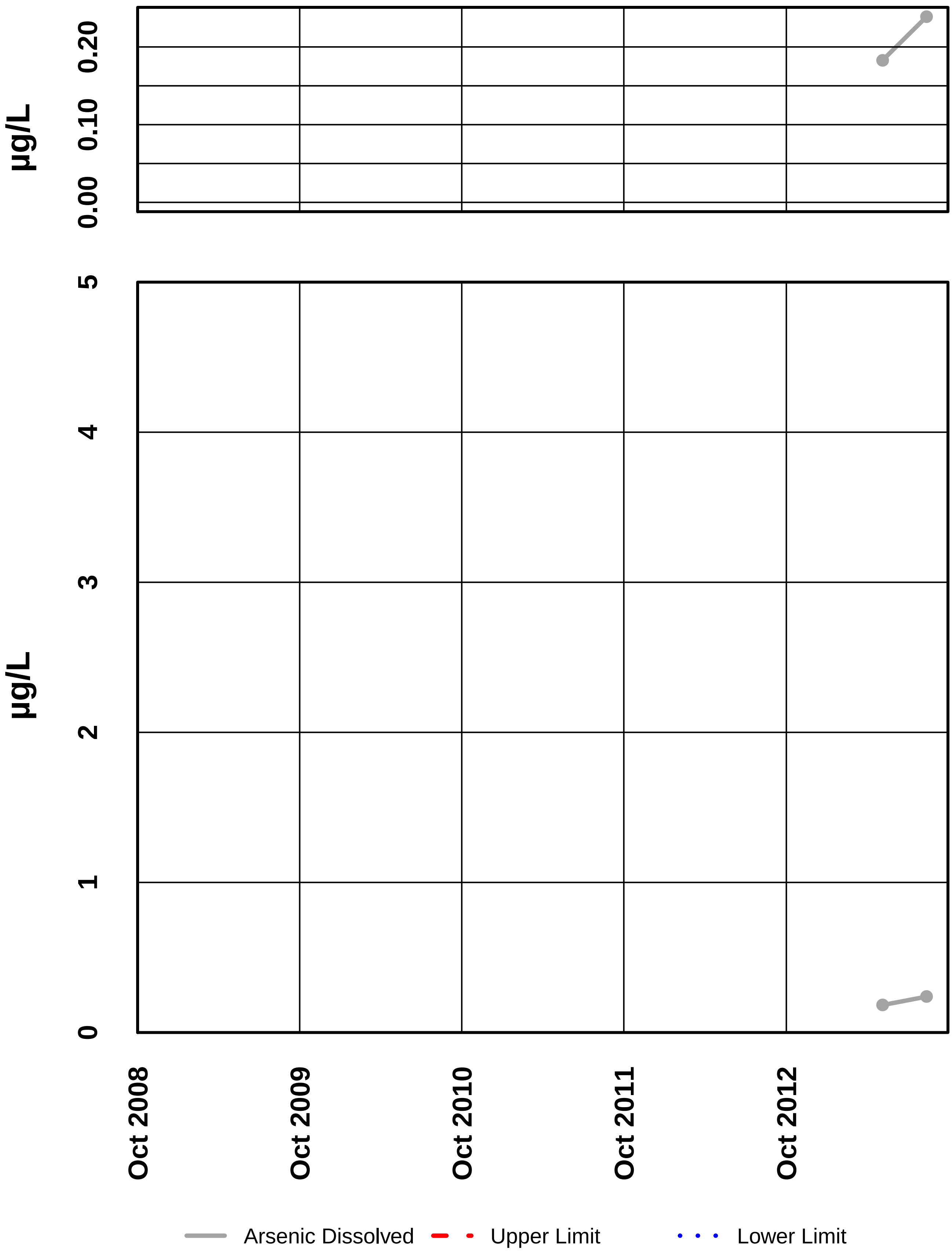
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 61 – Hardness

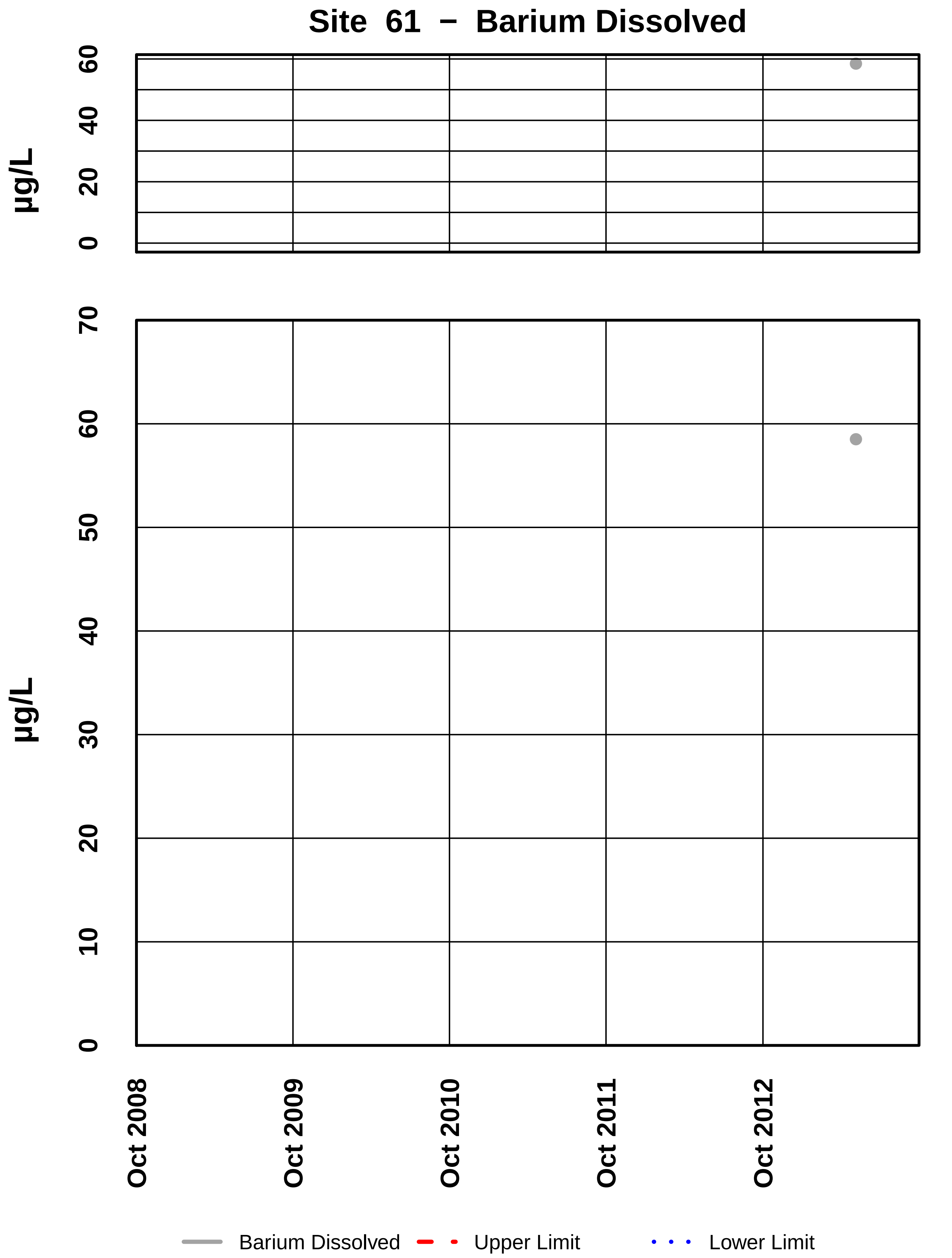


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 61 – Arsenic Dissolved

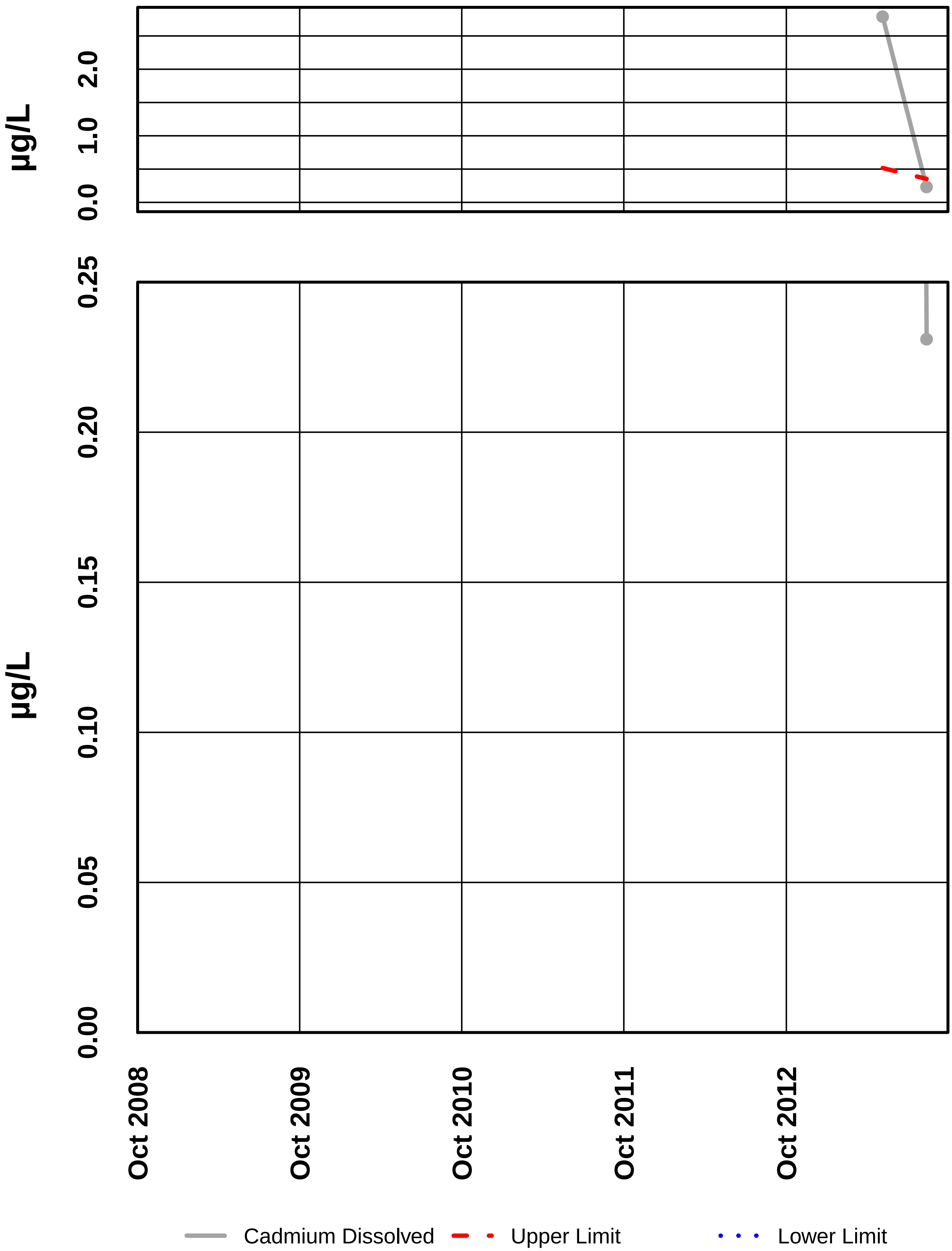


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

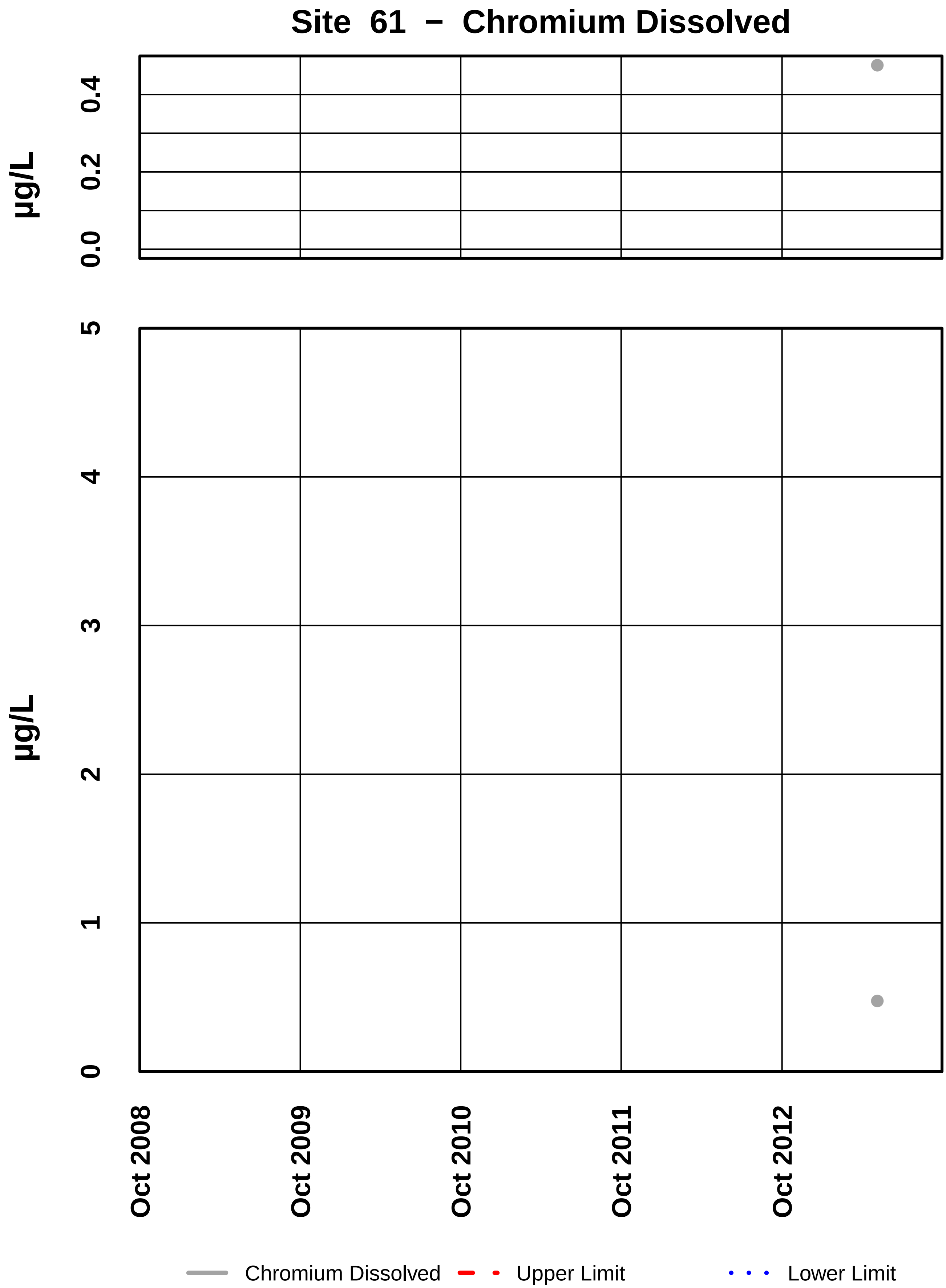


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 61 – Cadmium Dissolved

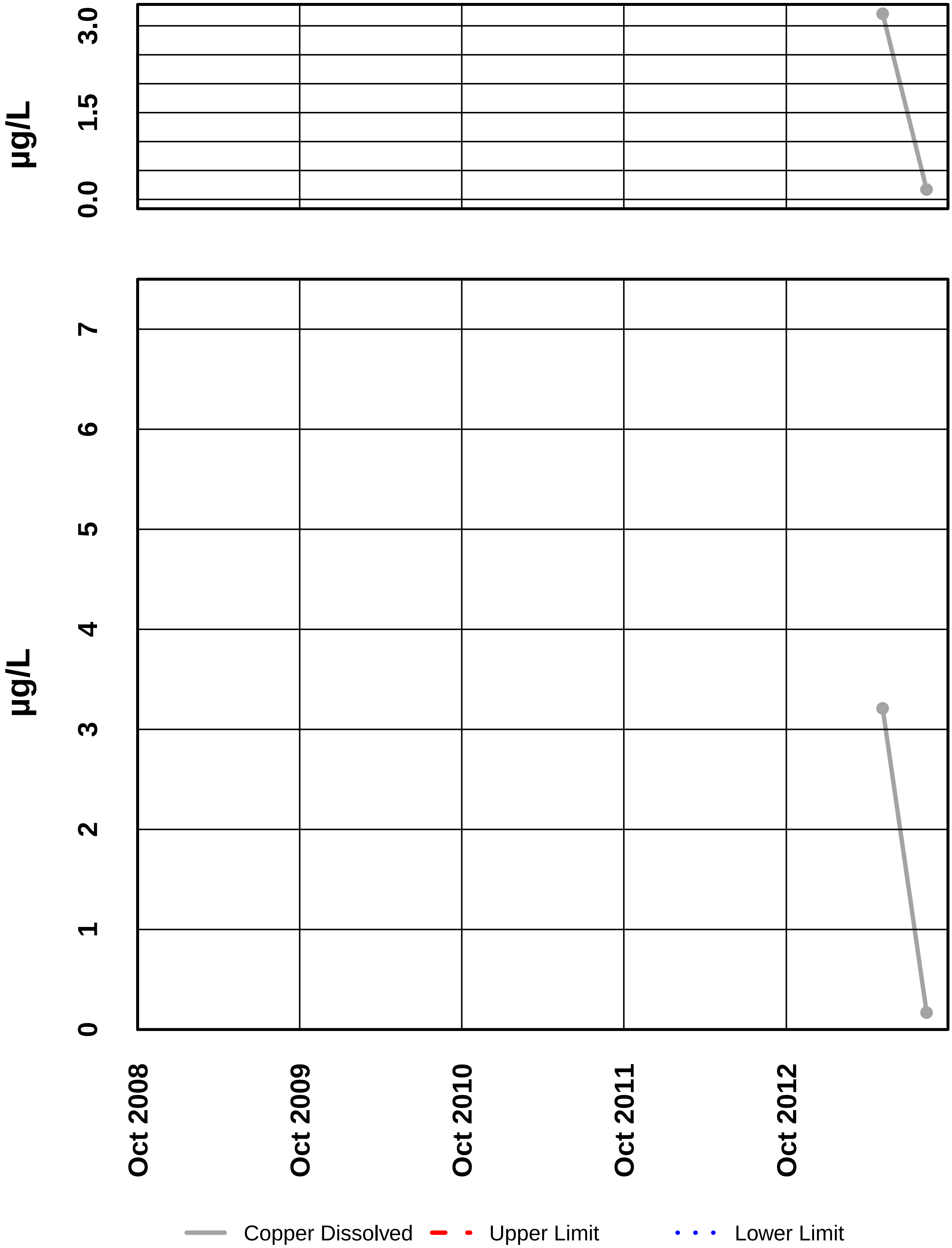


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



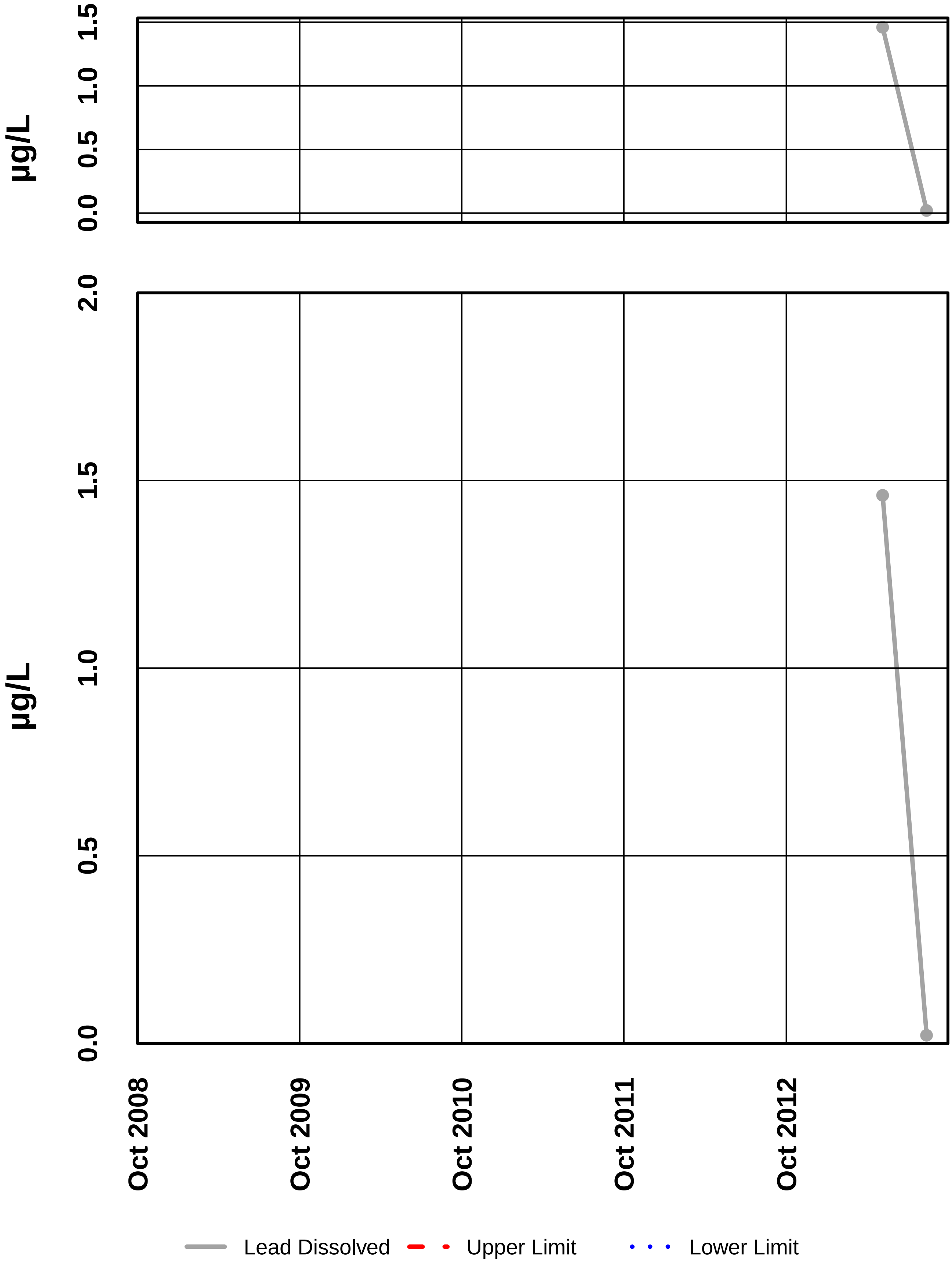
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 61 – Copper Dissolved



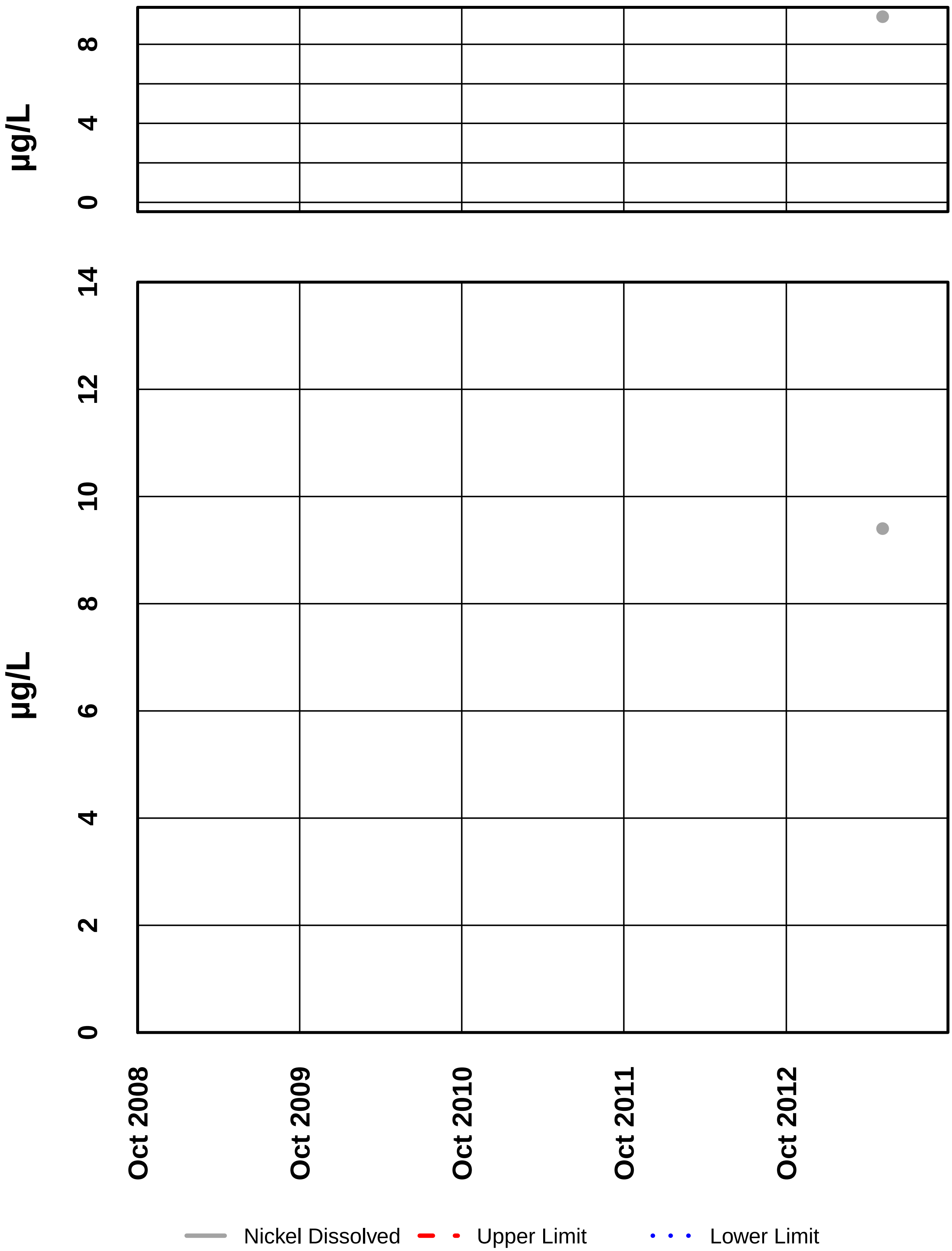
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 61 – Lead Dissolved



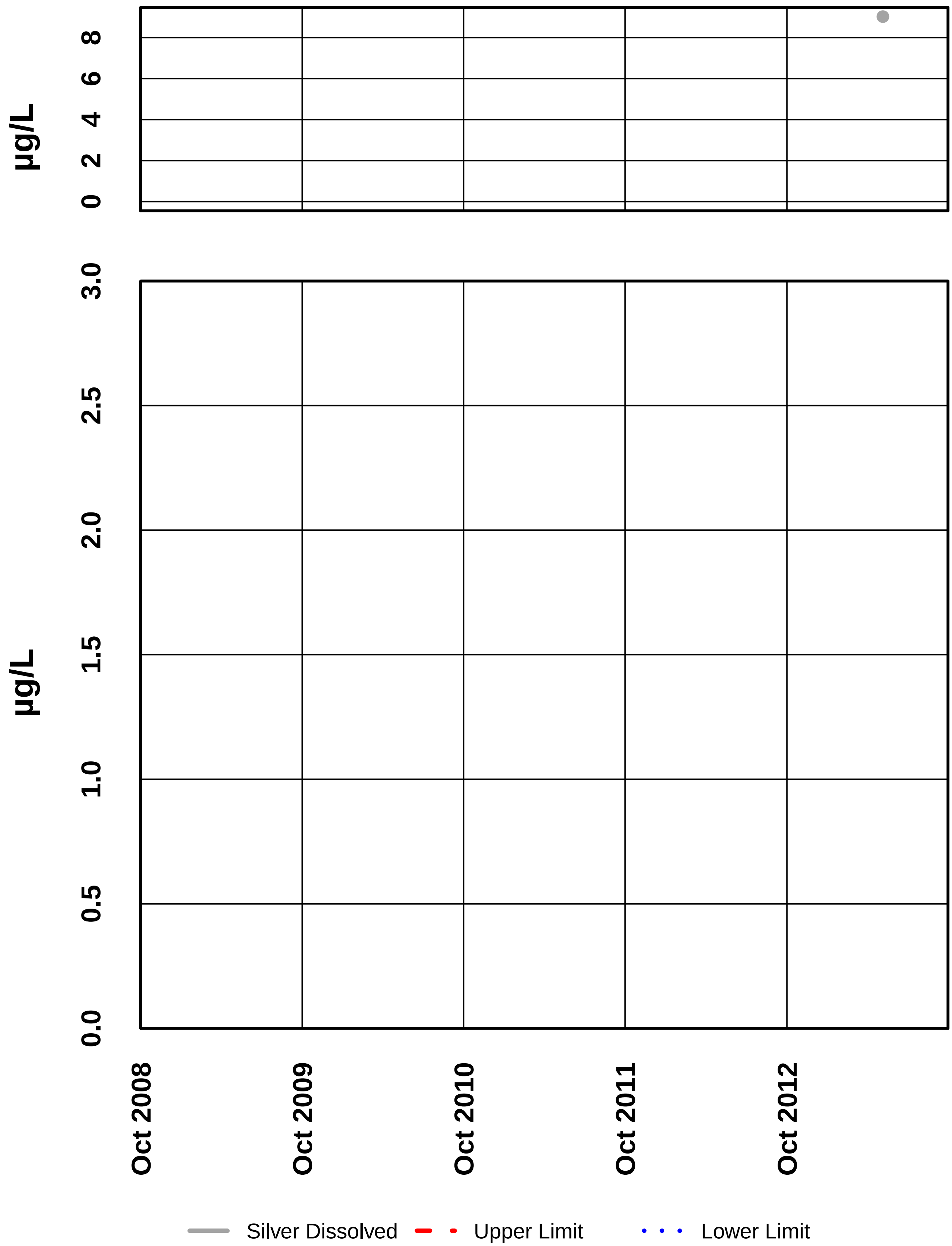
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 61 – Nickel Dissolved



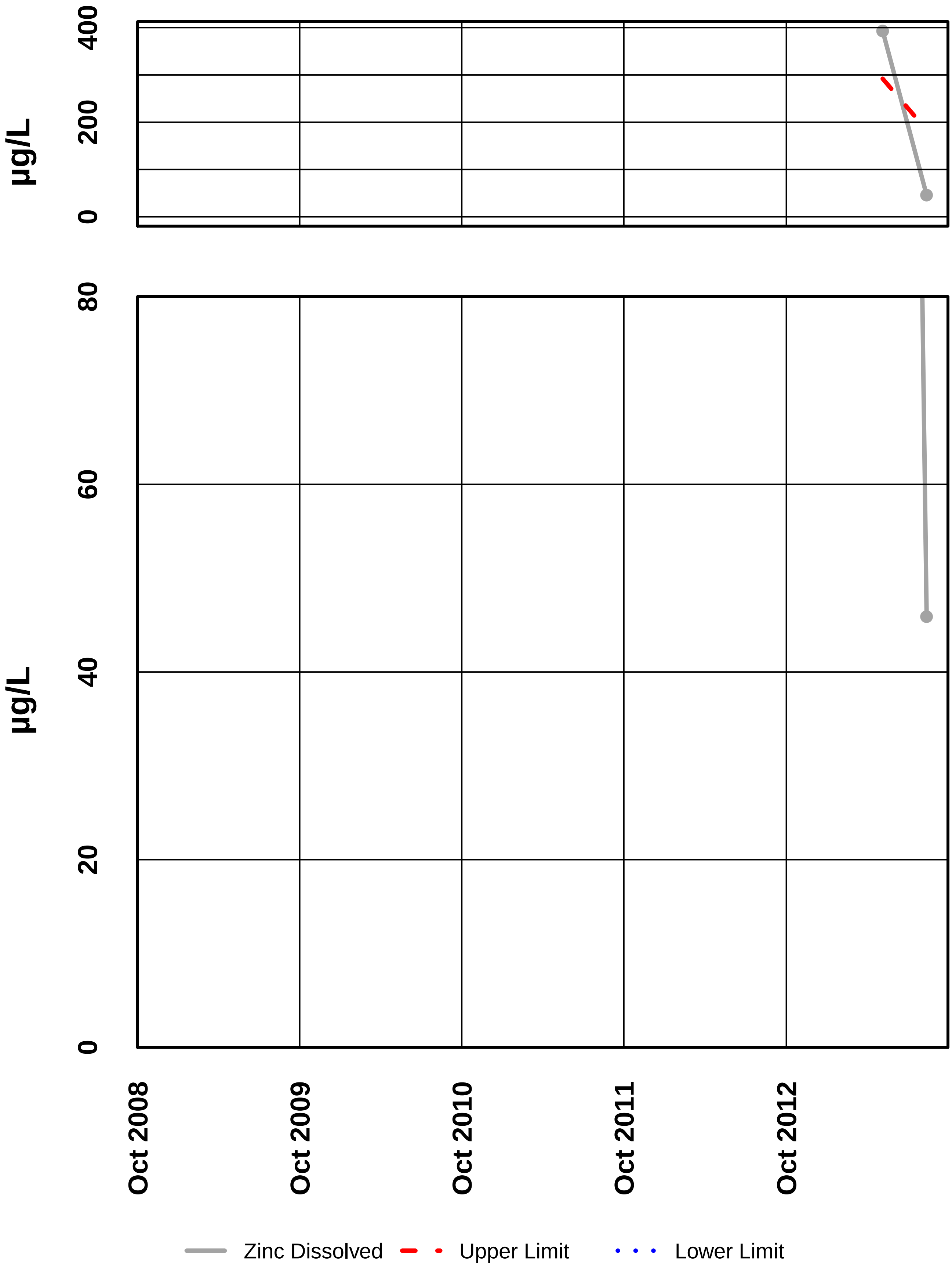
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 61 – Silver Dissolved



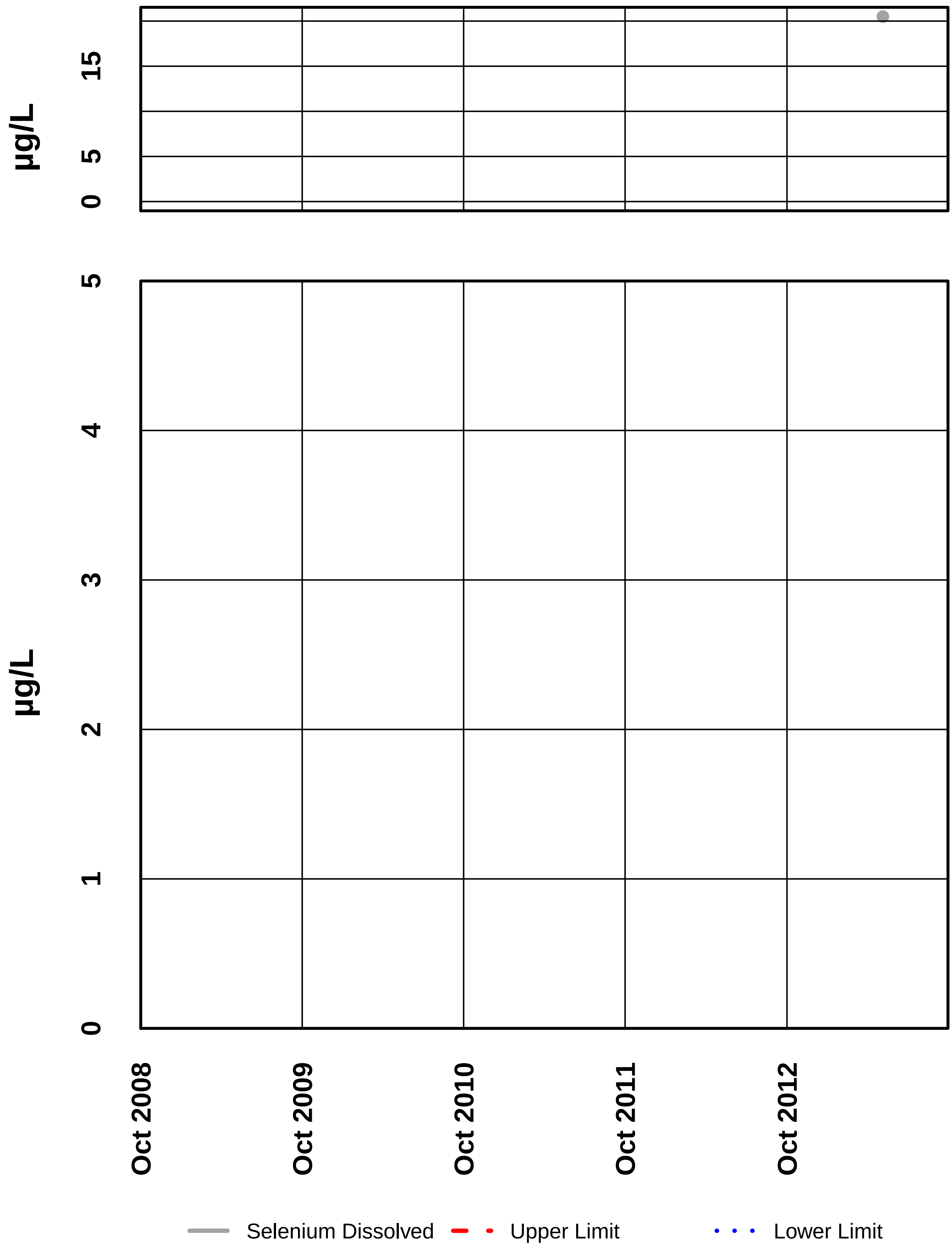
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 61 – Zinc Dissolved

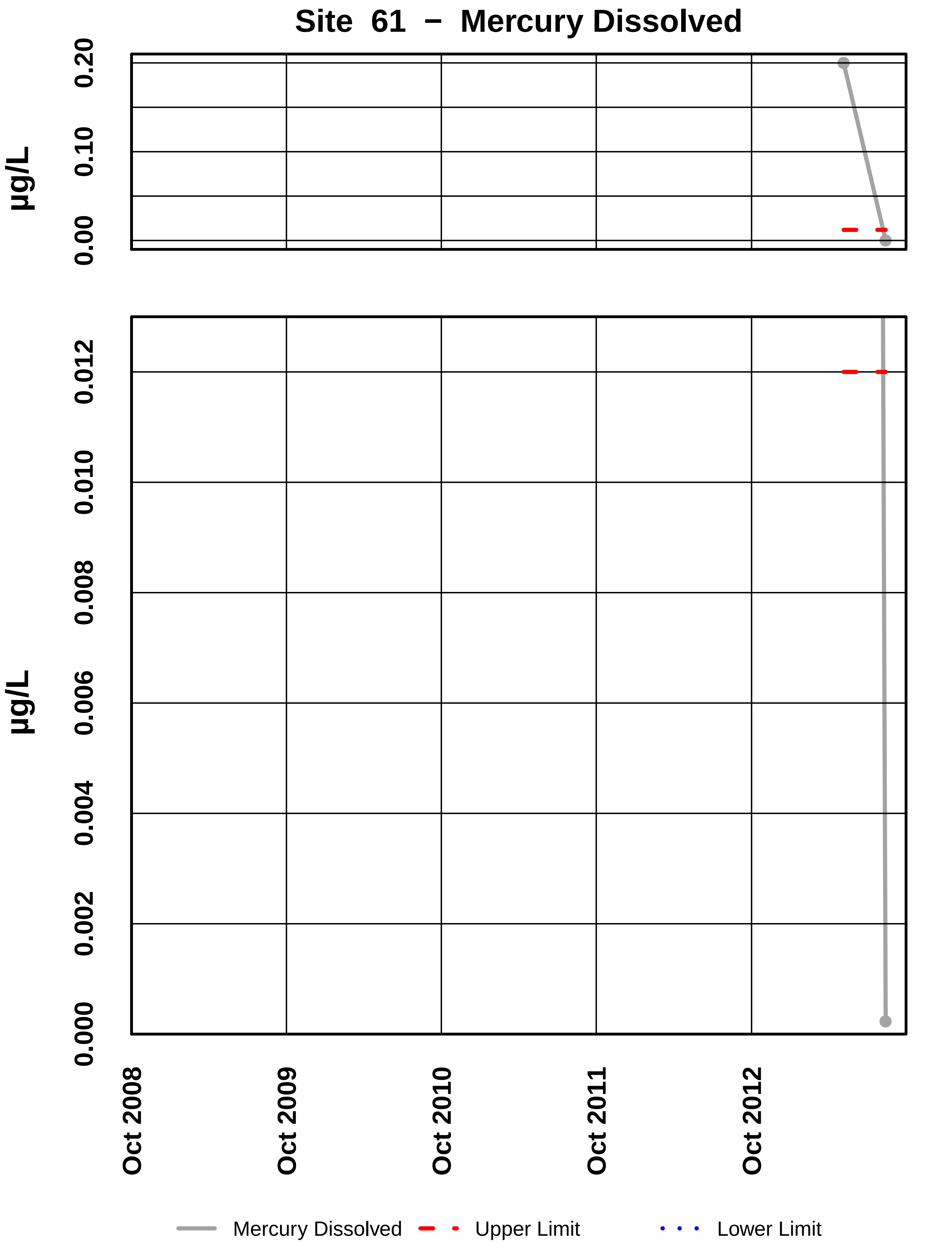


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 61 − 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 49

The data collected during the current water year are listed in the following "Table of Results for Water Year 2013" 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 2007 through September 2013.				

The data for Water Year 2013 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 2013

			Limits		
Sample Date	Parameter	Value	Lower	Upper	Hardness
No exceedances have been identified by HGCMC for the period of October 2012 through September 2013.					

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-07 and Sep-13(WY2008-WY2013). For datasets with a statistically significant trend ($\alpha/2=2.5\%$) a Seasonal-Sen's Slope estimate statistic has also been calculated. There were no statistically significant trends detected during the current water year.

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	0.08			
Alkalinity, Total	6	0.03			
Sulfate, Total	6	0.27			
Zinc, Dissolved	6	0.43			

* 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**

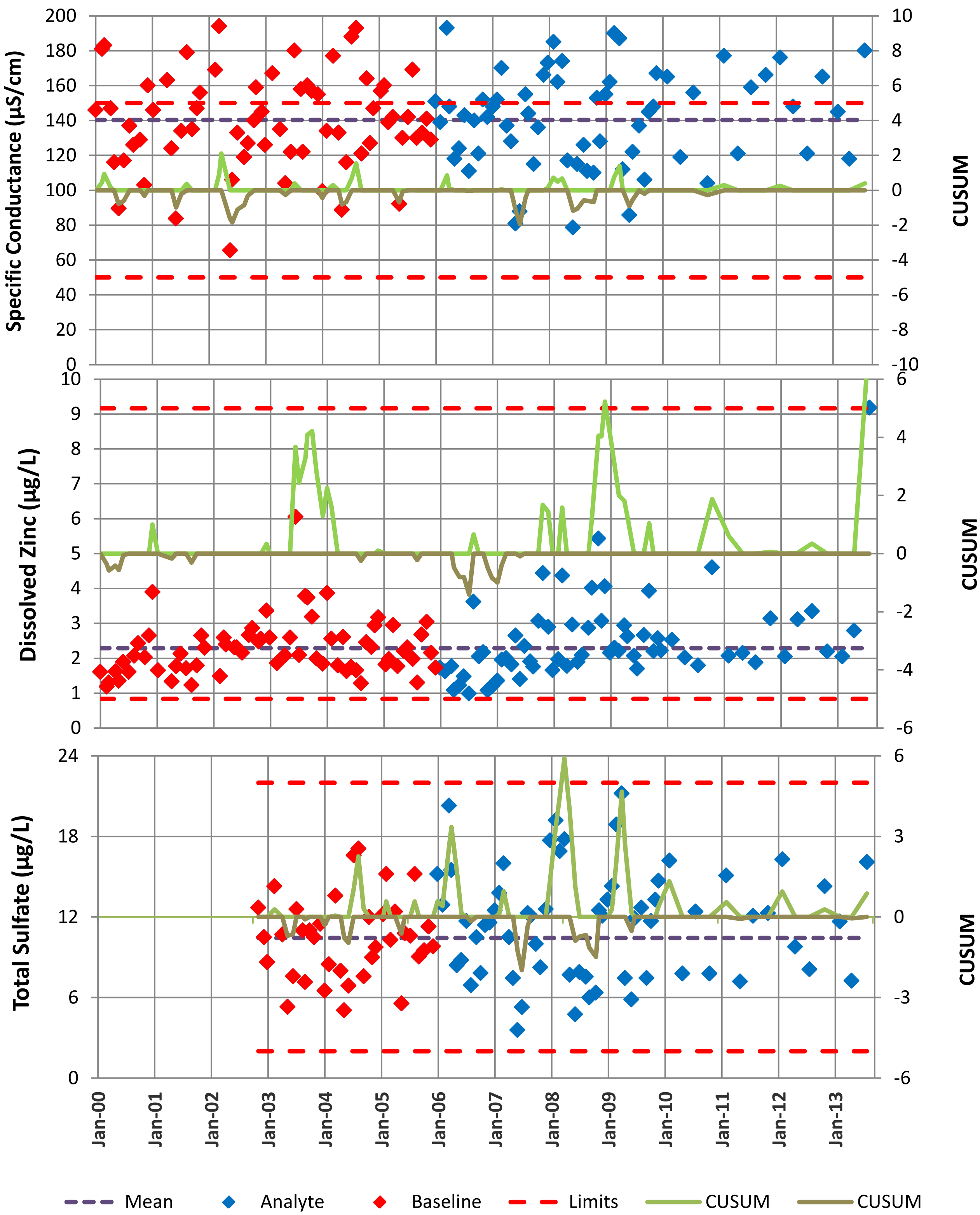


Table of Results for Water Year 2013

Site 049FMS - 'Upper Bruin Creek'

Sample Date/Parameter	Oct 2012	Nov 2012	Dec 2012	Jan 2013	Feb 2013	Mar 2013	Apr 2013	May 2013	Jun 2013	Jul 2013	Aug 2013	Sep 2013	**Median**
Water Temp (°C)		0.9			1.1			2.1			11.7		1.6
Conductivity-Field(μmho)		168			170			120			188		169.0
Conductivity-Lab (μmho)		165			145			118			180		155
pH Lab (standard units)		7.92			7.75			7.86			7.93		7.89
pH Field (standard units)		7.99			7.88			7.93			8.1		7.96
Total Alkalinity (mg/L)		74.9			64.8			48			73.5		69.2
Total Sulfate (mg/L)		14.3			11.7			7.3			16.1		13.0
Hardness (mg/L)		78.8			77.9			52			86.1		78.4
Dissolved As (ug/L)		0.179			0.156			0.148			0.222		0.168
Dissolved Ba (ug/L)		12			10.8								11.4
Dissolved Cd (ug/L)		0.0323			0.0265			0.0224			0.0315		0.0290
Dissolved Cr (ug/L)		0.272			0.579								0.426
Dissolved Cu (ug/L)		0.437			0.451			0.504			0.565		0.478
Dissolved Pb (ug/L)		0.0201			0.0015			0.0088			0.0088		0.0088
Dissolved Ni (ug/L)		1.19			1.15								1.170
Dissolved Ag (ug/L)		0.002			0.002								0.002
Dissolved Zn (ug/L)		2.19			2.05			2.79			9.18		2.49
Dissolved Se (ug/L)		1.4			0.663								1.032
Dissolved Hg (ug/L)		0.00123			0.00146			0.00205			0.00105		0.001345

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

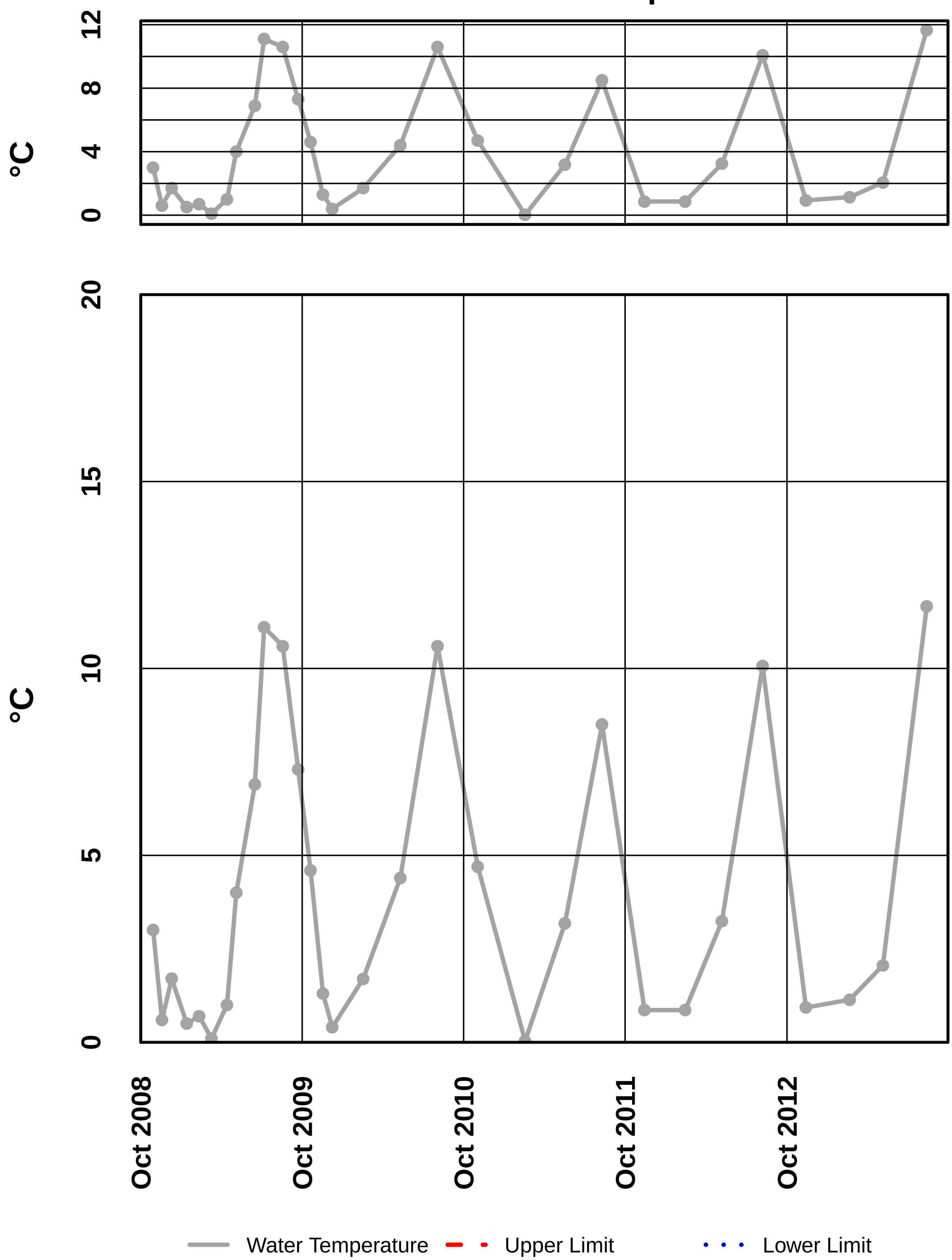
Qualified Data by QA Reviewer

Date Range: 10/01/2012 to 09/30/2013

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
49	11/13/2012	12:00 AM	pH Lab, su	7.92	J	Hold Time Violation
			Zn diss, µg/l	2.19	U	Field Blank Contamination
49	5/6/2013	12:00 AM	Pb diss, µg/l	0.00884	J	Below Quantitative Range
			pH Lab, su	7.86	J	Hold Time Violation
49	8/13/2013	12:00 AM	Cond, µmhos	180	J	Sample receipt temperature
			Alk, mg/L	73.5	J	Sample receipt temperature
			SO4 Tot, mg/l	16.1	J	Sample receipt temperature
			Pb diss, µg/l	0.00882	U	Field Blank Contamination

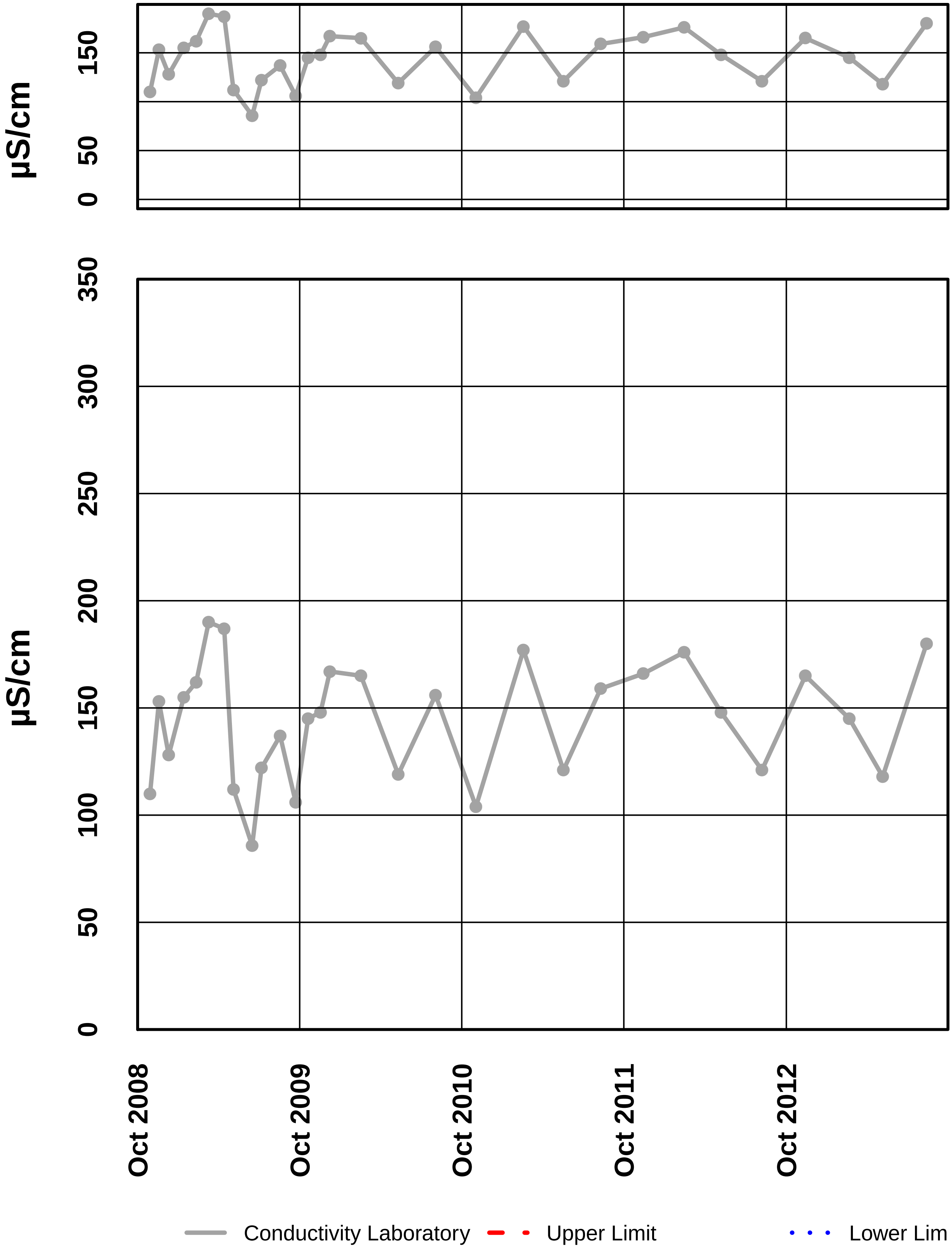
Qualifier	Description
J	Positively Identified - Approximate concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit

Site 49 – Water Temperature



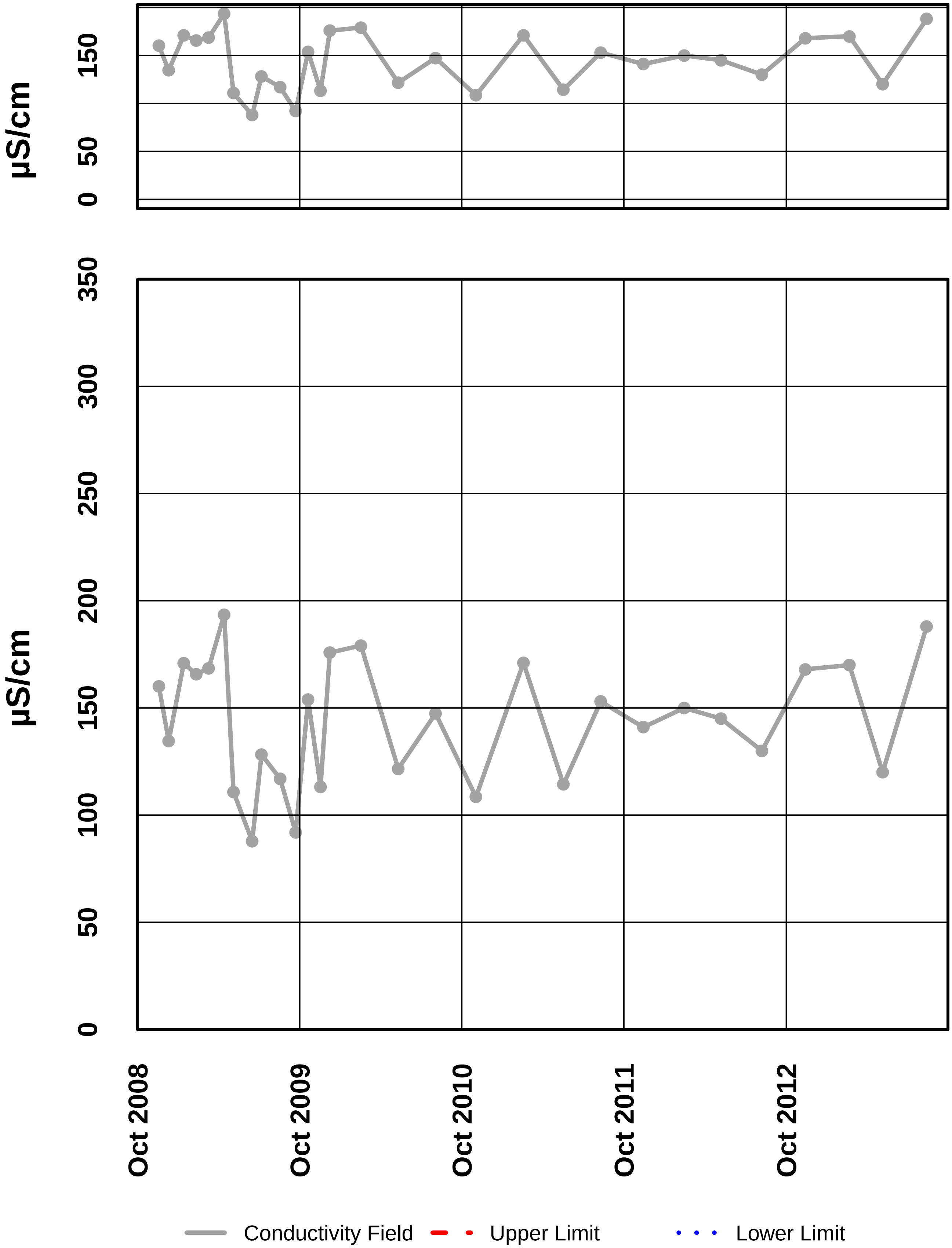
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 49 – Conductivity Laboratory



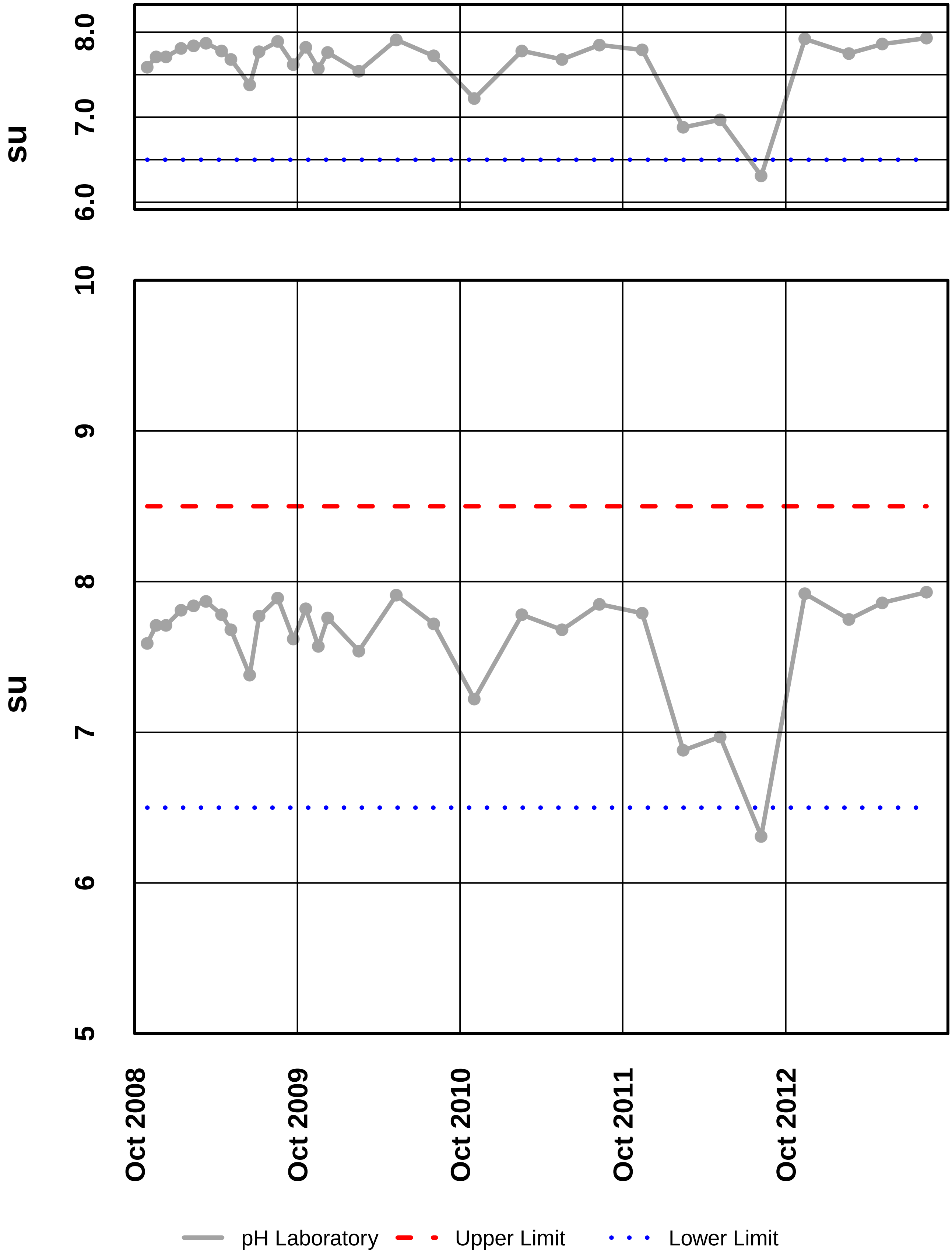
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 49 – Conductivity Field

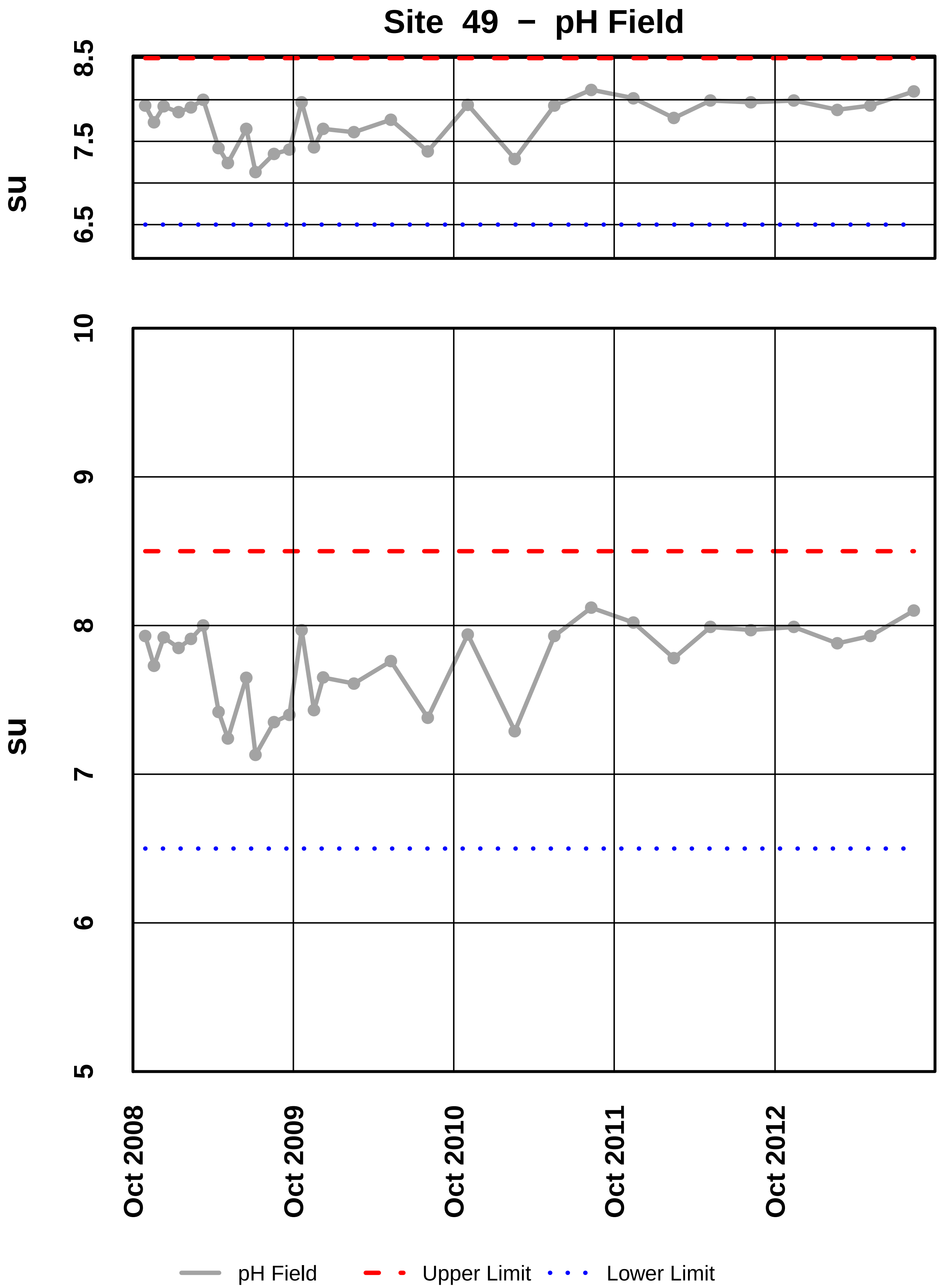


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 49 – pH Laboratory

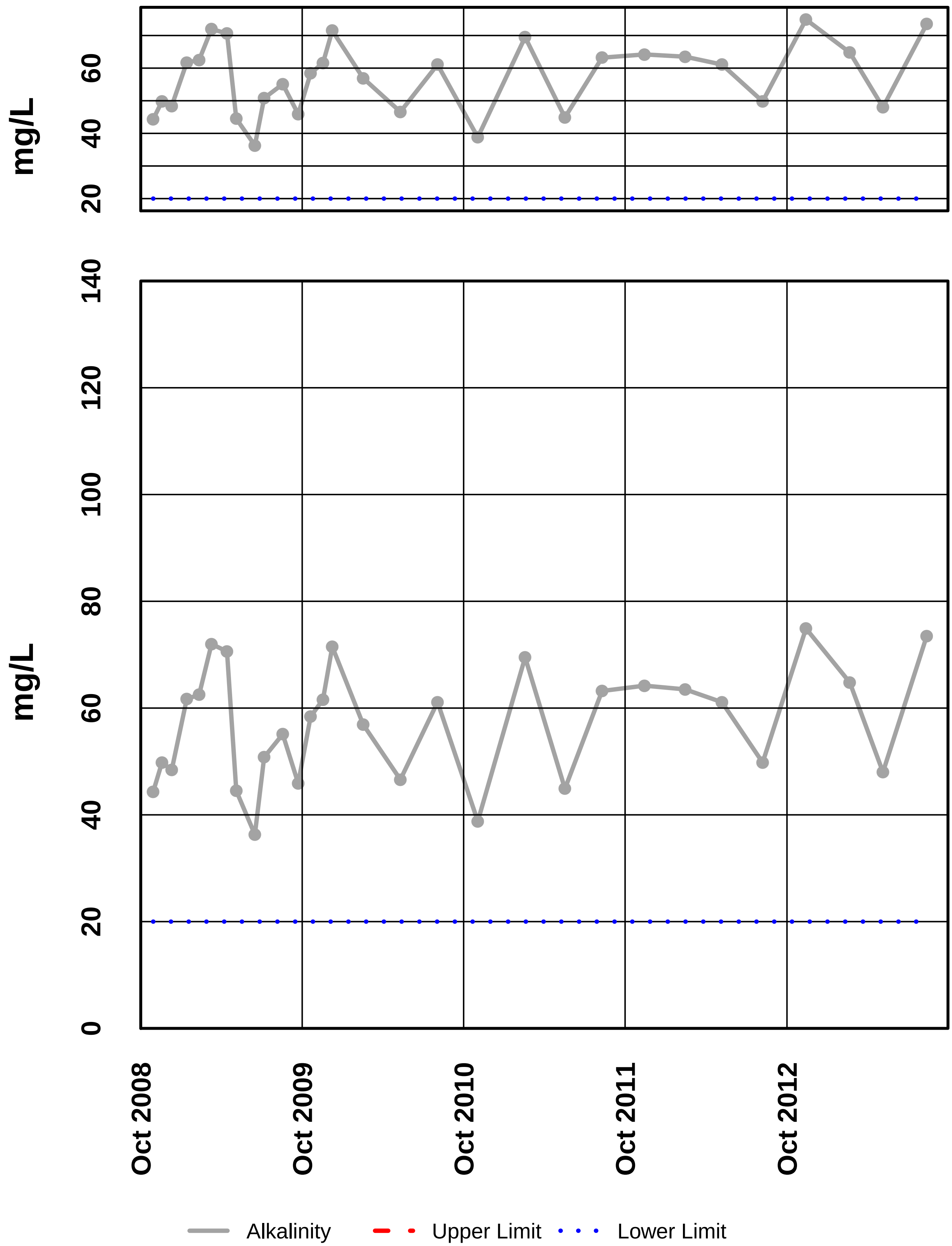


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



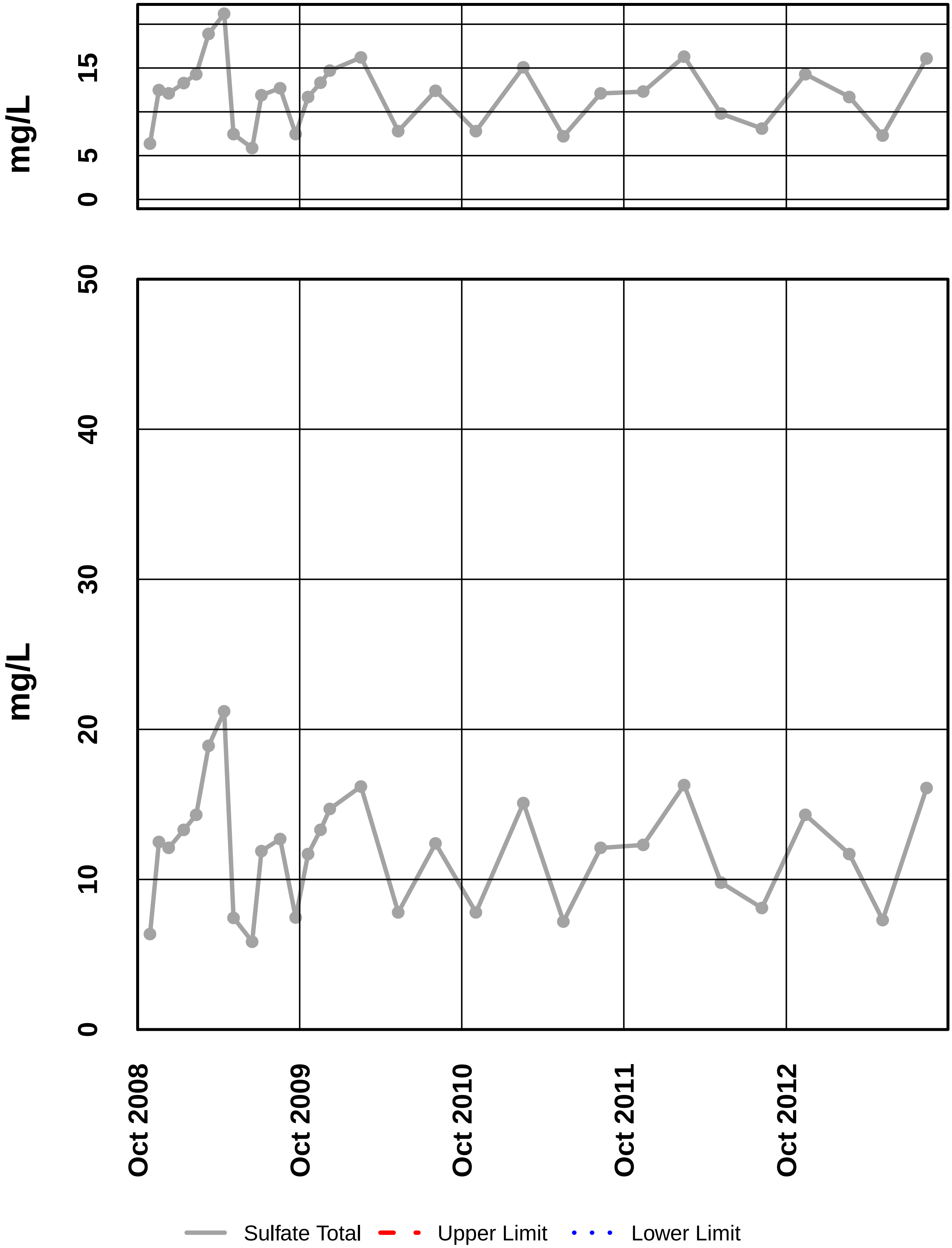
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 49 – Alkalinity

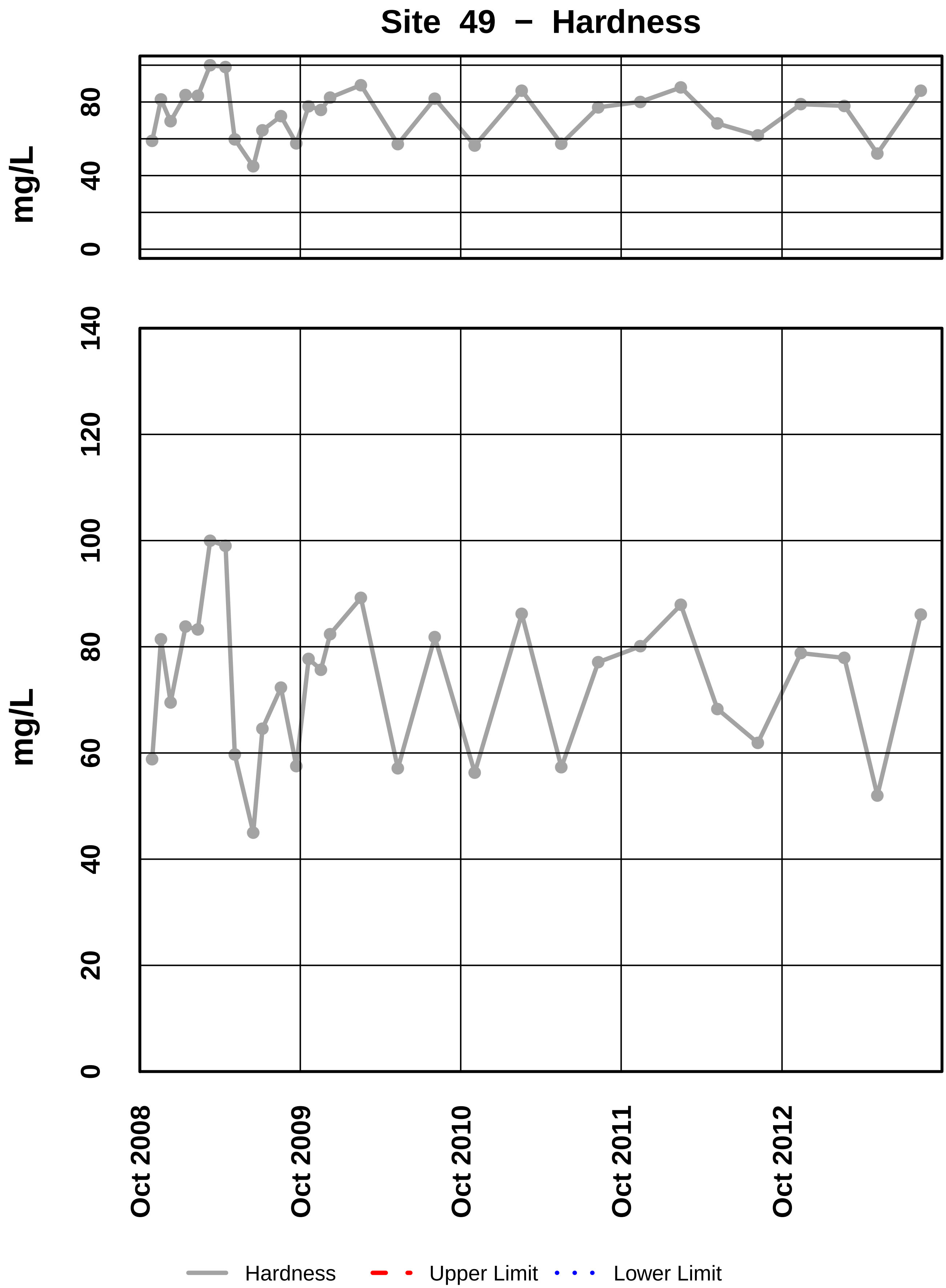


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 49 – Sulfate Total

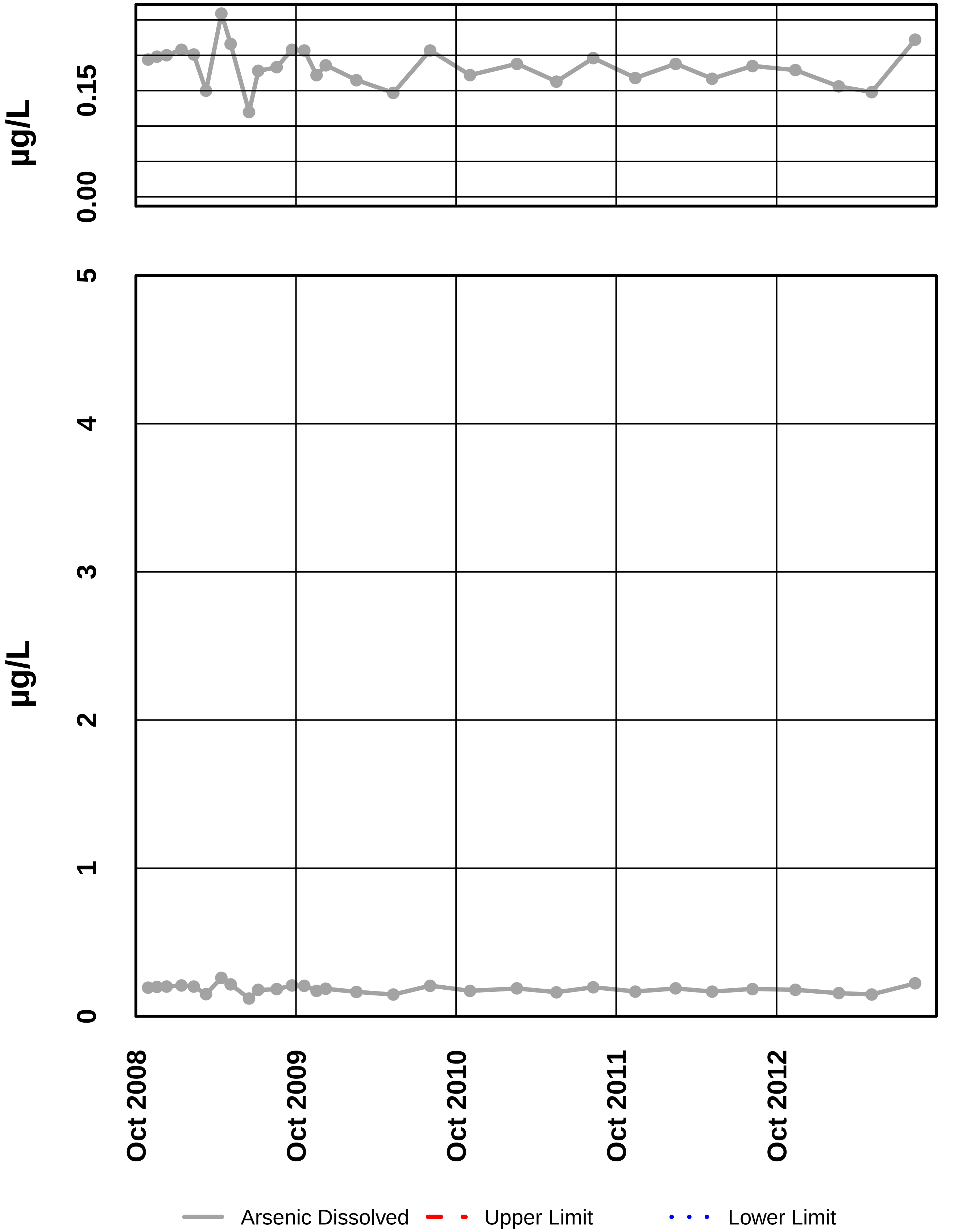


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

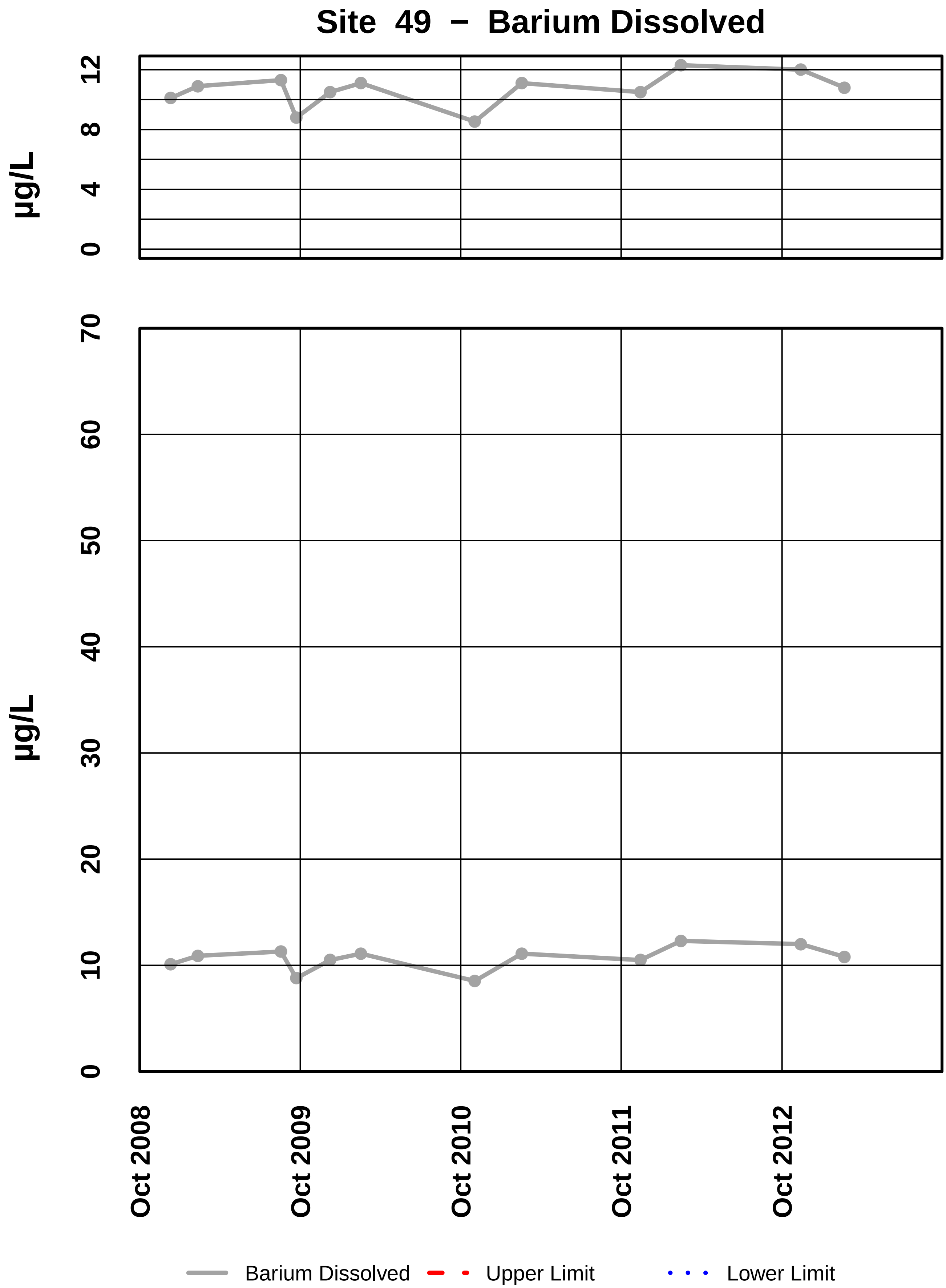


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 49 – Arsenic Dissolved

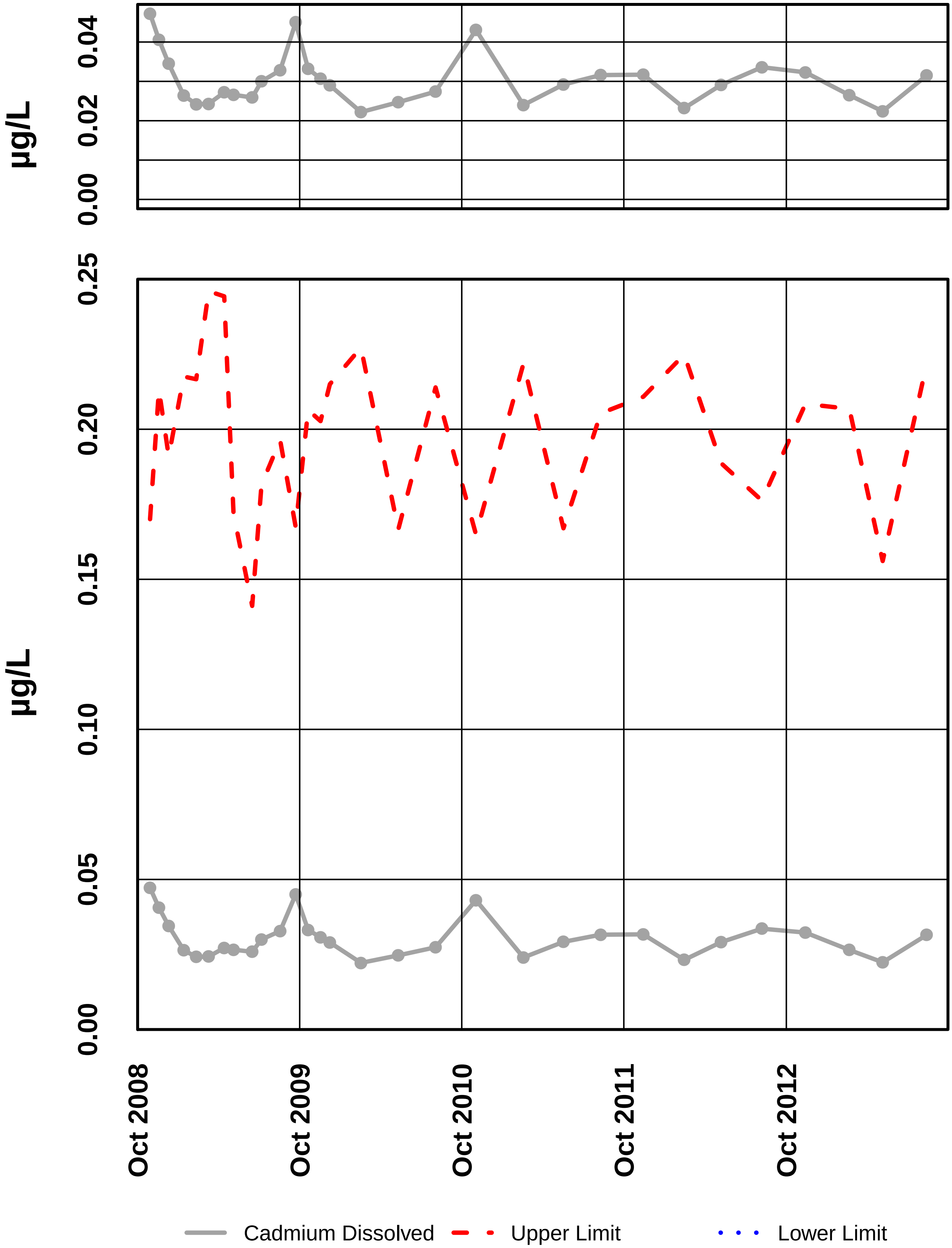


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

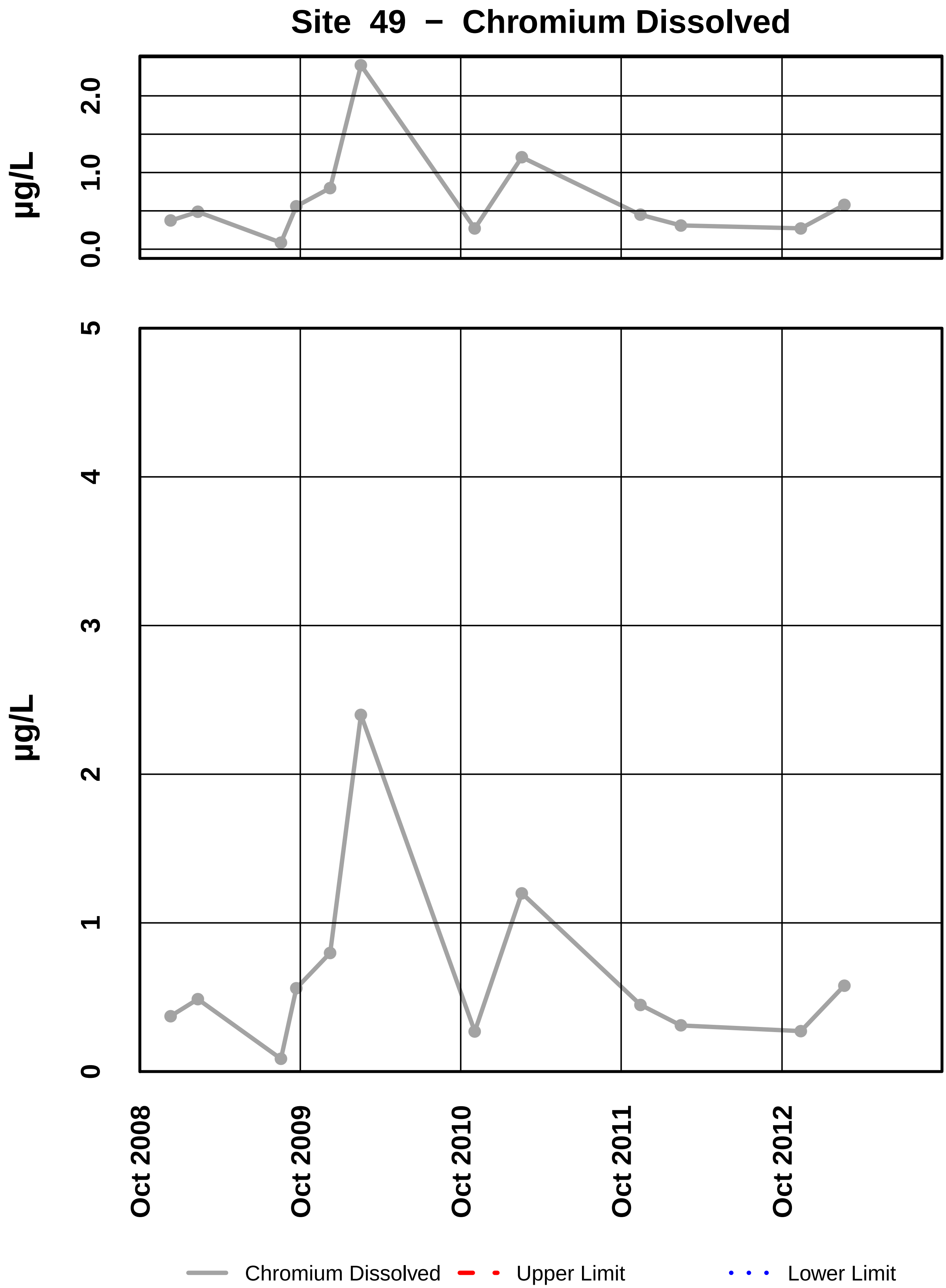


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 49 – Cadmium Dissolved

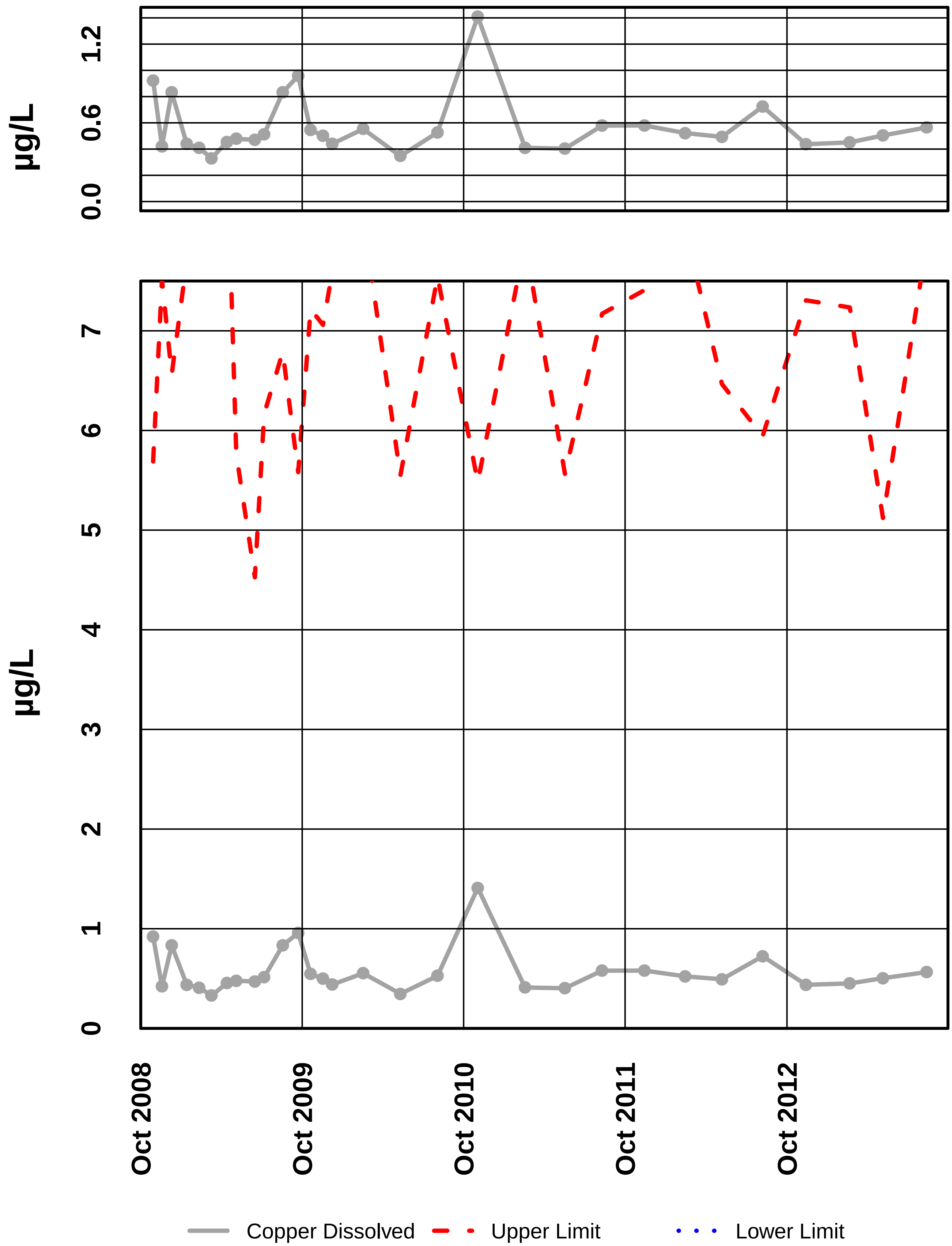


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



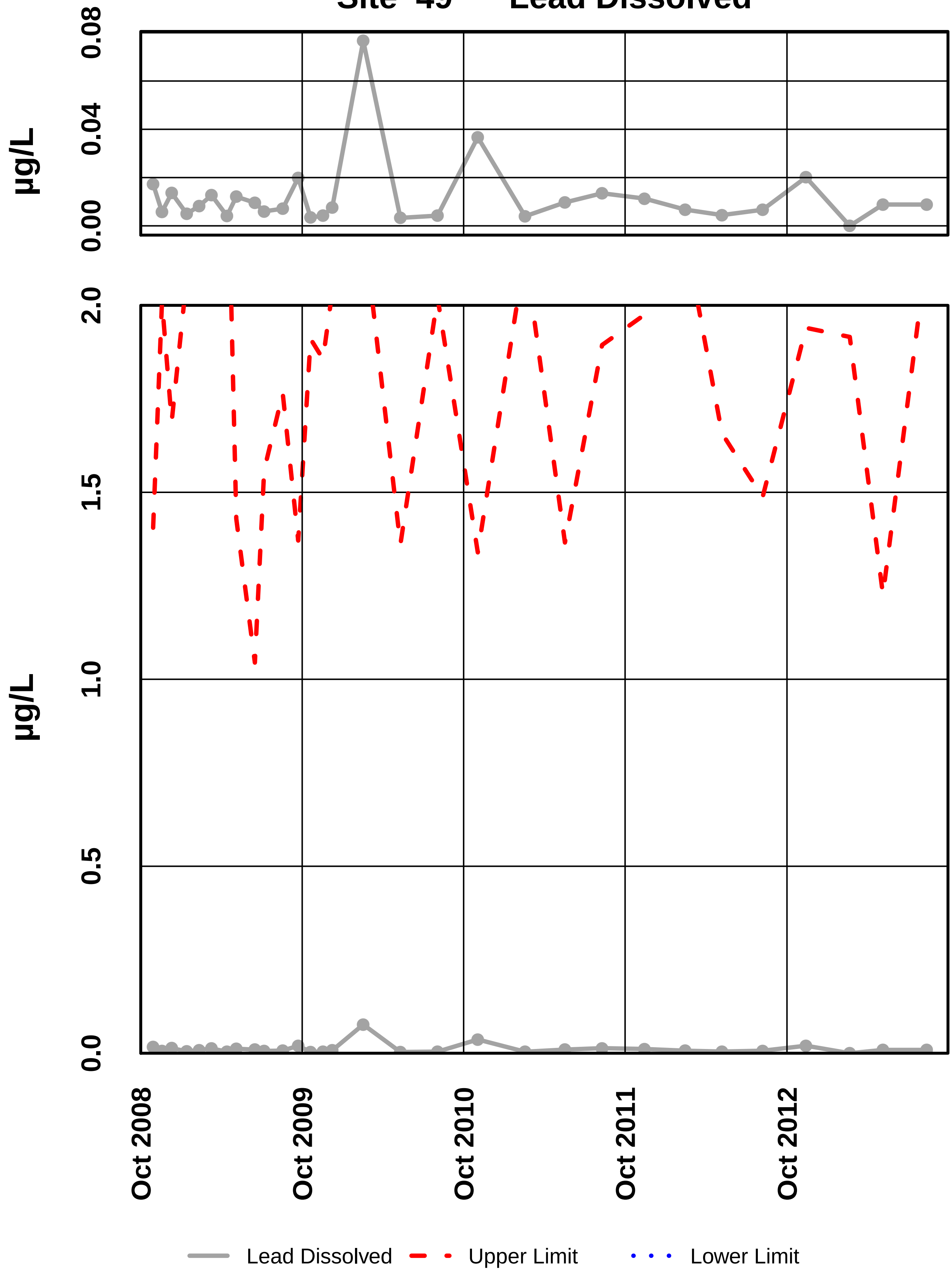
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 49 – Copper Dissolved

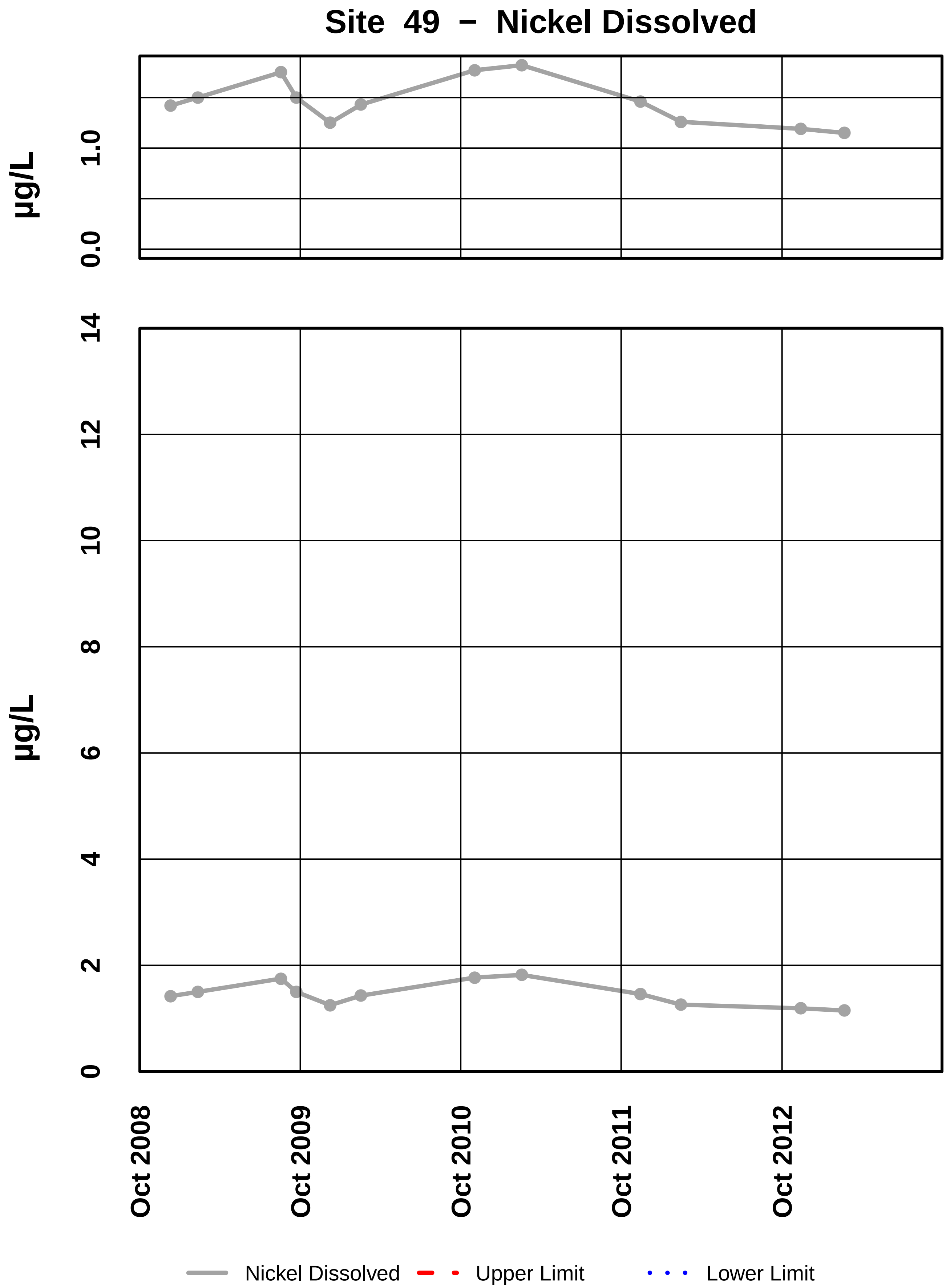


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

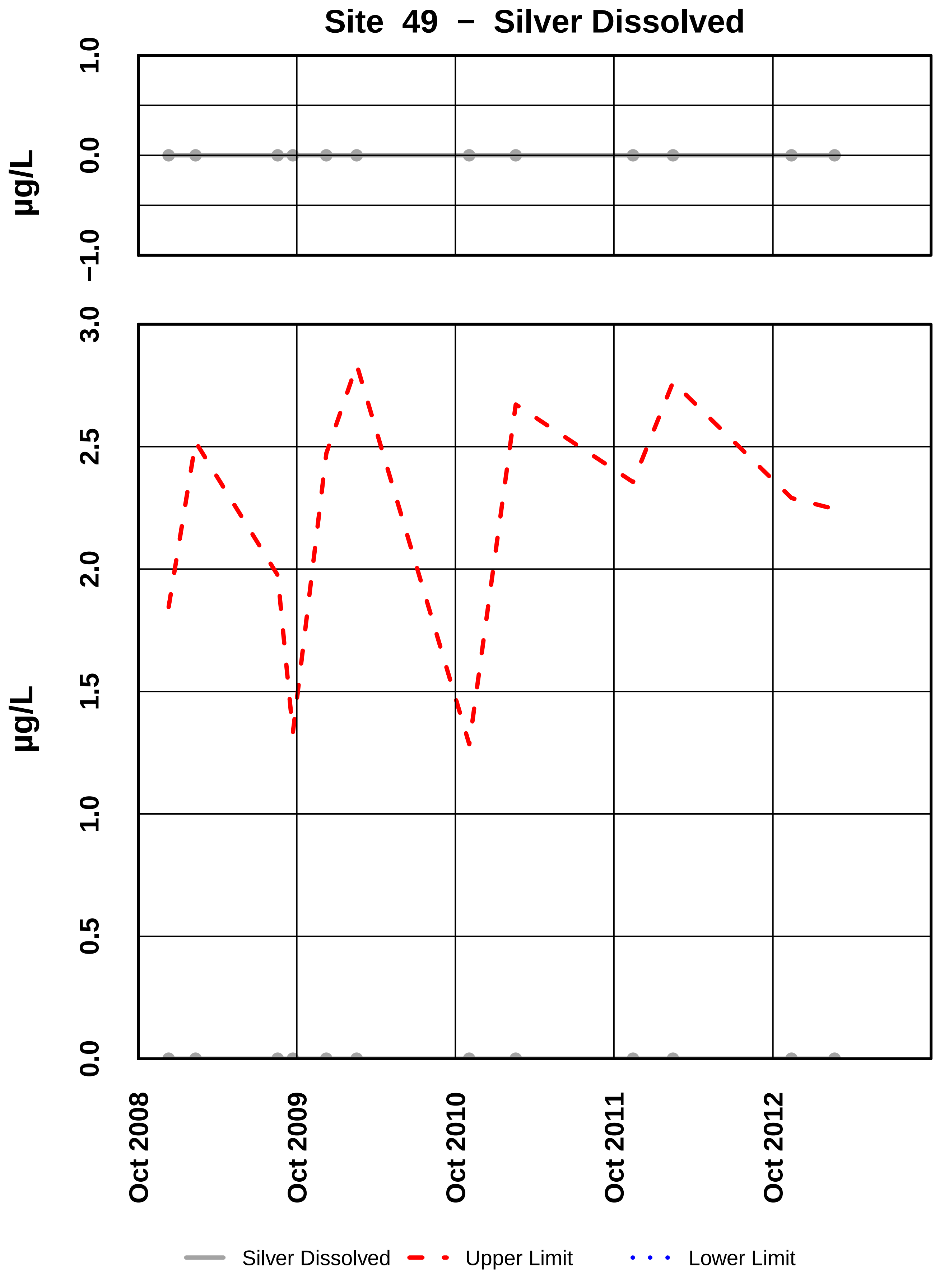
Site 49 − Lead Dissolved



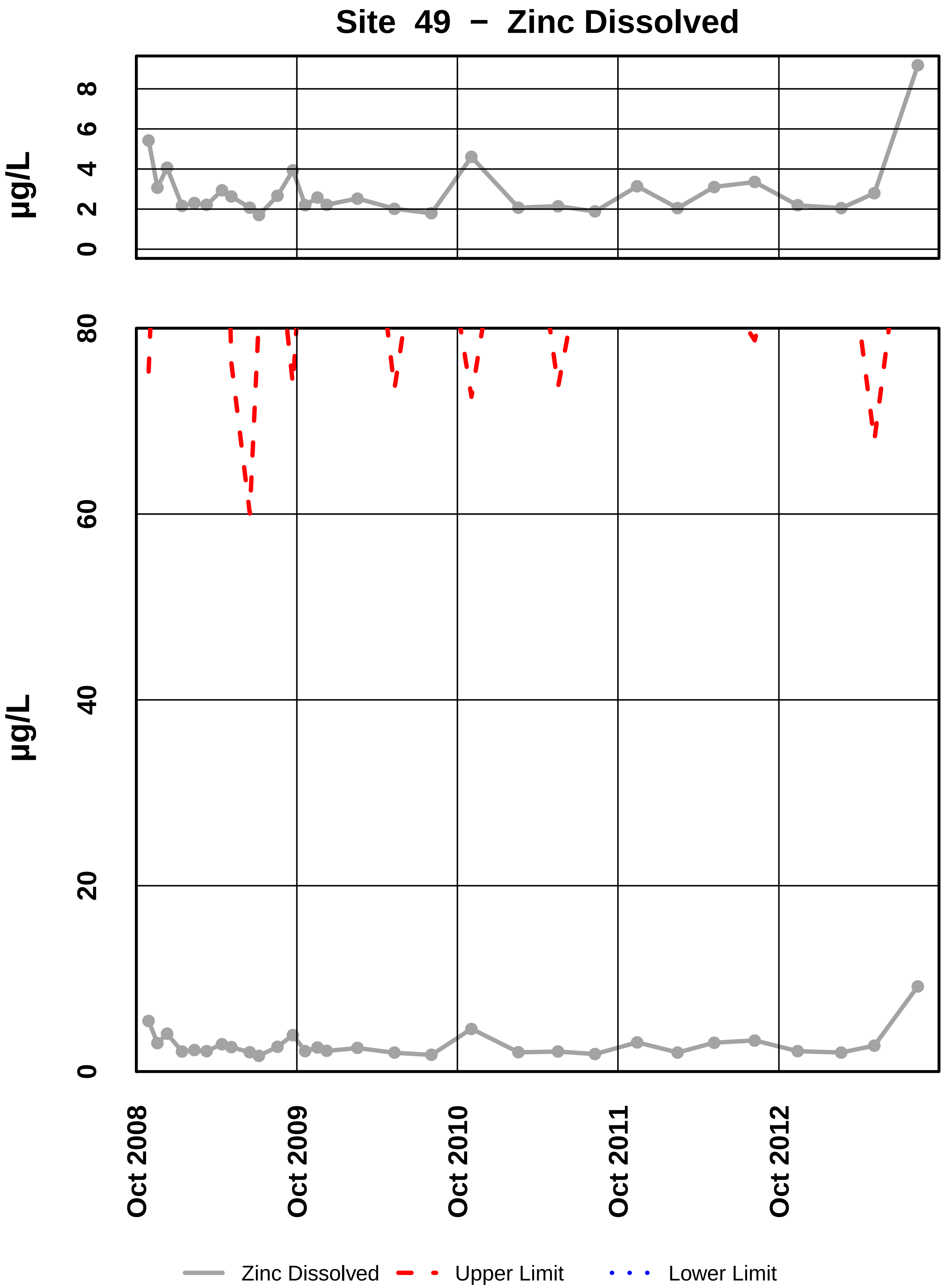
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

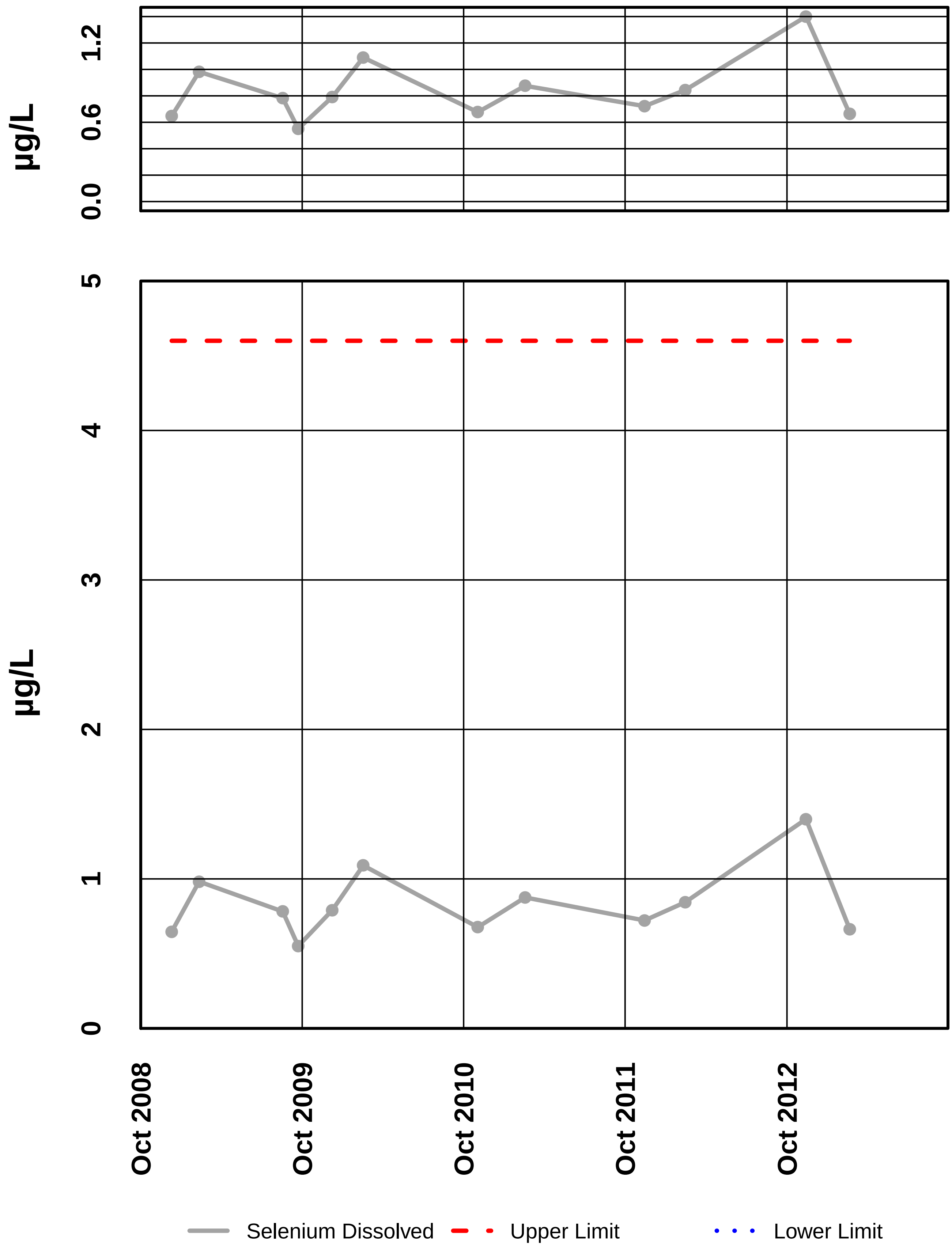


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

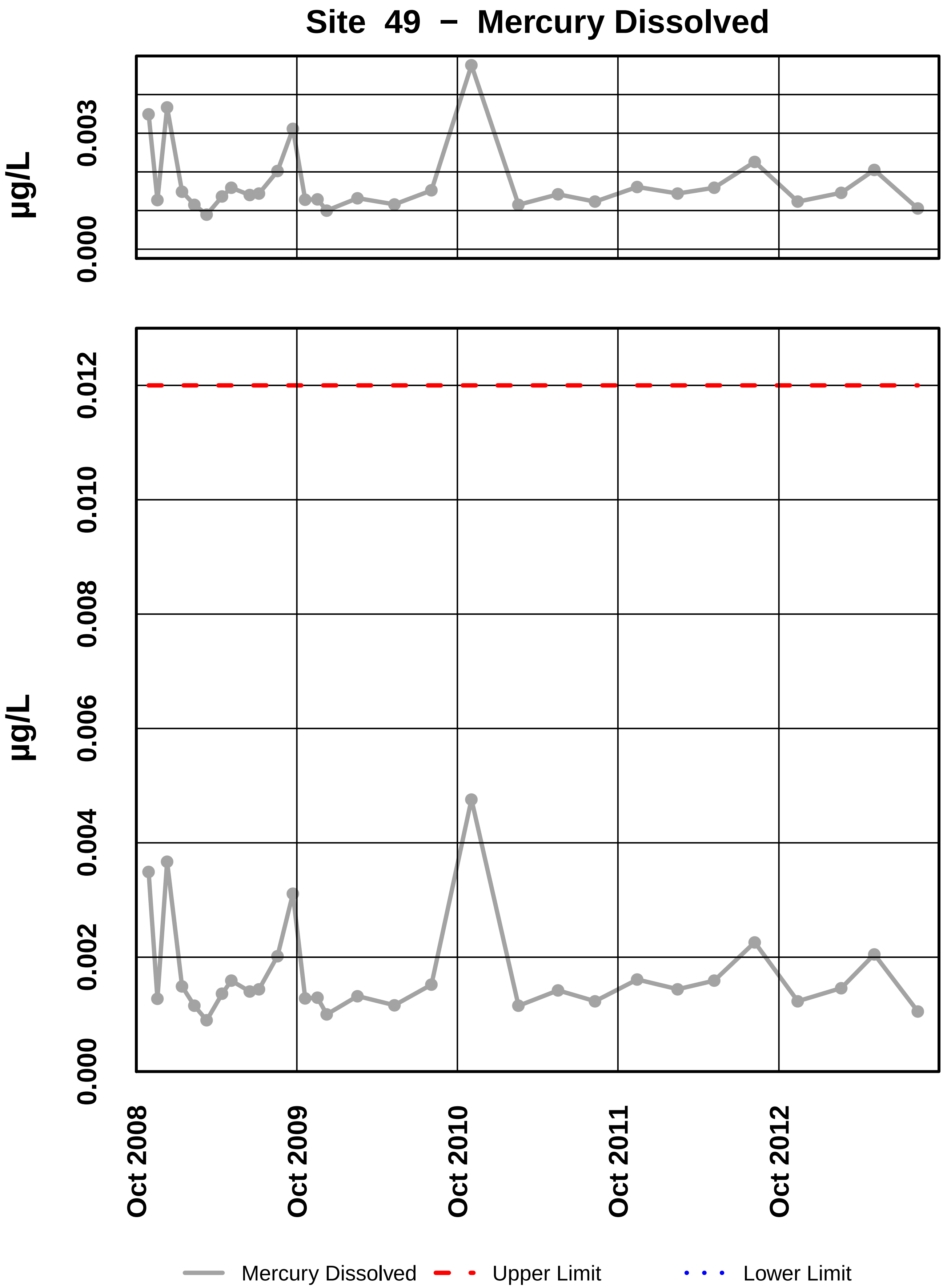


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 49 − 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 **#49** Seasonal Kendall analysis for Specific Conductance, Field (µS/cm)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**	130.1	155.4	183.8	193.7	196	191.8	168.1	124.3	91.7	112.8	119	112
b	**WY2009**		160.1	134.5	170.8	165.7	168.5	193.5	110.8	87.8	128.3	116.9	92
c	**WY2010**	153.9	113.2	175.8		179.1			121.6			147.4	
d	**WY2011**		108.5			171			114.3			153	
e	**WY2012**		141			150			145			130	
f	**WY2013**		168			170			120			188	
	n	2	6	3	2	6	2	2	6	2	2	6	2

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	2	6	3	2	6	2	2	6	2	2	6	2
t_2	0	0	0	0	0	0	0	0	0	0	0	0
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a		1	-1	-1	-1	-1	1	-1	-1	1	-1	-1
c-a	1	-1	-1		-1			-1			1	
d-a		-1			-1			-1			1	
e-a		-1			-1			1			1	
f-a		1			-1			-1			1	
c-b		-1	1		1			1			1	
d-b		-1			1			1			1	
e-b		-1			-1			1			1	
f-b		1			1			1			1	
d-c		-1			-1			-1			1	
e-c		1			-1			1			-1	
f-c		1			-1			-1			1	
e-d		1			-1			1			-1	
f-d		1			-1			1			1	
f-e		1			1			-1			1	
S_k	1	1	-1	-1	-7	-1	1	1	-1	1	9	-1

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	1.00	28.33	3.67	1.00	28.33	1.00	1.00	28.33	1.00	1.00	28.33	1.00
$Z_k = S_k/\sigma_S$	1.00	0.19	-0.52	-1.00	-1.32	-1.00	1.00	0.19	-1.00	1.00	1.69	-1.00
Z^2_k	1.00	0.04	0.27	1.00	1.73	1.00	1.00	0.04	1.00	1.00	2.86	1.00

ΣZ_k= -0.77

ΣZ^2_k= 11.93

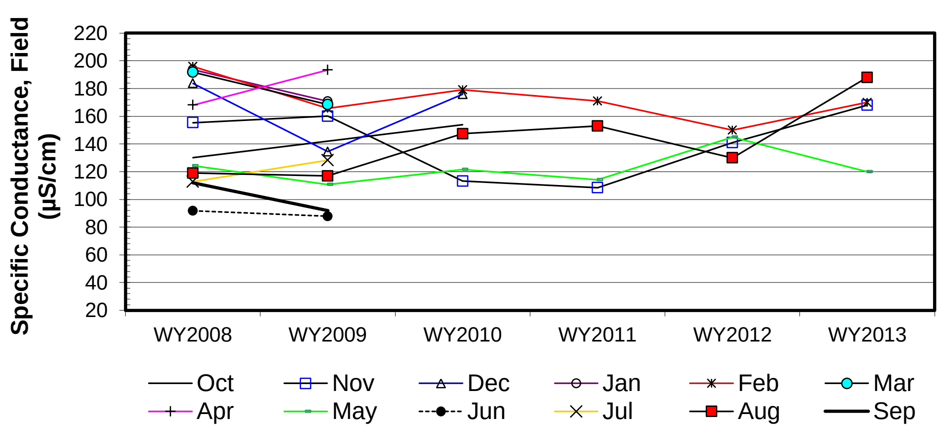
Z-bar=$\Sigma Z_k/K$= -0.06

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	41	0	0	0	0

Σn 41

ΣS_k 2

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=		11.88	@α=5% $\chi^2_{(K-1)}$=	19.68	Test for station homogeneity
	p	**0.373**			$\chi^2_h<\chi^2_{(K-1)}$ ACCEPT
ΣVAR(S_k)	Z_{calc}	0.09	@α/2=2.5% Z=	1.96	**H_0** (No trend) ACCEPT
124.00	**p**	**0.536**			**H_A** (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-5.23		11.31
0.050	-3.92	**1.41**	4.78
0.100	-3.37		3.06
0.200	-1.86		2.61

Site **#49** Seasonal Kendall analysis for pH, Field, Standard Units

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**	8.0	7.6	7.8	8.0	7.6		8.0	8.0	7.9	7.8	7.2	7.6
b	**WY2009**	7.9	7.7	7.9	7.9	7.9	8.0	7.4	7.2	7.7	7.1	7.4	7.4
c	**WY2010**	8.0	7.4	7.7		7.6			7.8			7.4	
d	**WY2011**		7.9			7.3			7.9			8.1	
e	**WY2012**		8.0			7.8			8.0			8.0	
f	**WY2013**		8.0			7.9			7.9			8.1	
	n	3	6	3	2	6	1	2	6	2	2	6	2

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	3	6	3	2	6	1	2	2	2	2	6	2
t_2	0	0	0	0	0	0	0	2	0	0	0	0
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a	-1	1	1	-1	1		-1	-1	-1	-1	1	-1
c-a	-1	-1	-1		-1			-1			1	
d-a		1			-1			-1			1	
e-a		1			1			0			1	
f-a		1			1			-1			1	
c-b	1	-1	-1		-1			1			1	
d-b		1			-1			1			1	
e-b		1			-1			1			1	
f-b		1			-1			1			1	
d-c		1			-1			1			1	
e-c		1			1			1			1	
f-c		1			1			1			1	
e-d		1			1			1			-1	
f-d		1			1			0			-1	
f-e		-1			1			-1			1	
S_k	-1	9	-1	-1	1	0	-1	3	-1	-1	11	-1

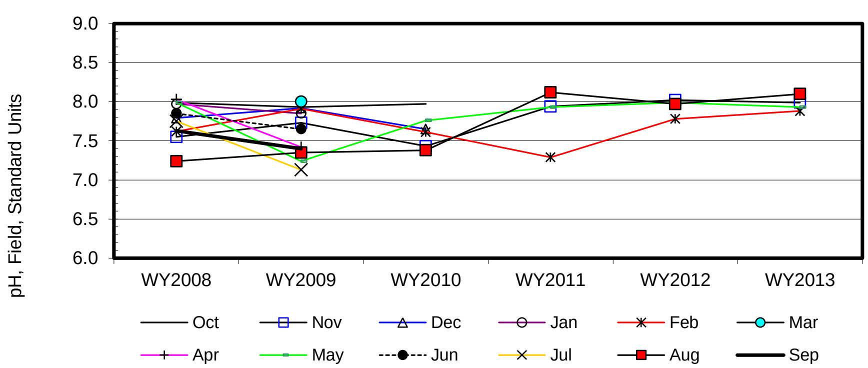
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	3.67	28.33	3.67	1.00	28.33		1.00	26.33	1.00	1.00	28.33	1.00
$Z_k = S_k/\sigma_S$	-0.52	1.69	-0.52	-1.00	0.19		-1.00	0.58	-1.00	-1.00	2.07	-1.00
Z^2_k	0.27	2.86	0.27	1.00	0.04		1.00	0.34	1.00	1.00	4.27	1.00

ΣZ_k= -1.51
ΣZ^2_k= 13.05
Z-bar=$\Sigma Z_k/K$= -0.14

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	37	2	0	0	0

Σn 41
ΣS_k 17

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	12.84	@α=5% $\chi^2_{(K-1)}$= 18.31	Test for station homogeneity
p	**0.233**		$\chi^2_h<\chi^2_{(K-1)}$ ACCEPT
ΣVAR(S_k)	Z_{calc} 1.44	@α/2=2.5% Z= 1.96	H_0 (No trend) ACCEPT
123.67	**p** **0.925**		H_A (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.01		0.13
0.050	0.00	**0.06**	0.11
0.100	0.01		0.10
0.200	0.04		0.09

Site #49 Seasonal Kendall analysis for Total Alk, (mg/l)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**	50.8	60.4	73.9	79.1	65.9	66.0	68.6	49.6	35.7	45.7	50.3	44.4
b	**WY2009**	44.3	49.8	48.4	61.7	62.5	72.0	70.6	44.5	36.3	50.8	55.1	45.9
c	**WY2010**	58.4	61.6	71.5		56.9			46.6			61.1	
d	**WY2011**		38.8			69.5			44.9			63.2	
e	**WY2012**		64.2			63.5			61.1			49.8	
f	**WY2013**		74.9			64.8			48.0			73.5	
	n	3	6	3	2	6	2	2	6	2	2	6	2

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	3	6	3	2	6	2	2	6	2	2	6	2
t_2	0	0	0	0	0	0	0	0	0	0	0	0
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a	-1	-1	-1	-1	-1	1	1	-1	1	1	1	1
c-a	1	1	-1		-1			-1			1	
d-a		-1			1			-1			1	
e-a		1			-1			1			-1	
f-a		1			-1			-1			1	
c-b	1	1	1		-1			1			1	
d-b		-1			1			1			1	
e-b		1			1			1			-1	
f-b		1			1			1			1	
d-c		-1			1			-1			1	
e-c		1			1			1			-1	
f-c		1			1			1			1	
e-d		1			-1			1			-1	
f-d		1			-1			1			1	
f-e		1			1			-1			1	
S_k	1	7	-1	-1	1	1	1	3	1	1	7	1

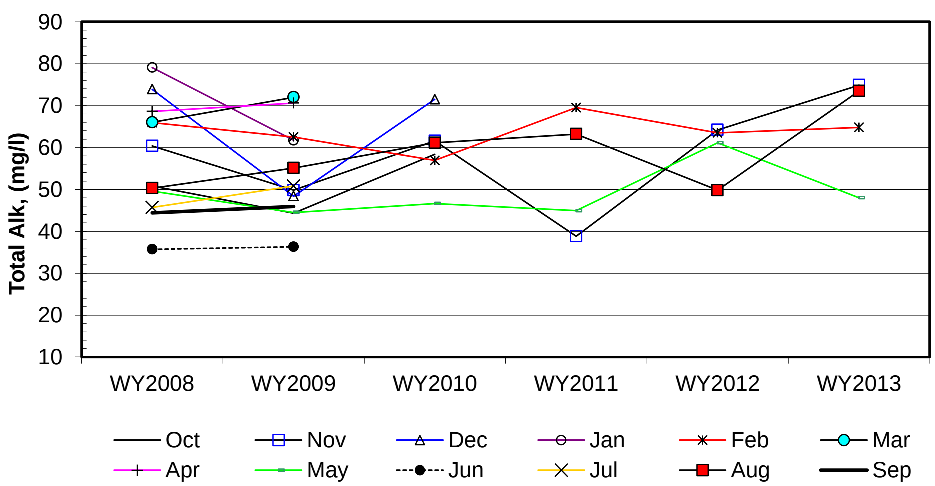
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	3.67	28.33	3.67	1.00	28.33	1.00	1.00	28.33	1.00	1.00	28.33	1.00
$Z_k = S_k/\sigma_S$	0.52	1.32	-0.52	-1.00	0.19	1.00	1.00	0.56	1.00	1.00	1.32	1.00
Z^2_k	0.27	1.73	0.27	1.00	0.04	1.00	1.00	0.32	1.00	1.00	1.73	1.00

ΣZ_k=	7.38
ΣZ^2_k=	10.36
Z-bar=ΣZ_k/K=	0.62

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	42	0	0	0	0

Σn	42
ΣS_k	22

$\chi^2_h=\Sigma Z^2_k$-K(Z-bar)^2=		5.82	@α=5% $\chi^2_{(K-1)}$=	19.68	Test for station homogeneity	
	p	**0.885**			$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc}	1.87	@α/2=2.5% **Z**=	1.96	H_0 (No trend)	ACCEPT
126.67	**p**	**0.969**			H_A (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.35		4.15
0.050	0.30	**1.40**	3.35
0.100	0.55		2.88
0.200	0.67		2.10

Site #49

Seasonal Kendall analysis for Sulfate, Total (mg/l)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**	10.0	8.3	12.6	17.7	19.2	16.9	17.8	7.7	4.8	7.9	7.6	6.0
b	**WY2009**	6.4	12.5	12.1	13.3	14.3	18.9	21.2	7.5	5.9	11.9	12.7	7.5
c	**WY2010**	11.7	13.3	14.7		16.2			7.8			12.4	
d	**WY2011**		7.8			15.1			7.2			12.1	
e	**WY2012**		12.3			16.3			9.8			8.1	
f	**WY2013**		14.3			11.7			7.3			16.1	
	n	3	6	3	2	6	2	2	6	2	2	6	2

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	3	6	3	2	6	2	2	6	2	2	6	2
t_2	0	0	0	0	0	0	0	0	0	0	0	0
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a	-1	1	-1	-1	-1	1	1	-1	1	1	1	1
c-a	1	1	1		-1			1			1	
d-a		-1			-1			-1			1	
e-a		1			-1			1			1	
f-a		1			-1			-1			1	
c-b	1	1	1		1			1			-1	
d-b		-1			1			-1			-1	
e-b		-1			1			1			-1	
f-b		1			-1			-1			1	
d-c		-1			-1			-1			-1	
e-c		-1			1			1			-1	
f-c		1			-1			-1			1	
e-d		1			1			1			-1	
f-d		1			-1			1			1	
f-e		1			-1			-1			1	
S_k	1	5	1	-1	-5	1	1	-1	1	1	3	1

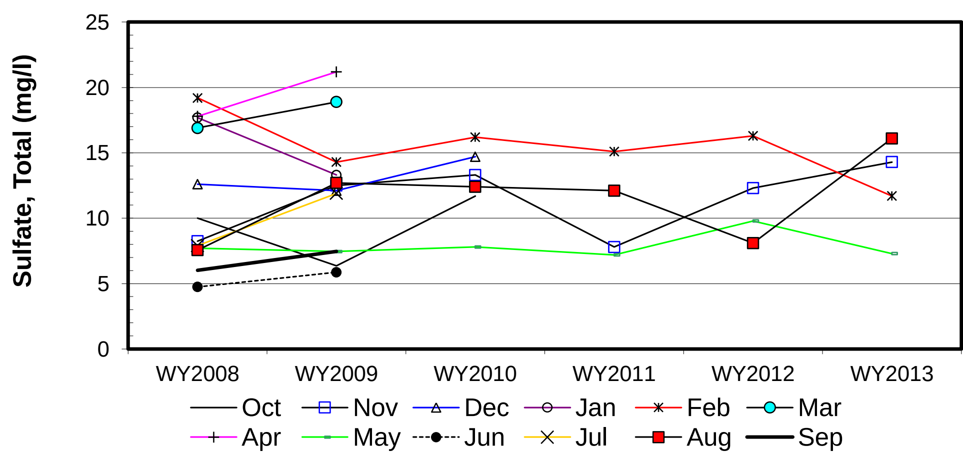
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	3.67	28.33	3.67	1.00	28.33	1.00	1.00	28.33	1.00	1.00	28.33	1.00
$Z_k = S_k/\sigma_S$	0.52	0.94	0.52	-1.00	-0.94	1.00	1.00	-0.19	1.00	1.00	0.56	1.00
Z^2_k	0.27	0.88	0.27	1.00	0.88	1.00	1.00	0.04	1.00	1.00	0.32	1.00

ΣZ_k= 5.42
ΣZ^2_k= 8.66
Z-bar=$\Sigma Z_k/K$= 0.45

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	42	0	0	0	0

Σn 42
ΣS_k 8

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	6.21	@α=5% $\chi^2_{(K-1)}$= 19.68	Test for station homogeneity	
p	**0.859**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
$\Sigma VAR(S_k)$	Z_{calc} 0.62	@α=2.5% Z= 1.96	H_0 (No trend)	ACCEPT
126.67	p **0.733**		H_A (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.30		1.06
0.050	-0.17	0.23	0.85
0.100	-0.13		0.78
0.200	-0.06		0.50

Site #49 — Seasonal Kendall analysis for Zinc, Dissolved (ug/l)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**	3.1	4.4	2.9	1.7	2.0	4.4	1.8	3.0	1.9	2.1	2.9	4.0
b	**WY2009**	5.4	3.1	4.1	2.2	2.3	2.2	2.9	2.6	2.1	1.7	2.7	3.9
c	**WY2010**	2.2	2.6	2.2		2.5			2.0			1.8	
d	**WY2011**		4.6			2.1			2.2			1.9	
e	**WY2012**		3.1			2.1			3.1			3.4	
f	**WY2013**		2.2			2.1			2.8			9.2	
	n	3	6	3	2	6	2	2	6	2	2	6	2

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	3	6	3	2	4	2	2	6	2	2	6	2
t_2	0	0	0	0	1	0	0	0	0	0	0	0
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a	1	-1	1	1	1	-1	1	-1	1	-1	-1	-1
c-a	-1	-1	-1		1			-1			-1	
d-a		1			1			-1			-1	
e-a		-1			1			1			1	
f-a		-1			1			-1			1	
c-b	-1	-1	-1		1			-1			-1	
d-b		1			-1			-1			-1	
e-b		1			-1			1			1	
f-b		-1			-1			1			1	
d-c		1			-1			1			1	
e-c		1			-1			1			1	
f-c		-1			-1			1			1	
e-d		-1			-1			1			1	
f-d		-1			-1			1			1	
f-e		-1			0			-1			1	
S_k	-1	-5	-1	1	-2	-1	1	1	1	-1	5	-1

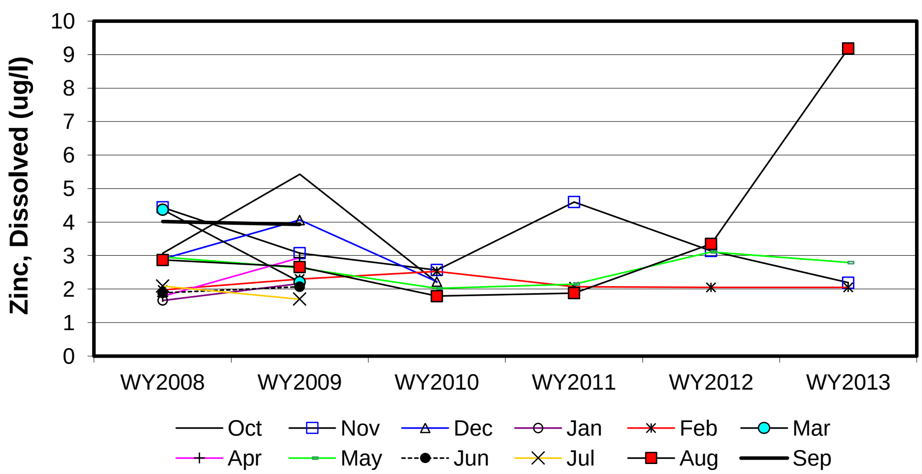
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	3.67	28.33	3.67	1.00	27.33	1.00	1.00	28.33	1.00	1.00	28.33	1.00
$Z_k = S_k/\sigma_S$	-0.52	-0.94	-0.52	1.00	-0.38	-1.00	1.00	0.19	1.00	-1.00	0.94	-1.00
Z^2_k	0.27	0.88	0.27	1.00	0.15	1.00	1.00	0.04	1.00	1.00	0.88	1.00

ΣZ_k= -1.24
ΣZ^2_k= 8.49
Z-bar=ΣZ_k/K= -0.10

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	40	1	0	0	0

Σn 42
ΣS_k -3

$\chi^2_h=\Sigma Z^2_k - K(\text{Z-bar})^2$= 8.36	@α=5% $\chi^2_{(K-1)}$= 19.68	Test for station homogeneity	
p **0.680**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc} -0.18	@α/2=2.5% Z= 1.96	H_0 (No trend)	ACCEPT
125.67	**p** **0.429**		H_A (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.32		0.16
0.050	-0.22	**-0.02**	0.06
0.100	-0.17		0.04
0.200	-0.11		0.02

INTERPRETIVE REPORT
SITE 46

The data collected during the current water year are listed in the following "Table of Results for Water Year 2013" 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 2007 through September 2013.				

The data for Water Year 2013 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 2013

			Limits		
Sample Date	Parameter	Value	Lower	Upper	Hardness
No exceedances have been identified by HGCMC for the period of October 2012 through September 2013.					

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-07 and Sep-13(WY2008-WY2013). Datasets with a statistically significant trend ($\alpha/2=2.5\%$) a Seasonal-Sen's Slope estimate statistic has also been calculated. There were no statistically significant trends detected during the current water year.

Table of Summary Statistics for Trend Analysis

Parameter	Mann-Kendall test statistics n*	p**	Trend	Sen's slope estimate Q	Q(%)
Conductivity Field	6	0.15			
pH Field	6	0.28			
Alkalinity, Total	6	0.05			
Sulfate, Total	6	0.12			
Zinc, Dissolved	6	0.50			

* 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 as specified in the Statistical Information Goals for Site 46. 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 test as a methodology for comparing median values. This is the same reason this technique has not been used previously with the wells at the tailings facility and that new methodologies are being investigated for intra-site comparison.

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 are not ‘out of control’ the data for those years 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 CUSUM technique was being used during water year 2003 it would have been concluded that the total sulfate 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 total sulfate 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 affect 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**

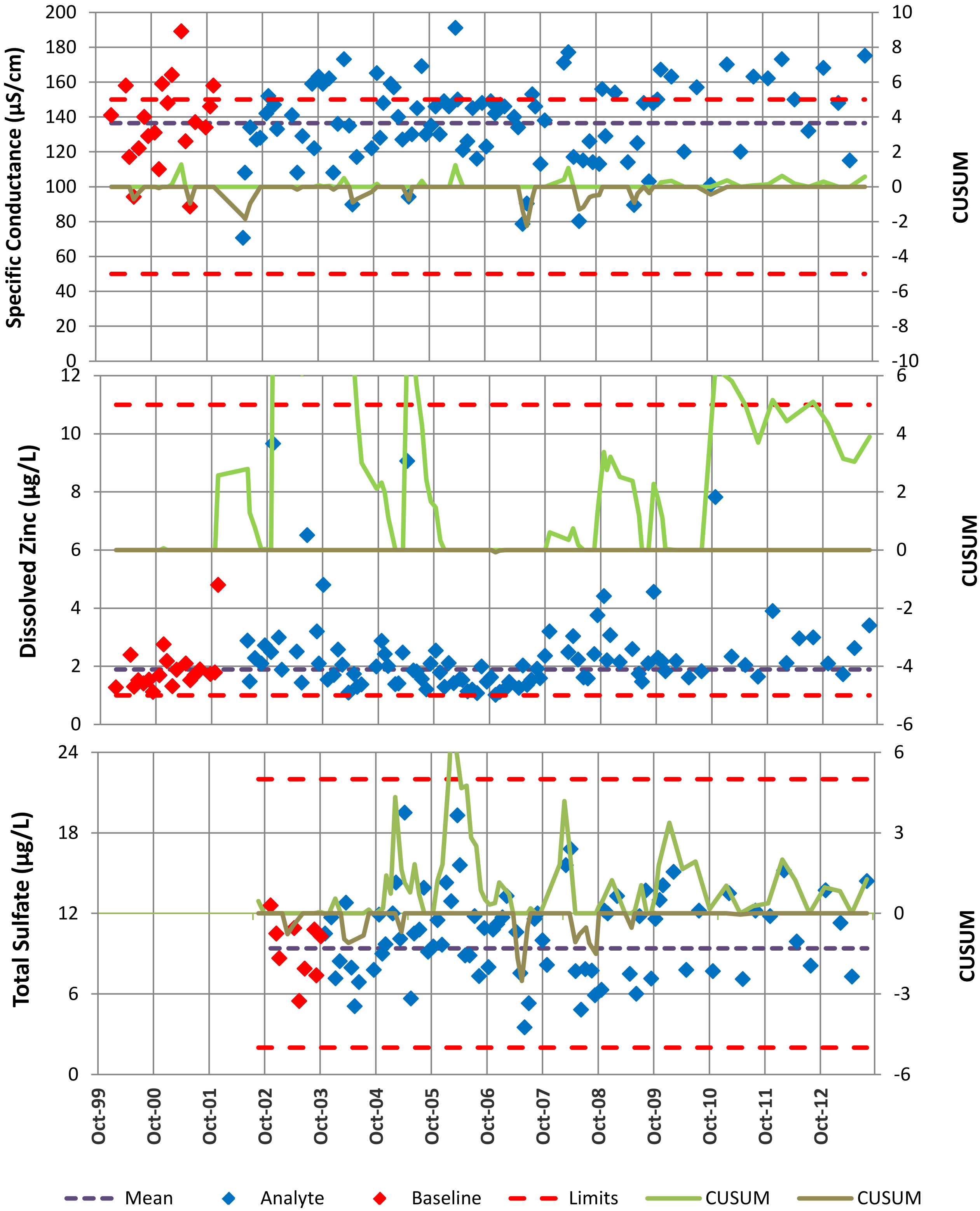


Figure 2. **Observed Measurements for Specific Conductance, Dissolved Zinc, and Total Sulfate from Site 46 Compared to the Shewhart-CUSUM Control Limits From Table 2**

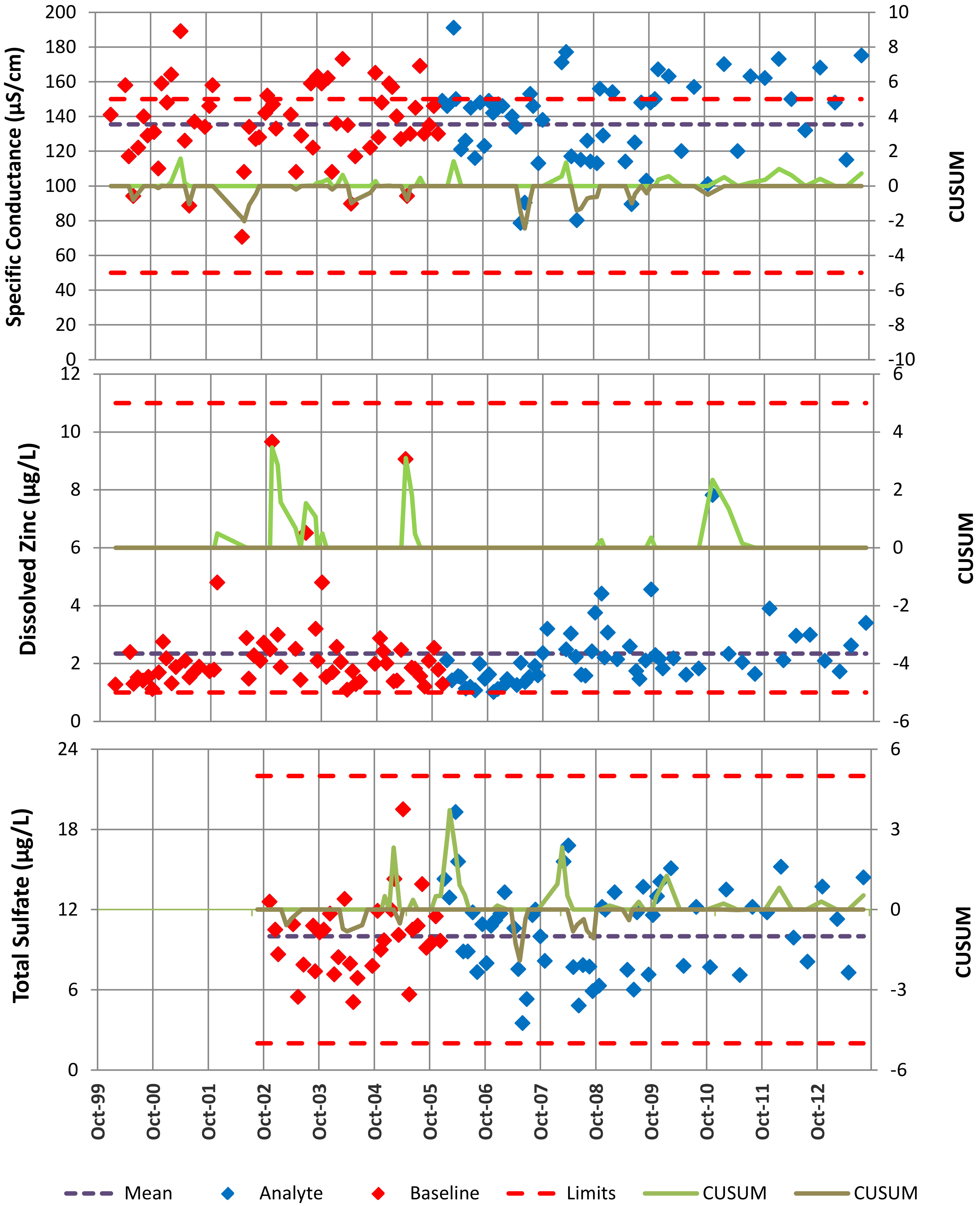


Table of Results for Water Year 2013

Site 046FMS - 'Lower Bruin Creek'

Sample Date/Parameter	Oct 2012	Nov 2012	Dec 2012	Jan 2013	Feb 2013	Mar 2013	Apr 2013	May 2013	Jun 2013	Jul 2013	Aug 2013	Sep 2013	**Median**
Water Temp (°C)		0.9			1.1			2.1			10.9		1.6
Conductivity-Field(μmho)		167			169			122			179		168.0
Conductivity-Lab (μmho)		168			148			115			175		158
pH Lab (standard units)		7.79			7.55			7.75			7.64		7.70
pH Field (standard units)		7.83			7.52			7.88			7.6		7.72
Total Alkalinity (mg/L)		74.4			64.1			46.5			66		65.1
Total Sulfate (mg/L)		13.7			11.3			7.3			14.4		12.5
Hardness (mg/L)		85.9			76.2			50.9			83.6		79.9
Dissolved As (ug/L)		0.226			0.23			0.22			0.216		0.223
Dissolved Ba (ug/L)		13			12.2								12.6
Dissolved Cd (ug/L)		0.0255			0.0234			0.0184			0.0357		0.0245
Dissolved Cr (ug/L)		0.257			0.399								0.328
Dissolved Cu (ug/L)		0.495			0.473			0.584			0.497		0.496
Dissolved Pb (ug/L)		0.0203			0.0047			0.0234			0.0073		0.0138
Dissolved Ni (ug/L)		0.989			0.978								0.984
Dissolved Ag (ug/L)		0.002			0.002								0.002
Dissolved Zn (ug/L)		2.09			1.72			2.62			3.4		2.36
Dissolved Se (ug/L)		0.891			0.741								0.816
Dissolved Hg (ug/L)		0.00129			0.00161			0.00229			0.00151		0.001560

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.

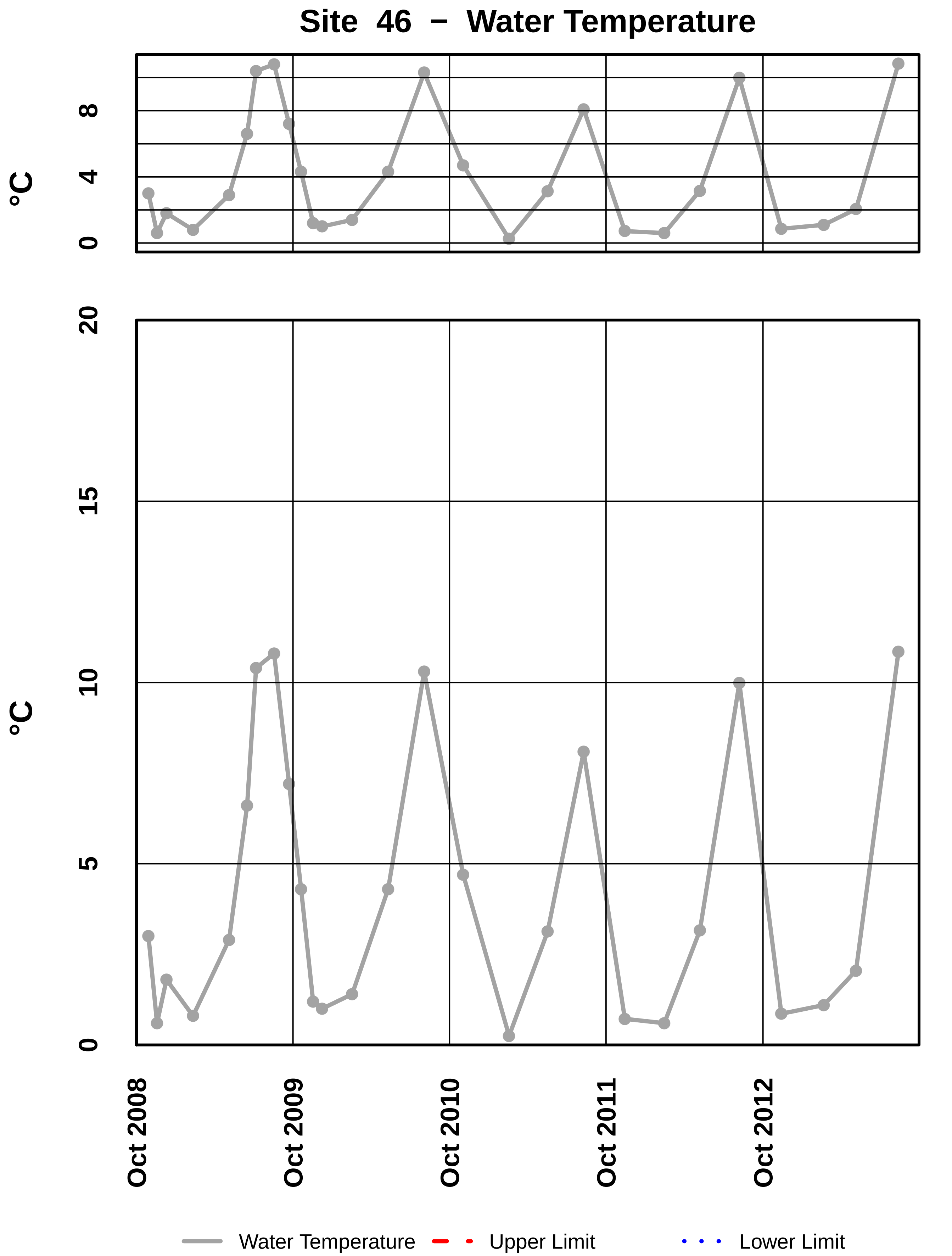
Shaded data has been qualified as an outlier by HGCMC and removed from any further analysis and is not included into the calculation of the median

Qualified Data by QA Reviewer

Date Range: 10/01/2012 to 09/30/2013

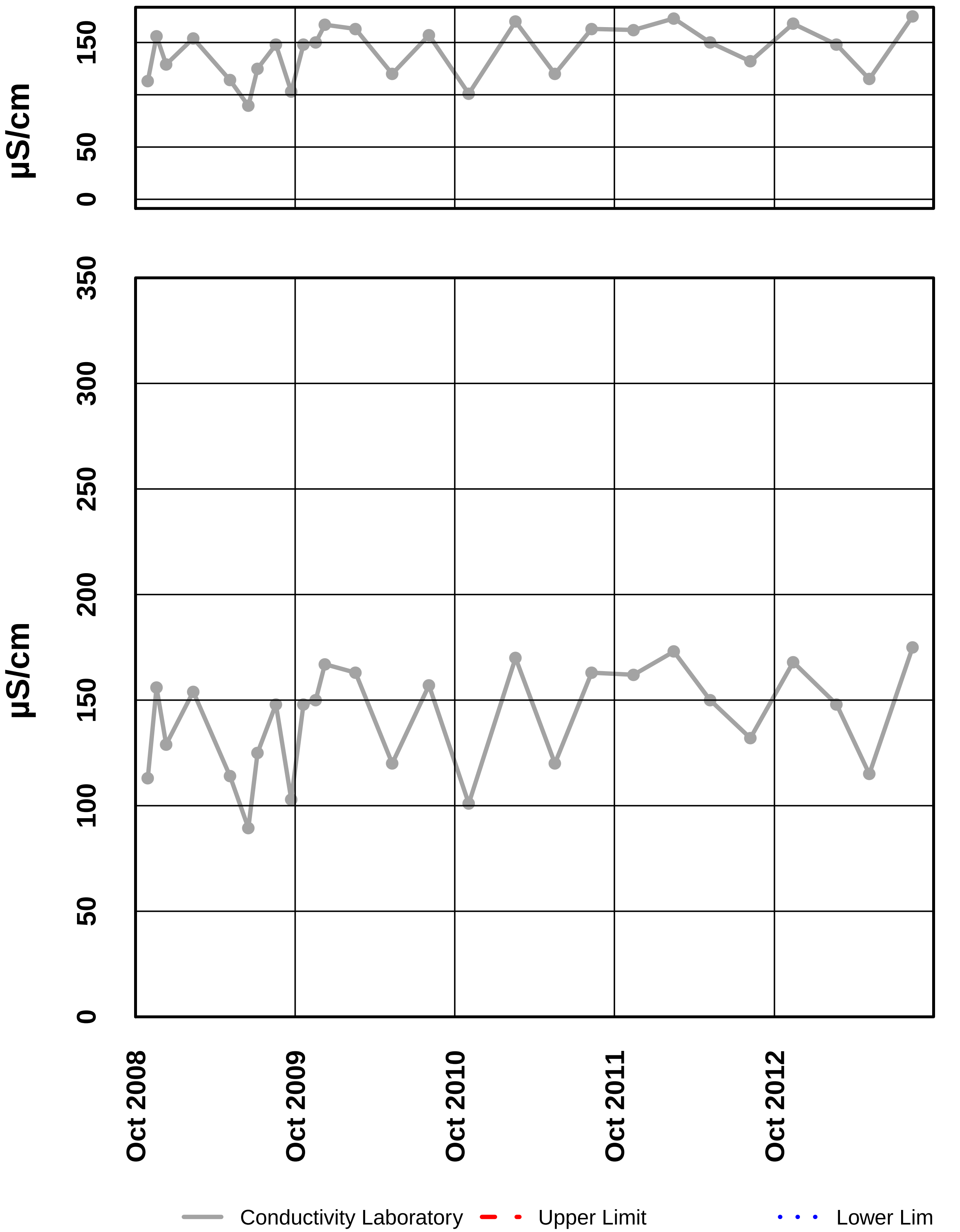
Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
46	11/13/2012	12:00 AM	pH Lab, su	7.79	J	Hold Time Violation
			Zn diss, µg/l	2.09	U	Field Blank Contamination
			Se diss, µg/l	0.89	U	Field Blank Contamination
46	2/20/2013	12:00 AM	Pb diss, µg/l	0.00467	J	Below Quantitative Range
46	5/6/2013	12:00 AM	pH Lab, su	7.75	J	Hold Time Violation
46	8/13/2013	12:00 AM	Cond, µmhos	175	J	Sample receipt temperature
			Alk, mg/L	66	J	Sample receipt temperature
			SO4 Tot, mg/l	14.4	J	Sample receipt temperature
			Pb diss, µg/l	0.00734	U	Field Blank Contamination

Qualifier	Description
J	Positively Identified - Approximate concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit



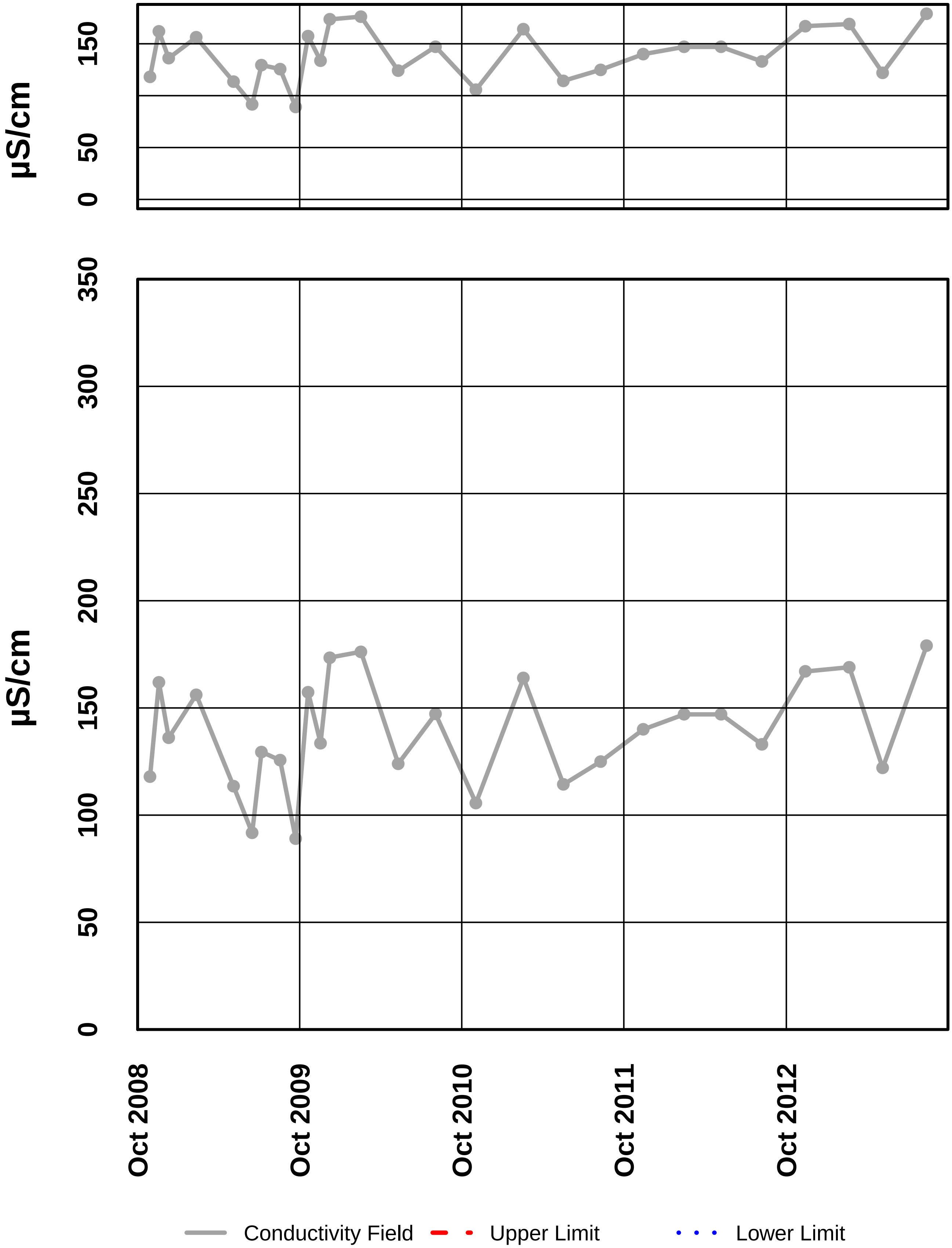
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 46 – Conductivity Laboratory

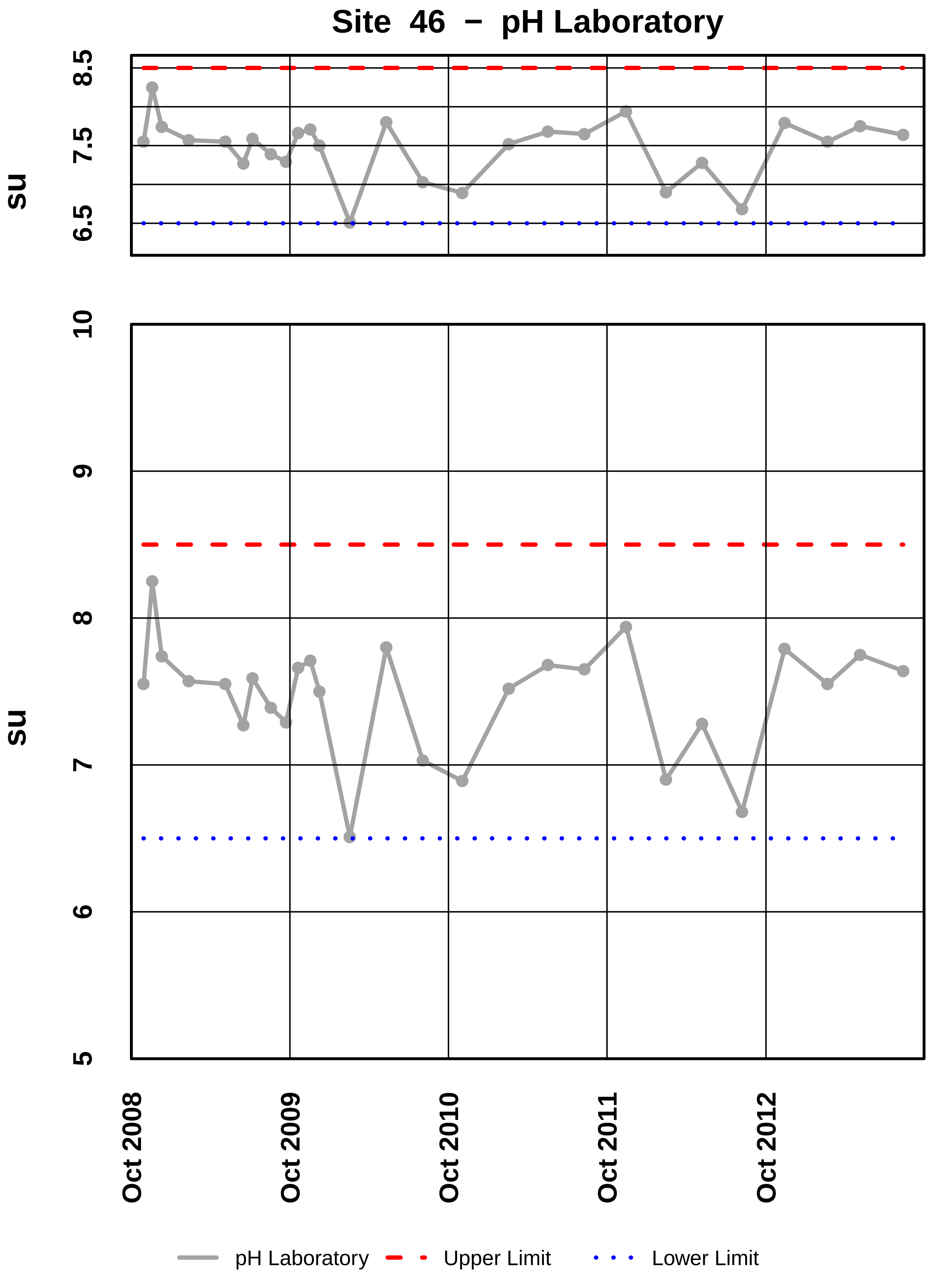


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 46 – Conductivity Field

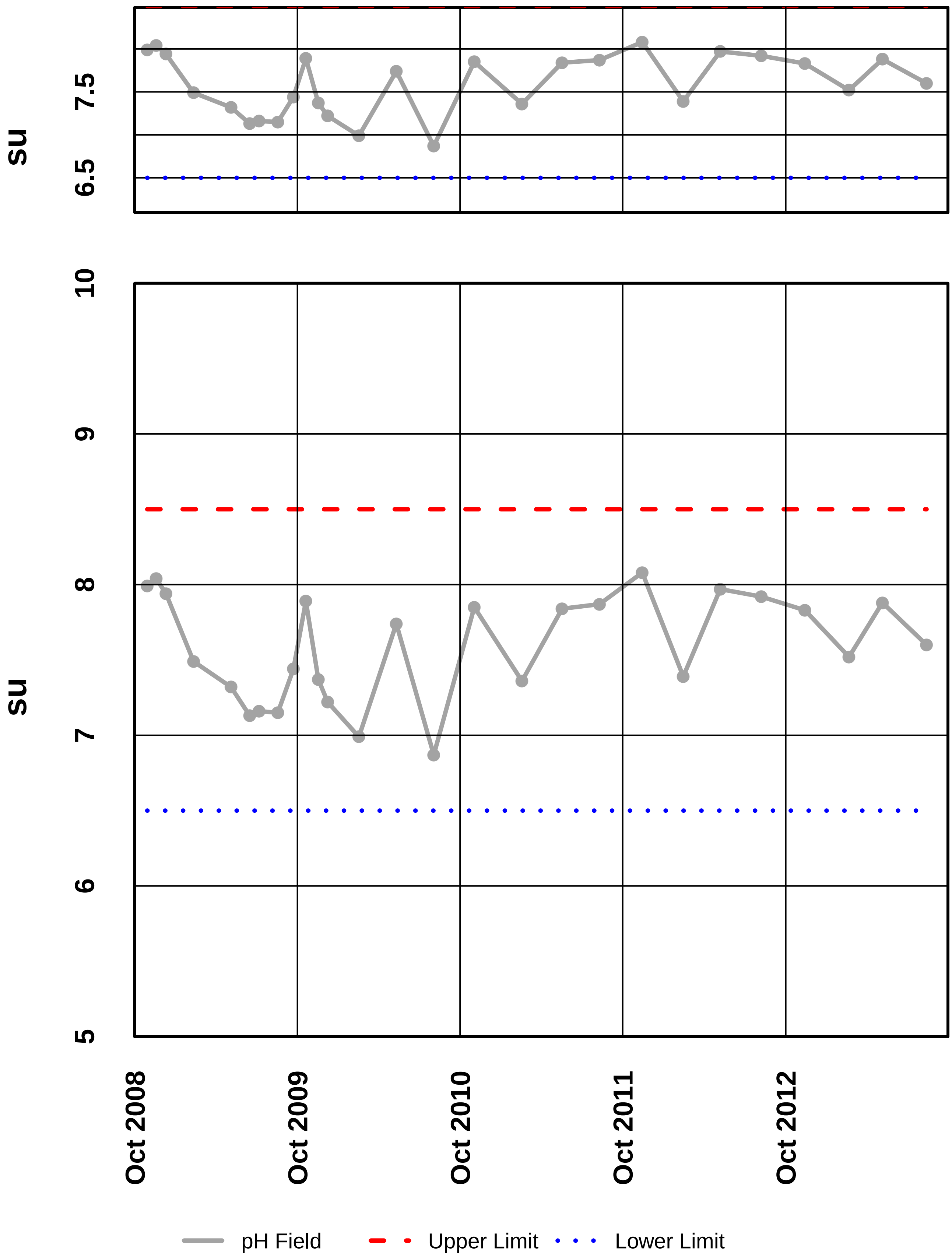


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

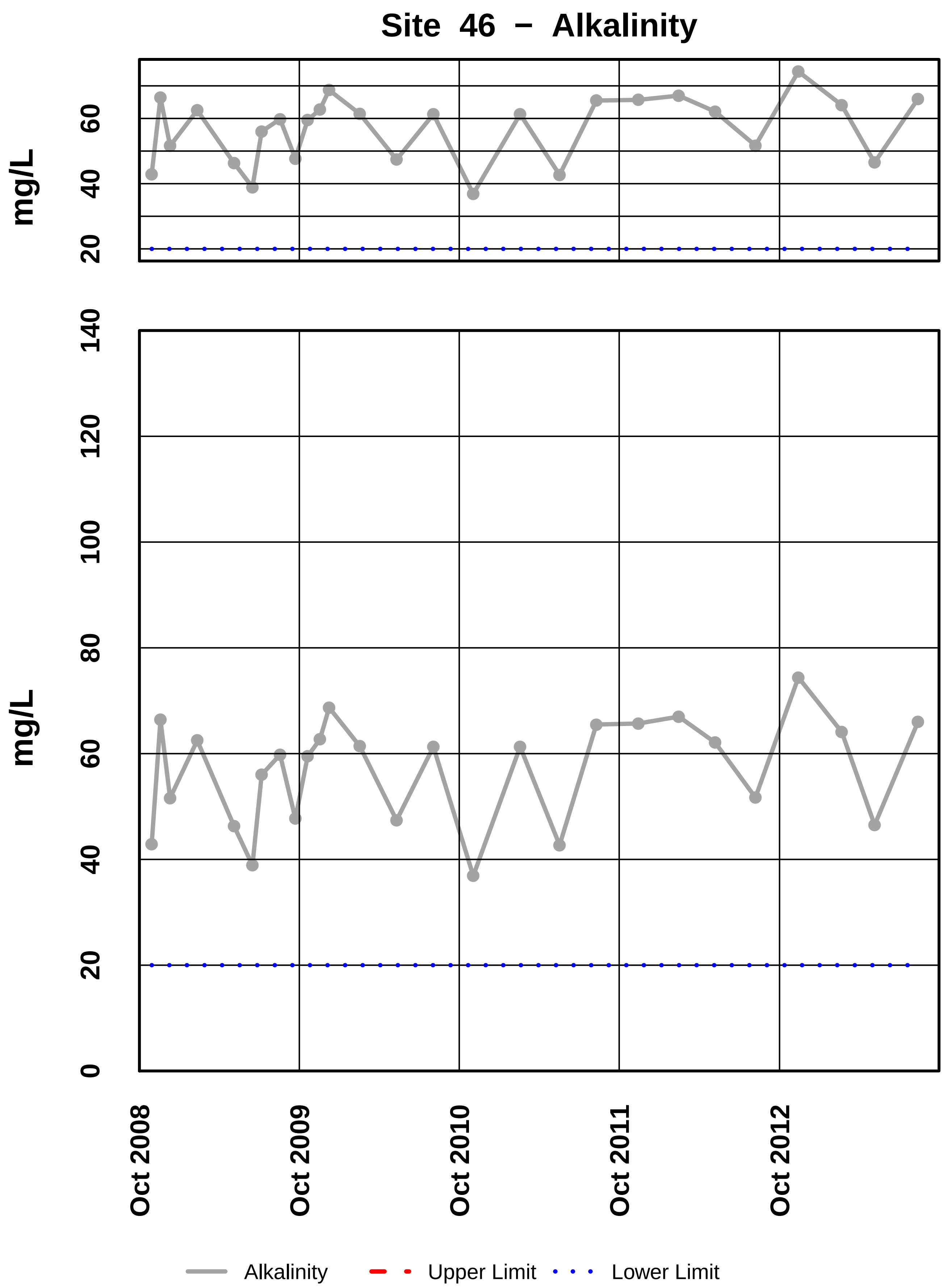


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

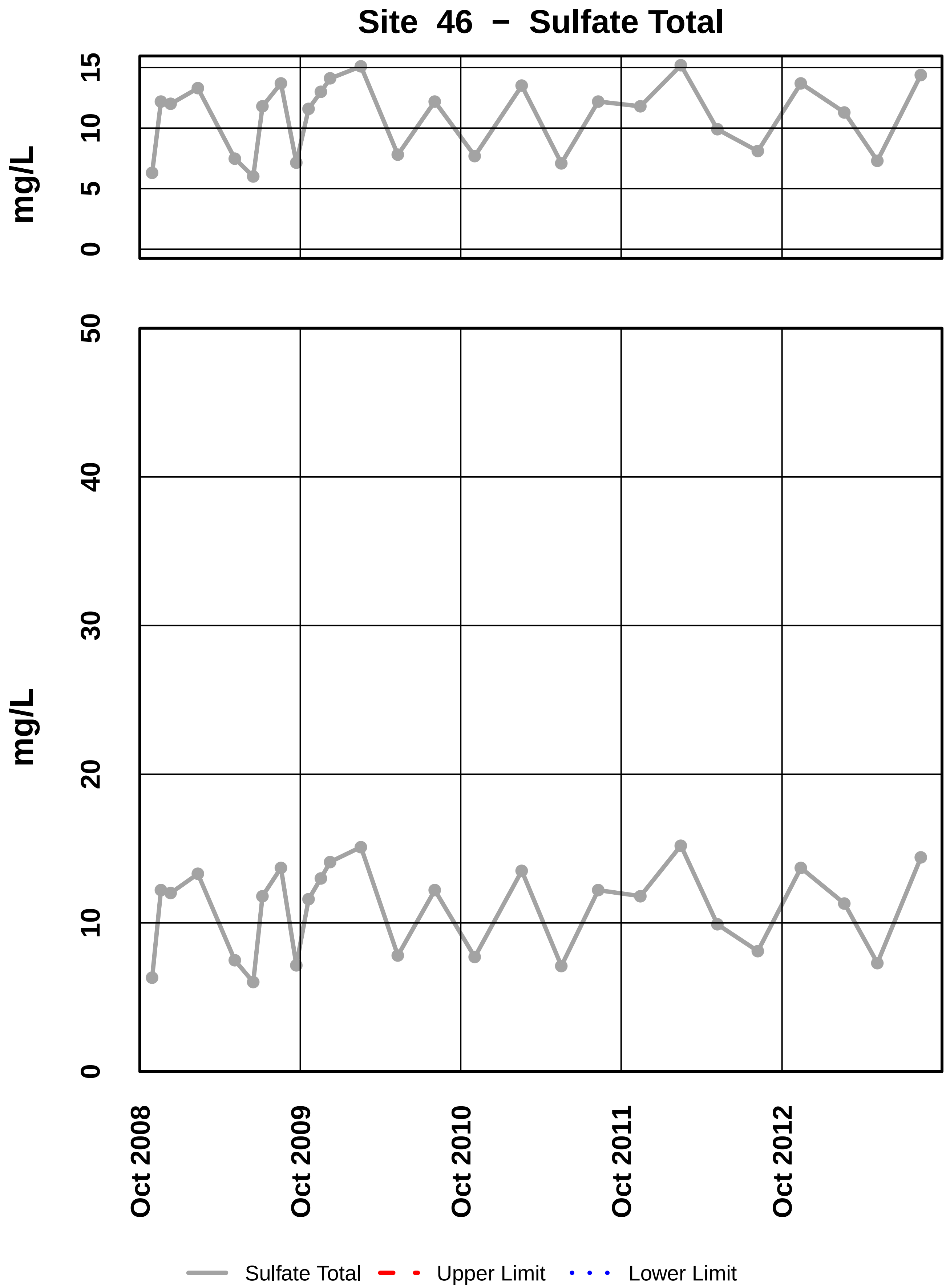
Site 46 – pH Field



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

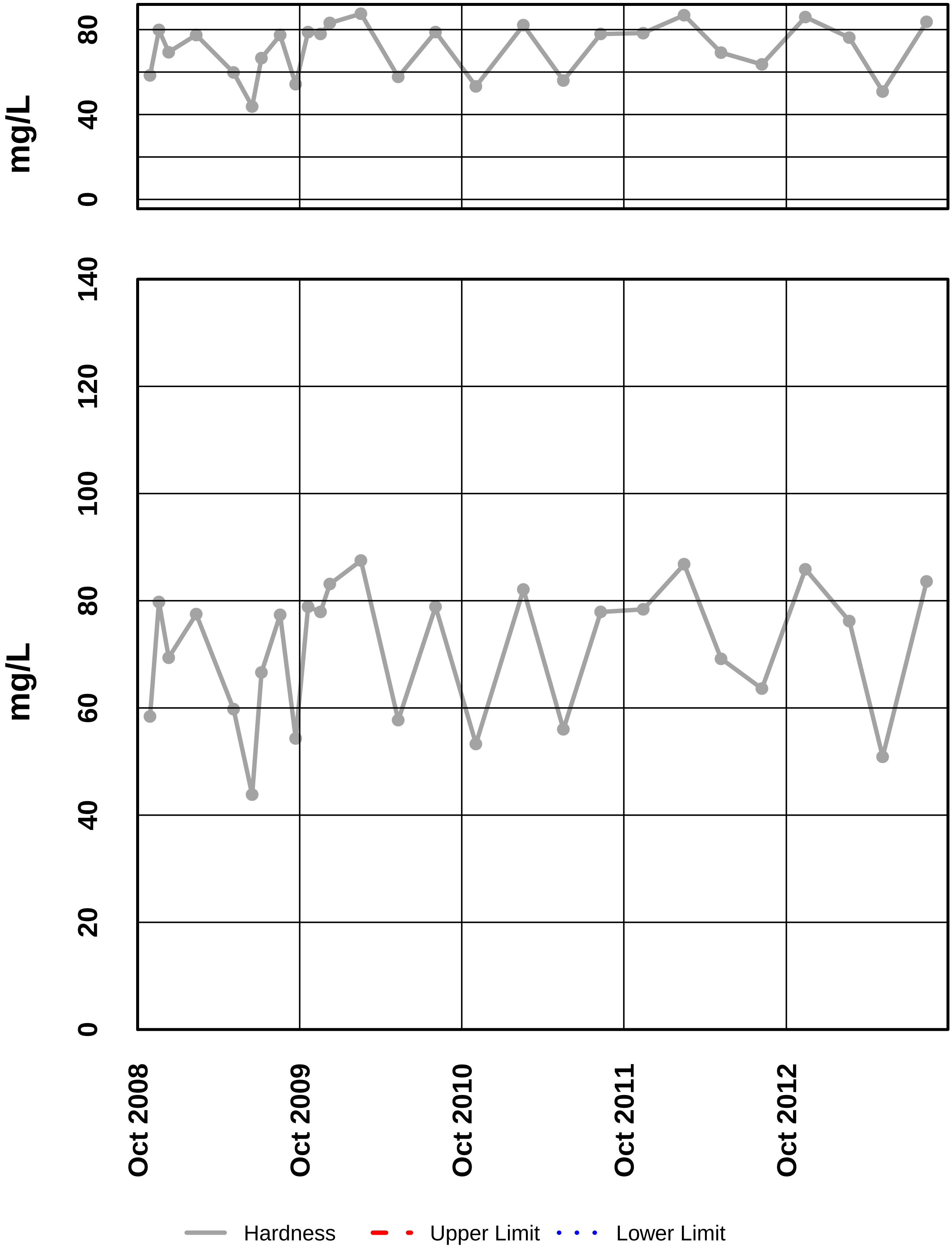


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

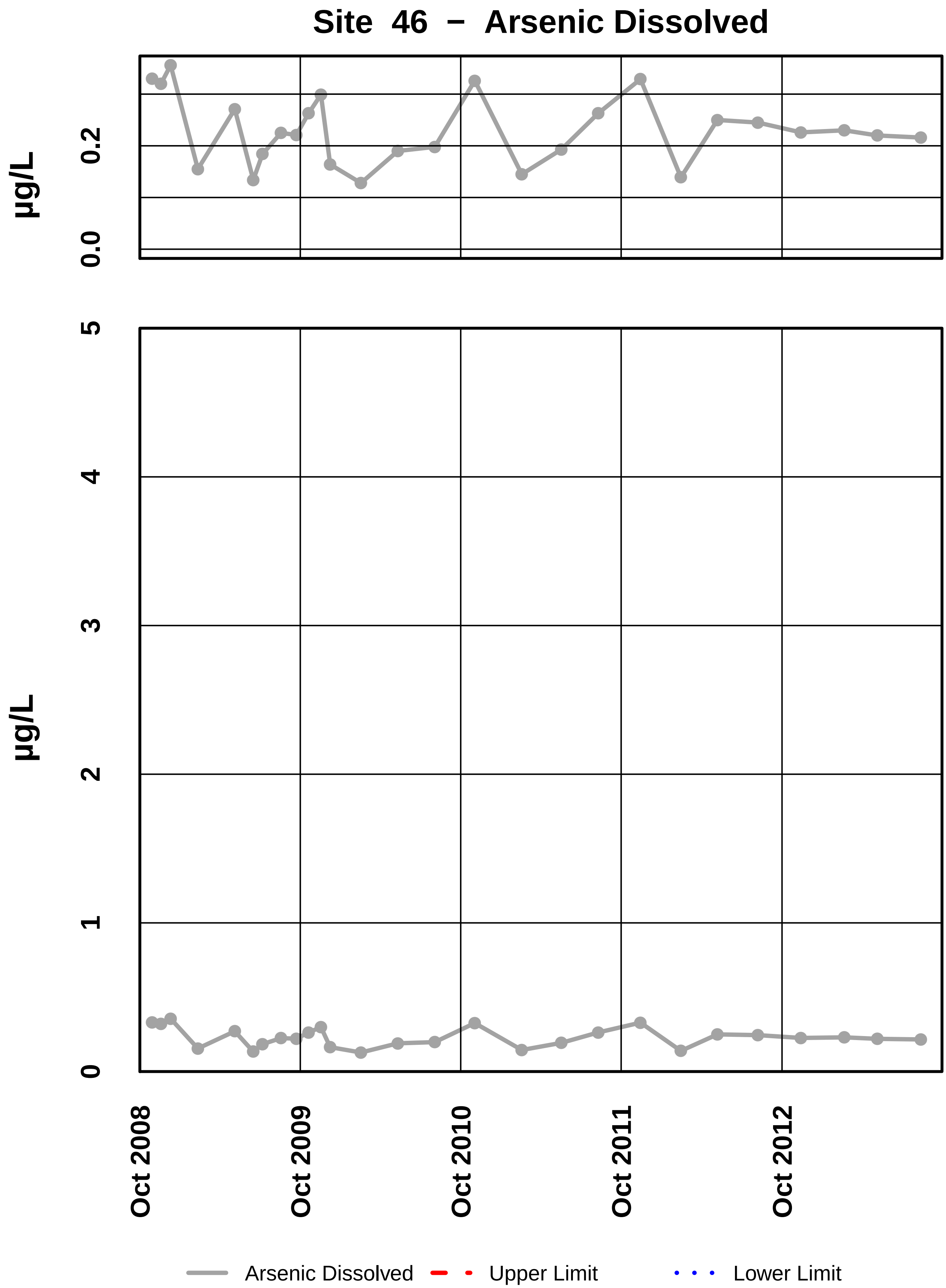


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 46 − Hardness

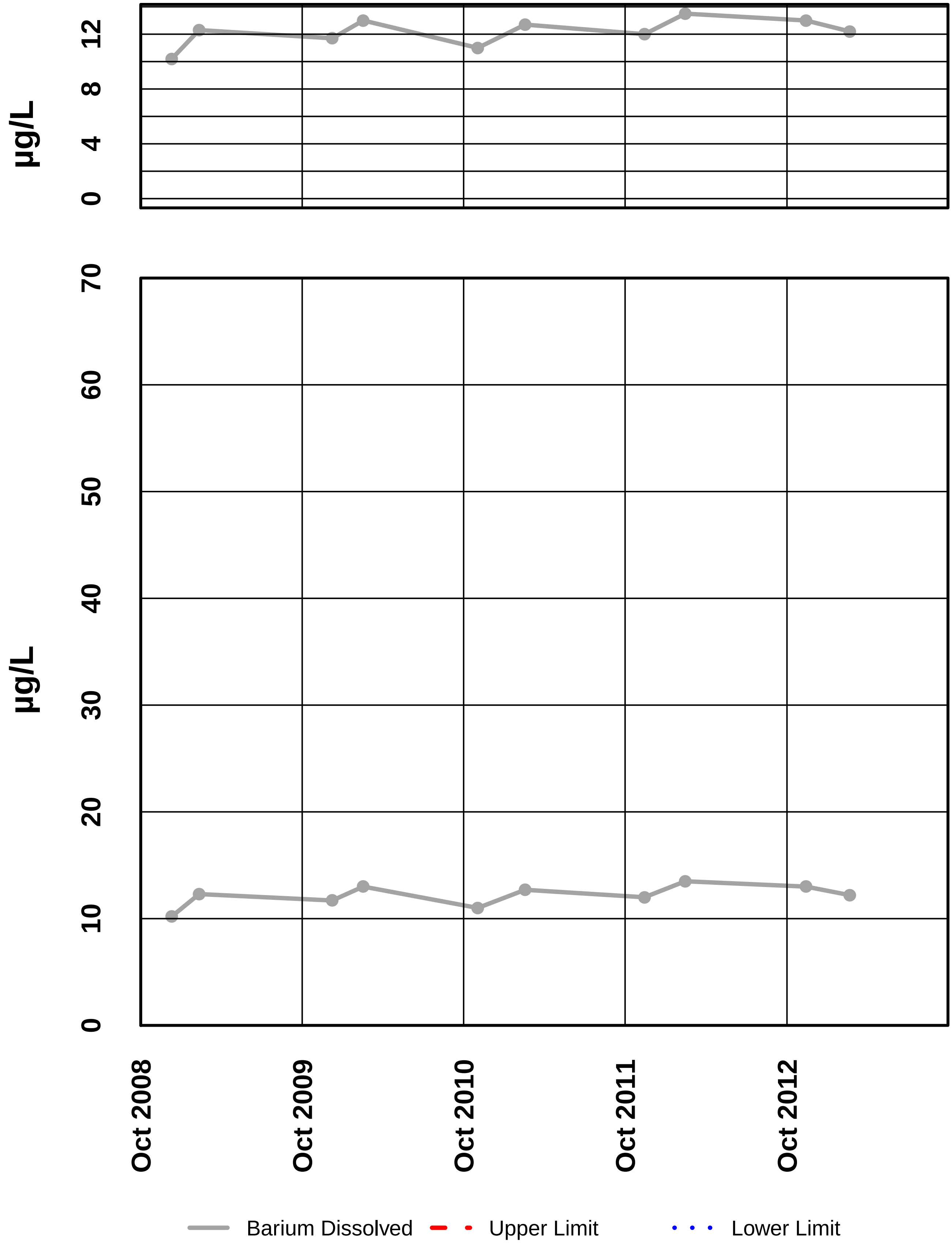


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

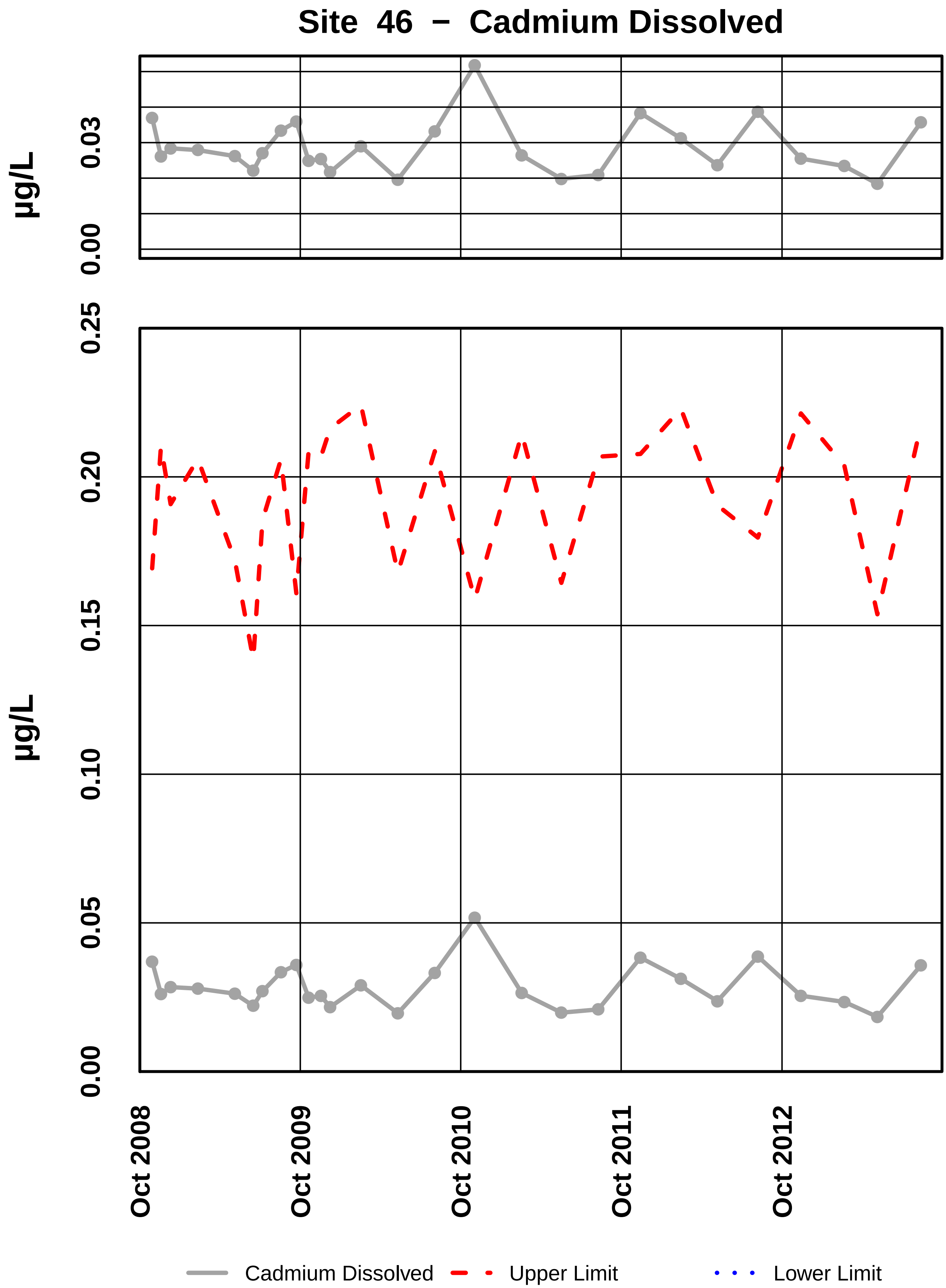


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

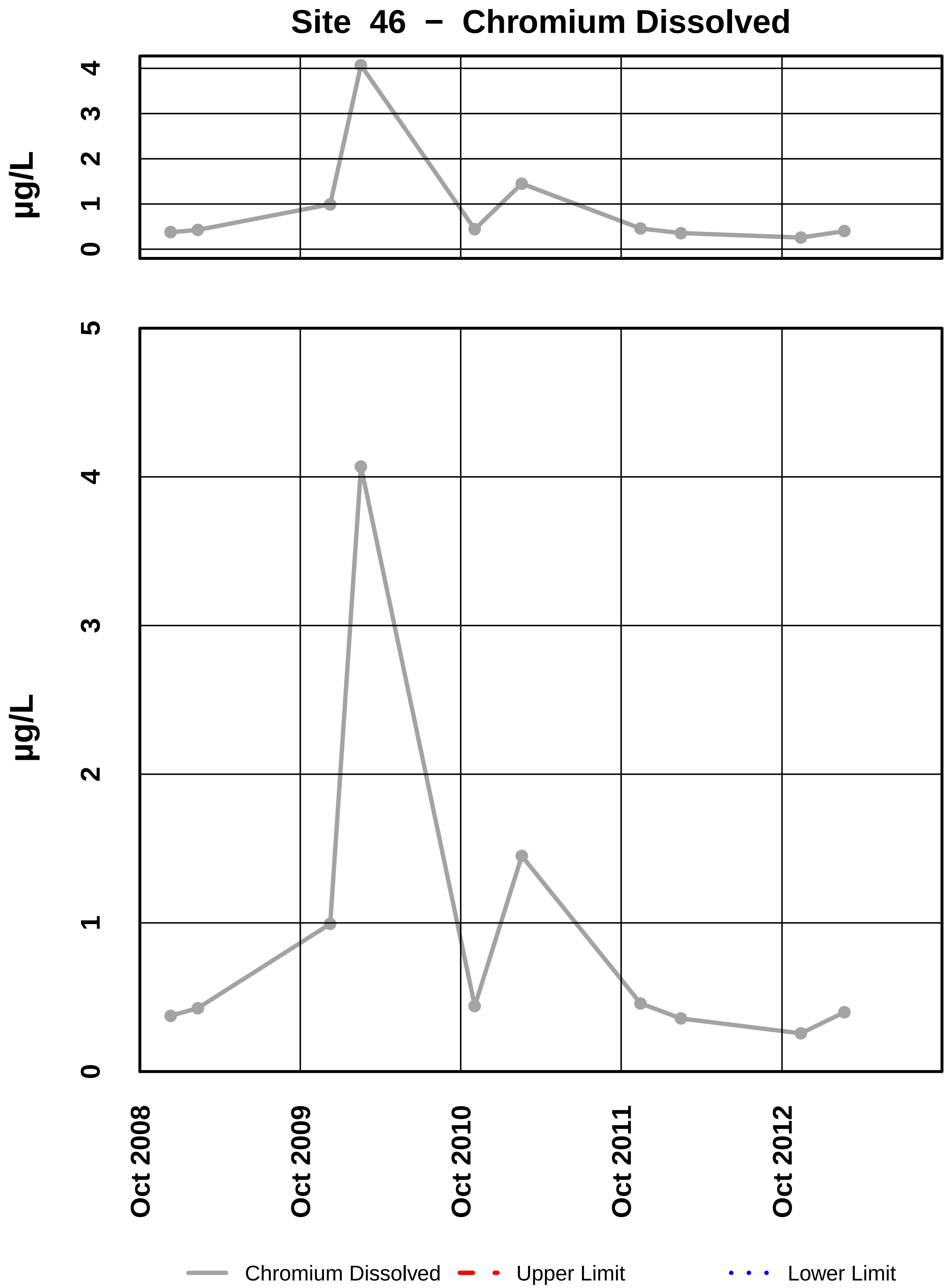
Site 46 – Barium Dissolved



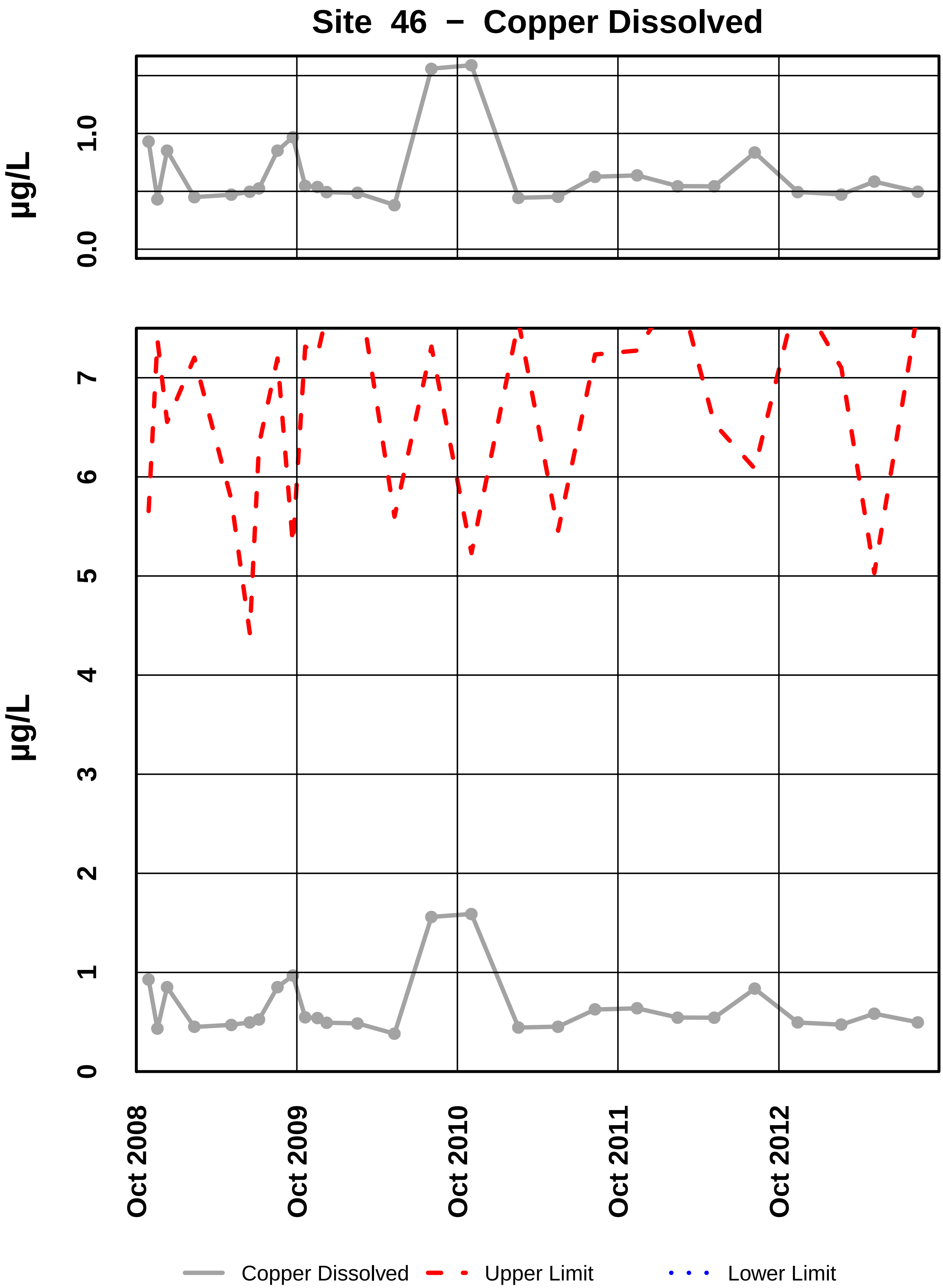
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

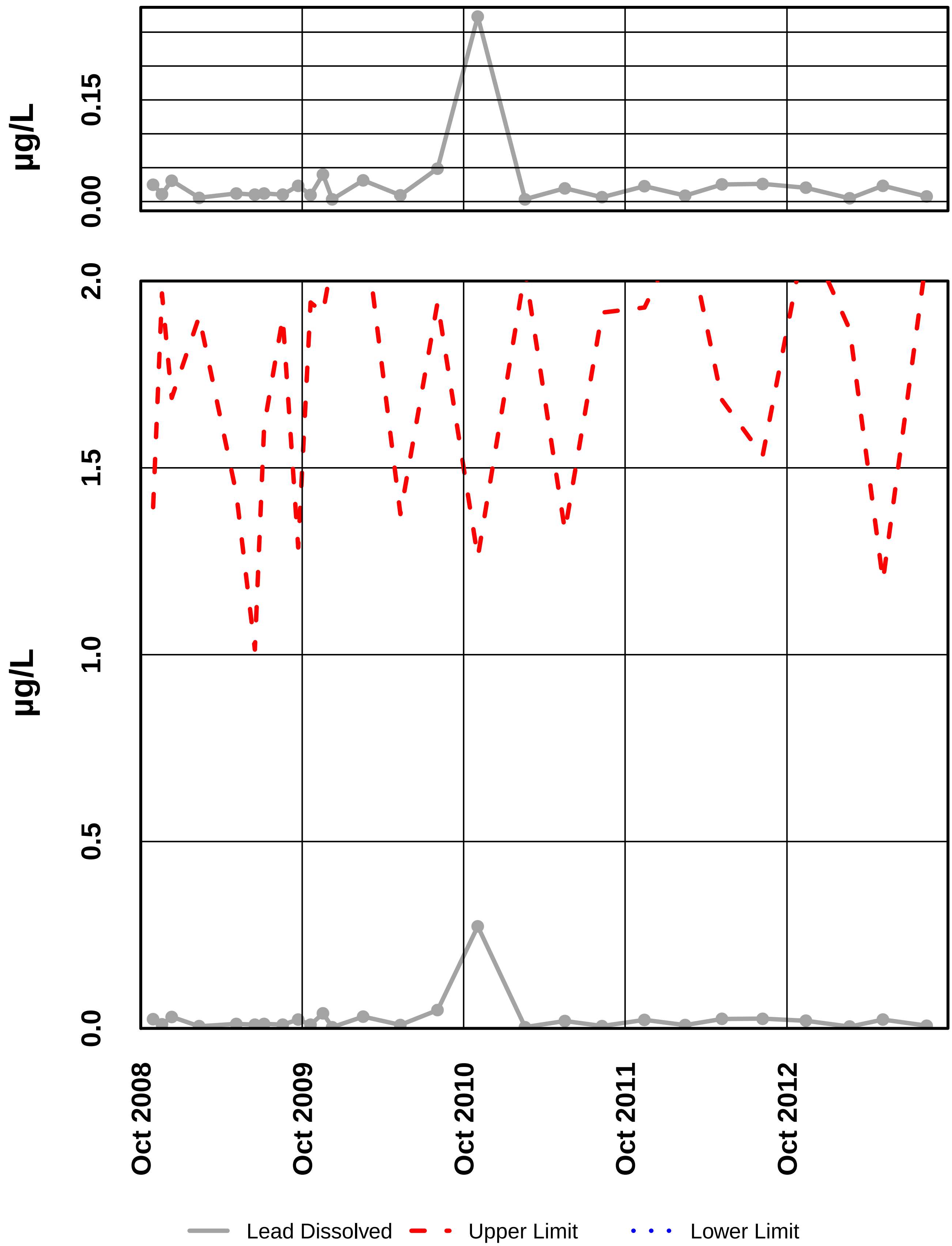


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



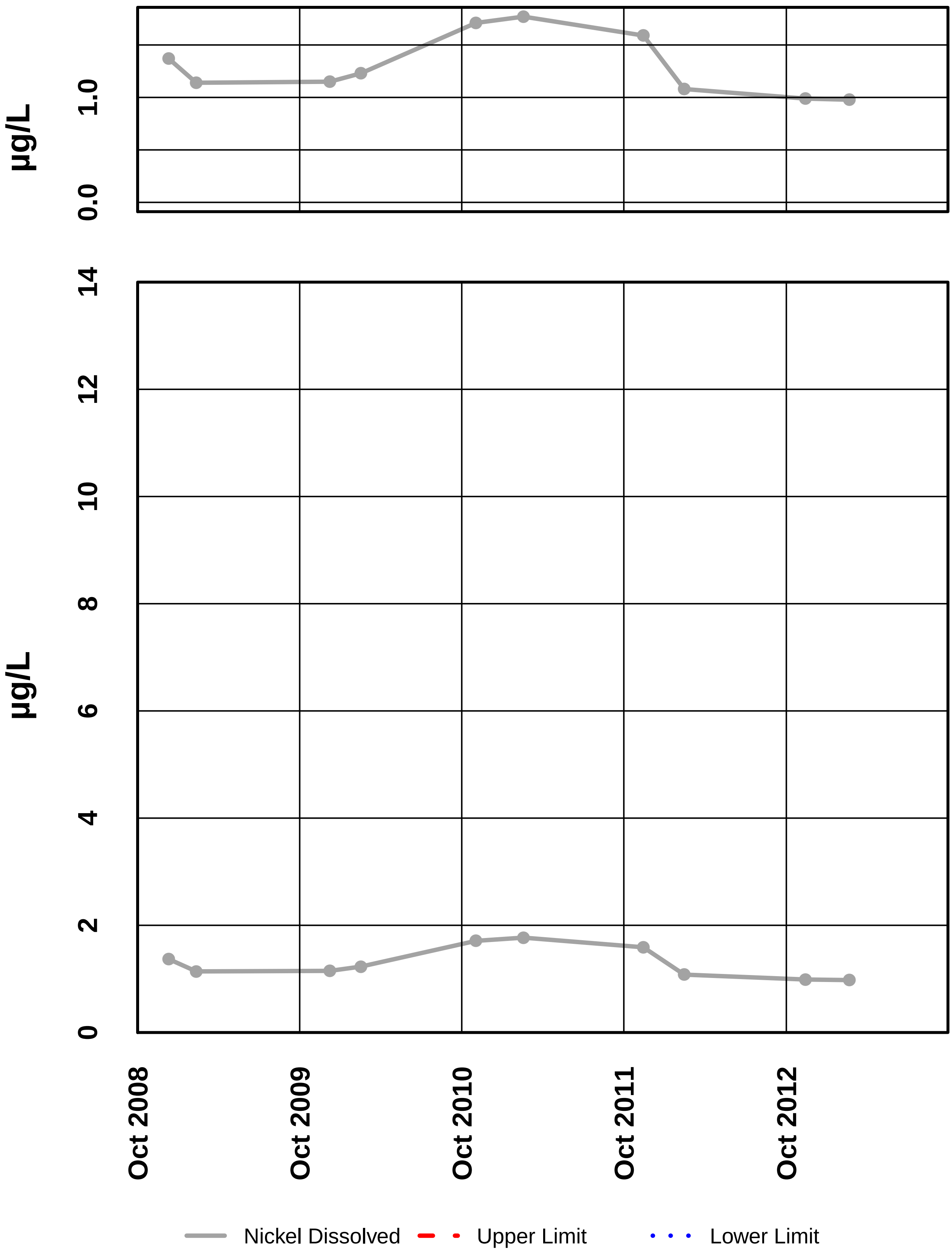
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 46 − Lead Dissolved



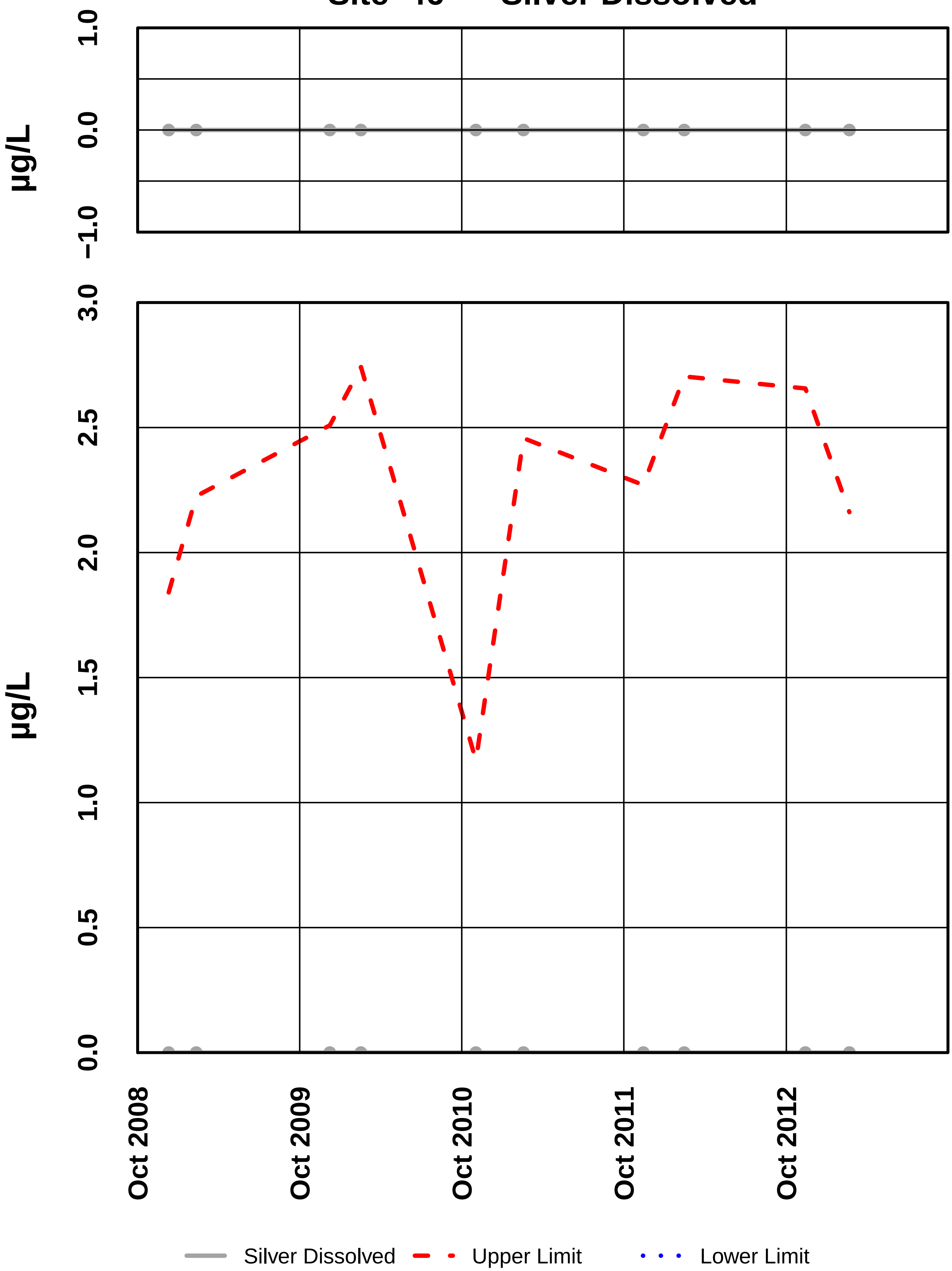
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 46 – Nickel Dissolved

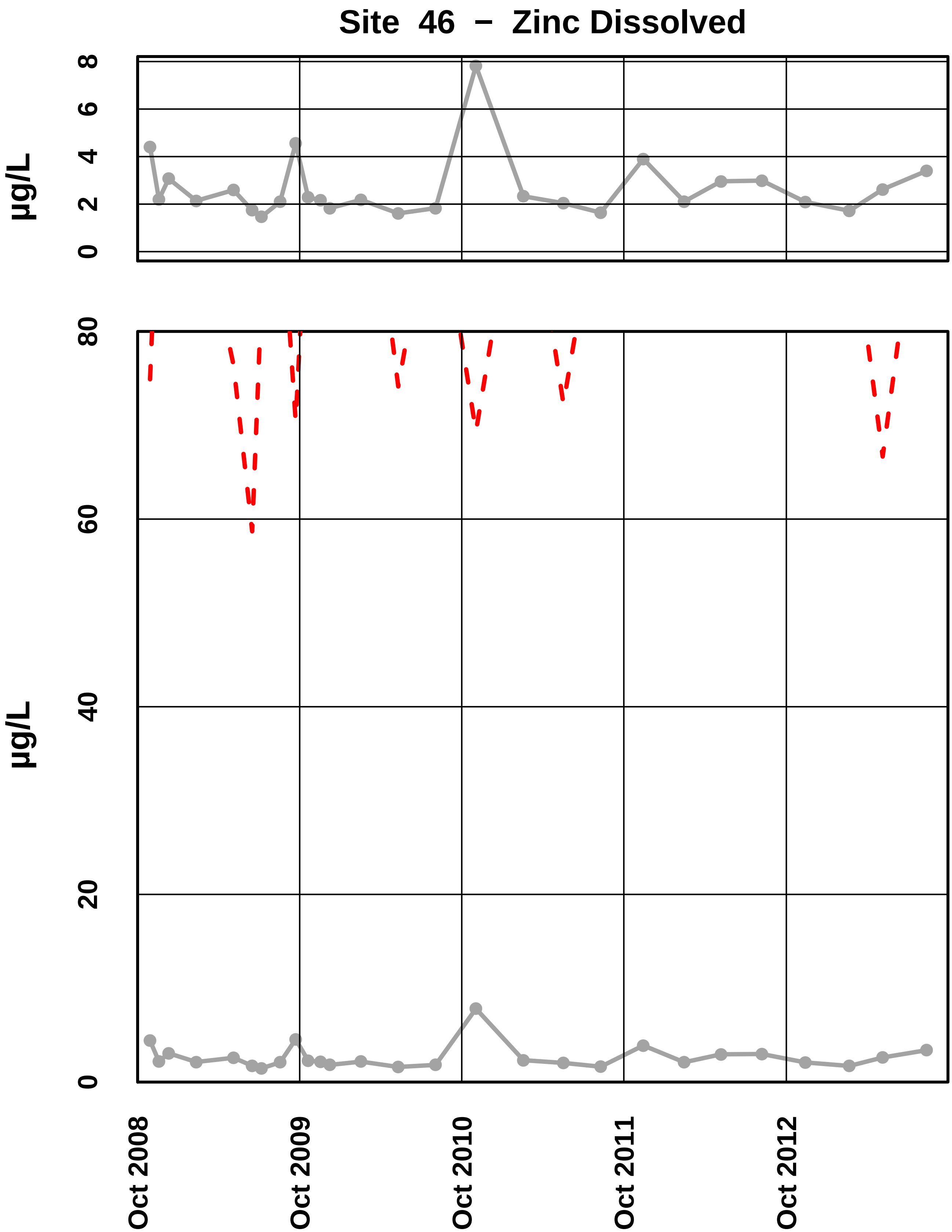


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

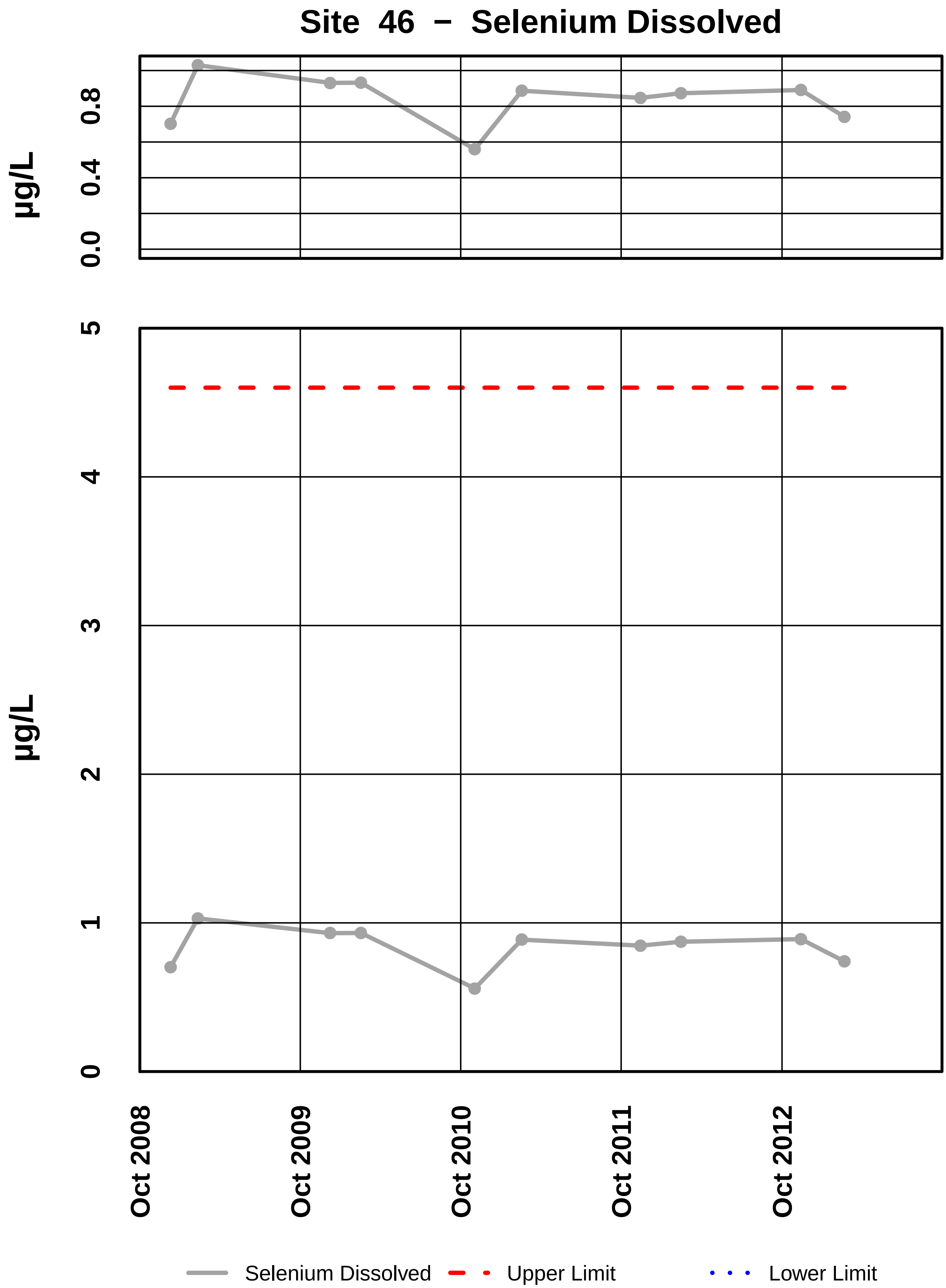
Site 46 − Silver Dissolved



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

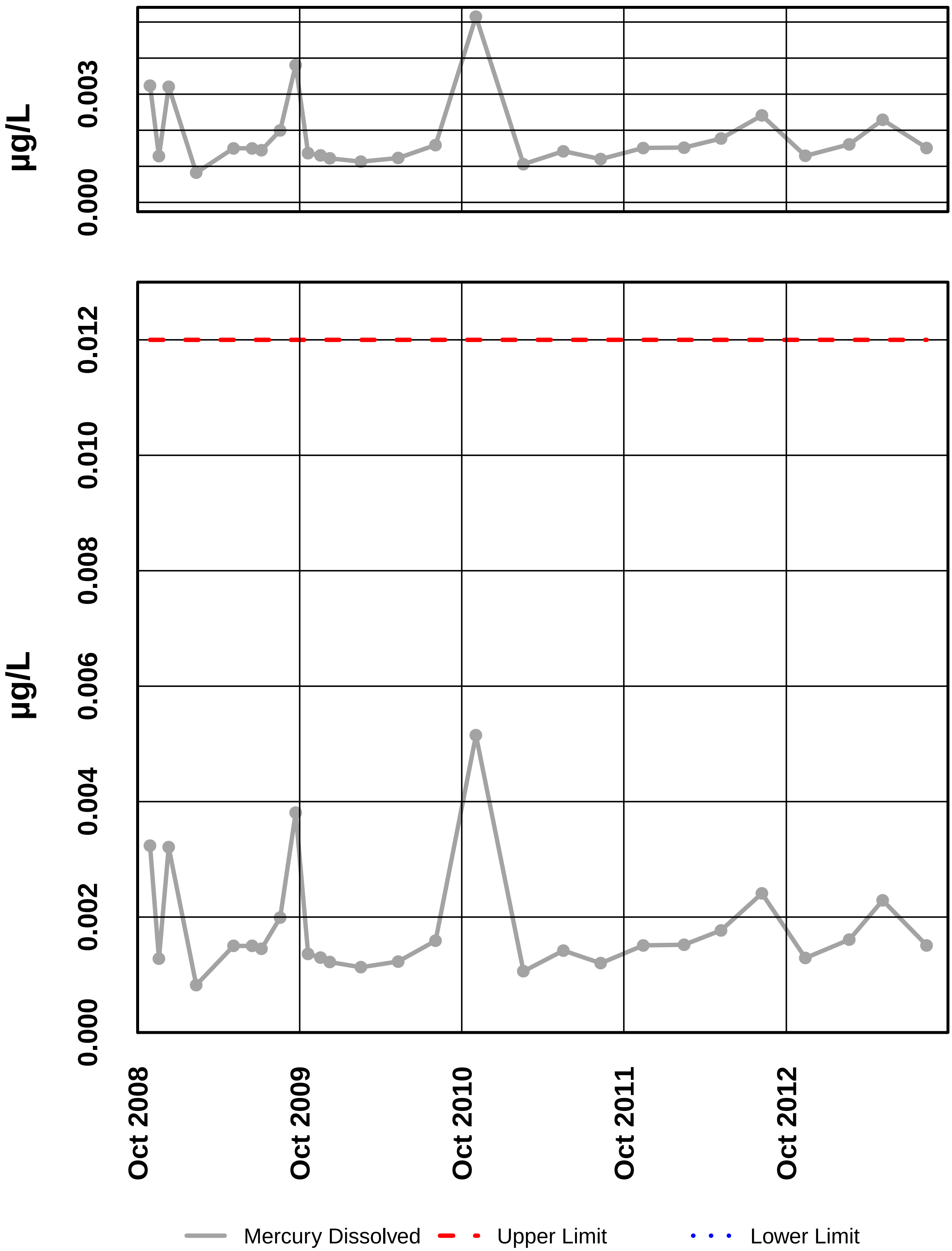


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

Site 46 – Mercury Dissolved



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

Site **#46** Seasonal Kendall analysis for Specific Conductance, Field (µS/cm)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**	134	153.8				207	151.8	125.5	93.7	117.2	121.9	113.4
b	**WY2009**	118	161.9	136.1		156.2			113.5	91.7	129.5	125.6	89
c	**WY2010**	157.4	133.6	173.5		176.2			124			147.2	
d	**WY2011**		105.6			164			114.3			125	
e	**WY2012**		140			147			147			133	
f	**WY2013**		167			169			122			179	
	n	3	6	2	0	5	1	1	6	2	2	6	2

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	3	6	2	0	5	1	1	6	2	2	6	2
t_2	0	0	0	0	0	0	0	0	0	0	0	0
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a	-1	1						-1	-1	1	1	-1
c-a	1	-1						-1			1	
d-a		-1						-1			1	
e-a		-1						1			1	
f-a		1						-1			1	
c-b	1	-1	1		1			1			1	
d-b		-1			1			1			-1	
e-b		-1			-1			1			1	
f-b		1			1			1			1	
d-c		-1			-1			-1			-1	
e-c		1			-1			1			-1	
f-c		1			-1			-1			1	
e-d		1			-1			1			1	
f-d		1			1			1			1	
f-e		1			1			-1			1	
S_k	1	1	1	0	0	0	0	1	-1	1	9	-1

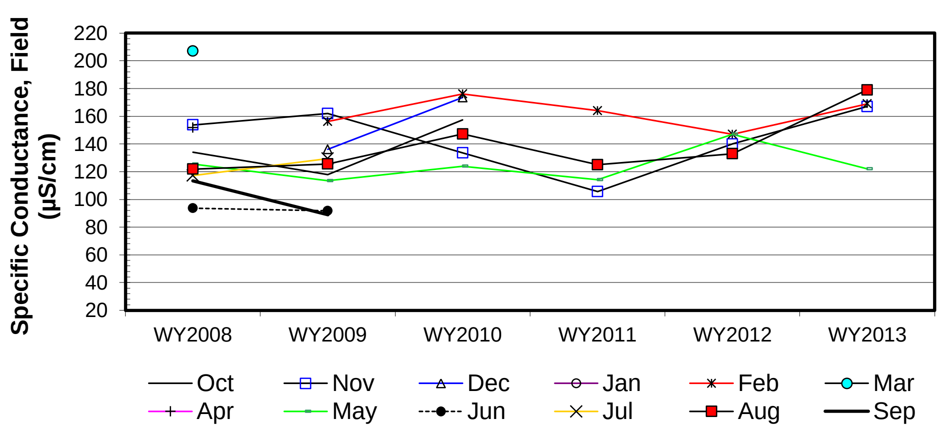
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	3.67	28.33	1.00		16.67			28.33	1.00	1.00	28.33	1.00
$Z_k = S_k/\sigma_S$	0.52	0.19	1.00		0.00			0.19	-1.00	1.00	1.69	-1.00
Z^2_k	0.27	0.04	1.00		0.00			0.04	1.00	1.00	2.86	1.00

ΣZ_k= 2.59
ΣZ^2_k= 7.20
Z-bar=ΣZ_k/K= 0.29

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	36	0	0	0	0

Σn 36
ΣS_k 12

$\chi^2_h=\Sigma Z^2_k$-K(Z-bar)^2=		6.46	@α=5% $\chi^2_{(K-1)}$=	15.51	Test for station homogeneity
	p	**0.596**			$\chi^2_h<\chi^2_{(K-1)}$ ACCEPT
ΣVAR(S_k)	Z_{calc}	1.05	@α/2=2.5% Z=	1.96	**H_0** (No trend) ACCEPT
109.33	p	**0.854**			**H_A** (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-3.13		10.69
0.050	-0.73	**2.57**	6.95
0.100	-0.56		3.89
0.200	0.78		3.40

Site **#46** Seasonal Kendall analysis for pH, Field, Standard Units

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**	8.1	7.9				7.5	7.5	7.9	8.0	7.7	7.3	7.6
b	**WY2009**	8.0	8.0	7.9		7.5			7.3	7.1	7.2	7.2	7.4
c	**WY2010**	7.9	7.4	7.2		7.0			7.7			6.9	
d	**WY2011**		7.9			7.4			7.8			7.9	
e	**WY2012**		8.1			7.4			8.0			7.9	
f	**WY2013**		7.8			7.5			7.9			7.6	
	n	3	6	2	0	5	1	1	6	2	2	6	2

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	3	4	2	0	5	1	1	6	2	2	6	2
t_2	0	1	0	0	0	0	0	0	0	0	0	0
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a	-1	1						-1	-1	-1	-1	-1
c-a	-1	-1						-1			-1	
d-a		0						-1			1	
e-a		1						1			1	
f-a		-1						-1			1	
c-b	-1	-1	-1		-1			1			-1	
d-b		-1			-1			1			1	
e-b		1			-1			1			1	
f-b		-1			1			1			1	
d-c		1			1			1			1	
e-c		1			1			1			1	
f-c		1			1			1			1	
e-d		1			1			1			1	
f-d		-1			1			1			-1	
f-e		-1			1			-1			-1	
S_k	-3	0	-1	0	4	0	0	5	-1	-1	5	-1

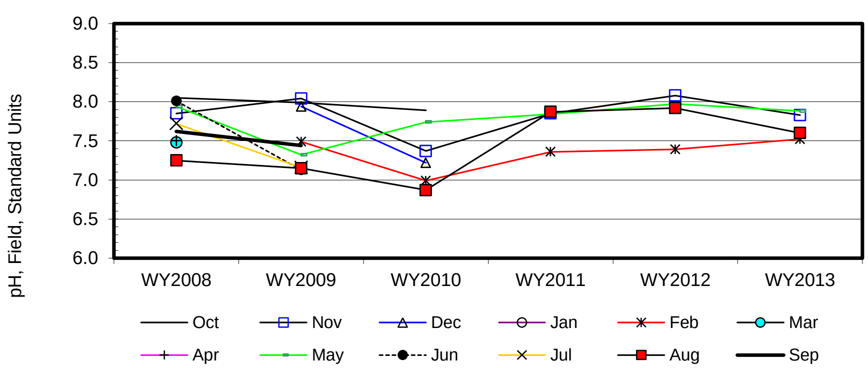
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	3.67	27.33	1.00		16.67			28.33	1.00	1.00	28.33	1.00
$Z_k = S_k/\sigma_S$	-1.57	0.00	-1.00		0.98			0.94	-1.00	-1.00	0.94	-1.00
Z^2_k	2.45	0.00	1.00		0.96			0.88	1.00	1.00	0.88	1.00

ΣZ_k= -2.71
ΣZ^2_k= 9.18
Z-bar=$\Sigma Z_k/K$= -0.30

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	34	1	0	0	0

Σn 36
ΣS_k 7

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$= 8.36	@α=5% $\chi^2_{(K-1)}$= 15.51	Test for station homogeneity	
p **0.399**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k) 108.33	Z_{calc} 0.58, **p** **0.718**	@α/2=2.5% Z= 1.96	**H_0** (No trend) ACCEPT; **H_A** (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.08		0.13
0.050	-0.04	**0.02**	0.11
0.100	-0.03		0.08
0.200	-0.01		0.05

Site #46 — Seasonal Kendall analysis for Total Alk, (mg/l)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**	52.4	61.0				71.7	75.2	48.7	34.8	46.5	53.1	45.6
b	**WY2009**	42.9	66.4	51.6		62.5			46.3	38.9	56.0	59.8	47.7
c	**WY2010**	59.5	62.7	68.7		61.4			47.4			61.3	
d	**WY2011**		36.9			61.3			42.7			65.5	
e	**WY2012**		65.7			67.0			62.1			51.7	
f	**WY2013**		74.4			64.1			46.5			66.0	
	n	3	6	2	0	5	1	1	6	2	2	6	2

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	3	6	2	0	5	1	1	6	2	2	6	2
t_2	0	0	0	0	0	0	0	0	0	0	0	0
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a	-1	1						-1	1	1	1	1
c-a	1	1						-1			1	
d-a		-1						-1			1	
e-a		1						1			-1	
f-a		1						-1			1	
c-b	1	-1	1		-1			1			1	
d-b		-1			-1			-1			1	
e-b		-1			1			1			-1	
f-b		1			1			1			1	
d-c		-1			-1			-1			1	
e-c		1			1			1			-1	
f-c		1			1			-1			1	
e-d		1			1			1			-1	
f-d		1			1			1			1	
f-e		1			-1			-1			1	
S_k	1	5	1	0	2	0	0	-1	1	1	7	1

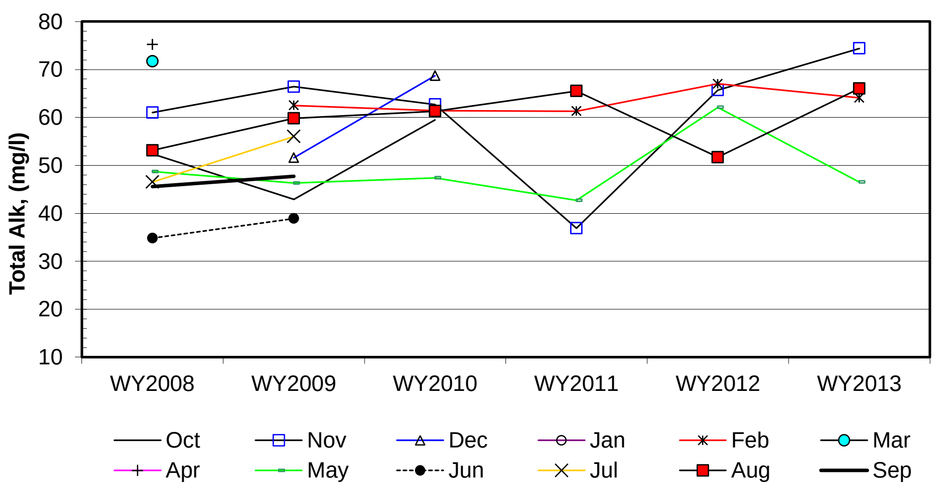
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	3.67	28.33	1.00		16.67			28.33	1.00	1.00	28.33	1.00
$Z_k = S_k/\sigma_S$	0.52	0.94	1.00		0.49			-0.19	1.00	1.00	1.32	1.00
Z^2_k	0.27	0.88	1.00		0.24			0.04	1.00	1.00	1.73	1.00

ΣZ_k= 7.08
ΣZ^2_k= 7.16
Z-bar=ΣZ_k/K= 0.79

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	36	0	0	0	0

Σn 36
ΣS_k 18

$\chi^2_h=\Sigma Z^2_k$-K(Z-bar)^2=	1.59	@α=5% $\chi^2_{(K-1)}$=	15.51	Test for station homogeneity
p	**0.991**			$\chi^2_h<\chi^2_{(K-1)}$ ACCEPT
ΣVAR(S_k)	Z_{calc} 1.63	@α/2=2.5% Z=	1.96	H_0 (No trend) ACCEPT
109.33	p **0.948**			H_A (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.36		3.38
0.050	-0.04	**1.50**	2.64
0.100	0.29		2.07
0.200	0.88		1.70

Site #46 — Seasonal Kendall analysis for Sulfate, Total (mg/l)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**	10.0	8.2				15.6	16.8	7.7	4.8	7.9	7.7	5.9
b	**WY2009**	6.3	12.2	12.0		13.3			7.5	6.0	11.8	13.7	7.2
c	**WY2010**	11.6	13.0	14.1		15.1			7.8			12.2	
d	**WY2011**		7.7			13.5			7.1			12.2	
e	**WY2012**		11.8			15.2			9.9			8.1	
f	**WY2013**		13.7			11.3			7.3			14.4	
	n	3	6	2	0	5	1	1	6	2	2	6	2

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	3	6	2	0	5	1	1	6	2	2	4	2
t_2	0	0	0	0	0	0	0	0	0	0	1	0
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a	-1	1						-1	1	1	1	1
c-a	1	1						1			1	
d-a		-1						-1			1	
e-a		1						1			1	
f-a		1						-1			1	
c-b	1	1	1		1			1			-1	
d-b		-1			1			-1			-1	
e-b		-1			1			1			-1	
f-b		1			-1			-1			1	
d-c		-1			-1			-1			0	
e-c		-1			1			1			-1	
f-c		1			-1			-1			1	
e-d		1			1			1			-1	
f-d		1			-1			1			1	
f-e		1			-1			-1			1	
S_k	1	5	1	0	0	0	0	-1	1	1	4	1

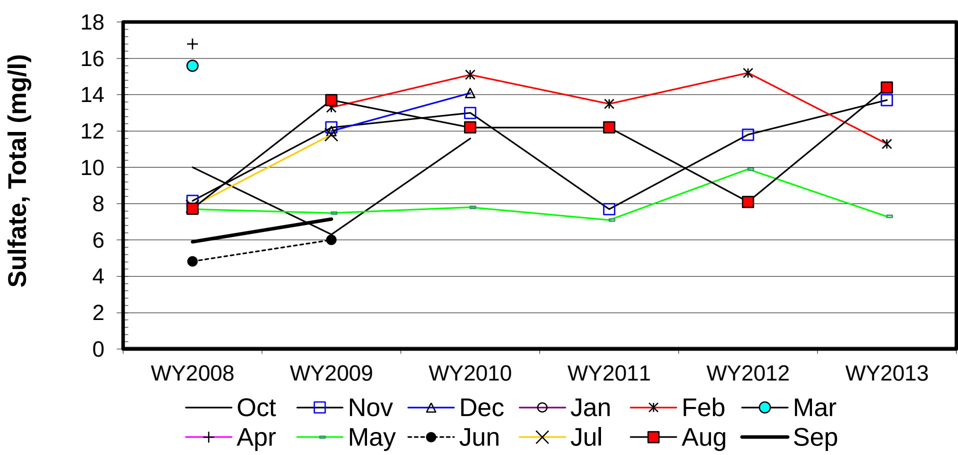
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
$\sigma^2_S=$	3.67	28.33	1.00		16.67			28.33	1.00	1.00	27.33	1.00
$Z_k = S_k/\sigma_S$	0.52	0.94	1.00		0.00			-0.19	1.00	1.00	0.77	1.00
Z^2_k	0.27	0.88	1.00		0.00			0.04	1.00	1.00	0.59	1.00

$\Sigma Z_k=$ 6.04
$\Sigma Z^2_k=$ 5.78
Z-bar$=\Sigma Z_k/K=$ 0.67

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	34	1	0	0	0

Σn 36
ΣS_k 13

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2=$	1.72	@α=5% $\chi^2_{(K-1)}=$ 15.51	Test for station homogeneity	
p	**0.988**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
$\Sigma VAR(S_k)$	Z_{calc} 1.15	@α=2.5% Z= 1.96	H_0 (No trend)	ACCEPT
108.33	**p** **0.876**		H_A (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.20		1.10
0.050	-0.11	**0.20**	0.80
0.100	-0.03		0.78
0.200	0.05		0.58

Site #46 — Seasonal Kendall analysis for Zinc, Dissolved (ug/l)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**	2.4	3.2				2.5	3.0	2.2	1.6	1.6	2.4	3.8
b	**WY2009**	4.4	2.2	3.1		2.1			2.6	1.7	1.5	2.1	4.6
c	**WY2010**	2.3	2.2	1.8		2.2			1.6			1.8	
d	**WY2011**		7.8			2.3			2.0			1.6	
e	**WY2012**		3.9			2.1			3.0			3.0	
f	**WY2013**		2.1			1.7			2.6			3.4	
	n	3	6	2	0	5	1	1	6	2	2	6	2

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	3	6	2	0	5	1	1	6	2	2	6	2
t_2	0	0	0	0	0	0	0	0	0	0	0	0
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a	1	-1						1	1	-1	-1	1
c-a	-1	-1						-1			-1	
d-a		1						-1			-1	
e-a		1						1			1	
f-a		-1						1			1	
c-b	-1	-1	-1		1			-1			-1	
d-b		1			1			-1			-1	
e-b		1			-1			1			1	
f-b		-1			-1			1			1	
d-c		1			1			1			-1	
e-c		1			-1			1			1	
f-c		-1			-1			1			1	
e-d		-1			-1			1			1	
f-d		-1			-1			1			1	
f-e		-1			-1			-1			1	
S_k	-1	-3	-1	0	-4	0	0	5	1	-1	3	1

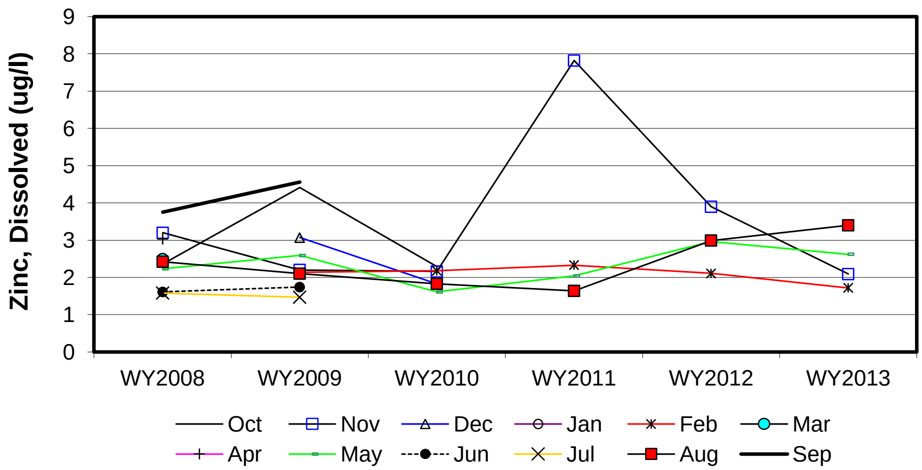
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	3.67	28.33	1.00		16.67			28.33	1.00	1.00	28.33	1.00
$Z_k = S_k/\sigma_S$	-0.52	-0.56	-1.00		-0.98			0.94	1.00	-1.00	0.56	1.00
Z^2_k	0.27	0.32	1.00		0.96			0.88	1.00	1.00	0.32	1.00

ΣZ_k= -0.56
ΣZ^2_k= 6.75
Z-bar=ΣZ_k/K= -0.06

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	36	0	0	0	0

Σn 36
ΣS_k 0

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	6.72	@α=5% $\chi^2_{(K-1)}$= 15.51	Test for station homogeneity	
p	**0.568**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k) Z_{calc}	0.00	@α/2=2.5% Z= 1.96	**H_0** (No trend)	ACCEPT
109.33 p	**0.500**		**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.22		0.29
0.050	-0.14	**0.00**	0.16
0.100	-0.09		0.14
0.200	-0.04		0.11

INTERPRETIVE REPORT
SITE 57

The data collected during the current water year are listed in the following “Table of Results for Water Year 2013” 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 2007 through September 2013.				

The data for Water Year 2013 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 2013

			Limits		
Sample Date	**Parameter**	**Value**	**Lower**	**Upper**	**Hardness**
No exceedances have been identified by HGCMC for the period of October 2012 through September 2013.					

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-07 and Sep-13 (WY2008-WY2013). Datasets with a statistically significant trend ($\alpha/2=2.5\%$) a Seasonal-Sen’s Slope estimate statistic has also been calculated. There were no statistically significant trends calculated for these parameters this water year.

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	-	-8.767	-2.072
pH Field	6	0.02	+	0.024	0.32
Alkalinity, Total	6	0.02	+	2.75	2.0
Sulfate, Total	6	0.50			
Zinc, Dissolved	6	0.30			

* 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**

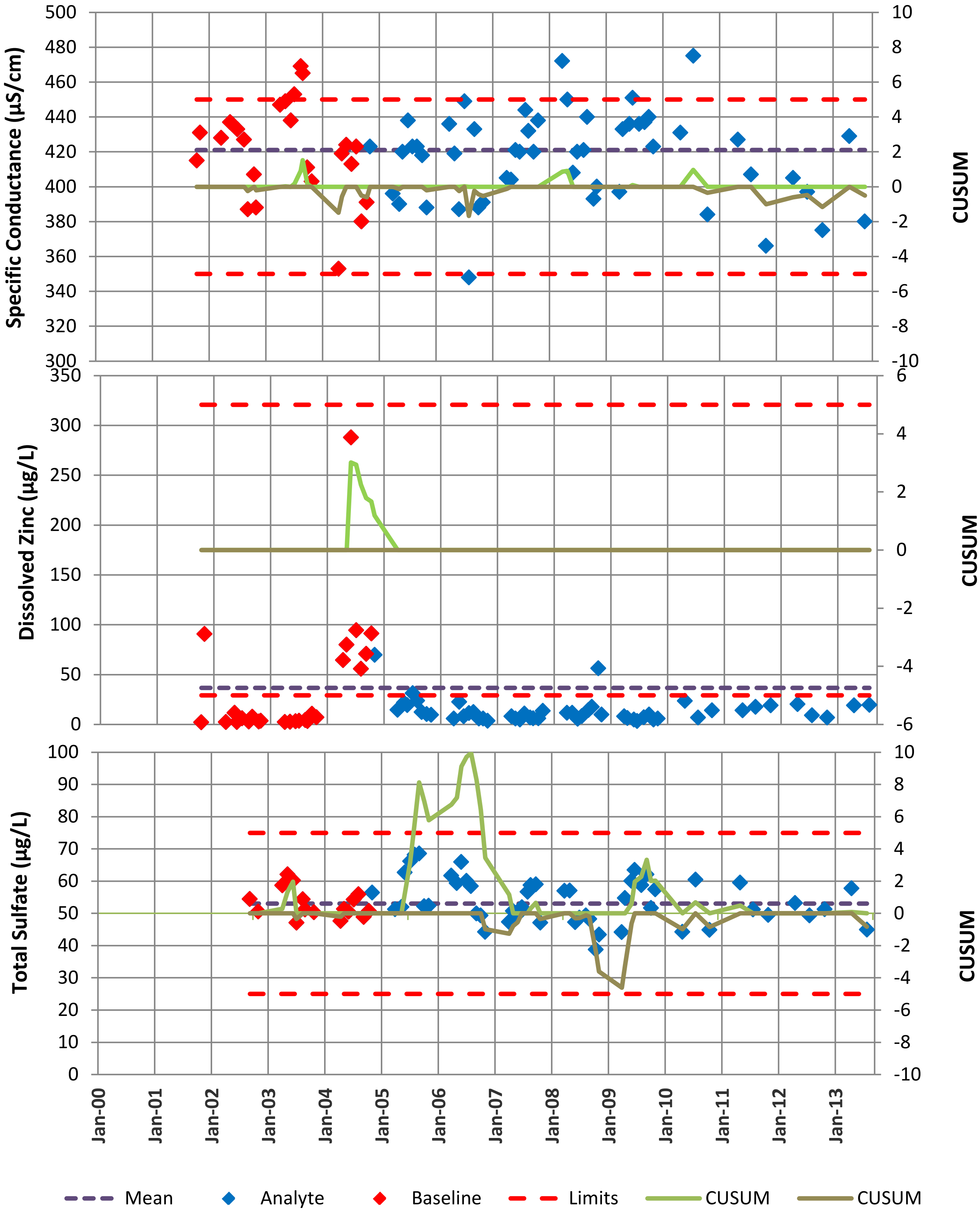


Table of Results for Water Year 2013

Site 057FMG - 'Monitoring Well -23-00-03'

Sample Date/Parameter	Oct 2012	Nov 2012	Dec 2012	Jan 2013	Feb 2013	Mar 2013	Apr 2013	May 2013	Jun 2013	Jul 2013	Aug 2013	Sep 2013	**Median**
Water Temp (°C)		4.5						5.1			6.5		5.1
Conductivity-Field(µmho)		375						429			380		380.0
Conductivity-Lab (µmho)		384						411			359		384
pH Lab (standard units)		7.57						7.54			7.69		7.57
pH Field (standard units)		7.73						7.54			7.78		7.73
Total Alkalinity (mg/L)		161						149			135		149.0
Total Sulfate (mg/L)		51.3						57.8			45		51.3
Hardness (mg/L)		196						202			184		196.0
Dissolved As (ug/L)		0.363						0.529			0.586		0.529
Dissolved Ba (ug/L)		31.4						31.5			29.3		31.4
Dissolved Cd (ug/L)		0.187						0.192			0.167		0.1870
Dissolved Cr (ug/L)		0.364						0.509			0.524		0.509
Dissolved Cu (ug/L)		0.318						1.49			0.78		0.780
Dissolved Pb (ug/L)		0.0353						1.11			0.185		0.1850
Dissolved Ni (ug/L)		1.86						2.34			2.85		2.340
Dissolved Ag (ug/L)		0.002						0.002			0		0.002
Dissolved Zn (ug/L)		6.92						19			19.6		19.00
Dissolved Se (ug/L)		0.965						0.544			0.77		0.770
Dissolved Hg (ug/L)		0.000187						0.000278			0.00028		0.000278

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.

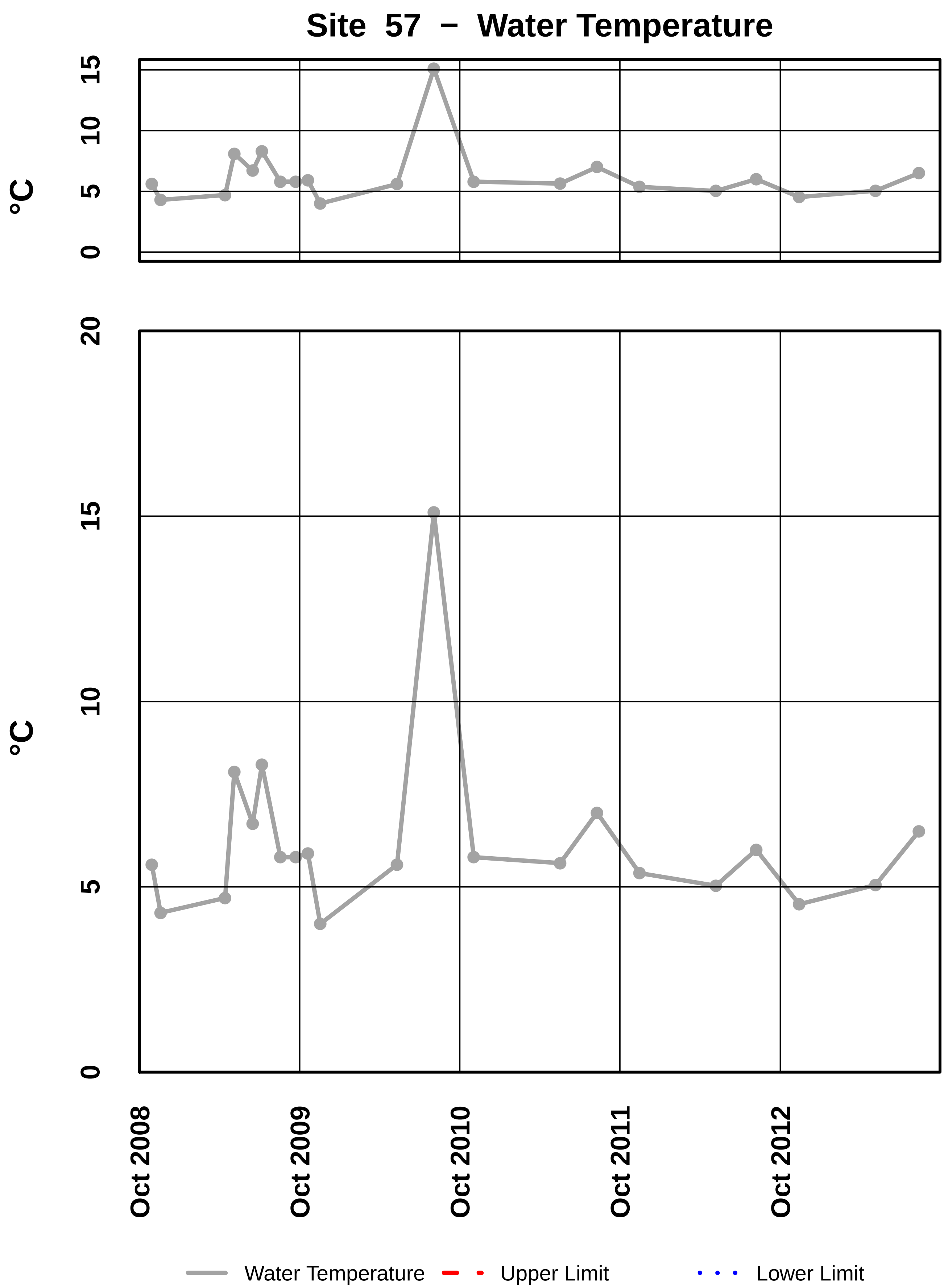
Shaded data has been qualified as an outlier by HGCMC and removed from any further analysis and is not included into the calculation of the median

Qualified Data by QA Reviewer

Date Range: 10/01/2012 to 09/30/2013

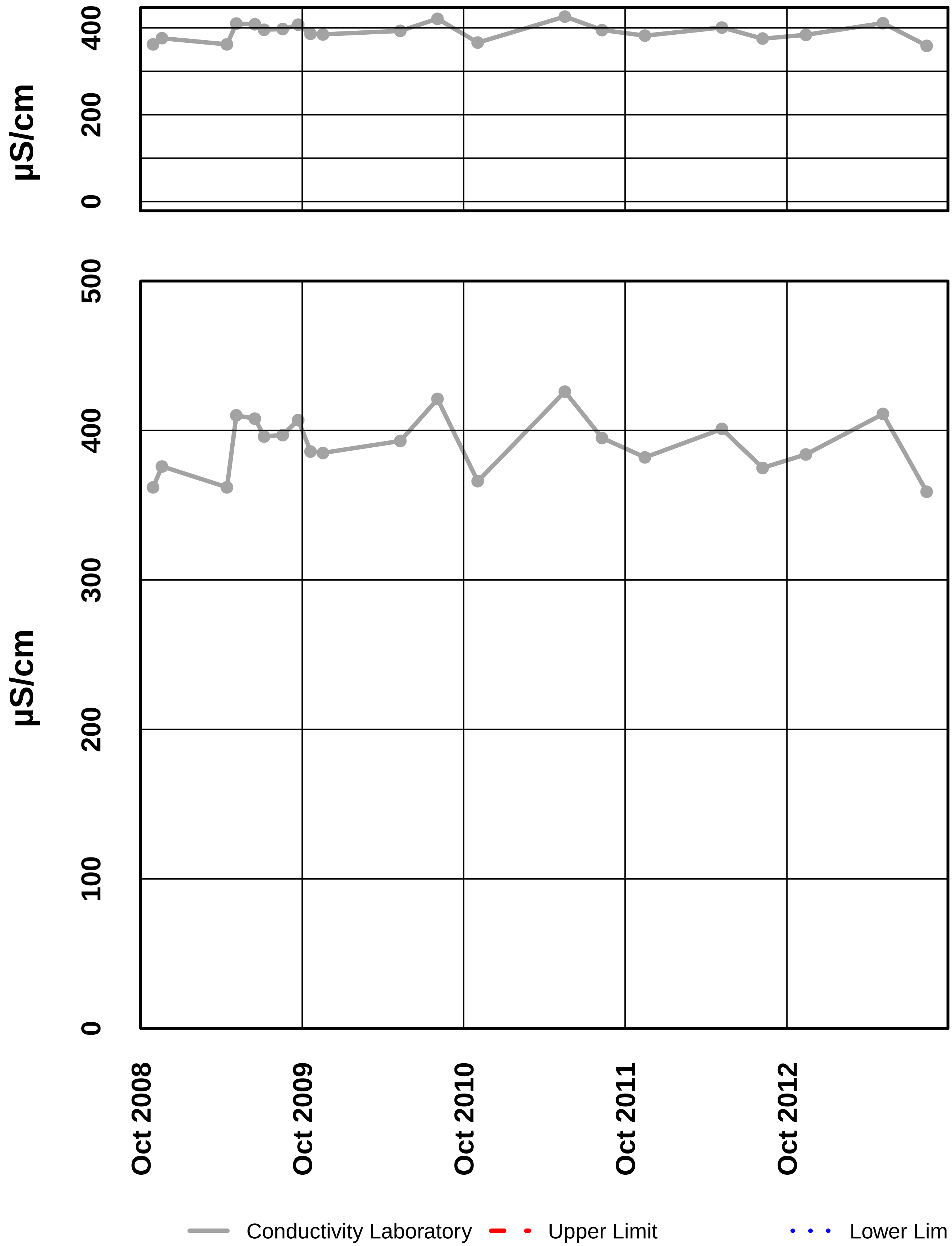
Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
57	11/13/2012	12:00 AM	pH Lab, su	7.57	J	Hold Time Violation
			Hg diss, µg/l	0.000187	U	Field Blank Contamination
57	5/6/2013	12:00 AM	pH Lab, su	7.54	J	Hold Time Violation
			Hg diss, µg/l	0.000278	U	Field Blank Contamination
57	8/13/2013	12:00 AM	Cond, µmhos	359	J	Sample receipt temperature
			Alk, mg/L	135	J	Sample receipt temperature
			SO4 Tot, mg/l	45	J	Sample receipt temperature
			Hg diss, µg/l	0.00028	U	Field Blank Contamination

Qualifier	Description
J	Positively Identified - Approximate concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit



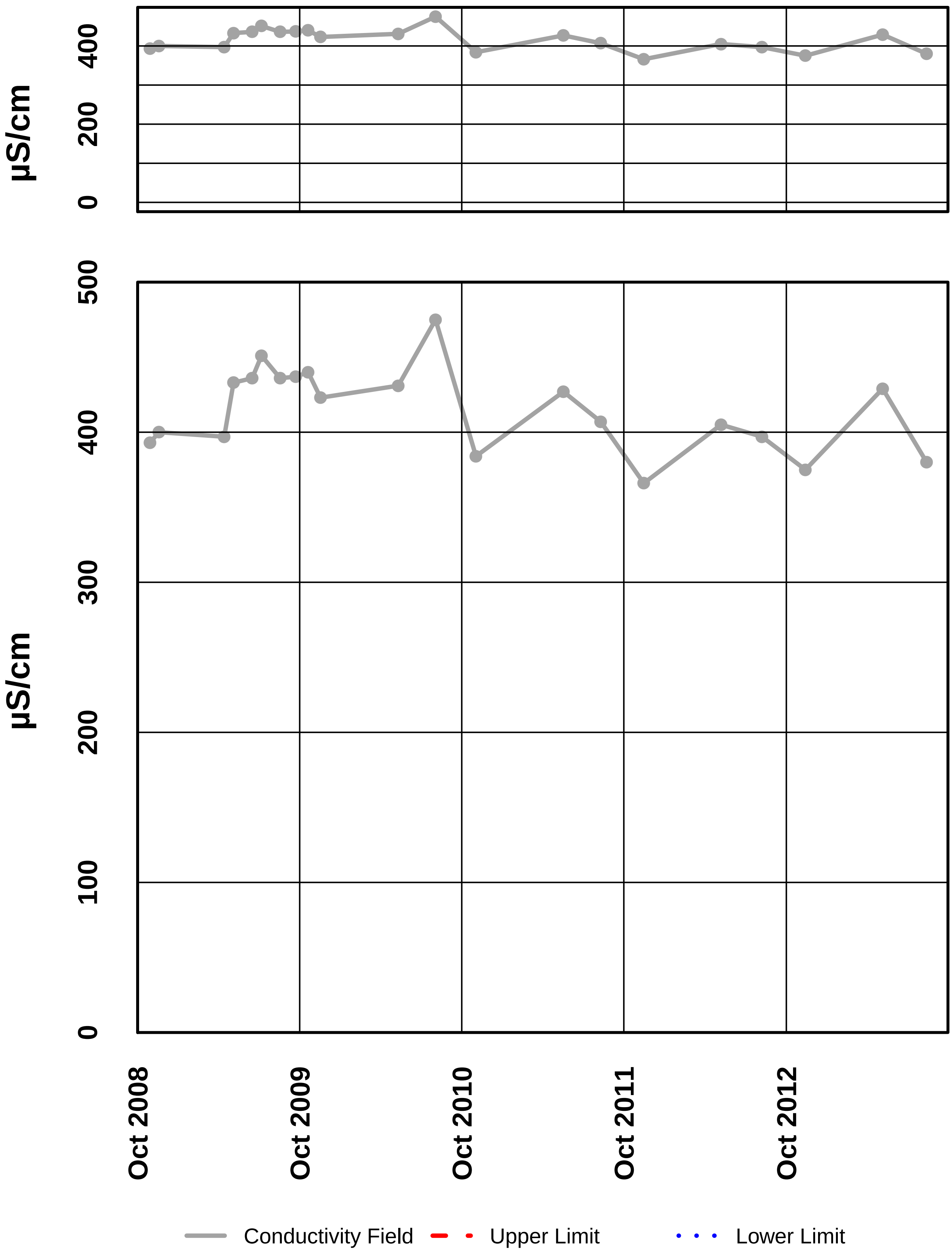
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 57 − Conductivity Laboratory

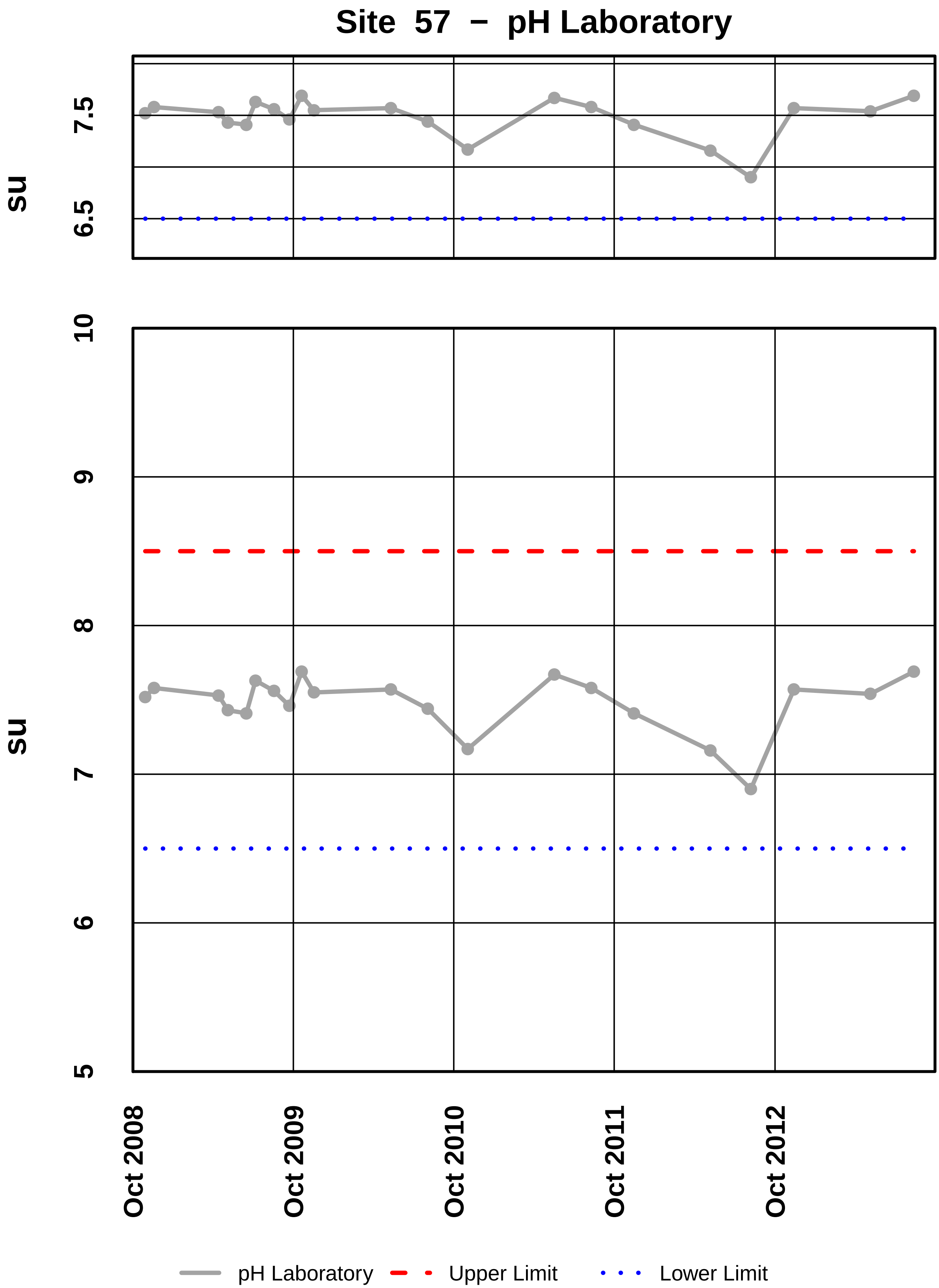


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 57 – Conductivity Field

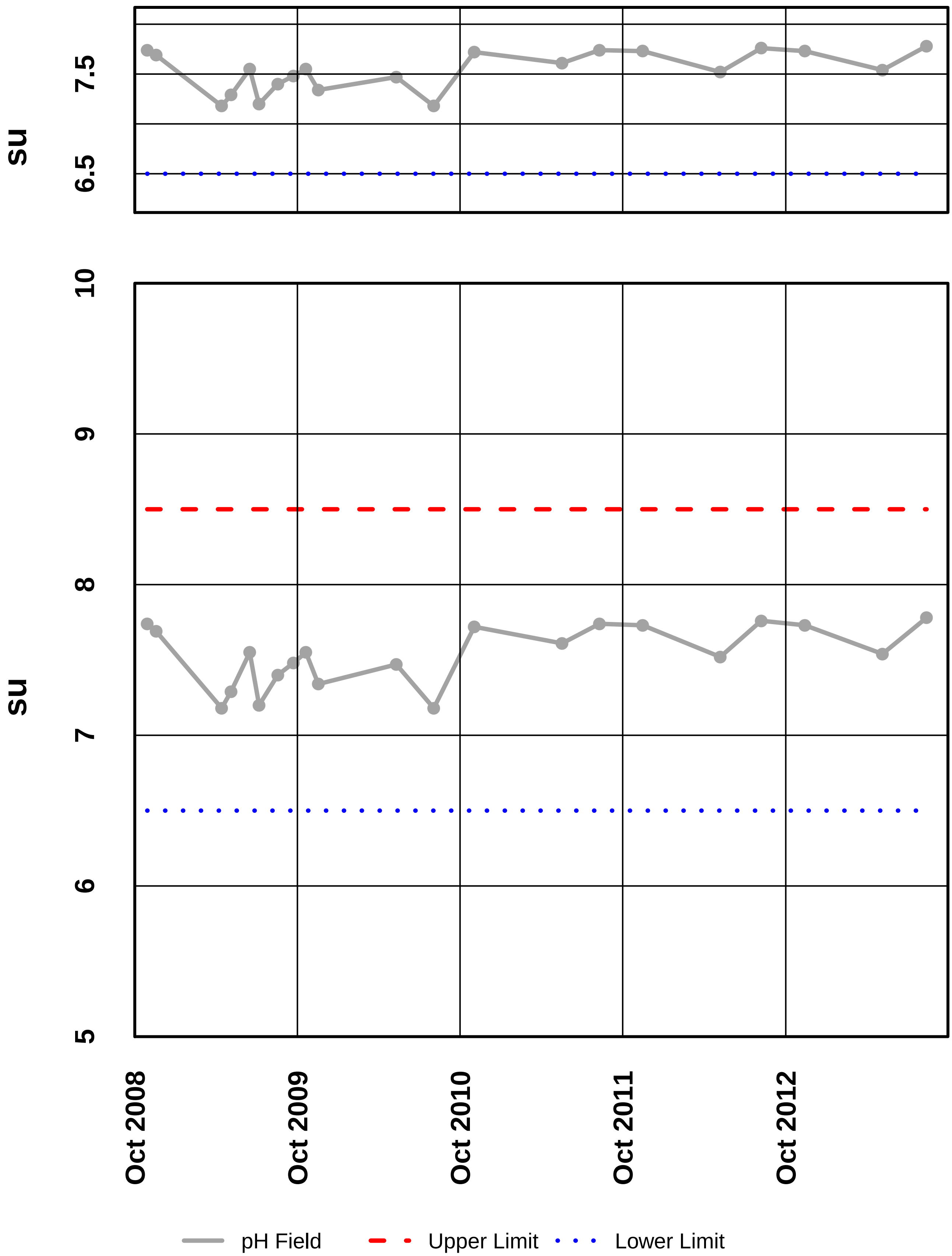


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

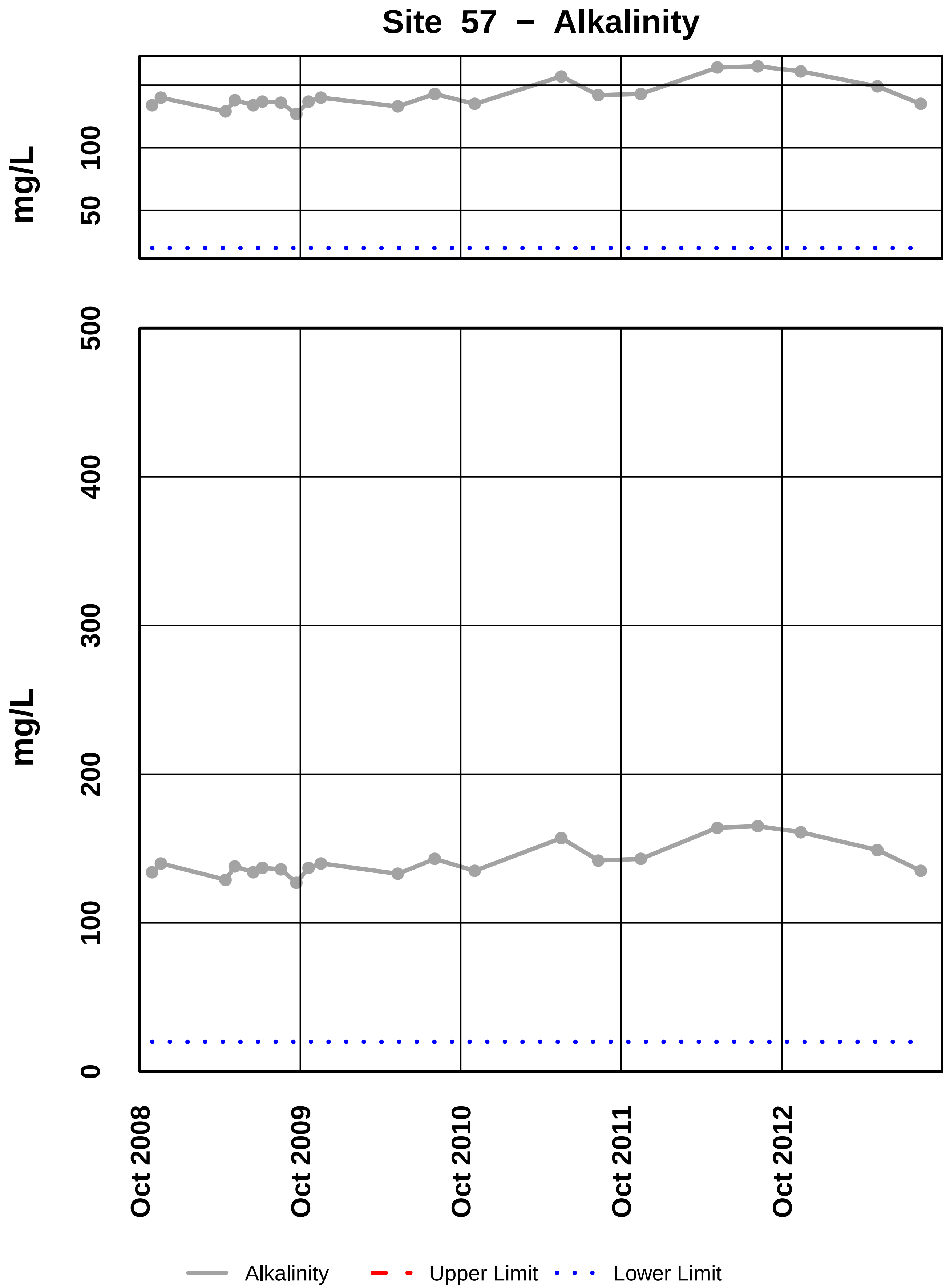


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 57 – pH Field

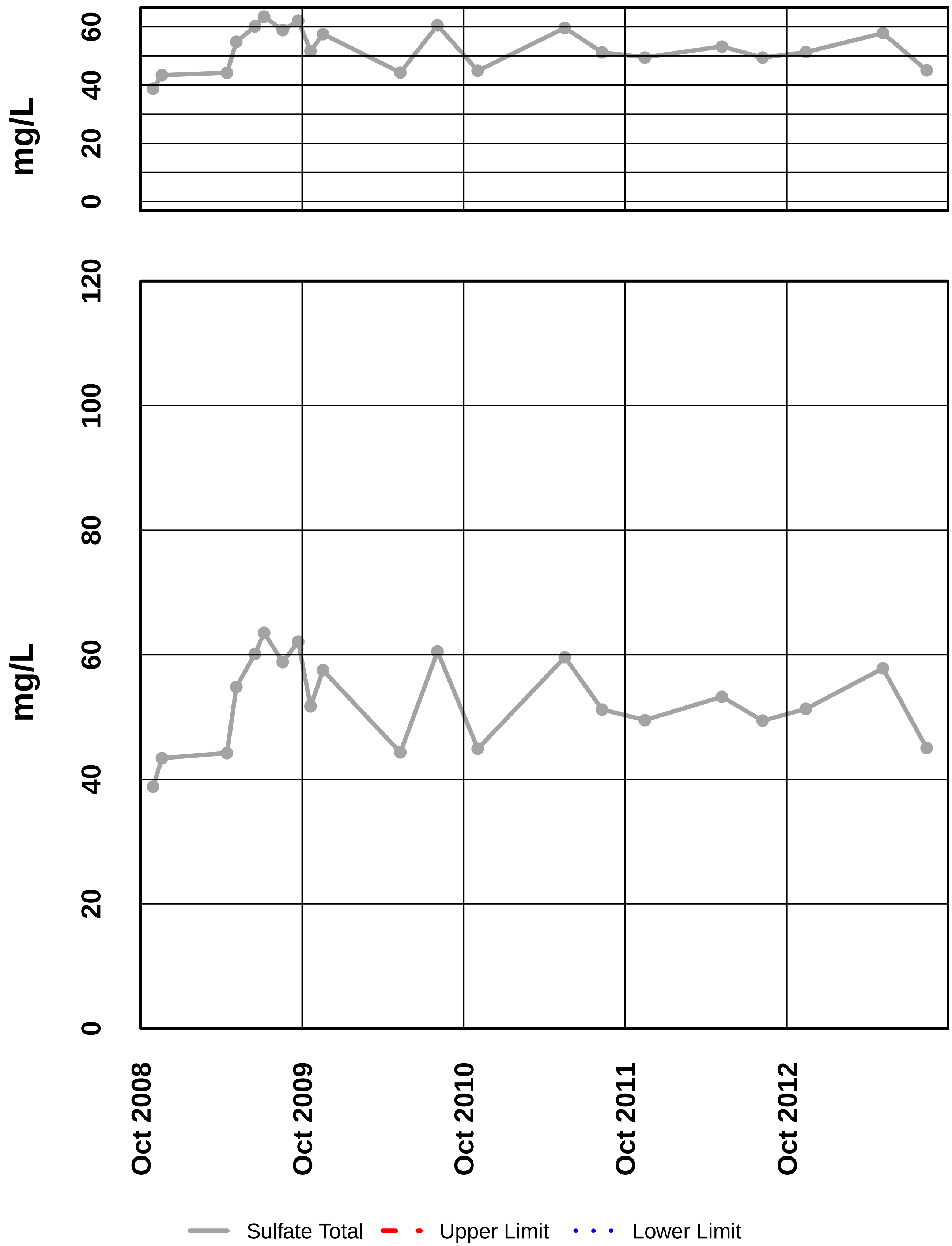


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



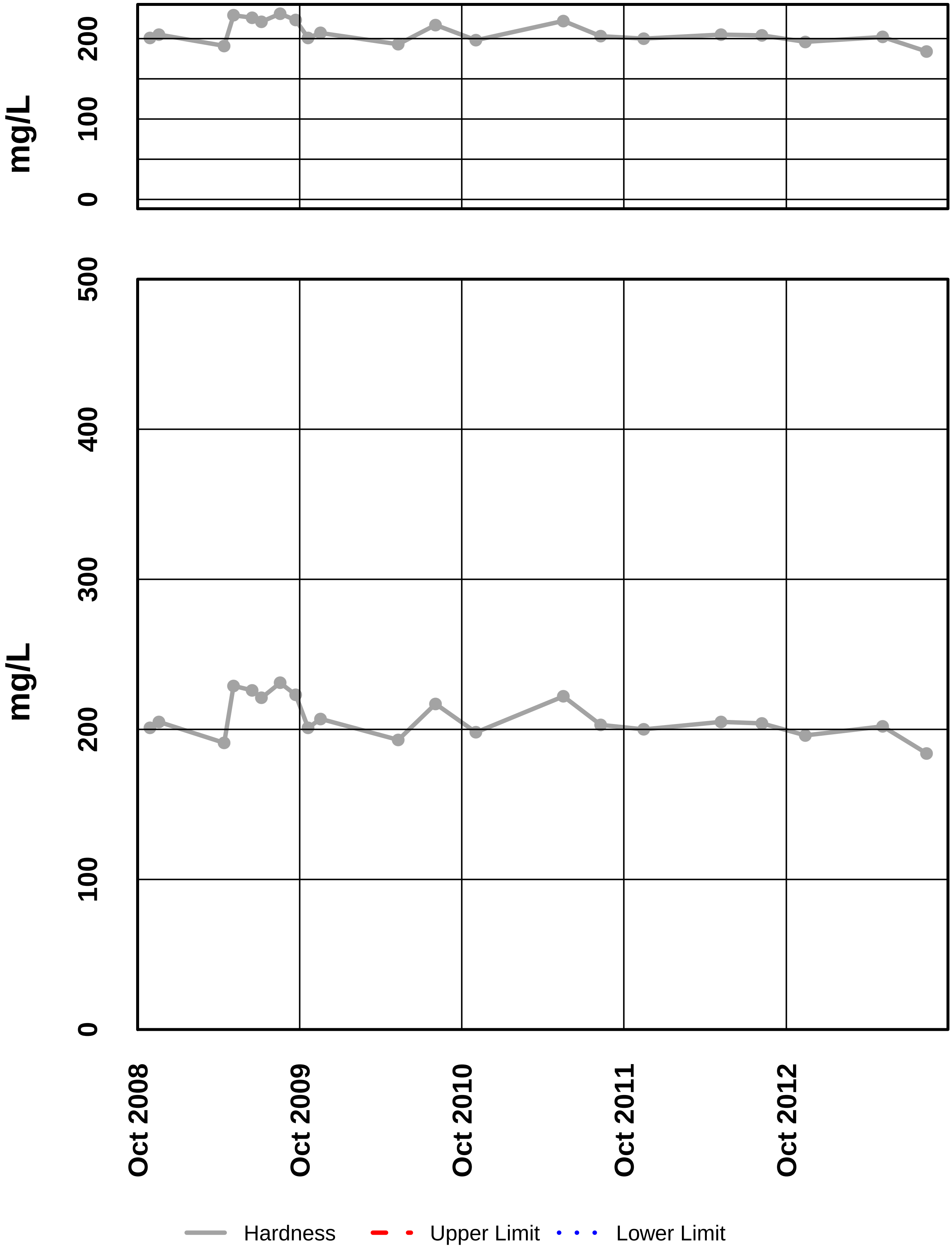
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 57 − Sulfate Total



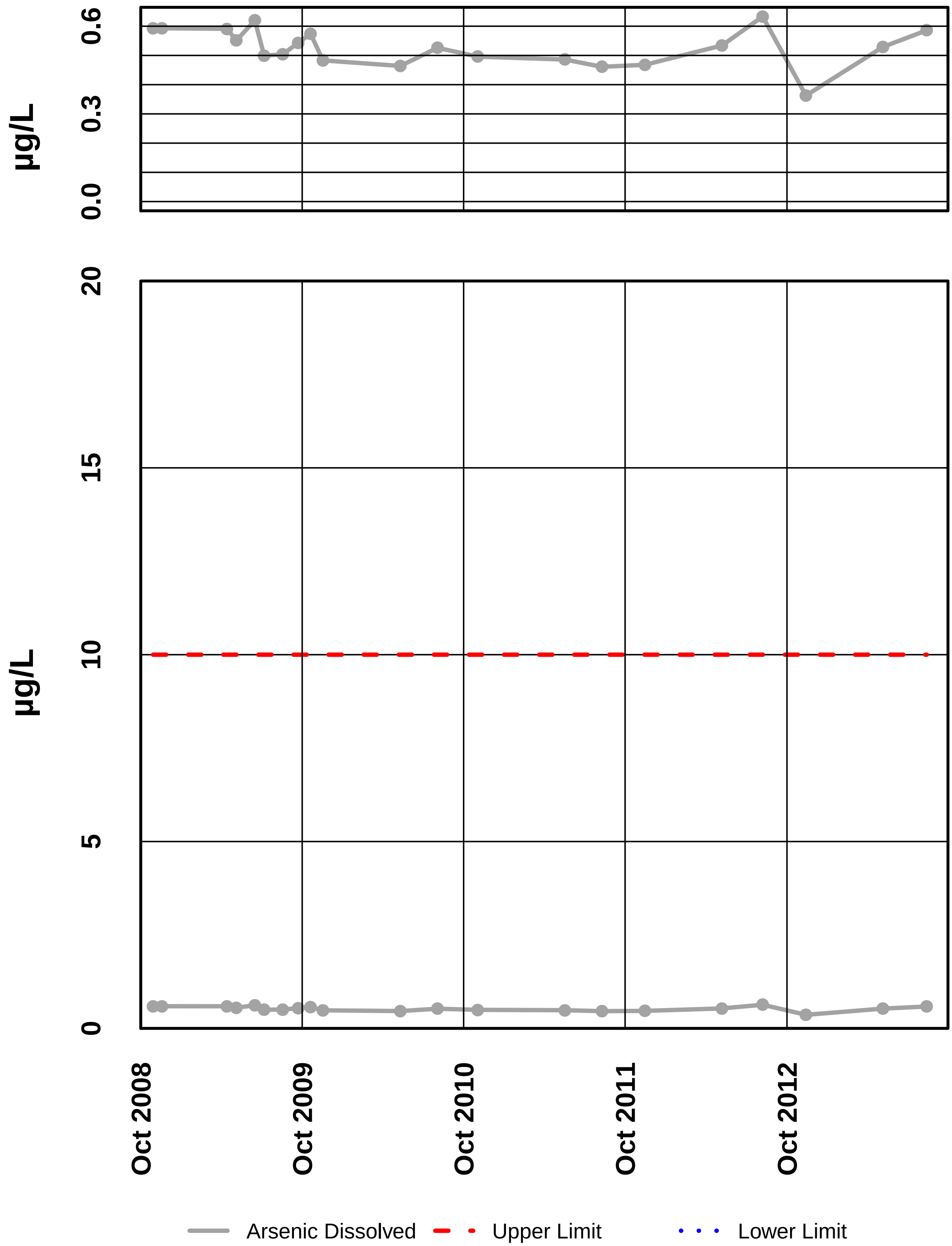
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 57 – Hardness



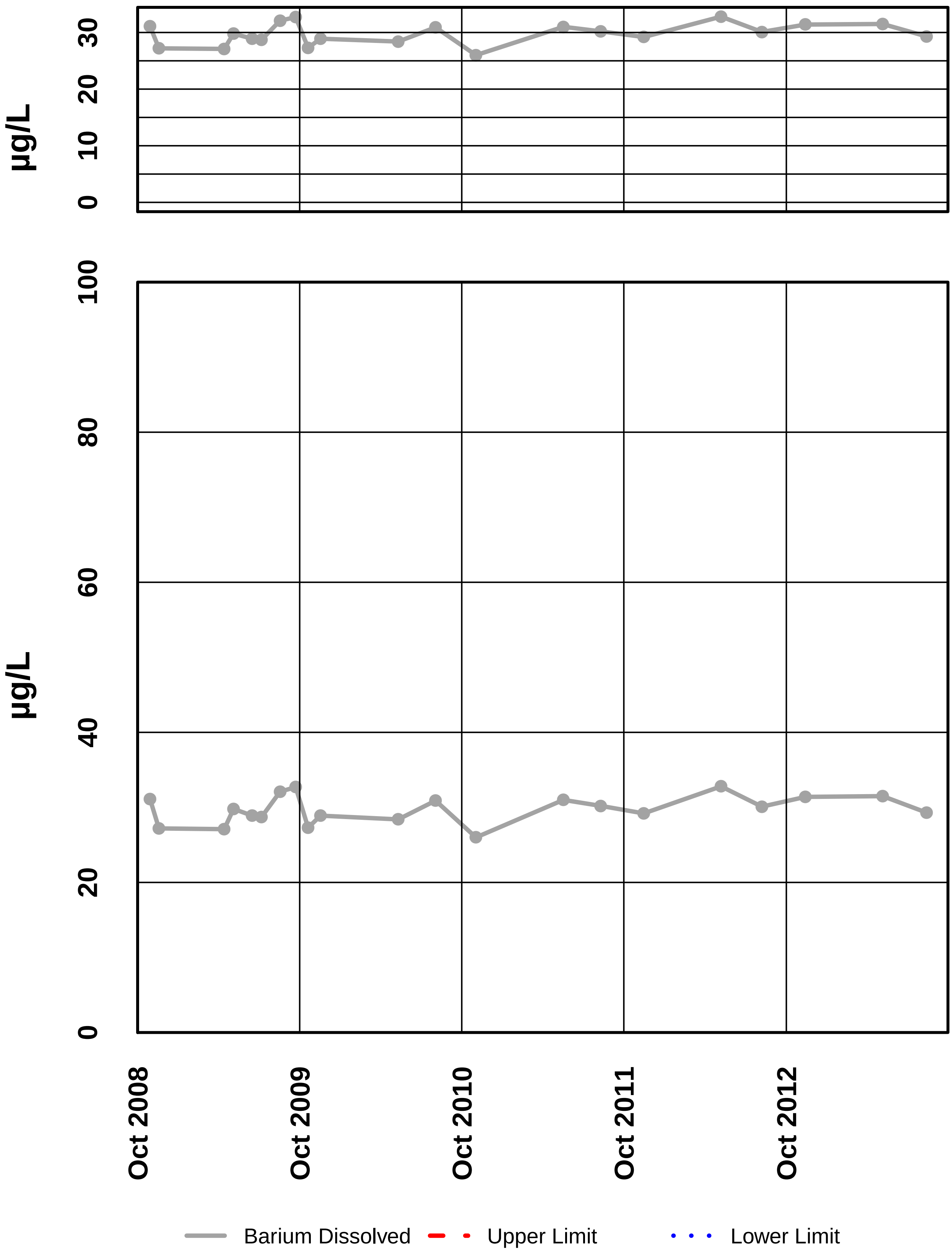
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 57 – Arsenic Dissolved



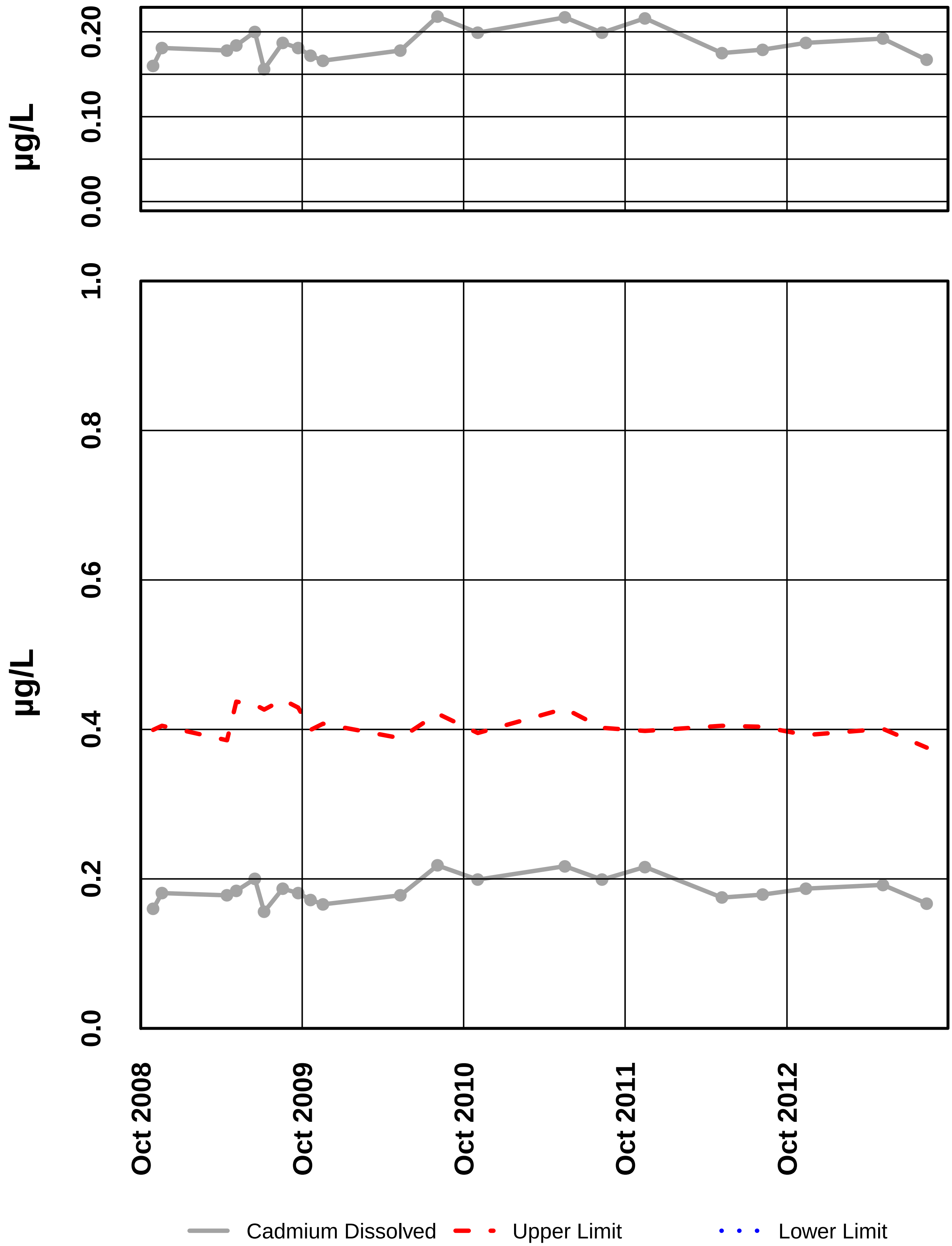
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 57 − Barium Dissolved



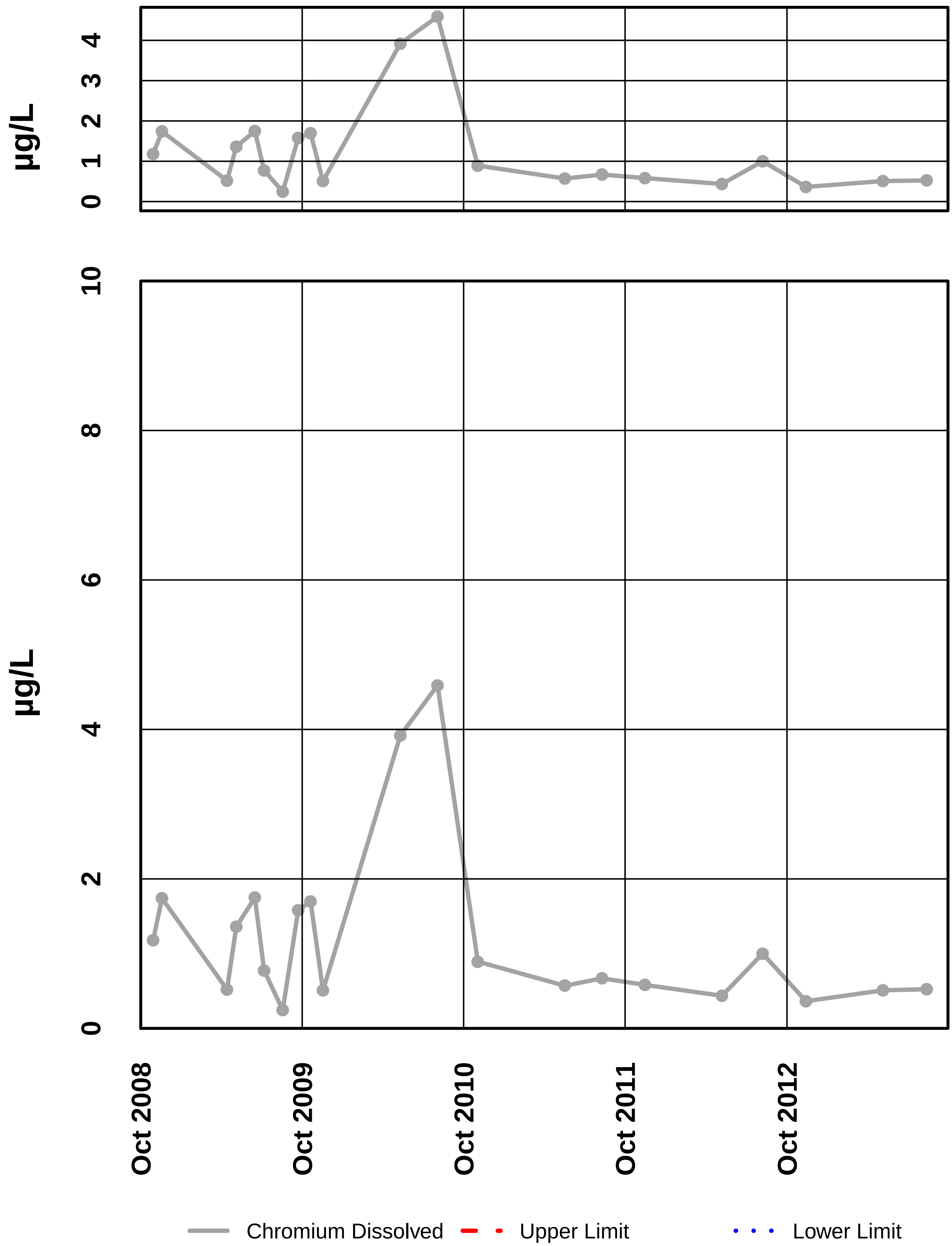
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 57 – Cadmium Dissolved



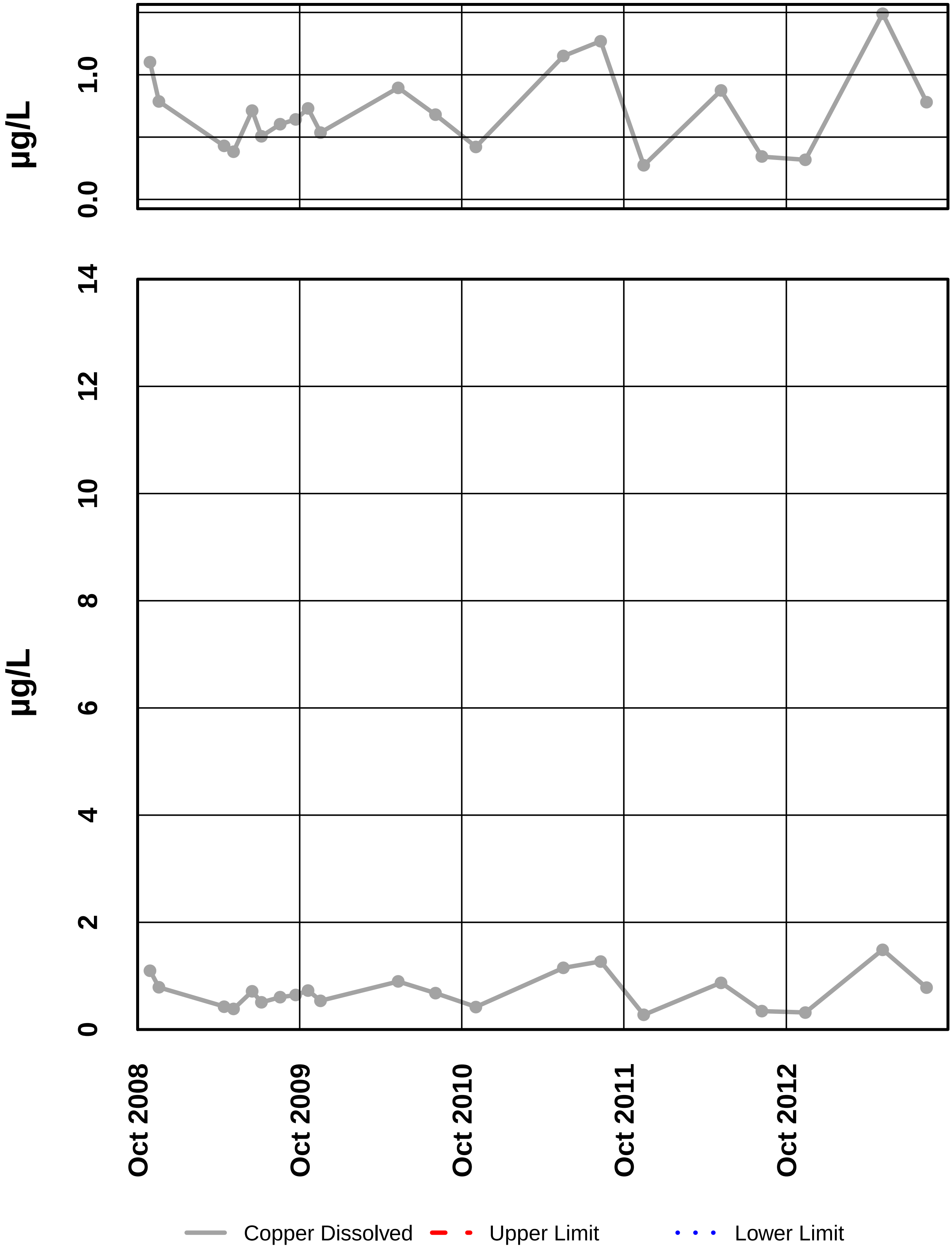
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 57 – Chromium Dissolved



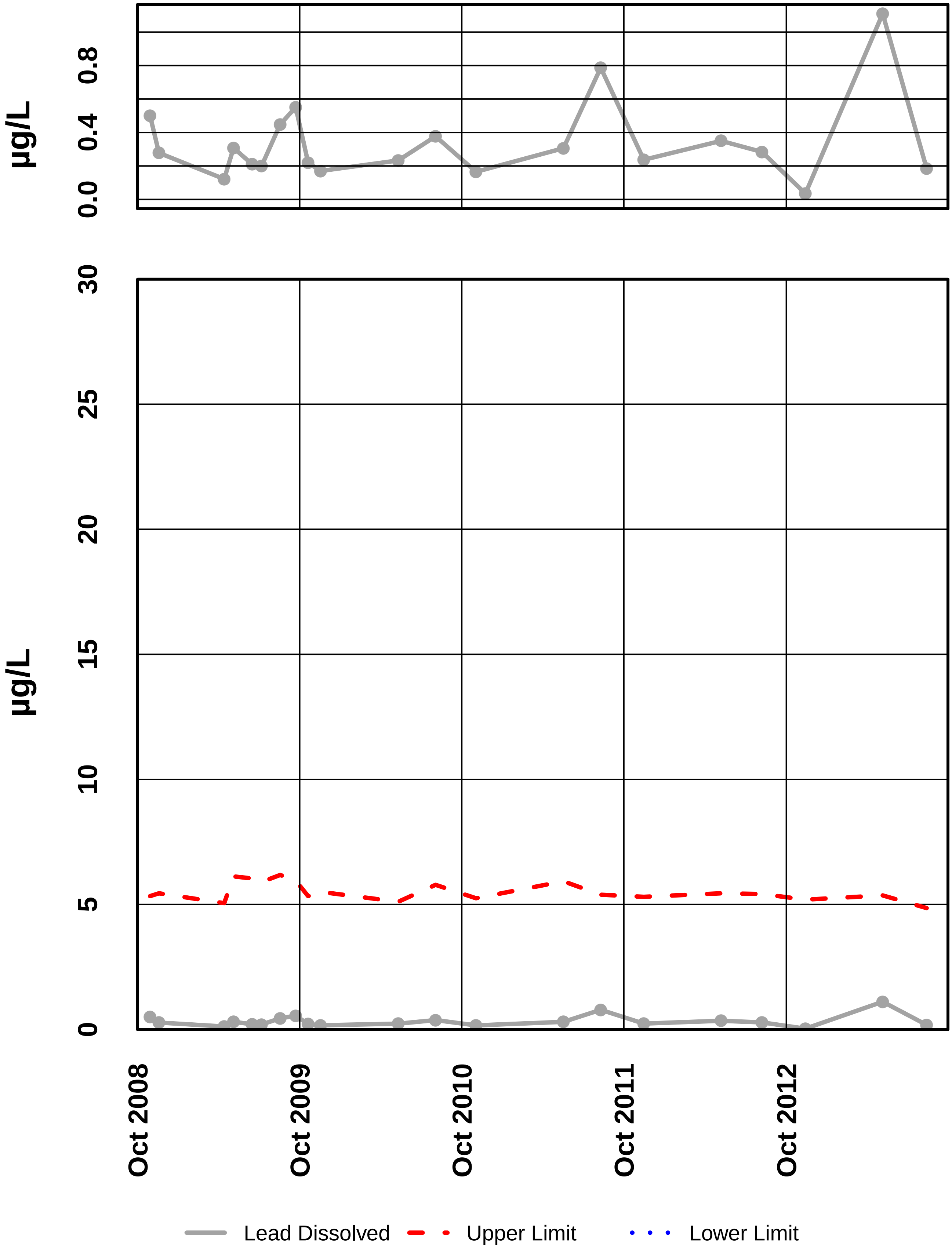
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 57 – Copper Dissolved



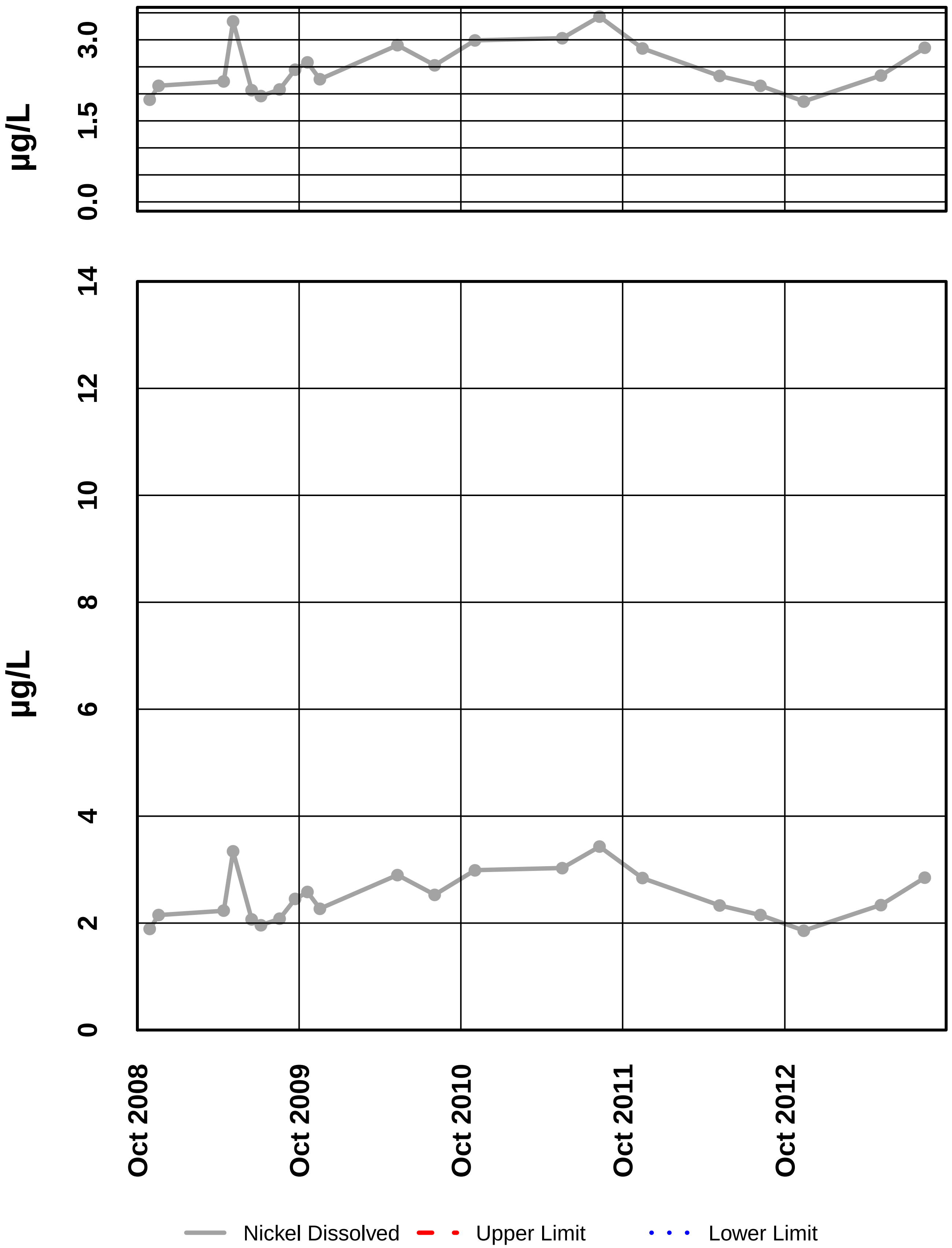
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 57 – Lead Dissolved



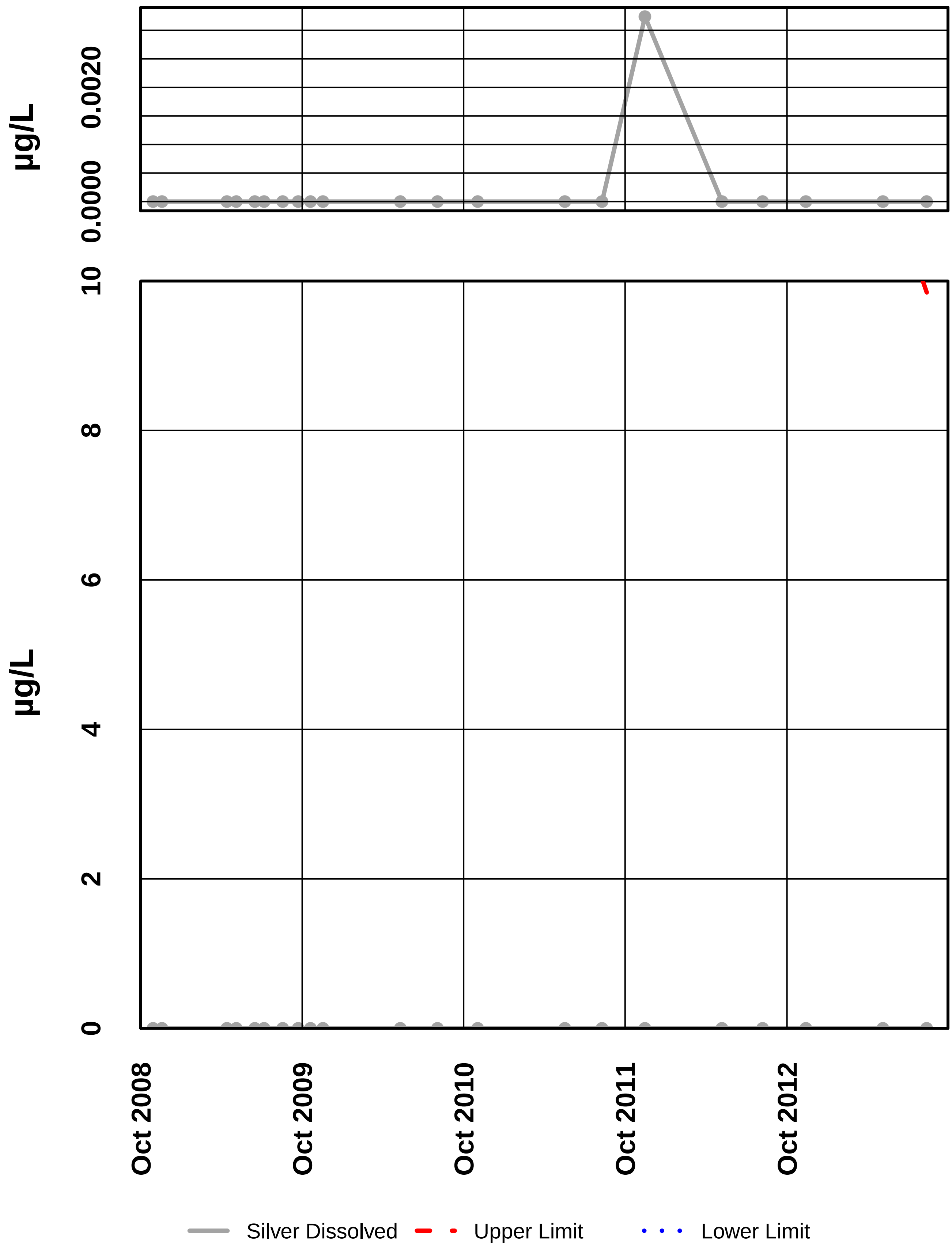
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 57 – Nickel Dissolved



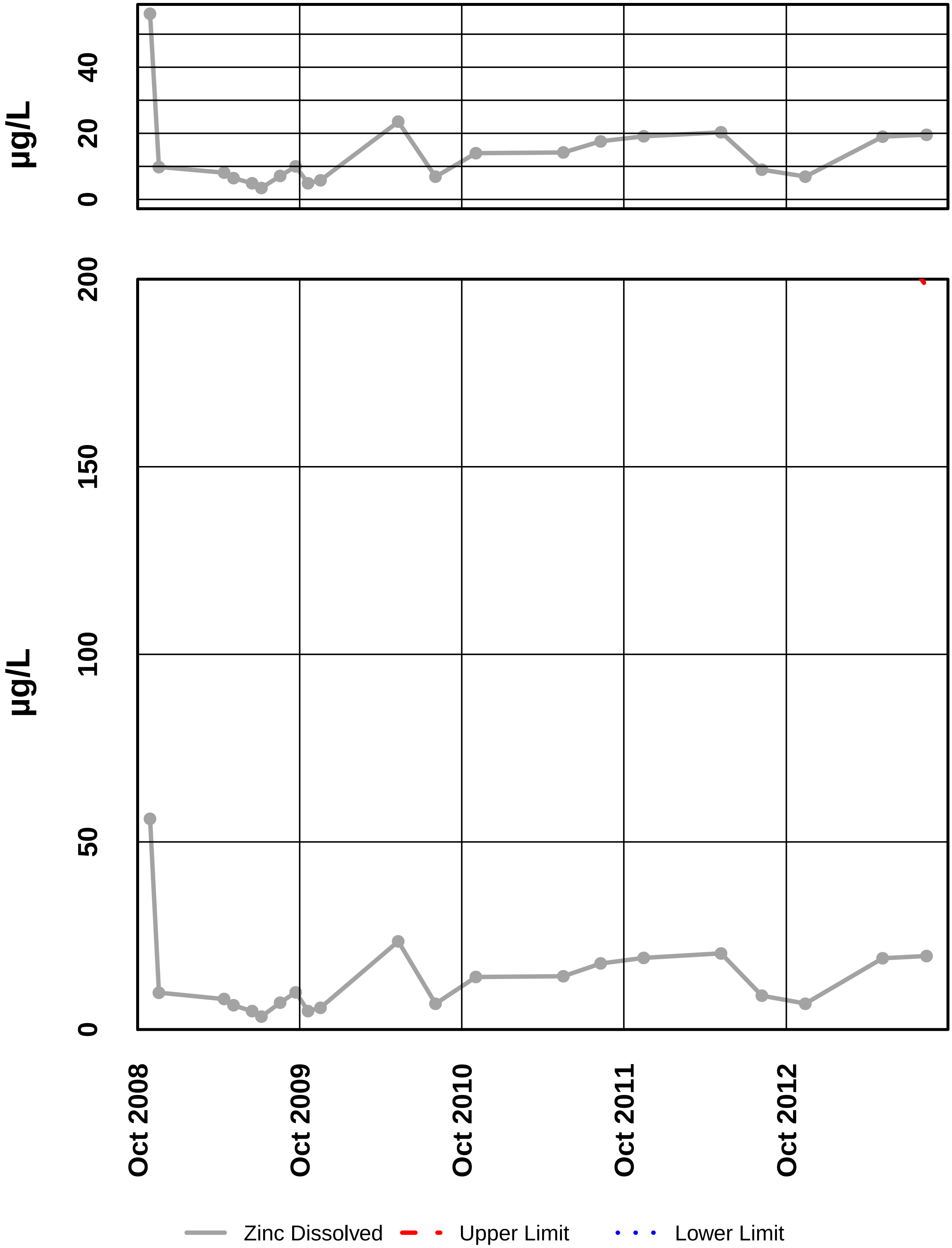
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 57 – Silver Dissolved



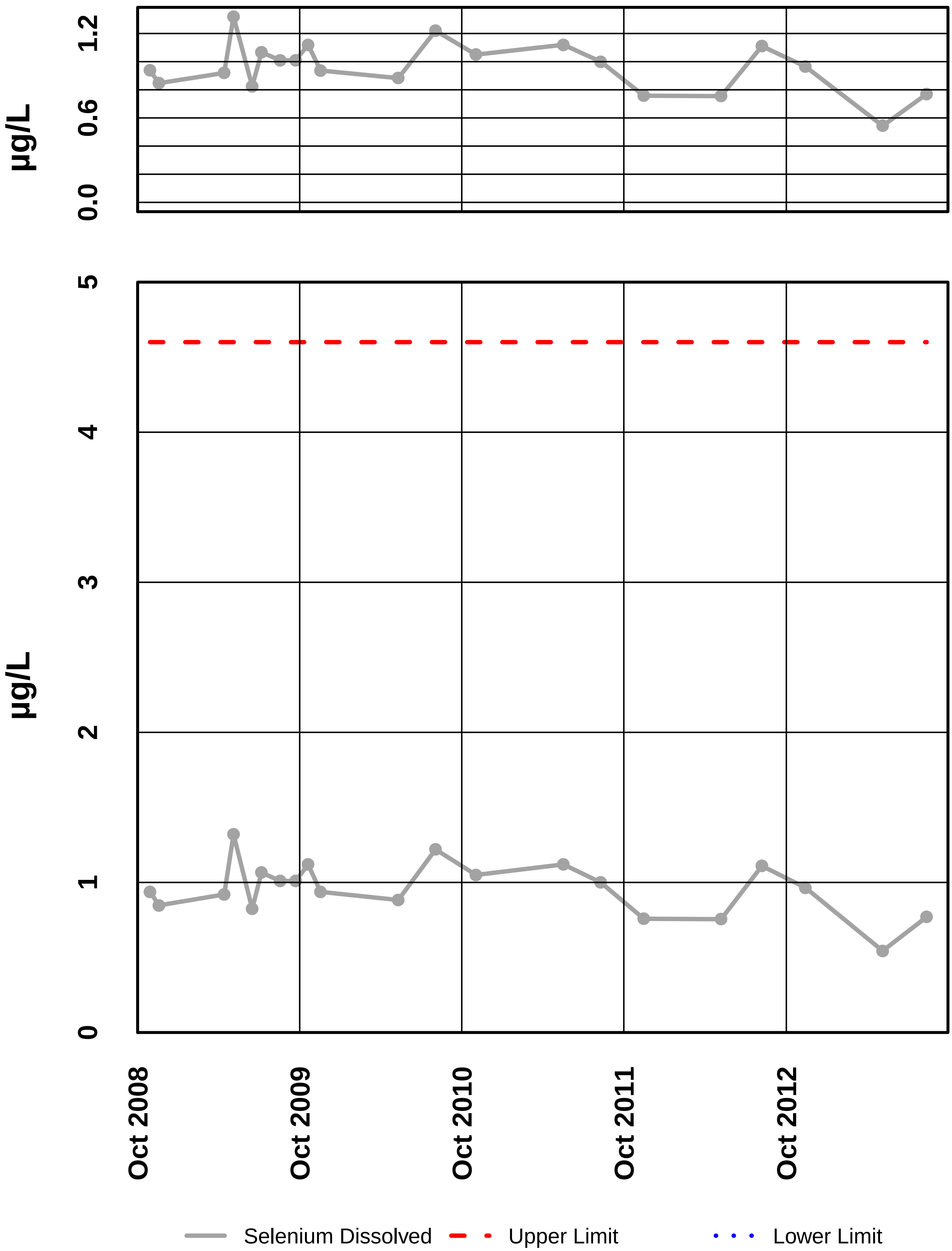
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 57 – Zinc Dissolved



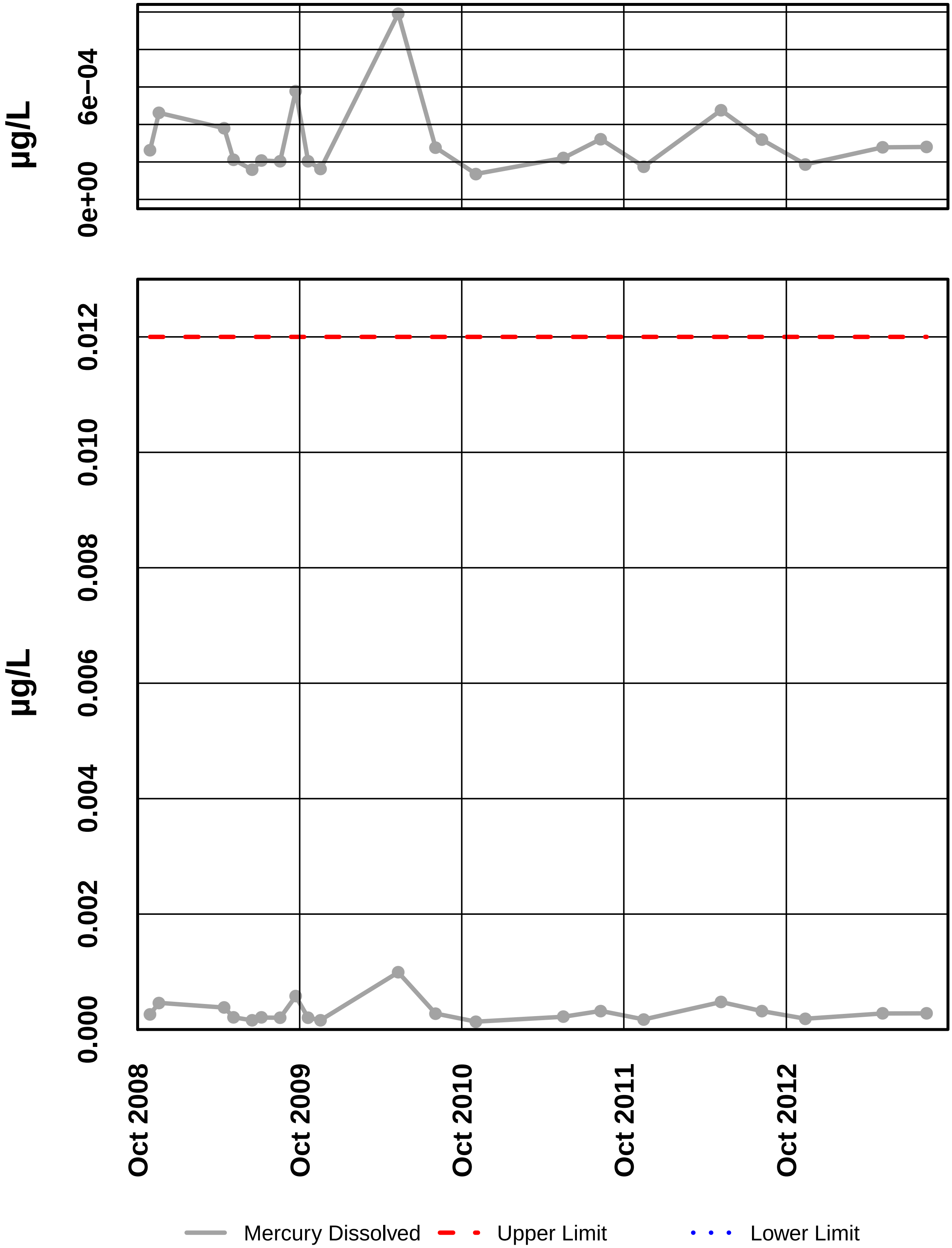
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 57 – Selenium Dissolved



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

Site 57 − Mercury Dissolved



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

Site #57 — Seasonal Kendall analysis for Specific Conductance, Field (µS/cm)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**	420	438					472	450	408	420	421	440
b	**WY2009**	393	400					397	433	436	451	436	437
c	**WY2010**	440	423						431			475	
d	**WY2011**		384						427			407	
e	**WY2012**		366						405			397	
f	**WY2013**		375						429			380	
	n	3	6	0	0	0	0	2	6	2	2	6	2

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	3	6	0	0	0	0	2	6	2	2	6	2
t_2	0	0	0	0	0	0	0	0	0	0	0	0
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a	-1	-1					-1	-1	1	1	1	-1
c-a	1	-1						-1			1	
d-a		-1						-1			-1	
e-a		-1						-1			-1	
f-a		-1						-1			-1	
c-b	1	1						-1			1	
d-b		-1						-1			-1	
e-b		-1						-1			-1	
f-b		-1						-1			-1	
d-c		-1						-1			-1	
e-c		-1						-1			-1	
f-c		-1						-1			-1	
e-d		-1						-1			-1	
f-d		-1						1			-1	
f-e		1						1			-1	
S_k	1	-11	0	0	0	0	-1	-11	1	1	-9	-1

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	3.67	28.33					1.00	28.33	1.00	1.00	28.33	1.00
$Z_k = S_k/\sigma_S$	0.52	-2.07					-1.00	-2.07	1.00	1.00	-1.69	-1.00
Z^2_k	0.27	4.27					1.00	4.27	1.00	1.00	2.86	1.00

ΣZ_k= -5.30

ΣZ^2_k= 15.67

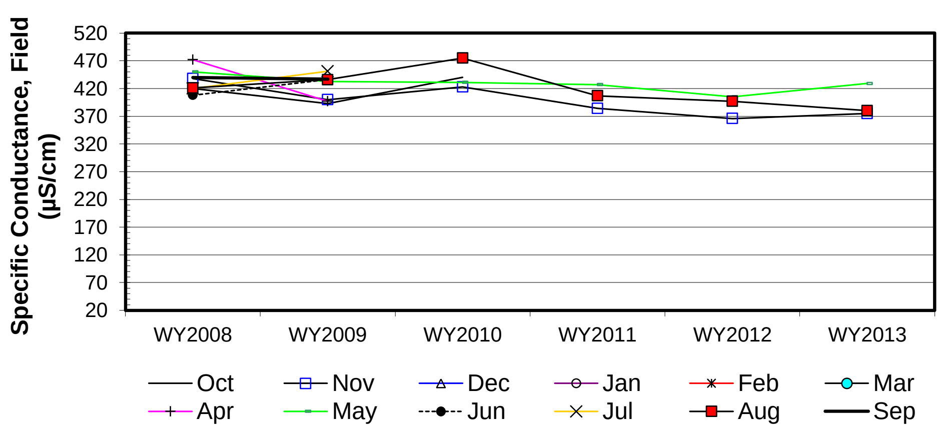
Z-bar=$\Sigma Z_k/K$= -0.66

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	29	0	0	0	0

Σn 29

ΣS_k -30

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=		12.16	@α=5% $\chi^2_{(K-1)}$=	14.07	Test for station homogeneity	
	p	**0.095**			$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
$\Sigma VAR(S_k)$	Z_{calc}	-3.01	@α/2=2.5% Z=	1.96	H_0 (No trend)	REJECT
92.67	p	**0.001**			H_A (± trend)	ACCEPT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-16.20		-3.00
0.050	-13.46	**-8.77**	-4.51
0.100	-13.00		-5.78
0.200	-11.40		-7.44

-2.1%

Site **#57** Seasonal Kendall analysis for pH, Field, Standard Units

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**	7.6	7.6					7.8	7.7	7.7	7.5	6.9	7.3
b	**WY2009**	7.7	7.7					7.2	7.3	7.6	7.2	7.4	7.5
c	**WY2010**	7.6	7.3						7.5			7.2	
d	**WY2011**		7.7						7.6			7.7	
e	**WY2012**		7.7						7.5			7.8	
f	**WY2013**		7.7						7.5			7.8	
	n	3	6	0	0	0	0	2	6	2	2	6	2

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	3	4	0	0	0	0	2	6	2	2	6	2
t_2	0	1	0	0	0	0	0	0	0	0	0	0
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a	1	1					-1	-1	-1	-1	1	1
c-a	-1	-1						-1			1	
d-a		1						-1			1	
e-a		1						-1			1	
f-a		1						-1			1	
c-b	-1	-1						1			-1	
d-b		1						1			1	
e-b		1						1			1	
f-b		1						1			1	
d-c		1						1			1	
e-c		1						1			1	
f-c		1						1			1	
e-d		1						-1			1	
f-d		1						-1			1	
f-e		0						1			1	
S_k	-1	10	0	0	0	0	-1	1	-1	-1	13	1

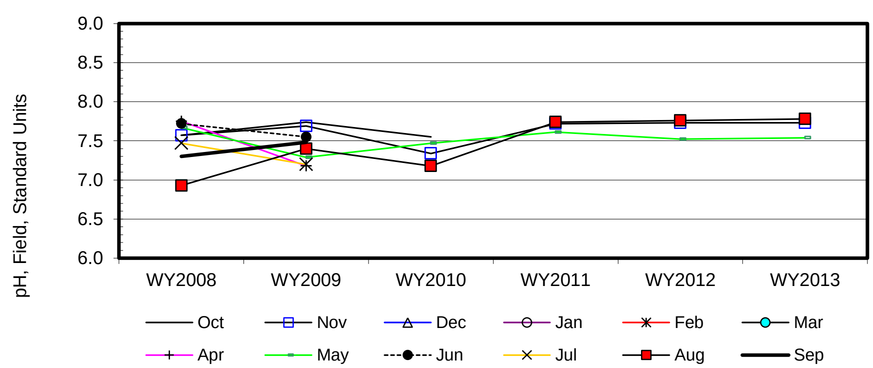
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	3.67	27.33					1.00	28.33	1.00	1.00	28.33	1.00
$Z_k = S_k/\sigma_S$	-0.52	1.91					-1.00	0.19	-1.00	-1.00	2.44	1.00
Z^2_k	0.27	3.66					1.00	0.04	1.00	1.00	5.96	1.00

ΣZ_k= 2.02
ΣZ^2_k= 13.93
Z-bar=$\Sigma Z_k/K$= 0.25

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	27	1	0	0	0

Σn 29
ΣS_k 21

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	13.42	@α=5% $\chi^2_{(K-1)}$= 14.07	Test for station homogeneity	
p	**0.062**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k) Z_{calc}	2.09	@α/2=2.5% Z= 1.96	H_0 (No trend)	REJECT
91.67 **p**	**0.982**		H_A (± trend)	ACCEPT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.01		0.13
0.050	0.01	**0.02**	0.12
0.100	0.01		0.08
0.200	0.02		0.05

0.3%

Site **#57** Seasonal Kendall analysis for Total Alk, (mg/l)

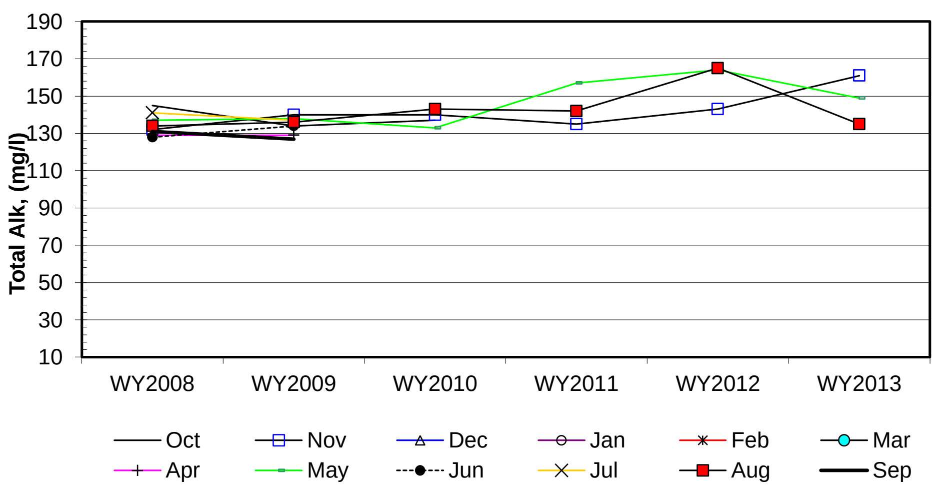
Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	WY2008	145.0	132.0					129.0	137.0	128.0	141.0	134.0	131.0
b	WY2009	134.0	140.0					129.0	138.0	134.0	137.0	136.0	127.0
c	WY2010	137.0	140.0						133.0			143.0	
d	WY2011		135.0						157.0			142.0	
e	WY2012		143.0						164.0			165.0	
f	WY2013		161.0						149.0			135.0	
	n	3	6	0	0	0	0	2	6	2	2	6	2
	t_1	3	4	0	0	0	0	0	6	2	2	6	2
	t_2	0	1	0	0	0	0	1	0	0	0	0	0
	t_3	0	0	0	0	0	0	0	0	0	0	0	0
	t_4	0	0	0	0	0	0	0	0	0	0	0	0
	t_5	0	0	0	0	0	0	0	0	0	0	0	0
	b-a	-1	1					0	1	1	-1	1	-1
	c-a	-1	1						-1			1	
	d-a		1						1			1	
	e-a		1						1			1	
	f-a		1						1			1	
	c-b	1	0						-1			1	
	d-b		-1						1			1	
	e-b		1						1			1	
	f-b		1						1			-1	
	d-c		-1						1			-1	
	e-c		1						1			1	
	f-c		1						1			-1	
	e-d		1						1			1	
	f-d		1						-1			-1	
	f-e		1						-1			-1	
	S_k	-1	10	0	0	0	0	0	7	1	-1	5	-1
	σ^2_S=	3.67	27.33						28.33	1.00	1.00	28.33	1.00
	$Z_k = S_k/\sigma_S$	-0.52	1.91						1.32	1.00	-1.00	0.94	-1.00
	Z^2_k	0.27	3.66						1.73	1.00	1.00	0.88	1.00

ΣZ_k= 2.64
ΣZ^2_k= 9.54
Z-bar=ΣZ_k/K= 0.38

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	25	2	0	0	0

Σn 29
ΣS_k 20

$\chi^2_h=\Sigma Z^2_k - K(\text{Z-bar})^2$=	8.40	@α=5% $\chi^2_{(K-1)}$= 14.07	Test for station homogeneity	
p	0.299		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc} 2.00	@α/2=2.5% Z= 1.96	H_0 (No trend)	REJECT
90.67	p 0.977		H_A (± trend)	ACCEPT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.31		6.77
0.050	0.34	2.75	5.72
0.100	1.00		5.26
0.200	1.50		4.00

2.0%

Site #57 — Seasonal Kendall analysis for Sulfate, Total (mg/l)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**	59.0	47.1					57.0	57.1	47.3	48.7	49.4	48.3
b	**WY2009**	38.8	43.4					44.2	54.8	60.1	63.5	58.8	62.1
c	**WY2010**	51.7	57.5						44.3			60.5	
d	**WY2011**		44.9						59.6			51.2	
e	**WY2012**		49.5						53.2			49.4	
f	**WY2013**		51.3						57.8			45.0	
	n	3	6	0	0	0	0	2	6	2	2	6	2

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	3	6	0	0	0	0	2	6	2	2	4	2
t_2	0	0	0	0	0	0	0	0	0	0	1	0
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a	-1	-1					-1	-1	1	1	1	1
c-a	-1	1						-1			1	
d-a		-1						1			1	
e-a		1						-1			0	
f-a		1						1			-1	
c-b	1	1						-1			1	
d-b		1						1			-1	
e-b		1						-1			-1	
f-b		1						1			-1	
d-c		-1						1			-1	
e-c		-1						1			-1	
f-c		-1						1			-1	
e-d		1						-1			-1	
f-d		1						-1			-1	
f-e		1						1			-1	
S_k	-1	5	0	0	0	0	-1	1	1	1	-6	1

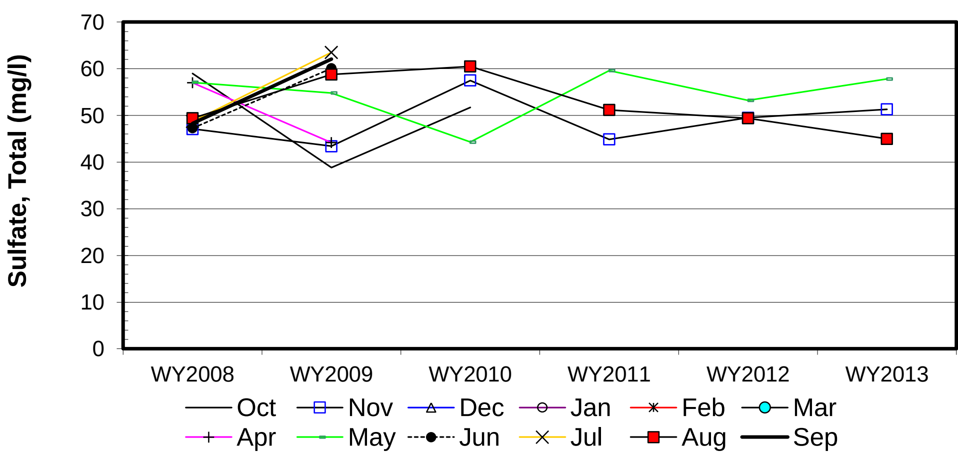
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	3.67	28.33					1.00	28.33	1.00	1.00	27.33	1.00
$Z_k = S_k/\sigma_S$	-0.52	0.94					-1.00	0.19	1.00	1.00	-1.15	1.00
Z^2_k	0.27	0.88					1.00	0.04	1.00	1.00	1.32	1.00

ΣZ_k= 1.46
ΣZ^2_k= 6.51
Z-bar=ΣZ_k/K= 0.18

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	27	1	0	0	0

Σn 29
ΣS_k 1

$\chi^2_h = \Sigma Z^2_k - K(\text{Z-bar})^2$= 6.24	@α=5% $\chi^2_{(K-1)}$= 14.07	Test for station homogeneity	
p **0.512**		$\chi^2_h < \chi^2_{(K-1)}$	ACCEPT
$\Sigma VAR(S_k)$ 91.67	Z_{calc} 0.00	@α=2.5% Z= 1.96	H_0 (No trend)	ACCEPT
	p **0.500**		H_A (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-3.48		2.08
0.050	-2.27	**0.07**	1.59
0.100	-1.84		0.83
0.200	-0.90		0.75

Site #57 — Seasonal Kendall analysis for Zinc, Dissolved (ug/l)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**	6.0	13.7					11.5	11.6	5.7	8.4	14.3	17.6
b	**WY2009**	56.2	9.8					8.1	6.5	4.9	3.5	7.1	10.0
c	**WY2010**	4.9	5.8						23.5			6.9	
d	**WY2011**		14.0						14.2			17.6	
e	**WY2012**		19.1						20.3			9.0	
f	**WY2013**		6.9						19.0			19.6	
	n	3	6	0	0	0	0	2	6	2	2	6	2

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	3	6	0	0	0	0	2	6	2	2	6	2
t_2	0	0	0	0	0	0	0	0	0	0	0	0
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a	1	-1					-1	-1	-1	-1	-1	-1
c-a	-1	-1						1			-1	
d-a		1						1			1	
e-a		1						1			-1	
f-a		-1						1			1	
c-b	-1	-1						1			-1	
d-b		1						1			1	
e-b		1						1			1	
f-b		-1						1			1	
d-c		1						-1			1	
e-c		1						-1			1	
f-c		1						-1			1	
e-d		1						1			-1	
f-d		-1						1			1	
f-e		-1						-1			1	
S_k	-1	1	0	0	0	0	-1	5	-1	-1	5	-1

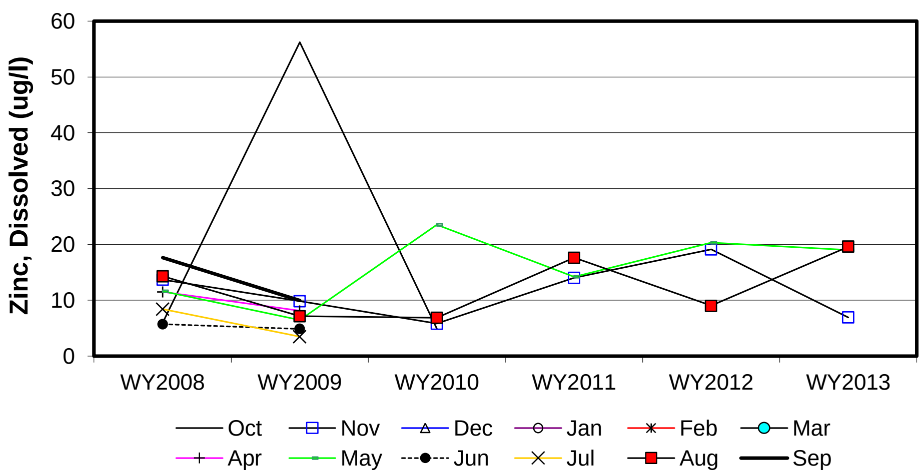
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	3.67	28.33					1.00	28.33	1.00	1.00	28.33	1.00
$Z_k = S_k/\sigma_S$	-0.52	0.19					-1.00	0.94	-1.00	-1.00	0.94	-1.00
Z^2_k	0.27	0.04					1.00	0.88	1.00	1.00	0.88	1.00

ΣZ_k= -2.46
ΣZ^2_k= 6.07
Z-bar=$\Sigma Z_k/K$= -0.31

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	29	0	0	0	0

Σn 29
ΣS_k 6

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	5.32	@α=5% $\chi^2_{(K-1)}$=	14.07	Test for station homogeneity	
p	**0.621**			$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
$\Sigma VAR(S_k)$	Z_{calc} 0.52	@$\alpha/2$=2.5% Z=	1.96	**H_0** (No trend)	ACCEPT
92.67	p **0.698**			**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-1.95		3.10
0.050	-1.32	**0.75**	2.03
0.100	-0.90		1.37
0.200	-0.56		1.07

INTERPRETIVE REPORT
SITE 13

The data collected during the current water year are listed in the following "Table of Results for Water Year 2013" 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 2007 through September 2013.				

The data for Water Year 2013 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 2013

			Limits		
Sample Date	Parameter	Value	Lower	Upper	Hardness
No exceedances have been identified by HGCMC for the period of October 2012 through September 2013.					

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, and a limited amount was removed in 2013; however HGCMC is planning to remove the rest of the material in 2014, leaving only the material that is in the access road. 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. No visually obvious trends were apparent.

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-07 and Sep-13(WY2008-WY2013). For datasets with a statistically significant trend a Seasonal-Sen's Slope estimate statistic has also been calculated.

Table of Summary Statistics for Trend Analysis

	Mann-Kendall test statistics			Sen's slope estimate	
Parameter	**n***	**p****	**Trend**	**Q**	**Q(%)**
Conductivity Field	6	0.28			
pH Field	6	0.23			
Alkalinity, Total	6	0.33			
Sulfate, Total	6	0.38			
Zinc, Dissolved	6	0.12			

* Number of Years ** Significance level

There were no statistically significant trends ($\alpha/2=2.5\%$) for Site 13 during the 2012 water year. HGCMC feels the current FWMP program is sufficient to monitor any future changes at Site 13 before any water quality values are impaired.

Table of Results for Water Year 2013

Site 013FMS - '1350 East Drainage'

Sample Date/Parameter	Oct 2012	Nov 2012	Dec 2012	Jan 2013	Feb 2013	Mar 2013	Apr 2013	May 2013	Jun 2013	Jul 2013	Aug 2013	Sep 2013	**Median**
Water Temp (°C)											11.2		11.2
Conductivity-Field(μmho)									723		731		727.0
Conductivity-Lab (μmho)									705		718		712
pH Lab (standard units)									7.85		7.75		7.80
pH Field (standard units)									7.63		8.13		7.88
Total Alkalinity (mg/L)									147		170		158.5
Total Sulfate (mg/L)									227		216		221.5
Hardness (mg/L)									401		391		396.0
Dissolved As (ug/L)									0.096		0.127		0.112
Dissolved Ba (ug/L)													
Dissolved Cd (ug/L)									0.0116		0.0069		0.0093
Dissolved Cr (ug/L)													
Dissolved Cu (ug/L)									0.921		0.448		0.685
Dissolved Pb (ug/L)									0.0189		0.0076		0.0133
Dissolved Ni (ug/L)													
Dissolved Ag (ug/L)													
Dissolved Zn (ug/L)									8		19.2		13.60
Dissolved Se (ug/L)													
Dissolved Hg (ug/L)									0.00099		0.000867		0.000929

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.

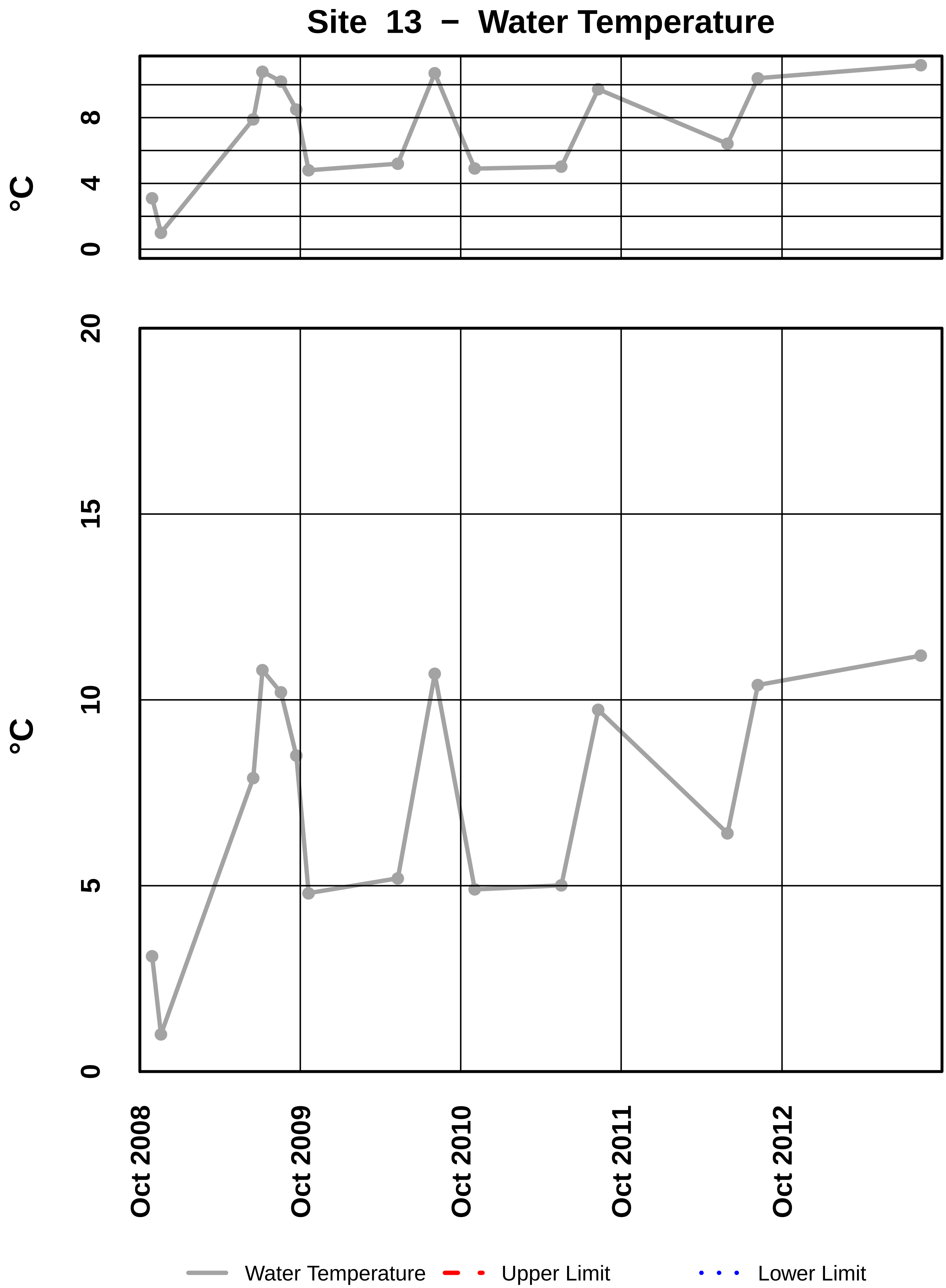
Shaded data has been qualified as an outlier by HGCMC and removed from any further analysis and is not included into the calculation of the median

Qualified Data by QA Reviewer

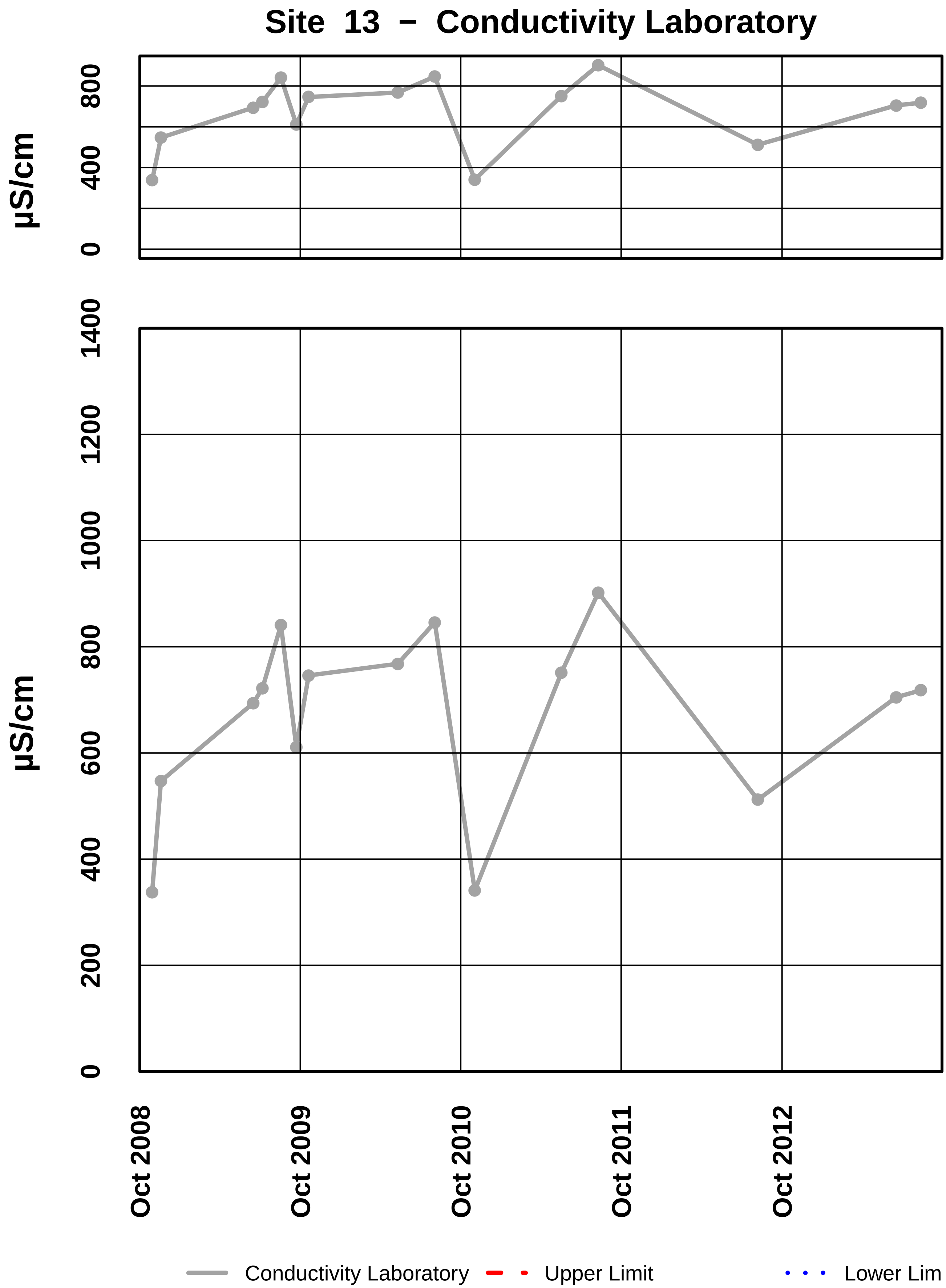
Date Range: 10/01/2012 to 09/30/2013

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
13	8/13/2013	12:00 AM	Cd diss, µg/l	0.00686	J	Below Quantitative Range
			Cond, µmhos	718	J	Sample receipt temperature
			Alk, mg/L	170	J	Sample receipt temperature
			SO4 Tot, mg/l	216	J	Sample receipt temperature
			Pb diss, µg/l	0.00757	U	Field Blank Contamination
			Hg diss, µg/l	0.000867	U	Field Blank Contamination

Qualifier	Description
J	Positively Identified - Approximate concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit

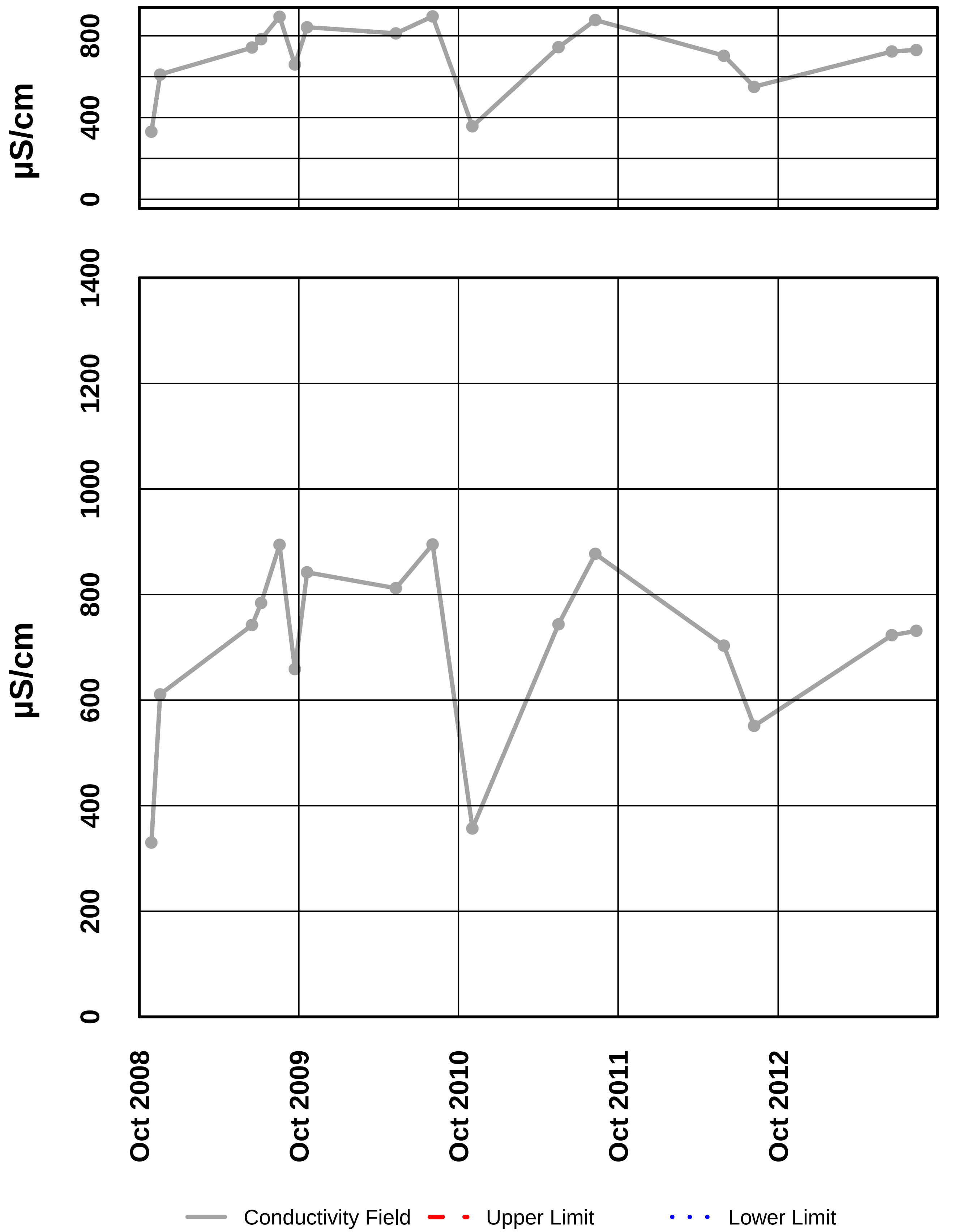


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



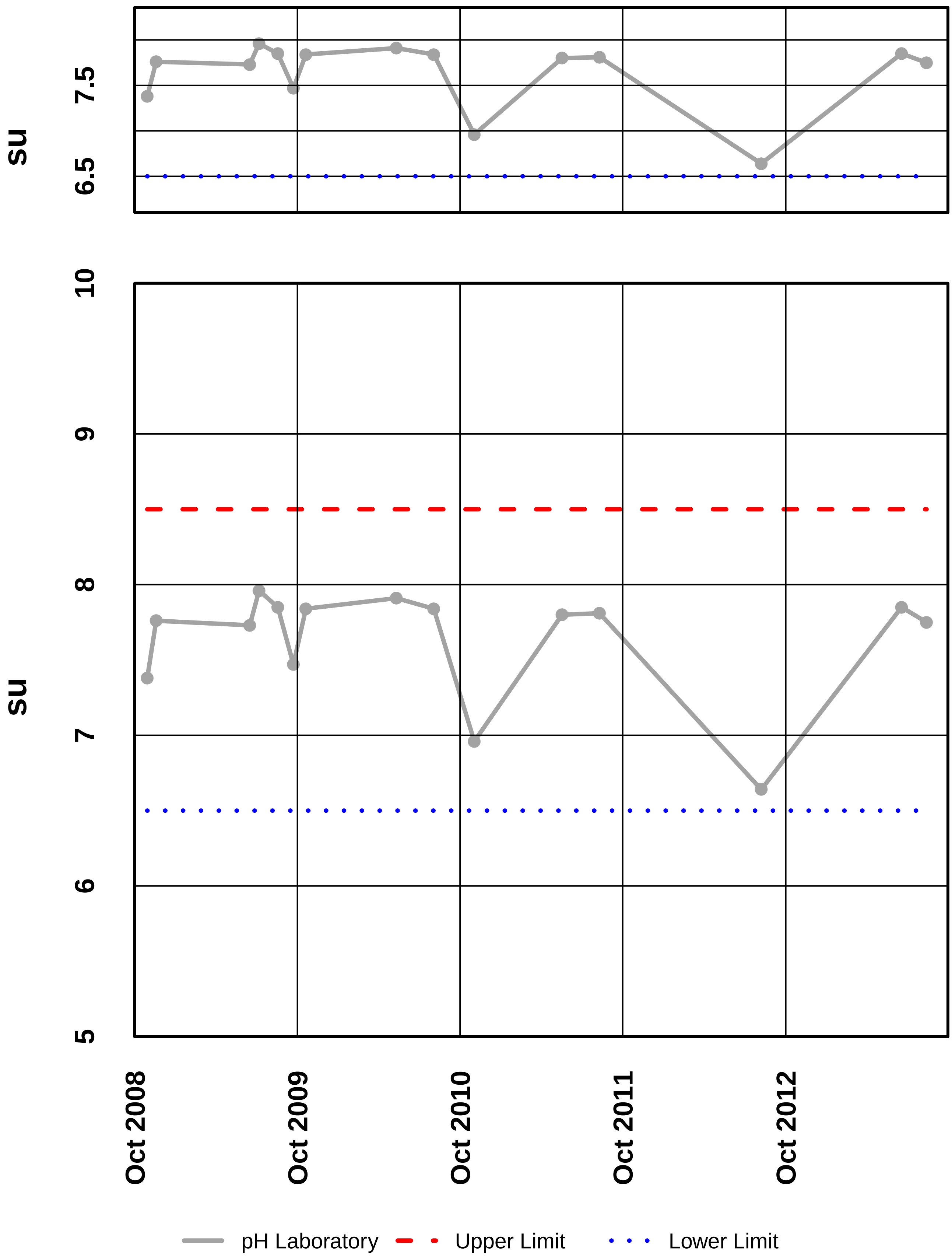
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 13 – Conductivity Field



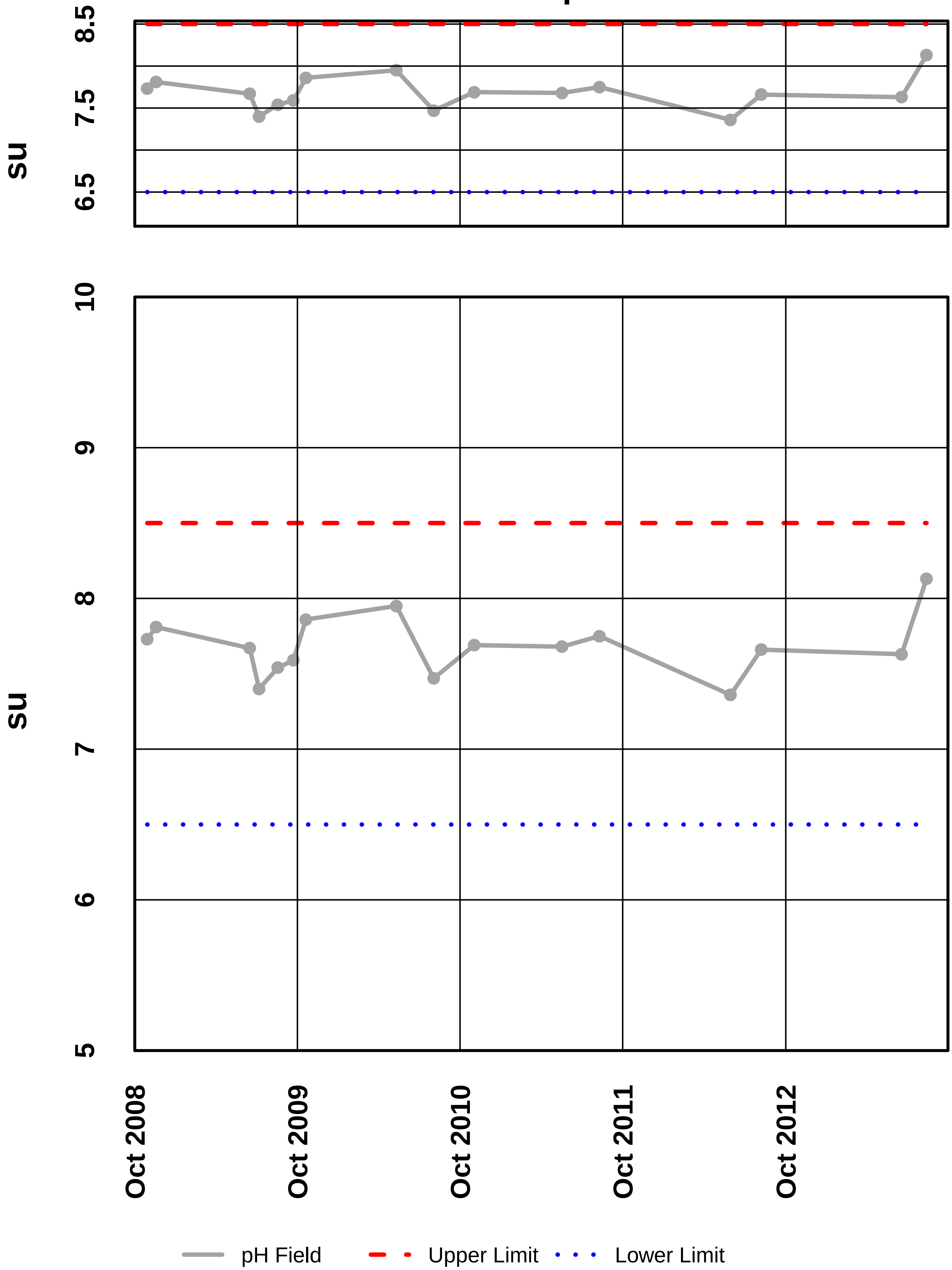
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 13 – pH Laboratory



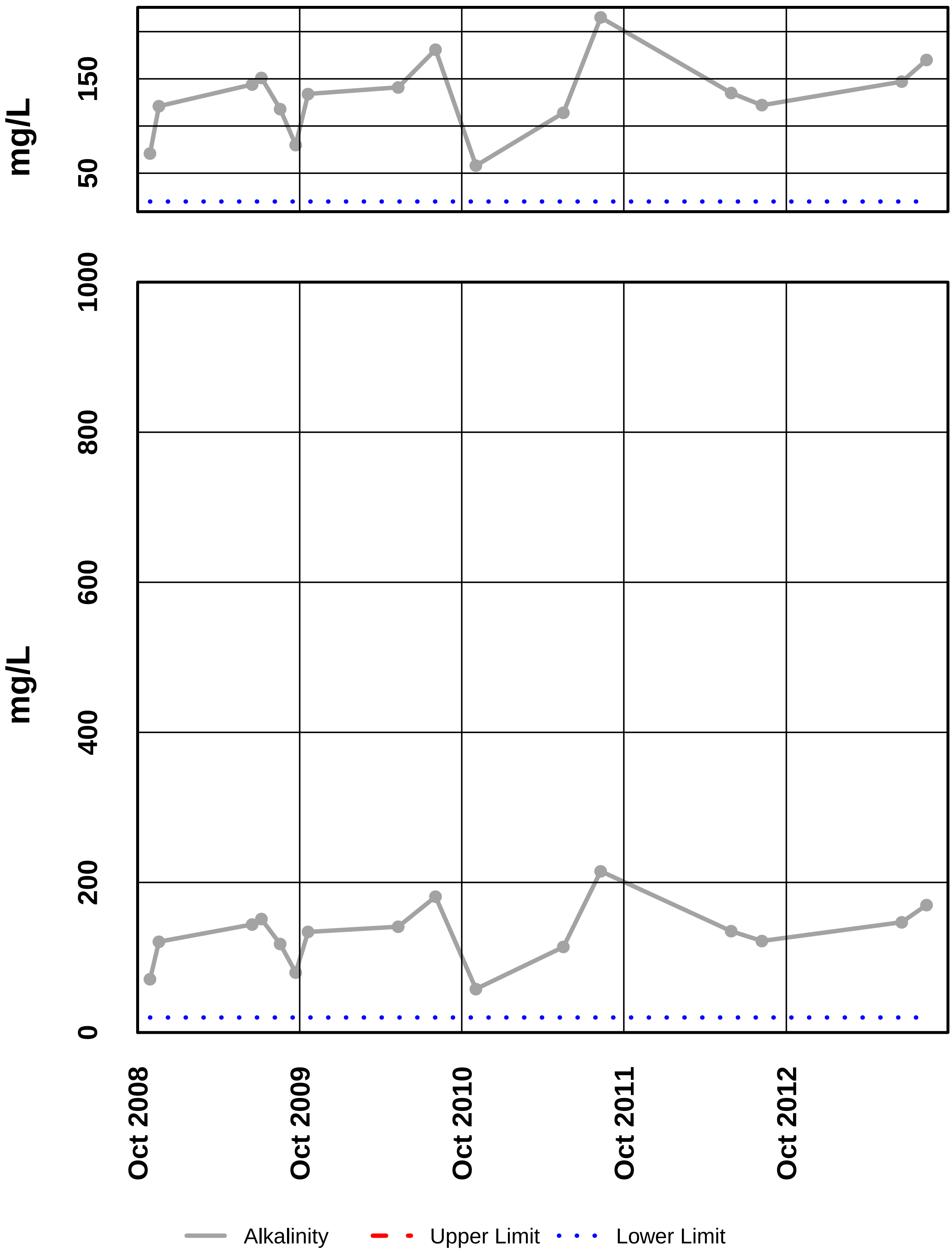
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 13 – pH Field

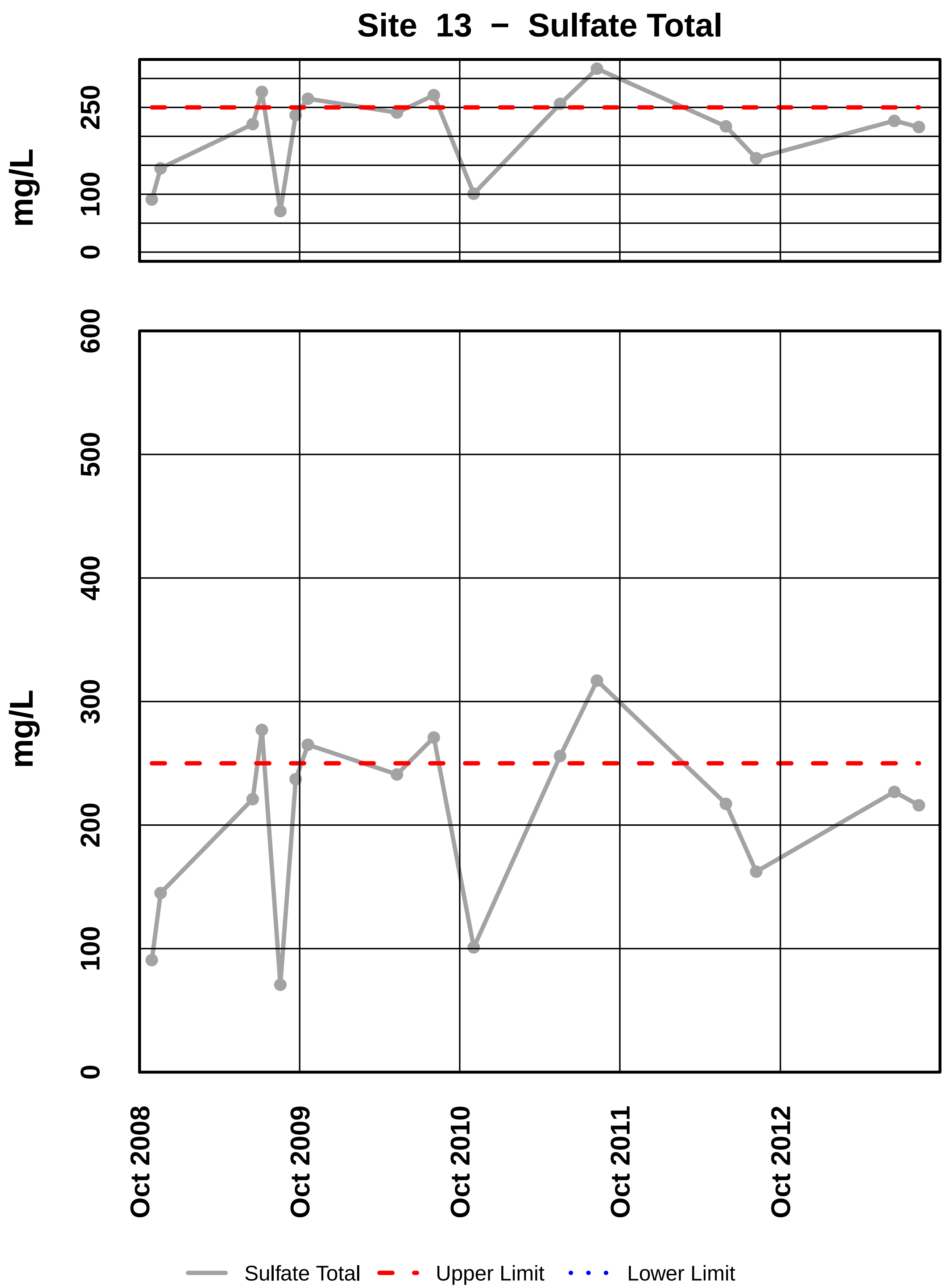


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

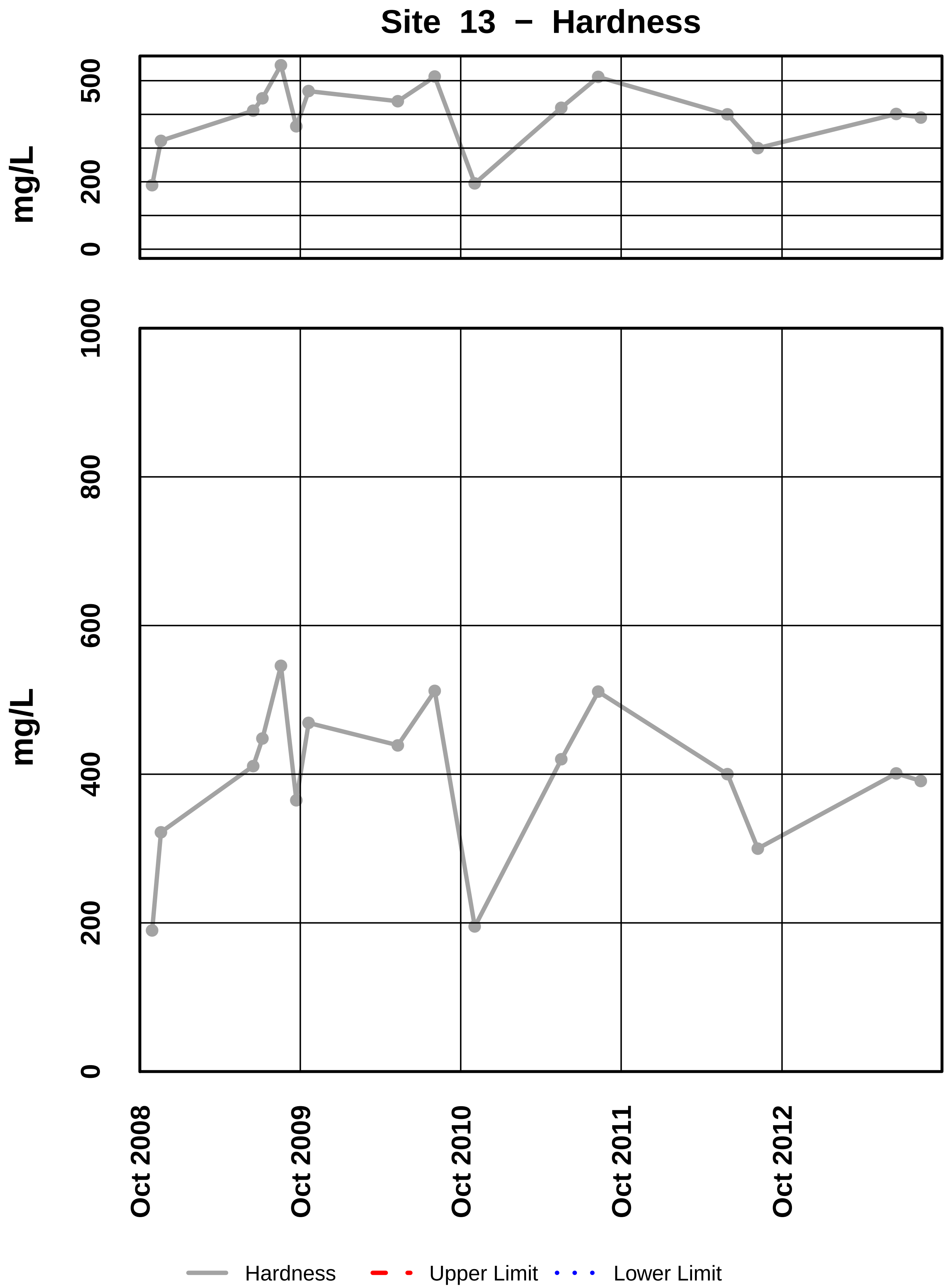
Site 13 − Alkalinity



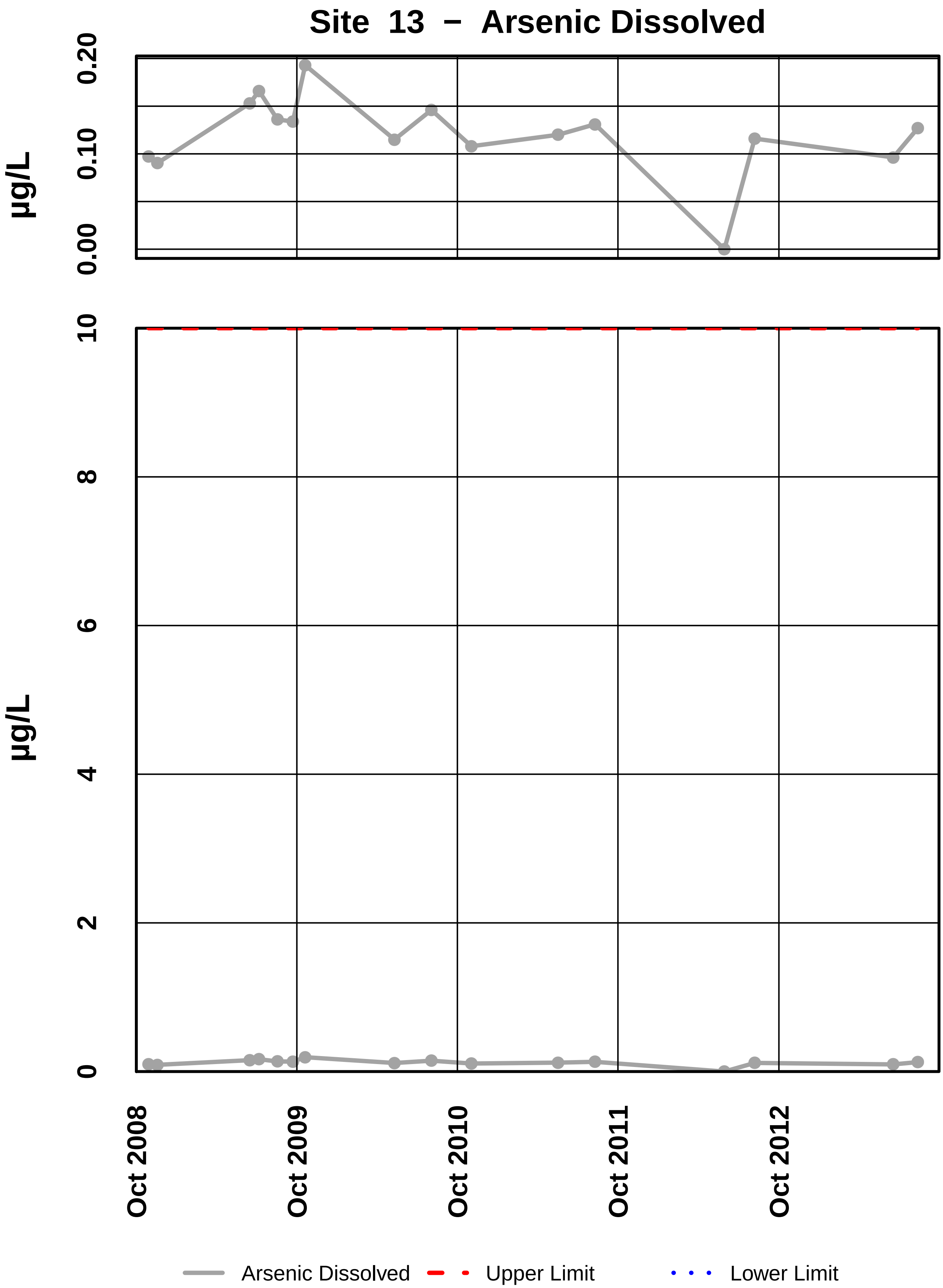
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

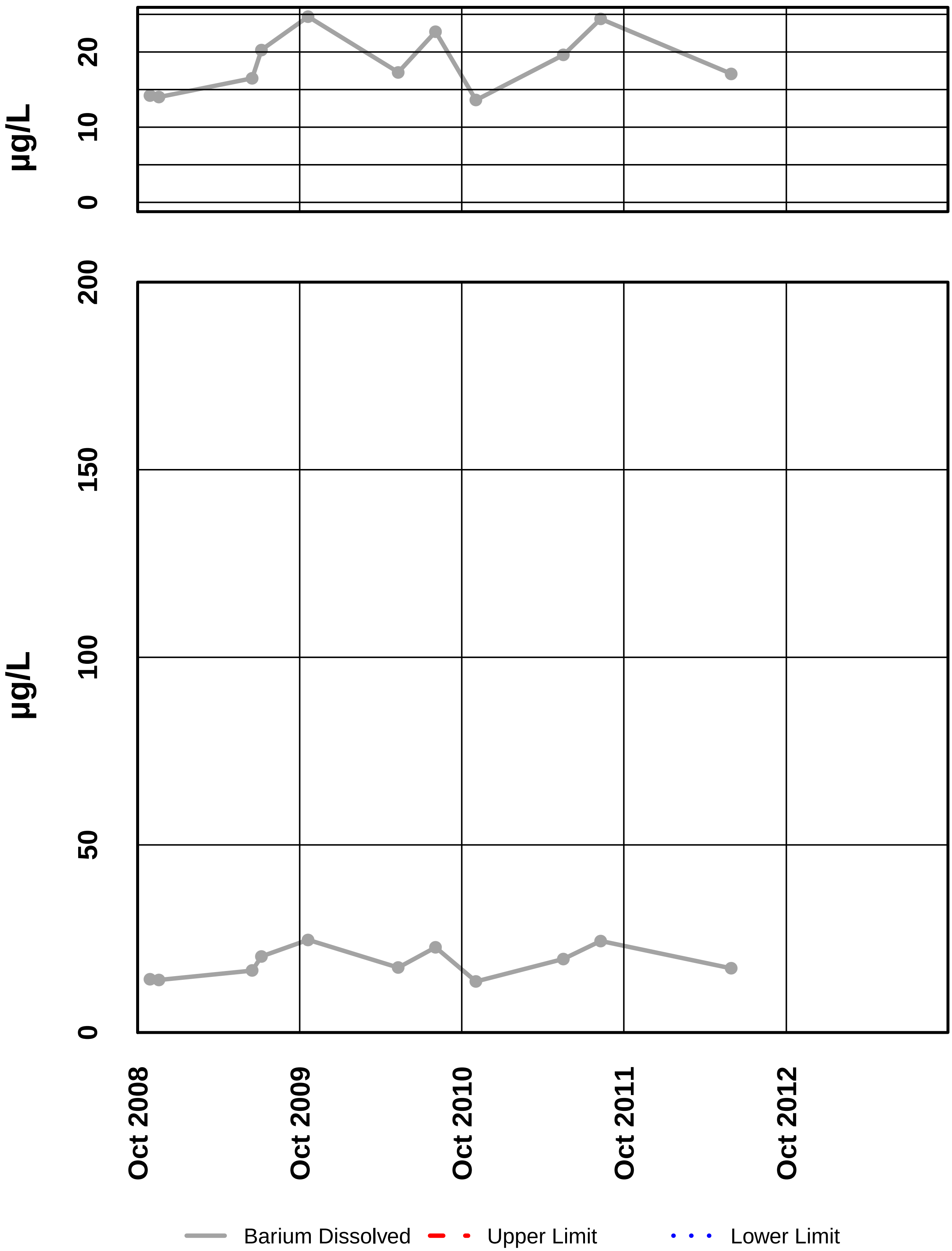


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

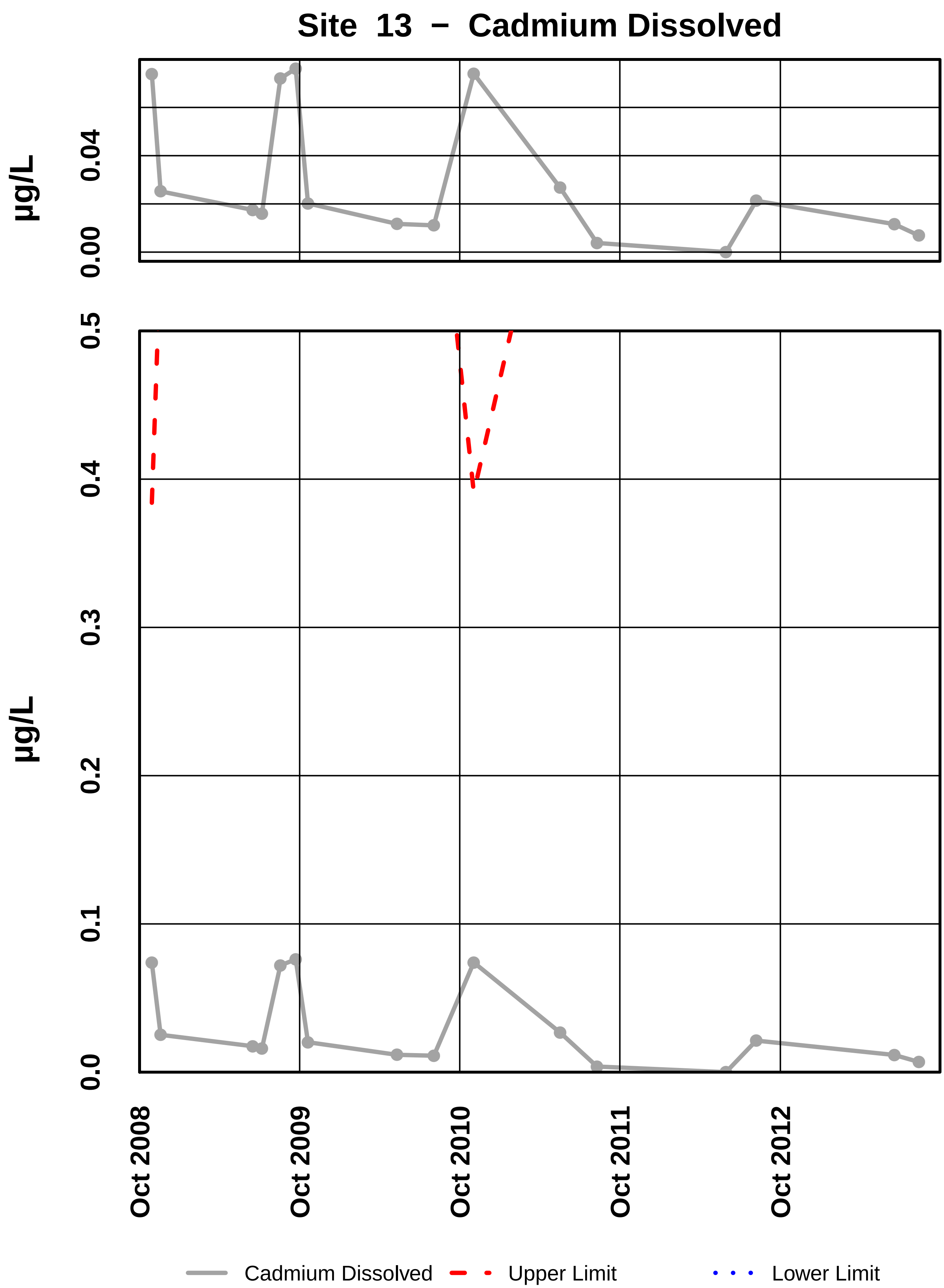


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 13 – Barium Dissolved

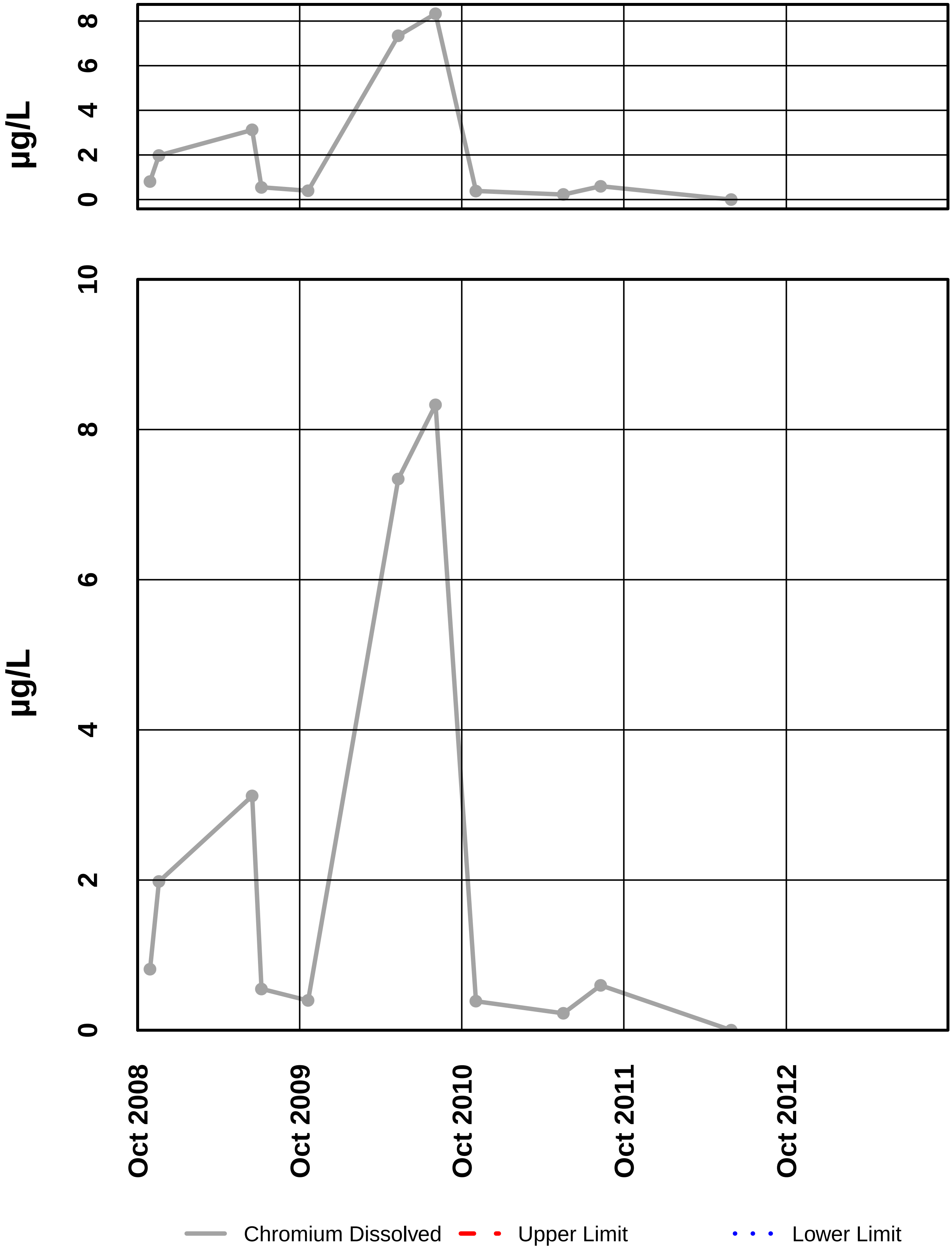


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

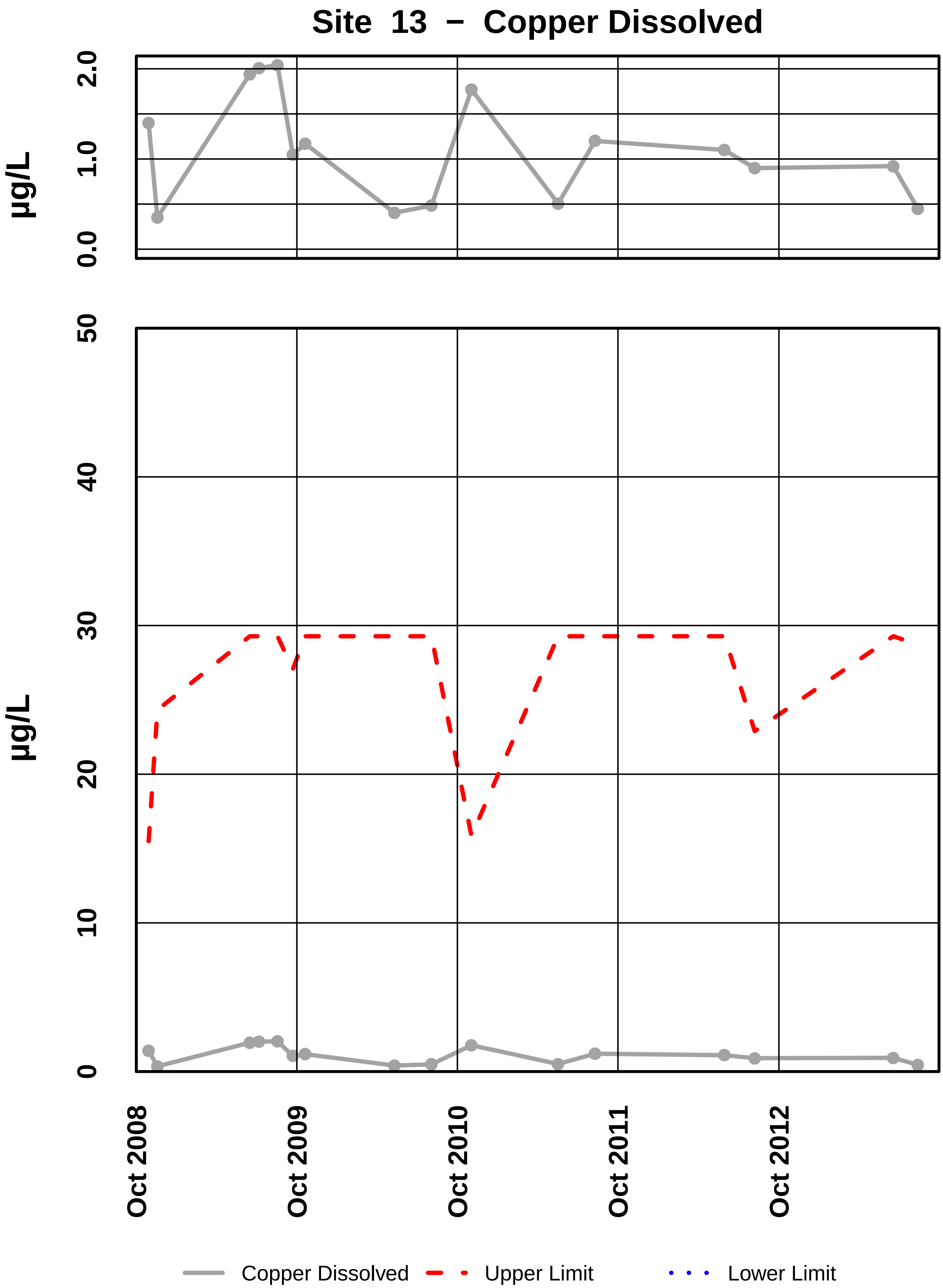


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

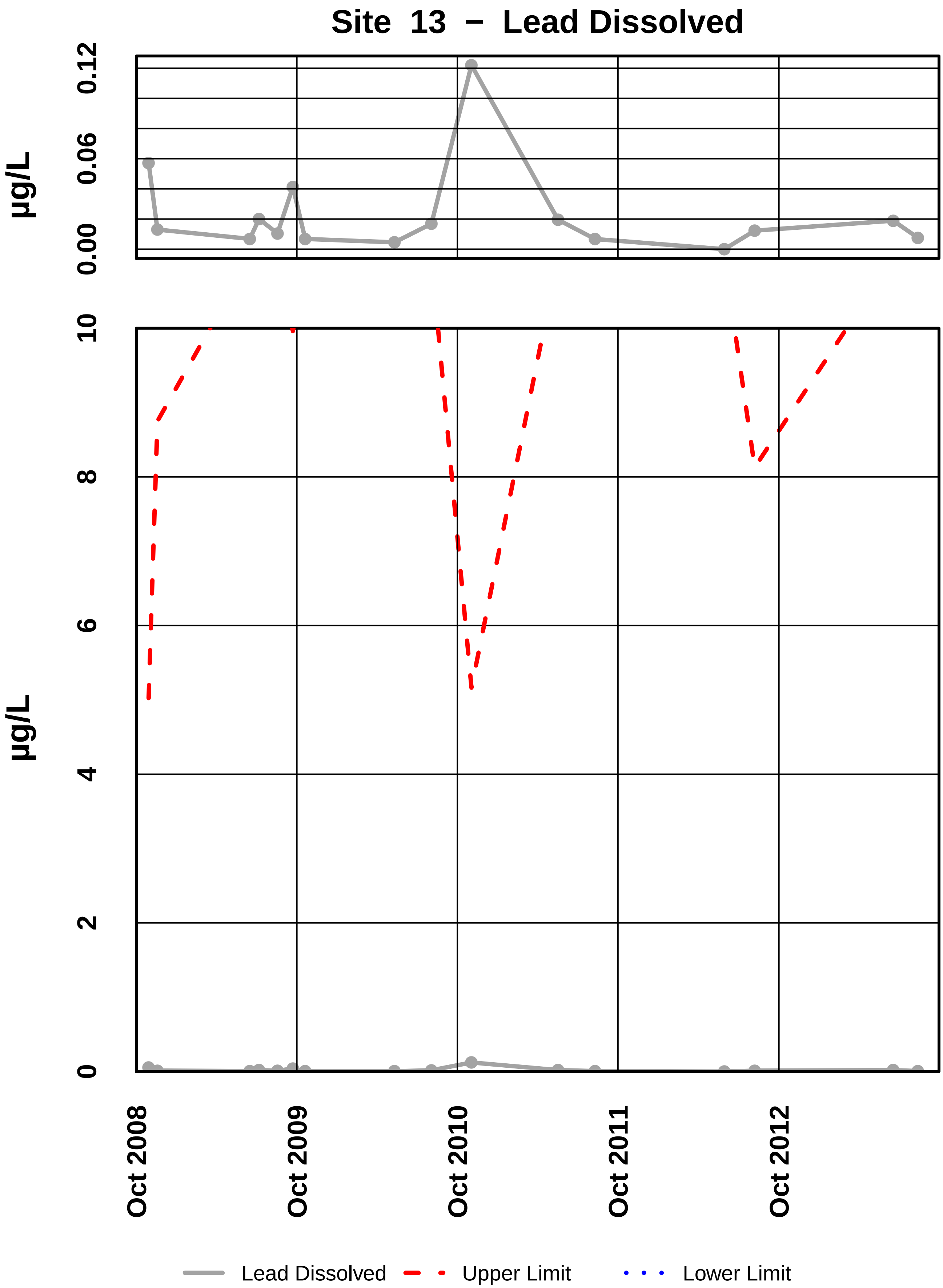
Site 13 − Chromium Dissolved



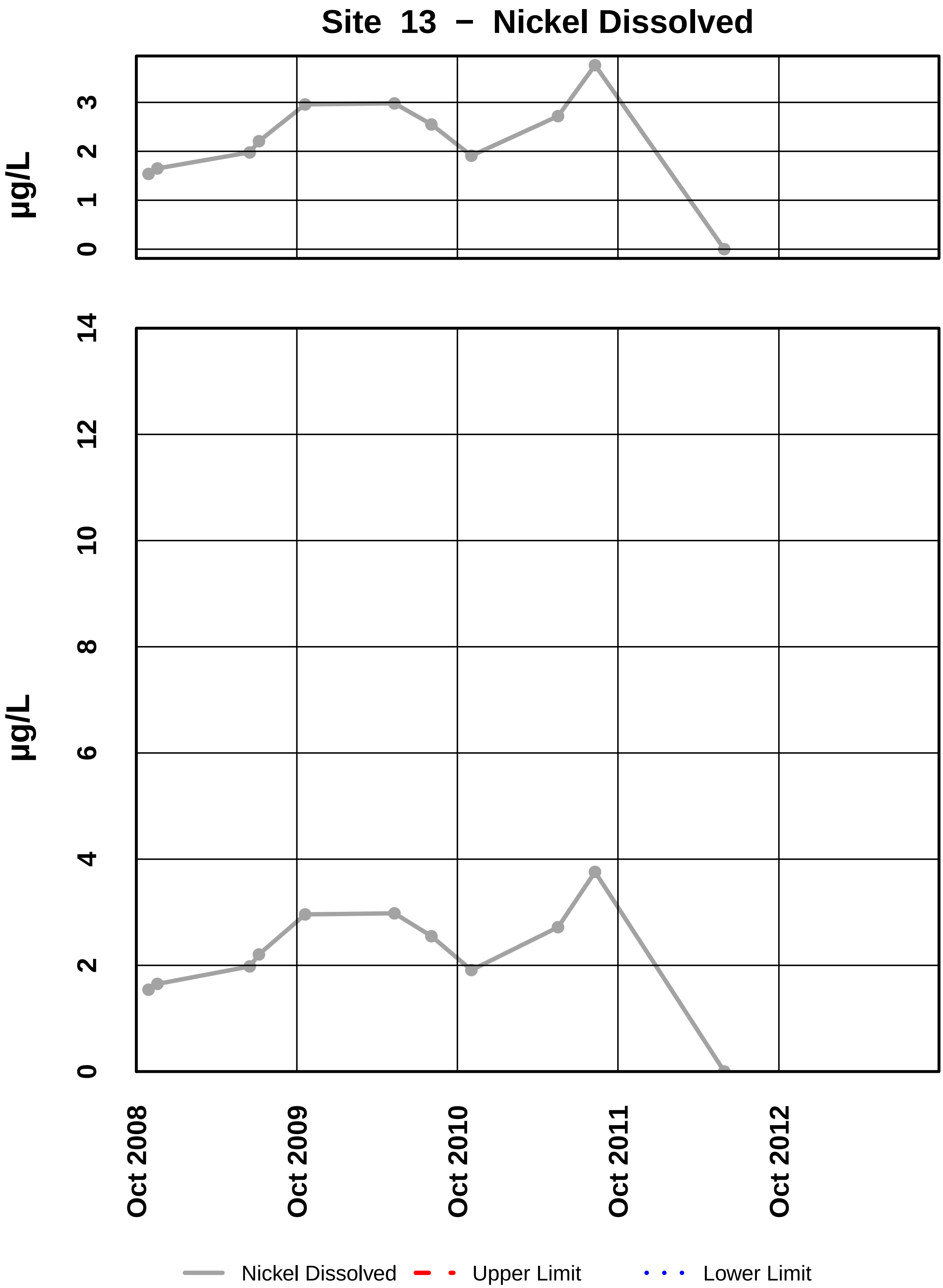
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

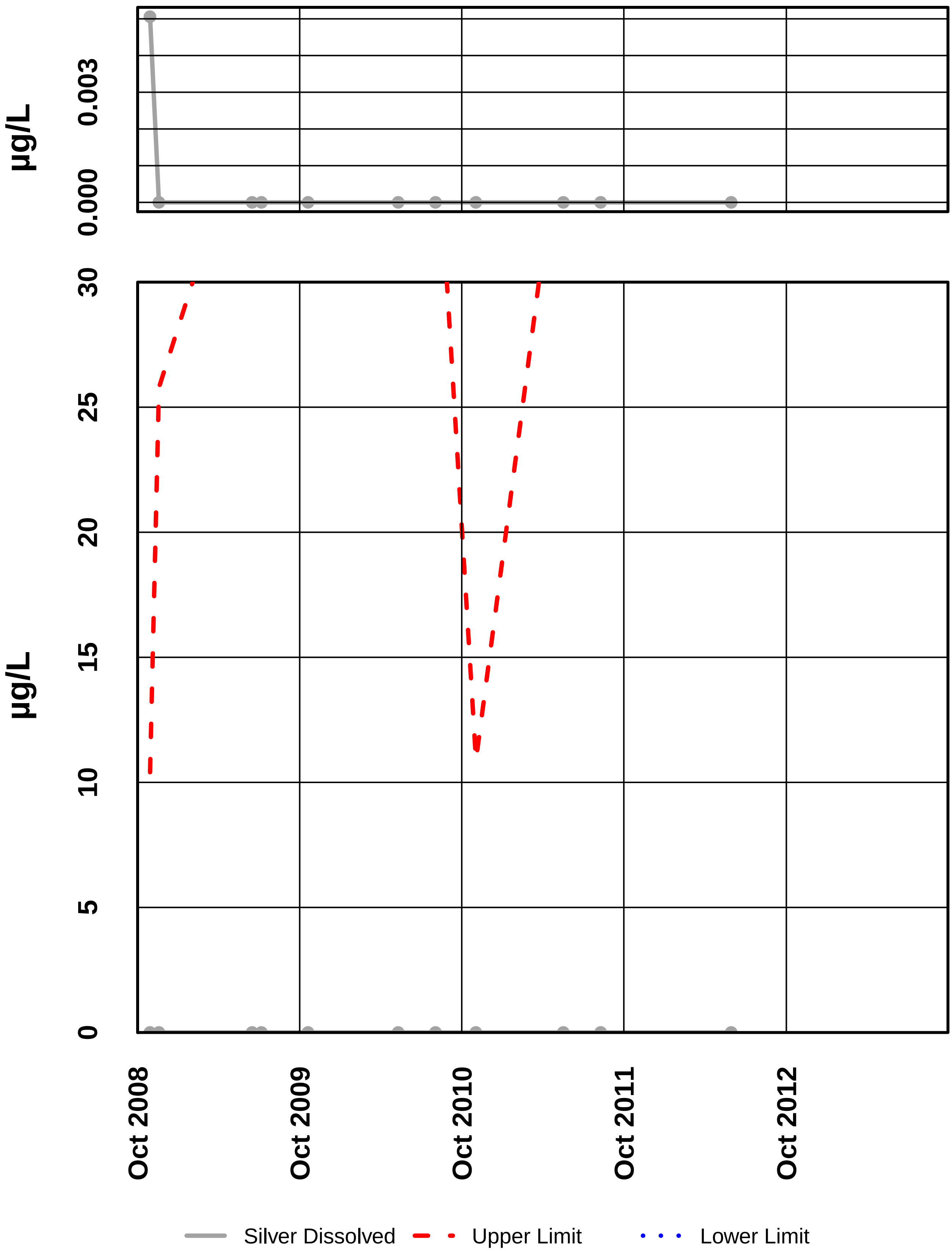


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



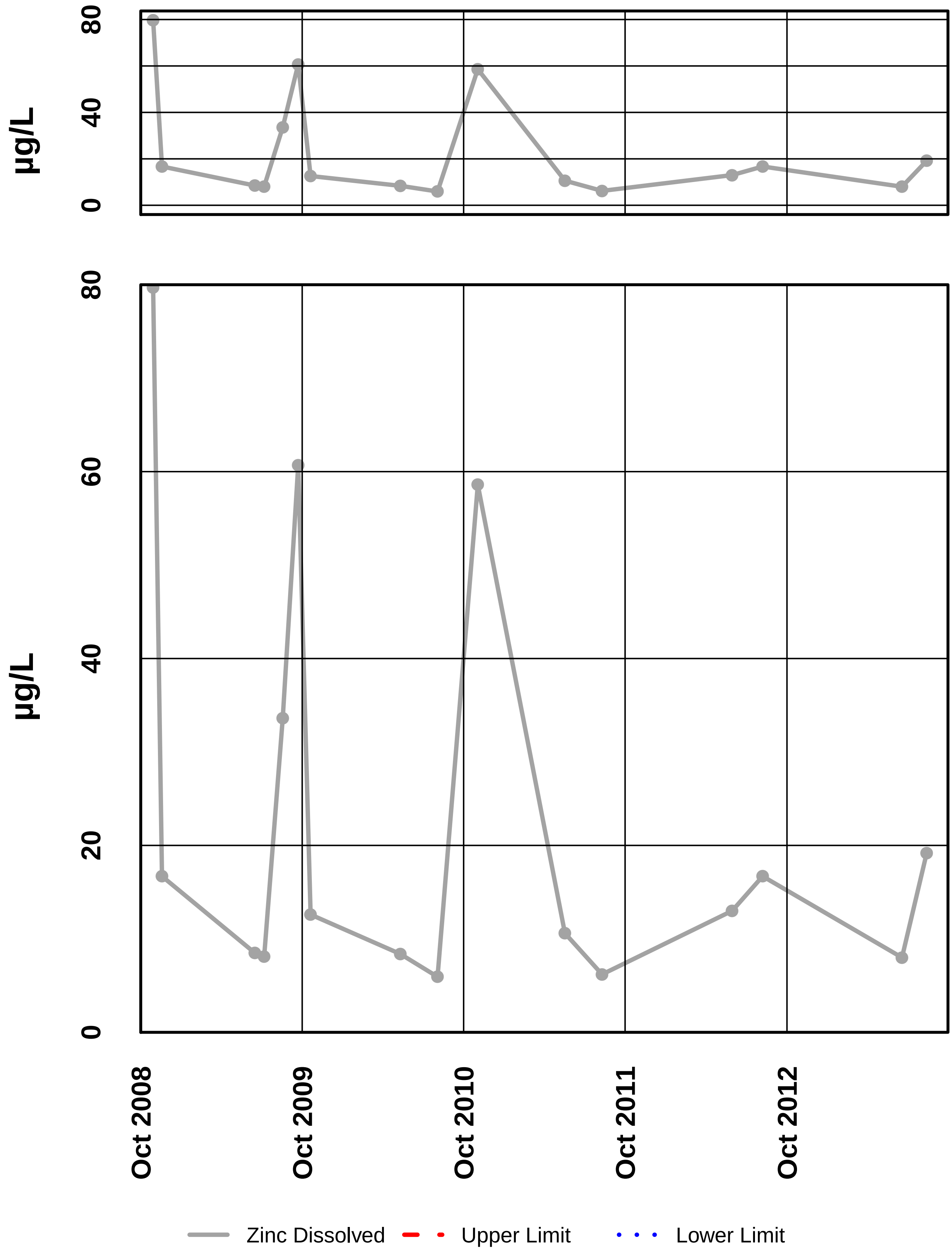
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 13 – Silver Dissolved

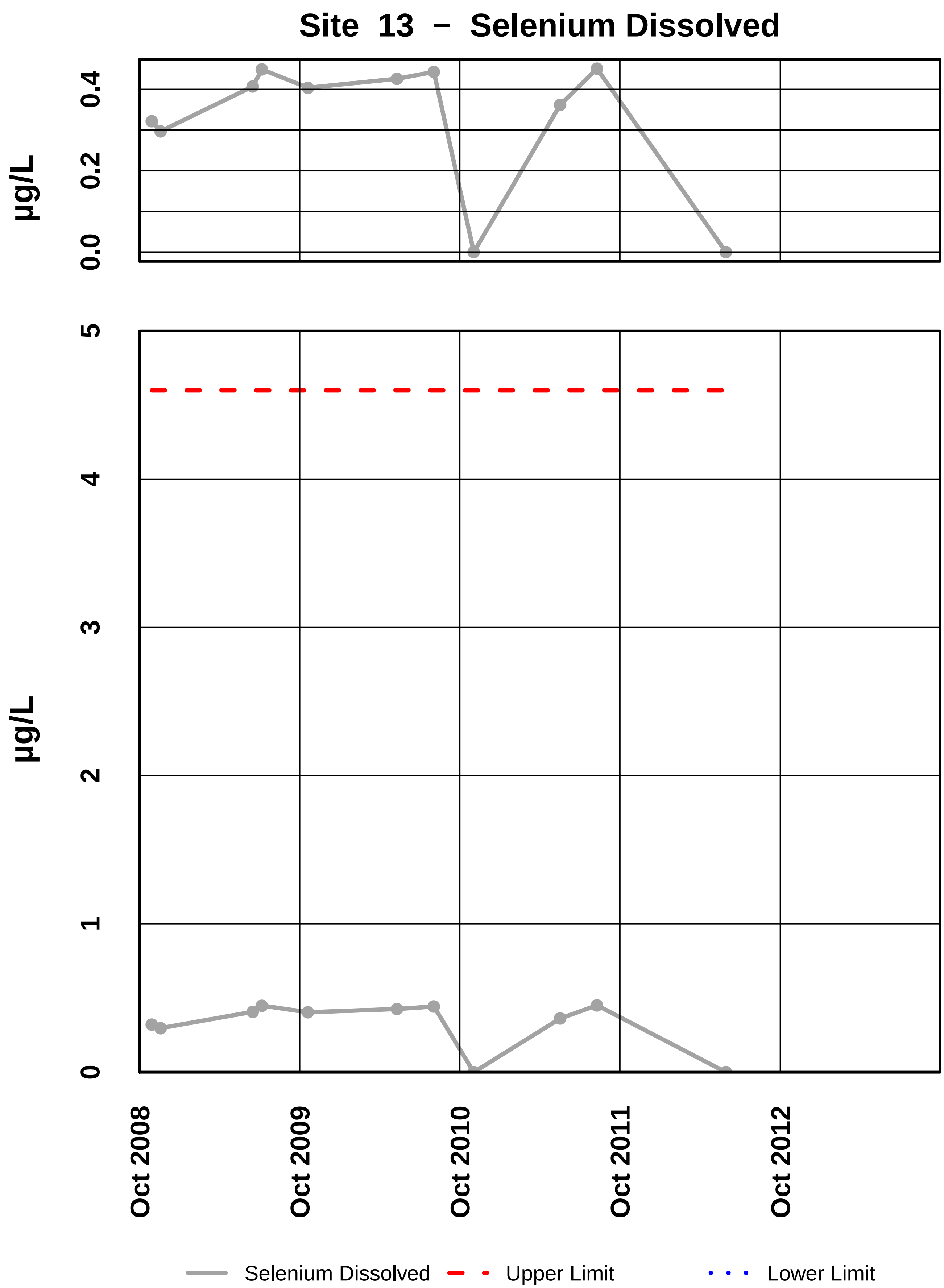


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 13 − Zinc Dissolved

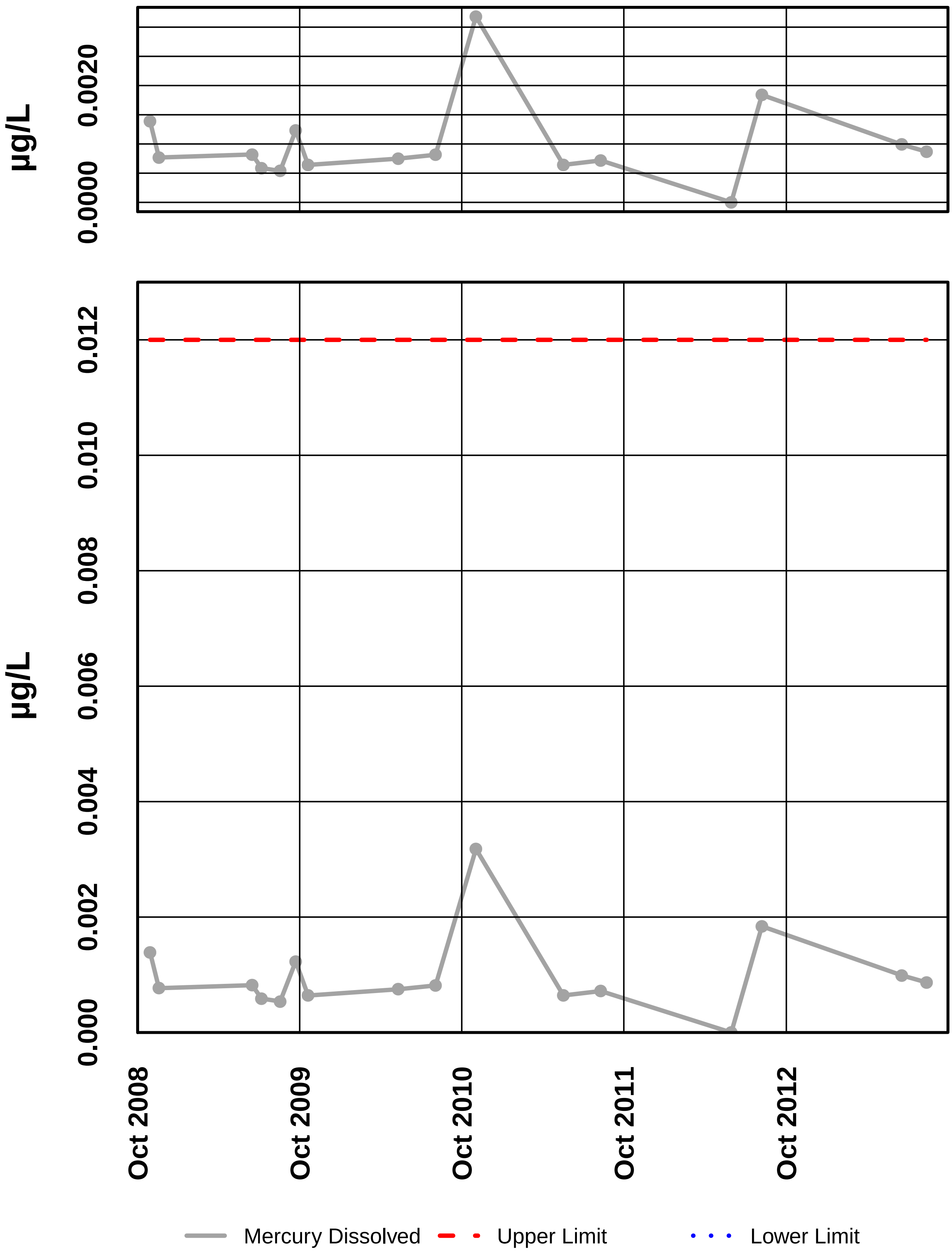


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

Site 13 − Mercury Dissolved



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

Site #13 — Seasonal Kendall analysis for Specific Conductance, Field (µS/cm)

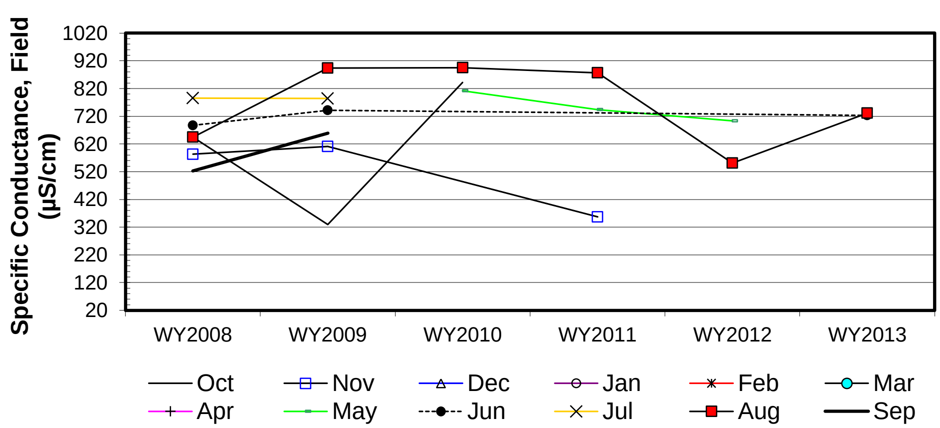
Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**	645	583							687	785	645	523
b	**WY2009**	330	611							742	784	894	659
c	**WY2010**	842							812			895	
d	**WY2011**		357						744			877	
e	**WY2012**								703			551	
f	**WY2013**									723		731	
	n	3	3	0	0	0	0	0	3	3	2	6	2
	t_1	3	3	0	0	0	0	0	3	3	2	6	2
	t_2	0	0	0	0	0	0	0	0	0	0	0	0
	t_3	0	0	0	0	0	0	0	0	0	0	0	0
	t_4	0	0	0	0	0	0	0	0	0	0	0	0
	t_5	0	0	0	0	0	0	0	0	0	0	0	0
	b-a	-1	1							1	-1	1	1
	c-a	1										1	
	d-a		-1									1	
	e-a											-1	
	f-a									1		1	
	c-b	1										1	
	d-b		-1									-1	
	e-b											-1	
	f-b									-1		-1	
	d-c								-1			-1	
	e-c								-1			-1	
	f-c											-1	
	e-d								-1			-1	
	f-d											-1	
	f-e											1	
	S_k	1	-1	0	0	0	0	0	-3	1	-1	-3	1
	σ^2_S=	3.67	3.67						3.67	3.67	1.00	28.33	1.00
	$Z_k = S_k/\sigma_S$	0.52	-0.52						-1.57	0.52	-1.00	-0.56	1.00
	Z^2_k	0.27	0.27						2.45	0.27	1.00	0.32	1.00

ΣZ_k=	-1.61
ΣZ^2_k=	5.59
Z-bar=ΣZ_k/K=	-0.23

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	22	0	0	0	0

Σn	22
ΣS_k	-5

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	5.22	@α=5% $\chi^2_{(K-1)}$=	12.59	Test for station homogeneity	
p	**0.516**			$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc} -0.60	@α/2=2.5% Z=	1.96	**H_0** (No trend)	ACCEPT
45.00	p **0.275**			**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-73.71		61.76
0.050	-54.89	**-8.50**	17.38
0.100	-51.78		5.95
0.200	-40.83		-0.35

Site **#13** Seasonal Kendall analysis for pH, Field, Standard Units

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**	7.7	7.8							7.8	8.0	7.1	7.6
b	**WY2009**	7.7	7.8							7.7	7.4	7.5	7.6
c	**WY2010**	7.9							8.0			7.5	
d	**WY2011**		7.7						7.7			7.8	
e	**WY2012**								7.4			7.7	
f	**WY2013**									7.6		8.1	
	n	3	3	0	0	0	0	0	3	3	2	6	2

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	1	3	0	0	0	0	0	3	3	2	6	2
t_2	1	0	0	0	0	0	0	0	0	0	0	0
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

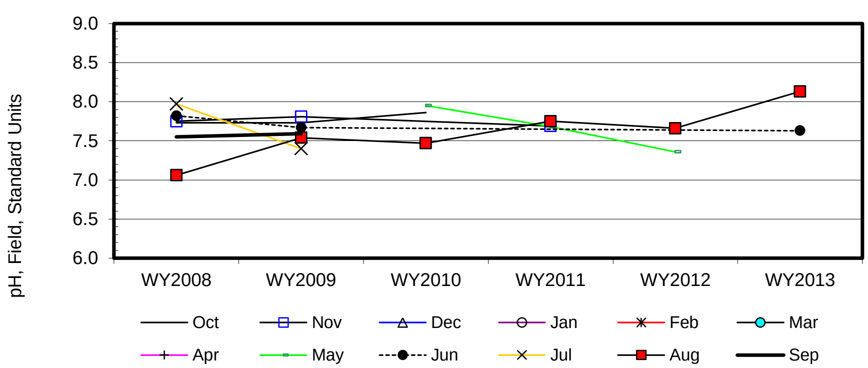
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a	0	1							-1	-1	1	1
c-a	1										1	
d-a		-1									1	
e-a											1	
f-a									-1		1	
c-b	1										-1	
d-b		-1									1	
e-b											1	
f-b									-1		1	
d-c								-1			1	
e-c								-1			1	
f-c											1	
e-d								-1			-1	
f-d											1	
f-e											1	
S_k	2	-1	0	0	0	0	0	-3	-3	-1	11	1
Qm											0.19	
$\sigma^2_S=$	2.67	3.67						3.67	3.67	1.00	28.33	1.00
$Z_k = S_k/\sigma_S$	1.22	-0.52						-1.57	-1.57	-1.00	2.07	1.00
Z^2_k	1.50	0.27						2.45	2.45	1.00	4.27	1.00

$\Sigma Z_k=$ -0.36
$\Sigma Z^2_k=$ 12.95
Z-bar=$\Sigma Z_k/K=$ -0.05

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	20	1	0	0	0

Σn 22
ΣS_k 6

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2=$ 12.93	@α=5% $\chi^2_{(K-1)}=$ 12.59	Test for station homogeneity	
p **0.044**		$\chi^2_h<\chi^2_{(K-1)}$	**REJECT**
ΣVAR(S_k) 44.00	Z_{calc} 0.75, **p** **0.775**	@α/2=2.5% Z= 1.96	**H_0** (No trend) NA
			H_A (± trend) NA



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.07		0.19
0.050	-0.04	**0.06**	0.15
0.100	-0.02		0.12
0.200	0.00		0.10

Site **#13** Seasonal Kendall analysis for Total Alk, (mg/l)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**	109.0	128.0							147.0	143.0	104.0	88.8
b	**WY2009**	70.9	121.0							144.0	151.0	118.0	80.0
c	**WY2010**	134.0							141.0			181.0	
d	**WY2011**		58.0						114.0			215.0	
e	**WY2012**								135.0			122.0	
f	**WY2013**									147.0		170.0	
	n	3	3	0	0	0	0	0	3	3	2	6	2

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	3	3	0	0	0	0	0	3	1	2	6	2
t_2	0	0	0	0	0	0	0	0	1	0	0	0
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a	-1	-1							-1	1	1	-1
c-a	1										1	
d-a		-1									1	
e-a											1	
f-a									0		1	
c-b	1										1	
d-b		-1									1	
e-b											1	
f-b									1		1	
d-c								-1			1	
e-c								-1			-1	
f-c											-1	
e-d								1			-1	
f-d											-1	
f-e											1	
S_k	1	-3	0	0	0	0	0	-1	0	1	7	-1

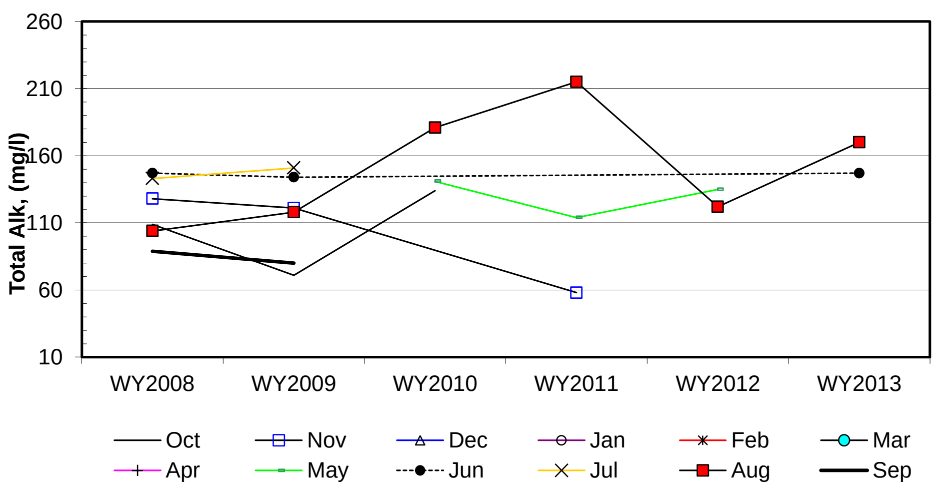
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	3.67	3.67						3.67	2.67	1.00	28.33	1.00
$Z_k = S_k/\sigma_S$	0.52	-1.57						-0.52	0.00	1.00	1.32	-1.00
Z^2_k	0.27	2.45						0.27	0.00	1.00	1.73	1.00

ΣZ_k= -0.25
ΣZ^2_k= 6.73
Z-bar=ΣZ_k/K= -0.04

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	20	1	0	0	0

Σn 22
ΣS_k 4

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$= 6.72		@α=5% $\chi^2_{(K-1)}$= 12.59	Test for station homogeneity	
p	**0.347**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc} 0.45	@α/2=2.5% Z= 1.96	H_0 (No trend)	ACCEPT
44.00	p **0.674**		H_A (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-22.68		23.80
0.050	-6.85	1.33	13.19
0.100	-3.50		12.88
0.200	-3.00		9.31

Site **#13** Seasonal Kendall analysis for Sulfate, Total (mg/l)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**	250.0	222.0							208.0	258.0	220.0	154.0
b	**WY2009**	90.6	145.0							221.0	277.0	70.8	237.0
c	**WY2010**	265.0							241.0			271.0	
d	**WY2011**		101.0						256.0			317.0	
e	**WY2012**								217.2			162.3	
f	**WY2013**									227.0		216.0	
	n	3	3	0	0	0	0	0	3	3	2	6	2

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	3	3	0	0	0	0	0	3	3	2	6	2
t_2	0	0	0	0	0	0	0	0	0	0	0	0
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a	-1	-1							1	1	-1	1
c-a	1										1	
d-a		-1									1	
e-a											-1	
f-a									1		-1	
c-b	1										1	
d-b		-1									1	
e-b											1	
f-b									1		1	
d-c								1			1	
e-c								-1			-1	
f-c											-1	
e-d								-1			-1	
f-d											-1	
f-e											1	
S_k	1	-3	0	0	0	0	0	-1	3	1	1	1

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	3.67	3.67						3.67	3.67	1.00	28.33	1.00
$Z_k = S_k/\sigma_S$	0.52	-1.57						-0.52	1.57	1.00	0.19	1.00
Z^2_k	0.27	2.45						0.27	2.45	1.00	0.04	1.00

ΣZ_k= 2.19

ΣZ^2_k= 7.49

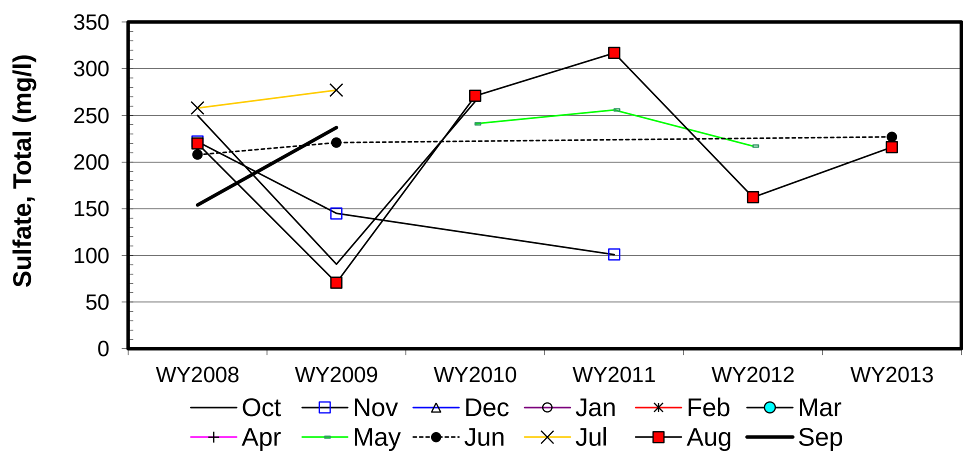
Z-bar=ΣZ_k/K= 0.31

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	22	0	0	0	0

Σn 22

ΣS_k 3

$\chi^2_h=\Sigma Z^2_k - K(\text{Z-bar})^2$=	6.81	@α=5% $\chi^2_{(K-1)}$= 12.59	Test for station homogeneity	
p	**0.339**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc} 0.30	@α=2.5% Z= 1.96	H_0 (No trend)	ACCEPT
45.00	p **0.617**		H_A (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-43.41		33.53
0.050	-22.29	3.80	25.59
0.100	-17.55		18.19
0.200	-12.71		13.65

Site #13 — Seasonal Kendall analysis for Zinc, Dissolved (ug/l)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**	104.0	60.5							12.2	19.7	50.5	71.1
b	**WY2009**	79.7	16.7							8.5	8.1	33.6	60.7
c	**WY2010**	12.6							8.4			5.9	
d	**WY2011**		58.6						10.6			6.2	
e	**WY2012**								13.0			16.7	
f	**WY2013**									8.0		19.2	
	n	3	3	0	0	0	0	0	3	3	2	6	2

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	3	3	0	0	0	0	0	3	3	2	6	2
t_2	0	0	0	0	0	0	0	0	0	0	0	0
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a	-1	-1							-1	-1	-1	-1
c-a	-1										-1	
d-a		-1									-1	
e-a											-1	
f-a									-1		-1	
c-b	-1										-1	
d-b		1									-1	
e-b											-1	
f-b									-1		-1	
d-c								1			1	
e-c								1			1	
f-c											1	
e-d								1			1	
f-d											1	
f-e											1	
S_k	-3	-1	0	0	0	0	0	3	-3	-1	-3	-1

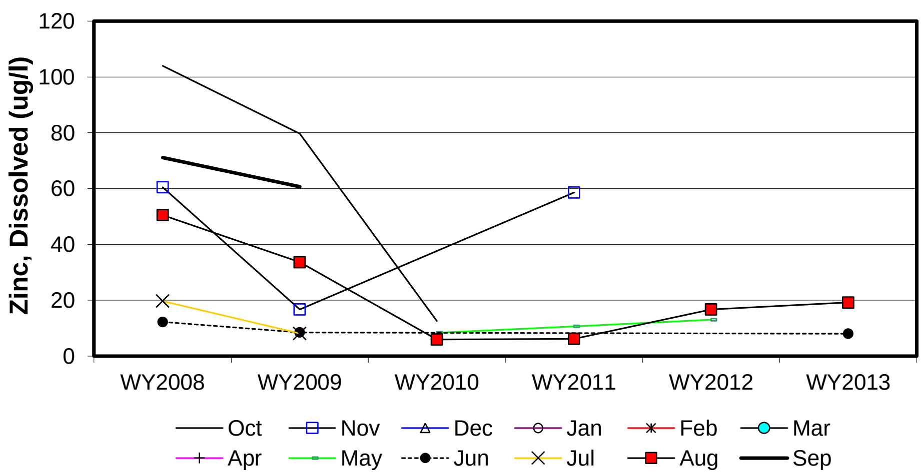
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	3.67	3.67						3.67	3.67	1.00	28.33	1.00
$Z_k = S_k/\sigma_S$	-1.57	-0.52						1.57	-1.57	-1.00	-0.56	-1.00
Z^2_k	2.45	0.27						2.45	2.45	1.00	0.32	1.00

ΣZ_k= -4.65
ΣZ^2_k= 9.95
Z-bar=$\Sigma Z_k/K$= -0.66

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	22	0	0	0	0

Σn 22
ΣS_k -9

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	6.86	@α=5% $\chi^2_{(K-1)}$= 12.59	Test for station homogeneity	
p	**0.334**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
$\Sigma VAR(S_k)$ 45.00	Z_{calc} -1.19	@α/2=2.5% Z= 1.96	H_0 (No trend)	ACCEPT
p	**0.117**		H_A (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-18.53		2.34
0.050	-13.72	**-3.71**	0.29
0.100	-11.36		-0.23
0.200	-9.08		-0.77

INTERPRETIVE REPORT
SITE 27

The data collected during the current water year are listed in the following "Table of Results for Water Year 2013" 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 2007 through September 2013.				

The data for water year2013 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 2013

			Limits		
Sample Date	Parameter	Value	Lower	Upper	Hardness
17-Jul-13	pH Field	6.01 su	6.5	8.5	
9-Sep-13	pH Field	5.86 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 median value recorded was 6.0µg/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-07 and Sep-13(WY2008-WY2013).

Table of Summary Statistics for Trend Analysis

Parameter	Mann-Kendall test statistics n*	p**	Trend	Sen's slope estimate Q	Q(%)
Conductivity Field	6	0.32			
pH Field	6	0.32			
Alkalinity, Total	6	0.01	+	3.44	12.5
Sulfate, Total	6	0.05			
Zinc, Dissolved	6	0.02	-	-0.577	-24.8

* 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 3.02mg/L/yr or a 12.52% increase over the last 6 years. 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.

Additional X-Y plots have been generated for total alkalinity, field pH, specific conductance, total sulfate, and dissolved zinc that co-plot data from Site 27 and Site 58, the upgradient control site, to aid in the comparison between those two sites. Total alkalinity and field pH are both approximately within the same range for both sites. Total sulfate and field conductivity are generally higher at the downgradient site. Dissolved zinc values typically have a similar range at both sites.

In general the waters for these two different sites are characterized by significantly different hydrological and geological conditions. Site 58 is located in close proximity to the large bedrock ridge, which defines the eastern geologic and hydrologic boundary of the tails area. The upslope portion of the ridge acts as the major recharge zone to the area aquifer. Along this ridge it is likely that groundwater flow is dominated by shallow or near surface flows due to the steep gradient and thin mineral soil. Thus, the groundwater at Site 58 is typically a mixture of surficial recharge from the immediate area with a component of relatively juvenile groundwater originating from the ridge to the east. In contrast, Site 27 is located in an area of gently sloping muskeg that forms part of the upper Tributary Creek drainage area. The area's groundwater is characterized by diffuse flow through the peat/sand strata that make up the upper portion of the unconsolidated sediment fill in the Tributary Creek valley. Additionally, Site 27 is located in an area identified as a groundwater discharge site into Tributary Creek. Thus, Site 27 samples groundwater that is relatively mature in comparison to Site 58 and may have a higher component of groundwater that has been in contact with a larger variety of strata for a longer period of time. Therefore, the groundwater would be expected to have a higher dissolved load. The lower pH would be due to the greater interaction with organic matter in the muskeg and would promote greater solubility for naturally occurring dissolved metals sampled at this site.

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 place 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**

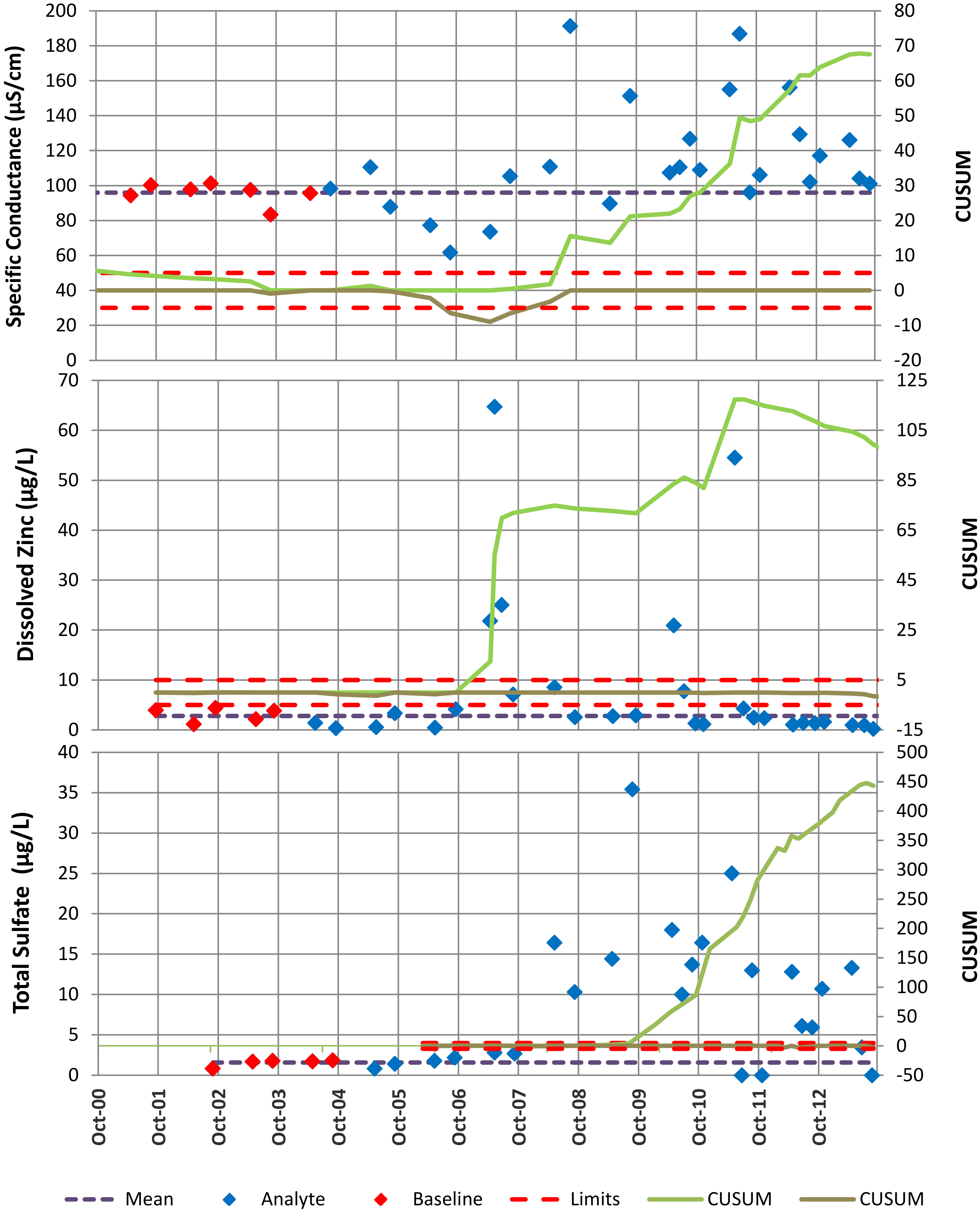


Table of Results for Water Year 2013

Site 027FMG - 'Monitoring Well - 2S'

Sample Date/Parameter	Oct 2012	Nov 2012	Dec 2012	Jan 2013	Feb 2013	Mar 2013	Apr 2013	May 2013	Jun 2013	Jul 2013	Aug 2013	Sep 2013	**Median**
Water Temp (°C)		4.9						5.1		9.5		11	7.3
Conductivity-Field(µmho)		117						126		104		101	110.5
Conductivity-Lab (µmho)		119						104		89		83	97
pH Lab (standard units)		6.19						5.84		5.98		5.95	5.97
pH Field (standard units)		6.75						6.67		6.01		5.86	6.34
Total Alkalinity (mg/L)		46.2						28.6		34		39.5	36.8
Total Sulfate (mg/L)		10.7						13.3		3.4		1.3	7.1
Hardness (mg/L)		38.7						25.8		26.1		29.5	27.8
Dissolved As (ug/L)		1.55						3.5		0.984		6.81	2.525
Dissolved Ba (ug/L)		46.1						33.5		30.7		44.4	39.0
Dissolved Cd (ug/L)		0.0013						0.0018		0.0018		0.0018	0.0018
Dissolved Cr (ug/L)		0.626						0.467		0.552		1.48	0.589
Dissolved Cu (ug/L)		0.106						0.05		0.184		0.15	0.128
Dissolved Pb (ug/L)		0.0364						0.0196		0.108		0.0336	0.0350
Dissolved Ni (ug/L)		0.571						0.682		0.58		0.917	0.631
Dissolved Ag (ug/L)		0.002						0.002		0.002		0.002	0.002
Dissolved Zn (ug/L)		1.6						0.93		0.95		0.16	0.94
Dissolved Se (ug/L)		0.183						0.241		0.199		0.205	0.202
Dissolved Hg (ug/L)		0.000938						0.000533		0.00653		0.000901	0.000920

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.

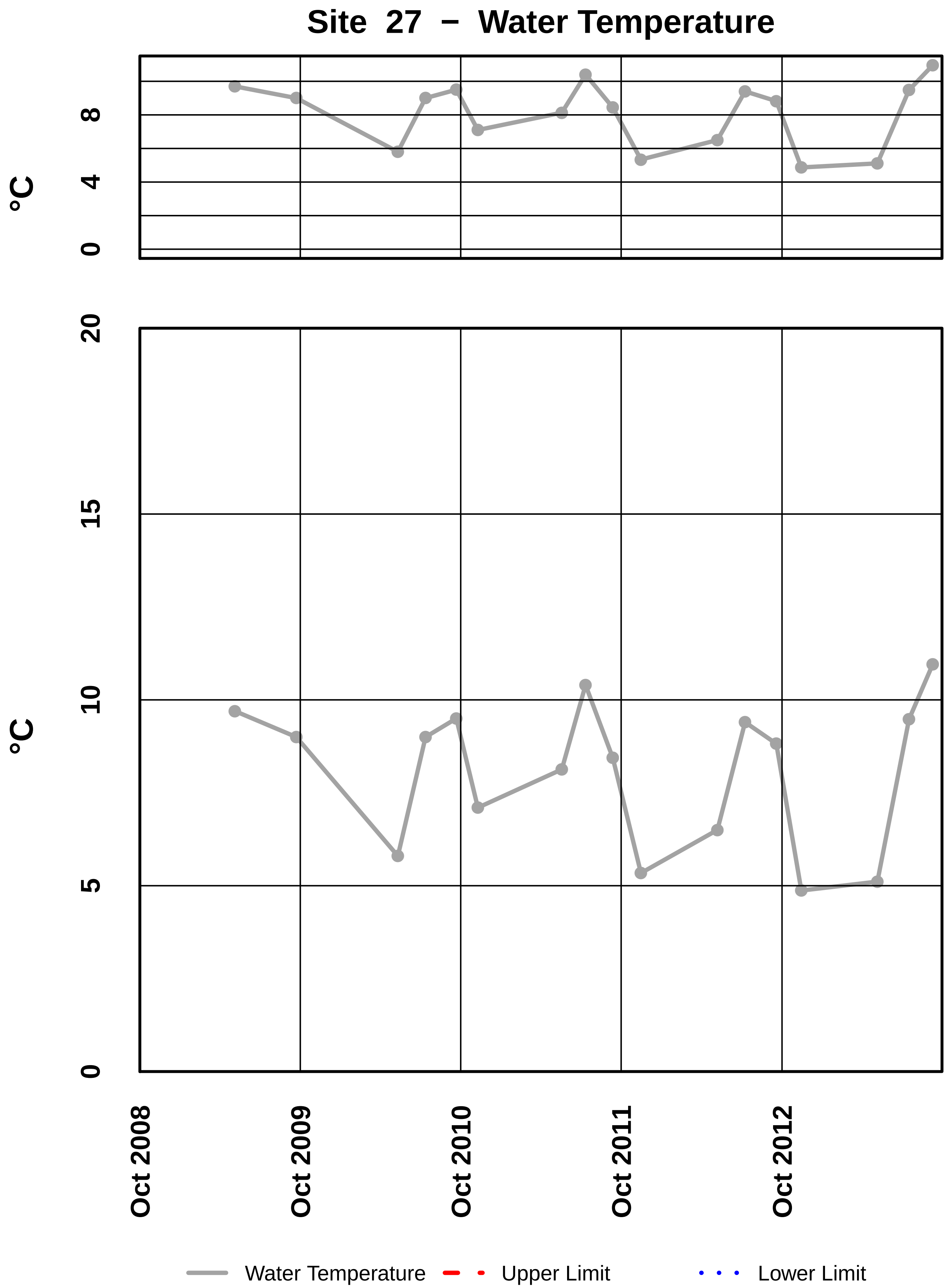
Shaded data has been qualified as an outlier by HGCMC and removed from any further analysis and is not included into the calculation of the median

Qualified Data by QA Reviewer

Date Range: 10/01/2012 to 09/30/2013

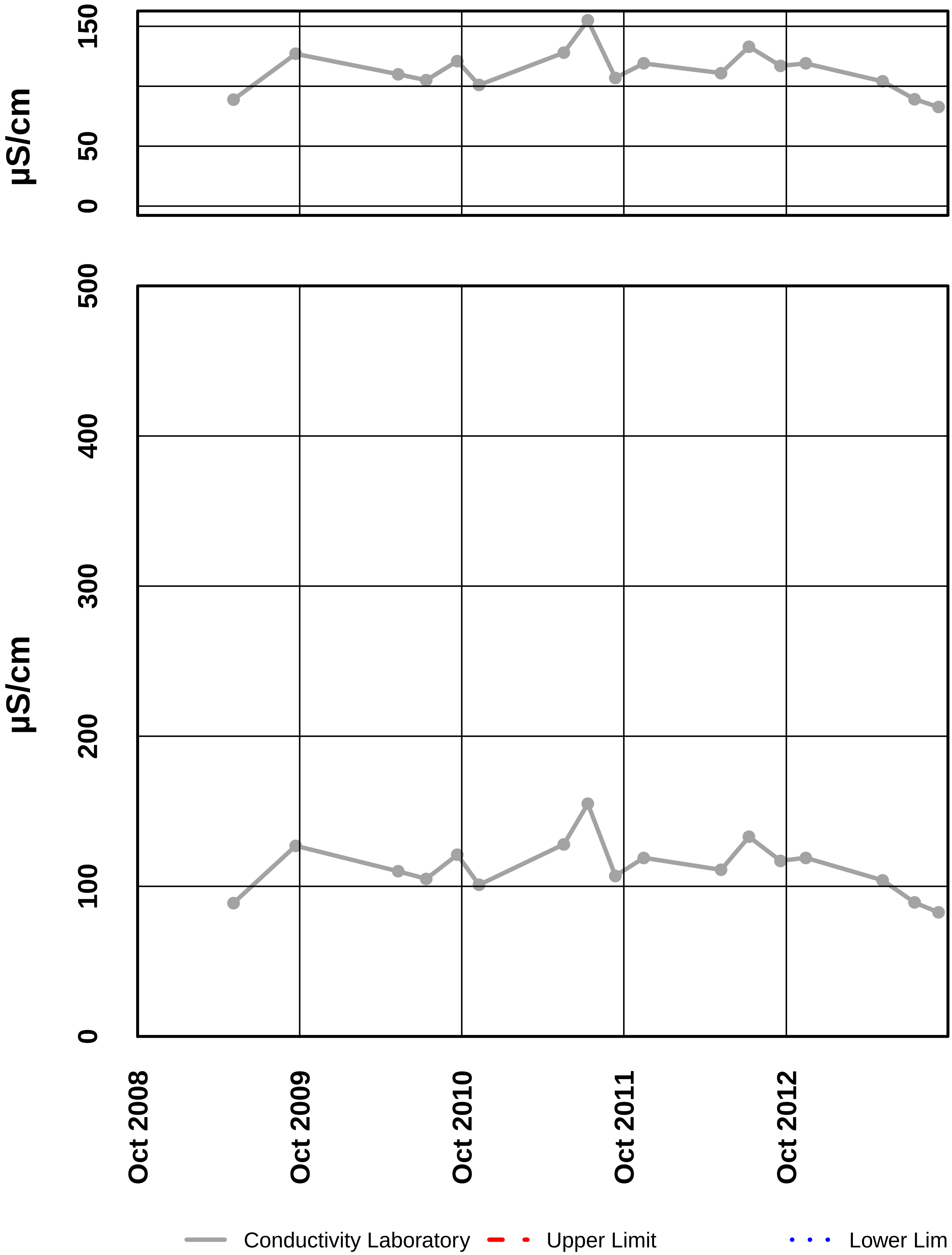
Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
27	11/14/2012	12:00 AM	Ag diss, µg/l	0.00206	J	Below Quantitative Range
			Cd diss, µg/l	0.00132	J	Below Quantitative Range
			Cu diss, µg/l	0.1	U	Field Blank Contamination
			Zn diss, µg/l	1.6	U	Field Blank Contamination
			Se diss, µg/l	0.18	U	Field Blank Contamination
27	5/6/2013	12:00 AM	SO4 Tot, mg/l	13.32	J	Sample Receipt Temperature
			Se diss, µg/l	0.24	J	Below Quantitative Range
			pH Lab, su	5.84	J	Hold Time Violation
			Hg diss, µg/l	0.000533	U	Field Blank Contamination
			Alk, mg/L	28.6	U	Field Blank Contamination
27	7/17/2013	12:00 AM	SO4 Tot, mg/l	3.43	J	Sample Receipt Temperature
			Se diss, µg/l	0.19	J	Below Quantitative Range
			Zn diss, µg/l	0.95	U	Field Blank Contamination
27	9/9/2013	12:00 AM	Se diss, µg/l	0.2	J	Below Quantitative Range
			Zn diss, µg/l	0.16	U	Method Blank Contamination
			Hg diss, µg/l	0.000901	U	Field Blank Contamination
			SO4 Tot, mg/l	-2.5	UJ	Sample receipt temperature

Qualifier	Description
J	Positively Identified - Approximate concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit

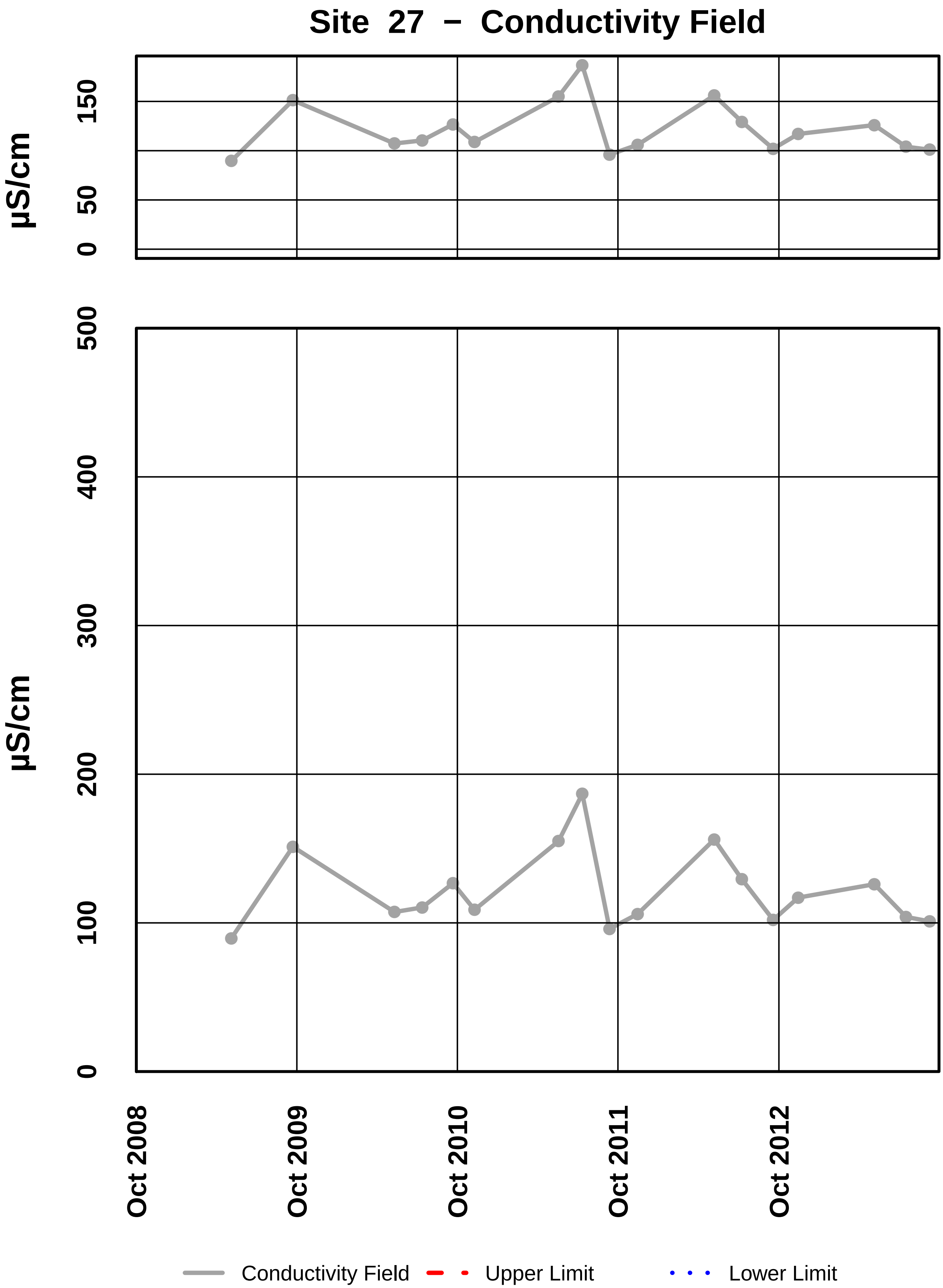


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 27 – Conductivity Laboratory

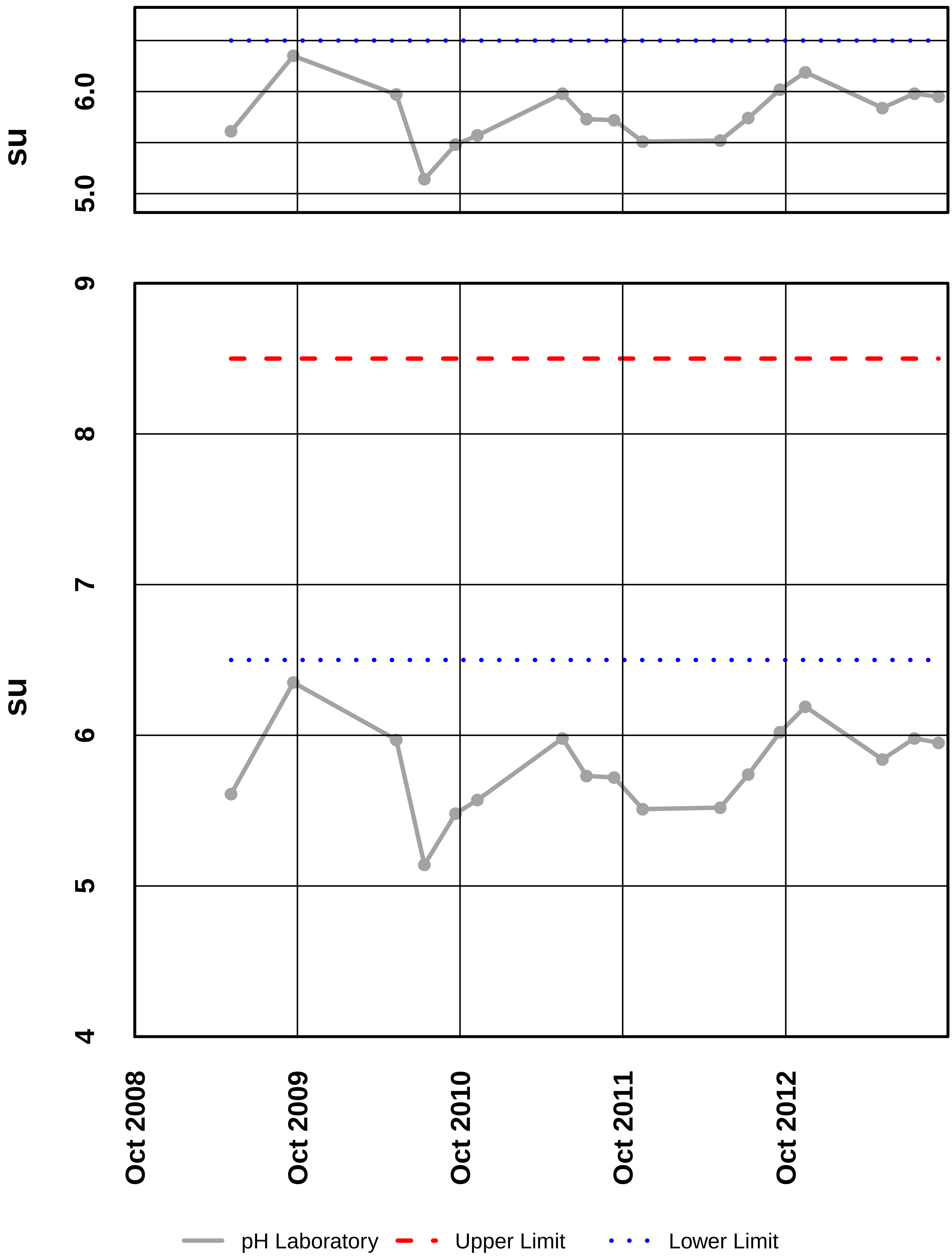


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



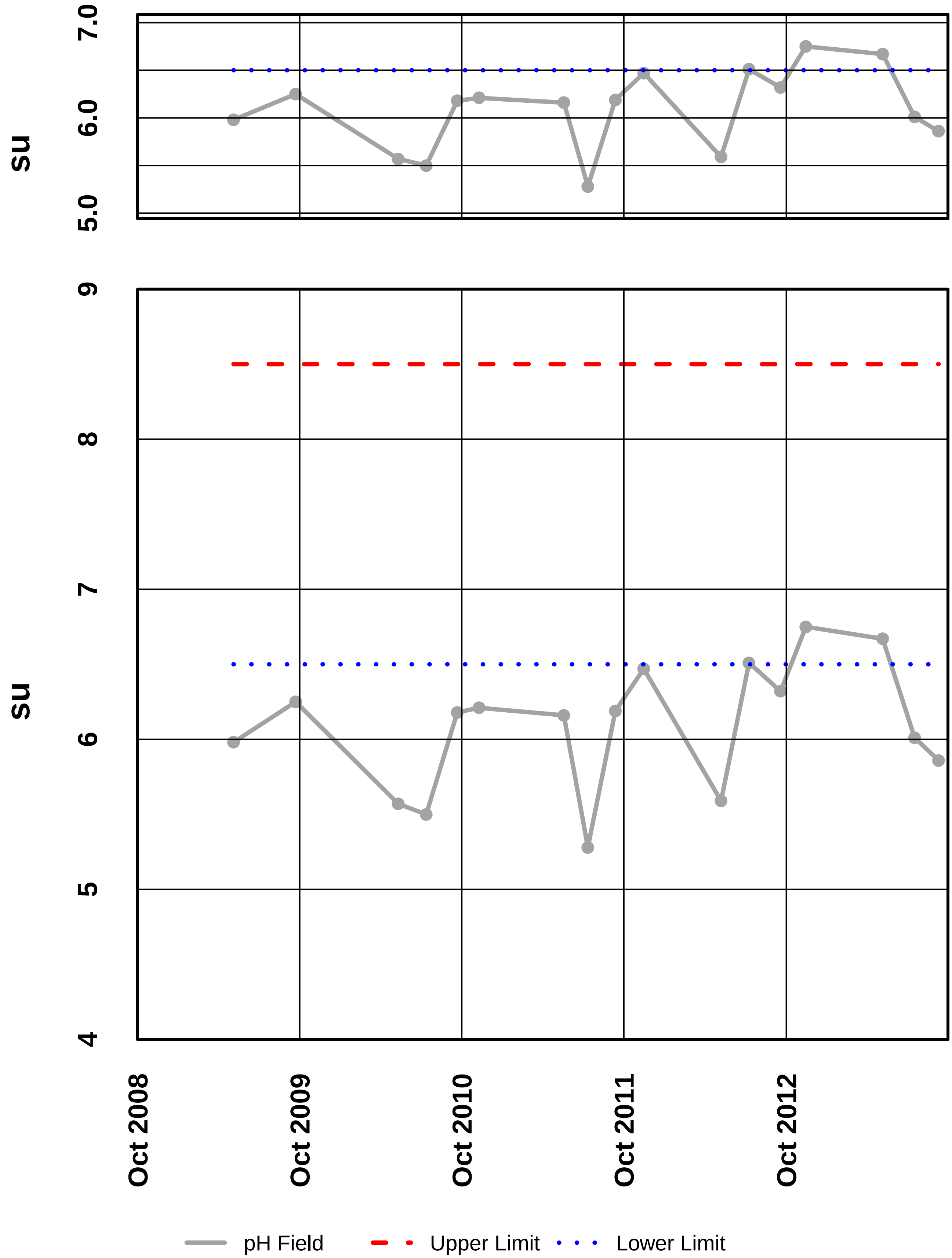
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 27 – pH Laboratory



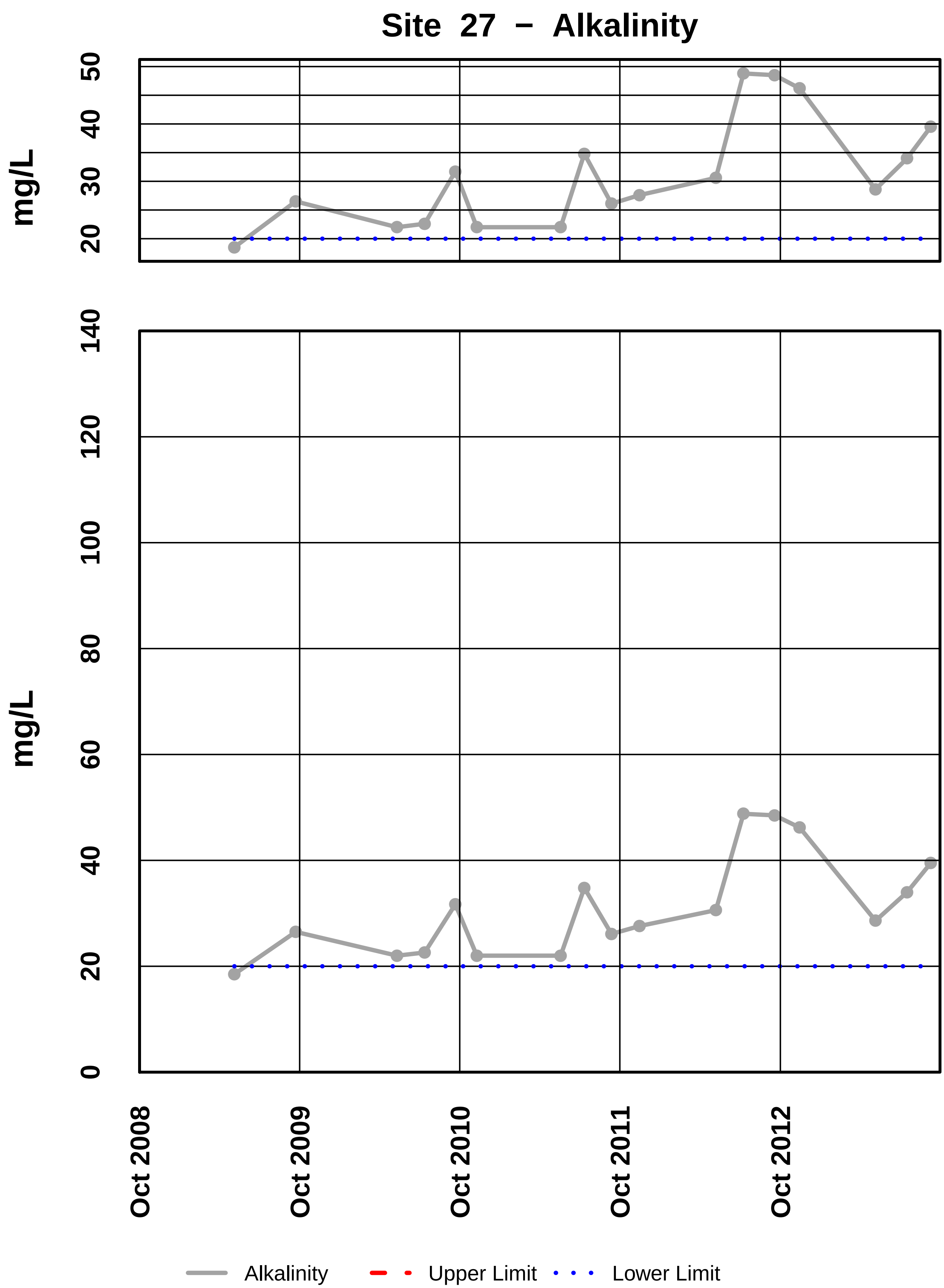
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 27 – pH Field



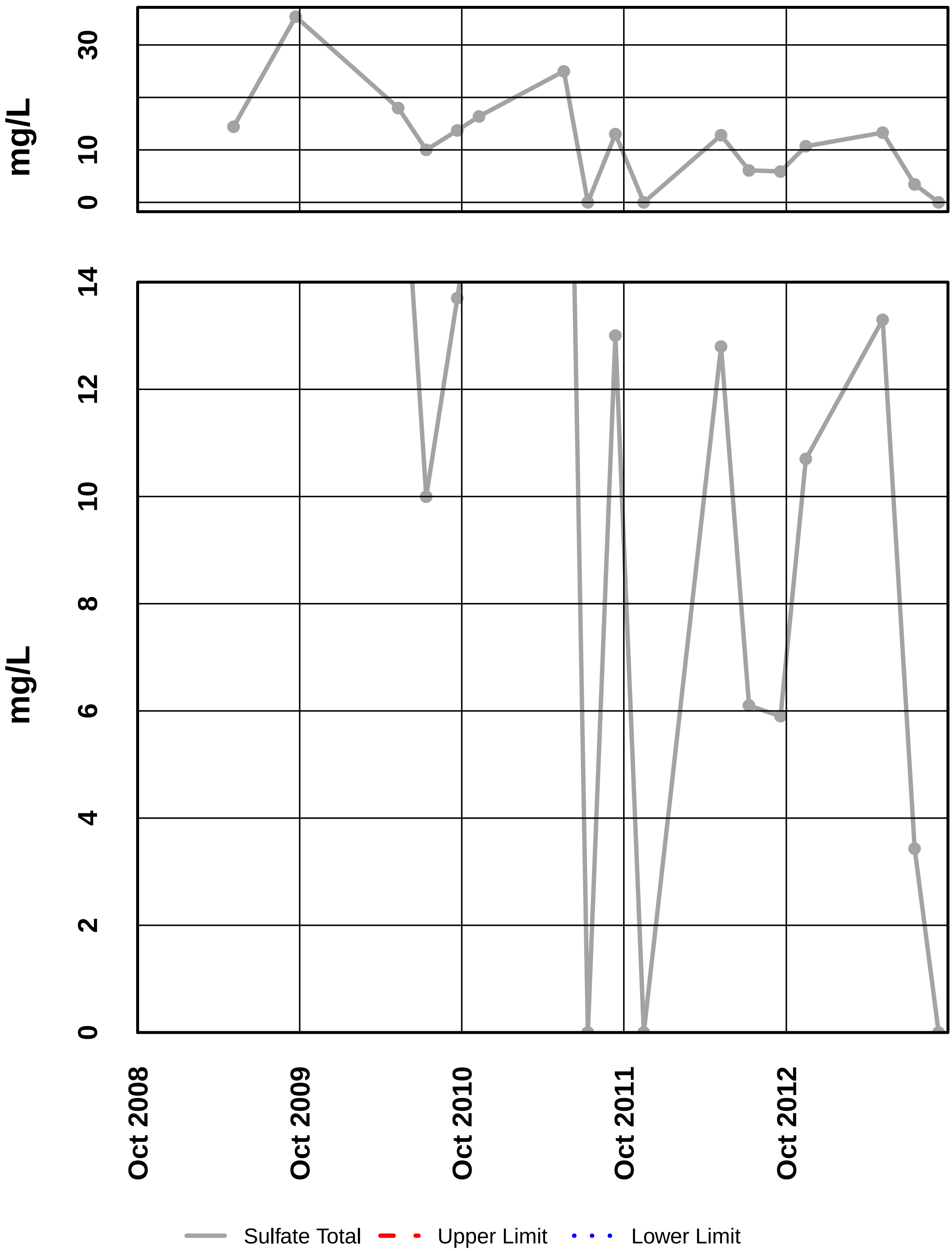
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 27 – Alkalinity



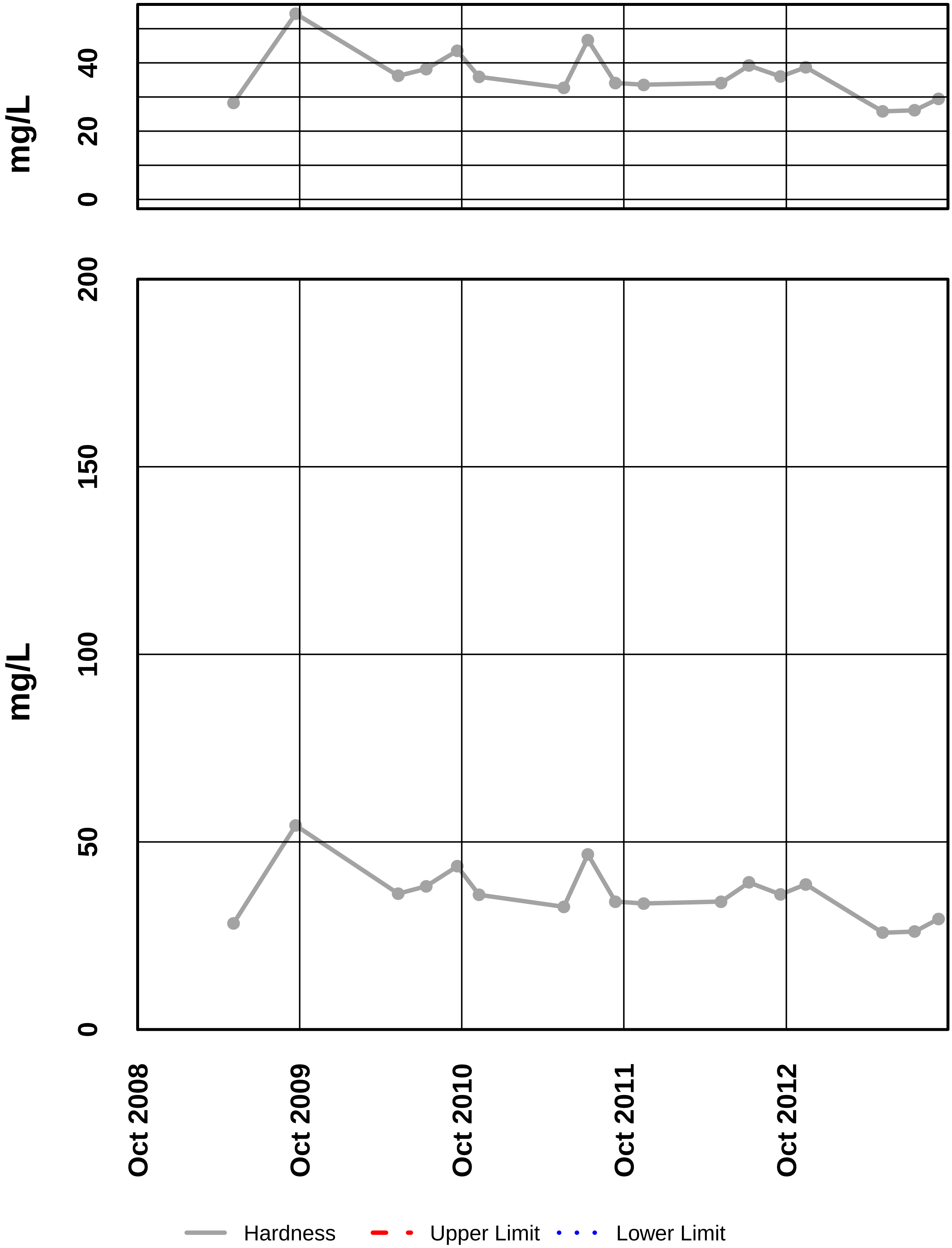
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 27 − Sulfate Total



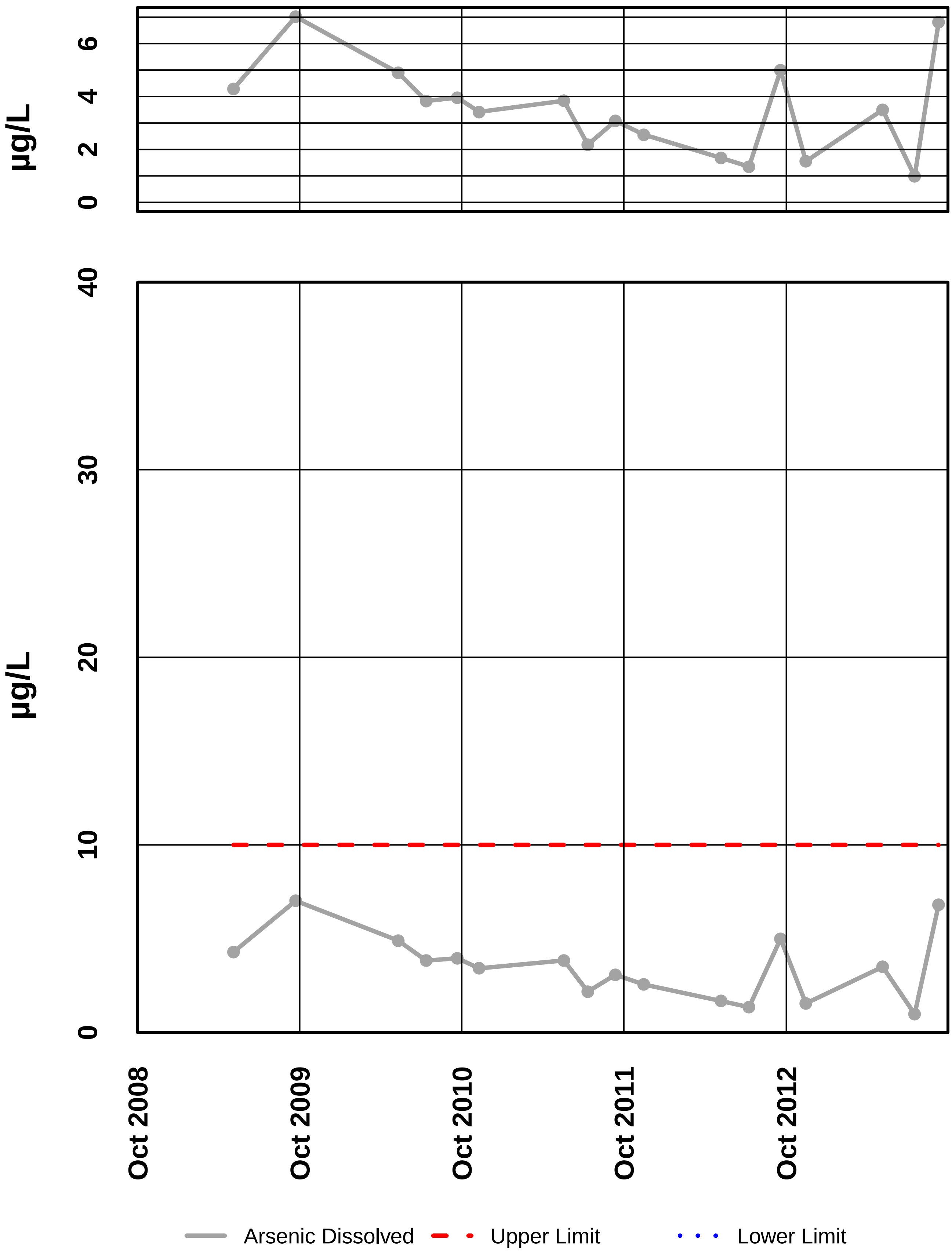
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 27 − Hardness

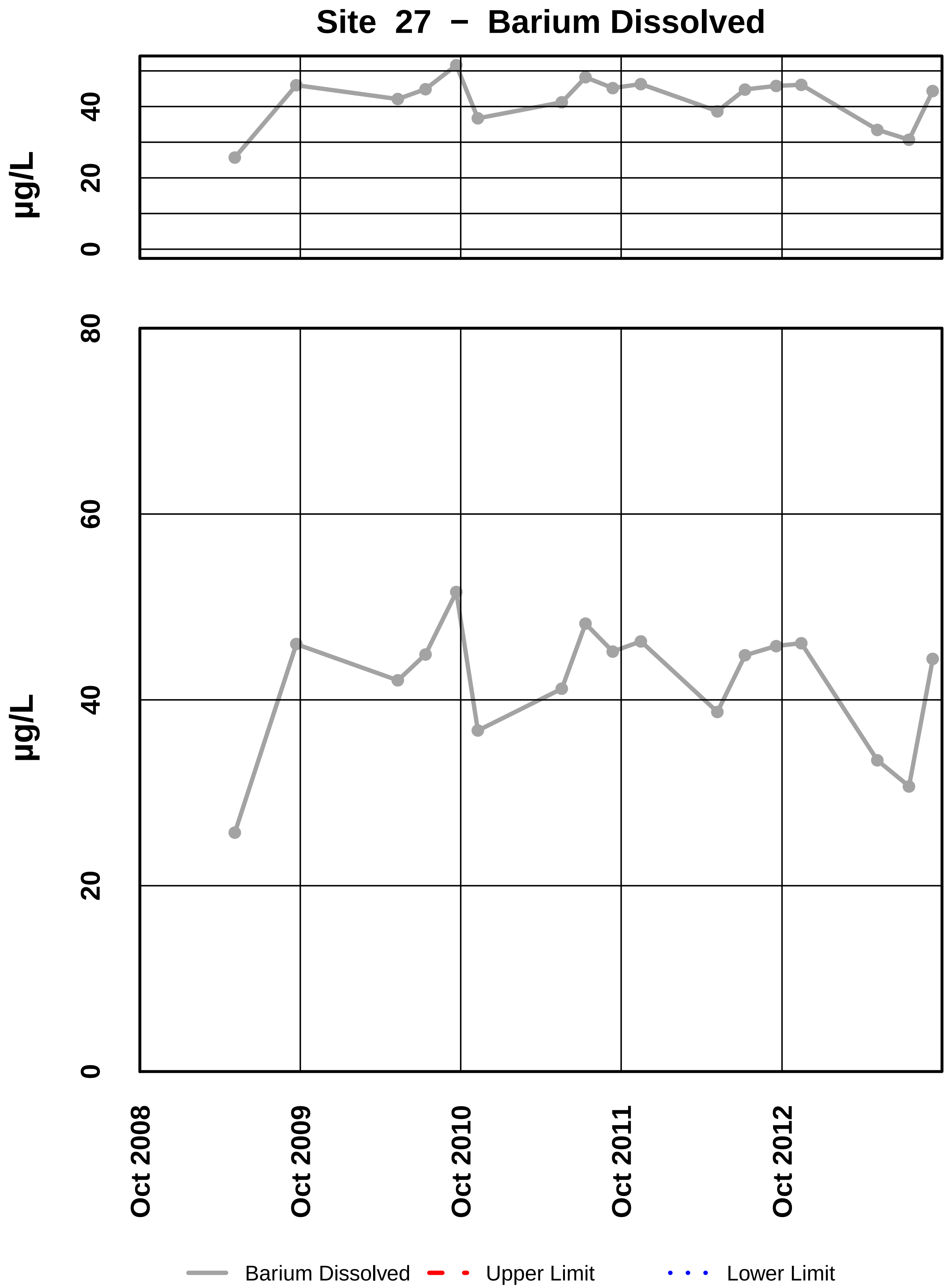


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

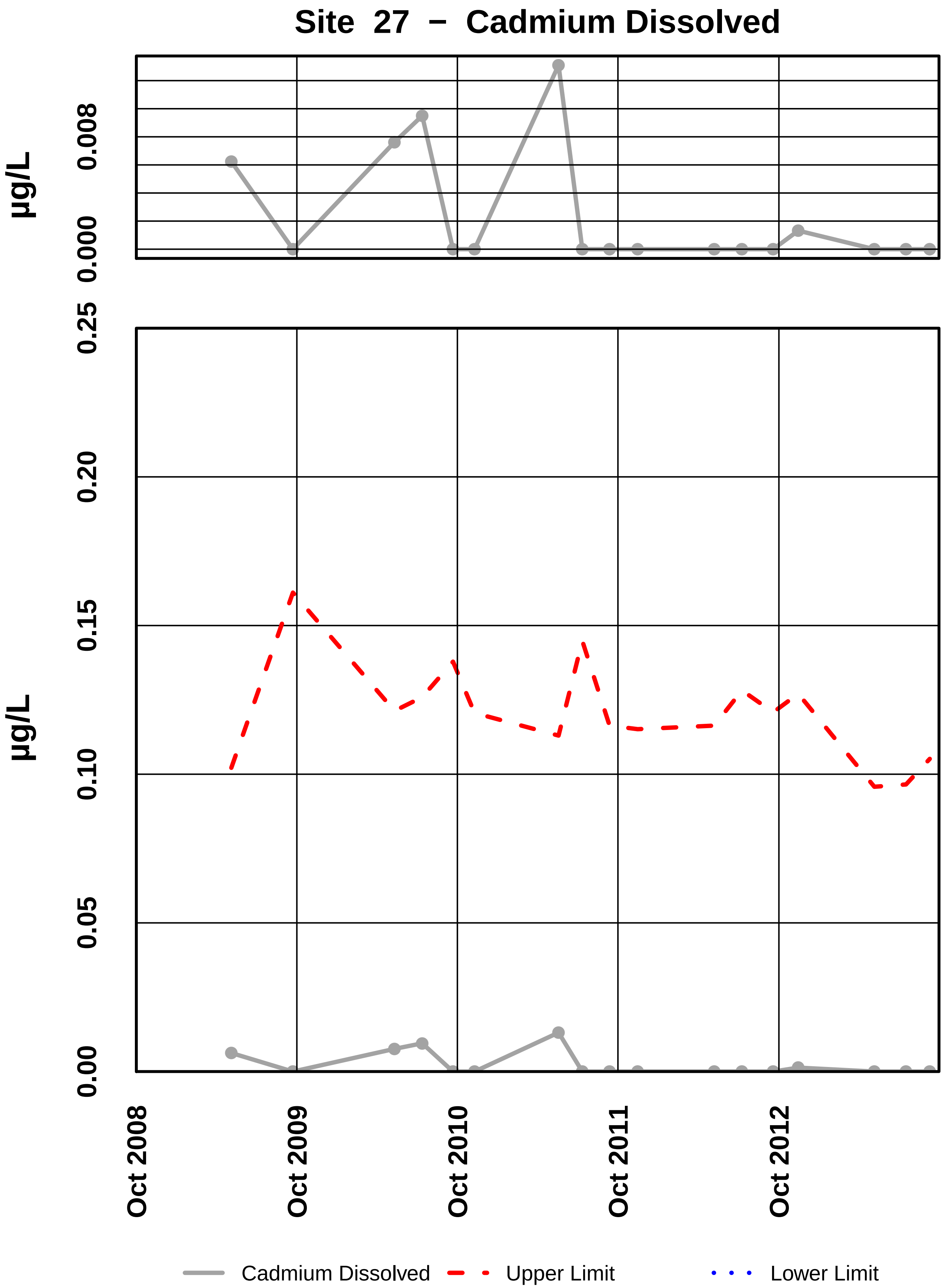
Site 27 – Arsenic Dissolved



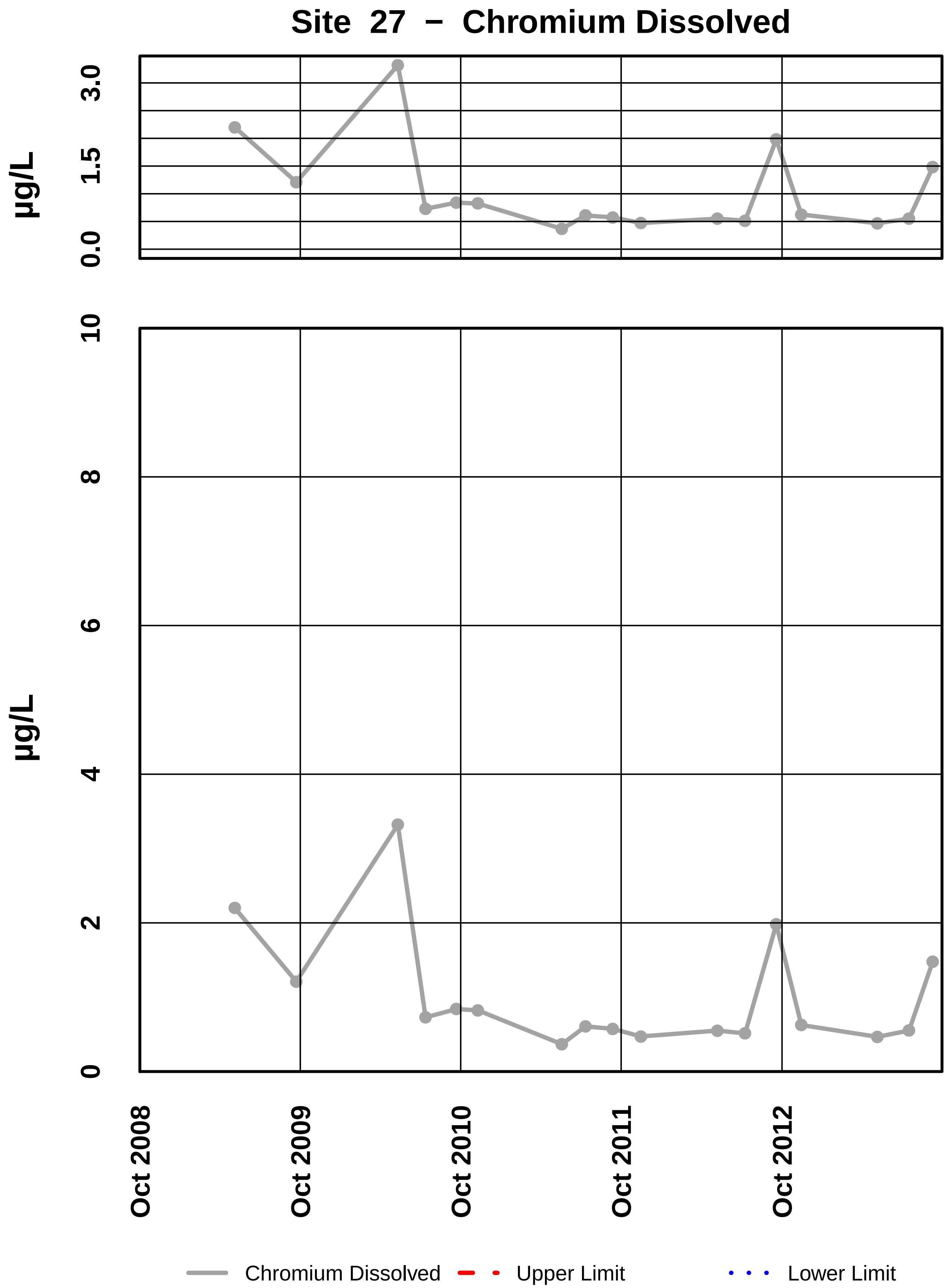
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



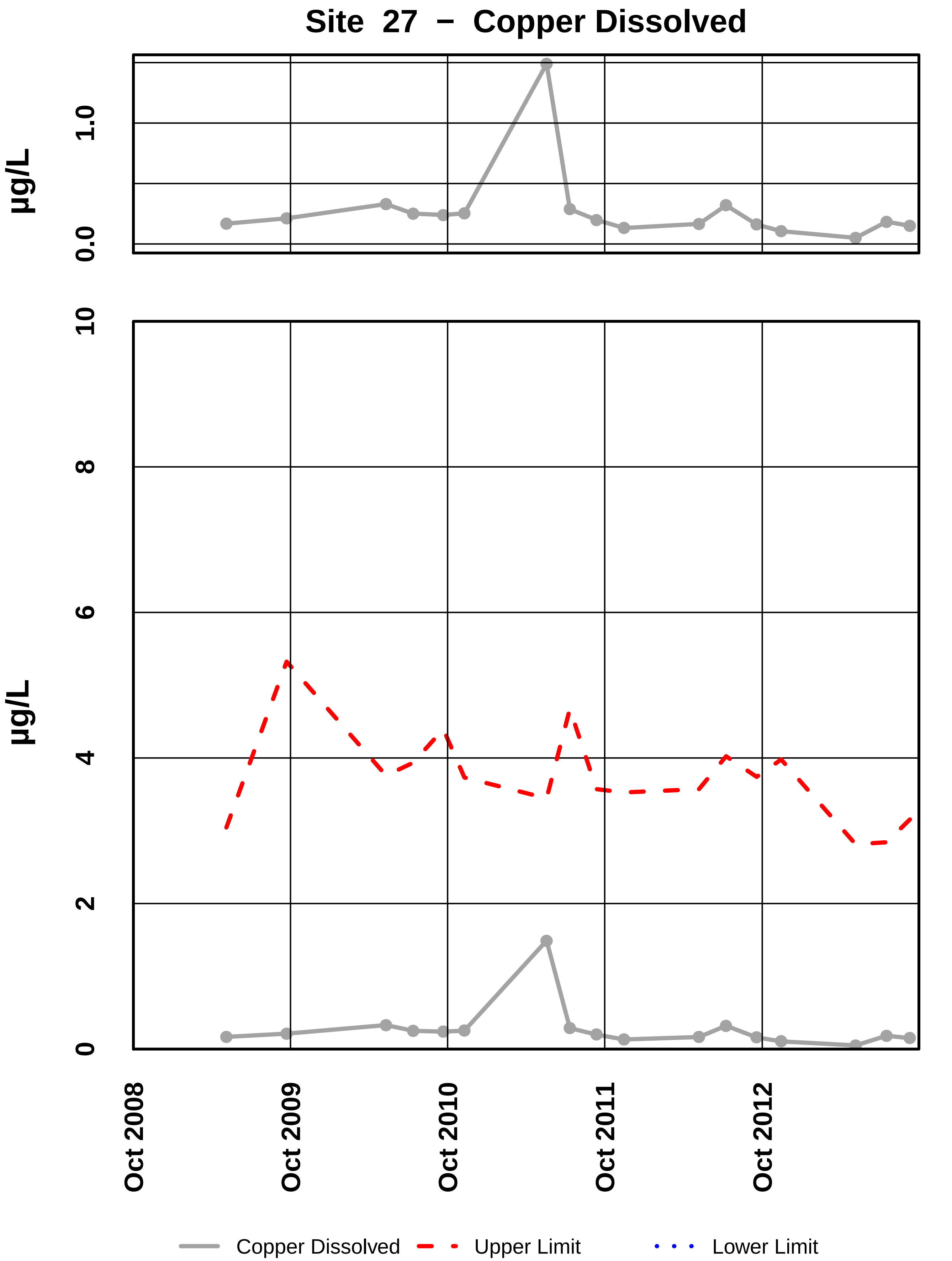
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

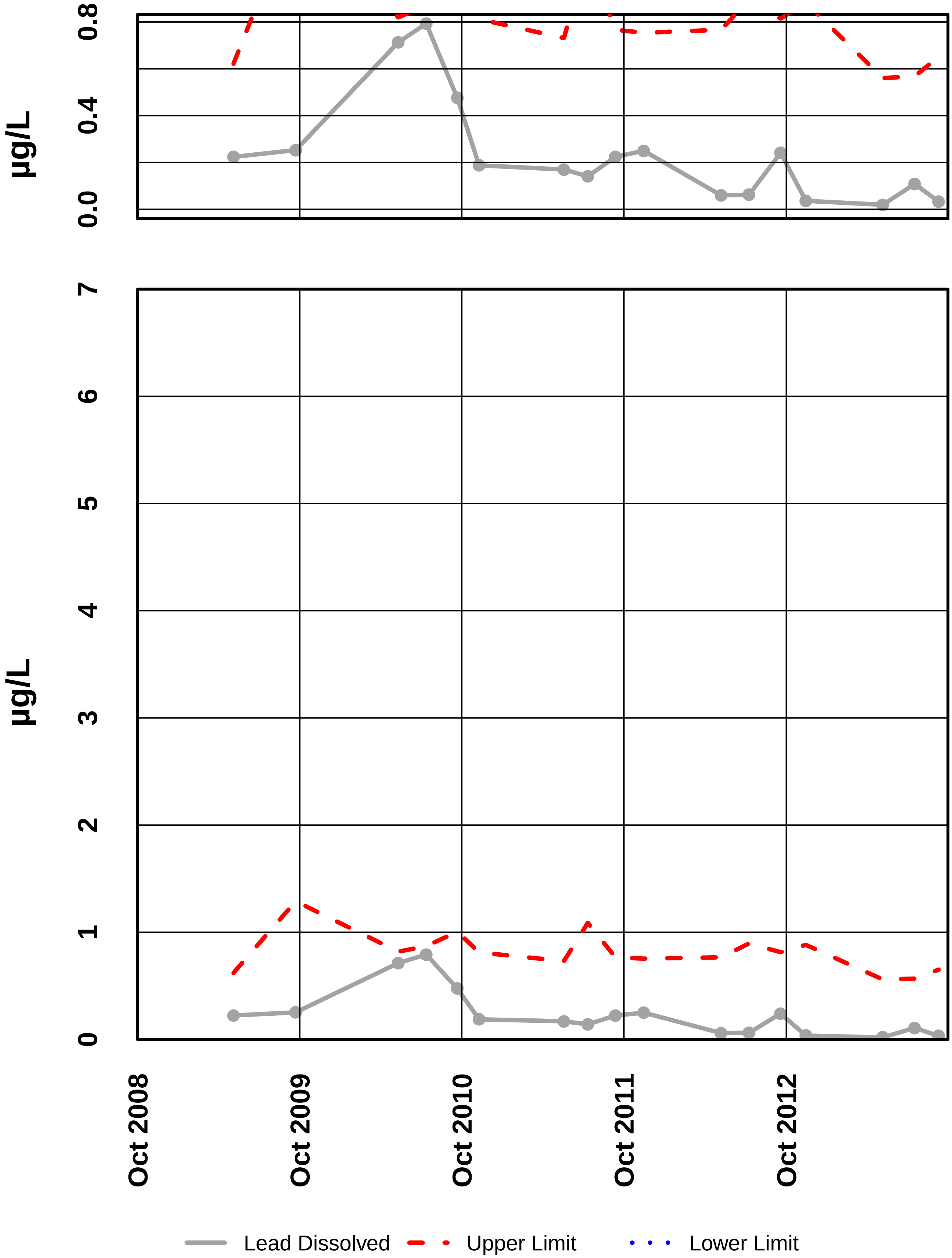


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



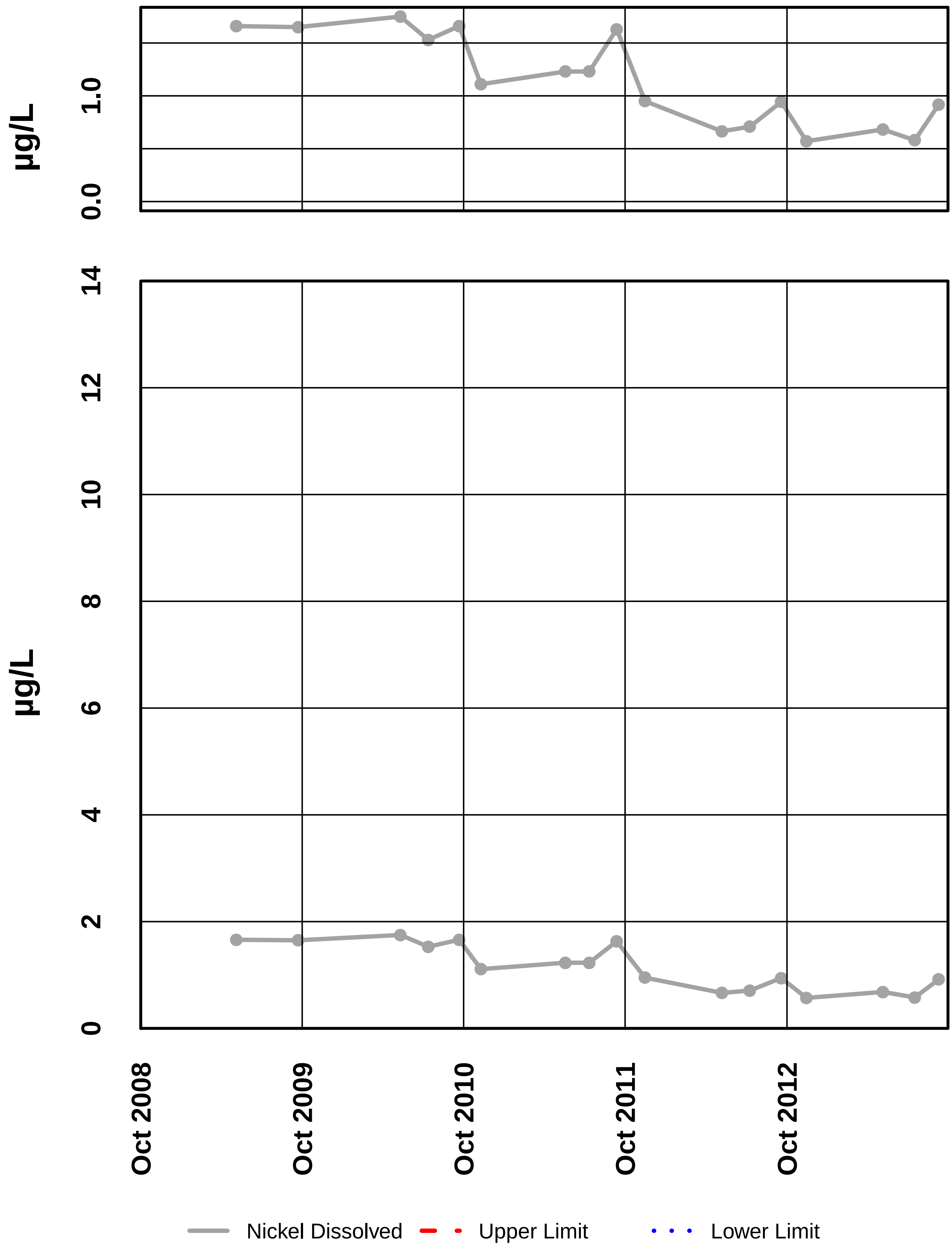
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 27 − Lead Dissolved



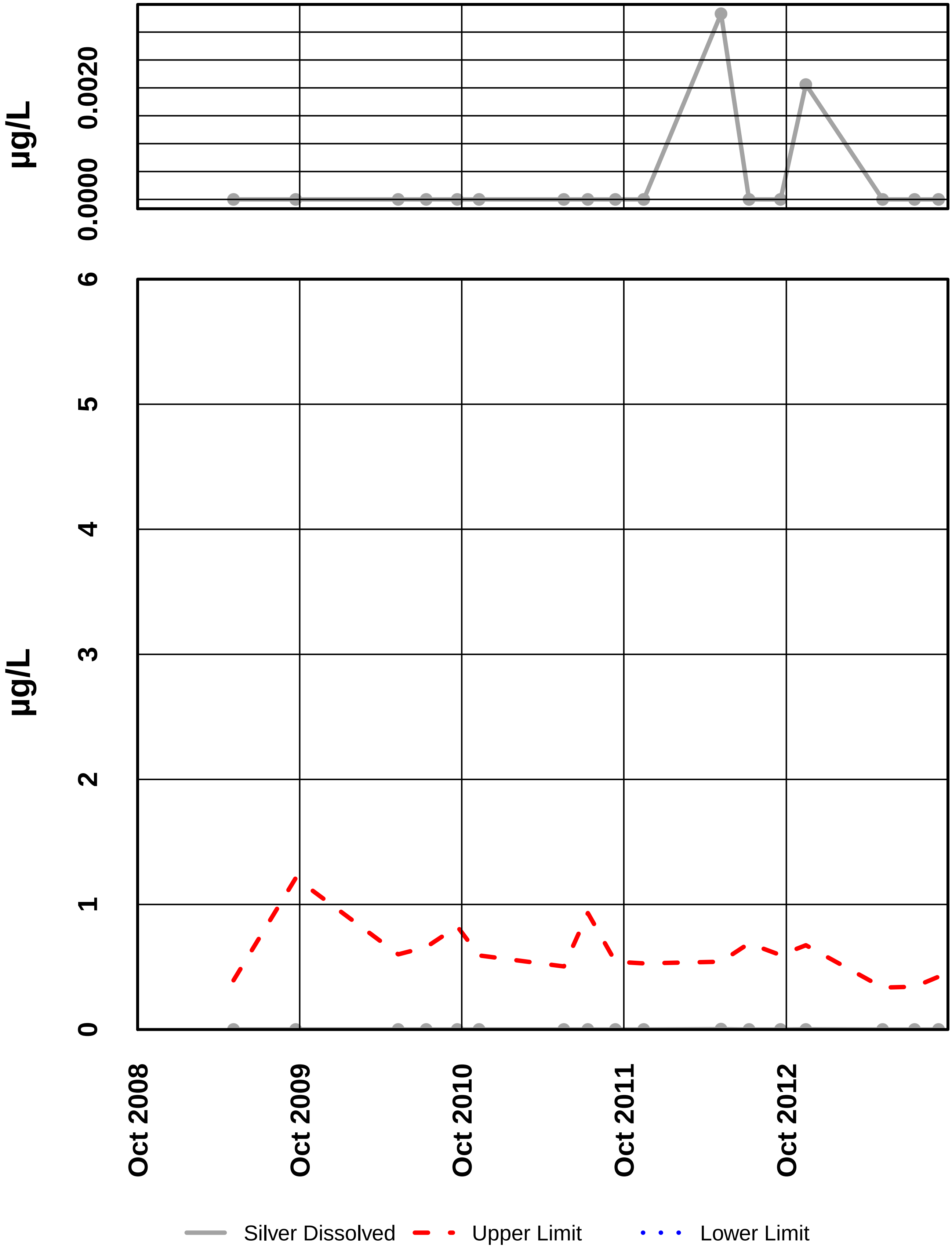
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 27 – Nickel Dissolved



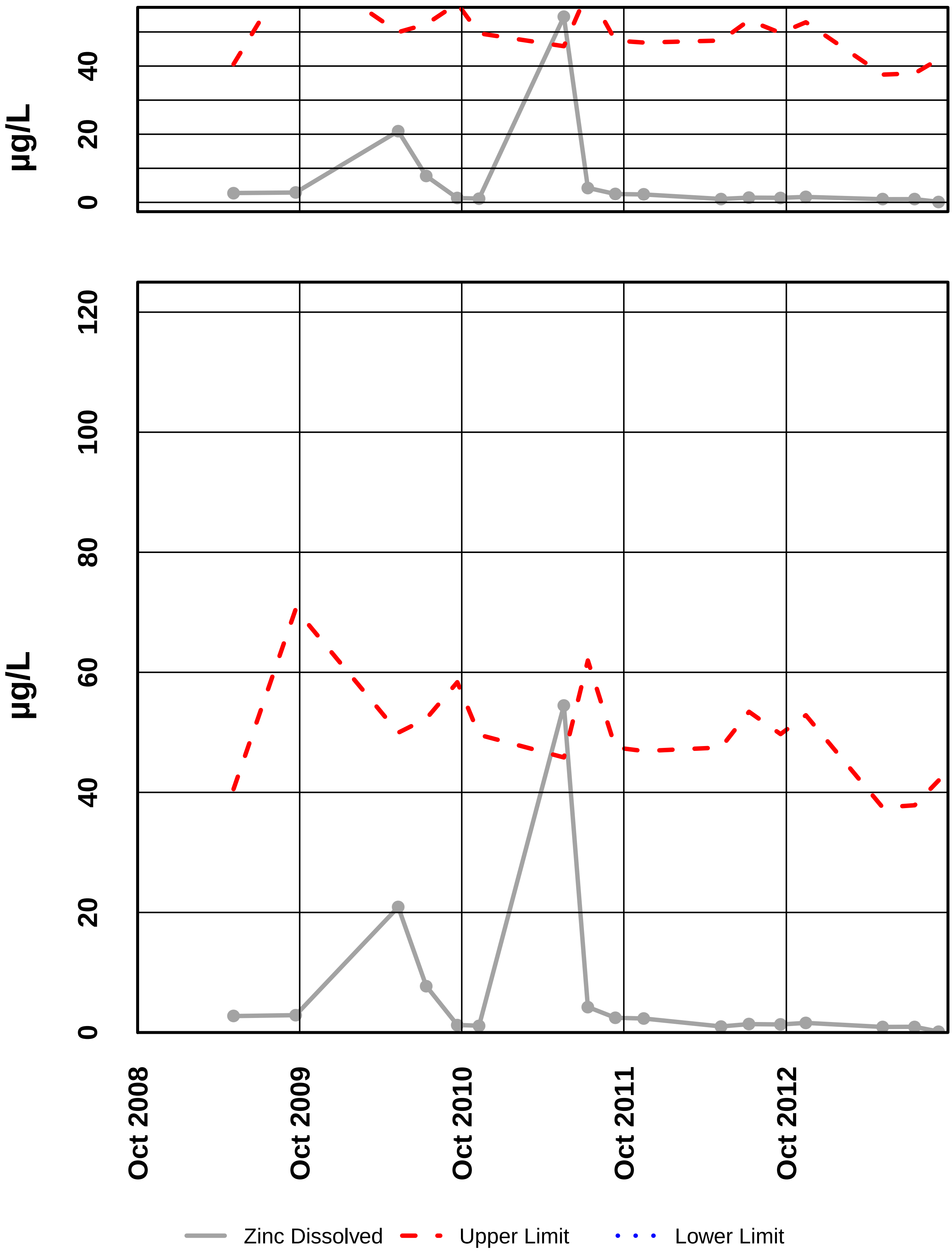
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 27 – Silver Dissolved

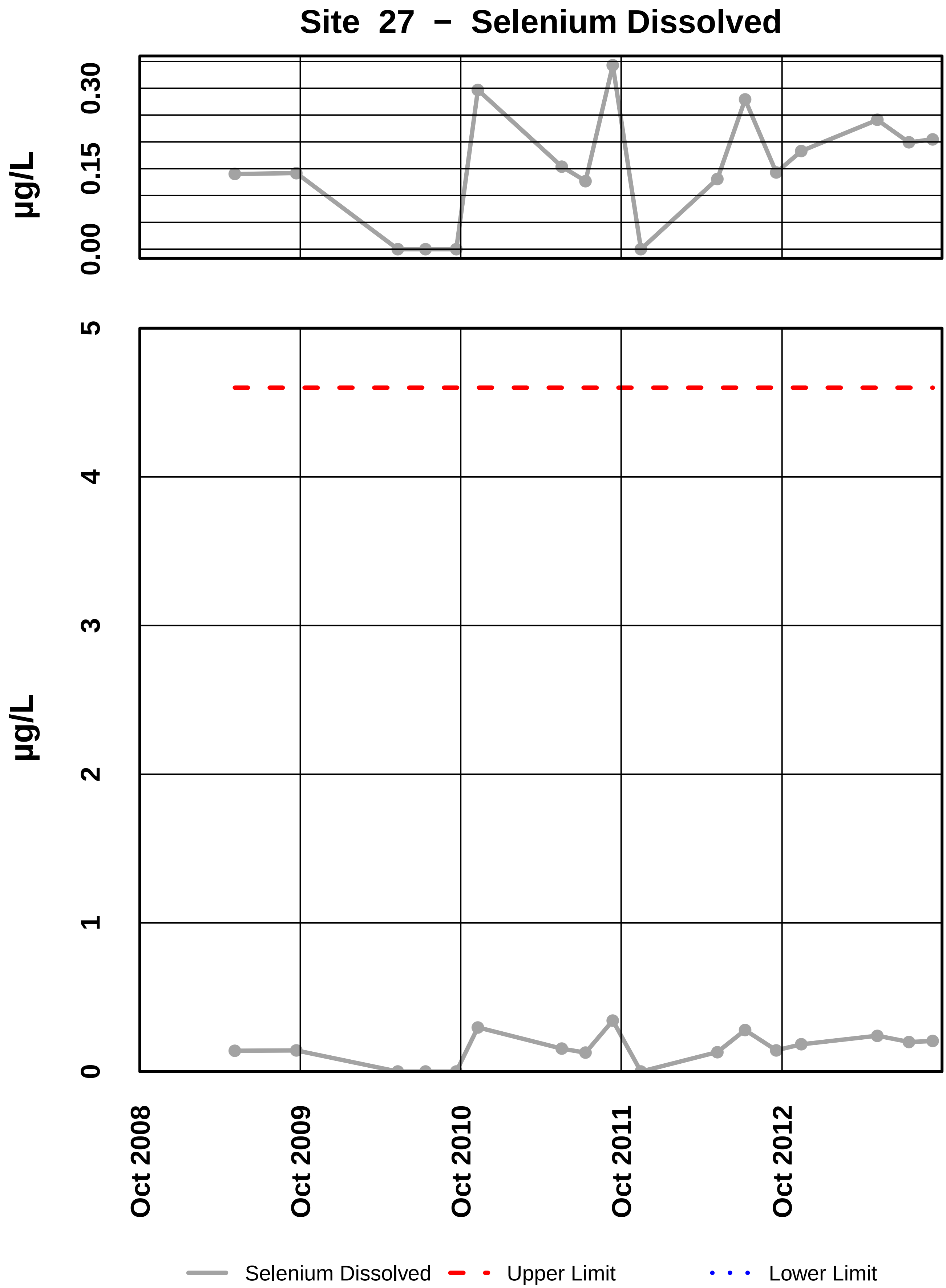


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

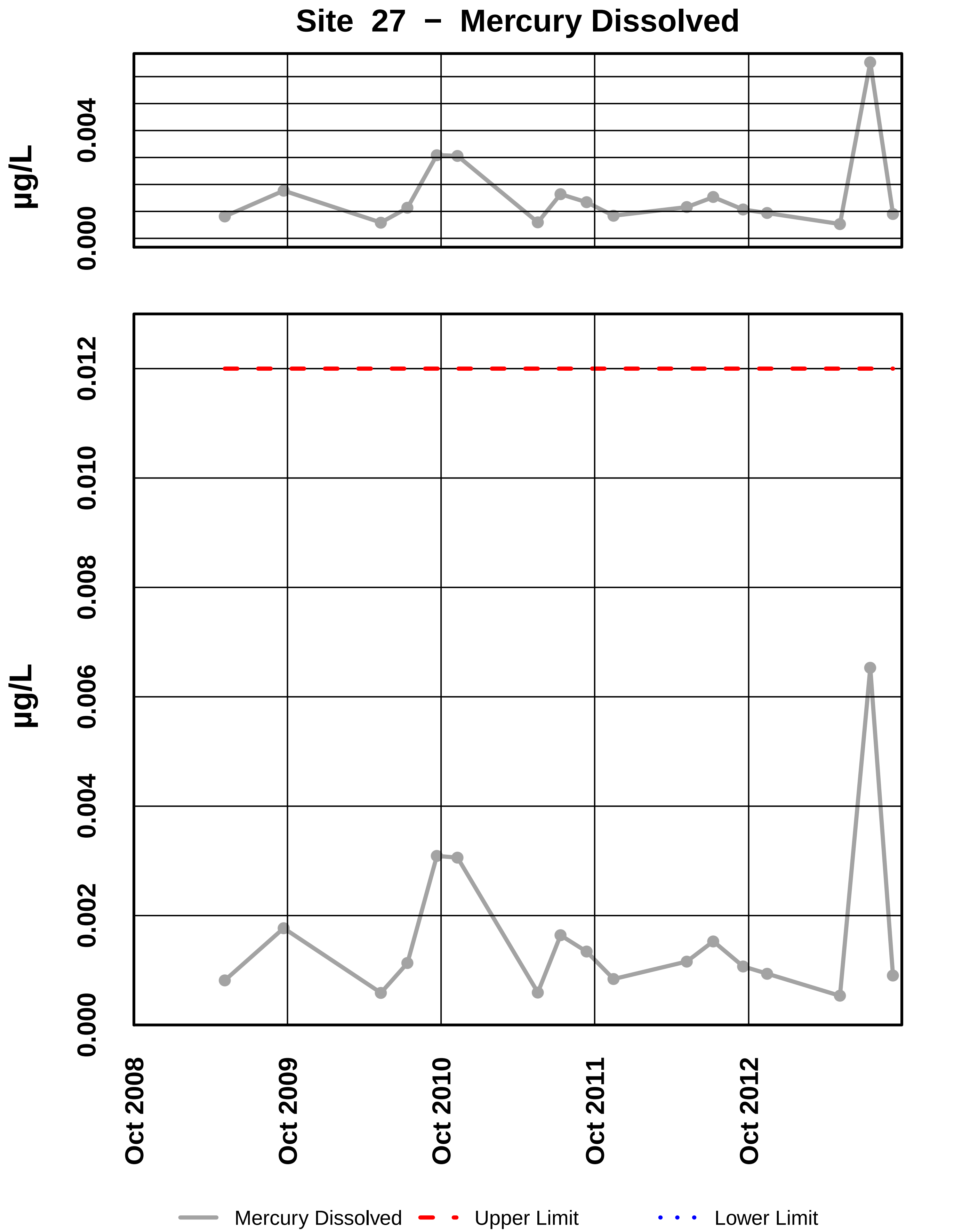
Site 27 – Zinc Dissolved



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



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

Site #27 — Seasonal Kendall analysis for Specific Conductance, Field (µS/cm)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**								110.7				191.2
b	**WY2009**								89.6				151.2
c	**WY2010**								107.3		110.4		126.7
d	**WY2011**		108.8						155		186.8		96
e	**WY2012**		106						156.1		129.3		102
f	**WY2013**		117						126		104		101
	n	0	3	0	0	0	0	0	6	0	4	0	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	0	3	0	0	0	0	0	6	0	4	0	6
t_2	0	0	0	0	0	0	0	0	0	0	0	0
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a								-1				-1
c-a								-1				-1
d-a								1				-1
e-a								1				-1
f-a								1				-1
c-b								1				-1
d-b								1				-1
e-b								1				-1
f-b								1				-1
d-c								1		1		-1
e-c								1		1		-1
f-c								1		-1		-1
e-d		-1						1		-1		1
f-d		1						-1		-1		1
f-e		1						-1		-1		-1
S_k	0	1	0	0	0	0	0	7	0	-2	0	-11

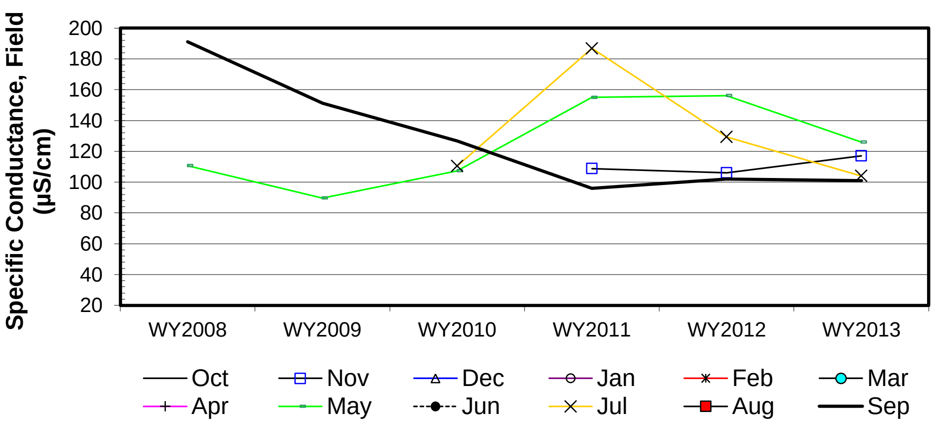
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=		3.67						28.33		8.67		28.33
$Z_k = S_k/\sigma_S$		0.52						1.32		-0.68		-2.07
Z^2_k		0.27						1.73		0.46		4.27

ΣZ_k= -0.91
ΣZ^2_k= 6.73
Z-bar=ΣZ_k/K= -0.23

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	19	0	0	0	0

Σn 19
ΣS_k -5

$\chi^2_h=\Sigma Z^2_k$-K(Z-bar)^2=	6.53	@α=5% $\chi^2_{(K-1)}$=	7.81	Test for station homogeneity	
p	**0.089**			$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k) Z_{calc}	-0.48	@α/2=2.5% Z=	1.96	H_0 (No trend)	ACCEPT
69.00 p	**0.315**			H_A (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-24.63		9.16
0.050	-19.05	**-2.13**	4.73
0.100	-16.06		2.96
0.200	-12.55		1.09

Site **#27** Seasonal Kendall analysis for pH, Field, Standard Units

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**								6.0				6.3
b	**WY2009**								6.0				6.3
c	**WY2010**								5.6		5.5		6.2
d	**WY2011**		6.2						6.2		5.3		6.2
e	**WY2012**		6.5						5.6		6.5		6.3
f	**WY2013**		6.8						6.7		6.0		5.9
	n	0	3	0	0	0	0	0	6	0	4	0	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	0	3	0	0	0	0	0	6	0	4	0	6
t_2	0	0	0	0	0	0	0	0	0	0	0	0
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a								1				-1
c-a								-1				-1
d-a								1				-1
e-a								-1				1
f-a								1				-1
c-b								-1				-1
d-b								1				-1
e-b								-1				1
f-b								1				-1
d-c								1		-1		1
e-c								1		1		1
f-c								1		1		-1
e-d		1						-1		1		1
f-d		1						1		1		-1
f-e		1						1		-1		-1
S_k	0	3	0	0	0	0	0	5	0	2	0	-5

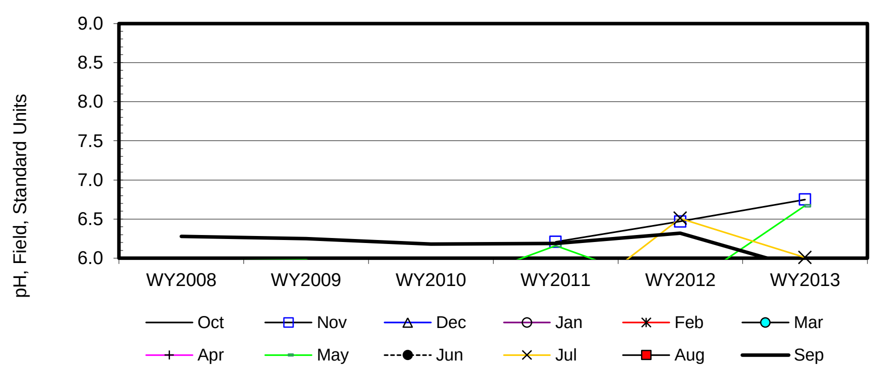
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=		3.67						28.33		8.67		28.33
$Z_k = S_k/\sigma_S$		1.57						0.94		0.68		-0.94
Z^2_k		2.45						0.88		0.46		0.88

ΣZ_k= 2.25
ΣZ^2_k= 4.68
Z-bar=ΣZ_k/K= 0.56

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	19	0	0	0	0

Σn 19
ΣS_k 5

$\chi^2_h = \Sigma Z^2_k - K(\text{Z-bar})^2$=	3.42	@α=5% $\chi^2_{(K-1)}$= 7.81	Test for station homogeneity	
p	**0.331**		$\chi^2_h < \chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc} 0.48	@α/2=2.5% Z= 1.96	H_0 (No trend)	ACCEPT
69.00	p **0.685**		H_A (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.10		0.19
0.050	-0.07	**0.01**	0.13
0.100	-0.05		0.09
0.200	-0.03		0.06

Site **#27** Seasonal Kendall analysis for Total Alk, (mg/l)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**								22.3				22.3
b	**WY2009**								18.5				26.5
c	**WY2010**								22.0		22.6		31.7
d	**WY2011**		22.0						22.0		34.8		26.1
e	**WY2012**		27.6						30.6		48.8		48.5
f	**WY2013**		46.2						28.6		34.0		39.5
	n	0	3	0	0	0	0	0	6	0	4	0	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	0	3	0	0	0	0	0	4	0	4	0	6
t_2	0	0	0	0	0	0	0	1	0	0	0	0
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a								-1				1
c-a								-1				1
d-a								-1				1
e-a								1				1
f-a								1				1
c-b								1				1
d-b								1				-1
e-b								1				1
f-b								1				1
d-c								0		1		-1
e-c								1		1		1
f-c								1		1		1
e-d		1						1		1		1
f-d		1						1		-1		1
f-e		1						-1		-1		-1
S_k	0	3	0	0	0	0	0	6	0	2	0	9

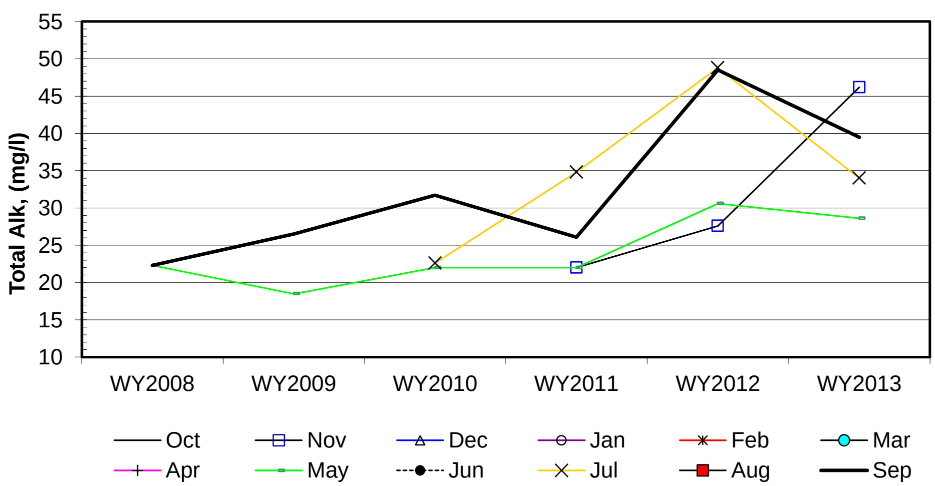
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
$\sigma^2_S=$		3.67						27.33		8.67		28.33
$Z_k = S_k/\sigma_S$		1.57						1.15		0.68		1.69
Z^2_k		2.45						1.32		0.46		2.86

$\Sigma Z_k=$ 5.08
$\Sigma Z^2_k=$ 7.09
$Z\text{-bar}=\Sigma Z_k/K=$ 1.27

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	17	1	0	0	0

Σn 19
ΣS_k 20

$\chi^2_h=\Sigma Z^2_k-K(Z\text{-bar})^2=$ 0.63	@α=5% $\chi^2_{(K-1)}=$ 7.81	Test for station homogeneity	
p **0.890**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k) 68.00	Z_{calc} 2.30, **p** **0.989**	@α/2=2.5% Z= 1.96	**H_0** (No trend) REJECT
		H_A (± trend)	ACCEPT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.01		6.56
0.050	1.61	**3.44**	4.84
0.100	2.10		4.28
0.200	2.53		4.03

12.5%

Site #27 — Seasonal Kendall analysis for Sulfate, Total (mg/l)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**								16.4				10.3
b	**WY2009**								14.4				35.4
c	**WY2010**								18.0		10.0		13.7
d	**WY2011**		16.4						25.0		0.0		13.0
e	**WY2012**		0.0						12.8		6.1		5.9
f	**WY2013**		10.7						13.3		3.4		0.0
	n	0	3	0	0	0	0	0	6	0	4	0	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	0	3	0	0	0	0	0	6	0	4	0	6
t_2	0	0	0	0	0	0	0	0	0	0	0	0
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a								-1				1
c-a								1				1
d-a								1				1
e-a								-1				-1
f-a								-1				-1
c-b								1				-1
d-b								1				-1
e-b								-1				-1
f-b								-1				-1
d-c								1		-1		-1
e-c								-1		-1		-1
f-c								-1		-1		-1
e-d		-1						-1		1		-1
f-d		-1						-1		1		-1
f-e		1						1		-1		-1
S_k	0	-1	0	0	0	0	0	-3	0	-2	0	-9

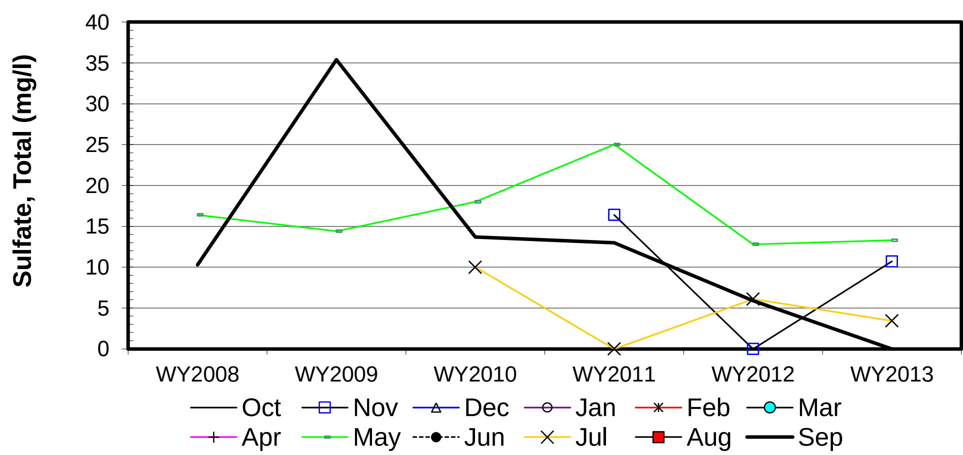
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=		3.67						28.33		8.67		28.33
$Z_k = S_k/\sigma_S$		-0.52						-0.56		-0.68		-1.69
Z^2_k		0.27						0.32		0.46		2.86

ΣZ_k= -3.46
ΣZ^2_k= 3.91
Z-bar=ΣZ_k/K= -0.86

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	19	0	0	0	0

Σn 19
ΣS_k -15

$\chi^2_h = \Sigma Z^2_k - K(\text{Z-bar})^2$=		0.92	@α=5% $\chi^2_{(K-1)}$=	7.81	Test for station homogeneity
	p	**0.819**		$\chi^2_h < \chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc}	-1.69	@α=2.5% Z=	1.96	**H_0** (No trend) ACCEPT
69.00	**p**	**0.046**			**H_A** (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-6.00		0.82
0.050	-4.12	**-1.95**	-0.45
0.100	-2.82		-0.63
0.200	-2.60		-0.90

Site #27 — Seasonal Kendall analysis for Zinc, Dissolved (ug/l)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**								8.5				2.5
b	**WY2009**								2.7				2.9
c	**WY2010**								20.9		7.7		1.3
d	**WY2011**		1.1						54.5		4.3		2.5
e	**WY2012**		2.3						1.0		1.4		1.3
f	**WY2013**		1.6						0.9		1.0		0.2
	n	0	3	0	0	0	0	0	6	0	4	0	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	0	3	0	0	0	0	0	6	0	4	0	6
t_2	0	0	0	0	0	0	0	0	0	0	0	0
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a								-1				1
c-a								1				-1
d-a								1				-1
e-a								-1				-1
f-a								-1				-1
c-b								1				-1
d-b								1				-1
e-b								-1				-1
f-b								-1				-1
d-c								1		-1		1
e-c								-1		-1		1
f-c								-1		-1		-1
e-d		1						-1		-1		-1
f-d		1						-1		-1		-1
f-e		-1						-1		-1		-1
S_k	0	1	0	0	0	0	0	-5	0	-6	0	-9

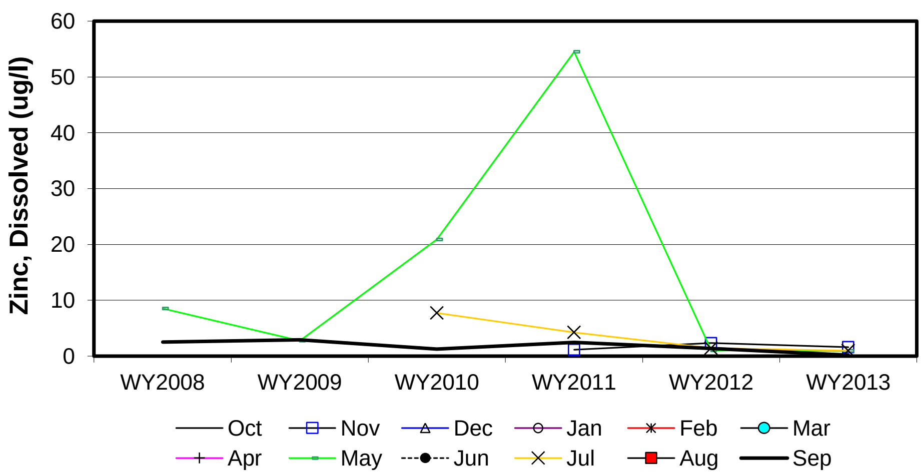
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=		3.67						28.33		8.67		28.33
$Z_k = S_k/\sigma_S$		0.52						-0.94		-2.04		-1.69
Z^2_k		0.27						0.88		4.15		2.86

ΣZ_k=	-4.15
ΣZ^2_k=	8.17
Z-bar=ΣZ_k/K=	-1.04

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	19	0	0	0	0

Σn	19
ΣS_k	-19

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	3.87	@α=5% $\chi^2_{(K-1)}$= 7.81	Test for station homogeneity	
p	**0.276**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc} -2.17	@α/2=2.5% Z= 1.96	H_0 (No trend)	REJECT
69.00	**p** **0.015**		H_A (± trend)	ACCEPT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-1.94		-0.01
0.050	-1.56	**-0.58**	-0.27
0.100	-1.17		-0.38
0.200	-1.11		-0.45

-24.7%

INTERPRETIVE REPORT
SITE 29

The data collected during the current water year are listed in the following "Table of Results for Water Year 2013" 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 2007 through September 2013.				

The data for Water Year 2013 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 2013

			Limits		
Sample Date	**Parameter**	**Value**	**Lower**	**Upper**	**Hardness**
14-Nov-12	Alkalinity	7.3 mg/L	20		
6-May-13	Alkalinity	7.9 mg/L	20		
17-Jul-13	Alkalinity	7.7 mg/L	20		
9-Sep-13	Alkalinity	12.3 mg/L	20		
14-Nov-12	pH Field	5.48 su	6.5	8.5	
6-May-13	pH Field	5.06 su	6.5	8.5	
17-Jul-13	pH Field	5.19 su	6.5	8.5	
9-Sep-13	pH Field	4.82 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 has routinely been in exceedance at Site 29 over the past several years there was a sharp increase in water year 2011 with values returning to below the AWQS limit by the middle of the Water Year 2012. Though zinc had been in exceedance during water year 2011 all samplings for the past couple water years were 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 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 2013 Tailings and Waste Rock Annual Report and will also be presented at the annual meeting in July 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 is a visually apparent downward trend in total alkalinity values across the last five water years. The same trend is apparent in the dissolved arsenic, dissolved barium, hardness, and conductivity data. Currently, HGCMC does not have an explanation for the mechanism that is in operation causing the visual decrease in these values.

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-07 and Sep-13(WY2008-WY2013).

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	-	-5.00	-9.7
pH Field	6	0.32			
Alkalinity, Total	6	0.24			
Sulfate, Total	6	Inconsistent detection limits			
Zinc, Dissolved	6	<0.01	-	-0.84	-22.9

* Number of Years ** Significance level

A couple significant decreasing trends were identified with this analysis. Field conductivity (p=0.02) was negatively trending with an estimated slope of -5.00 µs/cm/yr or a -9.7% decrease, this is similar in direction and magnitude calculated for the past couple water year. Dissolved zinc was trending with an estimated slope o f-0.84 µg/l/yr or a -22.9% decrease.

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 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**

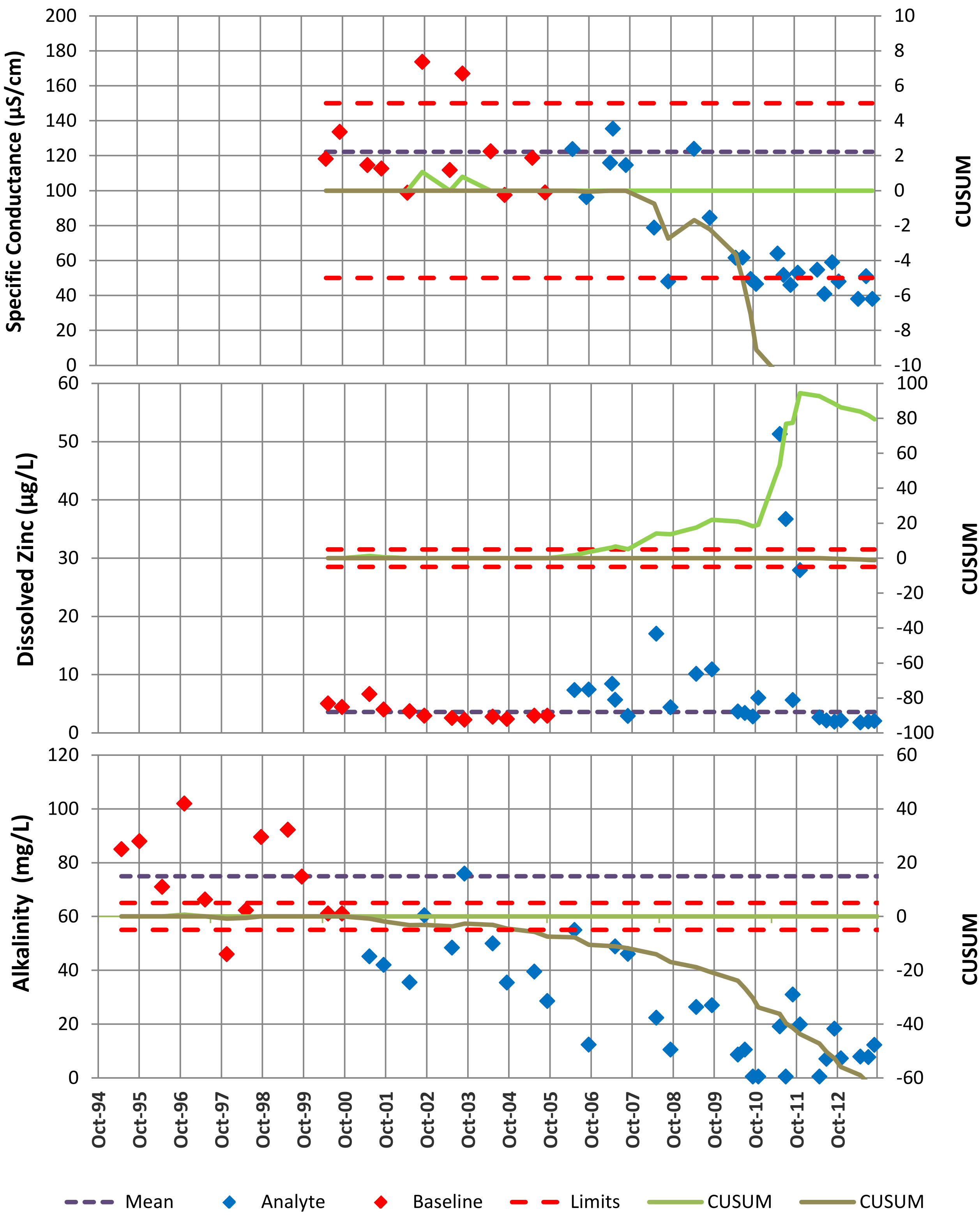


Table of Results for Water Year 2013

Site 029FMG - 'Monitoring Well - 3S'

Sample Date/Parameter	Oct 2012	Nov 2012	Dec 2012	Jan 2013	Feb 2013	Mar 2013	Apr 2013	May 2013	Jun 2013	Jul 2013	Aug 2013	Sep 2013	**Median**
Water Temp (°C)		6.7						5.8		6.4		7.1	6.6
Conductivity-Field(μmho)		48						38		51		38	43.0
Conductivity-Lab (μmho)		34						36		34		34	34
pH Lab (standard units)		4.8						4.82		5.11		4.99	4.91
pH Field (standard units)		5.48						5.06		5.19		4.82	5.13
Total Alkalinity (mg/L)		7.3						7.9		7.7		12.3	7.8
Total Sulfate (mg/L)		1.3						2.5		2.5		1.3	1.9
Hardness (mg/L)		12.8						14.5		16.1		21.8	15.3
Dissolved As (ug/L)		5.46						5.94		6.29		8.29	6.115
Dissolved Ba (ug/L)		5.1						5.3		5.7		7.4	5.5
Dissolved Cd (ug/L)		0.0036						0.0018		0.0018		0.0018	0.0018
Dissolved Cr (ug/L)		0.945						0.687		0.697		1.6	0.821
Dissolved Cu (ug/L)		0.16						0.093		0.146		0.228	0.153
Dissolved Pb (ug/L)		0.129						0.073		0.0913		0.11	0.1007
Dissolved Ni (ug/L)		1.13						0.911		1.06		1.2	1.095
Dissolved Ag (ug/L)		0.003						0.002		0.003		0.002	0.003
Dissolved Zn (ug/L)		2.15						1.77		1.95		2.01	1.98
Dissolved Se (ug/L)		0.349						0.057		0.176		0.152	0.164
Dissolved Hg (ug/L)		0.000813						0.00092		0.00742		0.00109	0.001005

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

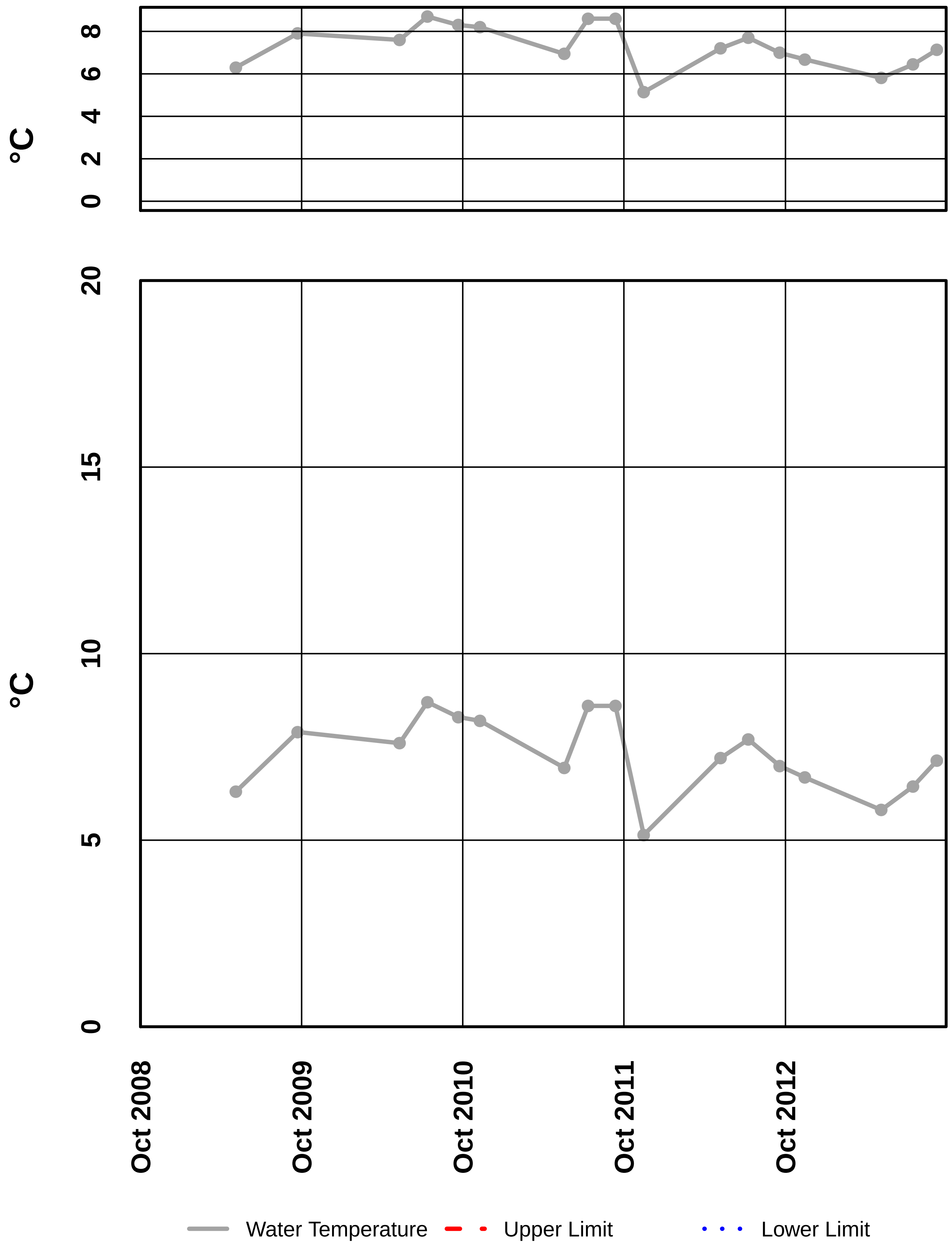
Qualified Data by QA Reviewer

Date Range: 10/01/2012 to 09/30/2013

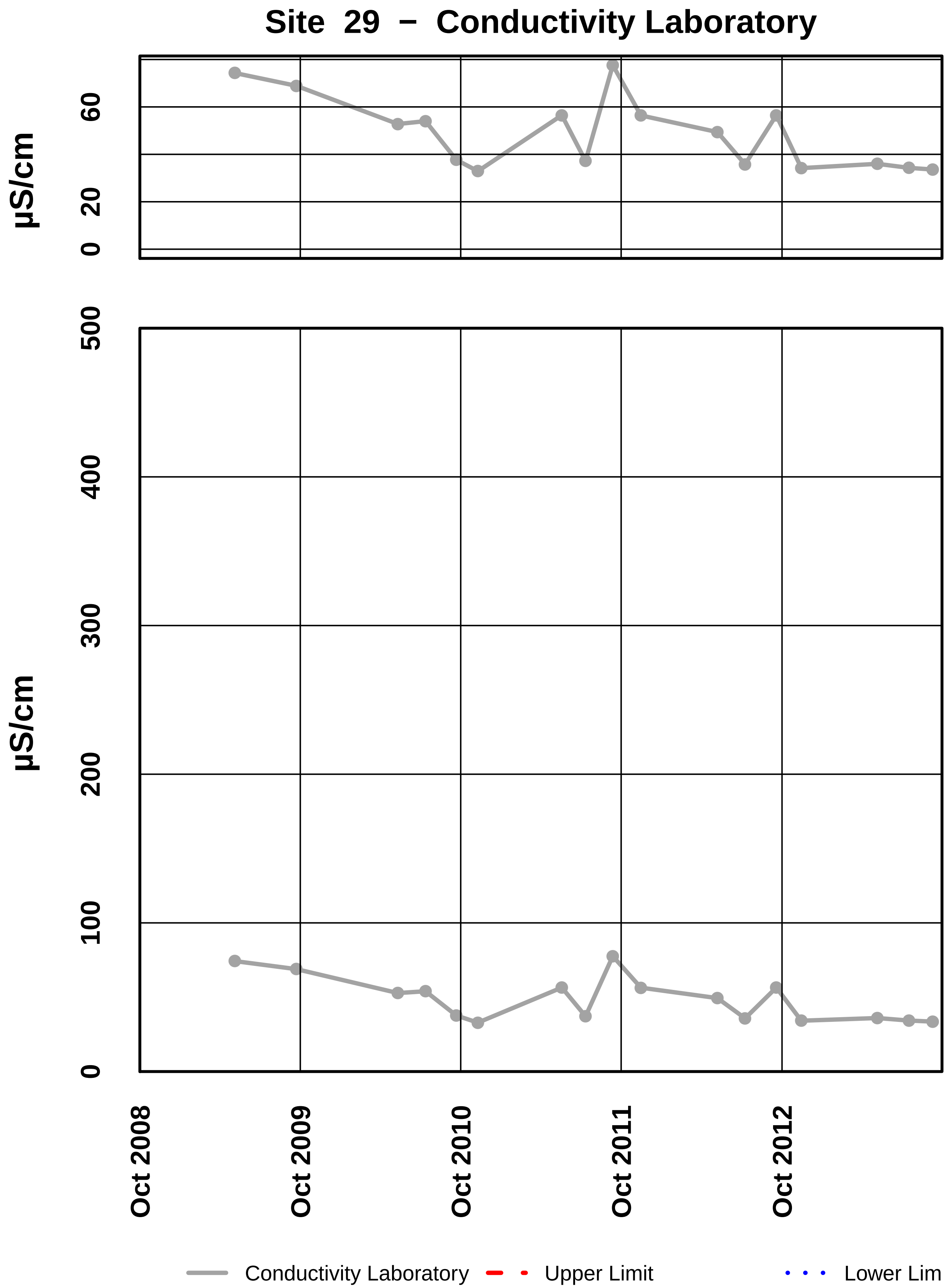
Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
29	11/14/2012	12:00 AM	Ag diss, µg/l	0.00337	J	Below Quantitative Range
			Cd diss, µg/l	0.00356	J	Below Quantitative Range
			Zn diss, µg/l	2.15	U	Field Blank Contamination
			Se diss, µg/l	0.34	U	Field Blank Contamination
29	5/6/2013	12:00 AM	pH Lab, su	4.82	J	Hold Time Violation
			Hg diss, µg/l	0.00092	U	Field Blank Contamination
			Cond, µmhos	36	U	Field Blank Contamination
			Alk, mg/L	7.9	U	Field Blank Contamination
			SO4 Tot, mg/l	-5	UJ	Sample Receipt Temperature
29	7/17/2013	12:00 AM	Se diss, µg/l	0.17	J	Below Quantitative Range
			Ag diss, µg/l	0.0032	J	Below Quantitative Range
			SO4 Tot, mg/l	-5	UJ	Sample Receipt Temperature
29	9/9/2013	12:00 AM	Se diss, µg/l	0.15	J	Below Quantitative Range
			SO4 Tot, mg/l	-2.5	UJ	Sample receipt temperature

Qualifier	Description
J	Positively Identified - Approximate concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit

Site 29 – Water Temperature

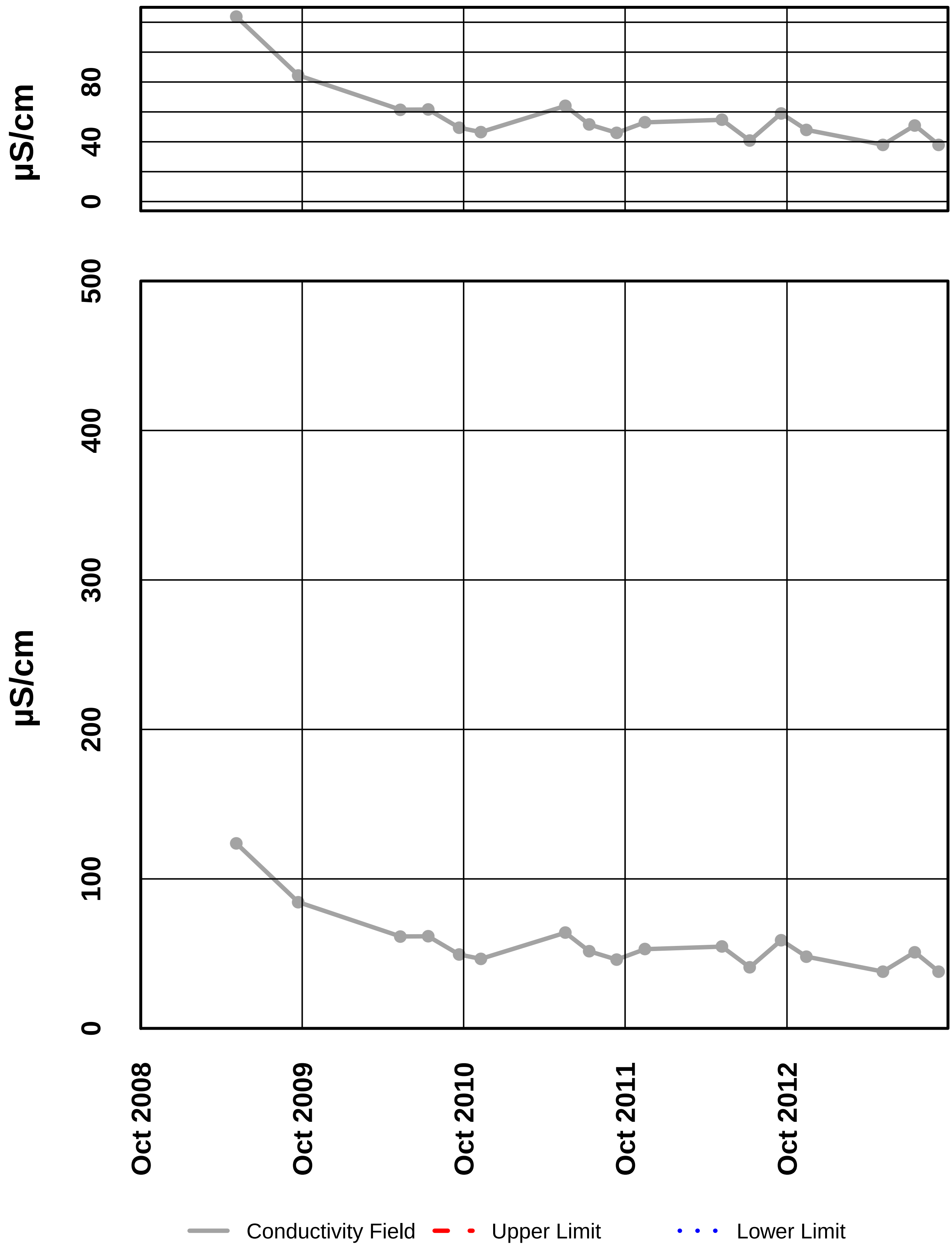


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



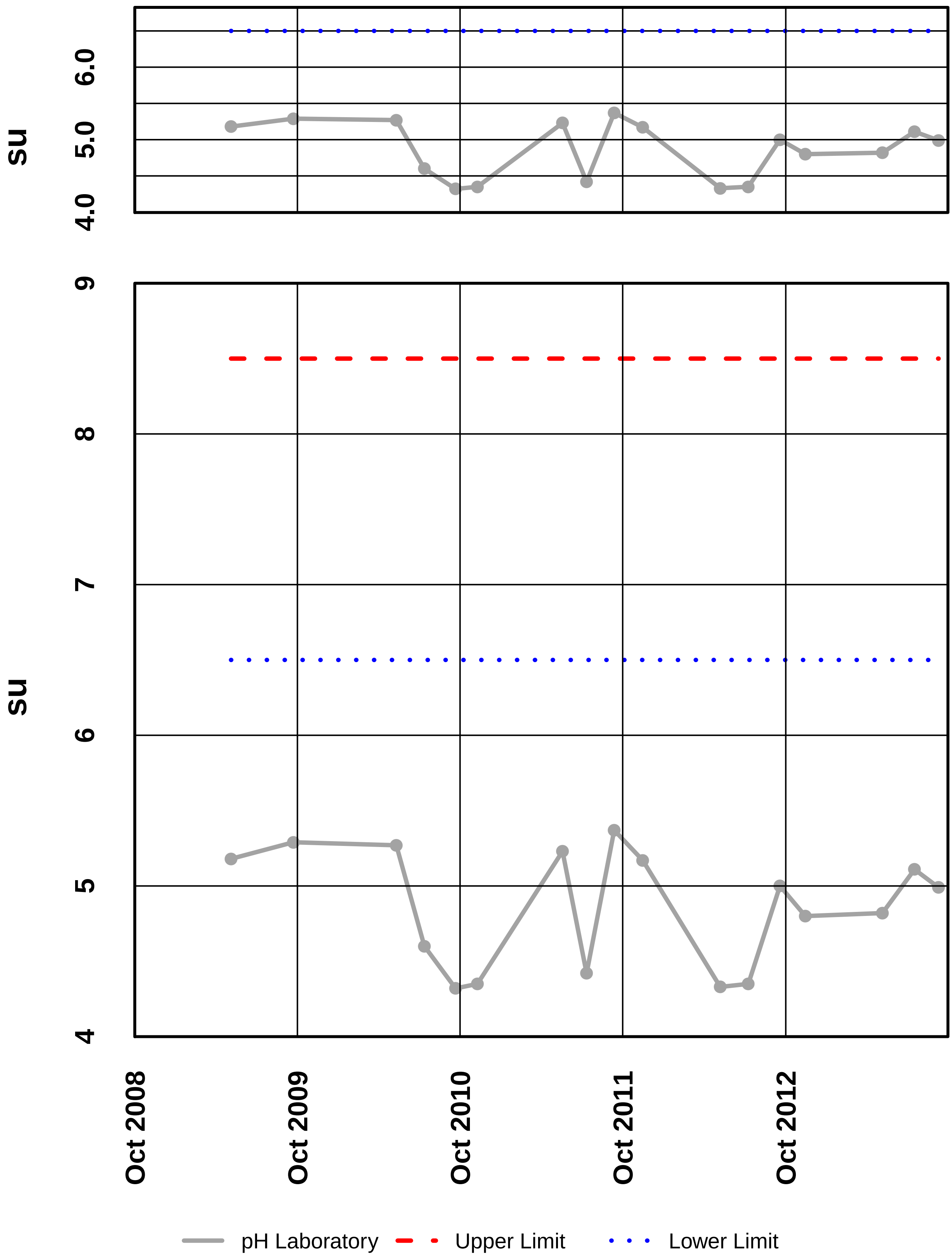
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 29 – Conductivity Field



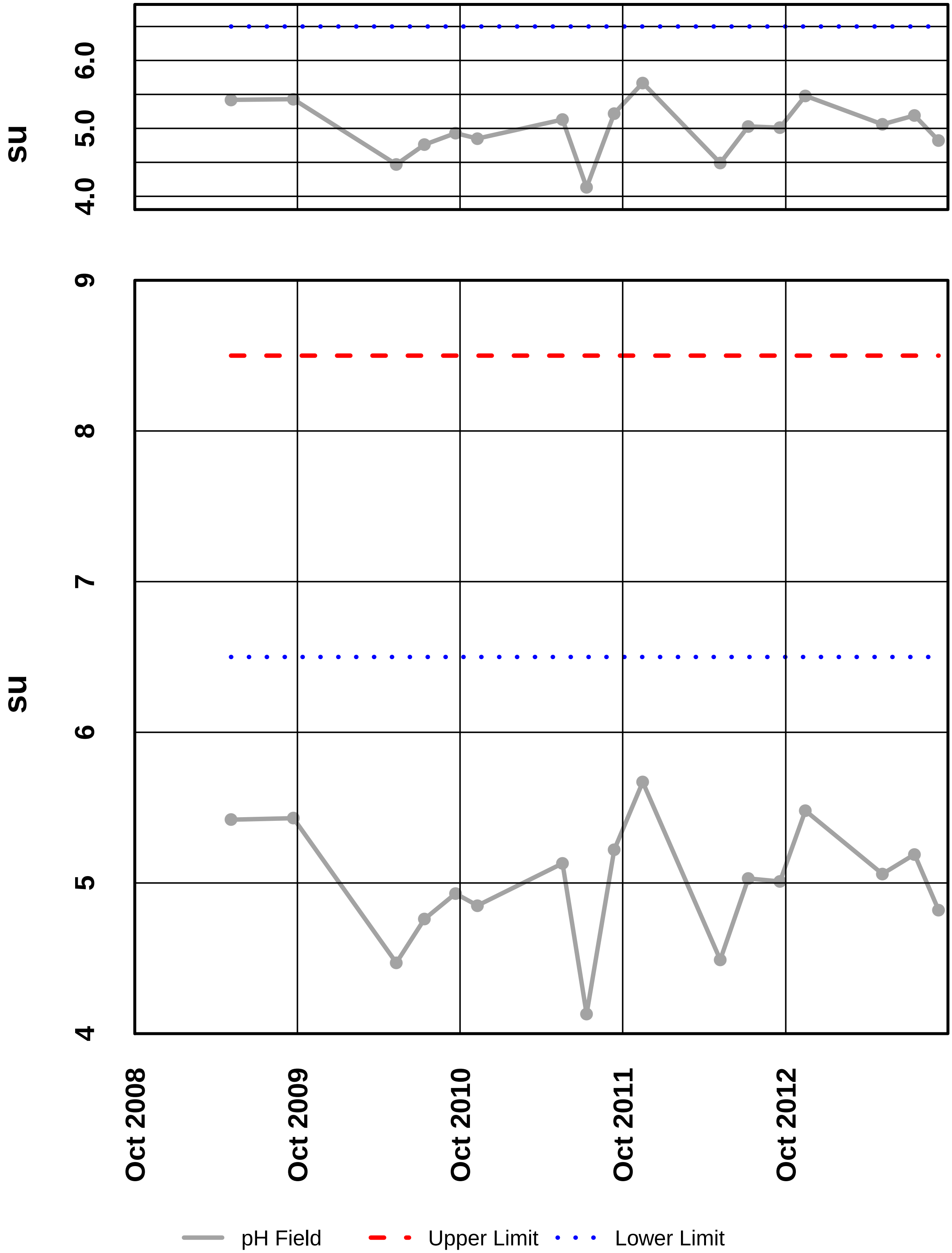
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 29 – pH Laboratory

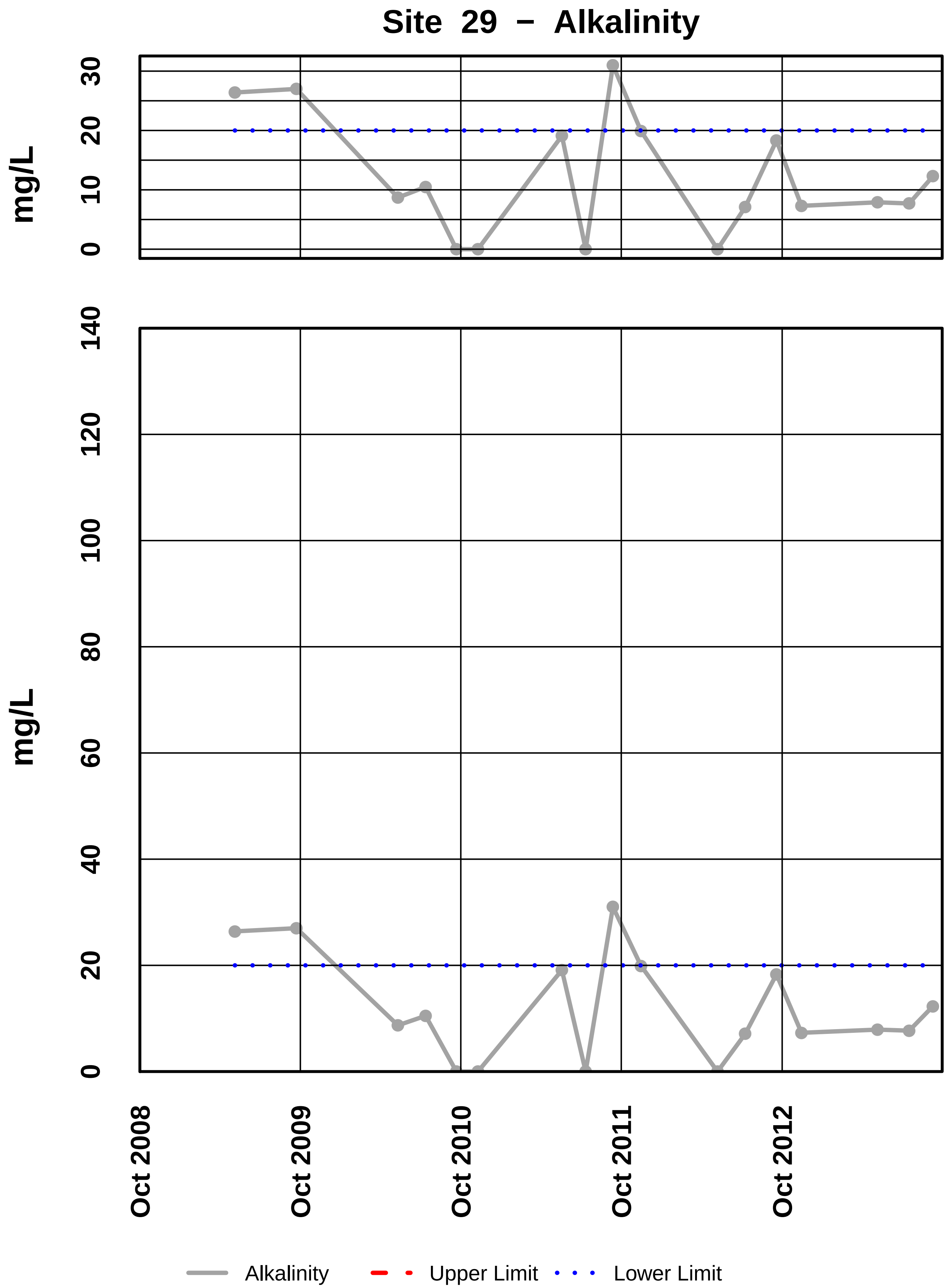


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 29 – pH Field

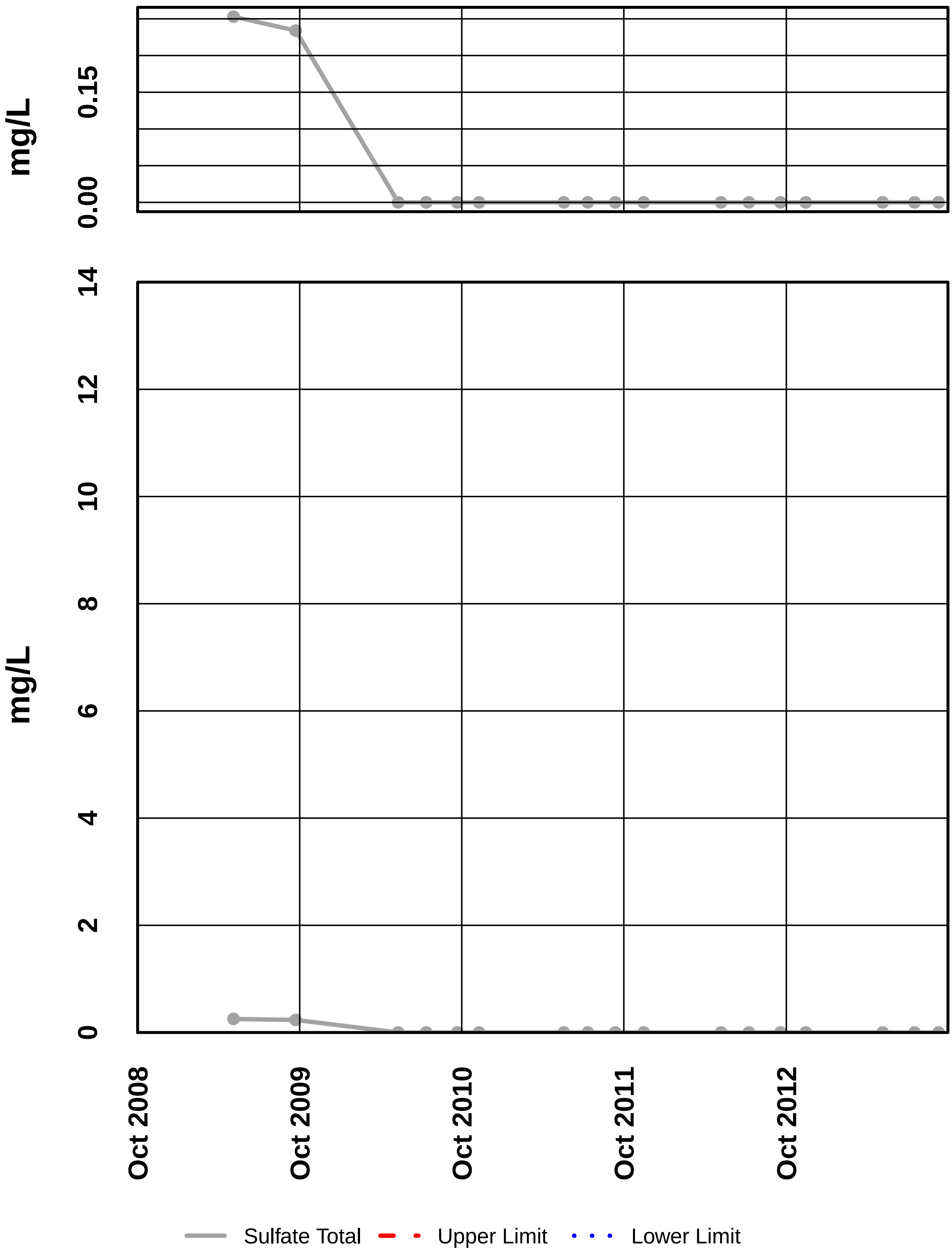


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



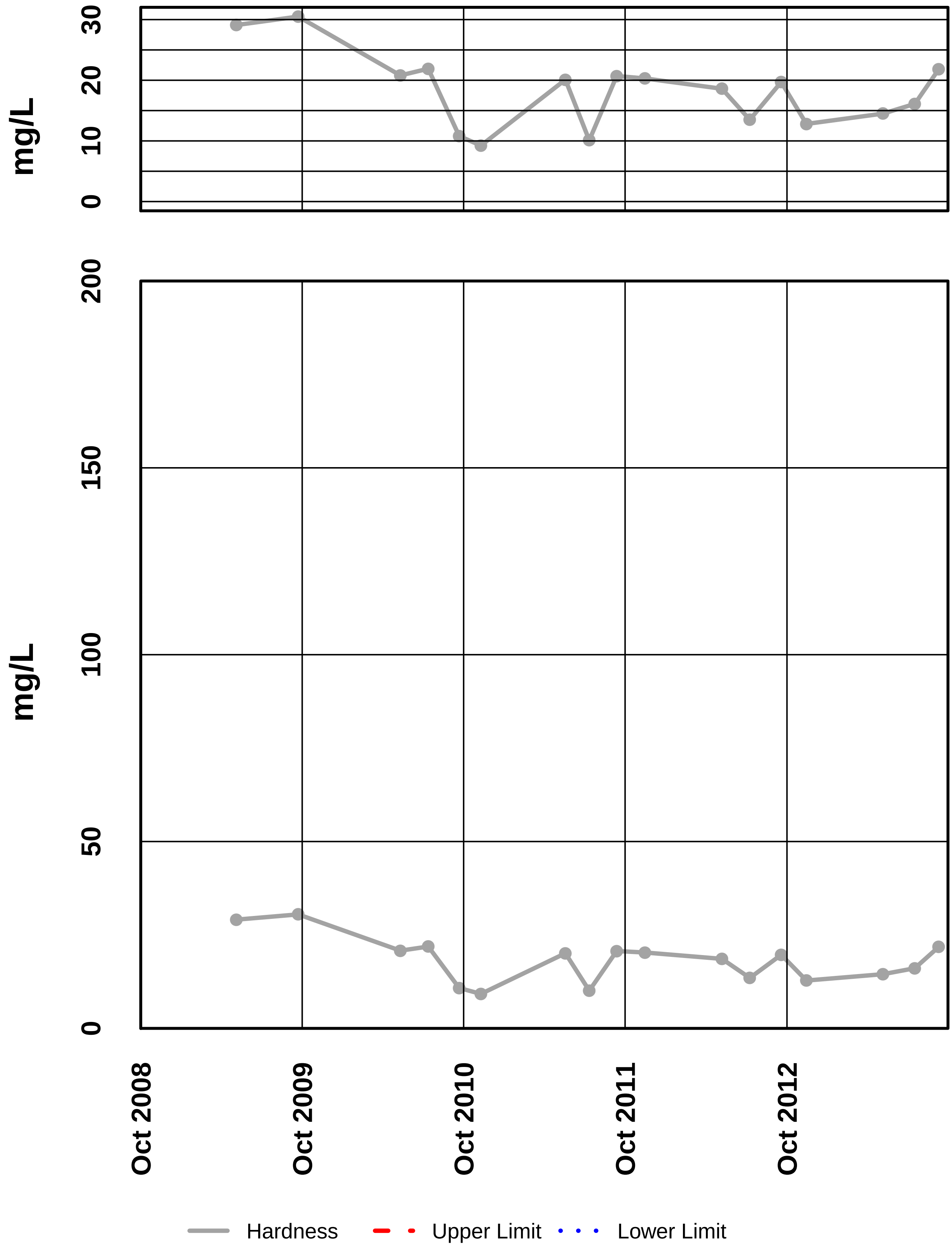
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 29 – Sulfate Total

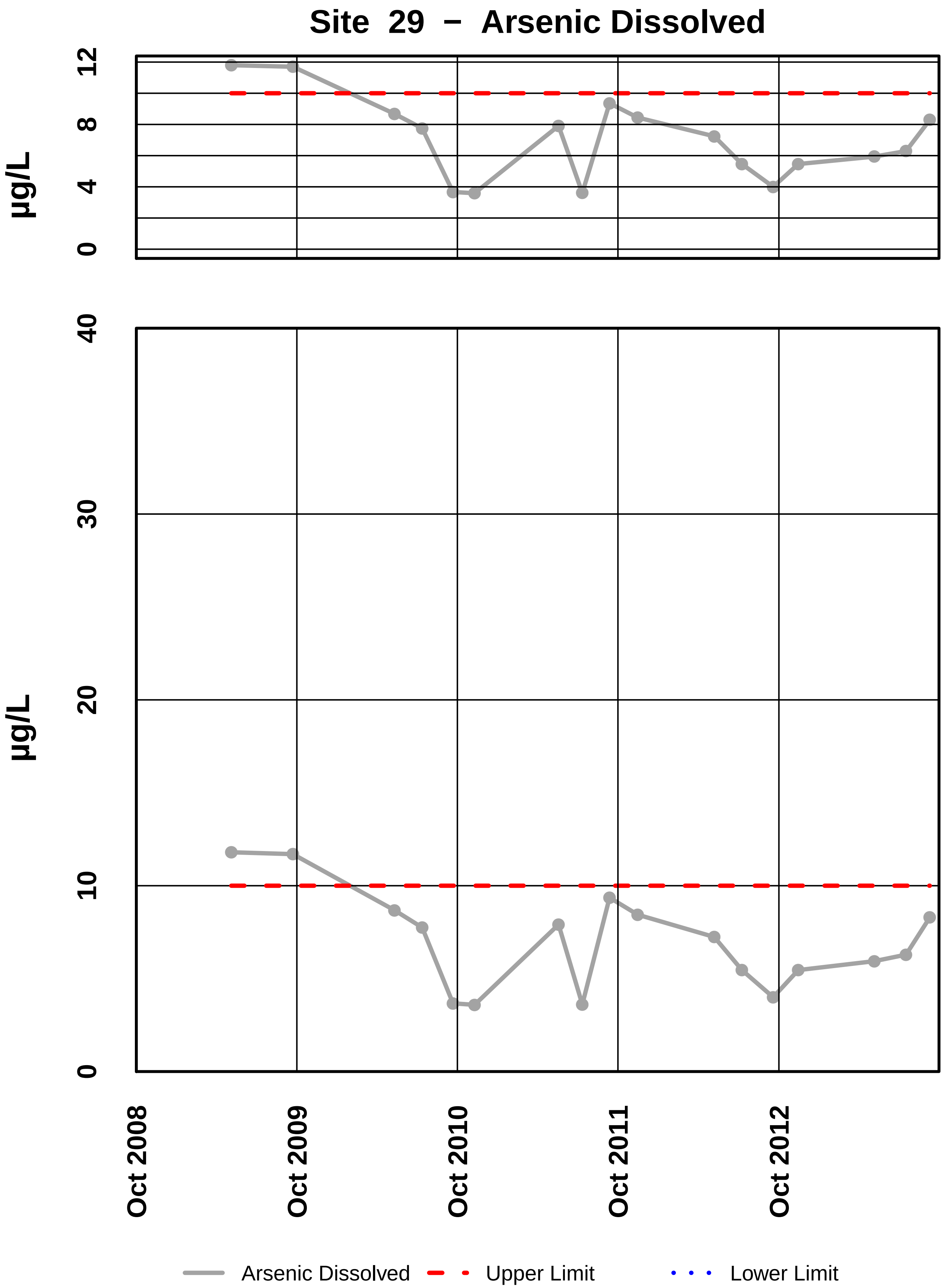


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 29 – Hardness

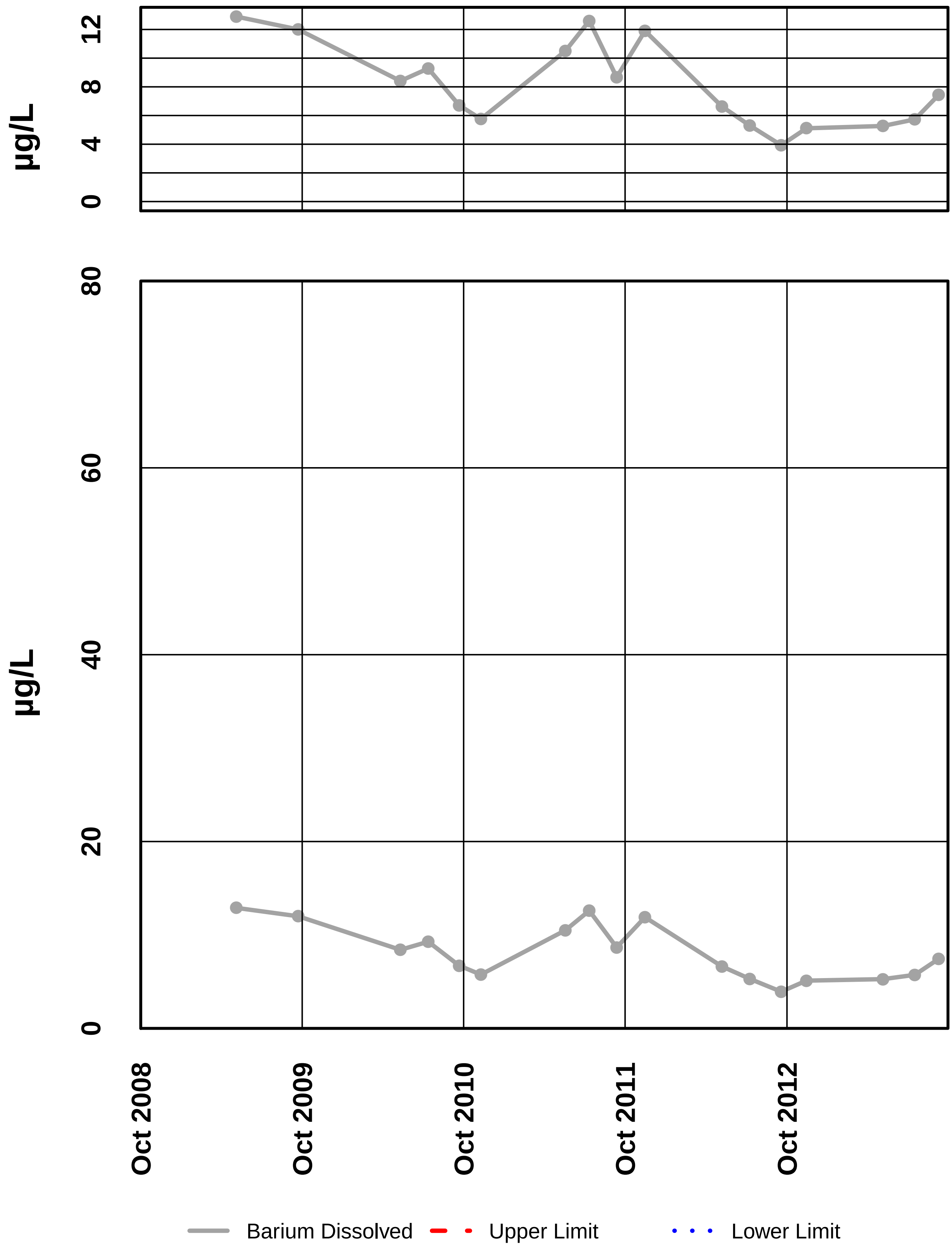


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

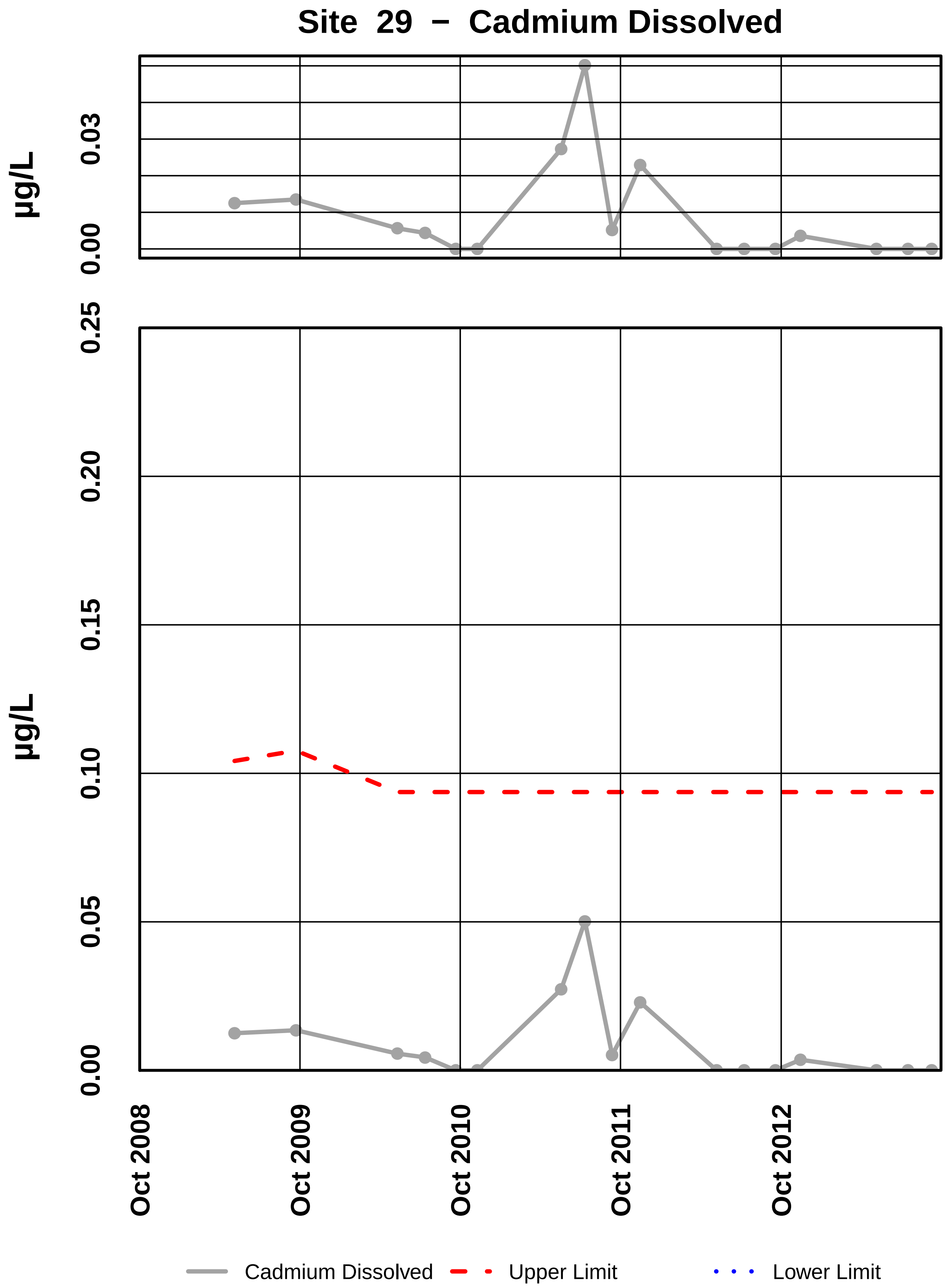


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 29 – Barium Dissolved

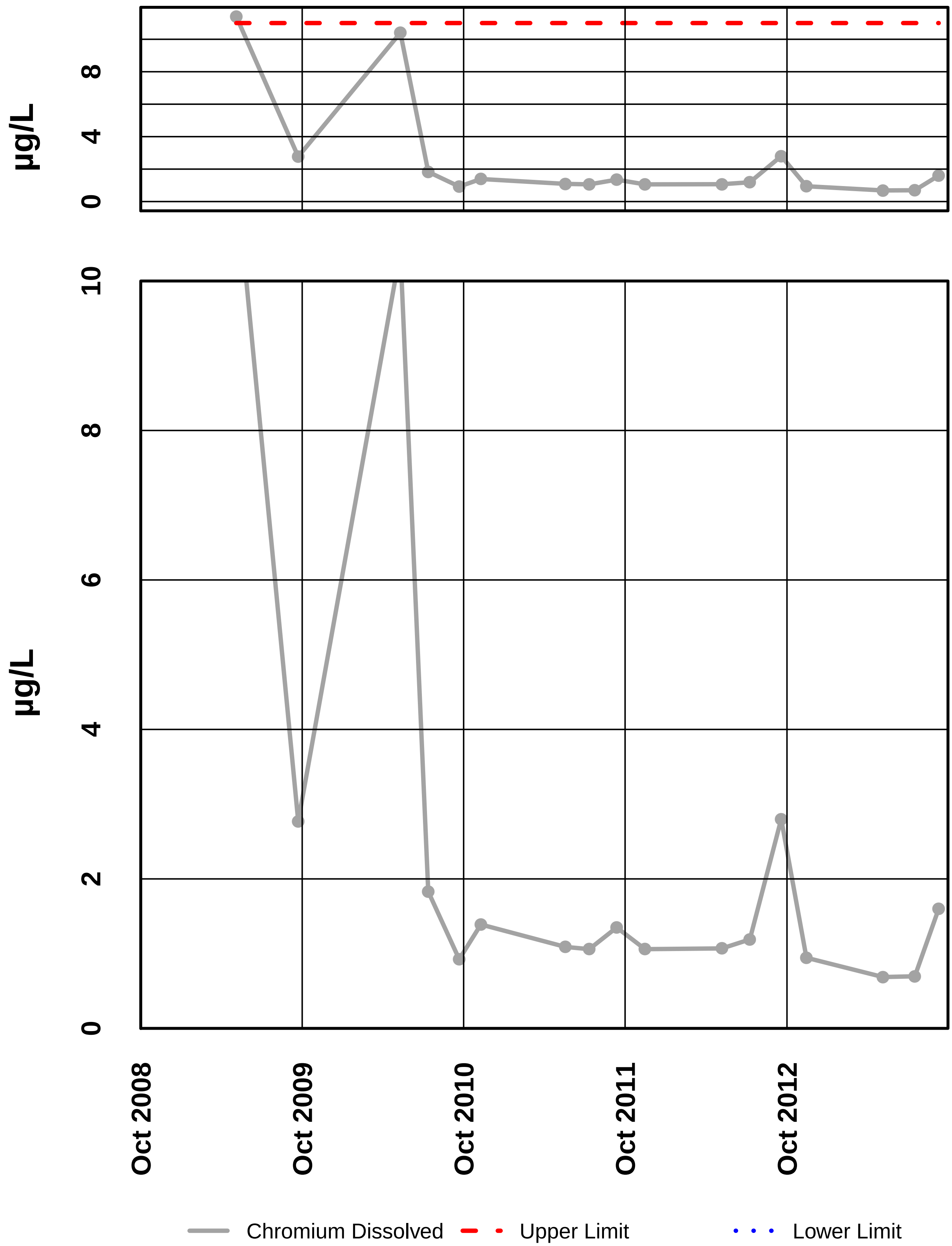


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



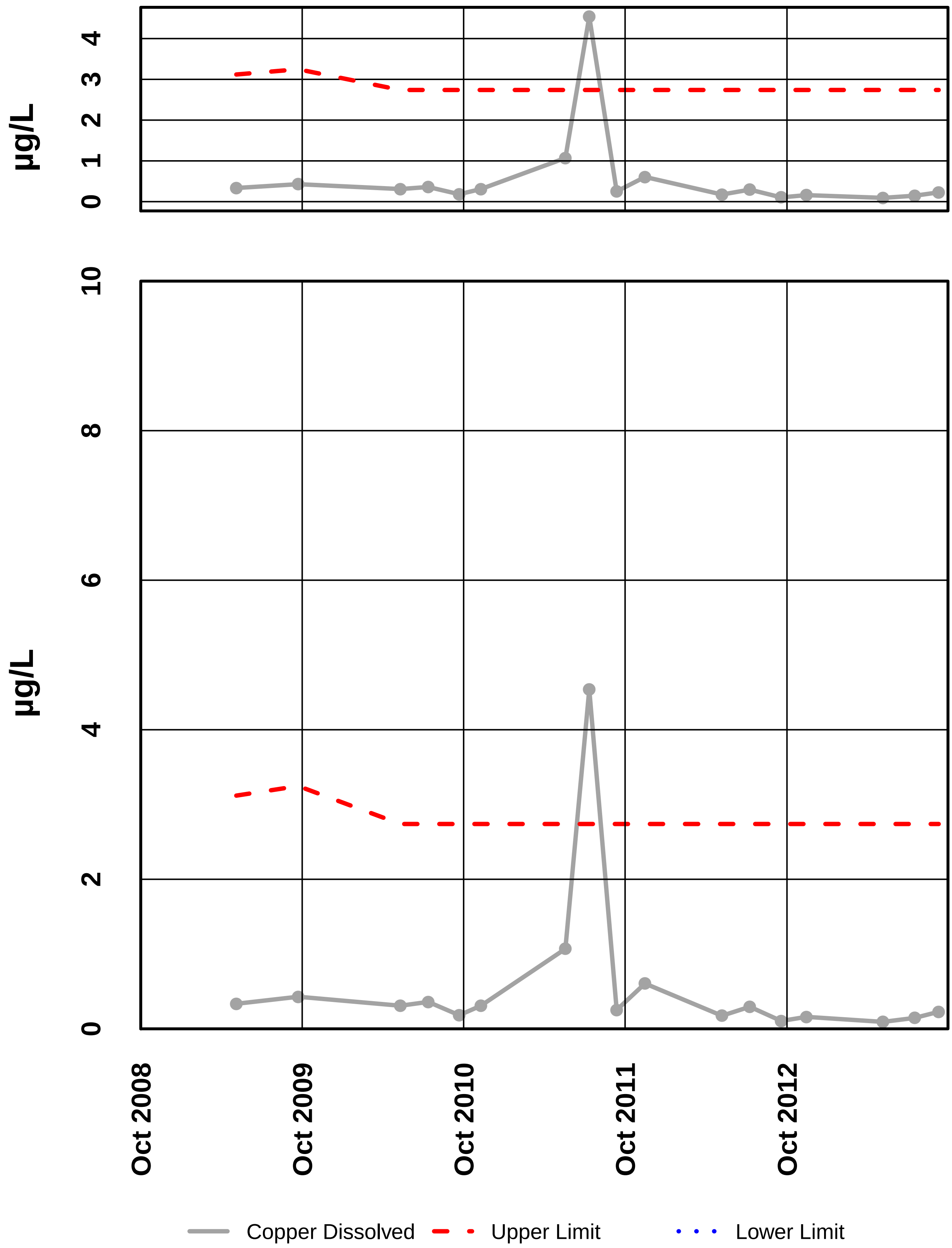
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 29 − Chromium Dissolved



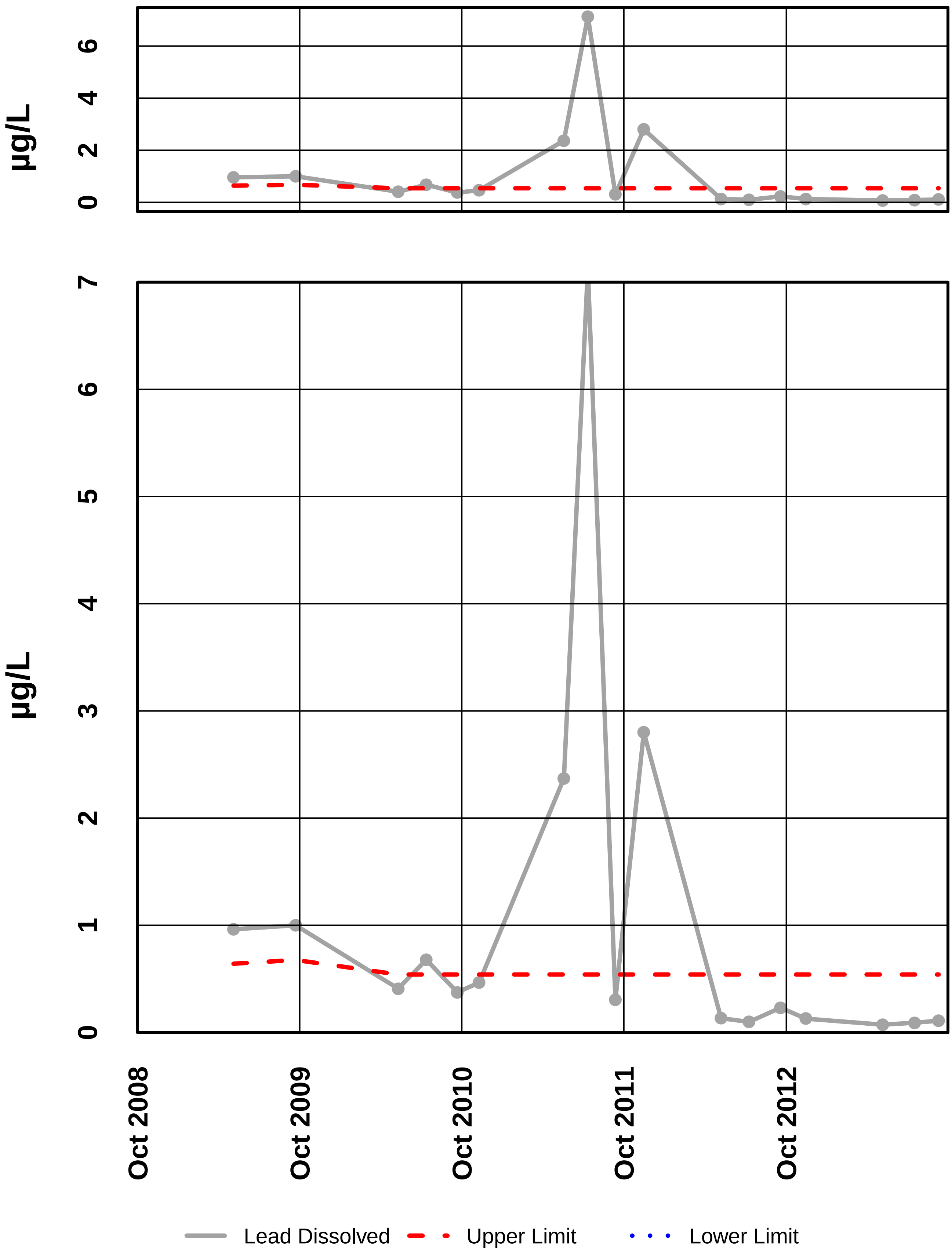
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 29 − Copper Dissolved

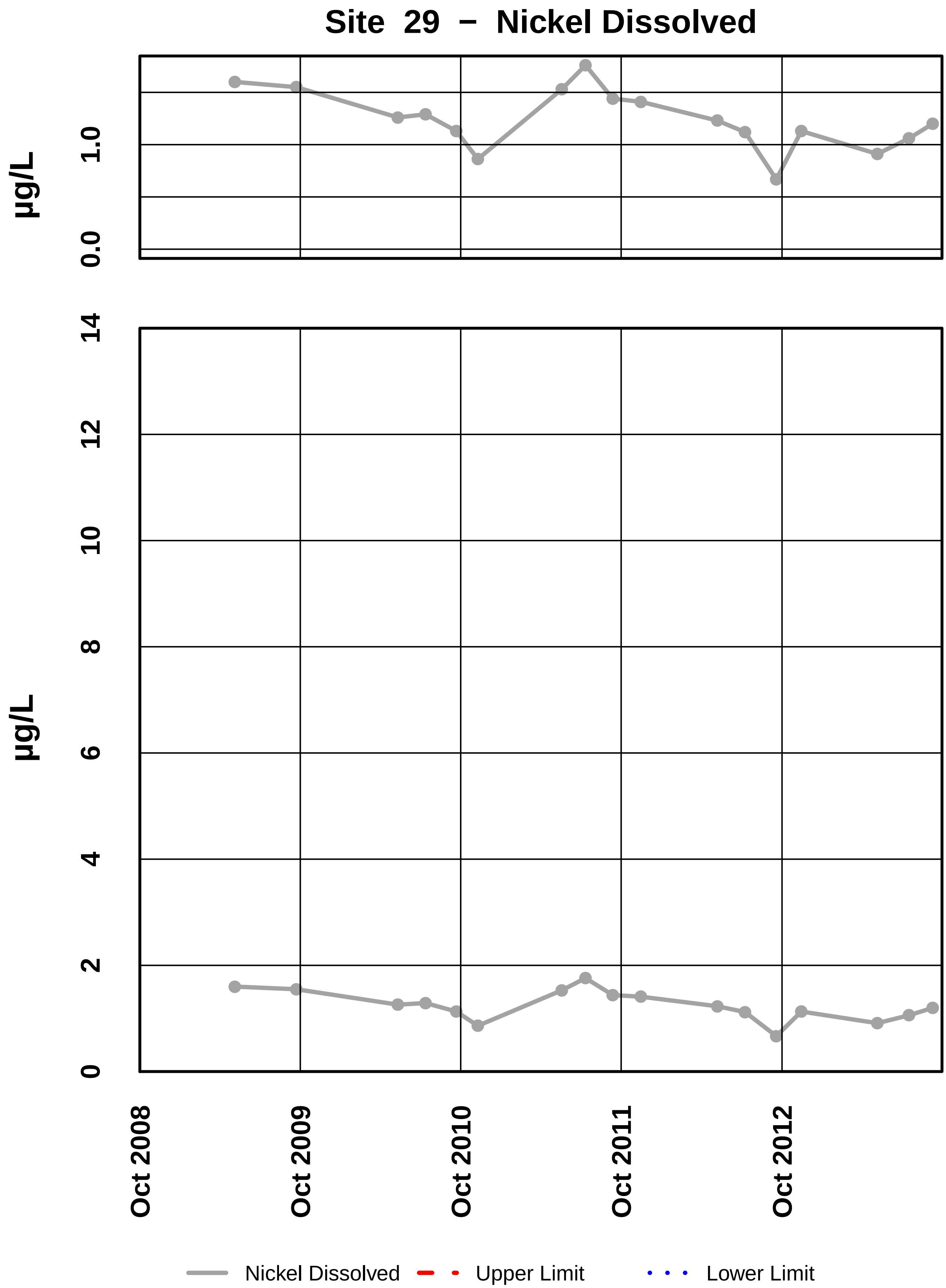


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 29 − Lead Dissolved

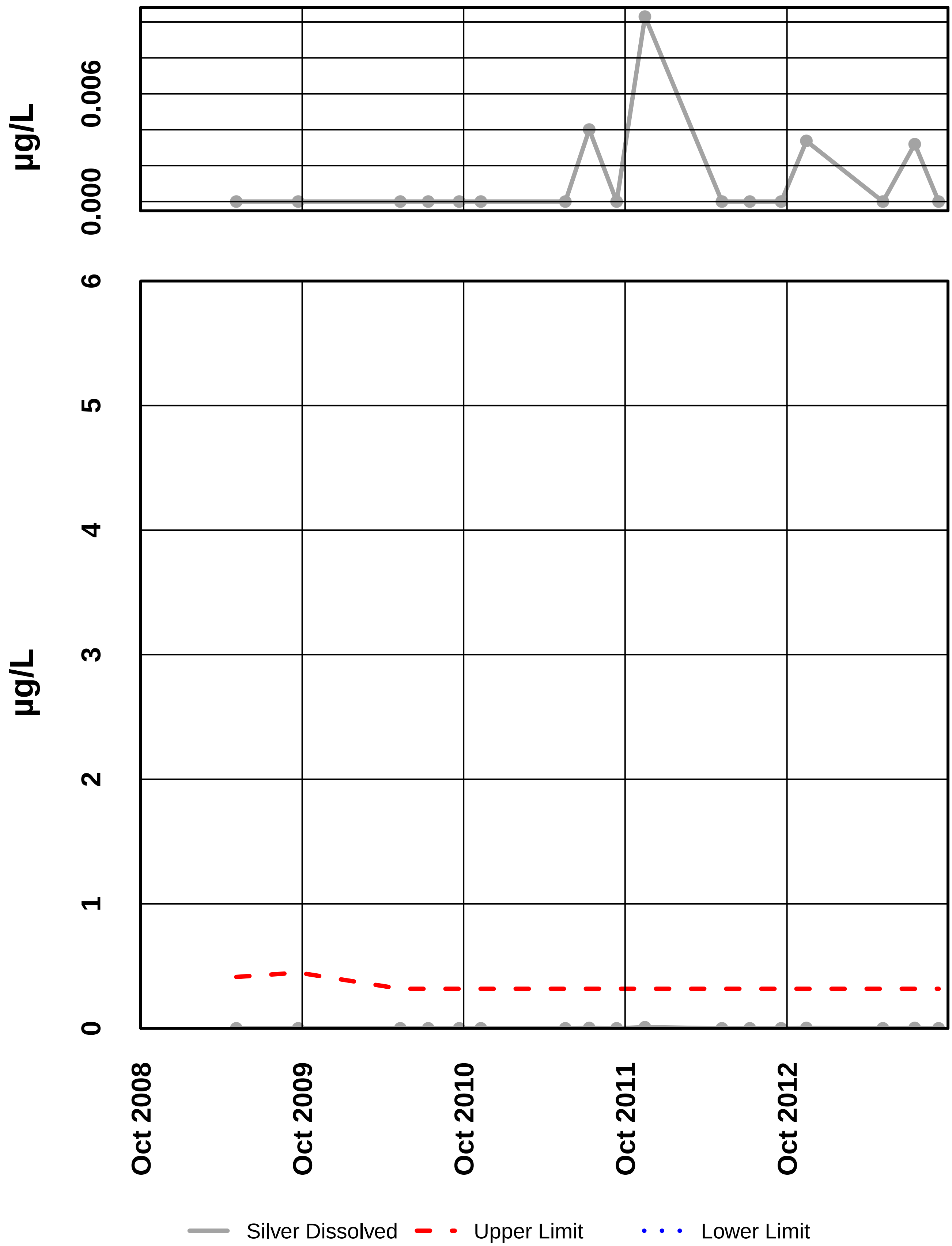


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

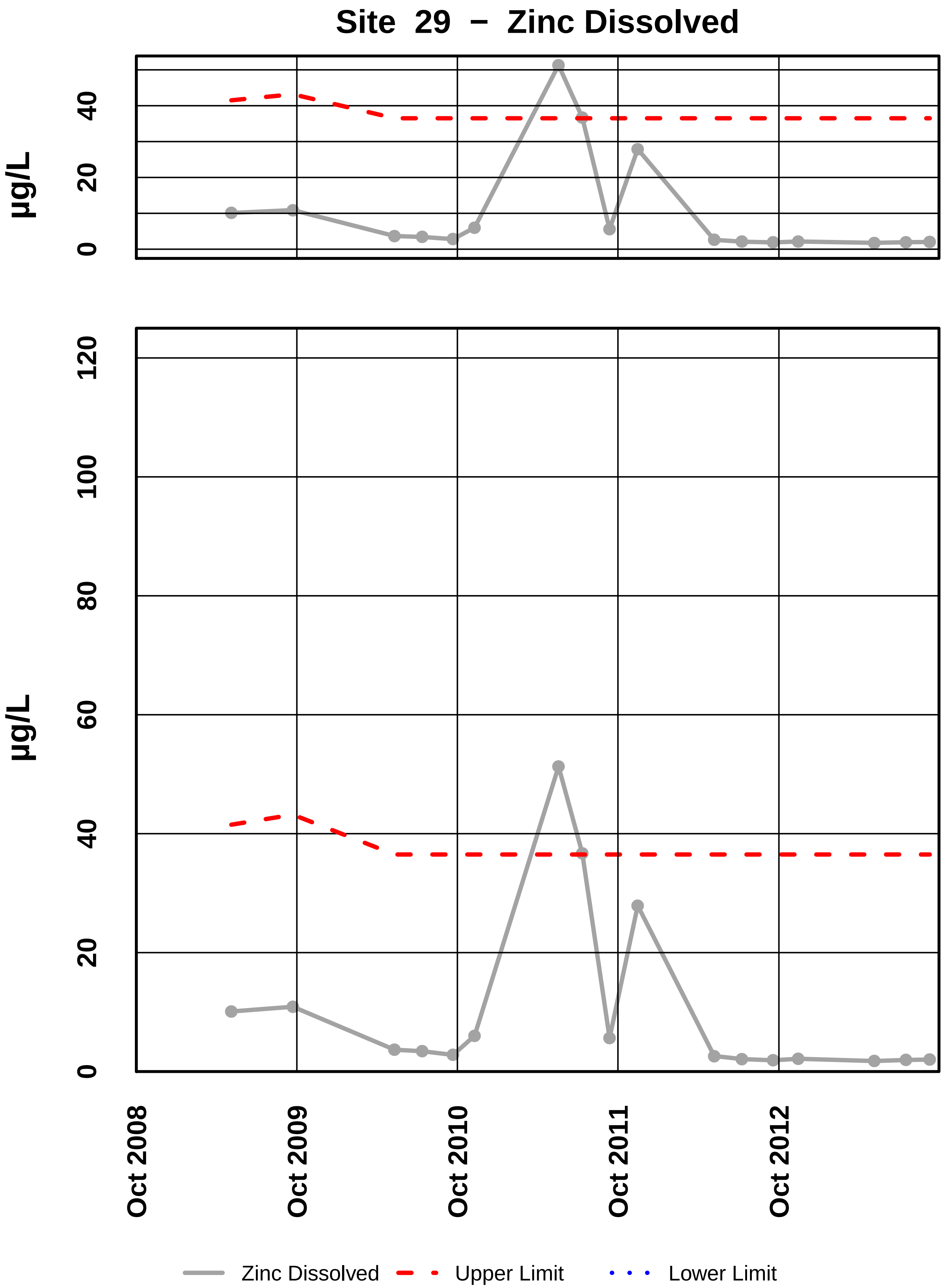


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

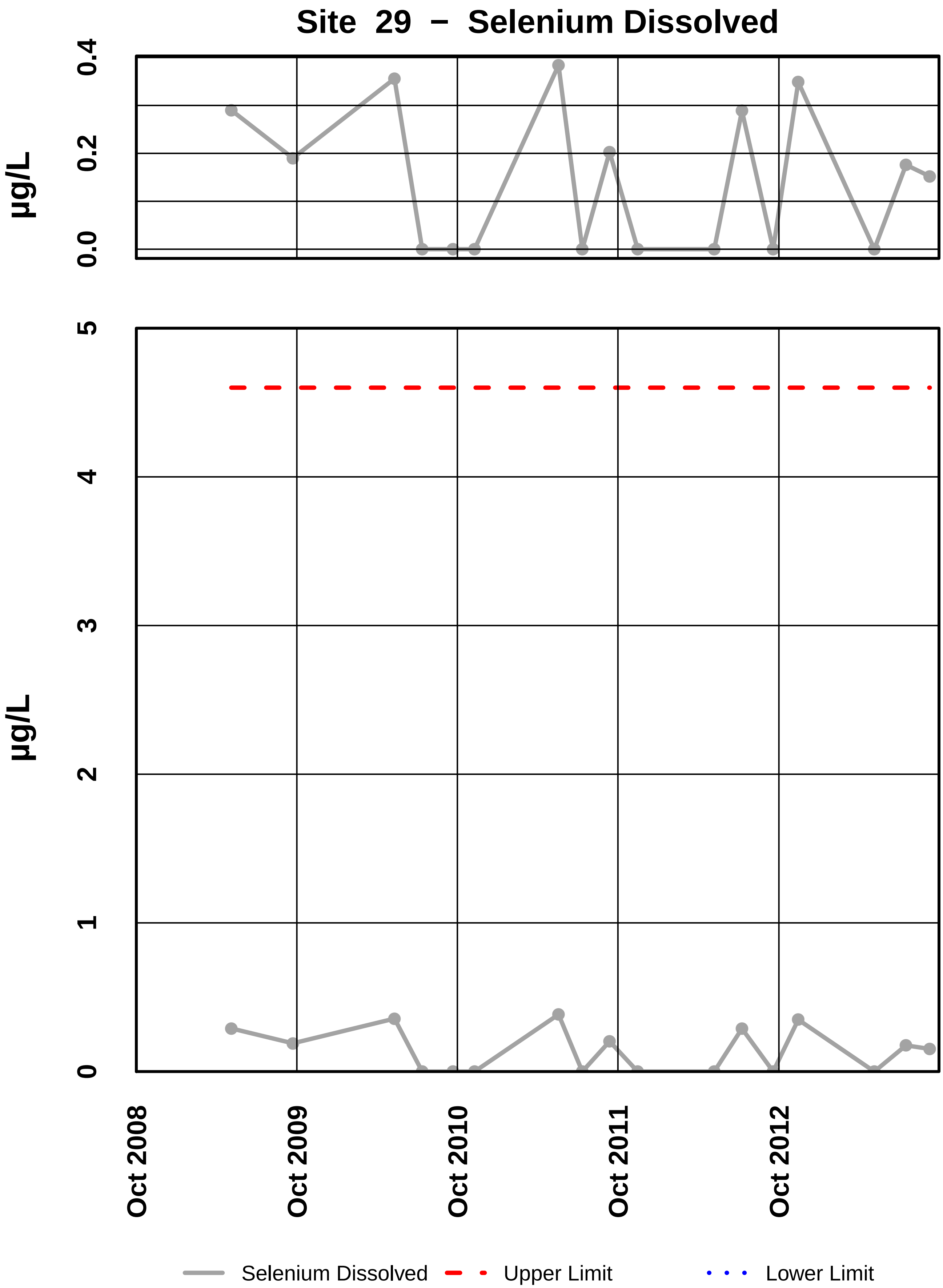
Site 29 – Silver Dissolved



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

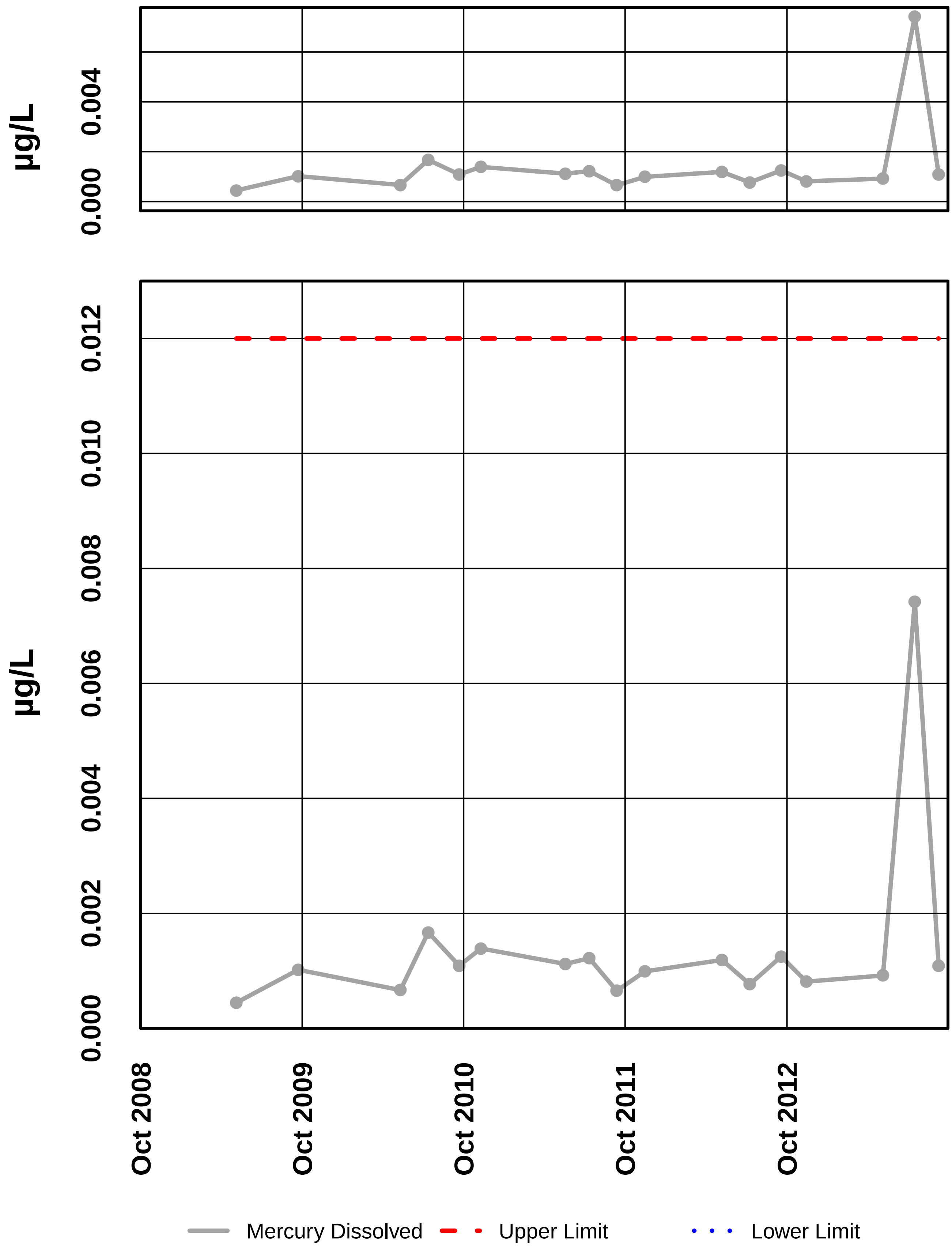


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

Site 29 − Mercury Dissolved



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

Site #29 — Seasonal Kendall analysis for Specific Conductance, Field (µS/cm)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**								78.8				48
b	**WY2009**								123.8				84.5
c	**WY2010**								61.5		61.6		49.4
d	**WY2011**		46.5						64		51.6		46
e	**WY2012**		53						54.7		40.8		59
f	**WY2013**		48						38		51		38
	n	0	3	0	0	0	0	0	6	0	4	0	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	0	3	0	0	0	0	0	6	0	4	0	6
t_2	0	0	0	0	0	0	0	0	0	0	0	0
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a								1				1
c-a								-1				1
d-a								-1				-1
e-a								-1				1
f-a								-1				-1
c-b								-1				-1
d-b								-1				-1
e-b								-1				-1
f-b								-1				-1
d-c								1		-1		-1
e-c								-1		-1		1
f-c								-1		-1		-1
e-d		1						-1		-1		1
f-d		1						-1		-1		-1
f-e		-1						-1		1		-1
S_k	0	1	0	0	0	0	0	-11	0	-4	0	-5

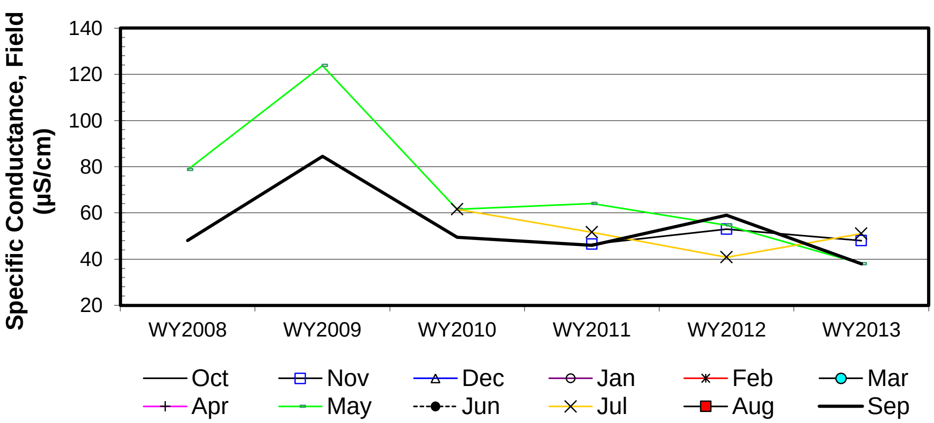
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=		3.67						28.33		8.67		28.33
$Z_k = S_k/\sigma_S$		0.52						-2.07		-1.36		-0.94
Z^2_k		0.27						4.27		1.85		0.88

ΣZ_k= -3.84
ΣZ^2_k= 7.27
Z-bar=$\Sigma Z_k/K$= -0.96

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	19	0	0	0	0

Σn 19
ΣS_k -19

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	3.58	@α=5% $\chi^2_{(K-1)}$=	7.81	Test for station homogeneity	
p	**0.310**			$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k) / Z_{calc}	-2.17	@α/2=2.5% Z=	1.96	**H_0** (No trend)	REJECT
69.00 / p	**0.015**			**H_A** (± trend)	ACCEPT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-11.85		-0.14
0.050	-10.13	**-5.00**	-2.94
0.100	-9.18		-3.42
0.200	-8.50		-3.80
		-9.7%	

Site **#29** Seasonal Kendall analysis for pH, Field, Standard Units

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**								5.3				5.0
b	**WY2009**								5.4				5.4
c	**WY2010**								4.5		4.8		4.9
d	**WY2011**		4.9						5.1		4.1		5.2
e	**WY2012**		5.7						4.5		5.0		5.0
f	**WY2013**		5.5						5.1		5.2		4.8
	n	0	3	0	0	0	0	0	6	0	4	0	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	0	3	0	0	0	0	0	6	0	4	0	6
t_2	0	0	0	0	0	0	0	0	0	0	0	0
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a								1				1
c-a								-1				-1
d-a								-1				1
e-a								-1				1
f-a								-1				-1
c-b								-1				-1
d-b								-1				-1
e-b								-1				-1
f-b								-1				-1
d-c								1		-1		1
e-c								1		1		1
f-c								1		1		-1
e-d		1						-1		1		-1
f-d		1						-1		1		-1
f-e		-1						1		1		-1
S_k	0	1	0	0	0	0	0	-5	0	4	0	-5

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=		3.67						28.33		8.67		28.33
$Z_k = S_k/\sigma_S$		0.52						-0.94		1.36		-0.94
Z^2_k		0.27						0.88		1.85		0.88

ΣZ_k= 0.00

ΣZ^2_k= 3.88

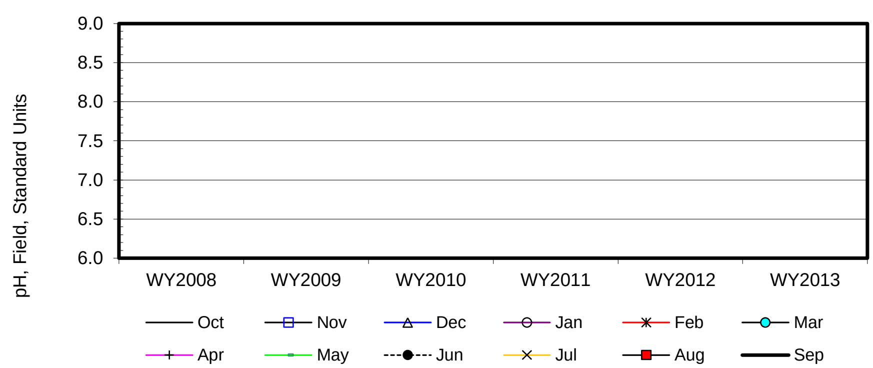
Z-bar=ΣZ_k/K= 0.00

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	19	0	0	0	0

Σn 19

ΣS_k -5

$\chi^2_h=\Sigma Z^2_k$-K(Z-bar)^2=	3.88	@α=5% $\chi^2_{(K-1)}$= 7.81	Test for station homogeneity	
p	**0.274**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc} -0.48	@α/2=2.5% Z= 1.96	**H_0** (No trend)	ACCEPT
69.00	**p** **0.315**		**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.19		0.15
0.050	-0.15	**-0.04**	0.09
0.100	-0.13		0.04
0.200	-0.09		0.01

Site #29 — Seasonal Kendall analysis for Total Alk, (mg/l)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**								22.4				10.5
b	**WY2009**								26.4				27.0
c	**WY2010**								8.7		10.5		0.0
d	**WY2011**		0.0						19.1		0.0		31.0
e	**WY2012**		19.9						0.0		7.1		18.3
f	**WY2013**		7.3						7.9		7.7		12.3
	n	0	3	0	0	0	0	0	6	0	4	0	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	0	3	0	0	0	0	0	6	0	4	0	6
t_2	0	0	0	0	0	0	0	0	0	0	0	0
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a								1				1
c-a								-1				-1
d-a								-1				1
e-a								-1				1
f-a								-1				1
c-b								-1				-1
d-b								-1				1
e-b								-1				-1
f-b								-1				-1
d-c								1		-1		1
e-c								-1		-1		1
f-c								-1		-1		1
e-d		1						-1		1		-1
f-d		1						-1		1		-1
f-e		-1						1		1		-1
S_k	0	1	0	0	0	0	0	-9	0	0	0	1

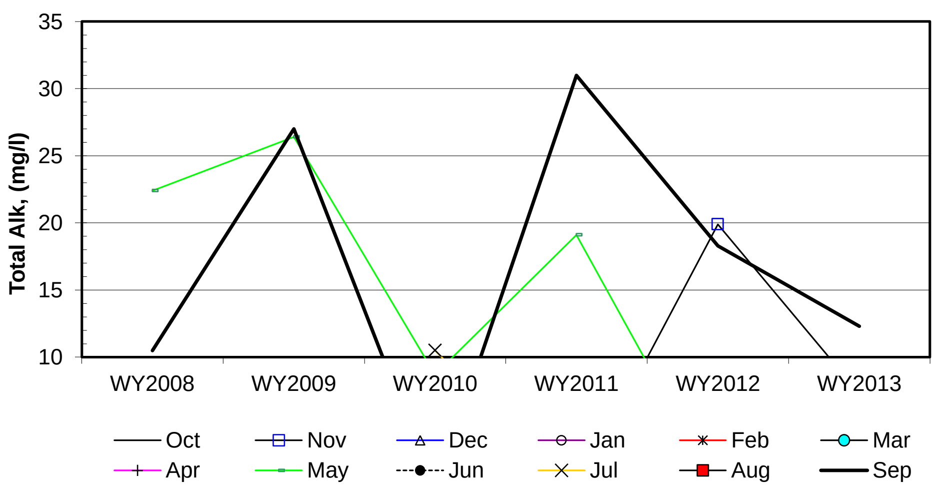
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=		3.67						28.33		8.67		28.33
$Z_k = S_k/\sigma_S$		0.52						-1.69		0.00		0.19
Z^2_k		0.27						2.86		0.00		0.04

ΣZ_k= -0.98
ΣZ^2_k= 3.17
Z-bar=ΣZ_k/K= -0.25

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	19	0	0	0	0

Σn 19
ΣS_k -7

$\chi^2_h=\Sigma Z^2_k - K(\text{Z-bar})^2$=	2.93	@α=5% $\chi^2_{(K-1)}$= 7.81	Test for station homogeneity	
p	**0.403**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc} -0.72	@α/2=2.5% Z= 1.96	**H_0** (No trend)	ACCEPT
69.00	**p** **0.235**		**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-6.14		3.87
0.050	-5.37	**-1.70**	1.97
0.100	-4.58		0.56
0.200	-3.67		-0.27

Site #29 — Seasonal Kendall analysis for Zinc, Dissolved (ug/l)

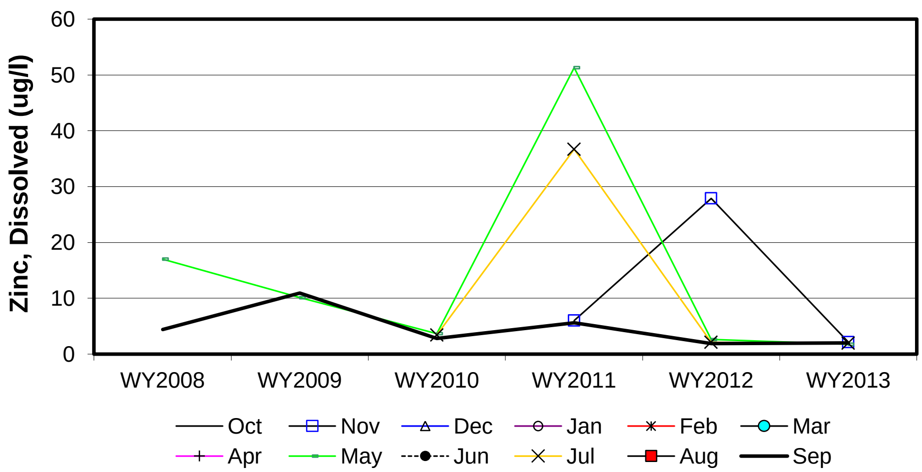
Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	WY2008								17.0				4.4
b	WY2009								10.1				10.9
c	WY2010								3.7		3.4		2.8
d	WY2011		6.0						51.3		36.7		5.6
e	WY2012		27.9						2.6		2.1		1.9
f	WY2013		2.2						1.8		2.0		2.0
	n	0	3	0	0	0	0	0	6	0	4	0	6
	t_1	0	3	0	0	0	0	0	6	0	4	0	6
	t_2	0	0	0	0	0	0	0	0	0	0	0	0
	t_3	0	0	0	0	0	0	0	0	0	0	0	0
	t_4	0	0	0	0	0	0	0	0	0	0	0	0
	t_5	0	0	0	0	0	0	0	0	0	0	0	0
	b-a								-1				1
	c-a								-1				-1
	d-a								1				1
	e-a								-1				-1
	f-a								-1				-1
	c-b								-1				-1
	d-b								1				-1
	e-b								-1				-1
	f-b								-1				-1
	d-c								1		1		1
	e-c								-1		-1		-1
	f-c								-1		-1		-1
	e-d		1						-1		-1		-1
	f-d		-1						-1		-1		-1
	f-e		-1						-1		-1		1
	S_k	0	-1	0	0	0	0	0	-9	0	-4	0	-7
	σ^2_S=		3.67						28.33		8.67		28.33
	$Z_k = S_k/\sigma_S$		-0.52						-1.69		-1.36		-1.32
	Z^2_k		0.27						2.86		1.85		1.73

ΣZ_k= -4.89
ΣZ^2_k= 6.71
Z-bar=ΣZ_k/K= -1.22

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	19	0	0	0	0

Σn 19
ΣS_k -21

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	0.74	@α=5% $\chi^2_{(K-1)}$= 7.81	Test for station homogeneity	
p	0.865		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc} -2.41	@α/2=2.5% Z= 1.96	H_0 (No trend)	REJECT
69.00	p 0.008		H_A (± trend)	ACCEPT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-4.17		-0.24
0.050	-3.02	-0.84	-0.49
0.100	-2.61		-0.55
0.200	-2.22		-0.63

-22.9%

INTERPRETIVE REPORT
SITE 32

The data collected during the current water year are listed in the following “Table of Results for Water Year 2013” 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 2007 through September 2013.				

The data for Water Year 2013 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 2013

			Limits		
Sample Date	**Parameter**	**Value**	**Lower**	**Upper**	**Hardness**
14-Nov-12	Alkalinity	18.6 mg/L	20		
6-May-13	Alkalinity	14.3 mg/L	20		
17-Jul-13	Alkalinity	14.5 mg/L	20		
14-Nov-12	Lead Dissolved	1.01 µg/L		0.54	8.56 mg/L
6-May-13	Lead Dissolved	0.861 µg/L		0.54	8.05 mg/L
17-Jul-13	Lead Dissolved	0.694 µg/L		0.54	8.62 mg/L
9-Sep-13	Lead Dissolved	1.11 µg/L		0.54	8.19 mg/L
14-Nov-12	pH Field	5.73 su	6.5	8.5	
6-May-13	pH Field	5.45 su	6.5	8.5	
17-Jul-13	pH Field	5.18 su	6.5	8.5	
9-Sep-13	pH Field	5.04 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, 42 of the past 43 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 five 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-07 and Sep-13(WY2008-WY2013).

Table of Summary Statistics for Trend Analysis

	Mann-Kendall test statistics			Sen's slope estimate	
Parameter	**n***	**p****	**Trend**	**Q**	**Q(%)**
Conductivity Field	6	0.07			
pH Field	6	0.41			
Alkalinity, Total	6	0.14			
Sulfate, Total	6		Inconsistent detection limits		
Zinc, Dissolved	6	0.01	-	-1.4	-13.725

* Number of Years ** Significance level

There was a significant negative (p=0.01) trend in dissolved zinc slope of -1.4 su/yr or a -13.7% this analysis. 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.

All three of 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. Specific conductance has shown the least amount of variability only going out of control after the last sampling in water year 2013. Alkalinity has mostly gone out of control as there has been a minor decrease in the parameter. It was only out of control at the end of water year 2013 when the measured value was at least twice the mean value. Because alkalinity and specific conductance do not have a similar pattern to going out of control as 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**

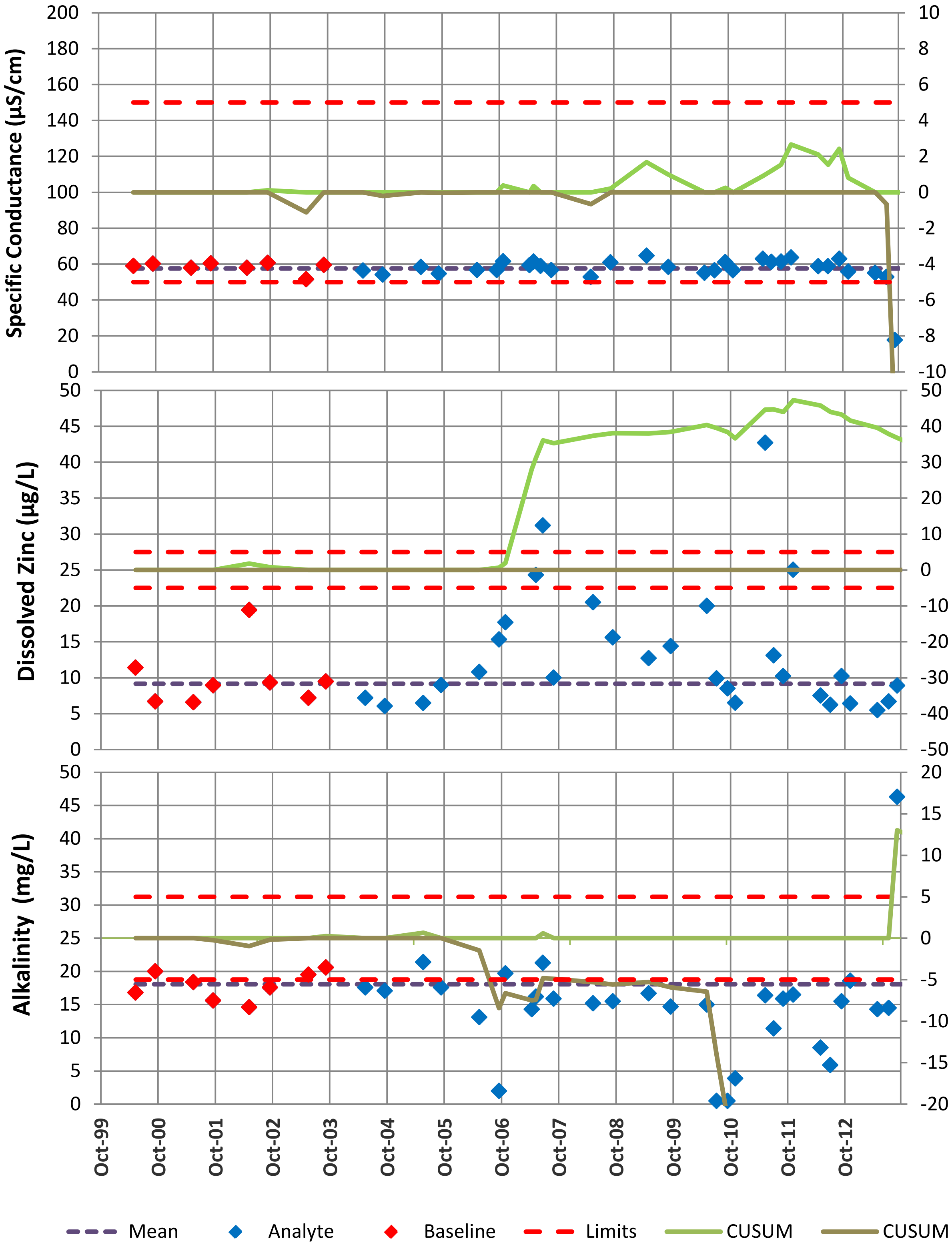


Table of Results for Water Year 2013

Site 032FMG - 'Monitoring Well - 5S'

Sample Date/Parameter	Oct 2012	Nov 2012	Dec 2012	Jan 2013	Feb 2013	Mar 2013	Apr 2013	May 2013	Jun 2013	Jul 2013	Aug 2013	Sep 2013	**Median**
Water Temp (°C)		7.2						6.2		7.1		7.7	7.2
Conductivity-Field(µmho)		55						66		66		65	65.5
Conductivity-Lab (µmho)		56						55		53		18	54
pH Lab (standard units)		5.16						5.03		5.19		4.89	5.10
pH Field (standard units)		5.73						5.45		5.18		5.04	5.32
Total Alkalinity (mg/L)		18.6						14.3		14.5		46.3	16.6
Total Sulfate (mg/L)		2.5						5		5		2.5	3.8
Hardness (mg/L)		8.6						8.1		8.6		8.2	8.4
Dissolved As (ug/L)		4.01						3.58		3.45		3.27	3.515
Dissolved Ba (ug/L)		13.7						12.8		14.6		20.4	14.2
Dissolved Cd (ug/L)		0.006						0.0063		0.0076		0.0113	0.0070
Dissolved Cr (ug/L)		2.13						1.26		1.58		1.76	1.670
Dissolved Cu (ug/L)		0.859						0.501		0.744		0.632	0.688
Dissolved Pb (ug/L)		1.01						0.861		0.694		1.11	0.9355
Dissolved Ni (ug/L)		3.33						2.96		2.94		2.94	2.950
Dissolved Ag (ug/L)		0.01						0.003		0.011		0.002	0.007
Dissolved Zn (ug/L)		6.41						5.46		6.69		8.91	6.55
Dissolved Se (ug/L)		0.664						0.057		0.402		0.057	0.230
Dissolved Hg (ug/L)		0.00142						0.00137		0.00672		0.00144	0.001430

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.

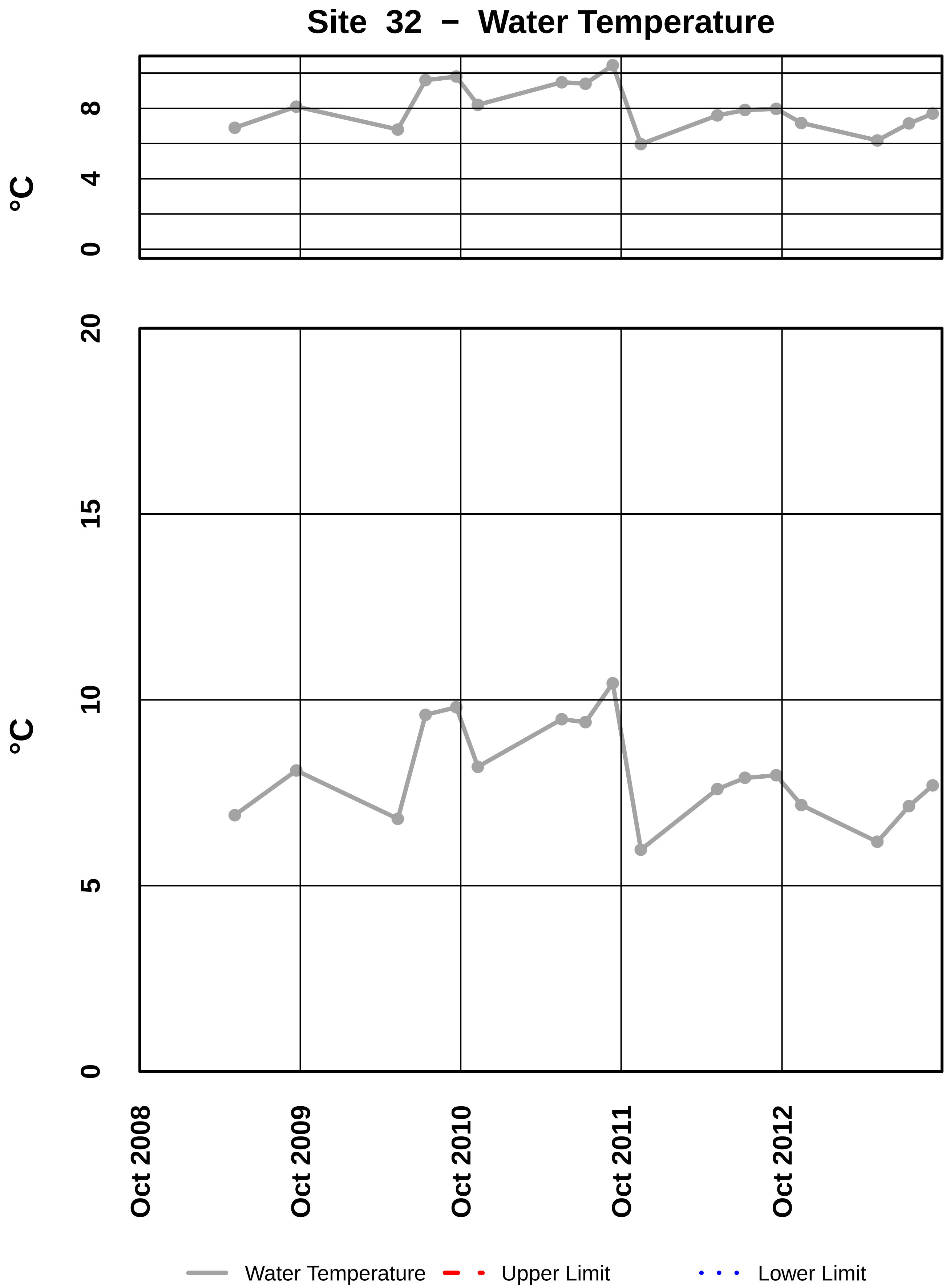
Shaded data has been qualified as an outlier by HGCMC and removed from any further analysis and is not included into the calculation of the median

Qualified Data by QA Reviewer

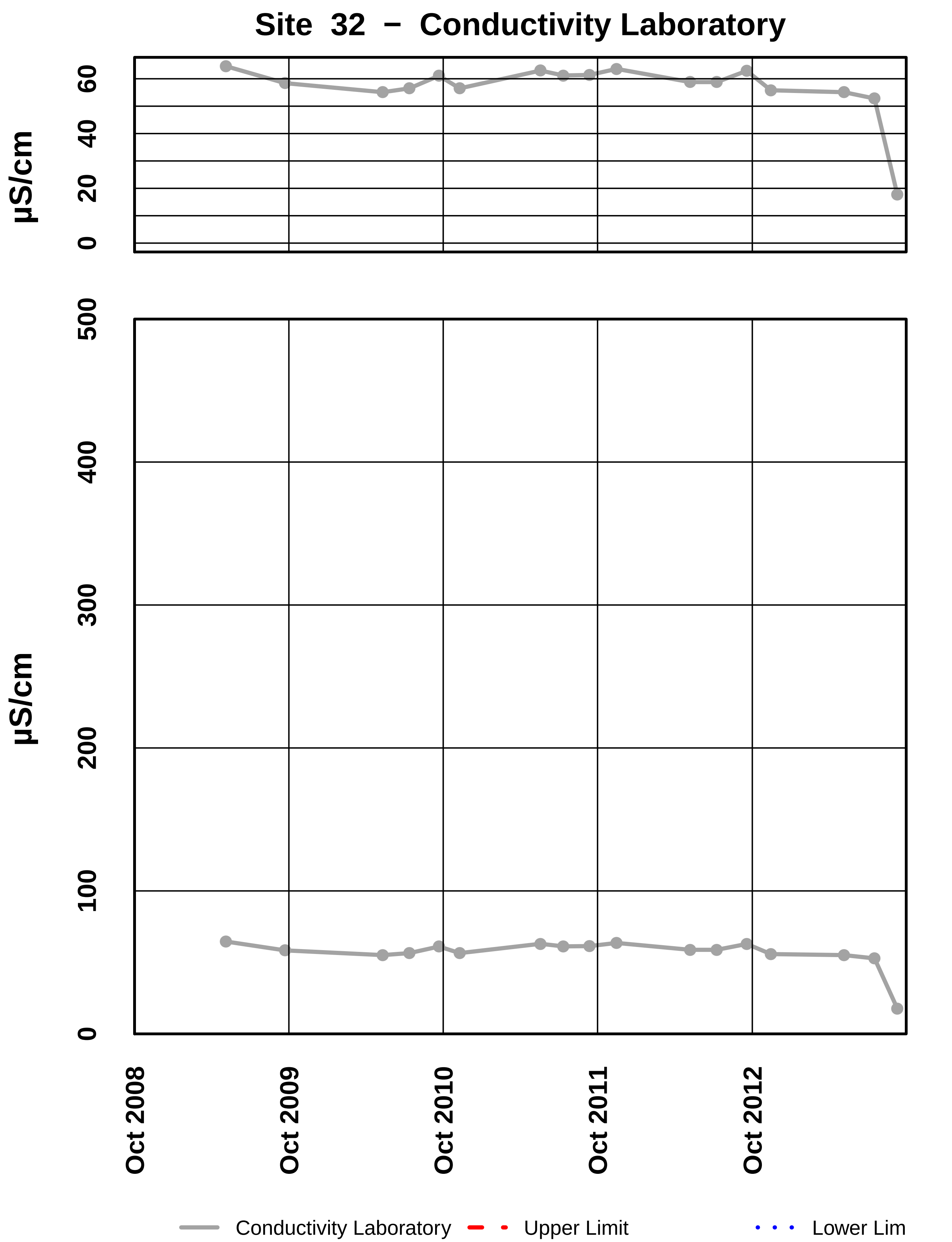
Date Range: 10/01/2012 to 09/30/2013

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
32	11/14/2012	12:00 AM	Ag diss, µg/l	0.00958	J	Below Quantitative Range
			Cd diss, µg/l	0.00603	J	Below Quantitative Range
			Zn diss, µg/l	6.41	U	Field Blank Contamination
			Se diss, µg/l	0.66	U	Field Blank Contamination
32	5/6/2013	12:00 AM	Ag diss, µg/l	0.00324	J	Below Quantitative Range
			Cd diss, µg/l	0.00628	J	Below Quantitative Range
			pH Lab, su	5.03	J	Hold Time Violation
			Cond, µmhos	55.1	U	Field Blank Contamination
			Alk, mg/L	14.3	U	Field Blank Contamination
			SO4 Tot, mg/l	-10	UJ	Sample Receipt Temperature
32	7/17/2013	12:00 AM	Cd diss, µg/l	0.0076	J	Below Quantitative Range
			SO4 Tot, mg/l	-10	UJ	Sample Receipt Temperature
32	9/9/2013	12:00 AM	Cond, µmhos	17.7	J	Below Quantitative Range
			SO4 Tot, mg/l	-5	UJ	Sample receipt temperature

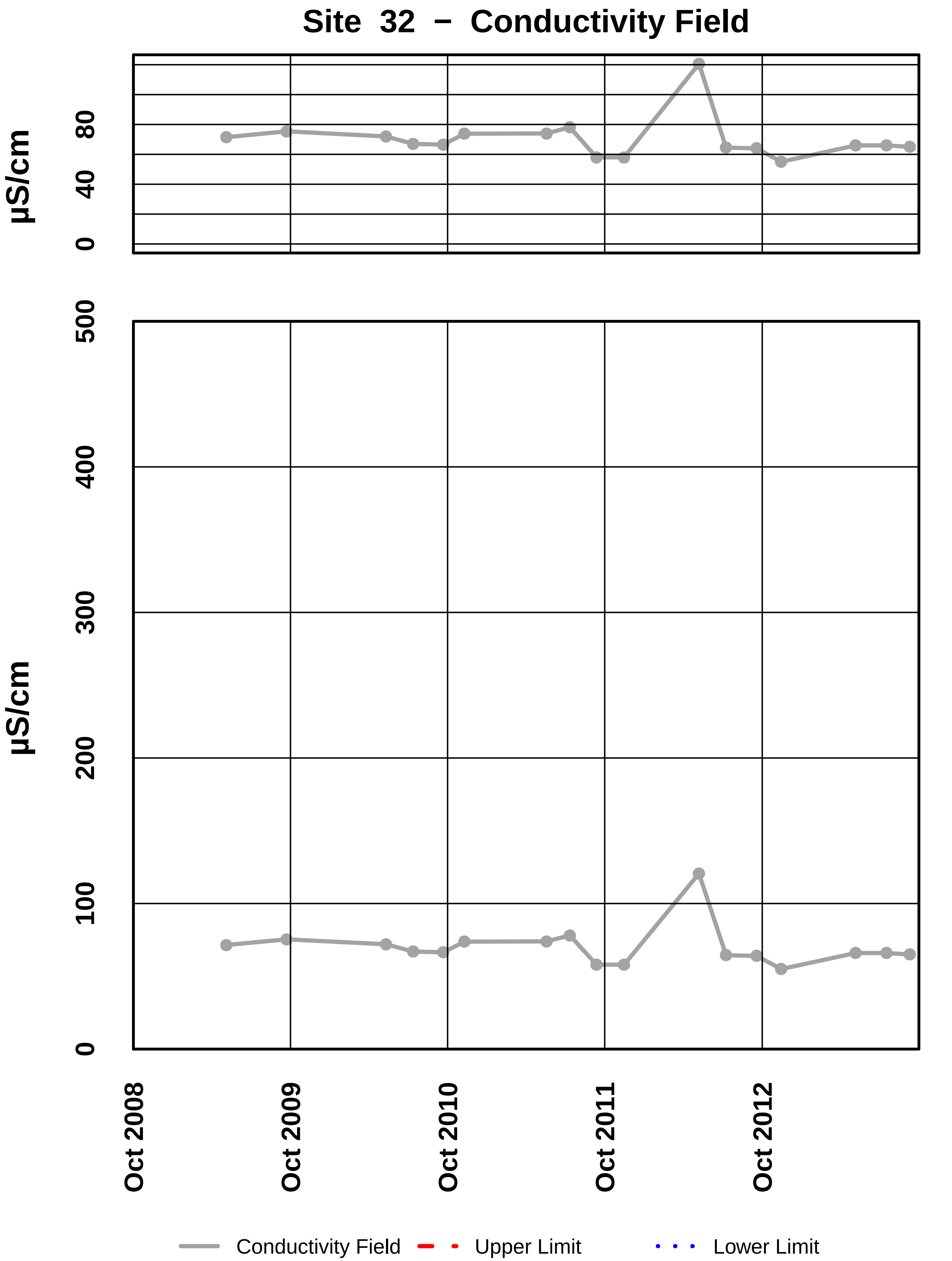
Qualifier	Description
J	Positively Identified - Approximate concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit



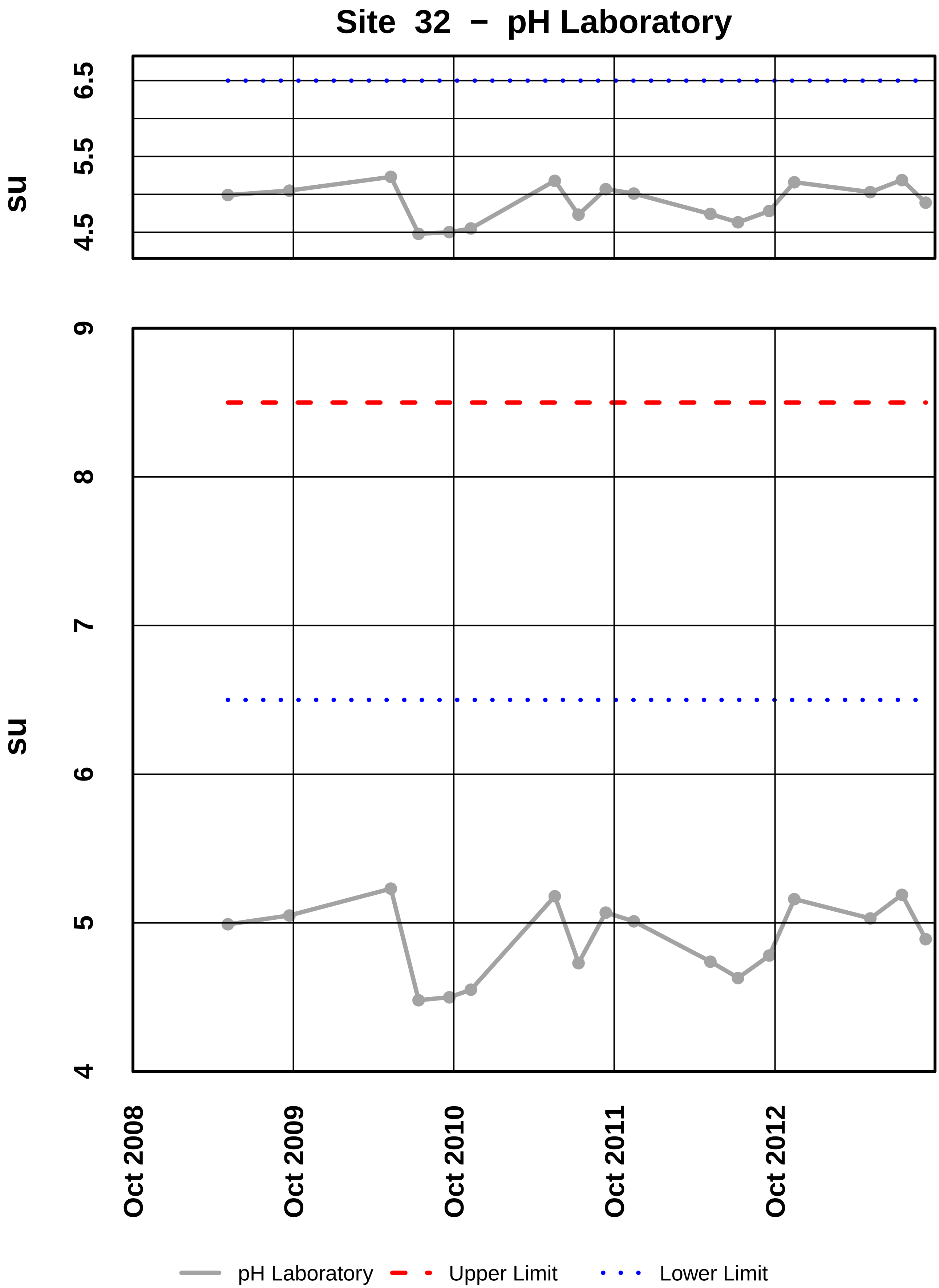
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



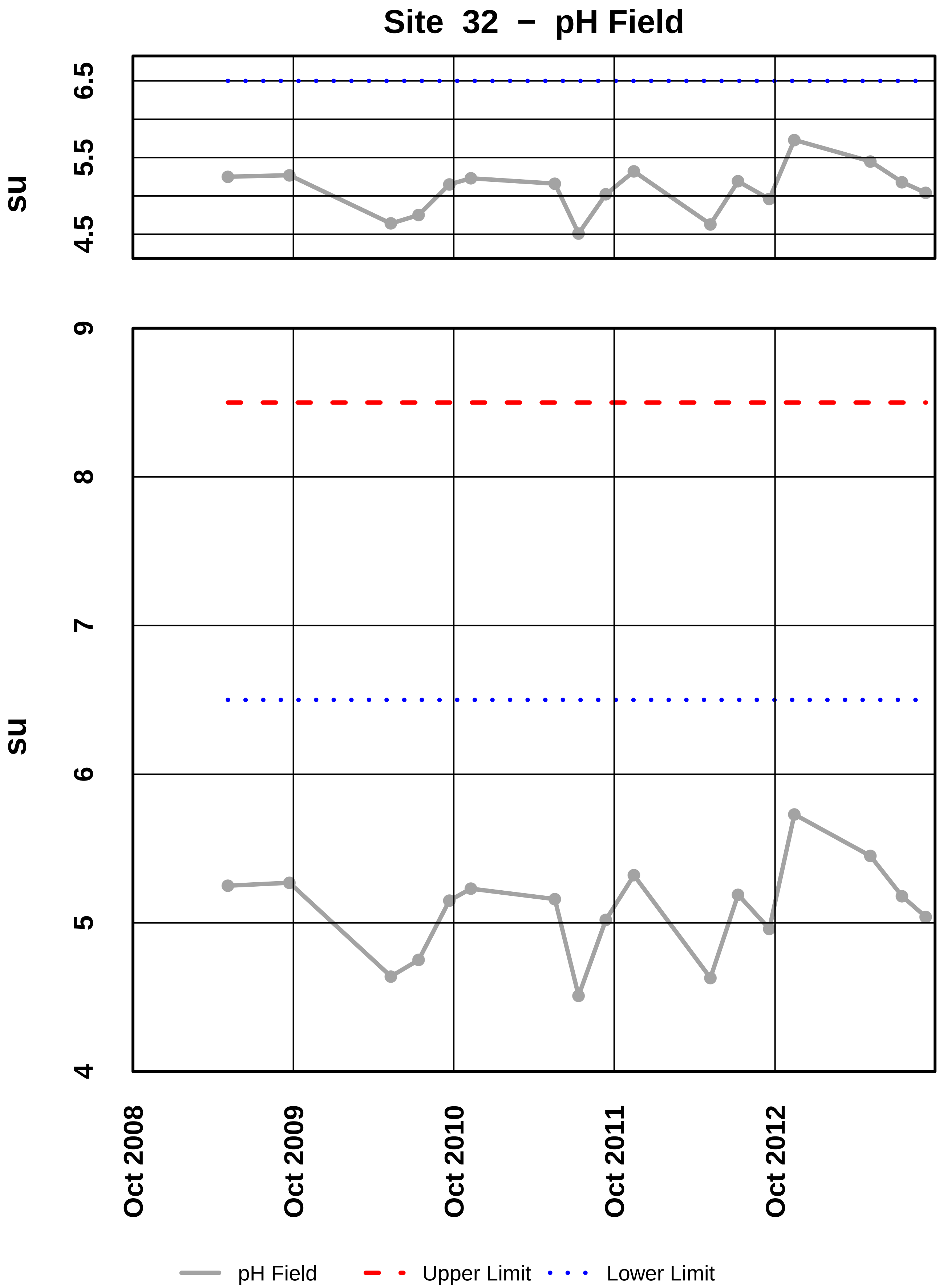
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

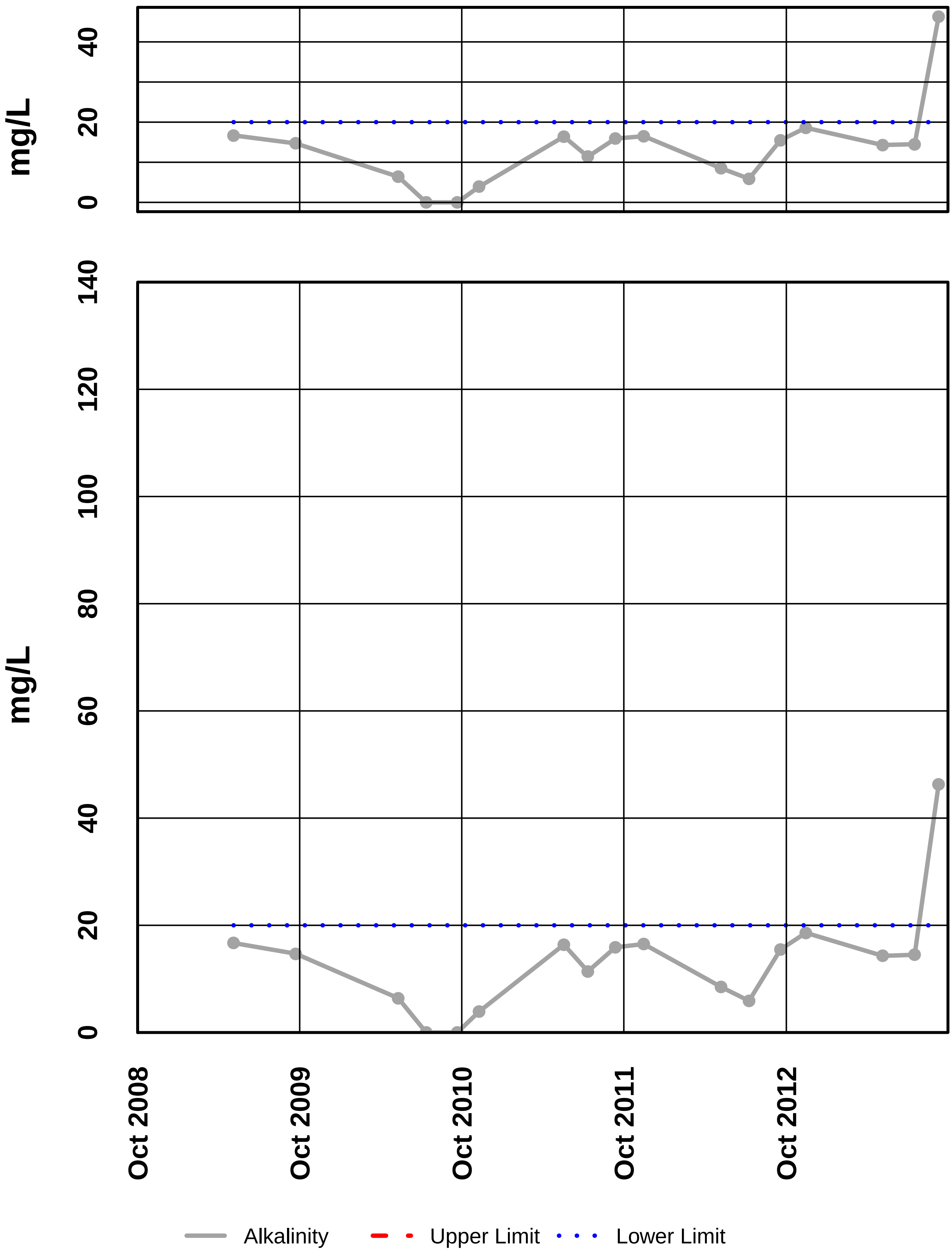


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



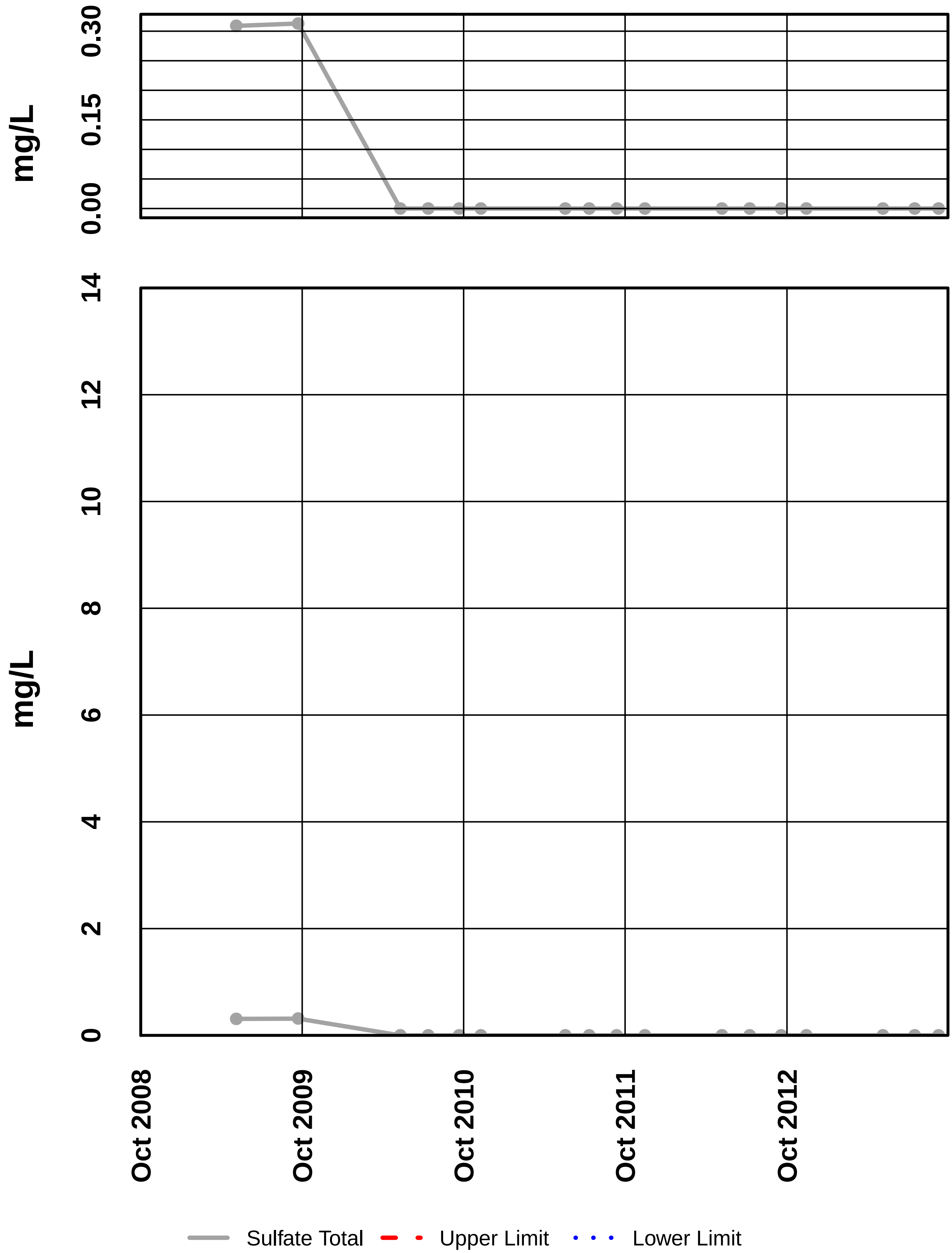
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 32 – Alkalinity

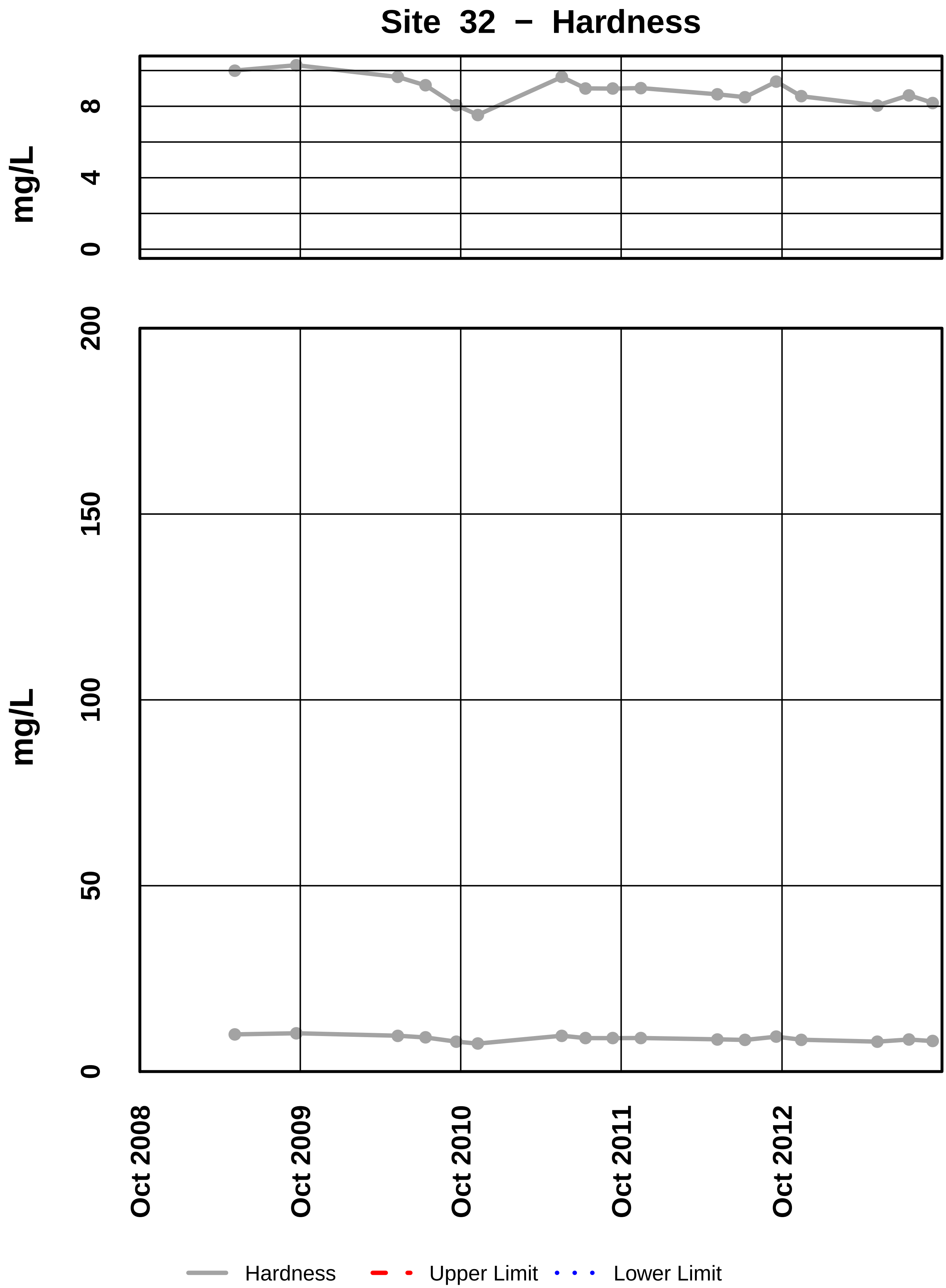


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

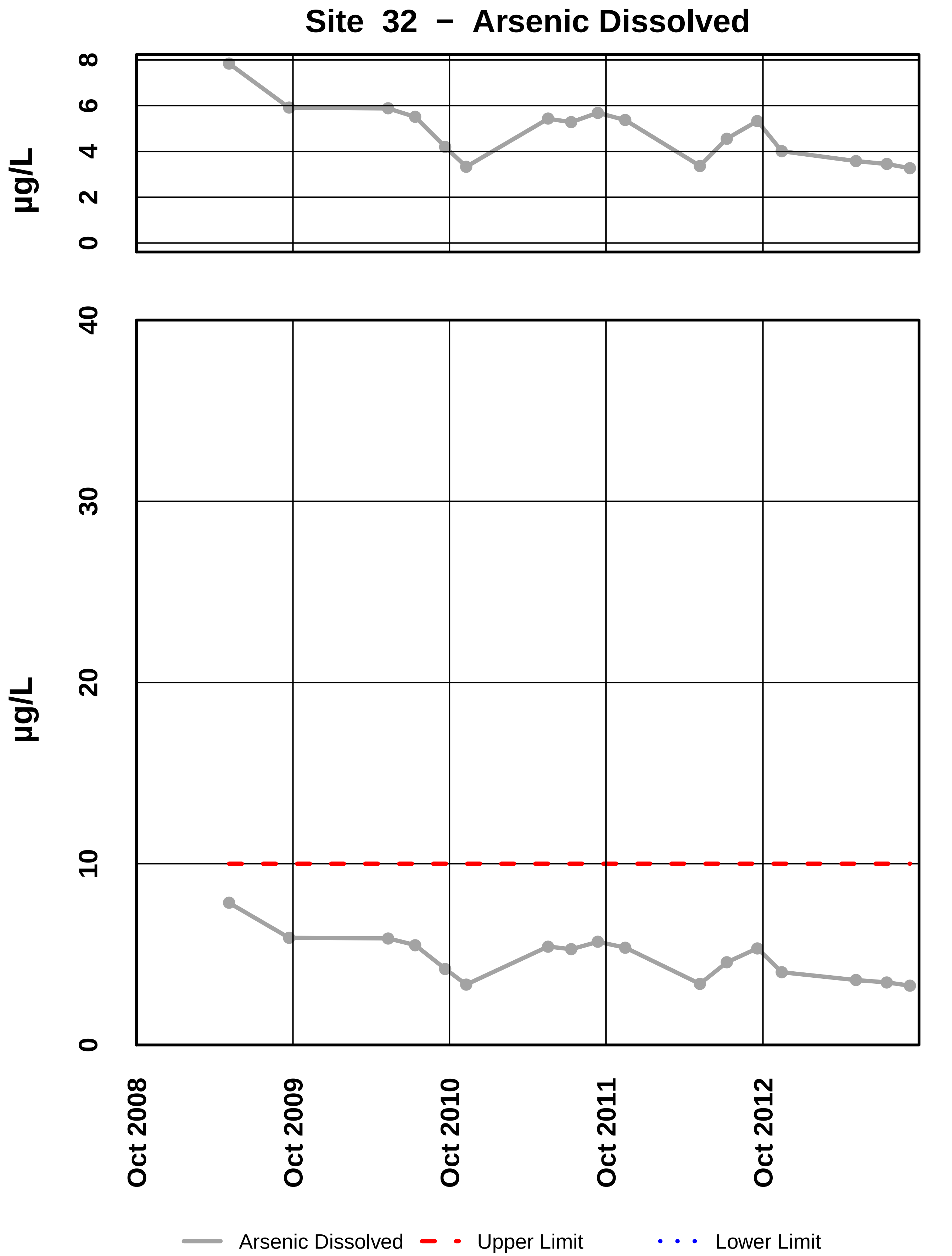
Site 32 − Sulfate Total



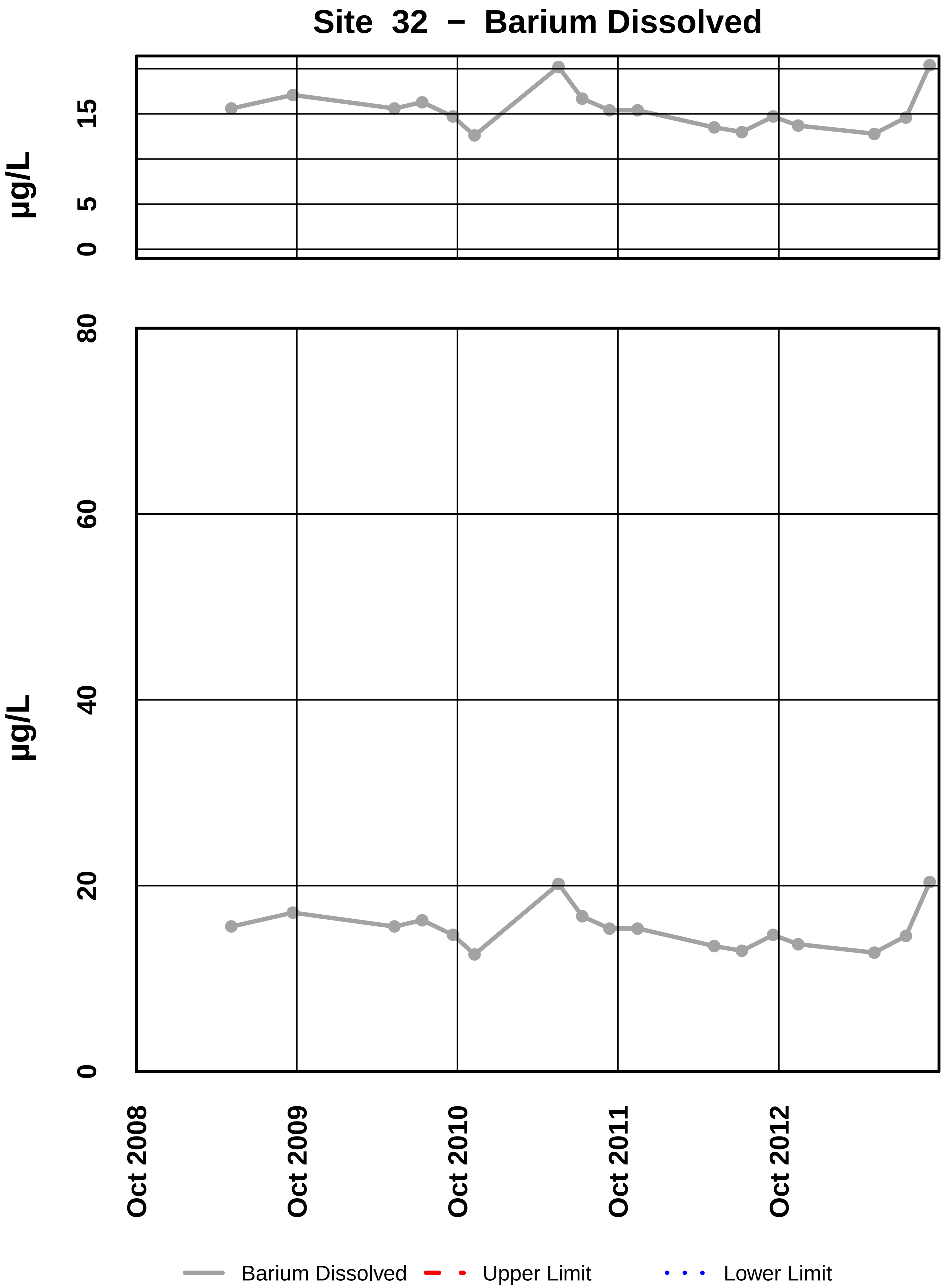
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



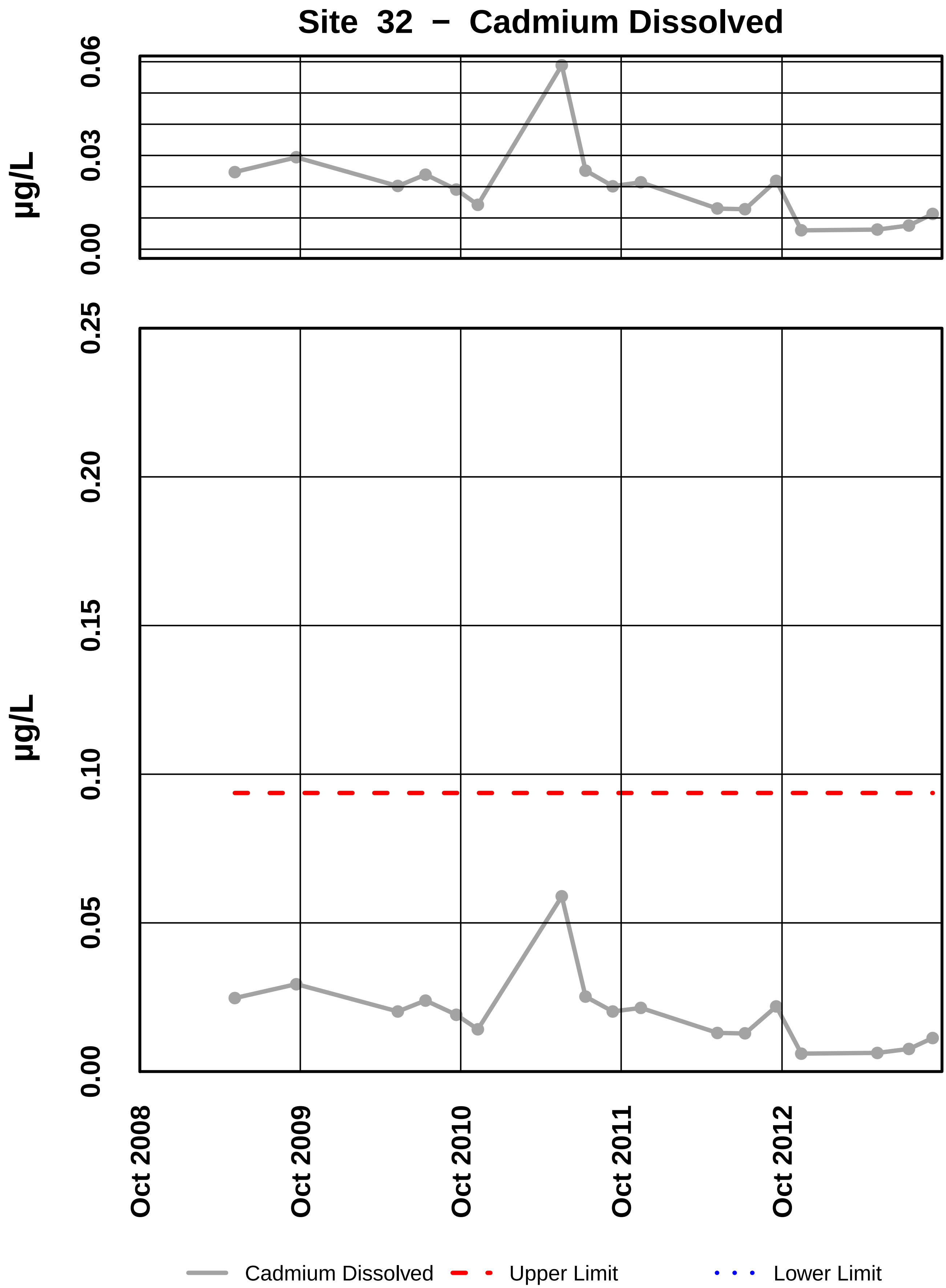
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

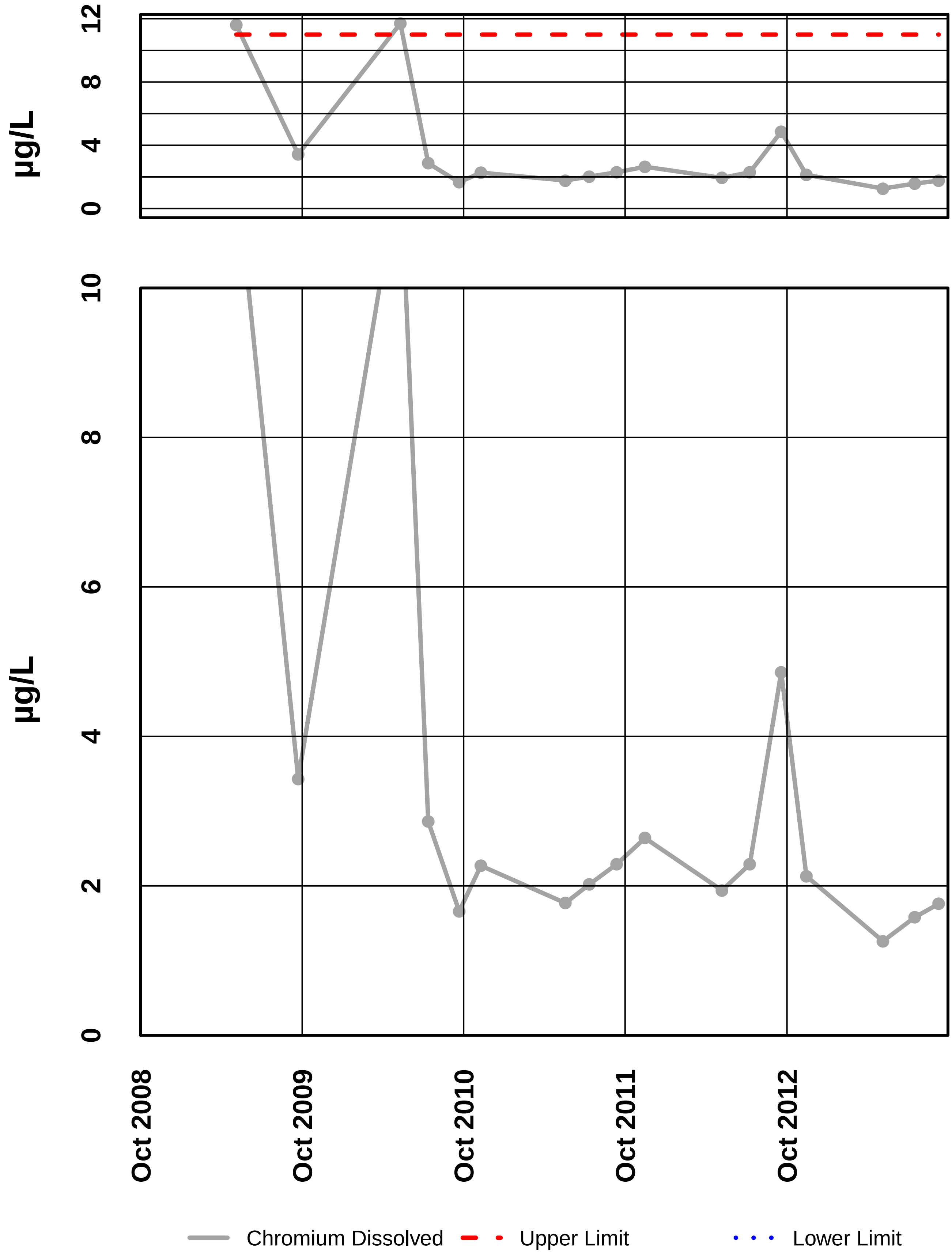


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



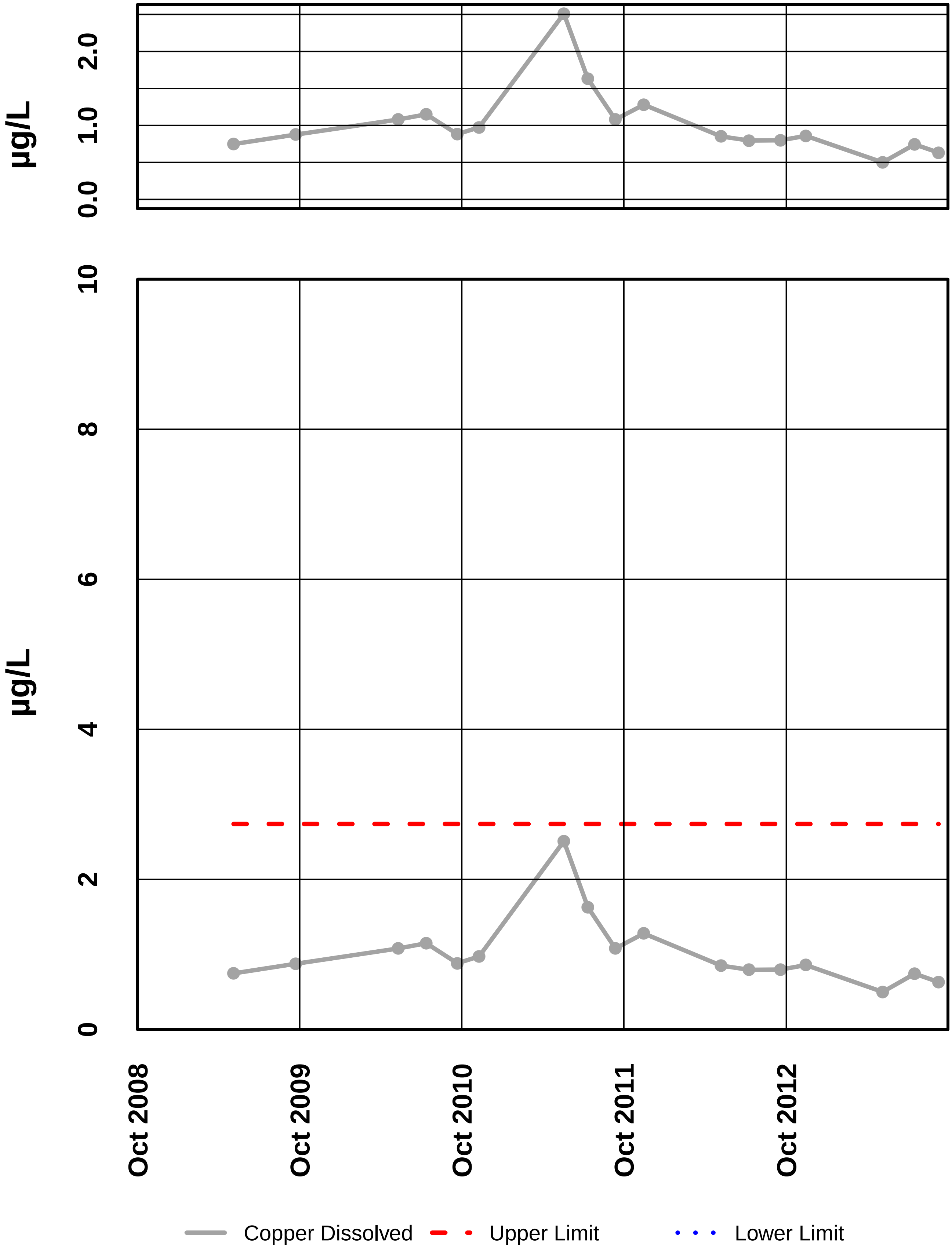
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 32 – Chromium Dissolved



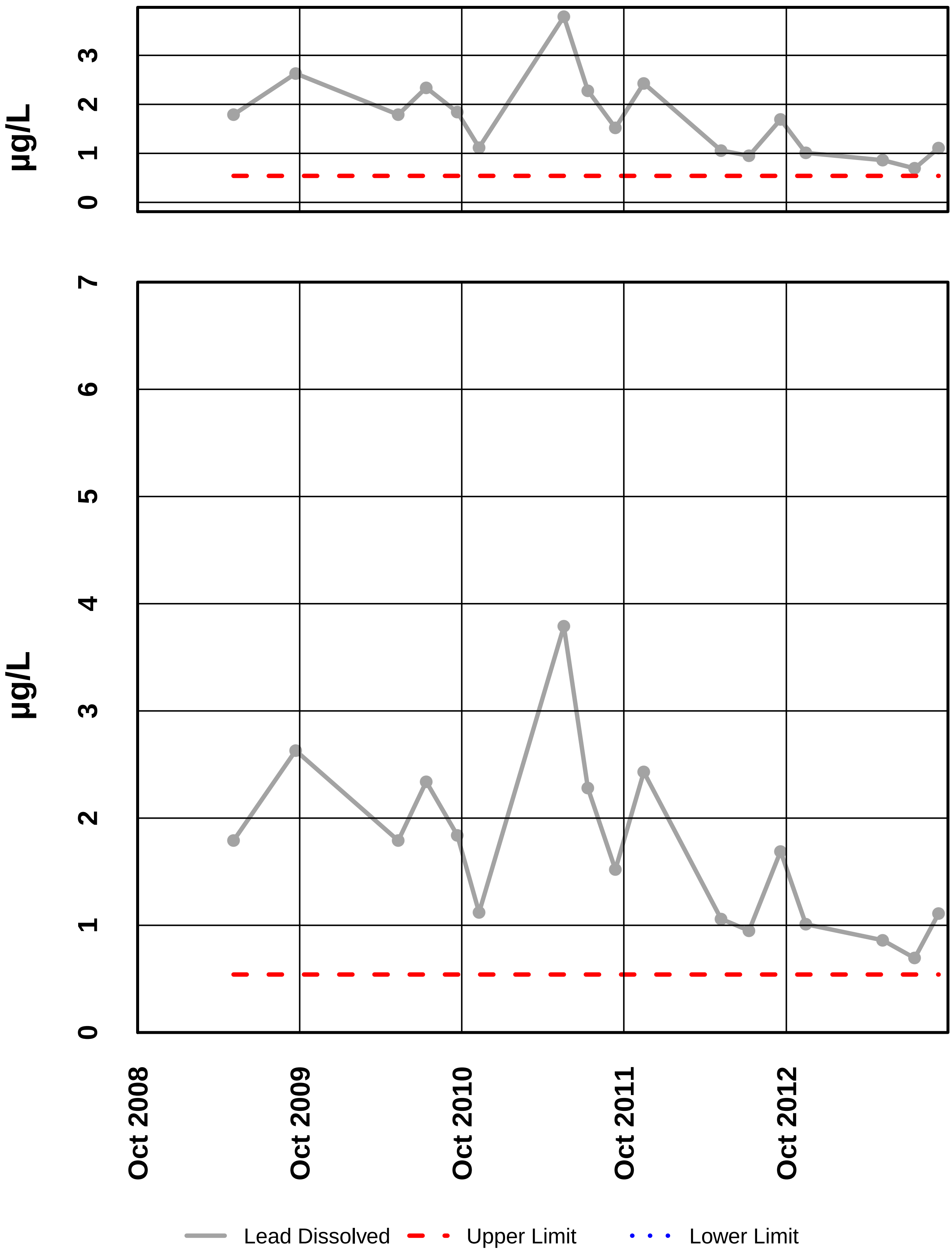
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 32 − Copper Dissolved



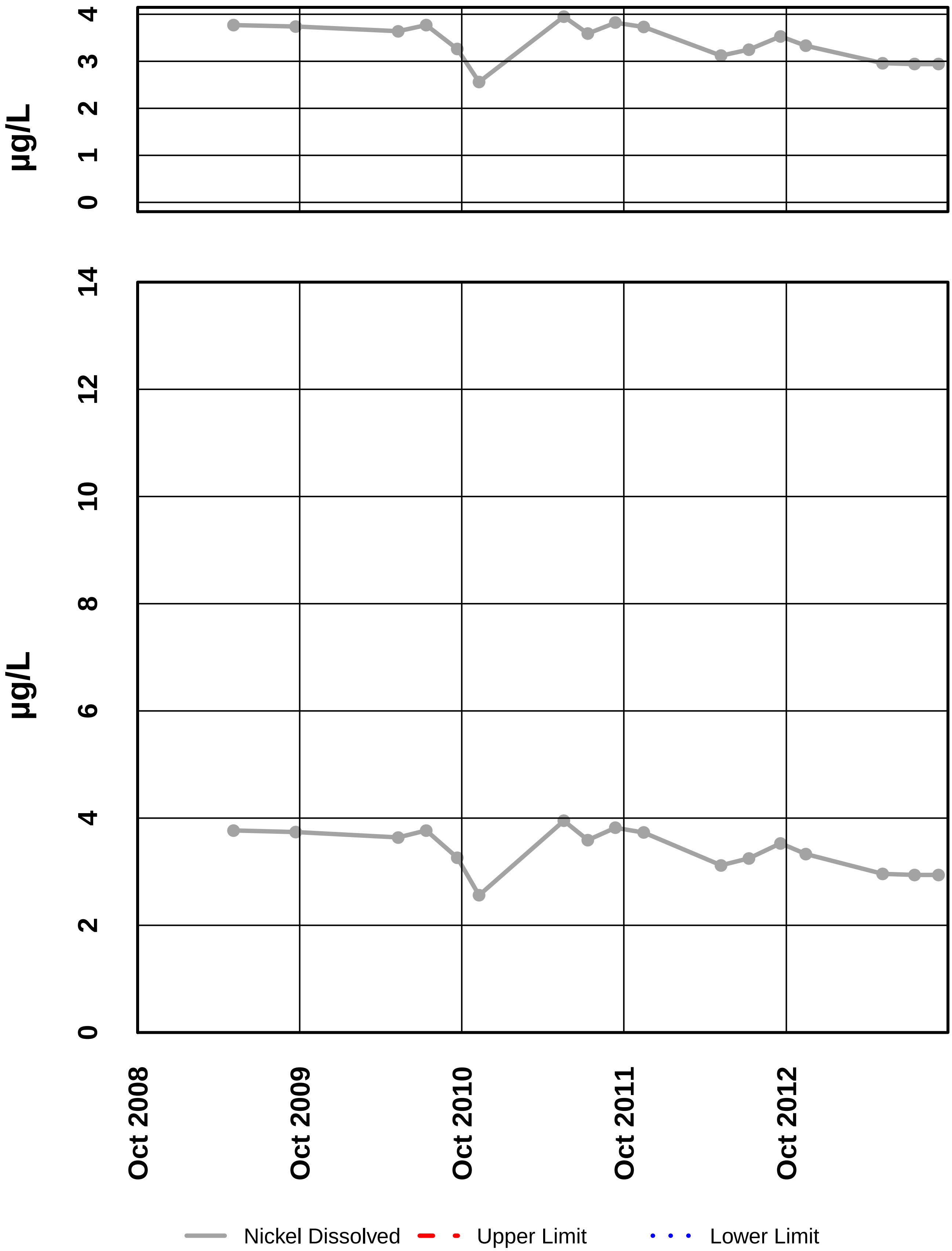
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 32 − Lead Dissolved

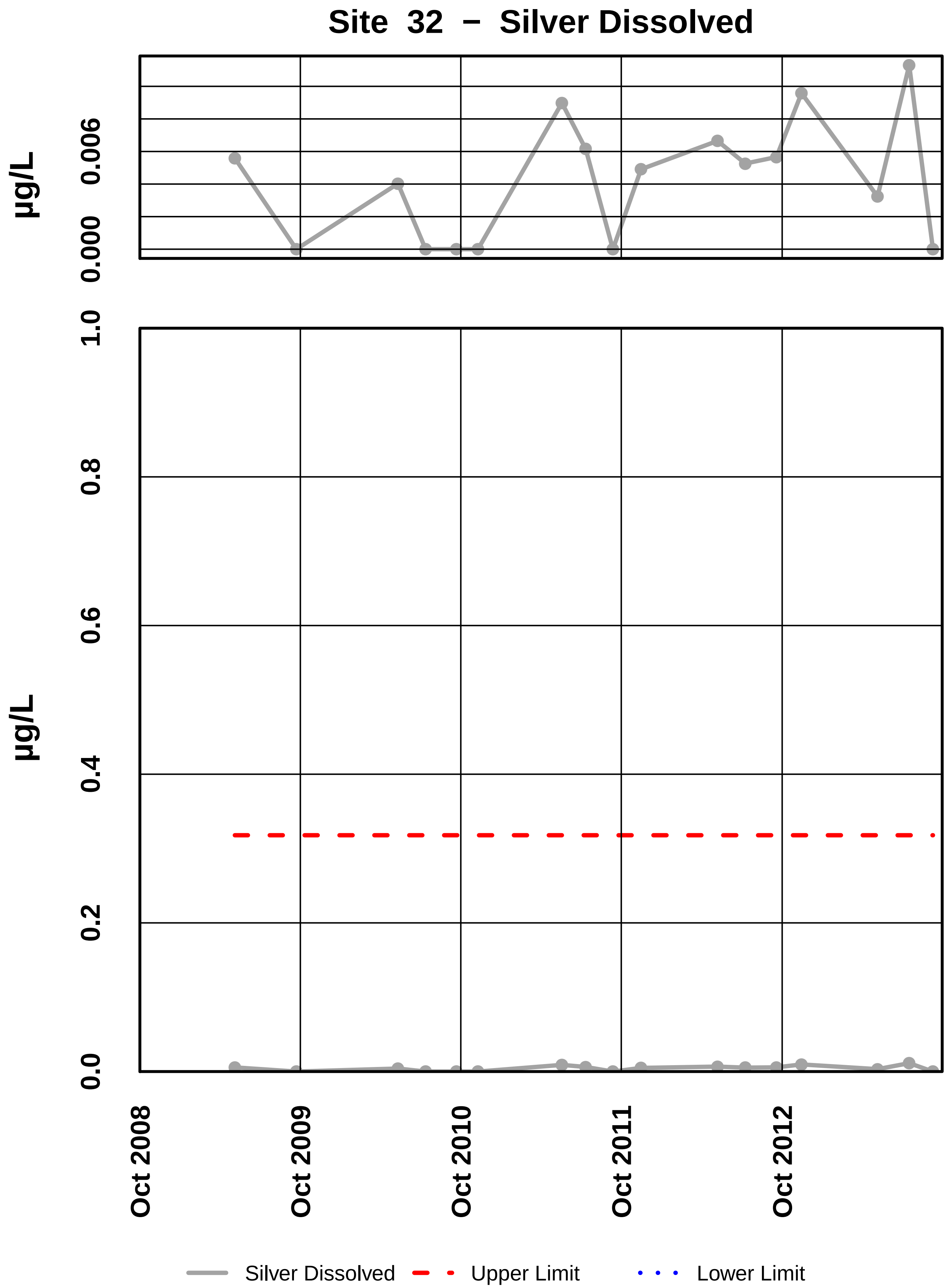


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 32 – Nickel Dissolved

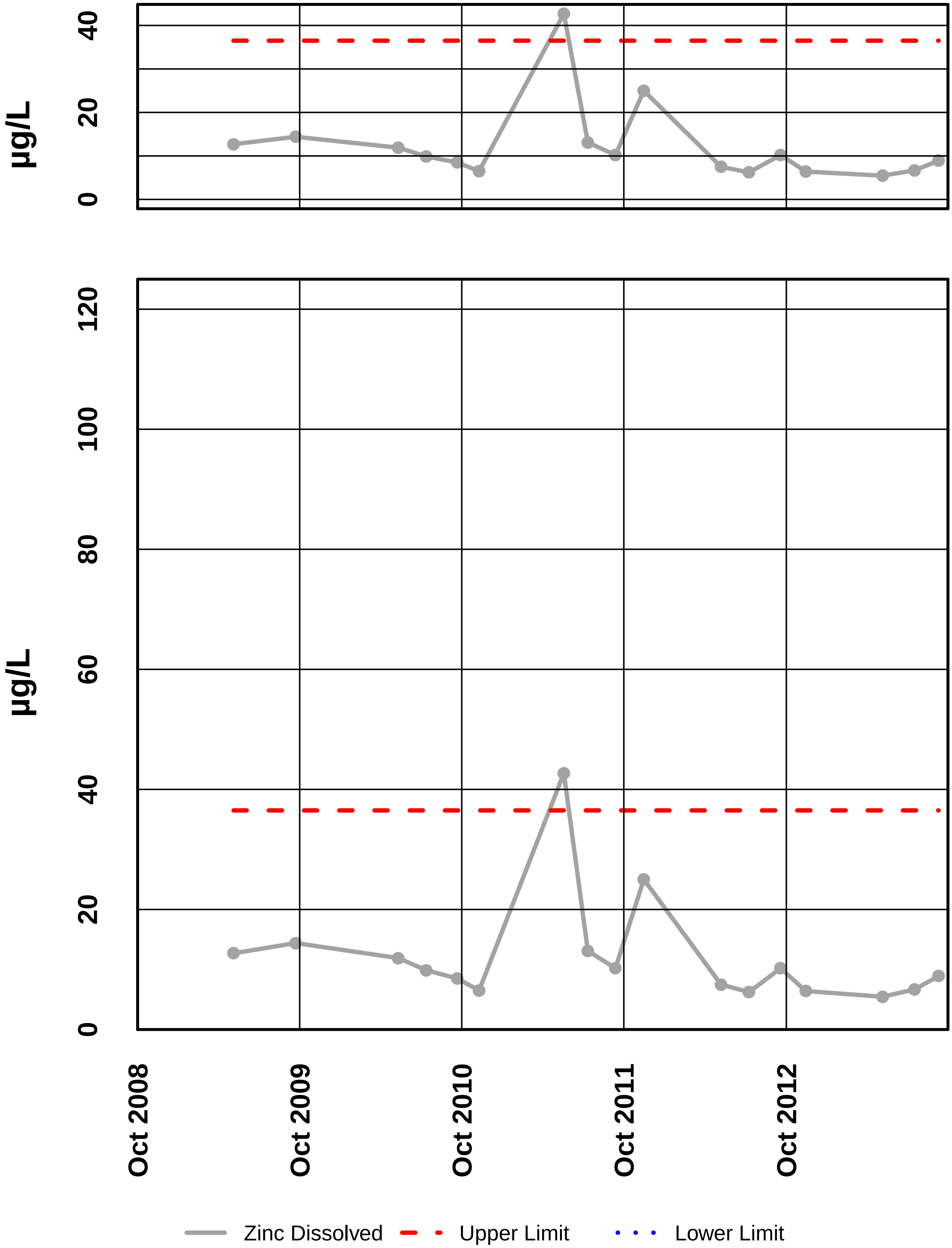


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



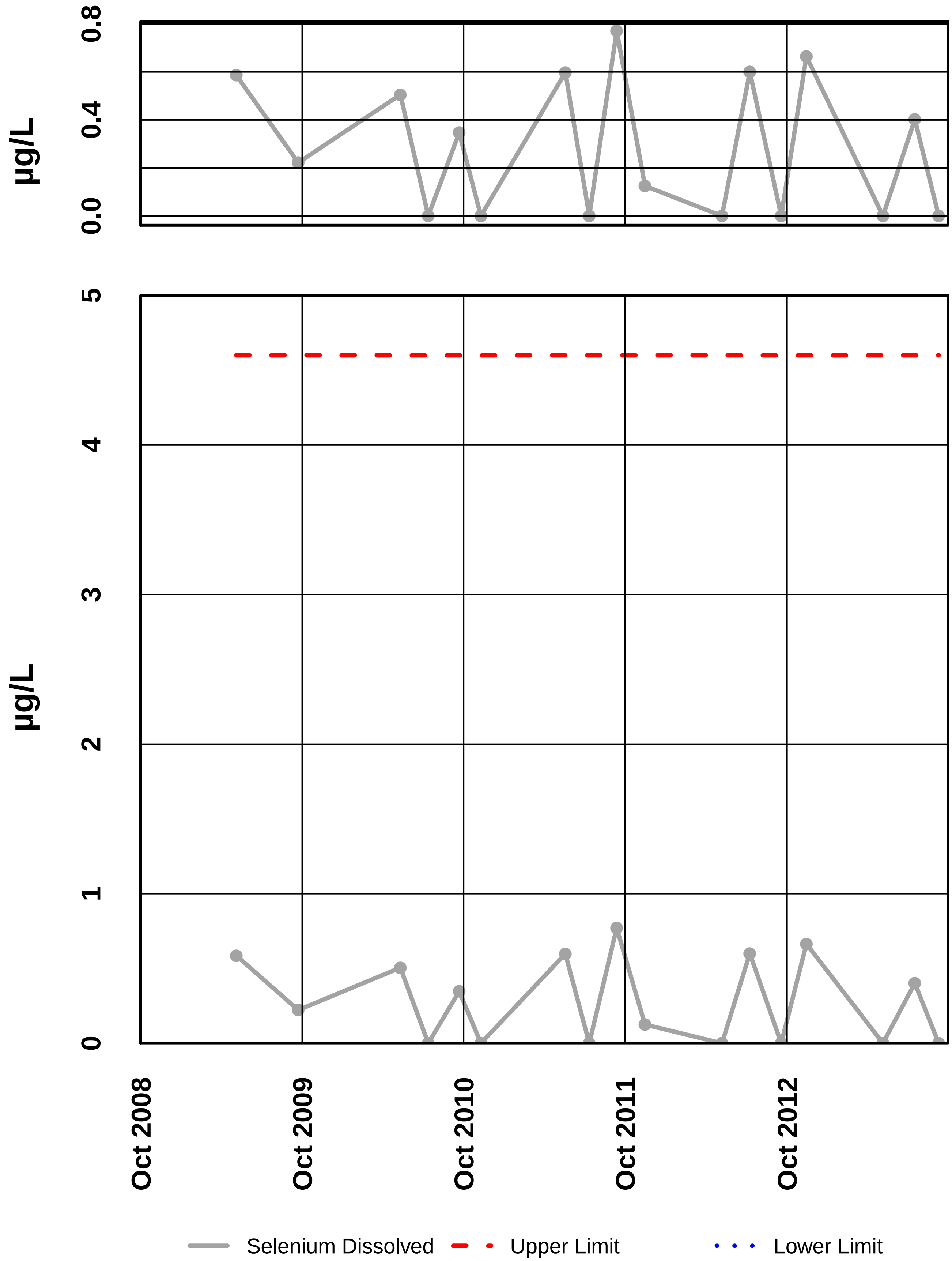
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 32 – Zinc Dissolved

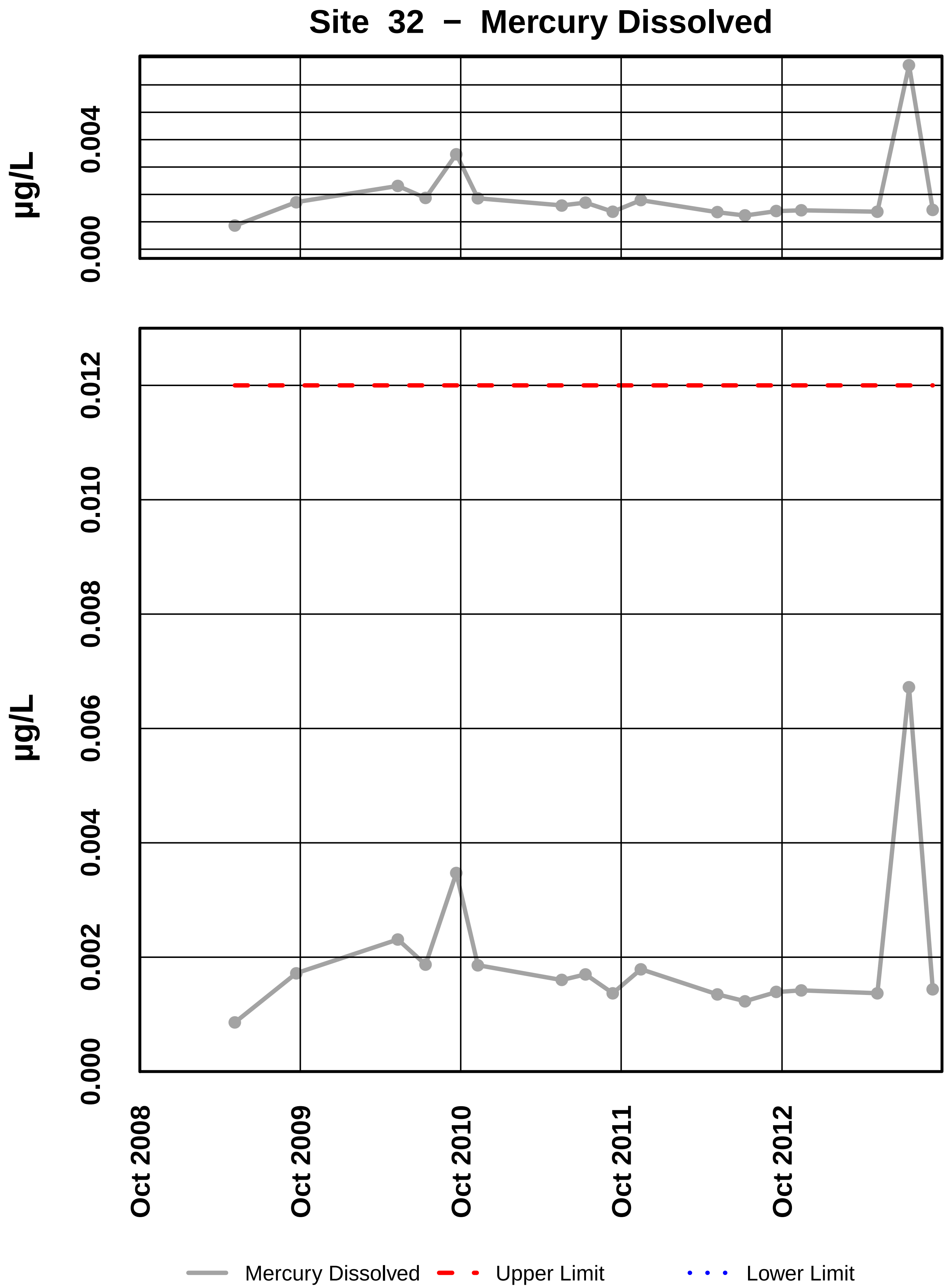


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 32 – 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 **#32** Seasonal Kendall analysis for Specific Conductance, Field (µS/cm)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**								105.6				67.4
b	**WY2009**								71.5				75.4
c	**WY2010**								72		67		66.5
d	**WY2011**		73.8						74		78.1		58
e	**WY2012**		58						120.6		64.5		64
f	**WY2013**		55						66		66		65
	n	0	3	0	0	0	0	0	6	0	4	0	6

		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
	t_1	0	3	0	0	0	0	0	6	0	4	0	6
	t_2	0	0	0	0	0	0	0	0	0	0	0	0
	t_3	0	0	0	0	0	0	0	0	0	0	0	0
	t_4	0	0	0	0	0	0	0	0	0	0	0	0
	t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a								-1				1
c-a								-1				-1
d-a								-1				-1
e-a								1				-1
f-a								-1				-1
c-b								1				-1
d-b								1				-1
e-b								1				-1
f-b								-1				-1
d-c								1		1		-1
e-c								1		-1		-1
f-c								-1		-1		-1
e-d		-1						1		-1		1
f-d		-1						-1		-1		1
f-e		-1						-1		1		1
S_k	0	-3	0	0	0	0	0	-1	0	-2	0	-7

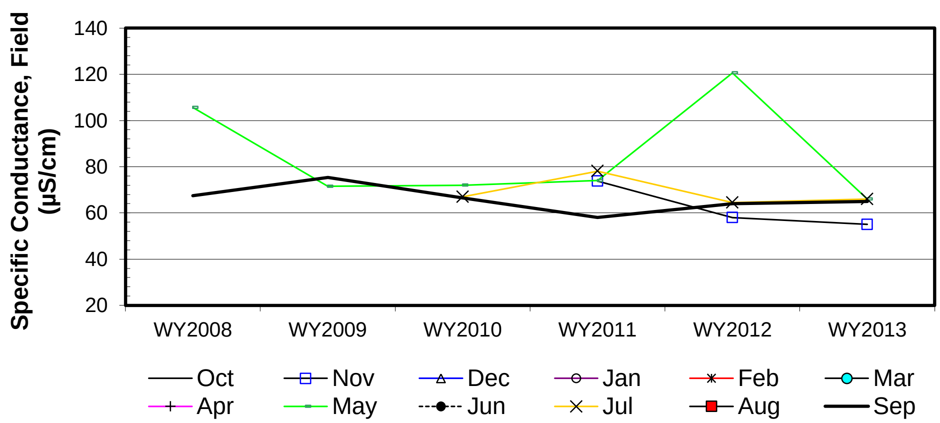
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=		3.67						28.33		8.67		28.33
$Z_k = S_k/\sigma_S$		-1.57						-0.19		-0.68		-1.32
Z^2_k		2.45						0.04		0.46		1.73

ΣZ_k= -3.75
ΣZ^2_k= 4.68
Z-bar=ΣZ_k/K= -0.94

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	19	0	0	0	0

Σn 19
ΣS_k -13

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	1.17	@α=5% $\chi^2_{(K-1)}$=	7.81	Test for station homogeneity	
p	**0.761**			$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k) Z_{calc}	-1.44	@α/2=2.5% Z=	1.96	**H_0** (No trend)	ACCEPT
69.00 **p**	**0.074**			**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-8.53		1.29
0.050	-4.68	**-1.25**	-0.06
0.100	-3.68		-0.46
0.200	-3.00		-0.50

Site **#32** Seasonal Kendall analysis for pH, Field, Standard Units

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**								5.2				5.1
b	**WY2009**								5.3				5.3
c	**WY2010**								4.6		4.8		5.2
d	**WY2011**		5.2						5.2		4.5		5.0
e	**WY2012**		5.3						4.6		5.2		5.0
f	**WY2013**		5.7						5.5		5.2		5.0
	n	0	3	0	0	0	0	0	6	0	4	0	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	0	3	0	0	0	0	0	6	0	4	0	6
t_2	0	0	0	0	0	0	0	0	0	0	0	0
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a								1				1
c-a								-1				1
d-a								-1				-1
e-a								-1				-1
f-a								1				-1
c-b								-1				-1
d-b								-1				-1
e-b								-1				-1
f-b								1				-1
d-c								1		-1		-1
e-c								-1		1		-1
f-c								1		1		-1
e-d		1						-1		1		-1
f-d		1						1		1		1
f-e		1						1		-1		1
S_k	0	3	0	0	0	0	0	-1	0	2	0	-7

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=		3.67						28.33		8.67		28.33
$Z_k = S_k/\sigma_S$		1.57						-0.19		0.68		-1.32
Z^2_k		2.45						0.04		0.46		1.73

ΣZ_k= 0.74

ΣZ^2_k= 4.68

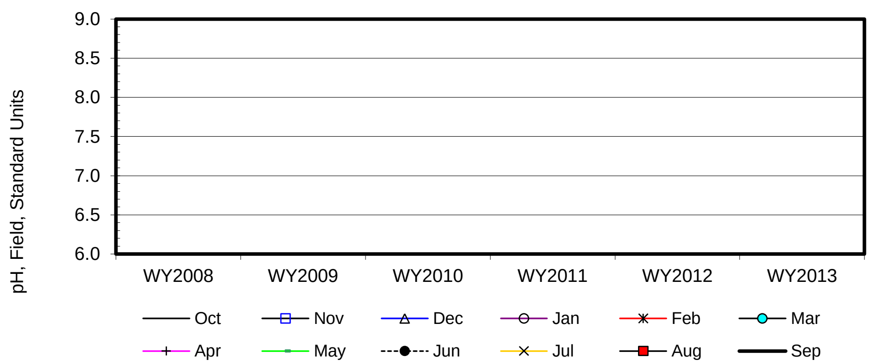
Z-bar=ΣZ_k/K= 0.19

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	19	0	0	0	0

Σn 19

ΣS_k -3

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	4.54	@α=5% $\chi^2_{(K-1)}$= 7.81	Test for station homogeneity
p	**0.209**		$\chi^2_h<\chi^2_{(K-1)}$ ACCEPT
ΣVAR(S_k) 69.00	Z_{calc} -0.24	@α/2=2.5% Z= 1.96	H_0 (No trend) ACCEPT
	p **0.405**		H_A (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.11		0.14
0.050	-0.06	**-0.01**	0.06
0.100	-0.04		0.05
0.200	-0.03		0.04

Site #32 — Seasonal Kendall analysis for Total Alk, (mg/l)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**								15.2				15.5
b	**WY2009**								16.7				14.7
c	**WY2010**								6.4		0.0		0.0
d	**WY2011**		3.9						16.4		11.4		15.9
e	**WY2012**		16.5						8.5		5.9		15.5
f	**WY2013**		18.6						14.3		14.5		46.3
	n	0	3	0	0	0	0	0	6	0	4	0	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	0	3	0	0	0	0	0	6	0	4	0	4
t_2	0	0	0	0	0	0	0	0	0	0	0	1
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a								1				-1
c-a								-1				-1
d-a								1				1
e-a								-1				0
f-a								-1				1
c-b								-1				-1
d-b								-1				1
e-b								-1				1
f-b								-1				1
d-c								1		1		1
e-c								1		1		1
f-c								1		1		1
e-d		1						-1		-1		-1
f-d		1						-1		1		1
f-e		1						1		1		1
S_k	0	3	0	0	0	0	0	-3	0	4	0	6

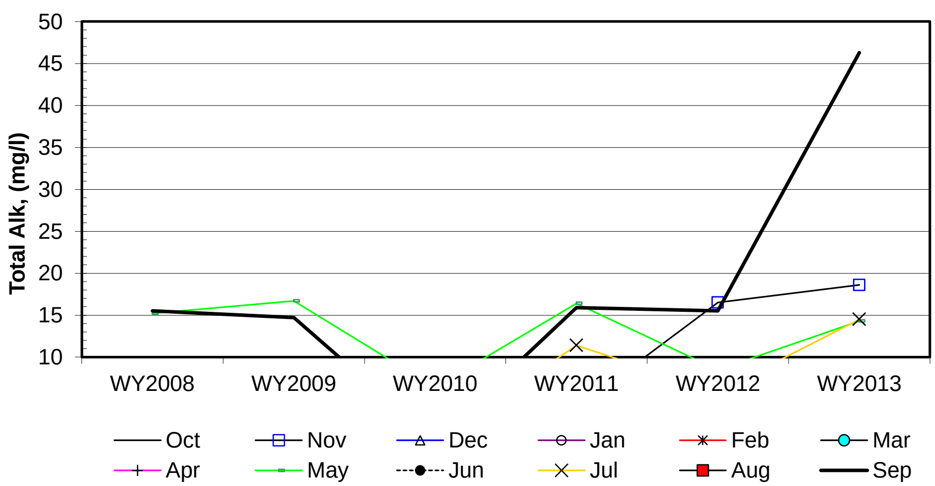
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=		3.67						28.33		8.67		27.33
$Z_k = S_k/\sigma_S$		1.57						-0.56		1.36		1.15
Z^2_k		2.45						0.32		1.85		1.32

ΣZ_k= 3.51
ΣZ^2_k= 5.94
Z-bar=ΣZ_k/K= 0.88

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	17	1	0	0	0

Σn 19
ΣS_k 10

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	2.86	@α=5% $\chi^2_{(K-1)}$=	7.81	Test for station homogeneity	
p	**0.414**			$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc} 1.09	@α/2=2.5% Z=	1.96	**H_0** (No trend)	ACCEPT
68.00	p **0.862**			**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.82		7.39
0.050	-0.24	**1.05**	5.11
0.100	-0.12		2.88
0.200	0.14		2.08

Site **#32** Seasonal Kendall analysis for Zinc, Dissolved (ug/l)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	WY2008								20.5				15.6
b	WY2009								12.7				14.4
c	WY2010								11.9		9.9		8.5
d	WY2011		6.5						42.7		13.1		10.2
e	WY2012		25.0						7.5		6.2		10.2
f	WY2013		6.4						5.5		6.7		8.9
	n	0	3	0	0	0	0	0	6	0	4	0	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	0	3	0	0	0	0	0	6	0	4	0	4
t_2	0	0	0	0	0	0	0	0	0	0	0	1
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a								-1				-1
c-a								-1				-1
d-a								1				-1
e-a								-1				-1
f-a								-1				-1
c-b								-1				-1
d-b								1				-1
e-b								-1				-1
f-b								-1				-1
d-c								1		1		1
e-c								-1		-1		1
f-c								-1		-1		1
e-d		1						-1		-1		0
f-d		-1						-1		-1		-1
f-e		-1						-1		1		-1
S_k	0	-1	0	0	0	0	0	-9	0	-2	0	-8

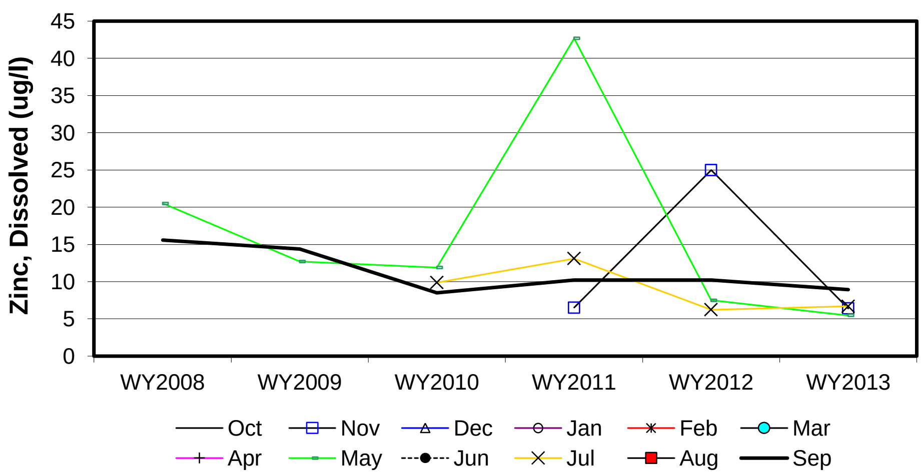
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=		3.67						28.33		8.67		27.33
$Z_k = S_k/\sigma_S$		-0.52						-1.69		-0.68		-1.53
Z^2_k		0.27						2.86		0.46		2.34

ΣZ_k= -4.42
ΣZ^2_k= 5.93
Z-bar=ΣZ_k/K= -1.11

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	17	1	0	0	0

Σn 19
ΣS_k -20

$\chi^2_h=\Sigma Z^2_k$-K(Z-bar)^2=	1.04	@α=5% $\chi^2_{(K-1)}$= 7.81	Test for station homogeneity	
p	**0.790**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc} -2.30	@α/2=2.5% Z= 1.96	H_0 (No trend)	REJECT
68.00	p **0.011**		H_A (± trend)	ACCEPT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-3.21		-0.05
0.050	-2.16	**-1.40**	-0.99
0.100	-2.08		-1.22
0.200	-1.82		-1.34

-13.7%

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 2013” 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 2007 through September 2013.				

The data for Water Year 2013 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 18.6 mg/L, and 11.5 mg/L for the November 2012, May 2013, sampling events respectively, which exceeds the AWQS lower limit of 20 mg/L.

Table of Exceedance for Water Year 2013

			Limits		
Sample Date	Parameter	Value	Lower	Upper	Hardness
14-Nov-12	Alkalinity	18.6 mg/L	20		
6-May-13	Alkalinity	11.5 mg/L	20		

As stated in past reports, the currently limited dataset for this site makes definitive interpretation of these exceedances difficult. Last water year there were two exceedances for dissolved lead, the first recorded exceedances in the past four years. In last year's report it was speculated that these exceedances may have resulted from HGCMC changing the area in which tailings were placed, higher and to the south. If this was the sole reason for the exceedances in water year 2012, then it would have been expected that these exceedances would have also occurred during the current water year, with placement occurring in higher and to the south also.

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-07 and Sep-13 (WY2008-WY2013). There were no statistically significant ($\alpha/2=2.5\%$) trends identified for the current water year. This marks the first time that there were a sufficient number years (n=6) of data for conducting these calculations.

Table of Summary Statistics for Trend Analysis

	Mann-Kendall test statistics			Sen's slope estimate	
Parameter	**n***	**p****	**Trend**	**Q**	**Q(%)**
Conductivity Field	6	0.20			
pH Field	6	0.12			
Alkalinity, Total	6	0.08			
Sulfate, Total	6	0.26			
Zinc, Dissolved	6	0.04			

* 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 2013

Site 009FMS - 'Lower Tributary Creek'

Sample Date/Parameter	Oct 2012	Nov 2012	Dec 2012	Jan 2013	Feb 2013	Mar 2013	Apr 2013	May 2013	Jun 2013	Jul 2013	Aug 2013	Sep 2013	**Median**
Water Temp (°C)		1.5						4.3		15.6		10.9	7.6
Conductivity-Field(µmho)		82						68		102		92	87.0
Conductivity-Lab (µmho)		85						64		95		72	79
pH Lab (standard units)		7.19						6.87		7.18		7.09	7.14
pH Field (standard units)		7.58						7.19		7.23		7.03	7.21
Total Alkalinity (mg/L)		18.6						11.5		28.1		20.5	19.6
Total Sulfate (mg/L)		15.2						9.2		9.6		11.6	10.6
Hardness (mg/L)		34.8						23		41.1		37.8	36.3
Dissolved As (ug/L)		0.848						0.52		1.11		1.18	0.979
Dissolved Ba (ug/L)		35.6						28		43.6		48.2	39.6
Dissolved Cd (ug/L)		0.0269						0.0291		0.0246		0.0447	0.0280
Dissolved Cr (ug/L)		0.617						0.515		0.599		0.94	0.608
Dissolved Cu (ug/L)		1.51						1.37		1.7		2.04	1.605
Dissolved Pb (ug/L)		0.447						0.294		0.433		0.592	0.4400
Dissolved Ni (ug/L)		2.14						1.6		2.44		3.23	2.290
Dissolved Ag (ug/L)		0.008						0.009		0.014		0.002	0.009
Dissolved Zn (ug/L)		5.91						5.05		3.1		5.33	5.19
Dissolved Se (ug/L)		0.248						0.057		0.284		0.178	0.213
Dissolved Hg (ug/L)		0.00358						0.00418		0.00394		0.00516	0.004060

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.

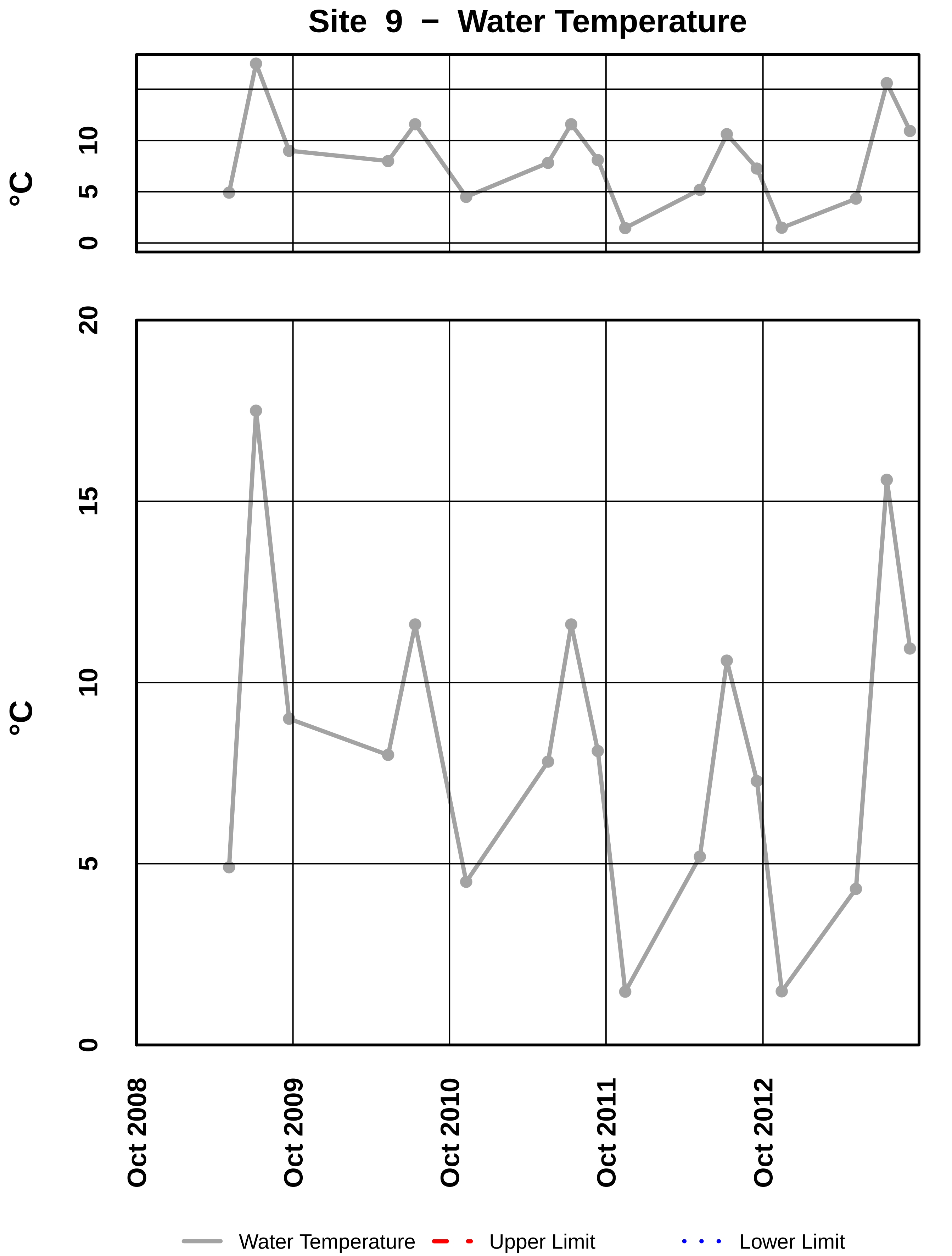
Shaded data has been qualified as an outlier by HGCMC and removed from any further analysis and is not included into the calculation of the median

Qualified Data by QA Reviewer

Date Range: 10/01/2012 to 09/30/2013

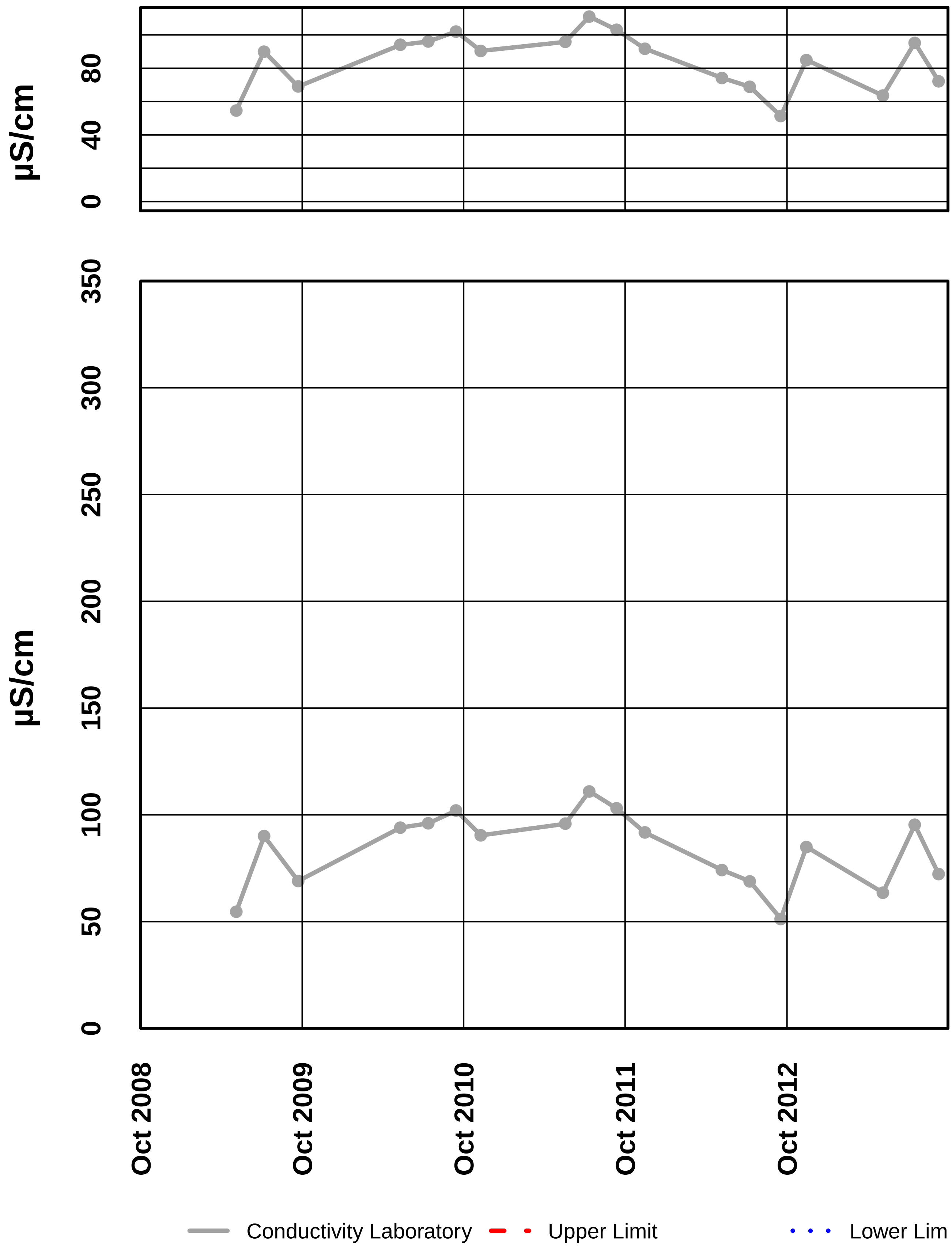
Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
9	11/14/2012	12:00 AM	Ag diss, µg/l	0.00804	J	Below Quantitative Range
			Zn diss, µg/l	5.91	U	Field Blank Contamination
			Se diss, µg/l	0.24	U	Field Blank Contamination
9	5/6/2013	12:00 AM	SO4 Tot, mg/l	9.23	J	Sample Receipt Temperature
			Ag diss, µg/l	0.00927	J	Below Quantitative Range
			pH Lab, su	6.87	J	Hold Time Violation
			Cond, µmhos	63.6	U	Field Blank Contamination
			Alk, mg/L	11.5	U	Field Blank Contamination
9	7/17/2013	12:00 AM	SO4 Tot, mg/l	9.6	J	Sample Receipt Temperature
			Se diss, µg/l	0.28	J	Below Quantitative Range
9	9/9/2013	12:00 AM	Se diss, µg/l	0.17	J	Below Quantitative Range
			SO4 Tot, mg/l	11.6	J	Sample receipt temperature

Qualifier	Description
J	Positively Identified - Approximate concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit



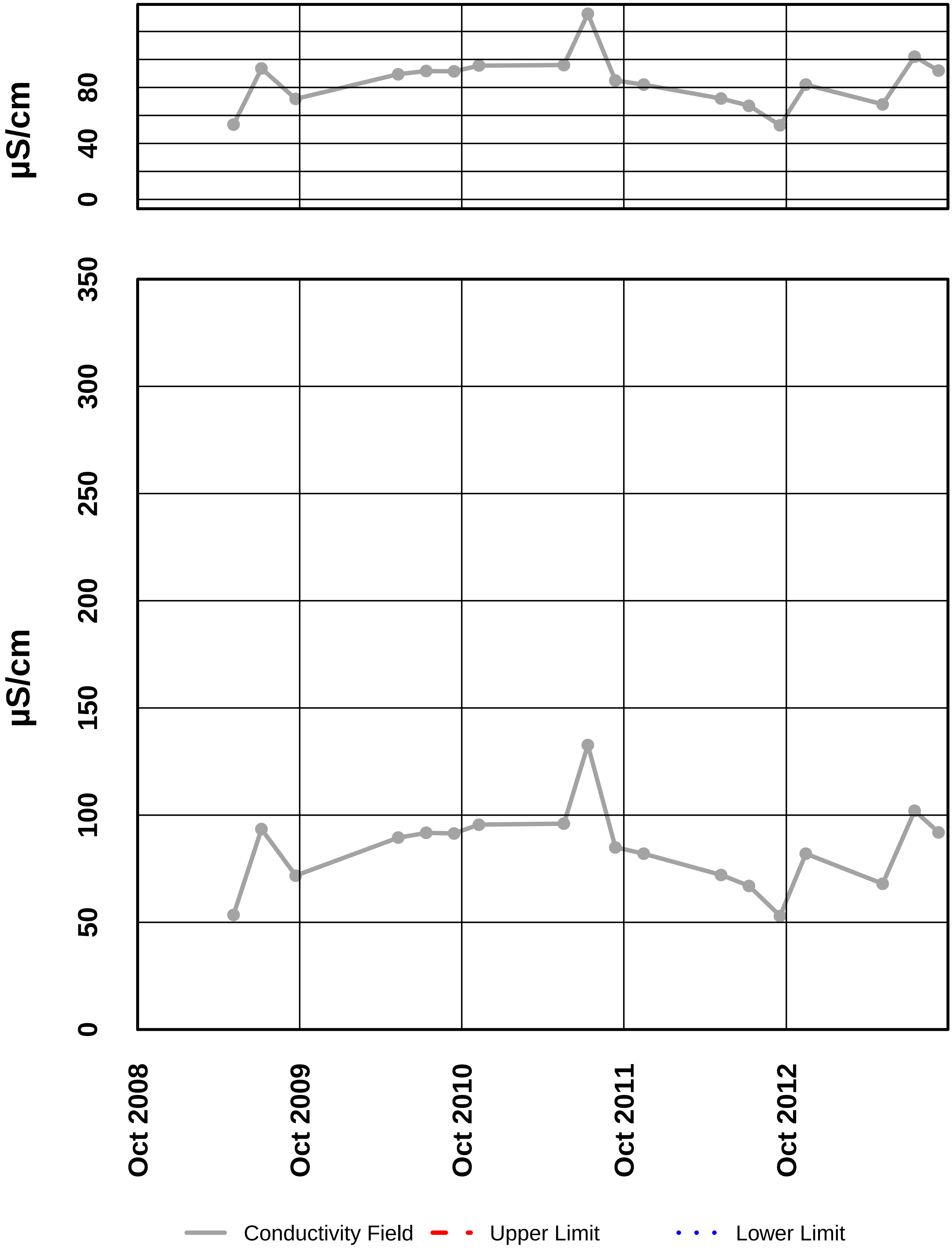
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 9 – Conductivity Laboratory



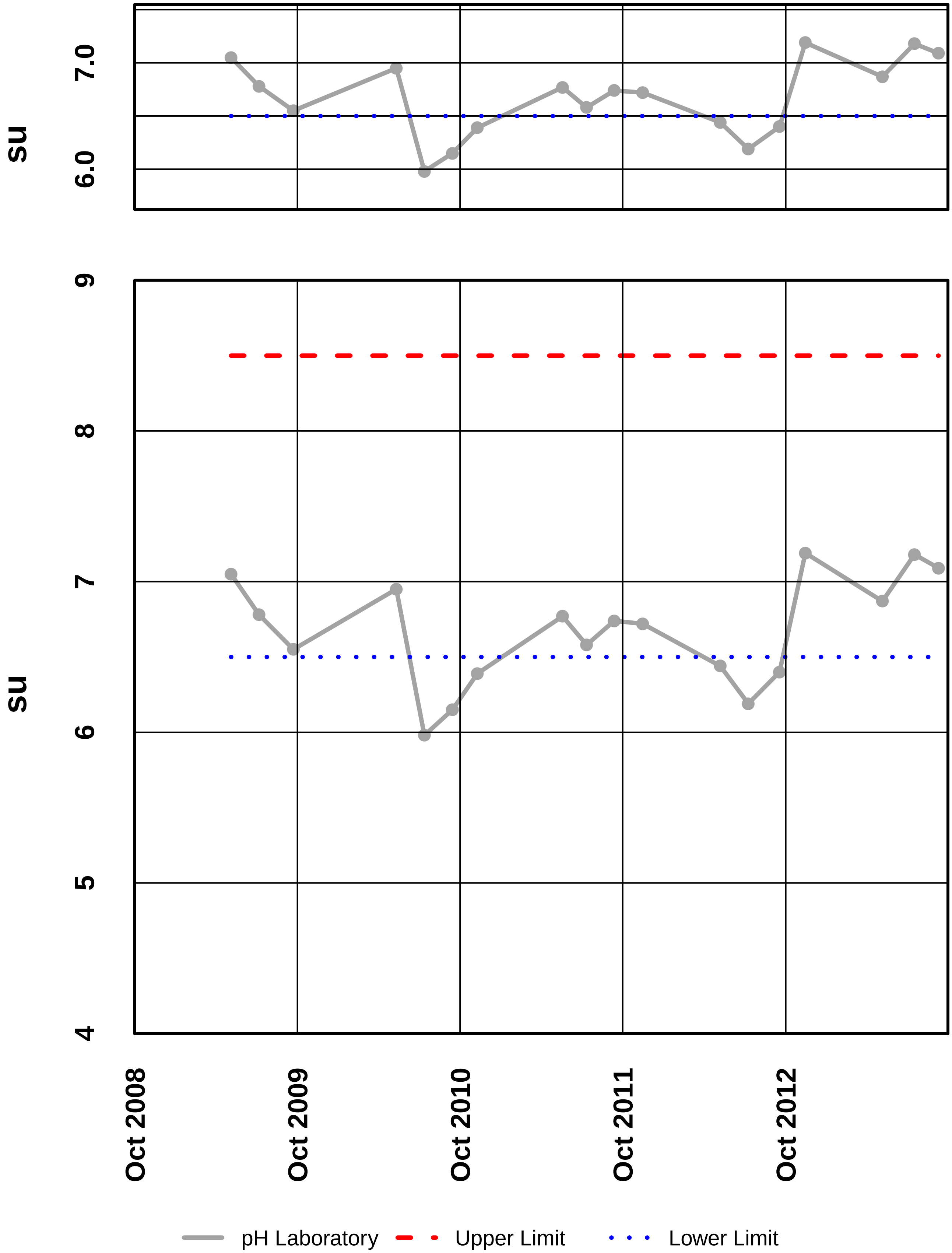
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 9 – Conductivity Field

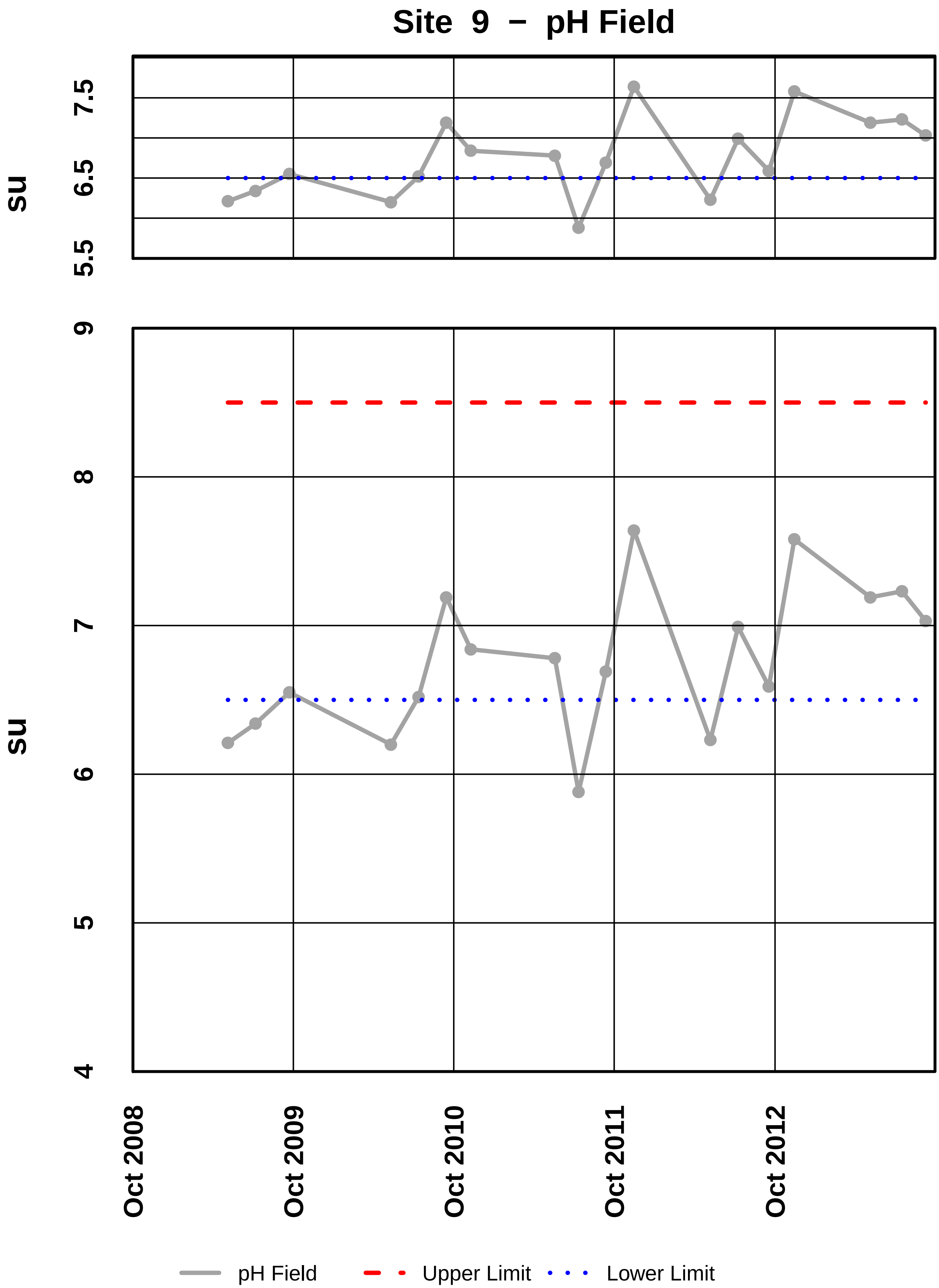


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

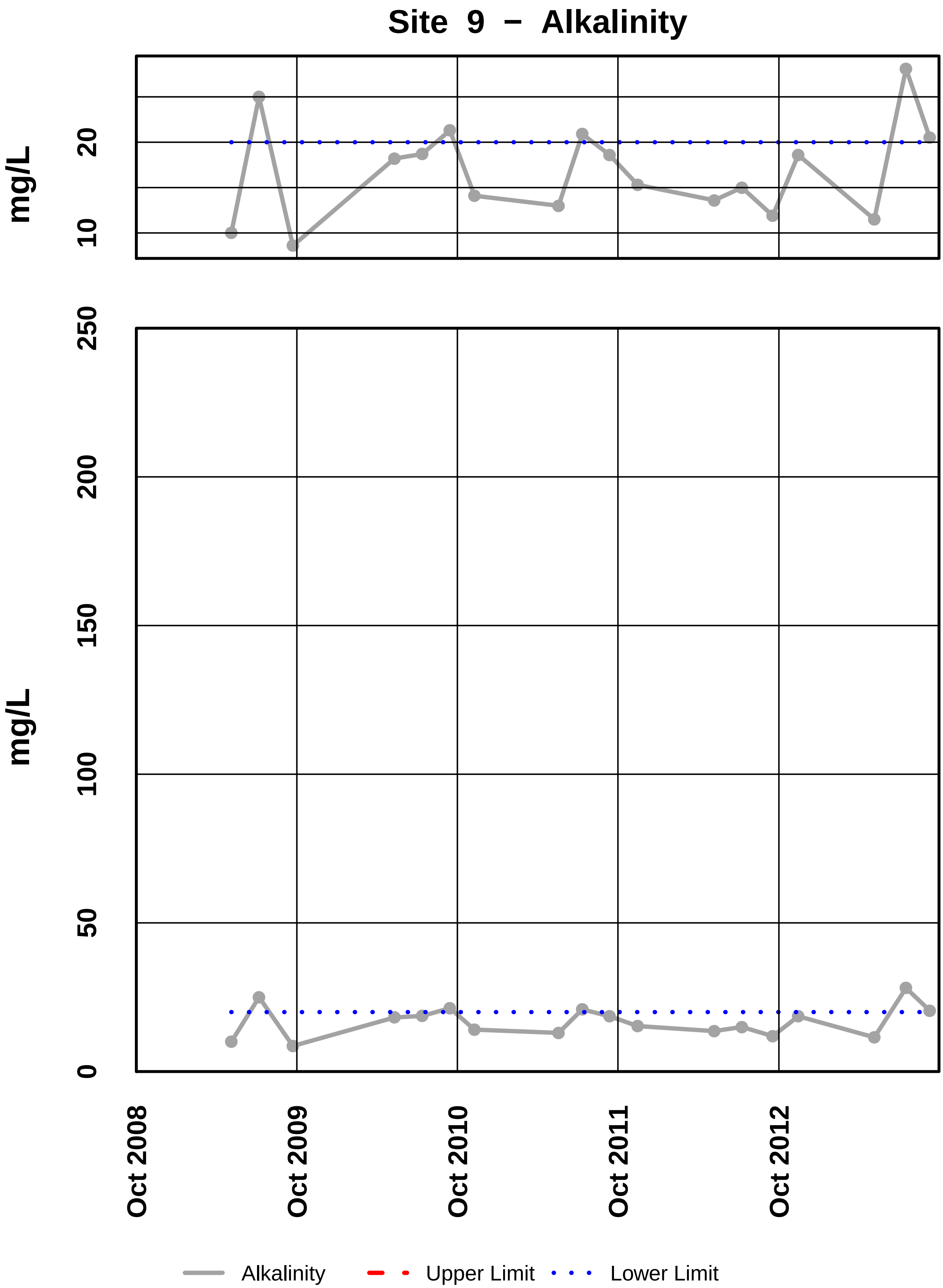
Site 9 – pH Laboratory



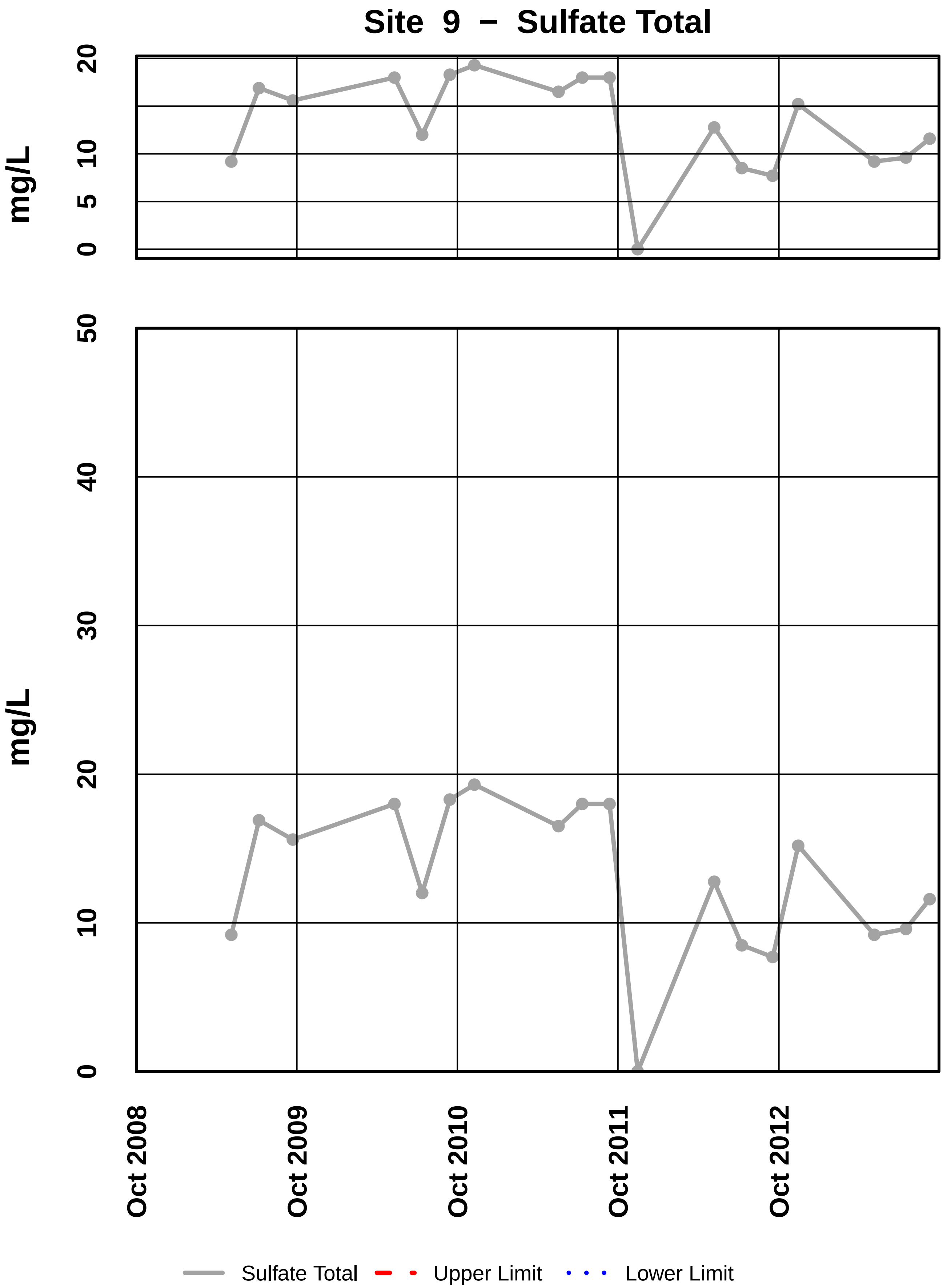
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



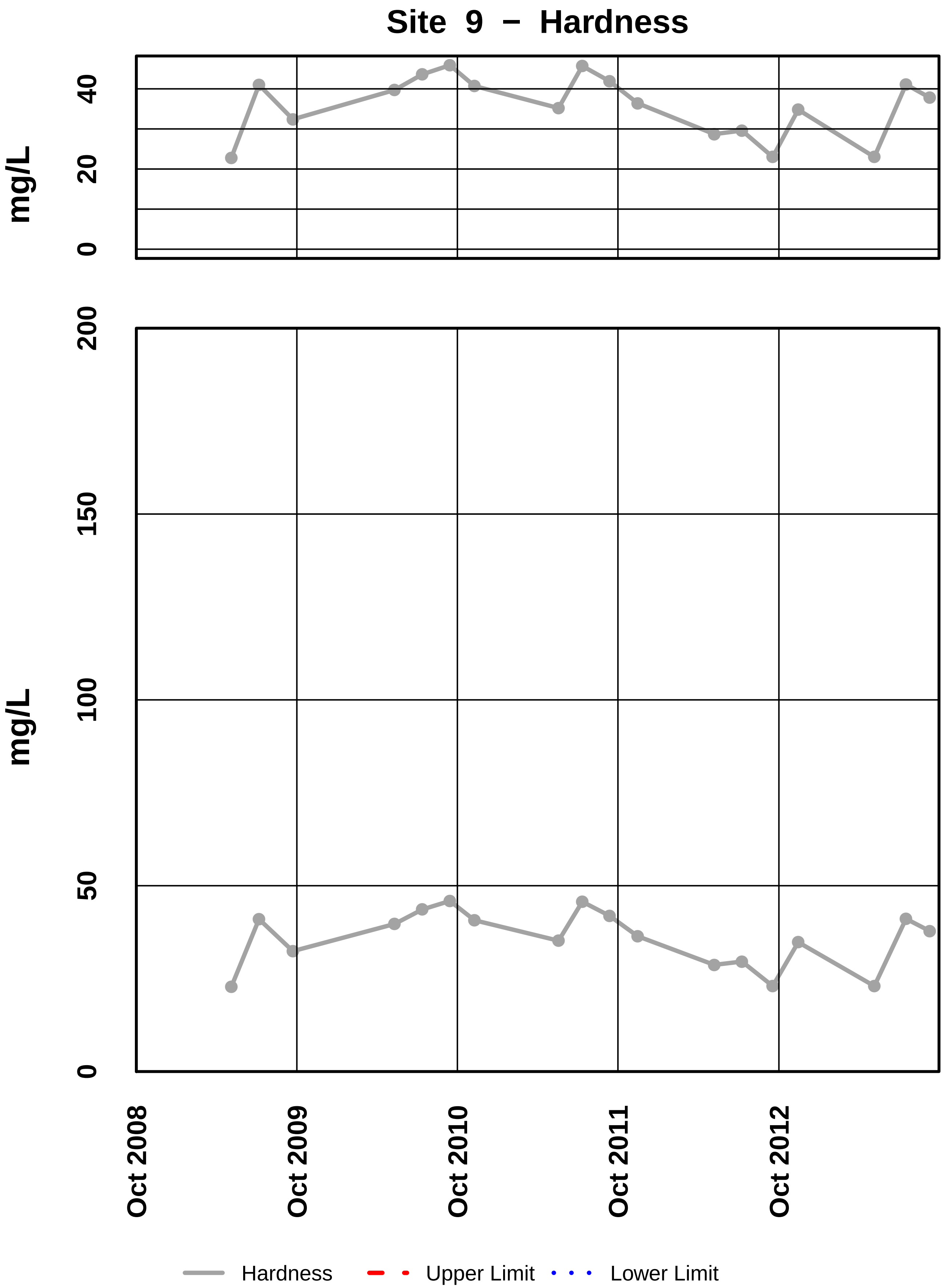
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



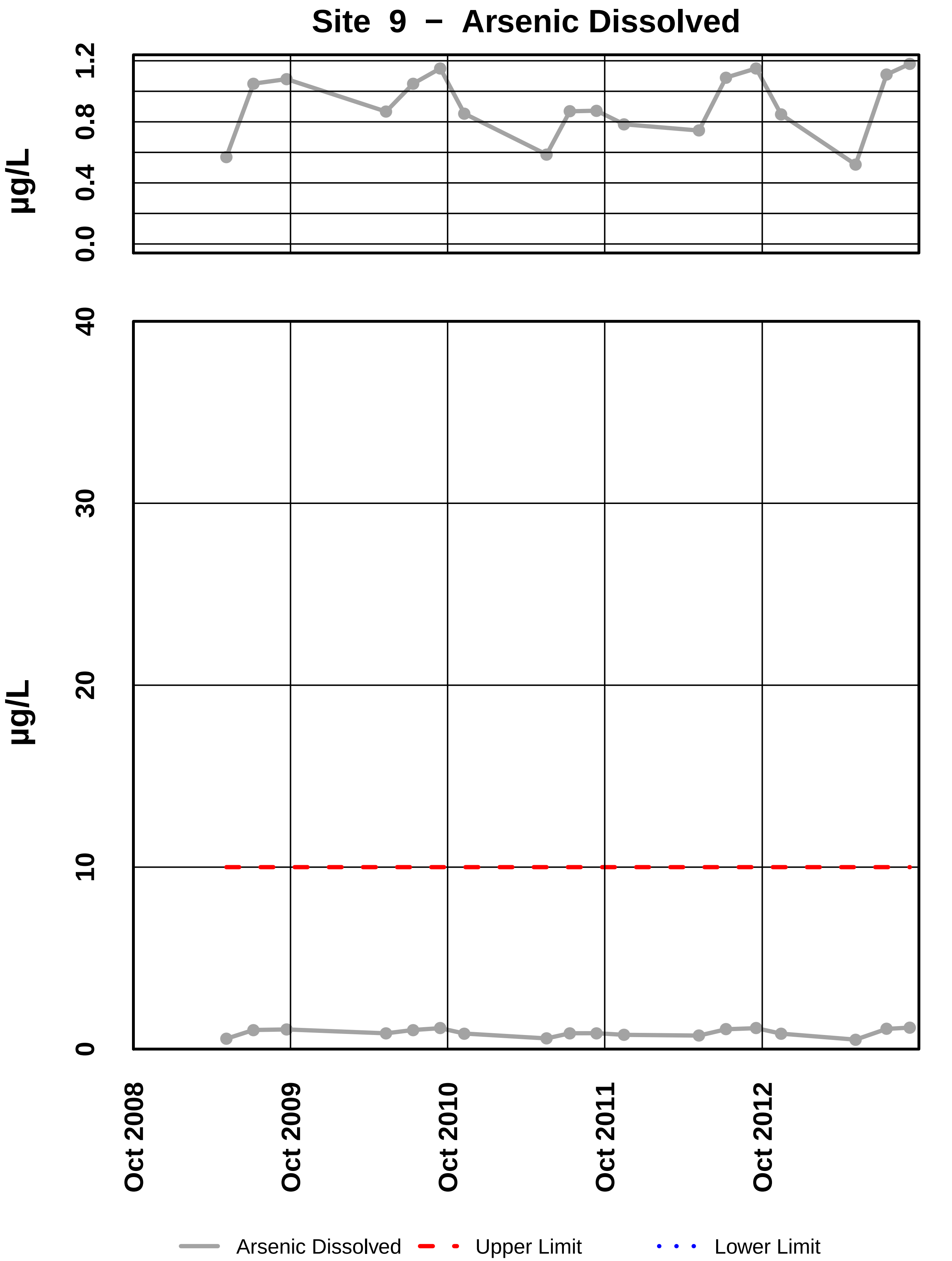
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

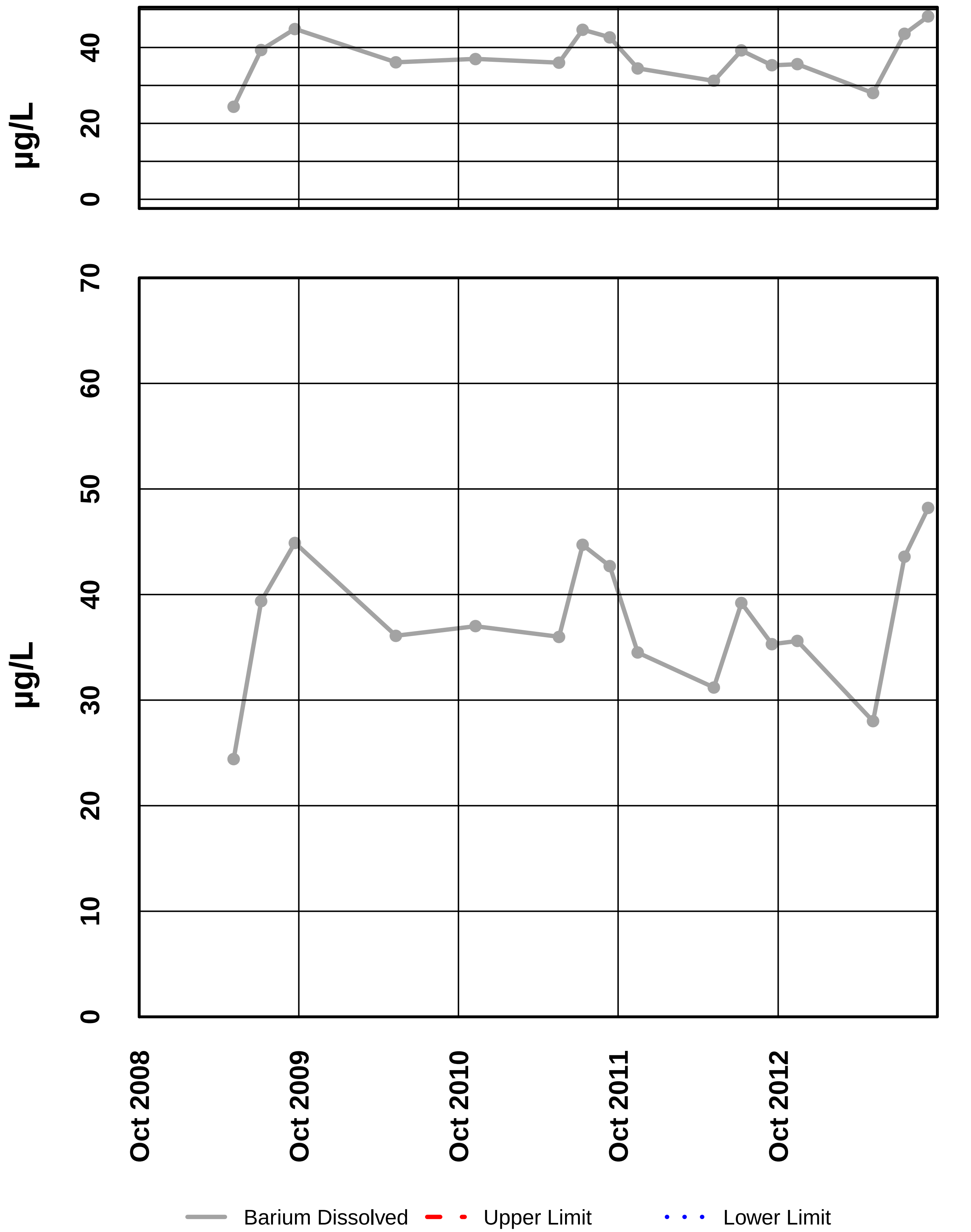


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



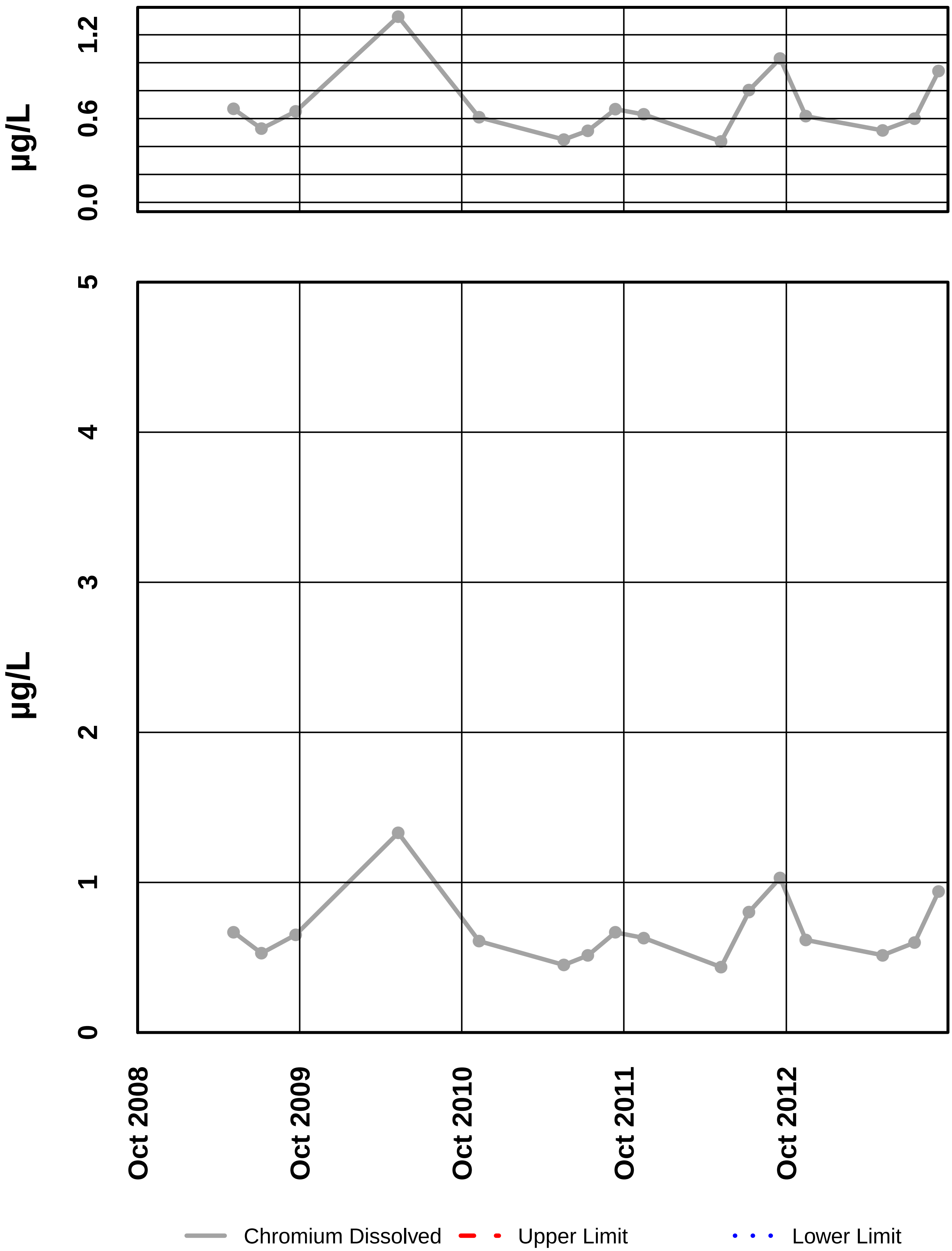
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 9 – Barium Dissolved

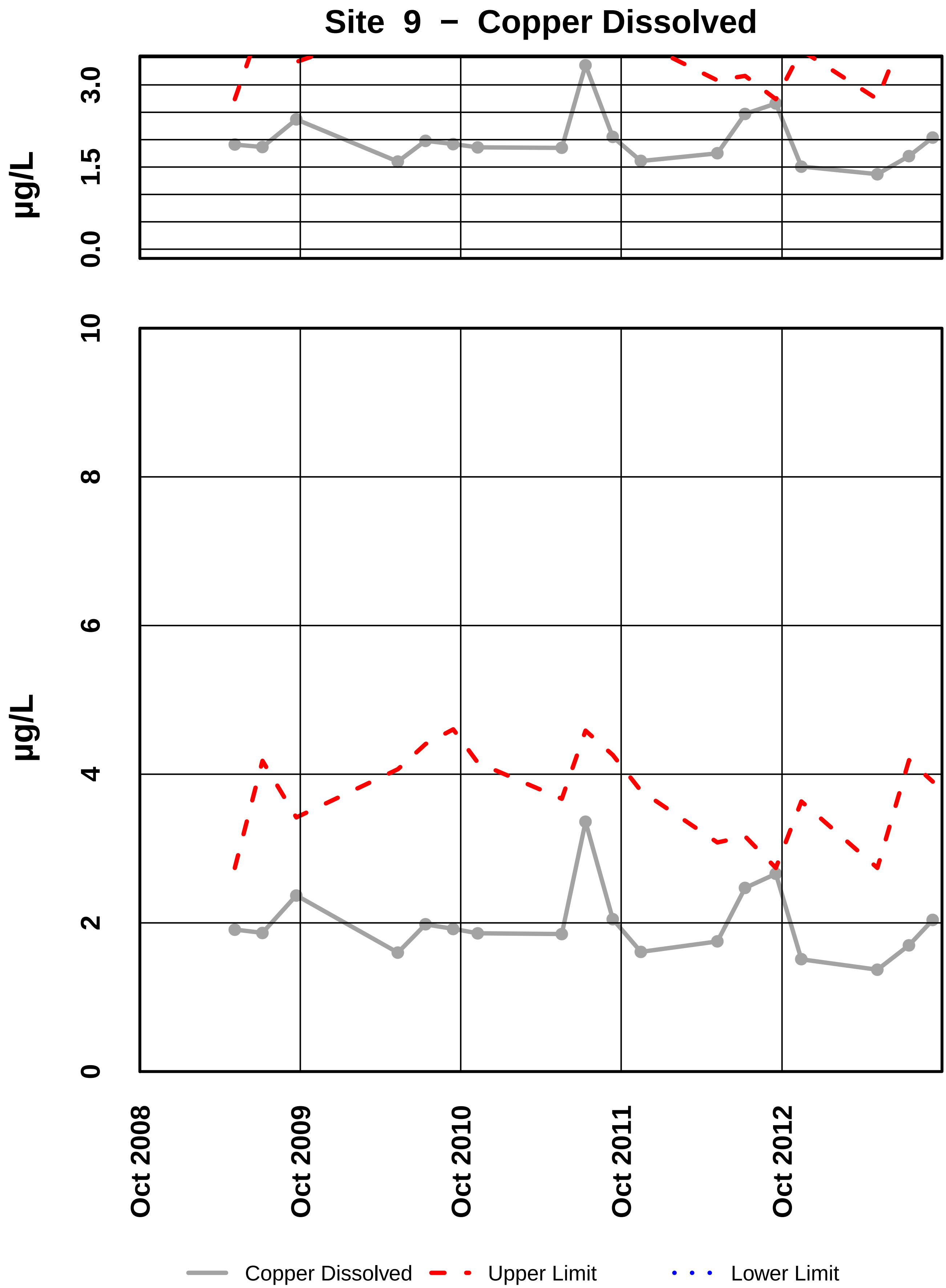


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 9 – Chromium Dissolved

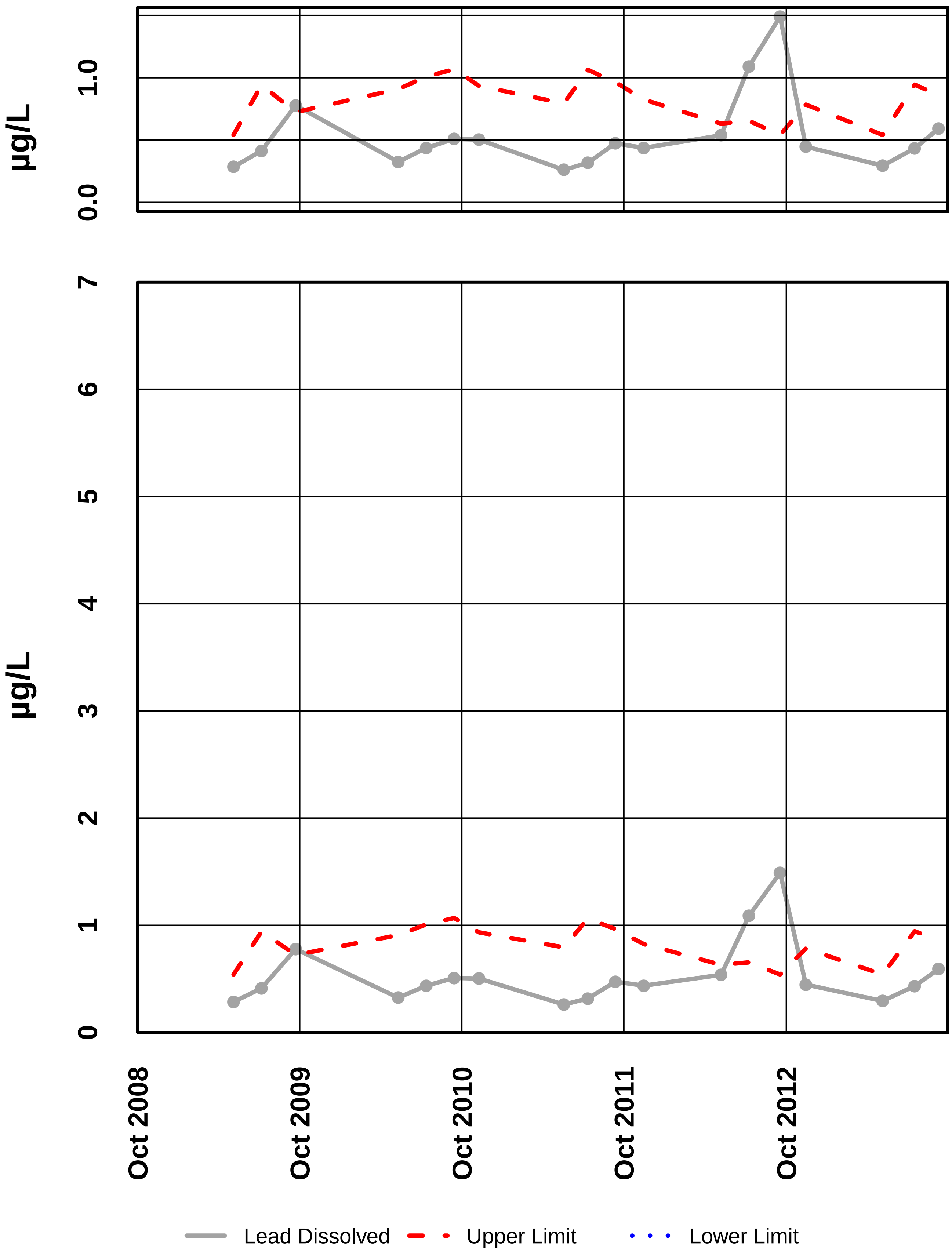


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

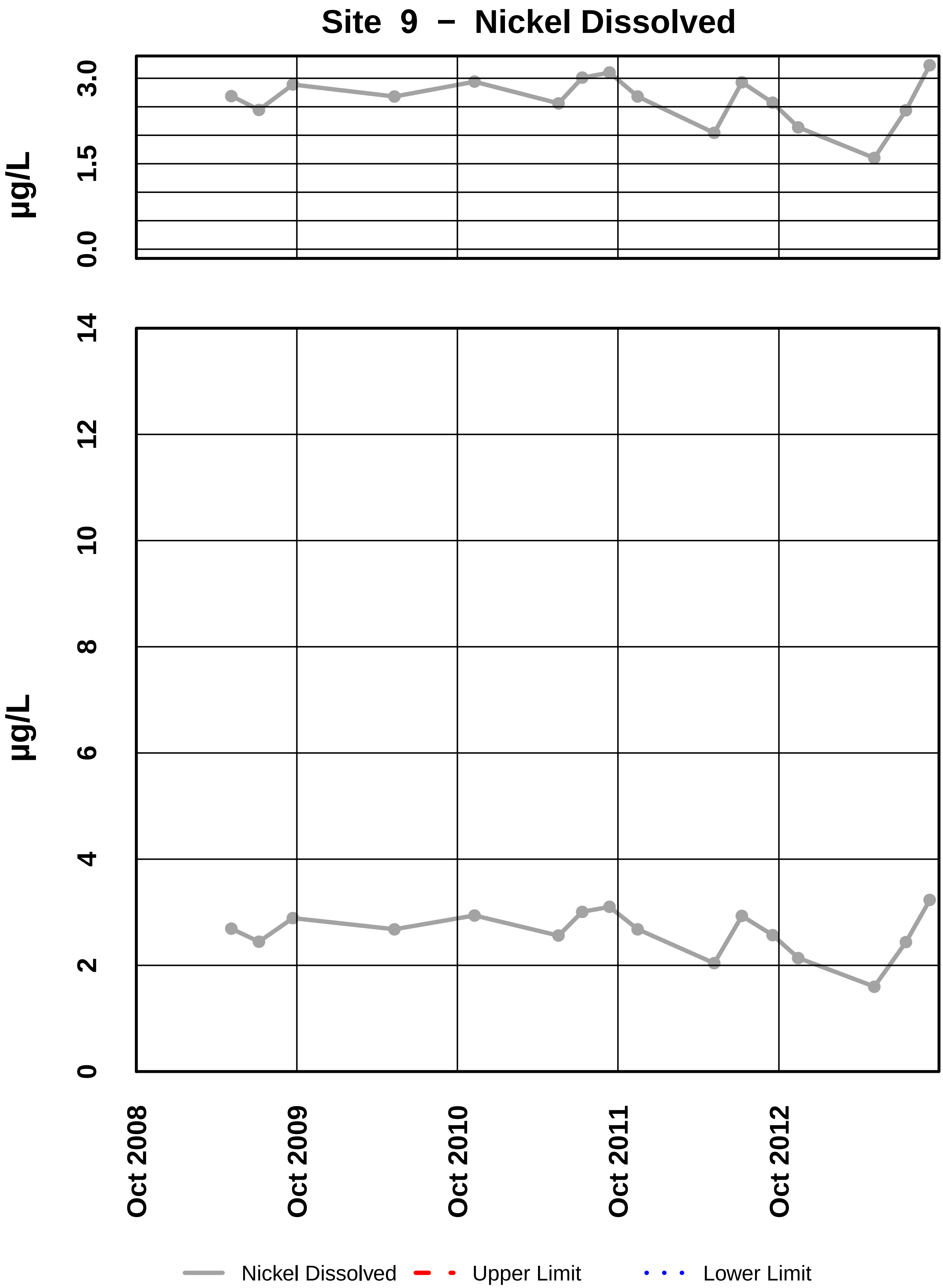


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

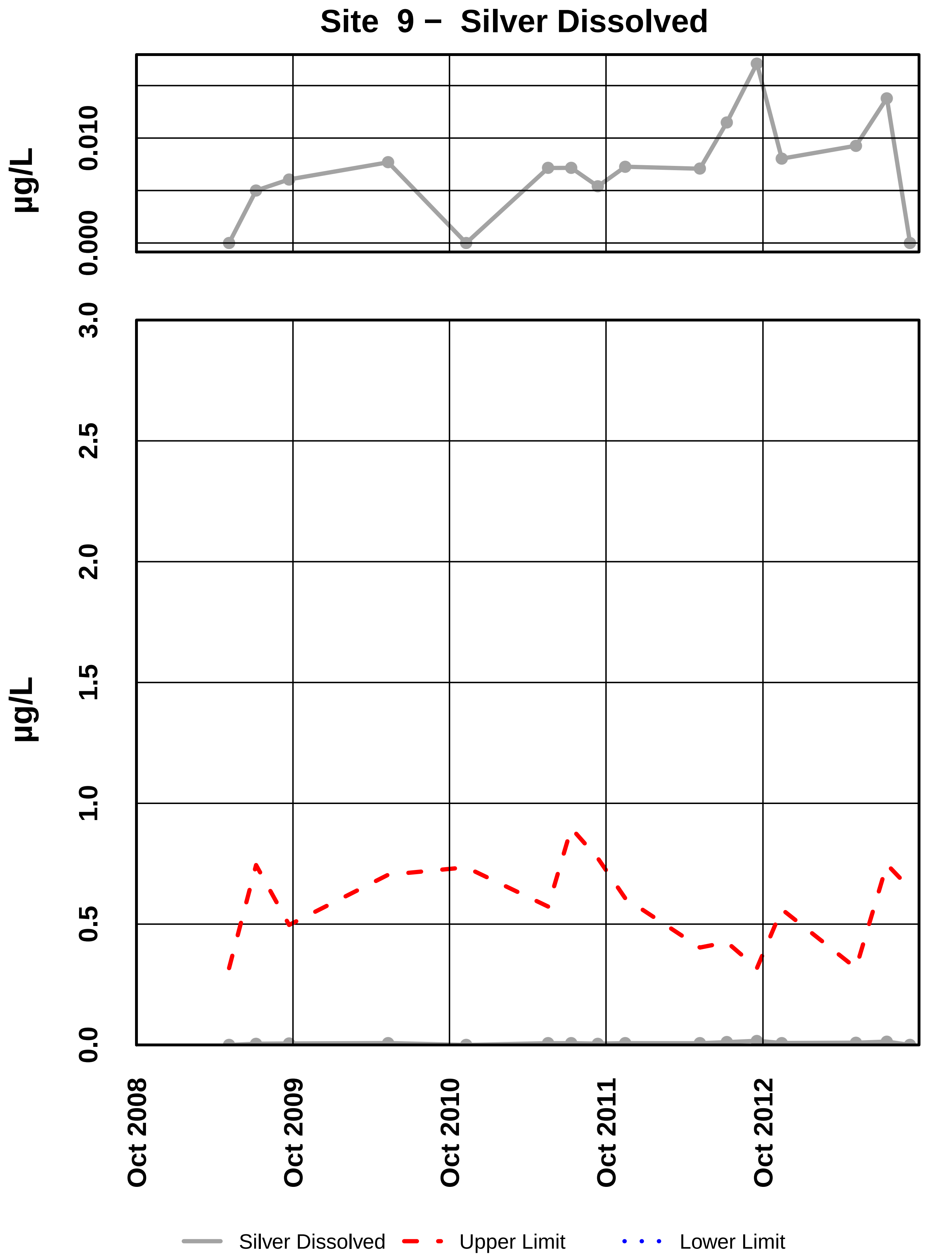
Site 9 – Lead Dissolved



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

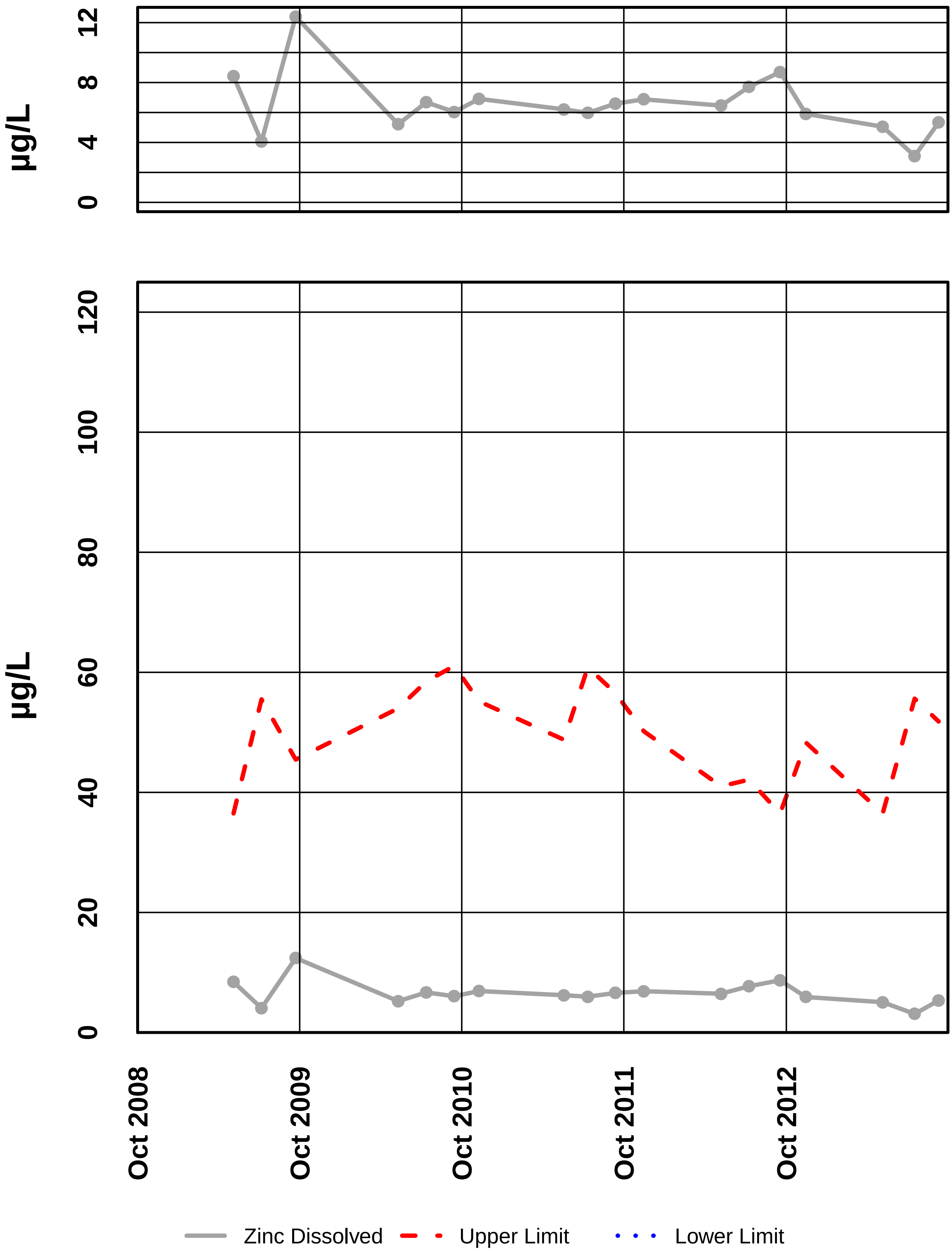


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



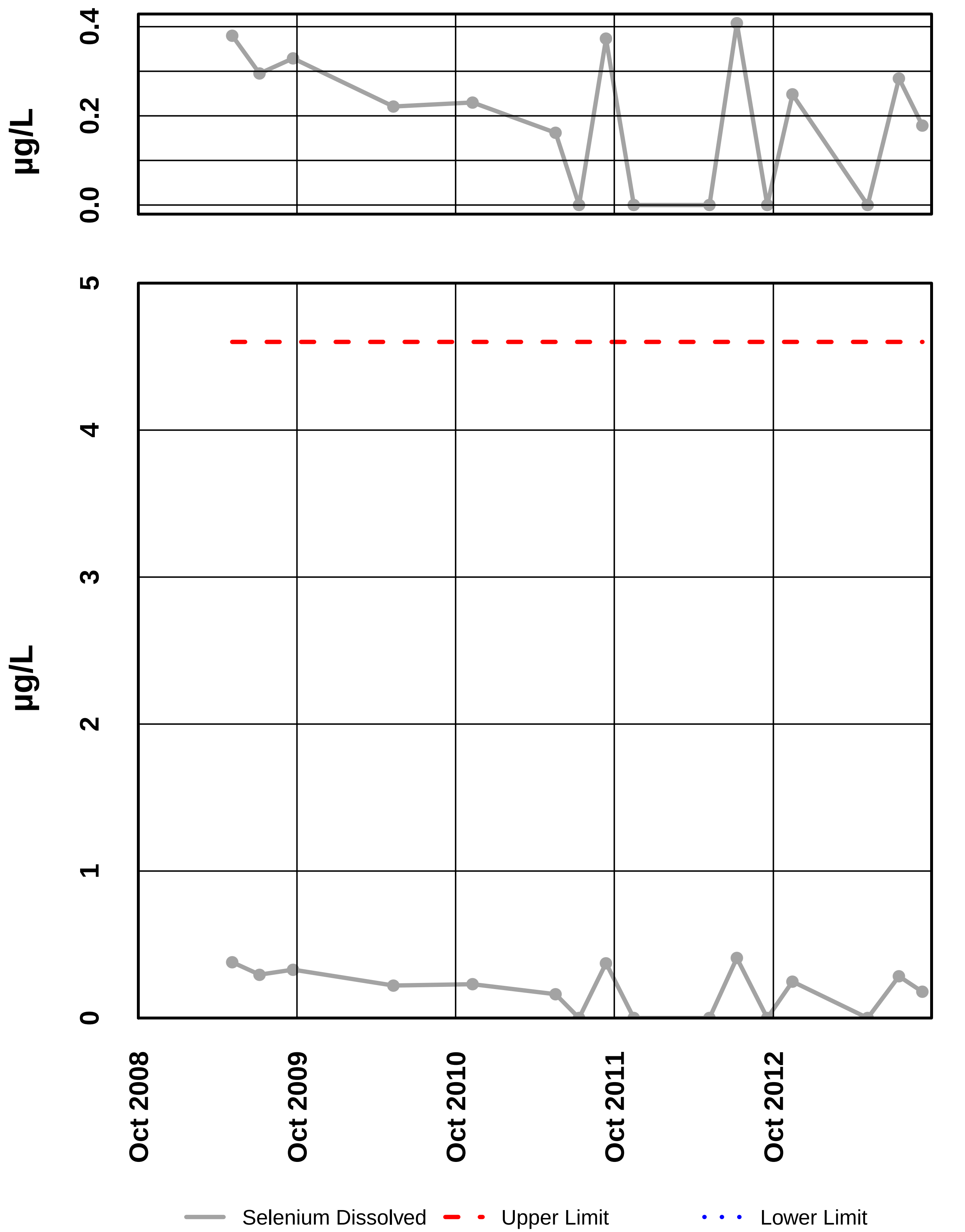
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 9 – Zinc Dissolved

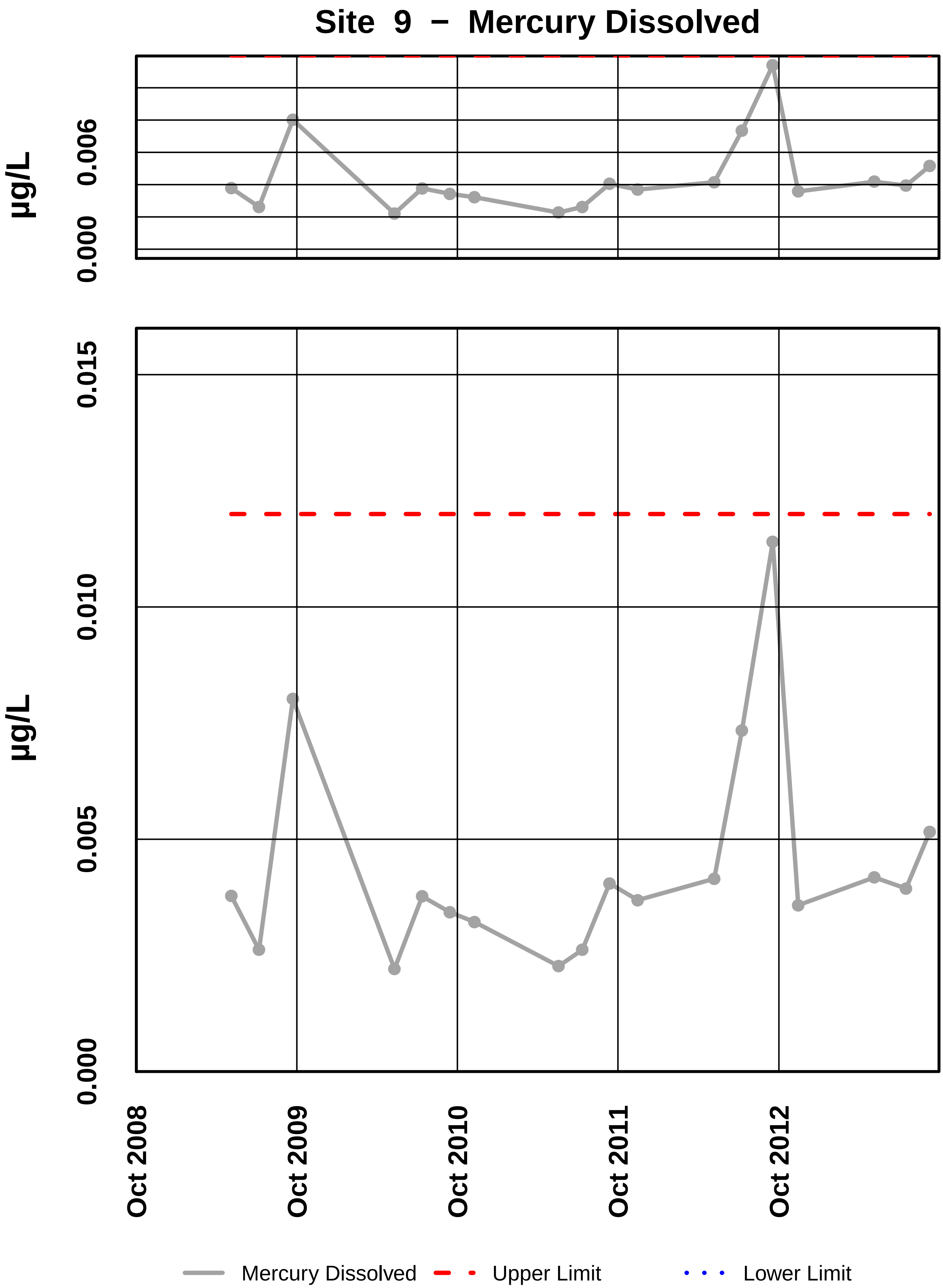


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 9 − 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 #9 — Seasonal Kendall analysis for Specific Conductance, Field (µS/cm)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**							79	61.5		87.6		71
b	**WY2009**								53.5		93.5		71.8
c	**WY2010**								89.5		91.7		91.5
d	**WY2011**		95.6						96		132.7		85
e	**WY2012**		82						72.1		67		53
f	**WY2013**		82						68		102		92
	n	0	3	0	0	0	0	1	6	0	6	0	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	0	1	0	0	0	0	1	6	0	6	0	6
t_2	0	1	0	0	0	0	0	0	0	0	0	0
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a								-1		1		1
c-a								1		1		1
d-a								1		1		1
e-a								1		-1		-1
f-a								1		1		1
c-b								1		-1		1
d-b								1		1		1
e-b								1		-1		-1
f-b								1		1		1
d-c								1		1		-1
e-c								-1		-1		-1
f-c								-1		1		1
e-d		-1						-1		-1		-1
f-d		-1						-1		-1		1
f-e		0						-1		1		1
S_k	0	-2	0	0	0	0	0	3	0	3	0	5

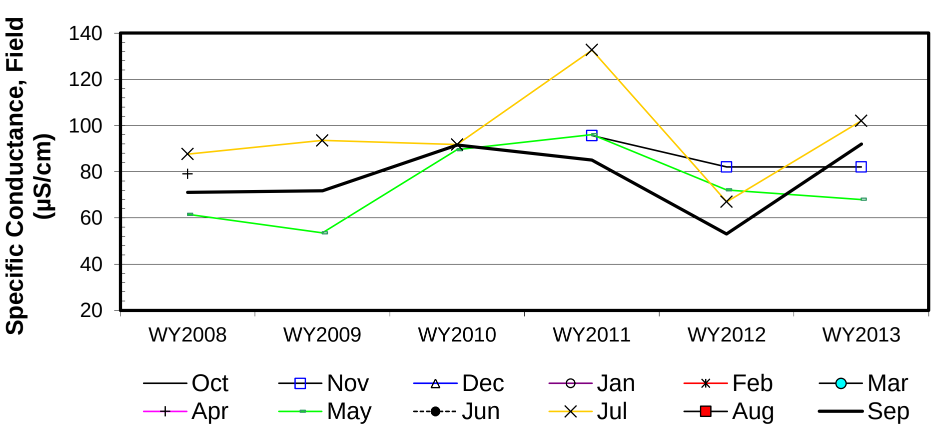
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=		2.67						28.33		28.33		28.33
$Z_k = S_k/\sigma_S$		-1.22						0.56		0.56		0.94
Z^2_k		1.50						0.32		0.32		0.88

ΣZ_k=	0.84
ΣZ^2_k=	3.02
Z-bar=ΣZ_k/K=	0.21

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	20	1	0	0	0

Σn	22
ΣS_k	9

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	2.84	@α=5% $\chi^2_{(K-1)}$=	7.81	Test for station homogeneity	
p	**0.417**			$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
$\Sigma VAR(S_k)$ / 87.67	Z_{calc} 0.85	@α/2=2.5% Z=	1.96	**H_0** (No trend)	ACCEPT
p	**0.804**			**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-6.77		6.17
0.050	-4.96	**2.09**	4.53
0.100	-4.10		3.62
0.200	0.01		3.40

Site **#9** Seasonal Kendall analysis for pH, Field, Standard Units

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**							7.2	7.1		6.9		6.7
b	**WY2009**								6.2		6.3		6.6
c	**WY2010**								6.2		6.5		7.2
d	**WY2011**		6.8						6.8		5.9		6.7
e	**WY2012**		7.6						6.2		7.0		6.6
f	**WY2013**		7.6						7.2		7.2		7.0
	n	0	3	0	0	0	0	1	6	0	6	0	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	0	3	0	0	0	0	1	6	0	6	0	6
t_2	0	0	0	0	0	0	0	0	0	0	0	0
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a								-1		-1		-1
c-a								-1		-1		1
d-a								-1		-1		1
e-a								-1		1		-1
f-a								1		1		1
c-b								-1		1		1
d-b								1		-1		1
e-b								1		1		1
f-b								1		1		1
d-c								1		-1		-1
e-c								1		1		-1
f-c								1		1		-1
e-d		1						-1		1		-1
f-d		1						1		1		1
f-e		-1						1		1		1
S_k	0	1	0	0	0	0	0	3	0	5	0	3

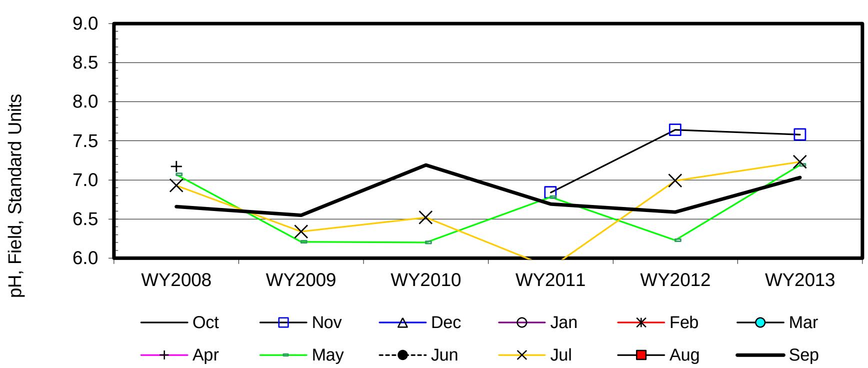
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=		3.67						28.33		28.33		28.33
$Z_k = S_k/\sigma_S$		0.52						0.56		0.94		0.56
Z^2_k		0.27						0.32		0.88		0.32

ΣZ_k= 2.59
ΣZ^2_k= 1.79
Z-bar=$\Sigma Z_k/K$= 0.65

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	22	0	0	0	0

Σn 22
ΣS_k 12

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$= 0.11	@α=5% $\chi^2_{(K-1)}$= 7.81	Test for station homogeneity	
p **0.990**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k) 88.67	Z_{calc} 1.17	@α/2=2.5% Z= 1.96	**H_0** (No trend)	ACCEPT
	p **0.879**		**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.10		0.24
0.050	-0.04	**0.04**	0.21
0.100	-0.01		0.18
0.200	0.01		0.12

Site **#9** Seasonal Kendall analysis for Total Alk, (mg/l)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**								11.0		17.5		11.6
b	**WY2009**								10.0		25.0		8.6
c	**WY2010**								18.2		18.7		21.3
d	**WY2011**		14.1						13.0		20.9		18.6
e	**WY2012**		15.3						13.6		15.0		11.9
f	**WY2013**		18.6						11.5		28.1		20.5
	n	0	3	0	0	0	0	0	6	0	6	0	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	0	3	0	0	0	0	0	6	0	6	0	6
t_2	0	0	0	0	0	0	0	0	0	0	0	0
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a								-1		1		-1
c-a								1		1		1
d-a								1		1		1
e-a								1		-1		1
f-a								1		1		1
c-b								1		-1		1
d-b								1		-1		1
e-b								1		-1		1
f-b								1		1		1
d-c								-1		1		-1
e-c								-1		-1		-1
f-c								-1		1		-1
e-d		1						1		-1		-1
f-d		1						-1		1		1
f-e		1						-1		1		1
S_k	0	3	0	0	0	0	0	3	0	3	0	5

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=		3.67						28.33		28.33		28.33
$Z_k = S_k/\sigma_S$		1.57						0.56		0.56		0.94
Z^2_k		2.45						0.32		0.32		0.88

ΣZ_k= 3.63

ΣZ^2_k= 3.97

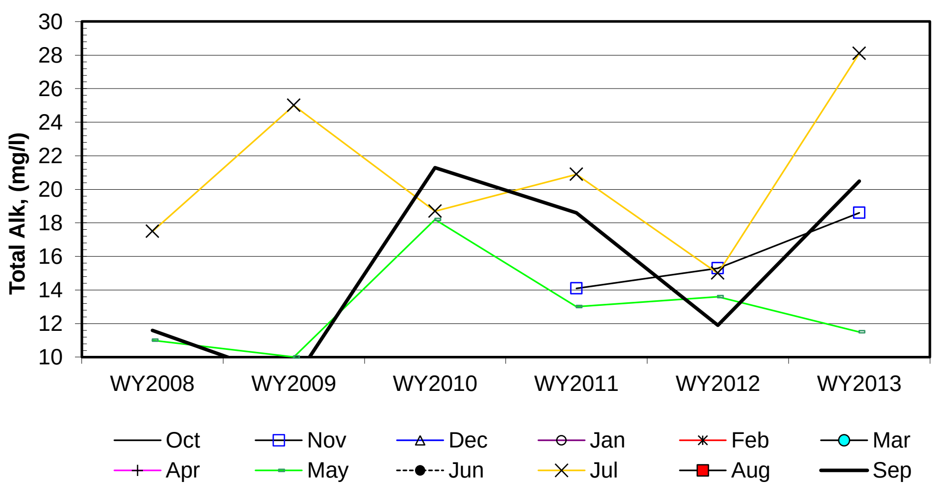
Z-bar=ΣZ_k/K= 0.91

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	21	0	0	0	0

Σn 21

ΣS_k 14

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=		0.67	@α=5% $\chi^2_{(K-1)}$= 7.81	Test for station homogeneity	
	p	**0.880**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc}	1.38	@α/2=2.5% Z= 1.96	**H_0** (No trend)	ACCEPT
88.67	p	**0.916**		**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-1.81		2.25
0.050	-0.53	**0.72**	1.71
0.100	0.06		1.21
0.200	0.38		1.13

Site **#9** Seasonal Kendall analysis for Sulfate, Total (mg/l)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**								8.8		15.2		12.0
b	**WY2009**								9.2		16.9		15.6
c	**WY2010**								18.0		12.0		18.3
d	**WY2011**		19.3						16.5		18.0		18.0
e	**WY2012**		0.0						12.8		8.5		7.4
f	**WY2013**		15.2						9.2		9.6		11.6
	n	0	3	0	0	0	0	0	6	0	6	0	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	0	3	0	0	0	0	0	4	0	6	0	6
t_2	0	0	0	0	0	0	0	1	0	0	0	0
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a								1		1		1
c-a								1		-1		1
d-a								1		1		1
e-a								1		-1		-1
f-a								1		-1		-1
c-b								1		-1		1
d-b								1		1		1
e-b								1		-1		-1
f-b								0		-1		-1
d-c								-1		1		-1
e-c								-1		-1		-1
f-c								-1		-1		-1
e-d		-1						-1		-1		-1
f-d		-1						-1		-1		-1
f-e		1						-1		1		1
S_k	0	-1	0	0	0	0	0	2	0	-5	0	-3

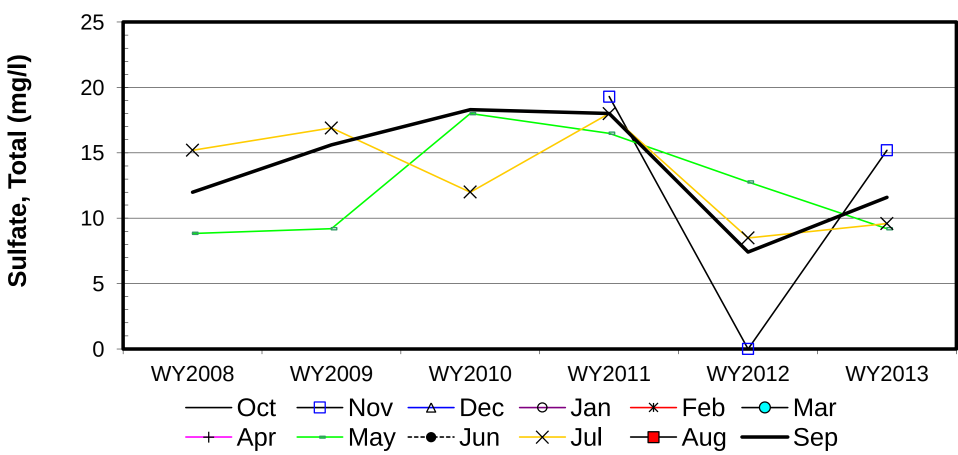
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=		3.67						27.33		28.33		28.33
$Z_k = S_k/\sigma_S$		-0.52						0.38		-0.94		-0.56
Z^2_k		0.27						0.15		0.88		0.32

ΣZ_k= -1.64
ΣZ^2_k= 1.62
Z-bar=ΣZ_k/K= -0.41

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	19	1	0	0	0

Σn 21
ΣS_k -7

$\chi^2_h = \Sigma Z^2_k - K(\text{Z-bar})^2$=		0.94	@α=5% $\chi^2_{(K-1)}$=	7.81	Test for station homogeneity
	p	**0.815**			$\chi^2_h < \chi^2_{(K-1)}$ ACCEPT
$\Sigma VAR(S_k)$	Z_{calc}	-0.64	@α=2.5% Z=	1.96	**H_0** (No trend) ACCEPT
87.67	p	**0.261**			**H_A** (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-2.72		1.18
0.050	-1.98	**-0.90**	0.82
0.100	-1.75		0.36
0.200	-1.59		0.00

Site **#9** Seasonal Kendall analysis for Zinc, Dissolved (ug/l)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**								6.4		7.0		10.8
b	**WY2009**								8.4		4.1		12.4
c	**WY2010**								5.2		6.7		6.0
d	**WY2011**		6.9						6.2		6.0		6.6
e	**WY2012**		6.9						6.5		7.7		8.7
f	**WY2013**		5.9						5.1		3.1		5.3
	n	0	3	0	0	0	0	0	6	0	6	0	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	0	3	0	0	0	0	0	6	0	6	0	6
t_2	0	0	0	0	0	0	0	0	0	0	0	0
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a								1		-1		1
c-a								-1		-1		-1
d-a								-1		-1		-1
e-a								1		1		-1
f-a								-1		-1		-1
c-b								-1		1		-1
d-b								-1		1		-1
e-b								-1		1		-1
f-b								-1		-1		-1
d-c								1		-1		1
e-c								1		1		1
f-c								-1		-1		-1
e-d		-1						1		1		1
f-d		-1						-1		-1		-1
f-e		-1						-1		-1		-1
S_k	0	-3	0	0	0	0	0	-5	0	-3	0	-7

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=		3.67						28.33		28.33		28.33
$Z_k = S_k/\sigma_S$		-1.57						-0.94		-0.56		-1.32
Z^2_k		2.45						0.88		0.32		1.73

ΣZ_k= -4.38

ΣZ^2_k= 5.38

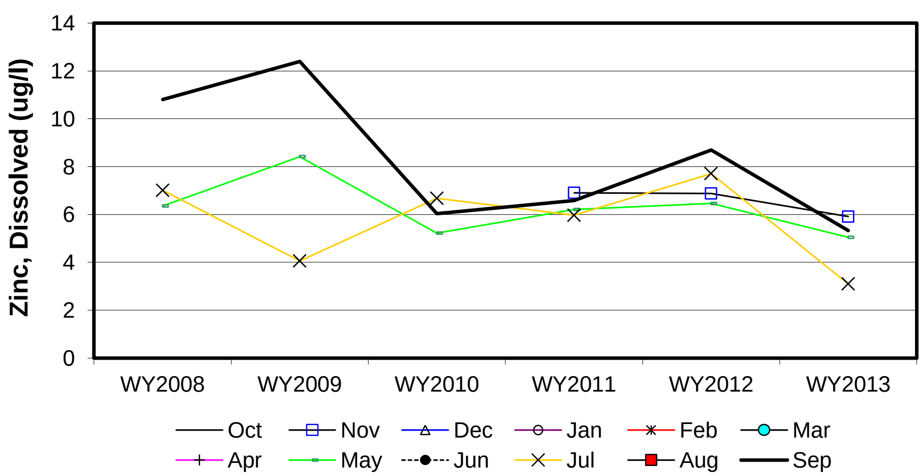
Z-bar=$\Sigma Z_k/K$= -1.10

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	21	0	0	0	0

Σn 21

ΣS_k -18

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	0.58	@α=5% $\chi^2_{(K-1)}$= 7.81	Test for station homogeneity	
p	**0.902**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
$\Sigma VAR(S_k)$ Z_{calc}	-1.81	@α/2=2.5% Z= 1.96	**H_0** (No trend)	ACCEPT
88.67 **p**	**0.036**		**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-1.19		0.17
0.050	-0.94	**-0.51**	-0.05
0.100	-0.78		-0.16
0.200	-0.65		-0.24

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 2013" 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 2007 through September 2013.				

The data for Water Year 2013 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 pHs 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 this is a continuation of the visual trend of decreasing alkalinity, towards pre-disturbance values. The two exceedances were for dissolved mercury, see discussion below.

Table of Exceedance for Water Year 2013

			Limits		
Sample Date	**Parameter**	**Value**	**Lower**	**Upper**	**Hardness**
14-Nov-12	Alkalinity	10.8 mg/L	20		
6-May-13	Alkalinity	10.7 mg/L	20		
17-Jul-13	Alkalinity	14.5 mg/L	20		
9-Sep-13	Alkalinity	11.7 mg/L	20		
17-Jul-13	Mercury Dissolved	0.0174 µg/L		0.01	
9-Sep-13	Mercury Dissolved	0.0174 µg/L		0.01	
9-Sep-13	pH Field	6.48 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. It is theorized that this too is an artifact from the construction of Pond 7. When the natural waters shifted to a more alkaline state after the disturbance caused by Pond 7 construction, this caused dissolved mercury that naturally existed at a low level to adsorb on to other particles and come out of solution. With the success of the pump back system the area is beginning to return to its natural state as previously mentioned. Because there is this fundamental chemistry shift in the pH the adsorbed mercury is now going back into solution causing the increased values. As the ‘pool’ of adsorbed mercury is depleted, mercury levels should return to levels recorded in 2006 (mean = 0.00395µg/L). As a result of data collected in Water Year 2013 the above hypothesis is being revised slightly. It is still HGCMC hypothesis that the issue is being driven by the adsorption and desorption of mercury with the change in pH. However, instead of creating a ‘pool’ of adsorbed mercury once and depleting it, this process has occurred several times. Though overall the pH of the system is headed to lower values there has been great fluctuations. It is believed that these fluctuations ‘see saw’ about the equilibrium point of the adsorption desorption mechanism.

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. HGCMC proposed that during the water year 2013 a pH survey of the muskeg region to the west of Pond 7 and also the drainage above Site 60 would be conducted in order to better understand the pH dynamics of the system. This work was not conducted in the prior water year and is now scheduled for the water year 2014. Along with this work an evaluation of the catchment and pump back system at Pond 7 will be conducted.

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-07 and Sep-13 (WY2008-WY2013). 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

	Mann-Kendall test statistics			Sen's slope estimate	
Parameter	**n***	**p****	**Trend**	**Q**	**Q(%)**
Conductivity Field	6	0.35			
pH Field	6	0.26			
Alkalinity, Total	6	0.35			
Sulfate, Total	6	0.17			
Zinc, Dissolved	6	<0.01	+	0.39	7.0

* 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 0.39 µg/L/yr. The current zinc values are approximately 12% 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 2013

Site 060FMS - 'Lower Althea creek'

Sample Date/Parameter	Oct 2012	Nov 2012	Dec 2012	Jan 2013	Feb 2013	Mar 2013	Apr 2013	May 2013	Jun 2013	Jul 2013	Aug 2013	Sep 2013	**Median**
Water Temp (°C)		2.4						4.4		10.4		11	7.4
Conductivity-Field(μmho)		43						64		60		63	61.5
Conductivity-Lab (μmho)		43						59		53		47	50
pH Lab (standard units)		6.72						6.54		6.84		6.42	6.63
pH Field (standard units)		8.37						6.85		6.58		6.48	6.72
Total Alkalinity (mg/L)		10.8						10.7		14.5		11.7	11.3
Total Sulfate (mg/L)		1.3						2.5		5		3.6	3.1
Hardness (mg/L)		19.1						20.4		25		27.8	22.7
Dissolved As (ug/L)		2.05						1.63		2.3		3.38	2.175
Dissolved Ba (ug/L)		17.3						19		24.5		31.1	21.8
Dissolved Cd (ug/L)		0.0134						0.0161		0.0234		0.0253	0.0198
Dissolved Cr (ug/L)		1.16						0.878		2.15		1.74	1.450
Dissolved Cu (ug/L)		0.94						0.935		1.21		1.32	1.075
Dissolved Pb (ug/L)		0.343						0.232		0.318		0.444	0.3305
Dissolved Ni (ug/L)		1.21						1.06		1.83		1.92	1.520
Dissolved Ag (ug/L)		0.01						0.014		0.017		0.008	0.012
Dissolved Zn (ug/L)		4.92						4.93		6		8.05	5.47
Dissolved Se (ug/L)		0.318						0.057		0.321		0.261	0.290
Dissolved Hg (ug/L)		0.0114						0.0107		0.0174		0.0174	0.014400

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

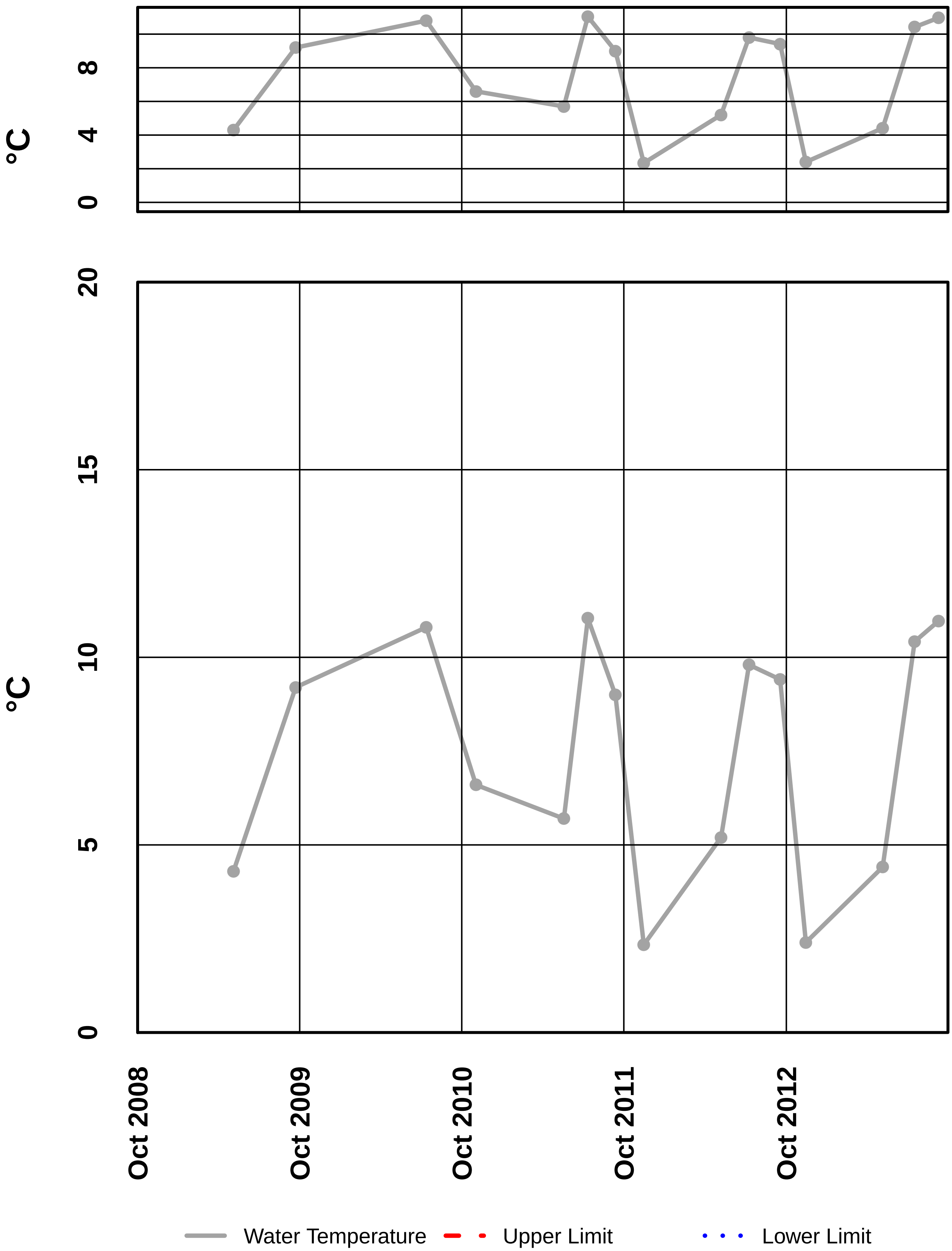
Qualified Data by QA Reviewer

Date Range: 10/01/2012 to 09/30/2013

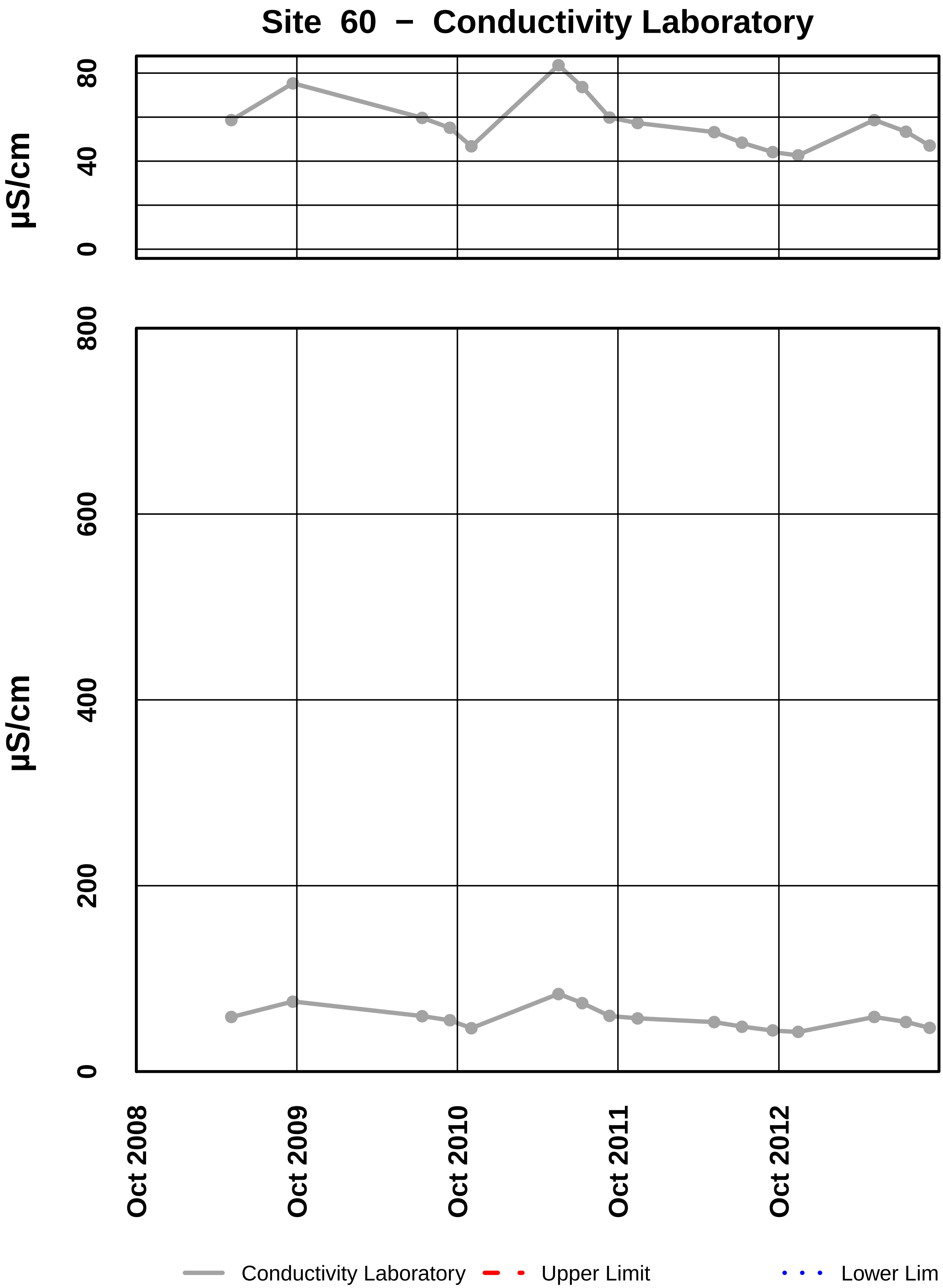
Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
60	11/14/2012	12:00 AM	Zn diss, µg/l	4.92	U	Field Blank Contamination
			Se diss, µg/l	0.31	U	Field Blank Contamination
60	5/6/2013	12:00 AM	pH Lab, su	6.54	J	Hold Time Violation
			Cond, µmhos	58.7	U	Field Blank Contamination
			Alk, mg/L	10.7	U	Field Blank Contamination
			SO4 Tot, mg/l	-5	UJ	Sample Receipt Temperature
60	7/17/2013	12:00 AM	Se diss, µg/l	0.32	J	Below Quantitative Range
			SO4 Tot, mg/l	-10	UJ	Sample Receipt Temperature
60	9/9/2013	12:00 AM	Se diss, µg/l	0.26	J	Below Quantitative Range
			Ag diss, µg/l	0.00846	J	Below Quantitative Range
			SO4 Tot, mg/l	3.62	J	Below Quantitative Range, Sample receipt temperature

Qualifier	Description
J	Positively Identified - Approximate concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit

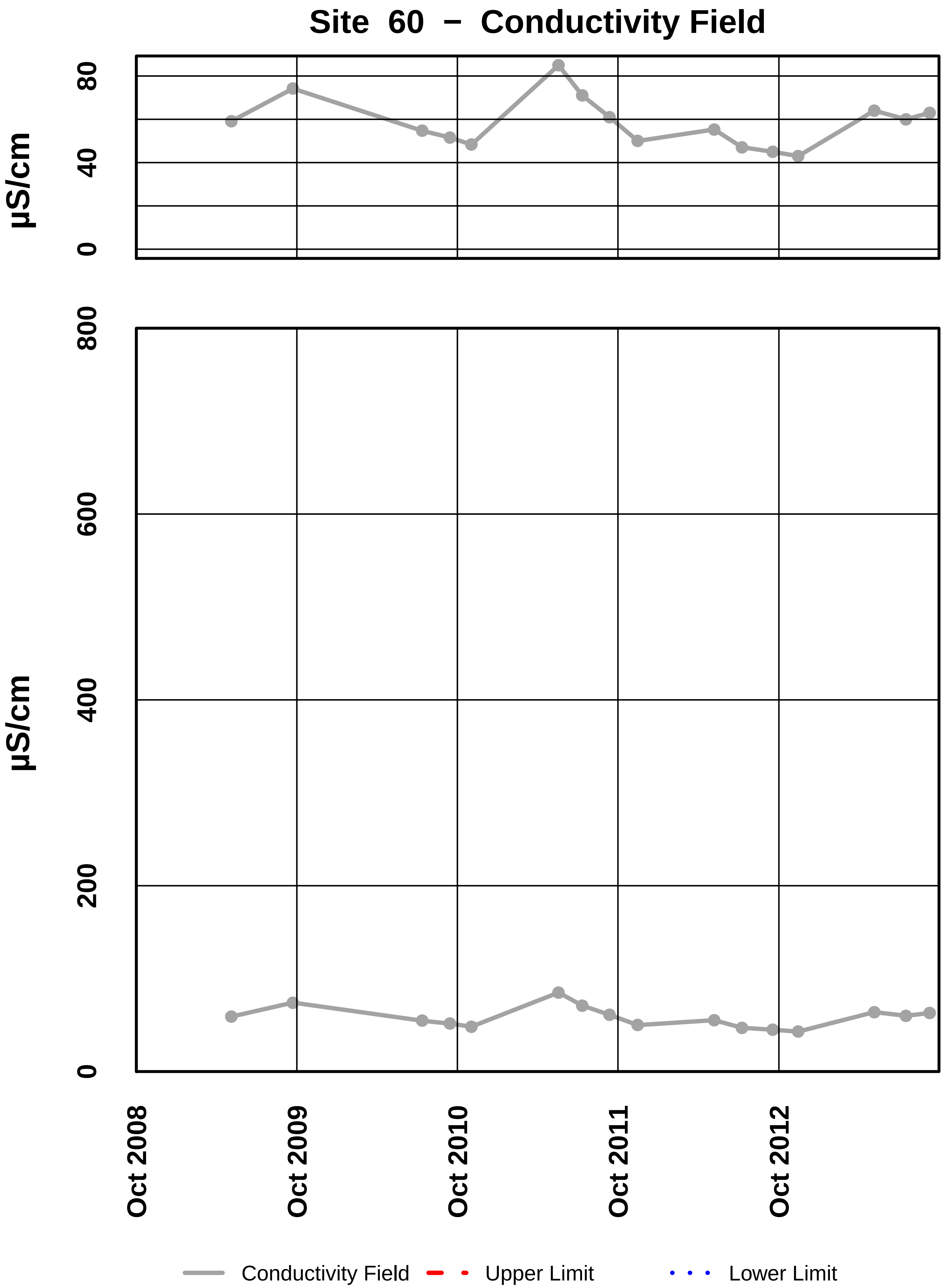
Site 60 − Water Temperature



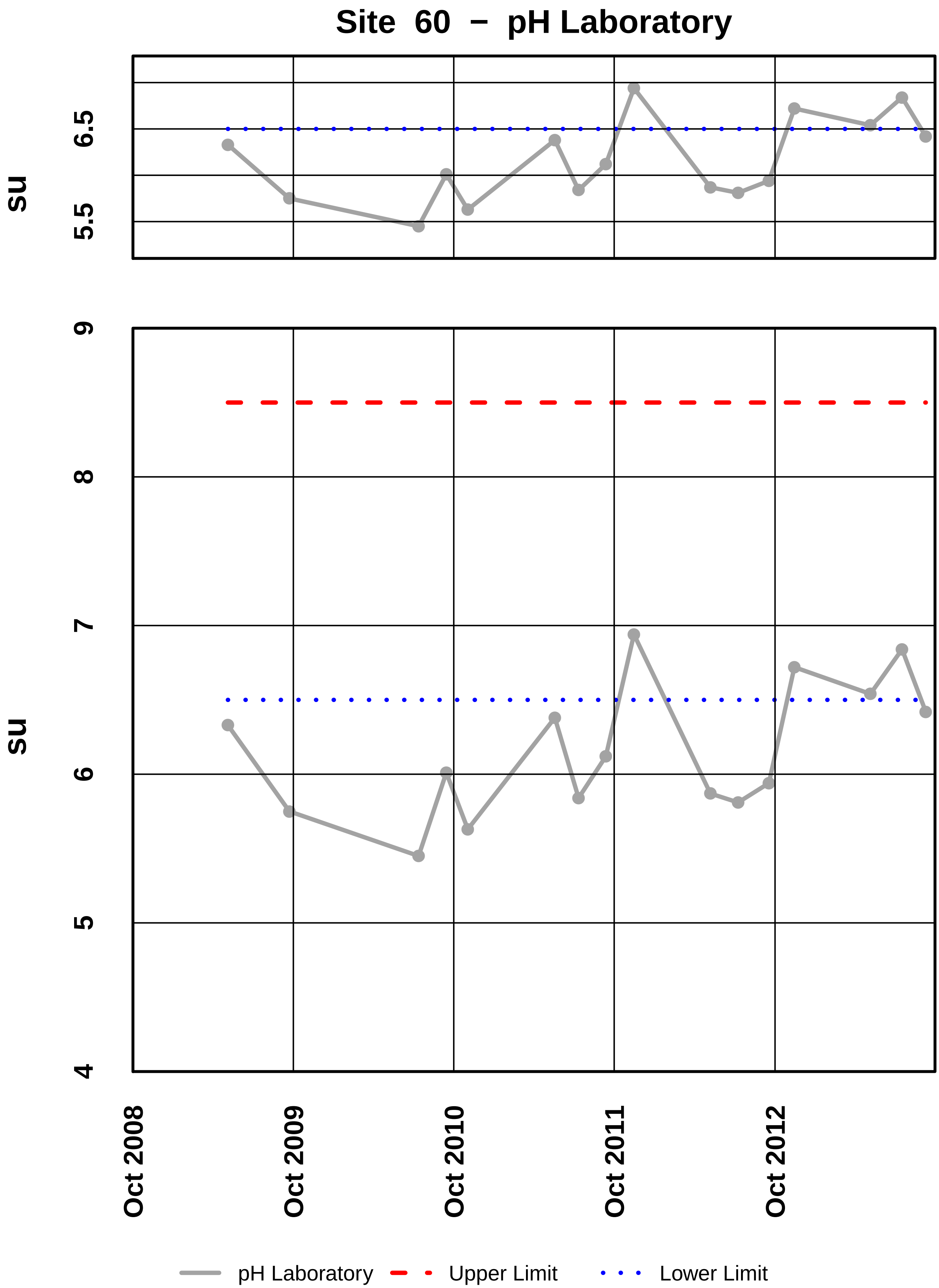
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

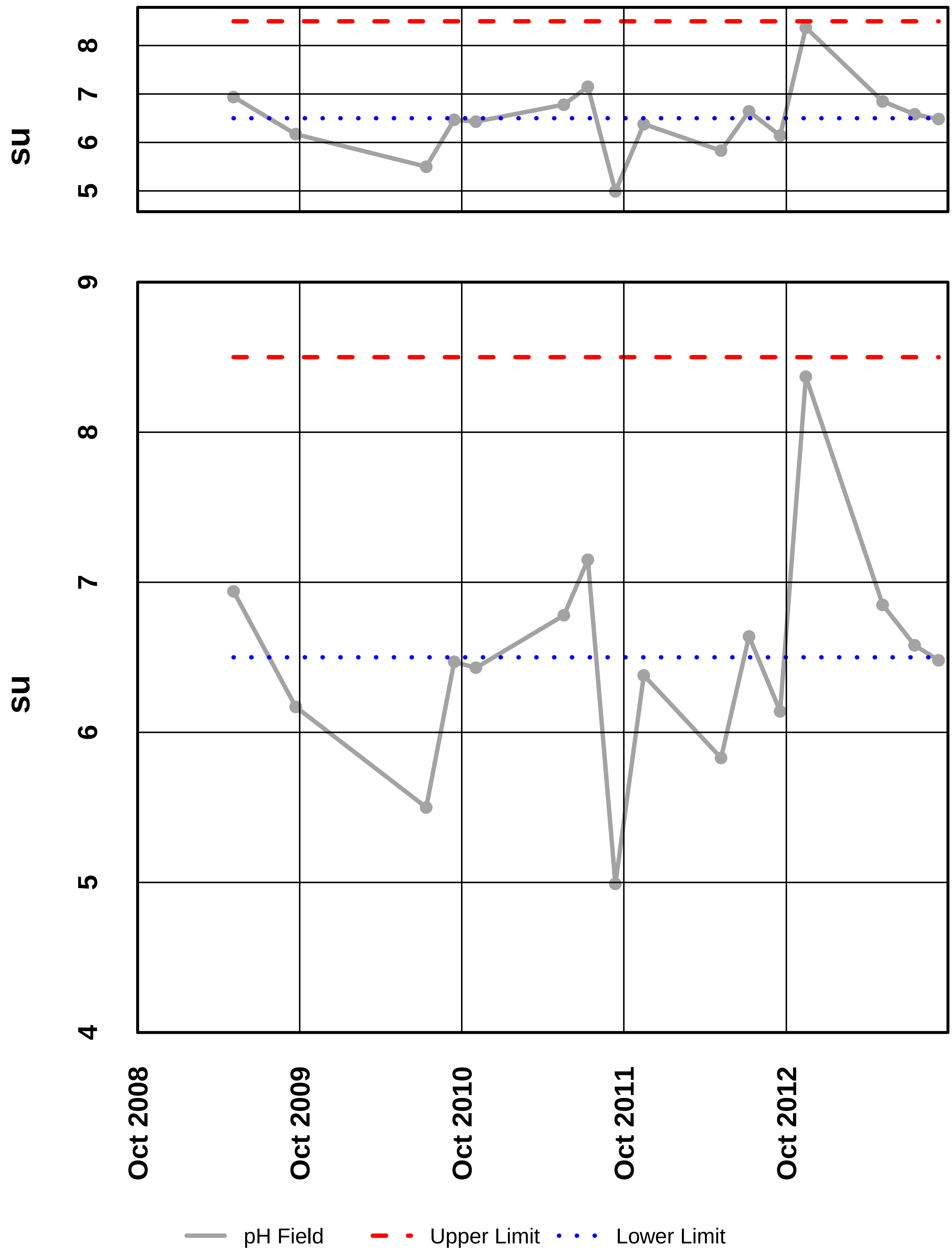


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



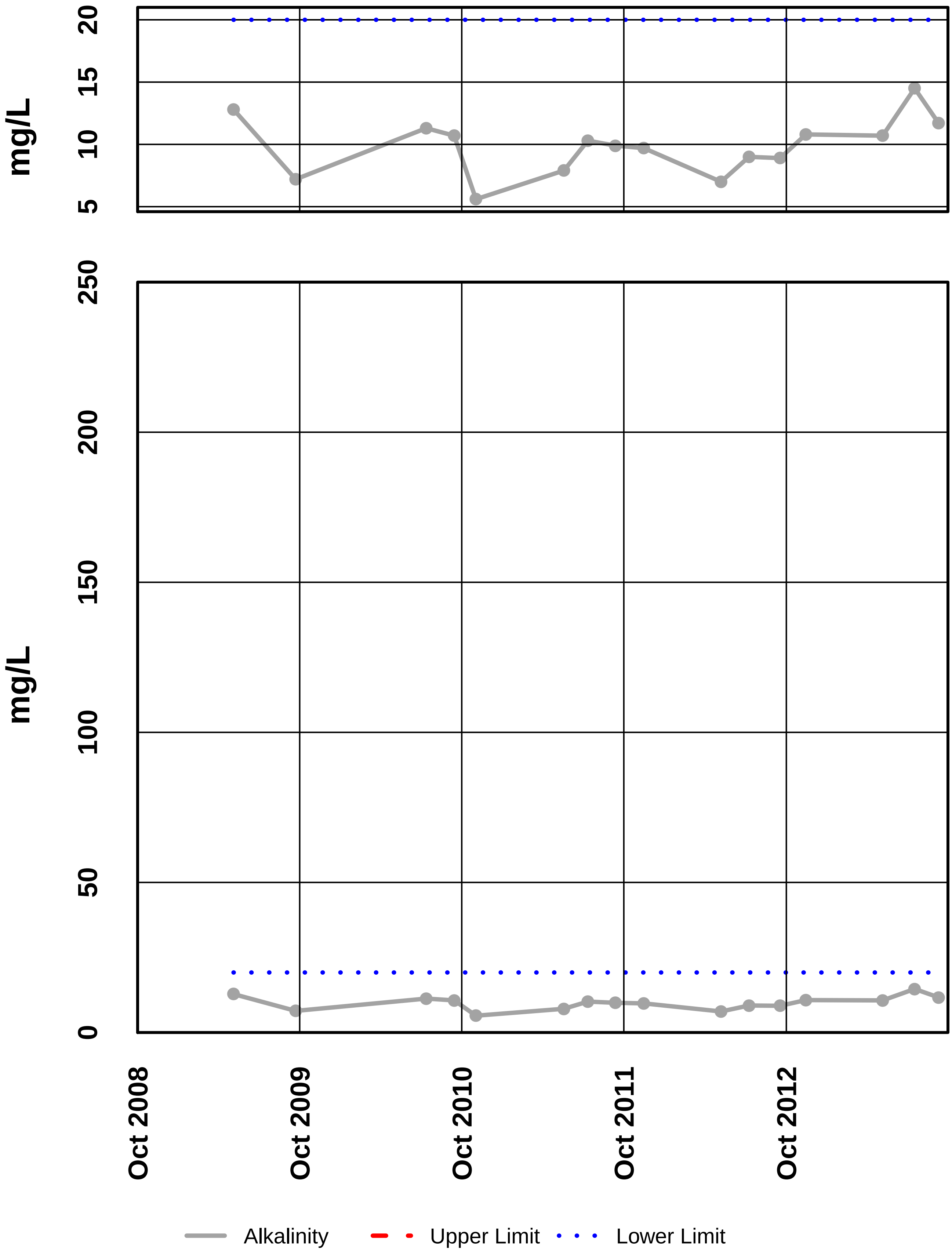
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 60 – pH Field

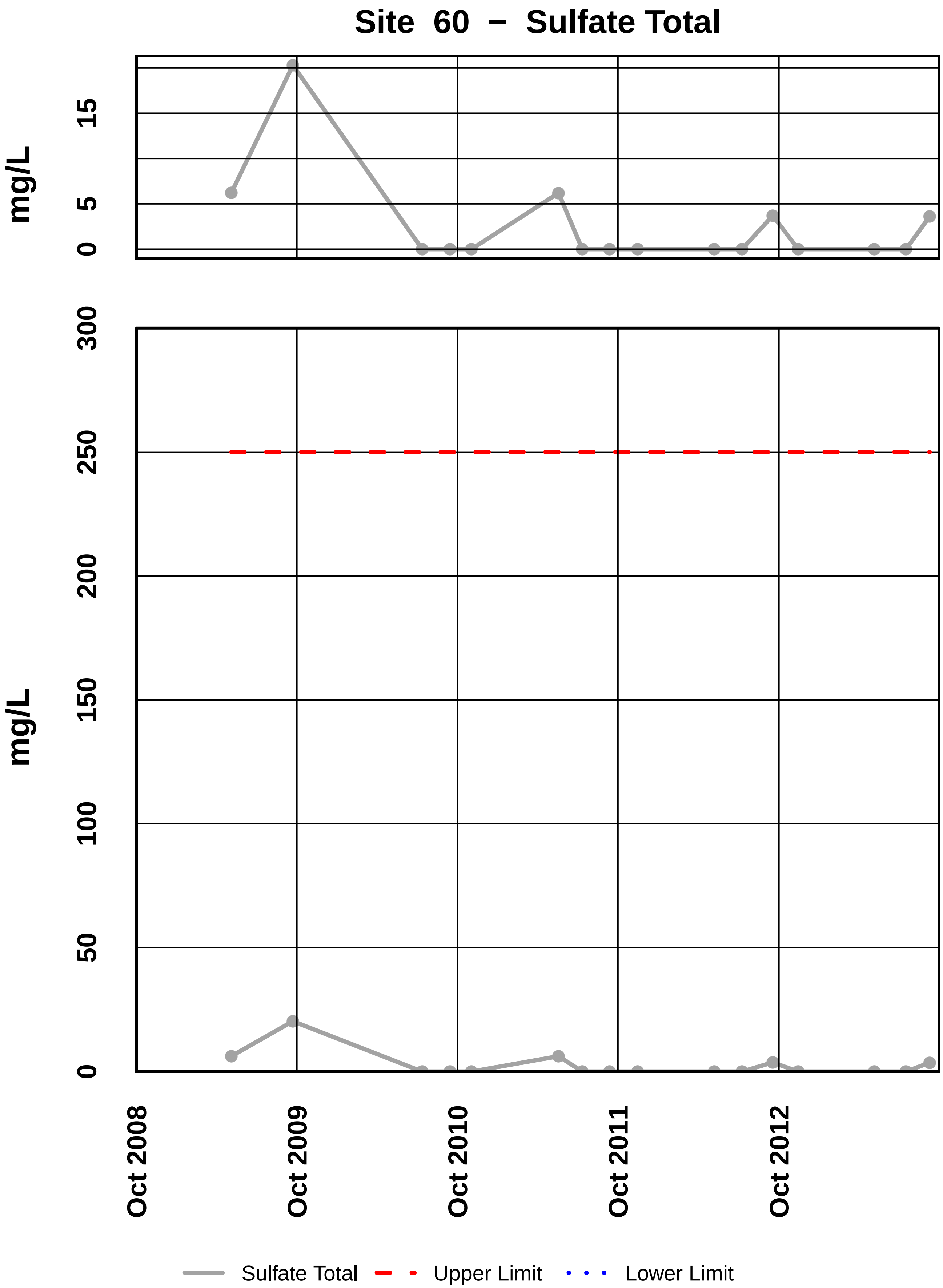


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 60 – Alkalinity

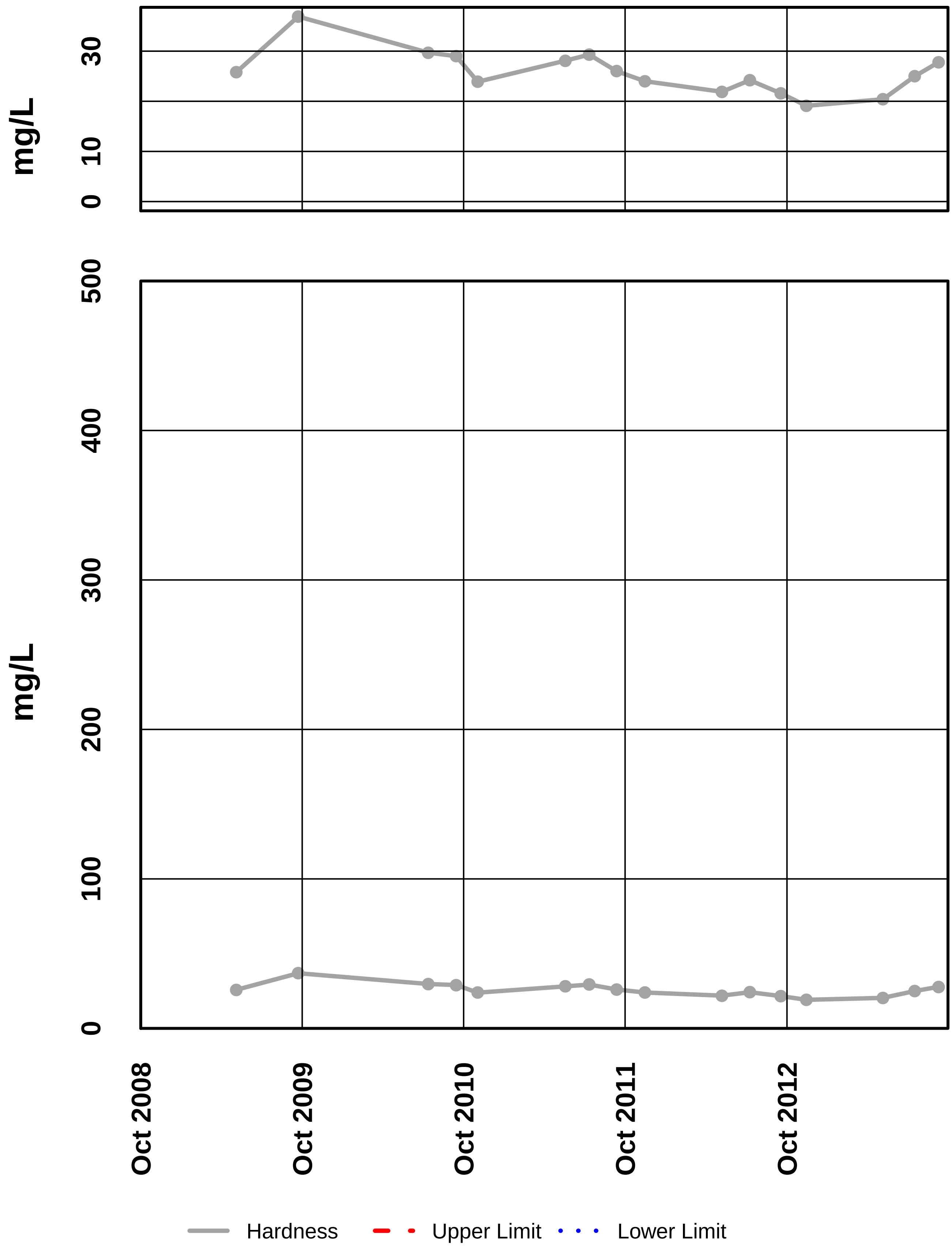


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

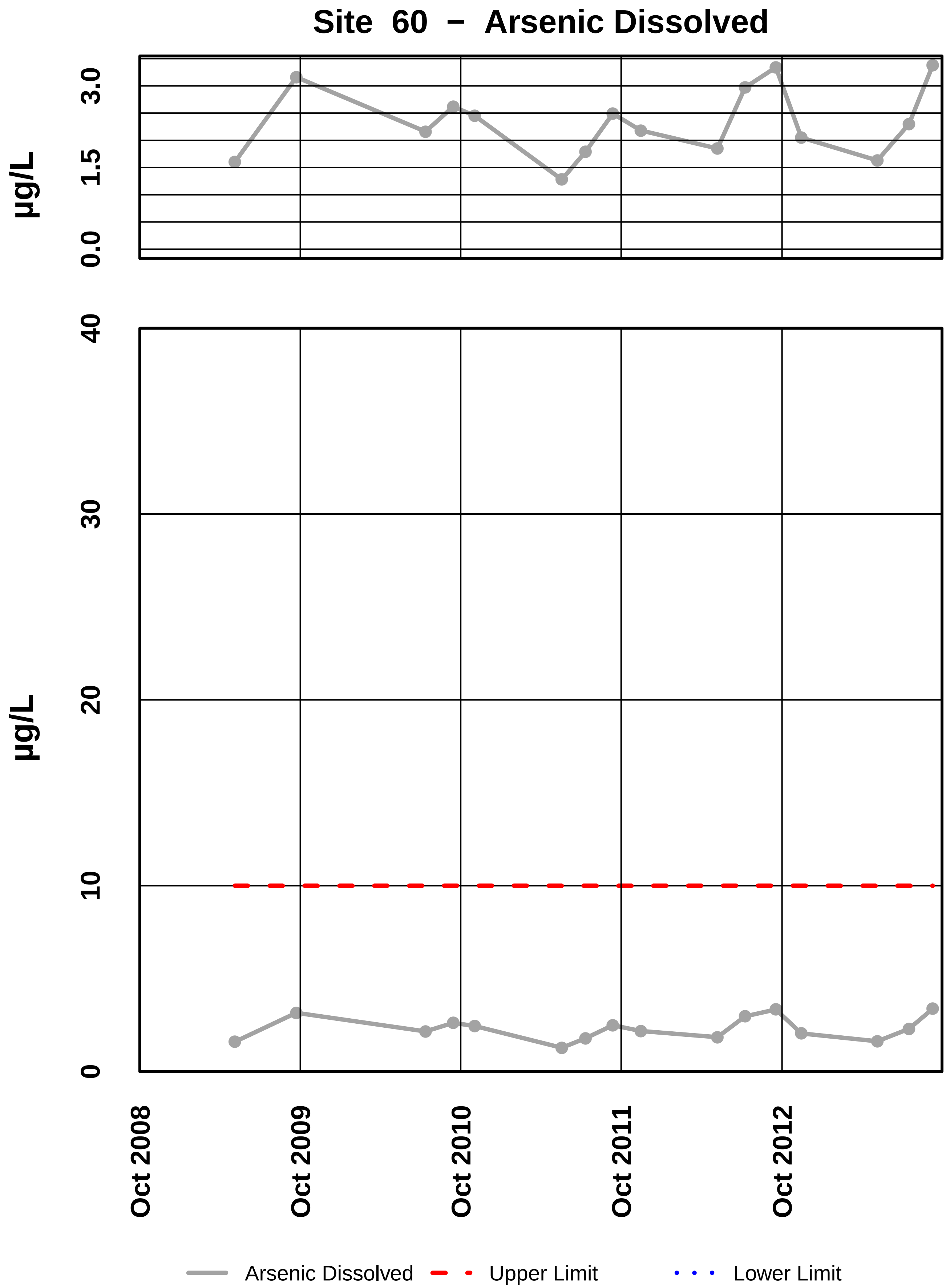


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 60 − Hardness

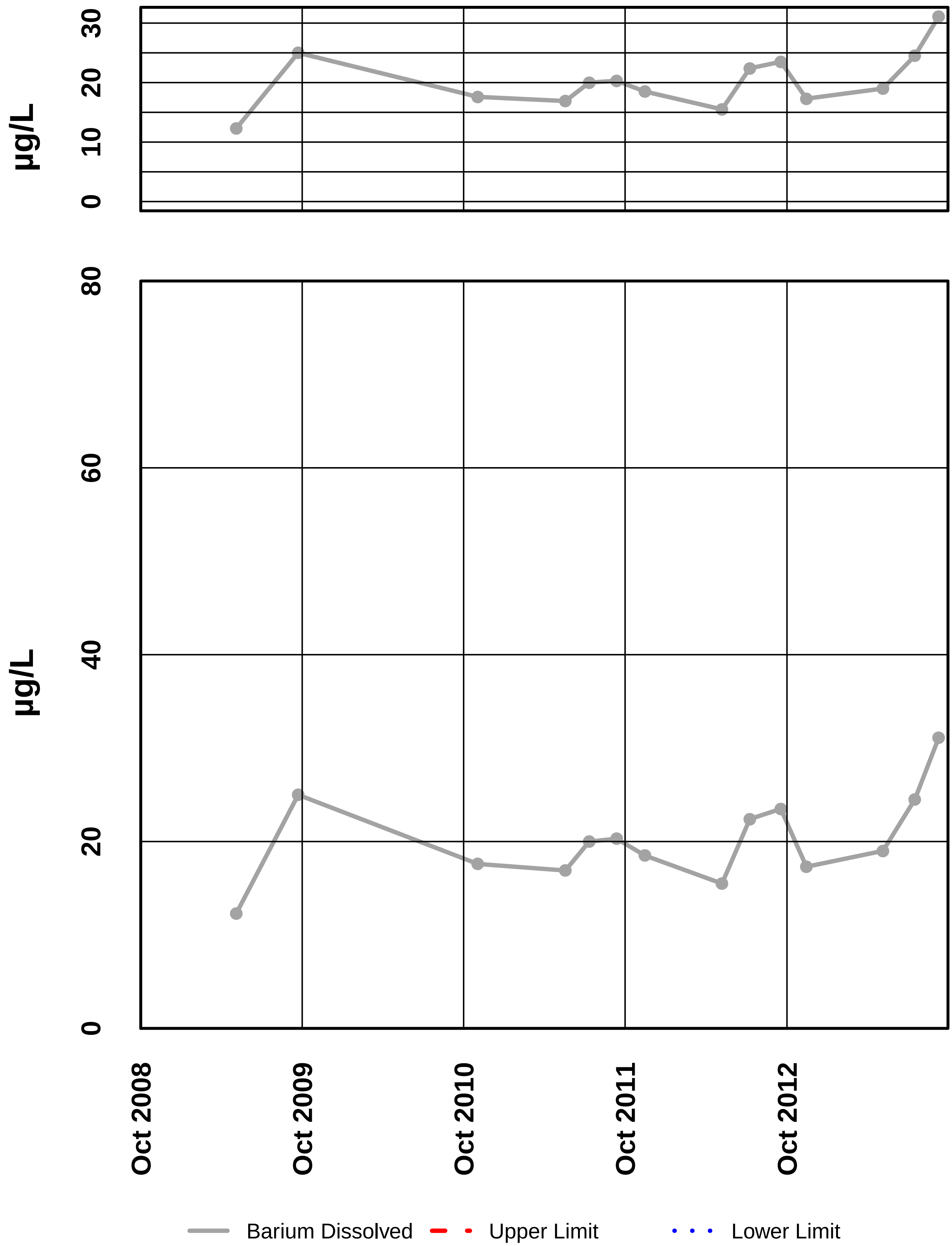


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



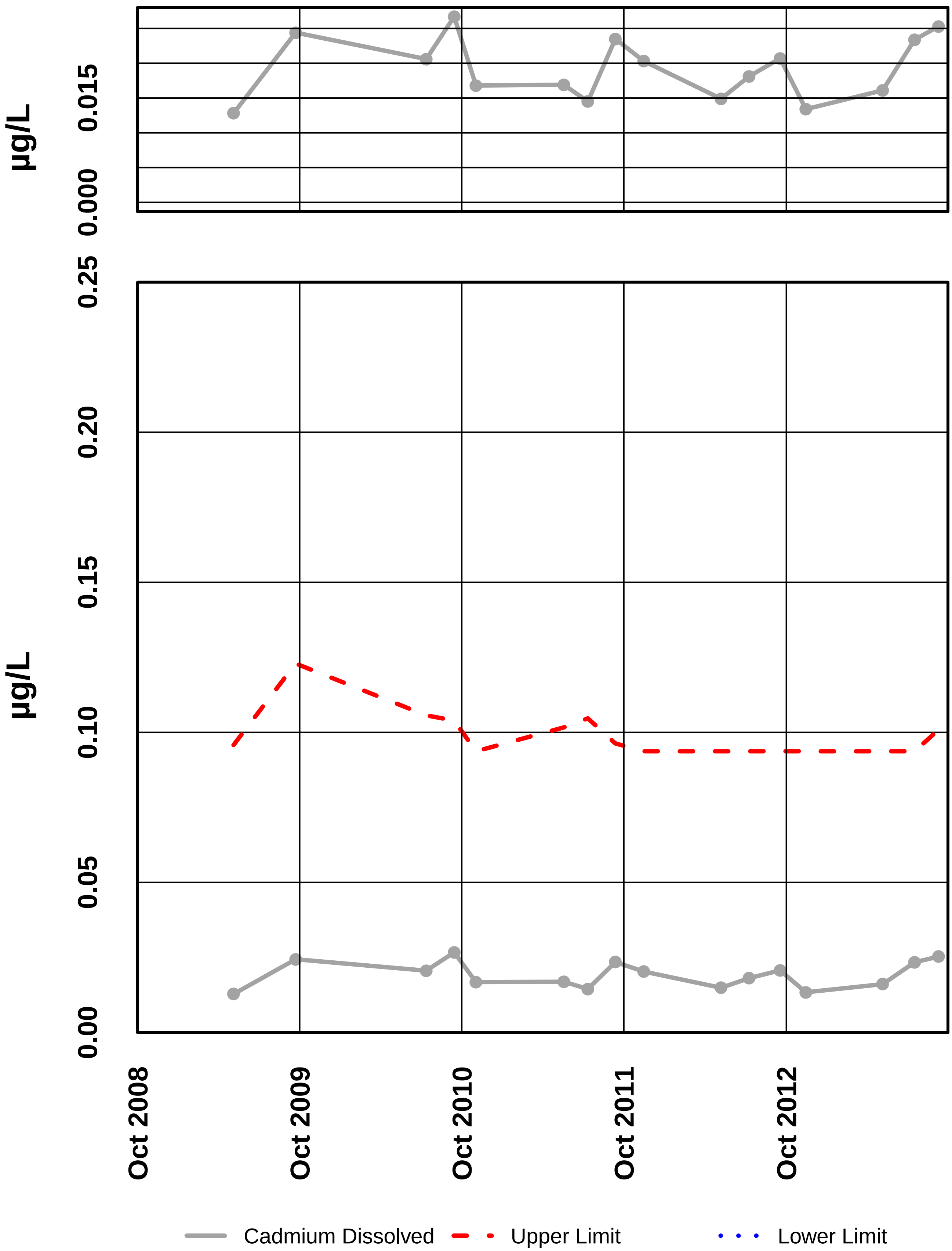
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 60 – Barium Dissolved



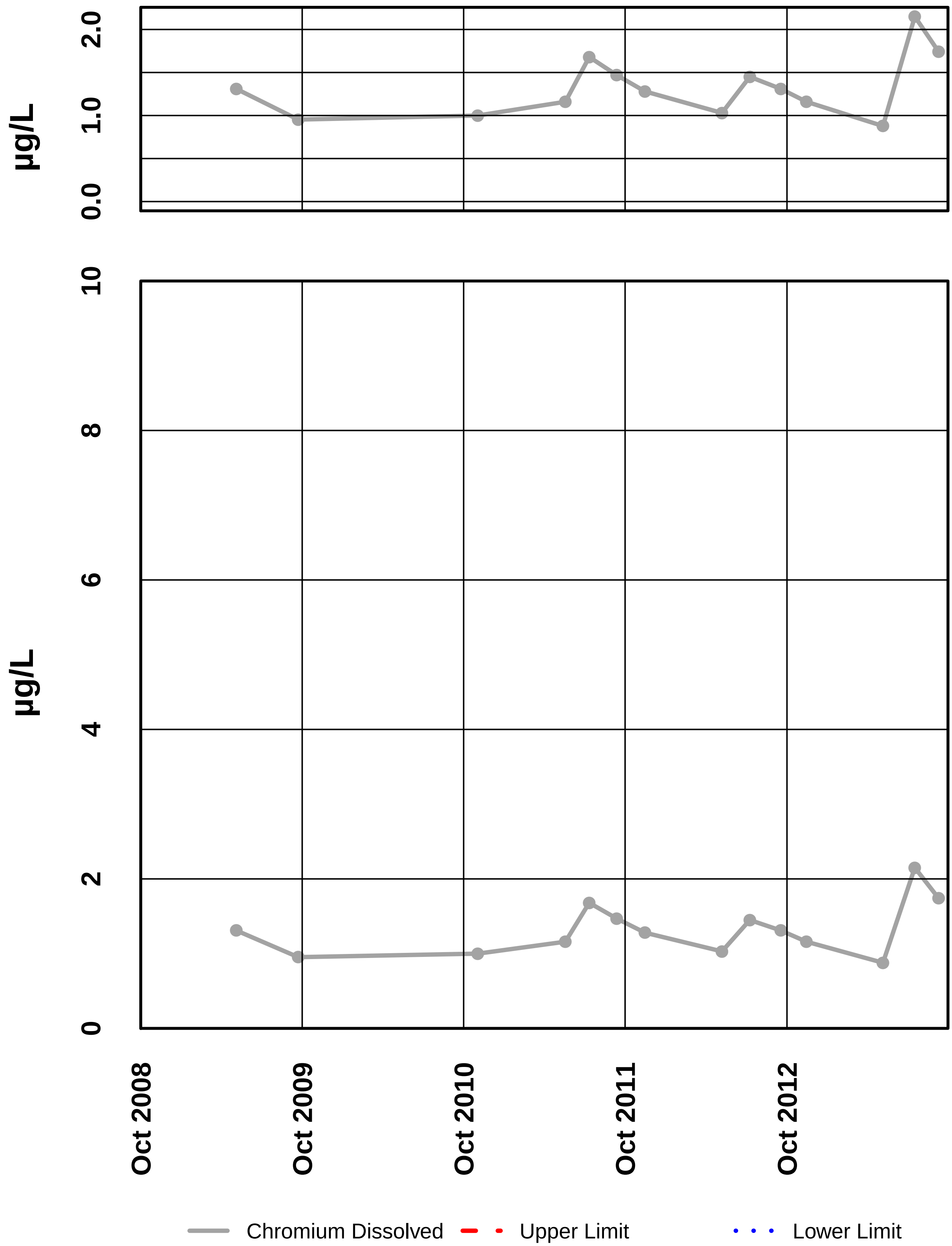
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 60 − Cadmium Dissolved

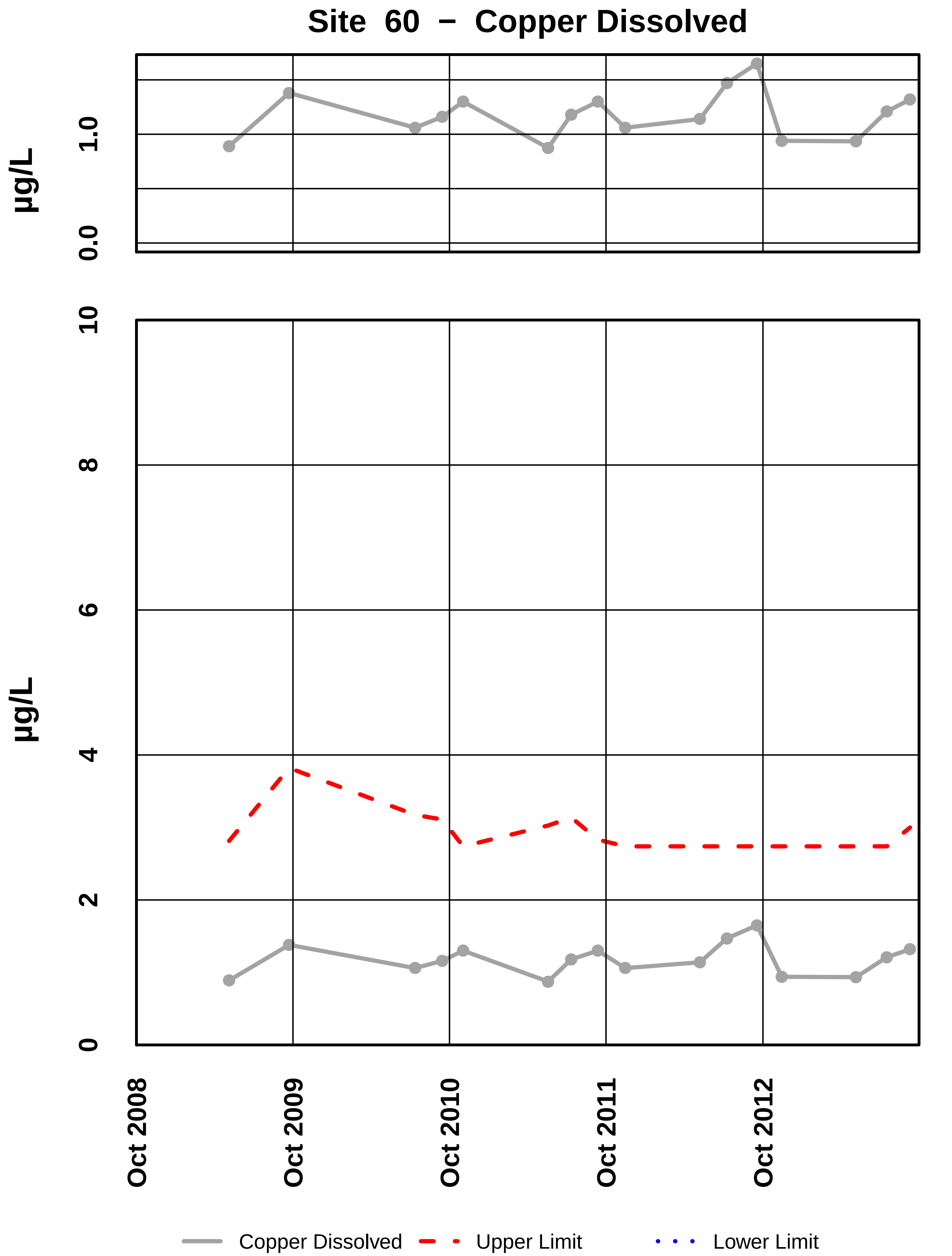


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

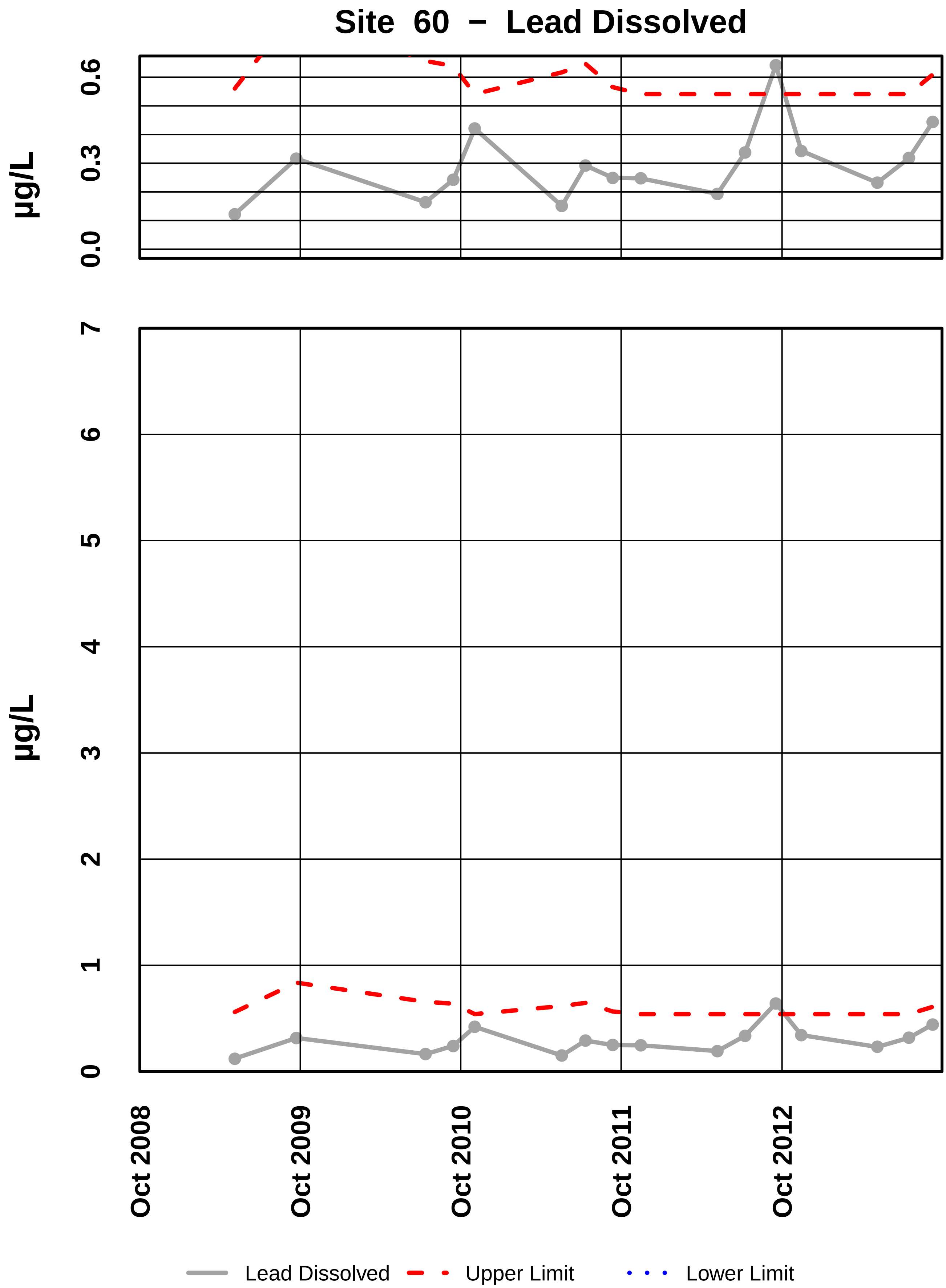
Site 60 – Chromium Dissolved



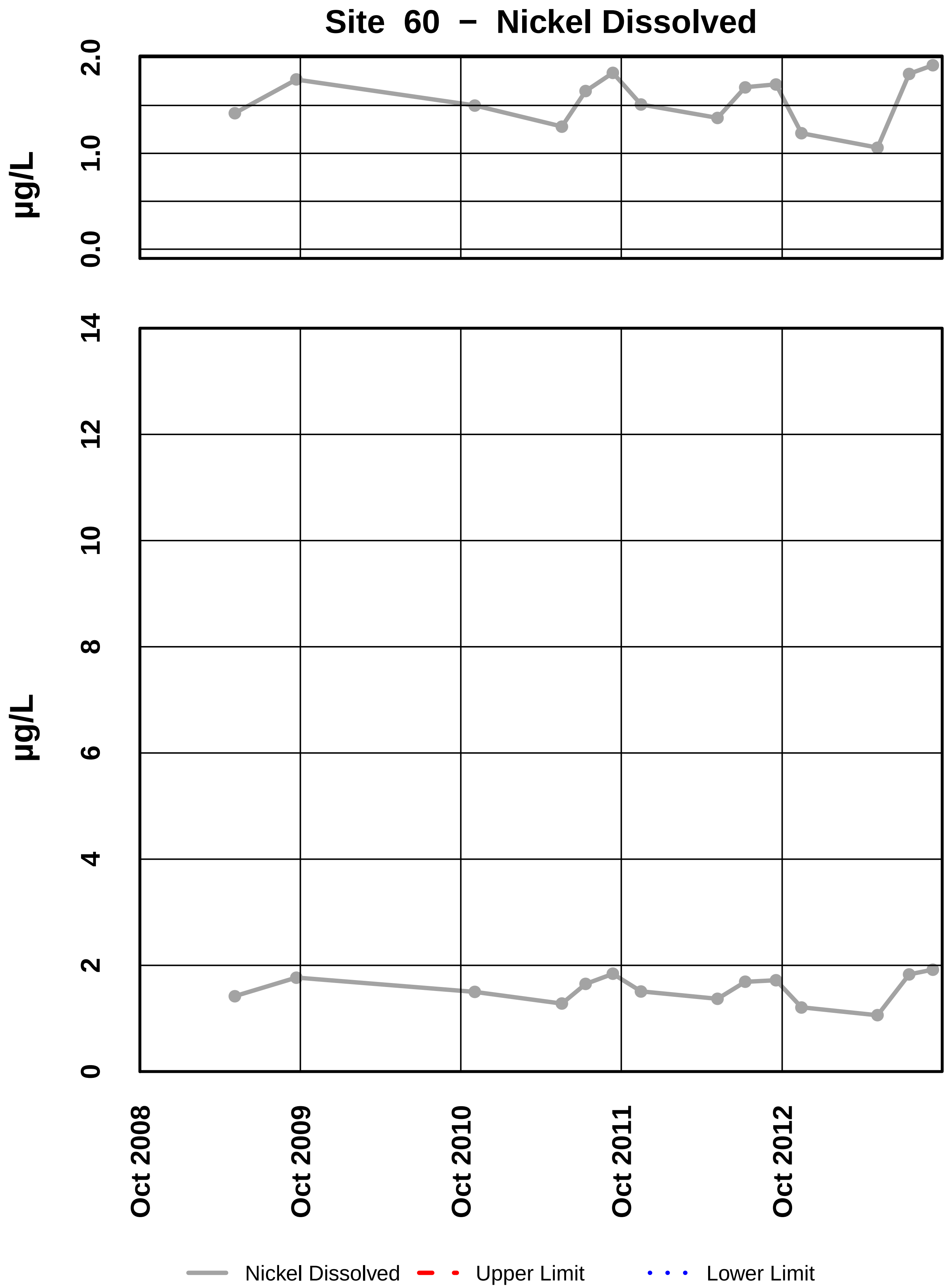
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



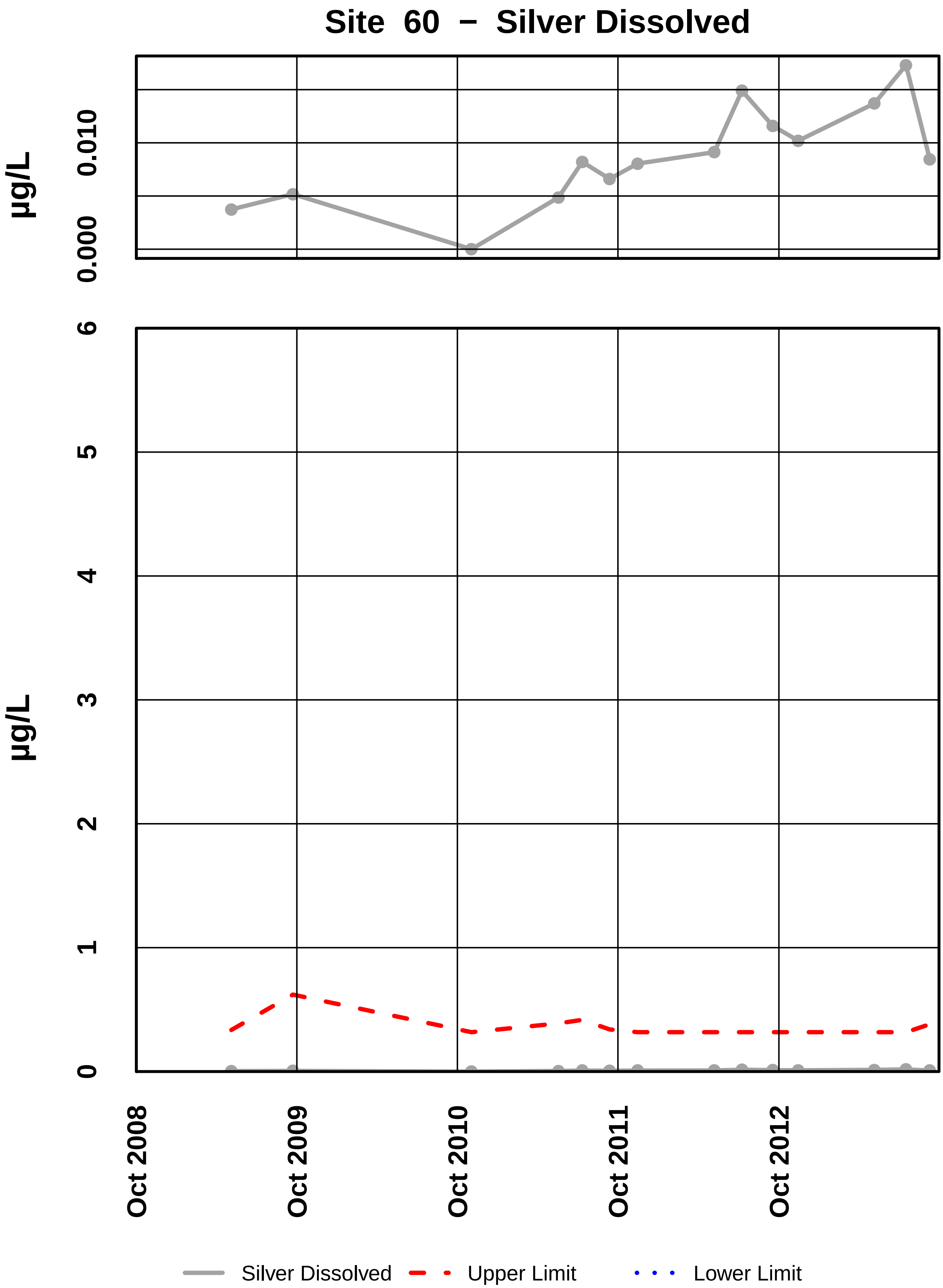
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



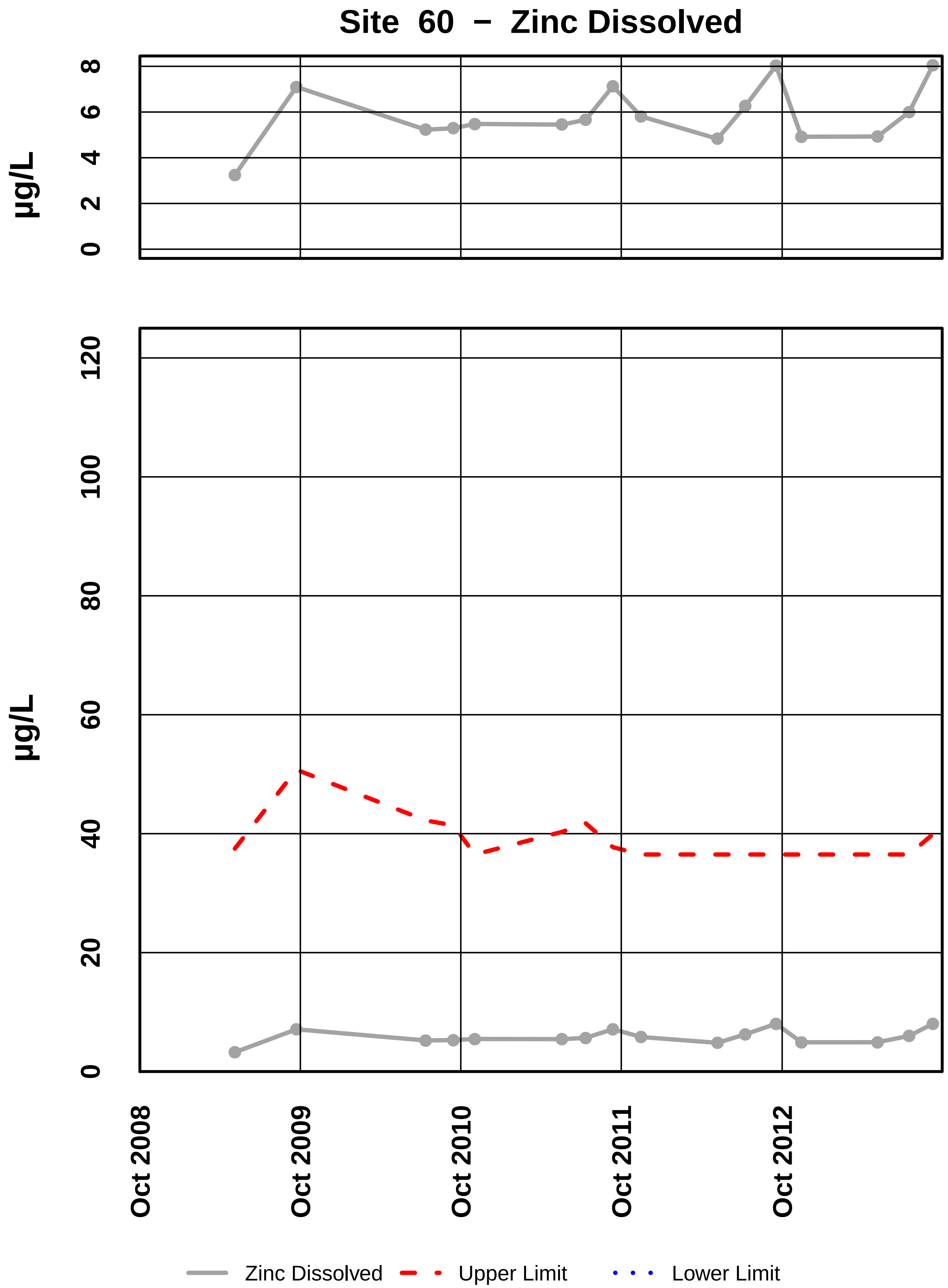
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



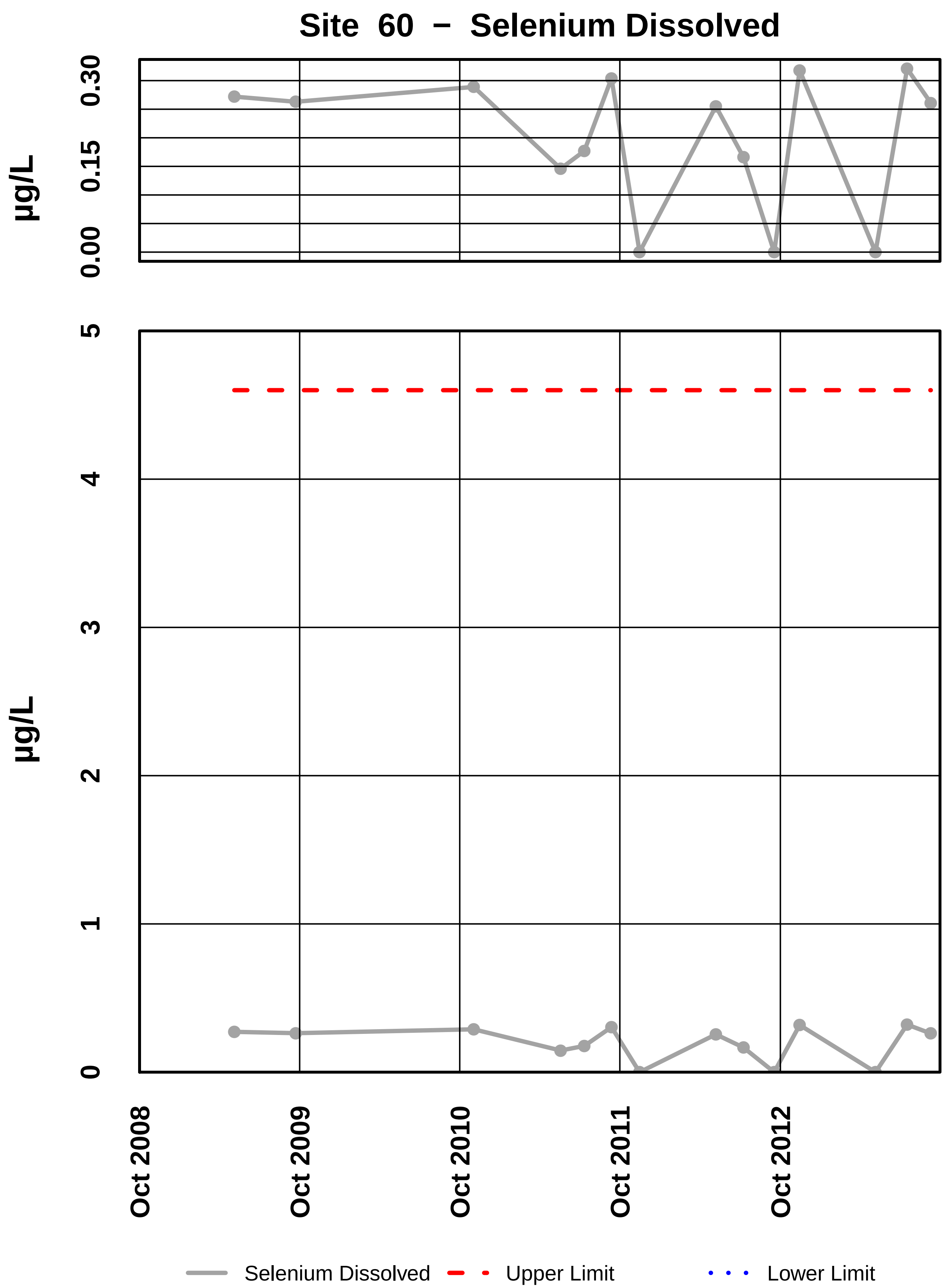
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

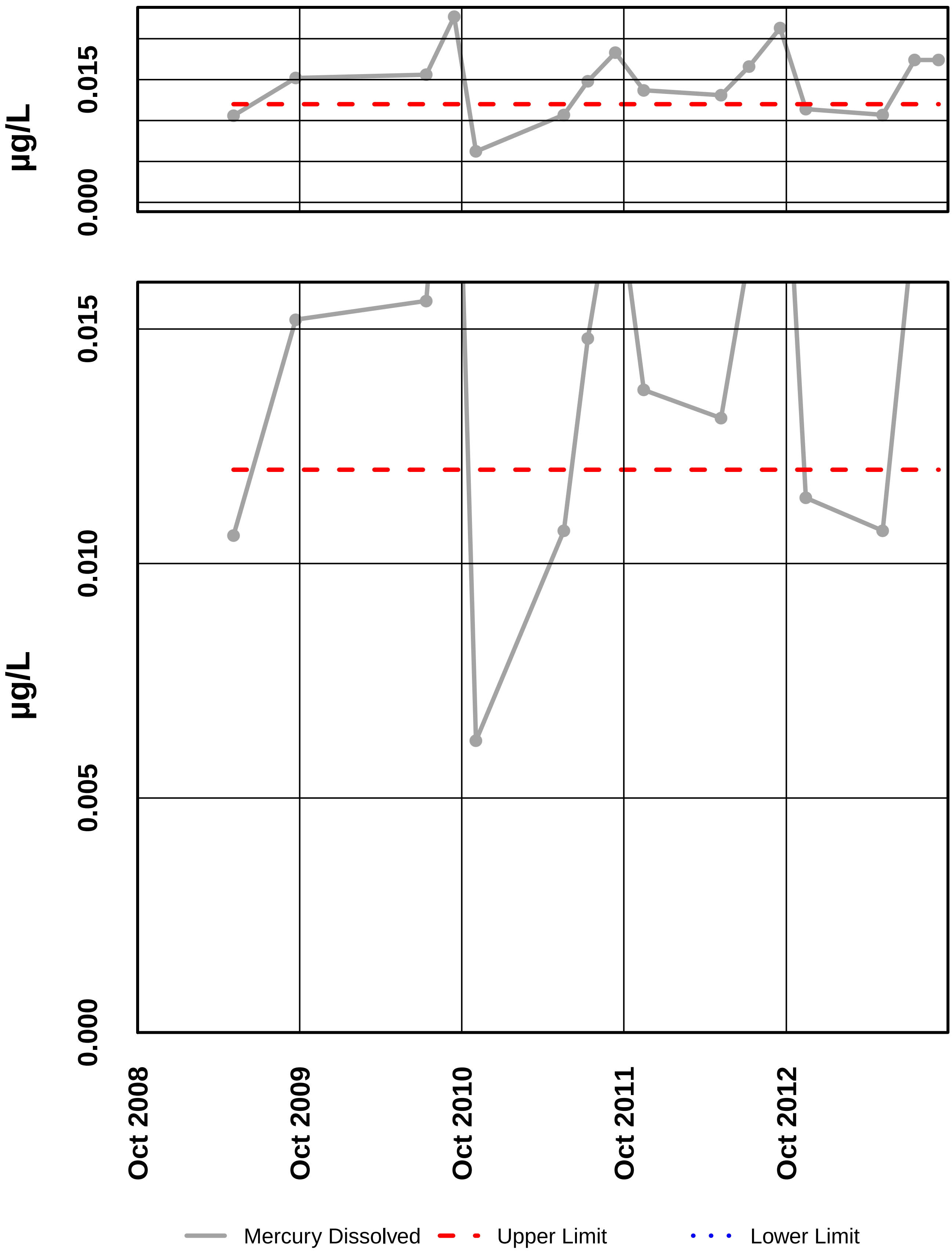


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

Site 60 – Mercury Dissolved



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

Site **#60** Seasonal Kendall analysis for Specific Conductance, Field (µS/cm)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**								0				60.1
b	**WY2009**								59.1				74.2
c	**WY2010**										54.7		51.6
d	**WY2011**		48.3						85		71		61
e	**WY2012**		50						55.3		47.1		45
f	**WY2013**		43						64		60		63
	n	0	3	0	0	0	0	0	5	0	4	0	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	0	3	0	0	0	0	0	5	0	4	0	6
t_2	0	0	0	0	0	0	0	0	0	0	0	0
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a								1				1
c-a												-1
d-a								1				1
e-a								1				-1
f-a								1				1
c-b												-1
d-b								1				-1
e-b								-1				-1
f-b								1				-1
d-c										1		1
e-c										-1		-1
f-c										1		1
e-d		1						-1		-1		-1
f-d		-1						-1		-1		1
f-e		-1						1		1		1
S_k	0	-1	0	0	0	0	0	4	0	0	0	-1

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=		3.67						16.67		8.67		28.33
$Z_k = S_k/\sigma_S$		-0.52						0.98		0.00		-0.19
Z^2_k		0.27						0.96		0.00		0.04

ΣZ_k= 0.27

ΣZ^2_k= 1.27

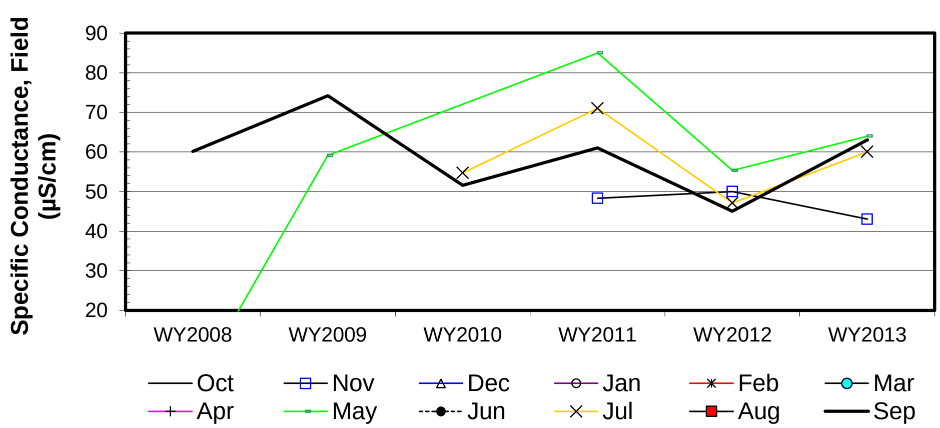
Z-bar=ΣZ_k/K= 0.07

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	18	0	0	0	0

Σn 18

ΣS_k 2

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=		1.25	@α=5% $\chi^2_{(K-1)}$=	7.81	Test for station homogeneity	
	p	**0.741**			$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
$\Sigma VAR(S_k)$	Z_{calc}	0.13	@α/2=2.5% Z=	1.96	H_0 (No trend)	ACCEPT
57.33	p	**0.553**			H_A (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-6.39		12.15
0.050	-3.90	**0.44**	4.91
0.100	-3.70		1.76
0.200	-2.89		1.31

Site **#60** Seasonal Kendall analysis for pH, Field, Standard Units

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**								0.0				6.5
b	**WY2009**								6.9				6.2
c	**WY2010**										5.5		6.5
d	**WY2011**		6.4						6.8		7.2		5.0
e	**WY2012**		6.4						5.8		6.6		6.1
f	**WY2013**		8.4						6.9		6.6		6.5
	n	0	3	0	0	0	0	0	5	0	4	0	6

t_1	0	3	0	0	0	0	0	5	0	4	0	6
t_2	0	0	0	0	0	0	0	0	0	0	0	0
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a								1				-1
c-a												-1
d-a								1				-1
e-a								1				-1
f-a								1				-1
c-b												1
d-b								-1				-1
e-b								-1				-1
f-b								-1				1
d-c										1		-1
e-c										1		-1
f-c										1		1
e-d		-1						-1		-1		1
f-d		1						1		-1		1
f-e		1						1		-1		1
S_k	0	1	0	0	0	0	0	2	0	0	0	-3

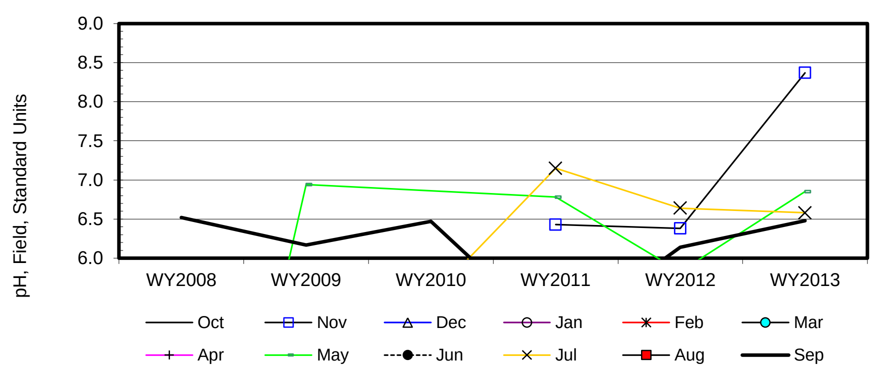
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=		3.67						16.67		8.67		28.33
$Z_k = S_k/\sigma_S$		0.52						0.49		0.00		-0.56
Z^2_k		0.27						0.24		0.00		0.32

ΣZ_k= 0.45
ΣZ^2_k= 0.83
Z-bar=$\Sigma Z_k/K$= 0.11

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	18	0	0	0	0

Σn 18
ΣS_k 0

$\chi^2_h=\Sigma Z^2_k - K(\text{Z-bar})^2$=	0.78	@α=5% $\chi^2_{(K-1)}$= 7.81	Test for station homogeneity	
p	**0.854**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k) Z_{calc}	0.00	@α/2=2.5% Z= 1.96	H_0 (No trend)	ACCEPT
57.33 p	**0.500**		H_A (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.26		0.93
0.050	-0.08	**0.00**	0.41
0.100	-0.06		0.33
0.200	-0.03		0.12

Site #60 Seasonal Kendall analysis for Total Alk, (mg/l)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	WY2008								0.0				12.6
b	WY2009								12.8				7.2
c	WY2010										11.3		10.7
d	WY2011		5.6						7.9		10.3		9.9
e	WY2012		9.7						7.0		9.0		8.9
f	WY2013		10.8						10.7		14.5		11.7
	n	0	3	0	0	0	0	0	5	0	4	0	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	0	3	0	0	0	0	0	5	0	4	0	6
t_2	0	0	0	0	0	0	0	0	0	0	0	0
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a								1				-1
c-a												-1
d-a								1				-1
e-a								1				-1
f-a								1				-1
c-b												1
d-b								-1				1
e-b								-1				1
f-b								-1				1
d-c										-1		-1
e-c										-1		-1
f-c										1		1
e-d		1						-1		-1		-1
f-d		1						1		1		1
f-e		1						1		1		1
S_k	0	3	0	0	0	0	0	2	0	0	0	-1

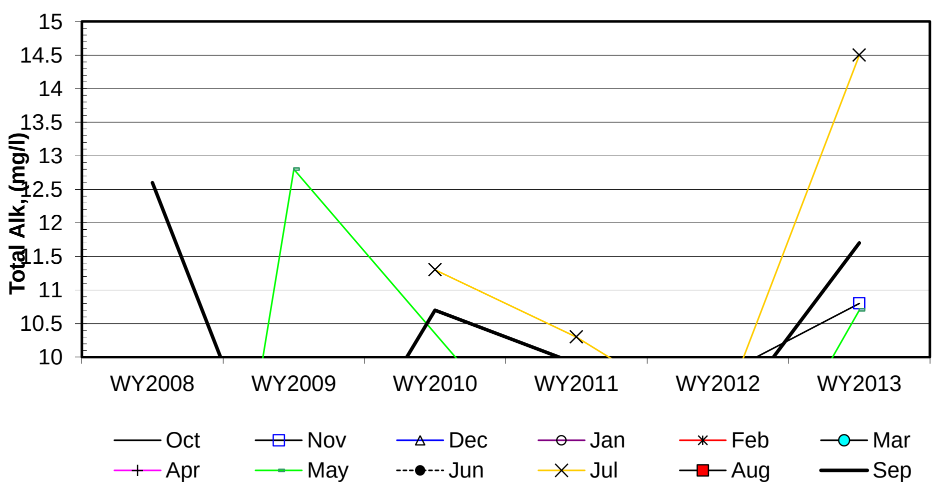
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=		3.67						16.67		8.67		28.33
$Z_k = S_k/\sigma_S$		1.57						0.49		0.00		-0.19
Z^2_k		2.45						0.24		0.00		0.04

ΣZ_k= 1.87
ΣZ^2_k= 2.73
Z-bar=ΣZ_k/K= 0.47

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	18	0	0	0	0

Σn 18
ΣS_k 4

$\chi^2_h=\Sigma Z^2_k$-K(Z-bar)^2=	1.86	@α=5% $\chi^2_{(K-1)}$= 7.81	Test for station homogeneity	
p	**0.603**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc} 0.40	@α/2=2.5% Z= 1.96	H_0 (No trend)	ACCEPT
57.33	p **0.654**		H_A (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.95		2.13
0.050	-0.90	**0.73**	1.48
0.100	-0.89		1.32
0.200	-0.58		1.10

Site #60 — Seasonal Kendall analysis for Sulfate, Total (mg/l)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**								0.0				0.0
b	**WY2009**								6.2				20.3
c	**WY2010**										0.0		0.0
d	**WY2011**		0.0						6.2		0.0		0.0
e	**WY2012**		0.0						0.0		0.0		4.1
f	**WY2013**		0.0						0.0		0.0		3.6
	n	0	3	0	0	0	0	0	5	0	4	0	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	0	0	0	0	0	0	0	2	0	0	0	3
t_2	0	0	0	0	0	0	0	0	0	0	0	0
t_3	0	1	0	0	0	0	0	1	0	0	0	1
t_4	0	0	0	0	0	0	0	0	0	1	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a								1				1
c-a												0
d-a								1				0
e-a								0				1
f-a								0				1
c-b												-1
d-b								-1				-1
e-b								-1				-1
f-b								-1				-1
d-c										0		0
e-c										0		1
f-c										0		1
e-d		0						-1		0		1
f-d		0						-1		0		1
f-e		0						0		0		-1
S_k	0	0	0	0	0	0	0	-3	0	0	0	2

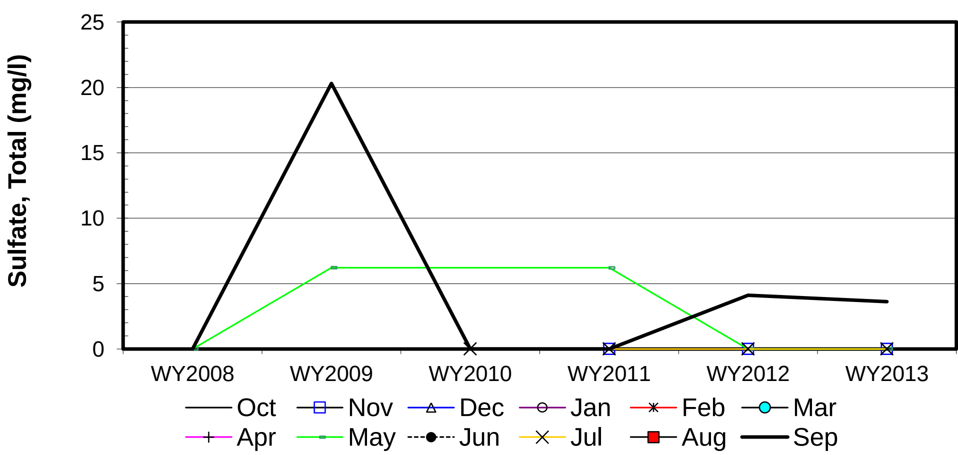
	Nov	May	Jul	Sep
σ^2_S=	0.00	13.00	0.00	24.67
$Z_k = S_k/\sigma_S$	#DIV/0!	-0.83	#DIV/0!	0.40
Z^2_k	#DIV/0!	0.69	#DIV/0!	0.16

ΣZ_k= #DIV/0!
ΣZ^2_k= #DIV/0!
Z-bar=ΣZ_k/K= #DIV/0!

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	5	0	3	1	0

Σn 18
ΣS_k -1

$\chi^2_h = \Sigma Z^2_k - K(\text{Z-bar})^2$=	#DIV/0!	@α=5% $\chi^2_{(K-1)}$= 7.81	Test for station homogeneity	
p	**#DIV/0!**		$\chi^2_h < \chi^2_{(K-1)}$	#DIV/0!
ΣVAR(S_k)	Z_{calc} 0.00	@α=2.5% Z= 1.96	H_0 (No trend)	ACCEPT
37.67	p **0.500**		H_A (± trend)	#DIV/0!



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.07		0.00
0.050	0.00	0.00	0.00
0.100	0.00		0.00
0.200	0.00		0.00

#DIV/0!

Site #60 — Seasonal Kendall analysis for Zinc, Dissolved (ug/l)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2008**								0.0				6.3
b	**WY2009**								3.2				7.1
c	**WY2010**										5.2		5.3
d	**WY2011**		5.5						5.5		5.7		7.1
e	**WY2012**		5.8						4.8		6.3		8.0
f	**WY2013**		4.9						4.9		6.0		8.1
	n	0	3	0	0	0	0	0	5	0	4	0	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	0	3	0	0	0	0	0	5	0	4	0	6
t_2	0	0	0	0	0	0	0	0	0	0	0	0
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a								1				1
c-a												-1
d-a								1				1
e-a								1				1
f-a								1				1
c-b												-1
d-b								1				1
e-b								1				1
f-b								1				1
d-c										1		1
e-c										1		1
f-c										1		1
e-d		1						-1		1		1
f-d		-1						-1		1		1
f-e		-1						1		-1		1
S_k	0	-1	0	0	0	0	0	6	0	4	0	11

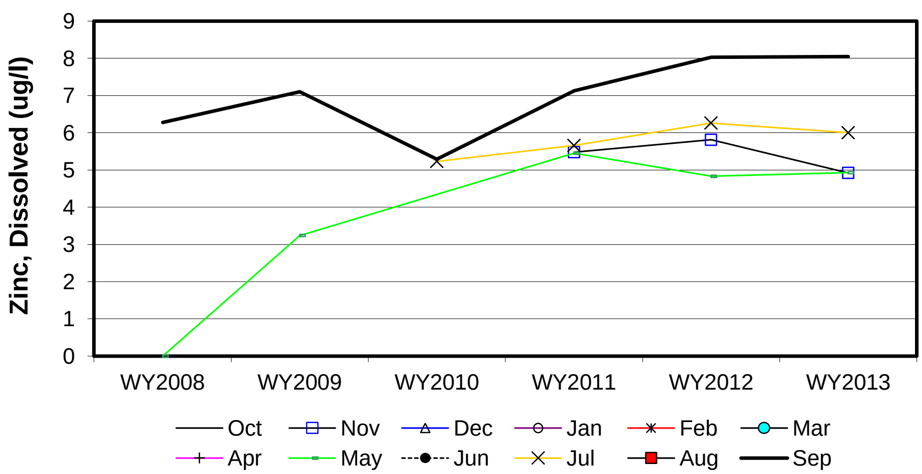
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=		3.67						16.67		8.67		28.33
$Z_k = S_k/\sigma_S$		-0.52						1.47		1.36		2.07
Z^2_k		0.27						2.16		1.85		4.27

ΣZ_k= 4.37
ΣZ^2_k= 8.55
Z-bar=ΣZ_k/K= 1.09

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	18	0	0	0	0

Σn 18
ΣS_k 20

$\chi^2_h=\Sigma Z^2_k - K(\text{Z-bar})^2$=	3.77	@α=5% $\chi^2_{(K-1)}$= 7.81	Test for station homogeneity	
p	**0.287**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k) Z_{calc}	2.51	@α/2=2.5% Z= 1.96	**H_0** (No trend)	REJECT
57.33 **p**	**0.994**		**H_A** (± trend)	ACCEPT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	0.02		0.88
0.050	0.15	**0.39**	0.55
0.100	0.24		0.51
0.200	0.28		0.44

7.0%

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 up gradient from the site.

The data collected during the current water year are listed in the following "Table of Results for Water Year 2013" 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 2013.				

The data for Water Year 2013 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 2013

			Limits		
Sample Date	**Parameter**	**Value**	**Lower**	**Upper**	**Hardness**
6-May-13	Alkalinity	16.8 mg/L	20		
9-Sep-13	Alkalinity	19 mg/L	20		

Though two of the three samples were below the minimal limit for alkalinity, the other sample was just at the lower limit. These low alkalinity values are expected, because a portion of the drainage through the site consists of waters originating in the low alkalinity muskegs areas, such as those being monitored at Site 29.

Table of Results for Water Year 2013

Site 609FMS - 'Further Creek Lower'

Sample Date/Parameter	Oct 2012	Nov 2012	Dec 2012	Jan 2013	Feb 2013	Mar 2013	Apr 2013	May 2013	Jun 2013	Jul 2013	Aug 2013	Sep 2013	**Median**
Water Temp (°C)								4		11.1		10.9	10.9
Conductivity-Field(µmho)								420		455		546	455.0
Conductivity-Lab (µmho)								404		438		404	404
pH Lab (standard units)								6.77		6.93		7.25	6.93
pH Field (standard units)								7.06		6.83		6.89	6.89
Total Alkalinity (mg/L)								16.8		20		19	19.0
Total Sulfate (mg/L)								165.8		183			174.4
Hardness (mg/L)								180		207		253	207.0
Dissolved As (ug/L)								0.903		0.944		1.65	0.944
Dissolved Ba (ug/L)								45.7		55.1		63.1	55.1
Dissolved Cd (ug/L)								0.249		0.146		0.219	0.2190
Dissolved Cr (ug/L)								0.753		1.29		1.62	1.290
Dissolved Cu (ug/L)								0.715		0.832		0.949	0.832
Dissolved Pb (ug/L)								0.396		0.273		0.561	0.3960
Dissolved Ni (ug/L)								4.83		5.38		7.63	5.380
Dissolved Ag (ug/L)								0.004		0.011		0.002	0.004
Dissolved Zn (ug/L)								94.2		59.1		98.1	94.20
Dissolved Se (ug/L)								1.06		0.388		1.46	1.060
Dissolved Hg (ug/L)								0.00303		0.00382		0.00508	0.003820

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

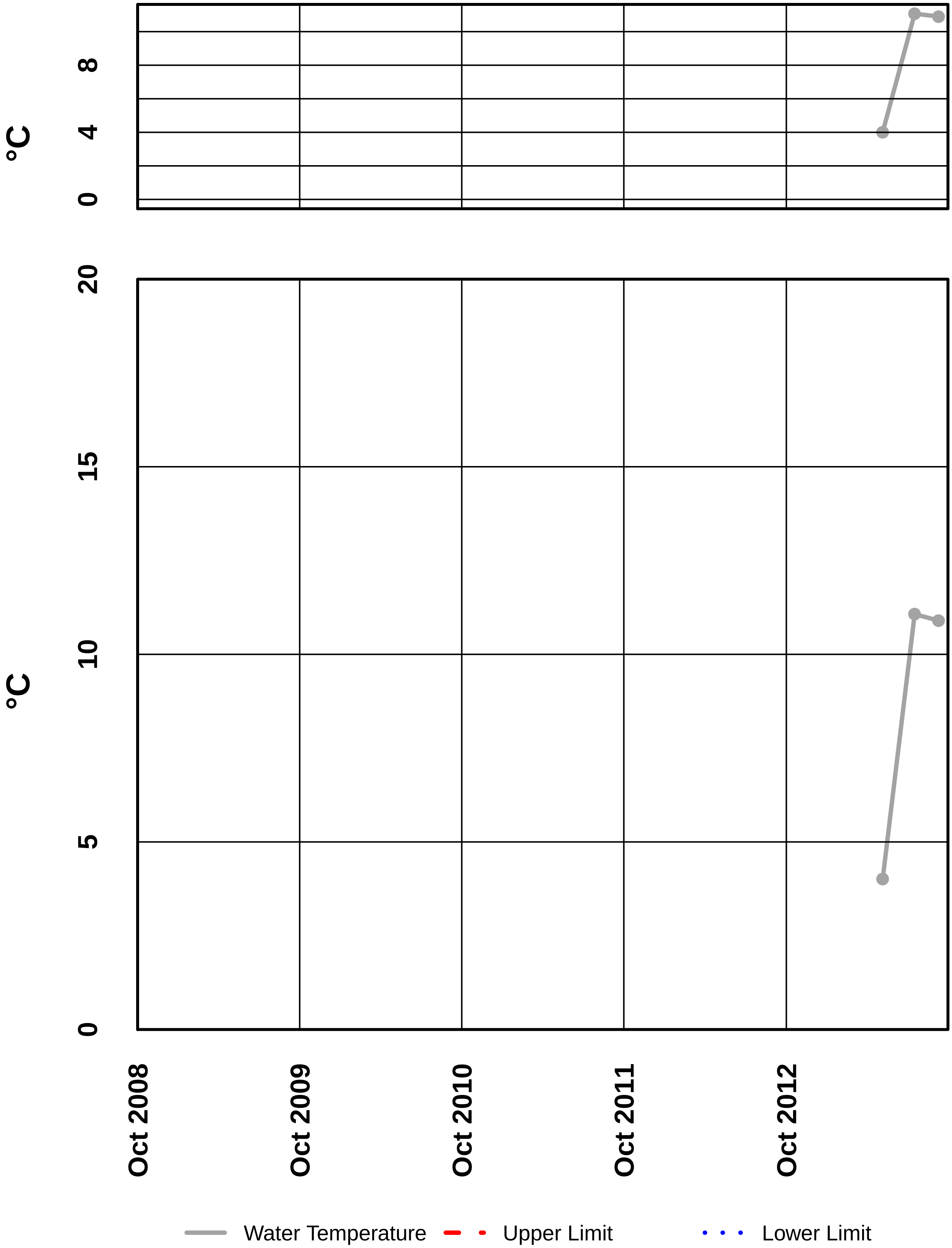
Qualified Data by QA Reviewer

Date Range: 10/01/2012 to 09/30/2013

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
609	9/9/2013	12:00 AM	SO4 Tot, mg/l	236	J	Sample receipt temperature
609	5/6/2013	12:00 AM	SO4 Tot, mg/l	165.8	J	Sample Receipt Temperature
			Ag diss, µg/l	0.0038	J	Below Quantitative Range
			pH Lab, su	6.77	J	Hold Time Violation
			Alk, mg/L	16.8	U	Field Blank Contamination
609	7/17/2013	12:00 AM	SO4 Tot, mg/l	183	J	Sample Receipt Temperature

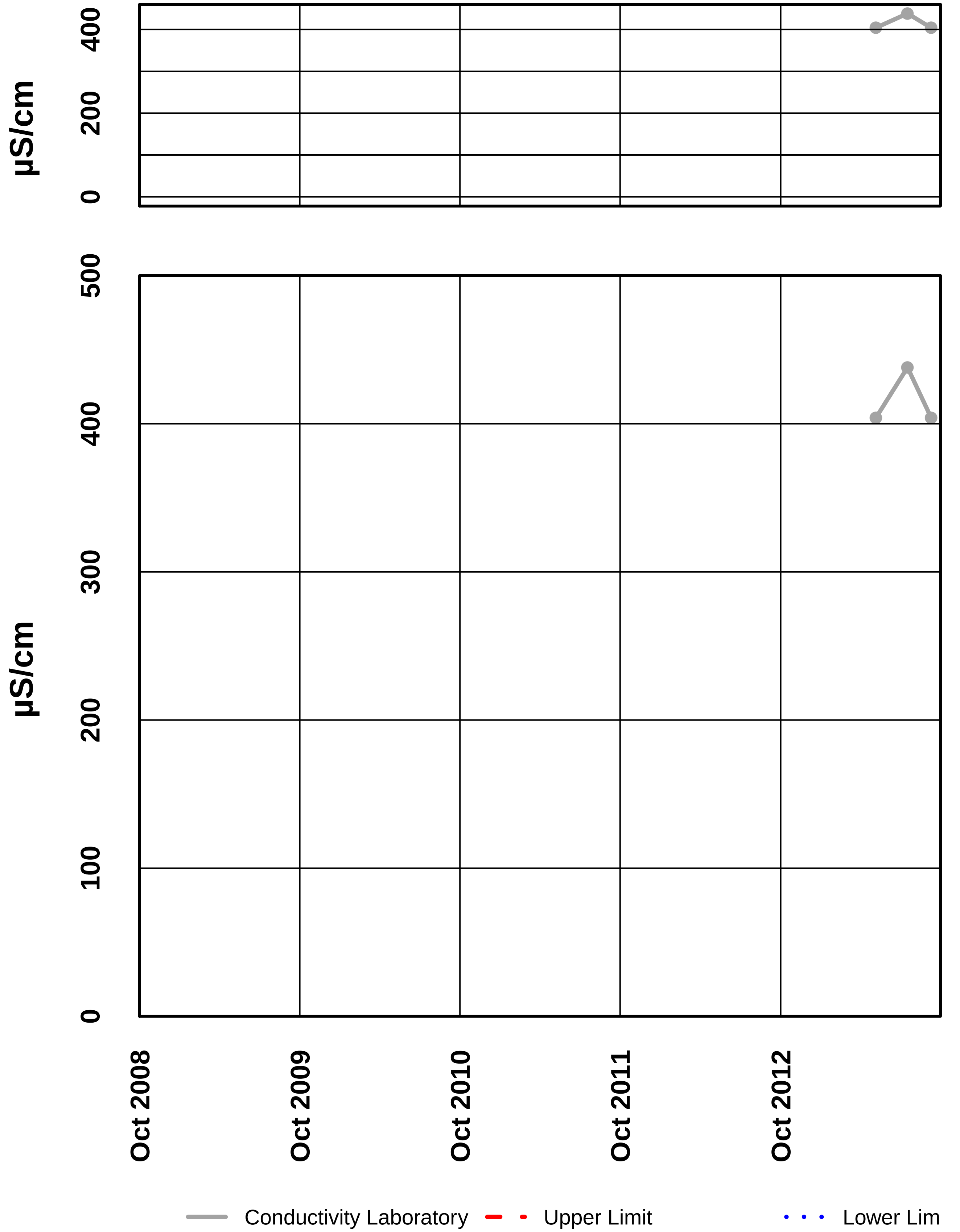
Qualifier	Description
J	Positively Identified - Approximate concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit

Site 609 – Water Temperature



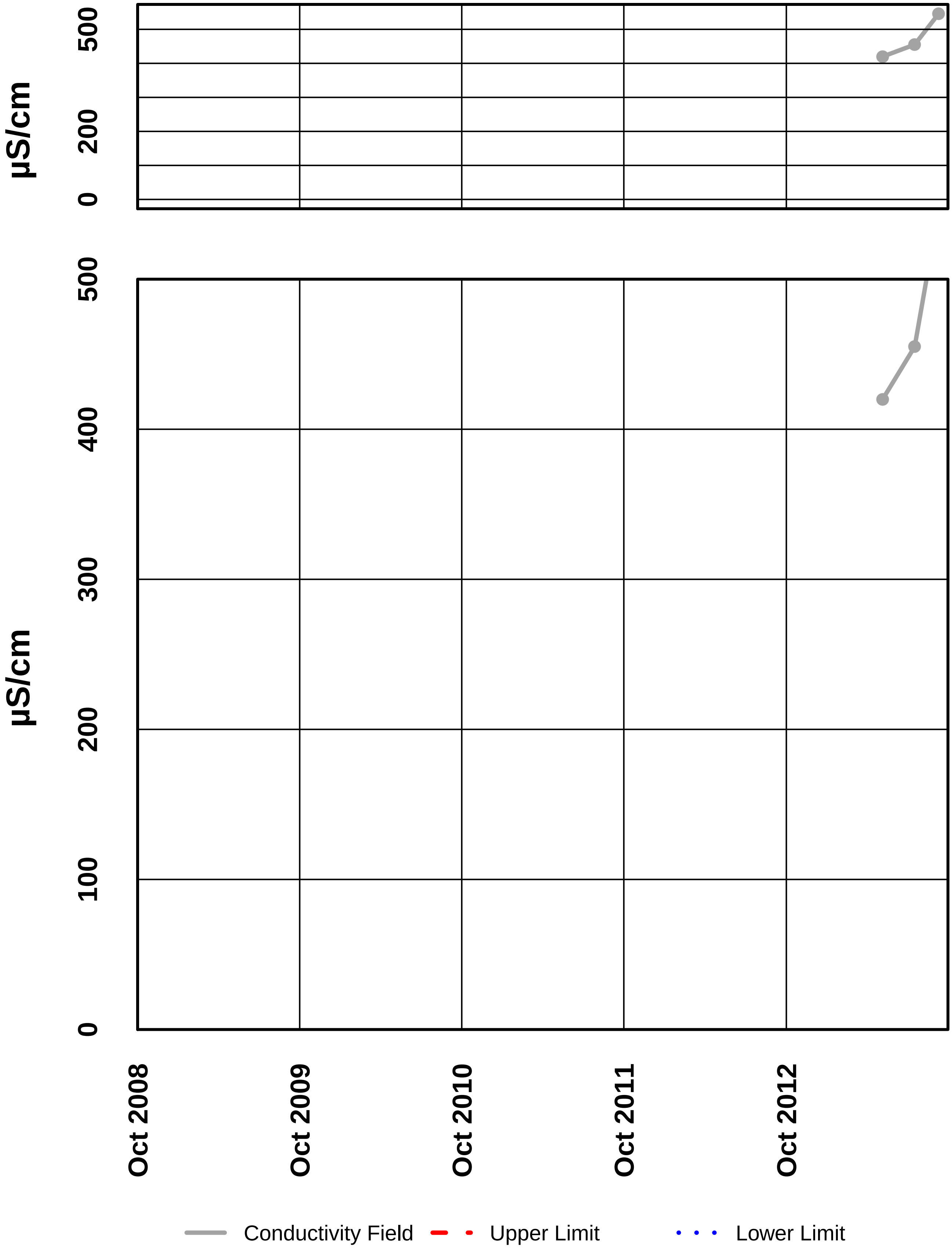
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 609 – Conductivity Laboratory



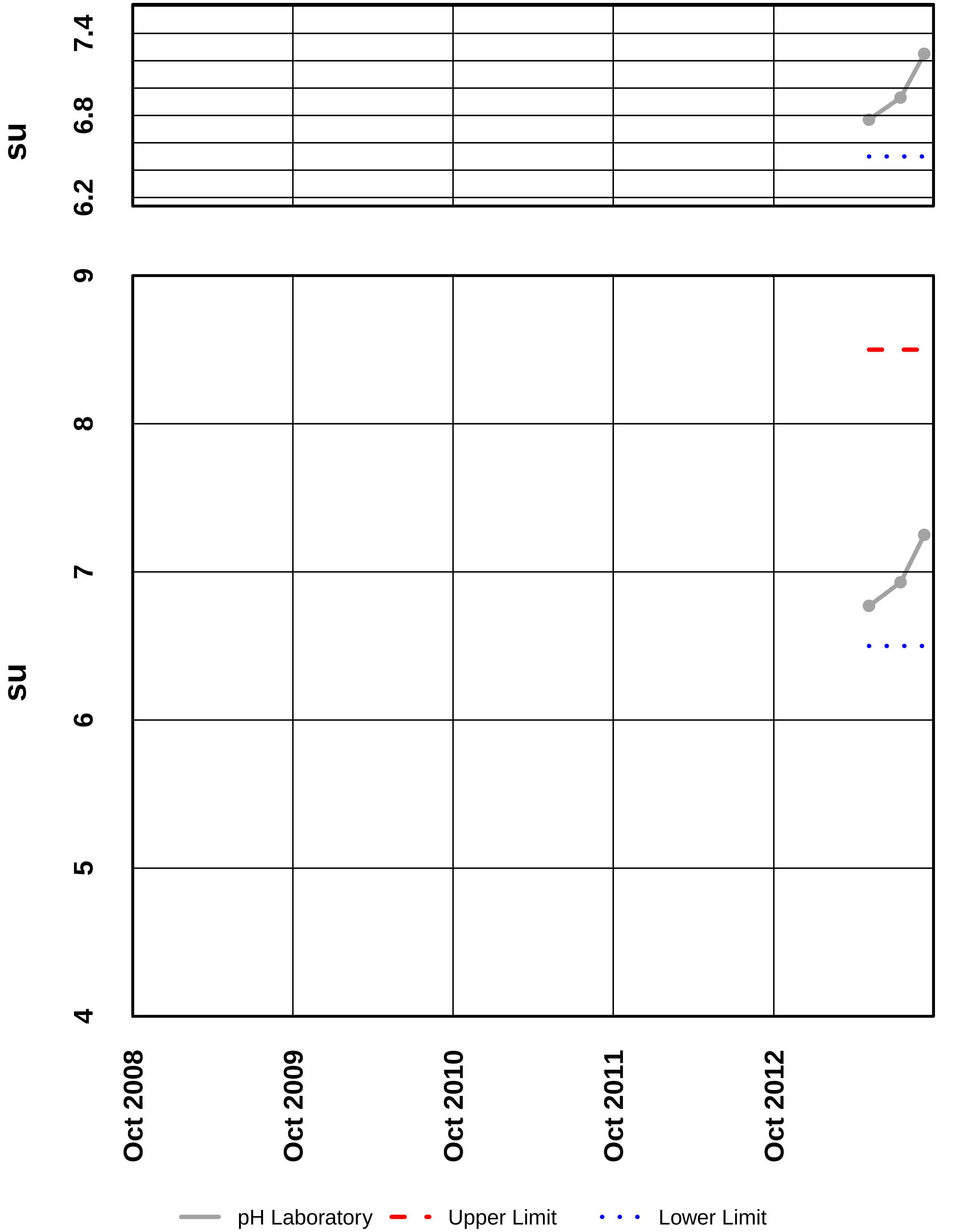
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 609 – Conductivity Field



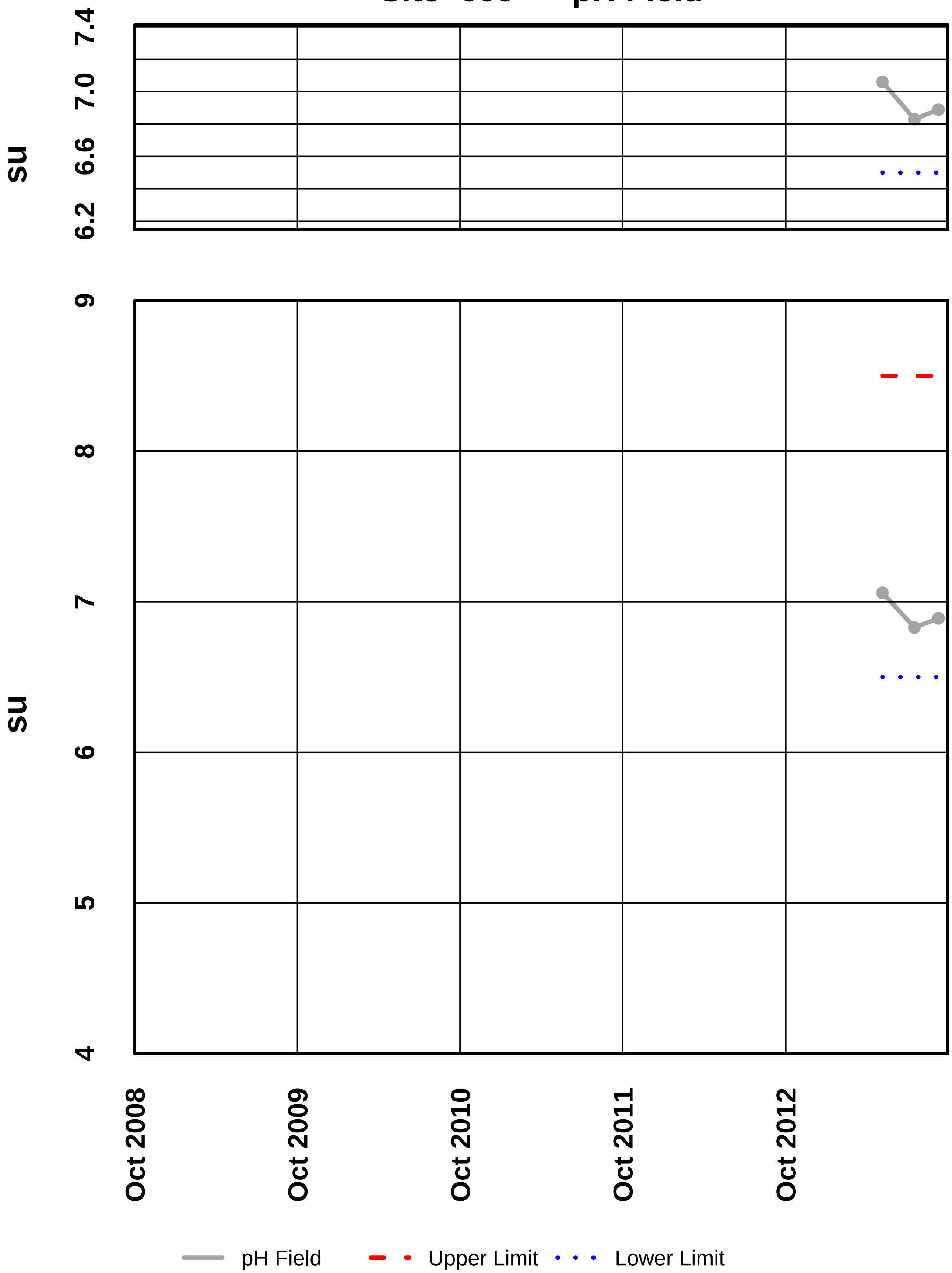
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 609 – pH Laboratory

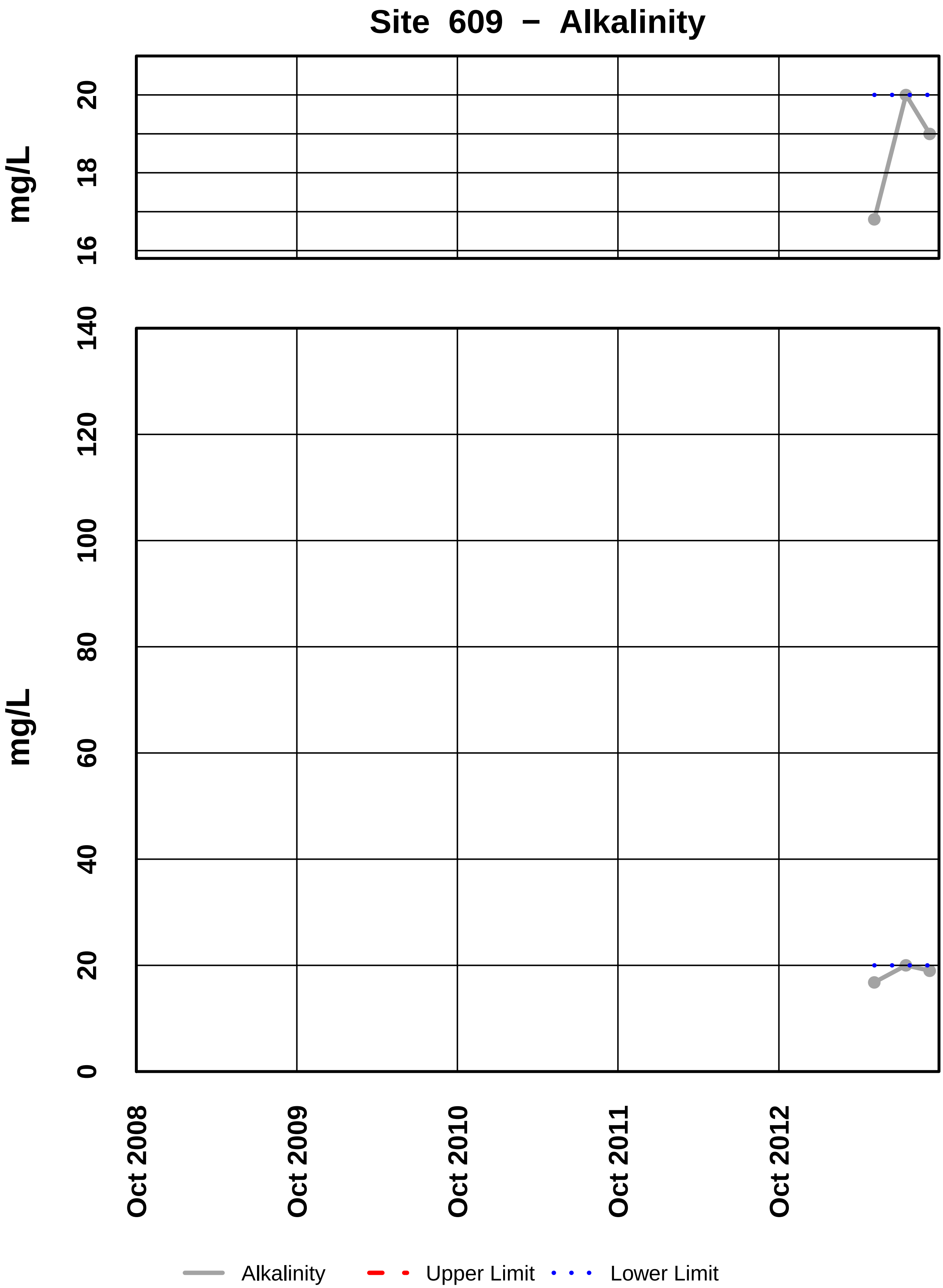


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 609 – pH Field

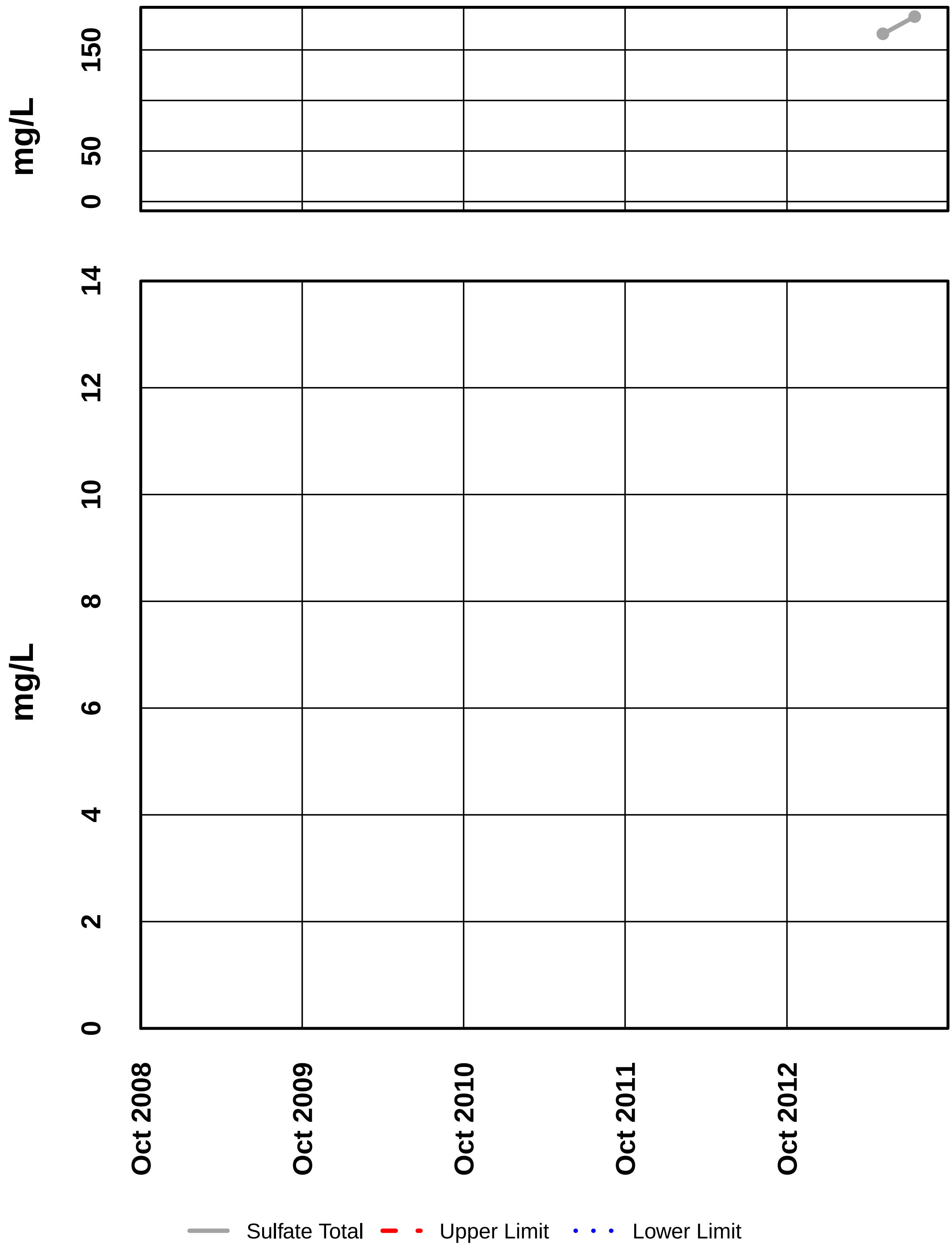


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



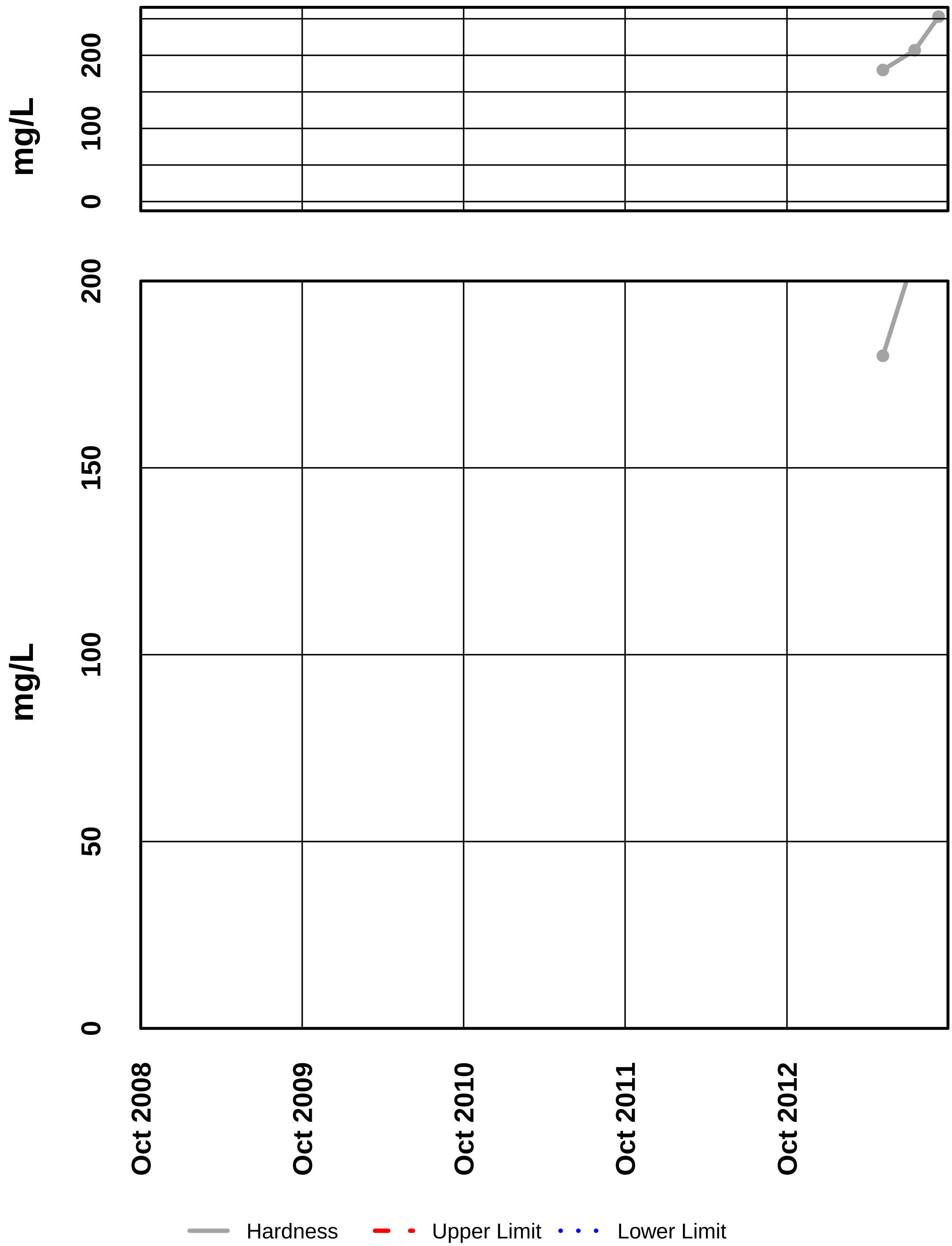
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 609 – Sulfate Total



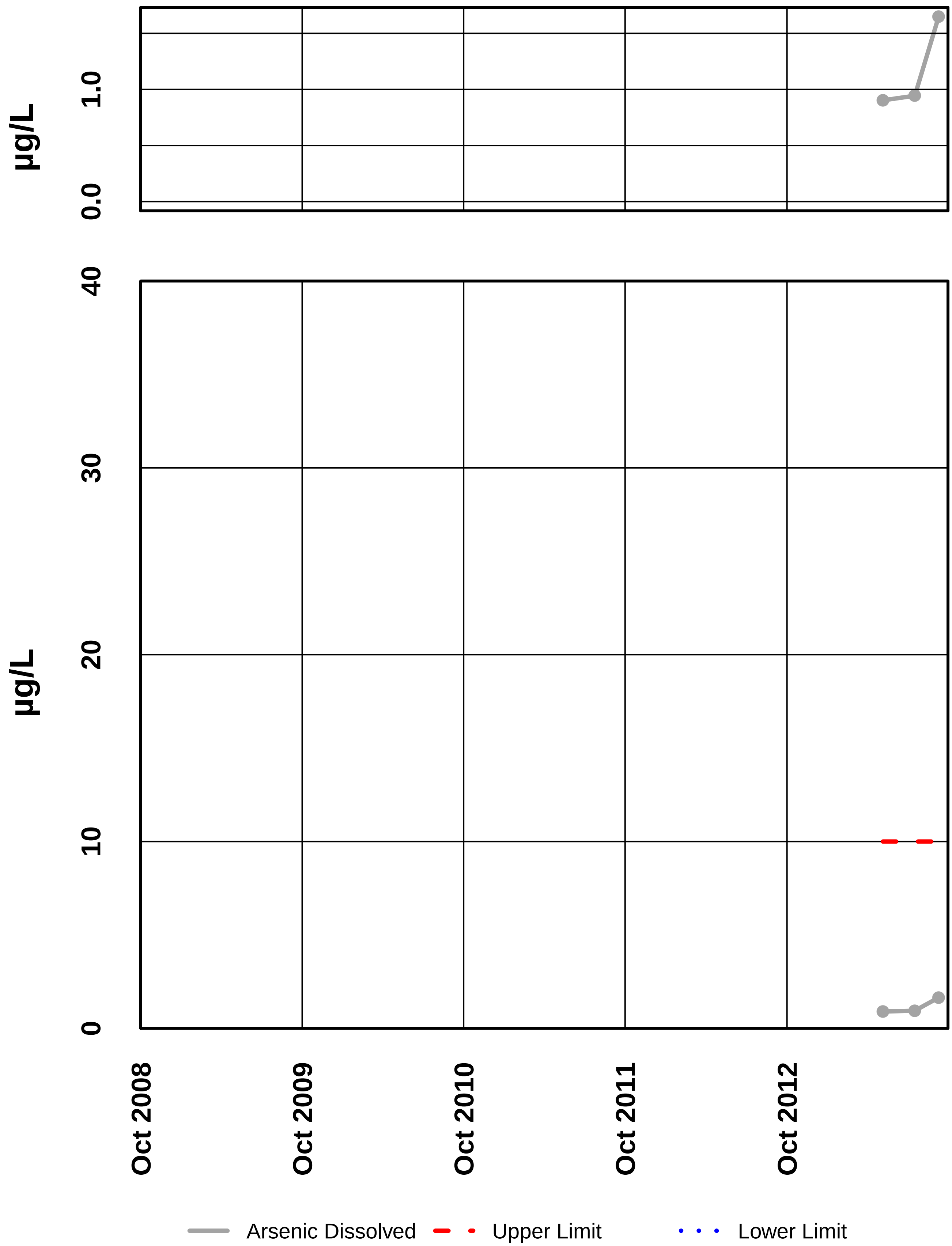
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 609 – Hardness



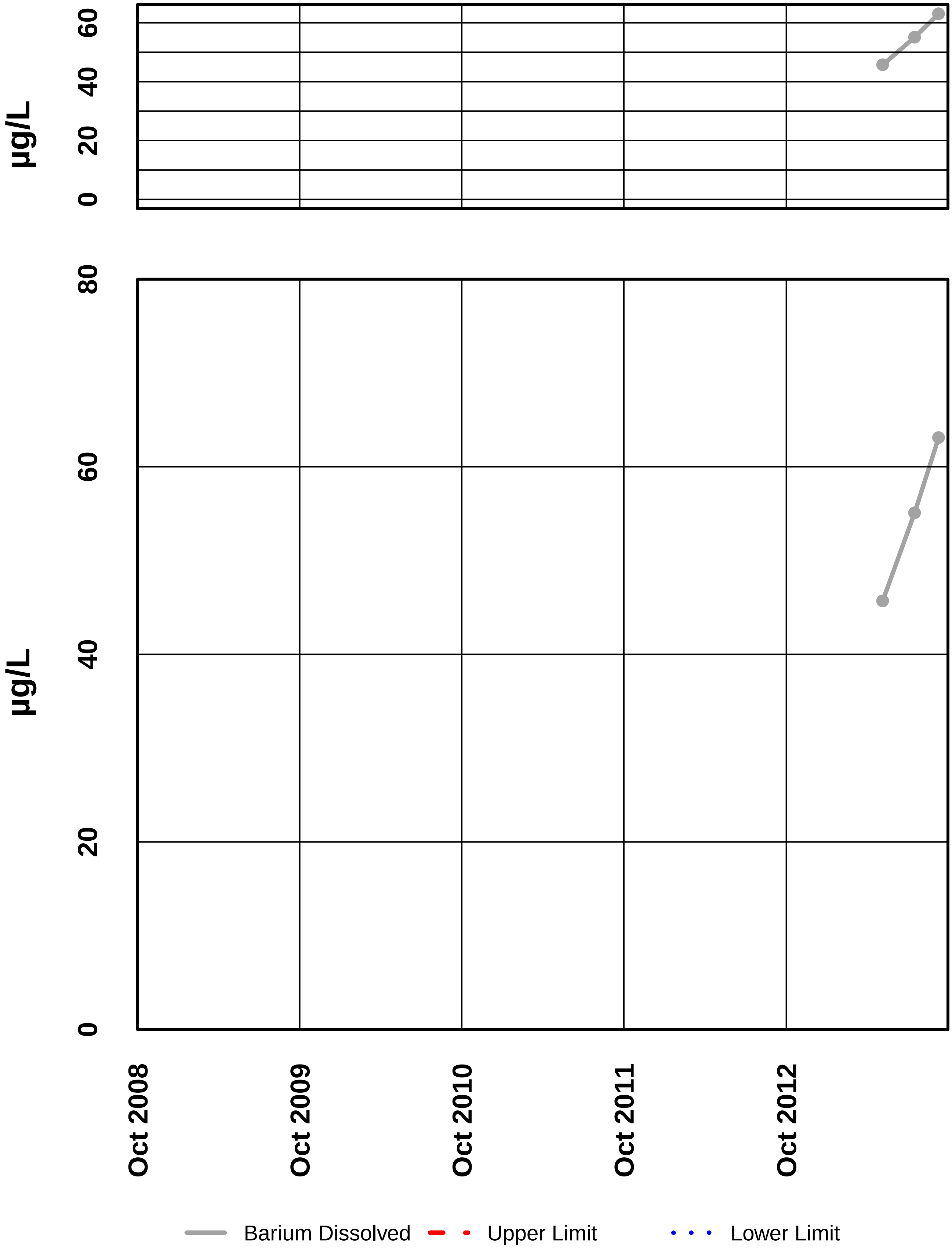
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 609 – Arsenic Dissolved



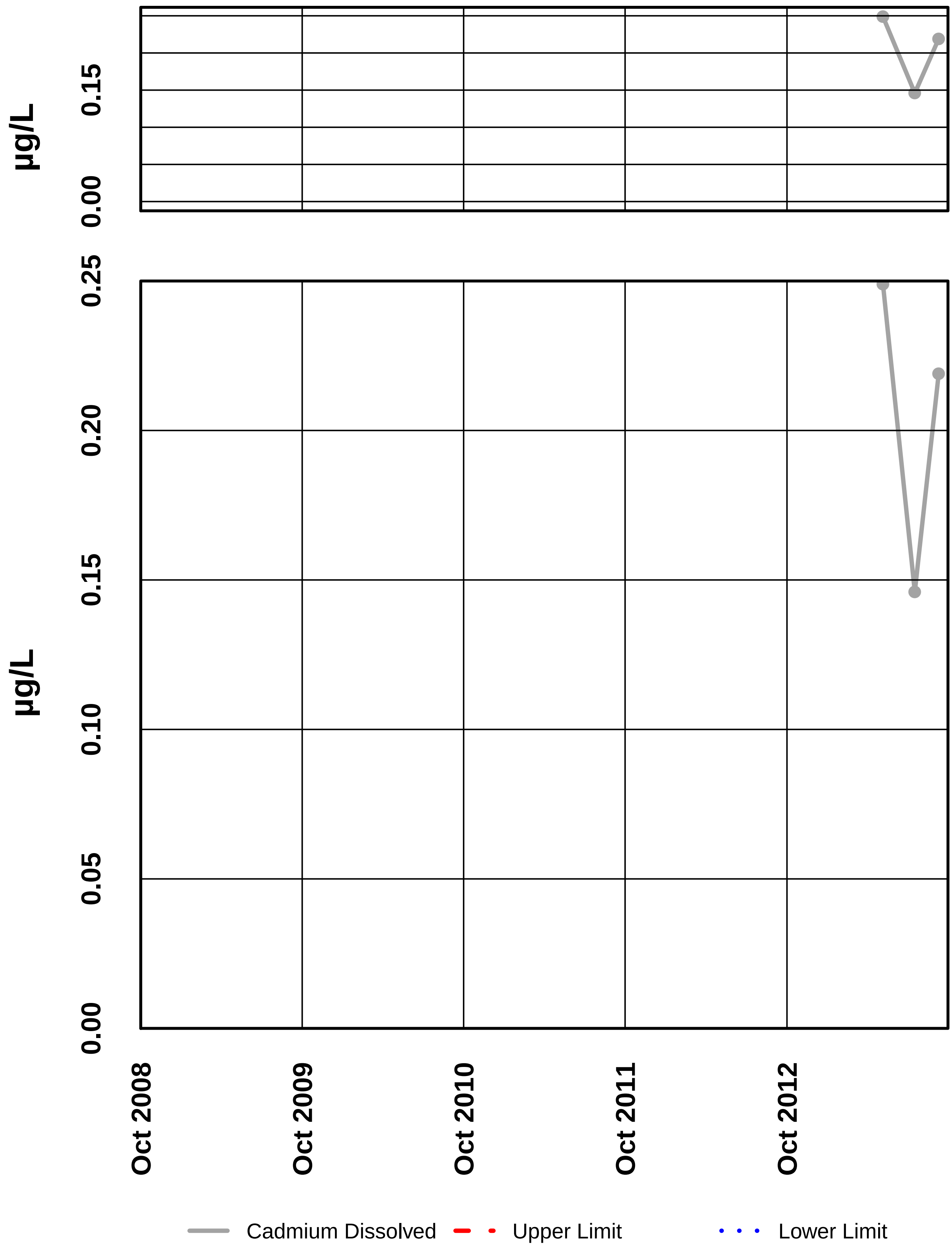
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 609 – Barium Dissolved



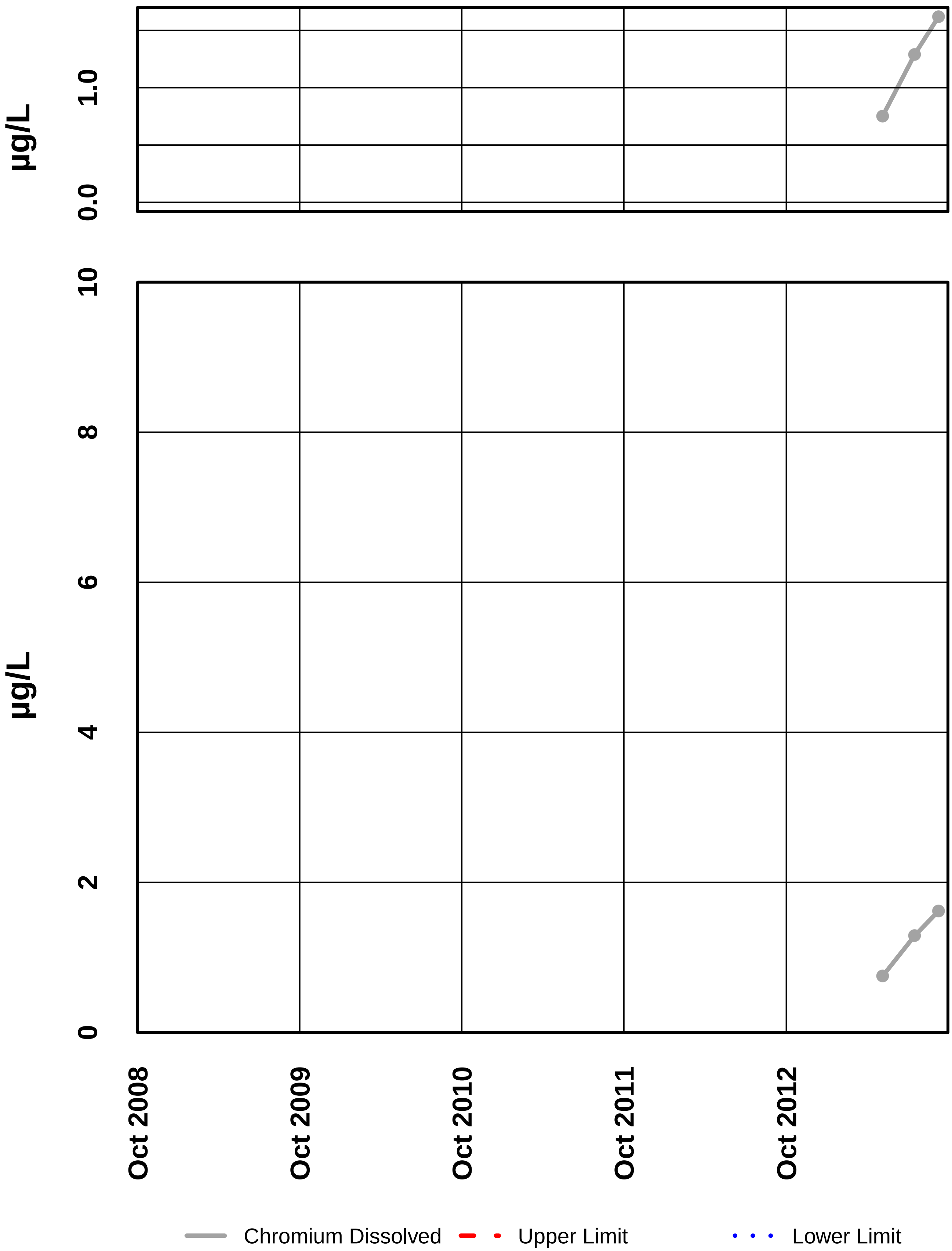
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 609 – Cadmium Dissolved



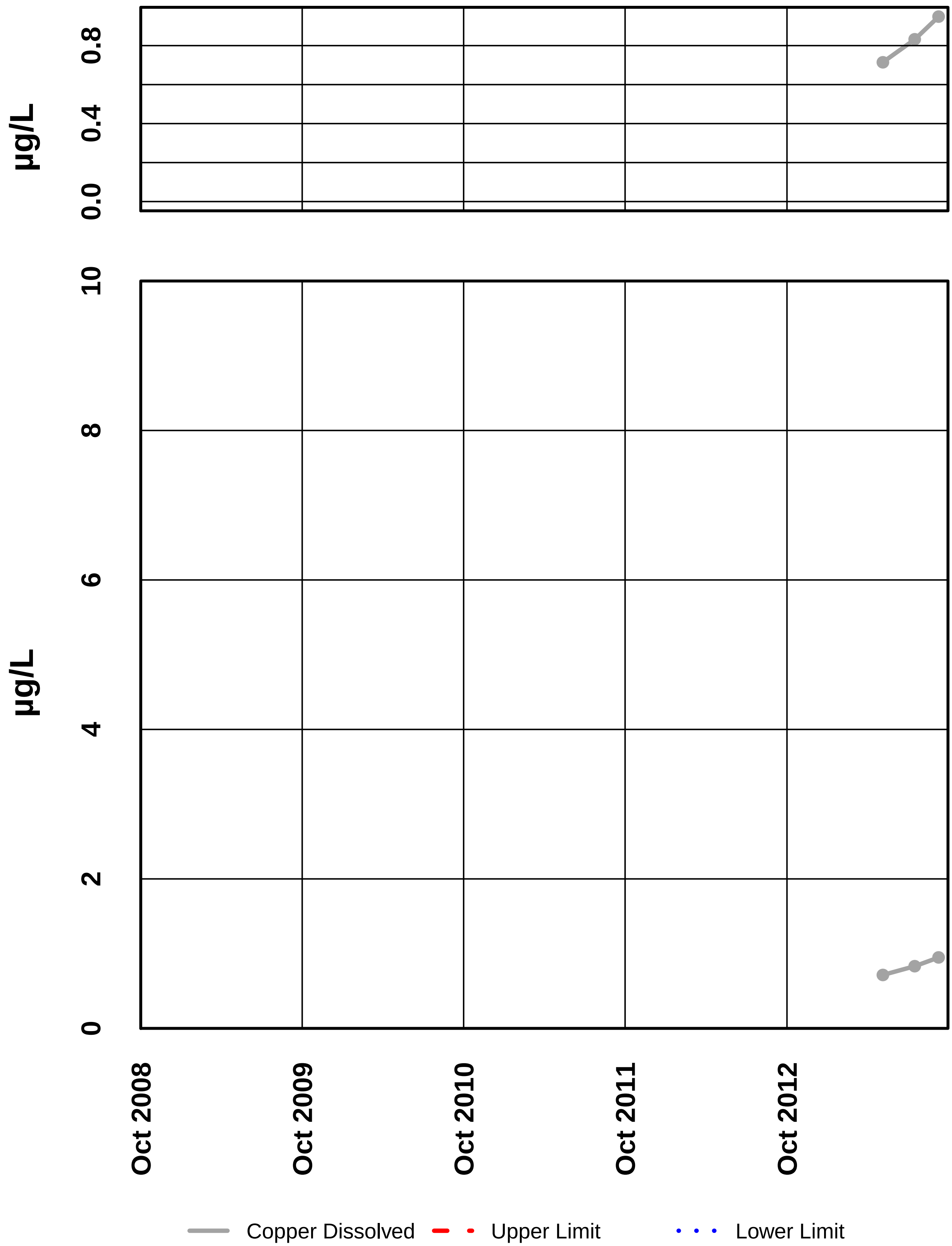
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 609 – Chromium Dissolved

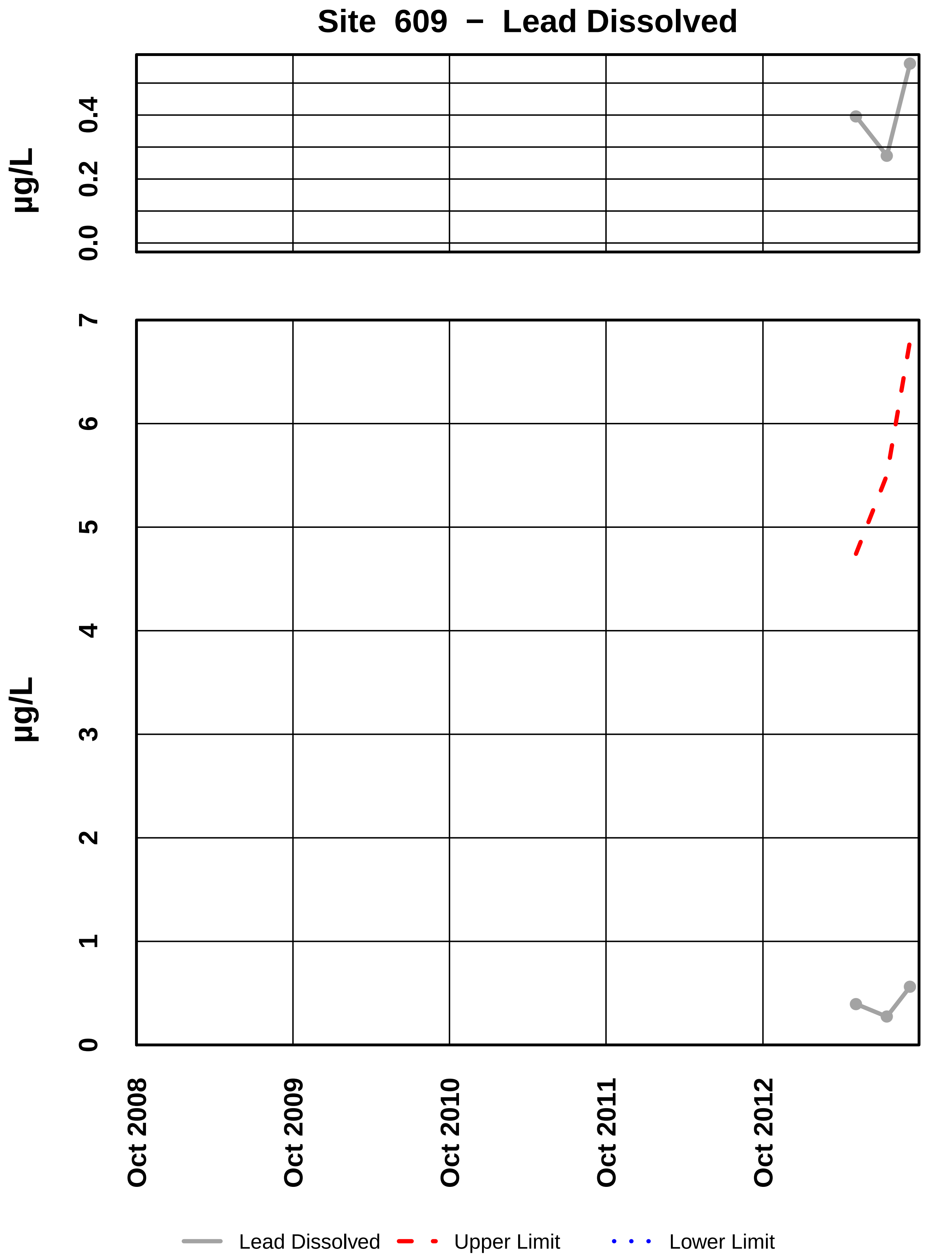


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 609 – Copper Dissolved

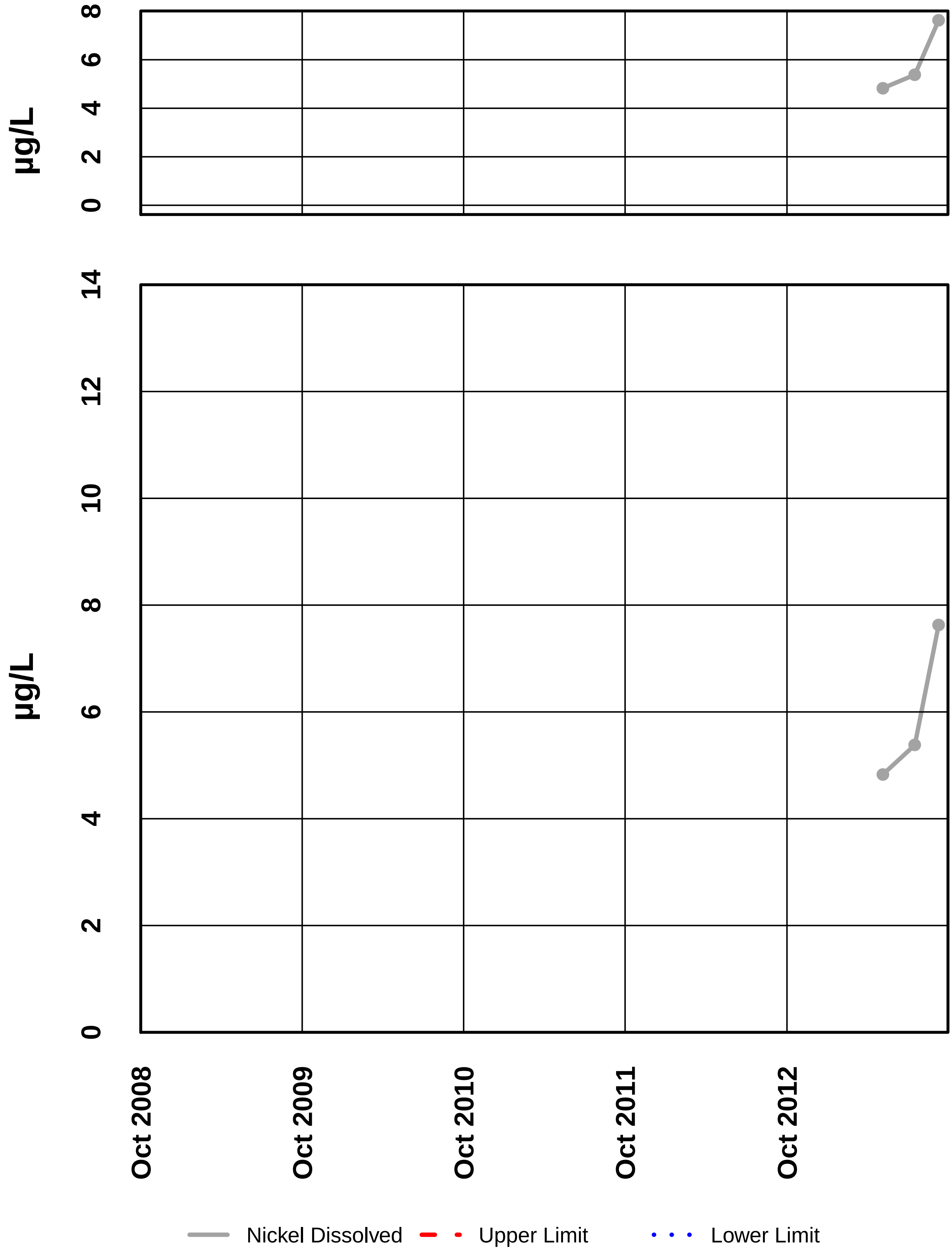


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



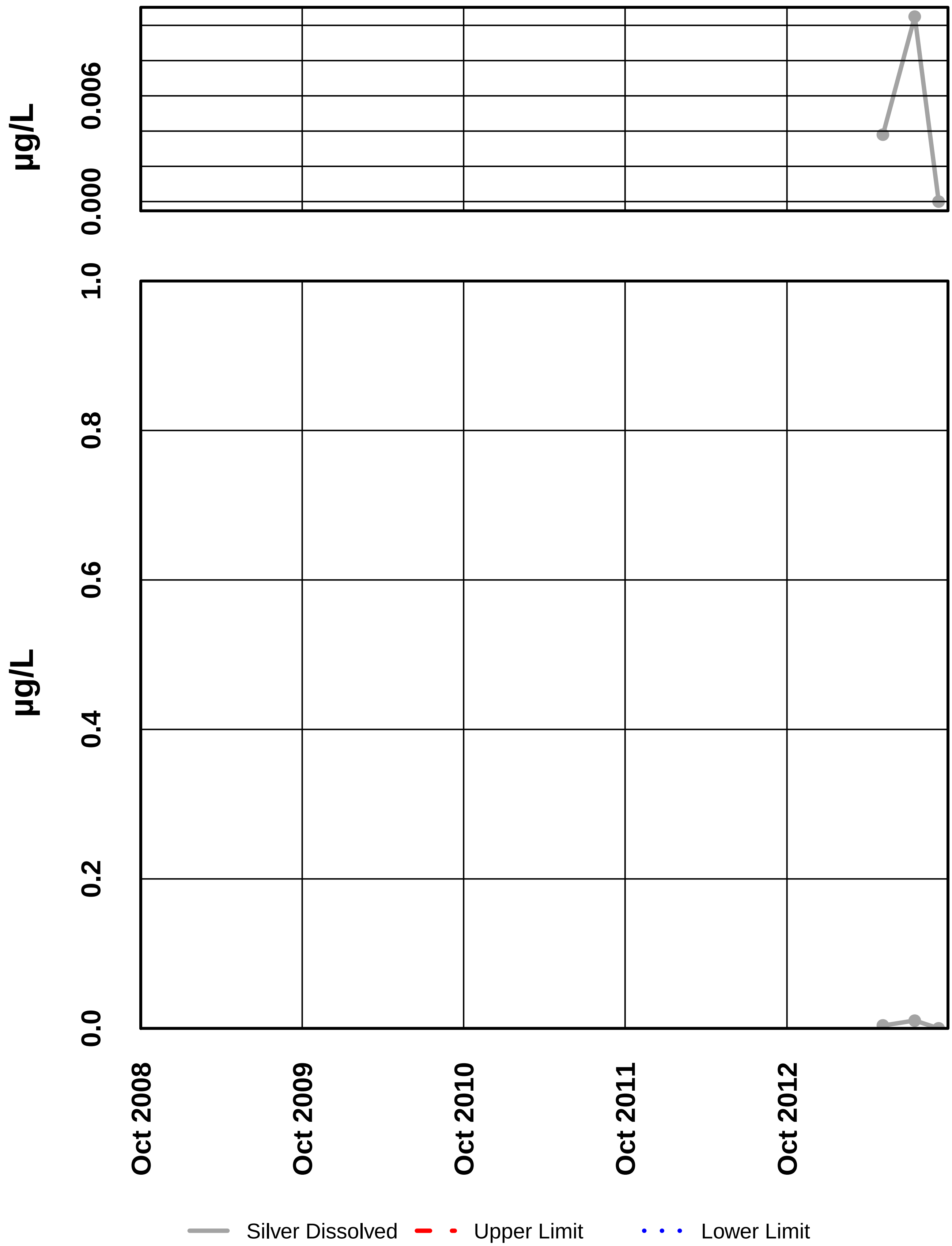
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 609 − Nickel Dissolved



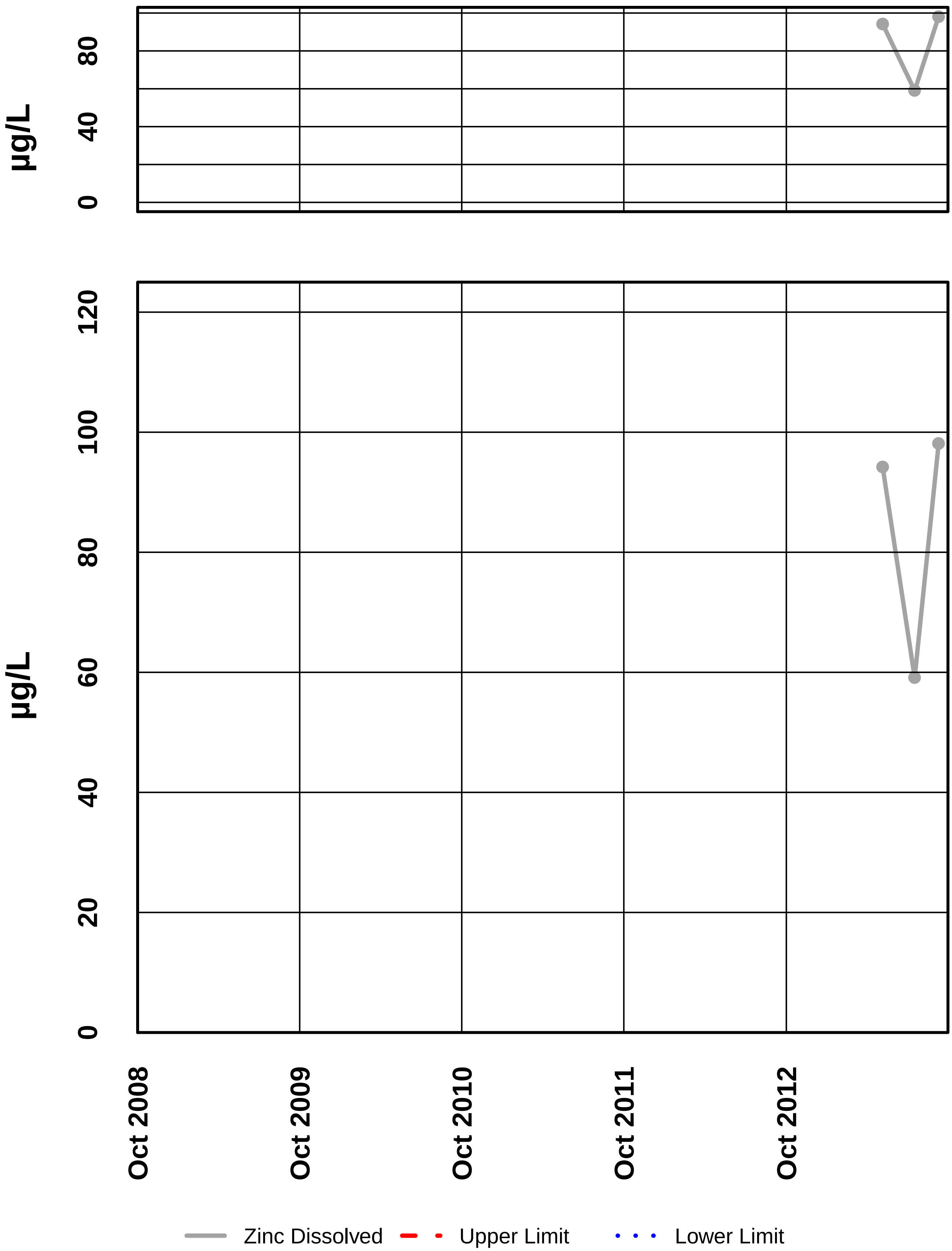
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 609 – Silver Dissolved

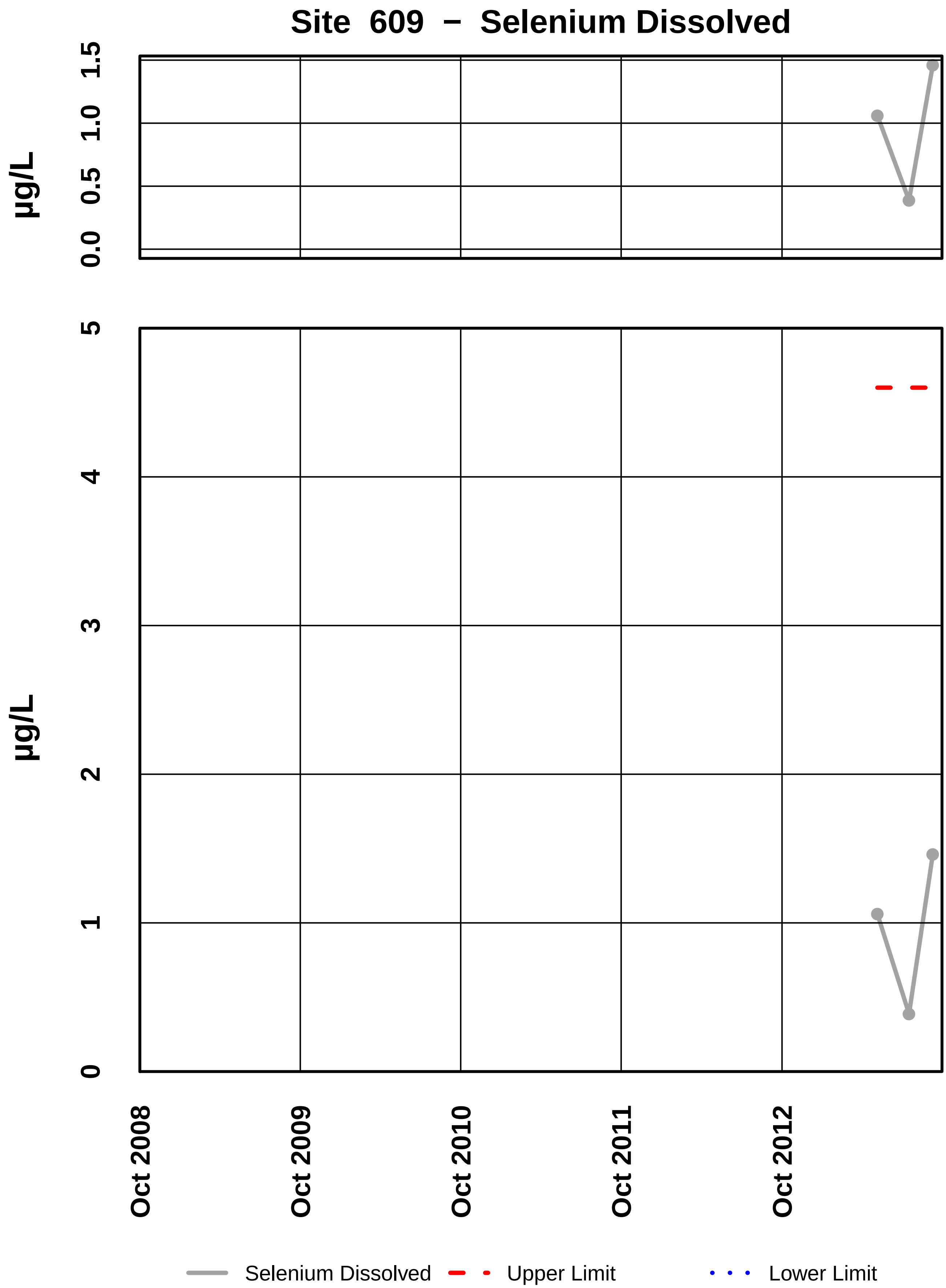


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

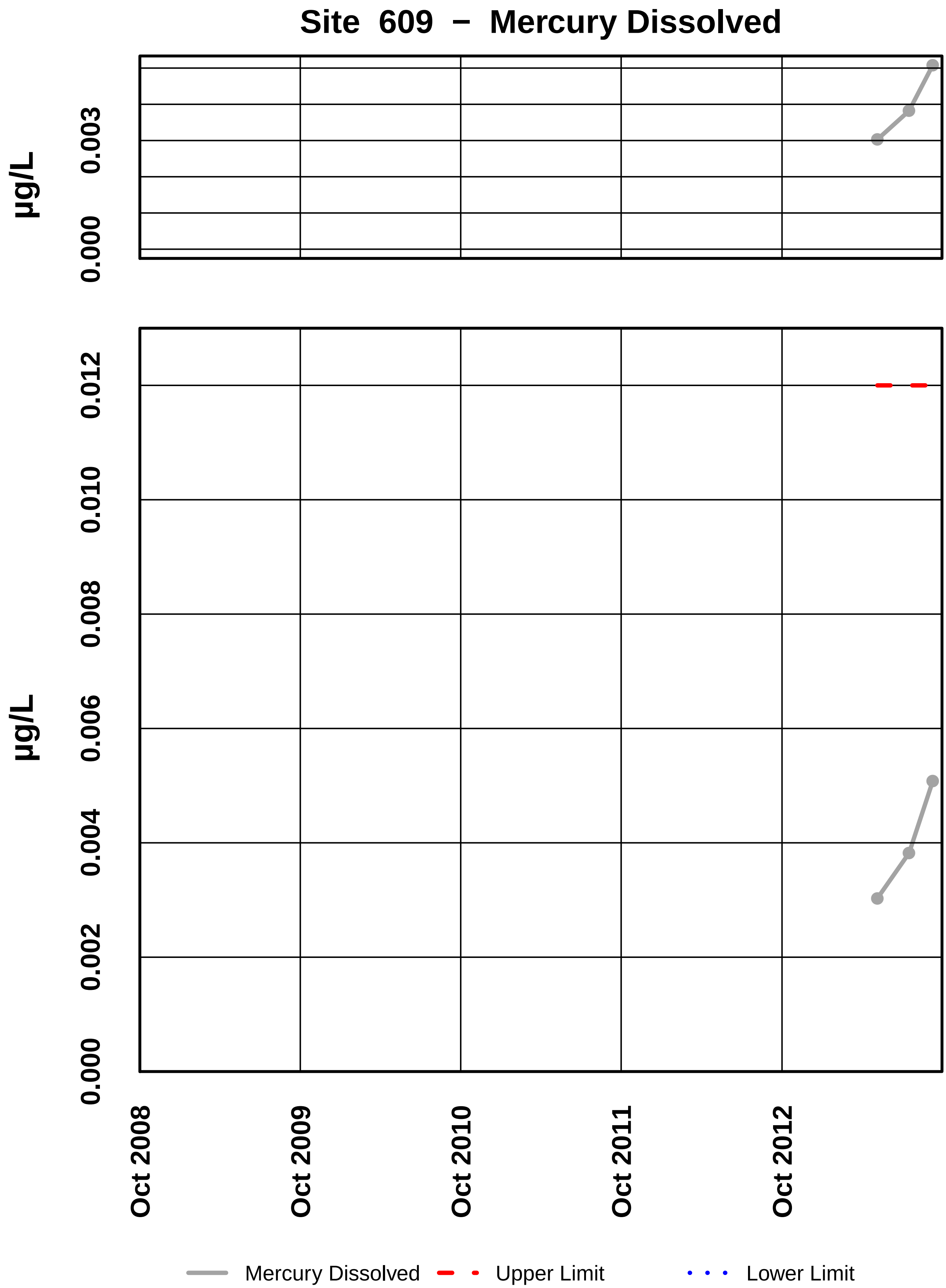
Site 609 – Zinc Dissolved



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

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

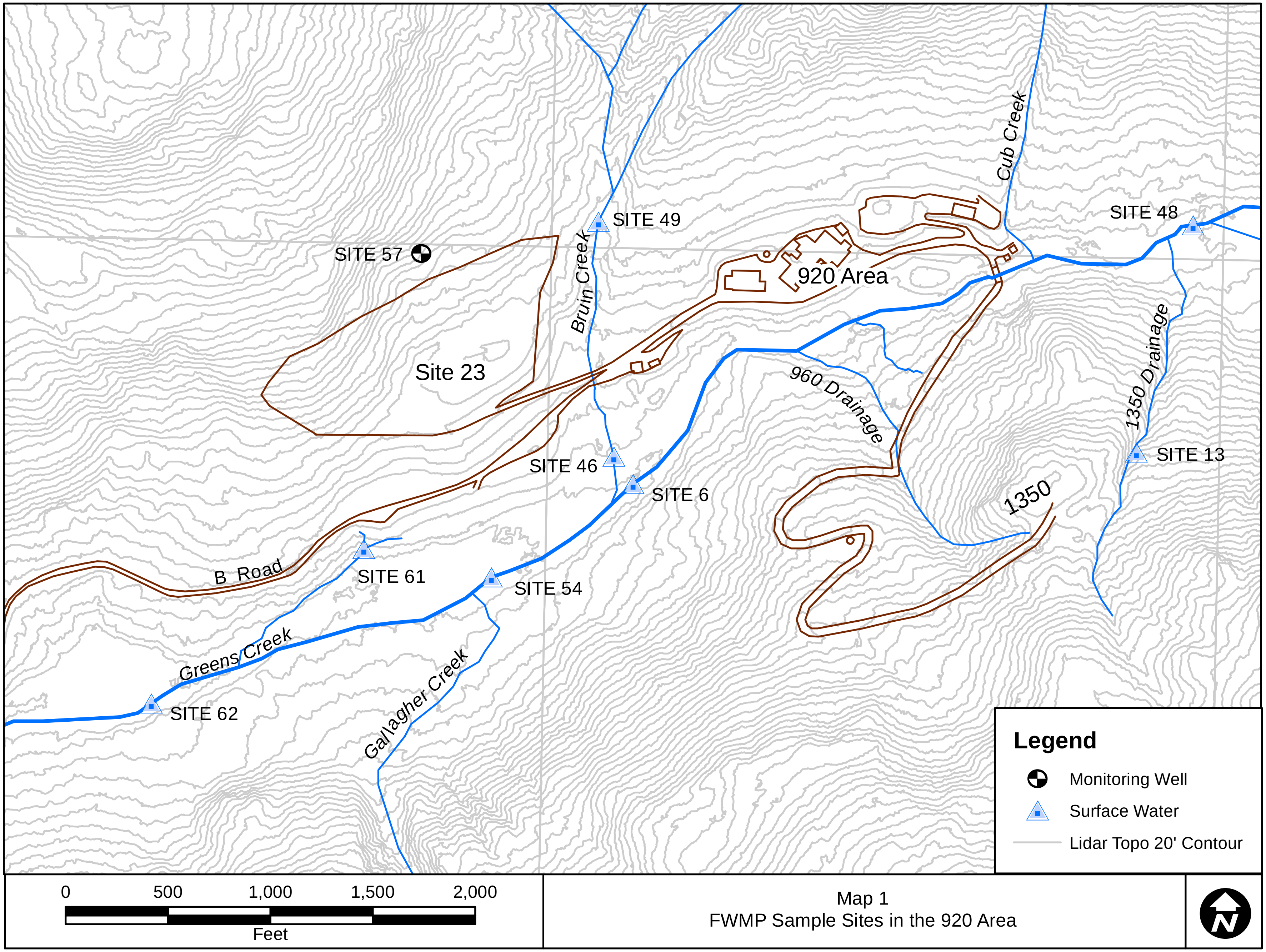
Source: http://www.dec.state.ak.us/water/wqsar/wqs/toxicsbook.xls

Table formatting was modified by HGCMC to include only parameters include in Suite P and Q and to highlight the strictest standard.

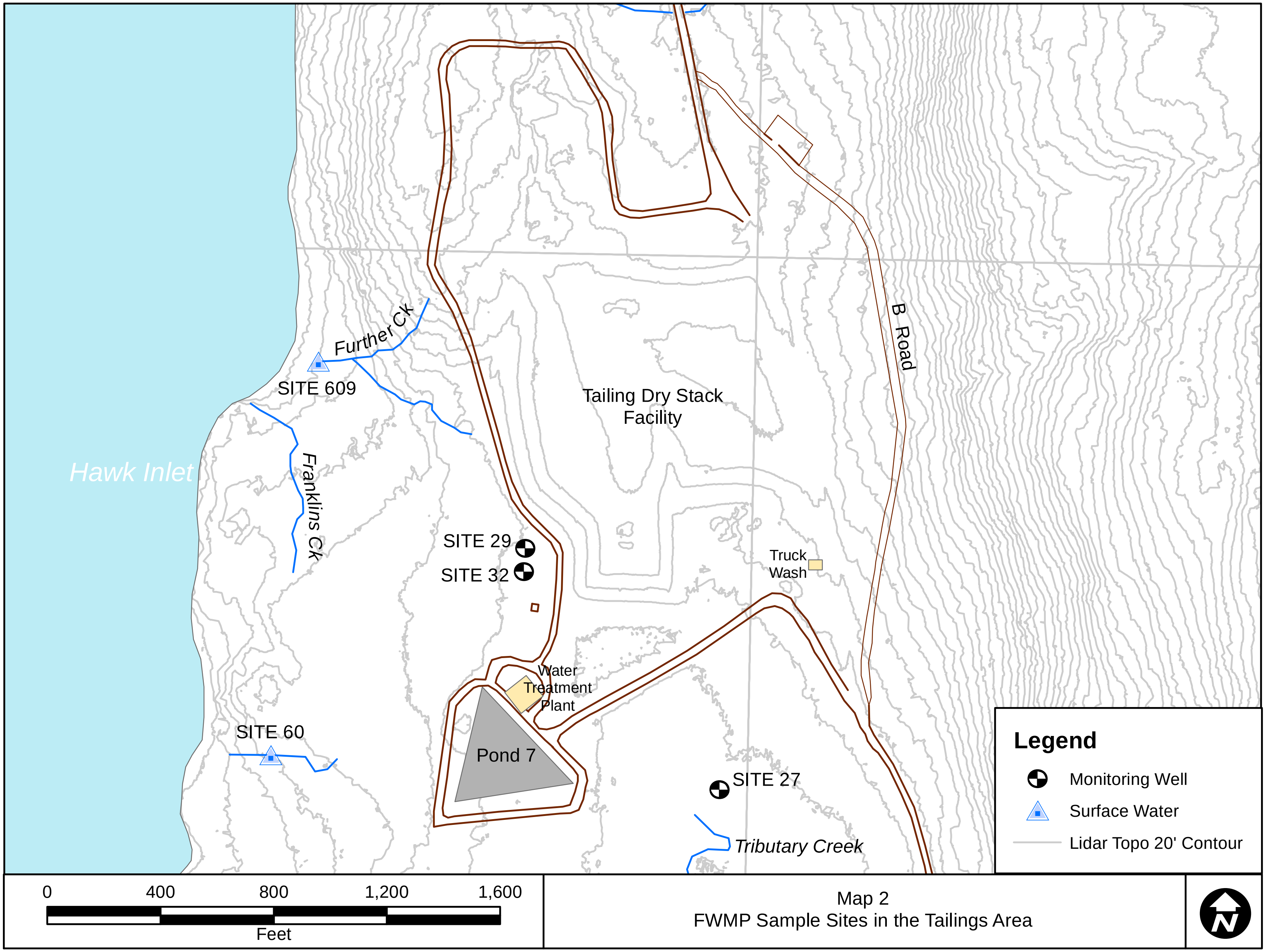
APPENDIX B

Map Sheets

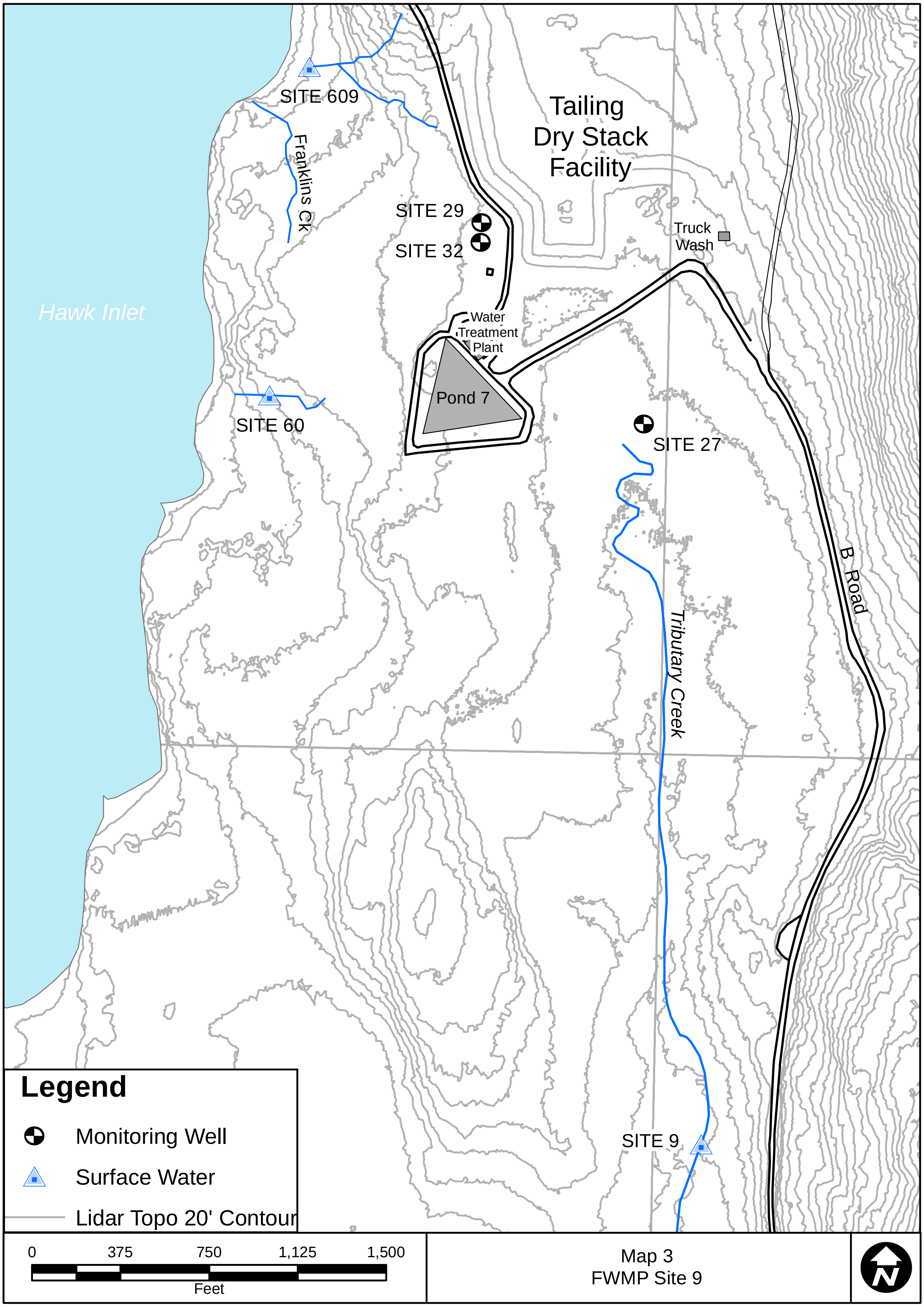
Map 1-920 Area FWMP Sites
Map 2-Tailings Area FWMP Sites
Map 3-Site 9, Tributary Creek



Map 1
FWMP Sample Sites in the 920 Area



Map 2
FWMP Sample Sites in the Tailings Area



Map 3
FWMP Site 9