FRESH WATER MONITORING PROGRAM
ANNUAL REPORT

WATER YEAR 2015

(October 1, 2014 through September 30, 2015)

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EXECUTIVE SUMMARY

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

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

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

No exceedances of Alaska Water Quality Standards (AWQS) occurred along Greens Creek at the four monitoring points (Site 48, Site 6, Site 54, and Site 62) during Water Year 2015. Four exceedances (dissolved cadmium, dissolved mercury, dissolved selenium, and dissolved zinc) were recorded in May 2013 at the new surface water location Site 61, however the downgradient site (Site 62), which receives this drainage, during the same sample period was well within AWQS. To further investigate HGCMC switched the sampling frequency at Site 61 from quarterly to monthly during Water Year 2014 and through Water Year 2015 (reduced in August 2015). After two years of increased monitoring the elevated metals measured in the May 2013 have not been approached since. There were no exceedances measured at Site 61 since the four from May 2013, HGCMC has reduced the sampling frequency back to quarterly in Water Year 2016.

Site 13 was in exceedance, three times, for dissolved cadmium and dissolved zinc . HGCMC removed 11,200 bank cubic yards of material from the 1350 during the 2014 summer season. It was after this disturbance that the exceedances started to occur. This has been seen before with other reclamation projects and with those the increased concentrations were short lived.
In 2015 HGCMC removed additional material, at the 1350, from the access to the raised bore ventilation shafts. HGCMC has no additional work planned for the 1350 reclamation, but will continue to monitor the area as it stabilizes and matures.

No exceedances of AWQS were recorded for Bruin Creek, during Water Year 2015; monitored at the up-gradient Site 49 and downgradient Site 46. There were natural exceedances for cadmium and zinc at the background monitoring Site 57, located upgradient from the mine operations near the waste rock facility Site 23.

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

Site 60 had exceedances for low alkalinity, low pH, and elevated mercury. This site's watershed was disturbed when the construction of Pond 7 began in 2004, resulting in a change from naturally acidic to alkaline conditions. HGCMC believes that the increase in pH and alkalinity increases the potential for adsorption of mercury on sediments and soil particles in the drainage. The pH of the Site 60 drainage now fluctuates seasonally and from year to year and may control the storage and release of mercury from the adsorbed fraction. Dissolution of tailings dust particles, which contain small amounts of mercury, and atmospheric deposition of mercury from natural (e.g. volcanoes) and anthropogenic sources (e.g. coal fired power plants in Asia) are potential sources of this metal in the drainage area. One of the four samples collected during the current water year were within AWQS, the other three samples (0.0148 µg/L, 0.0129 µg/L and 0.0123 µg/L) were only slightly above the AWQS of 0.012 µg/L. Sampling in adjacent drainages during water year 2009 and water year 2013 showed that this issue was isolated to only the Site 60 watershed.

The final two sites associated with the tailings facility, Site 9 and Site 609, both had exceedances for low alkalinity. The low alkalinity values are expected given the naturally occurring acidic muskeg conditions in the headwaters near Site 27 and Site 29. Site 609 had an exceedance for total sulfate (516 mg/L), however the other 3 samples taken at the site were not in exceedance. Site 9 also had two exceedances of the AWQS for lead.

Graphical and non-parametric analyses for trends in the data were performed for all sites when sufficient data was available. It takes six years of monitoring a new site (Site 609, Site 711, Site 712, Site 61, and 62) before the statistical analyses can be performed. Statistically significant trends were identified for eleven sites: Site 48, increasing trend in pH; Site 6, upward trend in pH; Site 54, upward trend in pH; Site 57, increasing trends in pH and dissolved zinc, decreasing trend in conductivity and total sulfate; Site 60, upward trend in total sulfate; Site 27, decreasing trend in dissolved zinc and an upward trend in total alkalinity; Site 32, a downward trend in dissolved zinc and an increasing trend in total alkalinity; Site 13, decreasing trend in conductivity, total alkalinity, and total sulfate, increasing trend in dissolved zinc; Site 9, increasing trend in dissolved zinc and decreasing trend in conductivity, total alkalinity, and total sulfate; Site 46, increasing trend in pH; Site 49, increasing trend in pH.

Site 48, Site 49, and Site 57 are considered up-gradient control sites and thus the trends are likely due to natural variation. The Greens Creek sites (Site 48, Site 6, and Site 54) had similar low magnitude increasing trends in pH. Though this is an increasing trend the similar magnitude of increase across the three sites, including an upgradient background site, indicates natural variation.

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

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

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

With the removal of the Site 58 and Site 59 form the FWMP, it is not possible to perform inter-well comparison with the down gradient sites Site 27, Site 29, and Site 32. These sites are now also analyzed using the combined Shewhart-CUSUM control charts also. From this evaluation it is recognized that Site 27 has seen some recent changes. Primarily the specific conductance and total sulfate charts begin to go out of control early 2008. This is attributed to the building of the pad west of Pond 7. Both of these parameters are trending towards pre-pad disturbance levels, however with the construction of the tailings expansion (2015-2107) occurring immediately upgradient of the monitoring site some fluctuation in the water chemistry is expected. 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 2015 (October 1, 2014 through September 30, 20145 provides the information required by the Fresh Water Monitoring Program (FWMP). It is separated into several sections, the first of which provides general information applicable to the entire program, followed by a comprehensive analysis of the data for each specific site.

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

The monitoring schedule varies from site to site and different sites are monitored for different analytes on different months of the year. Occasionally, sites scheduled for sampling may not be available due to weather or more rarely operational reasons. A copy of the Water Year 2015 sampling log is included in this section and any variations from scheduled sampling events are noted on each site's table of results presented in the interpretive section.

The following table outlines the Statistical Information Goals for each site sampled during the Water Year 2015.

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

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

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

Statistical Tests

The Mann-Kendall seasonal trend test is a non-parametric test for zero slope of a linear regression of time-ordered data verse time. Briefly the test consists of tabulating the Mann-Kendall statistic S_k (k=1 to 12, for each month) and its variance VAR(S) for data from each season (month). The S_k statistic is simply the sum of the number of positive differences minus the number of negative differences for time ordered data pairs. Any seasonal trend is removed by only considering data pairs taken within the same month. The individual monthly Mann-Kendall statistics (S_k) are tested for homogeneity of trend which is used to determine if it is reasonable to combine the monthly S_k statistics into an overall annual statistic (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 **increase** by the weathering of carbonate mineralogy, associated with tailings	<0	X's **<** Y's	$W^+(calc) < W(table)_{\alpha,n}$
Total Sulfate	Total sulfate **increases** due to oxidation of sulfides	<0	X's **<** Y's	$W^+(calc) < W(table)_{\alpha,n}$
Dissolved Zinc	Dissolved zinc **increases** due to sulfide oxidation and is more readily soluble at neutral pH than other metals.	<0	X's **<** Y's	$W^+(calc) < W(table)_{\alpha,n}$

X: Upgradient Site

Y: Downgradient Site

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

Qualified Data by QA Reviewer - QA reports provide a summary for each site section of data limitations found in the monthly QA reviews. They list all data for that site that was qualified by the QA Reviewer for Water Year 2015 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 2015. 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.

GENERAL HISTORY

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

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

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

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

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

During the 2014 Water Year sampling at Site 61 was increased to monthly beginning in June 2014. This modification was initiated because of the exceedances recorded with the first sampling. After conducting this additional sampling for over a year, and with no further exceedances, the frequency of sampling was change back to quarterly as called for in the FWMP.

2015 Water Year October 2014 Through September 2015
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	Q	P	P	P	P	P
9	009FMS	Tributary Creek-Lower		Q						Q		Q		Q
13	013FMS	Mine Adit Discharge East		Q						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	Q	Q	P	P	P	Q	P	P	P
49	049FMS	Control Site Upper Bruin Creek		Q			Q			P			P	
54	054FMS	Greens Creek below D-Pond	Q	P	Q	P	Q	Q	P	P	P	P	P	P
57	057FMG	Monitoring Well -23-00-03		Q				Q		Q			Q	
60	060FMS	Althea Creek - Lower		Q						Q		Q		Q
61	061FMS	Greens Creek Floodplain	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	
62	062FMS	Greens Creek Lower Than 54	P	P	Q	P	Q	P	P	P	P	Q	P	P
609	609FMS	Further Creek Lower		Q						Q		Q		Q
711	711FMS	Greens Creek Above Site E									Q			P
712	712FMS	Greens Creek Below Site E									Q			P

Sample not taken

Increased sample frequency

Regular sample

SAMPLE SUITES

Suite P
(Surface water only)

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

Suite Q
(Groundwater and surface water)

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

PERSONNEL INVOLVED

<u>USFS</u>
Chad Van Ormer
Monument Manager
Matt Reece
Curtis Caton

<u>Biomonitoring (Fish and Game)</u>
Kate Kanouse
Jackie Timothy
Ben Brewster

<u>HGCMC</u>
Scott Hartman, General Manager

Christopher Wallace, Environmental Manager
Mitch Brooks, Environmental Engineer
David Landes, Environmental Engineer
Ted Morales, Environmental Technician
Gunnar Fredheim, Environmental Technician
Cameron Sell, Environmental Technician

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Geochemist

<u>Laboratory Analysis</u>

Brenda Lasorsa, Project Coordinator
Battelle Marine Sciences Laboratory

Sue Weber, Project Manager
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David Wetzel, Project Manager
Admiralty Environmental

<u>Data Review</u>
Suzan Huges, Project Coordinator
Environmental Synectics, Inc.
Evin McKinney , Senior Scientist
Environmental Synectics, Inc.
Leticia Sangalang, Senior Scientist
Environmental Synectics, Inc.

SITE COORDINATES

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

PROPOSED PROGRAM MODIFICATIONS

HGCMC is not proposing changes to the FWMP during the 2016 Water Year.

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

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

INTERPRETIVE REPORT
SITE 48

The data collected during the current water year are listed in the following "Table of Results for Water Year 2015" 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, in the past six years, have been identified by HGCMC.				

The data 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 2015

			Limits		
Sample Date	Parameter	Value	Lower	Upper	Hardness
No exceedances have been identified by HGCMC for the period of October 2014 through September 2015.					

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. A visual trend was observed with dissolved nickel; nickel concentrations have been decreasing over the last 5 years. Though pH had been increasing for a number of years it appears to have plateaued in the 2015 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 following table summarizes the results on the data collected between Oct-09 and Sep-15(WY2010-WY2015).

Table of Summary Statistics for Trend Analysis

Parameter	Mann-Kendall test statistics: n*	p**	Trend	Sen's slope estimate: Q	Q(%)
Conductivity Field	6	0.10			
pH Field	6	<0.01	+	0.113	1.472
Alkalinity, Total	6	0.06			
Sulfate, Total	6	0.25			
Zinc, Dissolved	6	0.22			

* 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 field pH has a slope estimate of 0.113 su/year, similar to the value of 0.112 su/year reported for the 2014 Water Year.

Table of Results for Water Year 2015

Site 048FMS - 'Upper Greens Creek'

Sample Date/Parameter	Oct 2014	Nov 2014	Dec 2014	Jan 2015	Feb 2015	Mar 2015	Apr 2015	May 2015	Jun 2015	Jul 2015	Aug 2015	Sep 2015	**Median**
Water Temp (°C)	5.6	3	2.10	0.5	1.80	1	2.54	3.9	10.8	11.2	10.5	7.6	3.45
Conductivity-Field(μmho)	108.1	143	82	93.6	119.5	132.6	94	98.9	109.9	117.4	113.4	124.1	111.7
Conductivity-Lab (μmho)	104	129	75	88	119	131	92	100	116	108	119	104	106
pH Lab (standard units)	7.76	7.41	7.56	7.68	7.32	7.54	7.63	7.21	7.97	7.87	7.92	7.86	7.66
pH Field (standard units)	8.03	8.06	7.27	7.23	7.32	7.54	7.4	8.01	8.04	7.95	8.04	8.01	7.98
Total Alkalinity (mg/L)	41.1	48.1	28.8	32.7	40.3	48.5	35.3	39.2	44.7	47.3	53.2	48	42.9
Total Sulfate (mg/L)	9.8	16.4	7.9	10.2	13.2	15.4	9.2	9.9	12.9	13.3	16.4	12.1	12.5
Hardness (mg/L)	50.3	63.5	34.4	43.1	54.1	61.4	42.9	50.7	56.4	56.5	58.3	57.8	55.3
Dissolved As (ug/L)	0.216	0.201	0.196	0.19	0.171	0.183	0.172	0.176	0.23	0.256	0.269	0.241	0.199
Dissolved Ba (ug/L)			19.5	21.5	26.2				36.4				23.9
Dissolved Cd (ug/L)	0.0372	0.0404	0.0297	0.0353	0.0345	0.0357	0.0329	0.027	0.033	0.0326	0.0389	0.0406	0.0349
Dissolved Cr (ug/L)			0.075	0.09	0.144				0.183				0.117
Dissolved Cu (ug/L)	0.49	0.342	0.627	0.566	0.364	0.441	0.588	0.367	0.278	0.348	0.385	1.38	0.413
Dissolved Pb (ug/L)	0.0062	0.0033	0.0113	0.0141	0.0053	0.003	0.0074	0.0015	0.0043	0.0015	0.0015	0.0502	0.0048
Dissolved Ni (ug/L)			0.475	0.476	0.376				0.321				0.426
Dissolved Ag (ug/L)			0.002	0.002	0.002				0.002				0.002
Dissolved Zn (ug/L)	3.37	3.91	2.91	3.79	3.23	3.54	3.37	2.57	2.19	2.29	2.81	4.95	3.30
Dissolved Se (ug/L)			0.512	0.569	0.742				0.816				0.656
Dissolved Hg (ug/L)	0.000755	0.000568	0.00157	0.00133	0.000662	0.000569	0.00133	0.000623	0.000374	0.000459	0.000539	0.000701	0.000643

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

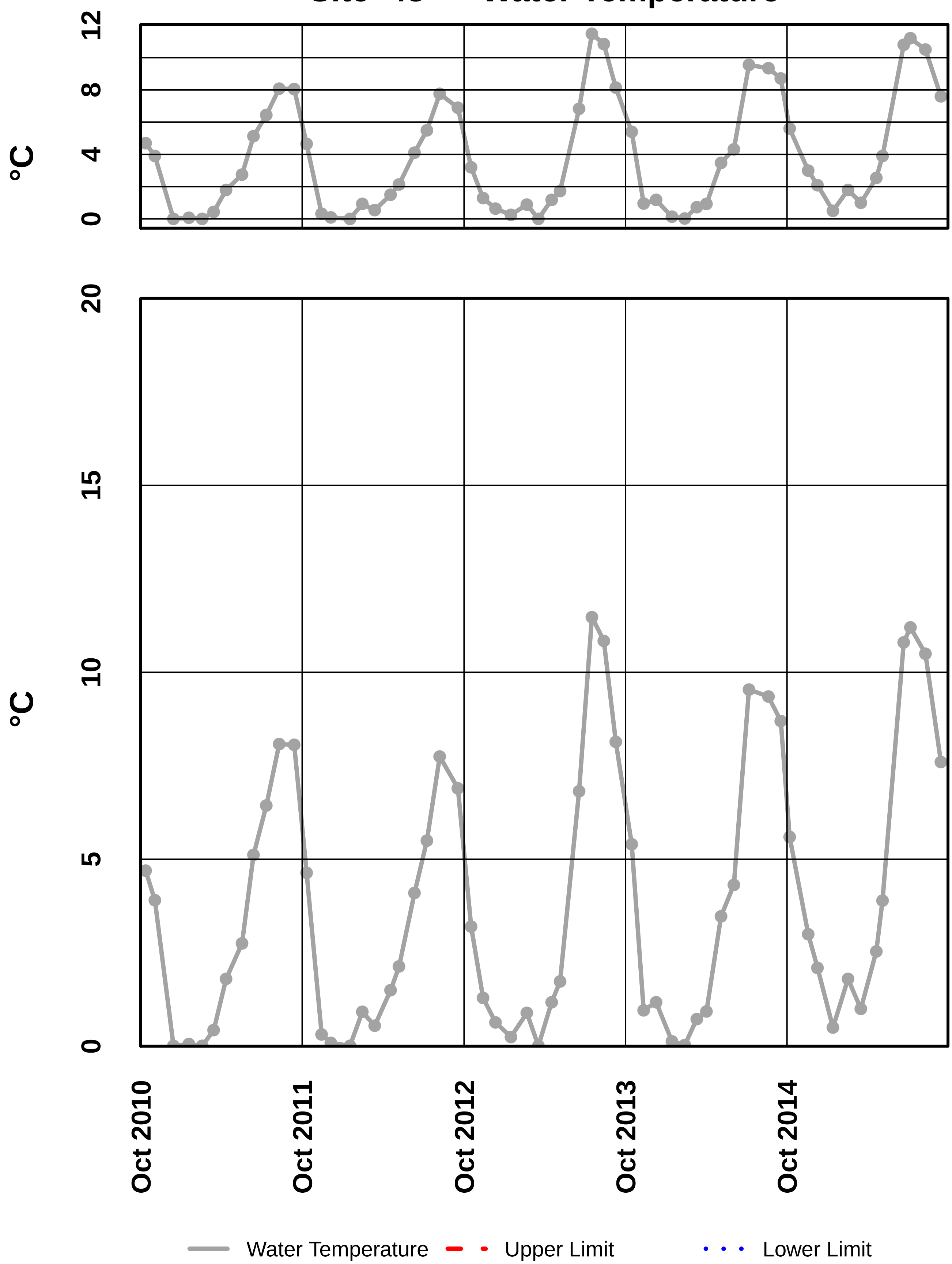
Qualified Data by QA Reviewer

Date Range: 10/01/2014 to 09/30/2015

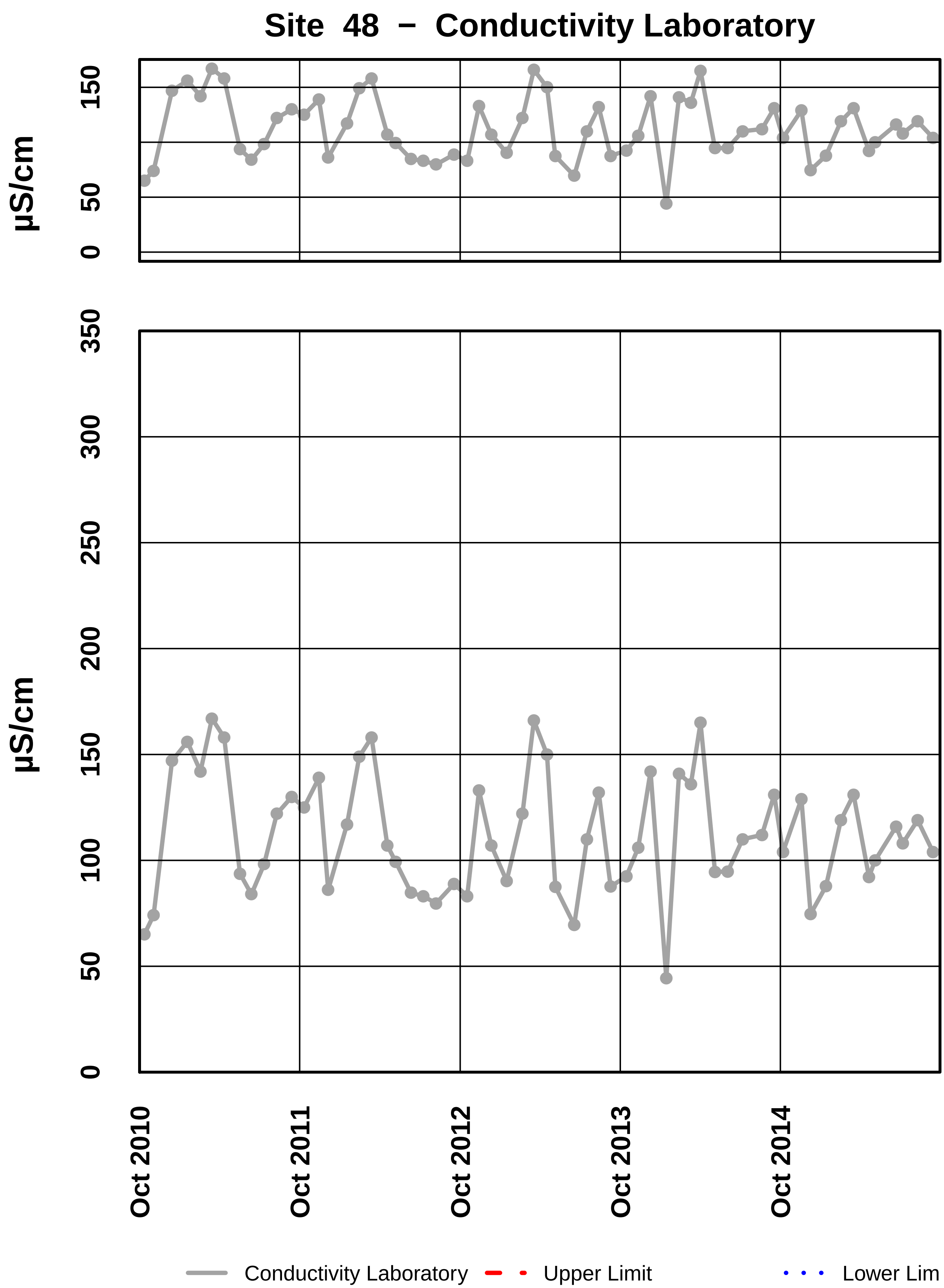
Site No.	Sample Date	Sample Time	Parameter	Value		Qualifier	Reason for Qualifier
048FMS	10/07/2014	12:00 AM	Diss. Pb-ICP/MS	0.00616	µg/L	U	Field Blank Contamination
			pH	7.76	pH units	J	Hold Time Violation
048FMS	11/18/2014	12:00 AM	Diss. Pb-ICP/MS	0.00333	µg/L	J	Below Quantitative Range
048FMS	12/09/2014	12:00 AM	Diss. Cr-ICP/MS	0.07	µg/L	J	Below Quantitative Range
			Diss. Zn-ICP/MS	2.91	µg/L	U	Field Blank Contamination
048FMS	01/13/2015	12:00 AM	Diss. Cr-ICP/MS	0.09	µg/L	J	Below Quantitative Range
			Diss. Hg-CVAF	0.00133	µg/L	U	Field Blank Contamination
048FMS	02/16/2015	12:00 AM	Diss. Cr-ICP/MS	0.14	µg/L	J	Below Quantitative Range
			Diss. Pb-ICP/MS	0.00528	µg/L	J	Below Quantitative Range
			pH	7.19	pH units	J	Hold Time Violation
048FMS	03/17/2015	12:00 AM	Diss. Pb-ICP/MS	0.00301	µg/L	J	Below Quantitative Range
048FMS	04/21/2015	12:00 AM	Diss. Pb-ICP/MS	0.0074	µg/L	J	Below Quantitative Range
048FMS	05/05/2015	12:00 AM	Sulfate	9.94	mg/L	J	Sample Receipt Temperature
048FMS	06/22/2015	12:00 AM	Diss. Pb-ICP/MS	0.00434	µg/L	J	Below Quantitative Range
048FMS	08/10/2015	12:00 AM	Sulfate	16.4	mg/L	J	Sample Receipt Temperature

Qualifier	Description
J	Positively Identified - Approximate Concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit

Site 48 – Water Temperature

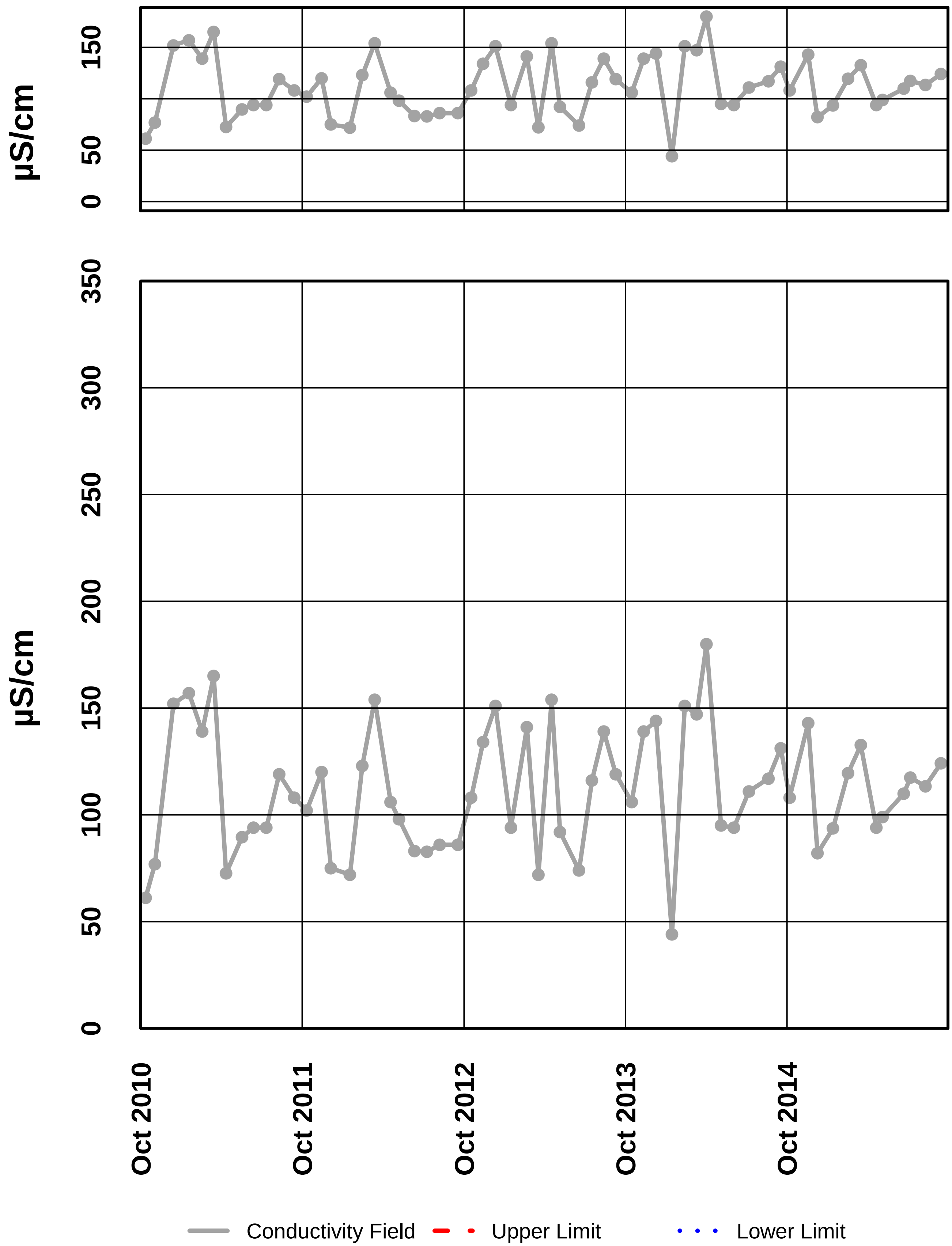


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



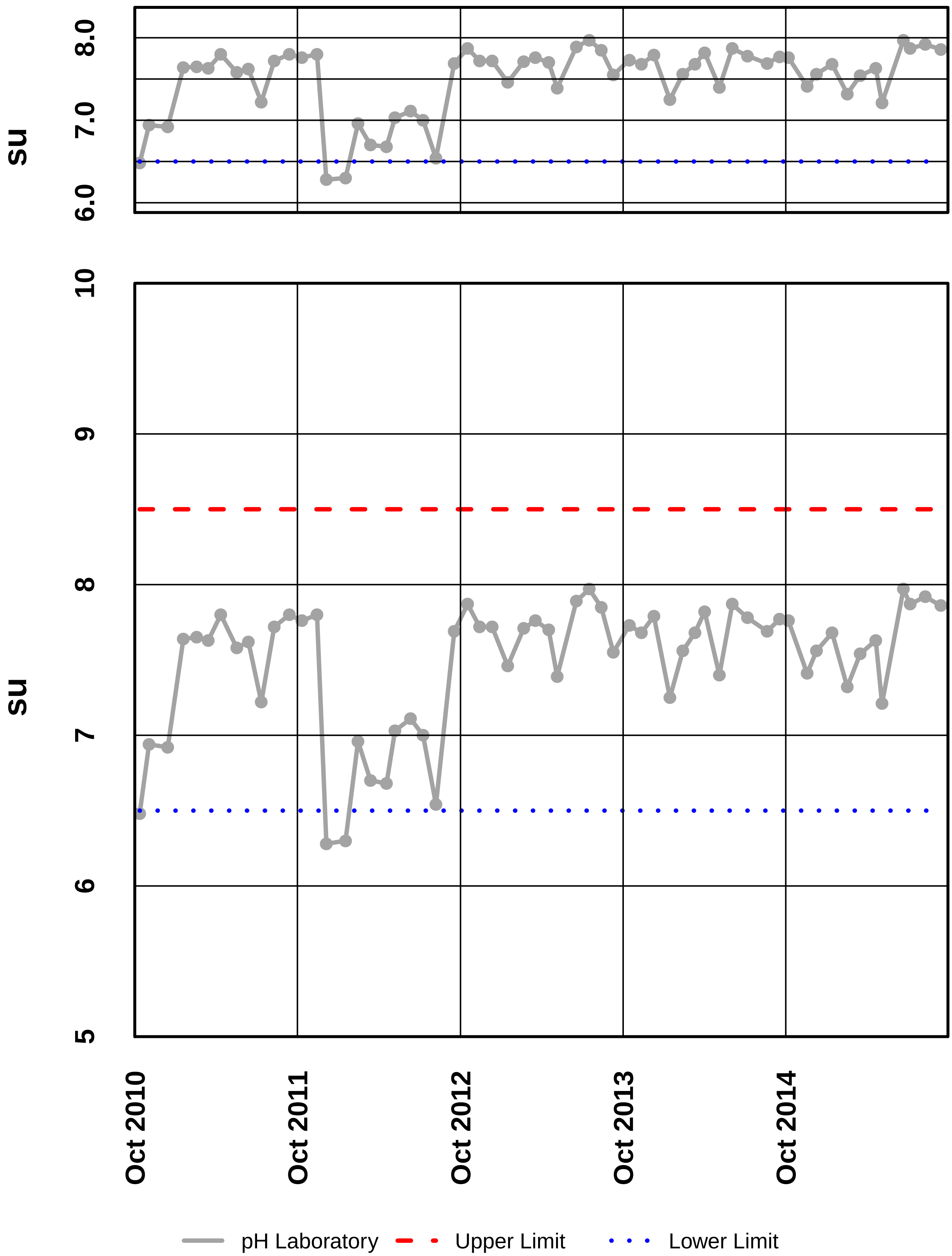
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 48 – Conductivity Field

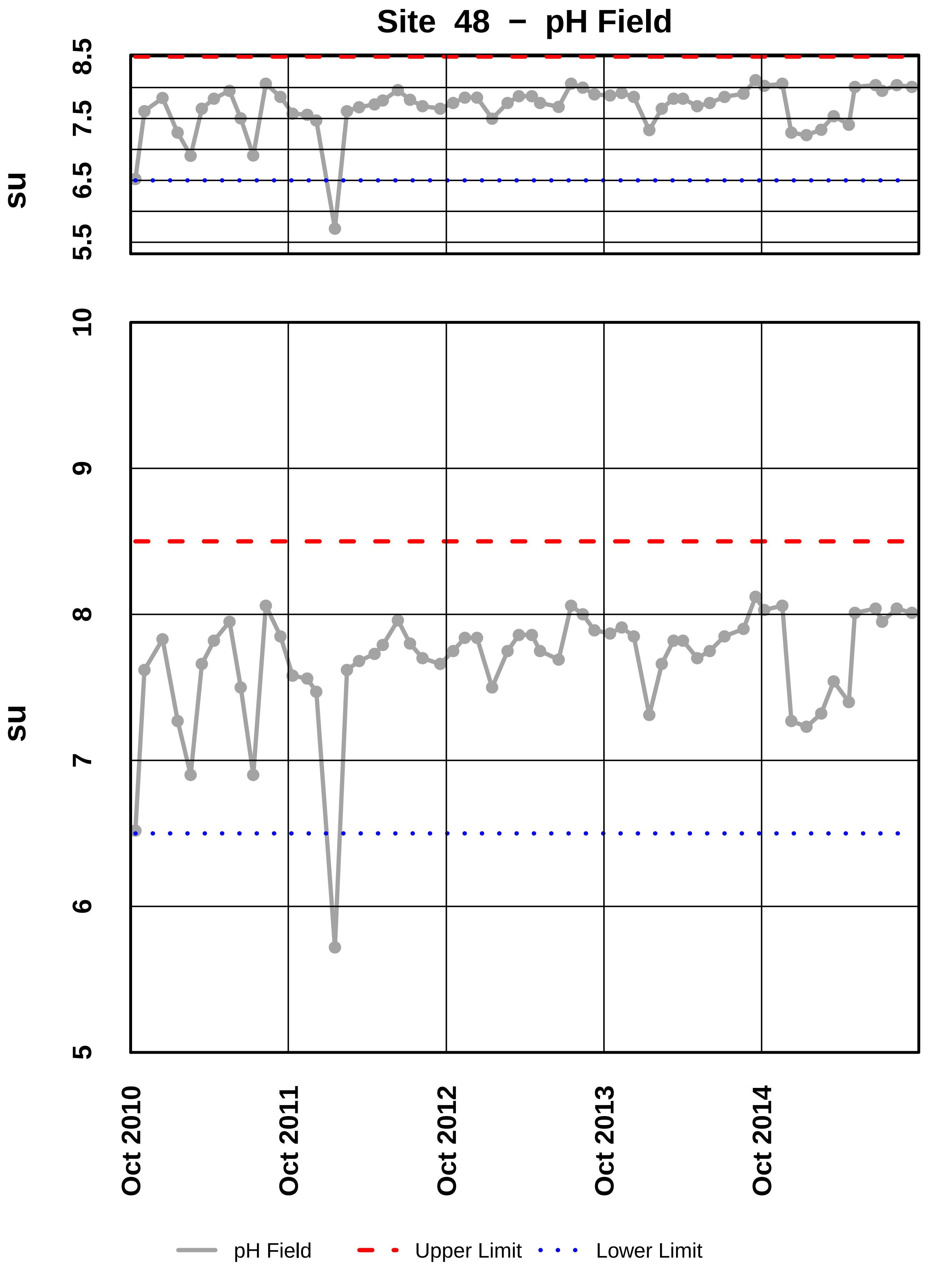


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

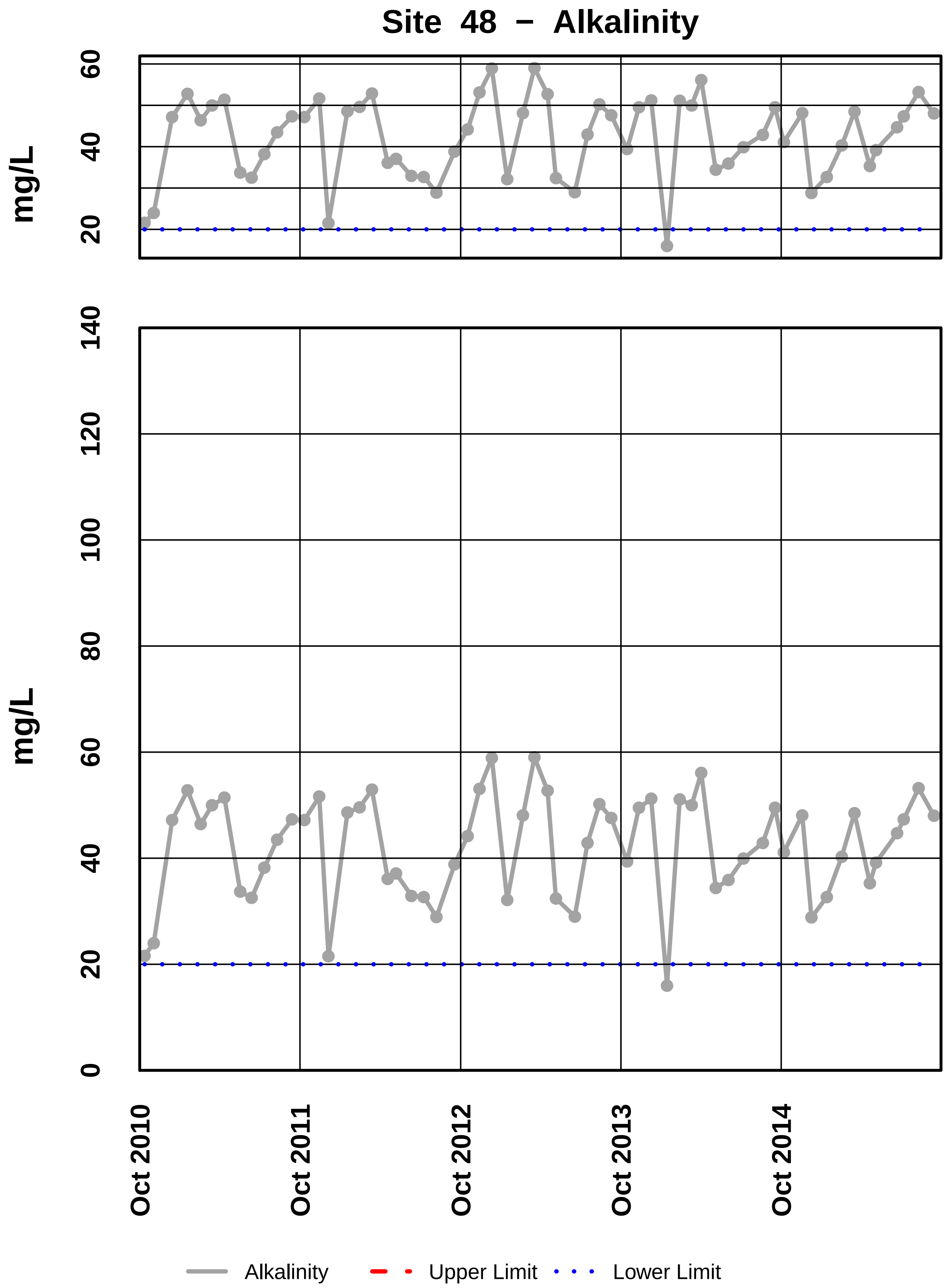
Site 48 – pH Laboratory



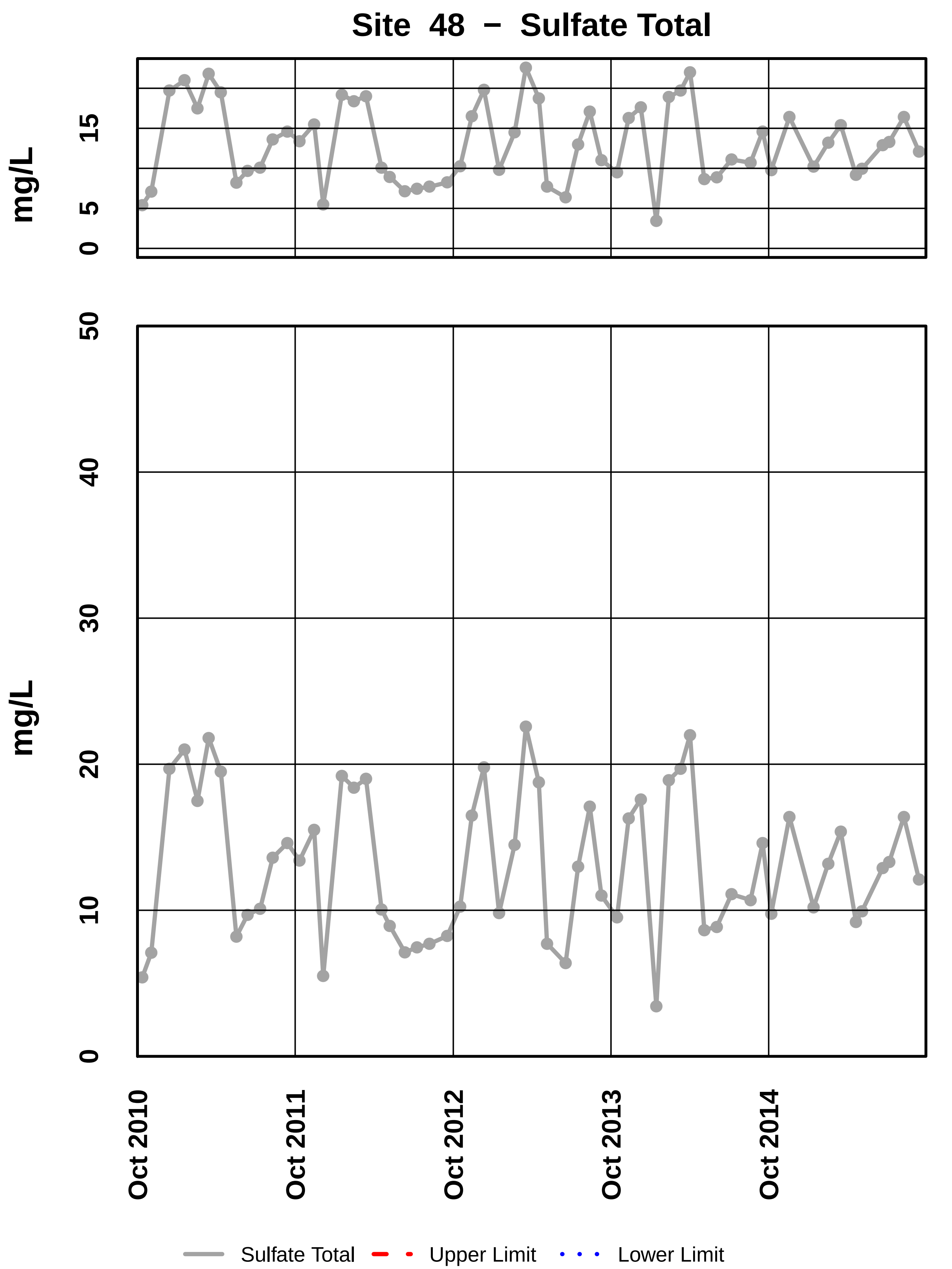
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

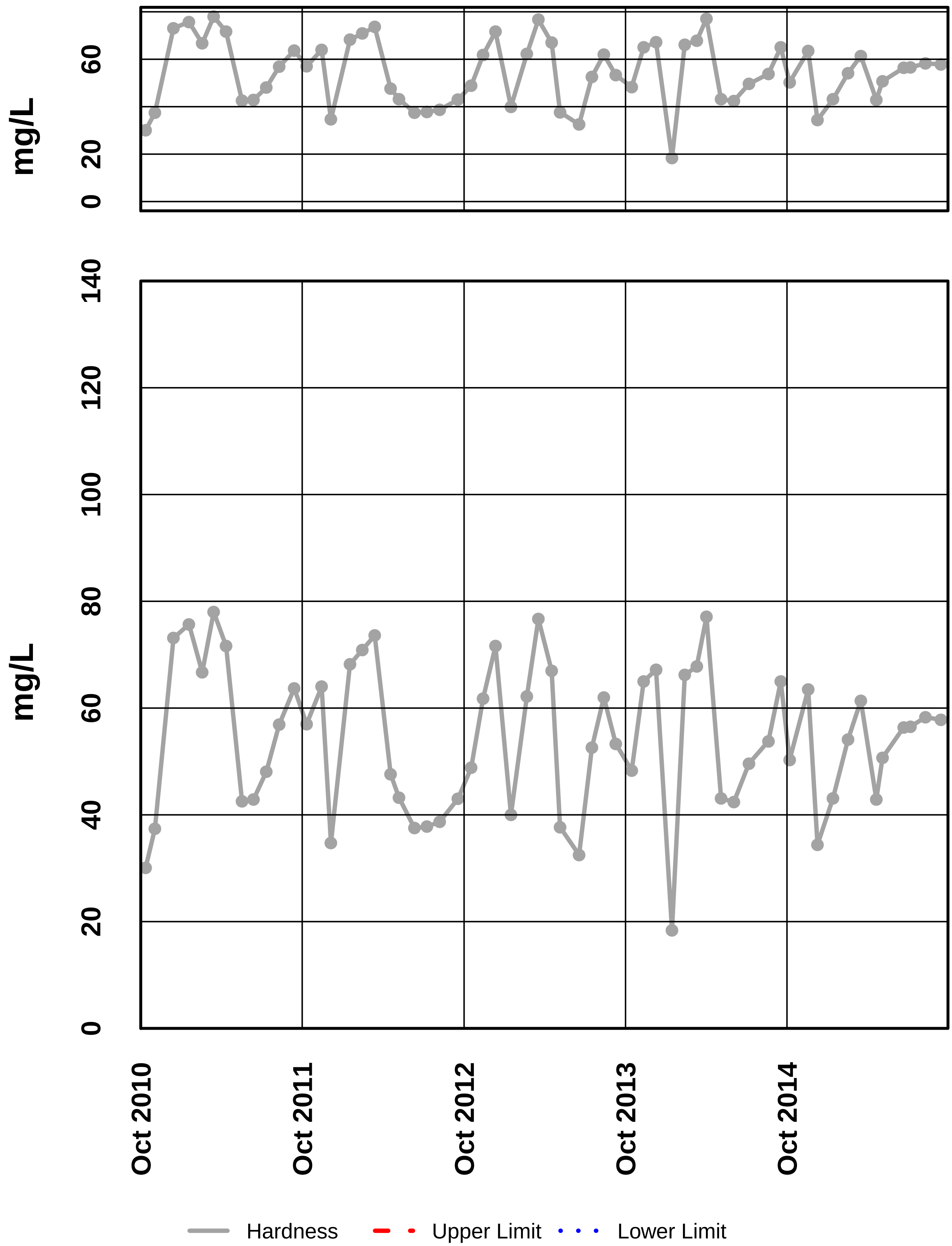


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



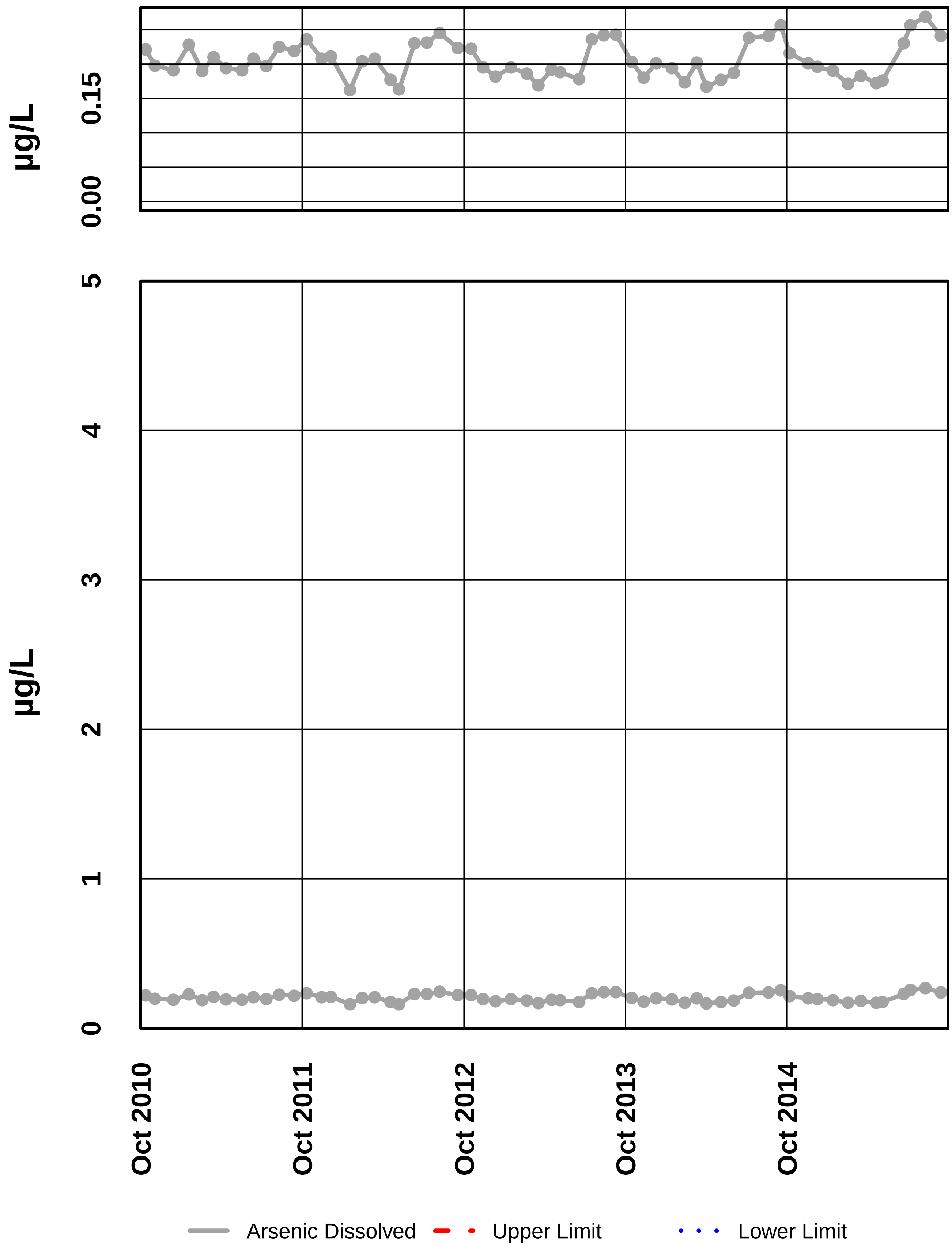
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 48 – Hardness

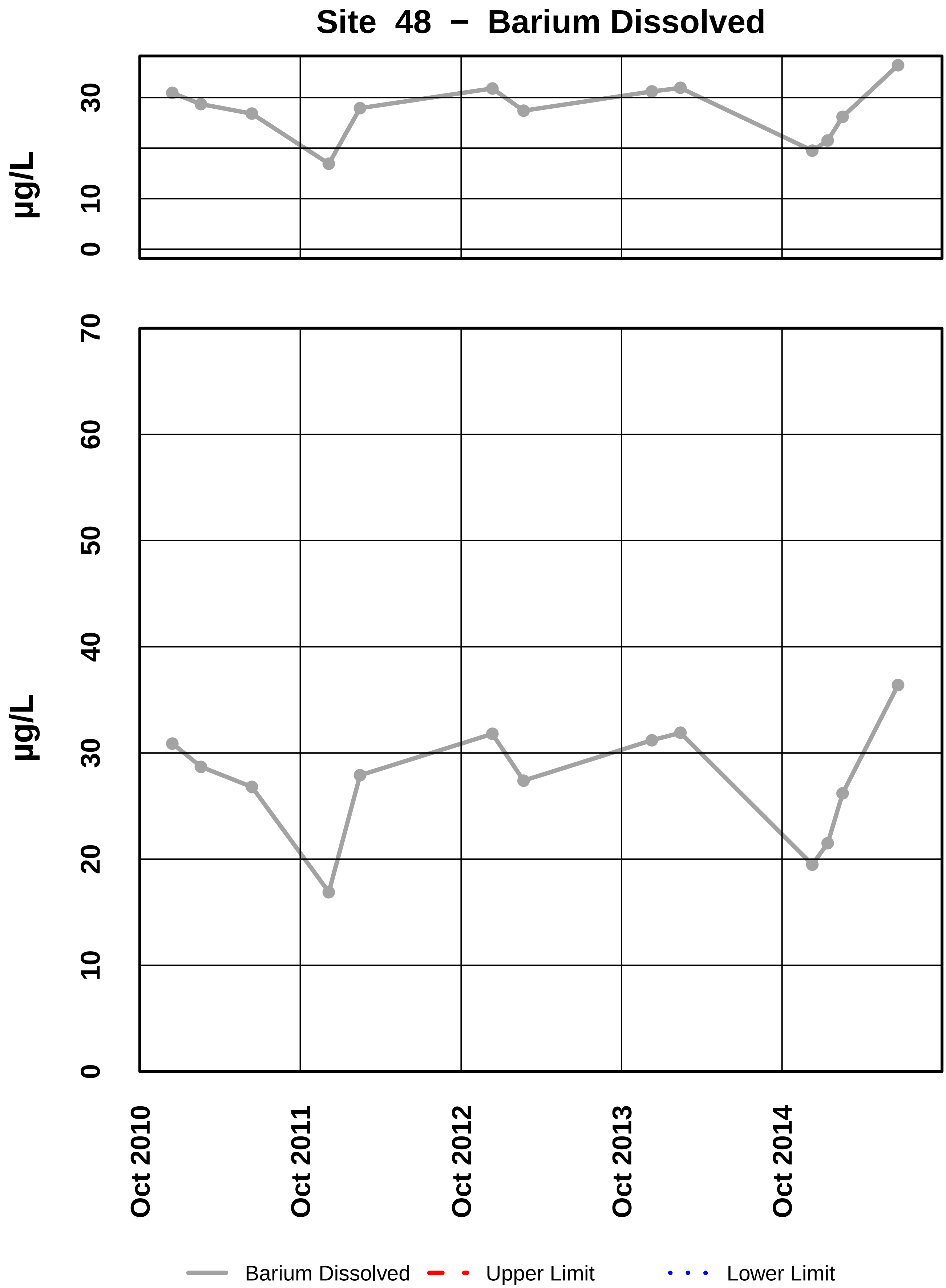


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

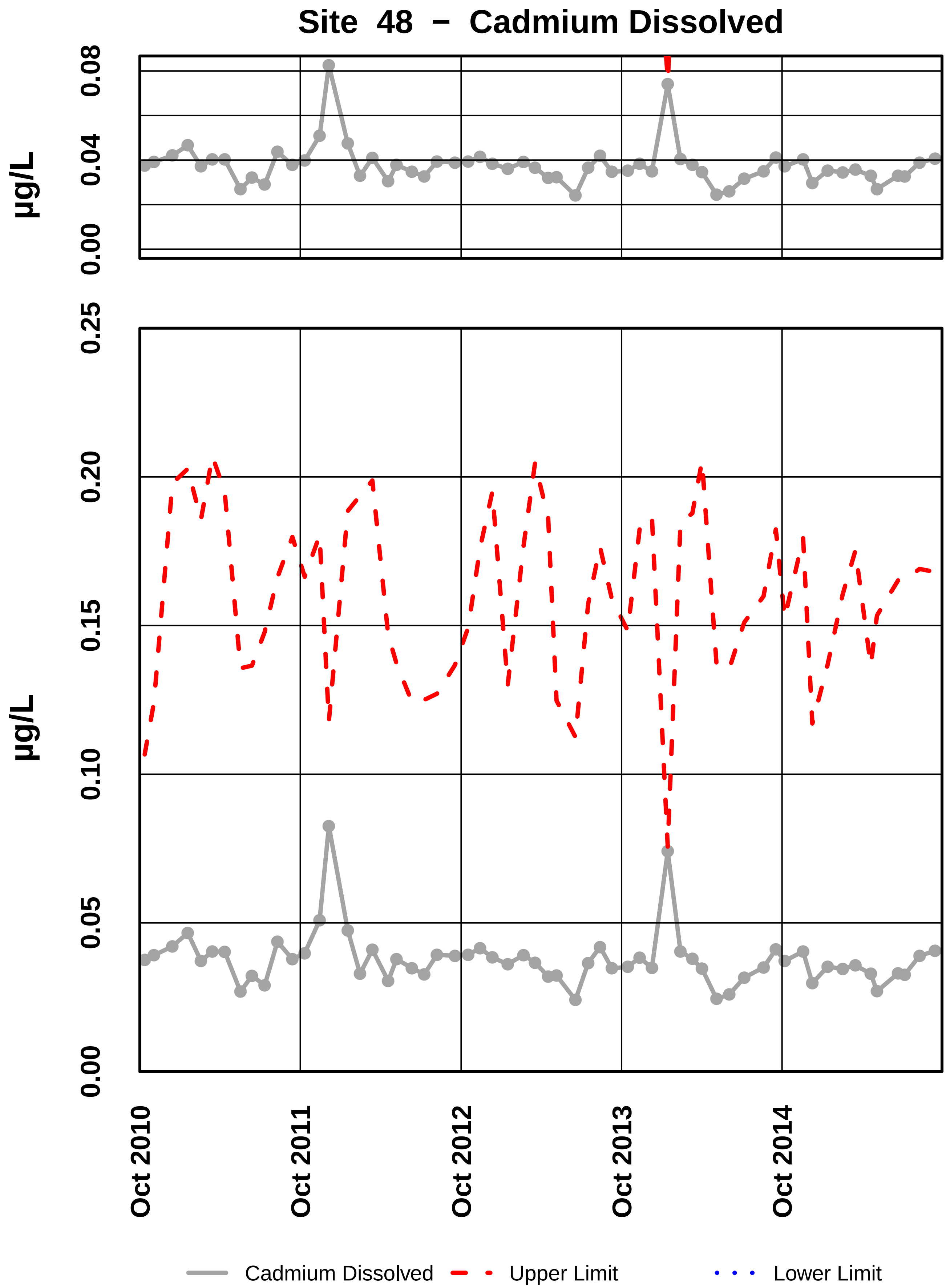
Site 48 – Arsenic Dissolved



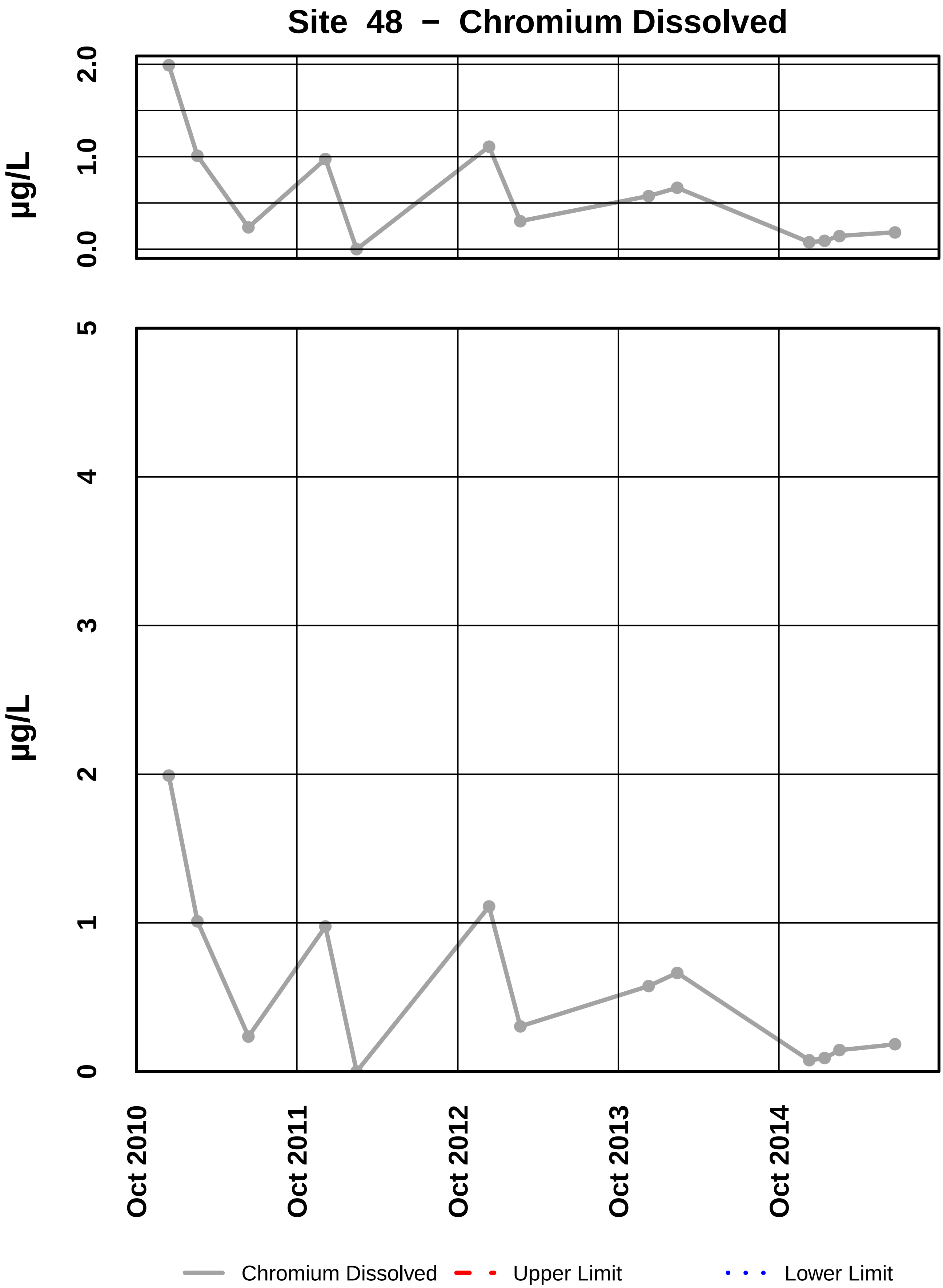
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

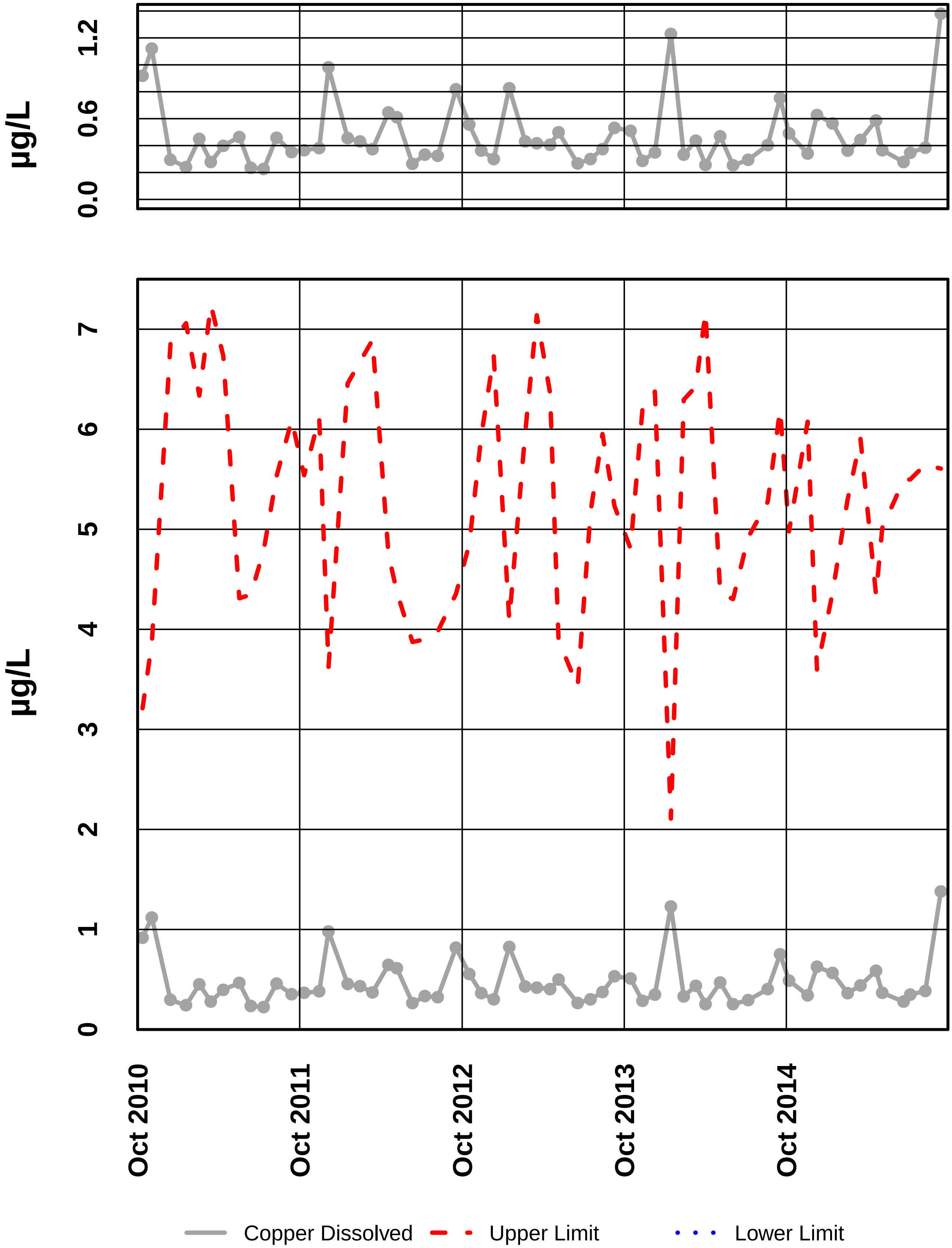


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

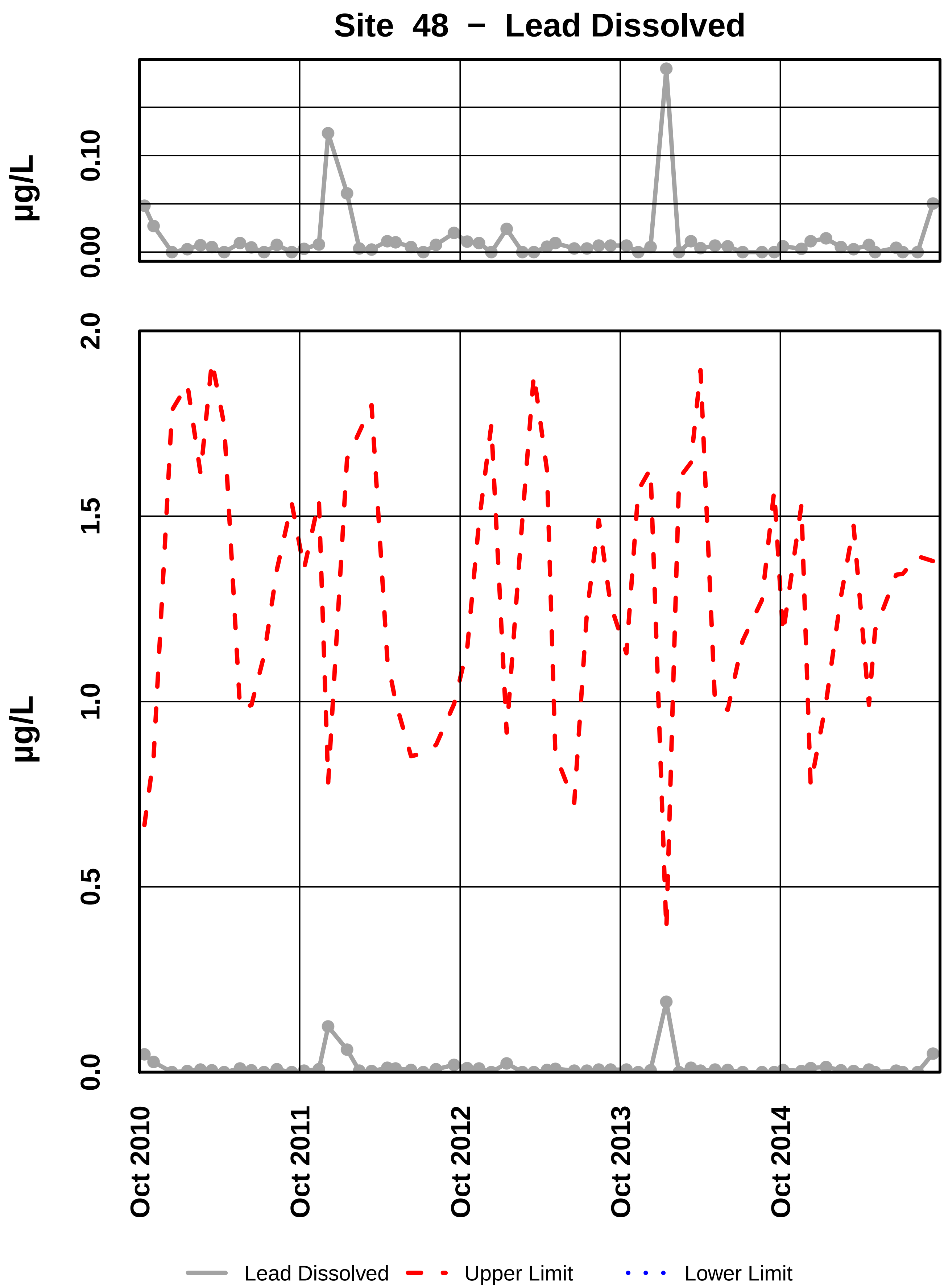


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 48 − Copper Dissolved

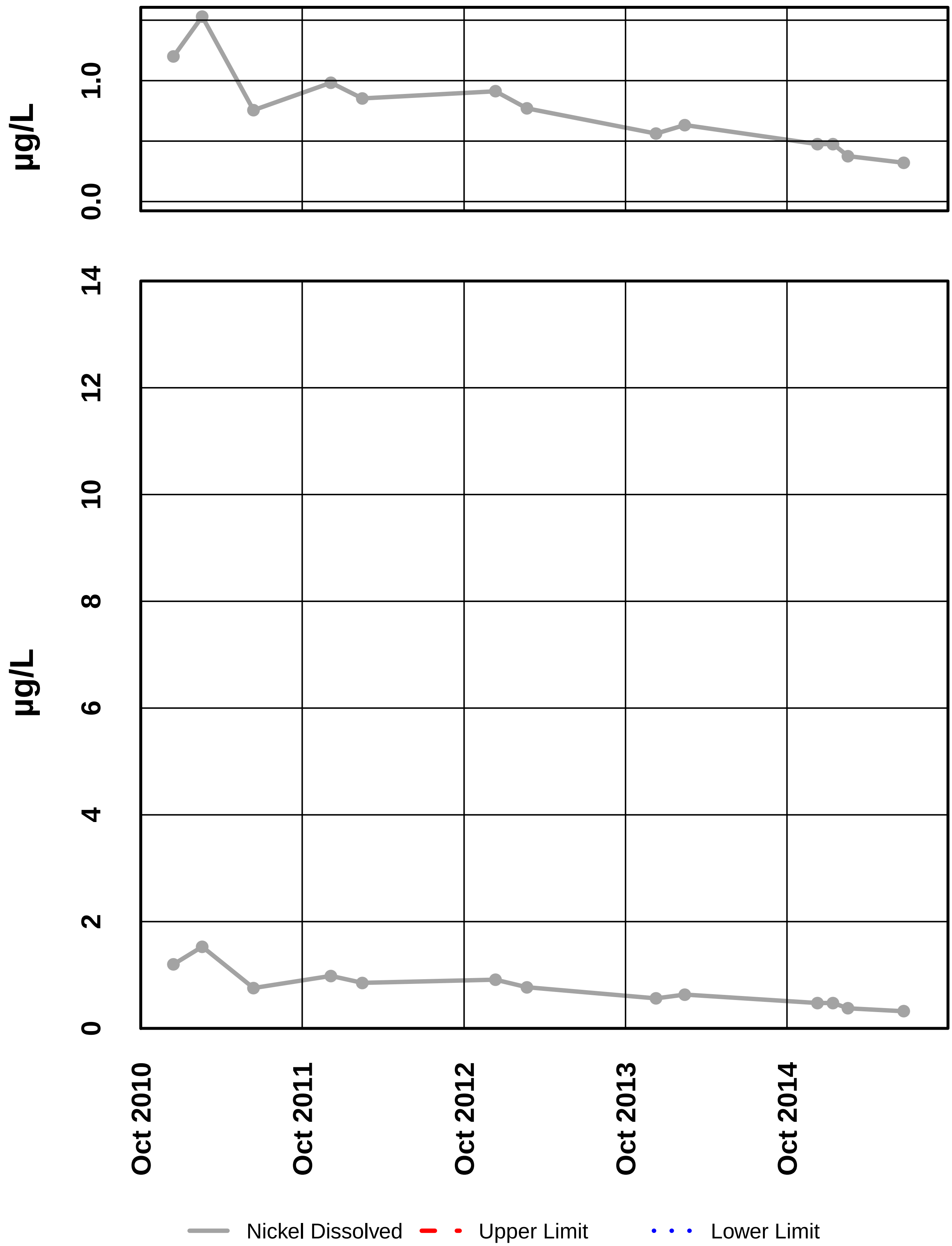


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

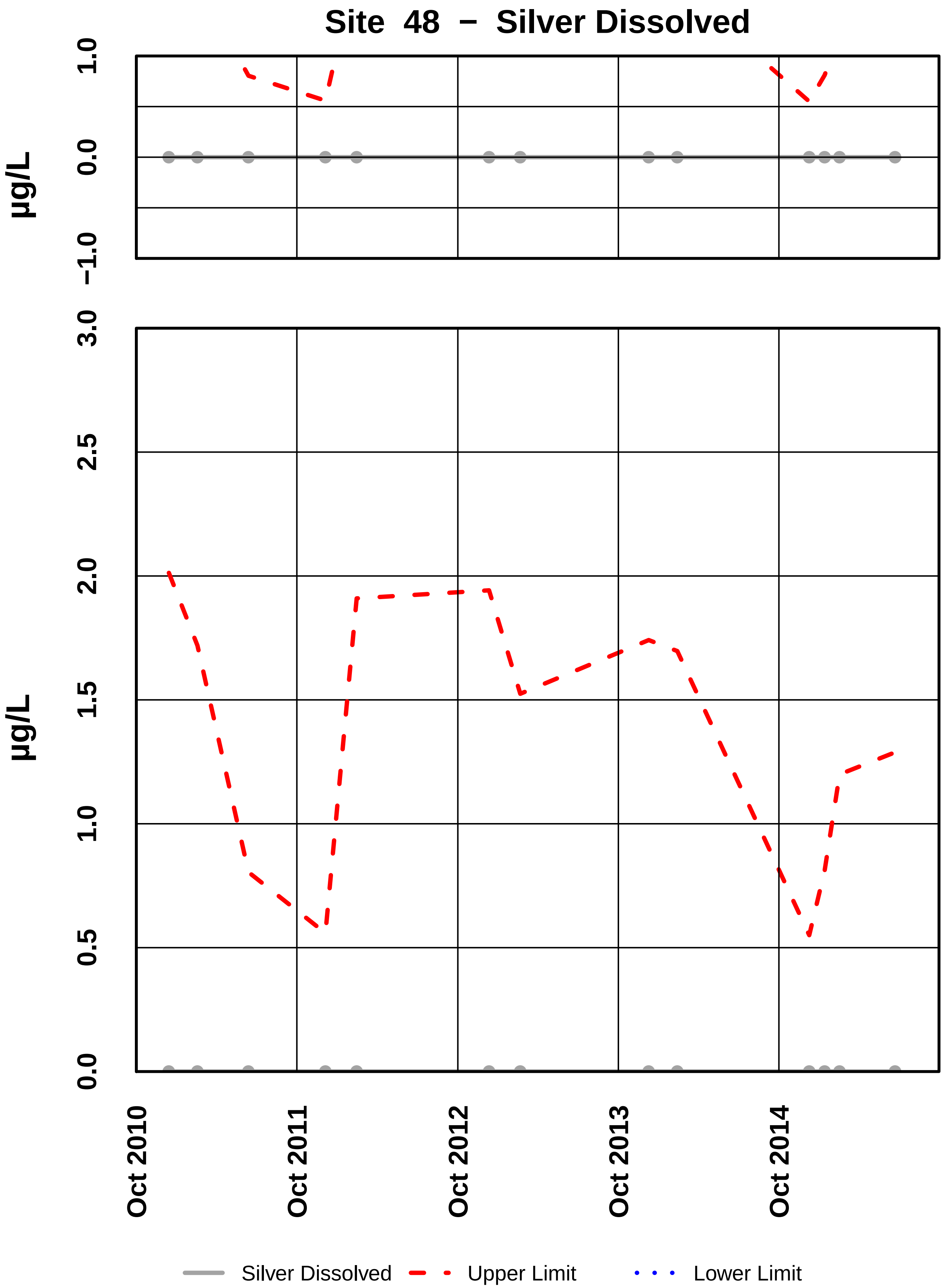


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

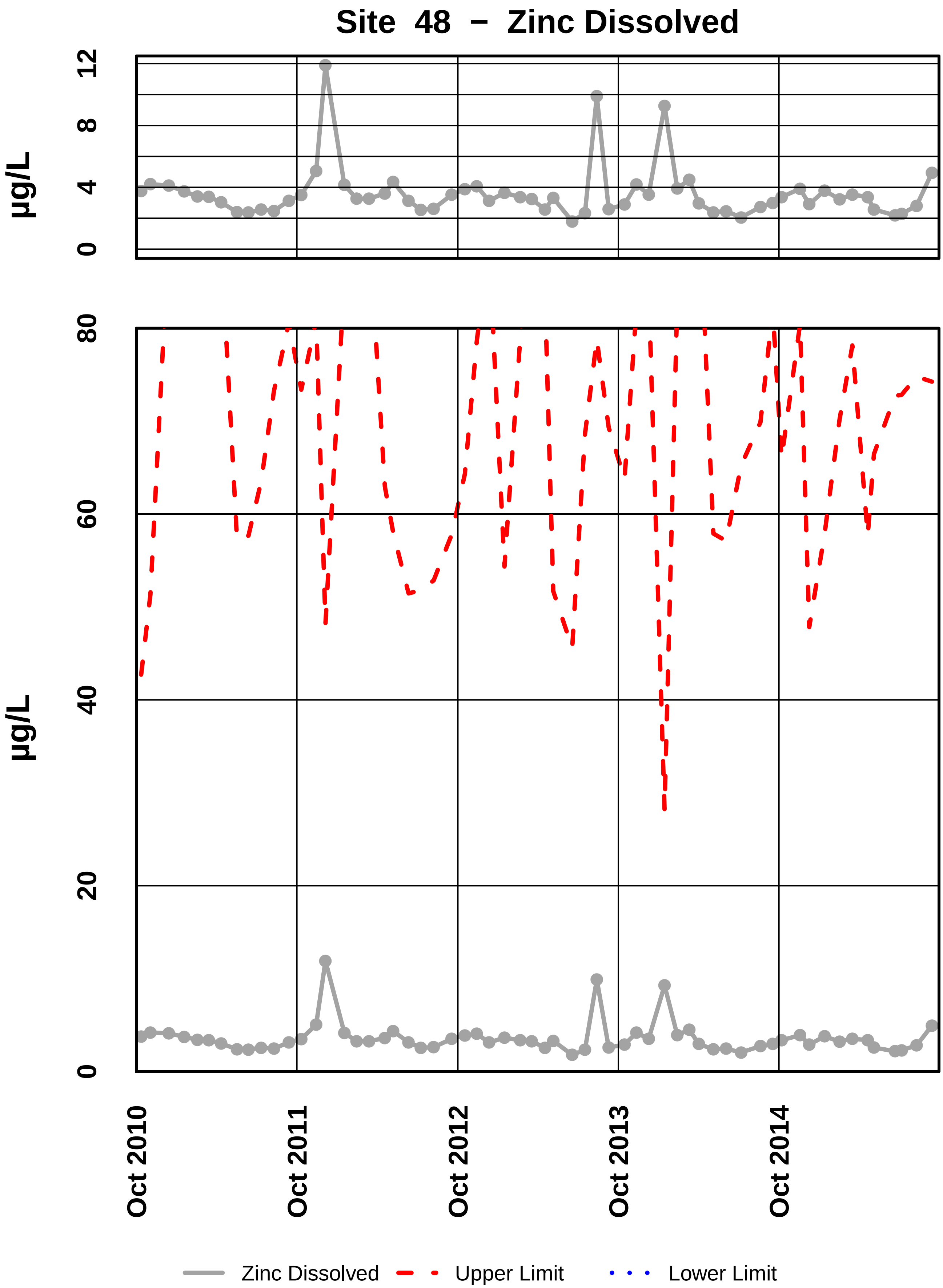
Site 48 – Nickel Dissolved



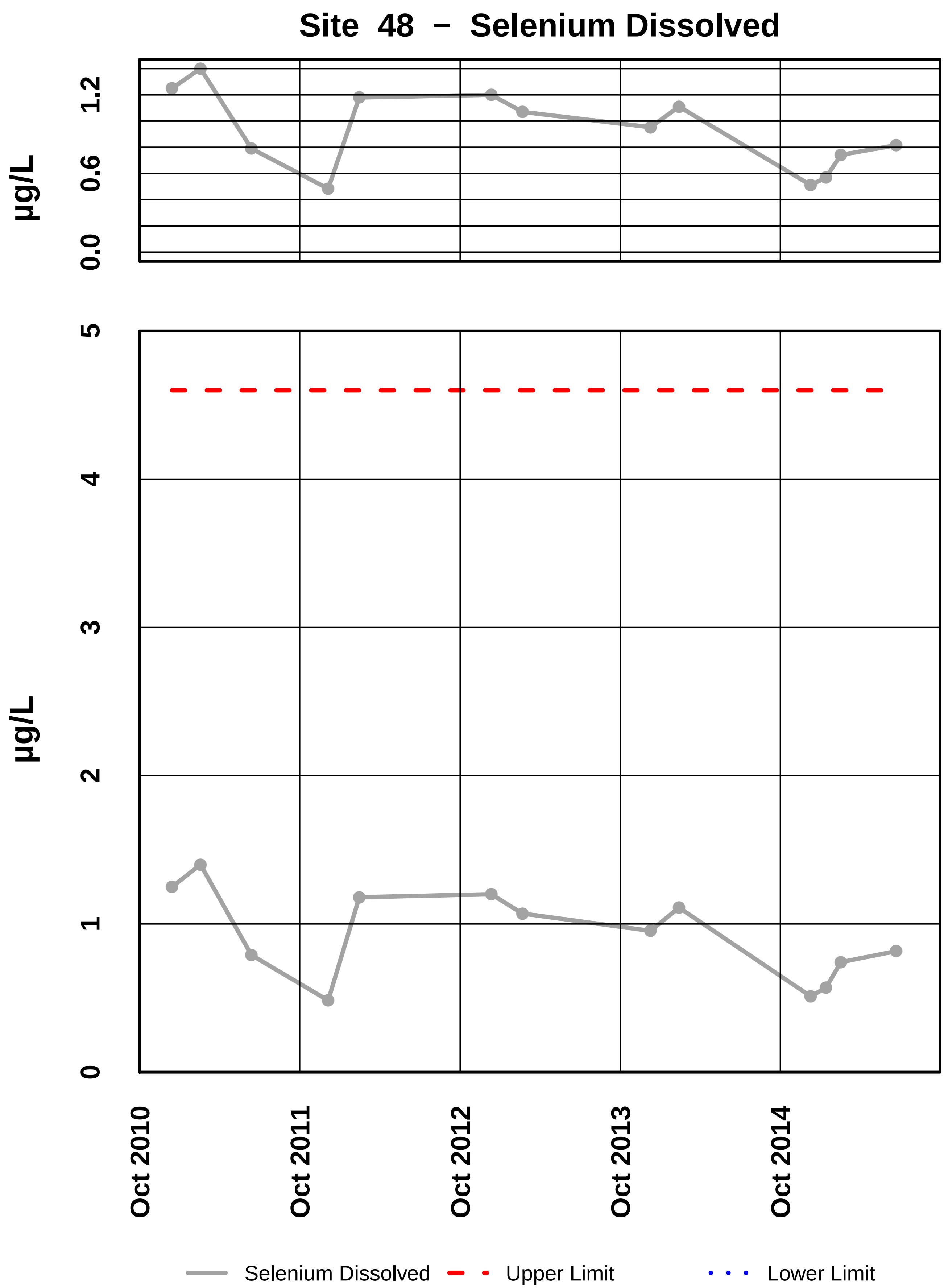
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



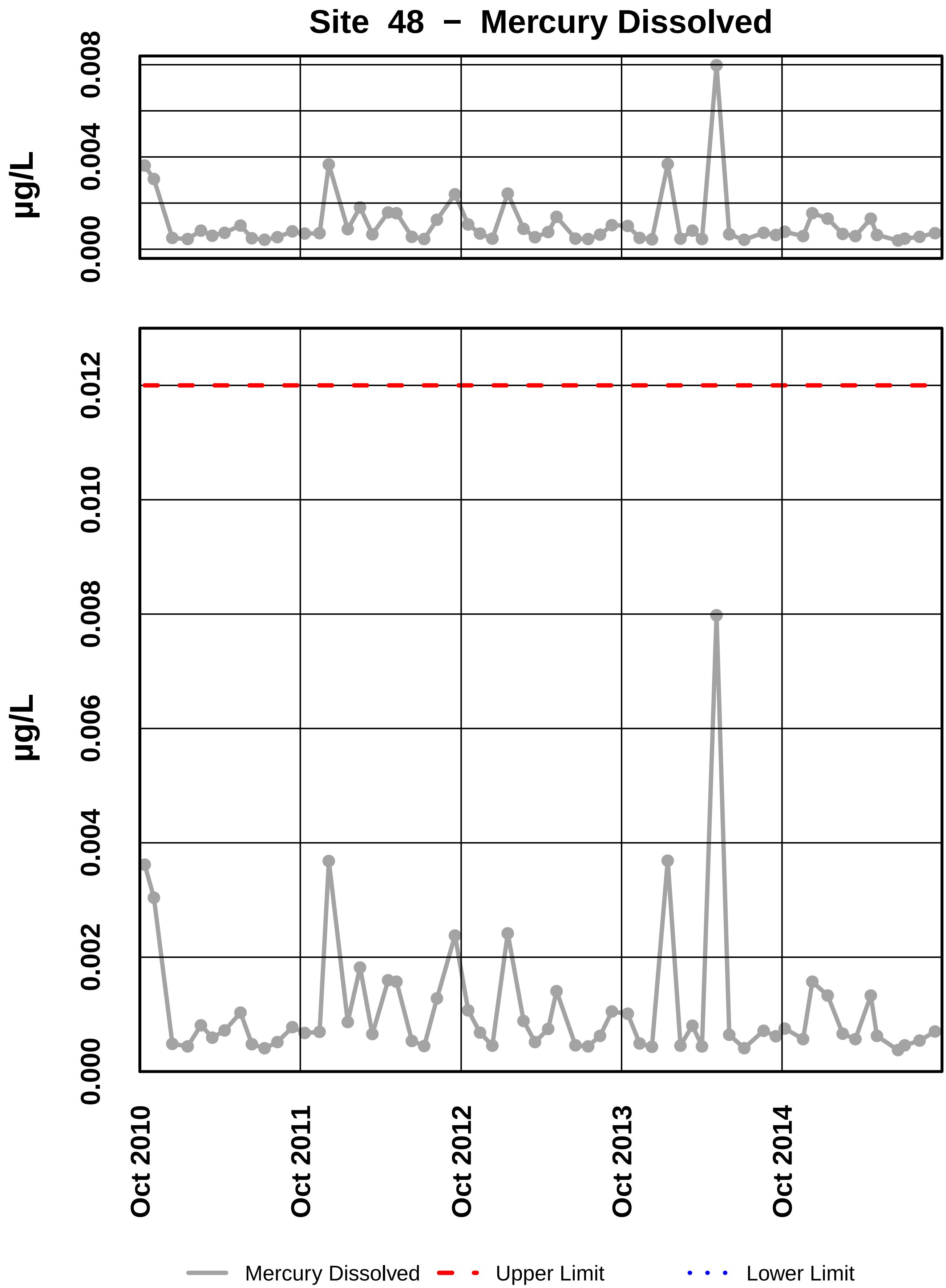
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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



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

INTERPRETIVE REPORT
SITE 6

The data collected during the current water year are listed in the following "Table of Results for Water Year 2015" 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, in the past six years, have been identified by HGCMC.				

The data 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 2015

			Limits		
Sample Date	**Parameter**	**Value**	**Lower**	**Upper**	**Hardness**
No exceedances have been identified by HGCMC for the period of October 2014 through September 2015.					

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. A visual trend was observed with dissolved nickel; nickel concentrations have been decreasing over the last 5 years. Though pH had been increasing for a number of years it appears to have plateaued in the 2015WY.

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-09 and Sep-15 (WY2010-WY2015).

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	<0.01	+	0.08	1.1
Alkalinity, Total	6	0.04			
Sulfate, Total	6	0.50			
Zinc, Dissolved	6	0.19			

* Number of Years ** Significance level

Out of the five parameters evaluated field pH had a statistically significant positive slope (0.08 su/year), similar to last year's trend (0.09 su/year). The direction and magnitude of trend is similar to the pH trend measured at the background site (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 2015 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	111.7	113.2	-5.5
pH Field	0.248	7.98	7.96	0
Alkalinity, Total	0.046	42.9	43.5	-1
Sulfate, Total	<0.01	12.5	13.70	-1.60
Zinc, Dissolved	<0.01	3.3	6.73	-3.21

Field pH 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 field pH for Site 48 and Site 6 are 7.98 su and 7.96 su respectively and the median of differences, Site 48 minus Site 6, is 0 mg/L.

The median values for field conductivity for Site 48 and Site 6 are 111.7 µS/cm and 113.2 µS/cm respectively. Median values for total alkalinity for Site 48 and Site 6 are 42.9 mg/L and 43.5

mg/L respectively. The median values for total sulfate for Site 48 and Site 6 are 12.5 mg/L and 13.70 mg/L respectively.

Dissolved zinc results are similar to those observed in previous years. The current median values for Site 48 and Site 6 are 3.3 µg/L and 6.73 µg/L respectively, with a median difference of -3.21 µg/L. Signed-rank test results for prior datasets for Water Years 2000 – 2014 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 for water quality changes in this section of Greens Creek. 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 2015

Site 006FMS - 'Greens Creek Middle'

Sample Date/Parameter	Oct 2014	Nov 2014	Dec 2014	Jan 2015	Feb 2015	Mar 2015	Apr 2015	May 2015	Jun 2015	Jul 2015	Aug 2015	Sep 2015	**Median**
Water Temp (°C)	5.5	2.9	2.1	0.6	1.6	1	2.5	2.9	10.7	10.9	10.5	7.6	2.9
Conductivity-Field(µmho)	111.3	149.6	89.3	112.3	124.9	138.6	100	104	114.1	111	119	128.1	113.2
Conductivity-Lab (µmho)	106	137	80	104	124	138	98	109	119	112	130	108	111
pH Lab (standard units)	7.74	7.38	7.49	7.66	7.34	7.54	7.57	7.06	7.94	7.8	7.92	7.76	7.62
pH Field (standard units)	8.03	8.03	7.12	7.25	7.34	7.54	7.44	7.96	8.02	7.95	8.03	8	7.96
Total Alkalinity (mg/L)	40.8	49.1	30.2	35.3	37.3	49.5	36.6	38.9	46.1	47.5	54.2	48.4	43.5
Total Sulfate (mg/L)	10.7	18.6	9.5	12.5	14.8	17.4	11.2	11	13.9	14.7	18.2	13.4	13.7
Hardness (mg/L)	51.7	67.1	37.8	48.4	56.1	64.1	45.8	51.6	56.7	60	66.7	59.9	56.4
Dissolved As (ug/L)	0.221	0.195	0.179	0.191	0.179	0.173	0.163	0.172	0.233	0.254	0.245	0.233	0.193
Dissolved Ba (ug/L)			20.1		26.1		20.7						20.7
Dissolved Cd (ug/L)	0.0502	0.0508	0.0432	0.0645	0.0412	0.0451	0.0472	0.0328	0.0358	0.0372	0.0477	0.0482	0.0462
Dissolved Cr (ug/L)			0.064		0.179		0.102						0.102
Dissolved Cu (ug/L)	0.556	0.379	0.635	0.657	0.424	0.44	0.682	0.394	0.298	0.389	0.426	0.477	0.433
Dissolved Pb (ug/L)	0.0133	0.0125	0.0233	0.0411	0.0075	0.0068	0.0139	0.0047	0.0079	0.0074	0.0096	0.0109	0.0103
Dissolved Ni (ug/L)			0.428		0.491		0.517						0.491
Dissolved Ag (ug/L)			0.002		0.002		0.002						0.002
Dissolved Zn (ug/L)	6.96	7.86	6.7	9.14	6.05	7.24	7.49	4.54	3.19	3.59	4.89	6.75	6.73
Dissolved Se (ug/L)			0.539		0.829		0.581						0.581
Dissolved Hg (ug/L)	0.000958	0.000577	0.0015	0.0014	0.000695	0.000659	0.00136	0.00059	0.000388	0.000503	0.000605	0.00075	0.000677

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

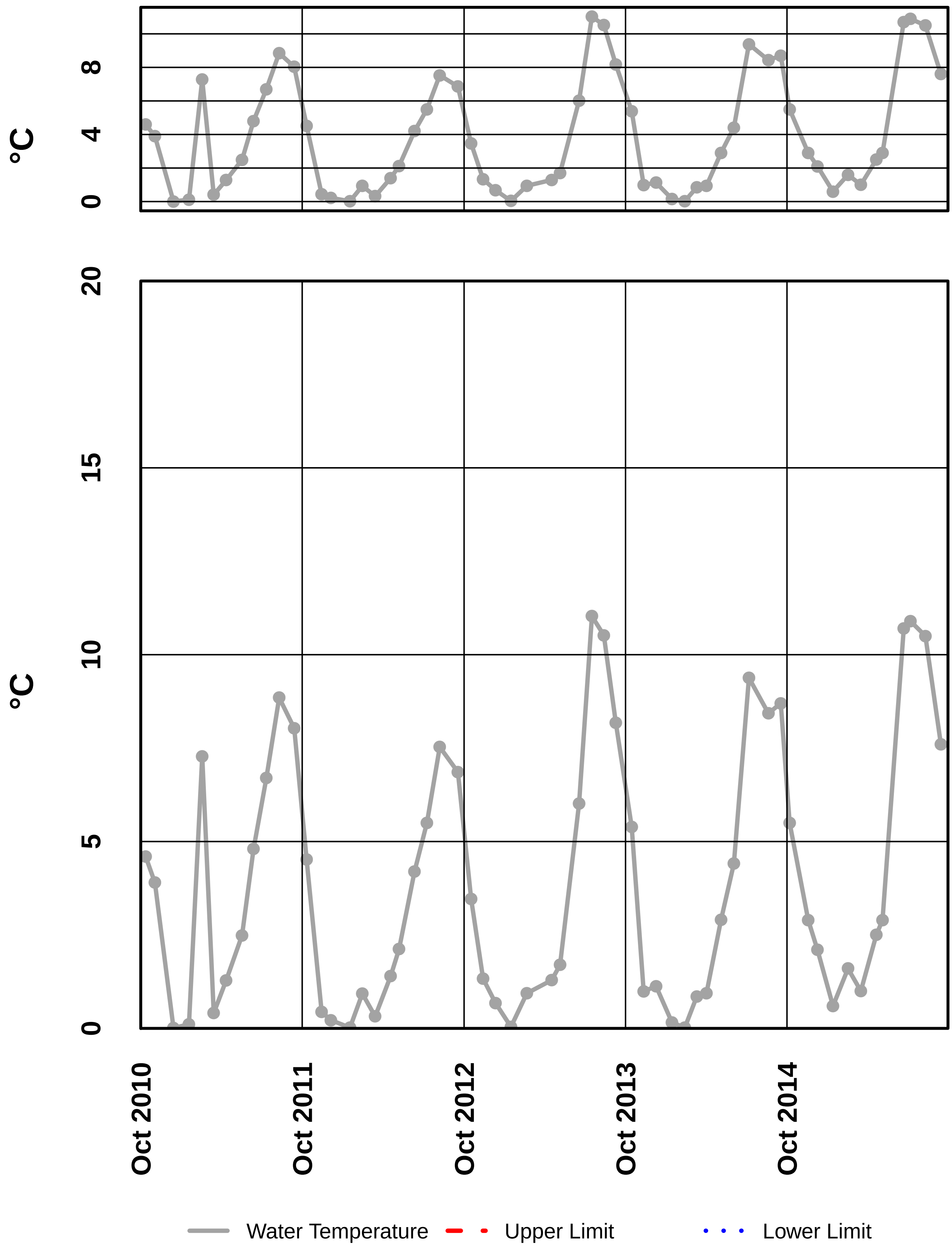
Qualified Data by QA Reviewer

Date Range: 10/01/2014 to 09/30/2015

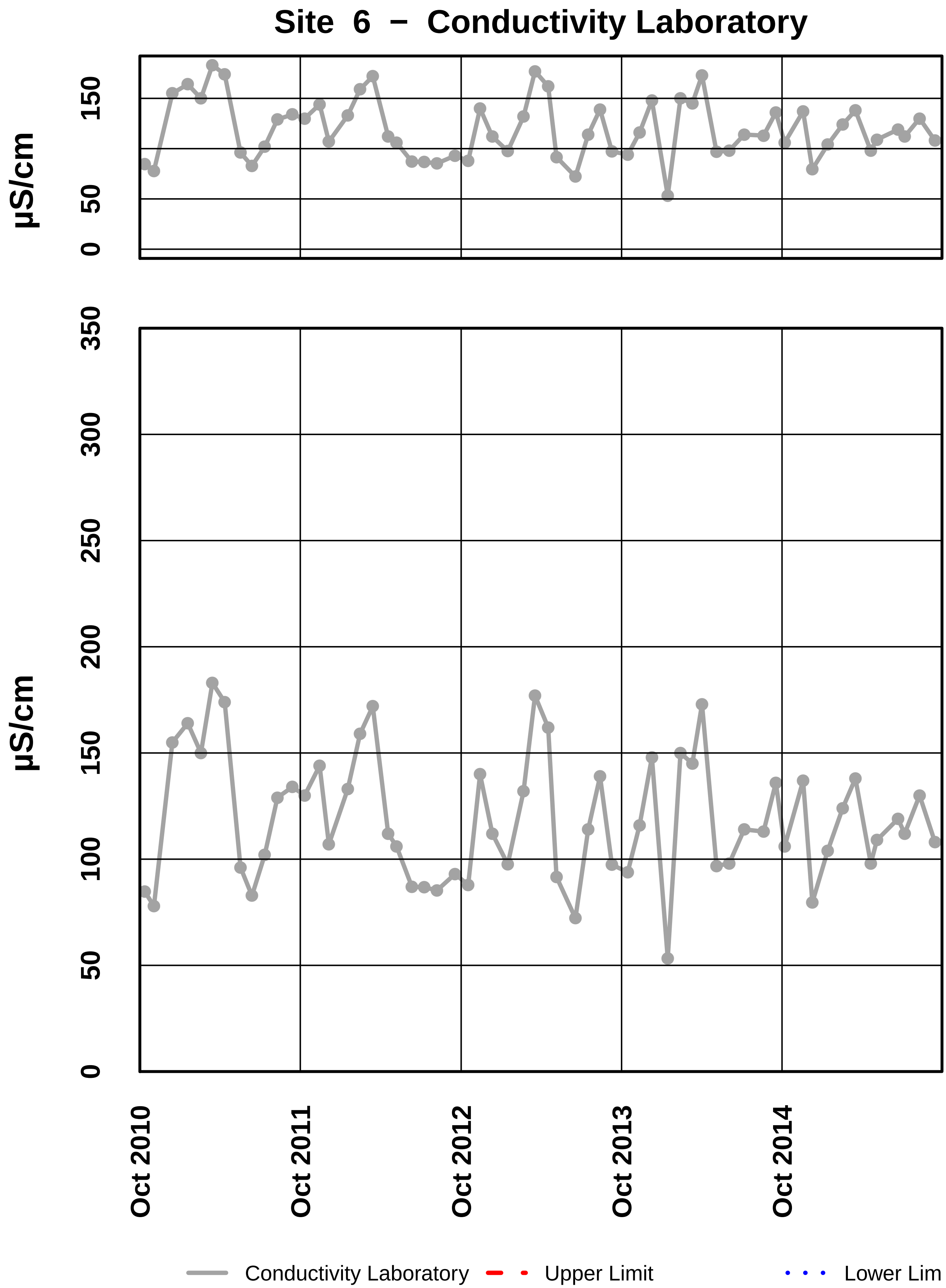
Site No.	Sample Date	Sample Time	Parameter	Value		Qualifier	Reason for Qualifier
006FMS	10/07/2014	12:00 AM	Diss. Pb-ICP/MS	0.01	µg/L	U	Field Blank Contamination
			pH	7.74	pH units	J	Hold Time Violation
006FMS	12/09/2014	12:00 AM	Diss. Cr-ICP/MS	0.06	µg/L	J	Below Quantitative Range
006FMS	02/16/2015	12:00 AM	Diss. Pb-ICP/MS	0.00751	µg/L	J	Below Quantitative Range
			pH	6.62	pH units	J	Hold Time Violation
006FMS	03/17/2015	12:00 AM	Diss. Pb-ICP/MS	0.00678	µg/L	J	Below Quantitative Range
006FMS	04/21/2015	12:00 AM	Diss. Cr-ICP/MS	0.1	µg/L	J	Below Quantitative Range
006FMS	05/05/2015	12:00 AM	Diss. Pb-ICP/MS	0.00473	µg/L	J	Below Quantitative Range
			Sulfate	11	mg/L	J	Sample Receipt Temperature
006FMS	06/22/2015	12:00 AM	Diss. Pb-ICP/MS	0.00791	µg/L	J	Below Quantitative Range
006FMS	07/07/2015	12:00 AM	Diss. Pb-ICP/MS	0.00737	µg/L	J	Below Quantitative Range
006FMS	08/10/2015	12:00 AM	Sulfate	18.2	mg/L	J	Sample Receipt Temperature

Qualifier	Description
J	Positively Identified - Approximate Concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit

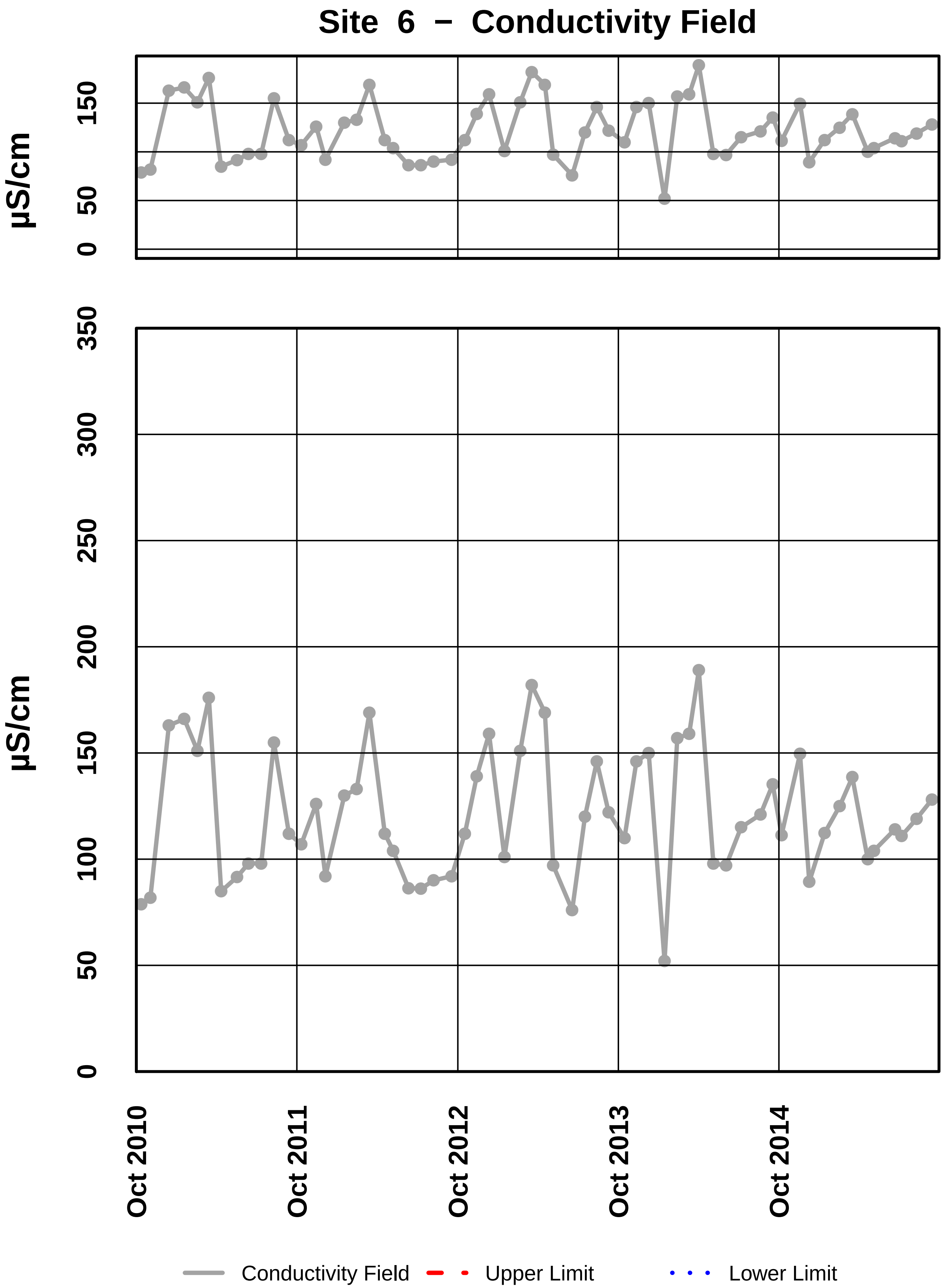
Site 6 – Water Temperature



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

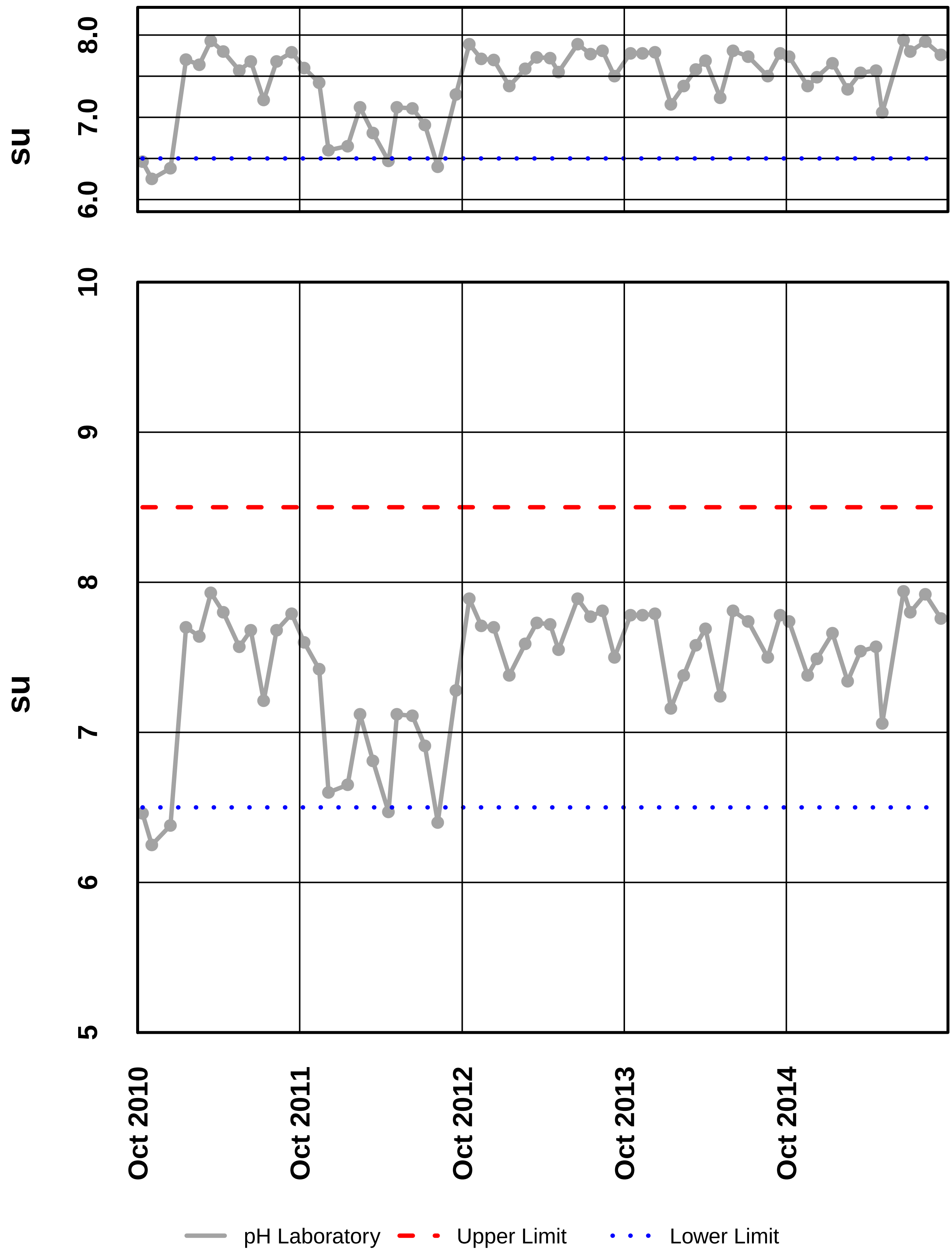


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



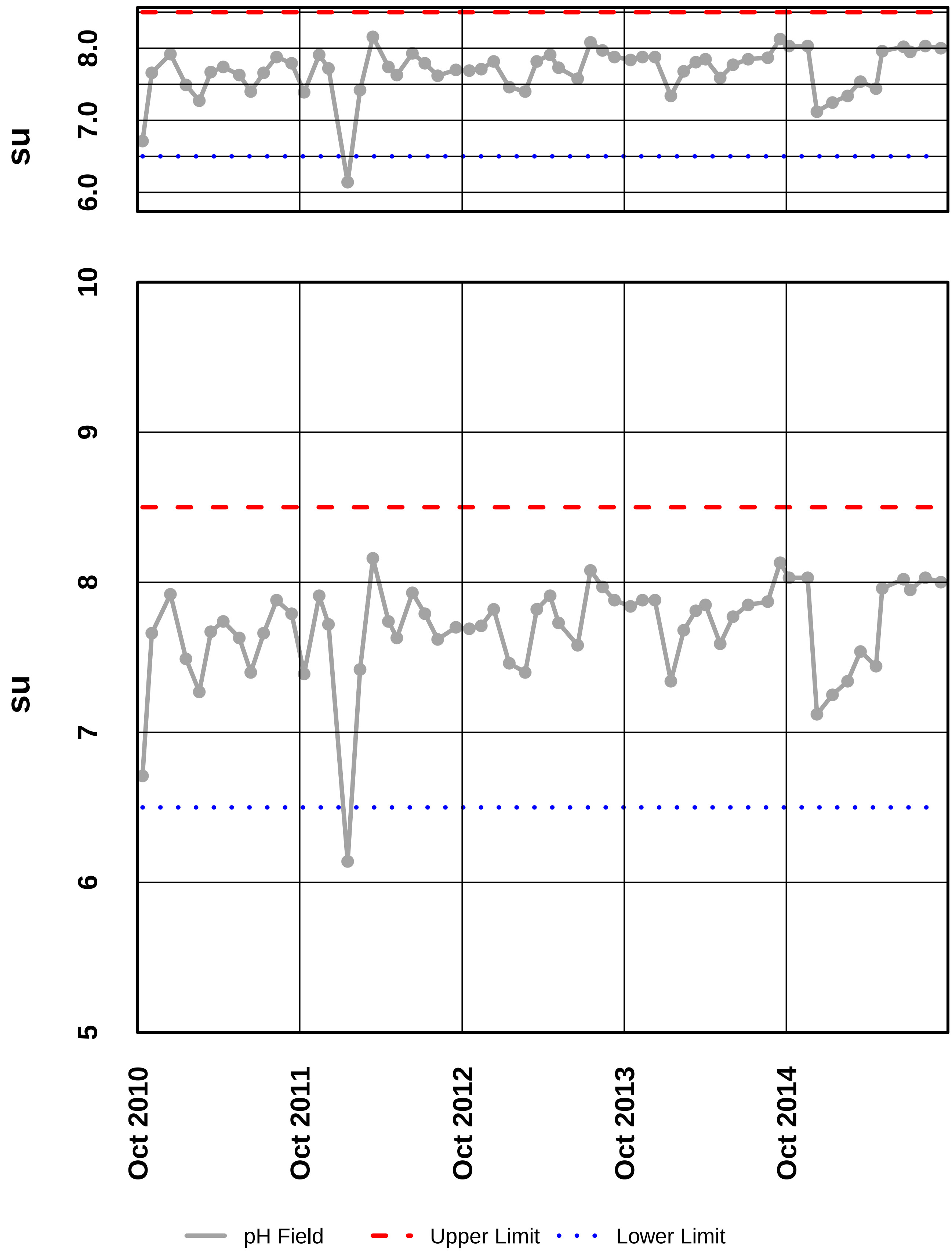
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 6 – pH Laboratory

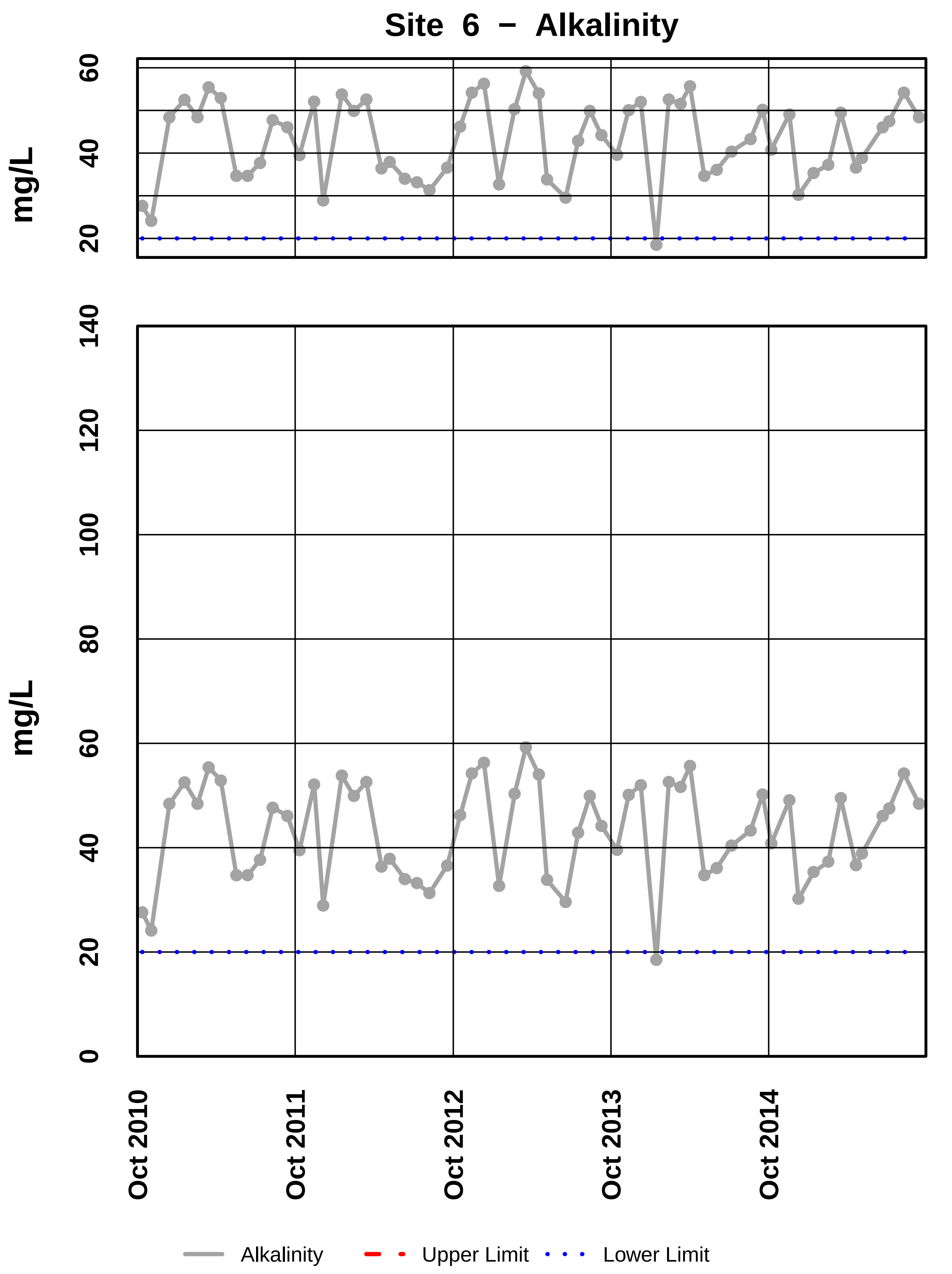


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

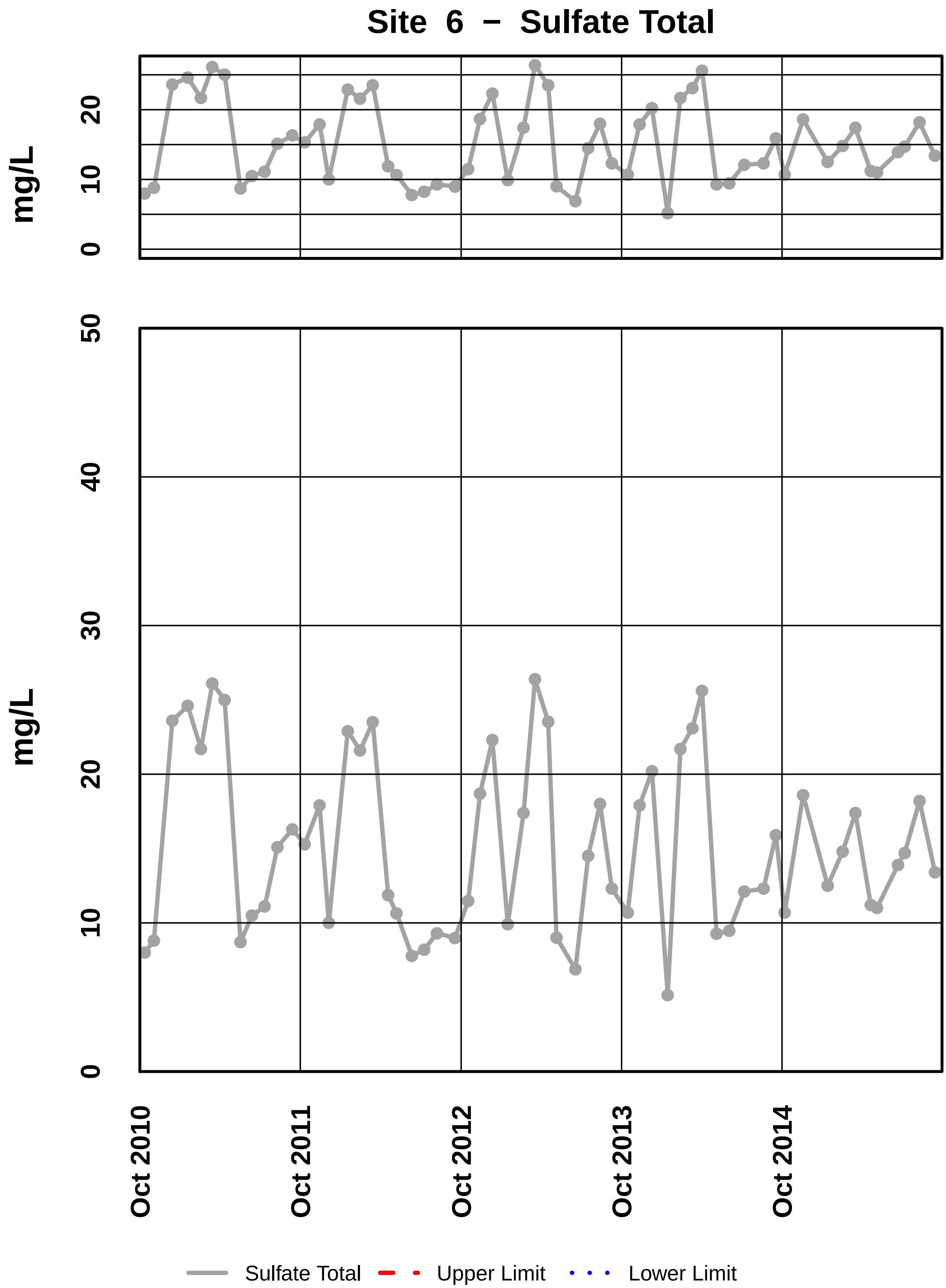
Site 6 − pH Field



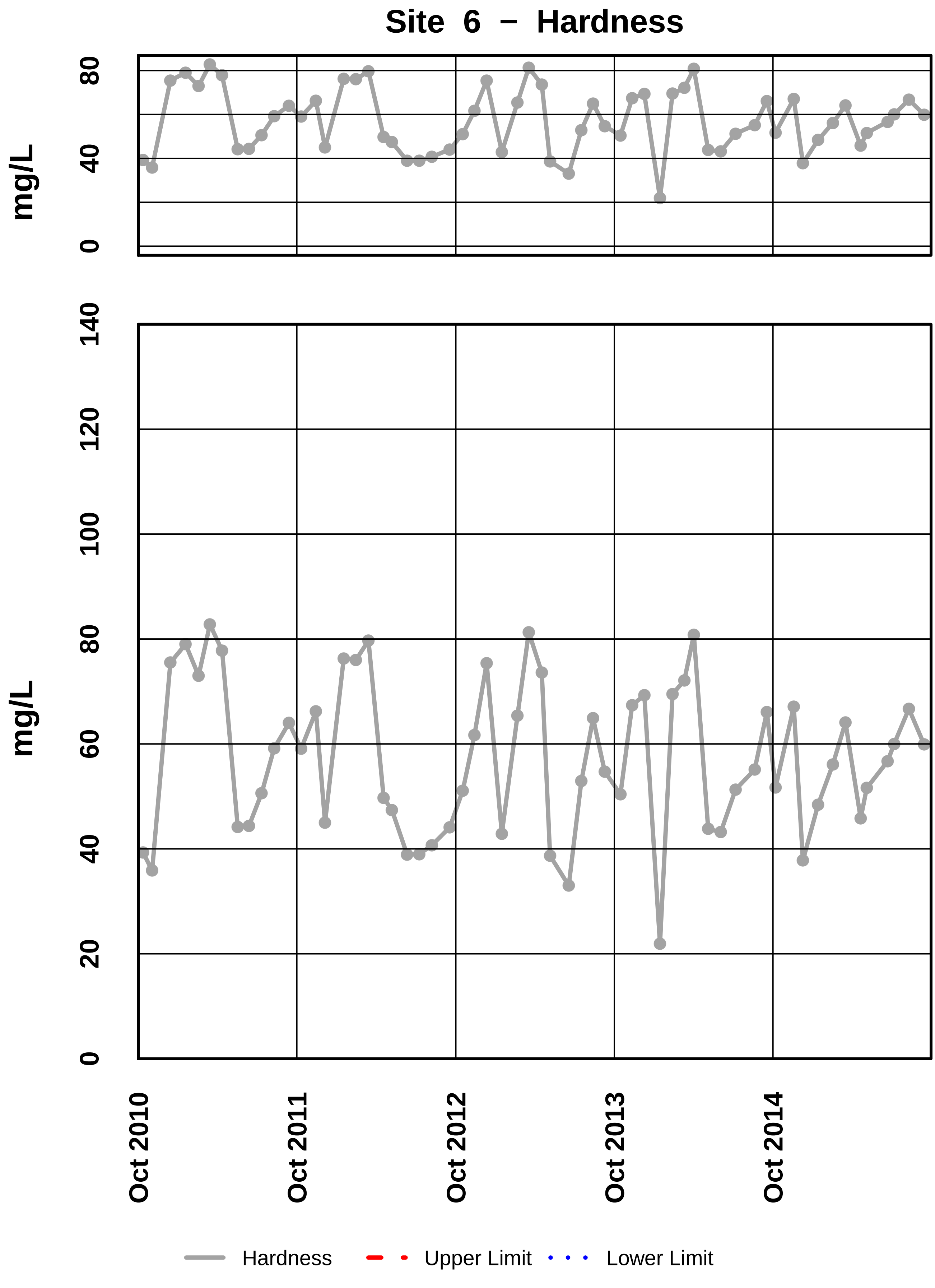
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

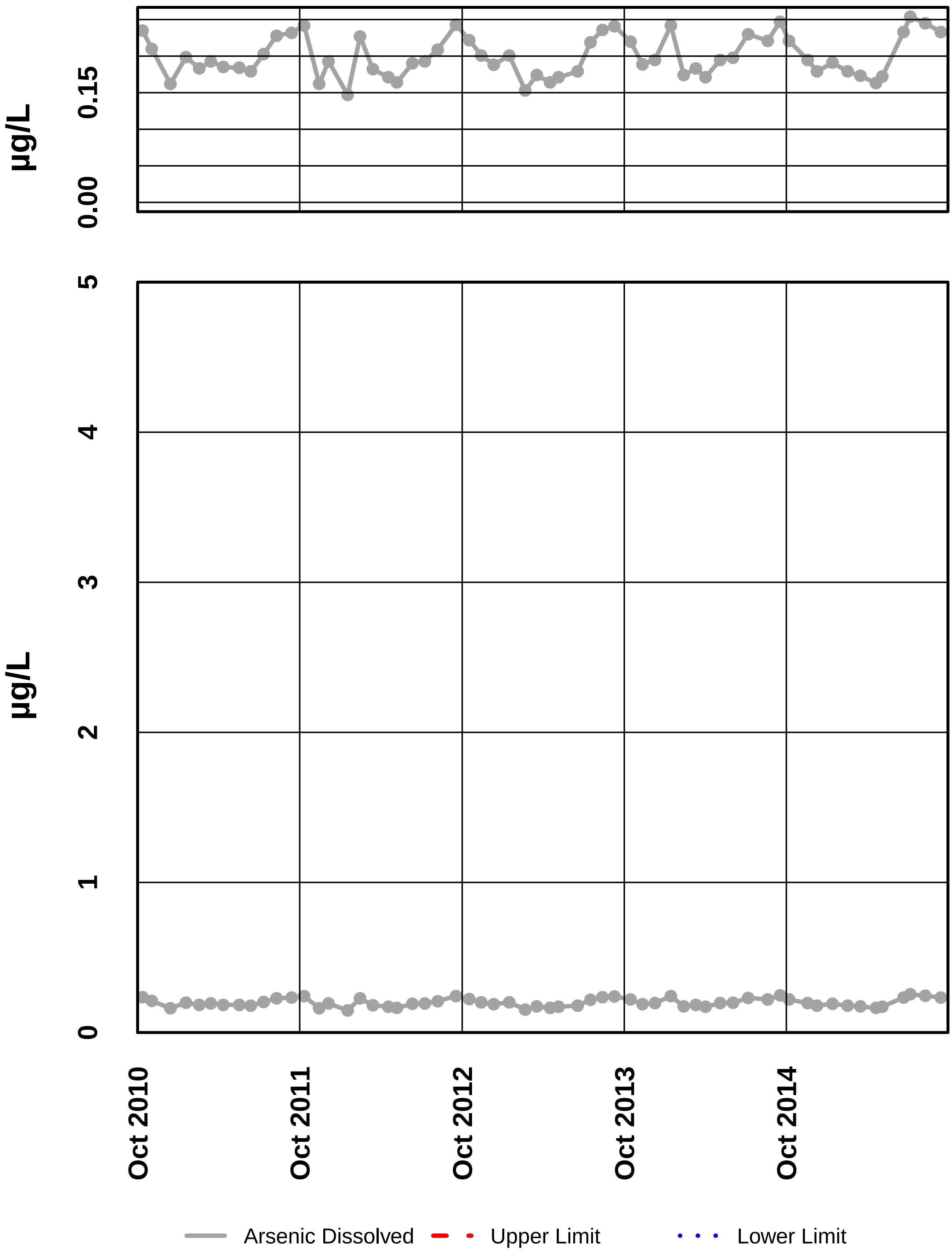


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

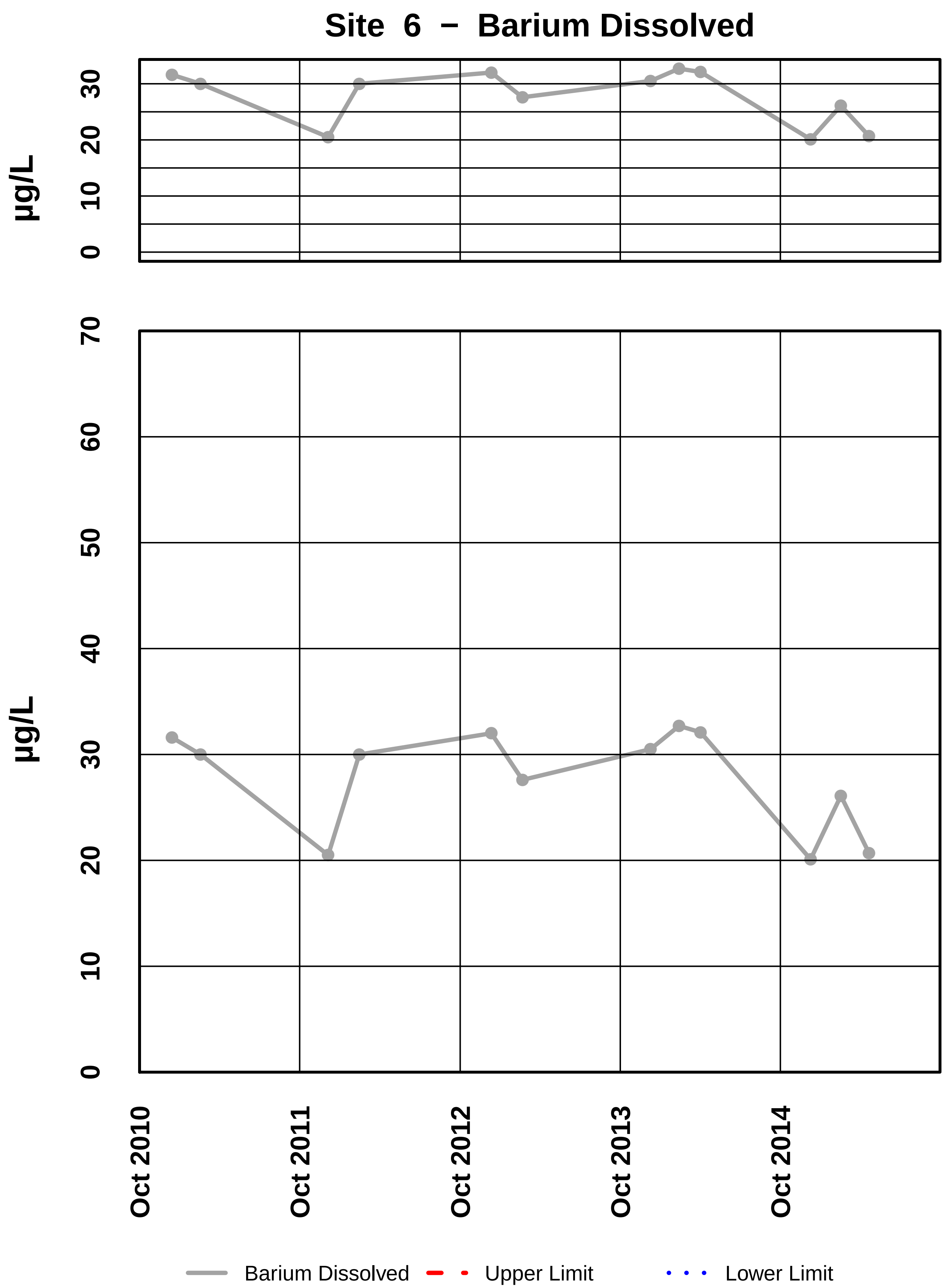


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

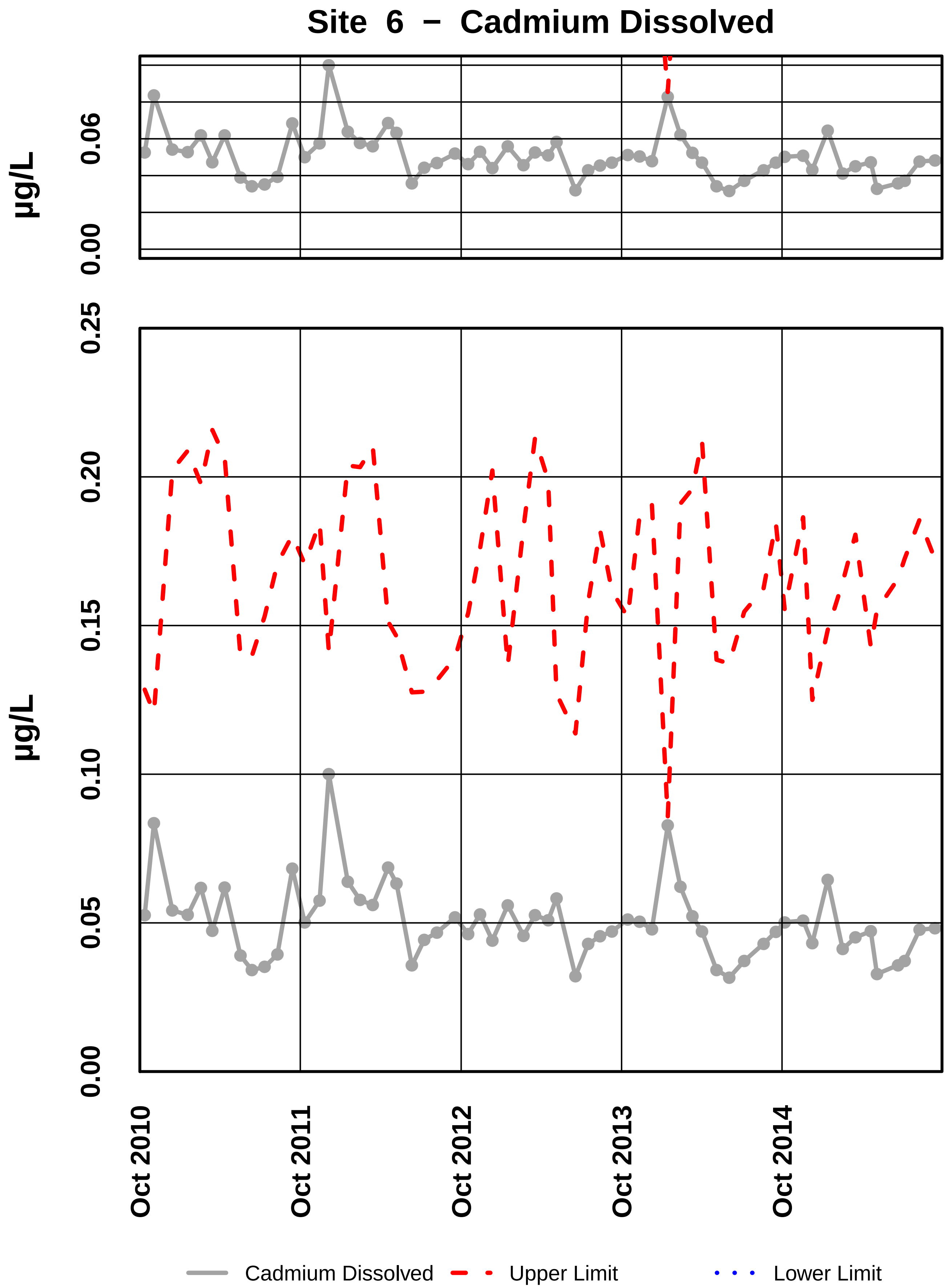
Site 6 – Arsenic Dissolved



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

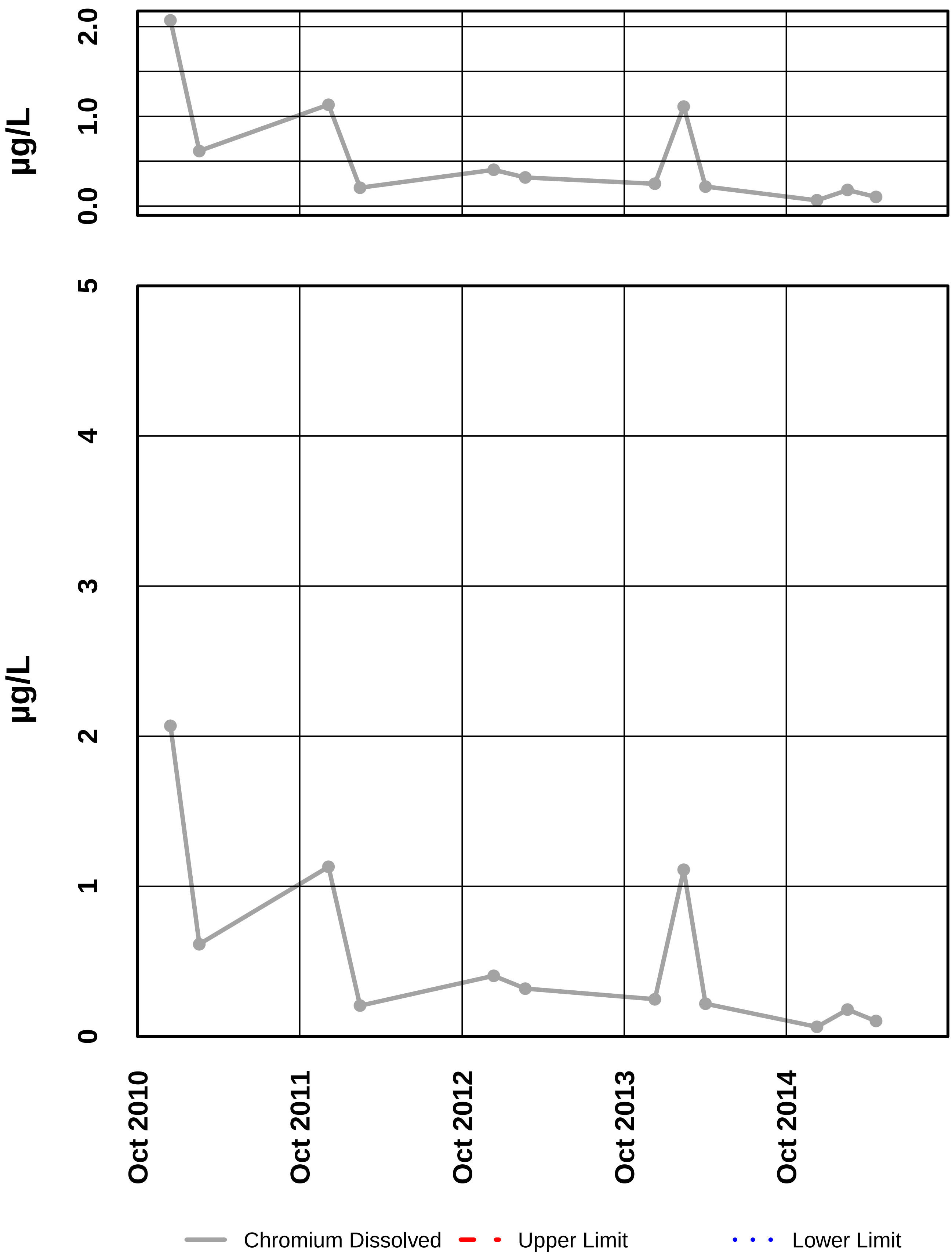


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



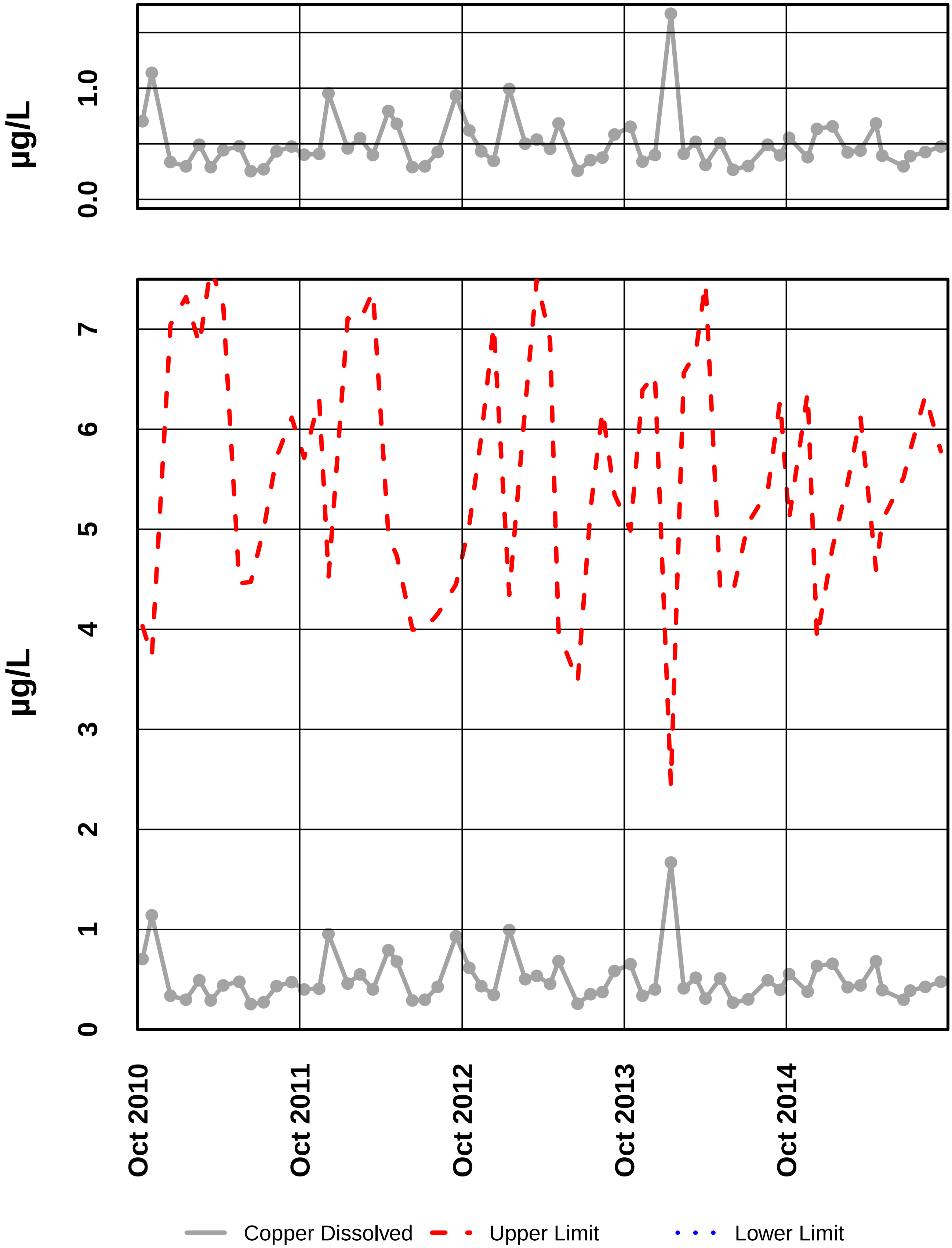
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 6 – Chromium Dissolved

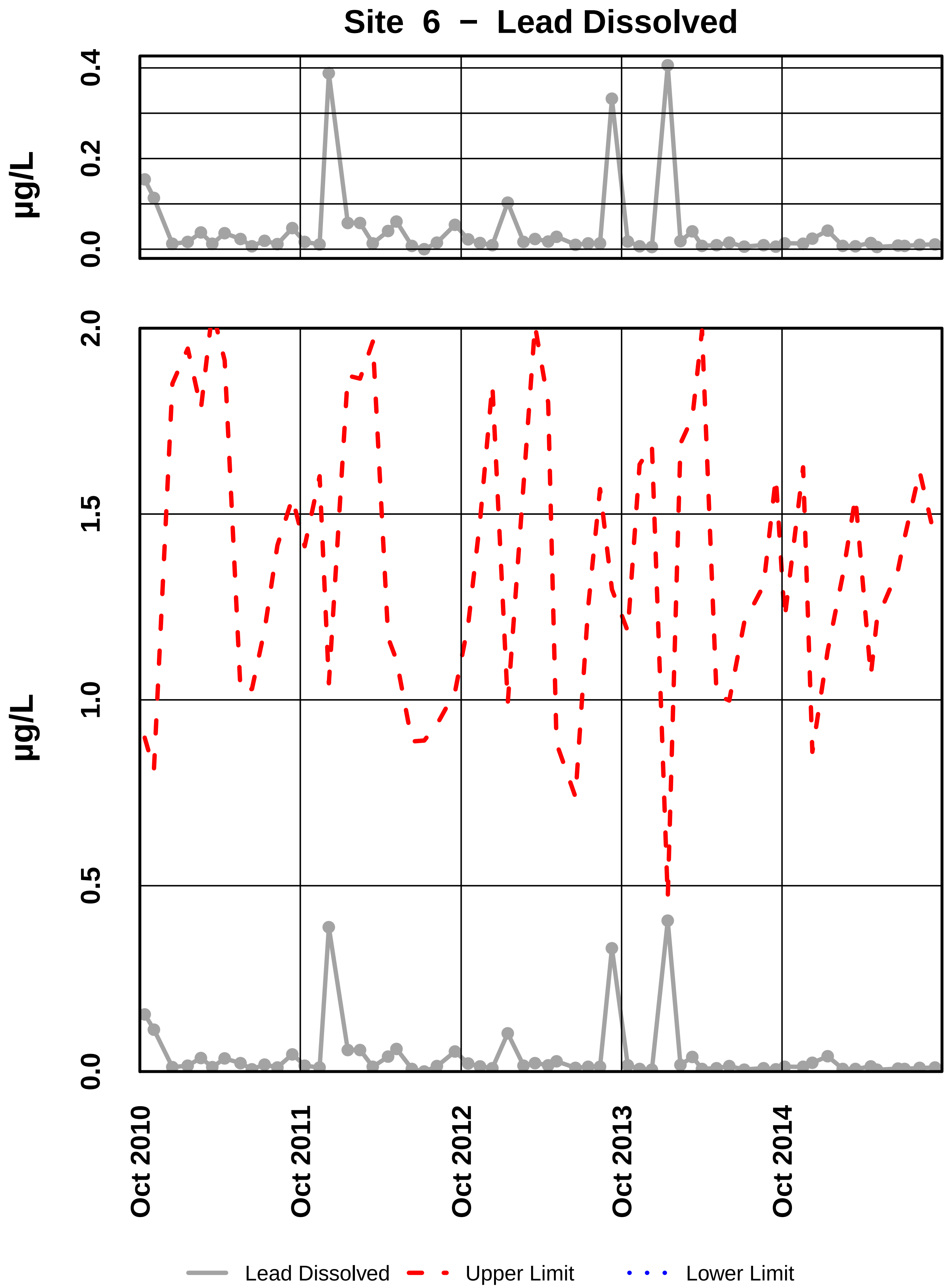


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

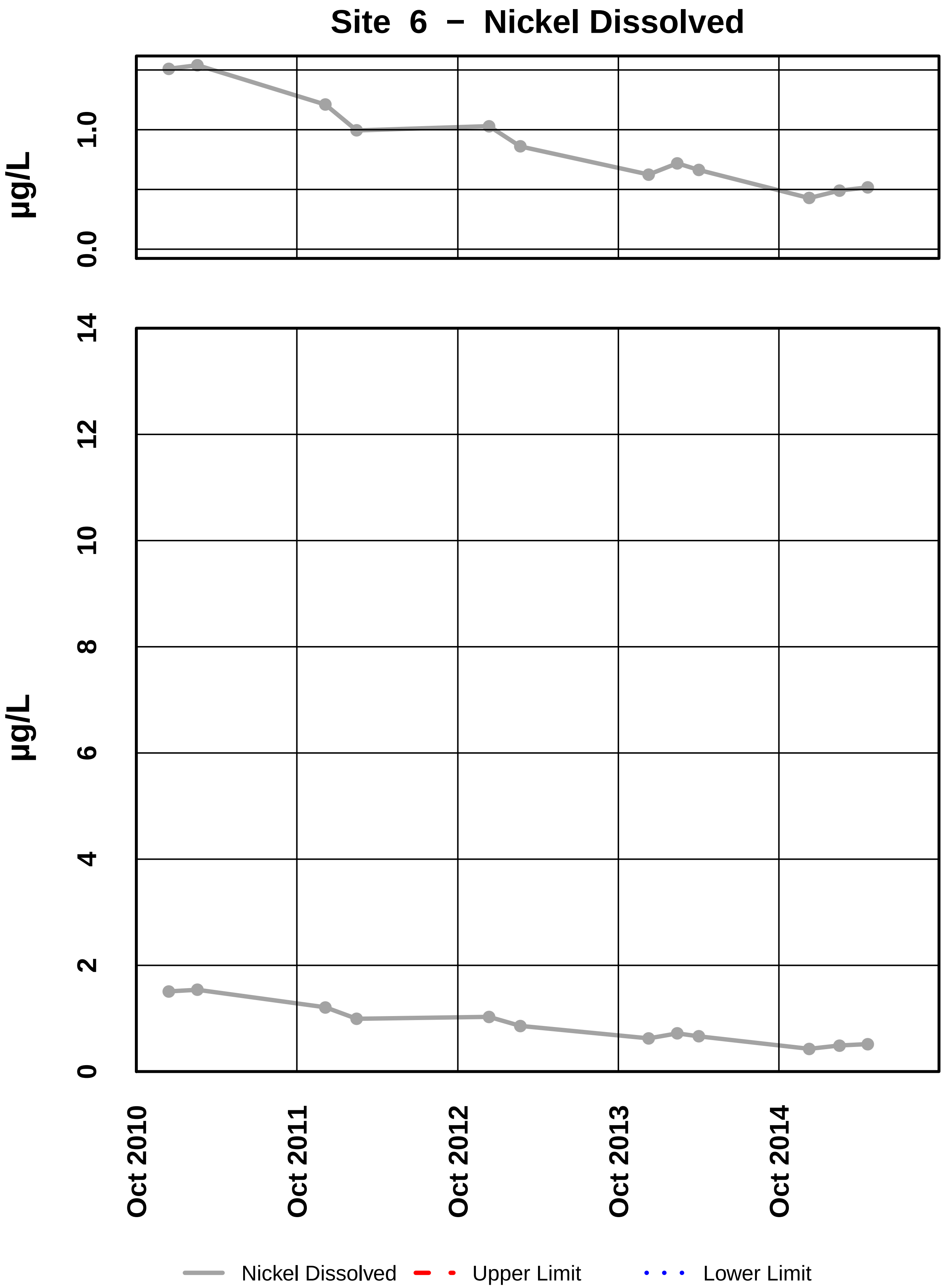
Site 6 – Copper Dissolved



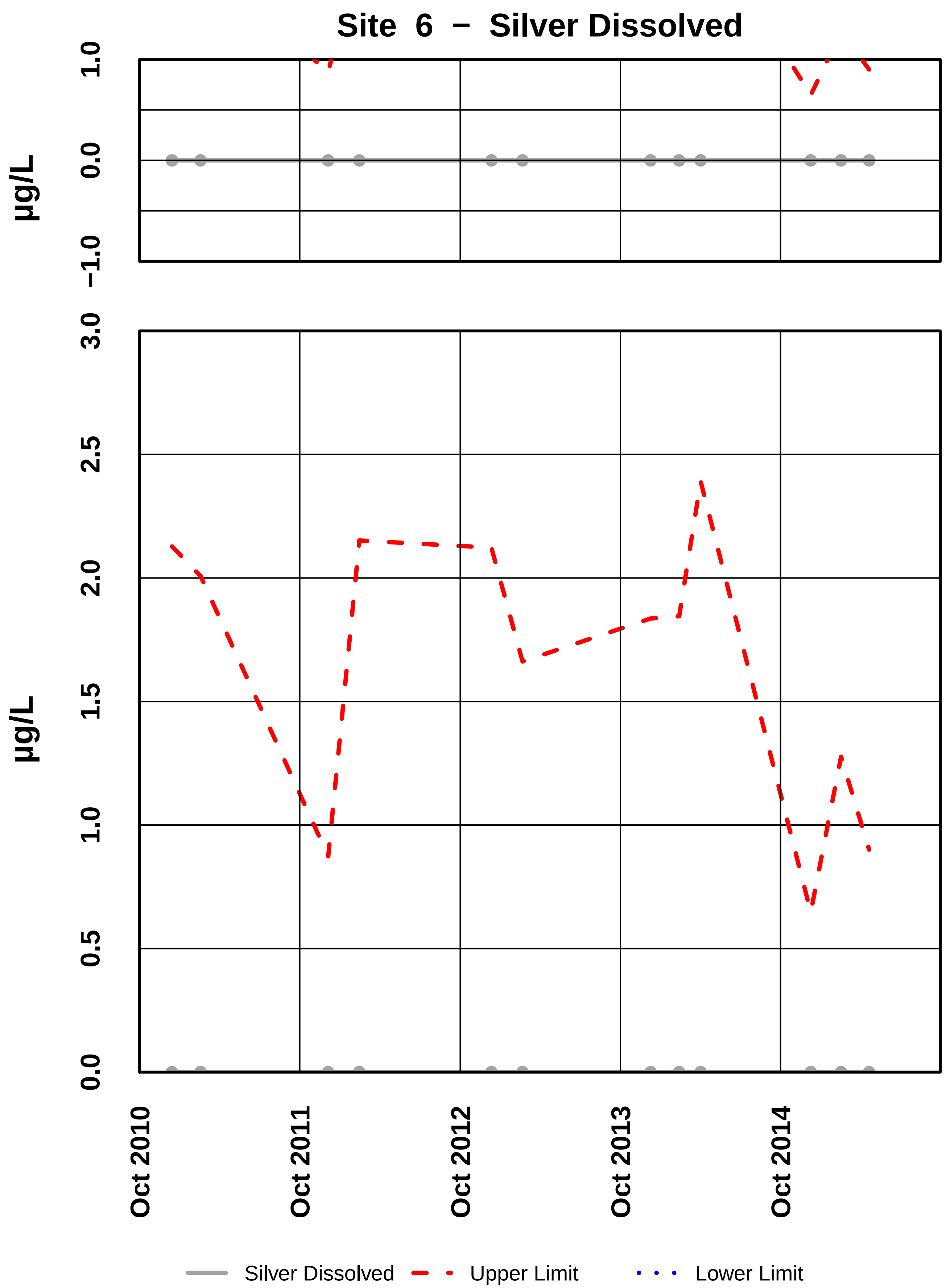
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



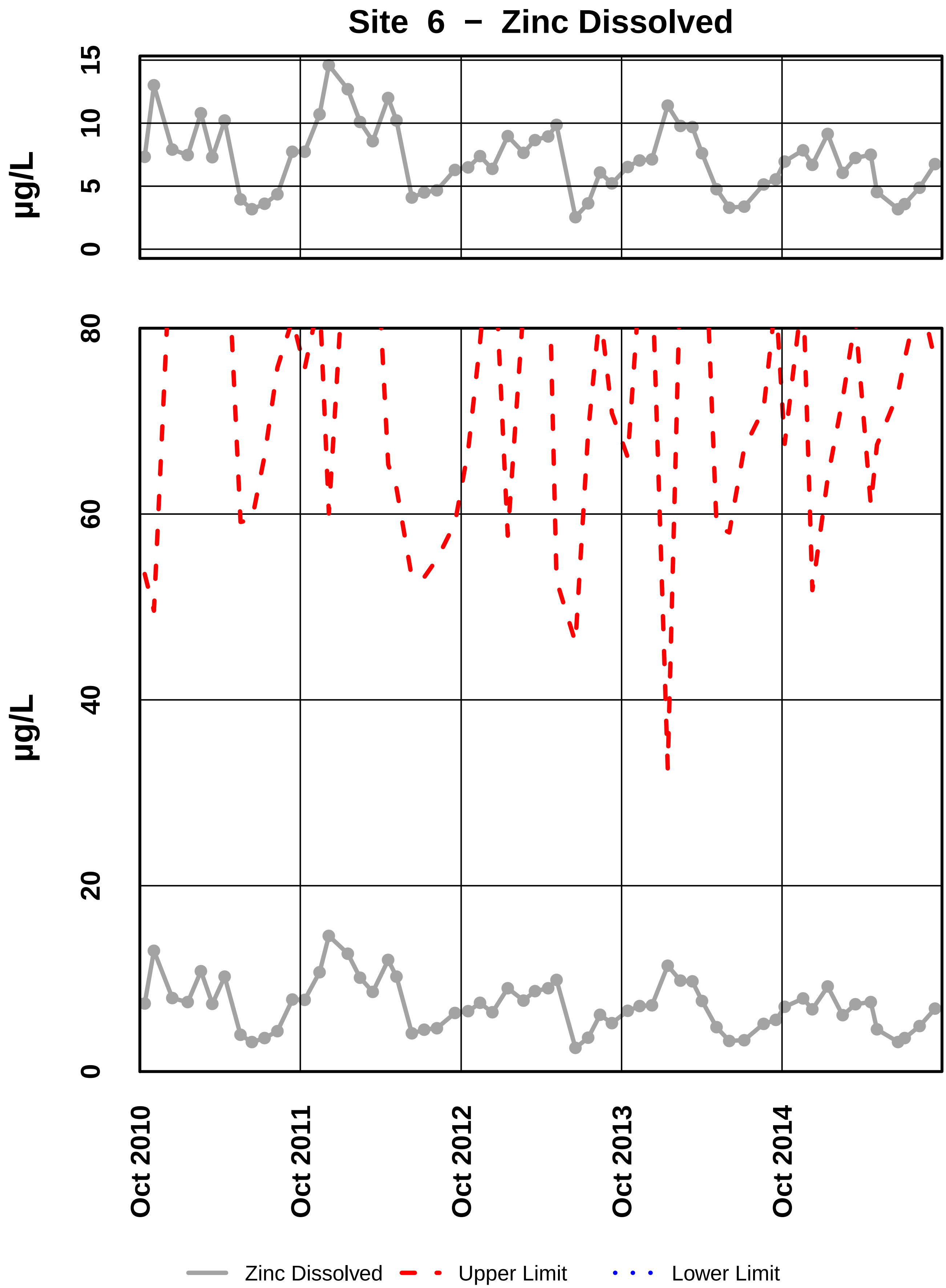
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



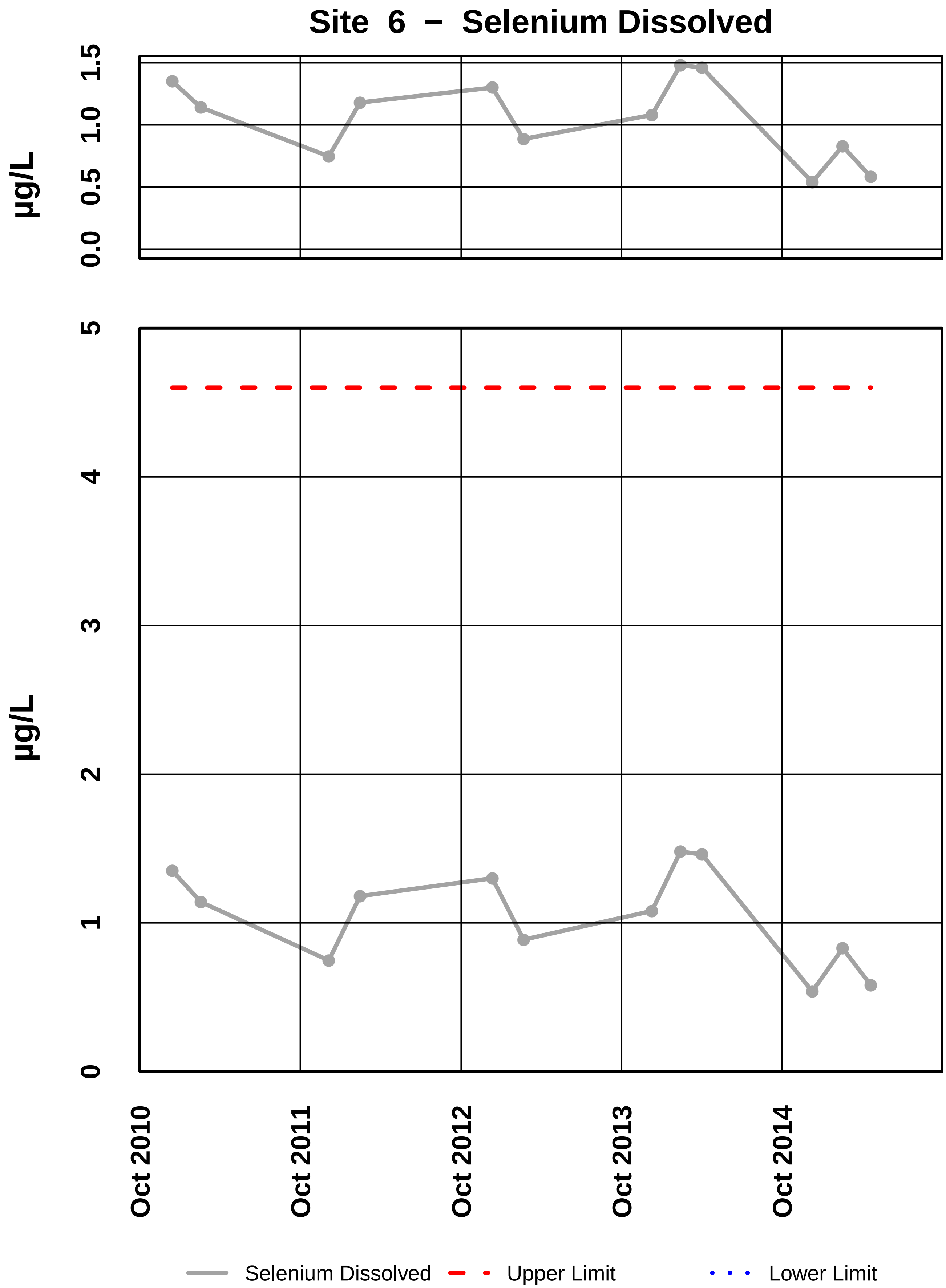
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

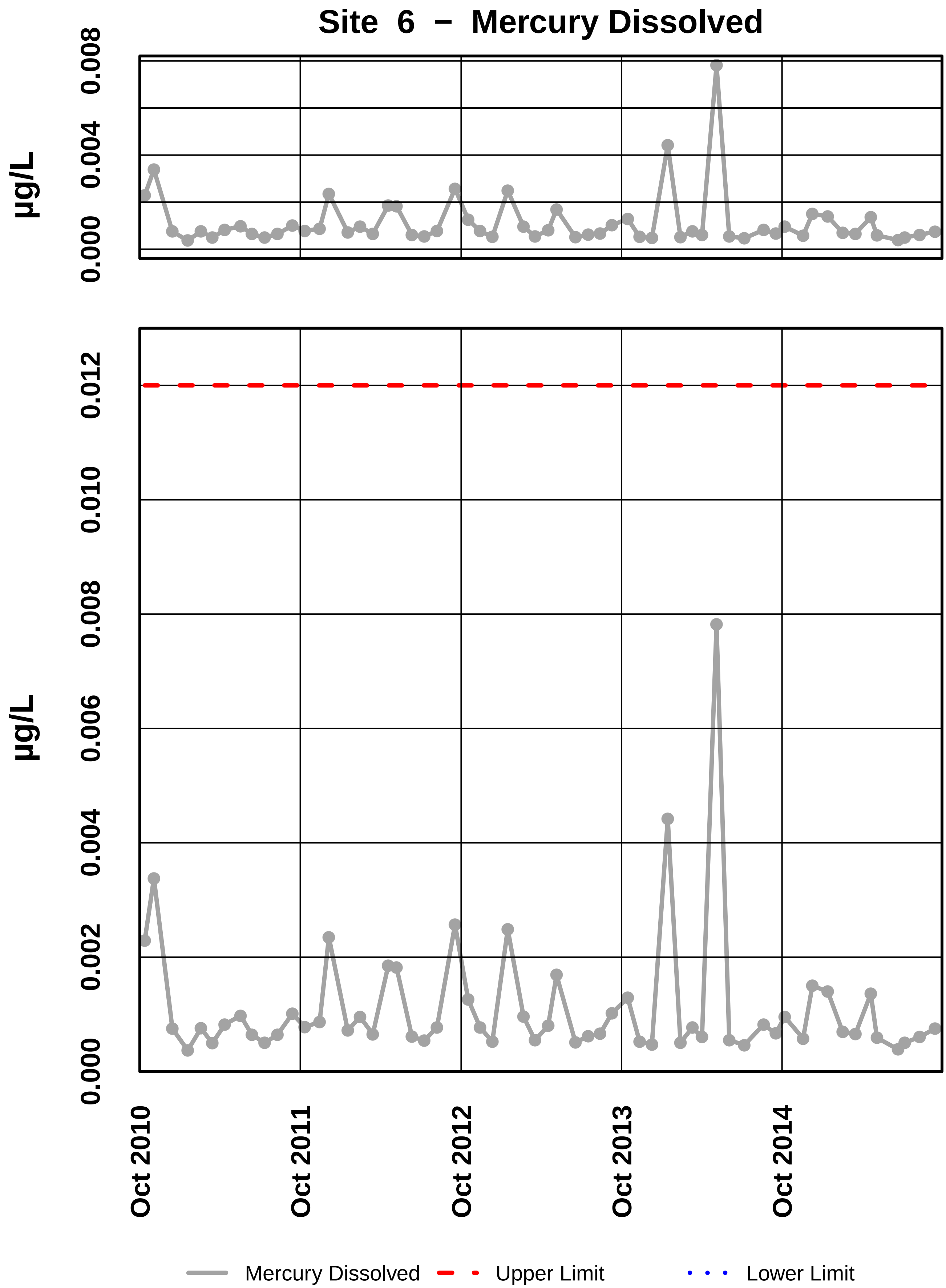


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

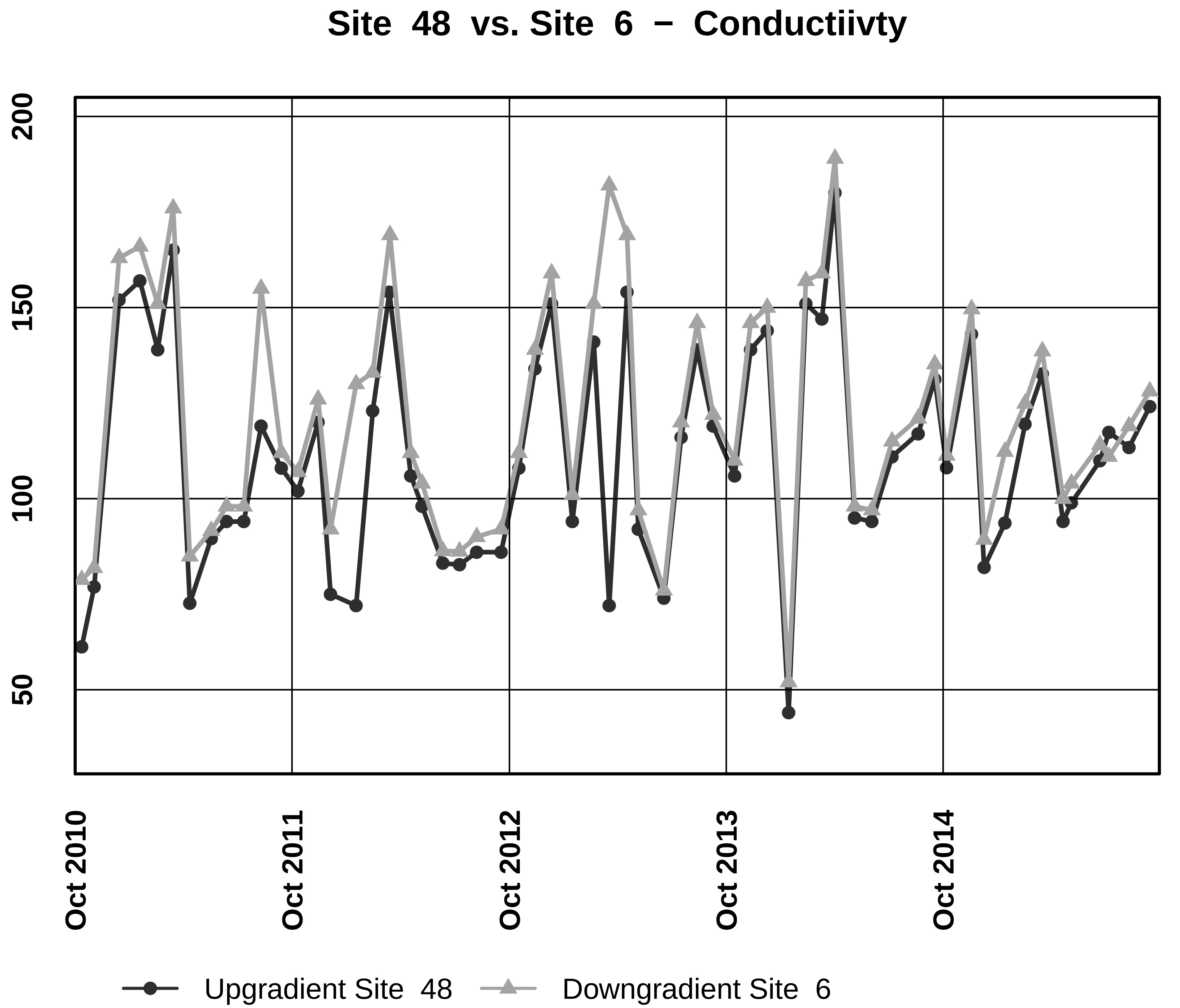


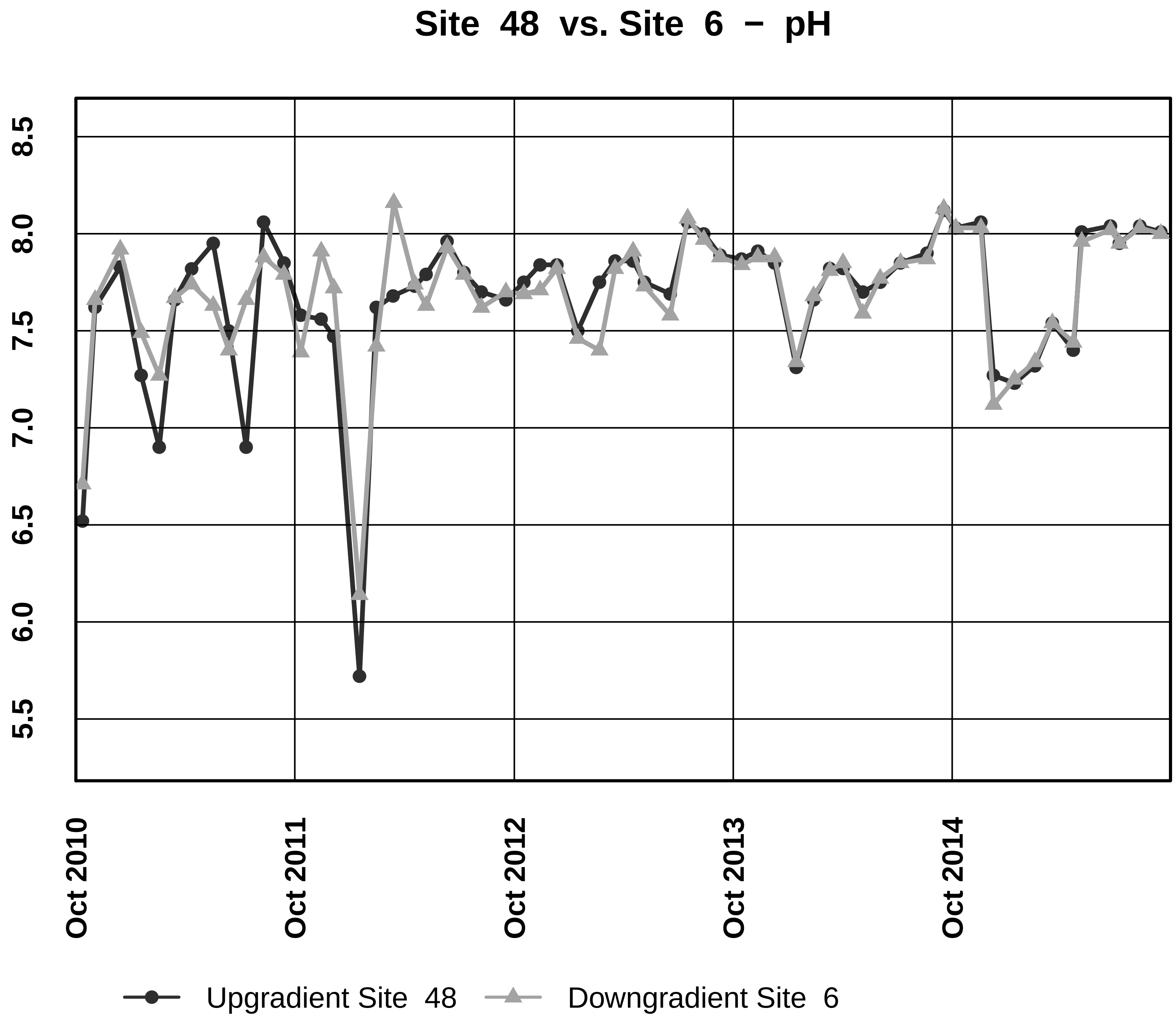
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

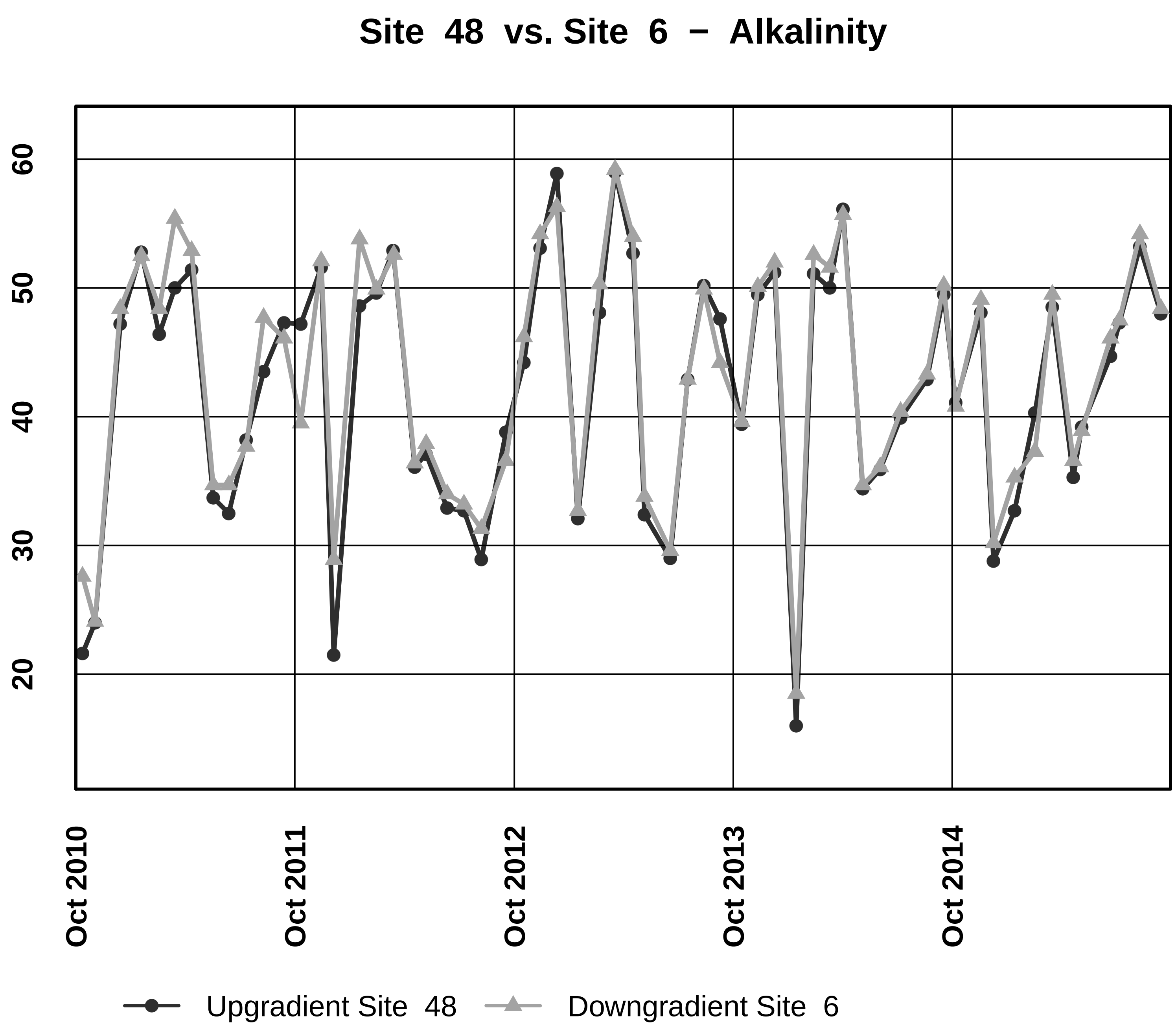
Site 6 – Mercury Dissolved



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

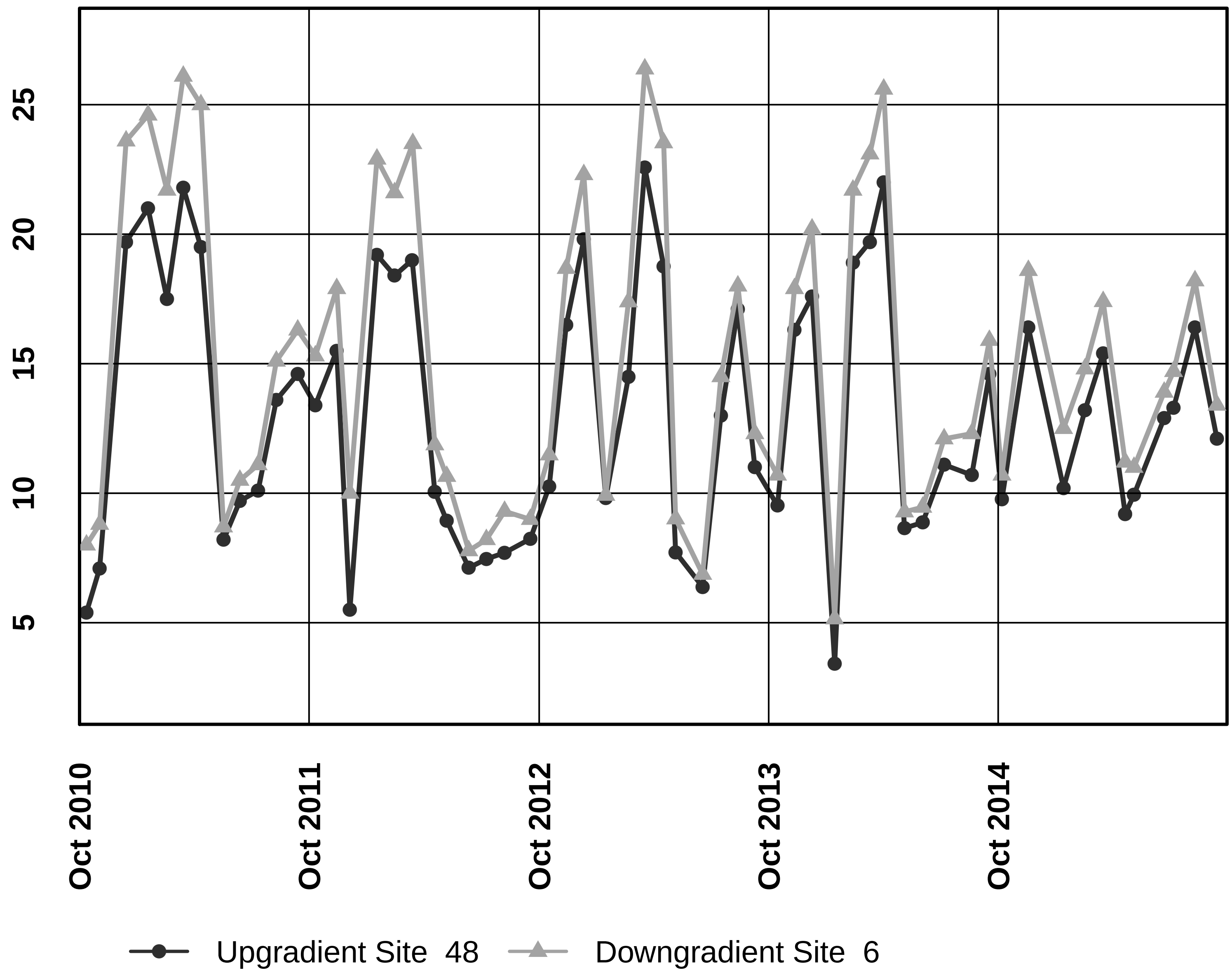

Site 48 vs. Site 6 − Conductiivty
200
150
100
50
Oct 2010
Oct 2011
Oct 2012
Oct 2013
Oct 2014
Upgradient Site 48
Downgradient Site 6


Site 48 vs. Site 6 − pH
8.5
8.0
7.5
7.0
6.5
6.0
5.5
Oct 2010
Oct 2011
Oct 2012
Oct 2013
Oct 2014
Upgradient Site 48
Downgradient Site 6

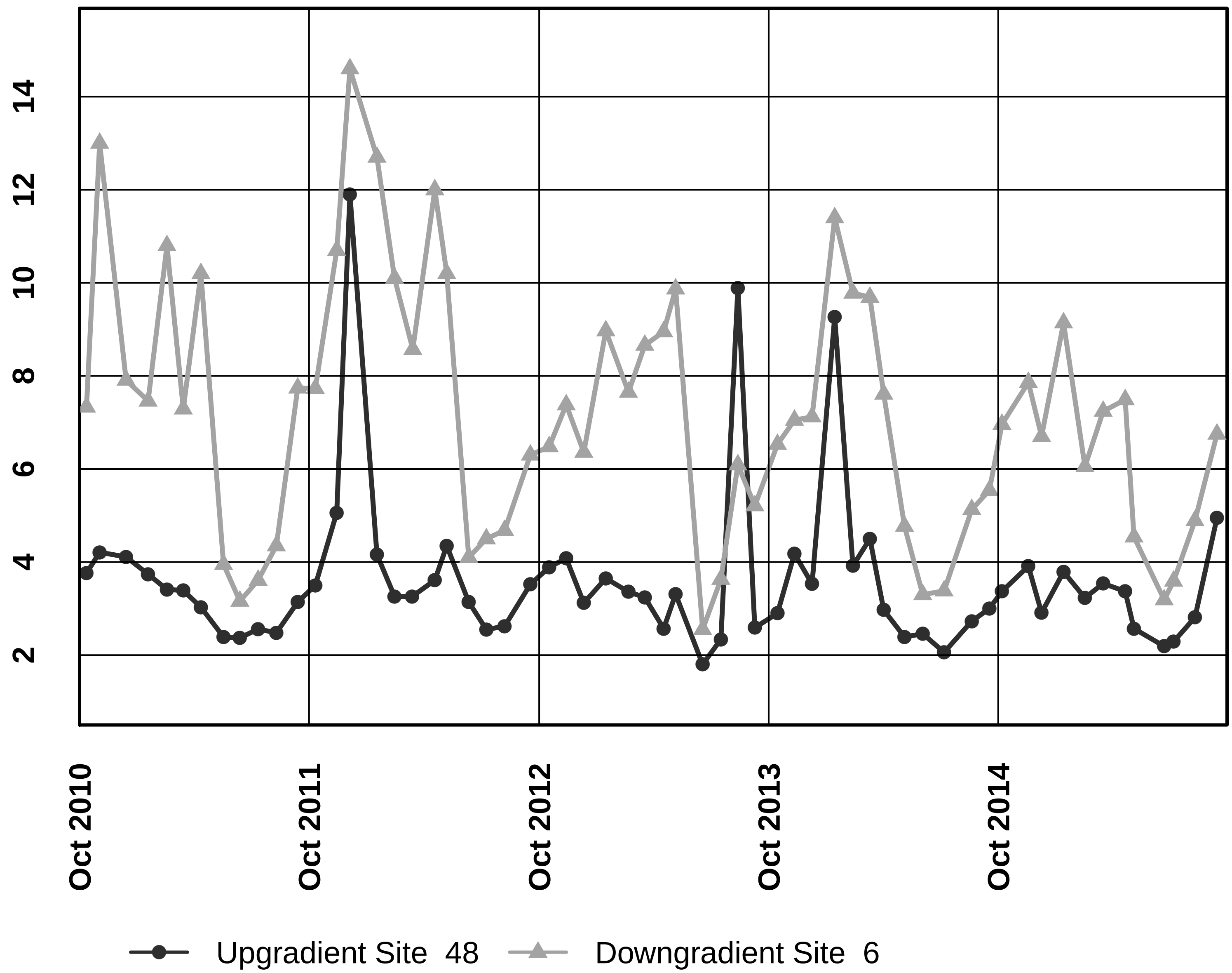


Site 48 vs. Site 6 − Alkalinity
60
50
40
30
20
Oct 2010
Oct 2011
Oct 2012
Oct 2013
Oct 2014
Upgradient Site 48
Downgradient Site 6

Site 48 vs. Site 6 − Sulfate



Site 48 vs. Site 6 − Zinc



Wilcoxon-signed-ranks test

Exact Form

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

	X	**Y**			
Site	#48	#6	Differences		
Year	WY2015	WY2015	**D**	**|D|**	**Rank**
Oct	108.1	111.3	-3.2	3.2	-1
Nov	143.0	149.6	-6.6	6.6	-10
Dec	82.0	89.3	-7.3	7.3	-11
Jan	93.6	112.3	-18.7	18.7	-12
Feb	119.5	124.9	-5.4	5.4	-5
Mar	132.6	138.6	-6.0	6.0	-7.5
Apr	94.0	100.0	-6.0	6.0	-7.5
May	98.9	104.0	-5.1	5.1	-4
Jun	109.9	114.1	-4.2	4.2	-3
Jul	117.4	111.0	6.4	6.4	9
Aug	113.4	119.0	-5.6	5.6	-6
Sep	124.1	128.1	-4.0	4.0	-2
Median	111.7	113.2	-5.5	5.8	

n	**m**
12	12

N= 12

ΣR= -60

α
0.05
W'α,n
17

W^{+}=
9
p-test
0.008

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	WY2015	WY2015	D	|D|	Rank
Oct	8.03	8.03	0.00		
Nov	8.06	8.03	0.03	0.03	6
Dec	7.27	7.12	0.15	0.15	9
Jan	7.23	7.25	-0.02	0.02	-4.5
Feb	7.32	7.34	-0.02	0.02	-4.5
Mar	7.54	7.54	0.00		
Apr	7.40	7.44	-0.04	0.04	-7
May	8.01	7.96	0.05	0.05	8
Jun	8.04	8.02	0.02	0.02	3
Jul	7.95	7.95	0.00		
Aug	8.04	8.03	0.01	0.01	1.5
Sep	8.01	8.00	0.01	0.01	1.5
Median	7.98	7.96	0.00	0.02	

n	m
12	9

N= 9

ΣR= 13

α
0.05
W'α,n
8

W^+=
16
p-test
0.248

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

Wilcoxon-signed-ranks test

Exact Form

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

	X	**Y**	Differences		
Site	#48	#6			
Year	WY2015	WY2015	**D**	**|D|**	**Rank**
Oct	41.1	40.8	0.3	0.3	2.5
Nov	48.1	49.1	-1.0	1.0	-6
Dec	28.8	30.2	-1.4	1.4	-9.5
Jan	32.7	35.3	-2.6	2.6	-11
Feb	40.3	37.3	3.0	3.0	12
Mar	48.5	49.5	-1.0	1.0	-6
Apr	35.3	36.6	-1.3	1.3	-8.00
May	39.2	38.9	0.3	0.3	2.5
Jun	44.7	46.1	-1.4	1.4	-9.5
Jul	47.3	47.5	-0.2	0.2	-1
Aug	53.2	54.2	-1.0	1.0	-6.00
Sep	48.0	48.4	-0.4	0.4	-4
Median	42.9	43.5	-1.0	1.0	

n	**m**
12	12

N= 12

$\Sigma R =$ -44

α
0.05
W'α,n
17

$W^{+}=$
17.00
p-test
0.046

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

Wilcoxon-signed-ranks test
Exact Form

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

	X	**Y**	Differences		
Site	#48	#6			
Year	WY2015	WY2015	**D**	**|D|**	**Rank**
Oct	9.8	10.7	-0.9	0.9	-1
Nov	16.4	18.6	-2.2	2.2	-11
Dec	7.9	9.5	-1.6	1.6	-7
Jan	10.2	12.5	-2.3	2.3	-12
Feb	13.2	14.8	-1.6	1.6	-6
Mar	15.4	17.4	-2.0	2.0	-9.5
Apr	9.2	11.2	-2.0	2.0	-9.5
May	9.9	11.0	-1.1	1.1	-3
Jun	12.9	13.9	-1.0	1.0	-2
Jul	13.3	14.7	-1.4	1.4	-5
Aug	16.4	18.2	-1.8	1.8	-8
Sep	12.1	13.4	-1.3	1.3	-4
Median	12.5	13.7	-1.6	1.6	

n	**m**
12	12

N= 12
ΣR= -78

α
0.05
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: **Zinc, Dissolved (ug/l)**

	X	**Y**			
Site	#48	#6	Differences		
Year	WY2015	WY2015	**D**	**|D|**	**Rank**
Oct	3.37	6.96	-3.59	3.59	-7
Nov	3.91	7.86	-3.95	3.95	-10
Dec	2.91	6.70	-3.79	3.79	-9
Jan	3.79	9.14	-5.35	5.35	-12
Feb	3.23	6.05	-2.82	2.82	-6
Mar	3.54	7.24	-3.70	3.70	-8
Apr	3.37	7.49	-4.12	4.12	-11
May	2.57	4.54	-1.97	1.97	-4
Jun	2.19	3.19	-1.00	1.00	-1
Jul	2.29	3.59	-1.30	1.30	-2
Aug	2.81	4.89	-2.08	2.08	-5
Sep	4.95	6.75	-1.80	1.80	-3
Median	3.30	6.73	-3.21	3.21	

n	**m**
12	12

N= 12

ΣR= -78

α
0.05
W'α,n
17

W^+=
0
p-test
0.000

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

INTERPRETIVE REPORT
SITE 54

The data collected during the current water year are listed in the following “Table of Results for Water Year 2015” 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, in the past six years, have been identified by HGCMC.				

The data 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 2015

			Limits		
Sample Date	**Parameter**	**Value**	**Lower**	**Upper**	**Hardness**
No exceedances have been identified by HGCMC for the period of October 2014 through September 2015.					

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

A non-parametric statistical analysis for trend was performed for specific conductivity, field pH, total alkalinity, total sulfate, and dissolved zinc. Calculation details of the Seasonal Kendall analyses are presented in detail on the pages following this interpretive section. The following table summarizes the results on the data collected between Oct-09 and Sep-15 (WY2010-WY2015).

Table of Summary Statistics for Trend Analysis

Parameter	Mann-Kendall test statistics n*	p**	Trend	Sen's slope estimate Q	Q(%)
Conductivity Field	6	0.18			
pH Field	6	<0.01	+	0.10	1.3
Alkalinity, Total	6	0.06			
Sulfate, Total	6	0.37			
Zinc, Dissolved	6	0.08			

* Number of Years ** Significance level

Field pH had a statistically significant (p<0.01) trend with a slope estimate of 0.10 su/yr or 1.3% increase. However given the low magnitude and similar trend noted at Site 6 and Site 48, HGCMC does not feel that this trend is 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 2015 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	113.2	120	-2
pH Field	0.102	7.96	7.95	0
Alkalinity, Total	<0.01	43.5	43.6	-1.2
Sulfate, Total	0.207	13.70	13.50	0.10
Zinc, Dissolved	<0.01	6.73	6.6	0.22

The significant difference in specific conductivity is similar in magnitude and direction as observed for WY2002 – WY2014. In general, the trend in conductivity is similar to differences measured between Site 48 and Site 6, although of a smaller magnitude. HGCMC feels the current FWMP program is adequate to measure and quantify future changes that may occur between Site 6 and Site 54, given the small magnitude of the differences and the consistency of the variations over the past several years.

Table of Results for Water Year 2015

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

Sample Date/Parameter	Oct 2014	Nov 2014	Dec 2014	Jan 2015	Feb 2015	Mar 2015	Apr 2015	May 2015	Jun 2015	Jul 2015	Aug 2015	Sep 2015	**Median**
Water Temp (°C)	5.5	2.8	2.1	0.6	1.6	1.1	2.5	2.9	10.5	10.9	10.5	7.6	2.9
Conductivity-Field(μmho)	112.4	152.2	91.8	119.6	126.9	139.7	102	105.2	114.9	122.3	120.3	130.1	120.0
Conductivity-Lab (μmho)	107	139	83	114	126	140	101	108	119	113	126	111	114
pH Lab (standard units)	7.76	7.35	7.57	7.67	7.39	7.55	7.61	7.08	7.98	7.81	7.9	7.88	7.64
pH Field (standard units)	8.02	8.03	7.21	7.28	7.39	7.59	7.43	7.97	8.02	7.93	8.02	8	7.95
Total Alkalinity (mg/L)	41.2	51.2	31.9	36.5	41.7	50	37.8	40.4	45.5	48.4	55.3	49	43.6
Total Sulfate (mg/L)	10.6	18.4	9.5	12.5	14.7	17.3	11	10.9	14	14.8	18.5	13	13.5
Hardness (mg/L)	52.2	66.9	39.4	49.6	57.8	67.4	45.7	53.3	57.1	59.4	69.2	60.6	57.5
Dissolved As (ug/L)	0.216	0.19	0.185	0.191	0.16	0.171	0.165	0.162	0.205	0.241	0.235	0.214	0.191
Dissolved Ba (ug/L)			19.9		25.7	27.8							25.7
Dissolved Cd (ug/L)	0.0479	0.0501	0.0426	0.0633	0.0417	0.0425	0.0442	0.0317	0.0359	0.0375	0.0462	0.0523	0.0434
Dissolved Cr (ug/L)			0.07		0.109	0.214							0.109
Dissolved Cu (ug/L)	0.56	0.395	0.651	0.66	0.41	0.432	0.688	0.4	0.296	0.39	0.458	0.55	0.445
Dissolved Pb (ug/L)	0.0175	0.0082	0.025	0.0406	0.0075	0.0065	0.0157	0.0063	0.0087	0.007	0.01	0.0152	0.0094
Dissolved Ni (ug/L)			0.529		0.448	0.532							0.529
Dissolved Ag (ug/L)			0.002		0.002	0.002							0.002
Dissolved Zn (ug/L)	6.67	7.23	6.55	8.89	5.69	6.65	6.97	4.36	3.22	3.43	4.78	6.83	6.60
Dissolved Se (ug/L)			0.566		0.82	0.98							0.820
Dissolved Hg (ug/L)	0.000981	0.000617	0.00156	0.0014	0.000732	0.000652	0.00151	0.000637	0.000402	0.000498	0.000592	0.000777	0.000692

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.

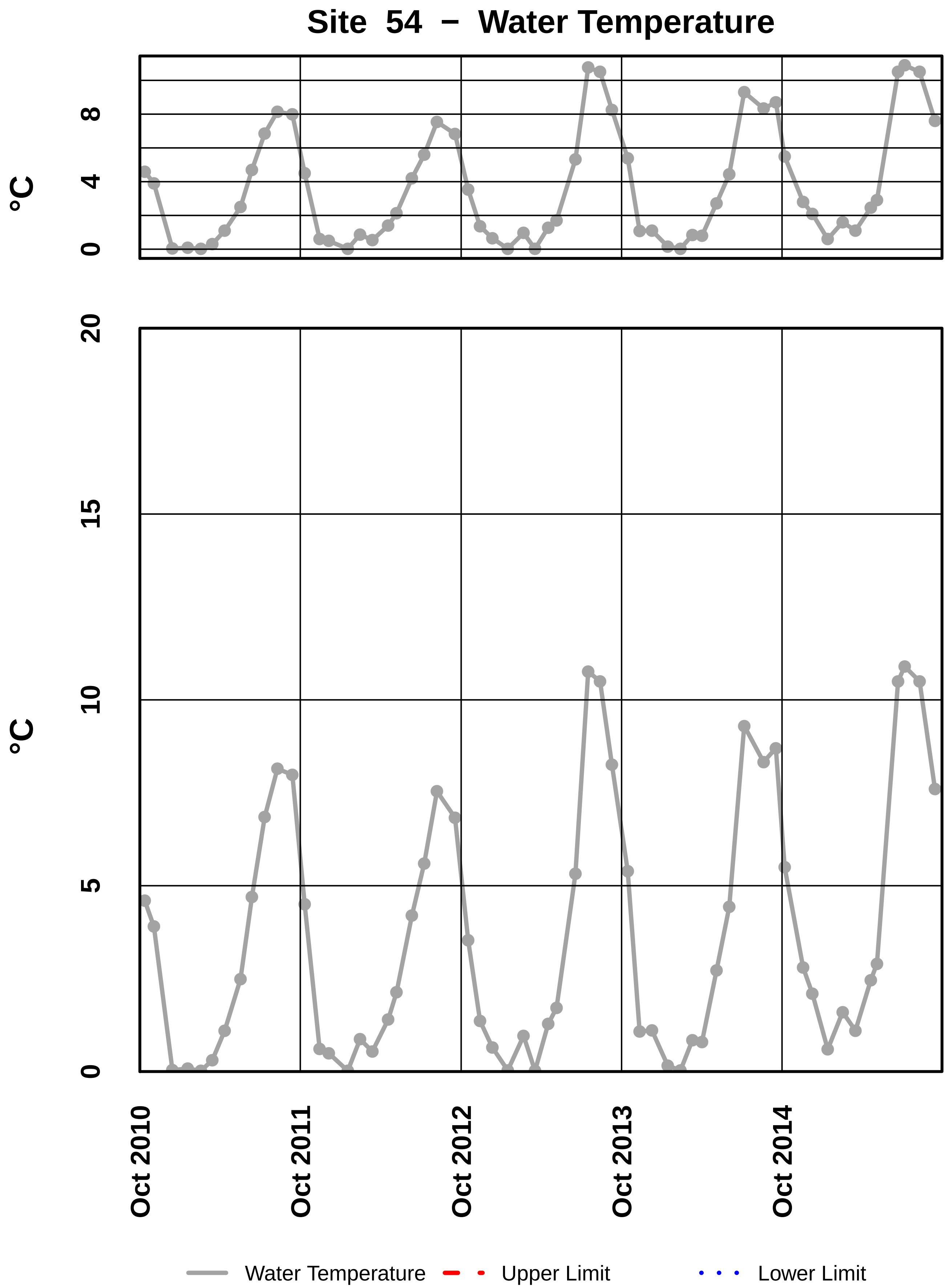
Shaded data has been qualified as an outlier by HGCMC and removed from any further analysis and is not included into the calculation of the median

Qualified Data by QA Reviewer

Date Range: 10/01/2014 to 09/30/2015

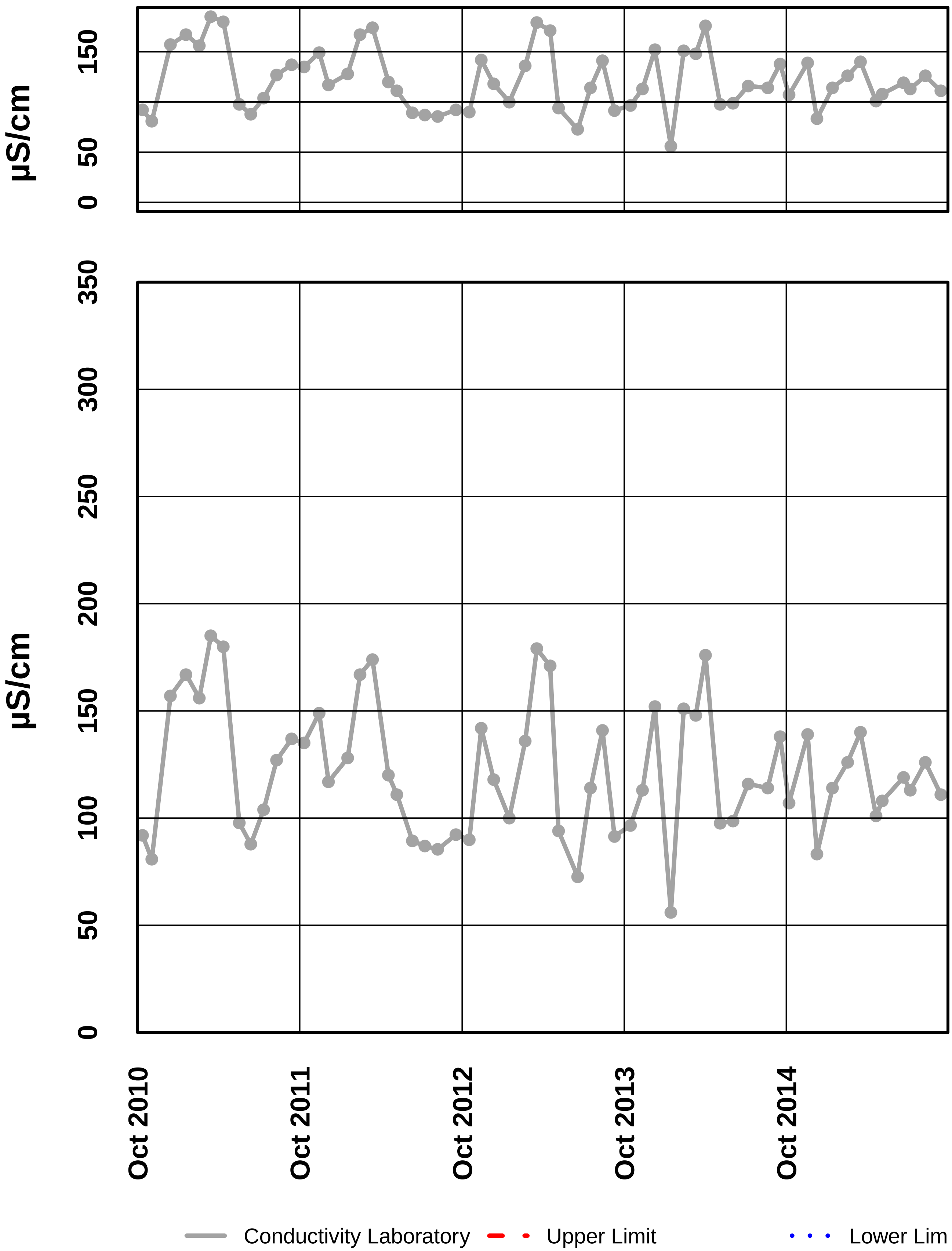
Site No.	Sample Date	Sample Time	Parameter	Value		Qualifier	Reason for Qualifier
054FMS	10/07/2014	12:00 AM	Diss. Pb-ICP/MS	0.01	µg/L	U	Field Blank Contamination
			pH	7.76	pH units	J	Hold Time Violation
054FMS	11/18/2014	12:00 AM	Diss. Pb-ICP/MS	0.0082	µg/L	J	Below Quantitative Range
054FMS	12/09/2014	12:00 AM	Diss. Cr-ICP/MS	0.06	µg/L	J	Below Quantitative Range
054FMS	02/16/2015	12:00 AM	Diss. Cr-ICP/MS	0.1	µg/L	J	Below Quantitative Range
			Diss. Pb-ICP/MS	0.00753	µg/L	J	Below Quantitative Range
			pH	7.2	pH units	J	Hold Time Violation
054FMS	03/17/2015	12:00 AM	Diss. Pb-ICP/MS	0.00654	µg/L	J	Below Quantitative Range
054FMS	05/05/2015	12:00 AM	Diss. Pb-ICP/MS	0.00631	µg/L	J	Below Quantitative Range
			Sulfate	10.9	mg/L	J	Sample Receipt Temperature
054FMS	06/22/2015	12:00 AM	Diss. Pb-ICP/MS	0.00871	µg/L	J	Below Quantitative Range
054FMS	07/07/2015	12:00 AM	Diss. Pb-ICP/MS	0.007	µg/L	J	Below Quantitative Range
054FMS	08/10/2015	12:00 AM	Sulfate	18.5	mg/L	J	Sample Receipt Temperature

Qualifier	Description
J	Positively Identified - Approximate Concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit

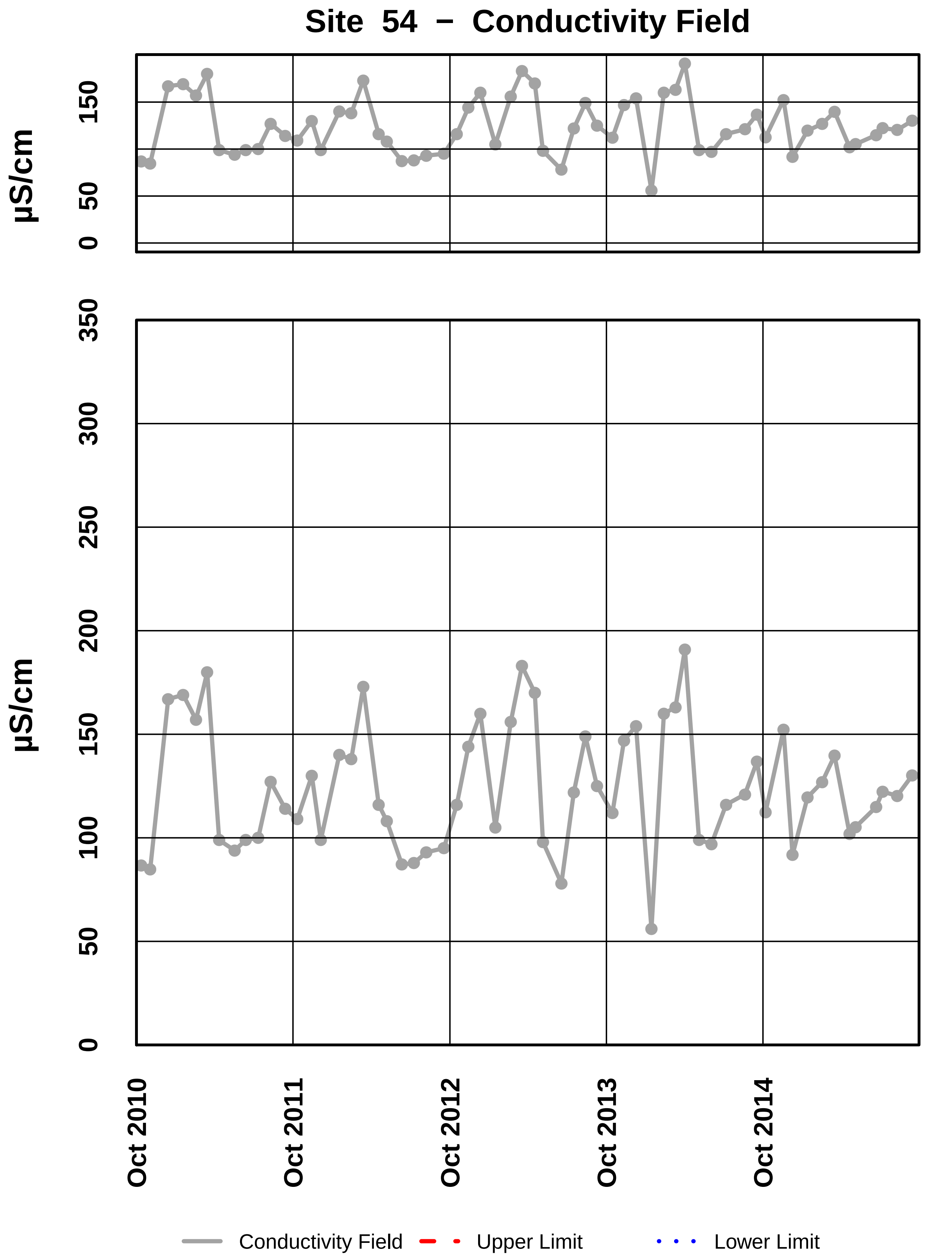


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

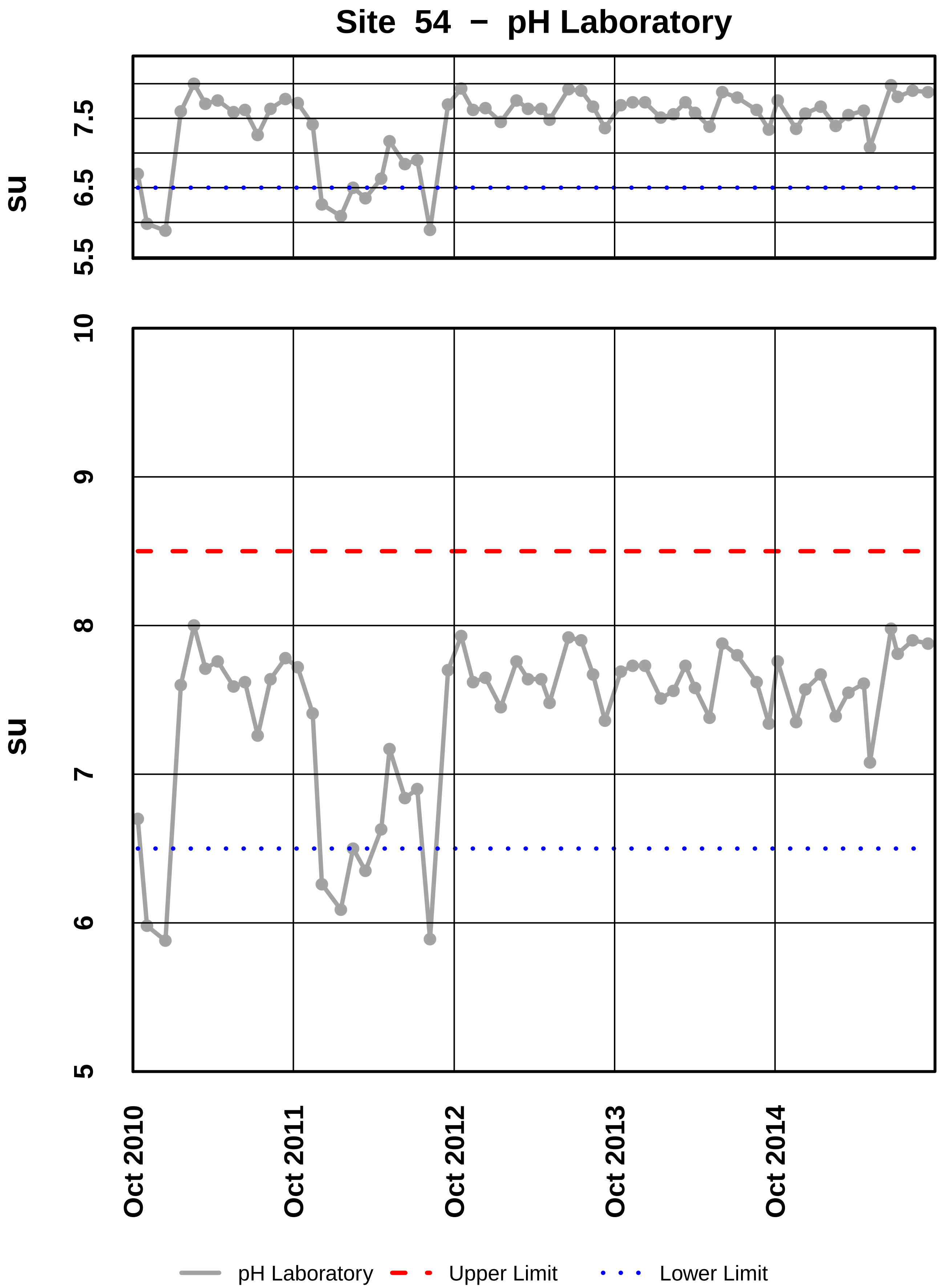
Site 54 − Conductivity Laboratory



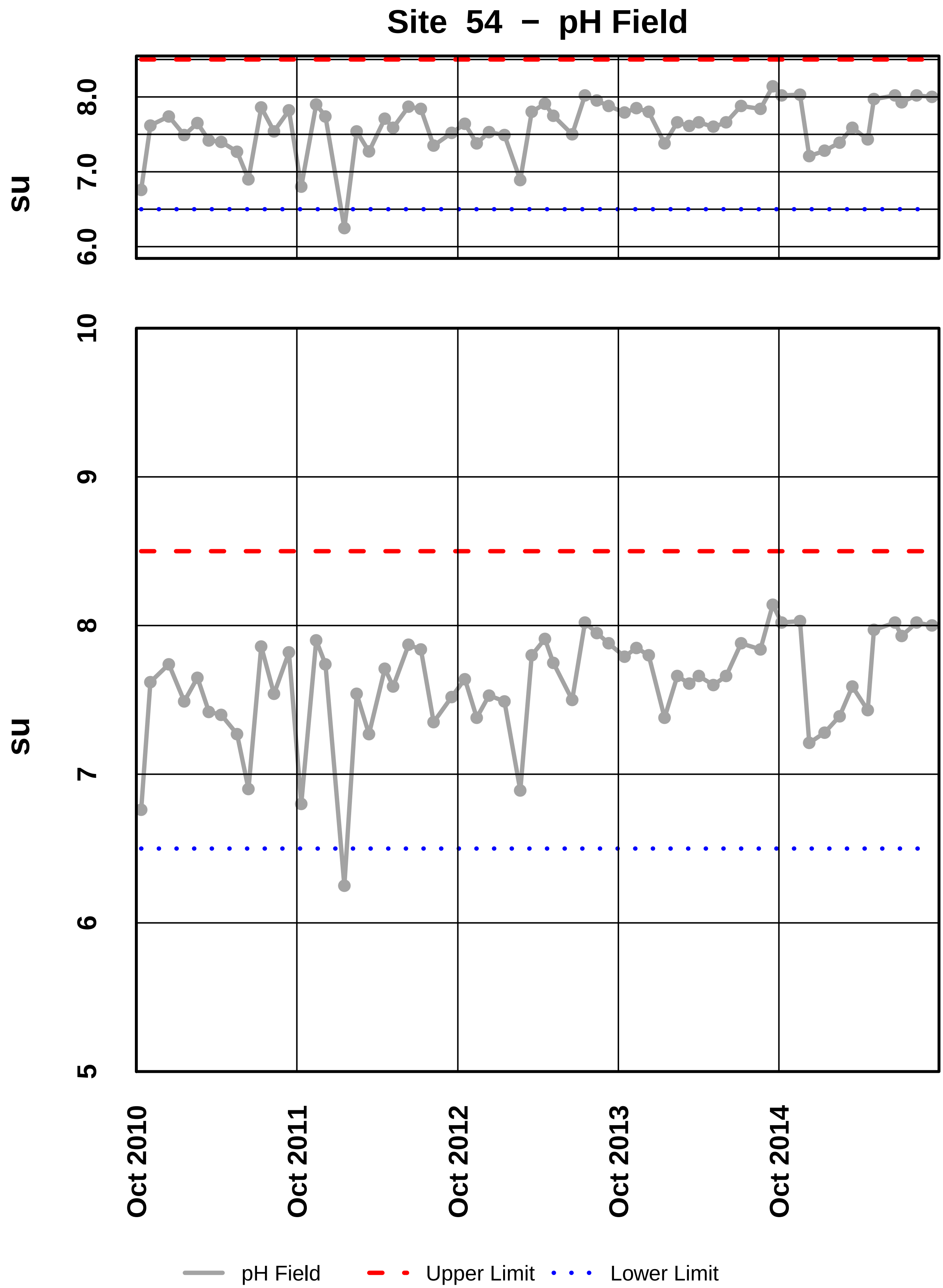
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



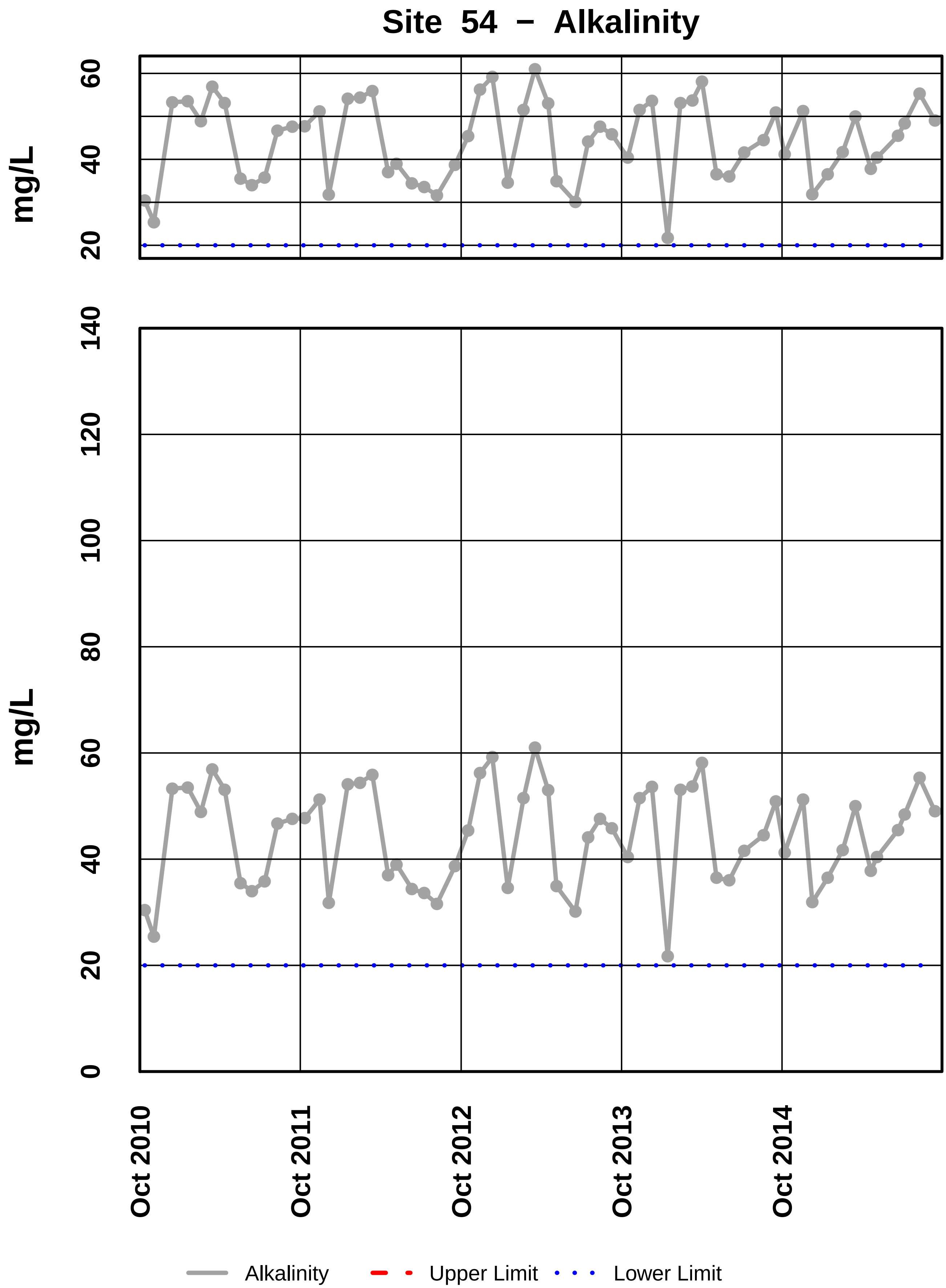
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

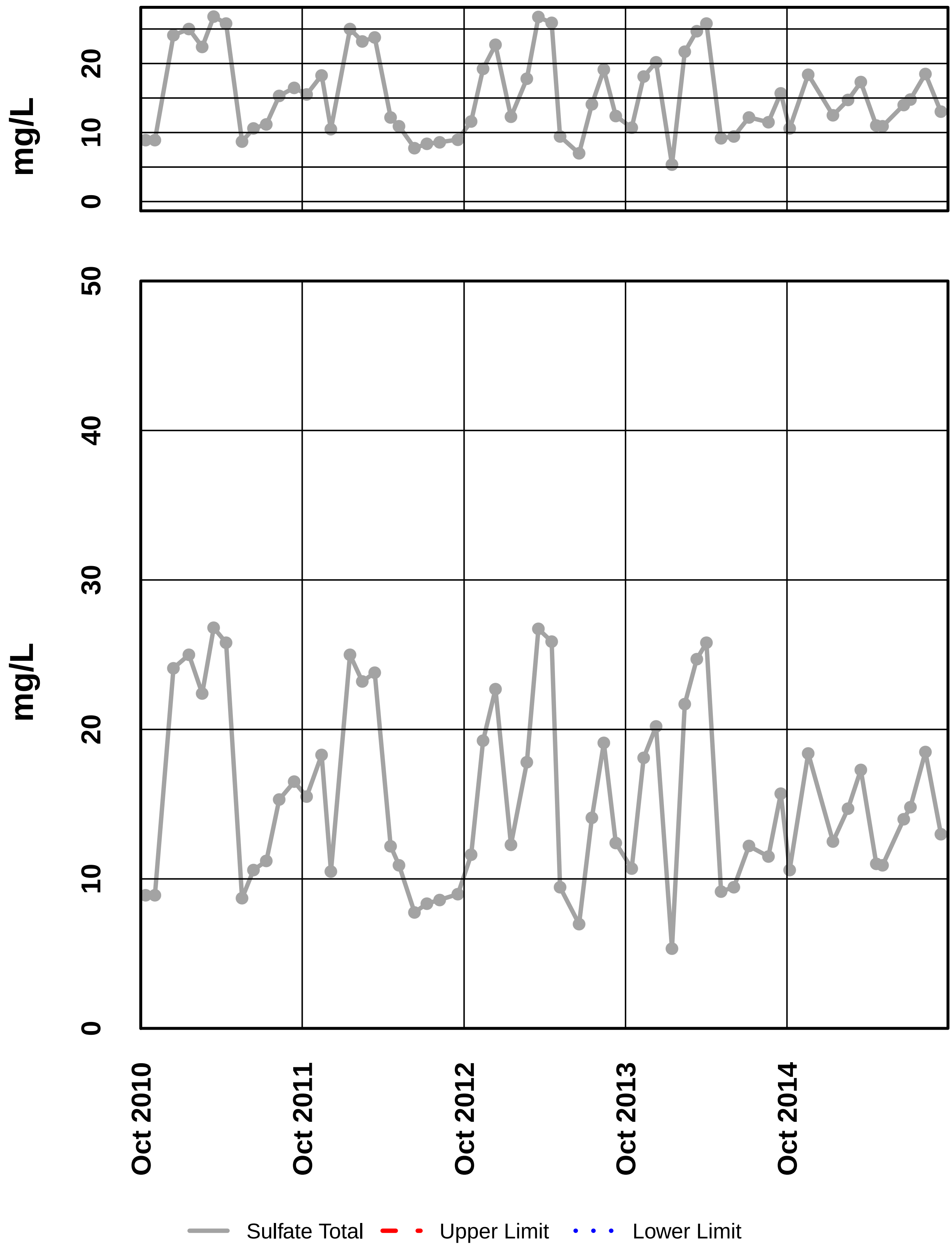


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



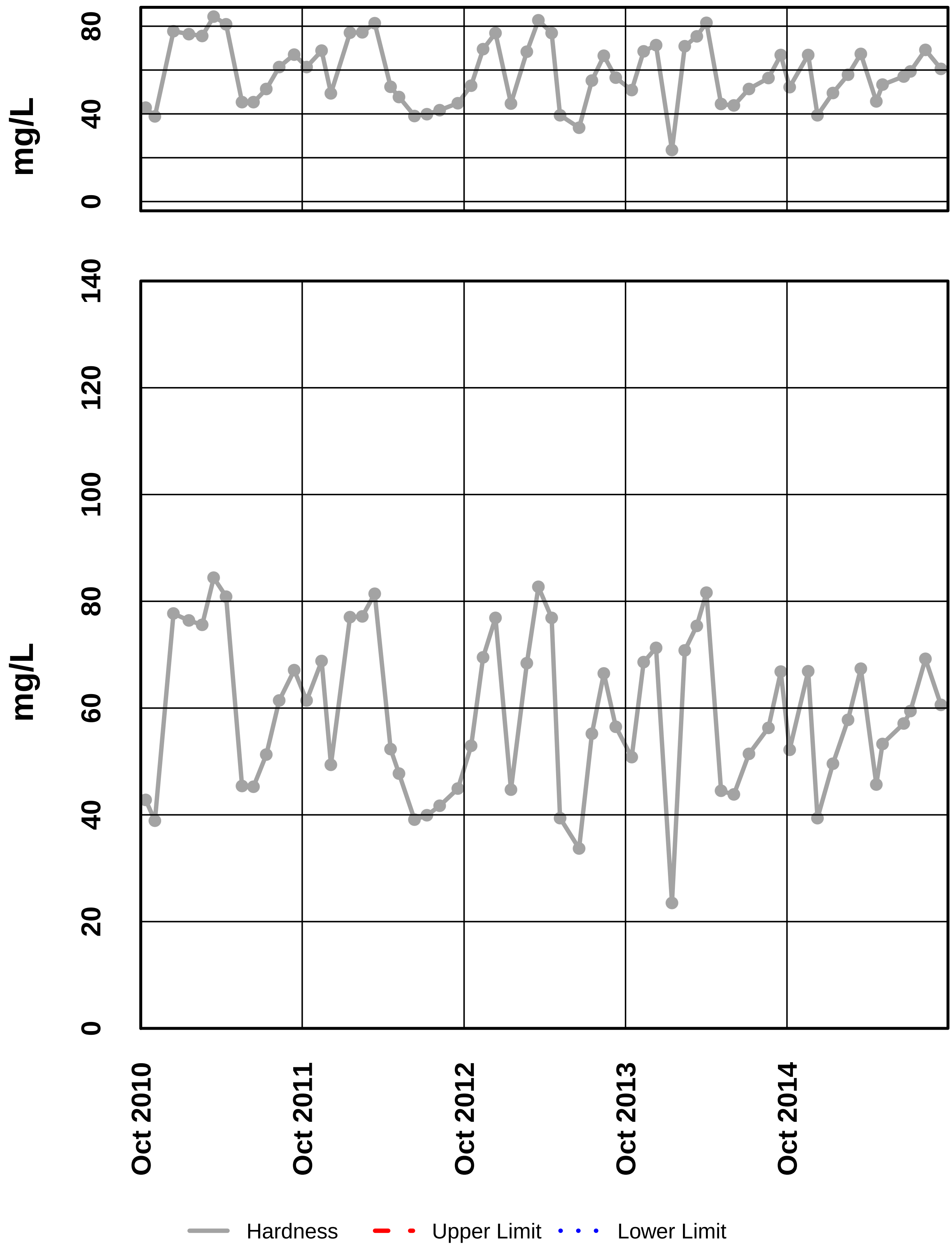
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 54 – Sulfate Total



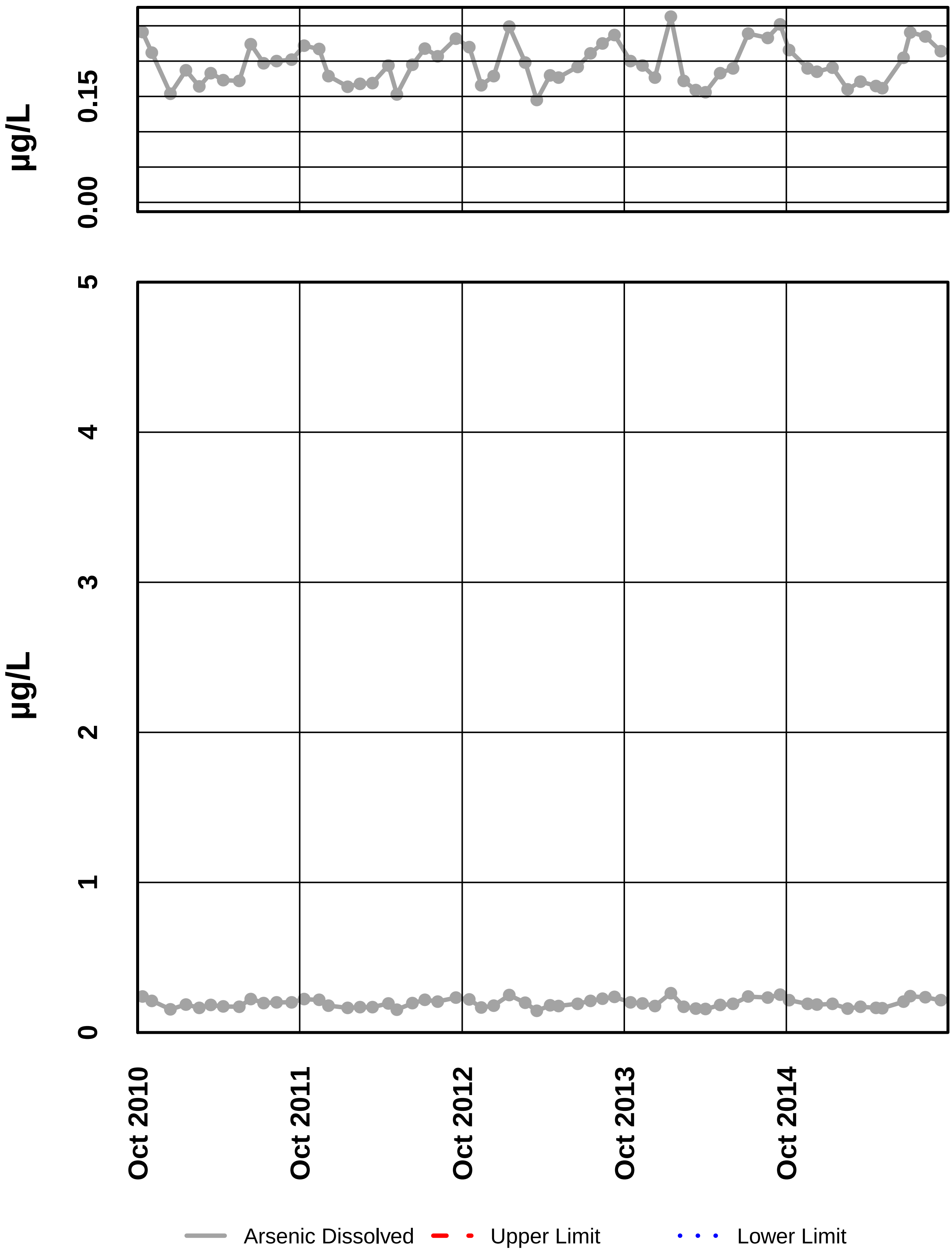
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 54 – Hardness



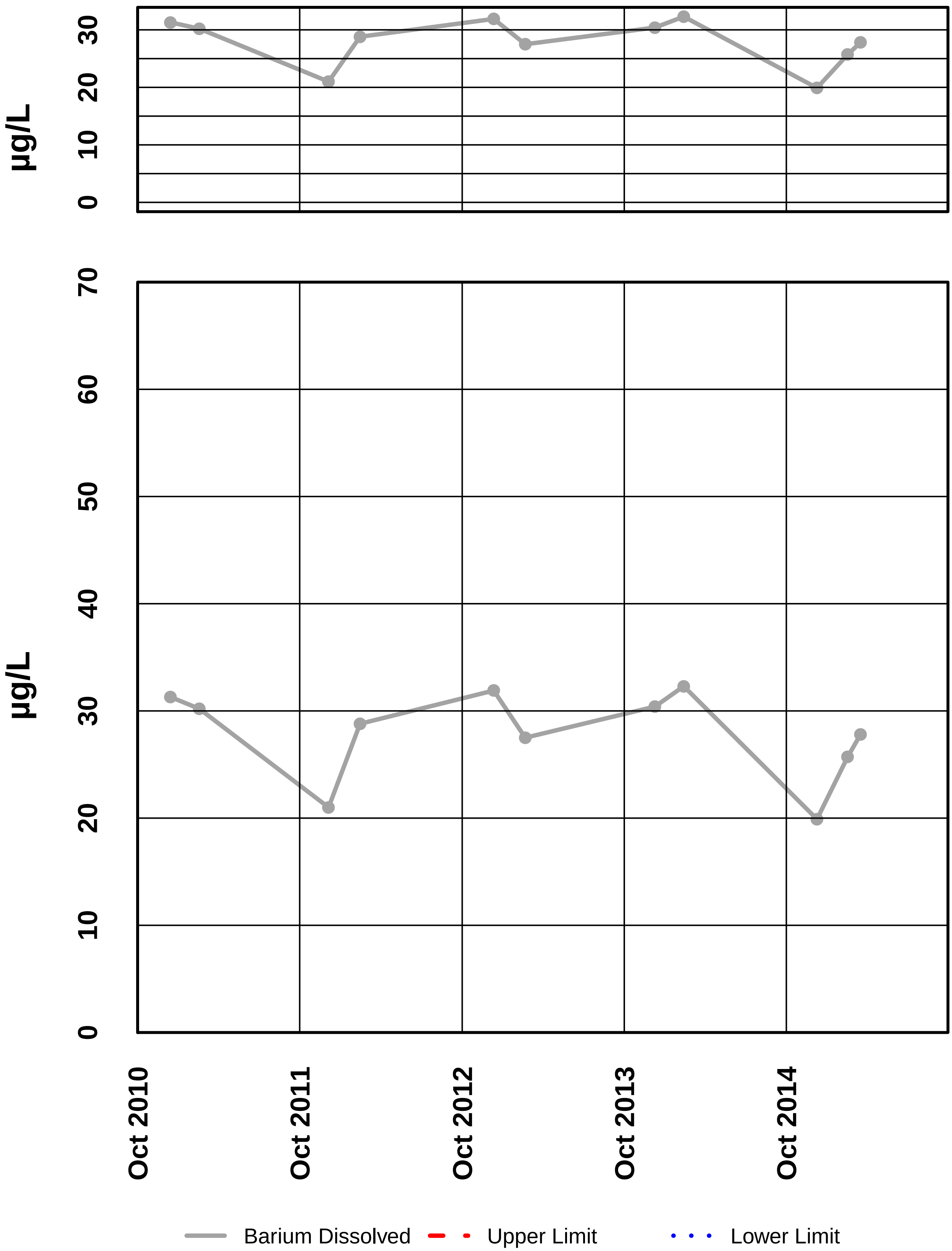
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 54 – Arsenic Dissolved

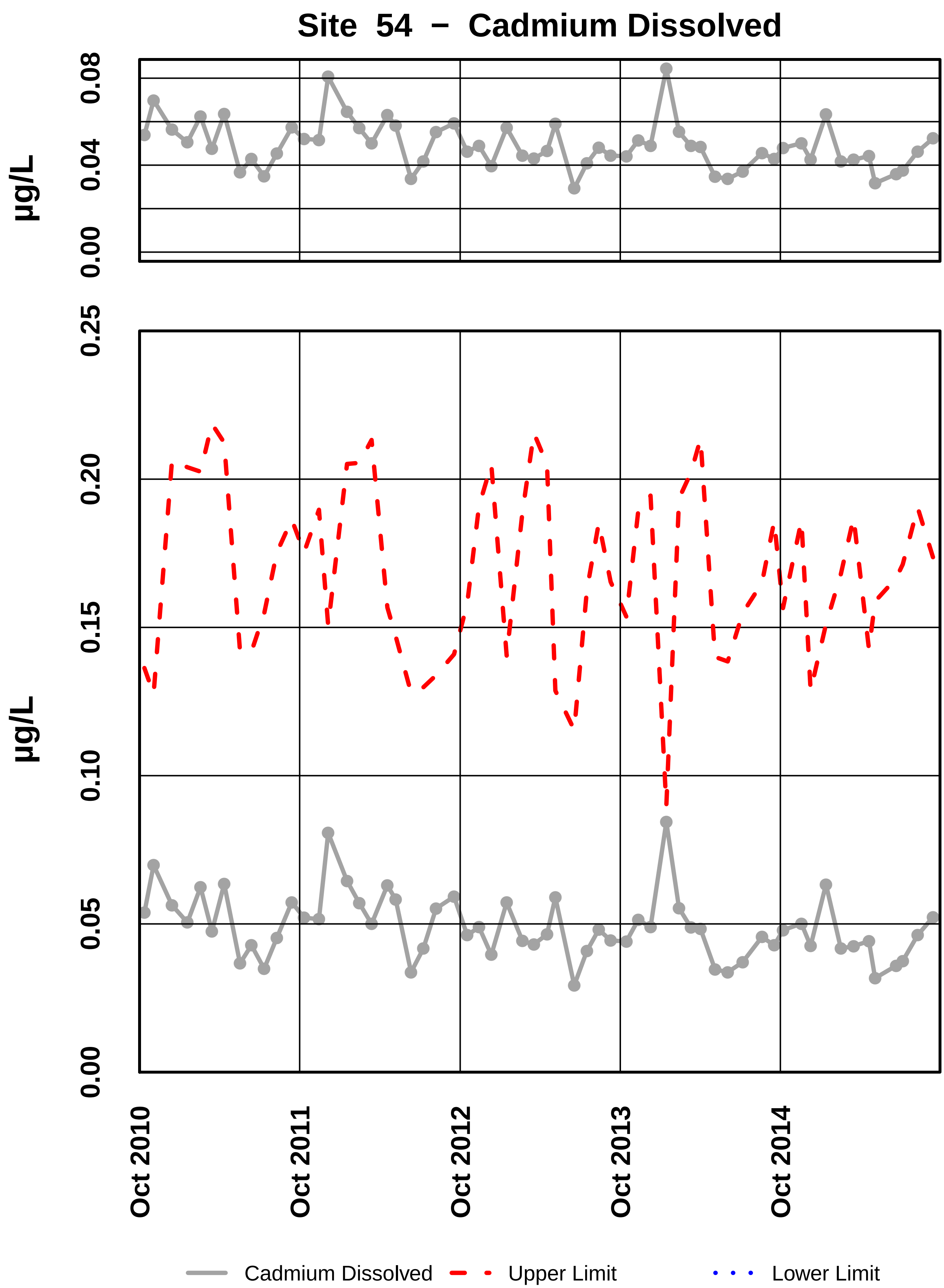


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

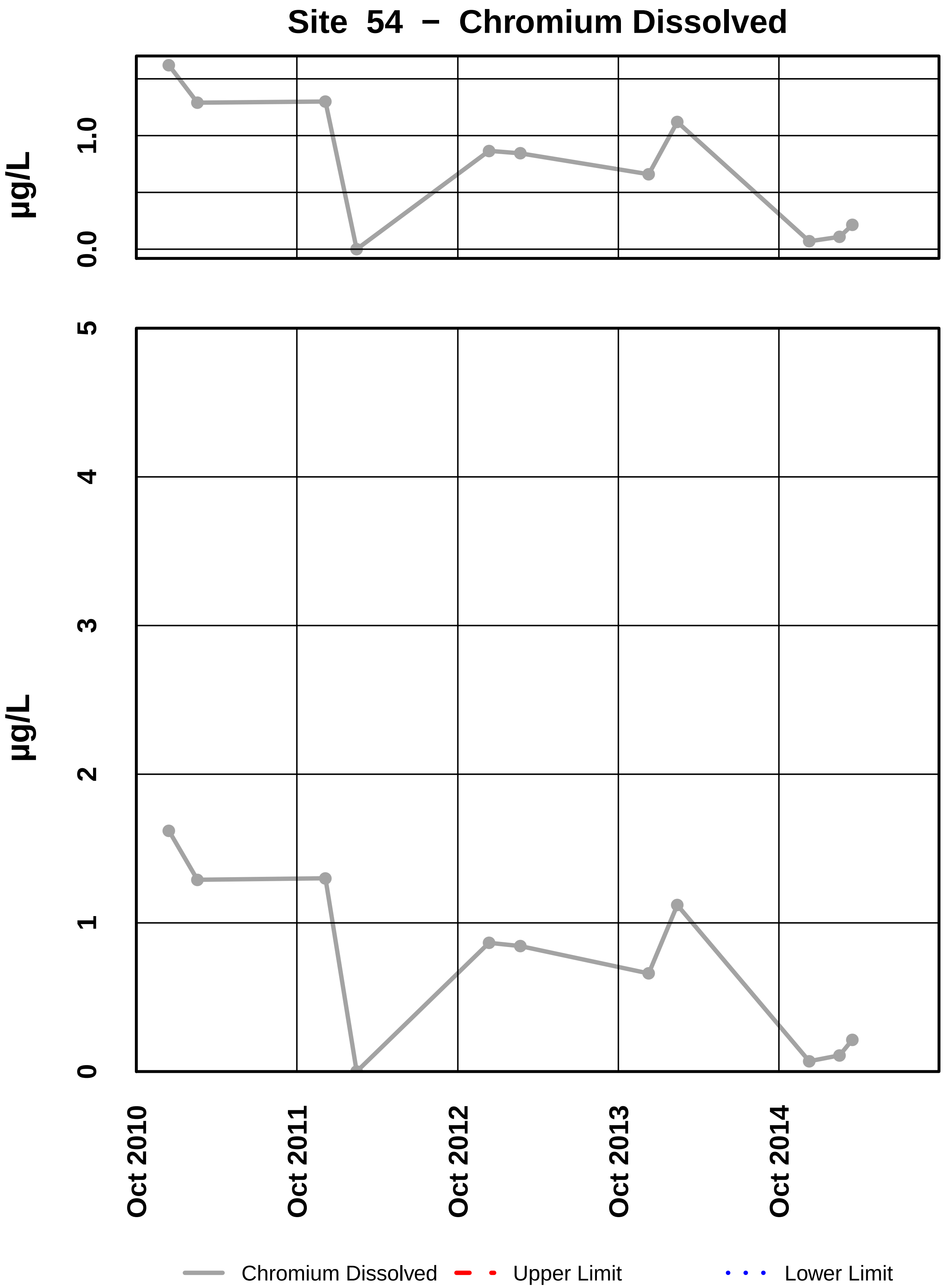
Site 54 − Barium Dissolved



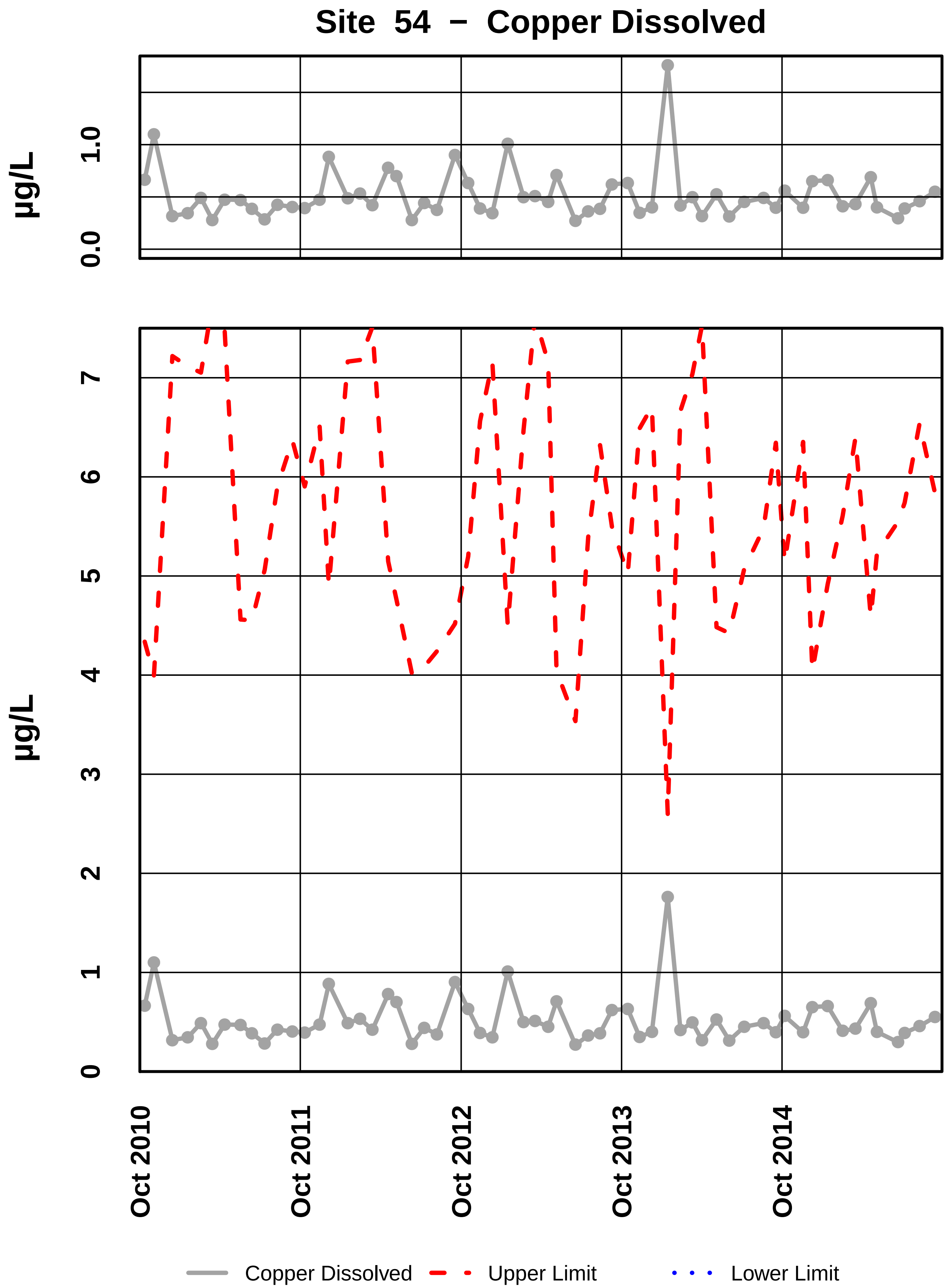
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



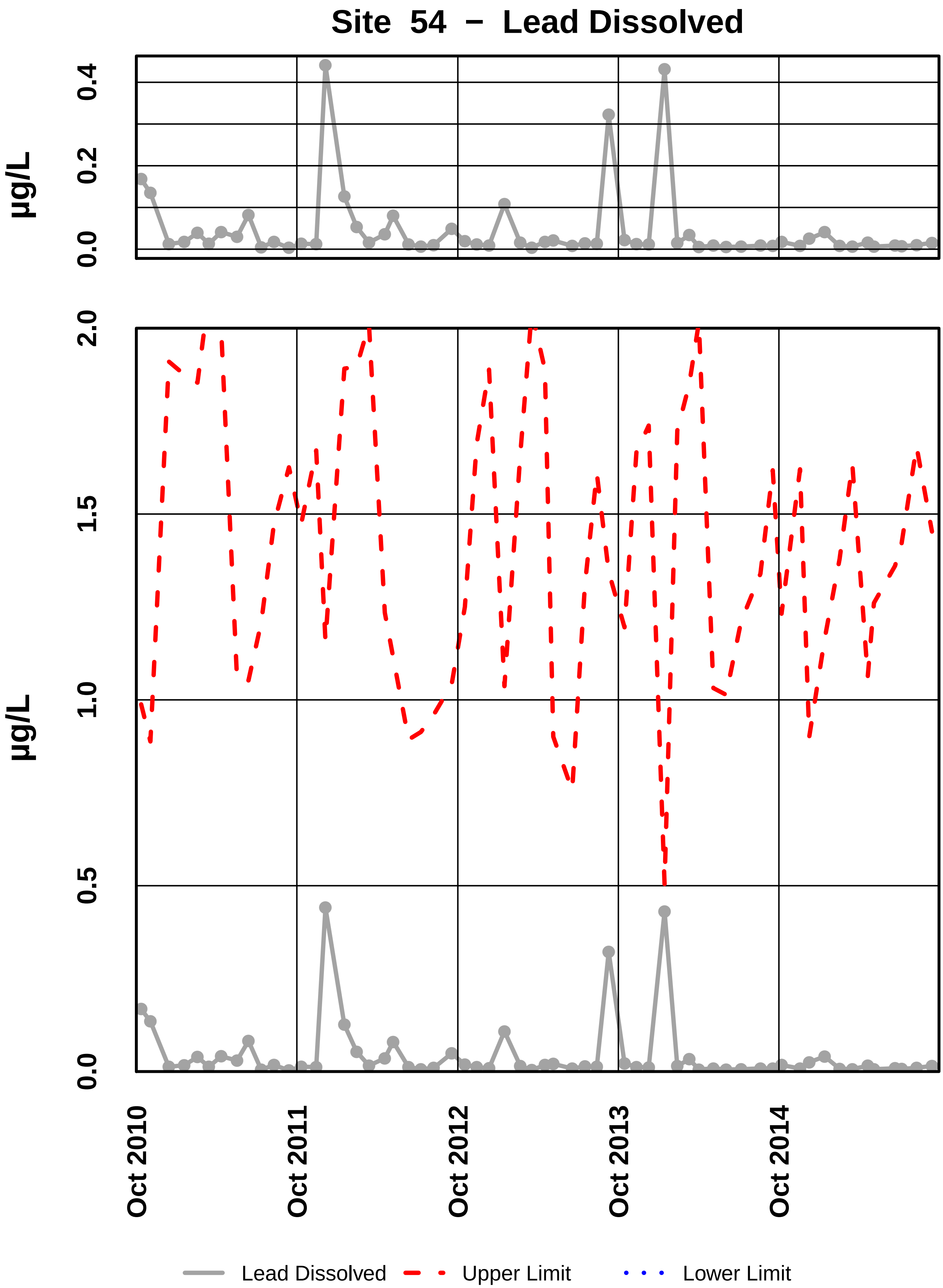
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

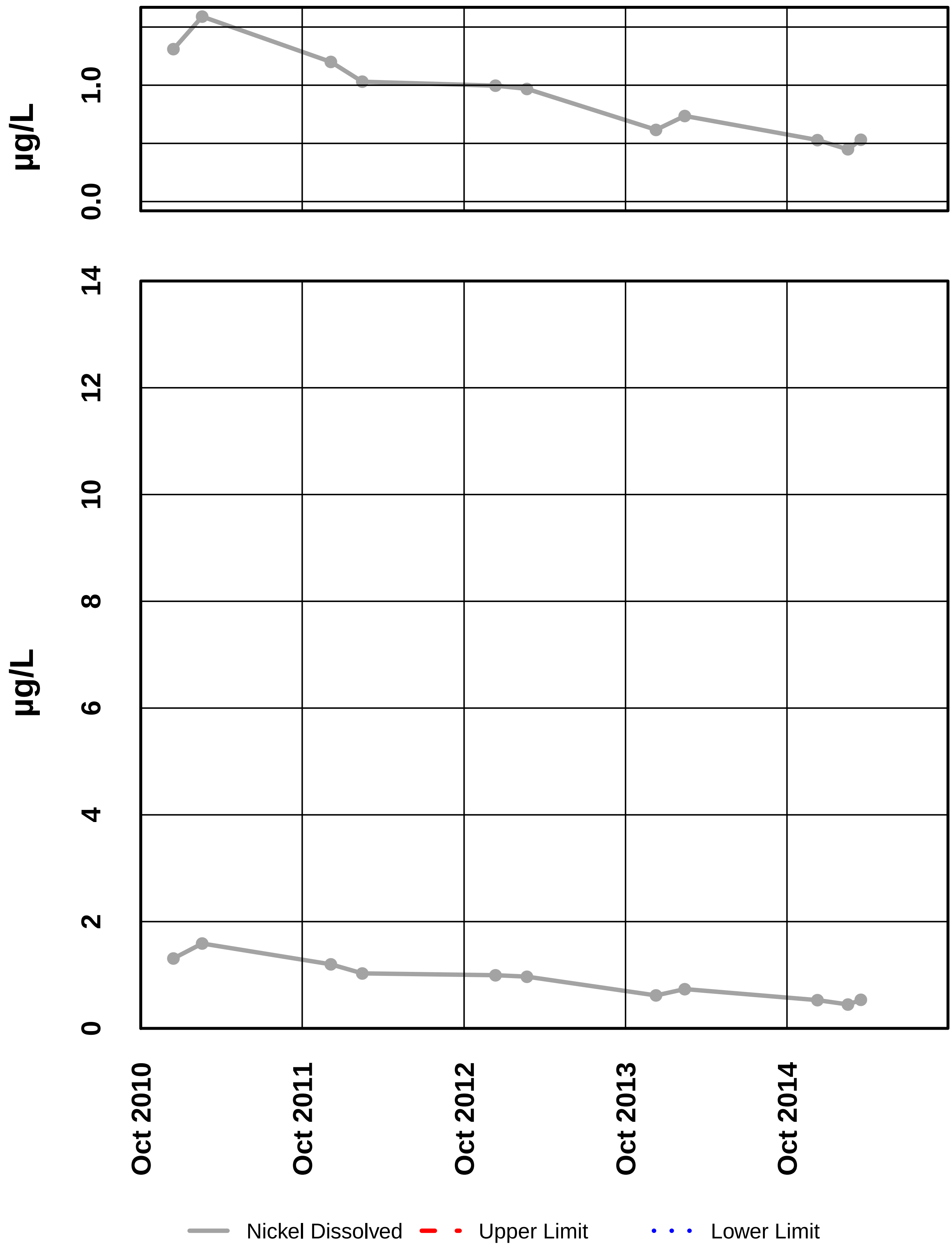


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

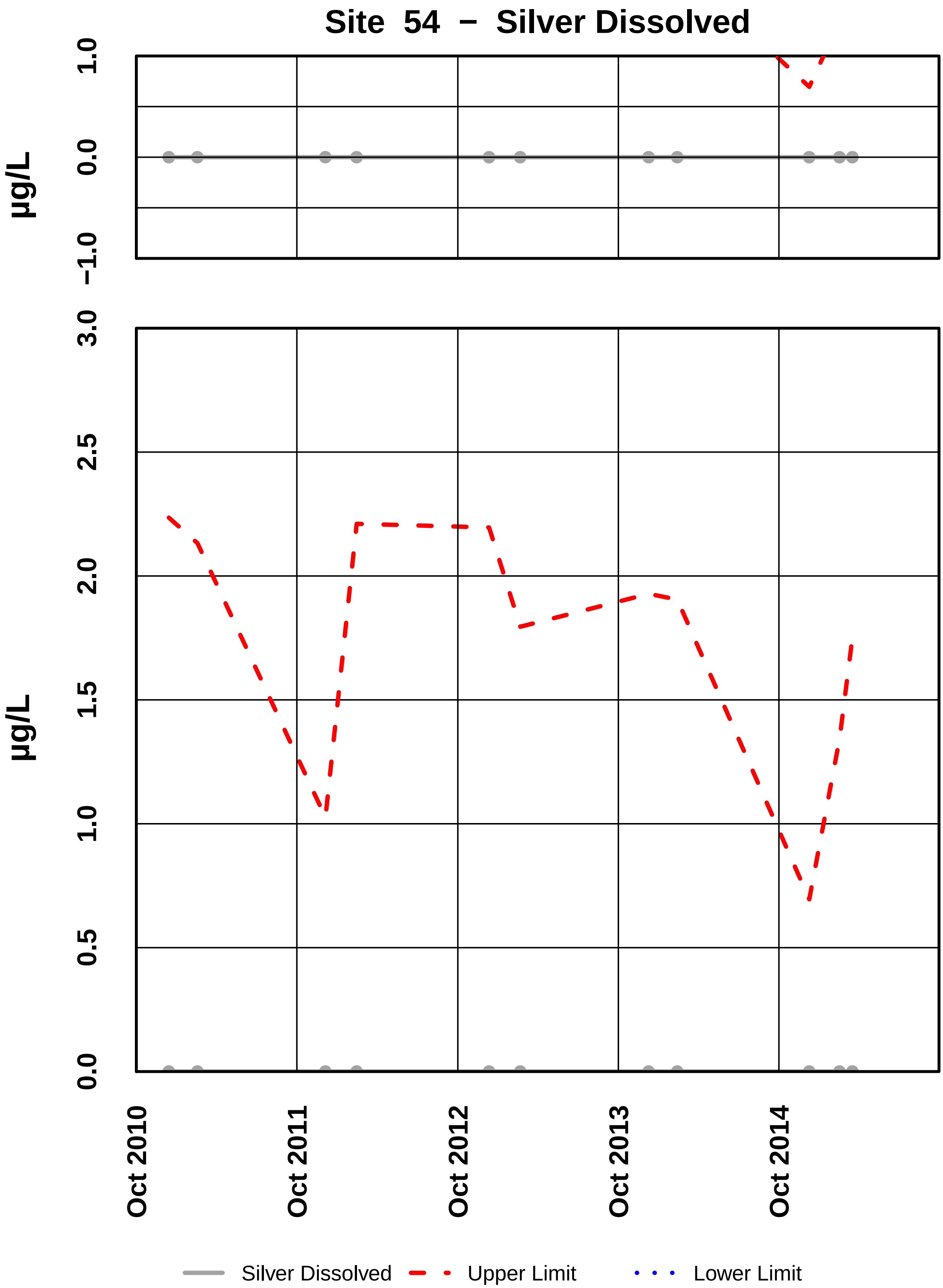


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 54 – Nickel Dissolved

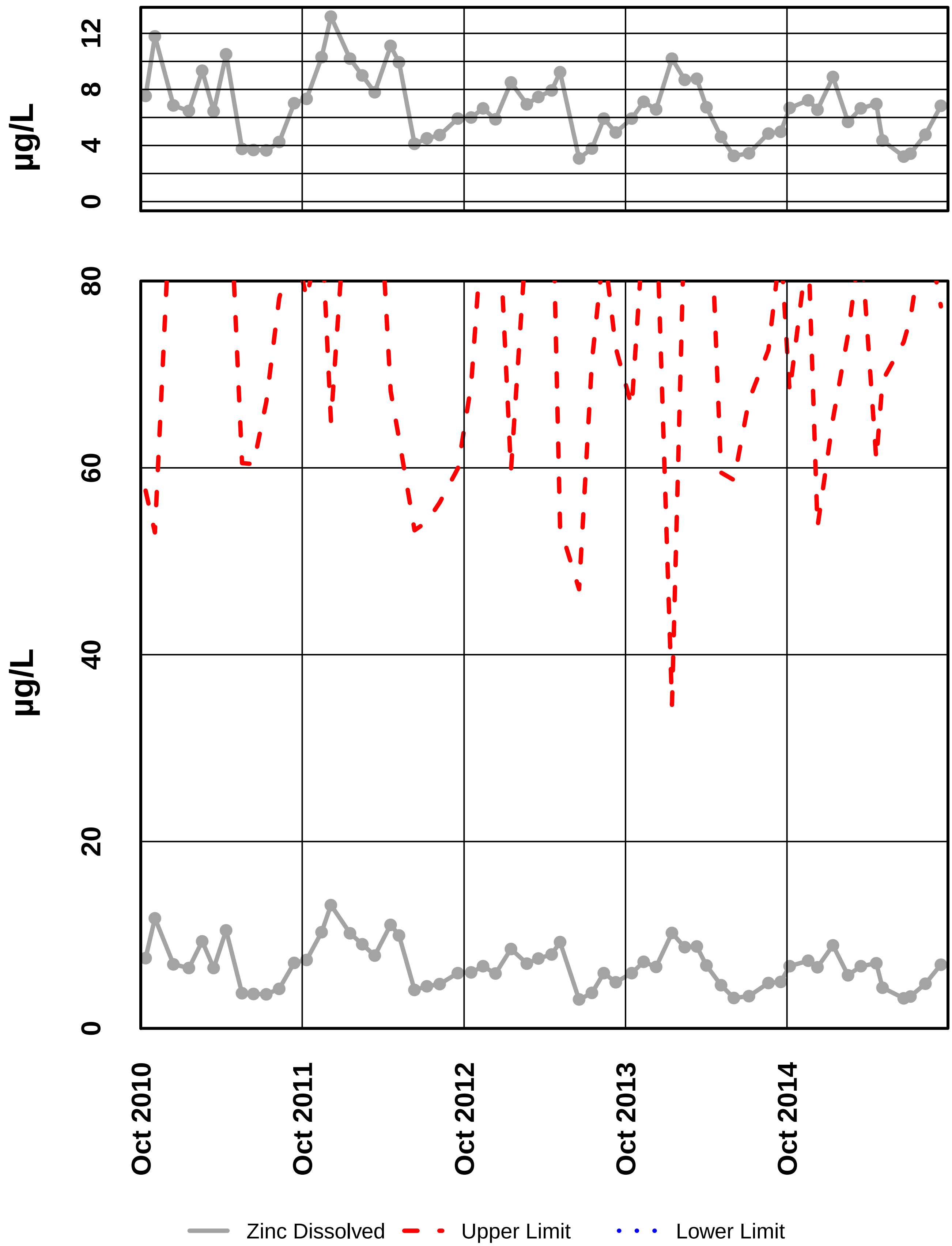


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

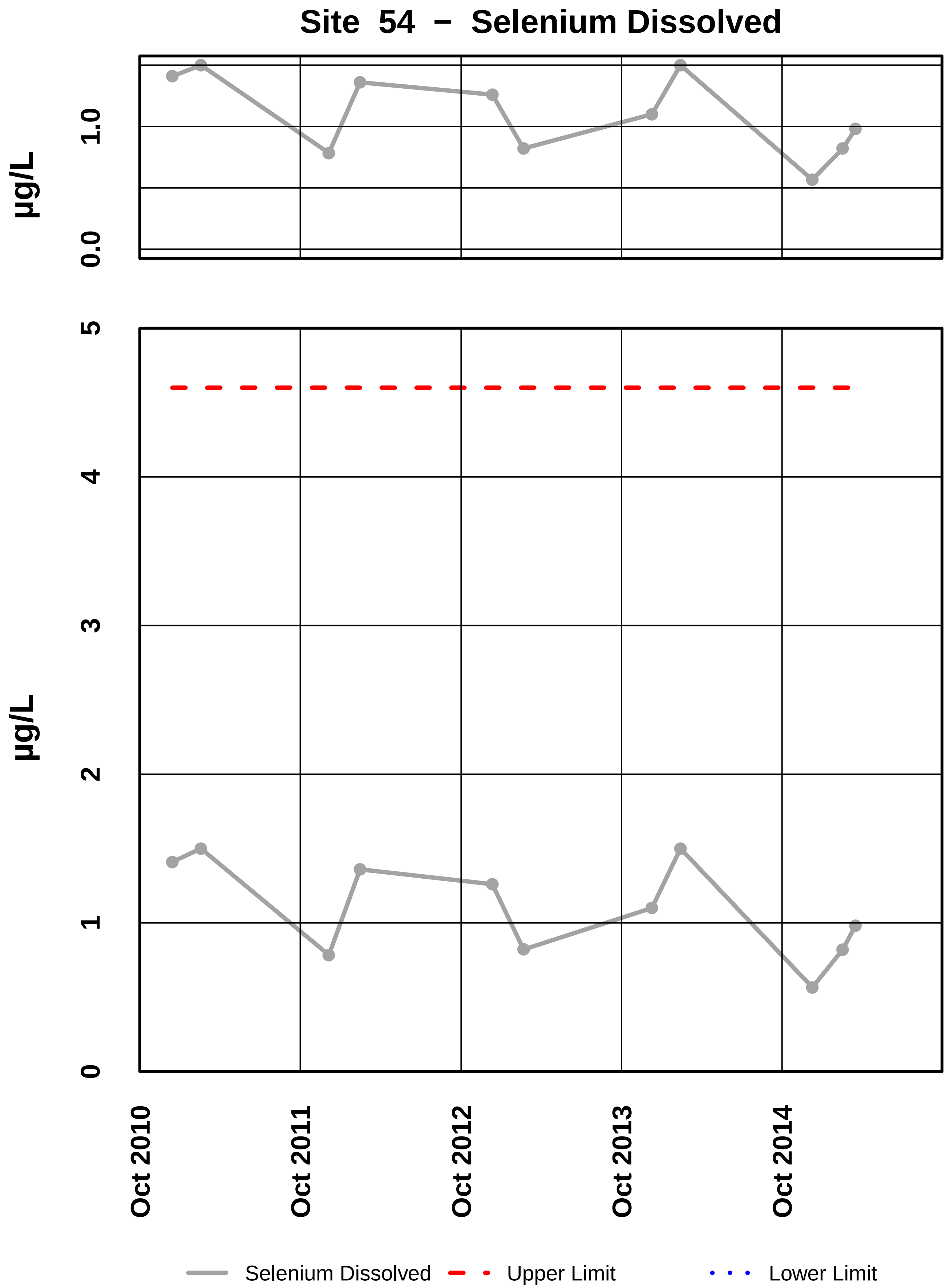


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 54 – Zinc Dissolved

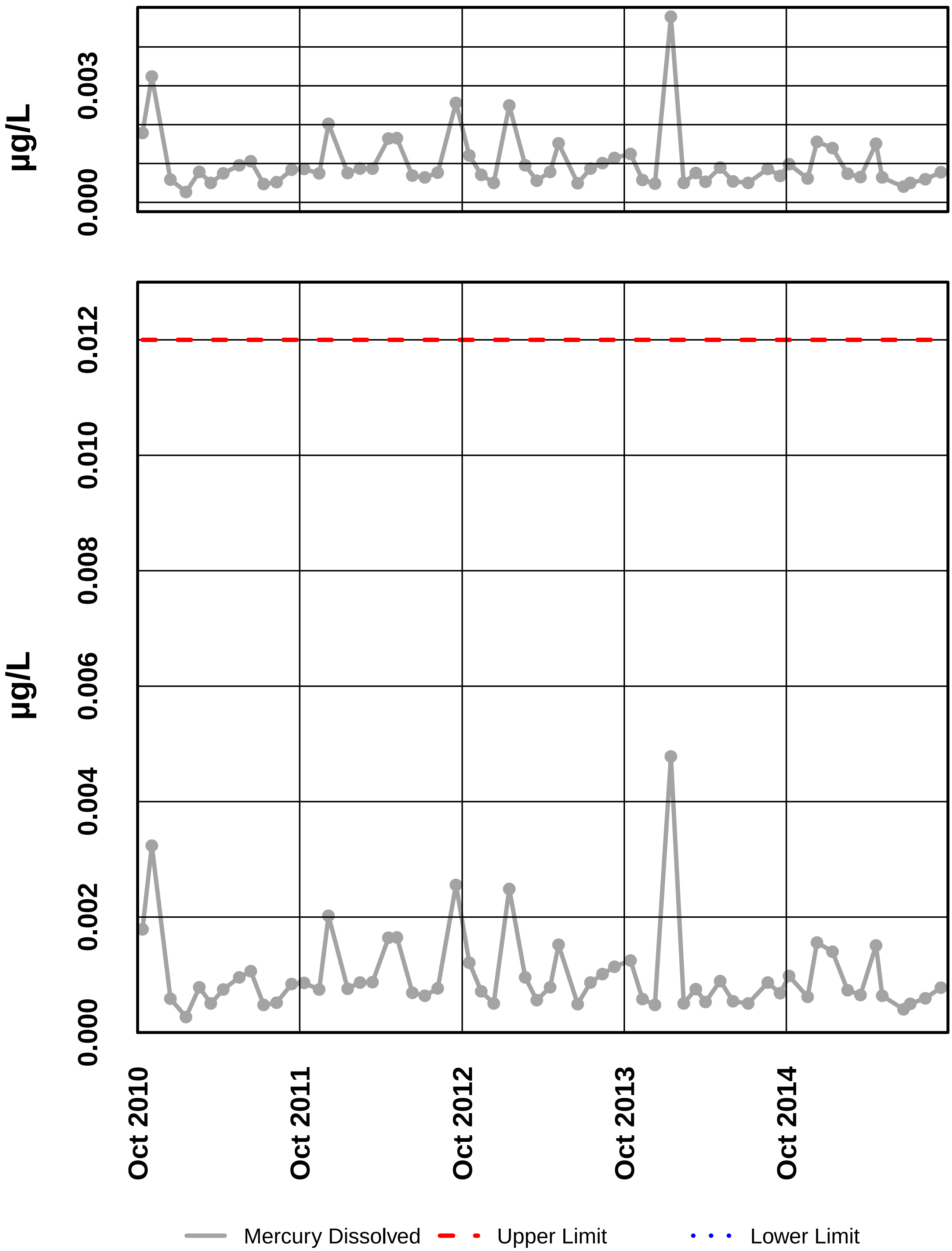


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

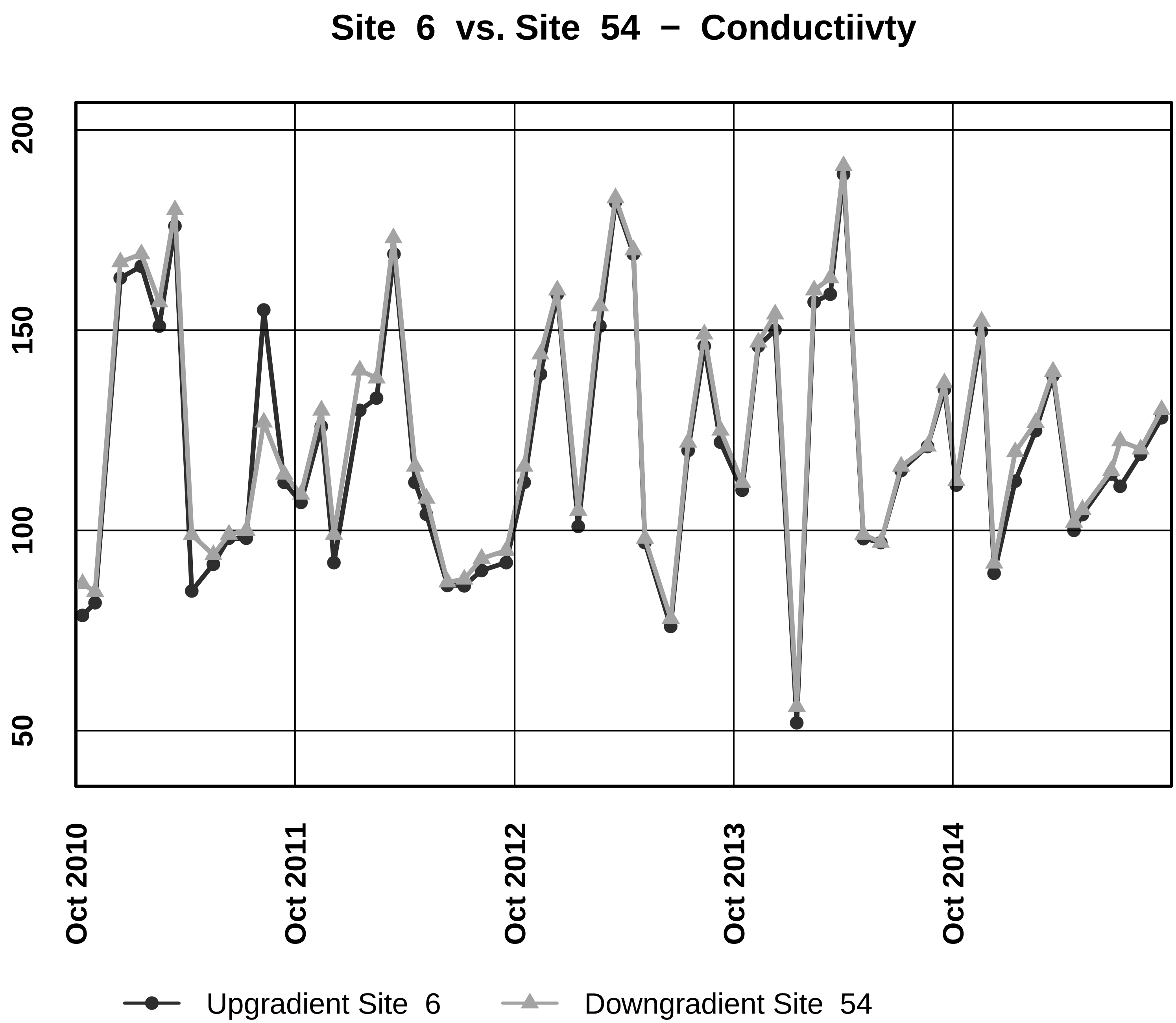


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 54 − Mercury Dissolved

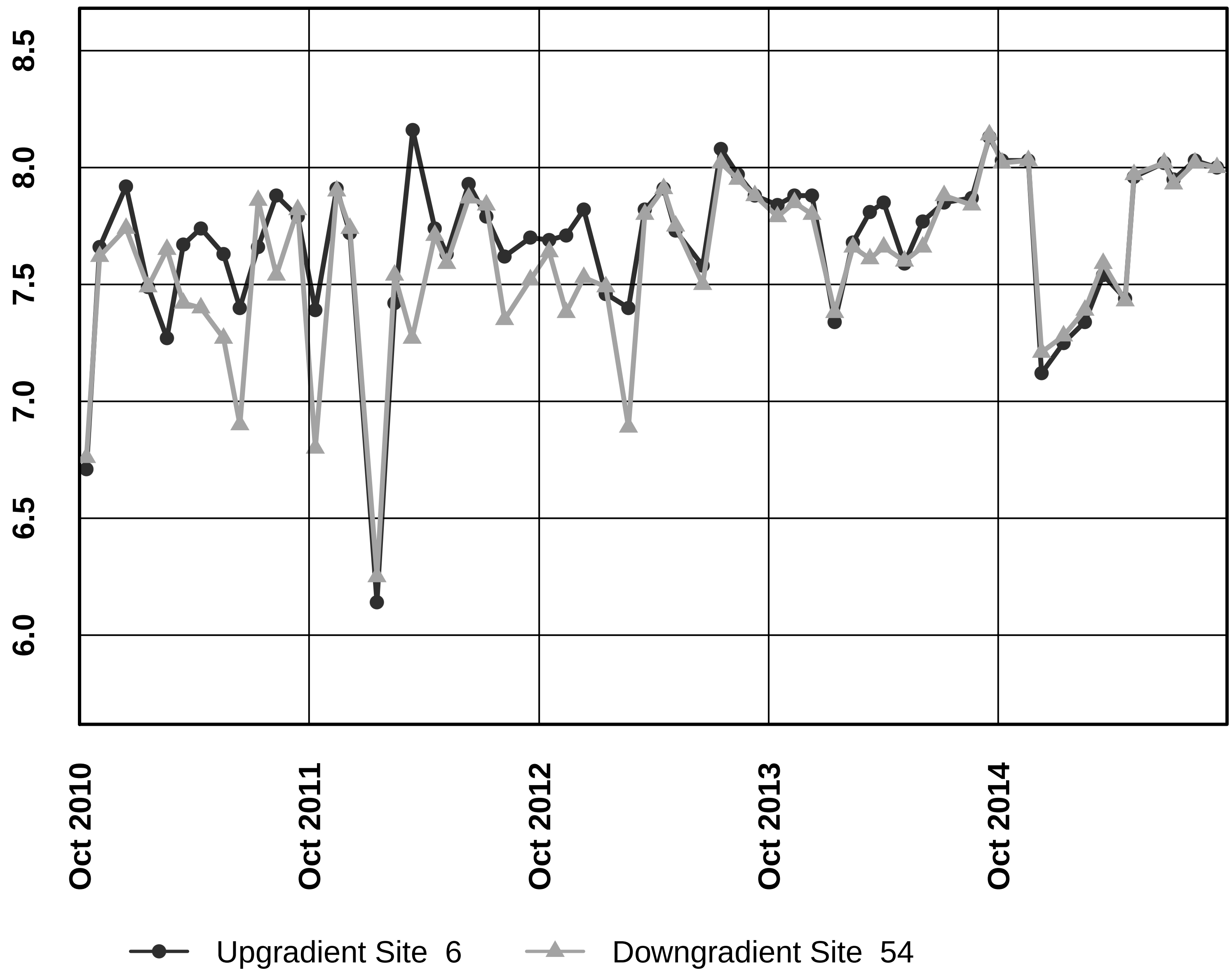


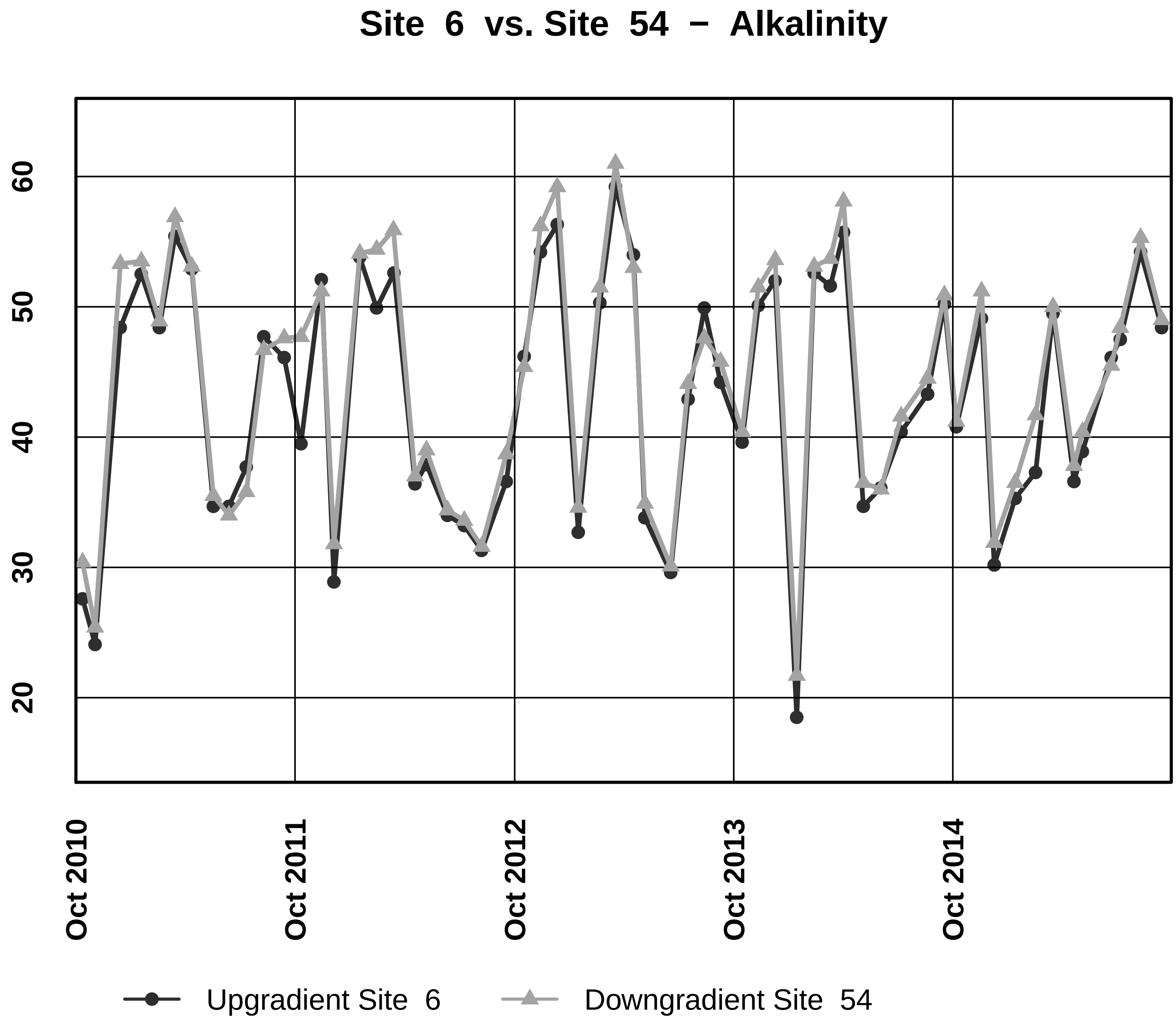
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



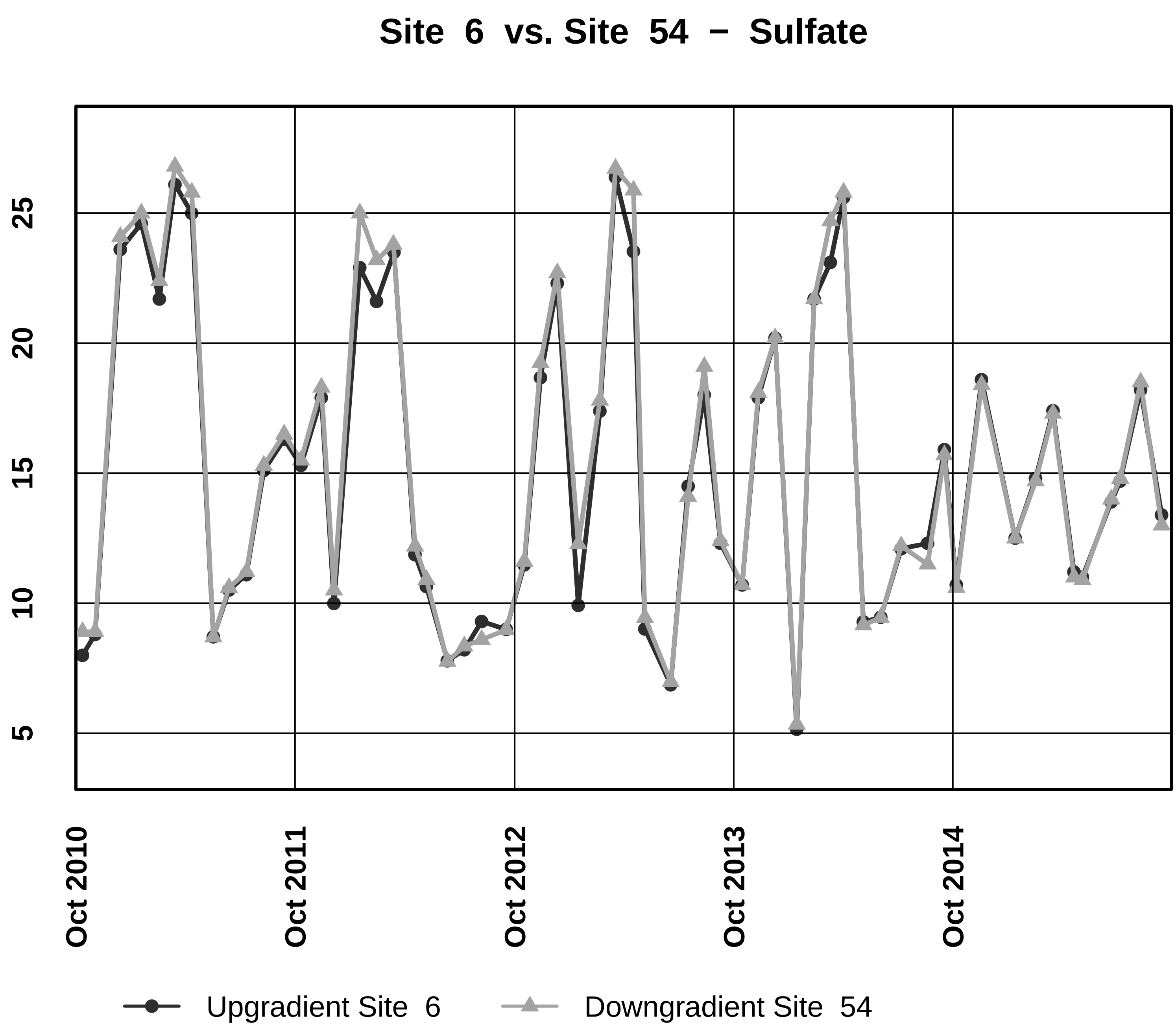
Site 6 vs. Site 54 − Conductiivty
200
150
100
50
Oct 2010
Oct 2011
Oct 2012
Oct 2013
Oct 2014
Upgradient Site 6
Downgradient Site 54

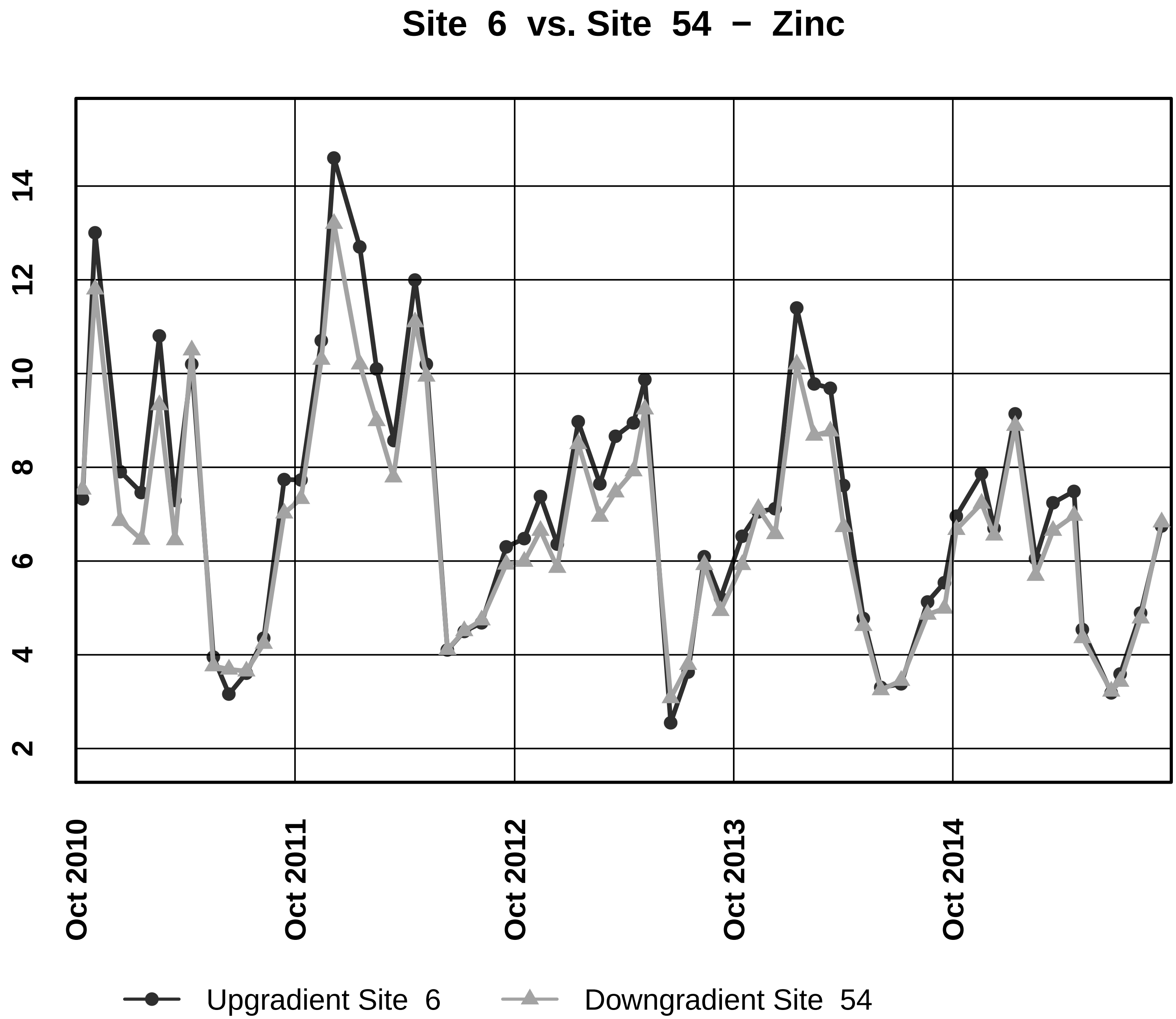
Site 6 vs. Site 54 − pH





Site 6 vs. Site 54 − Alkalinity
20
30
40
50
60
Oct 2010
Oct 2011
Oct 2012
Oct 2013
Oct 2014
Upgradient Site 6
Downgradient Site 54


Site 6 vs. Site 54 − Sulfate
5
10
15
20
25
Oct 2010
Oct 2011
Oct 2012
Oct 2013
Oct 2014
Upgradient Site 6
Downgradient Site 54


Site 6 vs. Site 54 − Zinc
2
4
6
8
10
12
14
Oct 2010
Oct 2011
Oct 2012
Oct 2013
Oct 2014
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	WY2015	WY2015	**D**	**|D|**	**Rank**
Oct	111.3	112.4	-1.1	1.1	-3
Nov	149.6	152.2	-2.6	2.6	-10
Dec	89.3	91.8	-2.5	2.5	-9
Jan	112.3	119.6	-7.3	7.3	-11
Feb	124.9	126.9	-2.0	2.0	-7
Mar	138.6	139.7	-1.1	1.1	-2
Apr	100.0	102.0	-2.0	2.0	-7
May	104.0	105.2	-1.2	1.2	-4
Jun	114.1	114.9	-0.8	0.8	-1
Jul	111.0	122.3	-11.3	11.3	-12
Aug	119.0	120.3	-1.3	1.3	-5
Sep	128.1	130.1	-2.0	2.0	-7
Median	113.2	120.0	-2.0	2.0	

n	**m**
12	12

N= 12

ΣR= -78

α
0.05
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			
Site	#6	#54	Differences		
Year	WY2015	WY2015	D	|D|	Rank
Oct	8.03	8.02	0.01	0.01	1.5
Nov	8.03	8.03	0.00		
Dec	7.12	7.21	-0.09	0.09	-9
Jan	7.25	7.28	-0.03	0.03	-6
Feb	7.34	7.39	-0.05	0.05	-7.5
Mar	7.54	7.59	-0.05	0.05	-7.5
Apr	7.44	7.43	0.01	0.01	3.5
May	7.96	7.97	-0.01	0.01	-3.5
Jun	8.02	8.02	0.00		
Jul	7.95	7.93	0.02	0.02	5
Aug	8.03	8.02	0.01	0.01	1.5
Sep	8.00	8.00	0.00		
Median	7.96	7.95	0.00	0.02	

n	m
12	9

N= 9

ΣR= -22

α
0.05
W'α,n
8

W^+=
11.5
p-test
0.102

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

Wilcoxon-signed-ranks test

Exact Form

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

	X	**Y**			
Site	#6	#54	Differences		
Year	WY2015	WY2015	**D**	**|D|**	**Rank**
Oct	40.8	41.2	-0.4	0.4	-1
Nov	49.1	51.2	-2.1	2.1	-11
Dec	30.2	31.9	-1.7	1.7	-10
Jan	35.3	36.5	-1.2	1.2	-7.5
Feb	37.3	41.7	-4.4	4.4	-12
Mar	49.5	50.0	-0.5	0.5	-2
Apr	36.6	37.8	-1.2	1.2	-7.50
May	38.9	40.4	-1.5	1.5	-9
Jun	46.1	45.5	0.6	0.6	3
Jul	47.5	48.4	-0.9	0.9	-5
Aug	54.2	55.3	-1.1	1.1	-6.00
Sep	48.4	49.0	-0.6	0.6	-4
Median	43.5	43.6	-1.2	1.2	

n	**m**
12	12

N= 12

ΣR= -72

α
0.05
W'α,n
17

W^+=
3.00
p-test
0.001

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

Wilcoxon-signed-ranks test
Exact Form

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

	X	**Y**			
Site	#6	#54	Differences		
Year	WY2015	WY2015	**D**	**|D|**	**Rank**
Oct	10.7	10.6	0.1	0.1	3
Nov	18.6	18.4	0.2	0.2	9
Dec	9.5	9.5	0.0	0.0	-1
Jan	12.5	12.5	0.0		
Feb	14.8	14.7	0.1	0.1	5.5
Mar	17.4	17.3	0.1	0.1	3
Apr	11.2	11.0	0.2	0.2	8
May	11.0	10.9	0.1	0.1	3
Jun	13.9	14.0	-0.1	0.1	-5.5
Jul	14.7	14.8	-0.1	0.1	-7
Aug	18.2	18.5	-0.3	0.3	-10
Sep	13.4	13.0	0.4	0.4	11
Median	13.7	13.5	0.1	0.1	

n	**m**
12	11

N= 11
ΣR= 19

α
0.05
W'α,n
13

W^+=
23.5
p-test
0.207

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

Wilcoxon-signed-ranks test
Exact Form

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

	X	Y	Differences		
Site	#6	#54			
Year	WY2015	WY2015	**D**	**|D|**	**Rank**
Oct	6.96	6.67	0.29	0.29	8
Nov	7.86	7.23	0.63	0.63	12
Dec	6.70	6.55	0.15	0.15	4
Jan	9.14	8.89	0.25	0.25	7
Feb	6.05	5.69	0.36	0.36	9
Mar	7.24	6.65	0.59	0.59	11
Apr	7.49	6.97	0.52	0.52	10
May	4.54	4.36	0.18	0.18	6
Jun	3.19	3.22	-0.03	0.03	-1
Jul	3.59	3.43	0.16	0.16	5
Aug	4.89	4.78	0.11	0.11	3
Sep	6.75	6.83	-0.08	0.08	-2
Median	6.73	6.60	0.22	0.22	

n	**m**
12	12

N= 12
ΣR= 72

α
0.05
W'α,n
17

W^+=
3
p-test
0.001

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

INTERPRETIVE REPORT
SITE 62

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

The data collected during the current water year are listed in the following “Table of Results for Water Year 2015” report. The table includes all the required FWMP analyte data (field and laboratory) collected for the current water year and a series of flags keyed to the summary report “Qualified Data by QA Reviewer”. The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of ½ MDL for the purpose of median calculation.

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

Sample Date	Parameter	Value	Qualifier	Notes
No outliers have been identified by HGCMC for the period of October 2012 through September 2015.				

The data 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 2015

			Limits		
Sample Date	Parameter	Value	Lower	Upper	Hardness
No exceedances have been identified by HGCMC for the period of October 2014 through September 2015.					

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

A comparison of median values for total alkalinity, field pH, field conductivity, total sulfate, and dissolved zinc between Site 62 and Site 54 has been conducted. Additionally, X-Y plots have been generated for total alkalinity, field pH, specific conductance, total sulfate, and dissolved zinc that co-plot data from Site 62 and Site 54, the upstream control site, to aid in the comparison between those sites. Calculation details of the non-parametric signed-rank tests are presented in detail on the pages following this interpretive section. The table below summarizes the results of the signed-rank test as performed on the Water Year 2015 dataset.

Table of Summary Statistics for Median Analysis

Site 62 vs Site 54				
Parameter	**Signed Ranks p-value**	**Site 54 median**	**Site 62 median**	**Median Differences**
Conductivity Field	<0.01	120	124.00	-7.7
pH Field	<0.01	7.95	7.83	0.14
Alkalinity, Total	<0.01	43.6	47.4	-3.5
Sulfate, Total	<0.01	13.5	14.6	-1.1
Zinc, Dissolved	0.515	6.6	6.22	-0.1

Three of the five parameters compared between Site 54 and Site 62 had statistically significant median differences. Similar results to these were obtained when comparing other paired (48-6 and 6-54) sites along Greens Creek. HGCMC feels the current FWMP program is adequate to measure and quantify future changes that may occur between Site 54 and Site 62.

Table of Results for Water Year 2015

Site 062FMS - 'Greens Creek Below Site 54'

Sample Date/Parameter	Oct 2014	Nov 2014	Dec 2014	Jan 2015	Feb 2015	Mar 2015	Apr 2015	May 2015	Jun 2015	Jul 2015	Aug 2015	Sep 2015	**Median**
Water Temp (°C)	5.3	2.8	2.0	0.7	1.7	1	2.3	2.9	10.1	10.7	10.3	7.5	2.9
Conductivity-Field(μmho)	119.2	156	98.6	130.6	139.4	150.8	110	112.8	107	120	128	134.8	124.0
Conductivity-Lab (μmho)	112	152	89	120	140	151	108	117	127	119	136	110	120
pH Lab (standard units)	7.71	7.38	7.54	7.48	7.29	7.27	6.94	7.35	7.91	7.77	7.84	7.57	7.51
pH Field (standard units)	7.83	7.89	6.99	7.01	7.29	7.27	6.94	7.93	8.02		7.89	8	7.83
Total Alkalinity (mg/L)	44.7	54.7	32	40.2	46	54.4	40	44.5	48.7	51.4	58.9	52.3	47.4
Total Sulfate (mg/L)	11.2	19.8	10.3	14	16.1	18.6	12	12	15.2	15.5	19.6	13.6	14.6
Hardness (mg/L)	57.2	72.4	42.8	55	64	70.2	50	56.9	60.3	63.4	74.8	64.5	61.9
Dissolved As (ug/L)	0.223	0.185	0.18	0.193	0.165	0.17	0.167	0.166	0.193	0.236	0.233	0.259	0.189
Dissolved Ba (ug/L)			20.4		26.4					35.9			26.4
Dissolved Cd (ug/L)	0.0465	0.051	0.0423	0.0548	0.0448	0.0467	0.0452	0.0353	0.0385	0.0391	0.0498	0.0483	0.0459
Dissolved Cr (ug/L)			0.077		0.204					0.029			0.077
Dissolved Cu (ug/L)	0.529	0.36	0.76	0.613	0.396	0.444	0.664	0.399	0.299	0.372	0.428	0.497	0.436
Dissolved Pb (ug/L)	0.015	0.0079	0.0275	0.0436	0.0079	0.0063	0.0171	0.0067	0.0053	0.0064	0.0141	0.012	0.0100
Dissolved Ni (ug/L)			0.435		0.51					0.4			0.435
Dissolved Ag (ug/L)			0.002		0.002					0.004			0.002
Dissolved Zn (ug/L)	6.35	7.5	6.37	7.82	6.09	6.87	6.82	4.56	3.49	3.55	4.9	6.02	6.22
Dissolved Se (ug/L)			0.68		0.941					0.871			0.871
Dissolved Hg (ug/L)	0.000963	0.000576	0.00147	0.00151	0.000746	0.000614	0.00143	0.000645	0.000581	0.000464	0.00062	0.000736	0.000691

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.

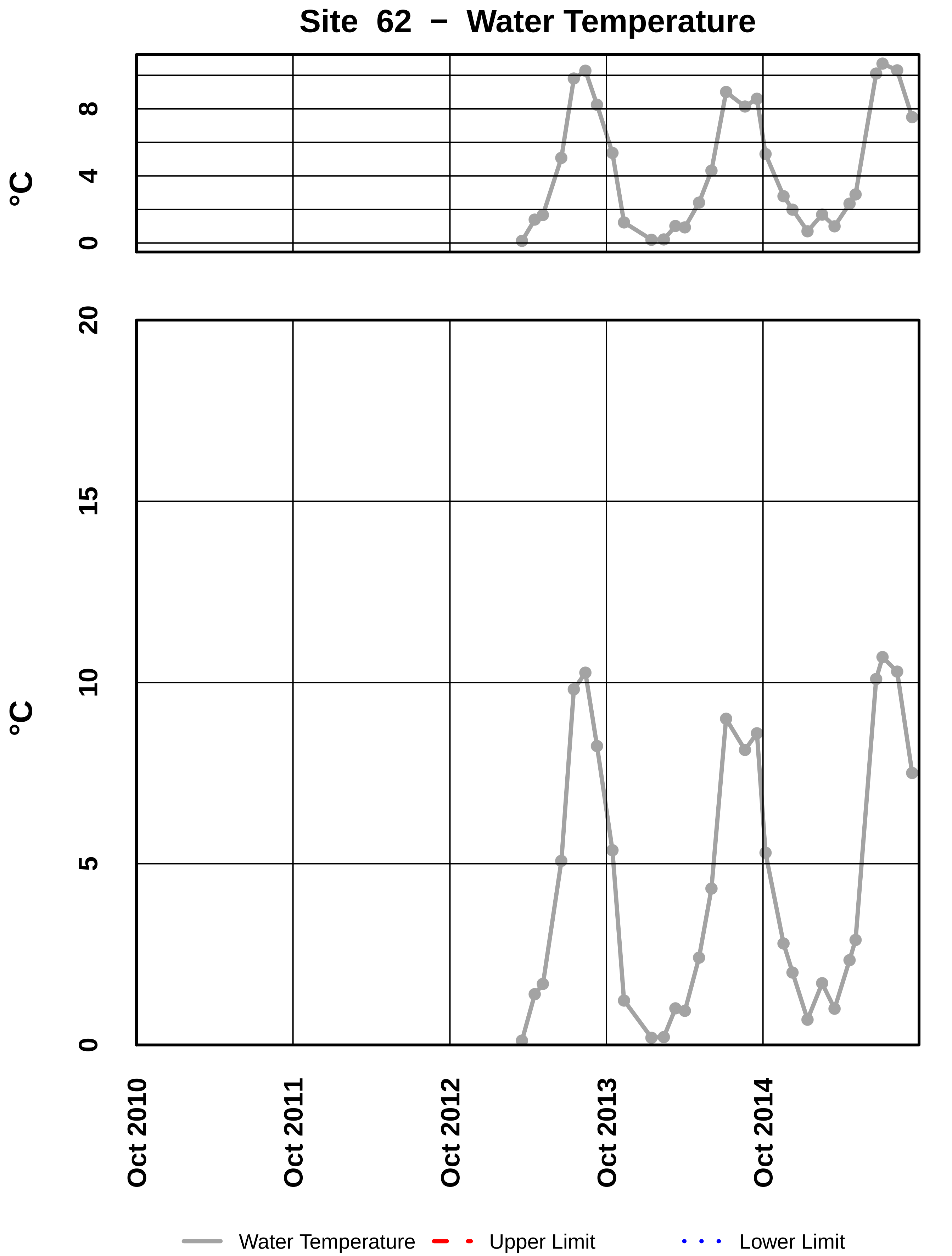
Shaded data has been qualified as an outlier by HGCMC and removed from any further analysis and is not included into the calculation of the median

Qualified Data by QA Reviewer

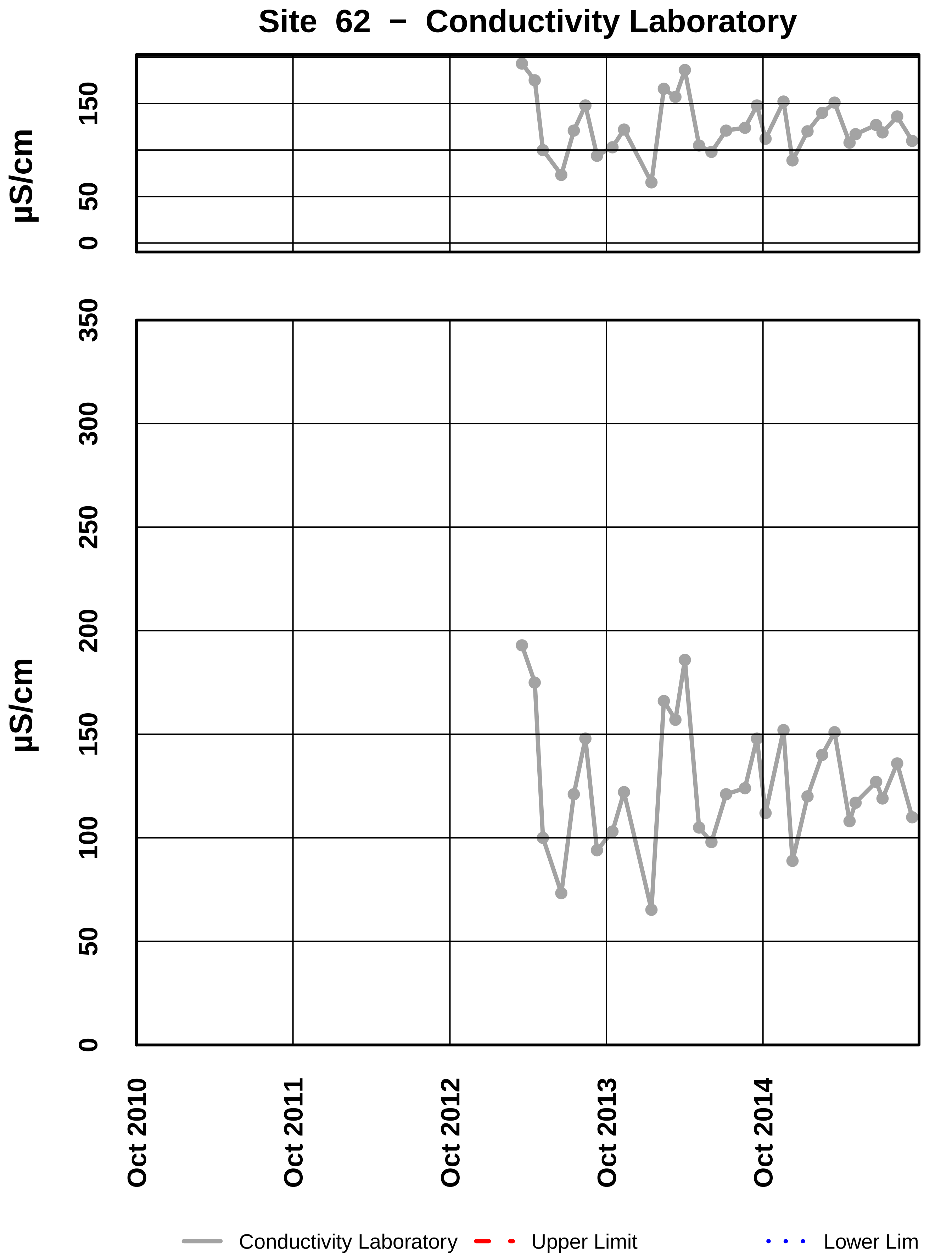
Date Range: 10/01/2014 to 09/30/2015

Site No.	Sample Date	Sample Time	Parameter	Value		Qualifier	Reason for Qualifier
062FMS	10/07/2014	12:00 AM	Diss. Pb-ICP/MS	0.01	µg/L	U	Field Blank Contamination
			pH	7.71	pH units	J	Hold Time Violation
062FMS	11/18/2014	12:00 AM	Diss. Pb-ICP/MS	0.00789	µg/L	J	Below Quantitative Range
062FMS	12/09/2014	12:00 AM	Diss. Cr-ICP/MS	0.07	µg/L	J	Below Quantitative Range
062FMS	02/16/2015	12:00 AM	Diss. Pb-ICP/MS	0.00789	µg/L	J	Below Quantitative Range
			pH	7.28	pH units	J	Hold Time Violation
062FMS	03/17/2015	12:00 AM	Diss. Pb-ICP/MS	0.00632	µg/L	J	Below Quantitative Range
062FMS	05/05/2015	12:00 AM	Diss. Pb-ICP/MS	0.00665	µg/L	J	Below Quantitative Range
			Sulfate	12	mg/L	J	Sample Receipt Temperature
062FMS	06/22/2015	12:00 AM	Diss. Pb-ICP/MS	0.00534	µg/L	J	Below Quantitative Range
062FMS	07/07/2015	12:00 AM	Diss. Ag-ICP/MS	0.00377	µg/L	J	Below Quantitative Range
			Diss. Pb-ICP/MS	0.00637	µg/L	J	Below Quantitative Range
062FMS	08/10/2015	12:00 AM	Sulfate	19.6	mg/L	J	Sample Receipt Temperature

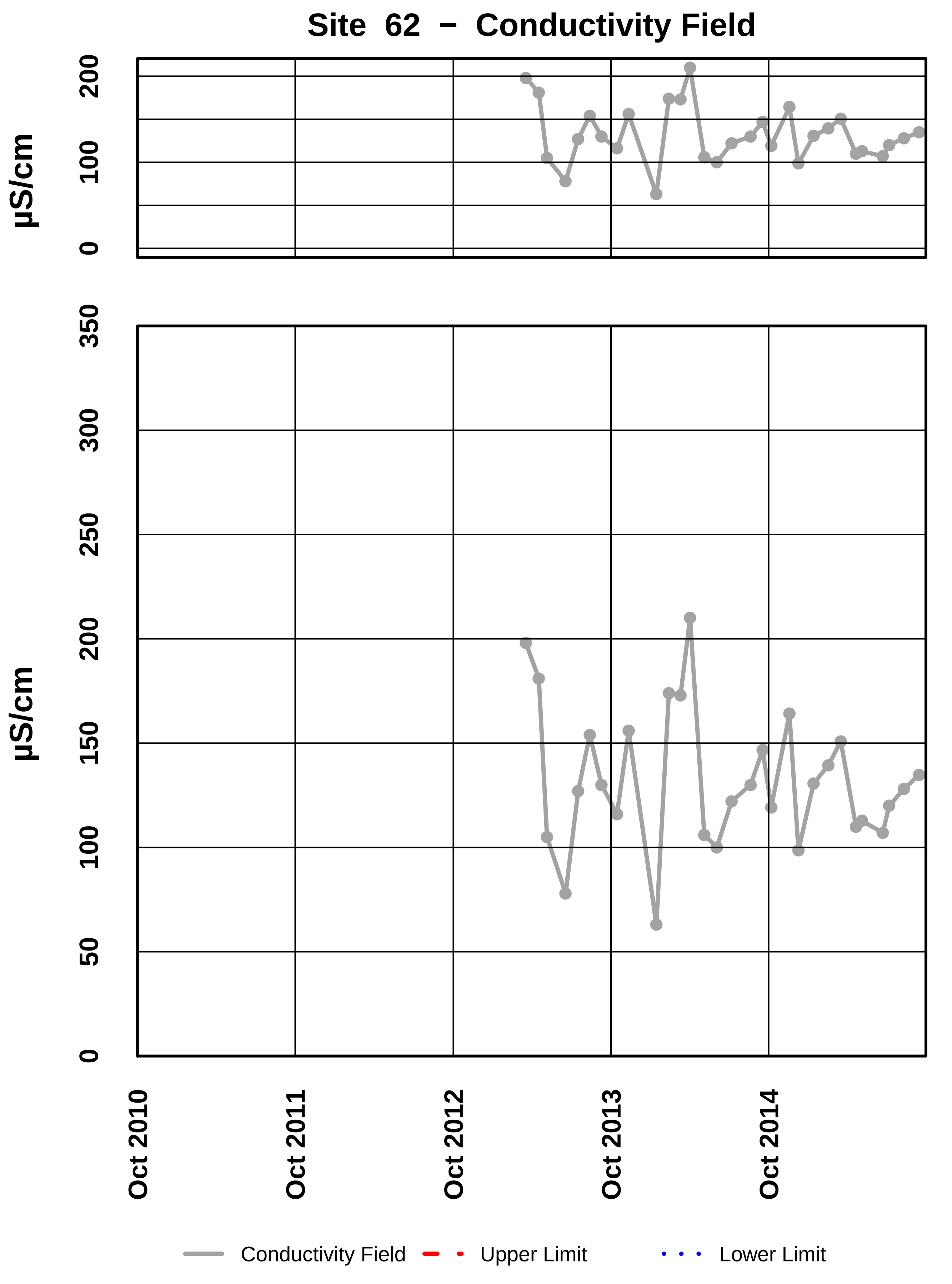
Qualifier	Description
J	Positively Identified - Approximate Concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit



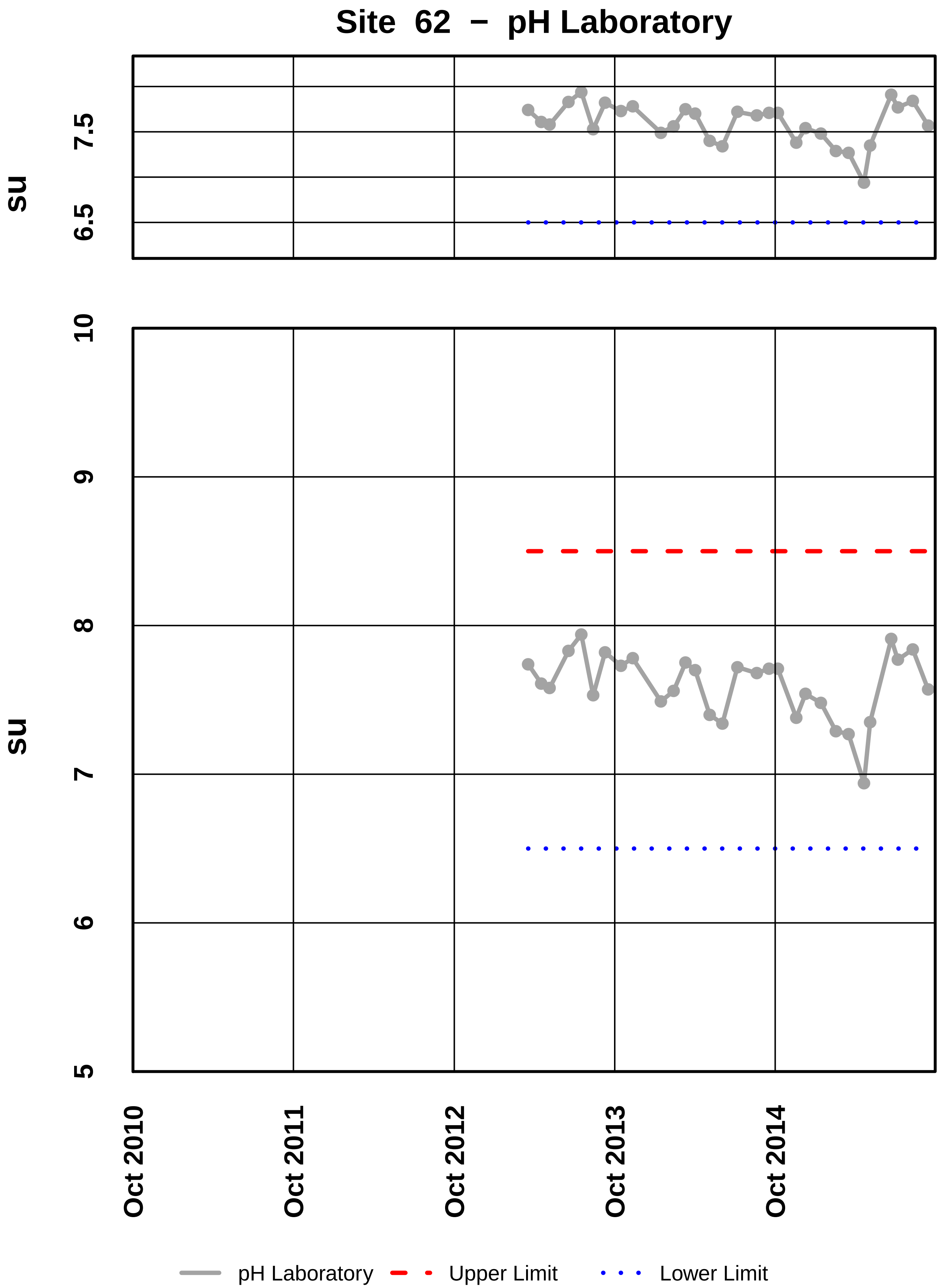
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



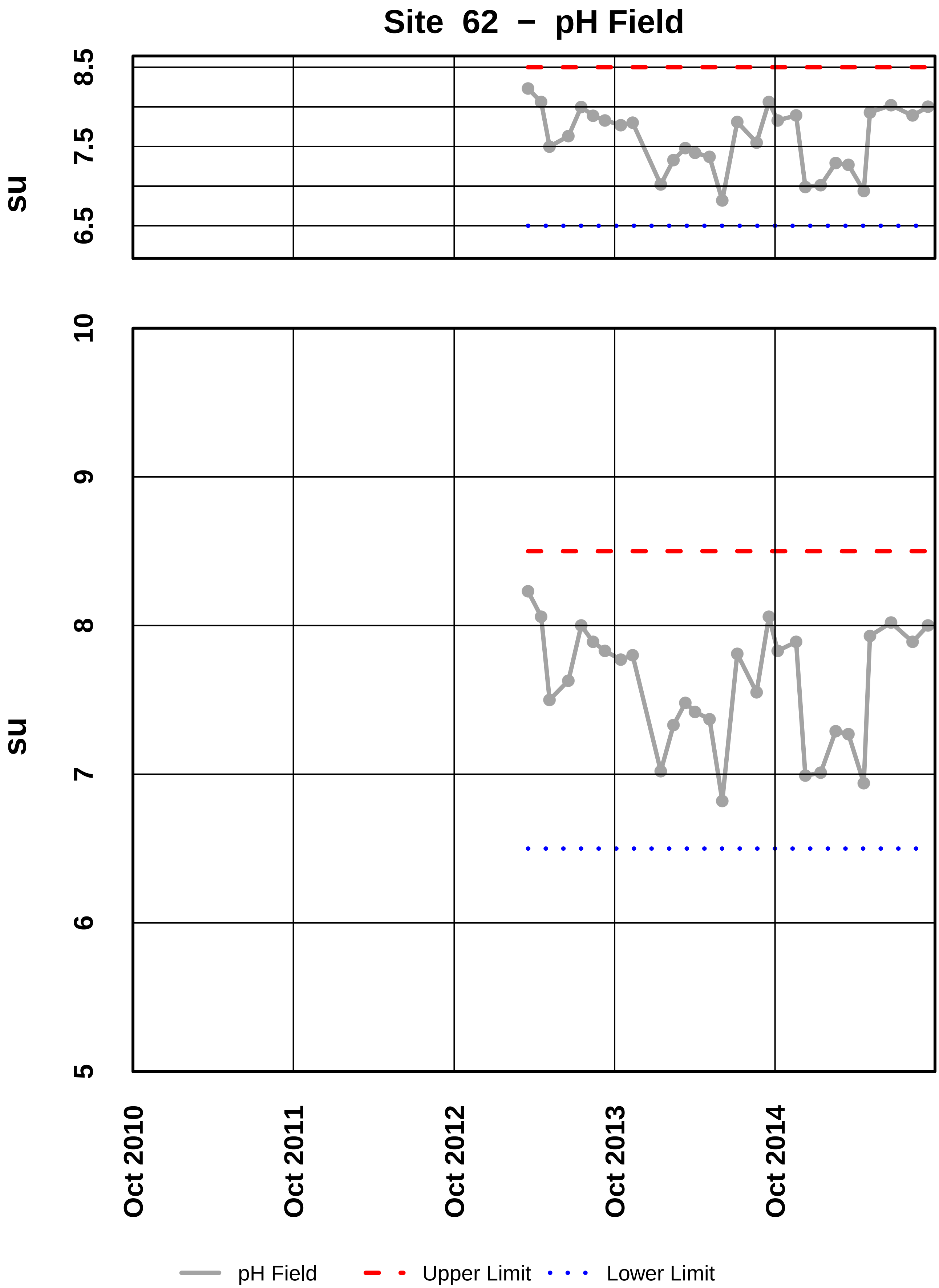
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

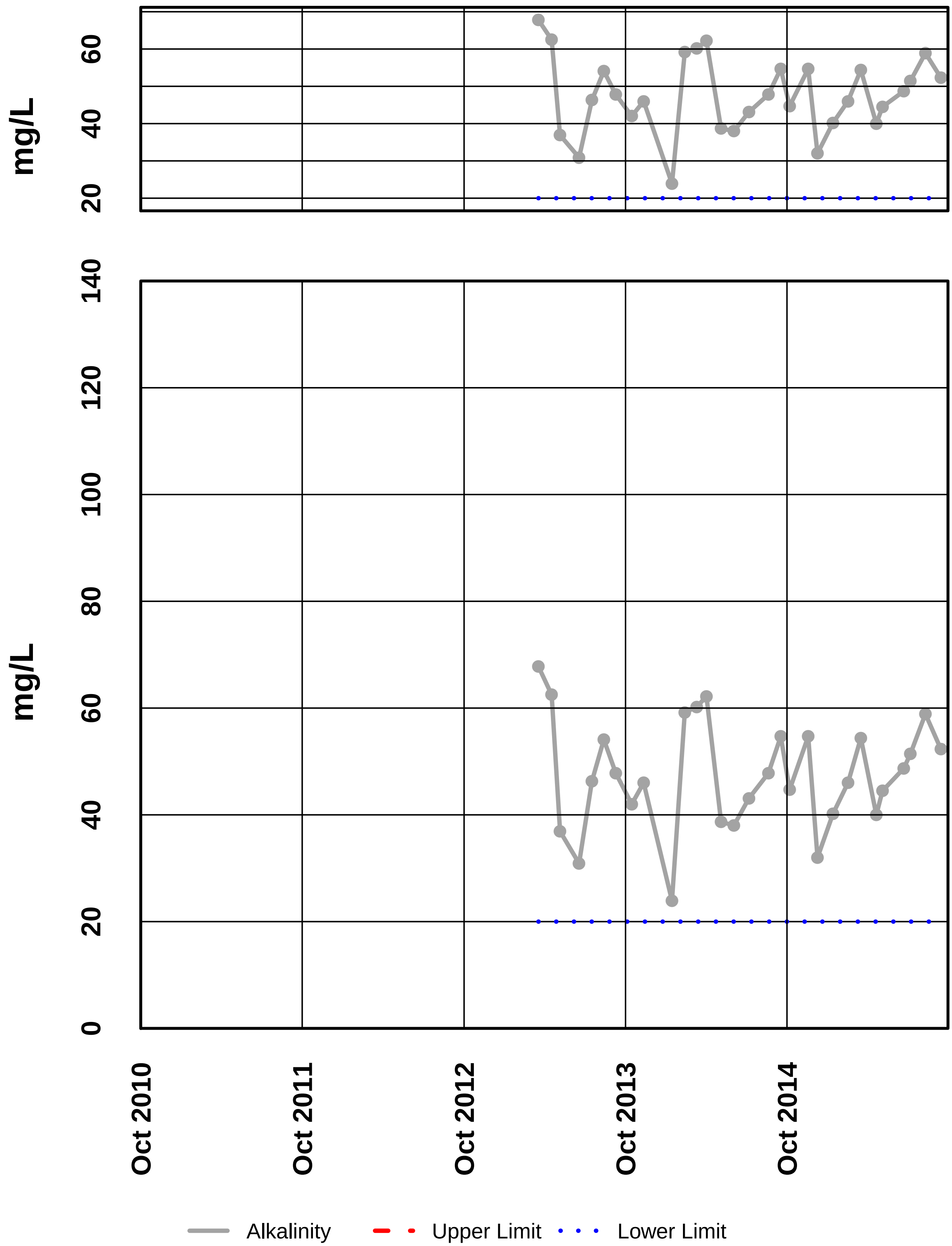


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

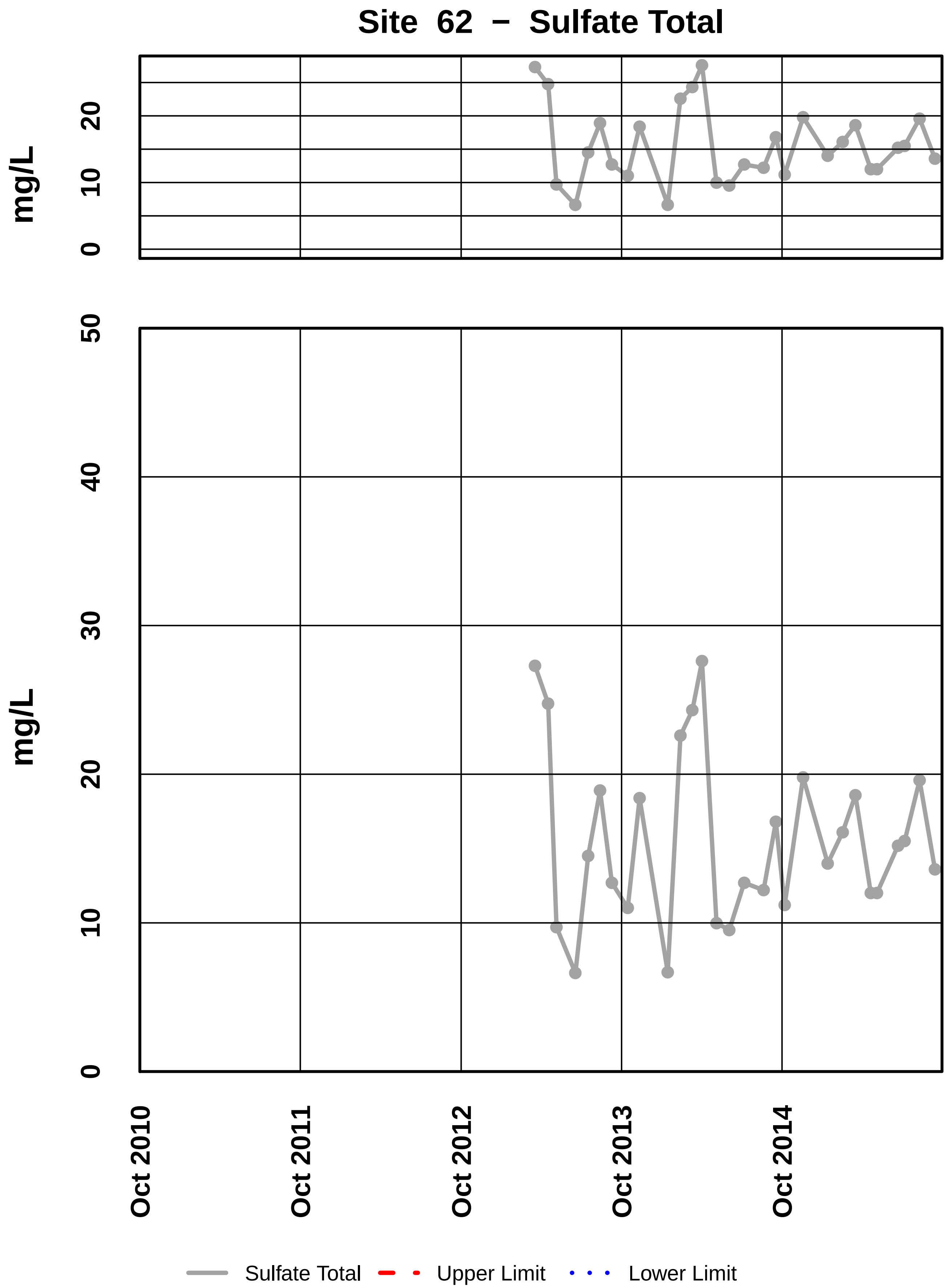


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 62 – Alkalinity

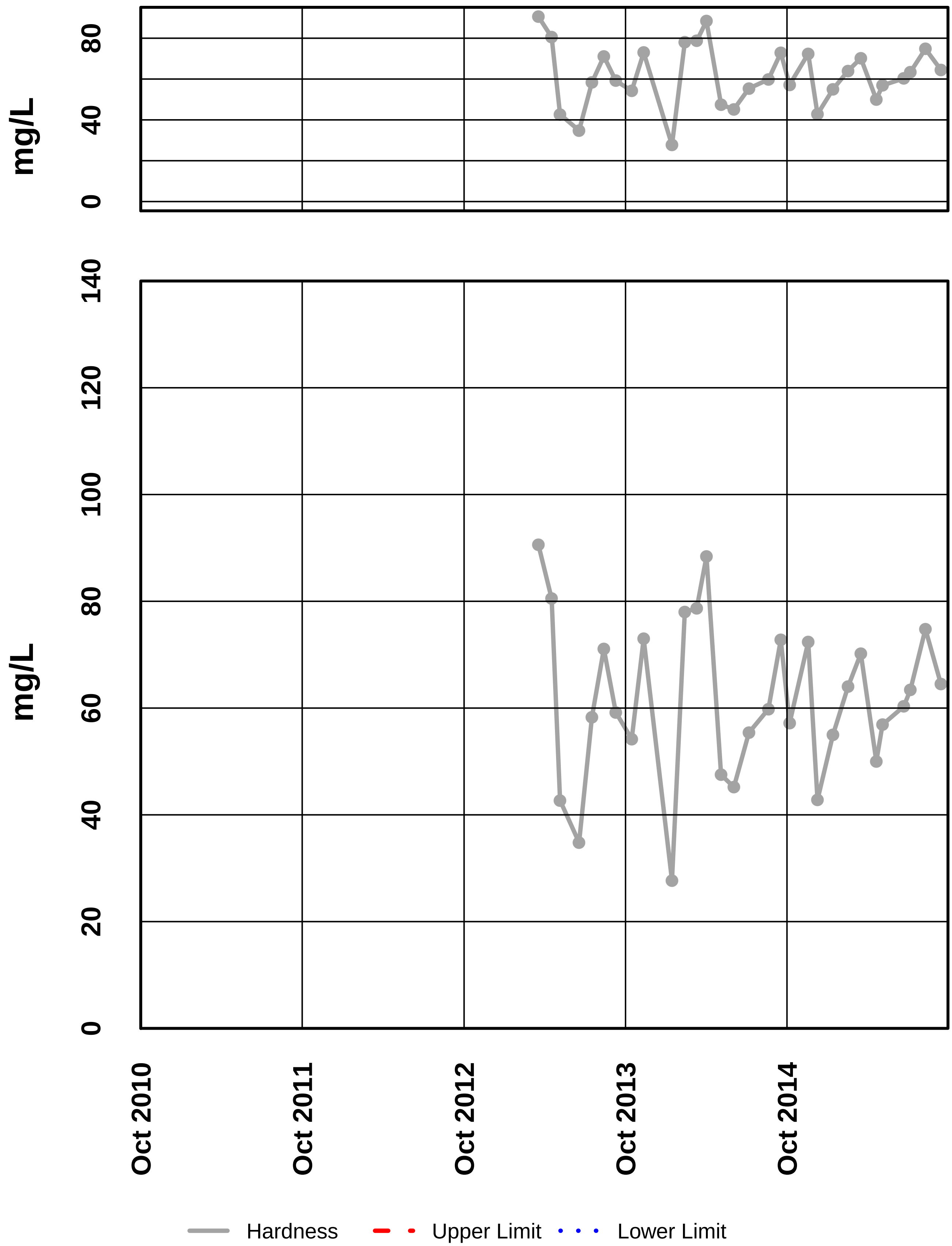


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



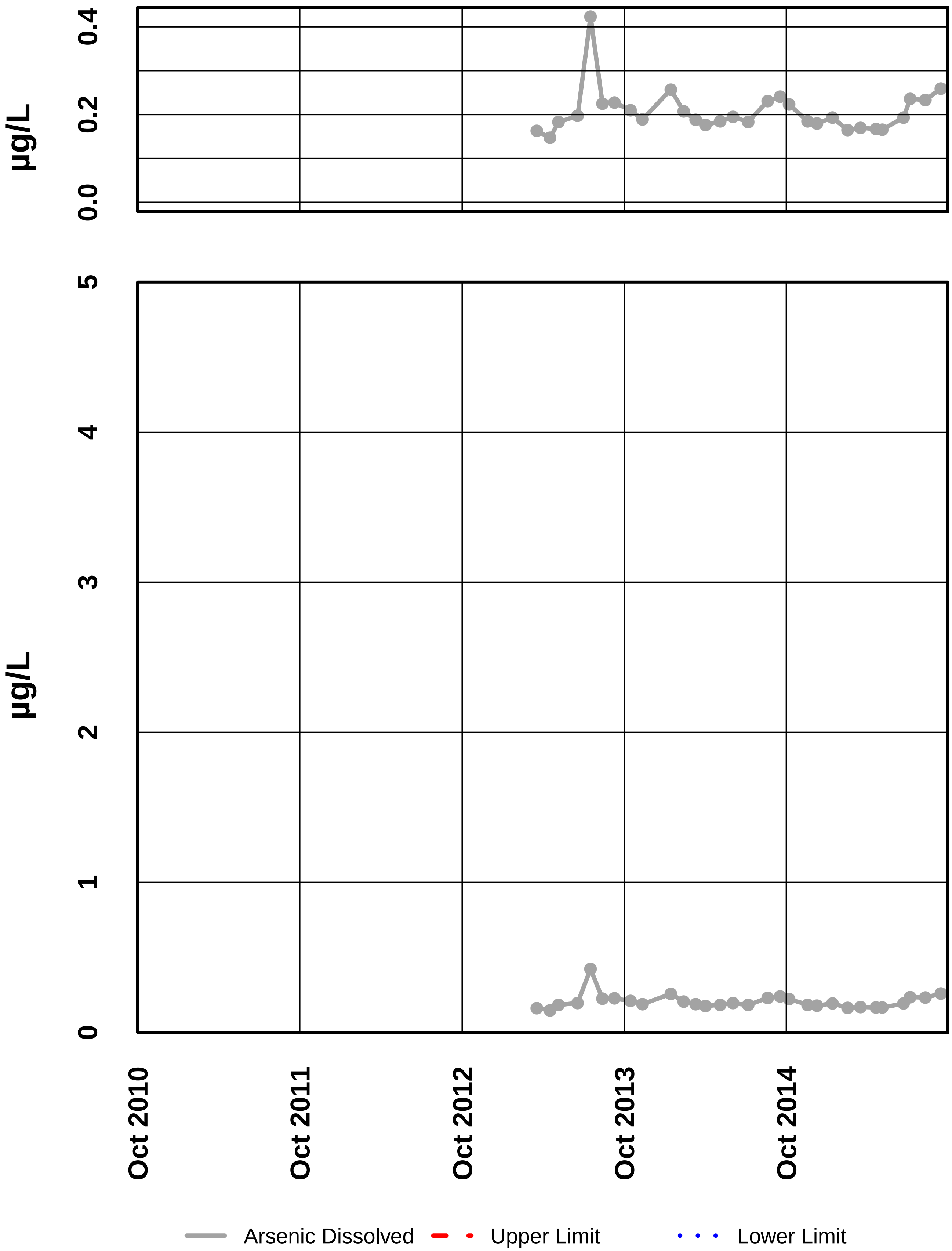
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 62 – Hardness



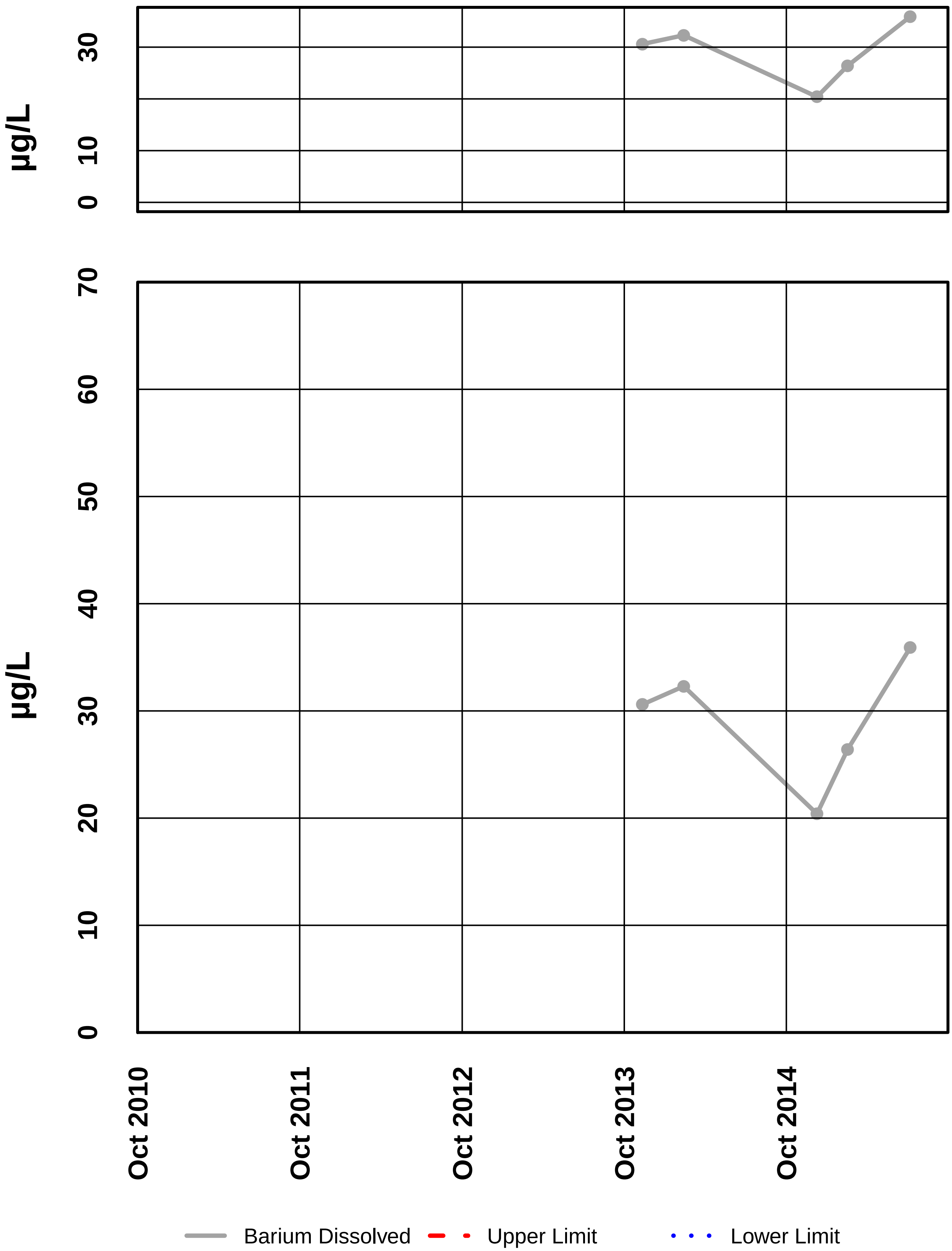
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 62 – Arsenic Dissolved

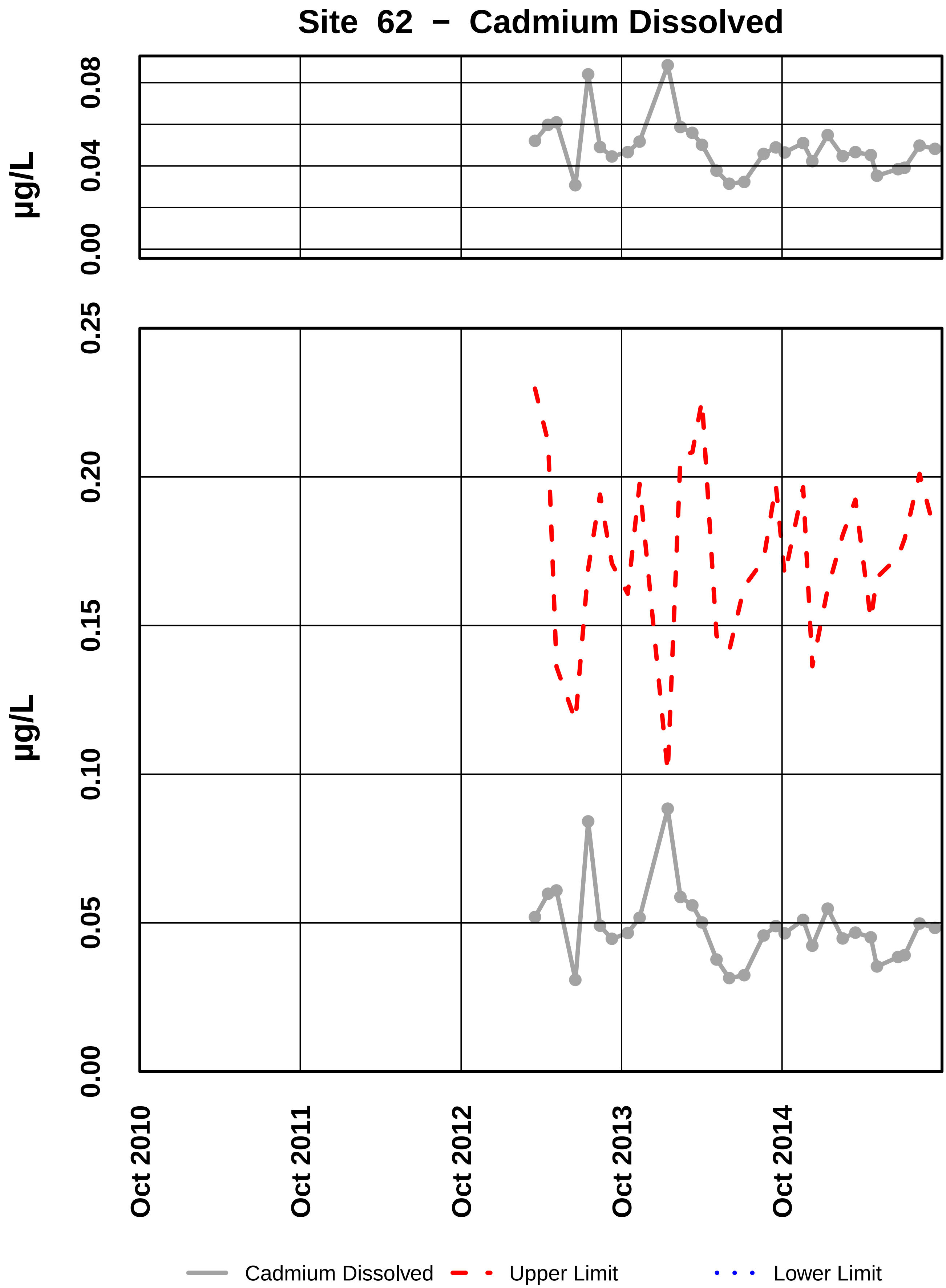


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 62 – Barium Dissolved

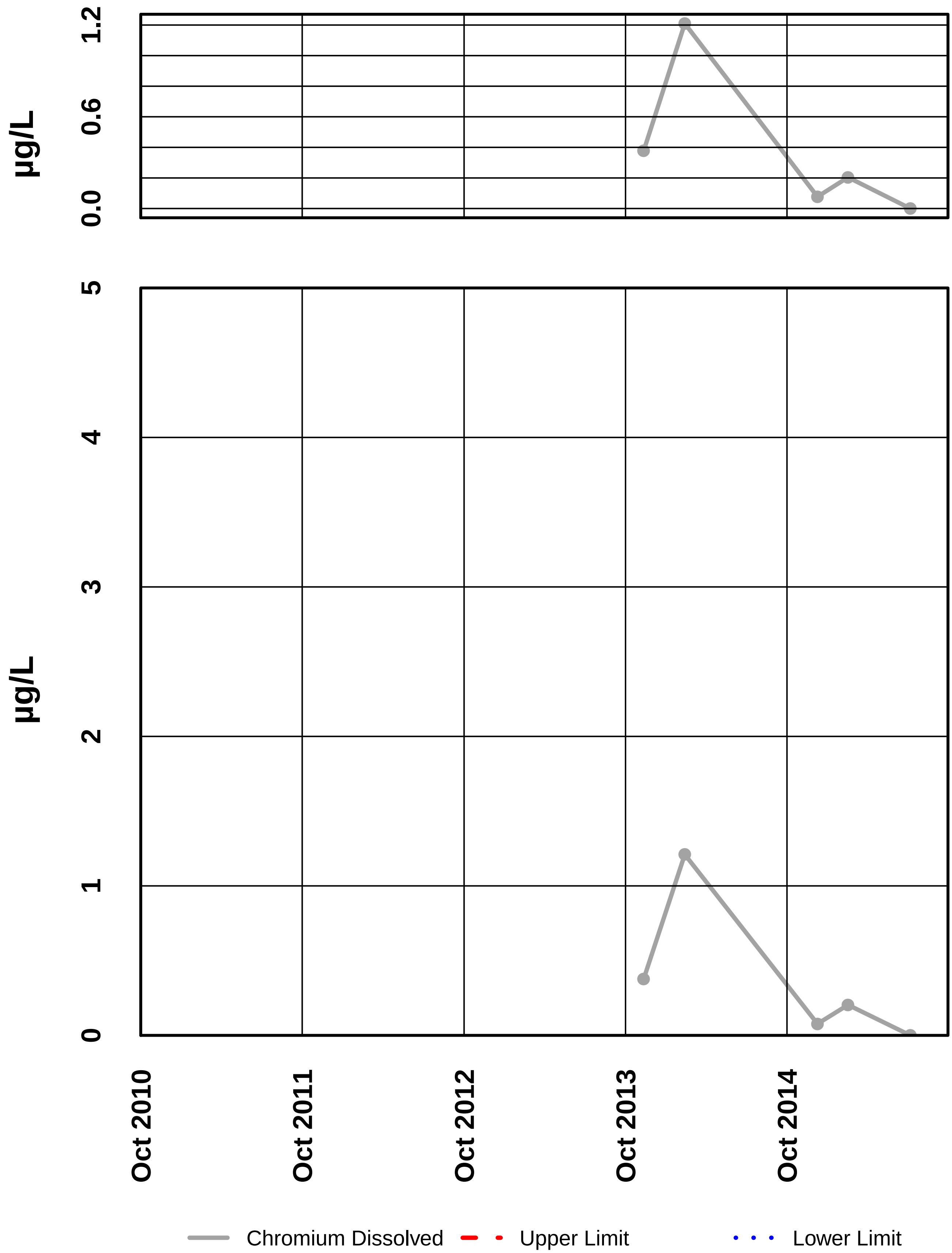


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

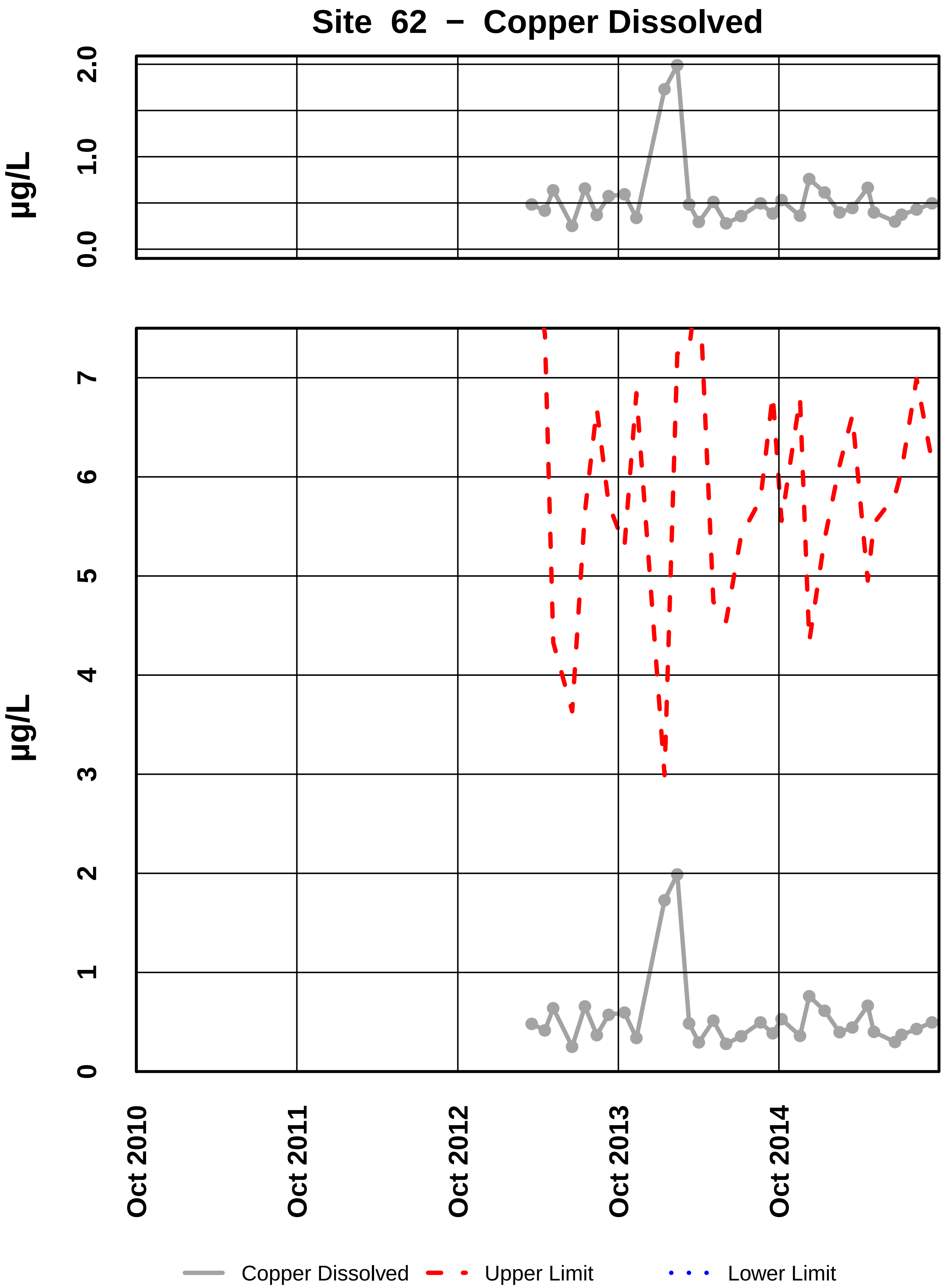


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

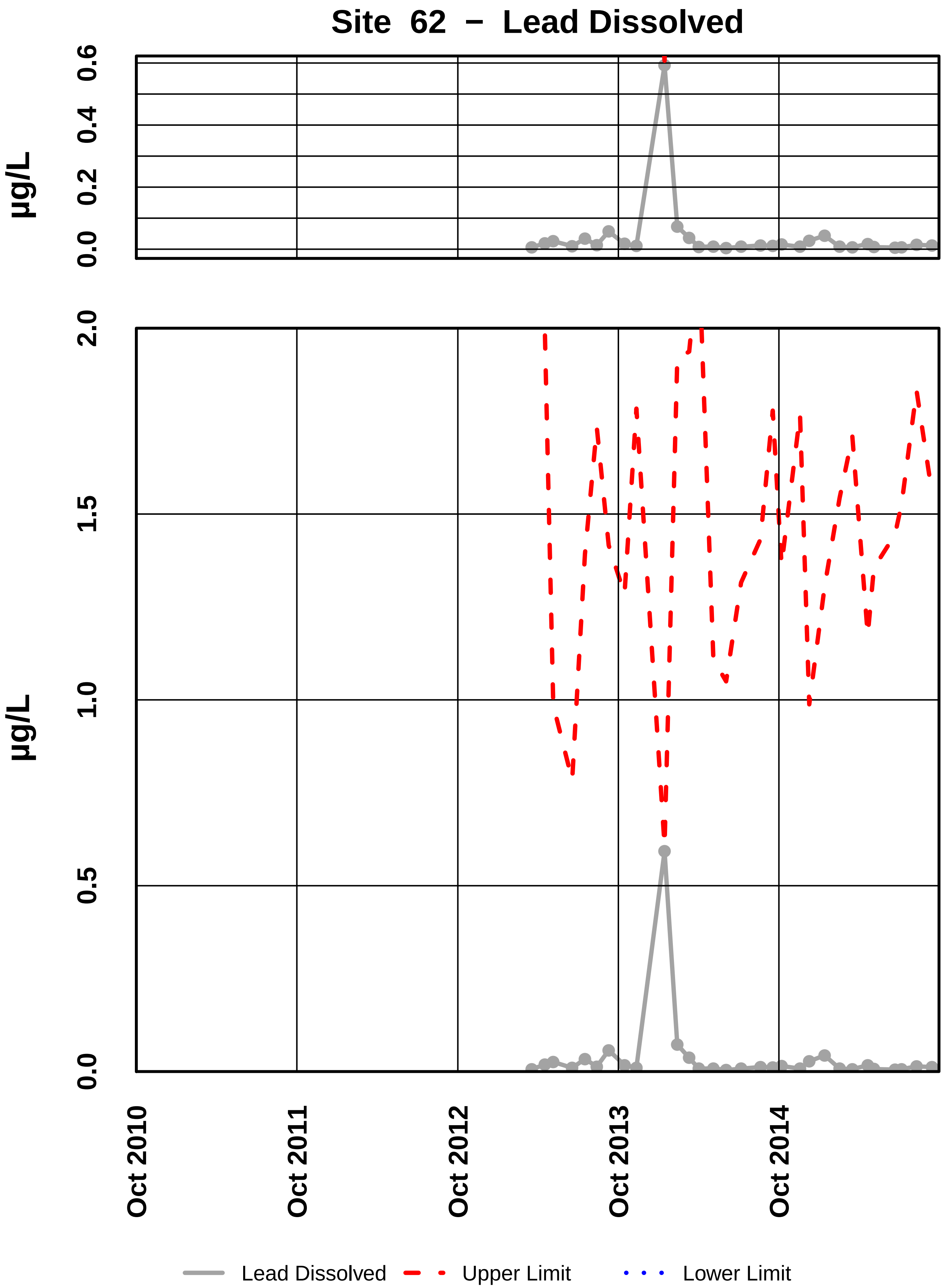
Site 62 – Chromium Dissolved



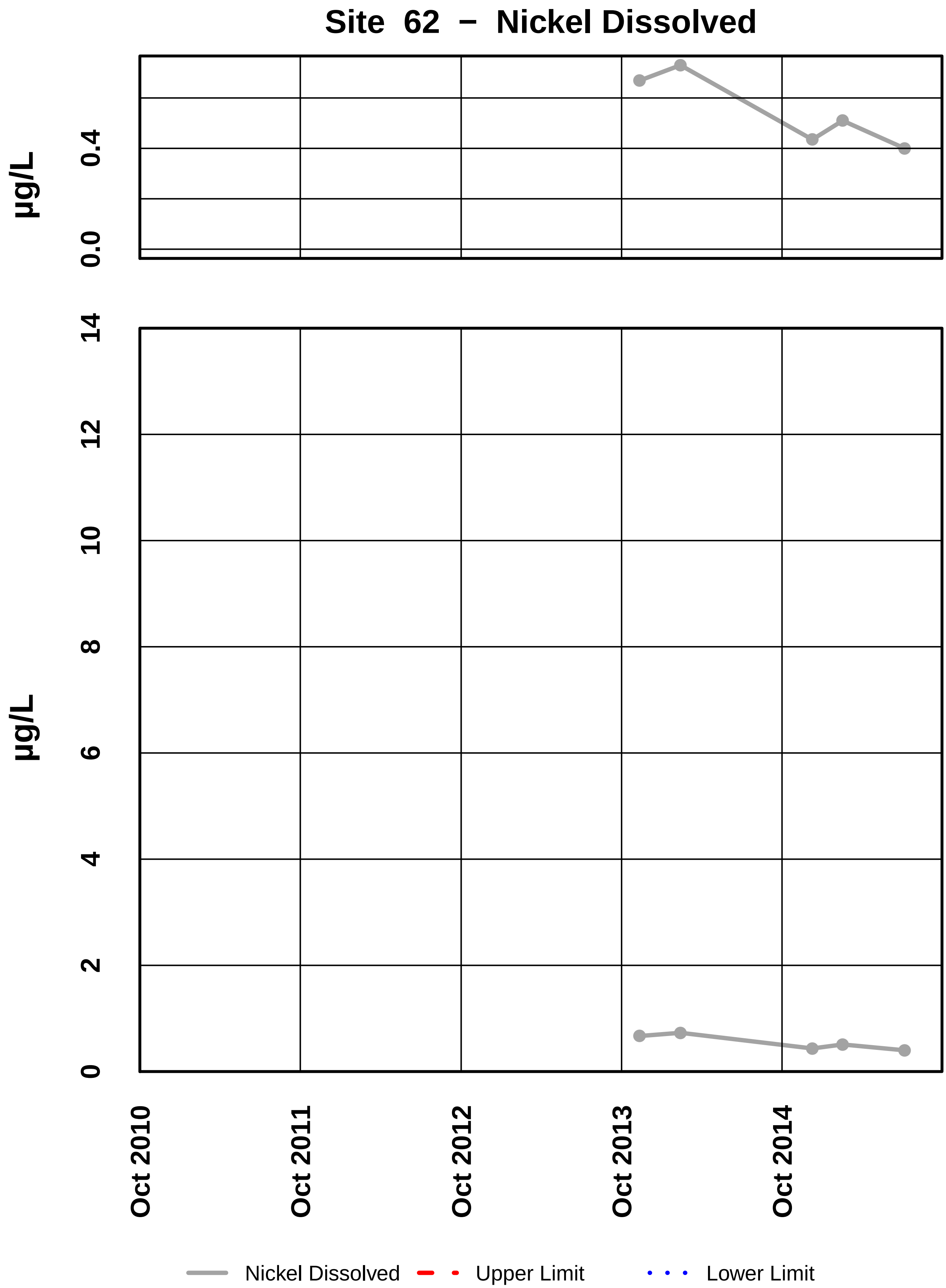
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



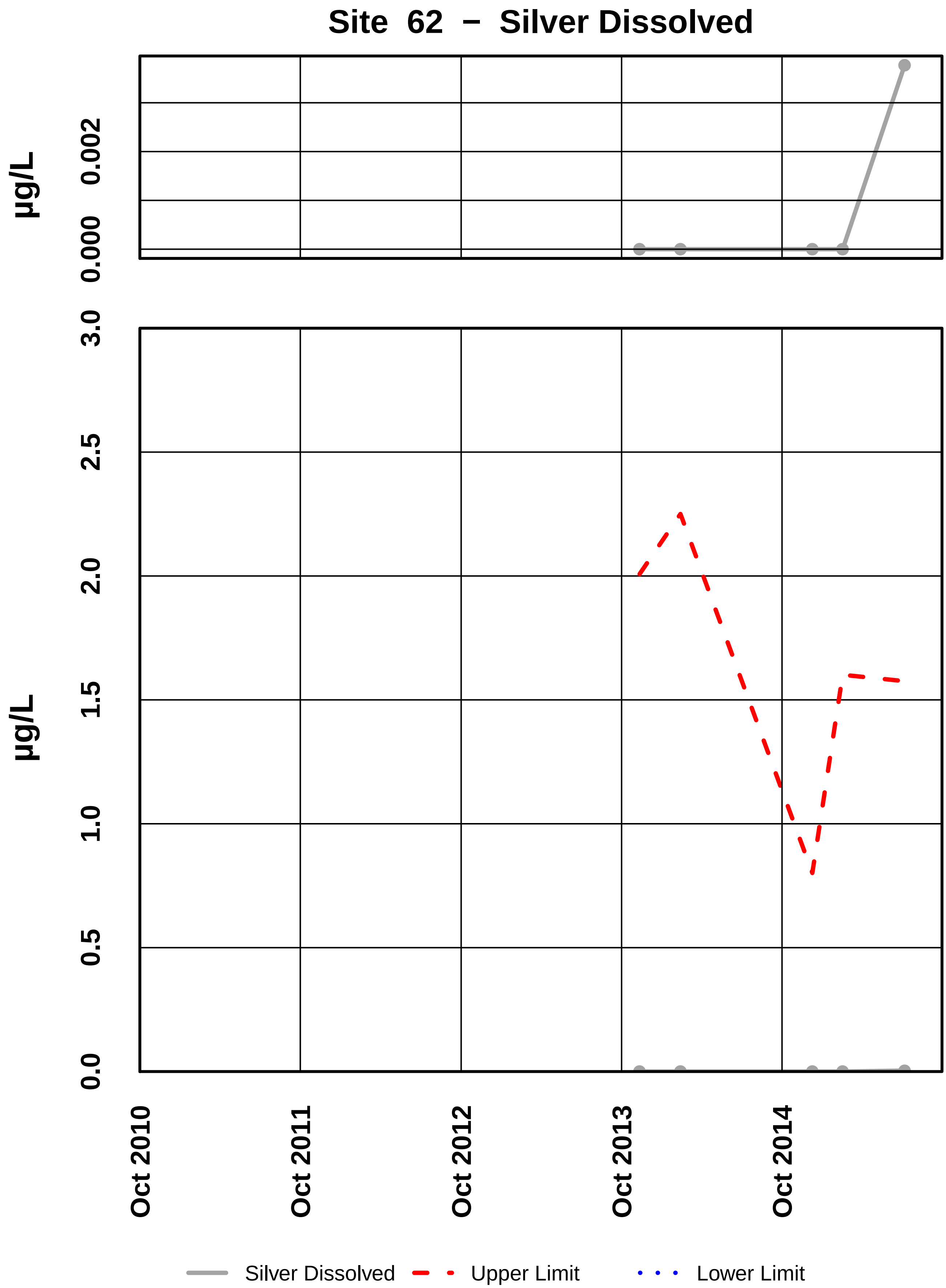
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



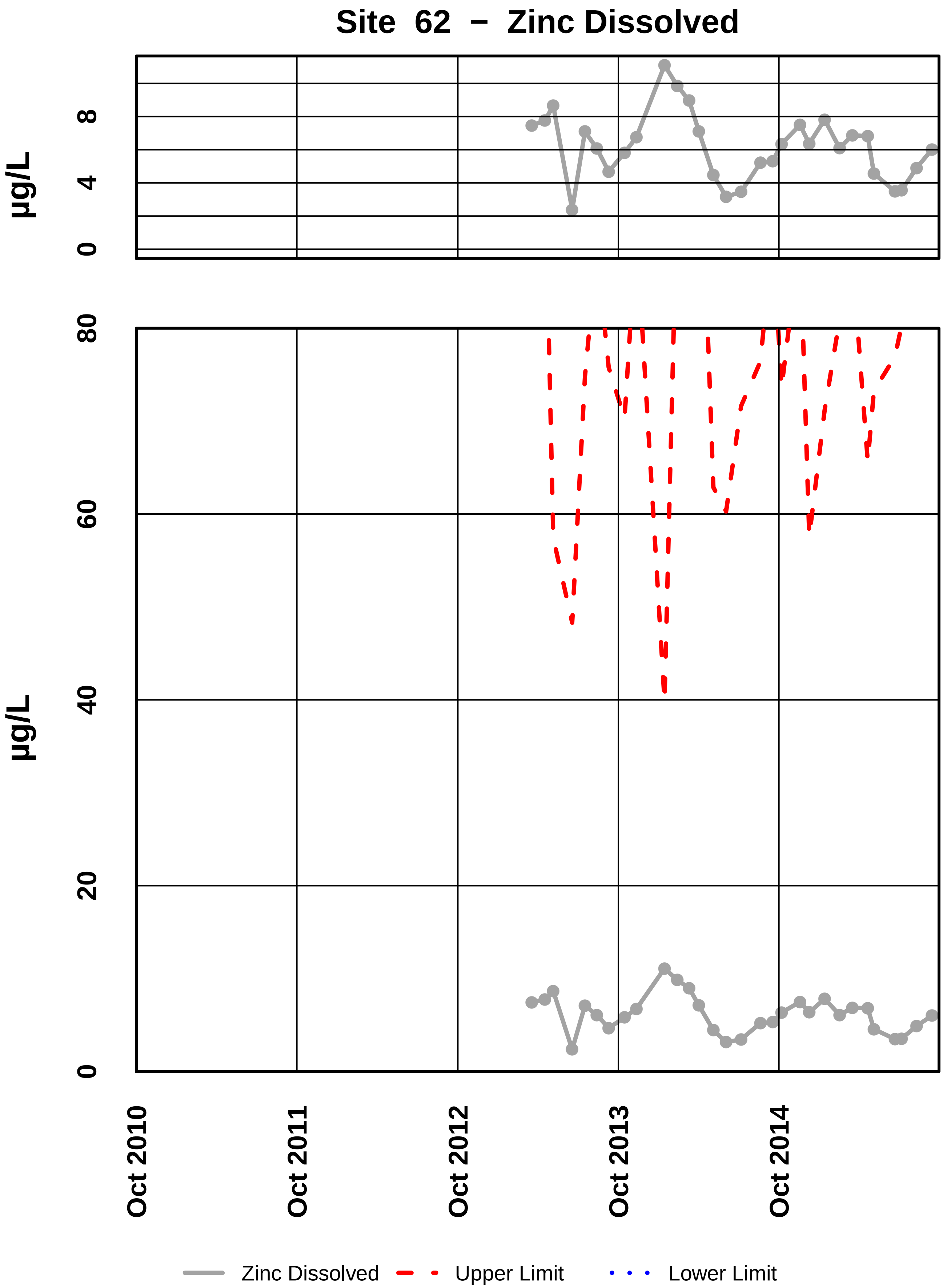
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



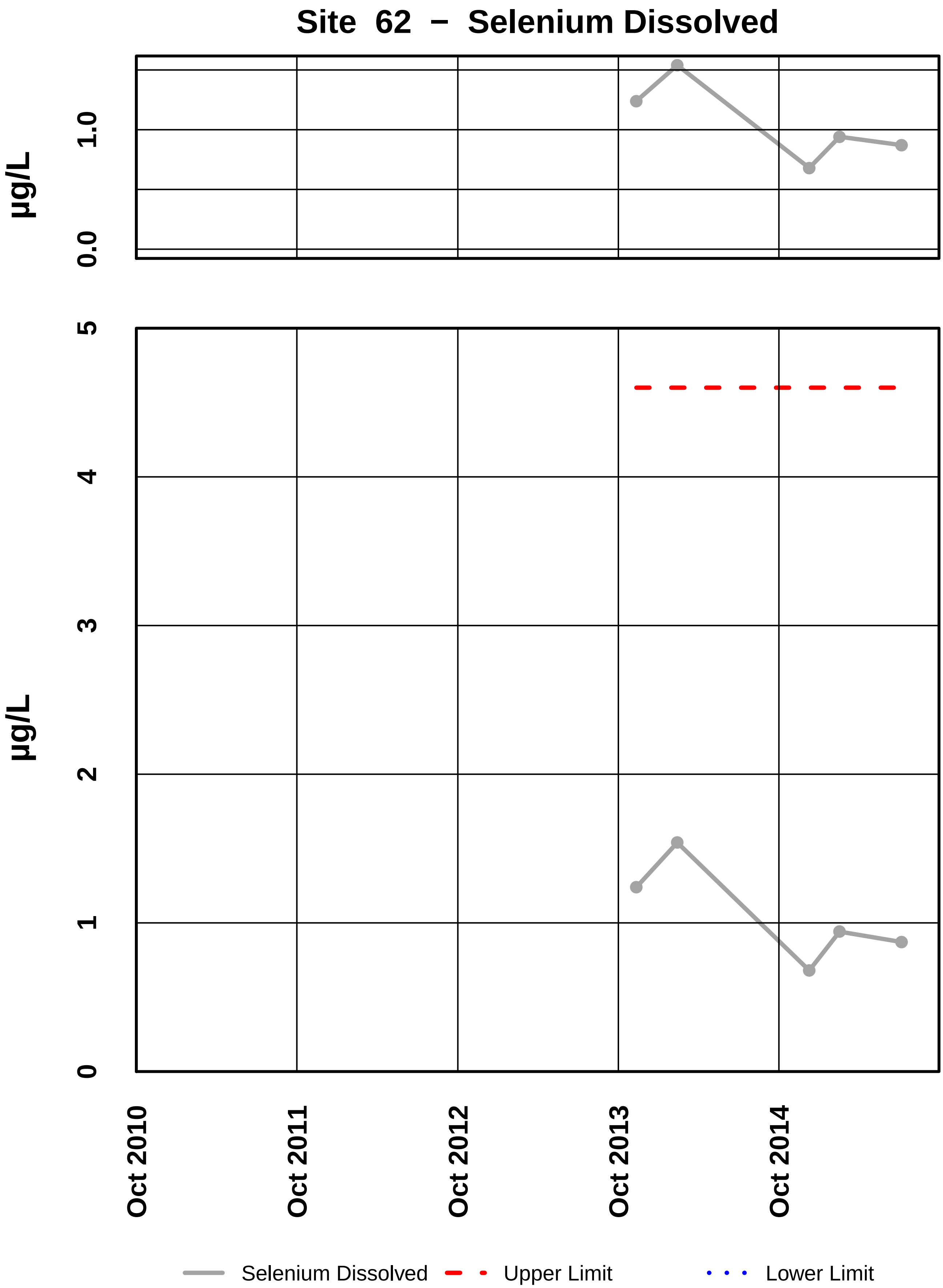
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

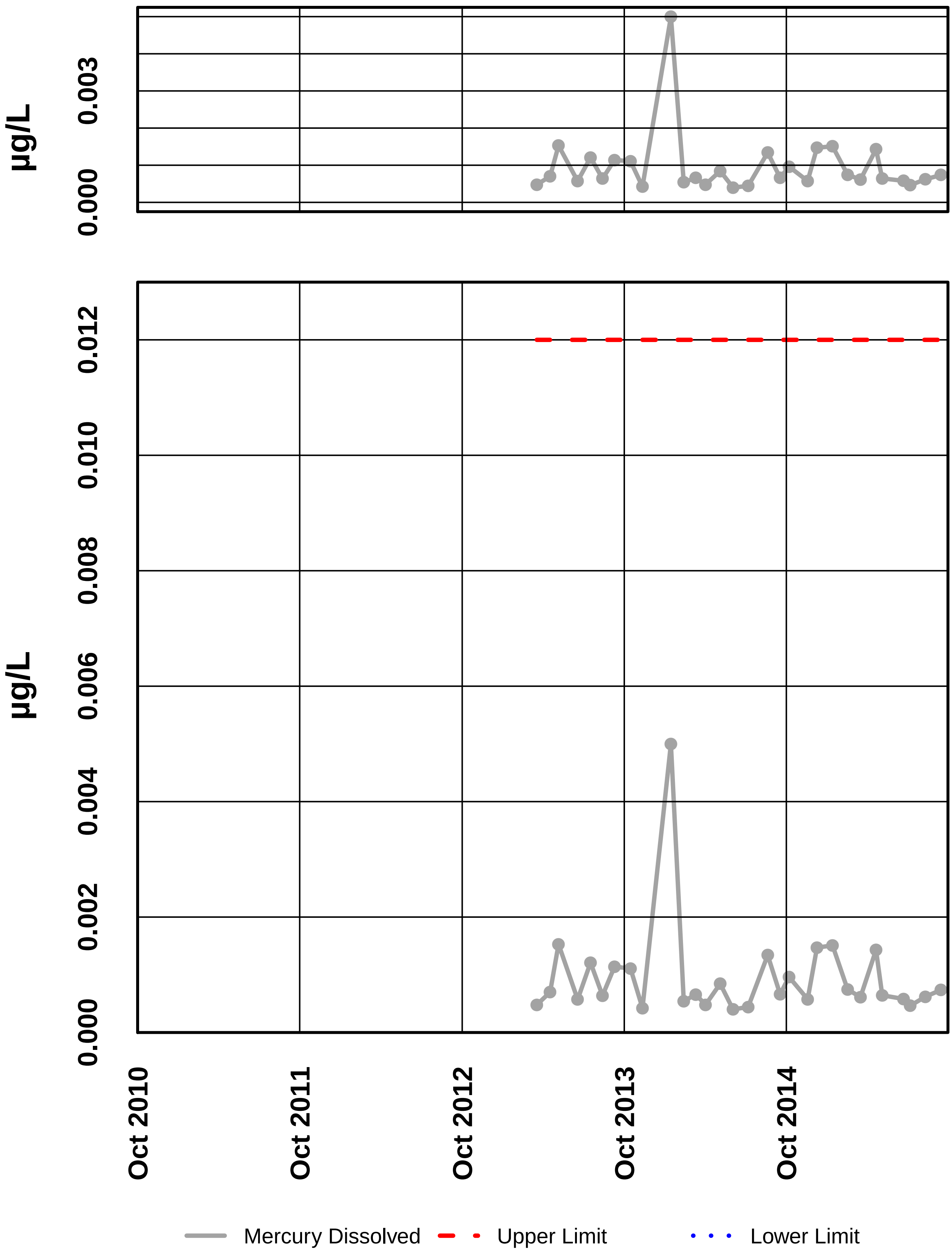


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

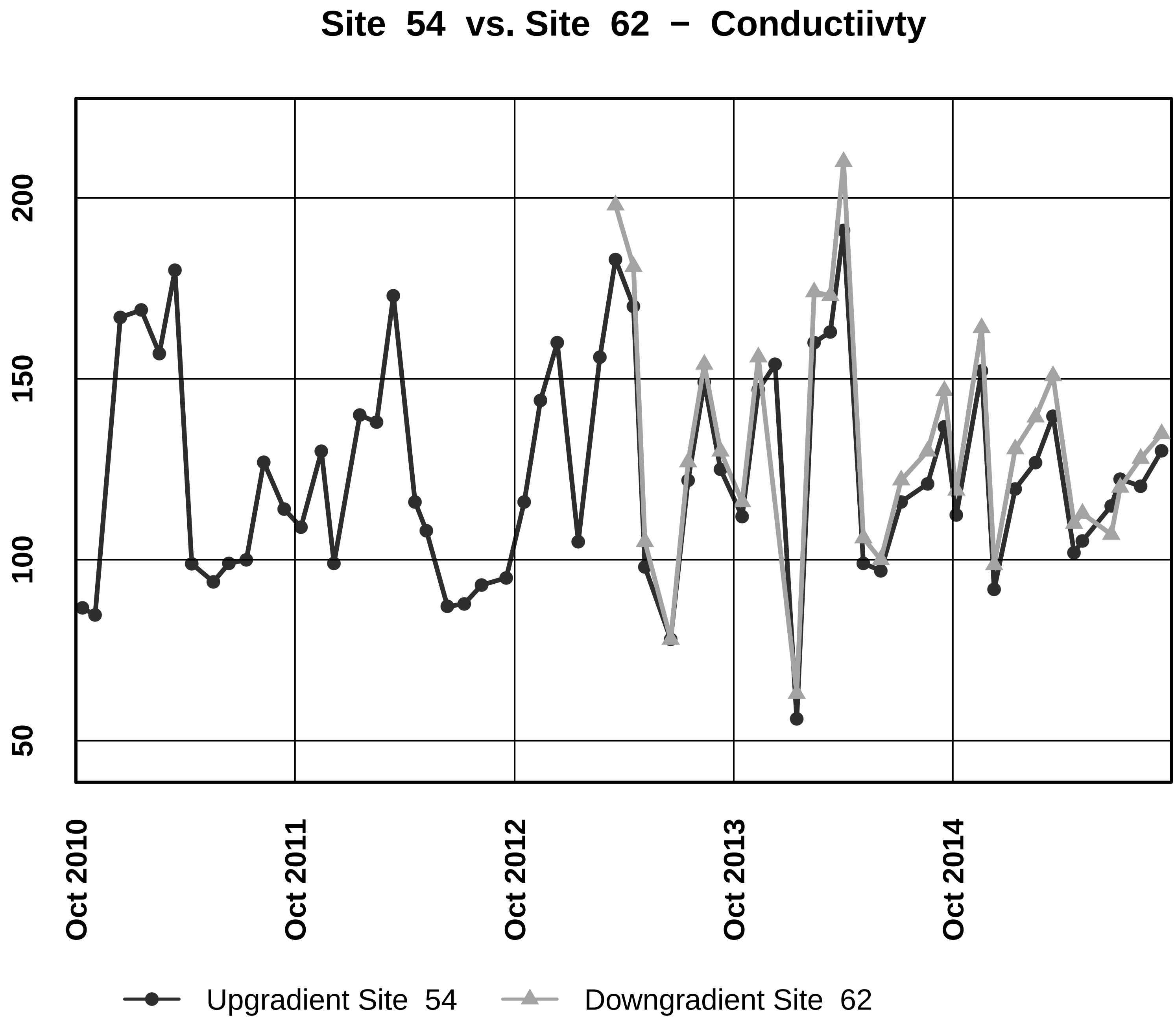


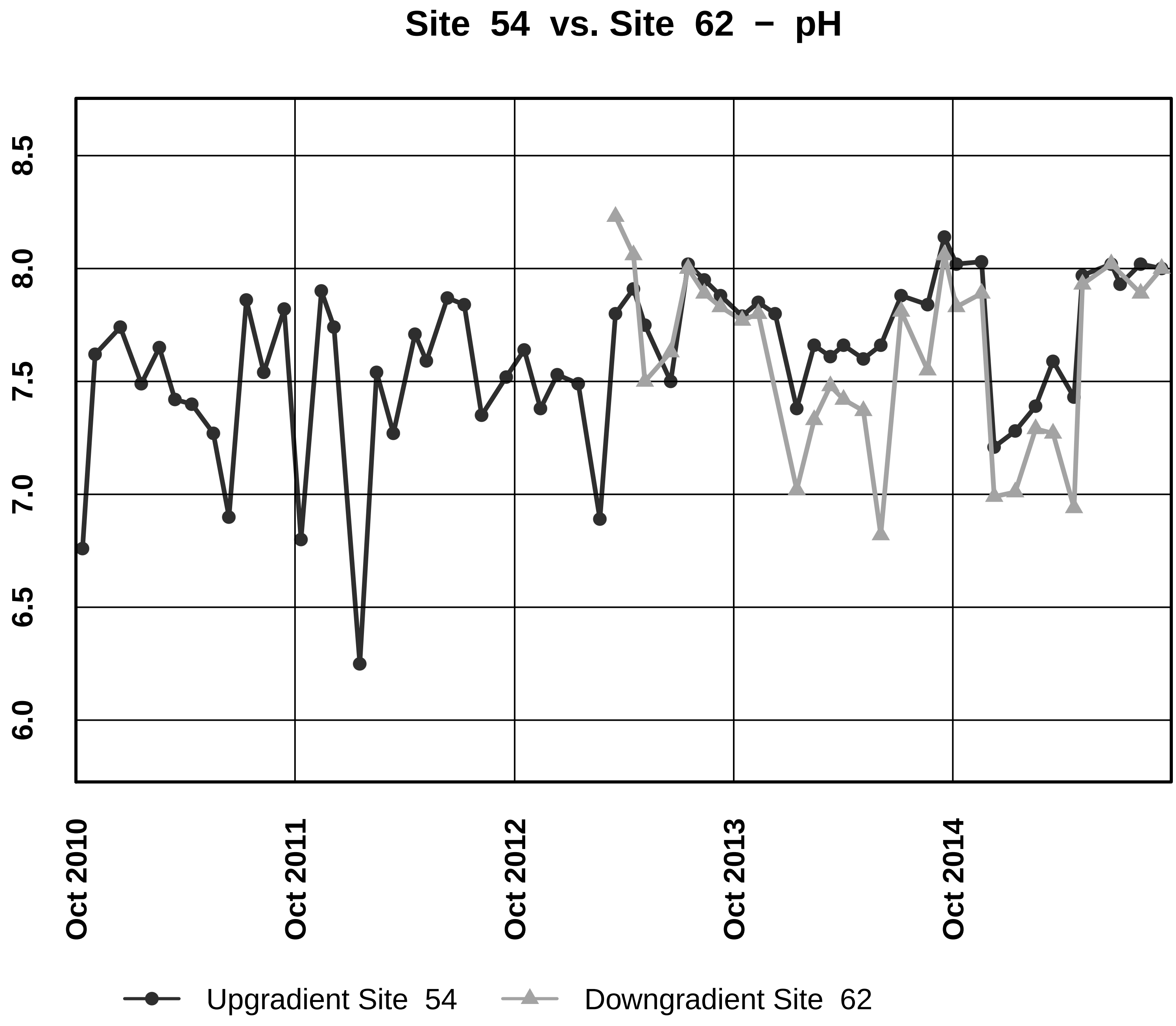
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 62 − Mercury Dissolved

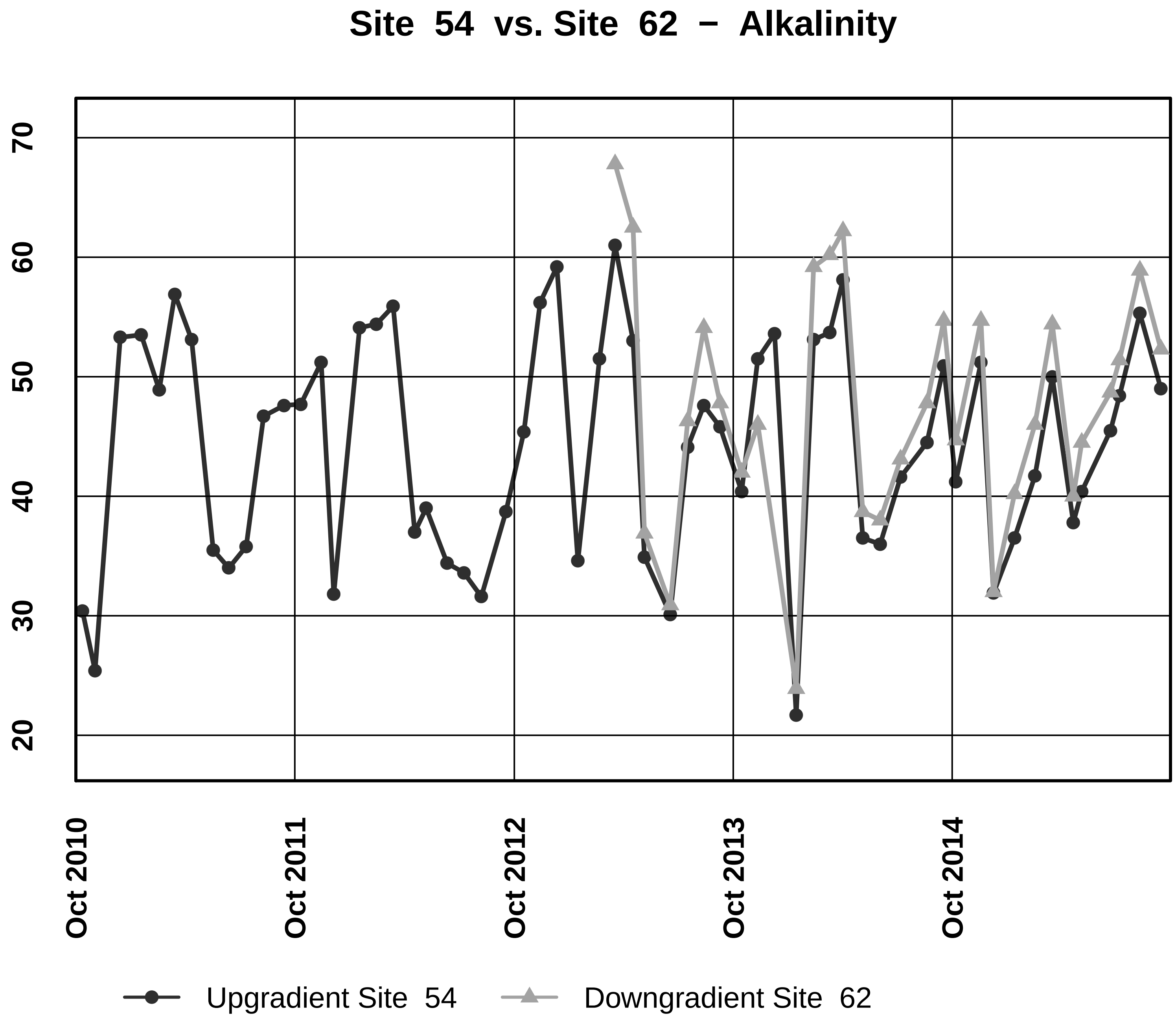


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis


Site 54 vs. Site 62 − Conductiivty
50
100
150
200
Oct 2010
Oct 2011
Oct 2012
Oct 2013
Oct 2014
Upgradient Site 54
Downgradient Site 62

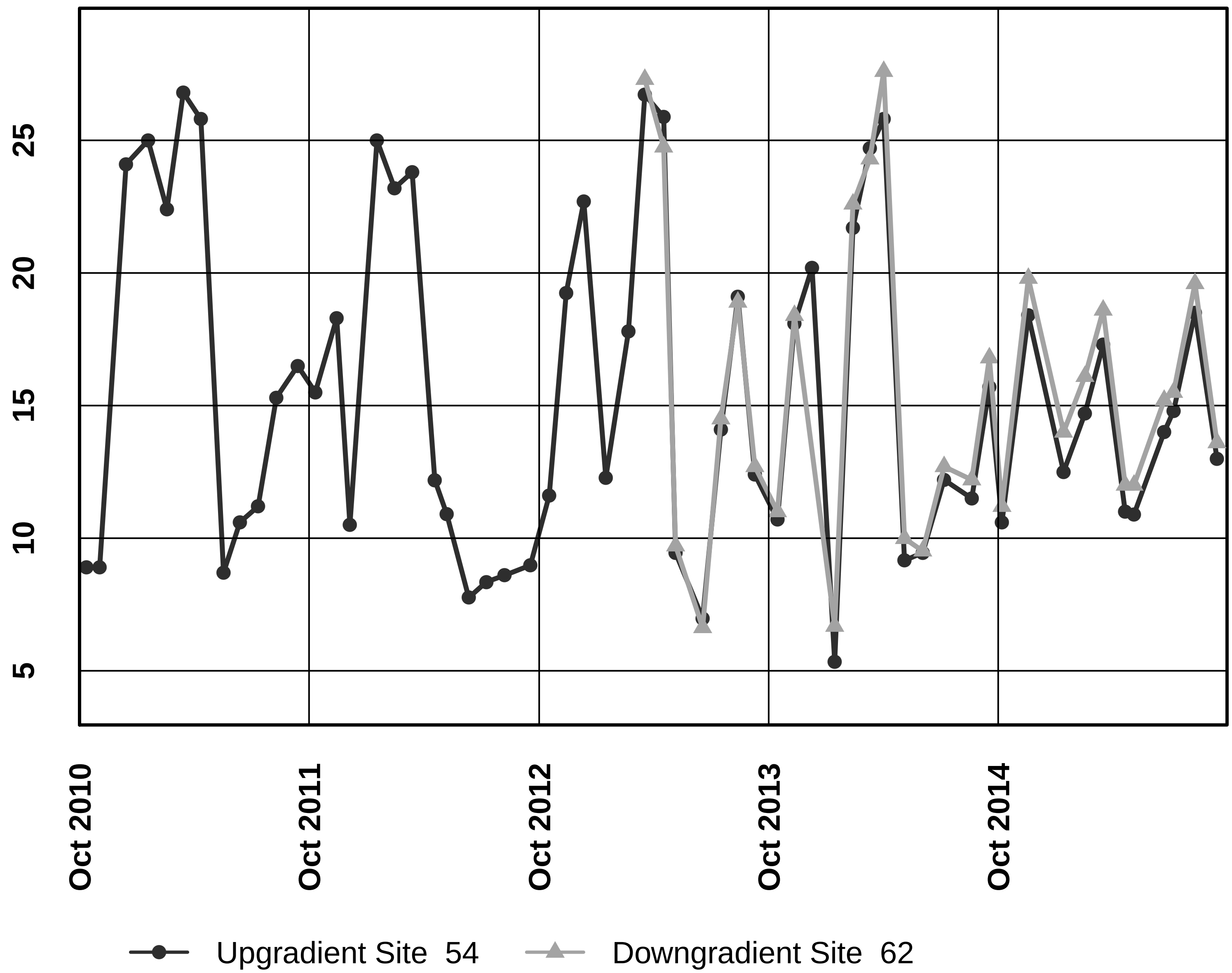


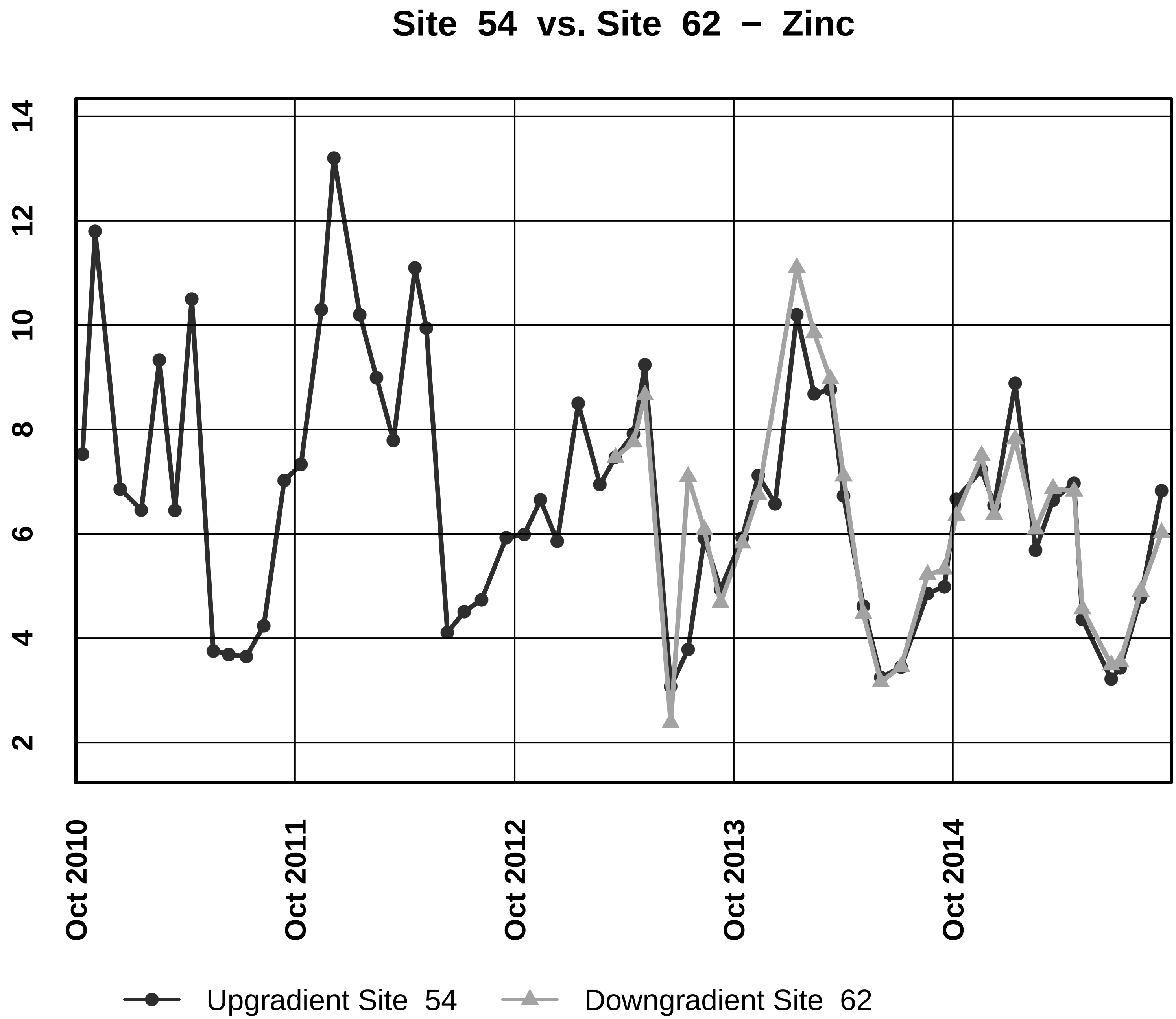
Site 54 vs. Site 62 − pH
8.5
8.0
7.5
7.0
6.5
6.0
Oct 2010
Oct 2011
Oct 2012
Oct 2013
Oct 2014
Upgradient Site 54
Downgradient Site 62



Site 54 vs. Site 62 − Alkalinity
70
60
50
40
30
20
Oct 2010
Oct 2011
Oct 2012
Oct 2013
Oct 2014
Upgradient Site 54
Downgradient Site 62

Site 54 vs. Site 62 − Sulfate




Site 54 vs. Site 62 − Zinc
2
4
6
8
10
12
14
Oct 2010
Oct 2011
Oct 2012
Oct 2013
Oct 2014
Upgradient Site 54
Downgradient Site 62

Wilcoxon-signed-ranks test

Exact Form

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

	X	**Y**			
Site	#54	#62	Differences		
Year	WY2015	WY2015	**D**	**|D|**	**Rank**
Oct	112.4	119.2	-6.8	6.8	-3.5
Nov	152.2	164.1	-11.9	11.9	-11
Dec	91.8	98.6	-6.8	6.8	-3.5
Jan	119.6	130.6	-11.0	11.0	-9
Feb	126.9	139.4	-12.5	12.5	-12
Mar	139.7	150.8	-11.1	11.1	-10
Apr	102.0	110.0	-8.0	8.0	-8
May	105.2	112.8	-7.6	7.6	-5
Jun	114.9	107.0	7.9	7.9	7
Jul	122.3	120.0	2.3	2.3	1
Aug	120.3	128.0	-7.7	7.7	-6
Sep	130.1	134.8	-4.7	4.7	-2
Median	120.0	124.0	-7.7	7.8	

n	**m**
12	12

N= 12

$\Sigma R =$ -62

α
0.05
W'$_{\alpha,n}$
17

$W^{+}=$
8
p-test
0.006

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

Wilcoxon-signed-ranks test
Exact Form

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

	X	Y	Differences		
Site	#54	#62			
Year	WY2015	WY2015	**D**	**|D|**	**Rank**
Oct	8.02	7.83	0.19	0.19	5
Nov	8.03	7.89	0.14	0.14	4
Dec	7.21	6.99	0.22	0.22	6
Jan	7.28	7.01	0.27	0.27	7
Feb	7.39	7.29	0.10	0.10	2
Mar	7.59	7.27	0.32	0.32	8
Apr	7.43	6.94	0.49	0.49	9
May	7.97	7.93	0.04	0.04	1
Jun	8.02	8.02	0.00		
Jul	7.93				
Aug	8.02	7.89	0.13	0.13	3
Sep	8.00	8.00	0.00		
Median	7.95	7.83	0.14	0.19	

n	m
11	9

N= 9
ΣR= 45

α
0.05
W'α,n
8

W^{+}=
0
p-test
0.002

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

Wilcoxon-signed-ranks test

Exact Form

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

	X	**Y**			
Site	#54	#62	Differences		
Year	WY2015	WY2015	**D**	**|D|**	**Rank**
Oct	41.2	44.7	-3.5	3.5	-6.5
Nov	51.2	54.7	-3.5	3.5	-6.5
Dec	31.9	32.0	-0.1	0.1	-1
Jan	36.5	40.2	-3.7	3.7	-9
Feb	41.7	46.0	-4.3	4.3	-11
Mar	50.0	54.4	-4.4	4.4	-12
Apr	37.8	40.0	-2.2	2.2	-2.00
May	40.4	44.5	-4.1	4.1	-10
Jun	45.5	48.7	-3.2	3.2	-4
Jul	48.4	51.4	-3.0	3.0	-3
Aug	55.3	58.9	-3.6	3.6	-8.00
Sep	49.0	52.3	-3.3	3.3	-5
Median	43.6	47.4	-3.5	3.5	

n	**m**
12	12

N= 12

$\Sigma R=$ -78

α
0.05
W'α,n
17

$W^{+}=$
0.00
p-test
0.000

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

Wilcoxon-signed-ranks test
Exact Form

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

	X	**Y**			
Site	#54	#62	Differences		
Year	WY2015	WY2015	**D**	**|D|**	**Rank**
Oct	10.6	11.2	-0.6	0.6	-1.5
Nov	18.4	19.8	-1.4	1.4	-10.5
Dec	9.5	10.3	-0.8	0.8	-4
Jan	12.5	14.0	-1.5	1.5	-12
Feb	14.7	16.1	-1.4	1.4	-10.5
Mar	17.3	18.6	-1.3	1.3	-9
Apr	11.0	12.0	-1.0	1.0	-5
May	10.9	12.0	-1.1	1.1	-6.5
Jun	14.0	15.2	-1.2	1.2	-8
Jul	14.8	15.5	-0.7	0.7	-3
Aug	18.5	19.6	-1.1	1.1	-6.5
Sep	13.0	13.6	-0.6	0.6	-1.5
Median	13.5	14.6	-1.1	1.1	

n	**m**
12	12

N= 12
ΣR= -78

α
0.05
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: **Zinc, Dissolved (ug/l)**

	X	Y			
Site	#54	#62	Differences		
Year	WY2015	WY2015	D	|D|	Rank
Oct	6.67	6.35	0.32	0.32	9
Nov	7.23	7.50	-0.27	0.27	-7.5
Dec	6.55	6.37	0.18	0.18	4
Jan	8.89	7.82	1.07	1.07	12
Feb	5.69	6.09	-0.40	0.40	-10
Mar	6.65	6.87	-0.22	0.22	-6
Apr	6.97	6.82	0.15	0.15	3
May	4.36	4.56	-0.20	0.20	-5
Jun	3.22	3.49	-0.27	0.27	-7.5
Jul	3.43	3.55	-0.12	0.12	-1.5
Aug	4.78	4.90	-0.12	0.12	-1.5
Sep	6.83	6.02	0.81	0.81	11
Median	6.60	6.22	-0.12	0.25	

n	m
12	12

N= 12
ΣR= 0

α
0.05
W'α,n
17

W^{+}=
39
p-test
0.515

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

INTERPRETIVE REPORT
SITE 61

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

The data collected during the current water year are listed in the following “Table of Results for Water Year 2015” report. The table includes all the required FWMP analyte data (field and laboratory) collected for the current water year and a series of flags keyed to the summary report “Qualified Data by QA Reviewer”. The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of ½ MDL for the purpose of median calculation.

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

Sample Date	Parameter	Value	Qualifier	Notes
No outliers have been identified by HGCMC for the period of October 2012 through September 2015.				

The data 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 2015

			Limits		
Sample Date	Parameter	Value	Lower	Upper	Hardness
No exceedances have been identified by HGCMC for the period of October 2014 through September 2015.					

As a result of the monitoring and reporting for Water Year 2013, HGCMC increased the sample frequency to monthly for Site 61. The first sample collected at Site 61 (6 May 2013) was in exceedance for cadmium, mercury, selenium, and zinc. Since that sampling there have been no other water quality exceedances. HGCMC returned to sampling Site 61 on a quarterly basis after the August 2015 sampling event.

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

Table of Results for Water Year 2015

Site 061FMS - 'Greens Creek Floodplain'

Sample Date/Parameter	Oct 2014	Nov 2014	Dec 2014	Jan 2015	Feb 2015	Mar 2015	Apr 2015	May 2015	Jun 2015	Jul 2015	Aug 2015	Sep 2015	**Median**
Water Temp (°C)	6.5	4.5	3.4	2.9	3.6	3.3	5.1	5.2	9.9	7.7	7.3		5.1
Conductivity-Field(μmho)	545	347	558	562	464	548	537	548	484	389	361		537.0
Conductivity-Lab (μmho)	499	484	513	509	447	503	532	521	478	361	359		499
pH Lab (standard units)	7.48	7.48	7.39	7.34	7.43	7.51	7.29	7.43	7.58	7.61	7.5		7.48
pH Field (standard units)	7.69	7.69	7.3	7.2	7.43	7.51	7.04	7.78	7.66	7.61	7.54		7.54
Total Alkalinity (mg/L)	113	119	109	106	109	119	121	126	115	120	111		115.0
Total Sulfate (mg/L)	124	120	136	140	94.1	123	147	129	109	59.1	69.5		123.0
Hardness (mg/L)	256	242	250	263	223	254	273	280	237	188	186		250.0
Dissolved As (ug/L)	0.218	0.175	0.191	0.172	0.176	0.185	0.183	0.18	0.23	0.23	0.248		0.185
Dissolved Ba (ug/L)		46.3	45.8	48.1	42.5	46.1	49	45.9	58	47.1	47.9		46.7
Dissolved Cd (ug/L)	0.411	0.312	0.368	0.417	0.314	0.338	0.419	0.309	0.266	0.283	0.331		0.3310
Dissolved Cr (ug/L)		0.359	0.222	0.394	0.493	0.672	0.484	0.607	0.753	0.572	0.576		0.533
Dissolved Cu (ug/L)	0.336	0.418	0.343	0.445	0.339	0.34	0.48	0.382	0.438	0.307	0.422		0.382
Dissolved Pb (ug/L)	0.0171	0.0138	0.0195	0.022	0.0151	0.0121	0.0208	0.0106	0.0125	0.0131	0.0238		0.0151
Dissolved Ni (ug/L)		1.86	2.32	2.52	1.81	2.17	2.66	1.86	1.68	1.44	1.89		1.875
Dissolved Ag (ug/L)		0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002		0.002
Dissolved Zn (ug/L)	143	89.1	108	123	86.2	98.2	120	80.1	51.4	58.7	86.9		89.10
Dissolved Se (ug/L)		1.39	1.78	1.79	1.43	1.8	1.73	1.53	1.3	0.79	0.82		1.480
Dissolved Hg (ug/L)	0.000317	0.000154	0.000213	0.000465	0.000218	0.000162	0.000289	0.000185	0.000288	0.000147	0.00018		0.000213

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

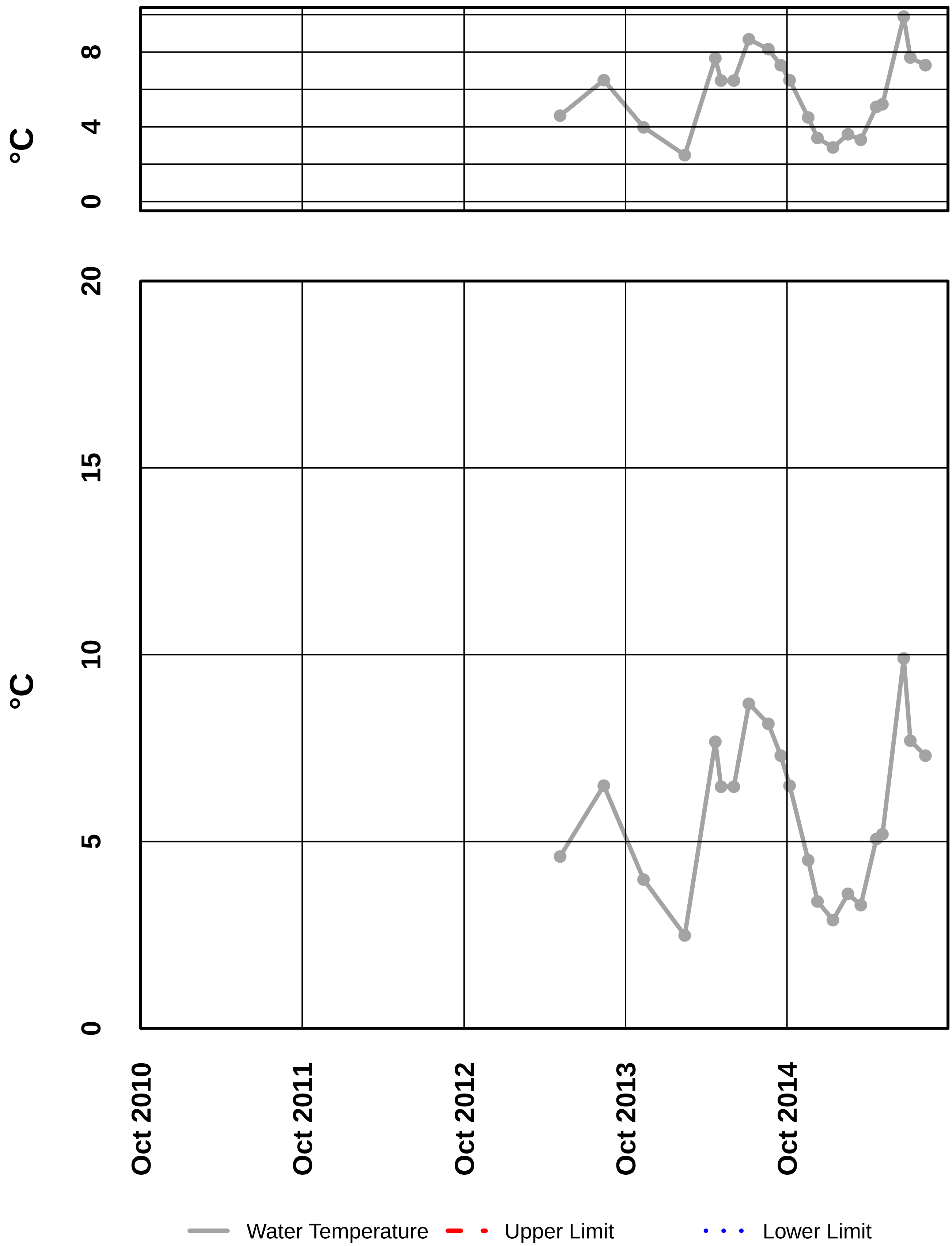
Qualified Data by QA Reviewer

Date Range: 10/01/2014 to 09/30/2015

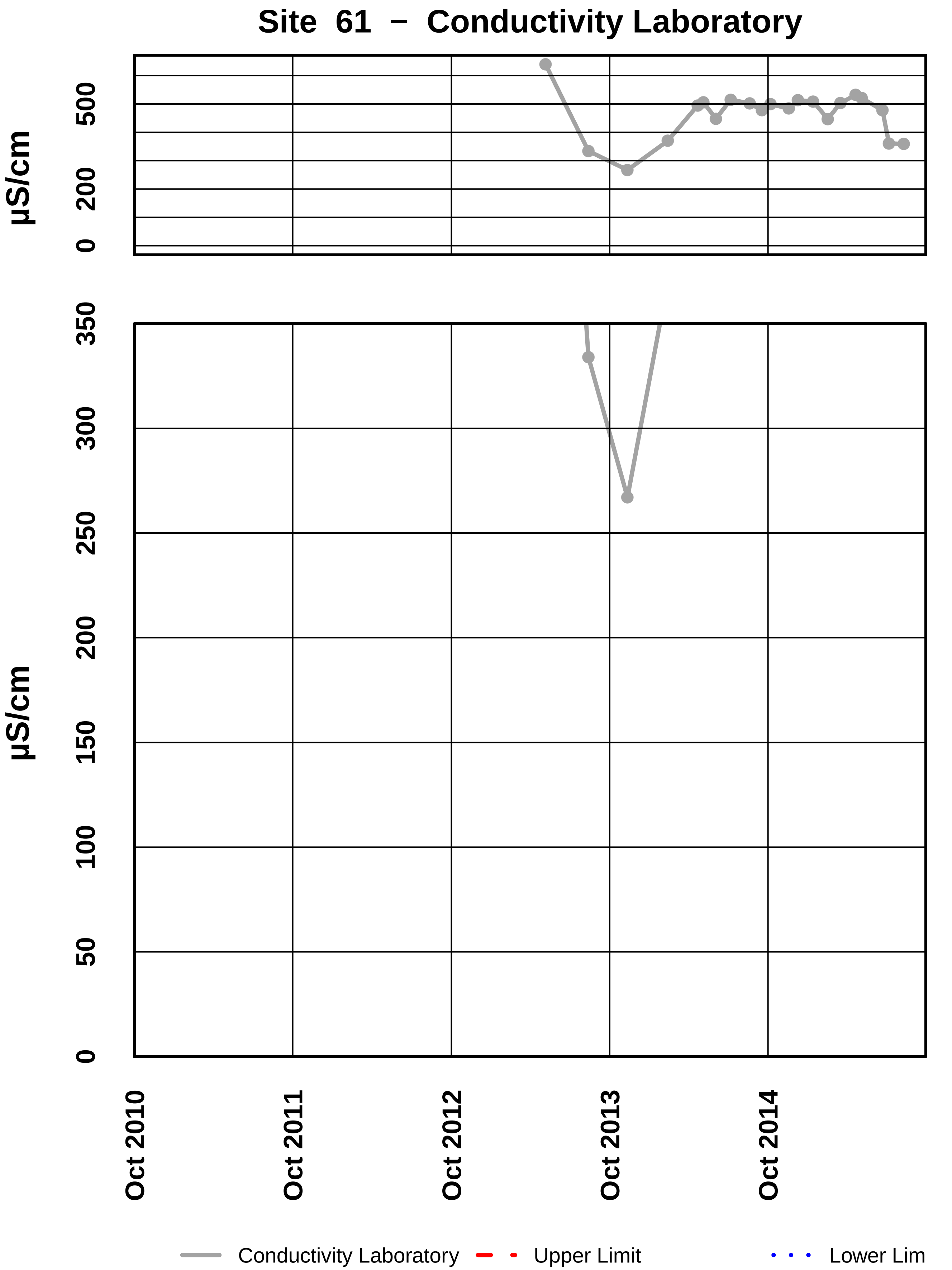
Site No.	Sample Date	Sample Time	Parameter	Value		Qualifier	Reason for Qualifier
061FMS	10/07/2014	12:00 AM	Diss. Pb-ICP/MS	0.01	µg/L	U	Field Blank Contamination
			pH	7.48	pH units	J	Hold Time Violation
061FMS	11/18/2014	12:00 AM	Diss. Hg-CVAF	0.000154	µg/L	J	Below Quantitative Range
061FMS	12/09/2014	12:00 AM	Diss. Hg-CVAF	0.000213	µg/L	J	Below Quantitative Range
061FMS	01/13/2015	12:00 AM	Diss. Hg-CVAF	0.000465	µg/L	U	Field Blank Contamination
061FMS	02/16/2015	12:00 AM	Diss. Hg-CVAF	0.000218	µg/L	J	Below Quantitative Range
			pH	7.29	pH units	J	Hold Time Violation
061FMS	03/17/2015	12:00 AM	Diss. Hg-CVAF	0.000162	µg/L	J	Below Quantitative Range
061FMS	04/21/2015	12:00 AM	Diss. Hg-CVAF	0.000289	µg/L	J	Below Quantitative Range
061FMS	05/05/2015	12:00 AM	Diss. Hg-CVAF	0.000185	µg/L	J	Below Quantitative Range
			Sulfate	129	mg/L	J	Sample Receipt Temperature
061FMS	06/22/2015	12:00 AM	Diss. Hg-CVAF	0.000288	µg/L	J	Below Quantitative Range
061FMS	07/07/2015	12:00 AM	Diss. Hg-CVAF	0.000147	µg/L	J	Below Quantitative Range
061FMS	08/10/2015	12:00 AM	Diss. Hg-CVAF	0.00018	µg/L	J	Below Quantitative Range
			Sulfate	69.5	mg/L	J	Sample Receipt Temperature

Qualifier	Description
J	Positively Identified - Approximate Concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit

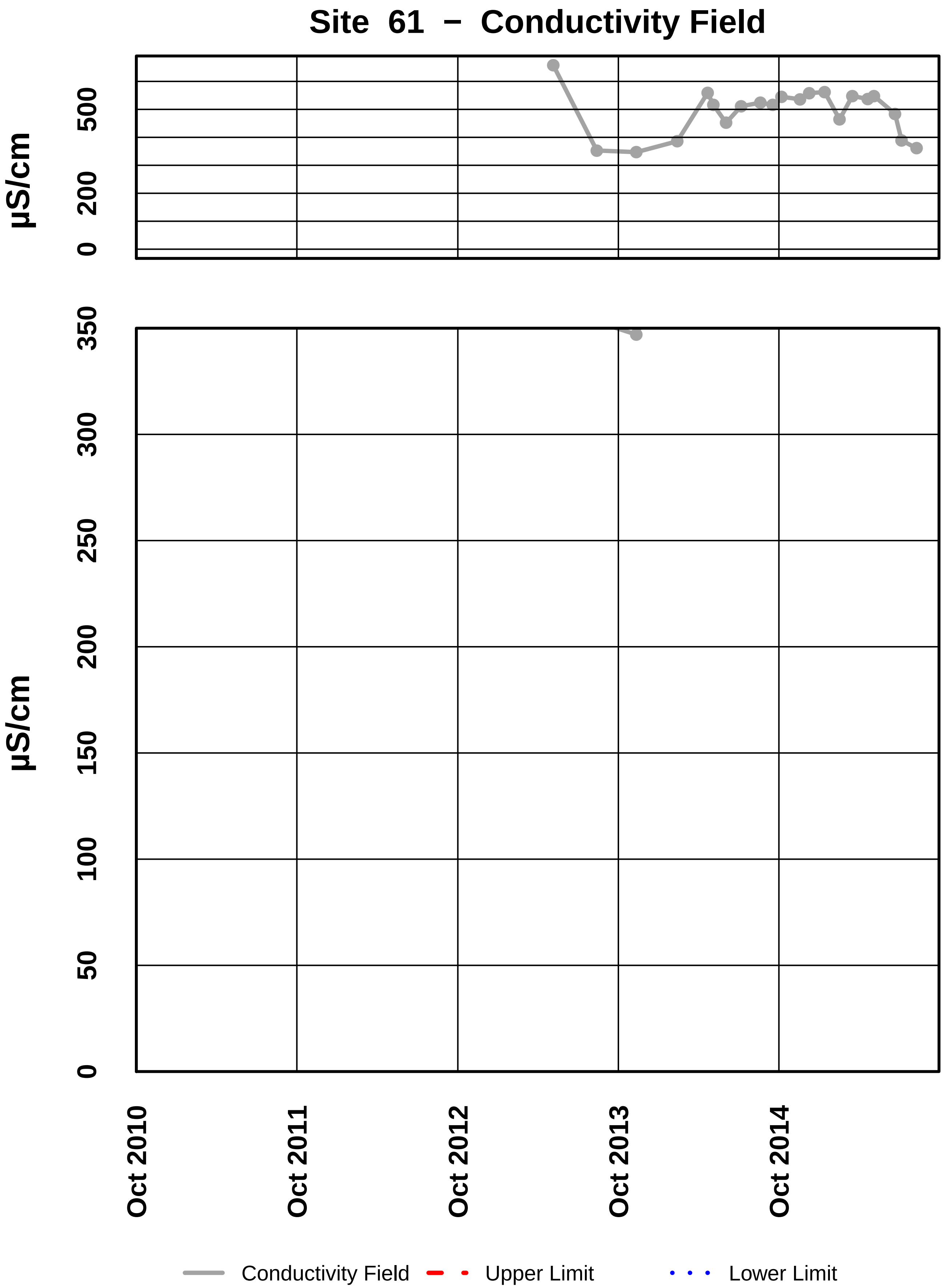
Site 61 – Water Temperature



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

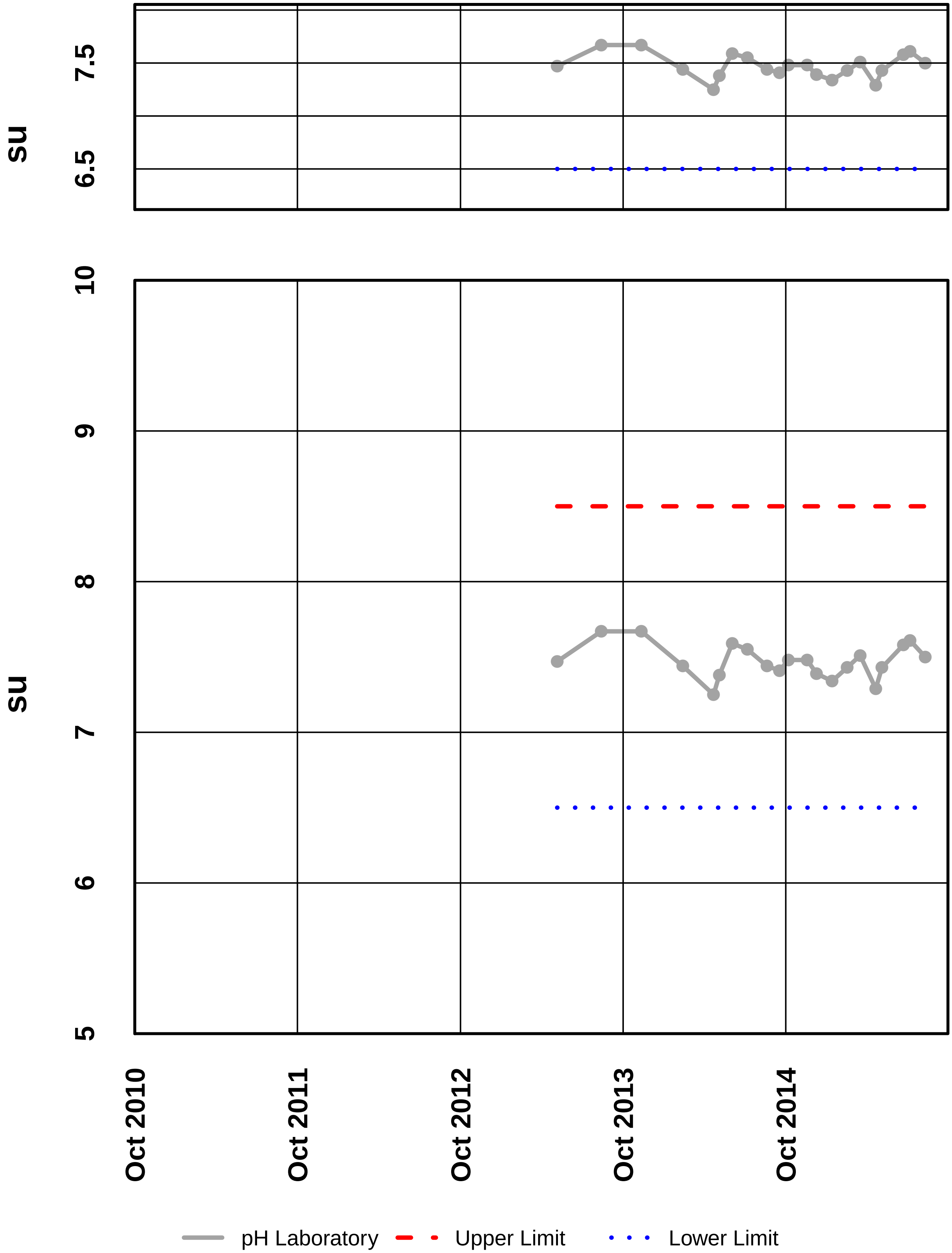


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

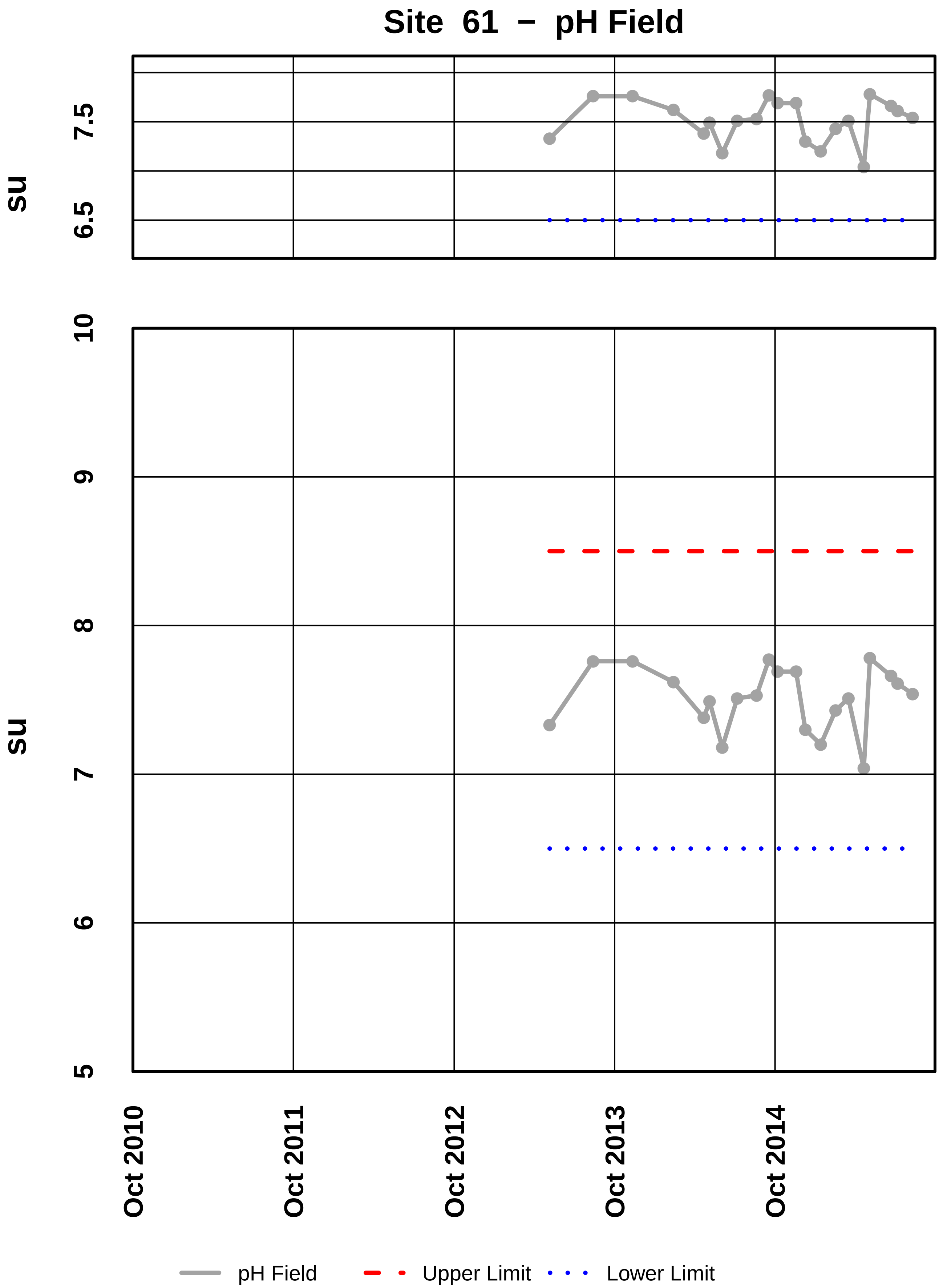


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

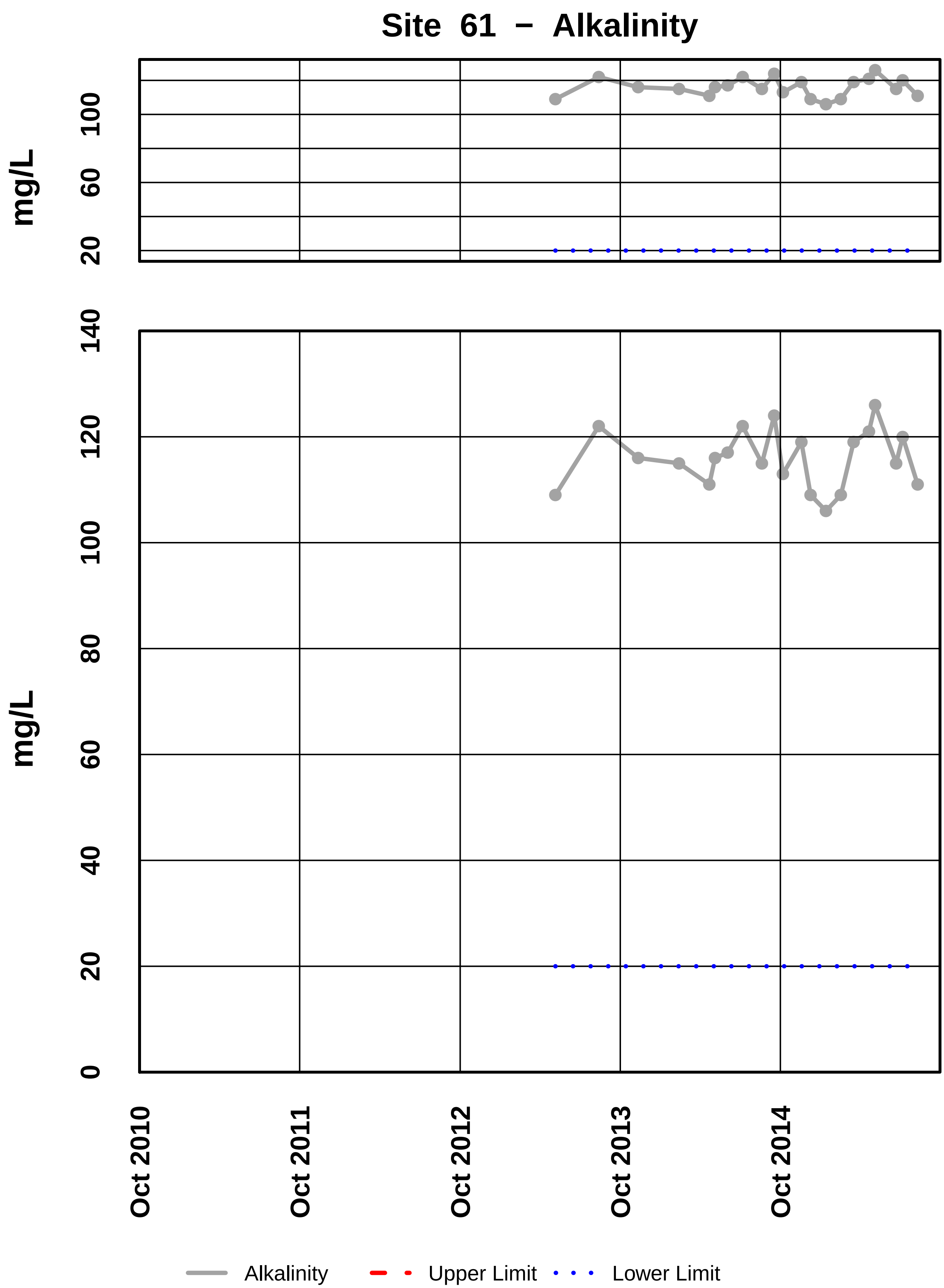
Site 61 – pH Laboratory



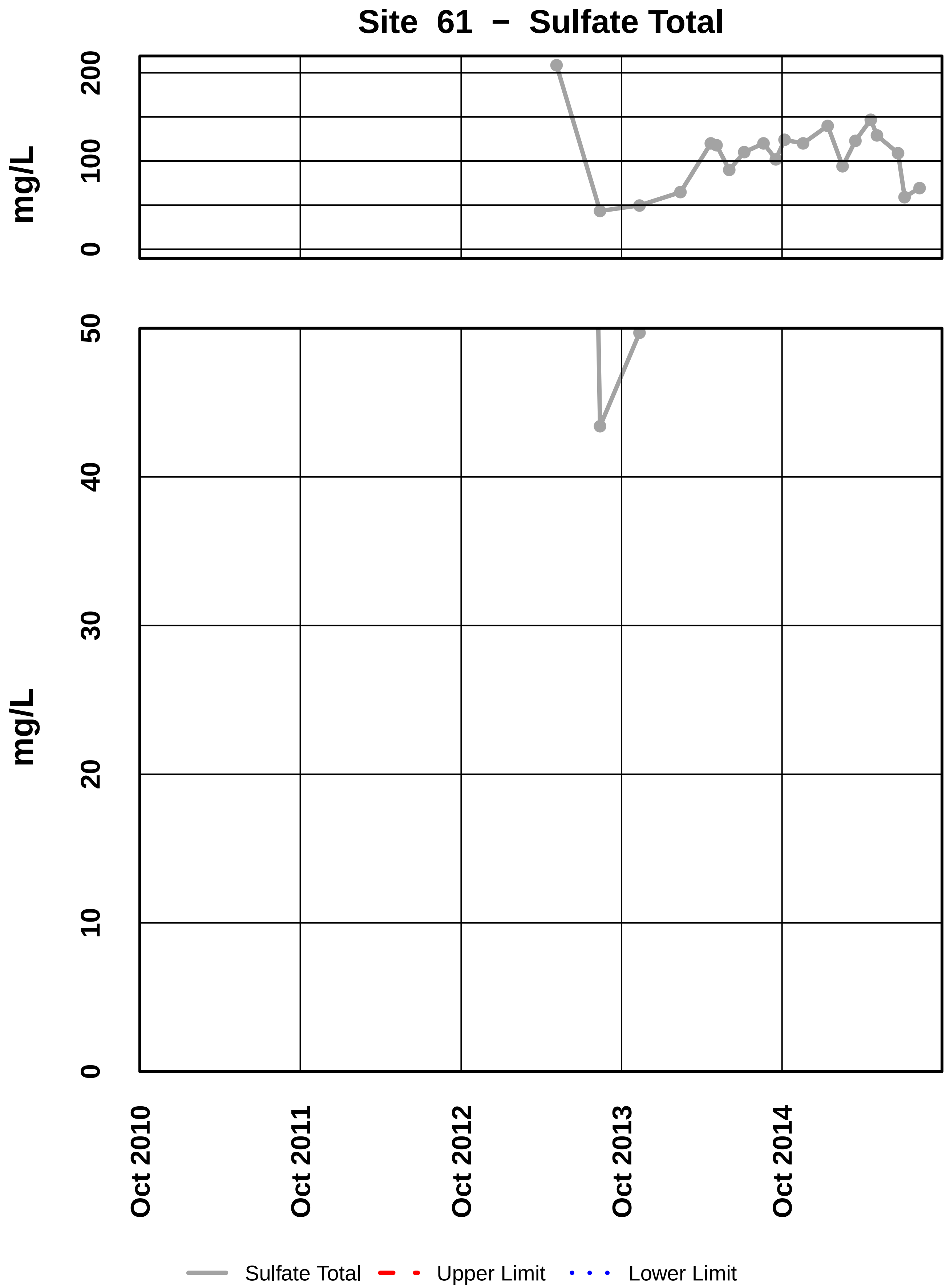
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

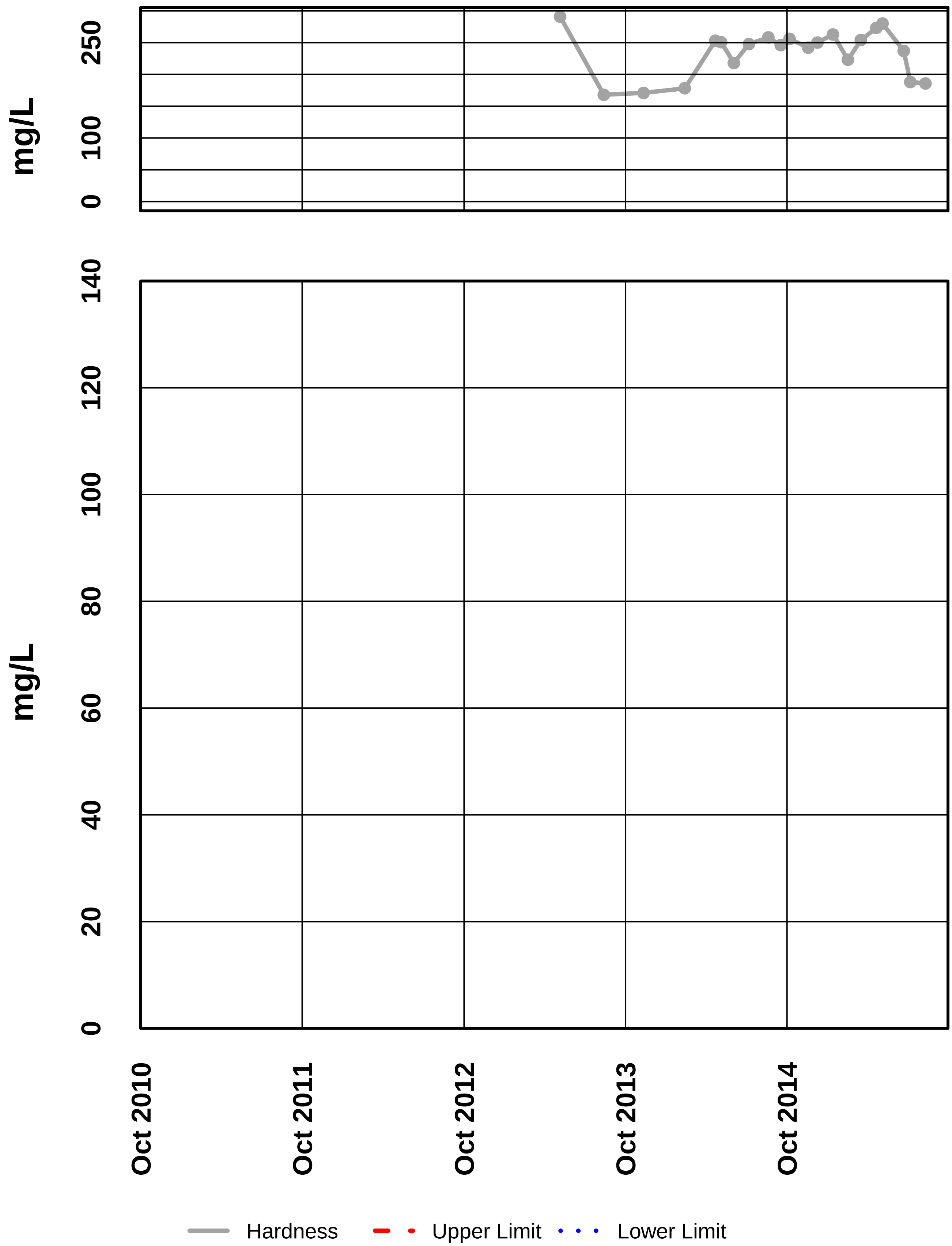


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



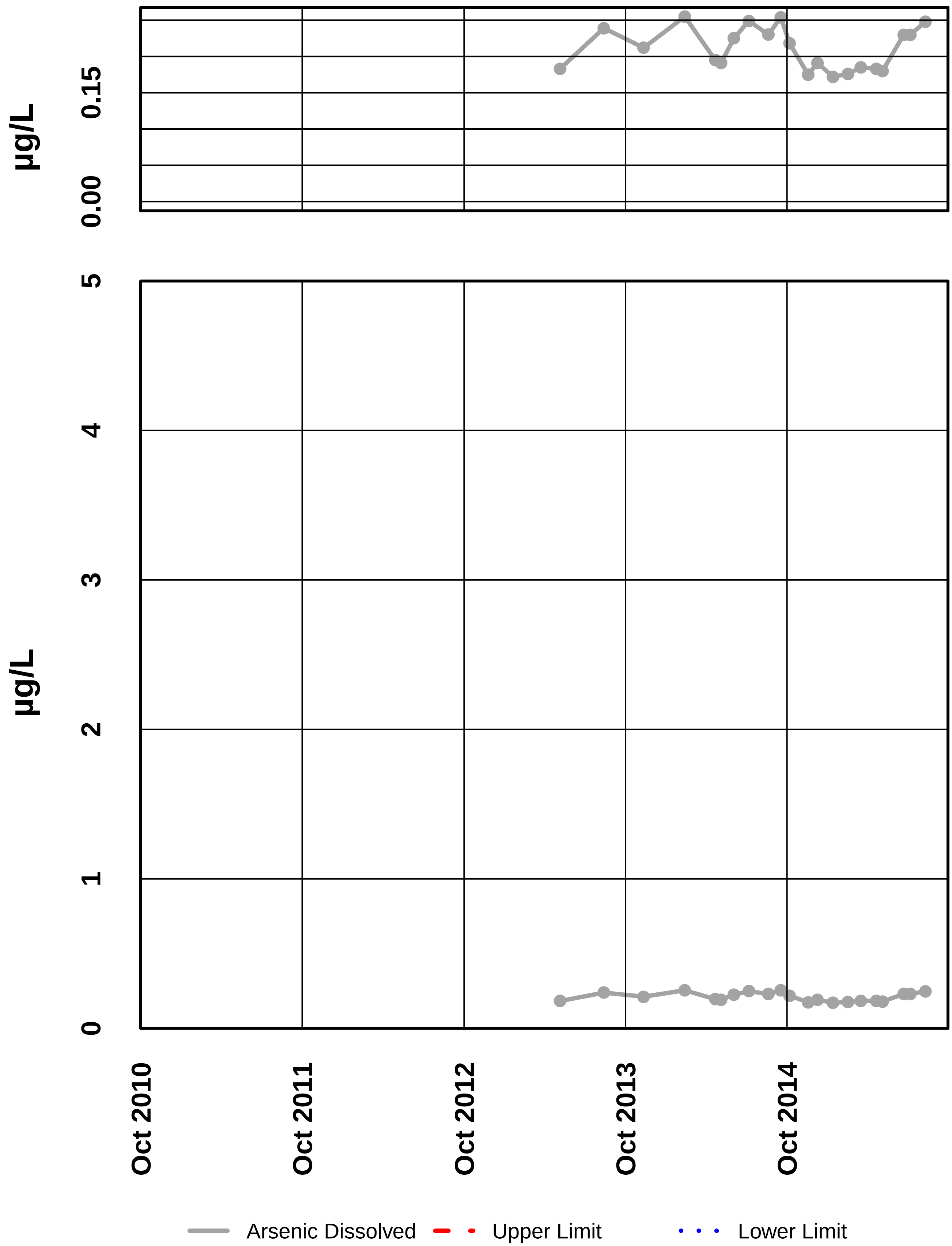
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 61 − Hardness



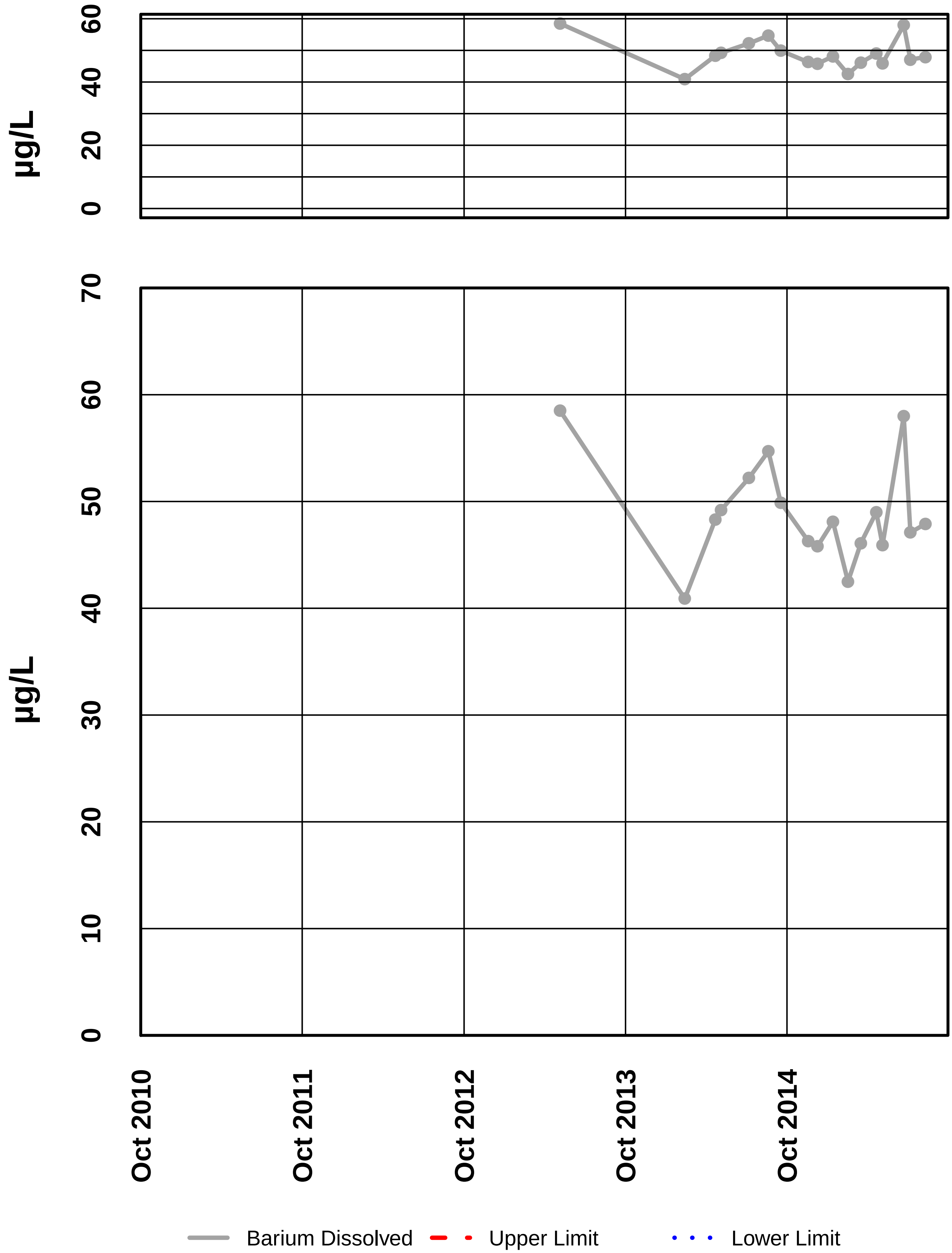
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 61 – Arsenic Dissolved



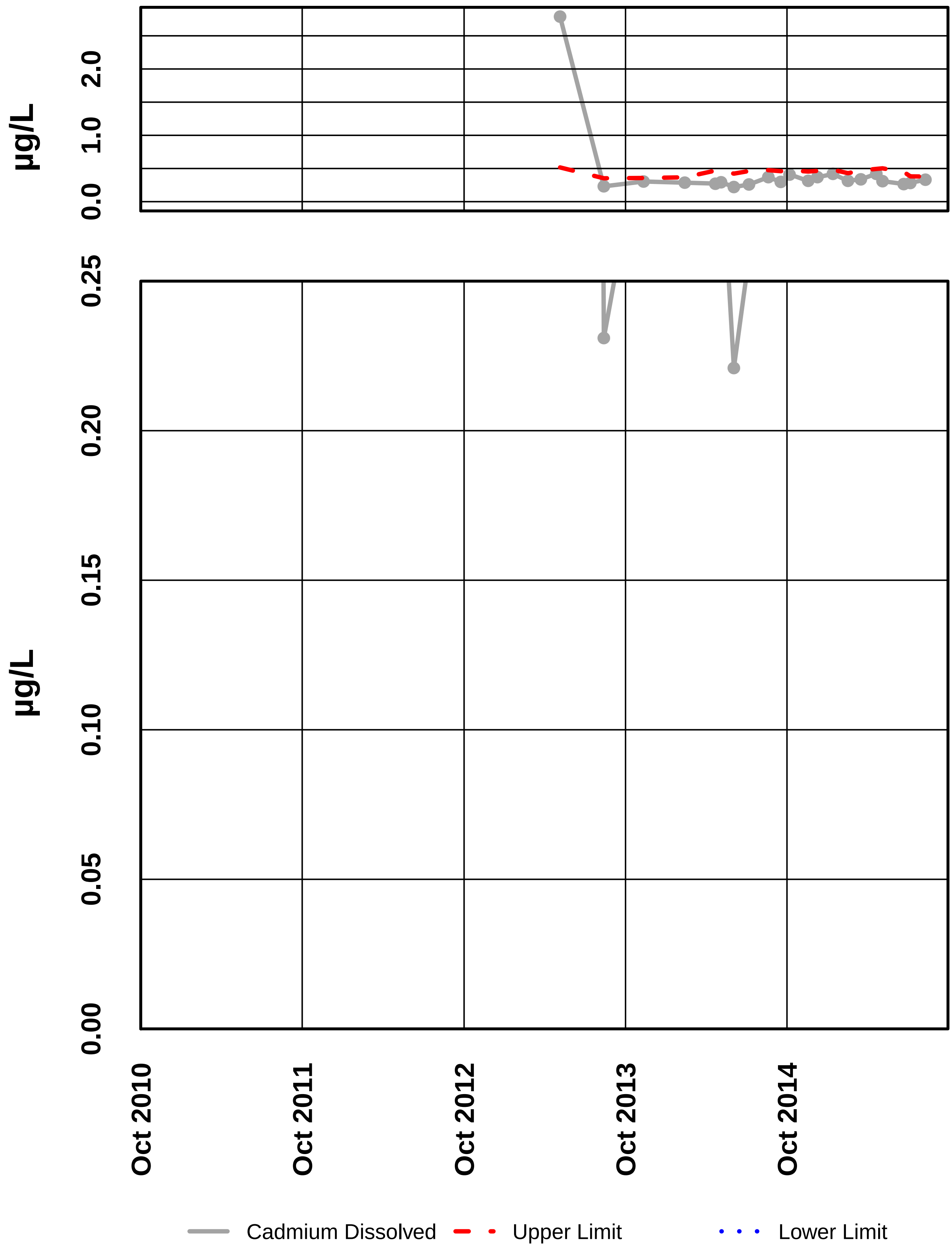
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 61 – Barium Dissolved



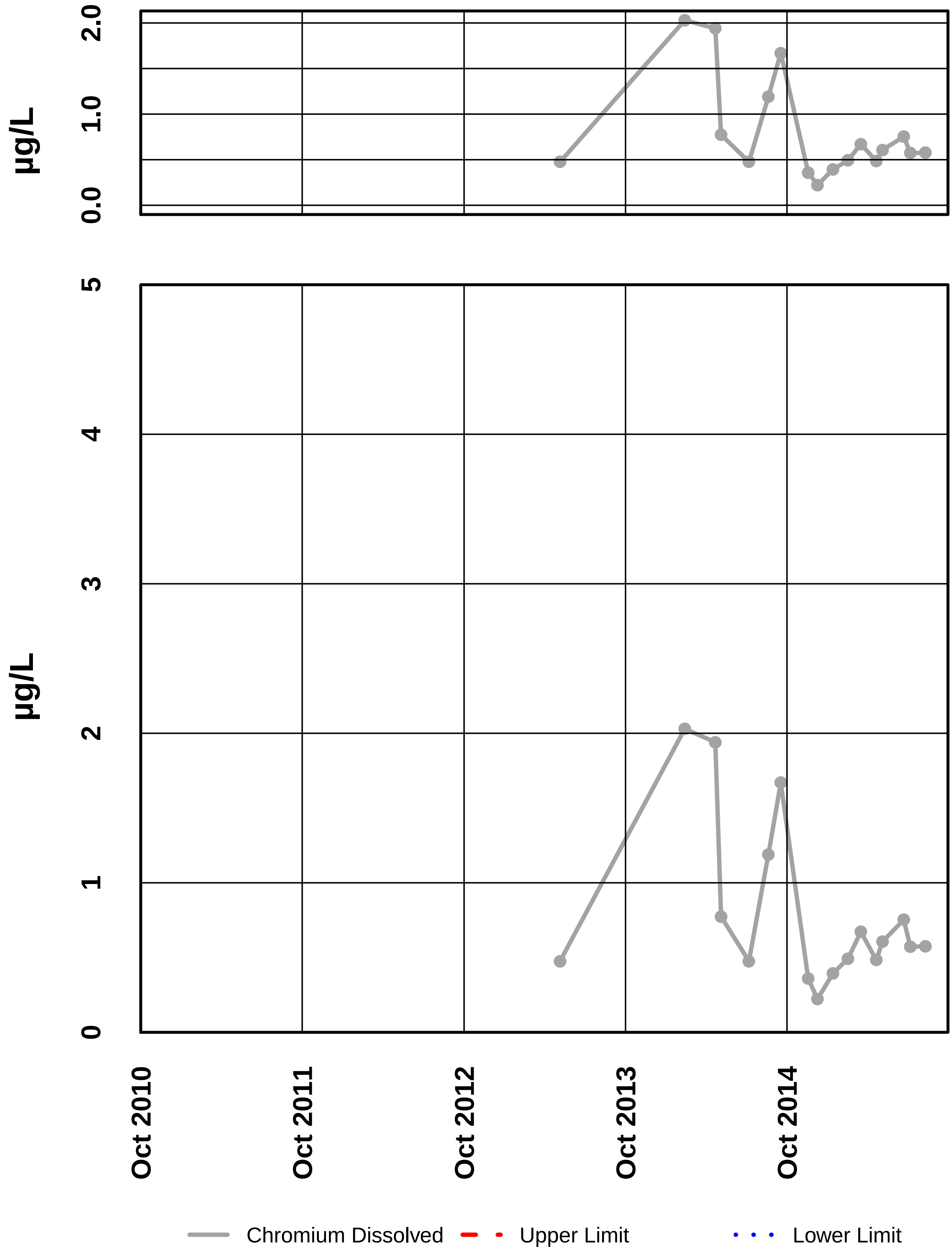
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 61 – Cadmium Dissolved



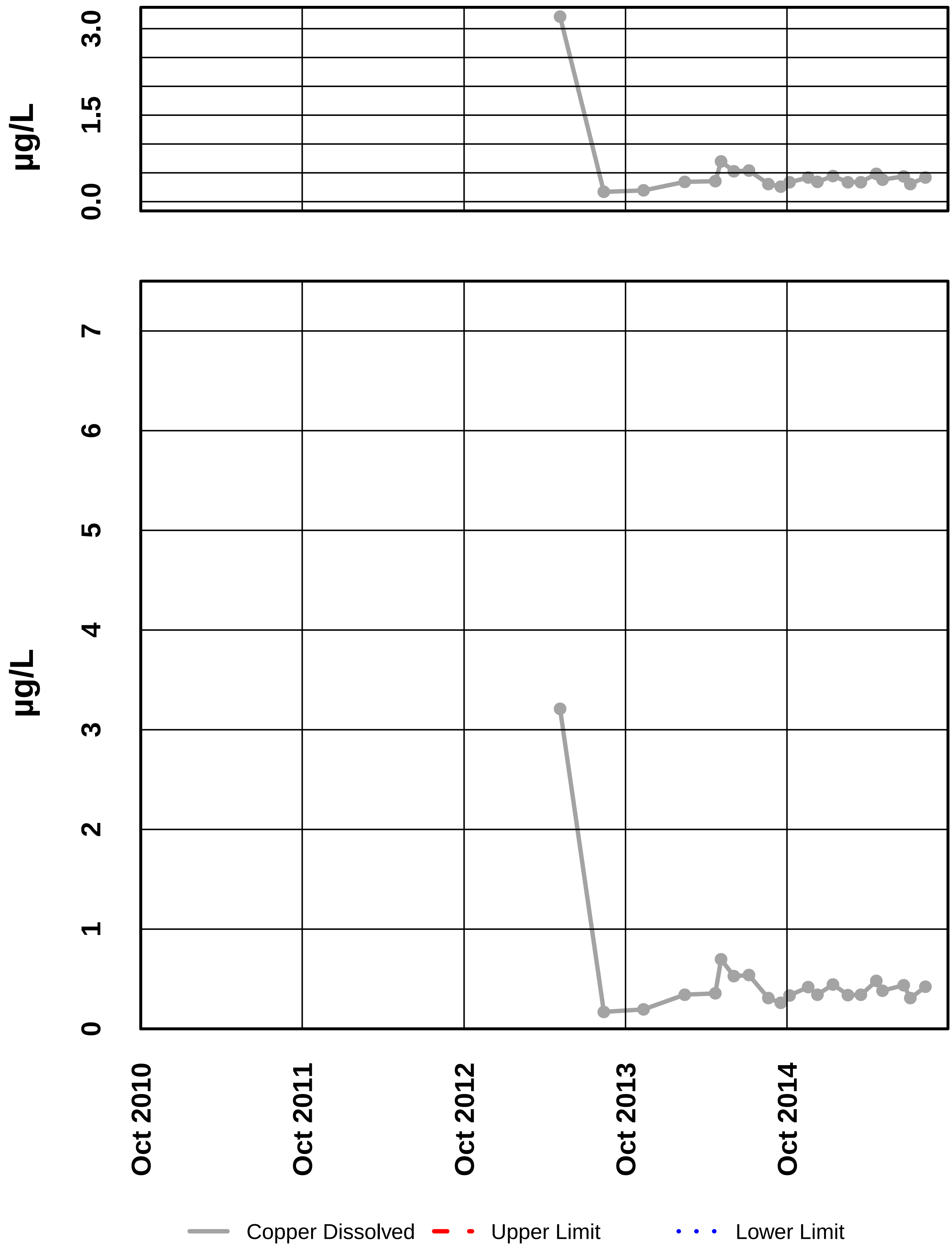
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 61 – Chromium Dissolved

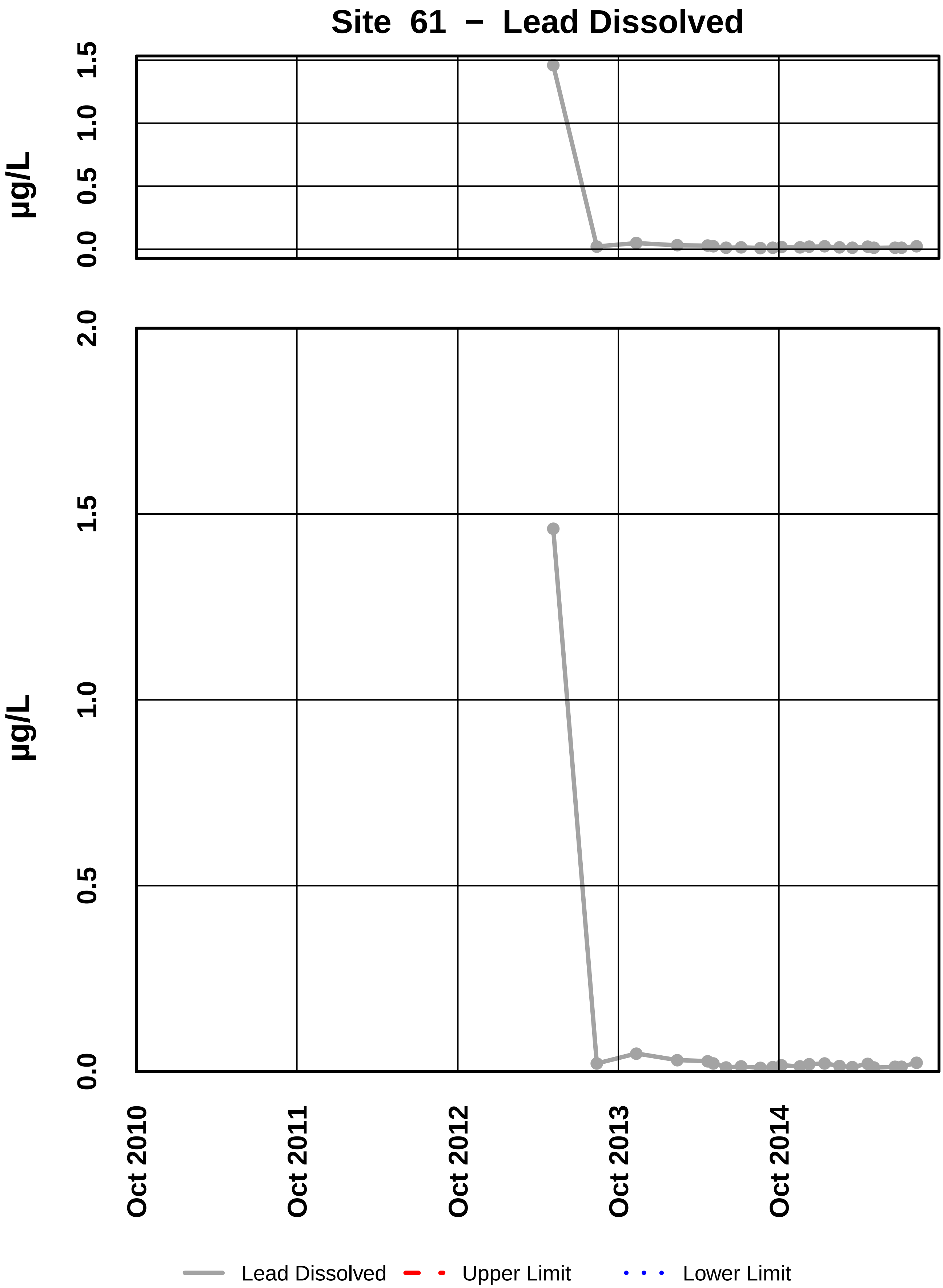


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 61 − Copper Dissolved

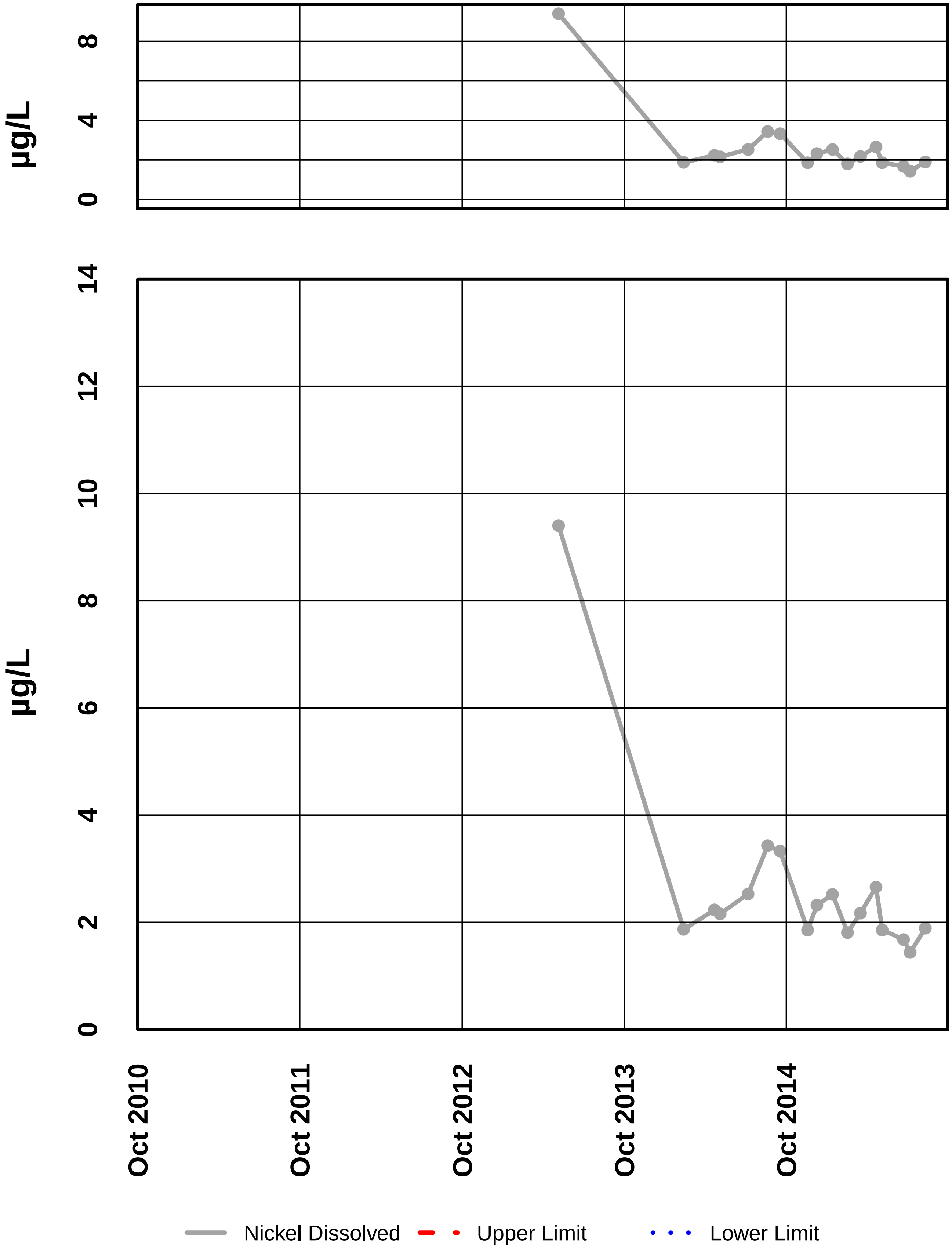


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



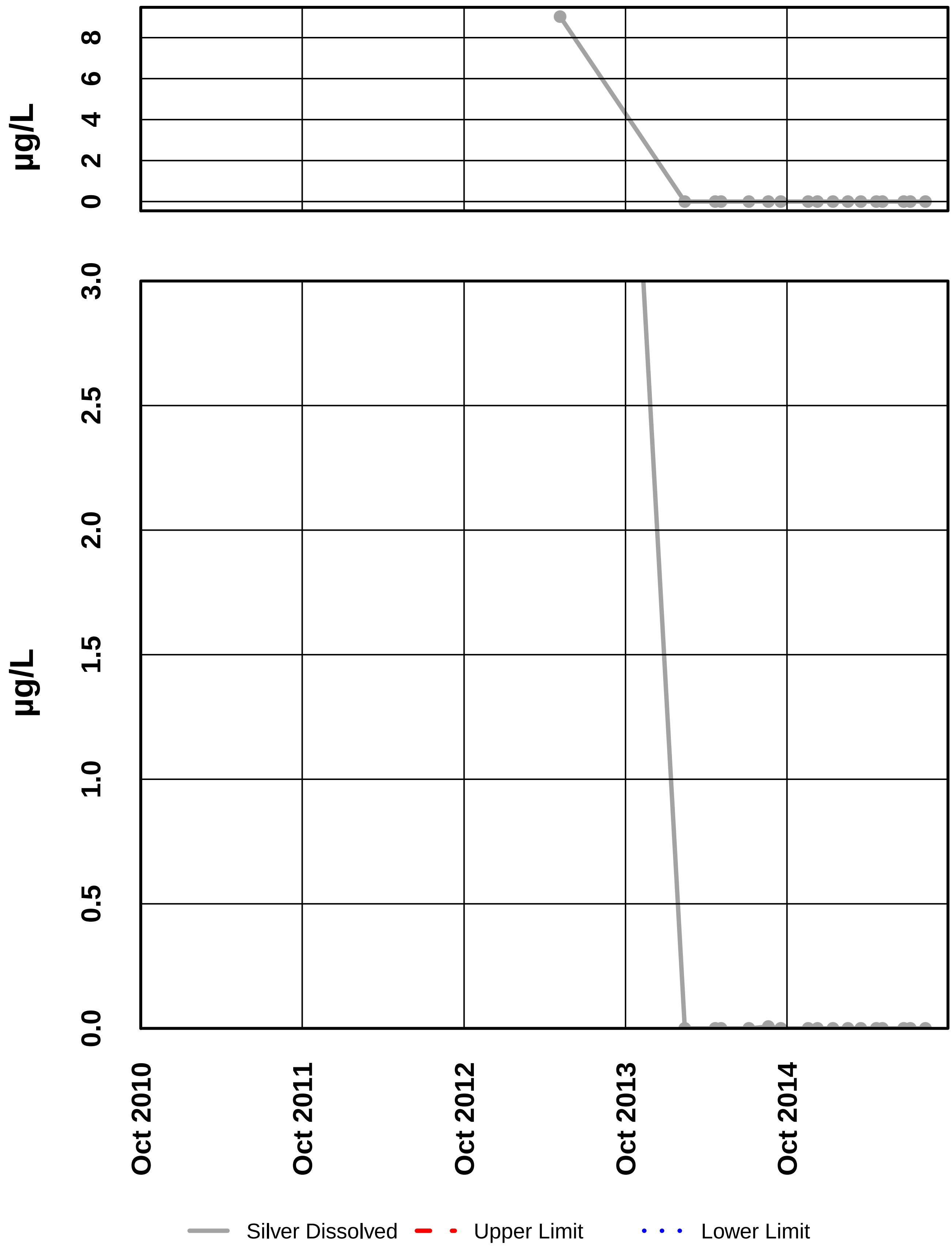
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 61 − Nickel Dissolved

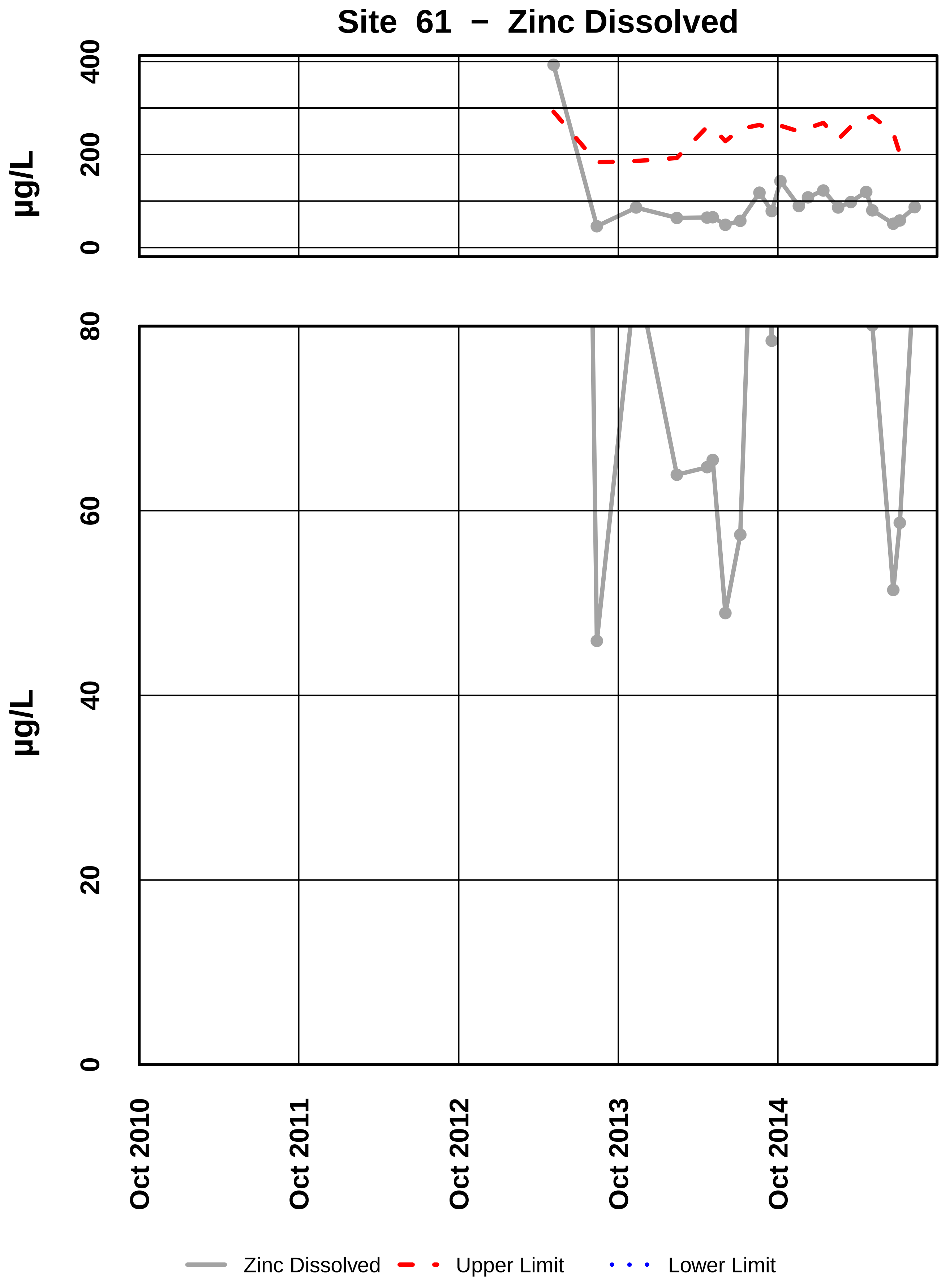


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 61 – Silver Dissolved

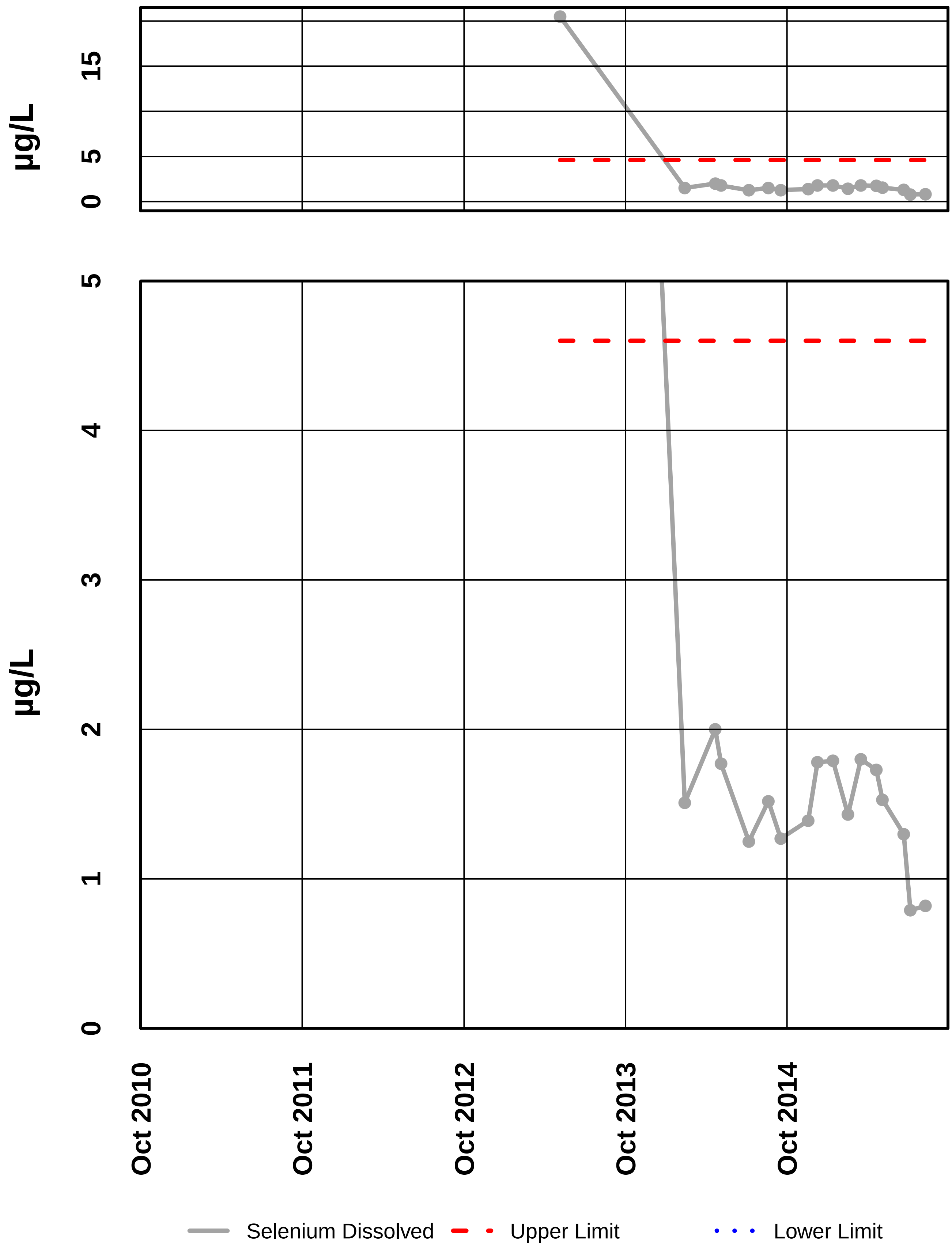


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

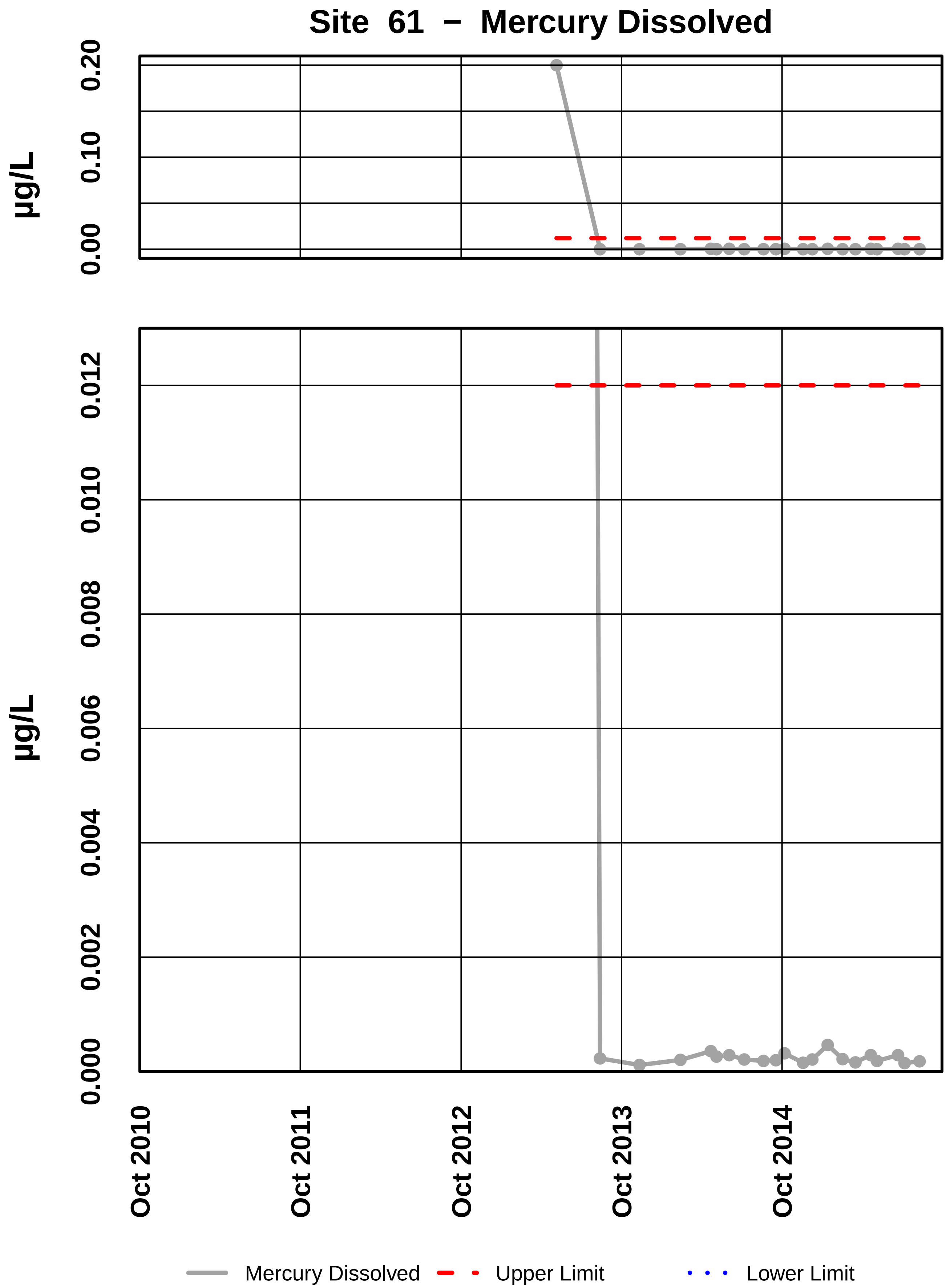


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

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 2015" 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, in the past six years, have been identified by HGCMC.				

The data 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 2015

			Limits		
Sample Date	**Parameter**	**Value**	**Lower**	**Upper**	**Hardness**
No exceedances have been identified by HGCMC for the period of October 2014 through September 2015.					

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. A visual trend was observed with dissolved nickel; nickel concentrations have been decreasing over the last 5 years, similar to the trend seen at Site 48.

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-09 and Sep-15(WY2010-WY2015). For datasets with a statistically significant trend ($\alpha/2=2.5\%$) a Seasonal-Sen's Slope estimate statistic has also been calculated. One statistically significant trend was detected for field pH during the current water year; similar as noted for Site 48.

Table of Summary Statistics for Trend Analysis

	Mann-Kendall test statistics			Sen's slope estimate	
Parameter	**n***	**p****	**Trend**	**Q**	**Q(%)**
Conductivity Field	6	0.39			
pH Field	6	<0.01	+	0.06	0.7
Alkalinity, Total	6	0.11			
Sulfate, Total	6	0.20			
Zinc, Dissolved	6	0.17			

* Number of Years ** Significance level

Table of Results for Water Year 2015

Site 049FMS - 'Upper Bruin Creek'

Sample Date/Parameter	Oct 2014	Nov 2014	Dec 2014	Jan 2015	Feb 2015	Mar 2015	Apr 2015	May 2015	Jun 2015	Jul 2015	Aug 2015	Sep 2015	**Median**
Water Temp (°C)		3.6			1.3			3.9			10.8		3.8
Conductivity-Field(µmho)		167.7			141.8			115.6			141		141.4
Conductivity-Lab (µmho)		154			142			120			153		148
pH Lab (standard units)		7.59			7.52			7.64			7.93		7.62
pH Field (standard units)		8.16			7.52			8.11			8.11		8.11
Total Alkalinity (mg/L)		65			54.4			52.6			74.7		59.7
Total Sulfate (mg/L)		12.5			10.6			7.6			14.1		11.6
Hardness (mg/L)		77.7			67.8			61			83.8		72.8
Dissolved As (ug/L)		0.173			0.131			0.142			0.202		0.158
Dissolved Ba (ug/L)		10.6			9								9.8
Dissolved Cd (ug/L)		0.031			0.0237			0.0259			0.0339		0.0285
Dissolved Cr (ug/L)		0.166			0.197								0.182
Dissolved Cu (ug/L)		0.465			0.434			0.392			0.638		0.450
Dissolved Pb (ug/L)		0.0056			0.0058			0.0036			0.0045		0.0051
Dissolved Ni (ug/L)		0.79			0.742								0.766
Dissolved Ag (ug/L)		0.002			0.002								0.002
Dissolved Zn (ug/L)		2.37			1.97			2.04			1.93		2.01
Dissolved Se (ug/L)		0.572			0.394								0.483
Dissolved Hg (ug/L)		0.00115			0.00128			0.000965			0.00129		0.001215

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.

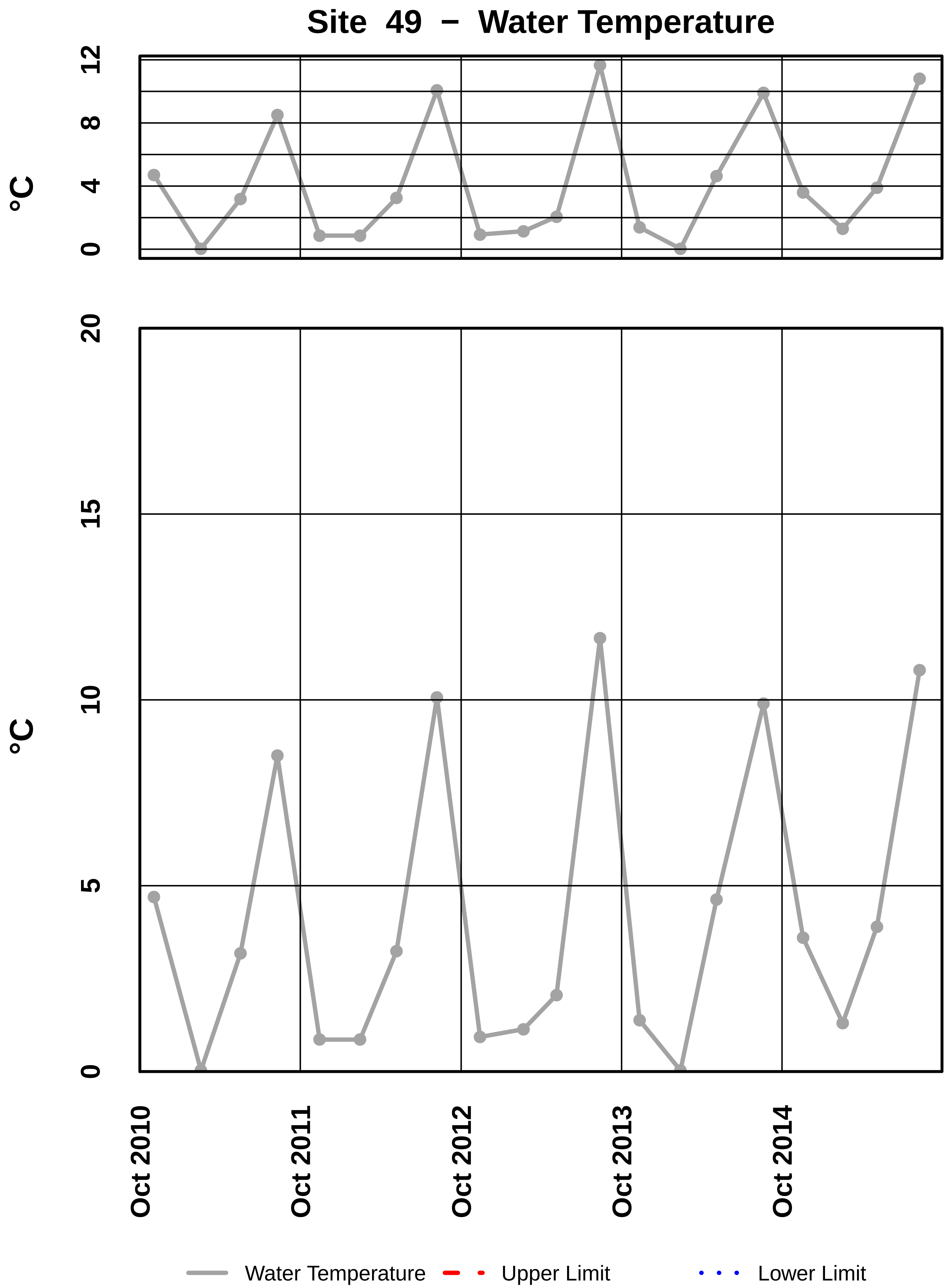
Shaded data has been qualified as an outlier by HGCMC and removed from any further analysis and is not included into the calculation of the median

Qualified Data by QA Reviewer

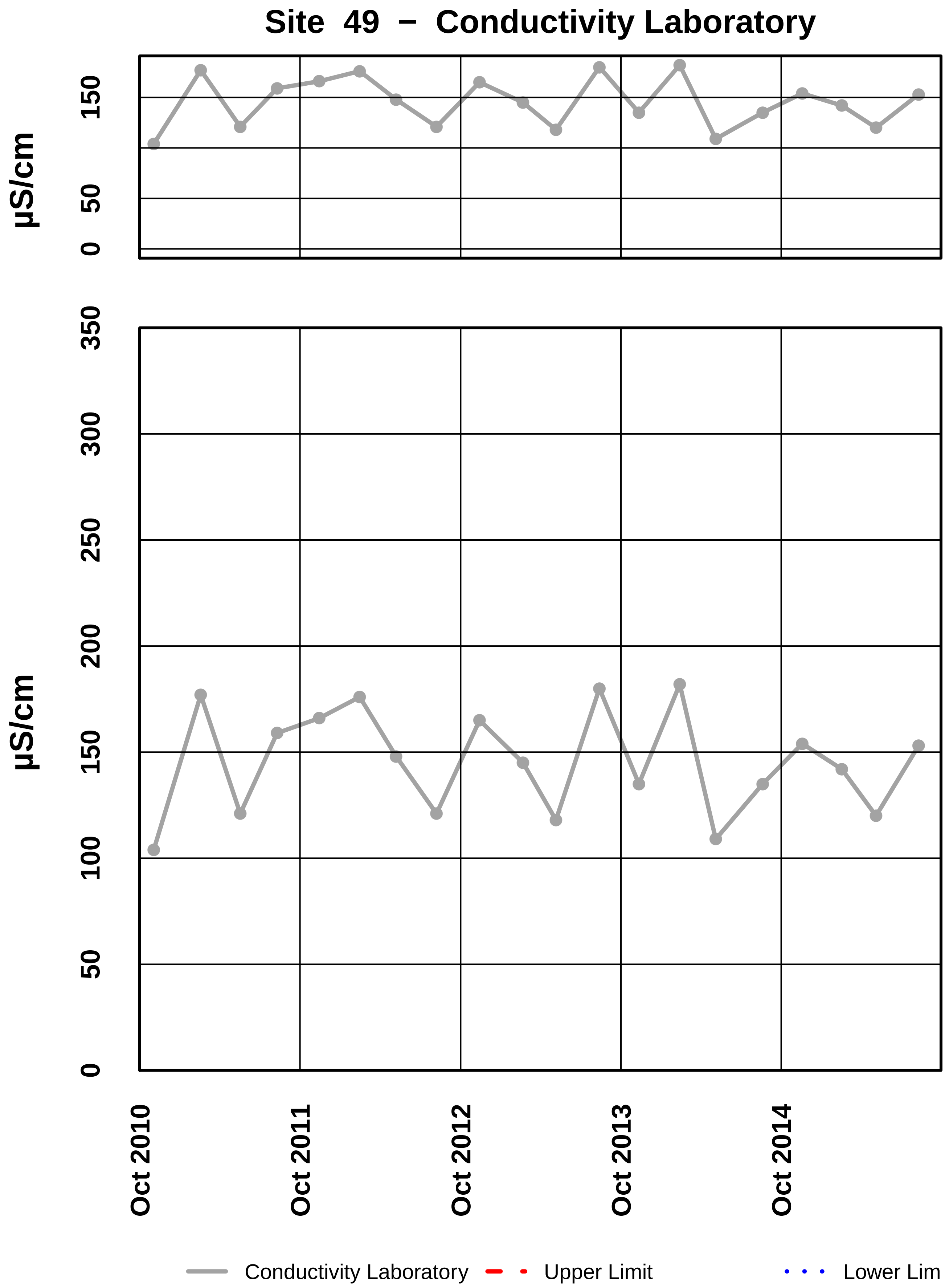
Date Range: 10/01/2014 to 09/30/2015

Site No.	Sample Date	Sample Time	Parameter	Value		Qualifier	Reason for Qualifier
049FMS	11/18/2014	12:00 AM	Diss. Cr-ICP/MS	0.16	µg/L	J	Below Quantitative Range
			Diss. Pb-ICP/MS	0.00559	µg/L	J	Below Quantitative Range
049FMS	02/16/2015	12:00 AM	Diss. Pb-ICP/MS	0.00582	µg/L	J	Below Quantitative Range
			pH	7.36	pH units	J	Hold Time Violation
049FMS	05/05/2015	12:00 AM	Diss. Pb-ICP/MS	0.00355	µg/L	J	Below Quantitative Range
			Sulfate	7.64	mg/L	J	Sample Receipt Temperature
049FMS	08/10/2015	12:00 AM	Diss. Pb-ICP/MS	0.00445	µg/L	J	Below Quantitative Range
			Sulfate	14.1	mg/L	J	Sample Receipt Temperature

Qualifier	Description
J	Positively Identified - Approximate Concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit

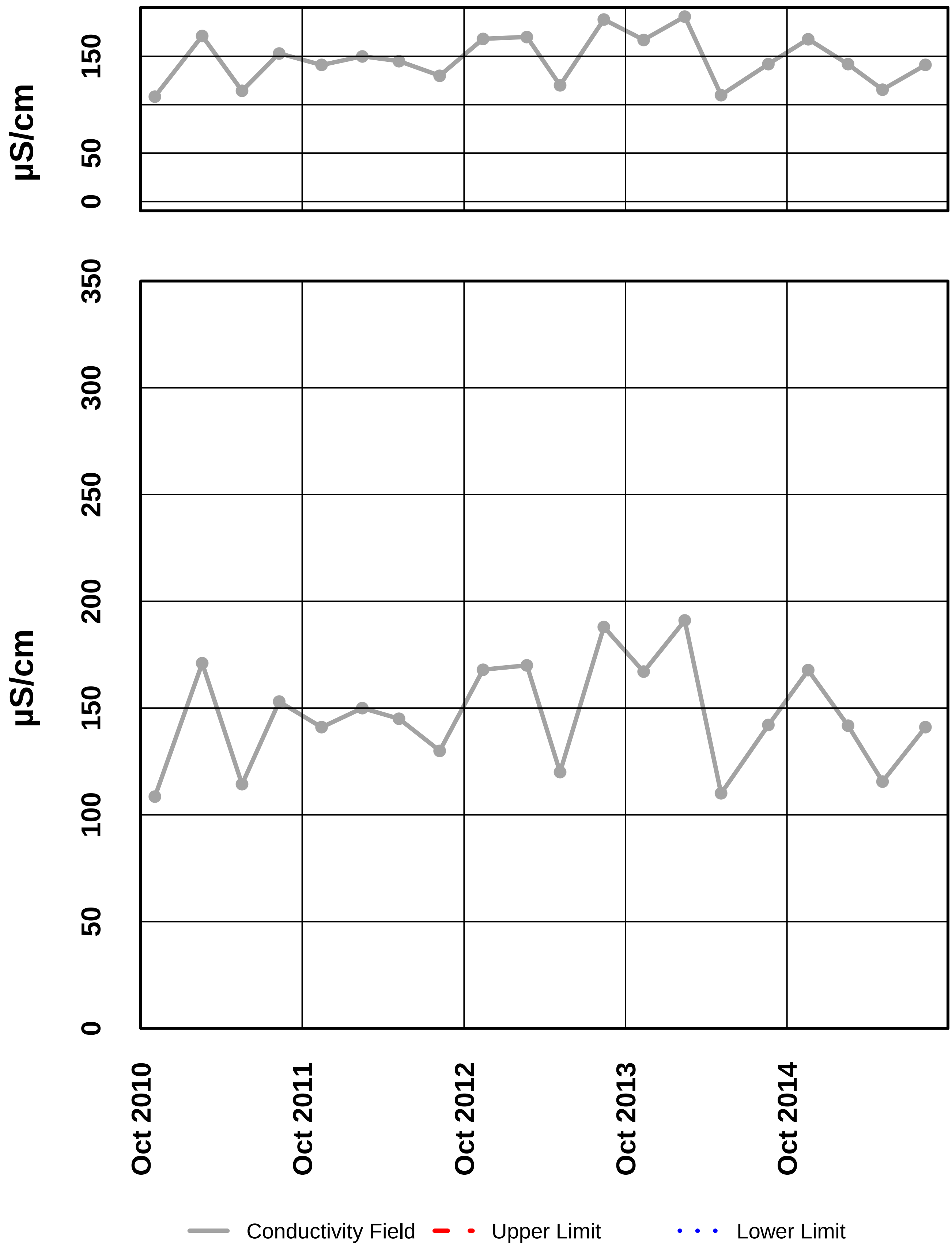


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

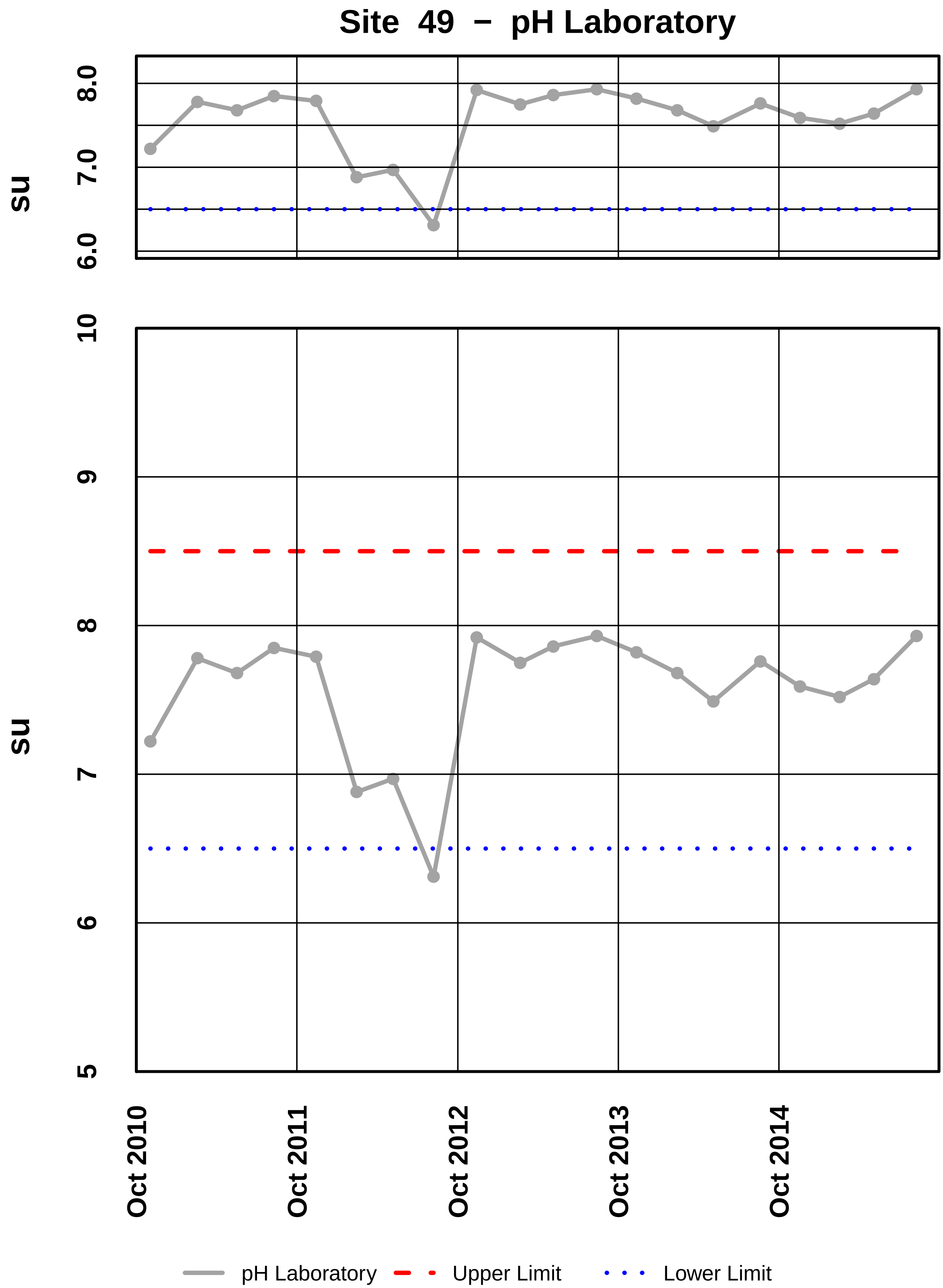


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

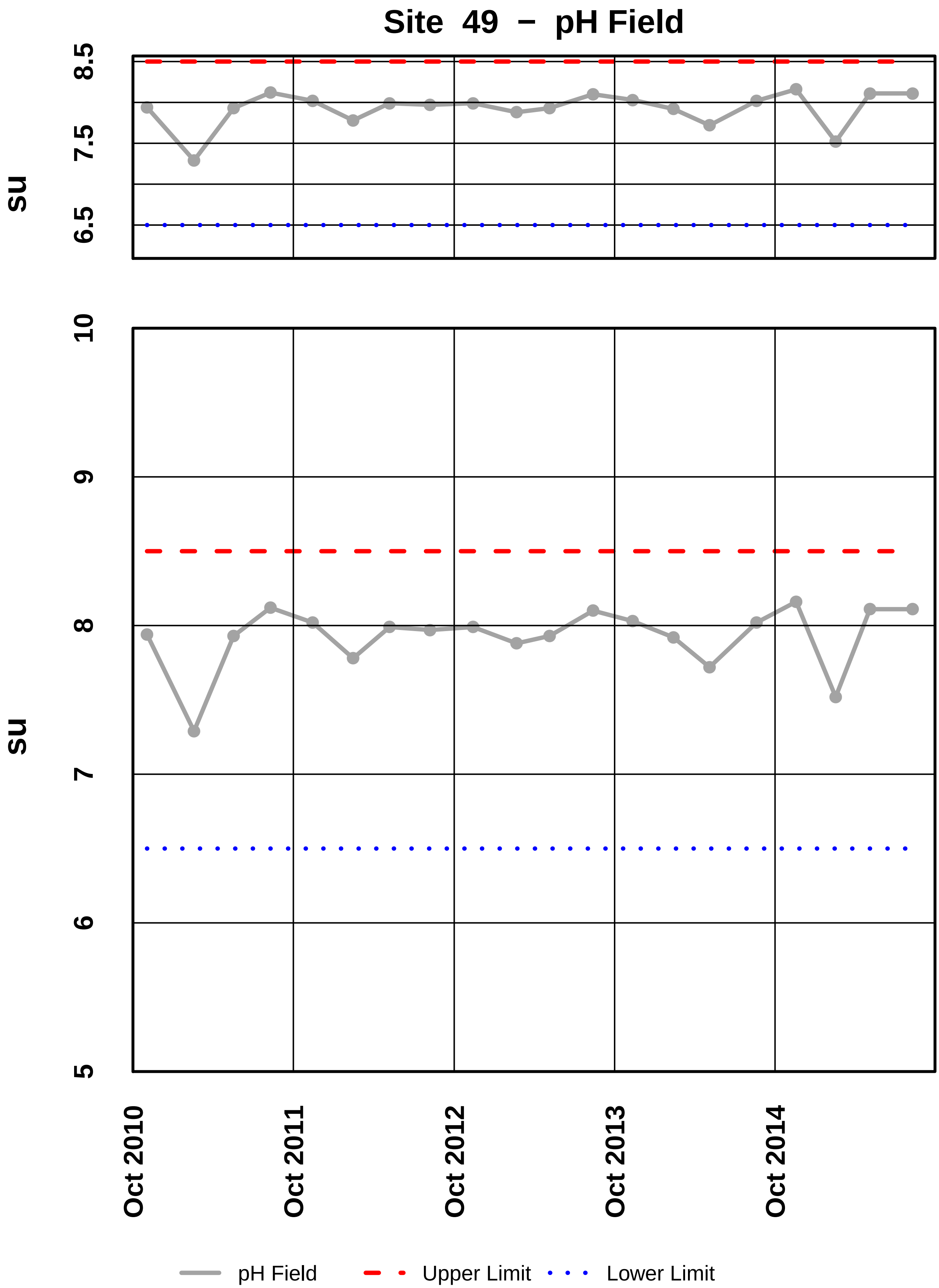
Site 49 – Conductivity Field



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

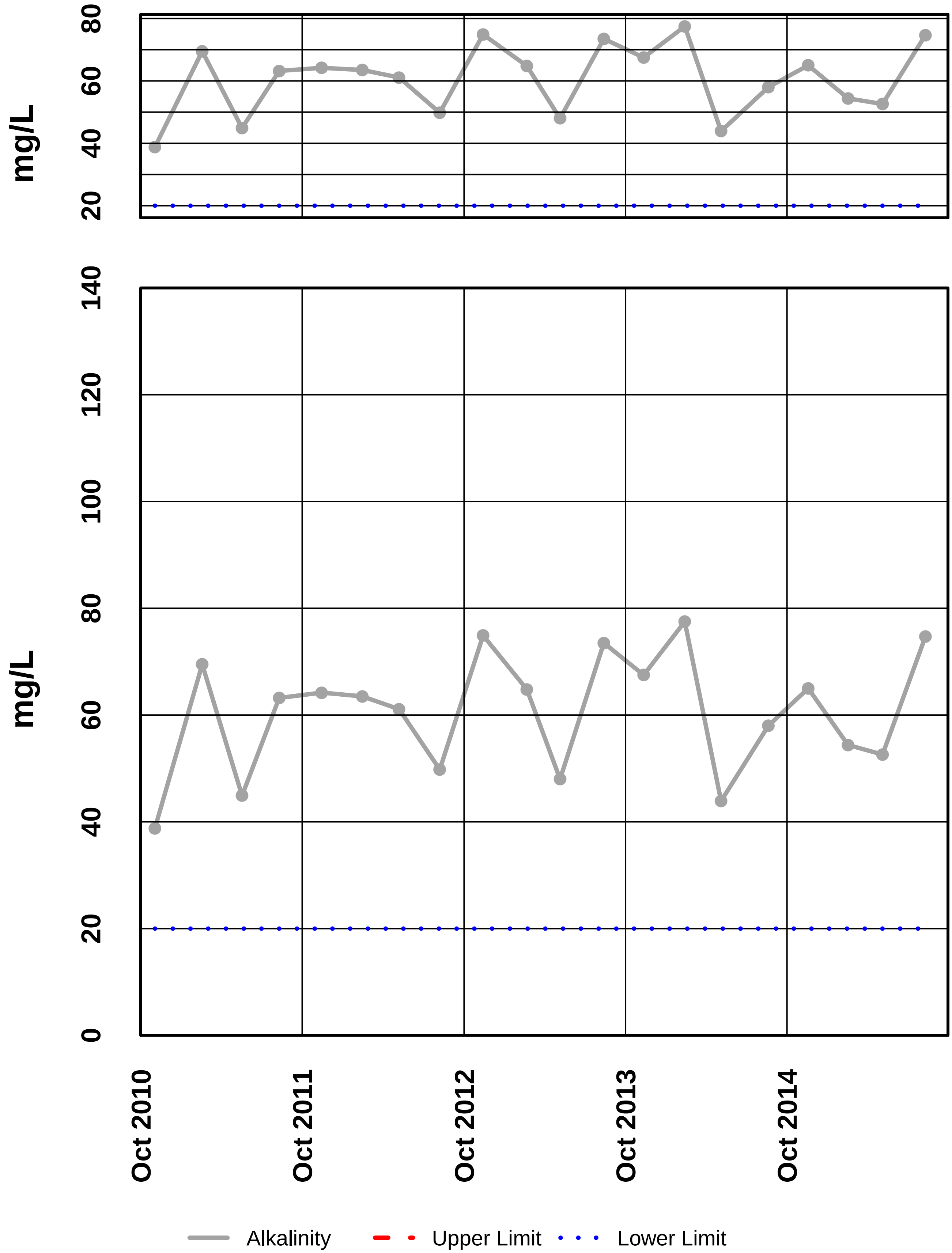


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



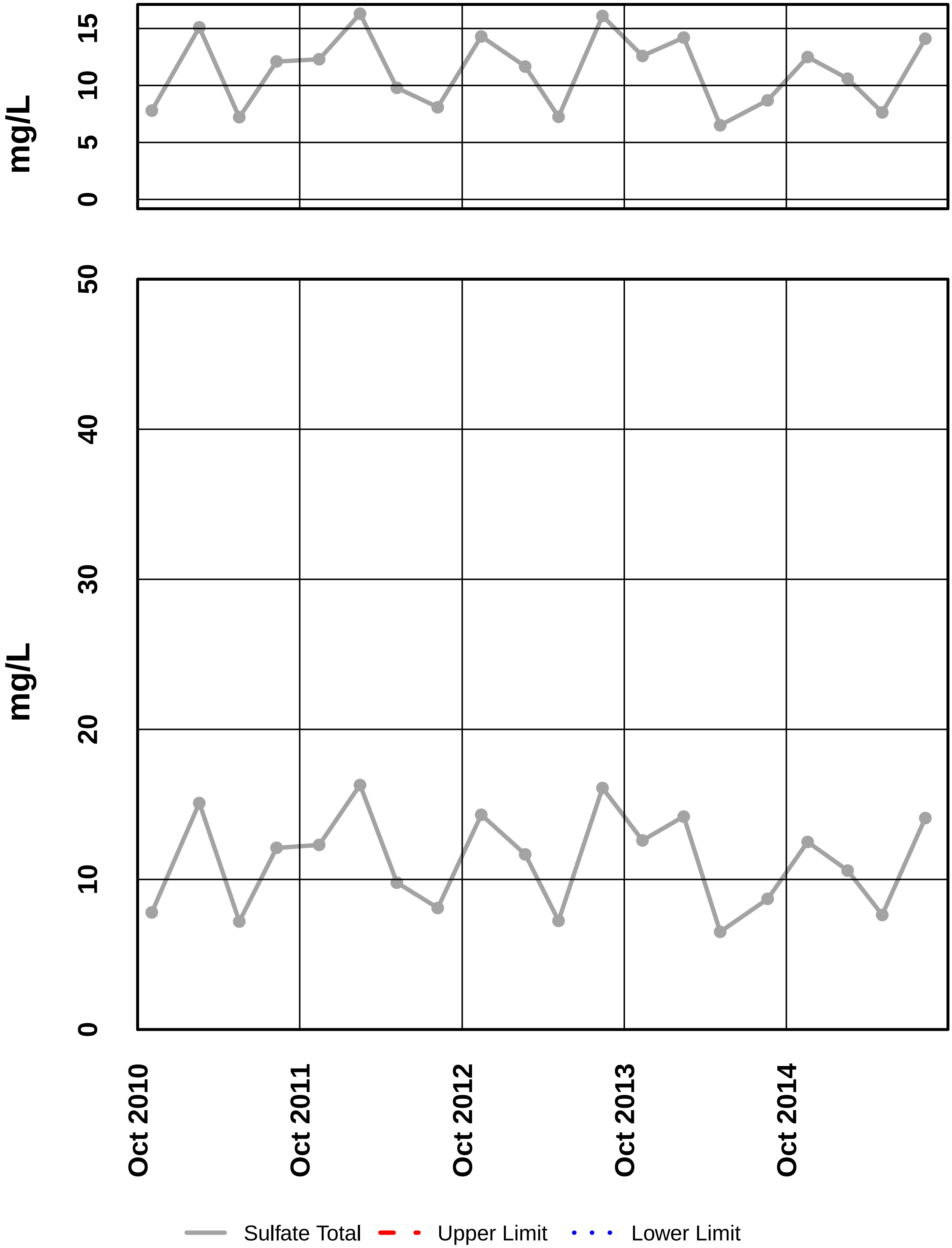
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 49 − Alkalinity

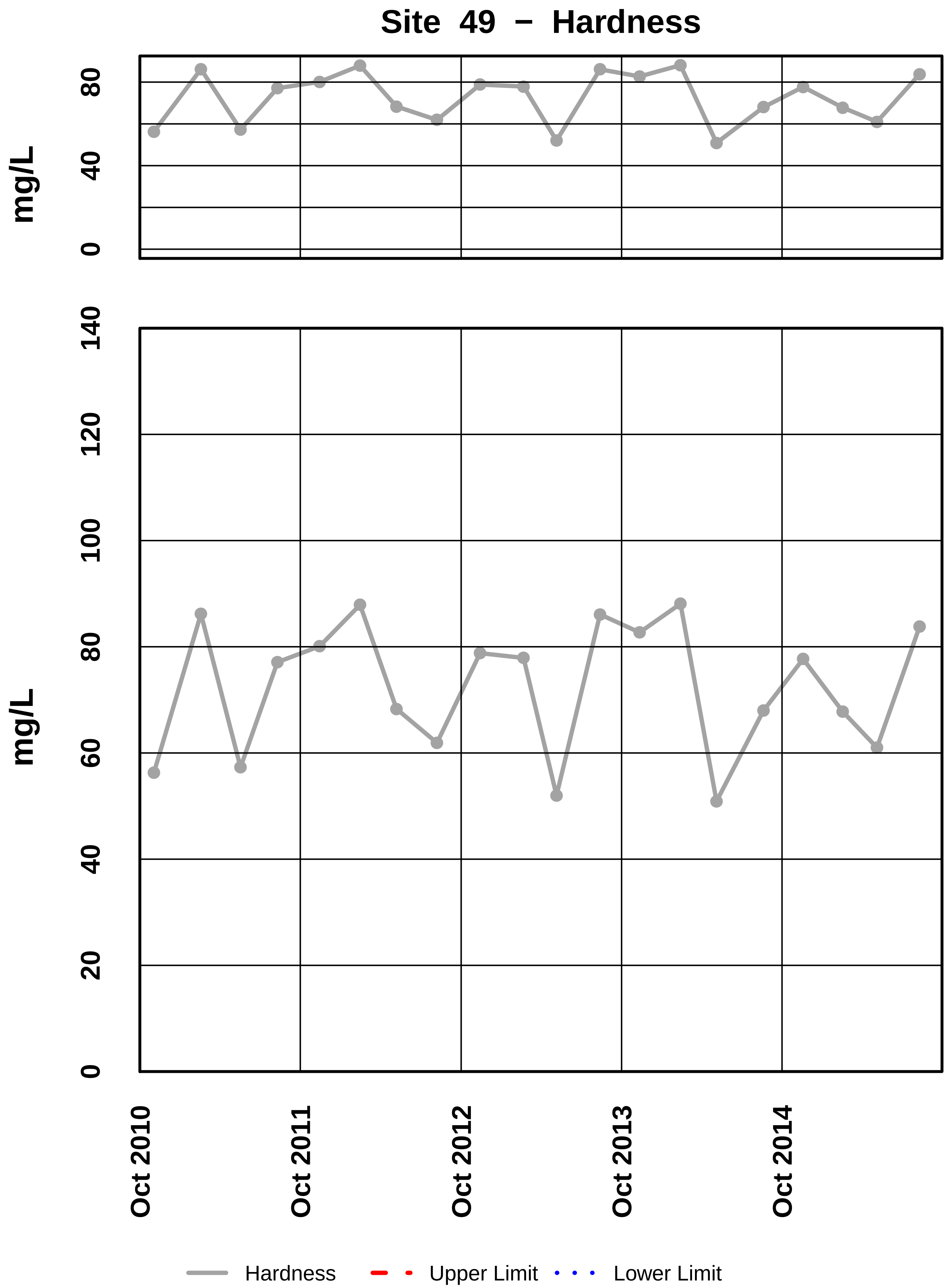


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

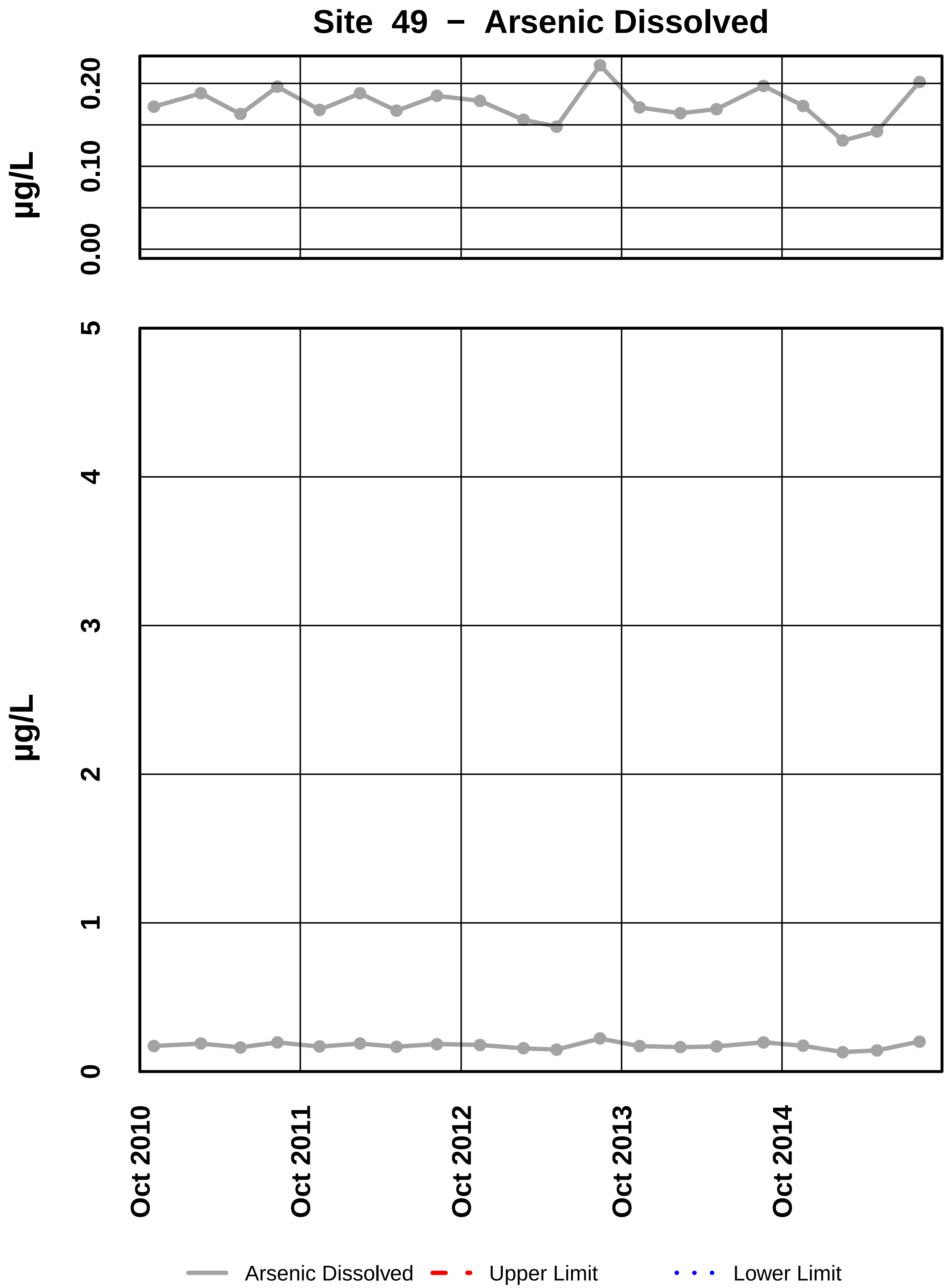
Site 49 – Sulfate Total



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

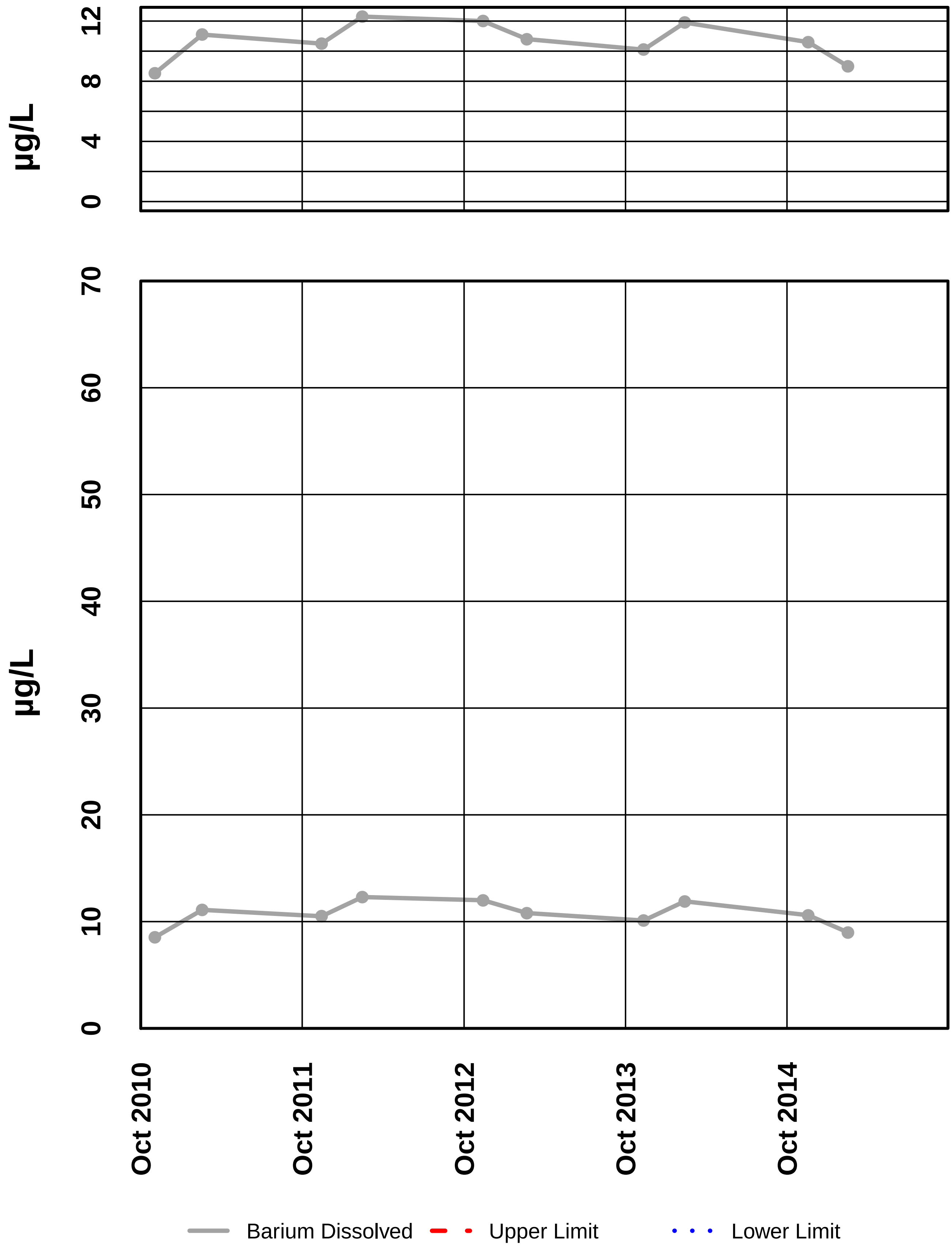


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



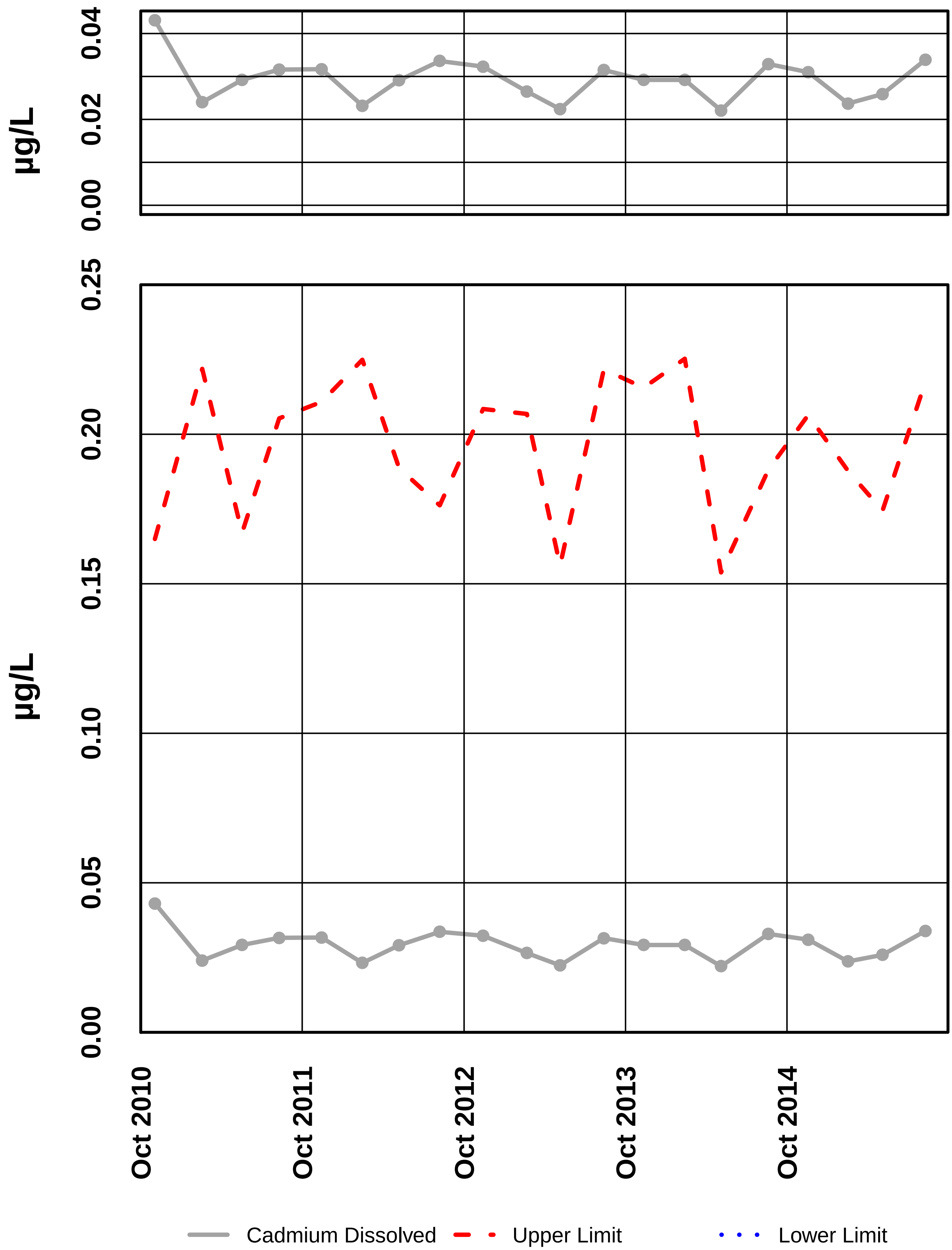
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 49 – Barium Dissolved



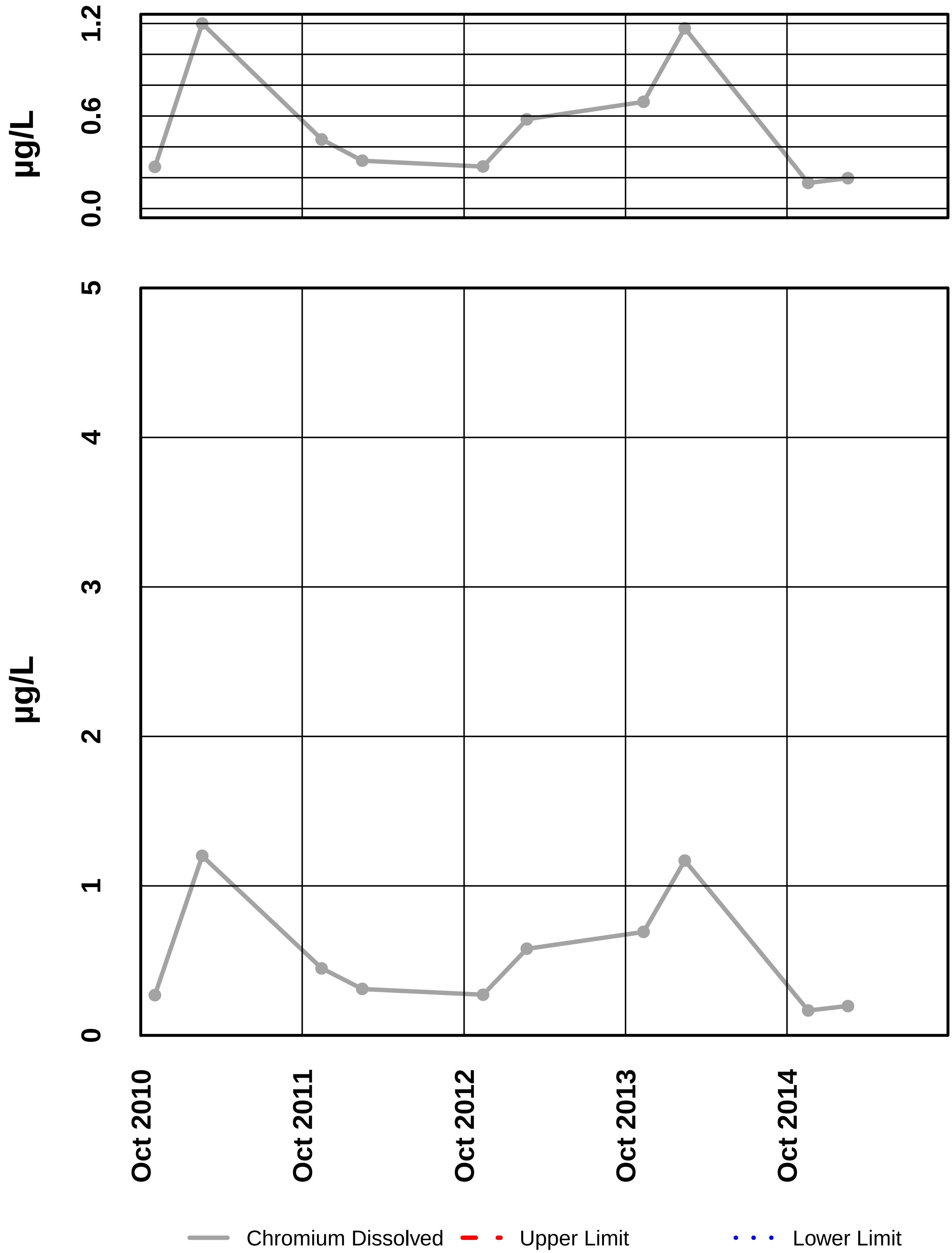
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 49 – Cadmium Dissolved

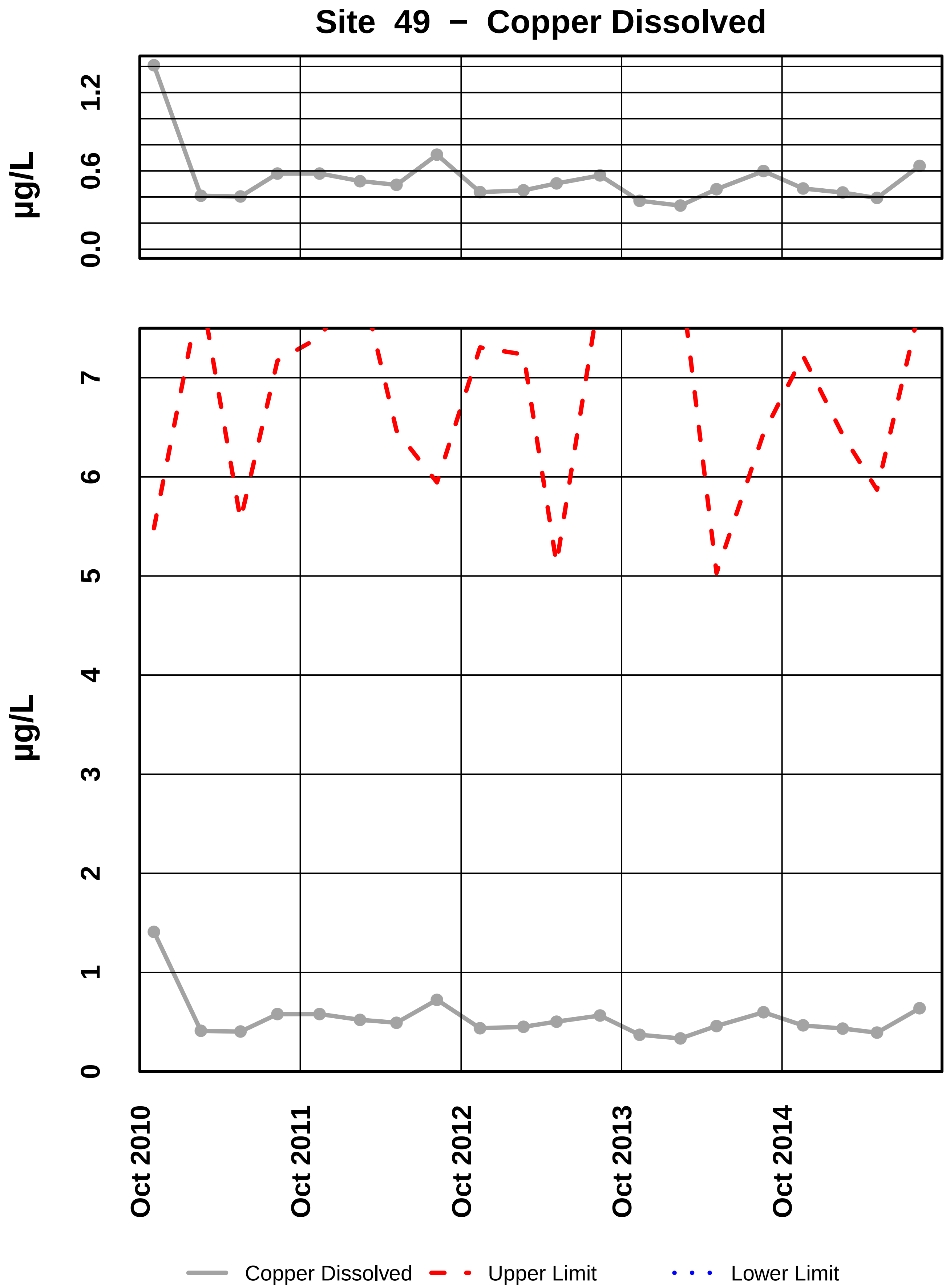


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

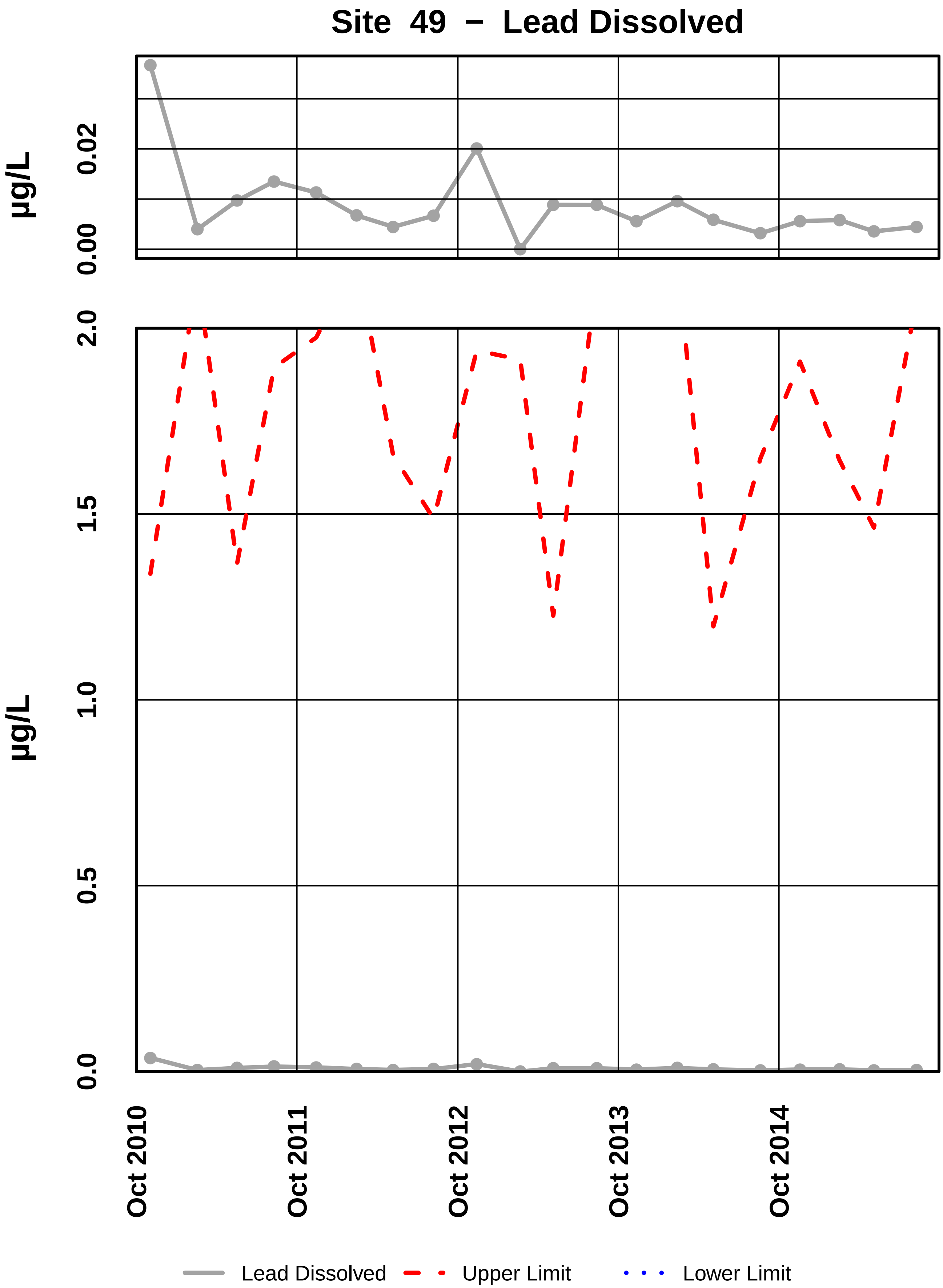
Site 49 – Chromium Dissolved



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

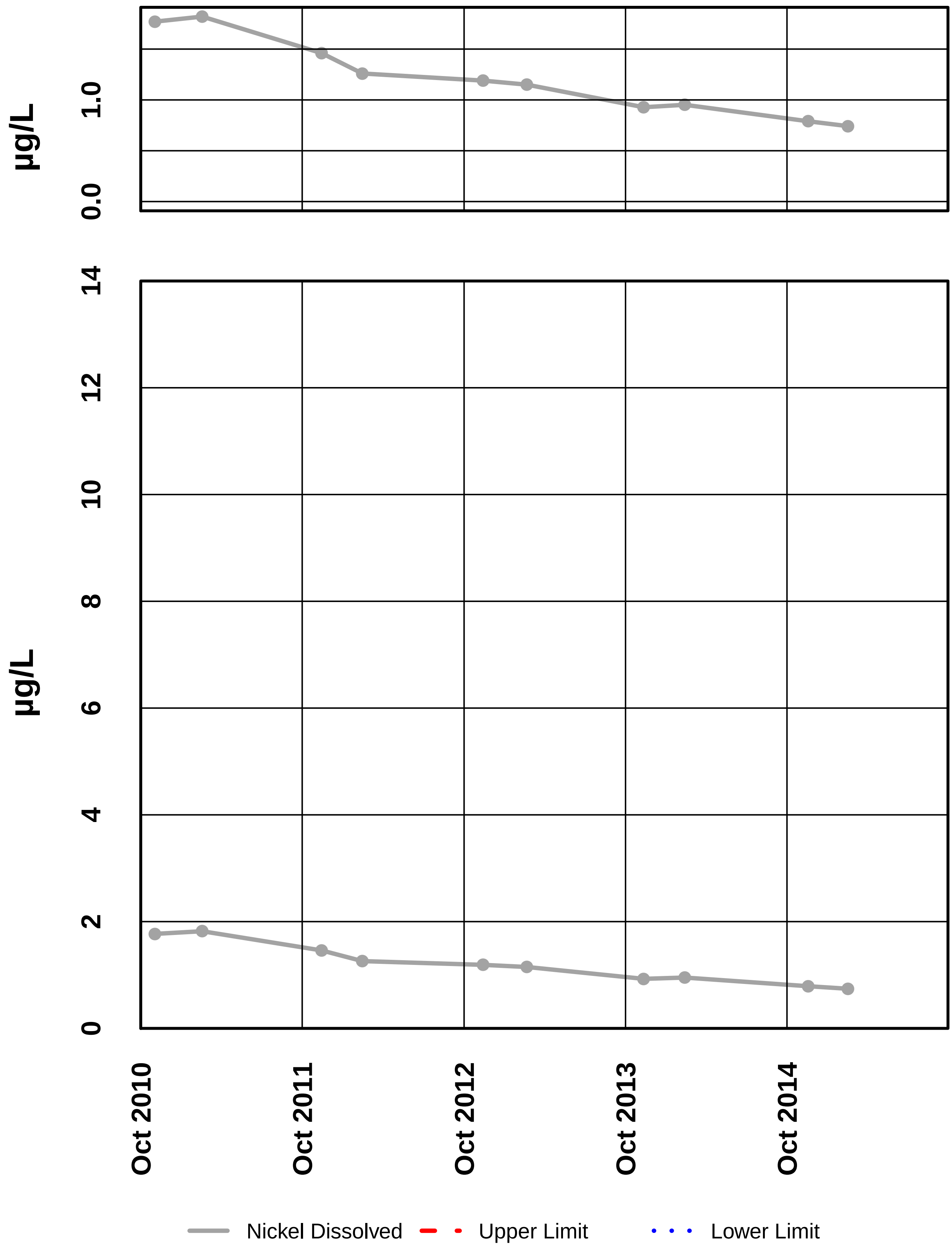


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

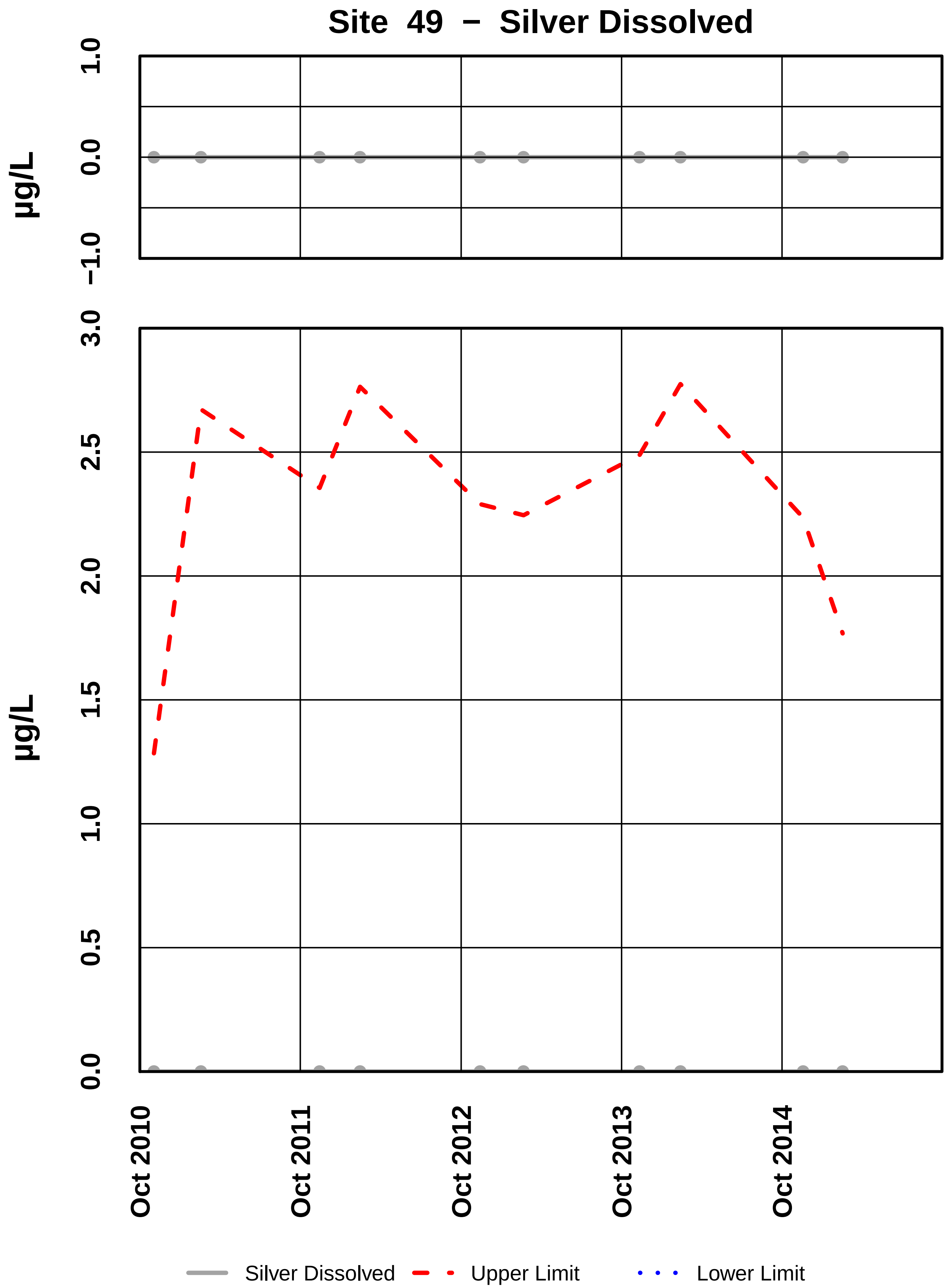


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

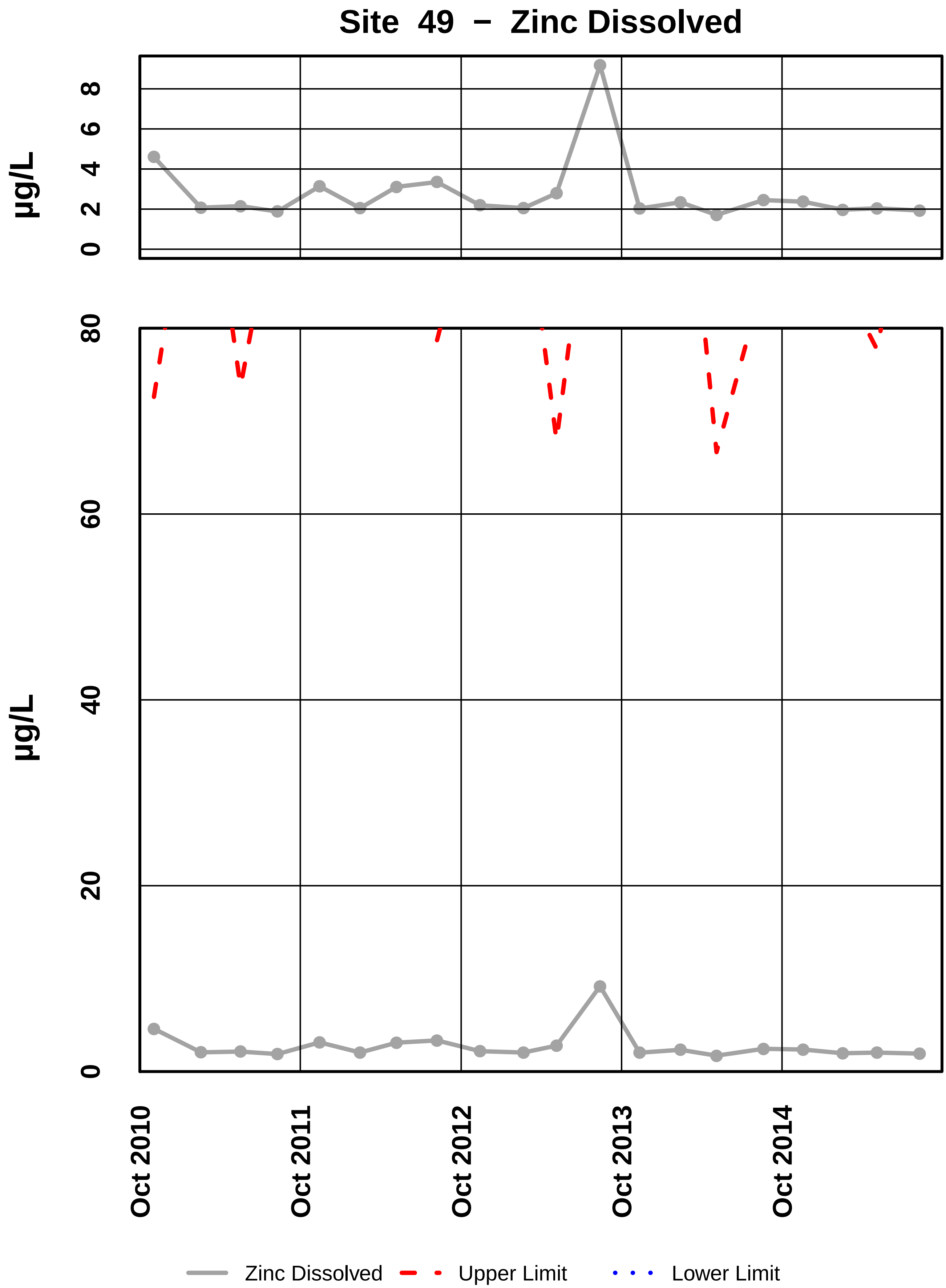
Site 49 – Nickel Dissolved



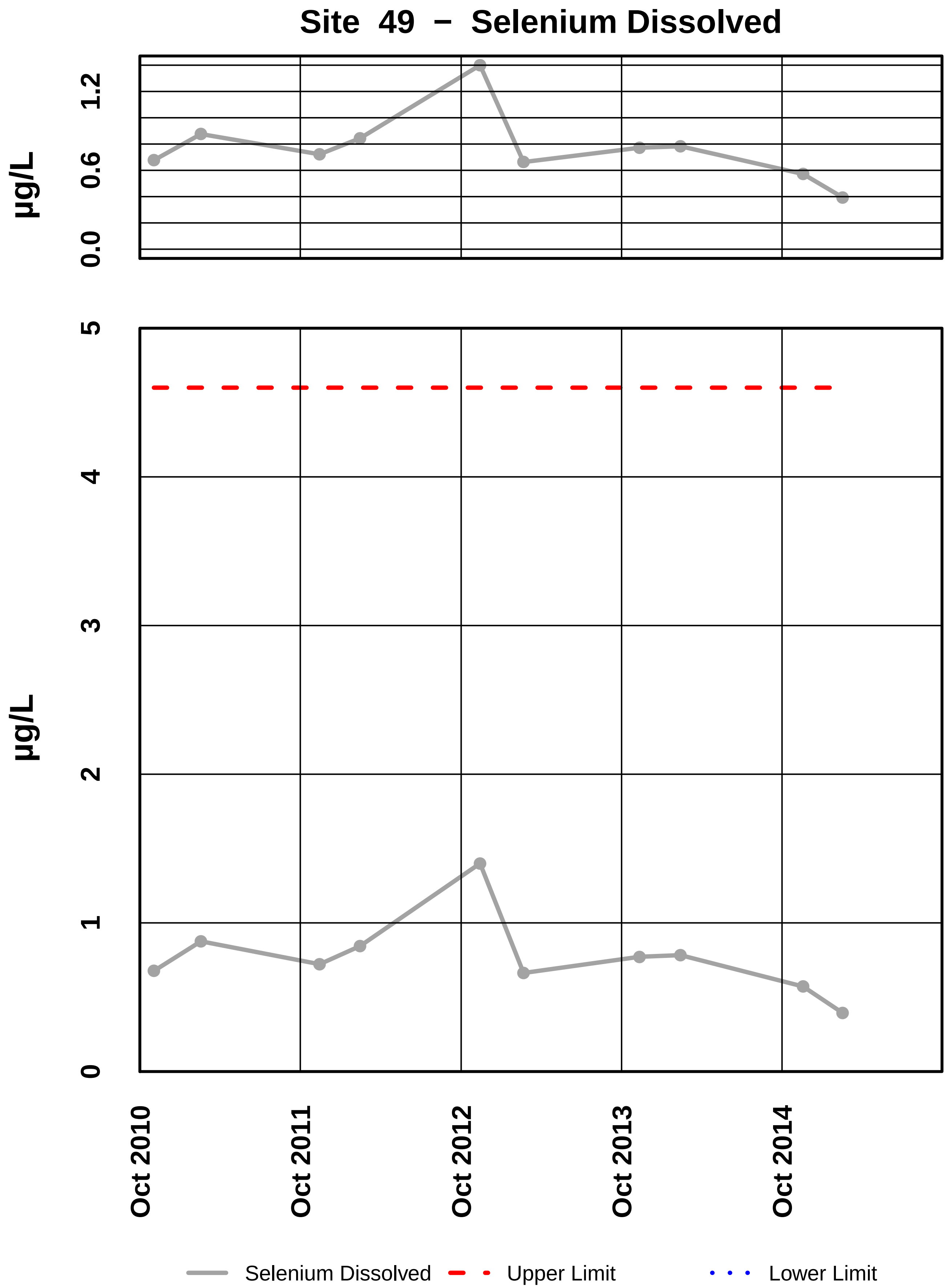
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

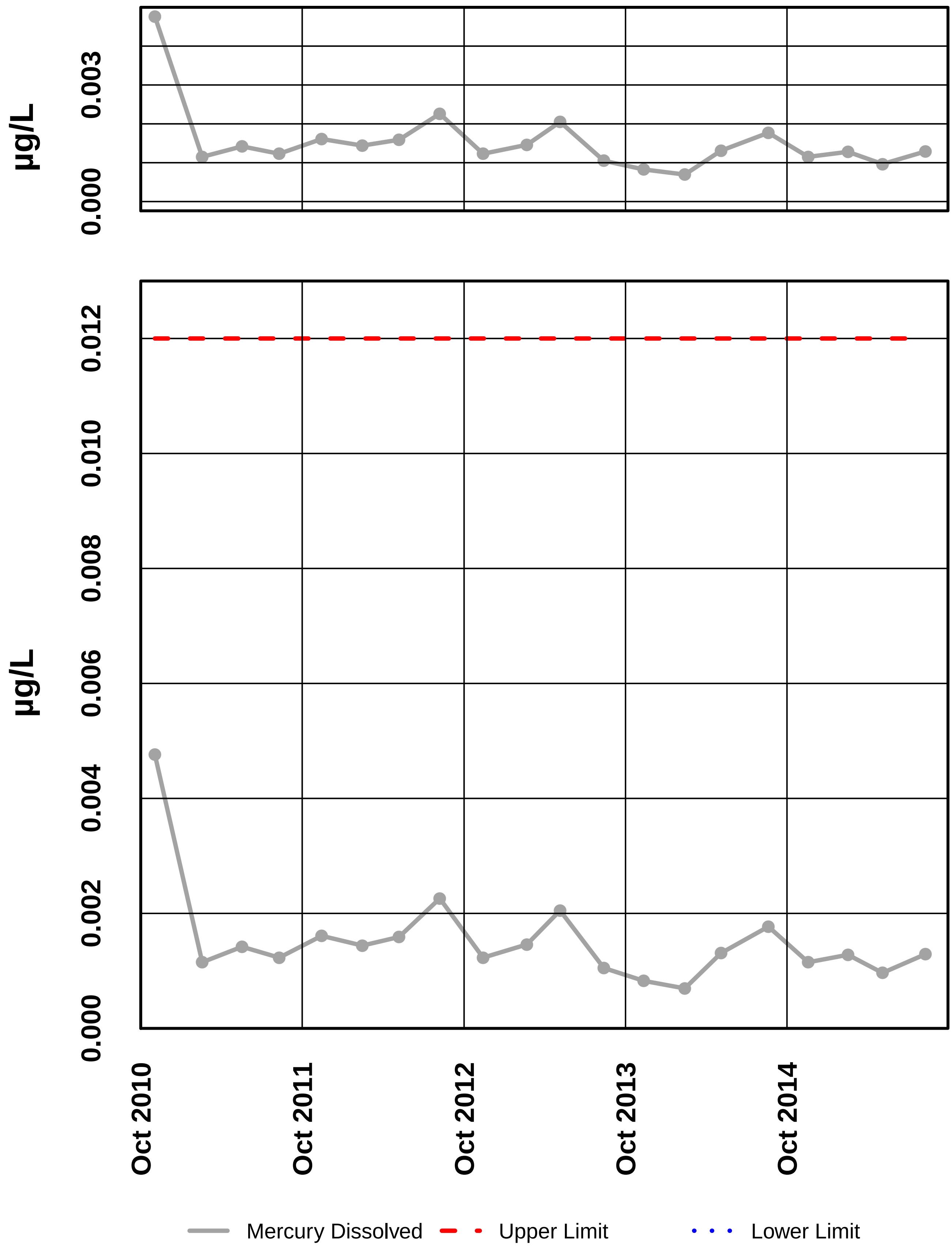


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

Site 49 – Mercury Dissolved



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

INTERPRETIVE REPORT
SITE 46

The data collected during the current water year are listed in the following “Table of Results for Water Year 2015” 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, in the past six years, have been identified by HGCMC.				

The data 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 2015

			Limits		
Sample Date	Parameter	Value	Lower	Upper	Hardness
No exceedances have been identified by HGCMC for the period of October 2014 through September 2015.					

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. A visual decreasing trend was observed with dissolved nickel, similar to the trend seen at Site 48. Furthermore, pH appears to be trending upward over the past five years.

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-09 and Sep-15(WY2010-WY2015). Datasets with a statistically significant trend ($\alpha/2=2.5\%$) a Seasonal-Sen’s Slope estimate statistic has also been calculated. There was one statistically significant trend detected for pH, during the current water year, which was similar in magnitude and direction as the trend noted for the upgradient background site.

Table of Summary Statistics for Trend Analysis

	Mann-Kendall test statistics			Sen's slope estimate	
Parameter	**n***	**p****	**Trend**	**Q**	**Q(%)**
Conductivity Field	6	0.50			
pH Field	6	<0.01	+	0.08	1.0
Alkalinity, Total	6	0.21			
Sulfate, Total	6	0.38			
Zinc, Dissolved	6	0.12			

* Number of Years ** Significance level

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

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

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

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

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

Setting $S_0 = 0$ ensures that only cumulative changes from background are monitored. When the value of S exceeds a certain threshold value, a change in value has been found. 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. The first five years of sampling were chosen for these calculations, 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 dissolved zinc 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 3.7 recorded for total sulfate. 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’.

Once a background value is established the proceeding years that are not ‘out of control’, can be used to recalculate the background values. It is suggested that these calculations be carried out every two years. In order to prevent the incorporation of a gradual trend into the background data, it is important to test for background trends on a routine basis. Currently, HGCMC is using the Mann-Kendall test for seasonal trends for trend analysis. Of the three analytes used, for the combined Shewhart-CUSUM control charts, none of them had a significant seasonal trend. Therefore, it should be possible to incorporate more of the measurements into the calculation of the baseline statistics. 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. Figure 1is the combined Shewhart-CUSUM charts for field conductivity, dissolved zinc, and total sulfate; using the baseline statistics from Table 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	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

Figure 1 is the control chart for Site 46, note that none of the analytes went out of control during the monitoring period. This supports the conclusion drawn in the previous FWMP reports that HGCMC activities in the Site23 / D Pile area are not having a measurable effect on Bruin Creek.

Figure 1. **Observed Measurements for Specific Conductance, Dissolved Zinc, and Total Sulfate from Site 46 Compared to the Shewhart-CUSUM Control Limits From Table 2**

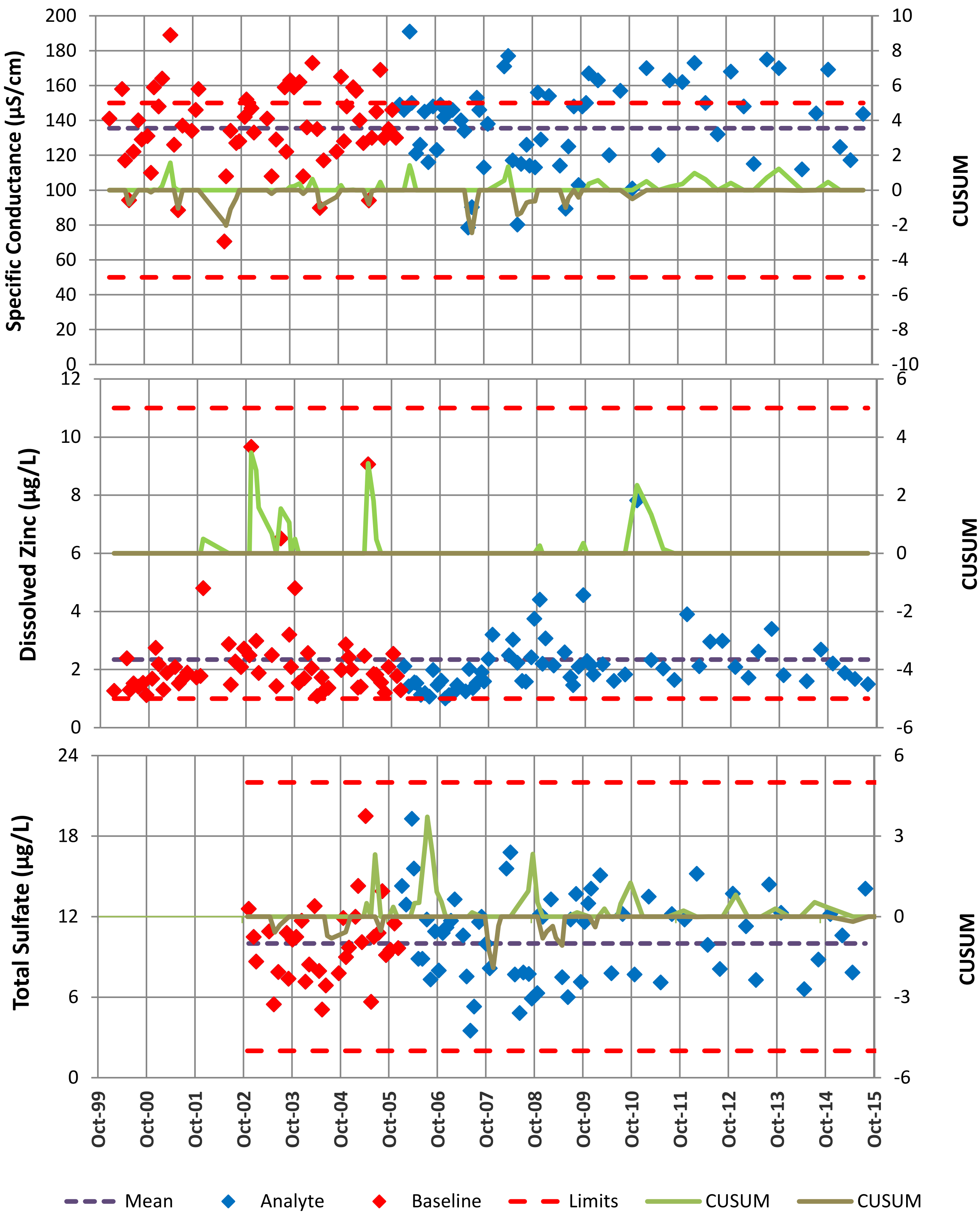


Table of Results for Water Year 2015

Site 046FMS - 'Lower Bruin Creek'

Sample Date/Parameter	Oct 2014	Nov 2014	Dec 2014	Jan 2015	Feb 2015	Mar 2015	Apr 2015	May 2015	Jun 2015	Jul 2015	Aug 2015	Sep 2015	**Median**
Water Temp (°C)		2.9			1.1			3.9			11		3.4
Conductivity-Field(µmho)		169.1			124.8			117.2			143.8		134.3
Conductivity-Lab (µmho)		157			144			125			156		150
pH Lab (standard units)		7.61			7.56			7.67			7.85		7.64
pH Field (standard units)		8.21			7.56			8.13			8.14		8.14
Total Alkalinity (mg/L)		65.2			56.2			53.1			73.9		60.7
Total Sulfate (mg/L)		12.2			10.6			7.8			14.1		11.4
Hardness (mg/L)		77.2			67.5			61.3			80.1		72.4
Dissolved As (ug/L)		0.295			0.226			0.187			0.293		0.260
Dissolved Ba (ug/L)		12			10.1								11.1
Dissolved Cd (ug/L)		0.0281			0.0209			0.0193			0.0289		0.0245
Dissolved Cr (ug/L)		0.137			0.262								0.200
Dissolved Cu (ug/L)		0.457			0.439			0.407			0.606		0.448
Dissolved Pb (ug/L)		0.0219			0.0079			0.0066			0.0104		0.0092
Dissolved Ni (ug/L)		0.711			0.721								0.716
Dissolved Ag (ug/L)		0.002			0.002								0.002
Dissolved Zn (ug/L)		2.21			1.88			1.68			1.5		1.78
Dissolved Se (ug/L)		0.564			0.45								0.507
Dissolved Hg (ug/L)		0.00107			0.00126			0.00116			0.00132		0.001210

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

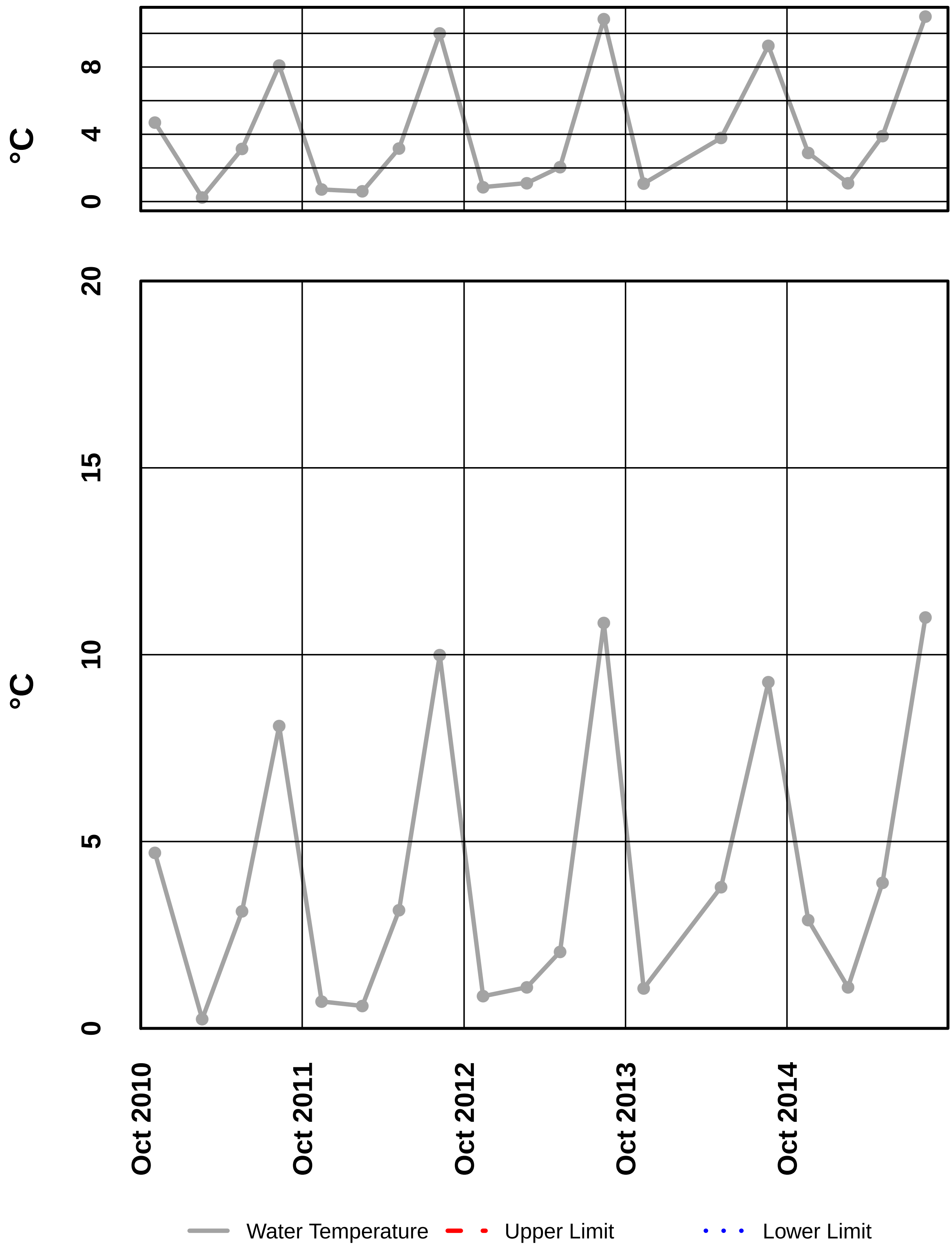
Qualified Data by QA Reviewer

Date Range: 10/01/2014 to 09/30/2015

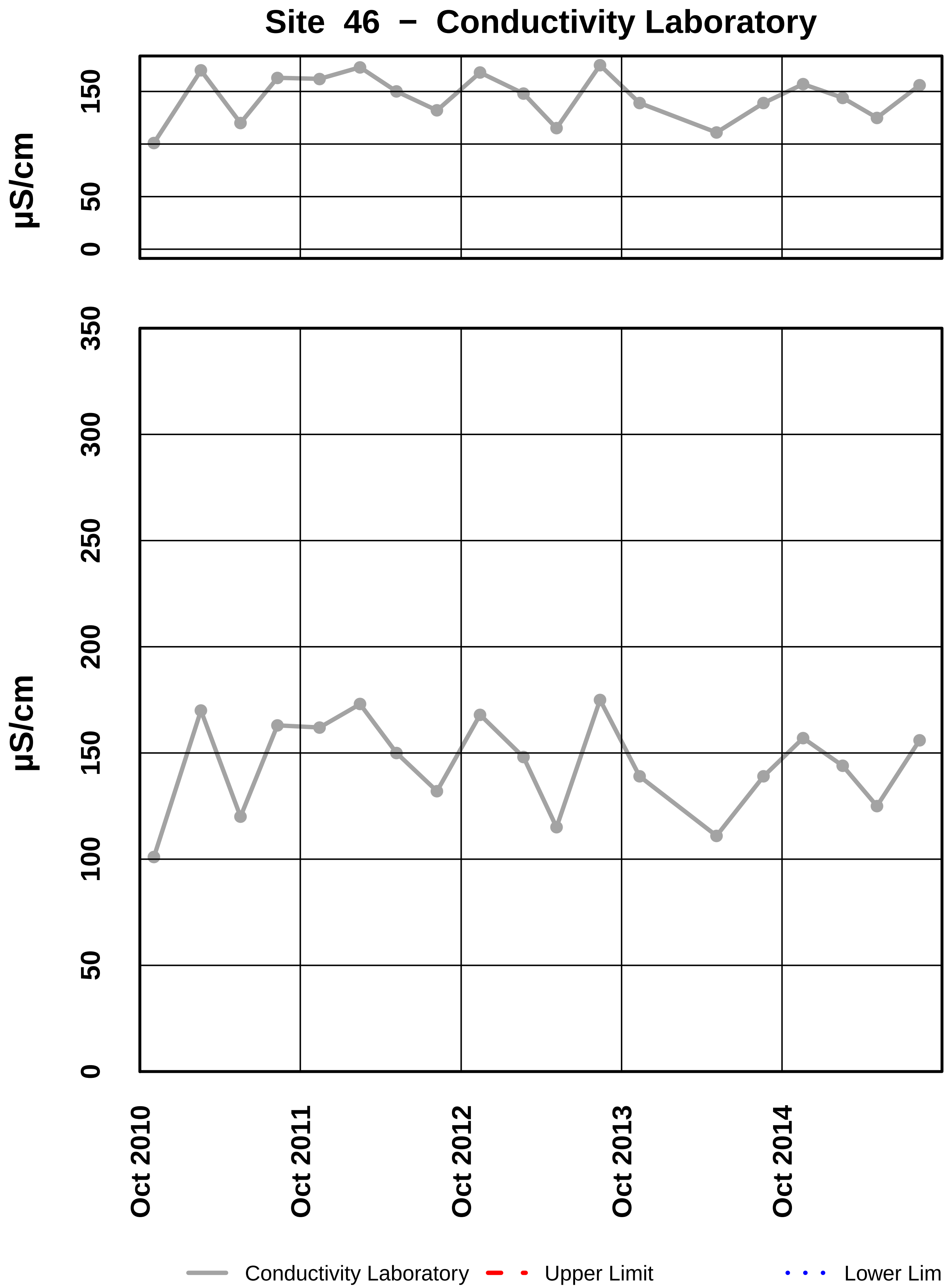
Site No.	Sample Date	Sample Time	Parameter	Value		Qualifier	Reason for Qualifier
046FMS	11/18/2014	12:00 AM	Diss. Cr-ICP/MS	0.13	µg/L	J	Below Quantitative Range
046FMS	02/16/2015	12:00 AM	Diss. Pb-ICP/MS	0.00786	µg/L	J	Below Quantitative Range
			pH	7.15	pH units	J	Hold Time Violation
046FMS	05/05/2015	12:00 AM	Diss. Pb-ICP/MS	0.00659	µg/L	J	Below Quantitative Range
			Sulfate	7.84	mg/L	J	Sample Receipt Temperature
046FMS	08/10/2015	12:00 AM	Sulfate	14.1	mg/L	J	Sample Receipt Temperature

Qualifier	Description
J	Positively Identified - Approximate Concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit

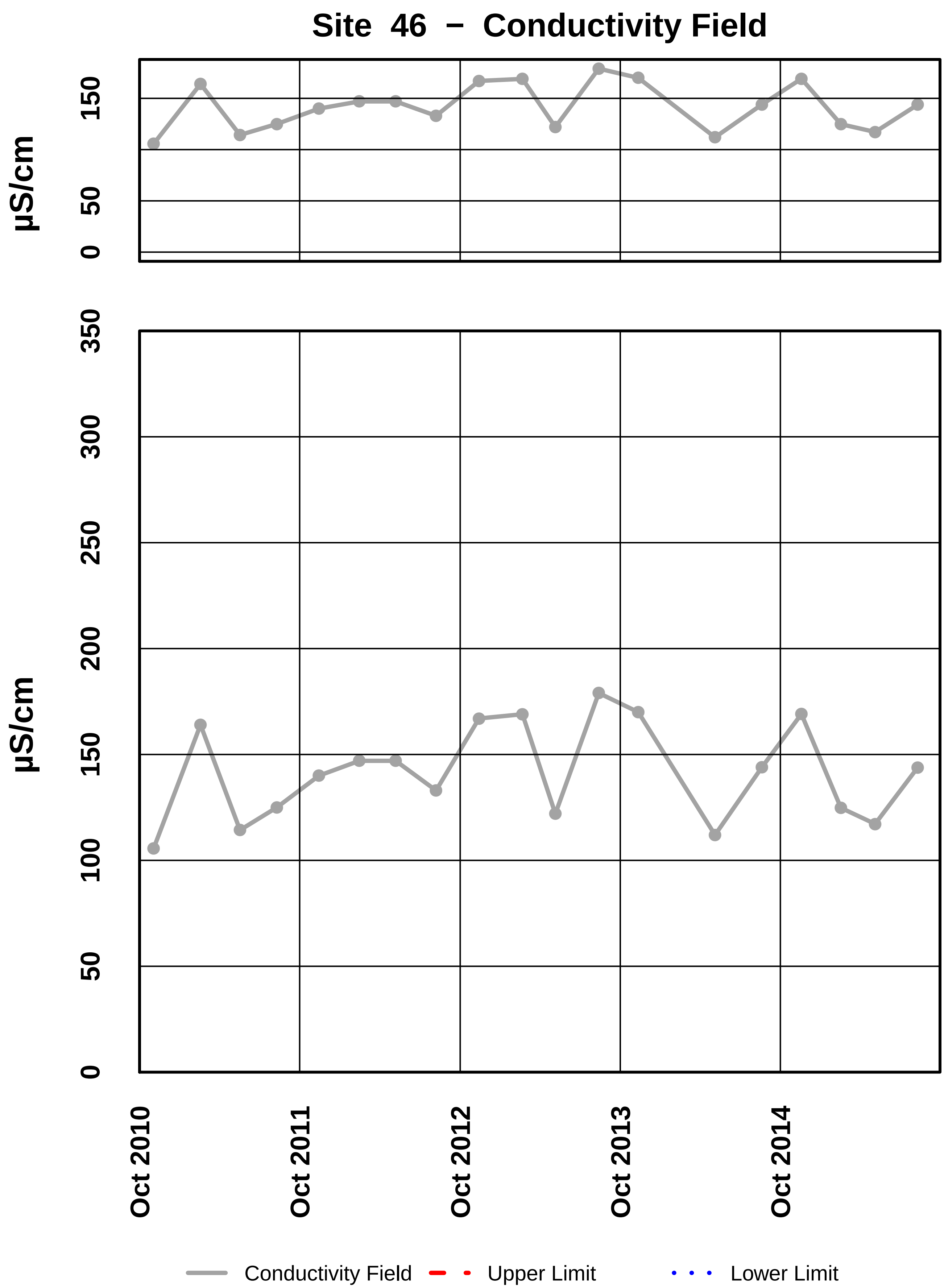
Site 46 – Water Temperature



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

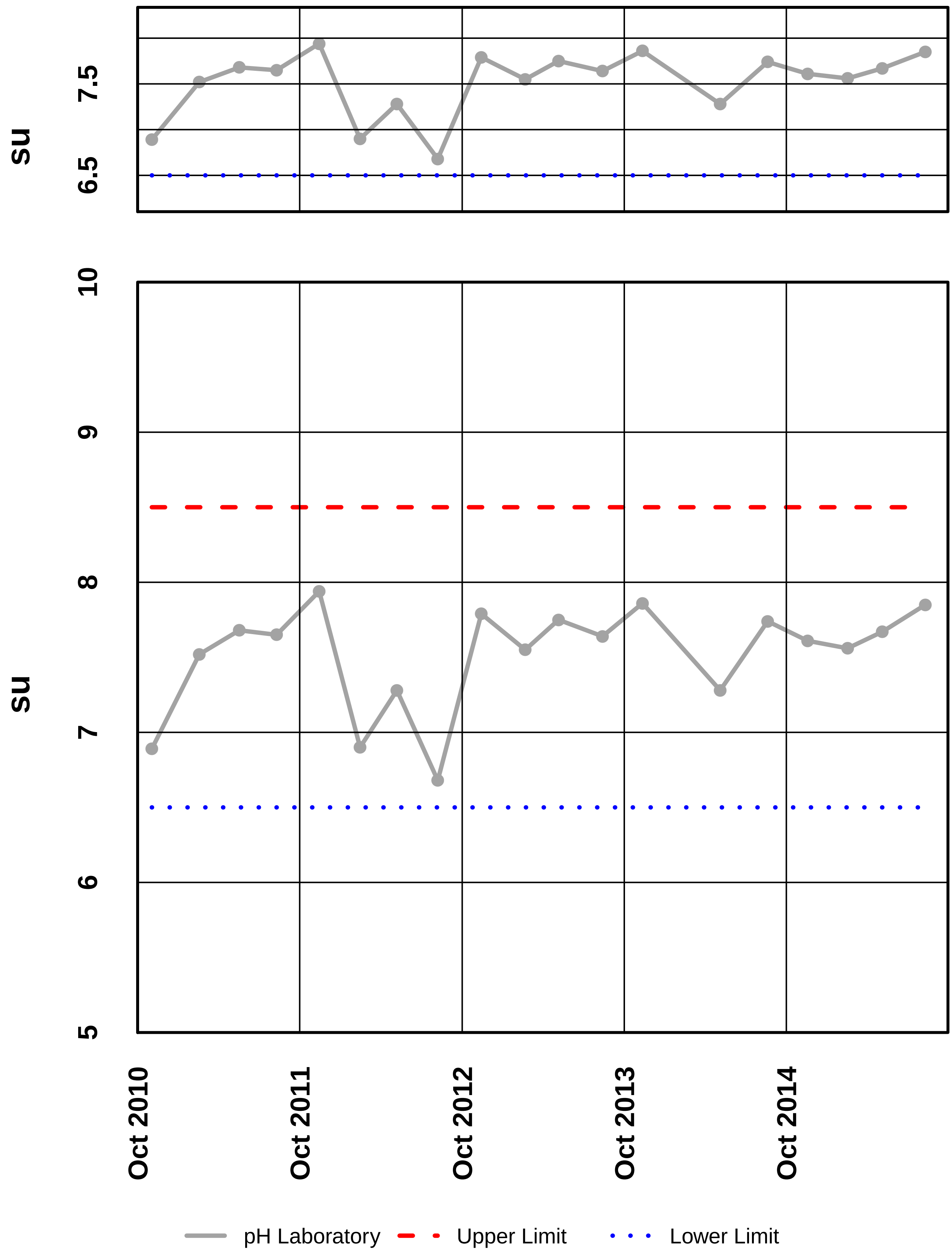


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



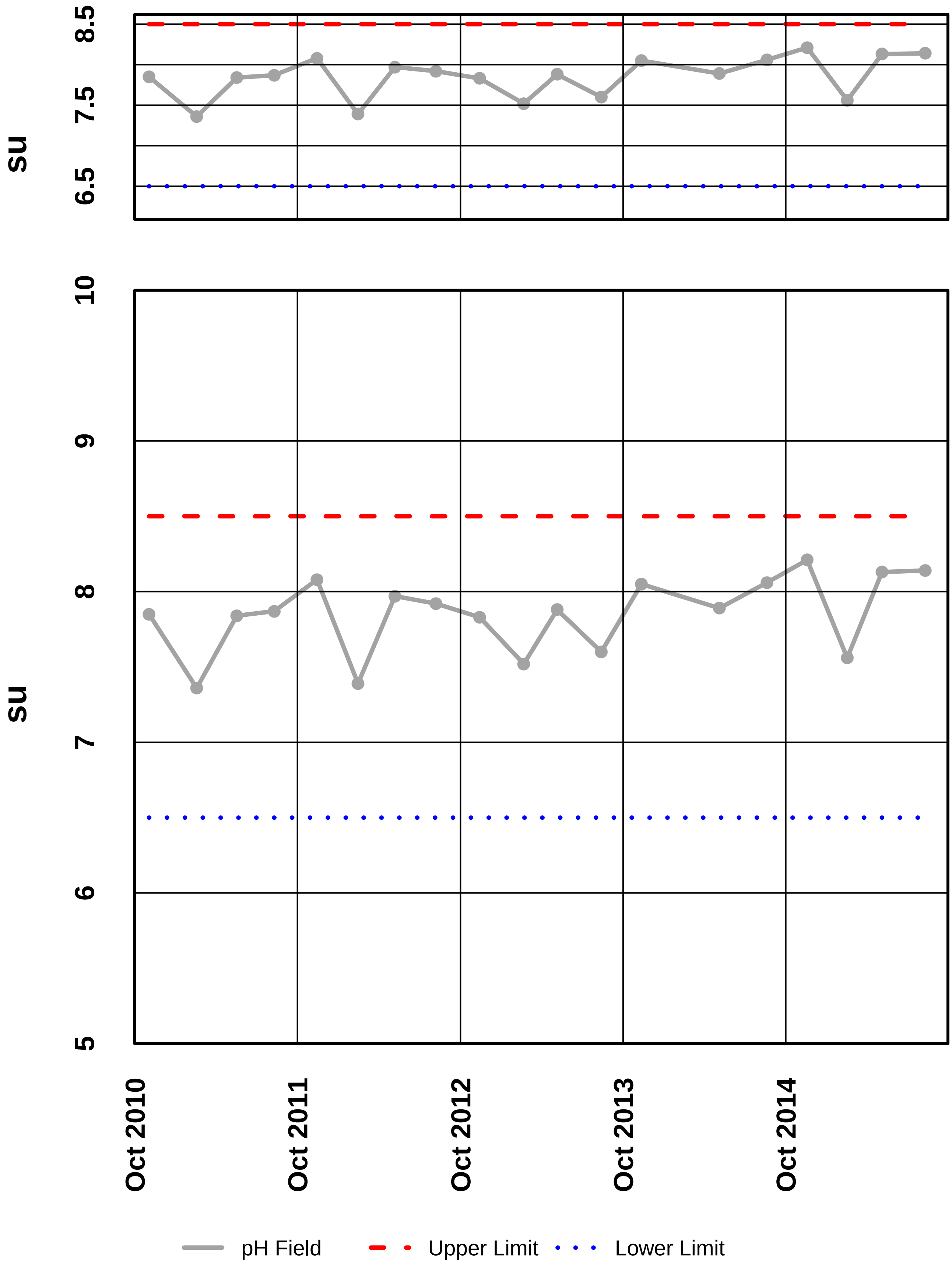
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 46 – pH Laboratory

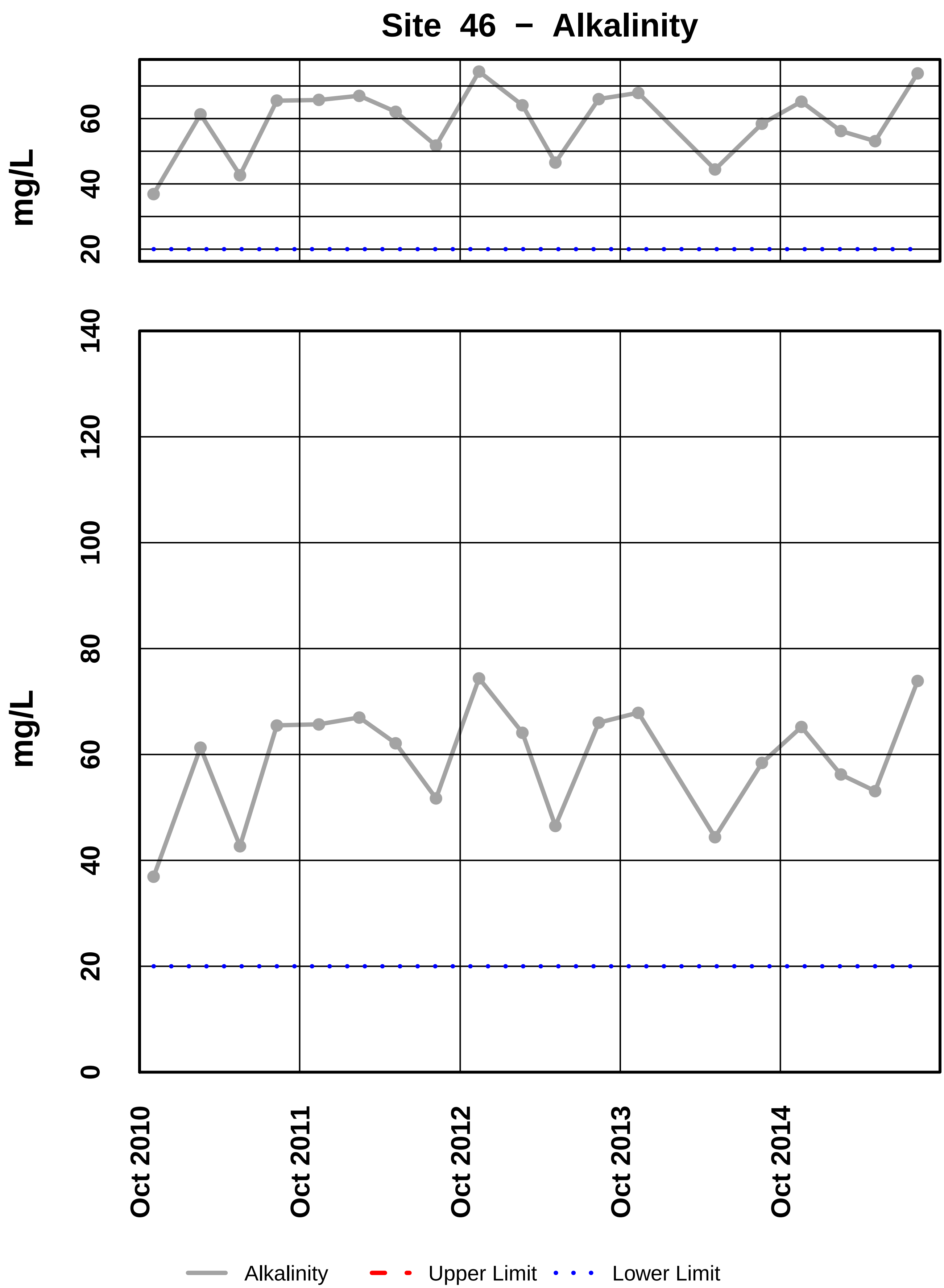


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 46 – pH Field

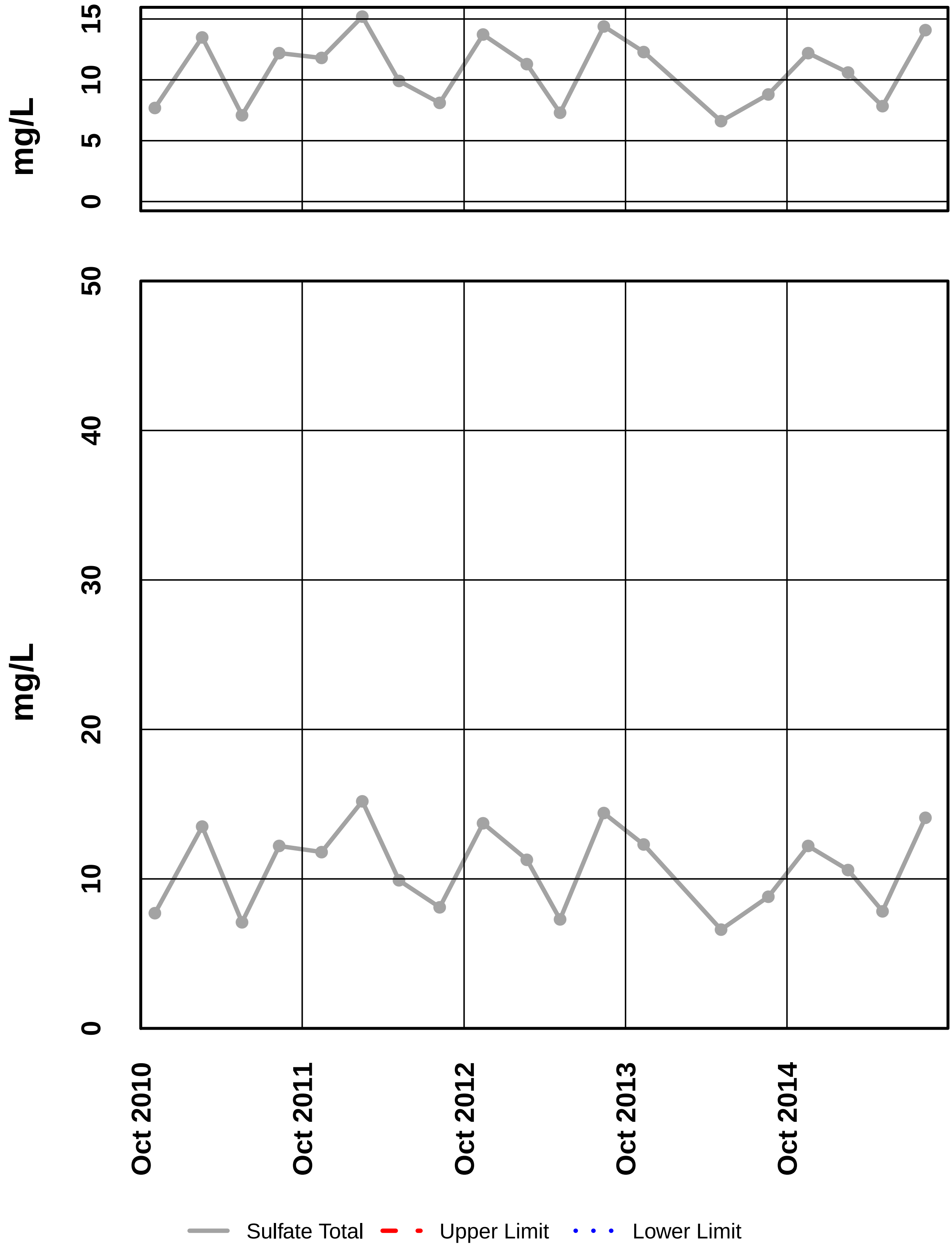


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

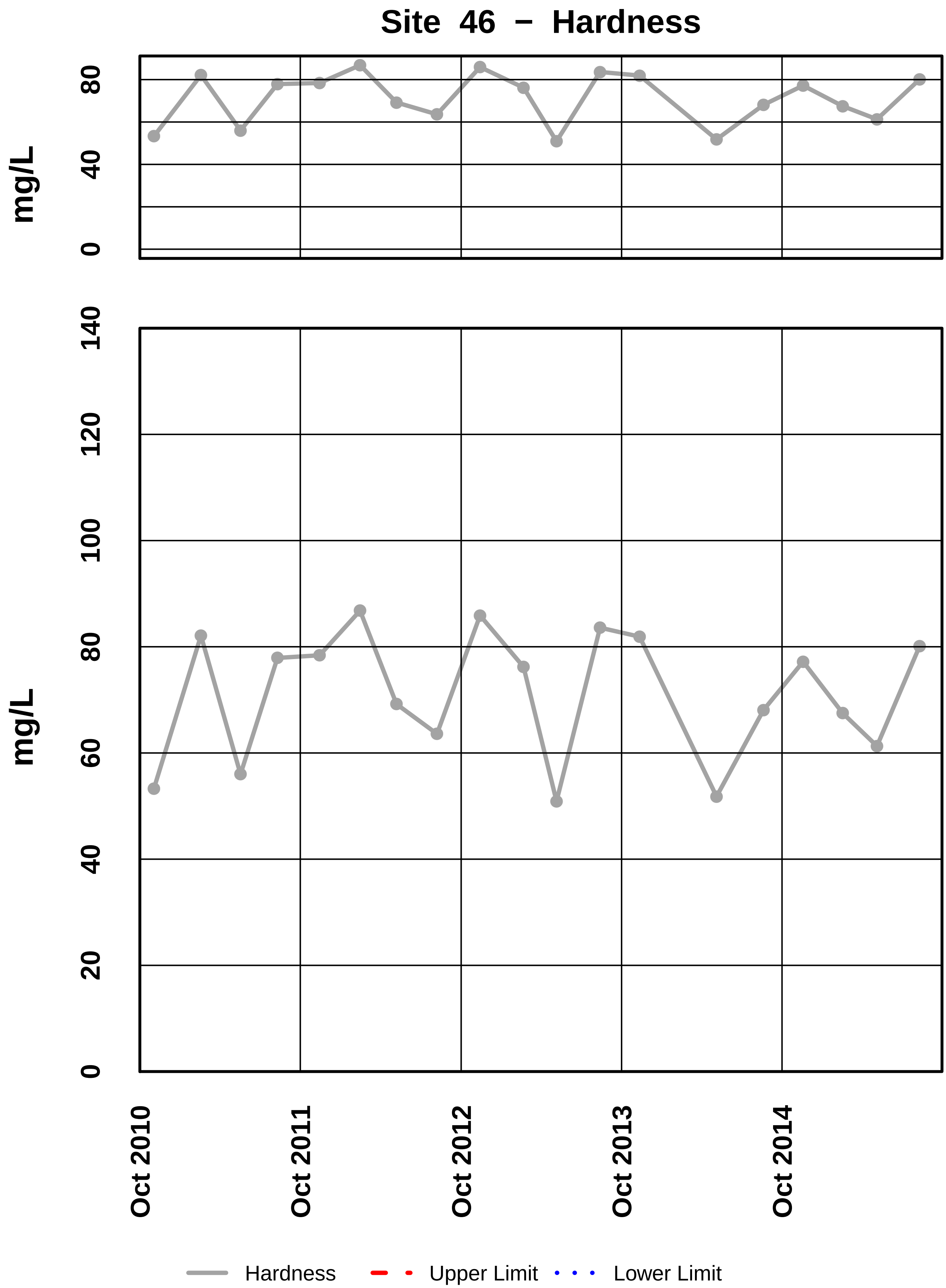


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 46 – Sulfate Total

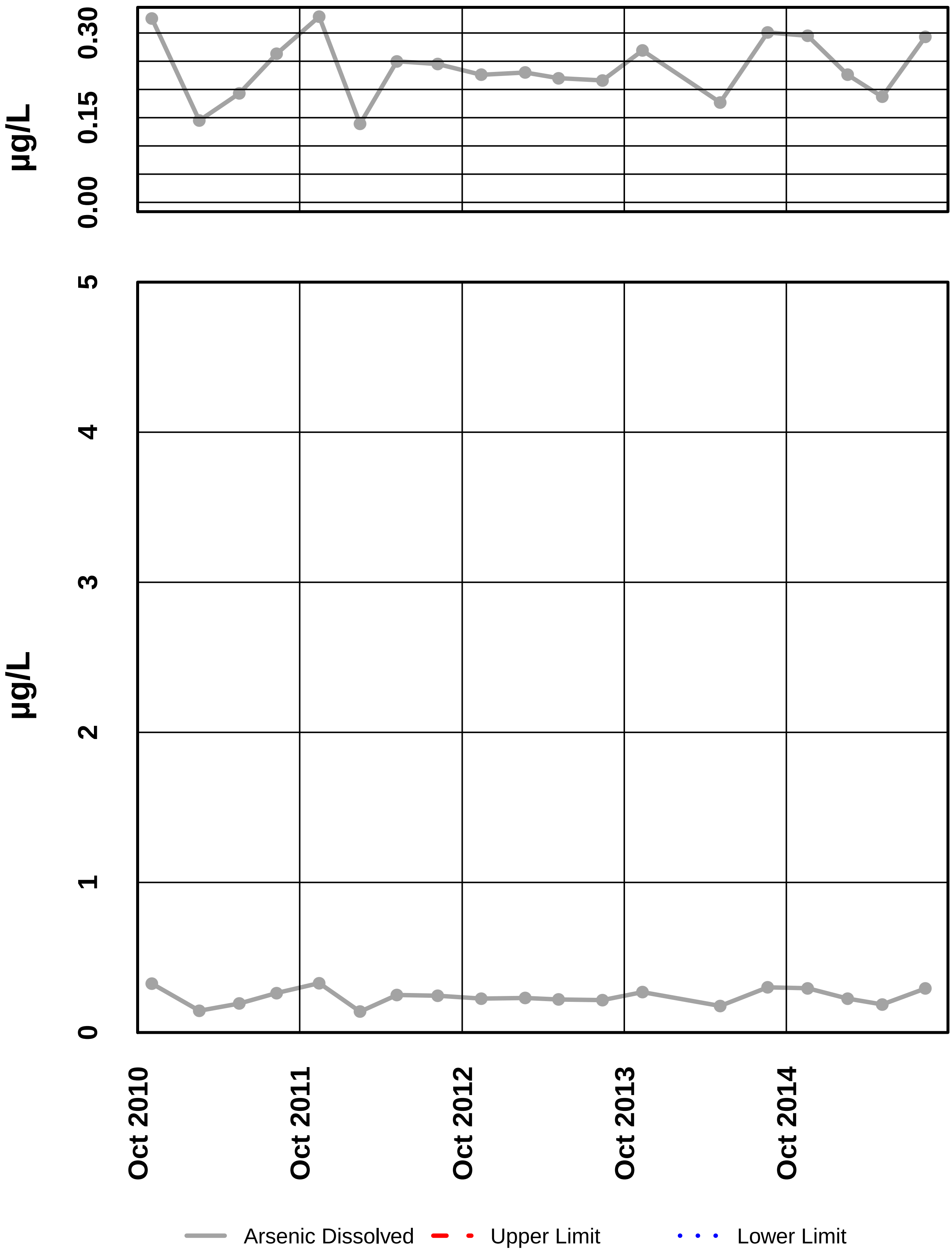


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



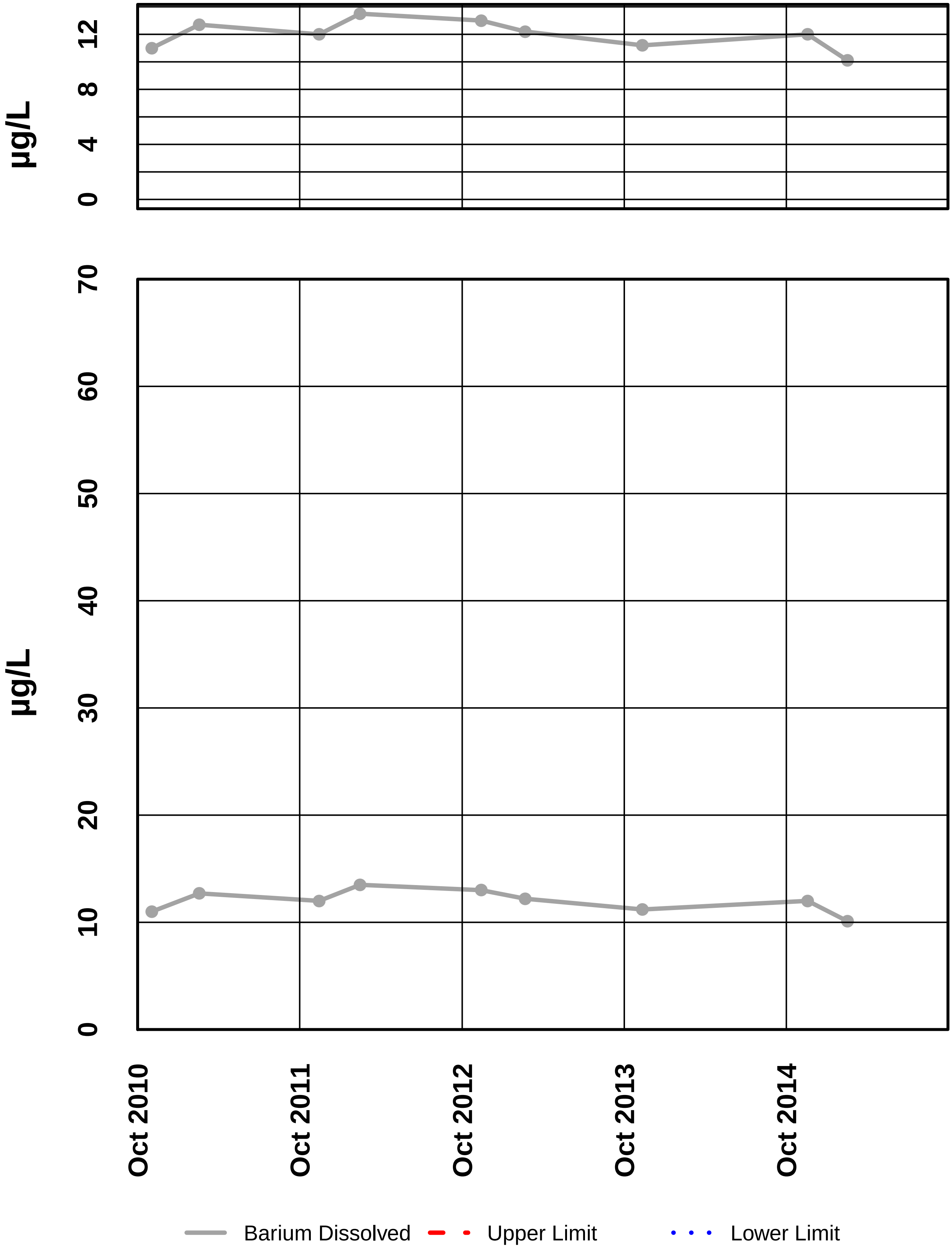
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 46 – Arsenic Dissolved

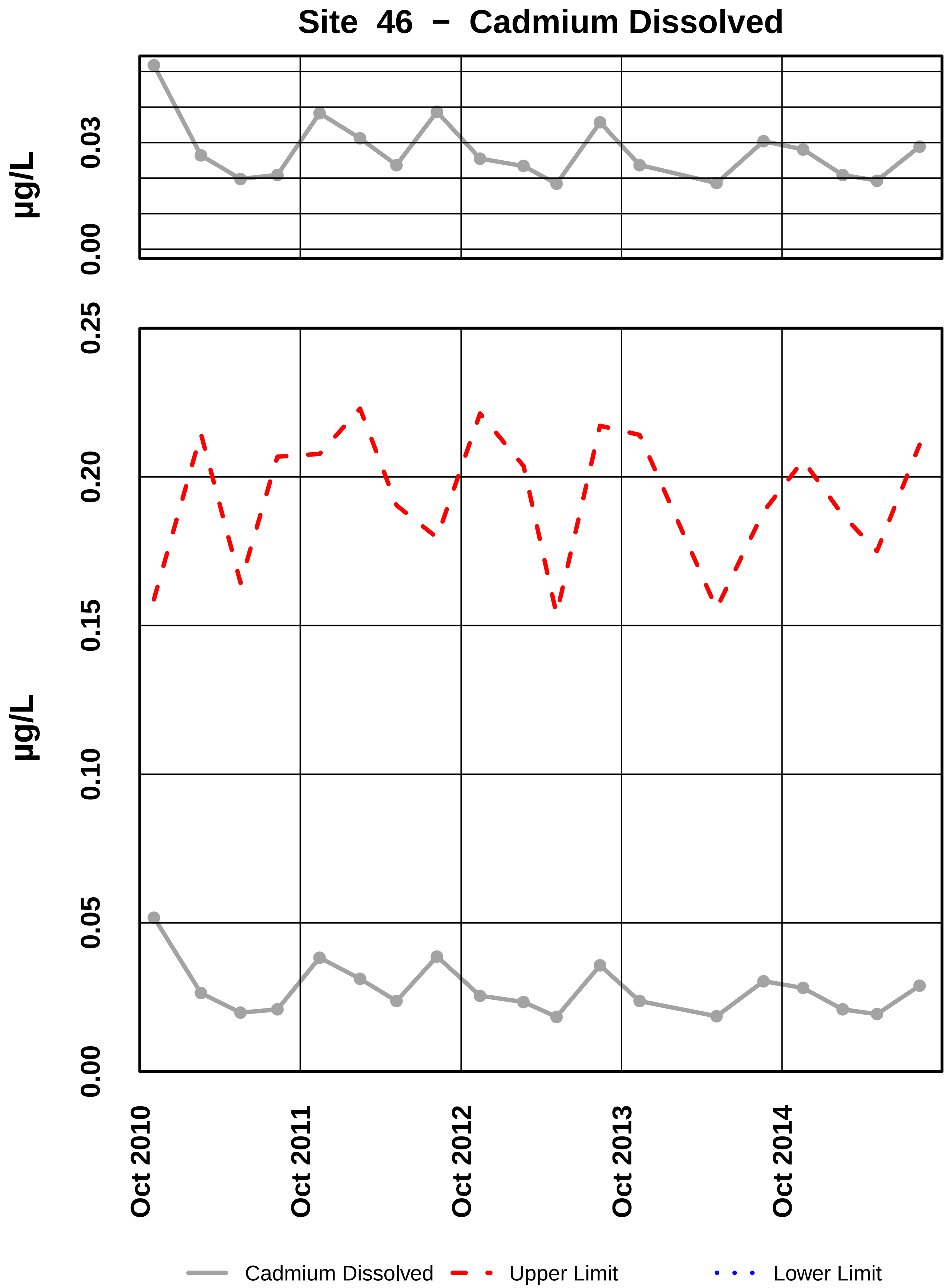


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

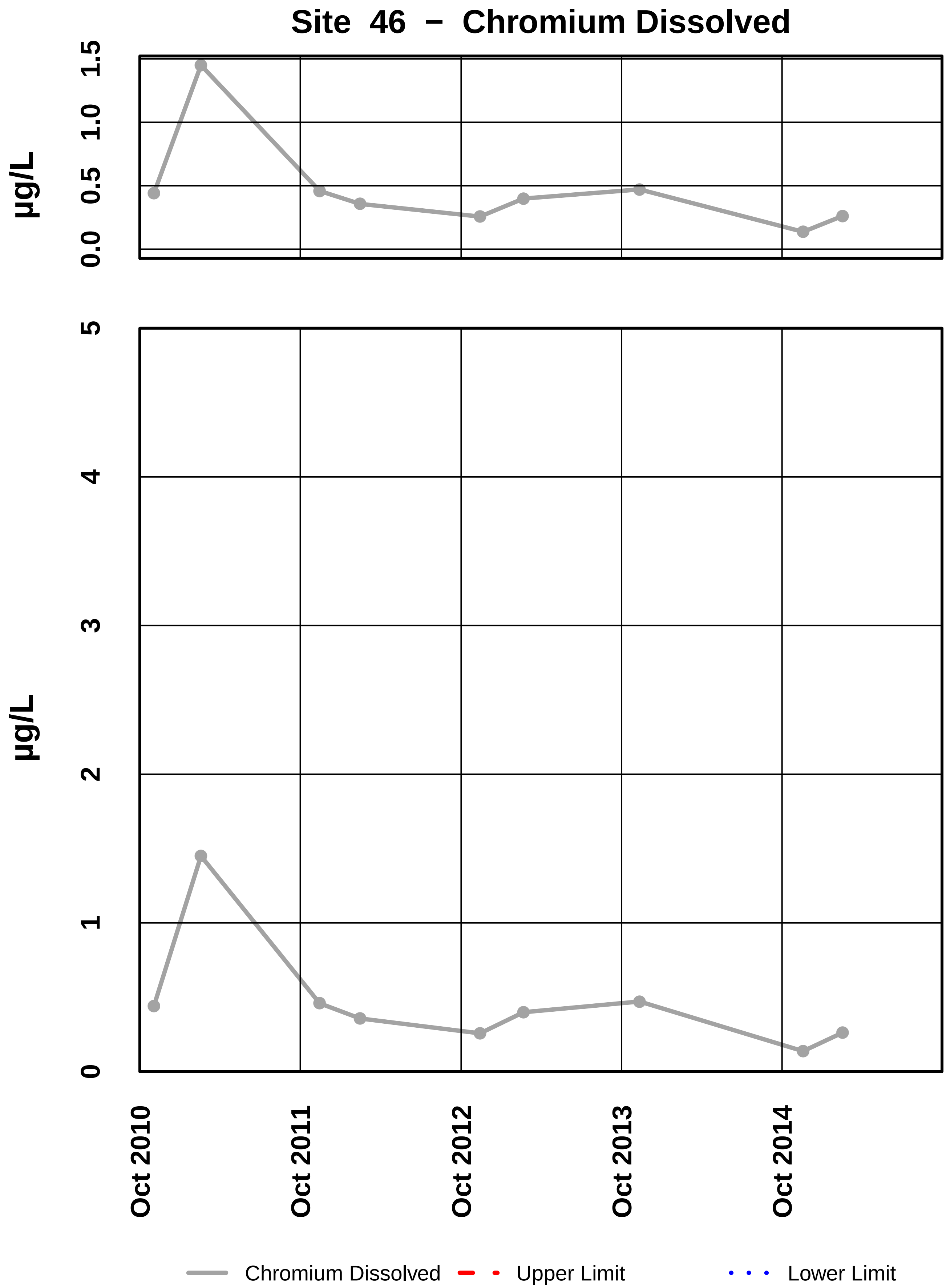
Site 46 – Barium Dissolved



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



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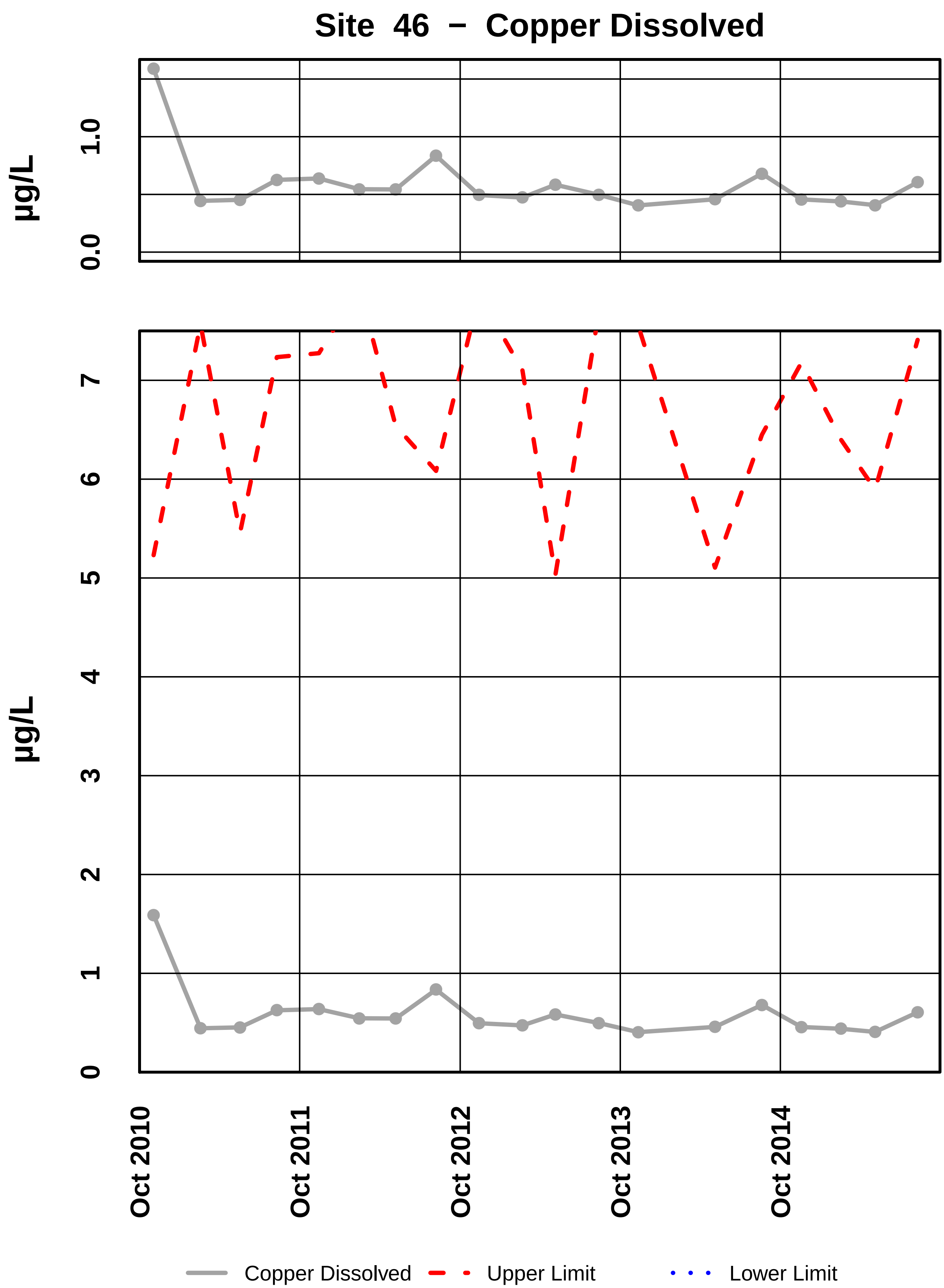
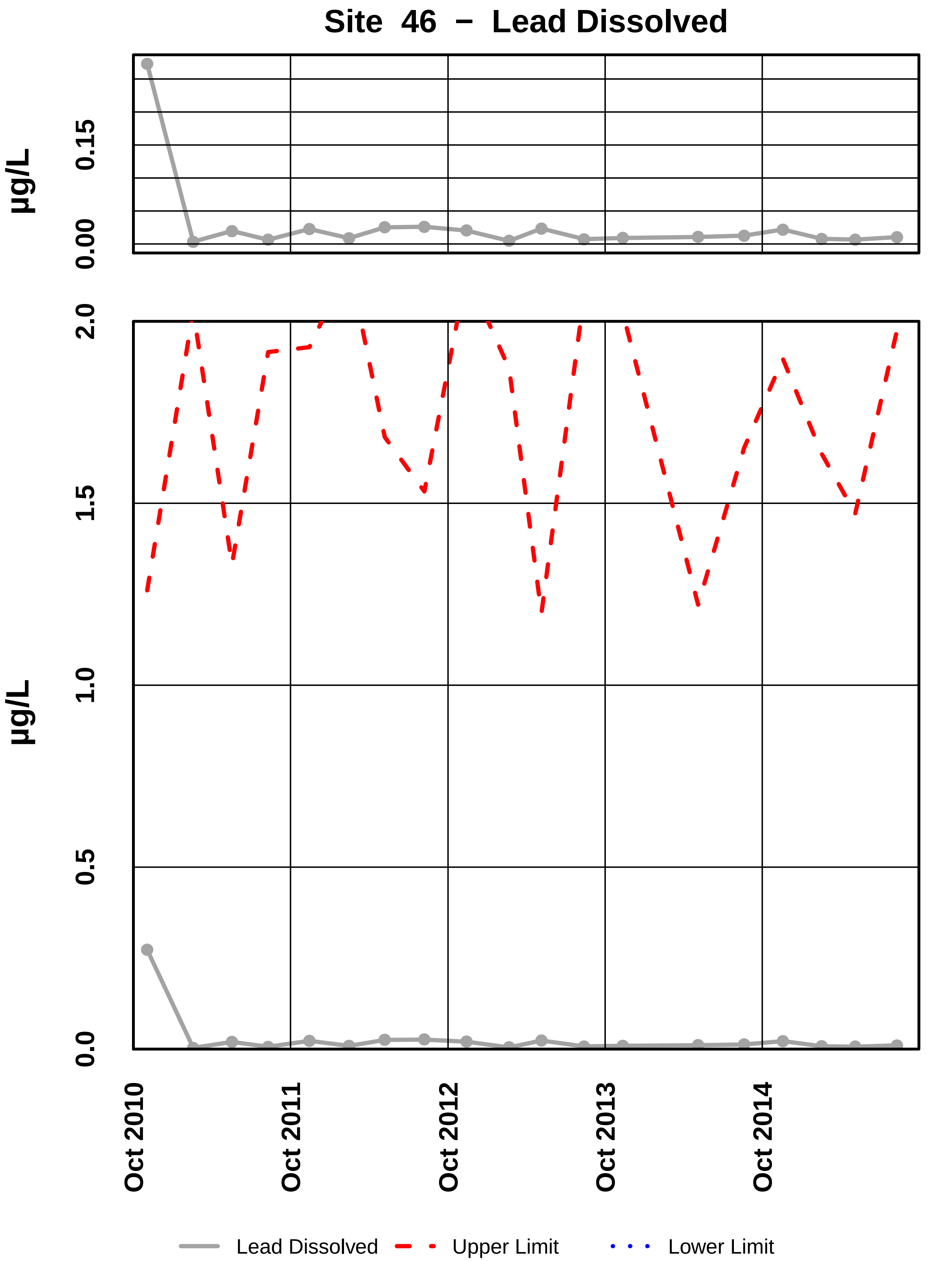
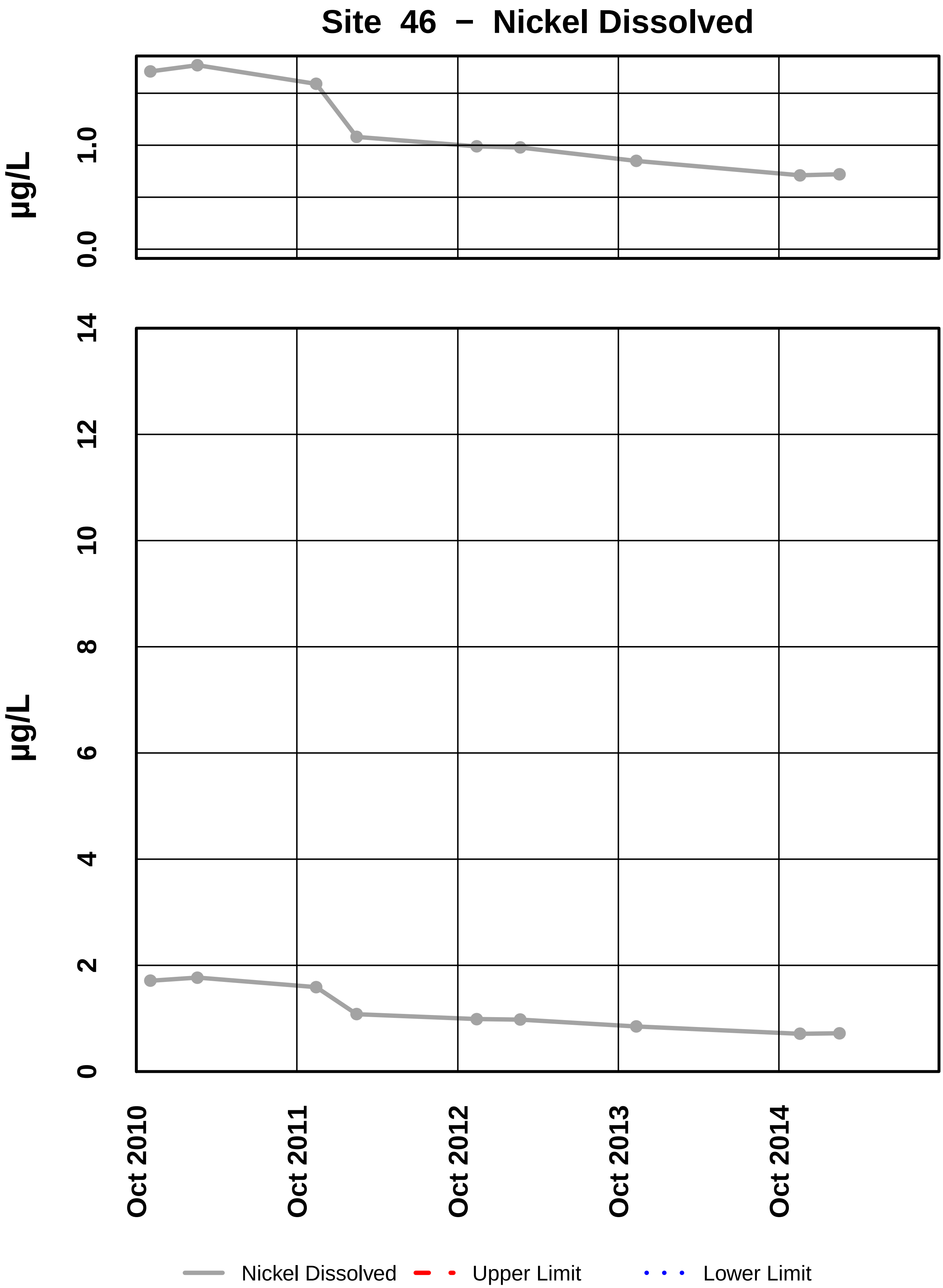


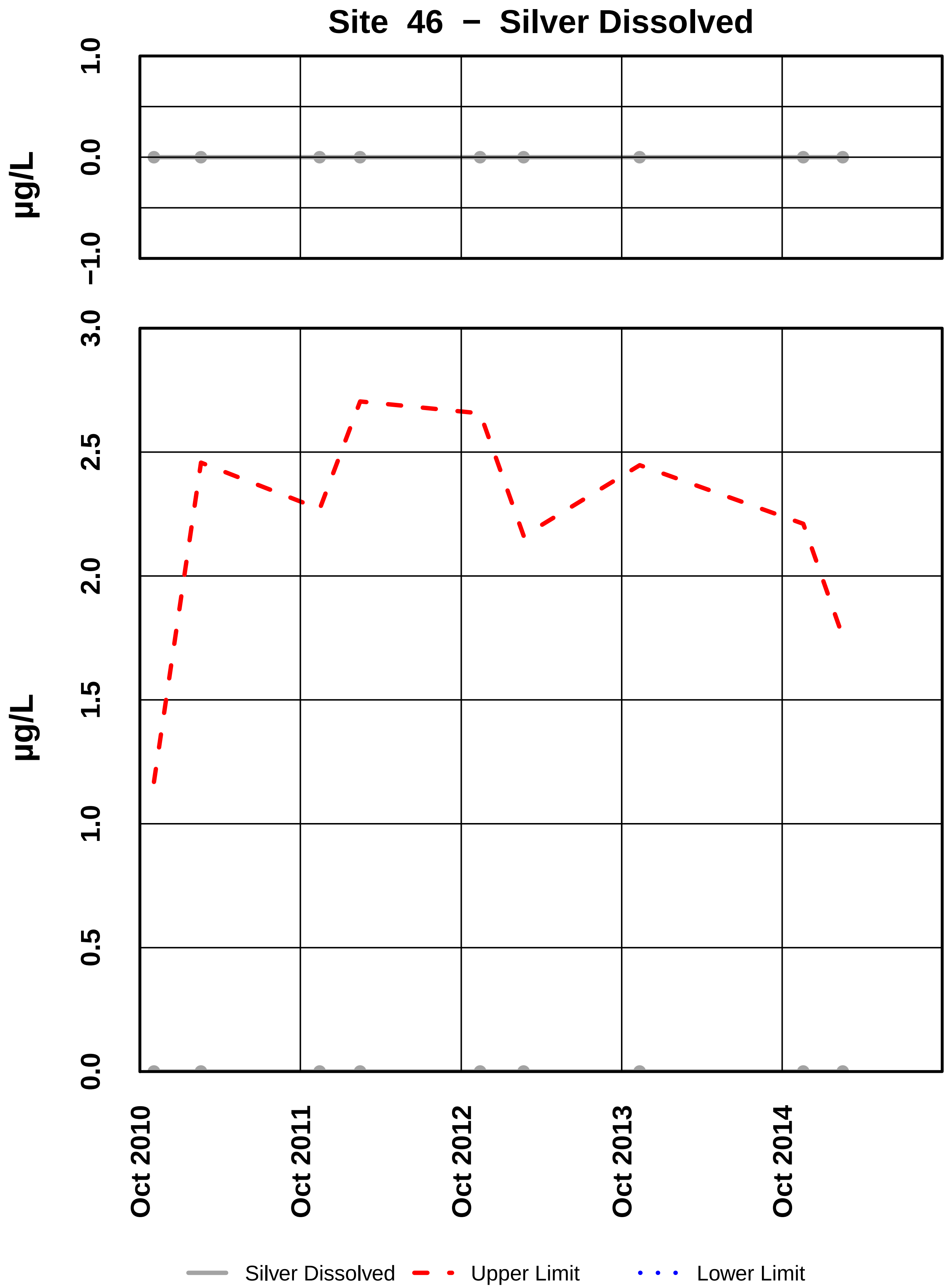
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



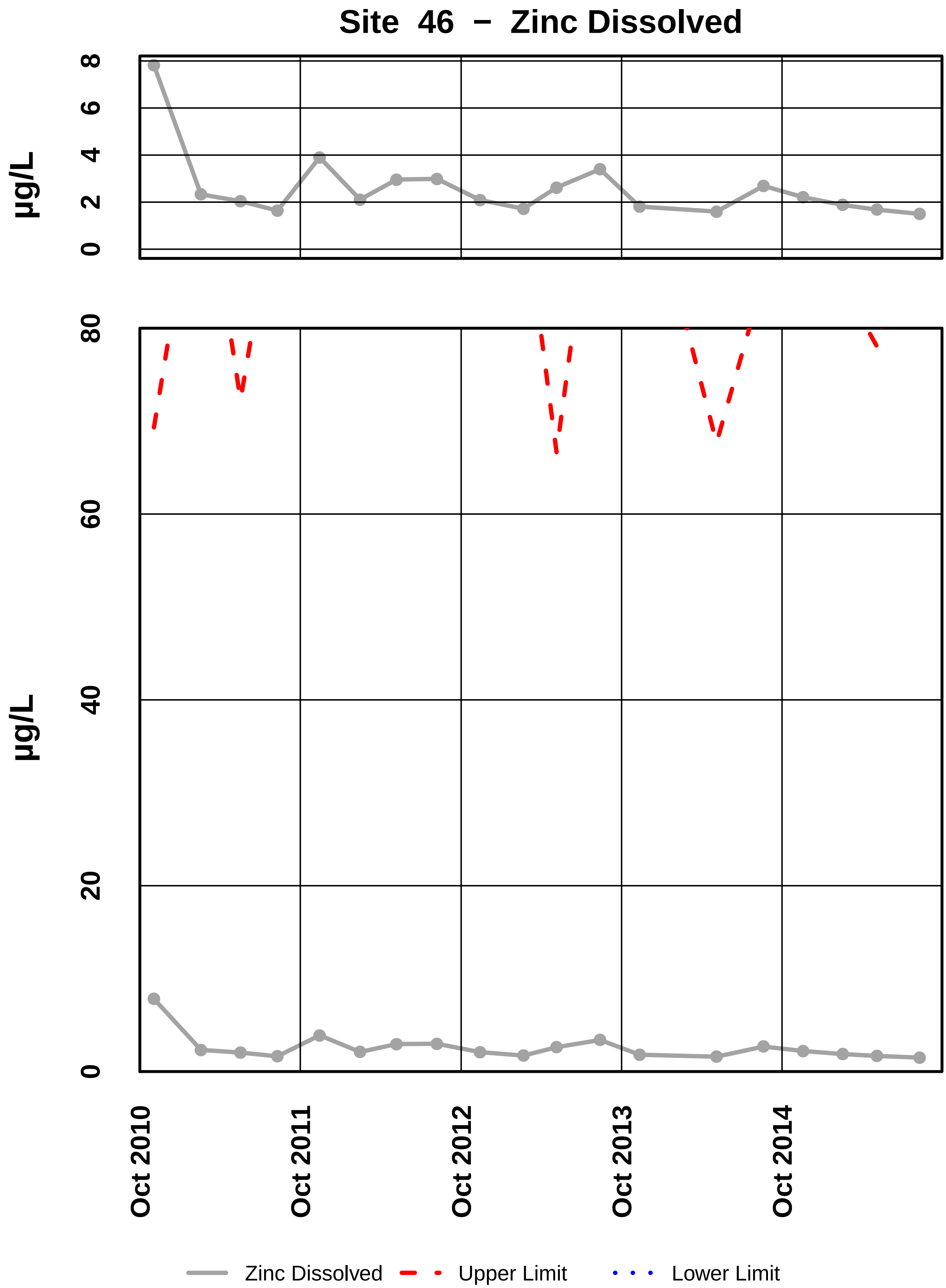
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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



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



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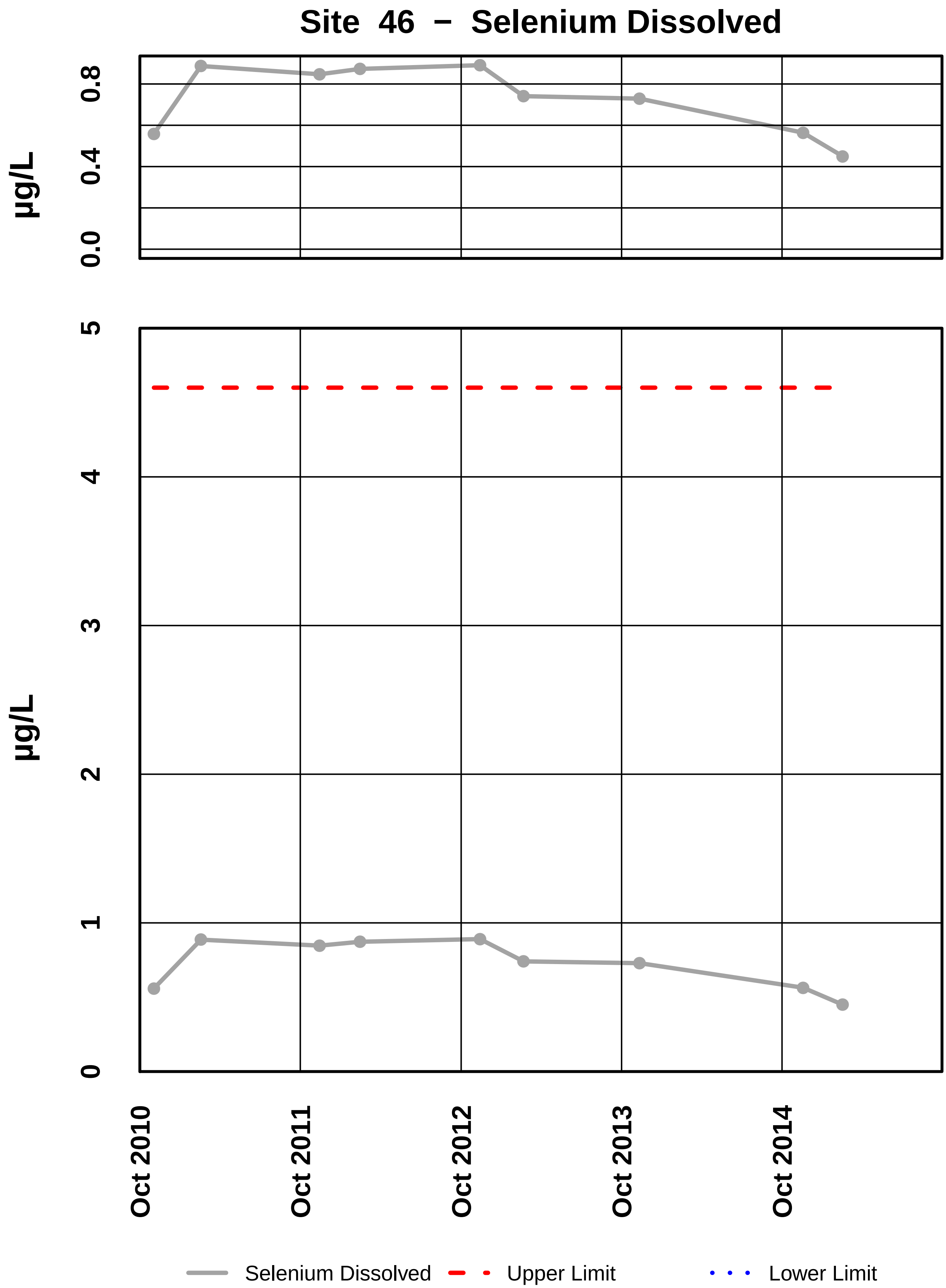
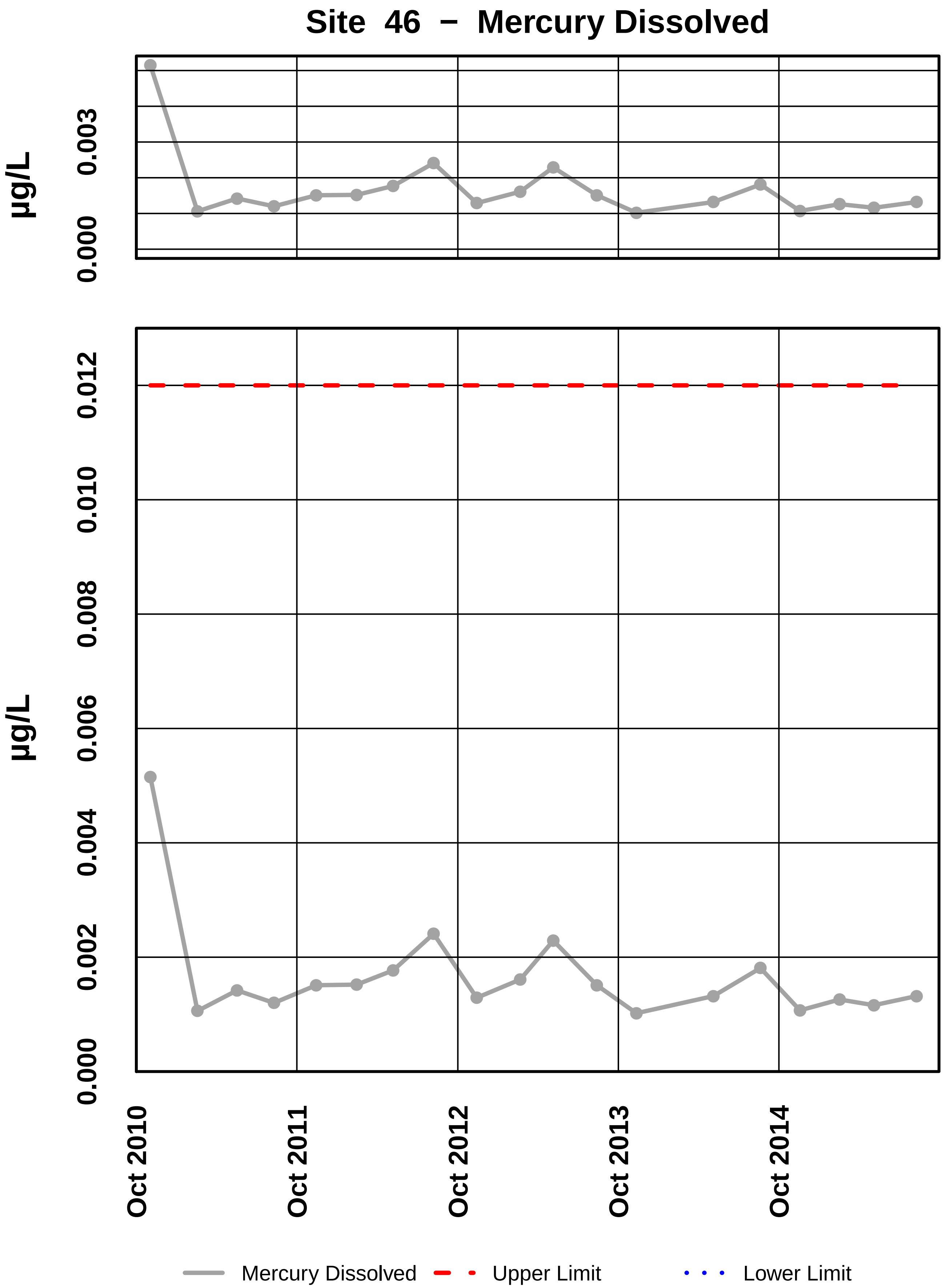


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

INTERPRETIVE REPORT
SITE 57

The data collected during the current water year are listed in the following "Table of Results for Water Year 2015" 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, in the past six years, have been identified by HGCMC.				

The data 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 2015

			Limits		
Sample Date	**Parameter**	**Value**	**Lower**	**Upper**	**Hardness**
18-Nov-14	Cadmium Dissolved	0.27 µg/L		0.24	94.4 mg/L
17-Mar-15	Cadmium Dissolved	0.38 µg/L		0.29	129 mg/L
18-Nov-14	Zinc Dissolved	273 µg/L		113	94.4 mg/L
17-Mar-15	Zinc Dissolved	178 µg/L		147	129 mg/L

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 hardness and conductivity have been trending down gradually for the past couple of years, in the 2015 Water Year both parameters dropped sharply but rebounded to 2014 Water Year levels by the August 2015 sampling. Dissolved cadmium and dissolved zinc, which have shown large variation in the past, were both in exceedance during and one sampling after the sharp drop in hardness. Also, there appears to be a gradual decrease in dissolved nickel over the past few years.

A non-parametric statistical analysis for trend was performed for specific conductivity, field pH, total alkalinity, total sulfate, and dissolved zinc. Calculation details of the Seasonal Kendall analyses are presented on the pages following this interpretive section. The following table summarizes the results on the data collected between Oct-09 and Sep-15 (WY2010-WY2015). Datasets with a statistically significant trend ($\alpha/2$=2.5%) a Seasonal-Sen's Slope estimate statistic has also been calculated. There were four statistically significant trends calculated for these parameters this water year. Of note is the increasing trend in dissolved zinc, with a Sen's slope estimate of 7.547 µg/L/yr. Site 57 is an upgradient background site and this trend is an example of the natural variability of the system.

Table of Summary Statistics for Trend Analysis

	Mann-Kendall test statistics			Sen's slope estimate	
Parameter	**n***	**p****	**Trend**	**Q**	**Q(%)**
Conductivity Field	6	<0.01	-	-16.8	-4.319
pH Field	6	<0.01	+	0.023	0.302
Alkalinity, Total	6	0.06			
Sulfate, Total	6	<0.01	-	-3.10	-6.28
Zinc, Dissolved	6	<0.01	+	7.547	39.516

* Number of Years ** Significance level

Table of Results for Water Year 2015

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

Sample Date/Parameter	Oct 2014	Nov 2014	Dec 2014	Jan 2015	Feb 2015	Mar 2015	Apr 2015	May 2015	Jun 2015	Jul 2015	Aug 2015	Sep 2015	**Median**
Water Temp (°C)		5.5				4.7		7			7.2		6.3
Conductivity-Field(µmho)		216				233		347			406		290.0
Conductivity-Lab (µmho)		205				250		277			367		264
pH Lab (standard units)		7.19				7.24		7.03			7.79		7.22
pH Field (standard units)		7.77				7.26		7.85			7.77		7.77
Total Alkalinity (mg/L)		80.6				95.2		126			140		110.6
Total Sulfate (mg/L)		39.6				26		30.4			50.6		35.0
Hardness (mg/L)		94.4				129		162			194		145.5
Dissolved As (ug/L)		0.387				0.512		0.542			0.67		0.527
Dissolved Ba (ug/L)		62.4				55.9		46.5			31.7		51.2
Dissolved Cd (ug/L)		0.272				0.383		0.226			0.176		0.2490
Dissolved Cr (ug/L)		0.229				0.717		0.587			1.08		0.652
Dissolved Cu (ug/L)		1.43				5.35		2.43			1.18		1.930
Dissolved Pb (ug/L)		0.762				0.758		0.401			0.421		0.5895
Dissolved Ni (ug/L)		0.912				1.46		0.938			1		0.969
Dissolved Ag (ug/L)		0.002				0.002		0.002			0.002		0.002
Dissolved Zn (ug/L)		273				178		78.7			46.7		128.35
Dissolved Se (ug/L)		0.374				0.495		0.63			0.743		0.563
Dissolved Hg (ug/L)		0.00101				0.000669		0.000469			0.000241		0.000569

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

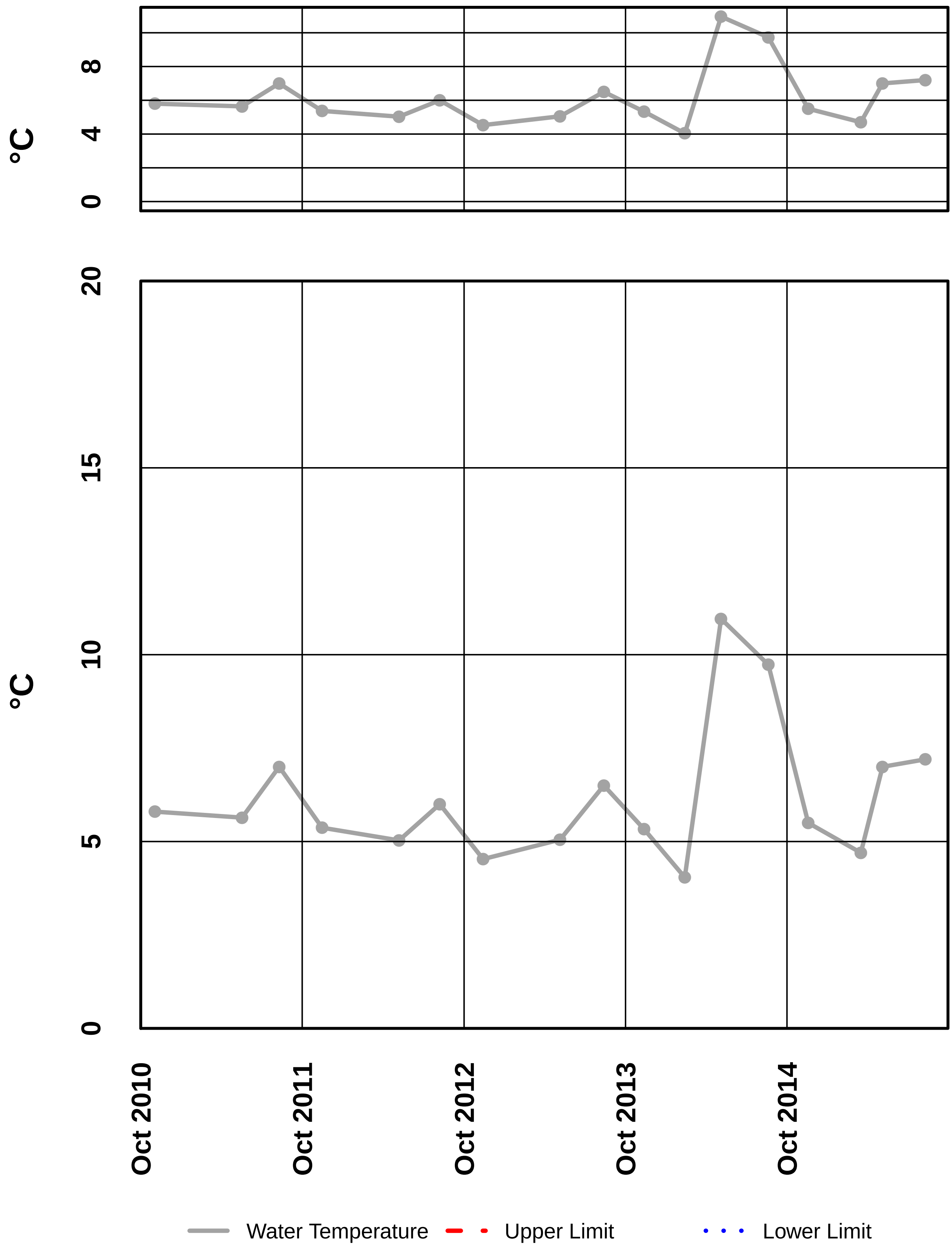
Qualified Data by QA Reviewer

Date Range: 10/01/2014 to 09/30/2015

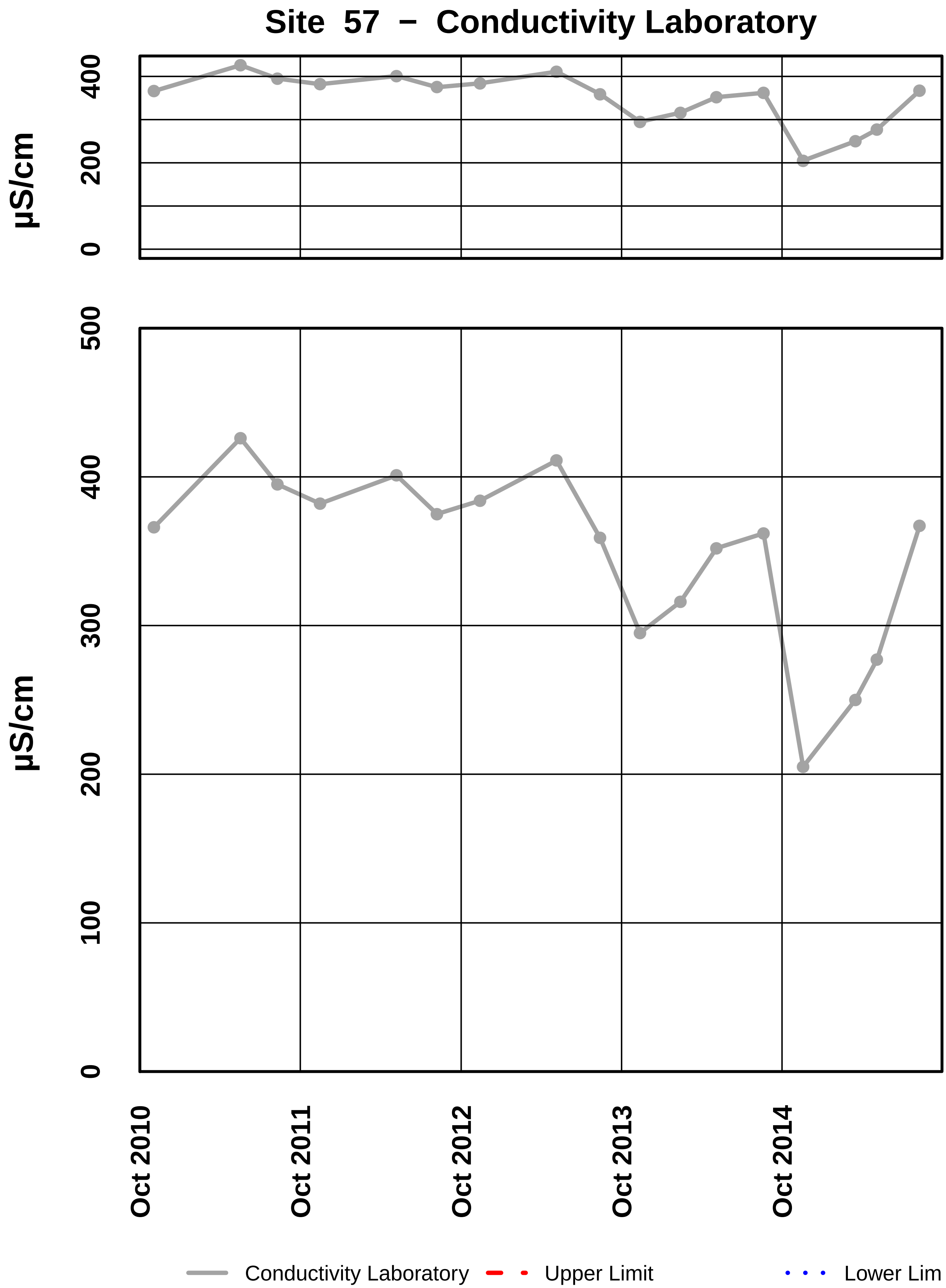
Site No.	Sample Date	Sample Time	Parameter	Value		Qualifier	Reason for Qualifier
057FMG	08/10/2015	12:00 AM	Diss. Hg-CVAF	0.000241	µg/L	J	Below Quantitative Range
			Sulfate	50.6	mg/L	J	Sample Receipt Temperature
057FMS	05/05/2015	12:00 AM	Sulfate	30.4	mg/L	J	Sample Receipt Temperature

Qualifier	Description
J	Positively Identified - Approximate Concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit

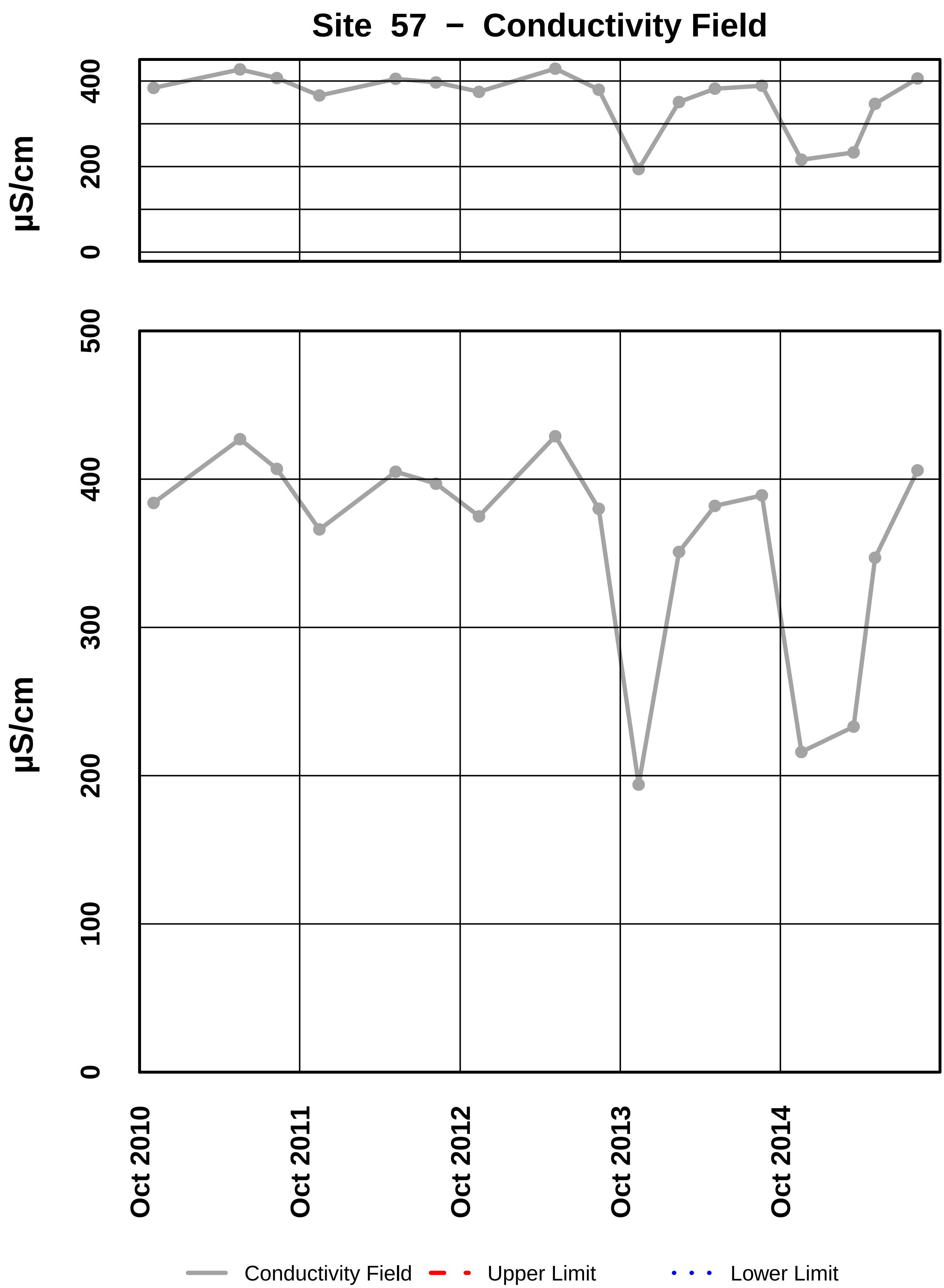
Site 57 – Water Temperature



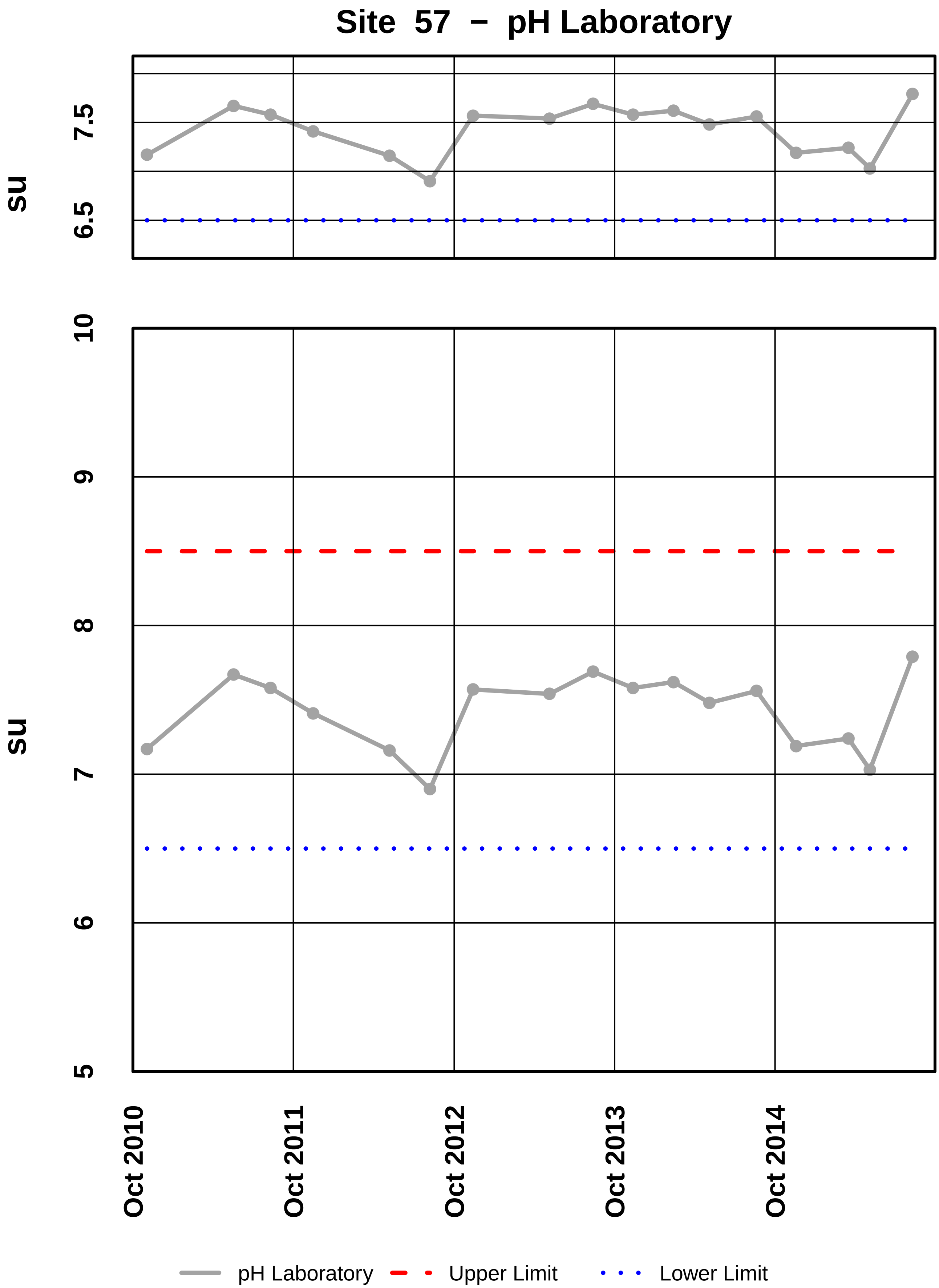
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

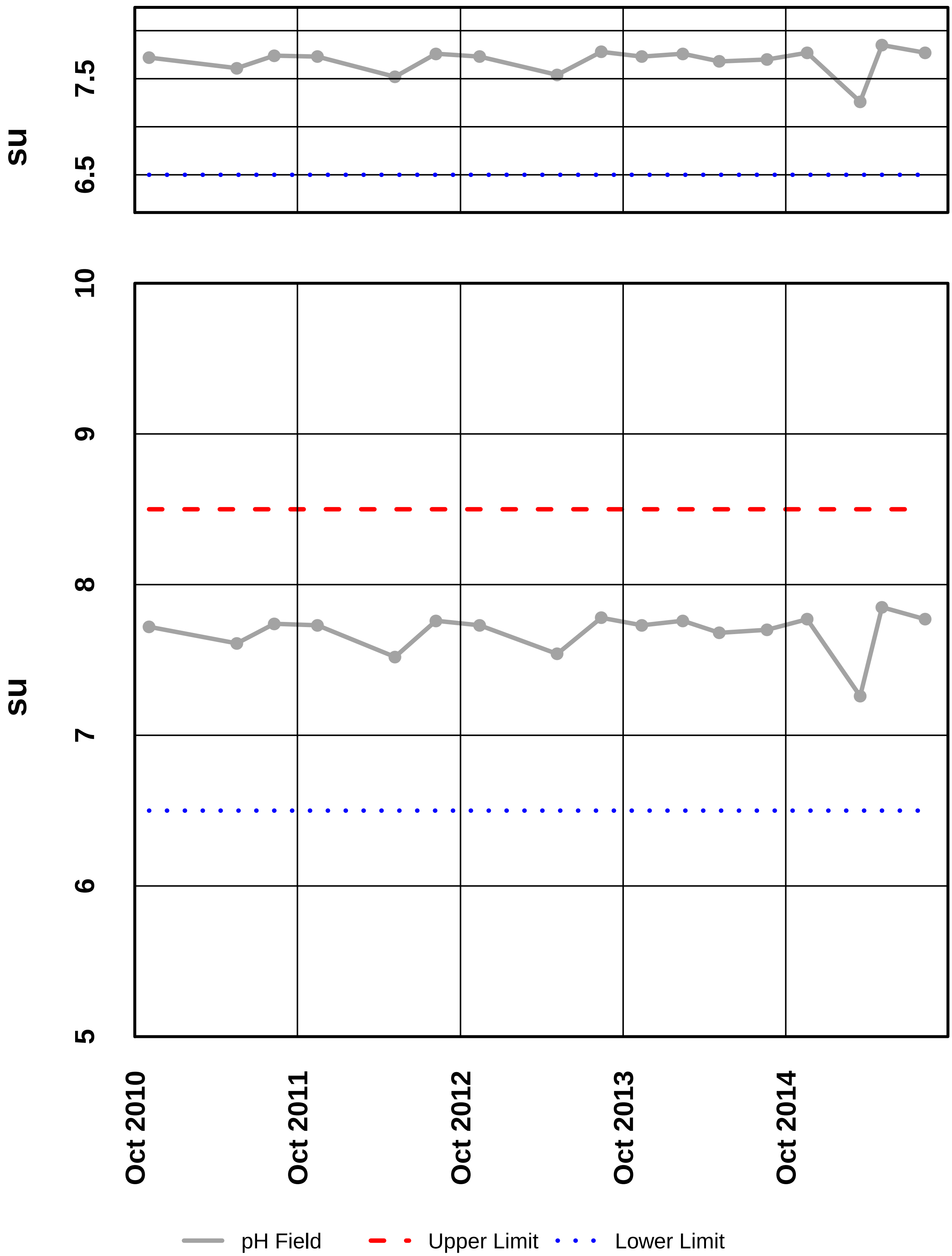


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

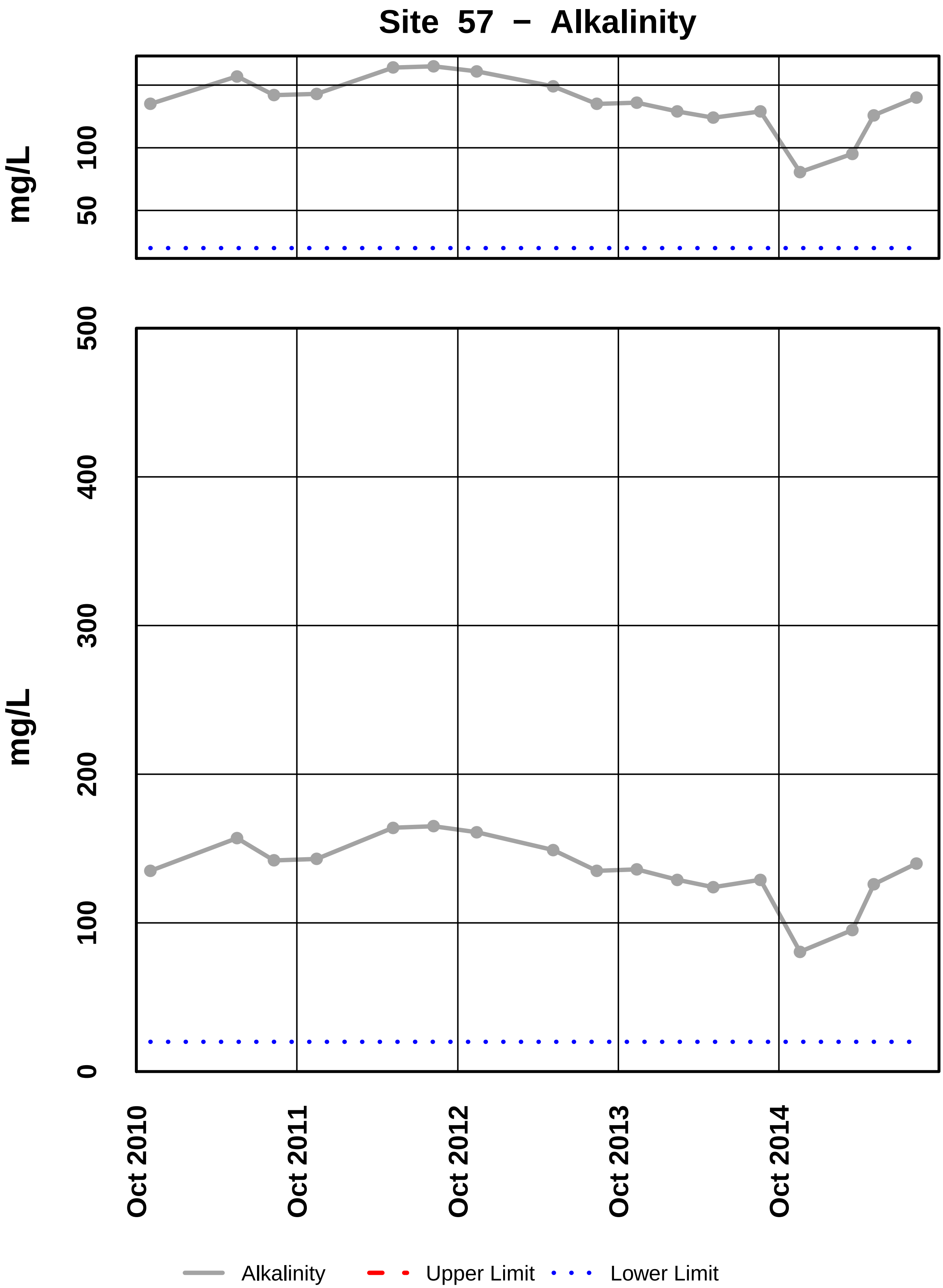


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

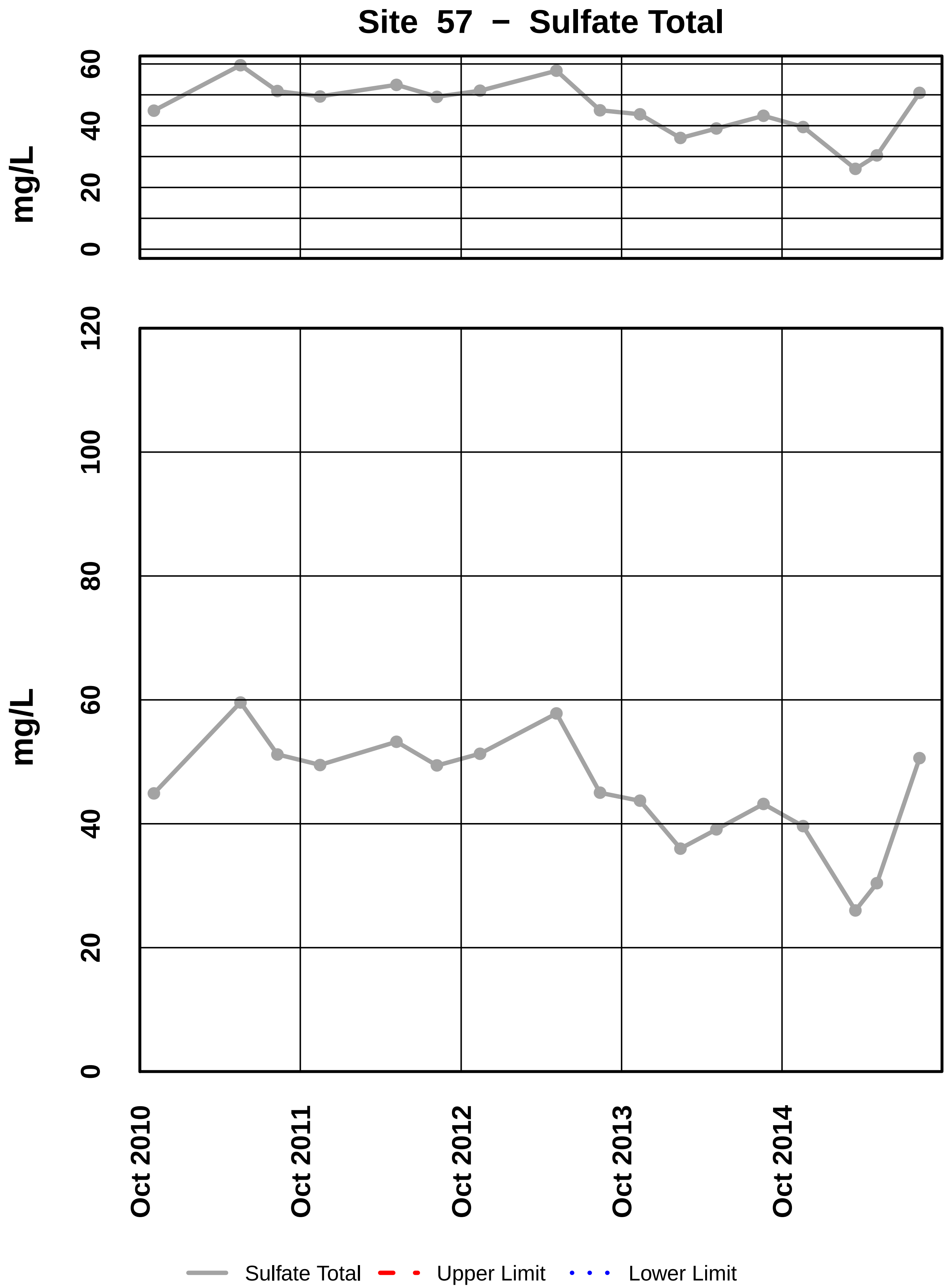
Site 57 – pH Field



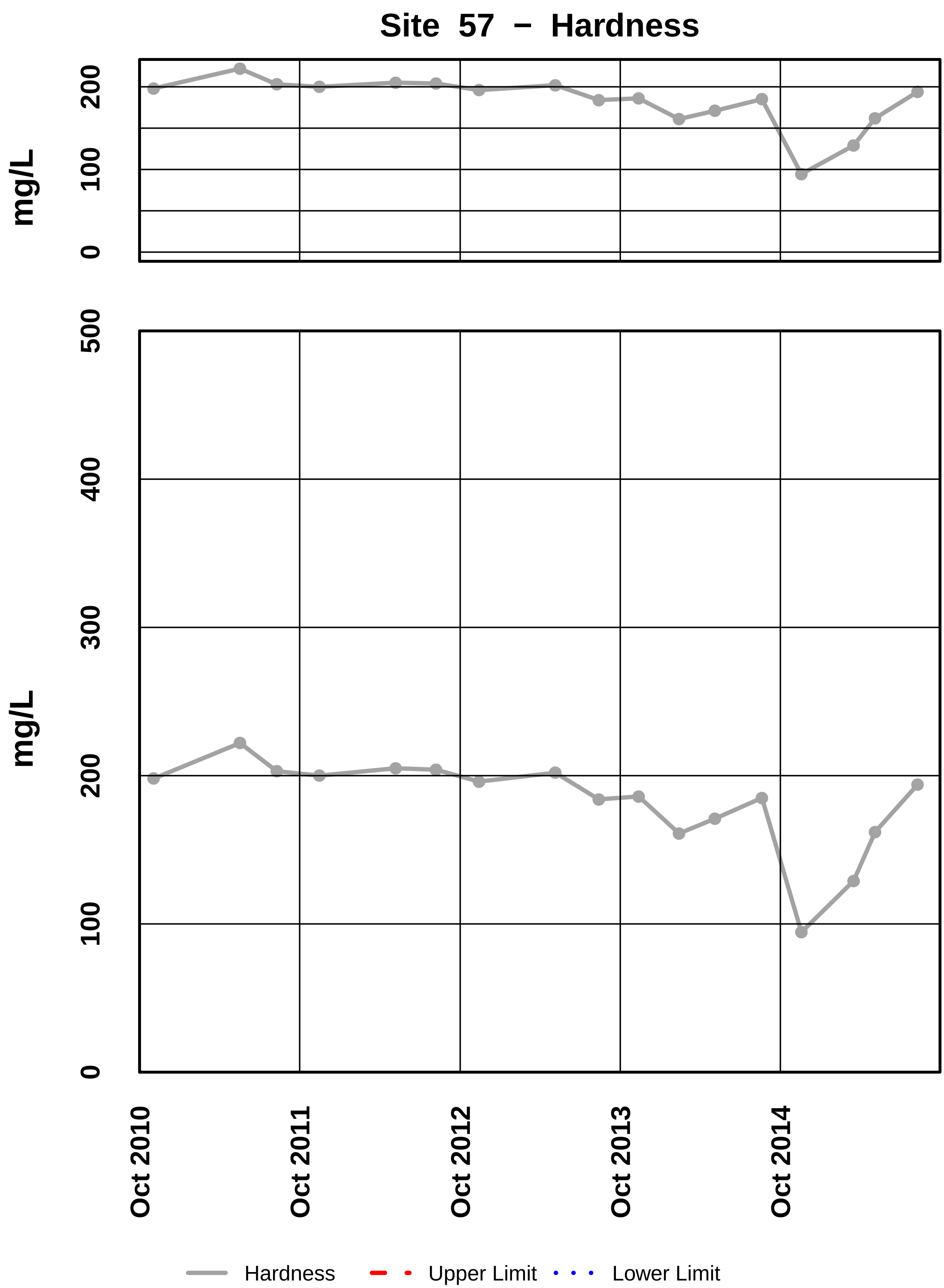
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



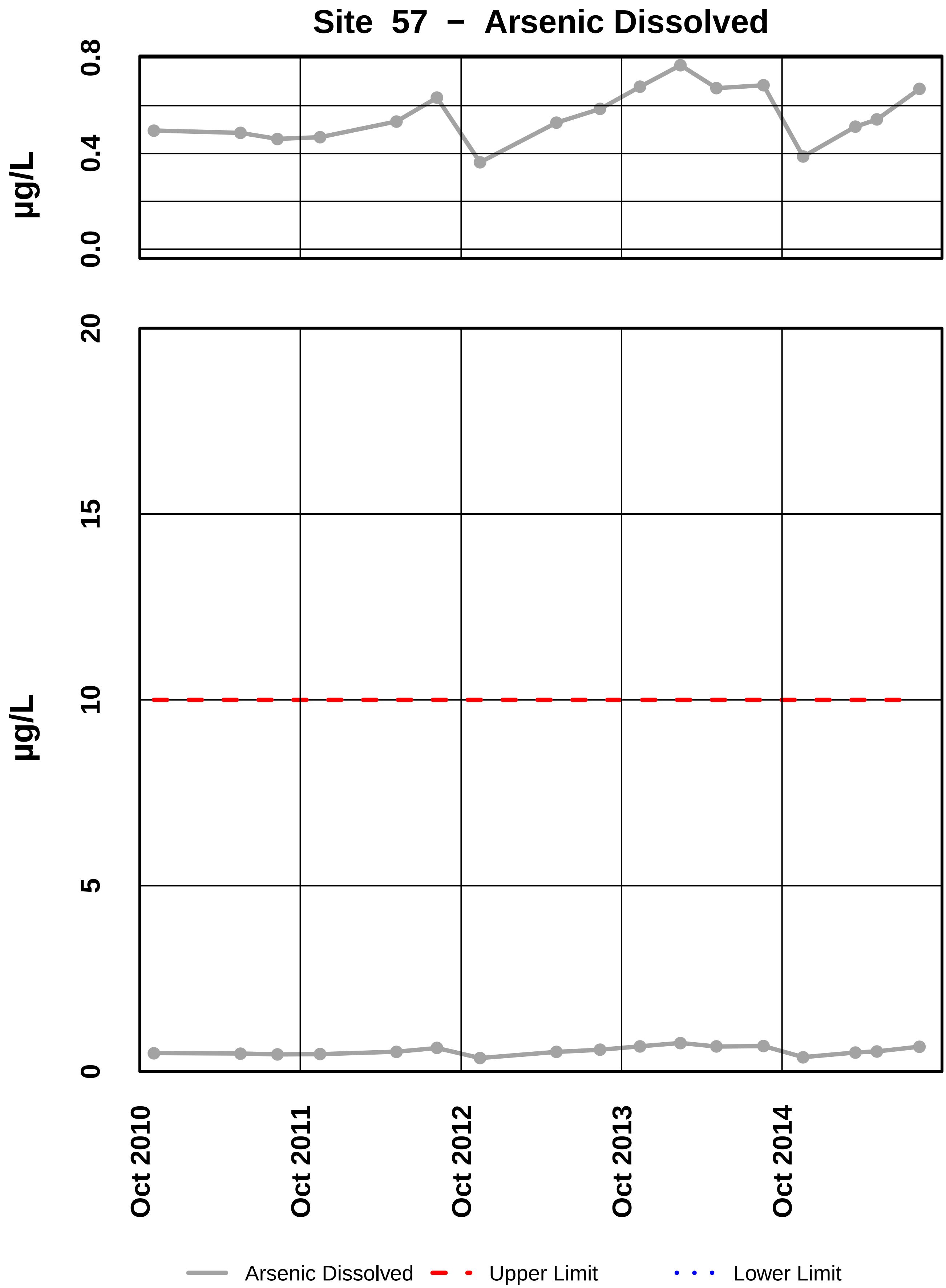
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



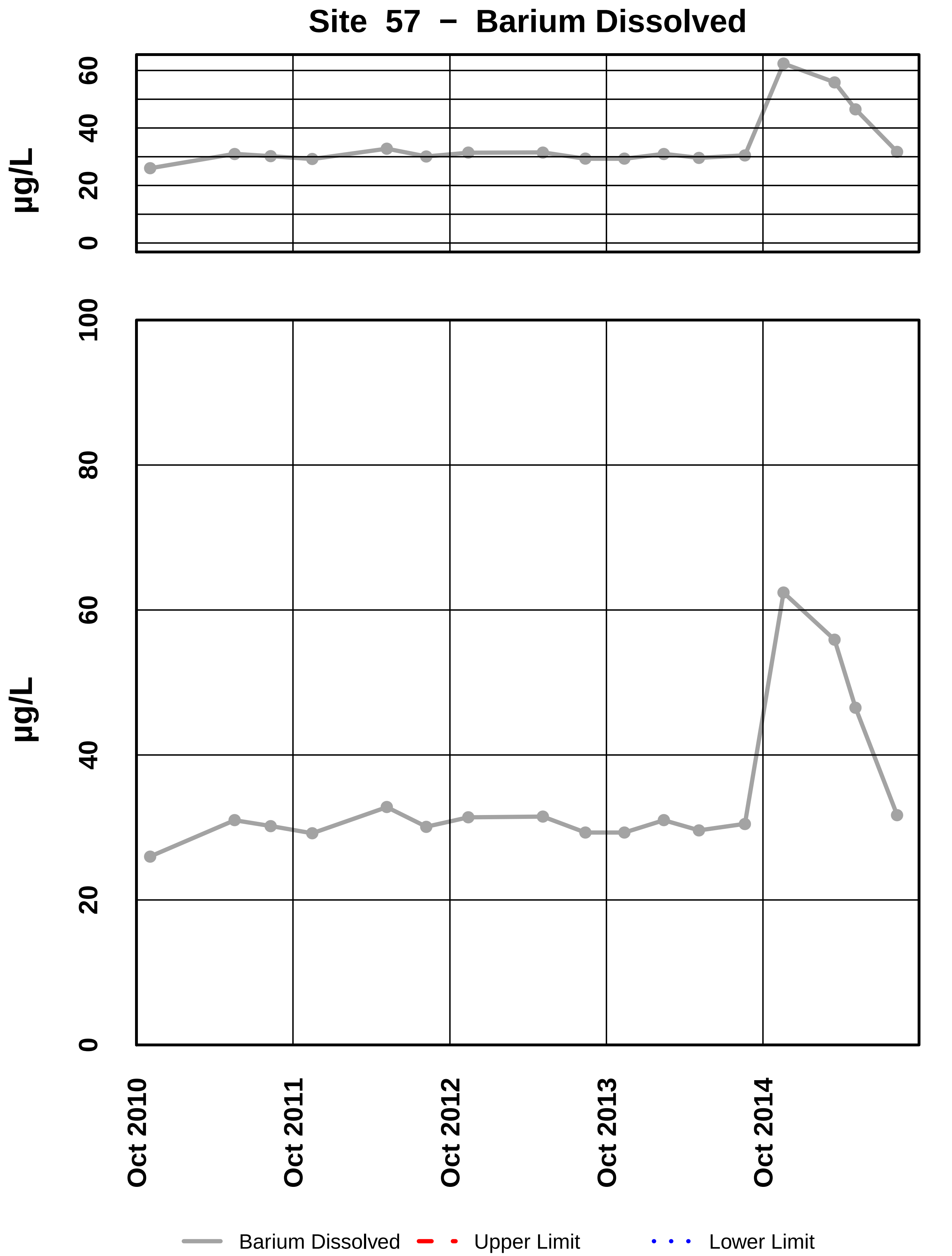
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



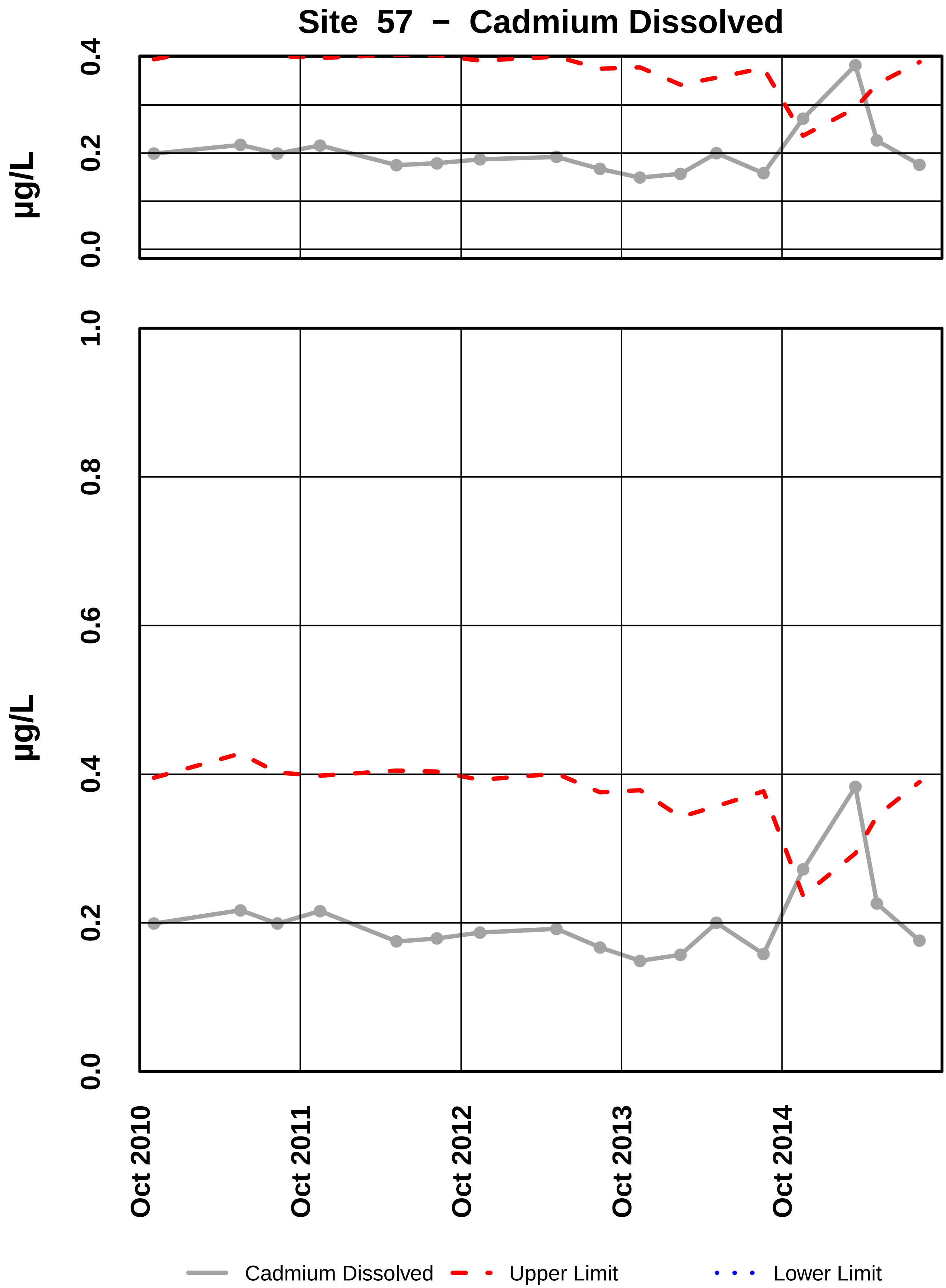
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

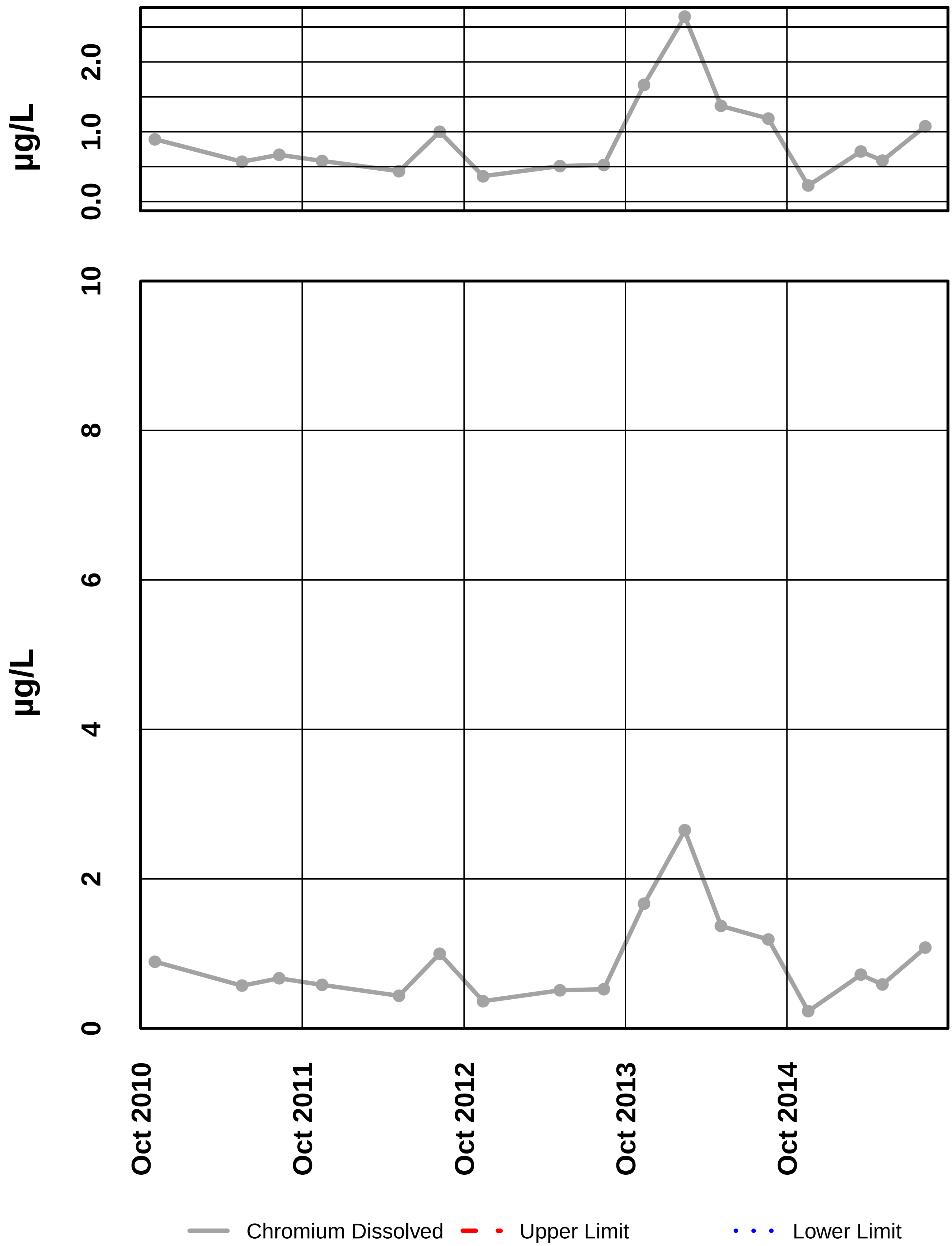


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



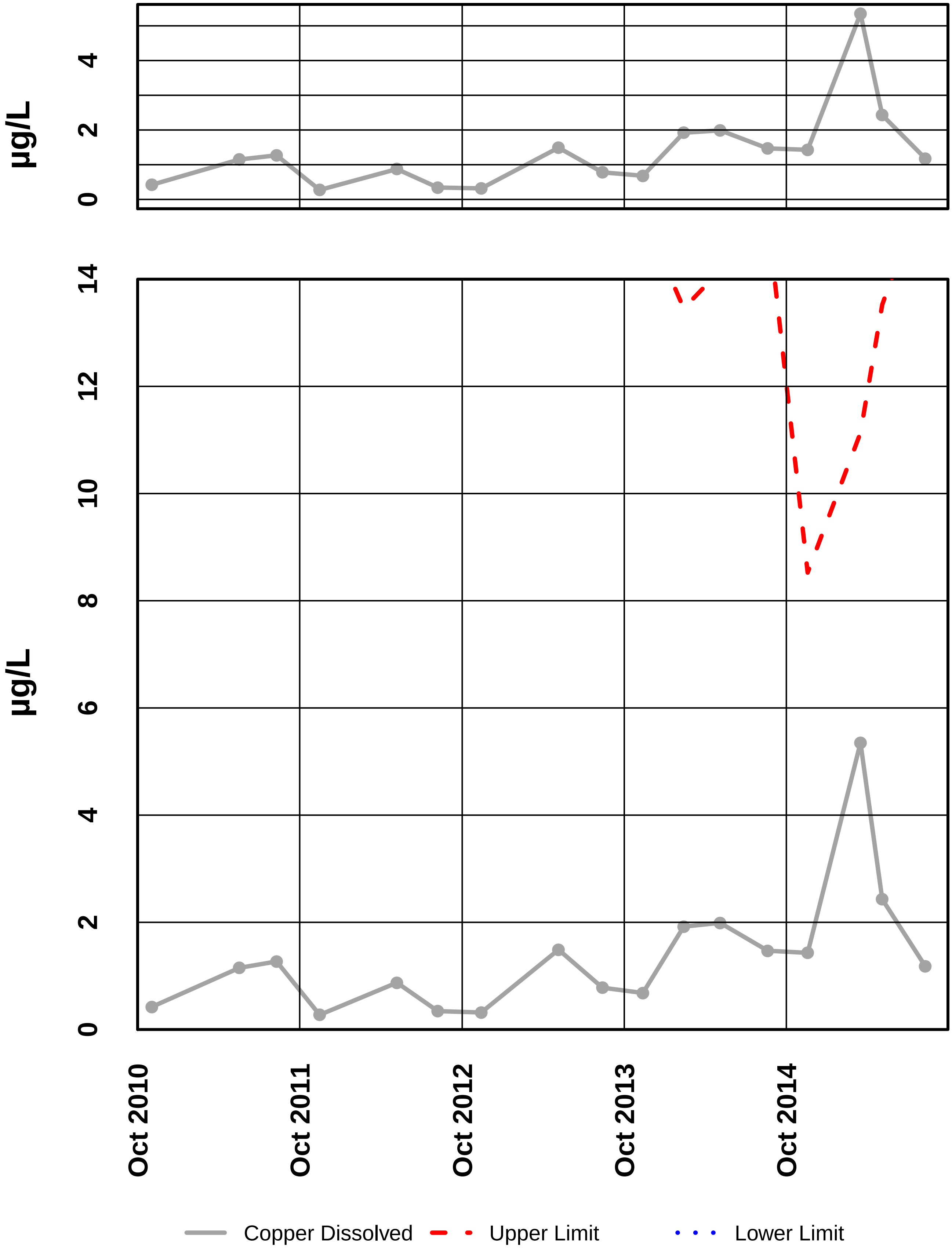
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 57 − Chromium Dissolved

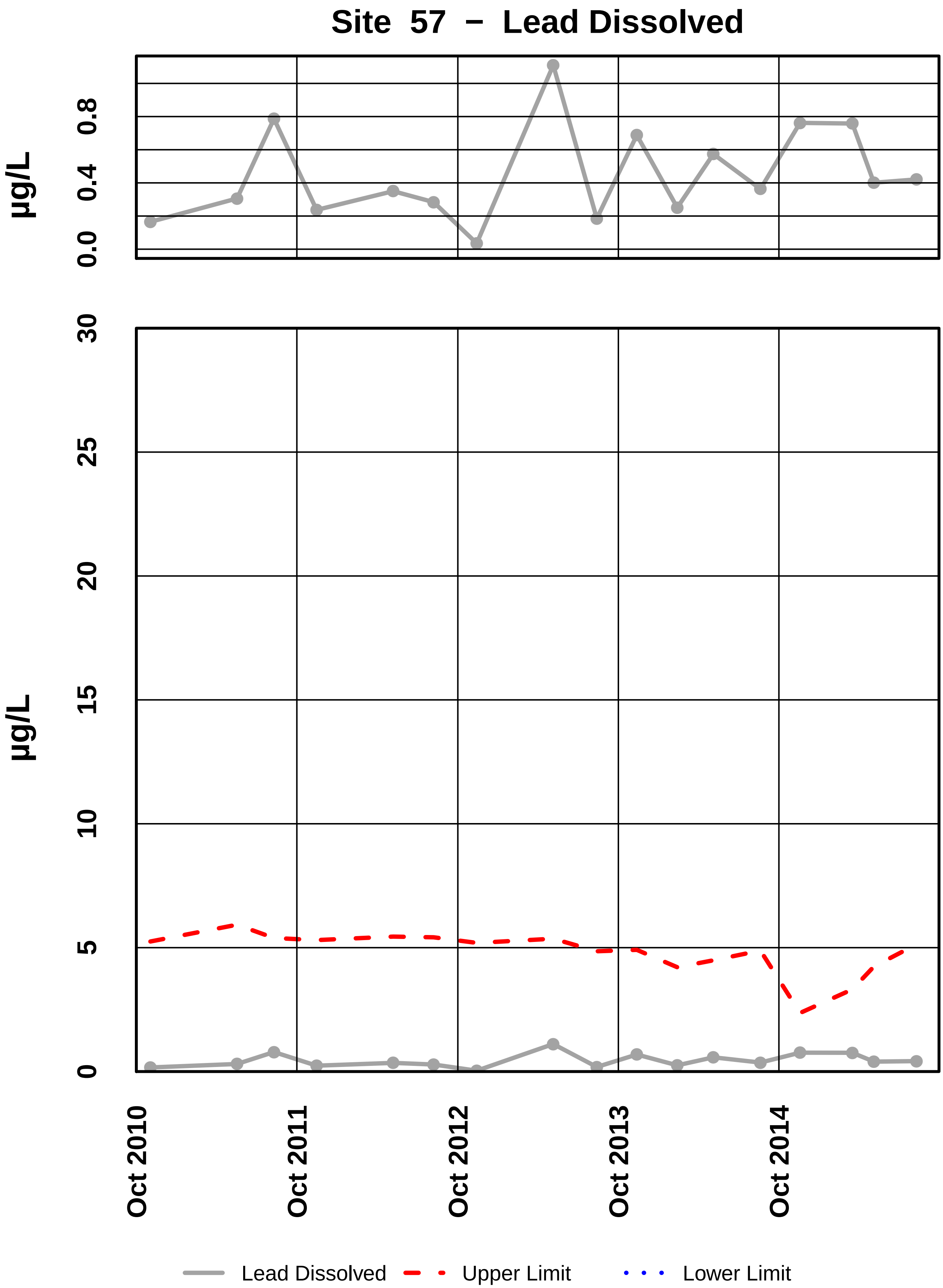


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 57 – Copper Dissolved

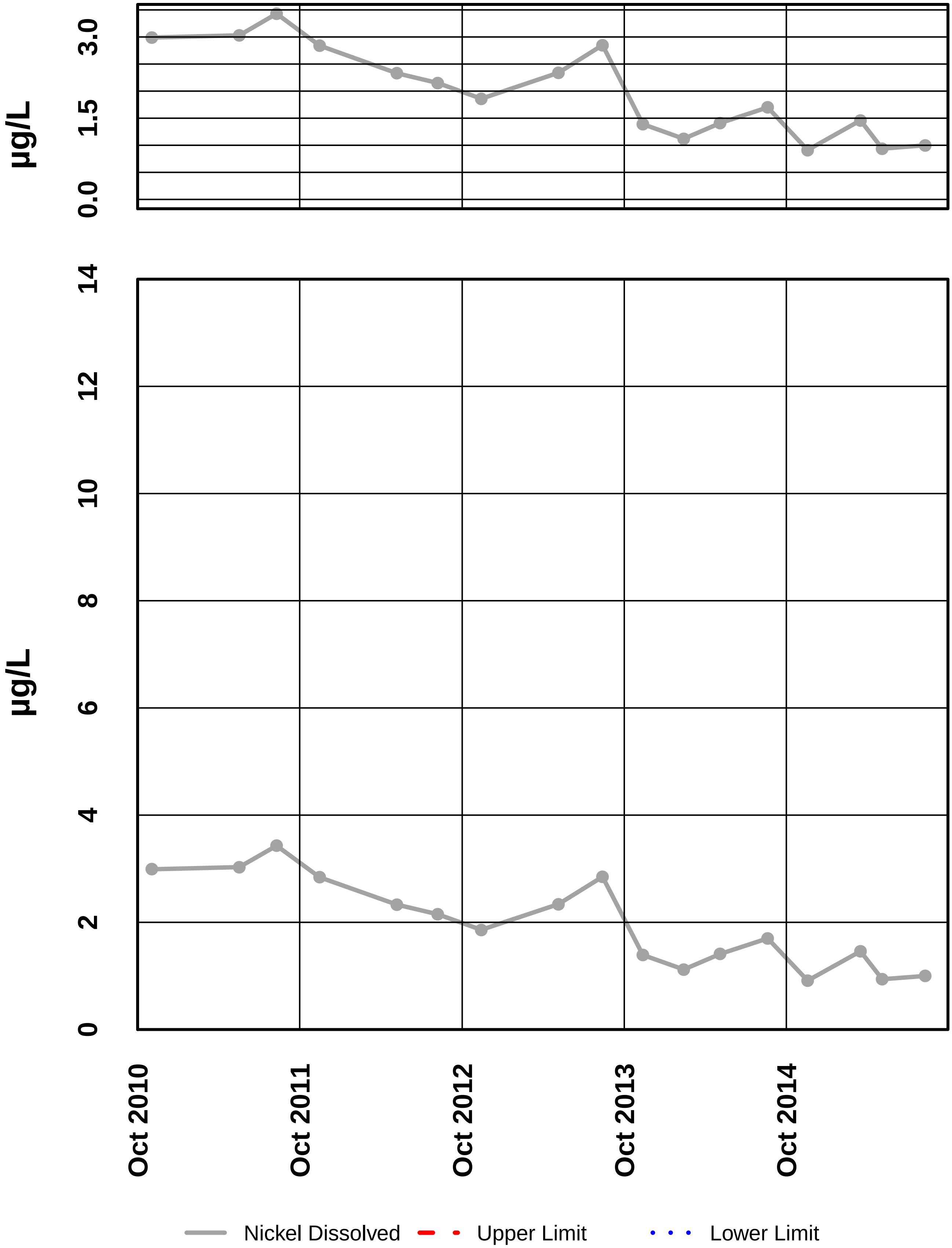


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



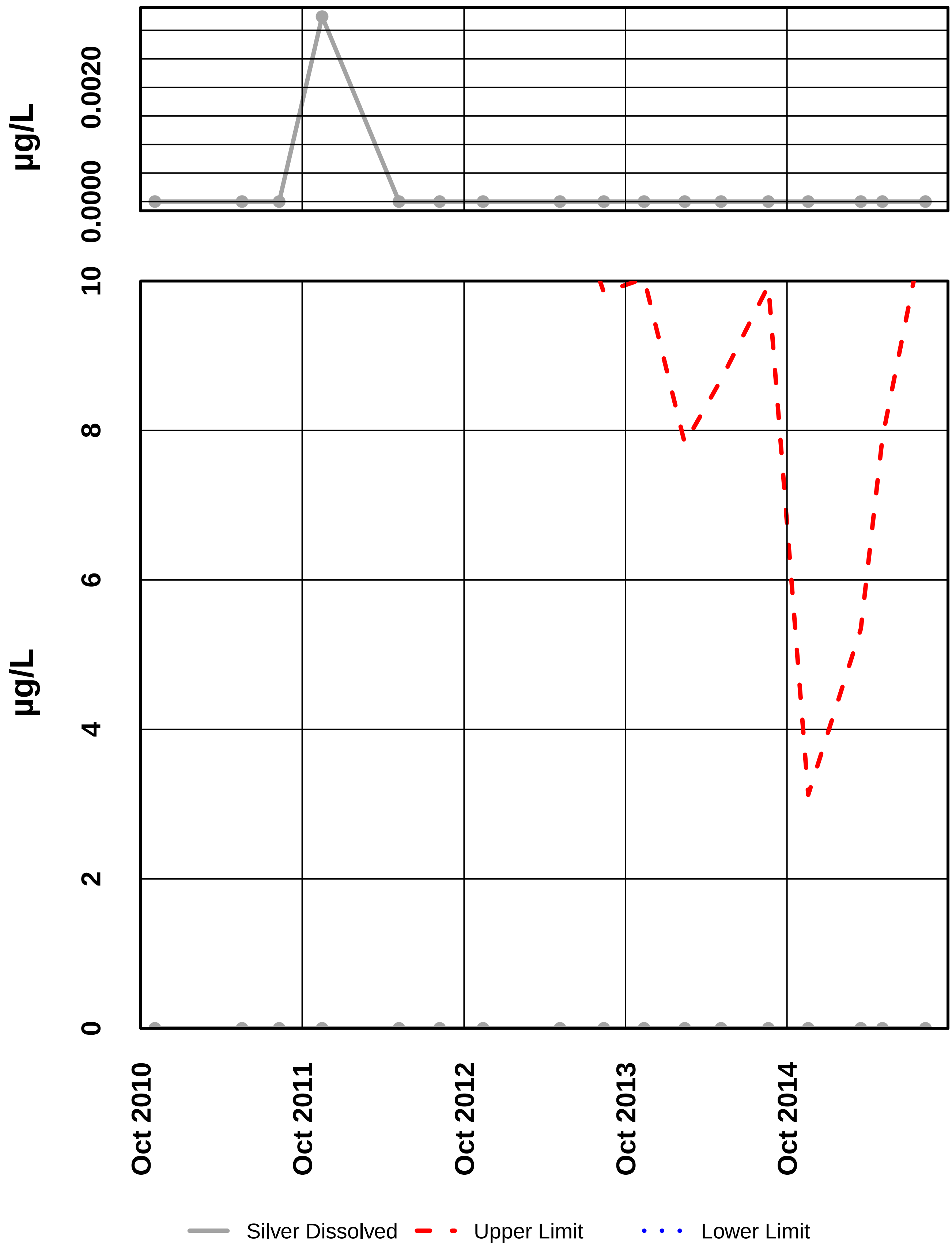
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 57 – Nickel Dissolved

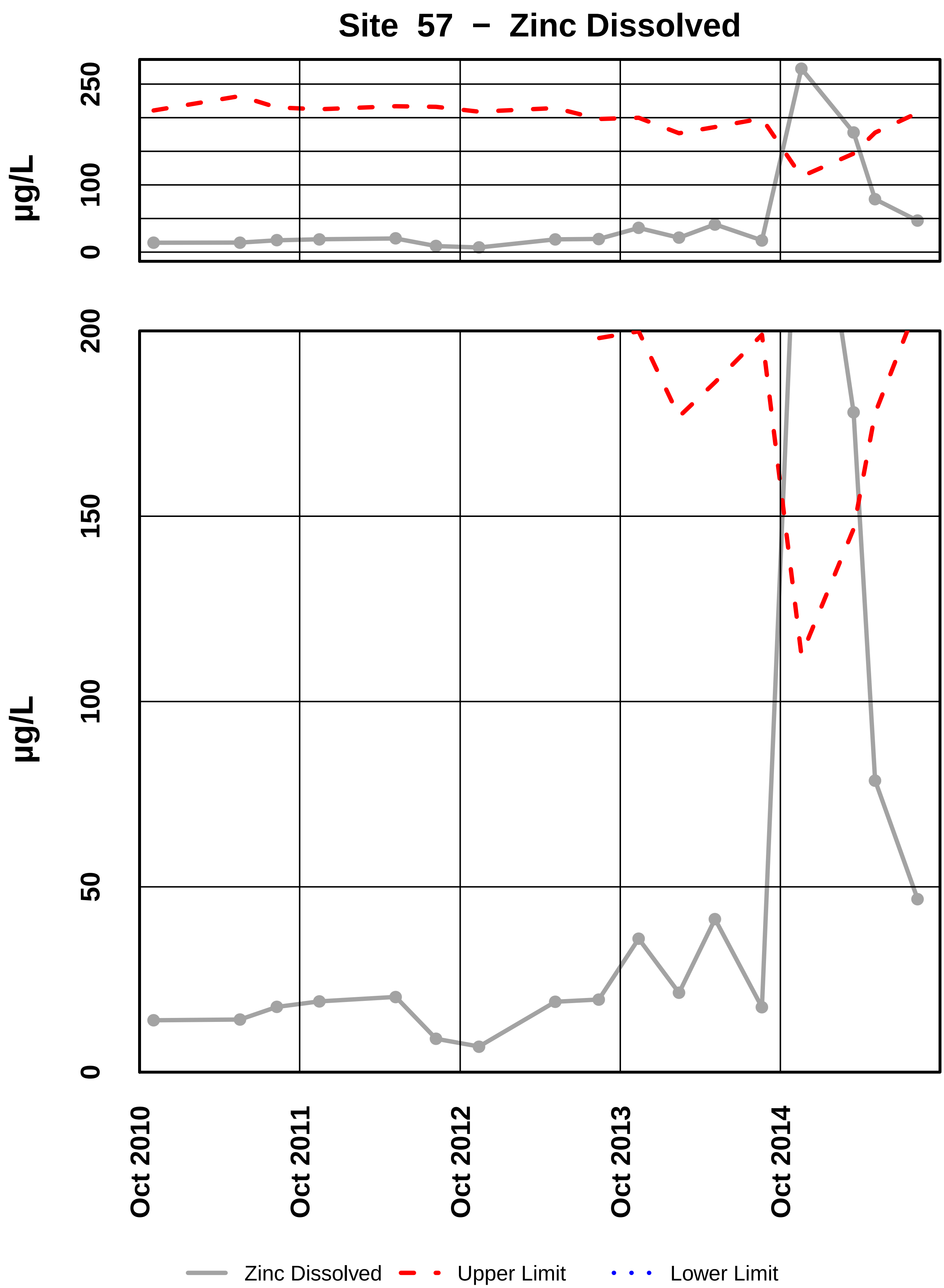


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 57 – Silver Dissolved

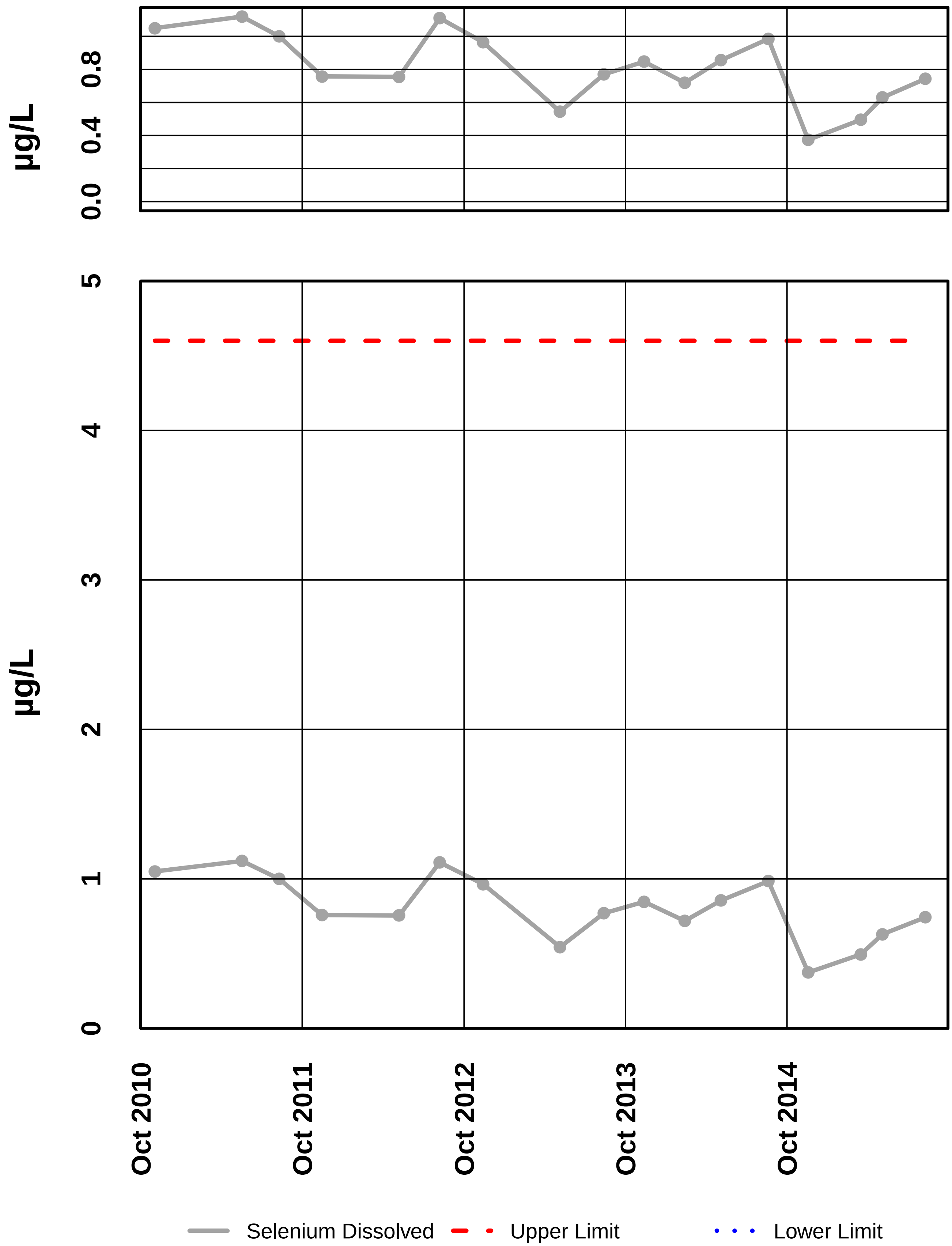


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



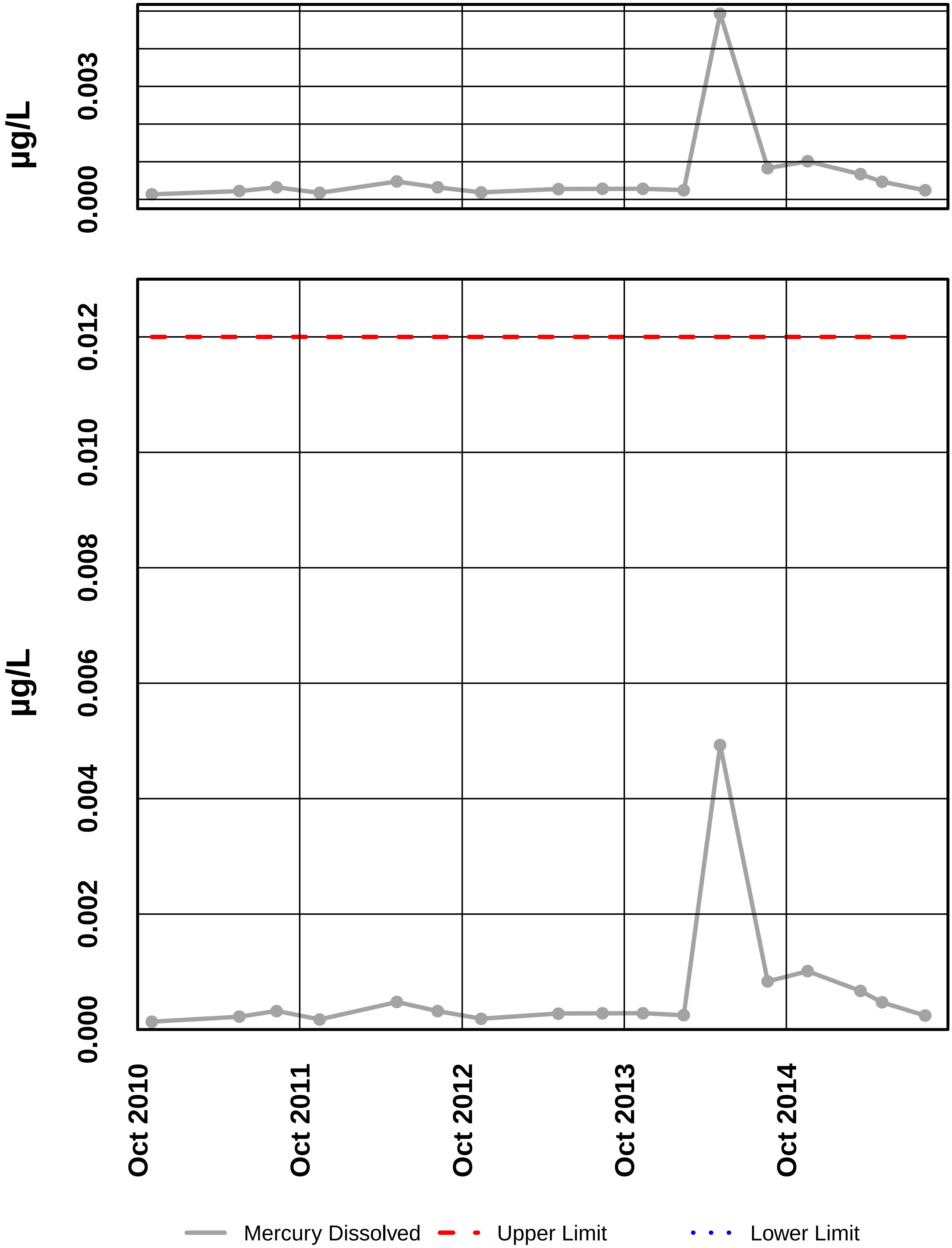
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

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

INTERPRETIVE REPORT
SITE 13

The data collected during the current water year are listed in the following “Table of Results for Water Year 2015” 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, in the past six years, have been identified by HGCMC.				

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

Table of Exceedance for Water Year 2015

			Limits		
Sample Date	Parameter	Value	Lower	Upper	Hardness
18-Nov-14	Cadmium Dissolved	1.2 µg/L		0.311	140 mg/L
10-Aug-15	Cadmium Dissolved	0.441 µg/L		0.366	177 mg/L
14-Sep-15	Cadmium Dissolved	5.85 µg/L		0.360	173 mg/L
18-Nov-14	Zinc Dissolved	471 µg/L		157	140 mg/L
10-Aug-15	Zinc Dissolved	266 µg/L		192	177 mg/L
14-Sep-15	Zinc Dissolved	2451 µg/L		188	173 mg/L

Over several years waste rock material has been removed from the 1350 Area. It was not until 2011 that any material was removed from the Eastern Lobe, the area that contributes to the Site 13 drainage; however the material removed was not in the direct drain path for Site 13. During 2012 no material was removed, a limited amount was removed in 2013, HGCMC removed most of the remaining material in 2014, and a small amount of material was removed in 2015. Only the material in the road access was left and it will be removed during final reclamation.

X-Y plots have been generated to graphically present the data for each of the analytes requested in the Statistical Information Goals for this site. Cadmium, nickel, lead, and zinc all sharply increased at Site 13 after waste rock material was removed in 2014. Lead levels were well below the AWQS in Water Year 2015, however dissolved zinc and dissolved cadmium had some measurements above the respective AWQS. As seen with other reclamation projects (e.g. the

960) there is usually an initial increase in metals concentration. HGCMC had expected to see these elevated levels attenuate throughout Water Year 2015 and until the end of the water year they appeared to had done so. It is still HGCMC expectation that the elevated metals are transient in nature and they will attenuate with time.

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-09 and Sep-15(WY2010-WY2015). For datasets with a statistically significant trend a Seasonal-Sen's Slope estimate statistic has also been calculated. There were four statistically significant trends ($\alpha/2=2.5\%$) for the parameters analyzed from Site 13. These trends are potentially a result of the material removal. HGCMC feels the current FWMP program is sufficient to monitor current and future changes at Site 13 before water quality values are impaired long term.

Table of Summary Statistics for Trend Analysis

	Mann-Kendall test statistics			Sen's slope estimate	
Parameter	**n***	**p****	**Trend**	**Q**	**Q(%)**
Conductivity Field	6	<0.01	-	-73.0	-10.4
pH Field	6	0.44			
Alkalinity, Total	6	0.01	-	-21.3	-17.5
Sulfate, Total	6	0.02	-	-26.4	-12.2
Zinc, Dissolved	6	0.01	+	10.4	62.4

* Number of Years ** Significance level

Table of Results for Water Year 2015

Site 013FMS - '1350 East Drainage'

Sample Date/Parameter	Oct 2014	Nov 2014	Dec 2014	Jan 2015	Feb 2015	Mar 2015	Apr 2015	May 2015	Jun 2015	Jul 2015	Aug 2015	Sep 2015	**Median**
Water Temp (°C)		1.2						5.4			12.9	9.6	7.5
Conductivity-Field(µmho)		299						373			393	363	368.0
Conductivity-Lab (µmho)		289						360			375	338	349
pH Lab (standard units)		7.24						7.25			7.72	7.38	7.32
pH Field (standard units)		7.8						7.68			7.62	7.57	7.65
Total Alkalinity (mg/L)		49.5						46			58	40.9	47.8
Total Sulfate (mg/L)		84.2						138			134	122	128.0
Hardness (mg/L)		140						189			177	173	175.0
Dissolved As (ug/L)		0.143						0.057			0.173	0.117	0.130
Dissolved Ba (ug/L)		8.7						3.7			7	12.5	7.9
Dissolved Cd (ug/L)		1.2						0.0864			0.441	5.85	0.8205
Dissolved Cr (ug/L)		0.104						0.108			0.188	0.079	0.106
Dissolved Cu (ug/L)		1.06						0.478			1.12	0.974	1.017
Dissolved Pb (ug/L)		0.17						0.0117			0.0141	0.0997	0.0569
Dissolved Ni (ug/L)		2.95						0.862			2.31	9.24	2.630
Dissolved Ag (ug/L)		0.005						0.002			0.002	0.002	0.002
Dissolved Zn (ug/L)		471						60.5			266	2451	368.50
Dissolved Se (ug/L)		0.213						0.057			0.149	0.18	0.165
Dissolved Hg (ug/L)		0.00154						0.000616			0.000691	0.000792	0.000742

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

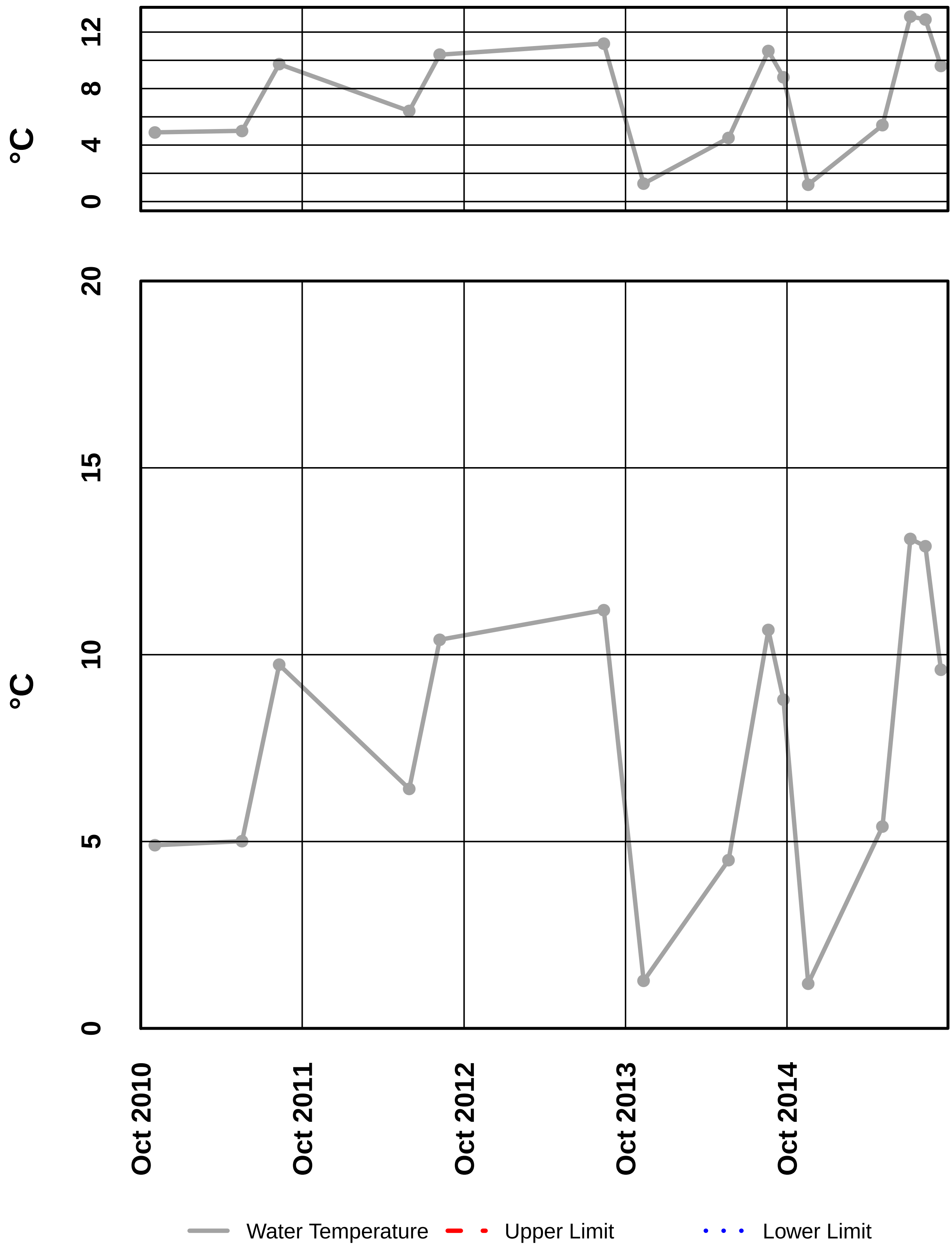
Qualified Data by QA Reviewer

Date Range: 10/01/2014 to 09/30/2015

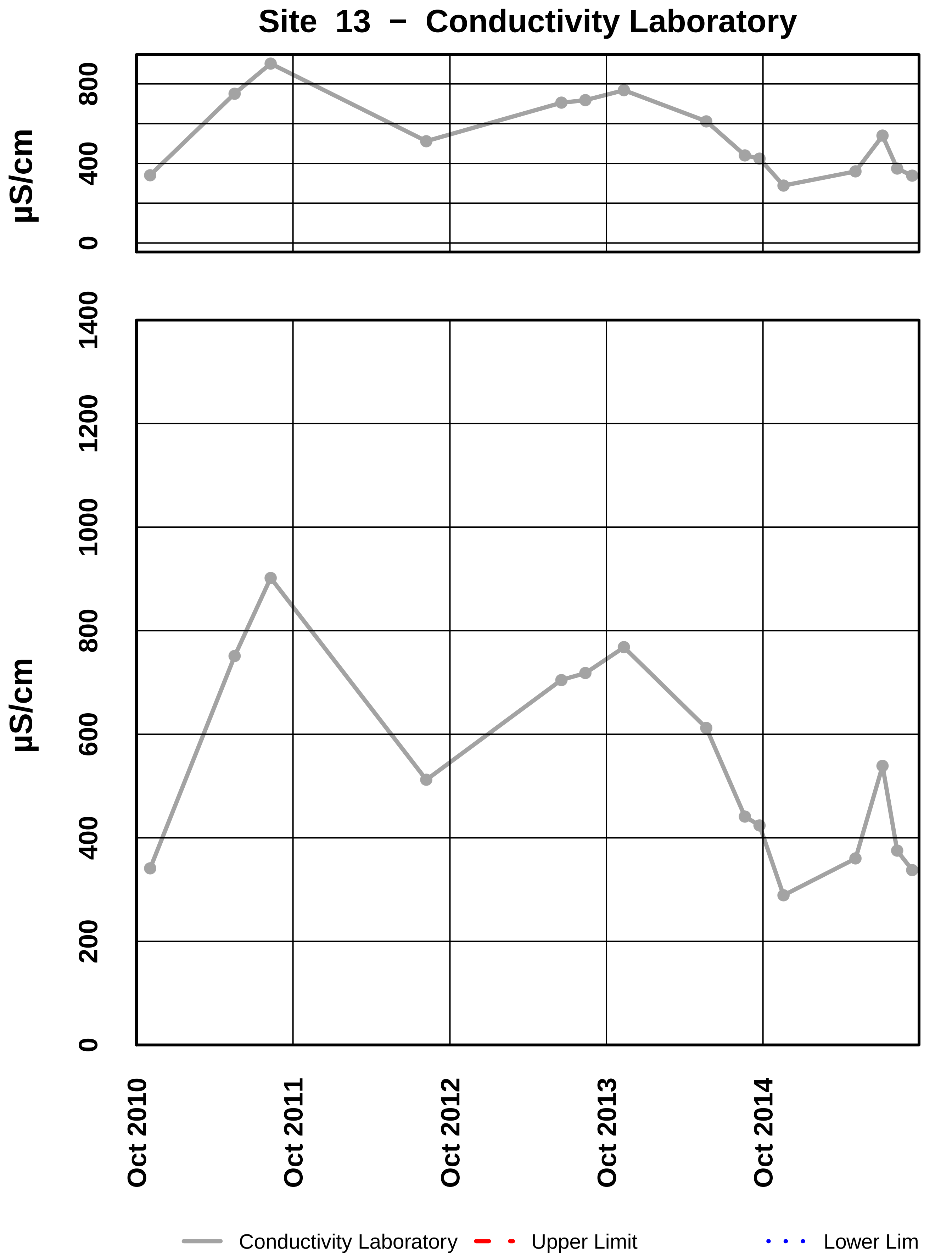
Site No.	Sample Date	Sample Time	Parameter	Value		Qualifier	Reason for Qualifier
013FMS	11/18/2014	12:00 AM	Diss. Ag-ICP/MS	0.00475	µg/L	J	Below Quantitative Range
			Diss. Cr-ICP/MS	0.1	µg/L	J	Below Quantitative Range
			Diss. Se-ICP/MS	0.21	µg/L	J	Below Quantitative Range
013FMS	05/05/2015	12:00 AM	Diss. Cr-ICP/MS	0.1	µg/L	J	Below Quantitative Range
			Sulfate	138	mg/L	J	Sample Receipt Temperature
013FMS	07/07/2015	12:00 AM	Diss. Se-ICP/MS	0.14	µg/L	J	Below Quantitative Range
013FMS	08/10/2015	12:00 AM	Diss. Se-ICP/MS	0.14	µg/L	J	Below Quantitative Range
			Sulfate	134	mg/L	J	Sample Receipt Temperature
013FMS	09/14/2015	12:00 AM	Diss. Cr-ICP/MS	0.07	µg/L	J	Below Quantitative Range
			Diss. Se-ICP/MS	0.18	µg/L	J	Below Quantitative Range

Qualifier	Description
J	Positively Identified - Approximate Concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit

Site 13 – Water Temperature

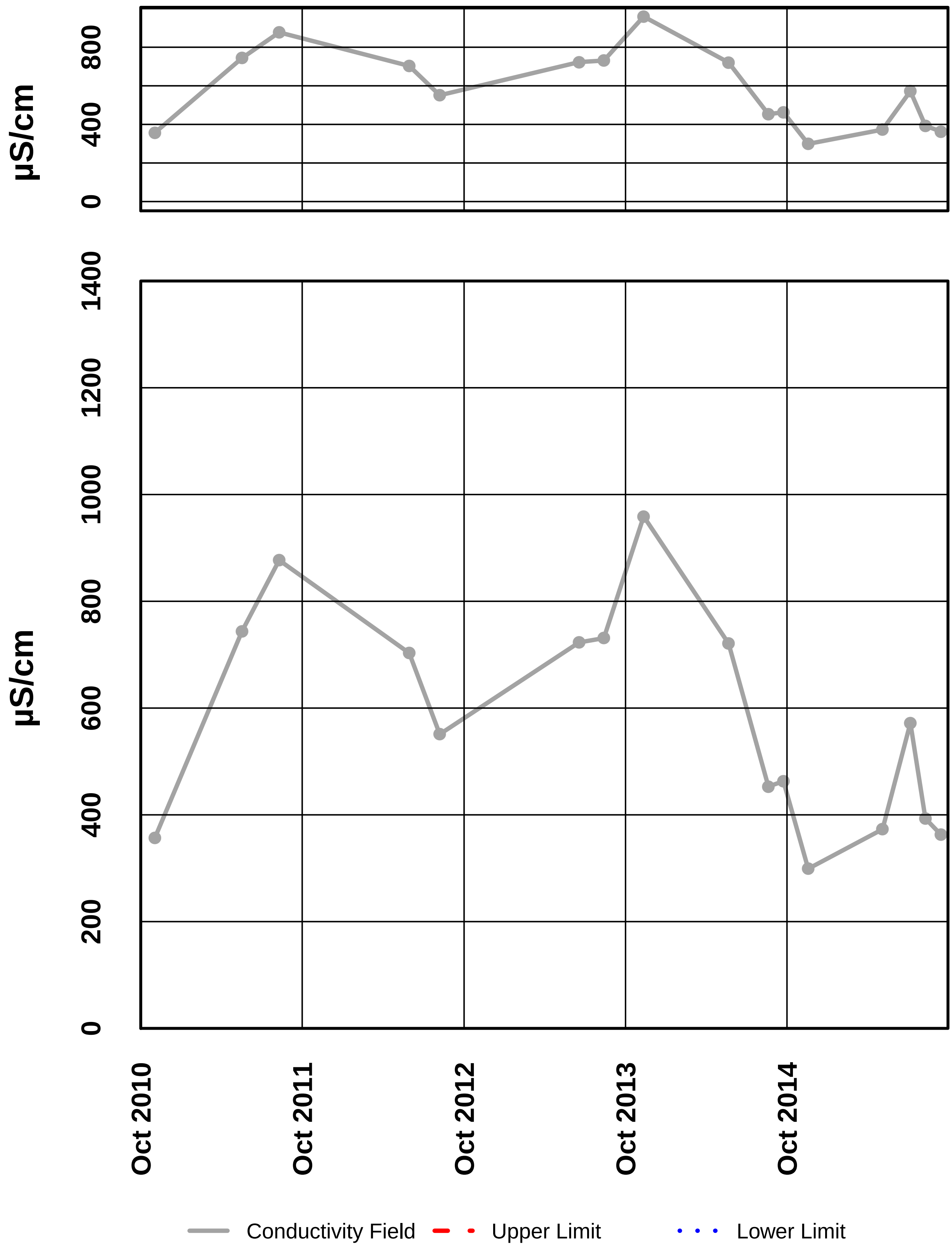


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

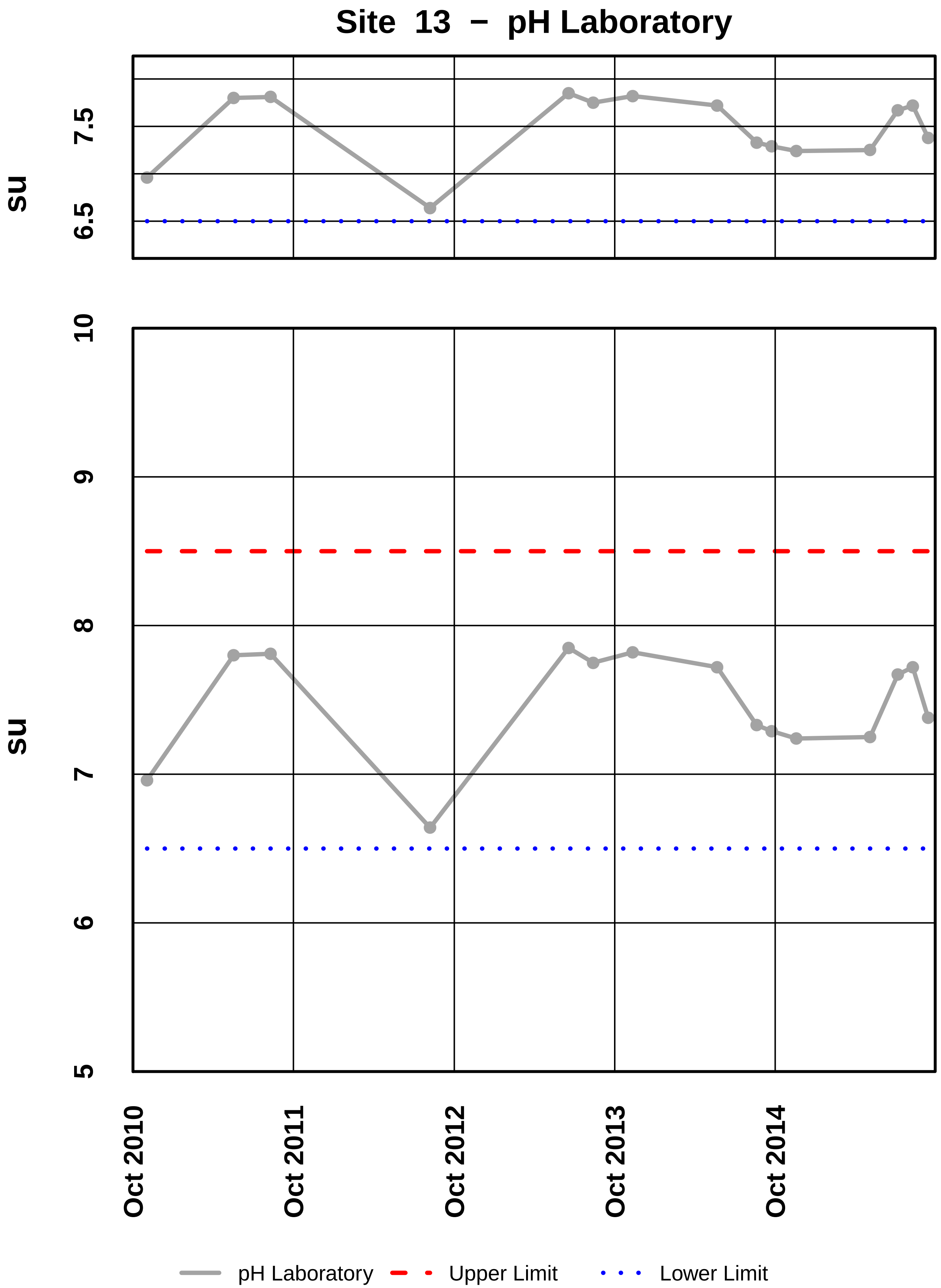


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

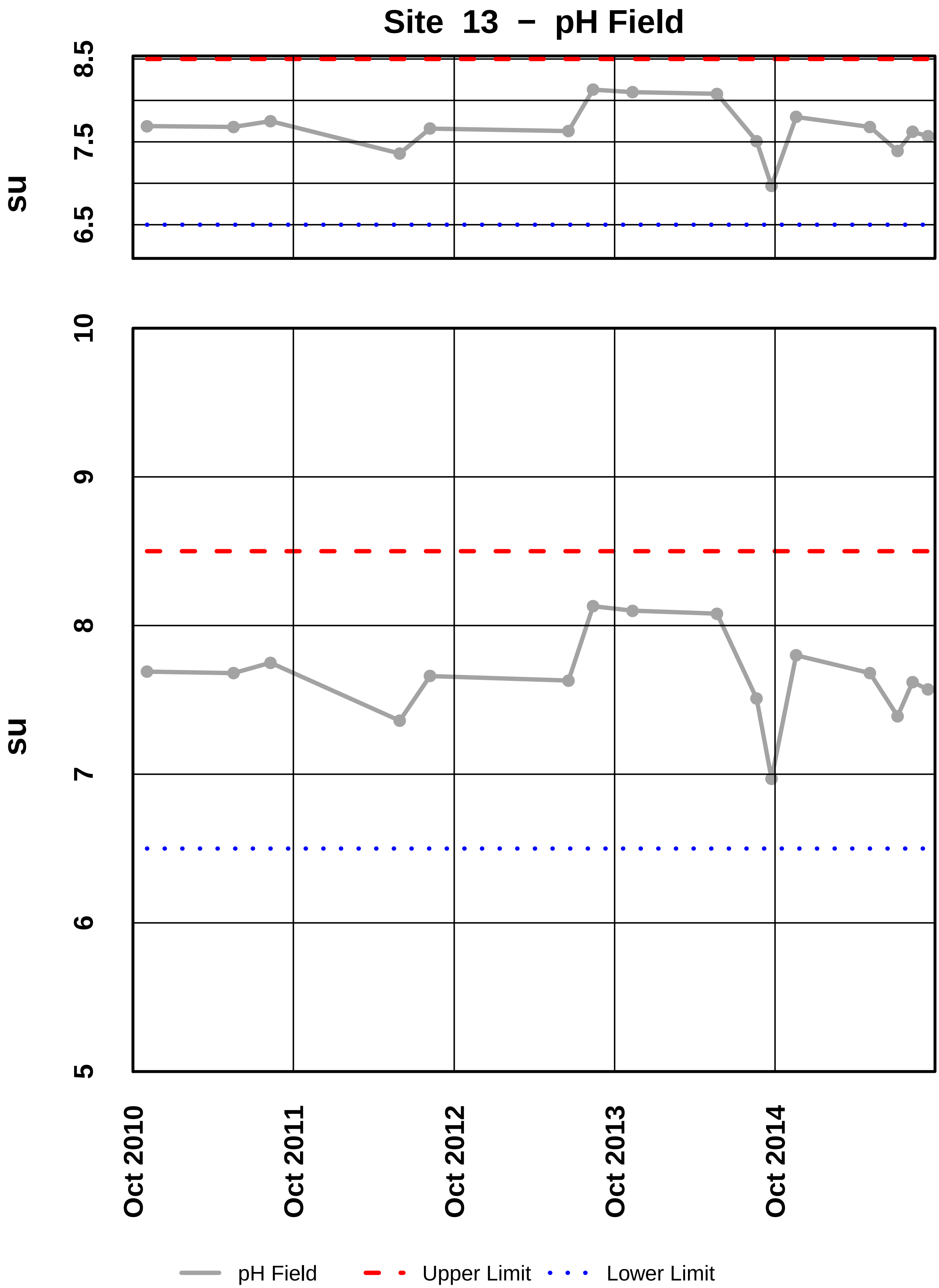
Site 13 – Conductivity Field



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

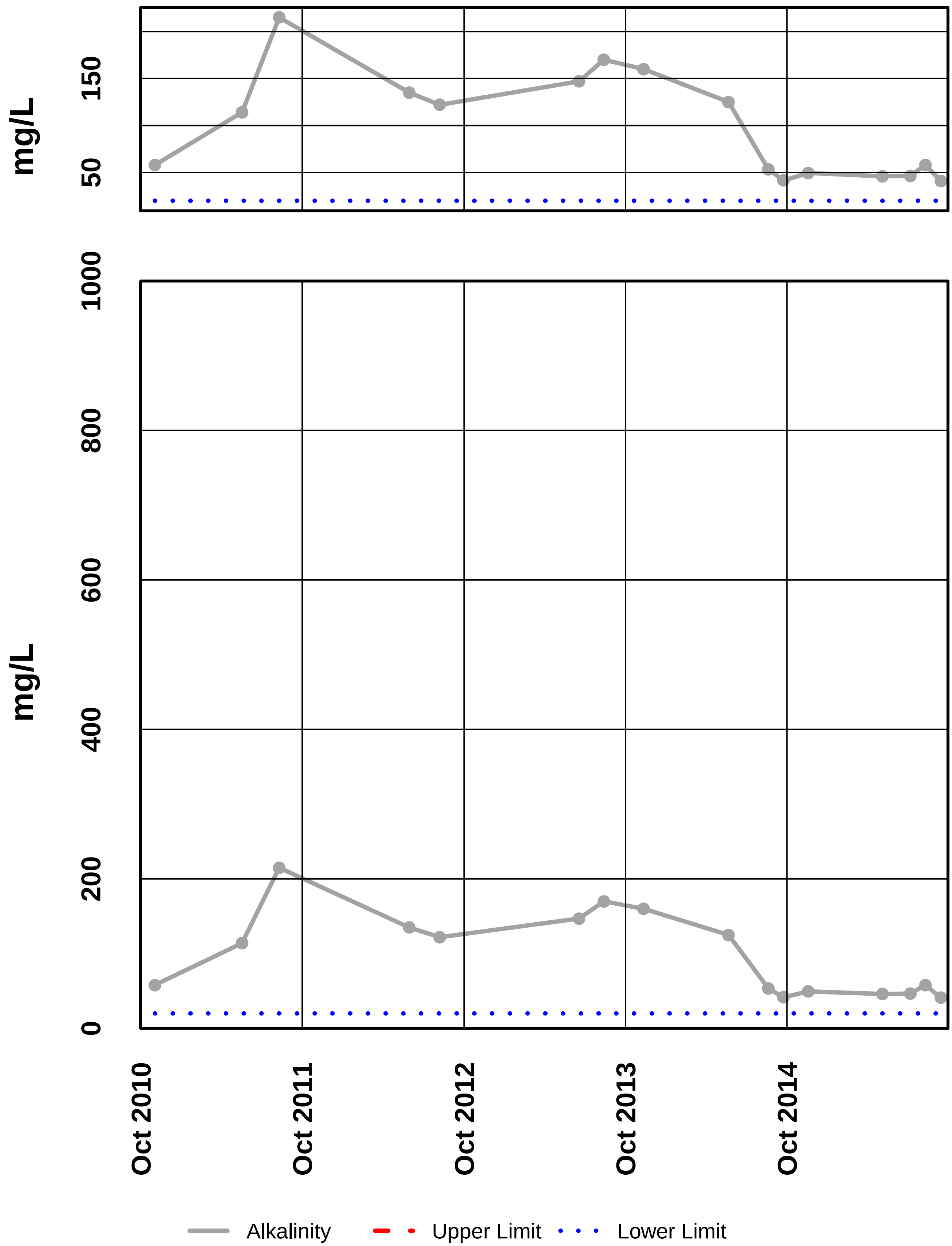


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

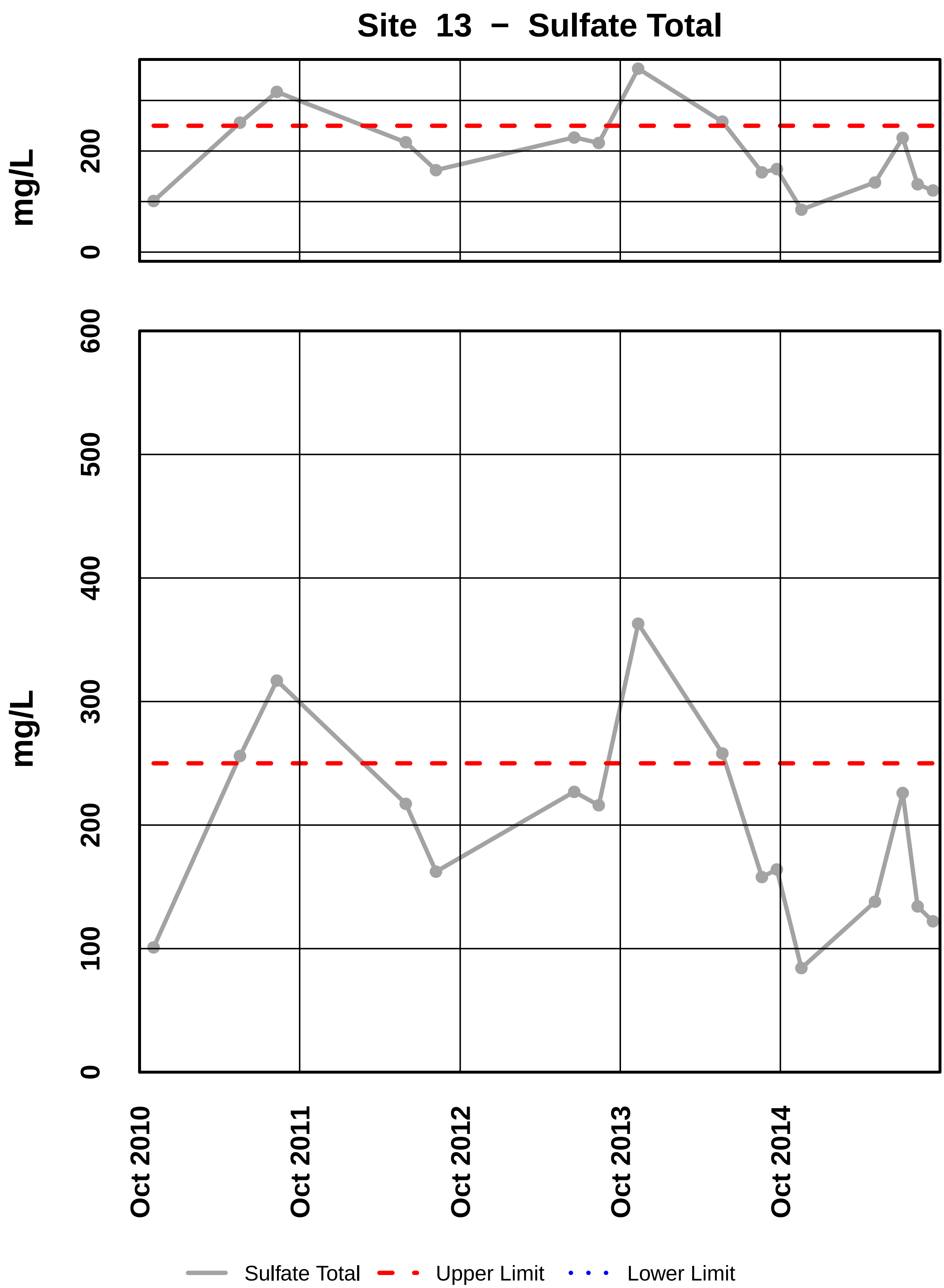


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 13 – Alkalinity

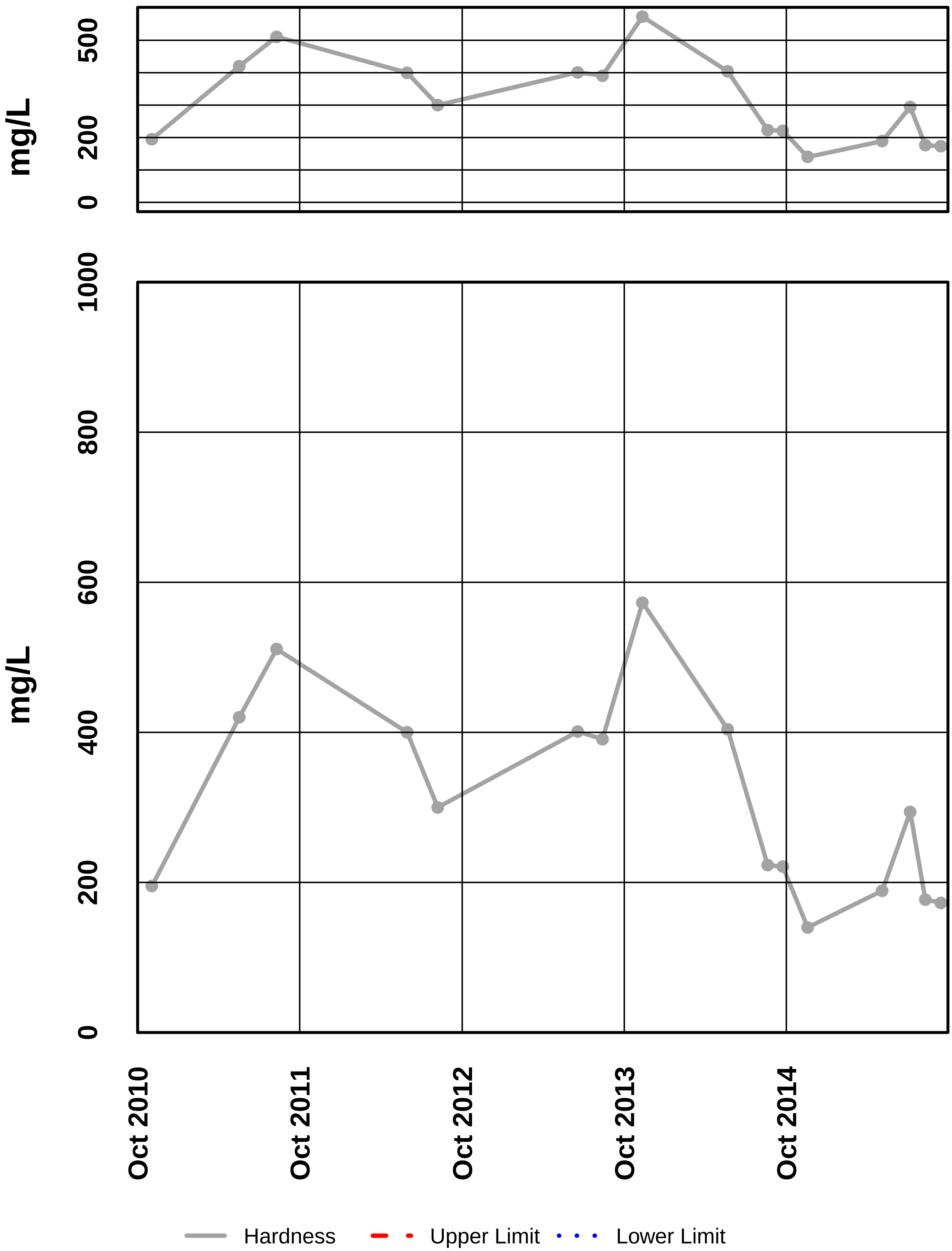


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

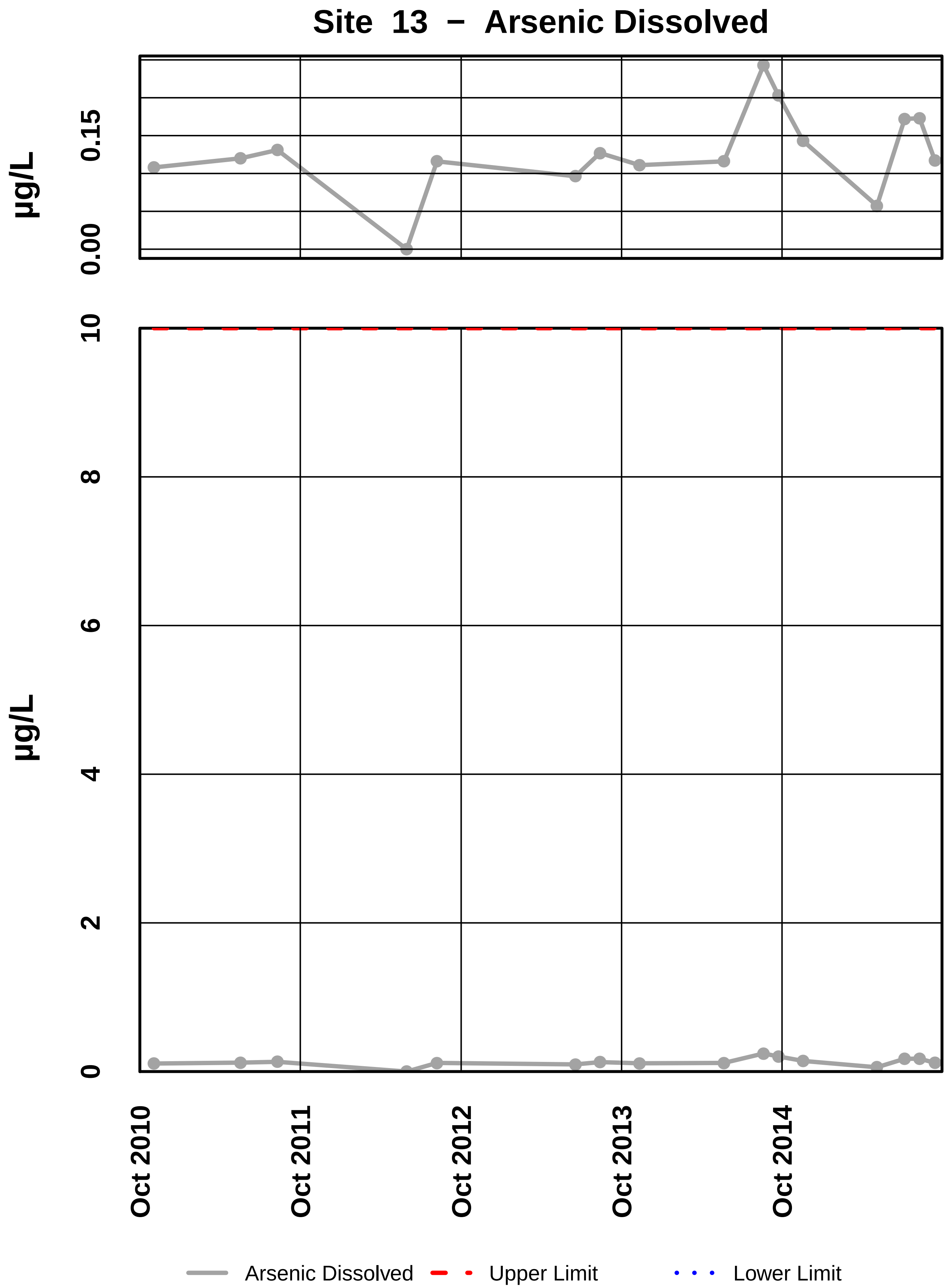


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

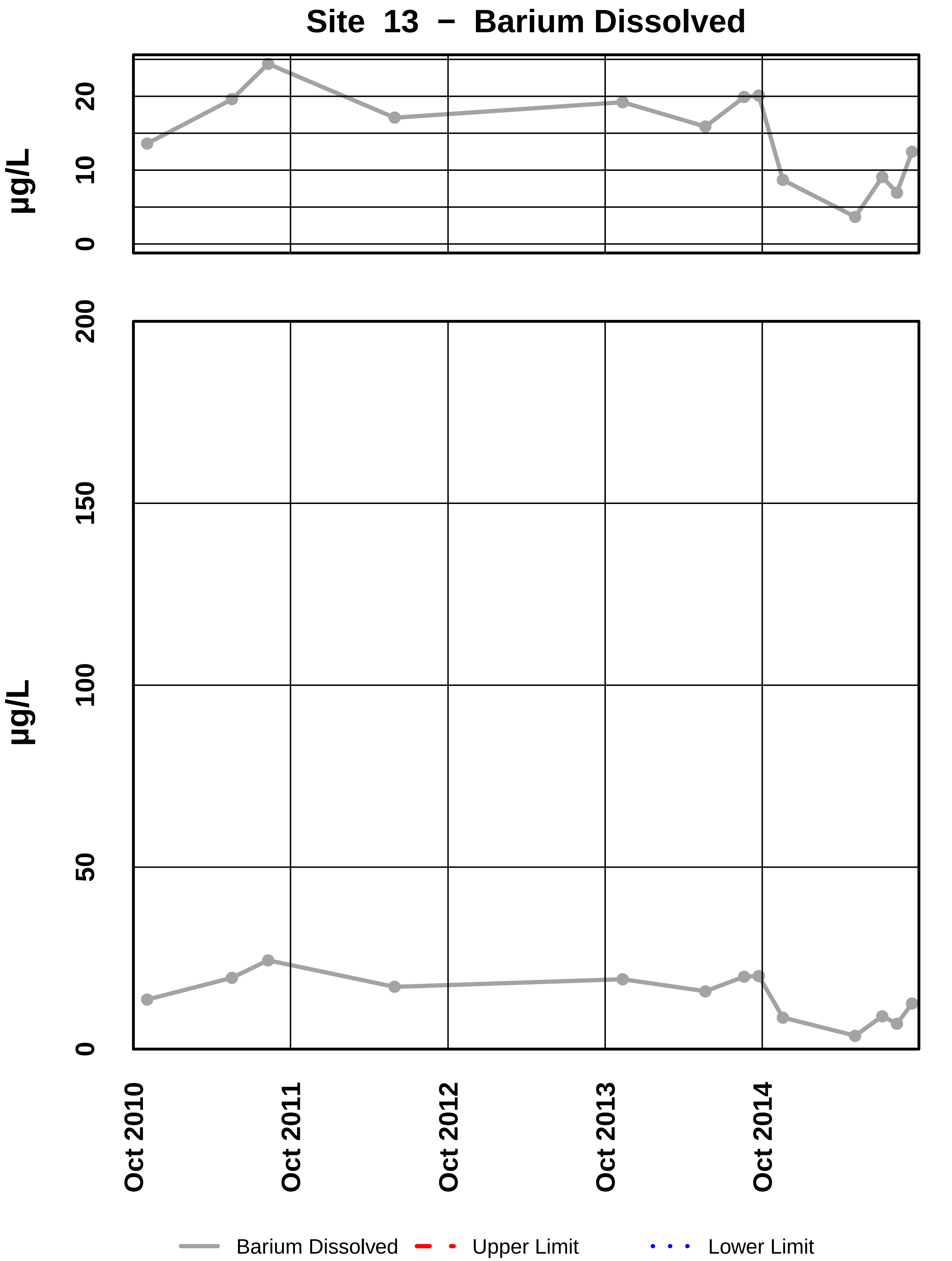
Site 13 – Hardness



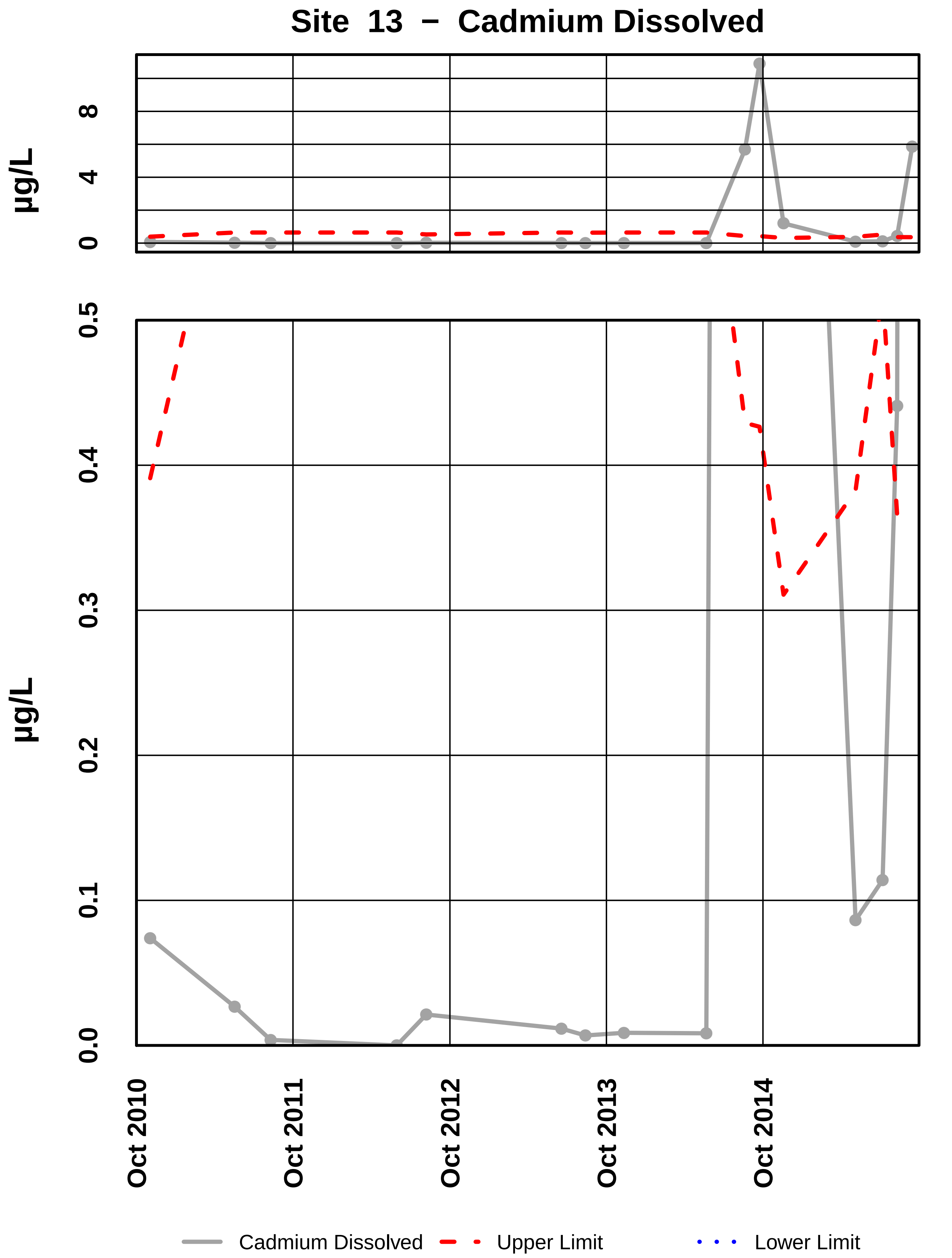
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



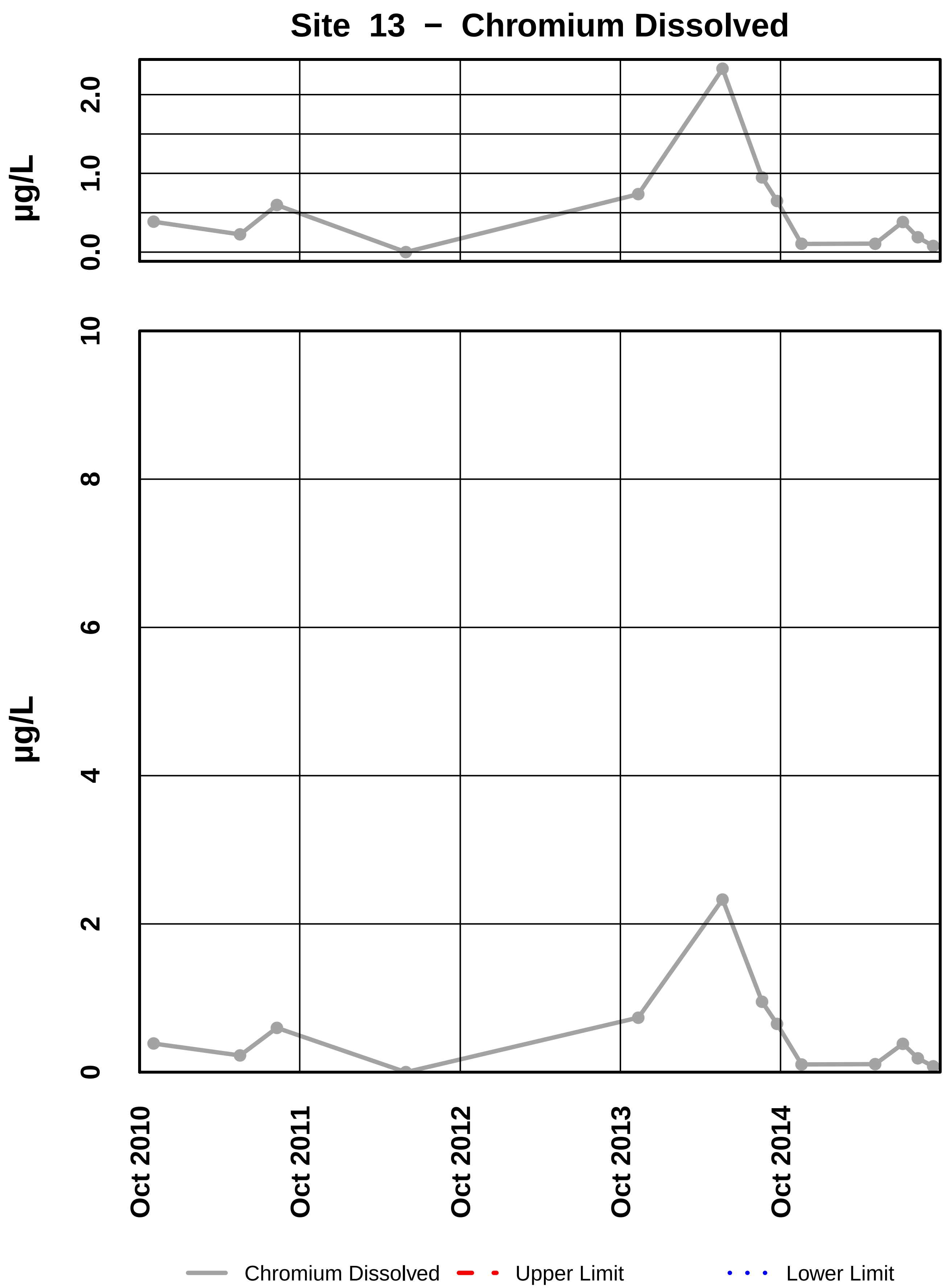
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



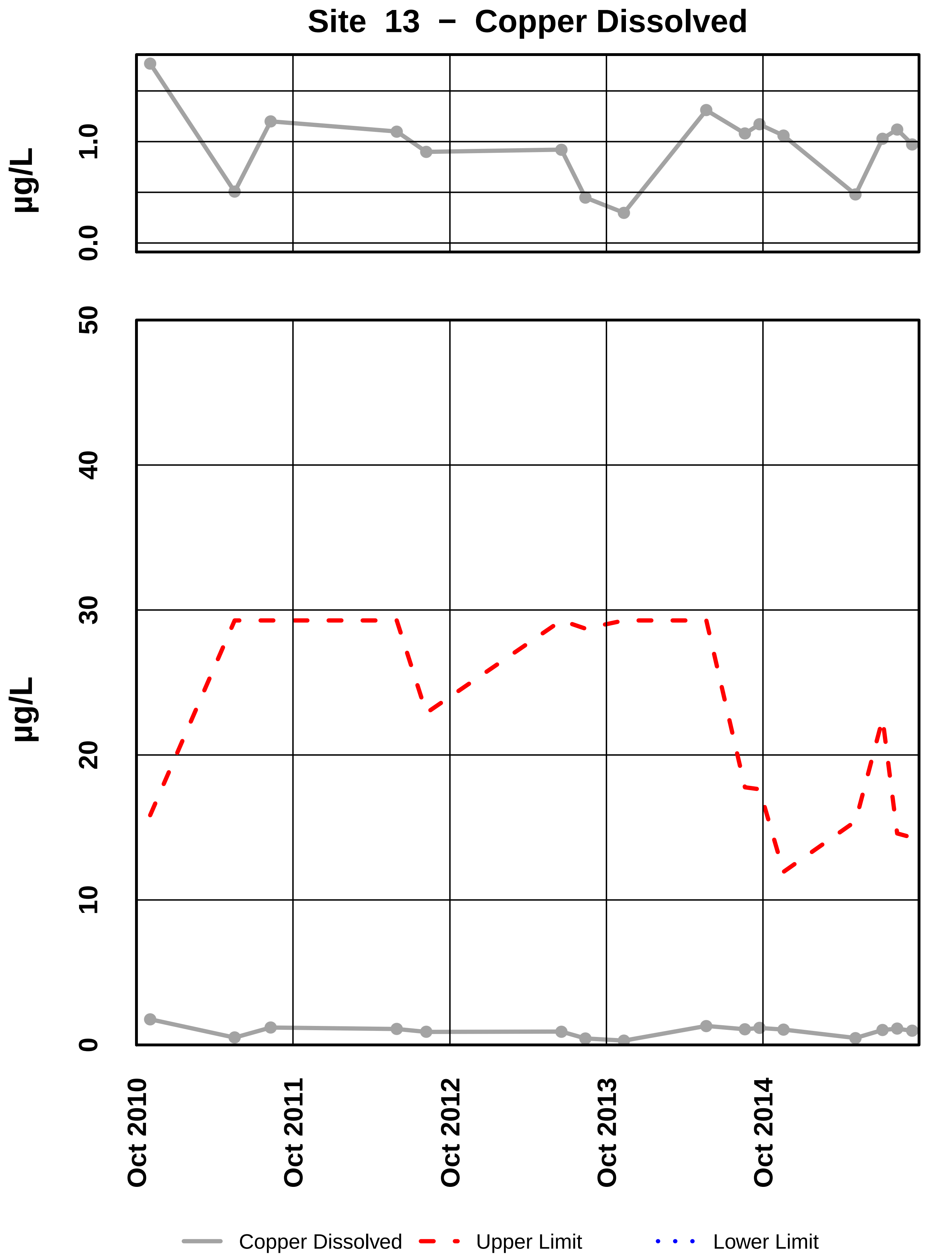
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

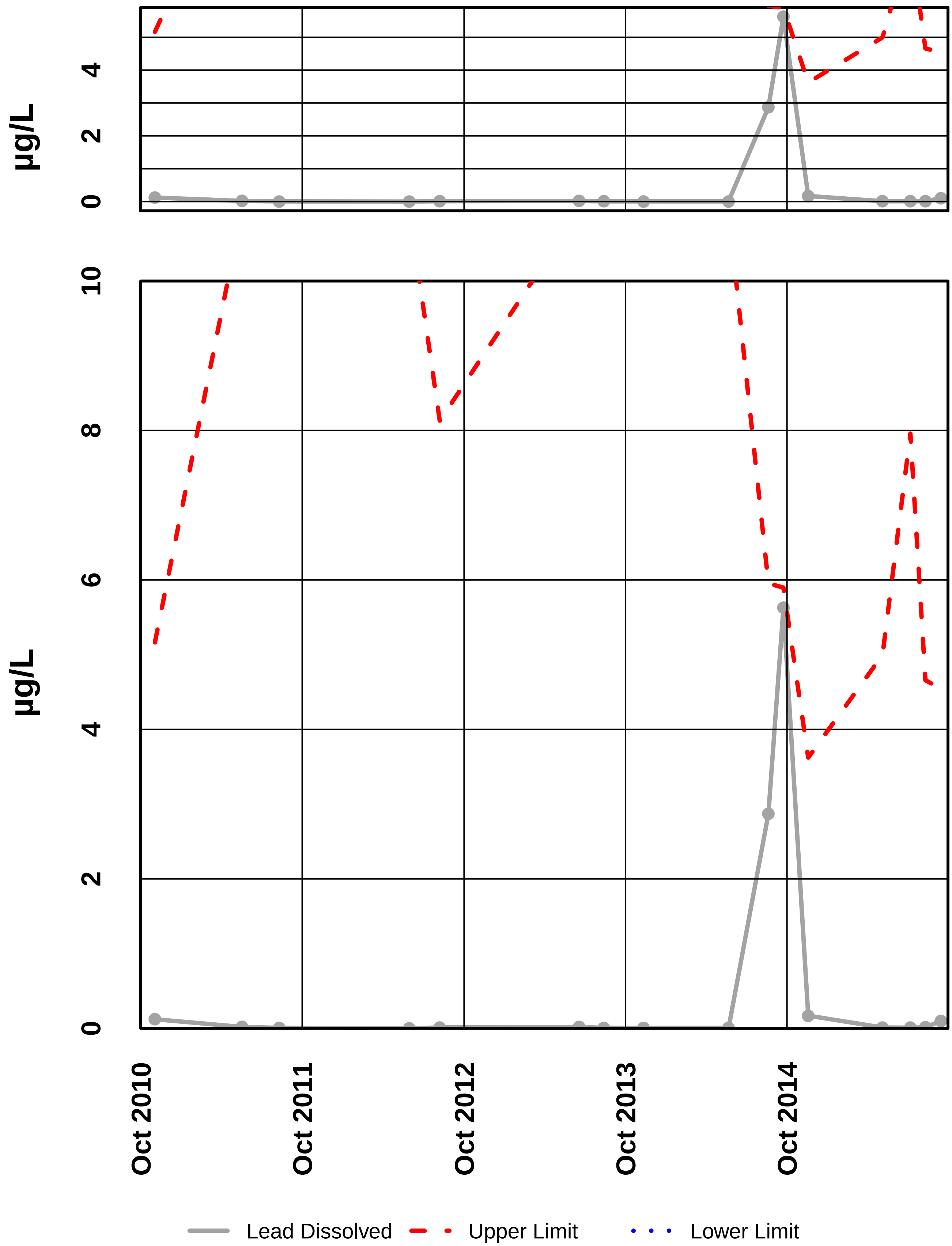


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



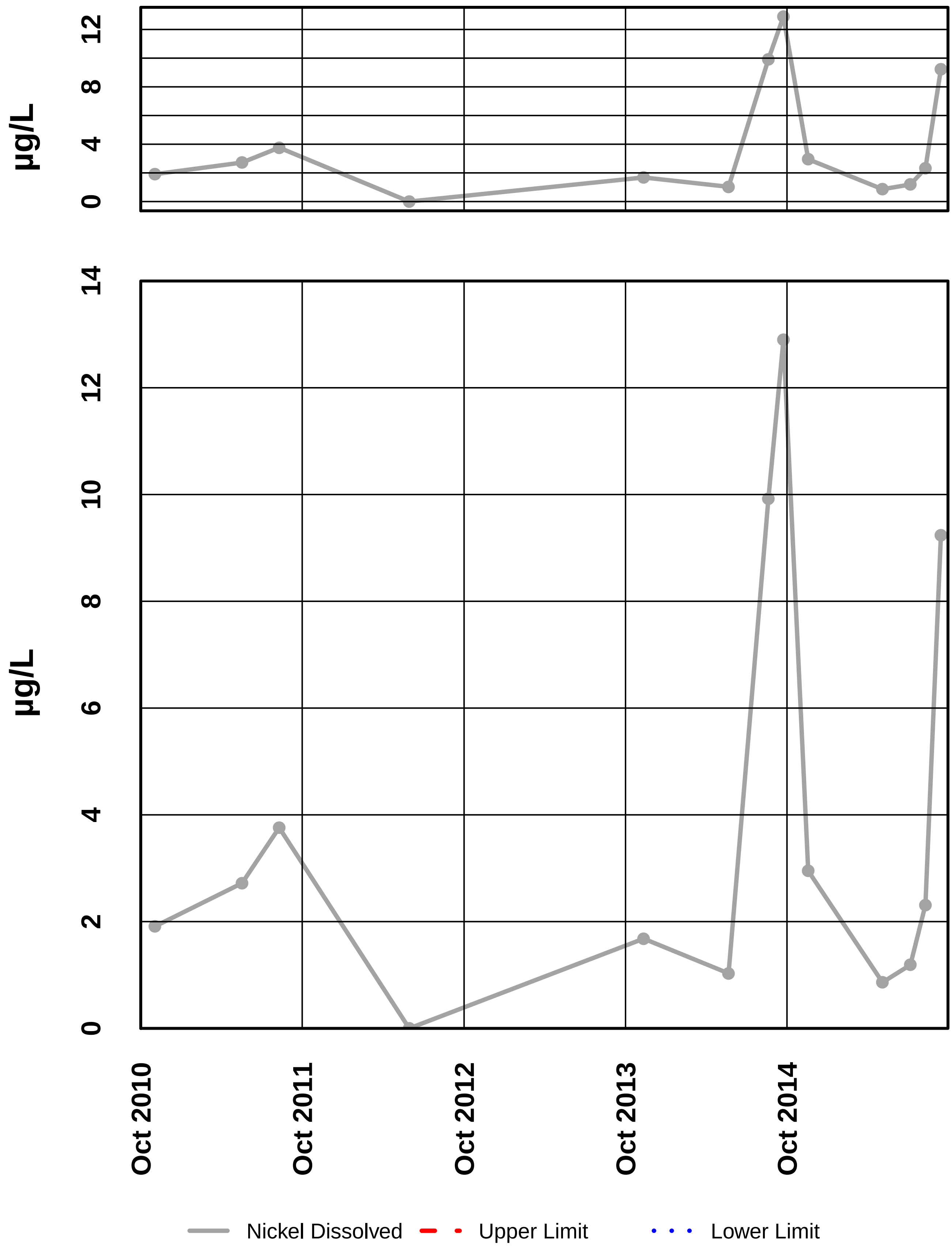
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 13 – Lead Dissolved

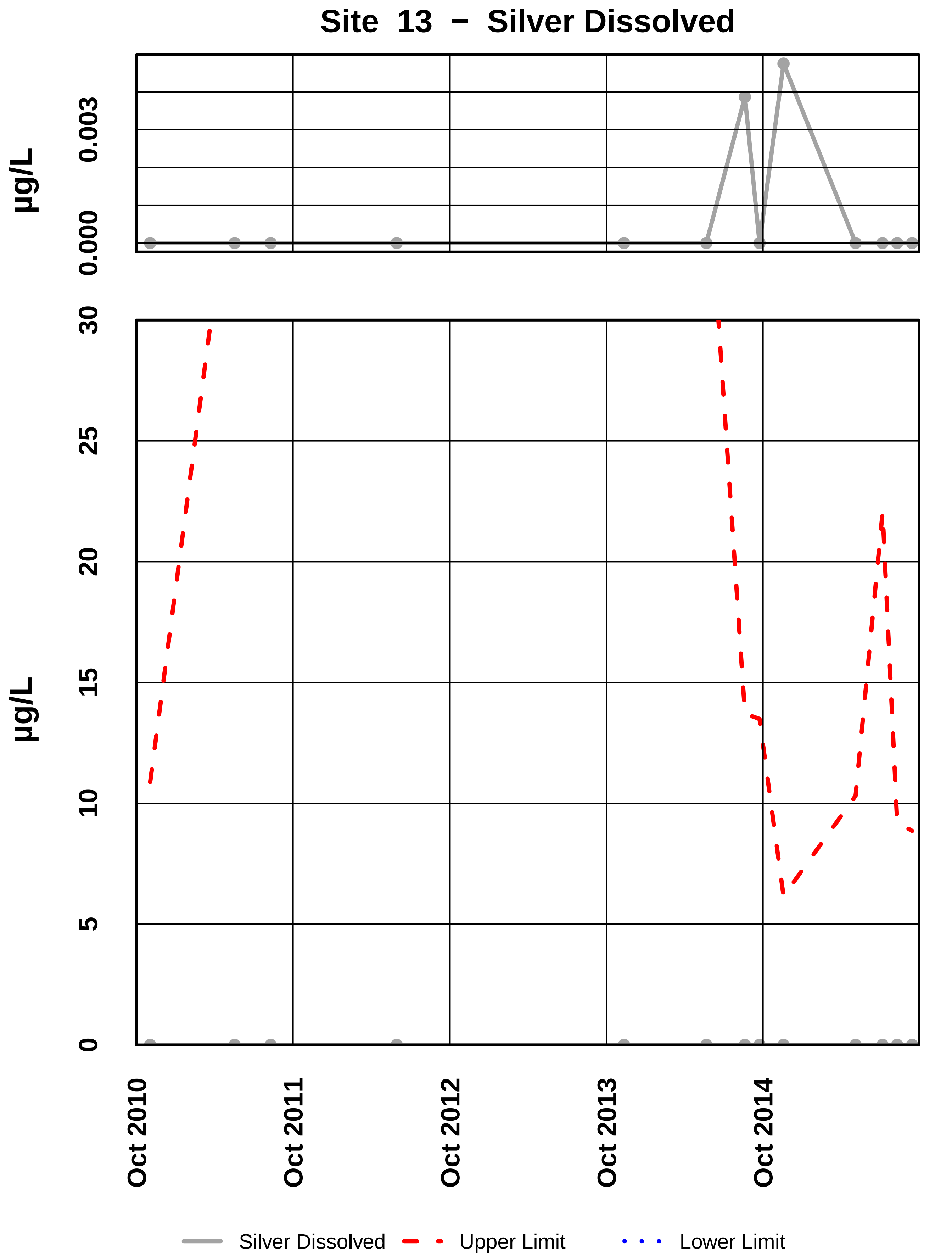


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

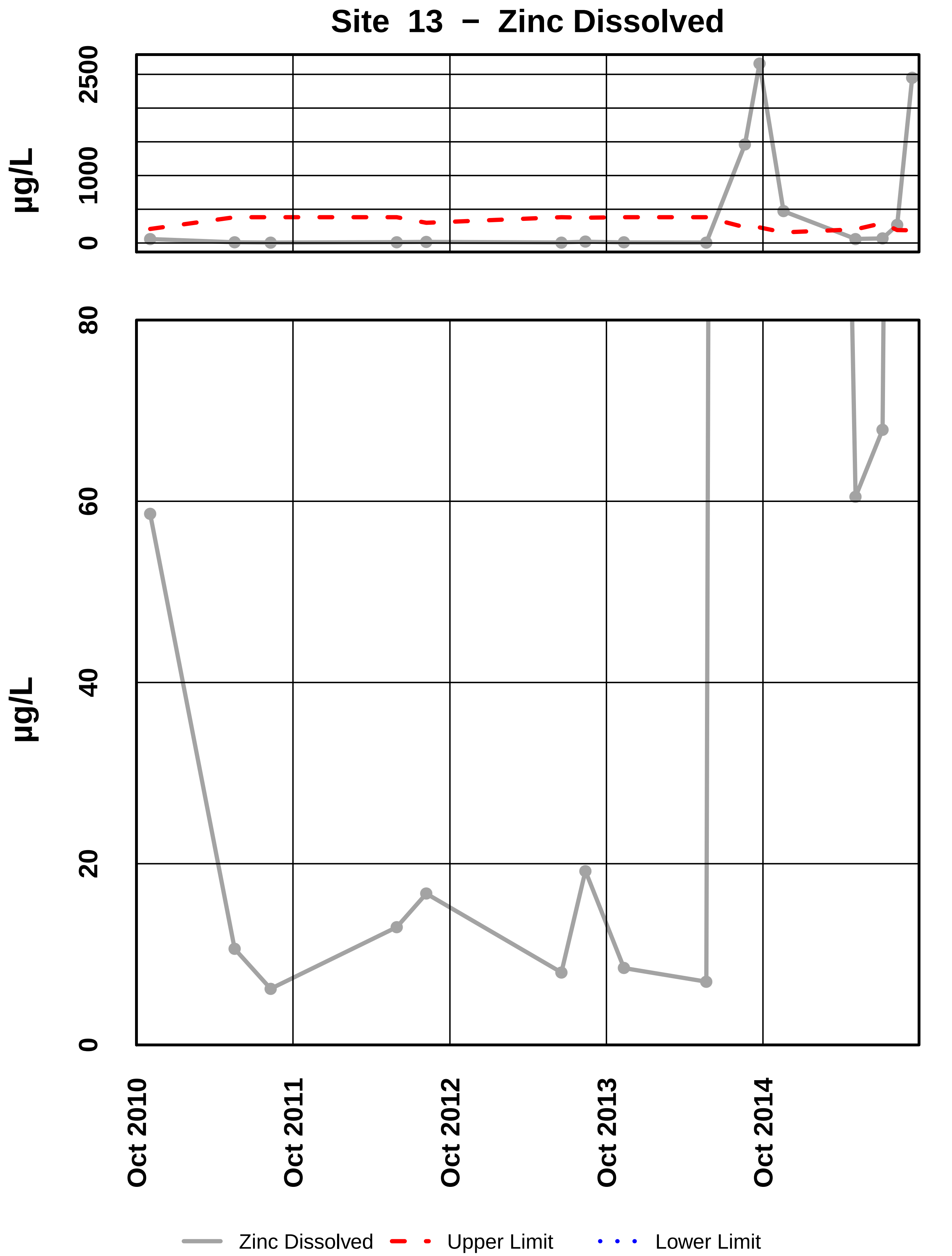
Site 13 − Nickel Dissolved



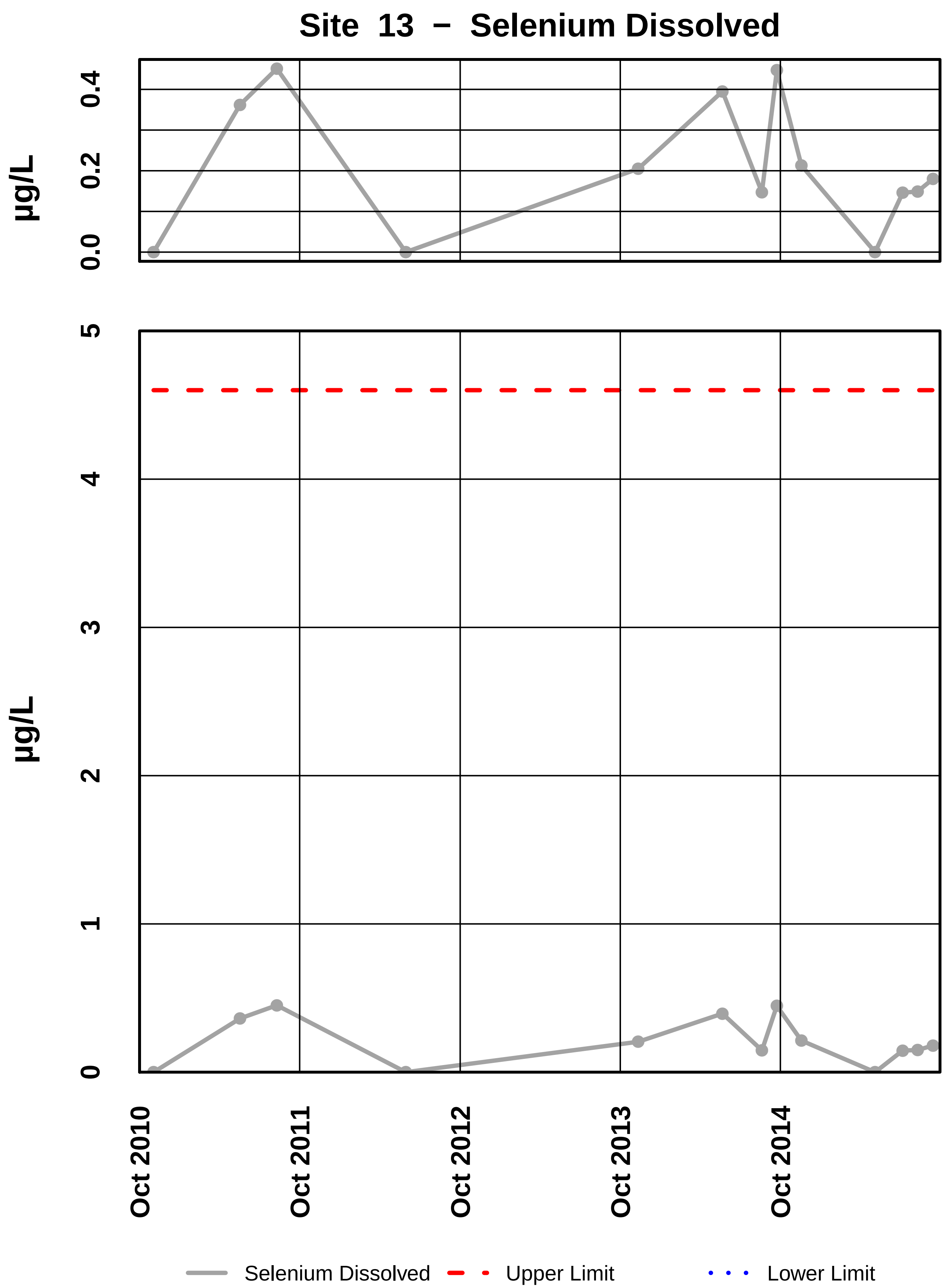
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



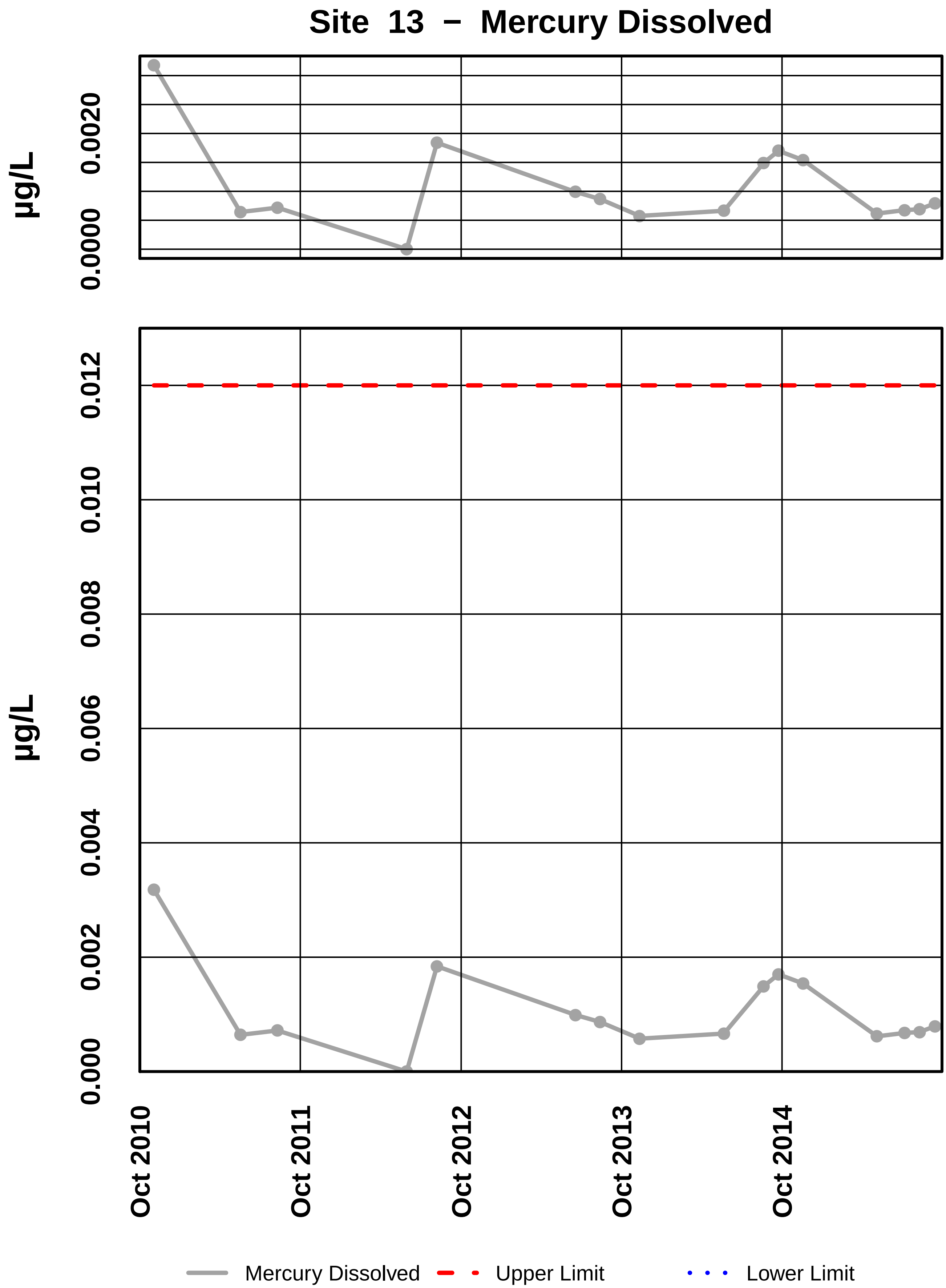
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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



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



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

INTERPRETIVE REPORT
SITE 27

The data collected during the current water year are listed in the following "Table of Results for Water Year 2015" 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, in the past six years, have been identified by HGCMC.				

The data 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 29 and 32). All of the other analytes were within AWQS for the current water year.

Table of Exceedance for Water Year 2015

			Limits		
Sample Date	**Parameter**	**Value**	**Lower**	**Upper**	**Hardness**
19-Nov-14	pH Field	5.53 su	6.5	8.5	
6-May-15	pH Field	6.14 su	6.5	8.5	
6-Jul-15	pH Field	6.4 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 34.8 mg/L in October 2009. During the current water year the mean value was 6.8 mg/L, which is slightly more than double the mean value from the 2006 through 2008 water years. As seen with other sites there has been a decreasing trend in dissolved nickel over the past 5 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-09 and Sep-15(WY2010-WY2015).

Table of Summary Statistics for Trend Analysis

	Mann-Kendall test statistics			Sen's slope estimate	
Parameter	**n***	**p****	**Trend**	**Q**	**Q(%)**
Conductivity Field	6	0.50			
pH Field	6	0.04			
Alkalinity, Total	6	<0.01	+	3.0	8.9
Sulfate, Total	6	0.04			
Zinc, Dissolved	6	0.02	-	-0.4	-26.2

* 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 3.0 mg/L/yr over the last 6 years (similar to the slope estimation, 3.07 mg/L/yr, for Water Year 2014. Over the same period, the statistically significant trend with dissolved zinc was decreasing by 0.4 µg/L /yr. With the changes that were made to the FWMP monitoring schedule (*i.e.* increase sampling frequency), HGCMC feels that the FWMP program is sufficient to monitor further changes, before the AWQS are exceeded.

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

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

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

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

Specific conductance also went out of control in water year 2008 as would be expected with the increase in total sulfate driving the increase in conductivity. Specific conductivity increased during the July and September 2015 sampling events, which would correlate with the excavation for the Stage 3 Phase 1 tailings expansion that began in May 2015.

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**

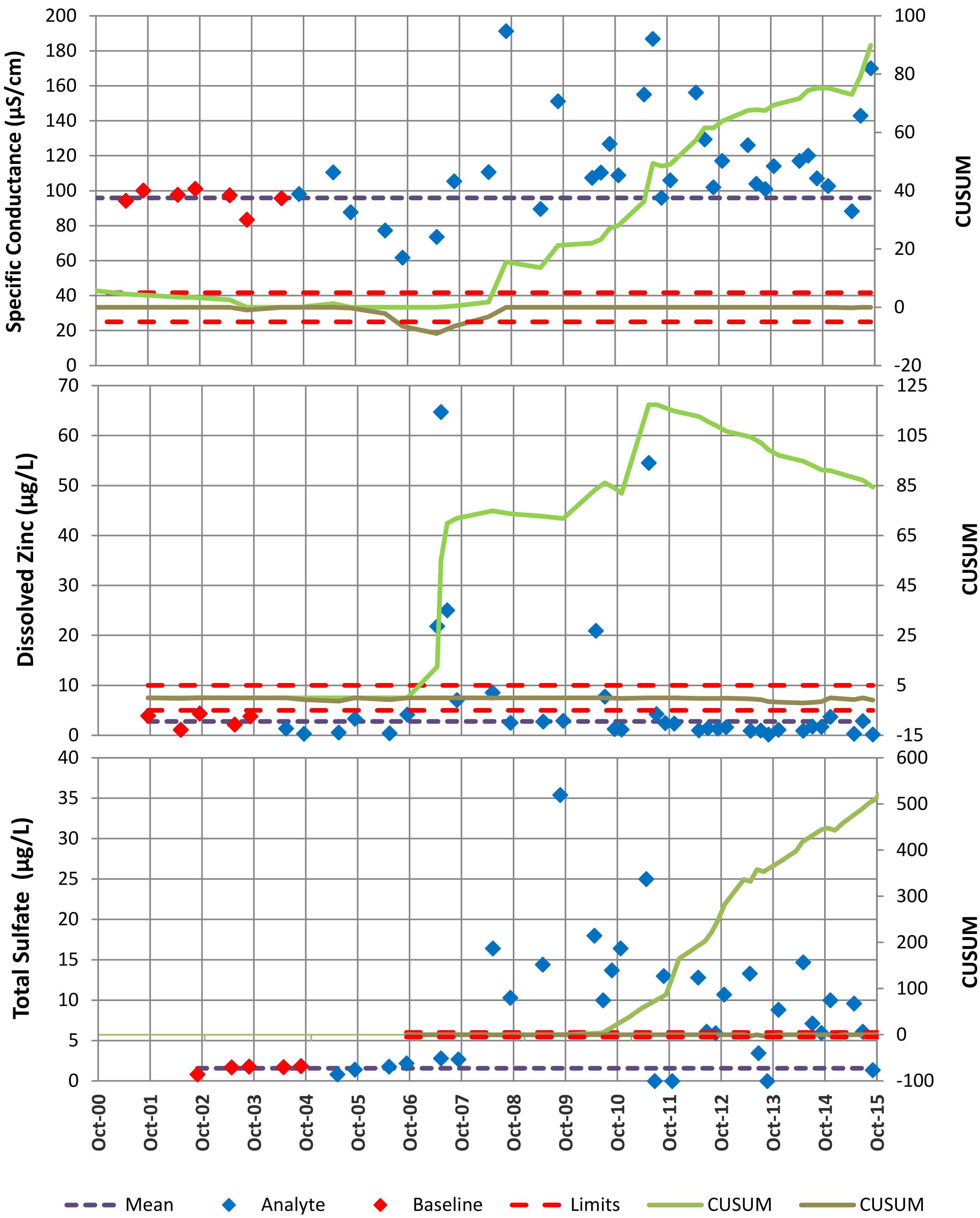


Table of Results for Water Year 2015

Site 027FMG - 'Monitoring Well - 2S'

Sample Date/Parameter	Oct 2014	Nov 2014	Dec 2014	Jan 2015	Feb 2015	Mar 2015	Apr 2015	May 2015	Jun 2015	Jul 2015	Aug 2015	Sep 2015	**Median**
Water Temp (°C)		5.7						8.3		11.1		9.9	9.1
Conductivity-Field(µmho)		102.7						88.3		142.9		170	122.8
Conductivity-Lab (µmho)		99						99		132		107	103
pH Lab (standard units)		5.73						5.48		6.39		6.23	5.98
pH Field (standard units)		5.53						6.14		6.4		6.51	6.27
Total Alkalinity (mg/L)		33.9						33.9		57.3		61.2	45.6
Total Sulfate (mg/L)		10						9.6		6.1		1.4	7.9
Hardness (mg/L)		27.8						29.4		40.4		40.3	34.9
Dissolved As (ug/L)		2.49						0.578		3.55		1.77	2.130
Dissolved Ba (ug/L)		38.7						27.8		51.3		40.4	39.6
Dissolved Cd (ug/L)		0.0018						0.0018		0.0018		0.0018	0.0018
Dissolved Cr (ug/L)		0.151						0.611		0.543		0.724	0.577
Dissolved Cu (ug/L)		0.142						0.086		0.116		0.121	0.119
Dissolved Pb (ug/L)		0.256						0.0237		0.248		0.0265	0.1373
Dissolved Ni (ug/L)		0.41						0.36		0.721		0.414	0.412
Dissolved Ag (ug/L)		0.002						0.002		0.002		0.002	0.002
Dissolved Zn (ug/L)		3.68						0.29		2.85		0.14	1.57
Dissolved Se (ug/L)		0.081						0.057		0.057		0.146	0.069
Dissolved Hg (ug/L)		0.00031						0.00122		0.00053		0.000779	0.000655

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.

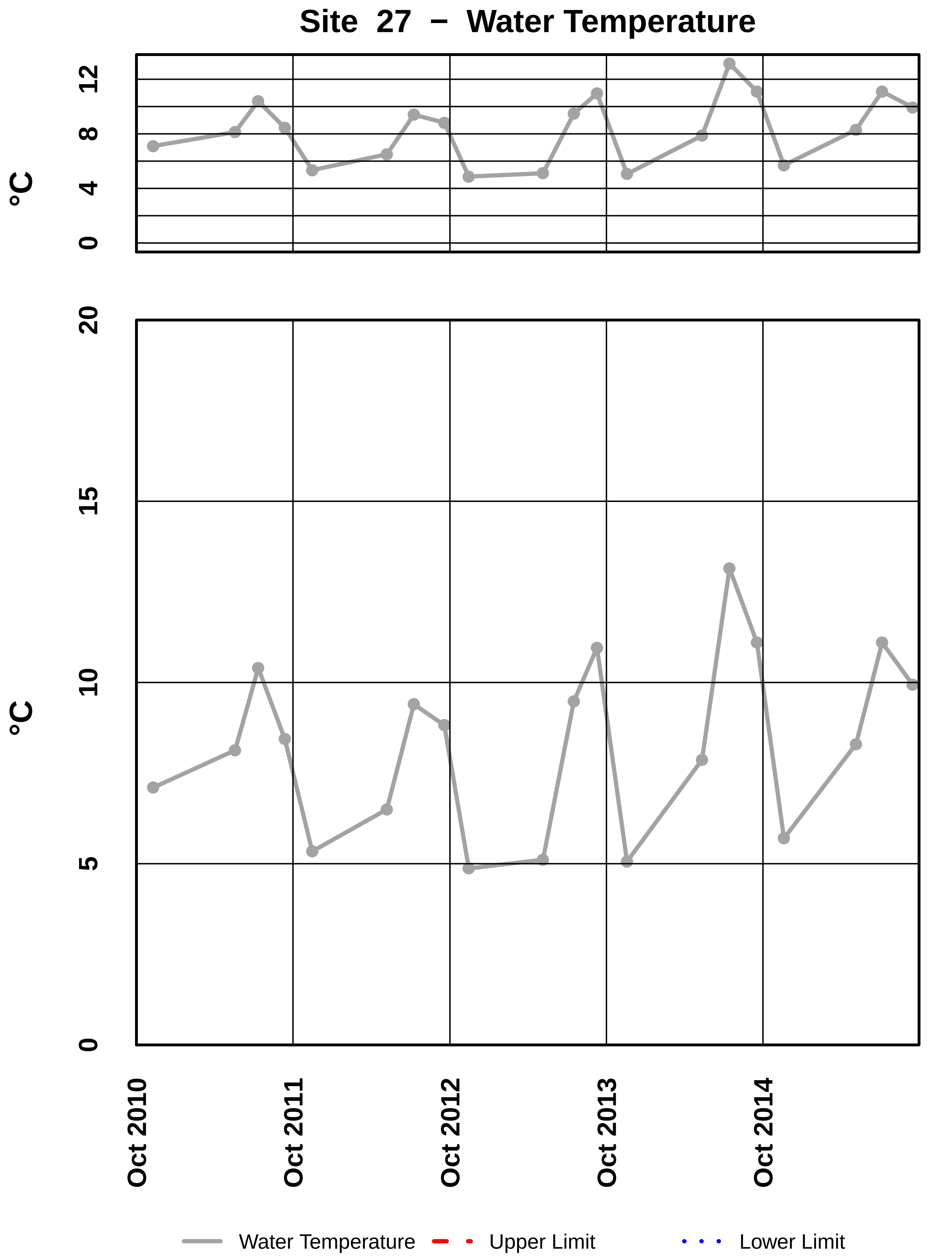
Shaded data has been qualified as an outlier by HGCMC and removed from any further analysis and is not included into the calculation of the median

Qualified Data by QA Reviewer

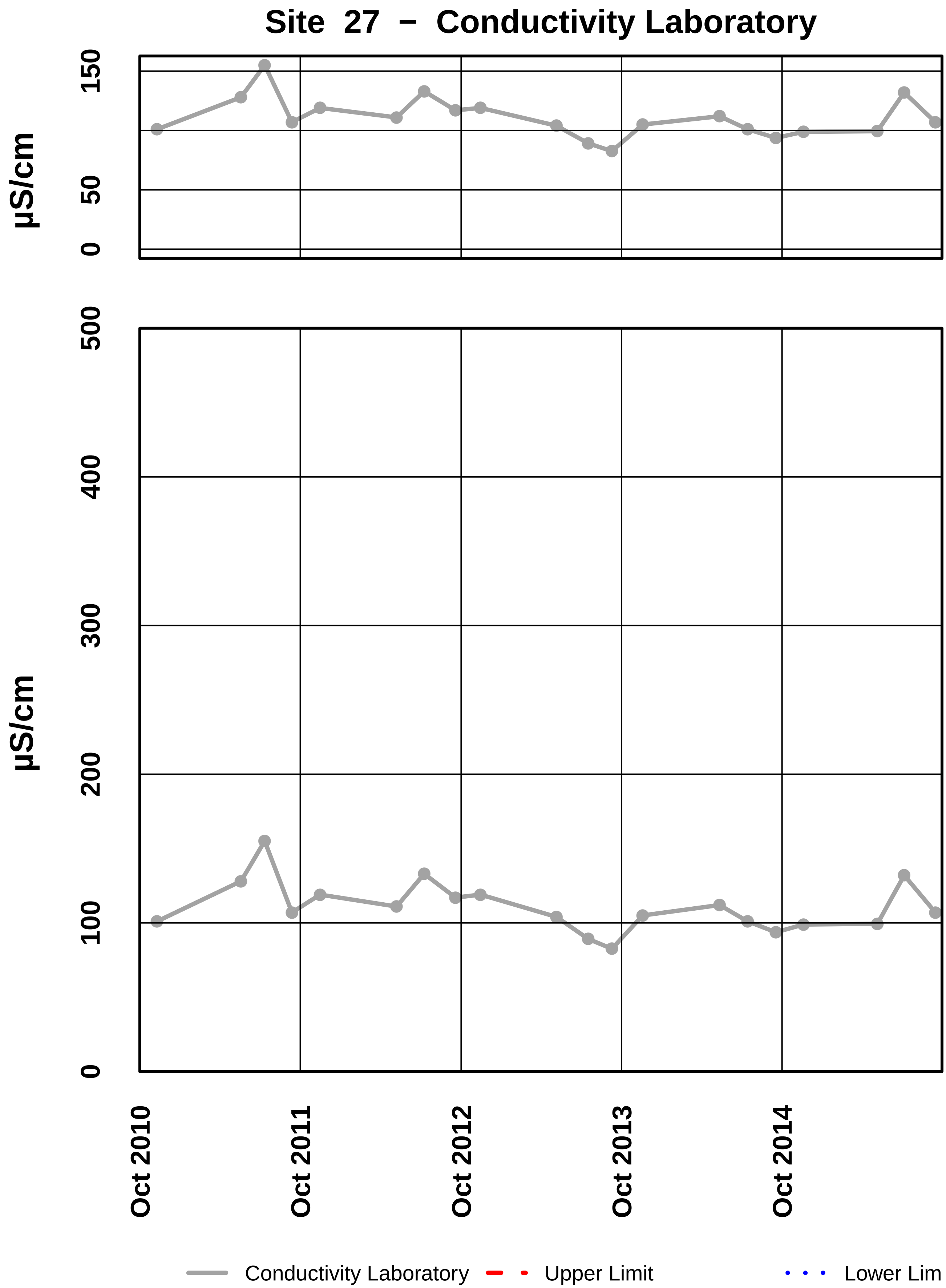
Date Range: 10/01/2014 to 09/30/2015

Site No.	Sample Date	Sample Time	Parameter	Value		Qualifier	Reason for Qualifier
027FMG	07/06/2015	12:00 AM	Diss. Cu-ICP/MS	0.11	µg/L	U	Field Blank Contamination
027FMG	09/15/2015	12:00 AM	Diss. Se-ICP/MS	0.14	µg/L	J	Below Quantitative Range
			Sulfate	1.35	mg/L	J	Below Quantitative Range
027FMS	11/19/2014	12:00 AM	Diss. Cr-ICP/MS	0.15	µg/L	J	Below Quantitative Range
			Diss. Se-ICP/MS	0.08	µg/L	J	Below Quantitative Range
			pH	5.73	pH units	J	Hold Time Violation
			Diss. Cd-ICP/MS	0.00459	µg/L	J	Below Quantitative Range
			pH	4.84	pH units	J	Hold Time Violation
029FMG	05/06/2015	12:00 AM	Alkalinity	1.9	mg/L	J	Below Quantitative Range

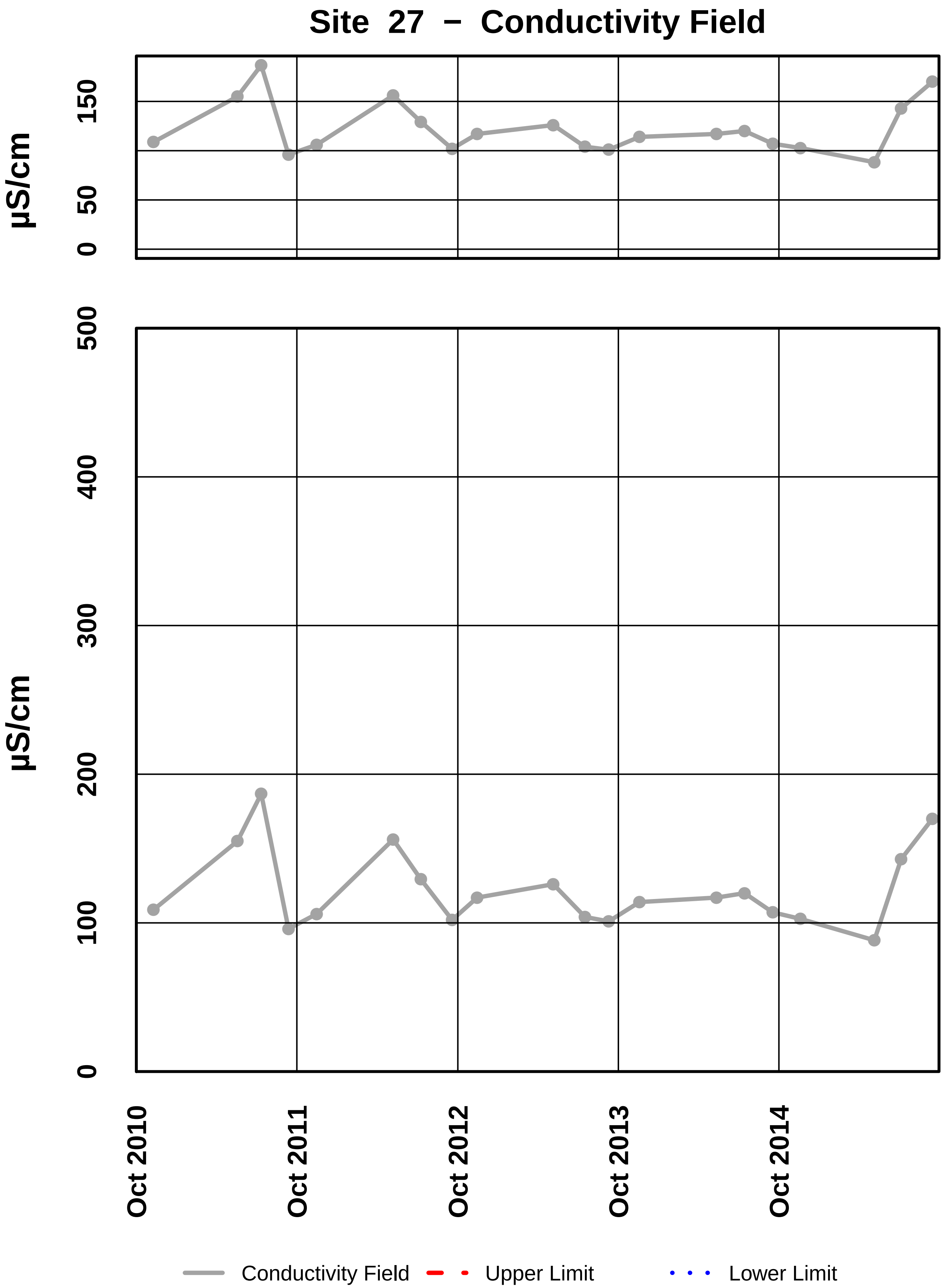
Qualifier	Description
J	Positively Identified - Approximate Concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit



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



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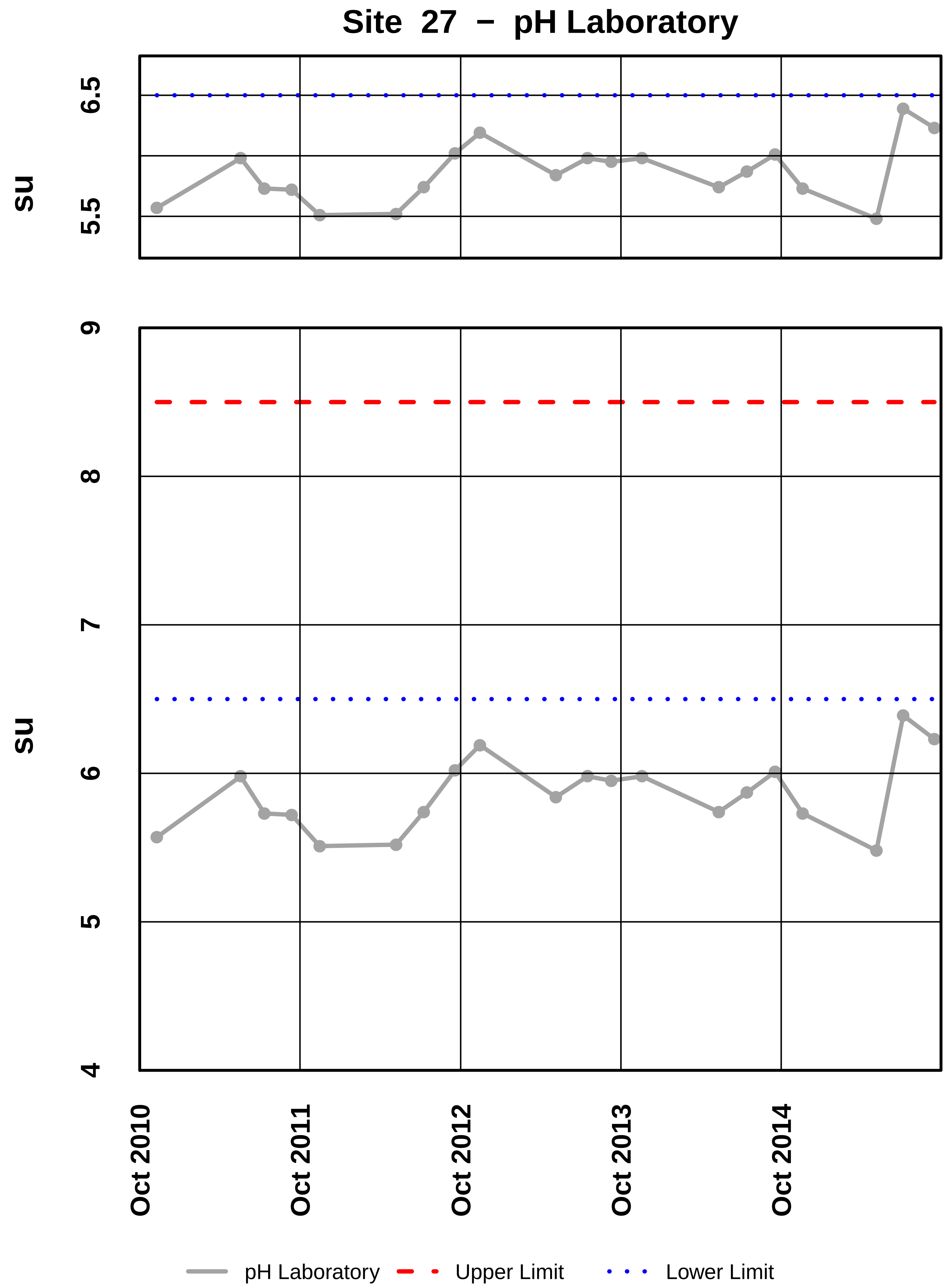
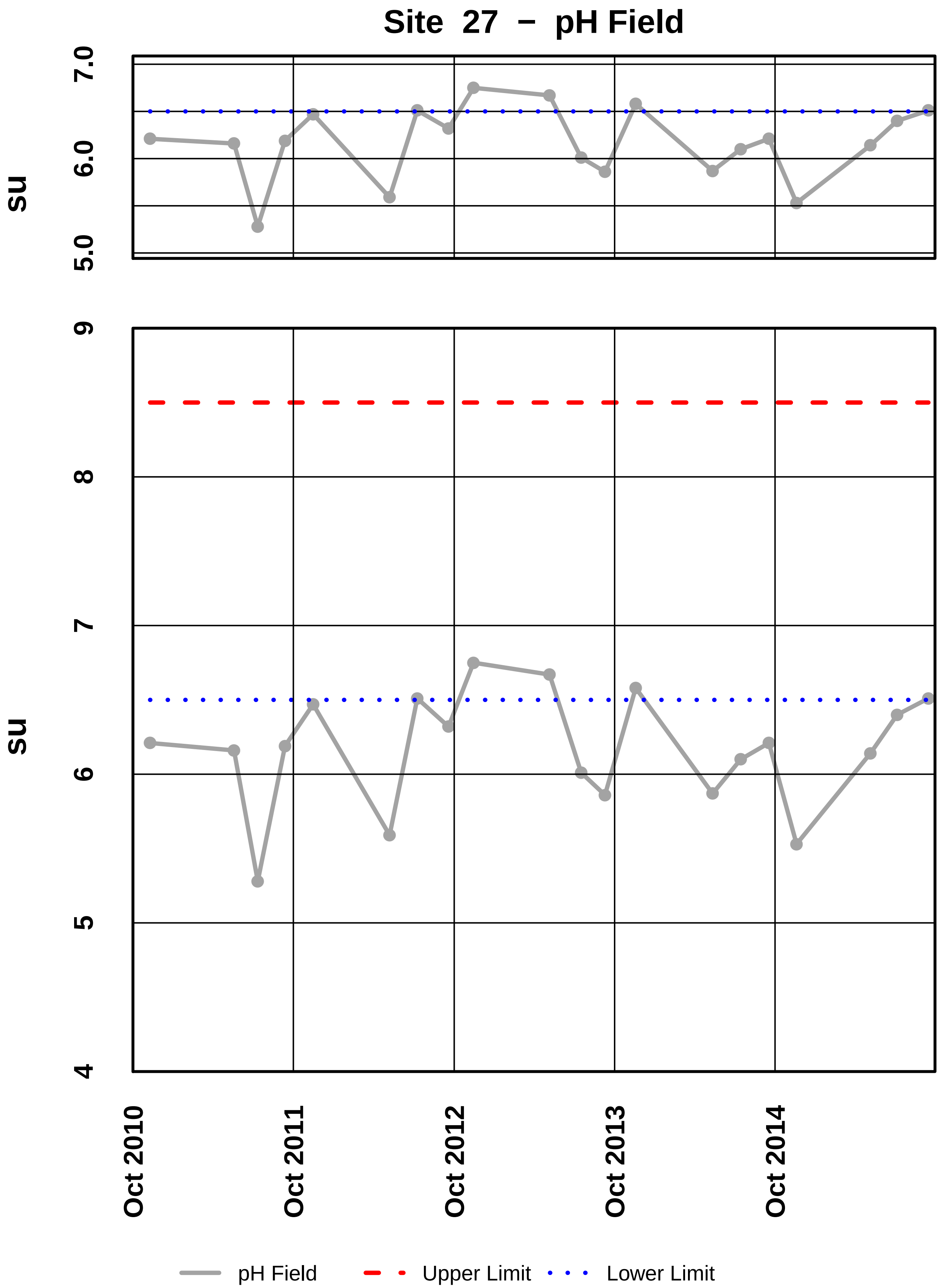
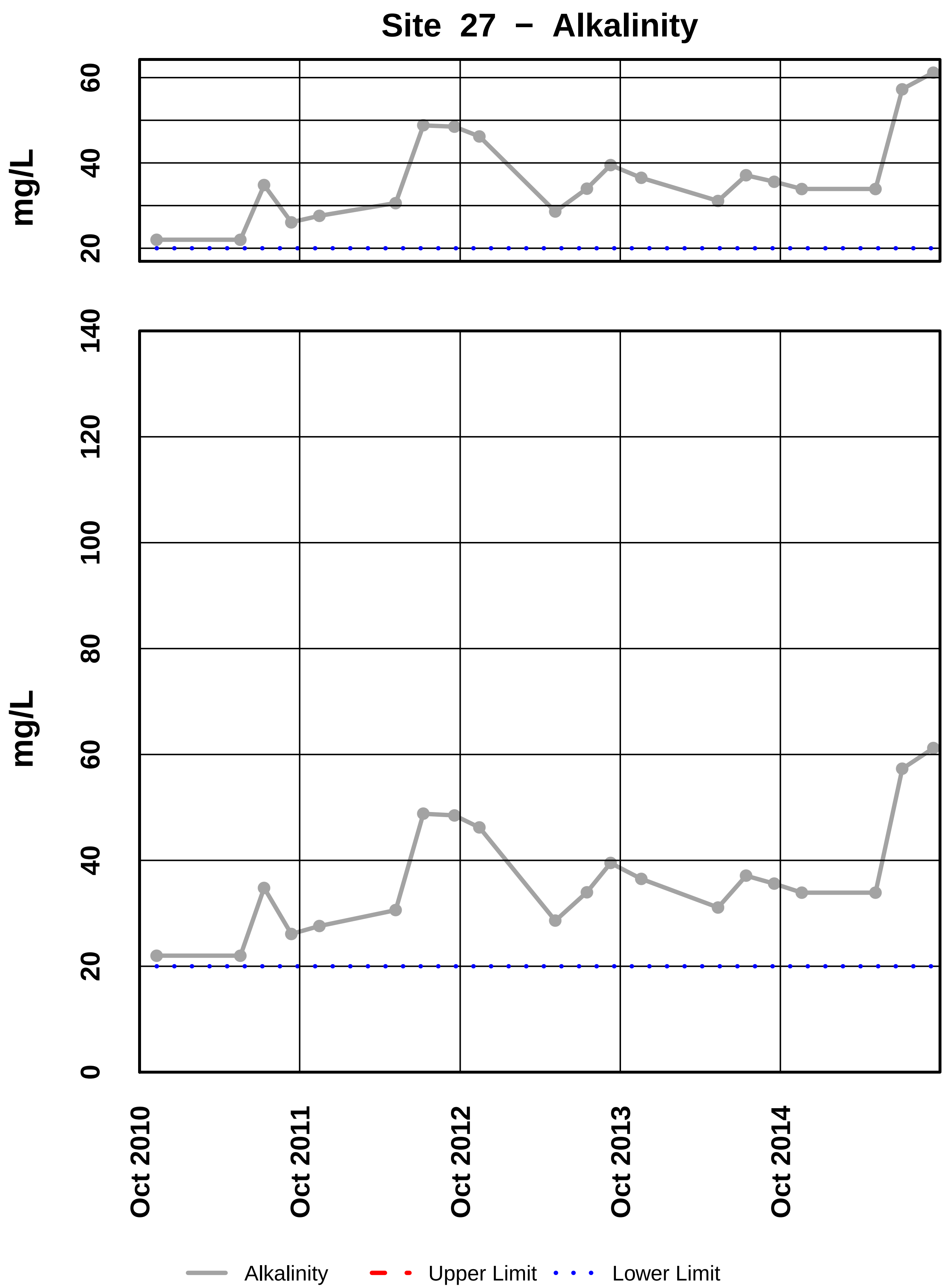


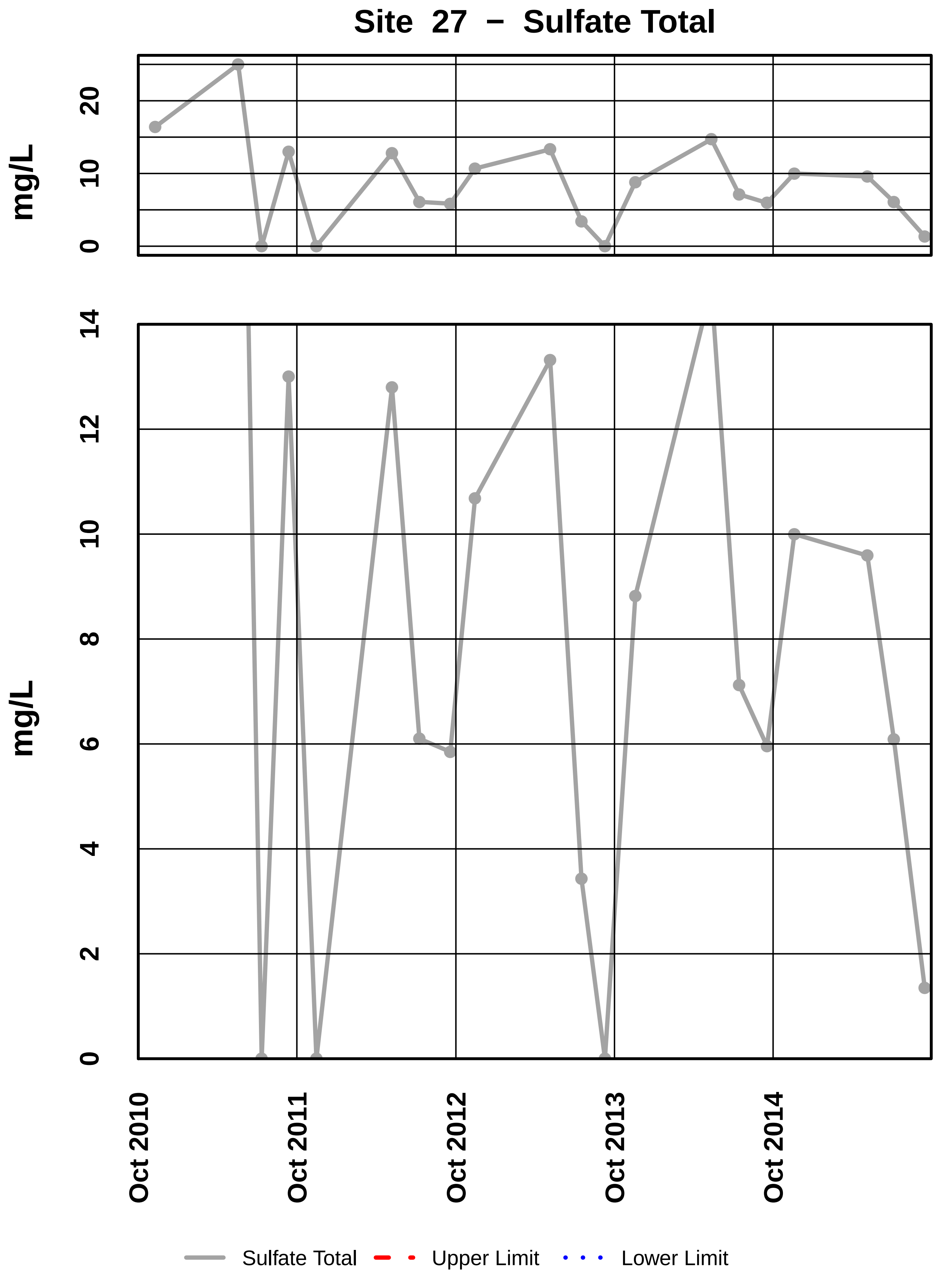
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



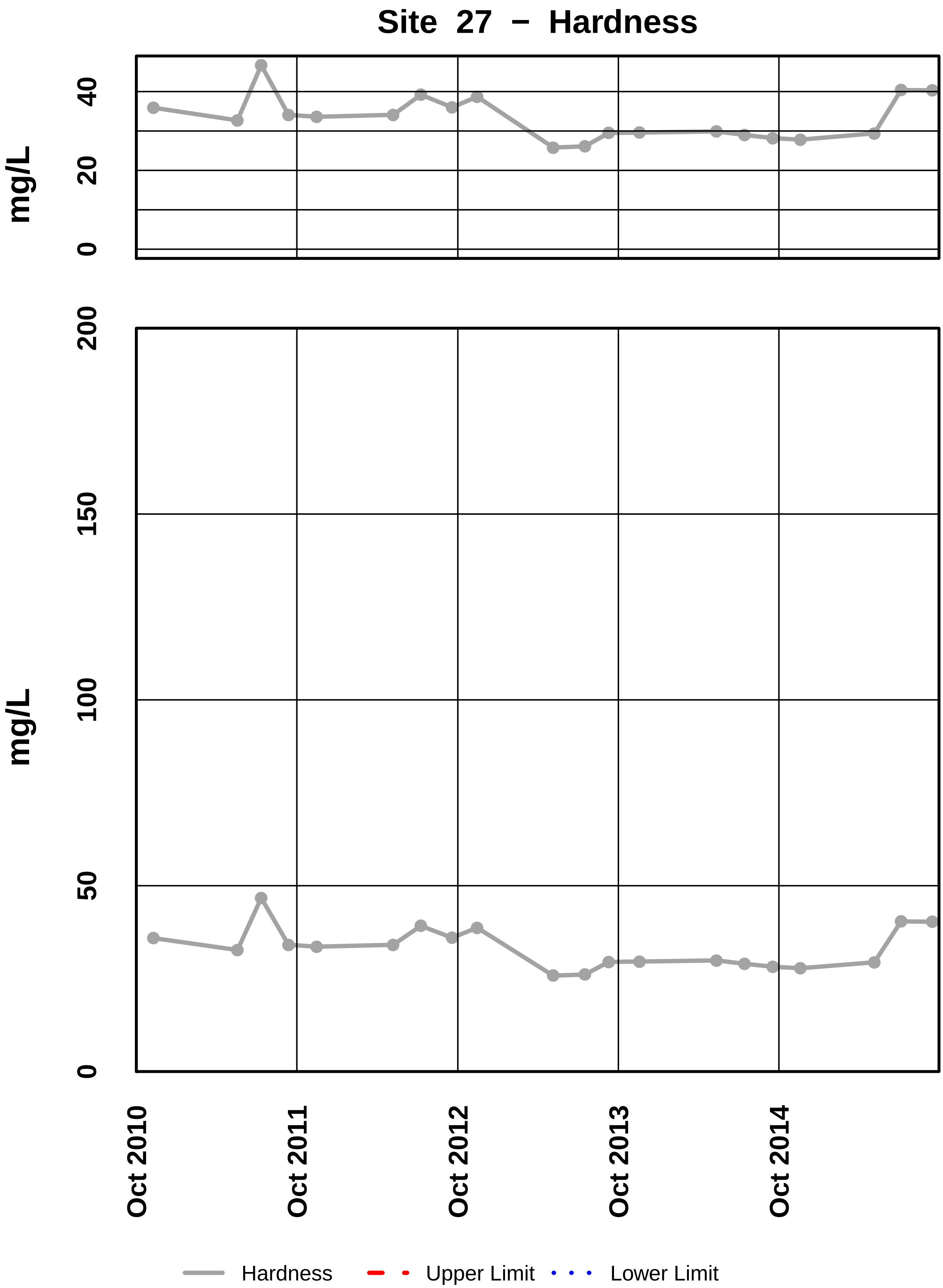
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

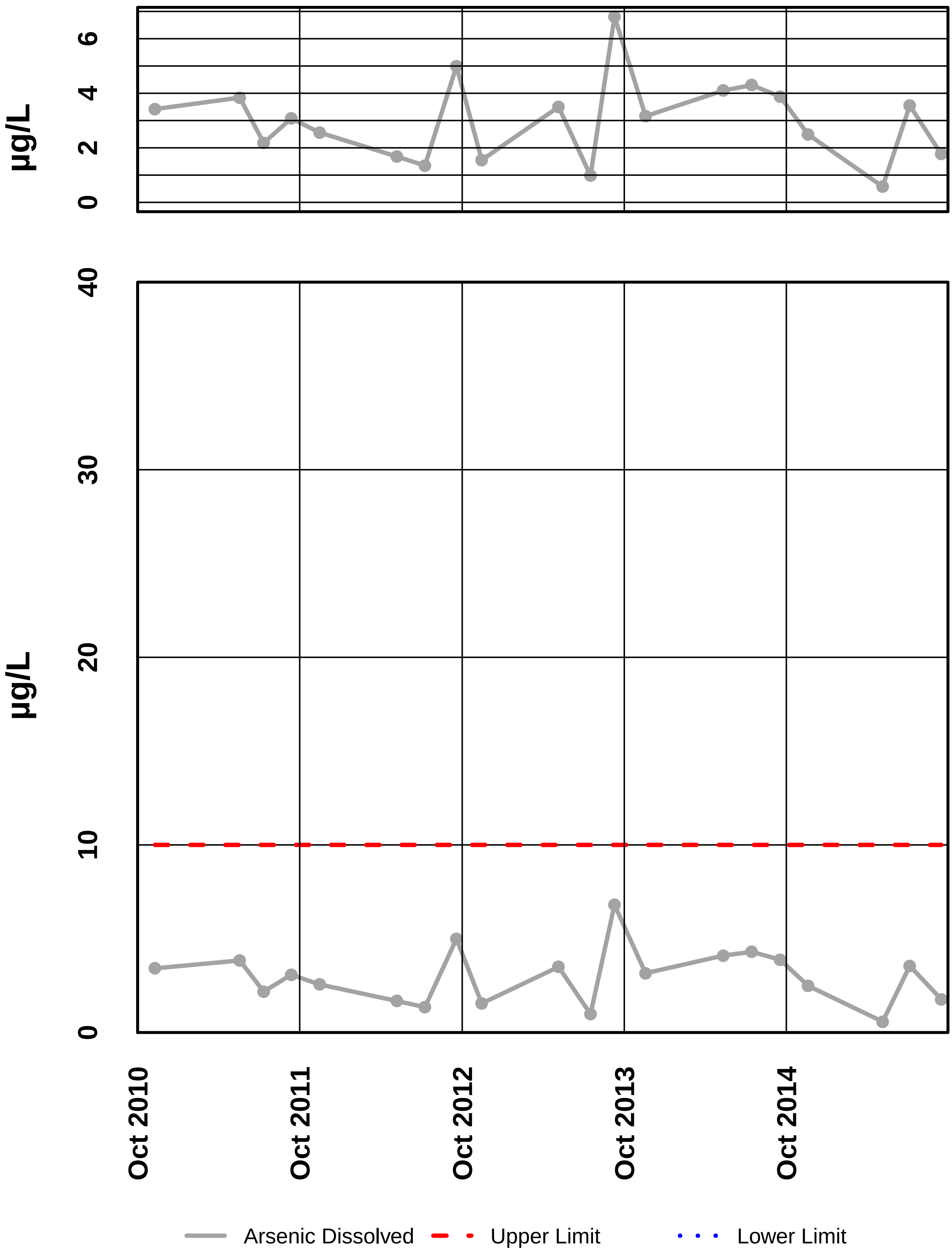


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

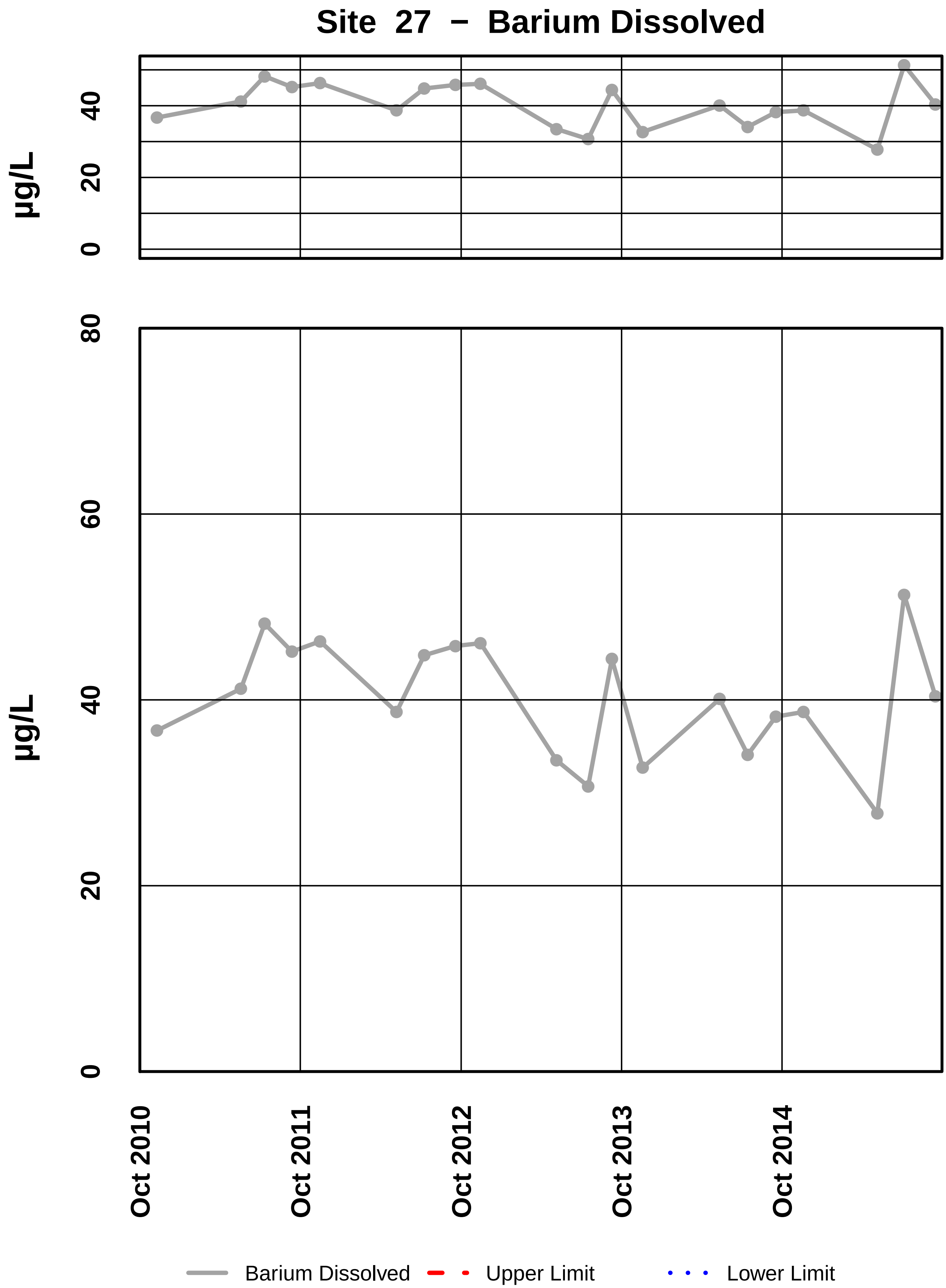


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 27 – Arsenic Dissolved

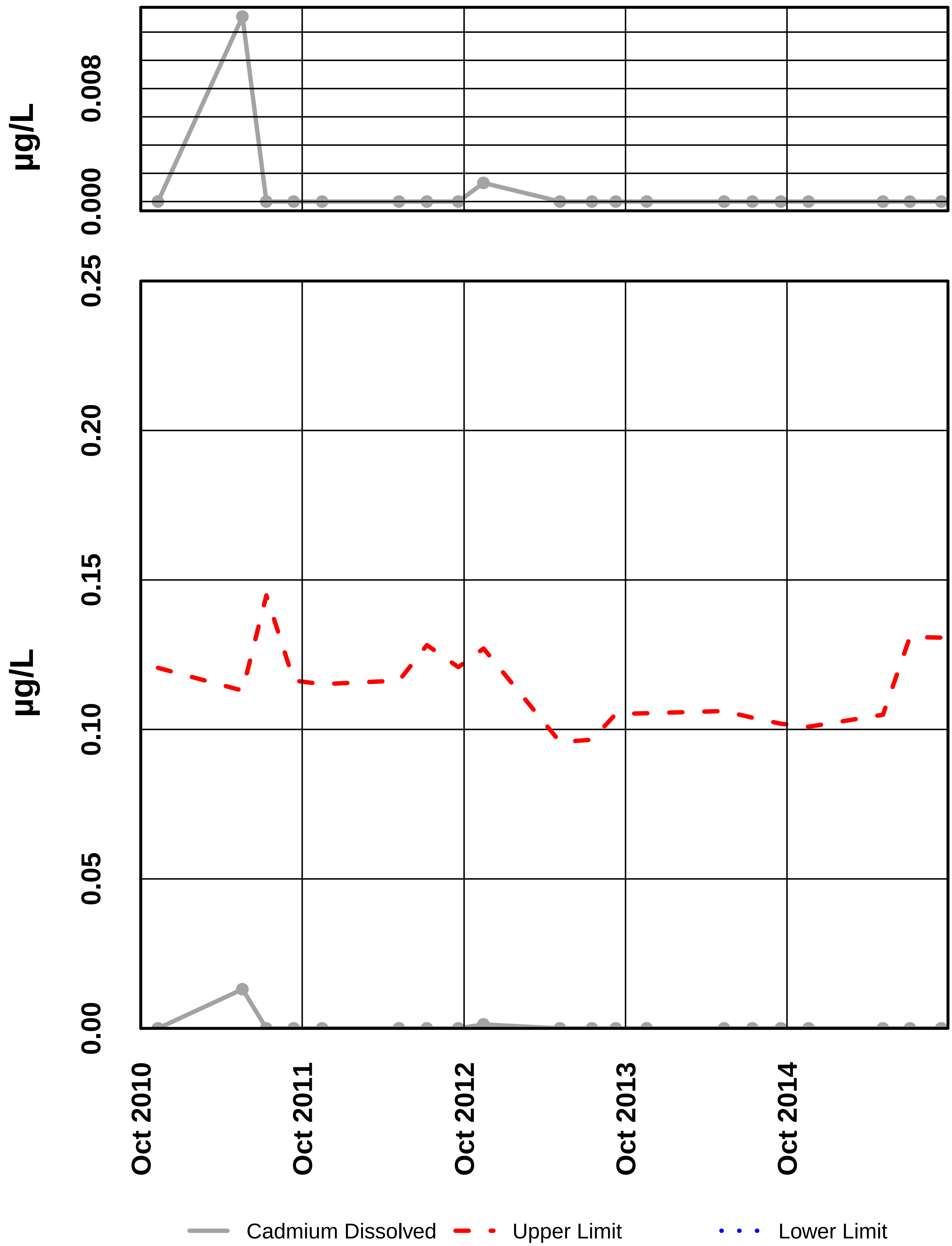


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

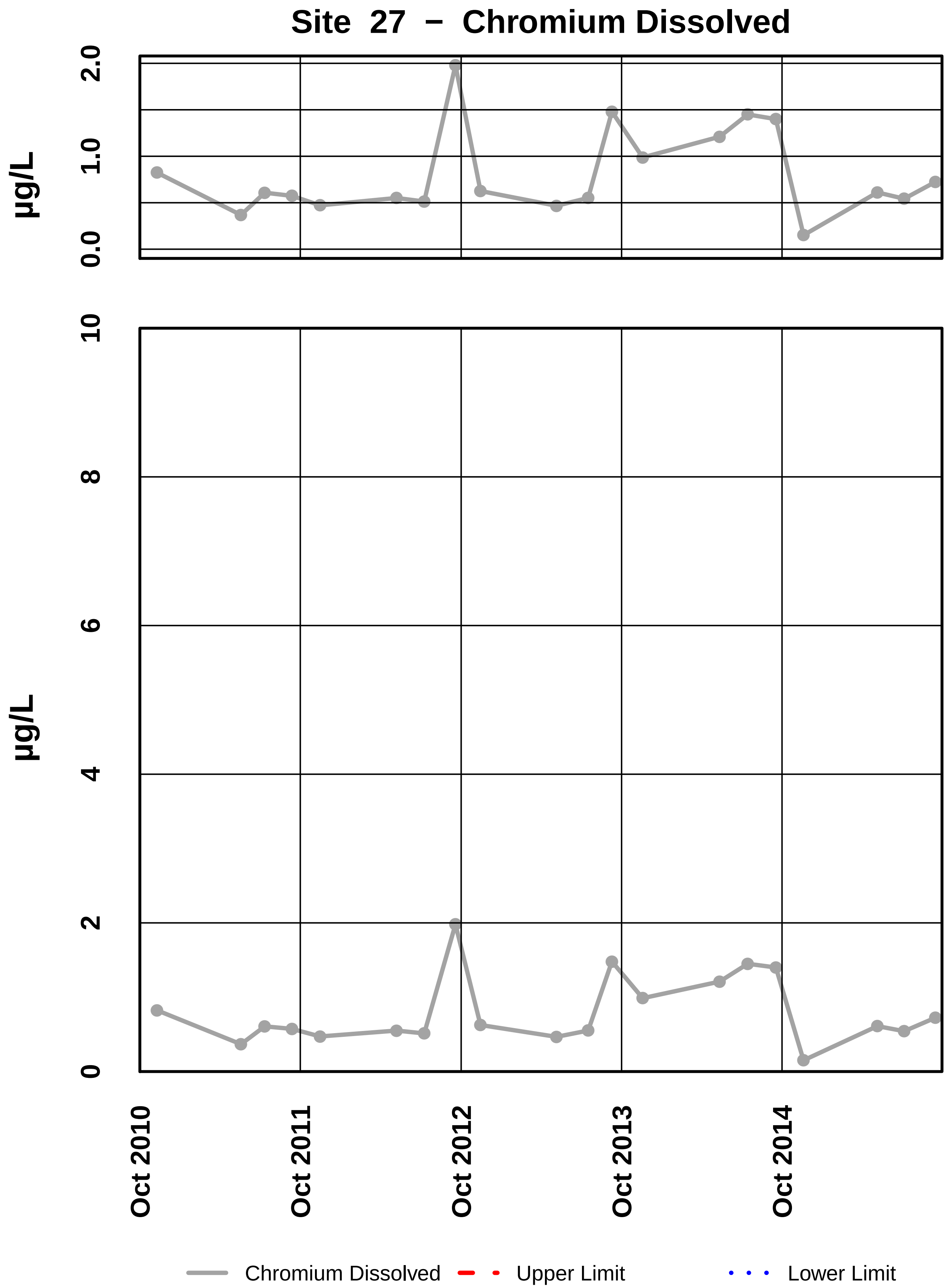


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

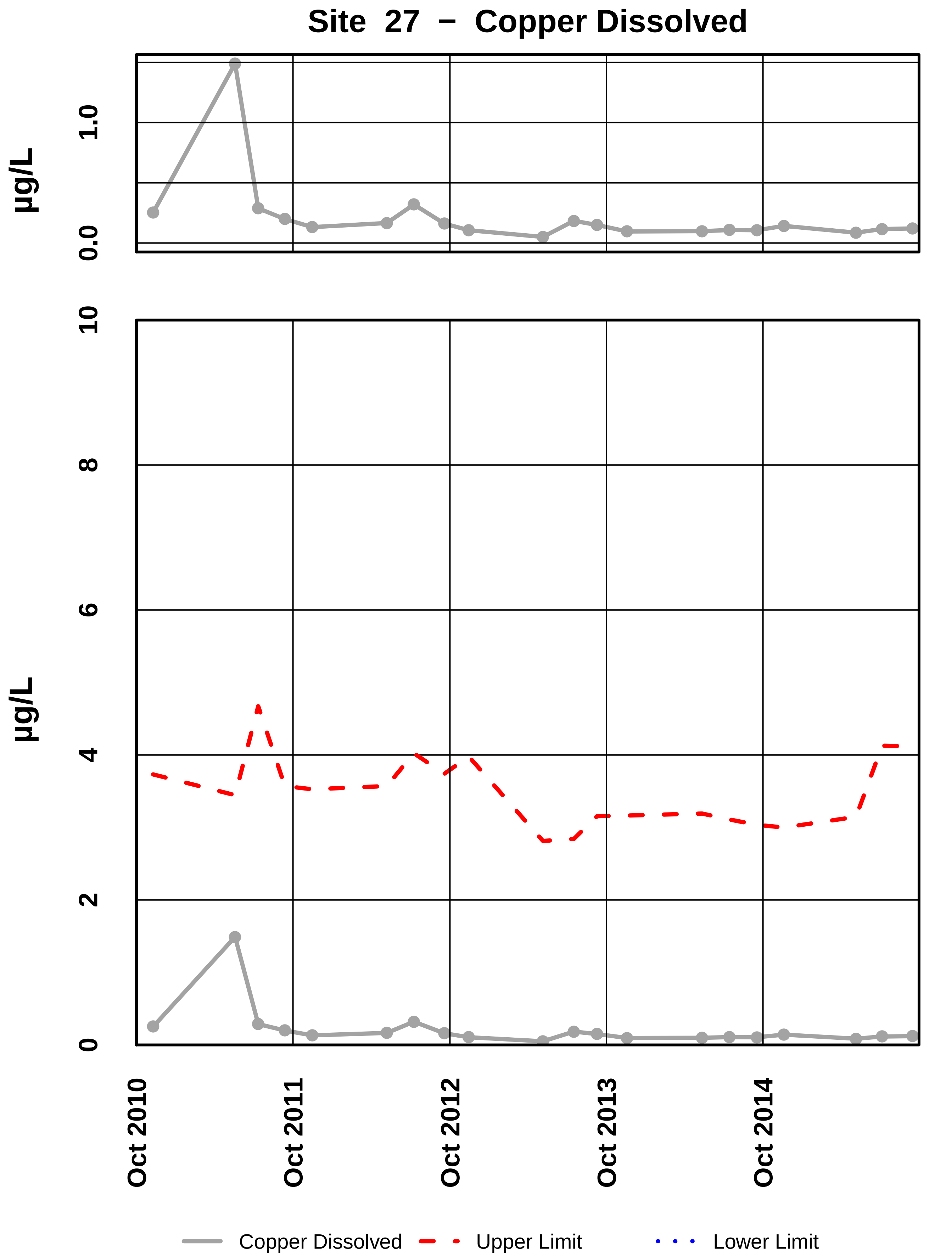
Site 27 – Cadmium Dissolved



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

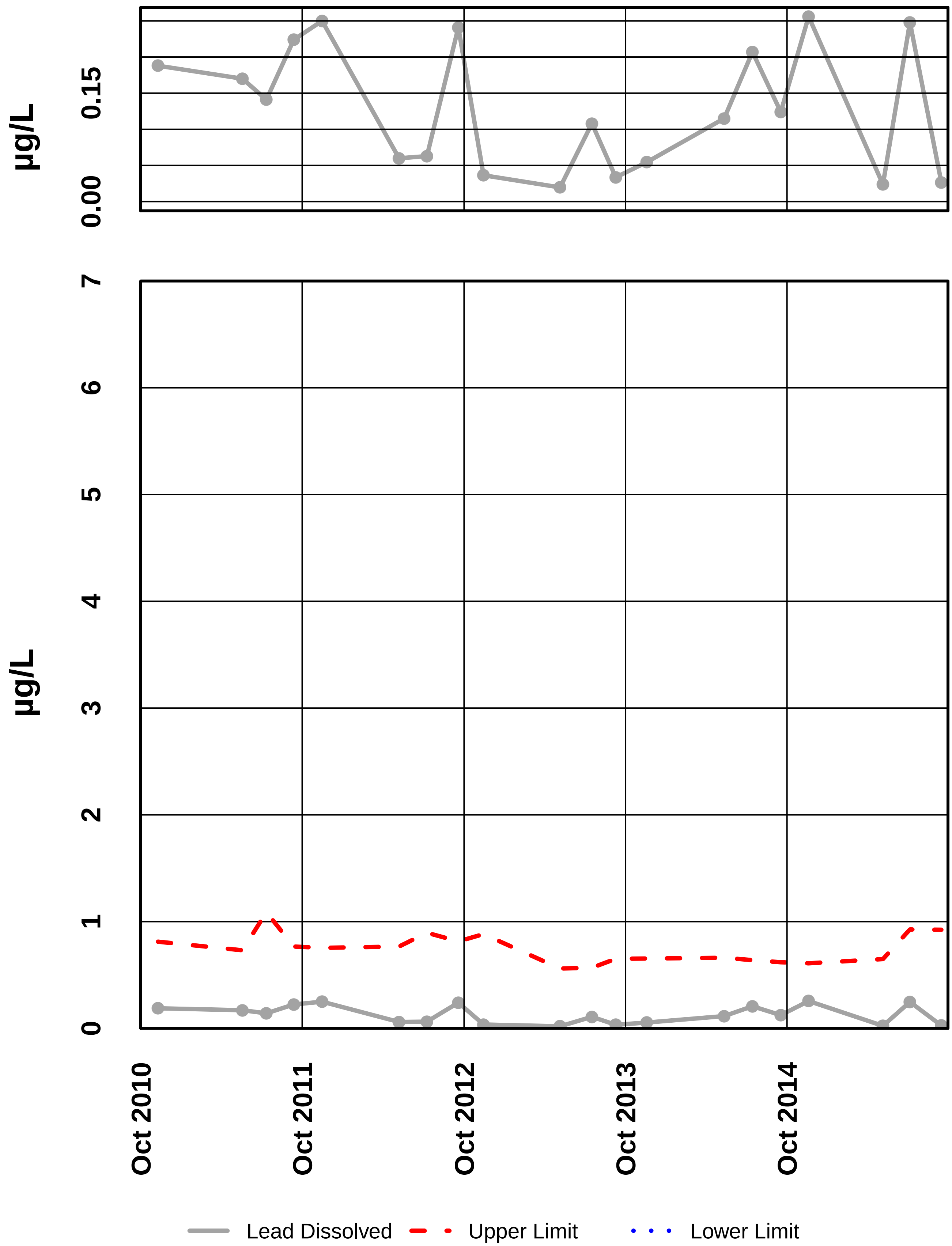


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

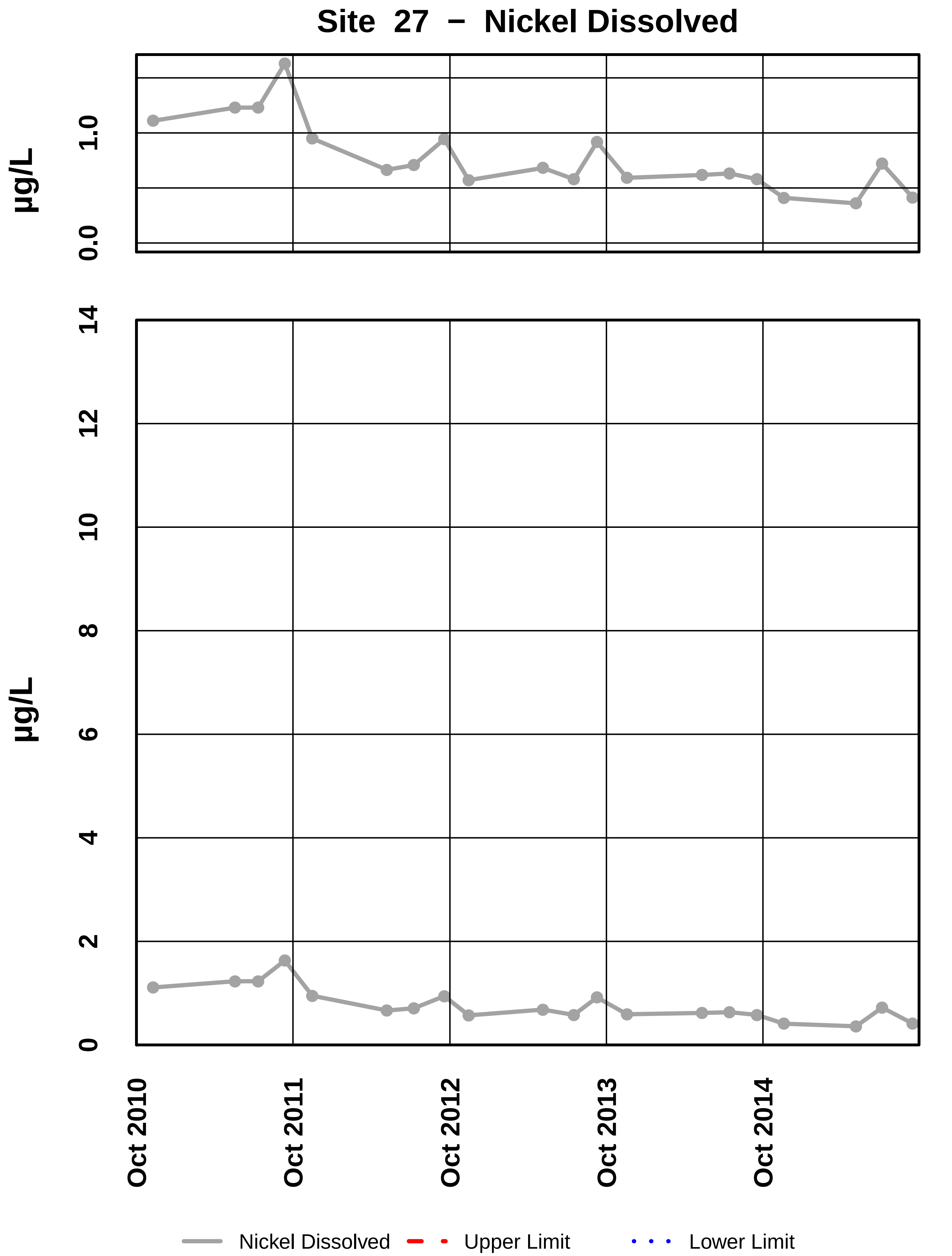


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 27 – Lead Dissolved

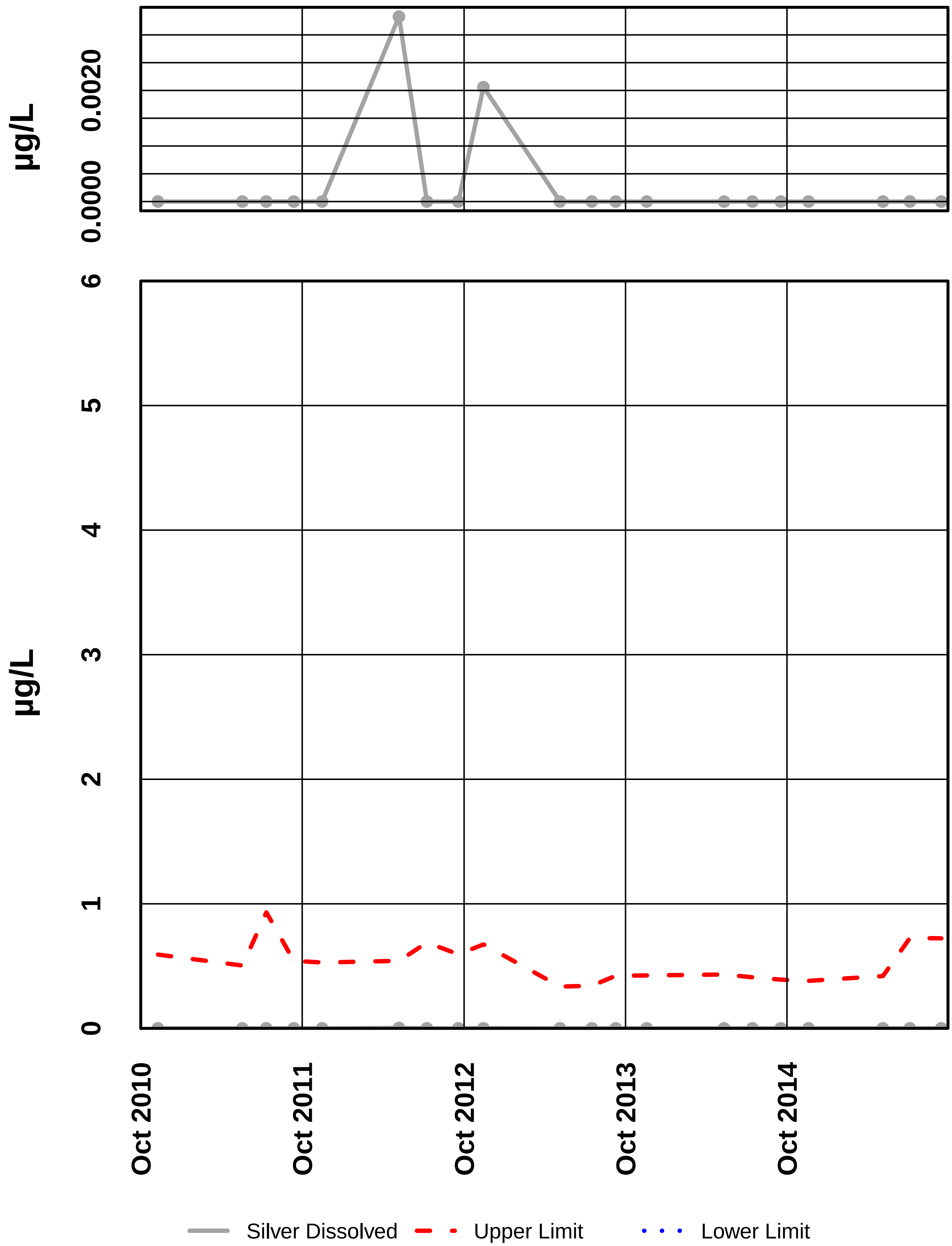


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



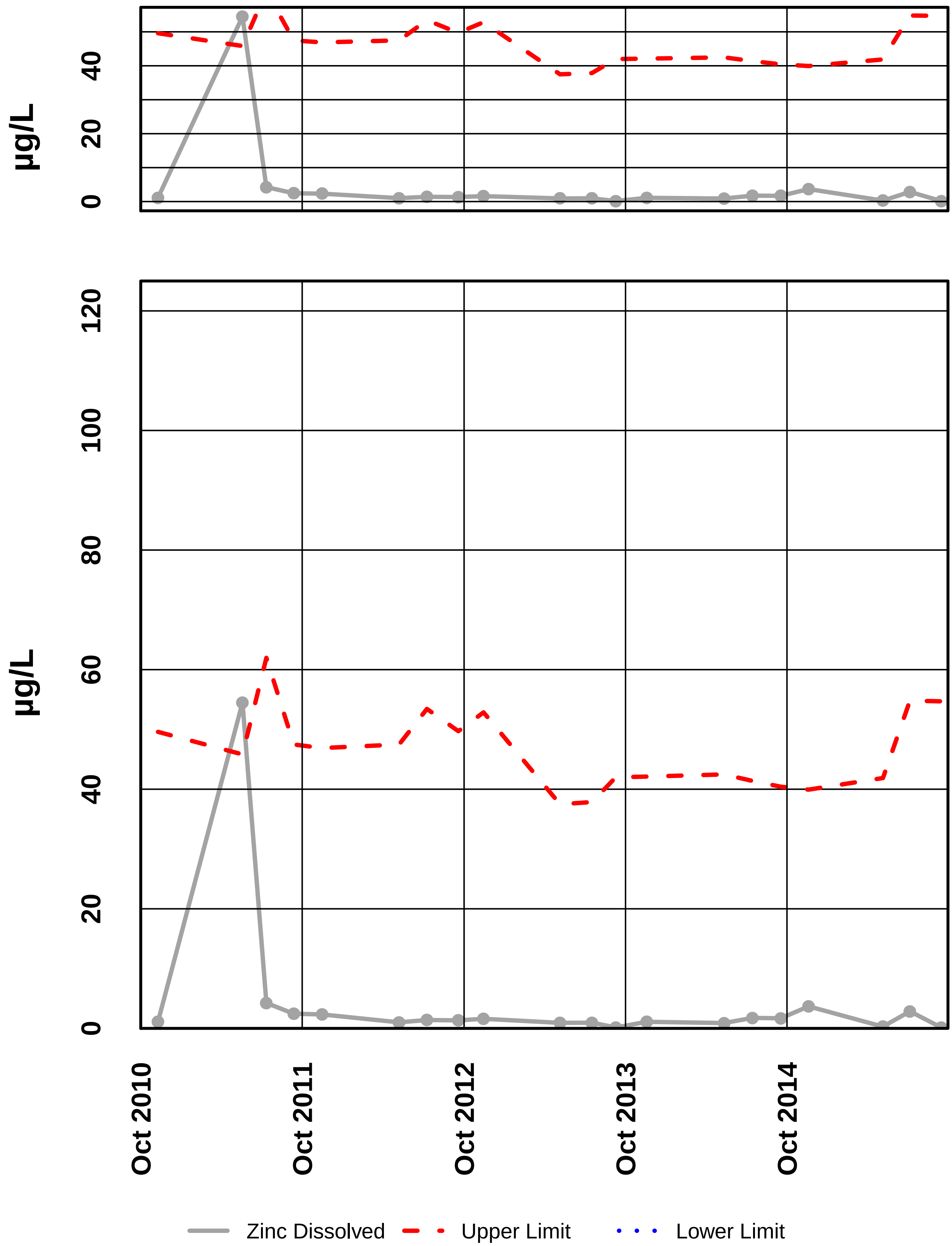
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 27 – Silver Dissolved

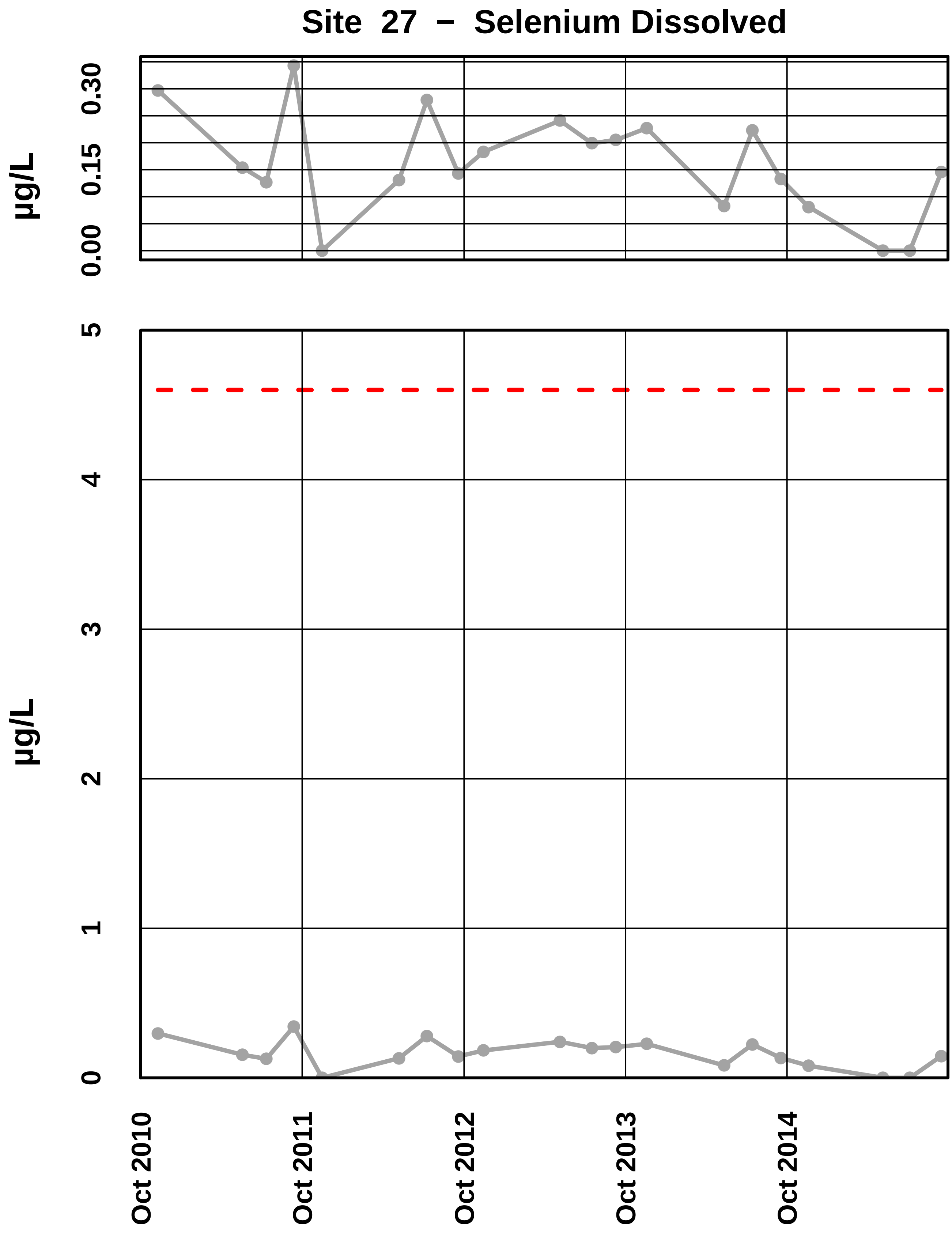


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

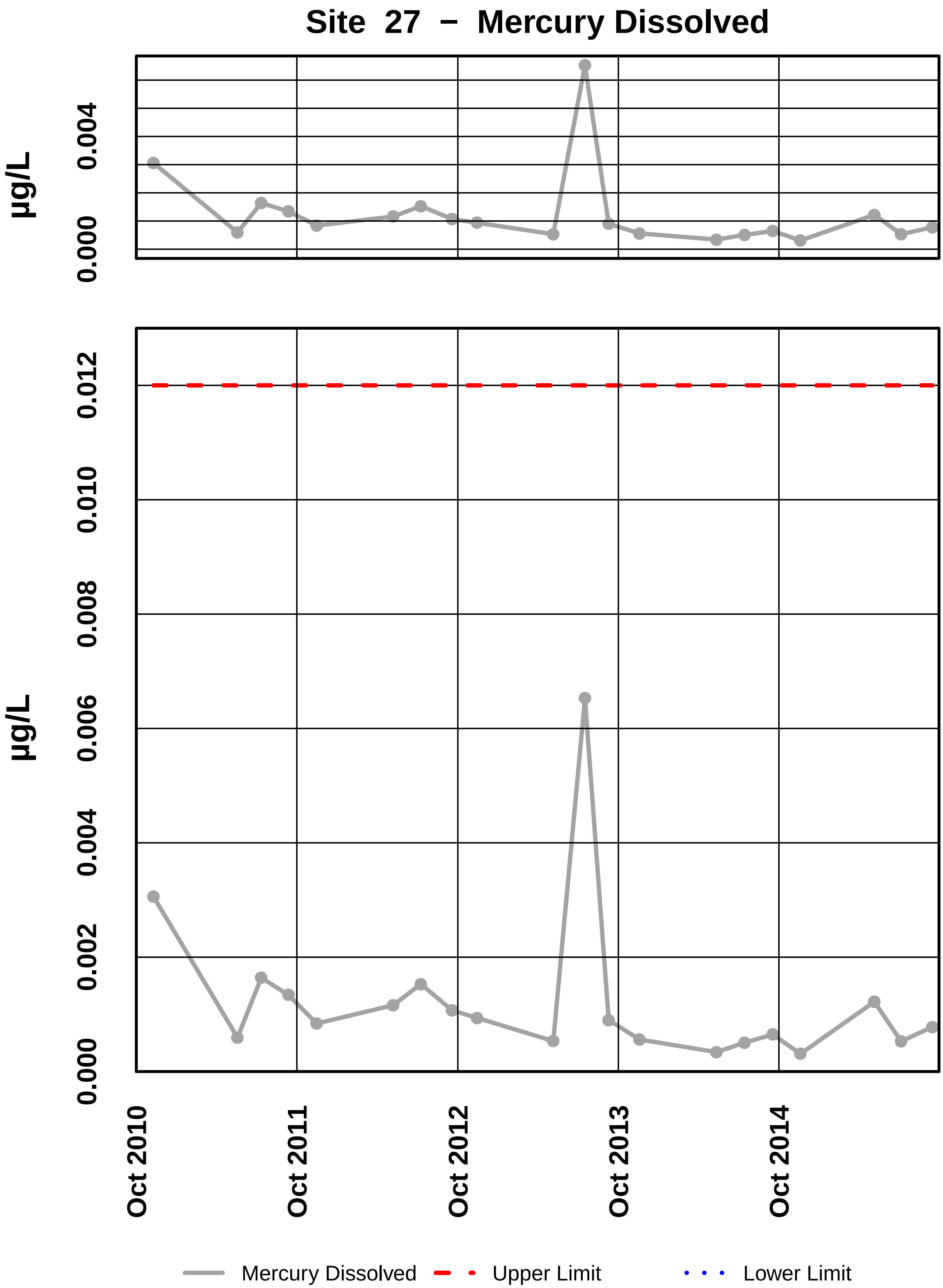
Site 27 – Zinc Dissolved



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

INTERPRETIVE REPORT
SITE 29

The data collected during the current water year are listed in the following "Table of Results for Water Year 2015" 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, in the past six years, have been identified by HGCMC.				

The data for Water Year 2015 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 2015

			Limits		
Sample Date	**Parameter**	**Value**	**Lower**	**Upper**	**Hardness**
19-Nov-14	Alkalinity	13.6 mg/L	20		
6-May-15	Alkalinity	1.9 mg/L	20		
15-Sep-15	Alkalinity	13.7 mg/L	20		
19-Nov-14	Lead Dissolved	0.543 µg/L		0.41	19.5 mg/L
19-Nov-14	pH Field	4.8 su	6.5	8.5	
6-May-15	pH Field	5.2 su	6.5	8.5	
6-Jul-15	pH Field	5.3 su	6.5	8.5	
15-Sep-15	pH Field	4.8 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.* Site 27 and 32). Three exceedances were for total alkalinity below the lower limit of 20 mg/L.

Only one of the four samples for dissolved lead was in exceedance. The most probable mechanism for dispersal of the lead, and potentially other metals away from the tailings pile, would be as fugitive tailings dust transported during cold, desiccating winds during winter or due to dust induced by truck traffic during dry summer conditions.

The temporal changes in some analytes (e.g. dissolved lead and zinc) may reflect the changing topography of the tails dry stack facility. After the northwest expansion was completed in 2008 HGCMC commenced to place the majority of the tailings in the northwest region. For a couple of years the northwest area was mostly bowl shaped and below the tree line. During the last couple of years this area 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, which likely explains the increase in lead observed during water year 2014. In Water Year 2015 tailings were not placed in the northwest, but primarily in the central and eastern portion of the facility. This would result in less fugitive dust in the area of Site 29 and may explain the lower lead values in the 2015 samples.

In 2011 HGCMC implemented a biweekly dust monitoring program to support the snow monitoring program. This program has continued into 2015 and the results from this monitoring are summarized in the 2015 Tailings and Waste Rock Annual Report.

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

A non-parametric statistical analysis for trend was performed for specific conductivity, field pH, total alkalinity, total sulfate, and dissolved zinc. Calculation details of the Seasonal Kendall analyses are presented in detail on the pages following this interpretive section. The following table summarizes the results on the data collected between Oct-09 and Sep-15(WY2010-WY2015). No statistically significant trends were found with the trend analysis.

Table of Summary Statistics for Trend Analysis

	Mann-Kendall test statistics			Sen's slope estimate	
Parameter	**n***	**p****	**Trend**	**Q**	**Q(%)**
Conductivity Field	6	0.28			
pH Field	6	0.08			
Alkalinity, Total	6	0.28			
Sulfate, Total	6	Inconsistent detection limits			
Zinc, Dissolved	6	0.06			

* Number of Years ** Significance level

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

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

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

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

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

All three of the parameters examined (Figure 1) eventually went out of control with respects to the chosen baseline data statistics. If the pore/contact water from inside the tailings 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 access roads and embankments for 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 5-6 years 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 groundwater collection system was brought online there were substantial increases for specific conductivity and alkalinity at Site 60. These are two examples of where the placement of construction rock 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 rock placed for construction of the tailings facility.

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

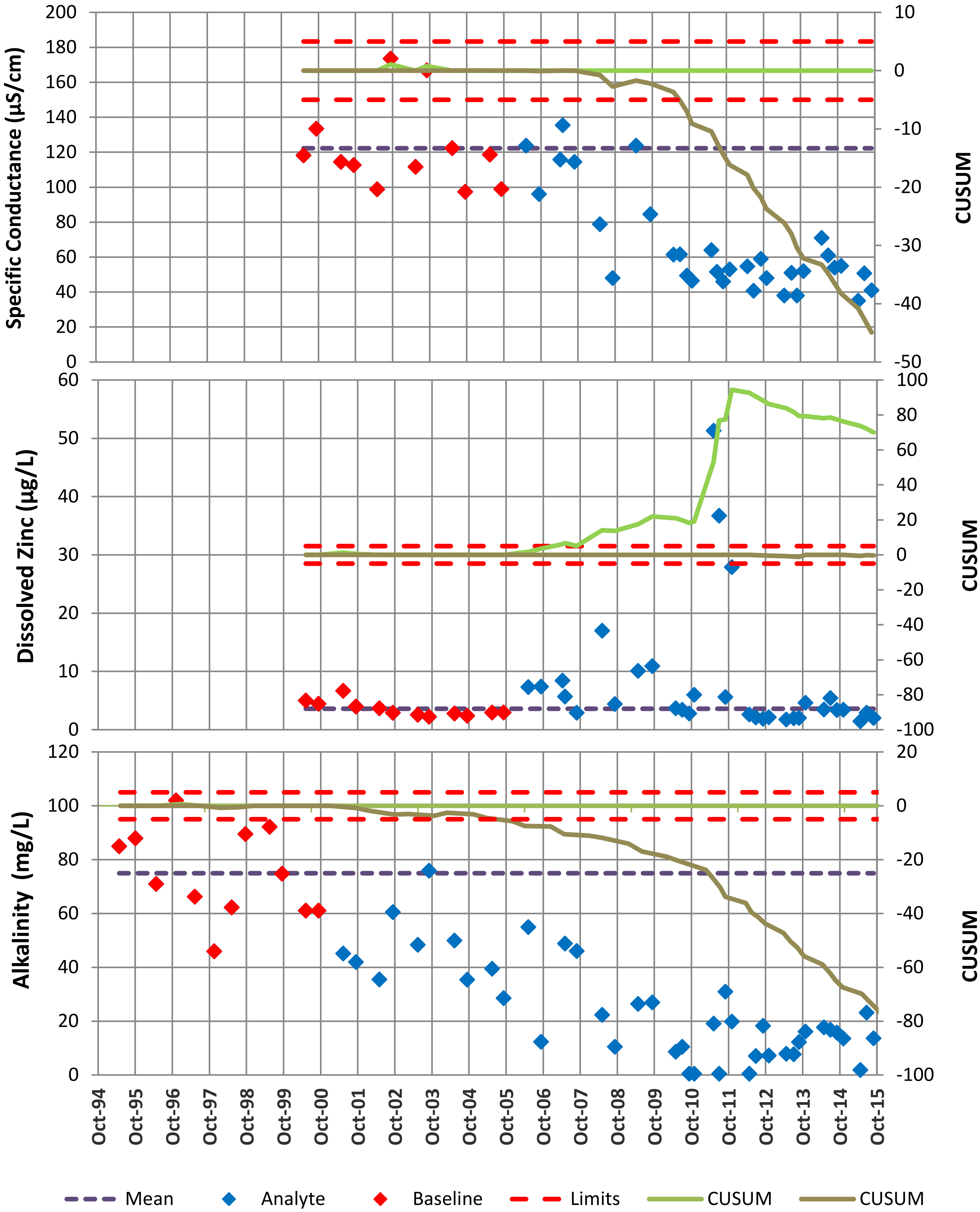


Table of Results for Water Year 2015

Site 029FMG - 'Monitoring Well - 3S'

Sample Date/Parameter	Oct 2014	Nov 2014	Dec 2014	Jan 2015	Feb 2015	Mar 2015	Apr 2015	May 2015	Jun 2015	Jul 2015	Aug 2015	Sep 2015	**Median**
Water Temp (°C)		7						8		8.5		7	7.5
Conductivity-Field(μmho)		55						35		50.8		41	45.9
Conductivity-Lab (μmho)		44						34		55		36	40
pH Lab (standard units)		4.84						4.59		5.27		5.14	4.99
pH Field (standard units)		4.8						5.22		5.3		4.77	5.01
Total Alkalinity (mg/L)		13.6						1.9		23.2		13.7	13.7
Total Sulfate (mg/L)		1.3						0.3		0.3		0.3	0.3
Hardness (mg/L)		19.5						18.1		22.8		21.9	20.7
Dissolved As (ug/L)		7.57						3.44		8.3		8.2	7.885
Dissolved Ba (ug/L)		8						3		7.1		6.3	6.7
Dissolved Cd (ug/L)		0.0046						0.0018		0.0018		0.0018	0.0018
Dissolved Cr (ug/L)		0.906						0.57		1.14		0.722	0.814
Dissolved Cu (ug/L)		0.3						0.074		0.252		0.123	0.188
Dissolved Pb (ug/L)		0.543						0.0504		0.213		0.119	0.1660
Dissolved Ni (ug/L)		1.2						0.507		1.24		1.1	1.150
Dissolved Ag (ug/L)		0.002						0.002		0.002		0.002	0.002
Dissolved Zn (ug/L)		3.44						1.45		2.9		2.02	2.46
Dissolved Se (ug/L)		0.057						0.057		0.057		0.057	0.057
Dissolved Hg (ug/L)		0.000681						0.00126		0.000655		0.000766	0.000724

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

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

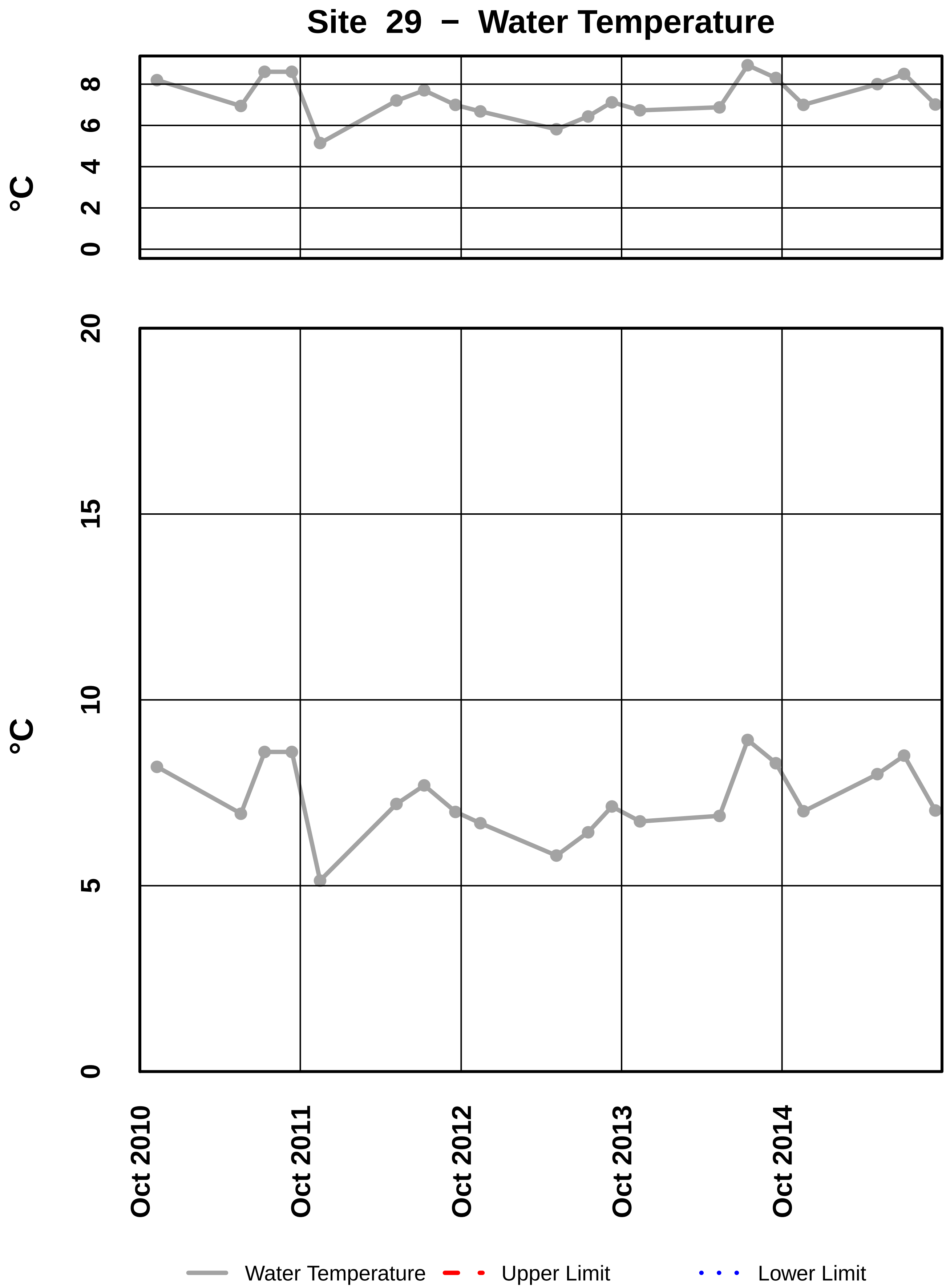
Shaded data has been qualified as an outlier by HGCMC and removed from any further analysis and is not included into the calculation of the median

Qualified Data by QA Reviewer

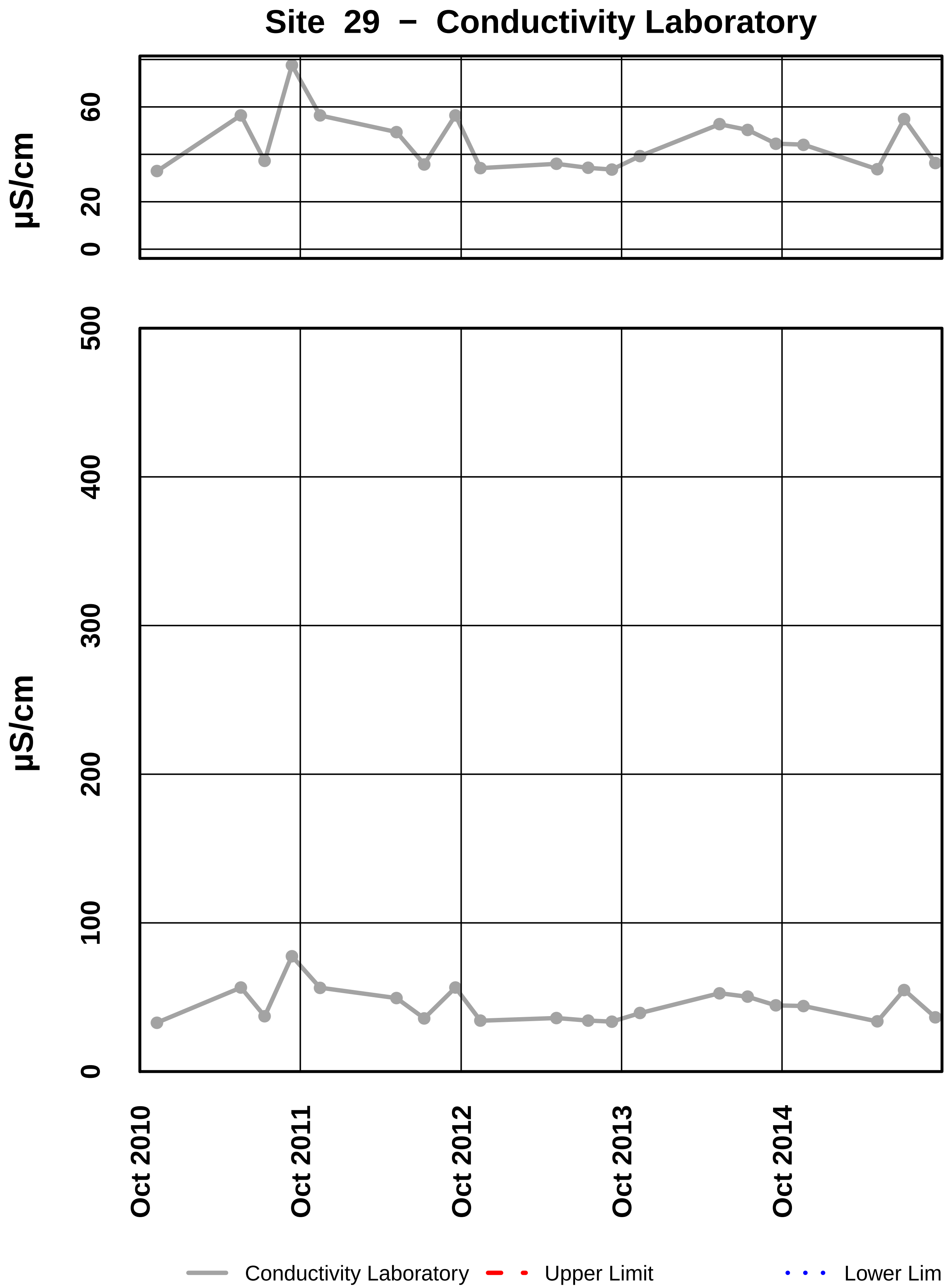
Date Range: 10/01/2013 to 09/30/2014

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

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



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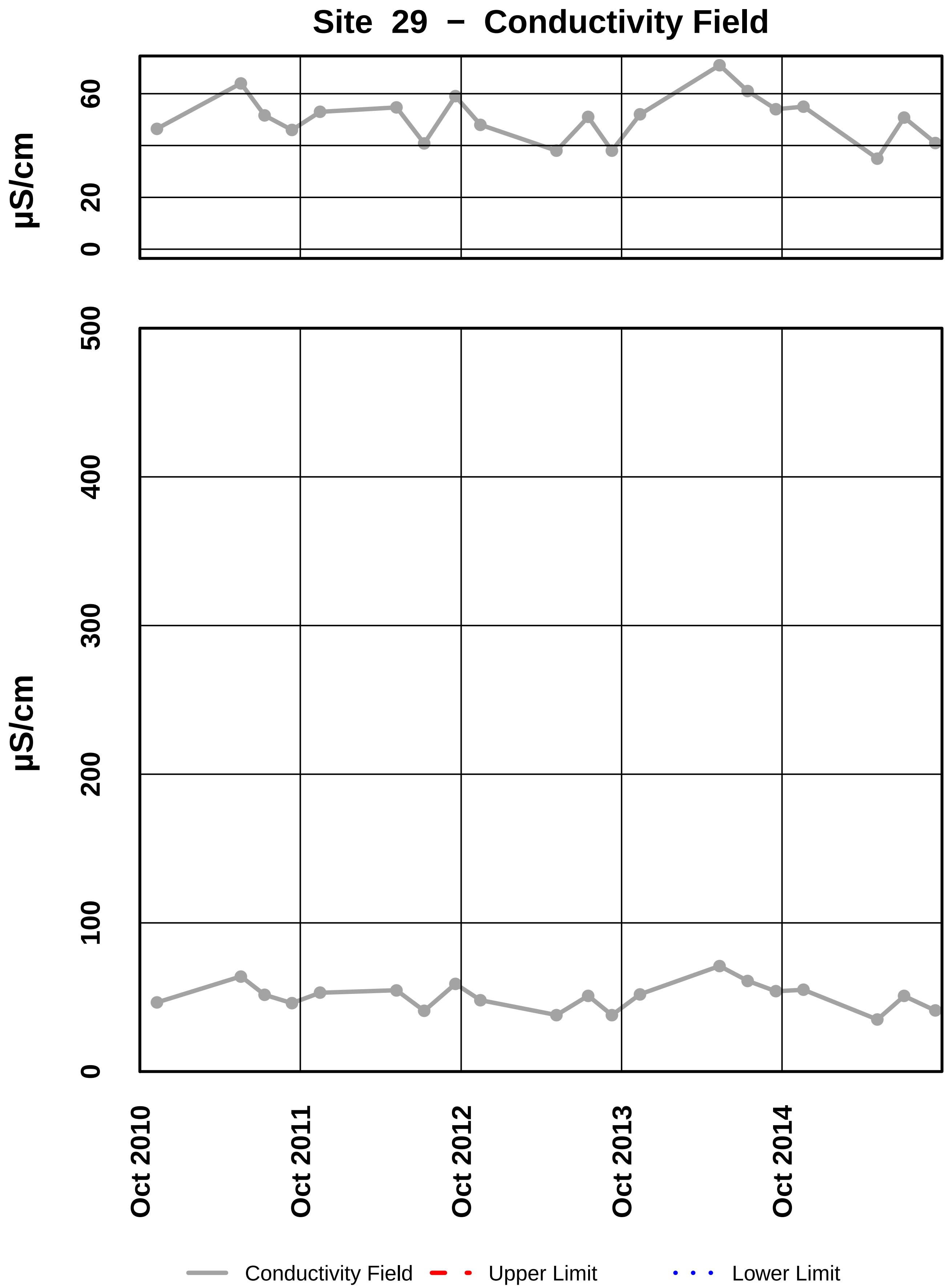
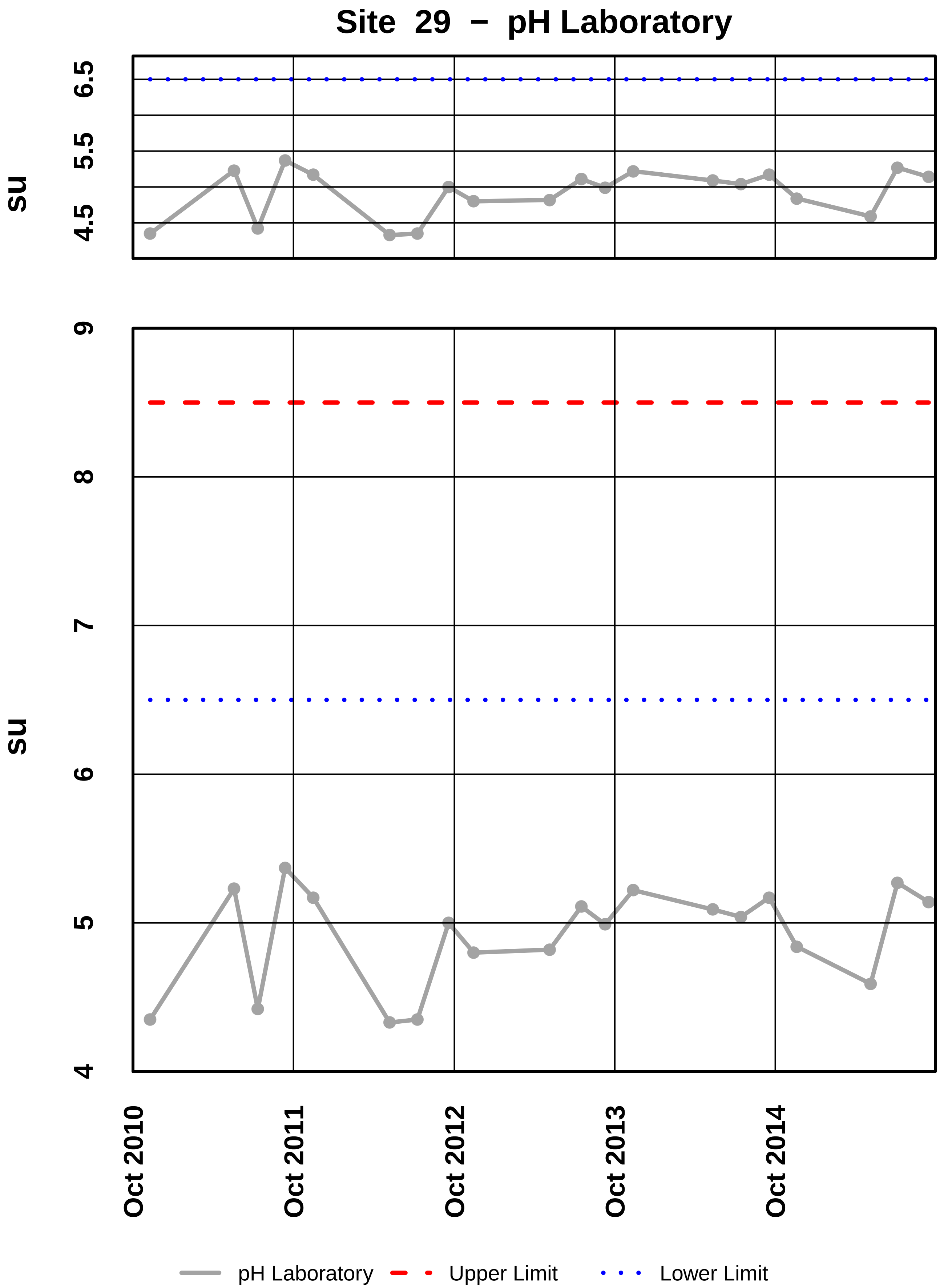
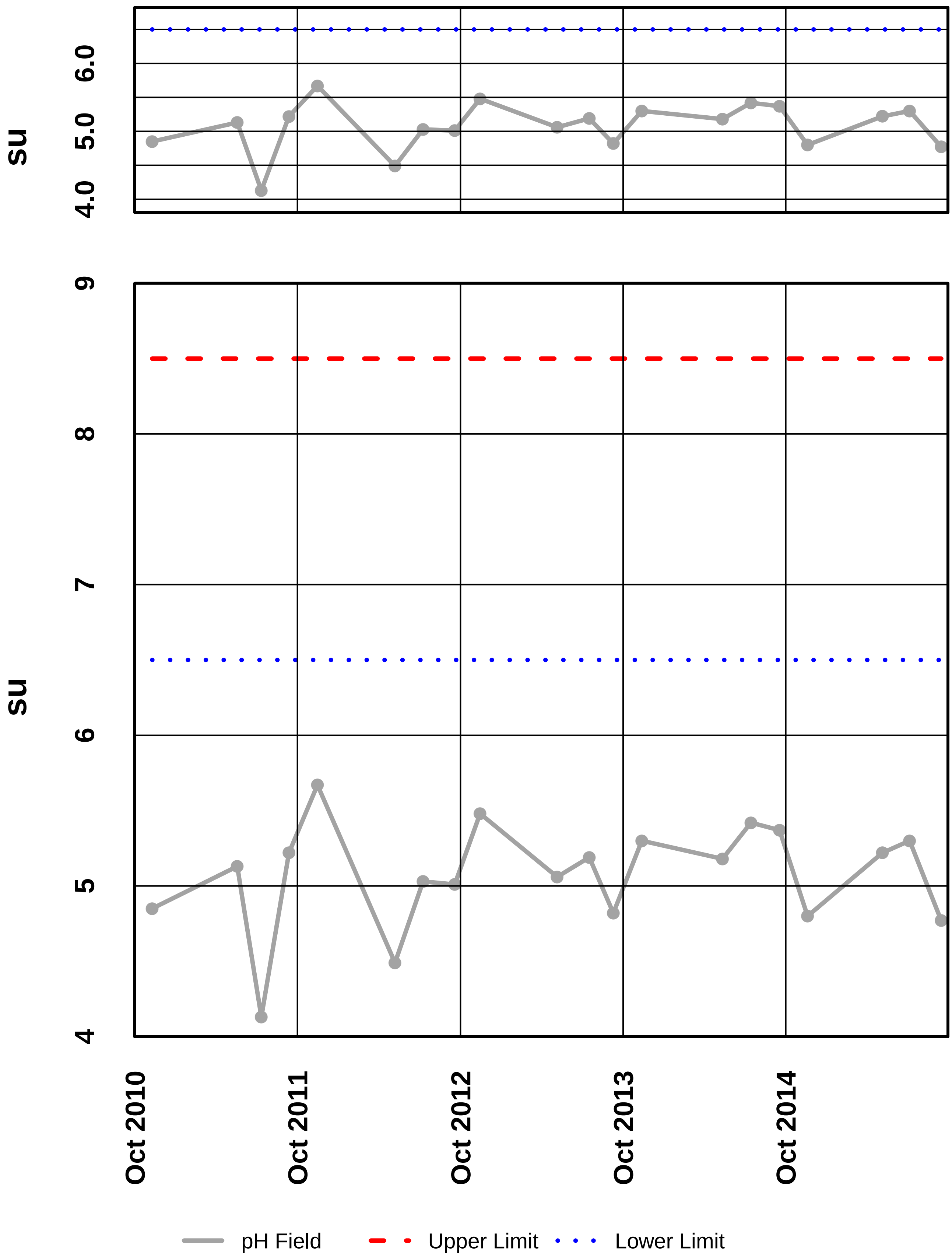


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

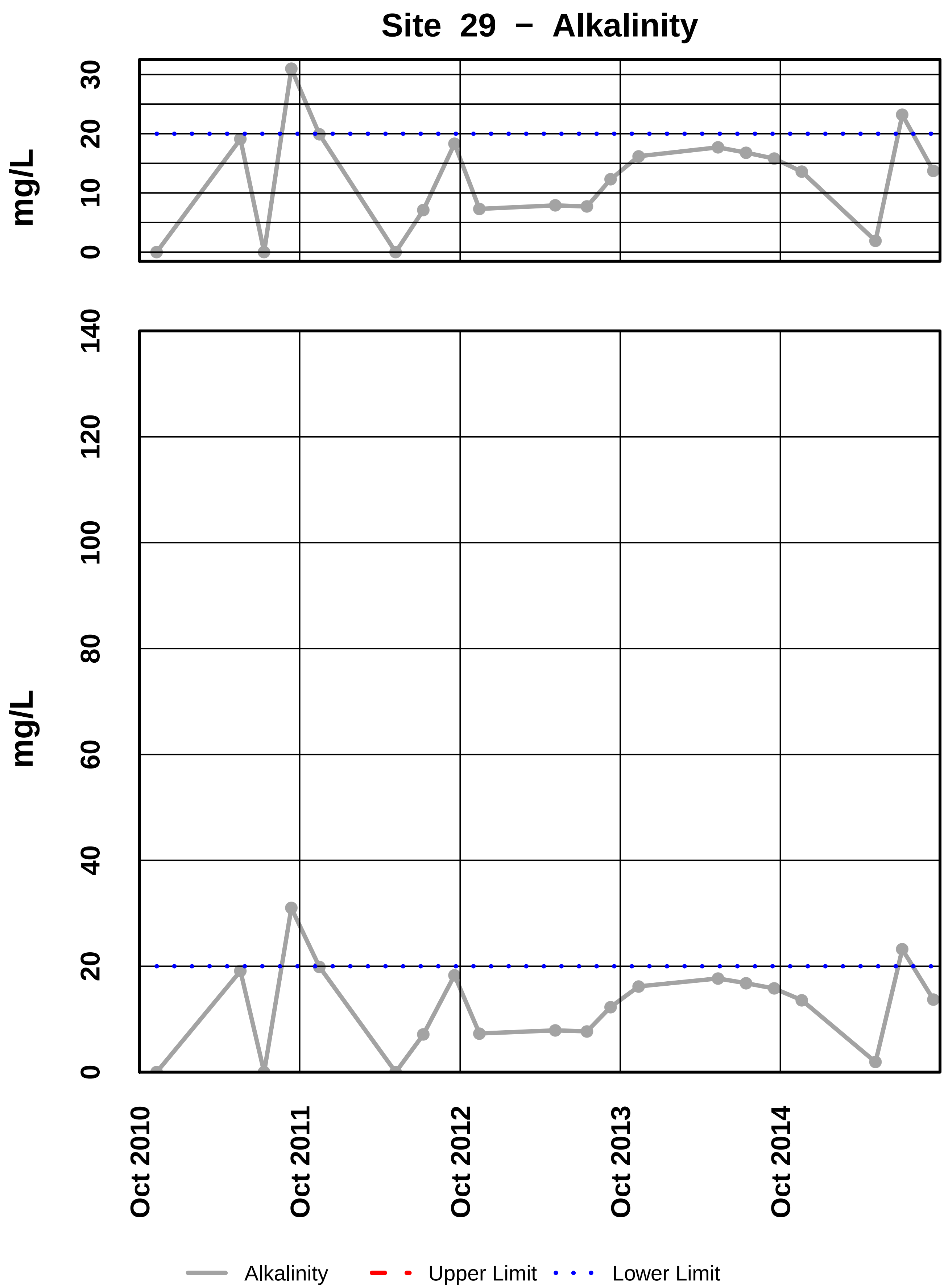


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

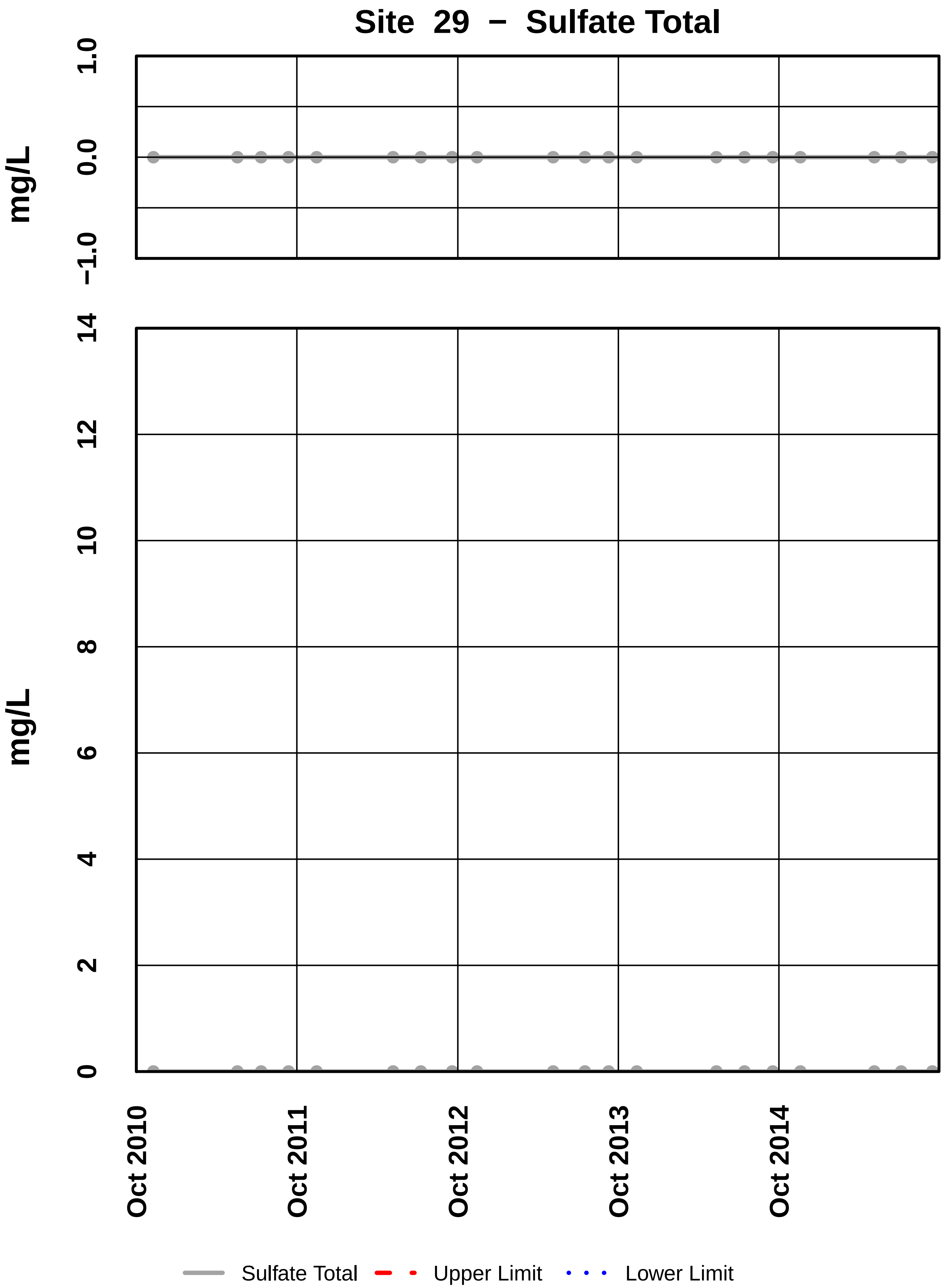
Site 29 – pH Field



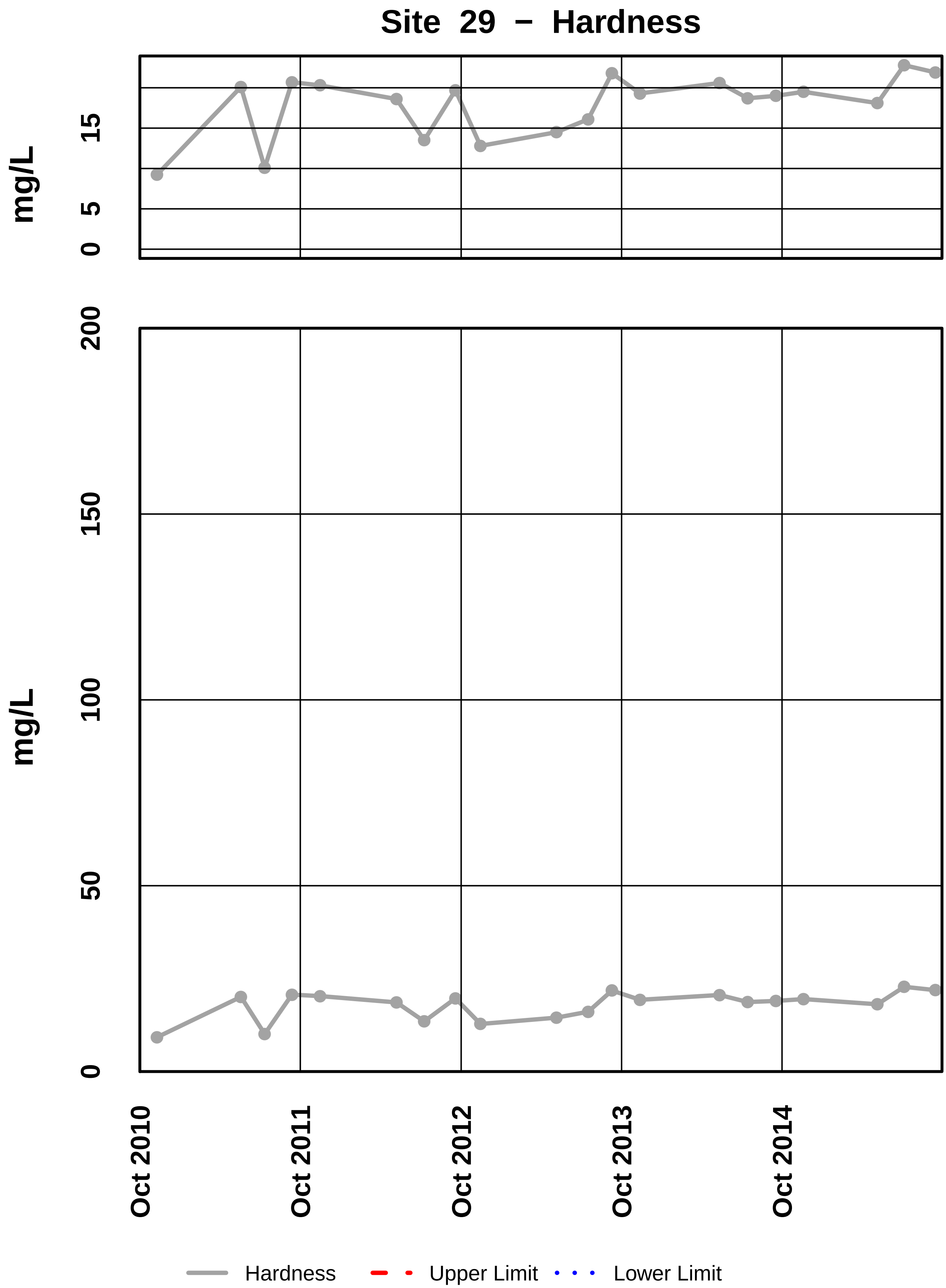
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

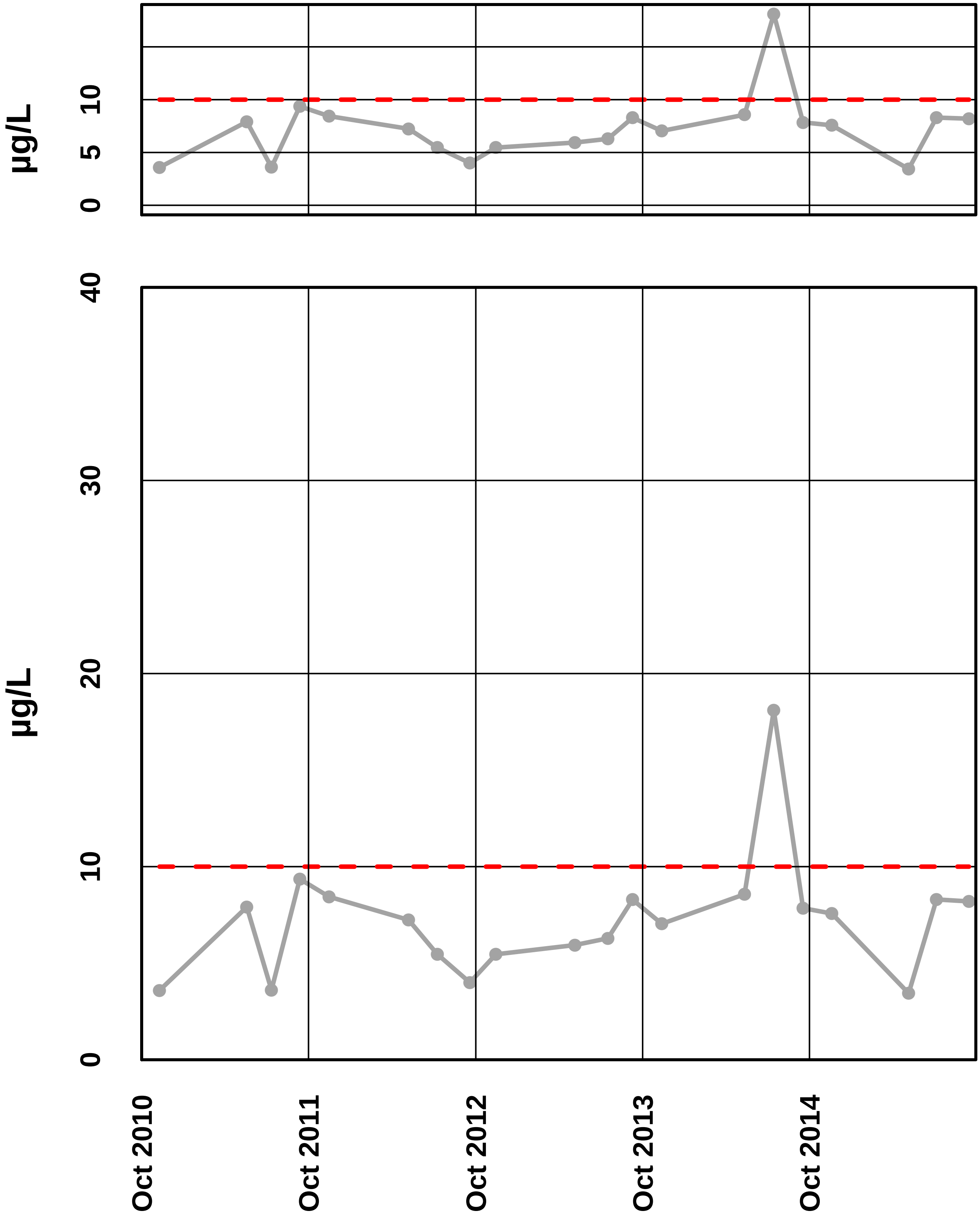


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

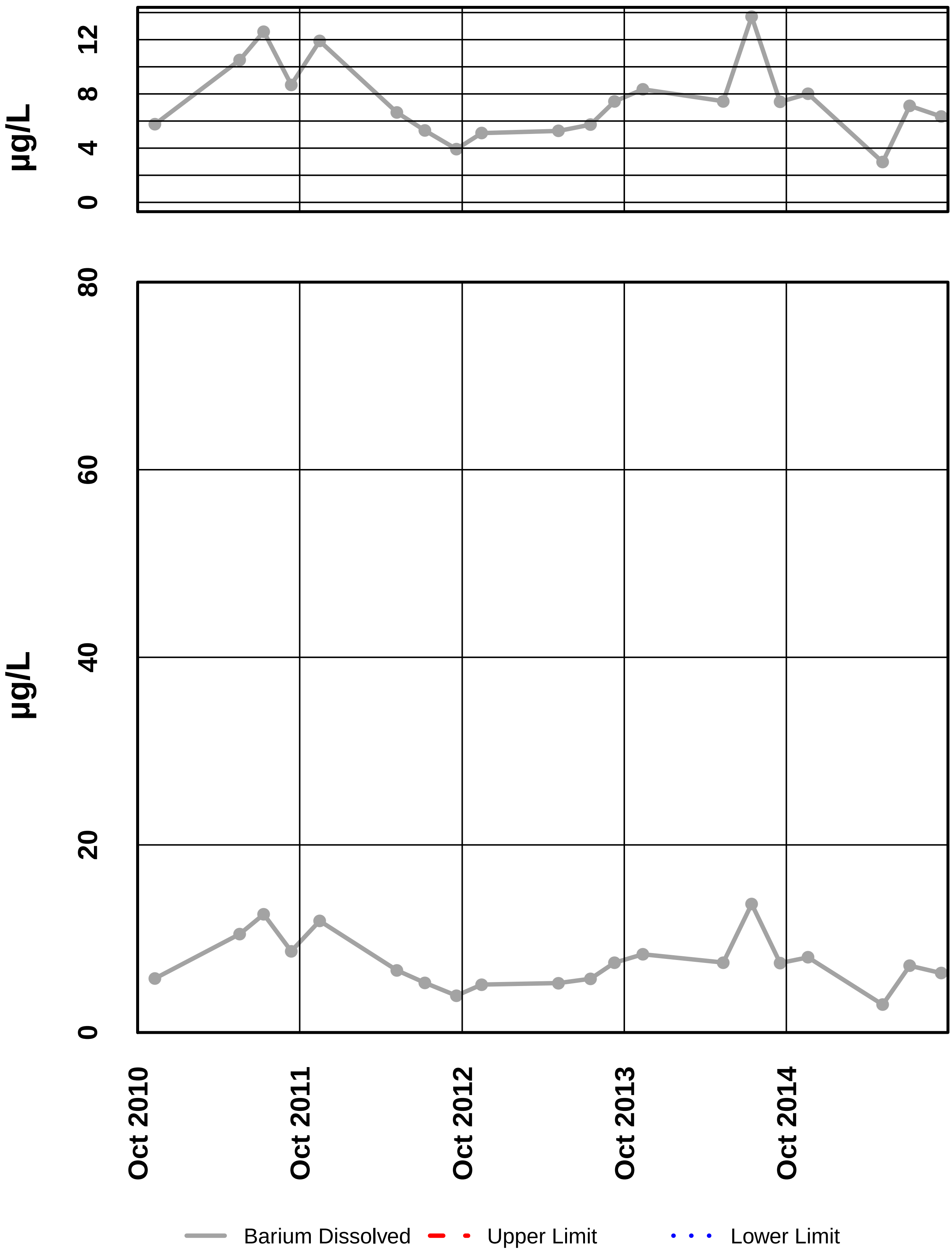
Site 29 – Arsenic Dissolved



Arsenic Dissolved   Upper Limit   Lower Limit

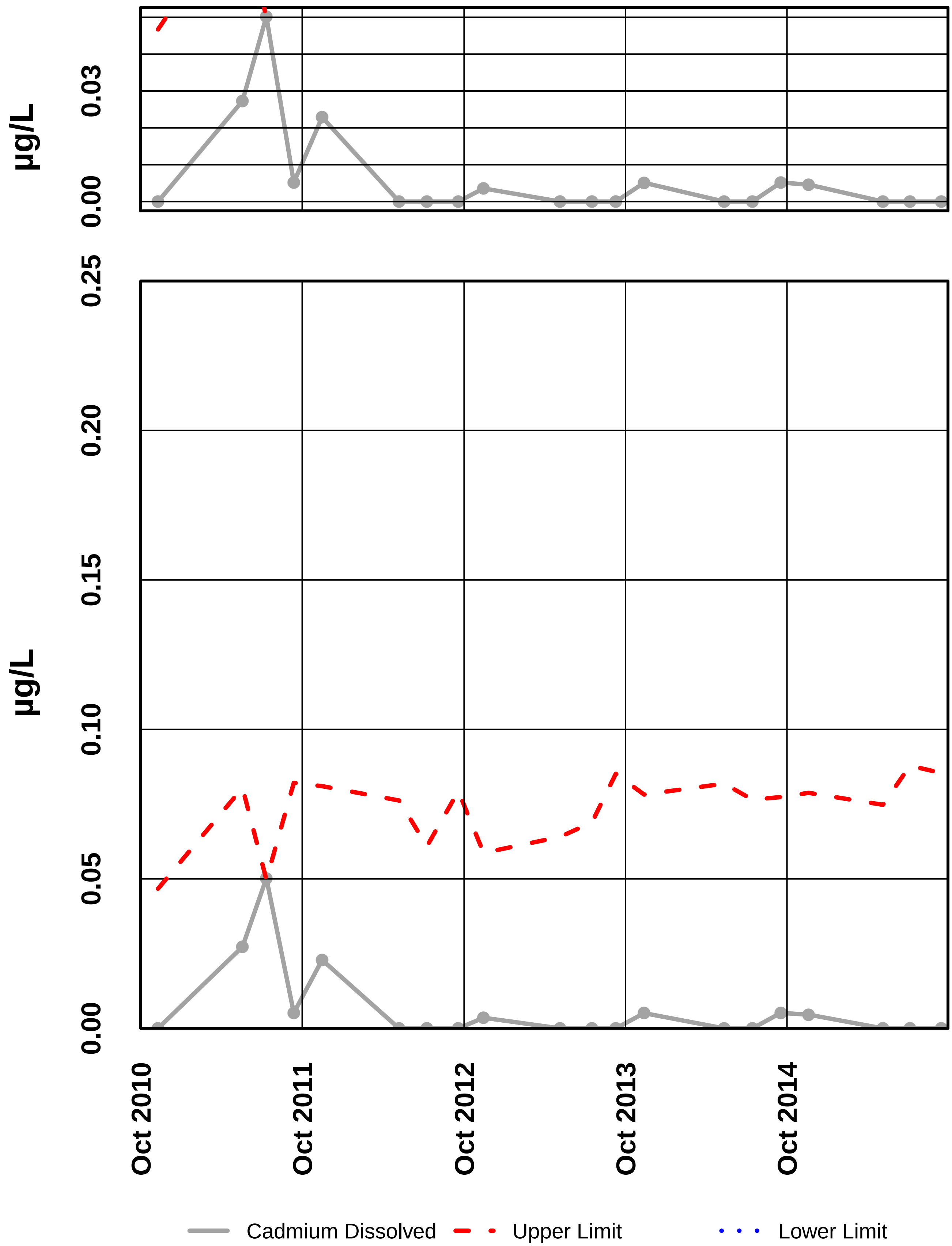
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 29 − Barium Dissolved



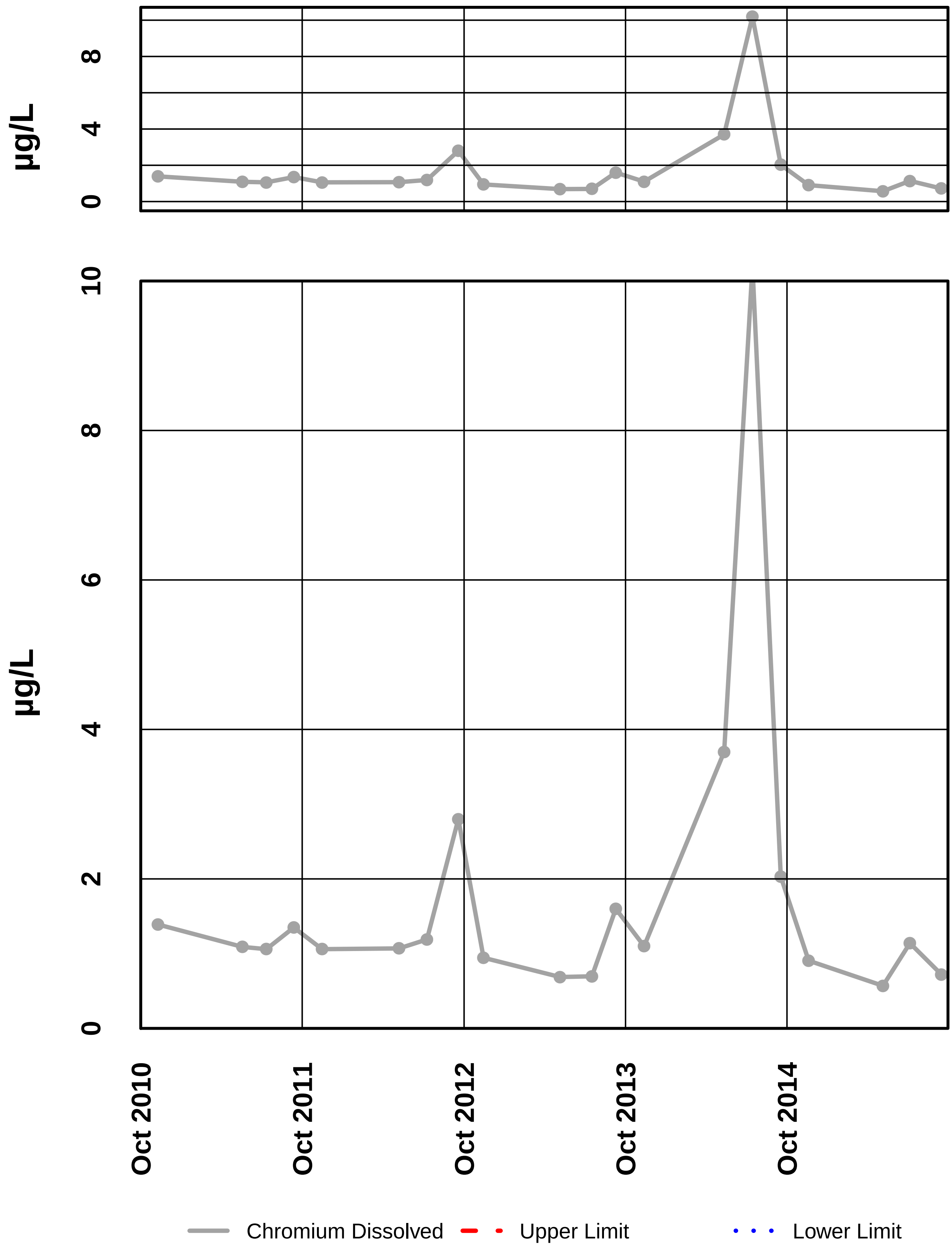
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 29 − Cadmium Dissolved



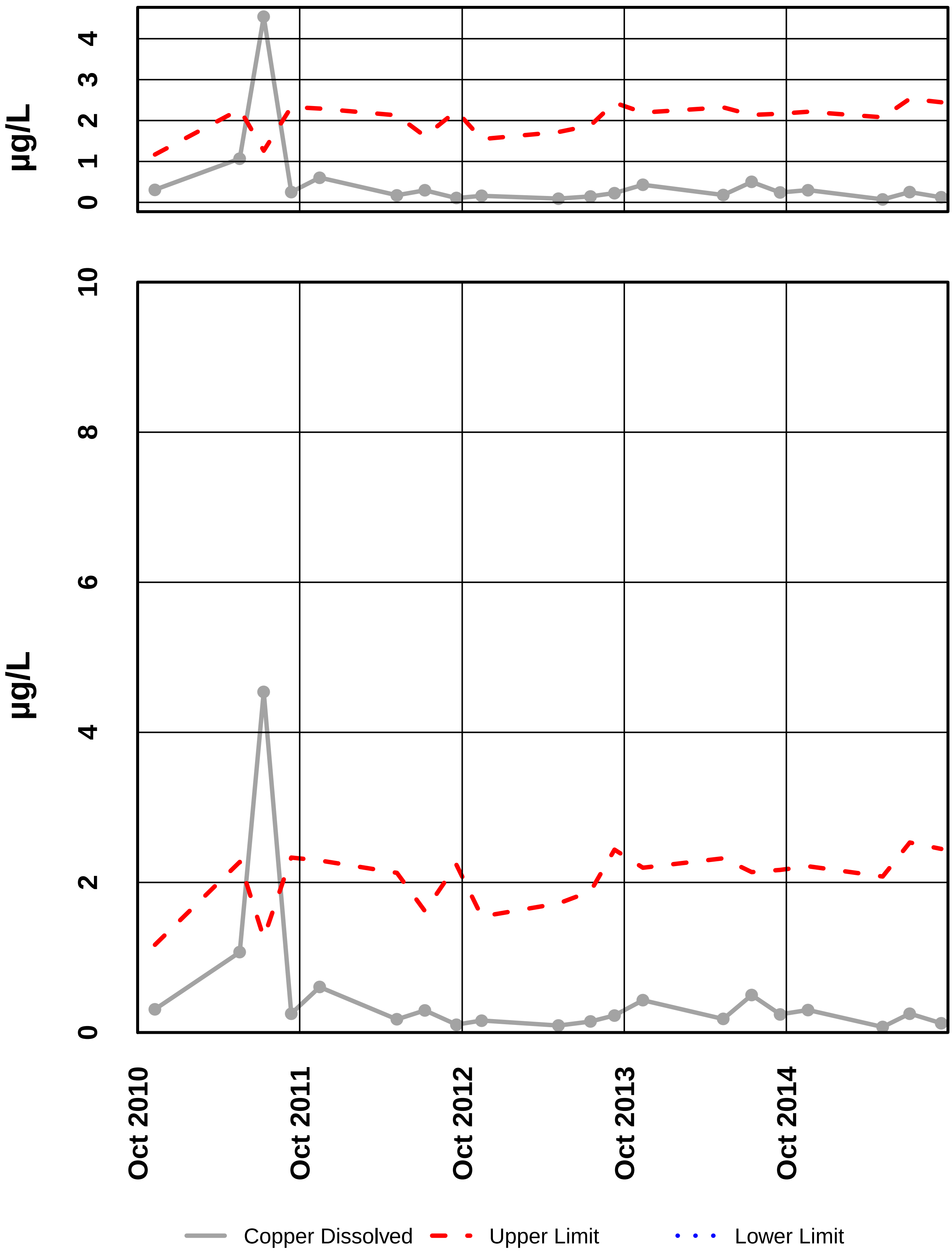
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 29 – Chromium Dissolved



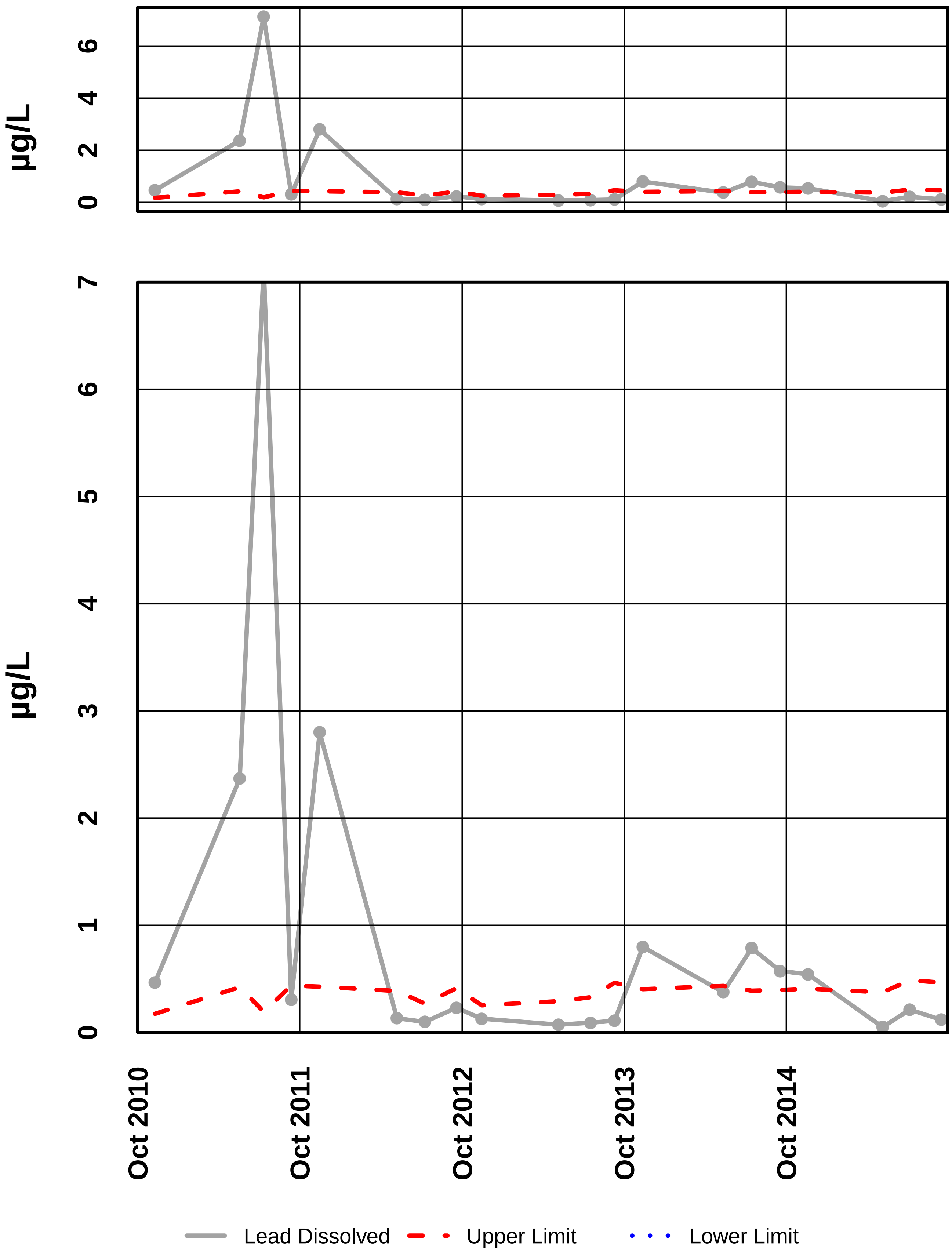
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 29 – Copper Dissolved

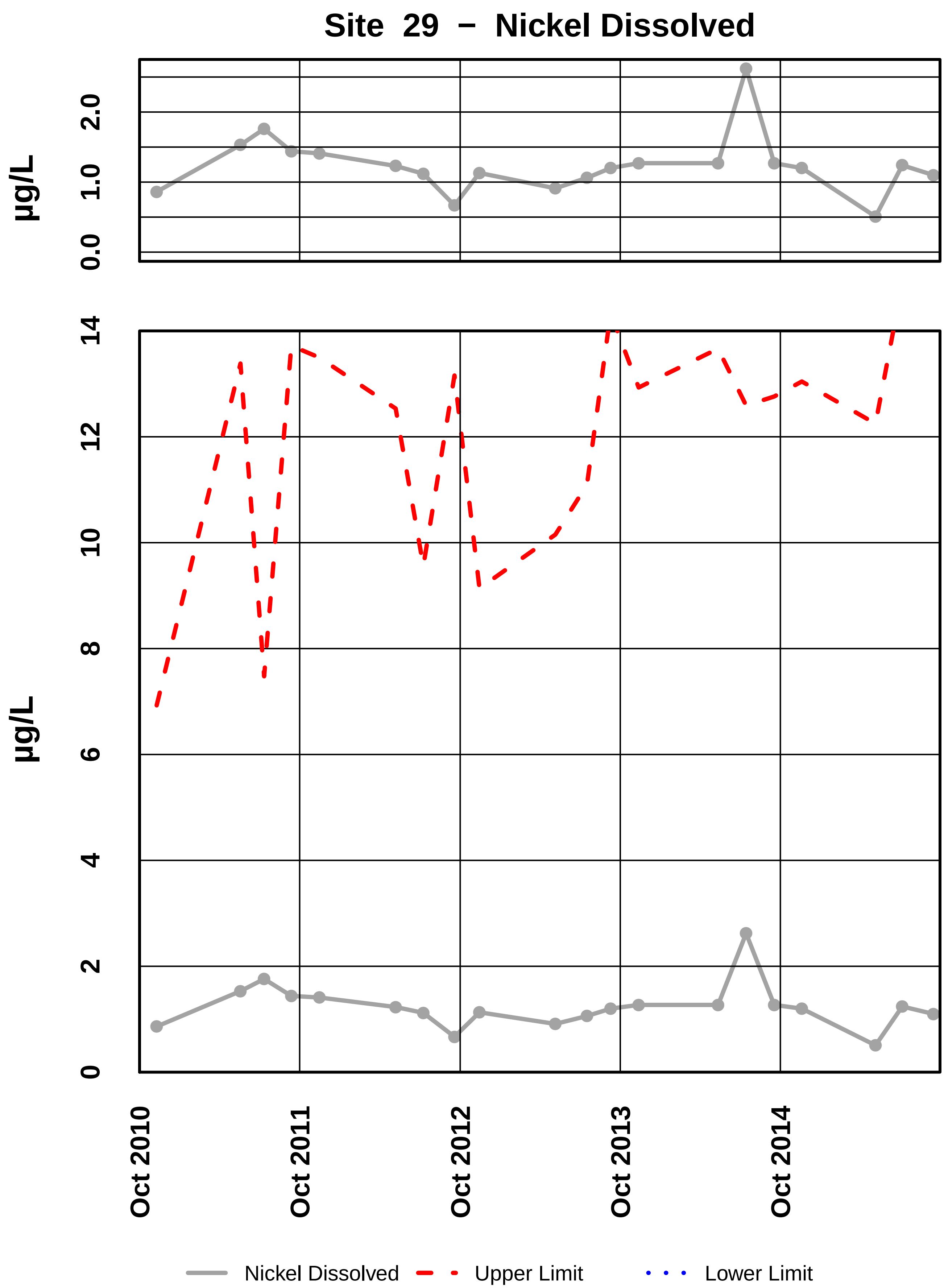


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 29 – Lead Dissolved

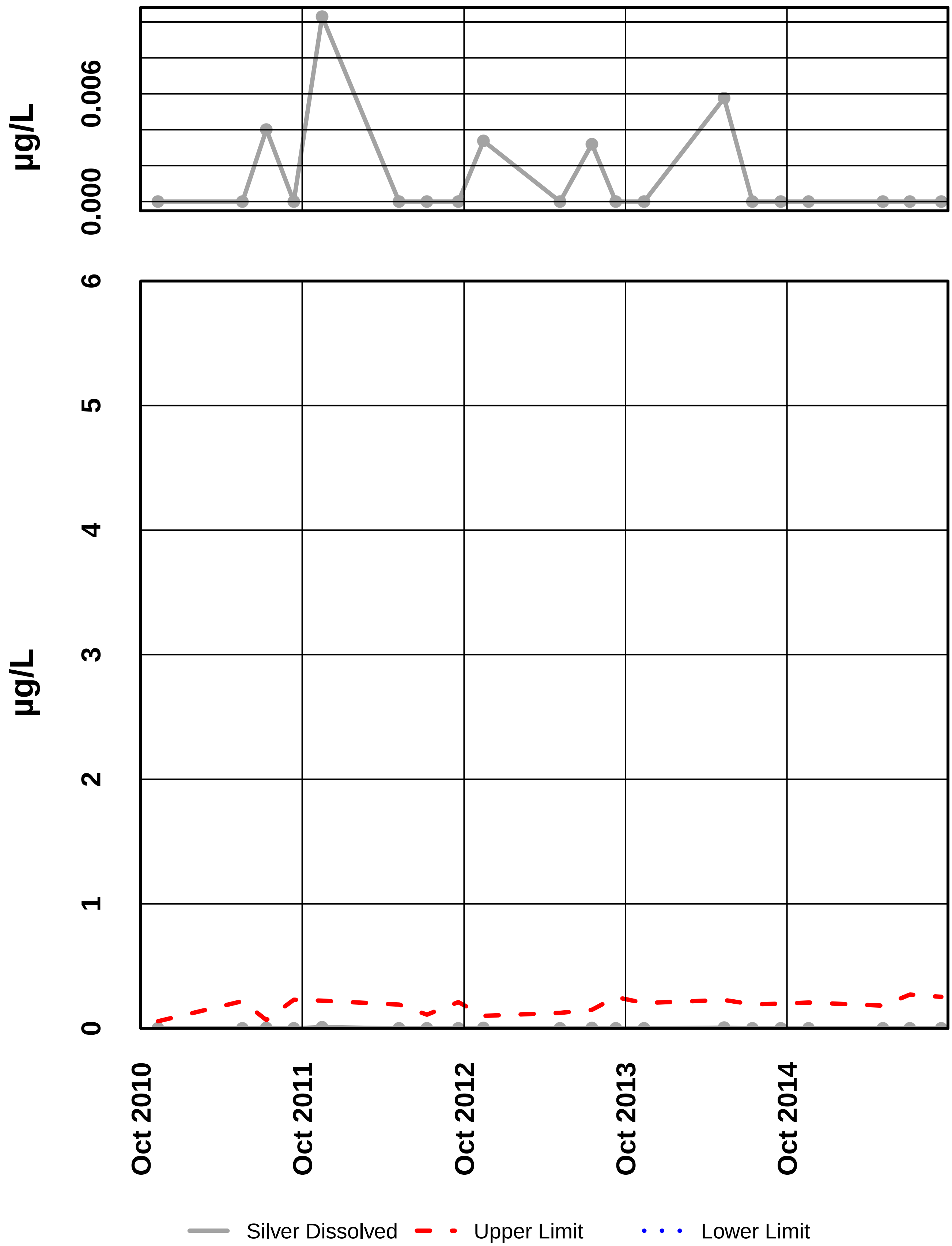


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



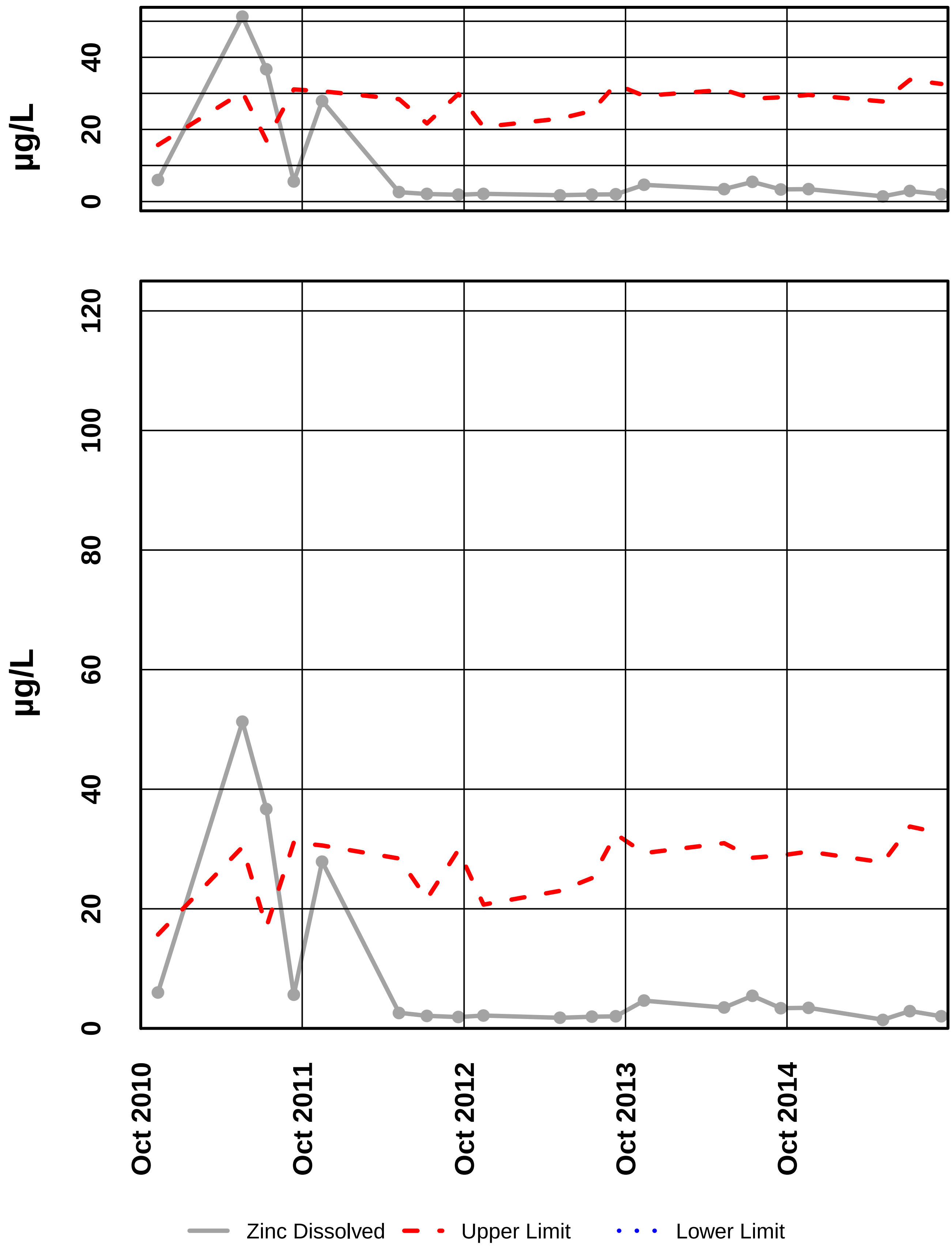
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 29 – Silver Dissolved



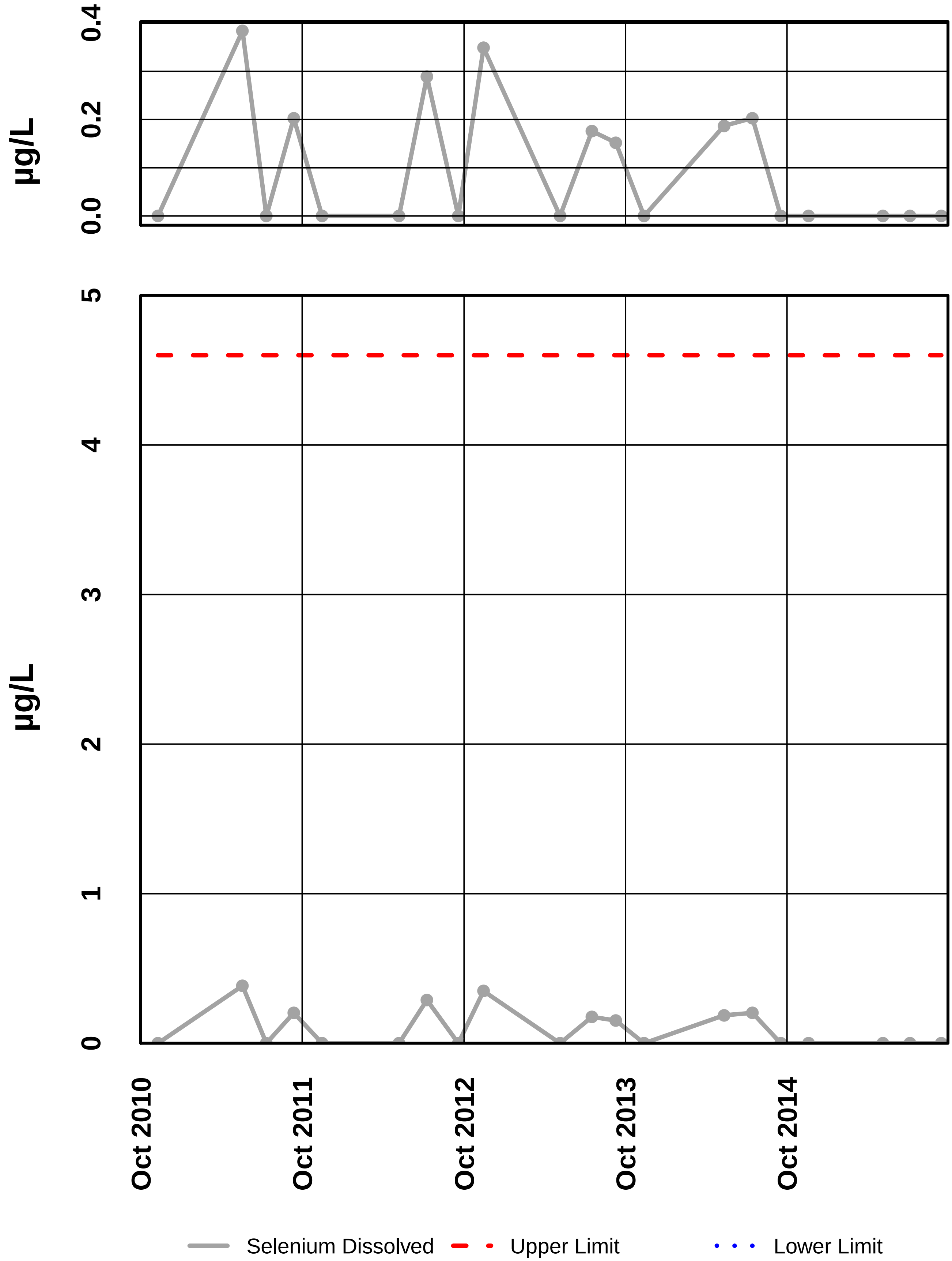
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 29 − Zinc Dissolved



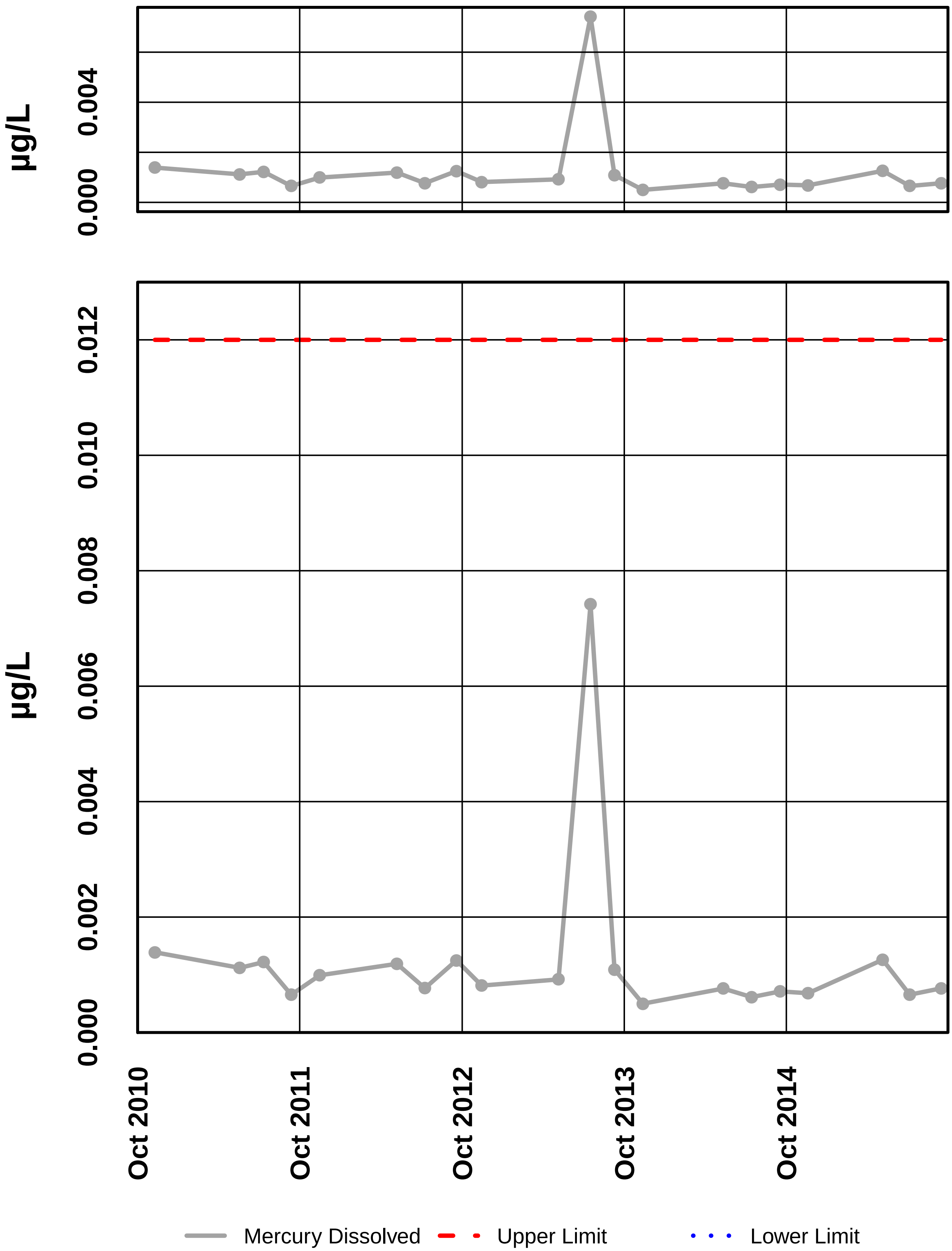
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 29 – Selenium Dissolved



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

Site 29 – Mercury Dissolved



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

INTERPRETIVE REPORT
SITE 32

The data collected during the current water year are listed in the following "Table of Results for Water Year 2015" 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, in the past six years, have been identified by HGCMC.				

The data for Water Year 2015 have been compared to the strictest fresh water quality criterion for each applicable analyte. Thirteen results exceeding these criteria have been identified as listed in the table below.

Table of Exceedance for Water Year 2015

			Limits		
Sample Date	**Parameter**	**Value**	**Lower**	**Upper**	**Hardness**
19-Nov-14	Alkalinity	13.0 mg/L	20		
6-May-15	Alkalinity	8.2 mg/L	20		
6-Jul-15	Alkalinity	19.5 mg/L	20		
15-Sep-15	Alkalinity	15.2 mg/L	20		
19-Nov-14	Lead Dissolved	1.730 µg/L		0.161	8.6 mg/L
6-May-15	Lead Dissolved	0.383 µg/L		0.170	9.0 mg/L
6-Jul-15	Lead Dissolved	0.888 µg/L		0.152	8.2 mg/L
15-Sep-15	Lead Dissolved	0.742 µg/L		0.163	8.7 mg/L
19-Nov-14	pH Field	4.7 su	6.5	8.5	
6-May-15	pH Field	5.3 su	6.5	8.5	
6-Jul-15	pH Field	5.2 su	6.5	8.5	
15-Sep-15	pH Field	4.9 su	6.5	8.5	
15-Sep-15	Zinc Dissolved	23.8 µg/L		14.9	8.7 mg/L

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, 50 of the past 51 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 and potentially to the dissolved zinc exceedance recorded during the September 2015 sampling.

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

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

A non-parametric statistical analysis for trend was performed for specific conductivity, field pH, total alkalinity, total sulfate, and dissolved zinc. Calculation details of the Seasonal Kendall analyses are presented in detail on the pages following this interpretive section. The adjacent table summarizes the results on the data collected between Oct-09 and Sep-15(WY2010-WY2015).

Table of Summary Statistics for Trend Analysis

	Mann-Kendall test statistics			Sen's slope estimate	
Parameter	**n***	**p****	**Trend**	**Q**	**Q(%)**
Conductivity Field	6	0.06			
pH Field	6	0.35			
Alkalinity, Total	6	0.02	+	2.1	13.816
Sulfate, Total	6	Inconsistent detection limits			
Zinc, Dissolved	6	0.24			

* Number of Years ** Significance level

Results from the trend analysis showed a positive trend for total alkalinity, increasing at 2.1 mg/L/yr). Trend analysis was not performed on the total sulfate dataset because of a change in the method detection limit used by 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.

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

Two of the three parameters examined (Figure 1) eventually went out of control with respects to the chosen baseline data statistics. If the pore/contact water from inside the tailings facility was not contained, the well water would have high conductivity, high dissolved zinc, and high alkalinity. Specific conductance has shown the least amount of variability, never going out of control. Total alkalinity went out of control because there has been a minor decrease in the parameter concentration. Because alkalinity and specific conductance do not have a similar pattern to going out of control as compared to dissolved zinc, it is not thought that these changes are a result of contact water leaching from containment. Dissolved zinc has periodically had higher values than the mean. As 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.

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

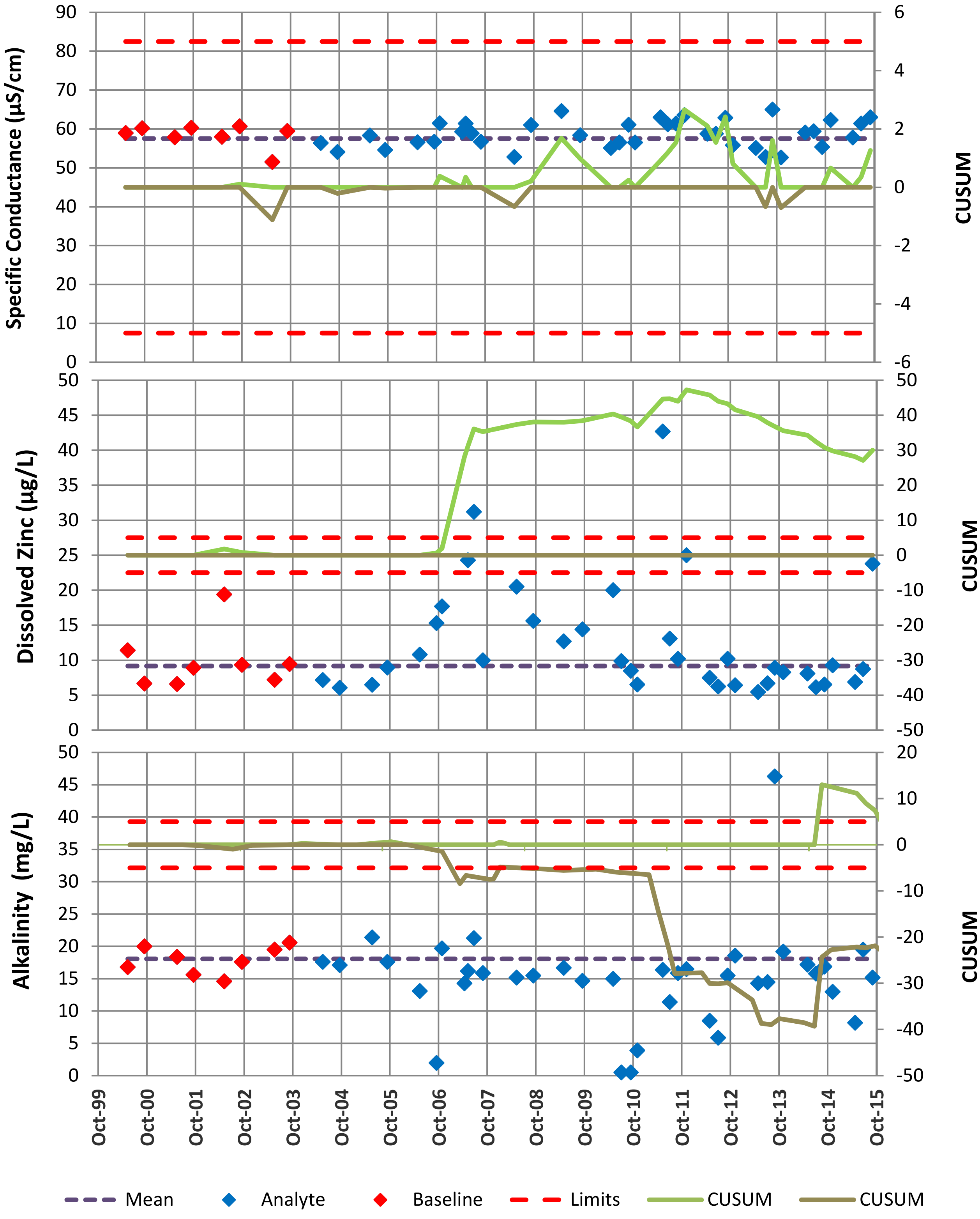


Table of Results for Water Year 2015

Site 032FMG - 'Monitoring Well - 5S'

Sample Date/Parameter	Oct 2014	Nov 2014	Dec 2014	Jan 2015	Feb 2015	Mar 2015	Apr 2015	May 2015	Jun 2015	Jul 2015	Aug 2015	Sep 2015	**Median**
Water Temp (°C)		7						8.7		9.6		7.7	8.2
Conductivity-Field(μmho)		62.3						57.8		61.4		63	61.9
Conductivity-Lab (μmho)		55						59		55		51	55
pH Lab (standard units)		4.89						4.61		5.21		5.1	5.00
pH Field (standard units)		4.71						5.27		5.16		4.86	5.01
Total Alkalinity (mg/L)		13						8.2		19.5		15.2	14.1
Total Sulfate (mg/L)		1.3						0.3		0.3		0.3	0.3
Hardness (mg/L)		8.6						9		8.2		8.7	8.7
Dissolved As (ug/L)		4.45						1.63		3.93		3.47	3.700
Dissolved Ba (ug/L)		16.8						7.5		13.1		15.6	14.4
Dissolved Cd (ug/L)		0.0157						0.0018		0.0103		0.004	0.0072
Dissolved Cr (ug/L)		1.61						1.09		1.97		1.73	1.670
Dissolved Cu (ug/L)		0.661						0.328		0.536		0.626	0.581
Dissolved Pb (ug/L)		1.73						0.383		0.888		0.742	0.8150
Dissolved Ni (ug/L)		3.31						1.58		3.16		3.03	3.095
Dissolved Ag (ug/L)		0.002						0.002		0.002		0.002	0.002
Dissolved Zn (ug/L)		9.28						6.88		8.72		23.8	9.00
Dissolved Se (ug/L)		0.233						0.057		0.156		0.212	0.184
Dissolved Hg (ug/L)		0.000875						0.00111		0.000903		0.00137	0.001007

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

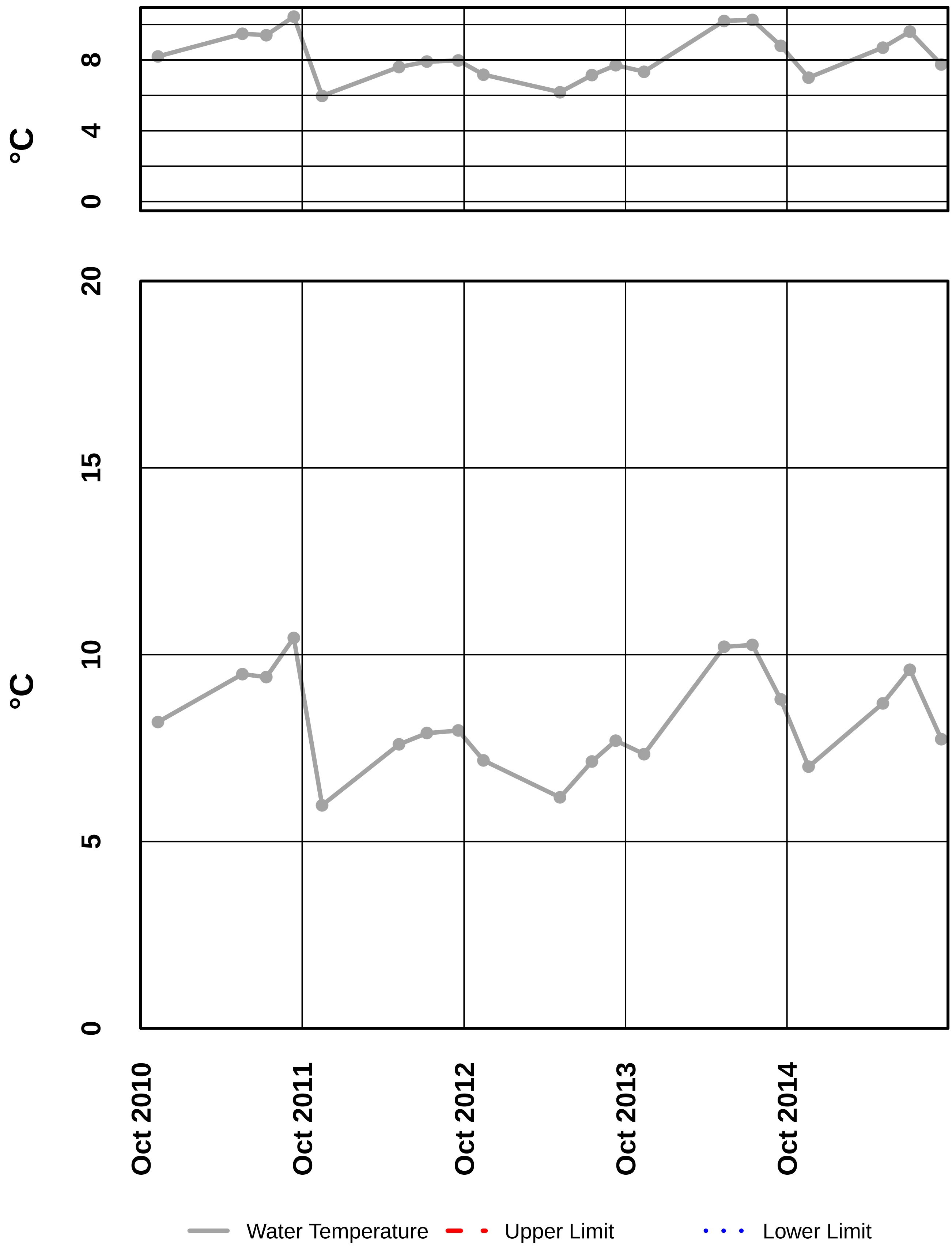
Qualified Data by QA Reviewer

Date Range: 10/01/2014 to 09/30/2015

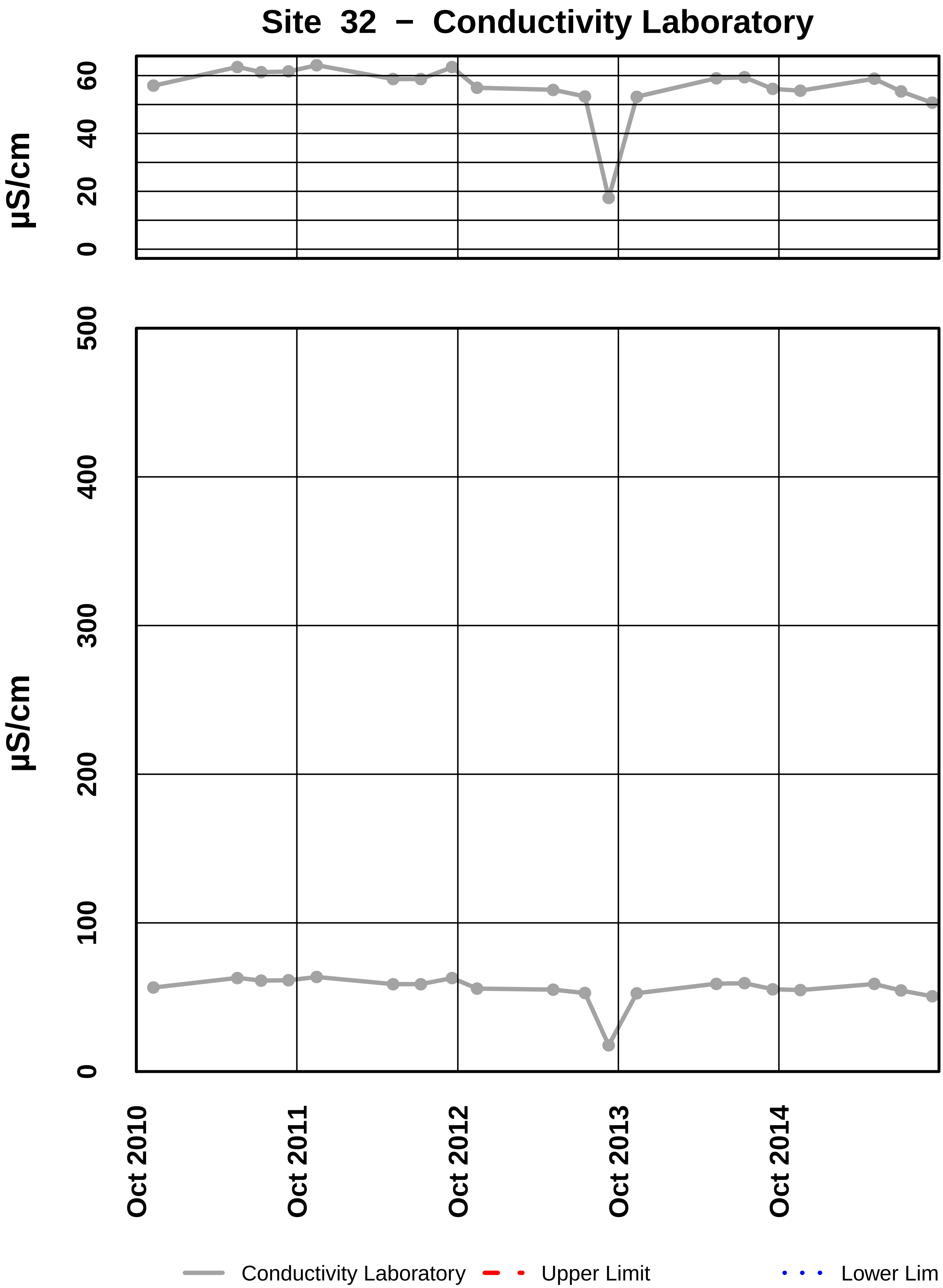
Site No.	Sample Date	Sample Time	Parameter	Value		Qualifier	Reason for Qualifier
032FMG	11/19/2014	12:00 AM	Diss. Se-ICP/MS	0.23	µg/L	J	Below Quantitative Range
			pH	4.89	pH units	J	Hold Time Violation
032FMG	07/06/2015	12:00 AM	Diss. Cd-ICP/MS	0.01	µg/L	J	Below Quantitative Range
			Diss. Se-ICP/MS	0.15	µg/L	J	Below Quantitative Range
032FMG	09/15/2015	12:00 AM	Diss. Cd-ICP/MS	0.00399	µg/L	J	Below Quantitative Range
			Diss. Se-ICP/MS	0.21	µg/L	J	Below Quantitative Range

Qualifier	Description
J	Positively Identified - Approximate Concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit

Site 32 − Water Temperature

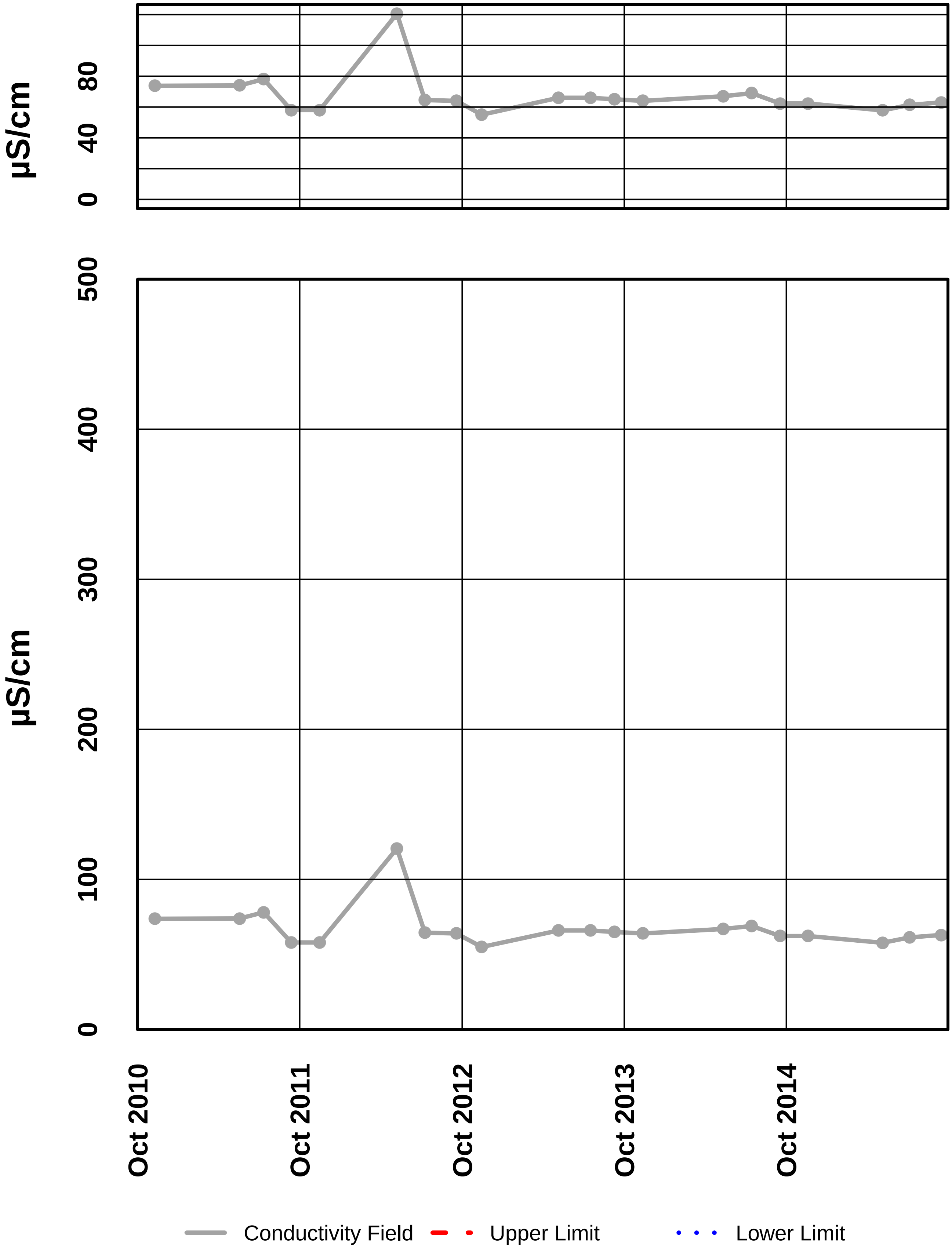


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



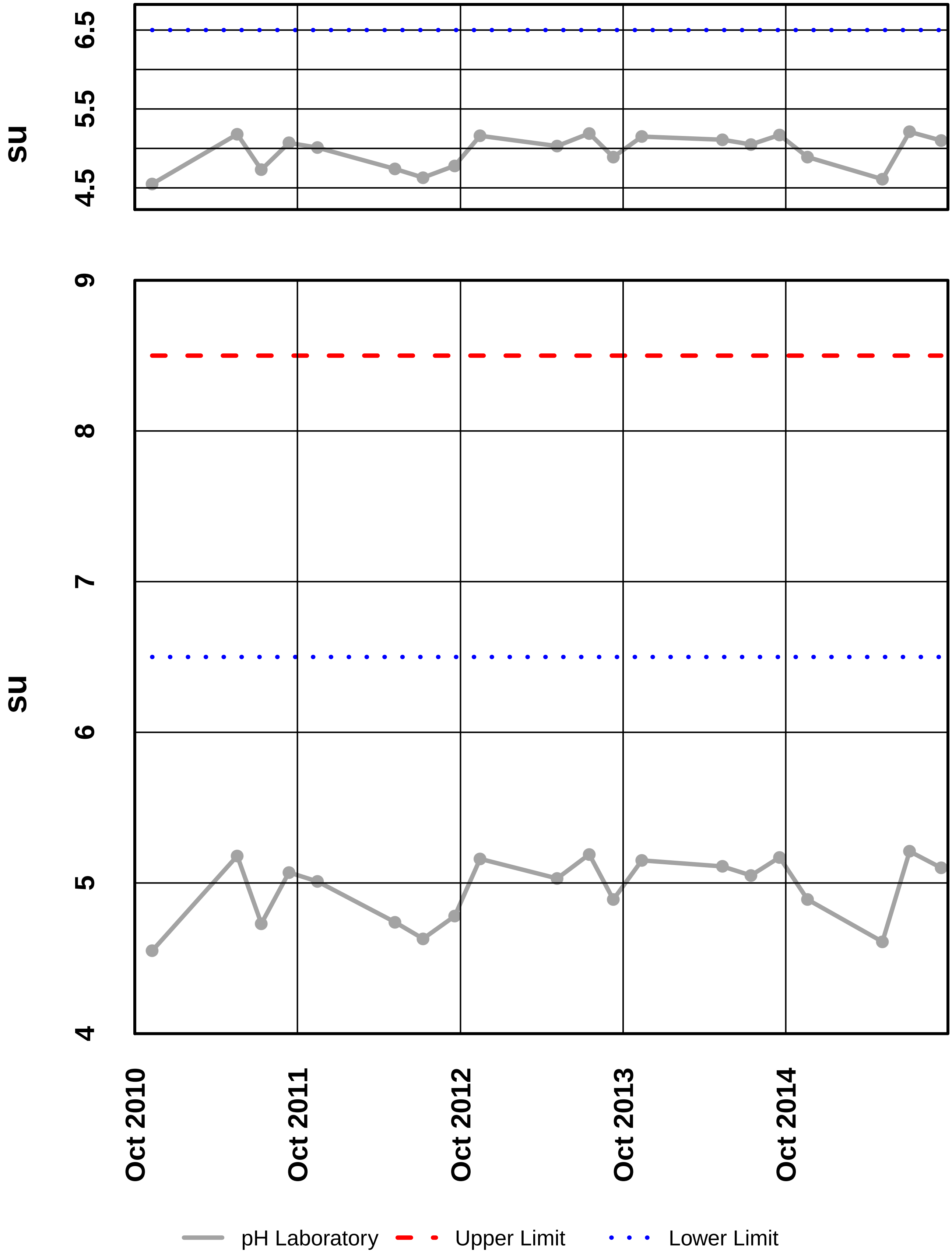
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 32 – Conductivity Field

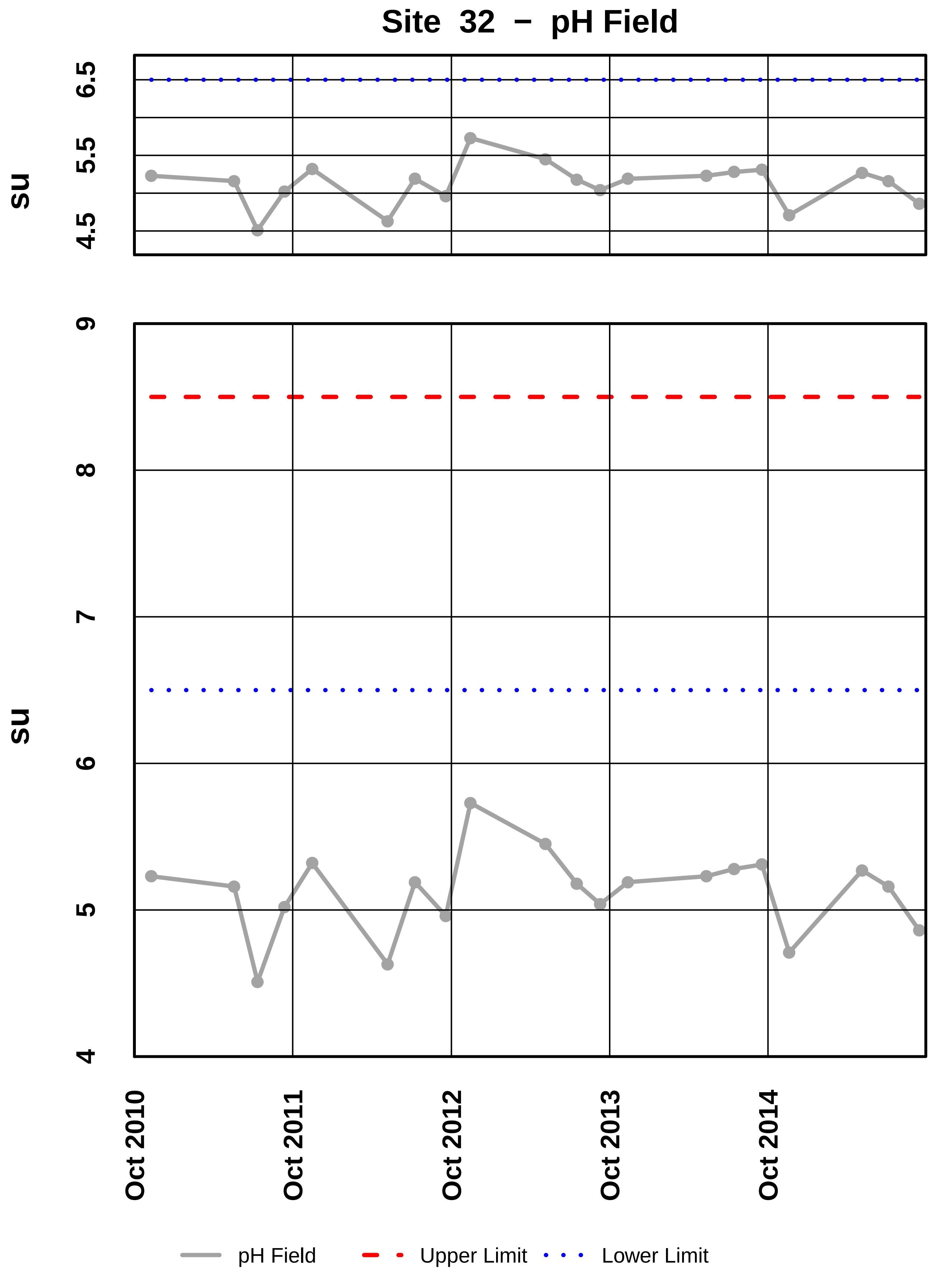


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

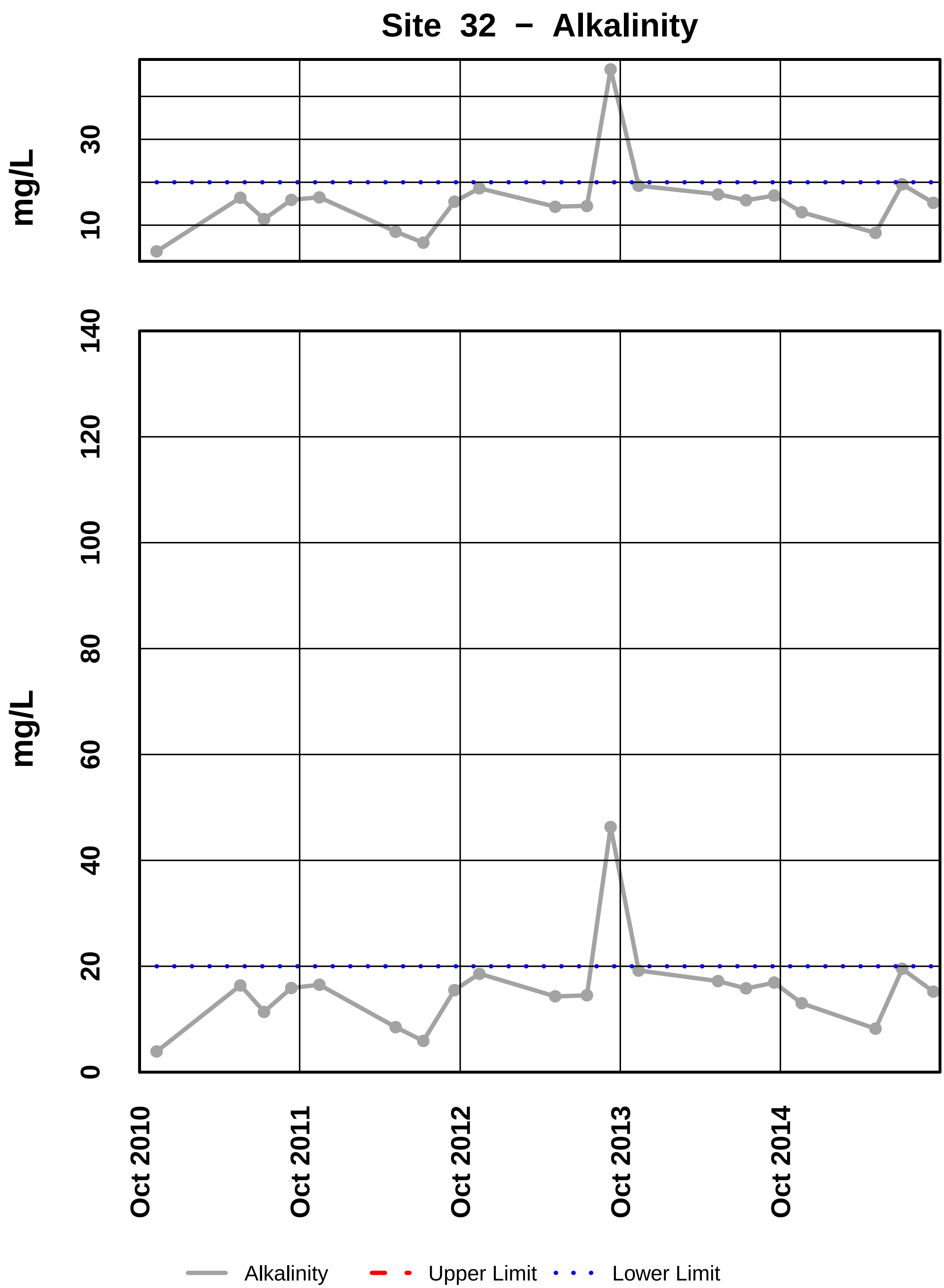
Site 32 – pH Laboratory



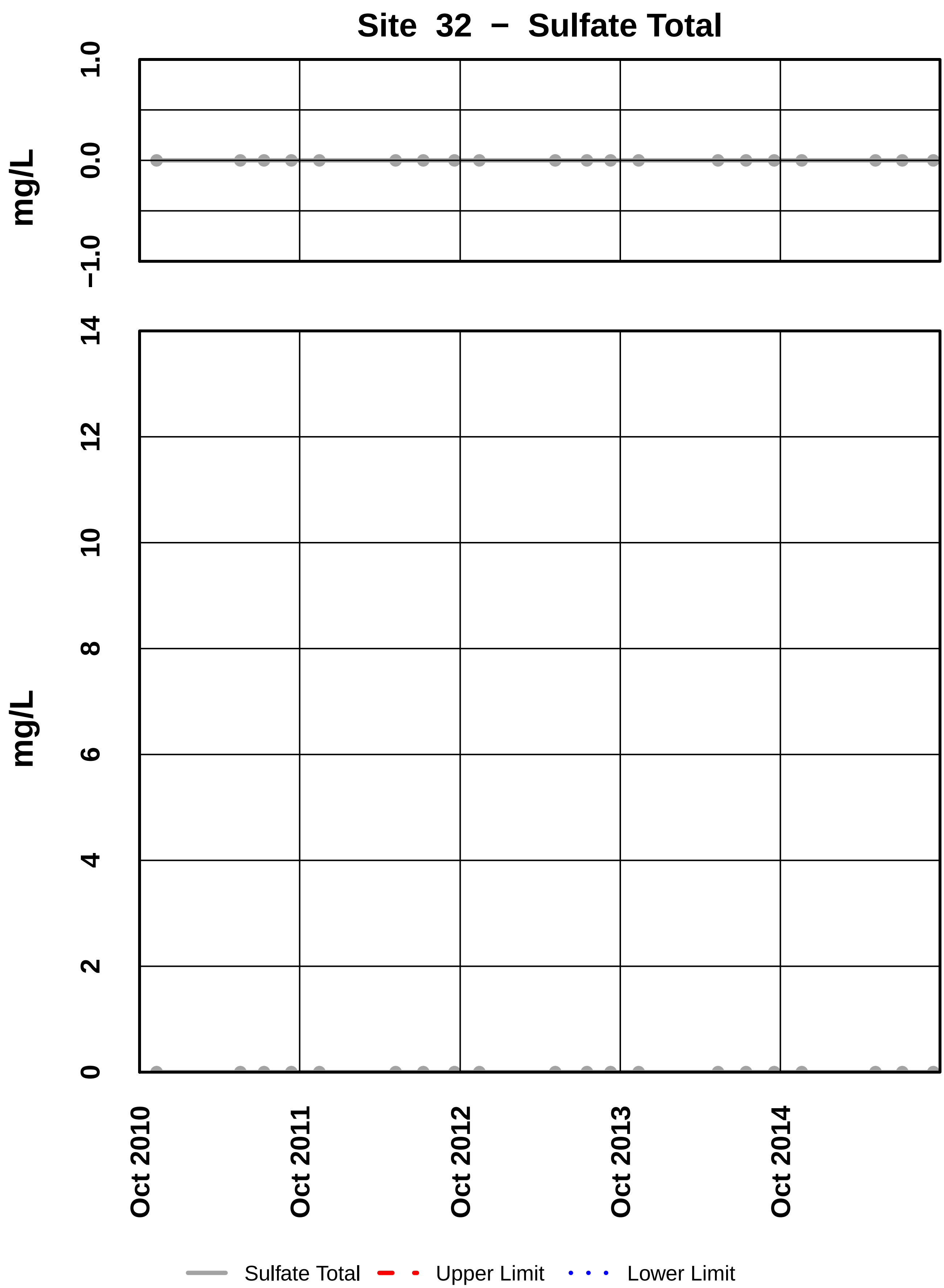
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



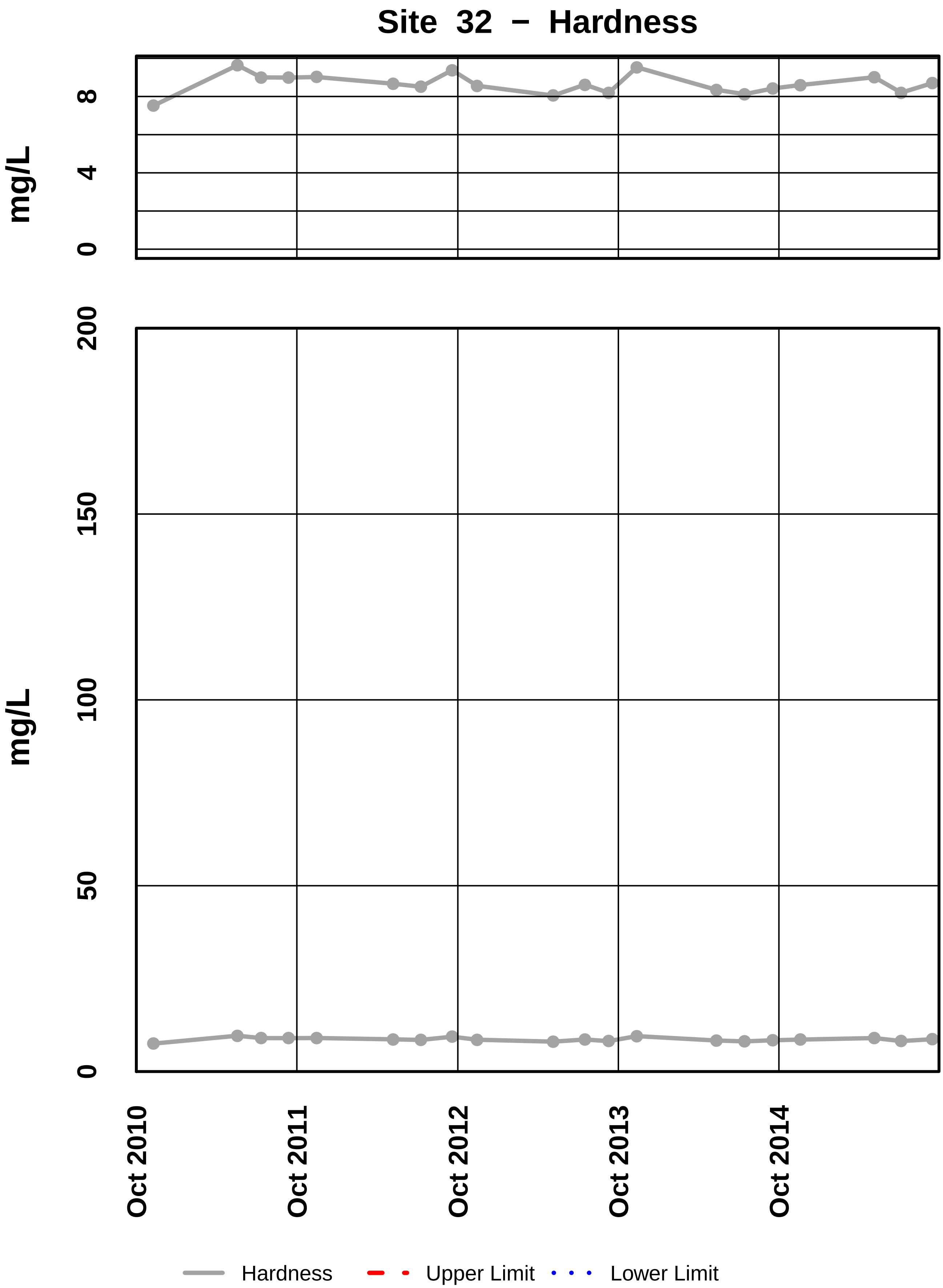
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



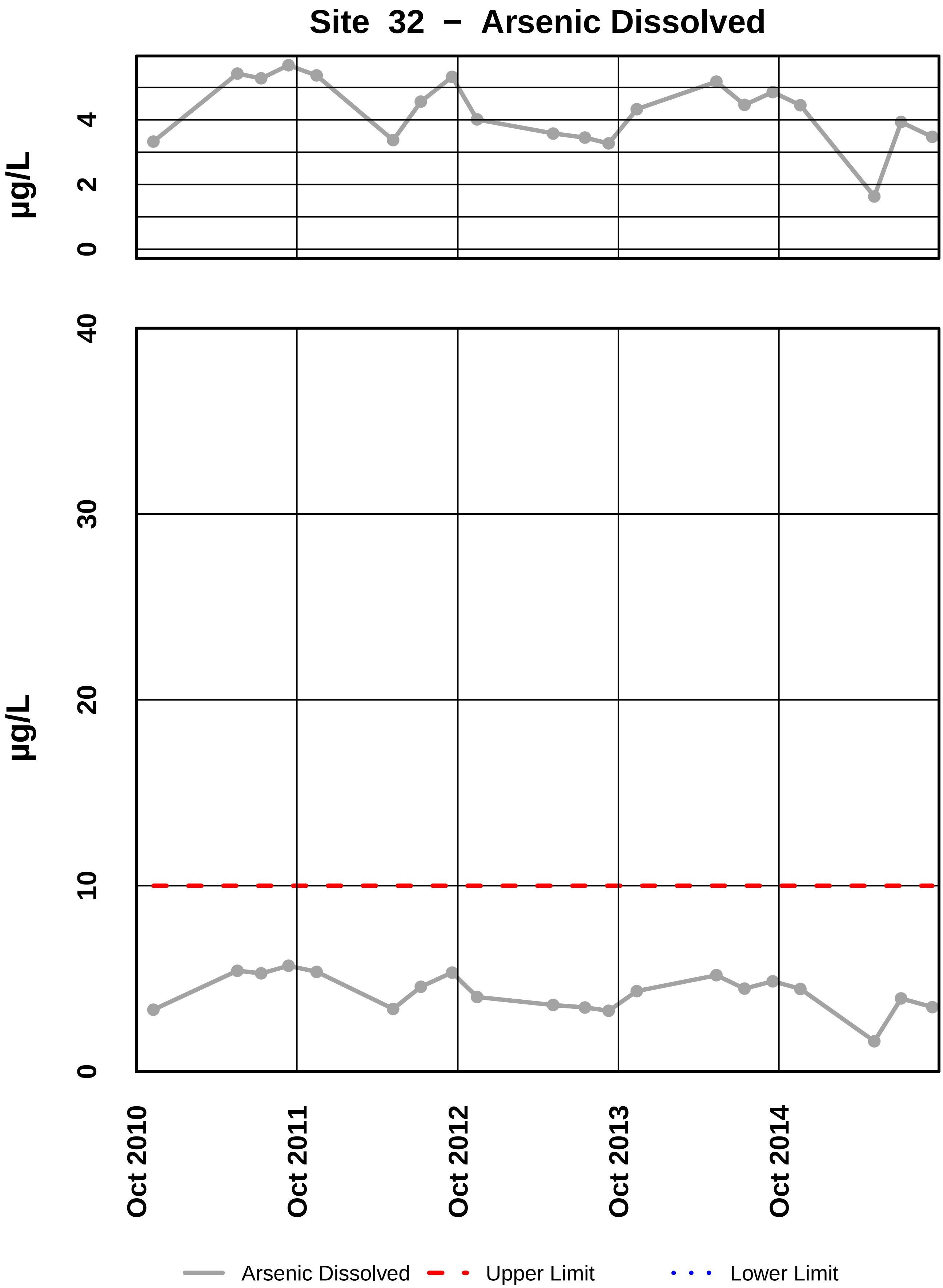
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

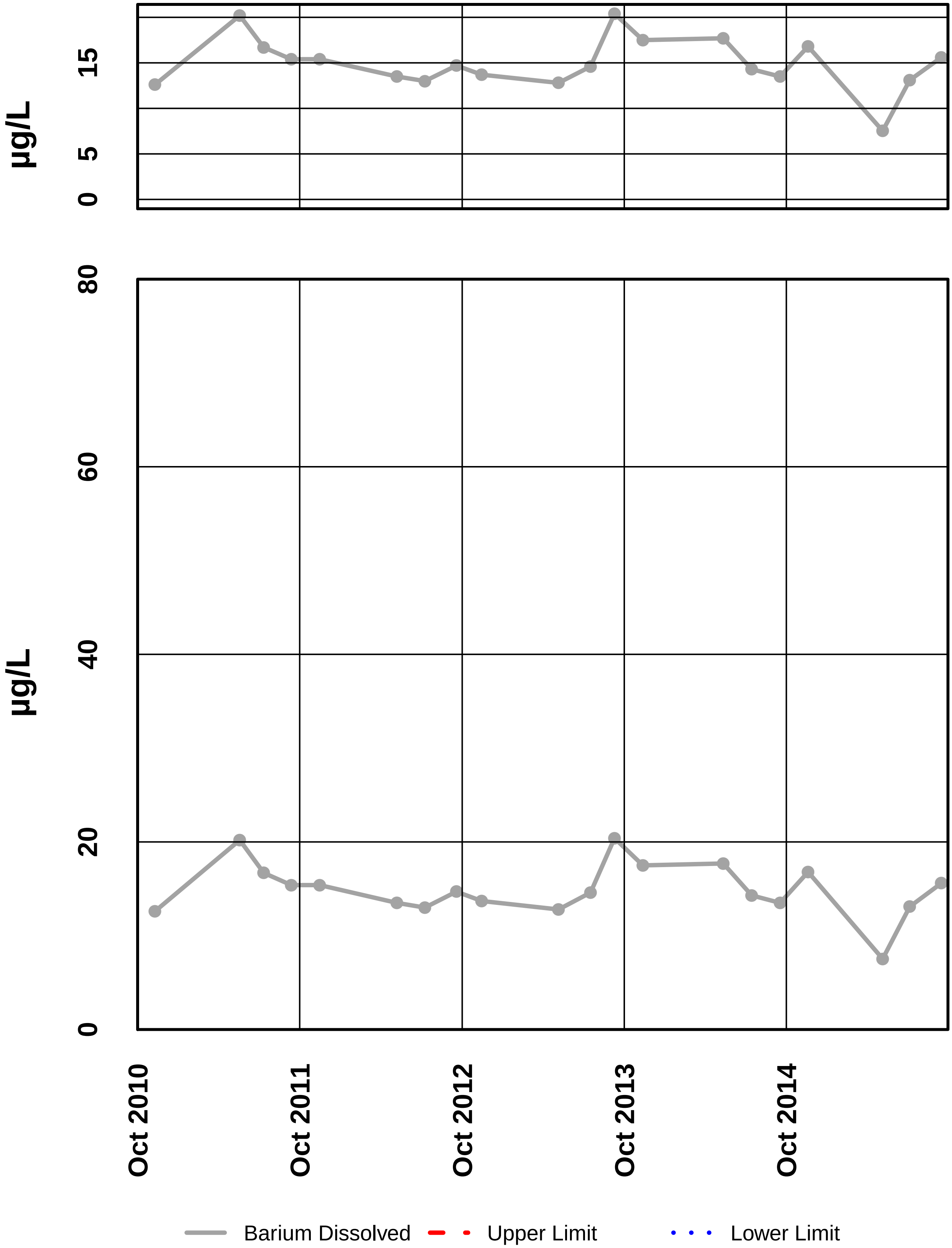


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



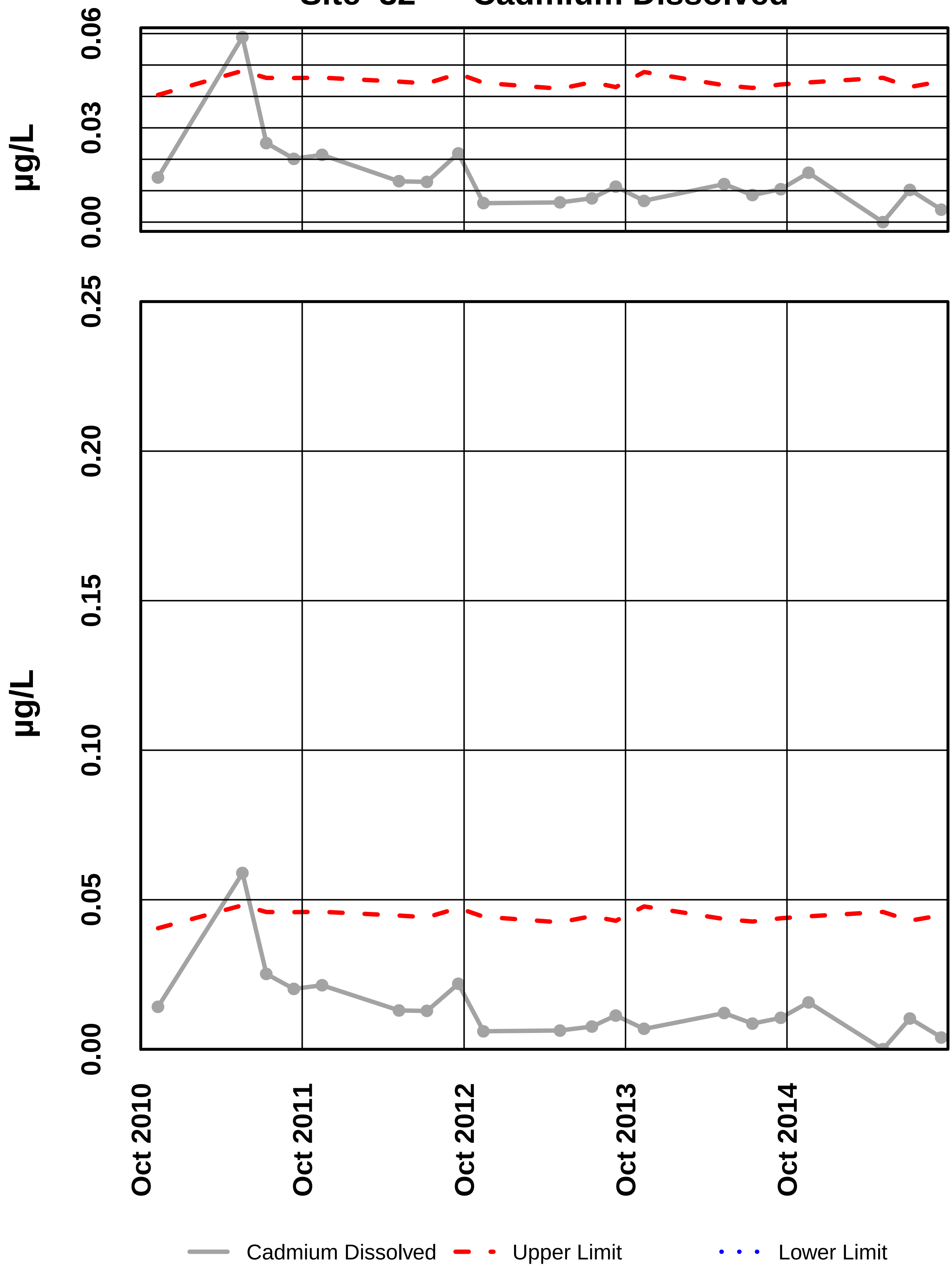
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 32 − Barium Dissolved



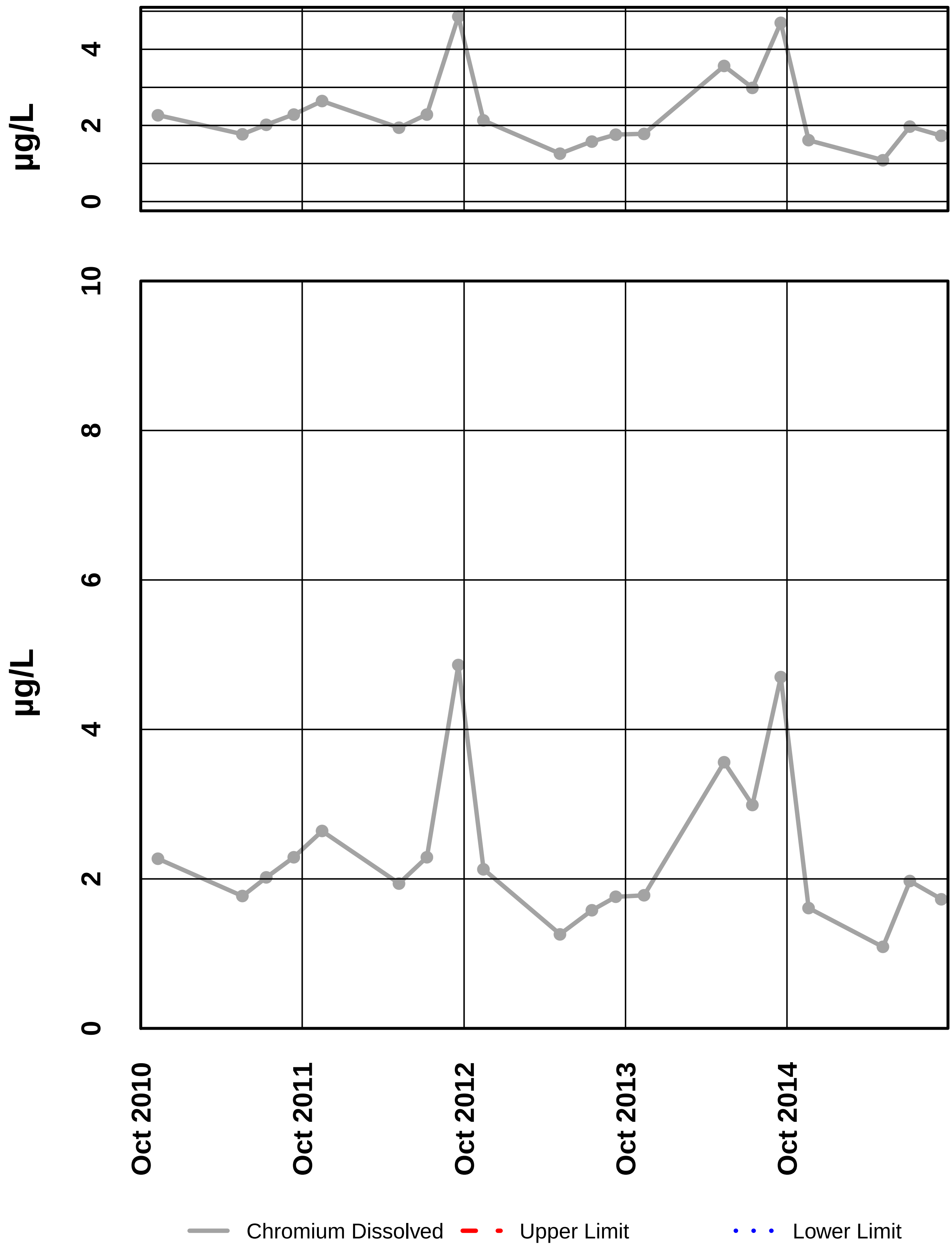
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 32 – Cadmium Dissolved



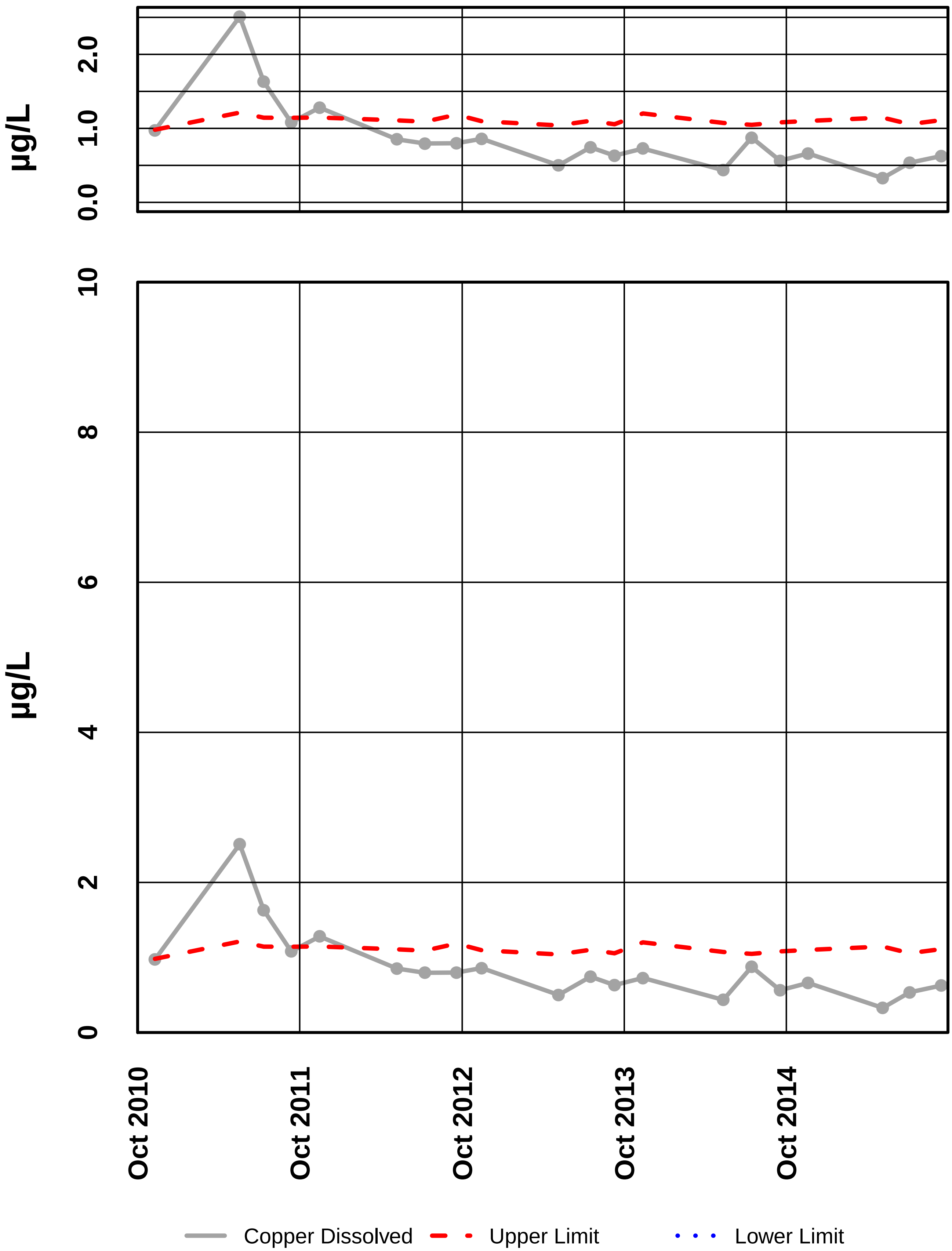
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 32 − Chromium Dissolved



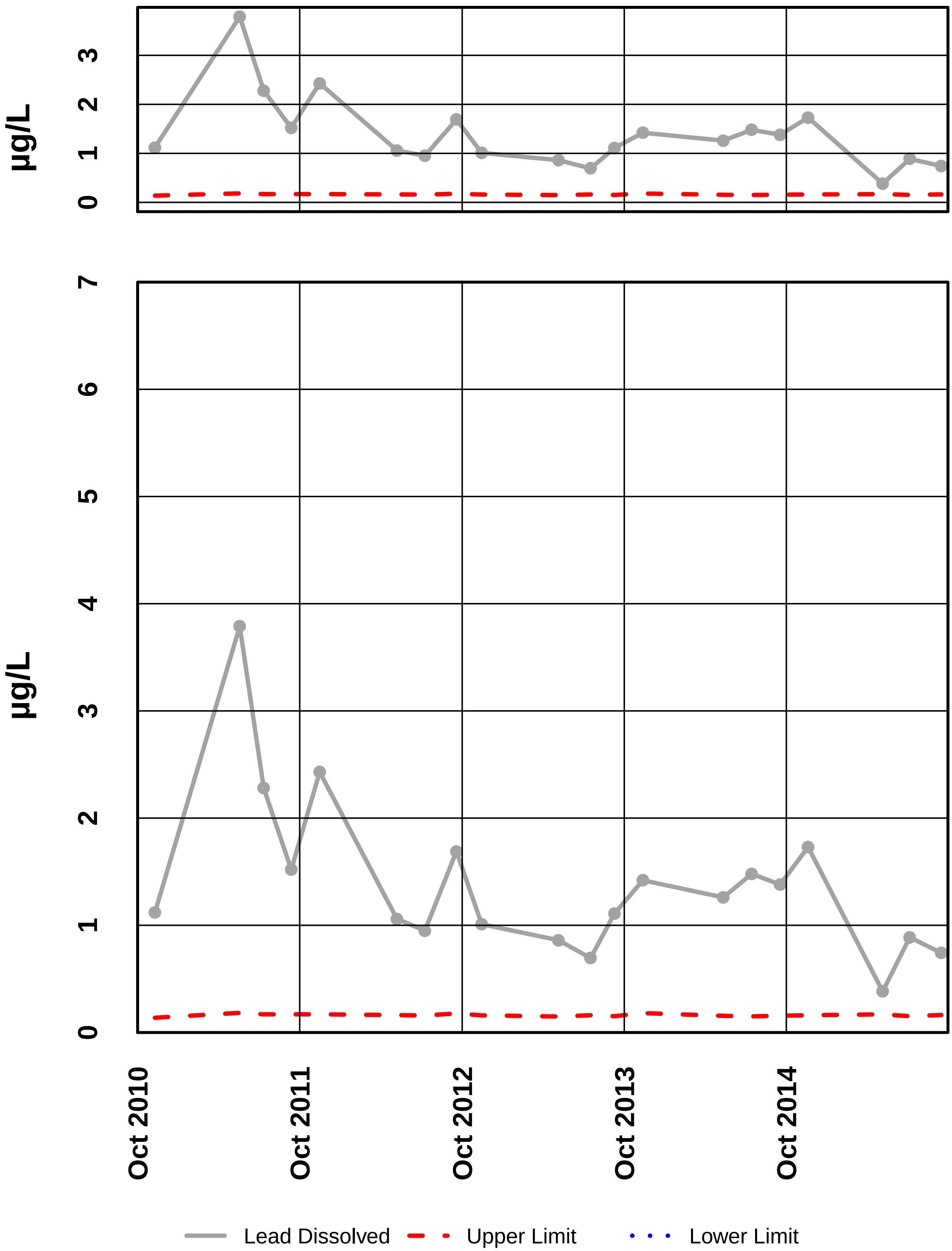
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 32 – Copper Dissolved



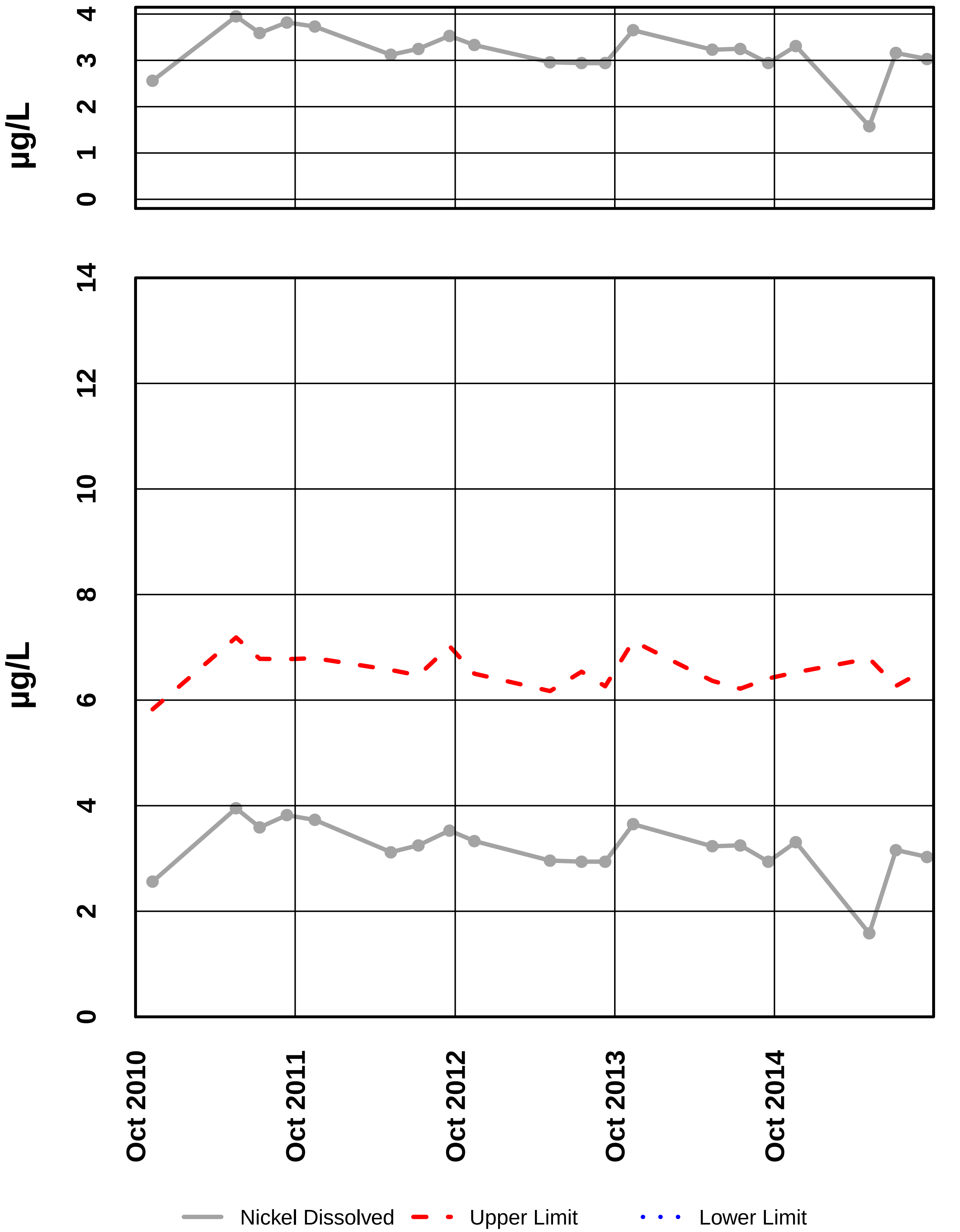
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 32 − Lead Dissolved

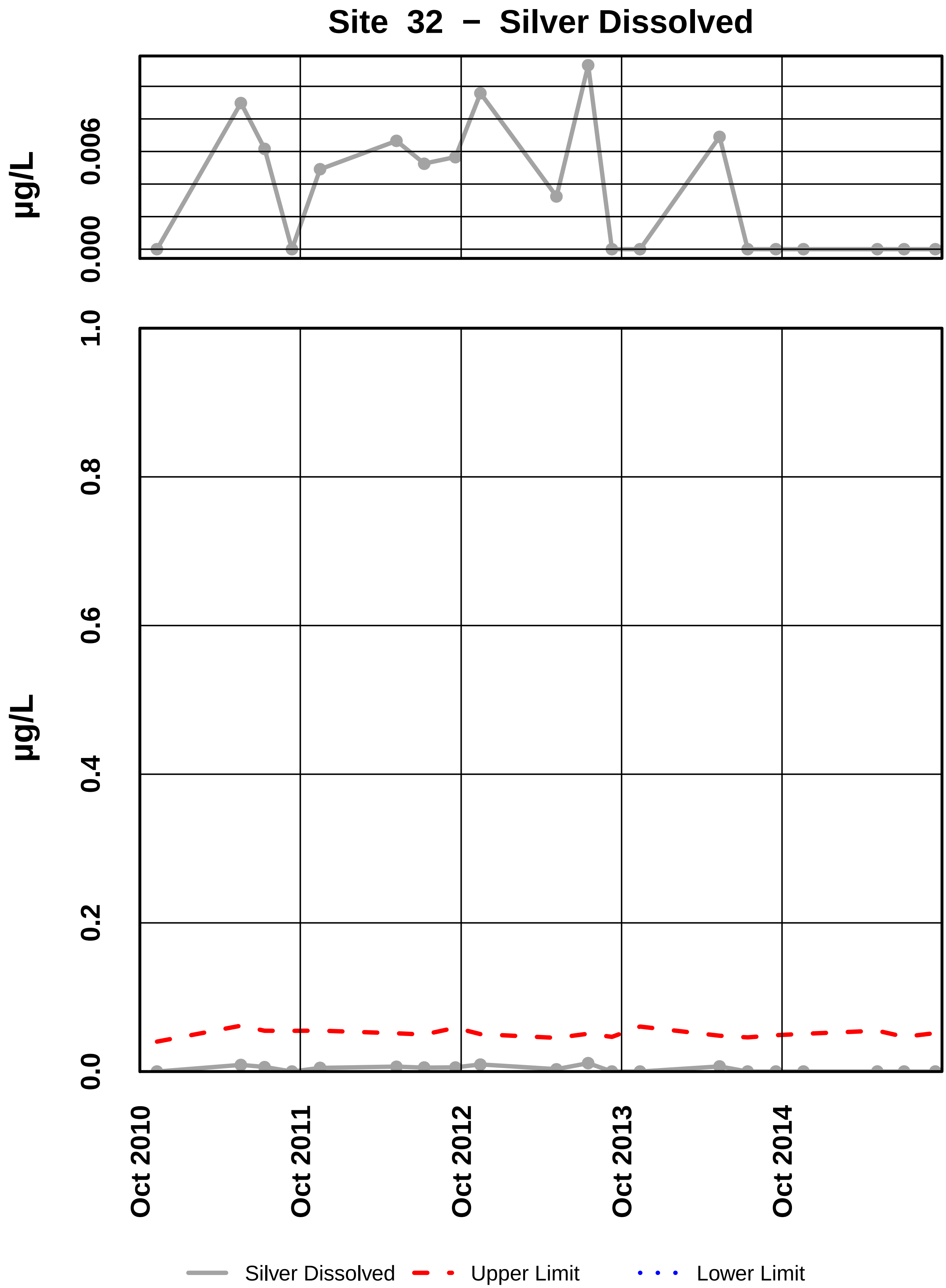


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 32 – Nickel Dissolved

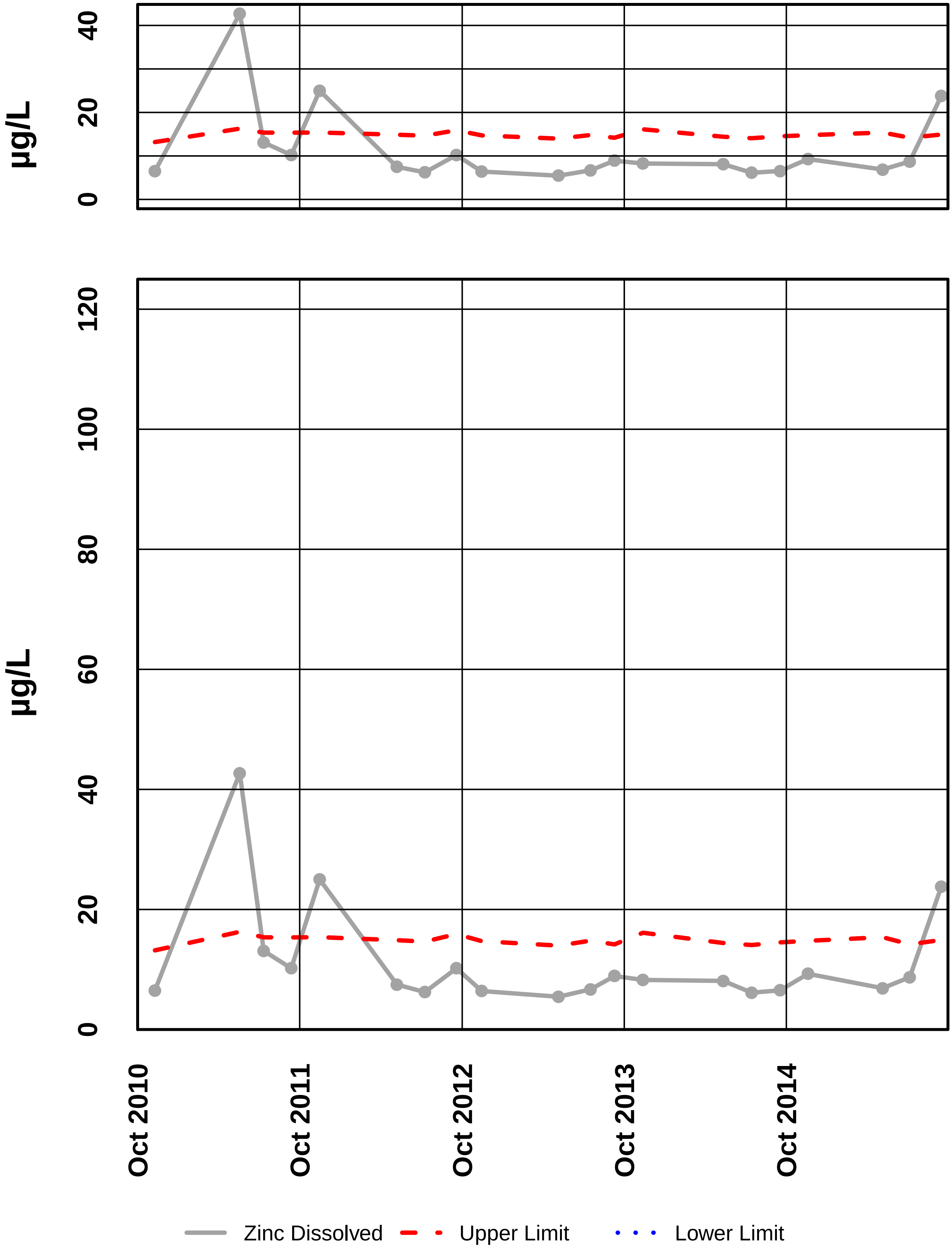


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

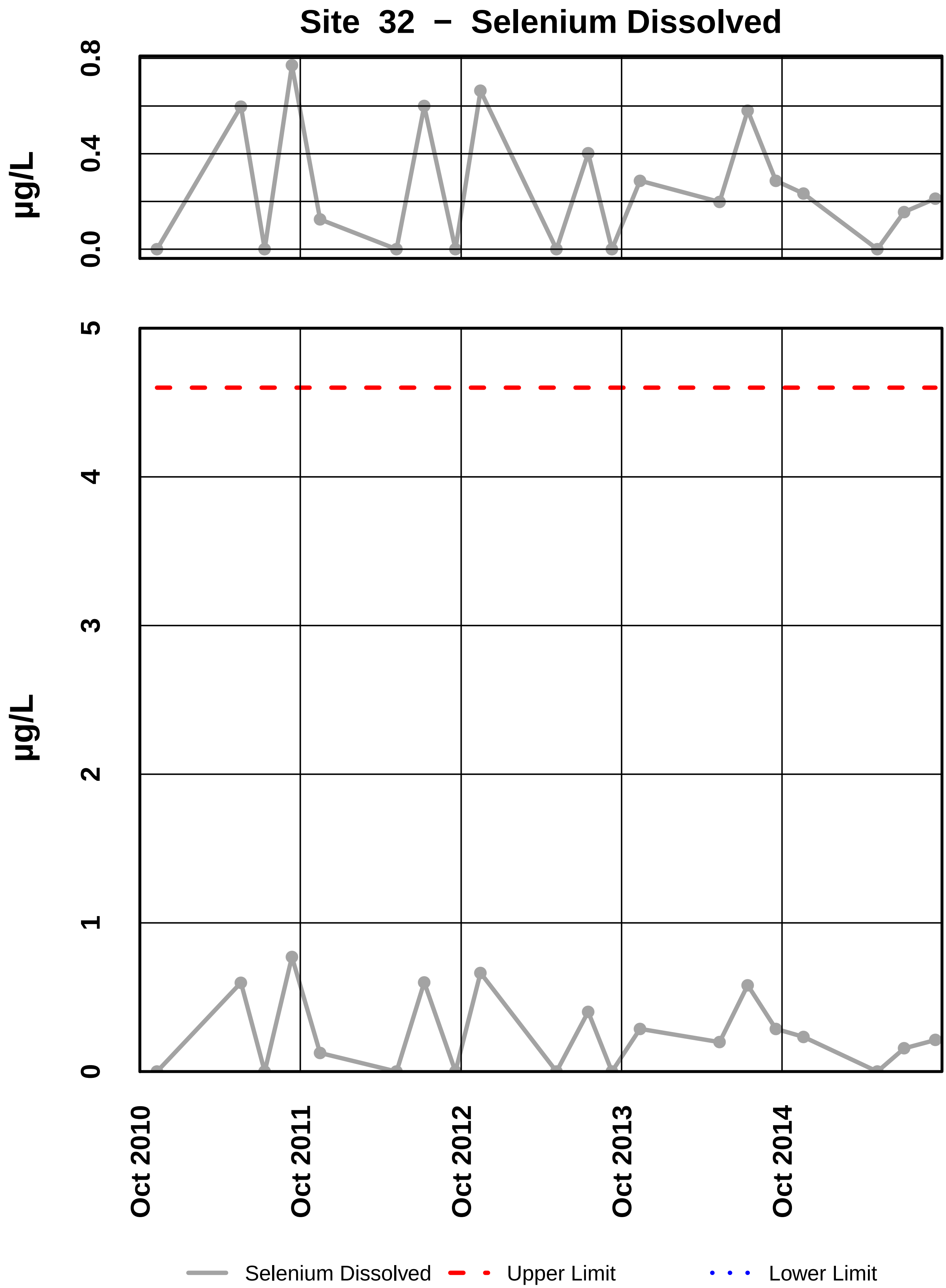


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

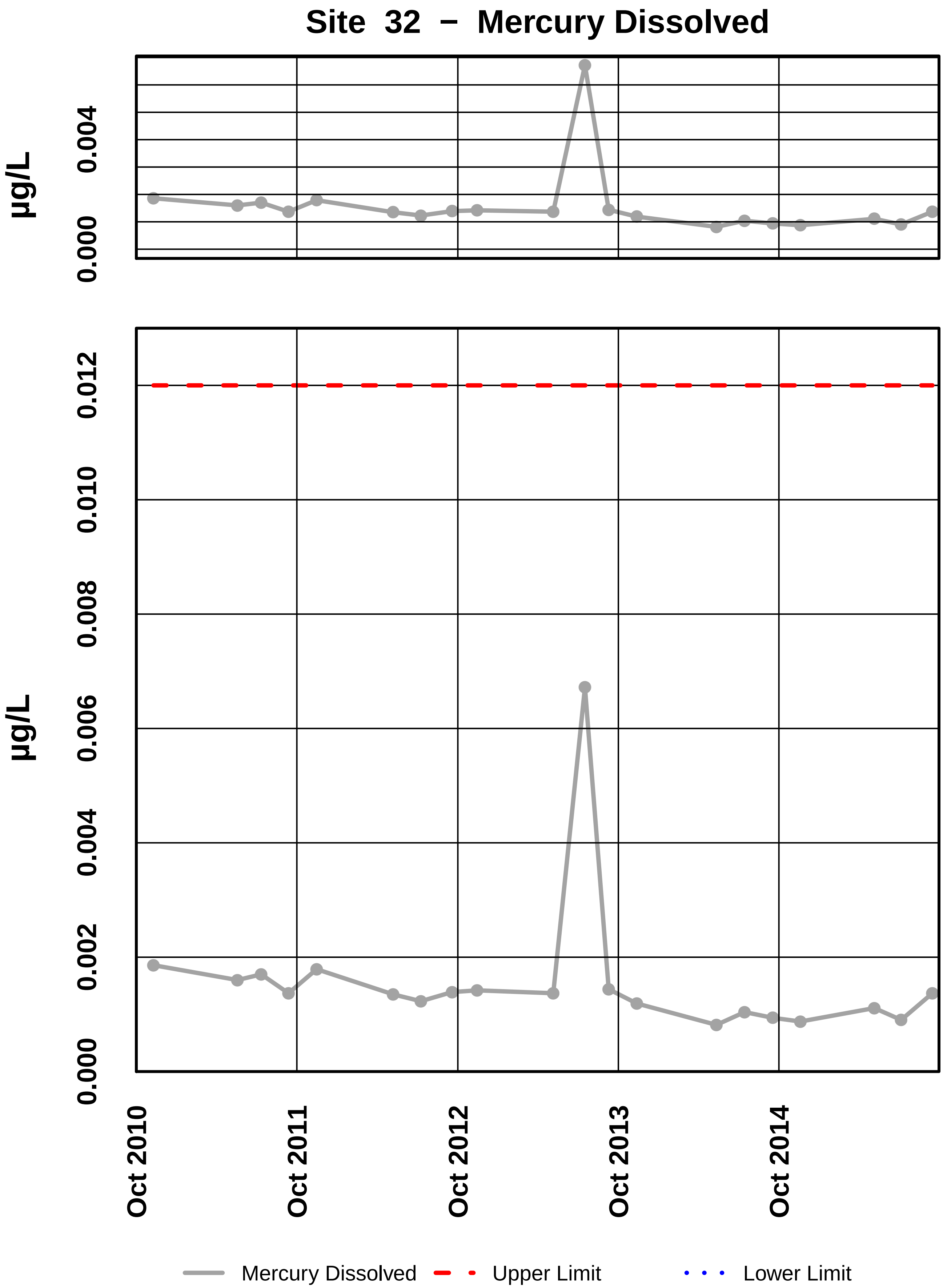
Site 32 – Zinc Dissolved



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



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



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

INTERPRETIVE REPORT
SITE 9

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

The data collected during the current water year are listed in the following "Table of Results for Water Year 2015" 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, in the past six years, have been identified by HGCMC.				

The data for Water Year 2015 have been compared to the strictest fresh water quality criterion for each applicable analyte. Five results exceeding these criteria have been identified, and listed in the table below.

Table of Exceedance for Water Year 2015

			Limits		
Sample Date	**Parameter**	**Value**	**Lower**	**Upper**	**Hardness**
19-Nov-14	Alkalinity	13.5 mg/L	20		
15-Sep-15	Alkalinity	15.1 mg/L	20		
19-Nov-14	Lead Dissolved	1.03 µg/L		0.58	26.6 mg/L
15-Sep-15	Lead Dissolved	0.72 µg/L		0.57	26.1 mg/L
19-Nov-14	pH Field	6.4 su	6.5	8.50	

X-Y plots have been generated to graphically present the data for each of the analytes that are listed in Suite Q. There appears to be no obvious visual trends.

A non-parametric statistical analysis for trend was performed for specific conductivity, field pH, total alkalinity, total sulfate, and dissolved zinc. Calculation details of the Seasonal Kendall analyses are presented in detail on the pages following this interpretive section. The following table summarizes the results on the data collected between Oct-09 and Sep-15 (WY2010-WY2015). There were two statistically significant ($\alpha/2=2.5\%$) trends identified for the current water year. This is the third year that there was a sufficient number years (n=6) of data for conducting these calculations. Trend analysis revealed statistically significant trends in total sulfate and dissolved zinc. Total sulfate has a negative slope of 1.55 mg/L/yr and dissolved zinc has a negative slope of 0.58 µg/L/yr.

Table of Summary Statistics for Trend Analysis

	Mann-Kendall test statistics			Sen's slope estimate	
Parameter	**n***	**p****	**Trend**	**Q**	**Q(%)**
Conductivity Field	6	0.10			
pH Field	6	0.12			
Alkalinity, Total	6	0.28			
Sulfate, Total	6	<0.01	-	-1.50	-12.50
Zinc, Dissolved	6	<0.01	-	-0.58	-10.284

* 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 2015

Site 009FMS - 'Lower Tributary Creek'

Sample Date/Parameter	Oct 2014	Nov 2014	Dec 2014	Jan 2015	Feb 2015	Mar 2015	Apr 2015	May 2015	Jun 2015	Jul 2015	Aug 2015	Sep 2015	**Median**
Water Temp (°C)		2.6						5.8		14.6		9.6	7.7
Conductivity-Field(μmho)		62.3						83.4		86		48.1	72.9
Conductivity-Lab (μmho)		59						88		86		48	73
pH Lab (standard units)		6.48						6.78		4.78		6.85	6.63
pH Field (standard units)		6.35						7.26		*		6.96	6.96
Total Alkalinity (mg/L)		13.5						20.6		28.3		15.1	17.9
Total Sulfate (mg/L)		8.9						15.2		10.8		5.9	9.9
Hardness (mg/L)		26.6						37.5		38.2		26.1	32.1
Dissolved As (ug/L)		0.799						0.743		1.14		1.15	0.970
Dissolved Ba (ug/L)		33.5						36.1		44.7		37.1	36.6
Dissolved Cd (ug/L)		0.0317						0.0185		0.0204		0.0384	0.0261
Dissolved Cr (ug/L)		0.583						0.537		0.647		0.82	0.615
Dissolved Cu (ug/L)		1.34						1.36		1.63		1.57	1.465
Dissolved Pb (ug/L)		1.03						0.303		0.416		0.721	0.5685
Dissolved Ni (ug/L)		1.82						1.57		2.17		2.6	1.995
Dissolved Ag (ug/L)		0.007						0.007		0.012		0.011	0.009
Dissolved Zn (ug/L)		5.1						3.47		3.12		5.64	4.29
Dissolved Se (ug/L)		0.127						0.134		0.149		0.164	0.142
Dissolved Hg (ug/L)		0.00544						0.00276		0.00295		0.00553	0.004195

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

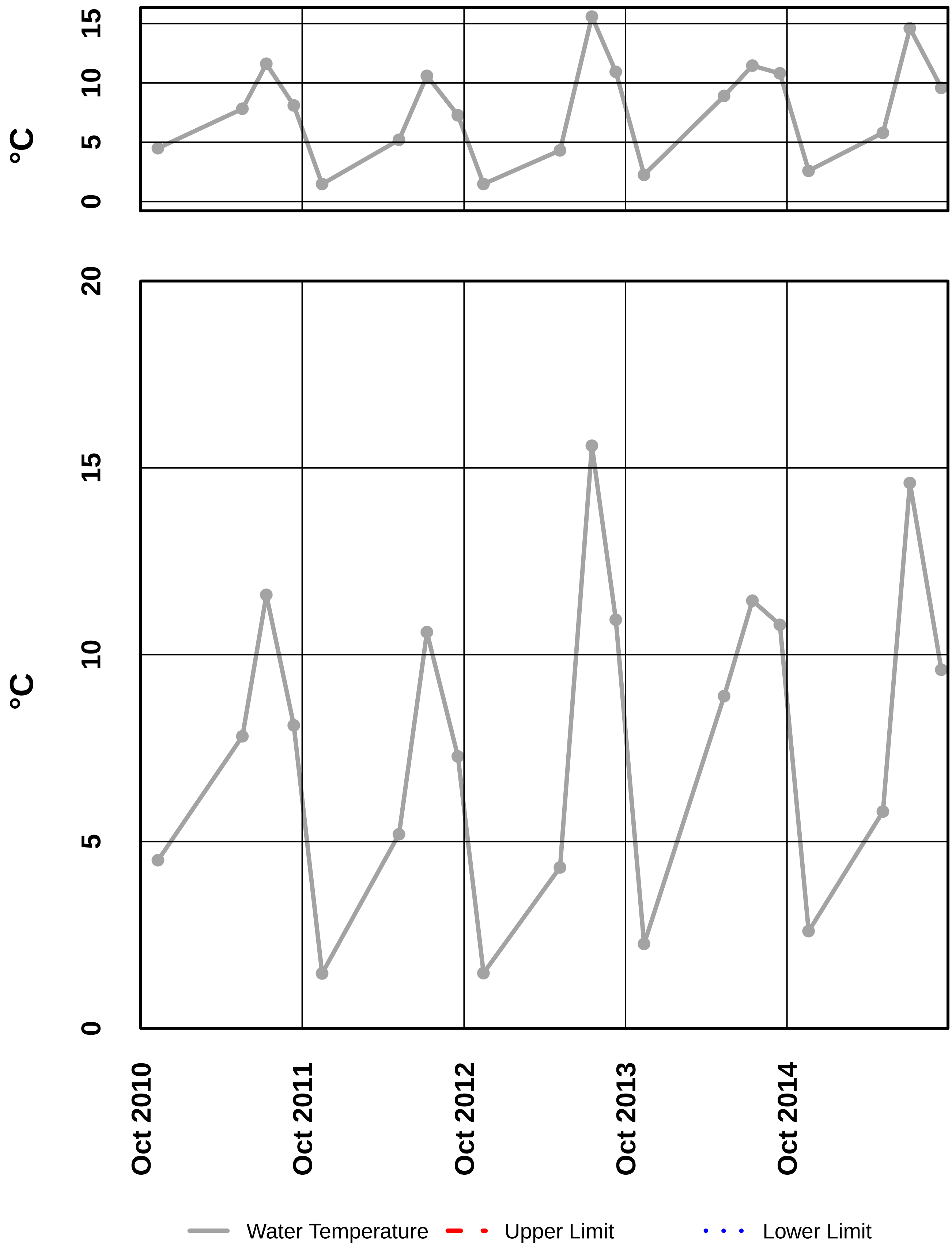
Qualified Data by QA Reviewer

Date Range: 10/01/2014 to 09/30/2015

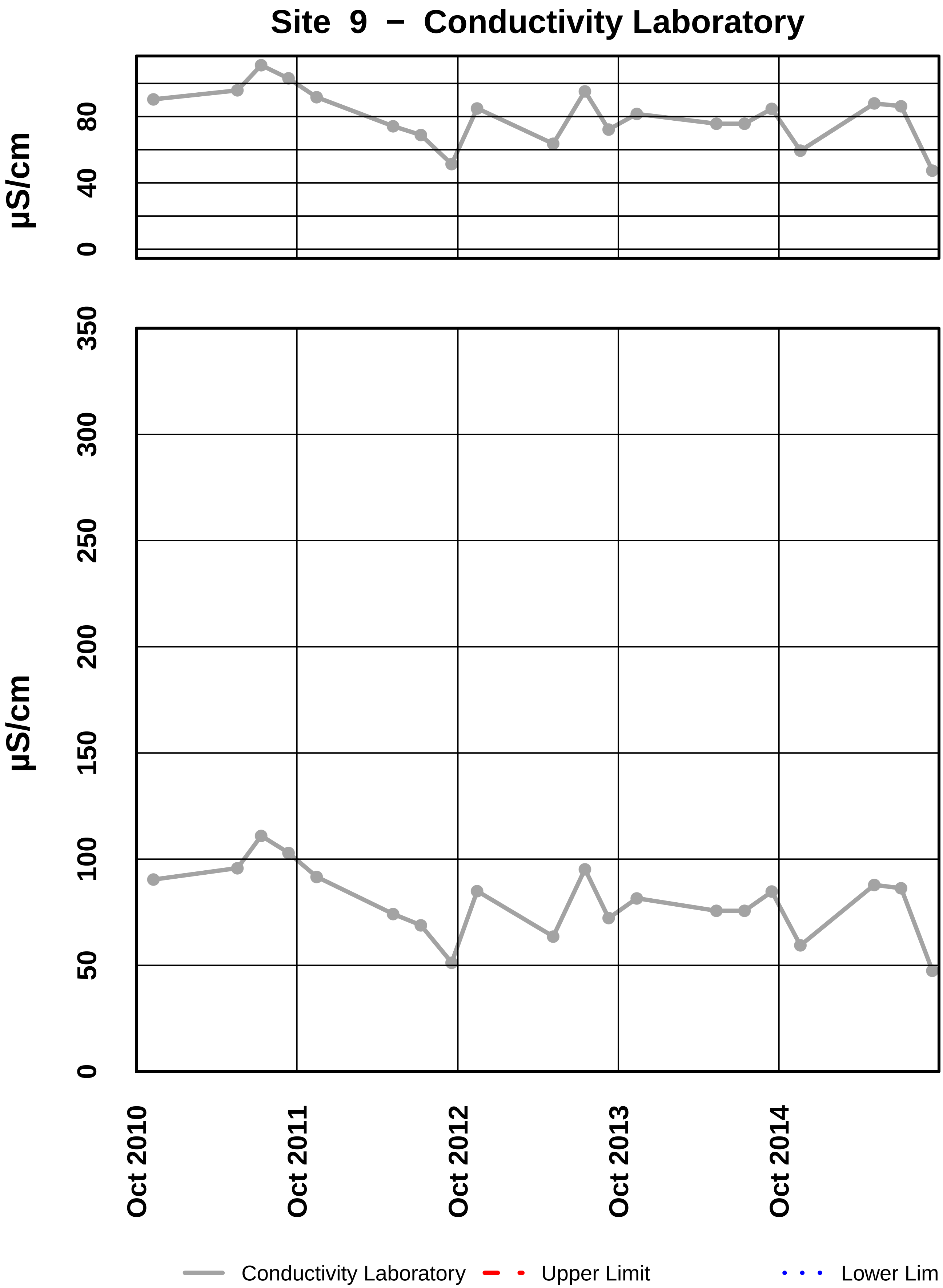
Site No.	Sample Date	Sample Time	Parameter	Value		Qualifier	Reason for Qualifier
009FMS	11/19/2014	12:00 AM	Diss. Ag-ICP/MS	0.00711	µg/L	J	Below Quantitative Range
			Diss. Se-ICP/MS	0.12	µg/L	J	Below Quantitative Range
			pH	6.48	pH units	J	Hold Time Violation
009FMS	05/06/2015	12:00 AM	Diss. Ag-ICP/MS	0.00698	µg/L	J	Below Quantitative Range
			Diss. Se-ICP/MS	0.13	µg/L	J	Below Quantitative Range
009FMS	07/06/2015	12:00 AM	Diss. Se-ICP/MS	0.14	µg/L	J	Below Quantitative Range
009FMS	09/15/2015	12:00 AM	Diss. Se-ICP/MS	0.16	µg/L	J	Below Quantitative Range

Qualifier	Description
J	Positively Identified - Approximate Concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit

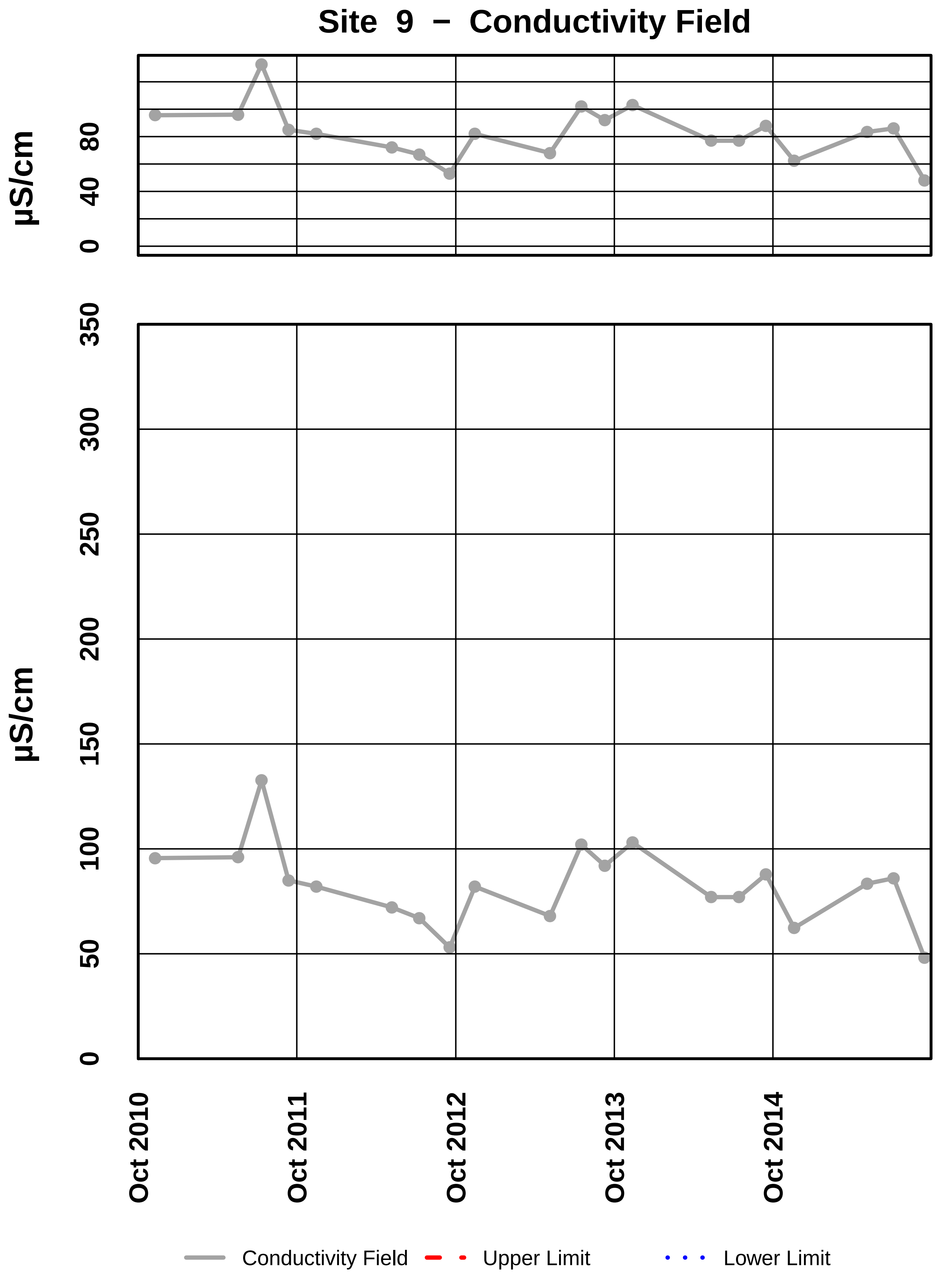
Site 9 − Water Temperature



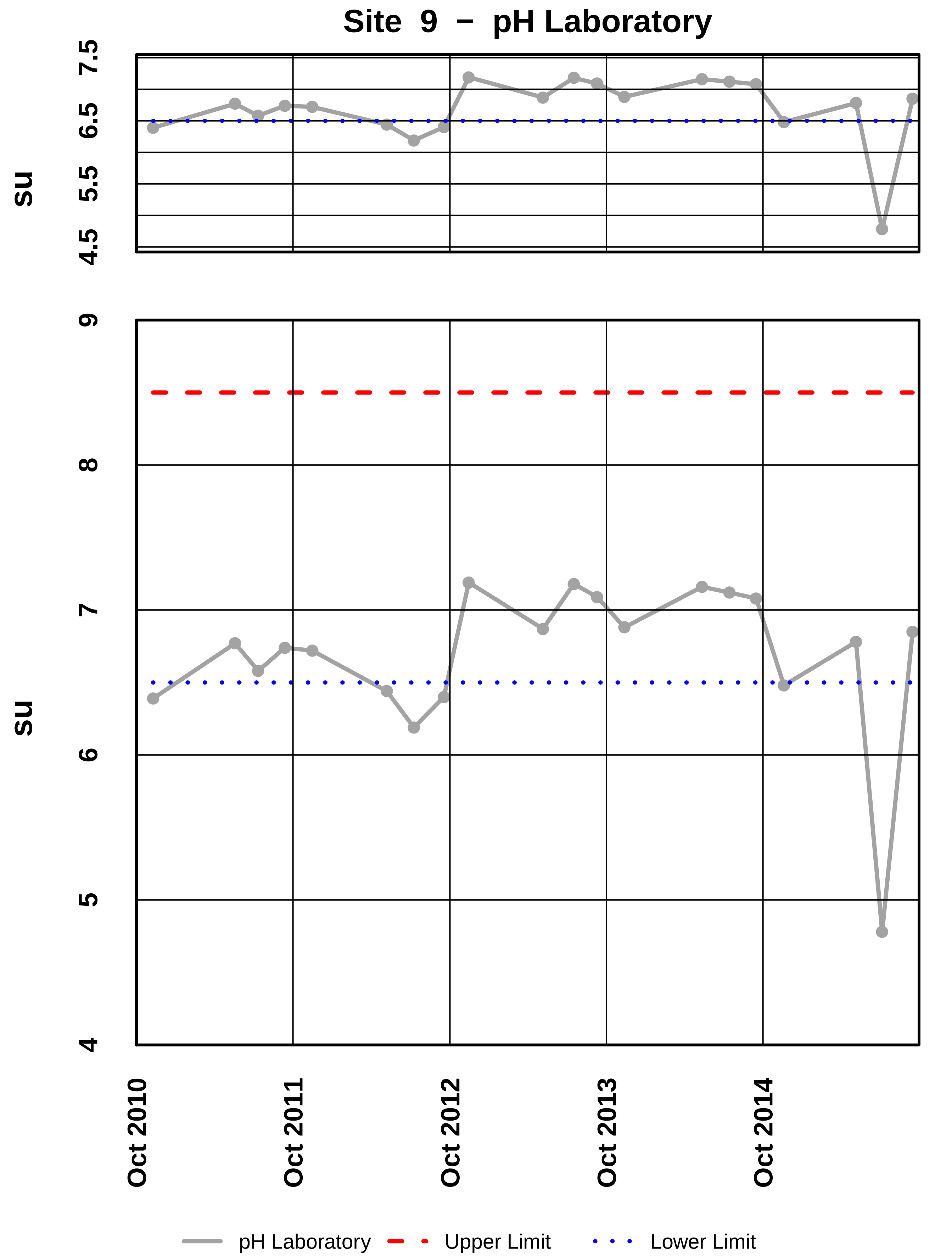
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



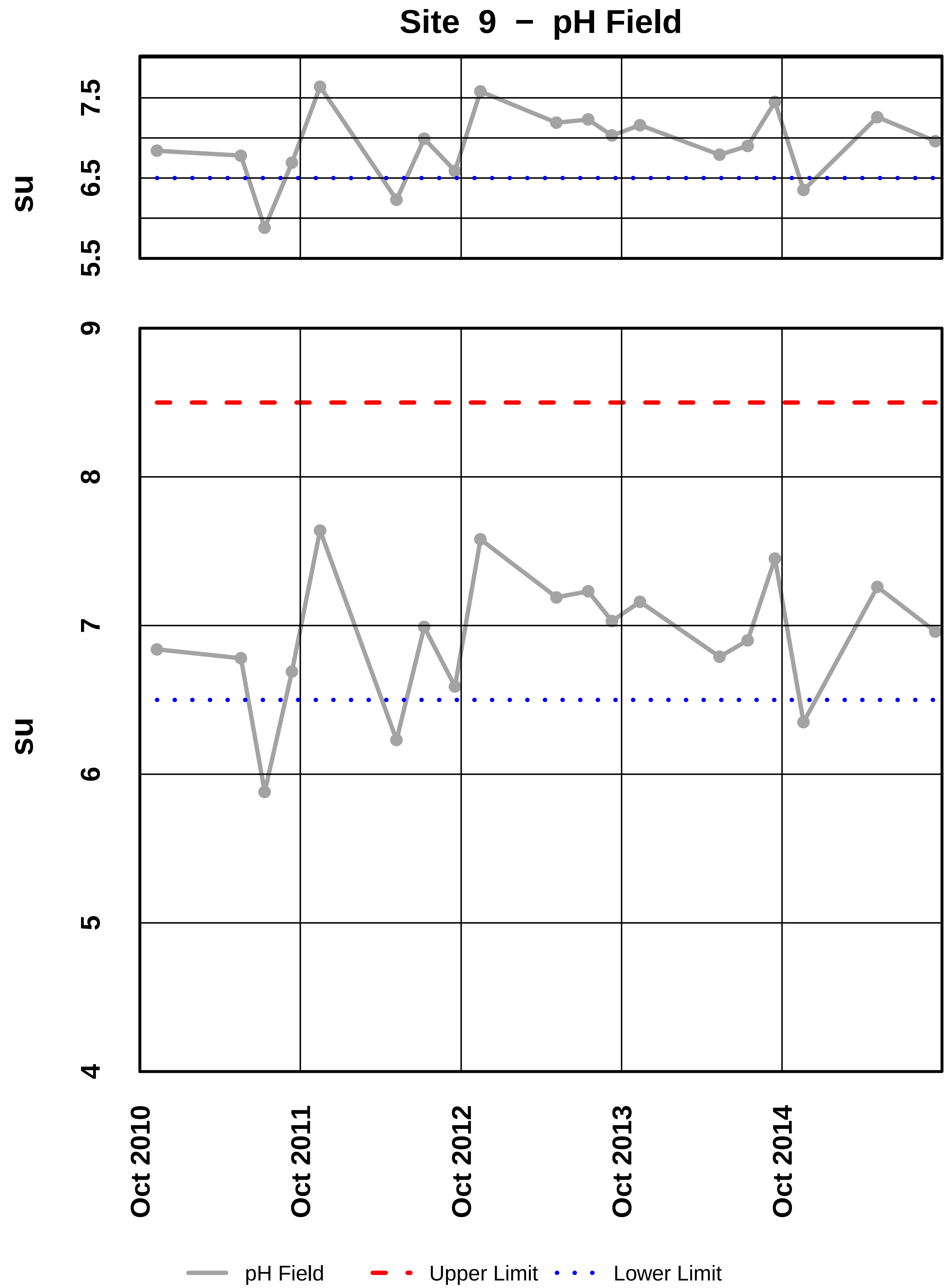
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



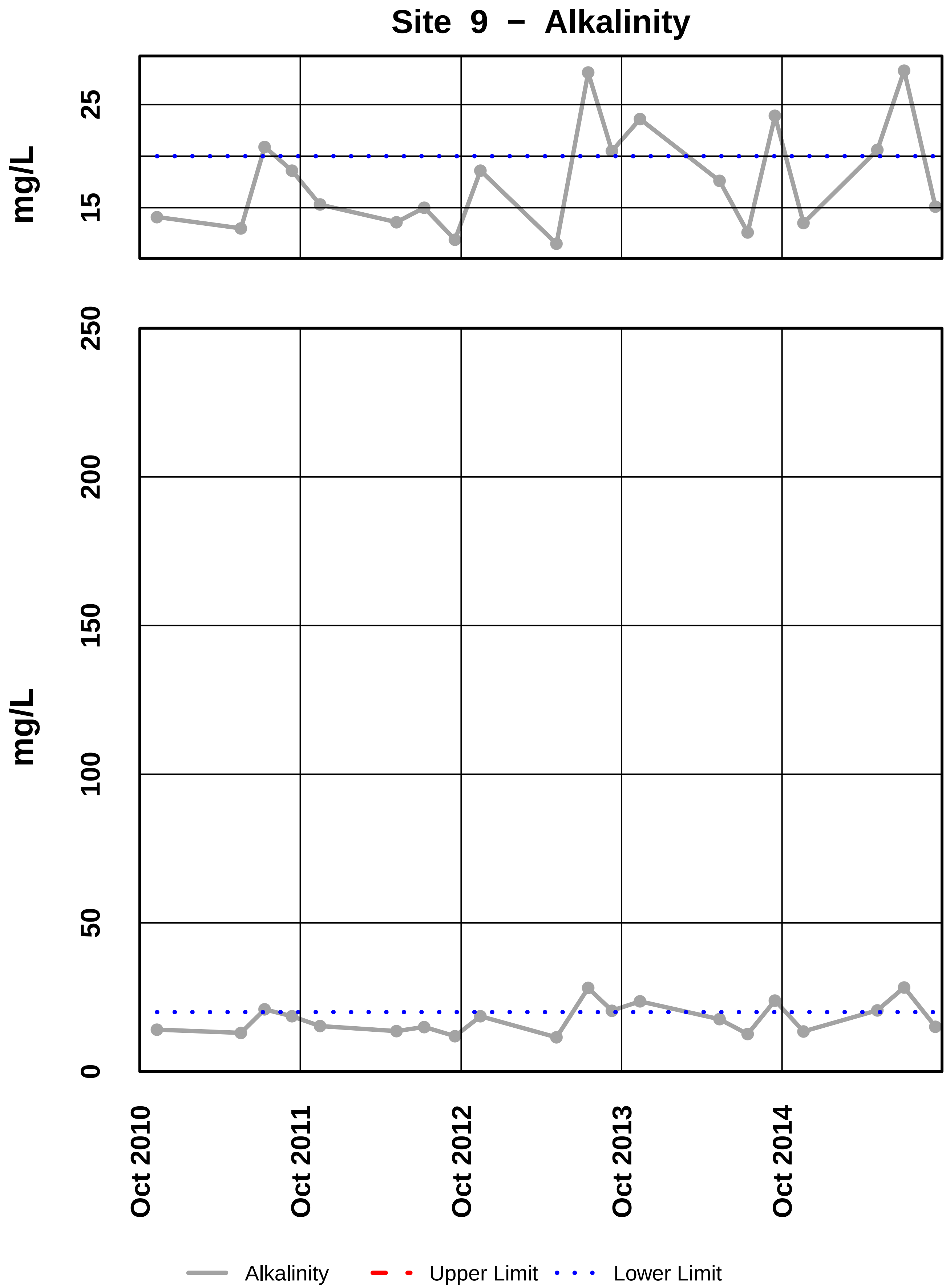
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



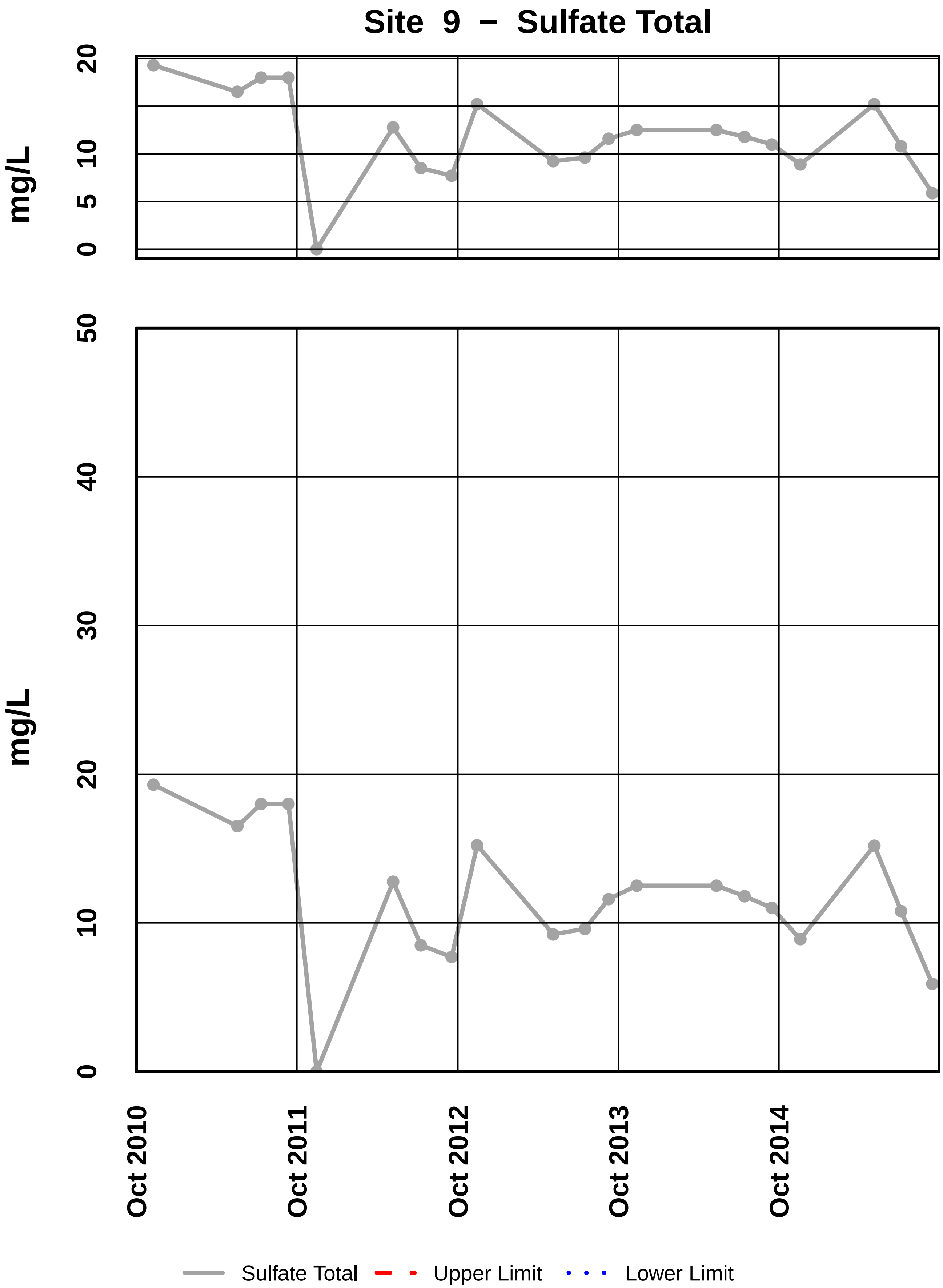
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



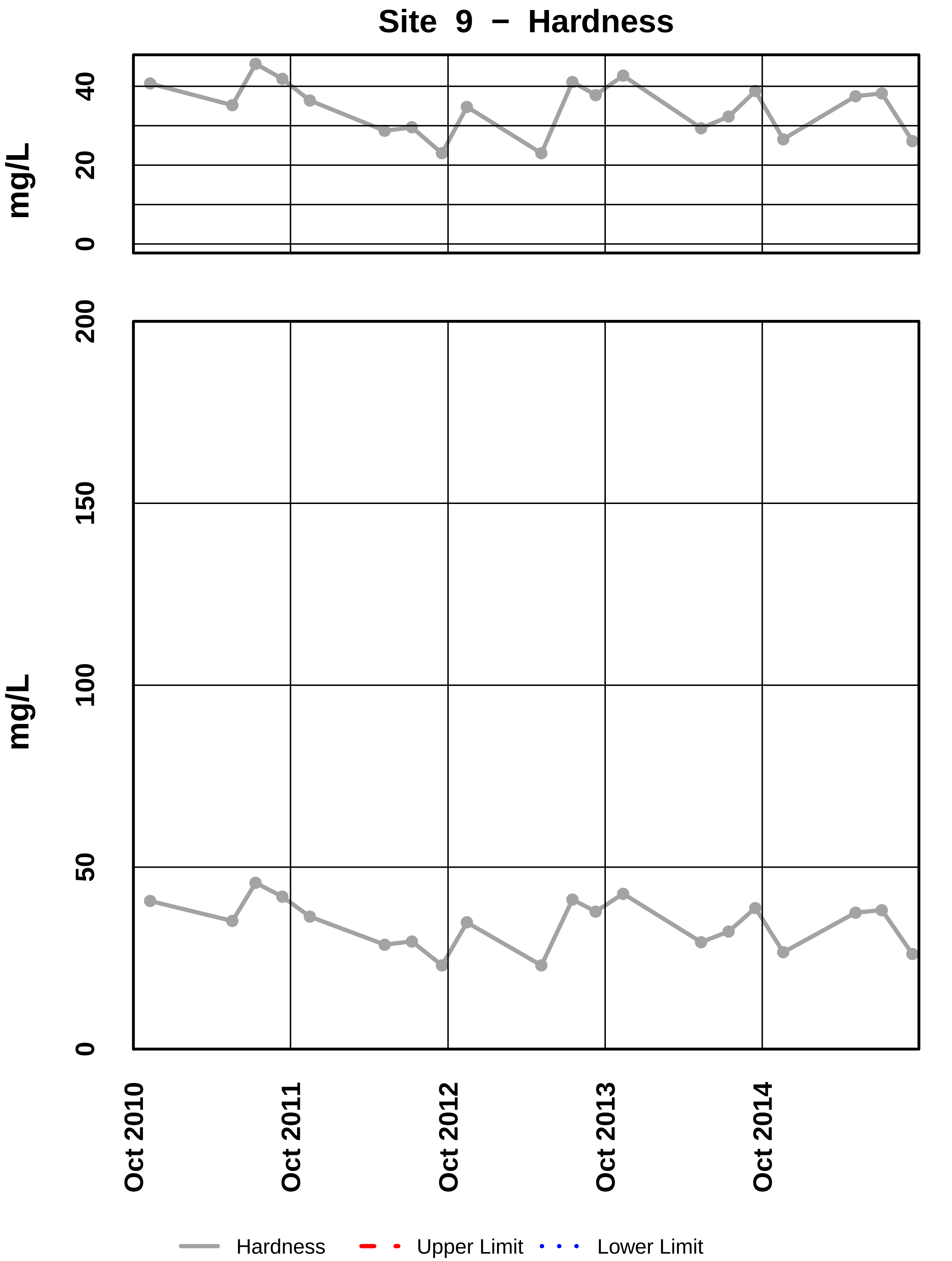
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



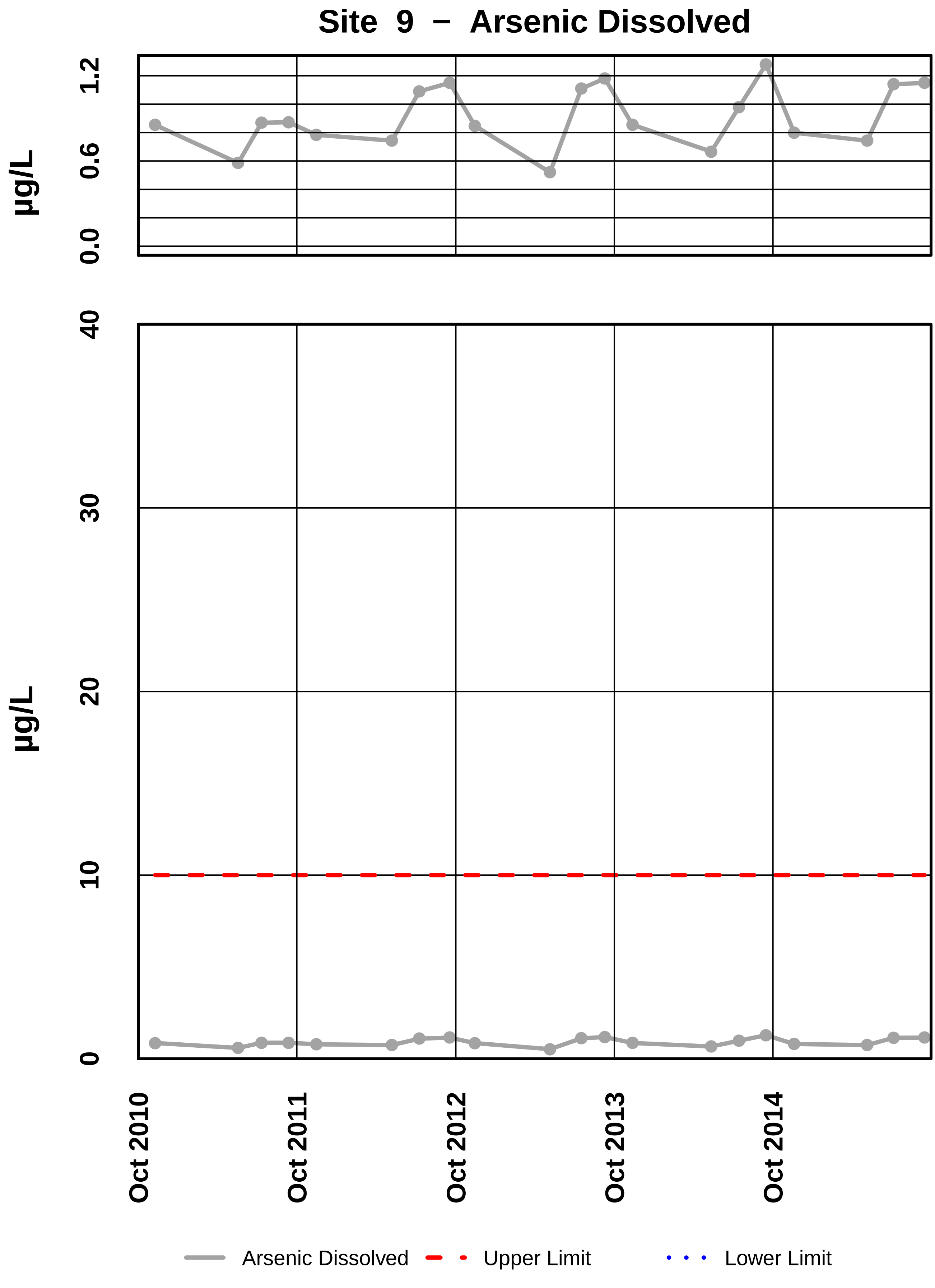
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



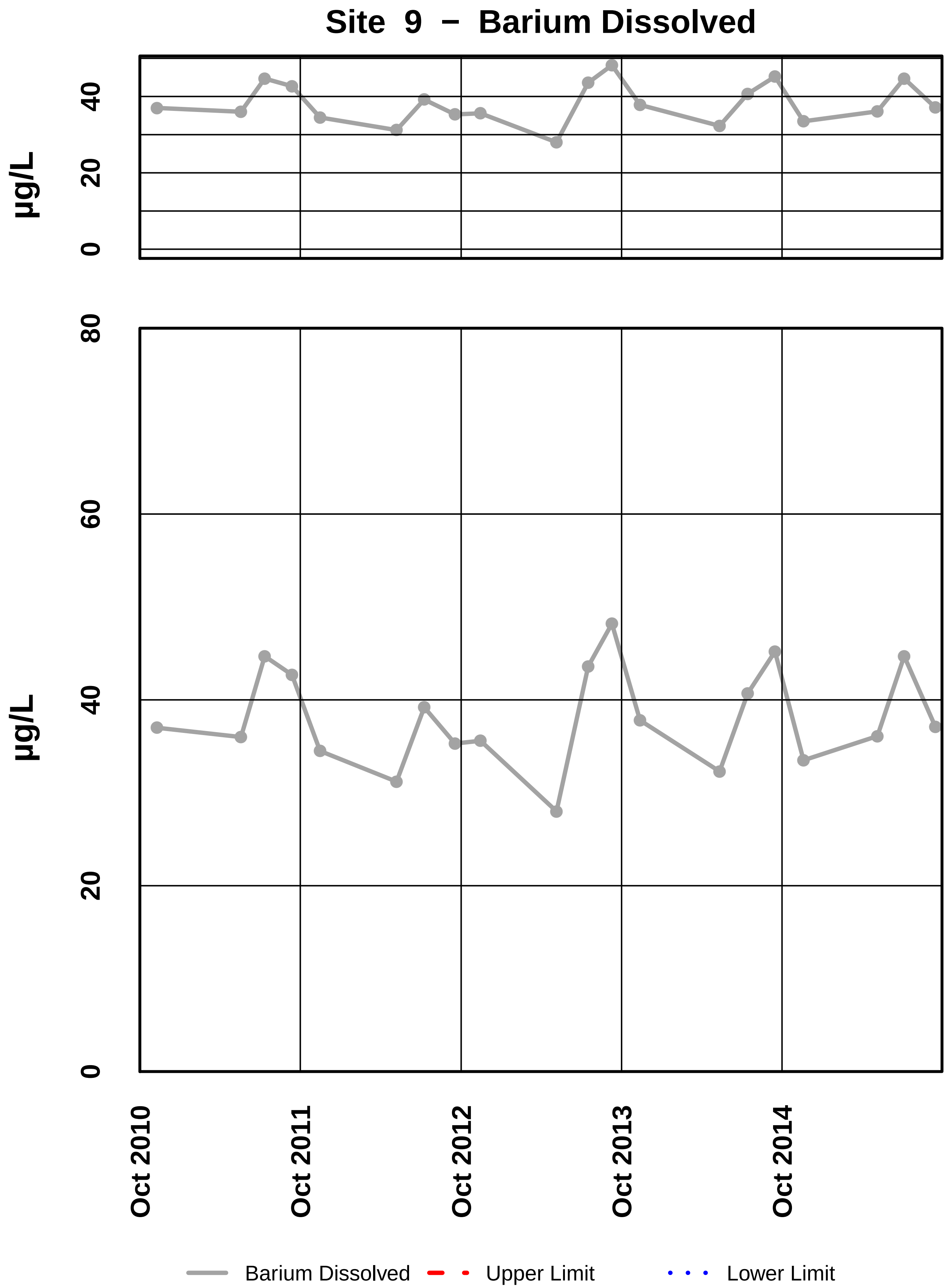
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

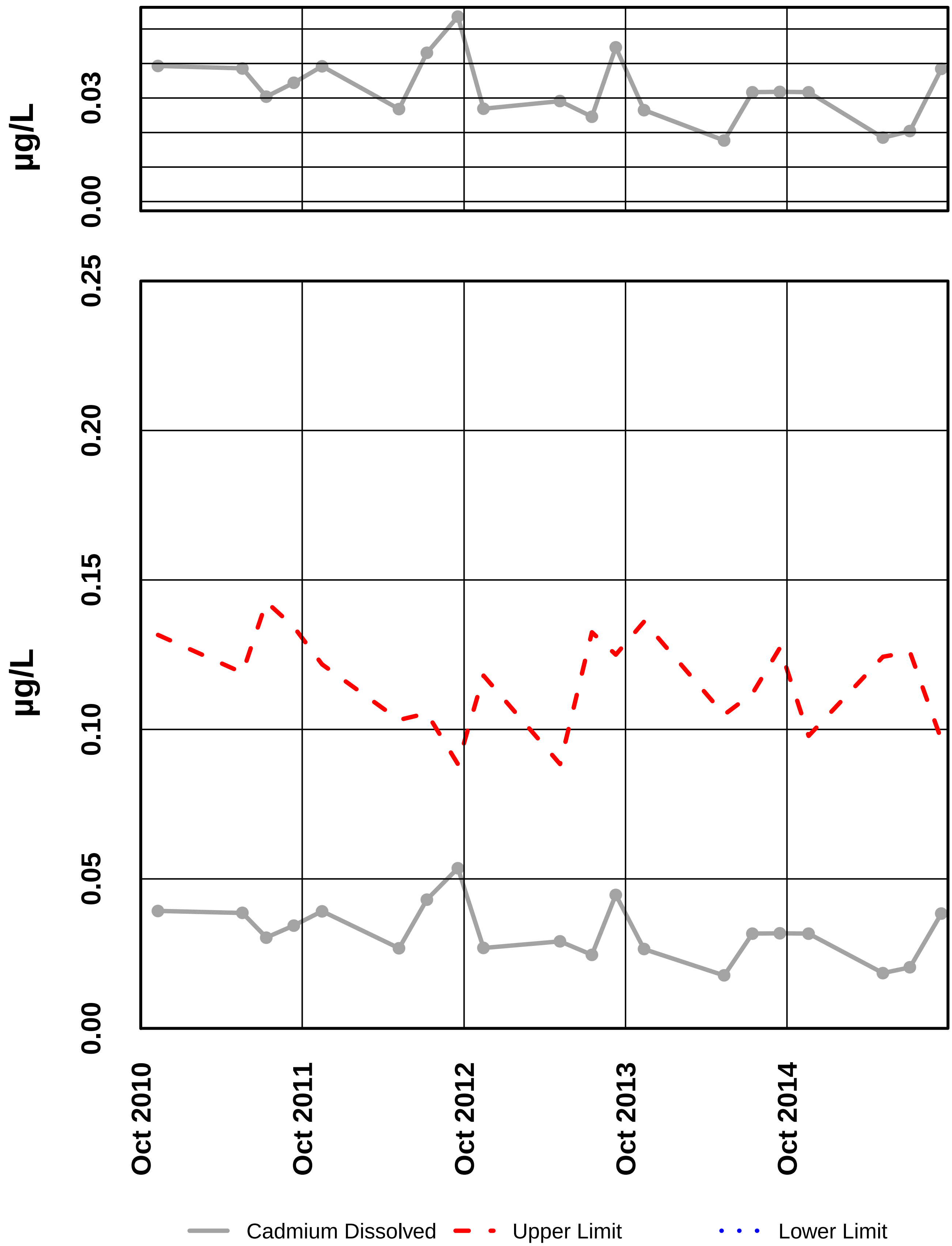


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

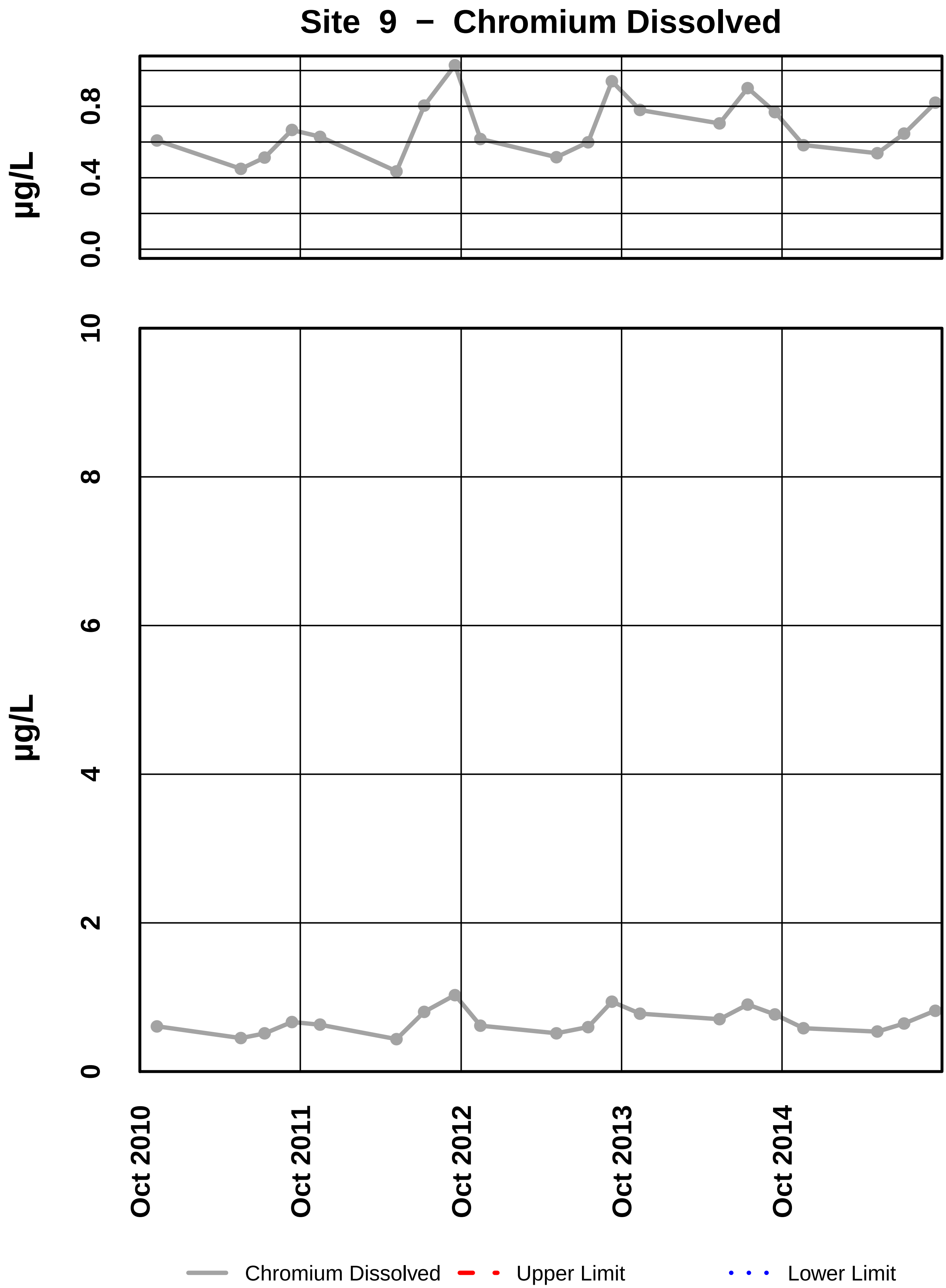


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 9 – Cadmium Dissolved

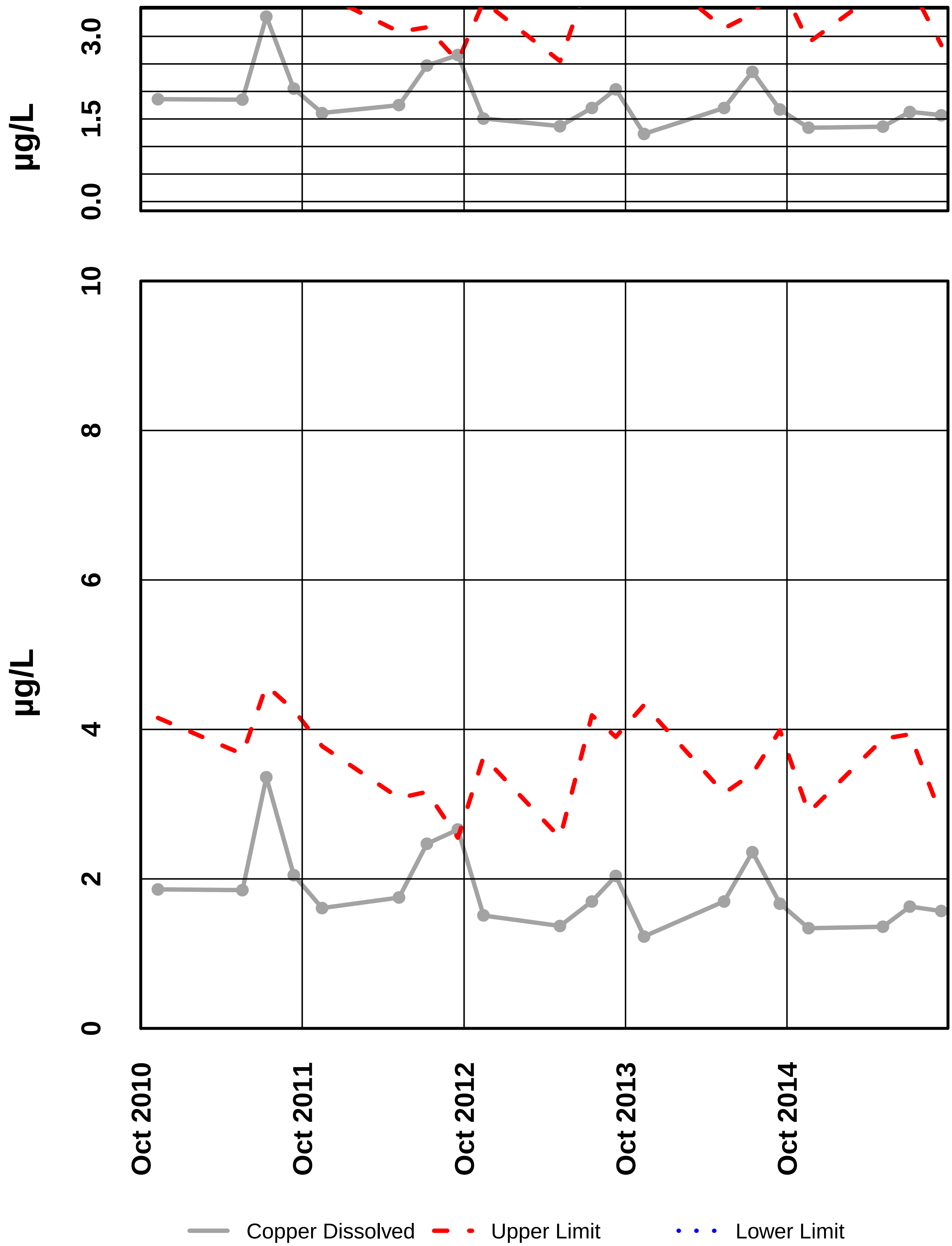


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



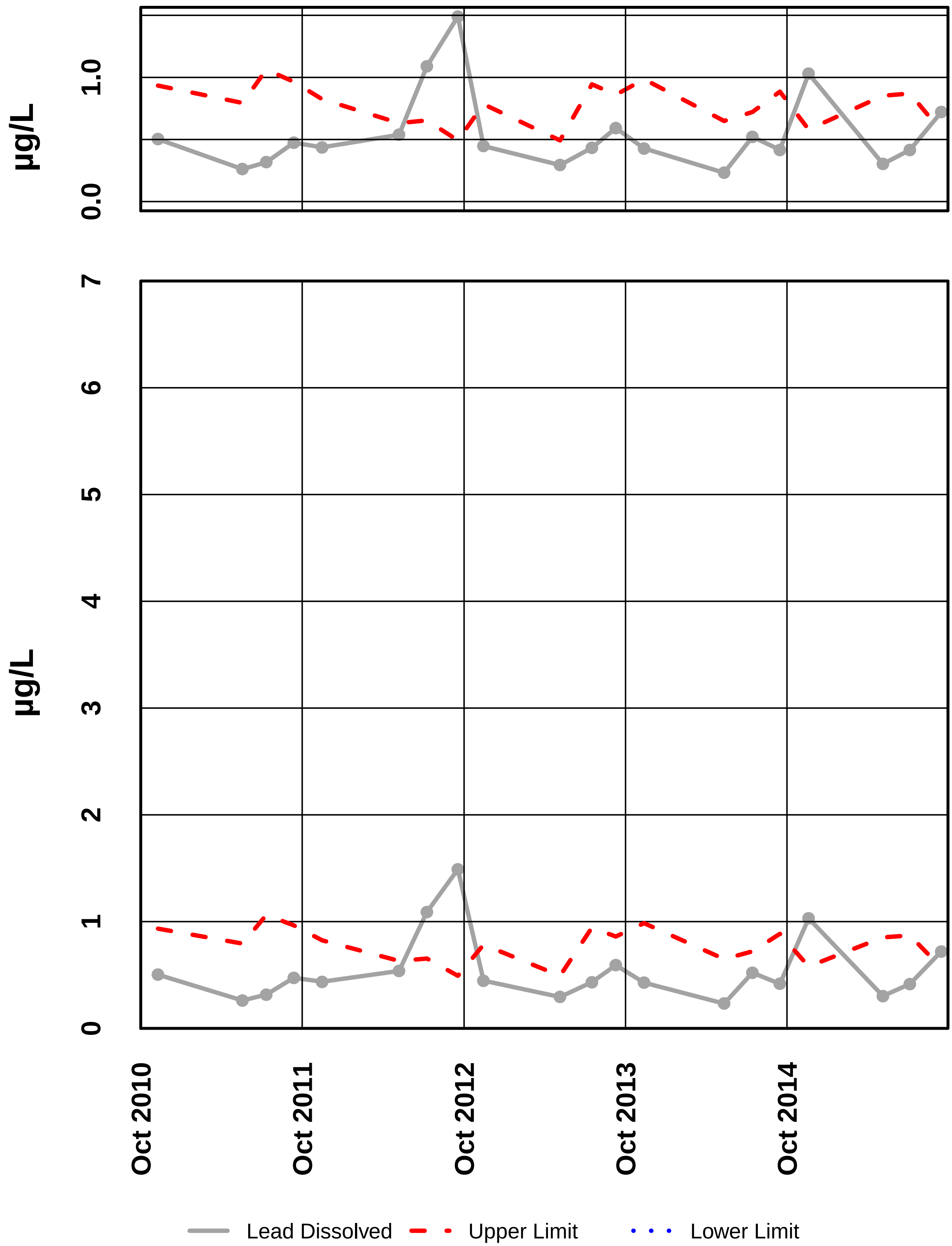
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 9 – Copper Dissolved



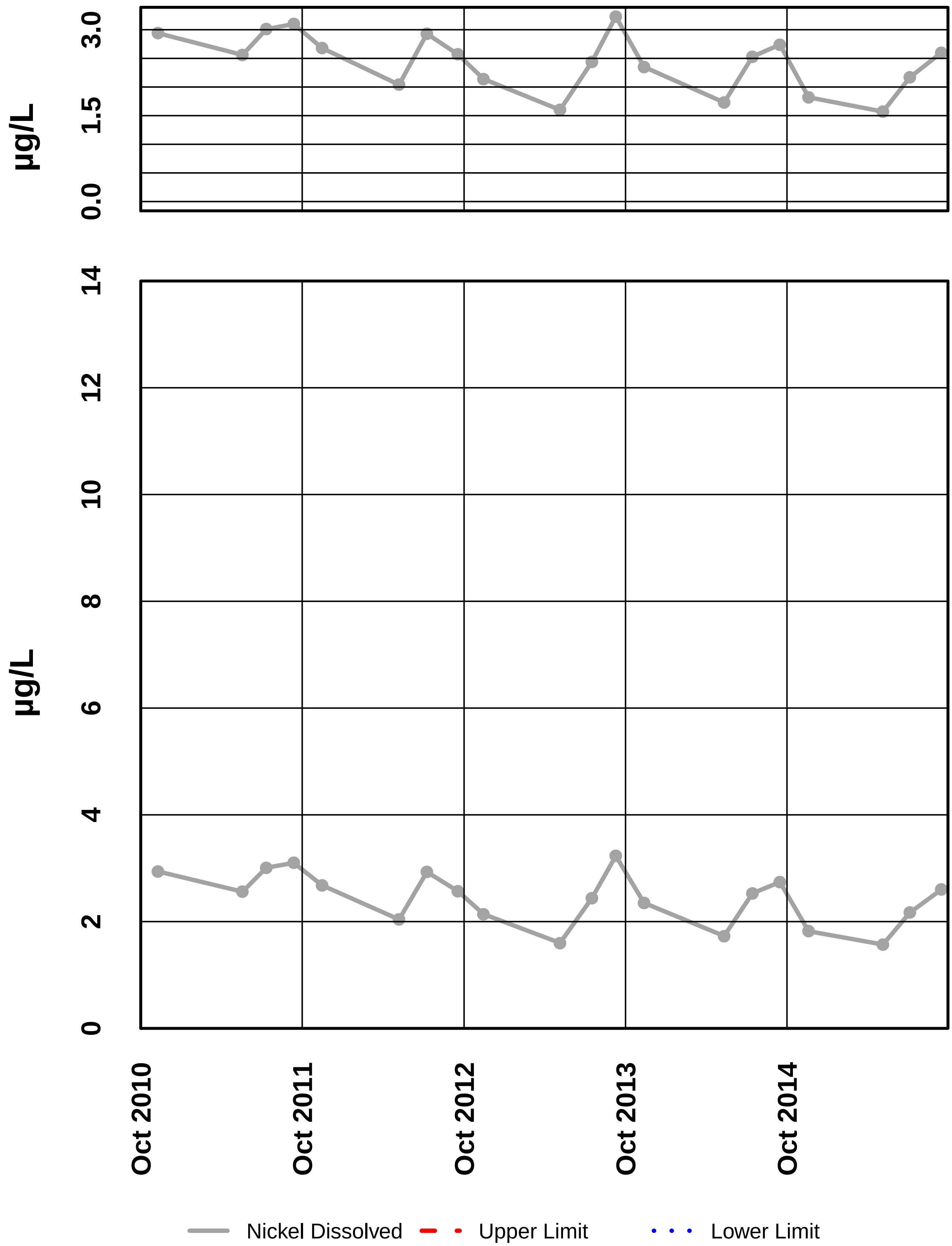
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 9 – Lead Dissolved



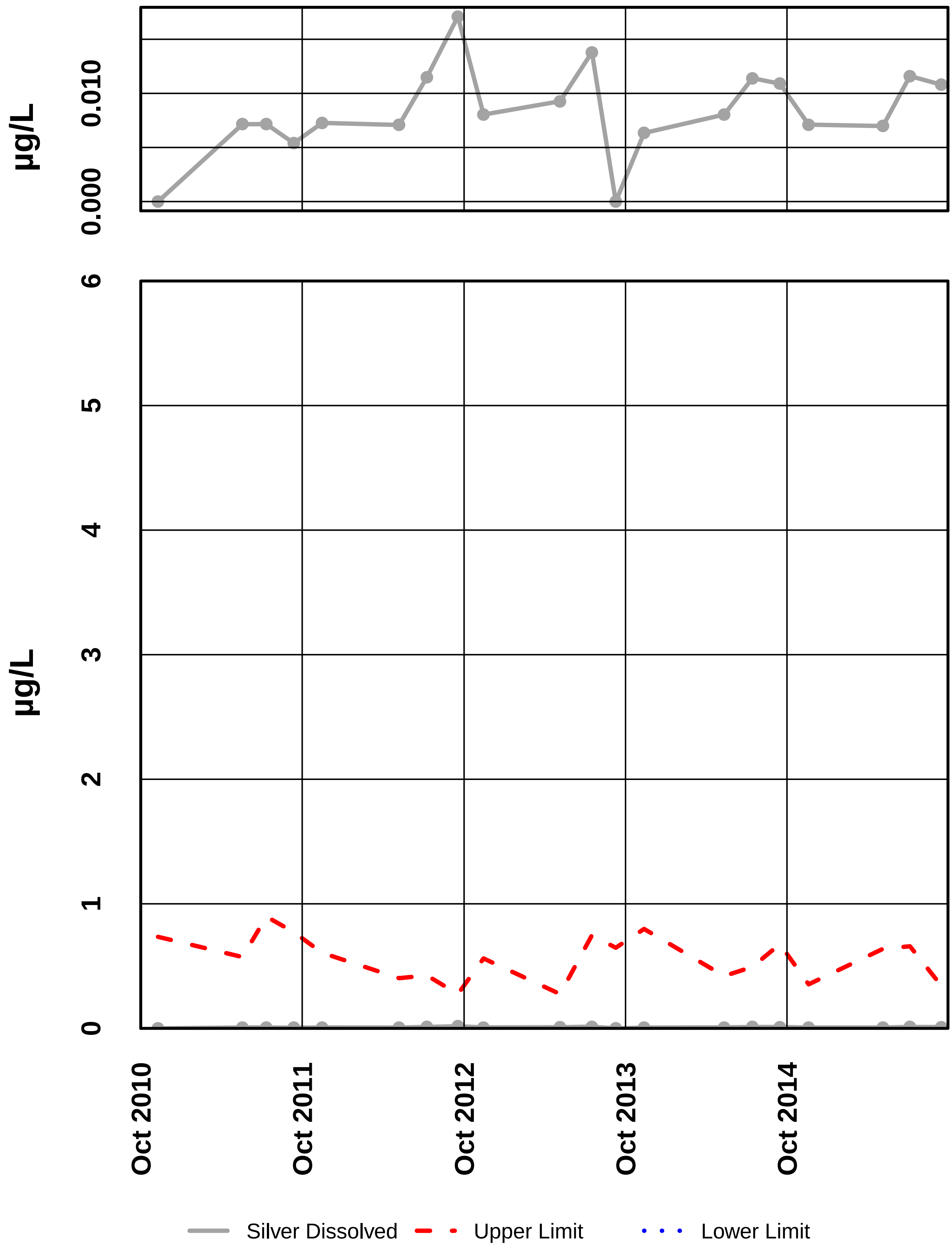
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 9 – Nickel Dissolved



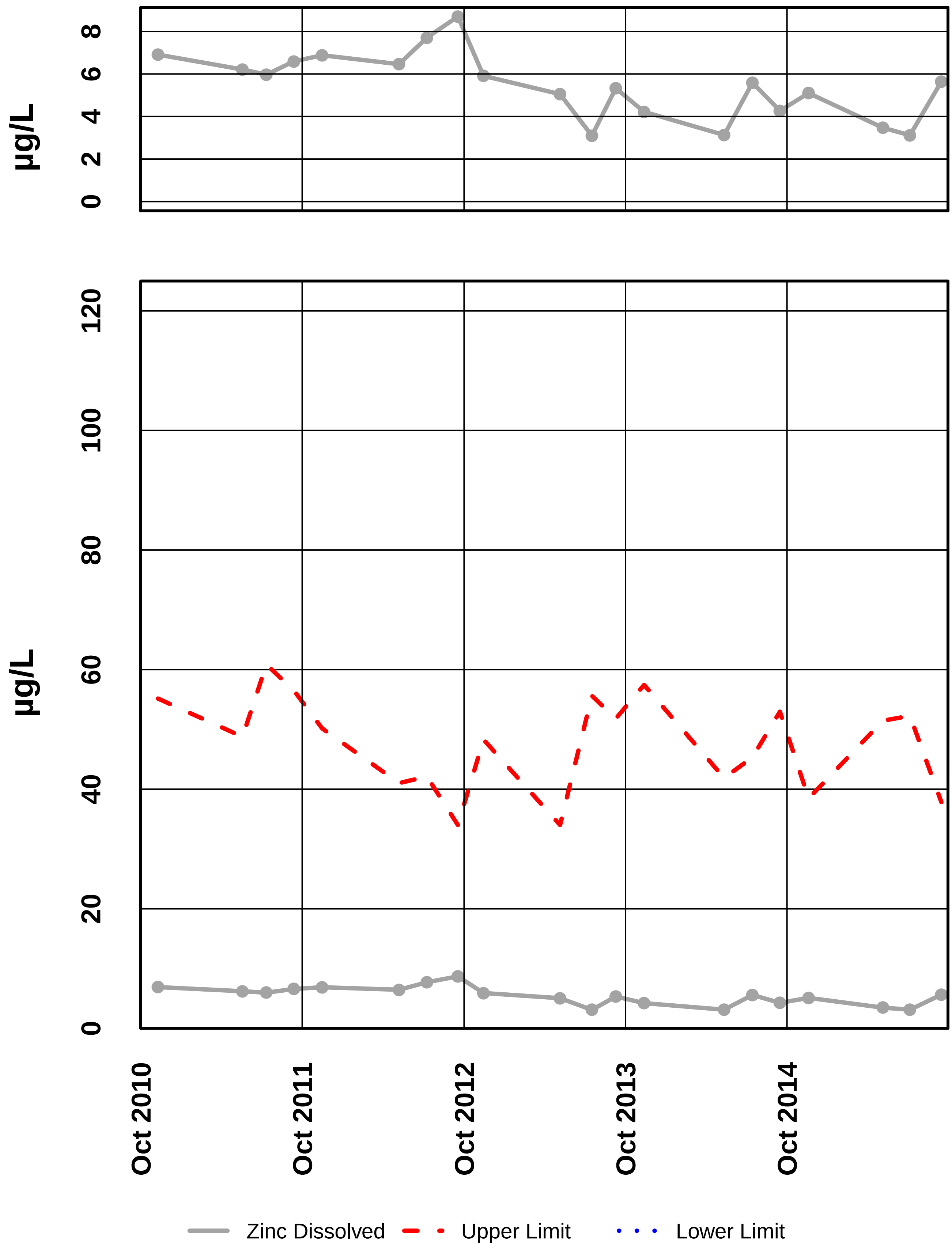
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 9 – Silver Dissolved

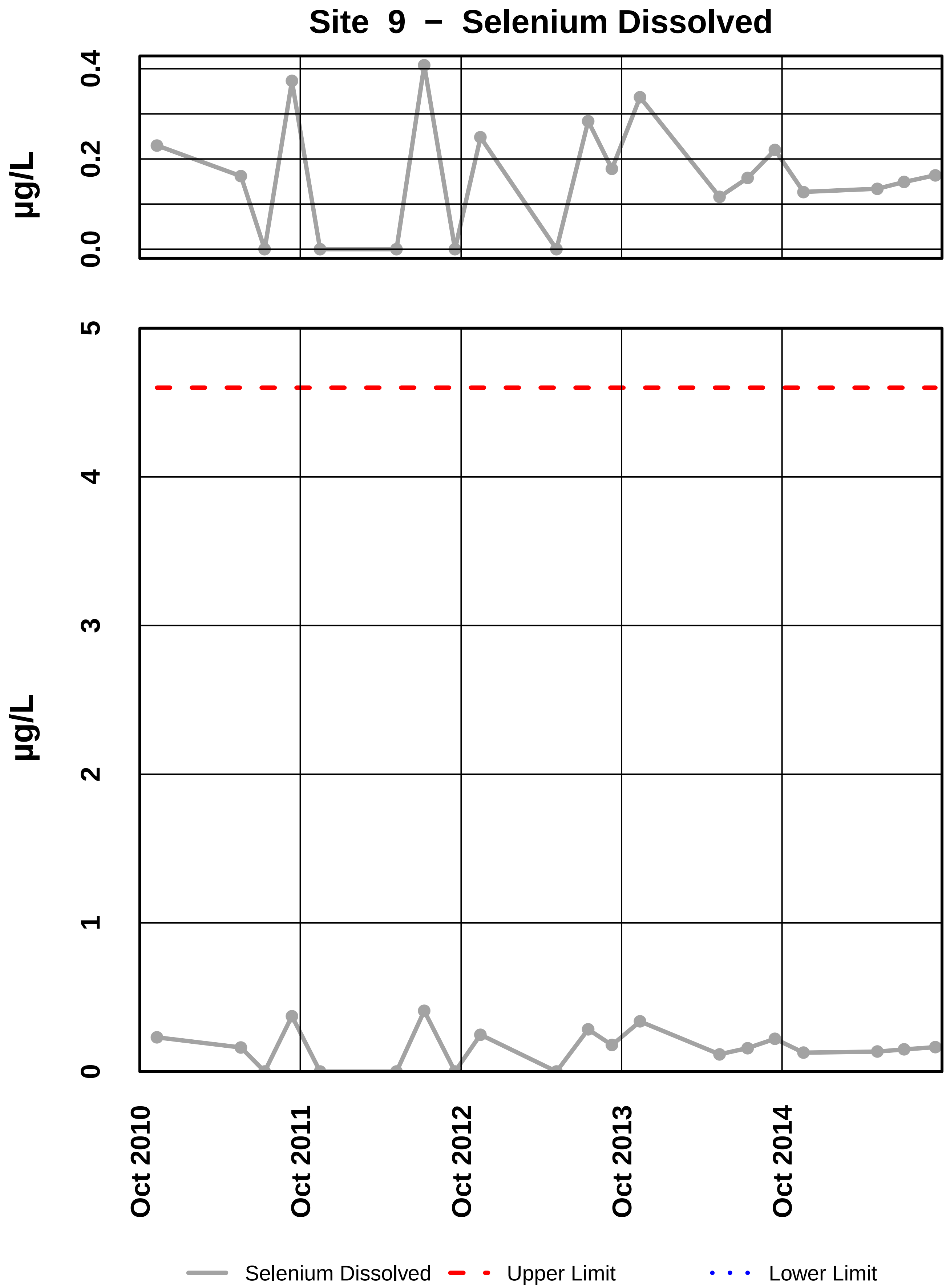


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 9 – Zinc Dissolved

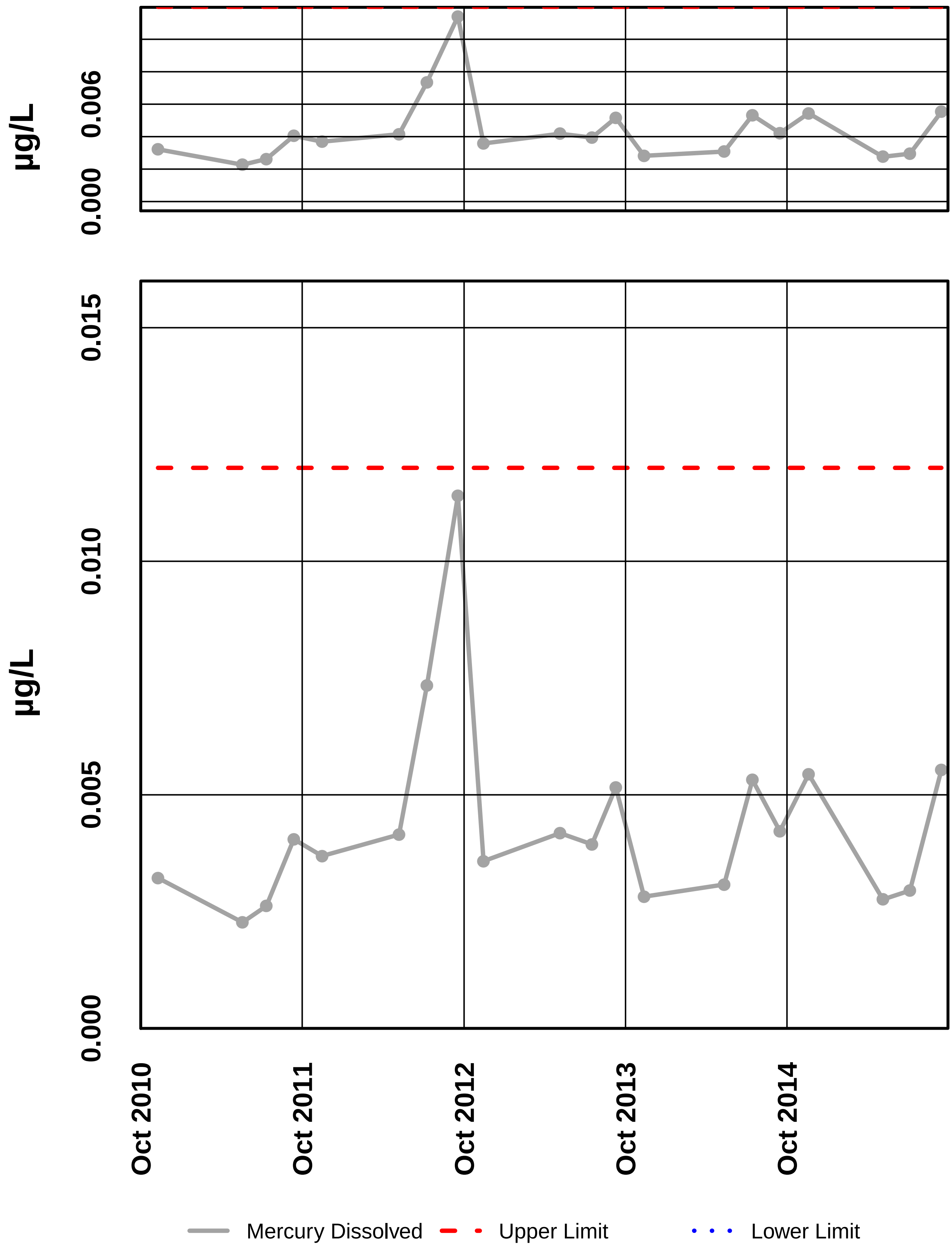


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

Site 9 – 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 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 2015" 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 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, in the past six years, have been identified by HGCMC.				

The data for Water Year 2015 have been compared to the strictest fresh water quality criterion for each applicable analyte. Nine results exceeding these criteria have been identified, as listed in the table below. Two of the exceedances were for field pH, though historical sampling for this site in 2003, prior to any disturbance that would directly impact the drainage, indicates that the natural background pH ranged from 4.1 su to 4.8 su. Also, for all four sampling events total alkalinity was in exceedance at Site 60, however these values are similar to those recorded for prior to disturbance values. The remaining three exceedances were for dissolved mercury, see discussion below.

Table of Exceedance for Water Year 2015

Sample Date	Parameter	Value	Limits Lower	Limits Upper	Hardness
19-Nov-14	Alkalinity	7.3 mg/L	20		
6-May-15	Alkalinity	7.8 mg/L	20		
6-Jul-15	Alkalinity	12.0 mg/L	20		
15-Sep-15	Alkalinity	16.7 mg/L	20		
19-Nov-14	Mercury Dissolved	0.015 µg/L		0.012	
6-May-15	Mercury Dissolved	0.013 µg/L		0.012	
6-Jul-15	Mercury Dissolved	0.012 µg/L		0.012	
19-Nov-14	pH Field	5.8 su	6.5	8.5	
6-Jul-15	pH Field	6.3 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. Site 60 was added to the FWMP as a monitoring point for potential impacts from Pond 7. There appears to be no obvious visual trends.

Dissolved mercury levels have been elevated slightly above the AWQS of 0.012 µg/L, intermittently for the past few years. Following construction of Pond 7, the alkalinity and pH at Site 60 increased, likely as a result of fill material that was placed in the drainage area during pond construction. HGCMC believes that the increase in pH and alkalinity increases the potential for adsorption of mercury on sediments and soil particles in the drainage. The pH of the Site 60 drainage now fluctuates seasonally and from year to year and may control the storage and release of mercury from the adsorbed fraction. Dissolution of tailings dust particles, which contain small amounts of mercury, and atmospheric deposition of mercury from natural (e.g. volcanoes) and anthropogenic sources (e.g. coal fired power plants in Asia) are potential sources of this metal in the drainage area. Additional sampling in adjacent drainages during water year 2009 and Water Year 2012 showed that this issue was isolated to only the Site 60 watershed.

A non-parametric statistical analysis for trend was performed for specific conductivity, field pH, total alkalinity, total sulfate, and dissolved zinc. Calculation details of the Seasonal Kendall analyses are presented in detail on the pages following this interpretive section. The following table summarizes the results on the data collected between Oct-09 and Sep-15 (WY2010-WY2015). 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	0.30			
pH Field	6	0.30			
Alkalinity, Total	6	0.10			
Sulfate, Total	6	0.01	+	0.67	
Zinc, Dissolved	6	0.07			

* Number of Years ** Significance level

There was one statistically significant ($\alpha/2=2.5\%$) trend identified for the current water year, associated with an increasing trend in total sulfate with a Sen's slope estimate of 0.67 mg/L/yr. The current sulfate values are approximately 4% 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 2015

Site 060FMS - 'Lower Althea creek'

Sample Date/Parameter	Oct 2014	Nov 2014	Dec 2014	Jan 2015	Feb 2015	Mar 2015	Apr 2015	May 2015	Jun 2015	Jul 2015	Aug 2015	Sep 2015	**Median**
Water Temp (°C)		4.1						5.6		11.7		9.9	7.8
Conductivity-Field(μmho)		38.2						38.2		51.4		67.7	44.8
Conductivity-Lab (μmho)		38						40		46		68	43
pH Lab (standard units)		6.1						5.76		6.63		6.71	6.37
pH Field (standard units)		5.77						6.53		6.25		6.77	6.39
Total Alkalinity (mg/L)		7.3						7.8		12		16.7	9.9
Total Sulfate (mg/L)		2						3.1		6		12.1	4.6
Hardness (mg/L)		18.9						19.9		23.7		39.4	21.8
Dissolved As (ug/L)		2.3						1.79		1.86		2.52	2.080
Dissolved Ba (ug/L)		21						19.8		25		34.9	23.0
Dissolved Cd (ug/L)		0.0173						0.0148		0.017		0.0187	0.0172
Dissolved Cr (ug/L)		1.06						1.62		1.74		1.13	1.375
Dissolved Cu (ug/L)		1.06						1.01		1.07		1	1.035
Dissolved Pb (ug/L)		0.348						0.255		0.361		0.31	0.3290
Dissolved Ni (ug/L)		1.14						1.05		1.26		1.34	1.200
Dissolved Ag (ug/L)		0.01						0.01		0.009		0.01	0.010
Dissolved Zn (ug/L)		8.43						5.22		6.08		6.12	6.10
Dissolved Se (ug/L)		0.144						0.134		0.13		0.21	0.139
Dissolved Hg (ug/L)		0.0148						0.0129		0.0123		0.0114	0.012600

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.

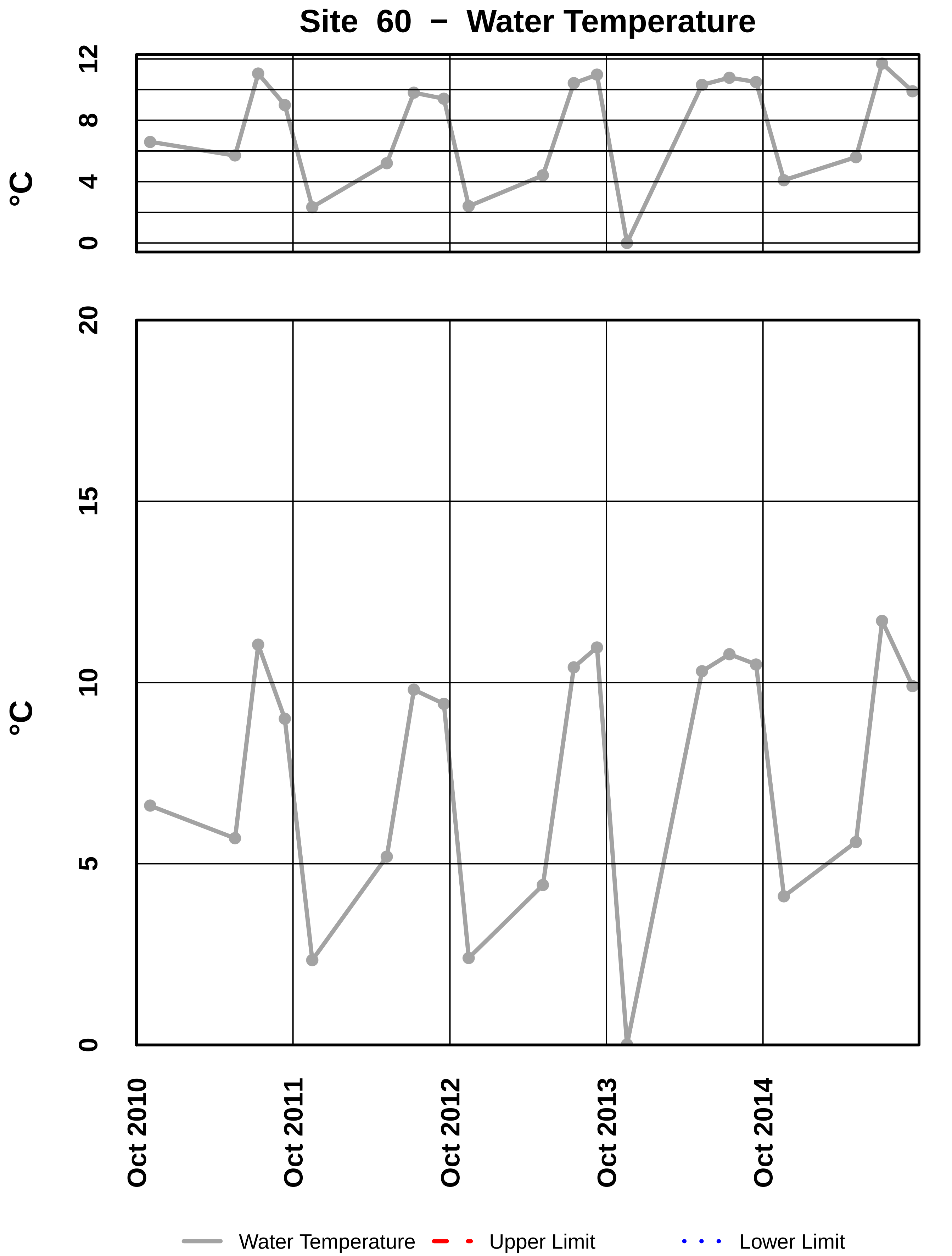
Shaded data has been qualified as an outlier by HGCMC and removed from any further analysis and is not included into the calculation of the median

Qualified Data by QA Reviewer

Date Range: 10/01/2014 to 09/30/2015

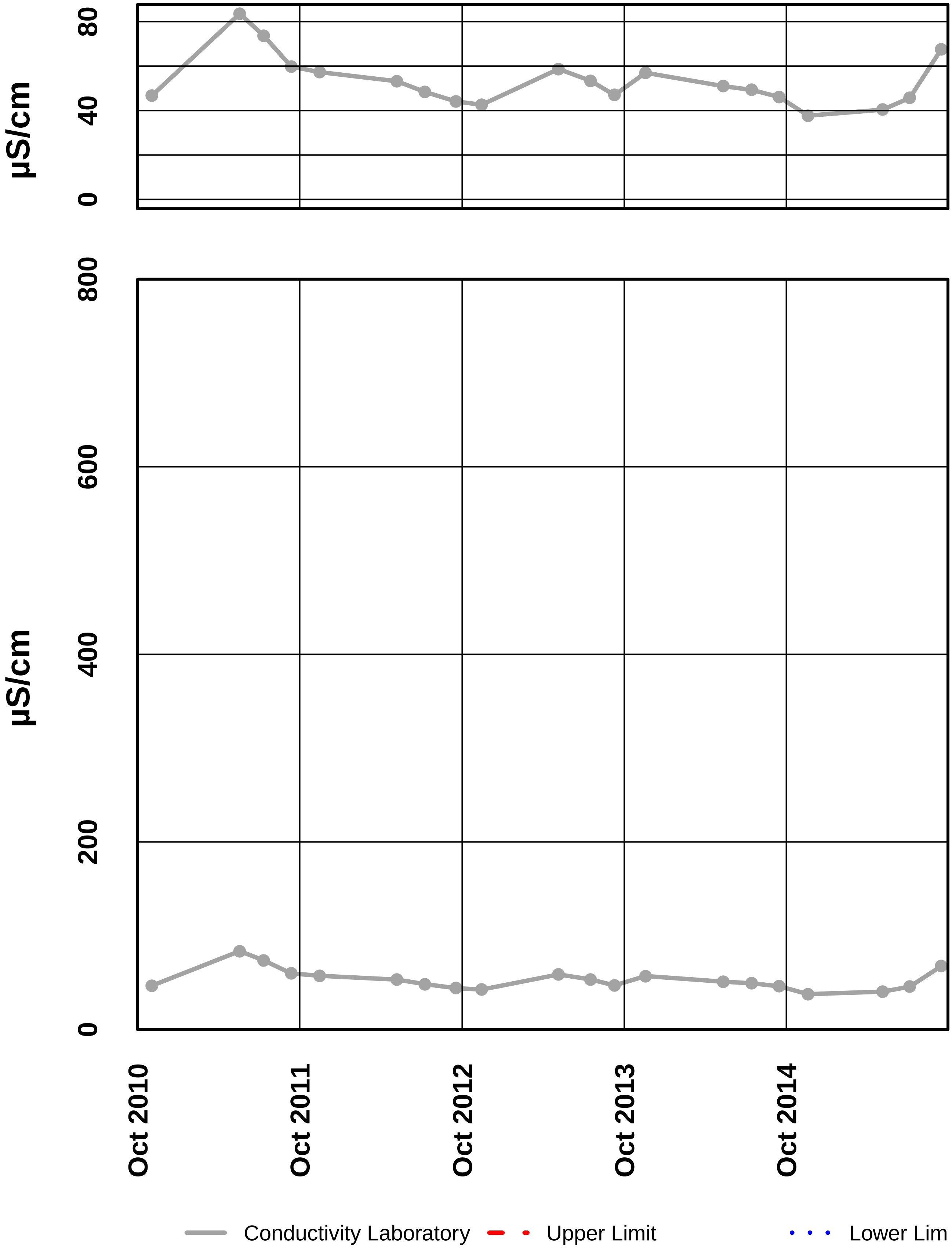
Site No.	Sample Date	Sample Time	Parameter	Value		Qualifier	Reason for Qualifier
060FMS	11/19/2014	12:00 AM	Diss. Se-ICP/MS	0.14	µg/L	J	Below Quantitative Range
			pH	6.1	pH units	J	Hold Time Violation
			Sulfate	1.95	mg/L	J	Below Quantitative Range
060FMS	05/06/2015	12:00 AM	Diss. Se-ICP/MS	0.13	µg/L	J	Below Quantitative Range
060FMS	07/06/2015	12:00 AM	Diss. Ag-ICP/MS	0.00948	µg/L	J	Below Quantitative Range
			Diss. Se-ICP/MS	0.13	µg/L	J	Below Quantitative Range
060FMS	09/15/2015	12:00 AM	Diss. Se-ICP/MS	0.21	µg/L	J	Below Quantitative Range

Qualifier	Description
J	Positively Identified - Approximate Concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit



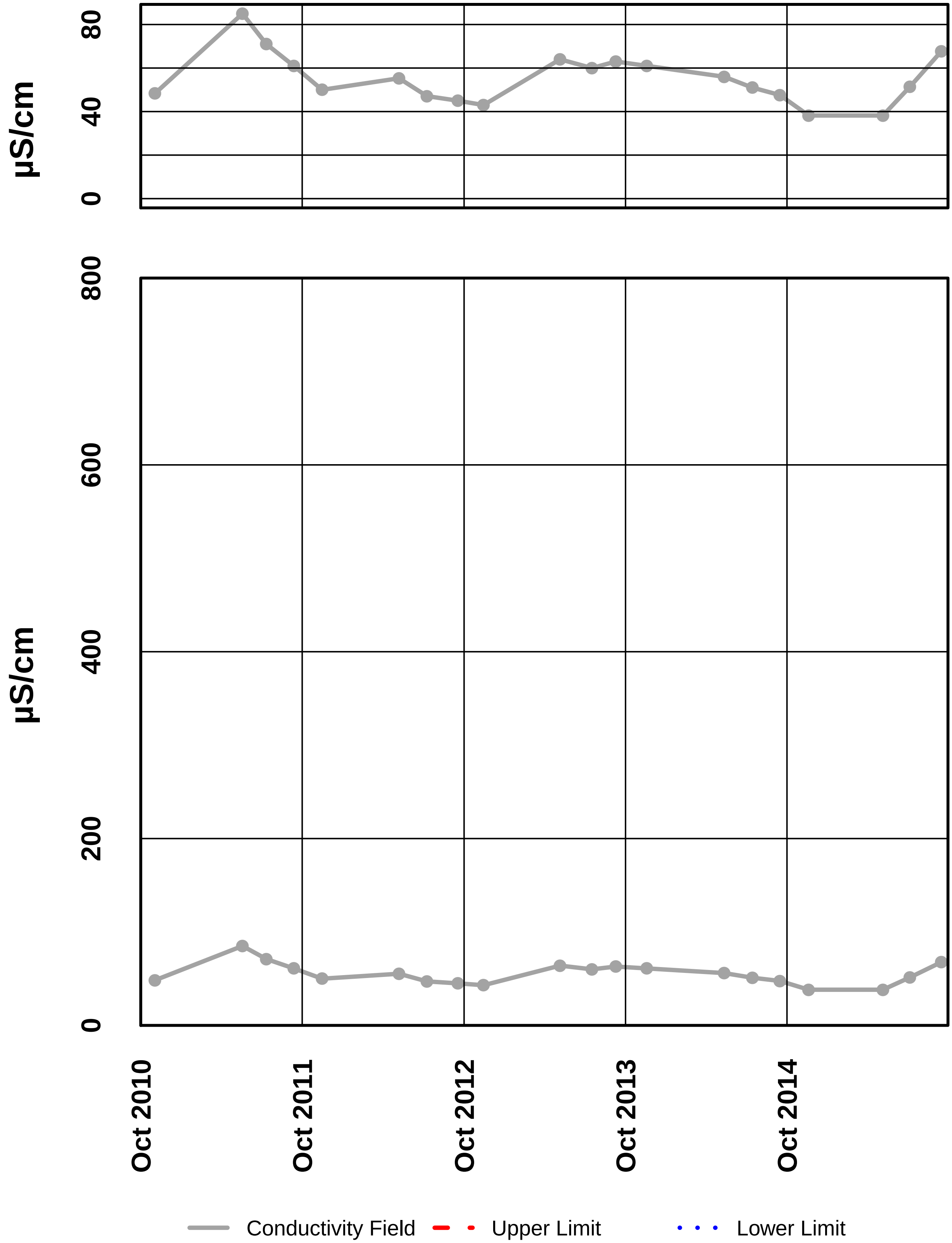
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 60 − Conductivity Laboratory



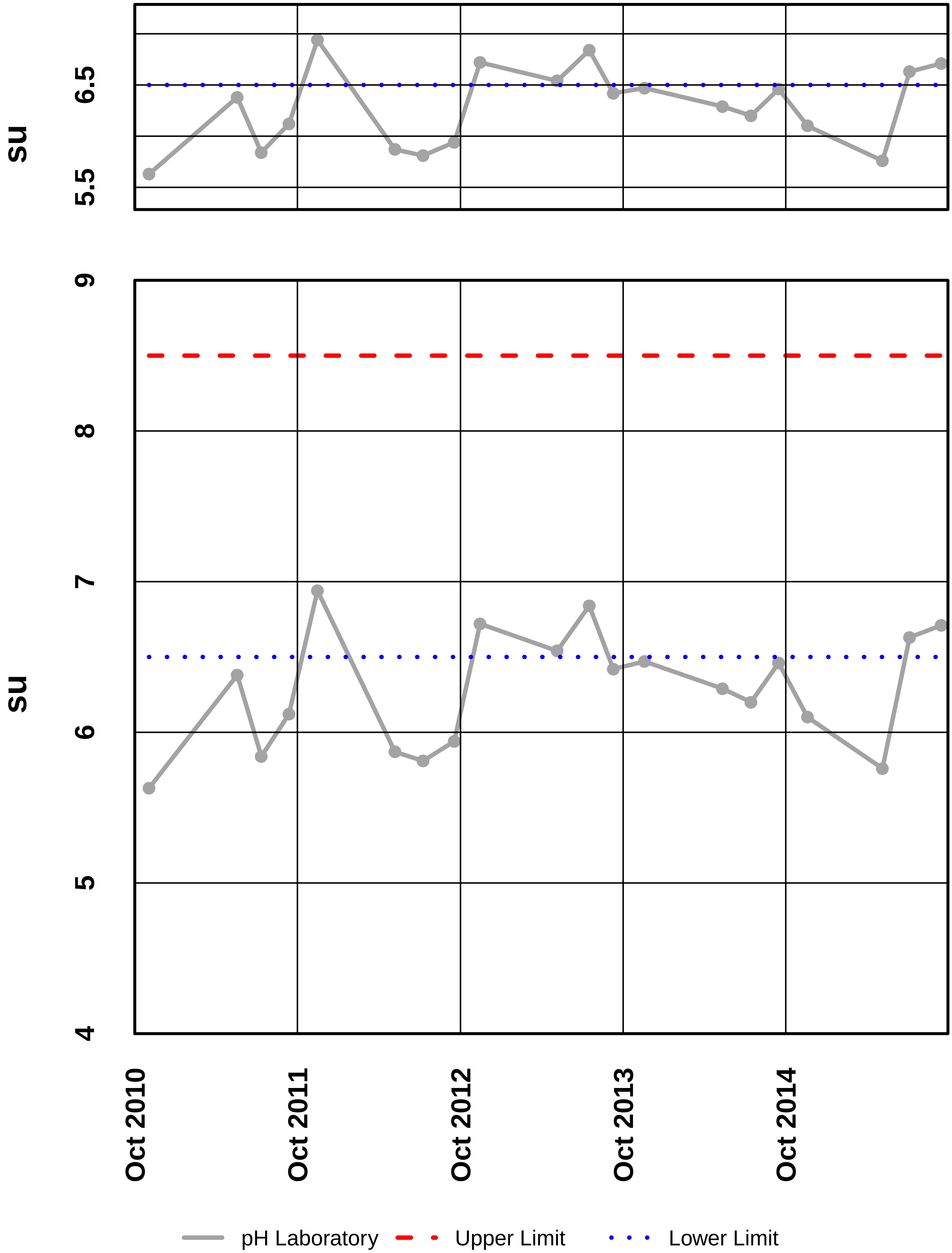
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 60 – Conductivity Field

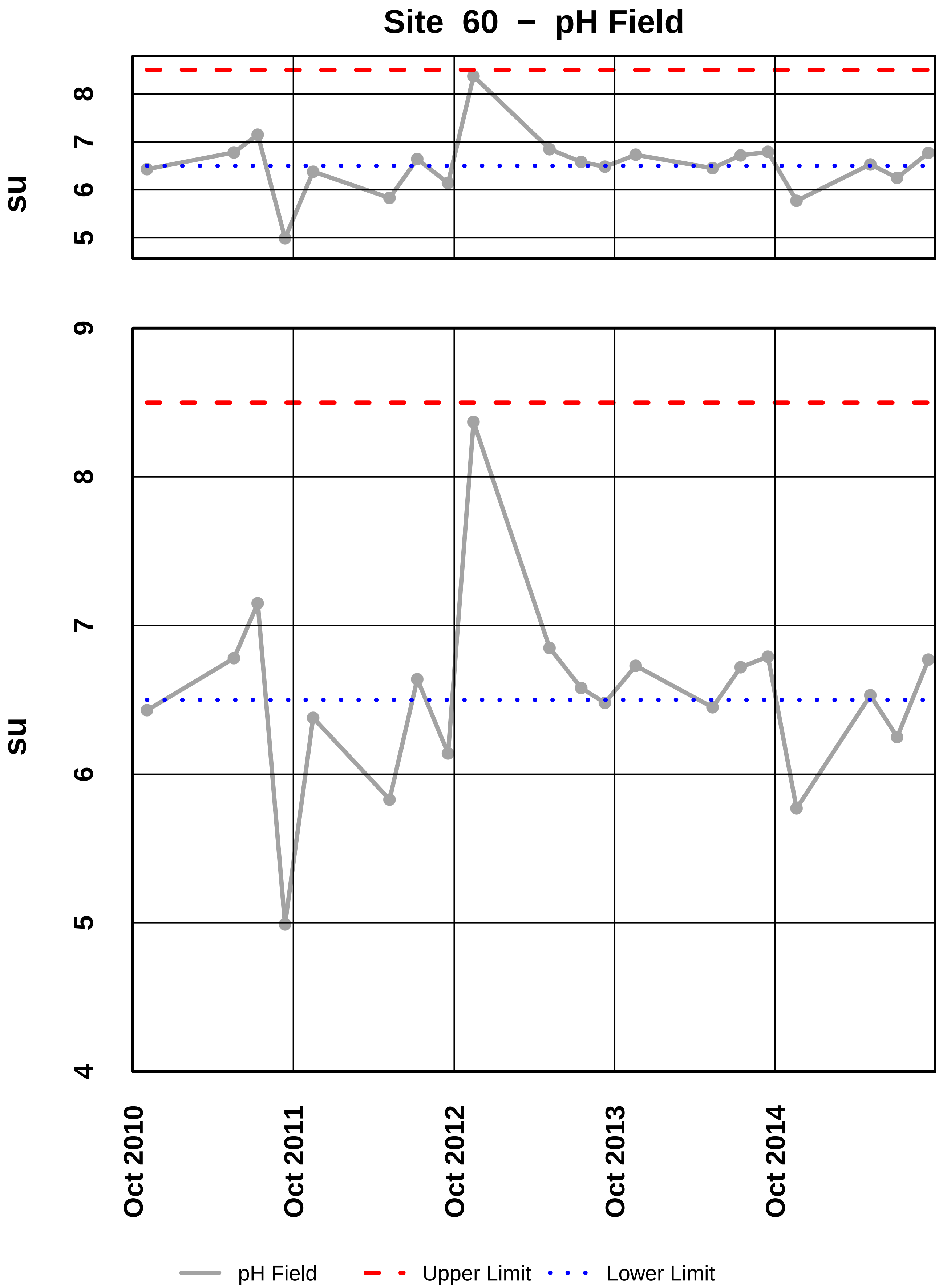


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

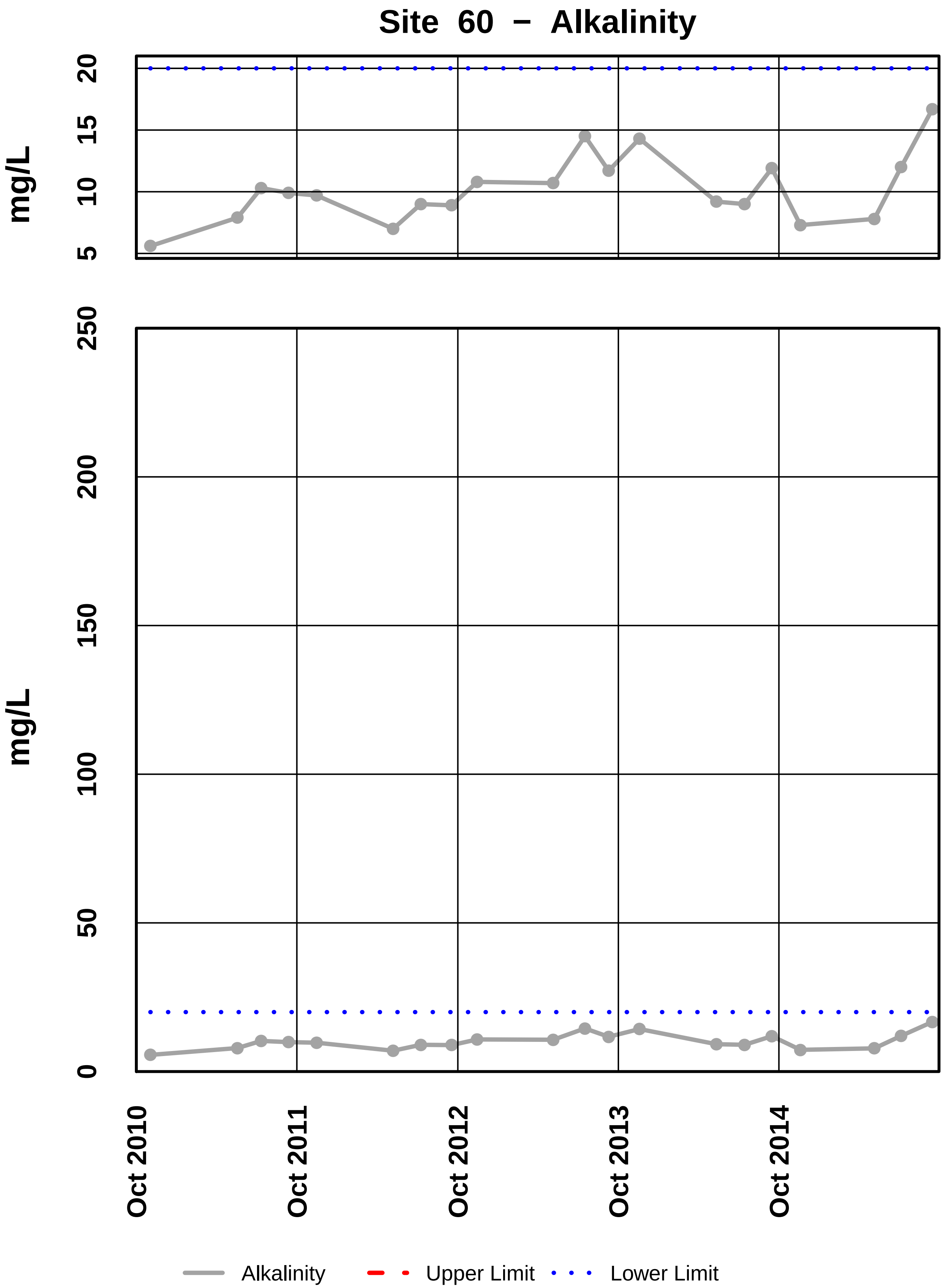
Site 60 − pH Laboratory



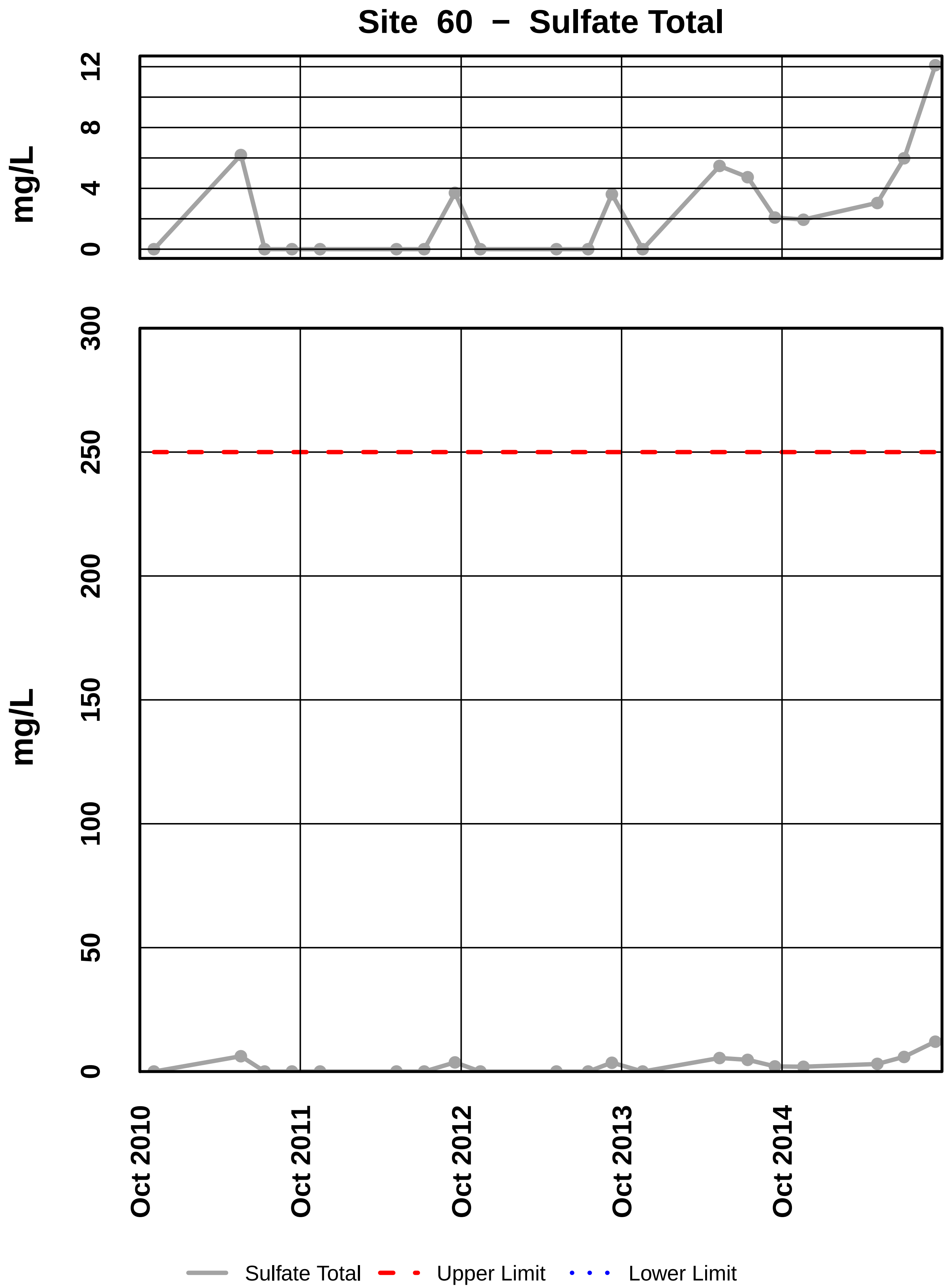
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



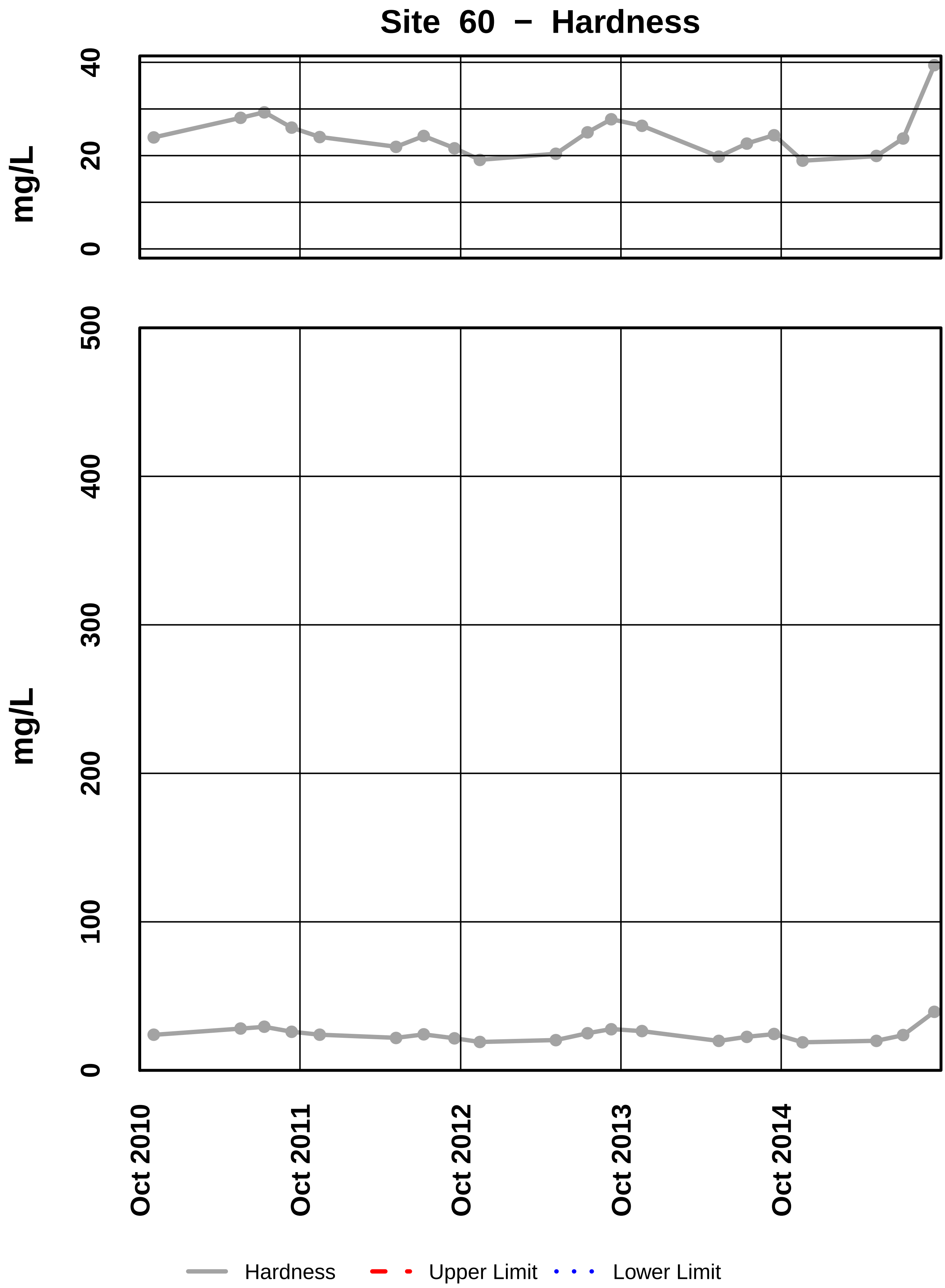
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

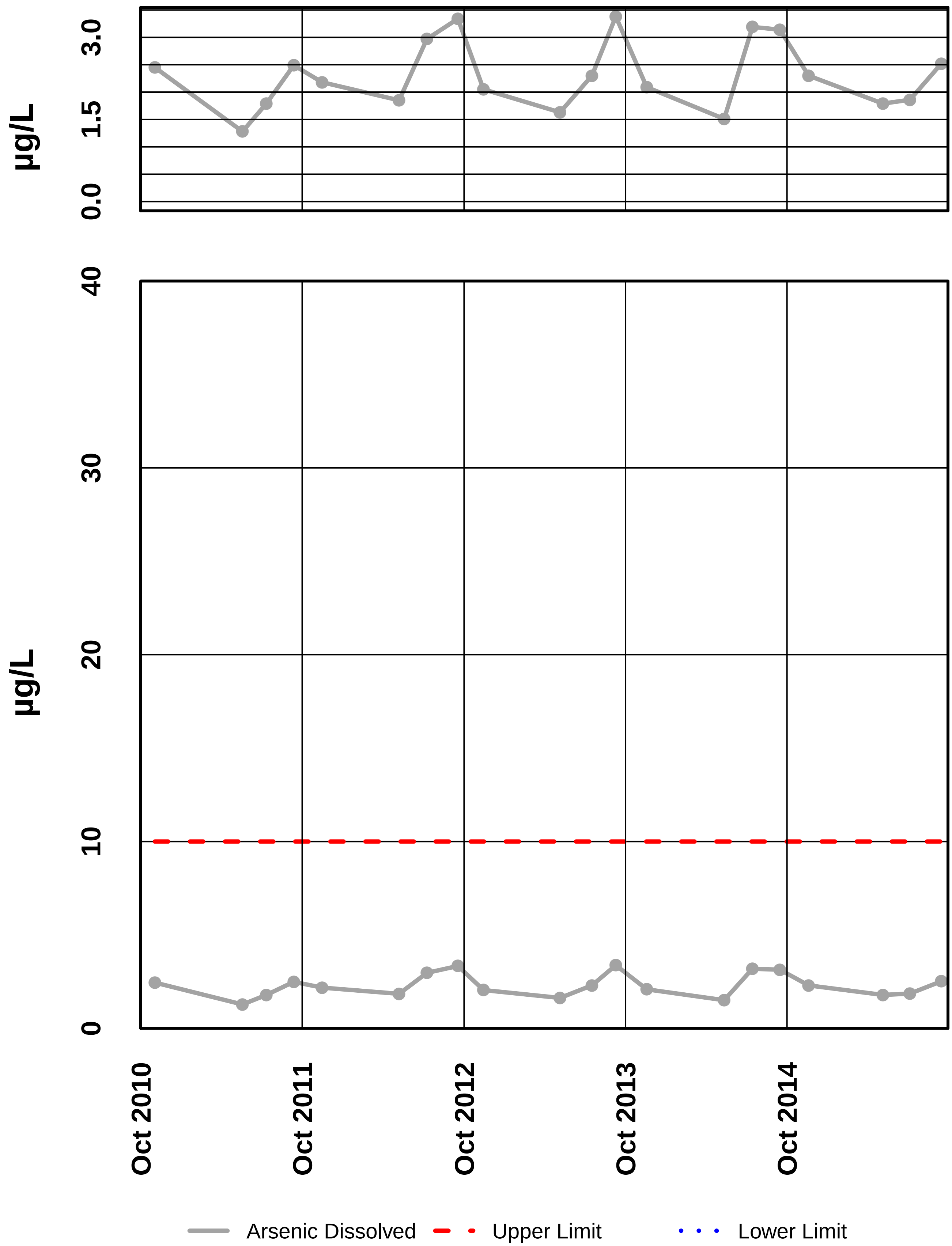


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



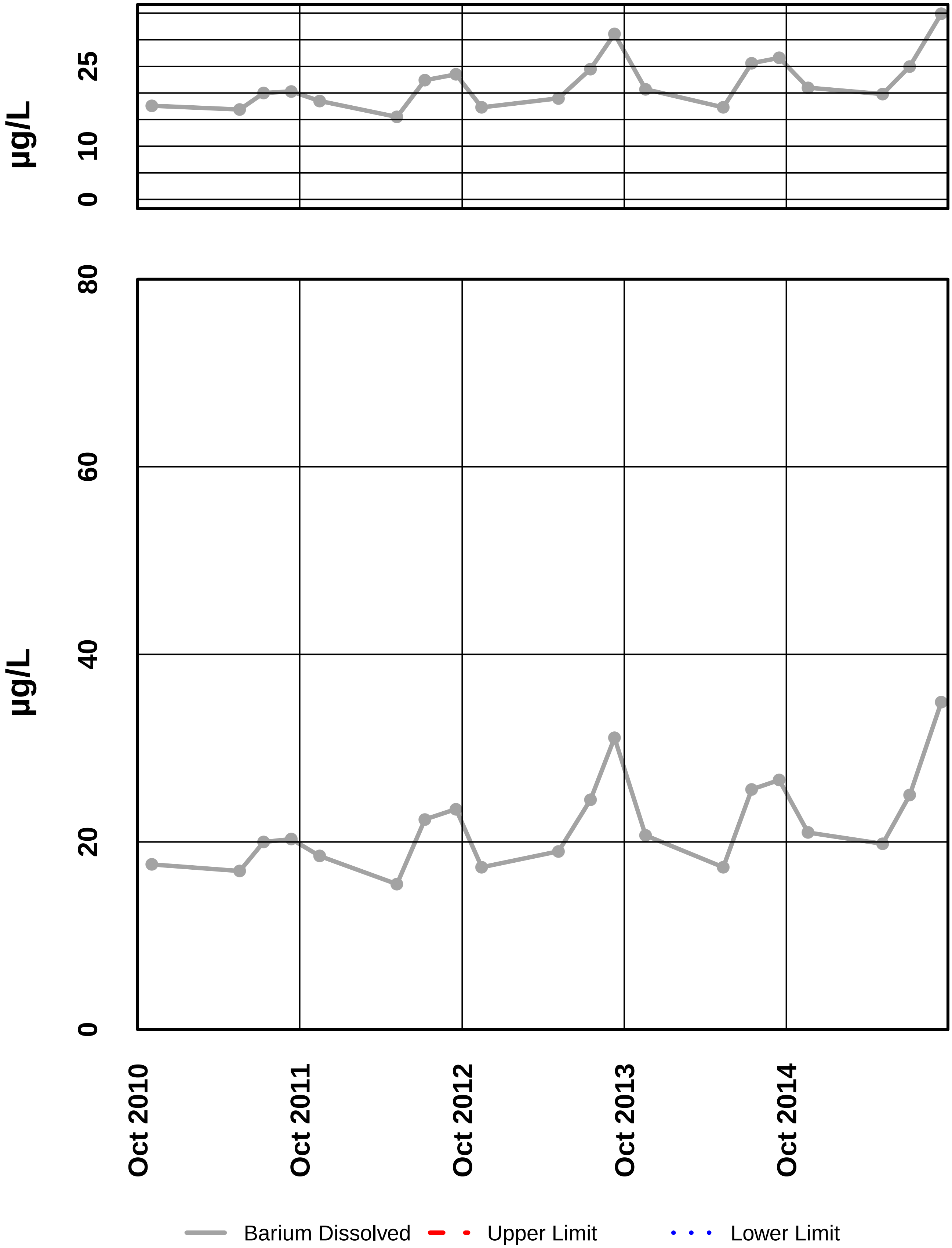
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 60 – Arsenic Dissolved

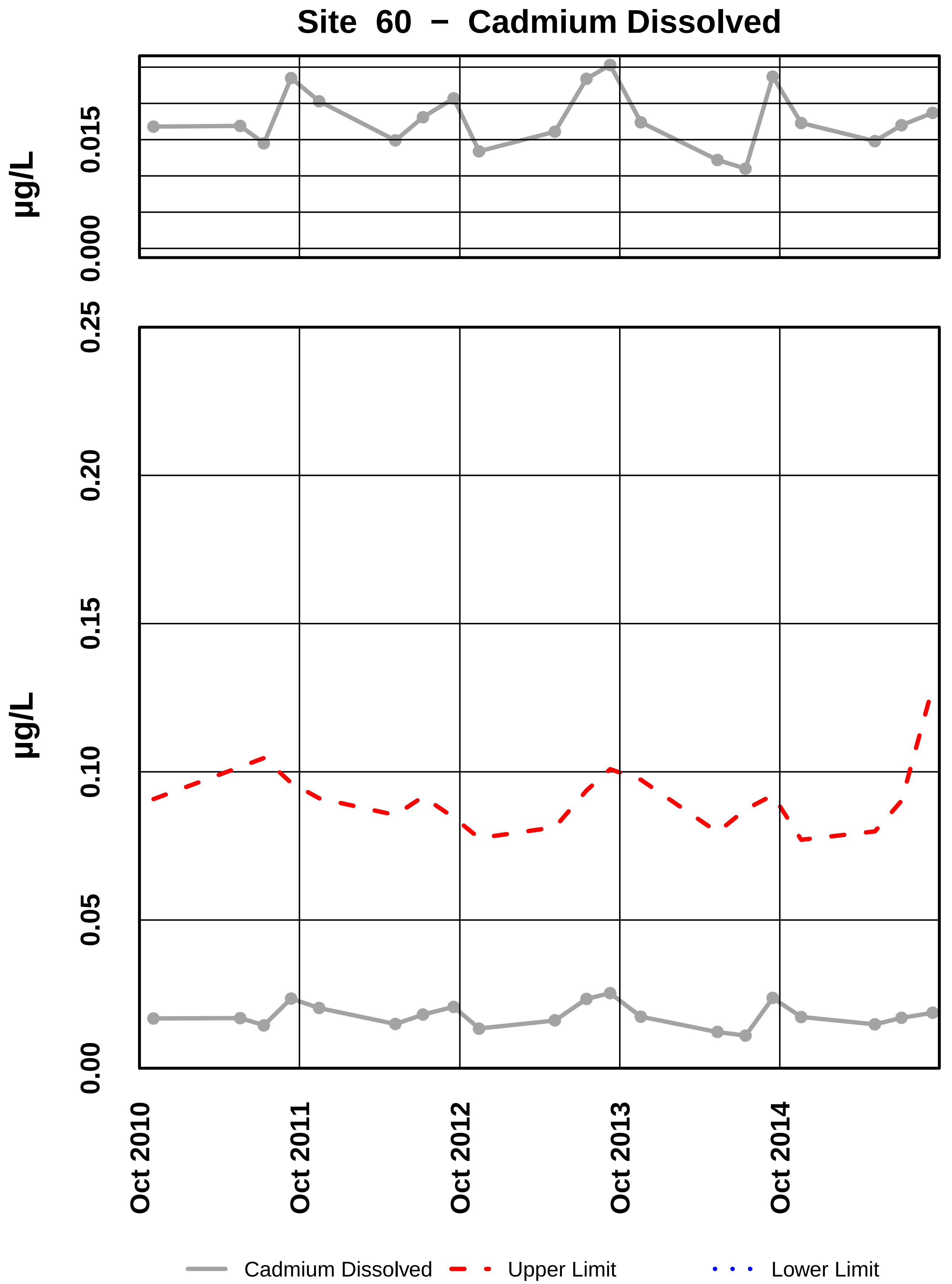


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

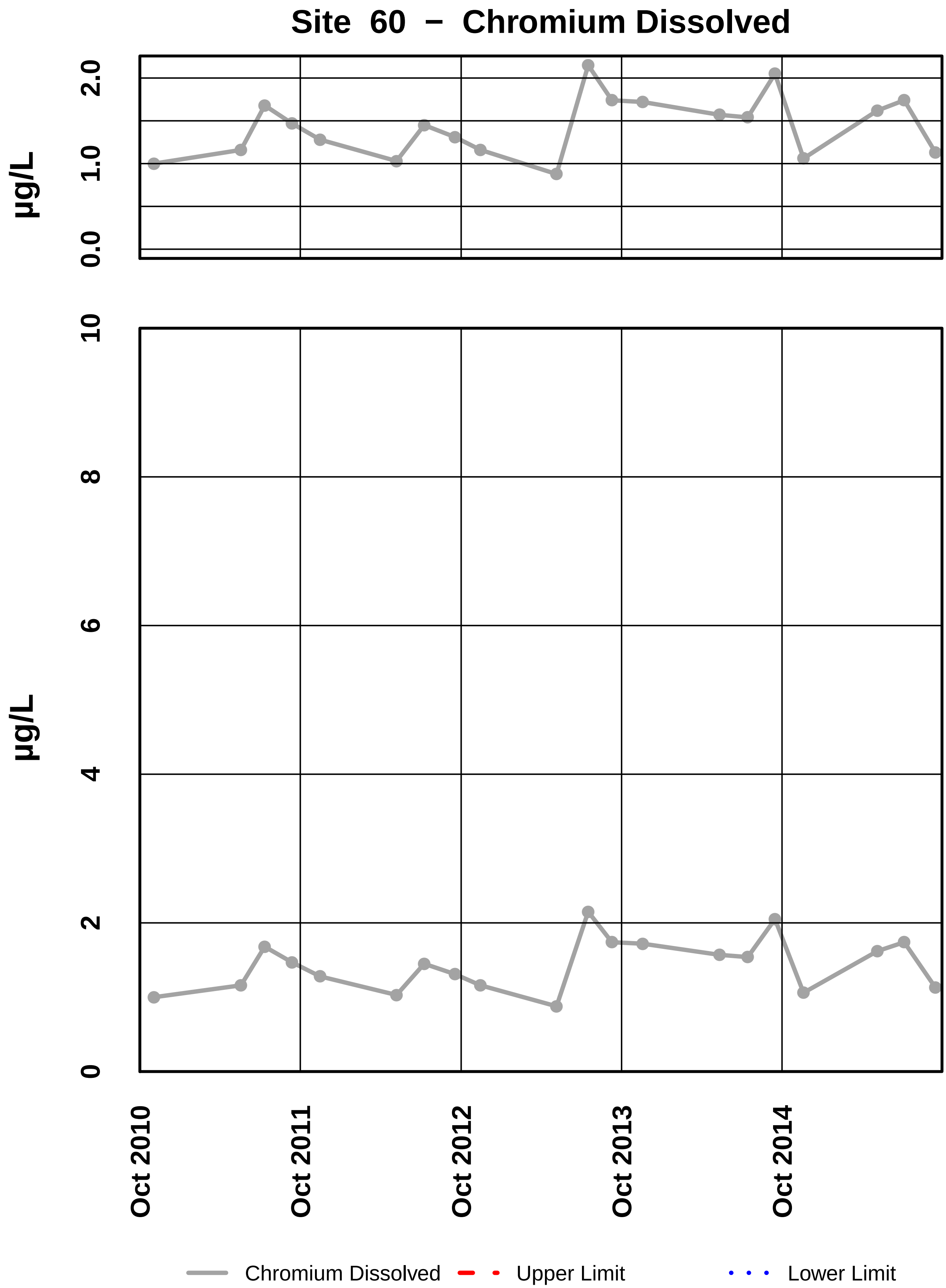
Site 60 − Barium Dissolved



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

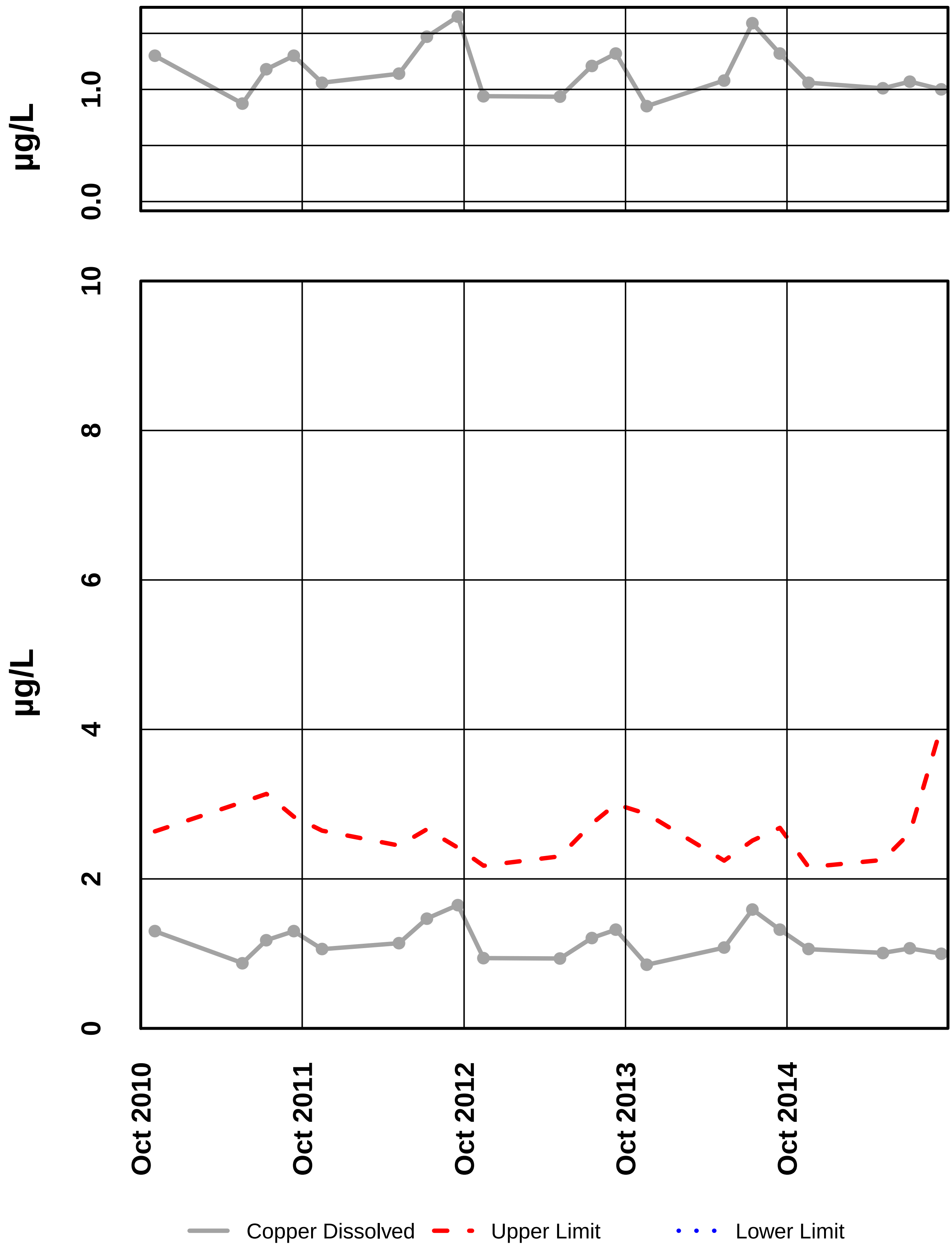


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



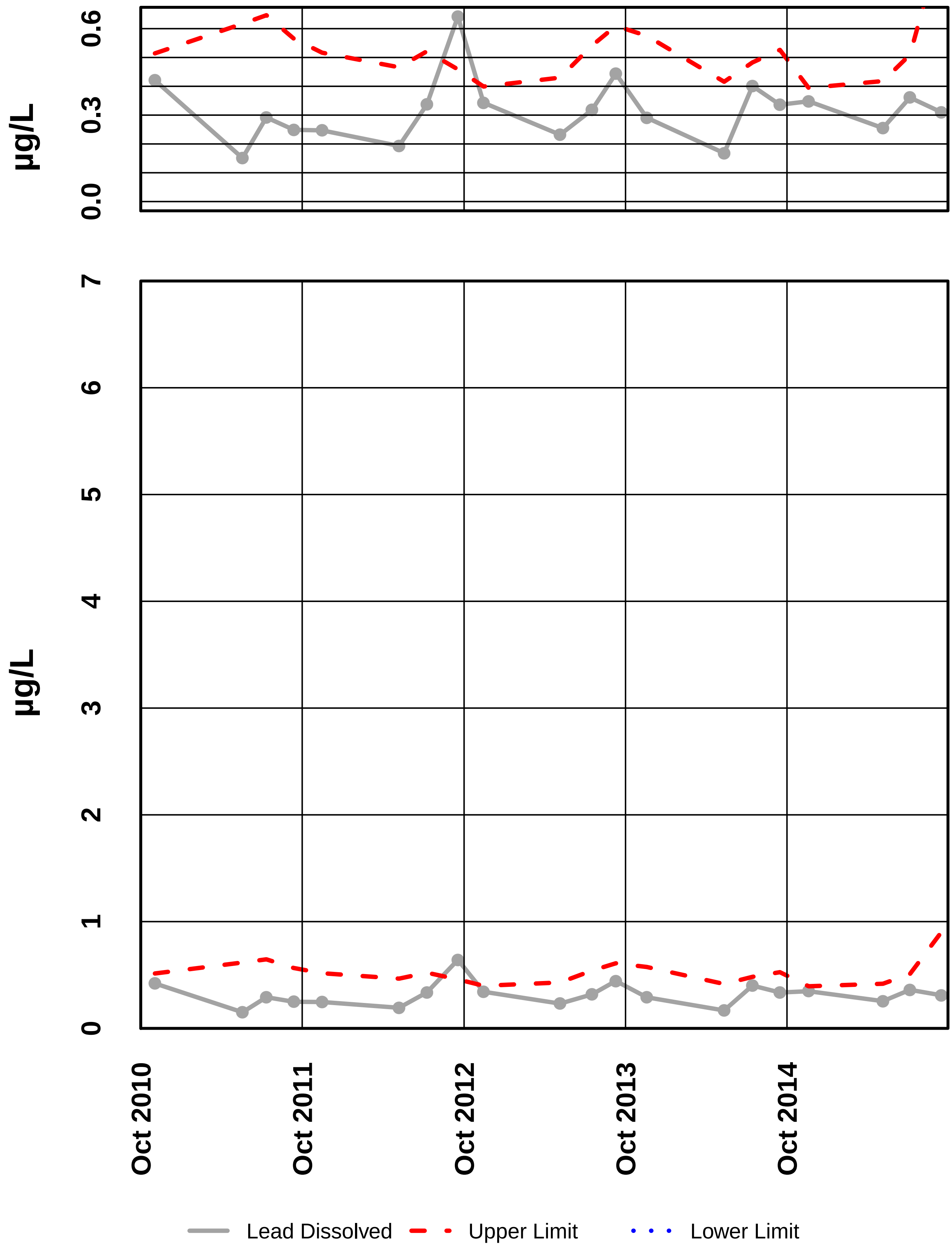
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 60 – Copper Dissolved



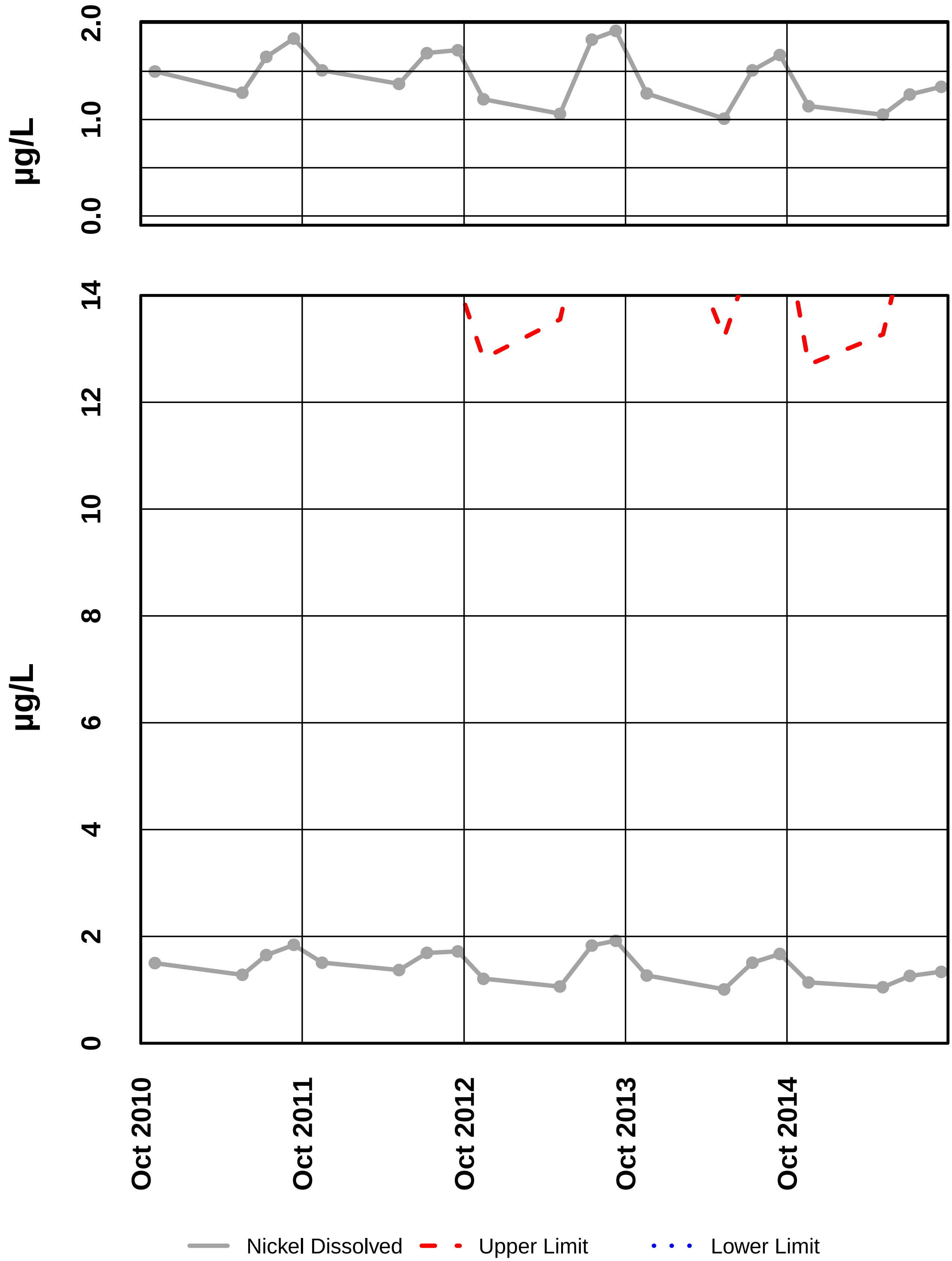
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 60 − Lead Dissolved



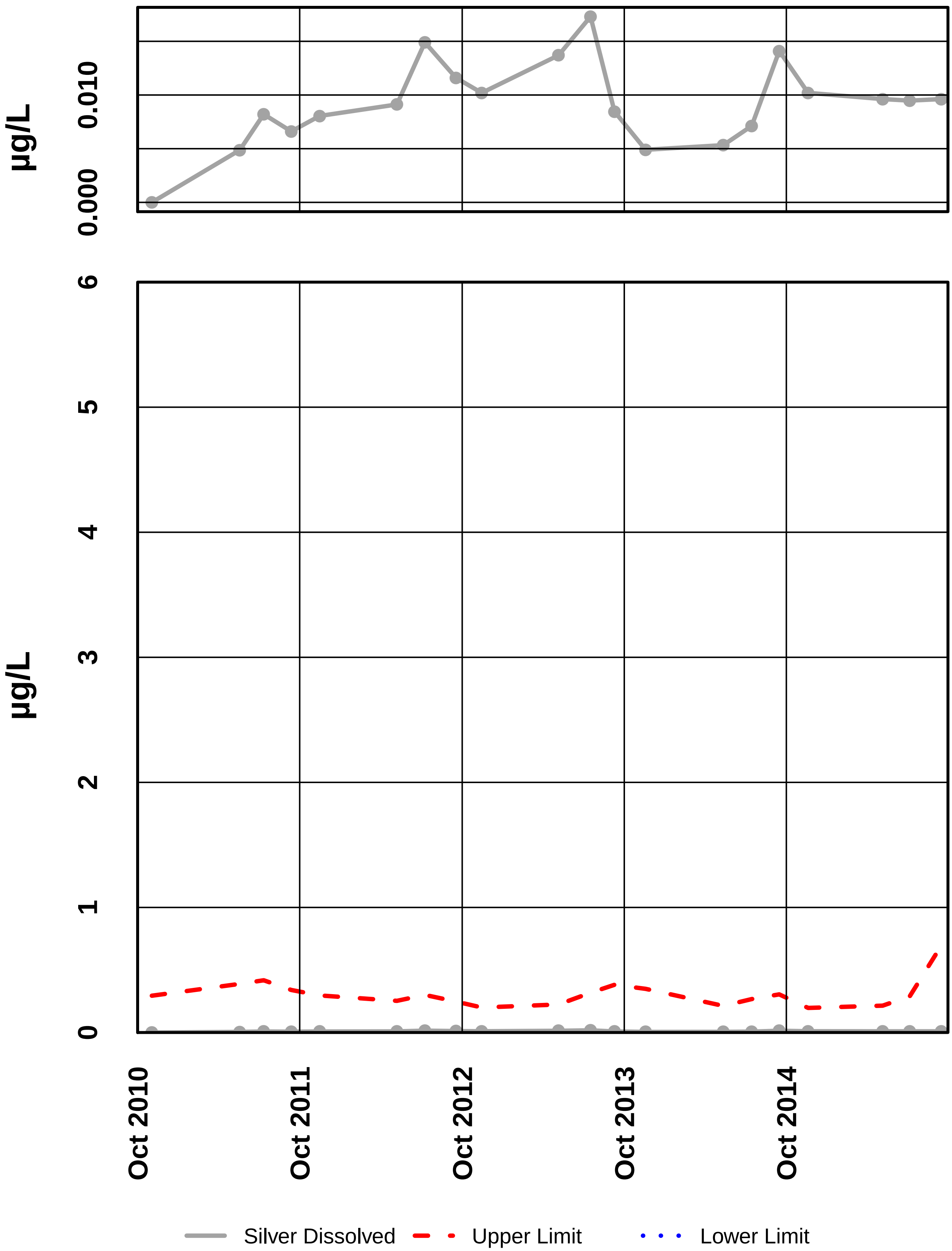
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 60 – Nickel Dissolved

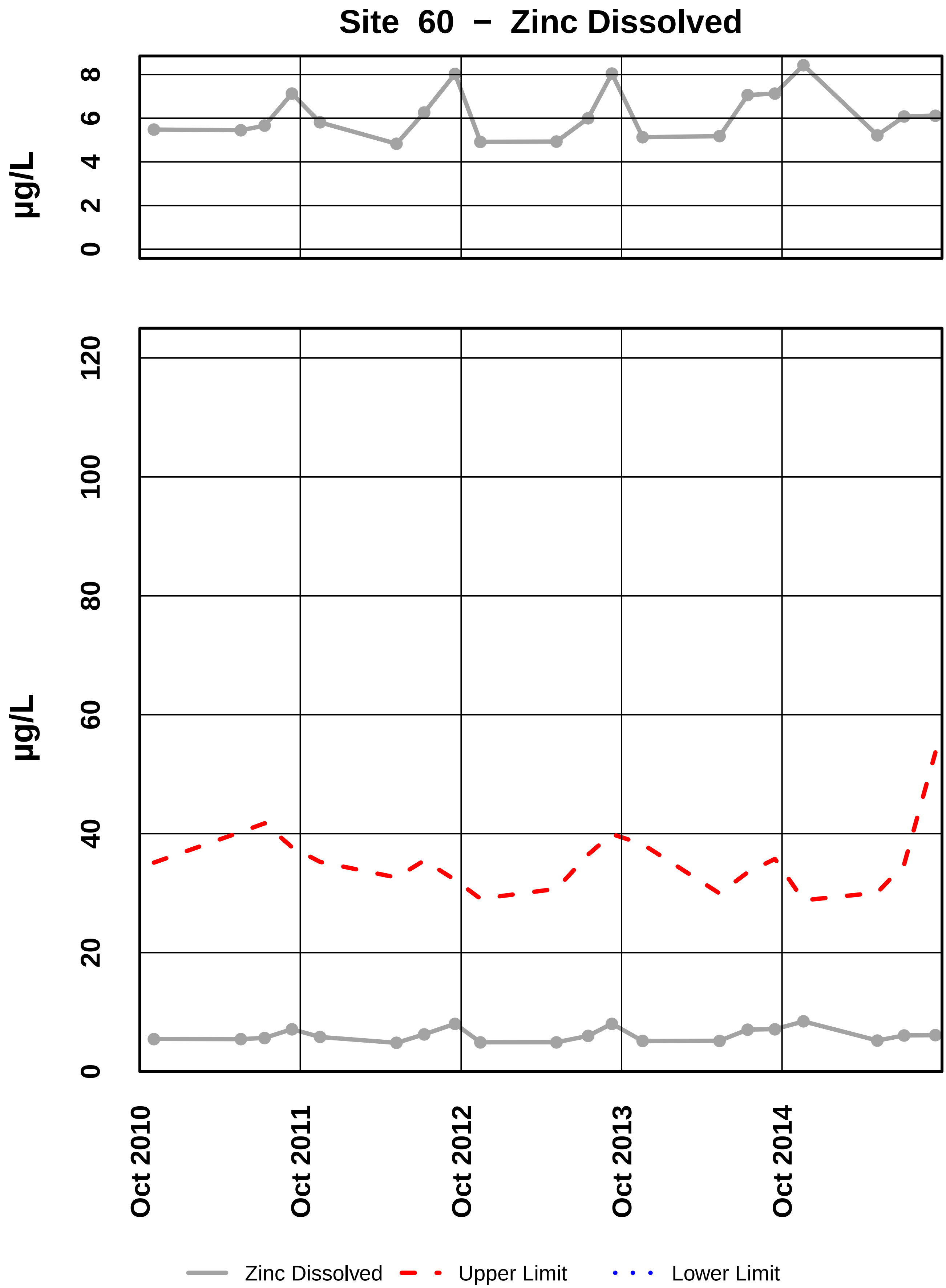


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 60 – Silver Dissolved

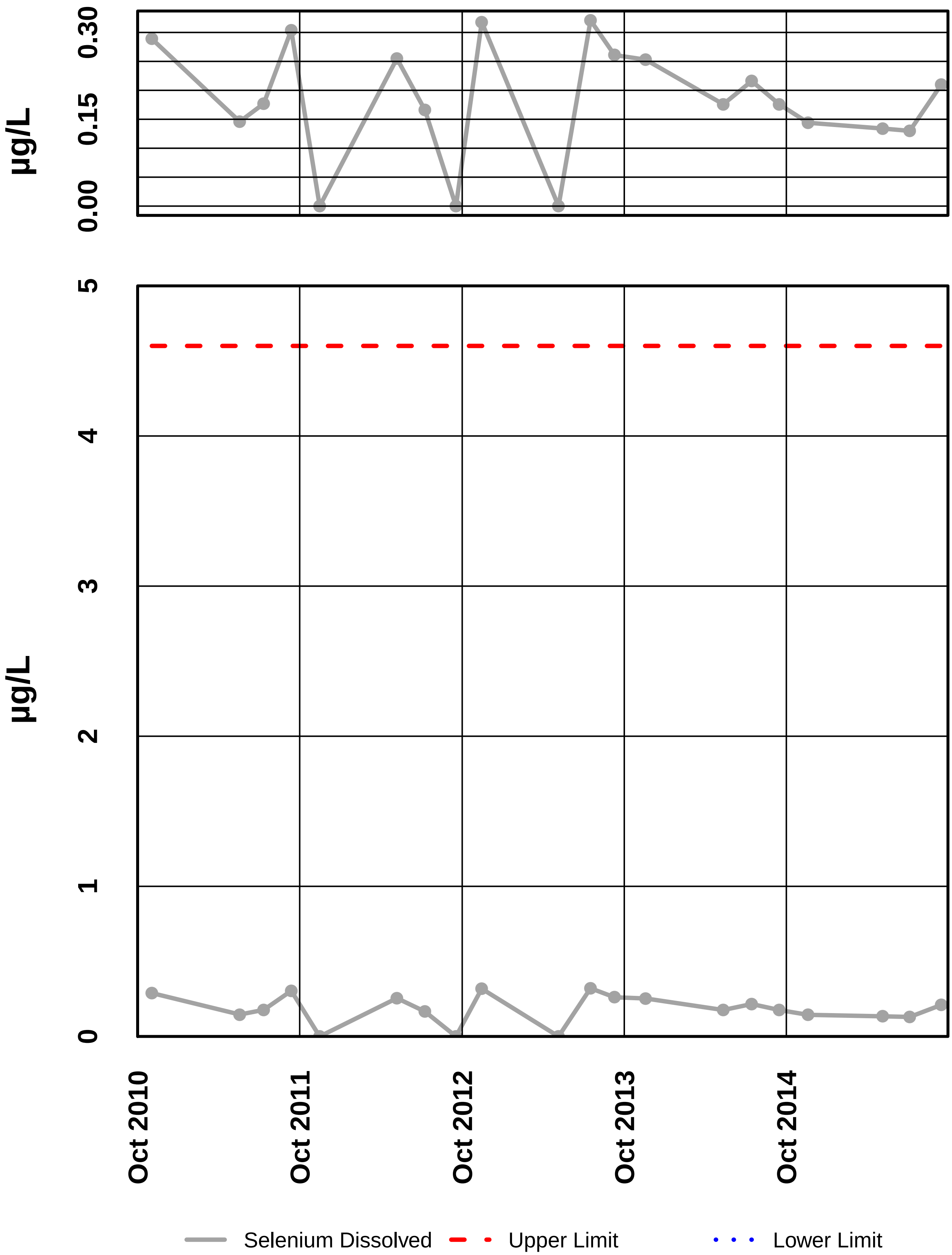


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

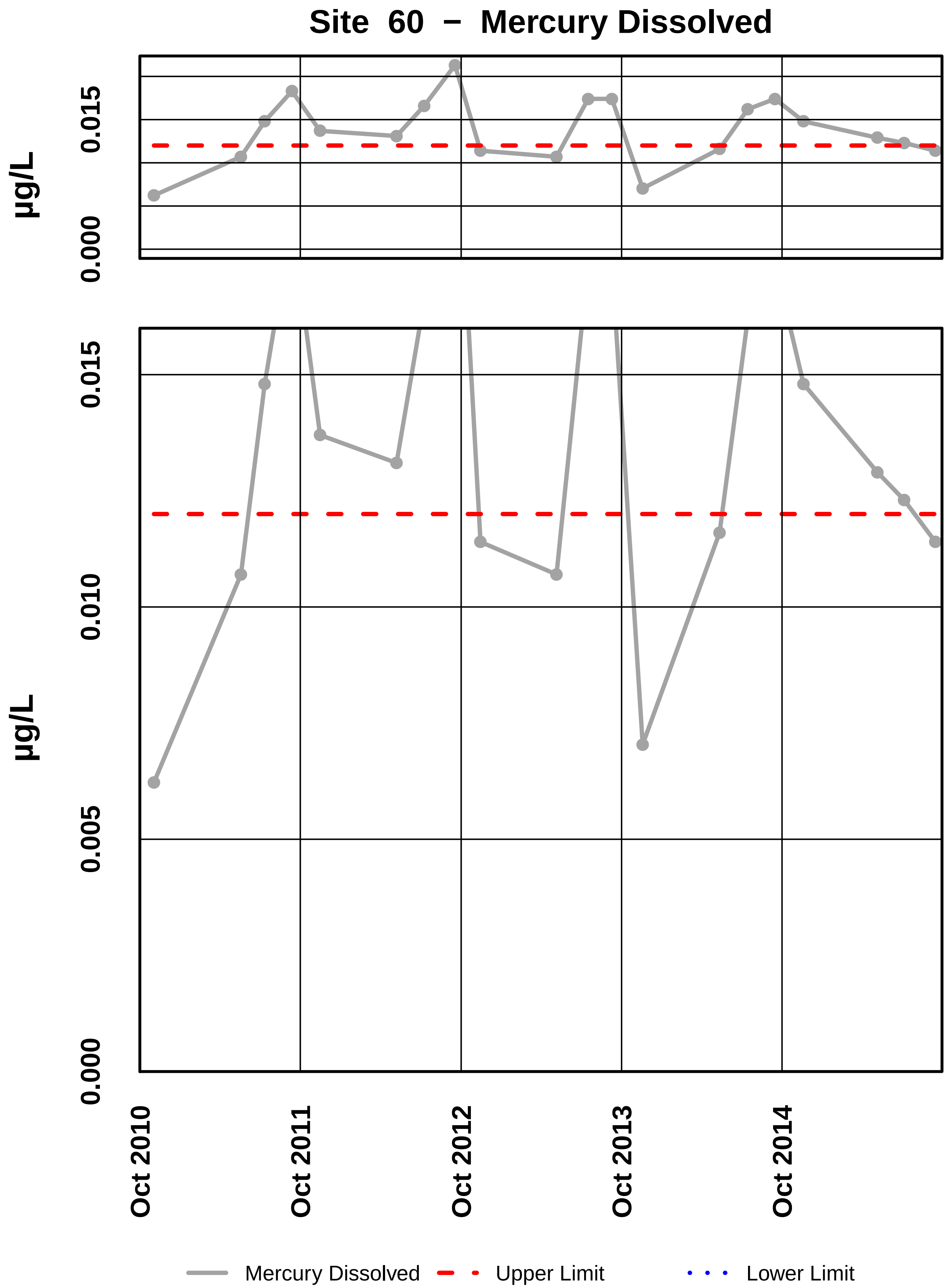


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 60 – Selenium Dissolved



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



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

INTERPRETIVE REPORT
SITE 609

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

The data collected during the current water year are listed in the following “Table of Results for Water Year 2015” 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 2015.				

The data for Water Year 2015 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 2015

			Limits		
Sample Date	**Parameter**	**Value**	**Lower**	**Upper**	**Hardness**
19-Nov-14	Alkalinity	17.3 mg/L	20		
6-Jul-15	Sulfate Total	516 mg/L		250	

Total sulfate was above the AWQS in July and by the September sample was below the AWQS, this is similar to the results from the 2014 water year monitoring. Two of the nine samples taken for total sulfate have been in exceedance, both samples were during July when the site is potentially the most oxidized (drier). The other sulfate samples taken at the site have all been below the AWQS. HGCMC will continue to monitor the site to determine if this increase was transient in nature.

Table of Results for Water Year 2015

Site 609FMS - 'Further Creek Lower'

Sample Date/Parameter	Oct 2014	Nov 2014	Dec 2014	Jan 2015	Feb 2015	Mar 2015	Apr 2015	May 2015	Jun 2015	Jul 2015	Aug 2015	Sep 2015	**Median**
Water Temp (°C)		4.6						6.1		11.5		9.8	8.0
Conductivity-Field(μmho)		404						506		1018		524	515.0
Conductivity-Lab (μmho)		372						471		101		483	422
pH Lab (standard units)		6.62						6.8		7.08		7.27	6.94
pH Field (standard units)		6.66						7.25		6.84		7.12	6.98
Total Alkalinity (mg/L)		17.3						30.1		35.3		34.2	32.2
Total Sulfate (mg/L)		154						210		516		195	202.5
Hardness (mg/L)		177						263		567		265	264.0
Dissolved As (ug/L)		1.43						0.682		0.604		1.4	1.041
Dissolved Ba (ug/L)		36.9						44.9		111		49.1	47.0
Dissolved Cd (ug/L)		0.148						0.158		0.149		0.123	0.1485
Dissolved Cr (ug/L)		1.06						1.03		0.786		1.13	1.045
Dissolved Cu (ug/L)		0.886						0.715		0.799		0.727	0.763
Dissolved Pb (ug/L)		0.431						0.18		0.0733		0.37	0.2750
Dissolved Ni (ug/L)		3.81						3.67		5.8		5.2	4.505
Dissolved Ag (ug/L)		0.005						0.004		0.002		0.003	0.004
Dissolved Zn (ug/L)		79.2						68.2		82.4		75.5	77.35
Dissolved Se (ug/L)		0.656						0.729		0.864		1.03	0.797
Dissolved Hg (ug/L)		0.00522						0.00202		0.00147		0.00333	0.002675

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

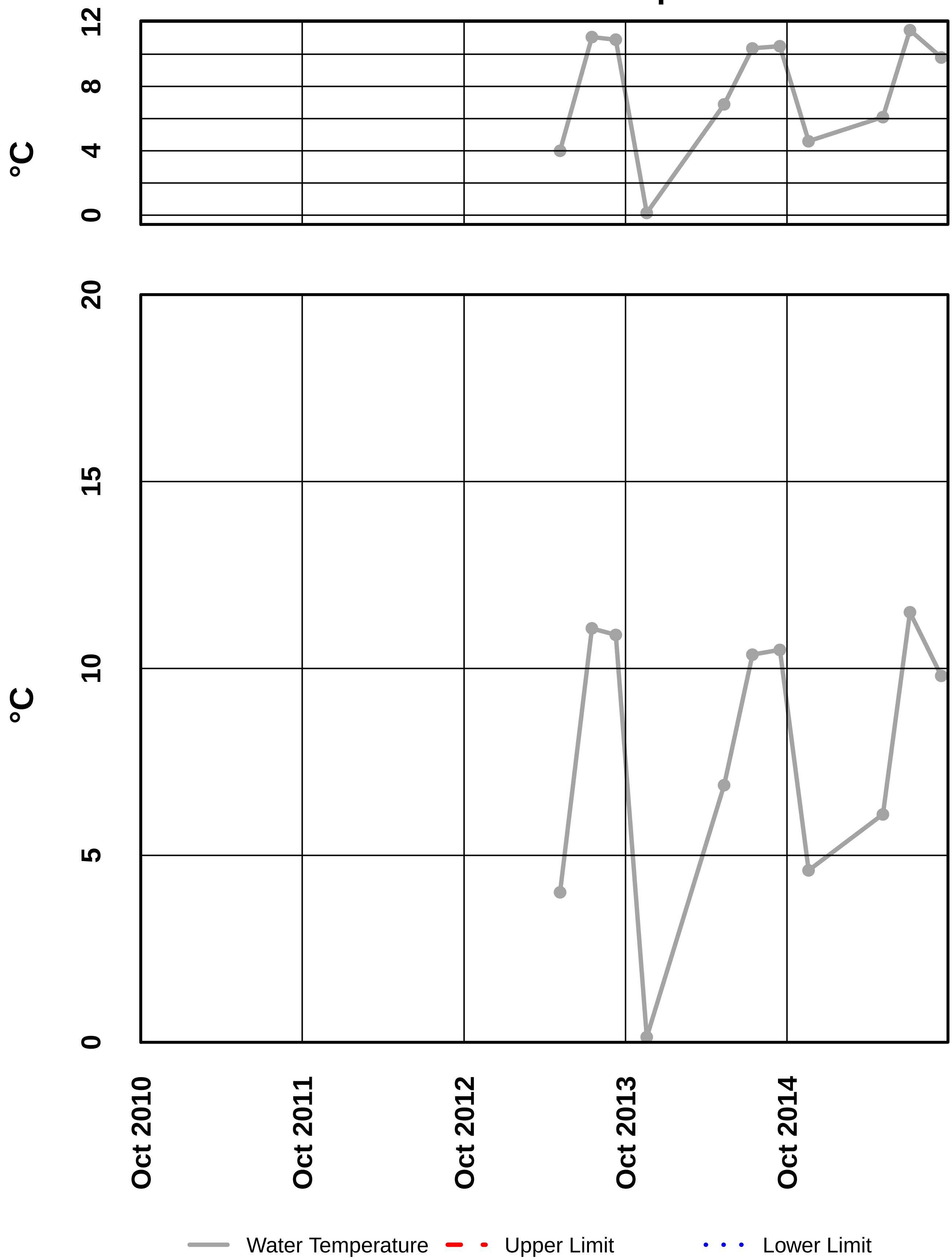
Qualified Data by QA Reviewer

Date Range: 10/01/2014 to 09/30/2015

Site No.	Sample Date	Sample Time	Parameter	Value		Qualifier	Reason for Qualifier
609FMS	11/19/2014	12:00 AM	Diss. Ag-ICP/MS	0.00487	µg/L	J	Below Quantitative Range
			pH	6.62	pH units	J	Hold Time Violation
609FMS	05/06/2015	12:00 AM	Diss. Ag-ICP/MS	0.0036	µg/L	J	Below Quantitative Range
609FMS	09/15/2015	12:00 AM	Diss. Ag-ICP/MS	0.00345	µg/L	J	Below Quantitative Range

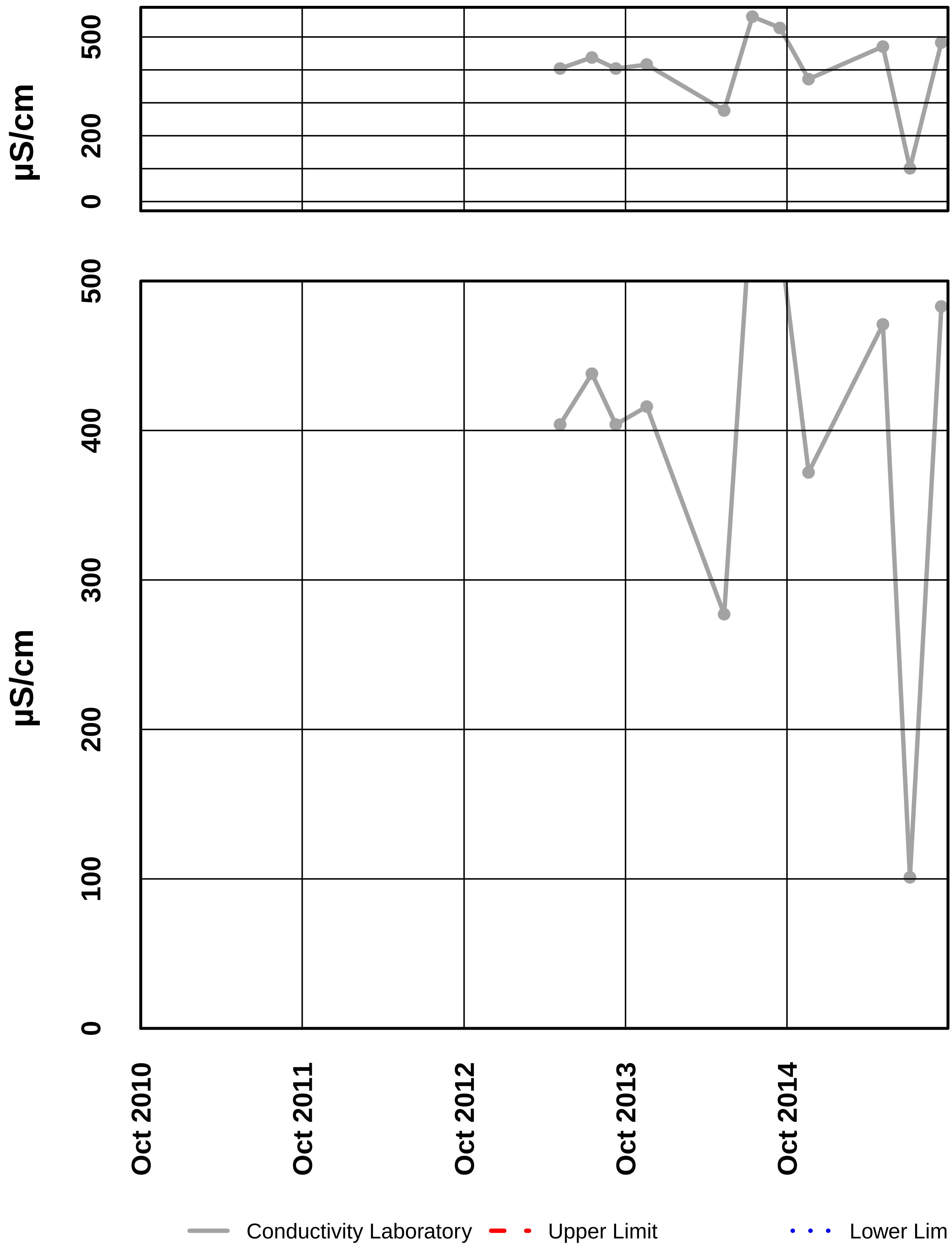
Qualifier	Description
J	Positively Identified - Approximate Concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit

Site 609 – Water Temperature

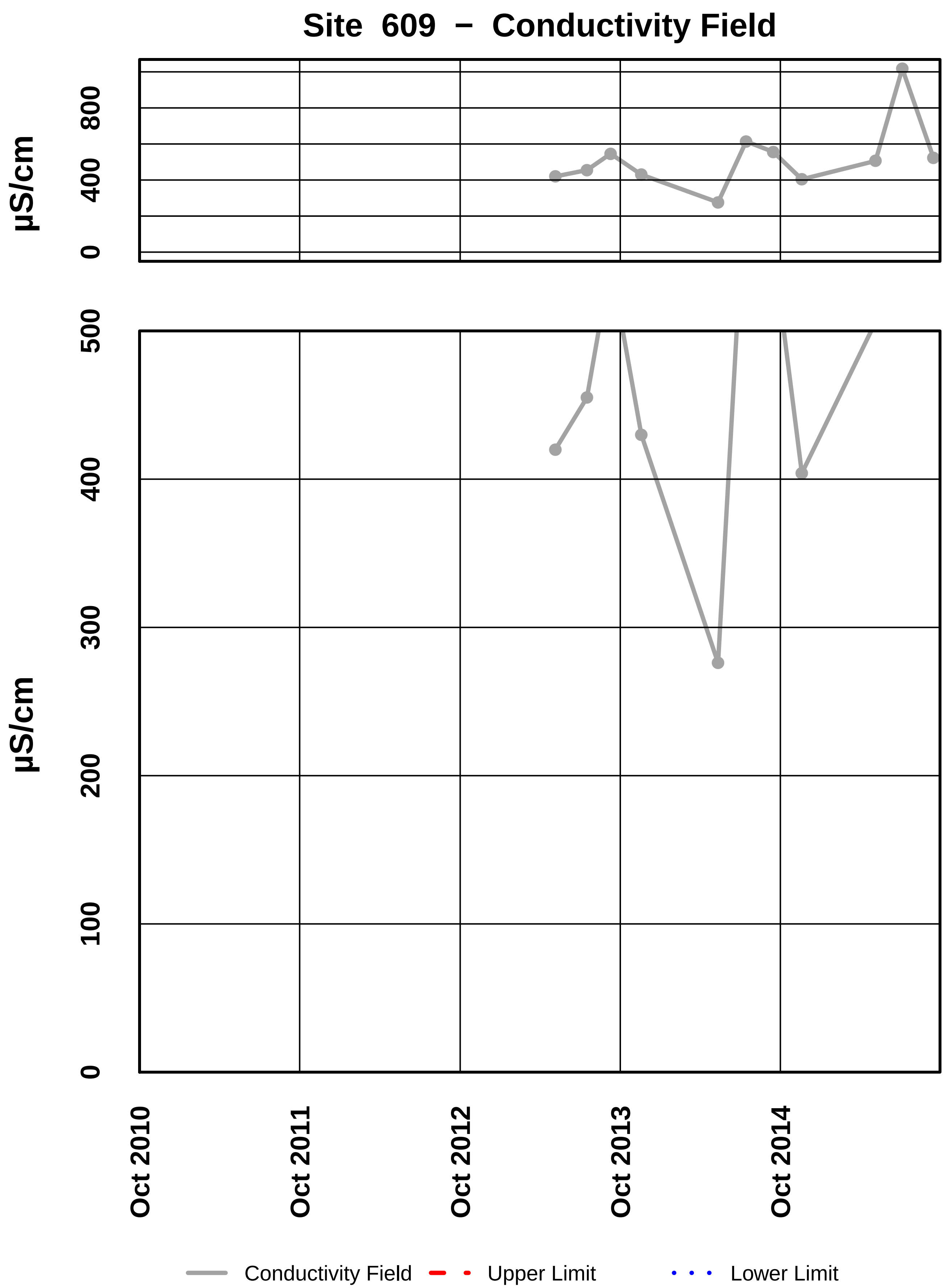


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

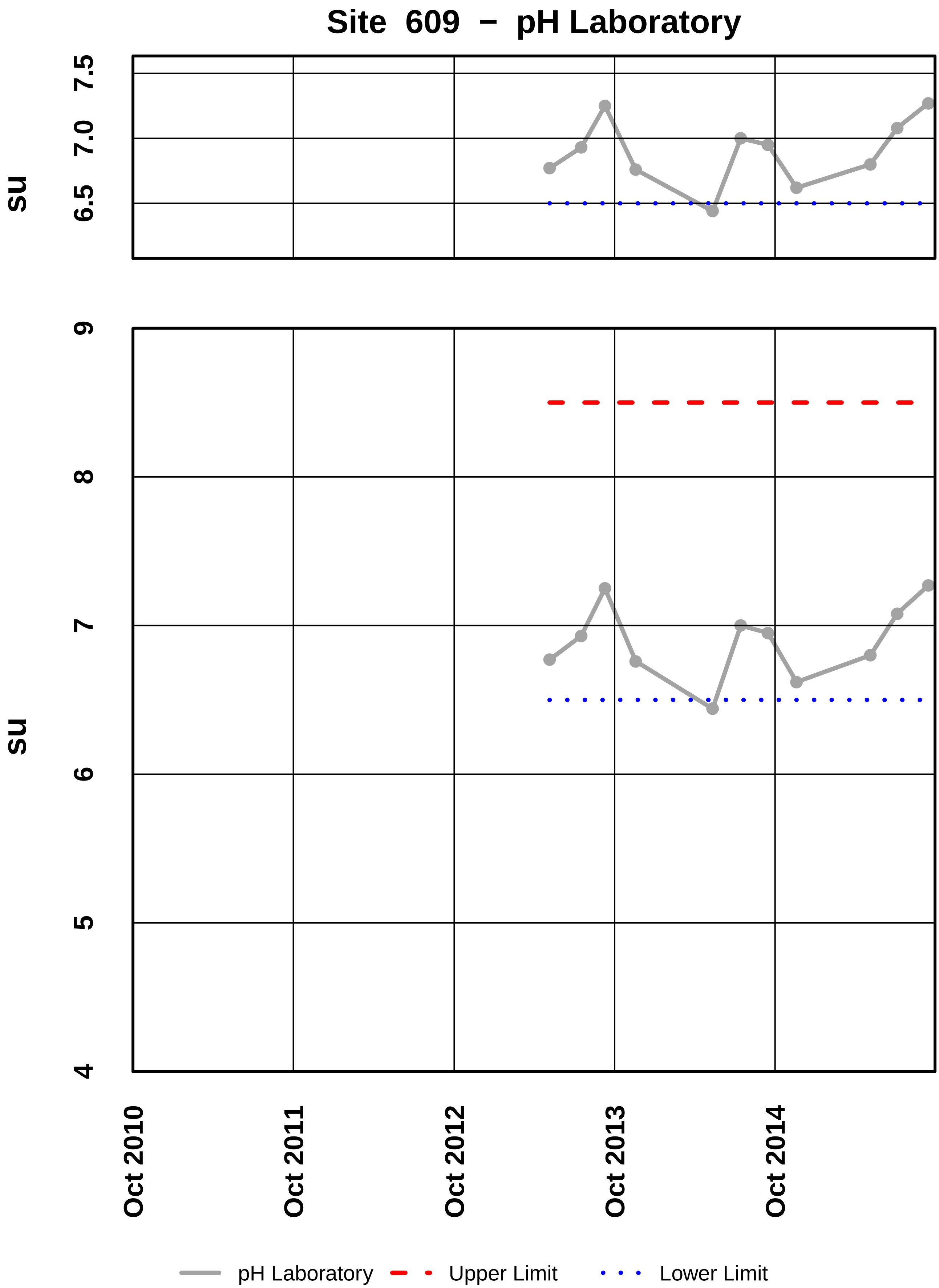
Site 609 – Conductivity Laboratory



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

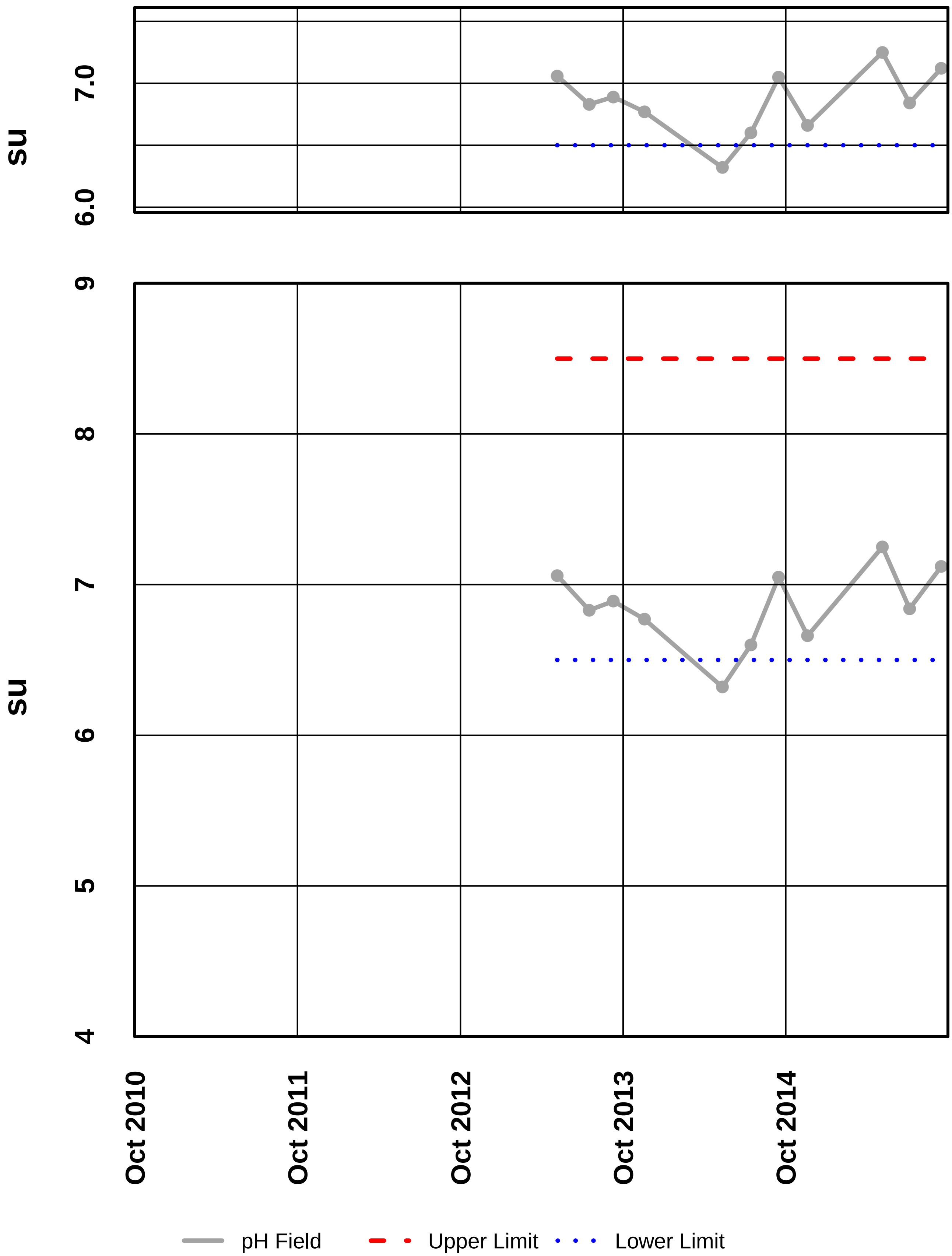


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

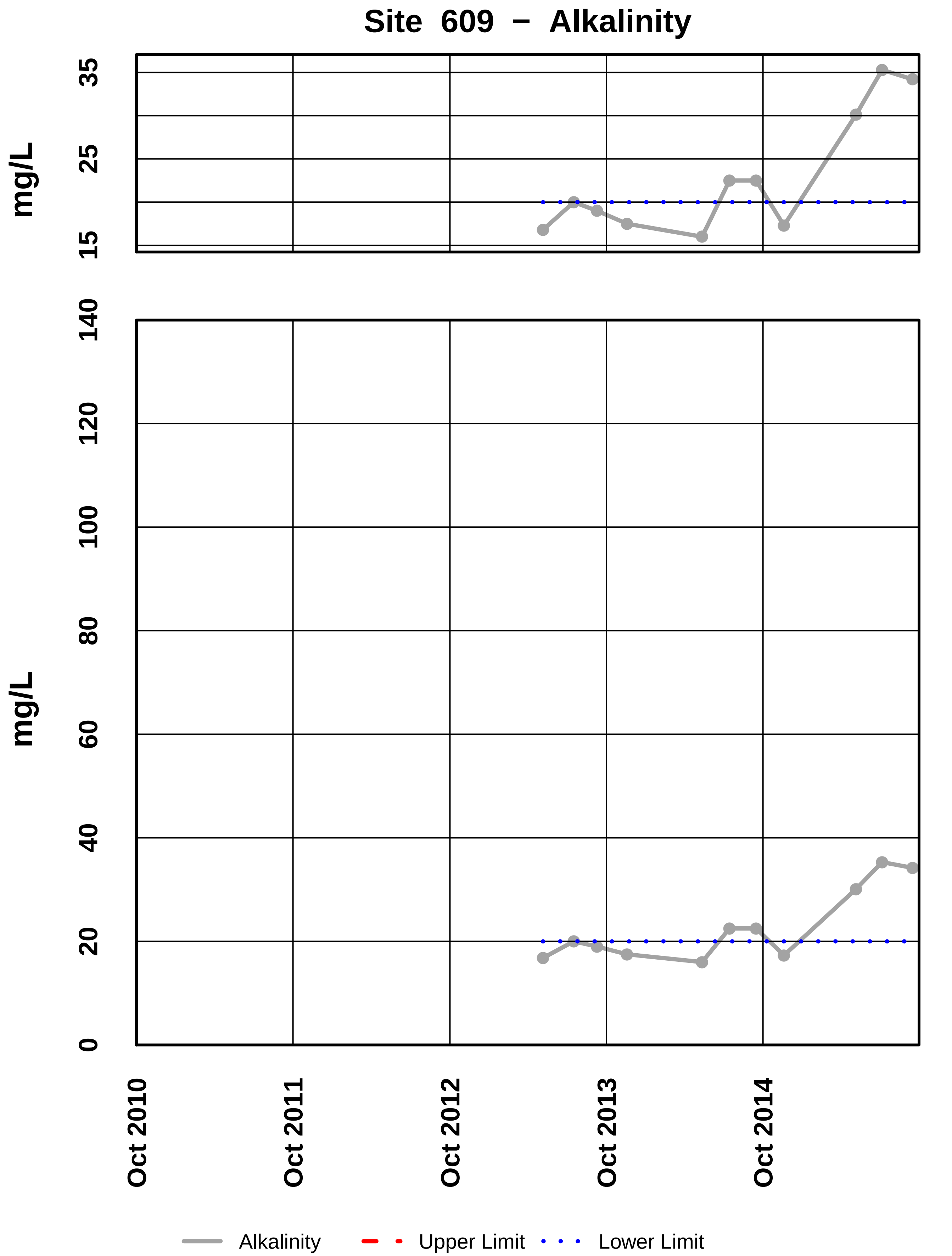


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

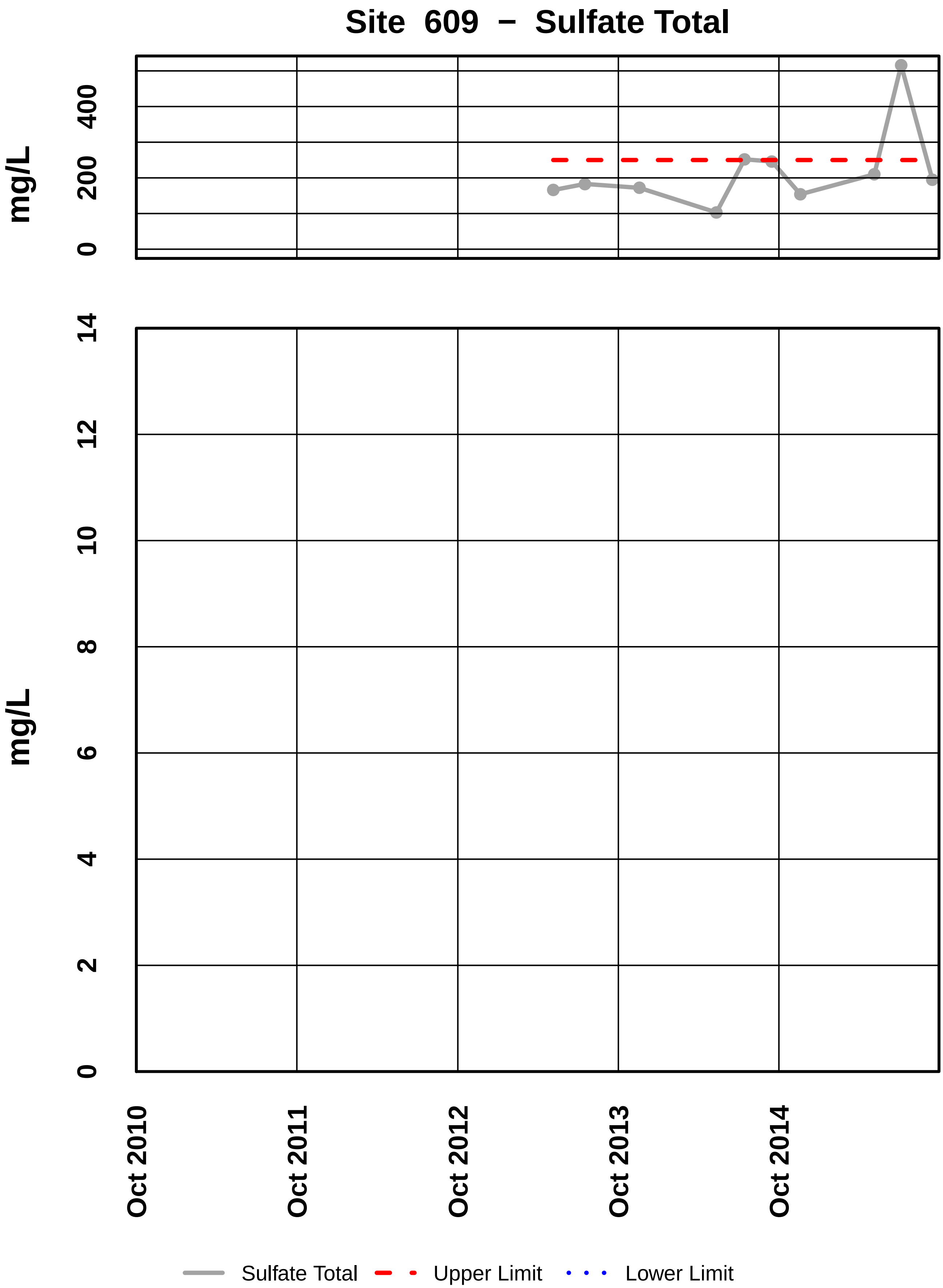
Site 609 – pH Field



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

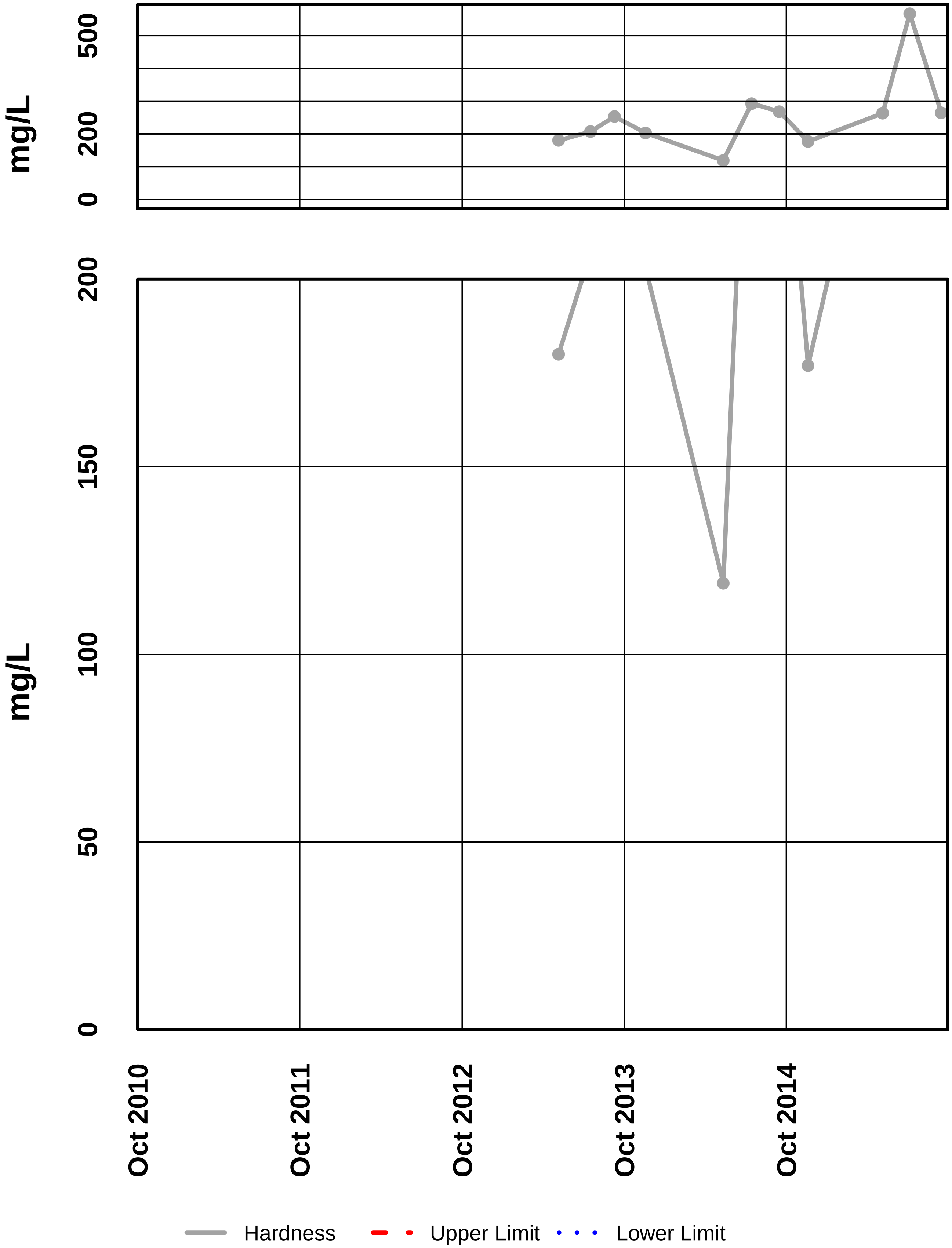


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

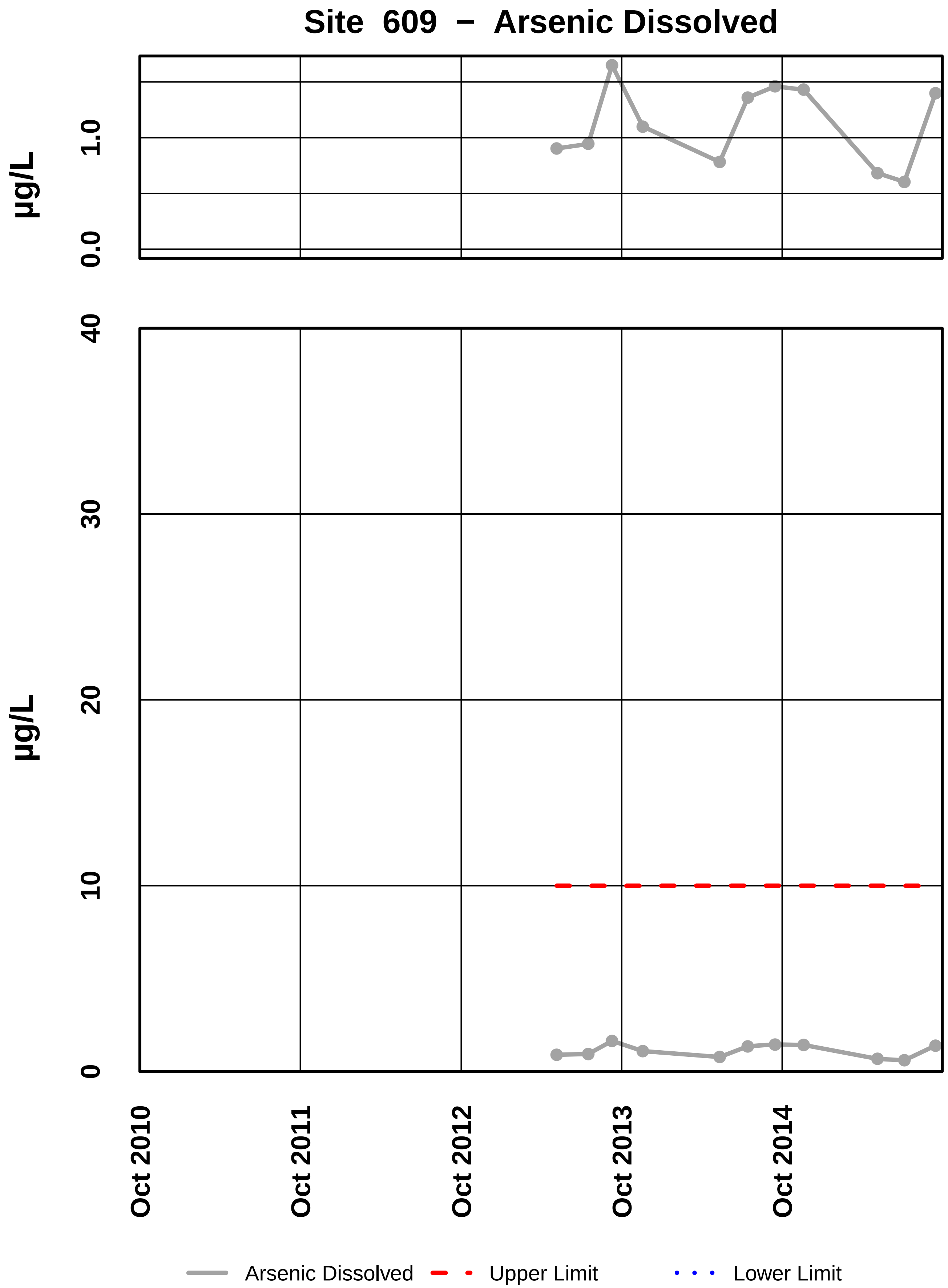


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 609 – Hardness

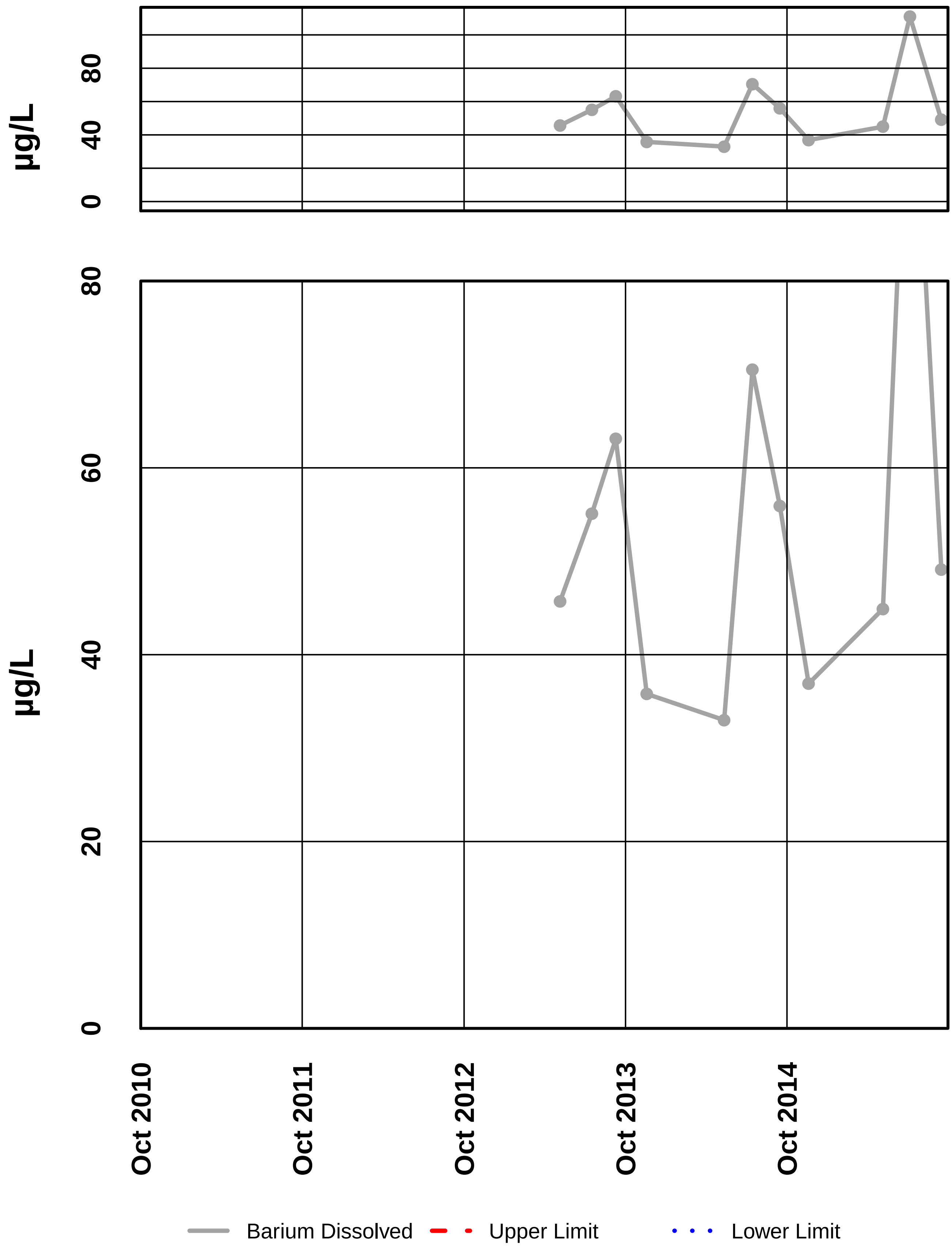


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



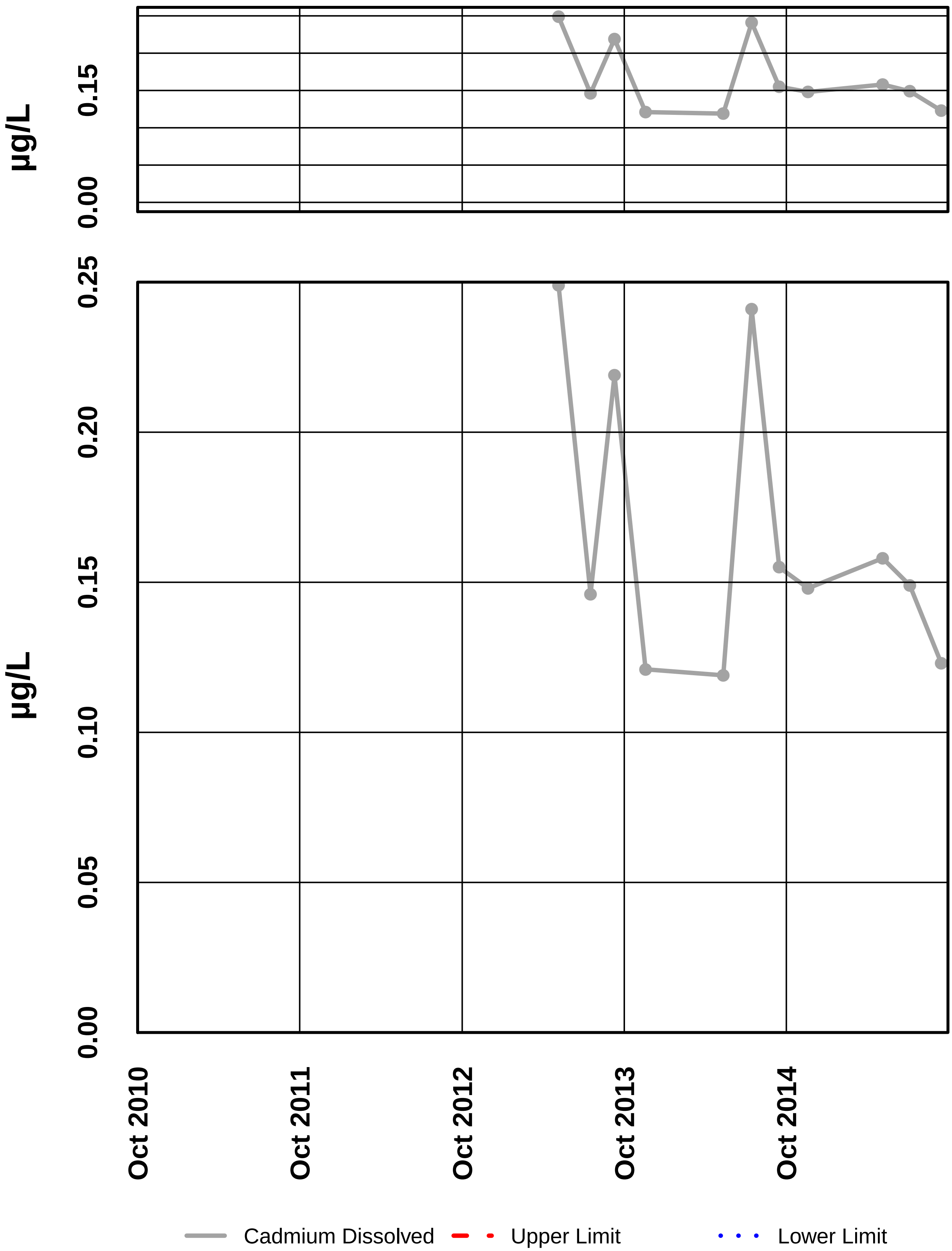
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 609 – Barium Dissolved

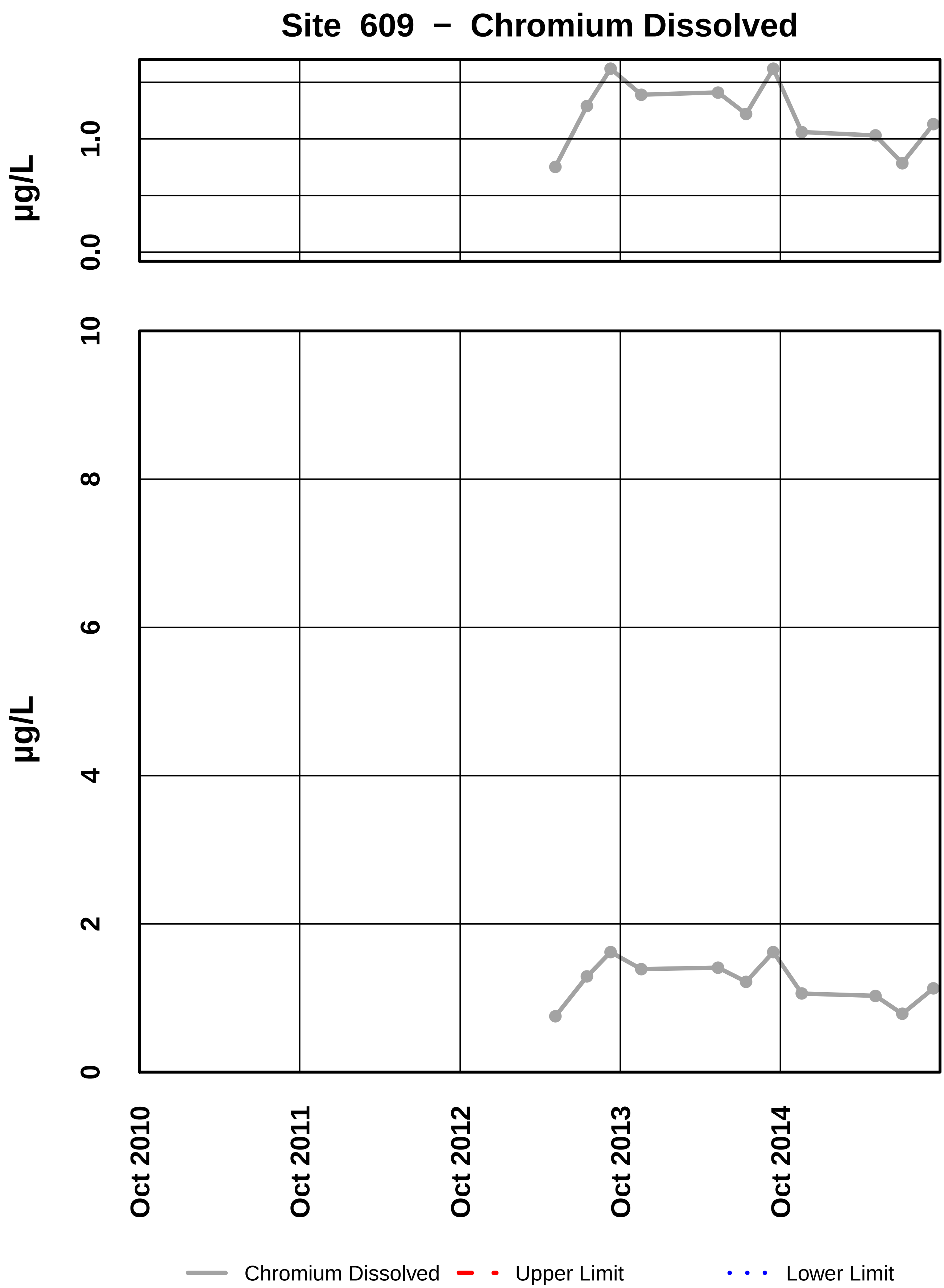


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 609 − Cadmium Dissolved

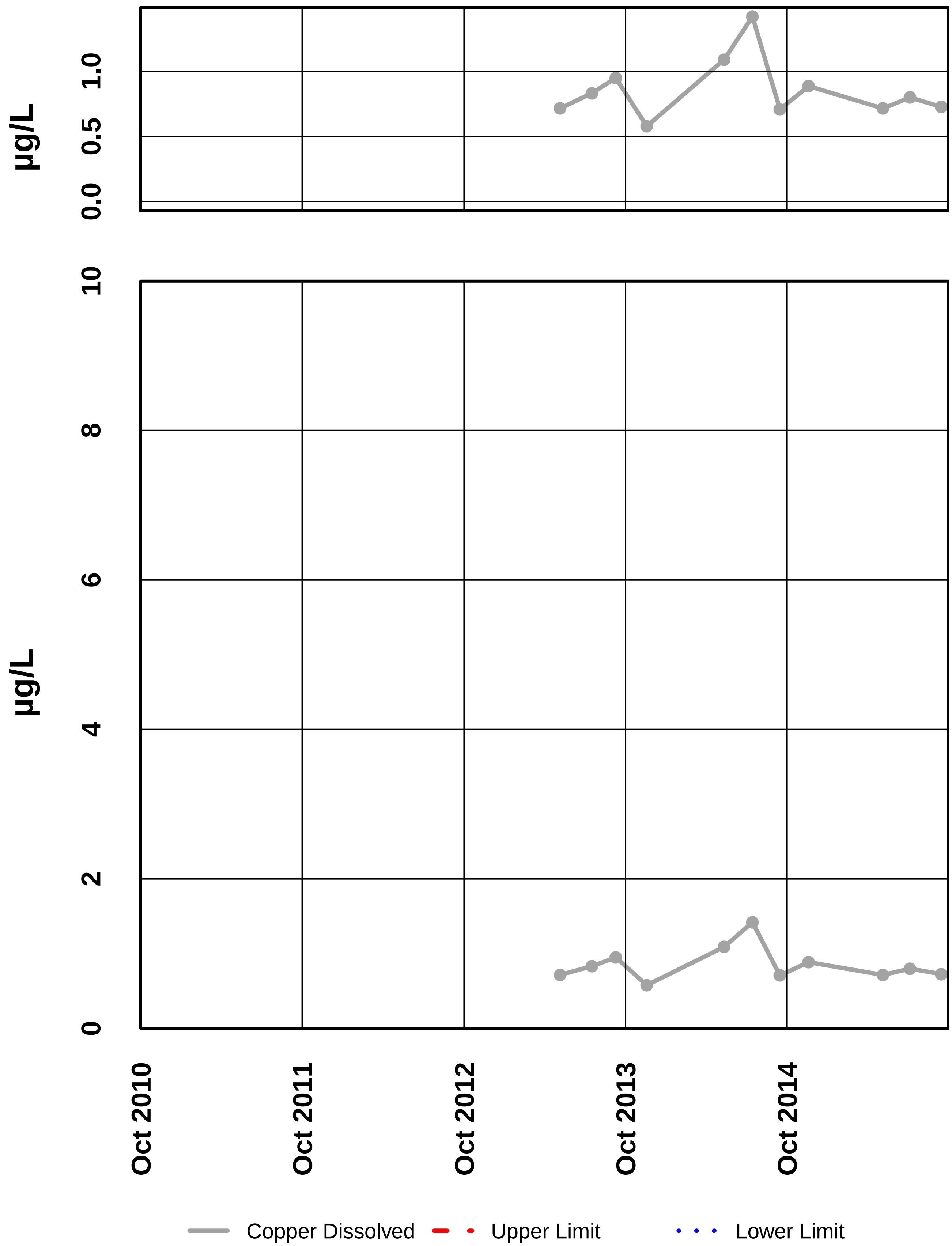


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

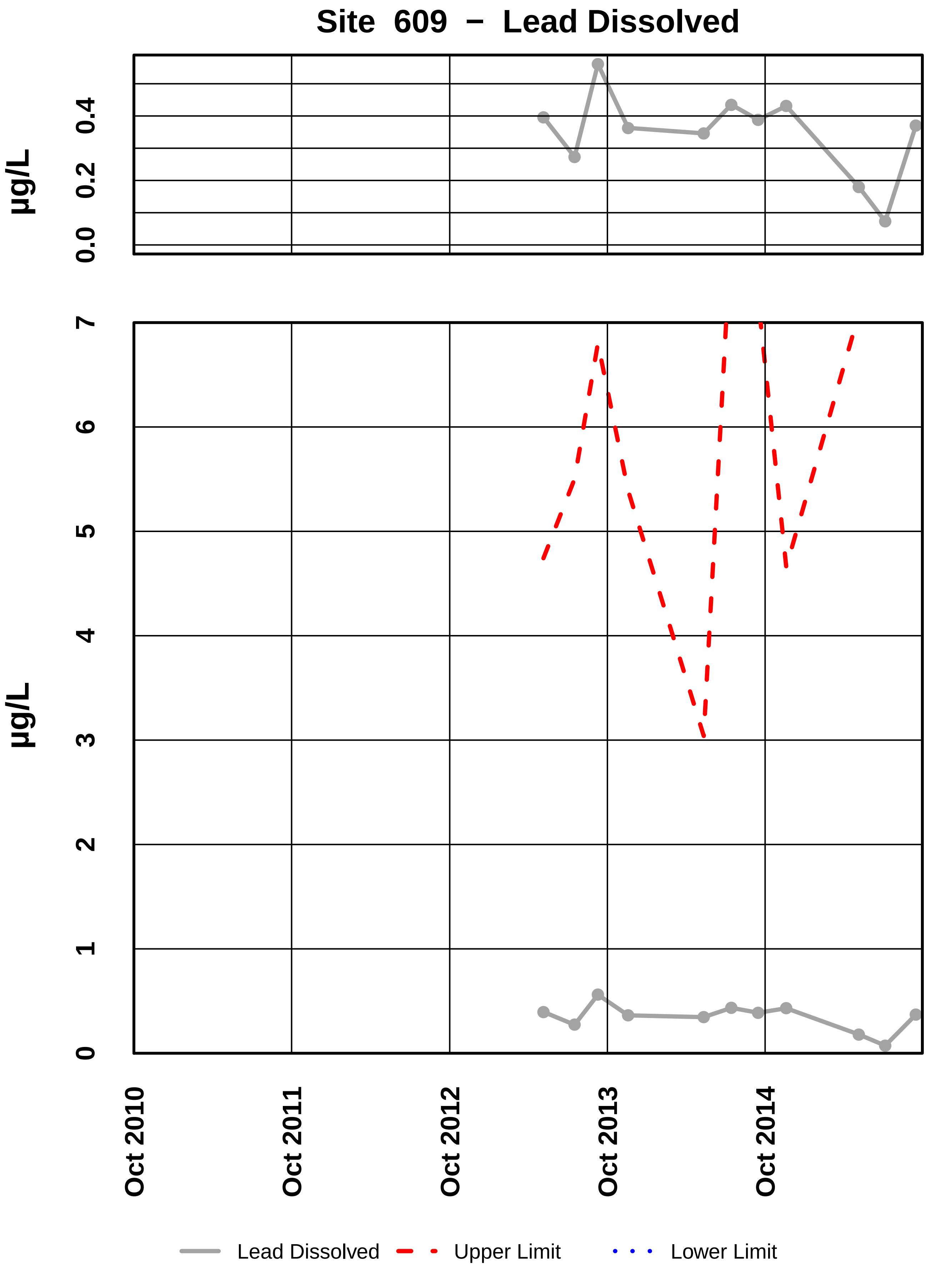


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 609 − Copper Dissolved

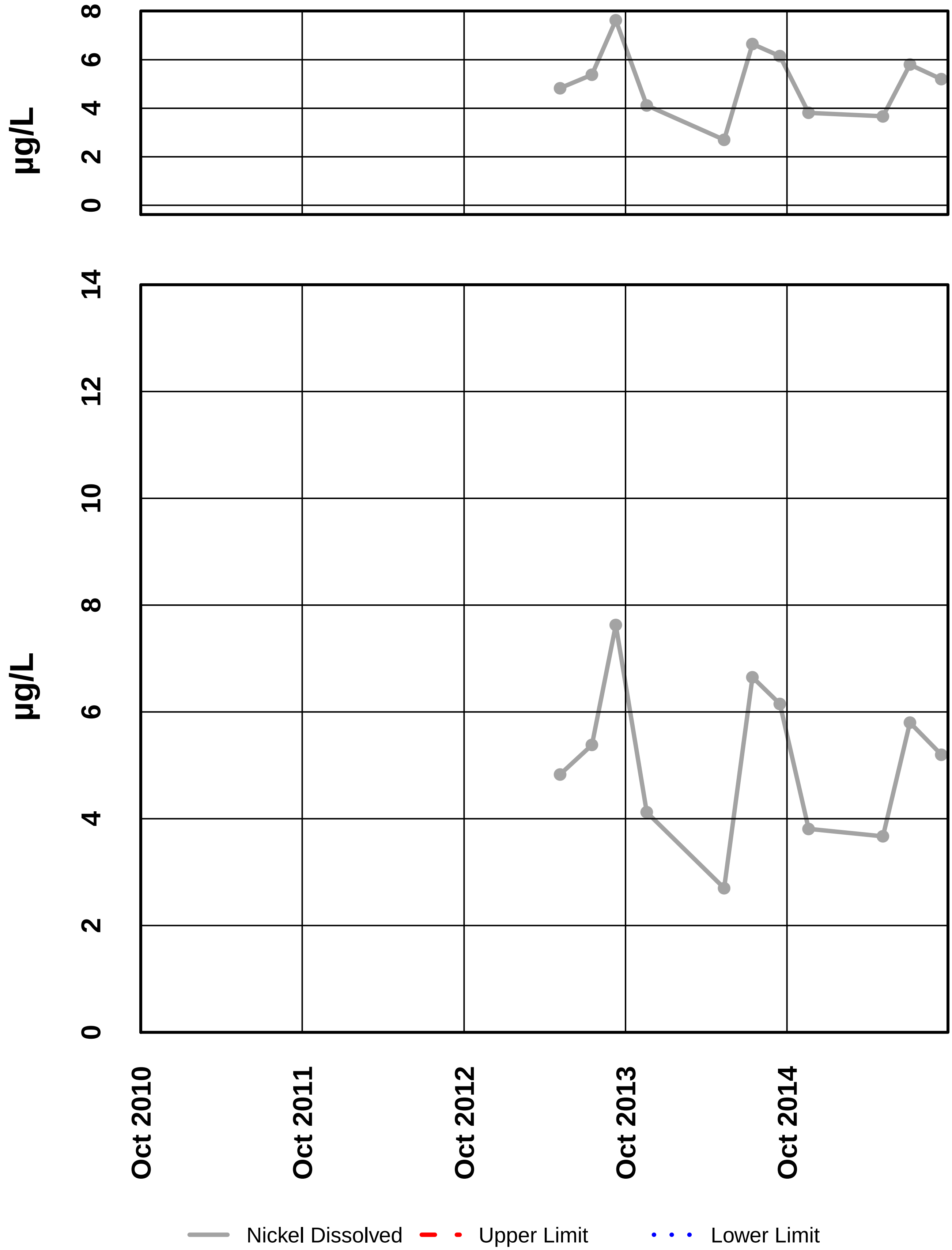


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

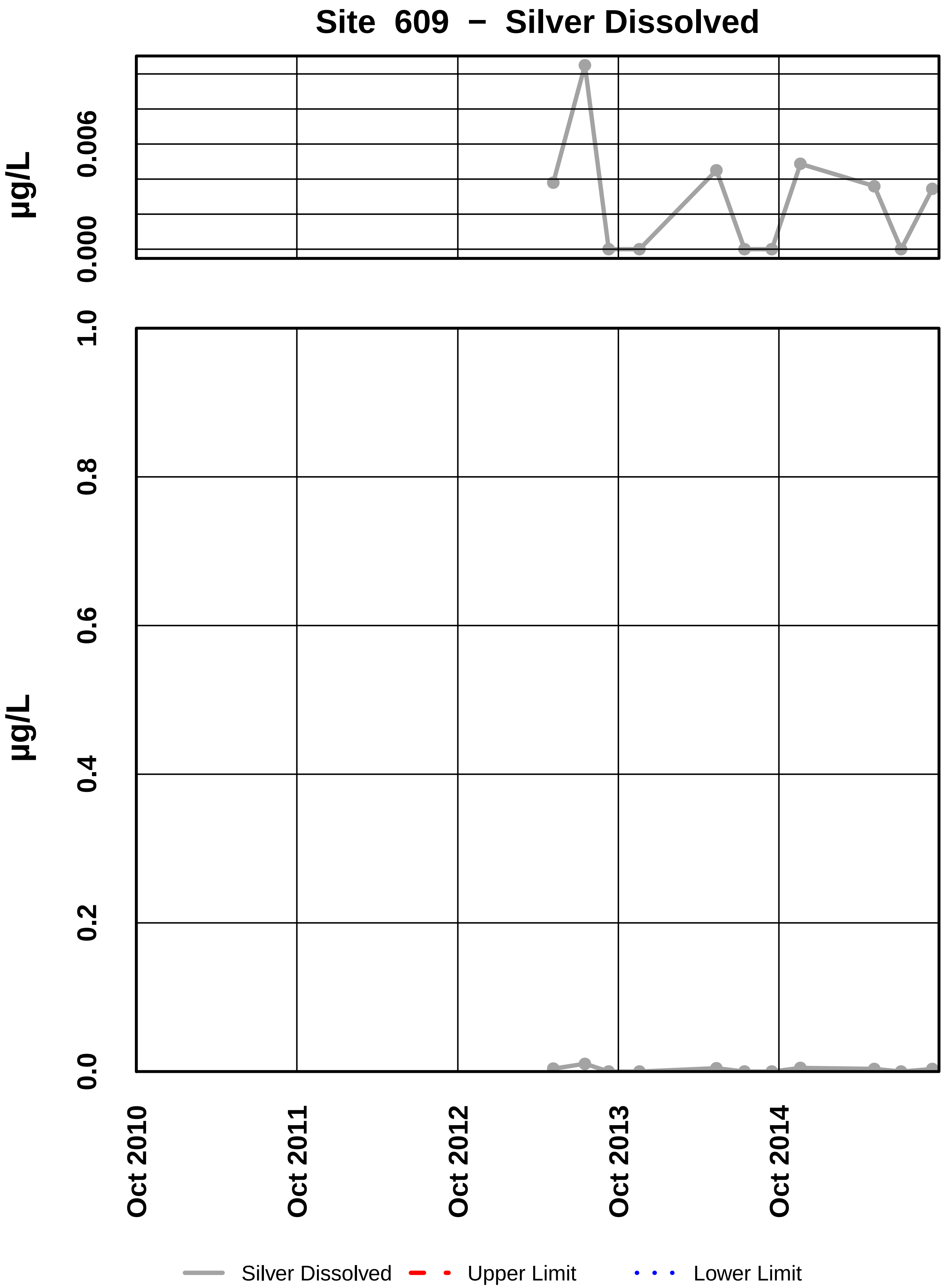


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 609 – Nickel Dissolved

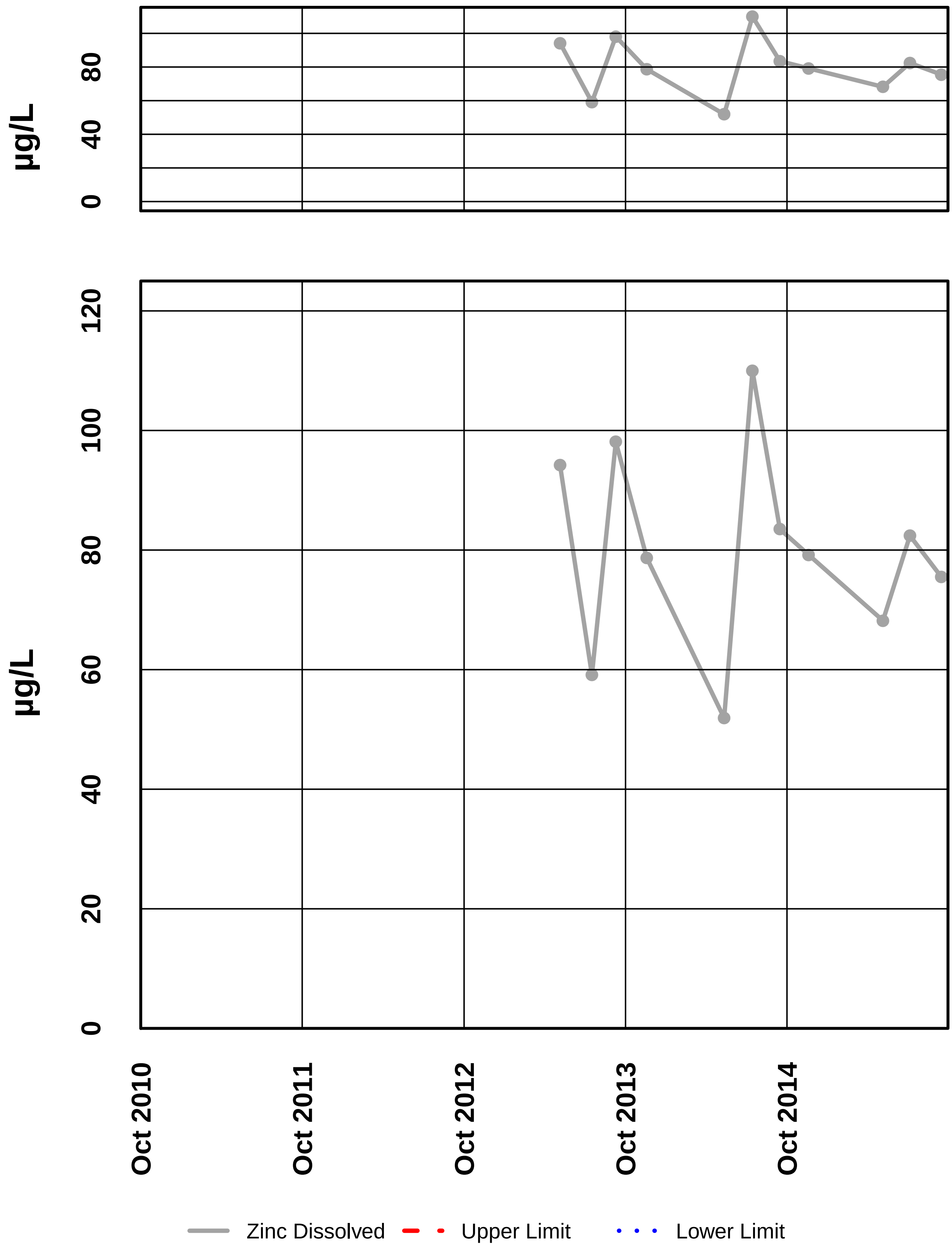


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

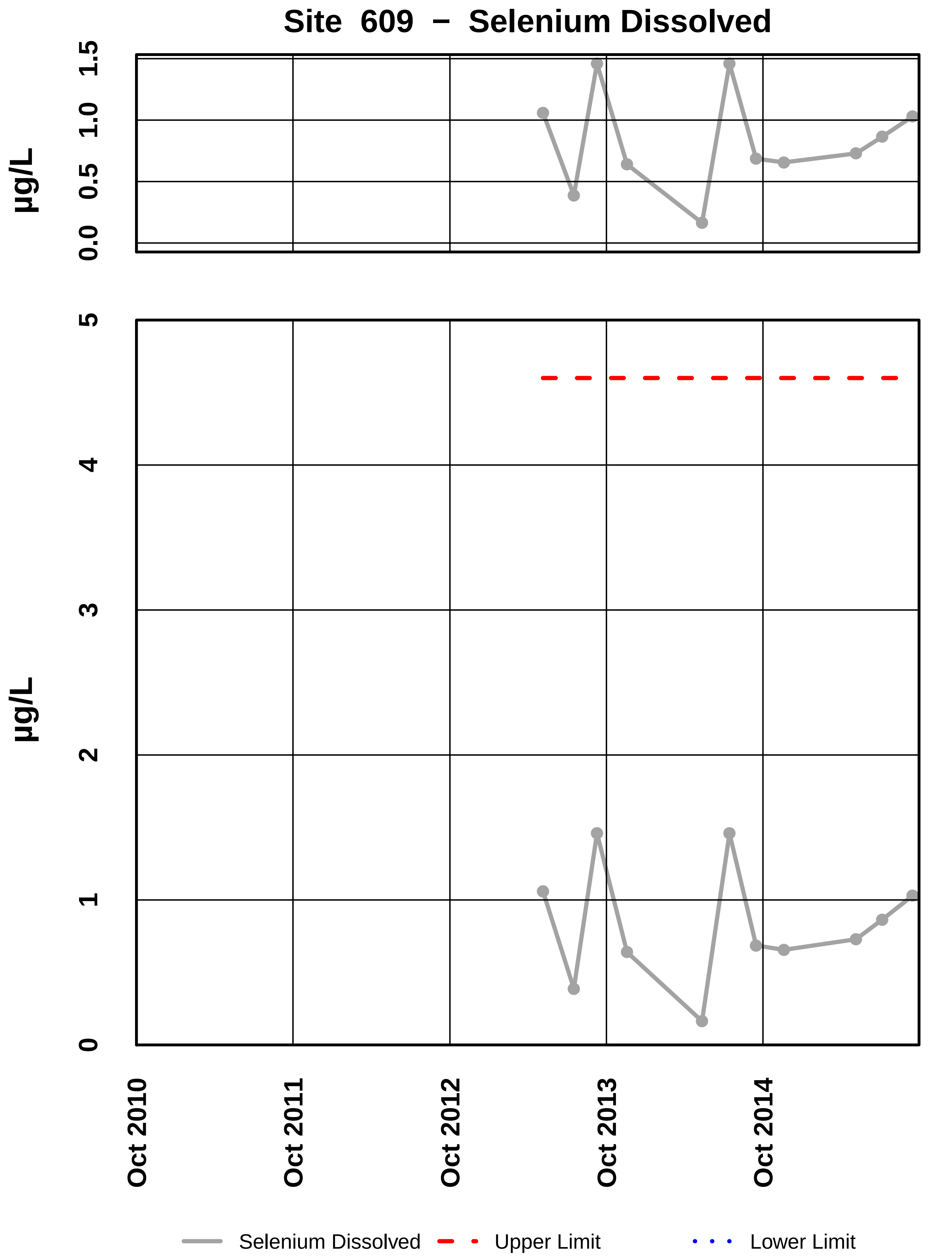


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 609 − Zinc Dissolved

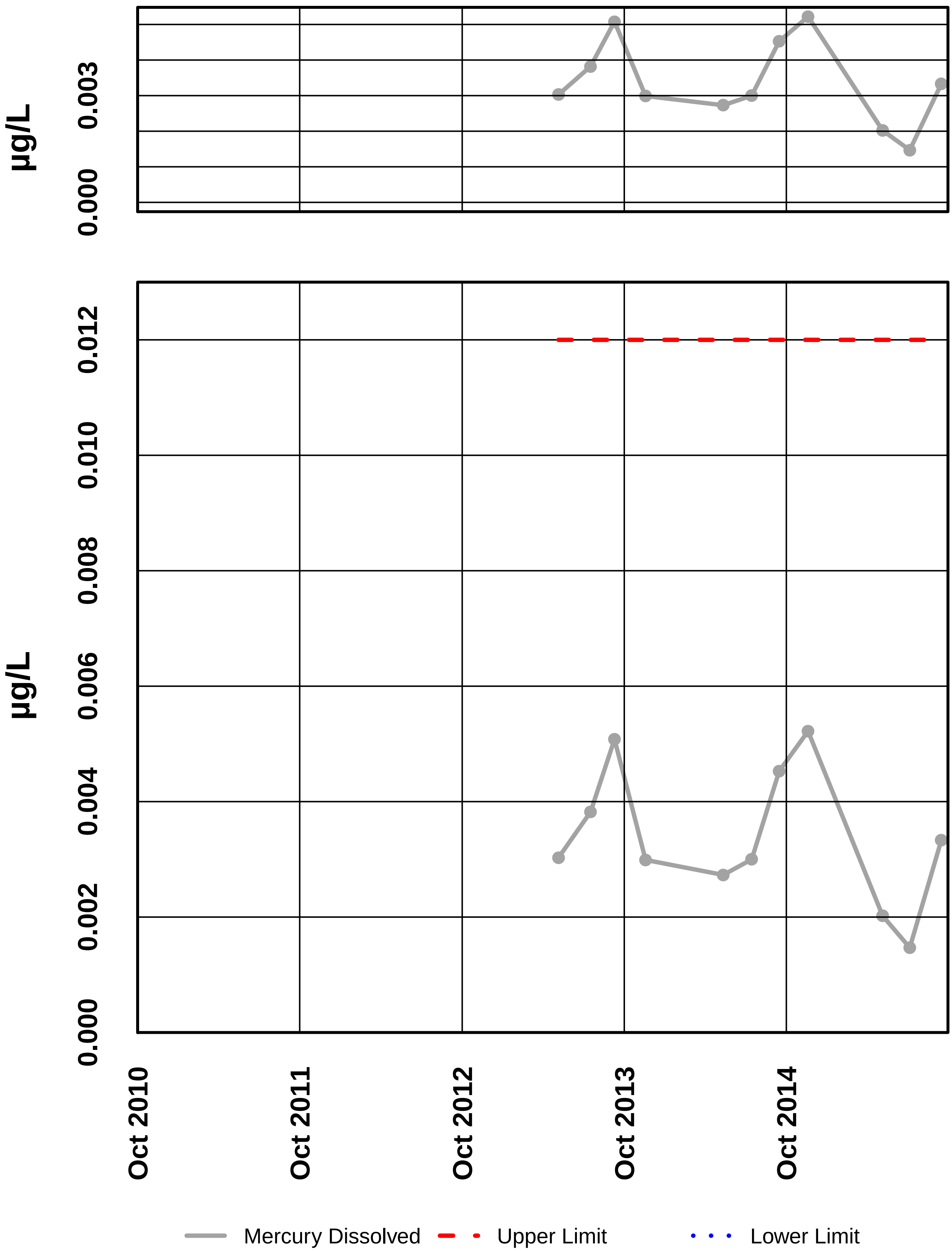


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

Site 609 – Mercury Dissolved



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

INTERPRETIVE REPORT
SITE 711

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

The data collected during the current water year are listed in the following “Table of Results for Water Year 2015” report. The table includes all the required FWMP analyte data (field and laboratory) collected for the current water year and a series of flags keyed to the summary report “Qualified Data by QA Reviewer”. The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of ½ MDL for the purpose of median calculation.

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

Sample Date	Parameter	Value	Qualifier	Notes
No outliers have been identified by HGCMC for the period of October 2013 through September 2015.				

The data for Water Year 2015 have been compared to the strictest fresh water quality criterion for each applicable analyte. No results exceeding these criteria were identified as listed in the table below.

Table of Exceedance for Water Year 2015

			Limits		
Sample Date	Parameter	Value	Lower	Upper	Hardness
No exceedances have been identified by HGCMC for the period of October 2014 through September 2015.					

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 2015

Site 711FMS - 'Greens Creek Above Site E'

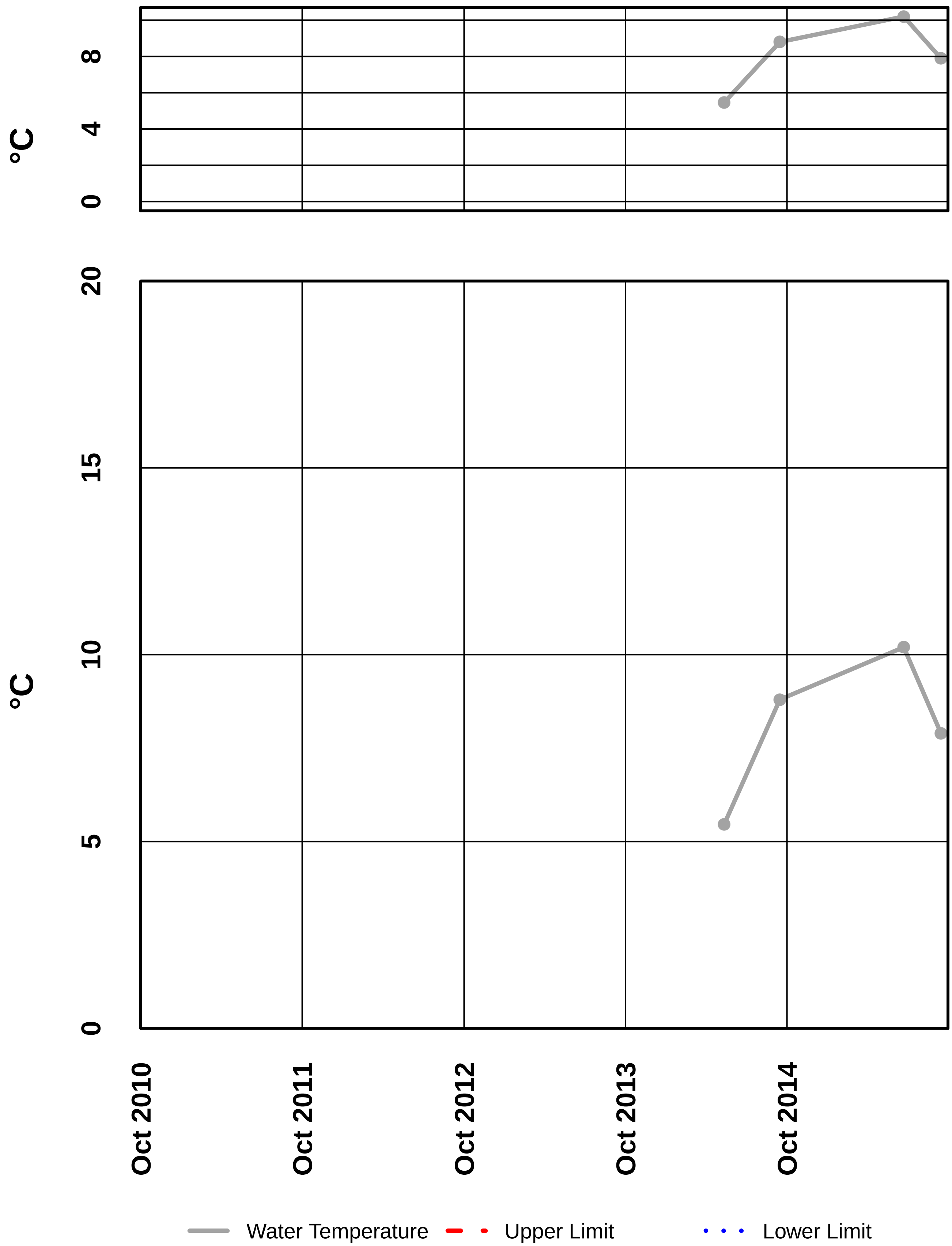
Sample Date/Parameter	Oct 2014	Nov 2014	Dec 2014	Jan 2015	Feb 2015	Mar 2015	Apr 2015	May 2015	Jun 2015	Jul 2015	Aug 2015	Sep 2015	**Median**
Water Temp (°C)									10.2			7.9	9.1
Conductivity-Field(μmho)									135			139.9	137.5
Conductivity-Lab (μmho)									139			114	127
pH Lab (standard units)									8.05			7.87	7.96
pH Field (standard units)									8.14			8.11	8.13
Total Alkalinity (mg/L)									54.6			54.2	54.4
Total Sulfate (mg/L)									16			12.8	14.4
Hardness (mg/L)									67.5			65.8	66.7
Dissolved As (ug/L)									0.212			0.25	0.231
Dissolved Ba (ug/L)									38.3				38.3
Dissolved Cd (ug/L)									0.0304			0.0323	0.0314
Dissolved Cr (ug/L)									0.25				0.250
Dissolved Cu (ug/L)									0.373			0.585	0.479
Dissolved Pb (ug/L)									0.0052			0.0174	0.0113
Dissolved Ni (ug/L)									0.448				0.448
Dissolved Ag (ug/L)									0.002				0.002
Dissolved Zn (ug/L)									2.47			3.42	2.95
Dissolved Se (ug/L)									0.877				0.877
Dissolved Hg (ug/L)									0.000389			0.000833	0.000611

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

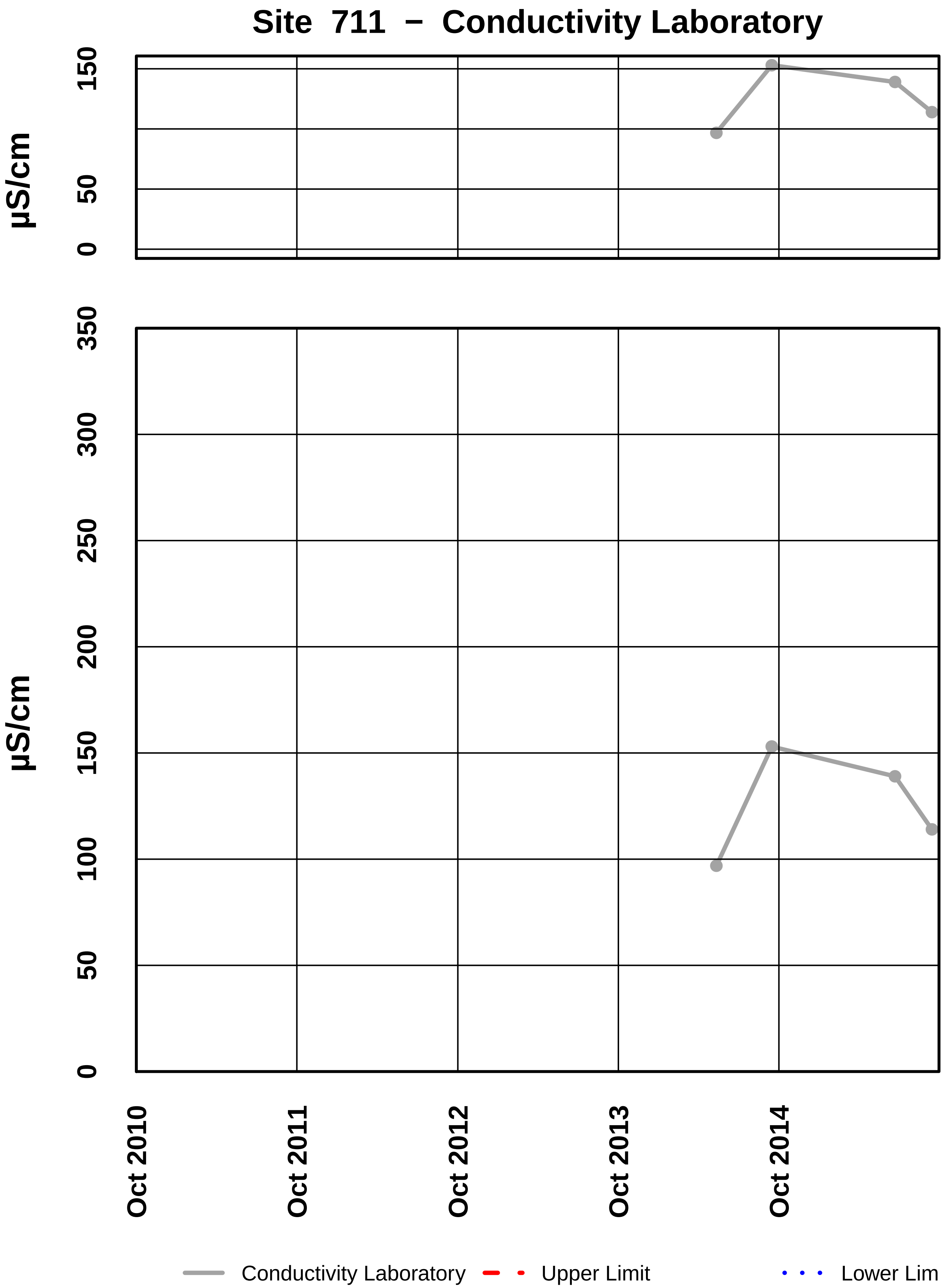
Values reported as less than MDL are replaced by 1/2 MDL for median calculation purposes.

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

Site 711 – Water Temperature

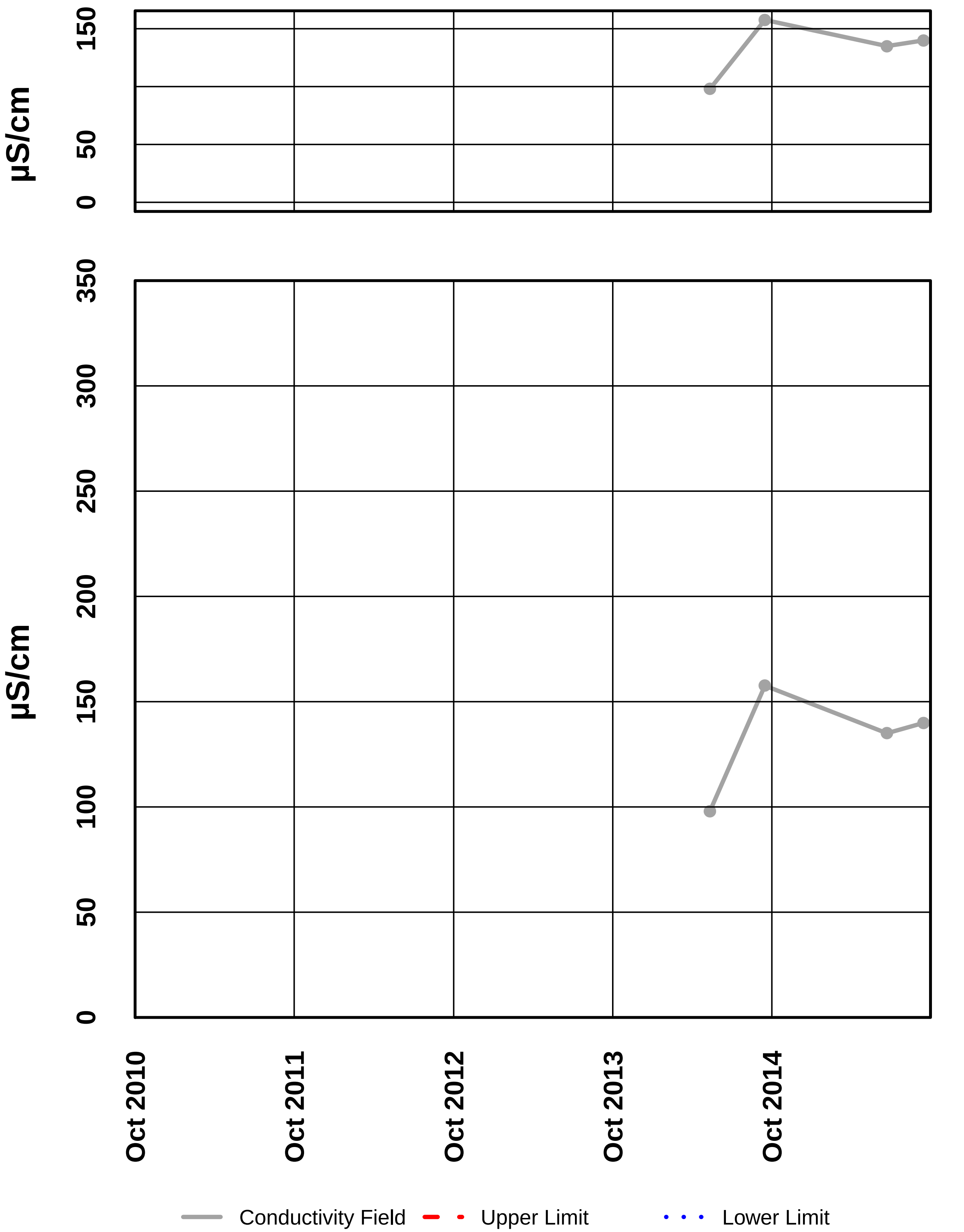


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

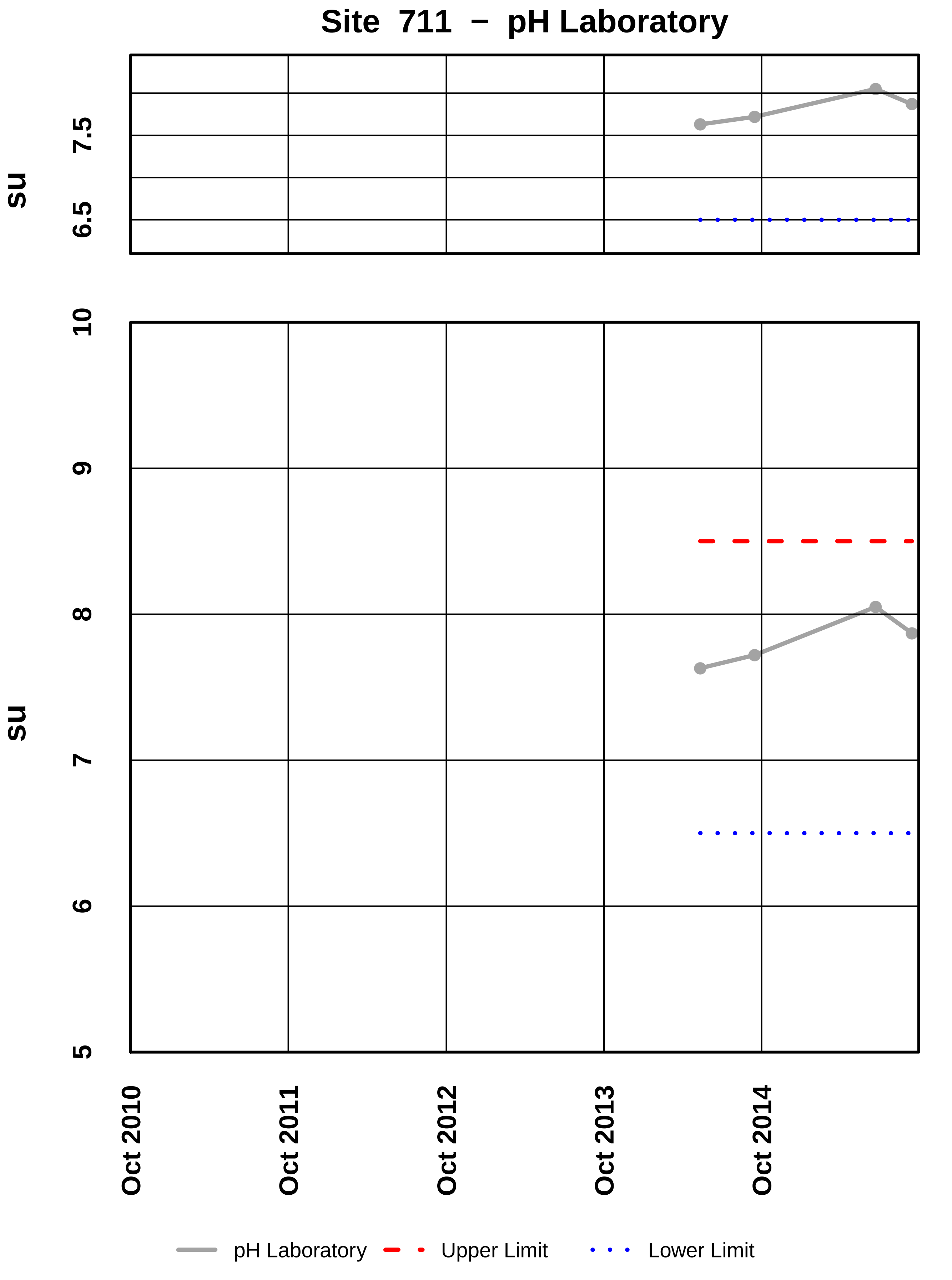


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 711 – Conductivity Field

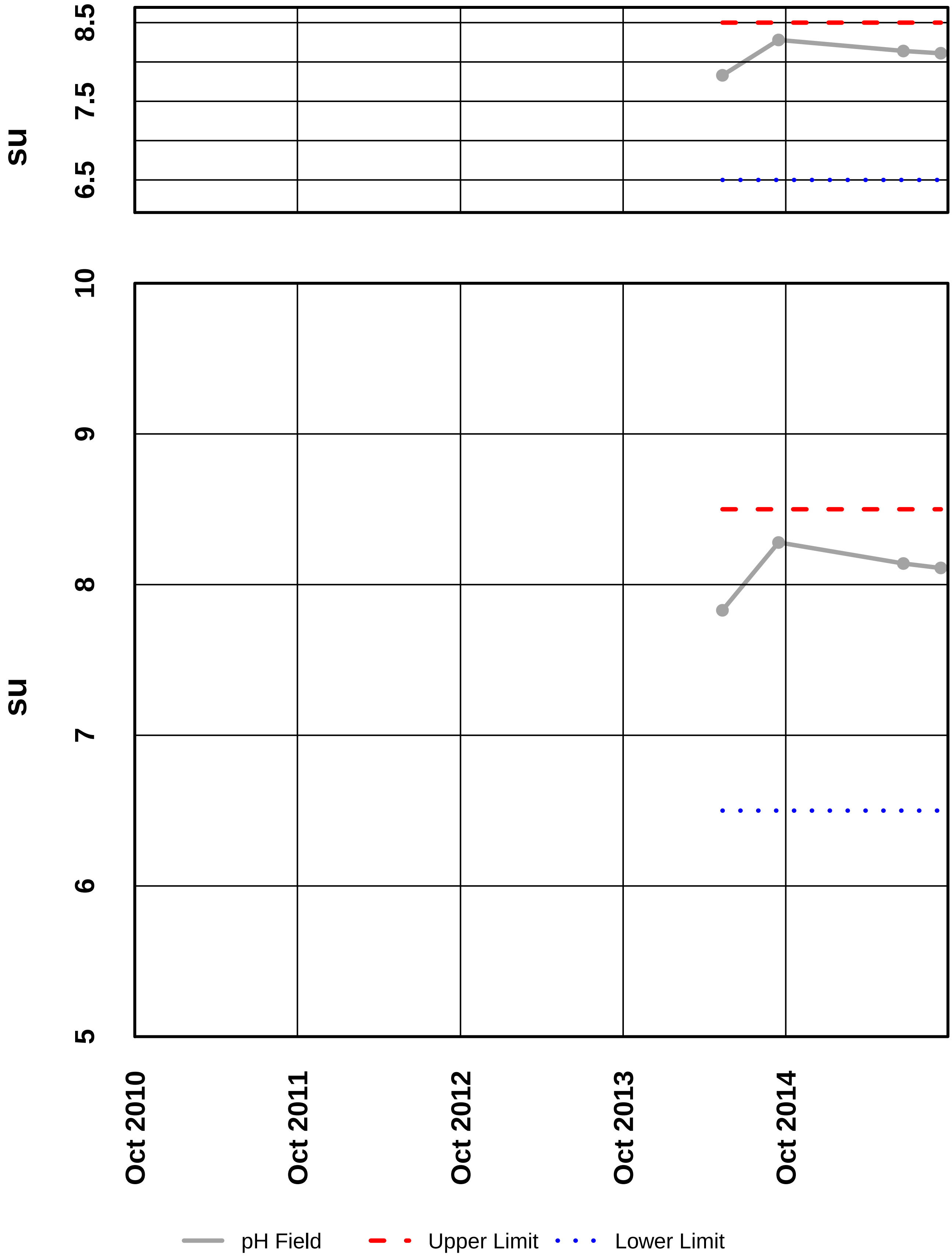


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



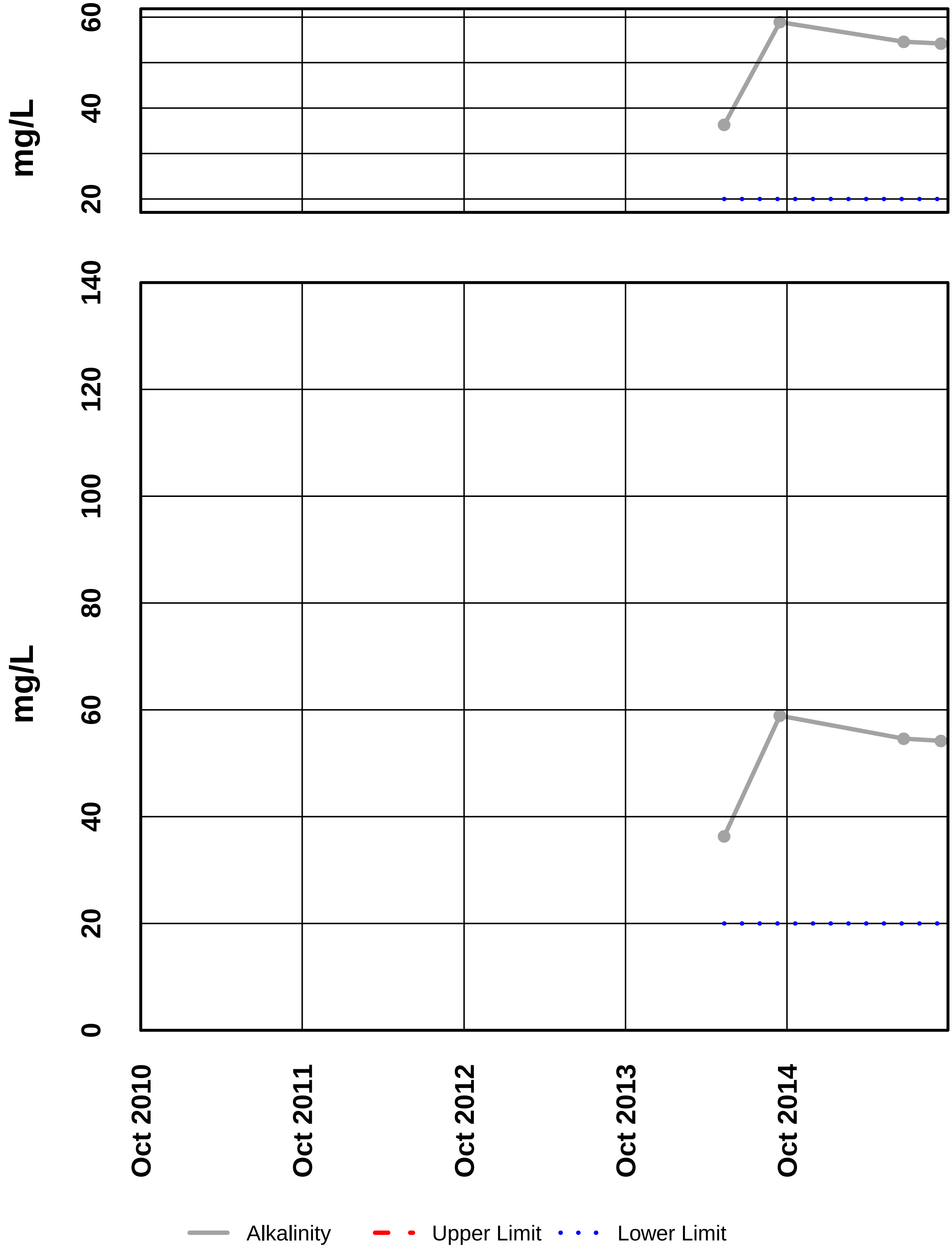
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 711 – pH Field



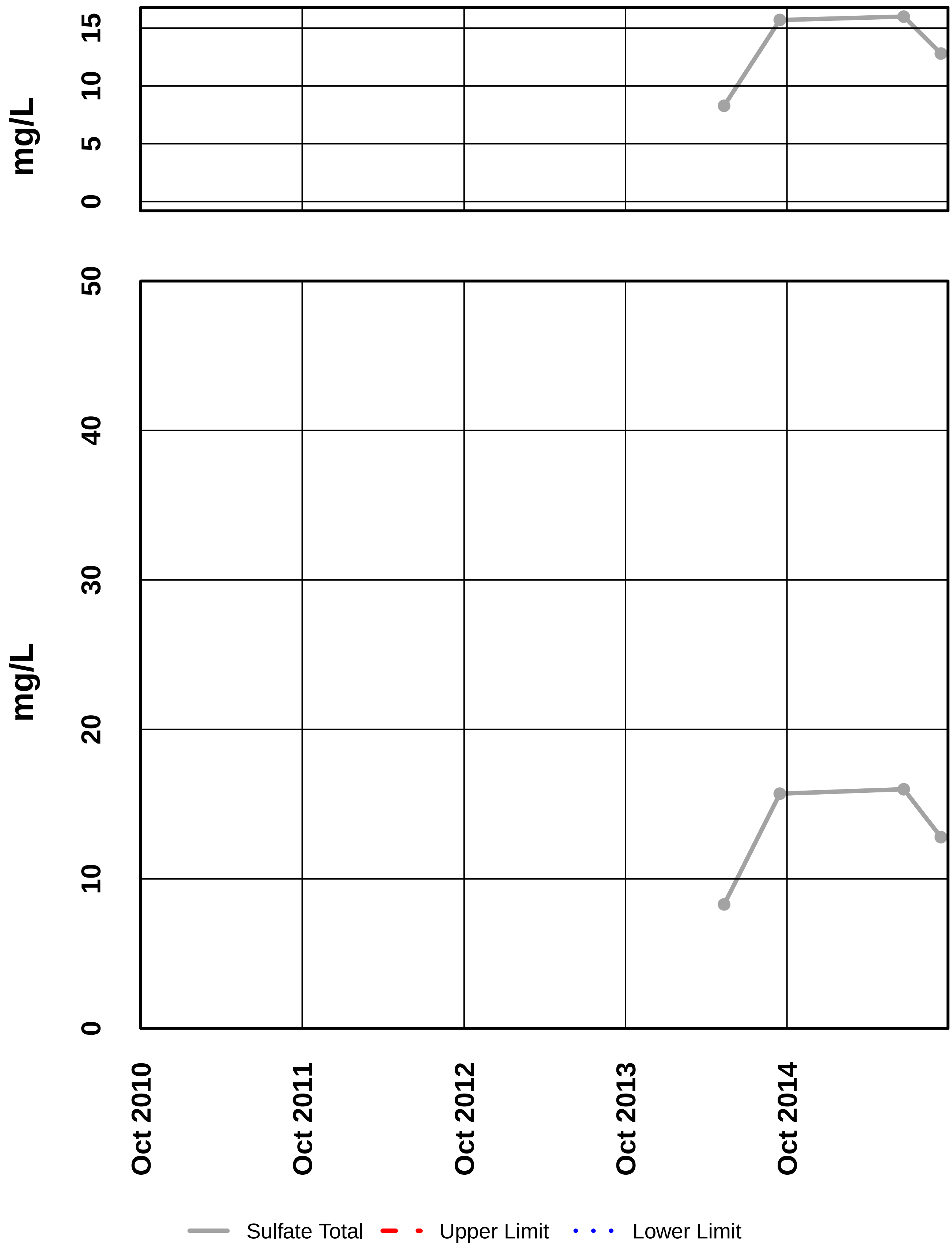
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 711 – Alkalinity



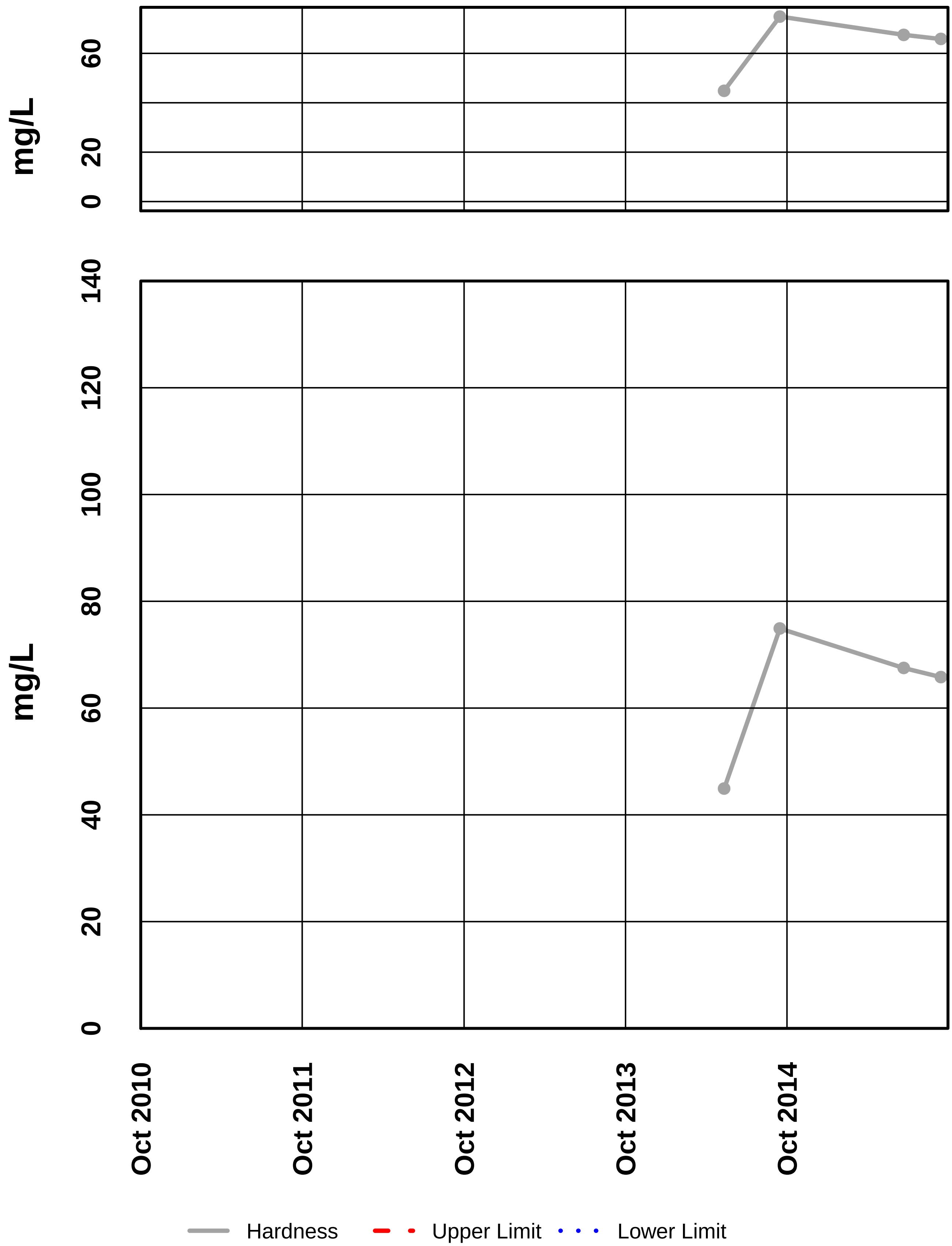
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 711 – Sulfate Total

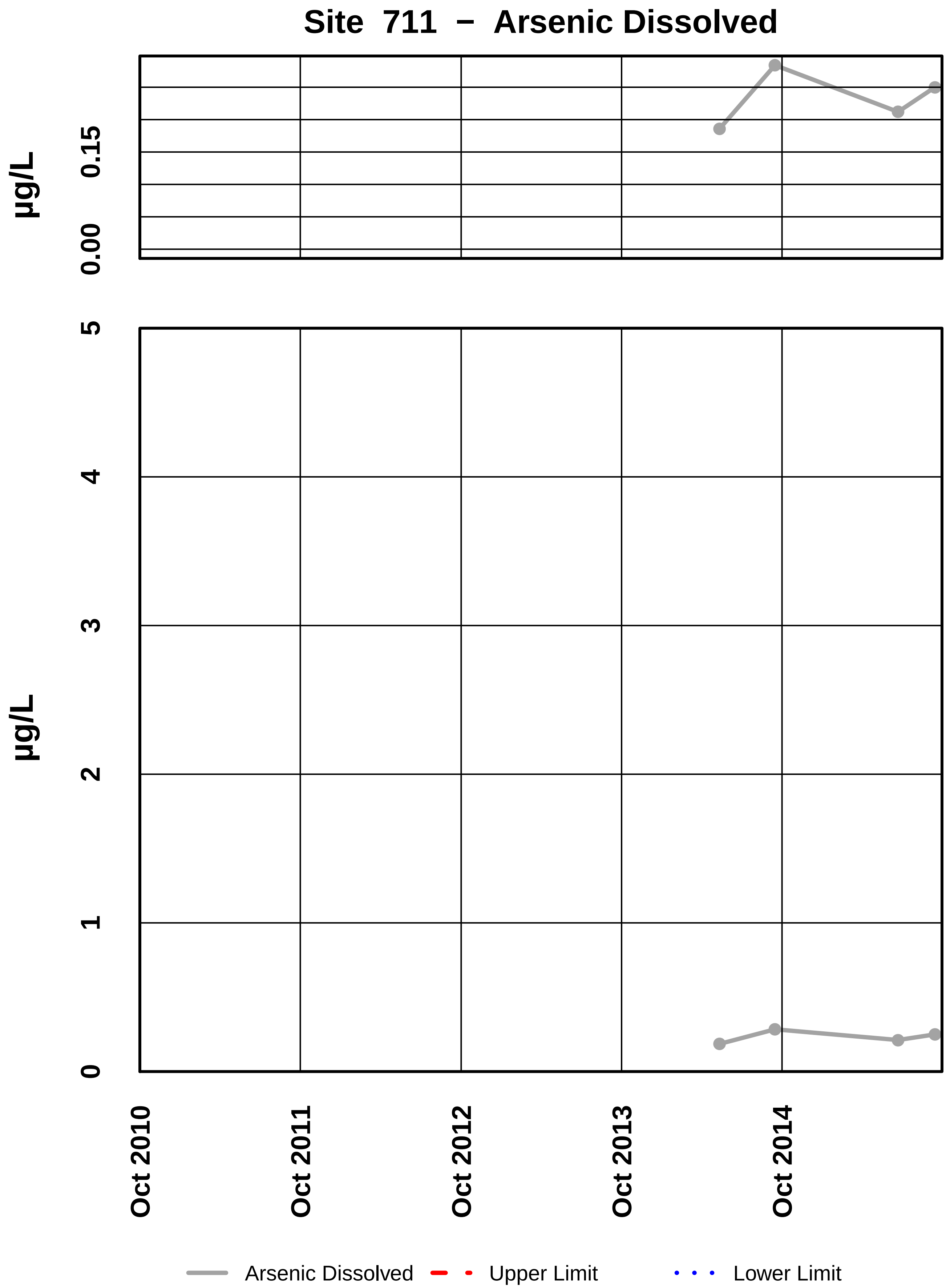


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 711 − Hardness

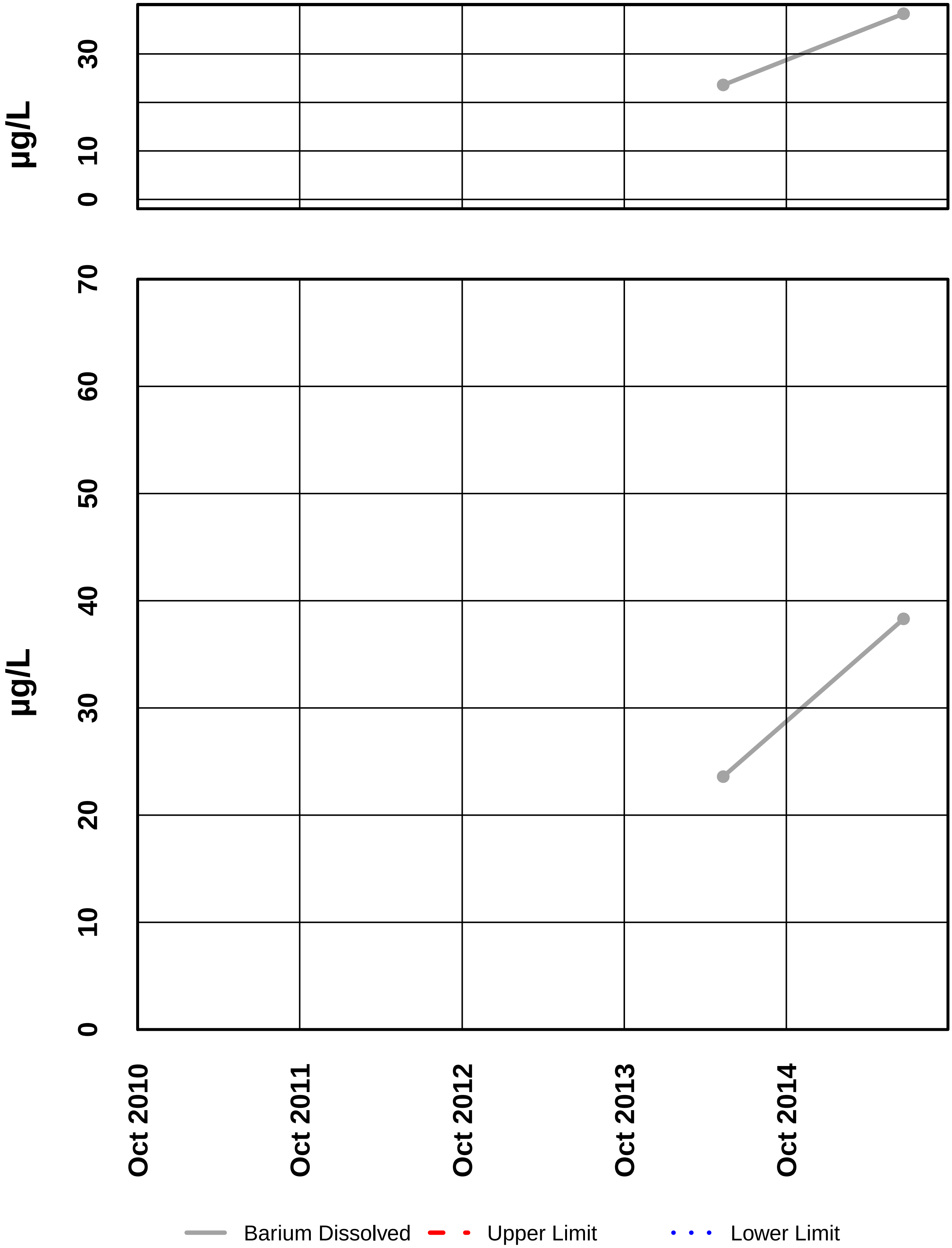


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



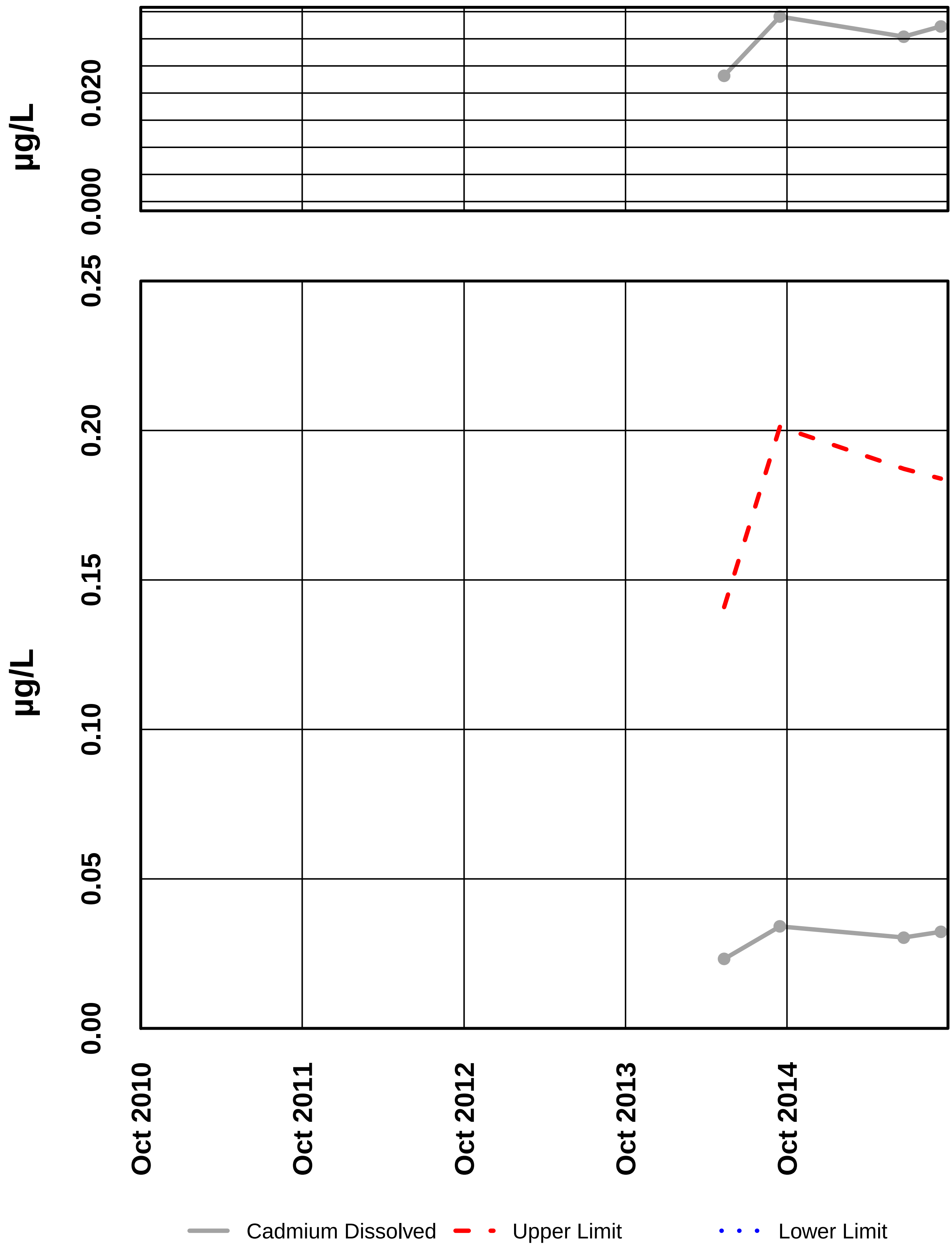
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 711 – Barium Dissolved



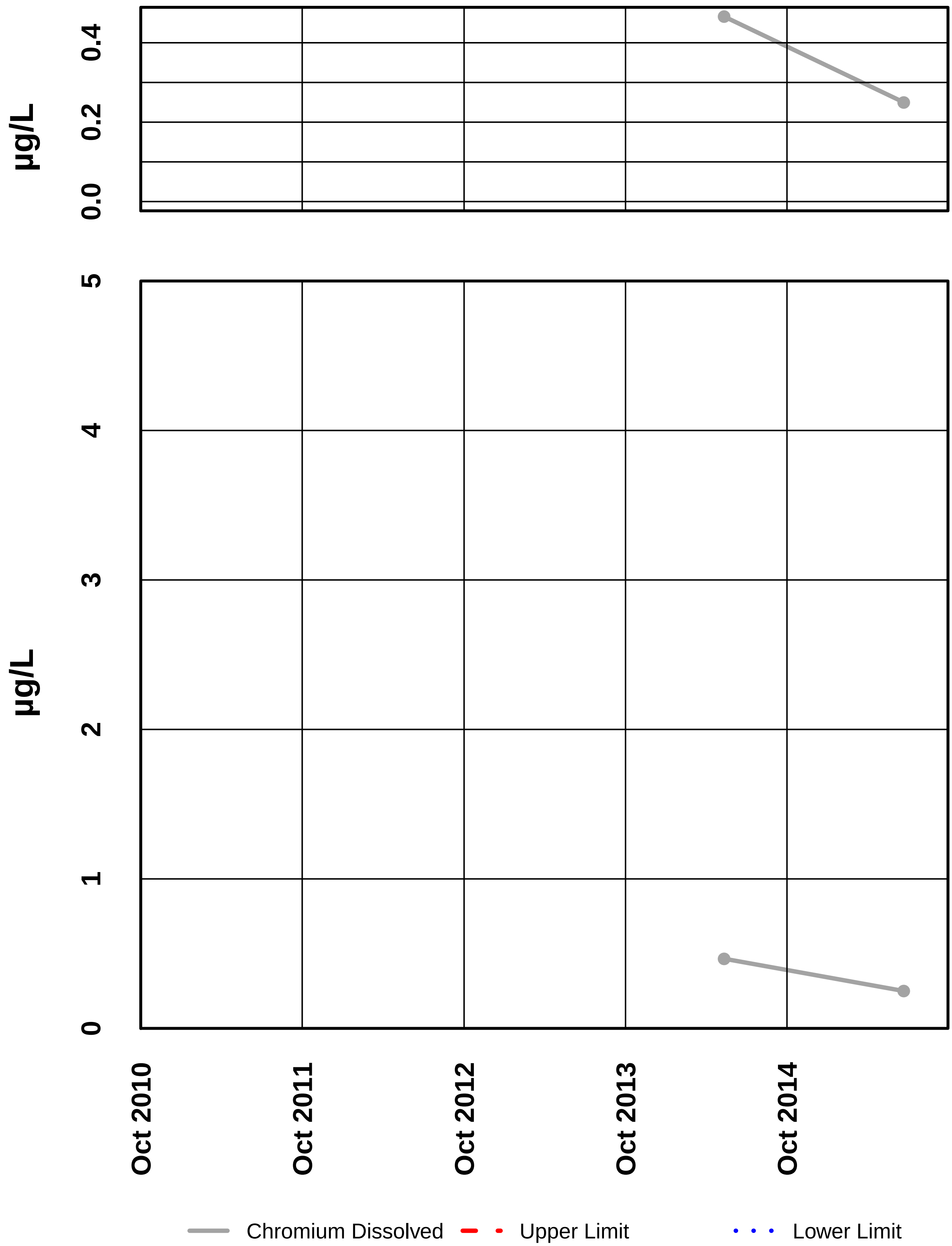
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 711 – Cadmium Dissolved



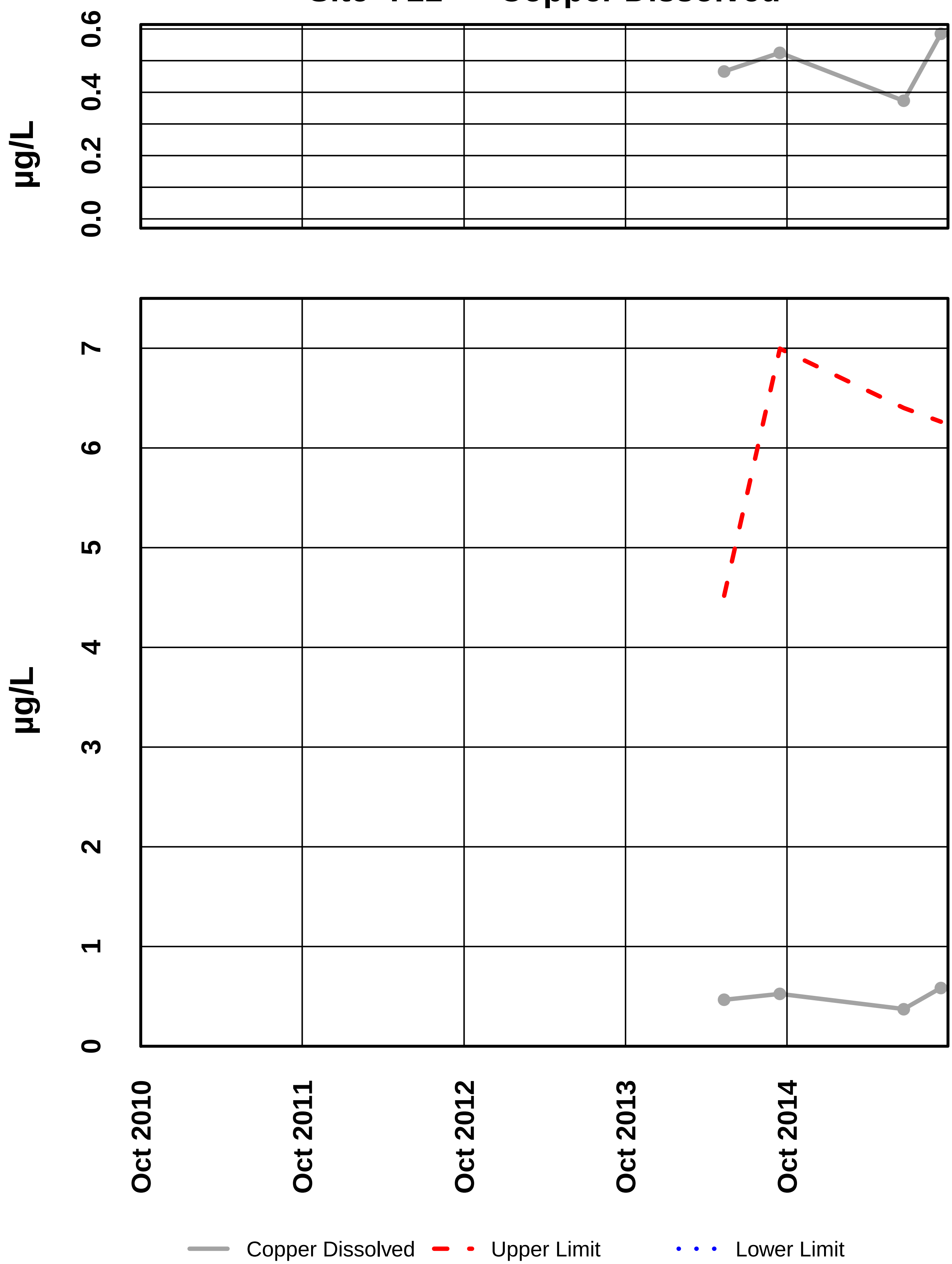
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 711 – Chromium Dissolved

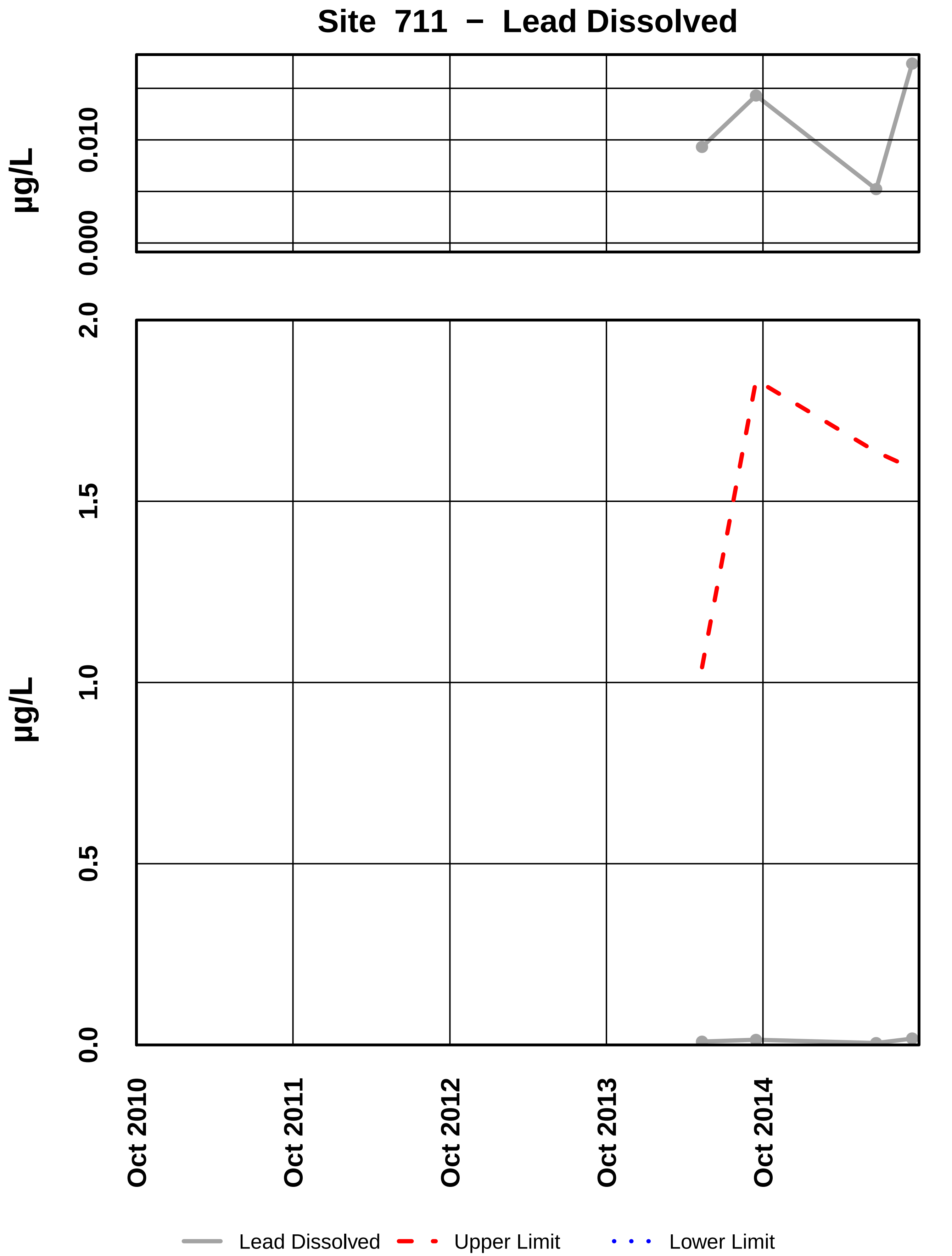


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 711 – Copper Dissolved

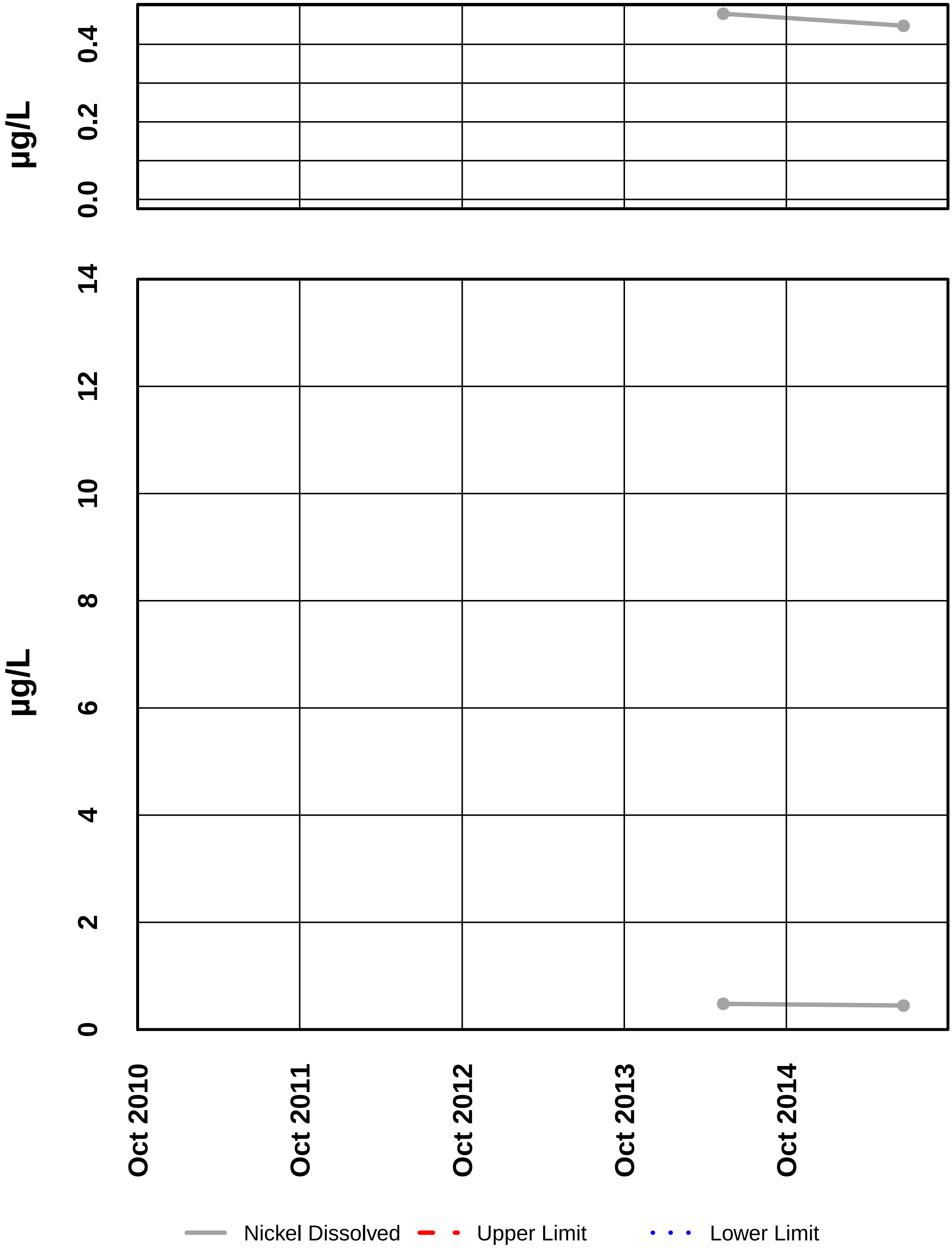


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



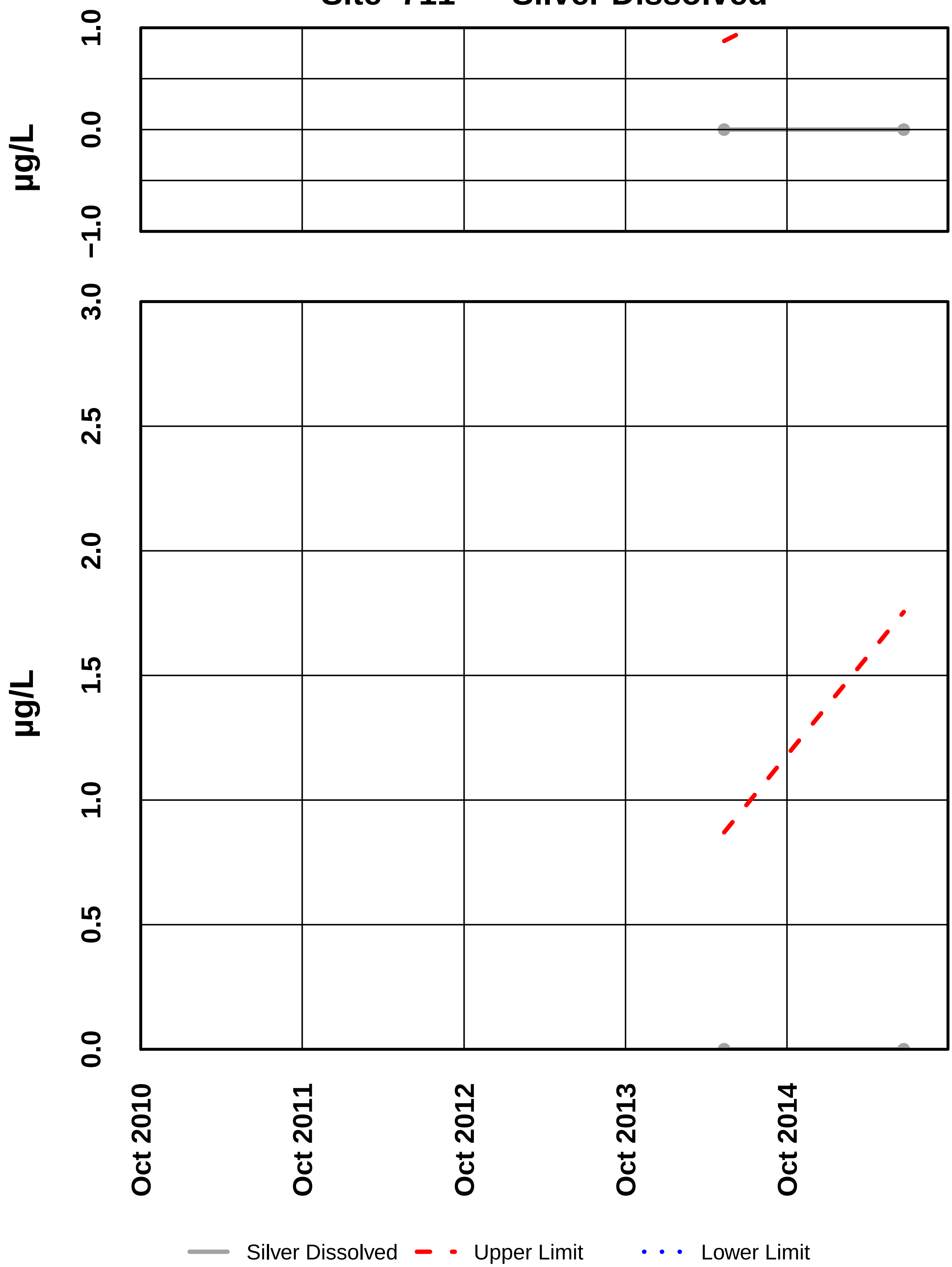
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 711 – Nickel Dissolved

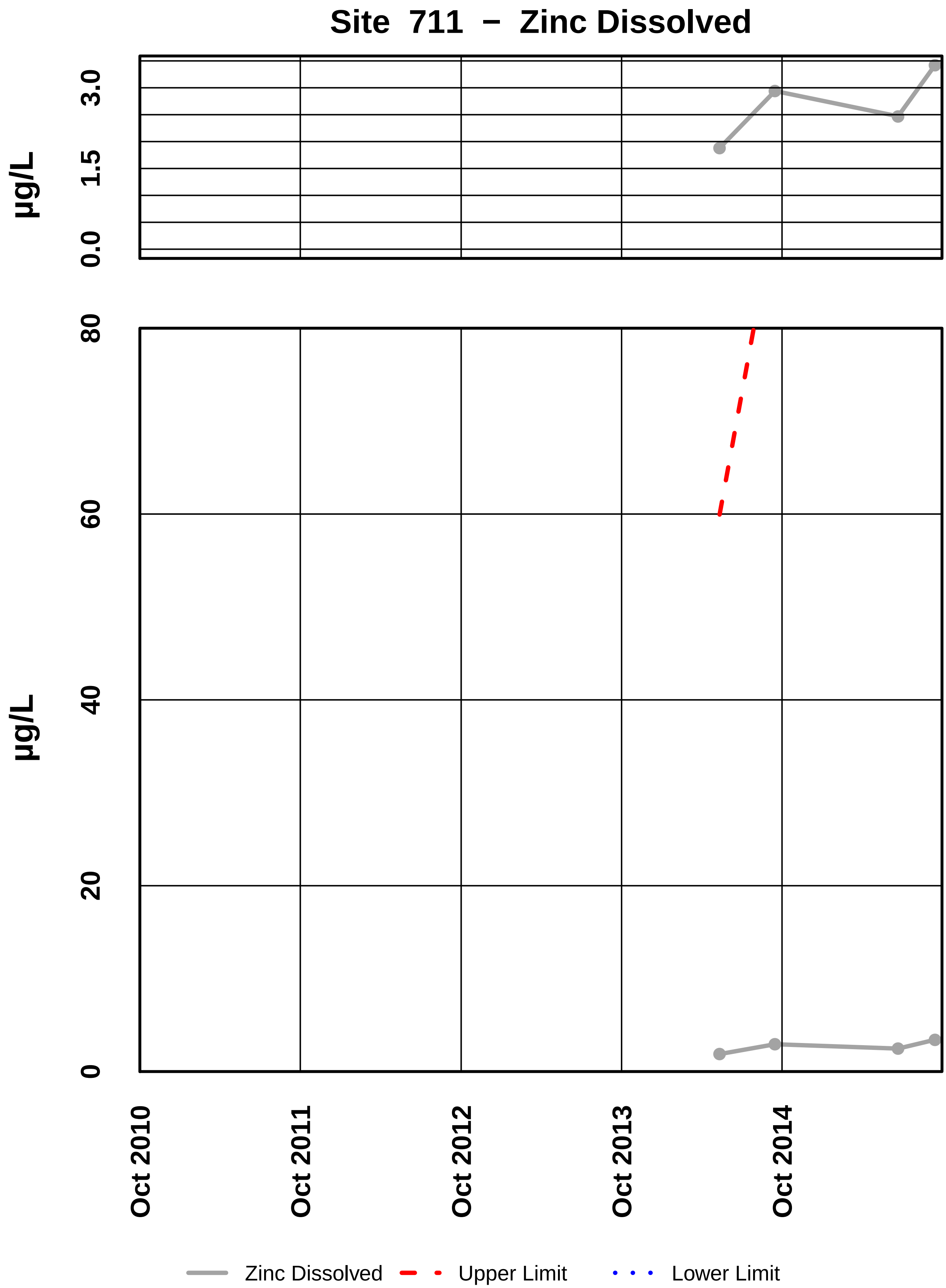


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

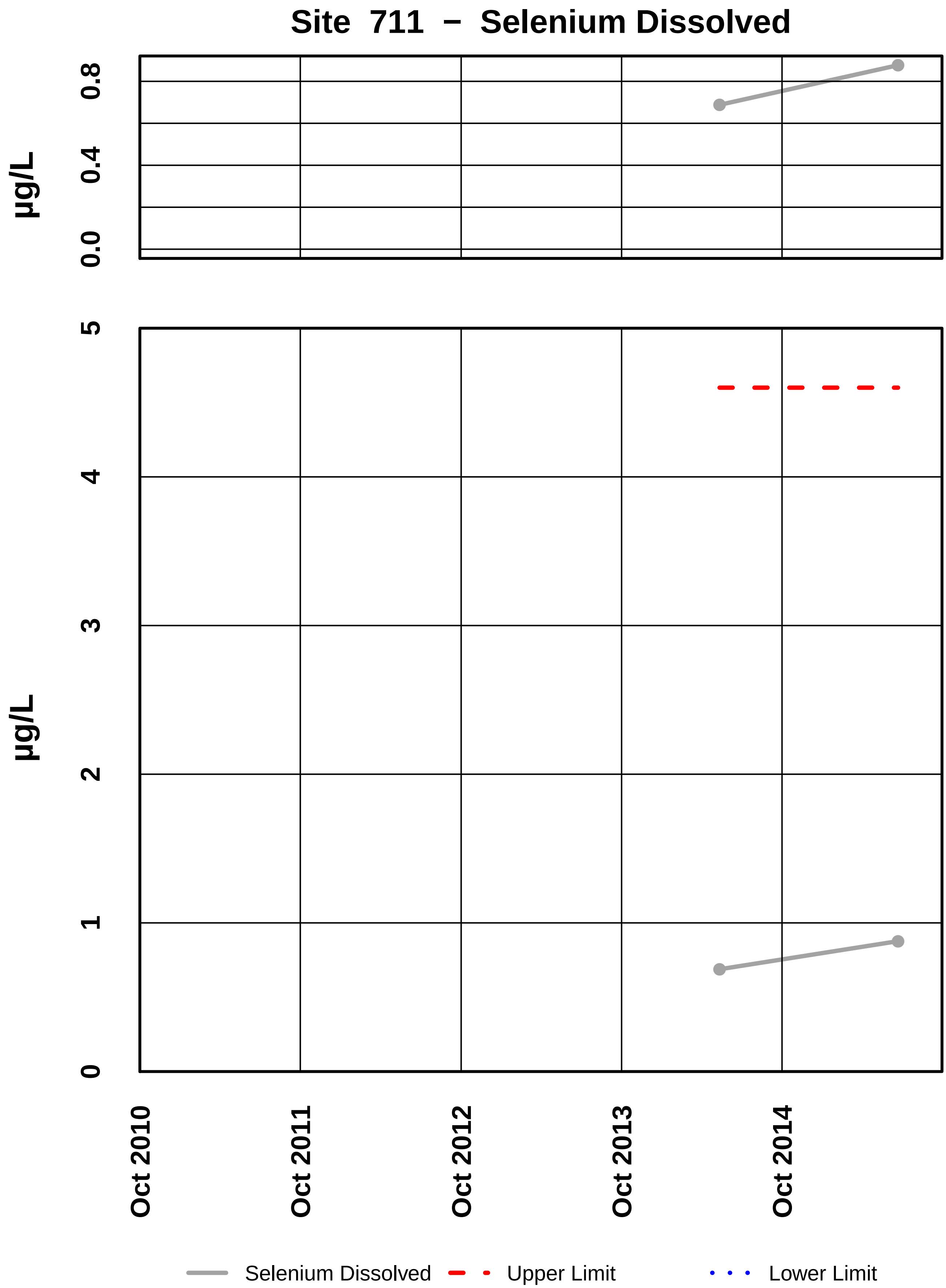
Site 711 − Silver Dissolved



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

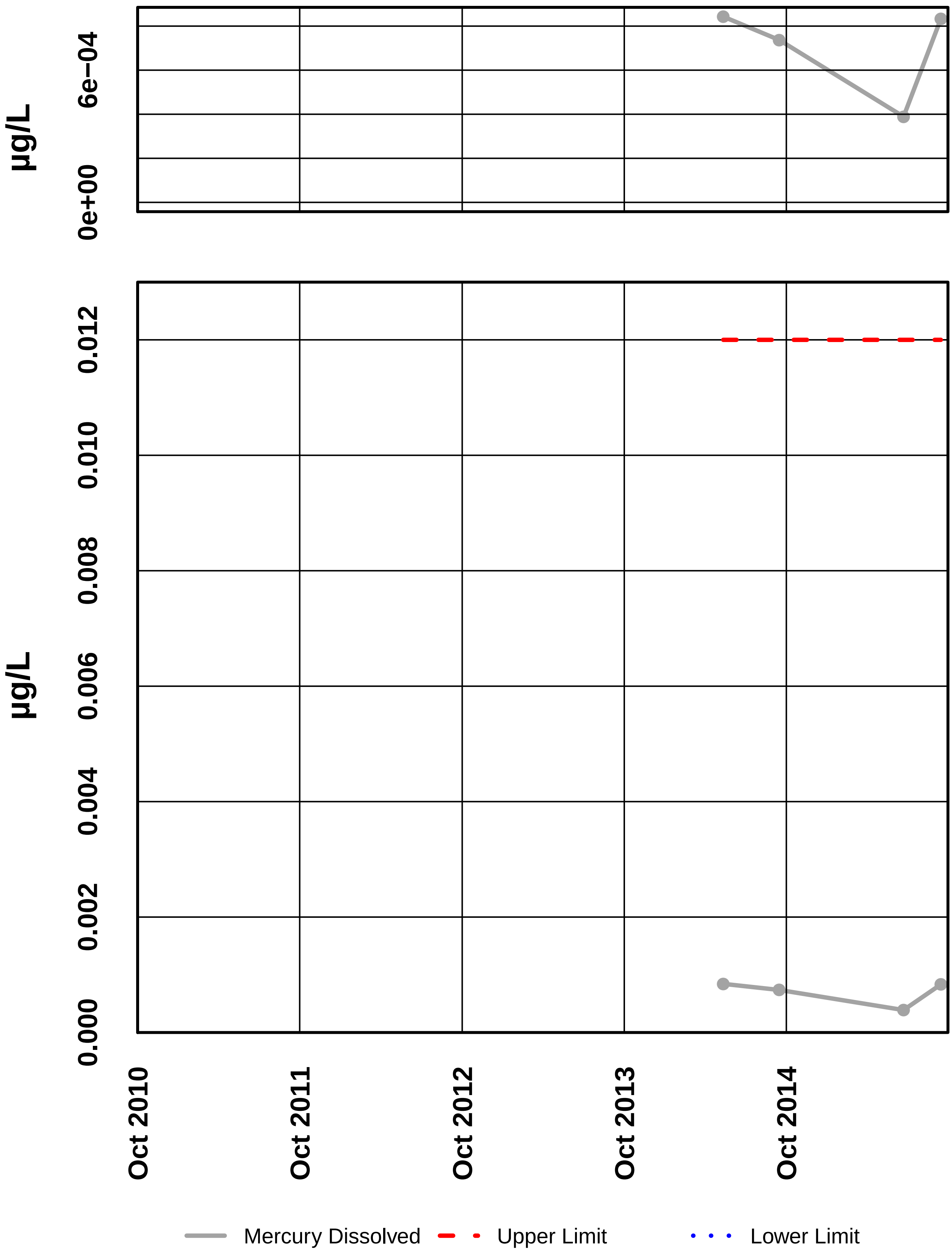


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

Site 711 – Mercury Dissolved



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

INTERPRETIVE REPORT
SITE 712

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

The data collected during the current water year are listed in the following "Table of Results for Water Year 2015" report. The table includes all the required FWMP analyte data (field and laboratory) collected for the current water year and a series of flags keyed to the summary report "Qualified Data by QA Reviewer". The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of ½ MDL for the purpose of median calculation.

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

Sample Date	Parameter	Value	Qualifier	Notes
No outliers have been identified by HGCMC for the period of October 2013 through September 2015.				

The data for Water Year 2015 have been compared to the strictest fresh water quality criterion for each applicable analyte. No results exceeding these criteria were identified as listed in the table below.

Table of Exceedance for Water Year 2015

			Limits		
Sample Date	**Parameter**	**Value**	**Lower**	**Upper**	**Hardness**
No exceedances have been identified by HGCMC for the period of October 2014 through September 2015.					

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 2015

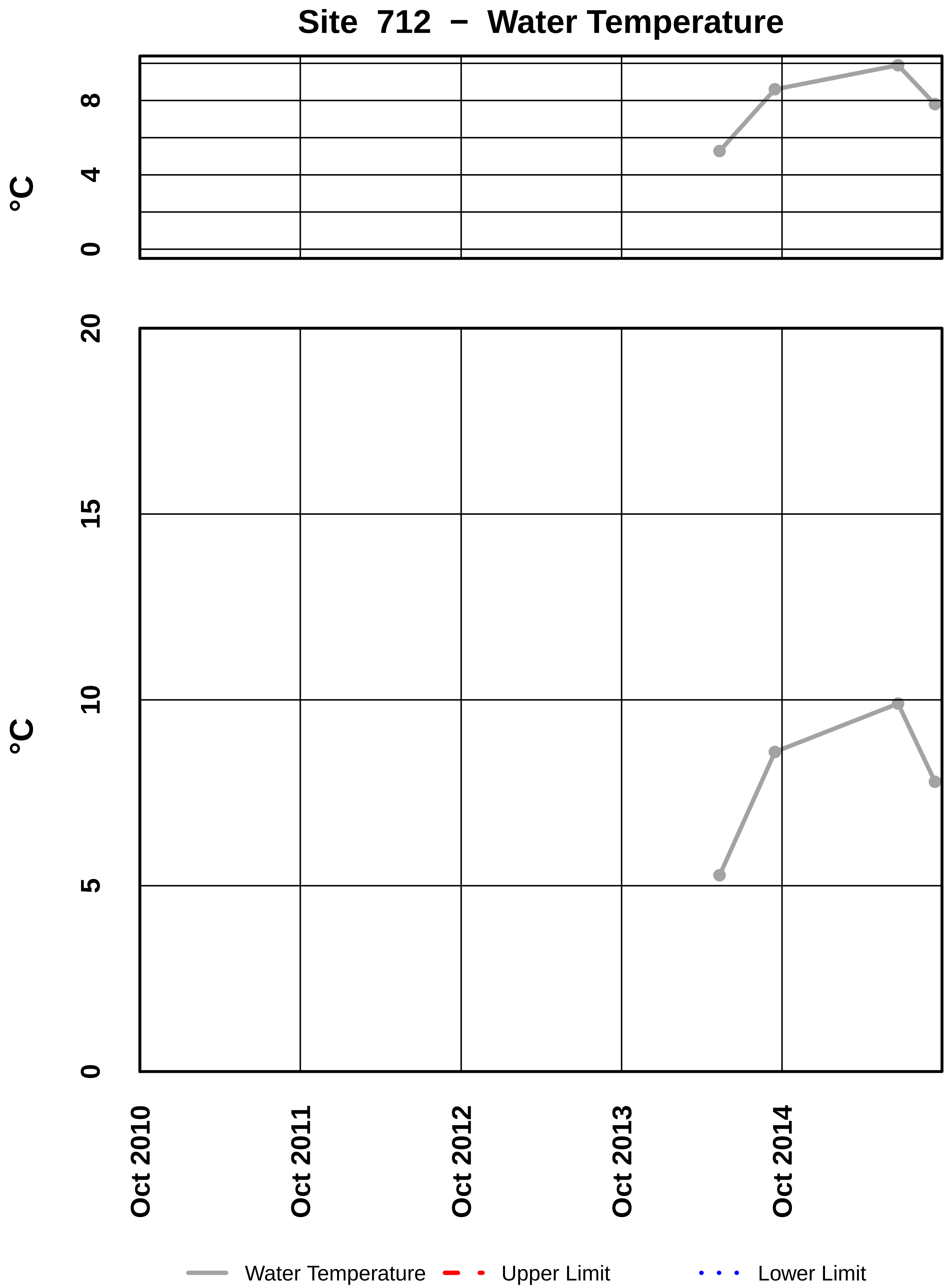
Site 712FMS - 'Greens Creek Below Site E'

Sample Date/Parameter	Oct 2014	Nov 2014	Dec 2014	Jan 2015	Feb 2015	Mar 2015	Apr 2015	May 2015	Jun 2015	Jul 2015	Aug 2015	Sep 2015	**Median**
Water Temp (°C)									9.9			7.8	8.9
Conductivity-Field(µmho)									137.6			142.6	140.1
Conductivity-Lab (µmho)									145			118	132
pH Lab (standard units)									7.98			7.88	7.93
pH Field (standard units)									8.14			8.07	8.11
Total Alkalinity (mg/L)									54.1			54.9	54.5
Total Sulfate (mg/L)									17			13.8	15.4
Hardness (mg/L)									69.4			67.3	68.4
Dissolved As (ug/L)									0.184			0.246	0.215
Dissolved Ba (ug/L)									38.5				38.5
Dissolved Cd (ug/L)									0.031			0.0385	0.0348
Dissolved Cr (ug/L)									0.266				0.266
Dissolved Cu (ug/L)									0.365			0.576	0.471
Dissolved Pb (ug/L)									0.006			0.0153	0.0107
Dissolved Ni (ug/L)									0.461				0.461
Dissolved Ag (ug/L)									0.002				0.002
Dissolved Zn (ug/L)									2.8			4.45	3.63
Dissolved Se (ug/L)									0.87				0.870
Dissolved Hg (ug/L)									0.000401			0.000881	0.000641

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

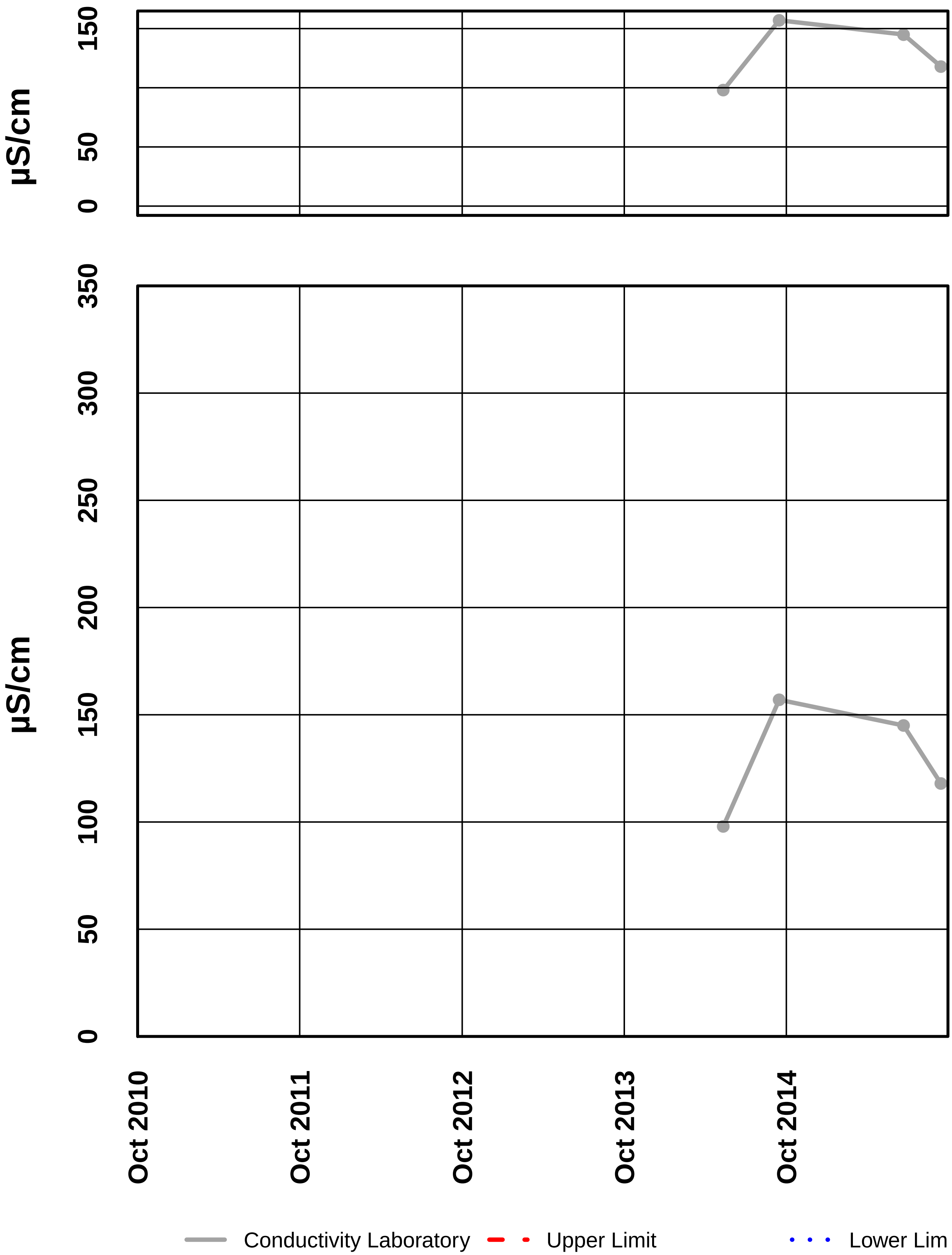
Values reported as less than MDL are replaced by 1/2 MDL for median calculation purposes.

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



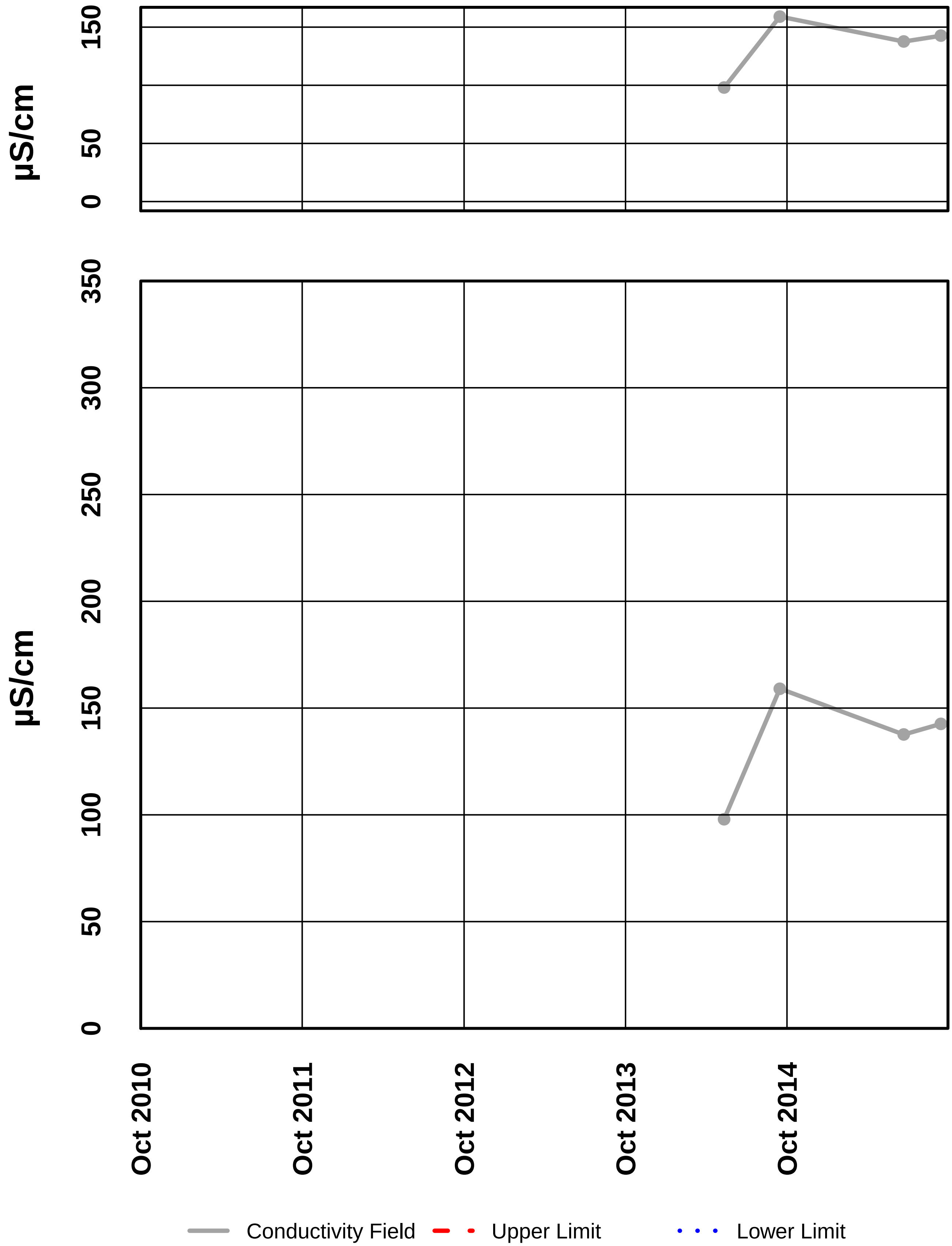
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 712 – Conductivity Laboratory



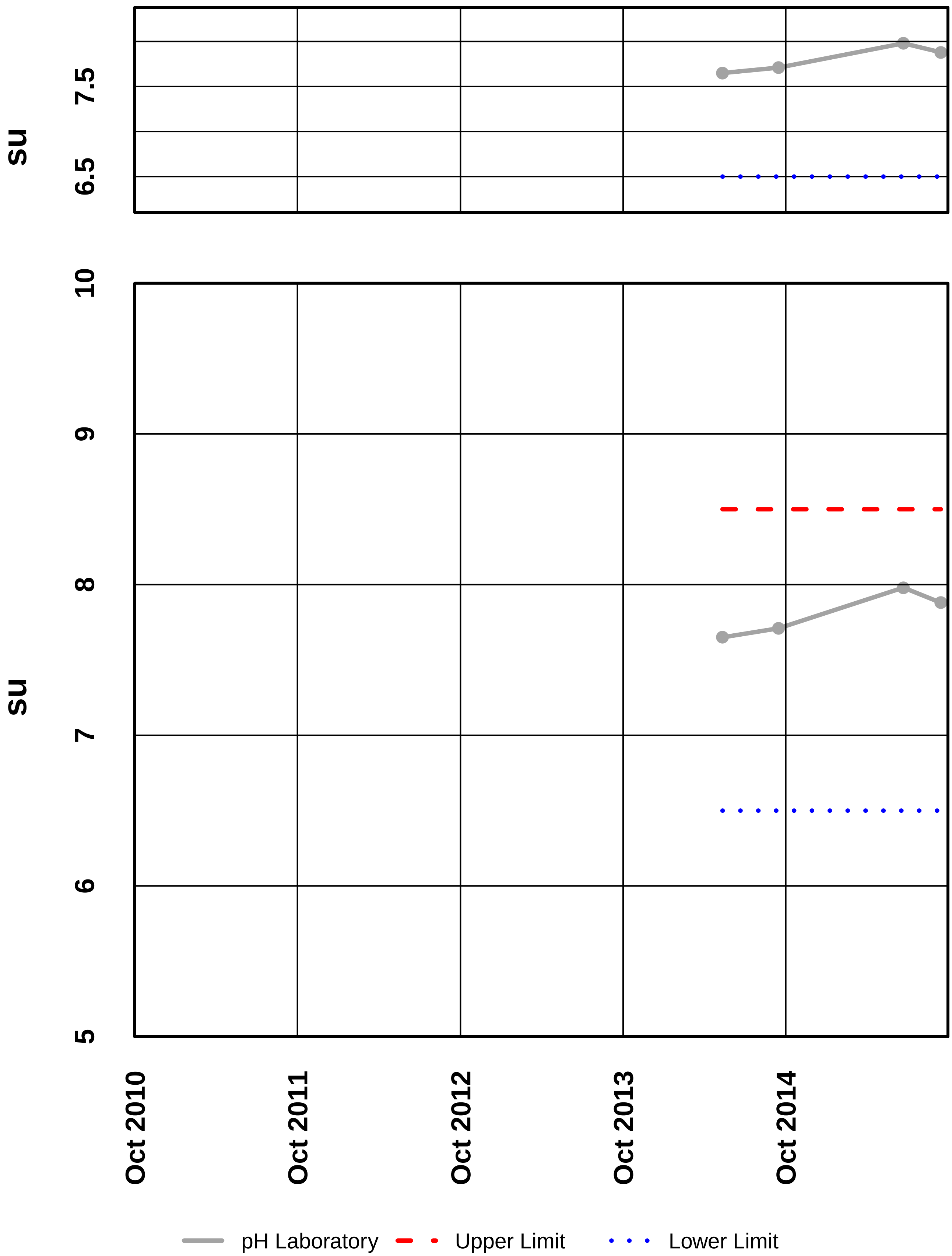
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 712 − Conductivity Field



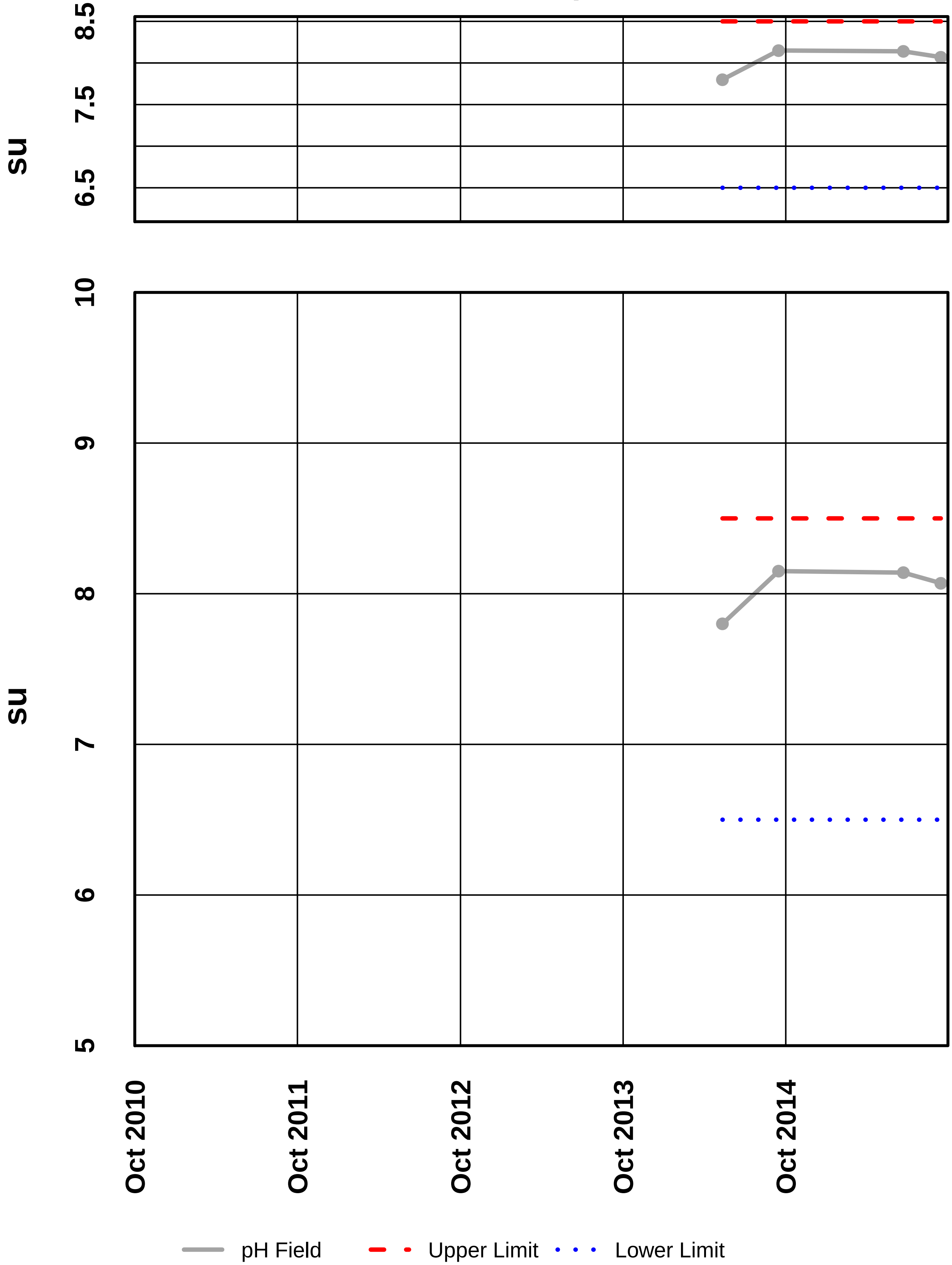
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 712 – pH Laboratory

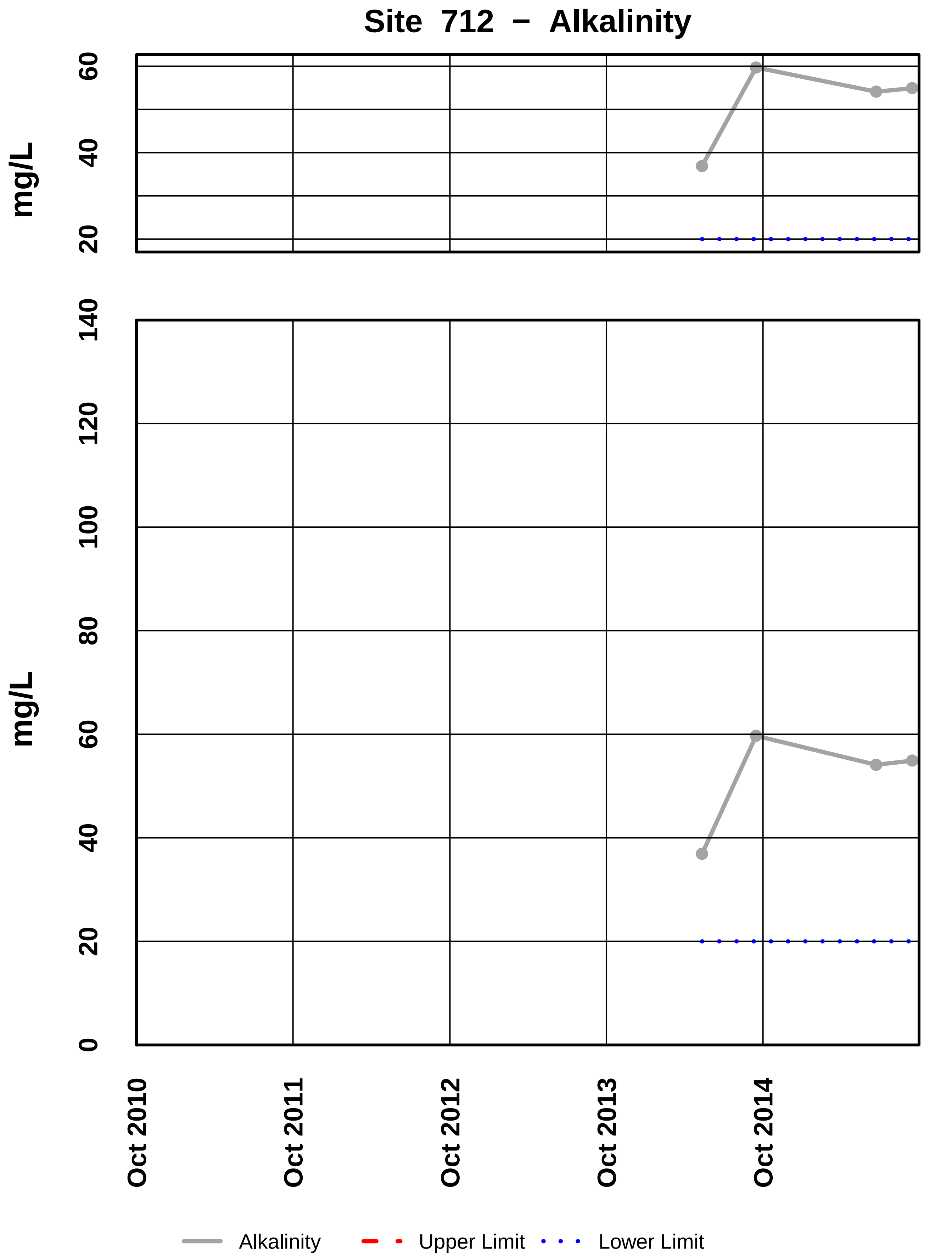


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

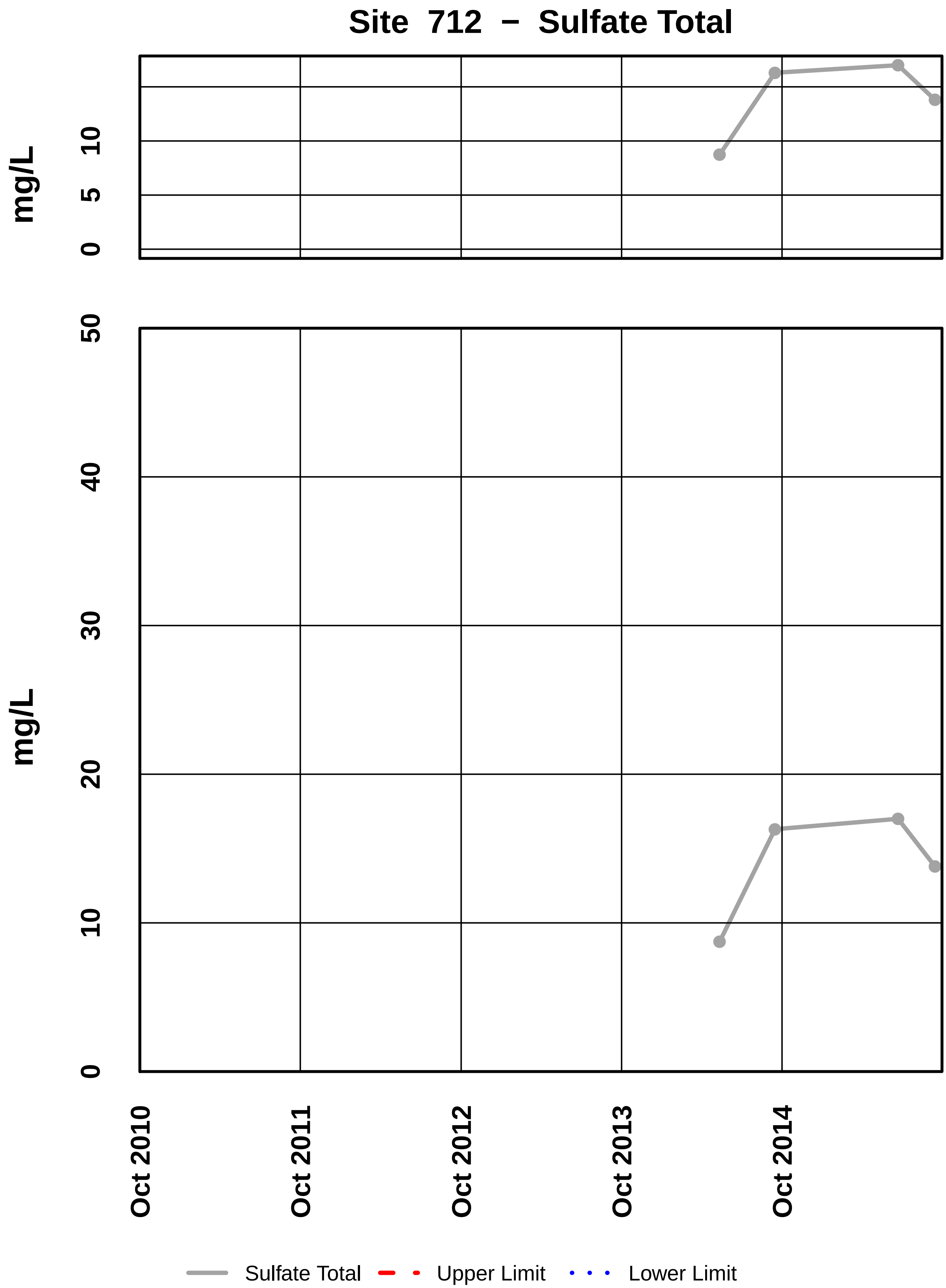
Site 712 – pH Field



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

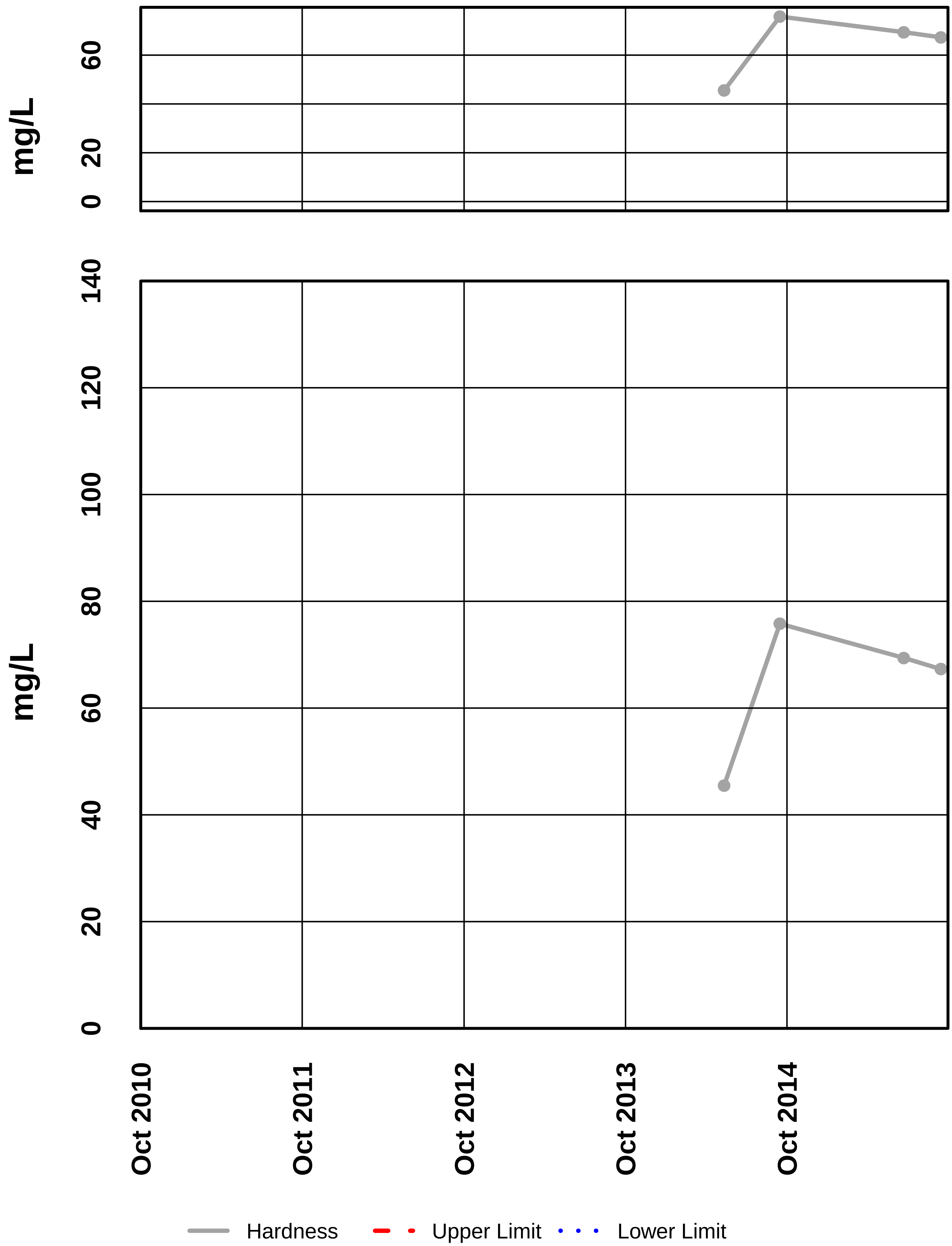


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

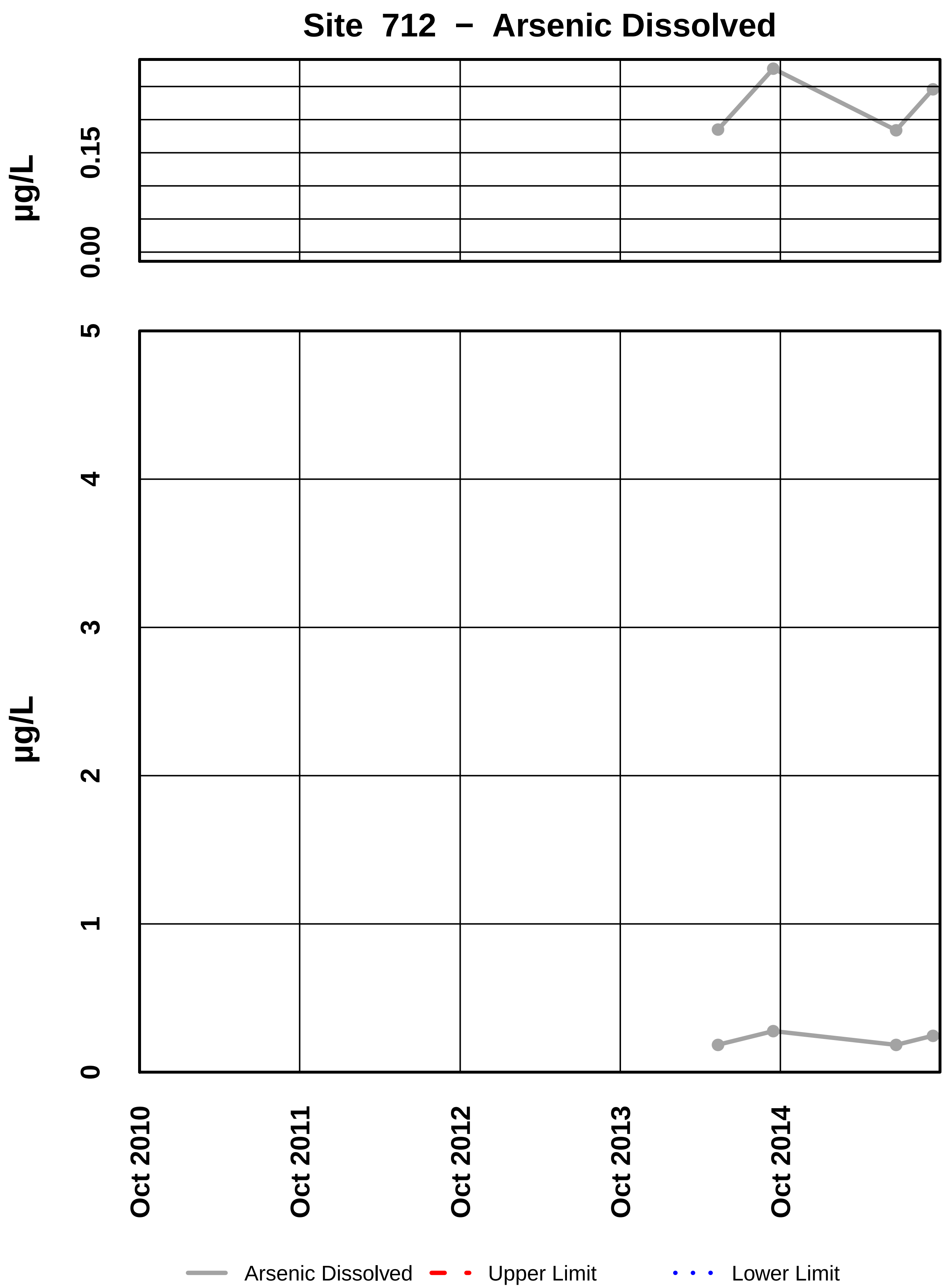


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 712 – Hardness

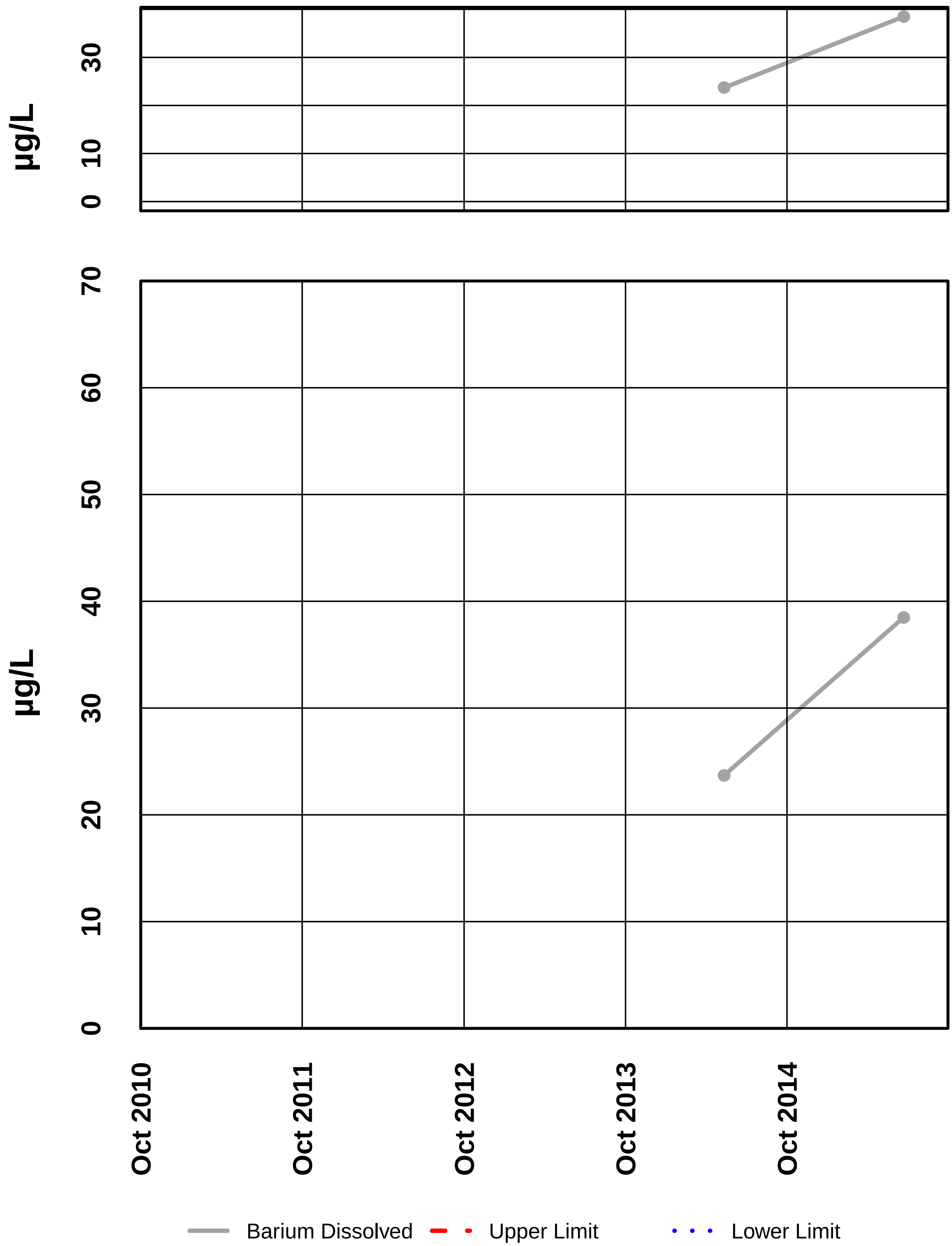


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

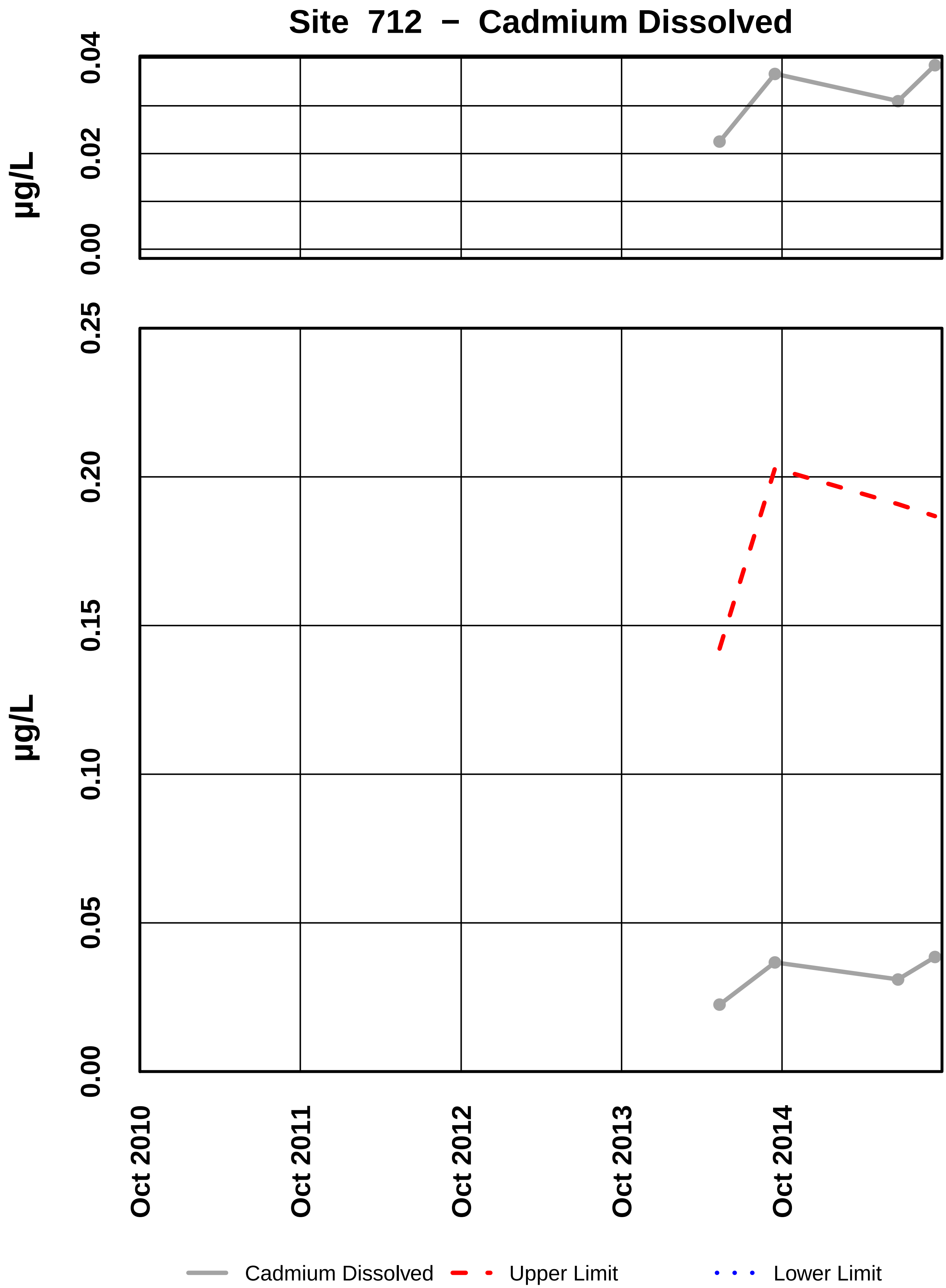


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 712 – Barium Dissolved

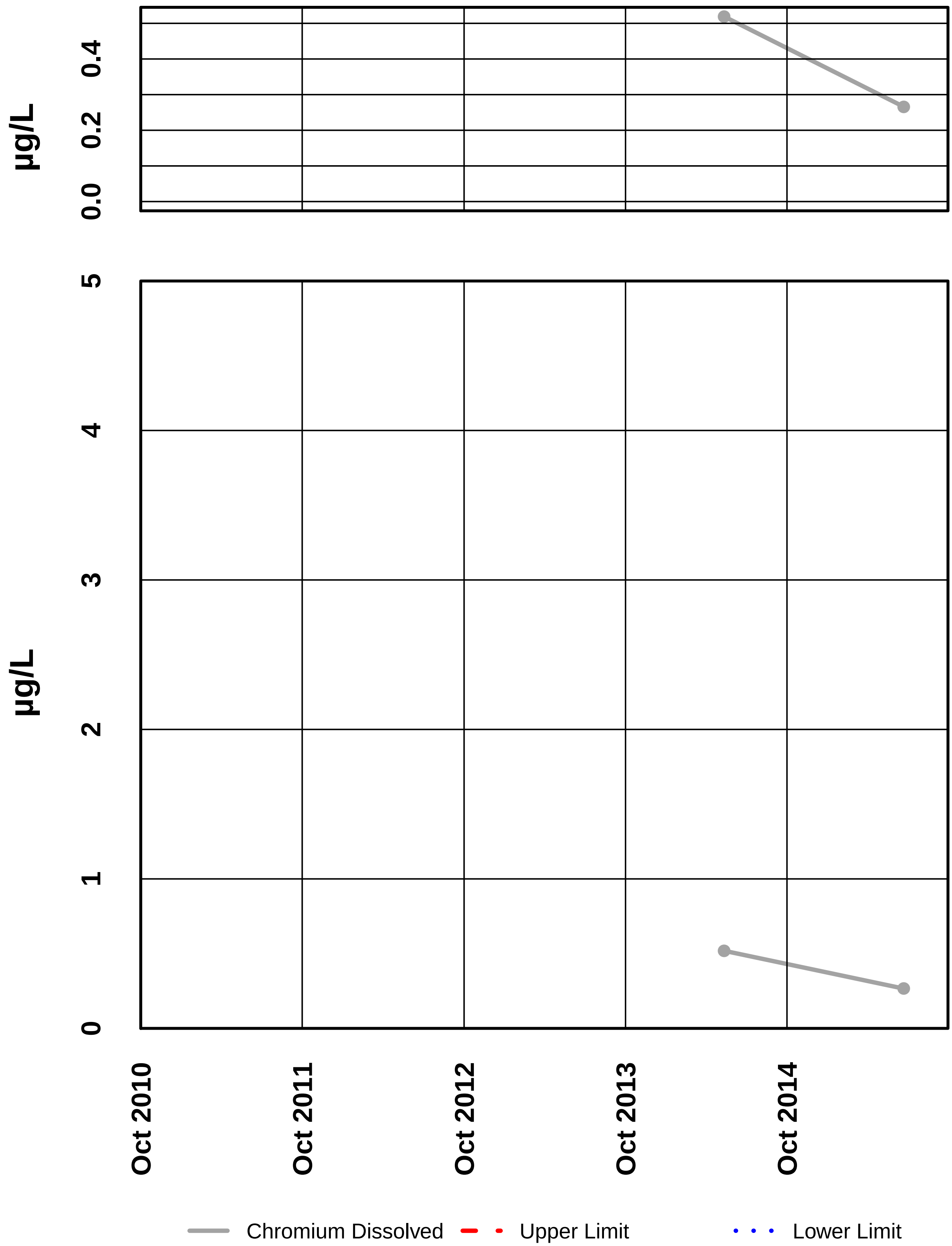


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

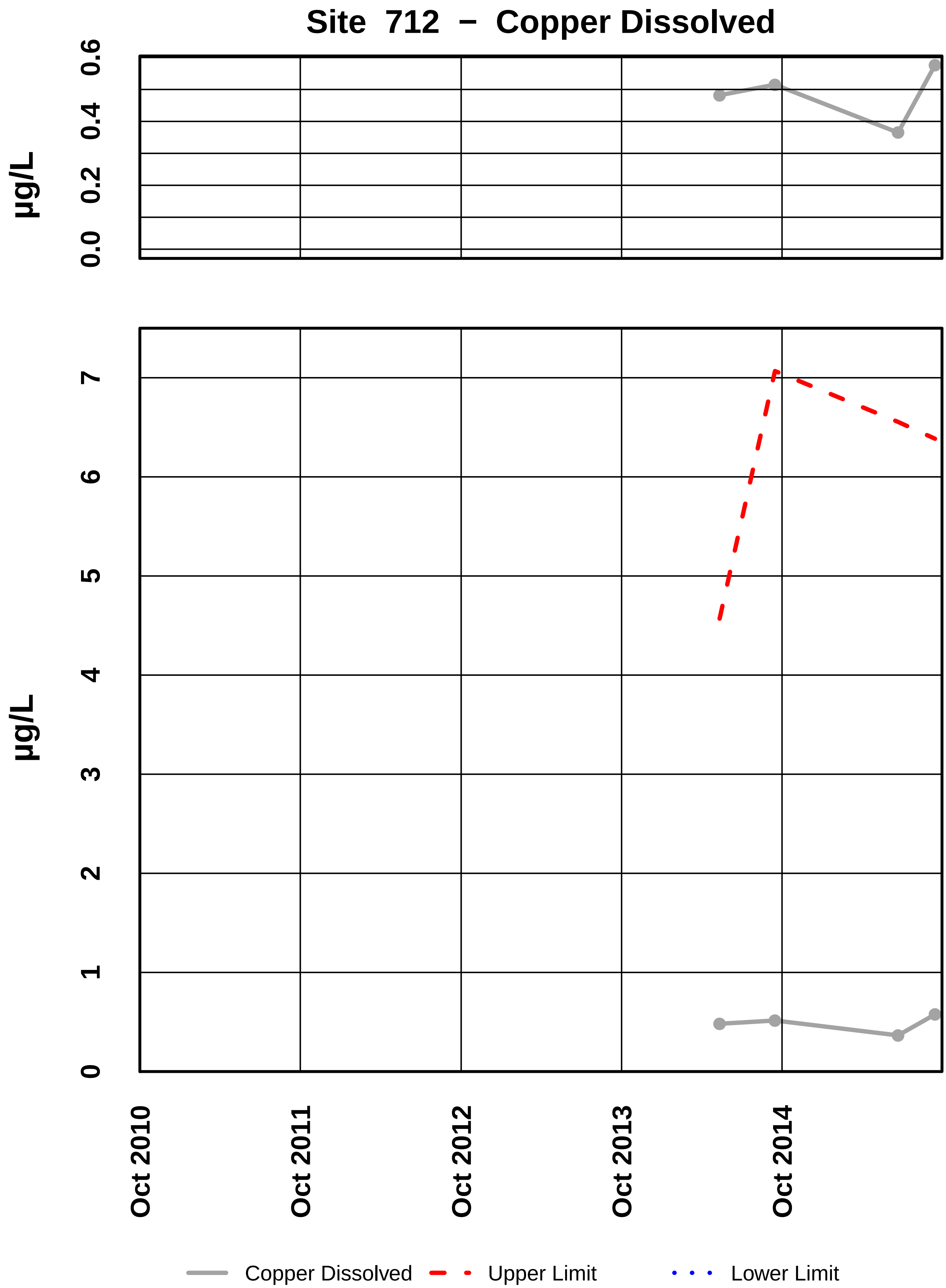


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 712 − Chromium Dissolved

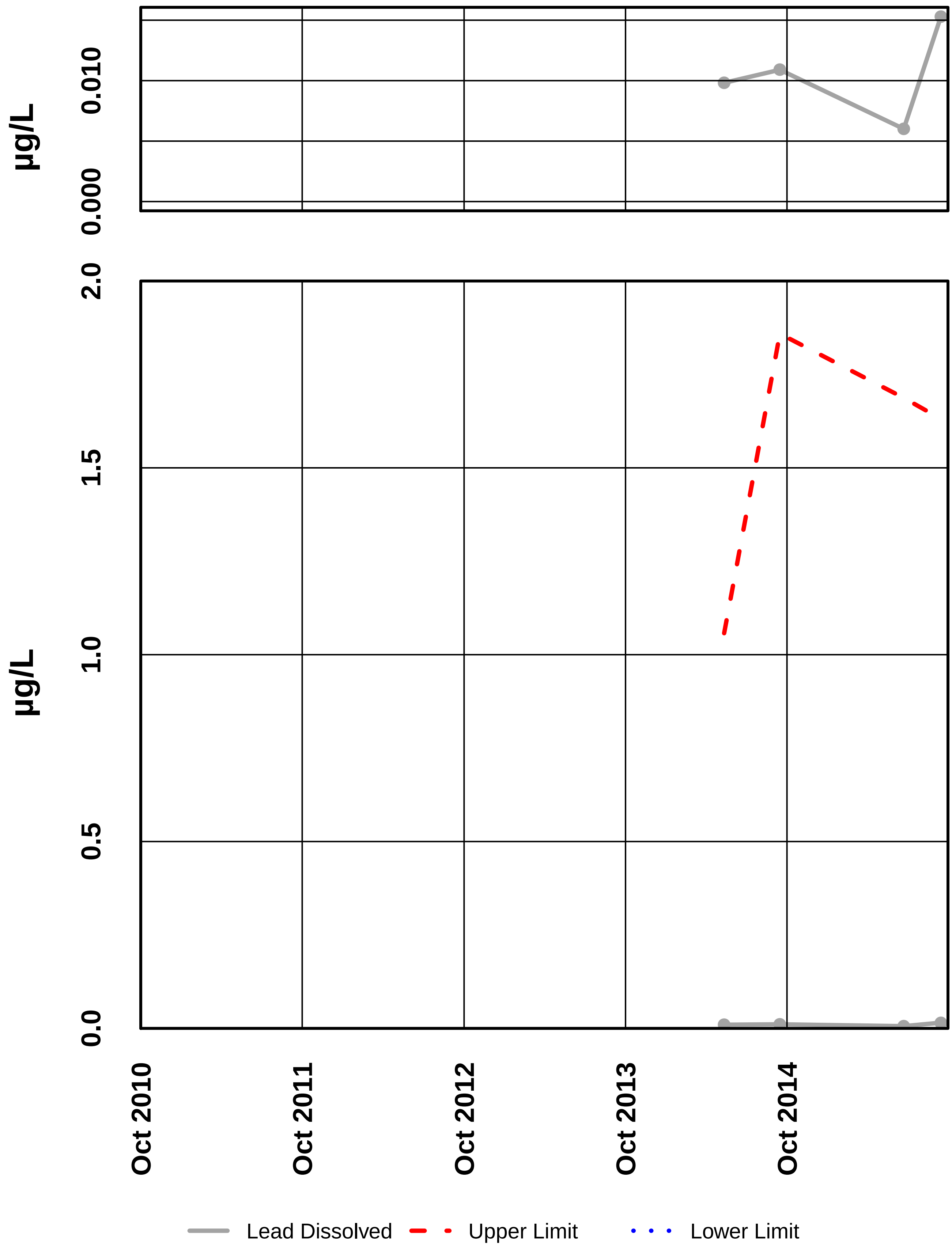


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



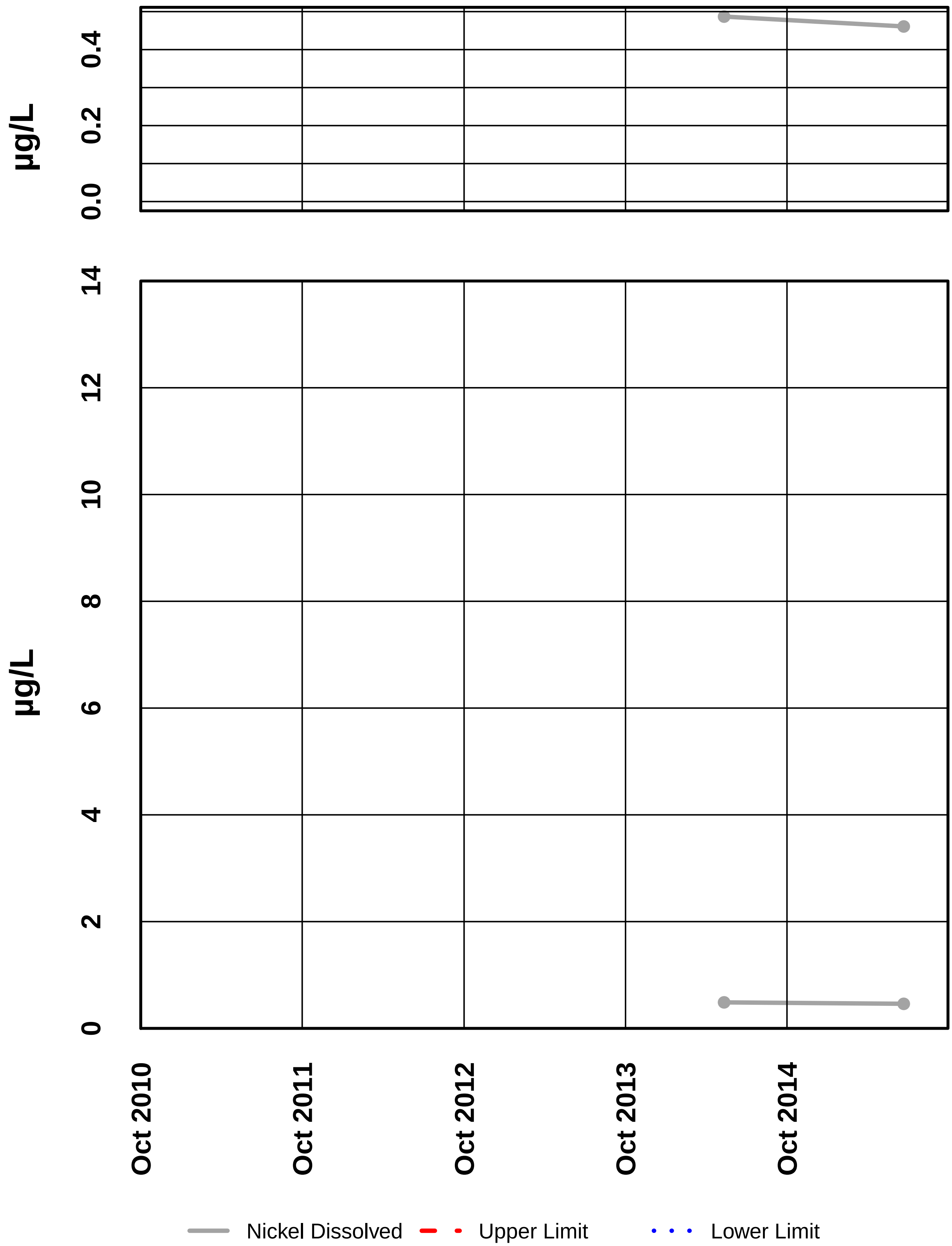
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 712 − Lead Dissolved



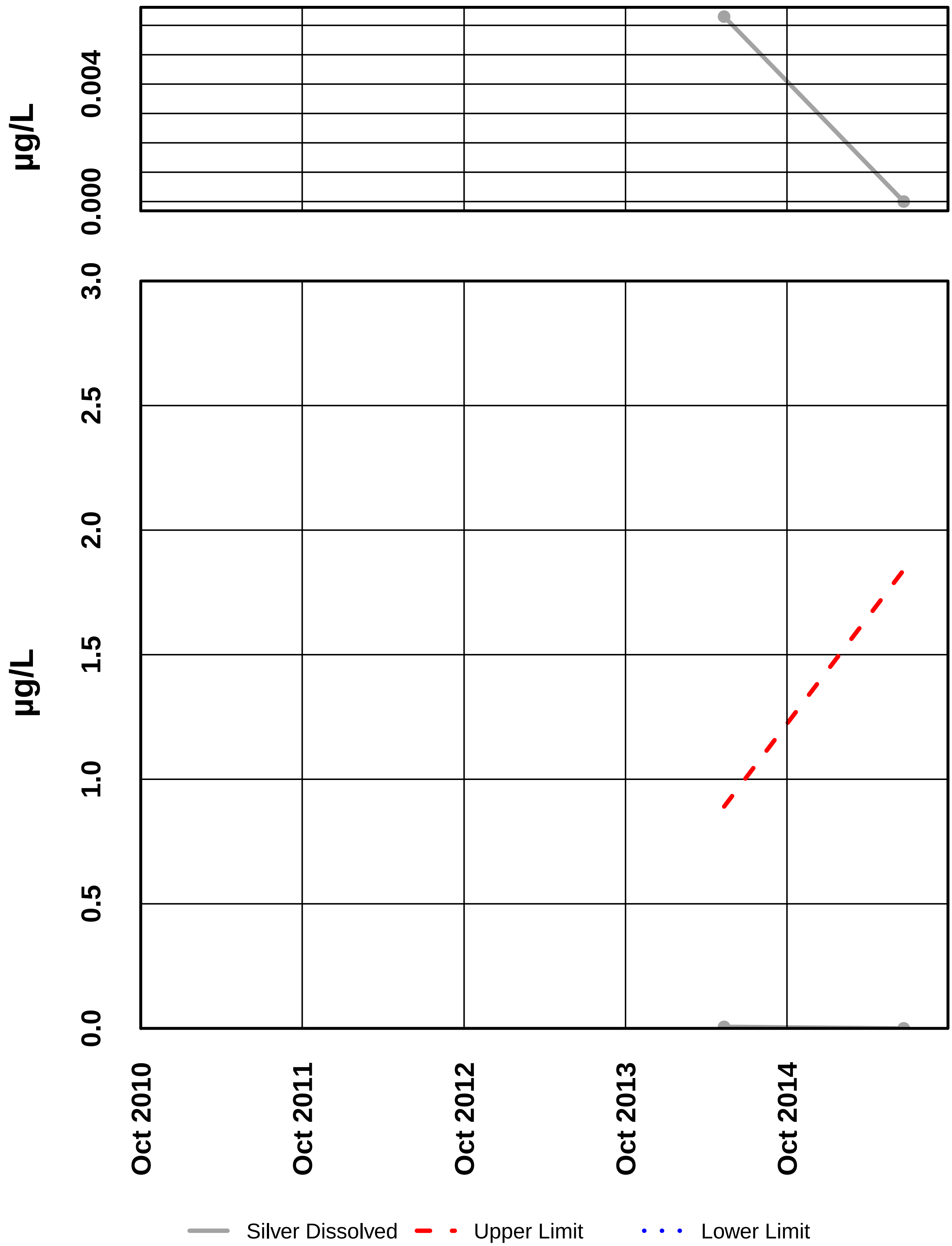
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 712 – Nickel Dissolved



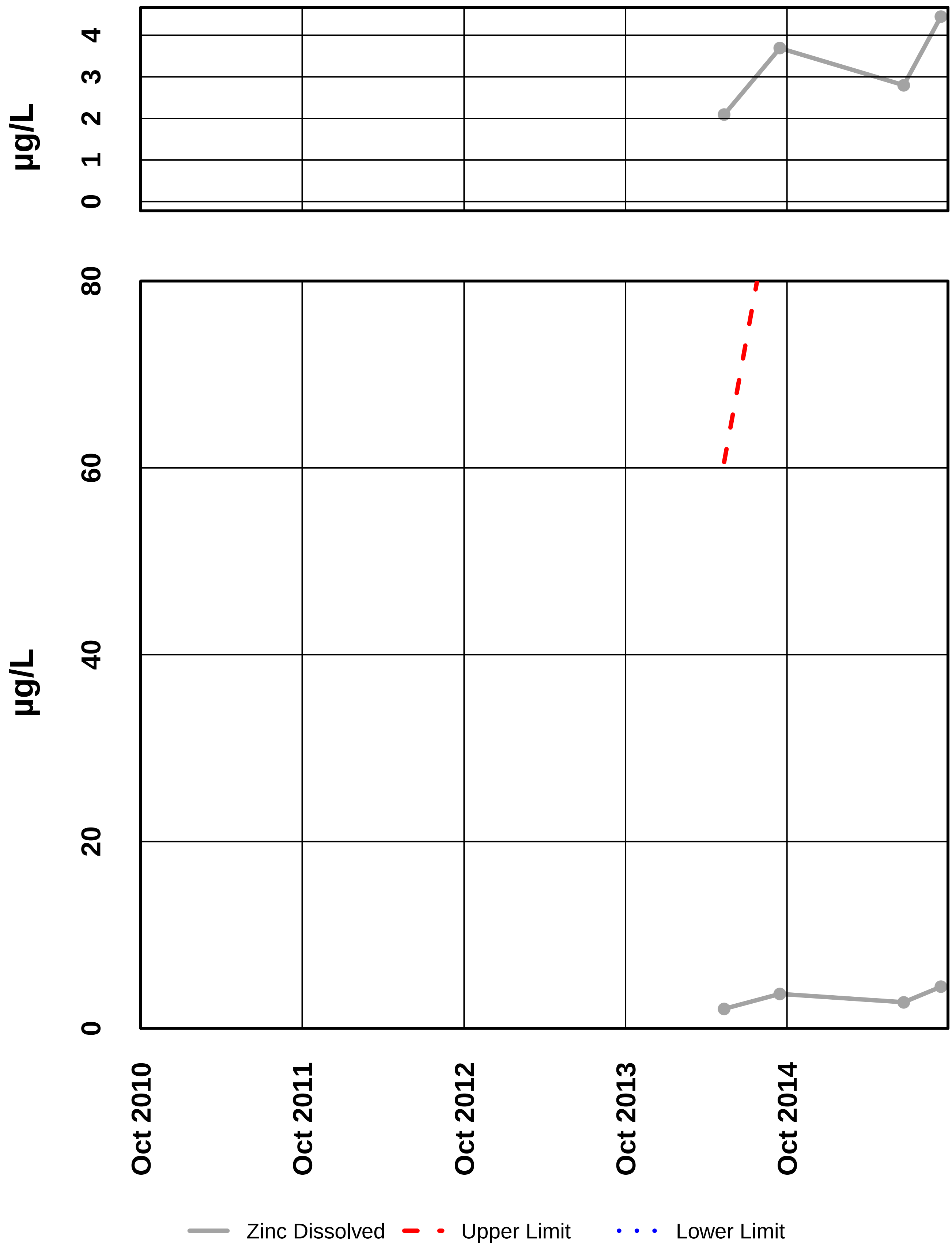
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 712 − Silver Dissolved



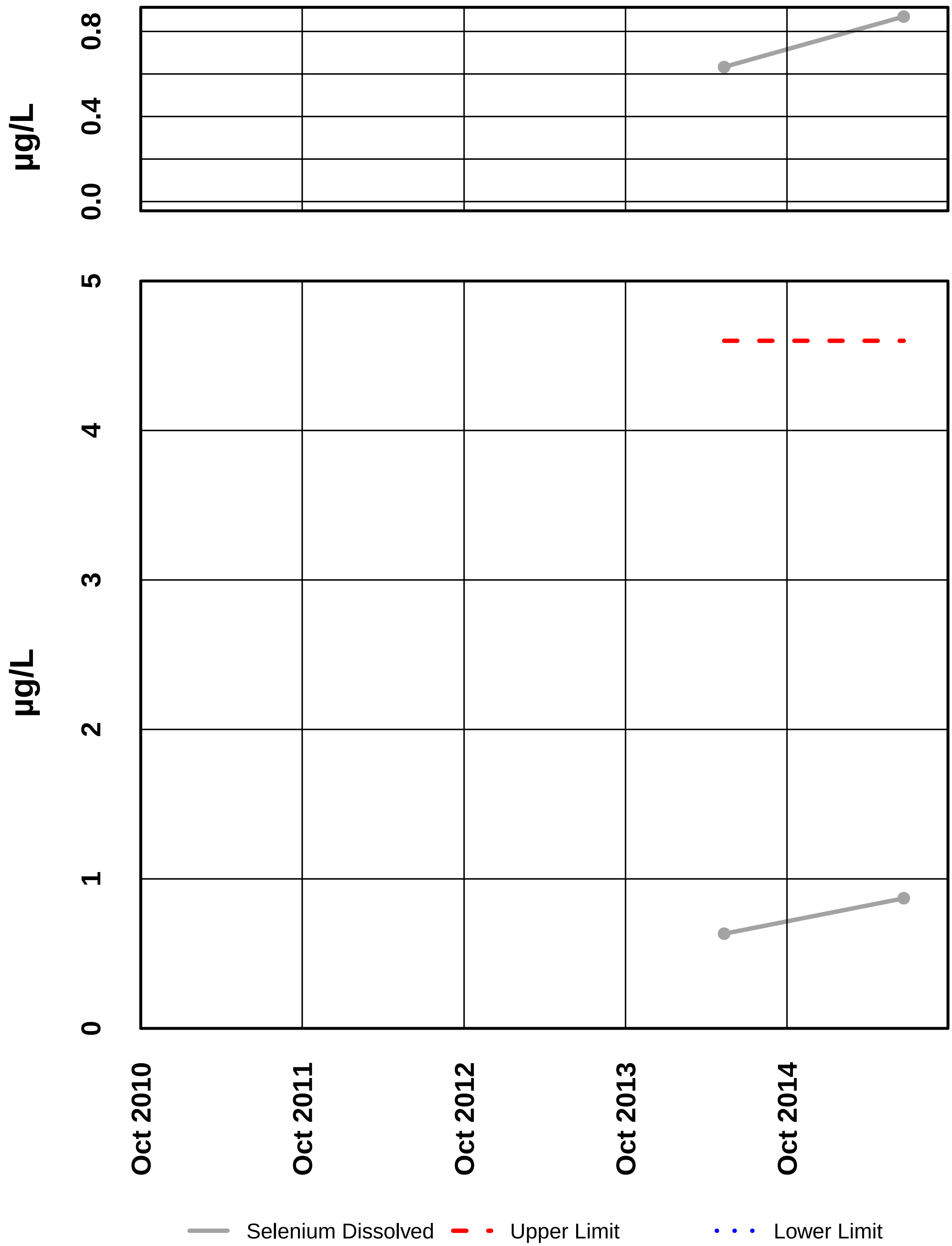
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 712 – Zinc Dissolved

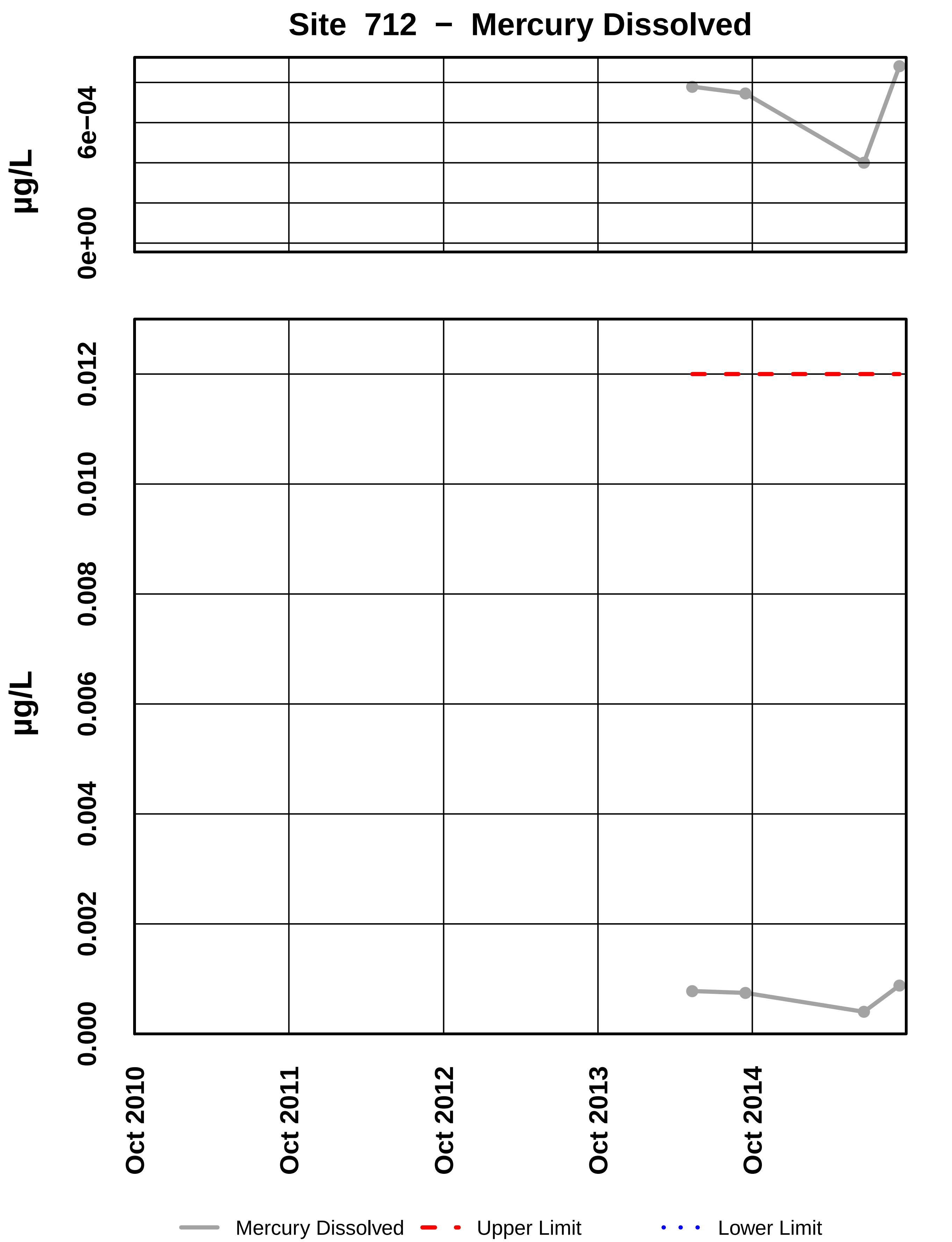


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 712 – 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

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

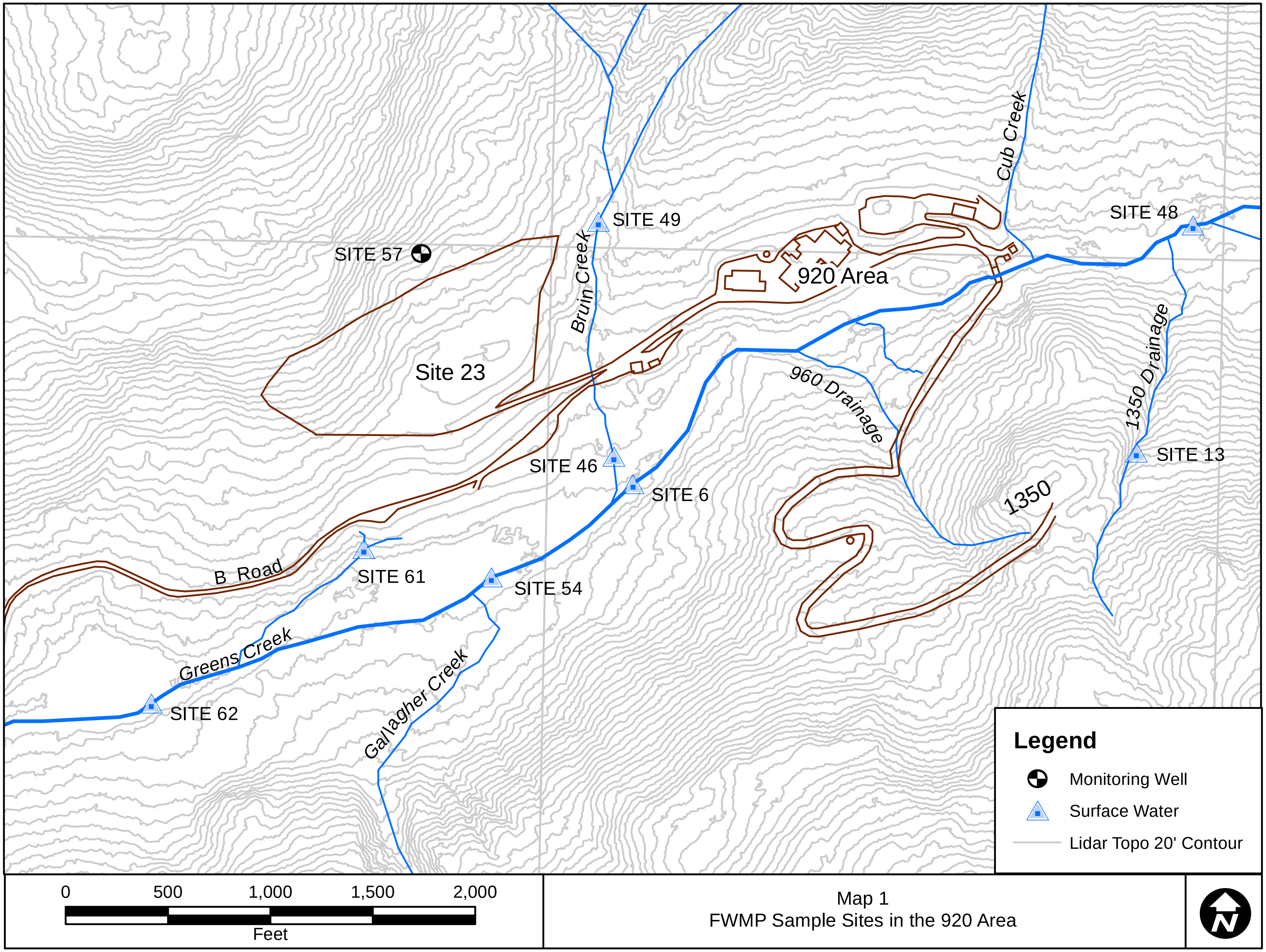
TR total recoverable
D dissolved
H some of the criteria for this parameter are hardness dependant
FWA Fresh Water Acute
FWC Fresh Water Chronic

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.

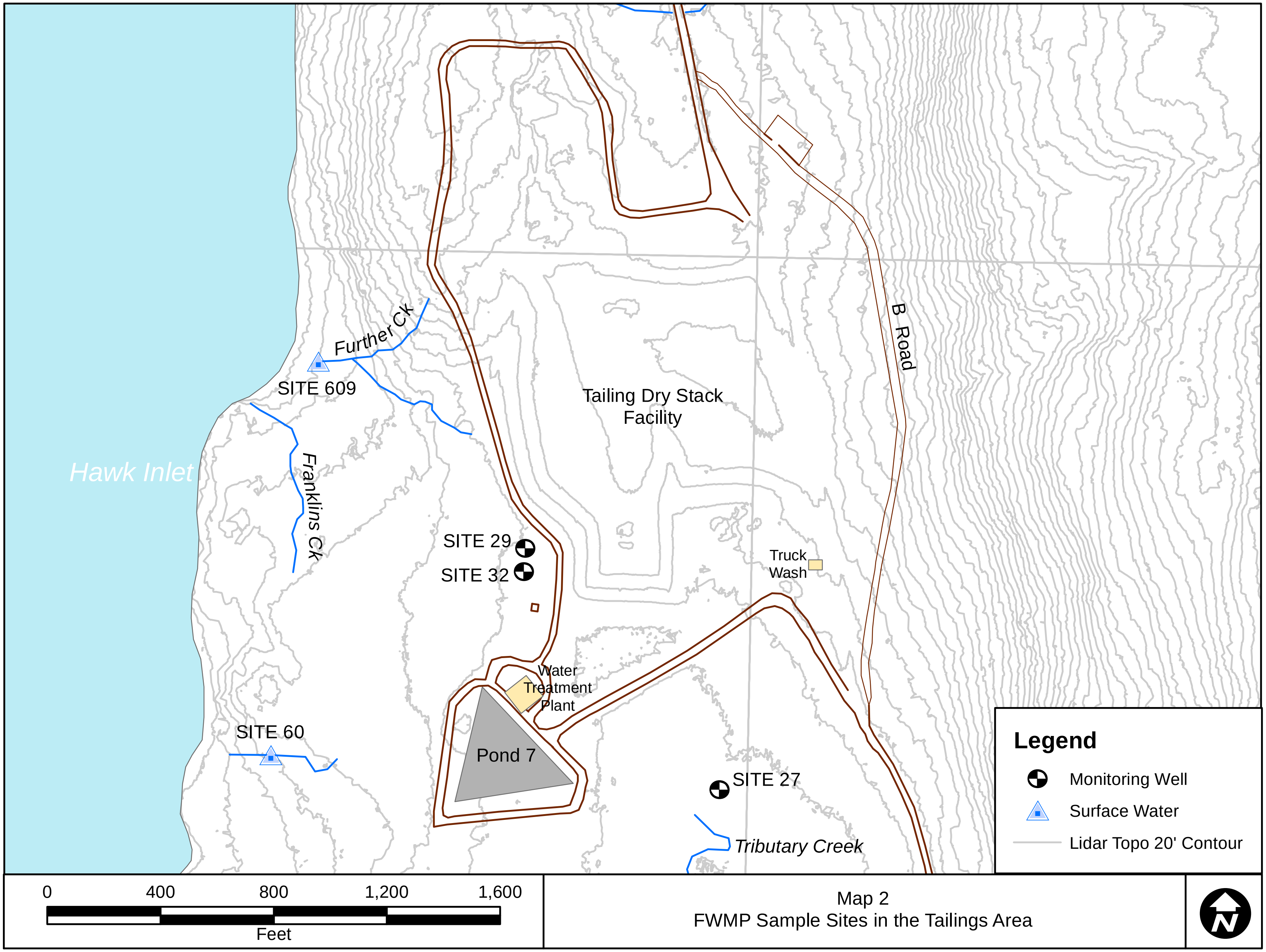
APPENDIX B

Map Sheets

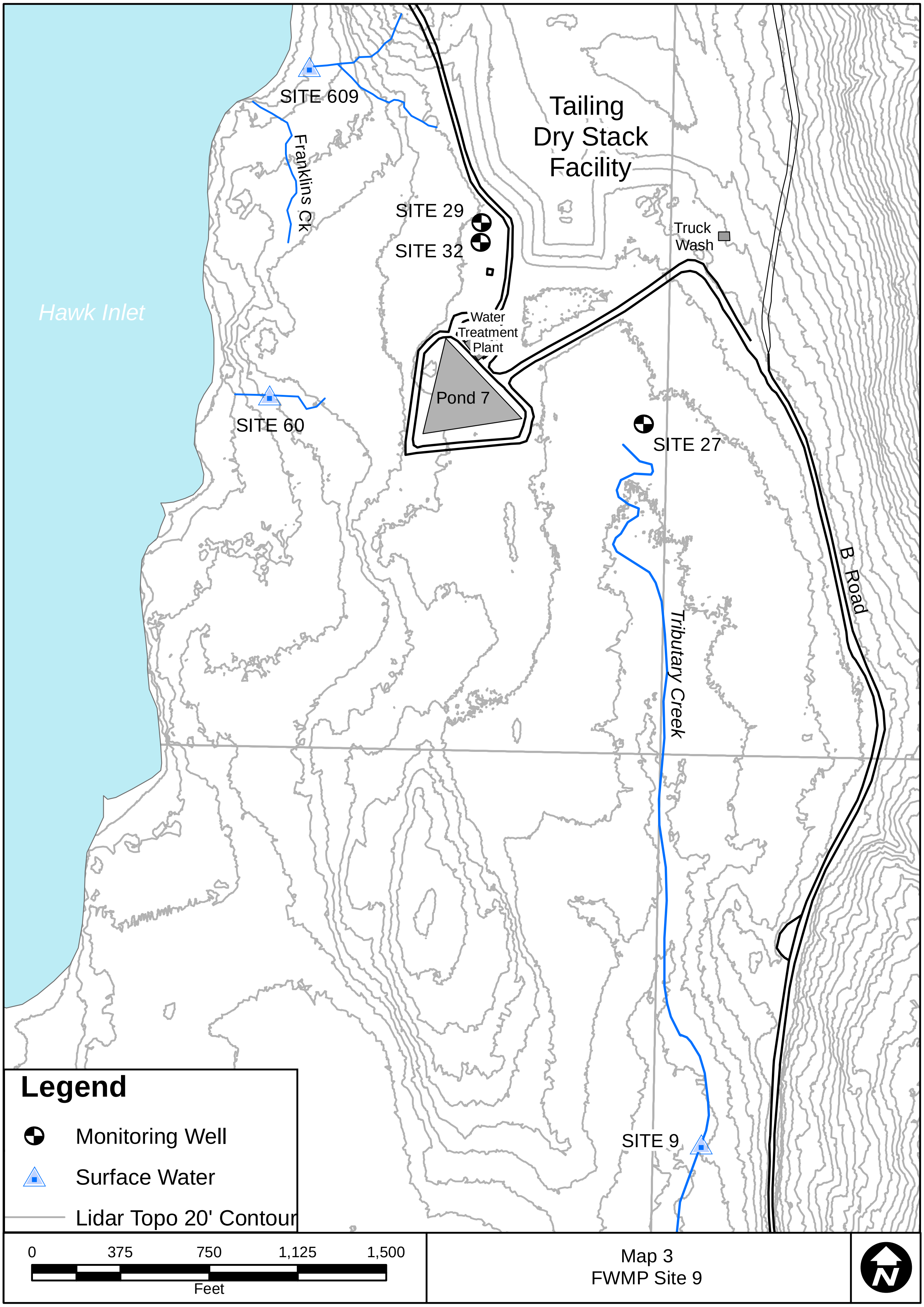
Map 1-920 Area FWMP Sites
Map 2-Tailings Area FWMP Sites
Map 3-Site 9, Tributary Creek



Map 1
FWMP Sample Sites in the 920 Area



Map 2
FWMP Sample Sites in the Tailings Area


SITE 609
Franklins Ck
Tailing
Dry Stack
Facility
SITE 29
SITE 32
Truck
Wash
Hawk Inlet
Water
Treatment
Plant
Pond 7
SITE 60
SITE 27
B Road
Tributary Creek
SITE 9
Legend
Monitoring Well
Surface Water
Lidar Topo 20' Contour
0
375
750
1,125
1,500
Feet
Map 3
FWMP Site 9