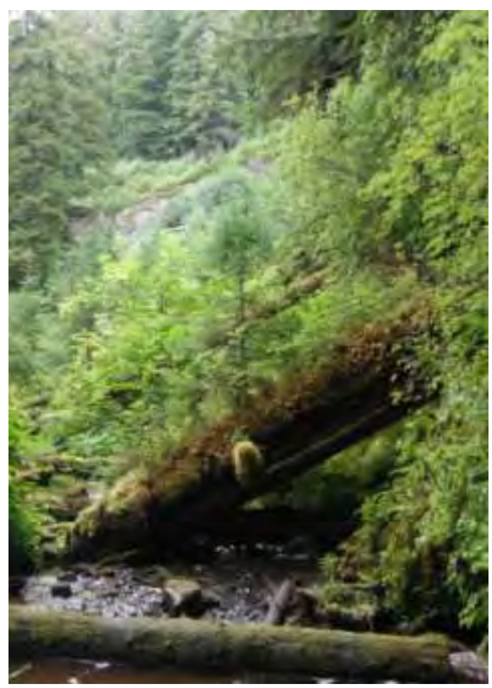
HECLA GREENS CREEK MINING COMPANY

FRESH WATER MONITORING PROGRAM ANNUAL REPORT

WATER YEAR 2012

(October 1, 2011 through September 30, 2012)

Tributary Creek – Spring 1987
Stream stabilization and cleanup completed (from rock slide) – ready for seeding and Alder transplants.



Tributary Creek – 8 August 2012

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EXECUTIVE SUMMARY

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

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

This was the second full year of sampling under the recently approved FWMP sampling schedule. All required sampling, except for the November sampling of Site 13, 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.

Three exceedances of Alaska Water Quality Standards (AWQS) occurred along Greens Creek at Site 48, Site 6, and Site 54 for low pH values during the January 2012 sampling. Because the background site (site 48) was below the AWQS, it is inferred that the exceedances resulted from natural variation and not HGCMC activity.

Though there are typically exceedances of AWQS at Site 13 for total sulfate, there were none this year. HGCMC had planned to finish removing material from the 1350 during the 2012 summer season; however there was no available storage at Site 23 on the interim storage pad. A considerable effort is being made to clear the pad by hauling the material underground. It is HGCMC's intention to remove the remaining material from the 1350 during the 2013 summer season.

Exceedances in the tailings area were noted for low pH, low alkalinity, and elevated levels of arsenic and lead. The shallow wells (sites 58, 27, 29, and 32) continued to display a long history of exceedances due to the low pH and low alkalinity that characterize these sites located in organic rich peat sediments. Eight exceedances for dissolved lead occurred at two of the three down gradient shallow wells (sites 29 and 32) and at the surface water sites 9 and 60. 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. The single deep, downgradient well, Site 28, had four exceedances for arsenic. This is a continuation of the trends established in prior years with elevated arsenic levels that are naturally associated with the marine unit that the well is completed in.

Of the remaining two sites, Site 60 had exceedances for low alkalinity, low pH, and elevated mercury. This site's watershed was disturbed when the construction of Pond 7 began in 2004: as the area recovers the water is returning to the naturally low pH and low alkalinity characteristic of the area. It has been theorized that the disturbance resulted in the watershed changing from naturally acidic to alkaline conditions. This change in fundamental chemistry is thought to have caused the naturally occurring, low level, dissolved mercury to adsorb onto soil particles. Now as the area reverts to the natural state of low pH and low alkalinity, this abundance of adsorbed mercury may be dissolving back into solution, resulting in the temporary mercury increase. After this disturbance mercury concentrations had continued to increase yearly until water year 2009, which showed a decrease in concentration. In water year 2010, the highest mercury measurement recorded (0.0227µg/L) occurred in September 2010. Then the concentration initially decreased and was below AWQS at the beginning of water year 2011, but by September 2011 the concentration was again in exceedance (0.0183 µg/L). After an initial decrease in concentration mercury concentrations rose to the second highest value (0.0213 µg/L) by the end of water year 2012. The first sampling (November 2012) of this site during the current water year (2013) had a measured value of 0.0116 µg/L.

As a result of data collected in water year 2012 the above hypothesis is being revised slightly. It is still HGCMC hypothesis that the issue is being driven by the adsorption and desorption of mercury with the change in pH. However, instead of creating a 'pool' of adsorbed mercury once and depleting it, this process has occurred several times. Though overall the pH of the system is headed to lower values there has been great fluctuations. It is believed that these fluctuations 'see saw' about the equilibrium point of the adsorption desorption mechanism. Additional sampling in adjacent drainages during water year 2009 and water year 2012 showed that this issue was isolated to only the Althea watershed. During the water year 2013 HGCMC proposes to conduct a pH survey of the muskeg region to the west of Pond 7 and also the drainage above Site 60, in order to better understand the pH dynamics of the system. Along with this work an evaluation of the catchment and pump back system at Pond 7 will be conducted.

The final tailings area site, Site 9, had exceedances for low alkalinity, low pH, and dissolved lead. The alkalinity values appear to be characteristic of the site since monitoring restarted in water year 2006, whereas the lower pH values have been recorded more recently (2009 -2010). The low alkalinity values are expected given the naturally occurring acidic muskeg conditions in the headwaters near Site 27 and Site 28. As for the dissolved lead these are the first exceedances for lead in over 2 ½ years. These values are unusual in that there were not exceedances for dissolved lead at Site 27 and that compared to other years fugitive dust emissions were minimal. This might indicate that the lag time from when material is deposited in the headwaters and reaches Site 9 is on the order of a year or so.

Graphical and non-parametric analyses for trends in the data were performed for all sites monitored. Statistically significant trends were identified for eleven sites: Site 48, downward trend in pH, and upward trends in dissolved zinc and total sulfate; Site 6, upward trends in dissolved zinc and total sulfate; Site 54, upward trends in dissolved zinc and total sulfate; Site 46, upward trend in dissolved zinc; Site 56, upward trend in total sulfate; Site 27, an upward trend in total alkalinity; Site 28, an upward trend in total sulfate; Site 29, decreasing trend in conductivity; Site 32, a downward trend in pH; Site 58, an upward trend in total alkalinity; Site

56, a downward trend in total sulfate; Site 60, downward trends in total alkalinity and conductivity, and an upward trend in dissolved zinc.

Site 48 and Site 58 are considered upgradient control sites and thus the trends are likely due to natural variation. However, with recent construction the East Ridge Expansion (ERE) at the tailing facility appears to have influence Site 58. Each of Greens Creek sites (Site 48, Site 6, and Site 54) had similar low magnitude increasing trends in dissolved zinc and total sulfate. Though these are increasing trends Site 48 indicates that a portion of the increase is natural variation. Also, the magnitude of difference between sites has remained consistent for a number of years. The magnitude of the dissolved zinc trend for Site 46 is low along with the trend for total sulfate at Site 56. The increasing sulfate values measured at Site 28 is low in magnitude and being from a deeper aquifer is considered natural variation. Conductivity at Site 29 has been trending downward for several years, however conductivities this low have been previously recorded for this site. Also, the upward trend in total alkalinity at Site 27 is still well within the historical range. The decreasing trends in total alkalinity and conductivity at Site 60 were expected to occur as the site returned to pre-disturbance conditions, and the increasing trend in dissolved zinc is low in magnitude.

A non-parametric comparison of medians was performed for all the appropriately paired surface (48-6, 6-54, and 49-46) and groundwater (57-56) sites around the 920 area. Significant differences were noted for the paired datasets from Greens Creek (48-6) for conductivity, total sulfate, and dissolved zinc. These differences have all been noted in previous annual reports and do not appear to be increasing in magnitude. Also, there were significant differences for the paired dataset (6-54) from Greens Creek for conductivity and total sulfate. There were no trends for the total alkalinity, total sulfate, or dissolved zinc data. With the reduction in the sampling frequency for the Bruin Creek sites (49 and 46) a statistical analysis of median values cannot be calculated, instead an attempt was made to analyze the data from Site 46 on a intra-site basis using the combined Shewhart-CUSUM control charts. An analysis using theses charts reached the same conclusion as in previous reports that HGCMC is not having an measurable effect on Site 46. As discussed in the interpretive report for Site 56, the combined effects of the difference in completion units and the different hydrological regimes likely explain the disparity in analyte concentrations found at sites 56 and 57. Therefore, this data was analyzed on an intra-well comparison using the combined Shewhart-CUSUM control chart approach. No data points used for the analysis of Site 56 had exceeded a control limit.

INTRODUCTION

This annual report for Water Year 2012 (October 1, 2011 through September 30, 2012) provides the information required by the Fresh Water Monitoring Program (FWMP) for the Hecla Greens Creek Mining Company (HGCMC). It is separated into several sections, the first of which provides general information applicable to the entire program, followed by a comprehensive analysis of the data for each specific site.

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

The monitoring schedule varies from site to site and different sites are monitored for different analytes on different months of the year. Occasionally, sites scheduled for sampling may not be available due to weather or more rarely operational reasons. A copy of the Water Year 2012 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.

Site	AWQS Comaprison	Trend Visual	Trend Calc	Calculate Median	Median Comparison
48	x	x	+	x	
6	x	x	+	x	6 vs 48
54	x	x	+	x	54 vs 6
49	x	x	+	x	
46	x	x	+	x	**
13	x	x	+	x	
57	x	x	+	x	
56	x	x	+	x	56 vs 57
58	x	x	+	x	
27	x	x	+	x	**
29	x	x	+	x	**
32	x	x	+	x	**
59	x	x	+	x	
28	x	x	+	x	**
9	x	x	+	x	
60	x	x	+	x	
	+: Additional statistical trend analysis done for conductivity, pH, alkalinity, and dissolved zinc.				
	**: insufficient Data for a robust statistical evaluation.				

The adjacent table outlines the requested Statistical Information Goals (SIGs) for each site sampled during the Water Year 2012. A comparison to Alaska Water Quality Standards (AWQS) is required for all sites. In Appendix A the specific water quality criteria used for each comparison are summarized. Trend analysis is carried out by two different methods. The first method is a visual trend analysis for each analyte. For each site sampled a series of time-concentration graphs are constructed for the previous five years of data collected. The second method is a non-parametric statistical method, Kendall seasonal trend analysis that is routinely done for conductivity, pH, alkalinity, and dissolved zinc. These are the key parameters along with sulfate that can be strongly affected by Acid Mine Drainage (AMD). Sulfate was added back into the required list of analytes in the 2002 Water Year. Median calculations are shown in the annual table of results for each site. Finally, for all down gradient sites that are paired with an upgradient reference site, which are monitored with a frequency greater than 4 times per year, a comparison of medians is presented for each specific site. These down gradient sites (upgradient site in parenthesis) include Site 6 (Site 48) and Site 54 (Site 6). Sampling frequency was changed to quarterly for Site 46 (Site 49) and Site 56 (Site 57). For each of these sites, the statistical information goals requested a comparison of medians for total alkalinity, pH, conductivity, total sulfate and dissolved zinc. The statistical test utilized is a non-parametric, Wilcoxon signed-rank test. A brief summary of the two main statistical procedures, the Wilcoxon-Mann-Whitney rank sum test and the Mann-Kendall seasonal trend are given below.

There have been concerns that the paired sites may not actually be completed in the same aquifer. This is the case with Site 57 and Site 56, which is evident when comparing the sites during the median analysis. More recently the analysis of data for Site 56 has been conducted using intra-well methodologies instead of an inter-well comparison. In the interpretive section of Site 56 is a discussion of this new methodology. This technique was also limitedly applied to Site 56, Site 46, and Site 27, and it is planned that more sites will be analyzed in this manner in Water Year 2013. 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.	>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 2012 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 2012. 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.

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

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

For several years the graphing and statistical analysis has been carried out in several Excel spreadsheets. This 2012 FWMP report breaks 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.

MID-YEAR MODIFICATIONS

There were no mid-year modifications made.

FWMP SAMPLE LOG

Water Year October 2011 Through September 2012

Annual Water Quality Monitoring Schedule-Laboratory Samples

Site	Site Name	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
6	Middle Greens Creek	10-11 P	11-14 P	12-05 Q	01-17 P	02-14 Q	03-14 P	04-18 P	05-07 P	06-11 P	07-09 P	08-07 P	09-17 P
9	Tributary Creek-Lower		11-15 Q						05-07 Q		07-09 Q		09-17 Q
13	Mine Adit Discharge East		Q						05-30 Q			08-07 Q	
27	Monitoring Well 2S		11-15 Q						05-07 Q		07-12 Q		09-18 Q
28	Monitoring Well 2D		11-15 Q						05-07 Q		07-12 Q		09-18 Q
29	Monitoring Well 3S		11-15 Q						05-07 Q		07-12 Q		09-18 Q
32	Monitoring Well 5S		11-15 Q						05-07 Q		07-12 Q		09-18 Q
46	Lower Bruin Creek		11-14 Q			02-14 Q			05-07 P			08-07 P	
48	Upper Greens Creek	10-11 P	11-14 P	12-05 Q	01-17 P	02-14 Q	03-13 P	04-18 P	05-07 P	06-11 P	07-09 P	08-07 P	09-17 P
49	Control Site Upper Bruin Creek		11-14 Q			02-14 Q			05-07 P			08-07 P	
54	Greens Creek below D-Pond	10-11 P	11-14 P	12-05 Q	01-17 P	02-14 Q	02-13 P	04-18 P	05-07 P	06-11 P	07-09 P	08-07 P	09-17 P
56	Monitoring Well-D-00-01		11-15 Q						05-07 Q			08-07 Q	
57	Monitoring Well-23-00-03		11-15 Q						05-07 Q			08-07 Q	
58	Monitoring Well-T-00-01C		11-15 Q						05-19 Q		07-09 Q		09-18 Q
59	Monitoring Well-T-00-01A		11-15 Q						05-07 Q		07-09 Q		09-18 Q
60	Althea Creek Lower		11-15 Q						05-07 Q		07-09 Q		09-17 Q
	Field Blank @ Site	54	46	6	48	49	54	6	60	48	59	57	9

Legend	Meaning
Date / Suite (white)	Regular monthly sample
Date / Suite (blue)	No Sample taken due to ice
Date / Suite (yellow)	Wrong Suite sampled
Date / Suite (orange)	No Sample taken due to lack of access (snow).
Date / Suite (pink)	No Sample taken due to lack of flow

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

USFS
Chad Van Ormer
Monument Manager
Sarah Samuelson
Joe Manning
Dave Barto

Biomonitoring (Fish and Game)
Kate Kanouse
Jackie Timothy
Nicole Legere
Rick Hoffman

Consultants
Pete Condon, Petros GeoConsulting, Geochemist

HGCMC
Scott Hartman, General Manager

Jennifer Saran, Environmental Manager
Christopher Wallace, Environmental Engineer
Mitch Brooks, Environmental Engineer
Ted Morales, Environmental Technician
Robin Jung, Environmental Technician
Sheri Williamson, Environmental Engineer

Laboratory and Data Review
Suzan Huges, Project Coordinator
Environmental Synectics, Inc.
Evin McKinney , Senior Scientist
Environmental Synectics, Inc.
Leticia Sangalang, Senior Scientist
Environmental Synectics, Inc.

Brenda Lasorsa, Project Coordinator
Battelle Marine Sciences Laboratory

Sue Weber, Project Manager
ACZ

David Wetzel, Project Manager
Admiralty Environmental

SITE COORDINATES

Site Number	Site Common 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°44'40.100" W
13	1350 East Drainage	58°04'47.685" N	134°37'39.951" W
27	MW-T-98-2S	58°06'48.546" N	134°44'38.365" W
28	MW-T-98-2D	58°06'48.600" N	134°44'37.344" W
29	MW-T-98-3S	58°06'59.860" N	134°44'53.821" W
32	MW-T-98-5	58°06'57.732" N	134°44'55.225" 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°37'33.359" W
49	Bruin Creek Upper	58°05'04.070" N	134°38'30.410" W
54	Greens Creek Lower	58°04'41.681" N	134°38'46.529" W
56	MW-D-00-01	58°04'48.140" N	134°38'32.580" W
57	MW-23-00-03	58°04'59.933" N	134°38'39.881" W
58	MW-T-00-1C	58°07'12.758" N	134°44'38.252" W
59	MW-T-00-1A	58°07'12.919" N	134°44'38.411" W
60	Althea Drainage	58°06'50.786" N	134°45'80.432" W

PROPOSED PROGRAM MODIFICATIONS

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

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

The approved modifications were implemented with the March 2013 FWMP sampling event. Furthermore, the modification of the FWMP and integration in to IWMMP of these changes is still waiting on comments from the agencies.

Hecla
GREENS CREEK

9 January 2013

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

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

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

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

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

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

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

1. Change the status of Site 28 (MW-2D) to inactive.
2. Change the status of Site 30 (MW-3D) to inactive.
3. Change the status of Site 58 (MW-T-00-01C) to inactive.
4. Change the status of Site 59 (MW-T-00-01A) to inactive.
5. Change the status of Site 56 (MW-D-00-01) to inactive.
6. Change the status of Site 32 (MW-5S) to active
7. Add and activate Site 609 (Further Creek Lower Reach) to the FWMP.
8. Add and activate a new site at the confluence of the two streams west of D pile in the Greens Creek floodplain (New Site #1).
9. Add and activate a new site on Greens Creek, ¼ mile downstream of Site 54, and adjacent to 7.7 mile along the B road (New site #2).

Attachments to this letter

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

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

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

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

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

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

- Site 56 (MW-D-00-01) was established in 2000 as a direct result of suggestions in the Shepherd-Miller report that had been commissioned by an Inter-Agency FWMP Review Team.
- This well was the downgradient component of a pair of wells for monitoring Site 23 and D pile, and is located to the southeast of D Pile (map 3). The corresponding upgradient well 57 (MW-23-00-03) is located to the north of Site 23 (map 3).

- After years of sampling it has been established that the water chemistry at Site 56 (MW-D-00-01) is not reflective of facility related drainage, but is heavily influenced by the Greens Creek flood plain.
- There are no expected changes to the effectiveness of the current FWMP ability to monitor the potential impact that Site 23 / D Pile facility is having on the surrounding environment.
- Statistical analysis for the upgradient Site 57 (MW-23-00-03) will now use intra-well analysis methodology.

Activation of Site 32 (MW-5S)

- HGCMC has been monitoring this site since the 2000 revision of the FWMP; however there was some confusion with the current FWMP whether or not this was an active monitoring site.
- Site 32 (MW-5S) is located to the west of the tailings storage facility (map 1), and completed in the peat strata in which tailings associated water would likely be seen (drill log MW-5S).
- Statistical analysis will now be conducted using intra-well methodology and not inter-well methodology, because of the proposed inactivation of Site 58 (MW-T-00- 01C).
- There are no expected changes to the effectiveness of the current FWMP ability to monitor the potential impact the tailings storage facility is having on the surrounding environment.

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

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

Addition and Activation of New Site #1

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

Addition and Activation of New Site #2

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

- As with the current FWMP there will be an inter-site statistical comparison made between this new downgradient site and Site 54 (Lower Greens Creek).

Current and Previous Sampling Schedule Changes

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

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

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

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

Sincerely,

Christopher Wallace

Christopher Wallace
Environmental Engineer

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INTERPRETIVE REPORT
SITE 48

The data collected during the current water year are listed in the following "Table of Results for Water Year 2012" report. The table includes all the required FWMP analyte data (field and laboratory) collected for the current water year and a series of flags keyed to the summary report "Qualified Data by QA Reviewer". The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of ½ MDL for the purpose of median calculation.

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

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

The data for water year 2012 have been compared to the strictest fresh water quality criterion for each applicable analyte. One result exceeding these criteria has been identified (see table below). With the January 2012 pH exceeded the lower limit of 6.5 su, however Site 48 is a background site and this low pH value is considered natural variation.

Table of Exceedance for Water Year 2012

			Limits		
Sample Date	**Parameter**	**Value**	**Lower**	**Upper**	**Hardness**
17-Jan-12	pH Field	5.72 su	6.5	8.50	

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

A non-parametric statistical analysis for trend was performed for specific conductivity, field pH, total alkalinity, total sulfate, and dissolved zinc. Calculation details of the Seasonal Kendall analyses are presented in detail on the pages following this interpretive section. The following table summarizes the results on the data collected between Oct-06 and Sep-12(WY2007-WY2012).

Table of Summary Statistics for Trend Analysis

Parameter	Mann-Kendall test statistics n*	p**	Trend	Sen's slope estimate Q	Q(%)
Conductivity Field	6	0.16			
pH Field	6	<0.01	-	-0.06	-0.782
Alkalinity, Total	6	0.15			
Sulfate, Total	6	0.01	+	0.45	3.52
Zinc, Dissolved	6	0.01	+	0.129	3.98

* 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 (2012), total sulfate has a slope estimate of 0.45 µg/L/yr, dissolved zinc showed an increasing trend with a slope estimate 0.129 µg/L/yr, and field pH was negatively trending with a slope estimate of -0.06 su/yr. These values are very similar to those values reported in water year 2011. As noted in the past annual reports, there has been a low and variable change in many of the analytes. Because of this, and the location of Site 48 (upgradient background), this variation in the analytes is considered part of the natural variation that can be expected for this type of monitoring.

Table of Results for Water Year 2012

Site 048GMS - 'Upper Greens Creek'

Sample Date/Parameter	Oct 2011	Nov 2011	Dec 2011	Jan 2012	Feb 2012	Mar 2012	Apr 2012	May 2012	Jun 2012	Jul 2012	Aug 2012	Sep 2012	**Median**
Water Temp (°C)	4.64	0.32	0.09	0.01	0.92	0.55	1.5	2.13	4.1	5.5	7.75	6.9	1.82
Conductivity-Field(μmho)	102	120	75	72	123	154	106	98	83.1	82.7	86	86	92.0
Conductivity-Lab (μmho)	125	139	86	117	149	158	107	99	85	83	80	89	103
pH Lab (standard units)	7.76	7.8	6.28	6.3	6.96	6.7	6.68	7.03	7.11	7	6.54	7.69	6.98
pH Field (standard units)	7.58	7.56	7.47	5.72	7.62	7.68	7.73	7.79	7.96	7.8	7.7	7.66	7.67
Total Alkalinity (mg/L)	47.2	51.6	21.5	48.6	49.6	52.9	36.1	37.1	32.9	32.7	28.9	38.8	38.0
Total Sulfate (mg/L)	13.4	15.5	5.5	19.2	18.4	19	10.1	8.9	7.1	7.5	7.7	8.2	9.5
Hardness (mg/L)	57	64	34.7	68.2	70.9	73.6	47.6	43.2	37.5	37.8	38.7	43	45.4
Dissolved As (ug/L)	0.236	0.208	0.211	0.162	0.204	0.208	0.177	0.163	0.23	0.231	0.245	0.223	0.210
Dissolved Ba (ug/L)			16.9		27.9								22.4
Dissolved Cd (ug/L)	0.0398	0.0509	0.0826	0.0475	0.0329	0.041	0.0305	0.0378	0.0348	0.0327	0.0393	0.0389	0.0391
Dissolved Cr (ug/L)			0.975		0.029								0.502
Dissolved Cu (ug/L)	0.366	0.382	0.982	0.456	0.432	0.373	0.646	0.612	0.264	0.333	0.324	0.818	0.407
Dissolved Pb (ug/L)	0.0036	0.008	0.123	0.061	0.0038	0.0028	0.0114	0.0102	0.0055	0.0015	0.0076	0.0198	0.0078
Dissolved Ni (ug/L)			0.983		0.853								0.918
Dissolved Ag (ug/L)			0.002		0.002								0.002
Dissolved Zn (ug/L)	3.5	5.06	11.9	4.16	3.26	3.26	3.61	4.35	3.14	2.55	2.62	3.52	3.51
Dissolved Se (ug/L)			0.484		1.18								0.832
Dissolved Hg (ug/L)	0.000674	0.000692	0.00368	0.000869	0.00182	0.000654	0.0016	0.00157	0.000537	0.000447	0.00128	0.00238	0.001075

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.

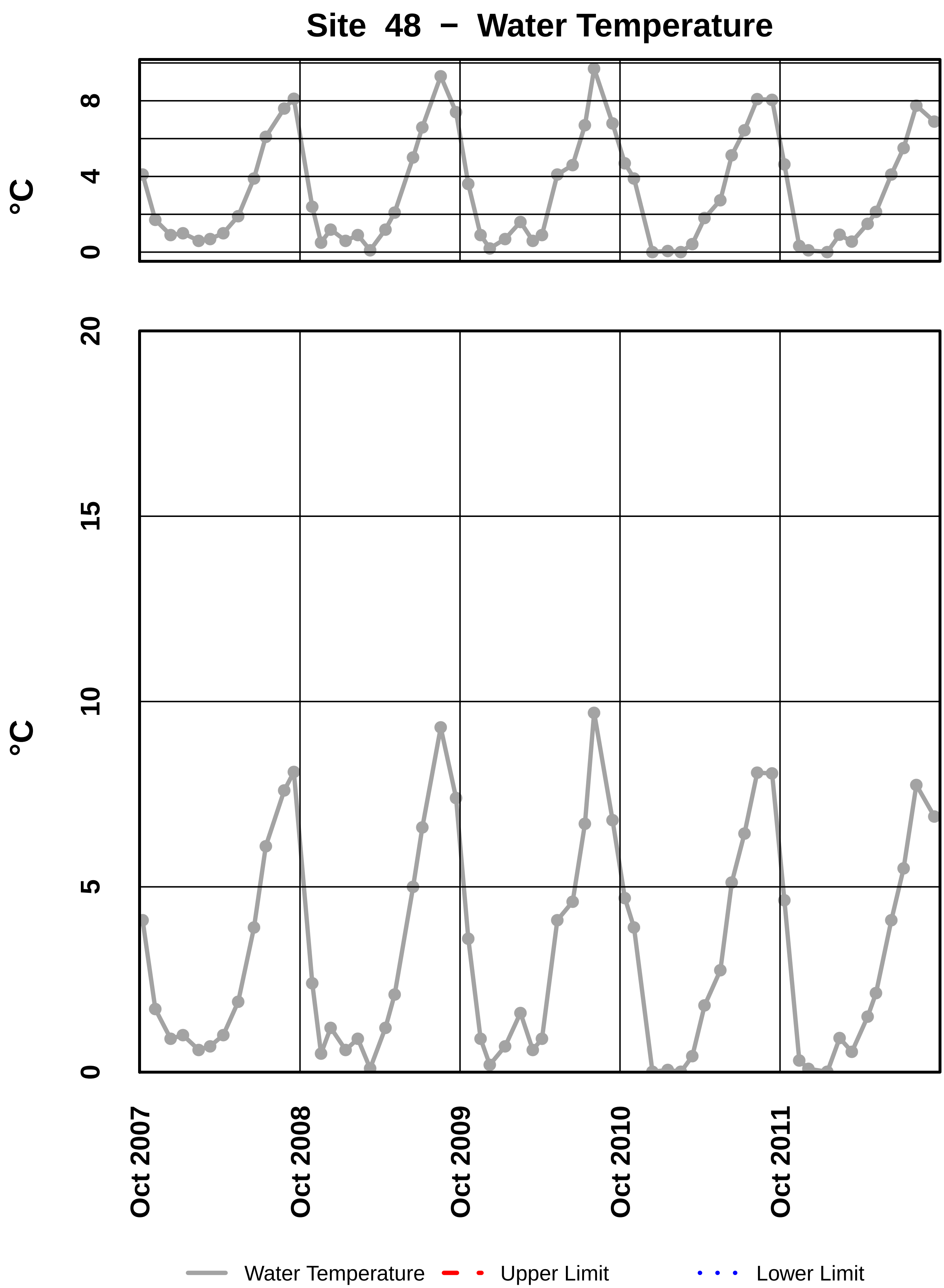
Shaded data has been qualified as an outlier by KGCMC and removed from any further analysis and is not included into the calculation of the median

Qualified Data by QA Reviewer

Date Range: 10/01/2011 to 09/30/2012

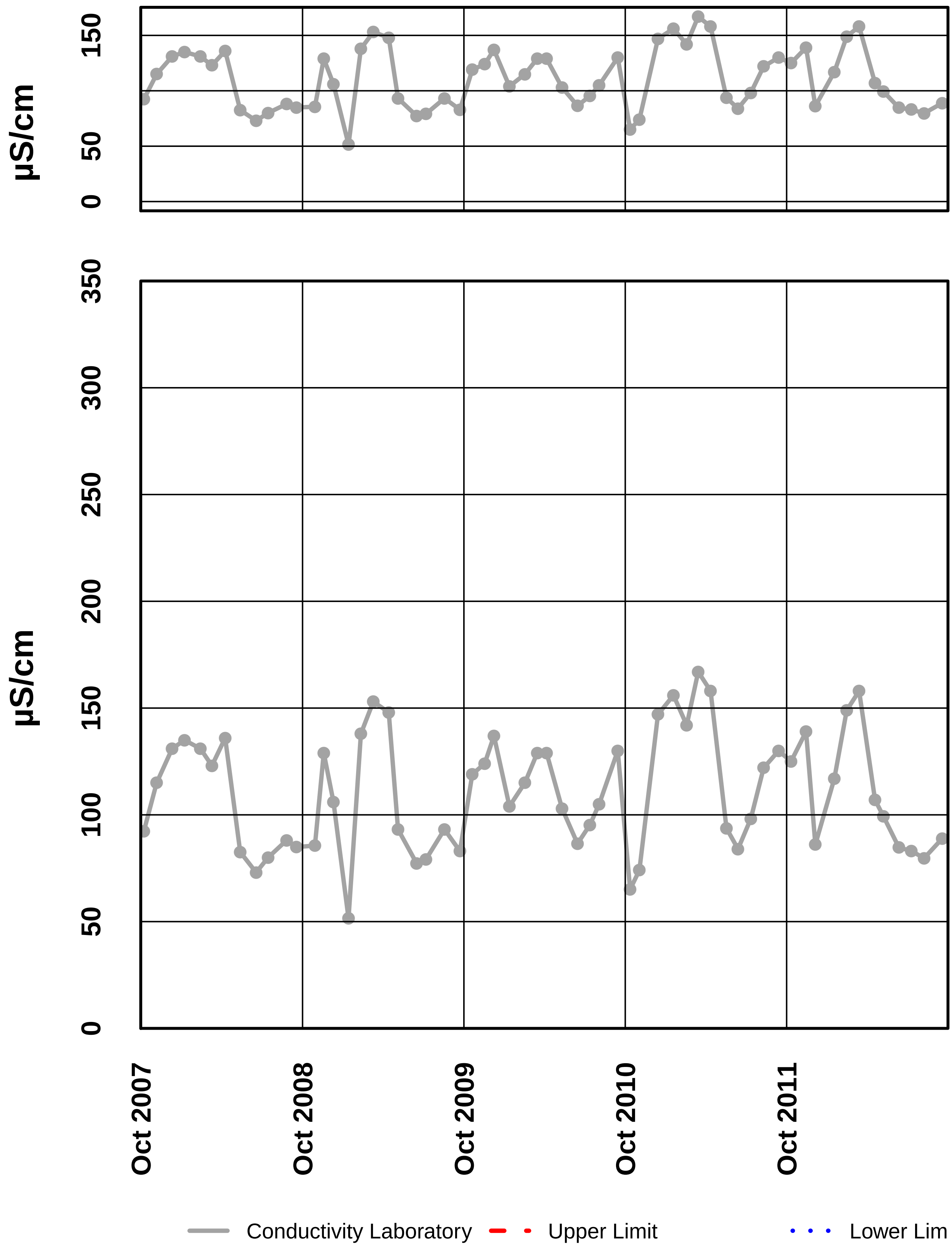
Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
48	10/11/2011	12:00 AM	Cu diss, µg/l	0.36	U	Field Blank Contamination
			Pb diss, µg/l	0.00355	U	Field Blank Contamination
			Zn diss, µg/l	3.5	U	Field Blank Contamination
			SO4 Tot, mg/l	13.4	J	Sample Temperature Receipt
48	11/14/2011	12:00 AM	Hg diss, µg/l	0.000692	U	Field Blank Contamination
			Pb diss, µg/l	0.00804	J	Below Quantitative Range
48	1/17/2012	12:00 AM	pH Lab, su	6.3	J	Hold Time Violation
48	2/14/2012	12:00 AM	Pb diss, µg/l	0.00382	U	Field Blank Contamination
48	3/13/2012	12:00 AM	Cu diss, µg/l	0.37	U	Field Blank Contamination
			Hg diss, µg/l	0.000654	U	Field Blank Contamination
			Pb diss, µg/l	0.00283	J	Below Quantitative Range
			Zn diss, µg/l	3.26	U	Field Blank Contamination
			pH Lab, su	6.7	J	Sample Hold Time
			SO4 Tot, mg/l	19.02	J	Sample Receipt Temperature
48	4/18/2012	12:00 AM	Pb diss, µg/l	0.01	U	Field Blank Contamination
			Zn diss, µg/l	3.61	U	Field Blank Contamination
			SO4 Tot, mg/l	10.06	J	Sample Receipt Temperature
48	5/7/2012	12:00 AM	Pb diss, µg/l	0.01	U	Field Blank Contamination
			SO4 Tot, mg/l	8.94	J	Sample Receipt Temperature
48	6/11/2012	12:00 AM	Pb diss, µg/l	0.00547	J	Below Quantitative Range
			SO4 Tot, mg/l	7.12	J	Sample Receipt Temperature
48	7/9/2012	12:00 AM	Hg diss, µg/l	0.000447	U	Field Blank Contamination
48	8/7/2012	12:00 AM	As diss, µg/l	0.24	J	LCS Recovery
			Pb diss, µg/l	0.00763	J	Below Quantitative Range
48	9/17/2012	12:00 AM	pH Lab, su	7.69	J	Hold Time Violation
			SO4 Tot, mg/l	8.24	J	Sample Receipt Temperature

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



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

Site 48 − Conductivity Laboratory



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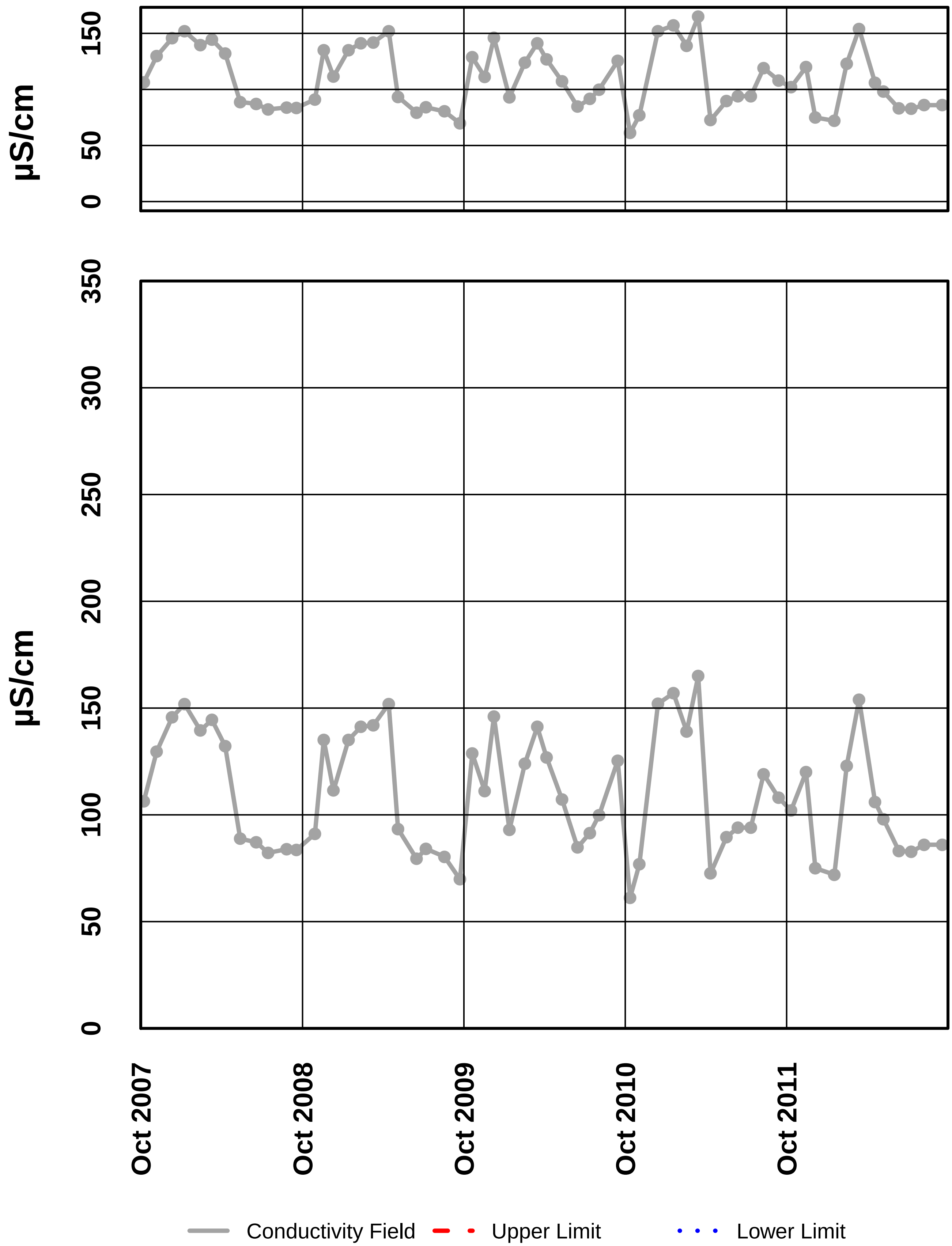
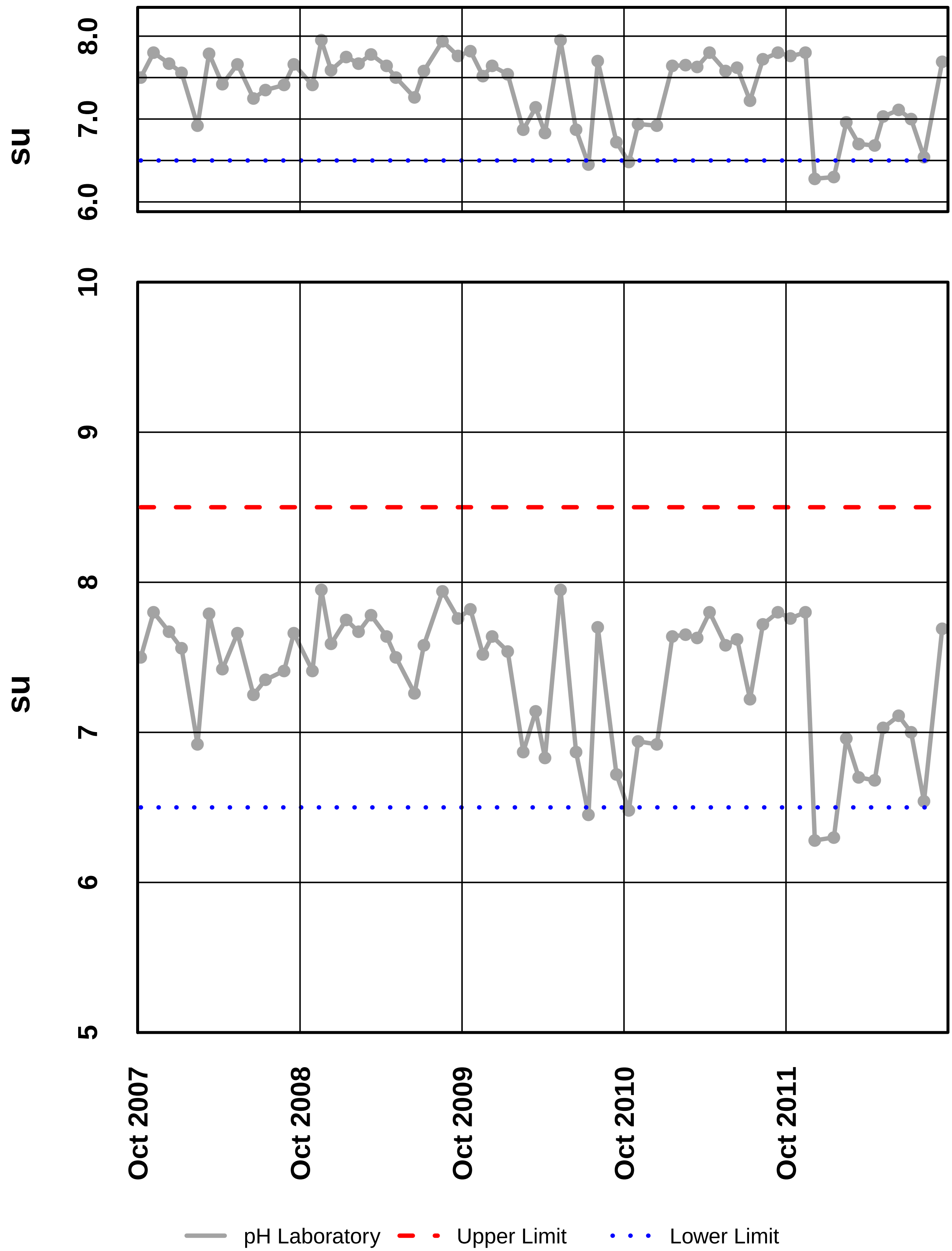
Site 48 – Conductivity Field



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

Site 48 – pH Laboratory



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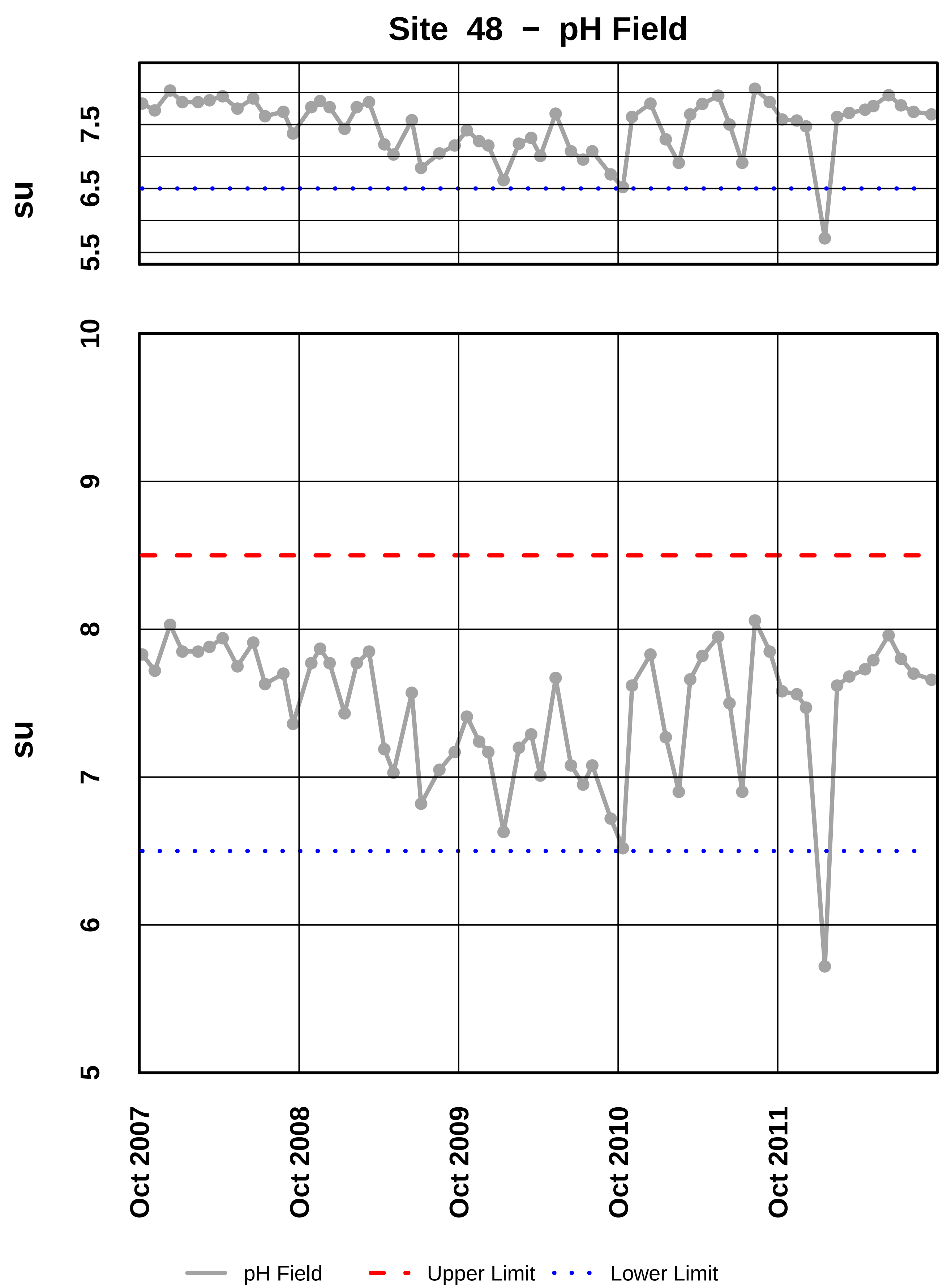

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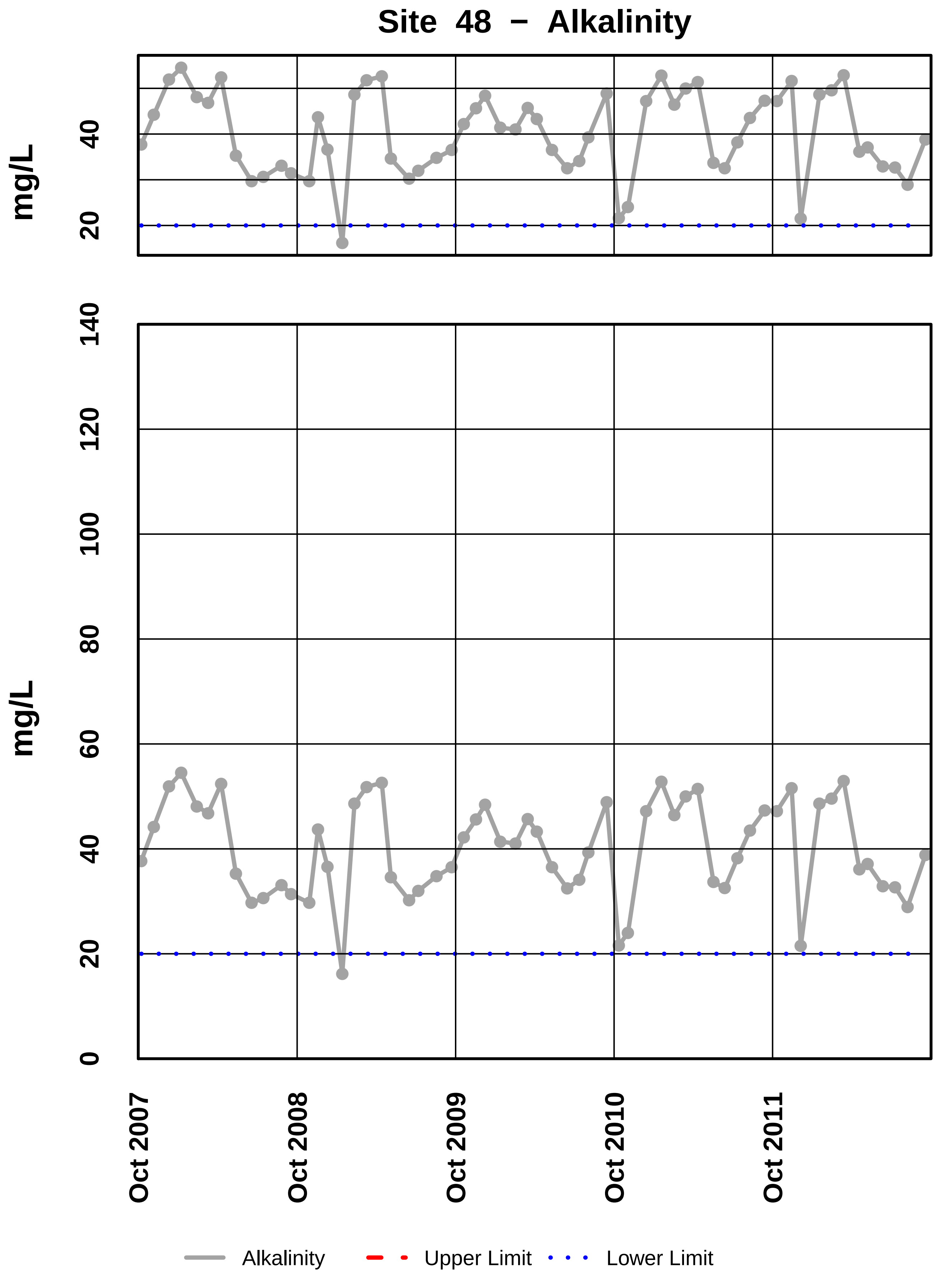

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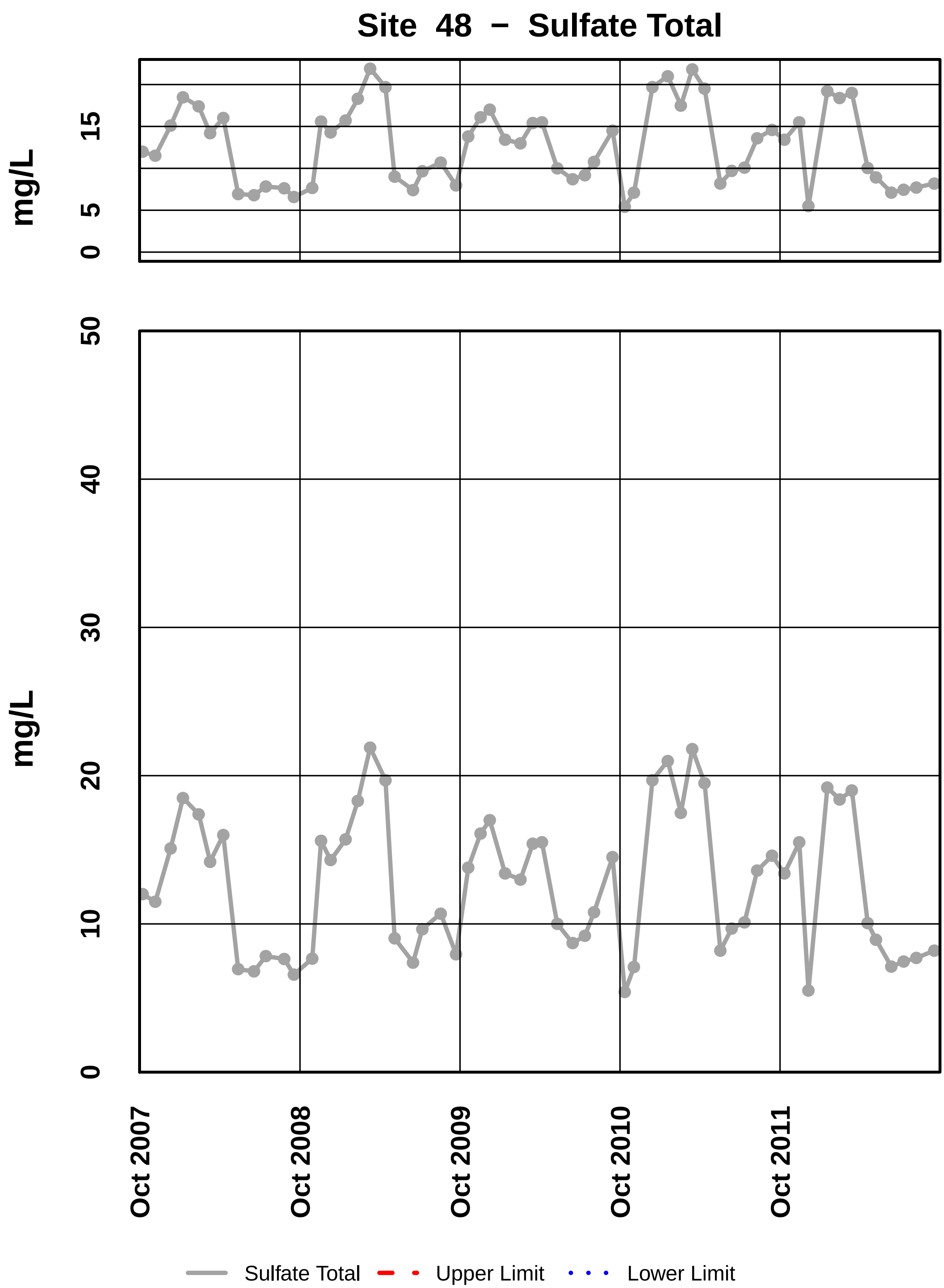

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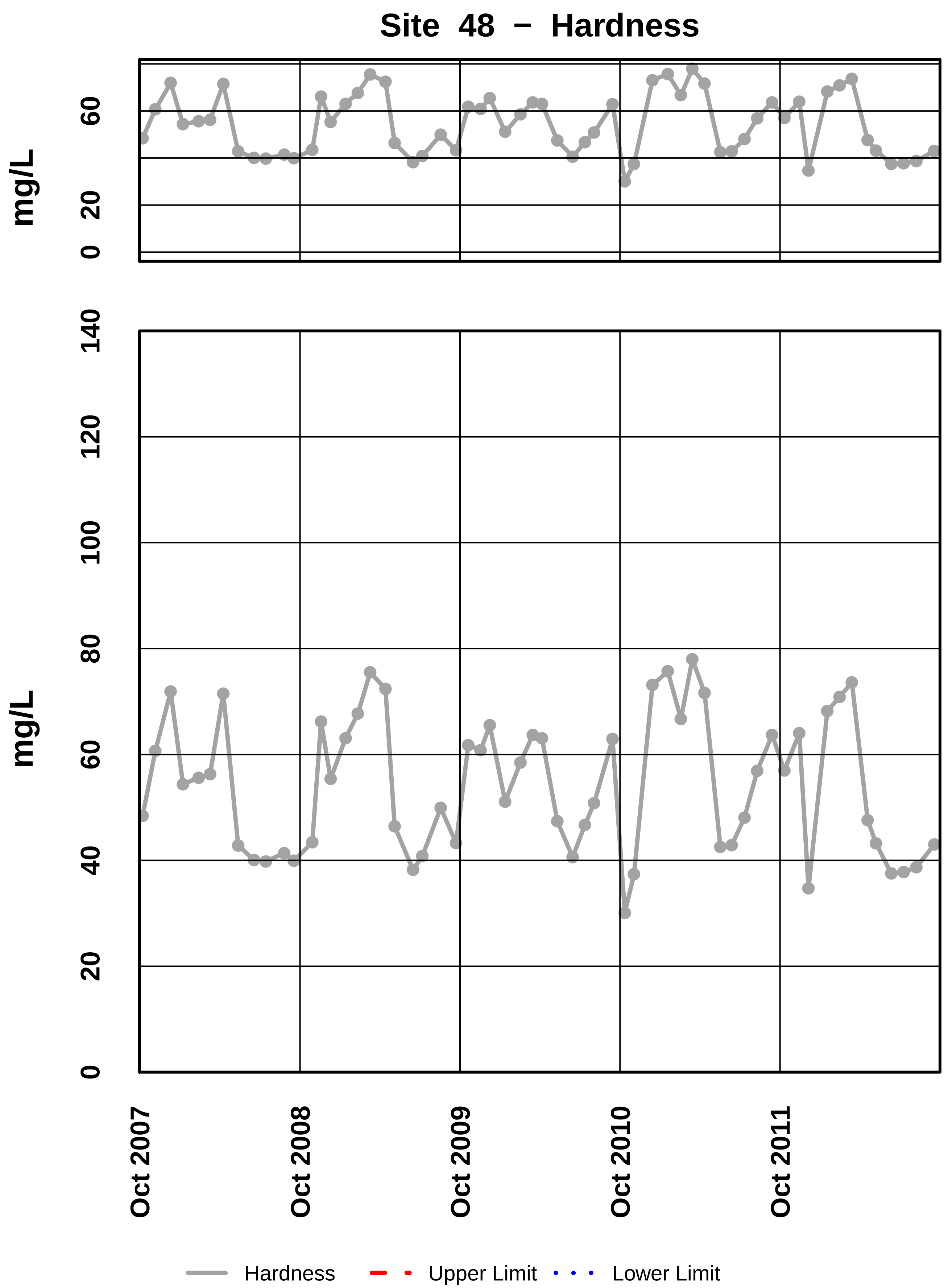

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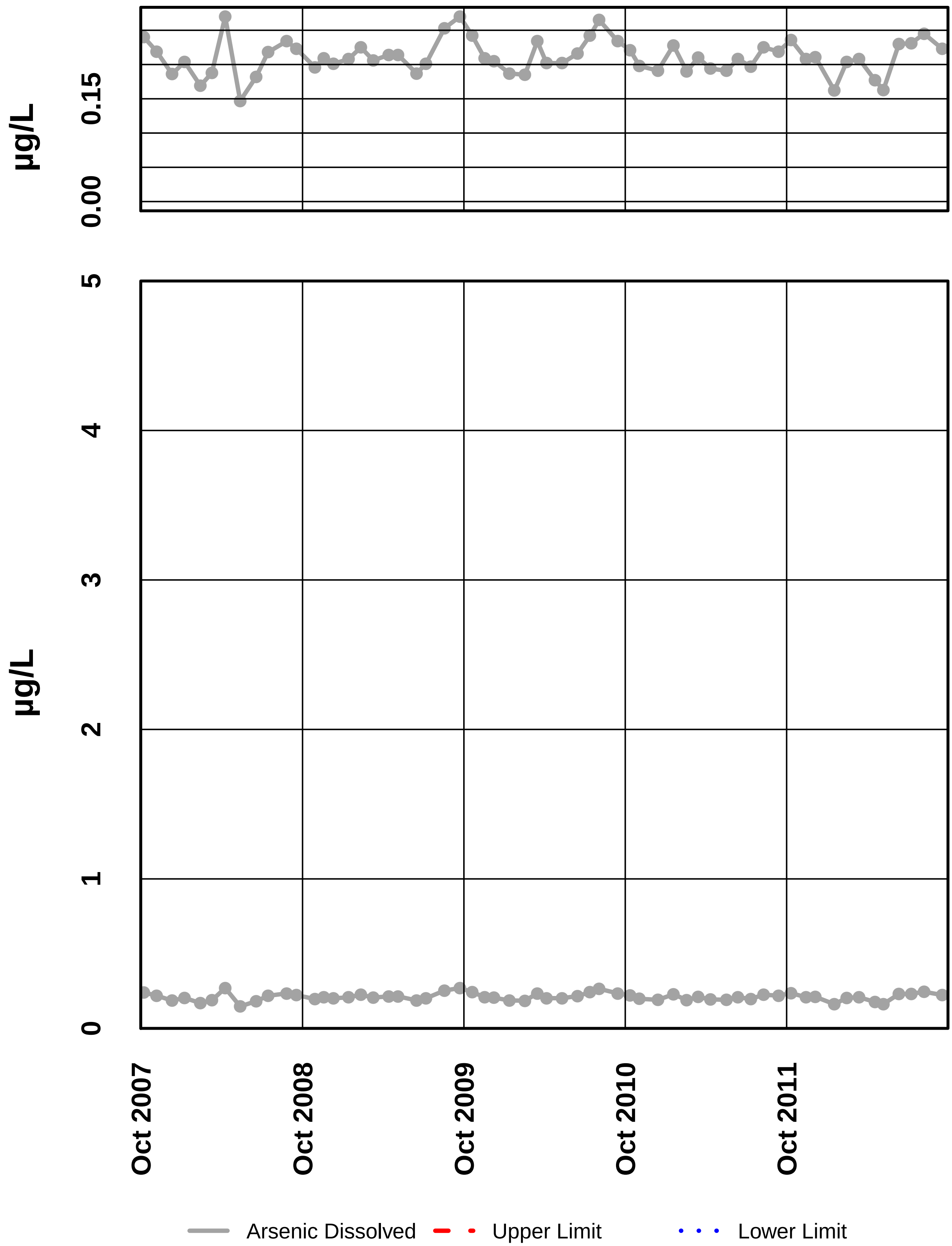
Site 48 – Arsenic Dissolved



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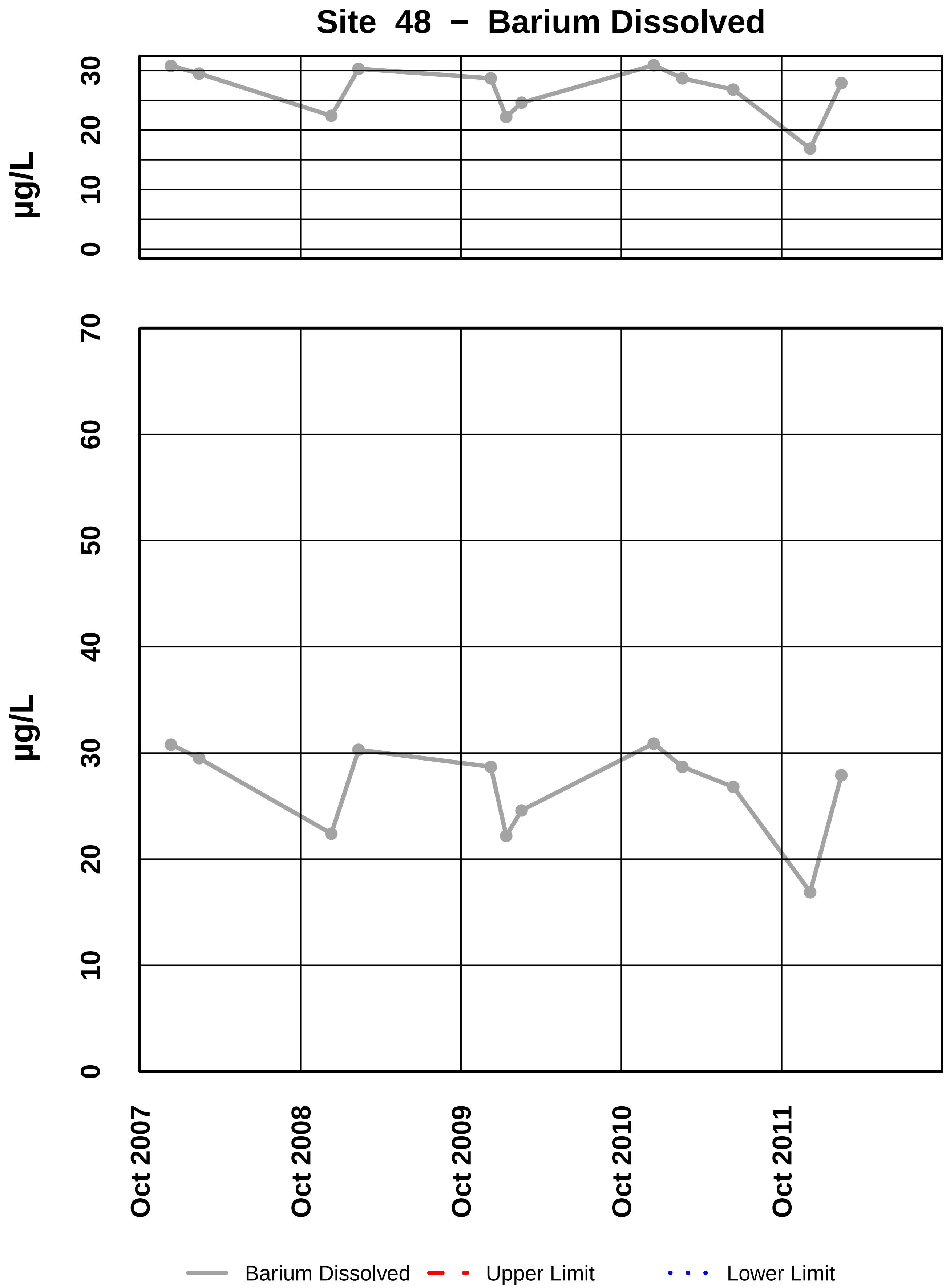

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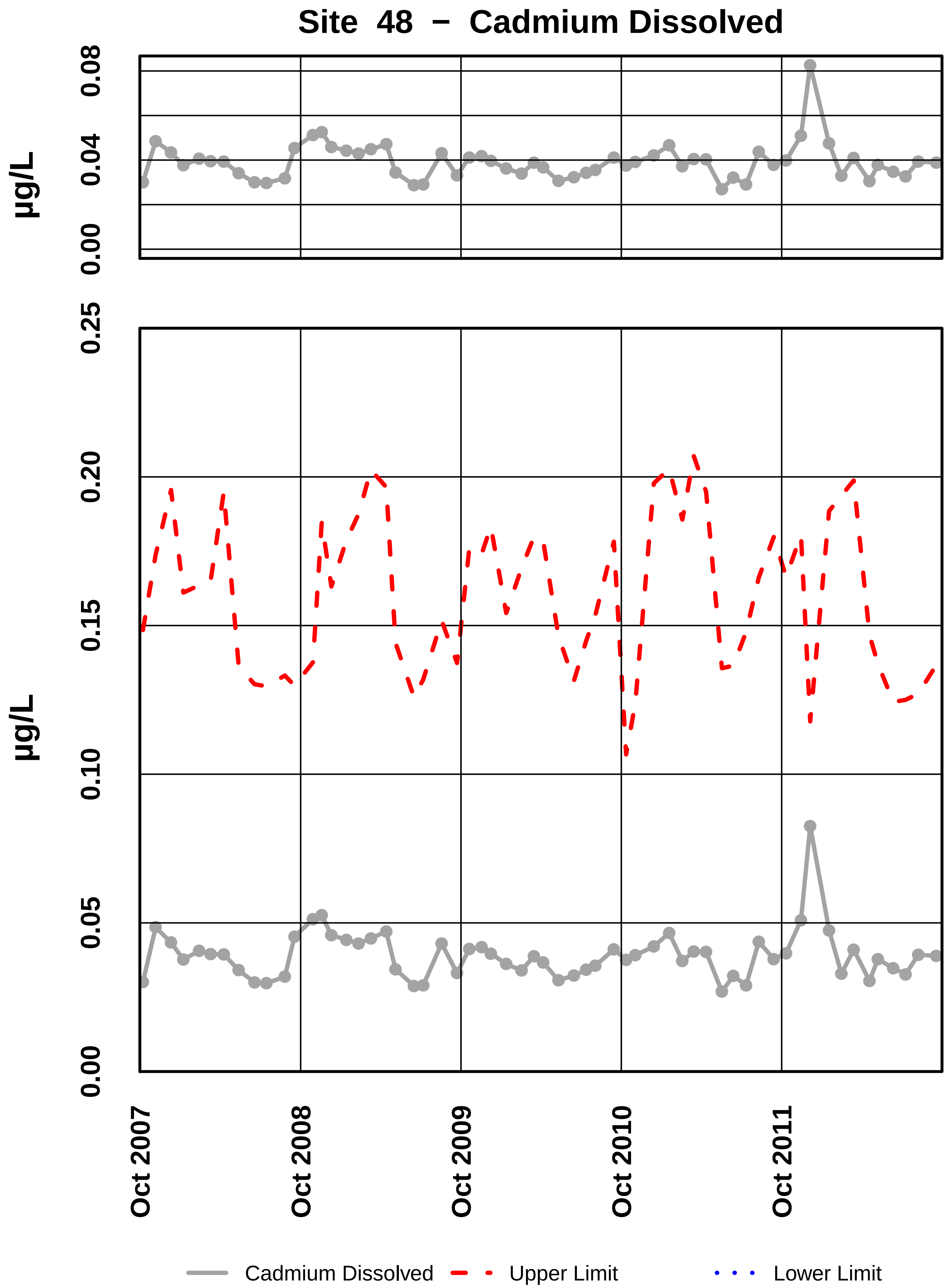

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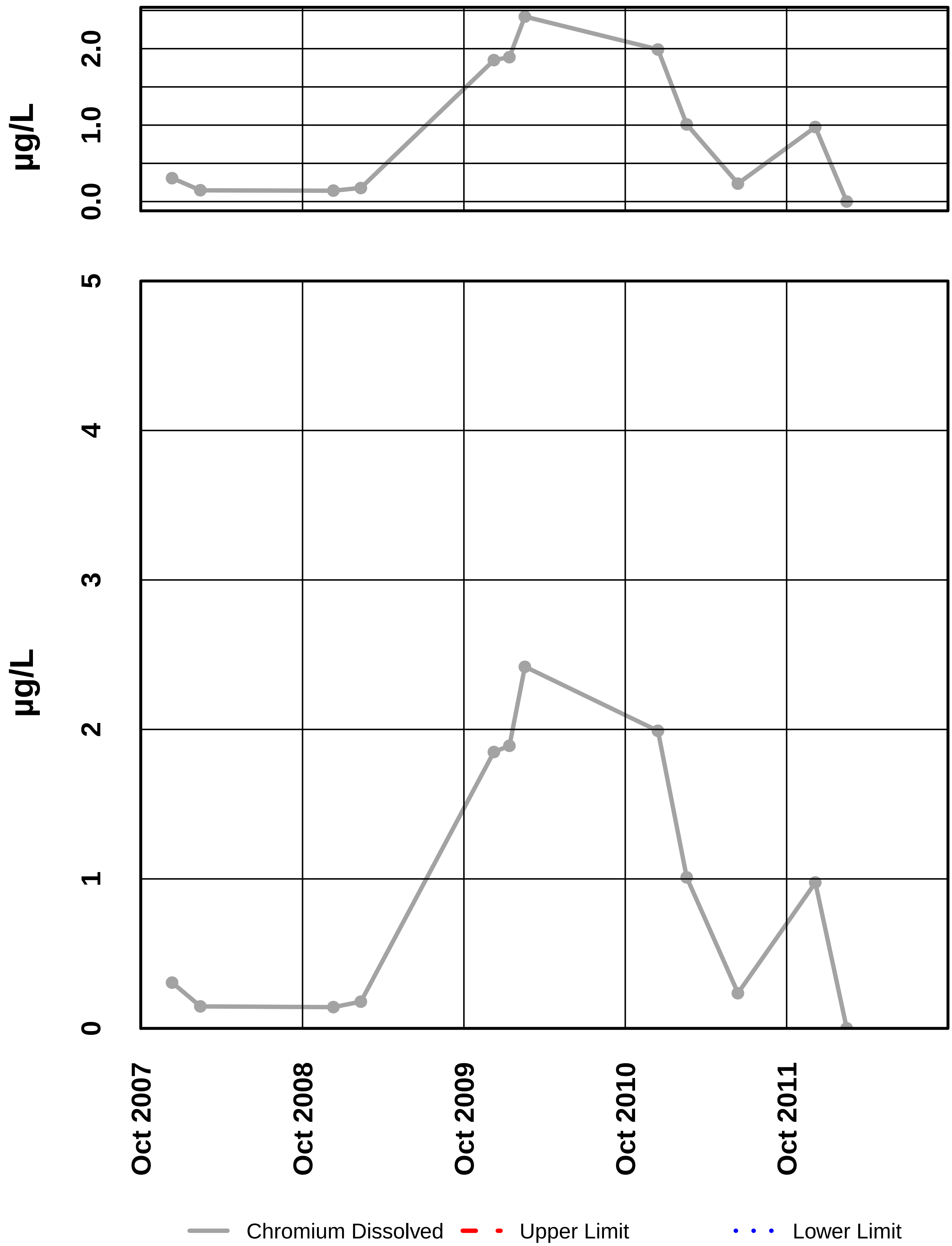
Site 48 – Chromium Dissolved



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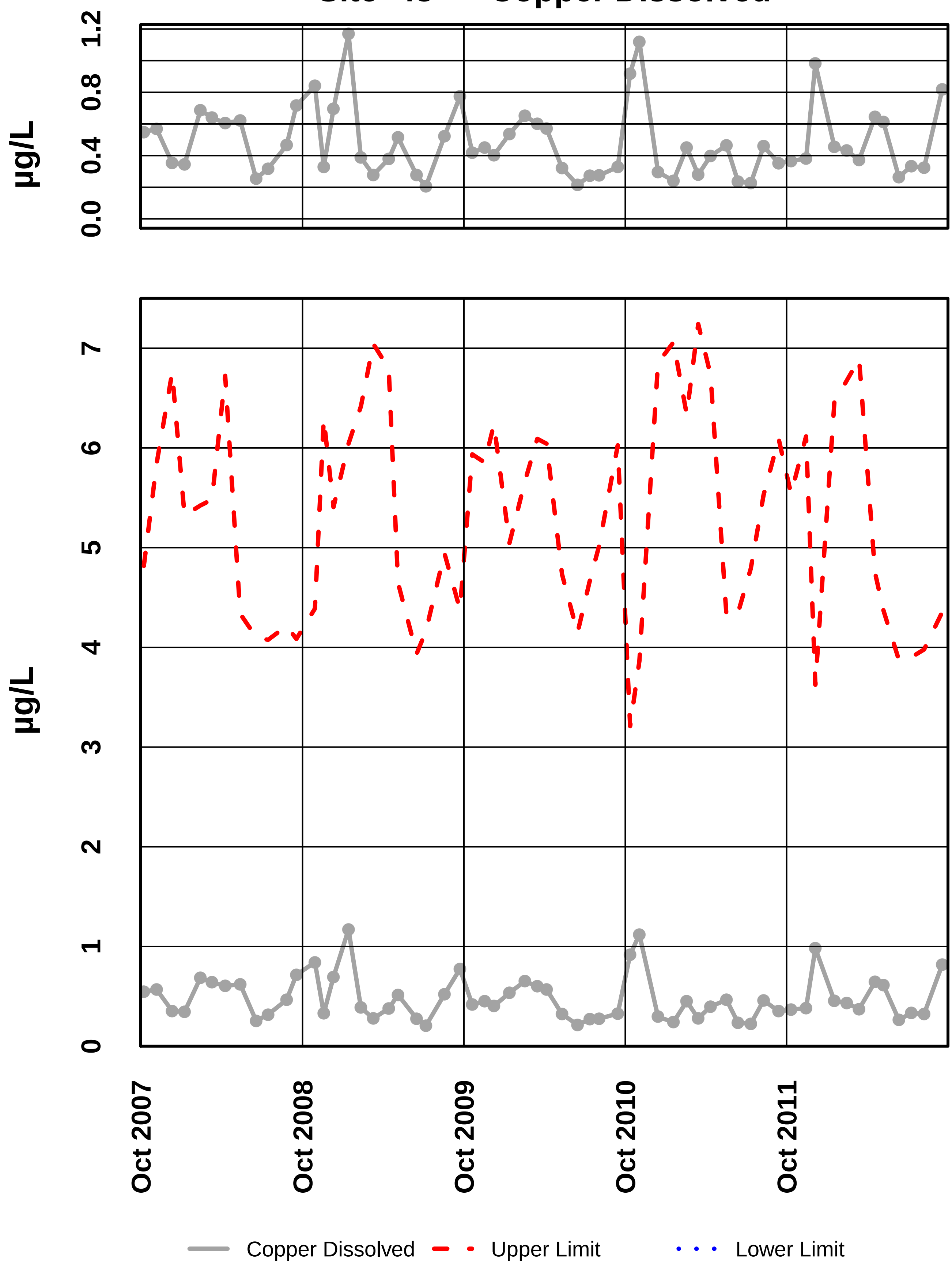
Site 48 – Copper Dissolved



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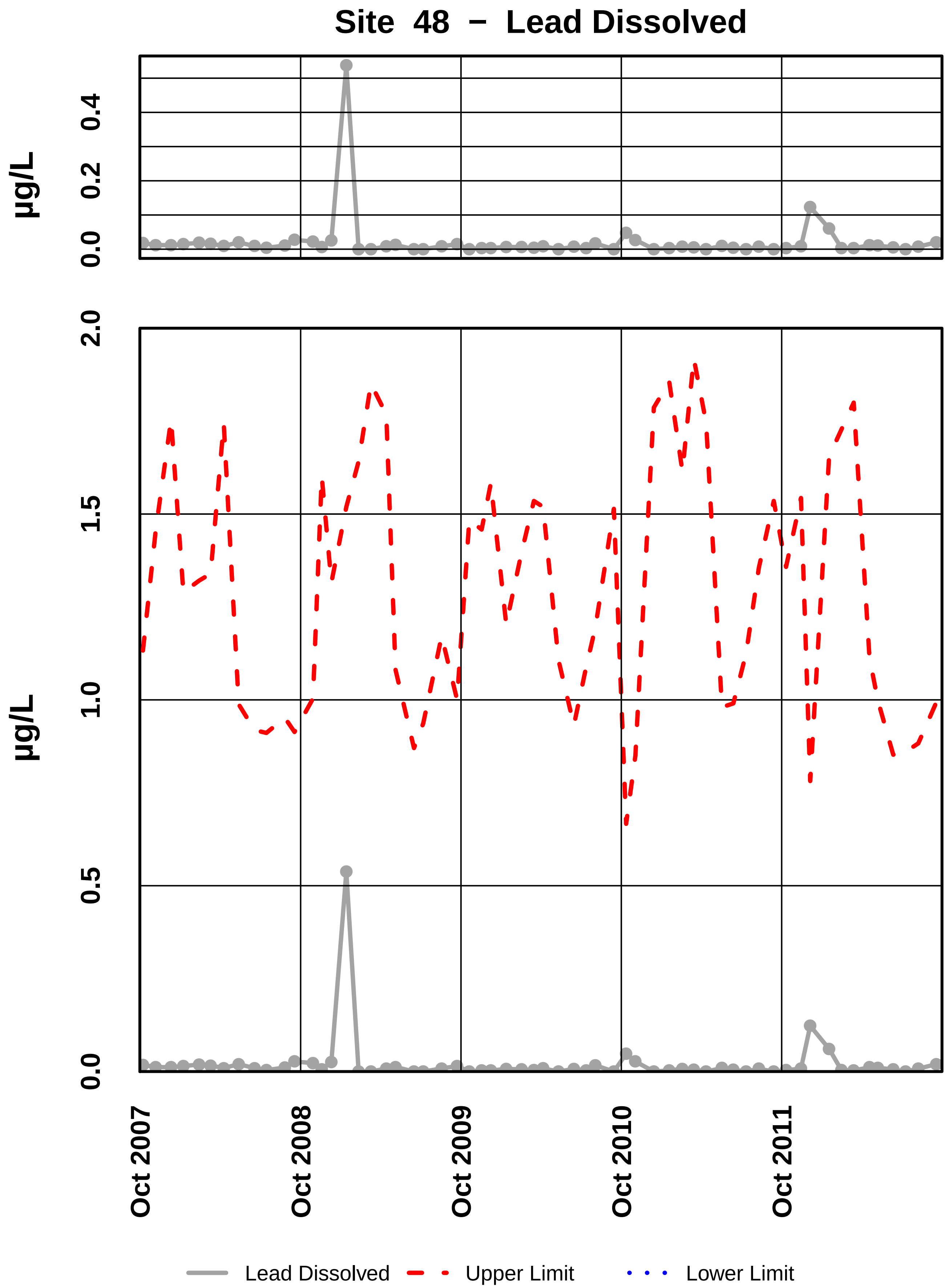

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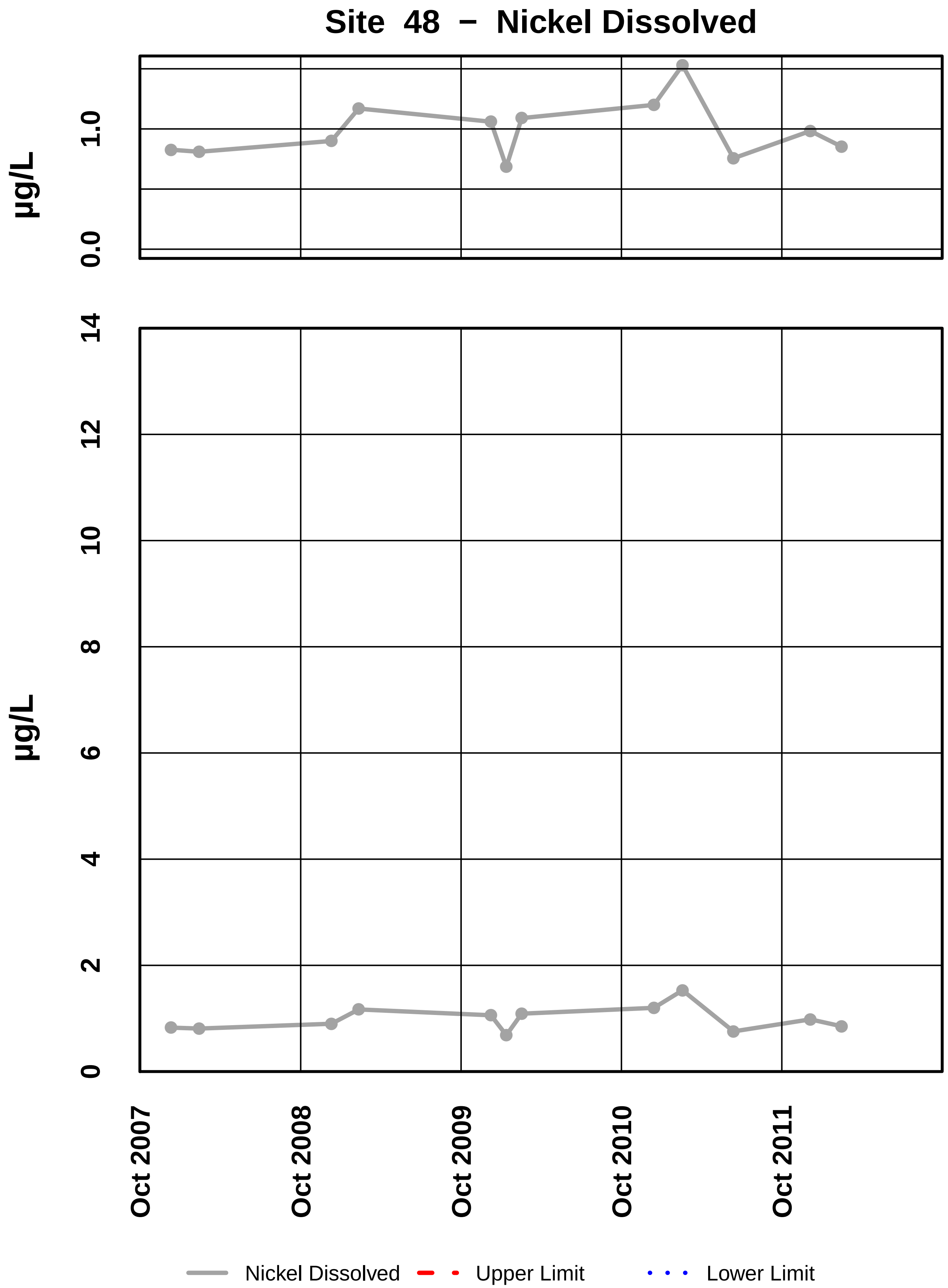

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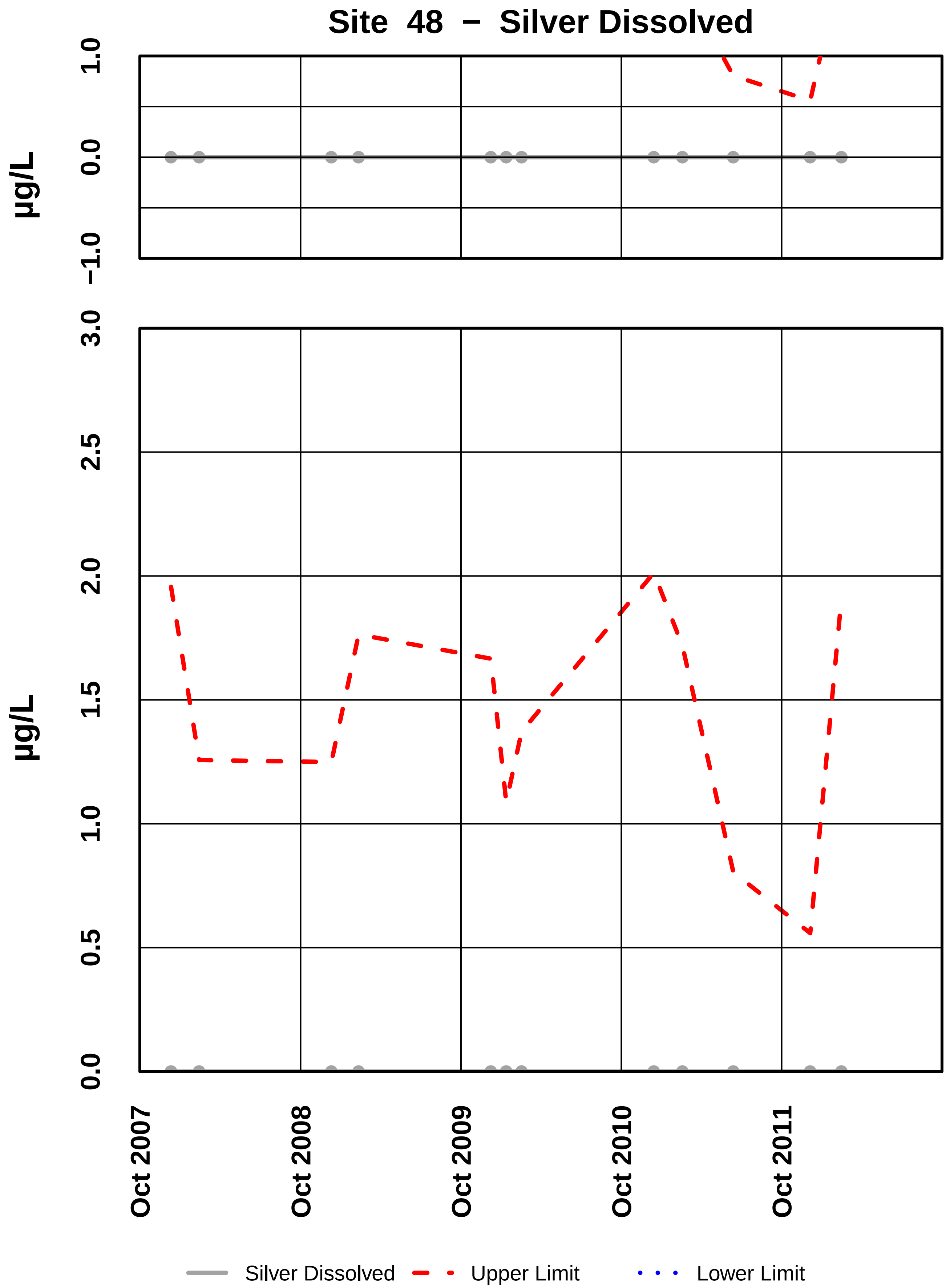

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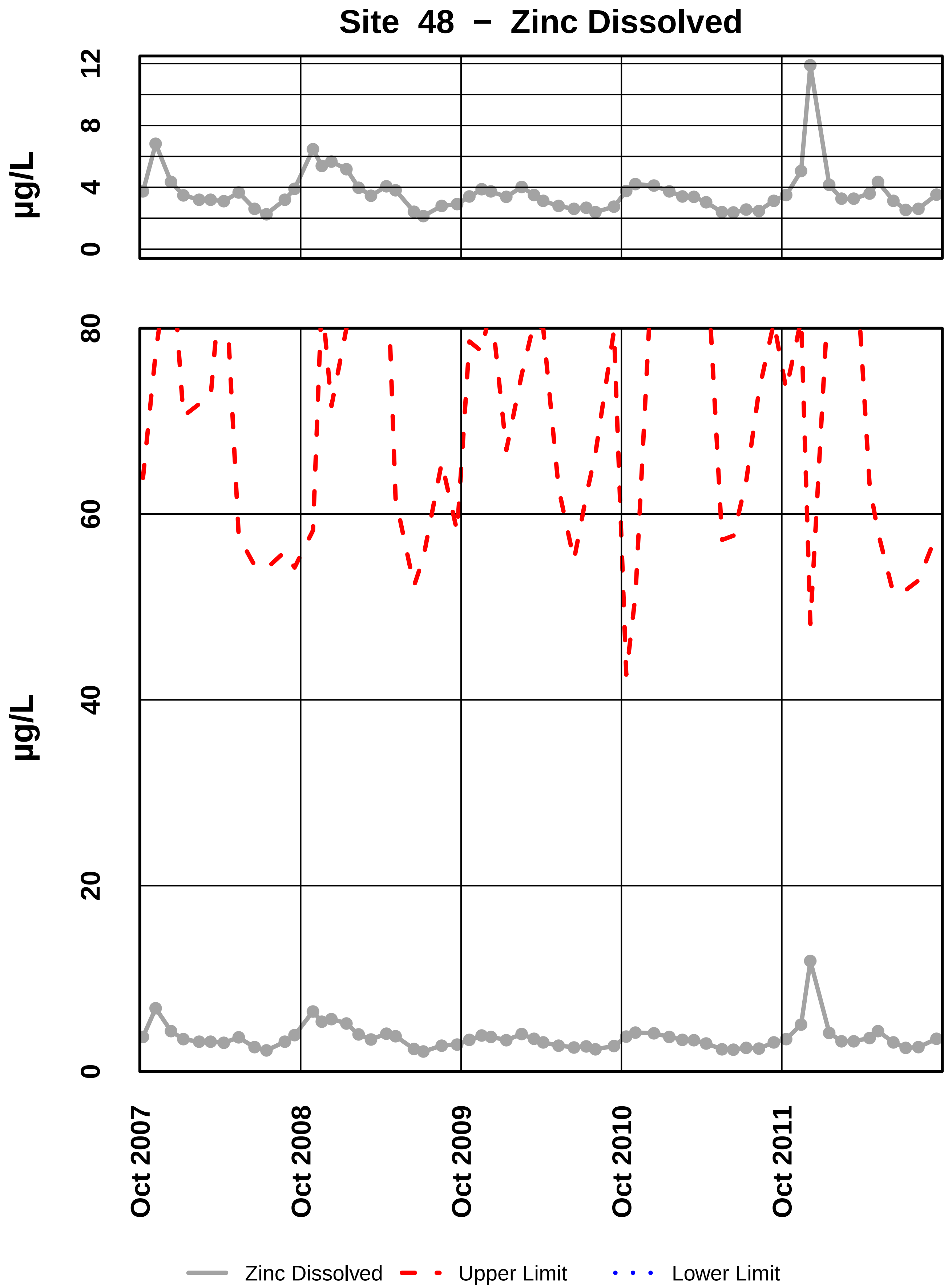

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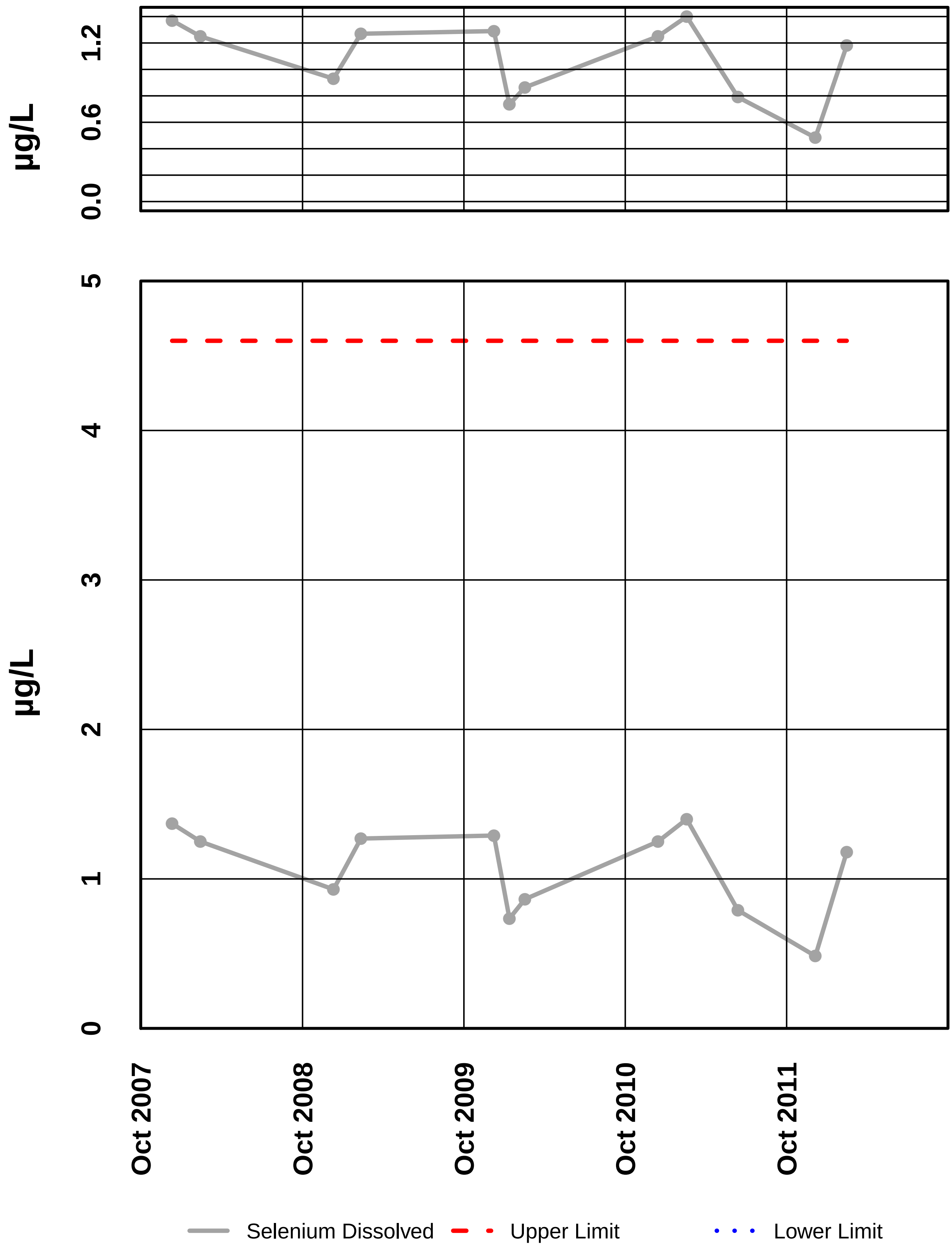
Site 48 – Selenium Dissolved



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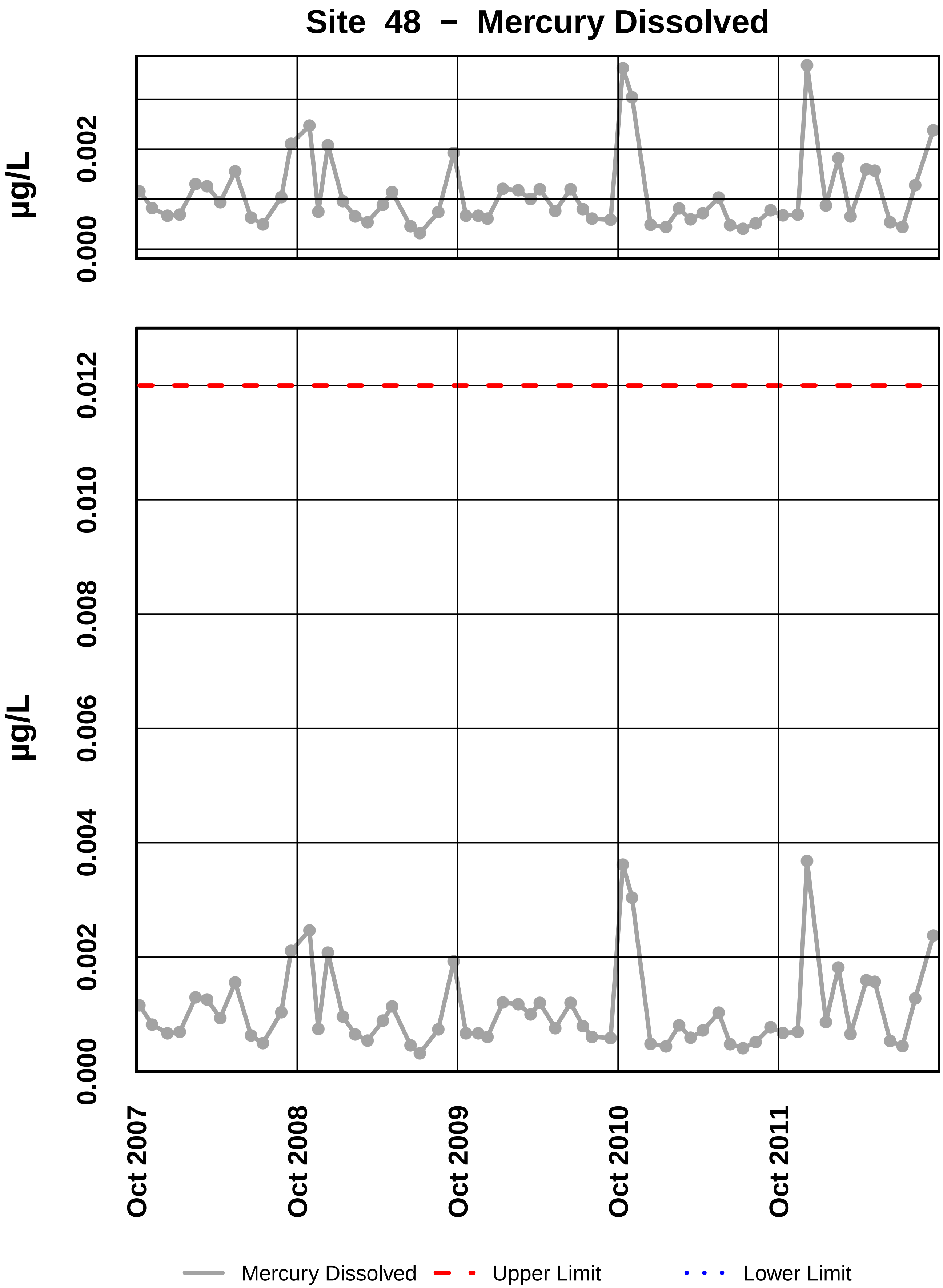


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	WY2007	136.4	139.8	135.8	121.3	144.9		117.1	94.5	80	74.5	120.6	120.1
b	WY2008	106.4	129.6	145.7	151.9	139.5	144.5	132.2	88.8	87.2	82.2	83.9	83.5
c	WY2009	91.1	135.1	111.4	135.1	141.2	141.9	151.9	93.4	79.4	84.1	80.4	69.8
d	WY2010	128.7	111.2	146.1	93	124	141.2	126.9	107.2	84.7	91.5	99.9	125.4
e	WY2011	61.2	76.9	152	157	139	165	72.6	89.6	94	94	119	108
f	WY2012	102	120	75	72	123	154	106	98	83.1	82.7	86	86
	n	6	6	6	6	6	5	6	6	6	6	6	6

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

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

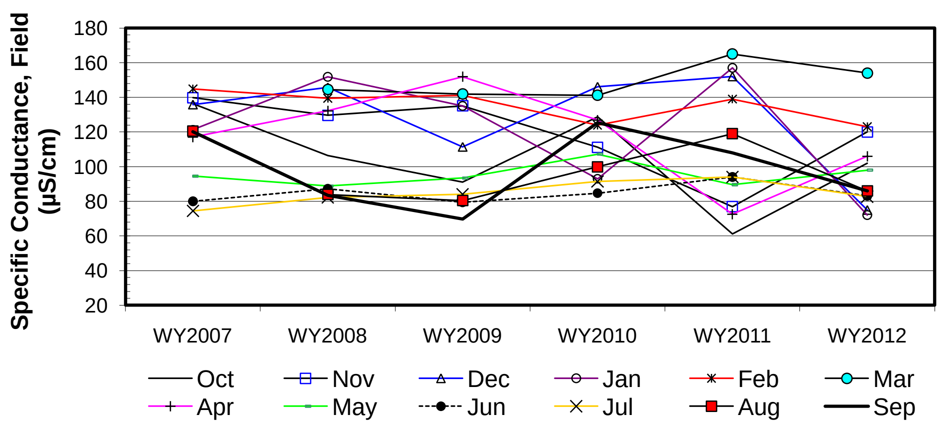
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	28.33	28.33	28.33	28.33	28.33	16.67	28.33	28.33	28.33	28.33	28.33	28.33
$Z_k = S_k/\sigma_S$	-1.32	-1.69	0.19	-0.56	-2.07	0.49	-0.94	0.56	0.56	1.69	-0.19	-0.19
Z^2_k	1.73	2.86	0.04	0.32	4.27	0.24	0.88	0.32	0.32	2.86	0.04	0.04

ΣZ_k= -3.46
ΣZ^2_k= 13.90
Z-bar=ΣZ_k/K= -0.29

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	71	0	0	0	0

Σn 71
ΣS_k -19

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	12.90	@α=5% $\chi^2_{(K-1)}$= 19.68	Test for station homogeneity	
p	0.300		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc} -0.99	@α/2=2.5% Z= 1.96	H_0 (No trend)	ACCEPT
328.33	p 0.160		H_A (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-5.24		1.67
0.050	-3.69	-1.10	0.62
0.100	-2.61		0.21
0.200	-2.24		-0.39

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**	7.7	7.7	7.8	7.7	7.9		7.5	7.8	7.8	7.3	7.9	7.9
b	**WY2008**	7.8	7.7	8.0	7.9	7.9	7.9	7.9	7.8	7.9	7.6	7.7	7.4
c	**WY2009**	7.8	7.9	7.8	7.4	7.8	7.9	7.2	7.0	7.6	6.8	7.1	7.2
d	**WY2010**	7.4	7.2	7.2	6.6	7.2	7.3	7.0	7.7	7.1	7.0	7.1	6.7
e	**WY2011**	6.5	7.6	7.8	7.3	6.9	7.7	7.8	8.0	7.5	6.9	8.1	7.9
f	**WY2012**	7.6	7.6	7.5	5.7	7.6	7.7	7.7	7.8	8.0	7.8	7.7	7.7
	n	6	6	6	6	6	5	6	6	6	6	6	6

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

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

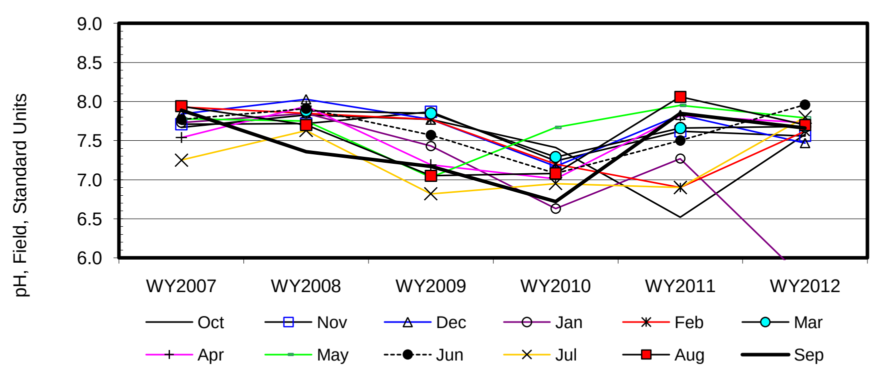
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	28.33	28.33	28.33	28.33	28.33	16.67	28.33	28.33	28.33	28.33	27.33	28.33
$Z_k = S_k/\sigma_S$	-1.32	-0.94	-1.32	-2.07	-2.07	-0.98	-0.19	0.56	-0.19	0.19	0.00	-0.56
Z^2_k	1.73	0.88	1.73	4.27	4.27	0.96	0.04	0.32	0.04	0.04	0.00	0.32

ΣZ_k= -8.87
ΣZ^2_k= 14.58
Z-bar=$\Sigma Z_k/K$= -0.74

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	69	1	0	0	0

Σn 71
ΣS_k -46

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	8.03	@α=5% $\chi^2_{(K-1)}$= 19.68	Test for station homogeneity	
p	**0.711**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k) Z_{calc}	-2.49	@α/2=2.5% Z= 1.96	H_0 (No trend)	REJECT
327.33 **p**	**0.006**		H_A (± trend)	ACCEPT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.12		-0.01
0.050	-0.09	**-0.06**	-0.03
0.100	-0.08		-0.04
0.200	-0.07		-0.05

-0.8%

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**	41.6	46.9	43.0	44.8	49.0	50.4	40.7	35.3	30.8	26.9	42.2	44.3
b	**WY2008**	37.7	44.2	51.9	54.5	48.1	46.8	52.4	35.3	29.7	30.6	33.1	31.4
c	**WY2009**	29.7	43.7	36.6		48.6	51.8	52.6	34.6	30.2	32.0	34.8	36.5
d	**WY2010**	42.2	45.6	48.4	41.4	41.0	45.7	43.3	36.5	32.5	34.1	39.3	48.9
e	**WY2011**	21.6	24.0	47.2	52.8	46.4	50.0	51.4	33.7	32.5	38.2	43.5	47.3
f	**WY2012**	47.2	51.6	21.5	48.6	49.6	52.9	36.1	37.1	32.9	32.7	28.9	38.8
	n	6	6	6	5	6	6	6	6	6	6	6	6

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

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a	-1	-1	1	1	-1	-1	1	0	-1	1	-1	-1
c-a	-1	-1	-1		-1	1	1	-1	-1	1	-1	-1
d-a	1	-1	1	-1	-1	-1	1	1	1	1	-1	1
e-a	-1	-1	1	1	-1	-1	1	-1	1	1	1	1
f-a	1	1	-1	1	1	1	-1	1	1	1	-1	-1
c-b	-1	-1	-1		1	1	1	-1	1	1	1	1
d-b	1	1	-1	-1	-1	-1	-1	1	1	1	1	1
e-b	-1	-1	-1	-1	-1	1	-1	-1	1	1	1	1
f-b	1	1	-1	-1	1	1	-1	1	1	1	-1	1
d-c	1	1	1		-1	-1	-1	1	1	1	1	1
e-c	-1	-1	1		-1	-1	-1	-1	1	1	1	1
f-c	1	1	-1		1	1	-1	1	1	1	-1	1
e-d	-1	-1	-1	1	1	1	1	-1	0	1	1	-1
f-d	1	1	-1	1	1	1	-1	1	1	-1	-1	-1
f-e	1	1	-1	-1	1	1	-1	1	1	-1	-1	-1
S_k	1	-1	-5	0	-1	3	-3	2	10	11	-1	3

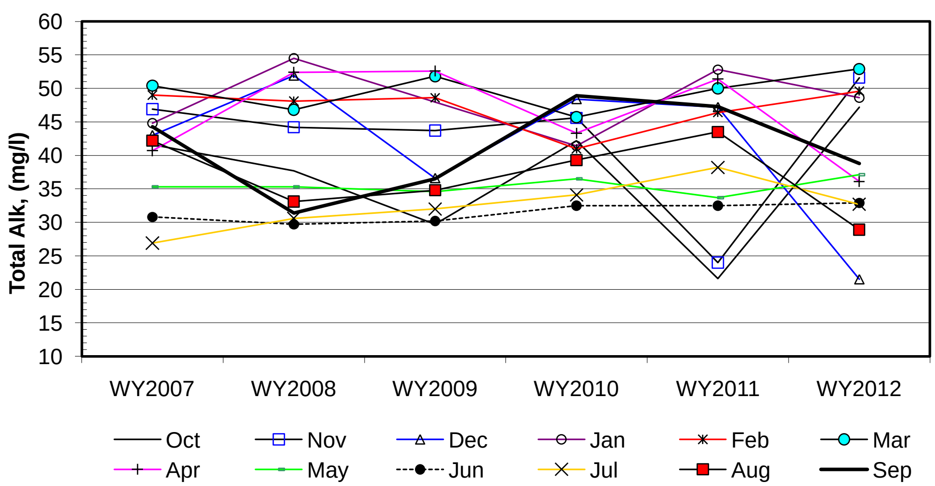
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	28.33	28.33	28.33	16.67	28.33	28.33	28.33	27.33	27.33	28.33	28.33	28.33
$Z_k = S_k/\sigma_S$	0.19	-0.19	-0.94	0.00	-0.19	0.56	-0.56	0.38	1.91	2.07	-0.19	0.56
Z^2_k	0.04	0.04	0.88	0.00	0.04	0.32	0.32	0.15	3.66	4.27	0.04	0.32

ΣZ_k= 3.61
ΣZ^2_k= 10.05
Z-bar=ΣZ_k/K= 0.30

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

Σn 71
ΣS_k 19

$\chi^2_h=\Sigma Z^2_k$-K(Z-bar)^2=	8.97	@α=5% $\chi^2_{(K-1)}$= 19.68	Test for station homogeneity	
p	**0.625**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc} 1.00	@α/2=2.5% Z= 1.96	**H_0** (No trend)	ACCEPT
326.33	**p** **0.840**		**H_A** ($\pm$ trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.56		0.85
0.050	-0.37	**0.36**	0.70
0.100	-0.21		0.53
0.200	0.11		0.46

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**	10.9	14.8	13.8	14.0	16.1	17.2	11.1	7.9	5.7	5.1	11.2	12.4
b	**WY2008**	12.0	11.5	15.1	18.5	17.4	14.2	16.0	6.9	6.8	7.8	7.6	6.6
c	**WY2009**	7.7	15.6	14.3	15.7	18.3	21.9	19.7	9.0	7.4	9.6	10.7	8.0
d	**WY2010**	13.8	16.1	17.0	13.4	13.0	15.4	15.5	10.0	8.7	9.2	10.8	14.5
e	**WY2011**	5.4	7.1	19.7	21.0	17.5	21.8	19.5	8.2	9.7	10.1	13.6	14.6
f	**WY2012**	13.4	15.5	5.5	19.2	18.4	19.0	10.1	8.9	7.1	7.5	7.7	8.2
	n	6	6	6	6	6	6	6	6	6	6	6	6

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

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

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

ΣZ_k= 8.27

ΣZ^2_k= 8.89

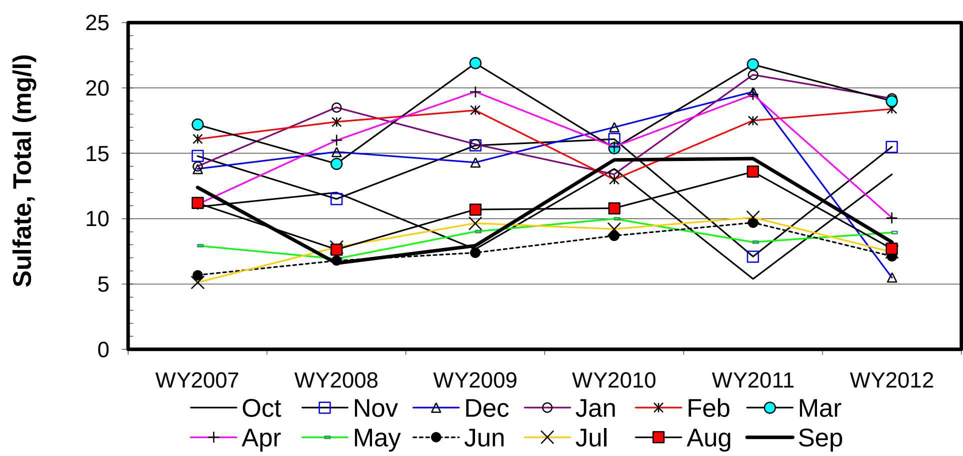
Z-bar=ΣZ_k/K= 0.69

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

Σn 72

ΣS_k 44

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=		3.20	@α=5% $\chi^2_{(K-1)}$=	19.68	Test for station homogeneity
	p	**0.988**			$\chi^2_h<\chi^2_{(K-1)}$ ACCEPT
ΣVAR(S_k)	Z_{calc}	2.33	@α=2.5% Z=	1.96	**H_0** (No trend) REJECT
340.00	p	**0.990**			**H_A** (± trend) ACCEPT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	0.00		0.90
0.050	0.10	**0.45**	0.77
0.100	0.18		0.69
0.200	0.26		0.59
		3.5%	

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	WY2007	2.1	2.2	2.8	2.3	2.3	2.5	2.2	3.4	2.2	2.5	2.6	1.8
b	WY2008	3.7	6.8	4.3	3.5	3.2	3.2	3.1	3.7	2.6	2.3	3.2	3.9
c	WY2009	6.5	5.4	5.7	5.2	4.0	3.5	4.1	3.8	2.4	2.1	2.8	2.9
d	WY2010	3.4	3.9	3.7	3.4	4.0	3.5	3.1	2.8	2.6	2.7	2.4	2.8
e	WY2011	3.8	4.2	4.1	3.7	3.4	3.4	3.0	2.4	2.4	2.6	2.5	3.1
f	WY2012	3.5	5.1	11.9	4.2	3.3	3.3	3.6	4.4	3.1	2.6	2.6	3.5
	n	6	6	6	6	6	6	6	6	6	6	6	6

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

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

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

ΣZ_k= 8.27

ΣZ^2_k= 8.89

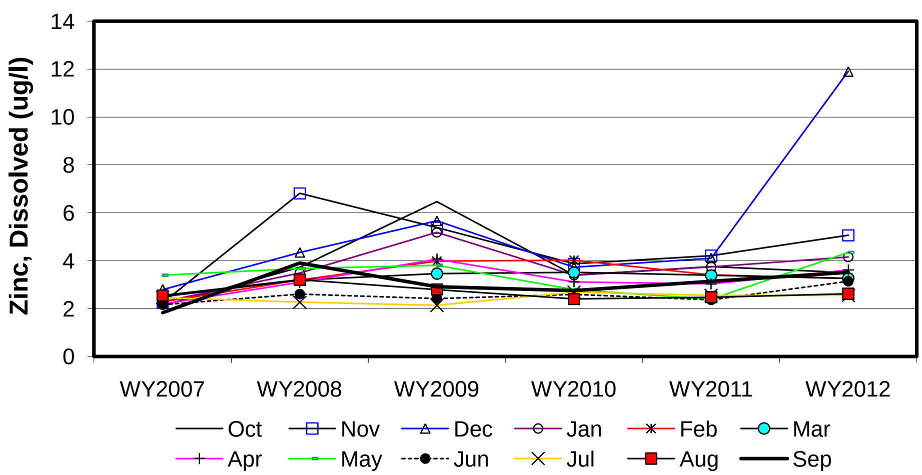
Z-bar=ΣZ_k/K= 0.69

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

Σn 72

ΣS_k 44

$\chi^2_h=\Sigma Z^2_k$-K(Z-bar)^2=		3.20	@α=5% $\chi^2_{(K-1)}$= 19.68	Test for station homogeneity	
	p	**0.988**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc}	2.33	@α/2=2.5% Z= 1.96	**H_0** (No trend)	REJECT
340.00	p	**0.990**		**H_A** (± trend)	ACCEPT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	0.00		0.23
0.050	0.02	**0.13**	0.20
0.100	0.05		0.18
0.200	0.07		0.15
		4.0%	

INTERPRETIVE REPORT
SITE 6

The data collected during the current water year are listed in the following "Table of Results for Water Year 2012" report. The table includes all the required FWMP analyte data (field and laboratory) collected for the current water year and a series of flags keyed to the summary report "Qualified Data by QA Reviewer". The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of ½ MDL for the purpose of median calculation.

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

Sample Date	Parameter	Value	Qualifier	Notes
No outliers have been identified by HGCMC for the period of October 2007 through September 2012.				

The data for water year 2012 have been compared to the strictest fresh water quality criterion for each applicable analyte. One result for pH exceeding these criteria has been identified. This is considered to be caused by natural background variation, for Site 48 also had an exceedance for pH during the same sampling event.

Table of Exceedance for Water Year 2012

			Limits		
Sample Date	Parameter	Value	Lower	Upper	Hardness
17-Jan-12	pH Field	6.14 su	6.5	8.50	

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

A non-parametric statistical analysis for trend was performed for specific conductivity, field pH, total alkalinity, total sulfate, and dissolved zinc. Calculation details of the Seasonal Kendall analyses are presented in detail on the pages following this interpretive section. The following table summarizes the results of the data collected between Oct-06 and Sep-11 (WY2007-WY2012).

Table of Summary Statistics for Trend Analysis

	Mann-Kendall test statistics			Sen's slope estimate	
Parameter	**n***	**p****	**Trend**	**Q**	**Q(%)**
Conductivity Field	6	0.13			
pH Field	6	0.29			
Alkalinity, Total	6	0.31			
Sulfate, Total	6	<0.01	+	0.36	2.4
Zinc, Dissolved	6	<0.01	+	0.40	5.4

* Number of Years ** Significance level

Dissolved zinc had a statistically significant positive slope of 0.36 µg/L/yr, which is similar to last year's slope of 0.39 µg/L/yr. Though these values are increasing they are still approximately 1/8th of the AWQS for dissolved zinc. Total sulfate was also increasing statistically significantly, with a Sen's slope estimate of 0.40 µg/L/yr, similar to last year's slope of 0.46 µg/L/yr. Currently, HGCMC does not feel that these increasing trends are 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 2011 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	92	105.5	-6
pH Field	0.259	7.67	7.71	0
Alkalinity, Total	0.088	38	37.3	-0.5
Sulfate, Total	<0.01	9.5	11.30	-1.90
Zinc, Dissolved	<0.01	3.51	9.34	-4.77

Field pH and total alkalinity do not have a statistically significant difference between measured median values at a significance level of α=0.05 for a one-tailed test. The median values for total alkalinity for Site 48 and Site 6 are 38 mg/L and 37.3 mg/L respectively and the median of differences, Site 48 minus Site 6, is -0.5 µS/cm.

The median values for field conductivity for Site 48 and Site 6 are 92 µS/cm and 105.5 µS/cm respectively. The median values for total sulfate for Site 48 and Site 6 are 9.5 mg/L and 11.3 mg/L respectively. Dissolved zinc results follow along in a similar manner where the median values for Site 48 and Site 6 are 3.51 µg/L and 9.34 µg/L respectively. Signed-rank test results for prior datasets for Water Years 2000 – 2011 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. HGCMC believes that no additional monitoring is warranted at this time due to the consistent differences in the measured analytes between the two sites. Taking into consideration the small magnitude of the differences that are measurable between the two sites, the current FWMP program is sufficient to monitor any future increases at Site 6. Thus, if an upward trend in total sulfate, or dissolved zinc at Site 6 is occurring, the current program is sufficient for identifying the change before any water quality values are impaired.

Table of Results for Water Year 2012

Site 006FMS - 'Greens Creek Middle'

Sample Date/Parameter	Oct 2011	Nov 2011	Dec 2011	Jan 2012	Feb 2012	Mar 2012	Apr 2012	May 2012	Jun 2012	Jul 2012	Aug 2012	Sep 2012	**Median**
Water Temp (°C)		0.4	0.2	0	0.9	0.3	1.4	2.1	4.2	5.5	7.5	6.9	1.4
Conductivity-Field(μmho)	107	126	92	130	133	169	112	104	86.3	86.2	90	92	105.5
Conductivity-Lab (μmho)	130	144	107	133	159	172	112	106	87	87	85	93	110
pH Lab (standard units)	7.6	7.42	6.6	6.65	7.12	6.81	6.47	7.12	7.11	6.91	6.4	7.28	7.01
pH Field (standard units)	7.39	7.91	7.72	6.14	7.42	8.16	7.74	7.63	7.93	7.79	7.62	7.7	7.71
Total Alkalinity (mg/L)	39.5	52.1	28.9	53.8	49.9	52.6	36.4	37.9	34	33.2	31.3	36.6	37.3
Total Sulfate (mg/L)	15.3	17.9	10	22.9	21.6	23.5	11.9	10.7	7.8	8.2	9.3	9	11.3
Hardness (mg/L)	59.1	66.2	45	76.3	76	79.7	49.7	47.4	38.9	39	40.7	44.1	48.6
Dissolved As (ug/L)	0.242	0.162	0.193	0.147	0.227	0.182	0.171	0.164	0.19	0.193	0.209	0.243	0.192
Dissolved Ba (ug/L)			20.5		30								25.3
Dissolved Cd (ug/L)	0.0501	0.0575	0.1	0.0639	0.0577	0.056	0.0686	0.0633	0.0357	0.0443	0.0468	0.0519	0.0568
Dissolved Cr (ug/L)			1.13		0.205								0.668
Dissolved Cu (ug/L)	0.402	0.41	0.953	0.46	0.55	0.4	0.794	0.679	0.29	0.297	0.426	0.933	0.443
Dissolved Pb (ug/L)	0.0161	0.0106	0.388	0.0582	0.0582	0.0129	0.0402	0.0611	0.0073	0.0015	0.0144	0.0539	0.0282
Dissolved Ni (ug/L)			1.21		0.994								1.102
Dissolved Ag (ug/L)			0.002		0.002								0.002
Dissolved Zn (ug/L)	7.73	10.7	14.6	12.7	10.1	8.57	12	10.2	4.1	4.5	4.68	6.3	9.34
Dissolved Se (ug/L)			0.747		1.18								0.964
Dissolved Hg (ug/L)	0.000778	0.000867	0.00235	0.000718	0.000956	0.000653	0.00185	0.00182	0.000612	0.000541	0.000773	0.00257	0.000823

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 KGCMC and removed from any further analysis and is not included into the calculation of the median

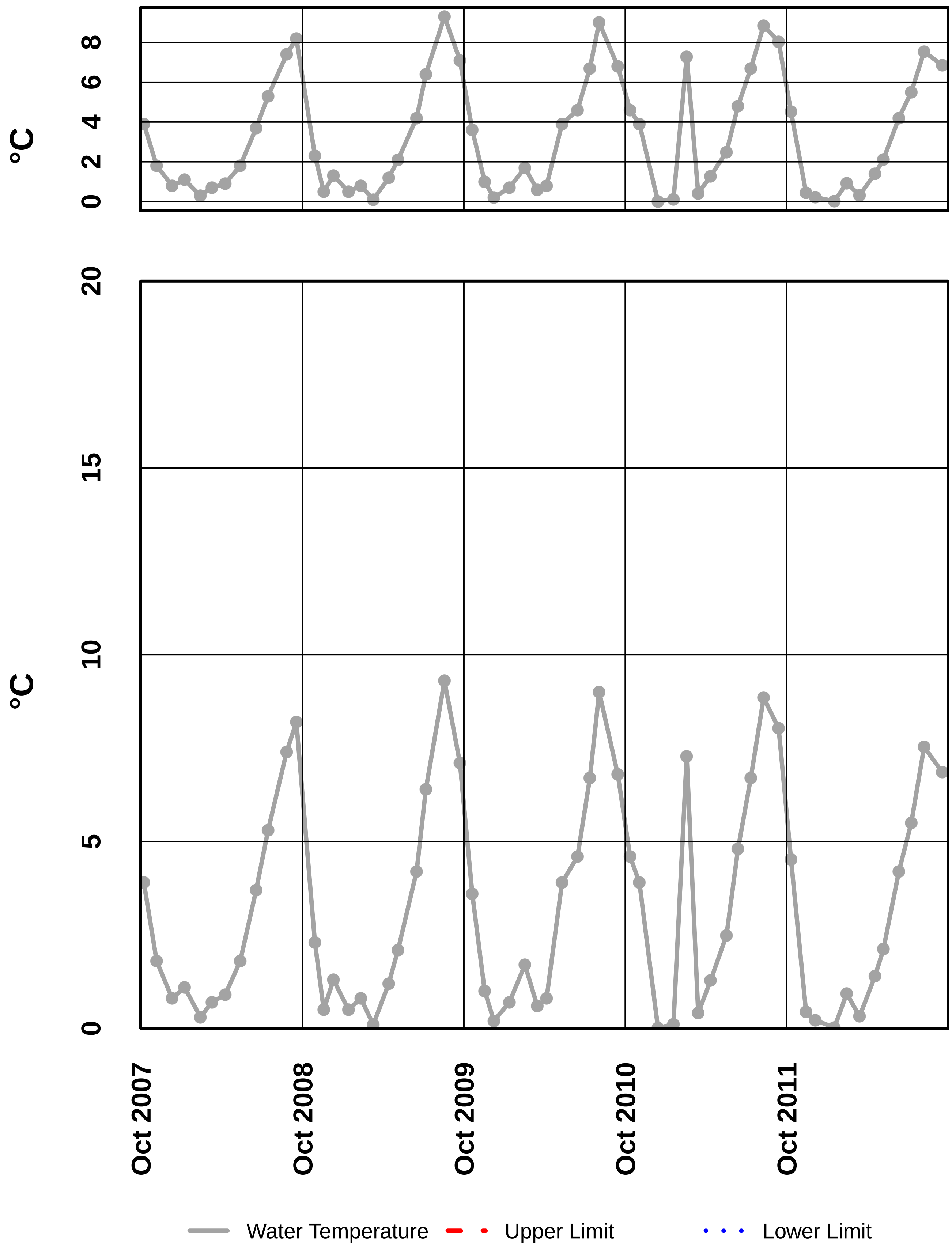
Qualified Data by QA Reviewer

Date Range: 10/01/2011 to 09/30/2012

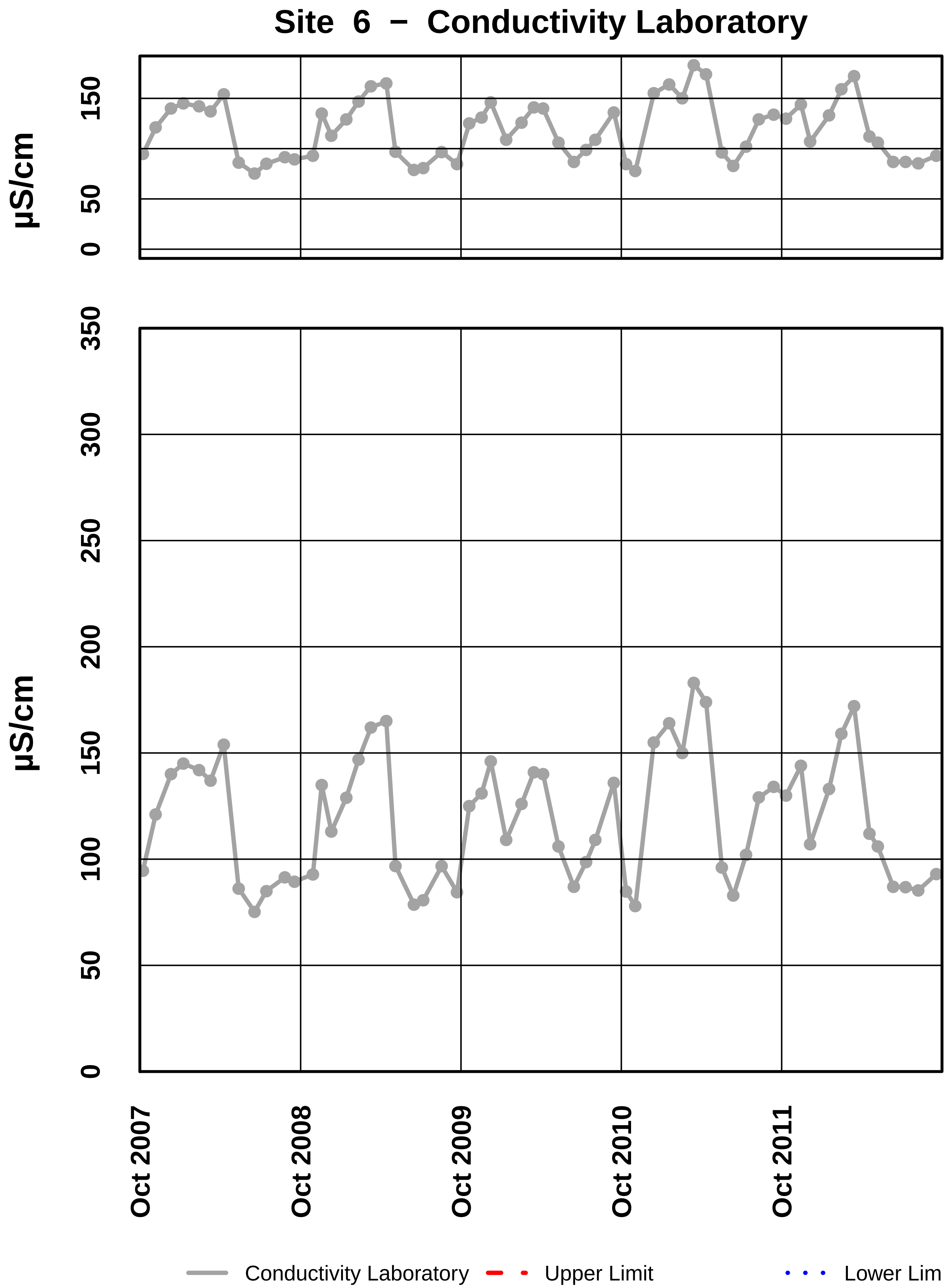
Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
6	10/11/2011	12:00 AM	Cu diss, µg/l	0.4	U	Field Blank Contamination
			Pb diss, µg/l	0.01	U	Field Blank Contamination
			Zn diss, µg/l	7.73	U	Field Blank Contamination
			SO4 Tot, mg/l	15.3	J	Sample Temperature Receipt
6	1/17/2012	12:00 AM	pH Lab, su	6.65	J	Hold Time Violation
6	2/14/2012	12:00 AM	Cr diss, µg/l	0.2	U	Field Blank Contamination
6	3/14/2012	12:00 AM	Cu diss, µg/l	0.4	U	Field Blank Contamination
			Hg diss, µg/l	0.000653	U	Field Blank Contamination
			SO4 Tot, mg/l	23.5	J	Sample Receipt Temperature
6	4/18/2012	12:00 AM	Pb diss, µg/l	0.04	U	Field Blank Contamination
			SO4 Tot, mg/l	11.87	J	Sample Receipt Temperature
6	5/7/2012	12:00 AM	SO4 Tot, mg/l	10.65	J	Sample Receipt Temperature
6	6/11/2012	12:00 AM	Pb diss, µg/l	0.00727	J	Below Quantitative Range
			SO4 Tot, mg/l	7.78	J	Sample Receipt Temperature
6	7/9/2012	12:00 AM	Hg diss, µg/l	0.000541	U	Field Blank Contamination
6	8/7/2012	12:00 AM	As diss, µg/l	0.2	J	LCS Recovery
6	9/17/2012	12:00 AM	pH Lab, su	7.28	J	Hold Time Violation
			SO4 Tot, mg/l	8.99	J	Sample Receipt Temperature

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

Site 6 − Water Temperature



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



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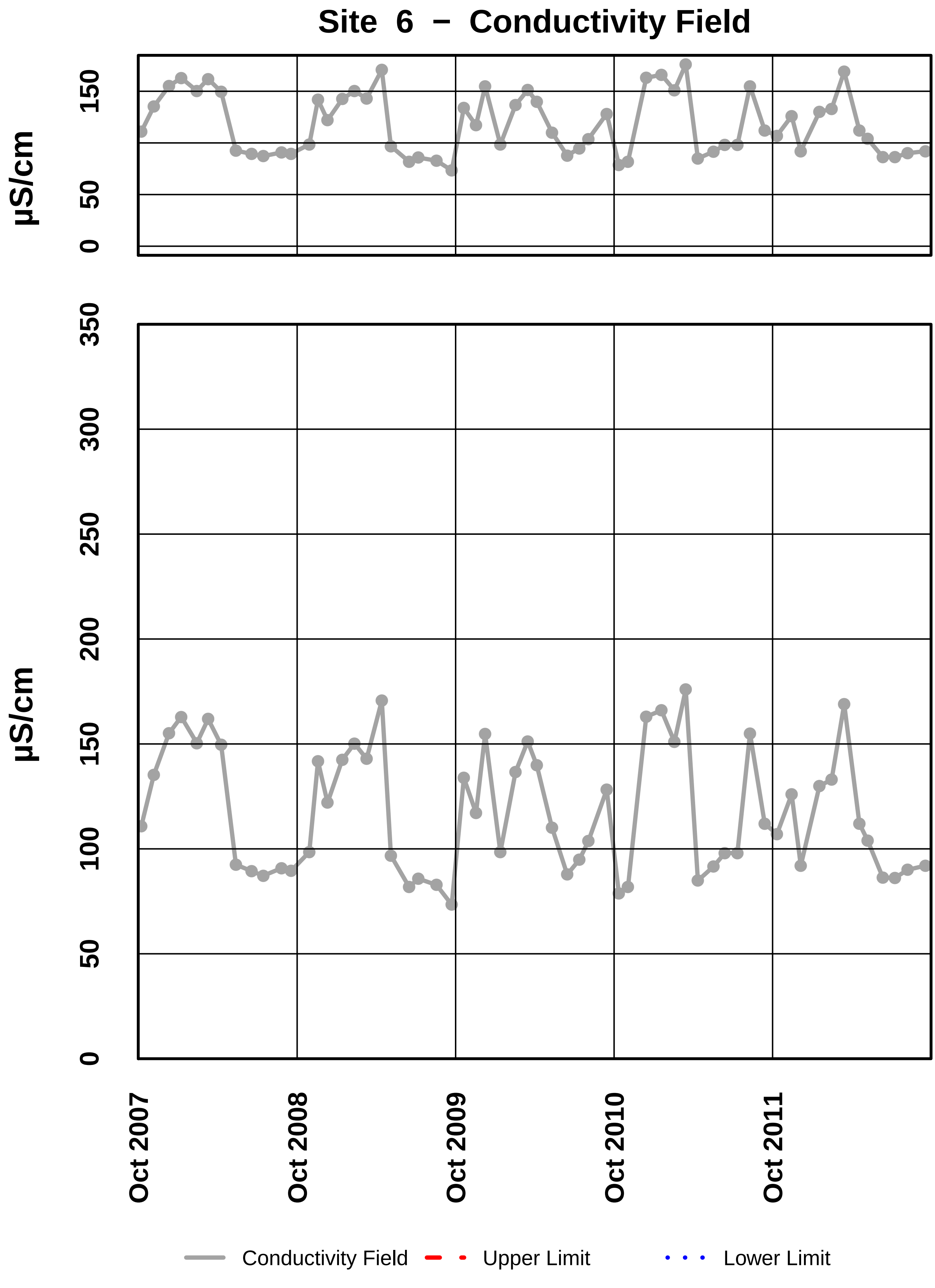

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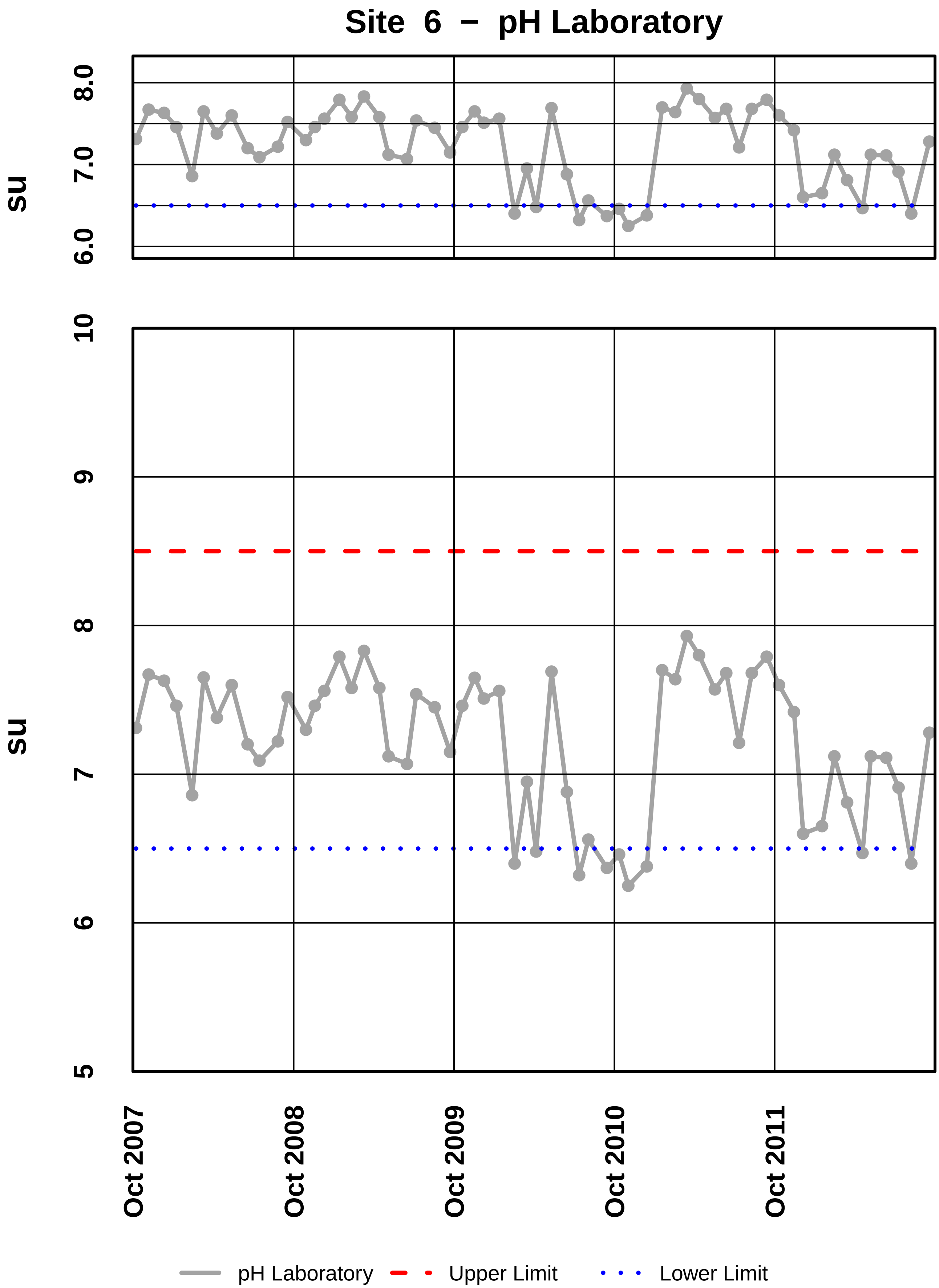

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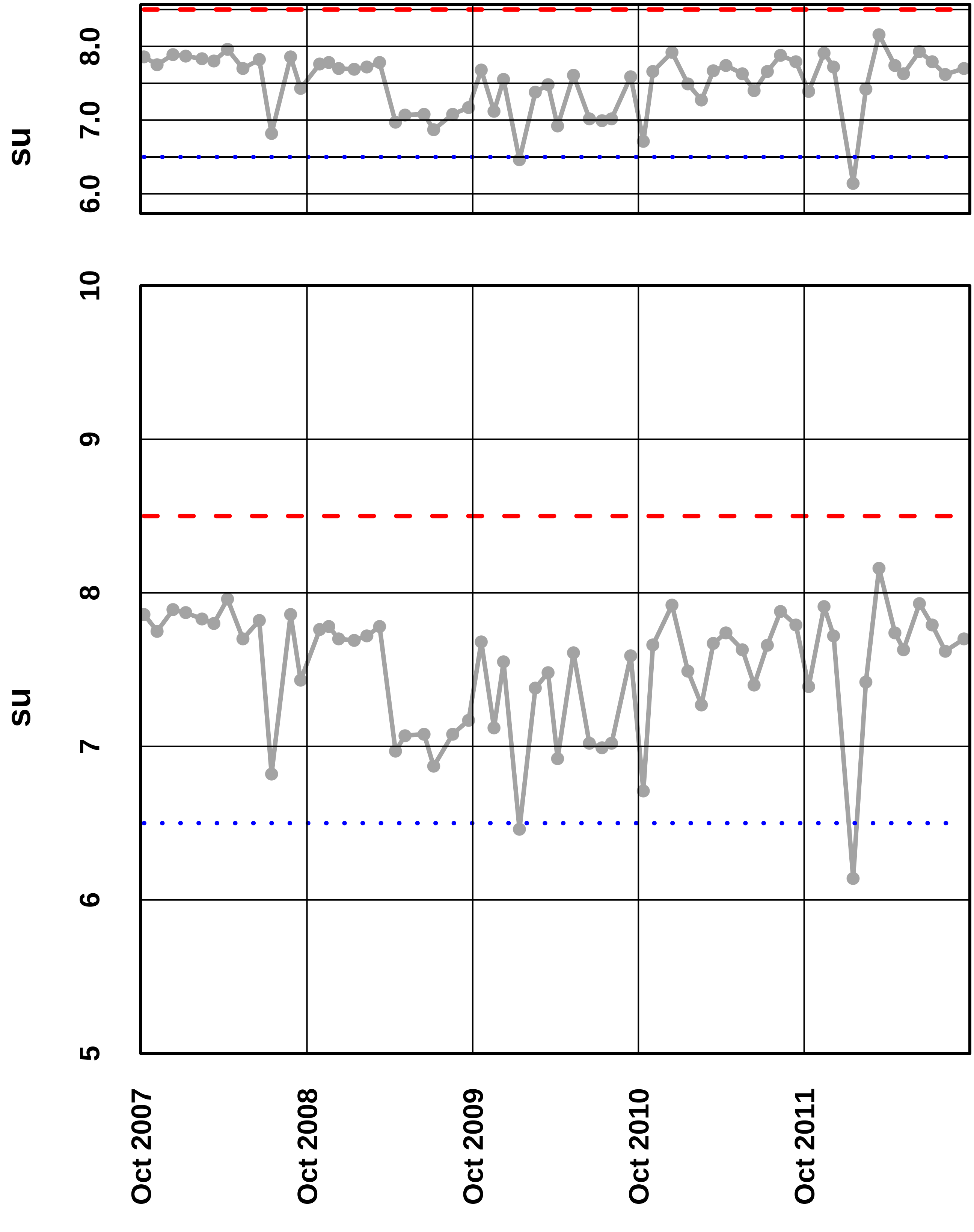
Site 6 − pH Field



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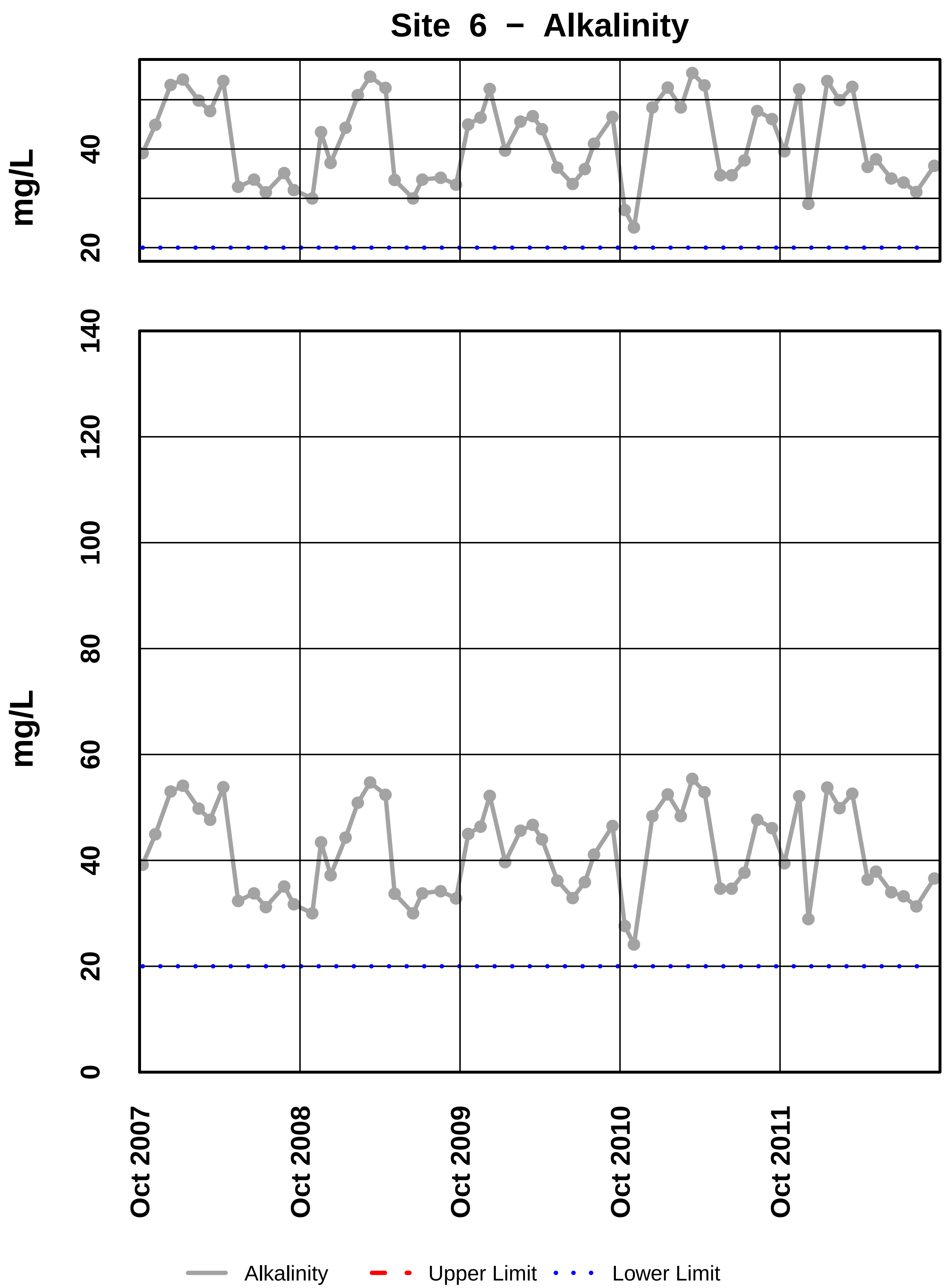

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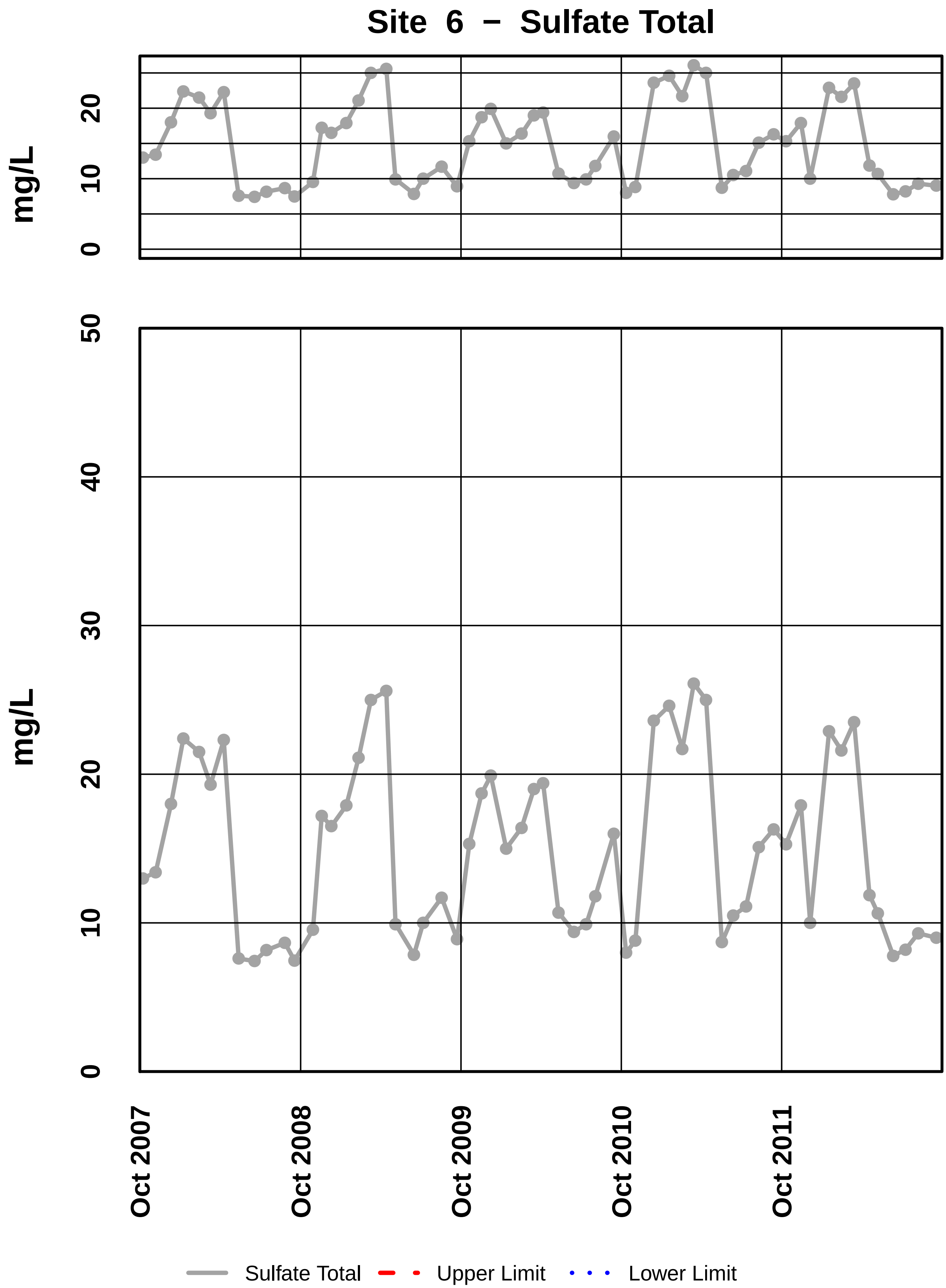

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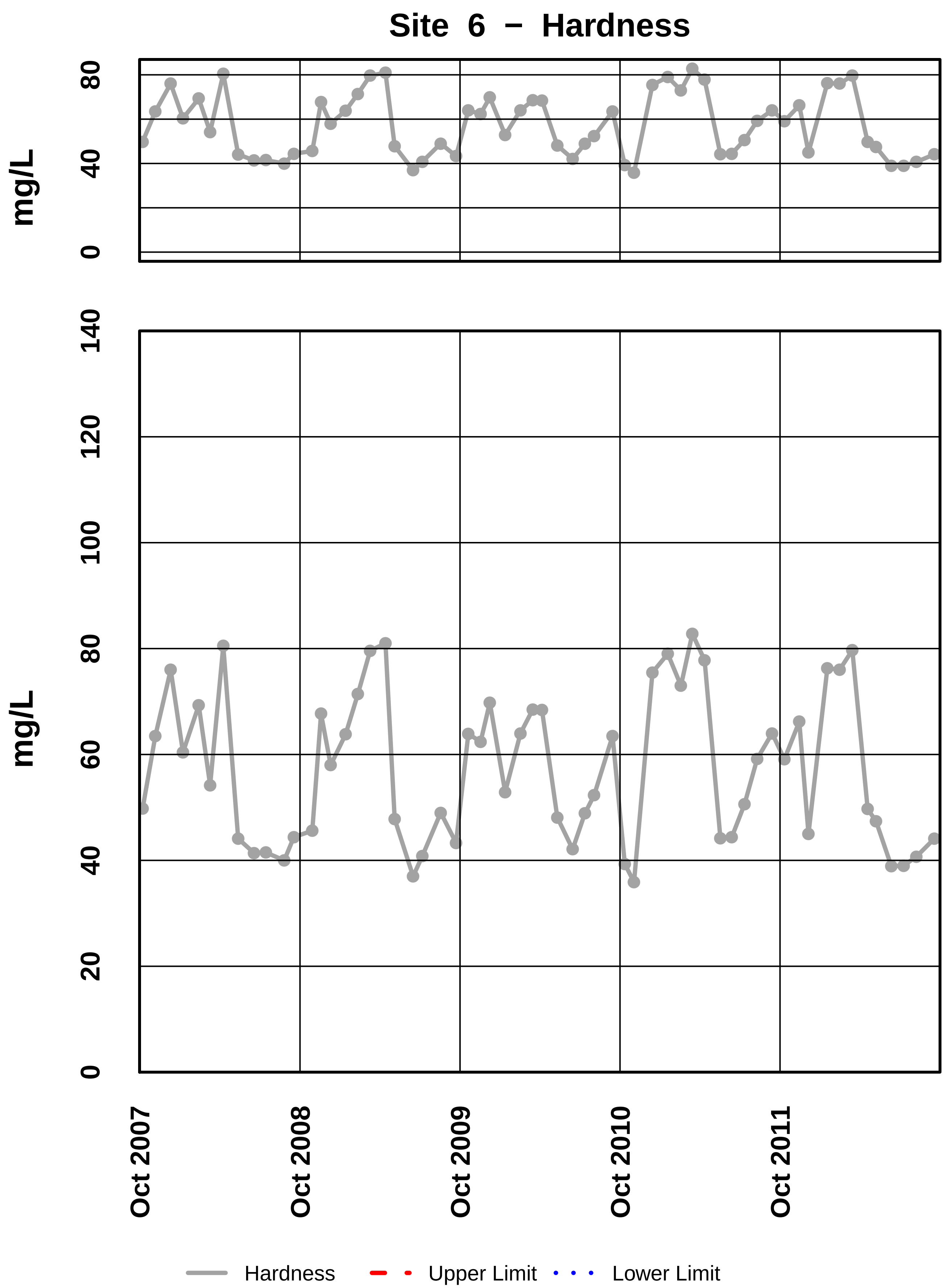

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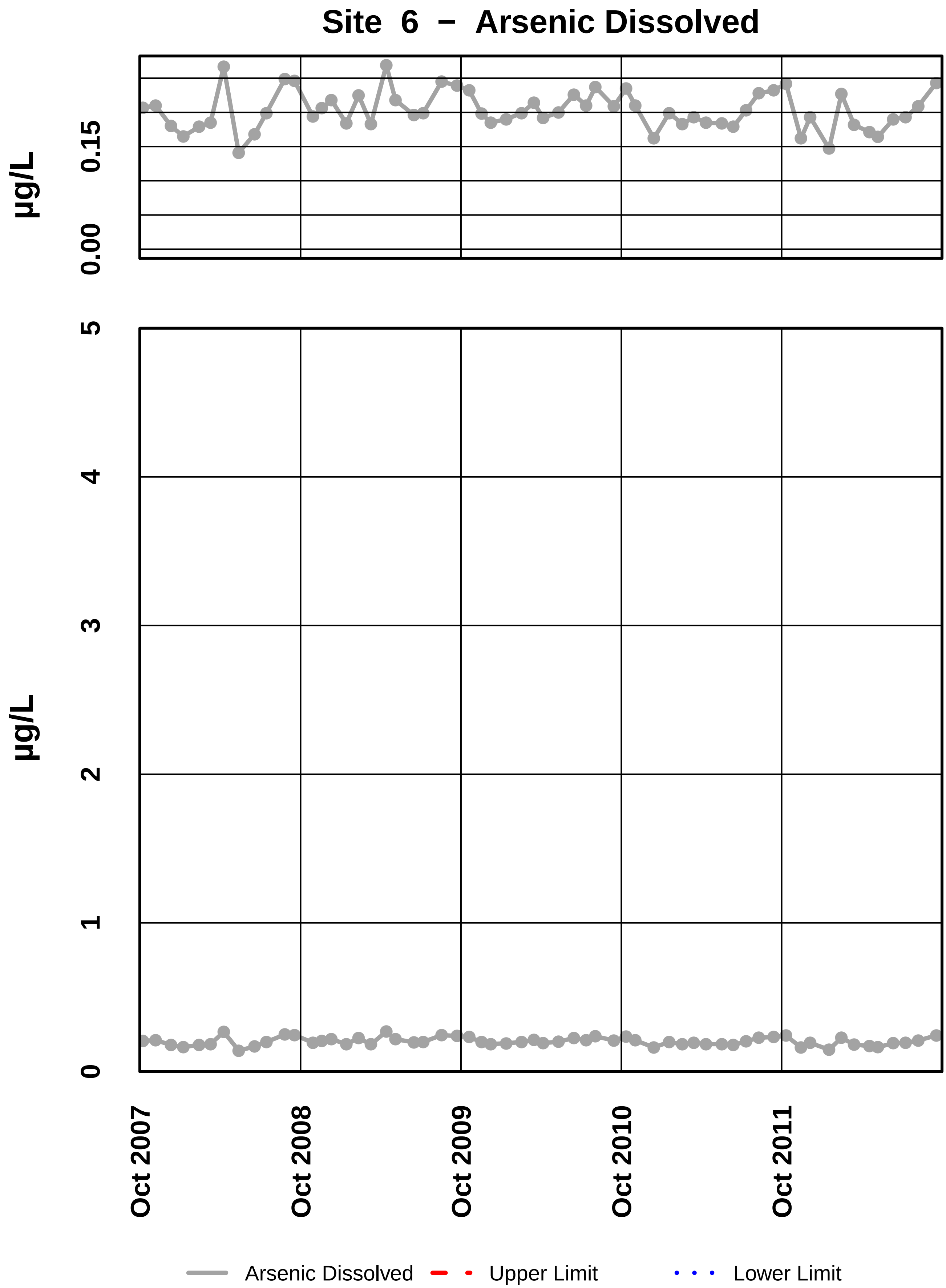
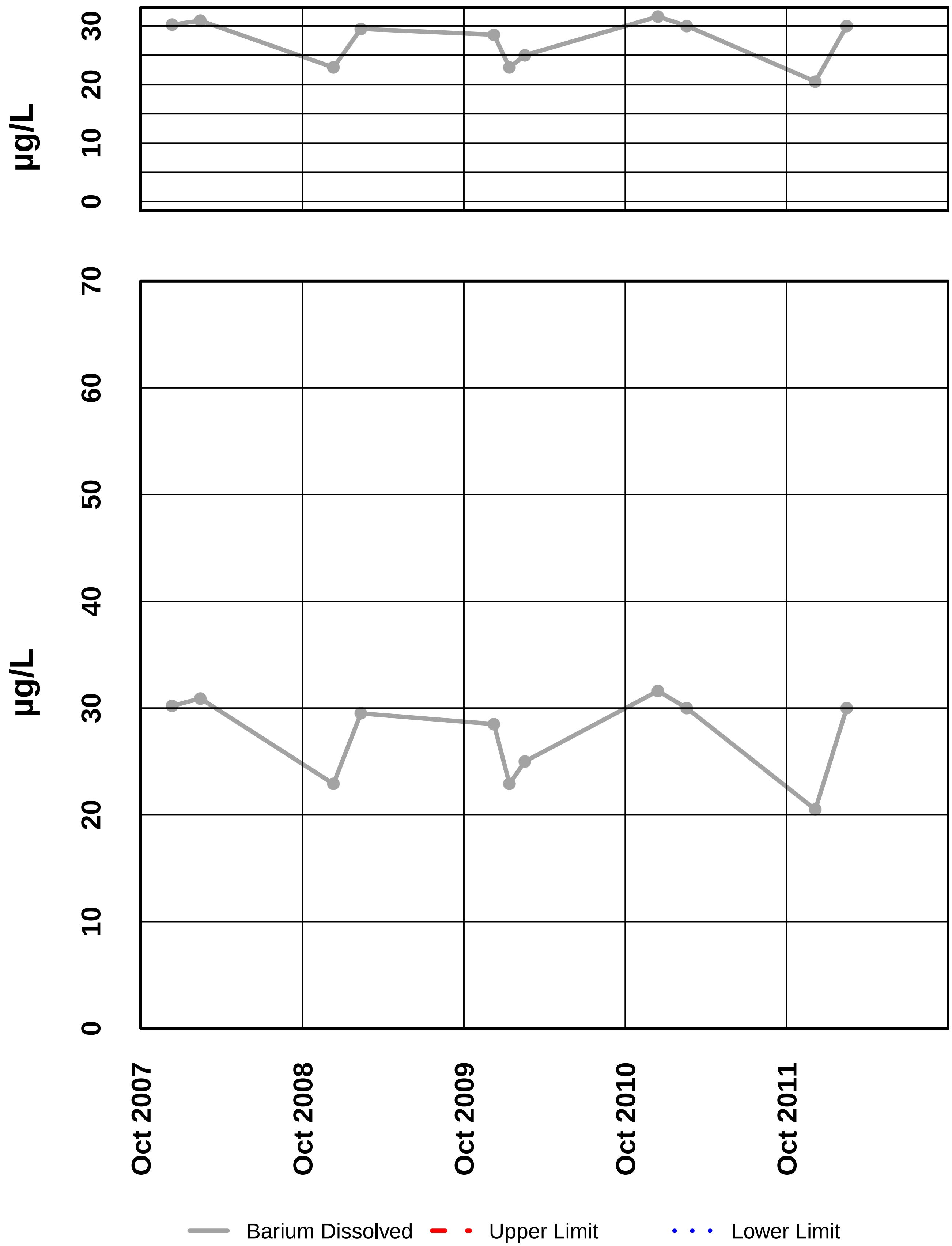


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 6 – Barium Dissolved



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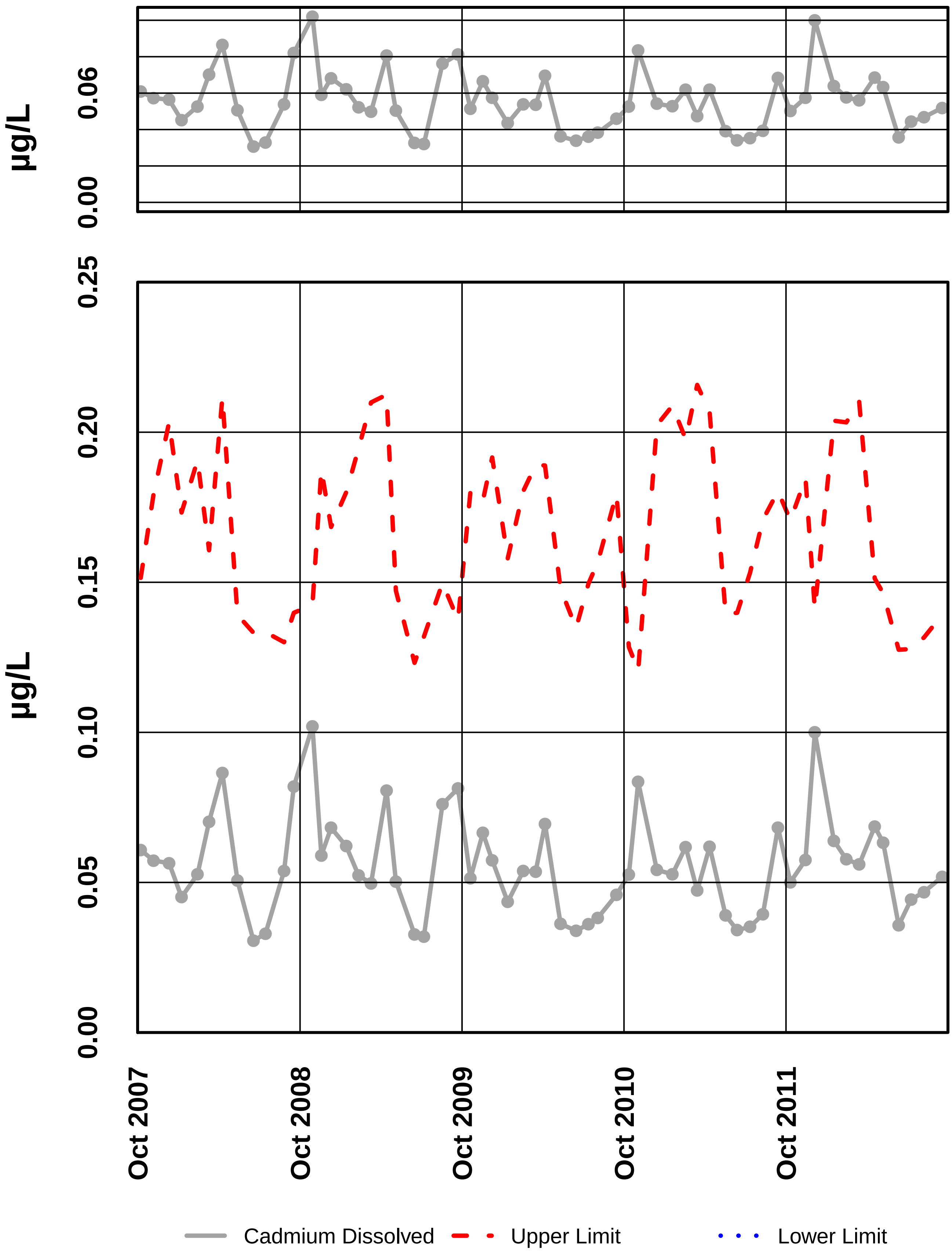
Site 6 − Cadmium Dissolved



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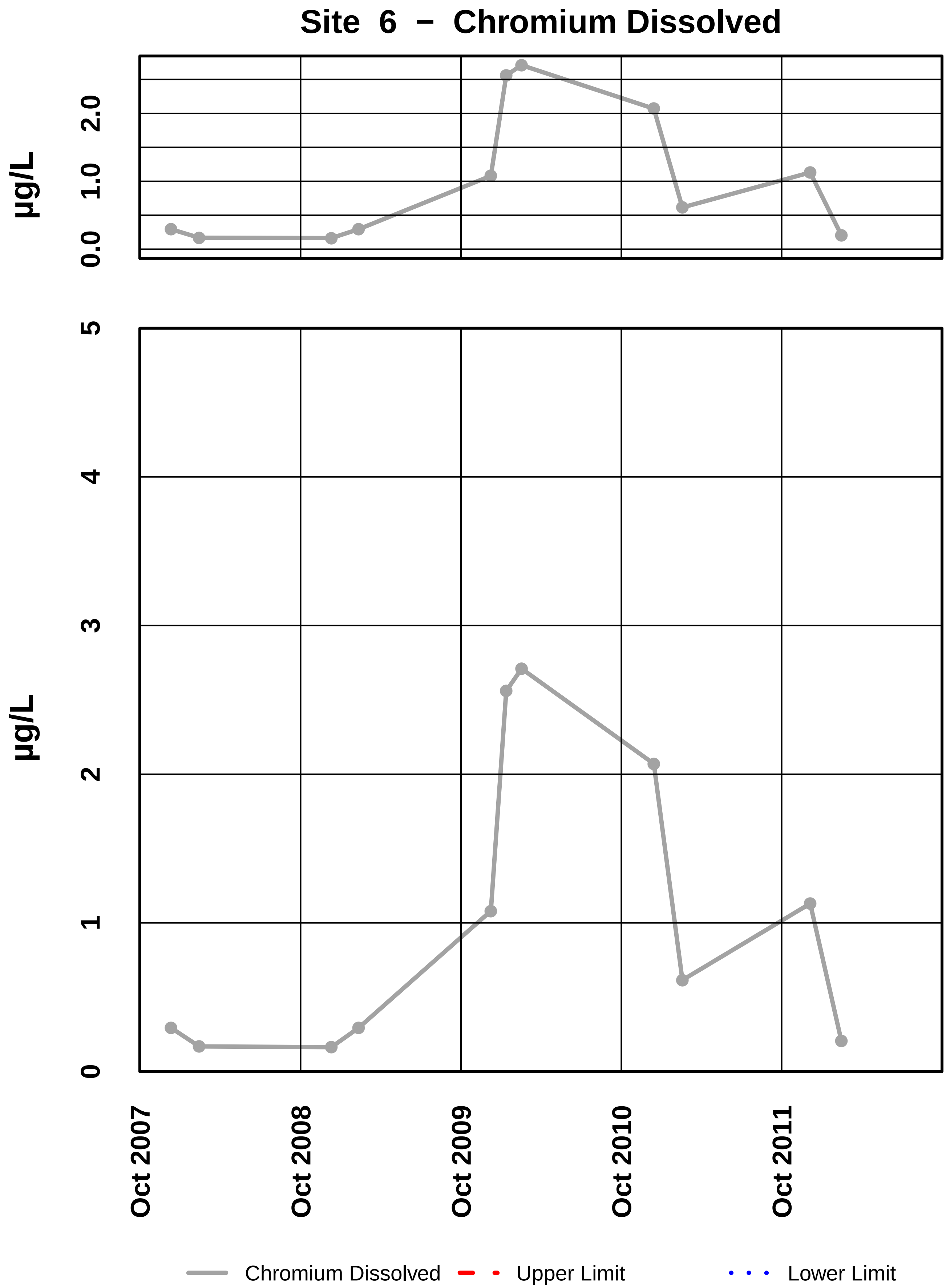

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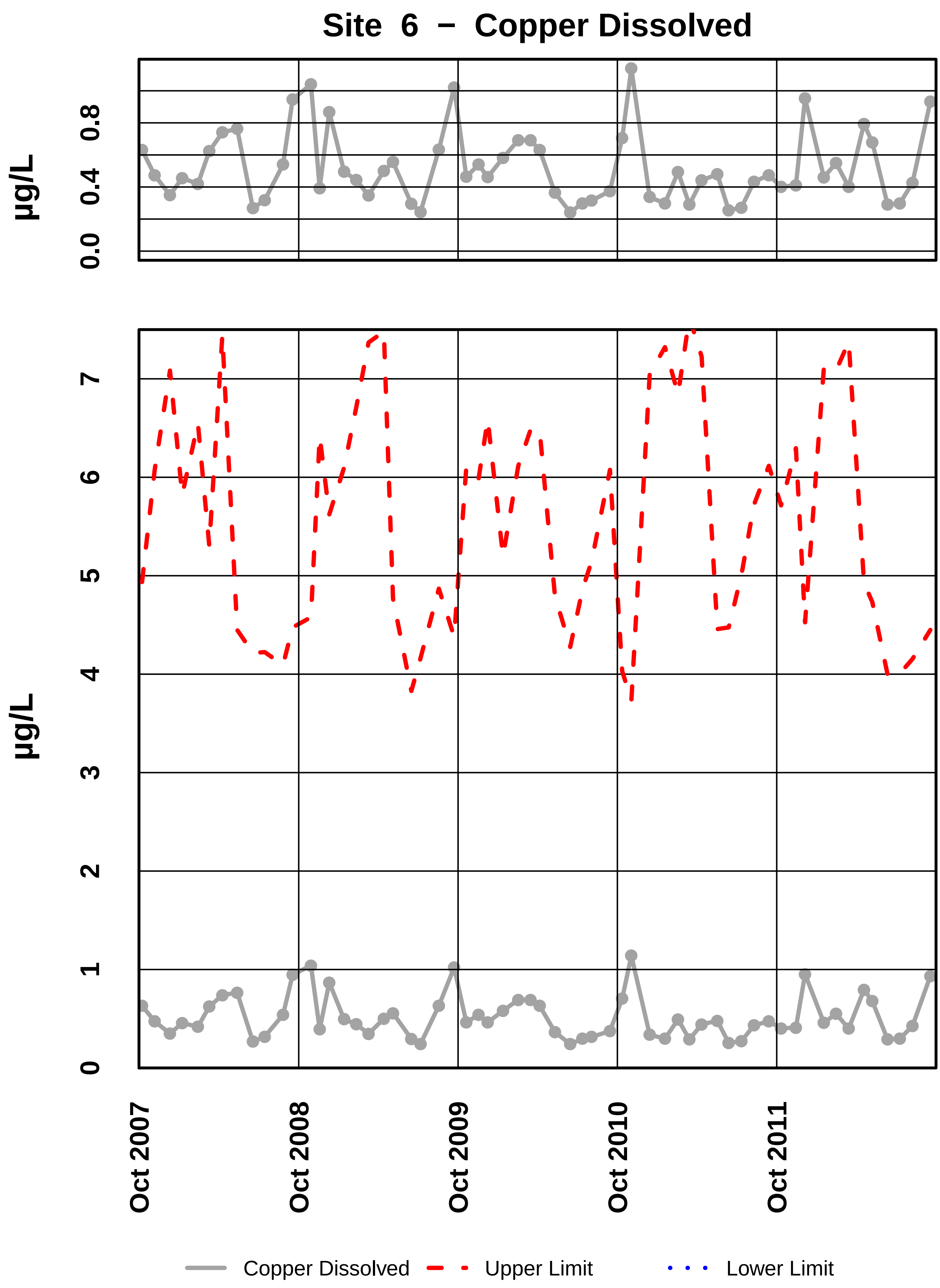

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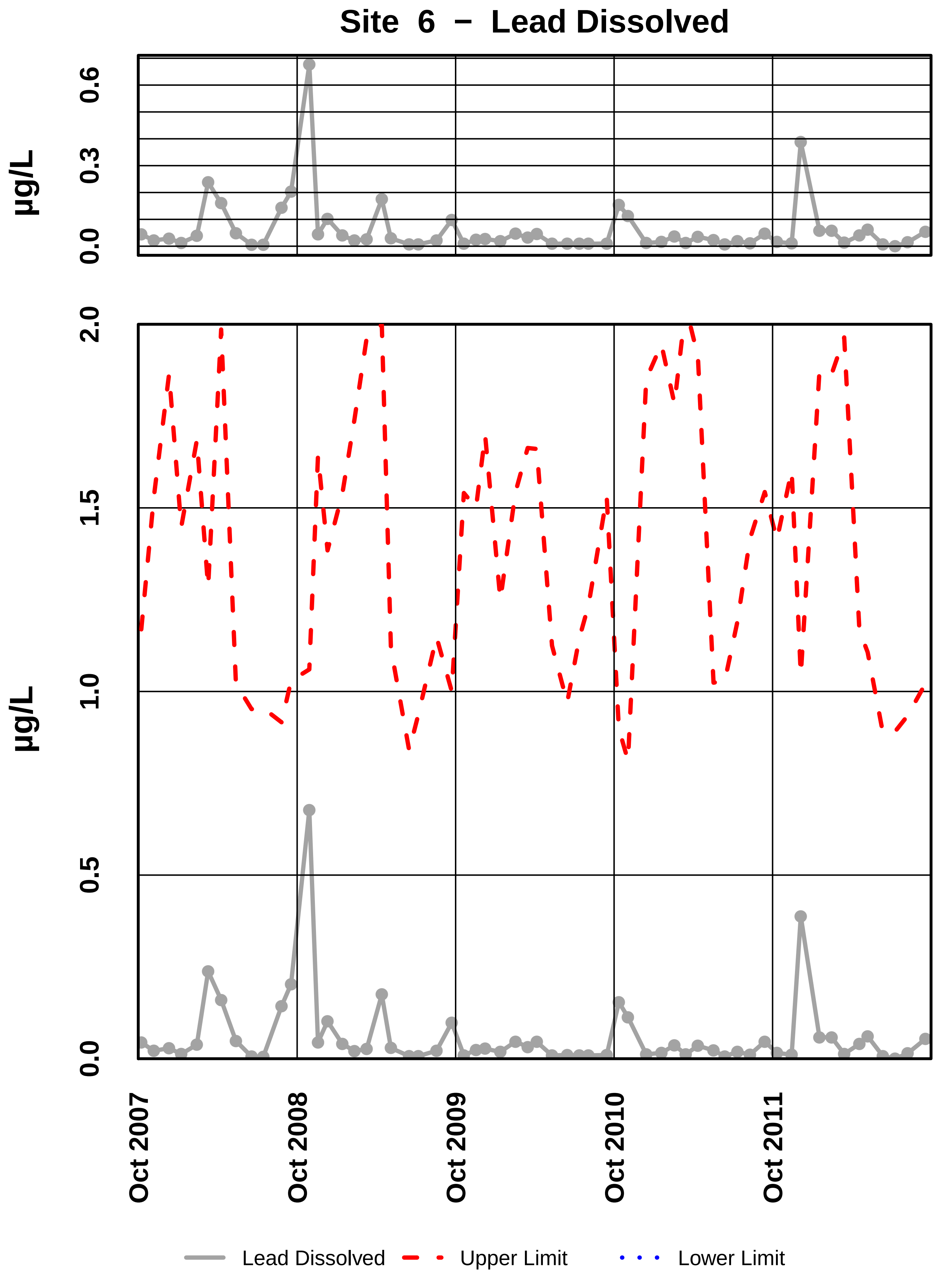

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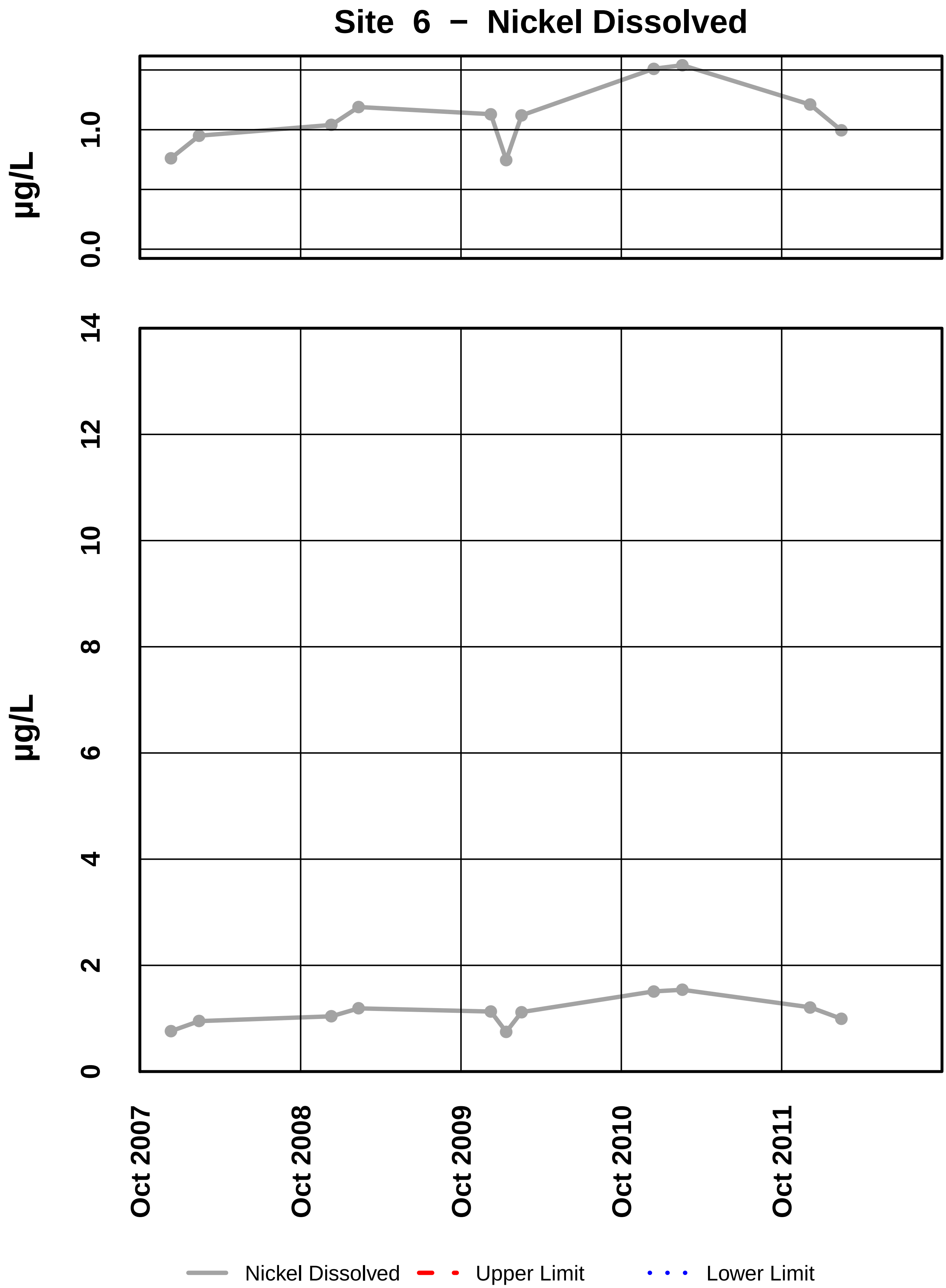

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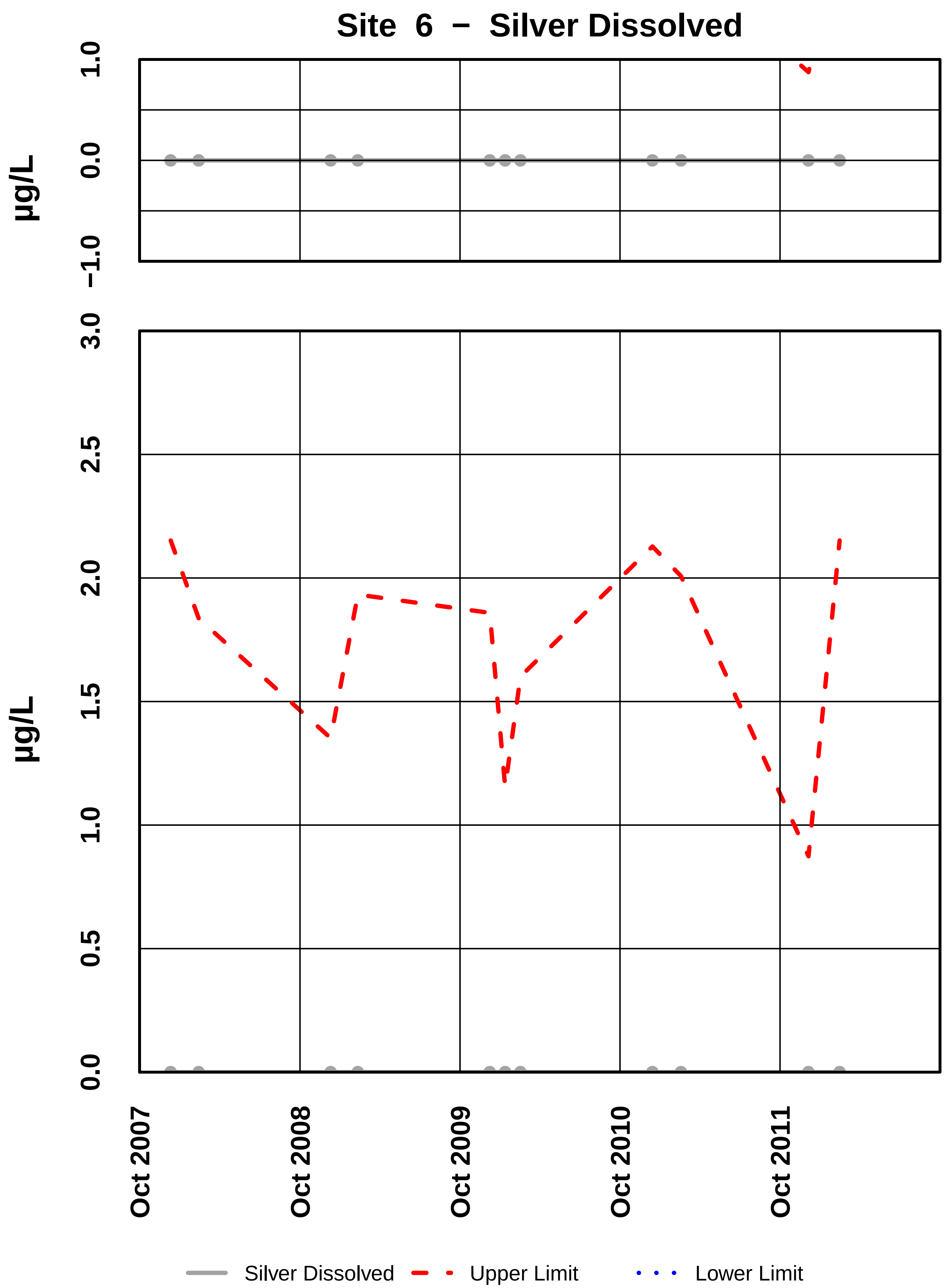

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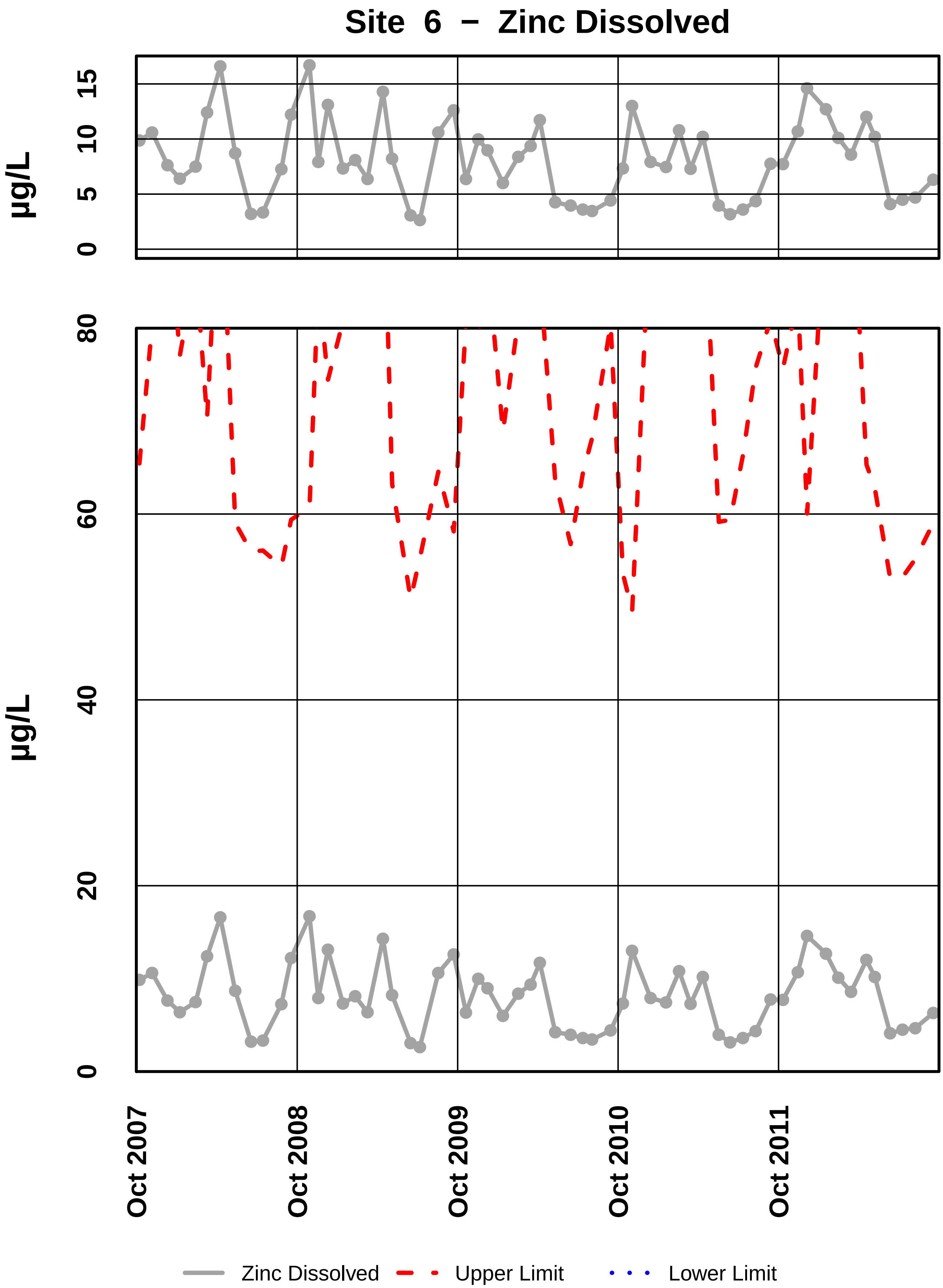

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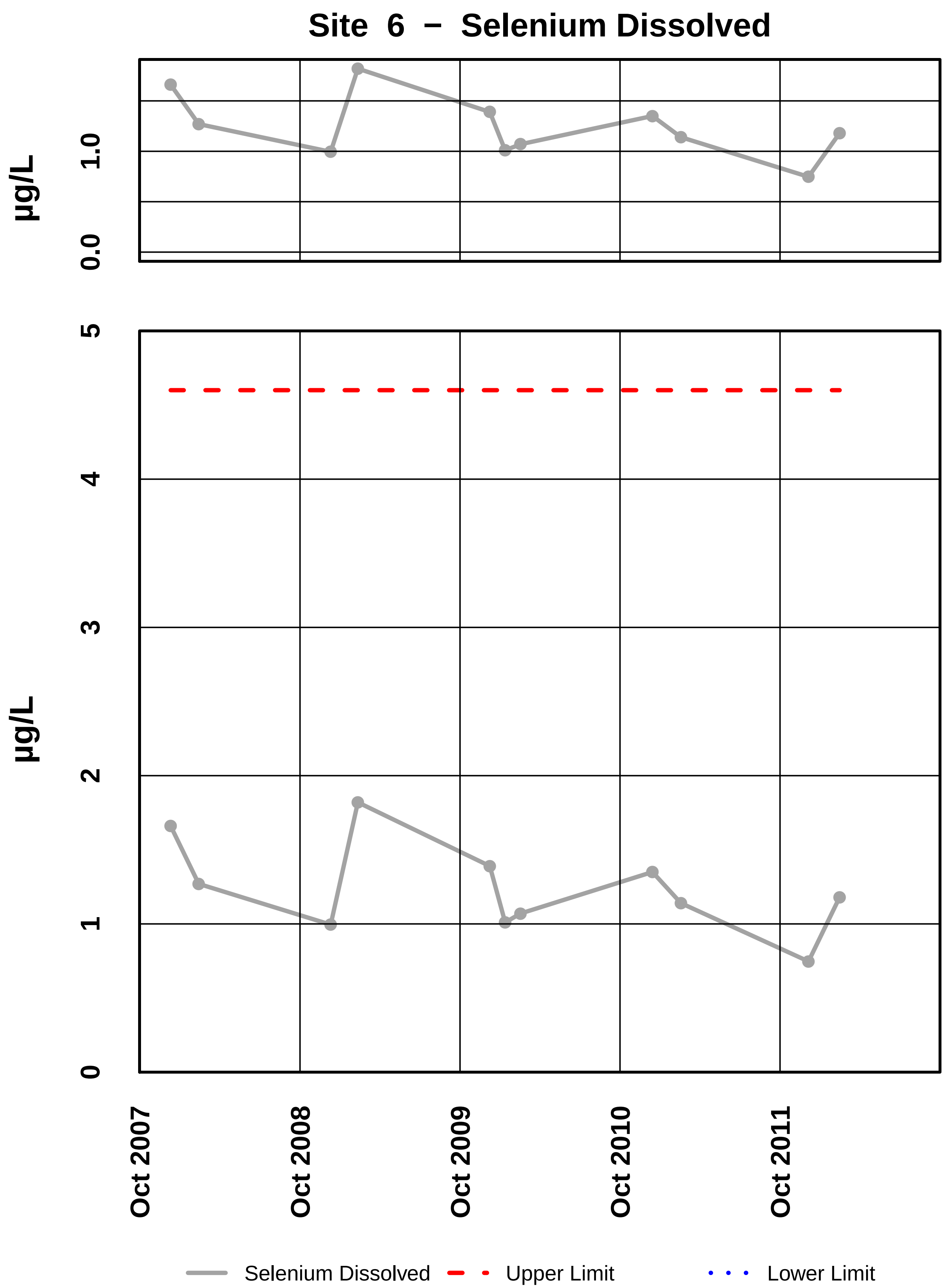

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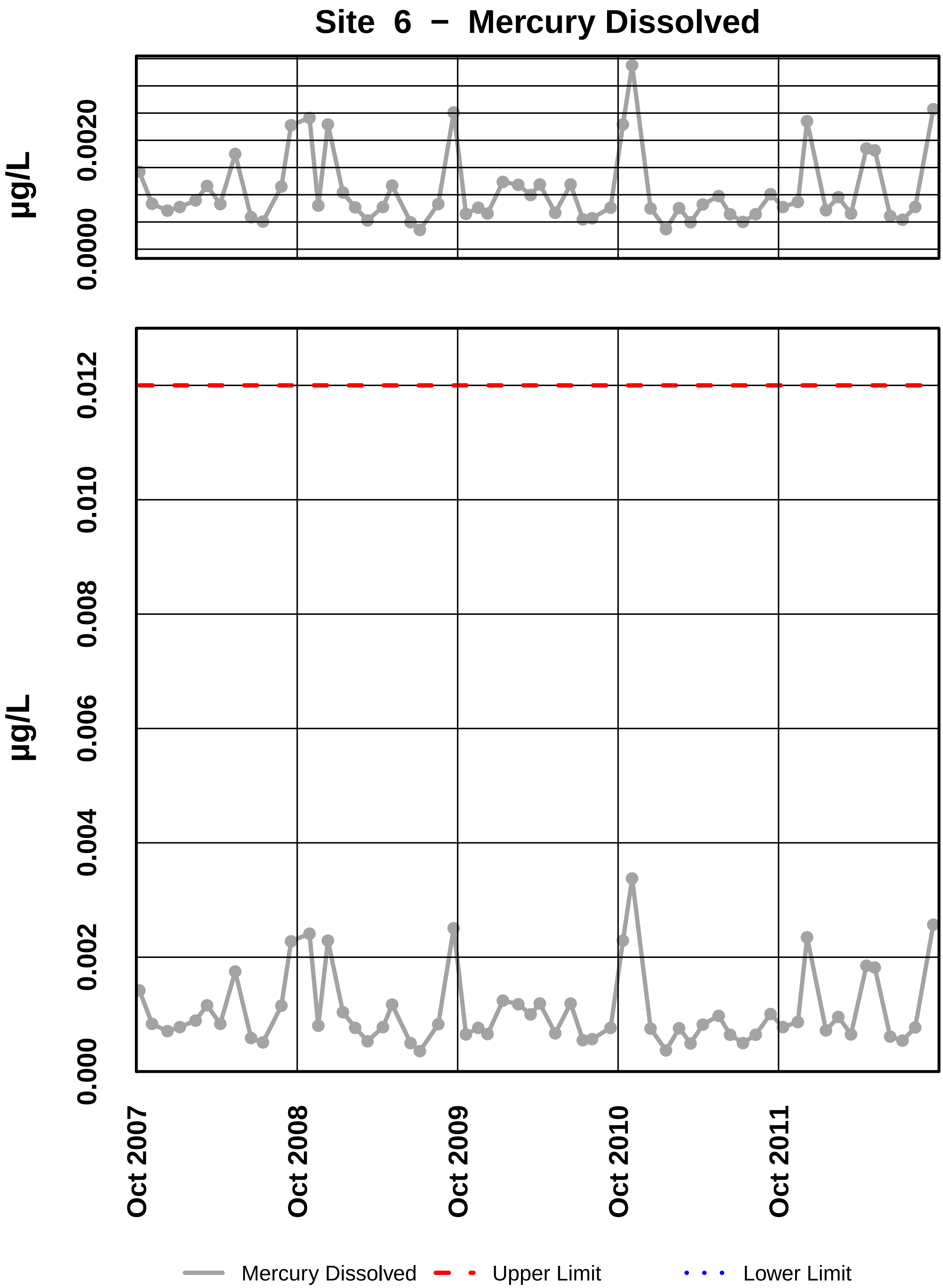


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site #6

Seasonal Kendall analysis for Specific Conductance, Field (µS/cm)

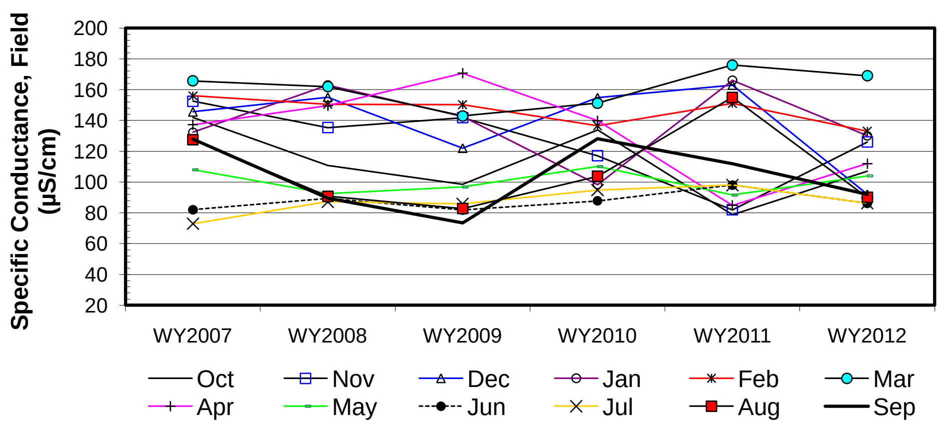
Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**	141.9	152.5	145.6	132.3	156	165.7	137.2	108	82	73	127.4	127.9
b	**WY2008**	110.8	135.3	155.1	162.9	150.4	161.9	149.6	92.5	89.4	87.2	90.8	89.5
c	**WY2009**	98.5	141.8	122	142.5	150.2	142.9	170.7	96.8	81.8	85.8	82.8	73.4
d	**WY2010**	133.8	117.1	154.8	98.4	136.6	151.2	139.8	110.1	87.8	94.8	103.8	128.2
e	**WY2011**	78.8	81.9	163	166	151	176	84.9	91.6	98	98	155	112
f	**WY2012**	107	126	92	130	133	169	112	104	86.3	86.2	90	92
	n	6	6	6	6	6	6	6	6	6	6	6	6
	t_1	6	6	6	6	6	6	6	6	6	6	6	6
	t_2	0	0	0	0	0	0	0	0	0	0	0	0
	t_3	0	0	0	0	0	0	0	0	0	0	0	0
	t_4	0	0	0	0	0	0	0	0	0	0	0	0
	t_5	0	0	0	0	0	0	0	0	0	0	0	0
	b-a	-1	-1	1	1	-1	-1	1	-1	1	1	-1	-1
	c-a	-1	-1	-1	1	-1	-1	1	-1	-1	1	-1	-1
	d-a	-1	-1	1	-1	-1	-1	1	1	1	1	-1	1
	e-a	-1	-1	1	1	-1	1	-1	-1	1	1	1	-1
	f-a	-1	-1	-1	-1	-1	1	-1	-1	1	1	-1	-1
	c-b	-1	1	-1	-1	-1	-1	1	1	-1	-1	-1	-1
	d-b	1	-1	-1	-1	-1	-1	-1	1	-1	1	1	1
	e-b	-1	-1	1	1	1	1	-1	-1	1	1	1	1
	f-b	-1	-1	-1	-1	-1	1	-1	1	-1	-1	-1	1
	d-c	1	-1	1	-1	-1	1	-1	1	1	1	1	1
	e-c	-1	-1	1	1	1	1	-1	-1	1	1	1	1
	f-c	1	-1	-1	-1	-1	1	-1	1	1	1	1	1
	e-d	-1	-1	1	1	1	1	-1	-1	1	1	1	-1
	f-d	-1	1	-1	1	-1	1	-1	-1	-1	-1	-1	-1
	f-e	1	1	-1	-1	-1	-1	1	1	-1	-1	-1	-1
	S_k	-7	-9	-1	-1	-9	3	-5	-1	3	7	-1	-1
	σ^2_S=	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33
	$Z_k = S_k/\sigma_S$	-1.32	-1.69	-0.19	-0.19	-1.69	0.56	-0.94	-0.19	0.56	1.32	-0.19	-0.19
	Z^2_k	1.73	2.86	0.04	0.04	2.86	0.32	0.88	0.04	0.32	1.73	0.04	0.04

ΣZ_k= -4.13
ΣZ^2_k= 10.87
Z-bar=ΣZ_k/K= -0.34

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

Σn 72
ΣS_k -22

$\chi^2_h=\Sigma Z^2_k$-K(Z-bar)^2=	9.45	@α=5% $\chi^2_{(K-1)}$=	19.68	Test for station homogeneity	
p	**0.581**			$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc} -1.14	@α/2=2.5% Z=	1.96	**H_0** (No trend)	ACCEPT
340.00	p **0.127**			**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-5.35		1.24
0.050	-4.64	**-0.88**	0.44
0.100	-4.15		0.06
0.200	-3.01		-0.21

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**	7.6	7.6	7.7	7.5	7.8	8.2	7.5	7.7	7.7	7.4	7.9	7.5
b	**WY2008**	7.9	7.8	7.9	7.9	7.8	7.8	8.0	7.7	7.8	6.8	7.9	7.4
c	**WY2009**	7.8	7.8	7.7	7.7	7.7	7.8	7.0	7.1	7.1	6.9	7.1	7.2
d	**WY2010**	7.7	7.1	7.6	6.5	7.4	7.5	6.9	7.6	7.0	7.0	7.0	7.6
e	**WY2011**	6.7	7.7	7.9	7.5	7.3	7.7	7.7	7.6	7.4	7.7	7.9	7.8
f	**WY2012**	7.4	7.9	7.7	6.1	7.4	8.2	7.7	7.6	7.9	7.8	7.6	7.7
	n	6	6	6	6	6	6	6	6	6	6	6	6

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

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

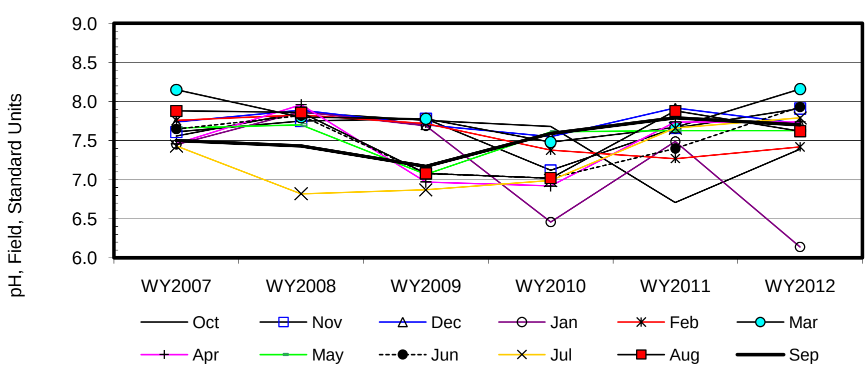
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	28.33	28.33	28.33	28.33	28.33	28.33	27.33	27.33	28.33	28.33	27.33	28.33
$Z_k = S_k/\sigma_S$	-1.32	0.94	-0.19	-1.32	-1.69	-0.56	0.00	-0.38	0.19	1.69	-0.77	1.32
Z^2_k	1.73	0.88	0.04	1.73	2.86	0.32	0.00	0.15	0.04	2.86	0.59	1.73

ΣZ_k= -2.09
ΣZ^2_k= 12.91
Z-bar=$\Sigma Z_k/K$= -0.17

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

Σn 72
ΣS_k -11

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	12.55	@α=5% $\chi^2_{(K-1)}$= 19.68	Test for station homogeneity	
p	**0.324**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k) Z_{calc}	-0.54	@α/2=2.5% Z= 1.96	**H_0** (No trend)	ACCEPT
337.00 **p**	**0.293**		**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.07		0.04
0.050	-0.06	**-0.02**	0.02
0.100	-0.05		0.01
0.200	-0.04		0.00

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**	43.3	51.5	45.3	46.8	50.8	50.3	42.9	37.5	31.2	28.8	41.5	45.7
b	**WY2008**	39.2	44.9	53.0	54.1	49.8	47.7	53.8	32.3	33.8	31.2	35.1	31.7
c	**WY2009**	30.0	43.4	37.2	44.3	50.9	54.7	52.4	33.7	30.0	33.8	34.2	32.8
d	**WY2010**	45.0	46.4	52.2	39.7	45.6	46.7	44.0	36.2	32.9	35.9	41.1	46.5
e	**WY2011**	27.6	24.1	48.4	52.5	48.4	55.4	52.9	34.7	34.7	37.7	47.7	46.1
f	**WY2012**	39.5	52.1	28.9	53.8	49.9	52.6	36.4	37.9	34.0	33.2	31.3	36.6
	n	6	6	6	6	6	6	6	6	6	6	6	6

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

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

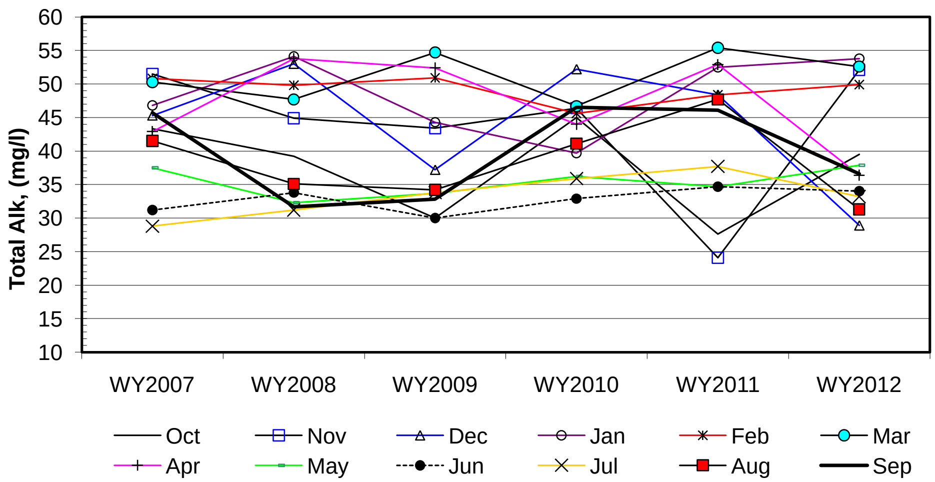
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
$\sigma^2_S=$	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33
$Z_k = S_k/\sigma_S$	-0.56	-0.19	-0.94	0.19	-0.56	0.56	-0.56	0.94	1.32	1.69	-0.56	0.56
Z^2_k	0.32	0.04	0.88	0.04	0.32	0.32	0.32	0.88	1.73	2.86	0.32	0.32

$\Sigma Z_k=$ 1.88
$\Sigma Z^2_k=$ 8.33
$Z\text{-bar}=\Sigma Z_k/K=$ 0.16

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

Σn 72
ΣS_k 10

$\chi^2_h=\Sigma Z^2_k-K(Z\text{-bar})^2=$ 8.04		@α=5% $\chi^2_{(K-1)}=$ 19.68	Test for station homogeneity	
p	**0.710**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc} 0.49	@α/2=2.5% $Z=$ 1.96	**H_0** (No trend)	ACCEPT
340.00	**p** **0.687**		**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.70		1.10
0.050	-0.47	**0.09**	0.75
0.100	-0.40		0.56
0.200	-0.20		0.44

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**	12.4	17.1	16.7	17.8	19.9	21.7	15.7	9.8	6.0	5.6	12.4	14.0
b	**WY2008**	13.0	13.4	18.0	22.4	21.5	19.3	22.3	7.6	7.4	8.2	8.7	7.5
c	**WY2009**	9.5	17.2	16.5	17.9	21.1	25.0	25.6	9.9	7.9	10.0	11.7	8.9
d	**WY2010**	15.3	18.7	19.9	15.0	16.4	19.0	19.4	10.7	9.4	9.9	11.8	16.0
e	**WY2011**	8.0	8.8	23.6	24.6	21.7	26.1	25.0	8.7	10.5	11.1	15.1	16.3
f	**WY2012**	15.3	17.9	10.0	22.9	21.6	23.5	11.9	10.7	7.8	8.2	9.3	9.0
	n	6	6	6	6	6	6	6	6	6	6	6	6

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

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

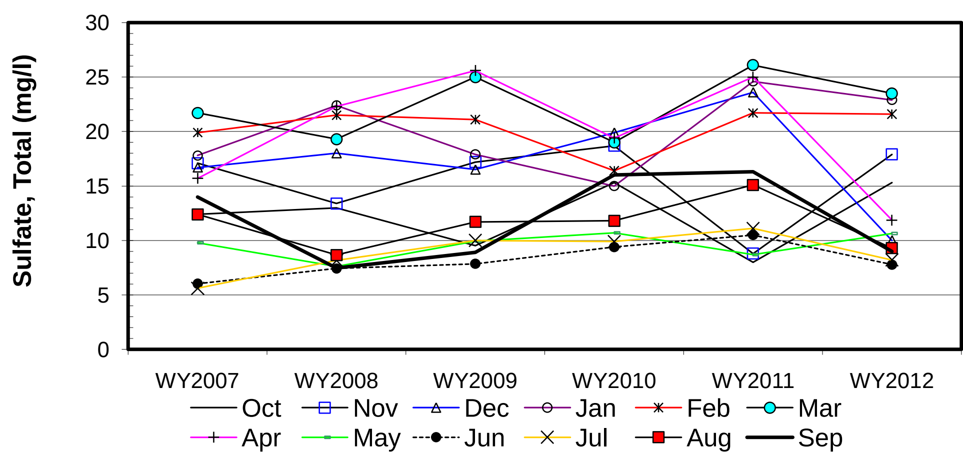
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	27.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33
$Z_k = S_k/\sigma_S$	0.38	0.56	0.19	0.94	0.94	0.56	-0.19	0.94	1.69	1.32	0.19	0.94
Z^2_k	0.15	0.32	0.04	0.88	0.88	0.32	0.04	0.88	2.86	1.73	0.04	0.88

ΣZ_k= 8.46
ΣZ^2_k= 9.01
Z-bar=$\Sigma Z_k/K$= 0.71

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

Σn 72
ΣS_k 45

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$= 3.04		@α=5% $\chi^2_{(K-1)}$= 19.68	Test for station homogeneity	
p **0.990**			$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc} 2.39	@α=2.5% Z= 1.96	**H_0** (No trend)	REJECT
339.00	**p** **0.992**		**H_A** (± trend)	ACCEPT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	0.01		0.93
0.050	0.07	0.36	0.68
0.100	0.13		0.60
0.200	0.19		0.55

2.4%

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**	3.8	3.7	4.7	6.5	4.9	5.2	11.1	8.8	2.7	2.3	3.6	3.0
b	**WY2008**	9.9	10.6	7.6	6.4	7.5	12.4	16.6	8.7	3.2	3.3	7.3	12.2
c	**WY2009**	16.7	7.9	13.1	7.3	8.1	6.4	14.3	8.2	3.1	2.6	10.6	12.6
d	**WY2010**	6.4	10.0	9.0	6.0	8.4	9.4	11.7	4.3	4.0	3.6	3.5	4.4
e	**WY2011**	7.3	13.0	7.9	7.5	10.8	7.3	10.2	4.0	3.2	3.6	4.4	7.7
f	**WY2012**	7.7	10.7	14.6	12.7	10.1	8.6	12.0	10.2	4.1	4.5	4.7	6.3
	n	6	6	6	6	6	6	6	6	6	6	6	6

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

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a	1	1	1	-1	1	1	1	-1	1	1	1	1
c-a	1	1	1	1	1	1	1	-1	1	1	1	1
d-a	1	1	1	-1	1	1	1	-1	1	1	-1	1
e-a	1	1	1	1	1	1	-1	-1	1	1	1	1
f-a	1	1	1	1	1	1	1	1	1	1	1	1
c-b	1	-1	1	1	1	-1	-1	-1	-1	-1	1	1
d-b	-1	-1	1	-1	1	-1	-1	-1	1	1	-1	-1
e-b	-1	1	1	1	1	-1	-1	-1	-1	1	-1	-1
f-b	-1	1	1	1	1	-1	-1	1	1	1	-1	-1
d-c	-1	1	-1	-1	1	1	-1	-1	1	1	-1	-1
e-c	-1	1	-1	1	1	1	-1	-1	1	1	-1	-1
f-c	-1	1	1	1	1	1	-1	1	1	1	-1	-1
e-d	1	1	-1	1	1	-1	-1	-1	-1	0	1	1
f-d	1	1	1	1	1	-1	1	1	1	1	1	1
f-e	1	-1	1	1	-1	1	1	1	1	1	1	-1
S_k	3	9	9	7	13	3	-3	-5	9	12	1	1

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	27.33	28.33	28.33
$Z_k = S_k/\sigma_S$	0.56	1.69	1.69	1.32	2.44	0.56	-0.56	-0.94	1.69	2.30	0.19	0.19
Z^2_k	0.32	2.86	2.86	1.73	5.96	0.32	0.32	0.88	2.86	5.27	0.04	0.04

ΣZ_k= 11.13

ΣZ^2_k= 23.44

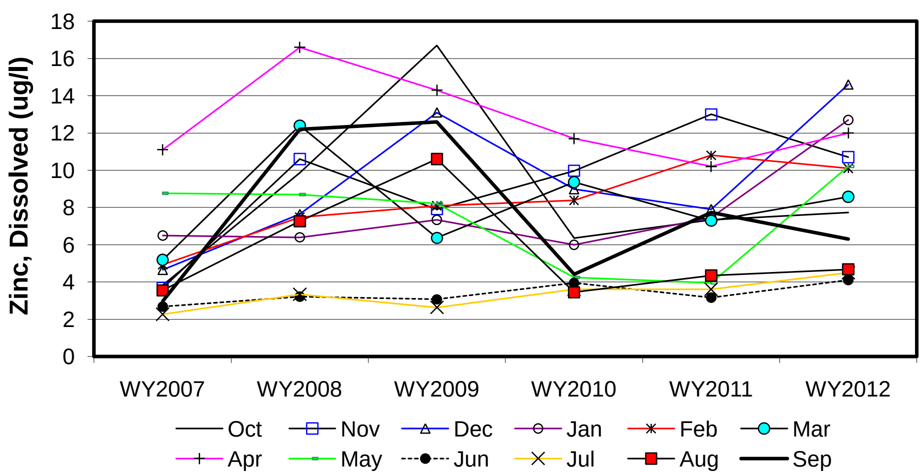
Z-bar=ΣZ_k/K= 0.93

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

Σn 72

ΣS_k 59

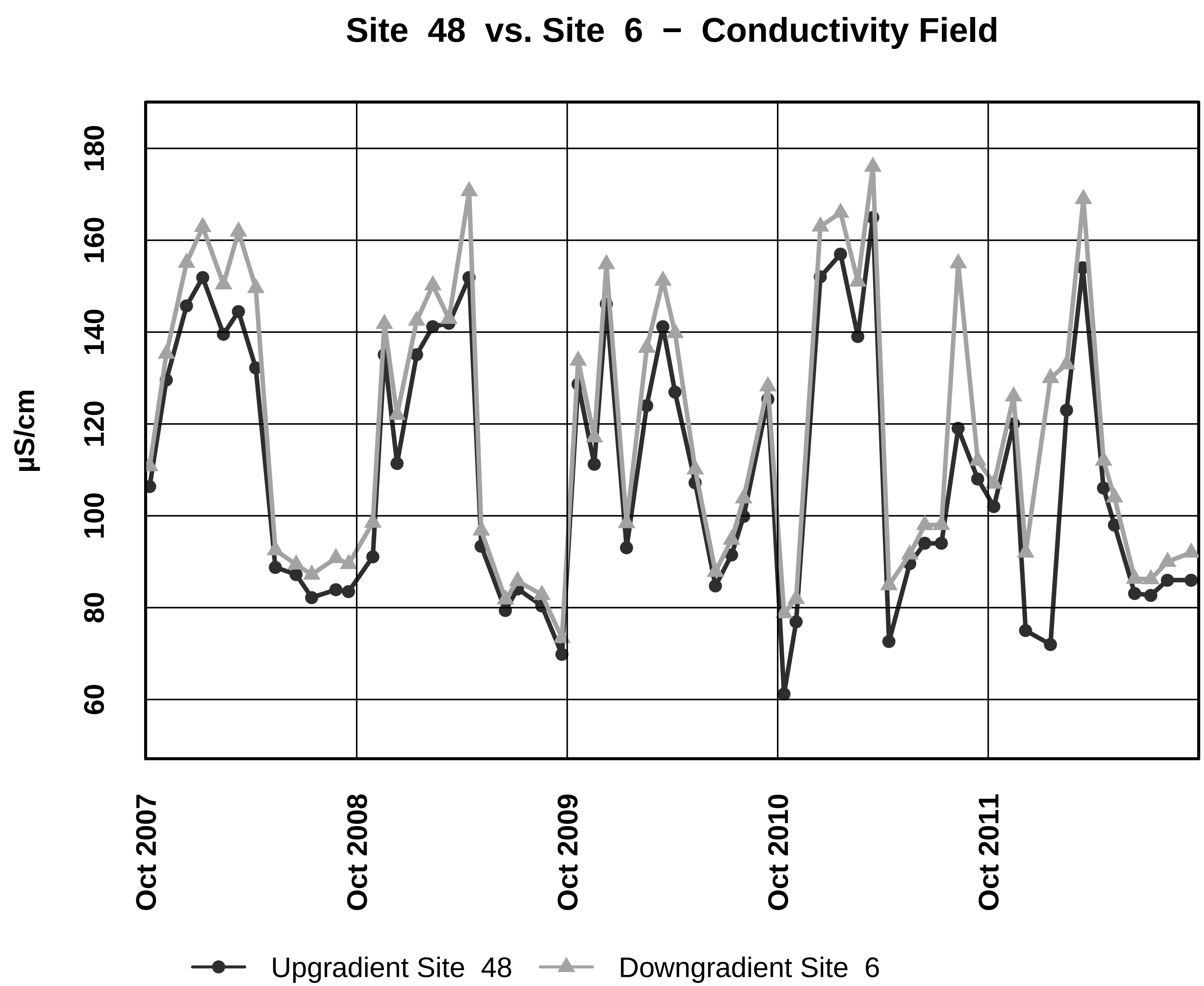
$\chi^2_h=\Sigma Z^2_k$-K(Z-bar)^2=	13.13	@α=5% $\chi^2_{(K-1)}$= 19.68	Test for station homogeneity	
p	**0.285**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc} 3.15	@α/2=2.5% Z= 1.96	**H_0** (No trend)	REJECT
339.00	**p** **0.999**		**H_A** (± trend)	ACCEPT

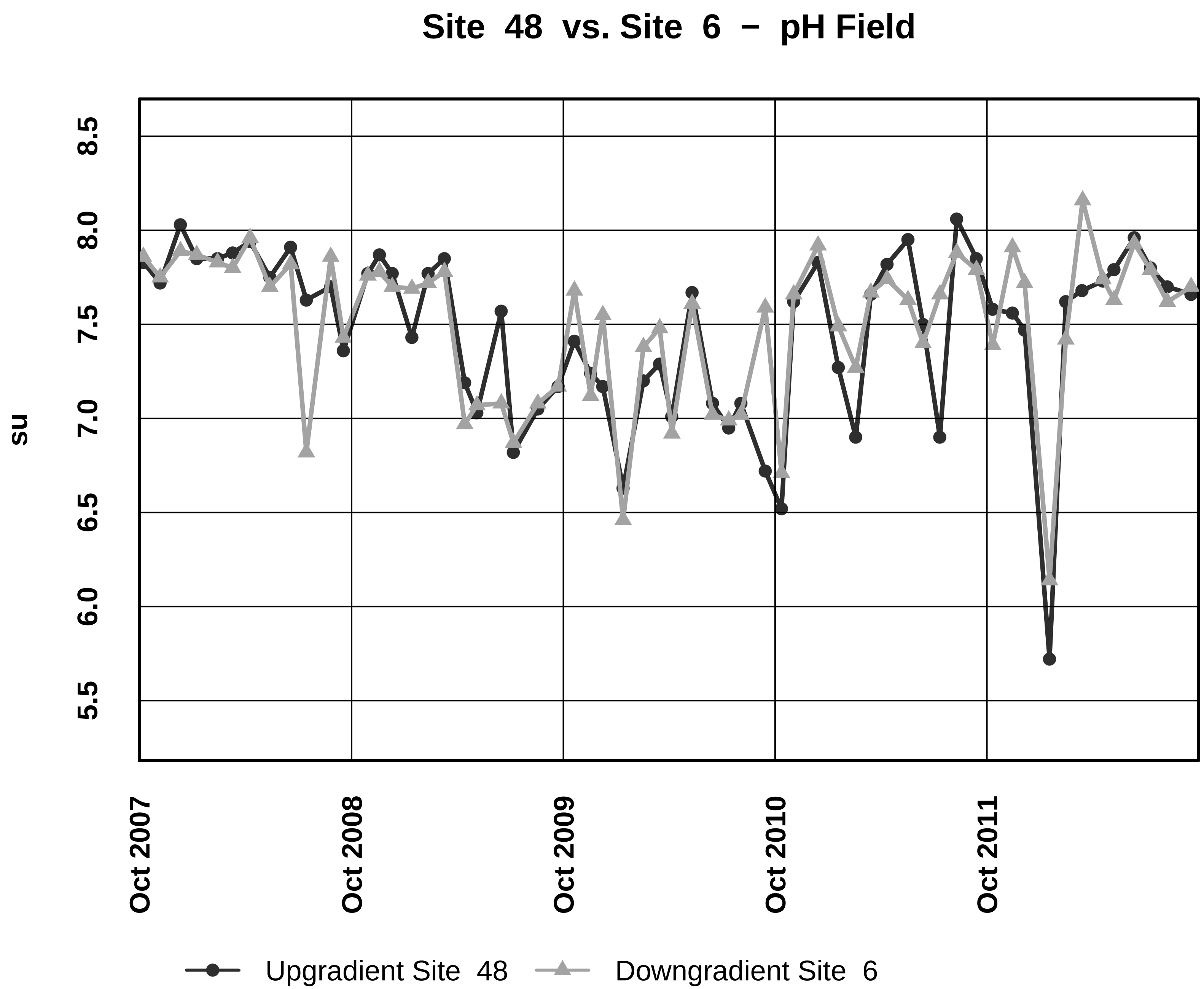


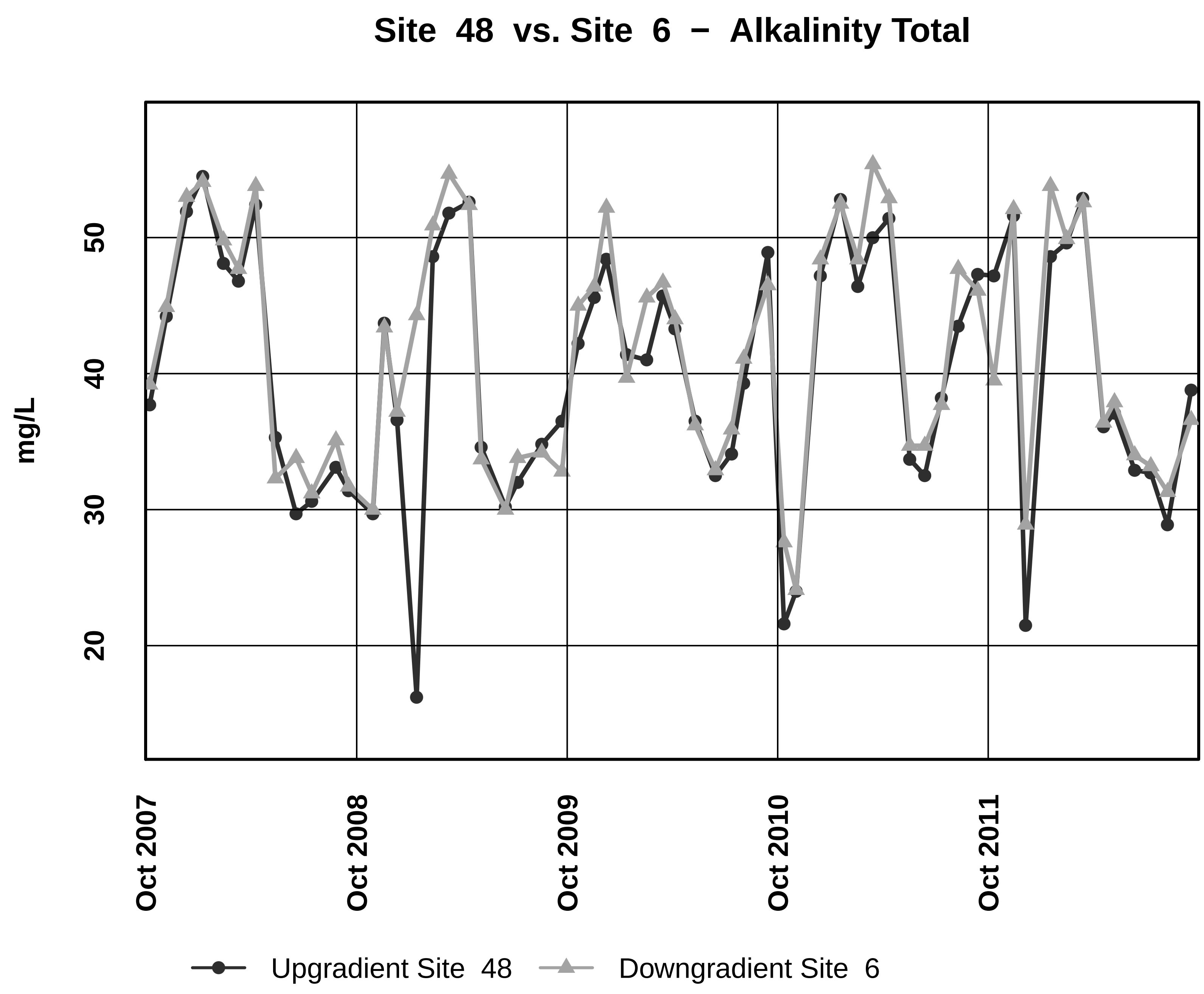
Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	0.13		0.67
0.050	0.20	**0.40**	0.61
0.100	0.25		0.52
0.200	0.30		0.46

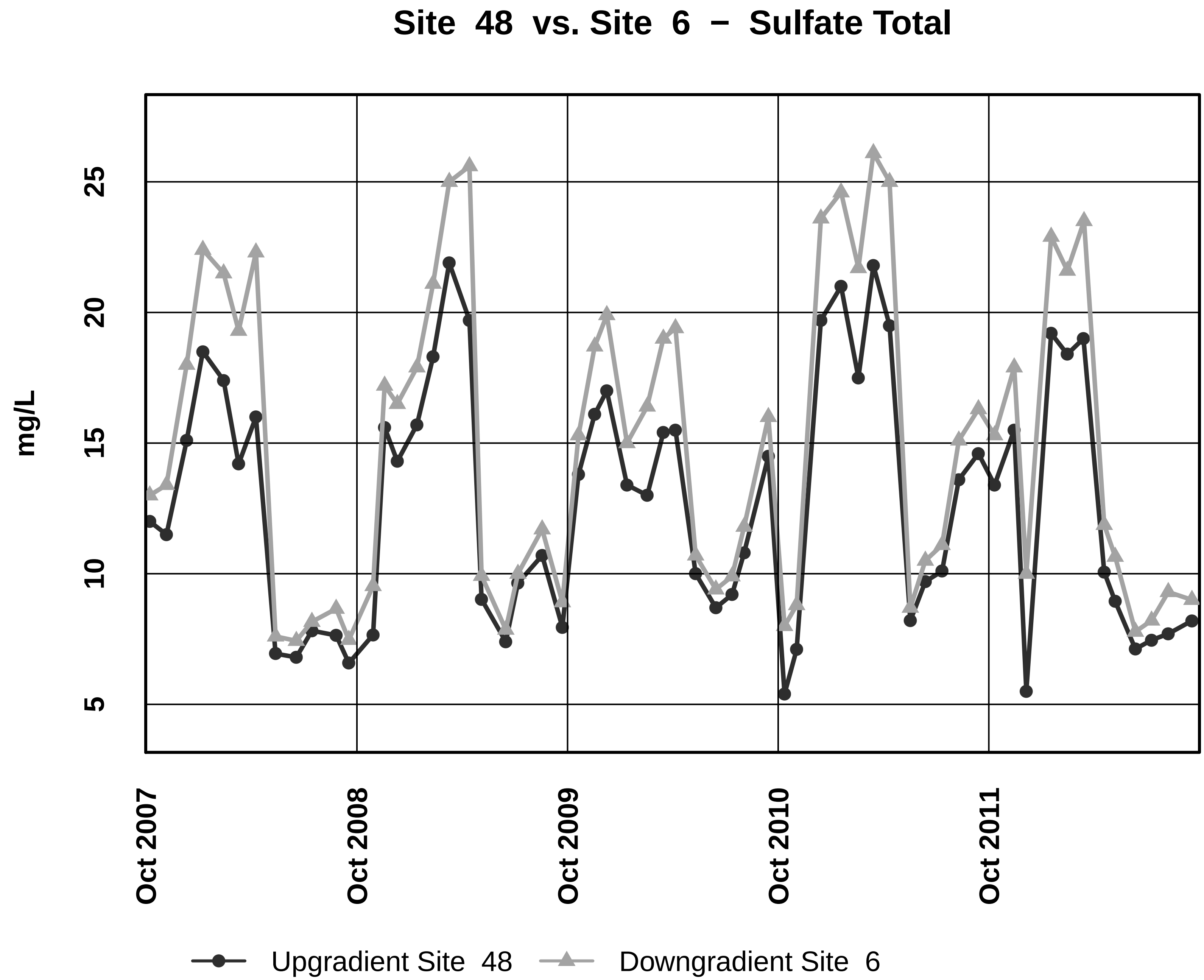
5.4%

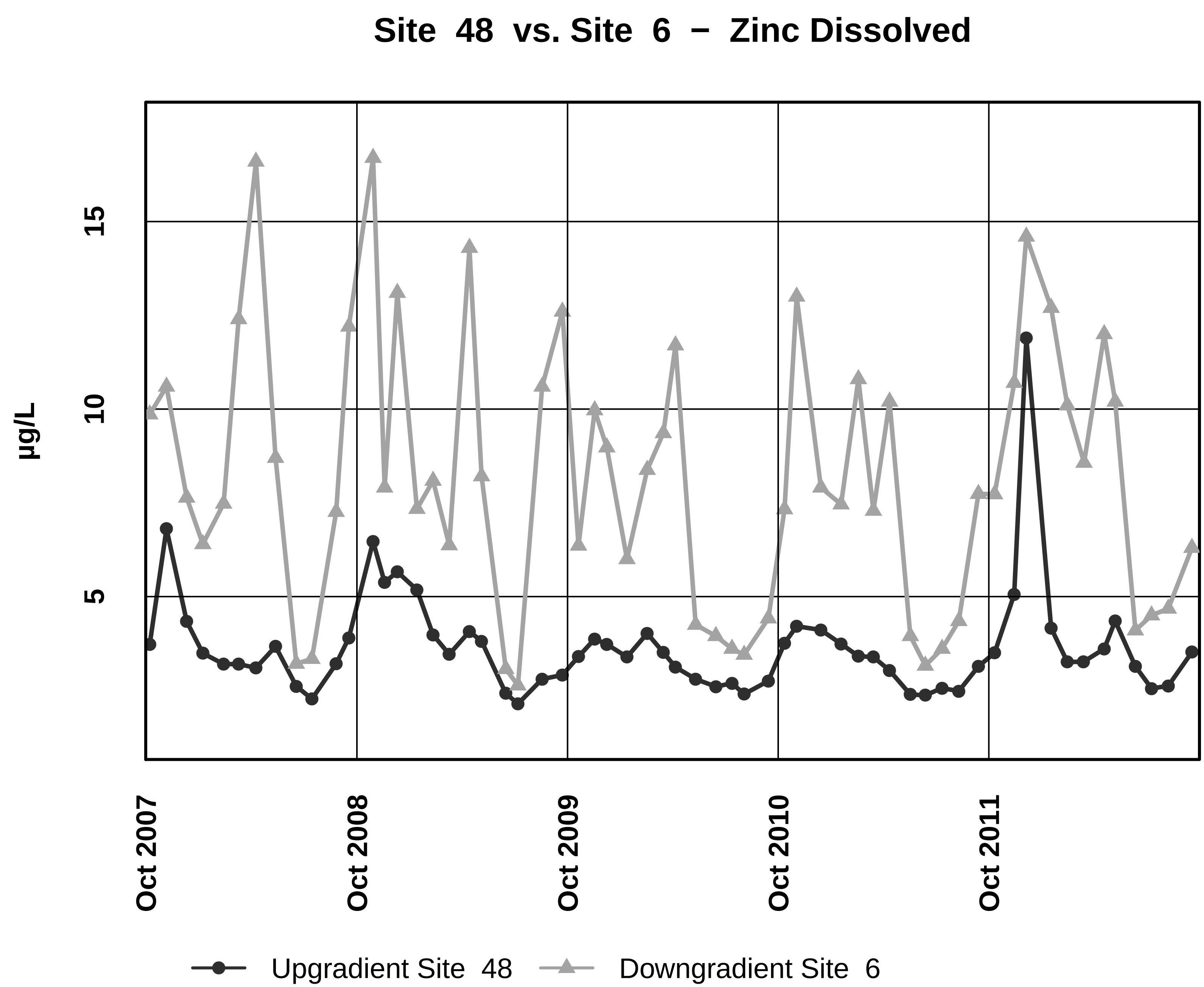

Site 48 vs. Site 6 − Conductivity Field
µS/cm
180
160
140
120
100
80
60
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 48
Downgradient Site 6


Site 48 vs. Site 6 − pH Field
su
8.5
8.0
7.5
7.0
6.5
6.0
5.5
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 48
Downgradient Site 6



Site 48 vs. Site 6 − Alkalinity Total
mg/L
20
30
40
50
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 48
Downgradient Site 6


Site 48 vs. Site 6 − Sulfate Total
mg/L
5
10
15
20
25
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 48
Downgradient Site 6



Site 48 vs. Site 6 − Zinc Dissolved
µg/L
5
10
15
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 48
Downgradient Site 6

Wilcoxon-signed-ranks test

Exact Form

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

	X	**Y**	Differences		
Site	#48	#6			
Year	WY2012	WY2012	**D**	**|D|**	**Rank**
Oct	102.0	107.0	-5.0	5.0	-4
Nov	120.0	126.0	-6.0	6.0	-6.5
Dec	75.0	92.0	-17.0	17.0	-11
Jan	72.0	130.0	-58.0	58.0	-12
Feb	123.0	133.0	-10.0	10.0	-9
Mar	154.0	169.0	-15.0	15.0	-10
Apr	106.0	112.0	-6.0	6.0	-6.5
May	98.0	104.0	-6.0	6.0	-6.5
Jun	83.1	86.3	-3.2	3.2	-1
Jul	82.7	86.2	-3.5	3.5	-2
Aug	86.0	90.0	-4.0	4.0	-3
Sep	86.0	92.0	-6.0	6.0	-6.5
Median	92.0	105.5	-6.0	6.0	

n	**m**
12	12

N= 12

$\Sigma R=$ -78

α
5.0%
W'$_{\alpha,n}$
17

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

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

Wilcoxon-signed-ranks test
Exact Form

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

	X	Y	Differences		
Site	#48	#6			
Year	WY2012	WY2012	**D**	**|D|**	**Rank**
Oct	7.58	7.39	0.19	0.19	7
Nov	7.56	7.91	-0.35	0.35	-10
Dec	7.47	7.72	-0.25	0.25	-9
Jan	5.72	6.14	-0.42	0.42	-11
Feb	7.62	7.42	0.20	0.20	8
Mar	7.68	8.16	-0.48	0.48	-12
Apr	7.73	7.74	-0.01	0.01	-2
May	7.79	7.63	0.16	0.16	6
Jun	7.96	7.93	0.03	0.03	3
Jul	7.80	7.79	0.01	0.01	1
Aug	7.70	7.62	0.08	0.08	5
Sep	7.66	7.70	-0.04	0.04	-4
Median	7.67	7.71	0.00	0.18	

n	**m**
12	12

N= 12
ΣR= -18

α
95.0%
W'α,n
59

W^+=
30
p-test
0.259

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	WY2012	WY2012	**D**	**|D|**	**Rank**
Oct	47.2	39.5	7.7	7.7	12
Nov	51.6	52.1	-0.5	0.5	-4.5
Dec	21.5	28.9	-7.4	7.4	-11
Jan	48.6	53.8	-5.2	5.2	-10
Feb	49.6	49.9	-0.3	0.3	-2.5
Mar	52.9	52.6	0.3	0.3	1
Apr	36.1	36.4	-0.3	0.3	-2.5
May	37.1	37.9	-0.8	0.8	-6
Jun	32.9	34.0	-1.1	1.1	-7
Jul	32.7	33.2	-0.5	0.5	-4.5
Aug	28.9	31.3	-2.4	2.4	-9
Sep	38.8	36.6	2.2	2.2	8
Median	38.0	37.3	-0.5	1.0	

n	**m**
12	12

N= 12
ΣR= -36

α
95.0%
W'$_{\alpha,n}$
59

W^{+}=
21
p-test
0.088

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

Wilcoxon-signed-ranks test
Exact Form

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

	X	Y	Differences		
Site	#48	#6			
Year	WY2012	WY2012	**D**	**|D|**	**Rank**
Oct	13.4	15.3	-1.9	1.9	-7
Nov	15.5	17.9	-2.4	2.4	-8
Dec	5.5	10.0	-4.5	4.5	-11.5
Jan	19.2	22.9	-3.7	3.7	-10
Feb	18.4	21.6	-3.2	3.2	-9
Mar	19.0	23.5	-4.5	4.5	-11.5
Apr	10.1	11.9	-1.8	1.8	-6
May	8.9	10.7	-1.7	1.7	-5
Jun	7.1	7.8	-0.7	0.7	-1
Jul	7.5	8.2	-0.8	0.8	-2
Aug	7.7	9.3	-1.6	1.6	-4
Sep	8.2	9.0	-0.8	0.8	-3
Median	9.5	11.3	-1.9	1.9	

n	**m**
12	12

N= 12
$\Sigma R = -78$

α
5.0%
W'$_{\alpha,n}$
17

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

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

Wilcoxon-signed-ranks test

Exact Form

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

	X	**Y**	Differences		
Site	#48	#6			
Year	WY2012	WY2012	**D**	**|D|**	**Rank**
Oct	3.50	7.73	-4.23	4.23	-6
Nov	5.06	10.70	-5.64	5.64	-8
Dec	11.90	14.60	-2.70	2.70	-4
Jan	4.16	12.70	-8.54	8.54	-12
Feb	3.26	10.10	-6.84	6.84	-10
Mar	3.26	8.57	-5.31	5.31	-7
Apr	3.61	12.00	-8.39	8.39	-11
May	4.35	10.20	-5.85	5.85	-9
Jun	3.14	4.10	-0.96	0.96	-1
Jul	2.55	4.50	-1.95	1.95	-2
Aug	2.62	4.68	-2.06	2.06	-3
Sep	3.52	6.30	-2.78	2.78	-5
Median	3.51	9.34	-4.77	4.77	

n	**m**
12	12

N= 12

ΣR= -78

α
5.0%
W'$_{\alpha,n}$
17

W^{+}=
0
p-test
0.000

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

INTERPRETIVE REPORT
SITE 54

The data collected during the current water year are listed in the following "Table of Results for Water Year 2012" report. The table includes all the required FWMP analyte data (field and laboratory) collected for the current water year and a series of flags keyed to the summary report "Qualified Data by QA Reviewer". The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of ½ MDL for the purpose of median calculation.

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

Sample Date	Parameter	Value	Qualifier	Notes
No outliers have been identified by HGCMC for the period of October 2007 through September 2012.				

The data for water year 2012 have been compared to the strictest fresh water quality criterion for each applicable analyte. One result for pH exceeding these criteria has been identified. This is considered to be caused by natural background variation, for Site 48 also had an exceedance for pH during the same sampling event.

Table of Exceedance for Water Year 2012

			Limits		
Sample Date	Parameter	Value	Lower	Upper	Hardness
17-Jan-12	pH Field	6.25 su	6.5	8.50	

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

A non-parametric statistical analysis for trend was performed for specific conductivity, field pH, total alkalinity, total sulfate, and dissolved zinc. Calculation details of the Seasonal Kendall analyses are presented in detail on the pages following this interpretive section. The following table summarizes the results on the data collected between Oct-06 and Sep-12 (WY2007-WY2012).

Table of Summary Statistics for Trend Analysis

Parameter	Mann-Kendall test statistics n*	p**	Trend	Sen's slope estimate Q	Q(%)
Conductivity Field	6	0.15			
pH Field	6	0.08			
Alkalinity, Total	6	0.14			
Sulfate, Total	6	<0.01	+	0.46	3.0
Zinc, Dissolved	6	<0.01	+	0.30	4.3

* Number of Years ** Significance level

Dissolved zinc had a statistically significant ($p < 0.01$) trend with a slope estimate of 0.30 µg/L/yr or a 4.3% increase. Furthermore, total sulfate had a statistically significant ($p<0.01$) trend with a slope estimate of 0.46 µg/L/yr or 3.0% increase. However given the low magnitude and similar trend noted at Site 6, HGCMC does not feel that these trends are a significant indication of changes in water chemistry at Site 54.

A comparison of median values for total alkalinity, field pH, field conductivity, total sulfate, and dissolved zinc between Site 54 and Site 6 has been conducted as specified in the Statistical Information Goals for Site 54. Additionally, X-Y plots have been generated for total alkalinity, field pH, specific conductance, total sulfate, and dissolved zinc that co-plot data from Site 54 and Site 6, the upstream control site, to aid in the comparison between those sites. Calculation details of the non-parametric signed-rank tests are presented in detail on the pages following this interpretive section. The table below summarizes the results of the signed-rank test as performed on the water year 2012 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	105.5	108.5	-4
pH Field	0.912	7.71	7.57	0.04
Alkalinity, Total	0.003	37.3	38.9	-0.9
Sulfate, Total	0.021	11.3	11.60	-0.30
Zinc, Dissolved	0.998	9.34	8.39	0.4

The median values for pH for Site 6 and Site 54 are 7.71 su and 7.57 su respectively and the median of differences, Site 6 minus Site 54, is 0.04 su. Site 54 has intermittently (6 out of 10) had statistically significantly lower pH readings for water years (WY2002 and WY2011). This difference may in part be due to inflow of Bruin Creek which typically has a slightly lower pH than Greens Creek.

The median values for total sulfate for Site 6 and Site 54 are 11.3 mg/L and 11.60 mg/L respectively. The median of the differences, Site 6 minus Site 54, is -0.30 mg/L total sulfate. Again similar results are obtained using the signed-rank test on the WY2004 - WY2011 total sulfate datasets.

Along with the significant difference in total sulfate there was a significant difference in field conductivity. Upgradient the median conductivity value was 105.5 µs/cm and the downgradient median value was 108.5 µs/cm, resulting in a -4.0 µs/cm median difference. Datasets from WY2002 – WY2011 yield similar significant results with similar magnitudes. In general, the trend in conductivity is similar to differences measured between Site 48 and Site 6, although of a smaller magnitude. HGCMC feels the current FWMP program is adequate to measure and quantify any future changes that may occur between Site 6 and Site 54, given the small magnitude of the differences and the consistency of the variations over the past several years.

Table of Results for Water Year 2012

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

Sample Date/Parameter	Oct 2011	Nov 2011	Dec 2011	Jan 2012	Feb 2012	Mar 2012	Apr 2012	May 2012	Jun 2012	Jul 2012	Aug 2012	Sep 2012	**Median**
Water Temp (°C)	4.5	0.6	0.5	0	0.9	0.5	1.4	2.1	4.2	5.6	7.5	6.8	1.8
Conductivity-Field(μmho)	109	130	99	140	138	173	116	108	87.1	87.8	93	95	108.5
Conductivity-Lab (μmho)	135	149	117	128	167	174	120	111	89	87	85	92	119
pH Lab (standard units)	7.72	7.41	6.26	6.09	6.5	6.35	6.63	7.17	6.84	6.9	5.89	7.7	6.74
pH Field (standard units)	6.8	7.9	7.74	6.25	7.54	7.27	7.71	7.59	7.87	7.84	7.35	7.52	7.57
Total Alkalinity (mg/L)	47.7	51.2	31.8	54.1	54.4	55.9	37	39	34.4	33.6	31.6	38.7	38.9
Total Sulfate (mg/L)	15.5	18.3	10.5	25	23.2	23.8	12.2	10.9	7.8	8.4	8.6	9	11.6
Hardness (mg/L)	61.4	68.8	49.4	77	77.2	81.4	52.3	47.7	39.1	39.9	41.7	44.9	50.9
Dissolved As (ug/L)	0.222	0.217	0.179	0.164	0.168	0.169	0.194	0.153	0.195	0.218	0.207	0.232	0.195
Dissolved Ba (ug/L)			21		28.8								24.9
Dissolved Cd (ug/L)	0.0521	0.0516	0.0807	0.0645	0.057	0.05	0.063	0.0582	0.0337	0.0417	0.0552	0.0592	0.0561
Dissolved Cr (ug/L)			1.3		0.029								0.665
Dissolved Cu (ug/L)	0.394	0.475	0.883	0.488	0.532	0.421	0.78	0.701	0.279	0.441	0.376	0.902	0.482
Dissolved Pb (ug/L)	0.013	0.0122	0.441	0.126	0.0534	0.0159	0.0358	0.08	0.0118	0.0065	0.0098	0.0489	0.0259
Dissolved Ni (ug/L)			1.2		1.03								1.115
Dissolved Ag (ug/L)			0.002		0.002								0.002
Dissolved Zn (ug/L)	7.33	10.3	13.2	10.2	8.99	7.79	11.1	9.94	4.11	4.51	4.74	5.93	8.39
Dissolved Se (ug/L)			0.784		1.36								1.072
Dissolved Hg (ug/L)	0.000857	0.000747	0.00202	0.00076	0.000868	0.00087	0.00164	0.00165	0.000686	0.00064	0.000762	0.00256	0.000863

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 KGCMC and removed from any further analysis and is not included into the calculation of the median

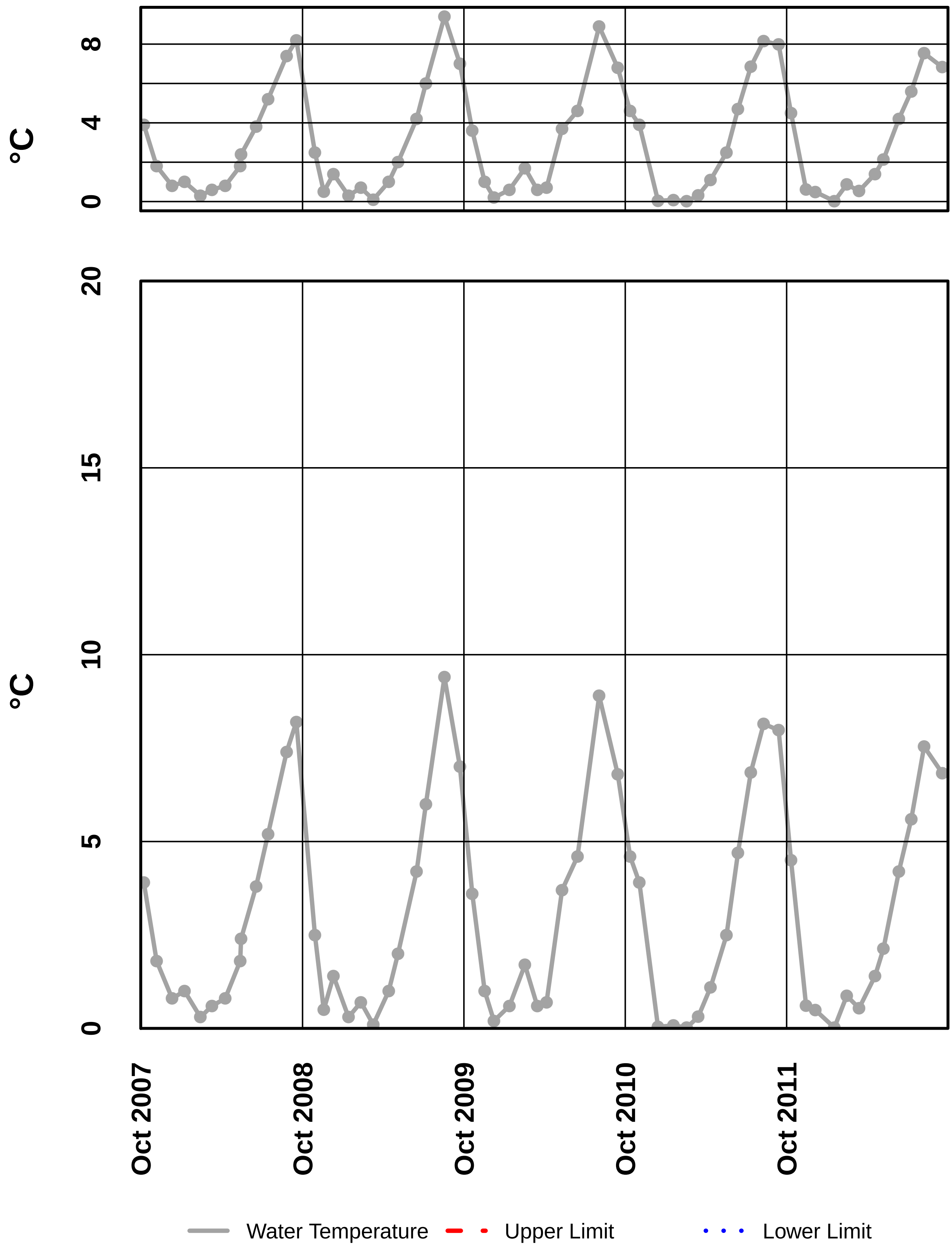
Qualified Data by QA Reviewer

Date Range: 10/01/2011 to 09/30/2012

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
54	10/11/2011	12:00 AM	Cu diss, µg/l	0.39	U	Field Blank Contamination
			Pb diss, µg/l	0.01	U	Field Blank Contamination
			Zn diss, µg/l	7.33	U	Field Blank Contamination
			SO4 Tot, mg/l	15.5	J	Sample Temperature Receipt
54	11/14/2011	12:00 AM	Hg diss, µg/l	0.000747	U	Field Blank Contamination
54	1/17/2012	12:00 AM	pH Lab, su	6.09	J	Hold Time Violation
54	3/13/2012	12:00 AM	Cu diss, µg/l	0.42	U	Field Blank Contamination
			Hg diss, µg/l	0.00087	U	Field Blank Contamination
			pH Lab, su	6.35	J	Sample Hold Time
			SO4 Tot, mg/l	23.83	J	Sample Receipt Temperature
54	4/18/2012	12:00 AM	Pb diss, µg/l	0.03	U	Field Blank Contamination
			SO4 Tot, mg/l	12.19	J	Sample Receipt Temperature
54	5/7/2012	12:00 AM	SO4 Tot, mg/l	10.91	J	Sample Receipt Temperature
54	6/11/2012	12:00 AM	SO4 Tot, mg/l	7.76	J	Sample Receipt Temperature
54	7/9/2012	12:00 AM	Hg diss, µg/l	0.00064	U	Field Blank Contamination
			Pb diss, µg/l	0.00652	J	Below Quantitative Range
54	8/7/2012	12:00 AM	As diss, µg/l	0.2	J	LCS Recovery
54	9/17/2012	12:00 AM	pH Lab, su	7.7	J	Hold Time Violation
			SO4 Tot, mg/l	8.98	J	Sample Receipt Temperature

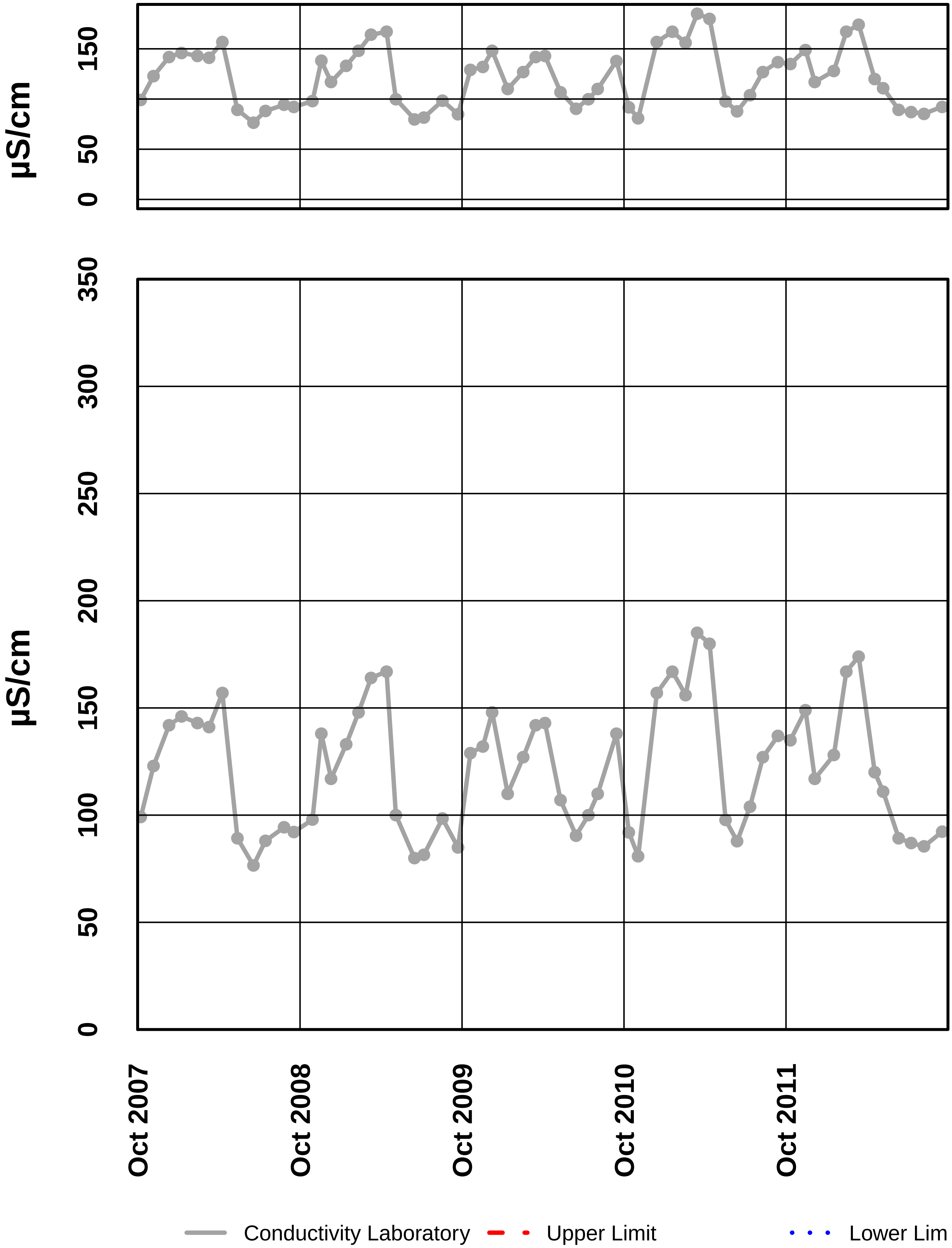
Qualifier	Description
J	Positively Identified - Approximate concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit

Site 54 – Water Temperature

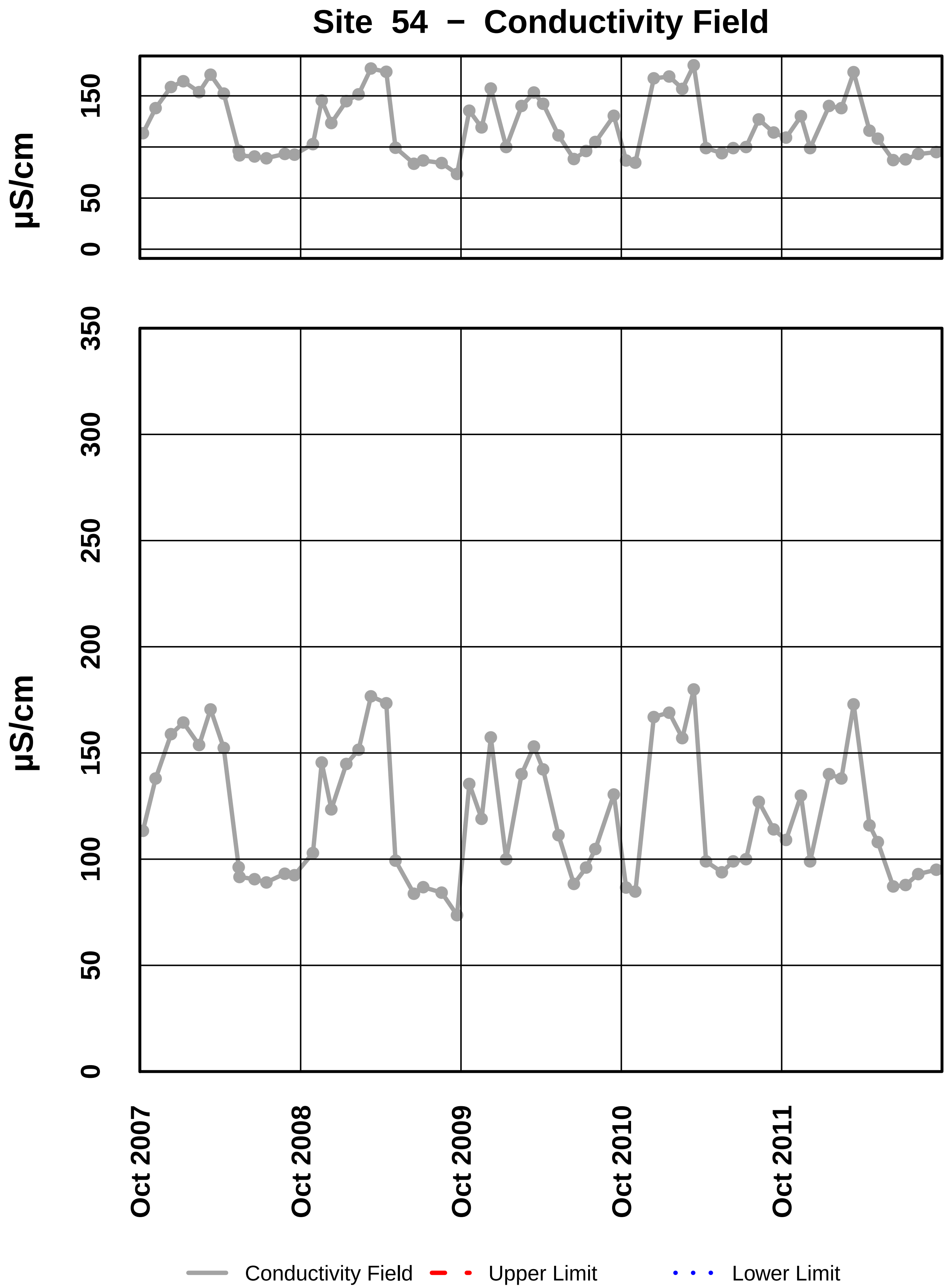


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 54 − Conductivity Laboratory

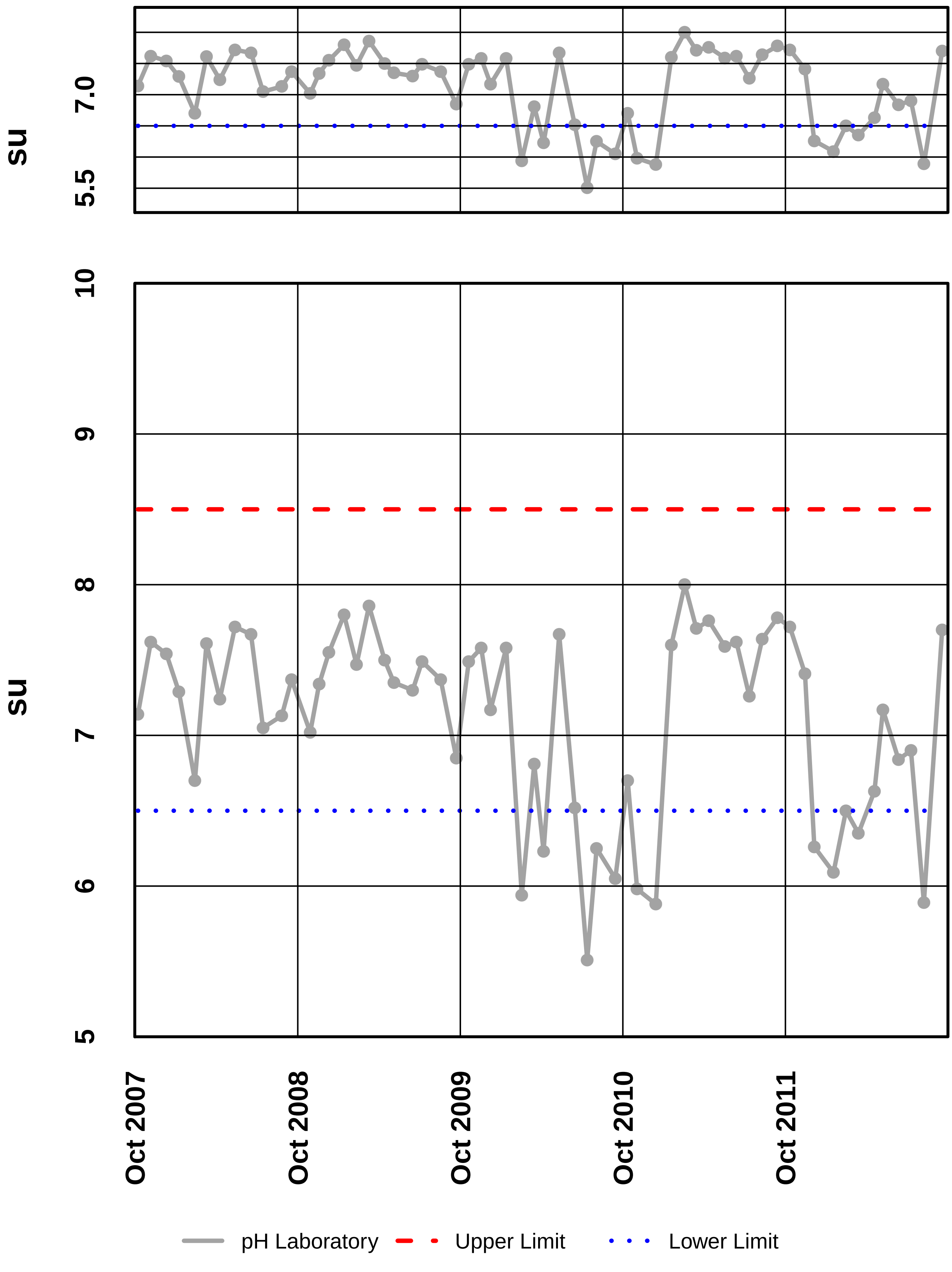


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

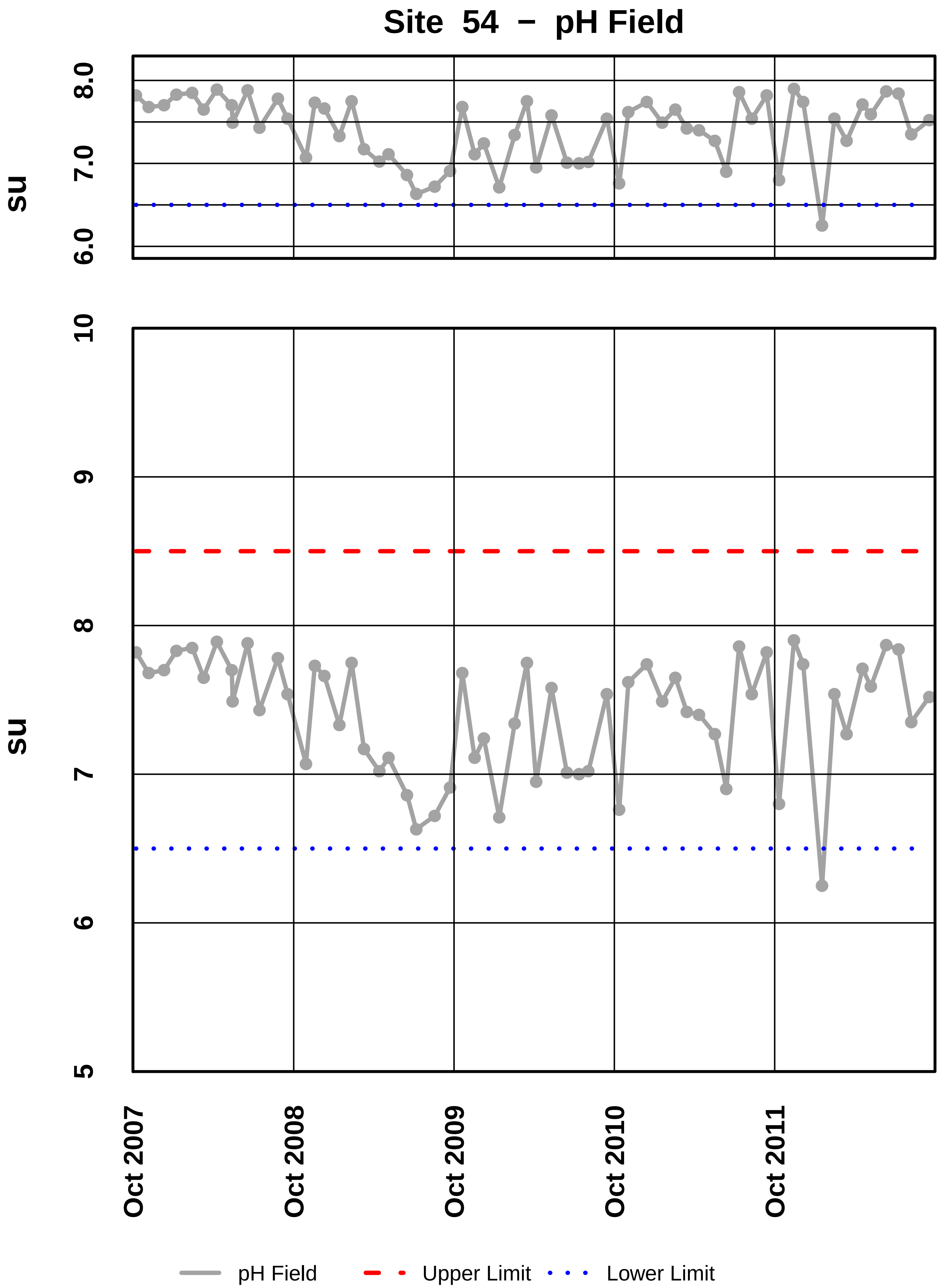


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

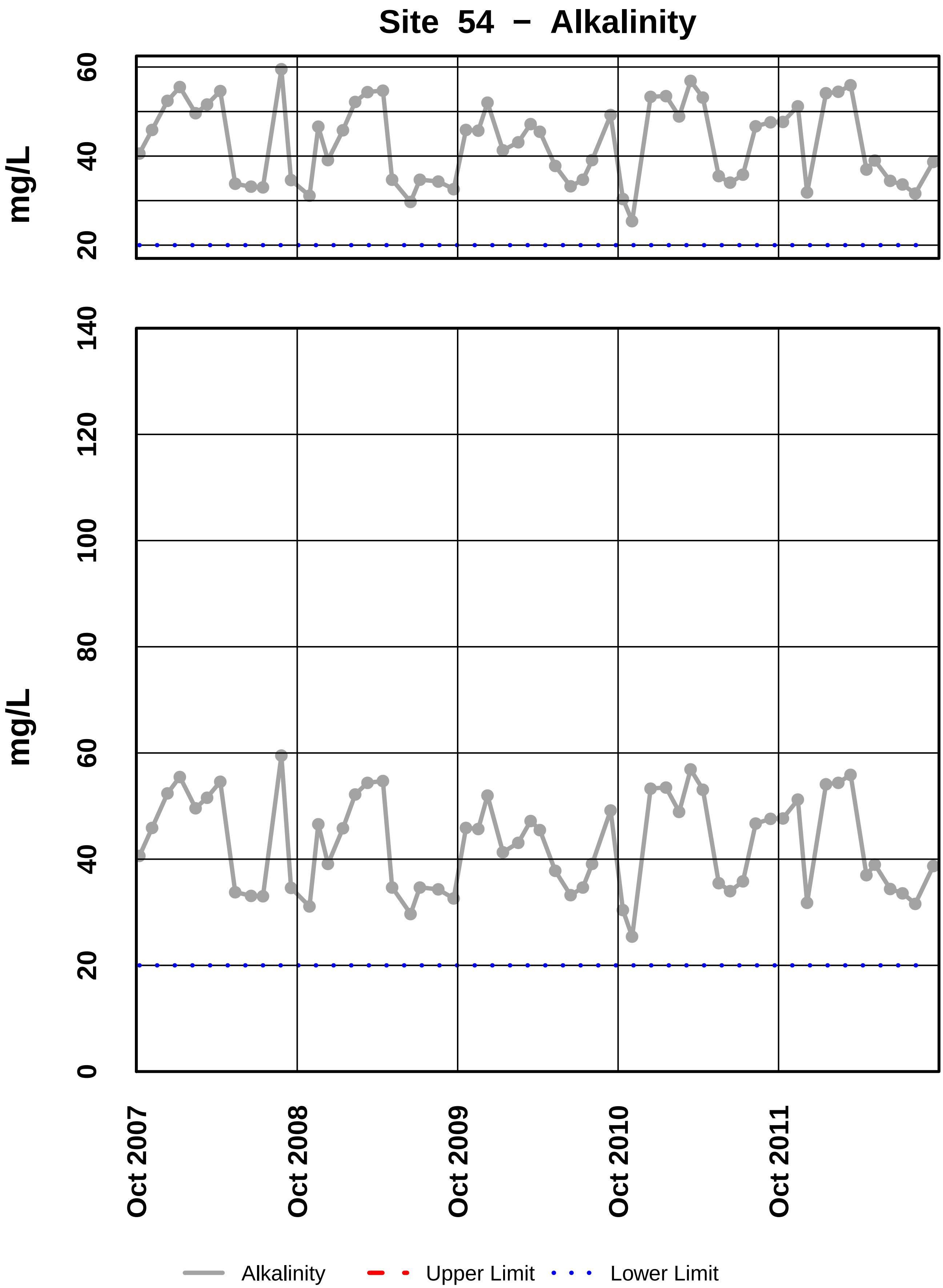
Site 54 – pH Laboratory



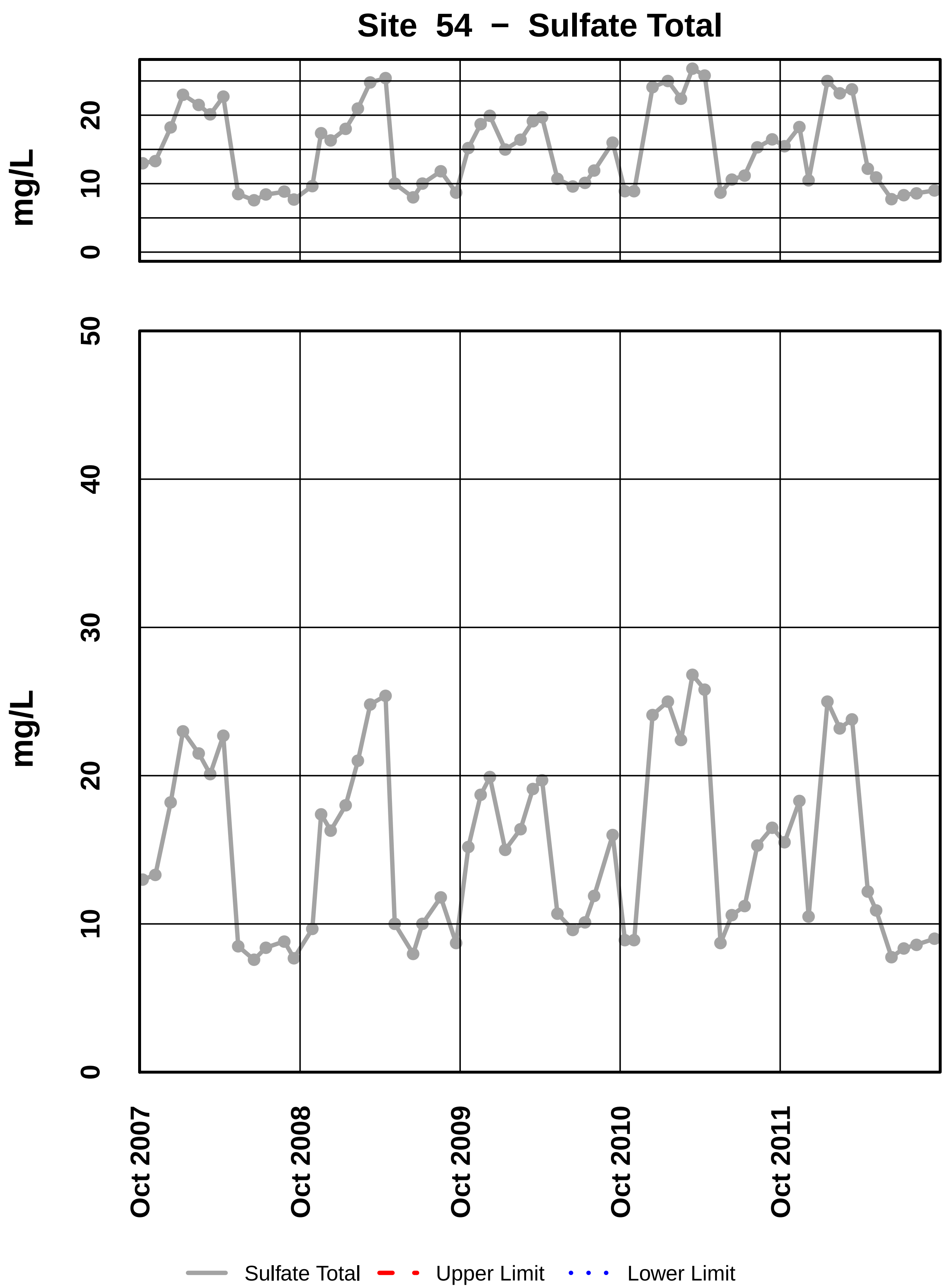
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



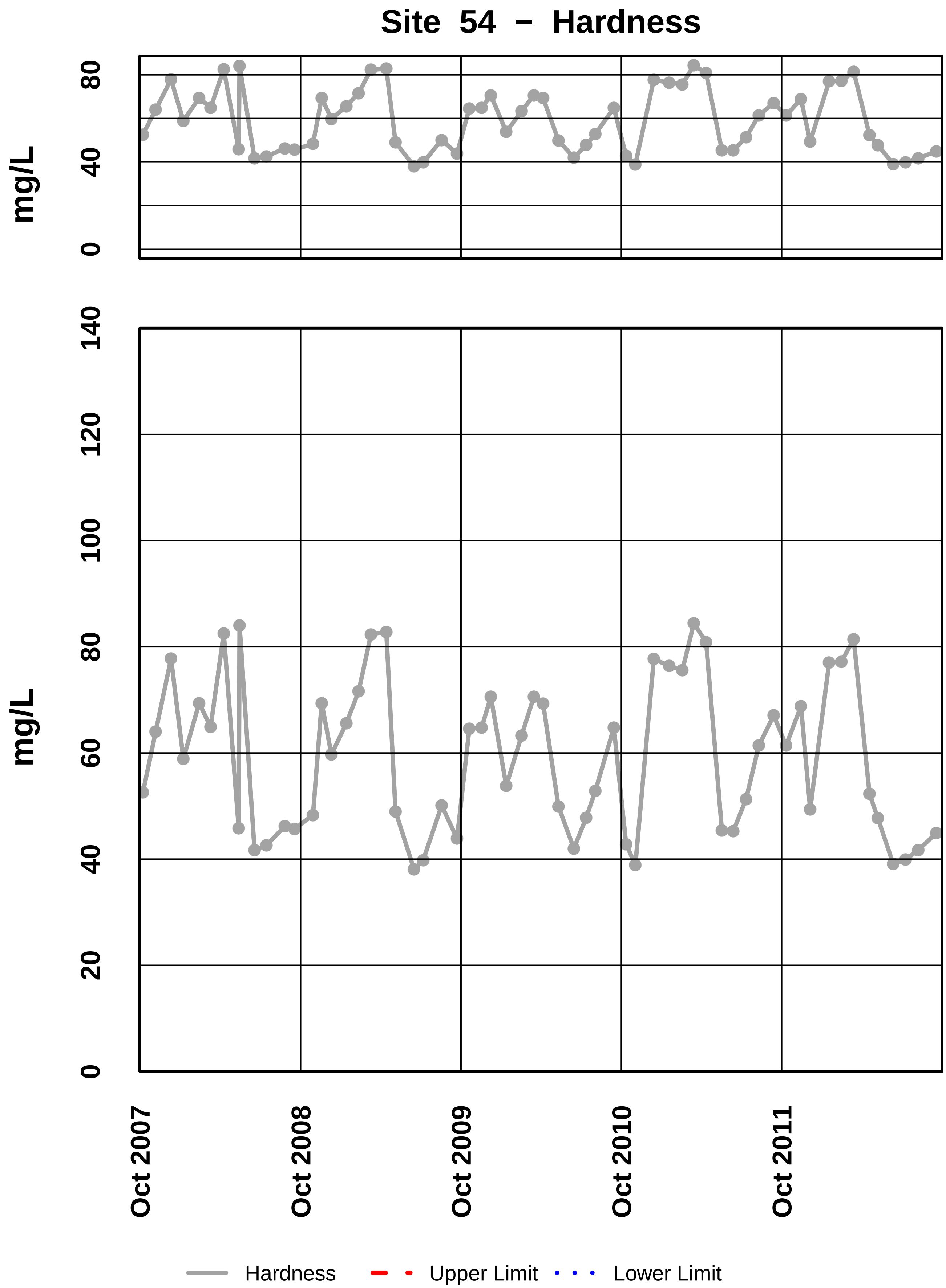
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



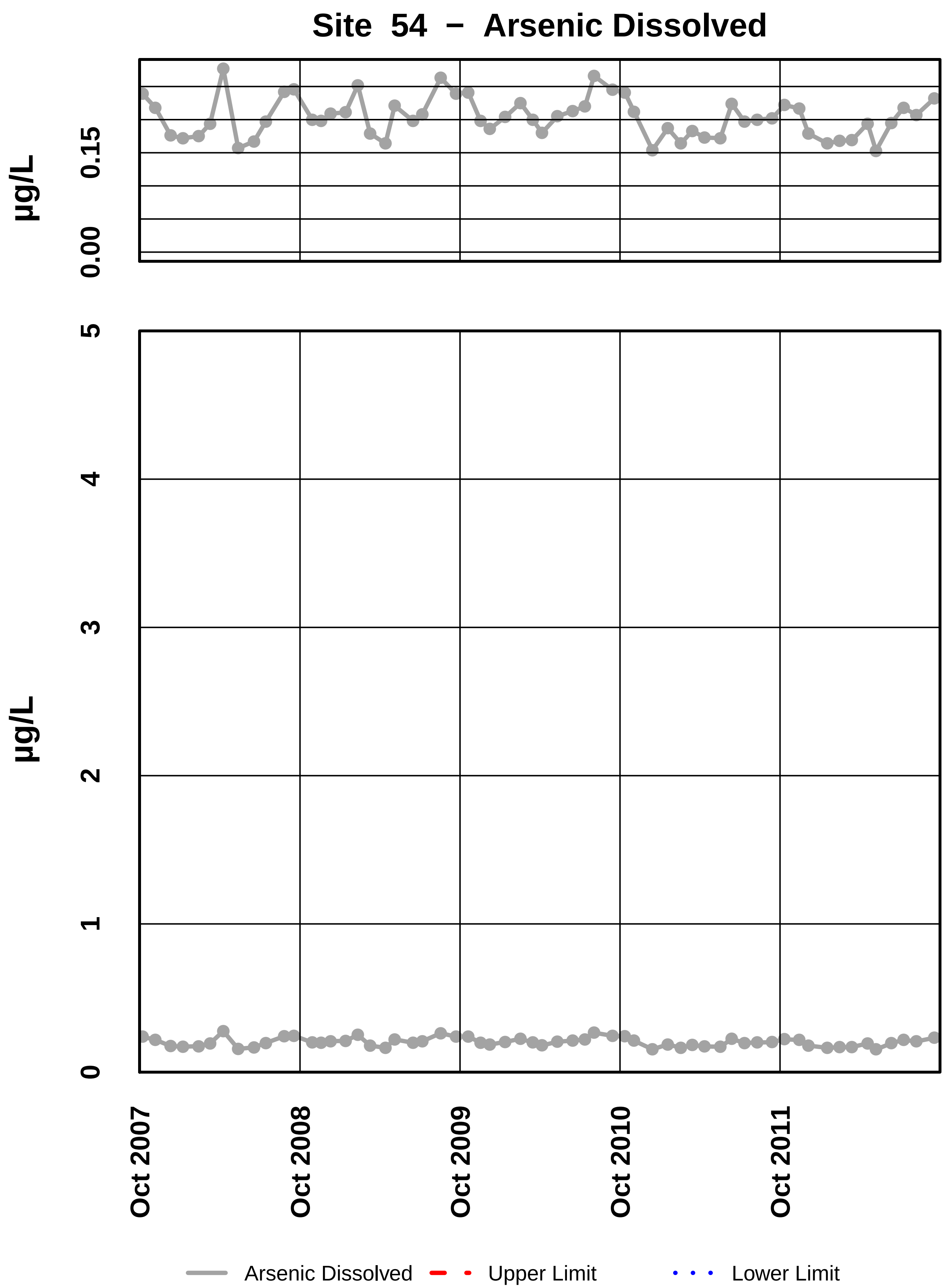
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

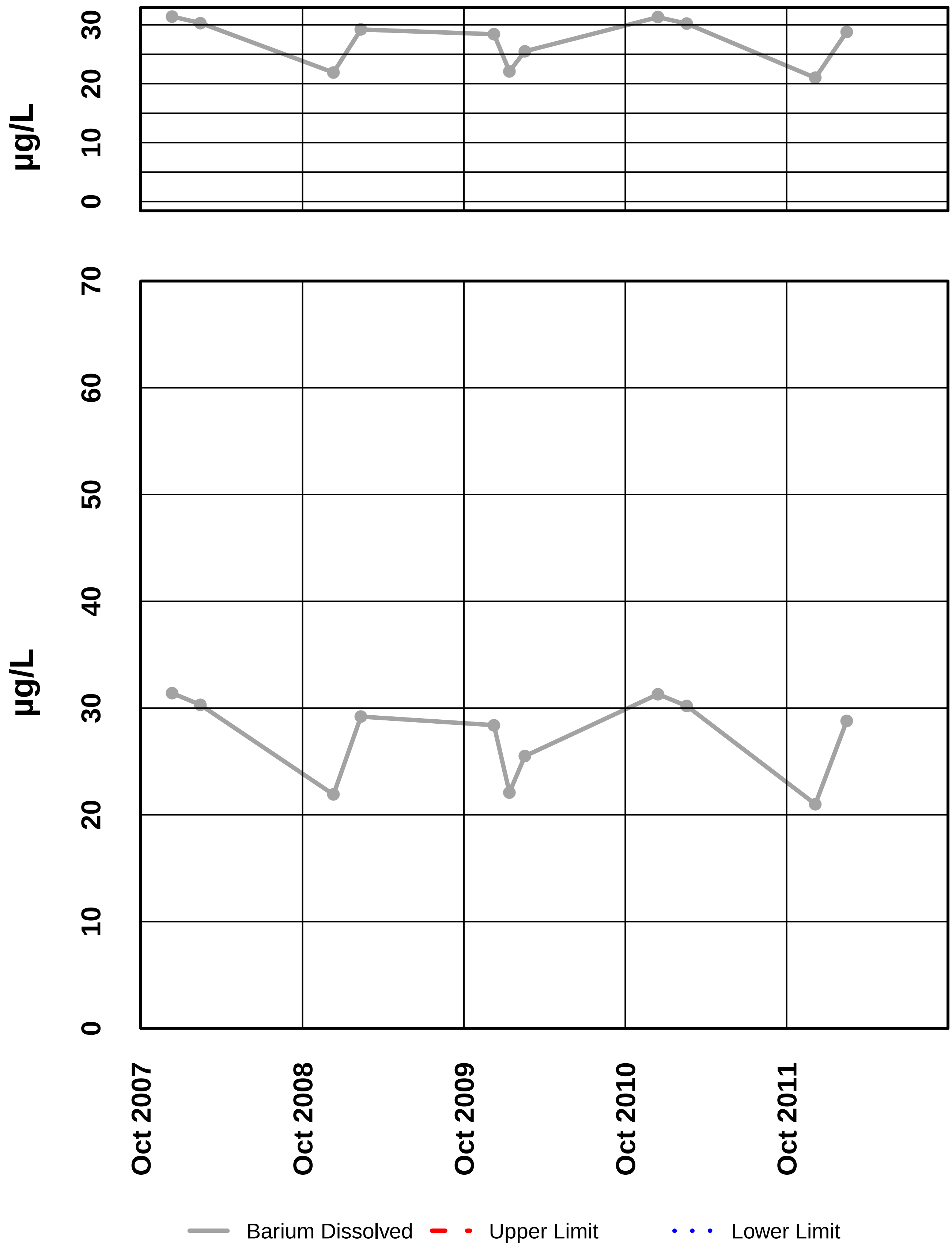


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

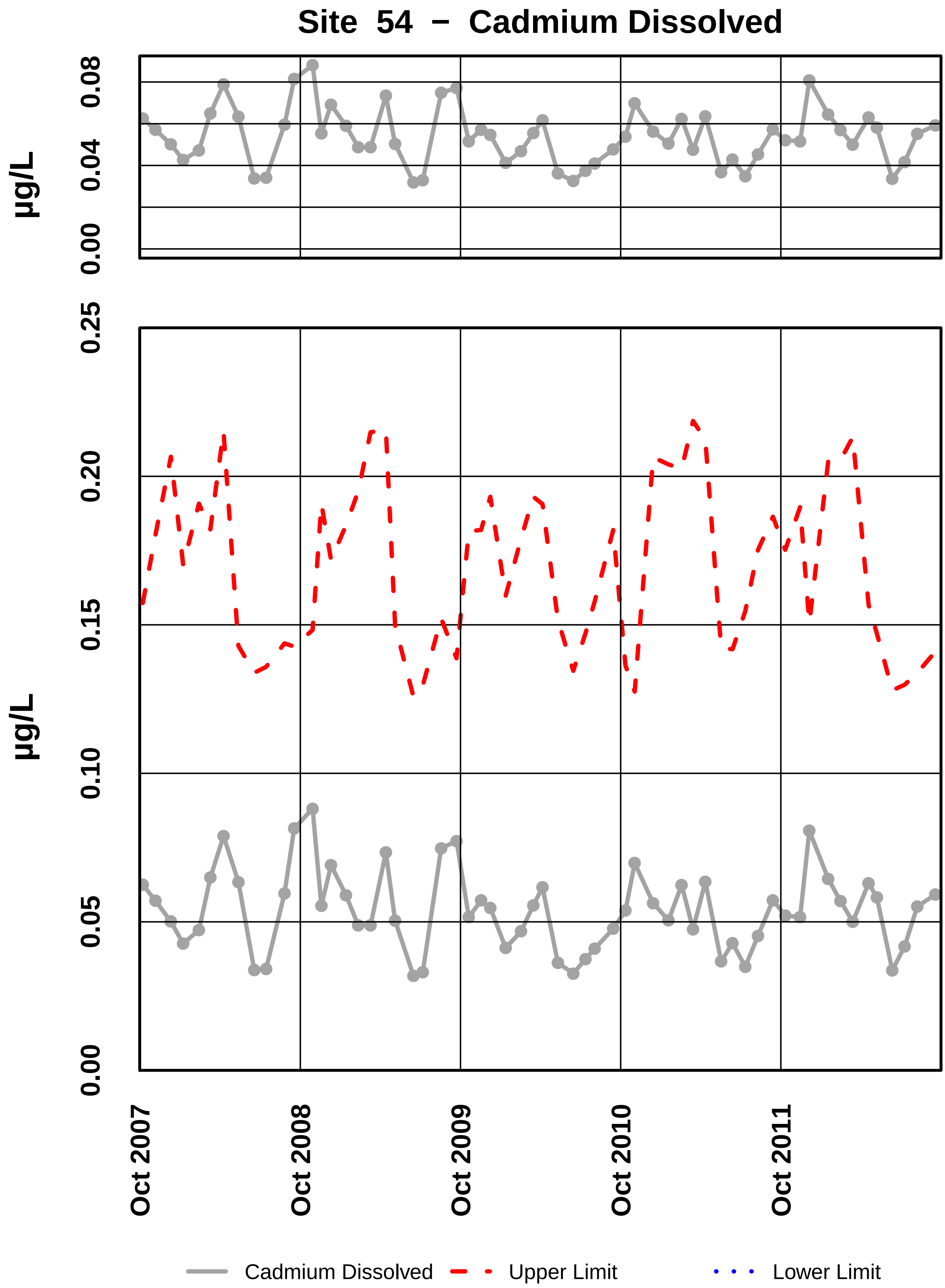


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

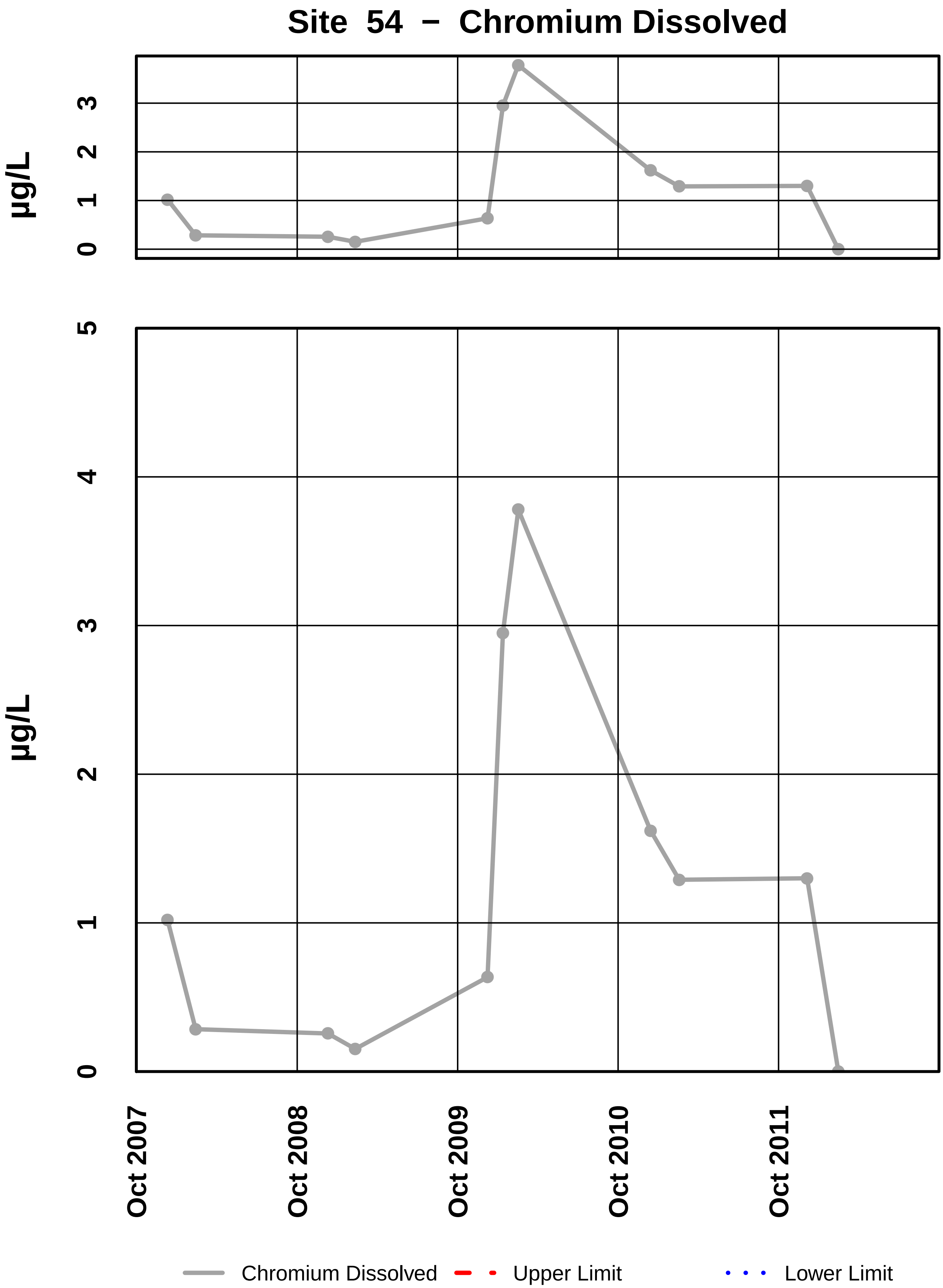
Site 54 − Barium Dissolved



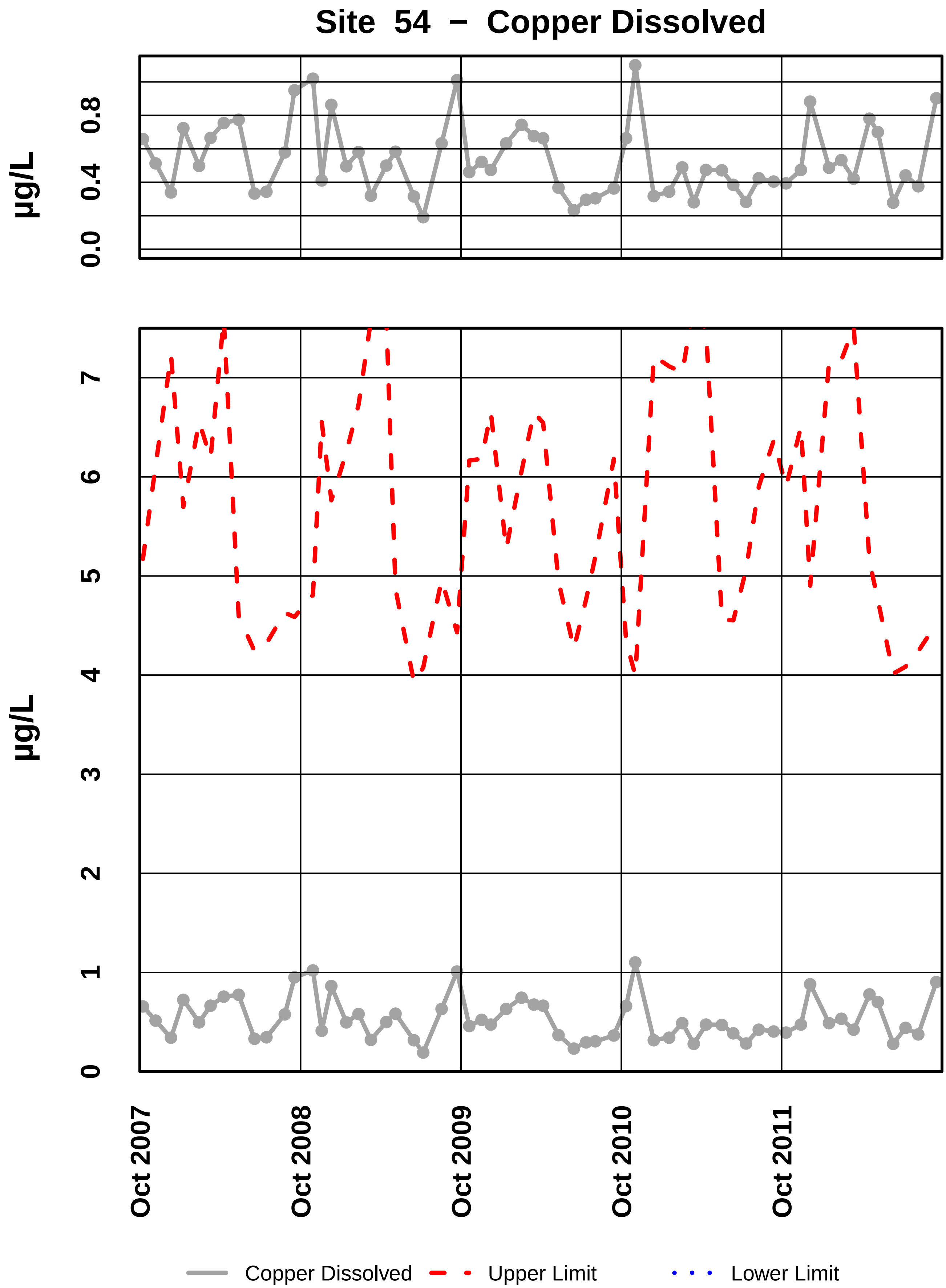
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



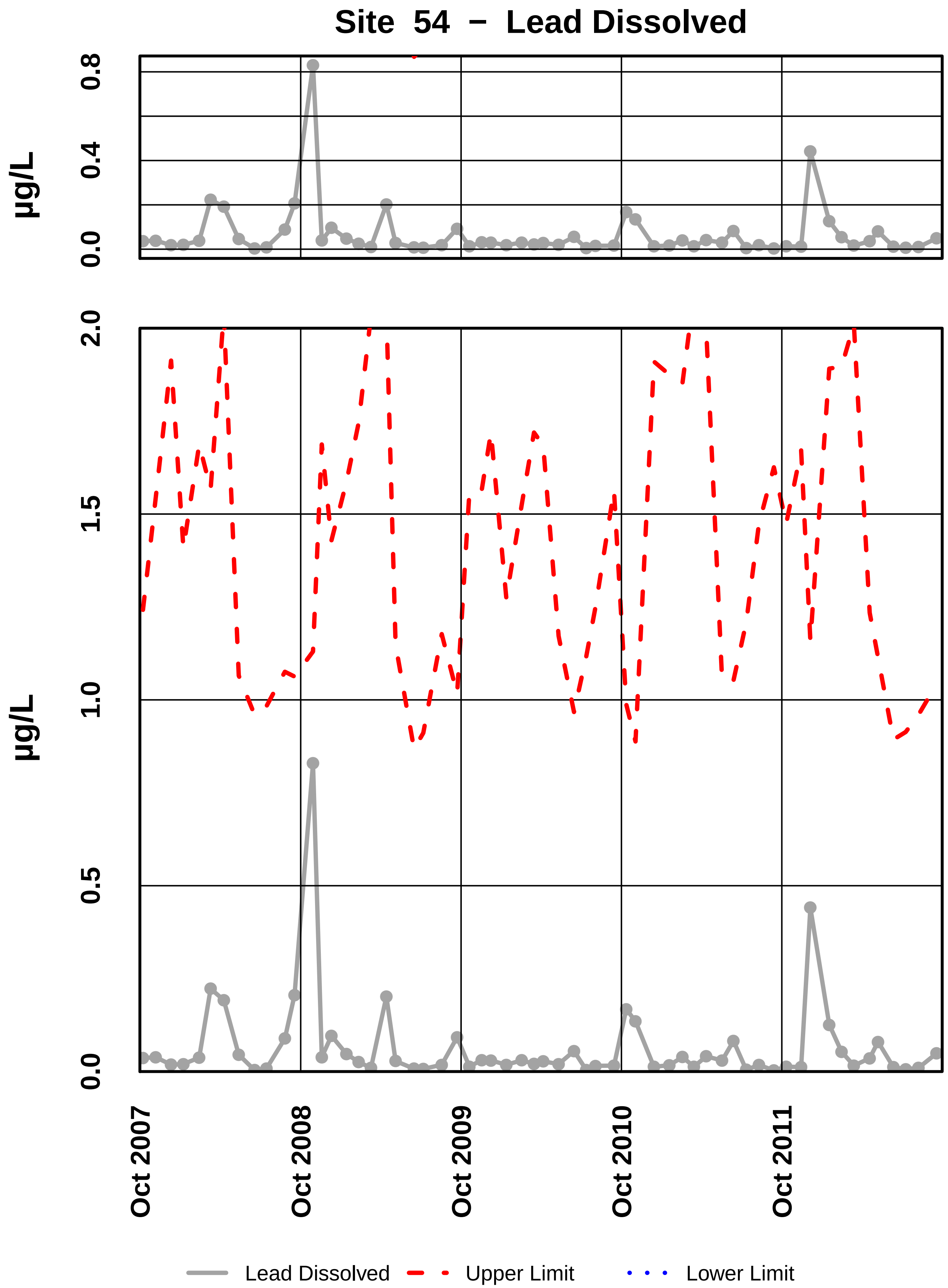
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



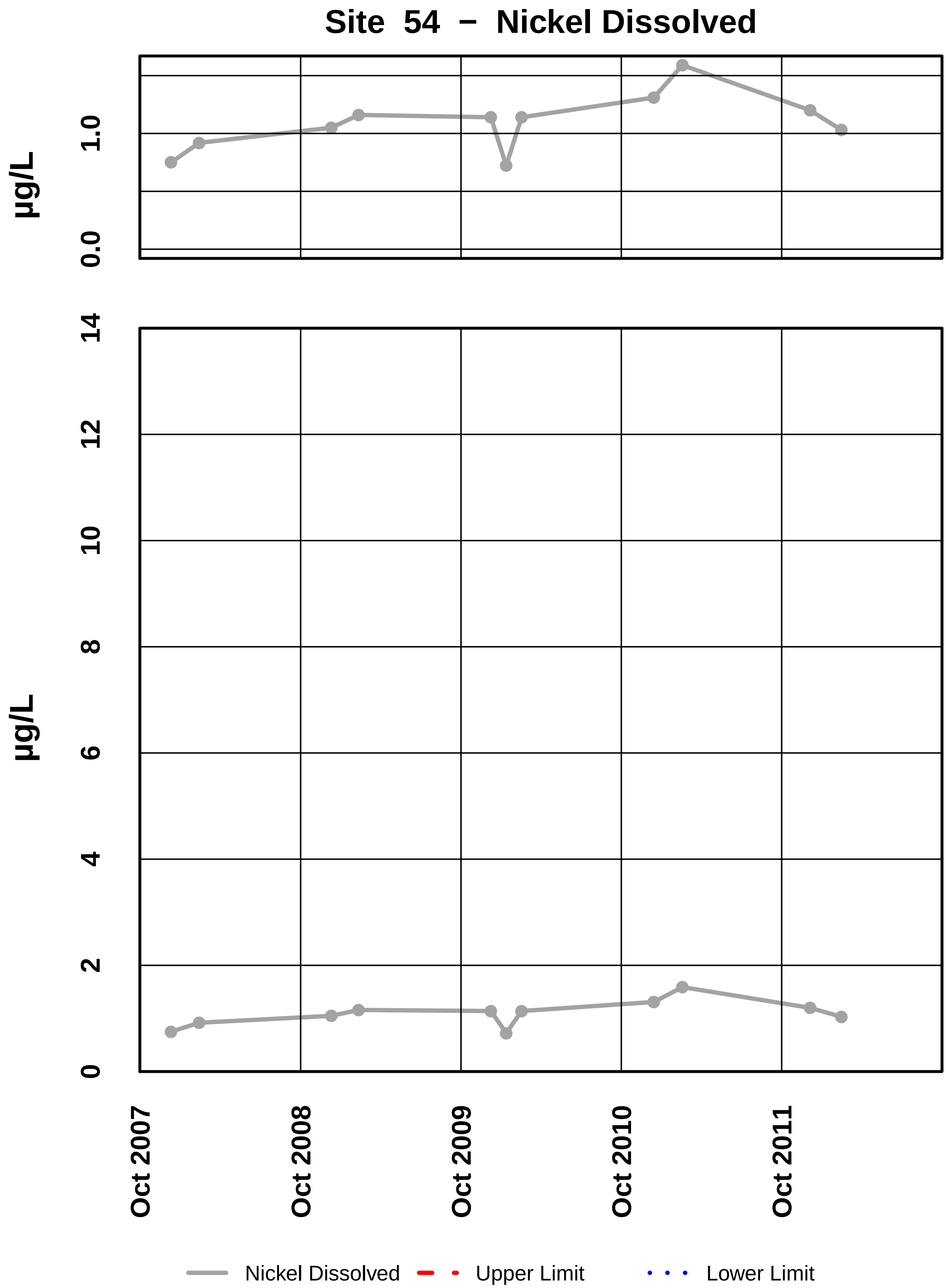
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



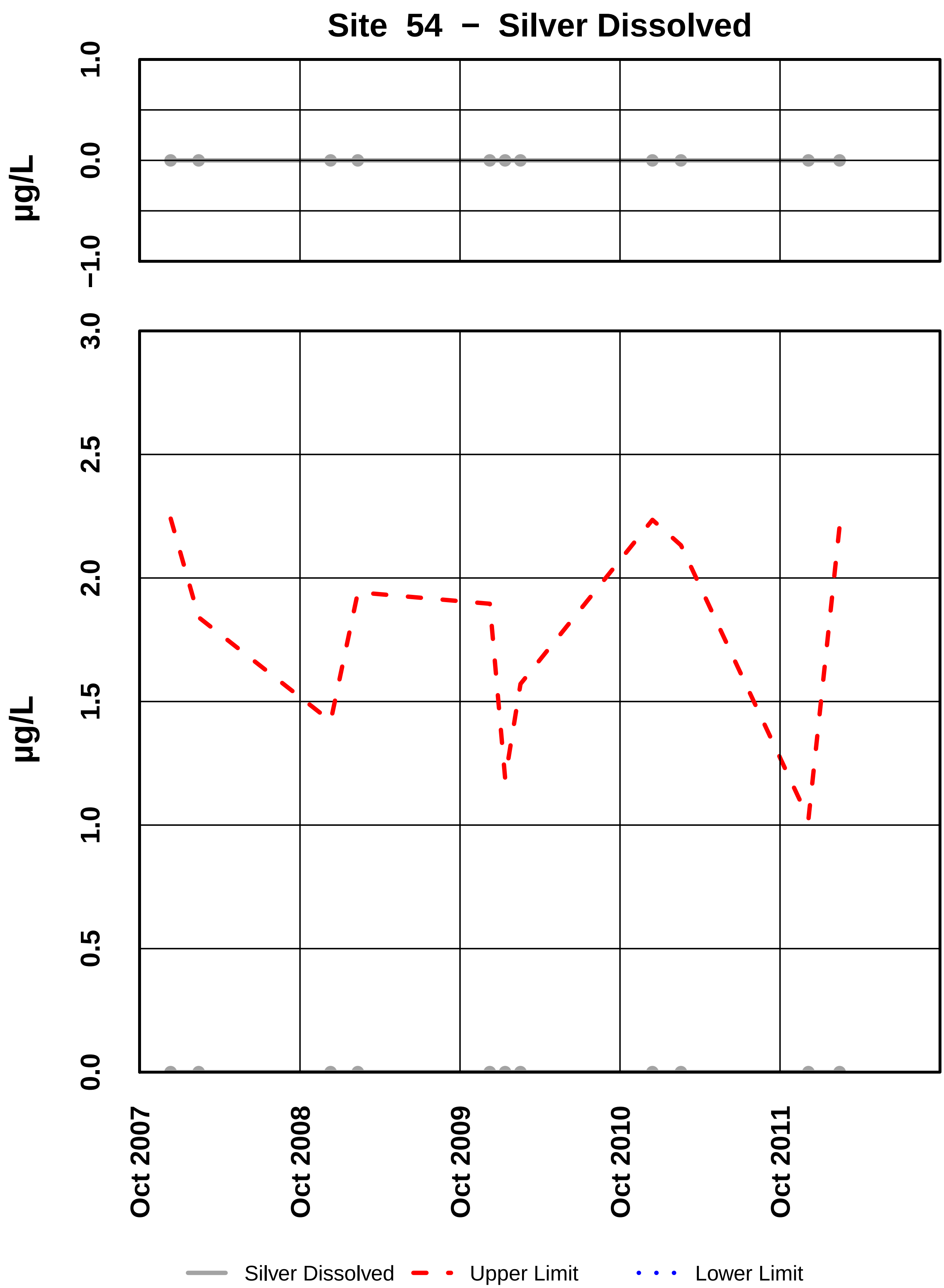
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



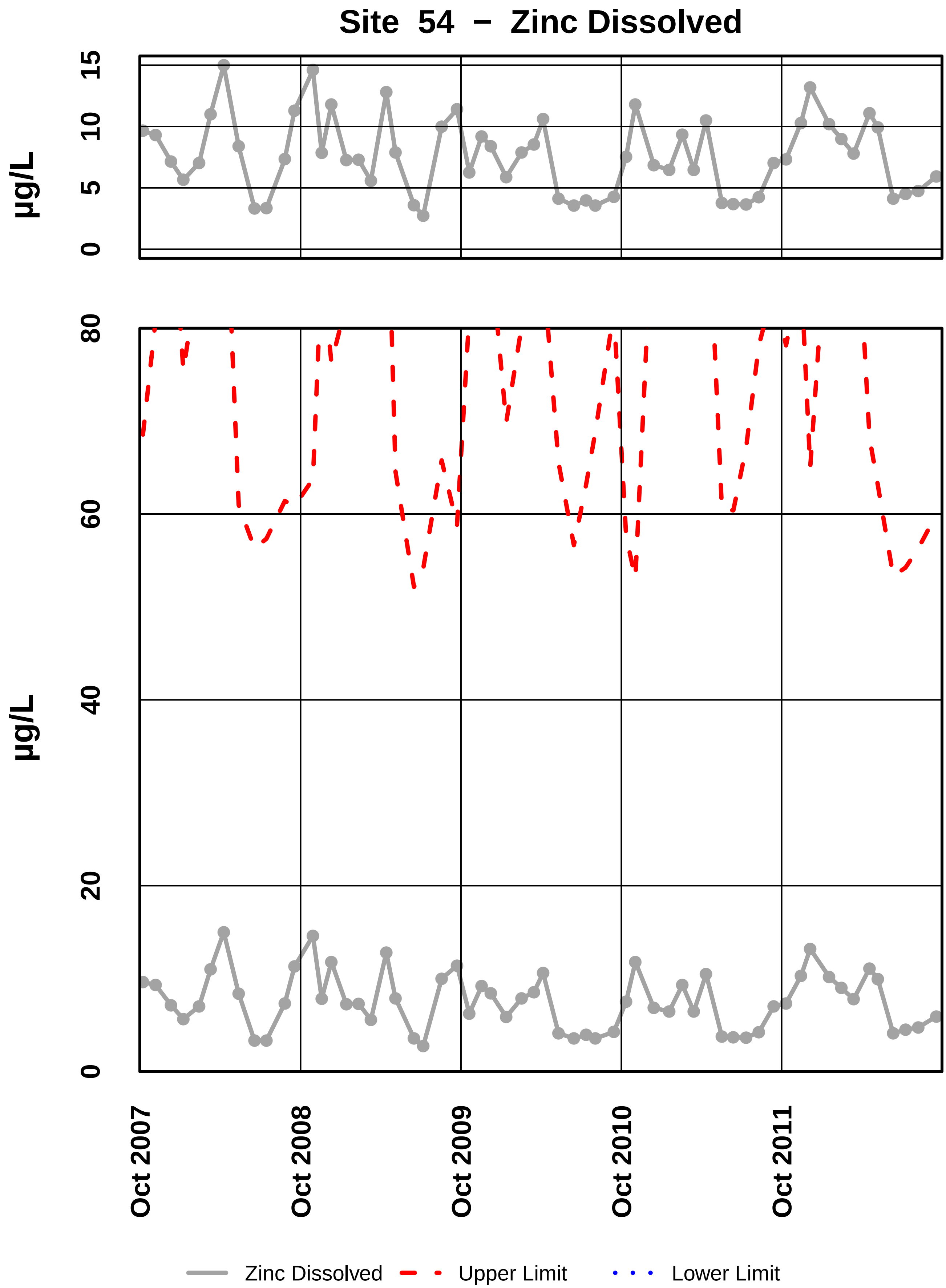
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

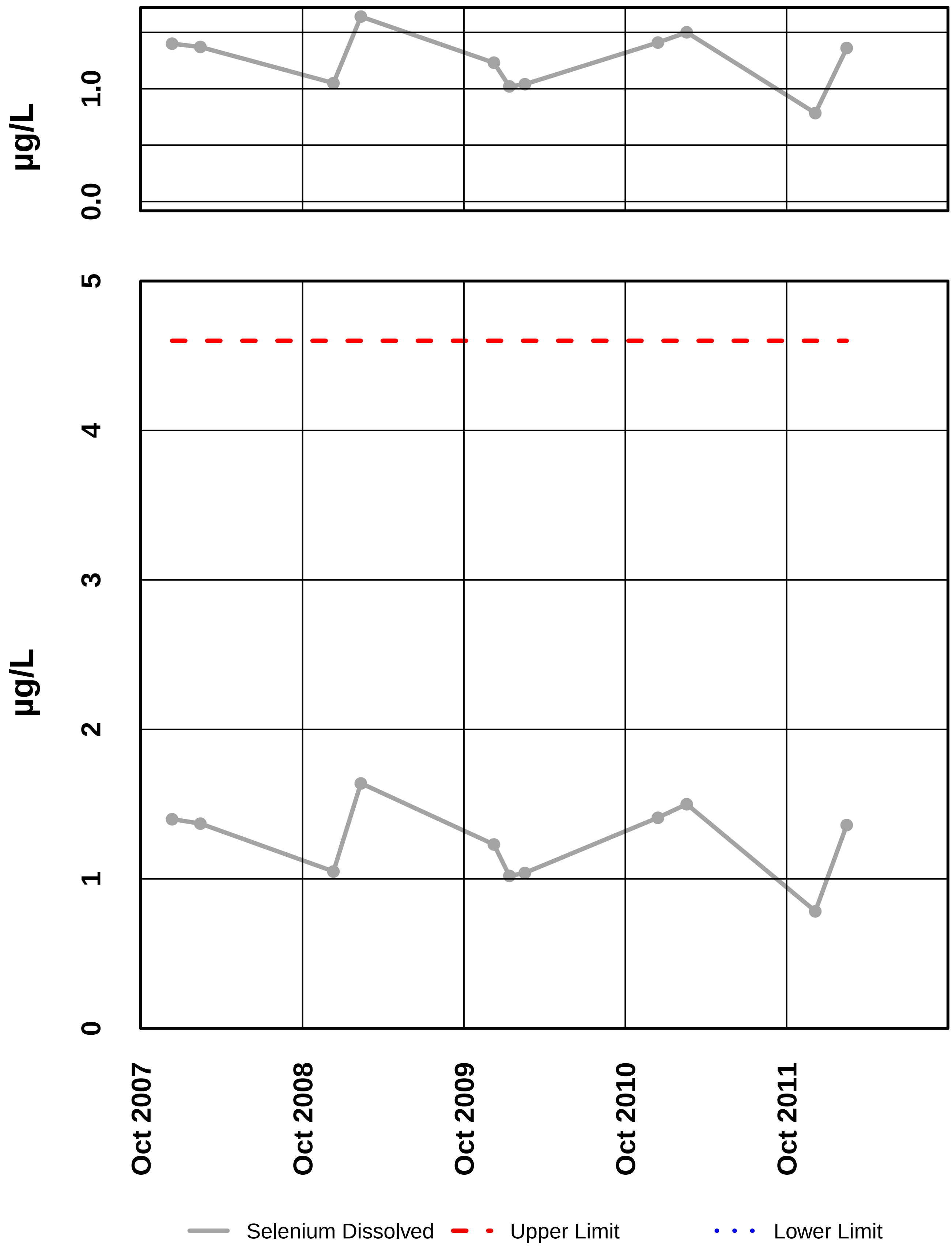


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

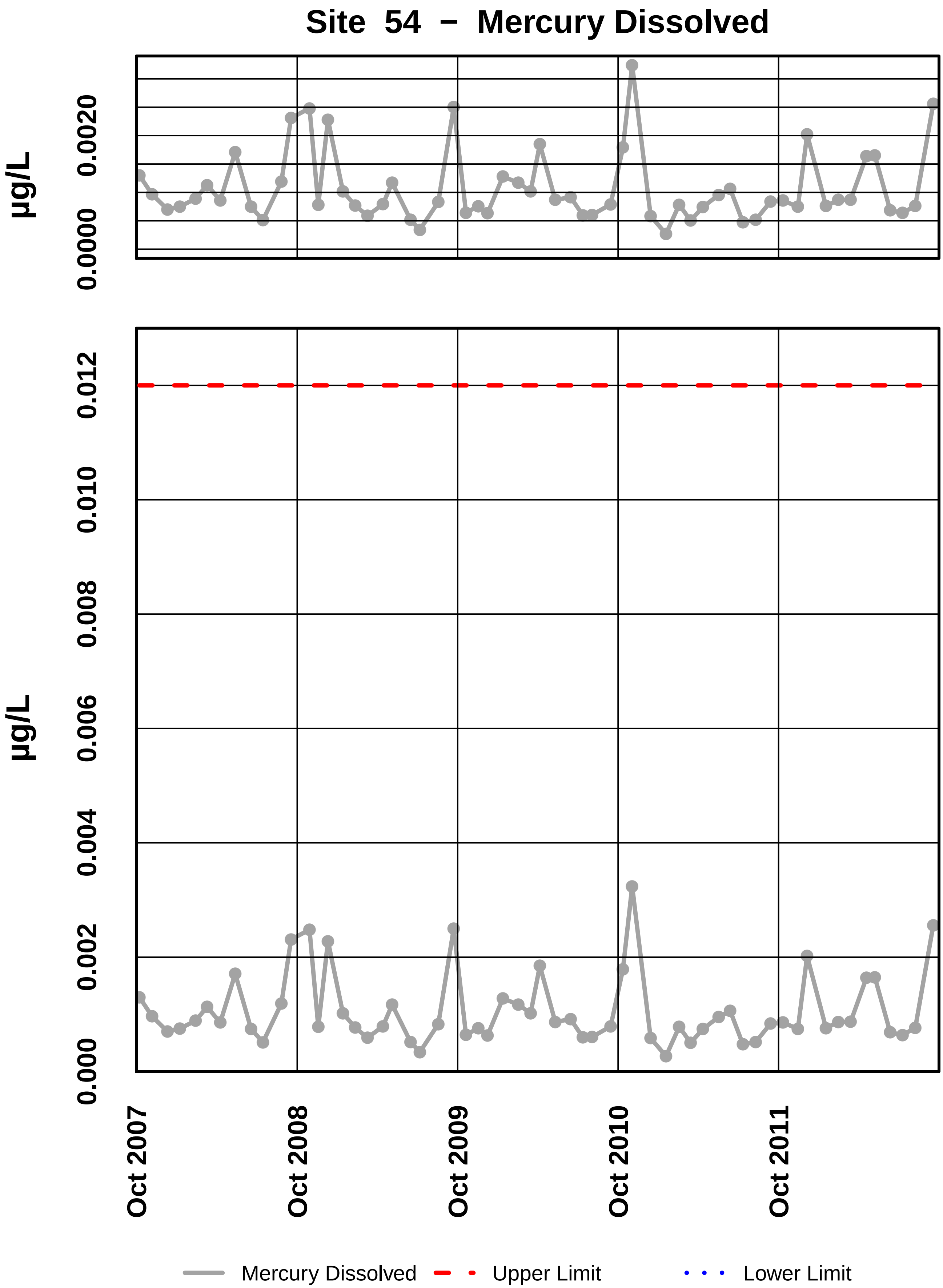


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 54 – Selenium Dissolved



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



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

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**	143	154.9	148.8	139.9	156.9	169.8	141.6	113.1	81.7	73.6	130.2	130.7
b	**WY2008**	113.4	138	158.8	164.3	153.7	170.6	152.3	91.6	90.6	89.1	93.2	92.5
c	**WY2009**	102.9	145.5	123.5	144.8	151.5	176.7	173.5	99.3	83.7	86.8	84.3	73.7
d	**WY2010**	135.5	119	157.3	100	140	153.1	142.3	111.3	88.3	96	104.8	130.5
e	**WY2011**	86.7	84.7	167	169	157	180	98.9	93.9	99	100	127	114
f	**WY2012**	109	130	99	140	138	173	116	108	87.1	87.8	93	95
	n	6	6	6	6	6	6	6	6	6	6	6	6

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

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

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

ΣZ_k= -3.38

ΣZ^2_k= 11.44

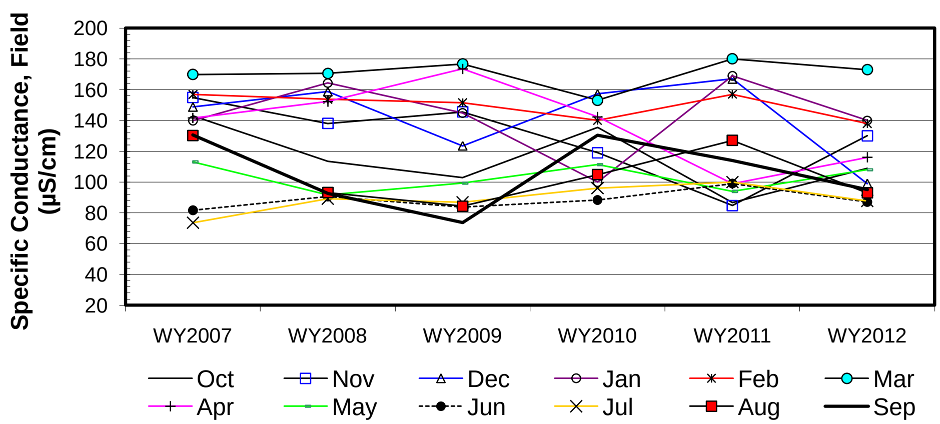
Z-bar=ΣZ_k/K= -0.28

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

Σn 72

ΣS_k -18

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	10.48	@α=5% $\chi^2_{(K-1)}$=	19.68	Test for station homogeneity	
p	**0.488**			$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
$\Sigma VAR(S_k)$ Z_{calc}	-0.92	@α/2=2.5% Z=	1.96	H_0 (No trend)	ACCEPT
340.00 **p**	**0.178**			H_A (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-5.05		1.11
0.050	-4.11	**-1.01**	0.63
0.100	-3.11		0.19
0.200	-2.28		-0.13

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**	7.9	7.7	7.7	7.6	7.4	8.0	7.7	7.6	7.4	7.4	7.8	7.2
b	**WY2008**	7.8	7.7	7.7	7.8	7.9	7.7	7.9	7.5	7.9	7.4	7.8	7.5
c	**WY2009**	7.1	7.7	7.7	7.3	7.8	7.2	7.0	7.1	6.9	6.6	6.7	6.9
d	**WY2010**	7.7	7.1	7.2	6.7	7.3	7.8	7.0	7.6	7.0	7.0	7.0	7.5
e	**WY2011**	6.8	7.6	7.7	7.5	7.7	7.4	7.4	7.3	6.9	7.9	7.5	7.8
f	**WY2012**	6.8	7.9	7.7	6.3	7.5	7.3	7.7	7.6	7.9	7.8	7.4	7.5
	n	6	6	6	6	6	6	6	6	6	6	6	6

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

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

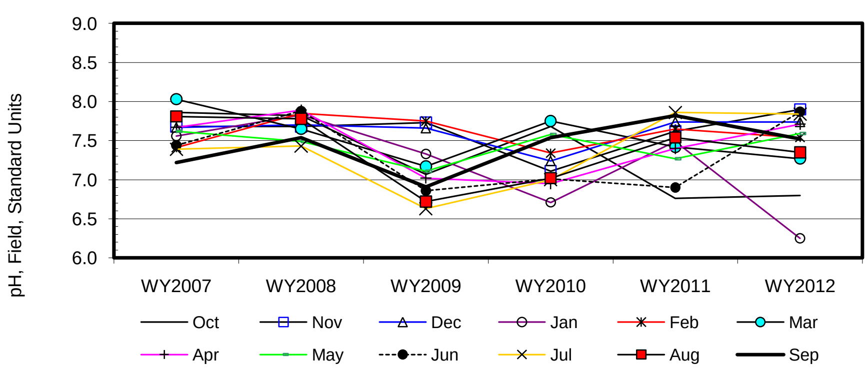
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	28.33	27.33	27.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	27.33
$Z_k = S_k/\sigma_S$	-2.07	0.38	0.77	-1.69	-0.56	-1.32	-0.19	-0.19	-0.19	0.94	-0.94	0.77
Z^2_k	4.27	0.15	0.59	2.86	0.32	1.73	0.04	0.04	0.04	0.88	0.88	0.59

ΣZ_k= -4.29
ΣZ^2_k= 12.36
Z-bar=ΣZ_k/K= -0.36

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

Σn 72
ΣS_k -23

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	10.83	@α=5% $\chi^2_{(K-1)}$= 19.68	Test for station homogeneity	
p	**0.457**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k) Z_{calc}	-1.20	@$\alpha/2$=2.5% Z= 1.96	H_0 (No trend)	ACCEPT
337.00 **p**	**0.115**		H_A (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.09		0.03
0.050	-0.08	**-0.02**	0.01
0.100	-0.07		0.00
0.200	-0.06		-0.01

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**	44.0	49.4	48.1	47.8	52.6	51.3	44.0	38.0	31.2	27.4	44.0	45.7
b	**WY2008**	40.6	45.9	52.4	55.5	49.6	51.6	54.6	33.8	33.1	33.0	59.5	34.6
c	**WY2009**	31.1	46.6	39.1	45.8	52.2	54.4	54.7	34.7	29.7	34.7	34.3	32.6
d	**WY2010**	45.9	45.7	52.0	41.3	43.1	47.2	45.5	37.8	33.2	34.7	39.1	49.2
e	**WY2011**	30.4	25.4	53.3	53.5	48.9	56.9	53.1	35.5	34.0	35.8	46.7	47.6
f	**WY2012**	47.7	51.2	31.8	54.1	54.4	55.9	37.0	39.0	34.4	33.6	31.6	38.7
	n	6	6	6	6	6	6	6	6	6	6	6	6

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

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a	-1	-1	1	1	-1	1	1	-1	1	1	1	-1
c-a	-1	-1	-1	-1	-1	1	1	-1	-1	1	-1	-1
d-a	1	-1	1	-1	-1	-1	1	-1	1	1	-1	1
e-a	-1	-1	1	1	-1	1	1	-1	1	1	1	1
f-a	1	1	-1	1	1	1	-1	1	1	1	-1	-1
c-b	-1	1	-1	-1	1	1	1	1	-1	1	-1	-1
d-b	1	-1	-1	-1	-1	-1	-1	1	1	1	-1	1
e-b	-1	-1	1	-1	-1	1	-1	1	1	1	-1	1
f-b	1	1	-1	-1	1	1	-1	1	1	1	-1	1
d-c	1	-1	1	-1	-1	-1	-1	1	1	0	1	1
e-c	-1	-1	1	1	-1	1	-1	1	1	1	1	1
f-c	1	1	-1	1	1	1	-1	1	1	-1	-1	1
e-d	-1	-1	1	1	1	1	1	-1	1	1	1	-1
f-d	1	1	-1	1	1	1	-1	1	1	-1	-1	-1
f-e	1	1	-1	1	1	-1	-1	1	1	-1	-1	-1
S_k	1	-3	-1	1	-1	7	-3	5	11	8	-5	1

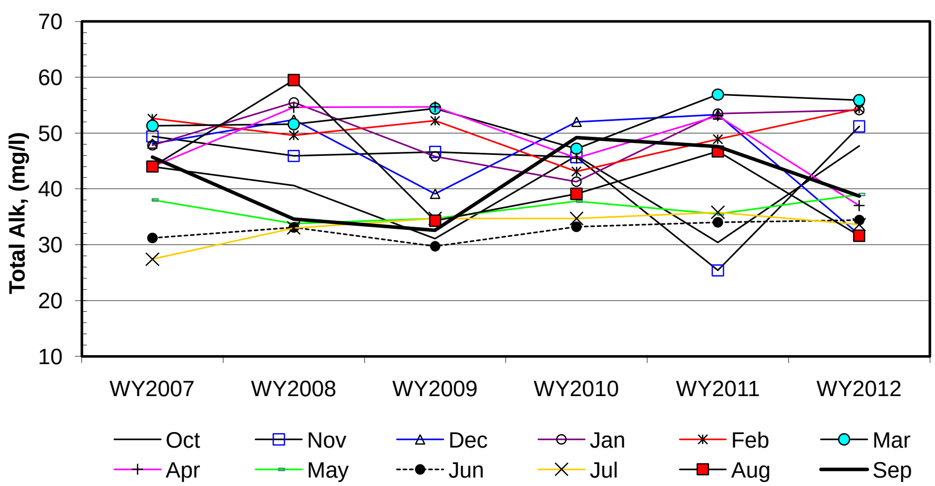
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	27.33	28.33	28.33
$Z_k = S_k/\sigma_S$	0.19	-0.56	-0.19	0.19	-0.19	1.32	-0.56	0.94	2.07	1.53	-0.94	0.19
Z^2_k	0.04	0.32	0.04	0.04	0.04	1.73	0.32	0.88	4.27	2.34	0.88	0.04

ΣZ_k= 3.97
ΣZ^2_k= 10.92
Z-bar=ΣZ_k/K= 0.33

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

Σn 72
ΣS_k 21

$\chi^2_h=\Sigma Z^2_k$-K(Z-bar)^2=	9.60	@α=5% $\chi^2_{(K-1)}$= 19.68	Test for station homogeneity	
p	**0.566**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc} 1.09	@α/2=2.5% Z= 1.96	**H_0** (No trend)	ACCEPT
339.00	p **0.861**		**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.64		0.90
0.050	-0.25	**0.38**	0.70
0.100	-0.09		0.64
0.200	0.11		0.59

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**	12.6	17.5	17.1	18.0	20.5	21.6	16.2	10.1	6.0	5.7	12.9	14.1
b	**WY2008**	13.0	13.3	18.2	23.0	21.5	20.1	22.7	8.5	7.6	8.4	8.8	7.7
c	**WY2009**	9.7	17.4	16.3	18.0	21.0	24.8	25.4	10.0	8.0	10.0	11.8	8.7
d	**WY2010**	15.2	18.7	19.9	15.0	16.4	19.1	19.7	10.7	9.6	10.1	11.9	16.0
e	**WY2011**	8.9	8.9	24.1	25.0	22.4	26.8	25.8	8.7	10.6	11.2	15.3	16.5
f	**WY2012**	15.5	18.3	10.5	25.0	23.2	23.8	12.2	10.9	7.8	8.4	8.6	9.0
	n	6	6	6	6	6	6	6	6	6	6	6	6

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

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

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	28.33	28.33	28.33	26.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33
$Z_k = S_k/\sigma_S$	0.56	0.19	0.19	0.97	1.32	0.56	0.19	0.94	1.69	1.32	-0.19	0.94
Z^2_k	0.32	0.04	0.04	0.95	1.73	0.32	0.04	0.88	2.86	1.73	0.04	0.88

ΣZ_k= 8.68

ΣZ^2_k= 9.81

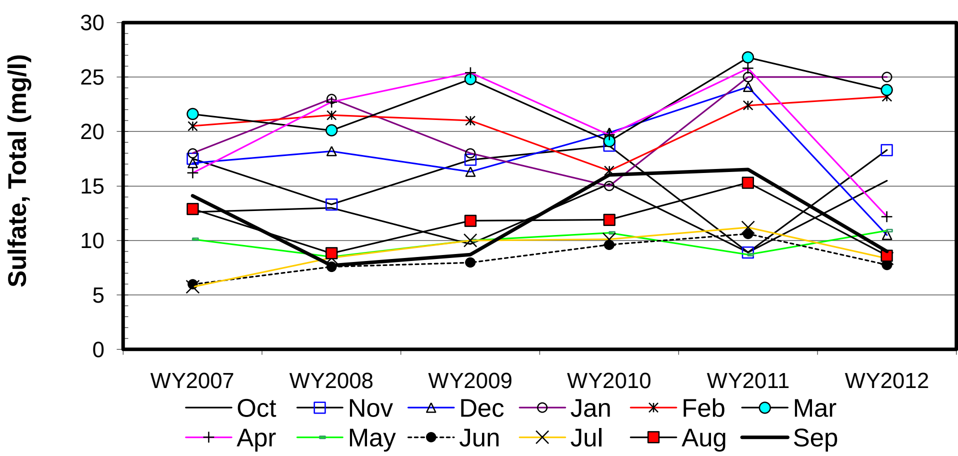
Z-bar=ΣZ_k/K= 0.72

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

Σn 72

ΣS_k 46

$\chi^2_h=\Sigma Z^2_k$-K(Z-bar)^2=	3.53	@α=5% $\chi^2_{(K-1)}$= 19.68	Test for station homogeneity
p	**0.982**		$\chi^2_h<\chi^2_{(K-1)}$ ACCEPT
ΣVAR(S_k)	Z_{calc} 2.45	@α=2.5% Z= 1.96	**H_0** (No trend) REJECT
338.00	p **0.993**		**H_A** (± trend) ACCEPT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	0.03		0.93
0.050	0.14	**0.46**	0.70
0.100	0.20		0.63
0.200	0.30		0.60
		3.0%	

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**	3.5	3.9	4.0	5.8	4.1	5.1	9.5	8.4	3.0	3.0	3.9	3.3
b	**WY2008**	9.7	9.3	7.1	5.7	7.0	11.0	15.0	8.4	3.3	3.4	7.3	11.3
c	**WY2009**	14.6	7.9	11.8	7.3	7.3	5.6	12.8	7.9	3.6	2.7	10.0	11.4
d	**WY2010**	6.2	9.2	8.4	5.9	7.9	8.5	10.6	4.1	3.6	4.0	3.6	4.3
e	**WY2011**	7.5	11.8	6.9	6.5	9.3	6.5	10.5	3.8	3.7	3.7	4.2	7.0
f	**WY2012**	7.3	10.3	13.2	10.2	9.0	7.8	11.1	9.9	4.1	4.5	4.7	5.9
	n	6	6	6	6	6	6	6	6	6	6	6	6

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

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a	1	1	1	-1	1	1	1	-1	1	1	1	1
c-a	1	1	1	1	1	1	1	-1	1	-1	1	1
d-a	1	1	1	1	1	1	1	-1	1	1	-1	1
e-a	1	1	1	1	1	1	1	-1	1	1	1	1
f-a	1	1	1	1	1	1	1	1	1	1	1	1
c-b	1	-1	1	1	1	-1	-1	-1	1	-1	1	1
d-b	-1	-1	1	1	1	-1	-1	-1	1	1	-1	-1
e-b	-1	1	-1	1	1	-1	-1	-1	1	1	-1	-1
f-b	-1	1	1	1	1	-1	-1	1	1	1	-1	-1
d-c	-1	1	-1	-1	1	1	-1	-1	-1	1	-1	-1
e-c	-1	1	-1	-1	1	1	-1	-1	1	1	-1	-1
f-c	-1	1	1	1	1	1	-1	1	1	1	-1	-1
e-d	1	1	-1	1	1	-1	-1	-1	1	-1	1	1
f-d	1	1	1	1	1	-1	1	1	1	1	1	1
f-e	-1	-1	1	1	-1	1	1	1	1	1	1	-1
S_k	1	9	7	9	13	3	-1	-5	13	9	1	1

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33
$Z_k = S_k/\sigma_S$	0.19	1.69	1.32	1.69	2.44	0.56	-0.19	-0.94	2.44	1.69	0.19	0.19
Z^2_k	0.04	2.86	1.73	2.86	5.96	0.32	0.04	0.88	5.96	2.86	0.04	0.04

ΣZ_k= 11.27

ΣZ^2_k= 23.58

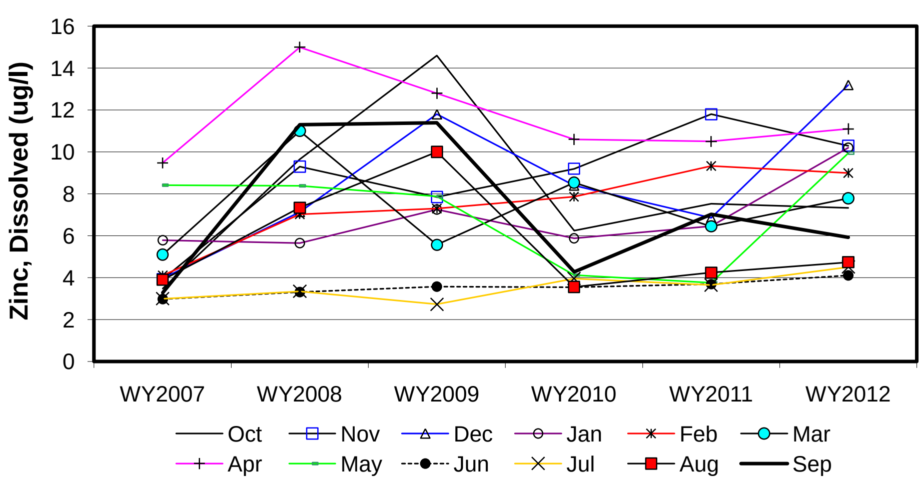
Z-bar=$\Sigma Z_k/K$= 0.94

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

Σn 72

ΣS_k 60

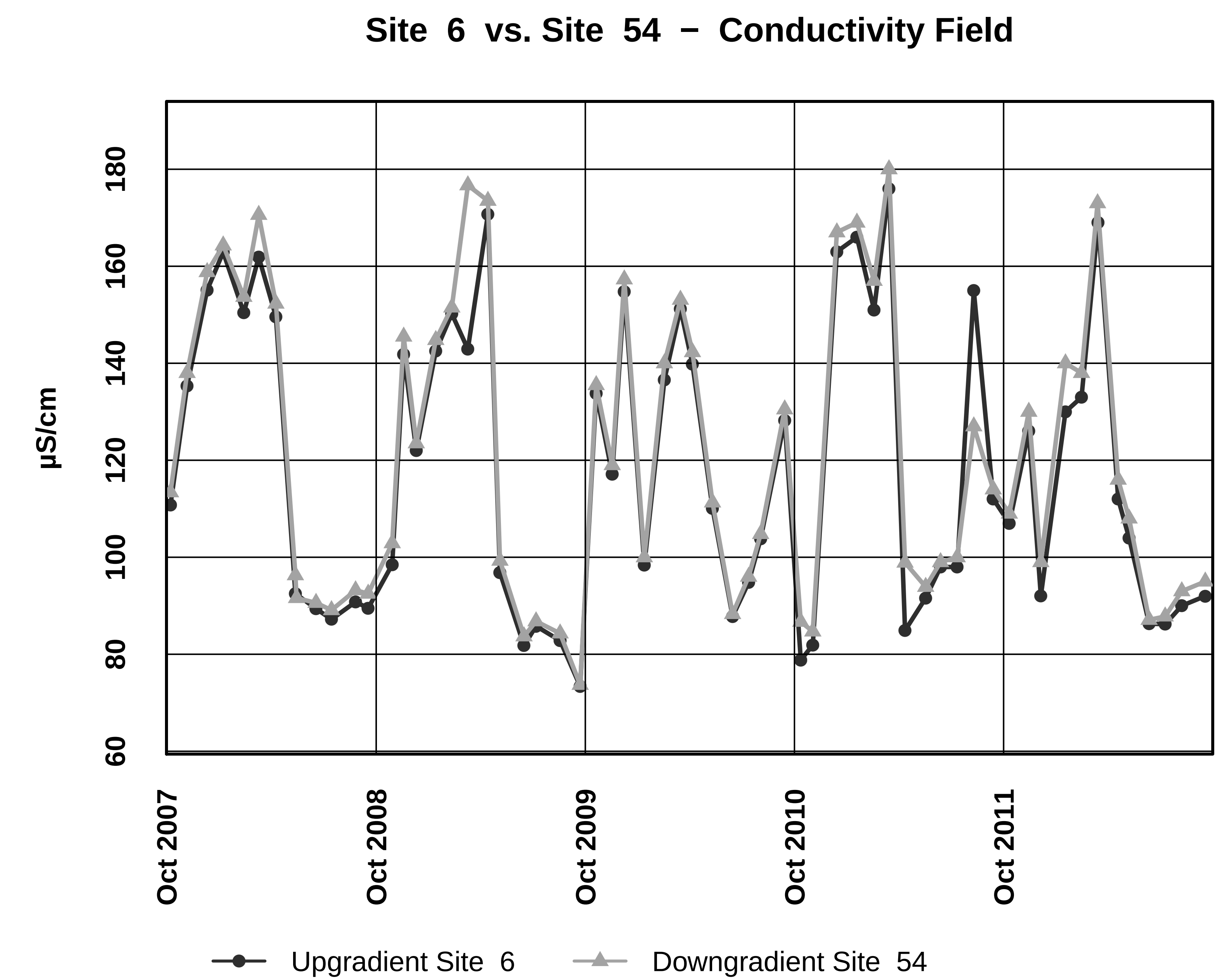
$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	12.99	@α=5% $\chi^2_{(K-1)}$= 19.68	Test for station homogeneity	
p	**0.294**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k) Z_{calc}	3.20	@$\alpha/2$=2.5% Z= 1.96	**H_0** (No trend)	REJECT
340.00 **p**	**0.999**		**H_A** (± trend)	ACCEPT

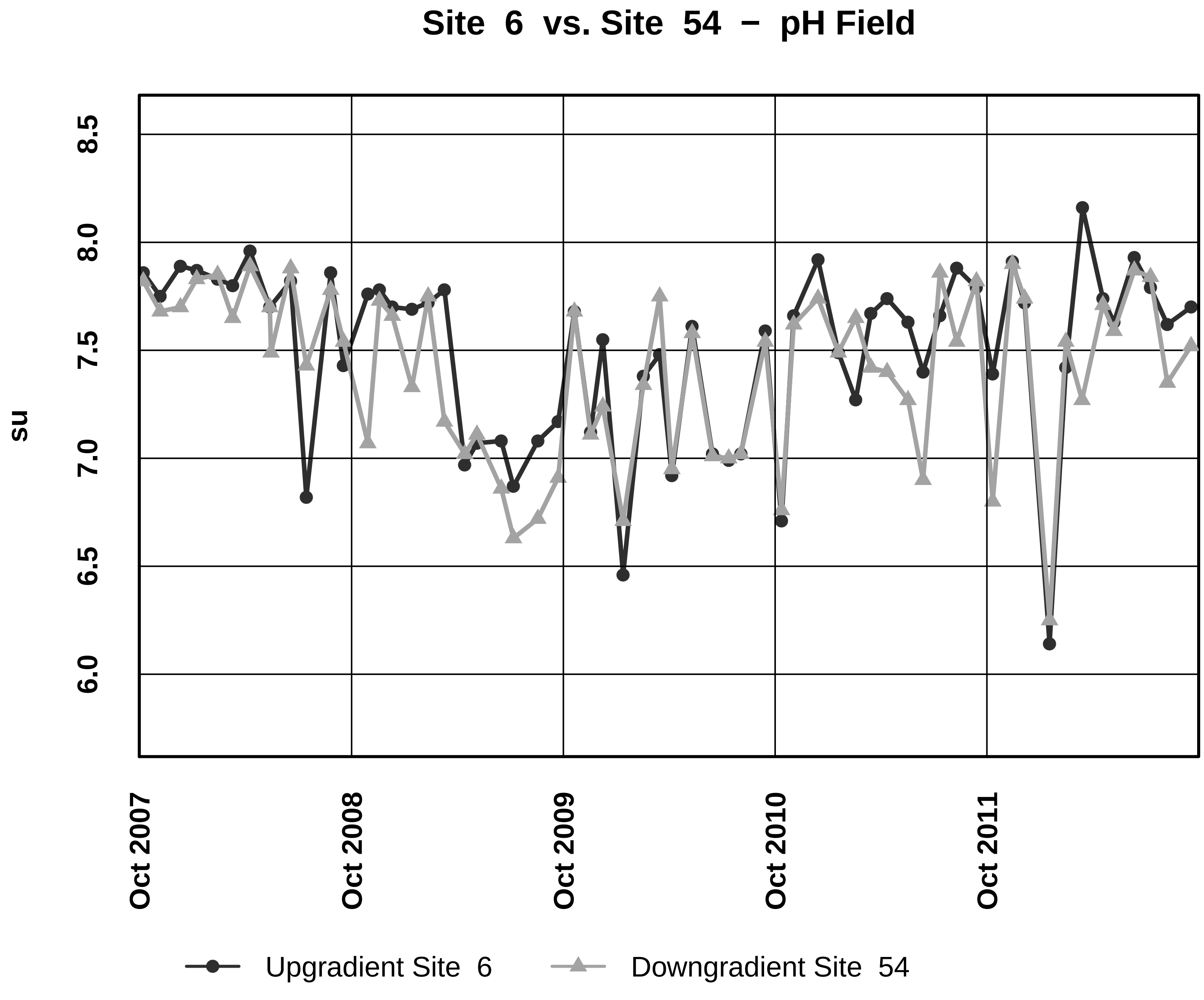


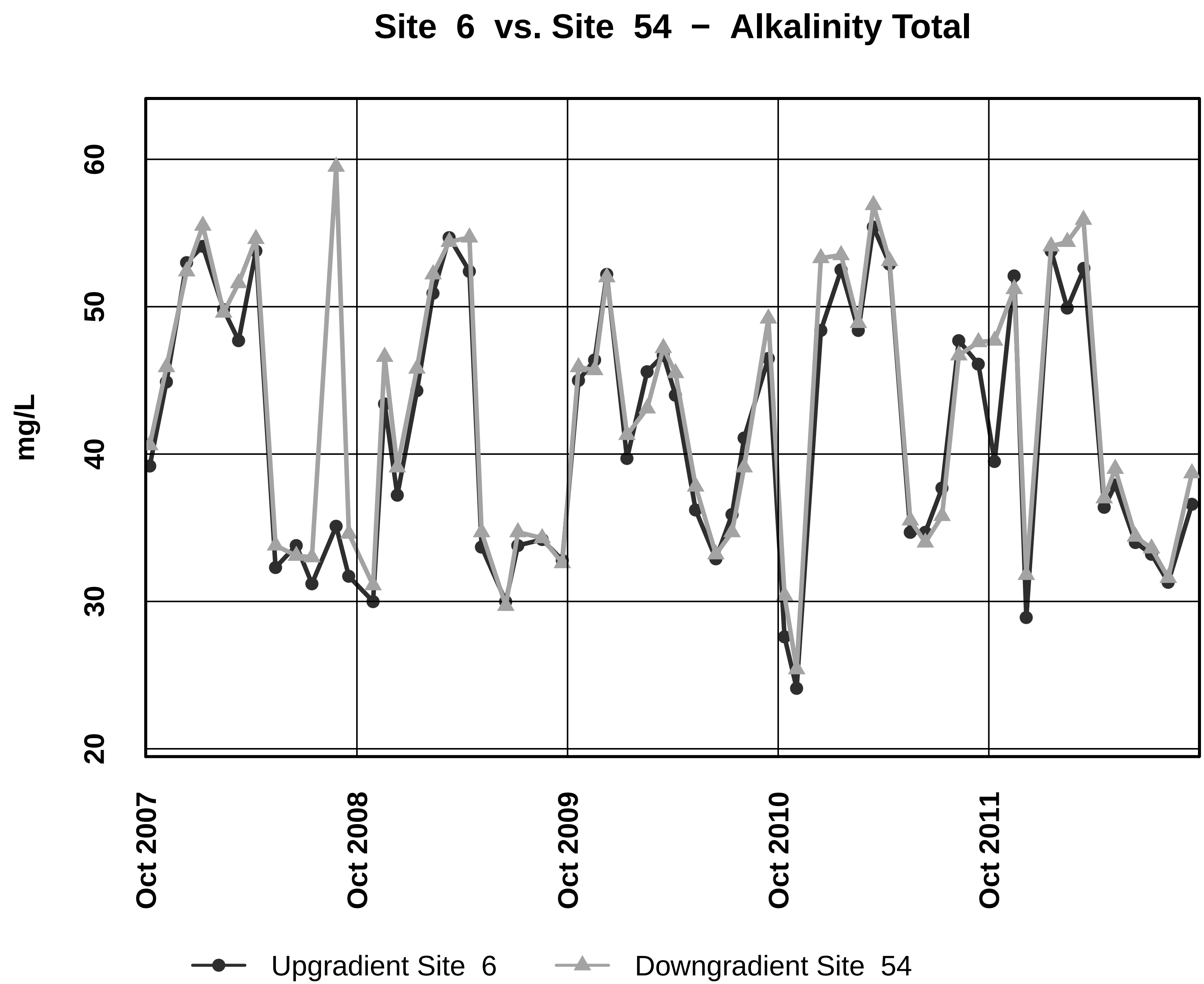
Seasonal-Kendall Slope Confidence Intervals

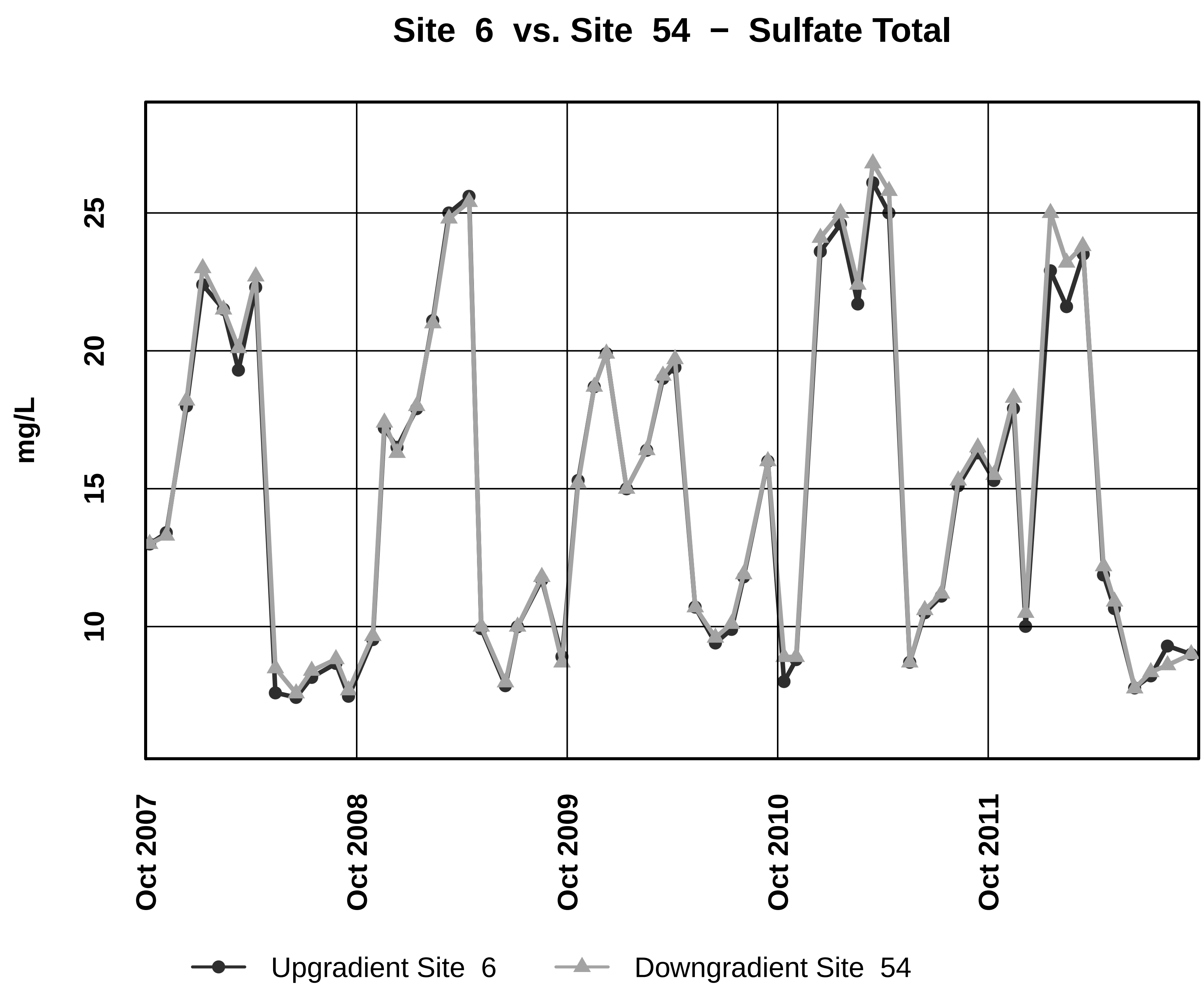
α	Lower Limit	Sen's Slope	Upper Limit
0.010	0.13		0.56
0.050	0.19	**0.30**	0.49
0.100	0.24		0.44
0.200	0.26		0.37

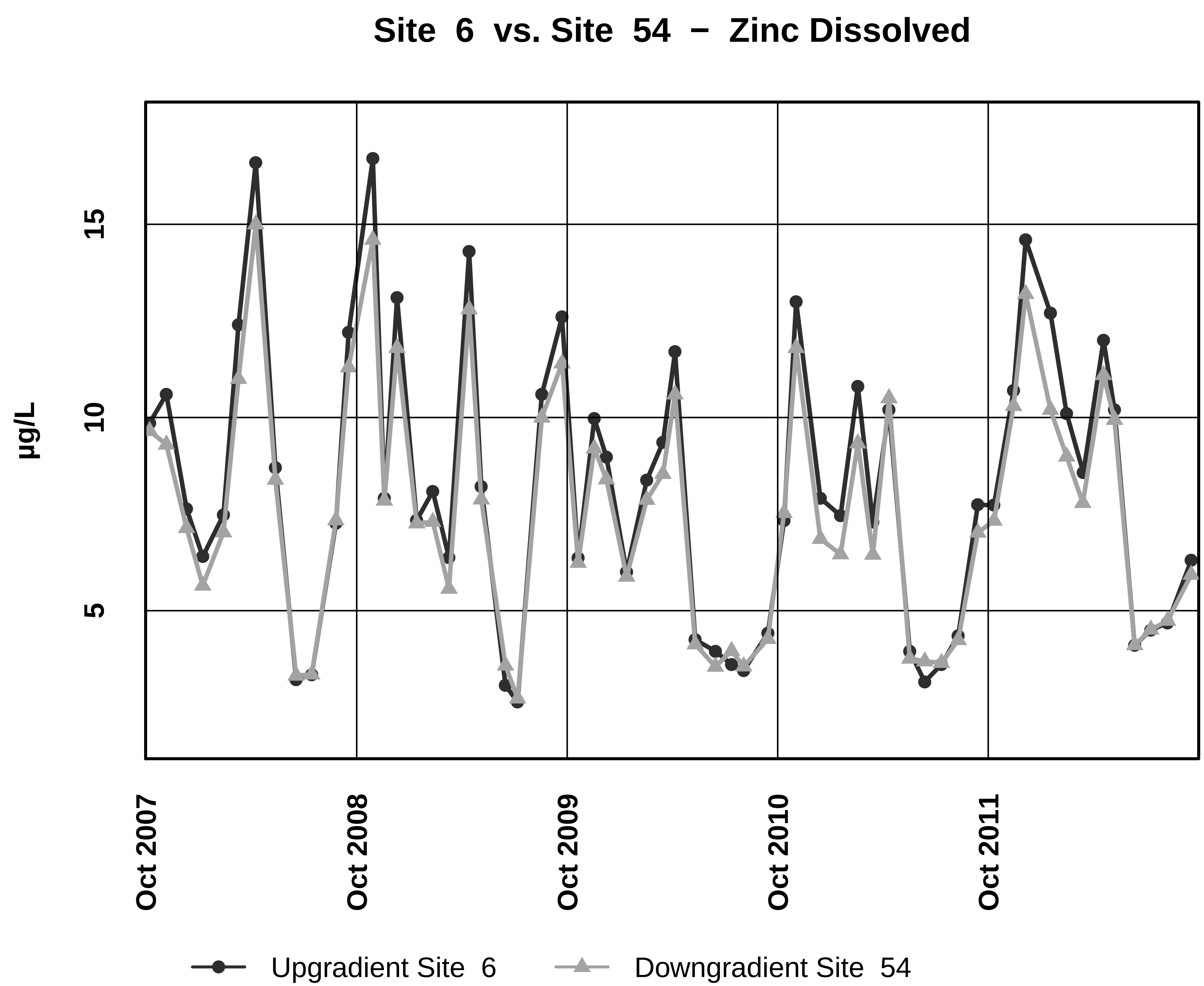
4.3%


Site 6 vs. Site 54 − Conductivity Field
µS/cm
60
80
100
120
140
160
180
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 6
Downgradient Site 54


Site 6 vs. Site 54 − pH Field
su
8.5
8.0
7.5
7.0
6.5
6.0
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 6
Downgradient Site 54


Site 6 vs. Site 54 − Alkalinity Total
mg/L
60
50
40
30
20
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 6
Downgradient Site 54


Site 6 vs. Site 54 − Sulfate Total
mg/L
10
15
20
25
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 6
Downgradient Site 54



Site 6 vs. Site 54 − Zinc Dissolved
µg/L
5
10
15
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
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	WY2012	WY2012	**D**	**|D|**	**Rank**
Oct	107.0	109.0	-2.0	2.0	-3
Nov	126.0	130.0	-4.0	4.0	-7.5
Dec	92.0	99.0	-7.0	7.0	-11
Jan	130.0	140.0	-10.0	10.0	-12
Feb	133.0	138.0	-5.0	5.0	-10
Mar	169.0	173.0	-4.0	4.0	-7.5
Apr	112.0	116.0	-4.0	4.0	-7.5
May	104.0	108.0	-4.0	4.0	-7.5
Jun	86.3	87.1	-0.8	0.8	-1
Jul	86.2	87.8	-1.6	1.6	-2
Aug	90.0	93.0	-3.0	3.0	-4.5
Sep	92.0	95.0	-3.0	3.0	-4.5
Median	105.5	108.5	-4.0	4.0	

n	**m**
12	12

N= 12

$\Sigma R =$ -78

α
5.0%
W'$_{\alpha,n}$
17

$W^+ =$
0
p-test
0.000

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

Wilcoxon-signed-ranks test
Exact Form

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

	X	Y	Differences		
Site	#6	#54			
Year	WY2012	WY2012	**D**	**|D|**	**Rank**
Oct	7.39	6.80	0.59	0.59	11
Nov	7.91	7.90	0.01	0.01	1
Dec	7.72	7.74	-0.02	0.02	-2
Jan	6.14	6.25	-0.11	0.11	-7
Feb	7.42	7.54	-0.12	0.12	-8
Mar	8.16	7.27	0.89	0.89	12
Apr	7.74	7.71	0.03	0.03	3
May	7.63	7.59	0.04	0.04	4
Jun	7.93	7.87	0.06	0.06	6
Jul	7.79	7.84	-0.05	0.05	-5
Aug	7.62	7.35	0.27	0.27	10
Sep	7.70	7.52	0.18	0.18	9
Median	7.71	7.57	0.04	0.08	

n	**m**
12	12

N= 12
ΣR= 34

α
95.0%
W'α,n
59

W^{+}=
56
p-test
0.912

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	#6	#54			
Year	WY2012	WY2012	**D**	**|D|**	**Rank**
Oct	39.5	47.7	-8.2	8.2	-12
Nov	52.1	51.2	0.9	0.9	6
Dec	28.9	31.8	-2.9	2.9	-9
Jan	53.8	54.1	-0.3	0.3	-1.5
Feb	49.9	54.4	-4.5	4.5	-11
Mar	52.6	55.9	-3.3	3.3	-10
Apr	36.4	37.0	-0.6	0.6	-5
May	37.9	39.0	-1.1	1.1	-7
Jun	34.0	34.4	-0.4	0.4	-3.5
Jul	33.2	33.6	-0.4	0.4	-3.5
Aug	31.3	31.6	-0.3	0.3	-1.5
Sep	36.6	38.7	-2.1	2.1	-8
Median	37.3	38.9	-0.9	1.0	

n	**m**
12	12

N= 12
ΣR= -66

α
95.0%
W'$_{\alpha,n}$
59

W^+=
6
p-test
0.003

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

Wilcoxon-signed-ranks test
Exact Form

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

	X	**Y**			
Site	#6	#54	Differences		
Year	WY2012	WY2012	**D**	**|D|**	**Rank**
Oct	15.3	15.5	-0.2	0.2	-3
Nov	17.9	18.3	-0.4	0.4	-7
Dec	10.0	10.5	-0.5	0.5	-8
Jan	22.9	25.0	-2.1	2.1	-11
Feb	21.6	23.2	-1.6	1.6	-10
Mar	23.5	23.8	-0.3	0.3	-5
Apr	11.9	12.2	-0.3	0.3	-6
May	10.7	10.9	-0.3	0.3	-4
Jun	7.8	7.8	0.0	0.0	1
Jul	8.2	8.4	-0.1	0.1	-2
Aug	9.3	8.6	0.7	0.7	9
Sep	9.0	9.0	0.0		
Median	11.3	11.6	-0.3	0.3	

n	**m**
12	11

N= 11
$\Sigma R=$ -46

α
5.0%
W'$_{\alpha,n}$
13

$W^{+}=$
10
p-test
0.021

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	#6	#54	Differences		
Year	WY2012	WY2012	**D**	**|D|**	**Rank**
Oct	7.73	7.33	0.40	0.40	7
Nov	10.70	10.30	0.40	0.40	6
Dec	14.60	13.20	1.40	1.40	11
Jan	12.70	10.20	2.50	2.50	12
Feb	10.10	8.99	1.11	1.11	10
Mar	8.57	7.79	0.78	0.78	8
Apr	12.00	11.10	0.90	0.90	9
May	10.20	9.94	0.26	0.26	4
Jun	4.10	4.11	-0.01	0.01	-2
Jul	4.50	4.51	-0.01	0.01	-1
Aug	4.68	4.74	-0.06	0.06	-3
Sep	6.30	5.93	0.37	0.37	5
Median	9.34	8.39	0.40	0.40	

n	**m**
12	12

N= 12
$\Sigma R=$ 66

α
5.0%
W'α,n
17

$W^+=$
72
p-test
0.998

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

INTERPRETIVE REPORT
SITE 49

The data collected during the current water year are listed in the following "Table of Results for Water Year 2012" report. The table includes all the required FWMP analyte data (field and laboratory) collected for the current water year and a series of flags keyed to the summary report "Qualified Data by QA Reviewer". The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of ½ MDL for the purpose of median calculation.

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

Sample Date	Parameter	Value	Qualifier	Notes
No outliers have been identified by HGCMC for the period of October 2007 through September 2012.				

The data for water year 2012 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 2012

			Limits		
Sample Date	Parameter	Value	Lower	Upper	Hardness
No exceedances have been identified by HGCMC for the period of October 2011 through September 2012.					

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

A non-parametric statistical analysis for trend was performed for specific conductivity, field pH, total alkalinity, total sulfate, and dissolved zinc. Calculation details of the Seasonal Kendall analyses are presented in detail on the pages following this interpretive section. The below table summarizes the results on the data collected between Oct-06 and Sep-12(WY2007-WY2012). For datasets with a statistically significant trend ($\alpha/2=2.5\%$) a Seasonal-Sen's Slope estimate statistic has also been calculated. There were no statistically significant trends detected during the current water year.

Table of Summary Statistics for Trend Analysis

	Mann-Kendall test statistics			Sen's slope estimate	
Parameter	**n***	**p****	**Trend**	**Q**	**Q(%)**
Conductivity Field	6	0.07			
pH Field	6	0.07			
Alkalinity, Total	6	0.40			
Sulfate, Total	6	0.03			
Zinc, Dissolved	6	0.06			

* Number of Years ** Significance level

Table of Results for Water Year 2012

Site 049FMS - 'Upper Bruin Creek'

Sample Date/Parameter	Oct 2011	Nov 2011	Dec 2011	Jan 2012	Feb 2012	Mar 2012	Apr 2012	May 2012	Jun 2012	Jul 2012	Aug 2012	Sep 2012	**Median**
Water Temp (°C)		0.9			0.9			3.2			10.1		2.1
Conductivity-Field(µmho)		141			150			145			130		143.0
Conductivity-Lab (µmho)		166			176			148			121		157
pH Lab (standard units)		7.79			6.88			6.97			6.31		6.93
pH Field (standard units)		8.02			7.78			7.99			7.97		7.98
Total Alkalinity (mg/L)		64.2			63.5			61.1			49.8		62.3
Total Sulfate (mg/L)		12.3			16.3			9.8			8.1		11.1
Hardness (mg/L)		80.1			87.9			68.3			61.9		74.2
Dissolved As (ug/L)		0.168			0.188			0.167			0.185		0.177
Dissolved Ba (ug/L)		10.5			12.3								11.4
Dissolved Cd (ug/L)		0.0317			0.0232			0.0291			0.0336		0.0304
Dissolved Cr (ug/L)		0.449			0.31								0.380
Dissolved Cu (ug/L)		0.58			0.522			0.493			0.724		0.551
Dissolved Pb (ug/L)		0.0113			0.0067			0.0045			0.0067		0.0067
Dissolved Ni (ug/L)		1.46			1.26								1.360
Dissolved Ag (ug/L)		0.002			0.002								0.002
Dissolved Zn (ug/L)		3.14			2.05			3.11			3.35		3.13
Dissolved Se (ug/L)		0.722			0.844								0.783
Dissolved Hg (ug/L)		0.00161			0.00144			0.00159			0.00226		0.001600

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.

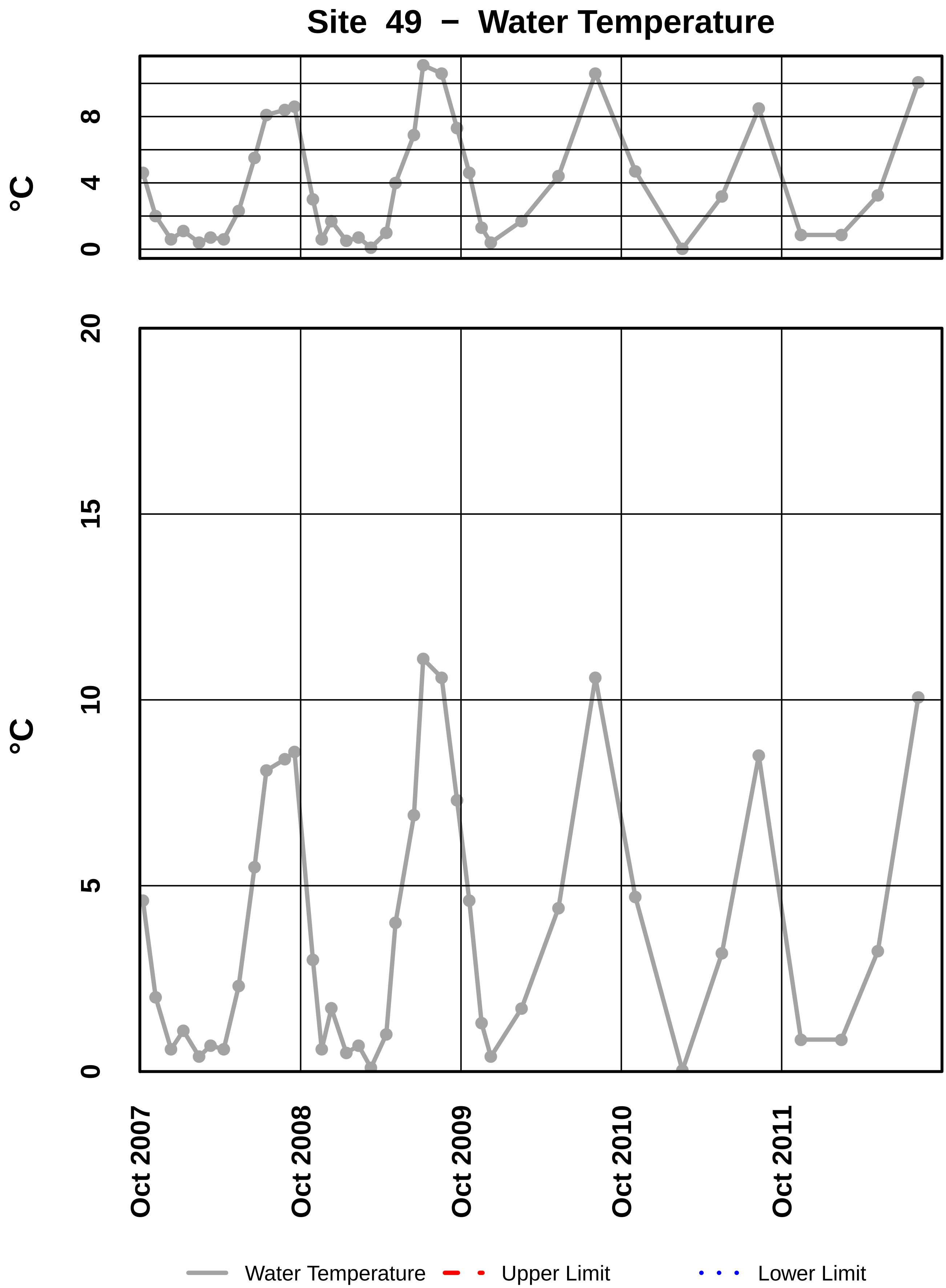
Shaded data has been qualified as an outlier by KGCMC and removed from any further analysis and is not included into the calculation of the median

Qualified Data by QA Reviewer

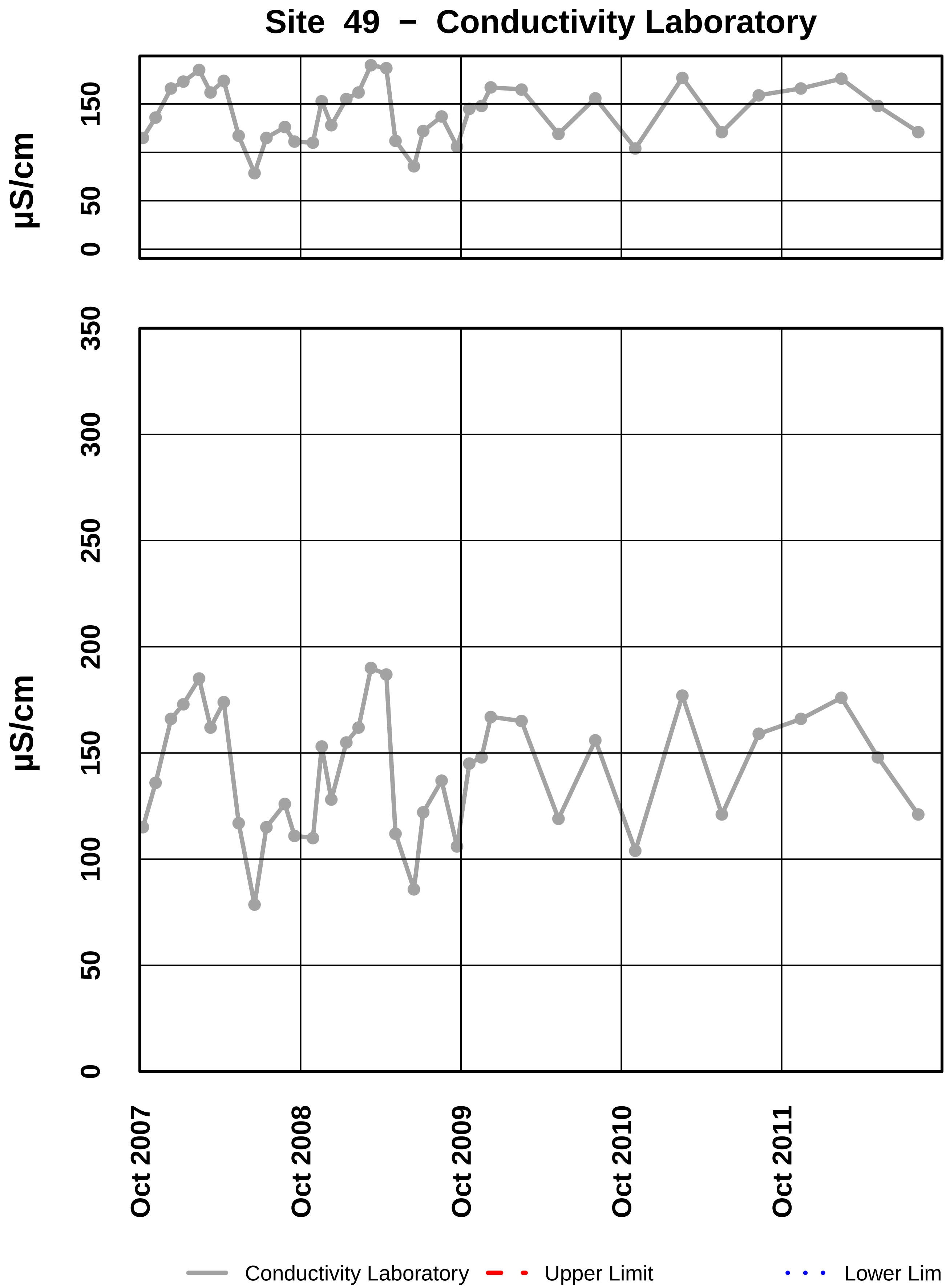
Date Range: 10/01/2011 to 09/30/2012

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
49	2/14/2012	12:00 AM	Cr diss, µg/l	0.31	U	Field Blank Contamination
			Pb diss, µg/l	0.00673	U	Field Blank Contamination
49	5/7/2012	12:00 AM	Pb diss, µg/l	0.00446	U	Field Blank Contamination
			SO4 Tot, mg/l	9.79	J	Sample Receipt Temperature
49	8/7/2012	12:00 AM	As diss, µg/l	0.18	J	LCS Recovery
			Pb diss, µg/l	0.00667	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

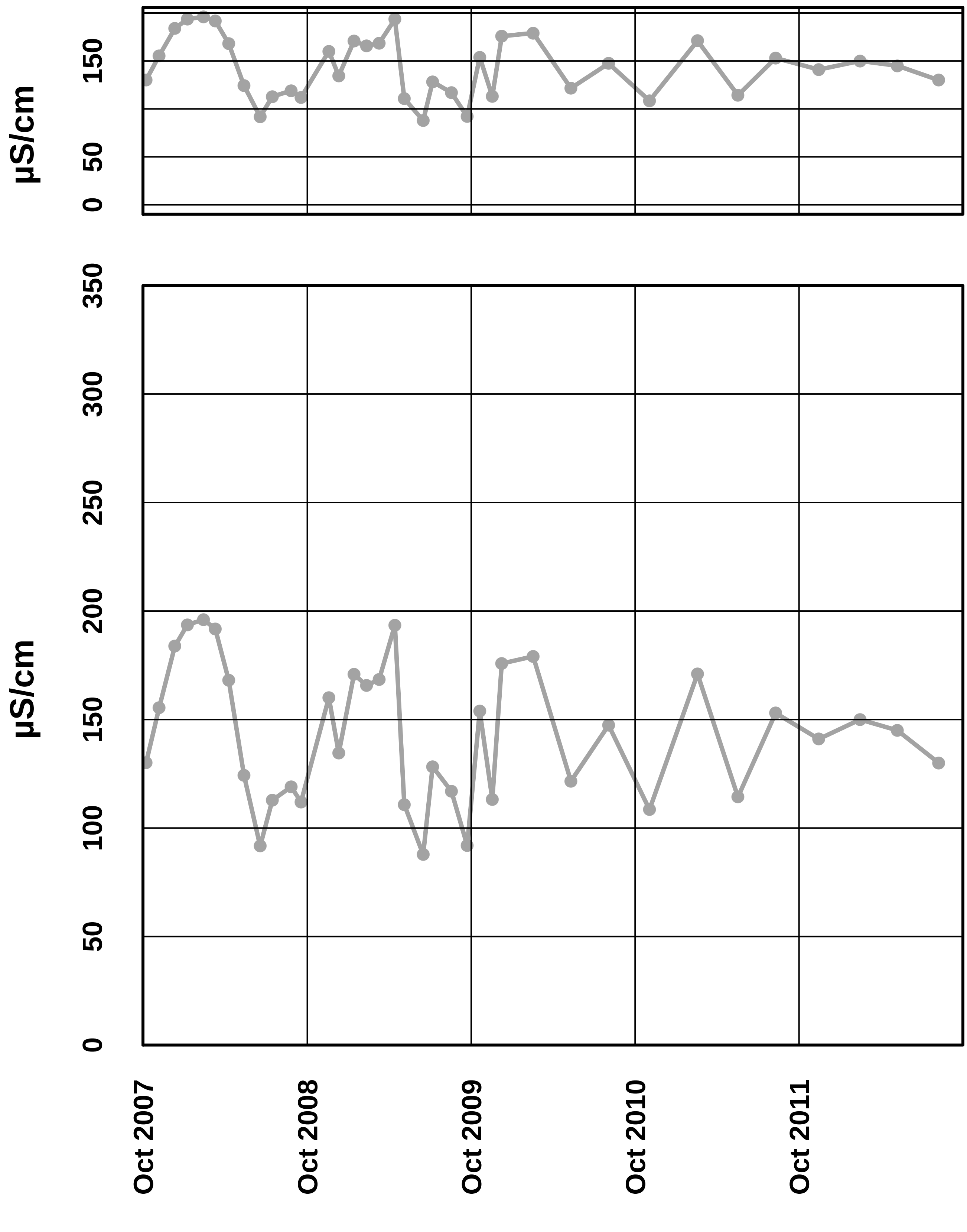


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

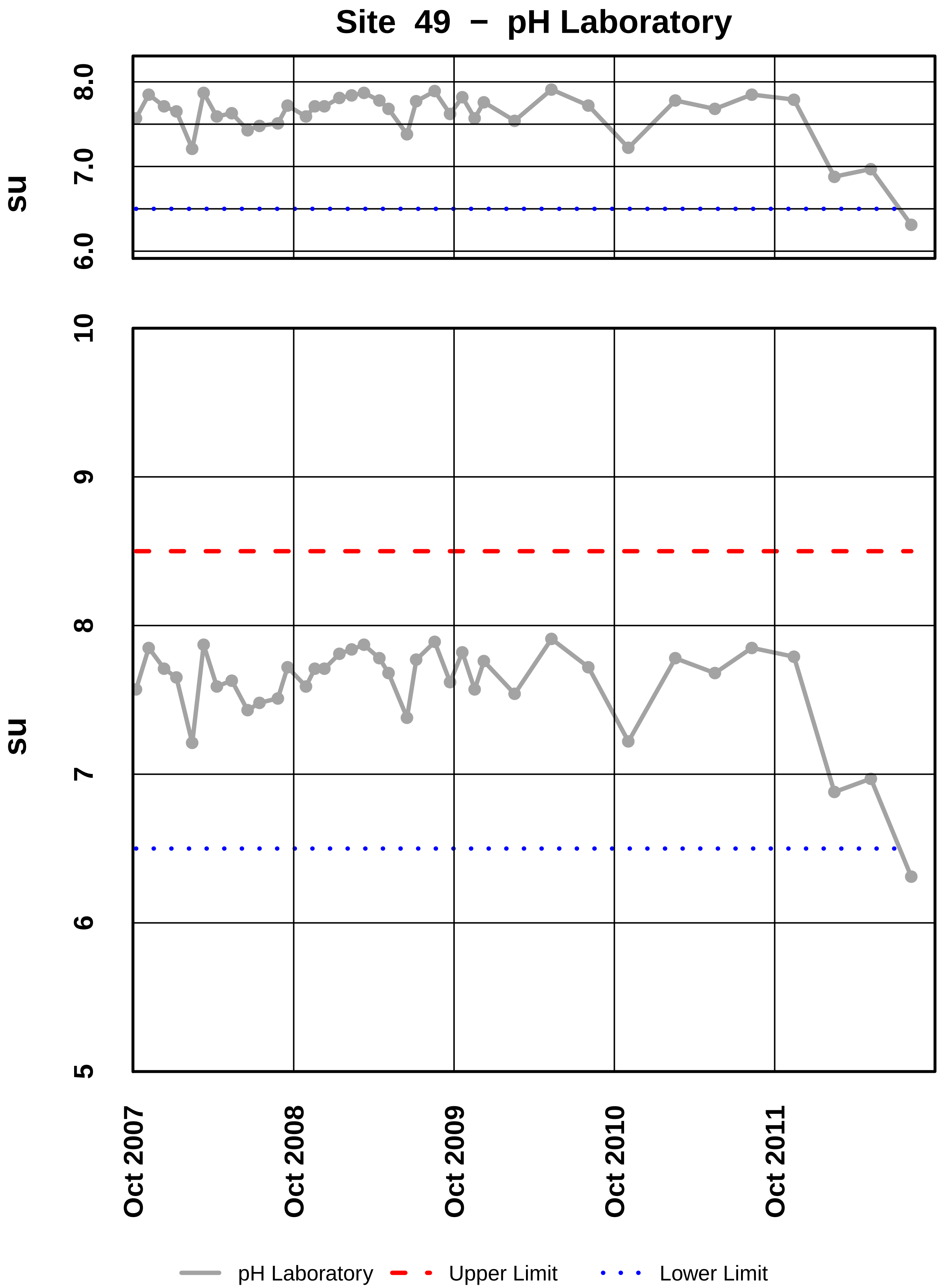


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 49 – Conductivity Field

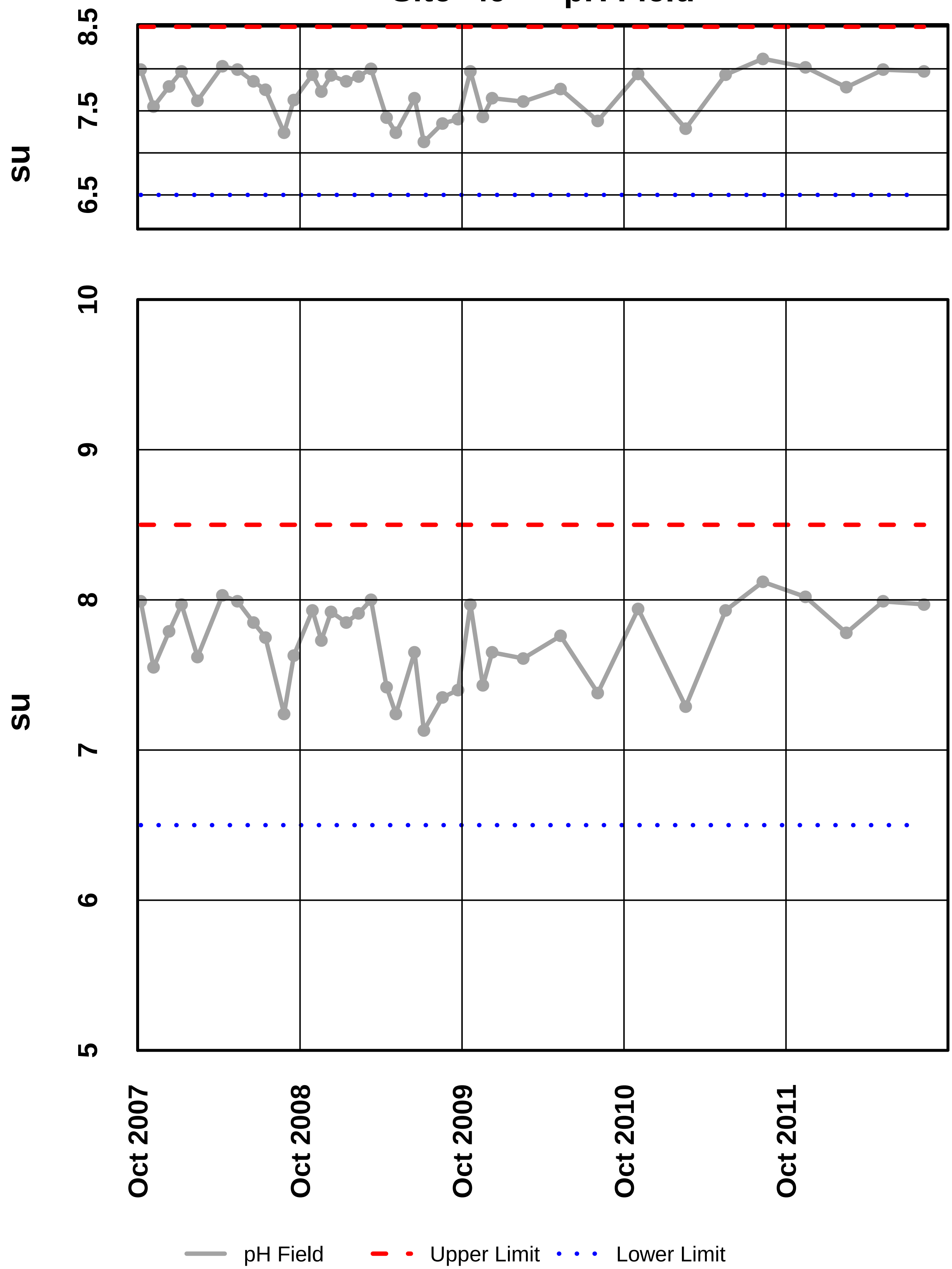


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



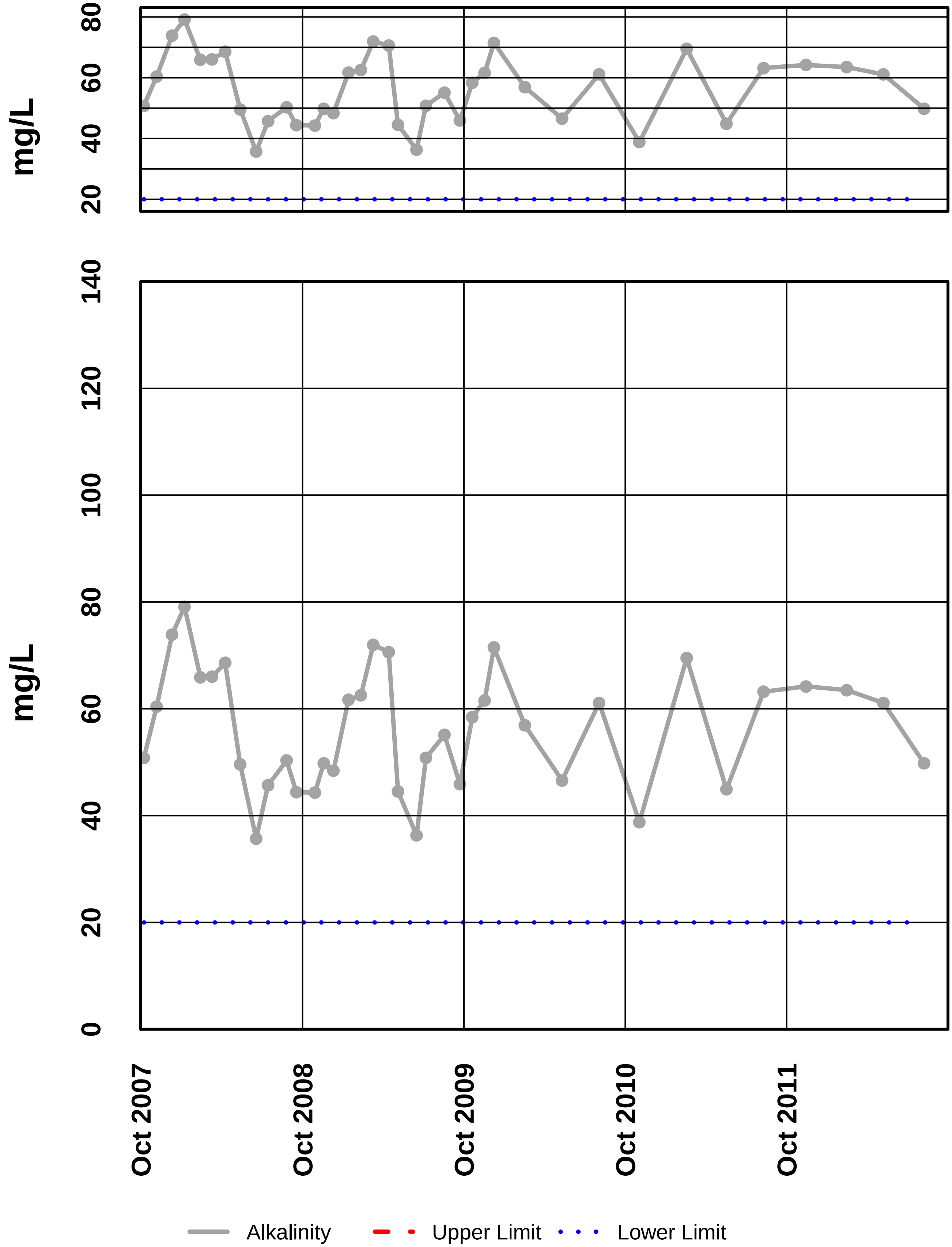
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 49 – pH Field



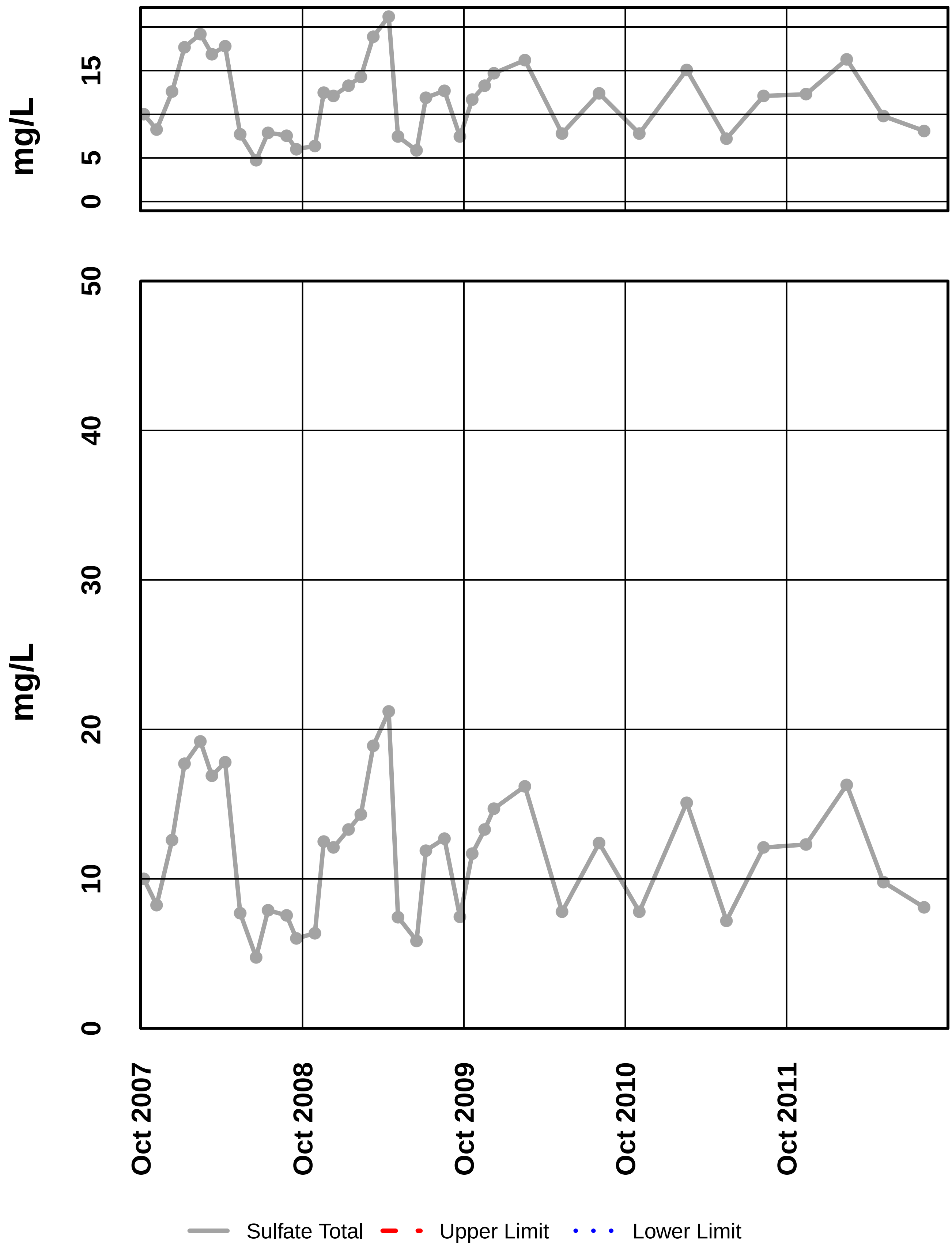
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 49 − Alkalinity

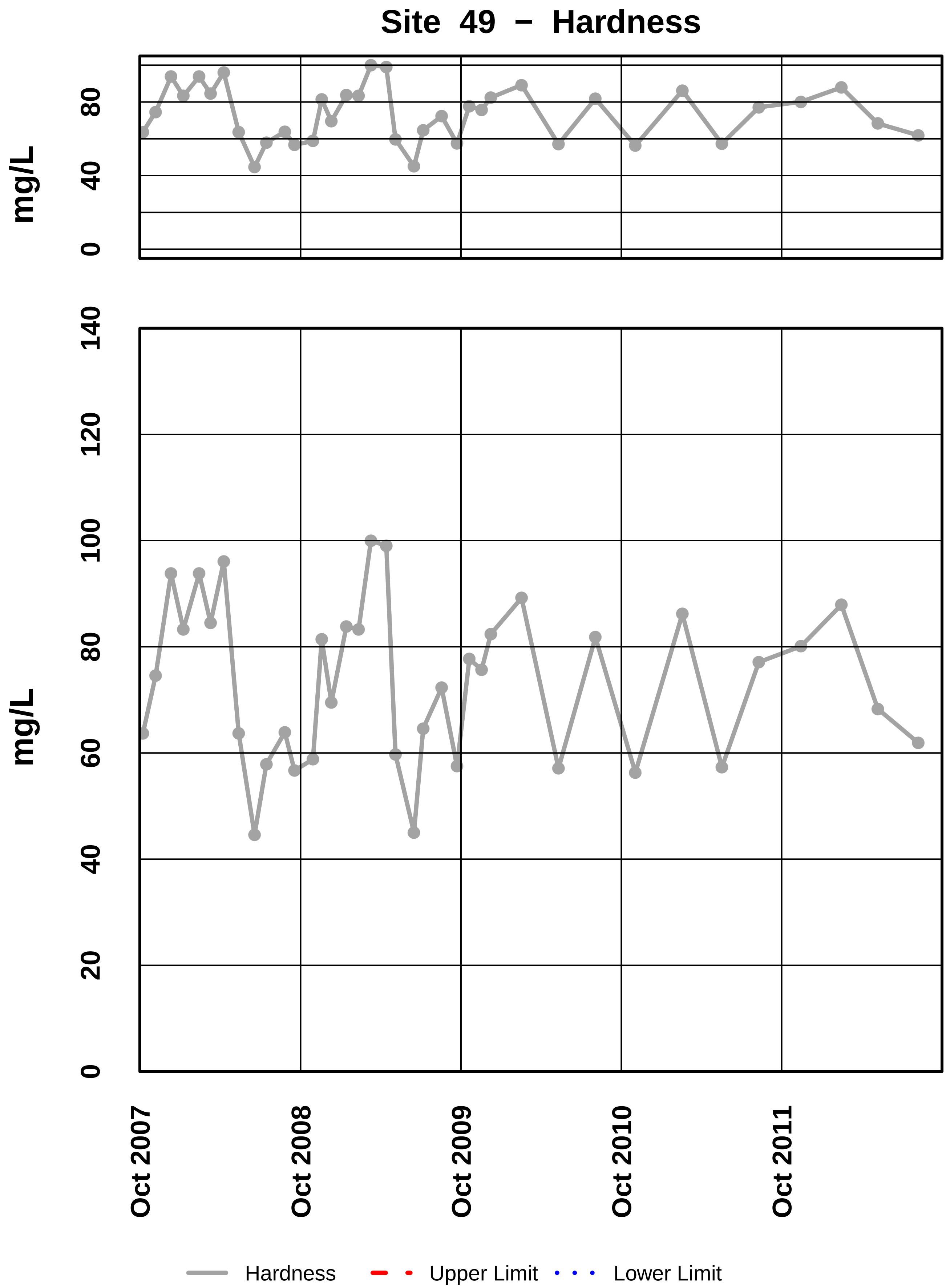


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 49 – Sulfate Total

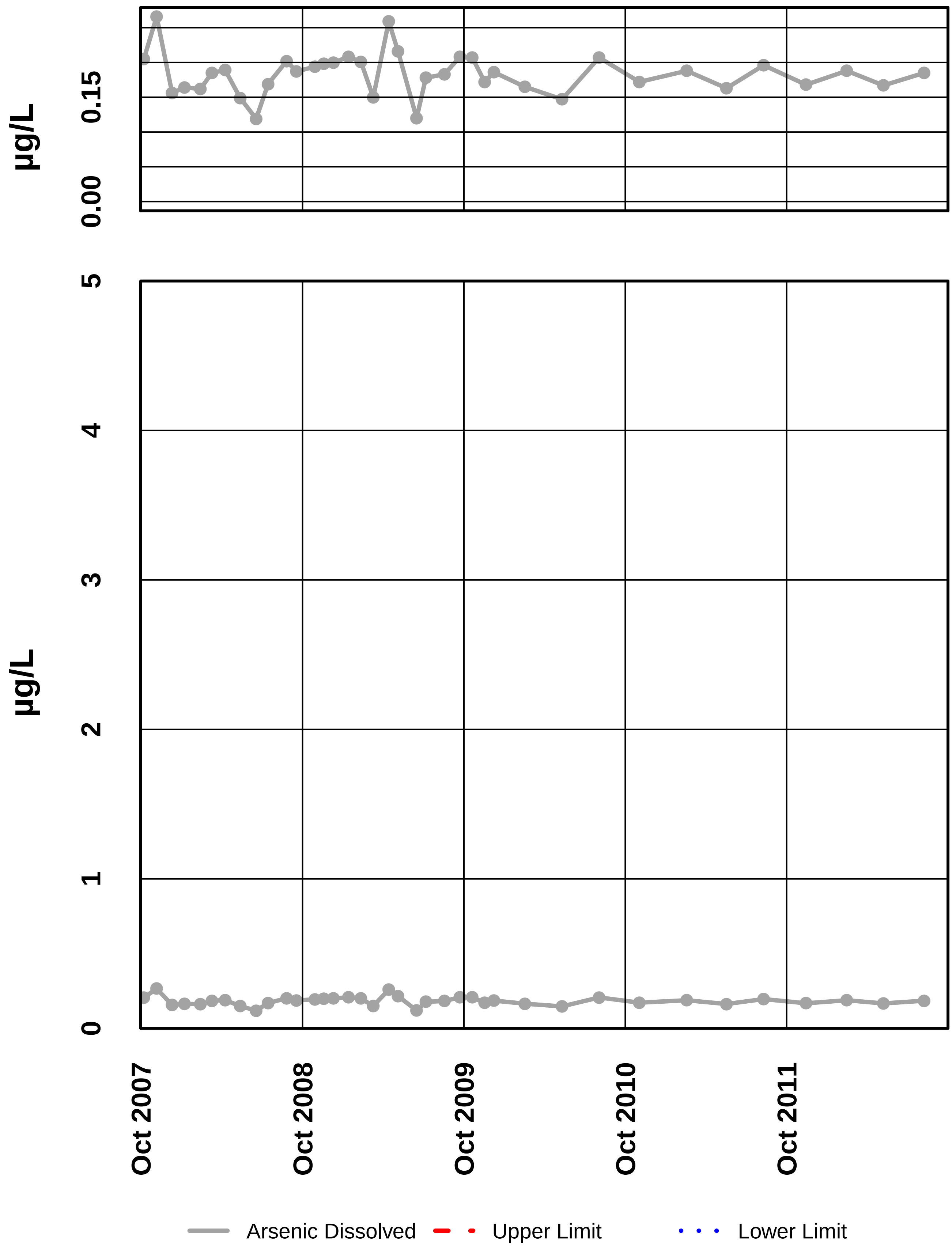


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

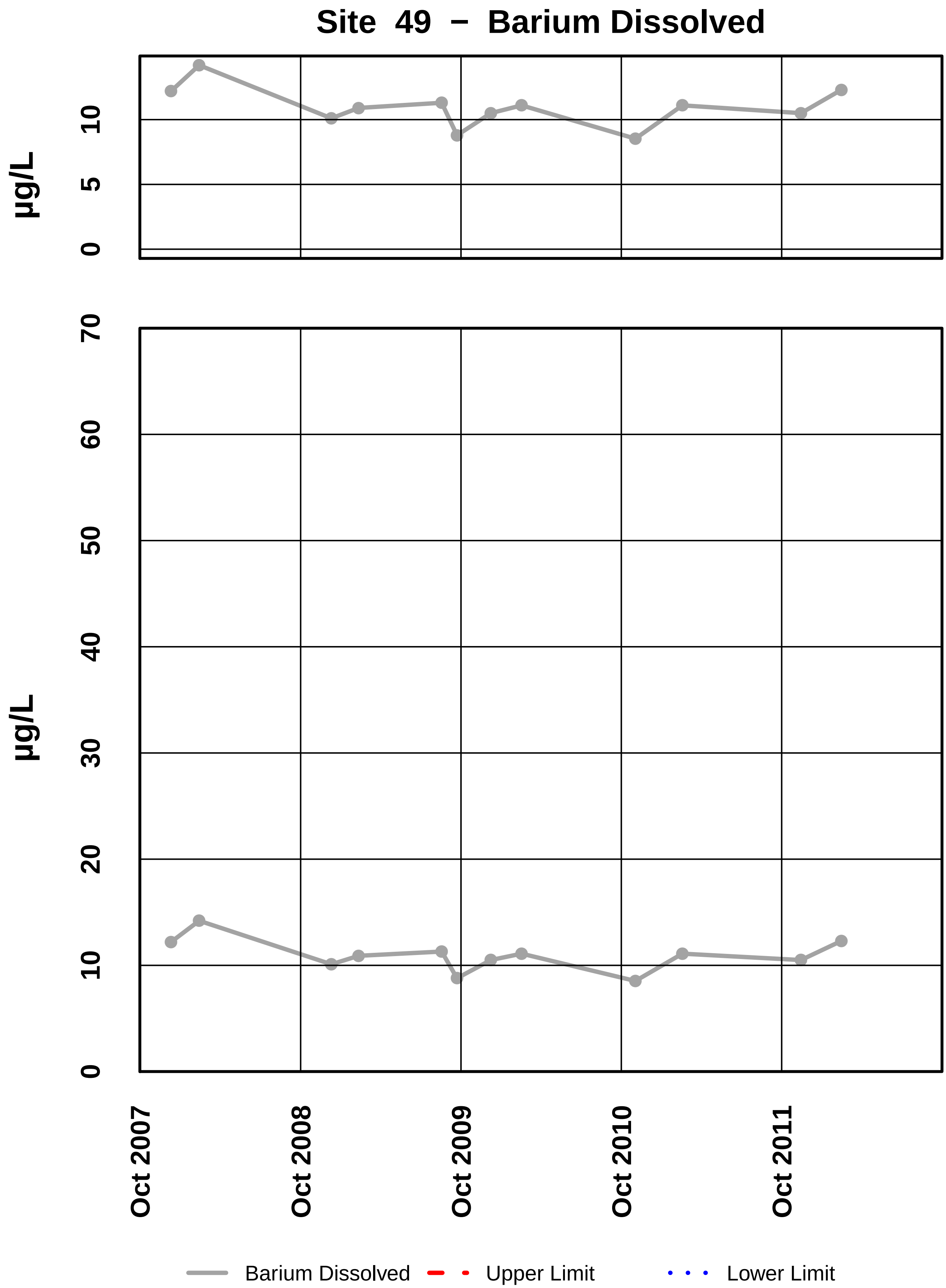


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

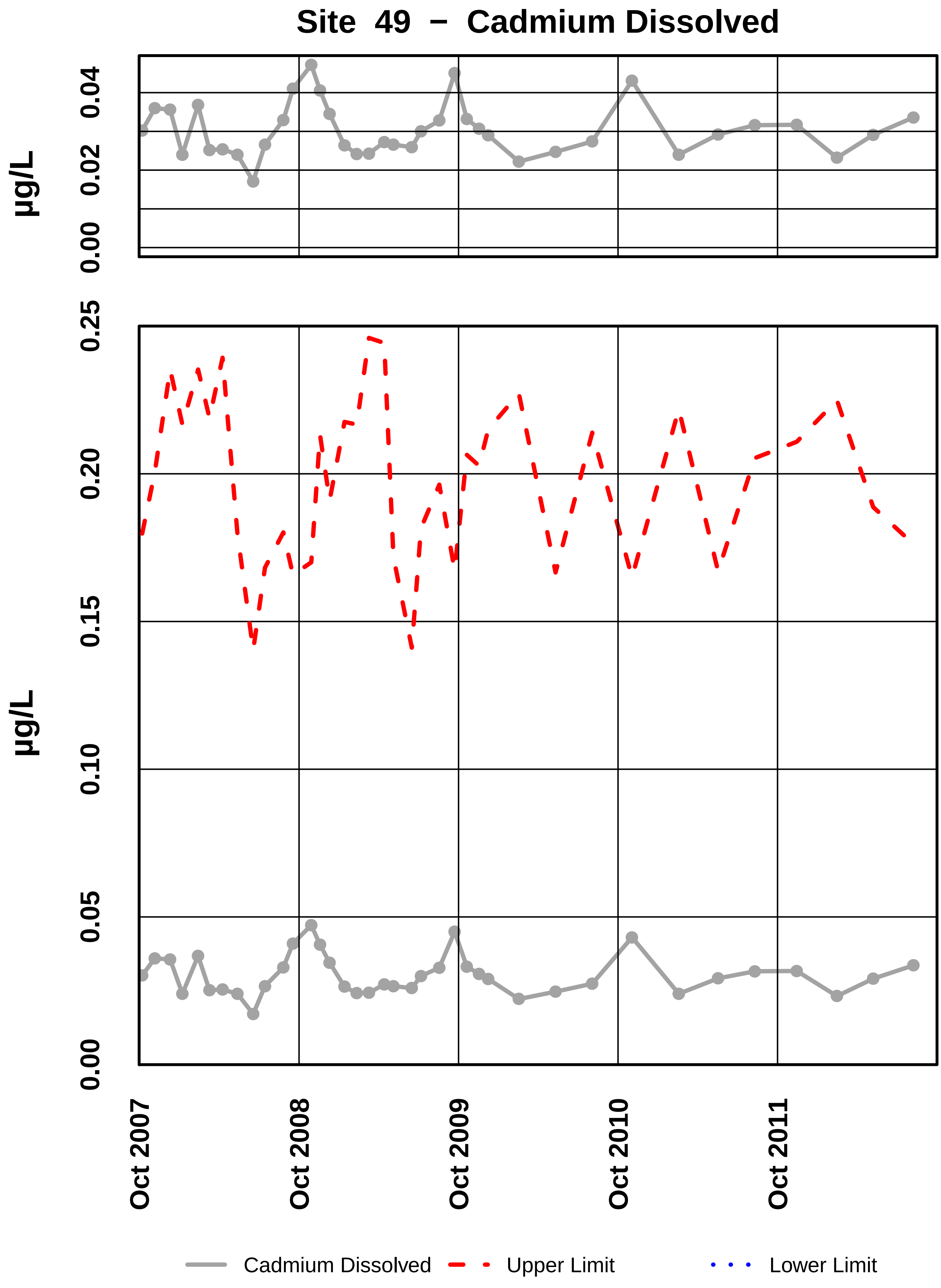
Site 49 – Arsenic Dissolved



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

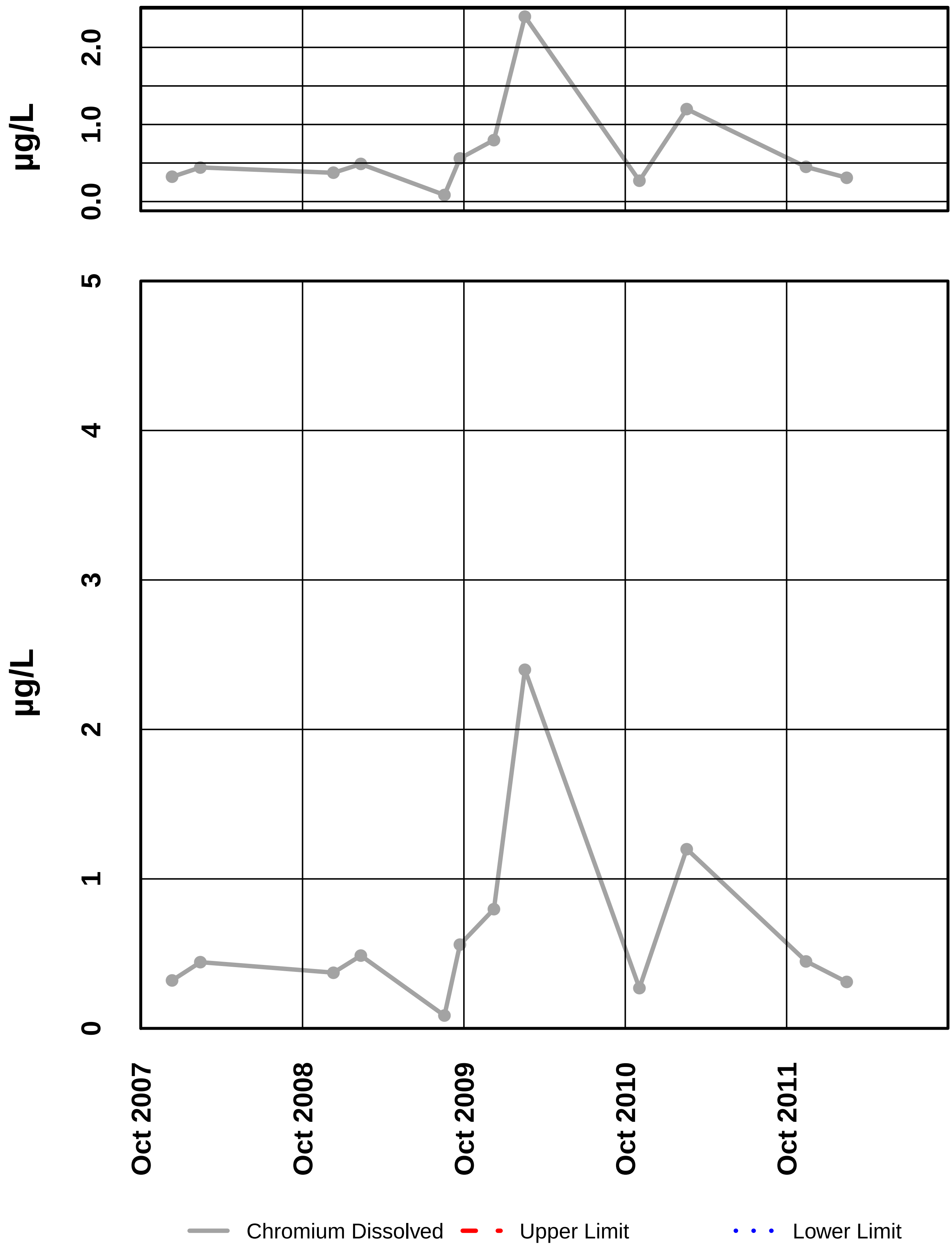


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

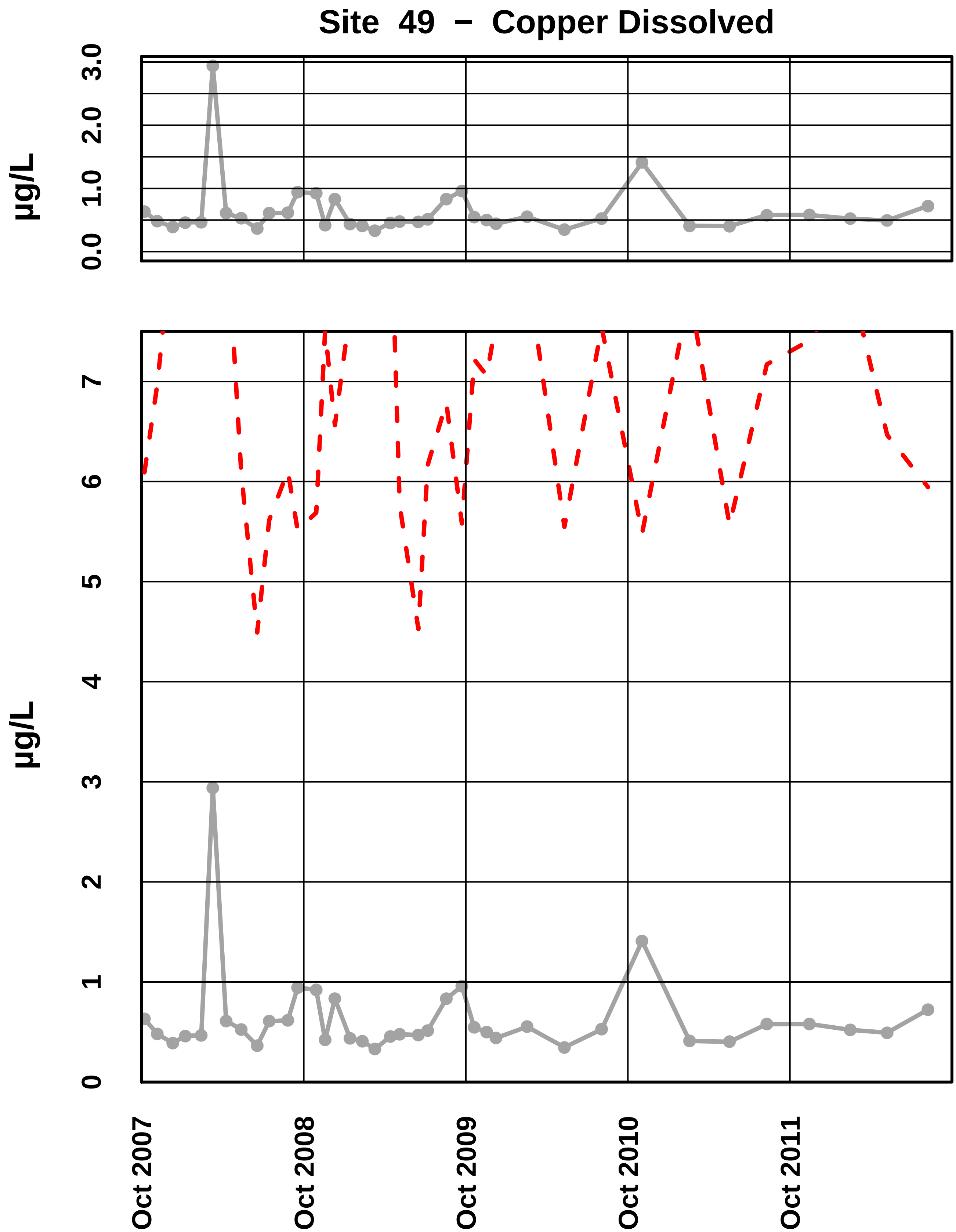


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

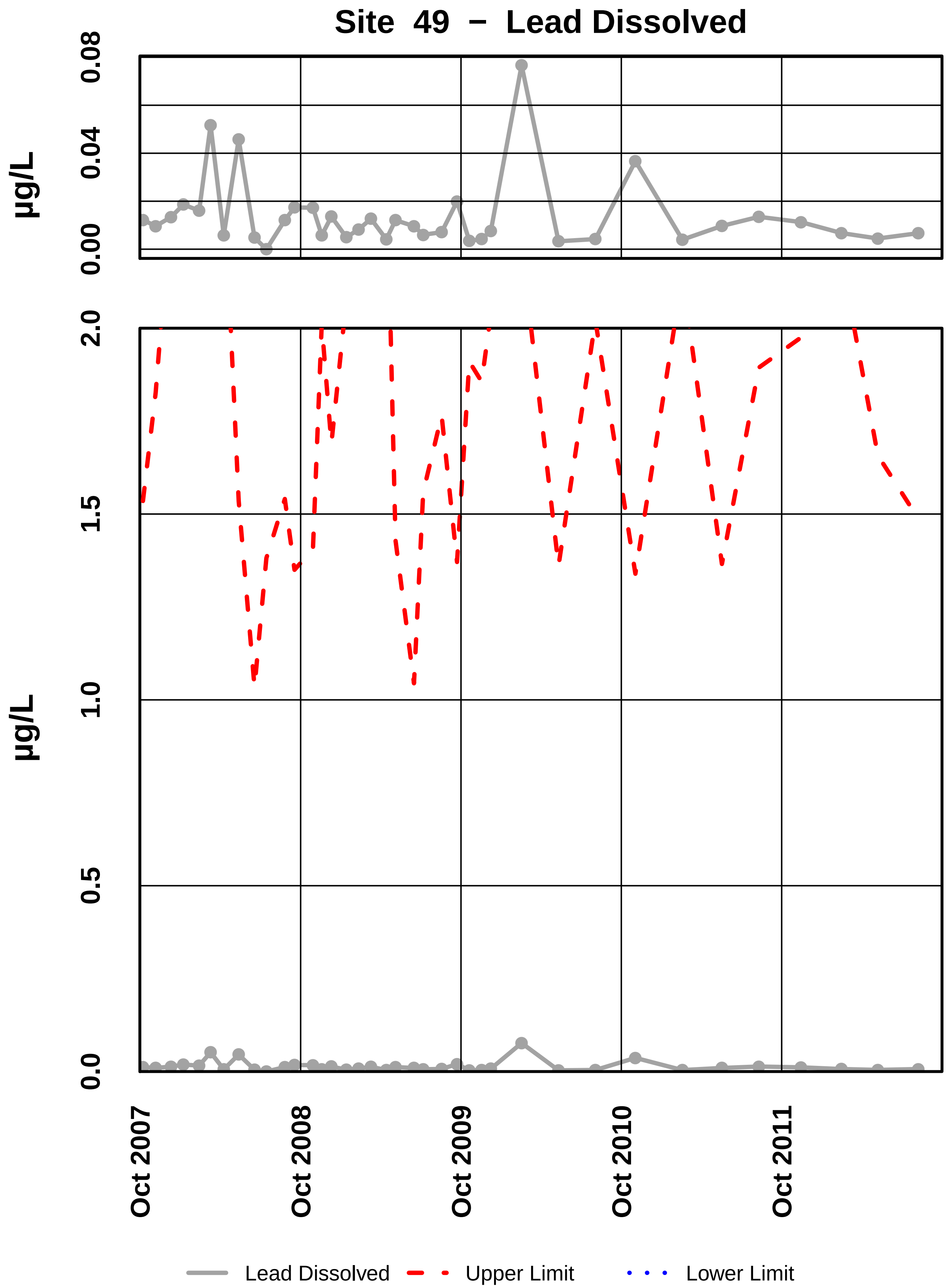
Site 49 – Chromium Dissolved



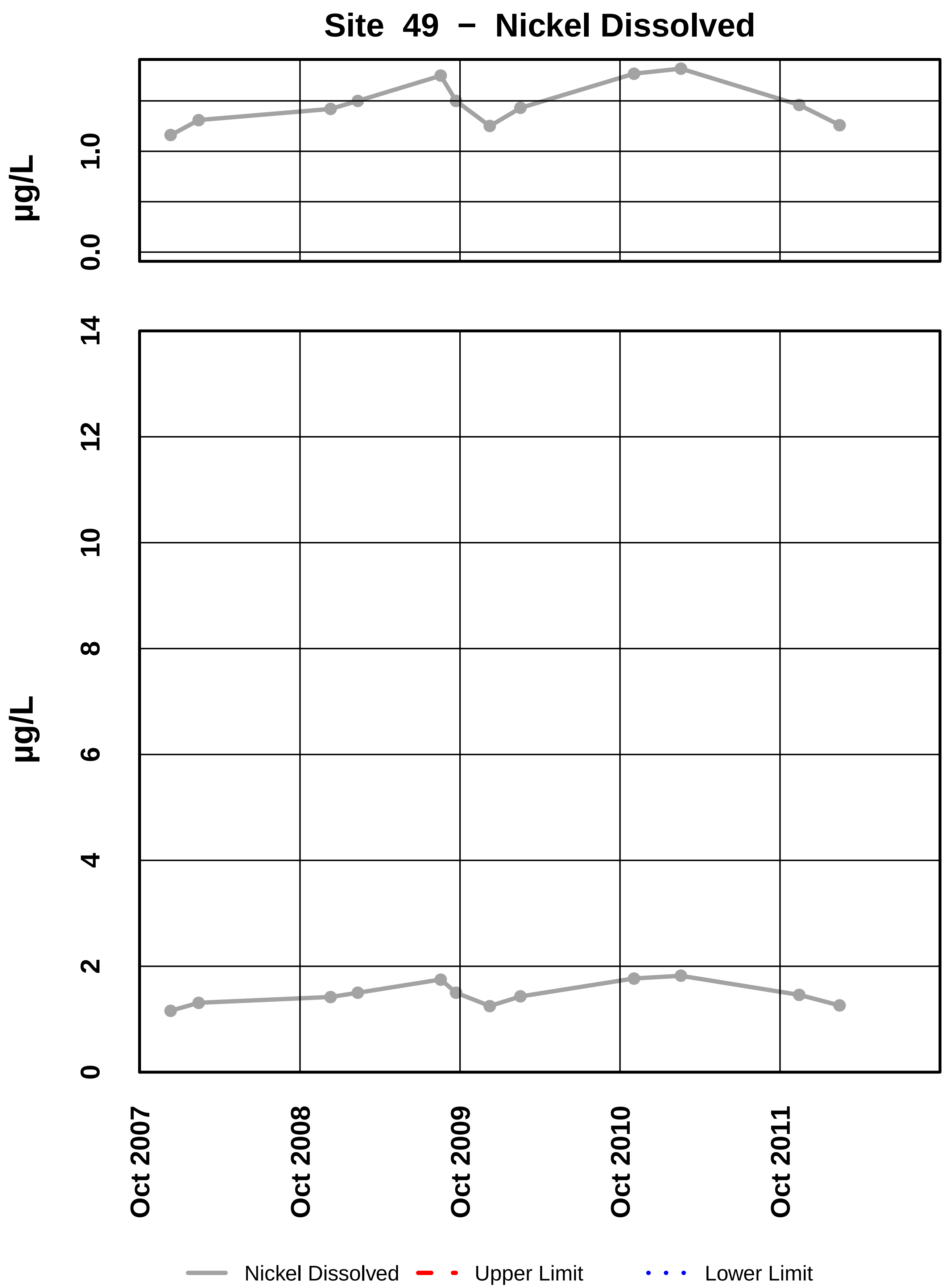
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

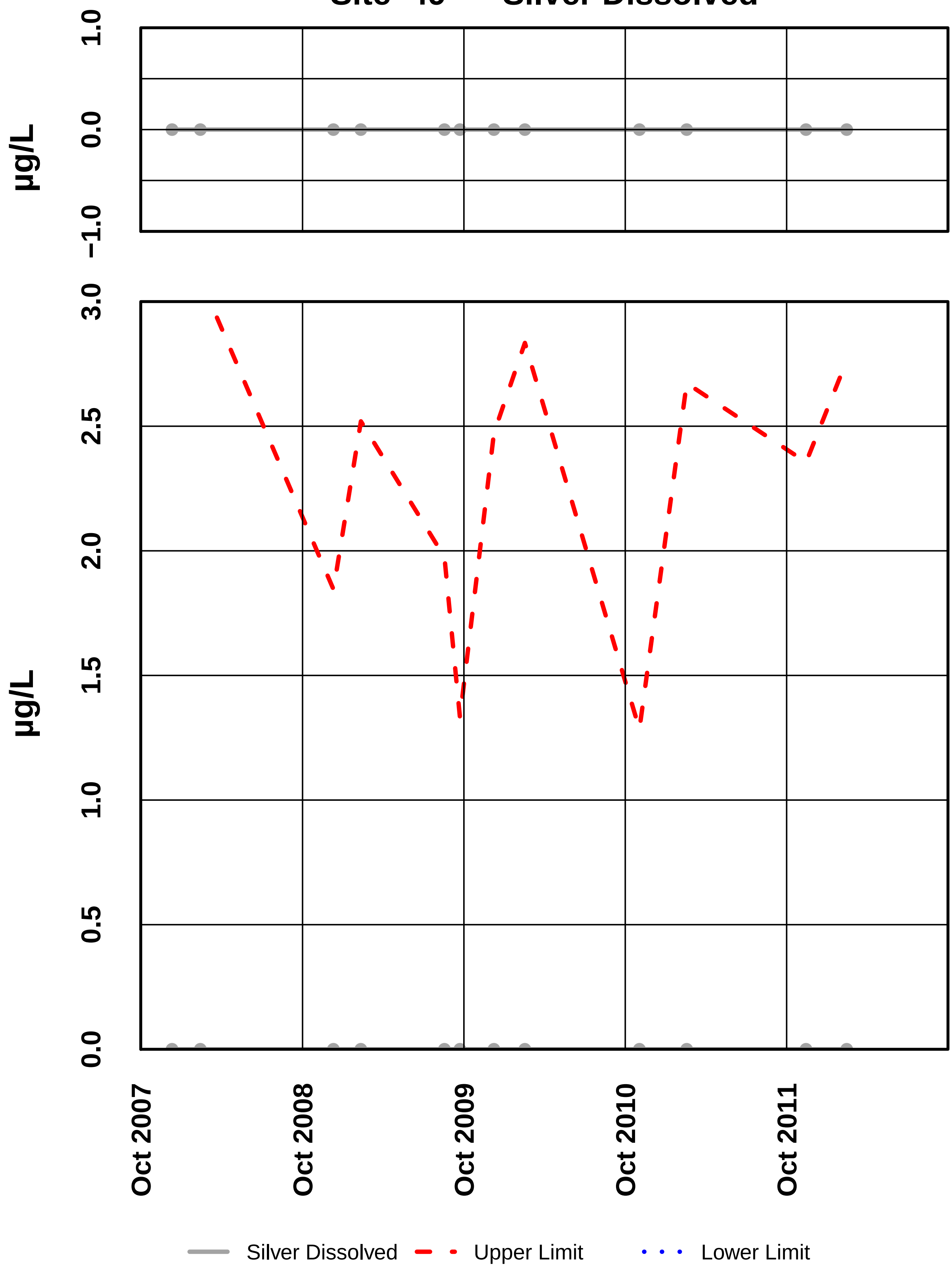


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

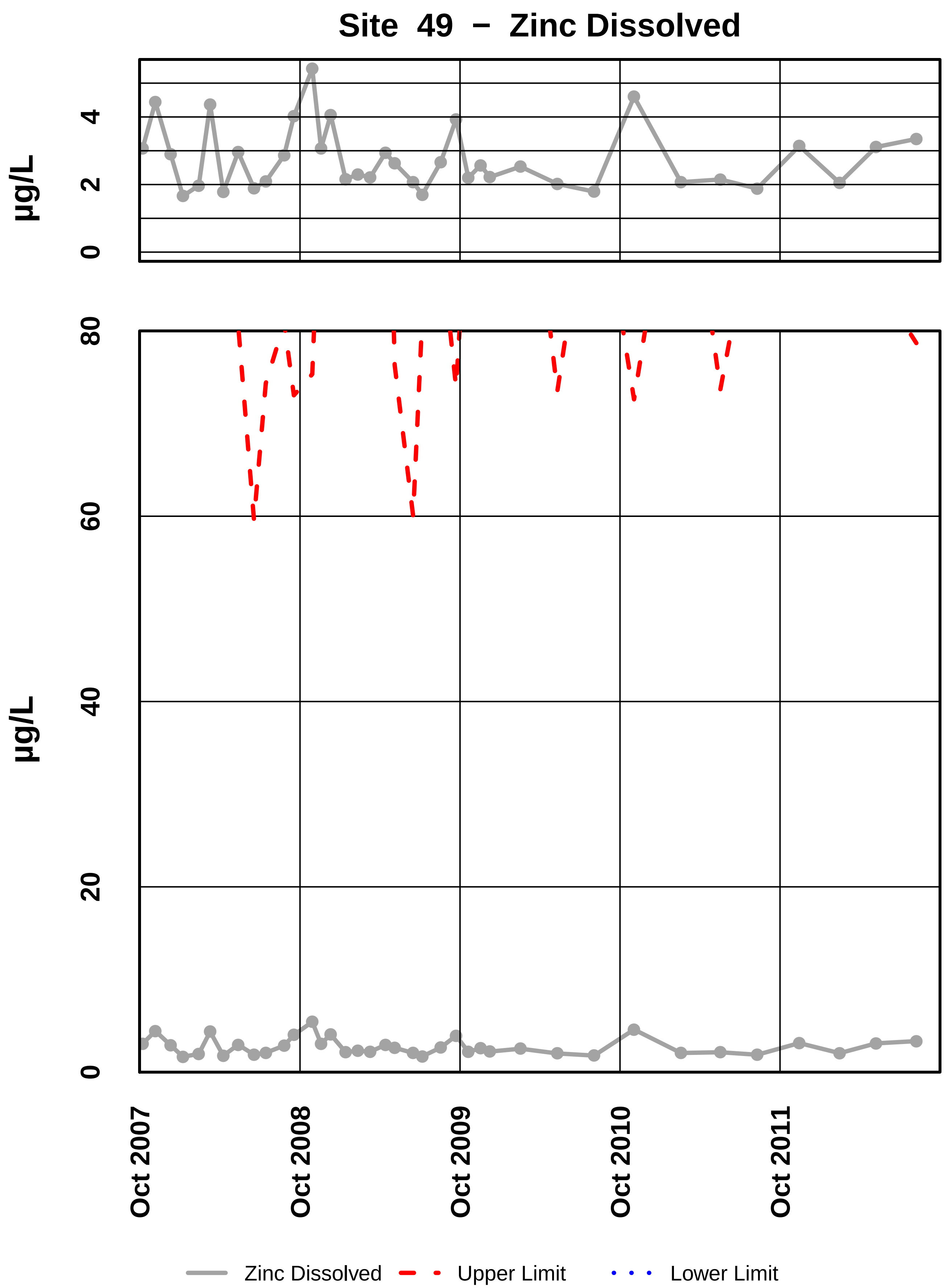


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 49 – Silver Dissolved

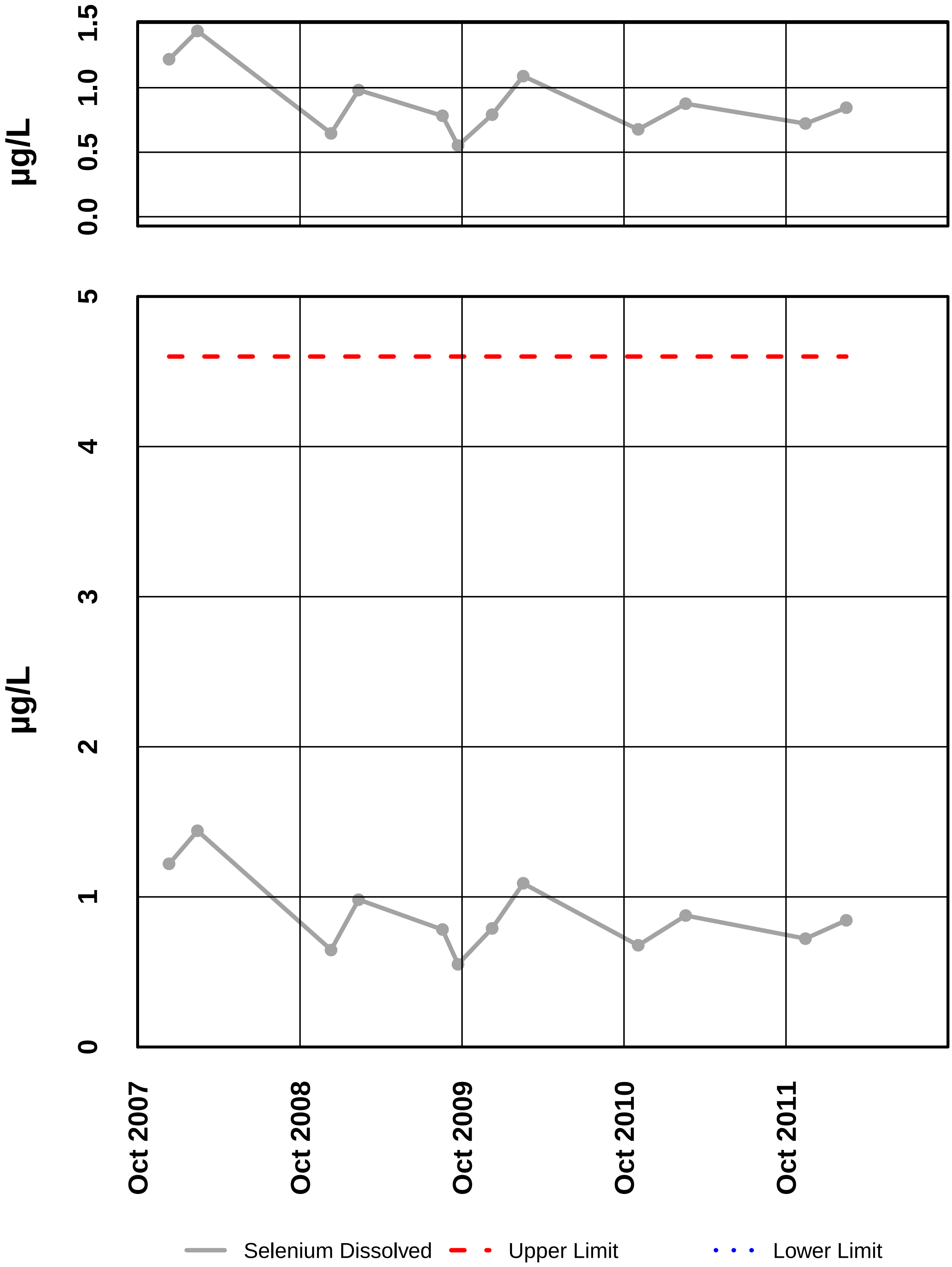


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

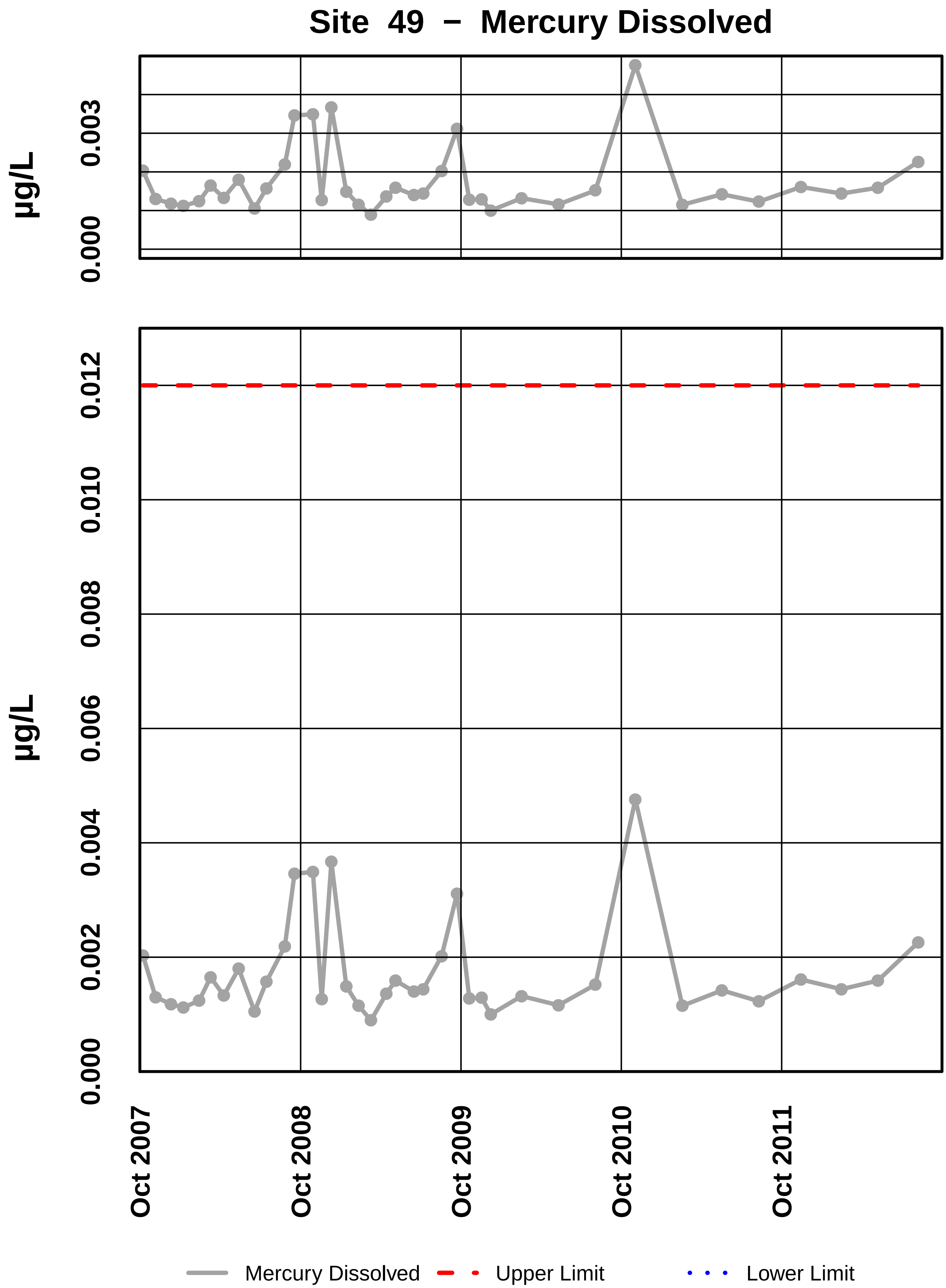


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 49 – Selenium Dissolved



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



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

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**	156.3	170.9	161.7	146.7	173.9	192.2	148.5	135.7	87.9	97.2	180.8	162.7
b	**WY2008**	130.1	155.4	183.8	193.7	196	191.8	168.1	124.3	91.7	112.8	119	112
c	**WY2009**		160.1	134.5	170.8	165.7	168.5	193.5	110.8	87.8	128.3	116.9	92
d	**WY2010**	153.9	113.2	175.8		179.1			121.6			147.4	
e	**WY2011**		108.5			171			114.3			153	
f	**WY2012**		141			150			145			130	
	n	3	6	4	3	6	3	3	6	3	3	6	3

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

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

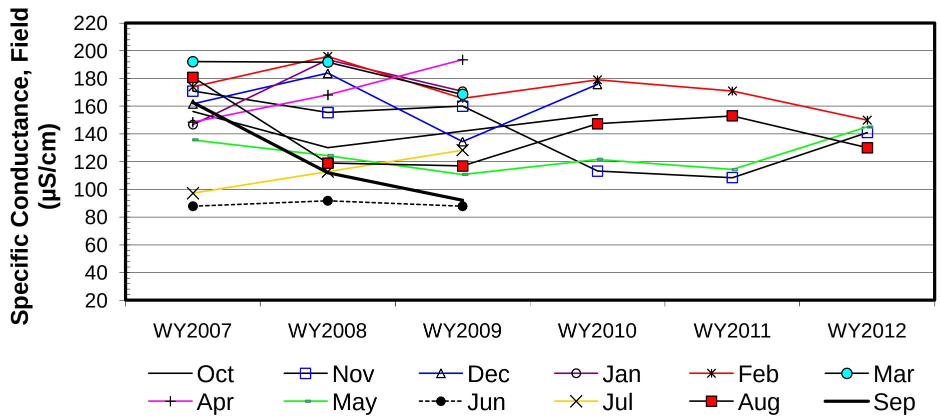
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	3.67	28.33	8.67	3.67	28.33	3.67	3.67	28.33	3.67	3.67	28.33	3.67
$Z_k = S_k/\sigma_S$	-0.52	-1.69	0.00	0.52	-1.32	-1.57	1.57	-0.19	-0.52	1.57	-0.19	-1.57
Z^2_k	0.27	2.86	0.00	0.27	1.73	2.45	2.45	0.04	0.27	2.45	0.04	2.45

ΣZ_k= -3.90
ΣZ^2_k= 15.30
Z-bar=$\Sigma Z_k/K$= -0.33

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	49	0	0	0	0

Σn 49
ΣS_k -19

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	14.03	@α=5% $\chi^2_{(K-1)}$= 19.68	Test for station homogeneity	
p	**0.232**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
$\Sigma VAR(S_k)$ Z_{calc}	-1.48	@α/2=2.5% Z= 1.96	**H_0** (No trend)	ACCEPT
147.67 p	**0.069**		**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-8.61		2.71
0.050	-7.12	**-4.00**	0.83
0.100	-6.09		-0.63
0.200	-5.30		-1.64

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**	8.0	8.1	8.0	7.8	7.9	8.2	7.5	8.0	8.0	7.9	8.1	7.7
b	**WY2008**	8.0	7.6	7.8	8.0	7.6		8.0	8.0	7.9	7.8	7.2	7.6
c	**WY2009**	7.9	7.7	7.9	7.9	7.9	8.0	7.4	7.2	7.7	7.1	7.4	7.4
d	**WY2010**	8.0	7.4	7.7		7.6			7.8			7.4	
e	**WY2011**		7.9			7.3			7.9			8.1	
f	**WY2012**		8.0			7.8			8.0			8.0	
	n	4	6	4	3	6	2	3	6	3	3	6	3
	t_1	4	6	4	3	6	2	3	4	3	3	6	3
	t_2	0	0	0	0	0	0	0	1	0	0	0	0
	t_3	0	0	0	0	0	0	0	0	0	0	0	0
	t_4	0	0	0	0	0	0	0	0	0	0	0	0
	t_5	0	0	0	0	0	0	0	0	0	0	0	0
	b-a	1	-1	-1	1	-1		1	-1	-1	-1	-1	-1
	c-a	-1	-1	-1	1	-1	-1	-1	-1	-1	-1	-1	-1
	d-a	-1	-1	-1		-1			-1			-1	
	e-a		-1			-1			-1			1	
	f-a		-1			-1			-1			-1	
	c-b	-1	1	1	-1	1		-1	-1	-1	-1	1	-1
	d-b	-1	-1	-1		-1			-1			1	
	e-b		1			-1			-1			1	
	f-b		1			1			0			1	
	d-c	1	-1	-1		-1			1			1	
	e-c		1			-1			1			1	
	f-c		1			-1			1			1	
	e-d		1			-1			1			1	
	f-d		1			1			1			1	
	f-e		1			1			1			-1	
	S_k	-2	1	-4	1	-7	-1	-1	-2	-3	-3	5	-3
	$\sigma^2_S=$	8.67	28.33	8.67	3.67	28.33	1.00	3.67	27.33	3.67	3.67	28.33	3.67
	$Z_k = S_k/\sigma_S$	-0.68	0.19	-1.36	0.52	-1.32	-1.00	-0.52	-0.38	-1.57	-1.57	0.94	-1.57
	Z^2_k	0.46	0.04	1.85	0.27	1.73	1.00	0.27	0.15	2.45	2.45	0.88	2.45

$\Sigma Z_k=$ -8.31

$\Sigma Z^2_k=$ 14.01

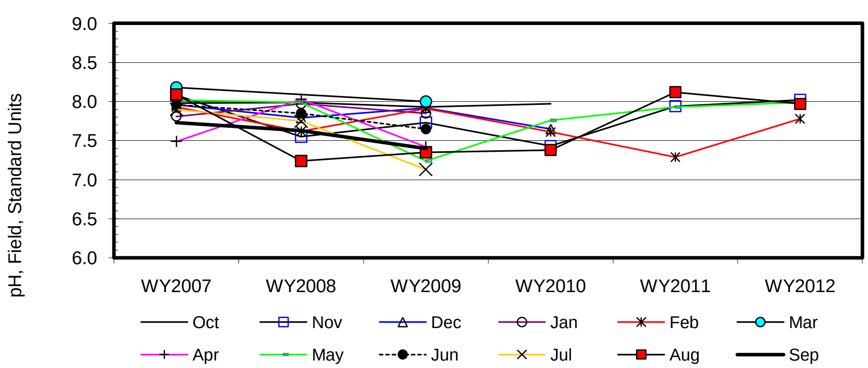
Z-bar=$\Sigma Z_k/K=$ -0.69

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	47	1	0	0	0

Σn 49

ΣS_k -19

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2=$	8.26	@α=5% $\chi^2_{(K-1)}=$ 19.68	Test for station homogeneity	
p	**0.690**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k) Z_{calc}	-1.47	@α/2=2.5% $Z=$ 1.96	**H_0** (No trend)	ACCEPT
149.00 **p**	**0.070**		**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.11		0.03
0.050	-0.09	**-0.02**	0.00
0.100	-0.06		-0.01
0.200	-0.04		-0.01

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**	54.8	65.4	59.3	64.1	69.2	64.9	51.3	52.0	36.4	39.4	69.8	67.8
b	**WY2008**	50.8	60.4	73.9	79.1	65.9	66.0	68.6	49.6	35.7	45.7	50.3	44.4
c	**WY2009**	44.3	49.8	48.4	61.7	62.5	72.0	70.6	44.5	36.3	50.8	55.1	45.9
d	**WY2010**	58.4	61.6	71.5		56.9			46.6			61.1	
e	**WY2011**		38.8			69.5			44.9			63.2	
f	**WY2012**		64.2			63.5			61.1			49.8	
	n	4	6	4	3	6	3	3	6	3	3	6	3

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

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

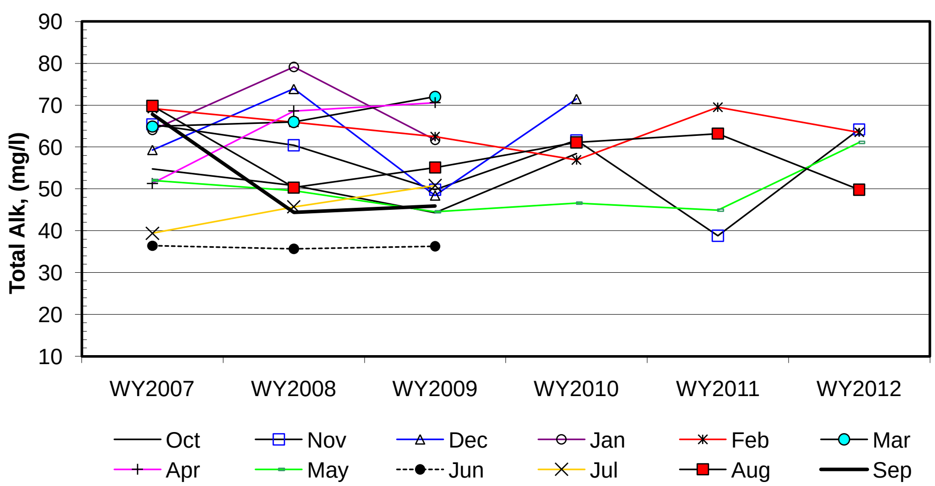
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	8.67	28.33	8.67	3.67	28.33	3.67	3.67	28.33	3.67	3.67	28.33	3.67
$Z_k = S_k/\sigma_S$	0.00	-0.56	0.00	-0.52	-0.56	1.57	1.57	-0.19	-0.52	1.57	-0.56	-0.52
Z^2_k	0.00	0.32	0.00	0.27	0.32	2.45	2.45	0.04	0.27	2.45	0.32	0.27

ΣZ_k= 1.25
ΣZ^2_k= 9.17
Z-bar=ΣZ_k/K= 0.10

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	50	0	0	0	0

Σn 50
ΣS_k -4

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	9.04	@α=5% $\chi^2_{(K-1)}$= 19.68	Test for station homogeneity	
p	**0.618**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
$\Sigma VAR(S_k)$	Z_{calc} -0.24	@α/2=2.5% Z= 1.96	**H_0** (No trend)	ACCEPT
152.67	p **0.404**		**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-2.59		1.89
0.050	-1.71	**-0.18**	1.20
0.100	-1.56		0.92
0.200	-1.21		0.39

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**	7.8	11.4	11.6	12.5	13.8	16.0	10.5	7.5	3.6	5.3	12.3	12.1
b	**WY2008**	10.0	8.3	12.6	17.7	19.2	16.9	17.8	7.7	4.8	7.9	7.6	6.0
c	**WY2009**	6.4	12.5	12.1	13.3	14.3	18.9	21.2	7.5	5.9	11.9	12.7	7.5
d	**WY2010**	11.7	13.3	14.7		16.2			7.8			12.4	
e	**WY2011**		7.8			15.1			7.2			12.1	
f	**WY2012**		12.3			16.3			9.8			8.1	
	n	4	6	4	3	6	3	3	6	3	3	6	3

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

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

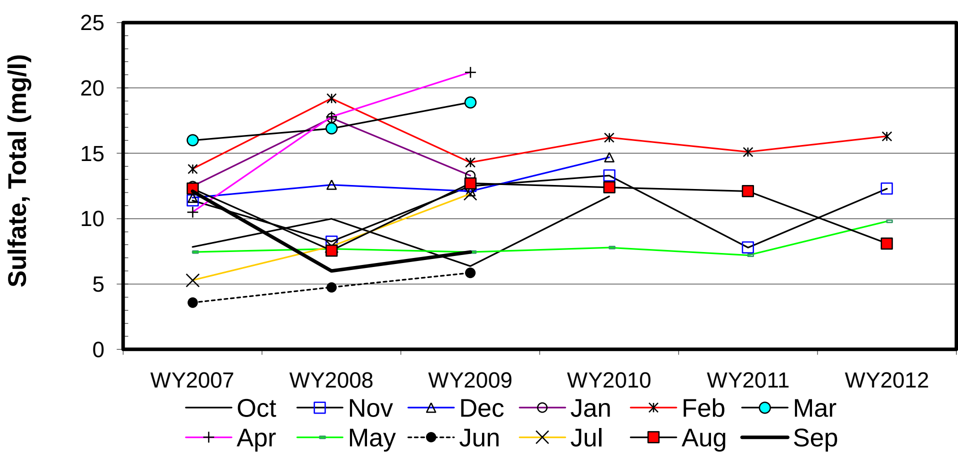
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	8.67	28.33	8.67	3.67	28.33	3.67	3.67	27.33	3.67	3.67	28.33	3.67
$Z_k = S_k/\sigma_S$	0.68	0.19	1.36	0.52	0.94	1.57	1.57	0.77	1.57	1.57	-0.56	-0.52
Z^2_k	0.46	0.04	1.85	0.27	0.88	2.45	2.45	0.59	2.45	2.45	0.32	0.27

ΣZ_k=	9.63
ΣZ^2_k=	14.49
Z-bar=ΣZ_k/K=	0.80

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	48	1	0	0	0

Σn	50
ΣS_k	25

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=		6.76	@α=5% $\chi^2_{(K-1)}$= 19.68	Test for station homogeneity	
	p	**0.818**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc}	1.95	@α=2.5% Z= 1.96	**H_0** (No trend)	ACCEPT
151.67	p	**0.974**		**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.06		1.00
0.050	0.05	0.38	0.80
0.100	0.12		0.66
0.200	0.20		0.53

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**	2.2	1.1	1.2	1.4	2.0	2.0	1.8	2.7	1.4	2.4	1.9	1.8
b	**WY2008**	3.1	4.4	2.9	1.7	2.0	4.4	1.8	3.0	1.9	2.1	2.9	4.0
c	**WY2009**	5.4	3.1	4.1	2.2	2.3	2.2	2.9	2.6	2.1	1.7	2.7	3.9
d	**WY2010**	2.2	2.6	2.2		2.5			2.0			1.8	
e	**WY2011**		4.6			2.1			2.2			1.9	
f	**WY2012**		3.1			2.1			3.1			3.4	
	n	4	6	4	3	6	3	3	6	3	3	6	3

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

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

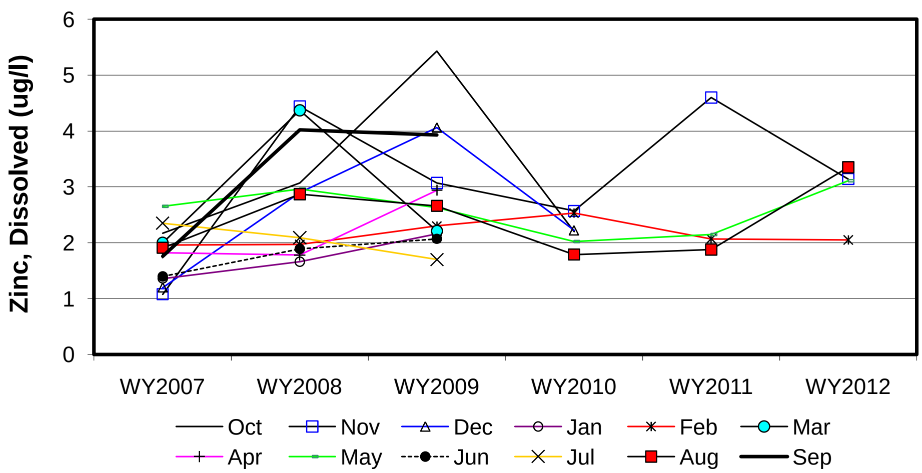
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
$\sigma^2{}_S=$	8.67	28.33	8.67	3.67	28.33	3.67	3.67	28.33	3.67	3.67	28.33	3.67
$Z_k = S_k/\sigma_S$	0.68	0.94	0.68	1.57	0.94	0.52	0.52	-0.19	1.57	-1.57	0.19	0.52
$Z^2{}_k$	0.46	0.88	0.46	2.45	0.88	0.27	0.27	0.04	2.45	2.45	0.04	0.27

$\Sigma Z_k=$ 6.37
$\Sigma Z^2{}_k=$ 10.94
Z-bar$=\Sigma Z_k/K=$ 0.53

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	50	0	0	0	0

Σn 50
ΣS_k 20

$\chi^2{}_h=\Sigma Z^2{}_k-K(\text{Z-bar})^2=$ 7.56	@α=5% $\chi^2{}_{(K-1)}=$ 19.68	Test for station homogeneity	
p **0.752**		$\chi^2{}_h<\chi^2{}_{(K-1)}$	ACCEPT
ΣVAR(S_k) 152.67 / Z_{calc} 1.54	@α/2=2.5% $Z=$ 1.96	$\mathbf{H_0}$ (No trend)	ACCEPT
p **0.938**		$\mathbf{H_A}$ ($\pm$ trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.06		0.30
0.050	-0.01	**0.09**	0.24
0.100	0.01		0.19
0.200	0.02		0.16

INTERPRETIVE REPORT
SITE 46

The data collected during the current water year are listed in the following "Table of Results for Water Year 2012" report. The table includes all the required FWMP analyte data (field and laboratory) collected for the current water year and a series of flags keyed to the summary report "Qualified Data by QA Reviewer". The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of ½ MDL for the purpose of median calculation.

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

Sample Date	Parameter	Value	Qualifier	Notes
No outliers have been identified by HGCMC for the period of October 2006 through September 20012.				

The data for water year 2012 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 2012

			Limits		
Sample Date	**Parameter**	**Value**	**Lower**	**Upper**	**Hardness**
No exceedances have been identified by HGCMC for the period of October 2011 through September 2012.					

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

A non-parametric statistical analysis for trend was performed for field conductivity, field pH, total alkalinity, total sulfate, and dissolved zinc. Calculation details of the Seasonal Kendall analyses are presented on the pages following this interpretive section. The following table summarizes the results on the data collected between Oct-06 and Sep-12(WY2007-WY2012). Datasets with a statistically significant trend ($\alpha/2$=2.5%) a Seasonal-Sen's Slope estimate statistic has also been calculated.

Table of Summary Statistics for Trend Analysis

Parameter	Mann-Kendall test statistics n*	p**	Trend	Sen's slope estimate Q	Q(%)
Conductivity Field	6	0.12			
pH Field	6	0.46			
Alkalinity, Total	6	0.30			
Sulfate, Total	6	0.03			
Zinc, Dissolved	6	0.02	+	0.19	8.8

* Number of Years ** Significance level

Dissolved zinc has a statistically significant ($p<0.02$) positive trend with a slope estimate of 0.19 µg/L/yr or a 8.8% increase over the period.

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

Analytical results from Site 46 were analyzed using the same technique that is in use for the intra-well analysis of Site 56. This technique consists of using combined Shewhart-CUSUM charts; see the interpretive report for Site 56 for an explanation of the methodology. To use these charts an average value and standard deviation first needs to be calculated for the each analyte of interest. These could be calculated from the historical process data or the background data collected prior to disturbance. Tables 1 and 2 summarize the baseline statistics for Site 46, differing in the number of samples (N) used in the calculation. From previous FWMP reports it is known that Site 46 is similar in chemistry as the background Site 49. Furthermore, it then can be inferred that changes in chemistry at Site 46 are a result of natural variation and not from HGCMC activities in the area. Therefore Site 46 is an ideal dataset for testing the effects of incorporating a larger set of values into the baseline statistics.

When comparing the baseline statistics for the two sample periods it is noted that the mean values are similar and the standard deviation increased for two of the three analytes. The increase in the standard deviation shows that with an increase in the number of samples the range also increased (greater variability). Also, the corollary decrease in standard deviation would mean a decreased range (less variability).   The similarity in the mean values with a change in the standard deviation signifies that the additional values were equally distributed about the previous calculated mean. A longer baseline period would incorporate greater natural variation. Regardless of the length of the baseline period each analyte that is goes out of control needs to be evaluated on an individual basis. Figures 1and 2 are the combined Shewhart-CUSUM charts for field conductivity, dissolved zinc, and total sulfate; using the baseline statistics from Tables 1 and 2.

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

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

Table 2. Specific Conductance, Dissolved Zinc, and Total Sulfate Baseline Periods, Summary Statistics and Various Control Limits

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

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

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

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

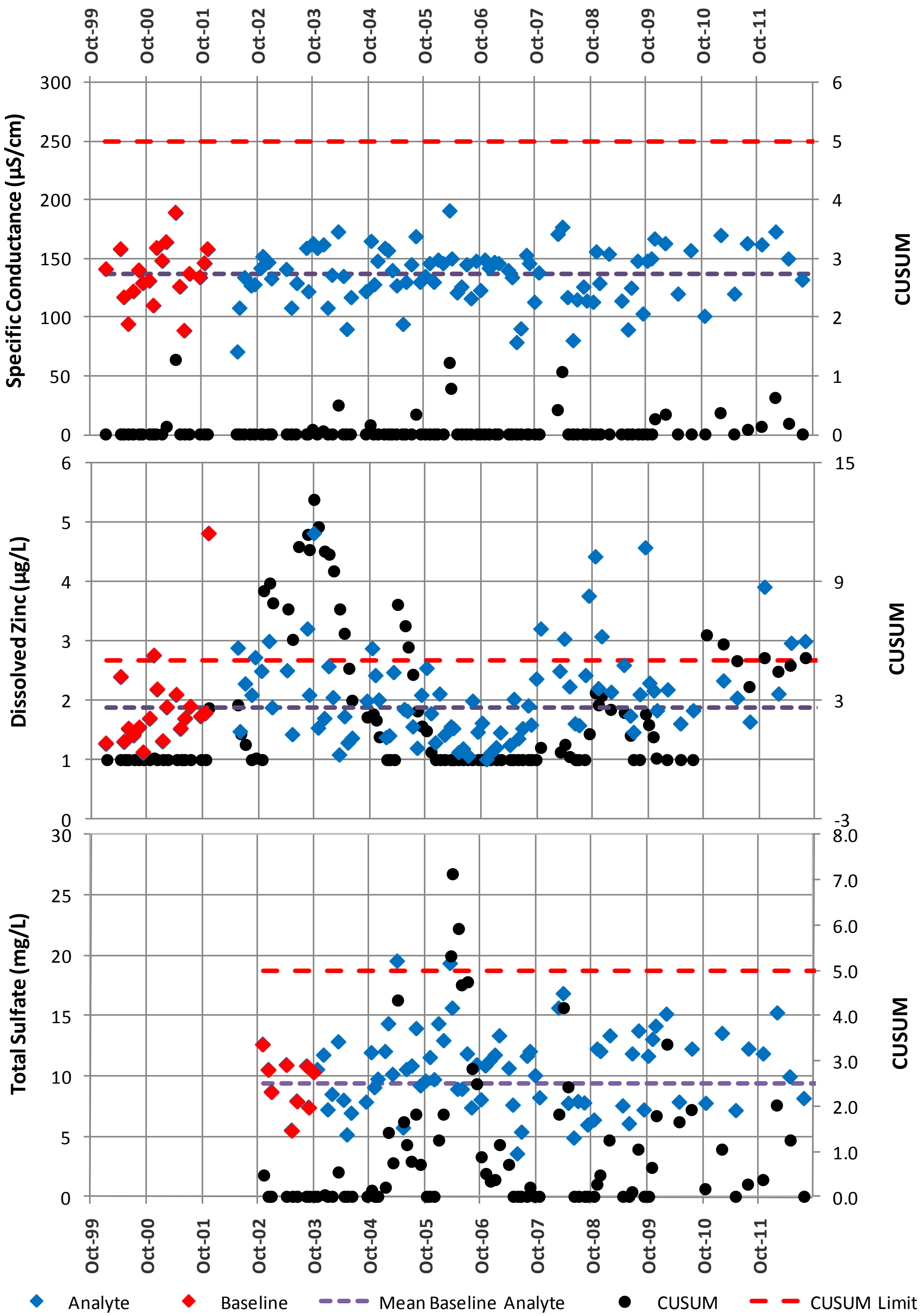


Figure 2. **Observed Measurements for Specific Conductance, Dissolved Zinc, and Total Sulfate from Site 46 Compared to the Shewhart-CUSUM Control Limits From Table 2**

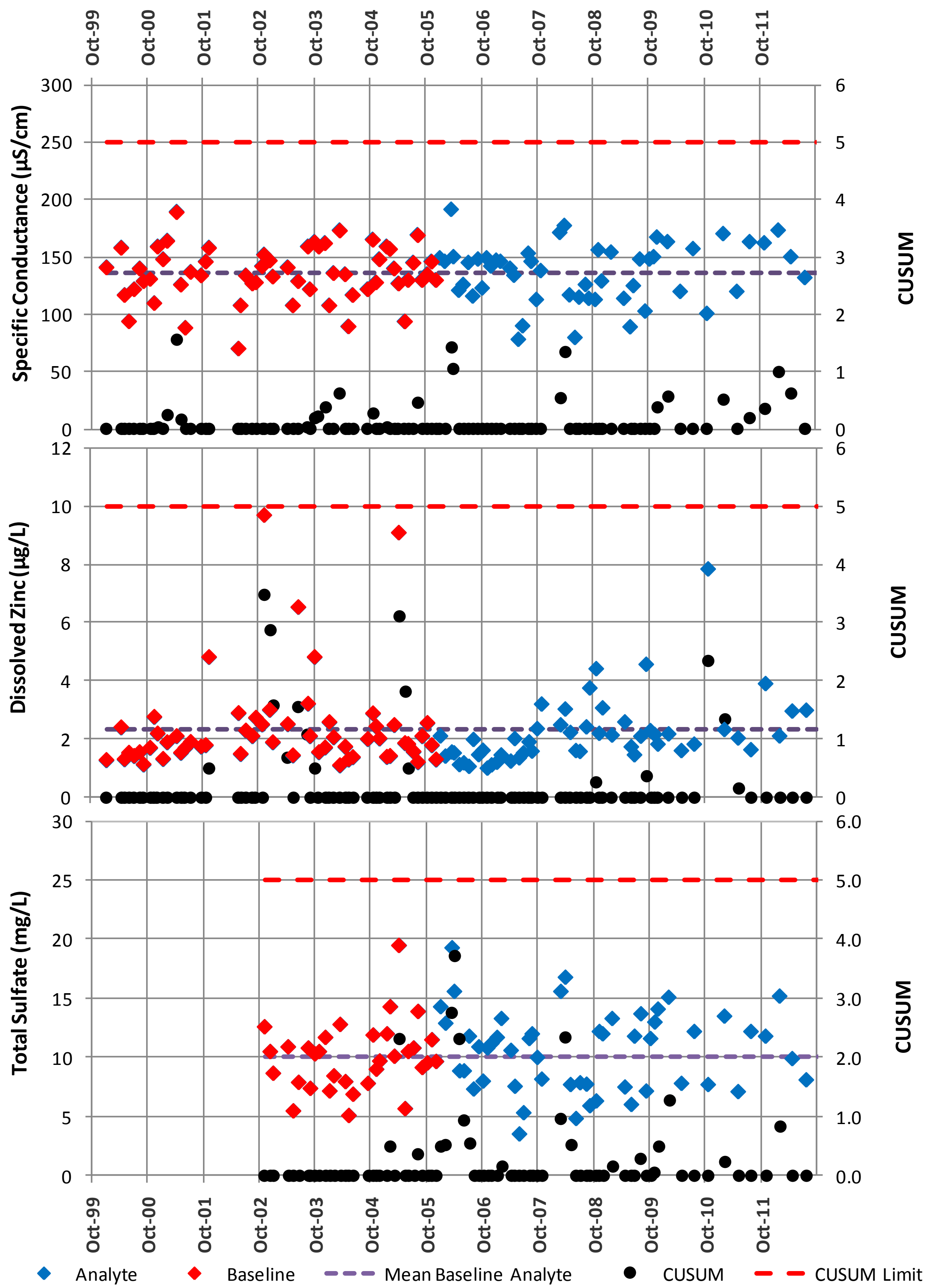


Table of Results for Water Year 2012

Site 046FMS - 'Lower Bruin Creek'

Sample Date/Parameter	Oct 2011	Nov 2011	Dec 2011	Jan 2012	Feb 2012	Mar 2012	Apr 2012	May 2012	Jun 2012	Jul 2012	Aug 2012	Sep 2012	**Median**
Water Temp (°C)		0.7			0.6			3.2			10		2.0
Conductivity-Field(μmho)		140			147			147			133		143.5
Conductivity-Lab (μmho)		162			173			150			132		156
pH Lab (standard units)		7.94			6.9			7.28			6.68		7.09
pH Field (standard units)		8.08			7.39			7.97			7.92		7.95
Total Alkalinity (mg/L)		65.7			67			62.1			51.7		63.9
Total Sulfate (mg/L)		11.8			15.2			9.9			8.1		10.9
Hardness (mg/L)		78.4			86.8			69.2			63.6		73.8
Dissolved As (ug/L)		0.329			0.139			0.25			0.245		0.248
Dissolved Ba (ug/L)		12			13.5								12.8
Dissolved Cd (ug/L)		0.0383			0.0312			0.0237			0.0387		0.0348
Dissolved Cr (ug/L)		0.459			0.357								0.408
Dissolved Cu (ug/L)		0.638			0.545			0.543			0.835		0.592
Dissolved Pb (ug/L)		0.0227			0.0088			0.0252			0.0261		0.0240
Dissolved Ni (ug/L)		1.59			1.08								1.335
Dissolved Ag (ug/L)		0.002			0.002								0.002
Dissolved Zn (ug/L)		3.9			2.11			2.96			2.99		2.98
Dissolved Se (ug/L)		0.847			0.873								0.860
Dissolved Hg (ug/L)		0.00151			0.00152			0.00177			0.00241		0.001645

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 KGCMC and removed from any further analysis and is not included into the calculation of the median

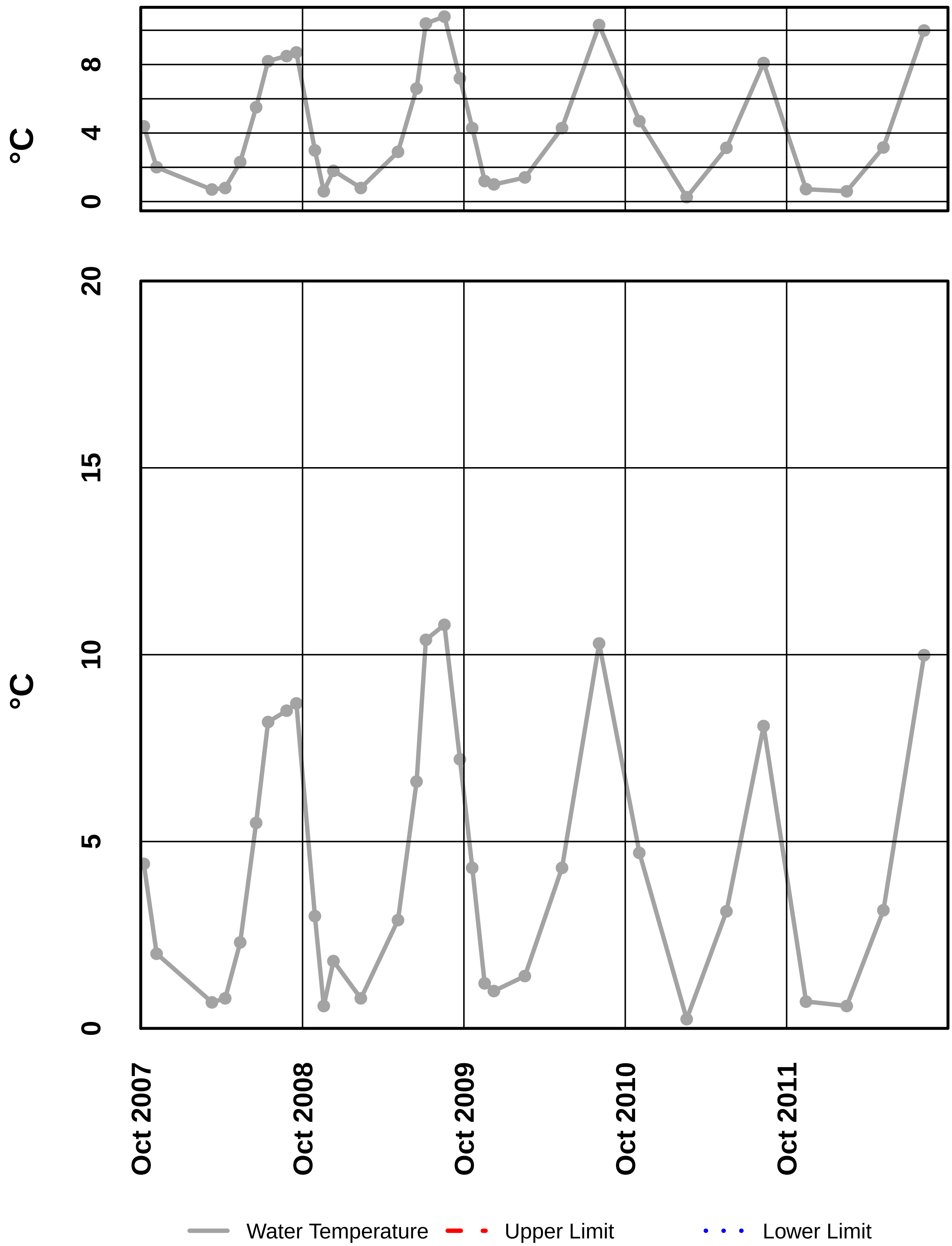
Qualified Data by QA Reviewer

Date Range: 10/01/2011 to 09/30/2012

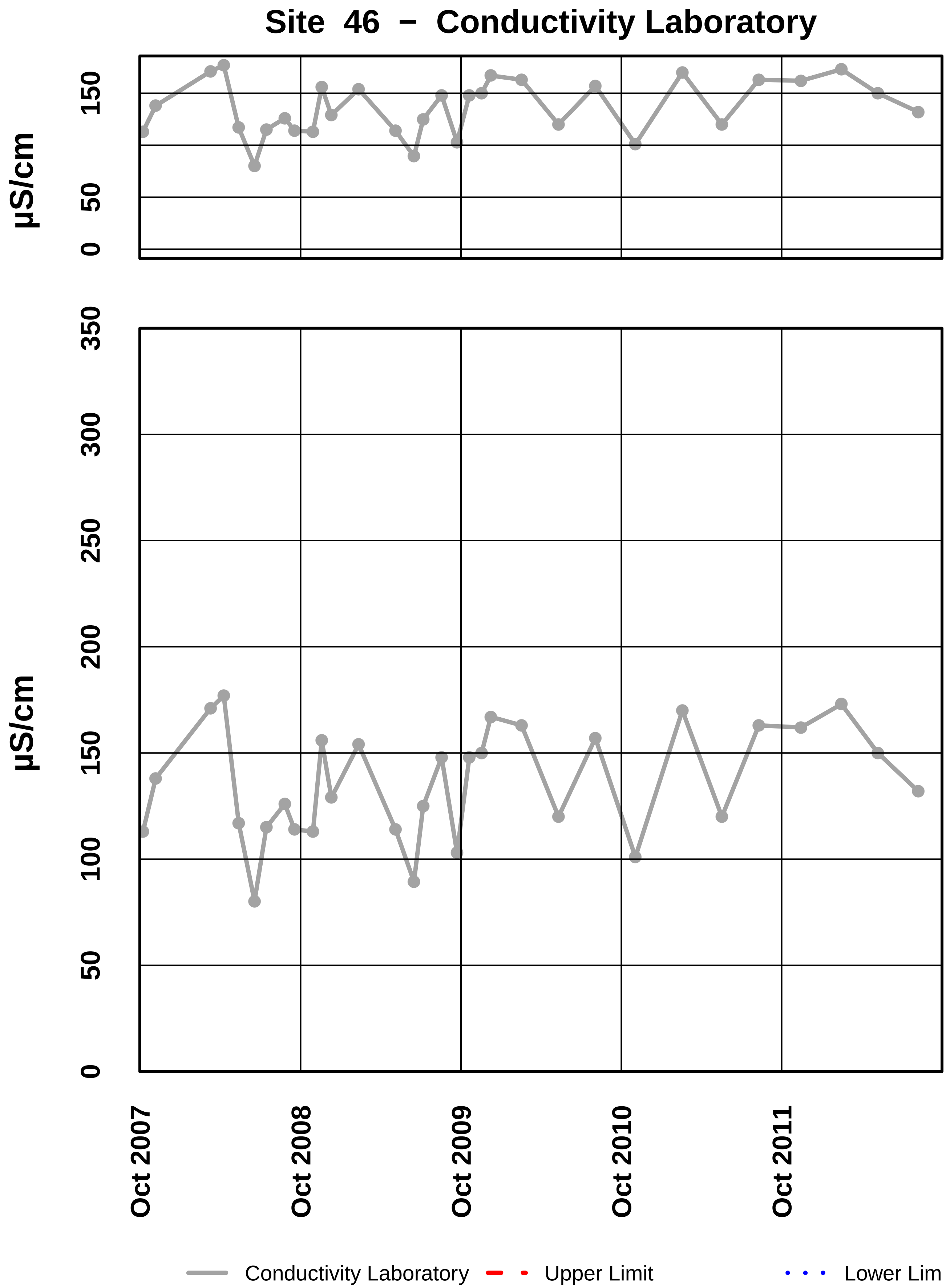
Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
46	11/14/2011	12:00 AM	Se diss, µg/l	0.84	J	Duplicate RPD
46	2/14/2012	12:00 AM	Cr diss, µg/l	0.35	U	Field Blank Contamination
			Pb diss, µg/l	0.00878	U	Field Blank Contamination
			Se diss, µg/l	0.87	J	Dupicate RPD
46	5/7/2012	12:00 AM	Pb diss, µg/l	0.02	U	Field Blank Contamination
			SO4 Tot, mg/l	9.9	J	Sample Receipt Temperature
46	8/7/2012	12:00 AM	As diss, µg/l	0.24	J	LCS Recovery

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

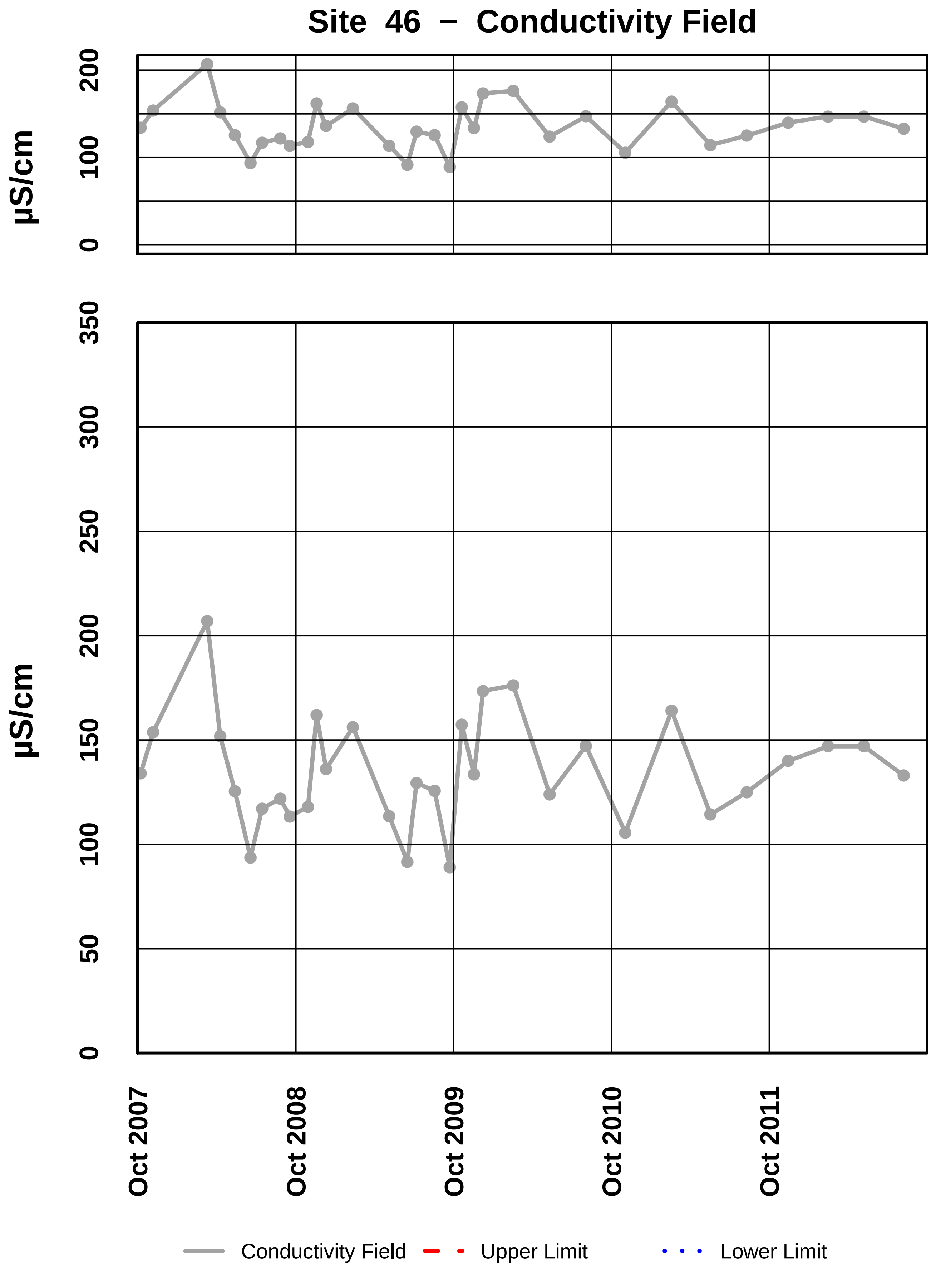
Site 46 – Water Temperature



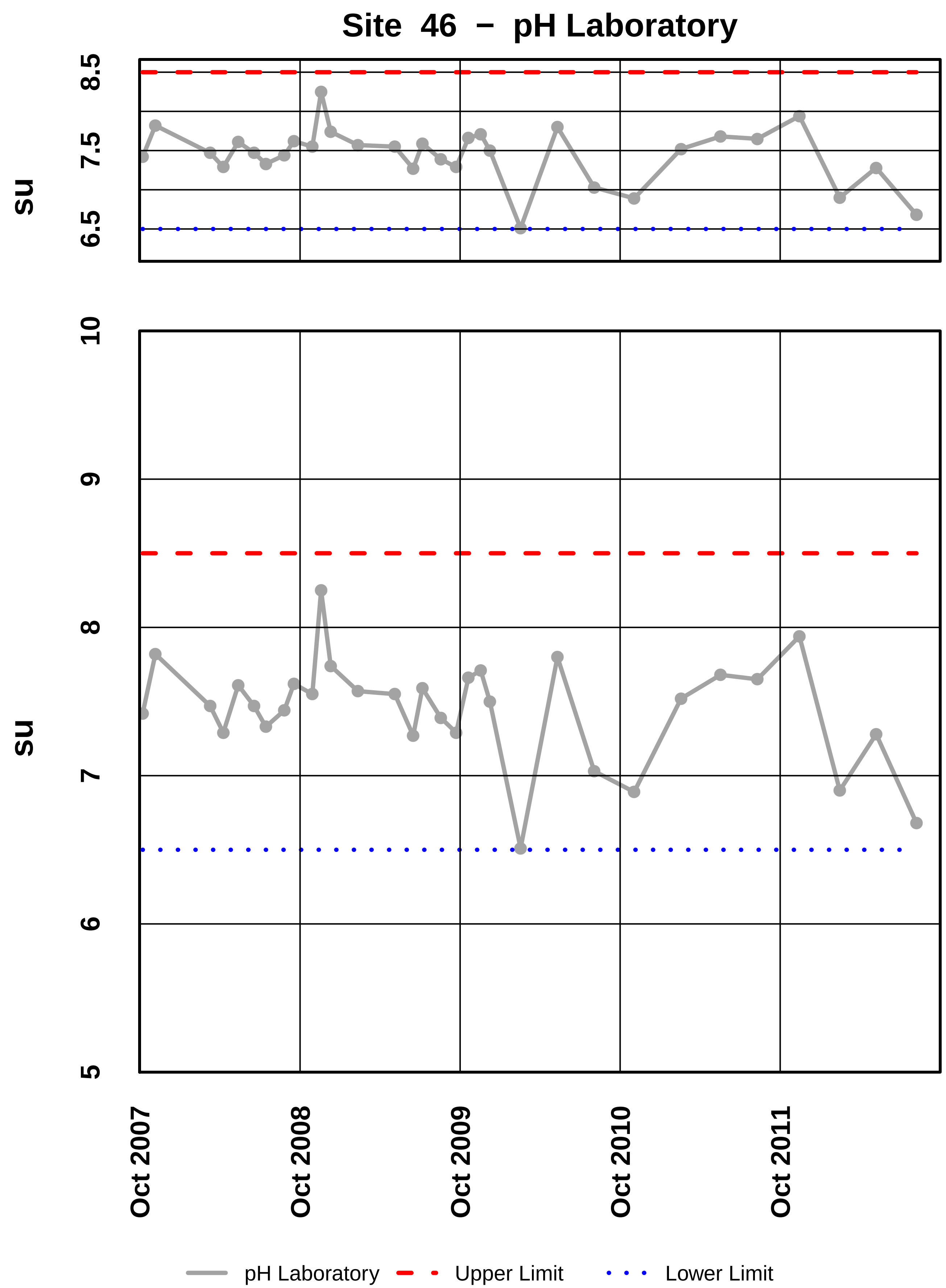
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

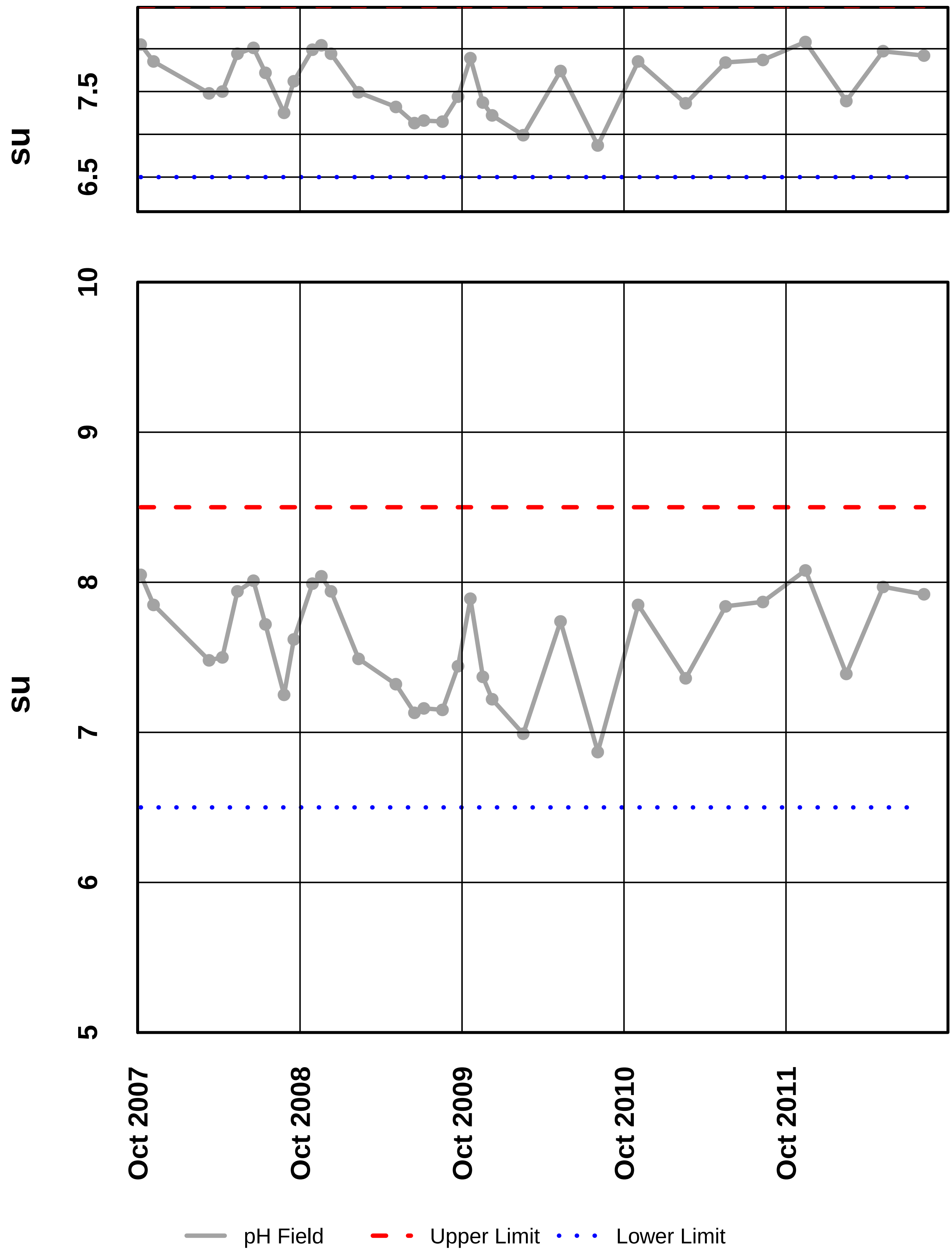


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

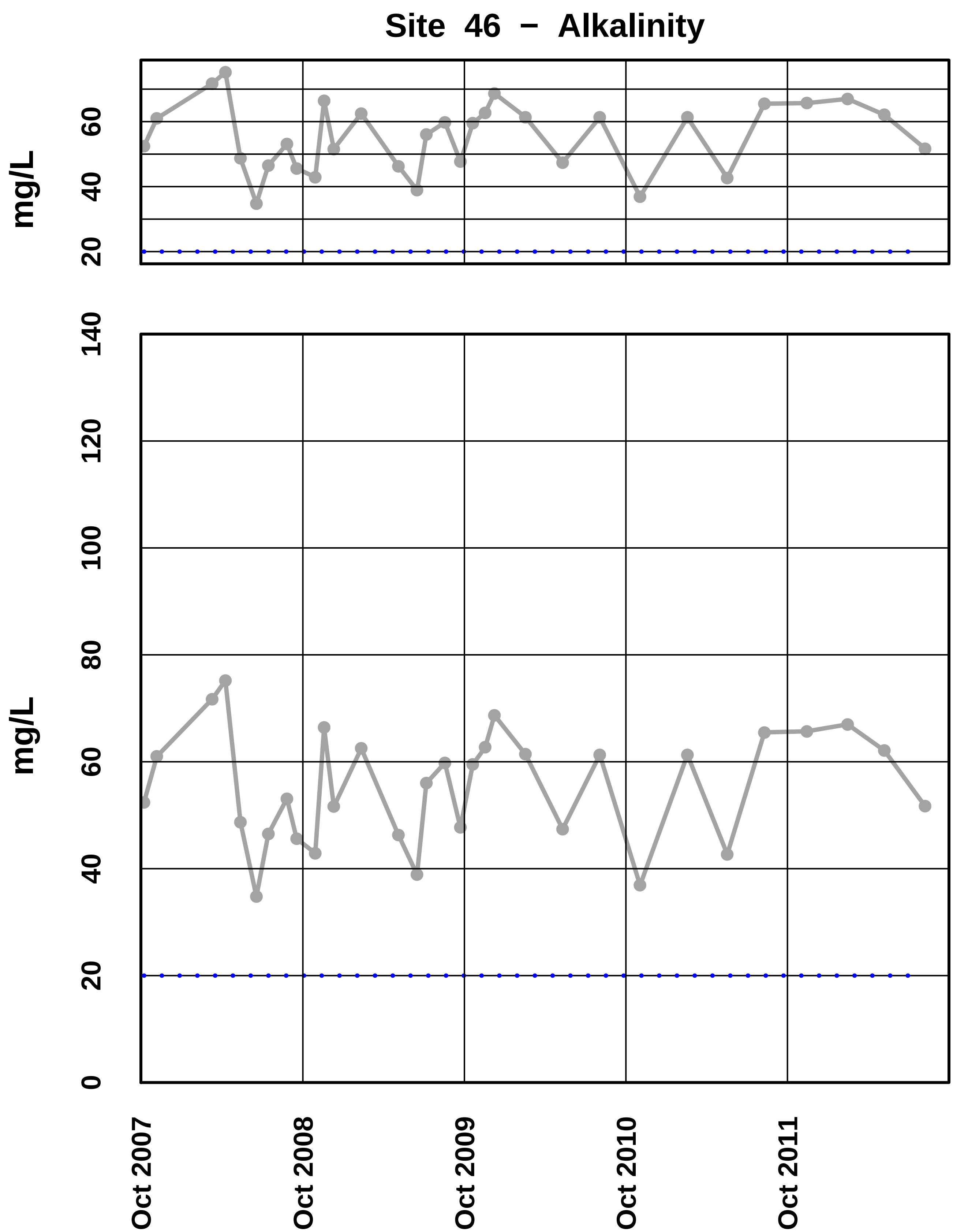


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 46 − pH Field

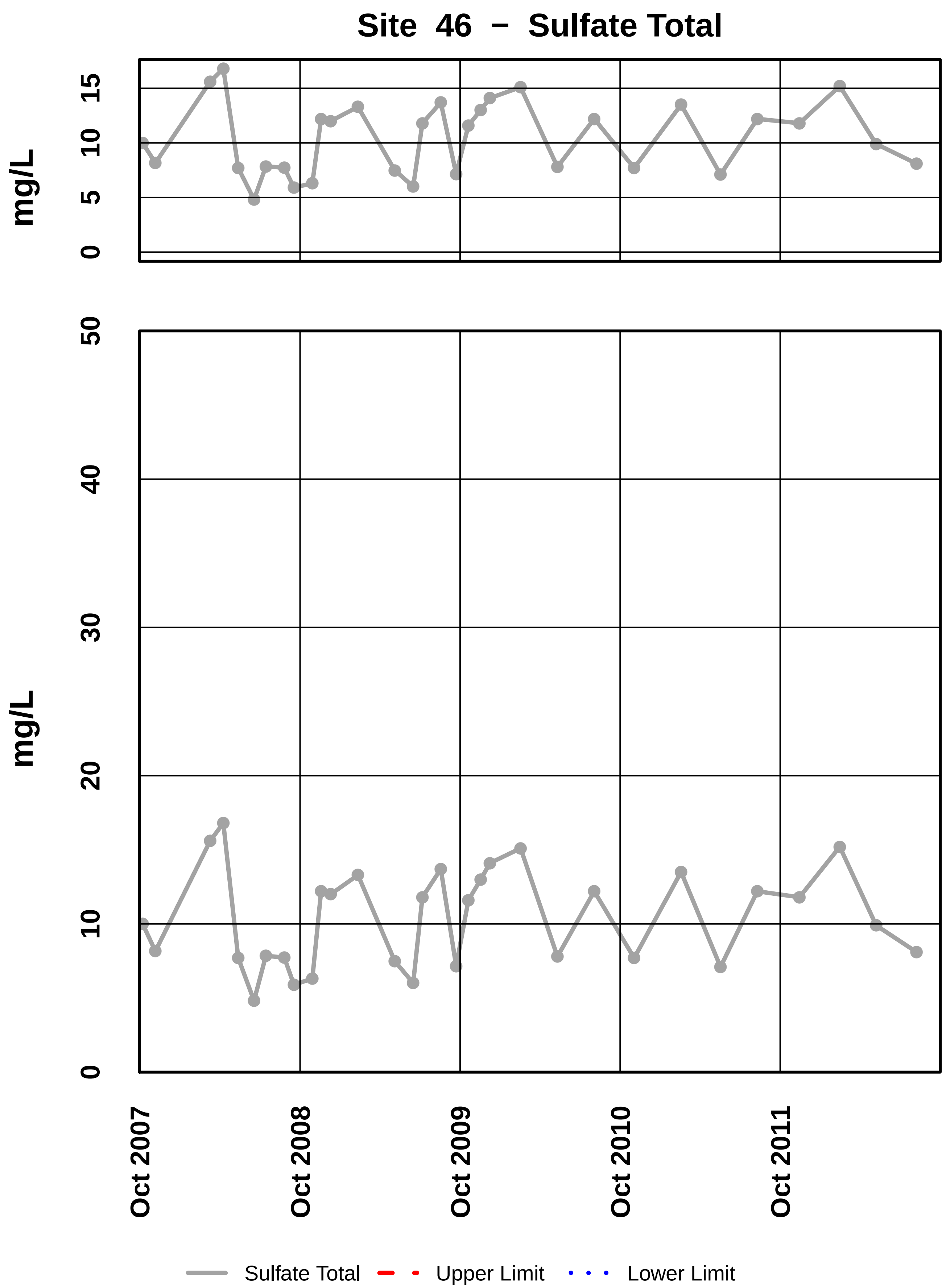


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



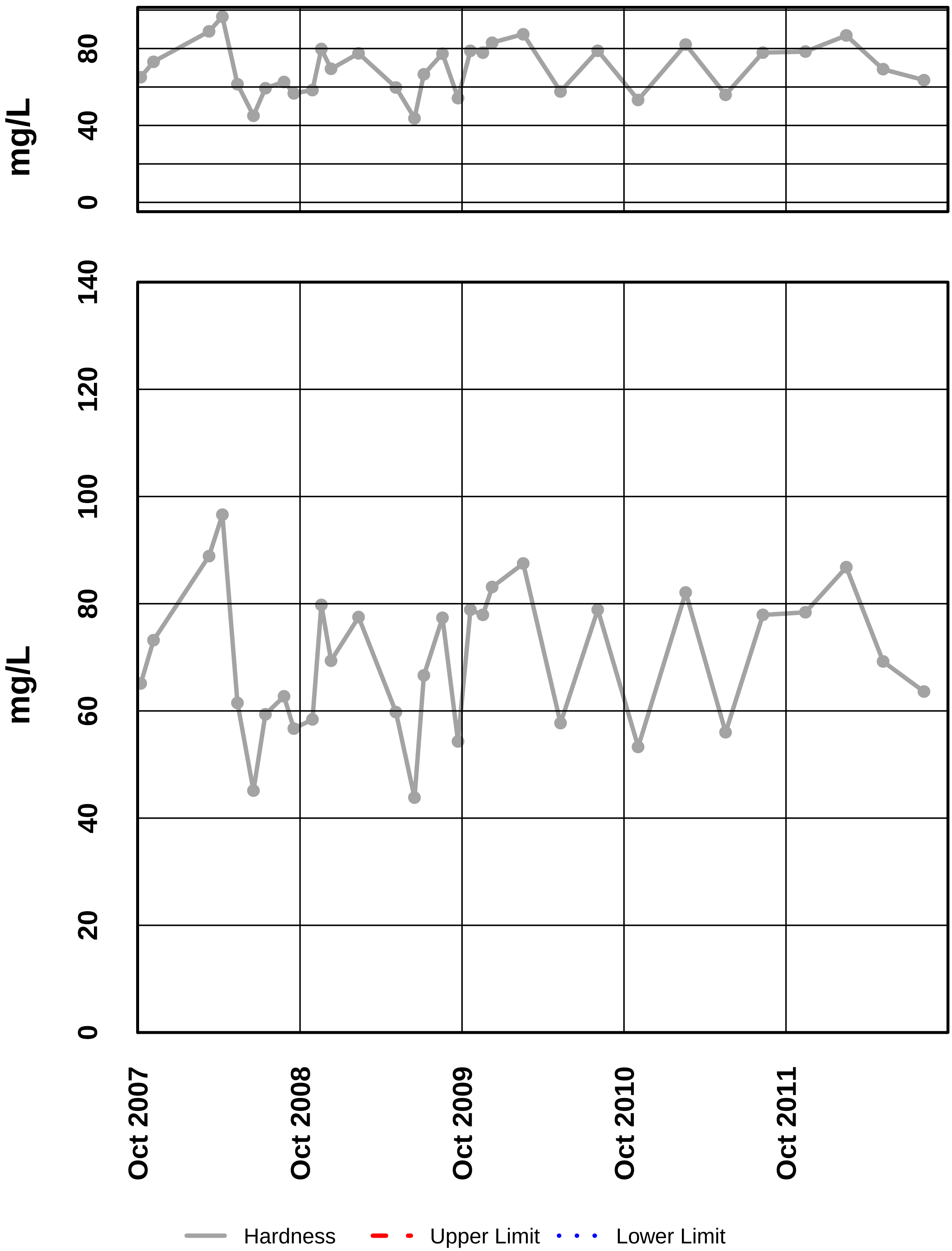
Alkalinity Upper Limit Lower Limit

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

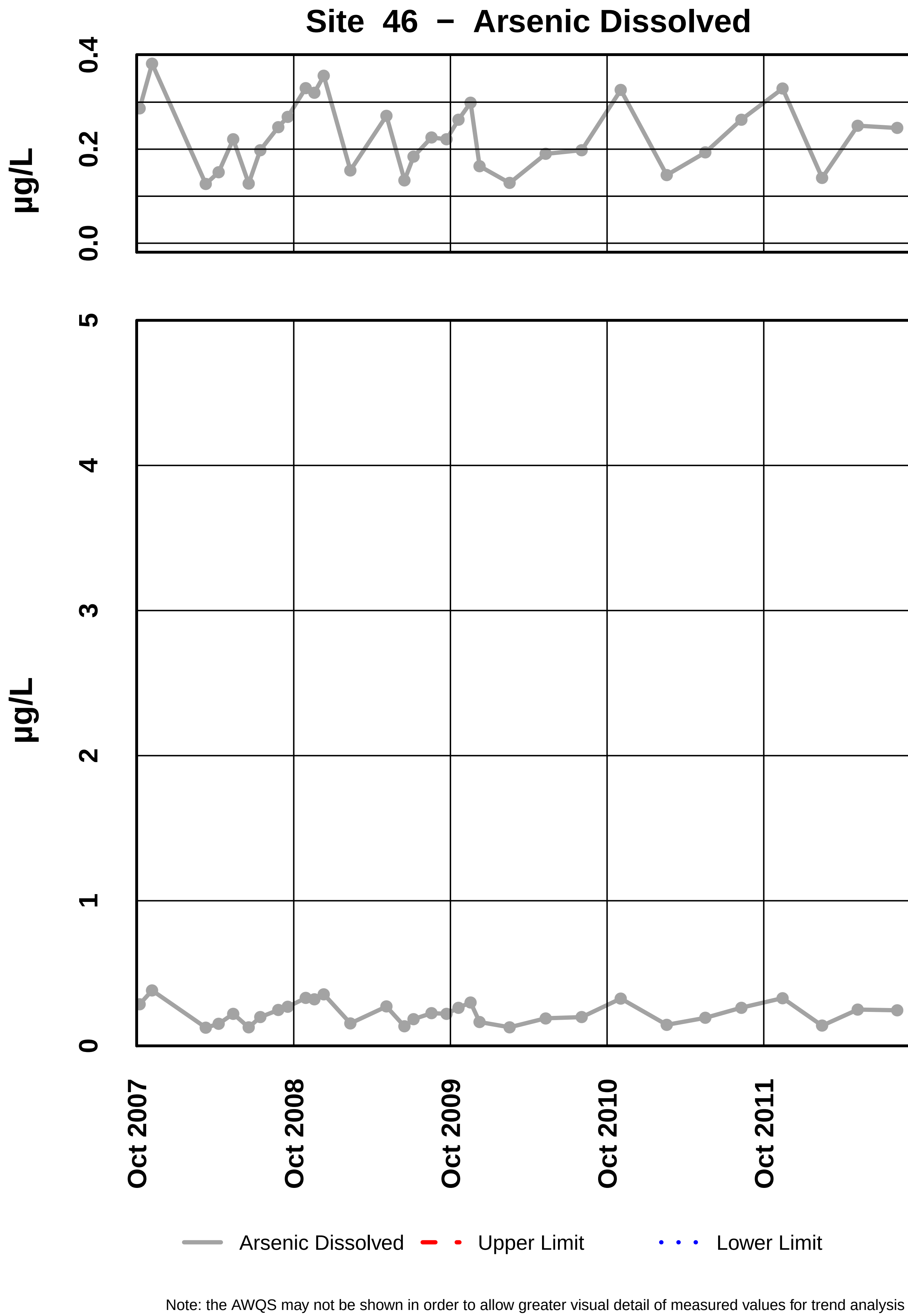


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 46 − Hardness

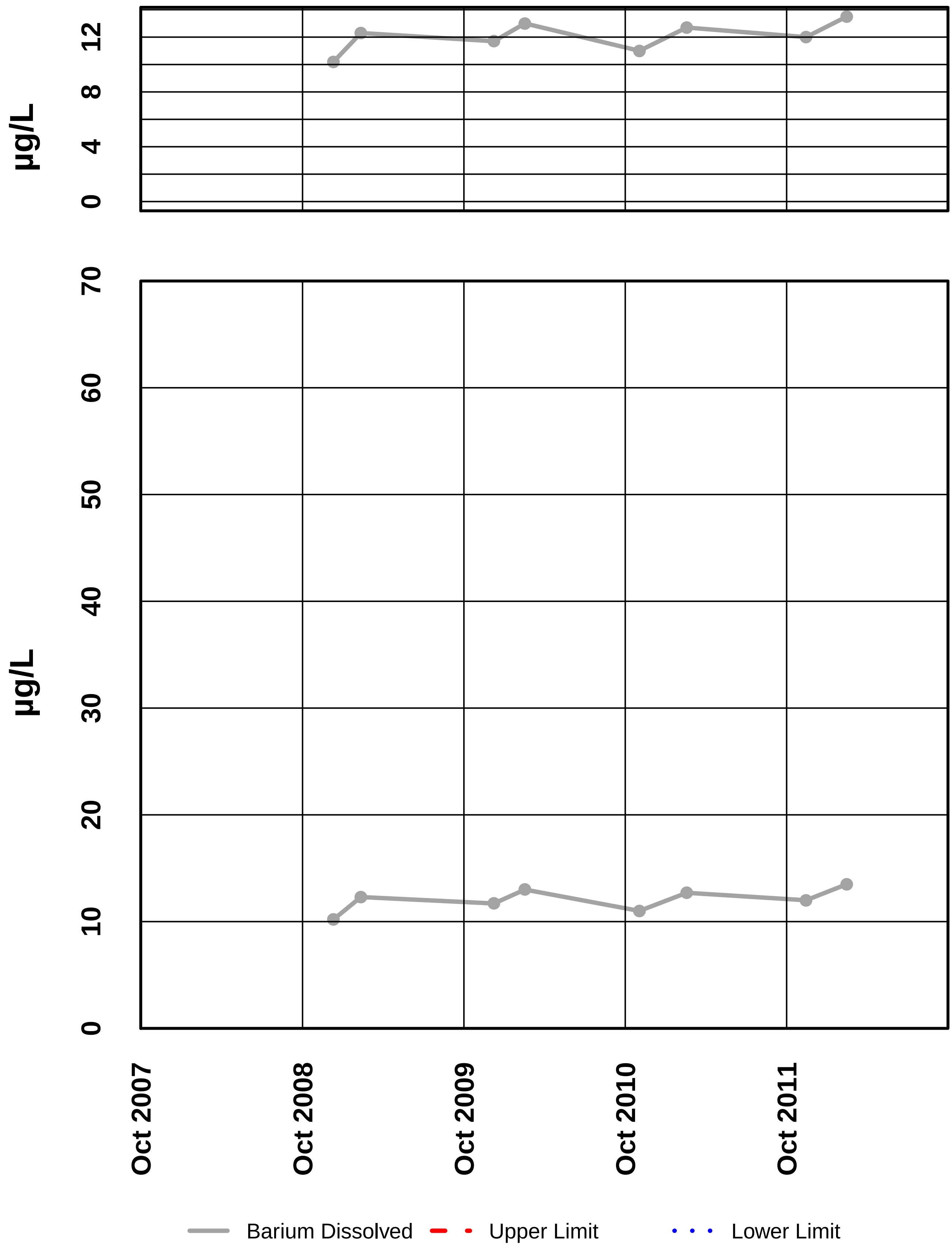


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

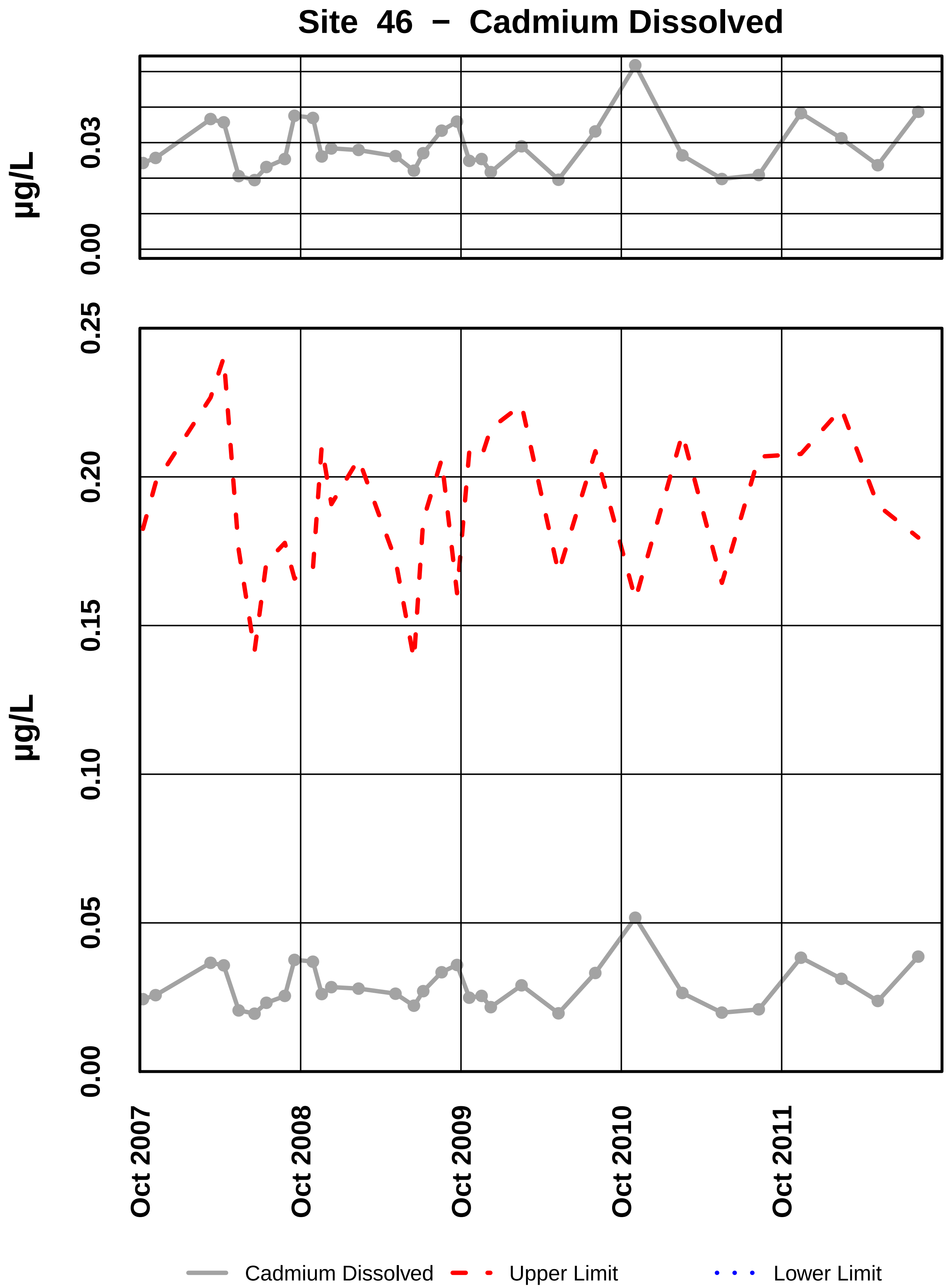


Site 46 – Arsenic Dissolved
µg/L
0.0
0.2
0.4
µg/L
0
1
2
3
4
5
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Arsenic Dissolved
Upper Limit
Lower Limit
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 46 − Barium Dissolved

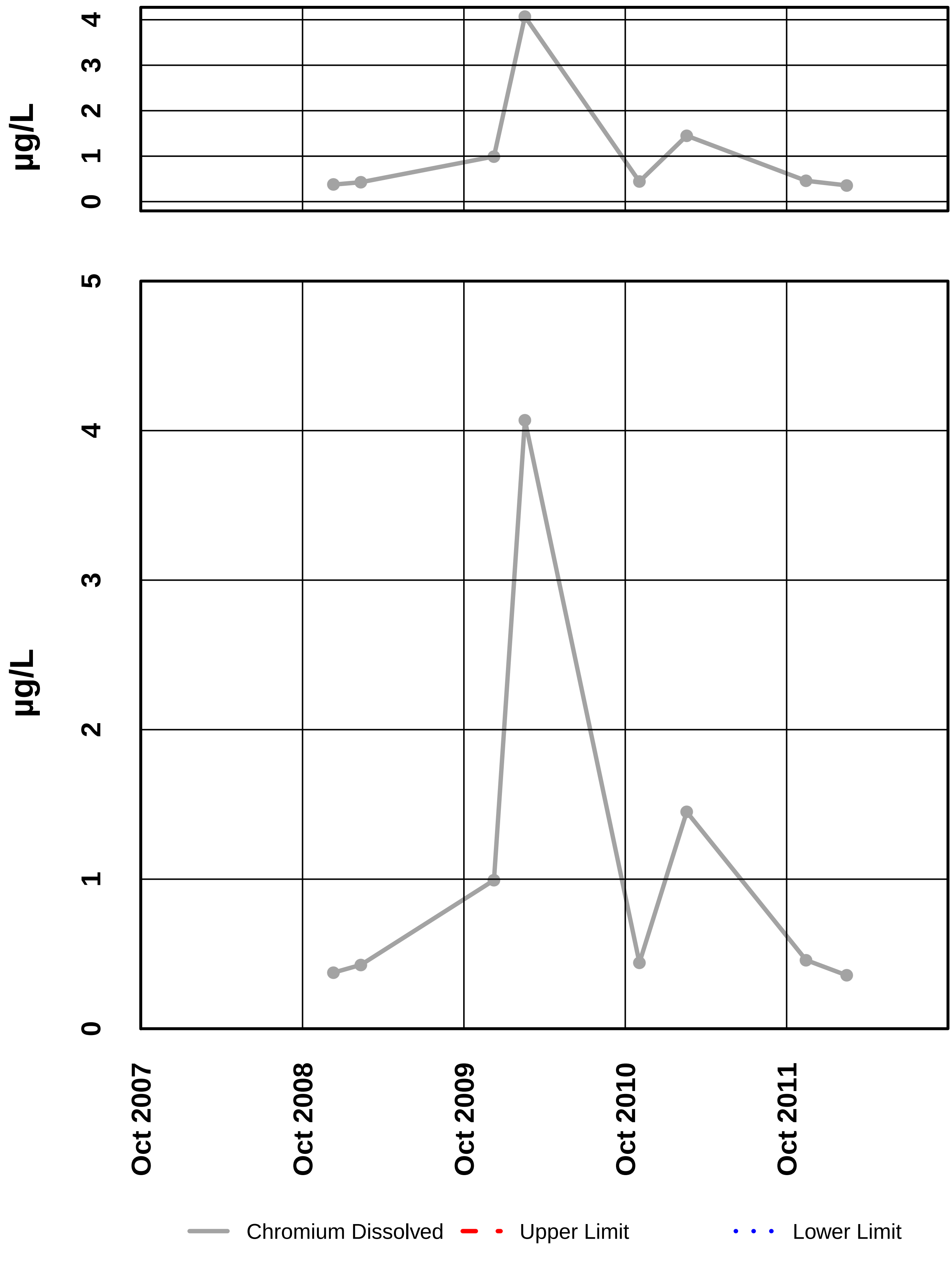


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

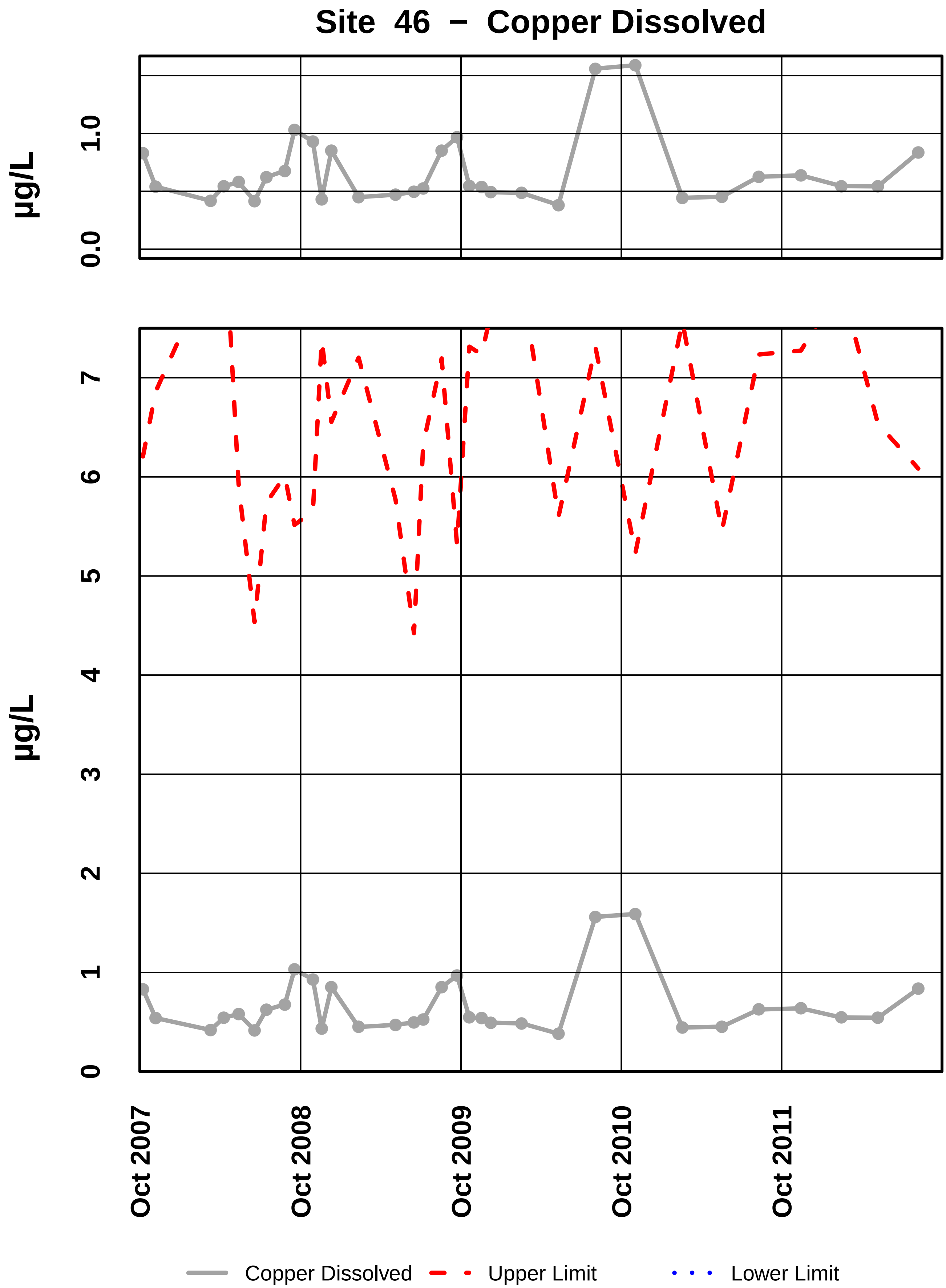


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

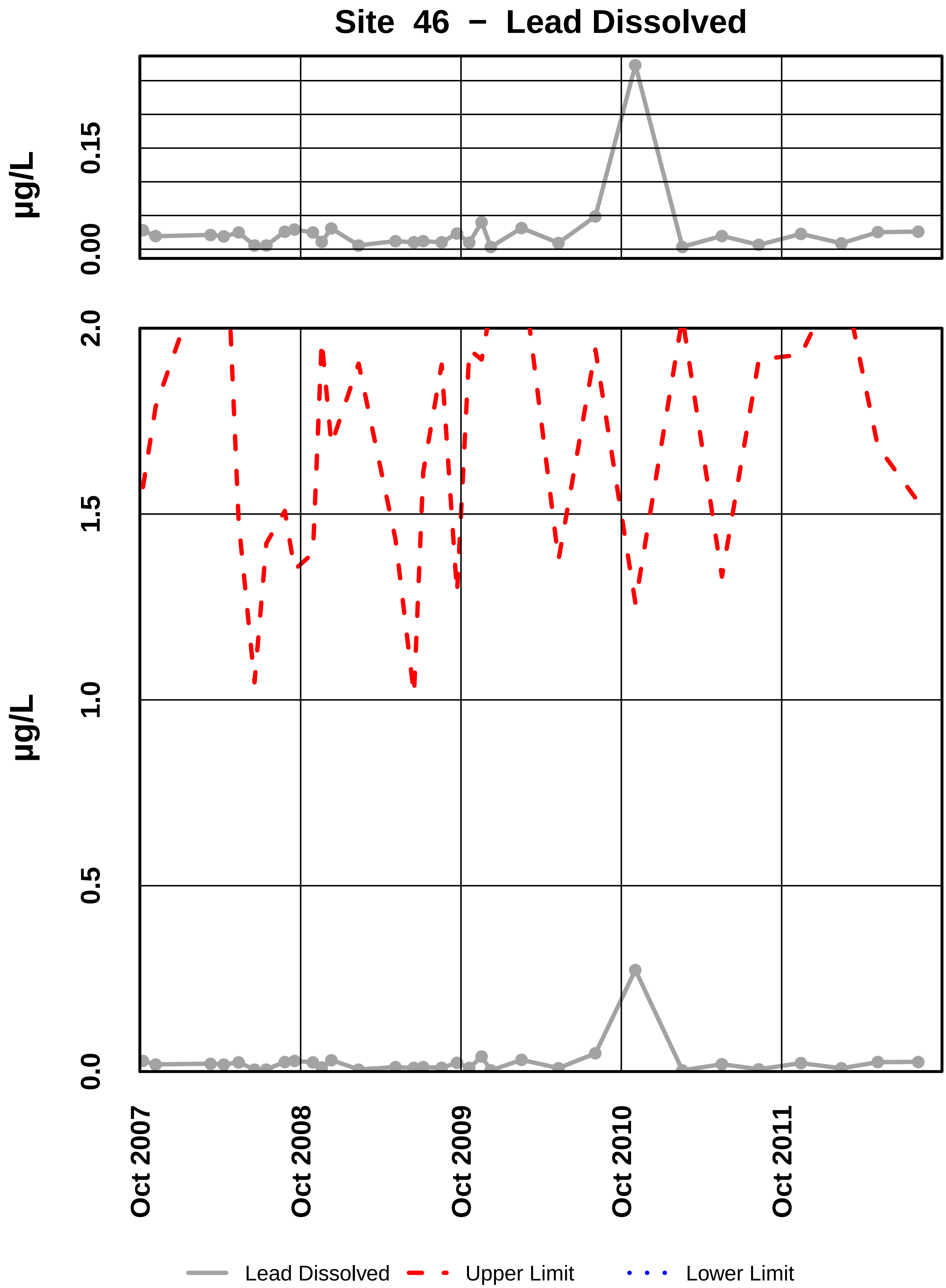
Site 46 – Chromium Dissolved



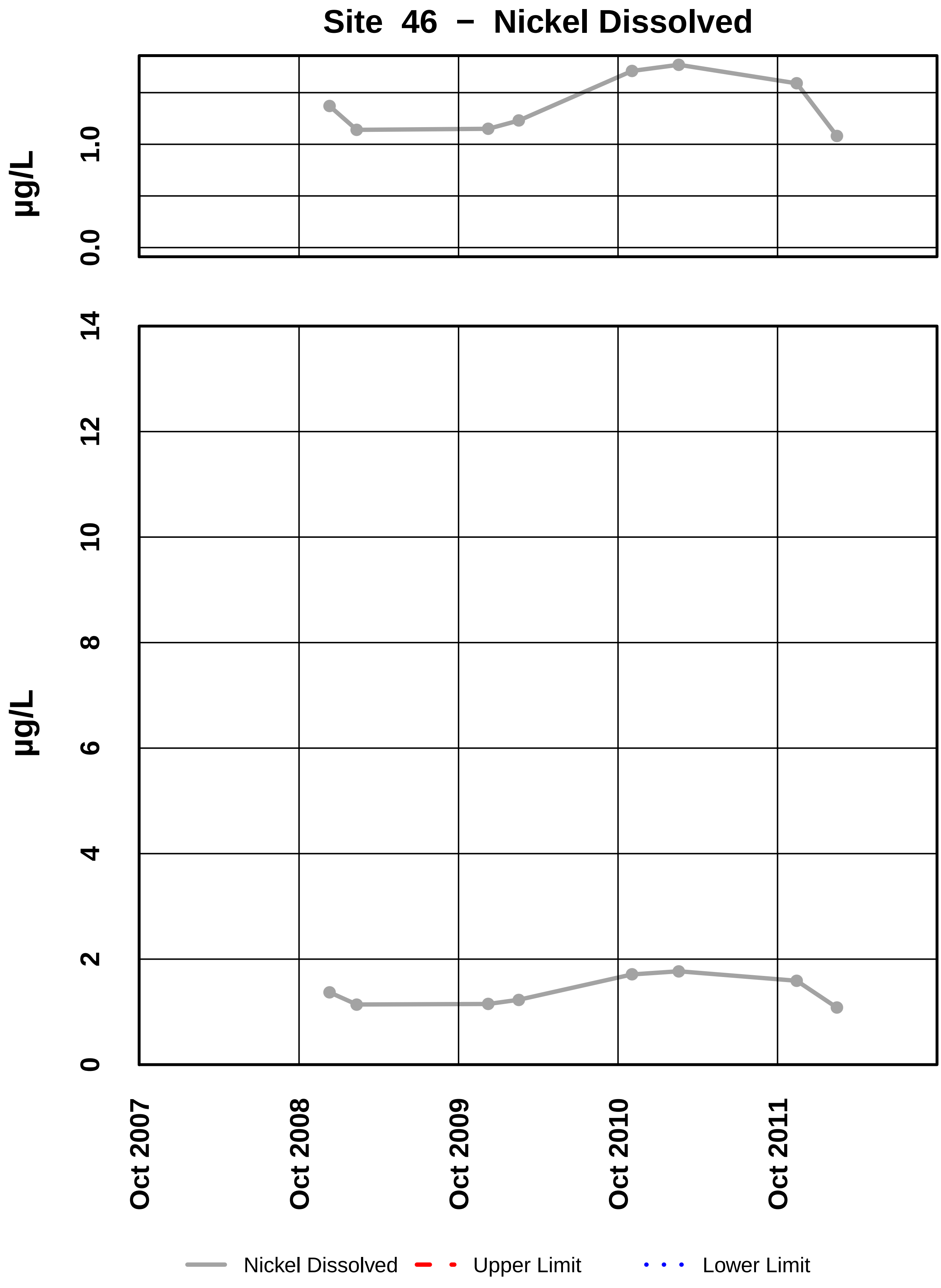
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



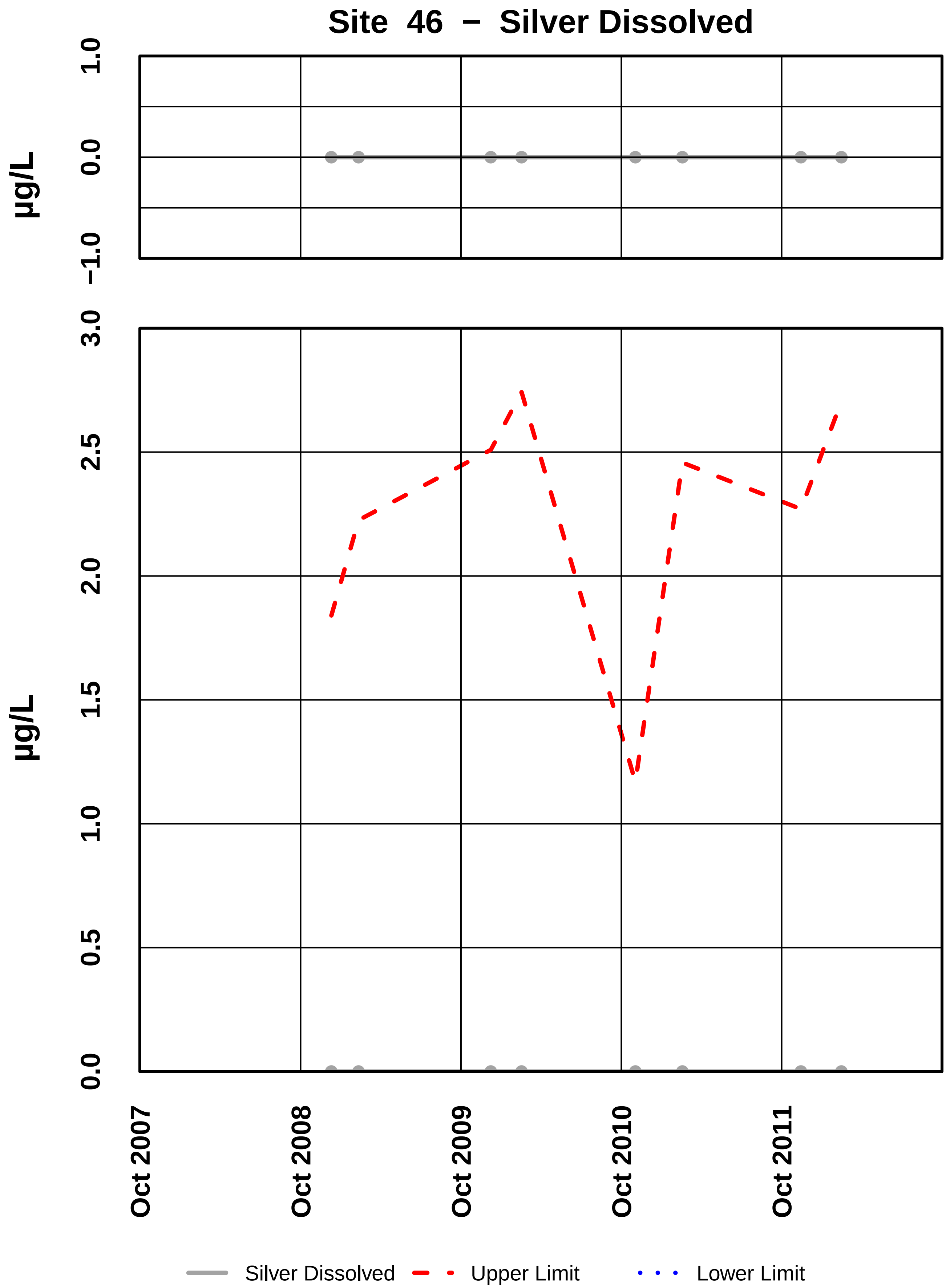
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



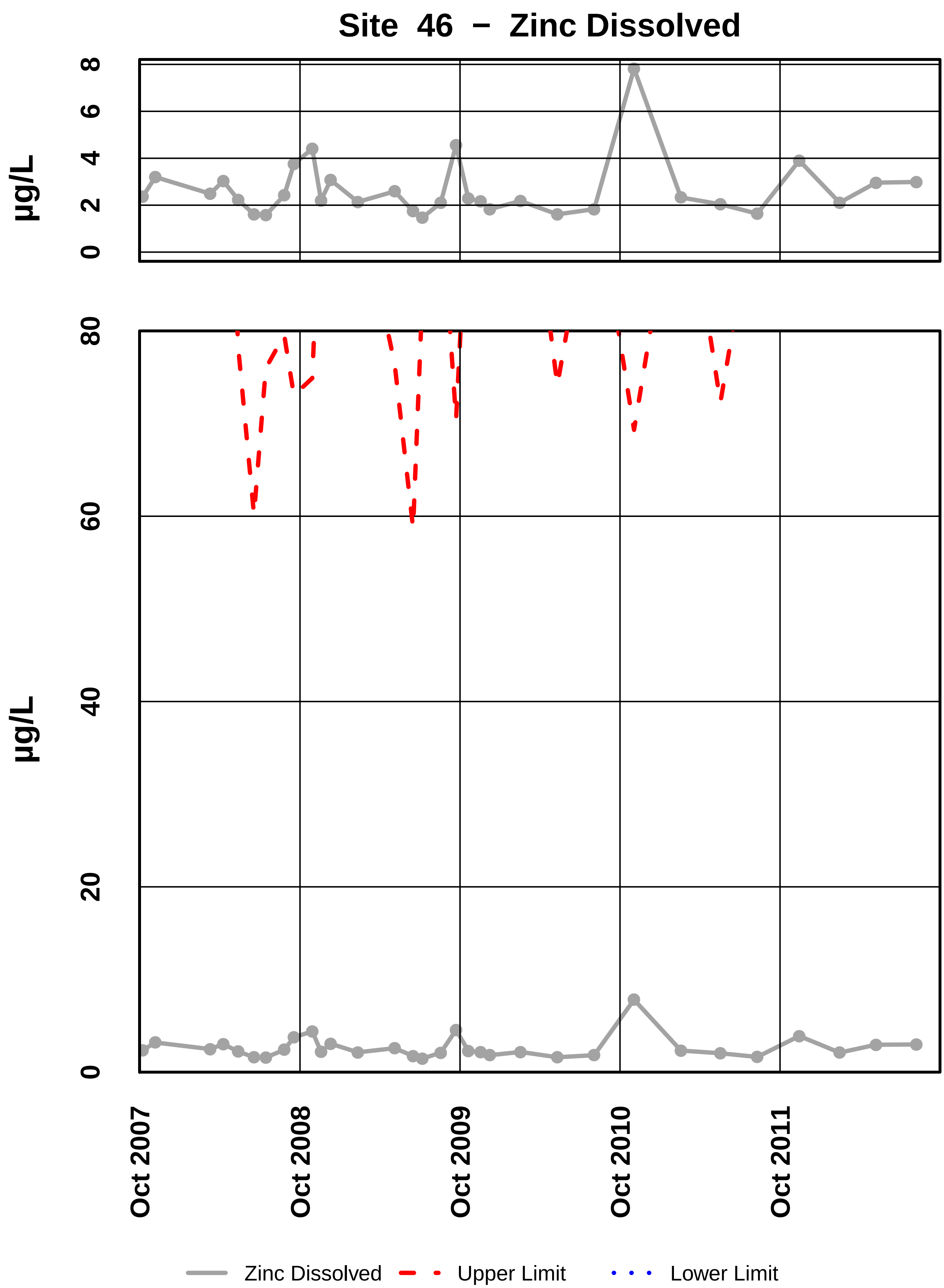
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



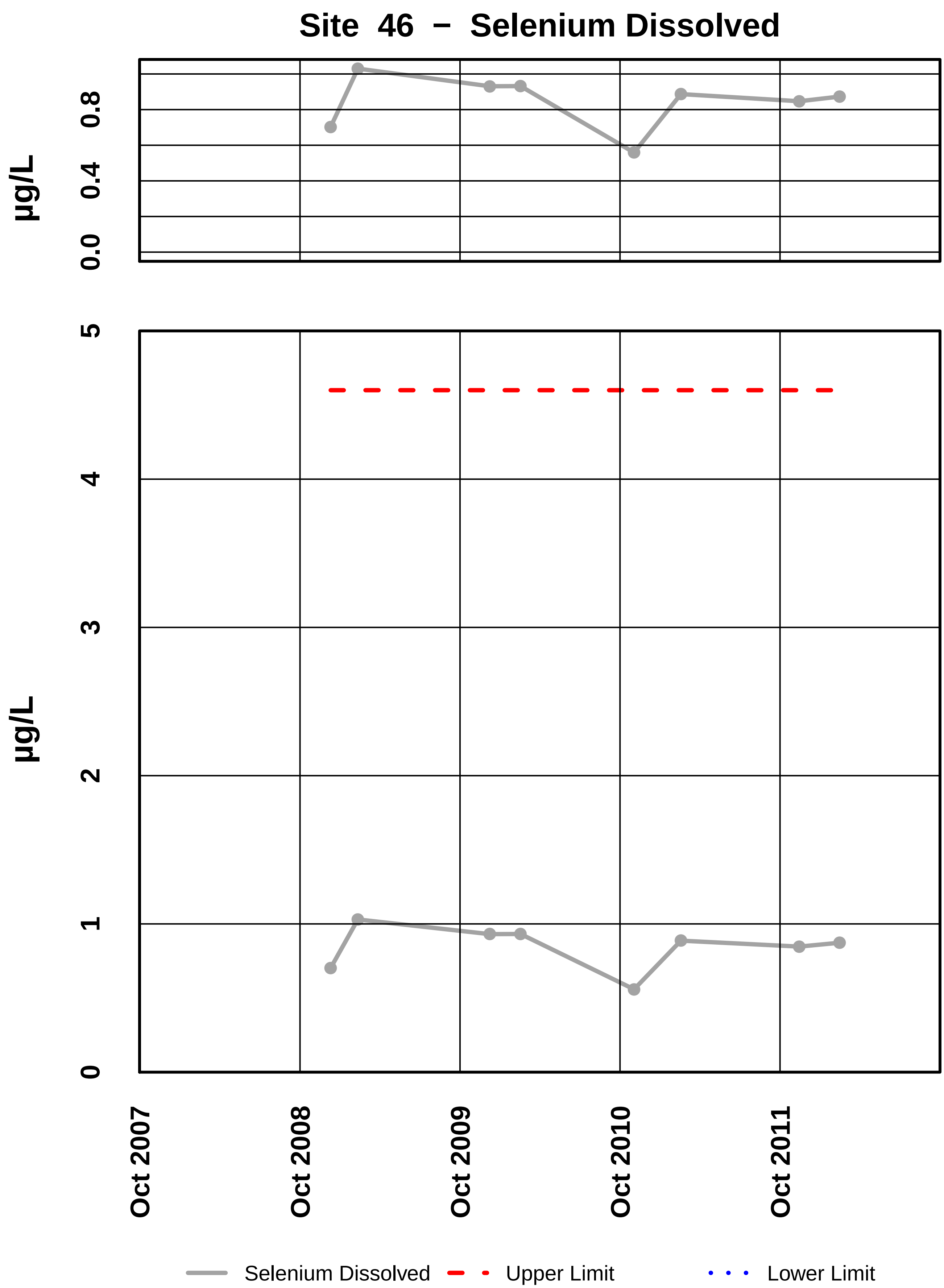
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



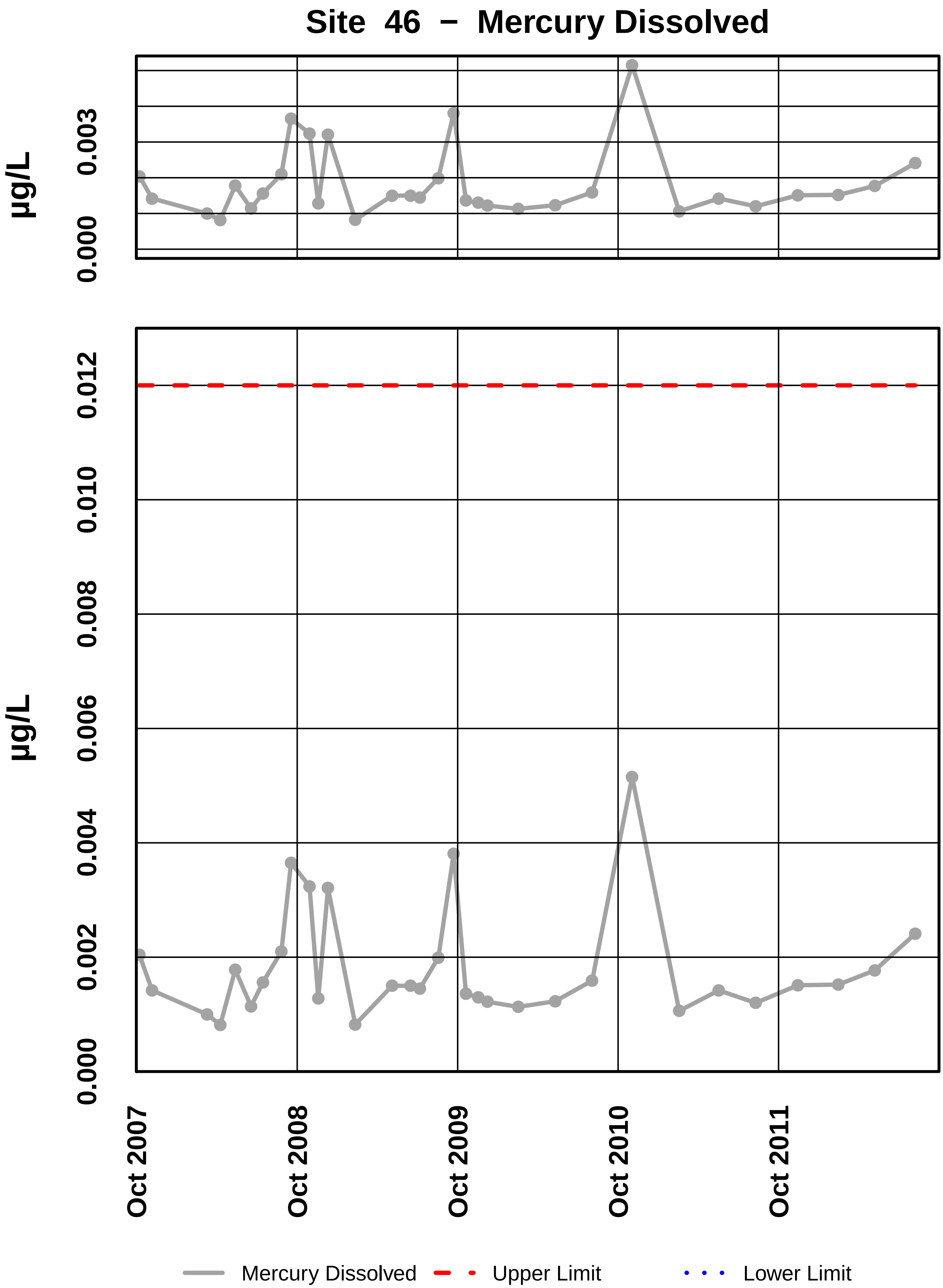
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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



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



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

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**	158.4	167.7	162.4	145.8	170		151.3	138.8	87.6	99.9	174.6	161.8
b	**WY2008**	134	153.8				207	151.8	125.5	93.7	117.2	121.9	113.4
c	**WY2009**	118	161.9	136.1		156.2			113.5	91.7	129.5	125.6	89
d	**WY2010**	157.4	133.6	173.5		176.2			124			147.2	
e	**WY2011**		105.6			164			114.3			125	
f	**WY2012**		140			147			147			133	
	n	4	6	3	1	5	1	2	6	3	3	6	3

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

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

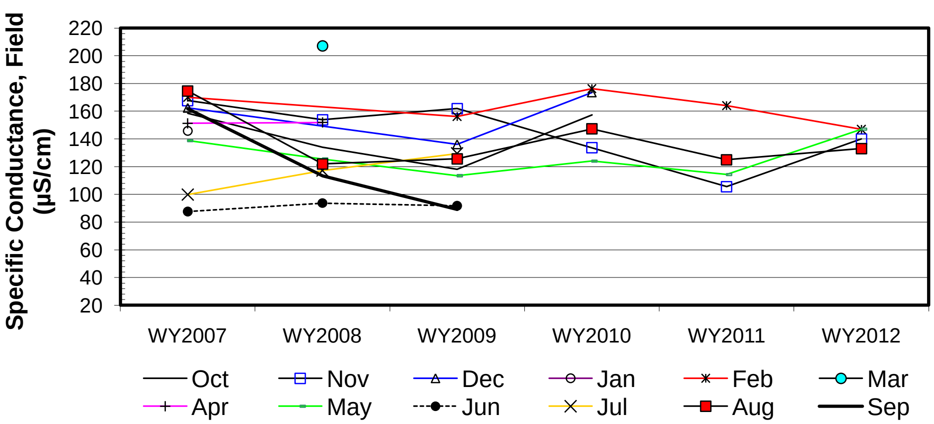
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	8.67	28.33	3.67		16.67		1.00	28.33	3.67	3.67	28.33	3.67
$Z_k = S_k/\sigma_S$	-0.68	-1.69	0.52		-0.98		1.00	-0.19	0.52	1.57	-0.19	-1.57
Z^2_k	0.46	2.86	0.27		0.96		1.00	0.04	0.27	2.45	0.04	2.45

ΣZ_k= -1.68
ΣZ^2_k= 10.81
Z-bar=ΣZ_k/K= -0.17

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	43	0	0	0	0

Σn 43
ΣS_k -14

$\chi^2_h=\Sigma Z^2_k$-K(Z-bar)^2=	10.52	@α=5% $\chi^2_{(K-1)}$=	16.92	Test for station homogeneity	
p	**0.310**			$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc} -1.16	@α/2=2.5% Z=	1.96	**H_0** (No trend)	ACCEPT
126.00	**p** **0.123**			**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-11.40		2.09
0.050	-8.51	**-3.26**	0.62
0.100	-7.14		-0.17
0.200	-5.96		-0.96

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**	7.4	7.8	7.8	7.5	7.5		7.6	8.0	7.7	7.7	7.7	7.6
b	**WY2008**	8.1	7.9				7.5	7.5	7.9	8.0	7.7	7.3	7.6
c	**WY2009**	8.0	8.0	7.9		7.5			7.3	7.1	7.2	7.2	7.4
d	**WY2010**	7.9	7.4	7.2		7.0			7.7			6.9	
e	**WY2011**		7.9			7.4			7.8			7.9	
f	**WY2012**		8.1			7.4			8.0			7.9	
	n	4	6	3	1	5	1	2	6	3	3	6	3

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

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

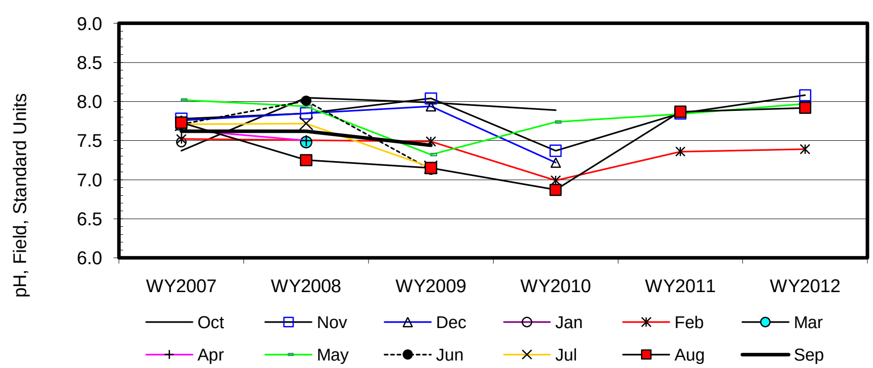
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	8.67	27.33	3.67		16.67		1.00	28.33	3.67	3.67	28.33	2.67
$Z_k = S_k/\sigma_S$	0.00	1.15	-0.52		-0.98		-1.00	-0.19	-0.52	-0.52	0.56	-1.22
Z^2_k	0.00	1.32	0.27		0.96		1.00	0.04	0.27	0.27	0.32	1.50

ΣZ_k=	-3.25
ΣZ^2_k=	5.95
Z-bar=$\Sigma Z_k/K$=	-0.32

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	39	2	0	0	0

Σn	43
ΣS_k	-2

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	4.89	@α=5% $\chi^2_{(K-1)}$= 16.92	Test for station homogeneity	
p	**0.844**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
$\Sigma VAR(S_k)$ / 124.00	Z_{calc} -0.09	@α/2=2.5% Z= 1.96	H_0 (No trend)	ACCEPT
	p **0.464**		H_A (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.09		0.07
0.050	-0.08	**0.00**	0.04
0.100	-0.06		0.03
0.200	-0.04		0.01

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**	55.9	66.9	59.0	62.5	65.7		54.8	56.2	35.0	41.3	65.5	66.1
b	**WY2008**	52.4	61.0				71.7	75.2	48.7	34.8	46.5	53.1	45.6
c	**WY2009**	42.9	66.4	51.6		62.5			46.3	38.9	56.0	59.8	47.7
d	**WY2010**	59.5	62.7	68.7		61.4			47.4			61.3	
e	**WY2011**		36.9			61.3			42.7			65.5	
f	**WY2012**		65.7			67.0			62.1			51.7	
	n	4	6	3	1	5	1	2	6	3	3	6	3

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

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

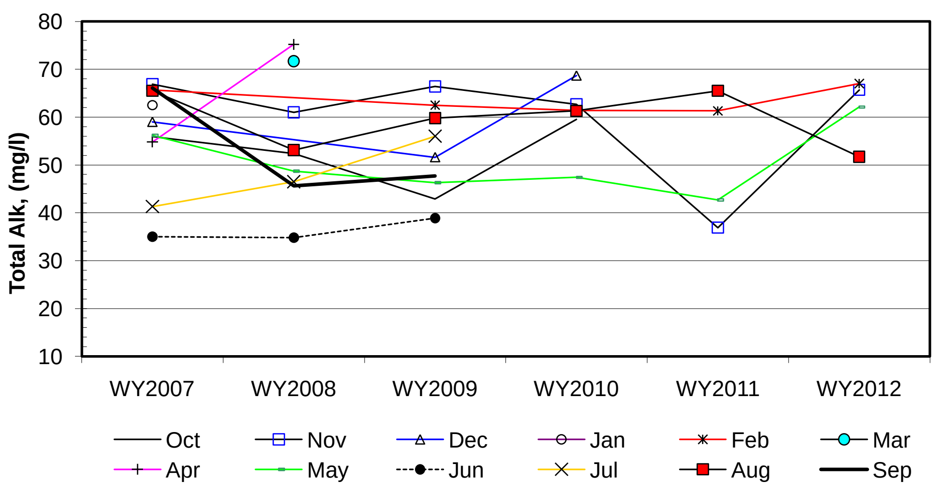
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	8.67	28.33	3.67		16.67		1.00	28.33	3.67	3.67	27.33	3.67
$Z_k = S_k/\sigma_S$	0.00	-0.94	0.52		-0.49		1.00	-0.56	0.52	1.57	-0.38	-0.52
Z^2_k	0.00	0.88	0.27		0.24		1.00	0.32	0.27	2.45	0.15	0.27

ΣZ_k= 0.71
ΣZ^2_k= 5.86
Z-bar=ΣZ_k/K= 0.07

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	41	1	0	0	0

Σn 43
ΣS_k -7

$\chi^2_h=\Sigma Z^2_k$-K(Z-bar)^2=	5.81	@α=5% $\chi^2_{(K-1)}$=	16.92	Test for station homogeneity
p	**0.759**			$\chi^2_h<\chi^2_{(K-1)}$ ACCEPT
ΣVAR(S_k)	Z_{calc} -0.54	@α/2=2.5% Z=	1.96	**H_0** (No trend) ACCEPT
125.00	p **0.296**			**H_A** (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-2.40		1.50
0.050	-1.47	**-0.24**	1.18
0.100	-1.40		1.11
0.200	-0.97		0.18

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**	8.0	10.8	11.2	11.7	13.3		10.6	7.6	3.5	5.3	11.6	12.0
b	**WY2008**	10.0	8.2				15.6	16.8	7.7	4.8	7.9	7.7	5.9
c	**WY2009**	6.3	12.2	12.0		13.3			7.5	6.0	11.8	13.7	7.2
d	**WY2010**	11.6	13.0	14.1		15.1			7.8			12.2	
e	**WY2011**		7.7			13.5			7.1			12.2	
f	**WY2012**		11.8			15.2			9.9			8.1	
	n	4	6	3	1	5	1	2	6	3	3	6	3

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

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

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	8.67	28.33	3.67		15.67		1.00	28.33	3.67	3.67	27.33	3.67
$Z_k = S_k/\sigma_S$	0.68	0.19	1.57		1.77		1.00	0.56	1.57	1.57	0.00	-0.52
Z^2_k	0.46	0.04	2.45		3.13		1.00	0.32	2.45	2.45	0.00	0.27

ΣZ_k= 8.38

ΣZ^2_k= 12.58

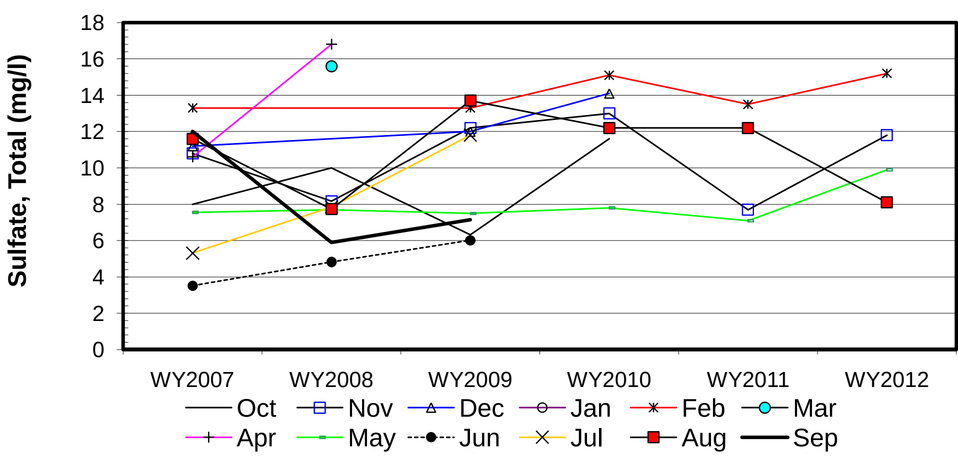
Z-bar=$\Sigma Z_k/K$= 0.84

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	39	2	0	0	0

Σn 43

ΣS_k 22

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	5.56	@α=5% $\chi^2_{(K-1)}$= 16.92	Test for station homogeneity	
p	**0.783**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
$\Sigma VAR(S_k)$ / 124.00	Z_{calc} 1.89	@α=2.5% Z= 1.96	**H_0** (No trend)	ACCEPT
	p **0.970**		**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.11		0.90
0.050	0.04	0.26	0.74
0.100	0.05		0.64
0.200	0.09		0.52

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**	1.6	1.0	1.1	1.2	1.5		1.3	2.0	1.4	1.5	1.9	1.6
b	**WY2008**	2.4	3.2				2.5	3.0	2.2	1.6	1.6	2.4	3.8
c	**WY2009**	4.4	2.2	3.1		2.1			2.6	1.7	1.5	2.1	4.6
d	**WY2010**	2.3	2.2	1.8		2.2			1.6			1.8	
e	**WY2011**		7.8			2.3			2.0			1.6	
f	**WY2012**		3.9			2.1			3.0			3.0	
	n	4	6	3	1	5	1	2	6	3	3	6	3

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

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

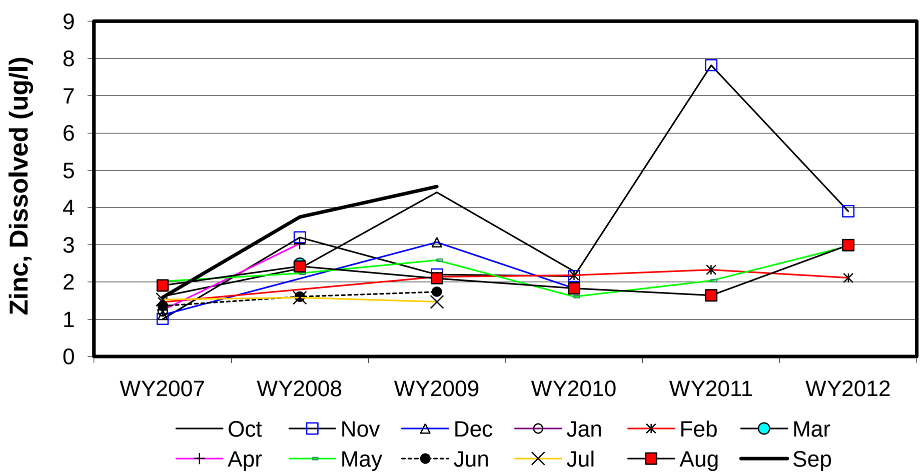
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	8.67	28.33	3.67		16.67		1.00	28.33	3.67	3.67	28.33	3.67
$Z_k = S_k/\sigma_S$	0.68	1.32	0.52		0.98		1.00	0.94	1.57	-0.52	-0.19	1.57
Z^2_k	0.46	1.73	0.27		0.96		1.00	0.88	2.45	0.27	0.04	2.45

ΣZ_k= 7.86
ΣZ^2_k= 10.52
Z-bar=$\Sigma Z_k/K$= 0.79

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	43	0	0	0	0

Σn 43
ΣS_k 24

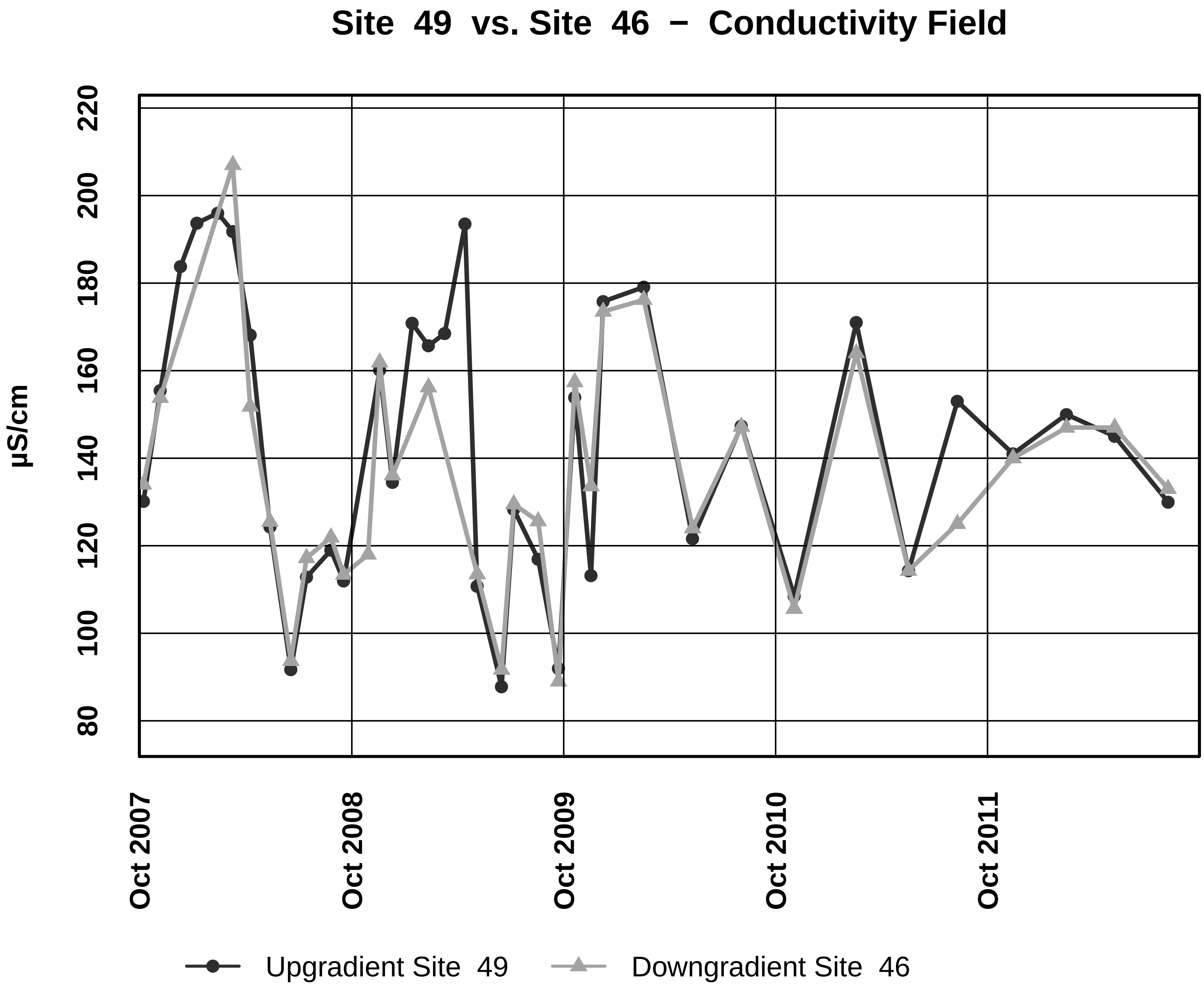
$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	4.35	@α=5% $\chi^2_{(K-1)}$= 16.92	Test for station homogeneity	
p	**0.887**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
$\Sigma VAR(S_k)$	Z_{calc} 2.05	@α/2=2.5% Z= 1.96	$\mathbf{H_0}$ (No trend)	REJECT
126.00	**p** **0.980**		$\mathbf{H_A}$ (± trend)	ACCEPT

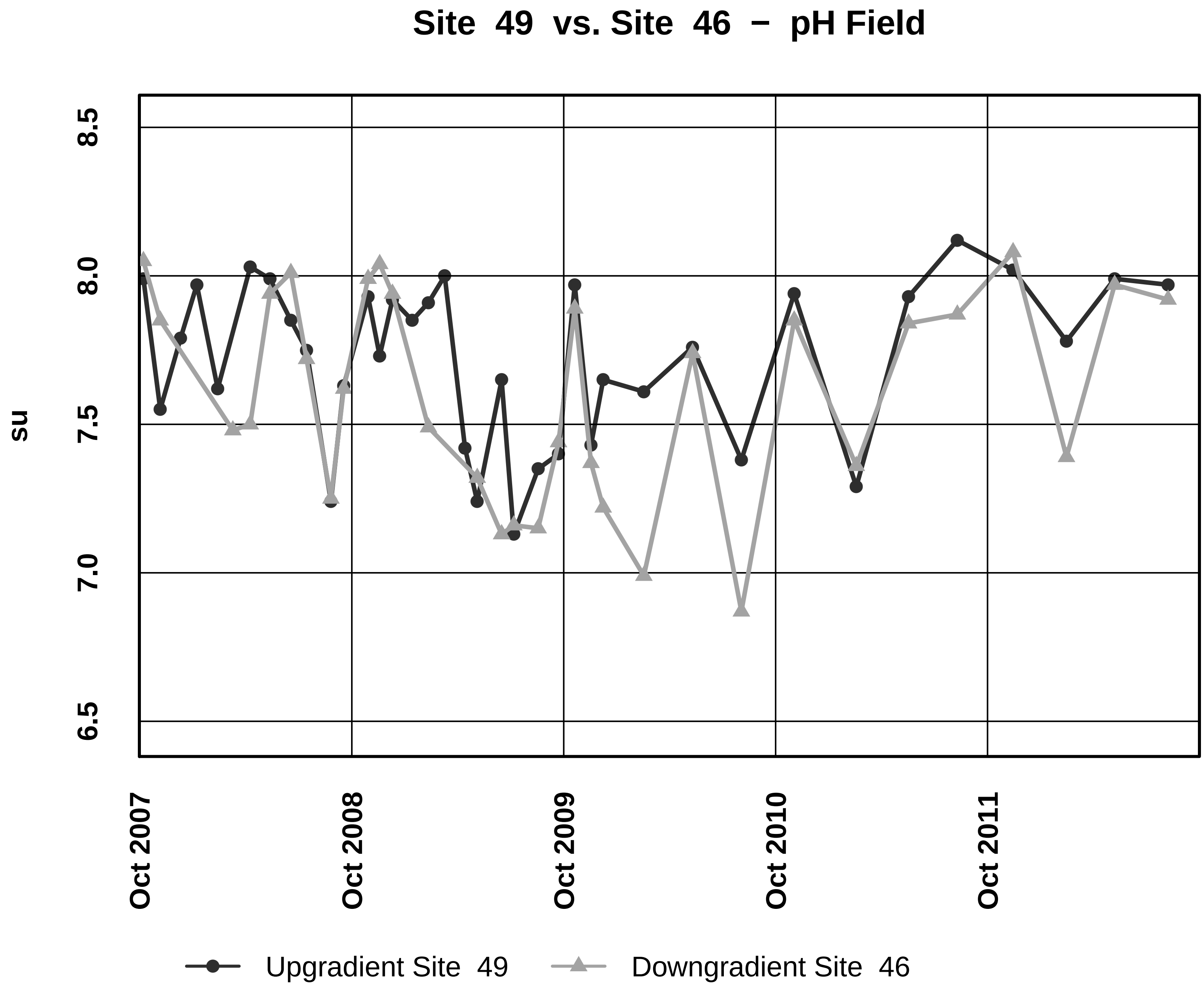


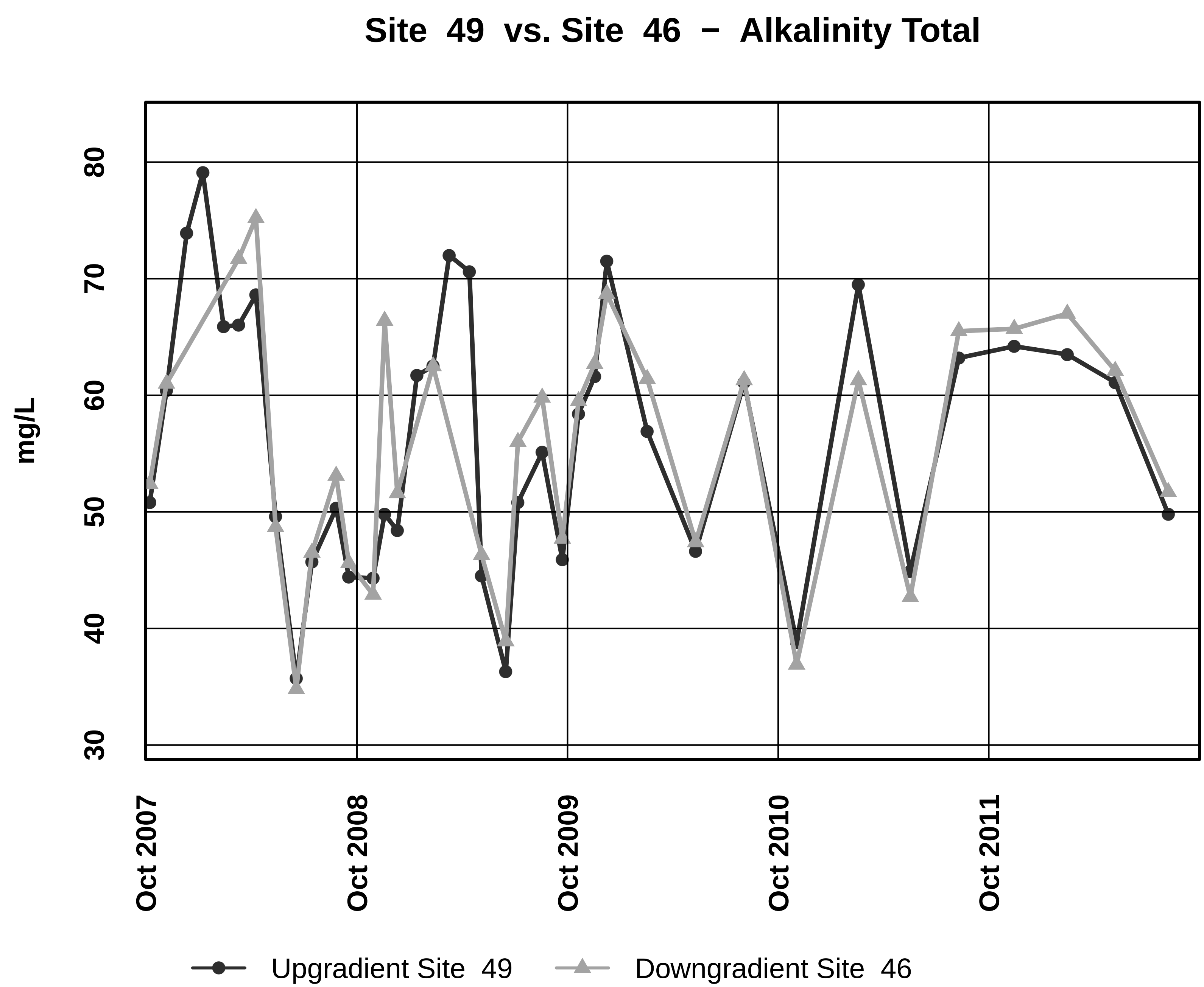
Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.03		0.36
0.050	0.05	**0.19**	0.26
0.100	0.10		0.24
0.200	0.13		0.22

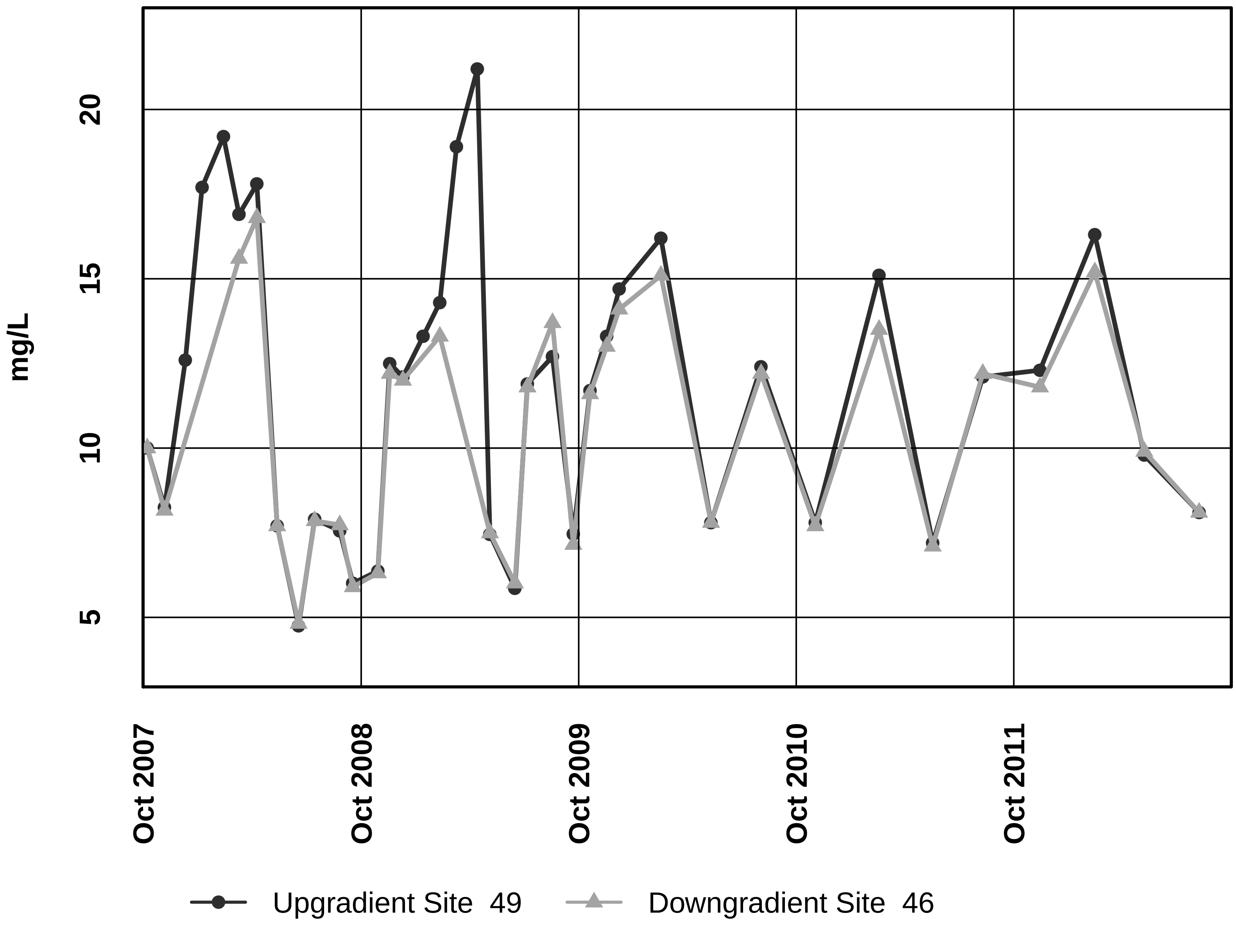
8.8%

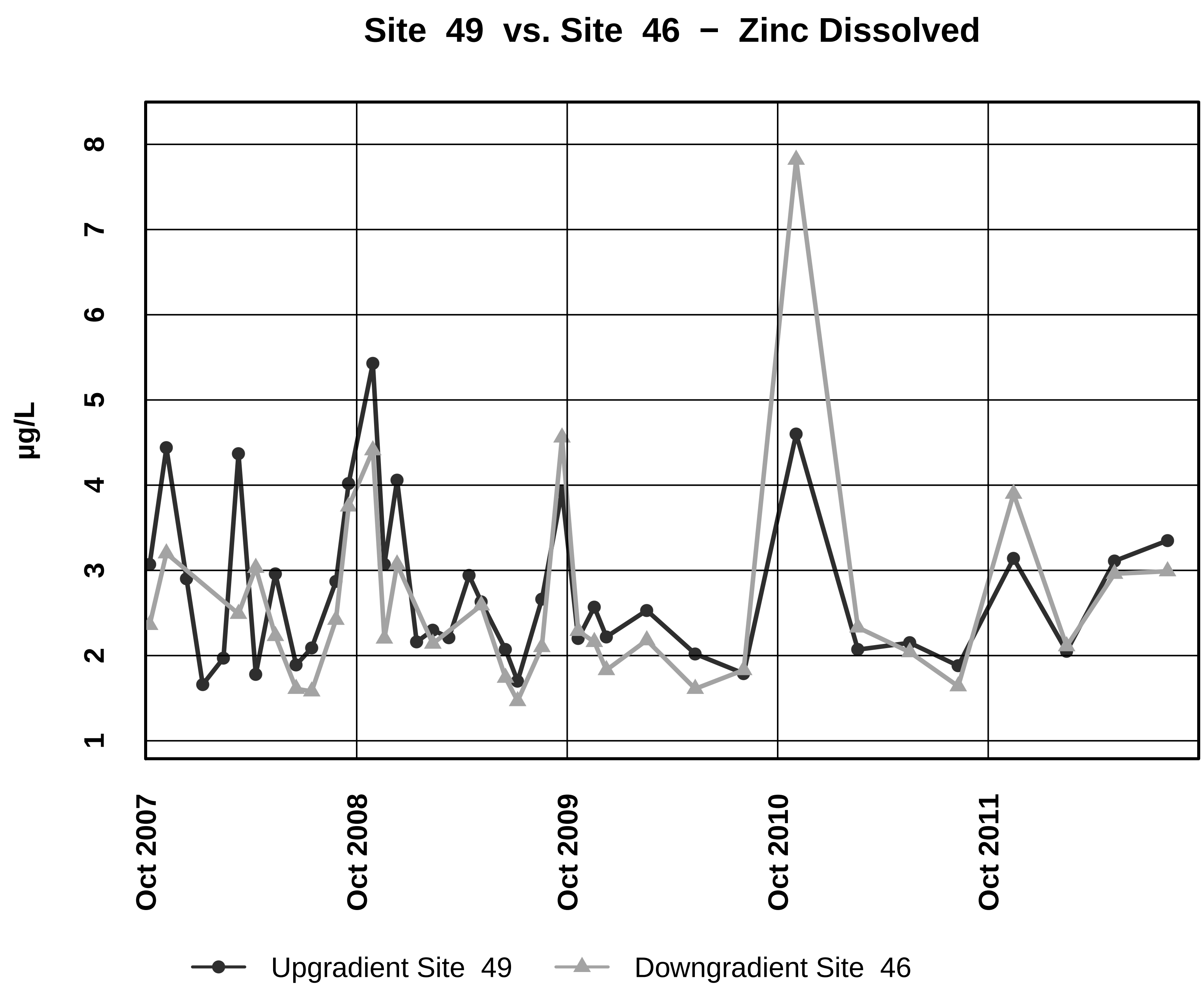

Site 49 vs. Site 46 − Conductivity Field
µS/cm
80
100
120
140
160
180
200
220
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 49
Downgradient Site 46


Site 49 vs. Site 46 − pH Field
su
8.5
8.0
7.5
7.0
6.5
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 49
Downgradient Site 46


Site 49 vs. Site 46 − Alkalinity Total
mg/L
30
40
50
60
70
80
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 49
Downgradient Site 46

Site 49 vs. Site 46 − Sulfate Total





Site 49 vs. Site 46 − Zinc Dissolved
µg/L
1
2
3
4
5
6
7
8
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 49
Downgradient Site 46

INTERPRETIVE REPORT
SITE 57

The data collected during the current water year are listed in the following “Table of Results for Water Year 2012” report. The table includes all the required FWMP analyte data (field and laboratory) collected for the current water year and a series of flags keyed to the summary report “Qualified Data by QA Reviewer”. The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of ½ MDL for the purpose of median calculation.

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

Sample Date	Parameter	Value	Qualifier	Notes
No outliers have been identified by HGCMC for the period of October 2007 through September 2012				

The data for Water year 2012 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 2012

			Limits		
Sample Date	Parameter	Value	Lower	Upper	Hardness
No exceedances have been identified by HGCMC for the period of October 2011 through September 2012.					

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

A non-parametric statistical analysis for trend was performed for specific conductivity, field pH, total alkalinity, total sulfate, and dissolved zinc. Calculation details of the Seasonal Kendall analyses are presented on the pages following this interpretive section. The following table summarizes the results on the data collected between Oct-06 and Sep-12 (WY2007-WY2012). Datasets with a statistically significant trend ($\alpha/2=2.5\%$) a Seasonal-Sen’s Slope estimate statistic has also been calculated. There were no statistically significant trends calculated for these parameters this water year.

Table of Summary Statistics for Trend Analysis

	Mann-Kendall test statistics			Sen's slope estimate	
Parameter	**n***	**p****	**Trend**	**Q**	**Q(%)**
Conductivity Field	6	0.14			
pH Field	6	0.35			
Alkalinity, Total	6	0.31			
Sulfate, Total	6	0.32			
Zinc, Dissolved	6	0.03			

* Number of Years ** Significance level

Table of Results for Water Year 2012

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

Sample Date/Parameter	Oct 2011	Nov 2011	Dec 2011	Jan 2012	Feb 2012	Mar 2012	Apr 2012	May 2012	Jun 2012	Jul 2012	Aug 2012	Sep 2012	**Median**
Water Temp (°C)		5.4						5			6		5.4
Conductivity-Field(μmho)		366						405			397		397.0
Conductivity-Lab (μmho)		382						401			375		382
pH Lab (standard units)		7.41						7.16			6.9		7.16
pH Field (standard units)		7.73						7.52			7.76		7.73
Total Alkalinity (mg/L)		143						164			165		164.0
Total Sulfate (mg/L)		49.5						53.2			49.4		49.5
Hardness (mg/L)		200						205			204		204.0
Dissolved As (ug/L)		0.468						0.534			0.633		0.534
Dissolved Ba (ug/L)		29.2						32.8			30.1		30.1
Dissolved Cd (ug/L)		0.216						0.175			0.179		0.1790
Dissolved Cr (ug/L)		0.582						0.436			1		0.582
Dissolved Cu (ug/L)		0.273						0.874			0.343		0.343
Dissolved Pb (ug/L)		0.237						0.35			0.284		0.2840
Dissolved Ni (ug/L)		2.84						2.33			2.15		2.330
Dissolved Ag (ug/L)		0.003						0.002			0.002		0.002
Dissolved Zn (ug/L)		19.1						20.3			9.01		19.10
Dissolved Se (ug/L)		0.758						0.755			1.11		0.758
Dissolved Hg (ug/L)		0.000175						0.000476			0.000319		0.000319

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.

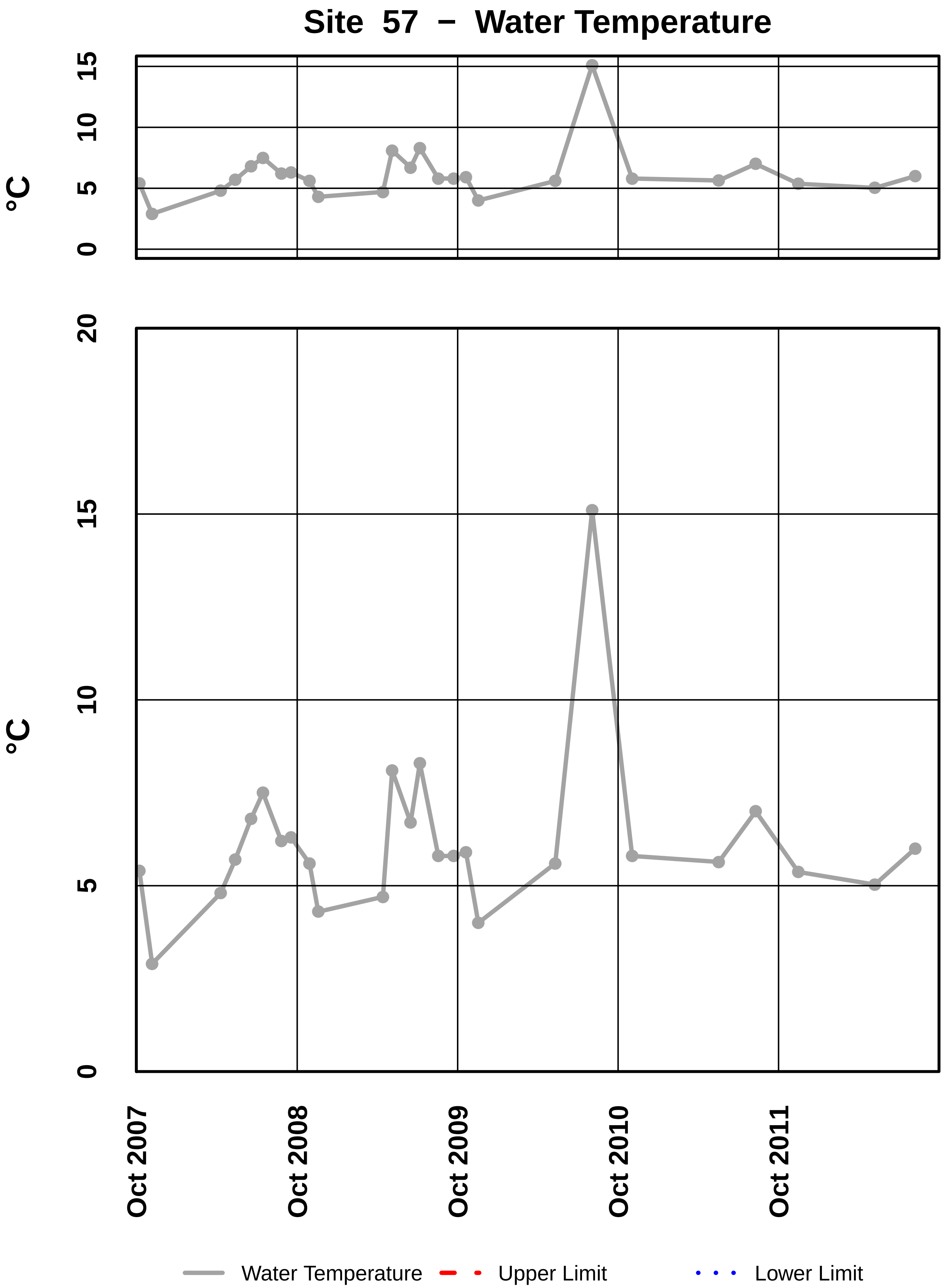
Shaded data has been qualified as an outlier by KGCMC and removed from any further analysis and is not included into the calculation of the median

Qualified Data by QA Reviewer

Date Range: 10/01/2011 to 09/30/2012

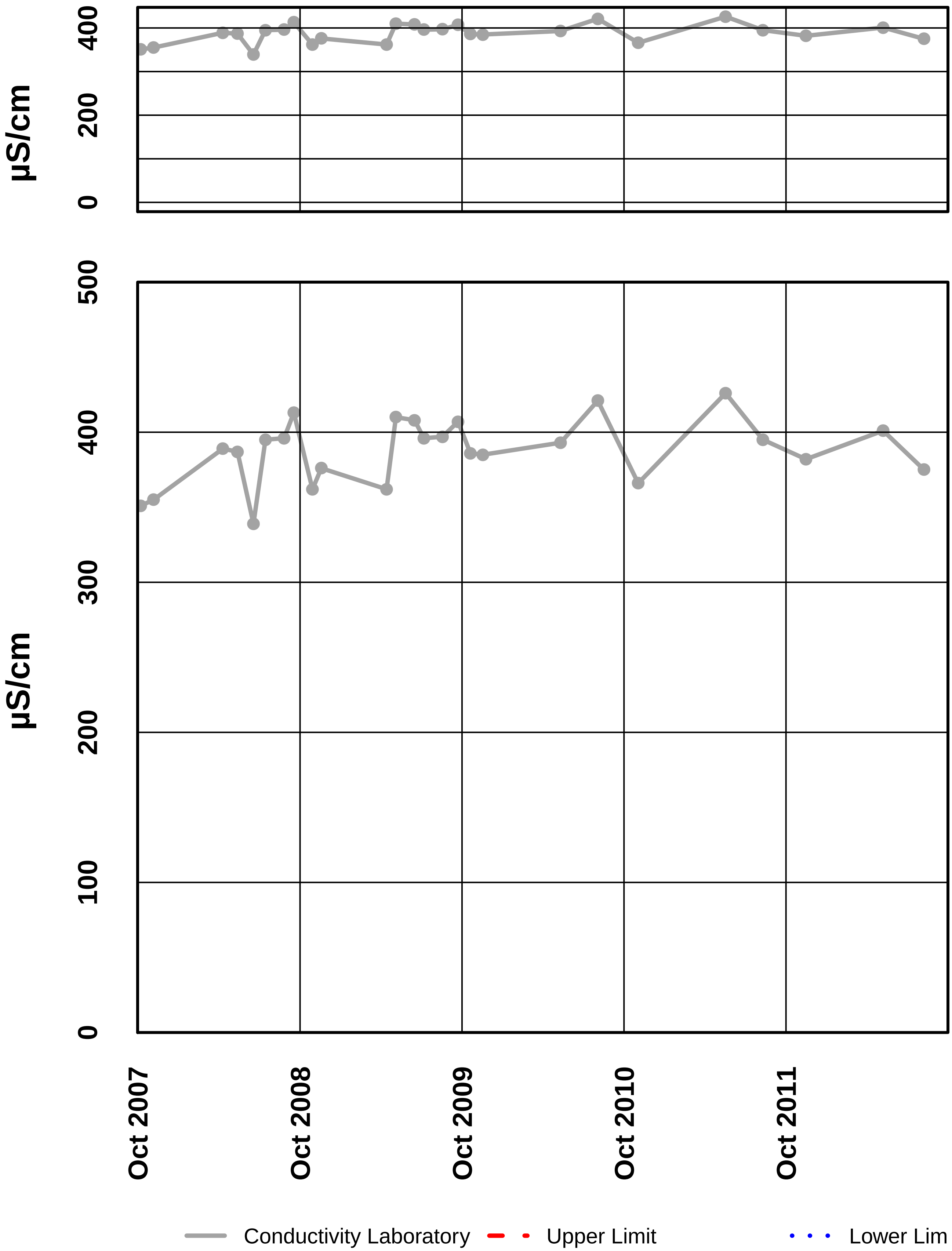
Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
57	11/15/2011	12:00 AM	Ag diss, µg/l	0.00324	U	Field Blank Contamination
			Hg diss, µg/l	0.000175	U	Field Blank Contamination
57	5/7/2012	12:00 AM	Hg diss, µg/l	0.000476	U	Field Blank Contamination
			SO4 Tot, mg/l	53.24	J	Sample Receipt Temperature
57	8/7/2012	12:00 AM	As diss, µg/l	0.63	J	LCS Recovery
			Hg diss, µg/l	0.000319	U	Field Blank Contamination

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



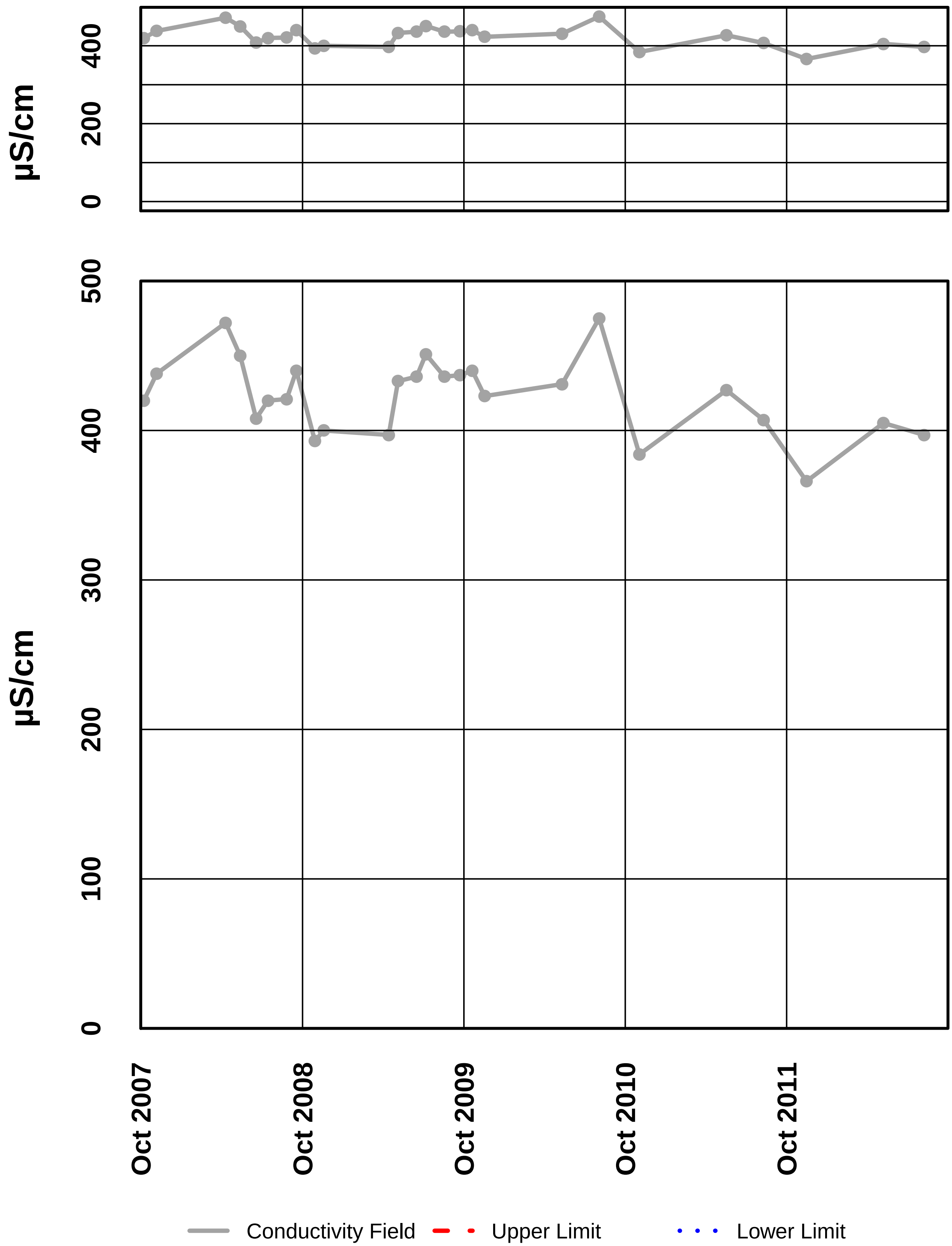
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 57 − Conductivity Laboratory



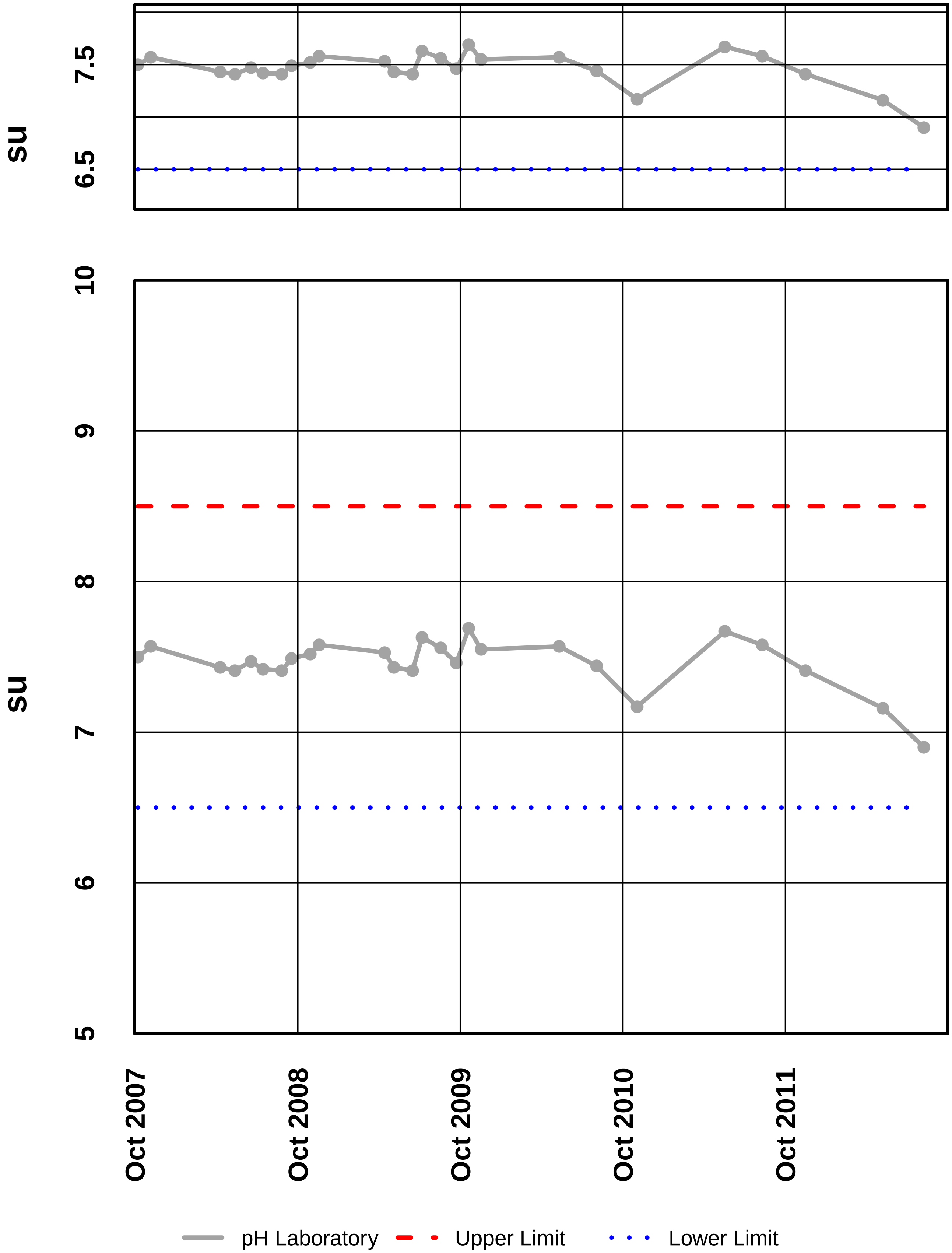
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 57 – Conductivity Field



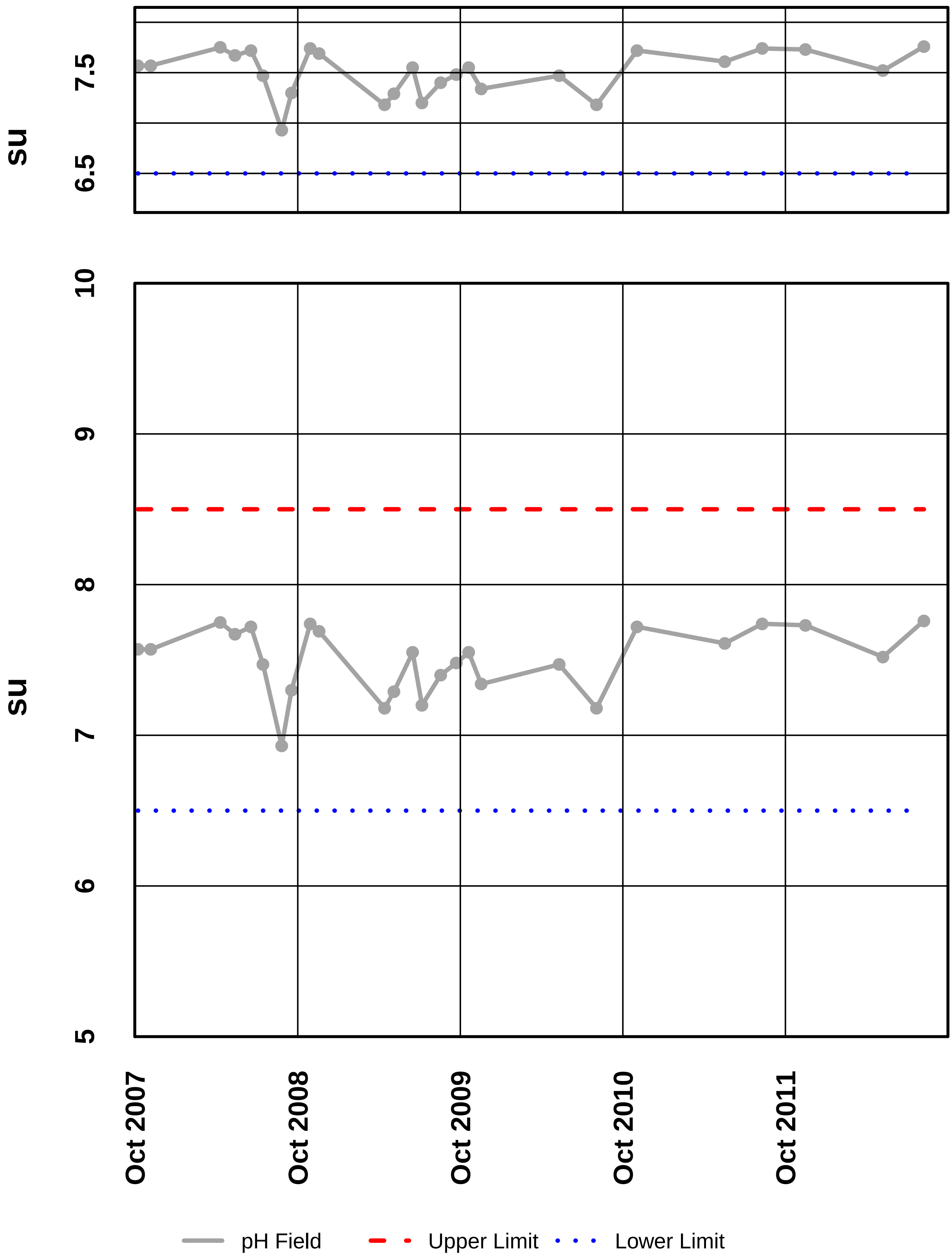
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 57 – pH Laboratory

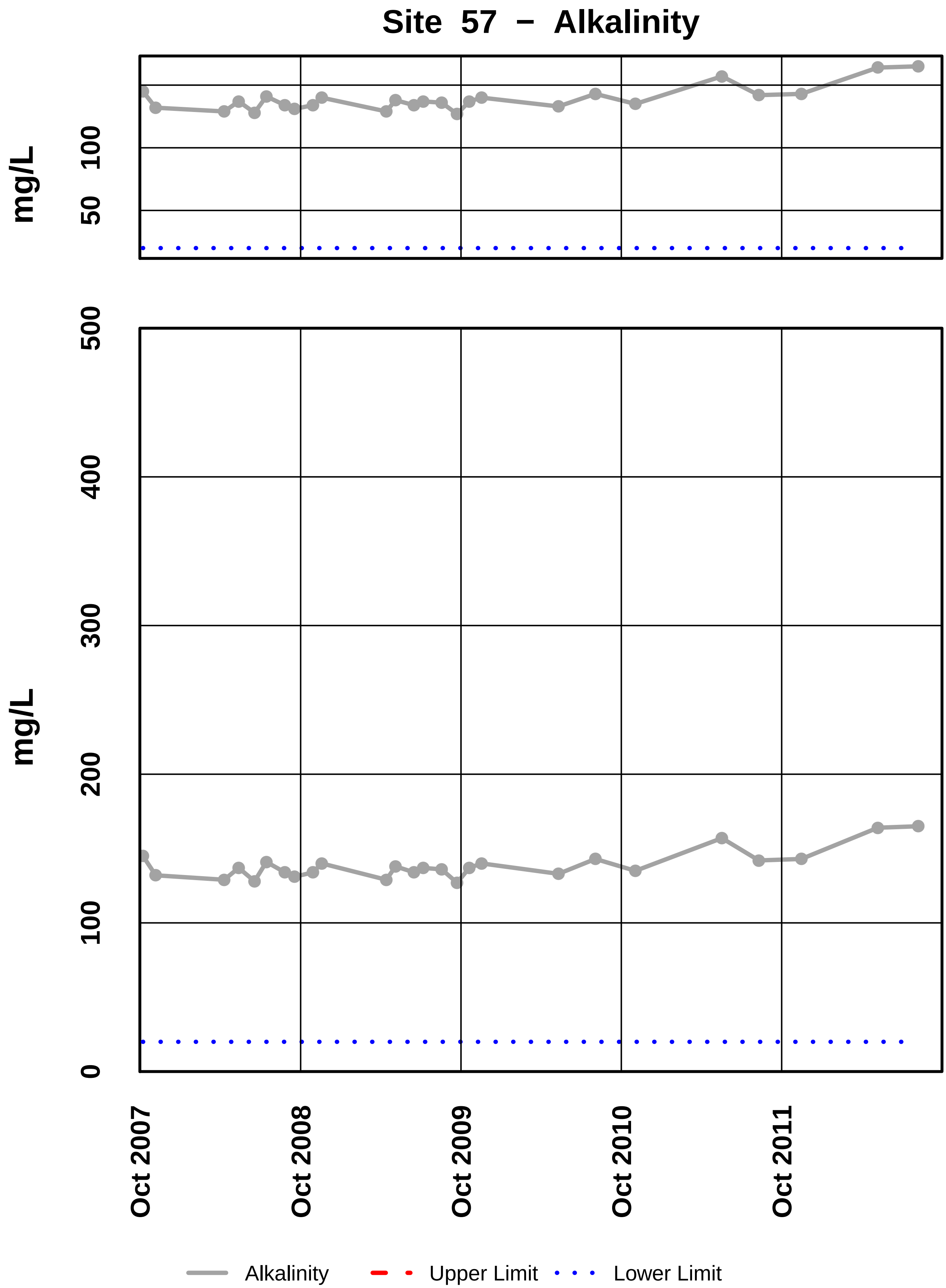


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

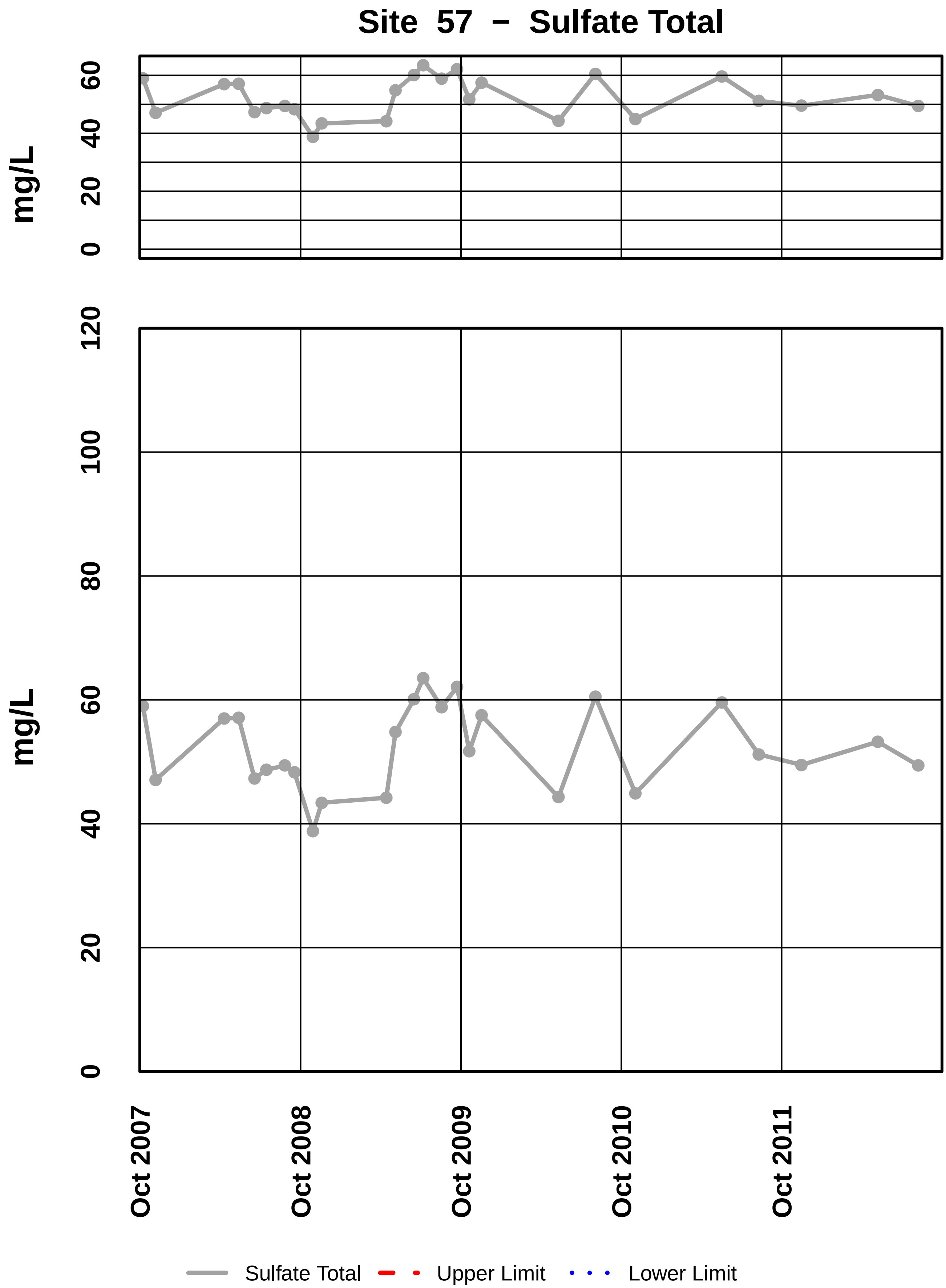
Site 57 – pH Field



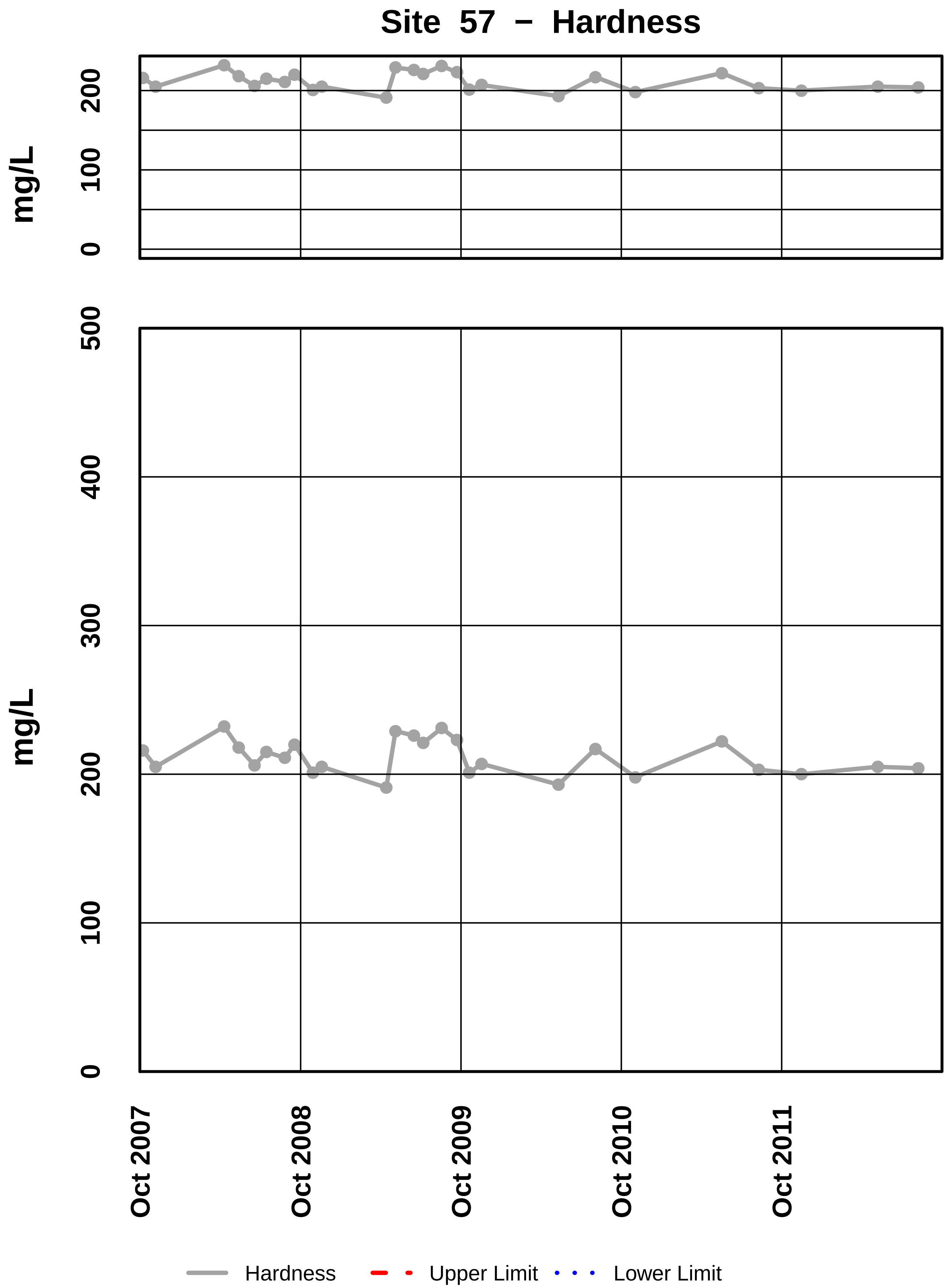
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

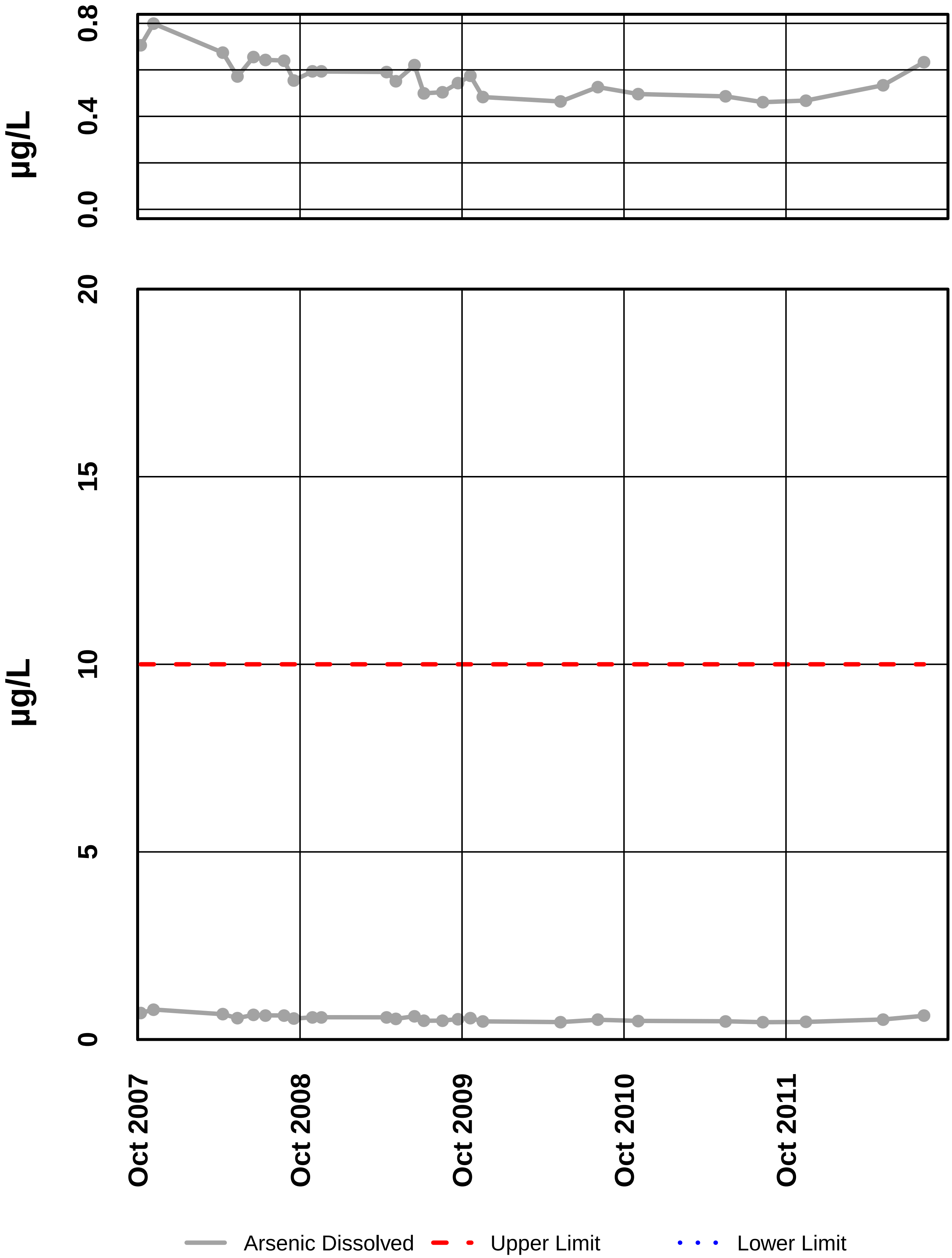


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

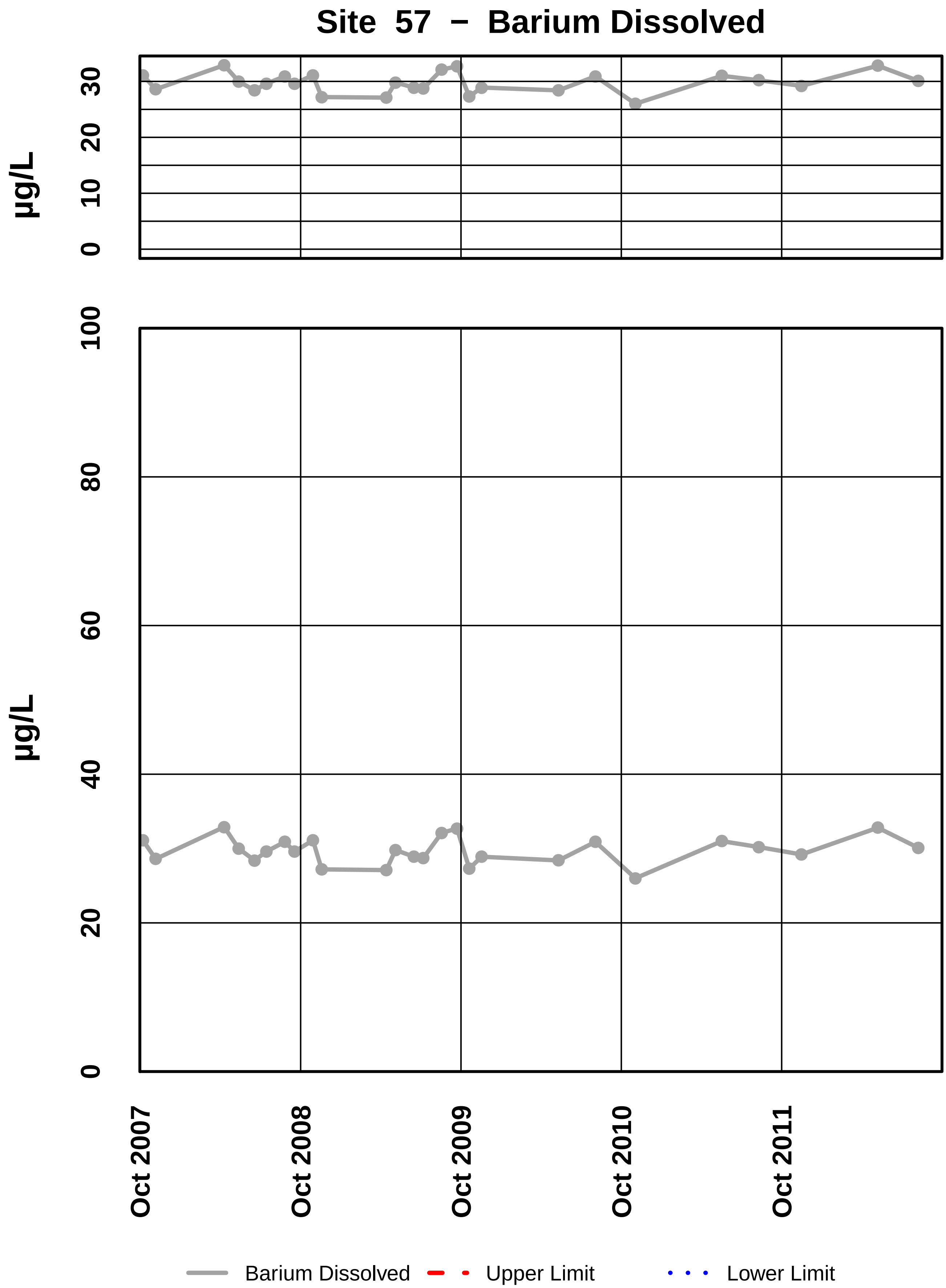


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 57 – Arsenic Dissolved

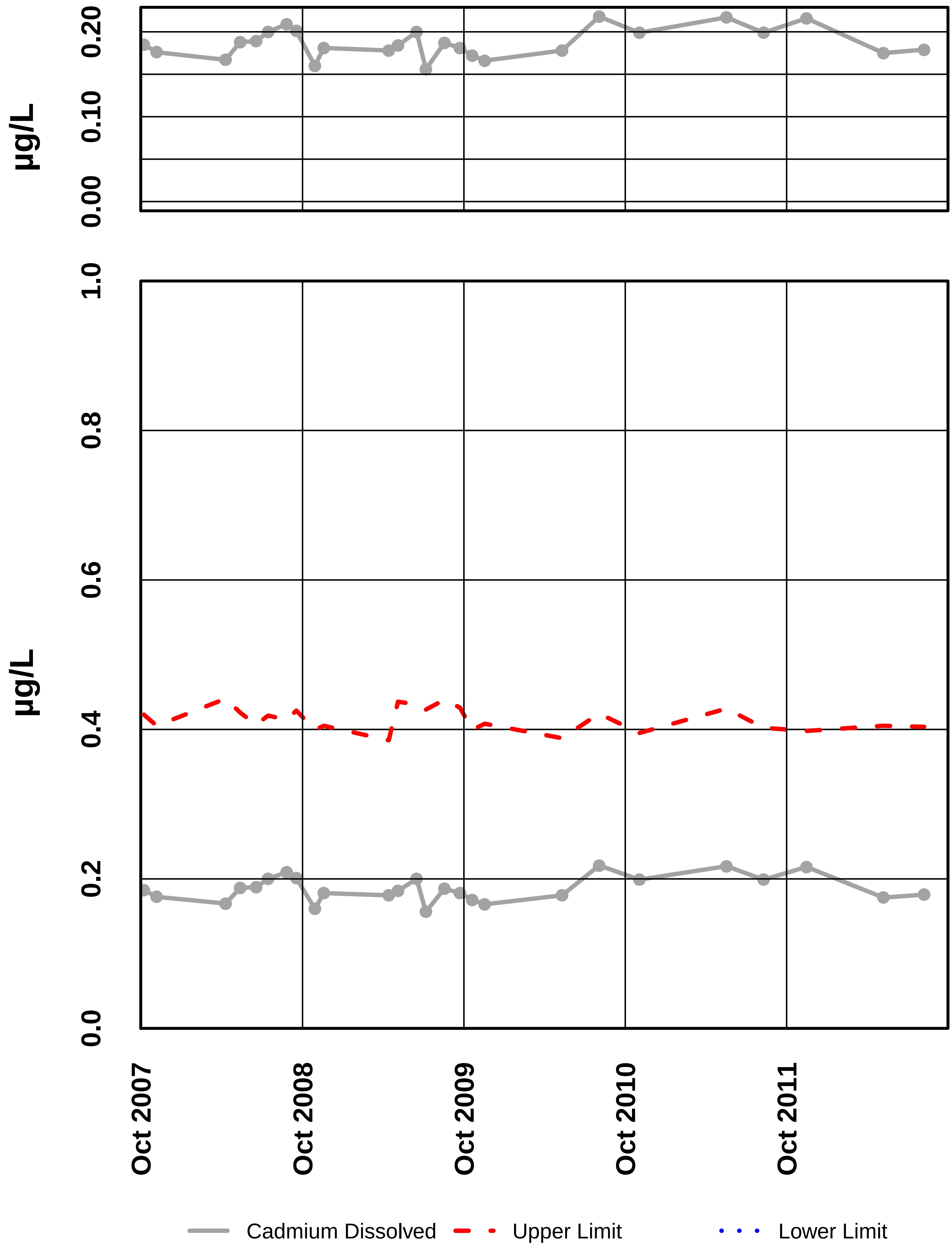


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

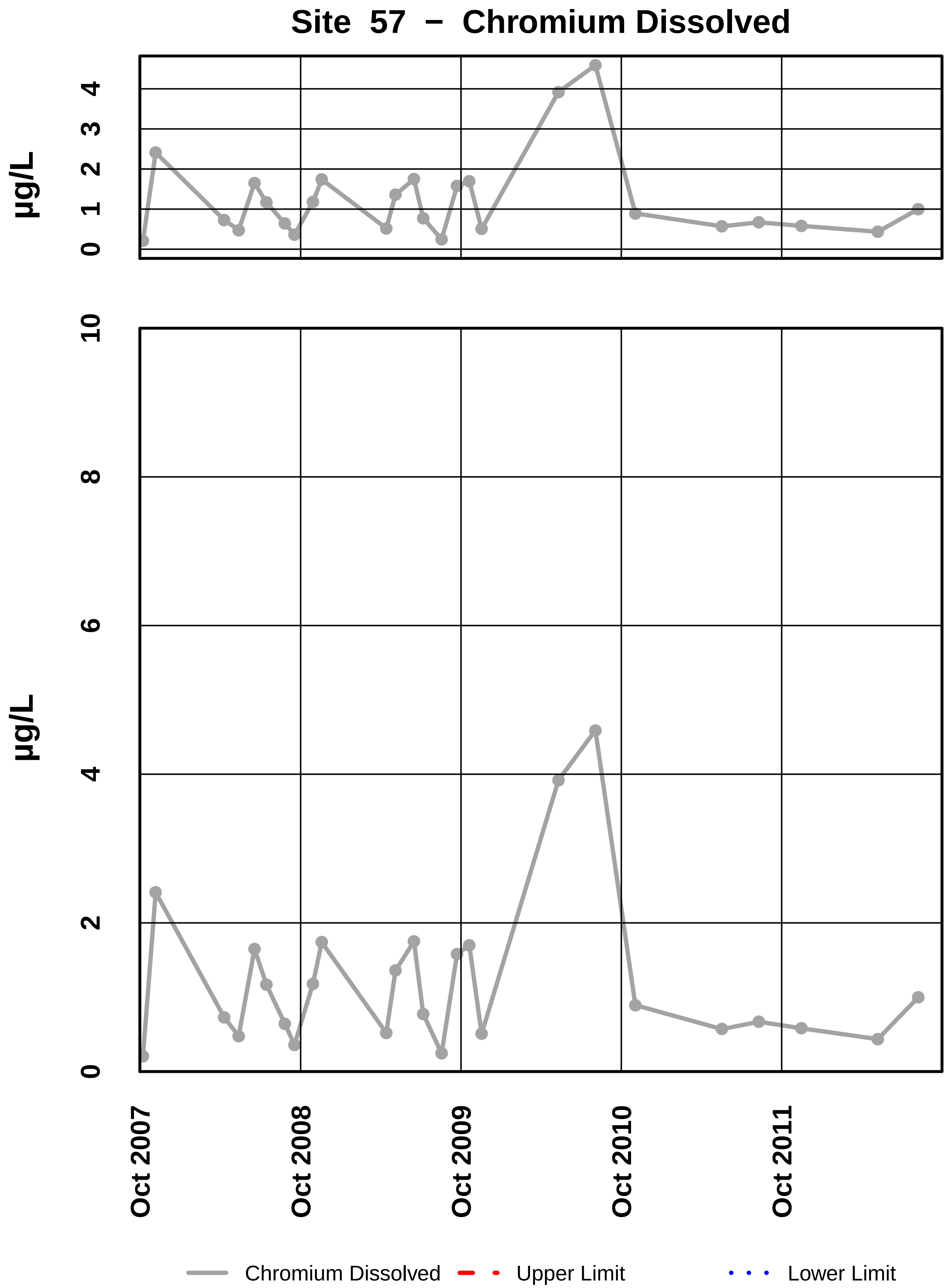


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

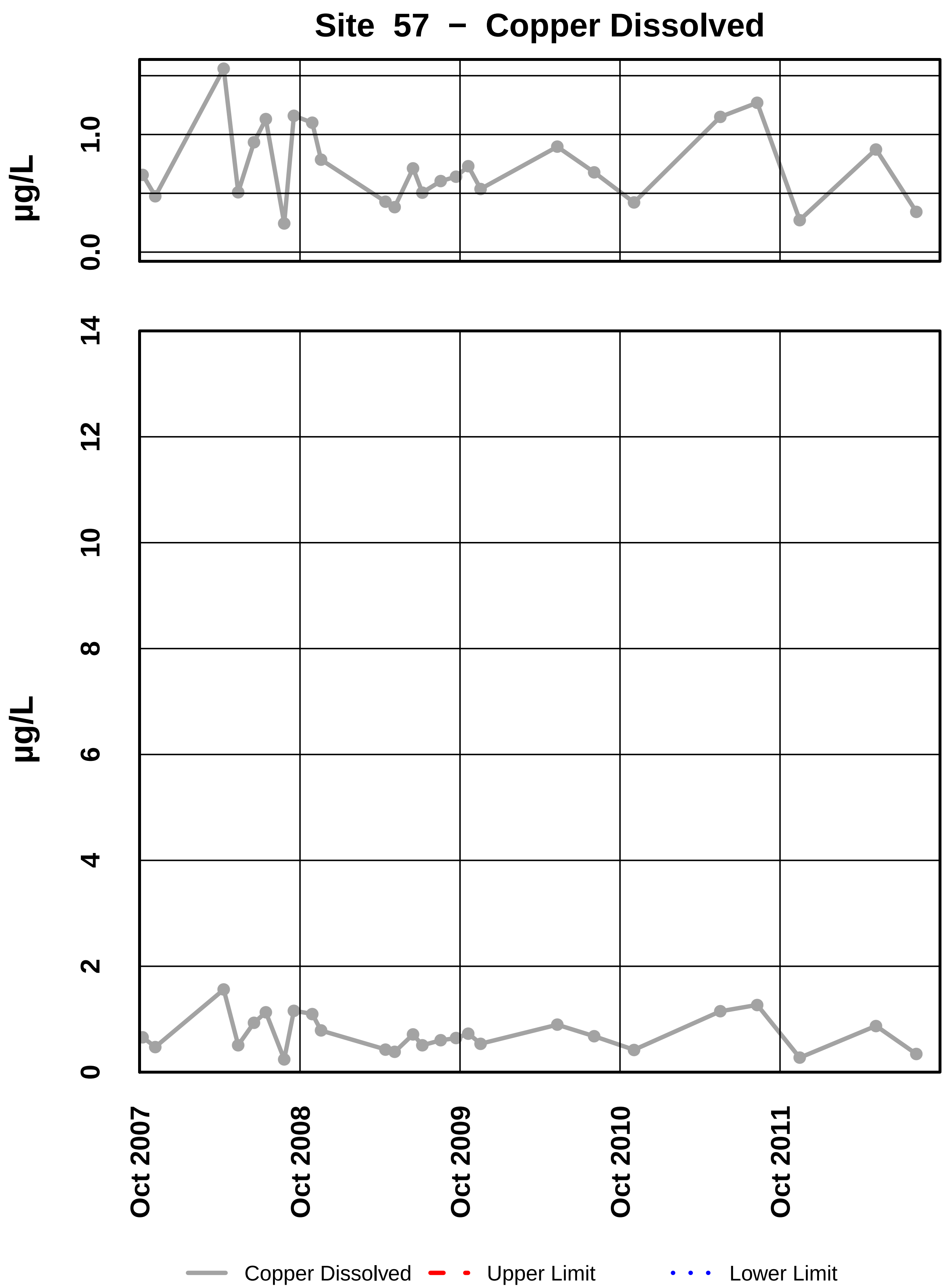
Site 57 – Cadmium Dissolved



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

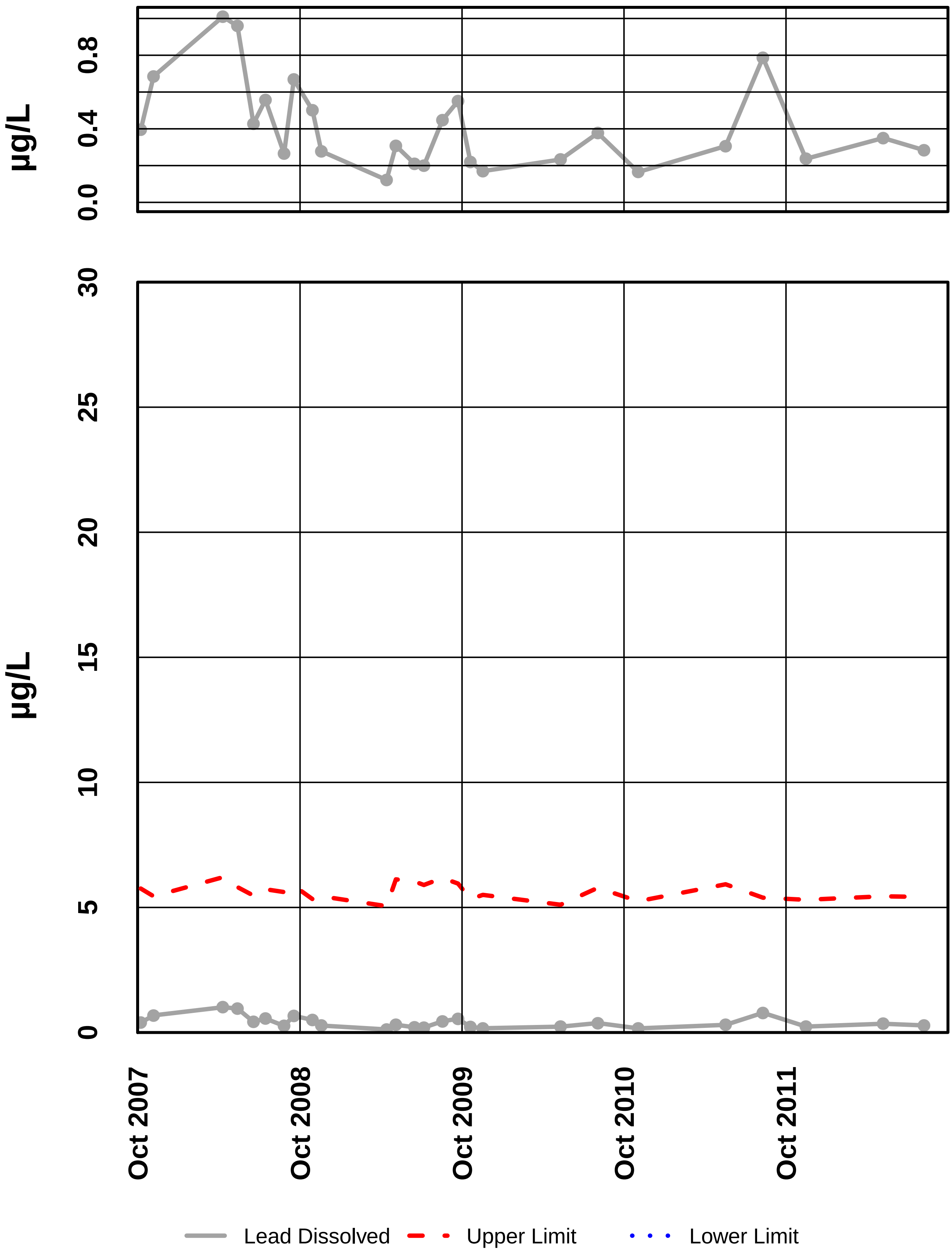


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



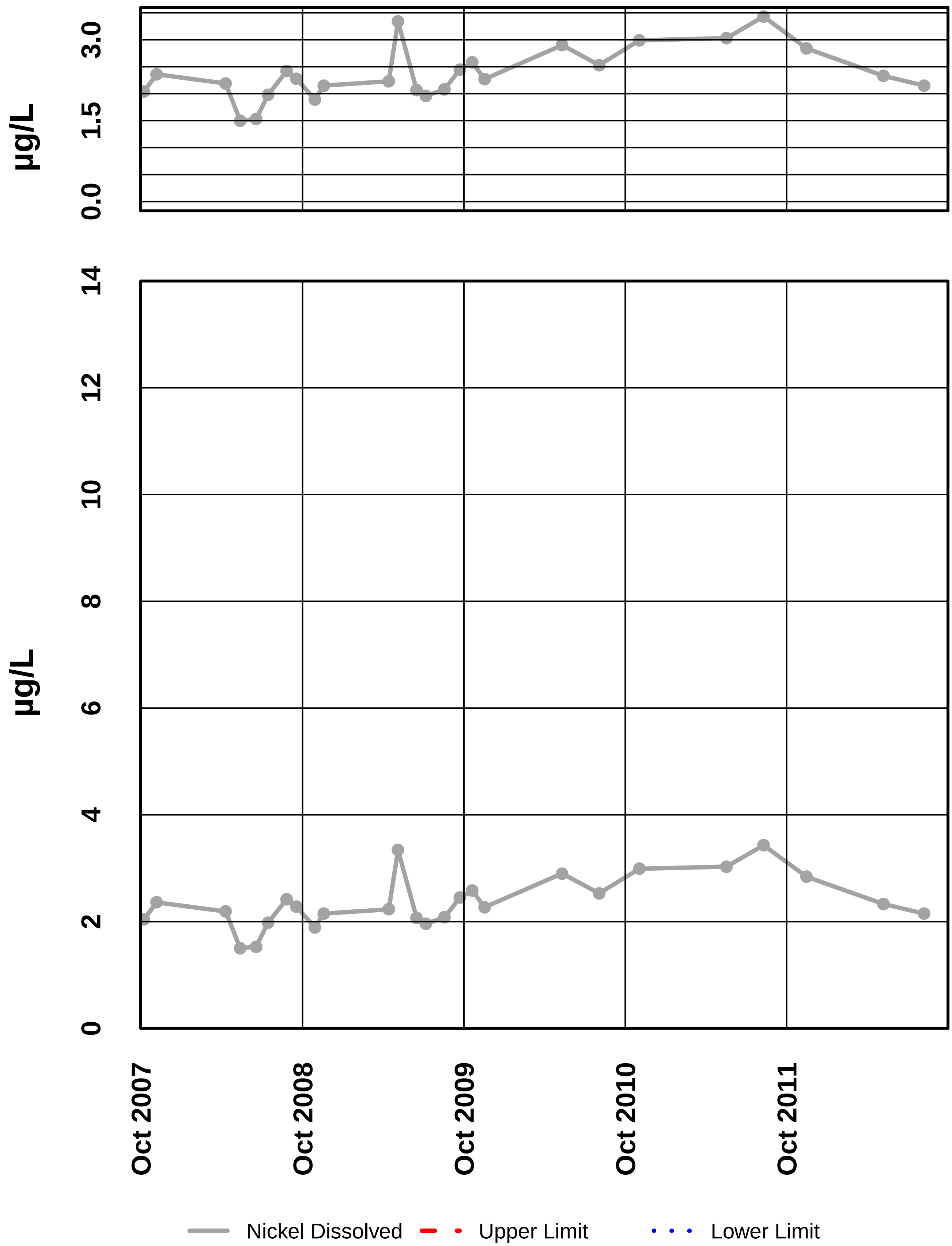
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 57 − Lead Dissolved

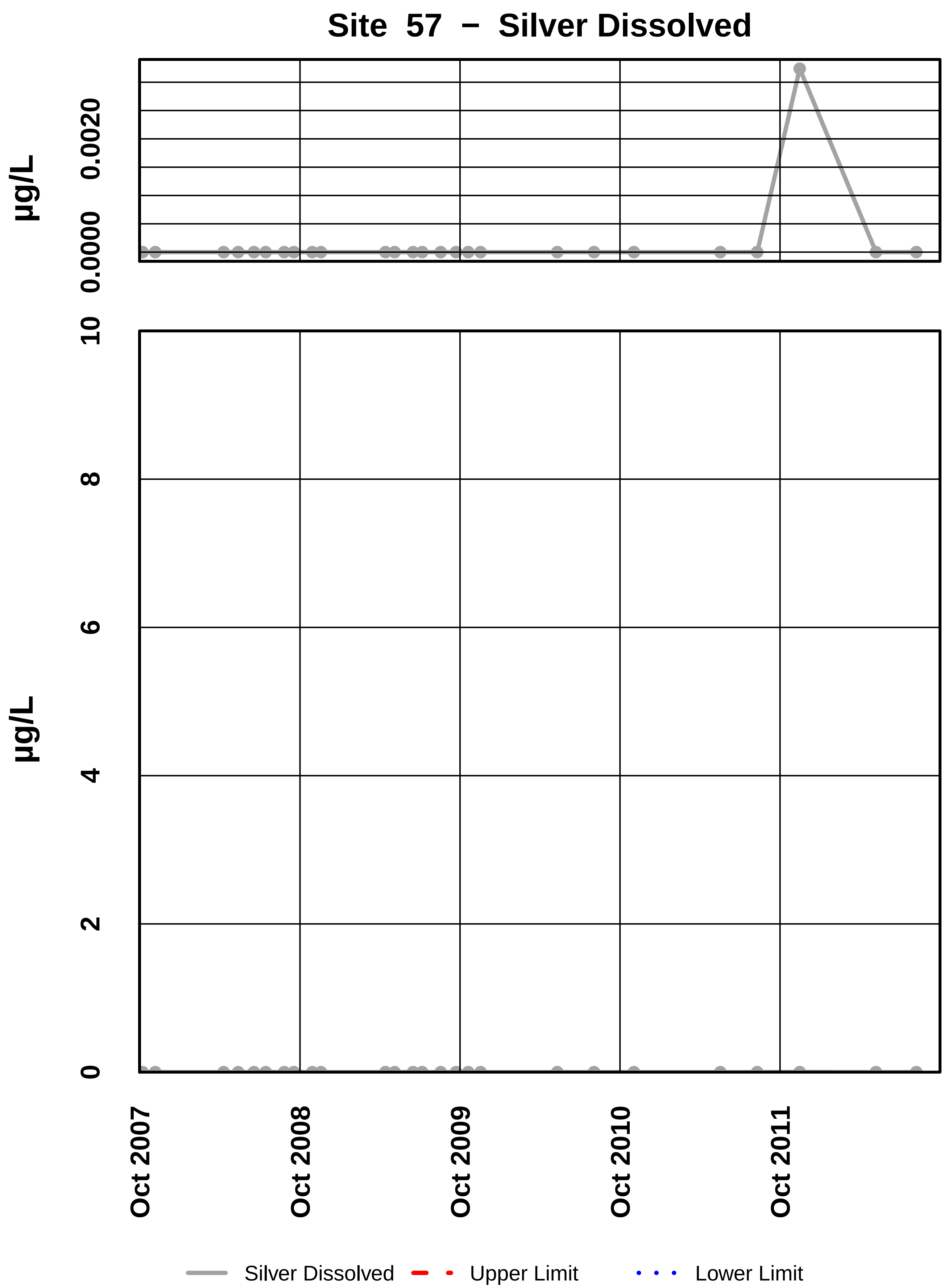


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

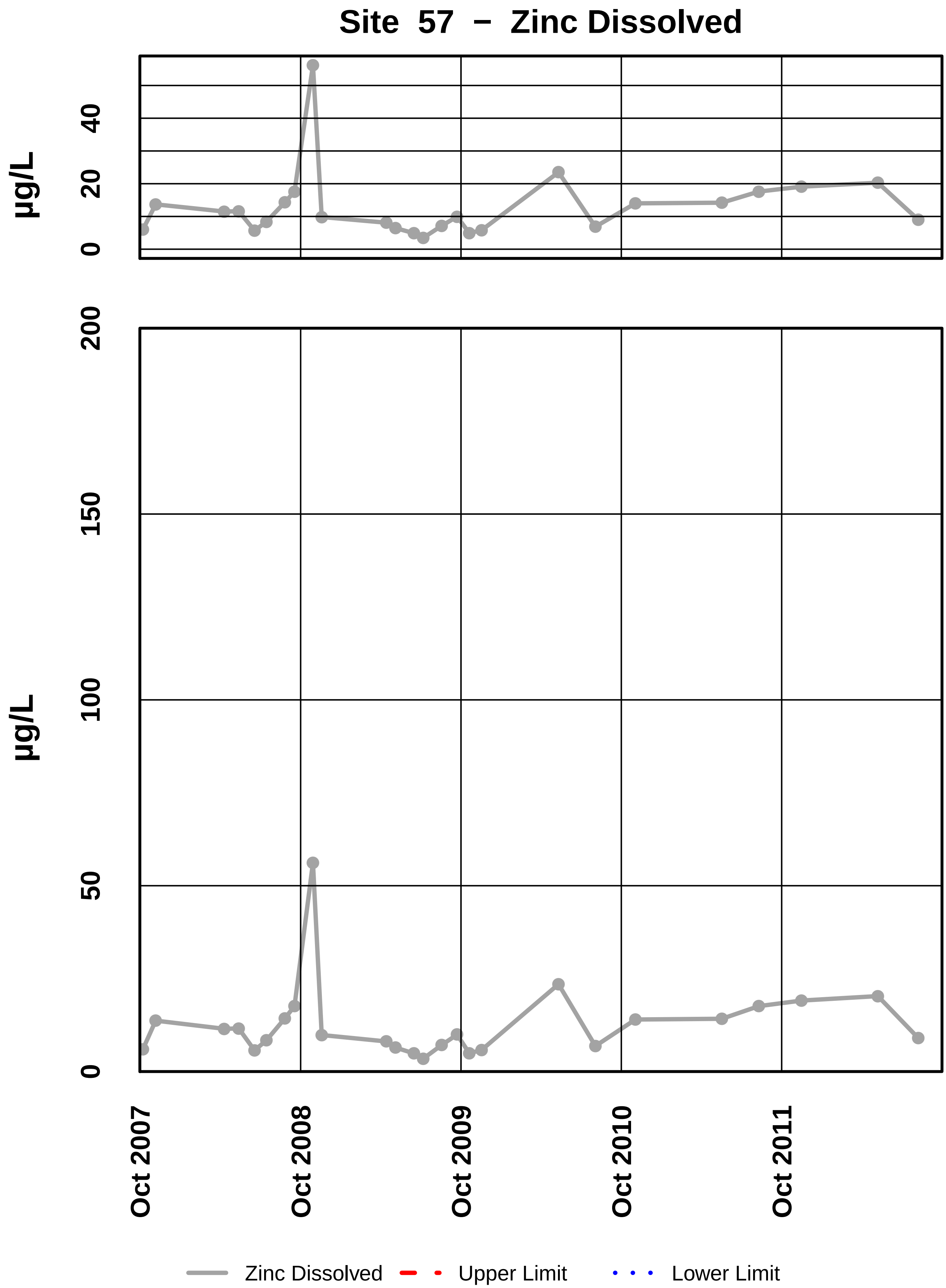
Site 57 − Nickel Dissolved



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

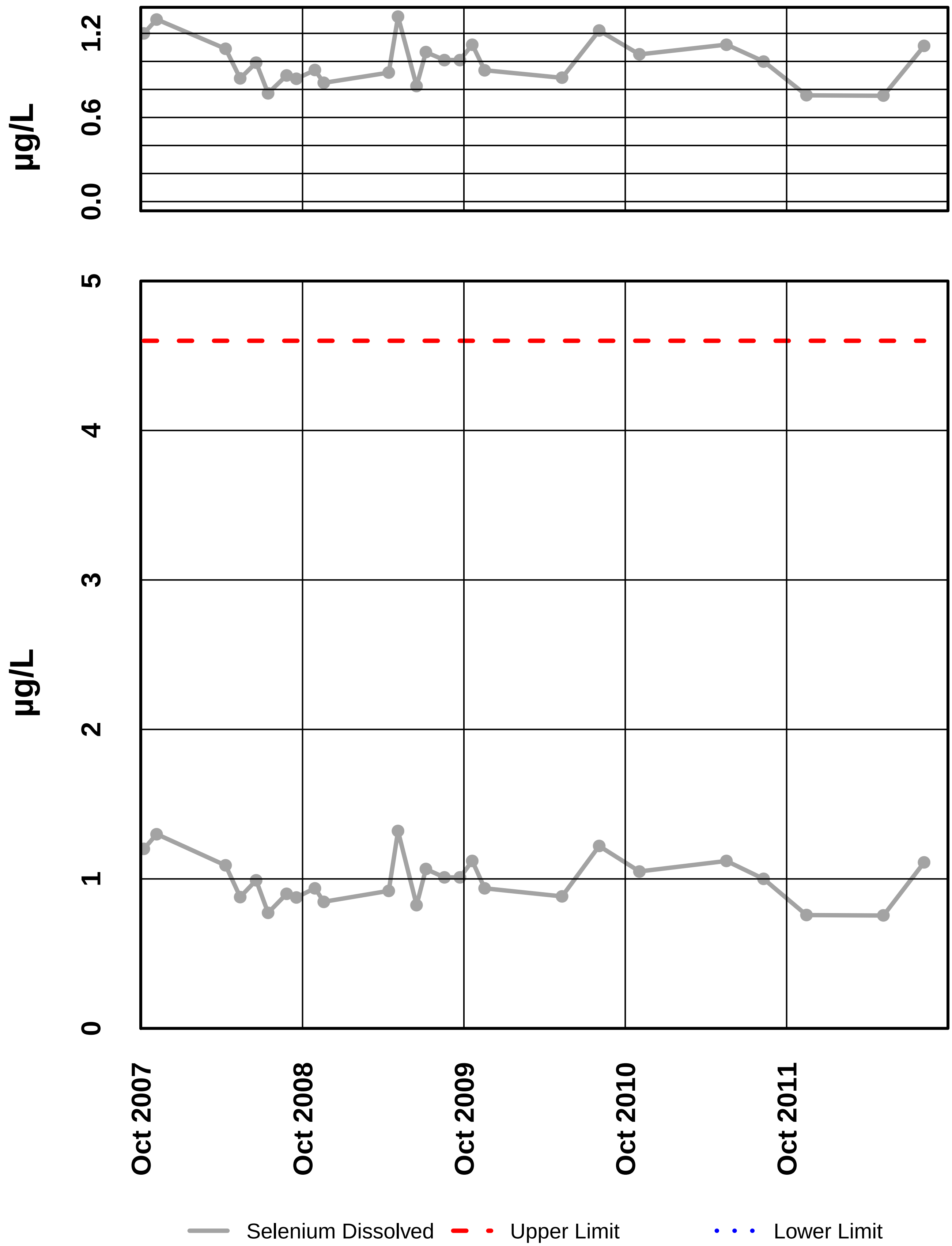


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



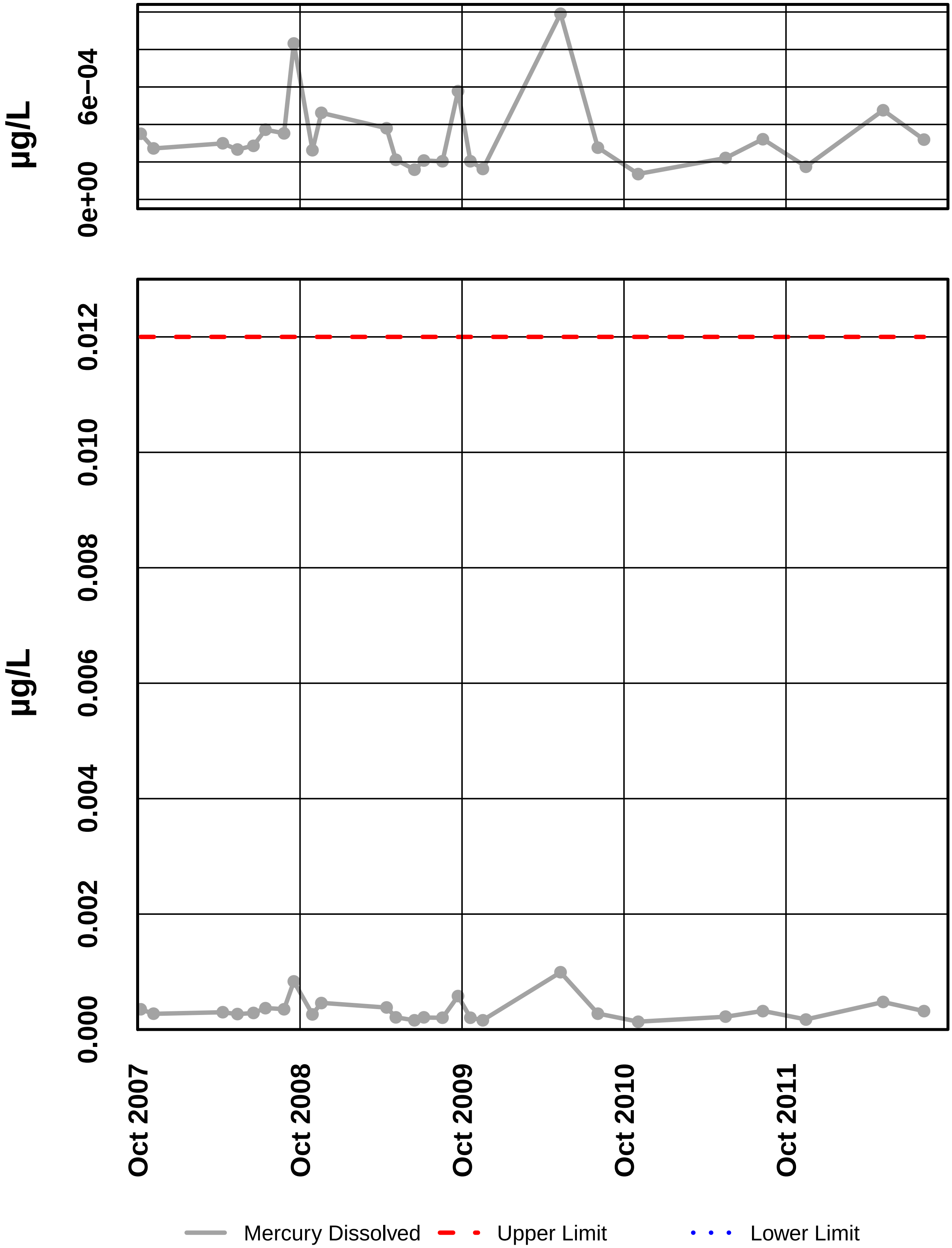
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

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

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**	388	391					405	404	421	420	444	432
b	**WY2008**	420	438					472	450	408	420	421	440
c	**WY2009**	393	400					397	433	436	451	436	437
d	**WY2010**	440	423						431			475	
e	**WY2011**		384						427			407	
f	**WY2012**		366						405			397	
	n	4	6	0	0	0	0	3	6	3	3	6	3

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

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

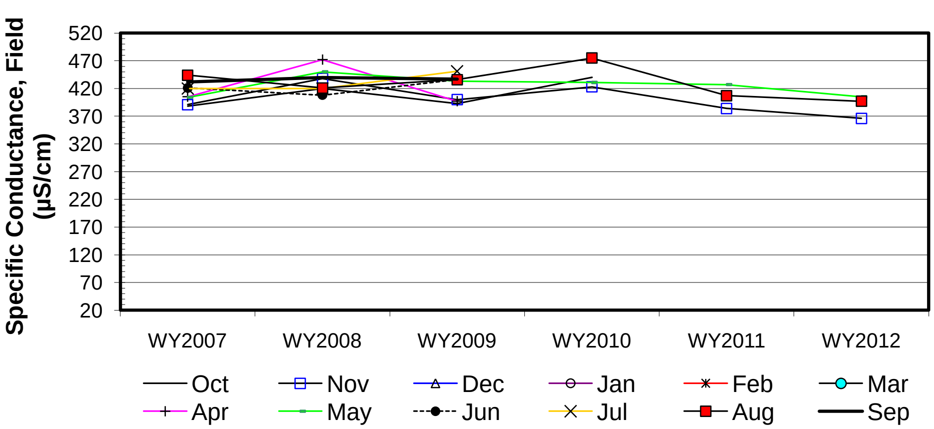
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	8.67	28.33					3.67	28.33	3.67	2.67	28.33	3.67
$Z_k = S_k/\sigma_S$	1.36	-1.32					-0.52	-0.94	0.52	1.22	-1.32	0.52
Z^2_k	1.85	1.73					0.27	0.88	0.27	1.50	1.73	0.27

ΣZ_k= -0.46
ΣZ^2_k= 8.51
Z-bar=$\Sigma Z_k/K$= -0.06

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	32	1	0	0	0

Σn 34
ΣS_k -12

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	8.48	@α=5% $\chi^2_{(K-1)}$=	14.07	Test for station homogeneity	
p	**0.292**			$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
$\Sigma VAR(S_k)$ Z_{calc}	-1.06	@α/2=2.5% Z=	1.96	**H_0** (No trend)	ACCEPT
107.33 p	**0.144**			**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-10.69		6.71
0.050	-9.33	**-4.00**	2.50
0.100	-8.17		0.03
0.200	-7.29		-2.14

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**	7.5	7.8					7.6	7.7	8.0	7.5	7.8	7.6
b	**WY2008**	7.6	7.6					7.8	7.7	7.7	7.5	6.9	7.3
c	**WY2009**	7.7	7.7					7.2	7.3	7.6	7.2	7.4	7.5
d	**WY2010**	7.6	7.3						7.5			7.2	
e	**WY2011**		7.7						7.6			7.7	
f	**WY2012**		7.7						7.5			7.8	
	n	4	6	0	0	0	0	3	6	3	3	6	3
	t_1	4	6	0	0	0	0	3	6	3	3	6	3
	t_2	0	0	0	0	0	0	0	0	0	0	0	0
	t_3	0	0	0	0	0	0	0	0	0	0	0	0
	t_4	0	0	0	0	0	0	0	0	0	0	0	0
	t_5	0	0	0	0	0	0	0	0	0	0	0	0
	b-a	1	-1					1	-1	-1	-1	-1	-1
	c-a	1	-1					-1	-1	-1	-1	-1	-1
	d-a	1	-1						-1			-1	
	e-a		-1						-1			-1	
	f-a		-1						-1			1	
	c-b	1	1					-1	-1	-1	-1	1	1
	d-b	-1	-1						-1			1	
	e-b		1						-1			1	
	f-b		1						-1			1	
	d-c	-1	-1						1			-1	
	e-c		1						1			1	
	f-c		1						1			1	
	e-d		1						1			1	
	f-d		1						1			1	
	f-e		1						-1			1	
	S_k	2	1	0	0	0	0	-1	-5	-3	-3	5	-1
	σ^2_S=	8.67	28.33					3.67	28.33	3.67	3.67	28.33	3.67
	$Z_k = S_k/\sigma_S$	0.68	0.19					-0.52	-0.94	-1.57	-1.57	0.94	-0.52
	Z^2_k	0.46	0.04					0.27	0.88	2.45	2.45	0.88	0.27

ΣZ_k= -3.31

ΣZ^2_k= 7.72

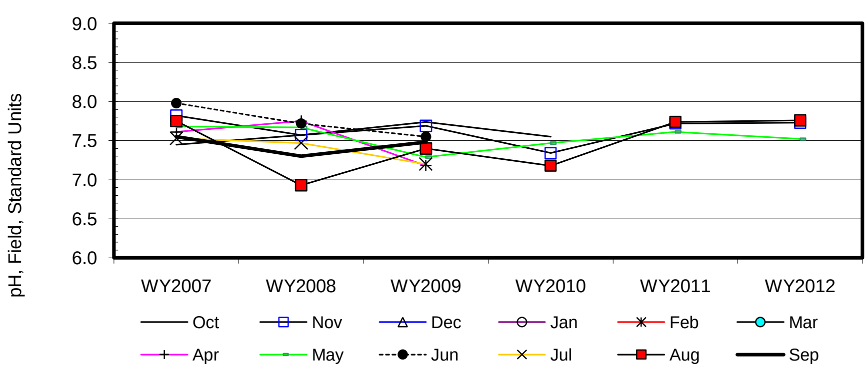
Z-bar=ΣZ_k/K= -0.41

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

Σn 34

ΣS_k -5

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=		6.35	@α=5% $\chi^2_{(K-1)}$= 14.07	Test for station homogeneity	
	p	**0.500**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc}	-0.38	@α/2=2.5% Z= 1.96	H_0 (No trend)	ACCEPT
108.33	**p**	**0.350**		H_A (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.11		0.07
0.050	-0.07	**-0.01**	0.03
0.100	-0.04		0.02
0.200	-0.03		0.01

Site #57

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**	141.0	143.0					140.0	149.0	145.0	139.0	138.0	141.0
b	**WY2008**	145.0	132.0					129.0	137.0	128.0	141.0	134.0	131.0
c	**WY2009**	134.0	140.0					129.0	138.0	134.0	137.0	136.0	127.0
d	**WY2010**	137.0	140.0						133.0			143.0	
e	**WY2011**		135.0						157.0			142.0	
f	**WY2012**		143.0						164.0			165.0	
	n	4	6	0	0	0	0	3	6	3	3	6	3

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

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

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	8.67	26.33					2.67	28.33	3.67	3.67	28.33	3.67
$Z_k = S_k/\sigma_S$	-0.68	0.19					-1.22	0.94	-0.52	-0.52	1.69	-1.57
Z^2_k	0.46	0.04					1.50	0.88	0.27	0.27	2.86	2.45

ΣZ_k= -1.69

ΣZ^2_k= 8.74

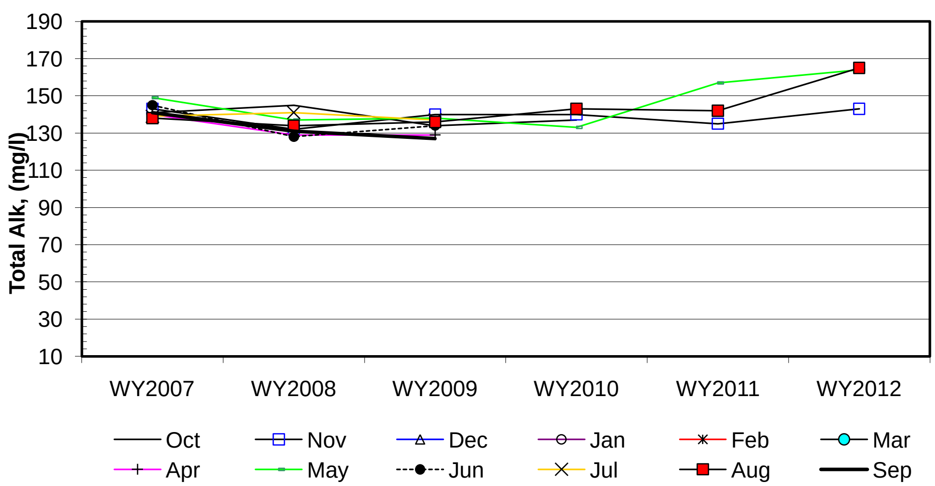
Z-bar=$\Sigma Z_k/K$= -0.21

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	28	3	0	0	0

Σn 34

ΣS_k 6

$\chi^2_h = \Sigma Z^2_k - K(\text{Z-bar})^2$=	8.38	@α=5% $\chi^2_{(K-1)}$= 14.07	Test for station homogeneity	
p	**0.300**		$\chi^2_h < \chi^2_{(K-1)}$	ACCEPT
$\Sigma VAR(S_k)$ 105.33	Z_{calc} 0.49	@α/2=2.5% Z= 1.96	**H_0** (No trend)	ACCEPT
	p **0.687**		**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-2.22		3.00
0.050	-1.31	**1.00**	2.63
0.100	-1.00		2.00
0.200	-0.82		1.64

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**	49.4	44.3					47.4	50.8	49.6	51.9	56.7	58.8
b	**WY2008**	59.0	47.1					57.0	57.1	47.3	48.7	49.4	48.3
c	**WY2009**	38.8	43.4					44.2	54.8	60.1	63.5	58.8	62.1
d	**WY2010**	51.7	57.5						44.3			60.5	
e	**WY2011**		44.9						59.6			51.2	
f	**WY2012**		49.5						53.2			49.4	
	n	4	6	0	0	0	0	3	6	3	3	6	3
	t_1	4	6	0	0	0	0	3	6	3	3	4	3
	t_2	0	0	0	0	0	0	0	0	0	0	1	0
	t_3	0	0	0	0	0	0	0	0	0	0	0	0
	t_4	0	0	0	0	0	0	0	0	0	0	0	0
	t_5	0	0	0	0	0	0	0	0	0	0	0	0
	b-a	1	1					1	1	-1	-1	-1	-1
	c-a	-1	-1					-1	1	1	1	1	1
	d-a	1	1						-1			1	
	e-a		1						1			-1	
	f-a		1						1			-1	
	c-b	-1	-1					-1	-1	1	1	1	1
	d-b	-1	1						-1			1	
	e-b		-1						1			1	
	f-b		1						-1			0	
	d-c	1	1						-1			1	
	e-c		1						1			-1	
	f-c		1						-1			-1	
	e-d		-1						1			-1	
	f-d		-1						1			-1	
	f-e		1						-1			-1	
	S_k	0	5	0	0	0	0	-1	1	1	1	-2	1
	σ^2_S=	8.67	28.33					3.67	28.33	3.67	3.67	27.33	3.67
	$Z_k = S_k/\sigma_S$	0.00	0.94					-0.52	0.19	0.52	0.52	-0.38	0.52
	Z^2_k	0.00	0.88					0.27	0.04	0.27	0.27	0.15	0.27

ΣZ_k= 1.79

ΣZ^2_k= 2.15

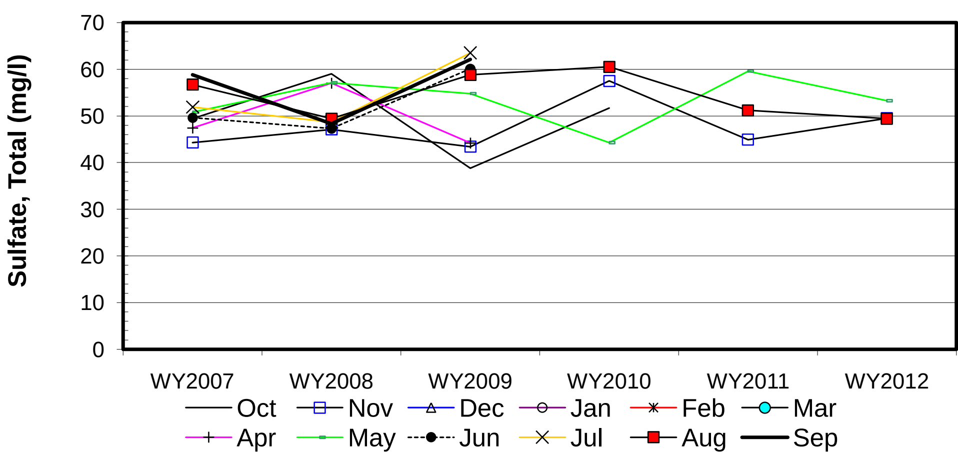
Z-bar=ΣZ_k/K= 0.22

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	32	1	0	0	0

Σn 34

ΣS_k 6

$\chi^2_h=\Sigma Z^2_k$-K(Z-bar)^2=		1.75	@α=5% $\chi^2_{(K-1)}$=	14.07	Test for station homogeneity	
	p	**0.972**			$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc}	0.48	@α=2.5% Z=	1.96	H_0 (No trend)	ACCEPT
107.33	p	**0.685**			H_A (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-2.24		2.13
0.050	-1.46	**0.60**	1.65
0.100	-1.02		1.08
0.200	-0.51		0.82

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**	6.0	3.7					8.1	5.9	4.8	10.8	7.0	6.1
b	**WY2008**	6.0	13.7					11.5	11.6	5.7	8.4	14.3	17.6
c	**WY2009**	56.2	9.8					8.1	6.5	4.9	3.5	7.1	10.0
d	**WY2010**	4.9	5.8						23.5			6.9	
e	**WY2011**		14.0						14.2			17.6	
f	**WY2012**		19.1						20.3			9.0	
	n	4	6	0	0	0	0	3	6	3	3	6	3

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

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

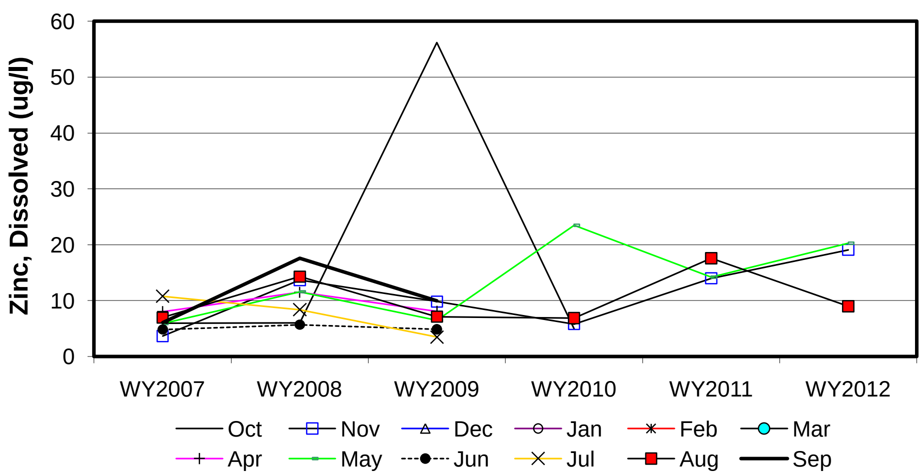
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	8.67	28.33					3.67	28.33	3.67	3.67	28.33	3.67
$Z_k = S_k/\sigma_S$	0.00	1.69					0.52	1.69	0.52	-1.57	0.56	0.52
Z^2_k	0.00	2.86					0.27	2.86	0.27	2.45	0.32	0.27

ΣZ_k=	3.95
ΣZ^2_k=	9.31
Z-bar=ΣZ_k/K=	0.49

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

Σn	34
ΣS_k	21

$\chi^2_h = \Sigma Z^2_k - K(\text{Z-bar})^2$=	7.36	@α=5% $\chi^2_{(K-1)}$= 14.07	Test for station homogeneity	
p	**0.392**		$\chi^2_h < \chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k) Z_{calc}	1.92	@α/2=2.5% Z= 1.96	H_0 (No trend)	ACCEPT
108.33 **p**	**0.973**		H_A (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.31		3.08
0.050	0.02	**0.87**	2.59
0.100	0.08		2.10
0.200	0.30		1.86

INTERPRETIVE REPORT
SITE 56

The data collected during the current water year are listed in the following "Table of Results for Water Year 2012" 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.

Sampling at this site was added to the FWMP in October-2001. All data collected at this site for the past six years are included in the data analyses. As shown in the table below, there were no data outliers.

Sample Date	Parameter	Value	Qualifier	Notes
No outliers have been identified by HGCMC for the period of October 2007 through September 2012.				

The data for Water year 2012 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 2012

			Limits		
Sample Date	Parameter	Value	Lower	Upper	Hardness
No exceedances have been identified by HGCMC for the period of October 2011 through September 2012.					

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

A non-parametric statistical analysis for trend was performed for specific conductivity, field pH, total alkalinity, total sulfate, and dissolved zinc. Calculation details of the Seasonal Kendall analyses are presented in detail on the pages following this interpretive section. The following table summarizes the results on the data collected between Oct-2005 and Sep-11 (WY2007-WY2012). There was one statistically significant ($\alpha/2=2.5\%$) trend identified for the current water year. Total sulfate had a positive trend with a slope estimate of 0.71 µg/L/yr or a 8.67% increase over the period, however the values are within the historical range.

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	0.19			
Alkalinity, Total	6	0.42			
Sulfate, Total	6	0.02	+	0.71	8.67
Zinc, Dissolved	6	0.35			

* 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 57 and Site 56 has been conducted as specified in the Statistical Information Goals for Site 56. With the change in the sampling frequency at Site 57 and Site 56 the resulting small sample size (N=4) eliminates the possibility of using the Wilcoxon Signed Ranks test as a methodology for comparing median values. This is the same reason this technique has not been used previously with the wells at the tailings facility.

For several years it has been accepted that there are great differences between the upgradient Site 57 and the downgradient Site 56. The two major differences between the sites are the unit of completion and the hydrological setting. The up-gradient control site, Site 57, is in an area away from the influence of any major surface flow. The screened interval is in the colluvial unit that underlies most of Site 23 production rock area and samples 63 to 68 feet below the surface. The aquifer sampled by the screened interval may be one of multiple perched aquifers located below Site 23 as noted in the “Site 23/D Hydrogeology and Geochemistry Analysis” report (EDE, 2004). The down-gradient well, Site 56, is to the southeast of the Site 23/D production rock areas and is located approximately 40 feet west of the lower reaches of Bruin Creek. The screened interval was originally interpreted as the same colluvial unit as Site 57, but recent drilling information suggests the completion is in the alluvial sands which underlie most of Site D. The sampled interval is at a depth of 14 to 19 feet.

The difference in the unit of completion may have an effect on the resulting water quality. The colluvium is characterized as a fine to coarse sand with angular to sub-rounded, partially weathered chloritic rock with localized residual pyrite. The alluvial sand is characterized as a fine to coarse sand with subangular to rounded gravel and is composed of well-weathered clasts with a more stable mineral assemblage. Thus the colluvial material, being less deeply weathered, would typically generate a higher leachable load of dissolved salts that would be reflected in the chemistry of the associated ground water. Additionally, the proximity of Site 56 to Bruin Creek and Greens Creek and its shallow completion depth suggest there would be a much greater influence of a surface water component relative to Site 57. The water temperature data for Site 56 reflects this by showing a very strong seasonal variation that is very similar to the data collected at the nearby surface sites 46 and 6. In contrast the Site 57 water temperature data shows a much lower variation that is indicative of groundwater with a minor seasonal surface component. The surface water recharge to the local aquifer would tend to act as a diluent with respect to the more concentrated dissolved fraction of groundwater. Finally, if Site 57 does sample a localized, perched aquifer it would probably be more strongly influenced by seasonal and/or annual variations in recharge rate since the area of capture would be more limited than for Site 56. In summary, the combined effects of the difference in completion units and the different hydrological regimes likely explain the disparity in analyte concentrations found at the two sites in past reports when comparing these two sites.

Because of the differences in the completions of these well the statistical analysis of the inter-comparison is prone to failure if not misinterpretation. This is the third season that the analysis for Site 56 is performed on an intra-well comparison basis using the combined Shewhart-CUSUM control chart approach. This method was first referenced by Westgard et al. 1977 then further developed by Lucas (1982). This form of analysis has been recommended for use in intra-well monitoring by the U.S. Environmental Protection Agency (EPA) (EPA 1989, 1992).

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

For this year’s FWMP report the combined Shewhart-CUSUM control chart statistical analysis was carried out on the specific conductance, dissolved zinc, and total sulfate data from Site 56 starting from October 2001. In order to use the analysis background values were calculated for each of the analytes. Without a true background record the first year of sampling was chosen for this calculation. Results of these calculations are summarized in the Table 1.

The visual representations of these calculations are graphed in Figure 1. All three of the analytes reached the lowest control limit (SCL=2) and only total sulfate reached the control limit of SCL=4. Each of the sites were below the EPA recommend control limit of SCL=4.5. Values for the CUMSUM statistic ranged from a low of 0, observed in each analysis to a high of 3.4 recorded for dissolved zinc. None of the analysis exceed the established limit of h=5. In order for a process to be considered ‘out of control’ both metrics (Shewhart & CUMSUM) need to be ‘out of control’. With these analyses the only analyte that neared both these limits was total sulfate.

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

This is the third year that the combined Shewhart-CUSUM control charts analysis was performed on Site 56 and the results obtained were identical to last year's. As this is a new technique for intra-well monitoring the results of these analyses need to be considered carefully. From the seasonal trend analyses, the similarity to Site 46 analytes, and the Shewhart-CUSUM results; it is concluded that the impact HGCMC has had on the groundwater at Site 56 is negligible or currently undetectable.

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

	Site 56 Conductivity (µS/cm)	Site 56 Diss. Zinc (µg/L)	Site 56 Total Sulfate (mg/L)
Baseline Statistics			
Baseline Period	10/25/01 - 11/12/02	11/12/02 - 11/06/03	10/25/01 - 11/12/02
Number of Samples	9	9	9
Mean (x)	137.20	1.07	9.47
Standard Deviation	26.20	1.02	2.33
Shewhart-CUSUM Control Limits (SCL)			
Control Limit (mean x+ 2s)	190	3	14
Control Limit (mean x + 3s)	216	4	16
Control Limit (mean x + 4s)	242	5	19
Control Limit (mean x + 4.5s)	255	6	20
CUSUM Control Limits			
Cumulative increase – h	5	5	5

Of the three analytes analyzed using the Shewhart-CUSUM control charts dissolved zinc approached the control limits for the August 2012 sampling. The other analytes had values measured values that were centered about the controlled mean values. At current limits all of the reported analytes are within limits. This is the first instance with using this methodology that an analyte has been detected approaching the control limit.

Figure 1. **Observed Measurements for Specific Conductance, Dissolved Zinc, and Total Sulfate from Site 56 Compared to the Shewhart-CUSUM Control Limits From Table 1**

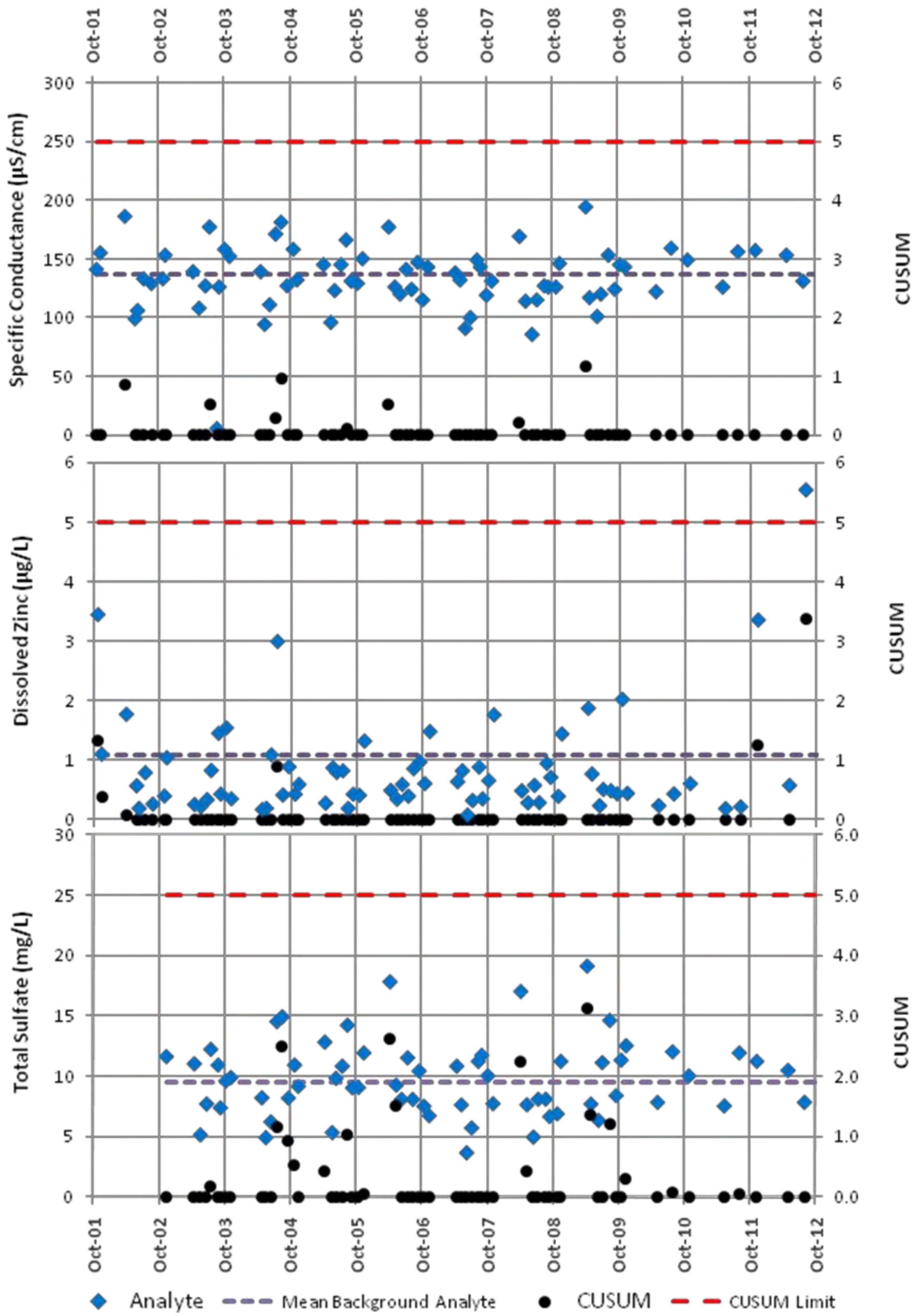


Table of Results for Water Year 2012

Site 056FMG - 'Monitoring Well -D-00-01'

Sample Date/Parameter	Oct 2011	Nov 2011	Dec 2011	Jan 2012	Feb 2012	Mar 2012	Apr 2012	May 2012	Jun 2012	Jul 2012	Aug 2012	Sep 2012	**Median**
Water Temp (°C)		3.7						2.8			9.1		3.7
Conductivity-Field(μmho)		140						154			135		140.0
Conductivity-Lab (μmho)		157						153			131		153
pH Lab (standard units)		7.31						7.15			6.07		7.15
pH Field (standard units)		7.86						7.75			7.58		7.75
Total Alkalinity (mg/L)		66						61.9			57.8		61.9
Total Sulfate (mg/L)		11.2						10.5			7.8		10.5
Hardness (mg/L)		75.1						72.8			61.4		72.8
Dissolved As (ug/L)		0.145						0.183			0.205		0.183
Dissolved Ba (ug/L)		11.8						10.6			11.9		11.8
Dissolved Cd (ug/L)		0.0254						0.0089			0.042		0.0254
Dissolved Cr (ug/L)		0.264						0.247			0.351		0.264
Dissolved Cu (ug/L)		0.647						0.9			0.885		0.885
Dissolved Pb (ug/L)		0.0155						0.0015			0.0339		0.0155
Dissolved Ni (ug/L)		1.04						0.909			0.834		0.909
Dissolved Ag (ug/L)		0.002						0.002			0.002		0.002
Dissolved Zn (ug/L)		3.36						0.59			5.54		3.36
Dissolved Se (ug/L)		0.804						0.468			0.681		0.681
Dissolved Hg (ug/L)		0.00167						0.00298			0.00302		0.002980

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.

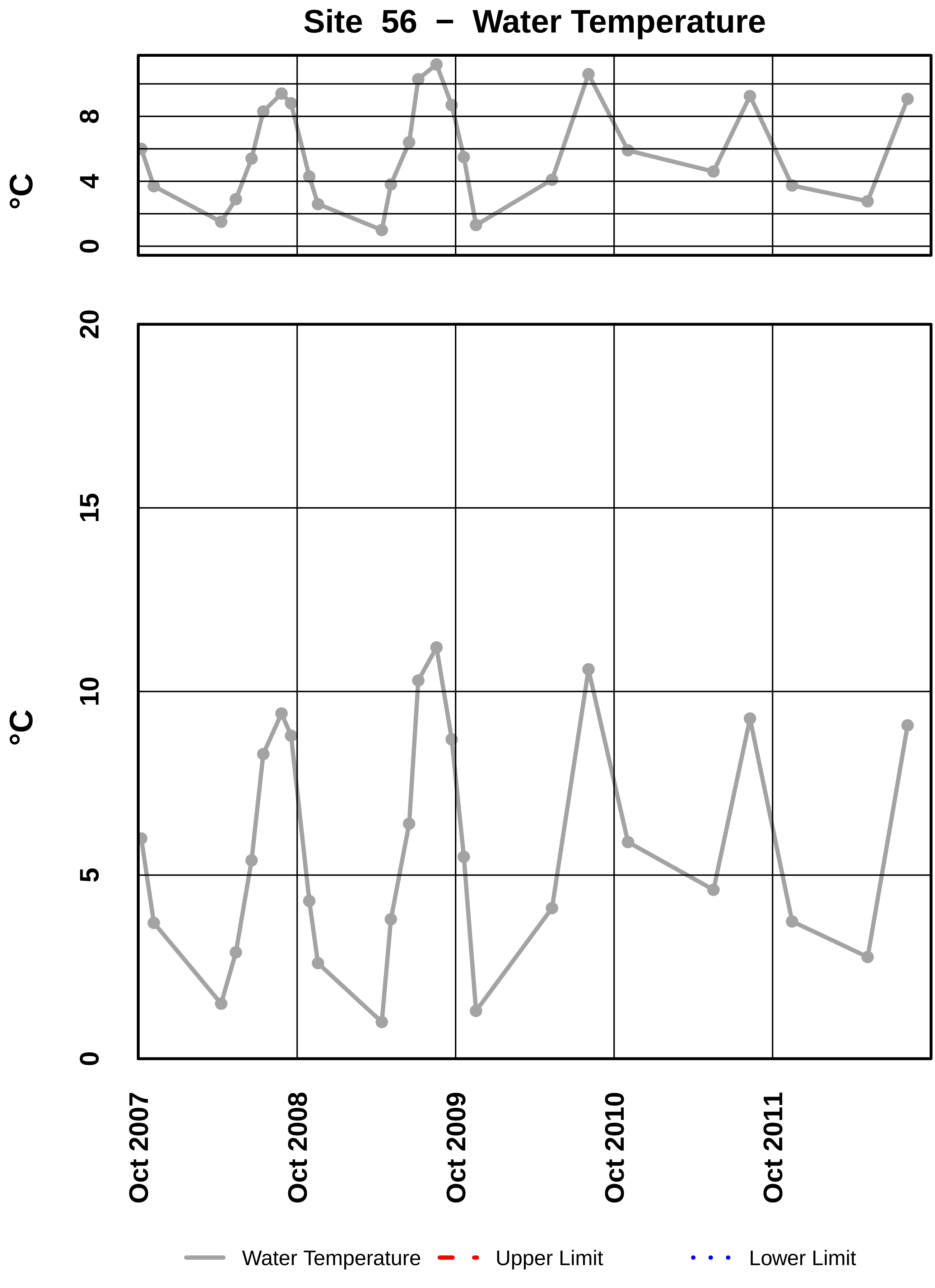
Shaded data has been qualified as an outlier by KGCMC and removed from any further analysis and is not included into the calculation of the median

Qualified Data by QA Reviewer

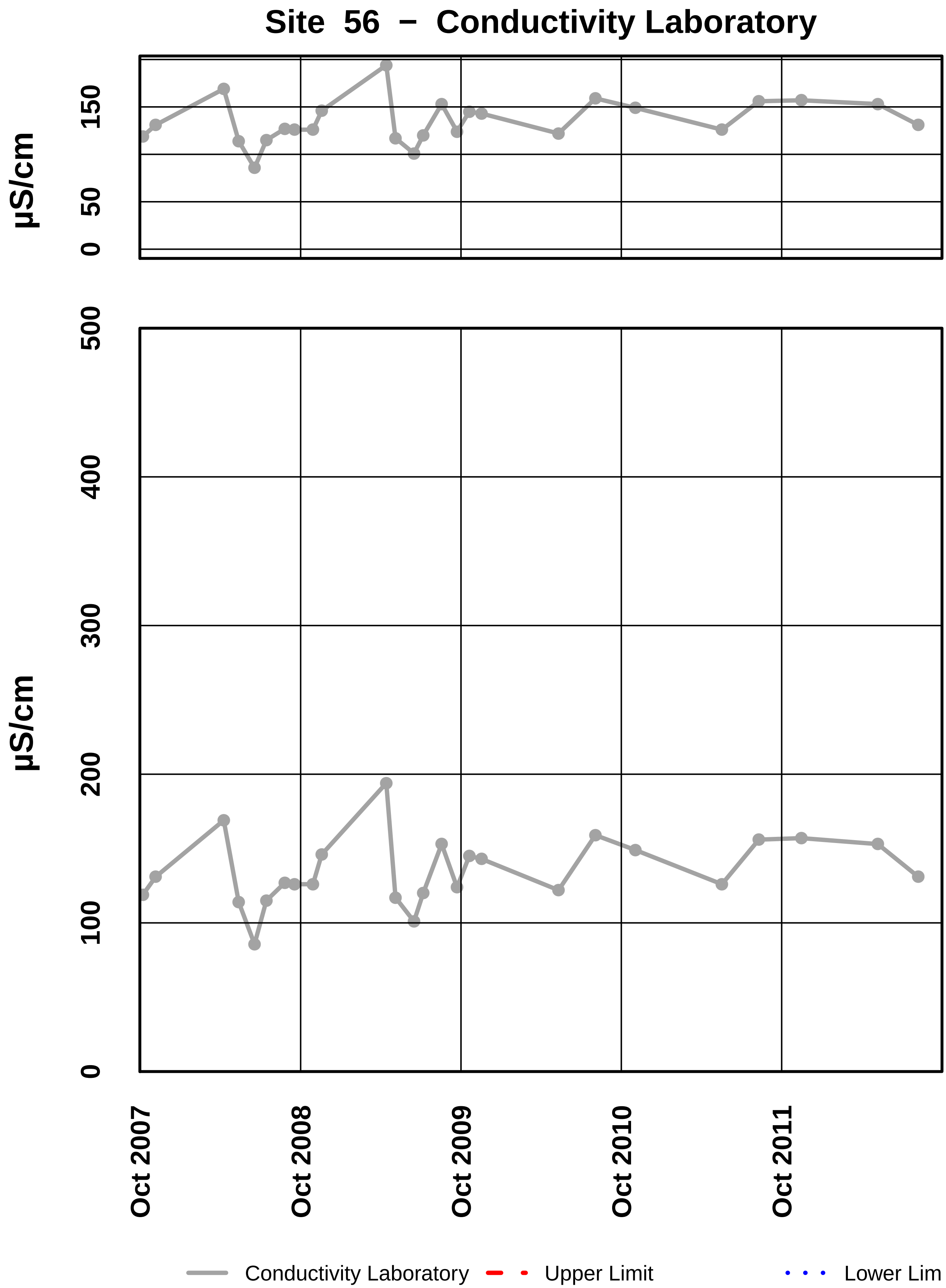
Date Range: 10/01/2011 to 09/30/2012

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
56	5/7/2012	12:00 AM	Cd diss, µg/l	0.00892	J	Below Quantitative Range
			Zn diss, µg/l	0.58	U	Field Blank Contamination
			SO4 Tot, mg/l	10.45	J	Sample Receipt Temperature
56	8/7/2012	12:00 AM	As diss, µg/l	0.2	J	LCS Recovery

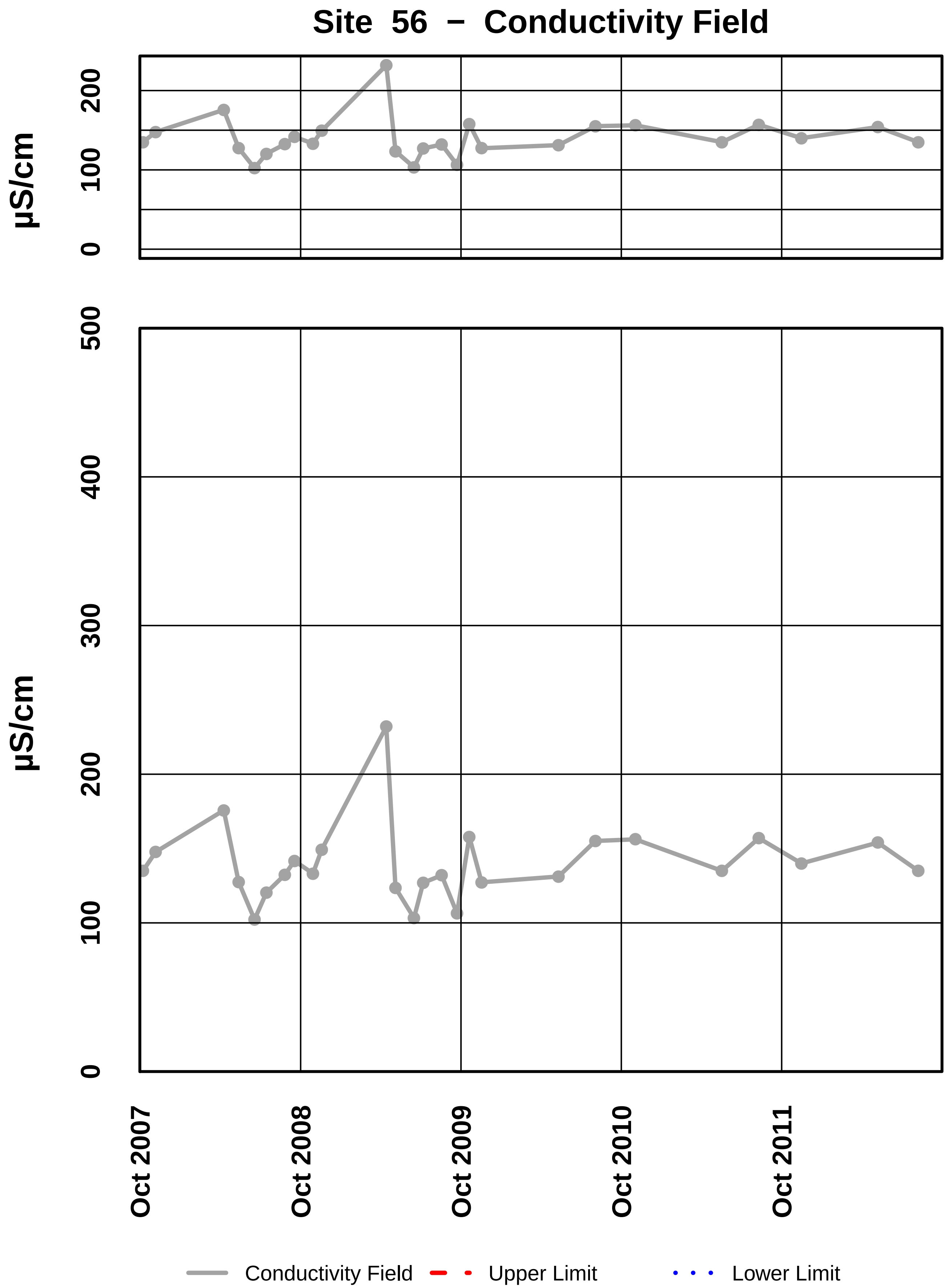
Qualifier	Description
J	Positively Identified - Approximate concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit



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

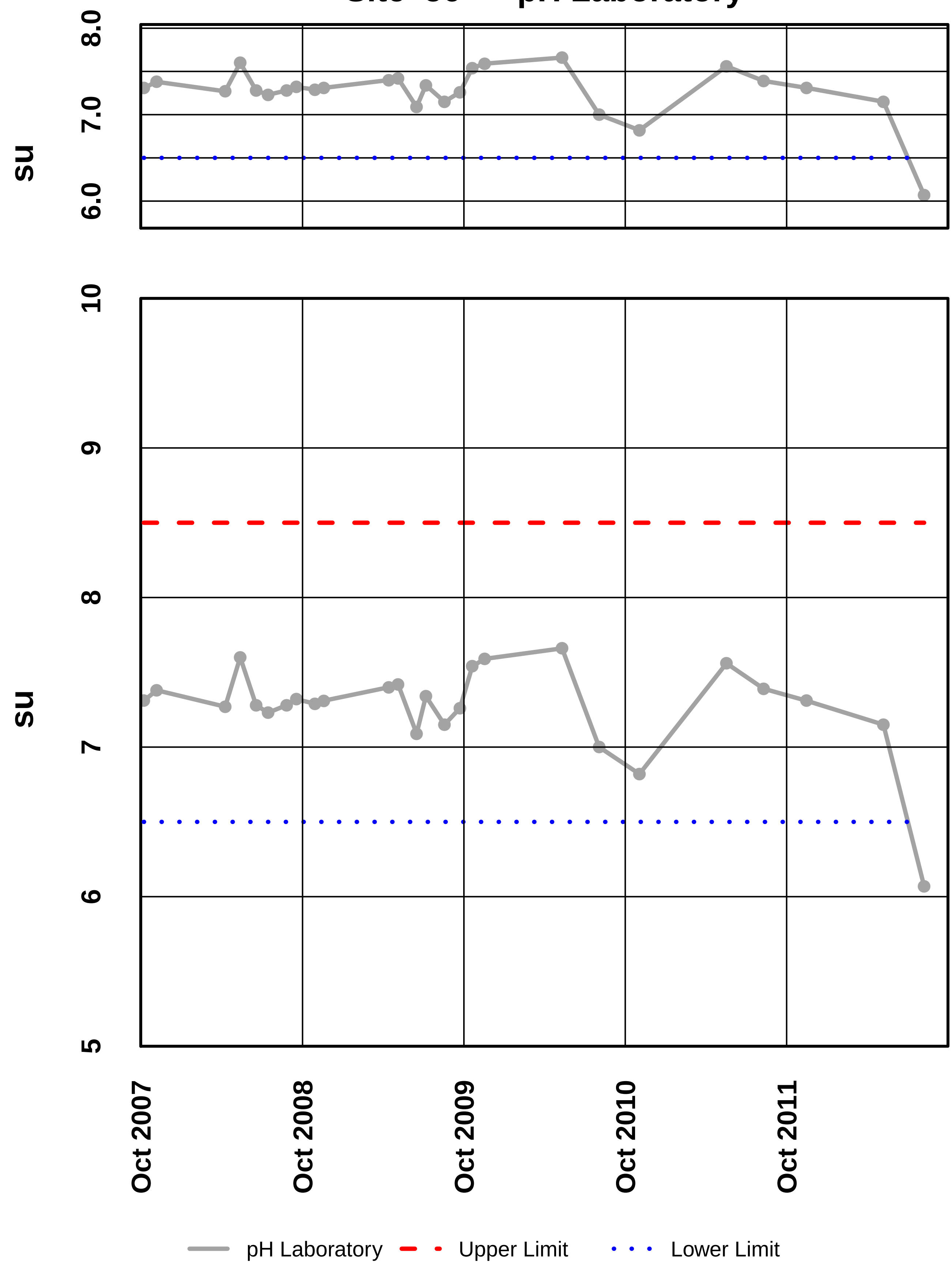


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



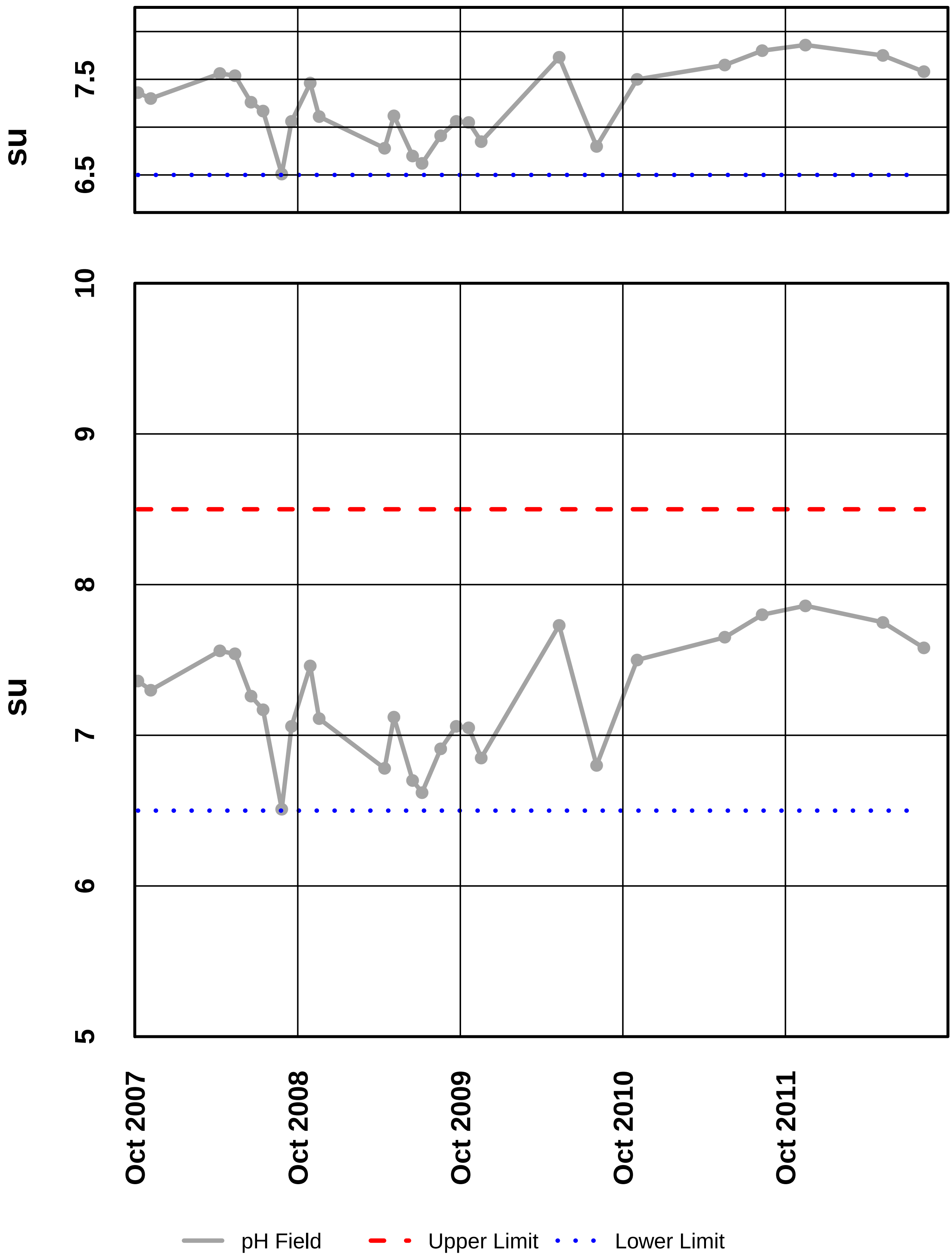
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 56 – pH Laboratory

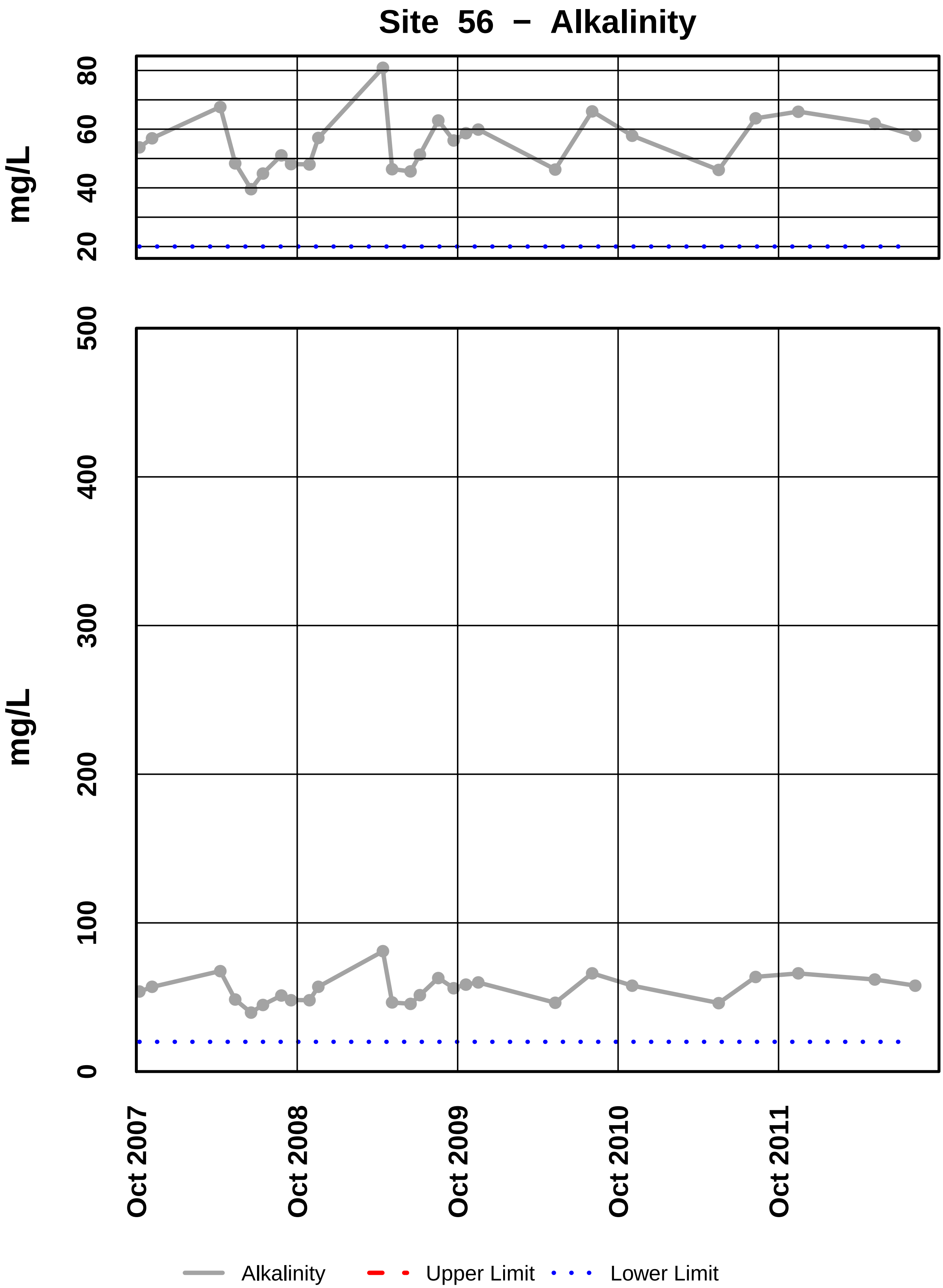


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

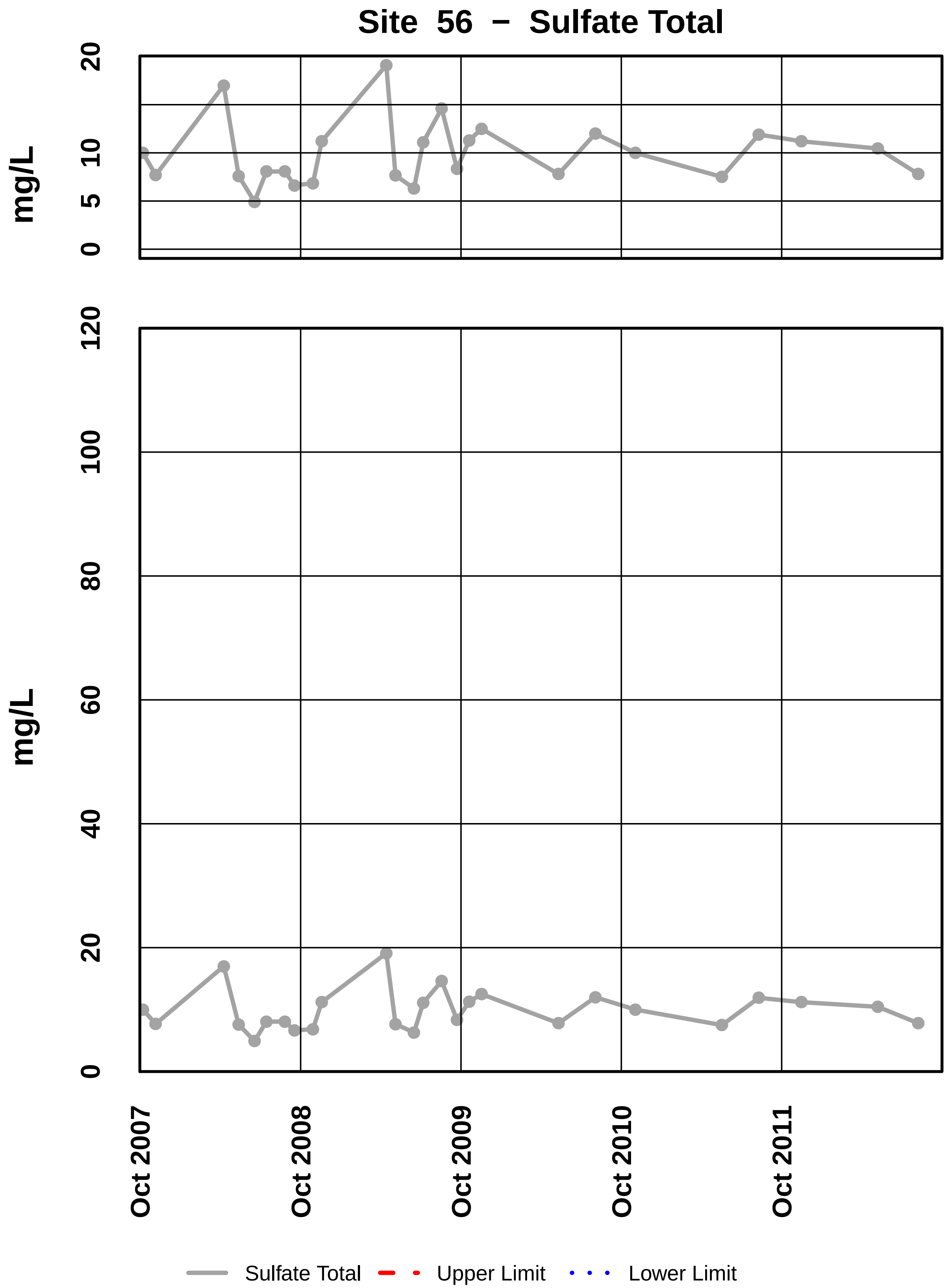
Site 56 – pH Field



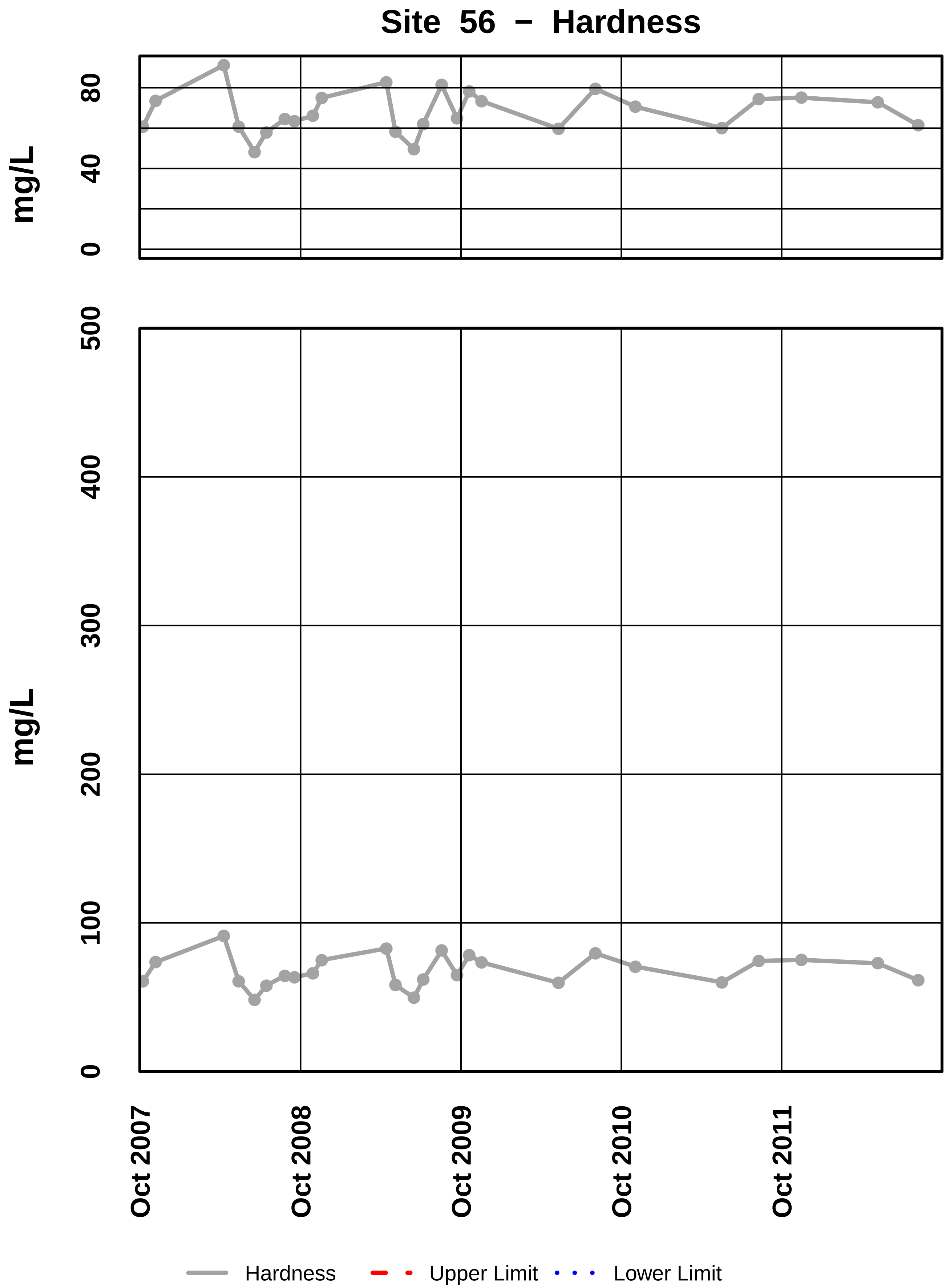
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



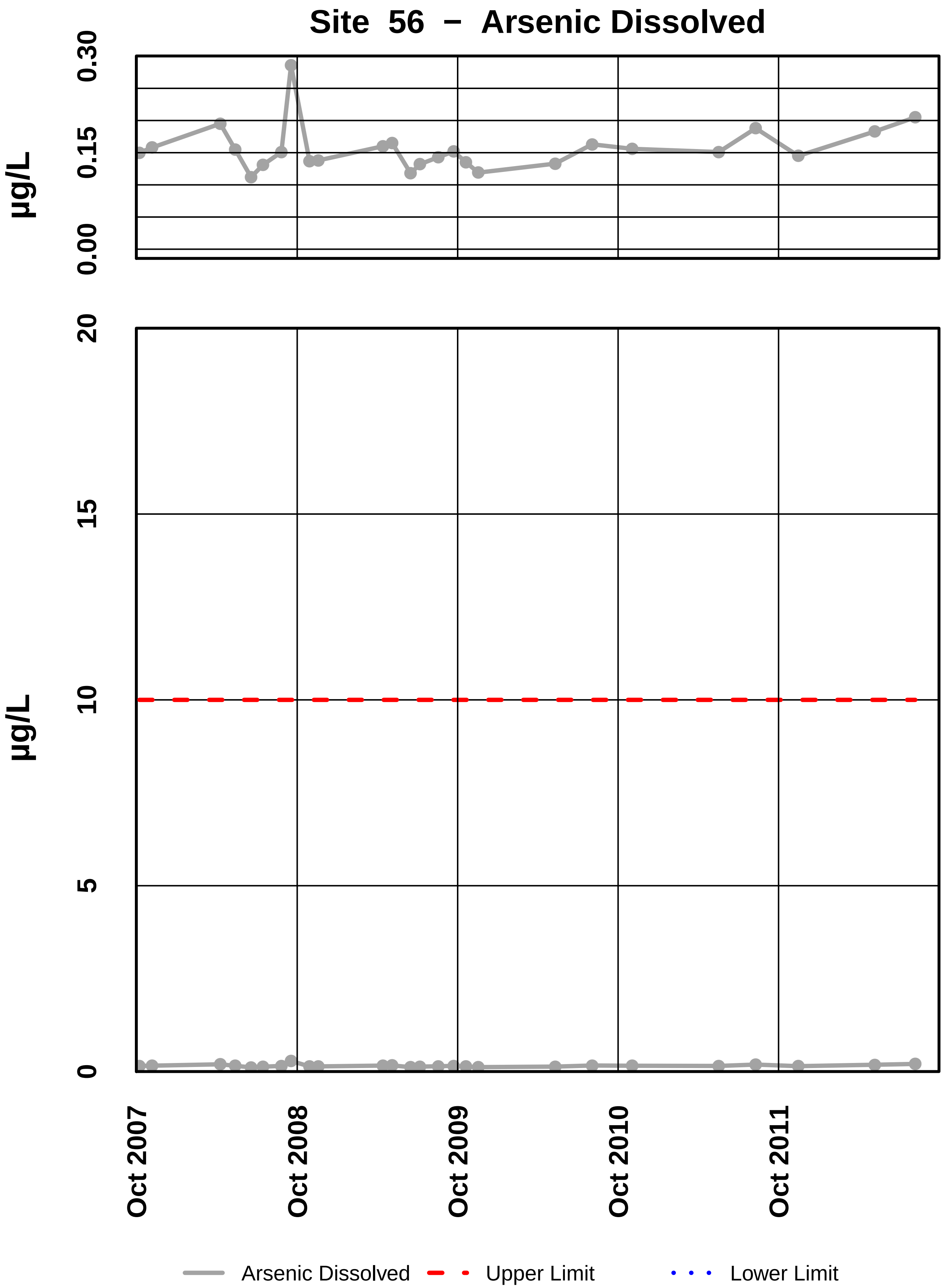
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

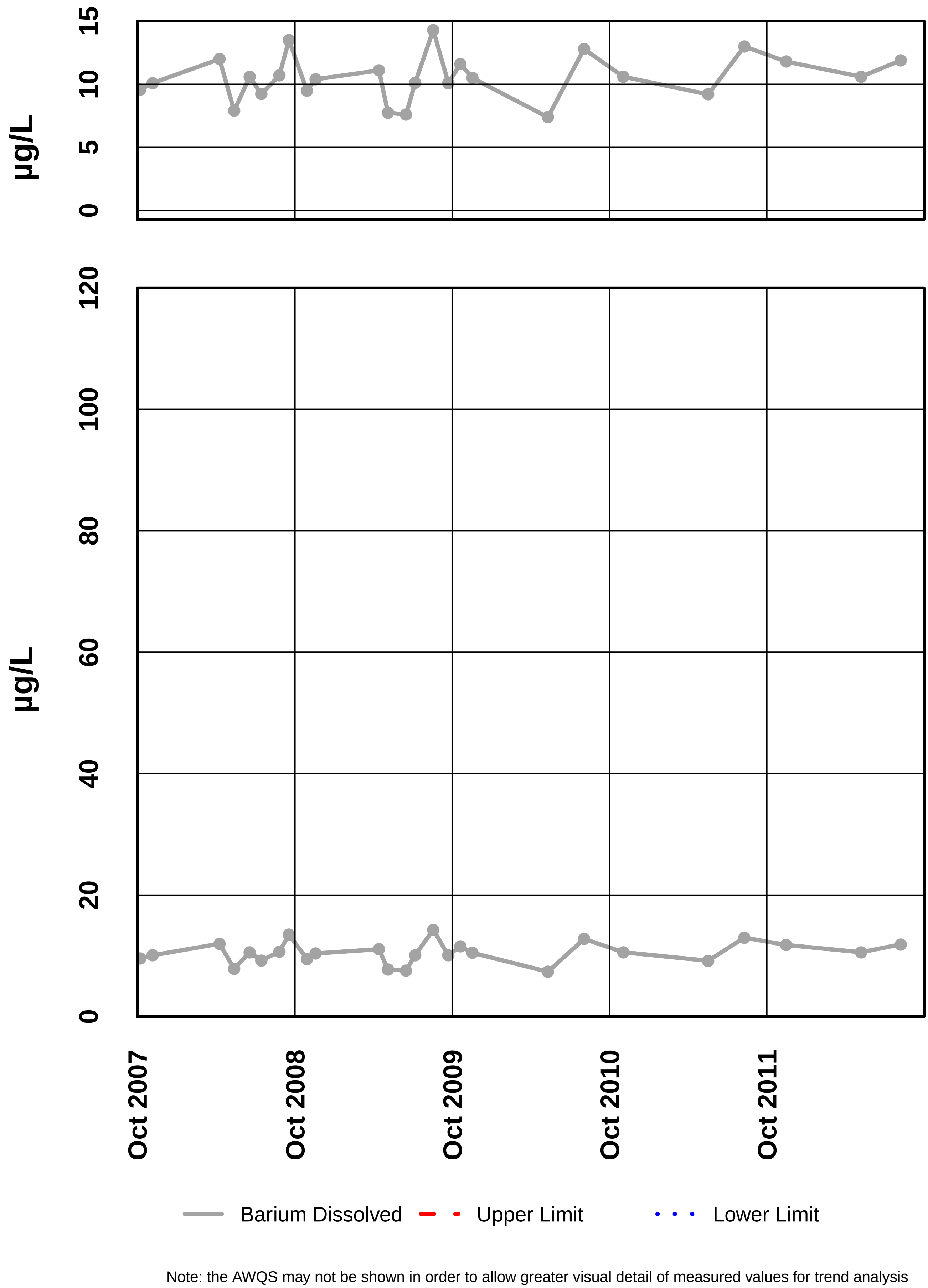


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

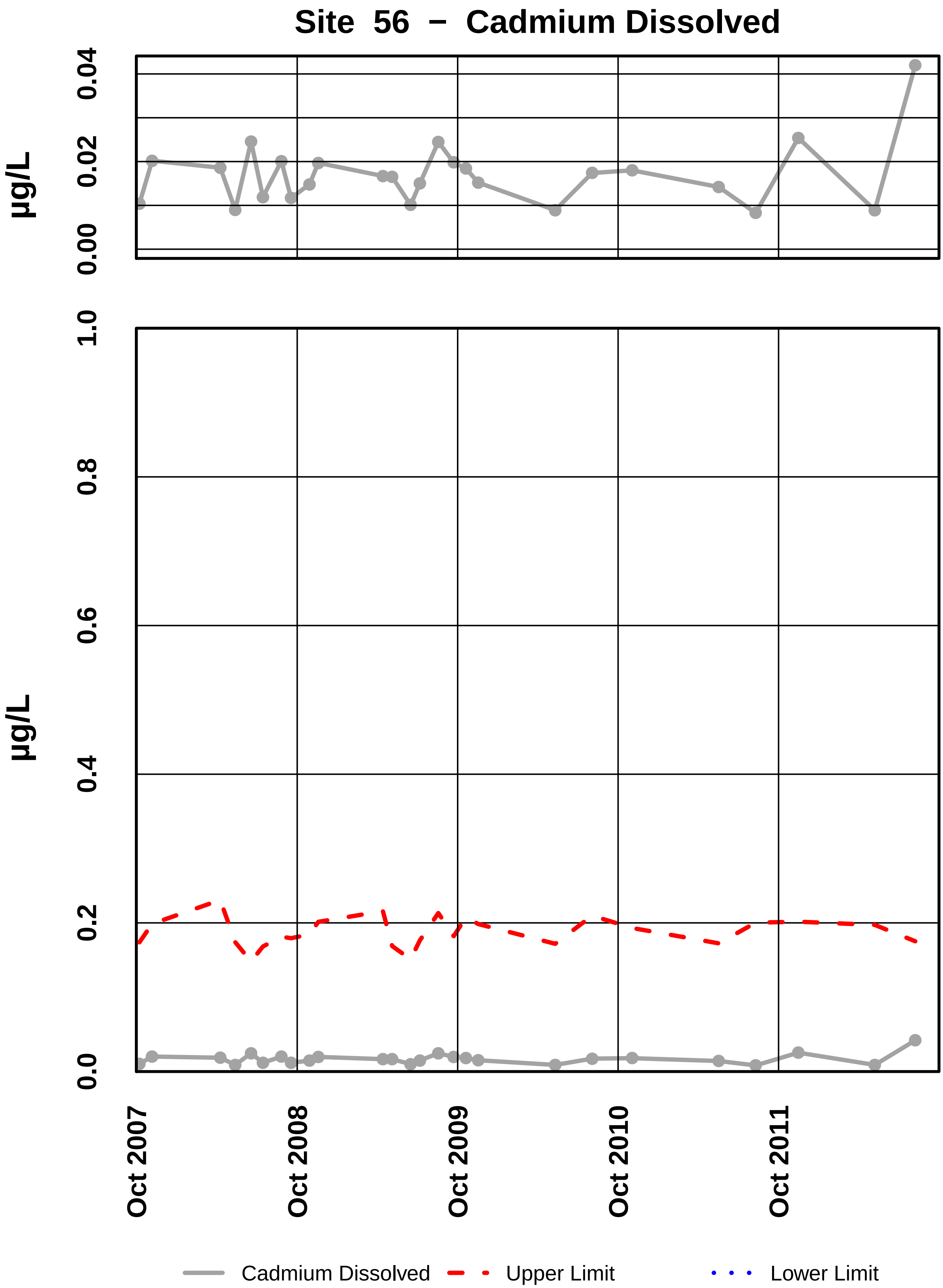


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 56 − Barium Dissolved

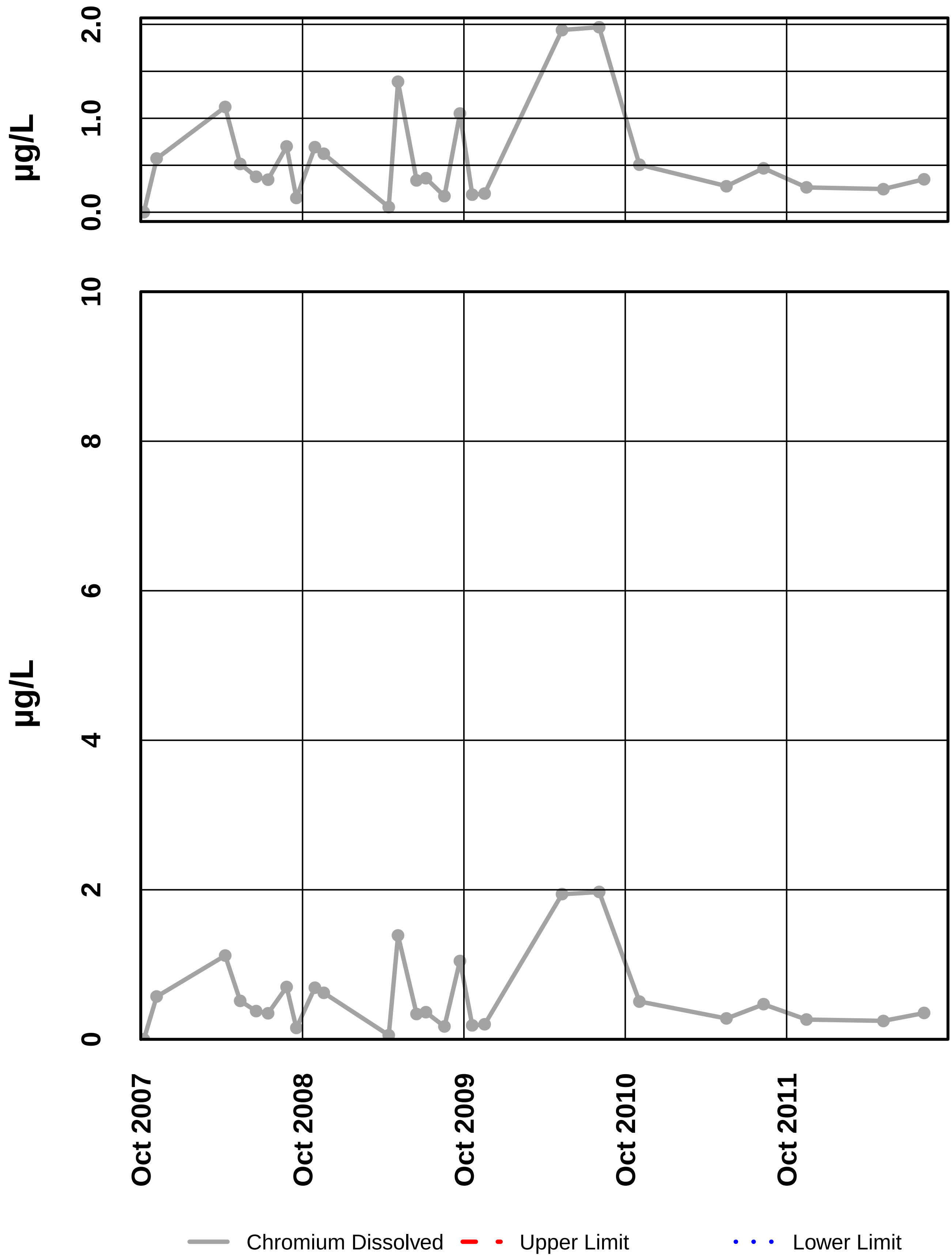


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



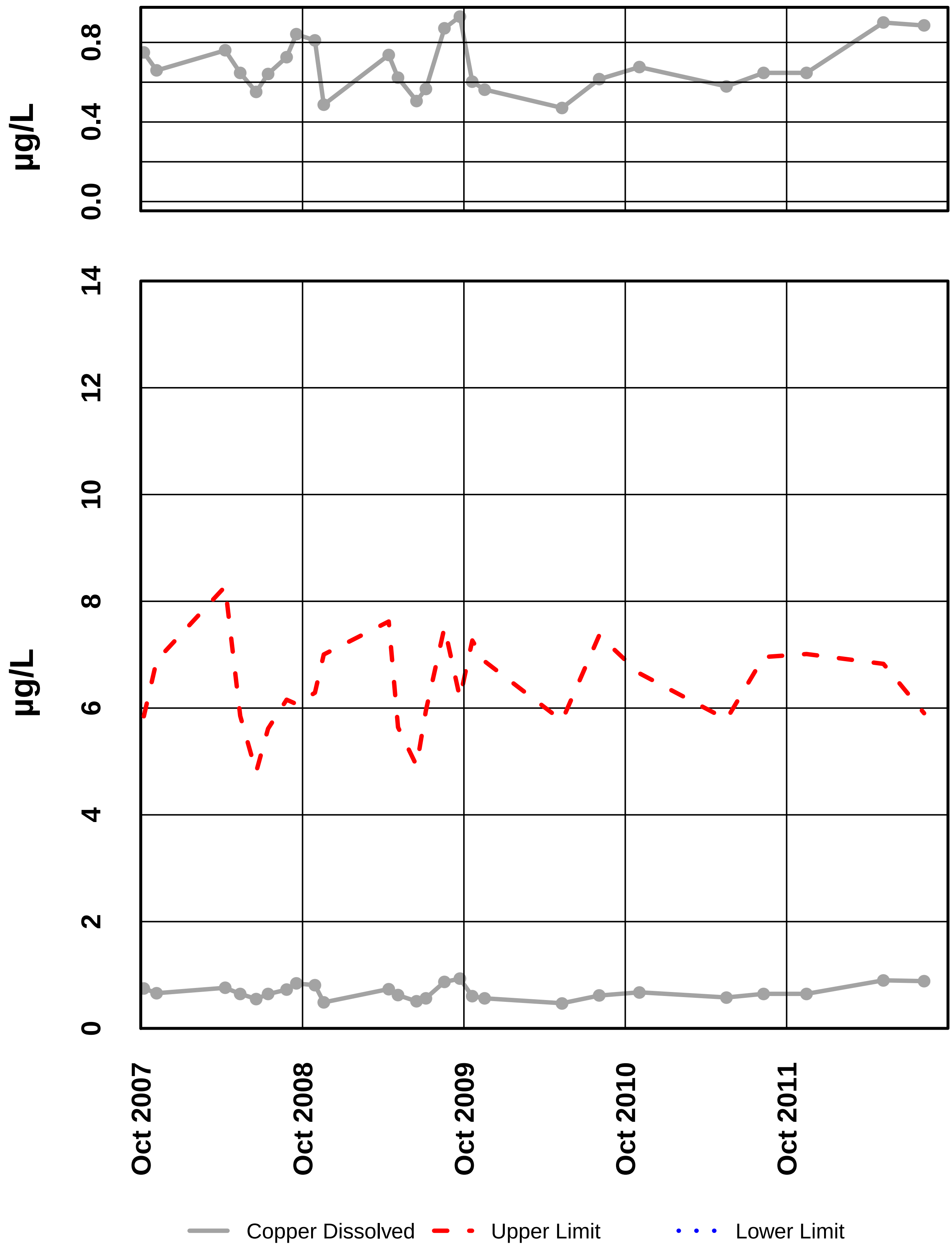
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 56 – Chromium Dissolved

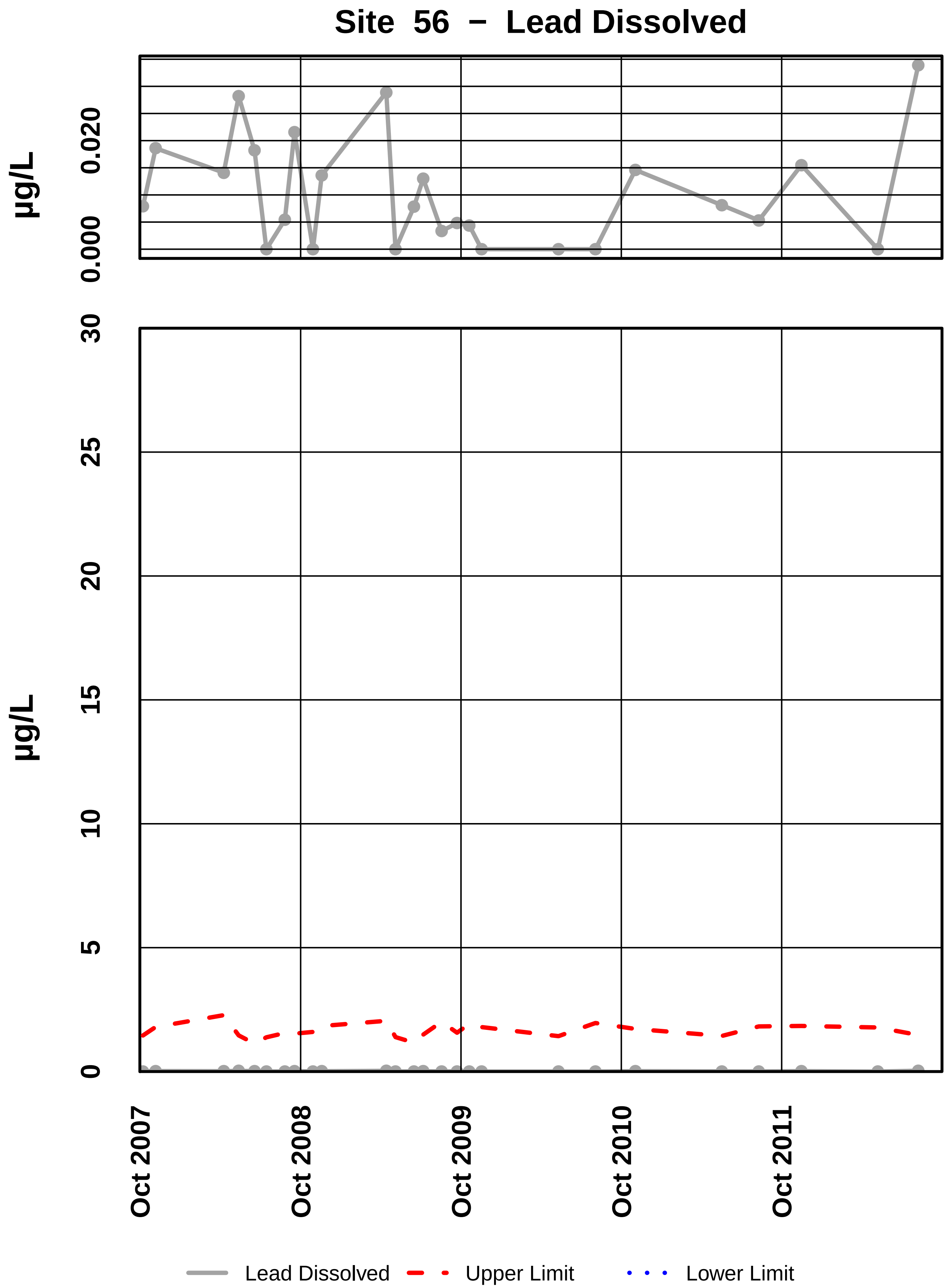


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

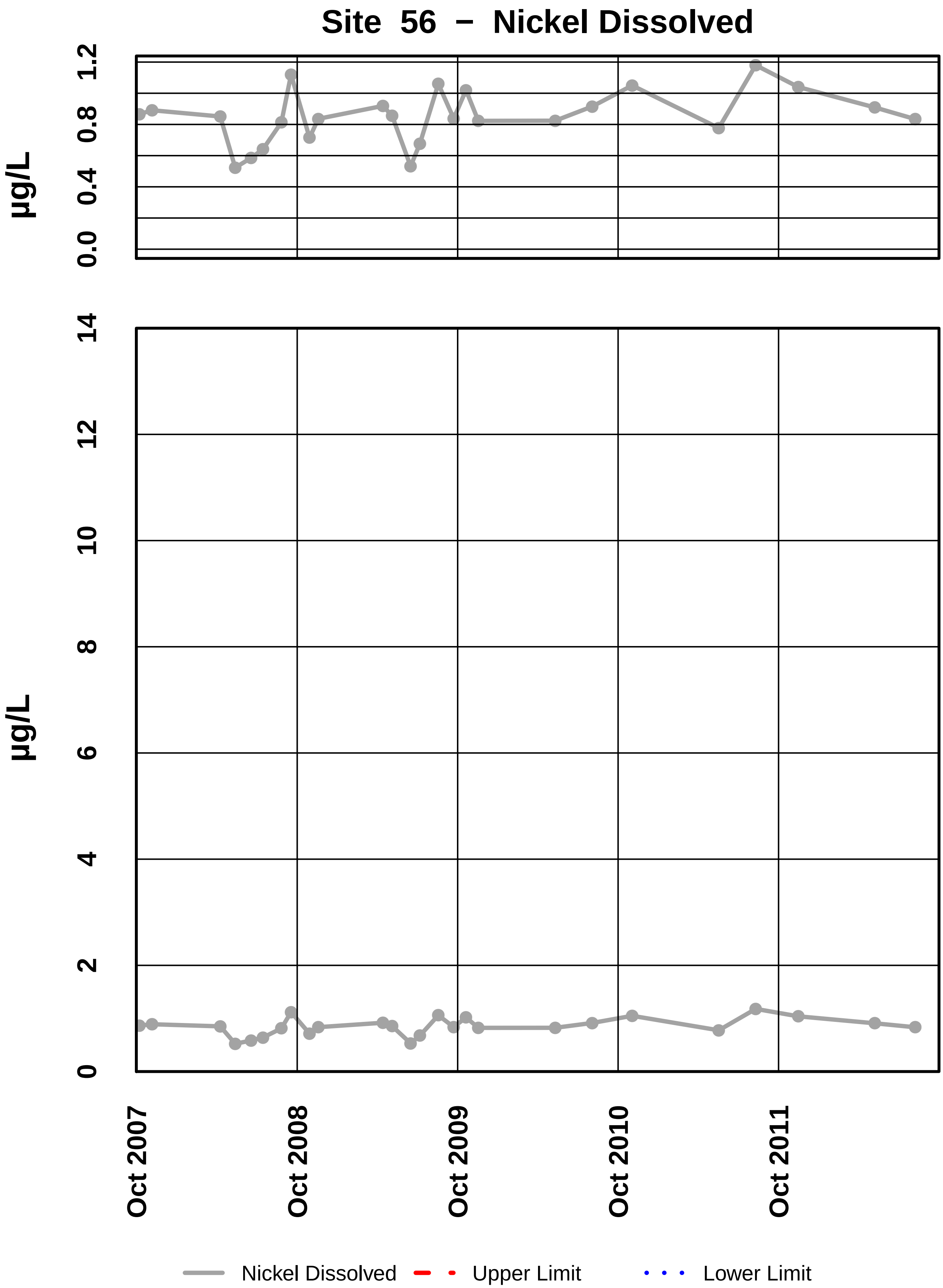
Site 56 – Copper Dissolved



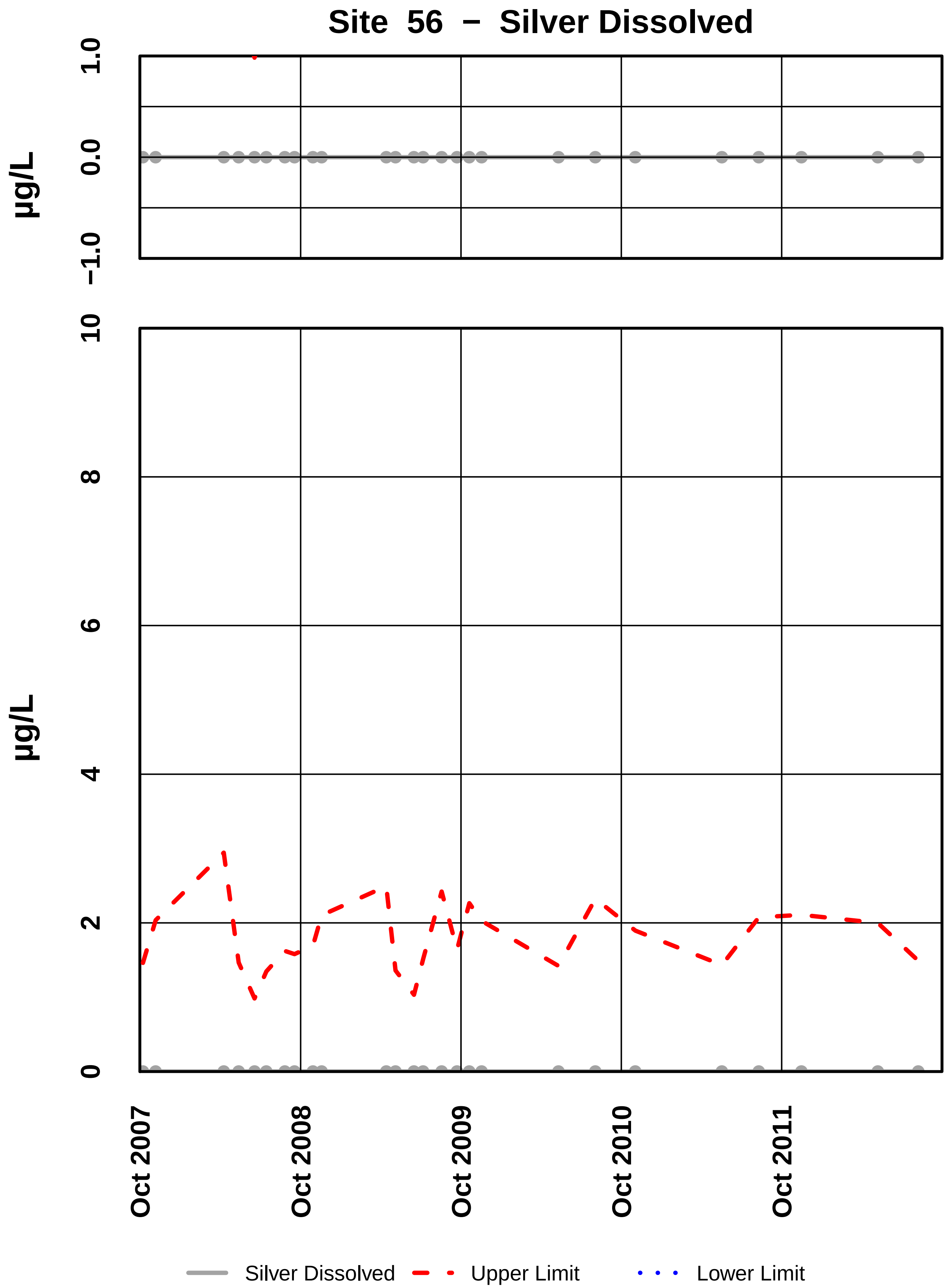
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

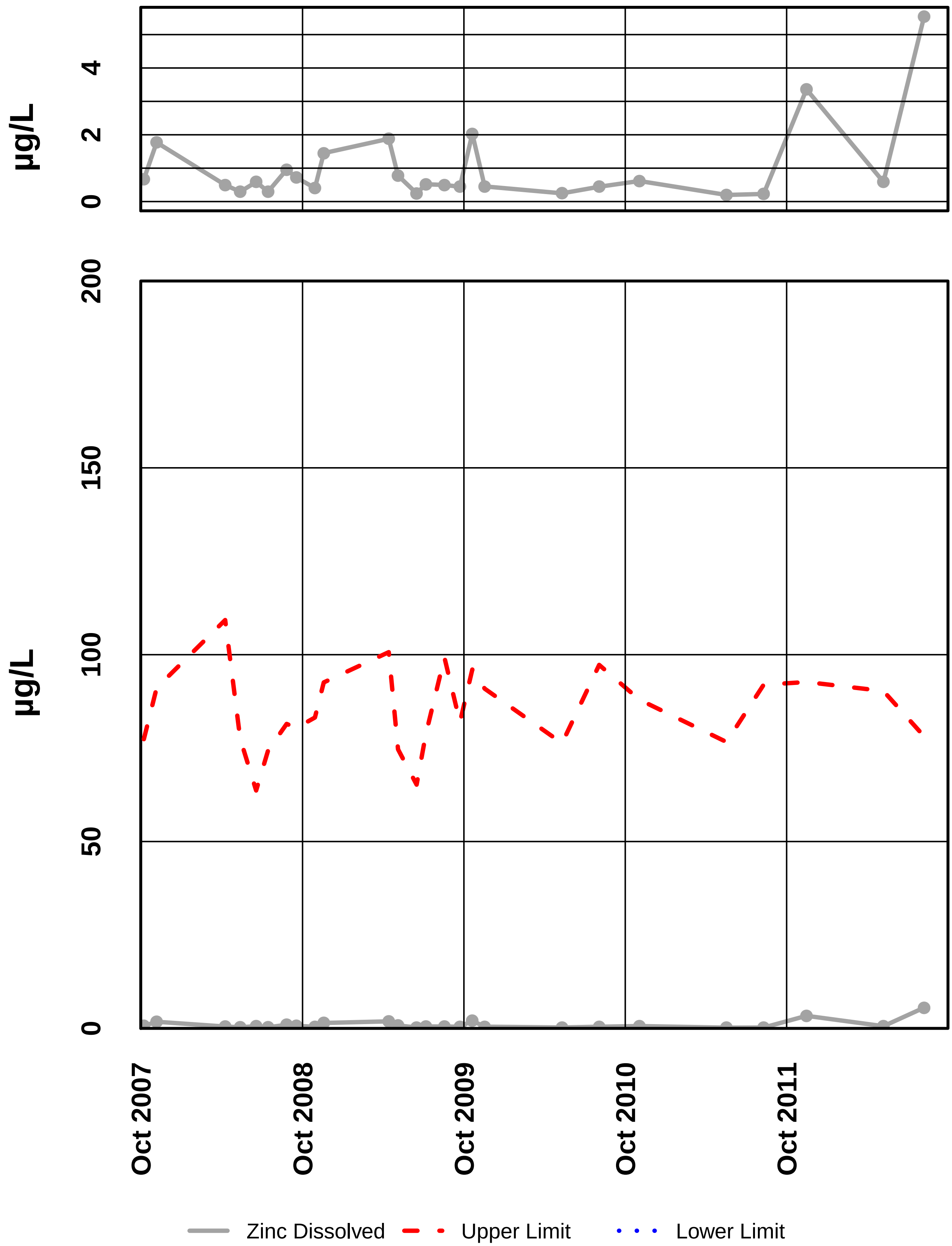


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

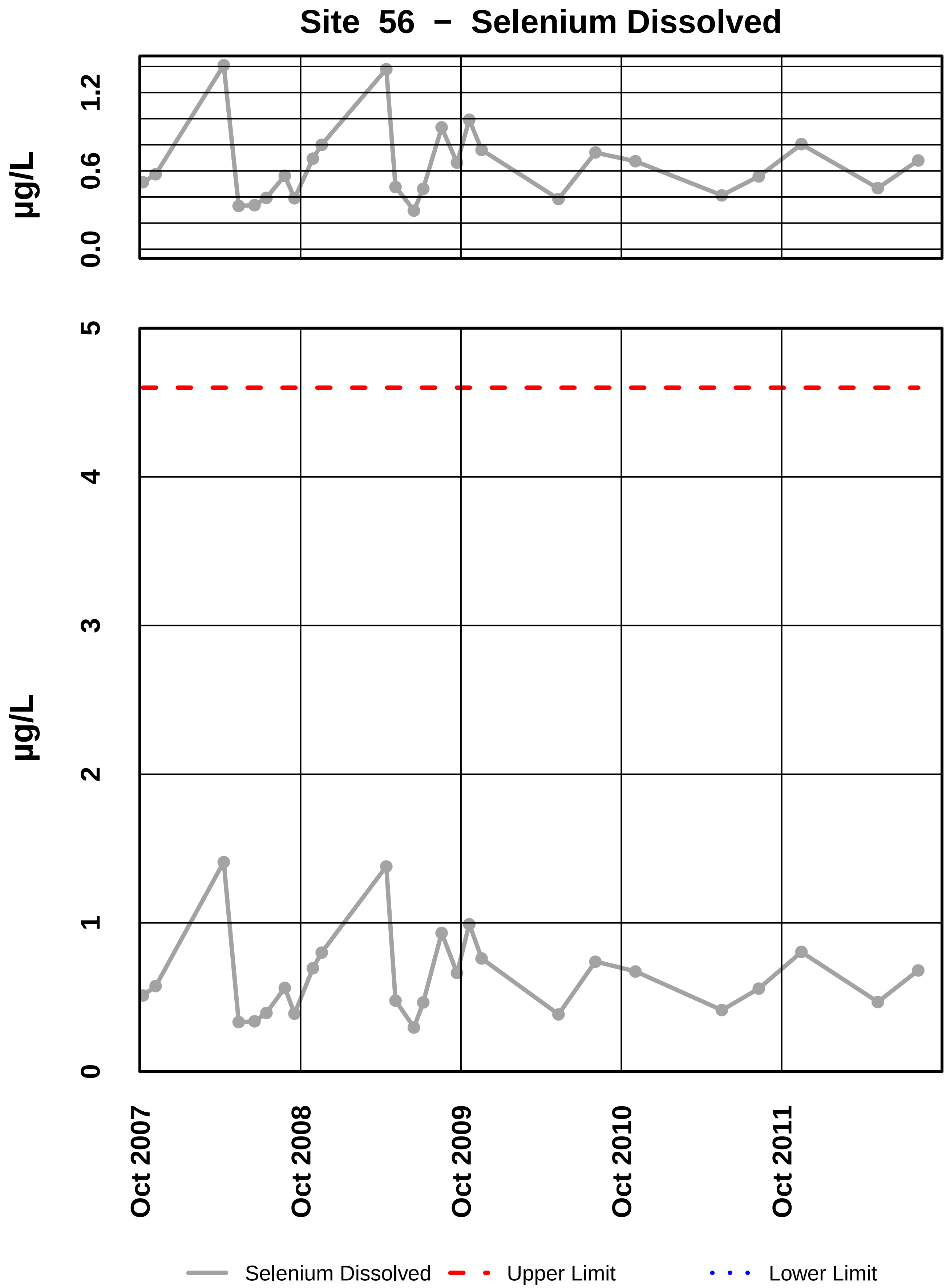


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

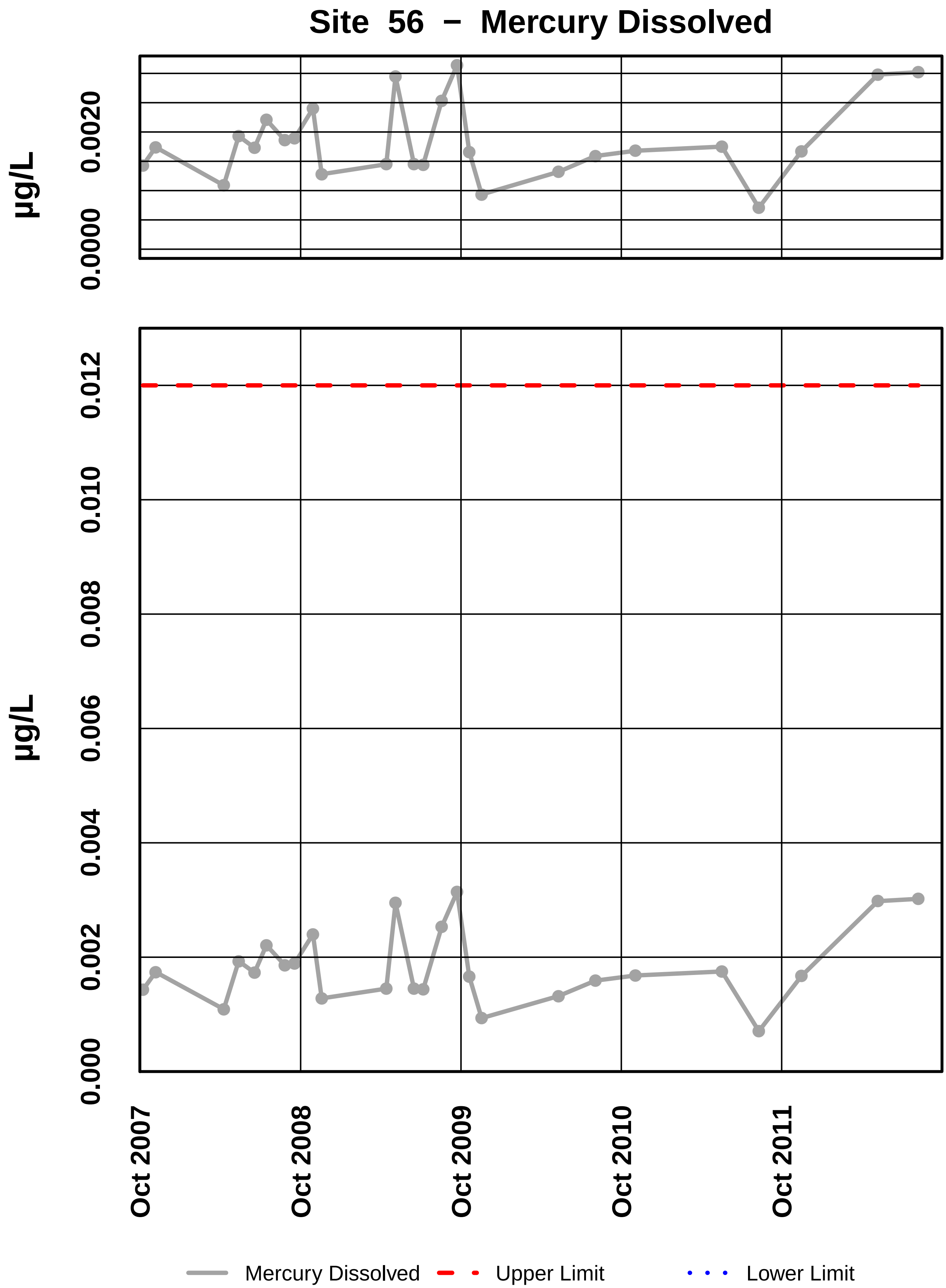
Site 56 – Zinc Dissolved



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



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



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

Site **#56** Seasonal Kendall analysis for Specific Conductance, Field (µS/cm)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**	154.7	154					179.2	145.8	101.9	129.2	182.2	167.4
b	**WY2008**	135	147.7					175.7	127.4	102.3	120.3	132.4	141.7
c	**WY2009**	133.2	149.3					232	123.5	103.3	127	132	106.4
d	**WY2010**	157.9	127.3						131.2			155.1	
e	**WY2011**		156.2						135			157	
f	**WY2012**		140						154			135	
	n	4	6	0	0	0	0	3	6	3	3	6	3

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

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

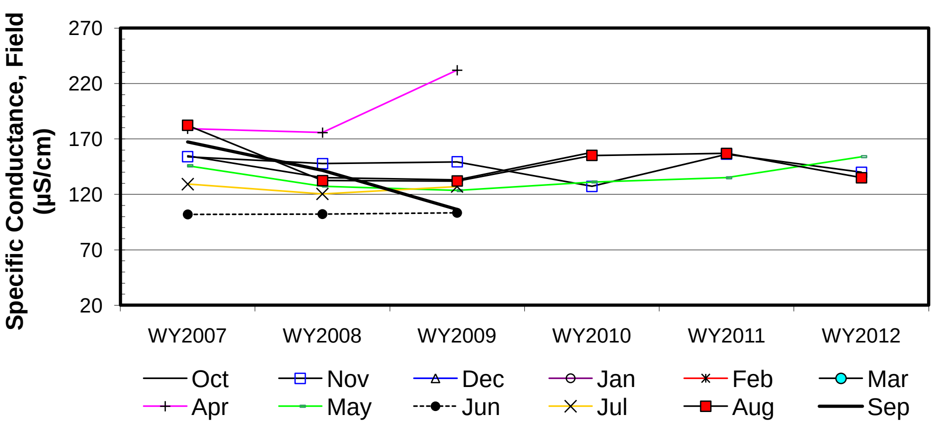
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	8.67	28.33					3.67	28.33	3.67	3.67	28.33	3.67
$Z_k = S_k/\sigma_S$	0.00	-0.56					0.52	0.94	1.57	-0.52	-0.19	-1.57
Z^2_k	0.00	0.32					0.27	0.88	2.45	0.27	0.04	2.45

ΣZ_k= 0.19
ΣZ^2_k= 6.69
Z-bar=ΣZ_k/K= 0.02

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

Σn 34
ΣS_k 1

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=		6.69	@α=5% $\chi^2_{(K-1)}$= 14.07	Test for station homogeneity	
	p	**0.462**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
$\Sigma VAR(S_k)$	Z_{calc}	0.00	@α/2=2.5% Z= 1.96	**H_0** (No trend)	ACCEPT
108.33	p	**0.500**		**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-6.30		2.72
0.050	-3.52	**0.40**	1.66
0.100	-2.85		1.16
0.200	-2.30		0.96

Site **#56** Seasonal Kendall analysis for pH, Field, Standard Units

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**	7.0	7.7					7.1	7.7	7.6	7.1	7.4	7.0
b	**WY2008**	7.4	7.3					7.6	7.5	7.3	7.2	6.5	7.1
c	**WY2009**	7.5	7.1					6.8	7.1	6.7	6.6	6.9	7.1
d	**WY2010**	7.1	6.9						7.7			6.8	
e	**WY2011**		7.5						7.7			7.8	
f	**WY2012**		7.9						7.8			7.6	
	n	4	6	0	0	0	0	3	6	3	3	6	3

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

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

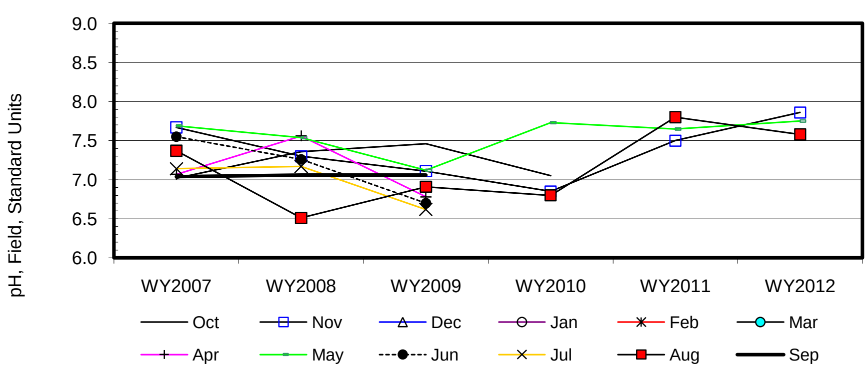
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	8.67	28.33					3.67	28.33	3.67	3.67	28.33	2.67
$Z_k = S_k/\sigma_S$	0.68	0.19					-0.52	0.94	-1.57	-0.52	0.94	1.22
Z^2_k	0.46	0.04					0.27	0.88	2.45	0.27	0.88	1.50

ΣZ_k= 1.36
ΣZ^2_k= 6.76
Z-bar=$\Sigma Z_k/K$= 0.17

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	32	1	0	0	0

Σn 34
ΣS_k 10

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$= 6.53	@α=5% $\chi^2_{(K-1)}$= 14.07	Test for station homogeneity	
p **0.479**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k) Z_{calc} 0.87	@α/2=2.5% Z= 1.96	**H_0** (No trend)	ACCEPT
107.33 **p** **0.807**		**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.17		0.13
0.050	-0.11	**0.01**	0.10
0.100	-0.05		0.05
0.200	0.00		0.04

Site **#56** Seasonal Kendall analysis for Total Alk, (mg/l)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**	51.2	61.3					52.1	53.5	42.3	45.8	66.3	66.3
b	**WY2008**	53.8	56.9					67.6	48.4	39.6	44.9	51.1	48.1
c	**WY2009**	48.0	57.0					80.9	46.4	45.6	51.3	63.0	56.1
d	**WY2010**	58.6	59.9						46.3			66.1	
e	**WY2011**		57.8						46.1			63.7	
f	**WY2012**		66.0						61.9			57.8	
	n	4	6	0	0	0	0	3	6	3	3	6	3

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

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

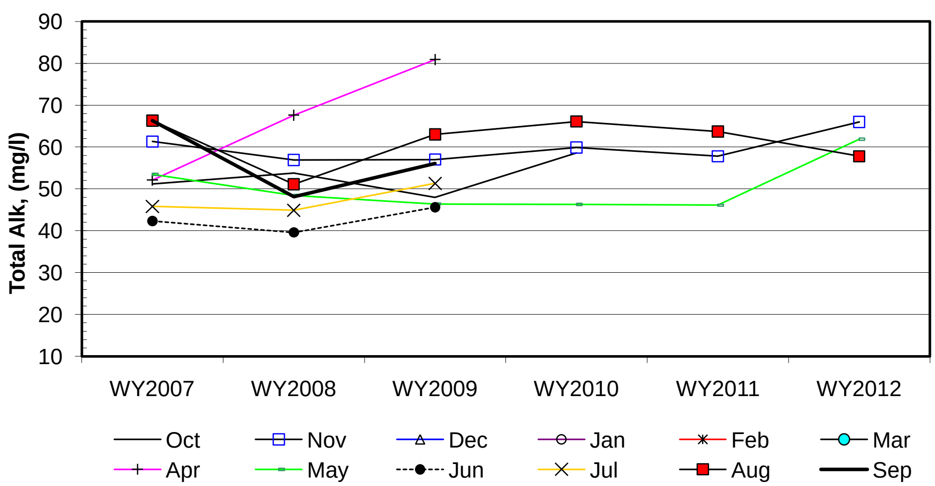
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	8.67	28.33					3.67	28.33	3.67	3.67	28.33	3.67
$Z_k = S_k/\sigma_S$	0.68	0.94					1.57	-0.94	0.52	0.52	-0.56	-0.52
Z^2_k	0.46	0.88					2.45	0.88	0.27	0.27	0.32	0.27

ΣZ_k= 2.20
ΣZ^2_k= 5.82
Z-bar=ΣZ_k/K= 0.28

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

Σn 34
ΣS_k 3

$\chi^2_h=\Sigma Z^2_k$-K(Z-bar)^2=		5.21	@α=5% $\chi^2_{(K-1)}$=	14.07	Test for station homogeneity
	p	**0.634**			$\chi^2_h<\chi^2_{(K-1)}$ ACCEPT
ΣVAR(S_k)	Z_{calc}	0.19	@α/2=2.5% Z=	1.96	**H_0** (No trend) ACCEPT
108.33	p	**0.576**			**H_A** (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-1.63		2.69
0.050	-0.88	**0.30**	2.28
0.100	-0.67		1.68
0.200	-0.19		1.43

Site **#56** Seasonal Kendall analysis for Sulfate, Total (mg/l)

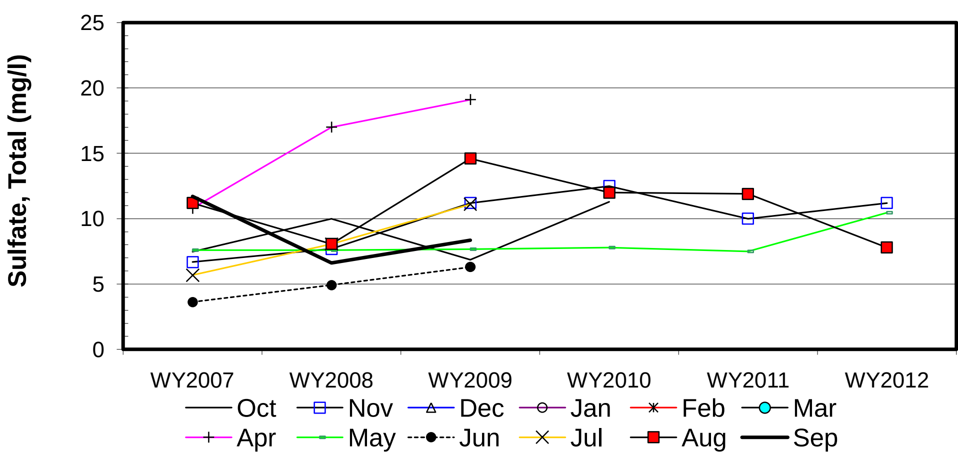
Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**	7.5	6.7					10.8	7.6	3.6	5.7	11.2	11.7
b	**WY2008**	10.0	7.7					17.0	7.6	4.9	8.1	8.1	6.6
c	**WY2009**	6.9	11.2					19.1	7.7	6.3	11.1	14.6	8.4
d	**WY2010**	11.3	12.5						7.8			12.0	
e	**WY2011**		10.0						7.5			11.9	
f	**WY2012**		11.2						10.5			7.8	
	n	4	6	0	0	0	0	3	6	3	3	6	3
	t_1	4	4	0	0	0	0	3	6	3	3	6	3
	t_2	0	1	0	0	0	0	0	0	0	0	0	0
	t_3	0	0	0	0	0	0	0	0	0	0	0	0
	t_4	0	0	0	0	0	0	0	0	0	0	0	0
	t_5	0	0	0	0	0	0	0	0	0	0	0	0
	b-a	1	1					1	1	1	1	-1	-1
	c-a	-1	1					1	1	1	1	1	-1
	d-a	1	1						1			1	
	e-a		1						-1			1	
	f-a		1						1			-1	
	c-b	-1	1					1	1	1	1	1	1
	d-b	1	1						1			1	
	e-b		1						-1			1	
	f-b		1						1			-1	
	d-c	1	1						1			-1	
	e-c		-1						-1			-1	
	f-c		0						1			-1	
	e-d		-1						-1			-1	
	f-d		-1						1			-1	
	f-e		1						1			-1	
	S_k	2	8	0	0	0	0	3	7	3	3	-3	-1
	σ^2_S=	8.67	27.33					3.67	28.33	3.67	3.67	28.33	3.67
	$Z_k = S_k/\sigma_S$	0.68	1.53					1.57	1.32	1.57	1.57	-0.56	-0.52
	Z^2_k	0.46	2.34					2.45	1.73	2.45	2.45	0.32	0.27

ΣZ_k=	7.14
ΣZ^2_k=	12.49
Z-bar=ΣZ_k/K=	0.89

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	32	1	0	0	0

Σn	34
ΣS_k	22

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=		6.12	@α=5% $\chi^2_{(K-1)}$= 14.07	Test for station homogeneity	
	p	**0.526**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc}	2.03	@α=2.5% Z= 1.96	**H_0** (No trend)	REJECT
107.33	**p**	**0.979**		**H_A** (± trend)	ACCEPT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.03		1.31
0.050	0.03	**0.71**	1.27
0.100	0.07		1.03
0.200	0.14		0.90

8.7%

Site **#56** Seasonal Kendall analysis for Zinc, Dissolved (ug/l)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**	0.6	1.5					0.7	0.8	0.1	0.3	0.9	0.4
b	**WY2008**	0.7	1.8					0.5	0.3	0.6	0.3	1.0	0.7
c	**WY2009**	0.4	1.5					1.9	0.8	0.2	0.5	0.5	0.4
d	**WY2010**	2.0	0.5						0.2			0.4	
e	**WY2011**		0.6						0.2			0.2	
f	**WY2012**		3.4						0.6			5.5	
	n	4	6	0	0	0	0	3	6	3	3	6	3

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

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

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	8.67	28.33					3.67	28.33	3.67	3.67	28.33	3.67
$Z_k = S_k/\sigma_S$	0.68	-0.19					0.52	-1.32	0.52	0.52	-0.56	0.52
Z^2_k	0.46	0.04					0.27	1.73	0.27	0.27	0.32	0.27

ΣZ_k= 0.70

ΣZ^2_k= 3.63

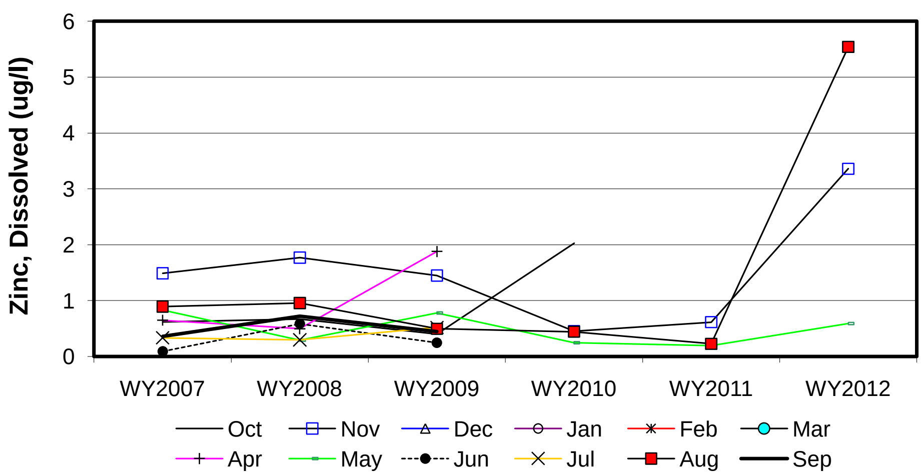
Z-bar=ΣZ_k/K= 0.09

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

Σn 34

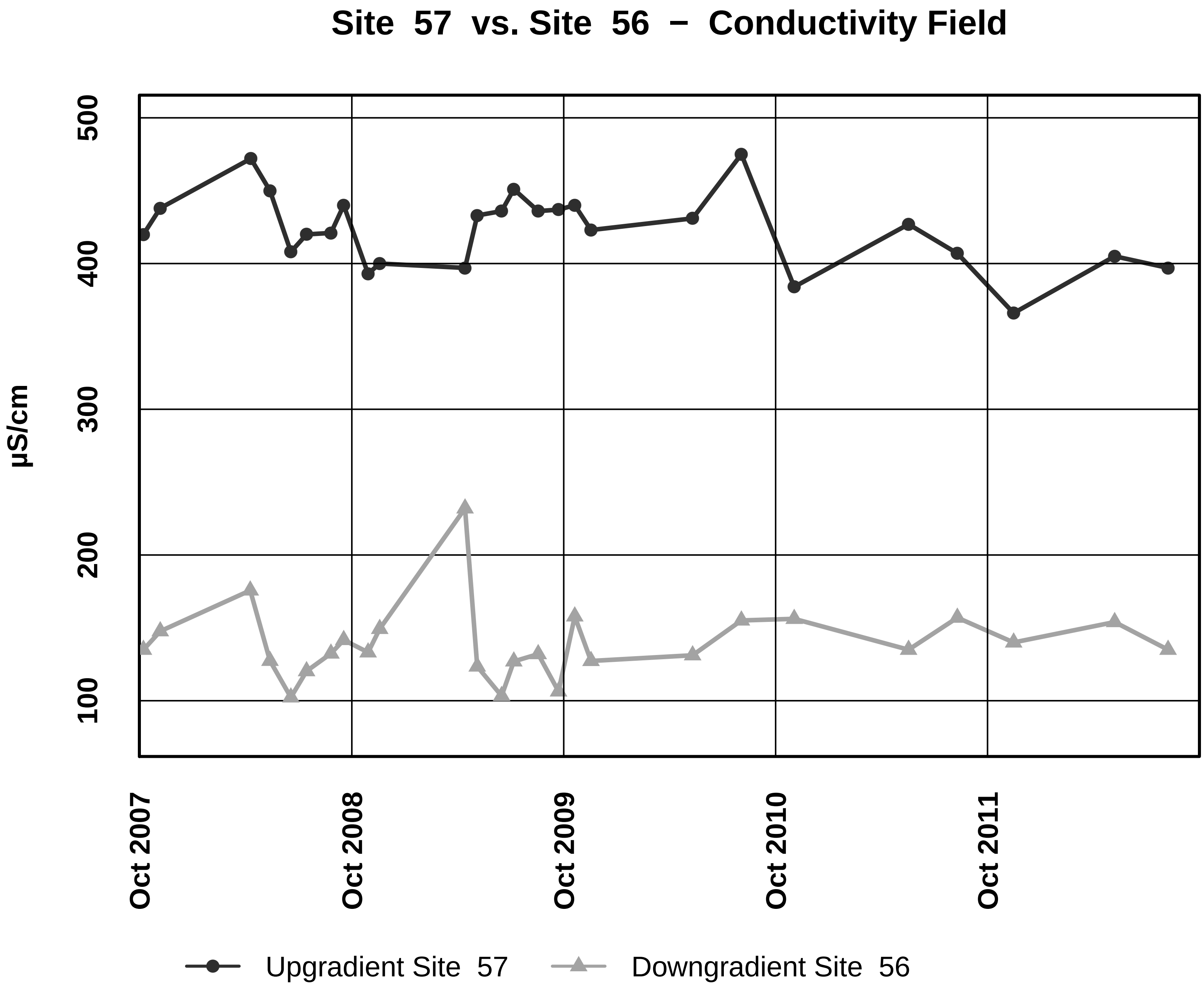
ΣS_k -5

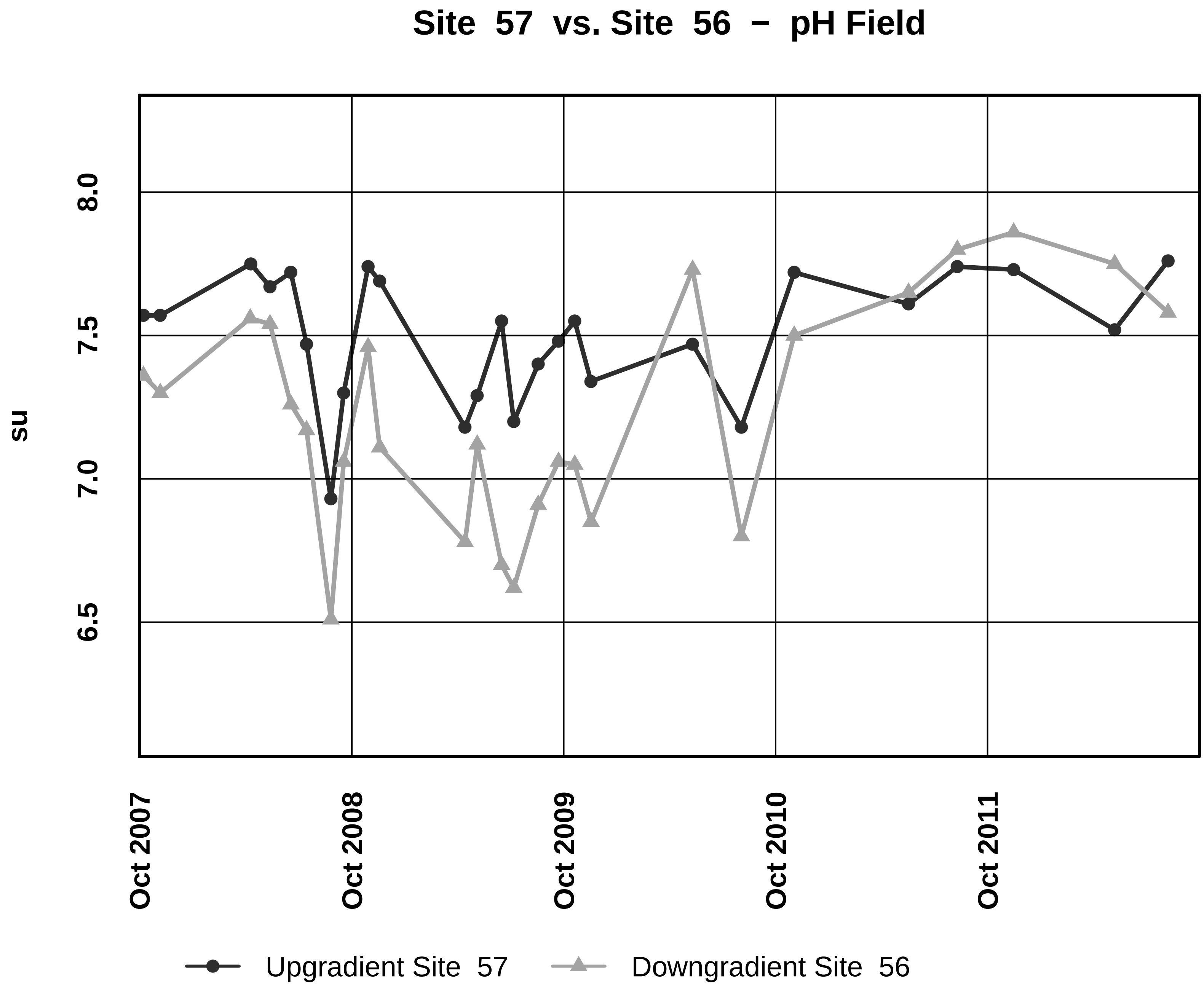
$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	3.57	@α=5% $\chi^2_{(K-1)}$= 14.07	Test for station homogeneity
p	**0.827**		$\chi^2_h<\chi^2_{(K-1)}$ ACCEPT
ΣVAR(S_k)	Z_{calc} -0.38	@α/2=2.5% Z= 1.96	**H_0** (No trend) ACCEPT
108.33	**p** **0.350**		**H_A** (± trend) REJECT



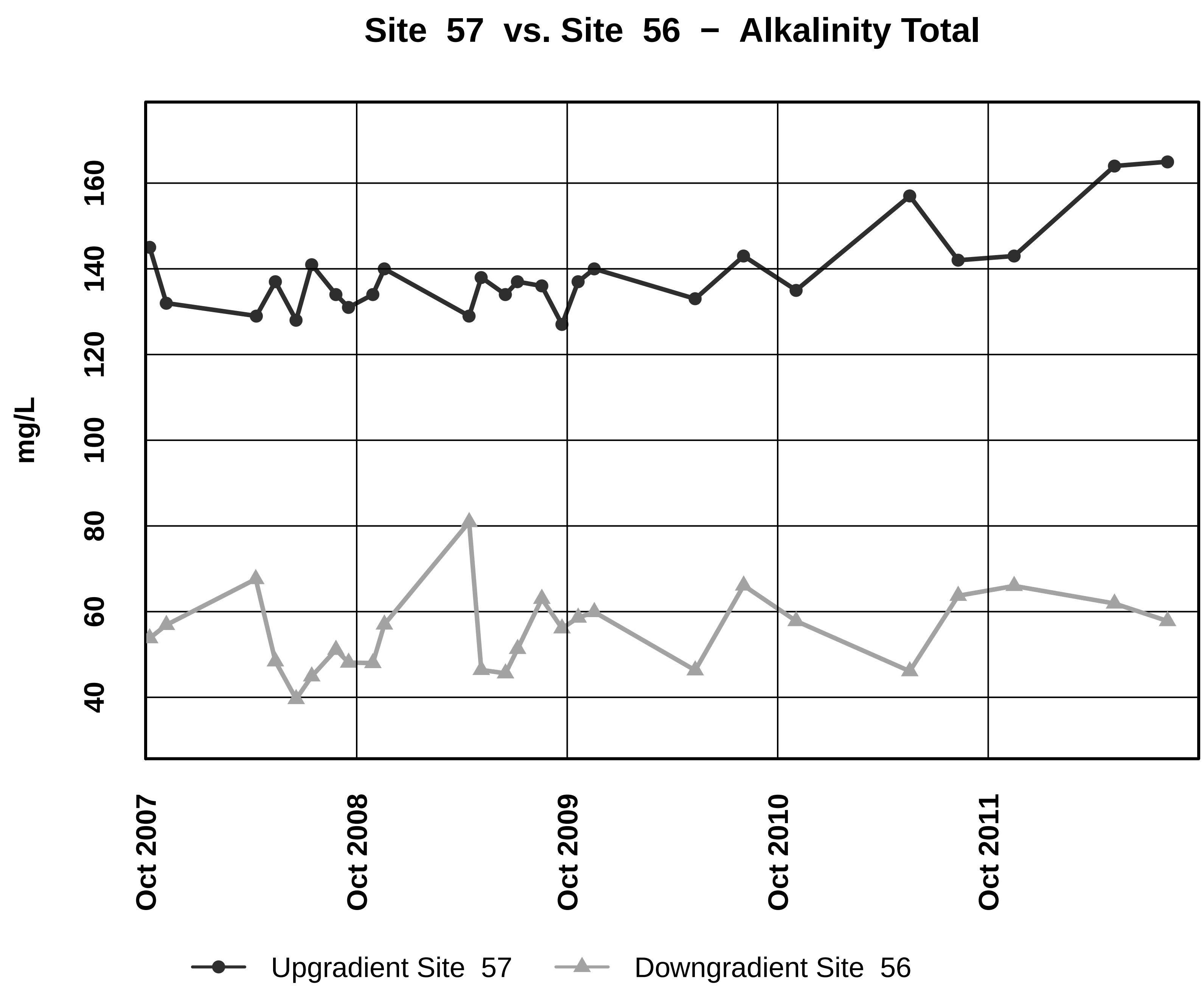
Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.18		0.26
0.050	-0.15	**-0.03**	0.10
0.100	-0.11		0.07
0.200	-0.05		0.05

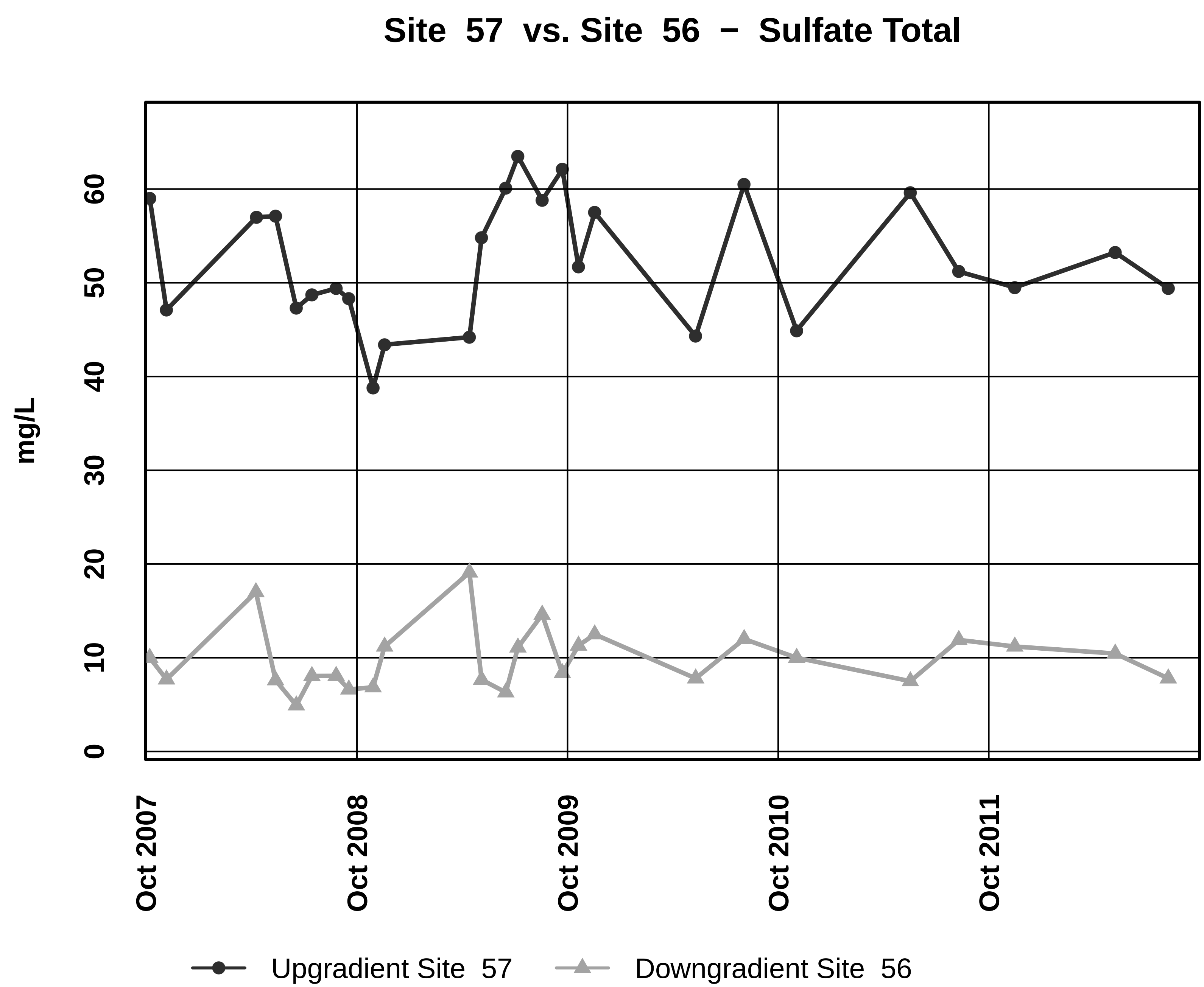

Site 57 vs. Site 56 − Conductivity Field
µS/cm
500
400
300
200
100
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 57
Downgradient Site 56



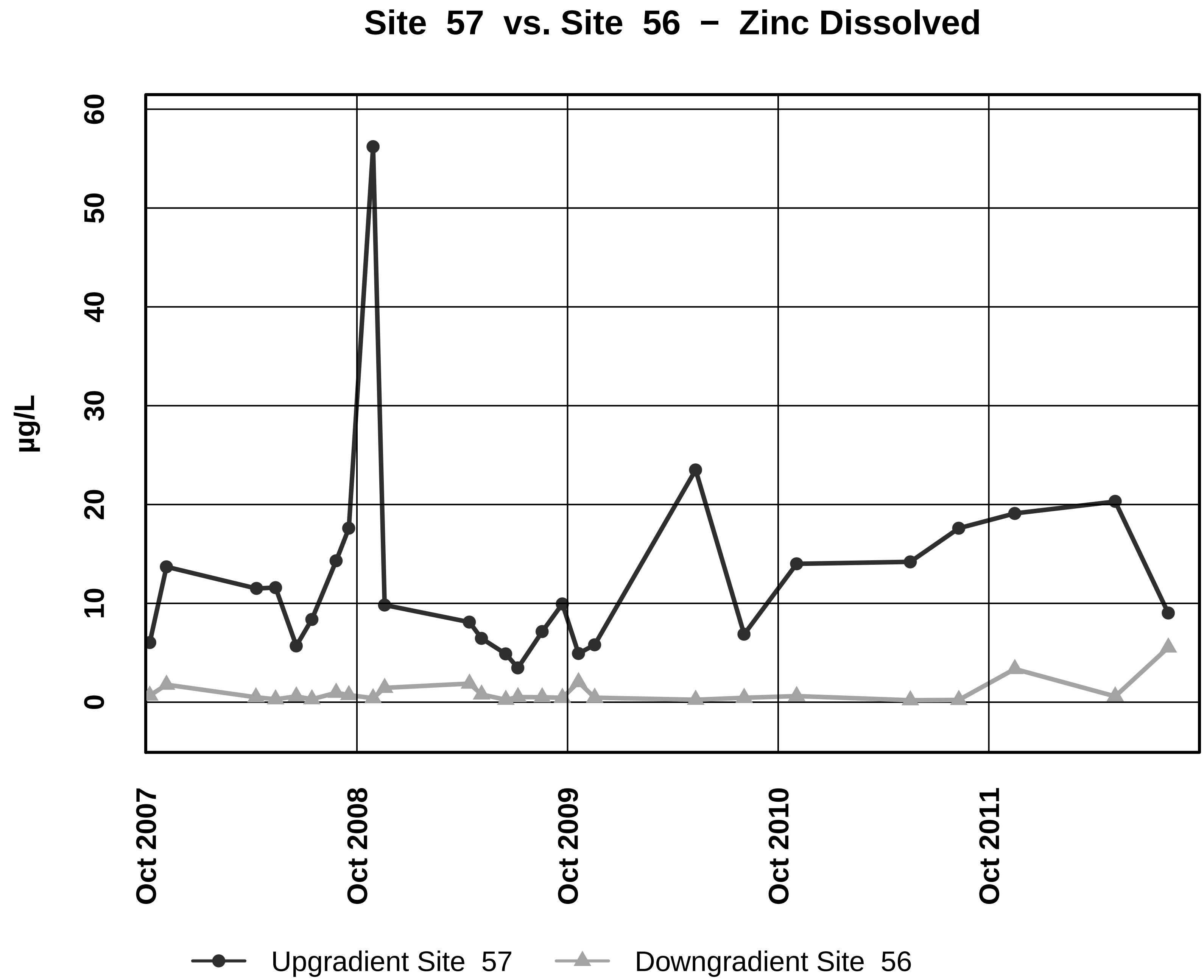
Site 57 vs. Site 56 − pH Field
su
8.0
7.5
7.0
6.5
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 57
Downgradient Site 56



Site 57 vs. Site 56 − Alkalinity Total
mg/L
40
60
80
100
120
140
160
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 57
Downgradient Site 56



Site 57 vs. Site 56 − Sulfate Total
mg/L
0
10
20
30
40
50
60
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 57
Downgradient Site 56


Site 57 vs. Site 56 − Zinc Dissolved
µg/L
0
10
20
30
40
50
60
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 57
Downgradient Site 56

INTERPRETIVE REPORT
SITE 13

The data collected during the current water year are listed in the following "Table of Results for Water Year 2012" report. The table includes all the required FWMP analyte data (field and laboratory) collected for the current water year and a series of flags keyed to the summary report "Qualified Data by QA Reviewer". The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of ½ MDL for the purpose of median calculation.

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

Sample Date	Parameter	Value	Qualifier	Notes
No outliers have been identified by HGCMC for the period of October 2007 through September 2012.				

The data for water year 2012 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 2012

			Limits		
Sample Date	Parameter	Value	Lower	Upper	Hardness
No exceedances have been identified by HGCMC for the period of October 2011 through September 2012.					

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 from the 1350; however HGCMC is planning to remove the rest of the material in 2013.

X-Y plots have been generated to graphically present the data for each of the analytes requested in the Statistical Information Goals for this site. No visually obvious trends were apparent.

A non-parametric statistical analysis for trend was performed for specific conductivity, field pH, total alkalinity, total sulfate, and dissolved zinc. Calculation details of the Seasonal Kendall analyses are presented in detail on the pages following this interpretive section. The following table summarizes the results on the data collected between Oct-06 and Sep-12(WY2007-WY2012). For datasets with a statistically significant trend a Seasonal-Sen's Slope estimate statistic has also been calculated.

Table of Summary Statistics for Trend Analysis

	Mann-Kendall test statistics			Sen's slope estimate	
Parameter	**n***	**p****	**Trend**	**Q**	**Q(%)**
Conductivity Field	6	0.40			
pH Field	6	0.50			
Alkalinity, Total	6	0.35			
Sulfate, Total	6	0.10			
Zinc, Dissolved	6	0.15			

* Number of Years ** Significance level

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

Table of Results for Water Year 2012

Site 013FMS - '1350 East Drainage'

Sample Date/Parameter	Oct 2011	Nov 2011	Dec 2011	Jan 2012	Feb 2012	Mar 2012	Apr 2012	May 2012	Jun 2012	Jul 2012	Aug 2012	Sep 2012	**Median**
Water Temp (°C)								6.4			10.4		8.4
Conductivity-Field(μmho)								703			551		627.0
Conductivity-Lab (μmho)											512		512
pH Lab (standard units)											6.64		6.64
pH Field (standard units)								7.36			7.66		7.51
Total Alkalinity (mg/L)								135			122		128.5
Total Sulfate (mg/L)								217.2			162.3		189.8
Hardness (mg/L)								400			300		350.0
Dissolved As (ug/L)								0.25			0.116		0.183
Dissolved Ba (ug/L)								17.1					17.1
Dissolved Cd (ug/L)								0.05			0.0213		0.0357
Dissolved Cr (ug/L)								0.25					0.250
Dissolved Cu (ug/L)								1.1			0.899		1.000
Dissolved Pb (ug/L)								0.05			0.0123		0.0312
Dissolved Ni (ug/L)								0.3					0.300
Dissolved Ag (ug/L)								0.025					0.025
Dissolved Zn (ug/L)								13			16.7		14.85
Dissolved Se (ug/L)								0.05					0.050
Dissolved Hg (ug/L)								0.015			0.00184		0.008420

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 KGCMC and removed from any further analysis and is not included into the calculation of the median

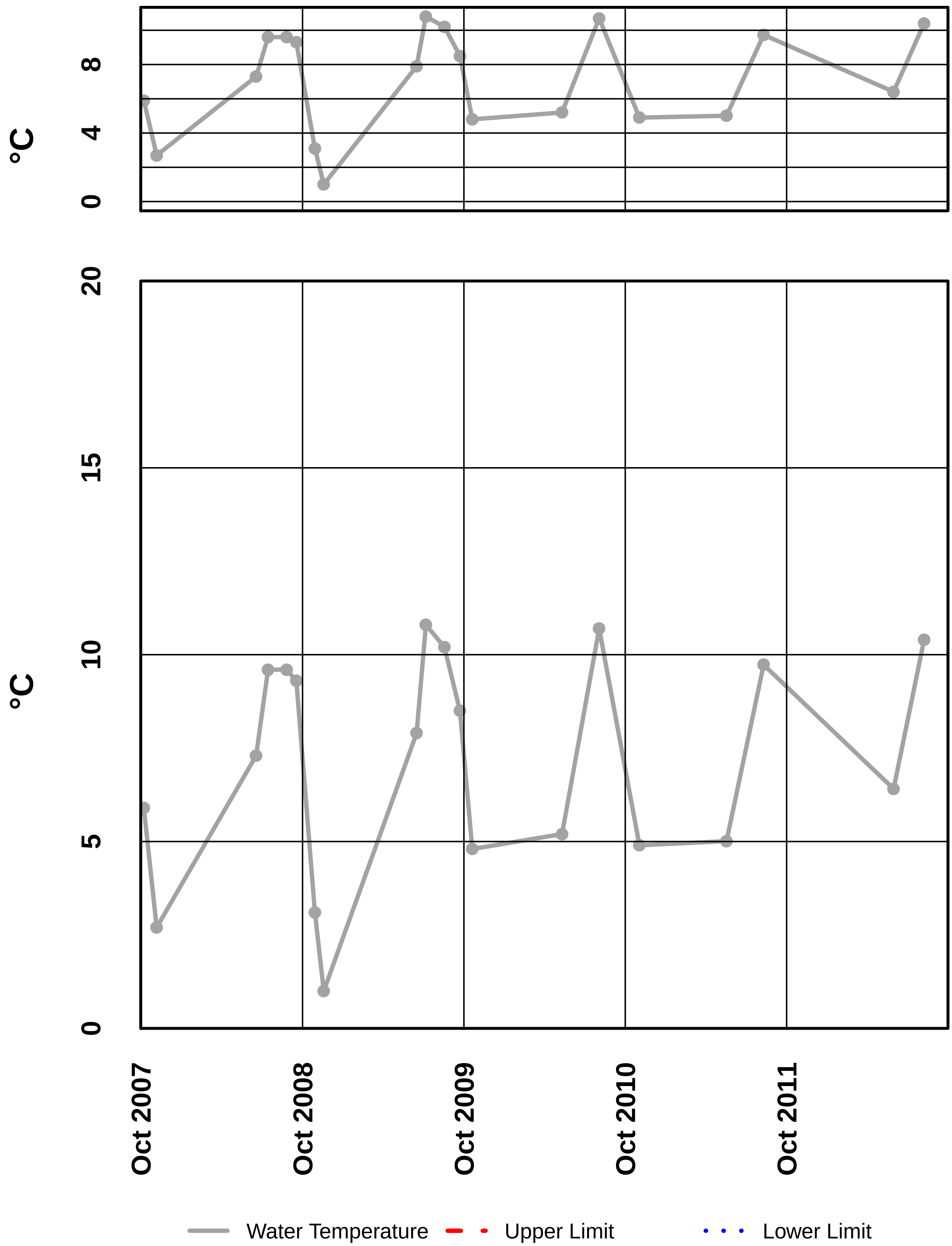
Qualified Data by QA Reviewer

Date Range: 10/01/2011 to 09/30/2012

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
13	5/30/2012	12:00 AM	Pb diss, µg/l	0.00748	U	Field Blank Contamination
13	8/7/2012	12:00 AM	As diss, µg/l	0.11	J	LCS Recovery

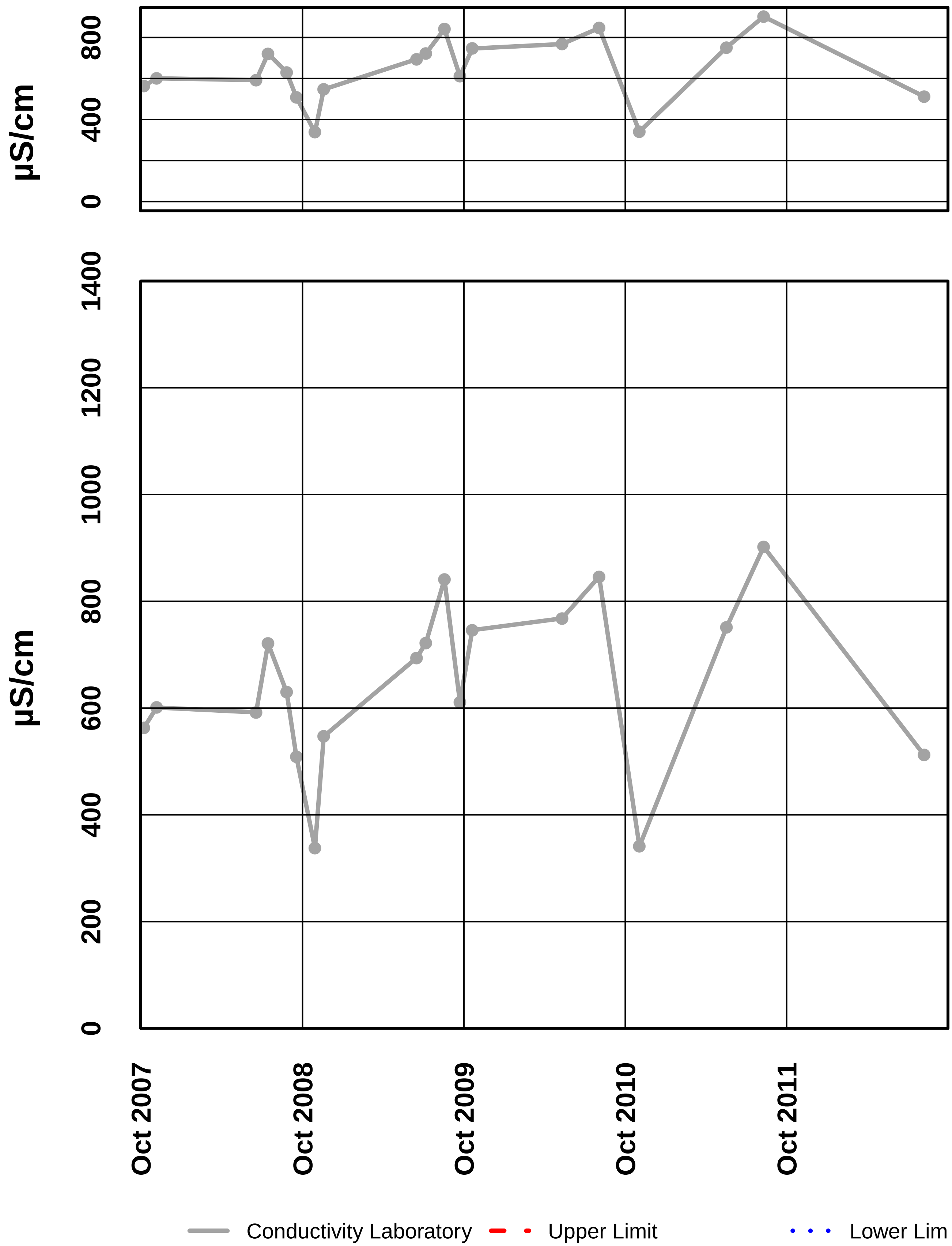
Qualifier	Description
J	Positively Identified - Approximate concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit

Site 13 – Water Temperature



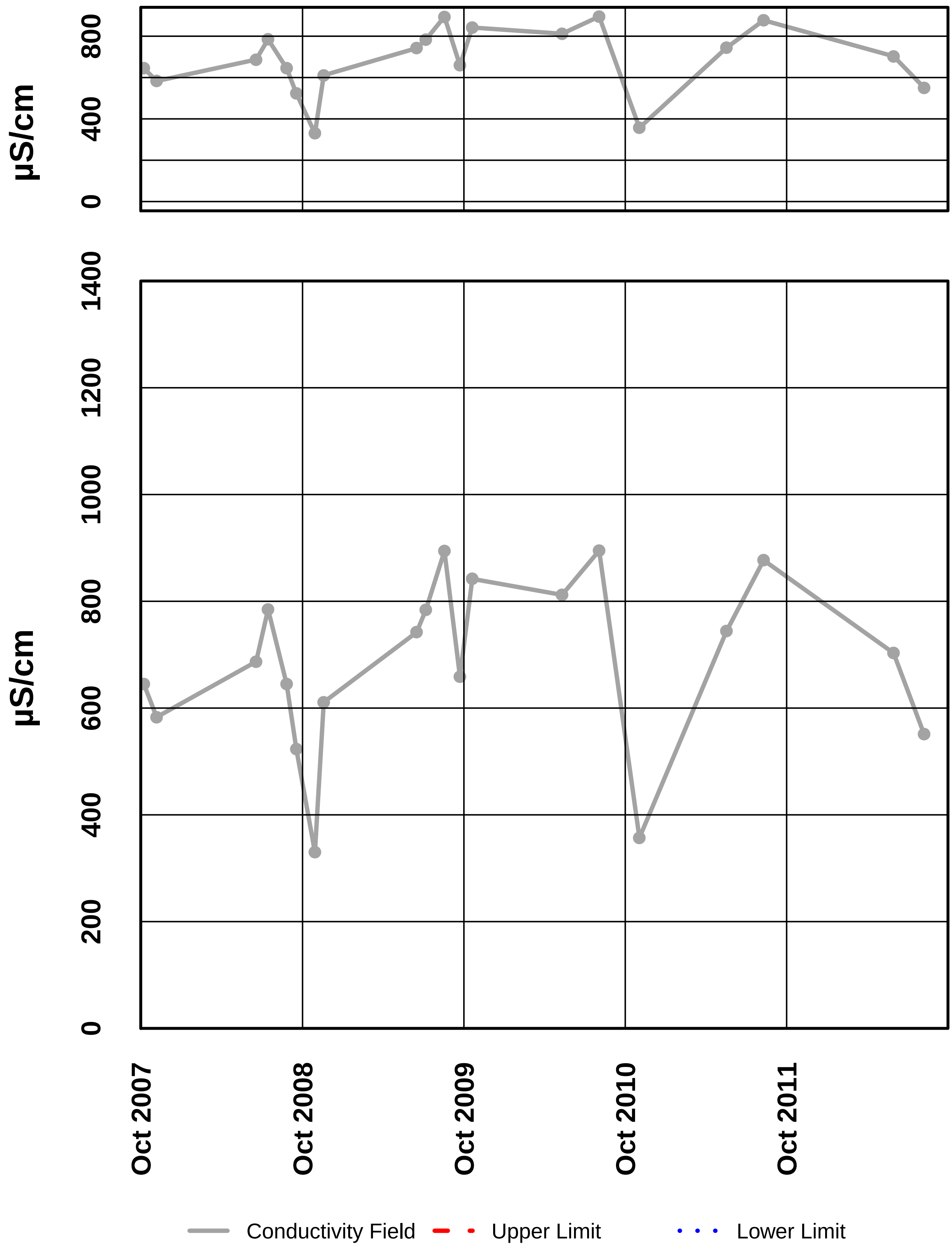
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 13 − Conductivity Laboratory

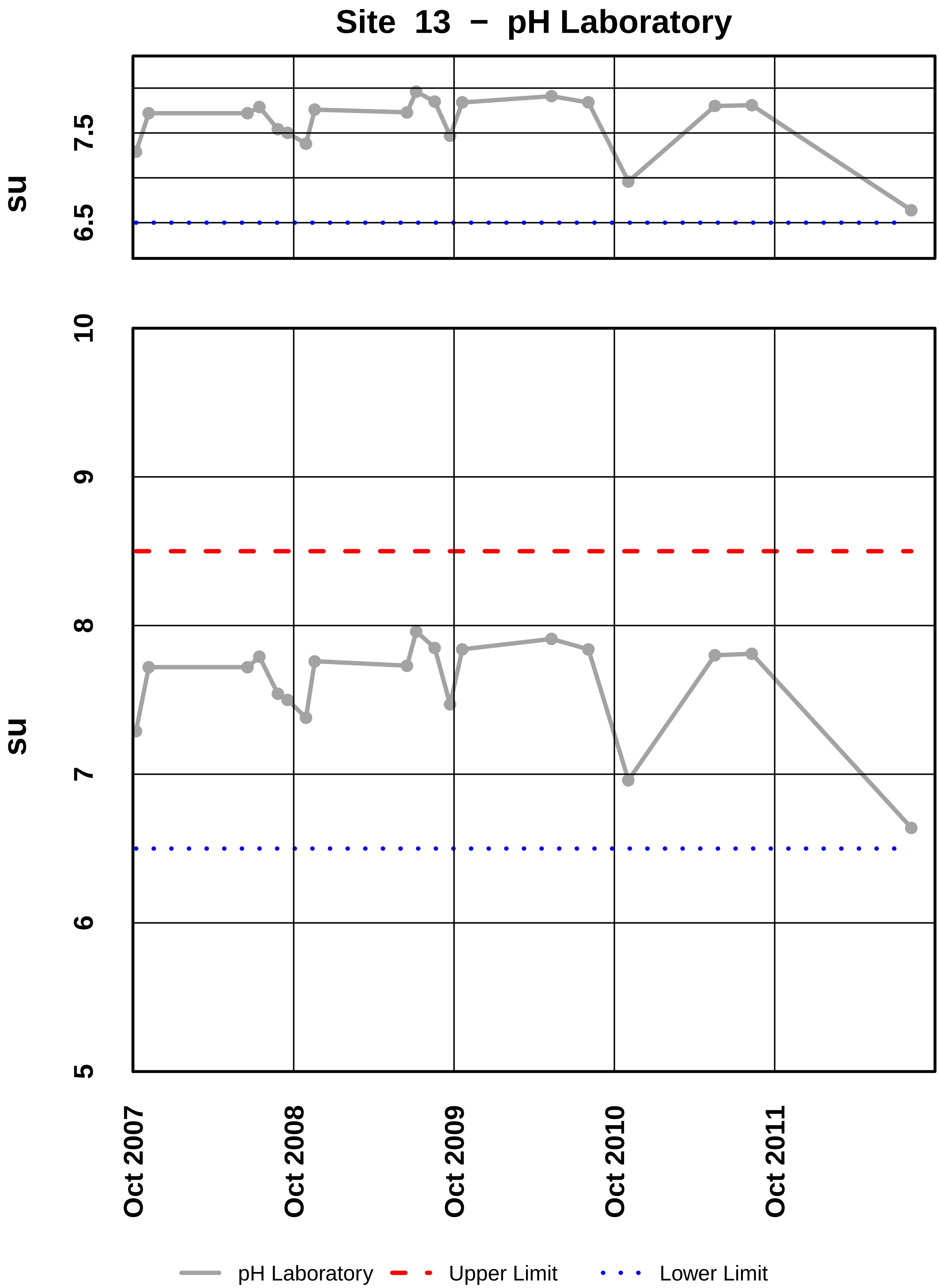


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 13 – Conductivity Field

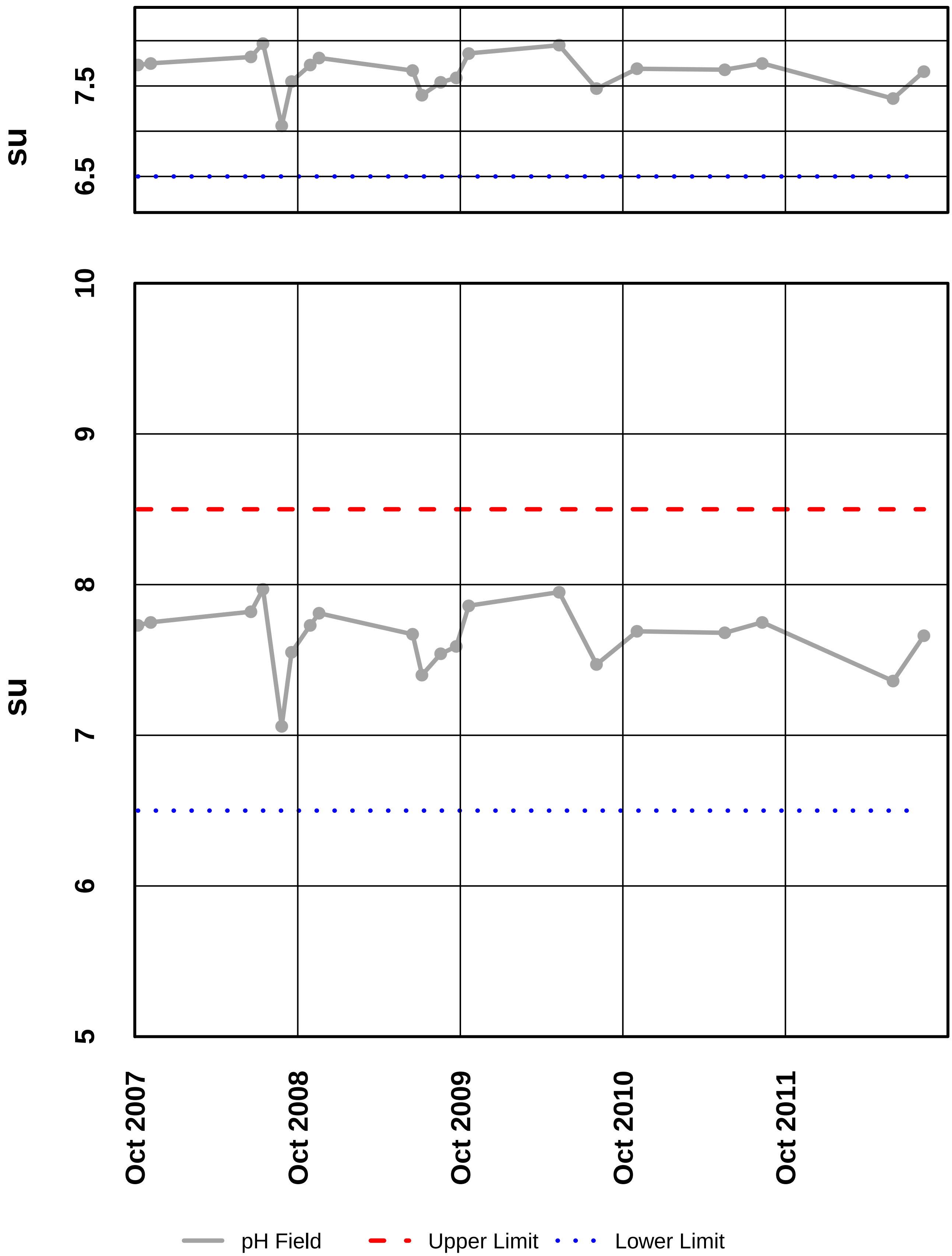


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



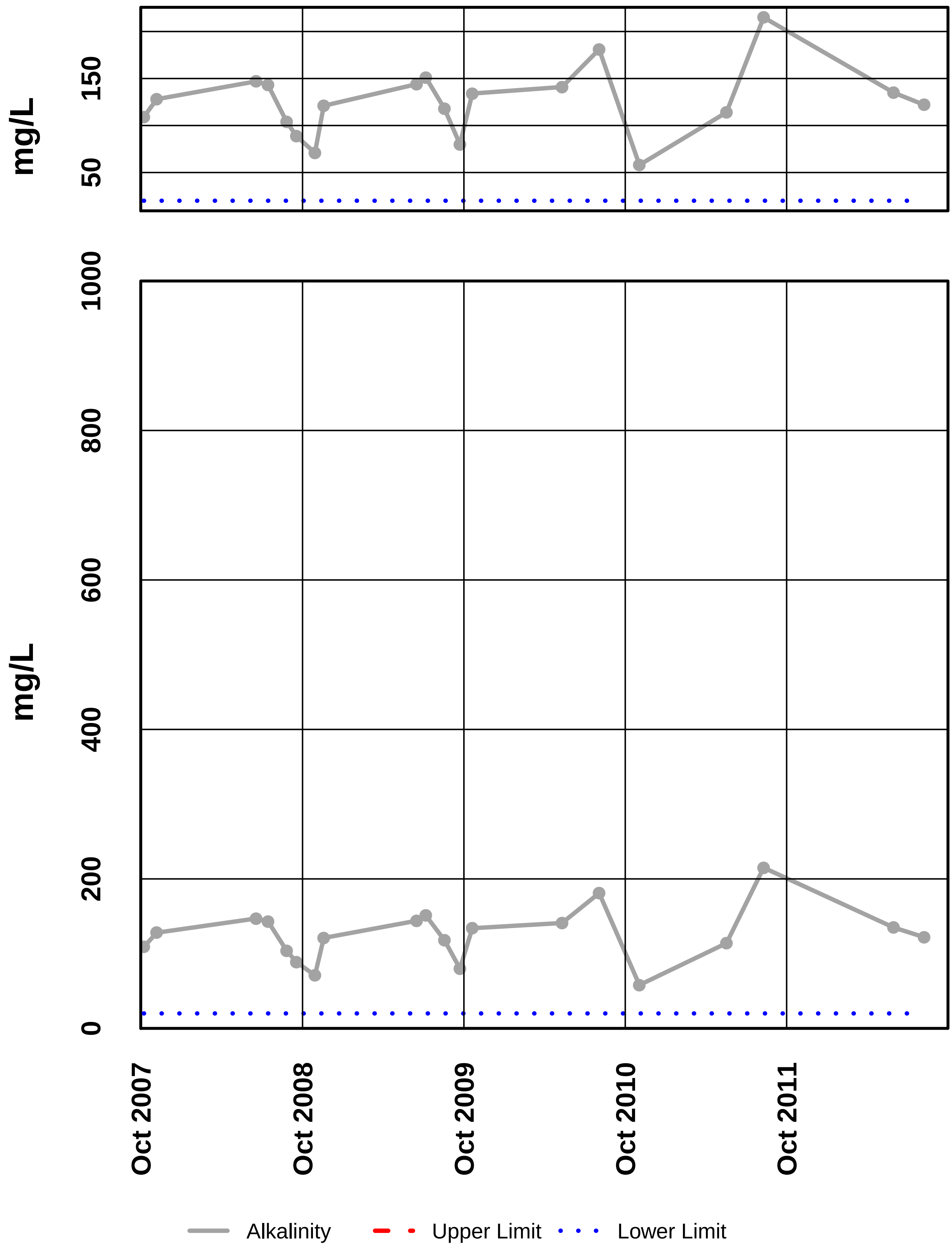
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 13 – pH Field

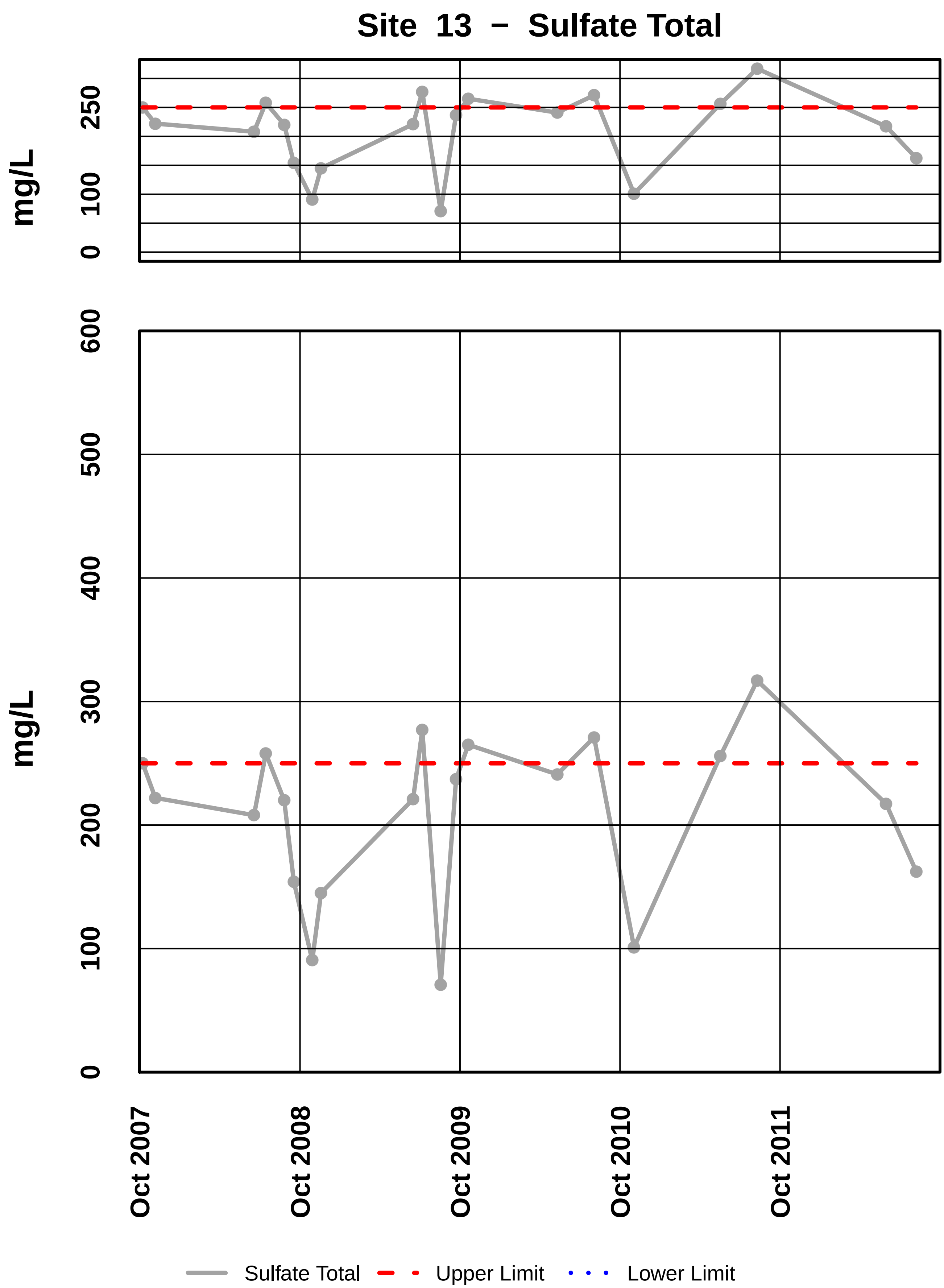


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 13 – Alkalinity

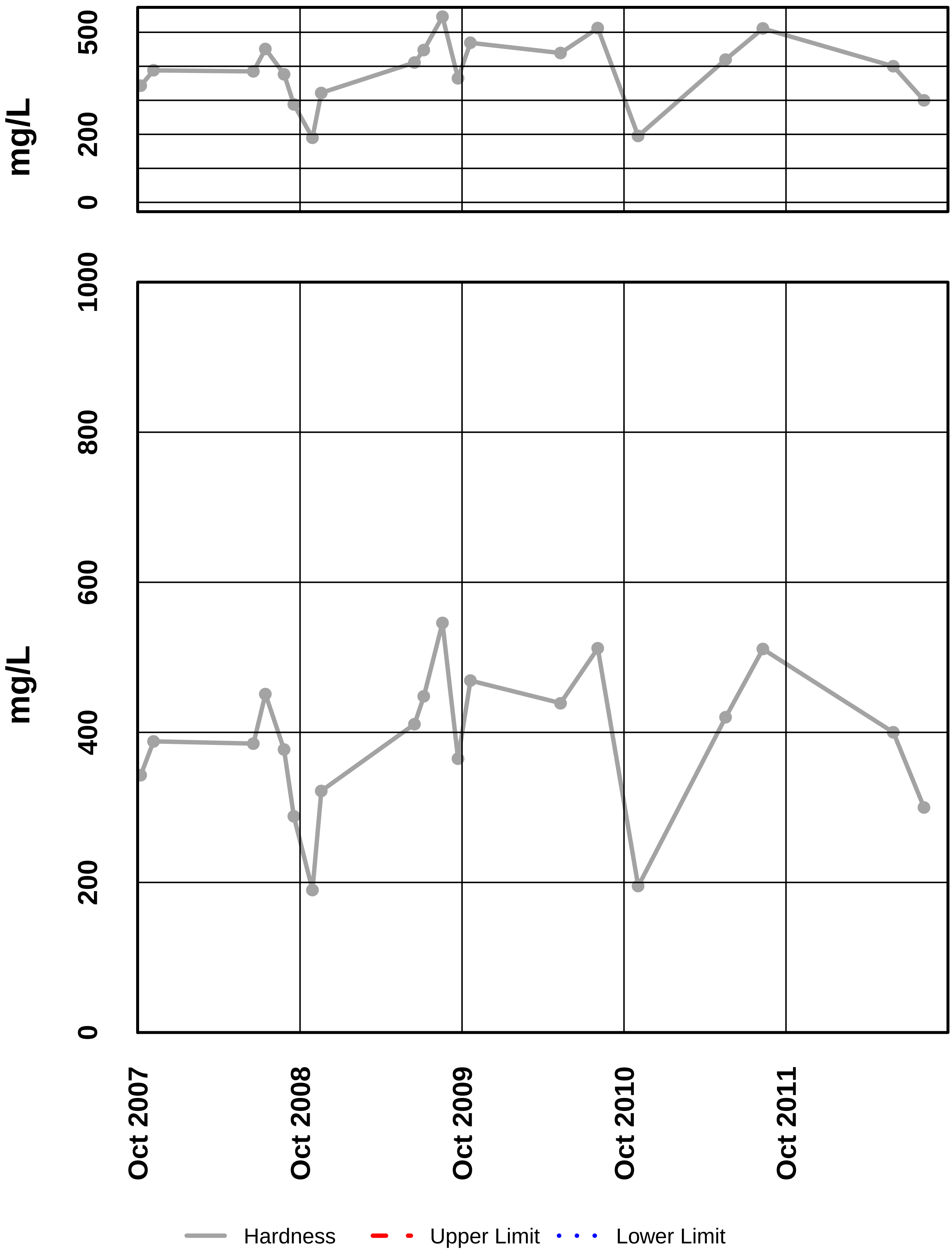


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



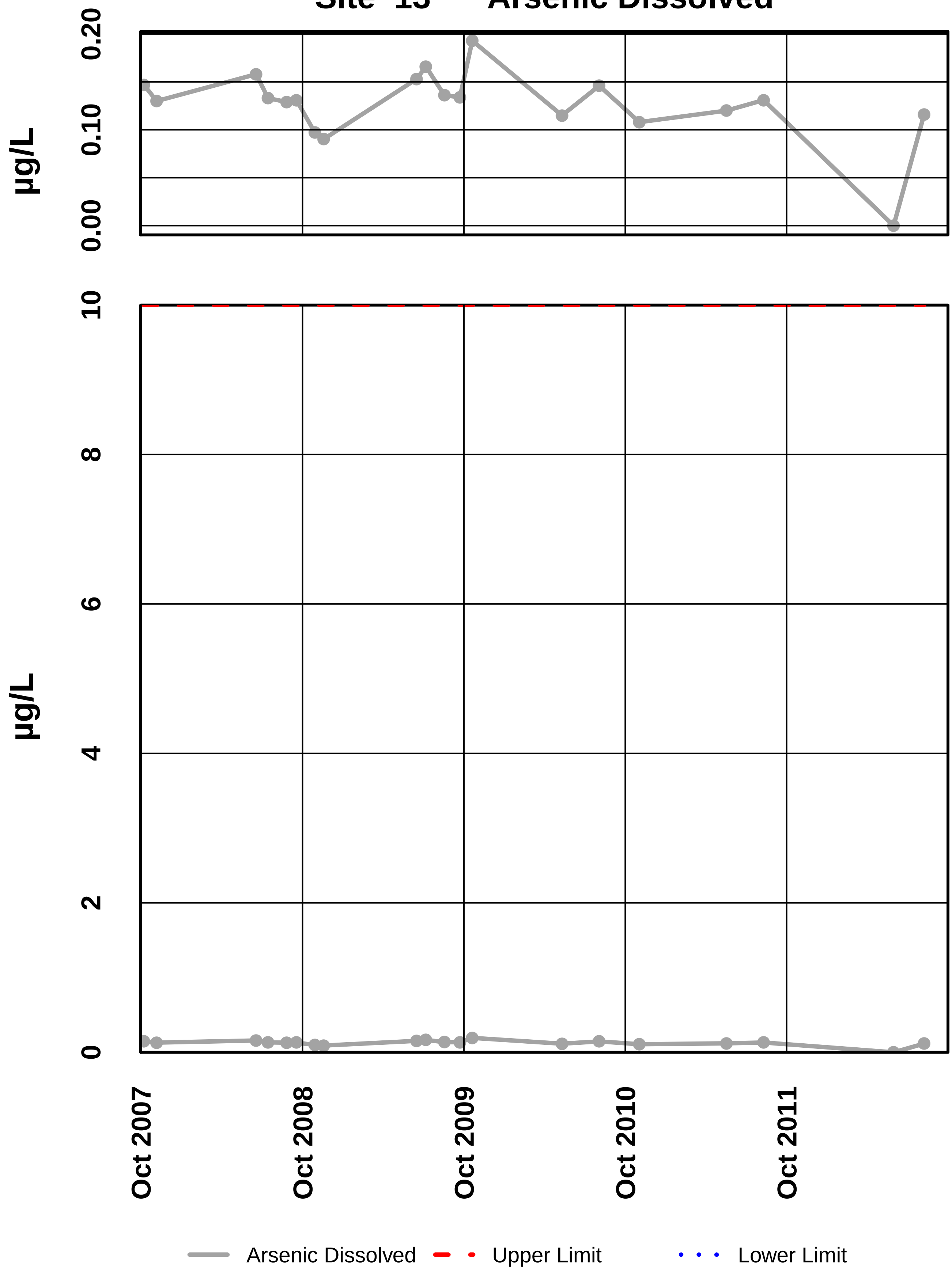
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 13 − Hardness



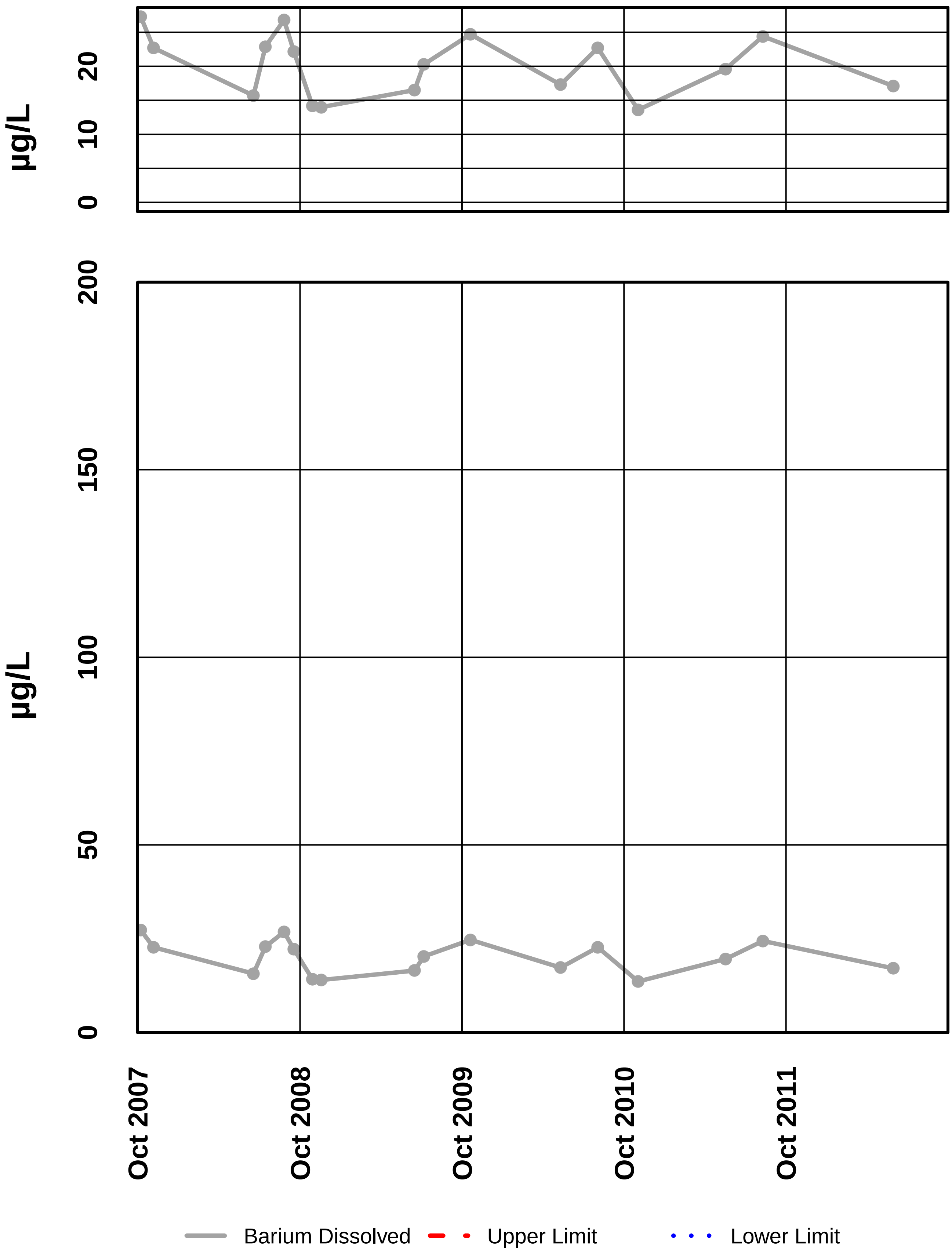
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 13 – Arsenic Dissolved



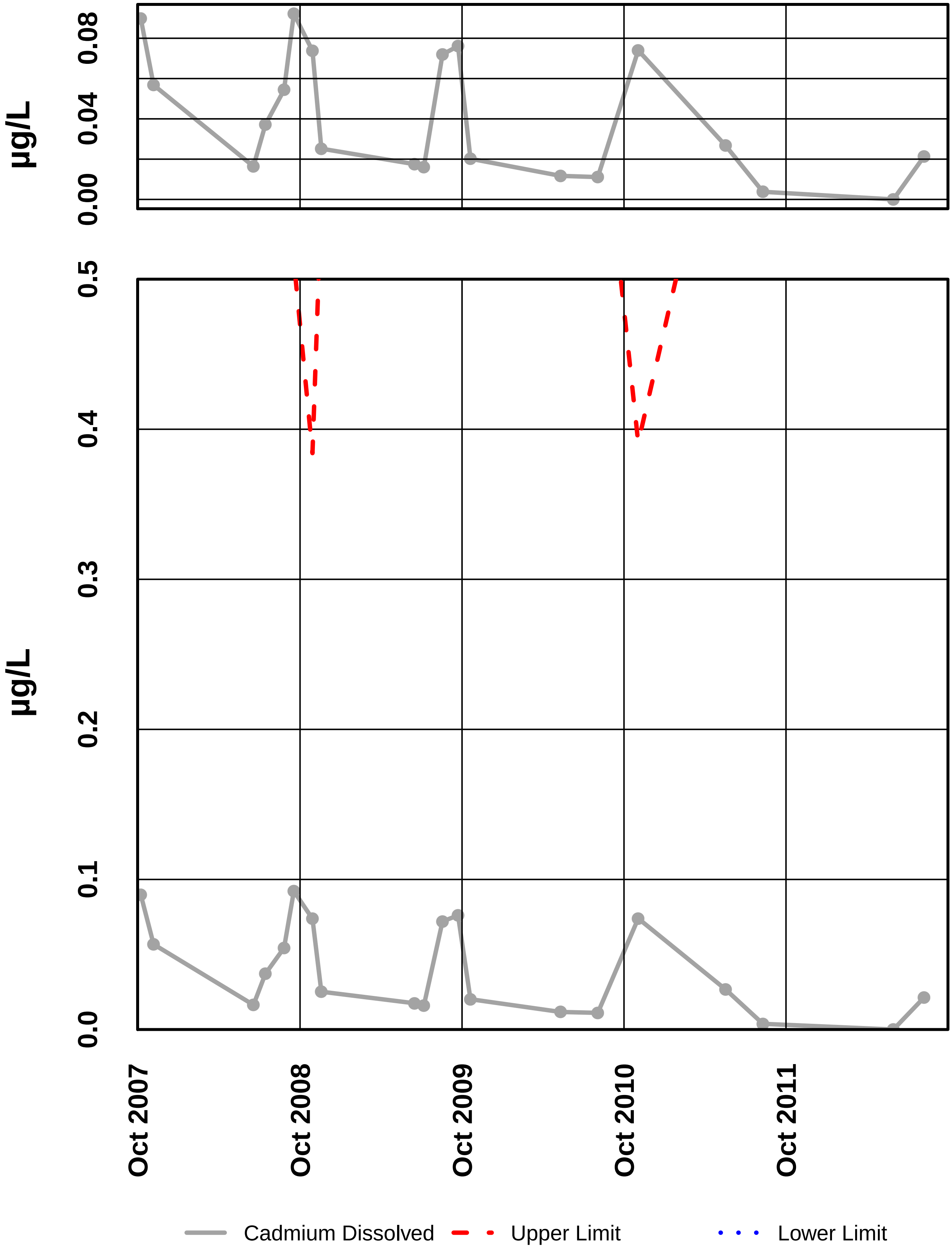
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 13 − Barium Dissolved



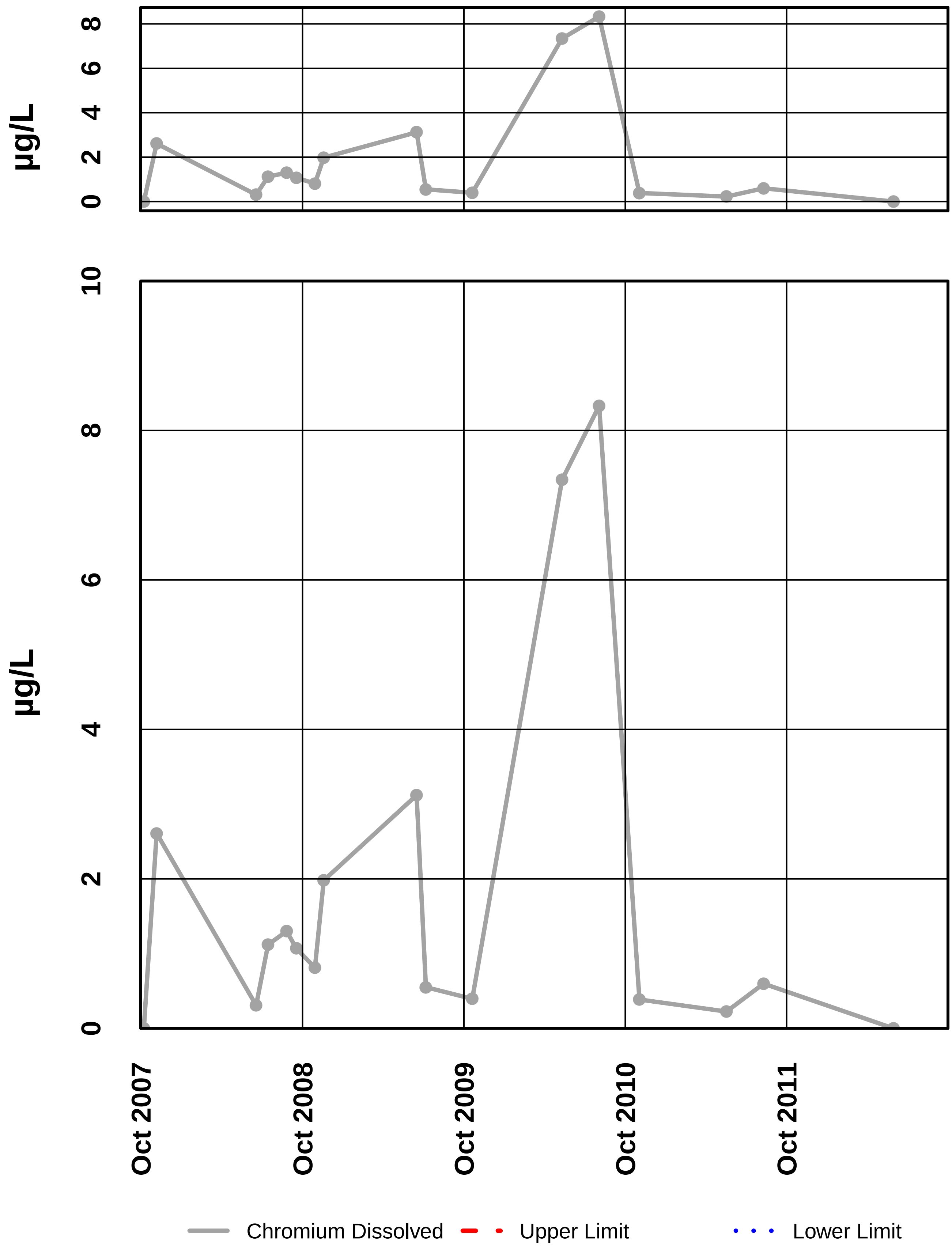
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 13 − Cadmium Dissolved

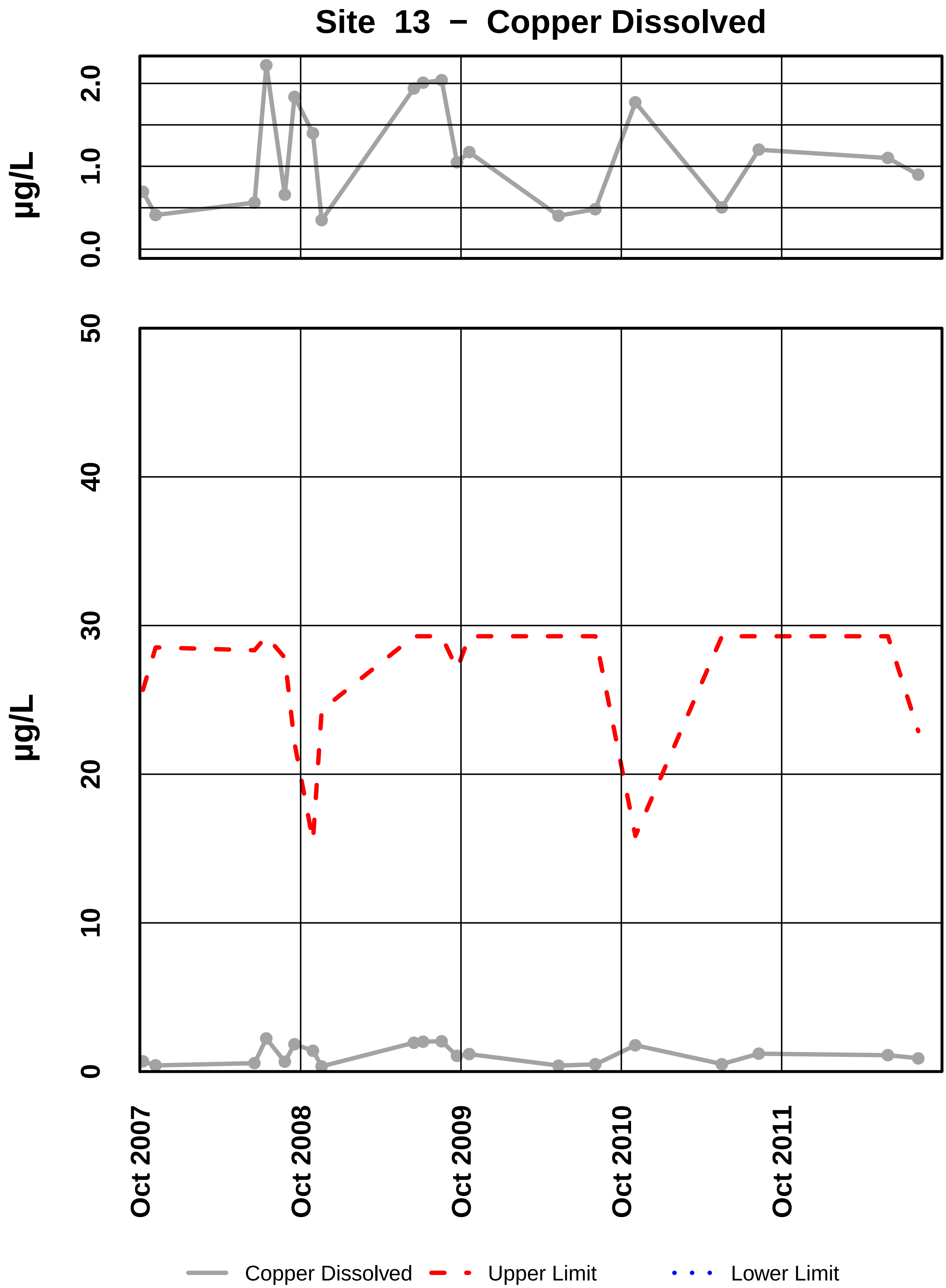


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

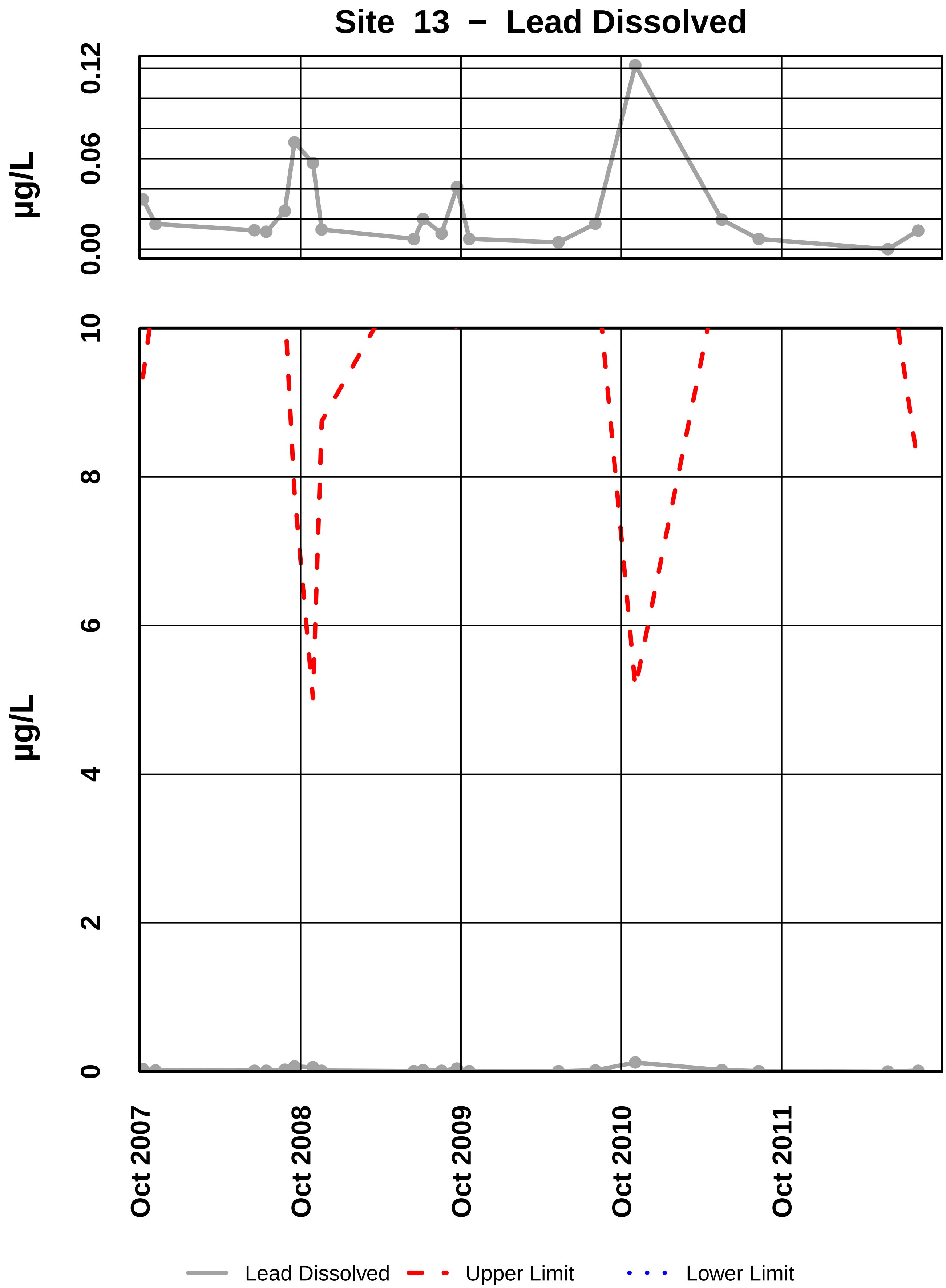
Site 13 − Chromium Dissolved



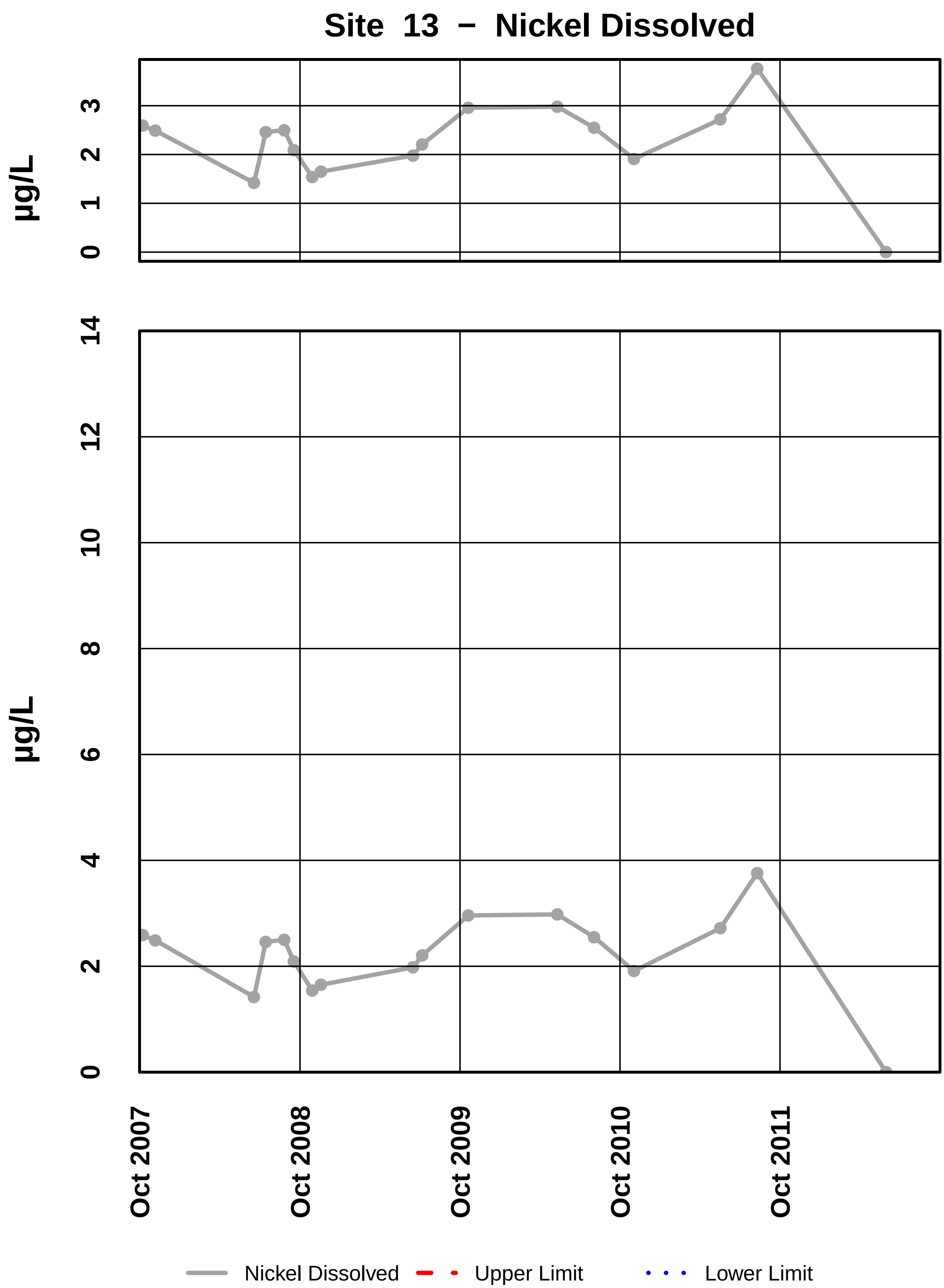
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



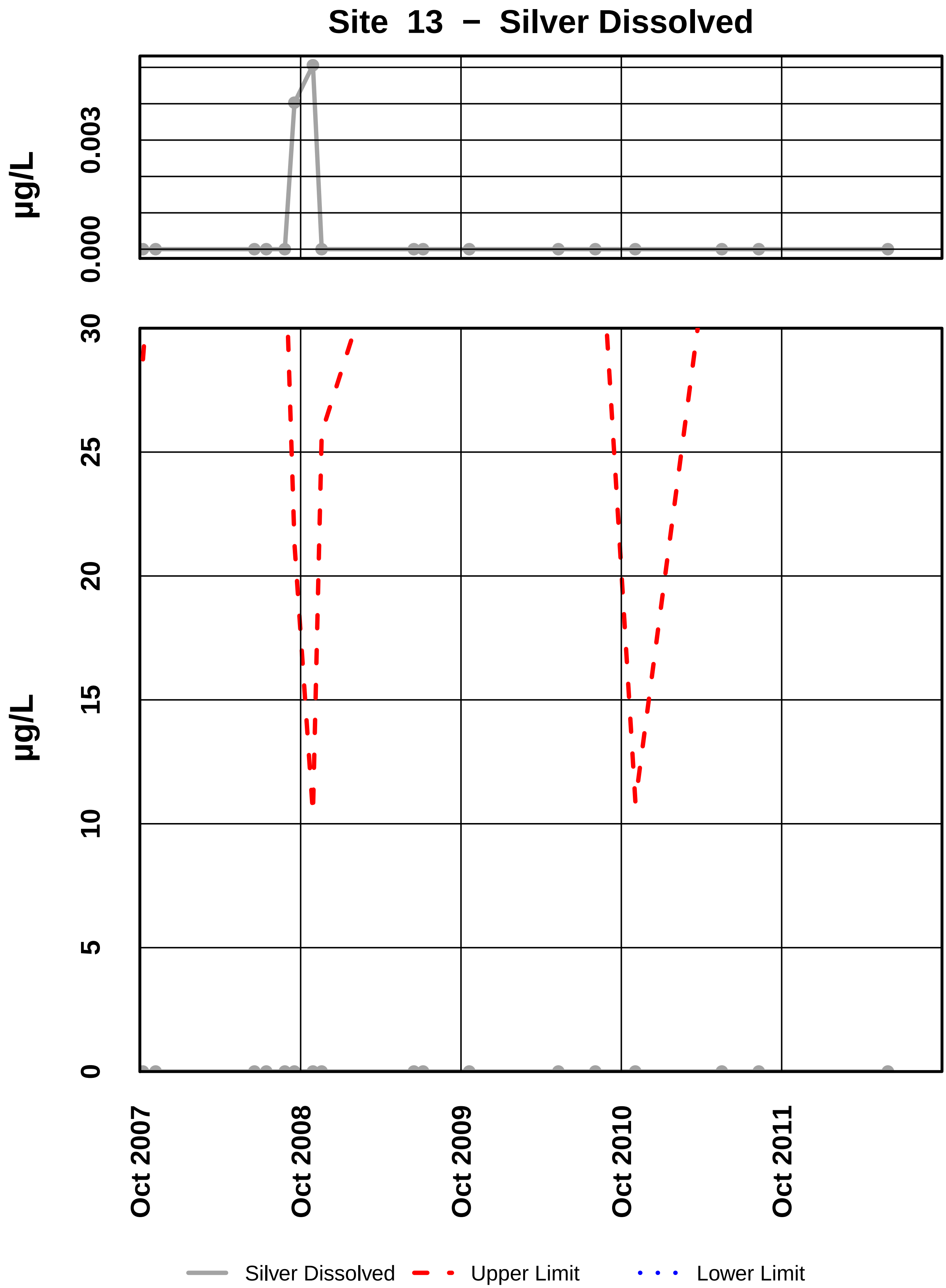
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

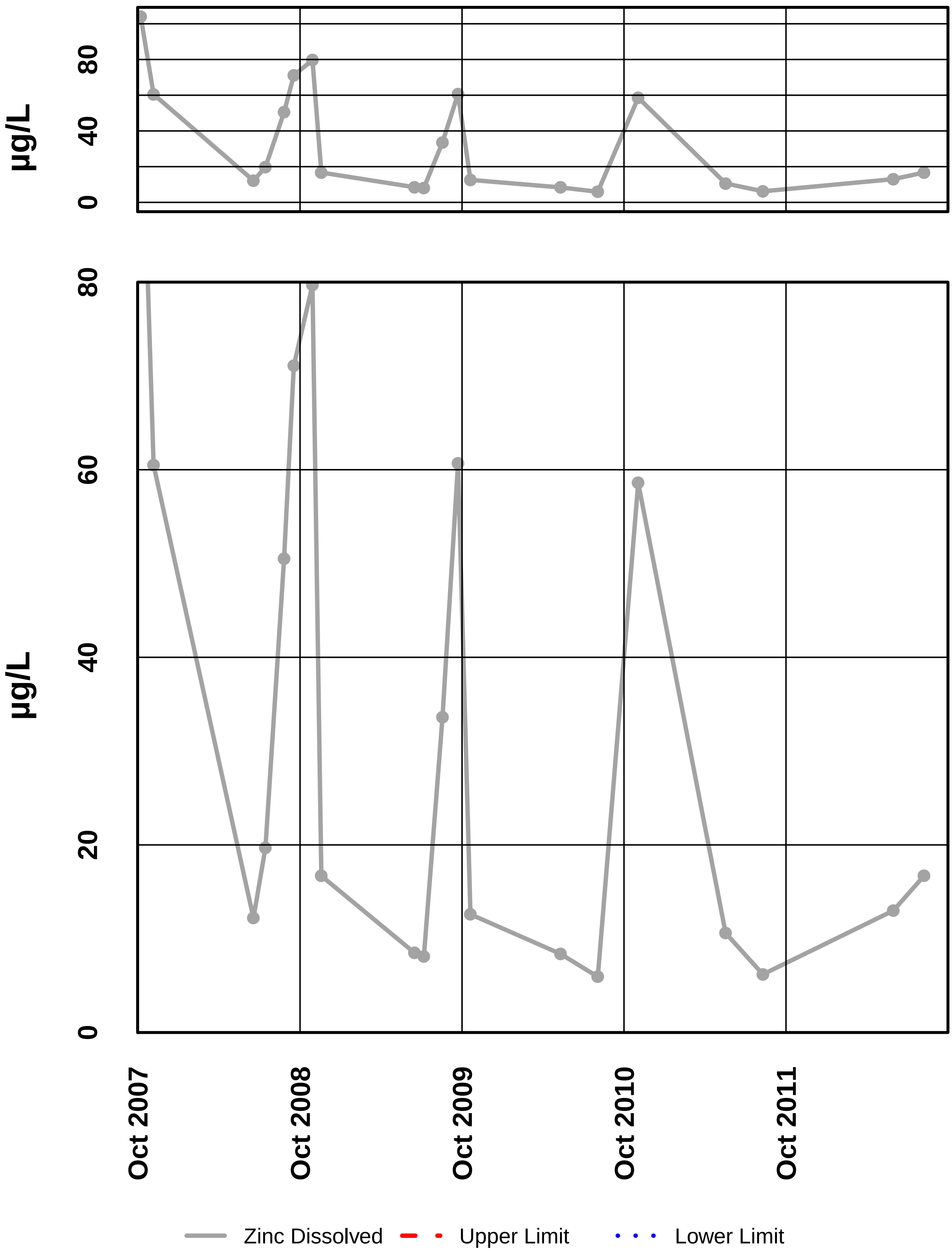


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

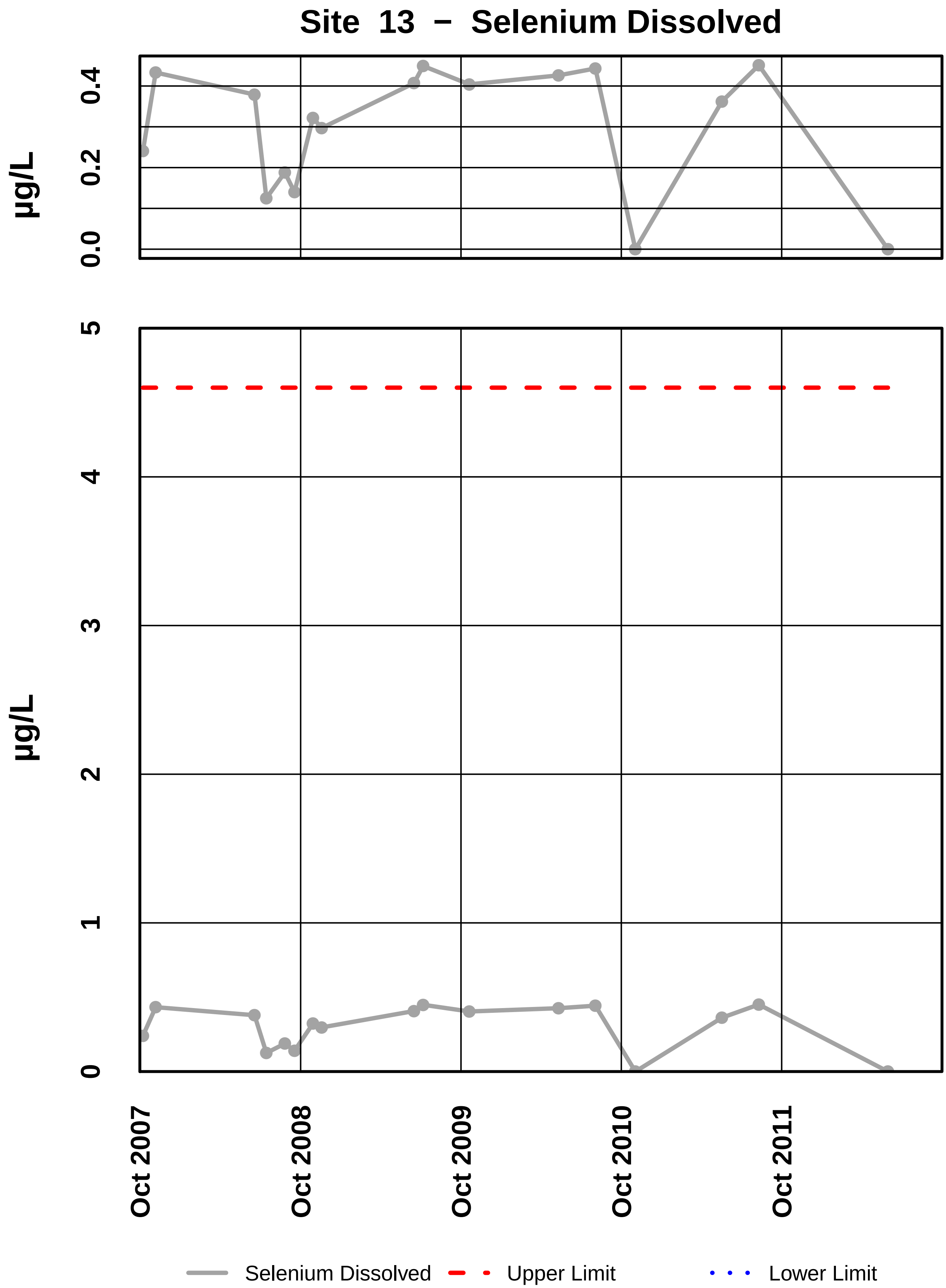


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

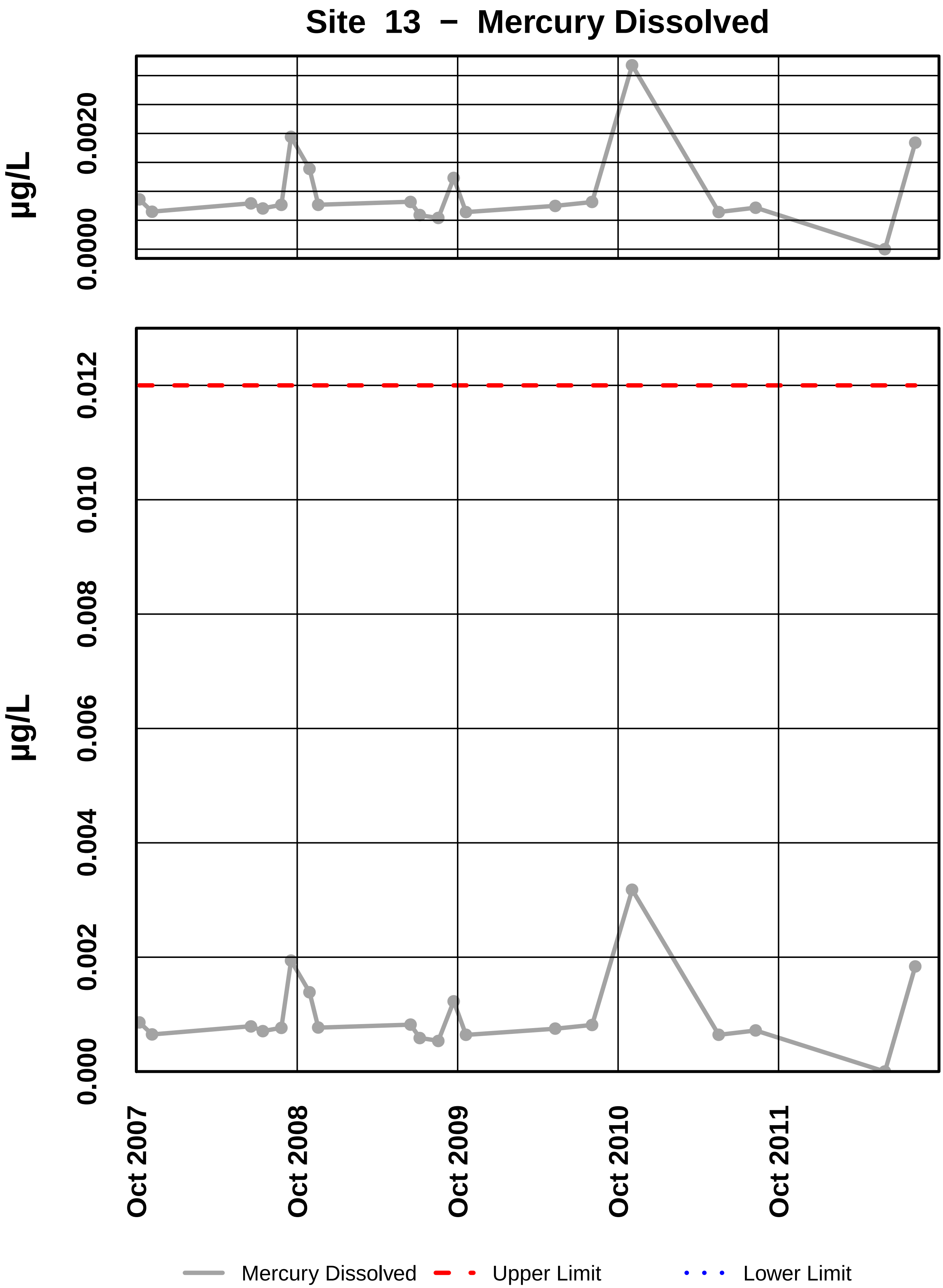
Site 13 − Zinc Dissolved



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



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



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

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**	522							511	591	287	735	774
b	**WY2008**	645	583							687	785	645	523
c	**WY2009**	330	611							742	784	894	659
d	**WY2010**	842							812			895	
e	**WY2011**		357						744			877	
f	**WY2012**								703			551	
	n	4	3	0	0	0	0	0	4	3	3	6	3

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

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

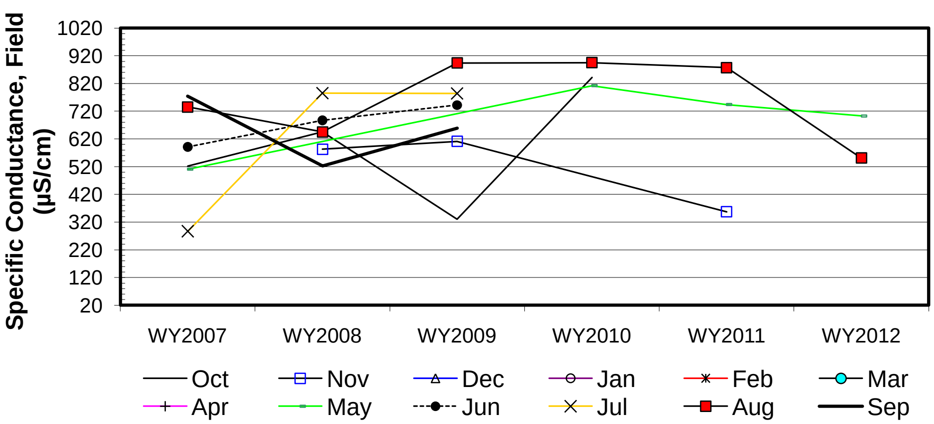
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	8.67	3.67						8.67	3.67	3.67	28.33	3.67
$Z_k = S_k/\sigma_S$	0.68	-0.52						0.00	1.57	0.52	-0.19	-0.52
Z^2_k	0.46	0.27						0.00	2.45	0.27	0.04	0.27

ΣZ_k= 1.54
ΣZ^2_k= 3.77
Z-bar=$\Sigma Z_k/K$= 0.22

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	26	0	0	0	0

Σn 26
ΣS_k 3

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	3.43	@α=5% $\chi^2_{(K-1)}$= 12.59	Test for station homogeneity	
p	**0.753**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
$\Sigma VAR(S_k)$	Z_{calc} 0.26	@α/2=2.5% Z= 1.96	H_0 (No trend)	ACCEPT
60.33	p **0.602**		H_A (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-63.12		88.33
0.050	-40.53	**28.00**	73.57
0.100	-29.85		56.55
0.200	-15.80		49.88

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

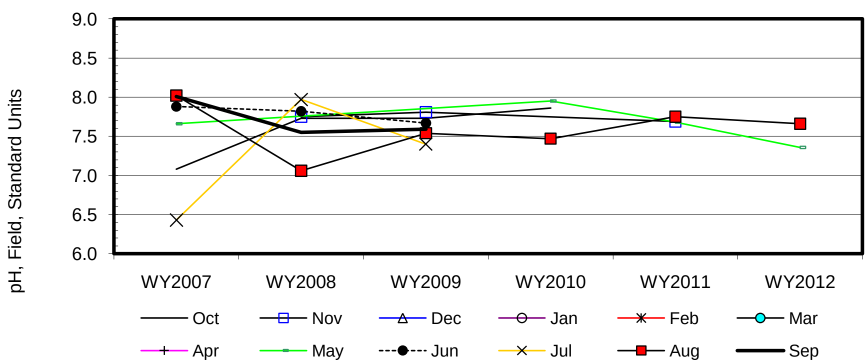
Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**	7.1							7.7	7.9	6.4	8.0	8.0
b	**WY2008**	7.7	7.8							7.8	8.0	7.1	7.6
c	**WY2009**	7.7	7.8							7.7	7.4	7.5	7.6
d	**WY2010**	7.9							8.0			7.5	
e	**WY2011**		7.7						7.7			7.8	
f	**WY2012**								7.4			7.7	
	n	4	3	0	0	0	0	0	4	3	3	6	3
	t_1	2	3	0	0	0	0	0	4	3	3	6	3
	t_2	1	0	0	0	0	0	0	0	0	0	0	0
	t_3	0	0	0	0	0	0	0	0	0	0	0	0
	t_4	0	0	0	0	0	0	0	0	0	0	0	0
	t_5	0	0	0	0	0	0	0	0	0	0	0	0
	b-a	1								-1	1	-1	-1
	c-a	1								-1	1	-1	-1
	d-a	1							1			-1	
	e-a								1			-1	
	f-a								-1			-1	
	c-b	0	1							-1	-1	1	1
	d-b	1										1	
	e-b		-1									1	
	f-b											1	
	d-c	1										-1	
	e-c		-1									1	
	f-c											1	
	e-d								-1			1	
	f-d								-1			1	
	f-e								-1			-1	
	S_k	5	-1	0	0	0	0	0	-2	-3	1	1	-1
	$\sigma^2_S=$	7.67	3.67						8.67	3.67	3.67	28.33	3.67
	$Z_k = S_k/\sigma_S$	1.81	-0.52						-0.68	-1.57	0.52	0.19	-0.52
	Z^2_k	3.26	0.27						0.46	2.45	0.27	0.04	0.27

$\Sigma Z_k=$	-0.77
$\Sigma Z^2_k=$	7.03
Z-bar=$\Sigma Z_k/K=$	-0.11

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	24	1	0	0	0

Σn	26
ΣS_k	0

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2=$	6.94	@α=5% $\chi^2_{(K-1)}=$	12.59	Test for station homogeneity	
p	**0.326**			$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
$\Sigma VAR(S_k)$	Z_{calc} 0.00	@$\alpha/2$=2.5% $Z=$	1.96	H_0 (No trend)	ACCEPT
59.33	**p** **0.500**			H_A ($\pm$ trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	**Lower Limit**	**Sen's Slope**	**Upper Limit**
0.010	-0.13		0.12
0.050	-0.07	**0.00**	0.09
0.100	-0.07		0.06
0.200	-0.06		0.04

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**	93.8							92.3	126.0	143.0	190.0	175.0
b	**WY2008**	109.0	128.0							147.0	143.0	104.0	88.8
c	**WY2009**	70.9	121.0							144.0	151.0	118.0	80.0
d	**WY2010**	134.0							141.0			181.0	
e	**WY2011**		58.0						114.0			215.0	
f	**WY2012**								135.0			122.0	
	n	4	3	0	0	0	0	0	4	3	3	6	3

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

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

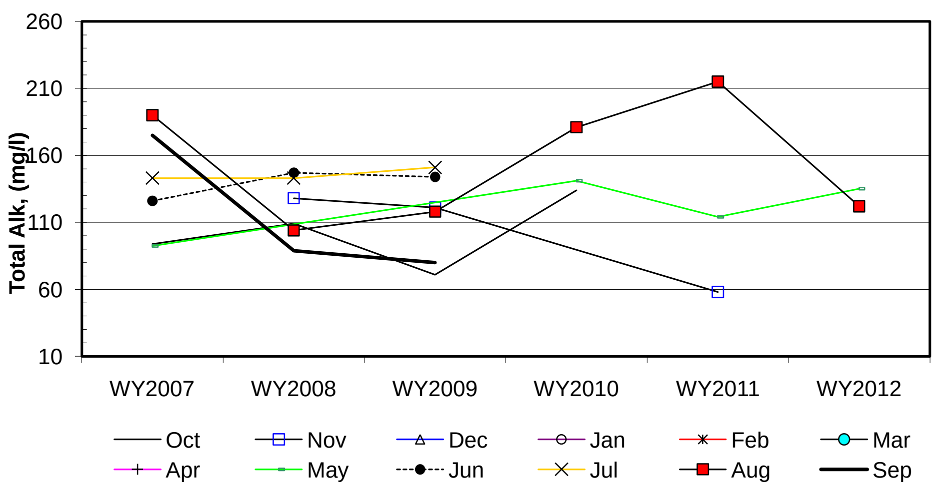
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	8.67	3.67						8.67	3.67	2.67	28.33	3.67
$Z_k = S_k/\sigma_S$	0.68	-1.57						0.68	0.52	1.22	0.56	-1.57
Z^2_k	0.46	2.45						0.46	0.27	1.50	0.32	2.45

ΣZ_k= 0.54
ΣZ^2_k= 7.92
Z-bar=ΣZ_k/K= 0.08

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	24	1	0	0	0

Σn 26
ΣS_k 4

$\chi^2_h=\Sigma Z^2_k$-K(Z-bar)^2=		7.88	@α=5% $\chi^2_{(K-1)}$=	12.59	Test for station homogeneity
	p	**0.247**			$\chi^2_h<\chi^2_{(K-1)}$ ACCEPT
ΣVAR(S_k)	Z_{calc}	0.39	@α/2=2.5% Z=	1.96	**H_0** (No trend) ACCEPT
59.33	**p**	**0.652**			**H_A** (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-18.07		13.68
0.050	-8.50	**4.00**	8.92
0.100	-4.74		8.24
0.200	-3.00		6.04

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**	149.0							155.0	158.0	179.0	194.0	232.0
b	**WY2008**	250.0	222.0							208.0	258.0	220.0	154.0
c	**WY2009**	90.6	145.0							221.0	277.0	70.8	237.0
d	**WY2010**	265.0							241.0			271.0	
e	**WY2011**		101.0						256.0			317.0	
f	**WY2012**								217.2			162.3	
	n	4	3	0	0	0	0	0	4	3	3	6	3

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

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

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	8.67	3.67						8.67	3.67	3.67	28.33	3.67
$Z_k = S_k/\sigma_S$	0.68	-1.57						0.68	1.57	1.57	0.56	0.52
Z^2_k	0.46	2.45						0.46	2.45	2.45	0.32	0.27

ΣZ_k= 4.01

ΣZ^2_k= 8.88

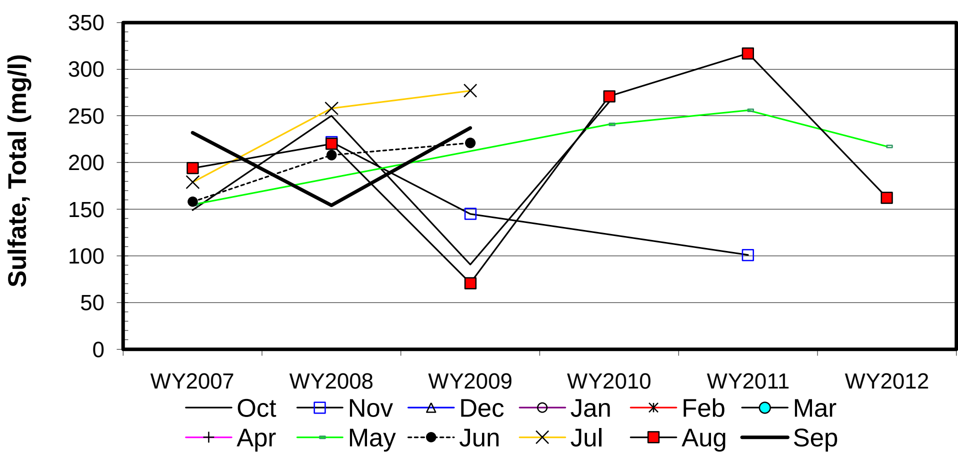
Z-bar=ΣZ_k/K= 0.57

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	26	0	0	0	0

Σn 26

ΣS_k 11

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=		6.58	@α=5% $\chi^2_{(K-1)}$= 12.59	Test for station homogeneity	
	p	**0.362**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc}	1.29	@α=2.5% Z= 1.96	H_0 (No trend)	ACCEPT
60.33	**p**	**0.901**		H_A (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-25.85		31.95
0.050	-11.26	**19.00**	30.29
0.100	-1.72		27.27
0.200	8.64		25.63

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

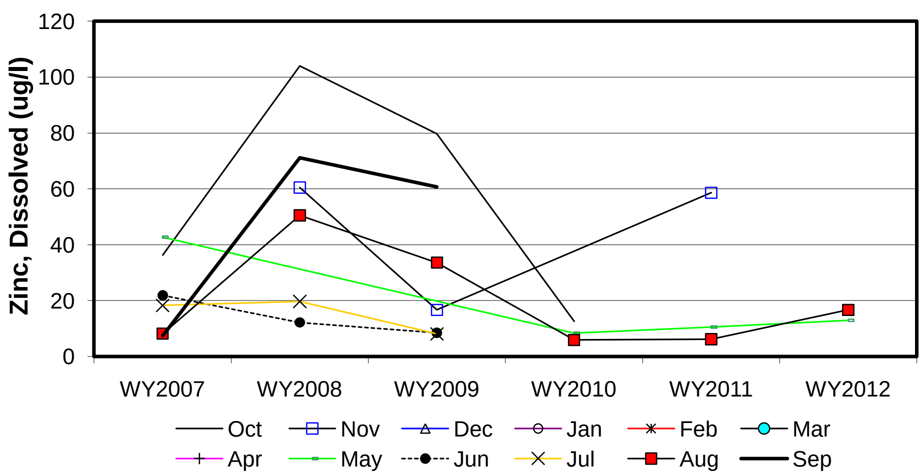
Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**	36.3							42.7	21.9	18.3	8.2	7.4
b	**WY2008**	104.0	60.5							12.2	19.7	50.5	71.1
c	**WY2009**	79.7	16.7							8.5	8.1	33.6	60.7
d	**WY2010**	12.6							8.4			5.9	
e	**WY2011**		58.6						10.6			6.2	
f	**WY2012**								13.0			16.7	
	n	4	3	0	0	0	0	0	4	3	3	6	3
	t_1	4	3	0	0	0	0	0	4	3	3	6	3
	t_2	0	0	0	0	0	0	0	0	0	0	0	0
	t_3	0	0	0	0	0	0	0	0	0	0	0	0
	t_4	0	0	0	0	0	0	0	0	0	0	0	0
	t_5	0	0	0	0	0	0	0	0	0	0	0	0
	b-a	1								-1	1	1	1
	c-a	1								-1	-1	1	1
	d-a	-1							-1			-1	
	e-a								-1			-1	
	f-a								-1			1	
	c-b	-1	-1							-1	-1	-1	-1
	d-b	-1										-1	
	e-b		-1									-1	
	f-b											-1	
	d-c	-1										-1	
	e-c		1									-1	
	f-c											-1	
	e-d								1			1	
	f-d								1			1	
	f-e								1			1	
	S_k	-2	-1	0	0	0	0	0	0	-3	-1	-3	1
	σ^2_S=	8.67	3.67						8.67	3.67	3.67	28.33	3.67
	$Z_k = S_k/\sigma_S$	-0.68	-0.52						0.00	-1.57	-0.52	-0.56	0.52
	Z^2_k	0.46	0.27						0.00	2.45	0.27	0.32	0.27

ΣZ_k=	-3.33
ΣZ^2_k=	4.05
Z-bar=$\Sigma Z_k/K$=	-0.48

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	26	0	0	0	0

Σn	26
ΣS_k	-9

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	2.47	@α=5% $\chi^2_{(K-1)}$= 12.59	Test for station homogeneity	
p	**0.872**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
$\Sigma VAR(S_k)$ / Z_{calc}	-1.03	@α/2=2.5% Z= 1.96	**H_0** (No trend)	ACCEPT
60.33 / **p**	**0.152**		**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-11.53		2.27
0.050	-9.56	**-5.10**	1.27
0.100	-8.23		-0.13
0.200	-7.62		-0.66

INTERPRETIVE REPORT
SITE 58

The data collected during the current water year are listed in the following "Table of Results for Water Year 2012" 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.

Sampling at this site was added to the FWMP in May-2002. As shown in the table below, there were no data outliers.

Sample Date	Parameter	Value	Qualifier	Notes
No outliers have been identified by HGCMC for the period of October 2007 through September 2012.				

The data for water year 2012 have been compared to the strictest fresh water quality criterion for each applicable analyte. Three field pH values exceeding these criteria have been identified, as listed in the table below. Values for field pH from other wells completed into organic rich peat sediments similar to Site 58 have historically resulted in pH values ranging from 5 to 6 su (*e.g.* Sites 27, 29, and 32).

Table of Exceedance for Water Year 2012

			Limits		
Sample Date	Parameter	Value	Lower	Upper	Hardness
7-May-12	pH Field	5.6 su	6.5	8.50	
9-Jul-12	pH Field	6.23 su	6.5	8.50	
18-Sep-12	pH Field	5.9 su	6.5	8.50	

X-Y plots have been generated to graphically present the data for each of the analytes requested in the Statistical Information Goals for this site. These plots have been visually analyzed for the appearance of any trend in concentration. There are visually increasing trends in total alkalinity and dissolved barium. Both of these parameters have been increasing for the past few years, however each is only a fraction of the AWQS limit. Along with these visual increasing trends is the increase variability in the field pH. This variability looks to have started with the preparatory work for the East Ridge Expansion in the spring of 2010, during the water year 2012 the variability still existed however it was decreasing in magnitude.

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-06 and Sep-12(WY2007-WY2012).

Table of Summary Statistics for Trend Analysis

	Mann-Kendall test statistics			Sen's slope estimate	
Parameter	**n***	**p****	**Trend**	**Q**	**Q(%)**
Conductivity Field	6	0.03			
pH Field	6	0.19			
Alkalinity, Total	6	0.02	+	3.3	12.132
Sulfate, Total	6	0.40			
Zinc, Dissolved	6	0.45			

* Number of Years ** Significance level

There was one statistically significant (p=0.02) increasing trend with total alkalinity identified at site 58 for the current water year. The Sen's slope estimate was 3.3 mg/L/yr or 12.1% increase over the period. With the building of the East Ridge Expansion the B-Road was moved to the east of this site and it was expected that this activity would affect the shallow groundwater chemistry.

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 58 Conductivity (µS/cm)	Site 58 Diss. Zinc (µg/L)	Site 58 Total Sulfate (mg/L)
Baseline Statistics			
Baseline Period	05/07/02-09/24/04	05/07/02-09/24/04	09/17/02-09/24/04
Number of Samples	6	6	5
Mean (x)	79.1	0.29	2.34
Standard Deviation	9.1	0.32	1.68
Shewhart-CUSUM Control Limits (SCL)			
Control Limit (mean x+ 2s)	97.2	0.9	5.7
Control Limit (mean x + 3s)	106.3	1.2	7.4
Control Limit (mean x + 4s)	115.3	1.6	9.1
Control Limit (mean x + 4.5s)	119.8	1.7	9.9
CUSUM Control Limits			
Cumulative increase – h	5	5	5

From figure 1 it can be determined that the three analytes were within the control limits for the first seven years. Dissolved zinc exceeded the control limit starting in water year 2009; however these elevated values are considered natural variation at an upgradient background site. In water years 2011 and 2012 there were several samples above the mean that drove the CUSUM up (>50). In past FWMP reports it has been discussed that this site was being impacted by the preparation and subsequent construction of the East Ridge Expansion (ERE) area. The last three samples from water year 2012 were around the mean baseline value as evident by the decreasing CUSUM. Once an analyte is out of control it can take several in control values to bring the CUSUM down again.

Specific conductance as seen from figure 1 initially went out of control during the fall of 2011 and has remained out of control. This is potentially natural variation the values are similar to those used to calculate the baseline, however given the timing it appears that it is related to the construction of the ERE. The final analyte total sulfate remained in control during the whole period examine.

Figure 1. **Observed Measurements for Specific Conductance, Dissolved Zinc, and Total Sulfate from Site 58 Compared to the Shewhart-CUSUM Control Limits From Table 1**

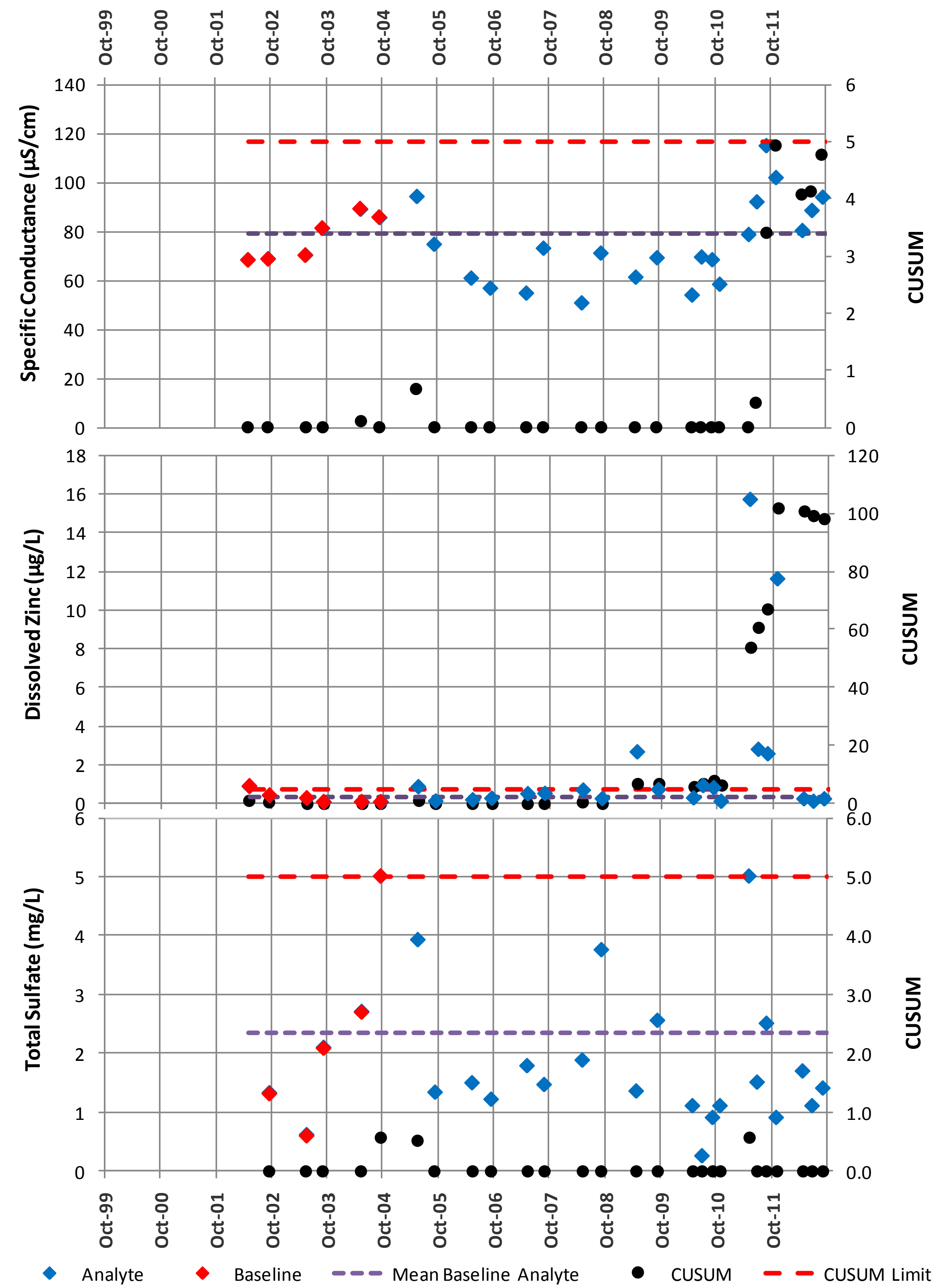


Table of Results for Water Year 2012

Site 058FMG - 'Monitoring Well -T-00-01C'

Sample Date/Parameter	Oct 2011	Nov 2011	Dec 2011	Jan 2012	Feb 2012	Mar 2012	Apr 2012	May 2012	Jun 2012	Jul 2012	Aug 2012	Sep 2012	**Median**
Water Temp (°C)		4.6						6.6		10.1		10	8.3
Conductivity-Field(μmho)		92						93.4		88.1		95	92.7
Conductivity-Lab (μmho)		102						80		89		94	92
pH Lab (standard units)		6.02						5.75		5.6		6.17	5.89
pH Field (standard units)		6.58						5.6		6.23		5.9	6.07
Total Alkalinity (mg/L)		32.9						39		35.1		44.5	37.1
Total Sulfate (mg/L)		0.9						1.7		1.1		1.4	1.3
Hardness (mg/L)		30.2						26.2		31.6		35.9	30.9
Dissolved As (ug/L)		0.32						0.219		0.292		0.301	0.297
Dissolved Ba (ug/L)		22.8						21.4		29.1		31.8	26.0
Dissolved Cd (ug/L)		0.0018						0.0018		0.0018		0.0018	0.0018
Dissolved Cr (ug/L)		0.985						0.62		0.868		2.45	0.927
Dissolved Cu (ug/L)		0.324						0.196		0.611		0.206	0.265
Dissolved Pb (ug/L)		0.188						0.0588		0.0803		0.11	0.0952
Dissolved Ni (ug/L)		0.935						0.456		0.568		0.632	0.600
Dissolved Ag (ug/L)		0.002						0.004		0.002		0.002	0.002
Dissolved Zn (ug/L)		11.6						0.24		0.11		0.23	0.24
Dissolved Se (ug/L)		0.174						0.313		0.328		0.057	0.244
Dissolved Hg (ug/L)		0.00156						0.00255		0.00133		0.00112	0.001445

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.

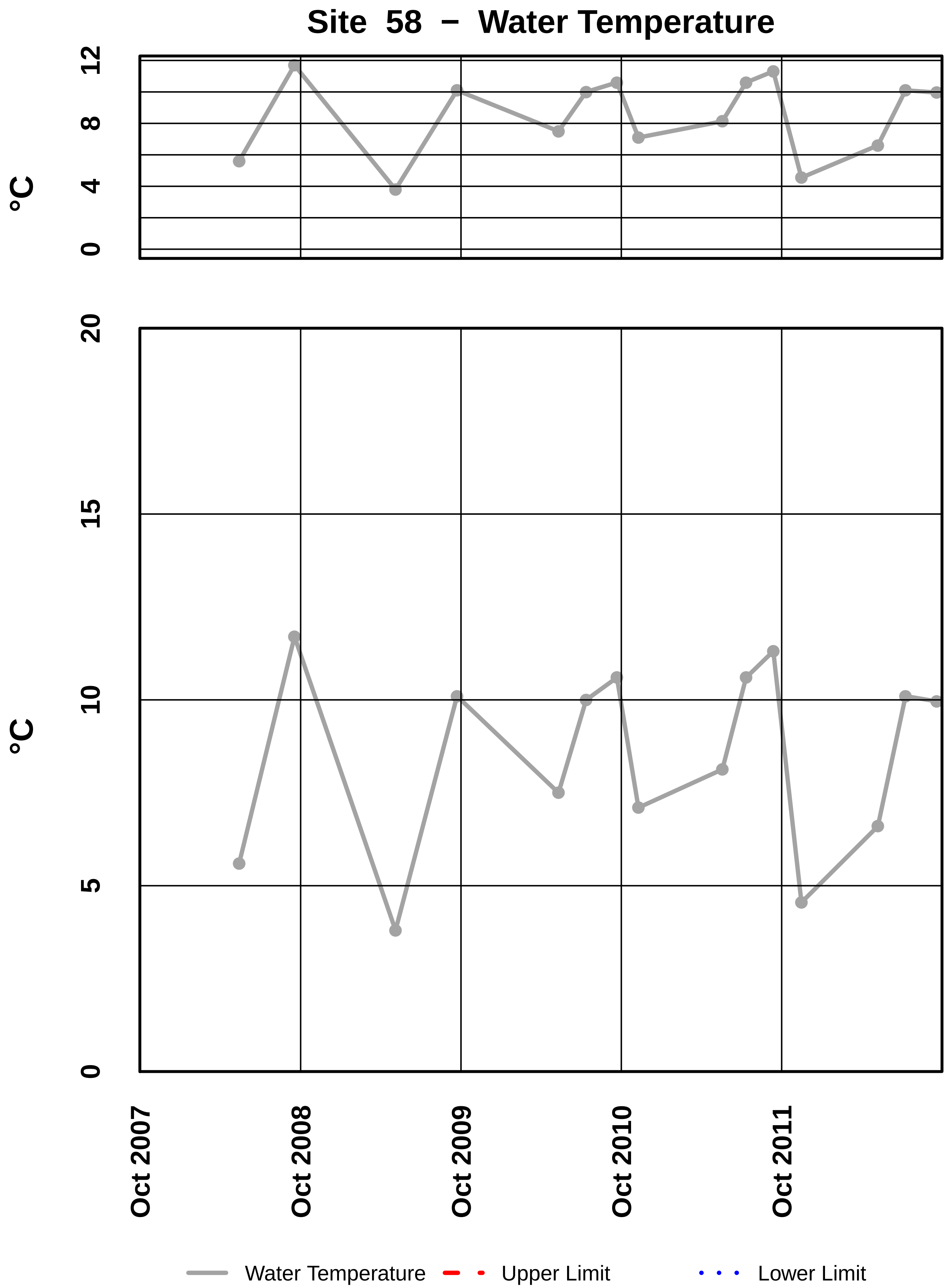
Shaded data has been qualified as an outlier by KGCMC and removed from any further analysis and is not included into the calculation of the median

Qualified Data by QA Reviewer

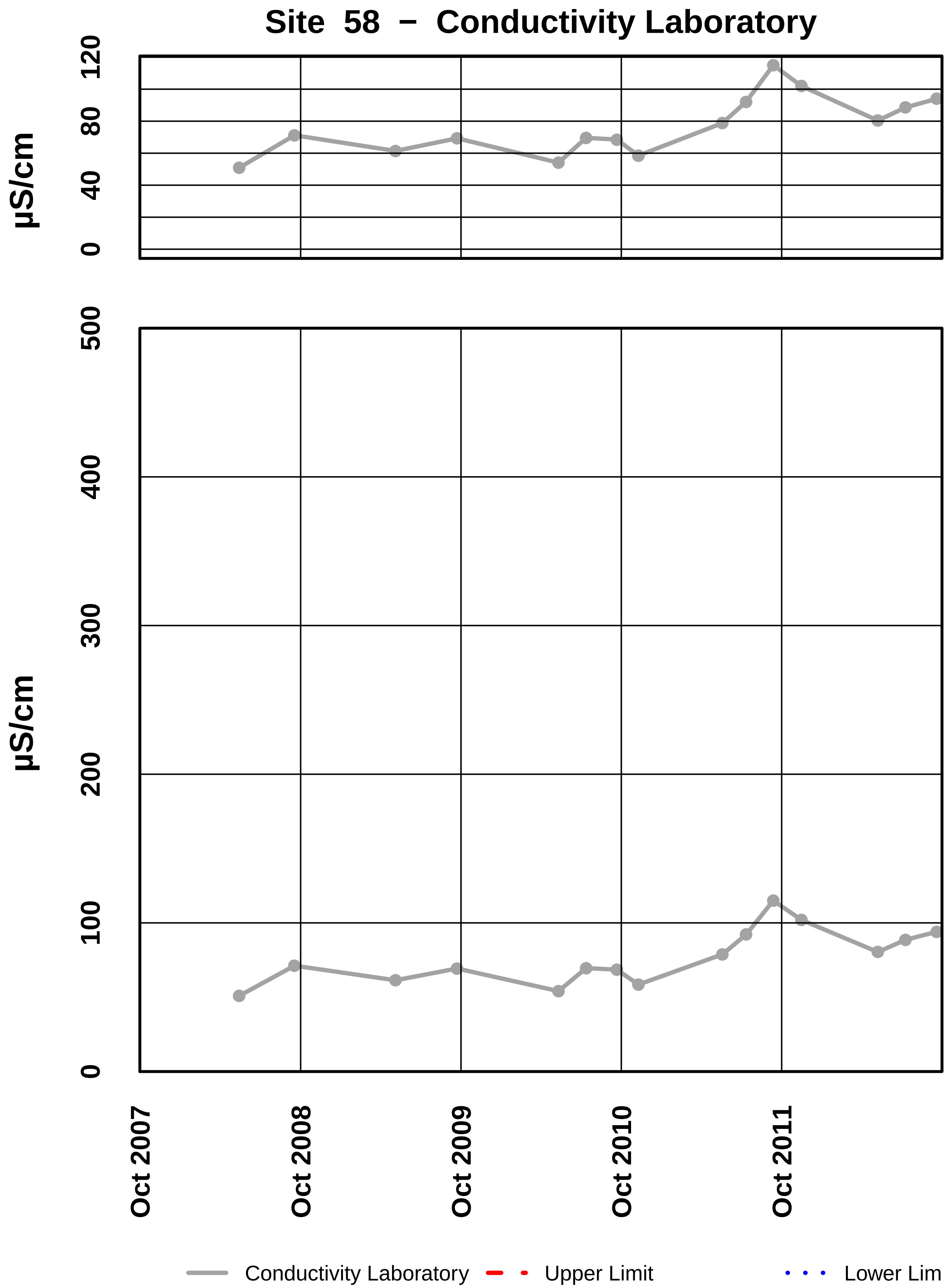
Date Range: 10/01/2011 to 09/30/2012

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
58	11/15/2011	12:00 AM	Se diss, µg/l	0.17	J	Below Quantitative Range
			SO4 Tot, mg/l	0.92	J	Below Quantitative Range
58	5/7/2012	12:00 AM	Ag diss, µg/l	0.00355	J	Below Quantitative Range
			Se diss, µg/l	0.31	J	Below Quantitative Range
			Zn diss, µg/l	0.23	U	Field Blank Contamination
			SO4 Tot, mg/l	1.69	J	Sample Receipt Temperature
58	7/9/2012	12:00 AM	Se diss, µg/l	0.32	J	Below Quantitative Range
			Zn diss, µg/l	0.1	U	Field Blank Contamination
			SO4 Tot, mg/l	1.1	J	Below Quantitative Range
58	9/18/2012	12:00 AM	SO4 Tot, mg/l	1.39	J	Sample Receipt Temperature
						Below Quantitative Range

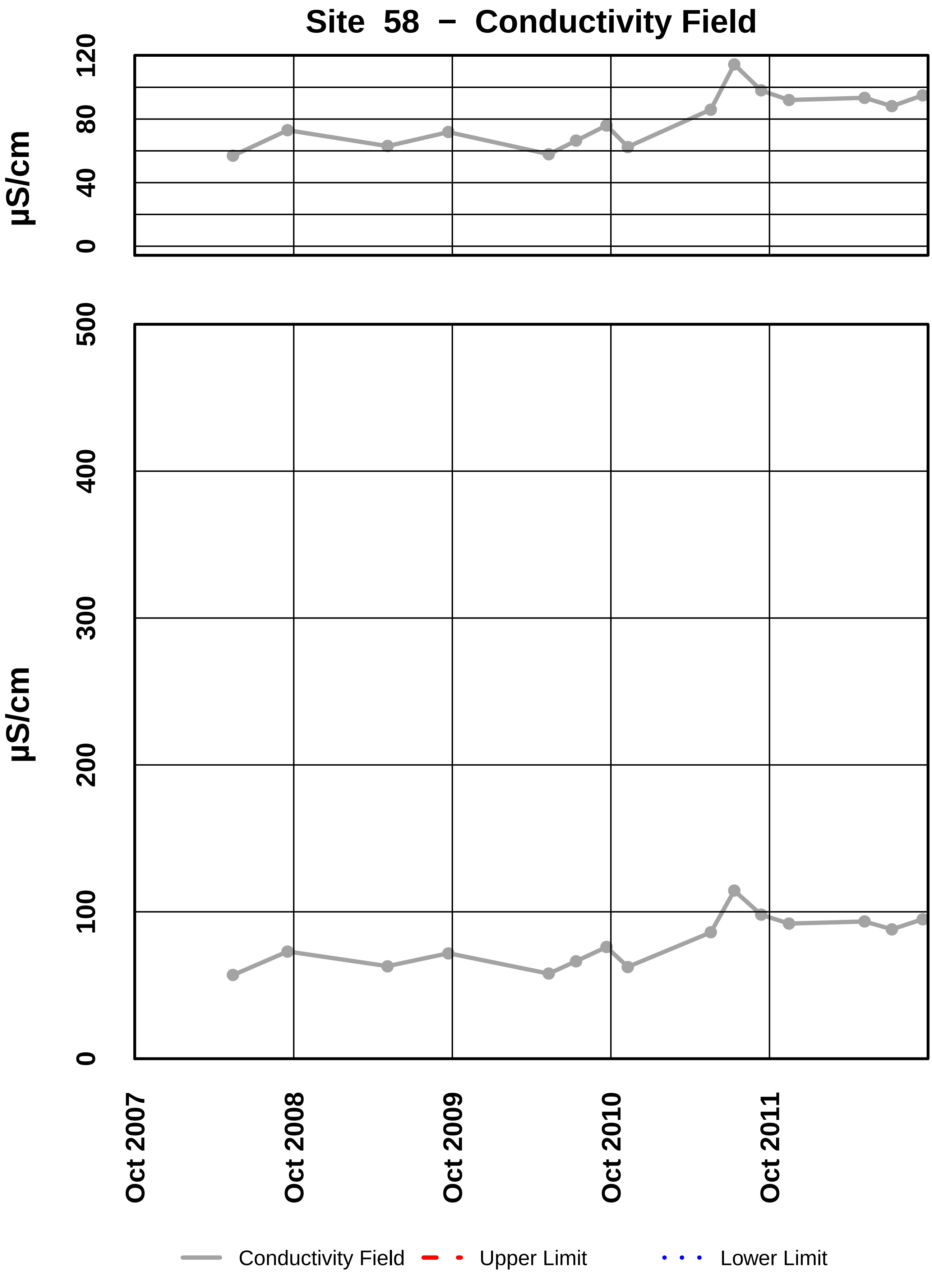
Qualifier	Description
J	Positively Identified - Approximate concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit



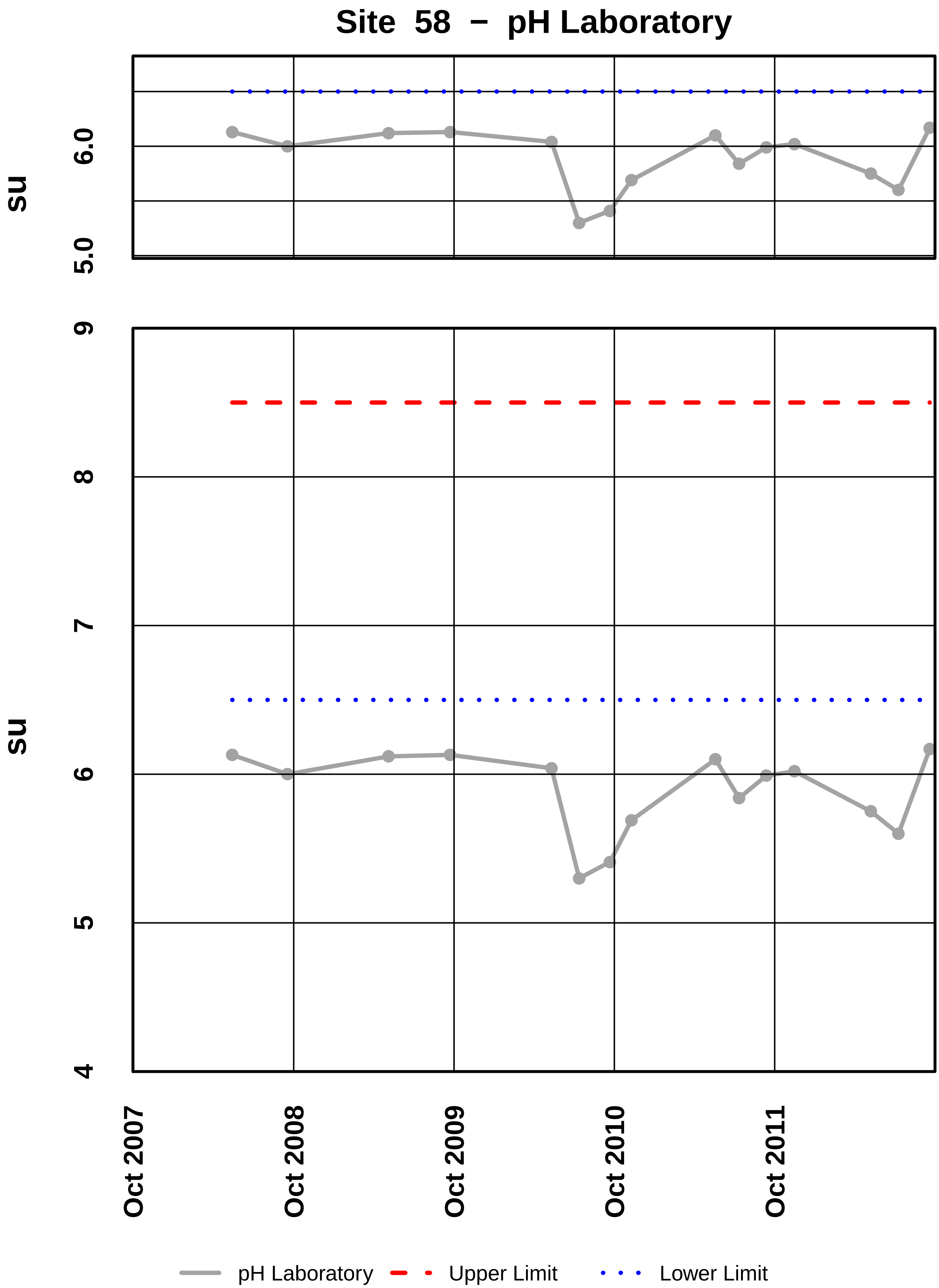
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



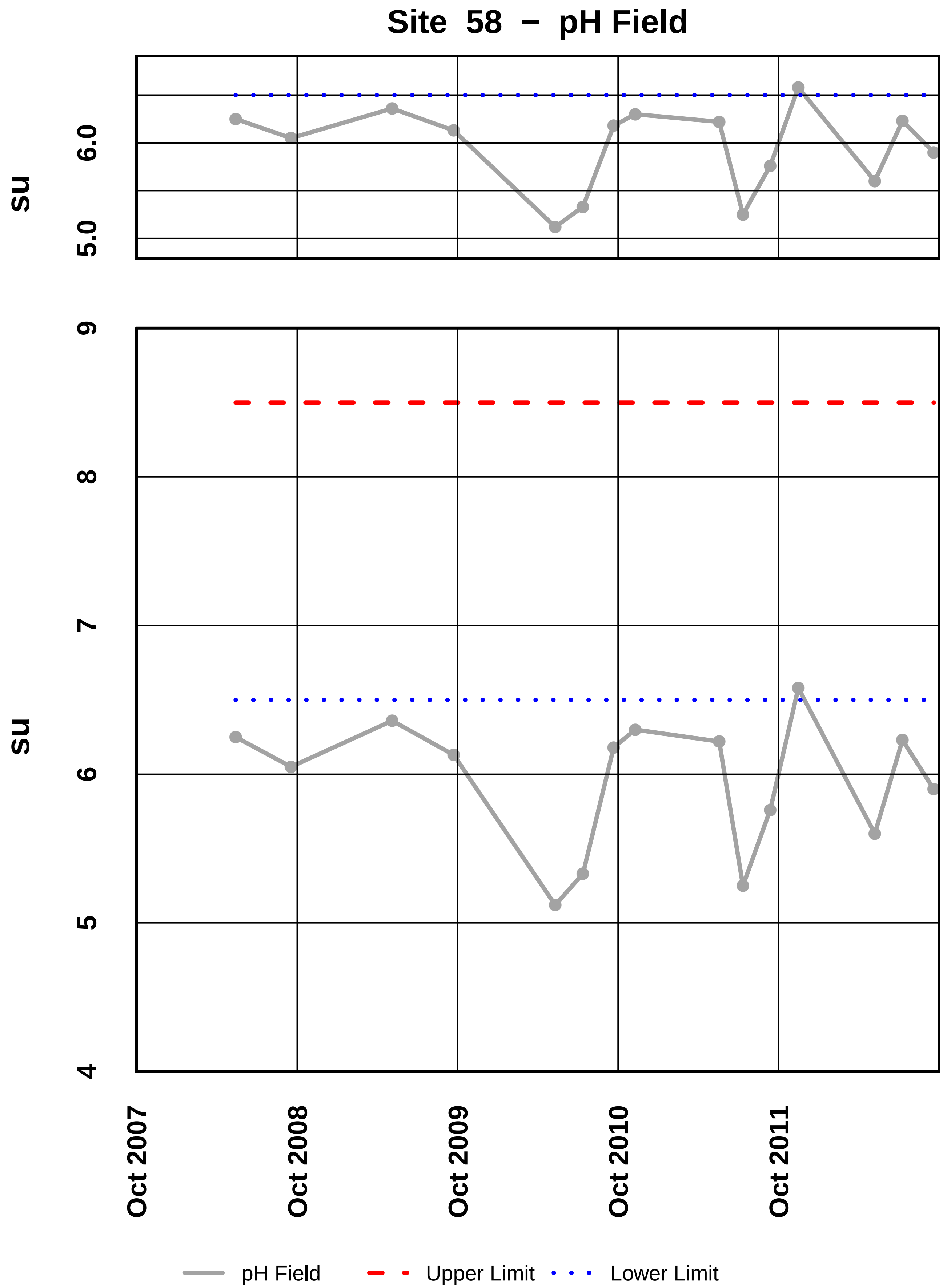
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



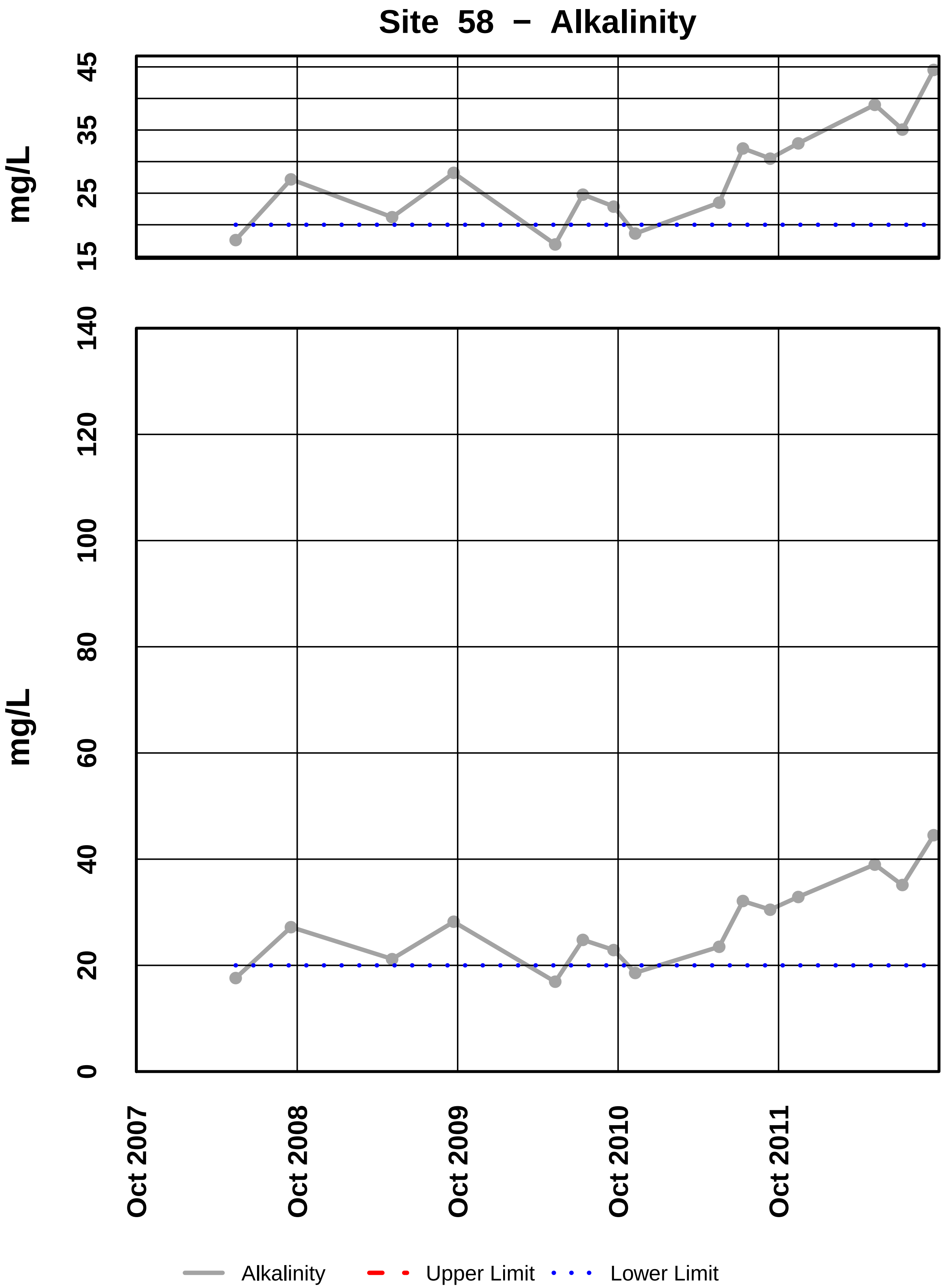
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

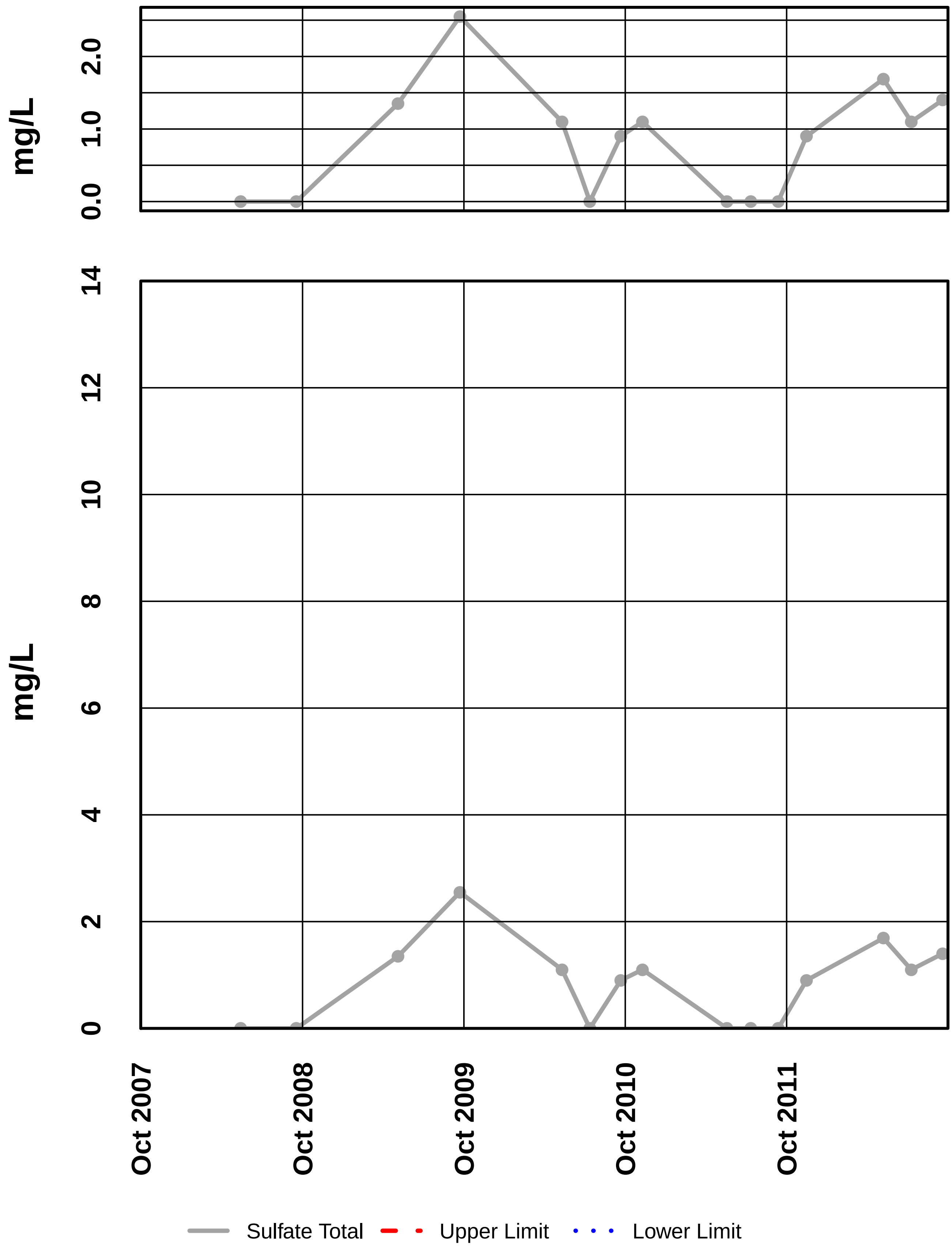


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

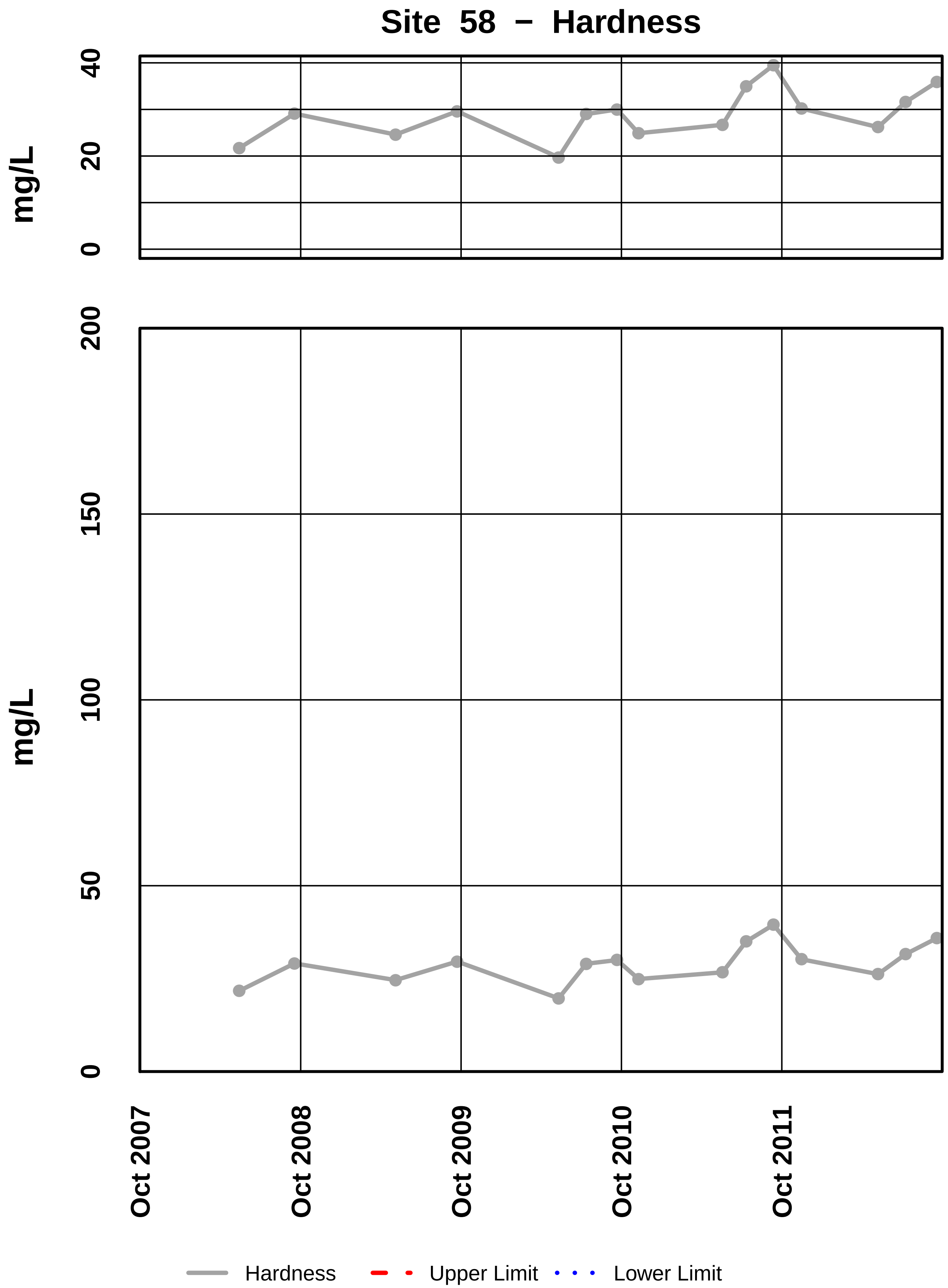


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

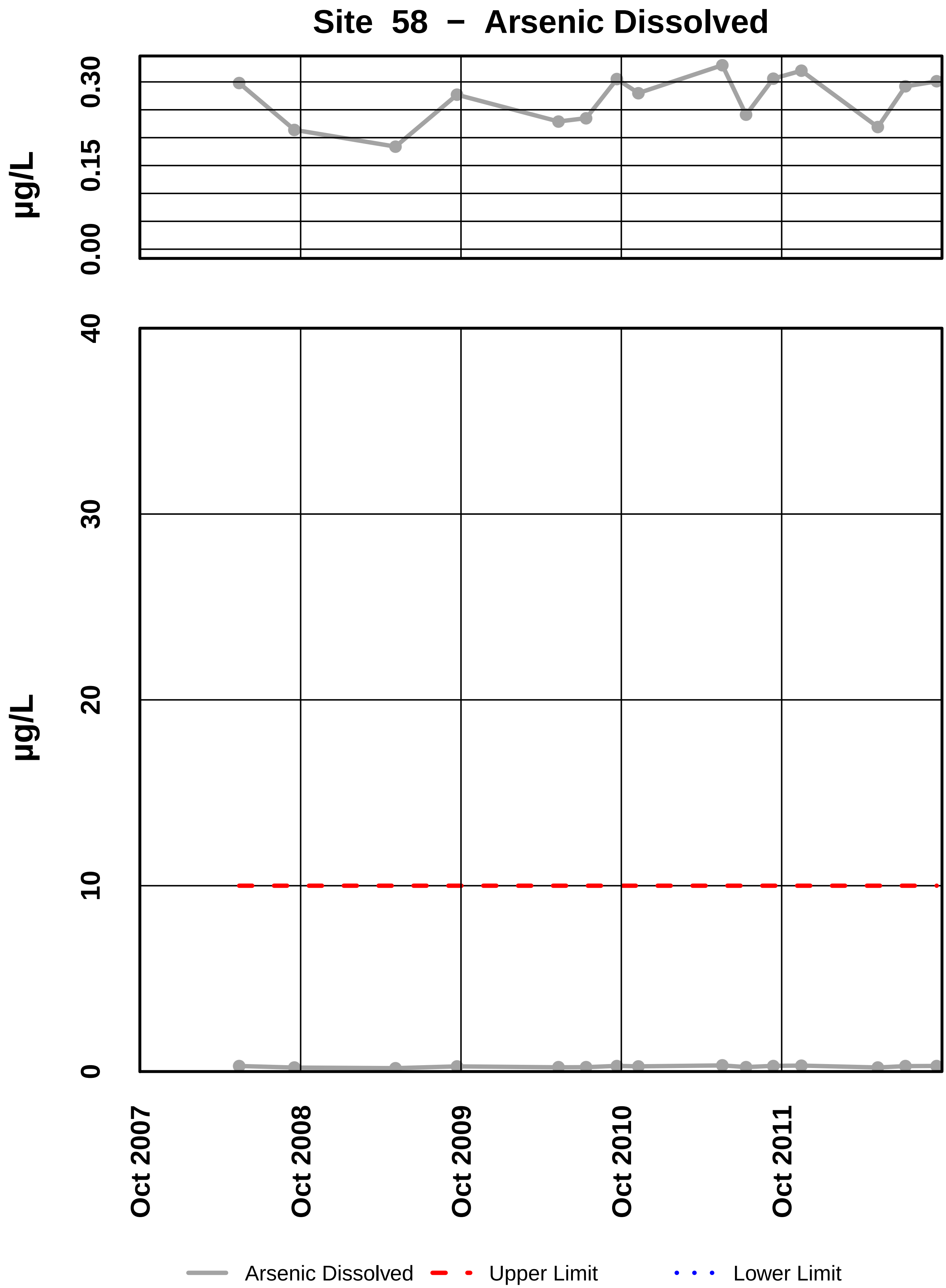
Site 58 − Sulfate Total



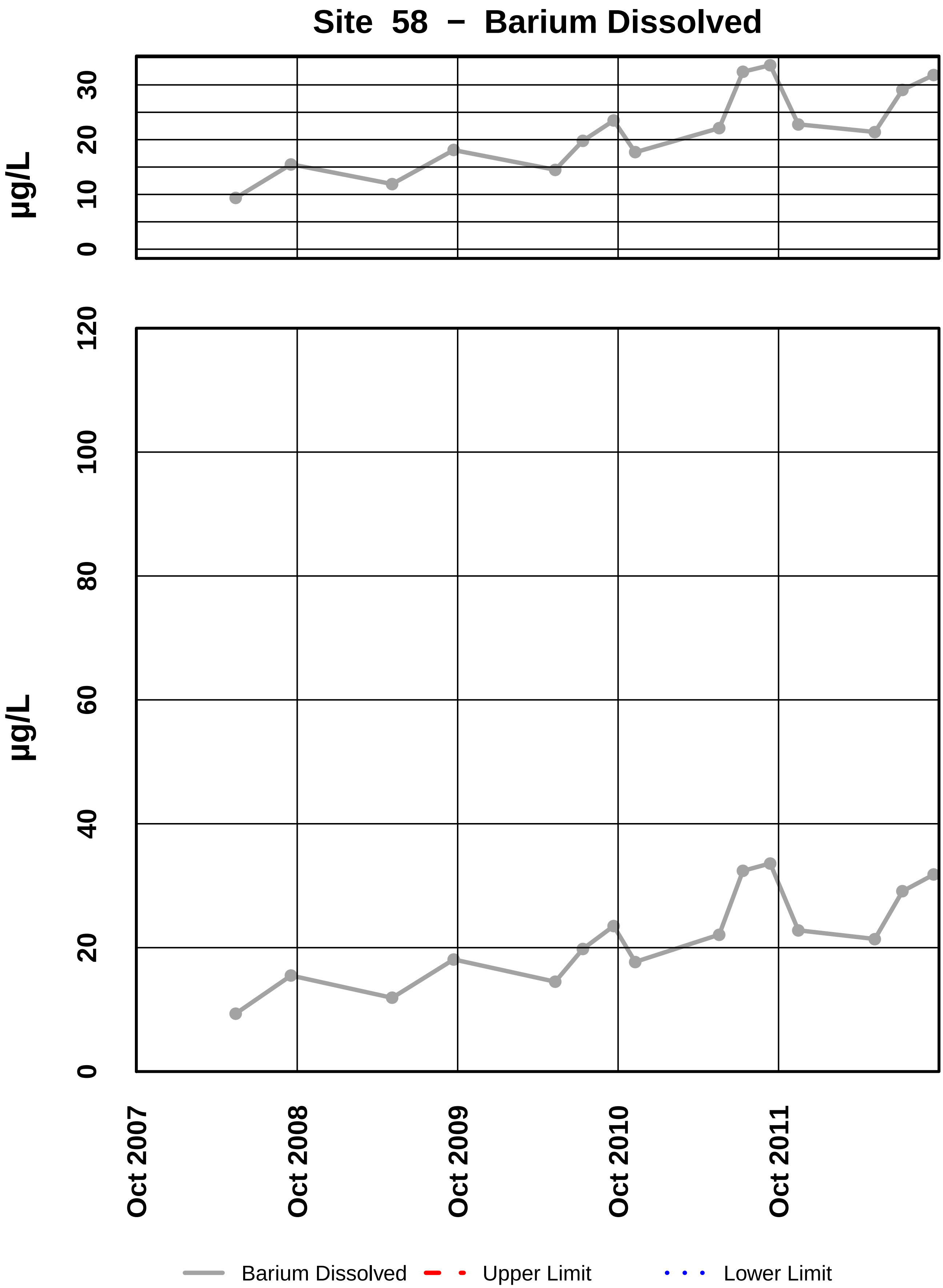
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



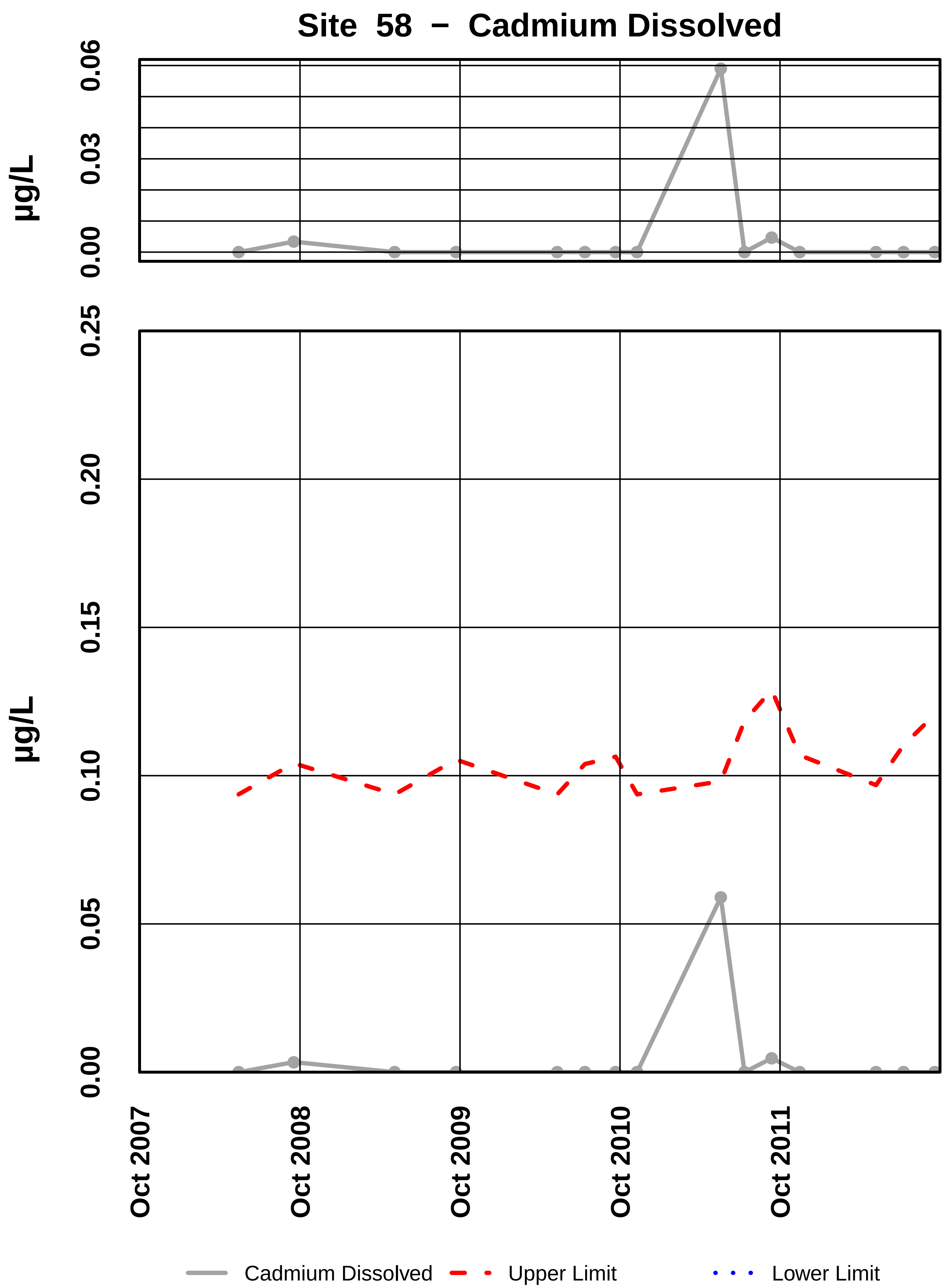
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



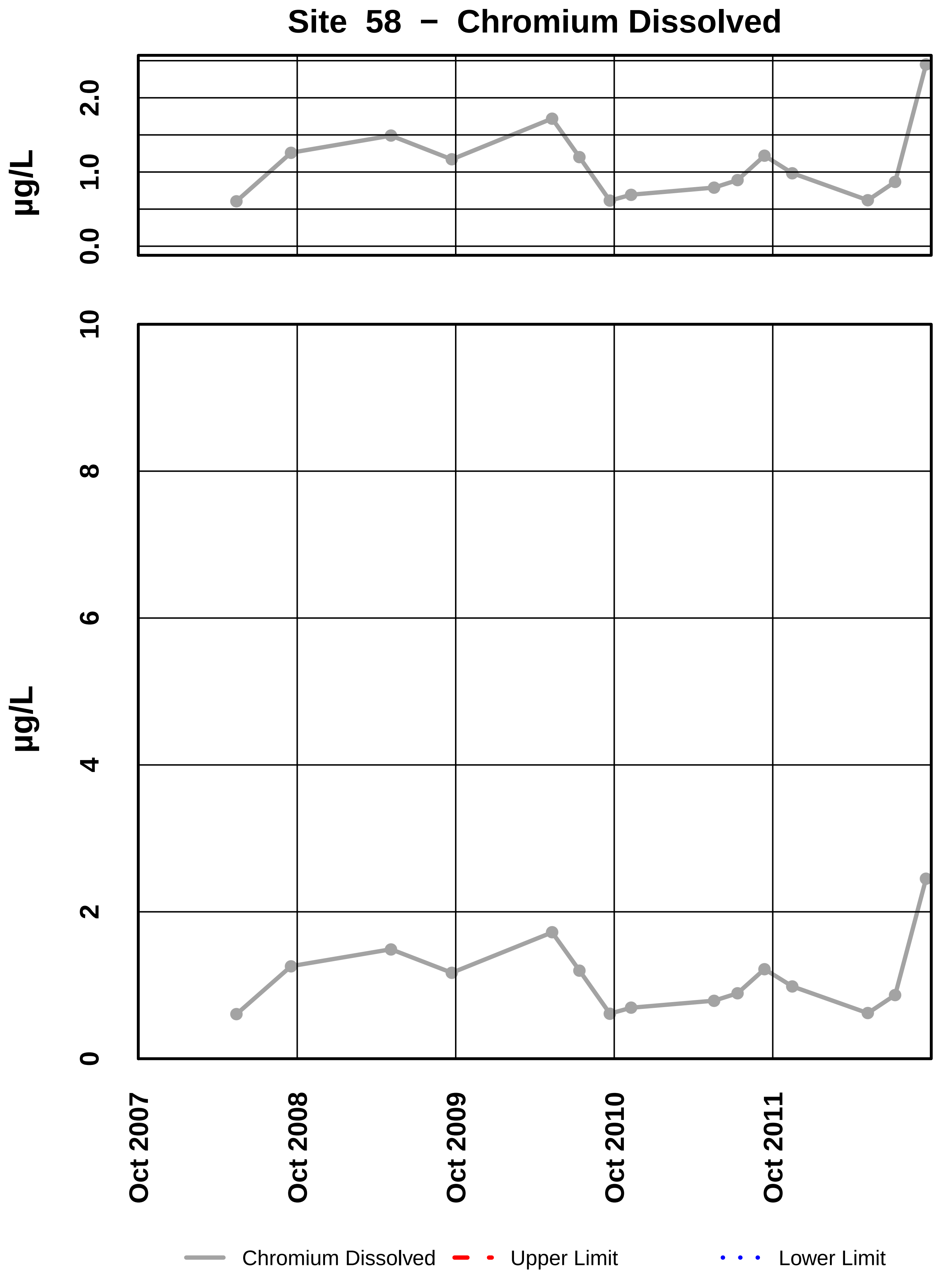
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



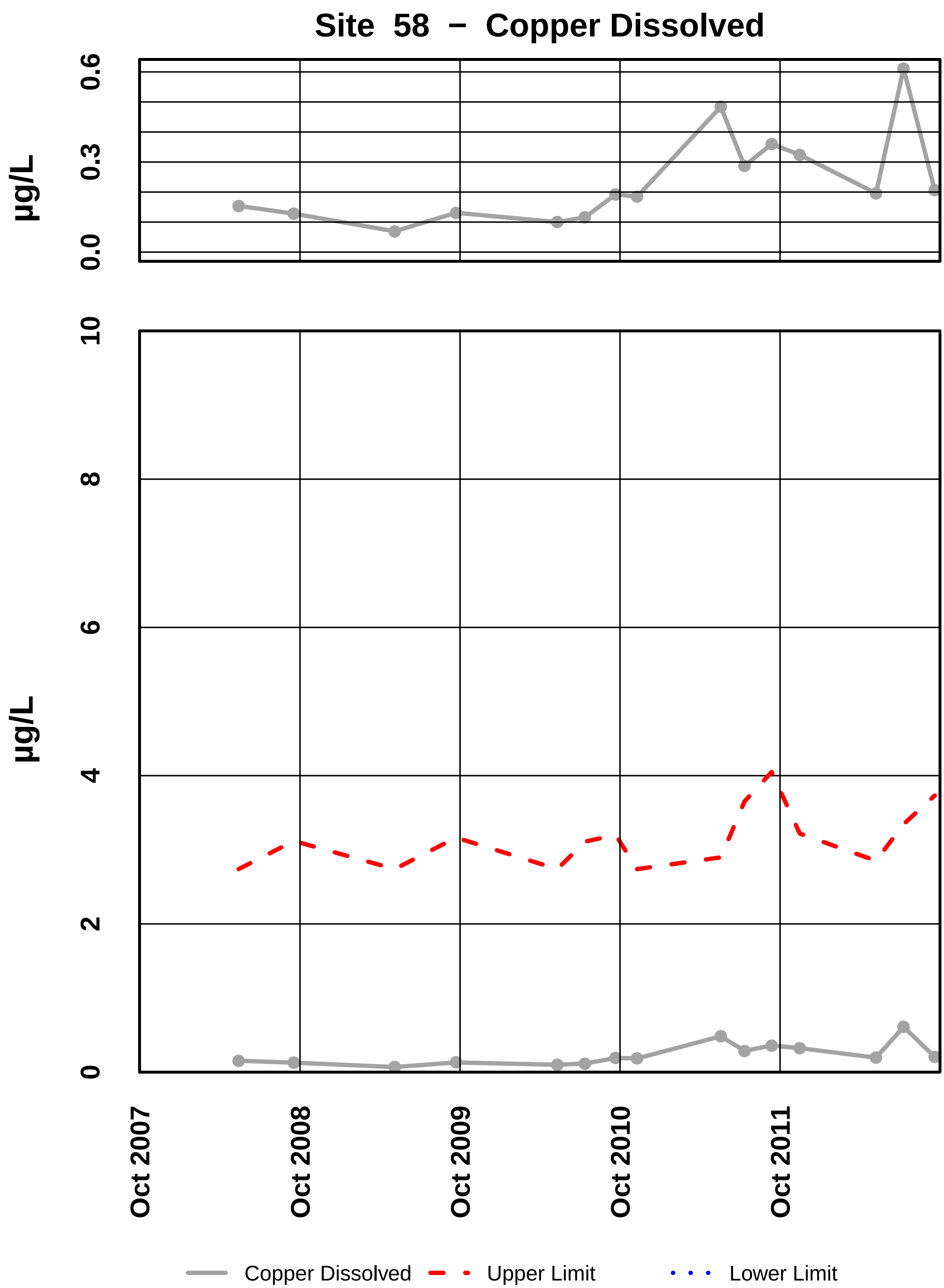
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



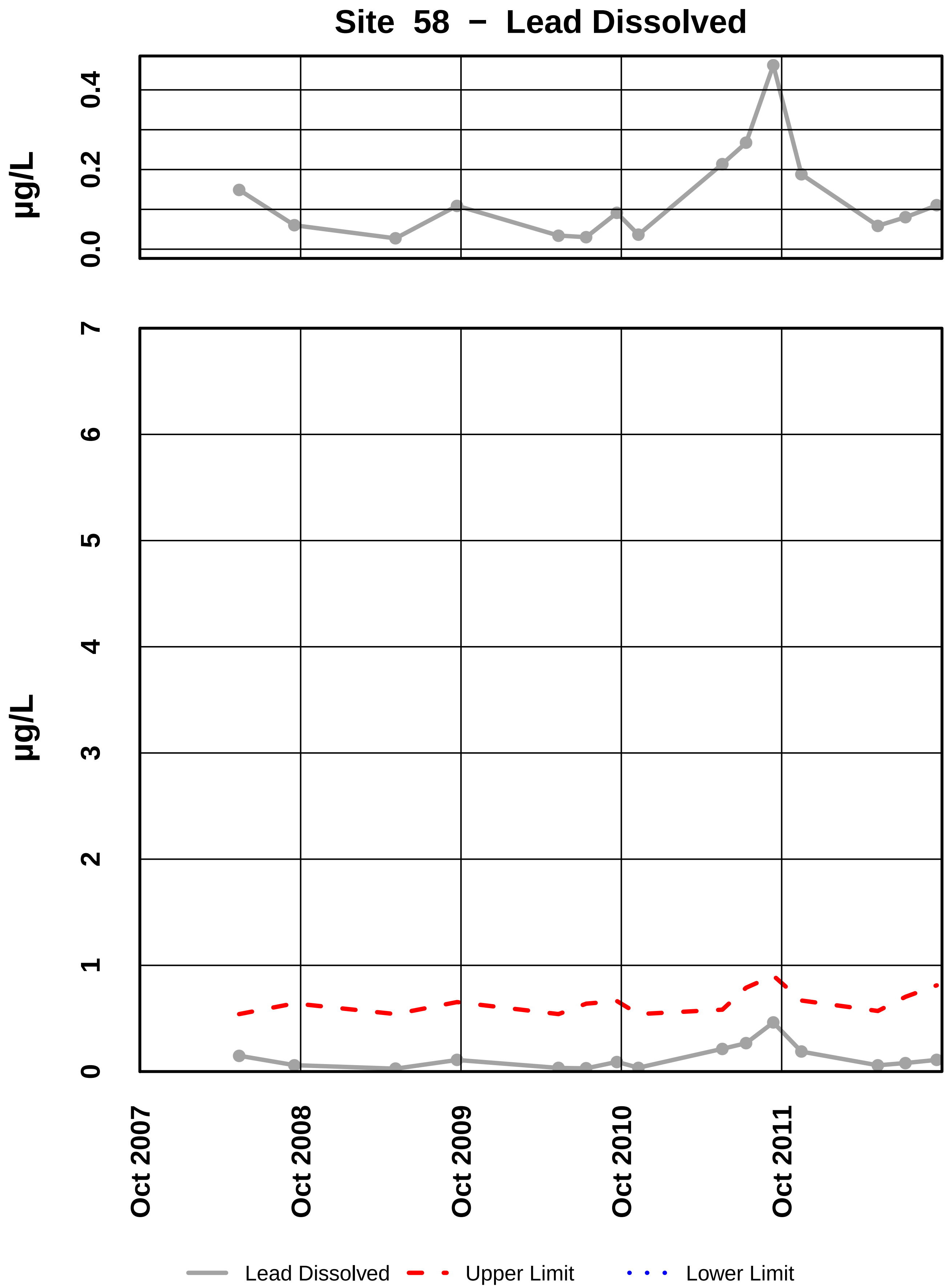
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

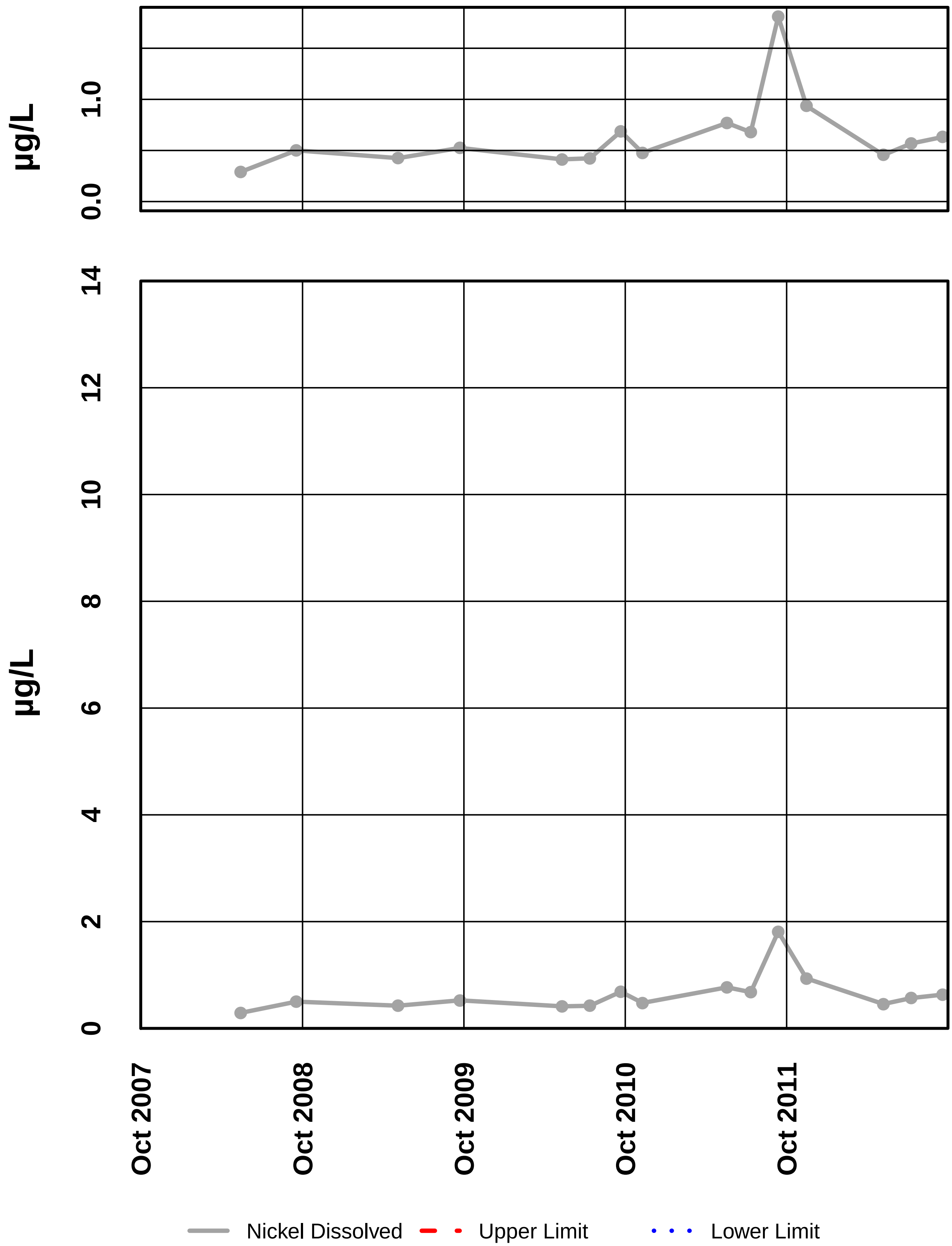


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

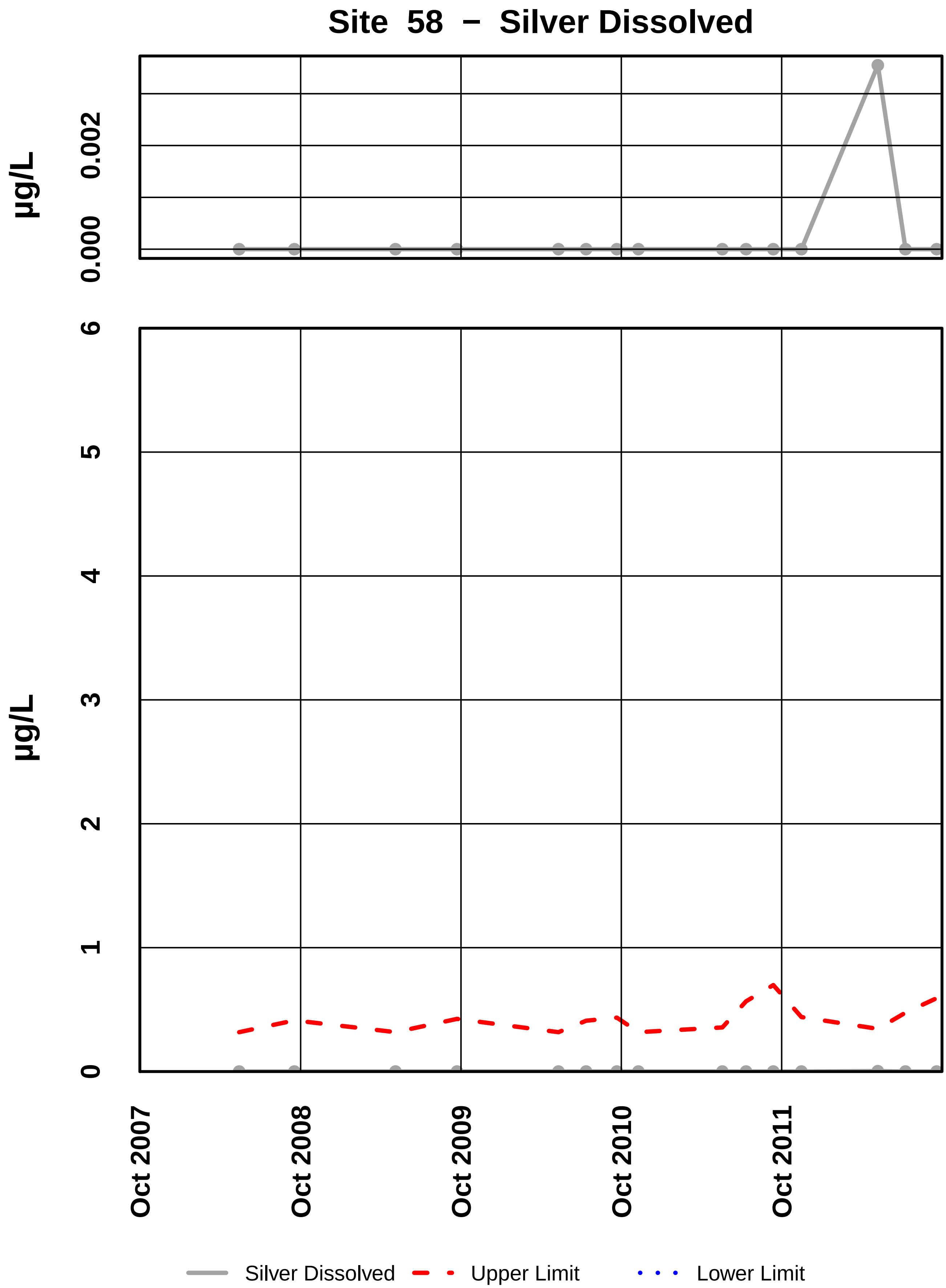


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

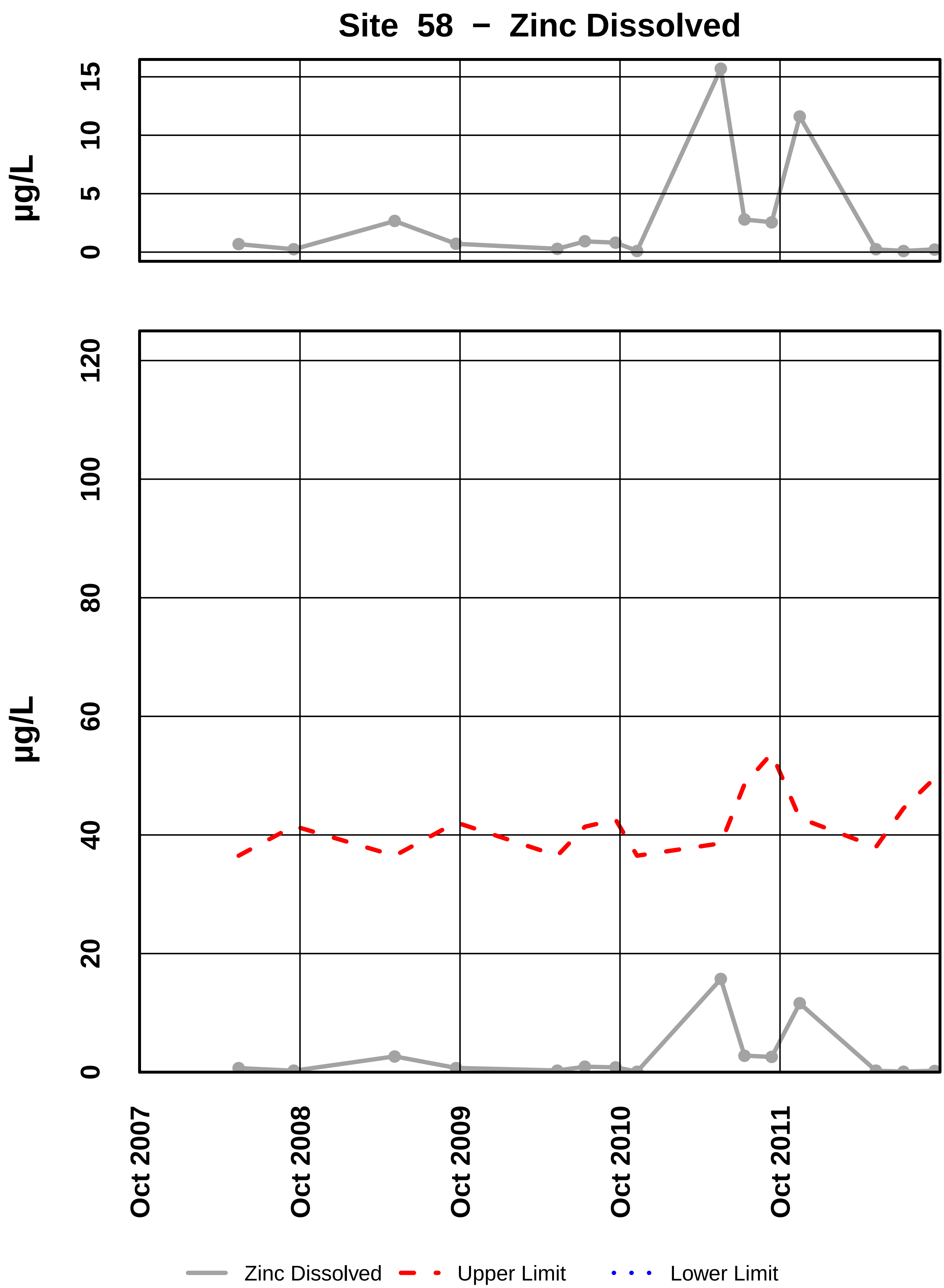
Site 58 − Nickel Dissolved



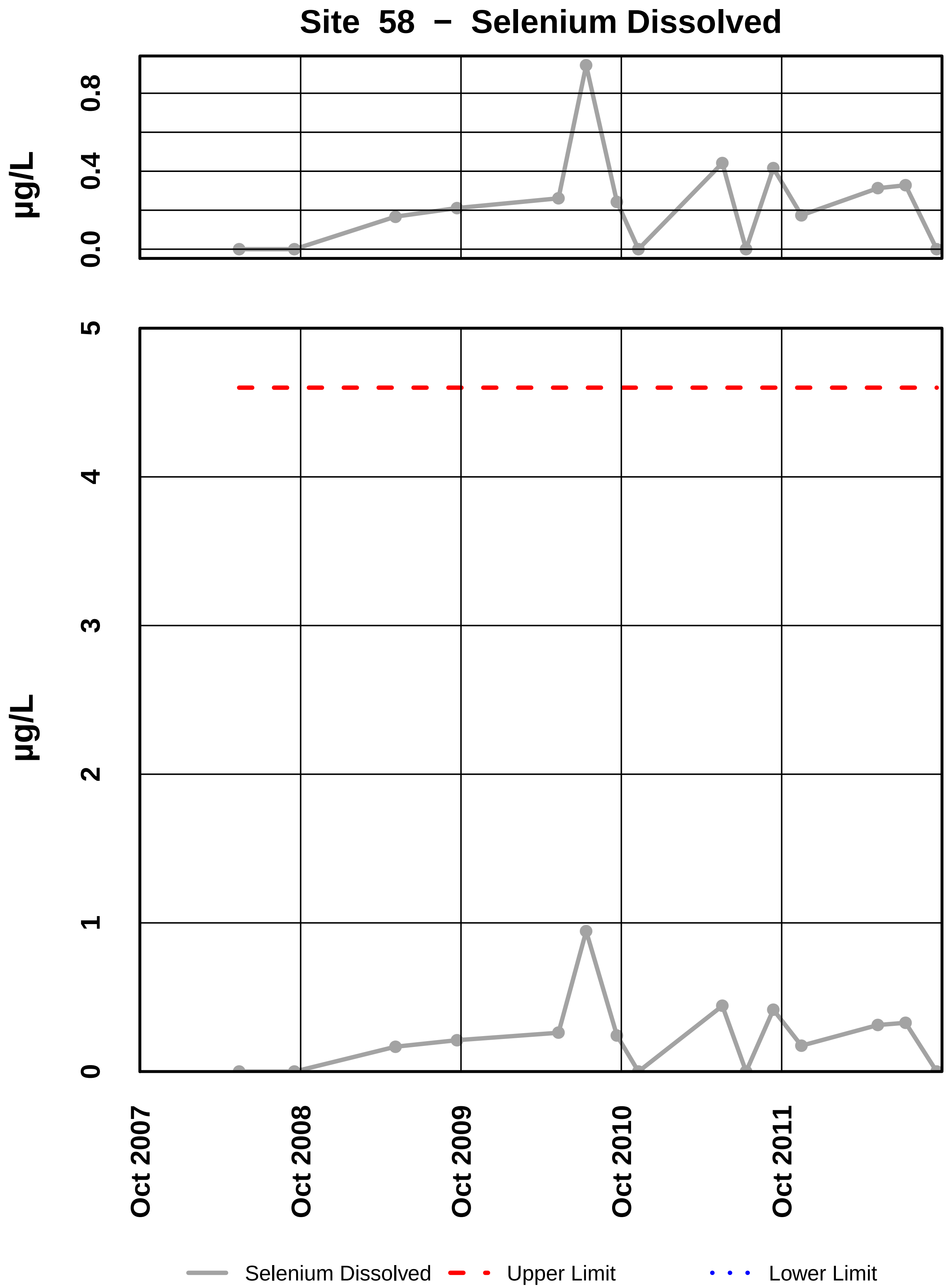
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

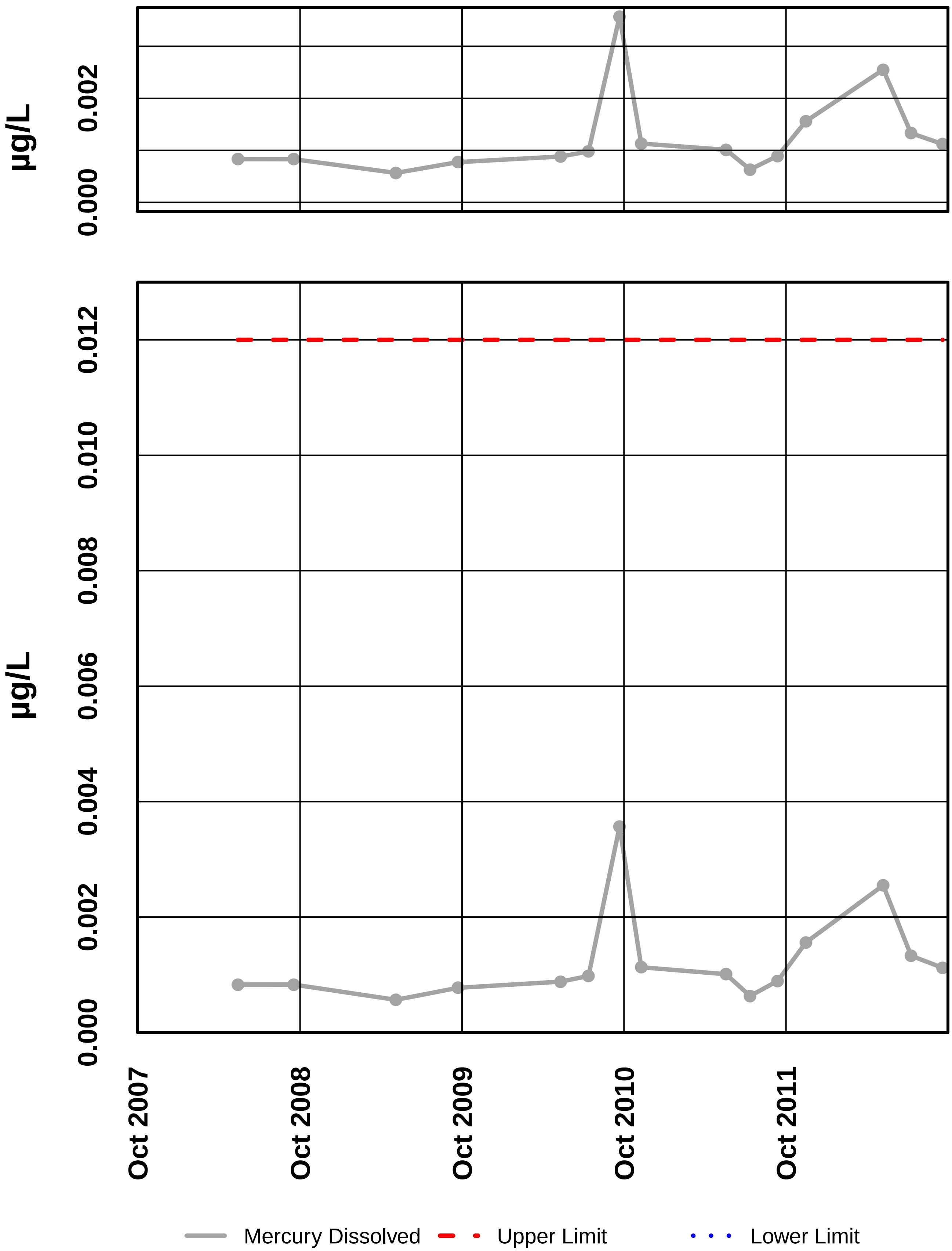


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

Site 58 – Mercury Dissolved



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

Site **#58** Seasonal Kendall analysis for Specific Conductance, Field (µS/cm)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**								62				81.1
b	**WY2008**								56.9				73
c	**WY2009**								63				71.8
d	**WY2010**								57.9		66.4		76
e	**WY2011**		62.5						86		114.4		98
f	**WY2012**		92						93.4		88.1		95
	n	0	2	0	0	0	0	0	6	0	3	0	6

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

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

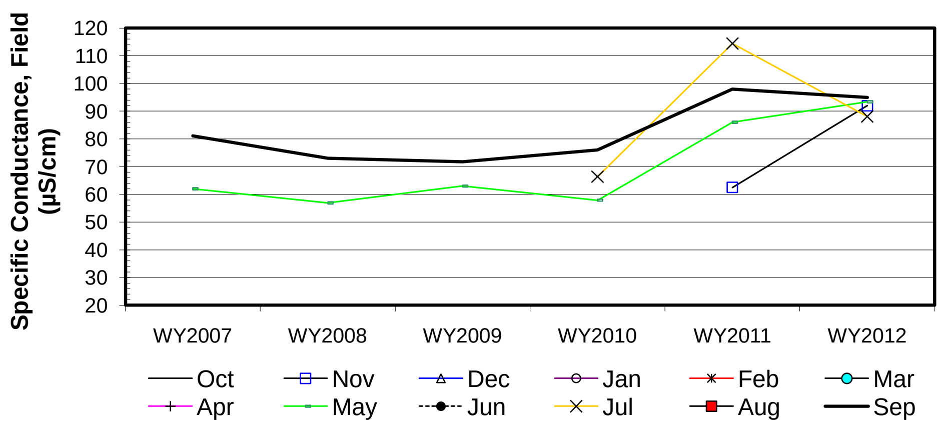
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=		1.00						28.33		3.67		28.33
$Z_k = S_k/\sigma_S$		1.00						1.69		0.52		0.94
Z^2_k		1.00						2.86		0.27		0.88

ΣZ_k= 4.15
ΣZ^2_k= 5.01
Z-bar=$\Sigma Z_k/K$= 1.04

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

Σn 17
ΣS_k 16

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=		0.70	@α=5% $\chi^2_{(K-1)}$=	7.81	Test for station homogeneity	
	p	**0.872**			$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
$\Sigma VAR(S_k)$	Z_{calc}	1.92	@α/2=2.5% Z=	1.96	H_0 (No trend)	ACCEPT
61.33	p	**0.972**			H_A (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-1.40		10.21
0.050	0.50	**6.05**	9.29
0.100	1.48		8.35
0.200	3.78		7.50

Site **#58** Seasonal Kendall analysis for pH, Field, Standard Units

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**								6.4				6.0
b	**WY2008**								6.3				6.1
c	**WY2009**								6.4				6.1
d	**WY2010**								5.1		5.3		6.2
e	**WY2011**		6.3						6.2		5.3		5.8
f	**WY2012**		6.6						5.6		6.2		5.9
	n	0	2	0	0	0	0	0	6	0	3	0	6

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

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

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

$\Sigma Z_k=$ -0.36

$\Sigma Z^2_k=$ 4.17

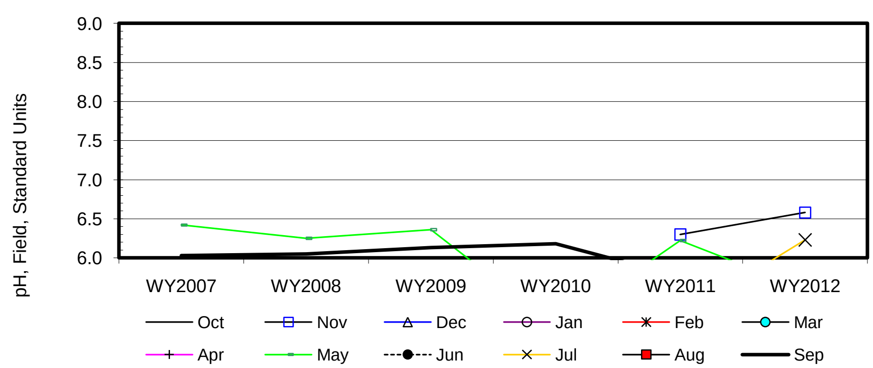
Z-bar=$\Sigma Z_k/K=$ -0.09

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

Σn 17

ΣS_k -8

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2=$ 4.14		@α=5% $\chi^2_{(K-1)}=$ 7.81	Test for station homogeneity	
p **0.247**			$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
$\Sigma VAR(S_k)$	Z_{calc} -0.89	@α/2=2.5% $Z=$ 1.96	H_0 (No trend)	ACCEPT
61.33	**p** **0.186**		H_A (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.17		0.07
0.050	-0.15	**-0.04**	0.05
0.100	-0.10		0.02
0.200	-0.08		-0.02

Site **#58** Seasonal Kendall analysis for Total Alk, (mg/l)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**								13.8				35.0
b	**WY2008**								17.6				27.2
c	**WY2009**								21.2				28.2
d	**WY2010**								16.9		24.8		22.9
e	**WY2011**		18.6						23.5		32.1		30.5
f	**WY2012**		32.9						39.0		35.1		44.5
	n	0	2	0	0	0	0	0	6	0	3	0	6

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

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

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=		1.00						28.33		3.67		28.33
$Z_k = S_k/\sigma_S$		1.00						2.07		1.57		0.56
Z^2_k		1.00						4.27		2.45		0.32

ΣZ_k= 5.20

ΣZ^2_k= 8.04

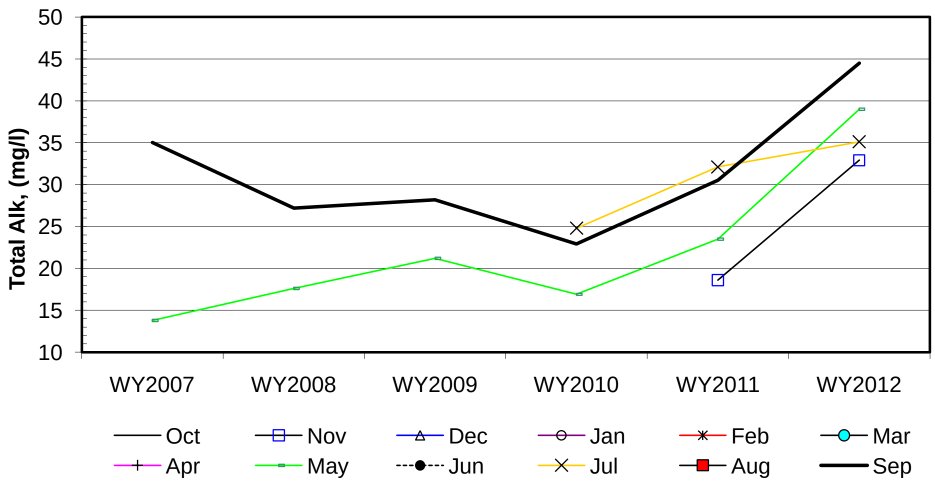
Z-bar=ΣZ_k/K= 1.30

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

Σn 17

ΣS_k 18

$\chi^2_h=\Sigma Z^2_k$-K(Z-bar)^2= 1.29	@α=5% $\chi^2_{(K-1)}$= 7.81	Test for station homogeneity	
p **0.731**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k) / Z_{calc} 2.17	@α/2=2.5% Z= 1.96	**H_0** (No trend)	REJECT
61.33 / **p** **0.985**		**H_A** ($\pm$ trend)	ACCEPT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.43		6.01
0.050	1.07	**3.30**	5.24
0.100	1.15		5.04
0.200	1.68		3.96

12.1%

Site **#58** Seasonal Kendall analysis for Sulfate, Total (mg/l)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**								1.8				1.5
b	**WY2008**								0.0				0.0
c	**WY2009**								1.4				2.6
d	**WY2010**								1.1		0.0		0.9
e	**WY2011**		1.1						0.0		0.0		0.0
f	**WY2012**		0.9						1.7		1.1		1.4
	n	0	2	0	0	0	0	0	6	0	3	0	6

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

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

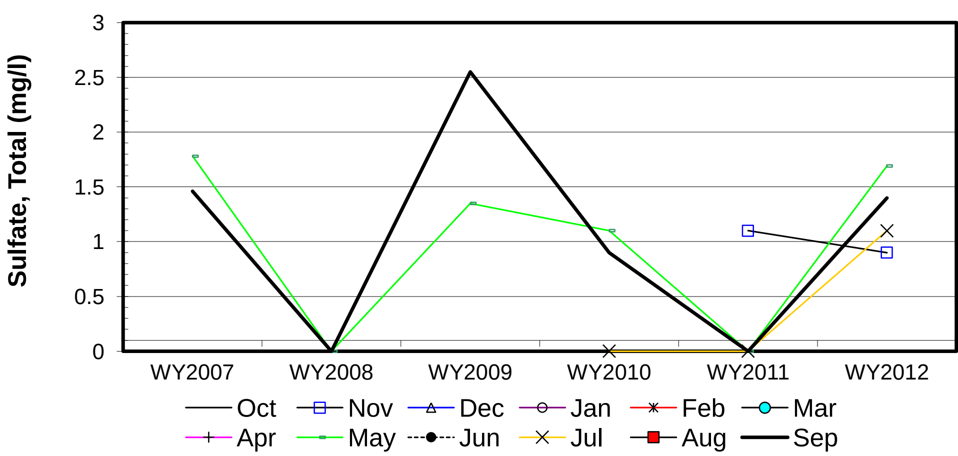
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=		1.00						27.33		2.67		27.33
$Z_k = S_k/\sigma_S$		-1.00						-0.38		1.22		-0.38
Z^2_k		1.00						0.15		1.50		0.15

ΣZ_k= -0.54
ΣZ^2_k= 2.79
Z-bar=ΣZ_k/K= -0.14

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	11	3	0	0	0

Σn 17
ΣS_k -3

$\chi^2_h=\Sigma Z^2_k-K(Z\text{-bar})^2$=	2.72	@α=5% $\chi^2_{(K-1)}$=	7.81	Test for station homogeneity	
p	**0.437**			$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k) 58.33	Z_{calc} -0.26	@α=2.5% Z=	1.96	**H_0** (No trend)	ACCEPT
	p **0.397**			**H_A** ($\pm$ trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.44		0.45
0.050	-0.28	**-0.01**	0.31
0.100	-0.23		0.24
0.200	-0.20		0.02

Site #58 — Seasonal Kendall analysis for Zinc, Dissolved (ug/l)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**								0.5				0.5
b	**WY2008**								0.7				0.2
c	**WY2009**								2.7				0.7
d	**WY2010**								0.3		0.9		0.8
e	**WY2011**		0.1						15.7		2.8		2.6
f	**WY2012**		11.6						0.2		0.1		0.2
	n	0	2	0	0	0	0	0	6	0	3	0	6

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

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

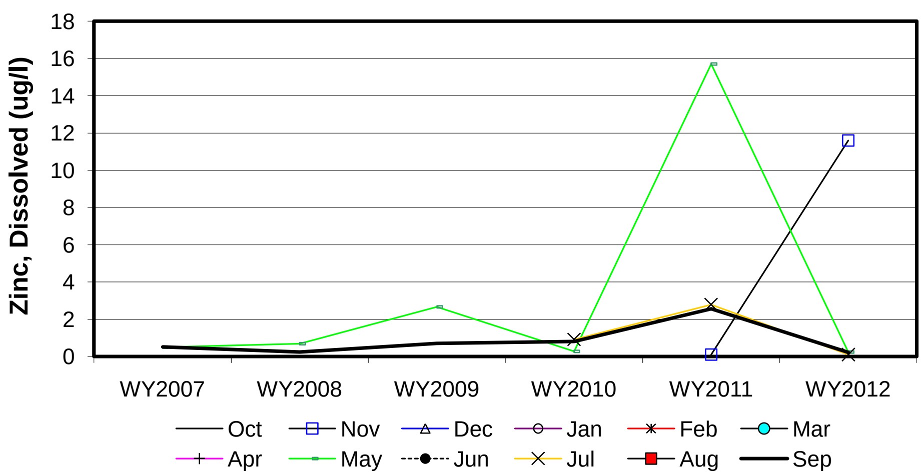
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=		1.00						28.33		3.67		28.33
$Z_k = S_k/\sigma_S$		1.00						-0.19		-0.52		0.56
Z^2_k		1.00						0.04		0.27		0.32

ΣZ_k=	0.85
ΣZ^2_k=	1.63
Z-bar=ΣZ_k/K=	0.21

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

Σn	17
ΣS_k	2

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=		1.44	@α=5% $\chi^2_{(K-1)}$=	7.81	Test for station homogeneity	
	p	**0.695**			$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc}	0.13	@α/2=2.5% Z=	1.96	**H_0** (No trend)	ACCEPT
61.33	**p**	**0.551**			**H_A** ($\pm$ trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.27		1.15
0.050	-0.13	**0.10**	0.63
0.100	-0.07		0.47
0.200	-0.05		0.21

INTERPRETIVE REPORT
SITE 27

The data collected during the current water year are listed in the following “Table of Results for Water Year 2012” report. The table includes all the required FWMP analyte data (field and laboratory) collected for the current water year and a series of flags keyed to the summary report “Qualified Data by QA Reviewer”. The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of ½ MDL for the purpose of median calculation.

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

Sample Date	Parameter	Value	Qualifier	Notes
No outliers have been identified by HGCMC for the period of October 2007 through September 2012.				

The data for water year2012 have been compared to the strictest fresh water quality criterion for each applicable analyte. Three samples exceeding these criteria have been identified, as listed in the table below. The exceedances were for field pH values which are below the lower limit of 6.5 su listed in the AWQS. Values for field pH from other wells completed into organic rich peat sediments similar to Site 27 have historically resulted in pH values ranging from 5 to 6 su (*e.g.* Sites 58, 29, and 32). All of the other analytes were within AWQS for the current water year.

Table of Exceedance for Water Year 2012

			Limits		
Sample Date	**Parameter**	**Value**	**Lower**	**Upper**	**Hardness**
15-Nov-11	pH Field	6.47 su	6.5	8.50	
7-May-12	pH Field	5.59 su	6.5	8.50	
18-Sep-12	pH Field	6.32 su	6.5	8.50	

X-Y plots have been generated to graphically present the data for each of the analytes requested in the Statistical Information Goals for this site. 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 34.8µg/L in October 2009, During the current water year the median value recorded was 6.0µg/L which is slightly more than doubled from the 2006 through 2008 water years.

Non-parametric statistical analyses were performed for specific conductivity, field pH, total alkalinity, total sulfate, and dissolved zinc. Calculation details of the Seasonal Kendall analyses are presented in detail on the pages following this interpretive section. The below table summarizes the results on the data collected between Oct-06 and Sep-12(WY2007-WY2012).

Table of Summary Statistics for Trend Analysis

	Mann-Kendall test statistics			Sen's slope estimate	
Parameter	**n***	**p****	**Trend**	**Q**	**Q(%)**
Conductivity Field	6	0.35			
pH Field	6	0.19			
Alkalinity, Total	6	0.01	+	3.017	12.517
Sulfate, Total	6	0.35			
Zinc, Dissolved	6	0.03			

* Number of Years ** Significance level

For datasets with a statistically significant trend ($\alpha/2$=2.5%) a Seasonal-Sen's Slope estimate statistic has also been calculated. The dataset for total alkalinity has a statistically significant (p = 0.01) trend with a slope estimate of 3.02mg/L/yr or a 12.52% increase over the last 6 years. With the changes that were made to the FWMP monitoring schedule (*i.e.* increase sampling frequency), HGCMC feels that the FWMP program is sufficient to monitor further changes, before the AWQS are exceeded.

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

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

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

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

	Site 27 Conductivity (µS/cm)	Site 27 Diss. Zinc (µg/L)	Site 27 Total Sulfate (mg/L)
Baseline Statistics			
Baseline Period	09/18/01-05/18/04	09/18/01-05/18/04	09/17/02-09/21/04
Number of Samples	6	6	5
Mean (x)	95.0	2.78	1.56
Standard Deviation	6.8	1.42	0.43
Shewhart-CUSUM Control Limits (SCL)			
Control Limit (mean x+ 2s)	108.6	5.6	2.4
Control Limit (mean x + 3s)	115.5	7.0	2.8
Control Limit (mean x + 4s)	122.3	8.4	3.3
Control Limit (mean x + 4.5s)	125.7	9.2	3.5
CUSUM Control Limits			
Cumulative increase – h	5	5	5

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

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

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

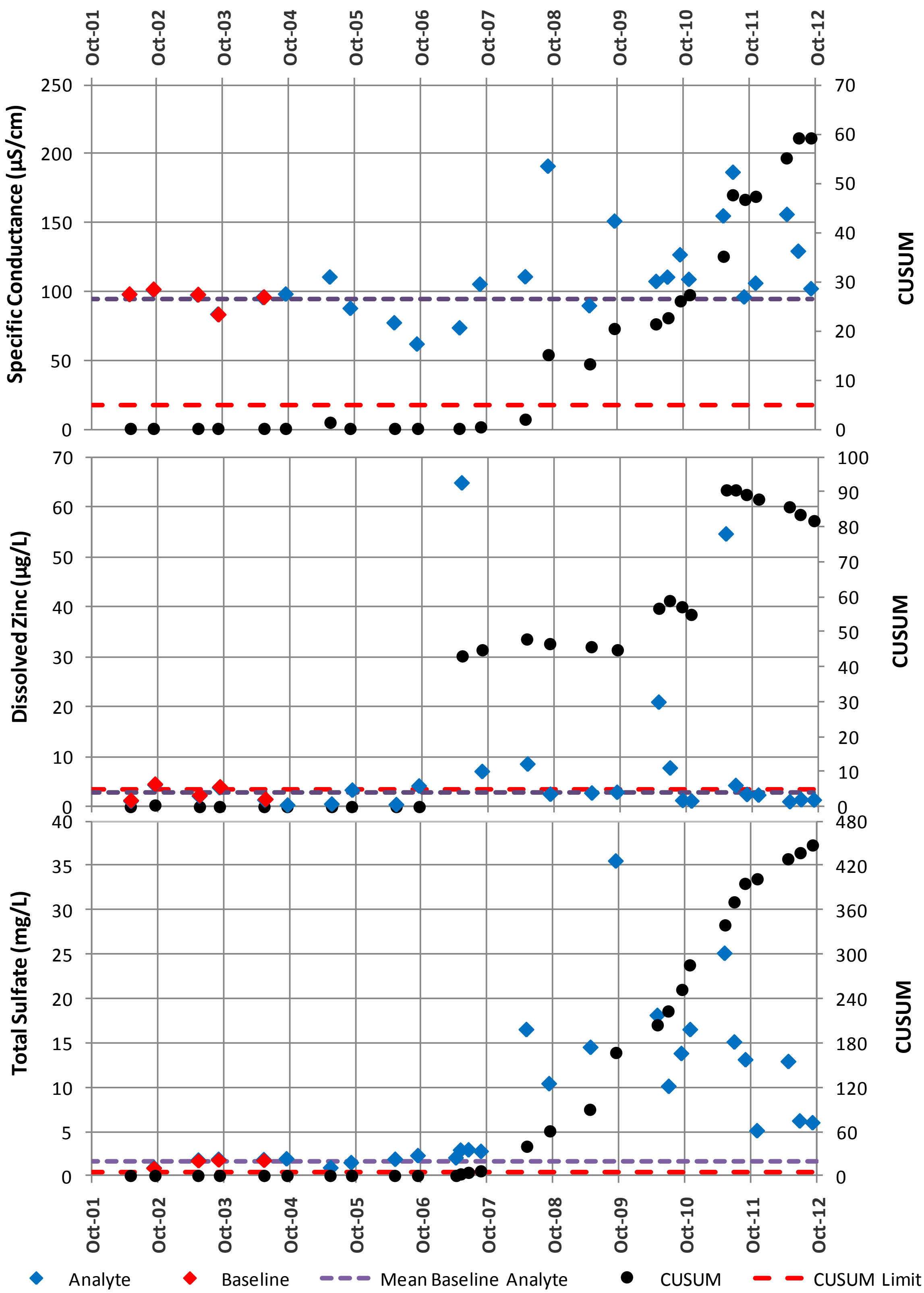


Table of Results for Water Year 2012

Site 027FMG - 'Monitoring Well - 2S'

Sample Date/Parameter	Oct 2011	Nov 2011	Dec 2011	Jan 2012	Feb 2012	Mar 2012	Apr 2012	May 2012	Jun 2012	Jul 2012	Aug 2012	Sep 2012	**Median**
Water Temp (°C)		5.3						6.5		9.4		8.8	7.7
Conductivity-Field(µmho)		106						156.1		129.3			129.3
Conductivity-Lab (µmho)		119						111		133		117	118
pH Lab (standard units)		5.51						5.52		5.74		6.02	5.63
pH Field (standard units)		6.47						5.59		6.51		6.32	6.40
Total Alkalinity (mg/L)		27.6						30.6		48.8		48.5	39.6
Total Sulfate (mg/L)		5						12.8		6.1		5.9	6.0
Hardness (mg/L)		33.6						34.1		39.2		36	35.1
Dissolved As (ug/L)		2.56						1.68		1.35		4.99	2.120
Dissolved Ba (ug/L)		46.3						38.7		44.8		45.8	45.3
Dissolved Cd (ug/L)		0.0018						0.0018		0.0018		0.0018	0.0018
Dissolved Cr (ug/L)		0.472						0.551		0.513		1.98	0.532
Dissolved Cu (ug/L)		0.132						0.166		0.32		0.161	0.164
Dissolved Pb (ug/L)		0.25						0.0599		0.0629		0.241	0.1520
Dissolved Ni (ug/L)		0.95						0.665		0.708		0.943	0.826
Dissolved Ag (ug/L)		0.002						0.003		0.002		0.002	0.002
Dissolved Zn (ug/L)		2.33						1.01		1.4		1.34	1.37
Dissolved Se (ug/L)		0.057						0.131		0.279		0.143	0.137
Dissolved Hg (ug/L)		0.00084						0.00116		0.00153		0.00107	0.001115

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 KGCMC and removed from any further analysis and is not included into the calculation of the median

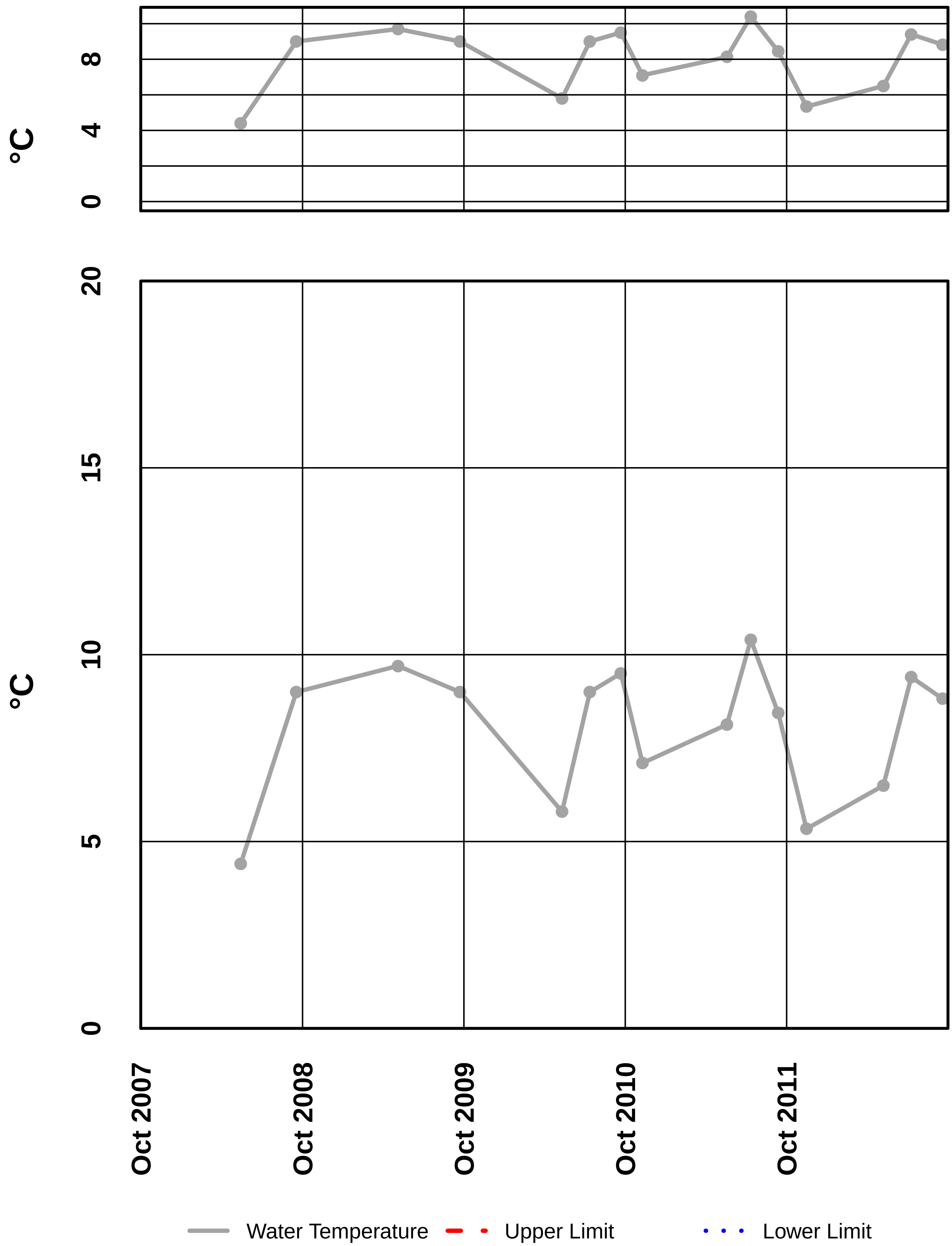
Qualified Data by QA Reviewer

Date Range: 10/01/2011 to 09/30/2012

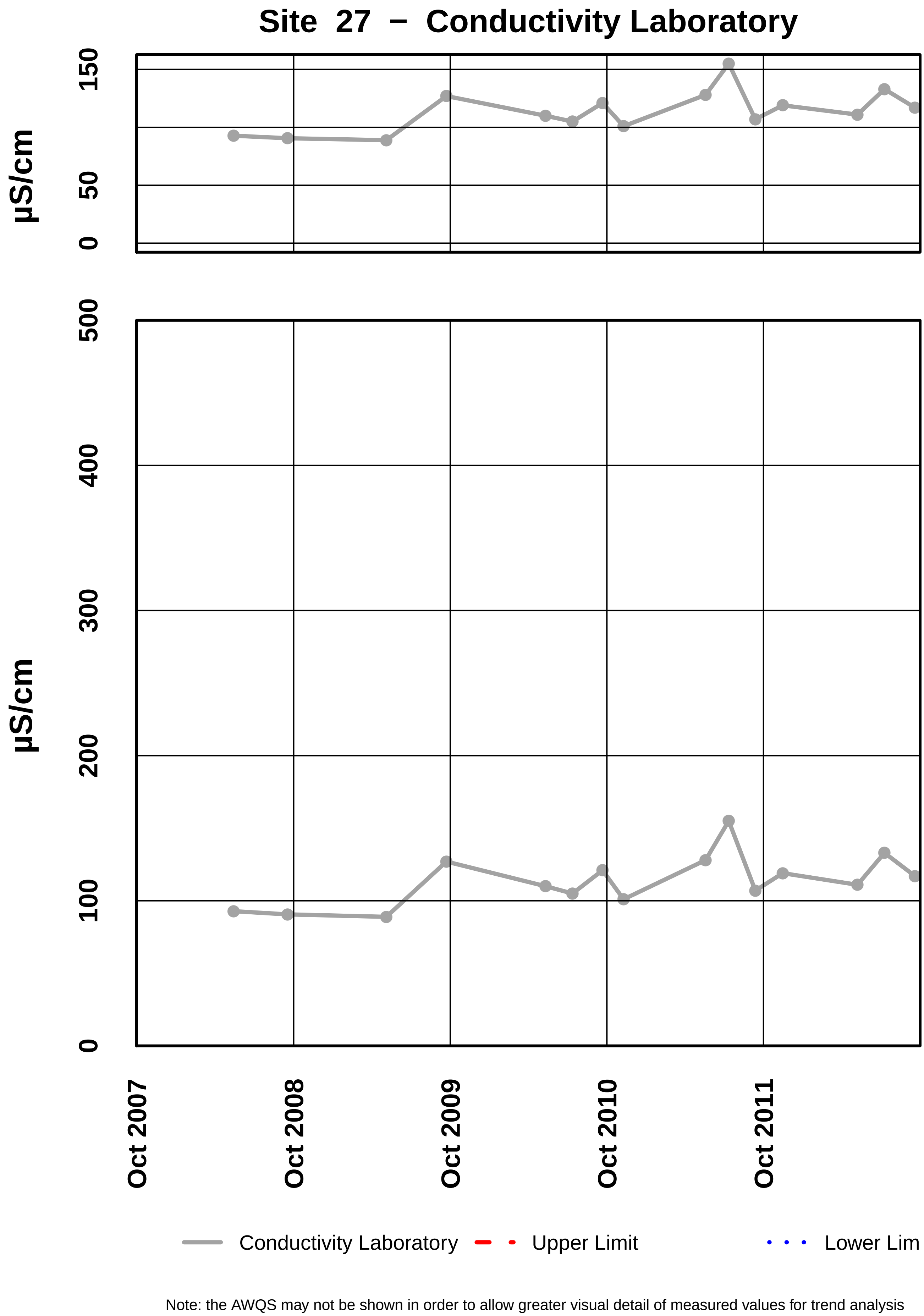
Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
27	5/7/2012	12:00 AM	Ag diss, µg/l	0.00333	J	Below Quantitative Range
			Se diss, µg/l	0.13	J	Below Quantitative Range
			Zn diss, µg/l	1.01	U	Field Blank Contamination
			SO4 Tot, mg/l	12.8	J	Sample Receipt Temperature
						Below Quantitative Range
27	7/9/2012	12:00 AM	Se diss, µg/l	0.27	J	Below Quantitative Range
			SO4 Tot, mg/l	6.1	J	Below Quantitative Range
27	9/18/2012	12:00 AM	Se diss, µg/l	0.14	J	Below Quantitative Range
			SO4 Tot, mg/l	5.85	J	Sample Receipt Temperature

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

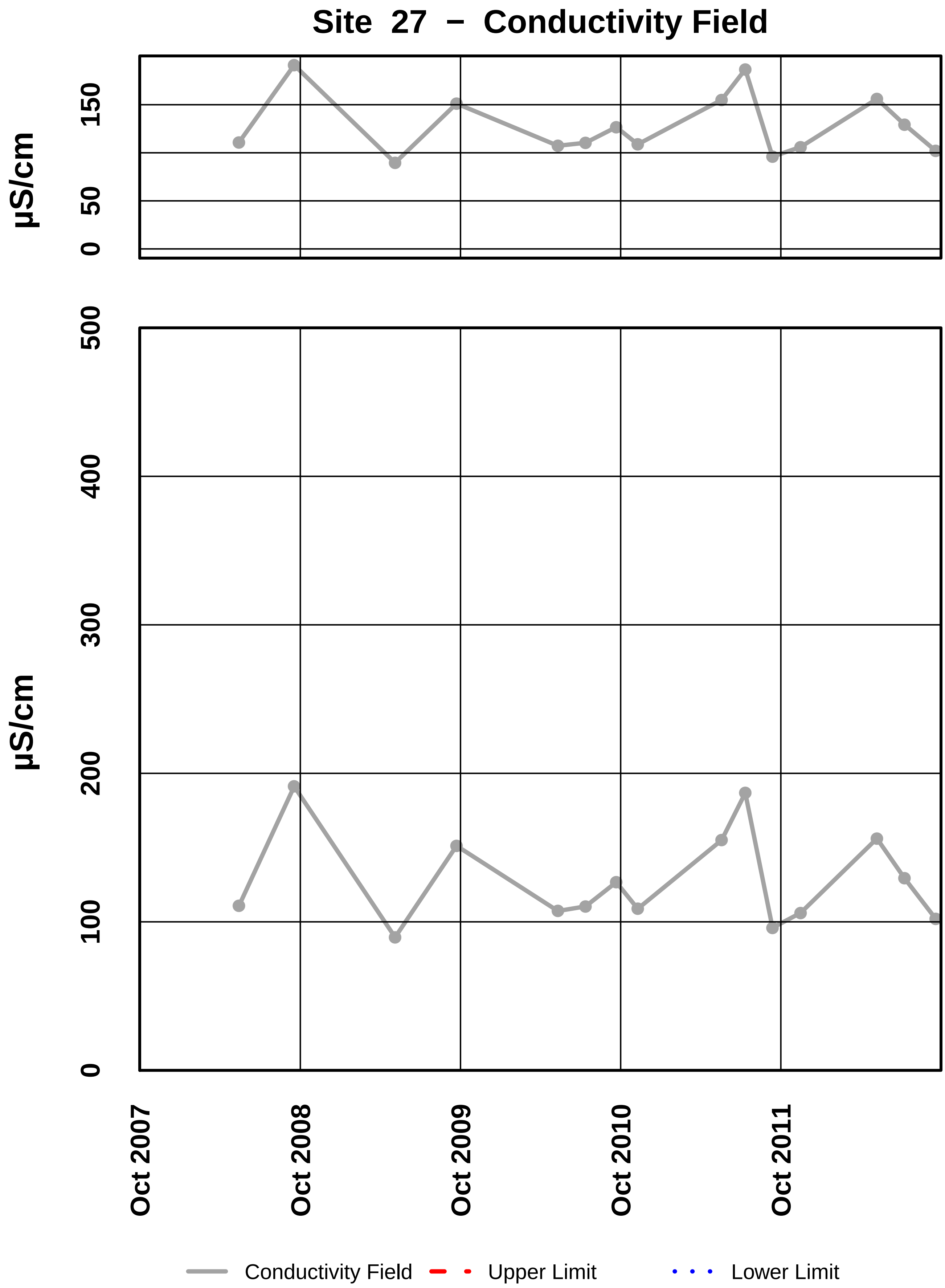
Site 27 – Water Temperature



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

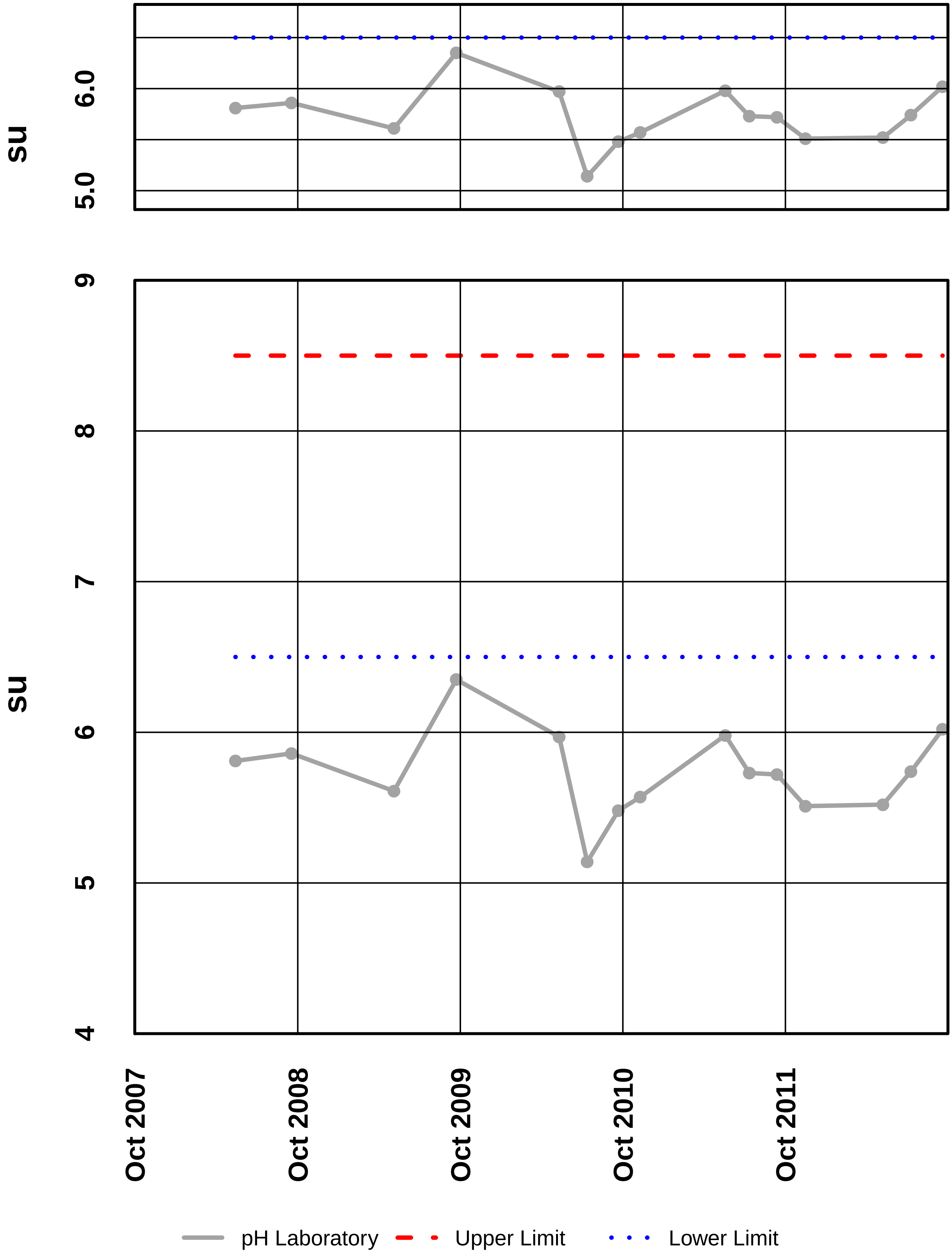


Site 27 − Conductivity Laboratory
µS/cm
0
50
150
µS/cm
0
100
200
300
400
500
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Conductivity Laboratory
Upper Limit
Lower Lim
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



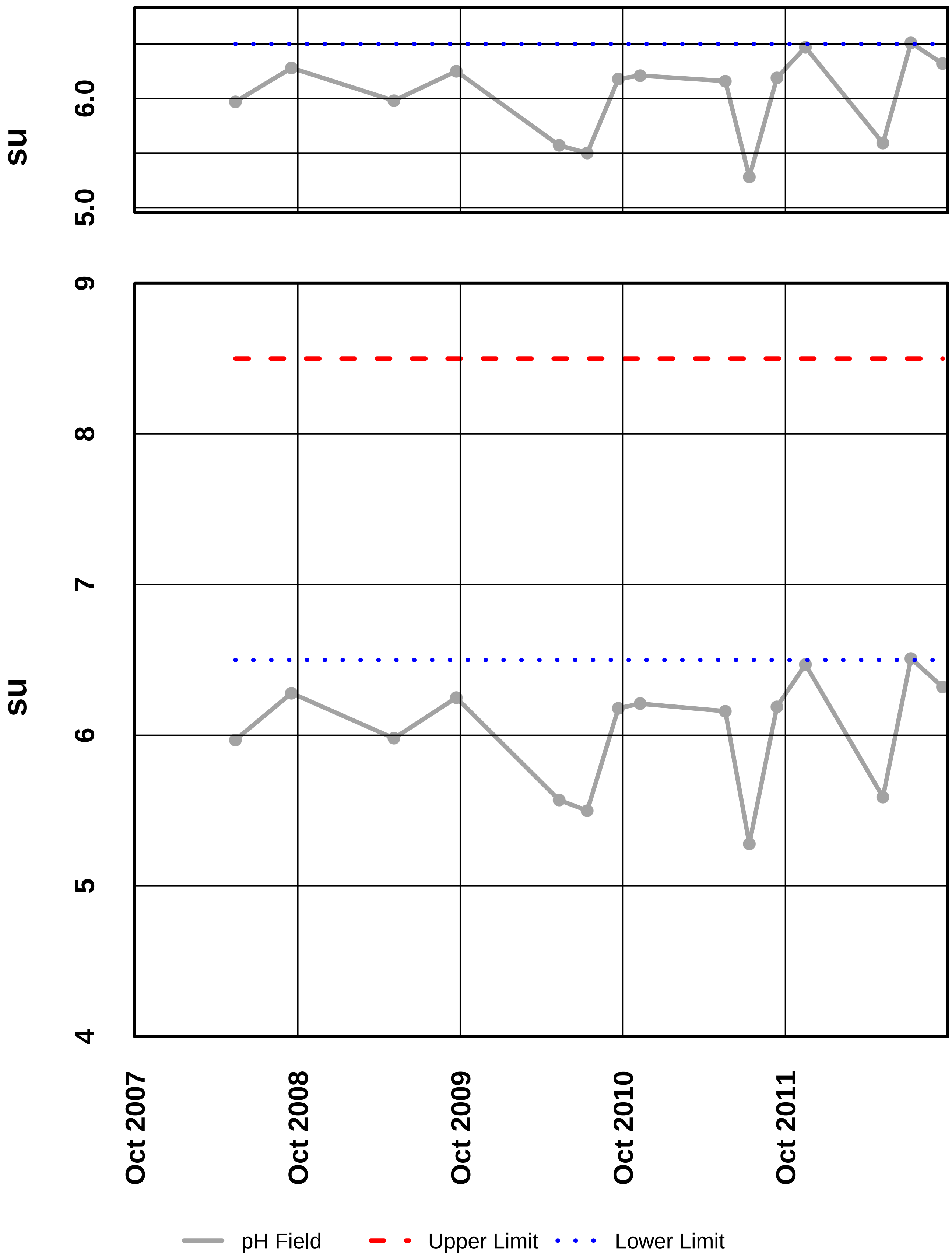
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 27 – pH Laboratory

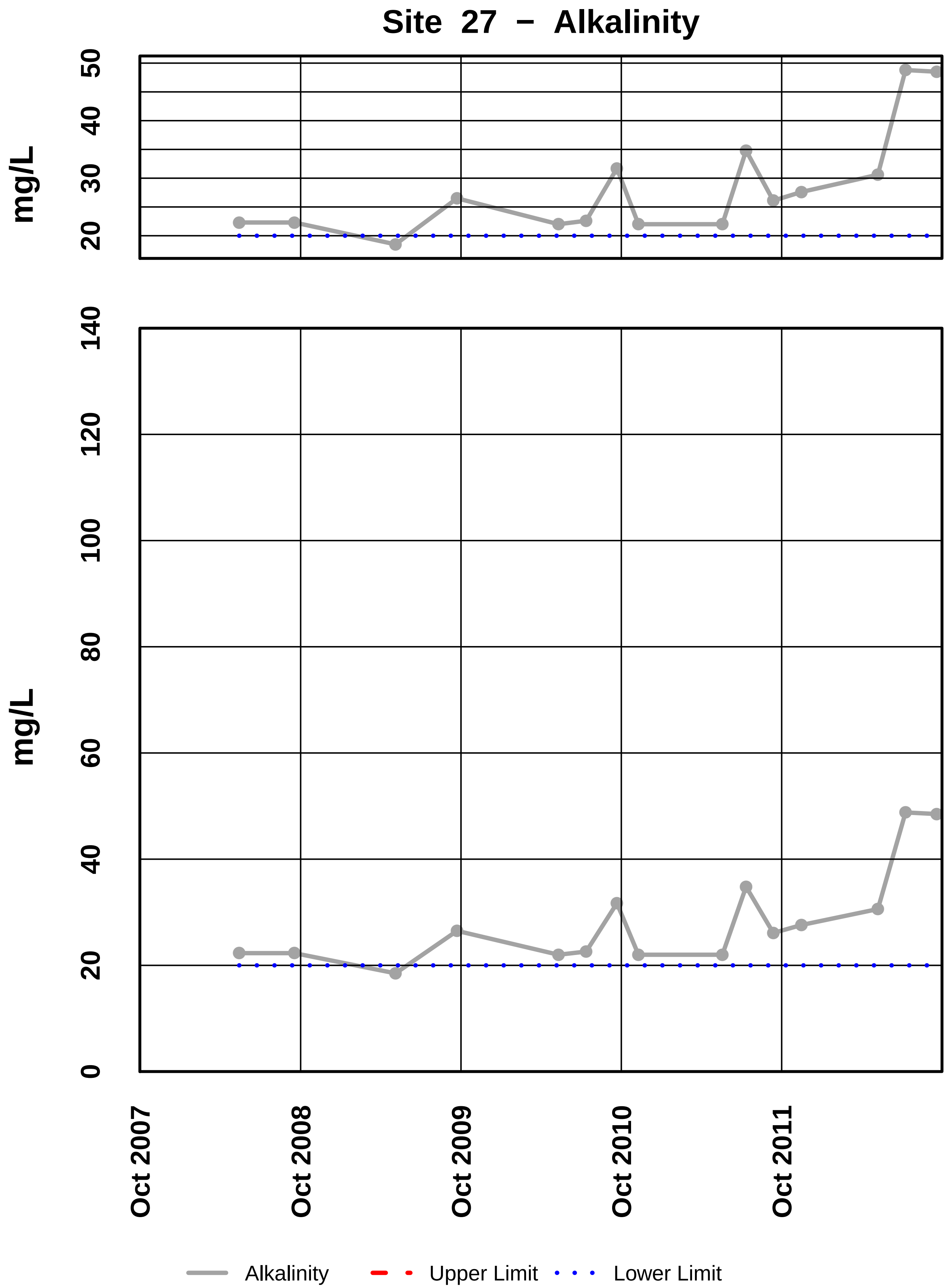


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

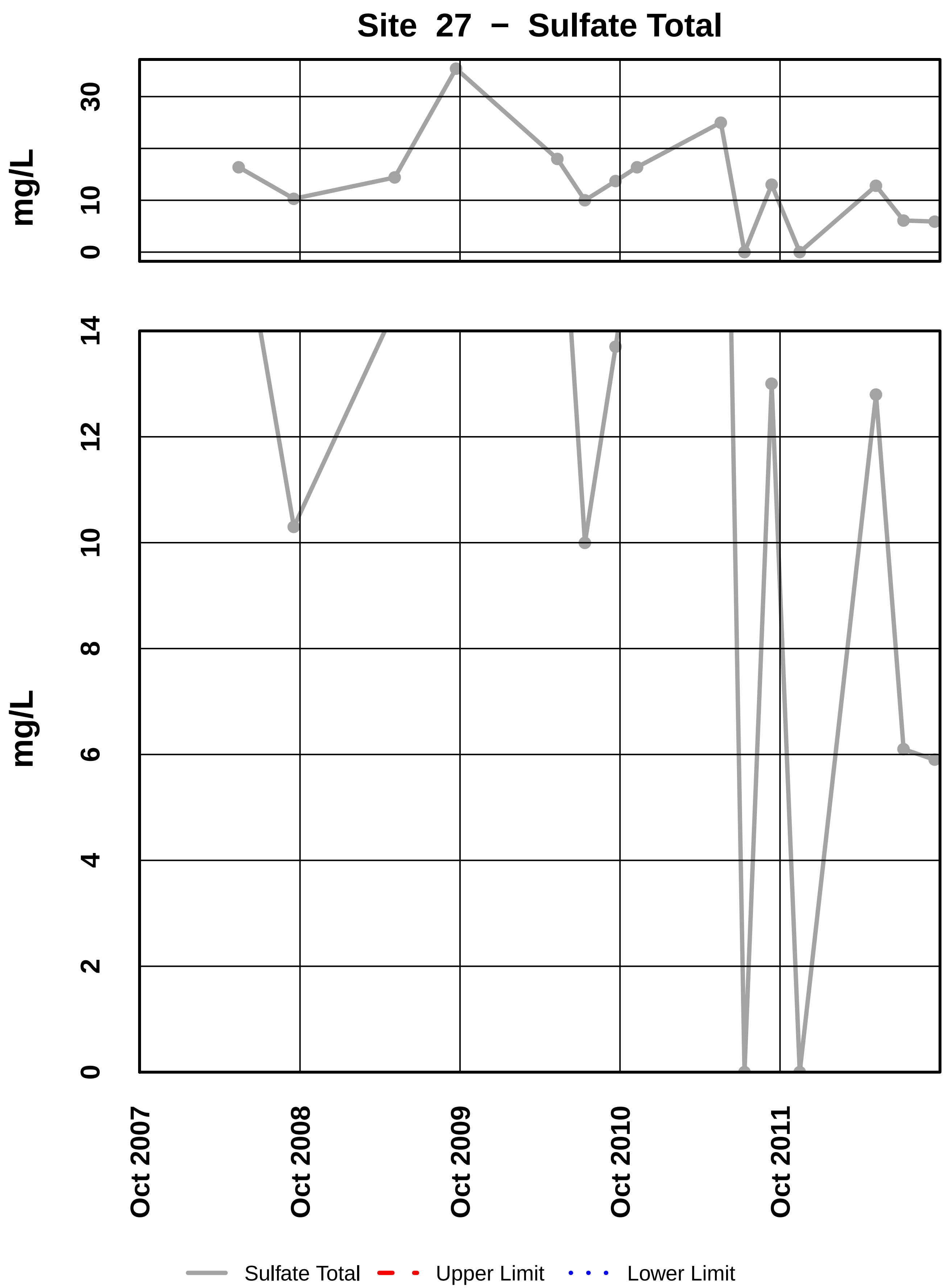
Site 27 – pH Field



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

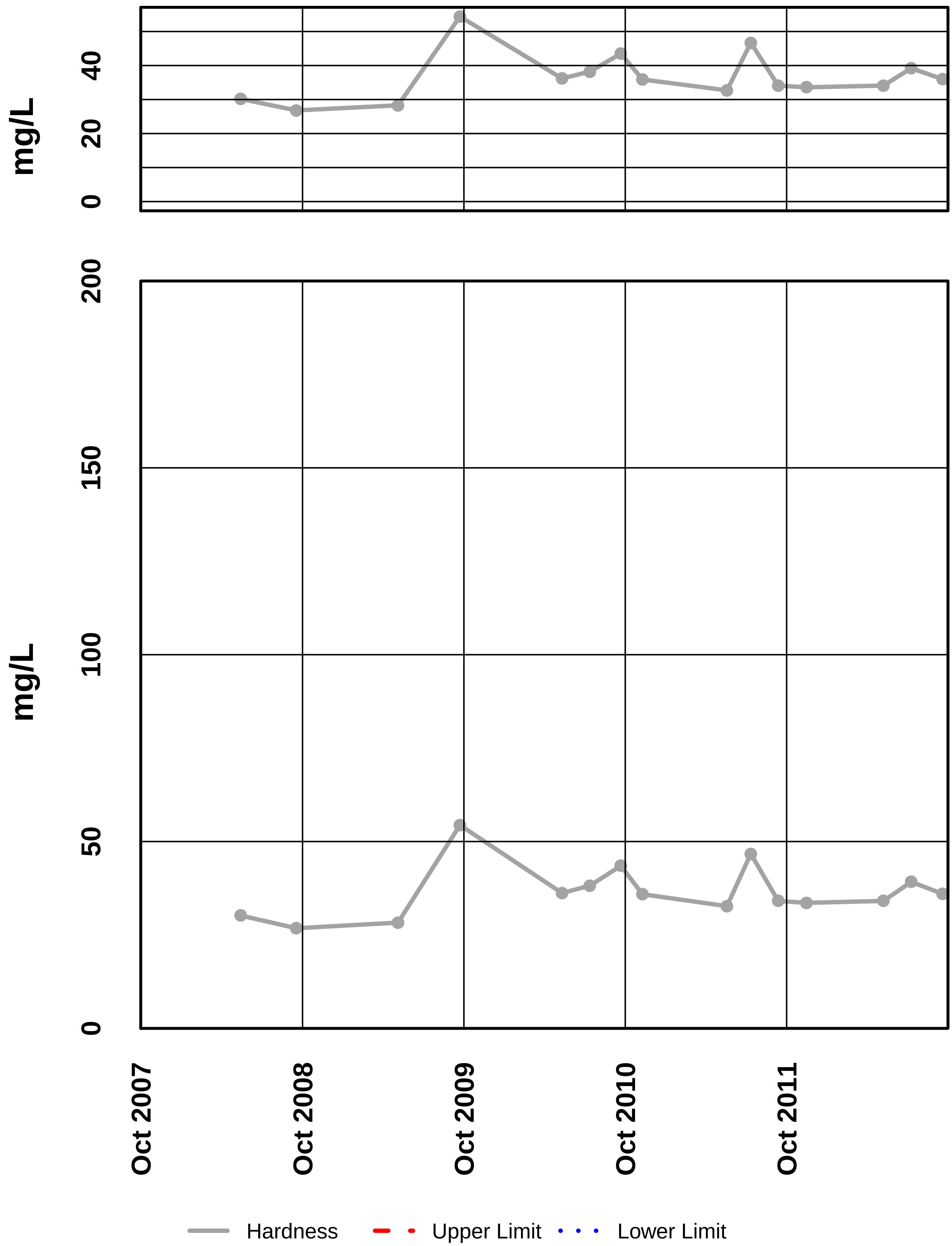


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

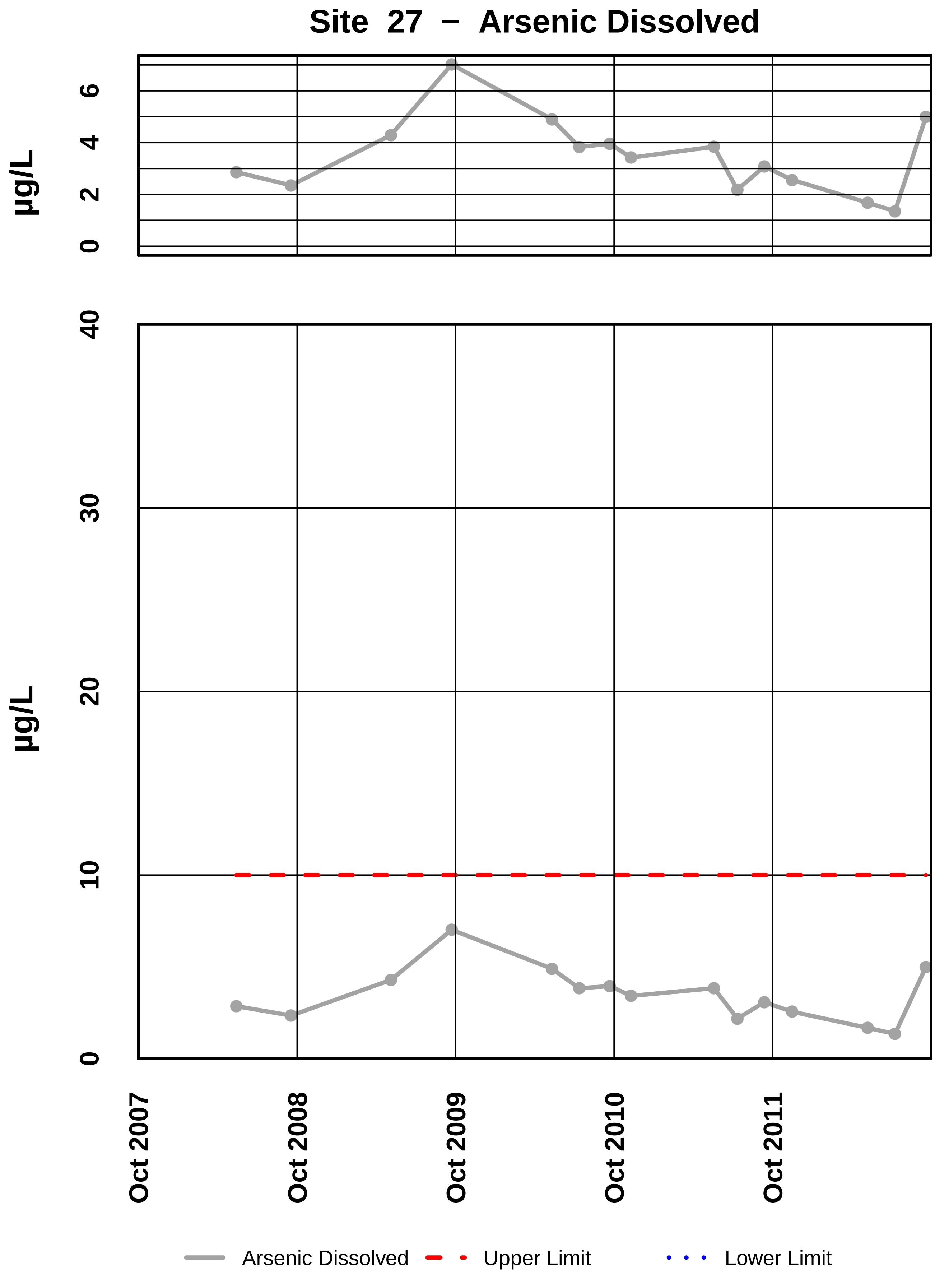


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

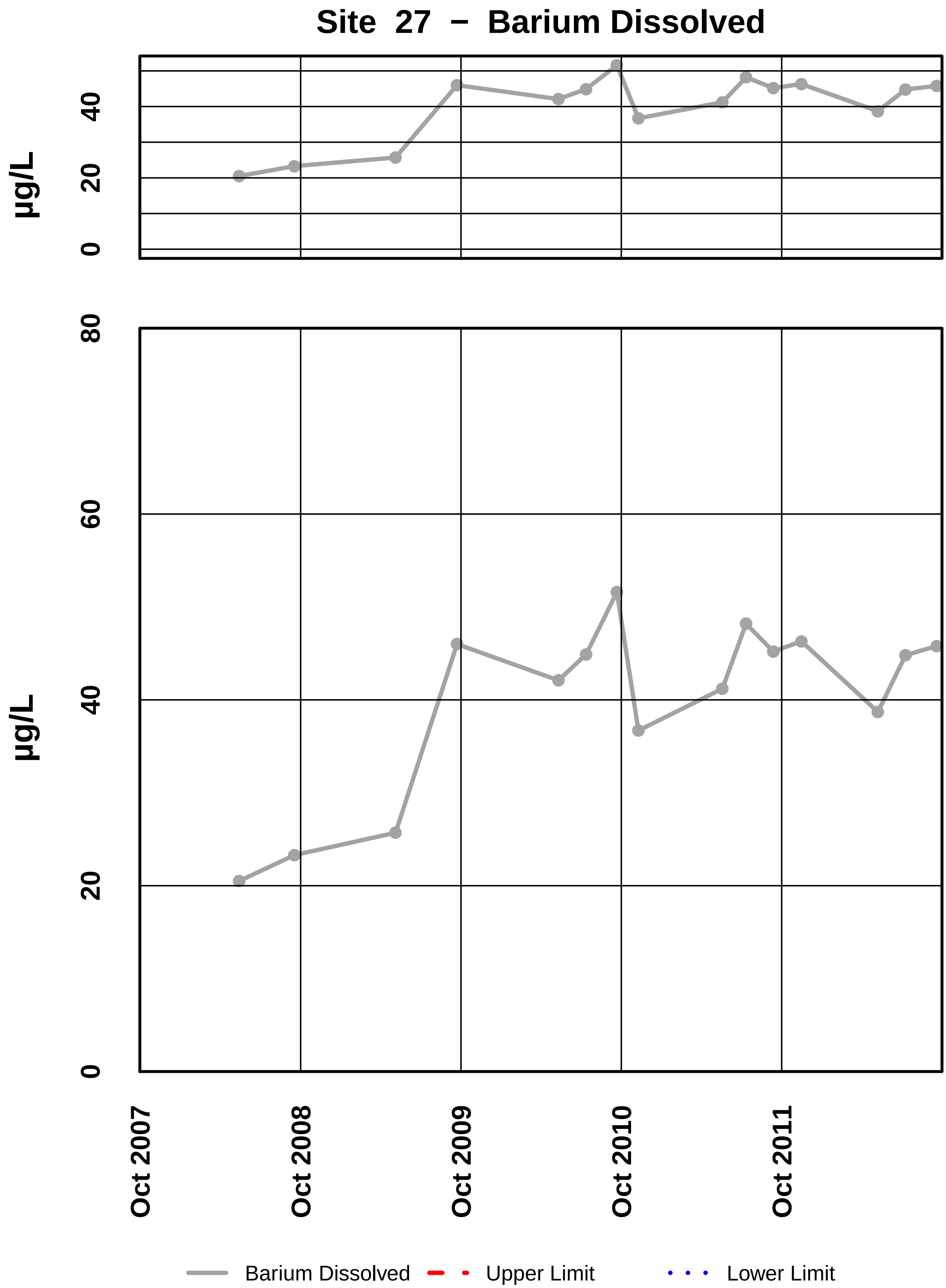
Site 27 − Hardness



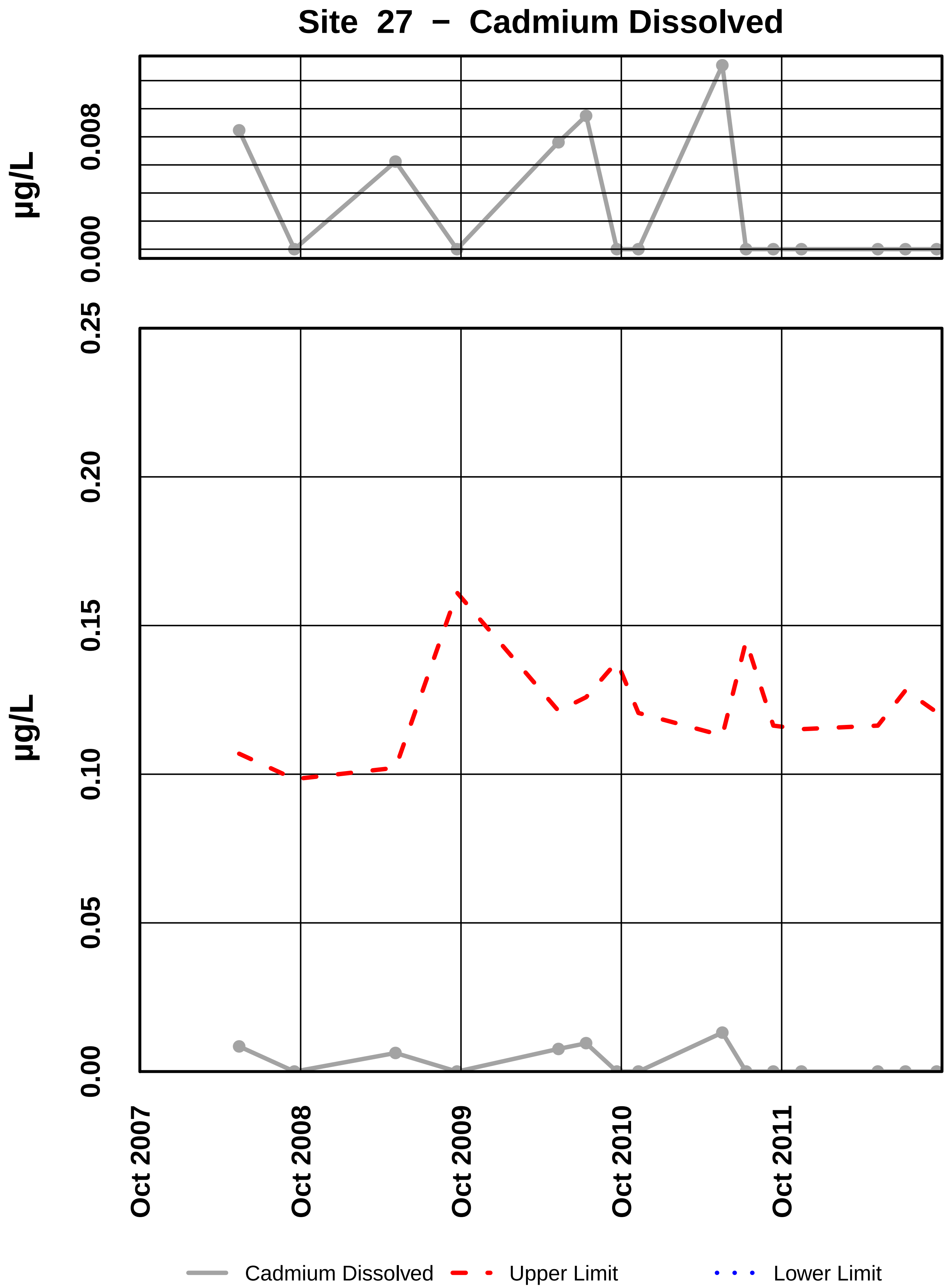
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



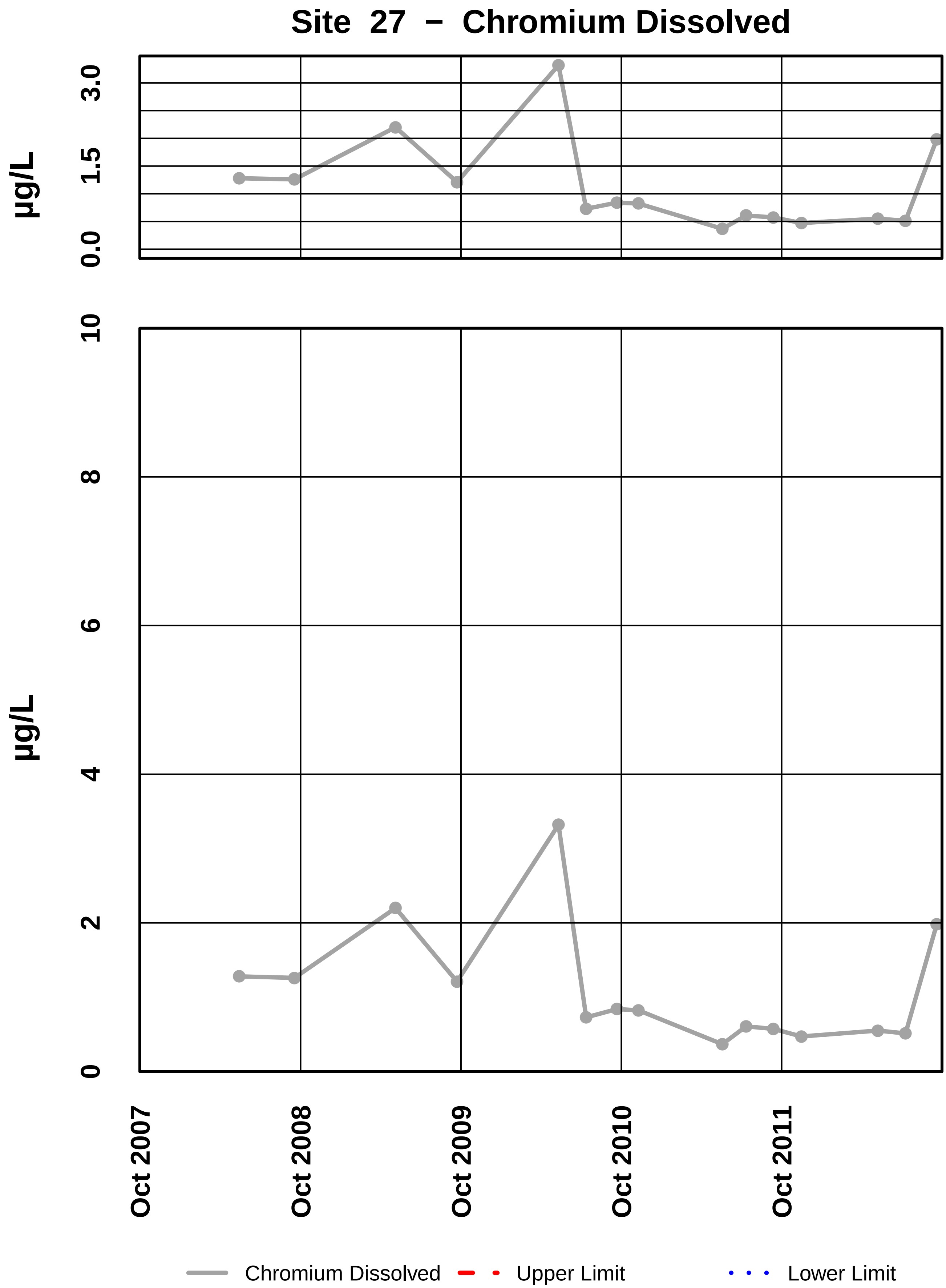
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



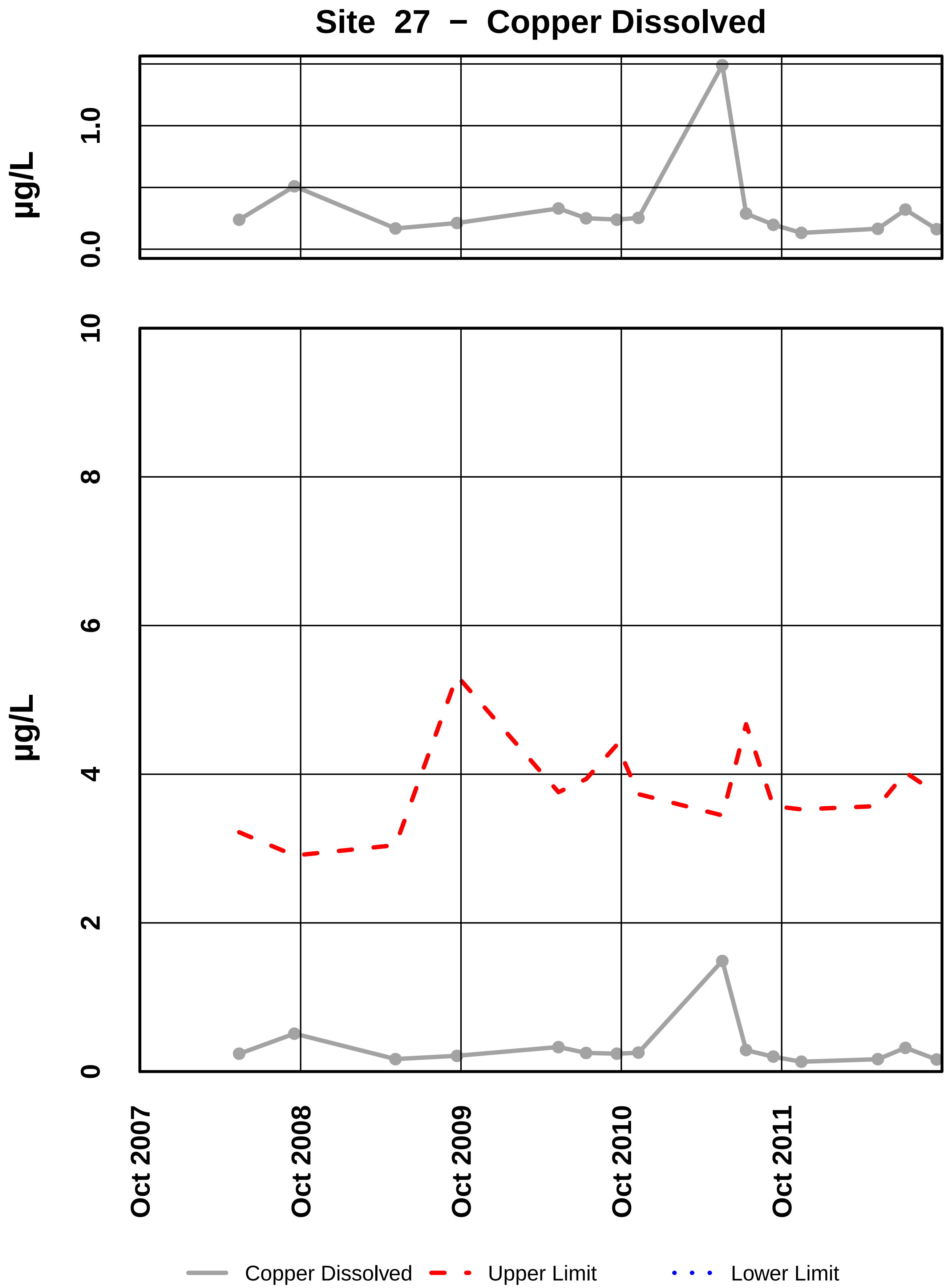
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



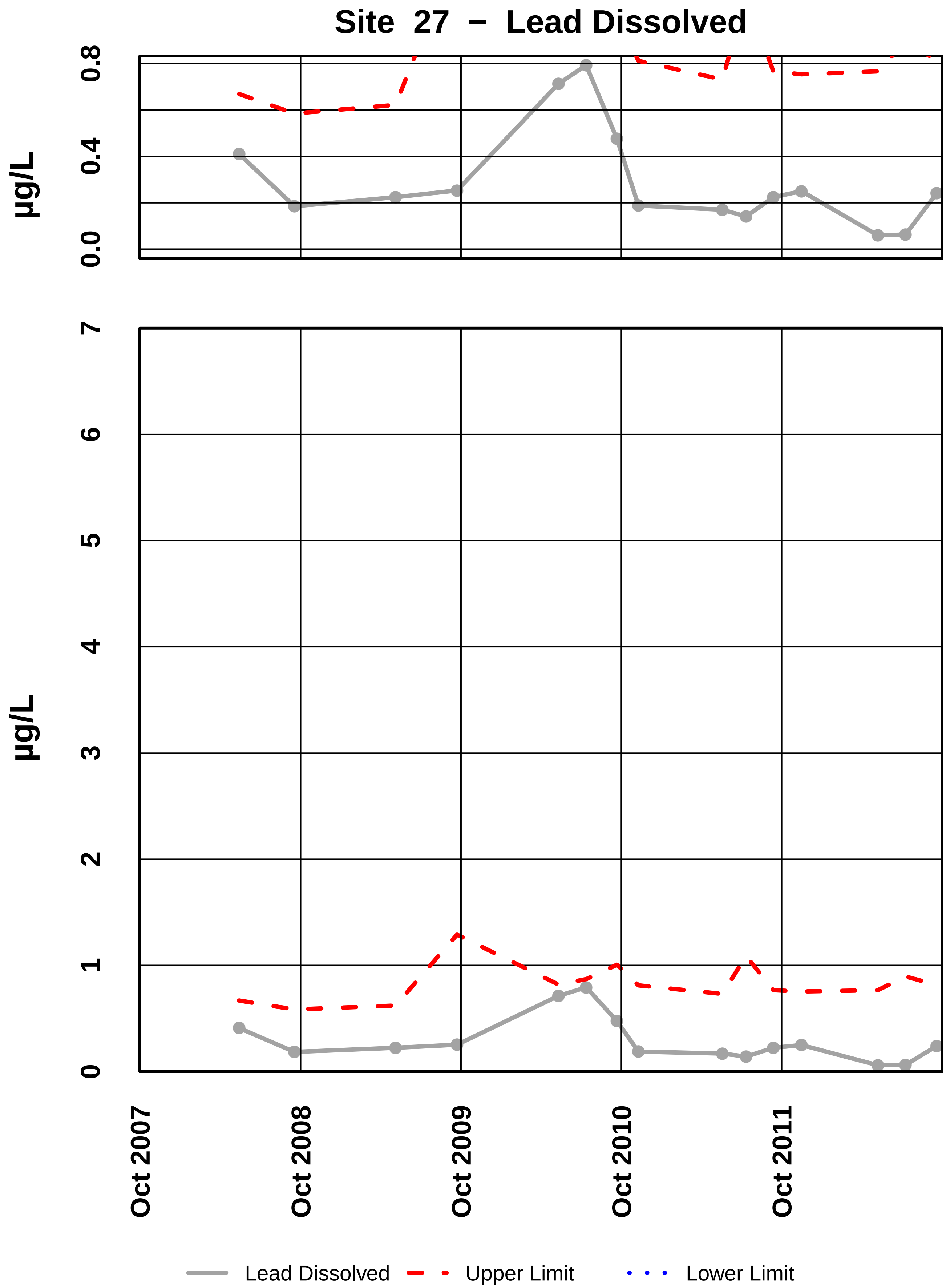
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



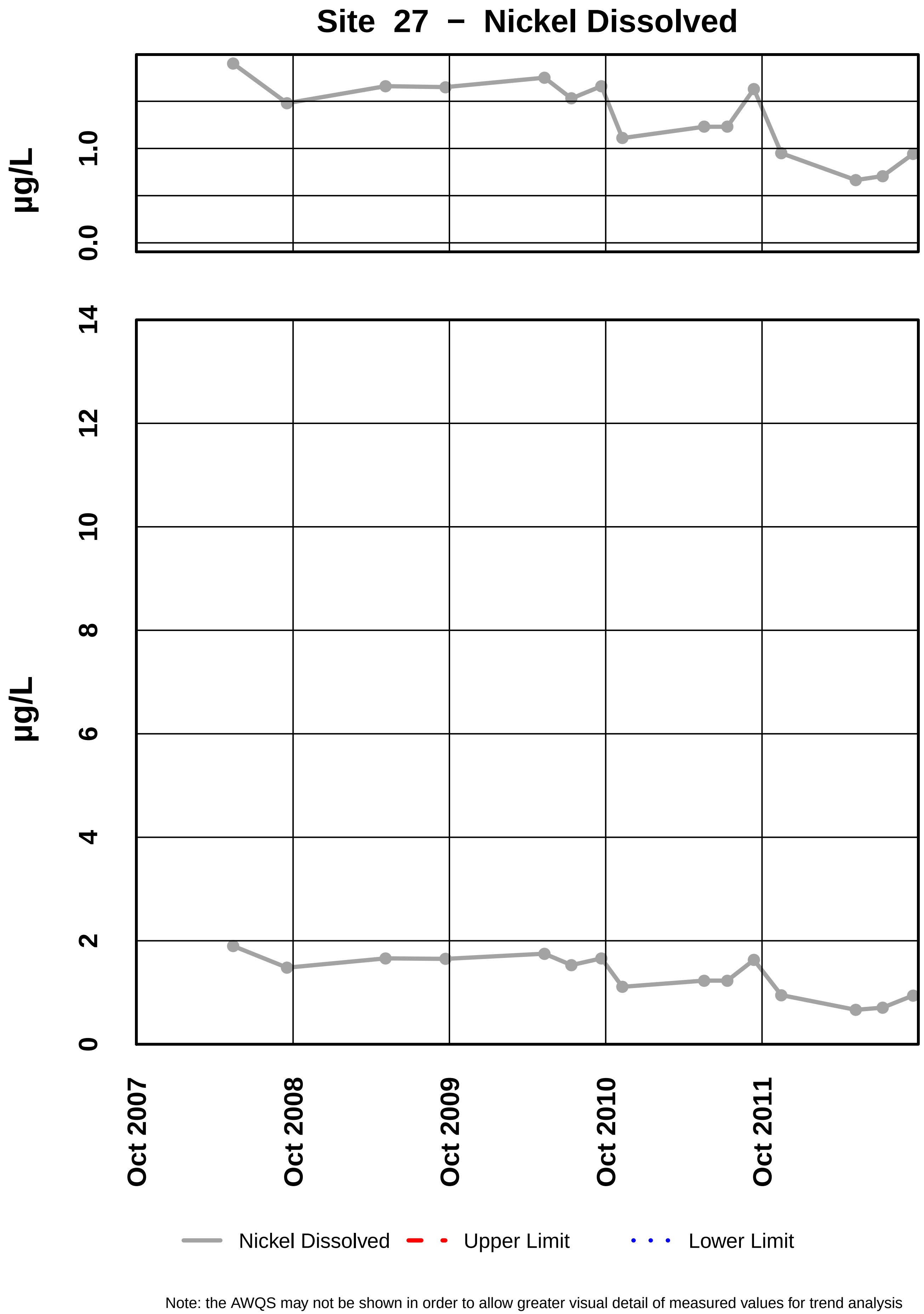
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



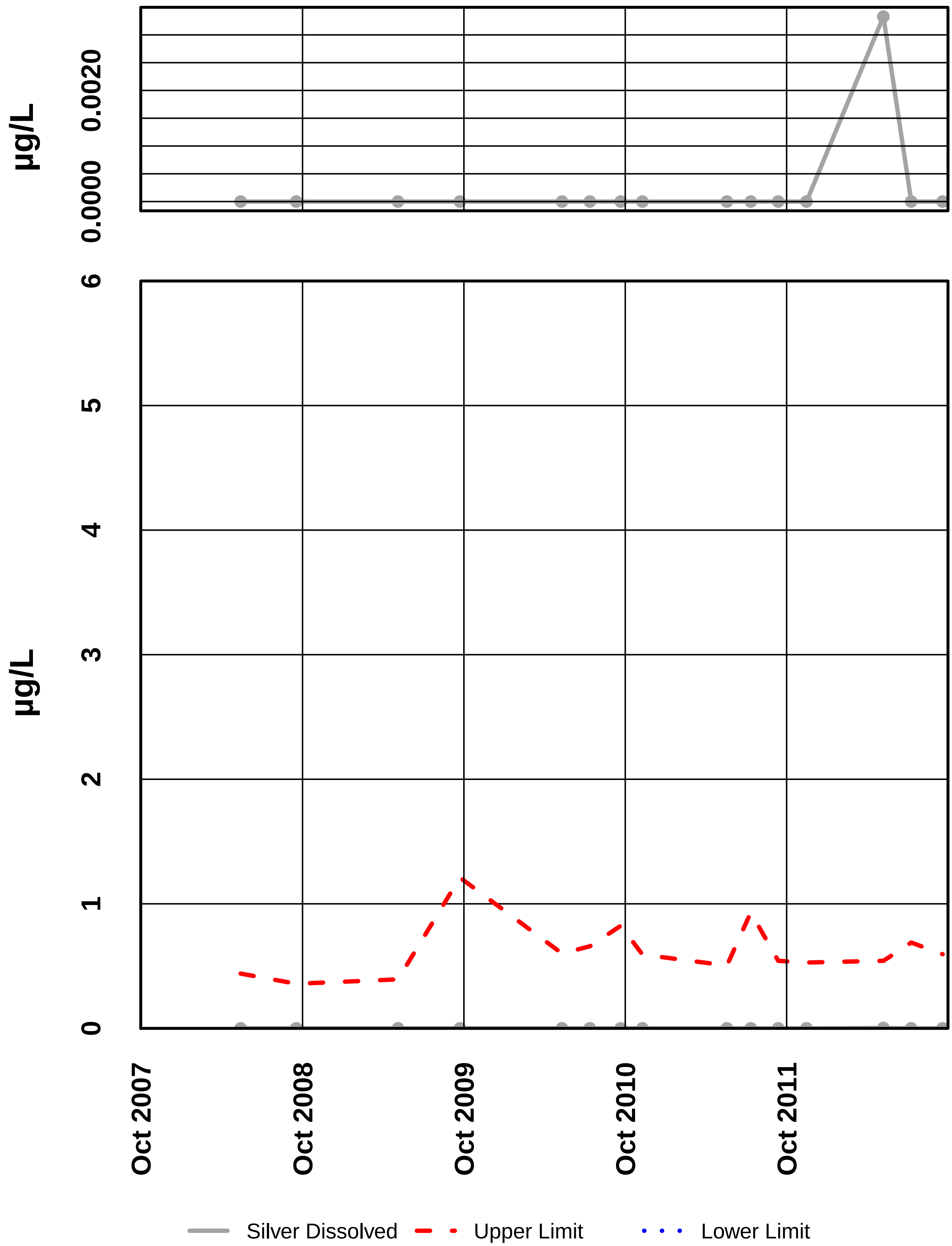
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

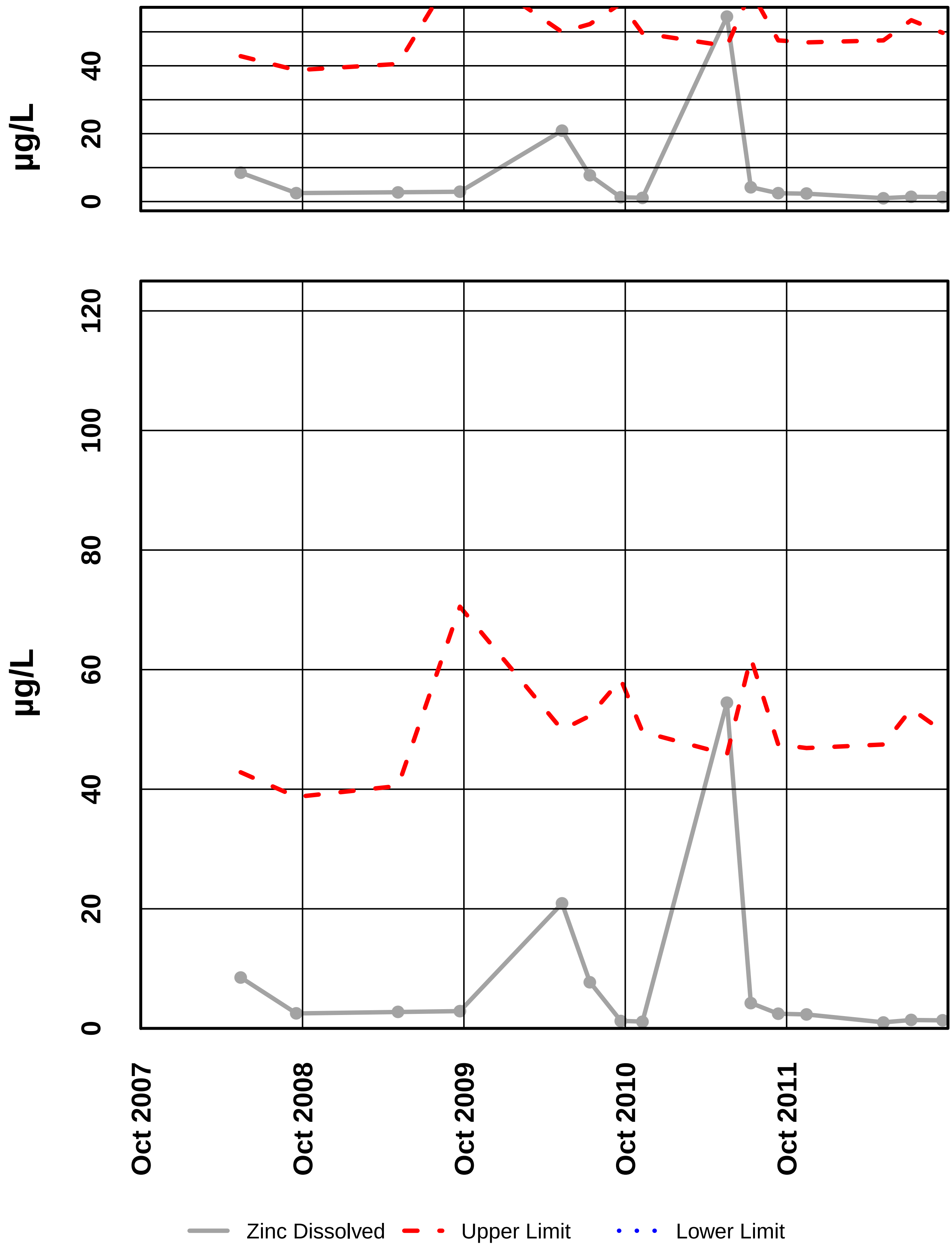

Site 27 − Nickel Dissolved
µg/L
0.0
1.0
µg/L
0
2
4
6
8
10
12
14
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Nickel Dissolved
Upper Limit
Lower Limit
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 27 – Silver Dissolved

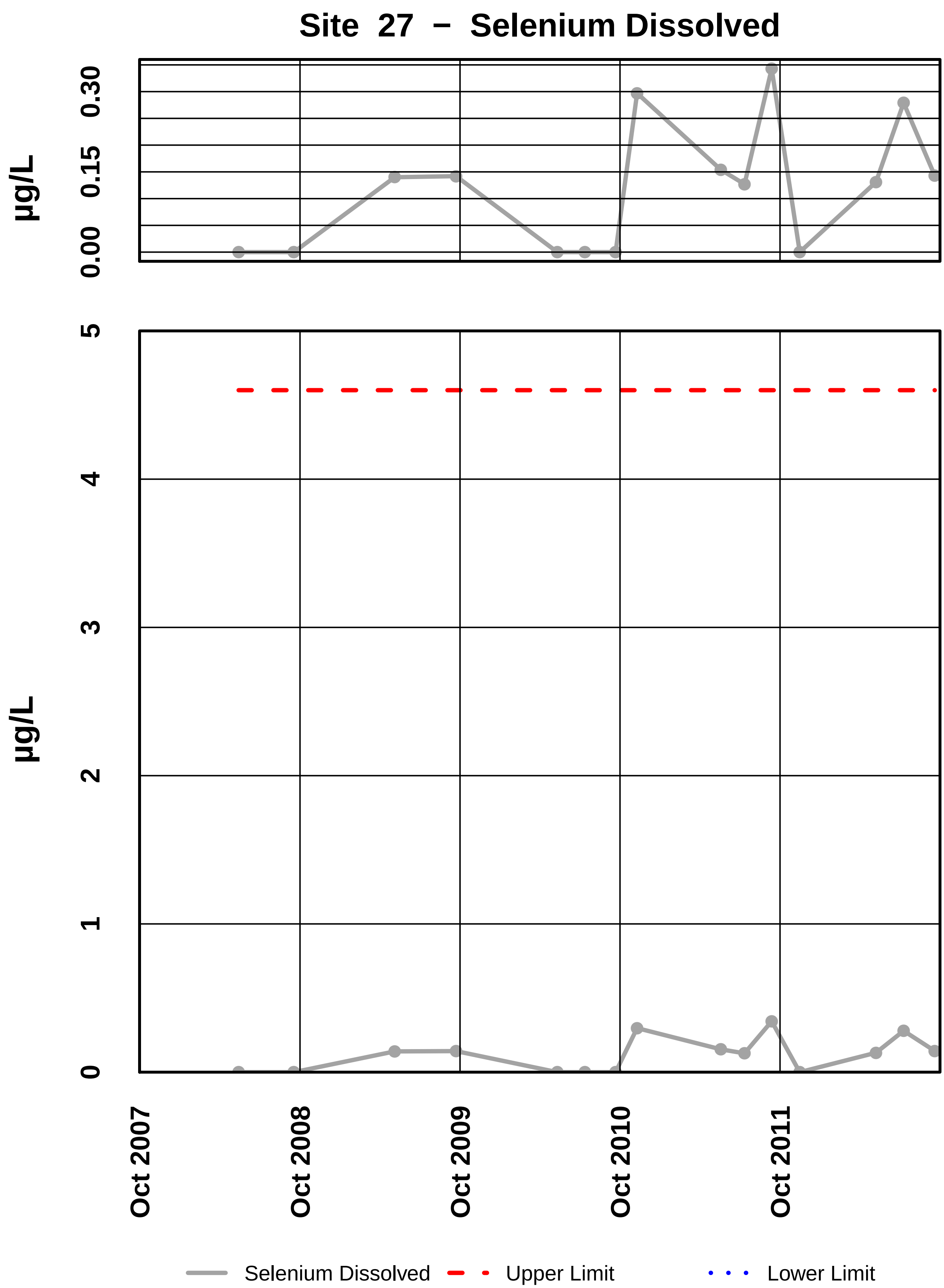


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 27 − Zinc Dissolved

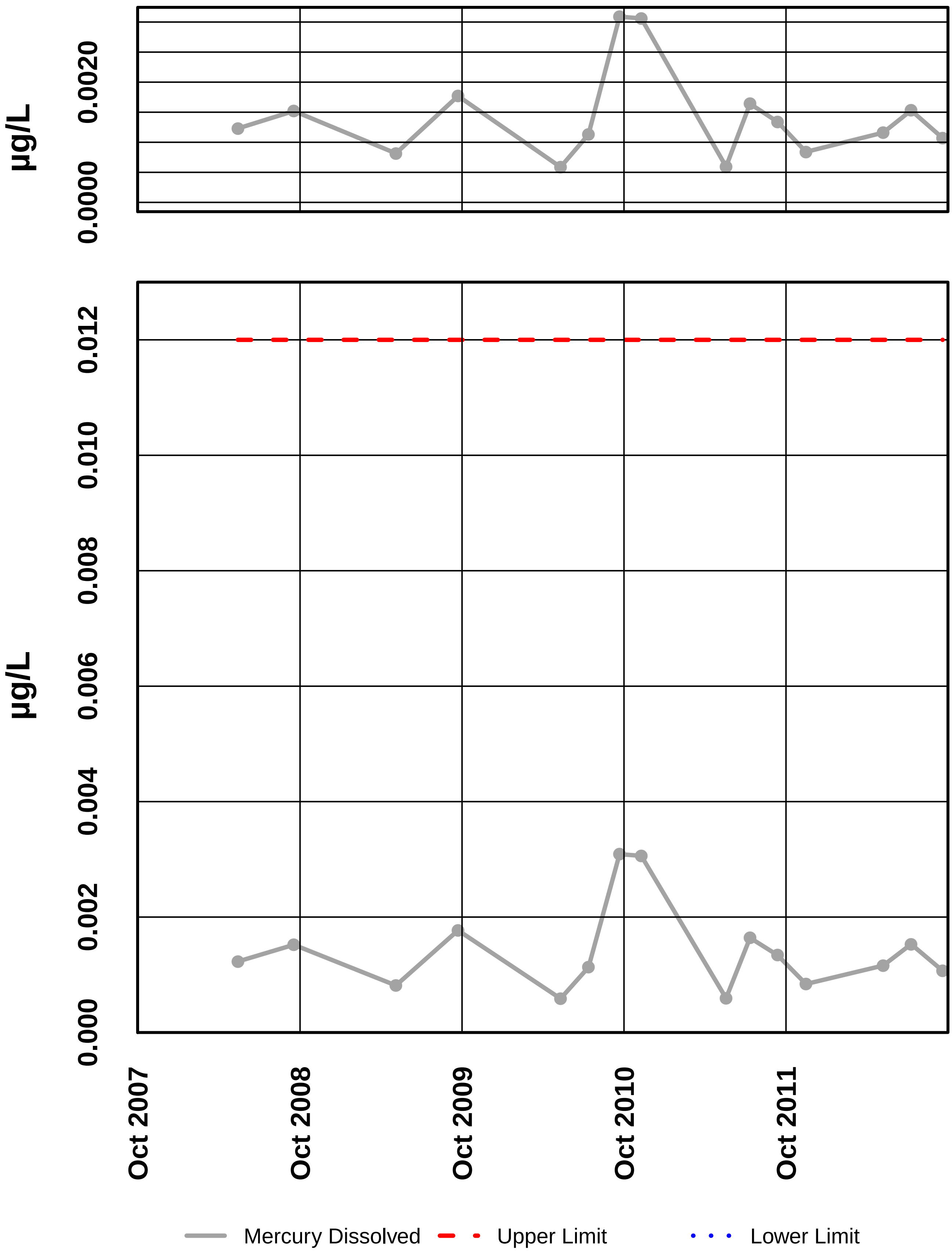


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

Site 27 − Mercury Dissolved



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

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**								73.5				105.3
b	**WY2008**								110.7				191.2
c	**WY2009**								89.6				151.2
d	**WY2010**								107.3		110.4		126.7
e	**WY2011**		108.8						155		186.8		96
f	**WY2012**		106						156.1		129.3		102
	n	0	2	0	0	0	0	0	6	0	3	0	6

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

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

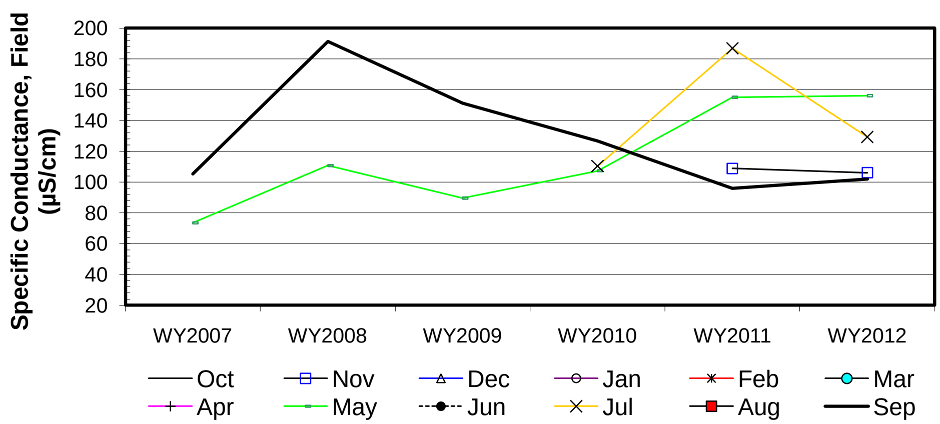
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=		1.00						28.33		3.67		28.33
$Z_k = S_k/\sigma_S$		-1.00						2.07		0.52		-1.32
Z^2_k		1.00						4.27		0.27		1.73

ΣZ_k=	0.27
ΣZ^2_k=	7.27
Z-bar=ΣZ_k/K=	0.07

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

Σn	17
ΣS_k	4

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=		7.25	@α=5% $\chi^2_{(K-1)}$=	7.81	Test for station homogeneity	
	p	**0.064**			$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc}	0.38	@α/2=2.5% Z=	1.96	**H_0** (No trend)	ACCEPT
61.33	p	**0.649**			**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-22.54		20.57
0.050	-14.14	**6.57**	15.54
0.100	-2.97		11.41
0.200	-1.88		9.99

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**								5.9				5.9
b	**WY2008**								6.0				6.3
c	**WY2009**								6.0				6.3
d	**WY2010**								5.6		5.5		6.2
e	**WY2011**		6.2						6.2		5.3		6.2
f	**WY2012**		6.5						5.6		6.5		6.3
	n	0	2	0	0	0	0	0	6	0	3	0	6

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

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

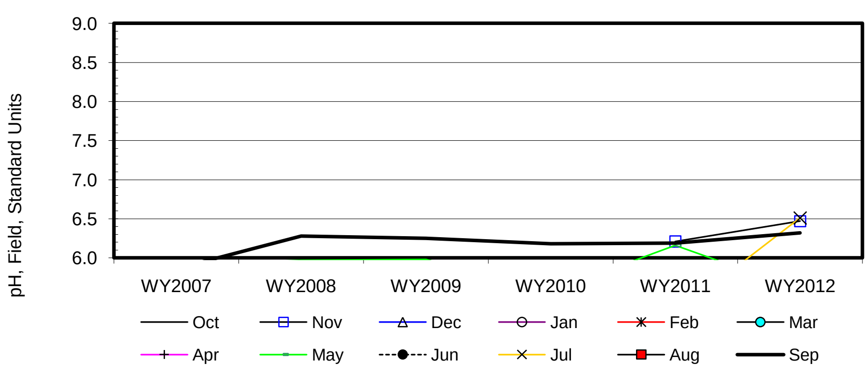
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=		1.00						28.33		3.67		28.33
$Z_k = S_k/\sigma_S$		1.00						0.19		0.52		0.94
Z^2_k		1.00						0.04		0.27		0.88

ΣZ_k= 2.65
ΣZ^2_k= 2.19
Z-bar=ΣZ_k/K= 0.66

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

Σn 17
ΣS_k 8

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	0.44	@α=5% $\chi^2_{(K-1)}$=	7.81	Test for station homogeneity	
p	**0.933**			$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k) Z_{calc}	0.89	@α/2=2.5% Z=	1.96	**H_0** (No trend)	ACCEPT
61.33 **p**	**0.814**			**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.07		0.09
0.050	-0.04	**0.02**	0.08
0.100	-0.03		0.06
0.200	0.00		0.06

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**								18.7				24.1
b	**WY2008**								22.3				22.3
c	**WY2009**								18.5				26.5
d	**WY2010**								22.0		22.6		31.7
e	**WY2011**		22.0						22.0		34.8		26.1
f	**WY2012**		27.6						30.6		48.8		48.5
	n	0	2	0	0	0	0	0	6	0	3	0	6

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

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

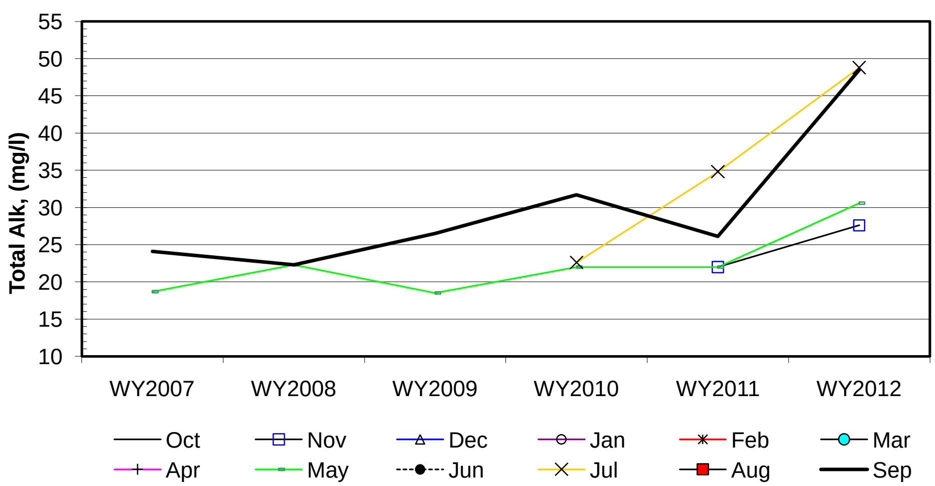
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
$\sigma^2_S=$		1.00						27.33		3.67		28.33
$Z_k = S_k/\sigma_S$		1.00						1.15		1.57		1.69
Z^2_k		1.00						1.32		2.45		2.86

$\Sigma Z_k=$ 5.41
$\Sigma Z^2_k=$ 7.63
$Z\text{-bar}=\Sigma Z_k/K=$ 1.35

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	15	1	0	0	0

Σn 17
ΣS_k 19

$\chi^2_h=\Sigma Z^2_k-K(Z\text{-bar})^2=$ 0.33		@α=5% $\chi^2_{(K-1)}=$ 7.81	Test for station homogeneity	
	p **0.955**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
$\Sigma VAR(S_k)$	Z_{calc} 2.32	@α/2=2.5% $Z=$ 1.96	H_0 (No trend)	REJECT
60.33	p **0.990**		H_A (± trend)	ACCEPT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	0.00		5.63
0.050	0.99	**3.02**	4.77
0.100	1.20		4.30
0.200	1.62		4.08

12.5%

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**								2.8				2.7
b	**WY2008**								16.4				10.3
c	**WY2009**								14.4				35.4
d	**WY2010**								18.0		10.0		13.7
e	**WY2011**		16.4						25.0		0.0		13.0
f	**WY2012**		0.0						12.8		6.1		5.9
	n	0	2	0	0	0	0	0	6	0	3	0	6

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

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

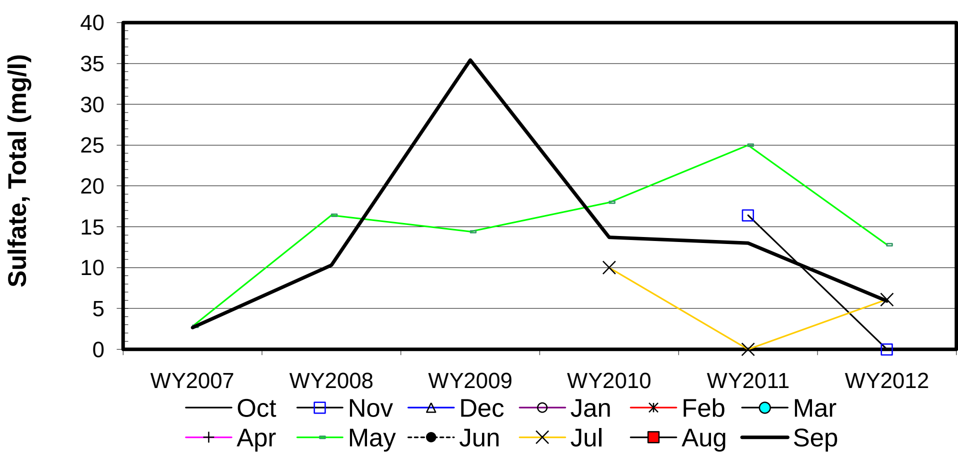
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=		1.00						28.33		3.67		28.33
$Z_k = S_k/\sigma_S$		-1.00						0.94		-0.52		0.19
Z^2_k		1.00						0.88		0.27		0.04

ΣZ_k= -0.40
ΣZ^2_k= 2.19
Z-bar=ΣZ_k/K= -0.10

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

Σn 17
ΣS_k 4

$\chi^2_h=\Sigma Z^2_k$-K(Z-bar)^2=		2.15	@α=5% $\chi^2_{(K-1)}$= 7.81	Test for station homogeneity	
	p	**0.542**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc}	0.38	@α=2.5% Z= 1.96	**H_0** (No trend)	ACCEPT
61.33	p	**0.649**		**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-4.25		5.33
0.050	-1.97	**0.85**	3.63
0.100	-1.12		2.88
0.200	-0.76		2.17

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**								64.7				7.1
b	**WY2008**								8.5				2.5
c	**WY2009**								2.7				2.9
d	**WY2010**								20.9		7.7		1.3
e	**WY2011**		1.1						54.5		4.3		2.5
f	**WY2012**		2.3						1.0		1.4		1.3
	n	0	2	0	0	0	0	0	6	0	3	0	6

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

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

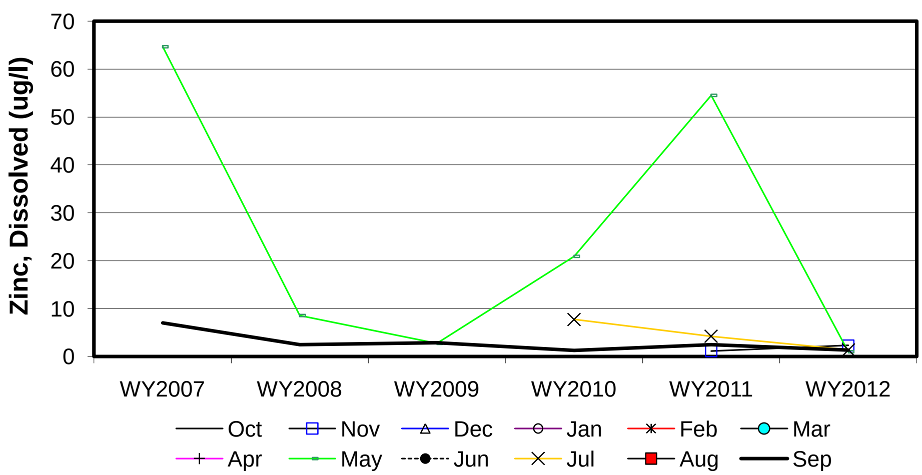
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=		1.00						28.33		3.67		28.33
$Z_k = S_k/\sigma_S$		1.00						-0.94		-1.57		-1.69
Z^2_k		1.00						0.88		2.45		2.86

ΣZ_k=	-3.20
ΣZ^2_k=	7.20
Z-bar=ΣZ_k/K=	-0.80

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

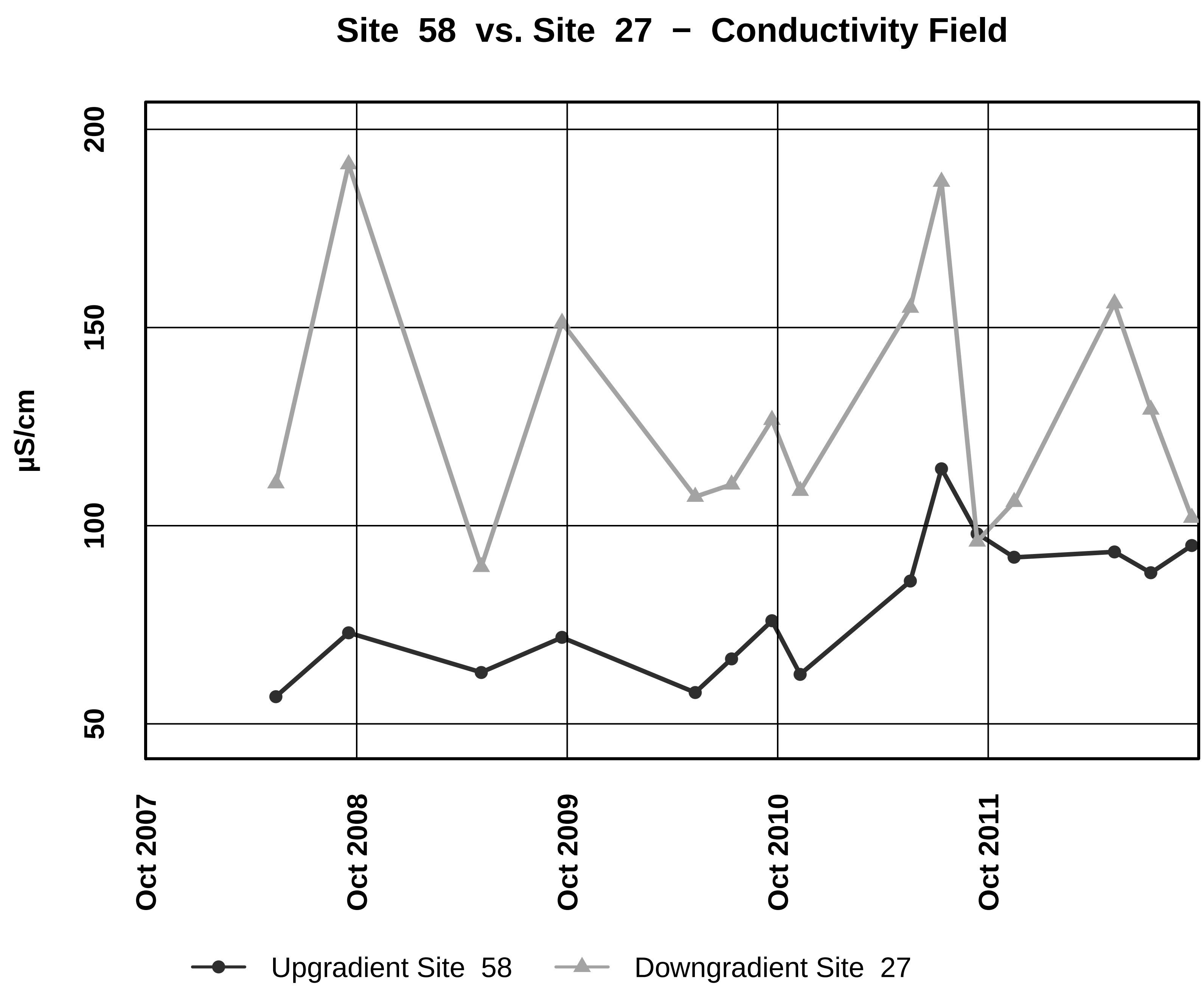
Σn	17
ΣS_k	-16

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	4.64	@α=5% $\chi^2_{(K-1)}$= 7.81	Test for station homogeneity	
p	**0.200**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k) 61.33	Z_{calc} -1.92	@α/2=2.5% Z= 1.96	**H_0** (No trend)	ACCEPT
	p **0.028**		**H_A** (± trend)	REJECT

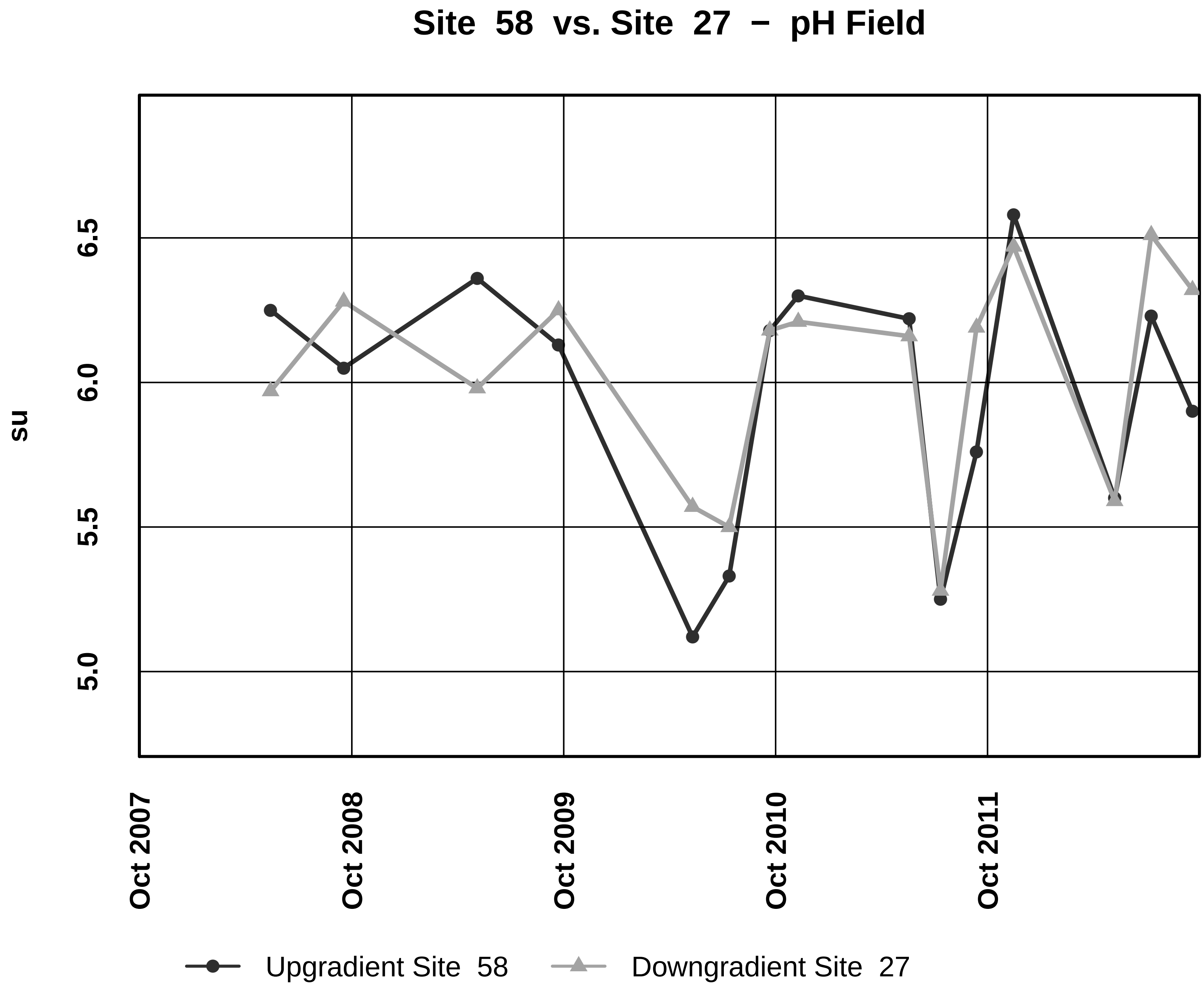


Seasonal-Kendall Slope Confidence Intervals

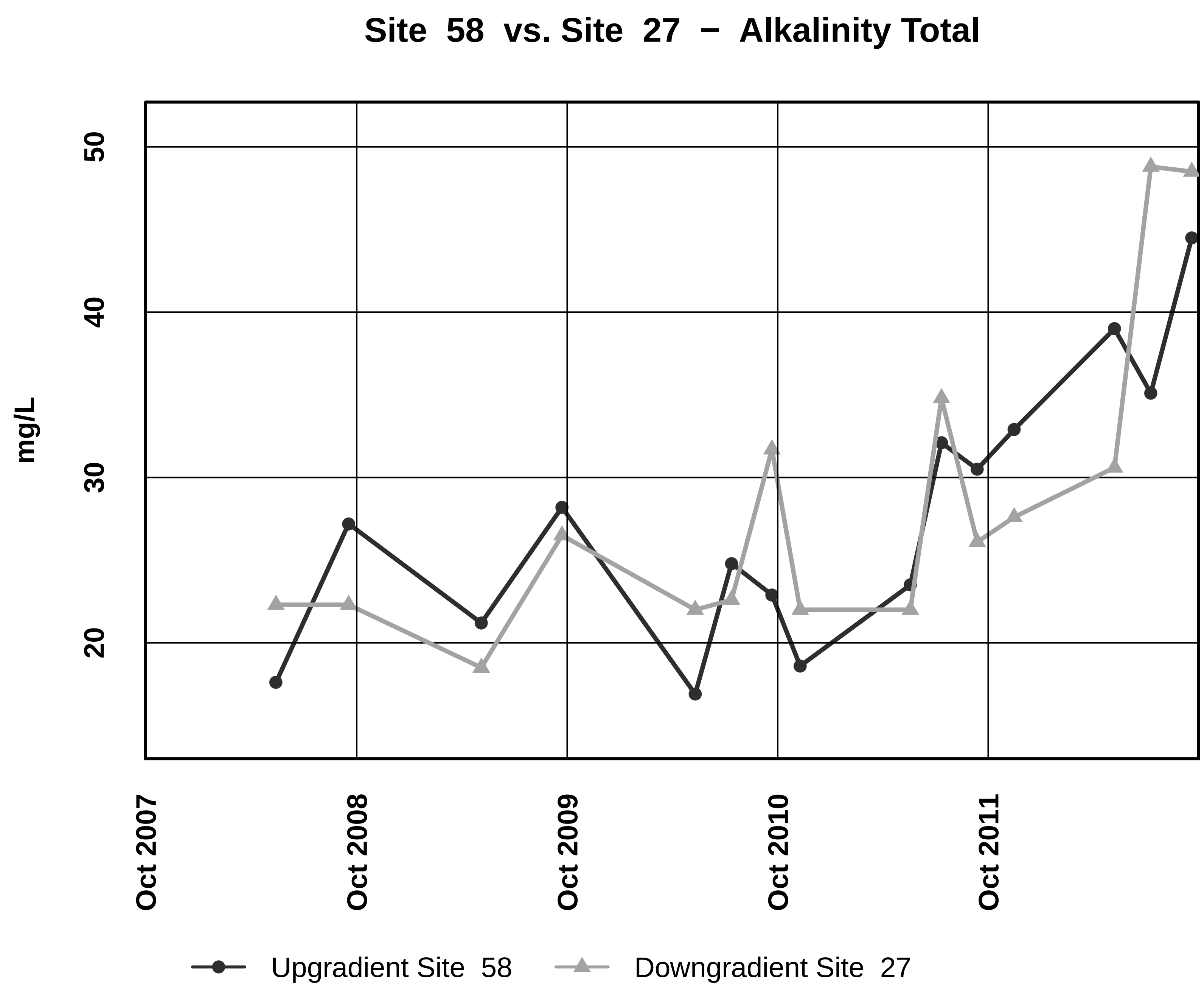
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-4.69		0.08
0.050	-2.99	**-1.15**	-0.26
0.100	-2.56		-0.51
0.200	-1.97		-0.61



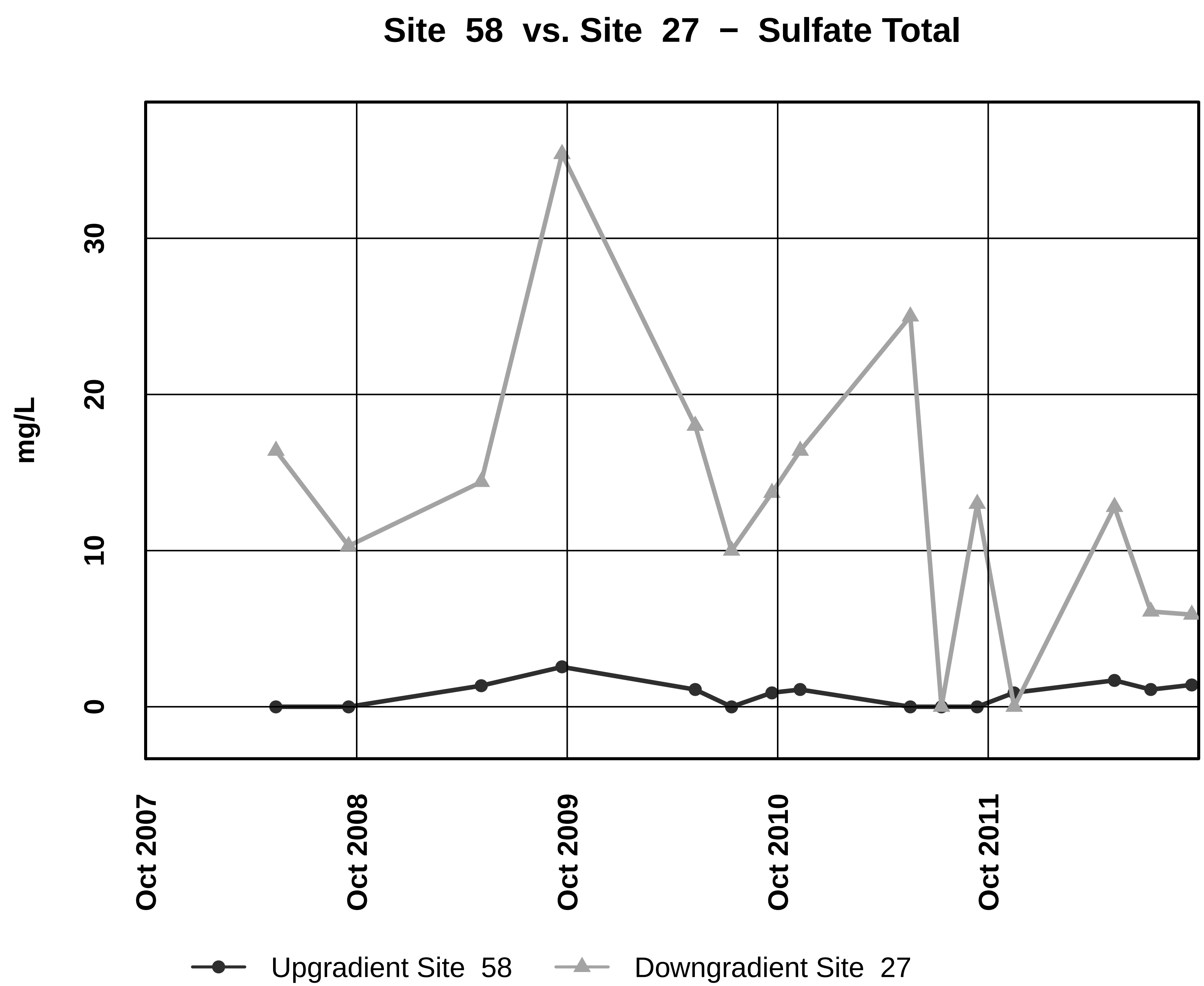
Site 58 vs. Site 27 − Conductivity Field
µS/cm
50
100
150
200
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 58
Downgradient Site 27

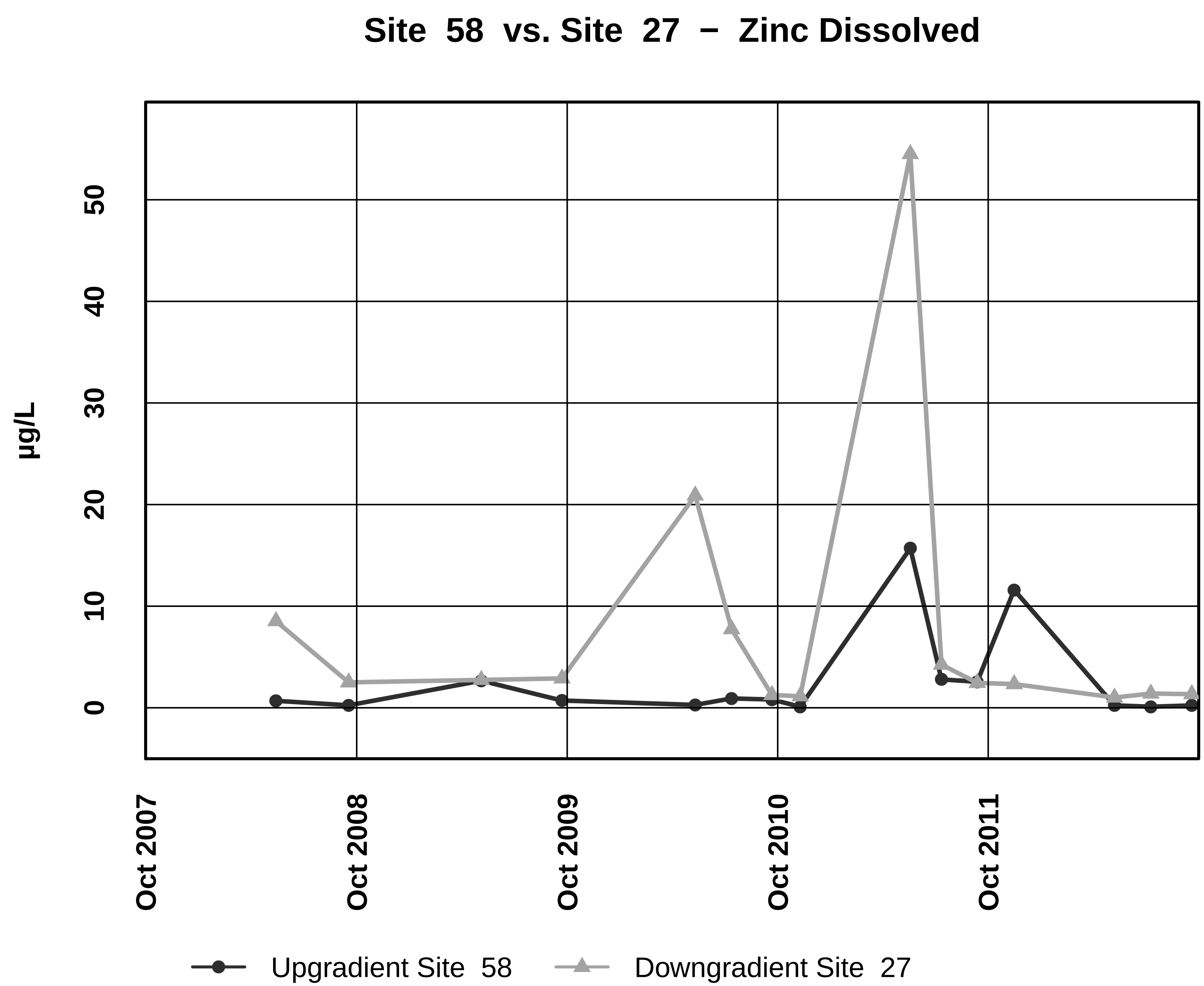


Site 58 vs. Site 27 − pH Field
su
5.0
5.5
6.0
6.5
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 58
Downgradient Site 27



Site 58 vs. Site 27 − Alkalinity Total
mg/L
50
40
30
20
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 58
Downgradient Site 27


Site 58 vs. Site 27 − Sulfate Total
mg/L
0
10
20
30
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 58
Downgradient Site 27


Site 58 vs. Site 27 − Zinc Dissolved
µg/L
0
10
20
30
40
50
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 58
Downgradient Site 27

INTERPRETIVE REPORT
SITE 29

The data collected during the current water year are listed in the following "Table of Results for Water Year 2012" report. The table includes all the required FWMP analyte data (field and laboratory) collected for the current water year and a series of flags keyed to the summary report "Qualified Data by QA Reviewer". The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of ½ MDL for the purpose of median calculation.

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

Sample Date	Parameter	Value	Qualifier	Notes
No outliers have been identified by HGCMC for the period of October 2007 through September 2012.				

The data for water year 2012 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 2012

			Limits		
Sample Date	**Parameter**	**Value**	**Lower**	**Upper**	**Hardness**
15-Nov-11	Alkalinity	19.9 mg/L	20		
15-Nov-11	Lead Dissolved	2.8 µg/L		0.54	20.30 mg/L
15-Nov-11	pH Field	5.67 su	6.5	8.50	
7-May-12	Alkalinity	0 mg/L	20		
7-May-12	pH Field	4.49 su	6.5	8.50	
9-Jul-12	Alkalinity	7.1 mg/L	20		
9-Jul-12	pH Field	5.03 su	6.5	8.50	
18-Sep-12	Alkalinity	18.3 mg/L	20		
18-Sep-12	pH Field	5.01 su	6.5	8.50	

Four of these records are for field pH with values below the lower limit of 6.5 su listed in AWQS. Field pH from other wells completed in organic rich peat sediments similar to Site 29 have historically resulted in pH values ranging from 5 to 6 su (*e.g.* Sites 58, 27, and 32). Four other exceedances were for total alkalinity below the lower limit of 20 mg/L. One exceedance was for dissolved lead November 2011.

Though dissolved lead has routinely been in exceedance at Site 29 over the past several years there was a sharp increase in water year 2011 with values returning to below the AWQS limit by the middle of the water year 2012. Though zinc had been in exceedance during water year 2011 all samplings were for water year 2013 were below the AWQS limit. 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, descanting winds during winter or due to dust induced by truck traffic during dry summer conditions.

The changes in these analytes may reflect the changing topography of the tails dry stack facility. After the northeast expansion was completed in 2008 HGCMC commenced to place the majority of the tailings in the northeast region. For a couple of years the northeast was mostly bowl shaped and below the tree line. During the last couple of years this area stopped being a bowl and has been brought up in elevation. With the increase in elevation this area is not as protected from the winds that predominantly prevail from the northeast. Dispersal of fugitive dust from this region would be to the southwest towards Site 29 and Site 32.

In 2011 HGCMC implemented a biweekly dust monitoring program to support the snow monitoring program. This program has continued into 2013 and the results from this monitoring are summarized in the 2012 Tailings and Waste Rock Annual Report and will also be presented at the annual meeting in June 2013.

X-Y plots have been generated to graphically present the data for each of the analytes requested in the Statistical Information Goals for this site. These plots have been visually analyzed for the appearance of any trend in concentration. There is a visually apparent downward trend in total alkalinity values across the last five water years. The same trend is apparent in the dissolved arsenic, dissolved barium, hardness, and conductivity data. Currently, HGCMC does not have an explanation for the mechanism that is in operation causing the visual decrease in these values.

A non-parametric statistical analysis for trend was performed for specific conductivity, field pH, total alkalinity, total sulfate, and dissolved zinc. Calculation details of the Seasonal Kendall analyses are presented in detail on the pages following this interpretive section. The following table summarizes the results on the data collected between Oct-06 and Sep-12(WY2007-WY2012).

Table of Summary Statistics for Trend Analysis

	Mann-Kendall test statistics			Sen's slope estimate	
Parameter	**n***	**p****	**Trend**	**Q**	**Q(%)**
Conductivity Field	6	0.02	-	-9.65	-16.0
pH Field	6	0.08			
Alkalinity, Total	6	0.05			
Sulfate, Total	6	Inconsistent detection limits			
Zinc, Dissolved	6	0.26			

* Number of Years ** Significance level

One significant trend was identified with this analysis. Field conductivity ($p=0.02$) was negatively trending with an estimated slope of -9.65 µs/cm/yr or a 16.0% decrease, this is similar in direction and magnitude calculated for the previous water year.

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

Additional X-Y plots have been generated for alkalinity, pH, conductance, sulfate, and dissolved zinc that co-plot data from Site 29 and Site 58, the up-gradient control site, to aid in the comparison between those two sites. Field conductivity and total alkalinity were within similar ranges at both sites until a couple years ago. Conductivity and total alkalinity have been decreasing at Site 29 whereas at Site 58 these parameters have increased. Field pH is slightly lower at Site 29 than Site 58, while total sulfate is slightly higher at Site 58 (note Site 29 typically returns sulfate values that are below the 0.1 mg/L SO_4 MDLThe hydro-geologic conditions that exist at Site 29 are similar to Site 27 with the exception that Site 29 is not typically in an active surface discharge zone. However, the area around Site 29 is located in an area of gently sloping muskeg that is part of the upper headwater region of Further Creek, which drains westward into Hawk Inlet. The site's groundwater is characterized by diffuse flow through the peat/sand strata. Thus the lower pH would be due to the greater interaction with organic matter in the muskeg. The lower pH would also promote greater solubility for dissolved metals sampled at this site.

Table of Results for Water Year 2012

Site 029FMG - 'Monitoring Well - 3S'

Sample Date/Parameter	Oct 2011	Nov 2011	Dec 2011	Jan 2012	Feb 2012	Mar 2012	Apr 2012	May 2012	Jun 2012	Jul 2012	Aug 2012	Sep 2012	**Median**
Water Temp (°C)		5.1						7.2		7.7		7	7.1
Conductivity-Field(μmho)		53						54.7		40.8		59	53.9
Conductivity-Lab (μmho)		56						49		36		57	53
pH Lab (standard units)		5.17						4.33		4.35		5	4.68
pH Field (standard units)		5.67						4.49		5.03		5.01	5.02
Total Alkalinity (mg/L)		19.9						0.5		7.1		18.3	12.7
Total Sulfate (mg/L)		2.5						2.5		2.5		1.3	2.5
Hardness (mg/L)		20.3						18.6		13.5		19.7	19.2
Dissolved As (ug/L)		8.44						7.24		5.46		4	6.350
Dissolved Ba (ug/L)		11.9						6.6		5.3		3.9	6.0
Dissolved Cd (ug/L)		0.0229						0.0018		0.0018		0.0018	0.0018
Dissolved Cr (ug/L)		1.06						1.07		1.19		2.8	1.130
Dissolved Cu (ug/L)		0.606						0.175		0.295		0.105	0.235
Dissolved Pb (ug/L)		2.8						0.133		0.0989		0.231	0.1820
Dissolved Ni (ug/L)		1.41						1.23		1.12		0.668	1.175
Dissolved Ag (ug/L)		0.01						0.002		0.002		0.002	0.002
Dissolved Zn (ug/L)		27.9						2.61		2.1		1.89	2.36
Dissolved Se (ug/L)		0.057						0.02		0.289		0.057	0.057
Dissolved Hg (ug/L)		0.000991						0.00119		0.000768		0.00125	0.001091

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.

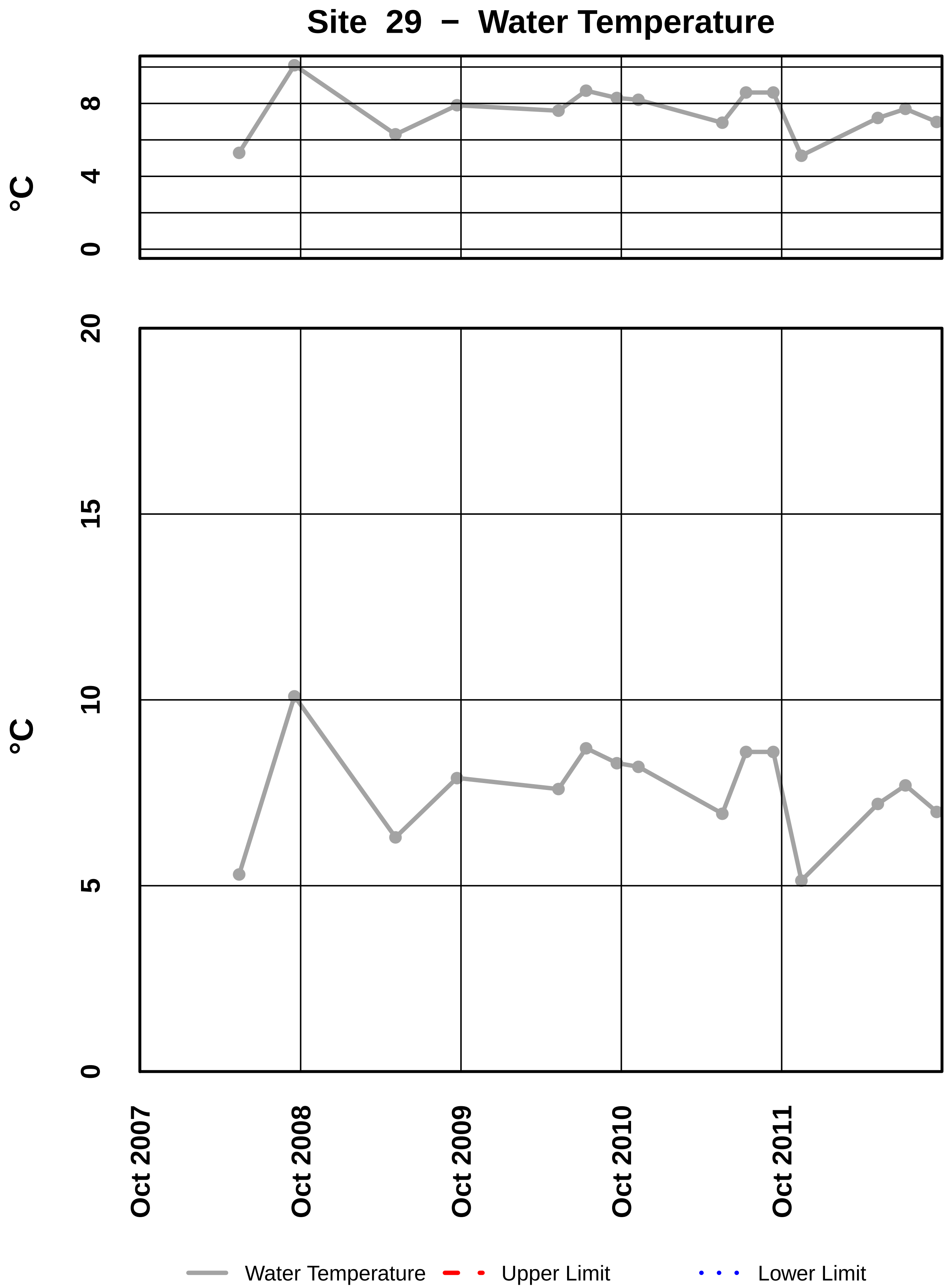
Shaded data has been qualified as an outlier by KGCMC and removed from any further analysis and is not included into the calculation of the median

Qualified Data by QA Reviewer

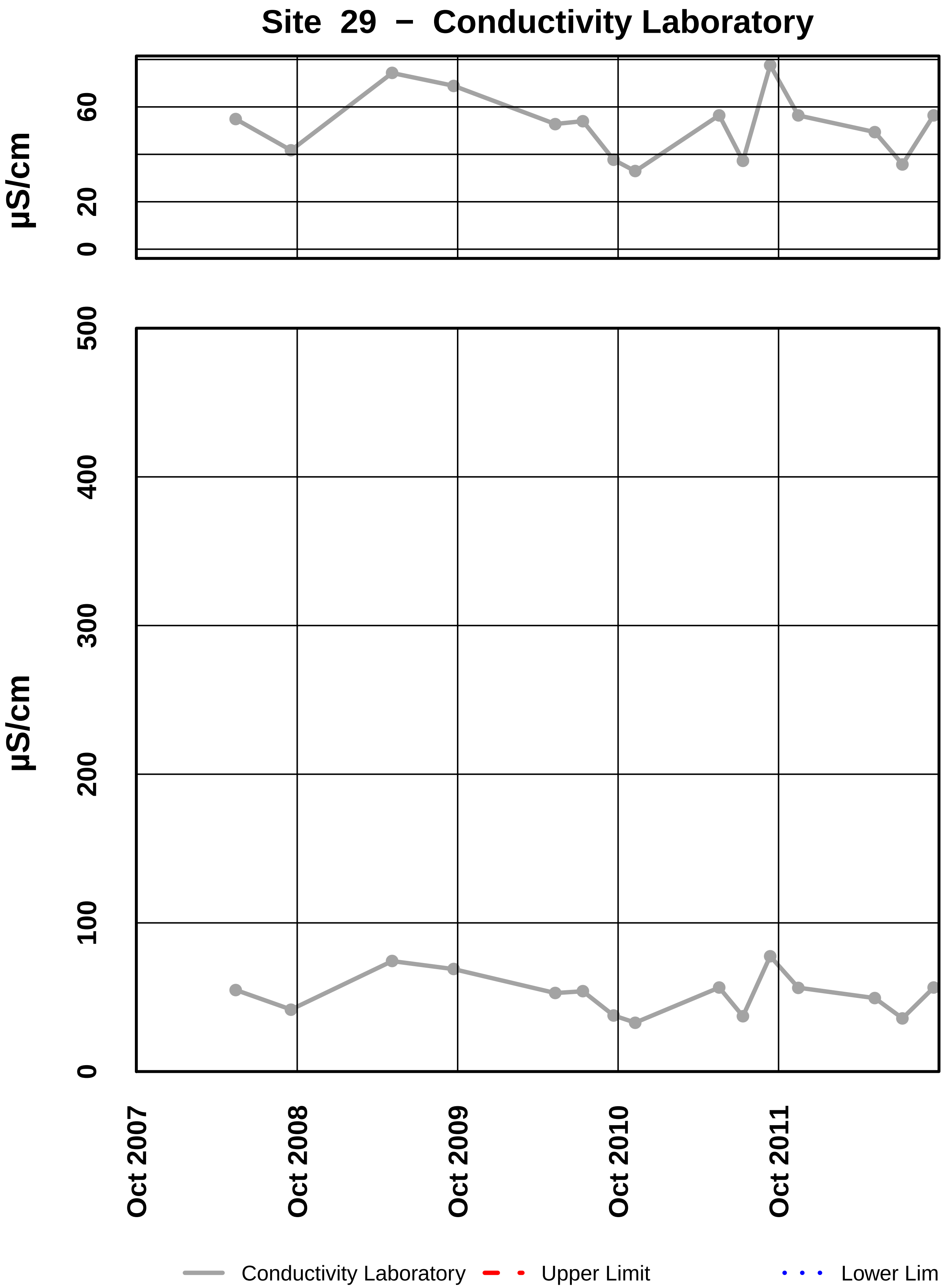
Date Range: 10/01/2011 to 09/30/2012

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
29	11/15/2011	12:00 AM	Ag diss, µg/l	0.01	U	Field Blank Contamination
29	5/7/2012	12:00 AM	SO4 Tot, mg/l	-5	UJ	Sample Receipt Temperature
29	7/9/2012	12:00 AM	Hg diss, µg/l	0.000768	U	Field Blank Contamination
			Se diss, µg/l	0.28	J	Below Quantitative Range
29	9/18/2012	12:00 AM	SO4 Tot, mg/l	-2.5	UJ	Sample Receipt Temperature

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

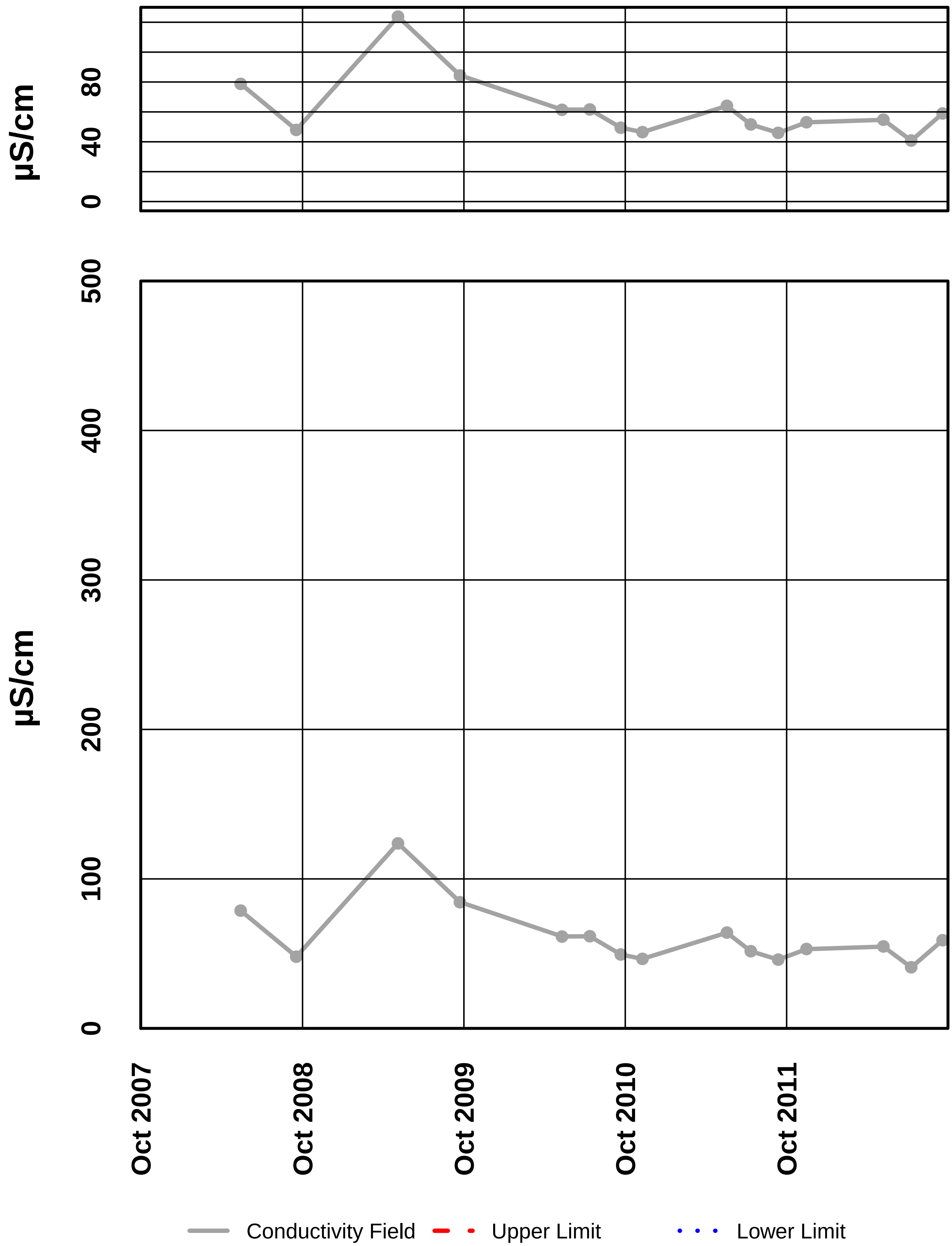


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

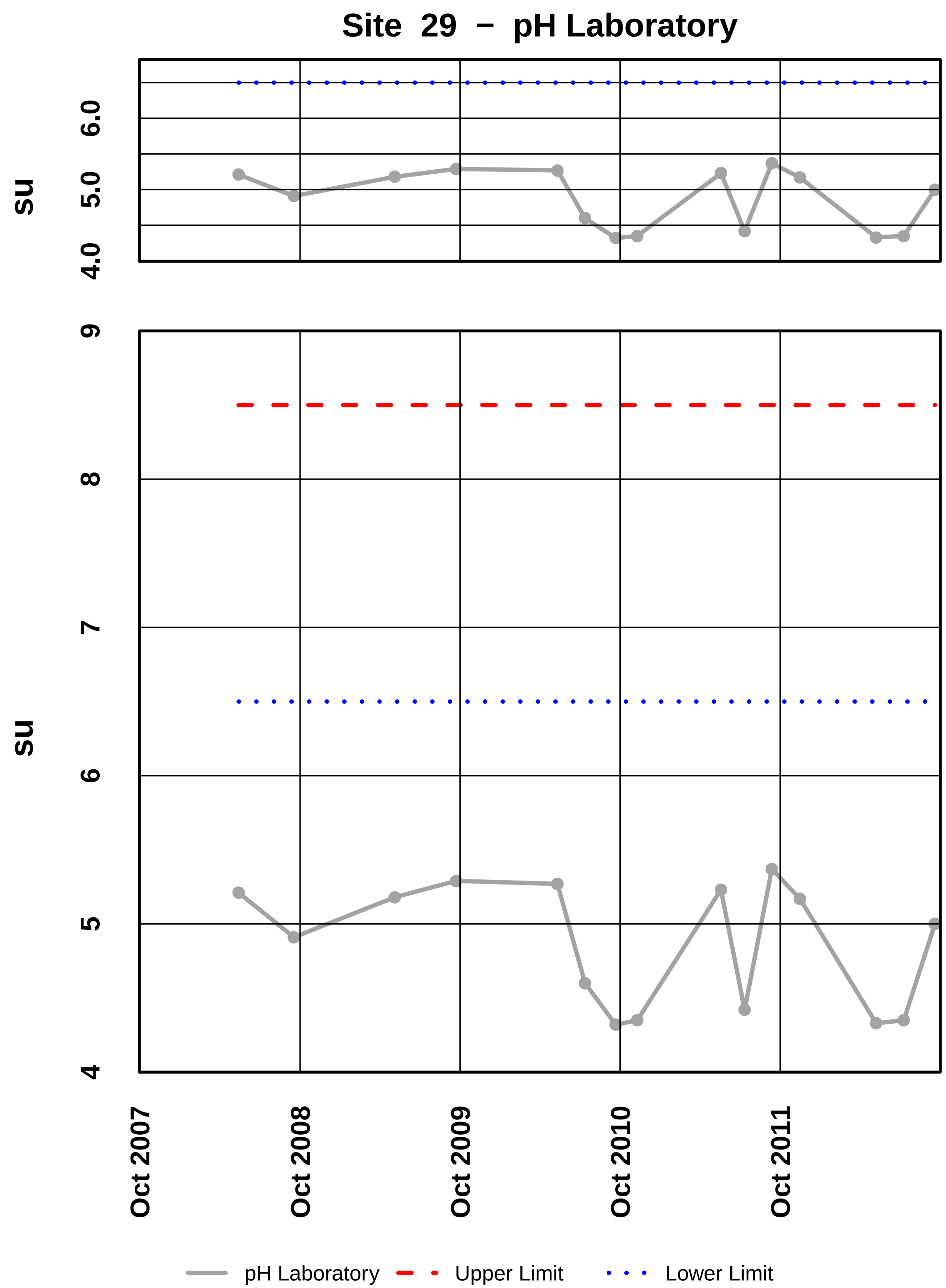


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 29 – Conductivity Field

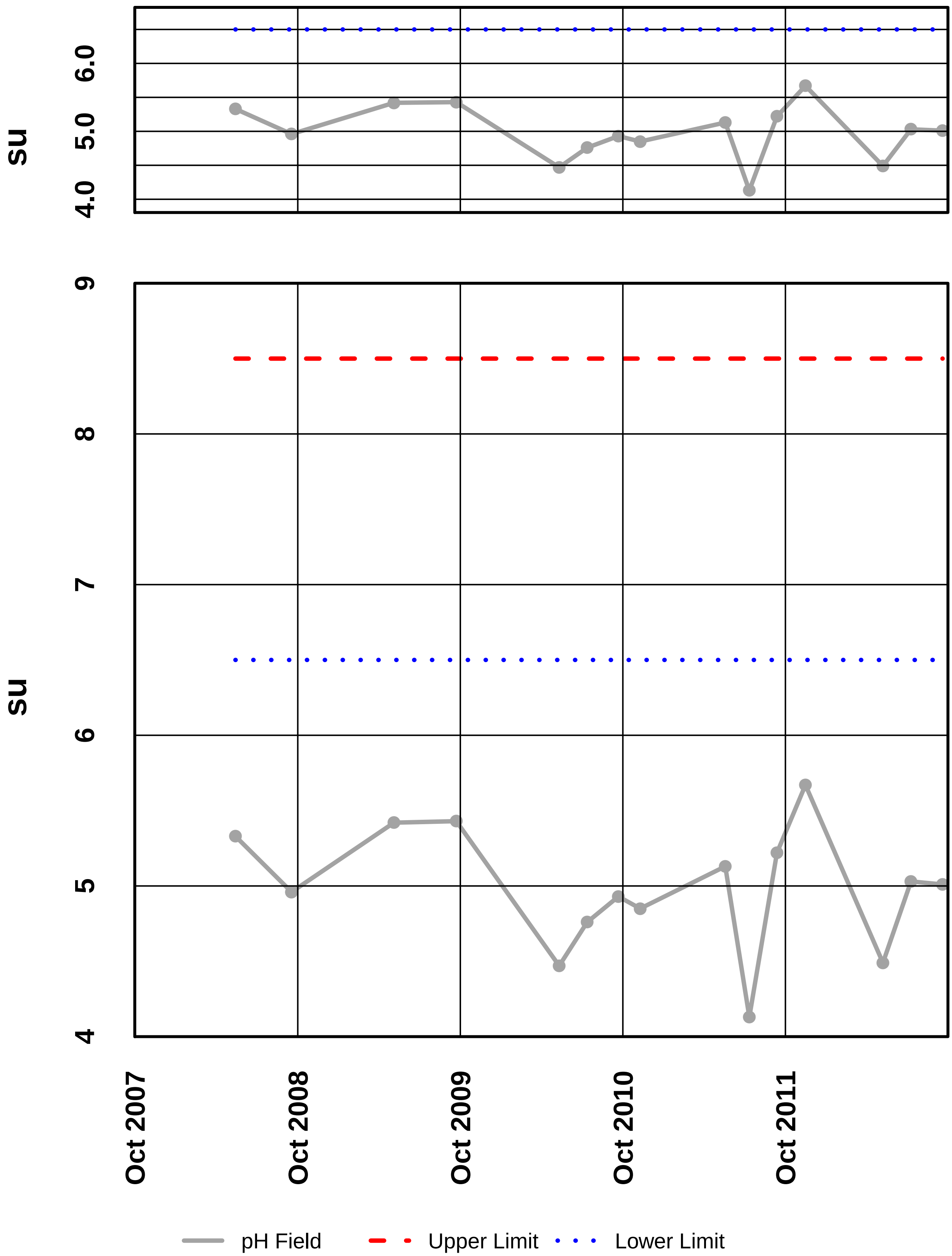


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



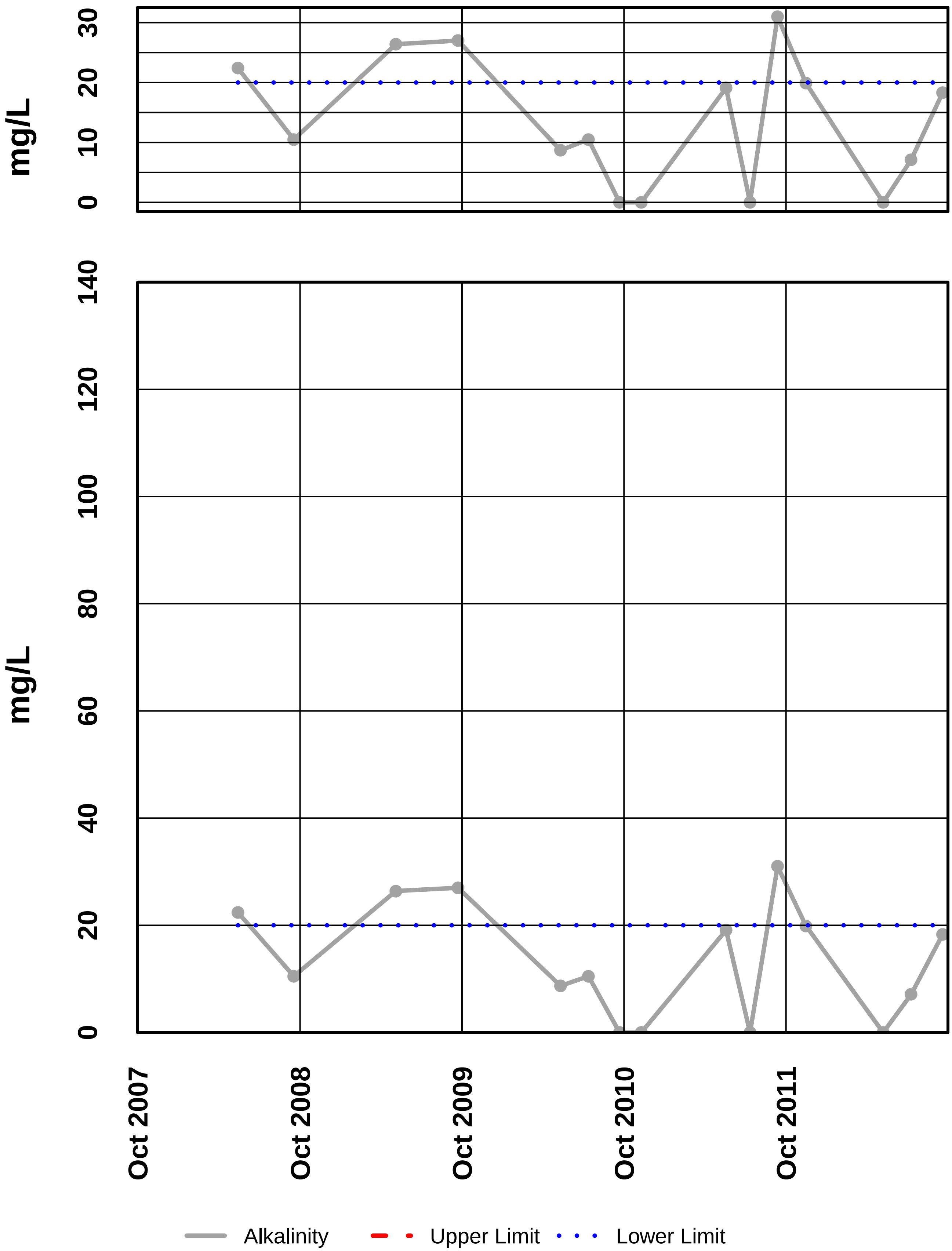
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 29 – pH Field



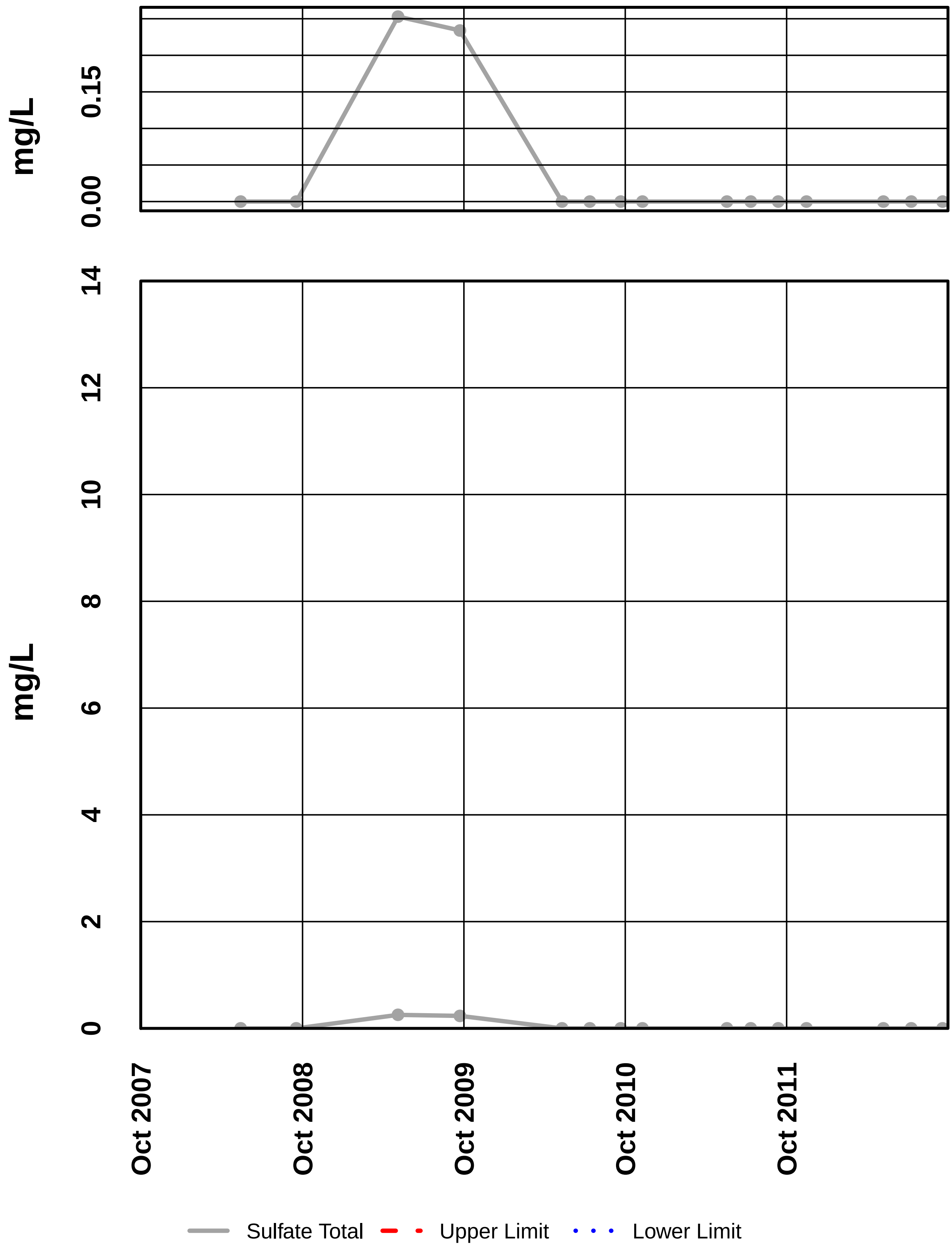
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 29 − Alkalinity



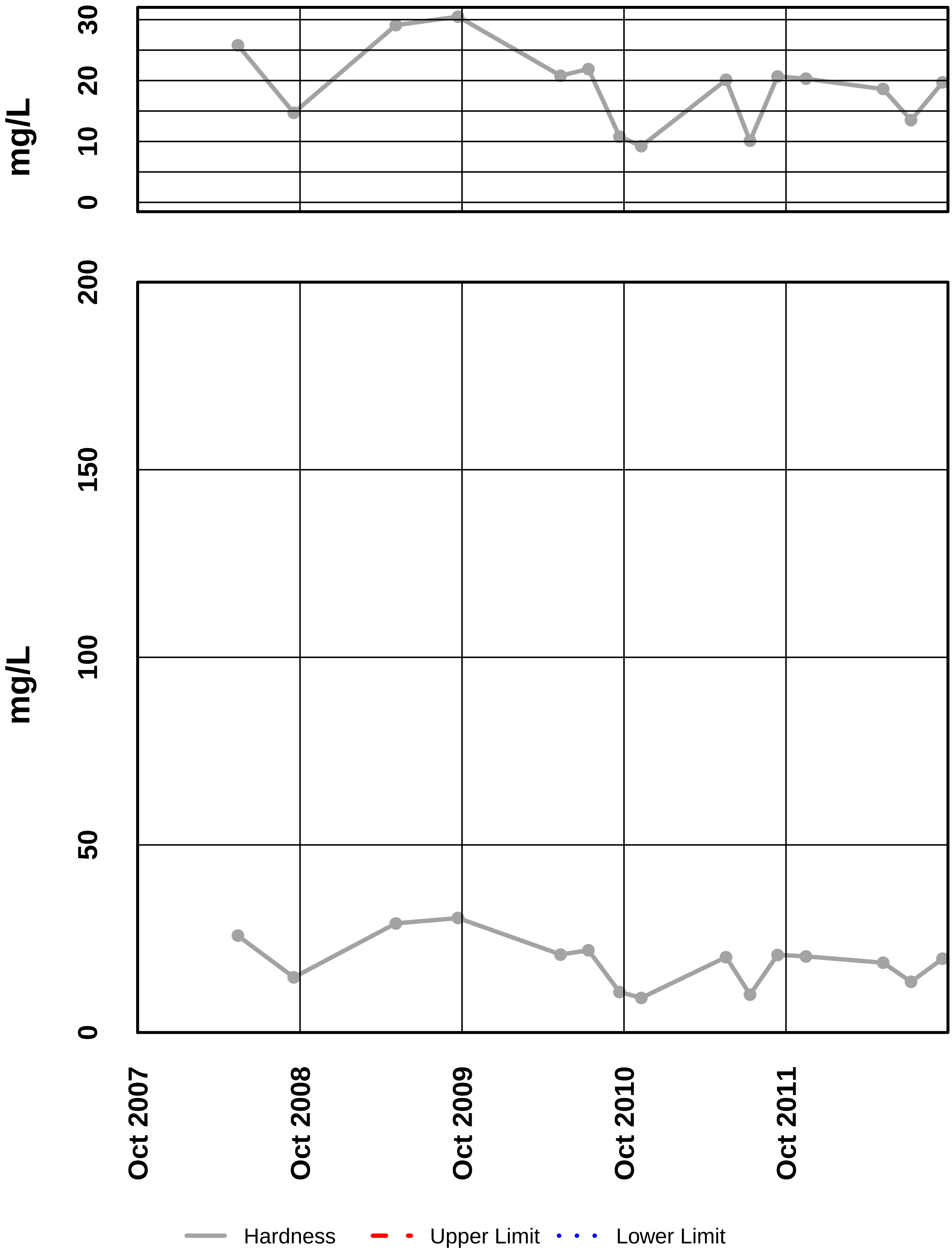
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 29 − Sulfate Total



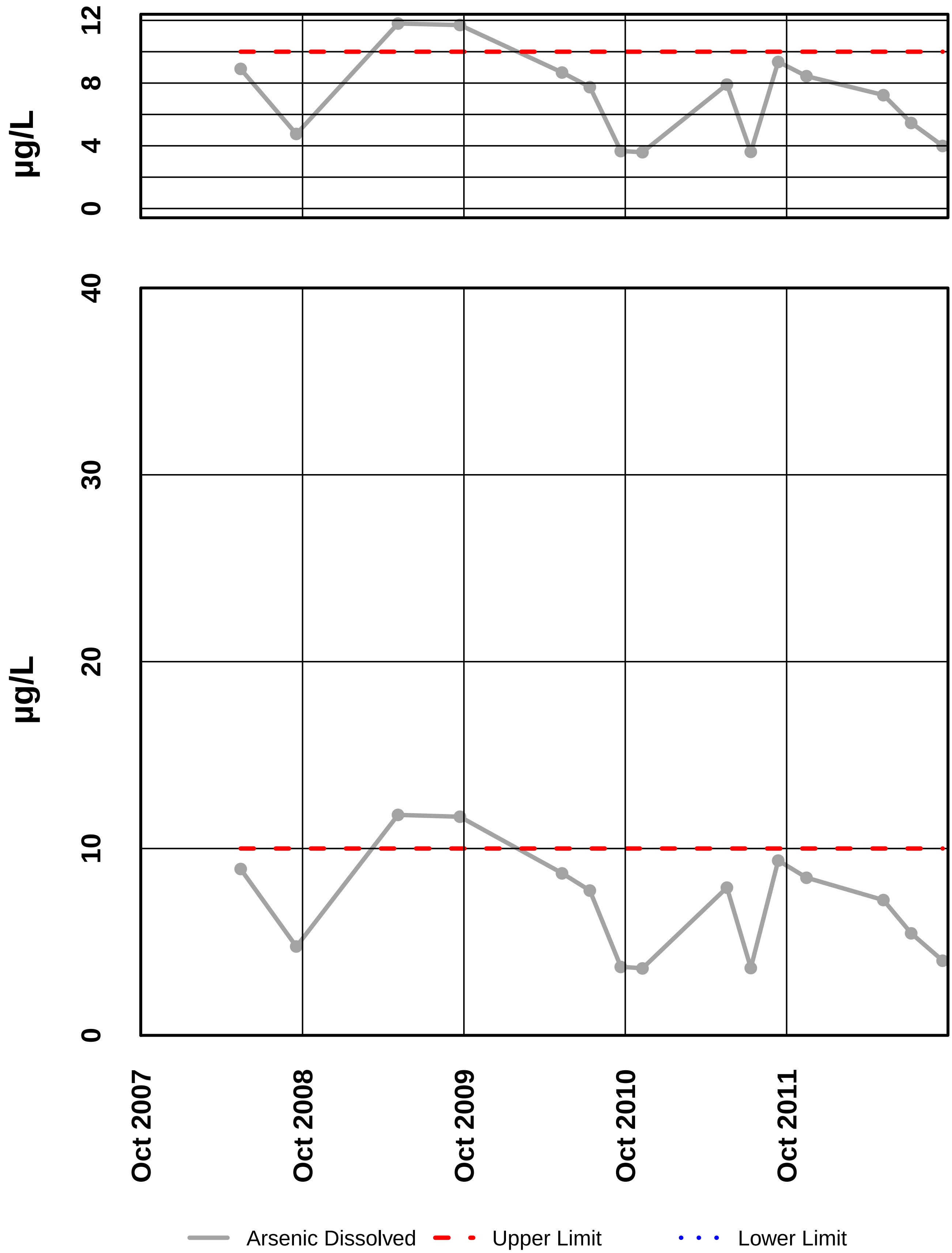
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 29 − Hardness

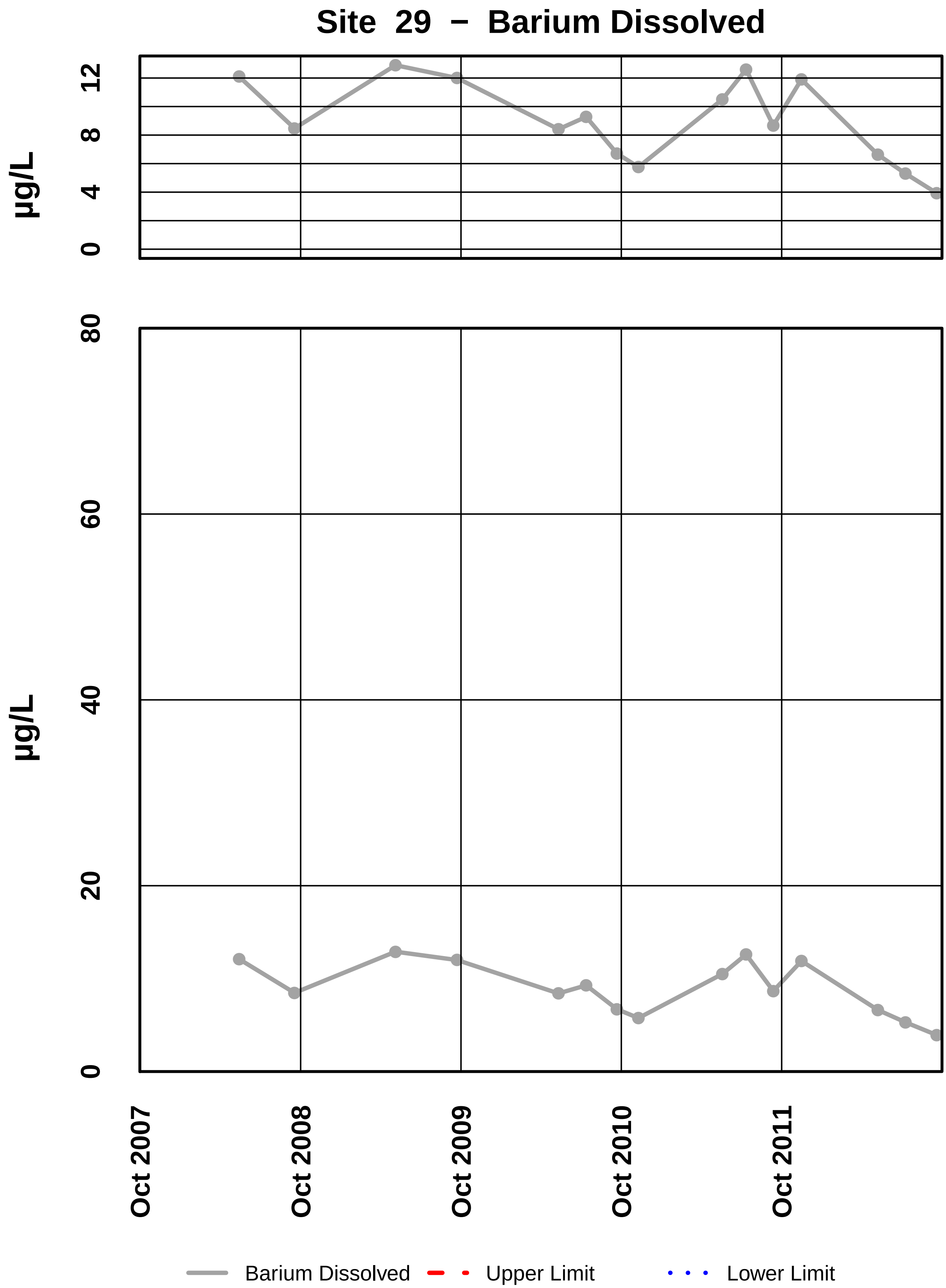


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

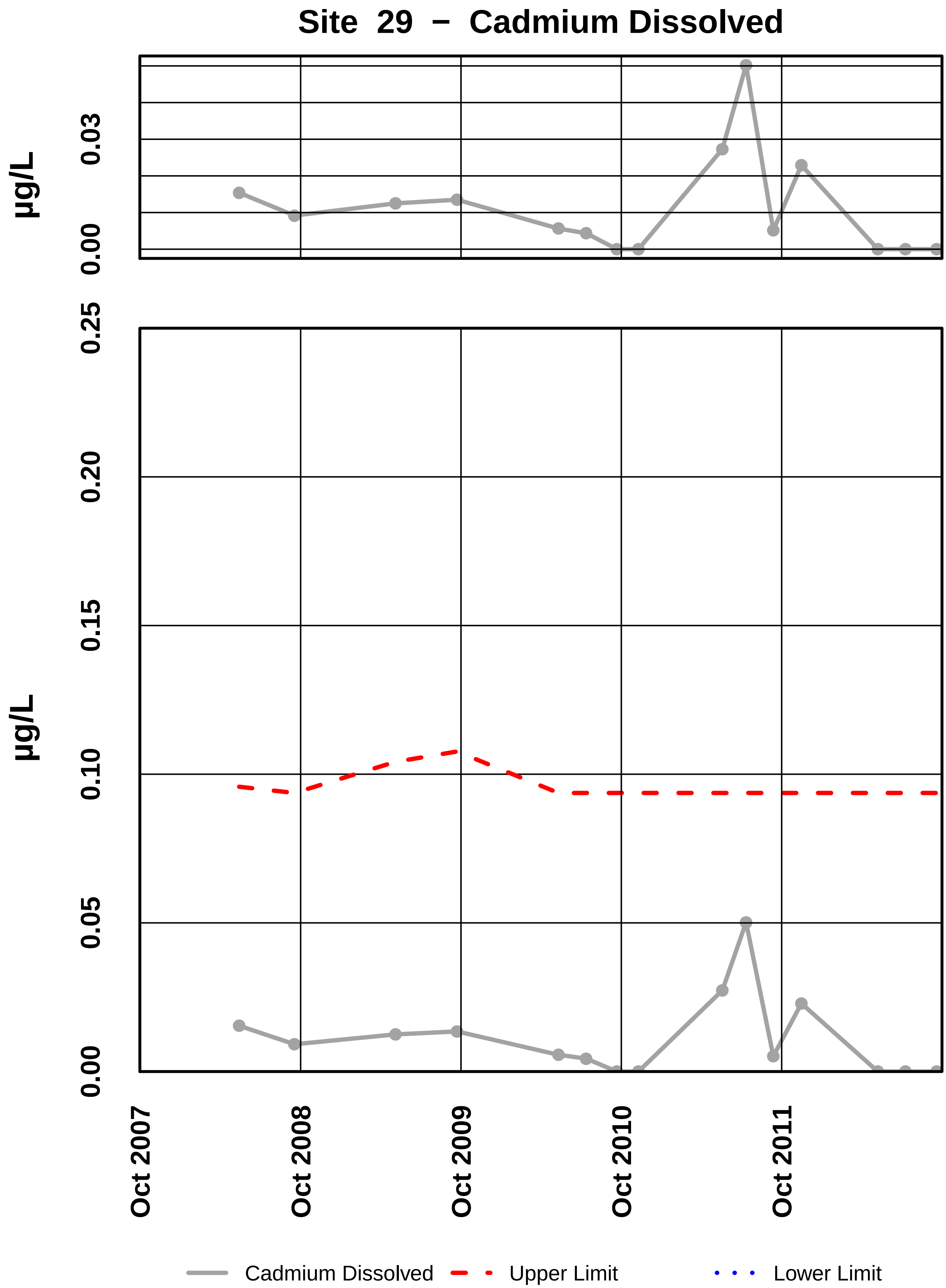
Site 29 – Arsenic Dissolved



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

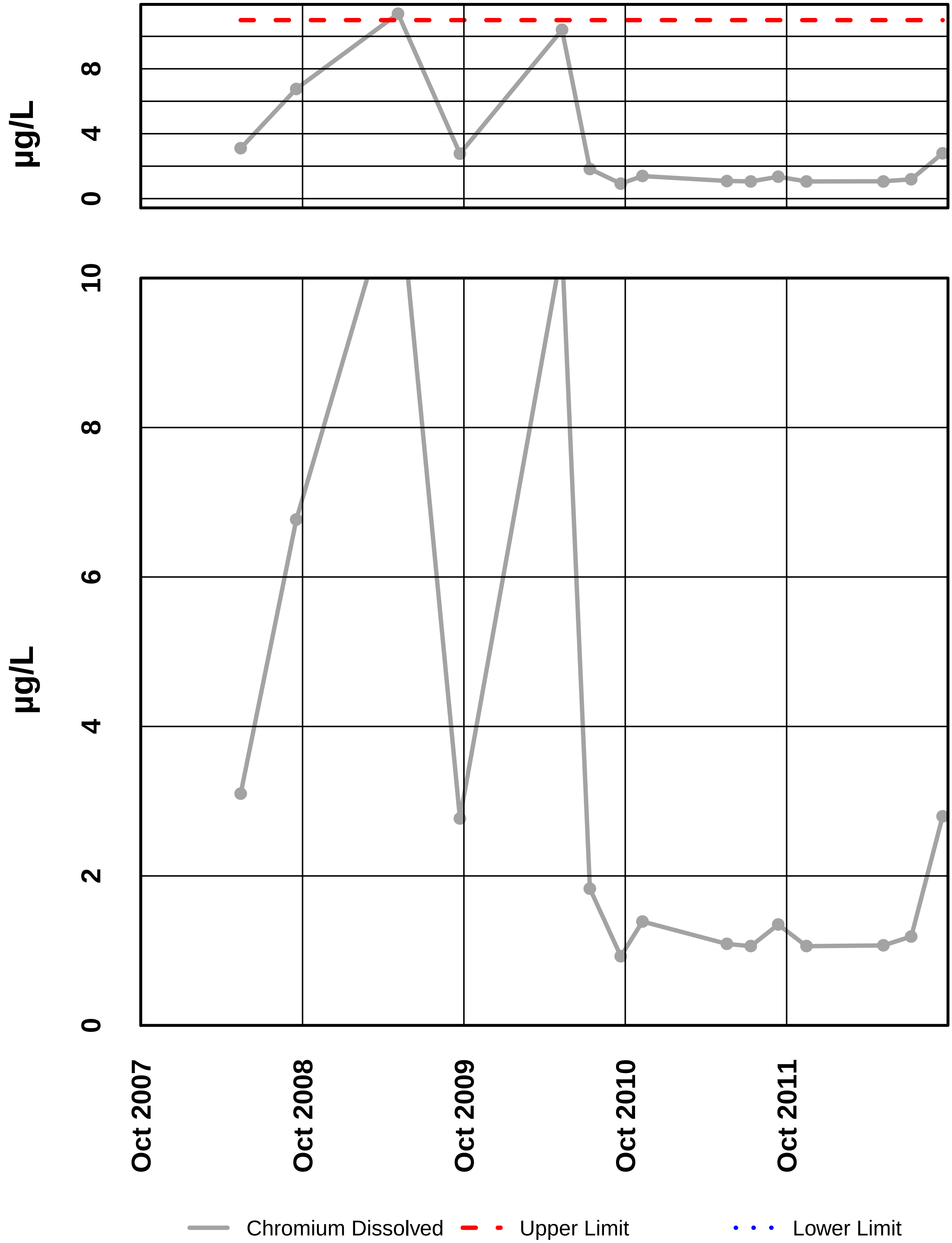


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



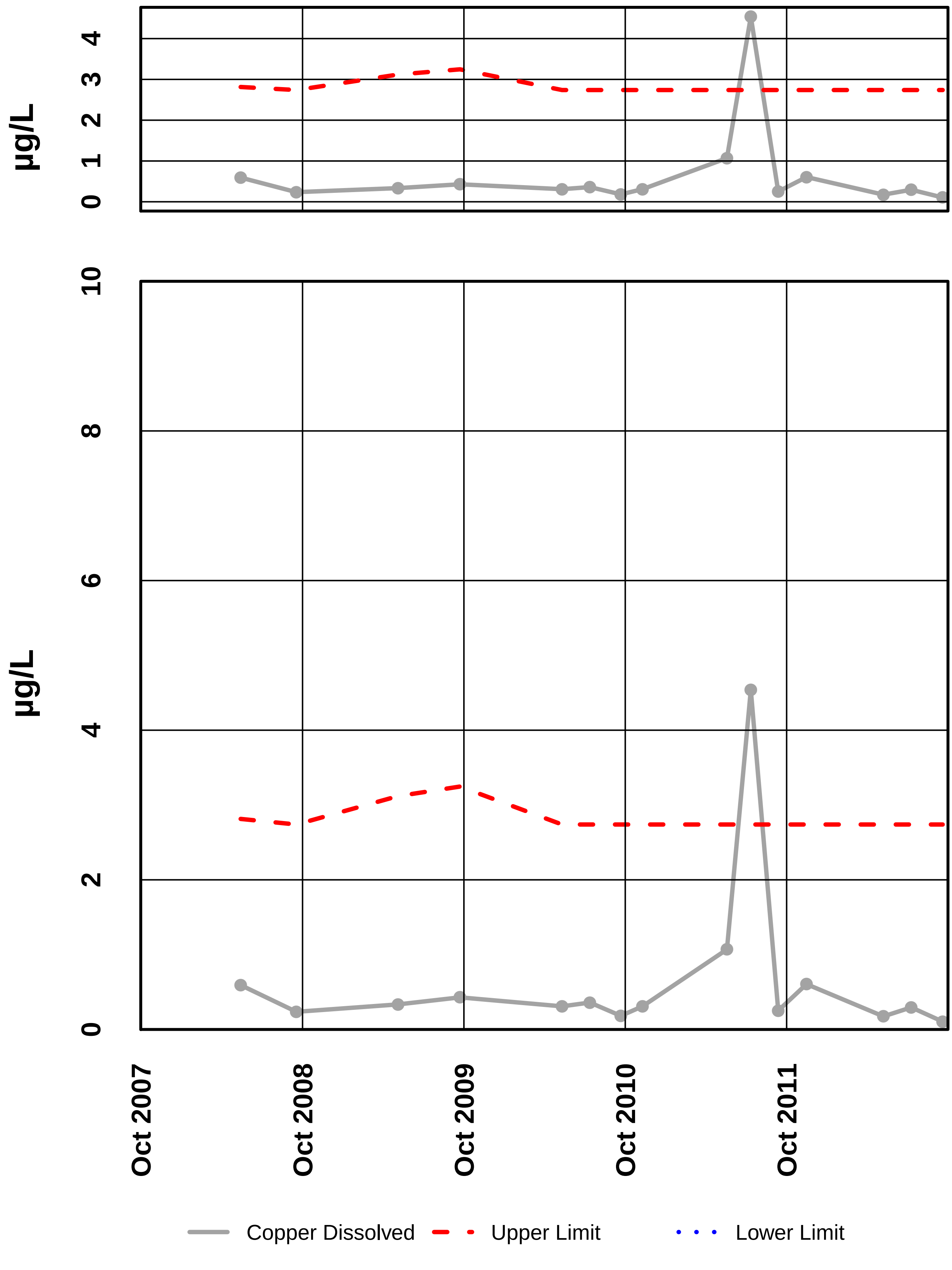
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 29 – Chromium Dissolved

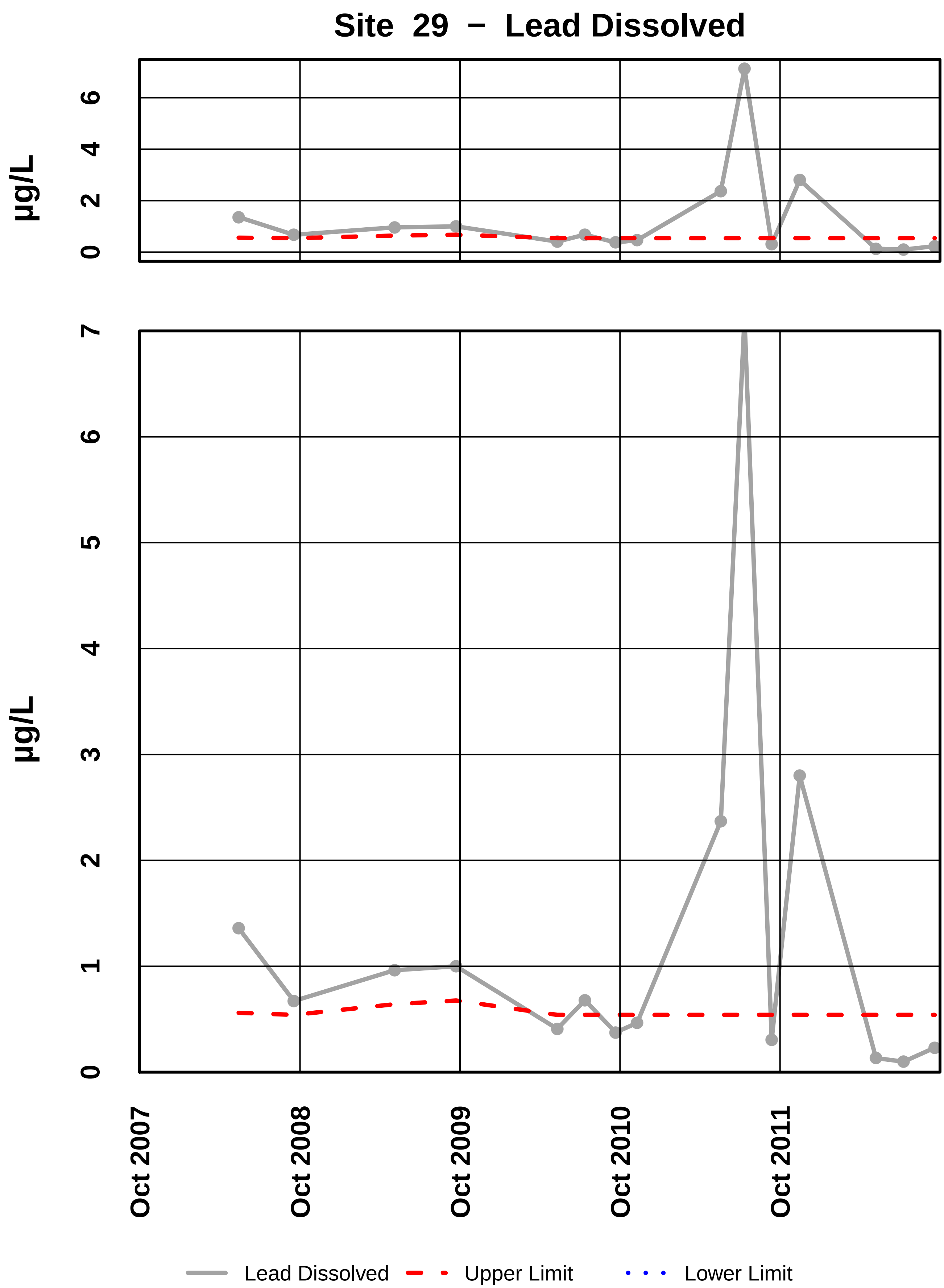


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 29 – Copper Dissolved

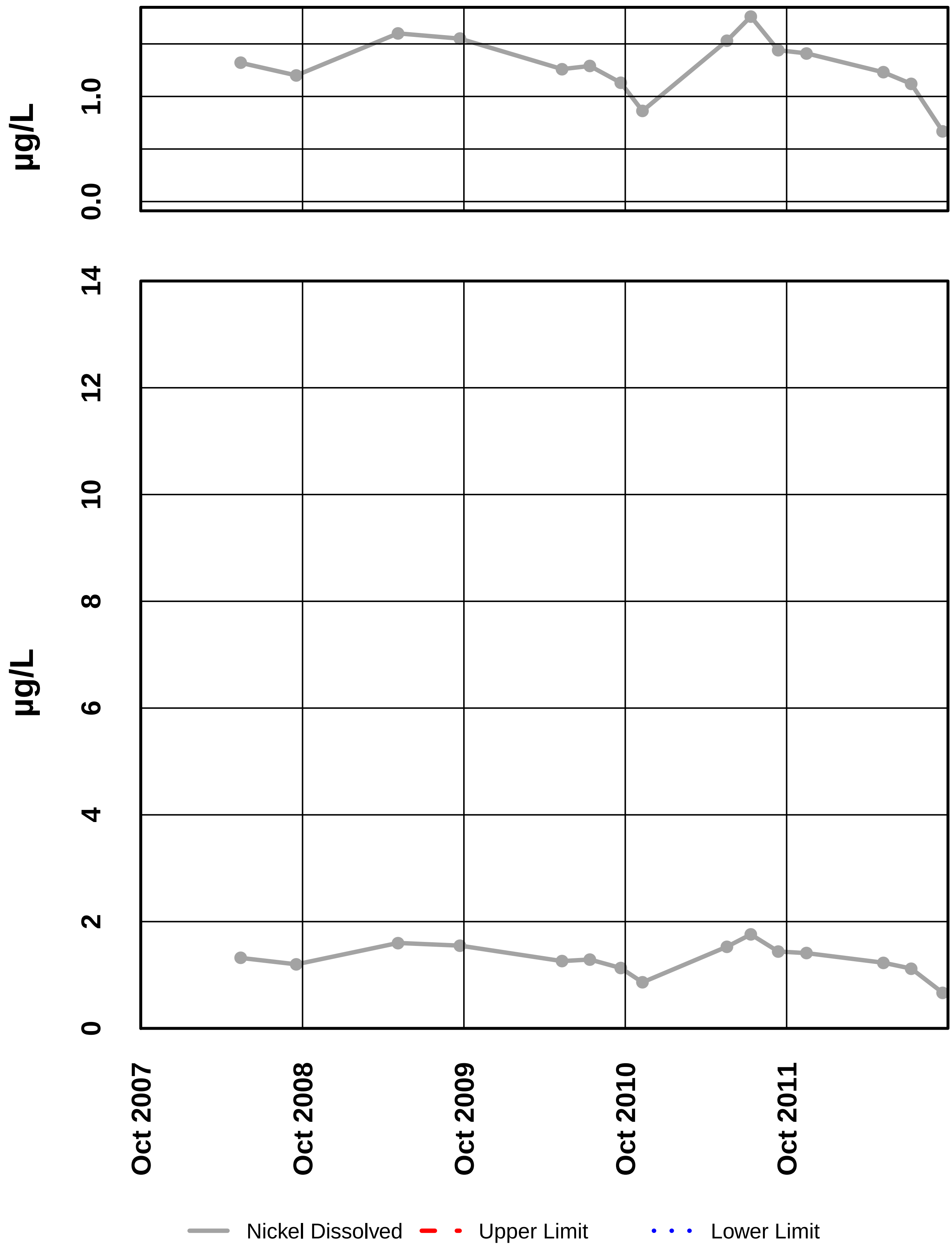


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

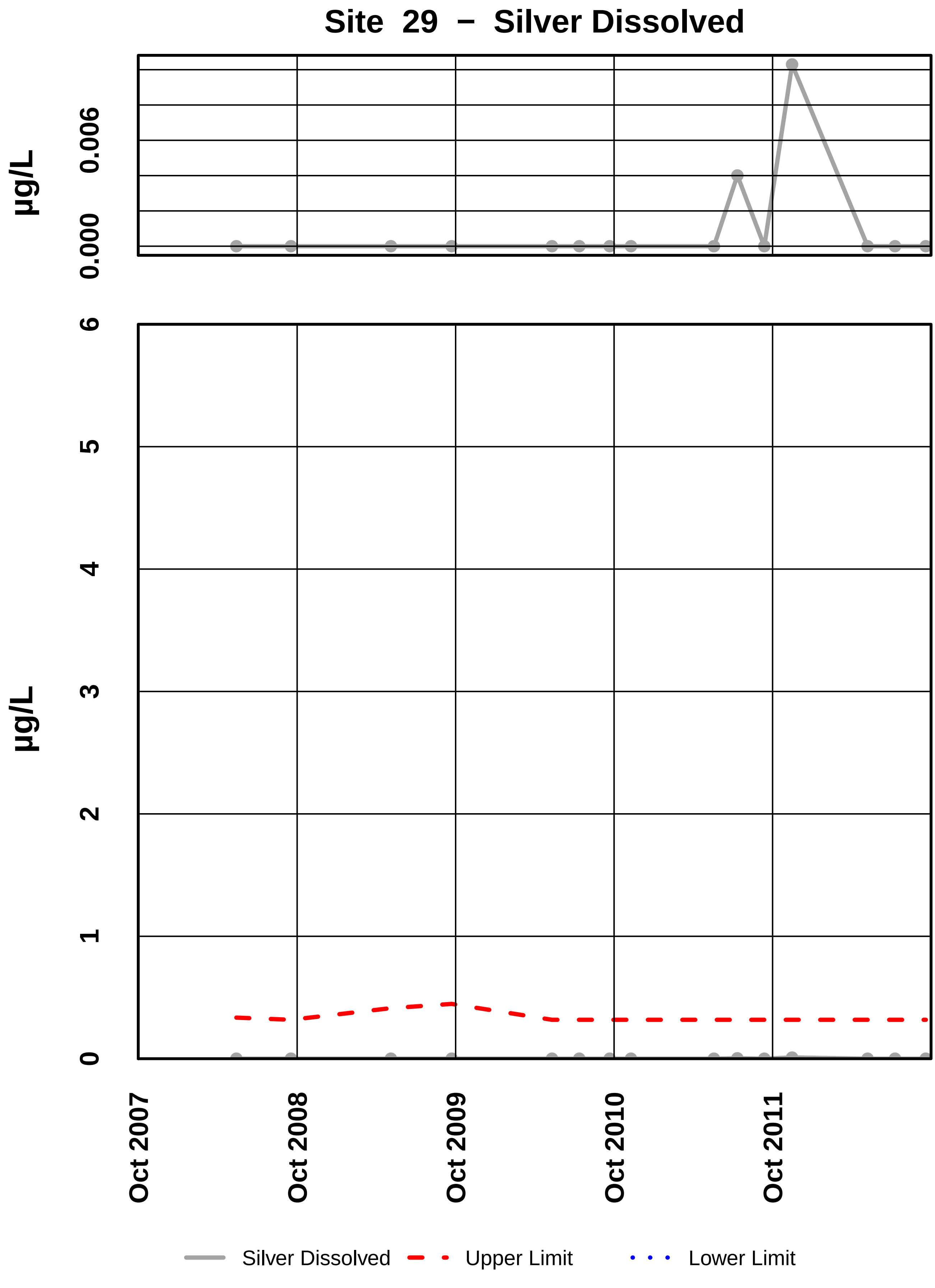


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 29 – Nickel Dissolved

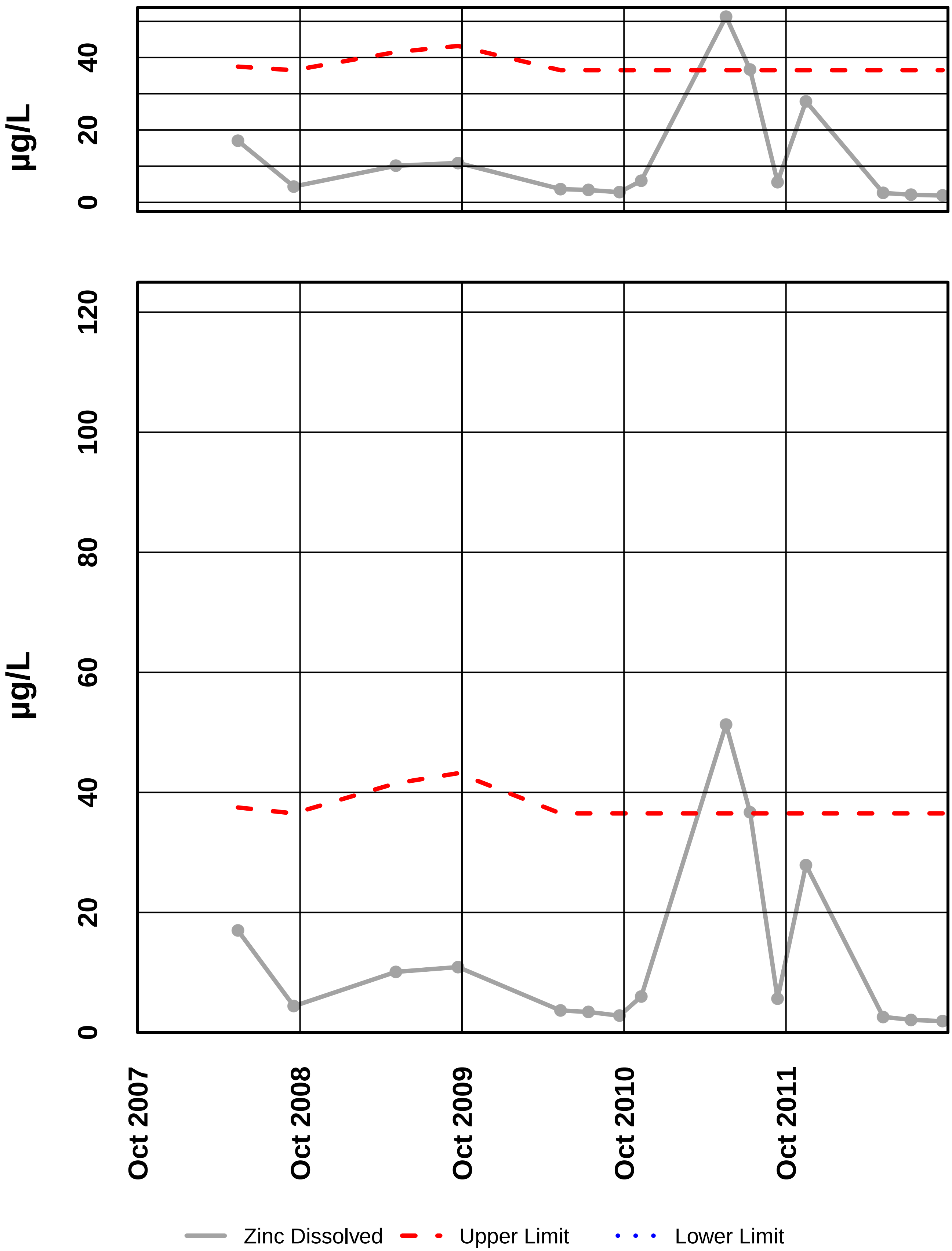


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



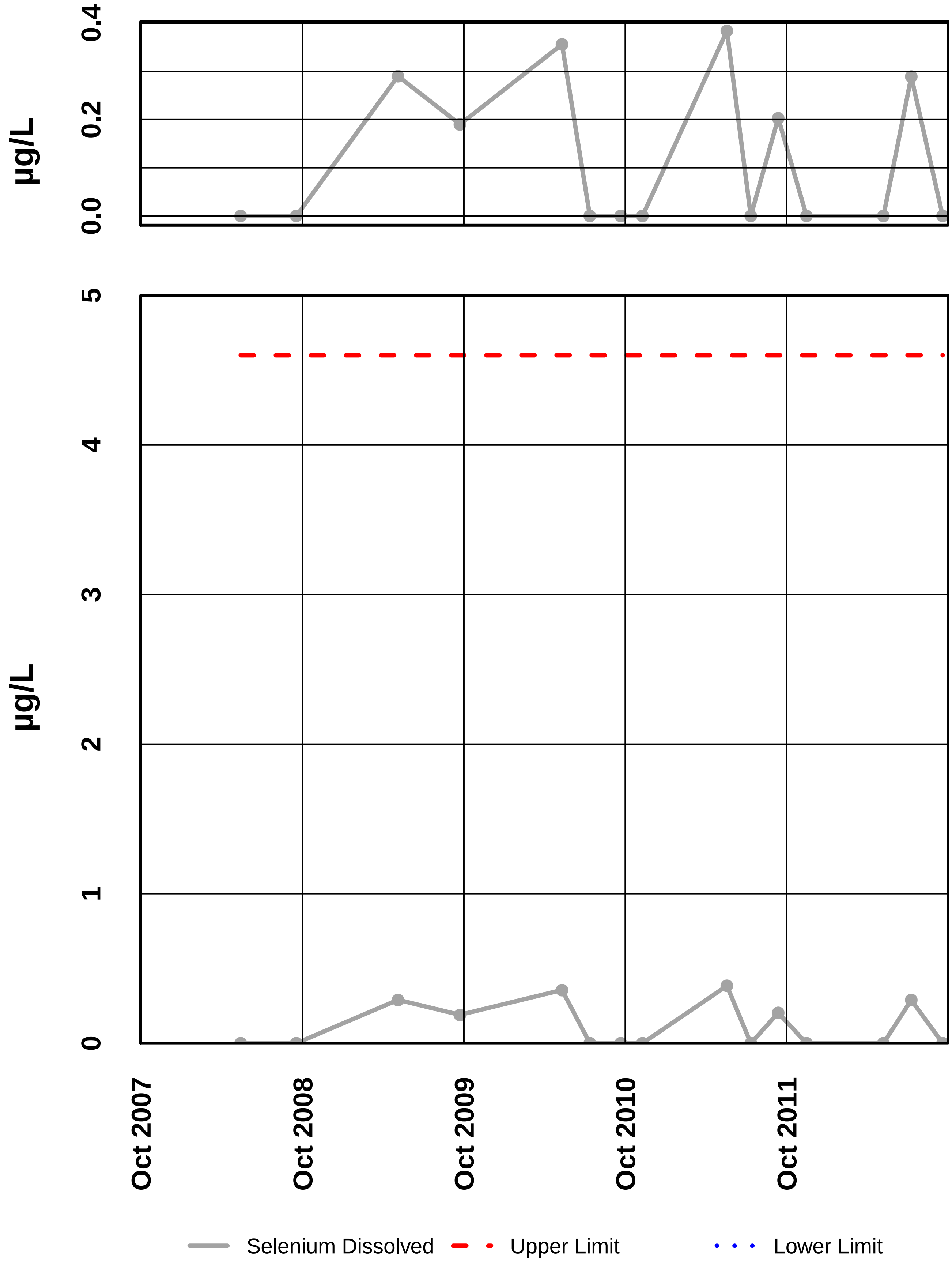
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 29 – Zinc Dissolved

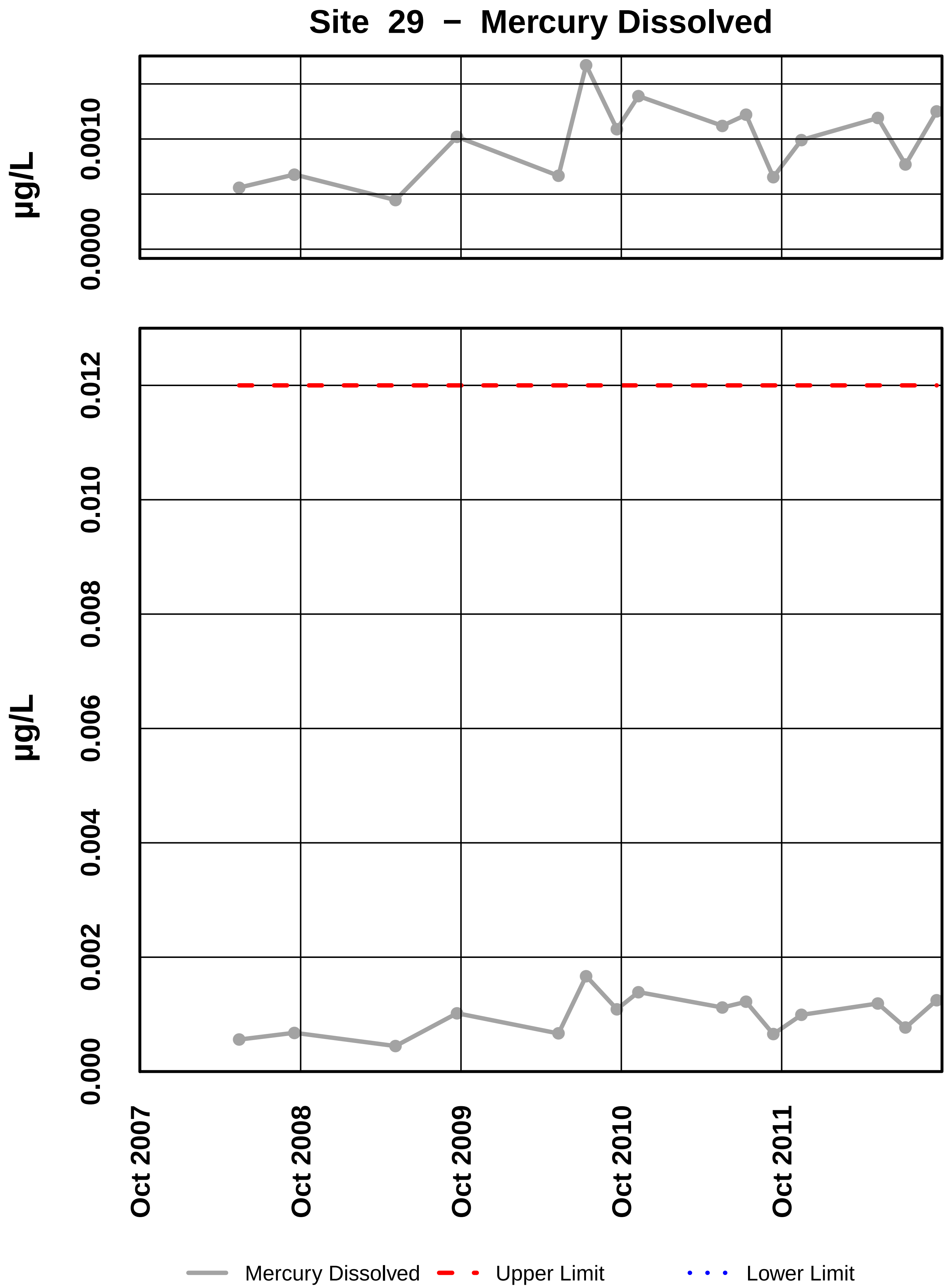


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 29 – Selenium Dissolved



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



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

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**							115.8	135.4				114.5
b	**WY2008**								78.8				48
c	**WY2009**								123.8				84.5
d	**WY2010**								61.5		61.6		49.4
e	**WY2011**		46.5						64		51.6		46
f	**WY2012**		53						54.7		40.8		59
	n	0	2	0	0	0	0	1	6	0	3	0	6

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

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

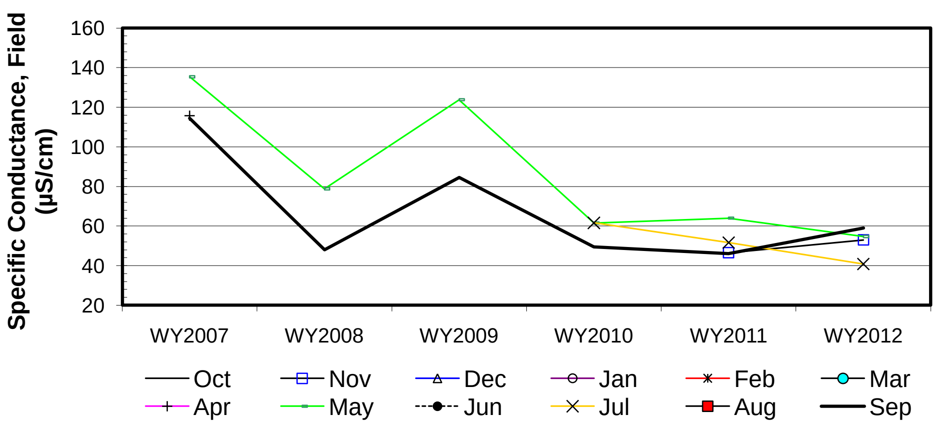
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=		1.00						28.33		3.67		28.33
$Z_k = S_k/\sigma_S$		1.00						-2.07		-1.57		-0.94
Z^2_k		1.00						4.27		2.45		0.88

ΣZ_k=	-3.57
ΣZ^2_k=	8.61
Z-bar=$\Sigma Z_k/K$=	-0.89

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	18	0	0	0	0

Σn	18
ΣS_k	-18

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=		5.42	@α=5% $\chi^2_{(K-1)}$=	7.81	Test for station homogeneity	
	p	**0.144**			$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
$\Sigma VAR(S_k)$	Z_{calc}	-2.17	@α/2=2.5% Z=	1.96	**H_0** (No trend)	REJECT
61.33	p	**0.015**			**H_A** (± trend)	ACCEPT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-21.85		-0.52
0.050	-17.44	**-9.65**	-4.26
0.100	-16.16		-5.78
0.200	-12.25		-7.77

-16.0%

Site	#29	Seasonal Kendall analysis for pH, Field, Standard Units											
Row label	**Water Year**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
a	**WY2007**							5.6	5.7				5.6
b	**WY2008**								5.3				5.0
c	**WY2009**								5.4				5.4
d	**WY2010**								4.5		4.8		4.9
e	**WY2011**		4.9						5.1		4.1		5.2
f	**WY2012**		5.7						4.5		5.0		5.0
	n	0	2	0	0	0	0	1	6	0	3	0	6

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

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

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=		1.00						28.33		3.67		28.33
$Z_k = S_k/\sigma_S$		1.00						-1.69		0.52		-0.94
Z^2_k		1.00						2.86		0.27		0.88

ΣZ_k= -1.11

ΣZ^2_k= 5.01

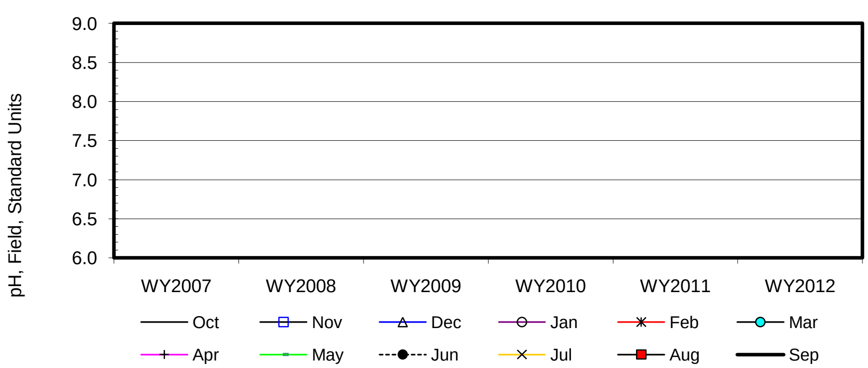
Z-bar=ΣZ_k/K= -0.28

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	18	0	0	0	0

Σn 18

ΣS_k -12

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=		4.71	@α=5% $\chi^2_{(K-1)}$= 7.81	Test for station homogeneity	
	p	**0.195**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc}	-1.40	@α/2=2.5% Z= 1.96	**H_0** (No trend)	ACCEPT
61.33	p	**0.080**		**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.37		0.05
0.050	-0.24	**-0.13**	0.00
0.100	-0.21		-0.07
0.200	-0.16		-0.10

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**								48.9				46.1
b	**WY2008**								22.4				10.5
c	**WY2009**								26.4				27.0
d	**WY2010**								8.7		10.5		0.0
e	**WY2011**		0.0						19.1		0.0		31.0
f	**WY2012**		19.9						0.0		7.1		18.3
	n	0	2	0	0	0	0	0	6	0	3	0	6

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

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

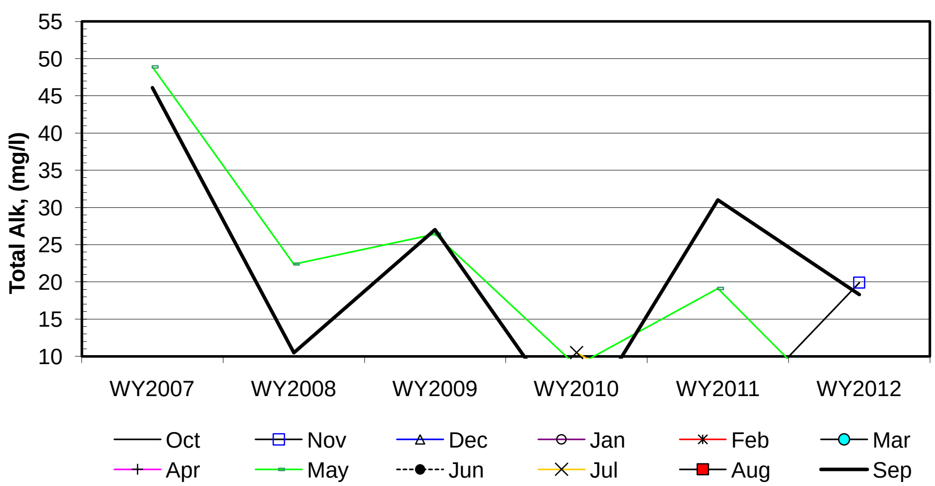
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
$\sigma^2{}_S=$		1.00						28.33		3.67		28.33
$Z_k = S_k/\sigma_S$		1.00						-2.07		-0.52		-0.56
$Z^2{}_k$		1.00						4.27		0.27		0.32

$\Sigma Z_k=$	-2.15
$\Sigma Z^2{}_k=$	5.86
Z-bar=$\Sigma Z_k/K=$	-0.54

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

Σn	17
ΣS_k	-14

$\chi^2{}_h=\Sigma Z^2{}_k$-K(Z-bar)^2=	4.70	@α=5% $\chi^2{}_{(K-1)}$=	7.81	Test for station homogeneity	
p	**0.195**			$\chi^2{}_h<\chi^2{}_{(K-1)}$	ACCEPT
ΣVAR(S_k) Z_{calc}	-1.66	@α/2=2.5% Z=	1.96	H_0 (No trend)	ACCEPT
61.33 p	**0.048**			H_A ($\pm$ trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-12.78		2.22
0.050	-10.10	**-5.41**	-1.44
0.100	-9.55		-2.88
0.200	-7.85		-3.74

Site **#29** Seasonal Kendall analysis for Sulfate, Total (mg/l)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**								0.0				0.0
b	**WY2008**								0.0				0.0
c	**WY2009**								0.3				0.2
d	**WY2010**								0.0		0.0		0.0
e	**WY2011**		0.0						0.0		0.0		0.0
f	**WY2012**		0.0						0.0		0.0		0.0
	n	0	2	0	0	0	0	0	6	0	3	0	6

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

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

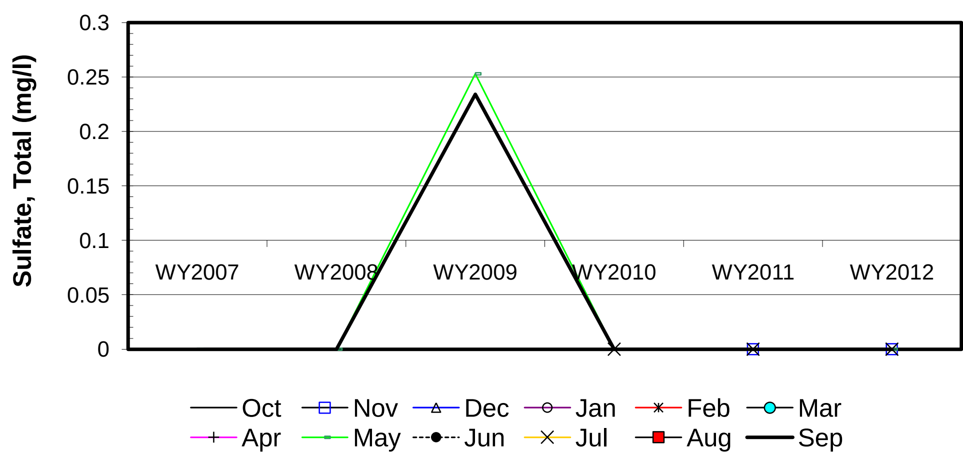
	Nov	May	Jul	Sep
σ^2_S=	0.00	11.67	0.00	11.67
$Z_k = S_k/\sigma_S$	#DIV/0!	-0.29	#DIV/0!	-0.29
Z^2_k	#DIV/0!	0.09	#DIV/0!	0.09

ΣZ_k= #DIV/0!
ΣZ^2_k= #DIV/0!
Z-bar=ΣZ_k/K= #DIV/0!

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	2	1	1	0	2

Σn 17
ΣS_k -2

$\chi^2_h = \Sigma Z^2_k - K(\text{Z-bar})^2$=	#DIV/0!	@α=5% $\chi^2_{(K-1)}$= 7.81	Test for station homogeneity	
p	**#DIV/0!**		$\chi^2_h < \chi^2_{(K-1)}$	#DIV/0!
ΣVAR(S_k) 23.33	Z_{calc} -0.21	@α=2.5% Z= 1.96	**H_0** (No trend)	ACCEPT
	p **0.418**		**H_A** (± trend)	#DIV/0!



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	0.00		0.00
0.050	0.00	**0.00**	0.00
0.100	0.00		0.00
0.200	0.00		0.00

#DIV/0!

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	WY2007								5.7				2.9
b	WY2008								17.0				4.4
c	WY2009								10.1				10.9
d	WY2010								3.7		3.4		2.8
e	WY2011		6.0						51.3		36.7		5.6
f	WY2012		27.9						2.6		2.1		1.9
	n	0	2	0	0	0	0	0	6	0	3	0	6

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

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

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

ΣZ_k= -0.65

ΣZ^2_k= 1.91

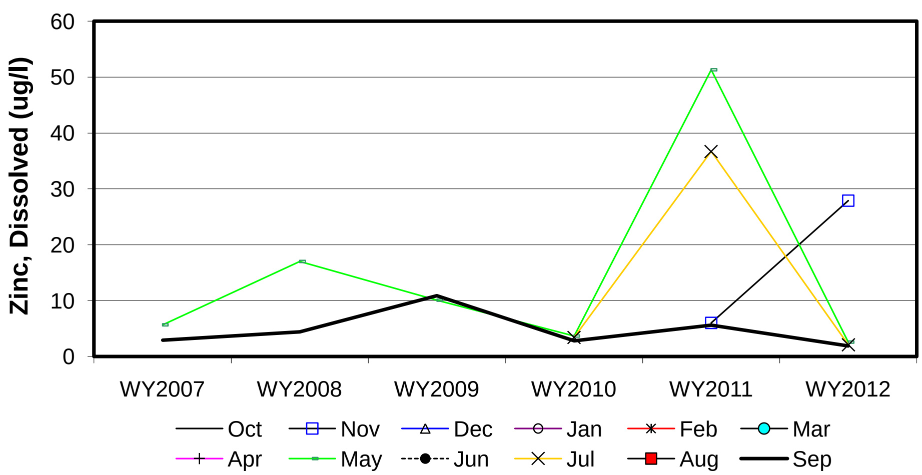
Z-bar=ΣZ_k/K= -0.16

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

Σn 17

ΣS_k -6

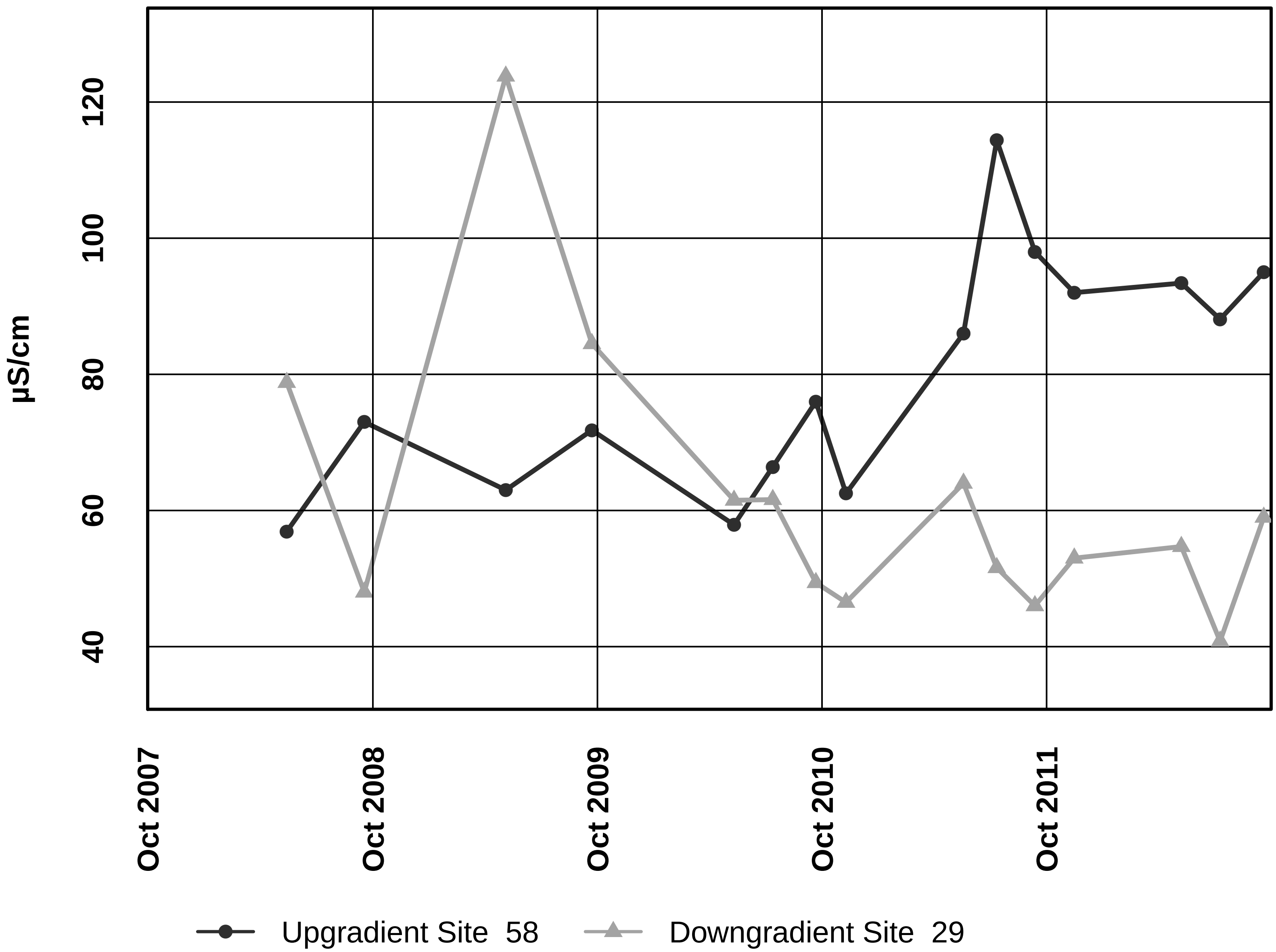
$\chi^2_h=\Sigma Z^2_k$-K(Z-bar)^2= 1.80		@α=5% $\chi^2_{(K-1)}$= 7.81	Test for station homogeneity	
	p **0.614**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc} -0.64	@α/2=2.5% Z= 1.96	**H_0** (No trend)	ACCEPT
61.33	**p** **0.262**		**H_A** ($\pm$ trend)	REJECT

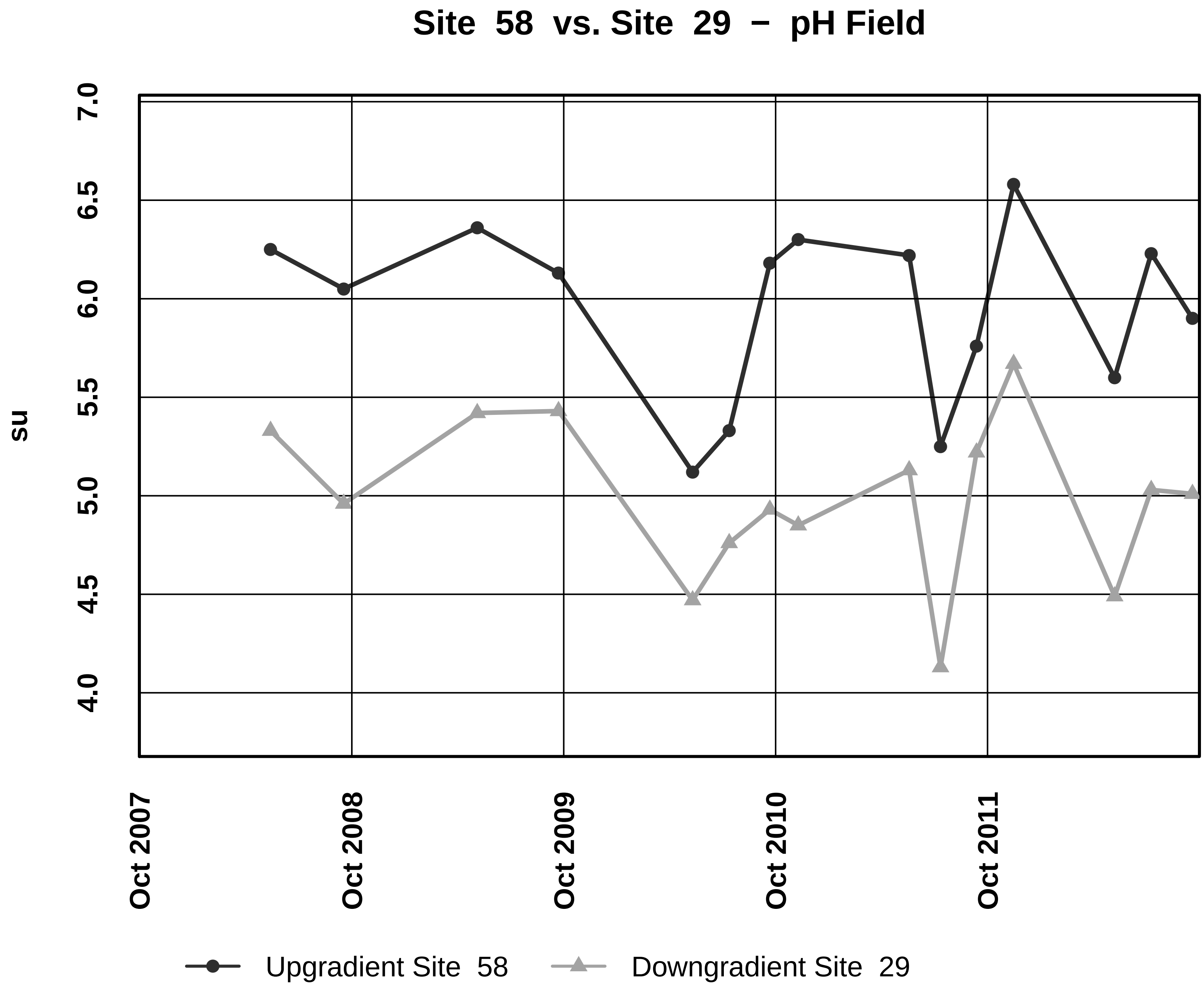


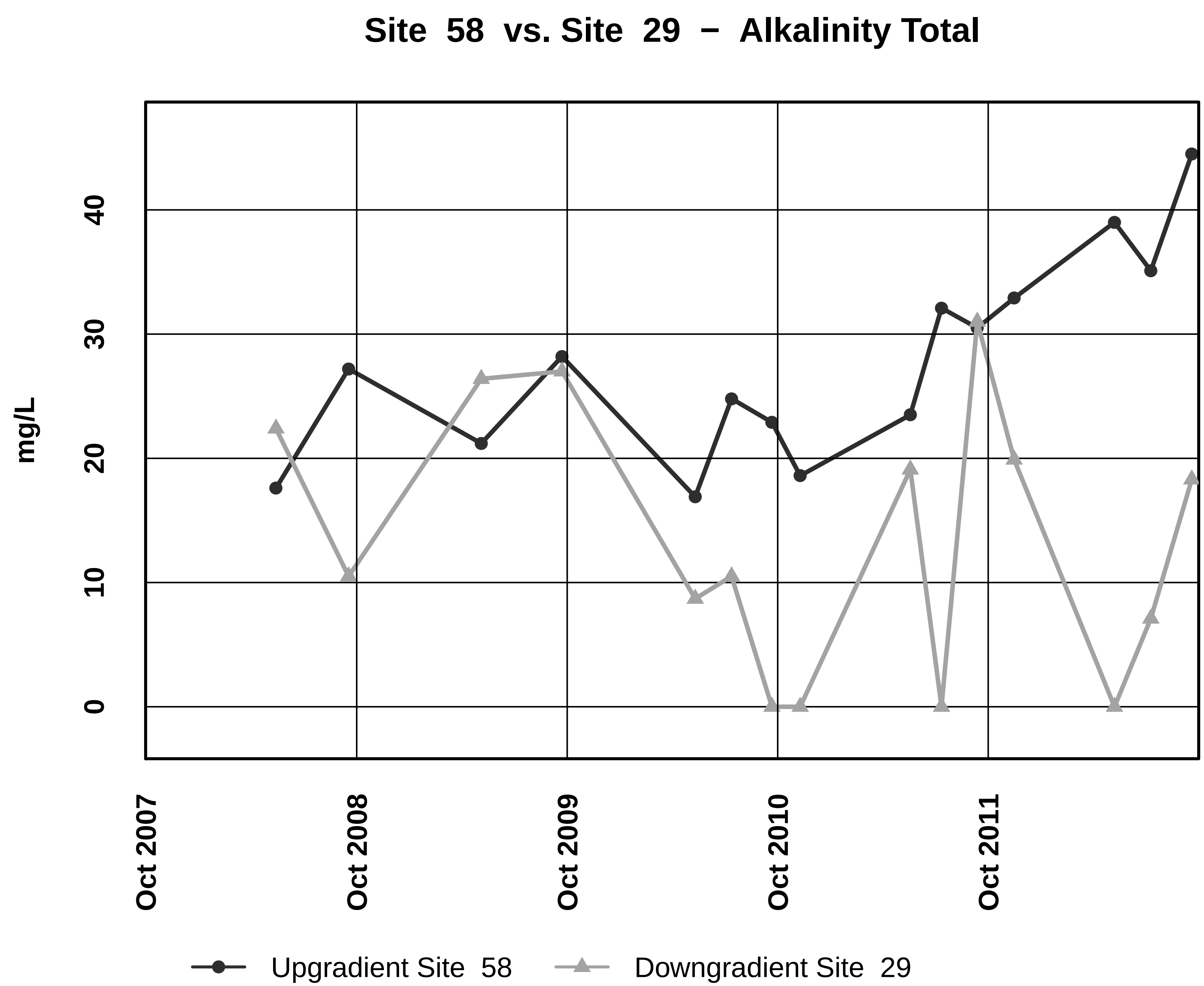
Seasonal-Kendall Slope Confidence Intervals

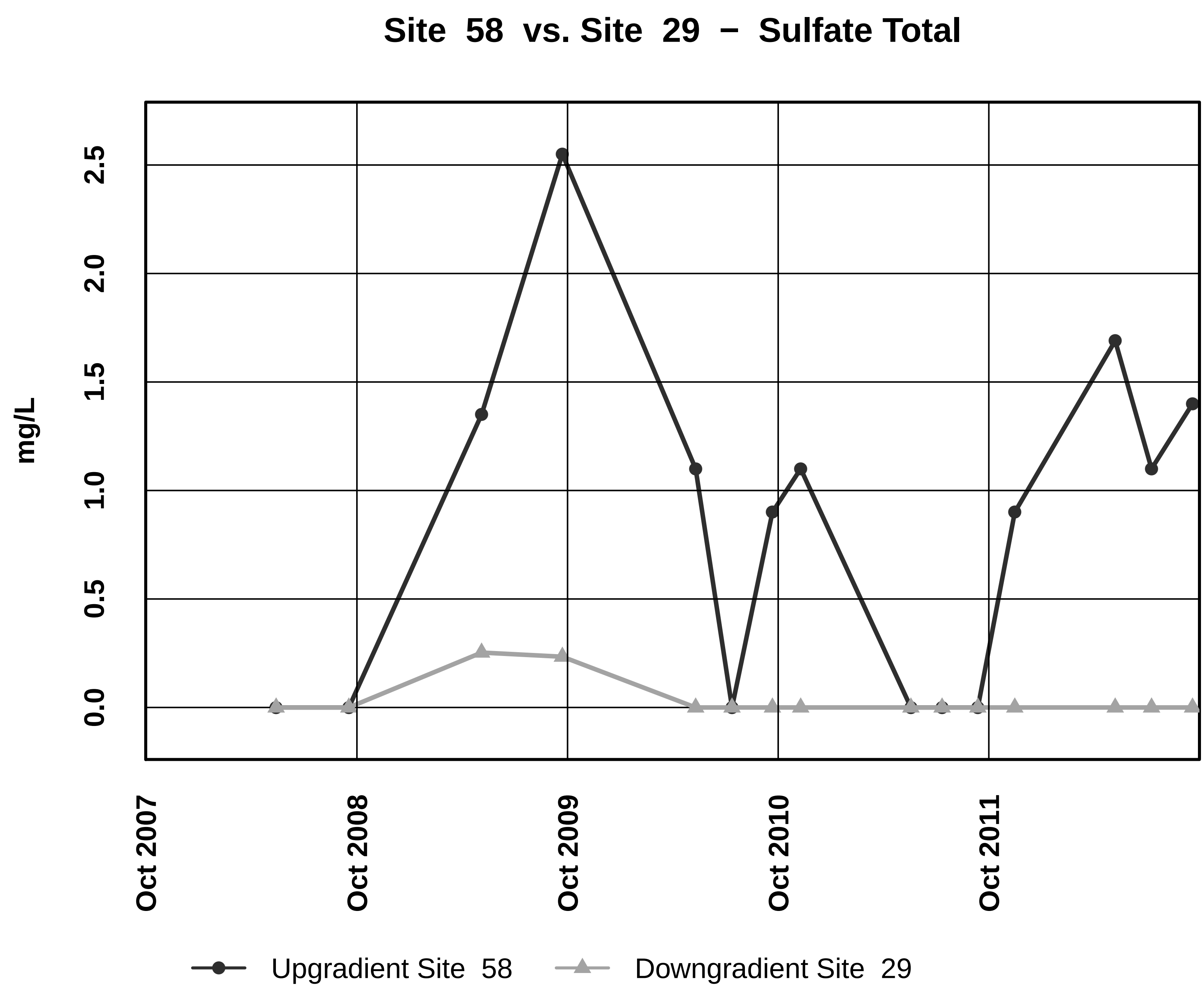
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-3.61		4.27
0.050	-2.56	**-0.49**	1.81
0.100	-0.83		0.69
0.200	-0.66		0.10

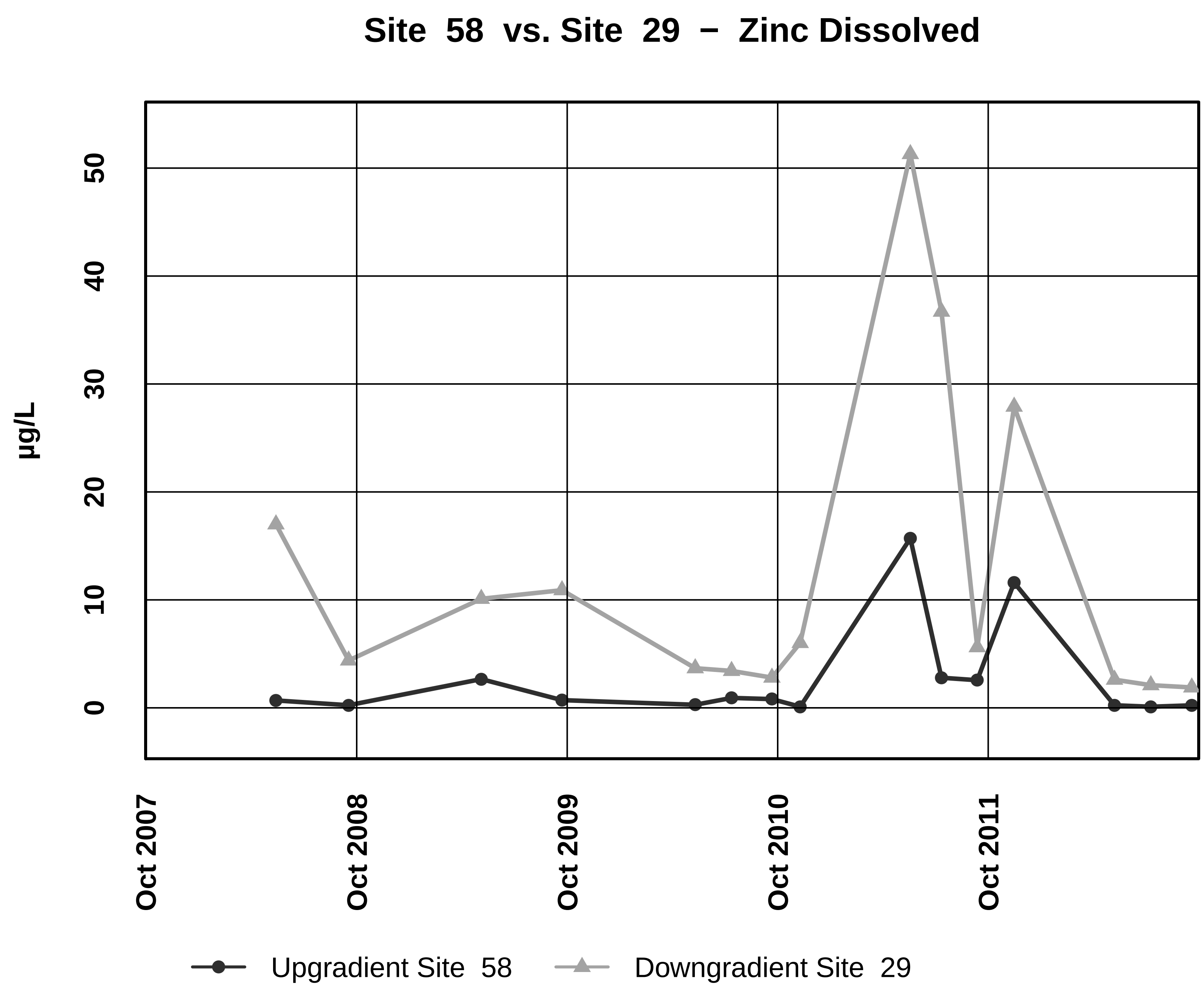
Site 58 vs. Site 29 − Conductivity Field




Site 58 vs. Site 29 − pH Field
su
7.0
6.5
6.0
5.5
5.0
4.5
4.0
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 58
Downgradient Site 29


Site 58 vs. Site 29 − Alkalinity Total
mg/L
0
10
20
30
40
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 58
Downgradient Site 29


Site 58 vs. Site 29 − Sulfate Total
mg/L
0.0
0.5
1.0
1.5
2.0
2.5
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 58
Downgradient Site 29



Site 58 vs. Site 29 − Zinc Dissolved
µg/L
0
10
20
30
40
50
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 58
Downgradient Site 29

INTERPRETIVE REPORT
SITE 32

The data collected during the current water year are listed in the following "Table of Results for Water Year 2012" report. The table includes all the required FWMP analyte data (field and laboratory) collected for the current water year and a series of flags keyed to the summary report "Qualified Data by QA Reviewer". The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of ½ MDL for the purpose of median calculation.

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

Sample Date	Parameter	Value	Qualifier	Notes
No outliers have been identified by HGCMC for the period of October 2007 through September 2012.				

The data for water year 2012 have been compared to the strictest fresh water quality criterion for each applicable analyte. Twelve results exceeding these criteria have been identified as listed in the table below.

Table of Exceedance for Water Year 2012

			Limits		
Sample Date	**Parameter**	**Value**	**Lower**	**Upper**	**Hardness**
15-Nov-11	Alkalinity	16.5 mg/L	20		
15-Nov-11	Lead Dissolved	2.43 µg/L		0.54	9.02 mg/L
15-Nov-11	pH Field	5.32 su	6.5	8.50	
7-May-12	Alkalinity	8.5 mg/L	20		
7-May-12	Lead Dissolved	1.06 µg/L		0.54	8.67 mg/L
7-May-12	pH Field	4.63 su	6.5	8.50	
9-Jul-12	Alkalinity	5.9 mg/L	20		
9-Jul-12	Lead Dissolved	0.95 µg/L		0.54	8.51 mg/L
9-Jul-12	pH Field	5.19 su	6.5	8.50	
18-Sep-12	Alkalinity	15.5 mg/L	20		
18-Sep-12	Lead Dissolved	1.69 µg/L		0.54	9.38 mg/L
18-Sep-12	pH Field	4.96 su	6.5	8.50	

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, 38 of the past 39 samples have returned lead values higher than the AWQS. As noted in the interpretive section for Site 29 fugitive tailings dust may be contributing to the elevated lead levels monitored at Site 32.

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

X-Y plots have been generated to graphically present the data for each of the analytes requested in the Statistical Information Goals for this site. These plots have been visually analyzed for the appearance of any trend in concentration. No obvious trends are apparent except for dissolved lead which has generally decreased the last five water years from a peak in water year 2006. A non-parametric statistical analysis for trend was performed for specific conductivity, field pH, total alkalinity, total sulfate, and dissolved zinc. Calculation details of the Seasonal Kendall analyses are presented in detail on the pages following this interpretive section. The adjacent table summarizes the results on the data collected between Oct-06 and Sep-12(WY2007-WY2012).

Table of Summary Statistics for Trend Analysis

	Mann-Kendall test statistics			Sen's slope estimate	
Parameter	**n***	**p****	**Trend**	**Q**	**Q(%)**
Conductivity Field	6	0.19			
pH Field	6	0.02	-	-0.066	-1.285
Alkalinity, Total	6	0.35			
Sulfate, Total	6	Inconsistent detection limits			
Zinc, Dissolved	6	0.15			

* Number of Years ** Significance level

There was a significant negative (p=0.02) trend in field pH having a slope of -0.07 su/yr or a -1.3% this analysis. Trend analysis was not performed on the total sulfate dataset because of a change in the method detection limit used by Analytica Laboratories. A primary assumption of the Mann-Kendall test is "… only one censoring threshold exists. When more than one detection limit exists, the Mann-Kendall test cannot be performed without further censoring the data." In order to prevent this from occurring HGCMC has worked to establish a consistent MDL for sulfate from the laboratory.

Additional X-Y plots have been generated for total alkalinity, field pH, specific conductance, total sulfate, and dissolved zinc that co-plot data from Site 32 and Site 58, the upgradient control site, to aid in comparison between those two sites. Typically, total sulfate, and total alkalinity are slightly higher at Site 58 while field pH is more basic at Site 58 than at Site 32. Field conductivity is usually similar in range until the last few measurements from the 2011& 2012 water years. The increase in conductivity seen in dataset for Site 58 is likely a result of the construction of the East Ridge Expansion. Dissolved zinc levels are higher at Site 32 than at Site 58. The long-term median value for dissolved zinc since June 1998 is ~10.0 µg/L, which is elevated with respect to Site 58 and the other shallow wells completed into peat (*e.g.* Site 27 and Site 29). The previously discussed mechanisms (fugitive dust) that may be elevating the dissolved lead levels would also be expected to increase dissolved zinc. In addition the lower pH at Site 32 with respect to the other shallow wells may exacerbate the elevated zinc concentration due to higher zinc solubility at lower pHs.

Table of Results for Water Year 2012

Site 032FMG - 'Monitoring Well - 5S'

Sample Date/Parameter	Oct 2011	Nov 2011	Dec 2011	Jan 2012	Feb 2012	Mar 2012	Apr 2012	May 2012	Jun 2012	Jul 2012	Aug 2012	Sep 2012	**Median**
Water Temp (°C)		6						7.6		7.9		8	7.8
Conductivity-Field(μmho)		58						120.6		64.5		64	64.3
Conductivity-Lab (μmho)		64						59		59		63	61
pH Lab (standard units)		5.01						4.74		4.63		4.78	4.76
pH Field (standard units)		5.32						4.63		5.19		4.96	5.08
Total Alkalinity (mg/L)		16.5						8.5		5.9		15.5	12.0
Total Sulfate (mg/L)		5						5		5		1.3	5.0
Hardness (mg/L)		9						8.7		8.5		9.4	8.9
Dissolved As (ug/L)		5.37						3.37		4.56		5.33	4.945
Dissolved Ba (ug/L)		15.4						13.5		13		14.7	14.1
Dissolved Cd (ug/L)		0.0214						0.013		0.0128		0.0219	0.0172
Dissolved Cr (ug/L)		2.64						1.94		2.29		4.86	2.465
Dissolved Cu (ug/L)		1.28						0.852		0.796		0.799	0.826
Dissolved Pb (ug/L)		2.43						1.06		0.95		1.69	1.3750
Dissolved Ni (ug/L)		3.73						3.12		3.25		3.53	3.390
Dissolved Ag (ug/L)		0.005						0.007		0.005		0.006	0.006
Dissolved Zn (ug/L)		25						7.49		6.23		10.2	8.85
Dissolved Se (ug/L)		0.125						0.057		0.6		0.057	0.091
Dissolved Hg (ug/L)		0.00179						0.00135		0.00123		0.00139	0.001370

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 KGCMC and removed from any further analysis and is not included into the calculation of the median

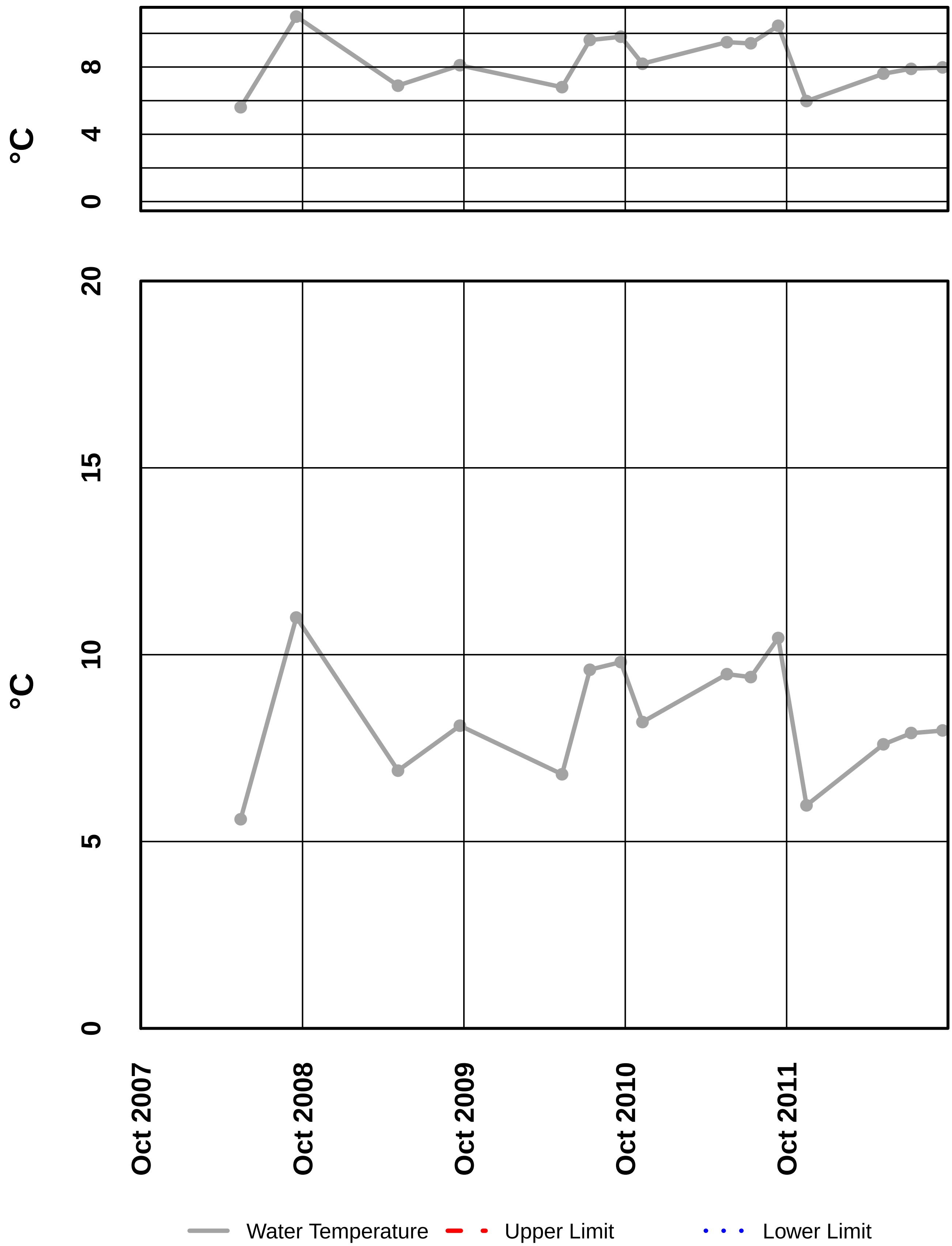
Qualified Data by QA Reviewer

Date Range: 10/01/2011 to 09/30/2012

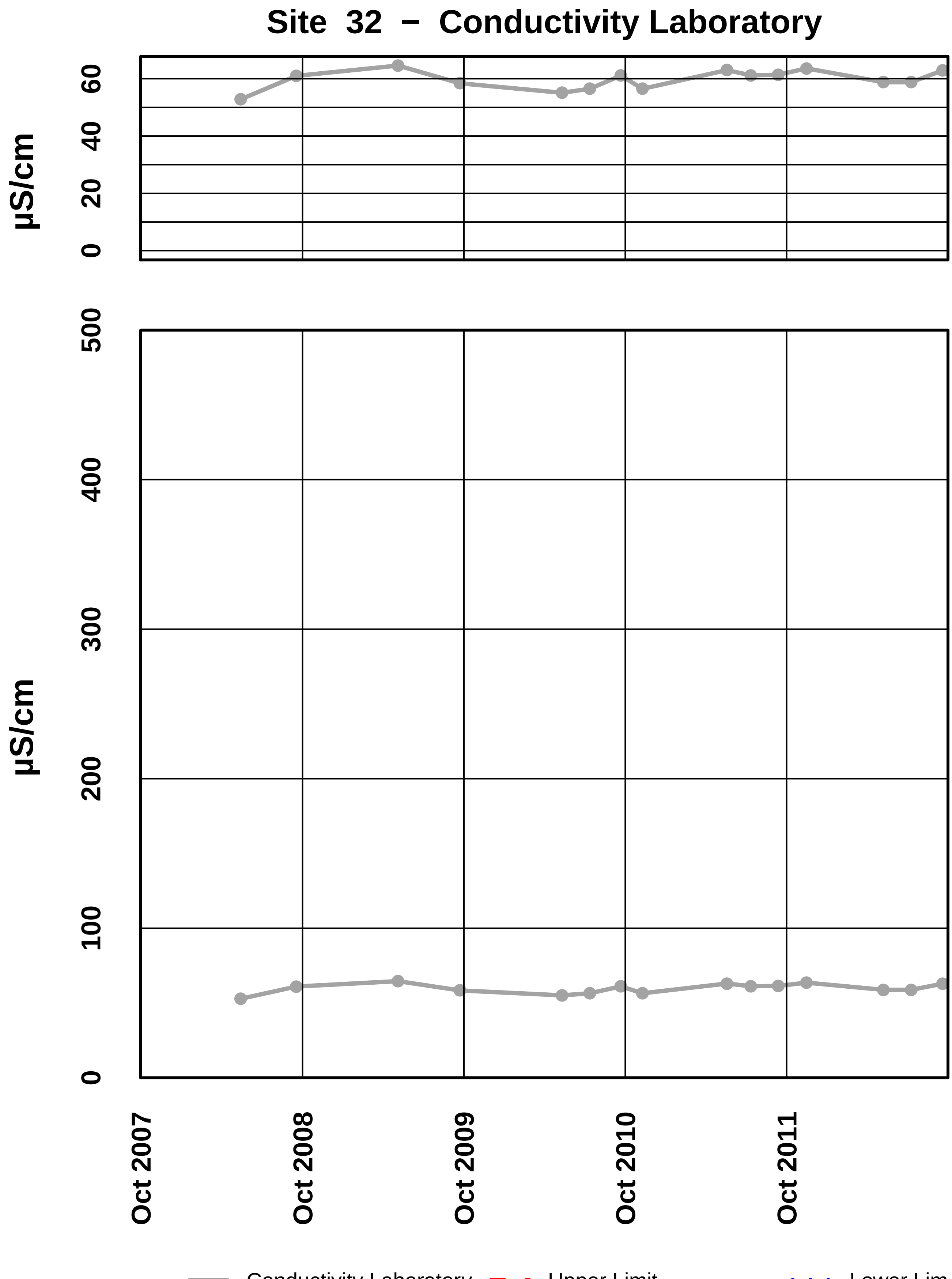
Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
32	11/15/2011	12:00 AM	Ag diss, µg/l	0.00491	U	Field Blank Contamination
			Se diss, µg/l	0.12	J	Below Quantitative Range
32	5/7/2012	12:00 AM	Ag diss, µg/l	0.00665	J	Below Quantitative Range
			SO4 Tot, mg/l	-10	UJ	Sample Receipt Temperature
32	7/9/2012	12:00 AM	Ag diss, µg/l	0.00526	J	Below Quantitative Range
32	9/18/2012	12:00 AM	Ag diss, µg/l	0.00566	J	Below Quantitative Range
			SO4 Tot, mg/l	-2.5	UJ	Sample Receipt Temperature

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

Site 32 – Water Temperature

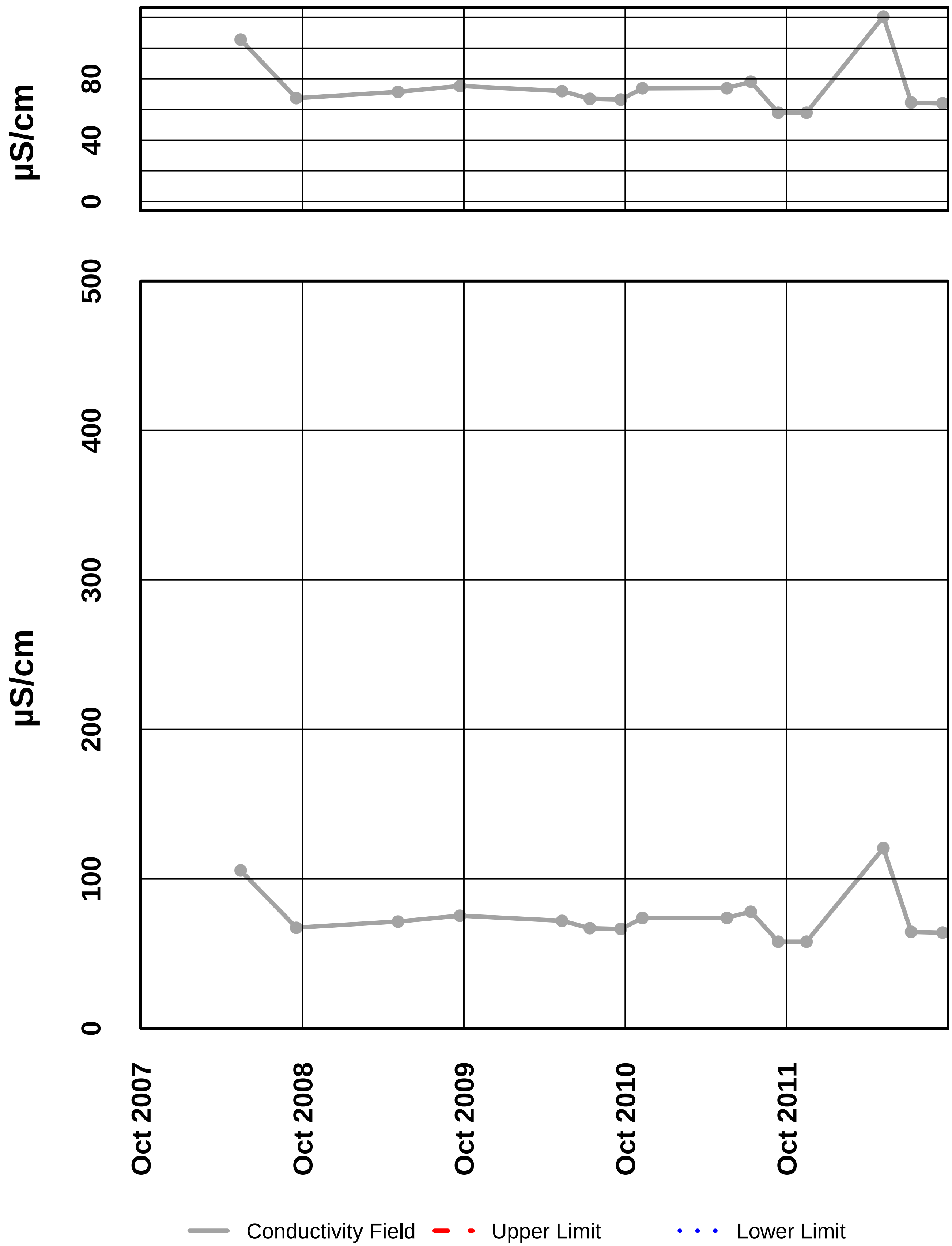


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

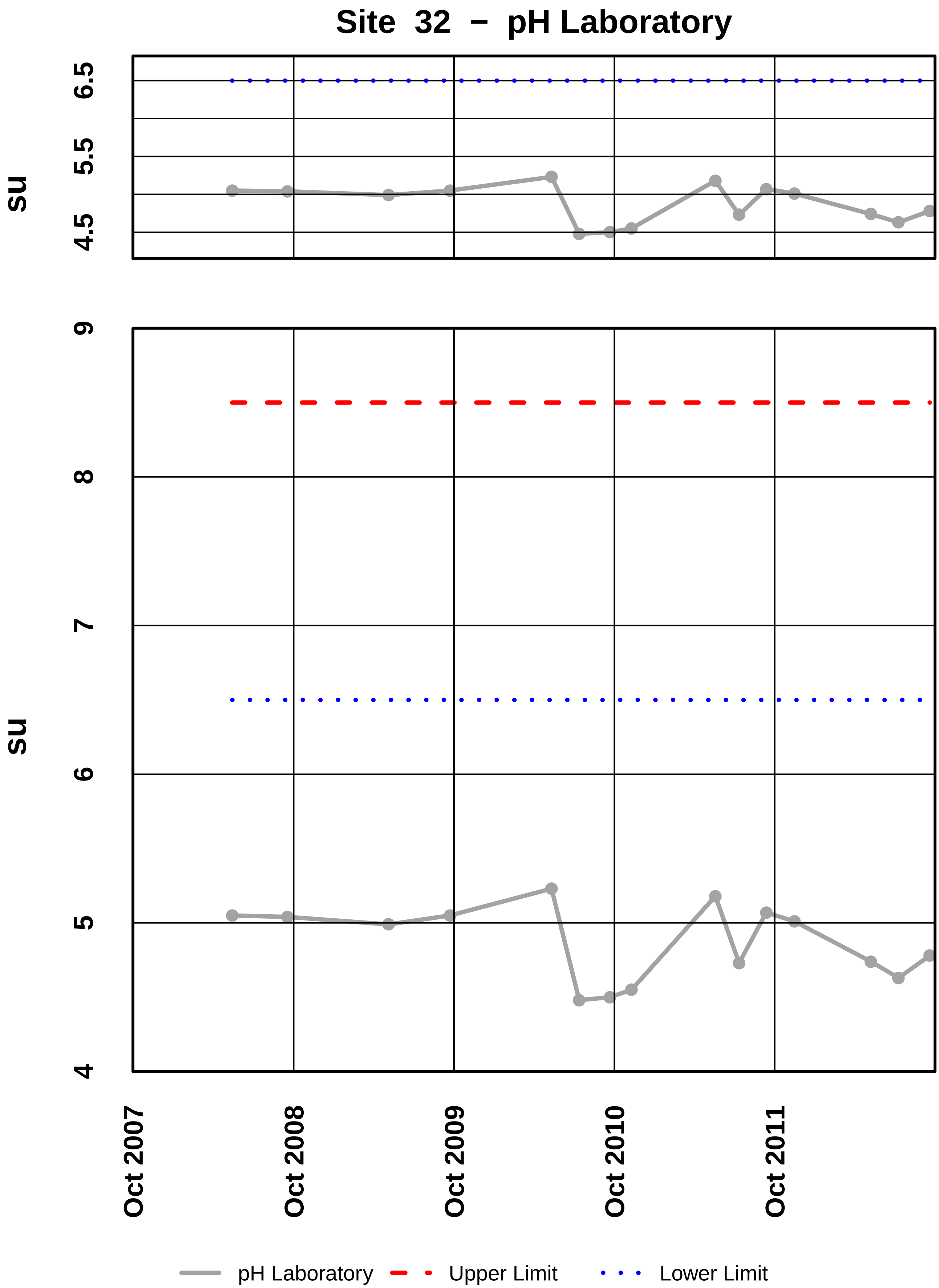


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 32 – Conductivity Field

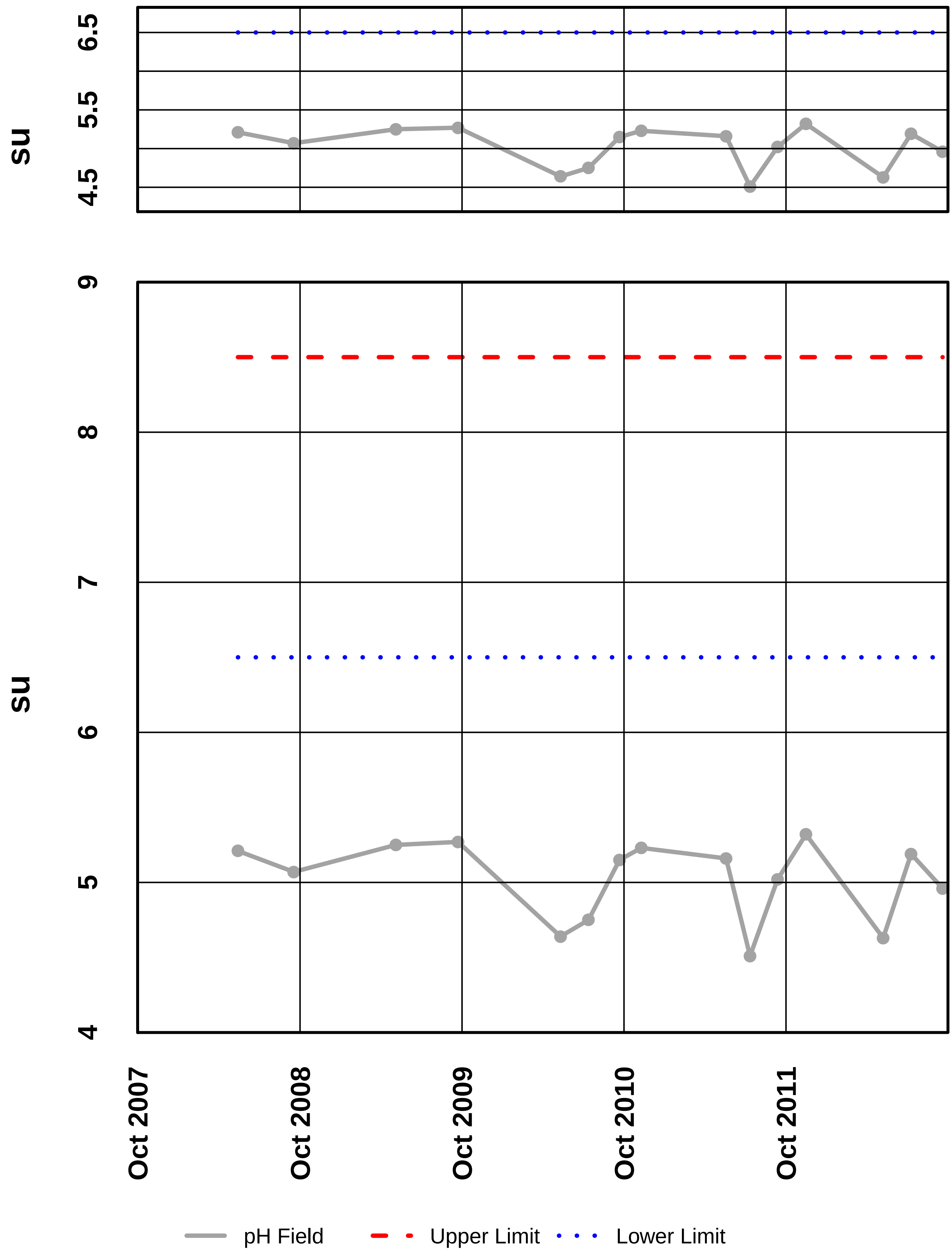


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



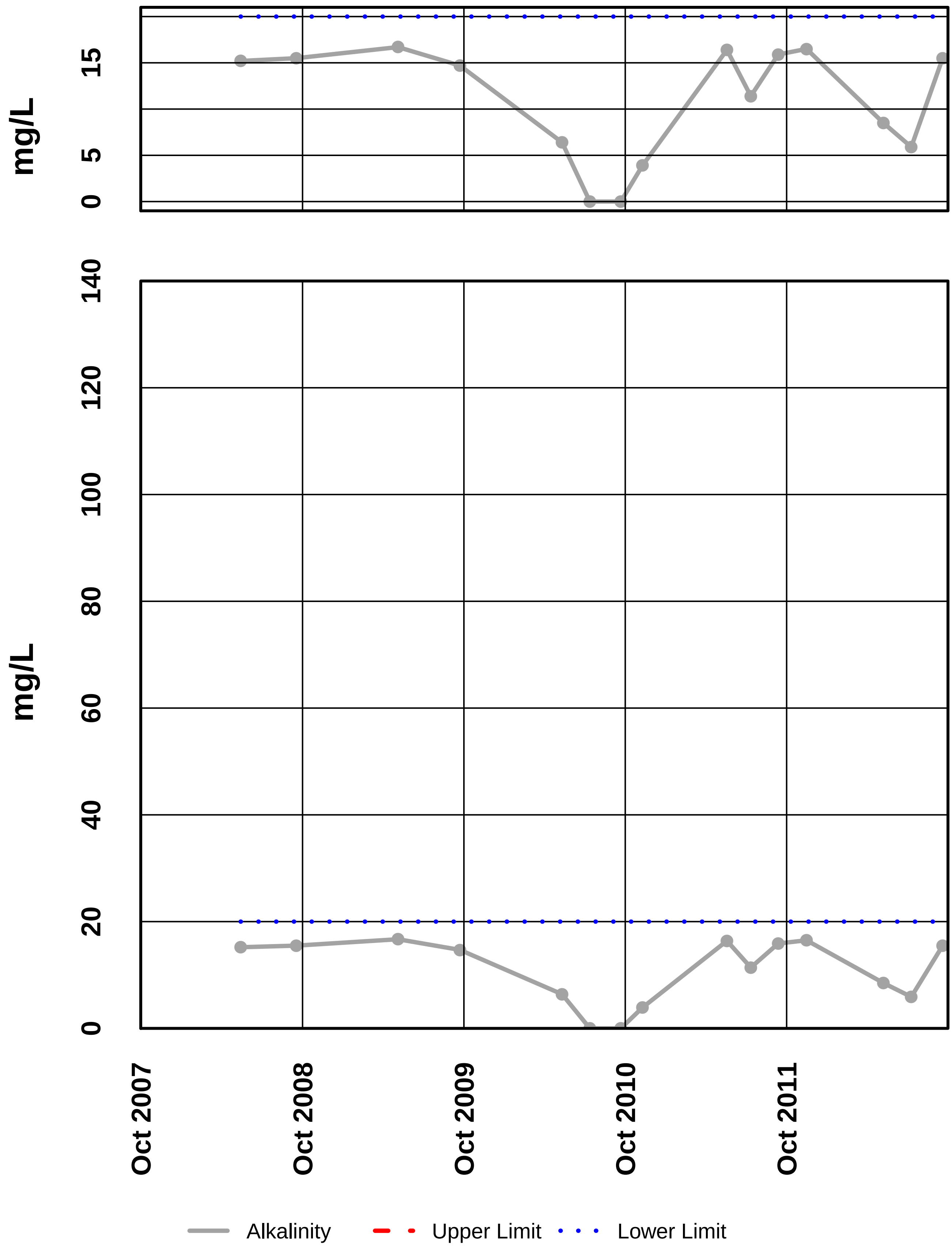
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 32 – pH Field

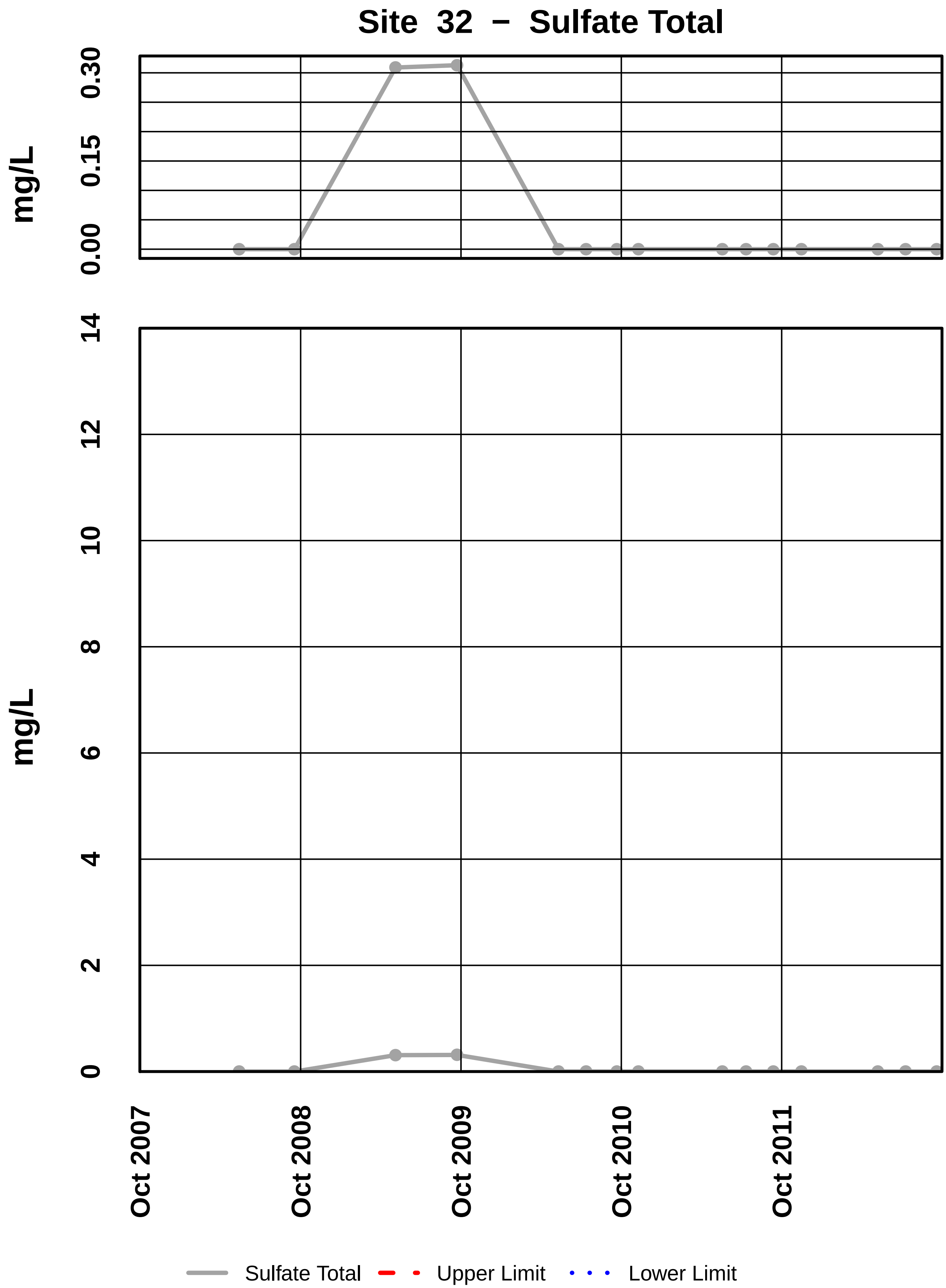


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 32 − Alkalinity

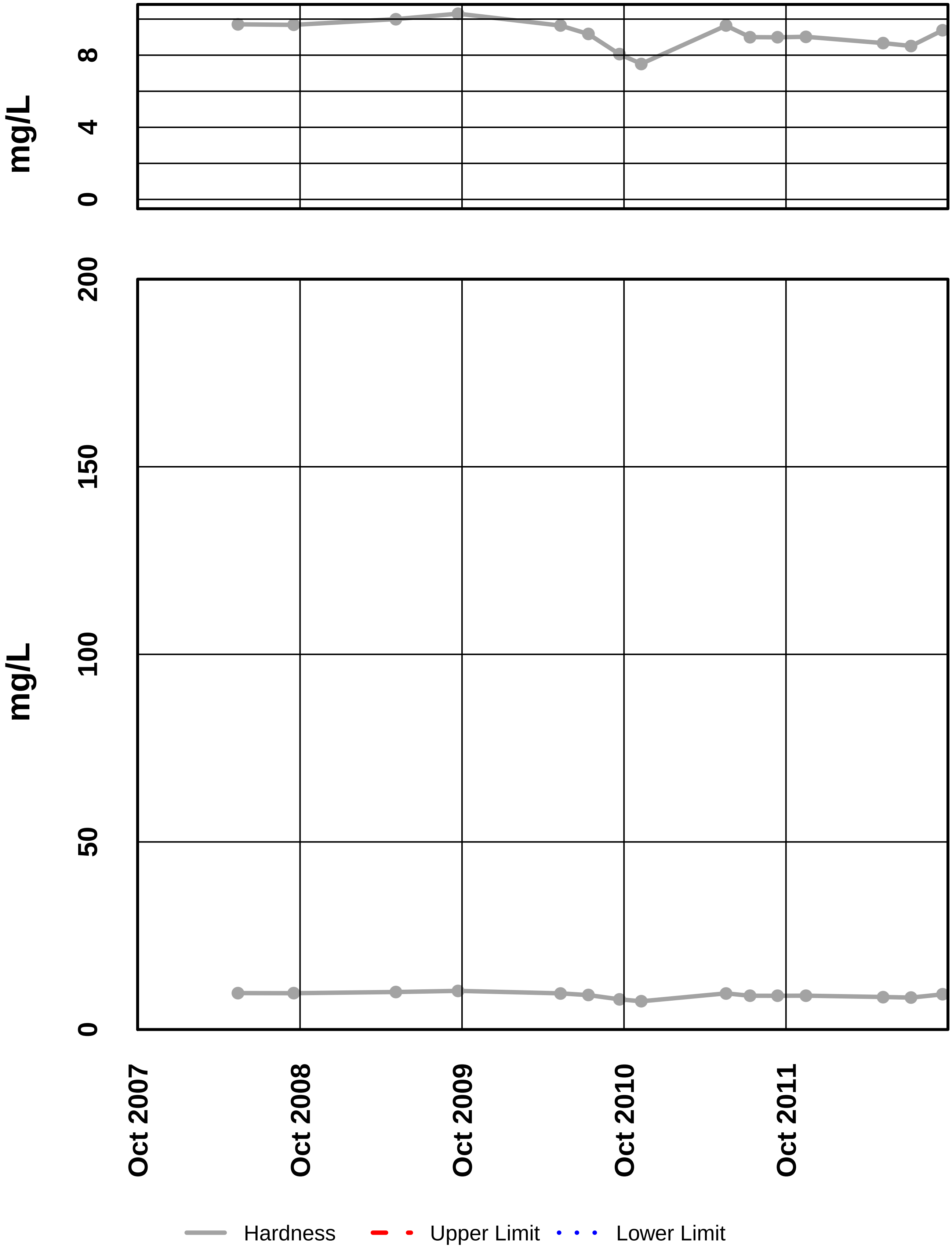


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

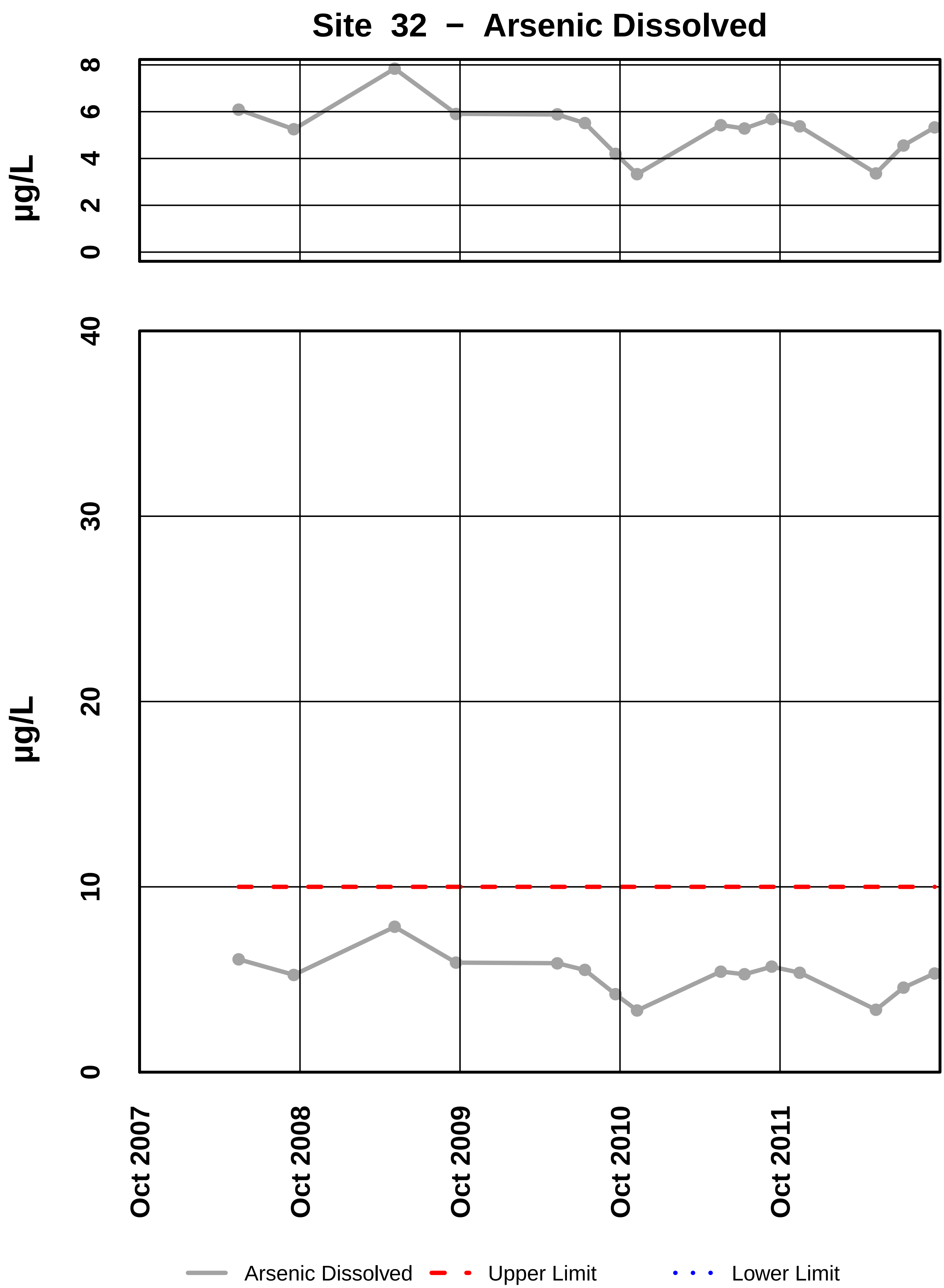


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

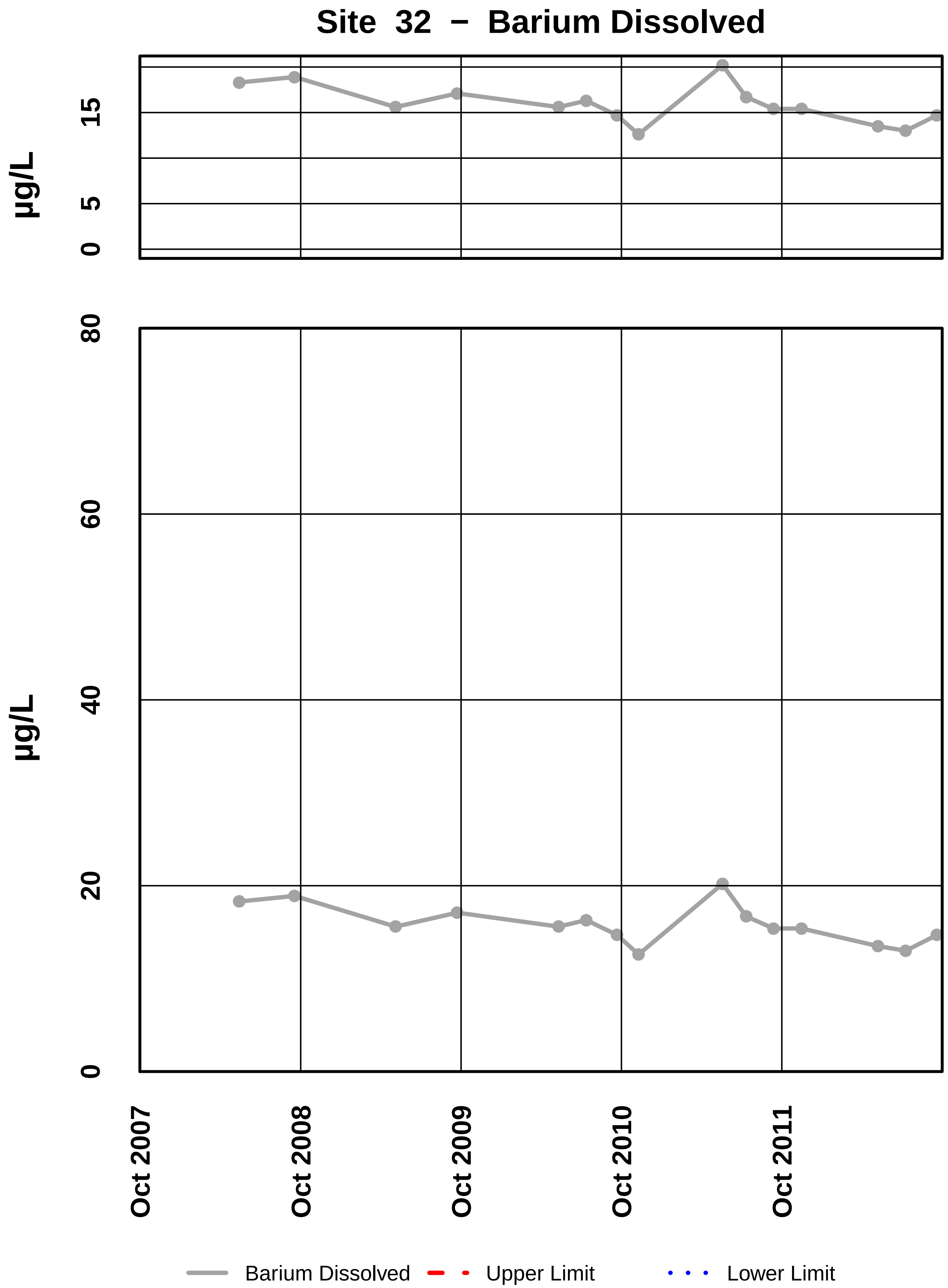
Site 32 − Hardness



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

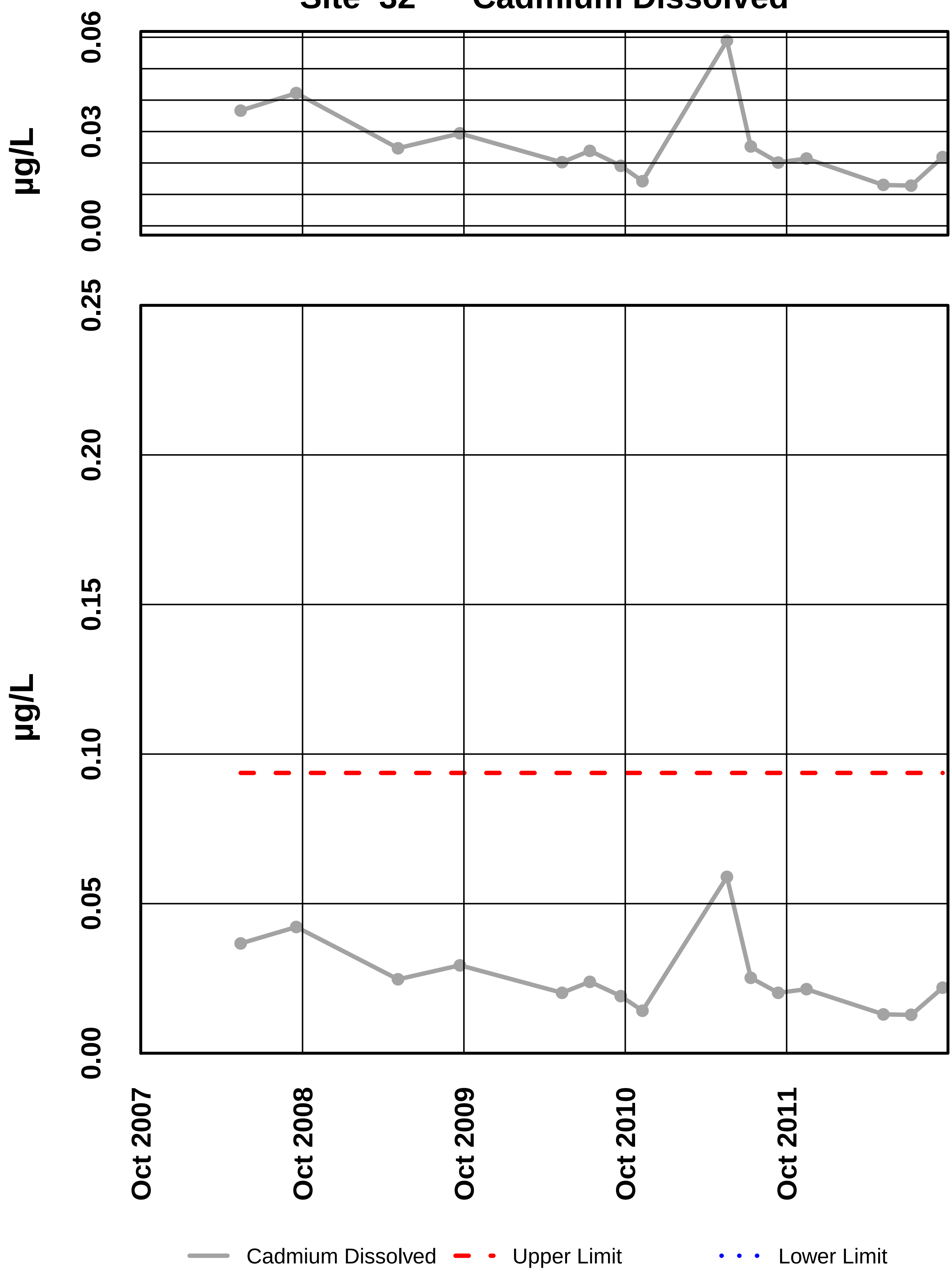


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

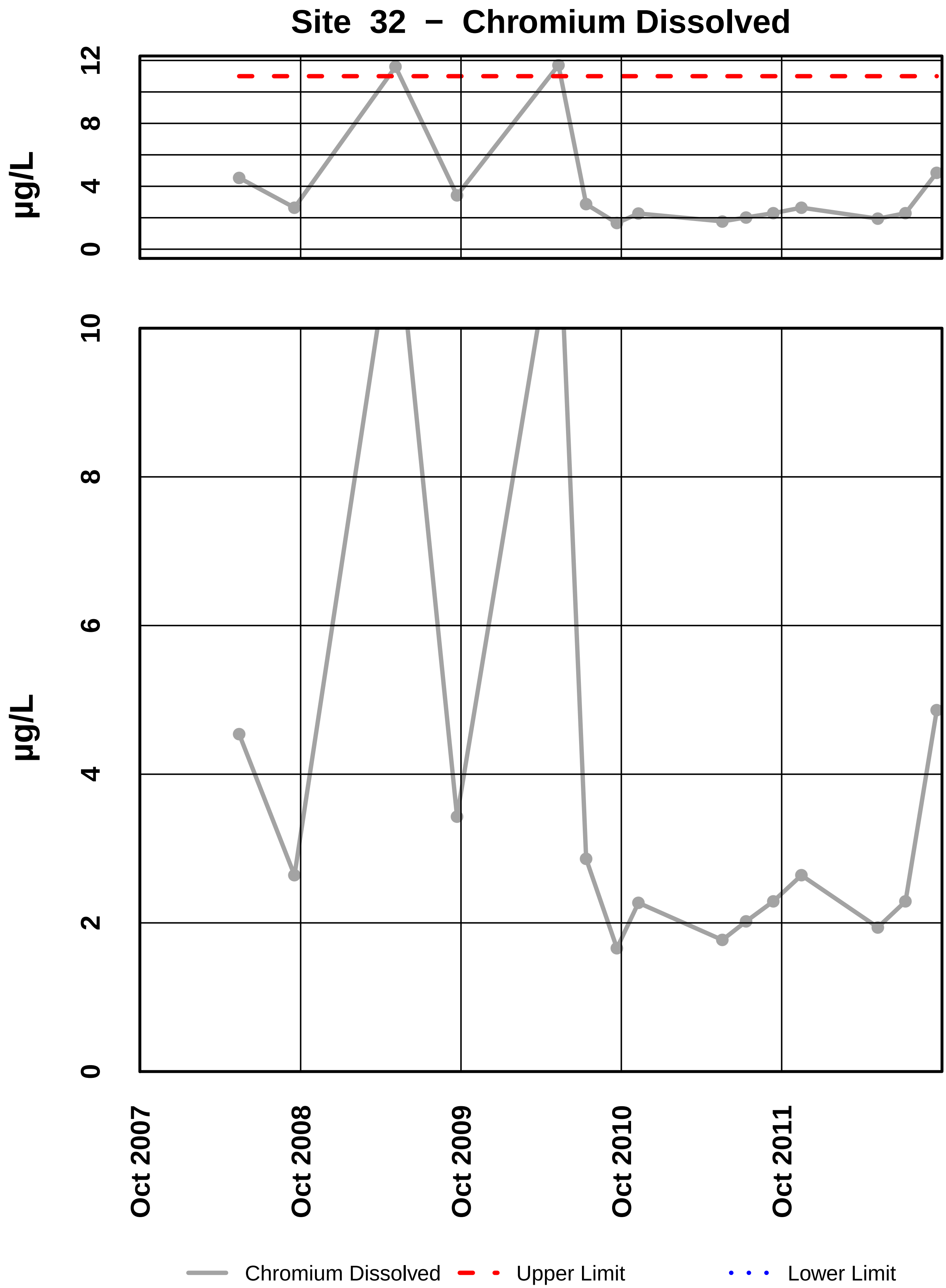


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

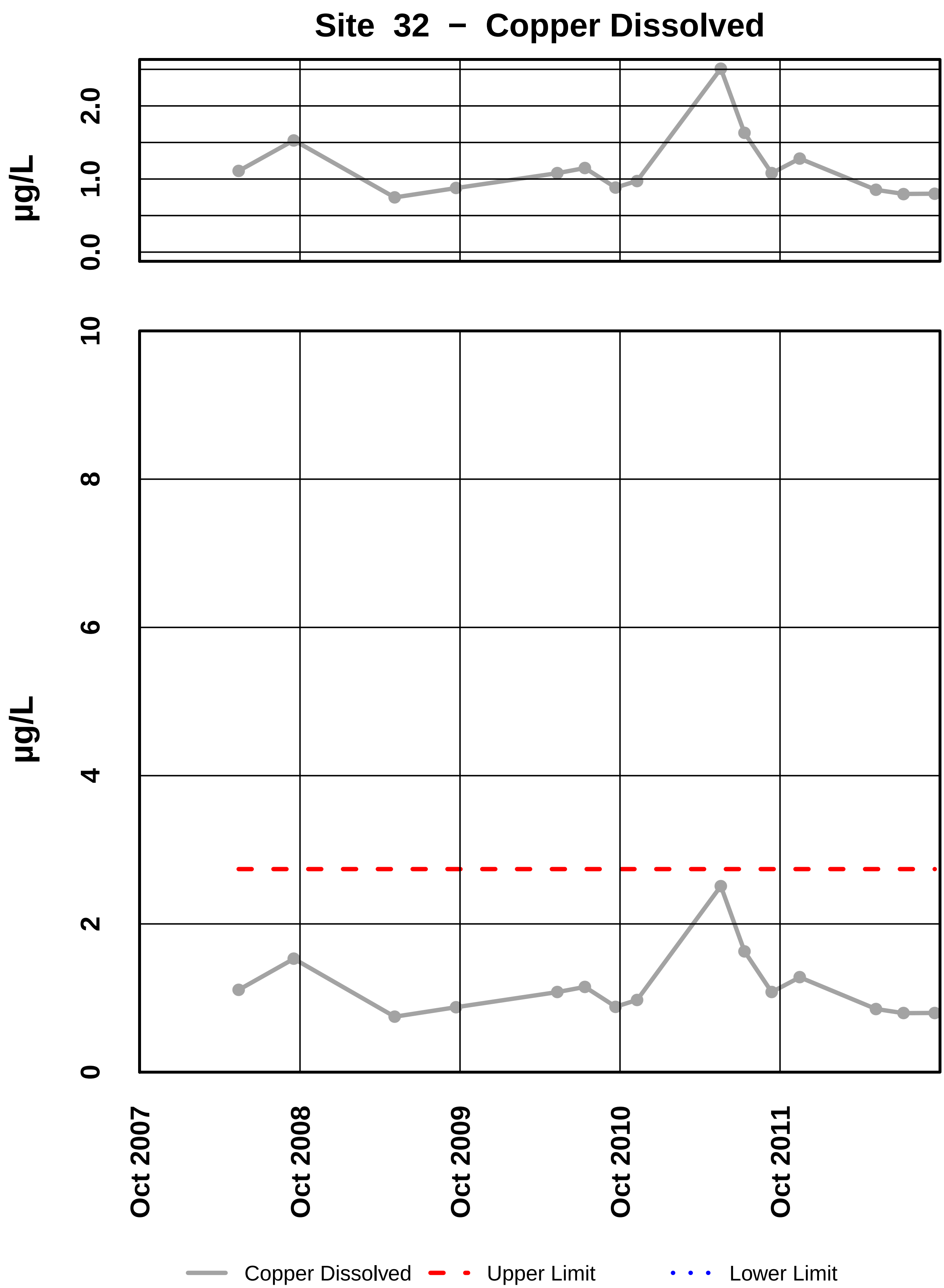
Site 32 − Cadmium Dissolved



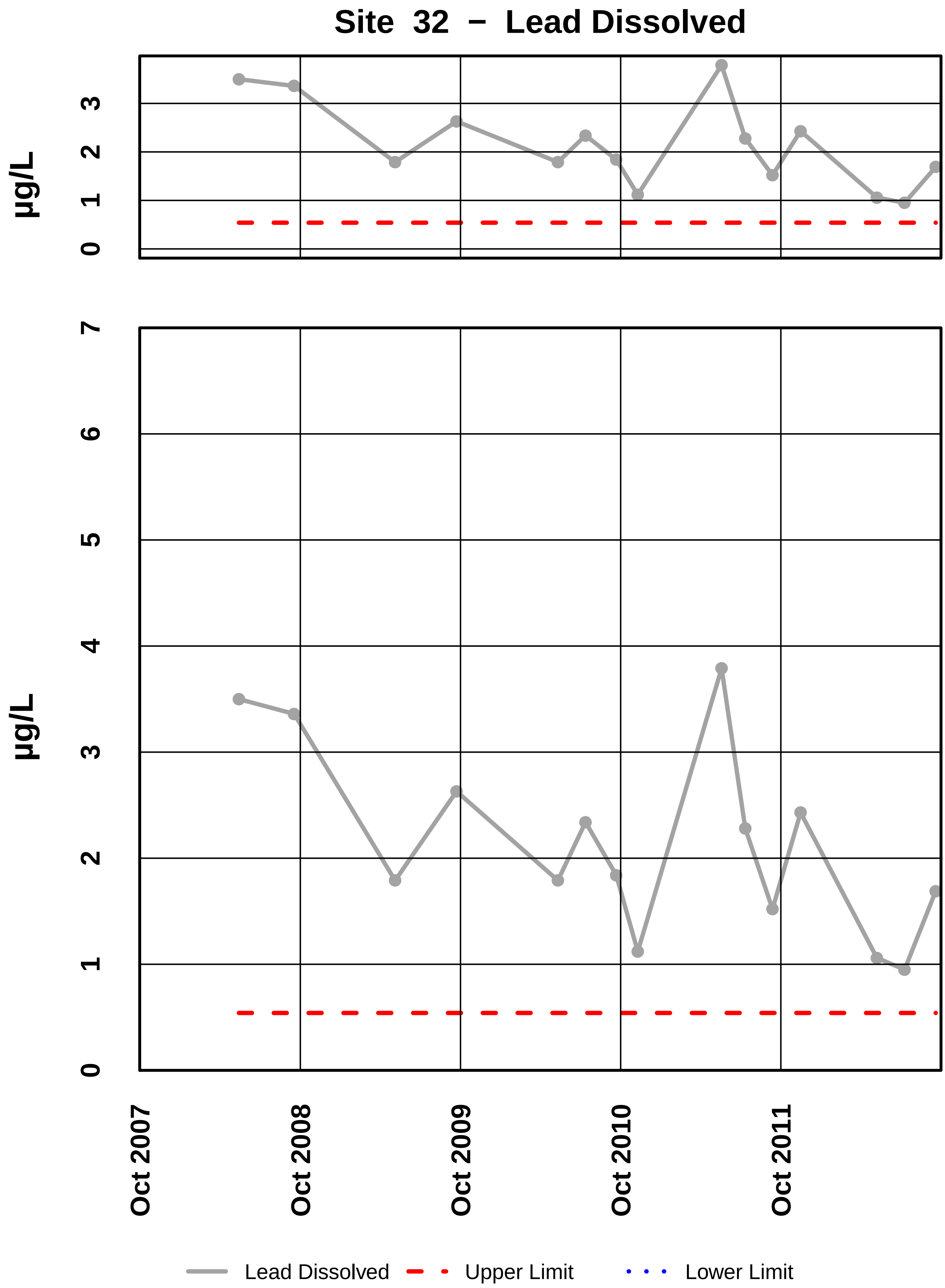
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

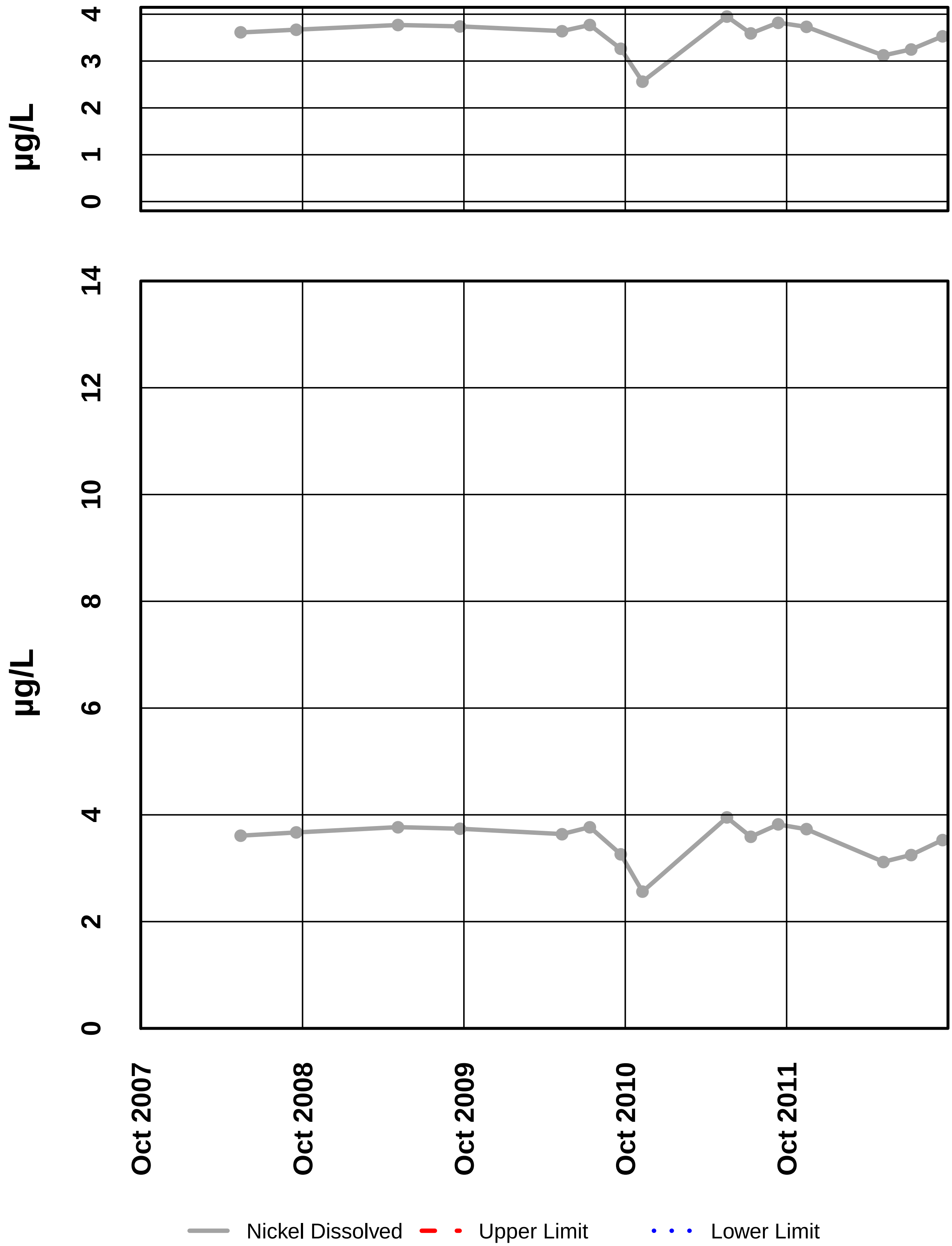


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



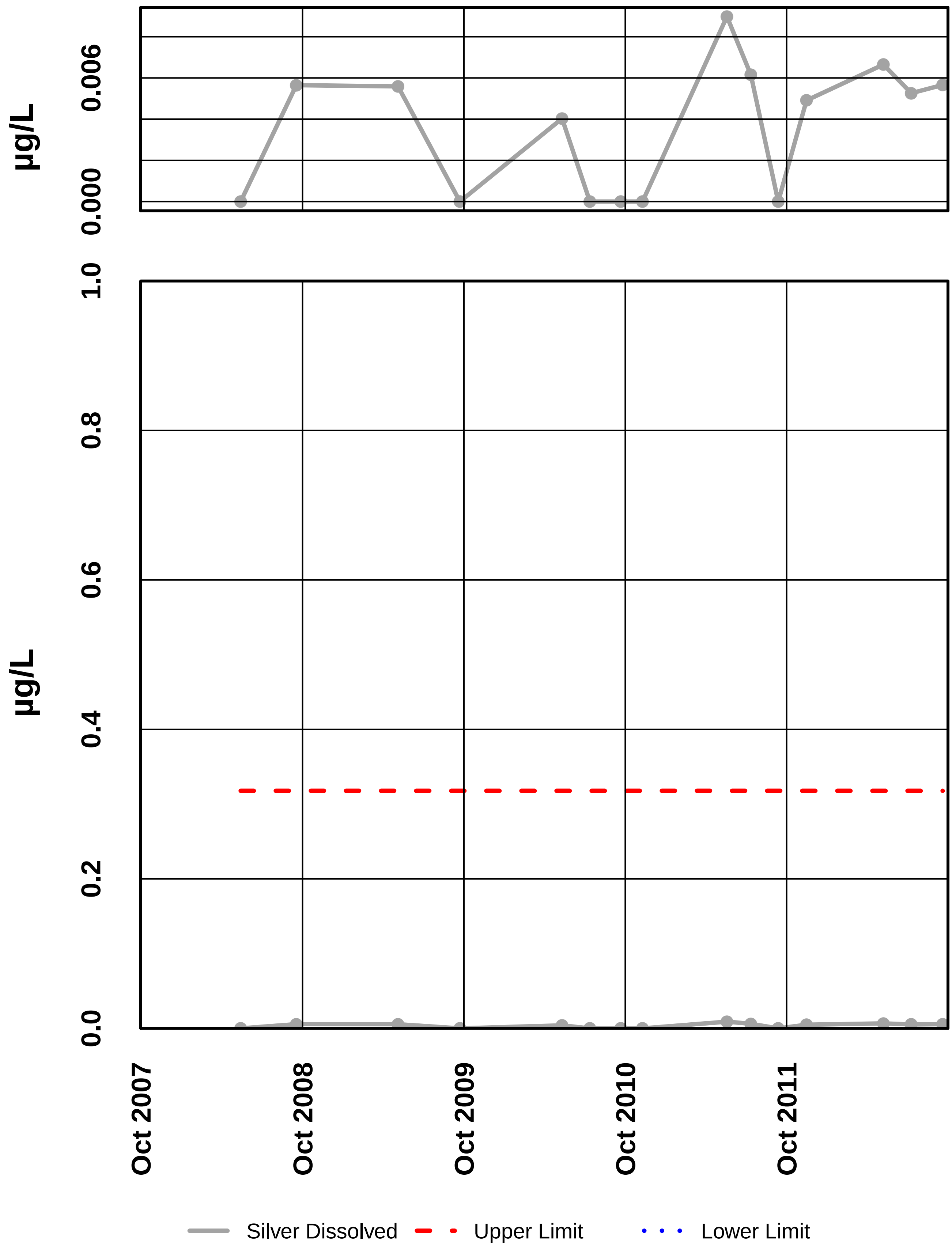
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 32 – Nickel Dissolved



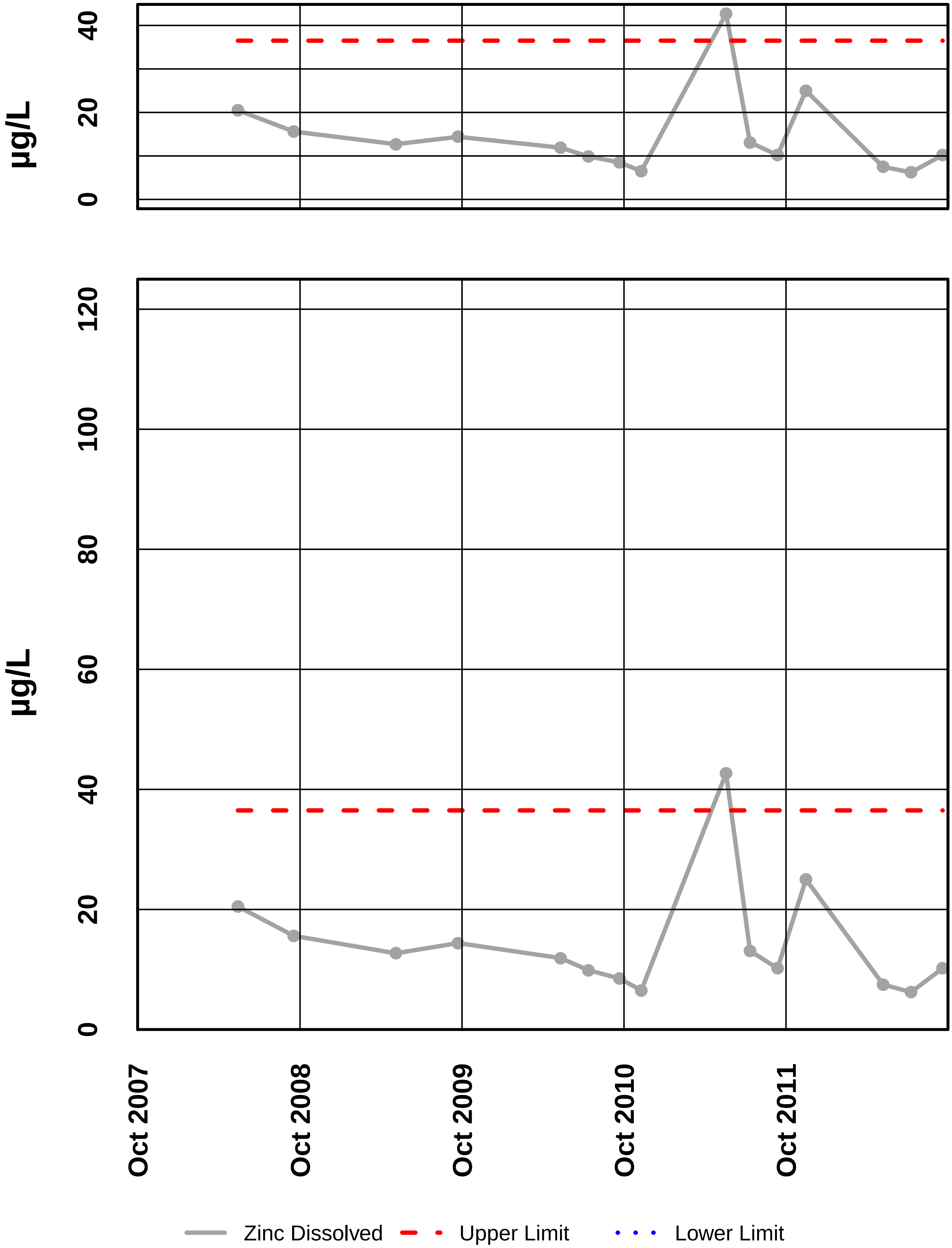
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 32 – Silver Dissolved

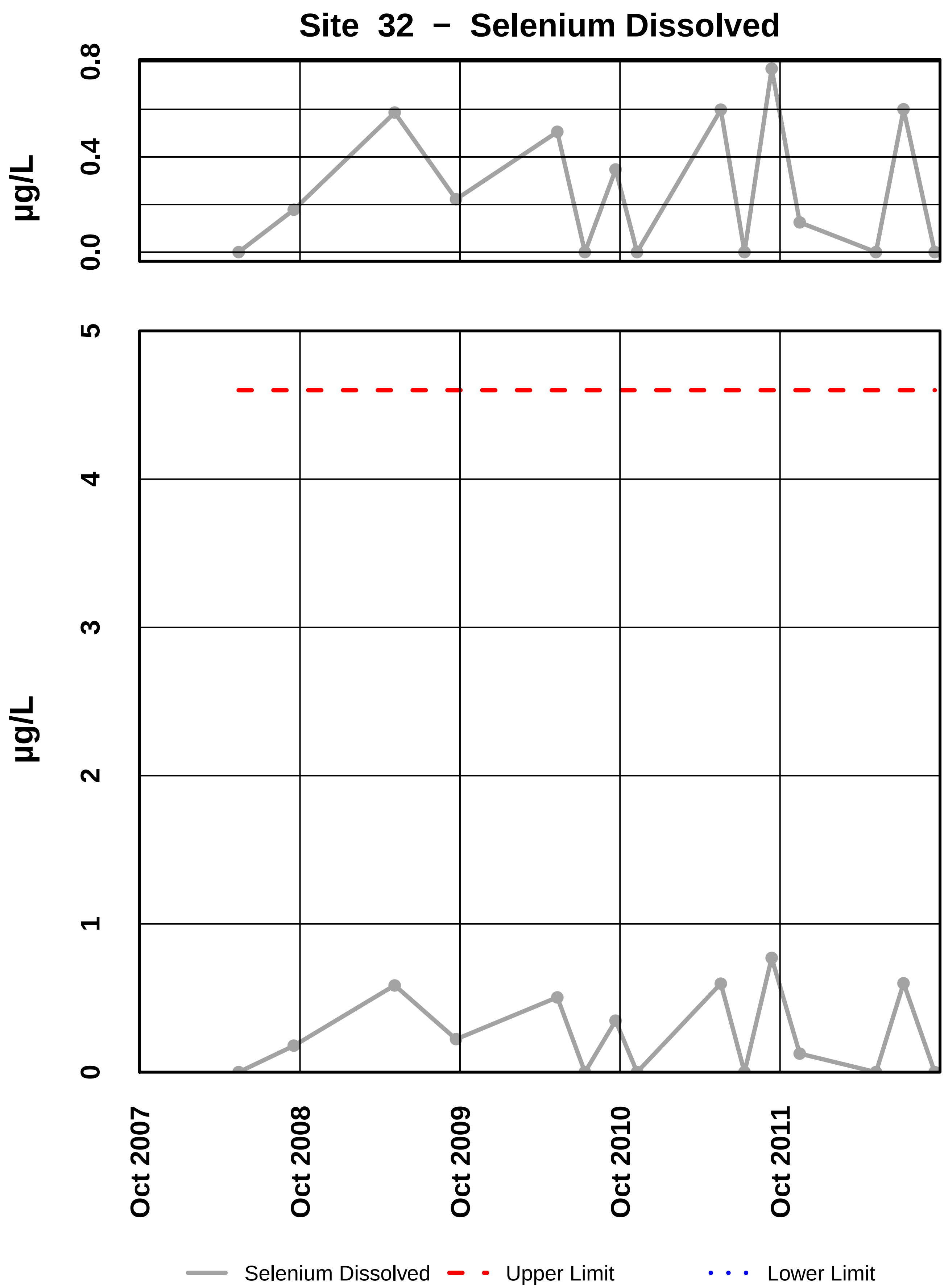


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

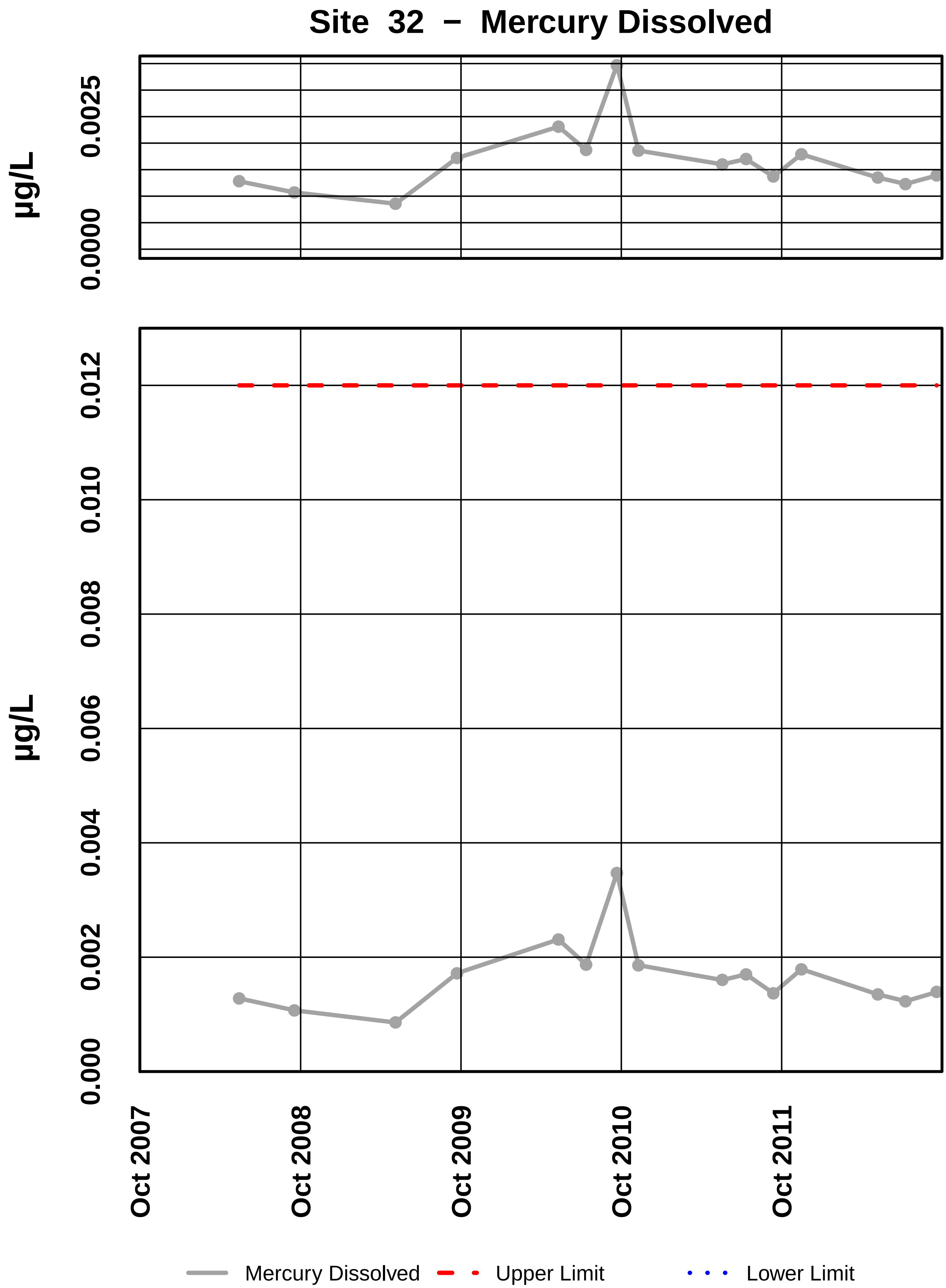
Site 32 − Zinc Dissolved



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



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



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

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**							69.6	80.6				69.1
b	**WY2008**								105.6				67.4
c	**WY2009**								71.5				75.4
d	**WY2010**								72		67		66.5
e	**WY2011**		73.8						74		78.1		58
f	**WY2012**		58						120.6		64.5		64
	n	0	2	0	0	0	0	1	6	0	3	0	6

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

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

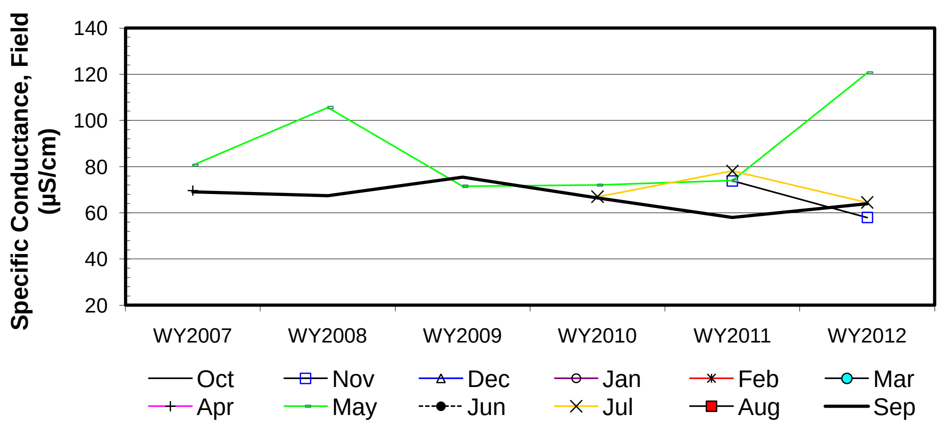
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=		1.00						28.33		3.67		28.33
$Z_k = S_k/\sigma_S$		-1.00						0.56		-0.52		-1.69
Z^2_k		1.00						0.32		0.27		2.86

ΣZ_k= -2.65
ΣZ^2_k= 4.45
Z-bar=$\Sigma Z_k/K$= -0.66

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	18	0	0	0	0

Σn 18
ΣS_k -8

					Test for station homogeneity	
$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=		2.69	@α=5% $\chi^2_{(K-1)}$=	7.81		
	p	**0.441**			$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc}	-0.89	@α/2=2.5% Z=	1.96	**H_0** (No trend)	ACCEPT
61.33	p	**0.186**			**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-8.52		4.00
0.050	-3.43	**-1.14**	1.58
0.100	-2.87		0.51
0.200	-2.02		-0.73

Site **#32** Seasonal Kendall analysis for pH, Field, Standard Units

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**							5.2	5.5				5.2
b	**WY2008**								5.2				5.1
c	**WY2009**								5.3				5.3
d	**WY2010**								4.6		4.8		5.2
e	**WY2011**		5.2						5.2		4.5		5.0
f	**WY2012**		5.3						4.6		5.2		5.0
	n	0	2	0	0	0	0	1	6	0	3	0	6

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

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

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

ΣZ_k= -2.24

ΣZ^2_k= 8.40

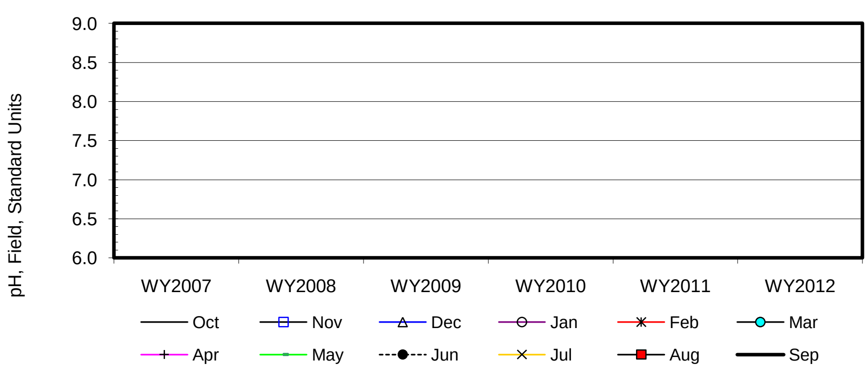
Z-bar=$\Sigma Z_k/K$= -0.56

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	18	0	0	0	0

Σn 18

ΣS_k -18

$\chi^2_h=\Sigma Z^2_k - K(\text{Z-bar})^2$=		7.15	@α=5% $\chi^2_{(K-1)}$= 7.81	Test for station homogeneity	
	p	**0.067**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc}	-2.17	@α/2=2.5% Z= 1.96	**H_0** (No trend)	REJECT
61.33	**p**	**0.015**		**H_A** (± trend)	ACCEPT



Seasonal-Kendall Slope Confidence Intervals

α	**Lower Limit**	**Sen's Slope**	**Upper Limit**
0.010	-0.17		0.00
0.050	-0.13	**-0.07**	-0.02
0.100	-0.12		-0.03
0.200	-0.10		-0.04
		-1.3%	

Site **#32** Seasonal Kendall analysis for Total Alk, (mg/l)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**								16.2				15.9
b	**WY2008**								15.2				15.5
c	**WY2009**								16.7				14.7
d	**WY2010**								6.4		0.0		0.0
e	**WY2011**		3.9						16.4		11.4		15.9
f	**WY2012**		16.5						8.5		5.9		15.5
	n	0	2	0	0	0	0	0	6	0	3	0	6

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

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

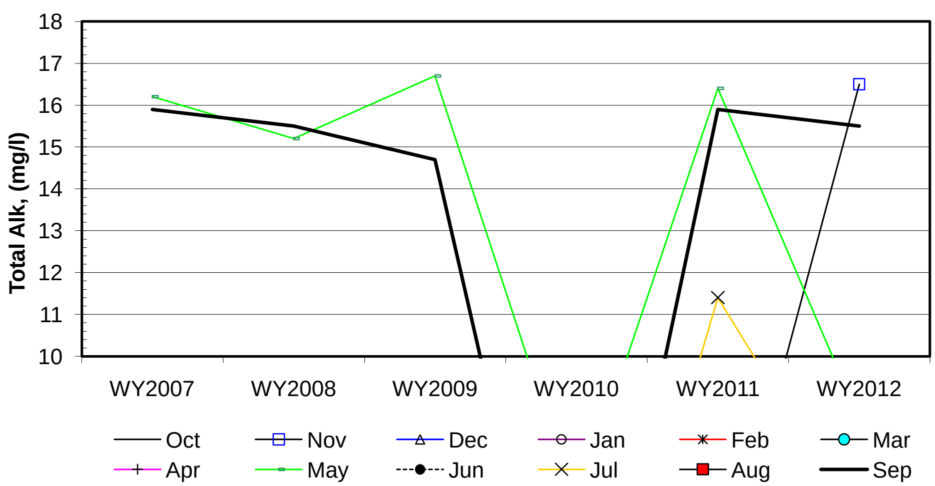
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=		1.00						28.33		3.67		26.33
$Z_k = S_k/\sigma_S$		1.00						-0.56		0.52		-0.58
Z^2_k		1.00						0.32		0.27		0.34

ΣZ_k= 0.37
ΣZ^2_k= 1.93
Z-bar=ΣZ_k/K= 0.09

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	13	2	0	0	0

Σn 17
ΣS_k -4

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	1.90	@α=5% $\chi^2_{(K-1)}$=	7.81	Test for station homogeneity	
p	**0.594**			$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
$\Sigma VAR(S_k)$	Z_{calc} -0.39	@α/2=2.5% Z=	1.96	**H_0** (No trend)	ACCEPT
59.33	p **0.348**			**H_A** ($\pm$ trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-3.25		0.59
0.050	-1.59	**-0.12**	0.26
0.100	-0.99		0.13
0.200	-0.65		0.01

Site **#32** Seasonal Kendall analysis for Sulfate, Total (mg/l)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**								0.0				0.1
b	**WY2008**								0.0				0.0
c	**WY2009**								0.3				0.3
d	**WY2010**								0.0		0.0		0.0
e	**WY2011**		0.0						0.0		0.0		0.0
f	**WY2012**		0.0						0.0		0.0		0.0
	n	0	2	0	0	0	0	0	6	0	3	0	6

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

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

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=		0.00						11.67		0.00		19.67
$Z_k = S_k/\sigma_S$		#DIV/0!						-0.29		#DIV/0!		-1.13
Z^2_k		#DIV/0!						0.09		#DIV/0!		1.27

ΣZ_k= #DIV/0!

ΣZ^2_k= #DIV/0!

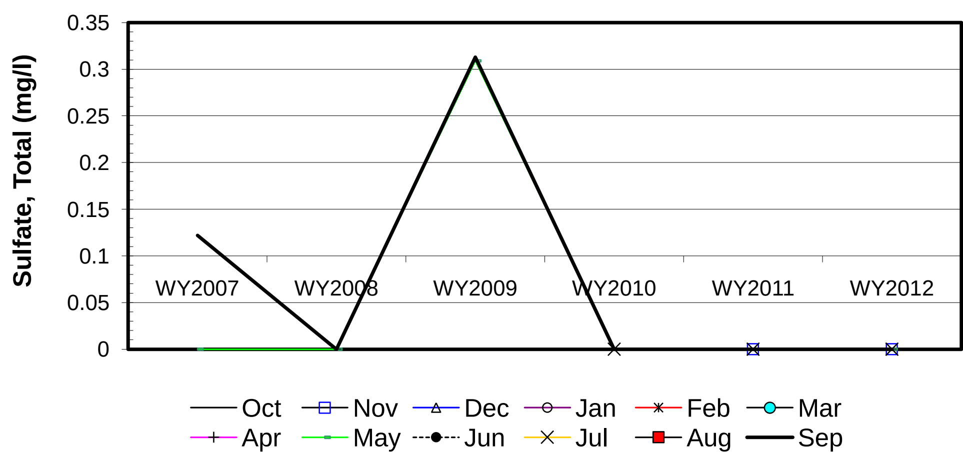
Z-bar=$\Sigma Z_k/K$= #DIV/0!

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	3	1	1	1	1

Σn 17

ΣS_k -6

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	#DIV/0!	@α=5% $\chi^2_{(K-1)}$= 7.81	Test for station homogeneity	
p	**#DIV/0!**		$\chi^2_h<\chi^2_{(K-1)}$	#DIV/0!
$\Sigma VAR(S_k)$	Z_{calc} -0.89	@α=2.5% Z= 1.96	H_0 (No trend)	ACCEPT
31.33	p **0.186**		H_A (± trend)	#DIV/0!



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.01		0.00
0.050	0.00	**0.00**	0.00
0.100	0.00		0.00
0.200	0.00		0.00

#DIV/0!

Site **#32** Seasonal Kendall analysis for Zinc, Dissolved (ug/l)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**								24.3				10.0
b	**WY2008**								20.5				15.6
c	**WY2009**								12.7				14.4
d	**WY2010**								11.9		9.9		8.5
e	**WY2011**		6.5						42.7		13.1		10.2
f	**WY2012**		25.0						7.5		6.2		10.2
	n	0	2	0	0	0	0	0	6	0	3	0	6

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

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

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=		1.00						28.33		3.67		27.33
$Z_k = S_k/\sigma_S$		1.00						-1.32		-0.52		-0.38
Z^2_k		1.00						1.73		0.27		0.15

ΣZ_k= -1.22

ΣZ^2_k= 3.15

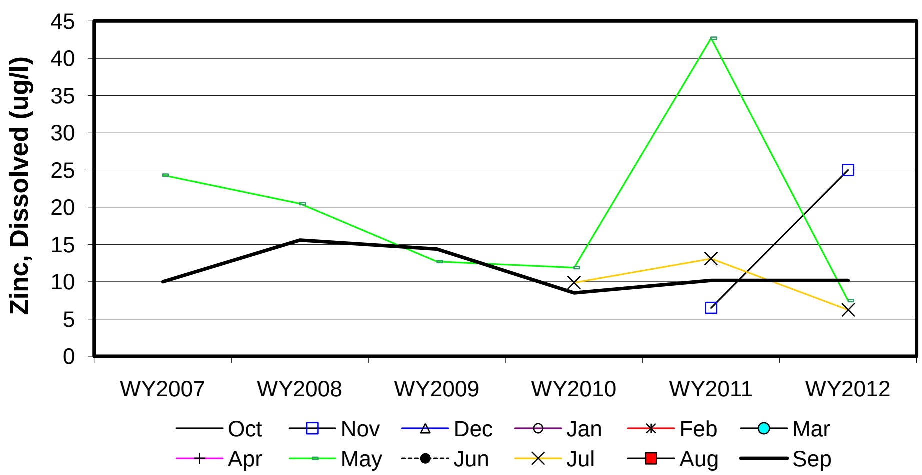
Z-bar=$\Sigma Z_k/K$= -0.30

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	15	1	0	0	0

Σn 17

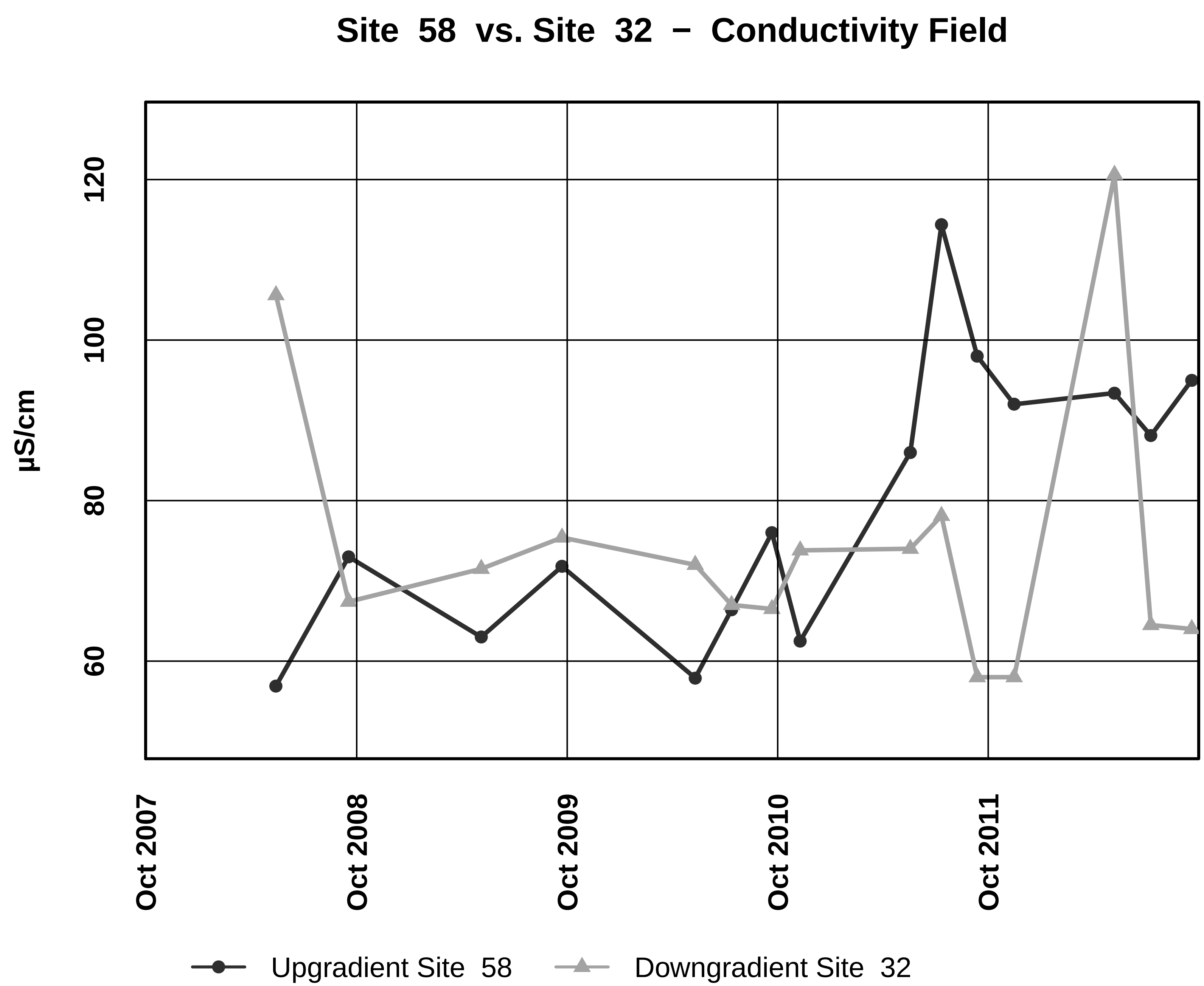
ΣS_k -9

$\chi^2_h = \Sigma Z^2_k - K(\text{Z-bar})^2$=	2.78	@α=5% $\chi^2_{(K-1)}$= 7.81	Test for station homogeneity	
p	**0.427**		$\chi^2_h < \chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k) Z_{calc}	-1.03	@α/2=2.5% Z= 1.96	H_0 (No trend)	ACCEPT
60.33 p	**0.152**		H_A (± trend)	REJECT

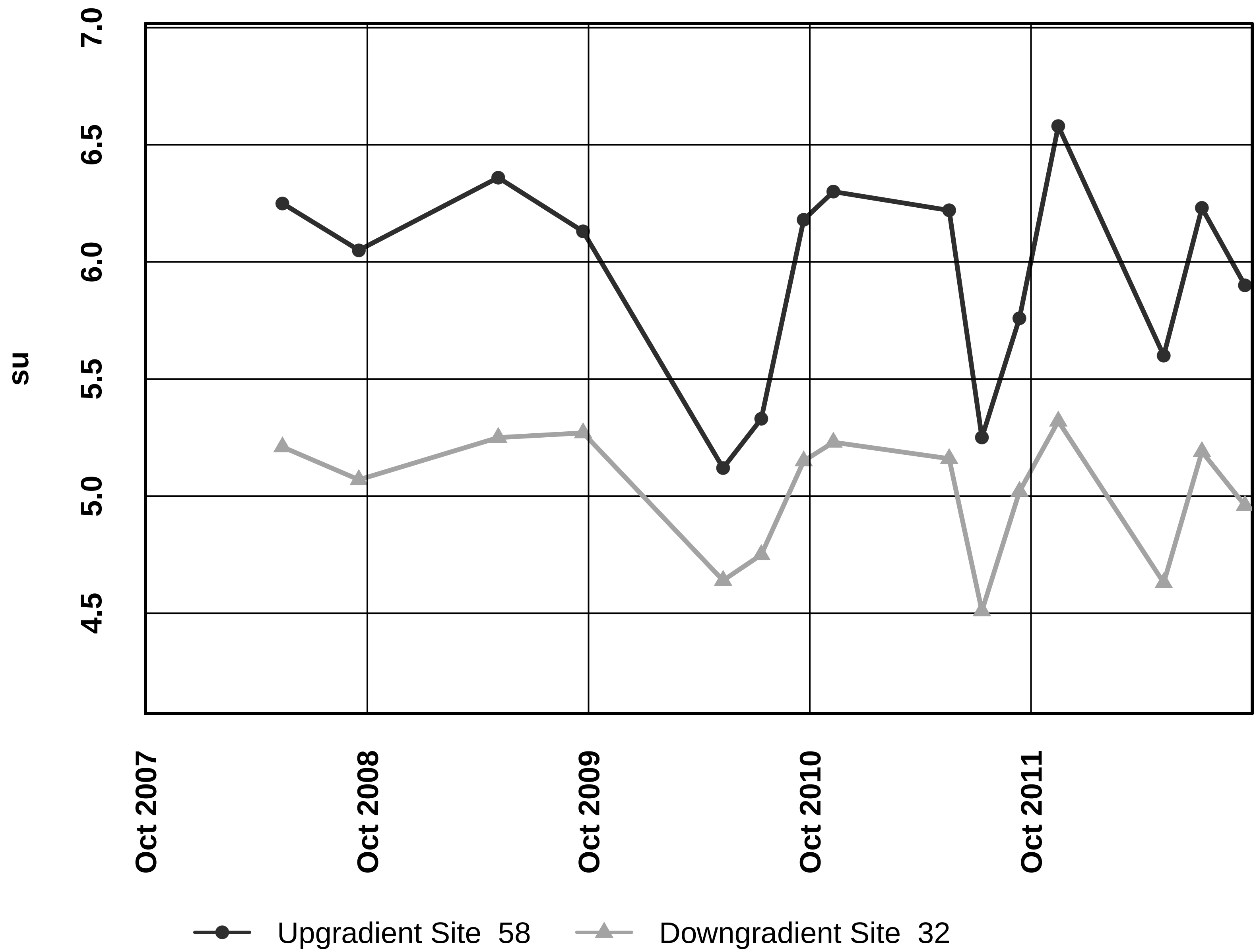


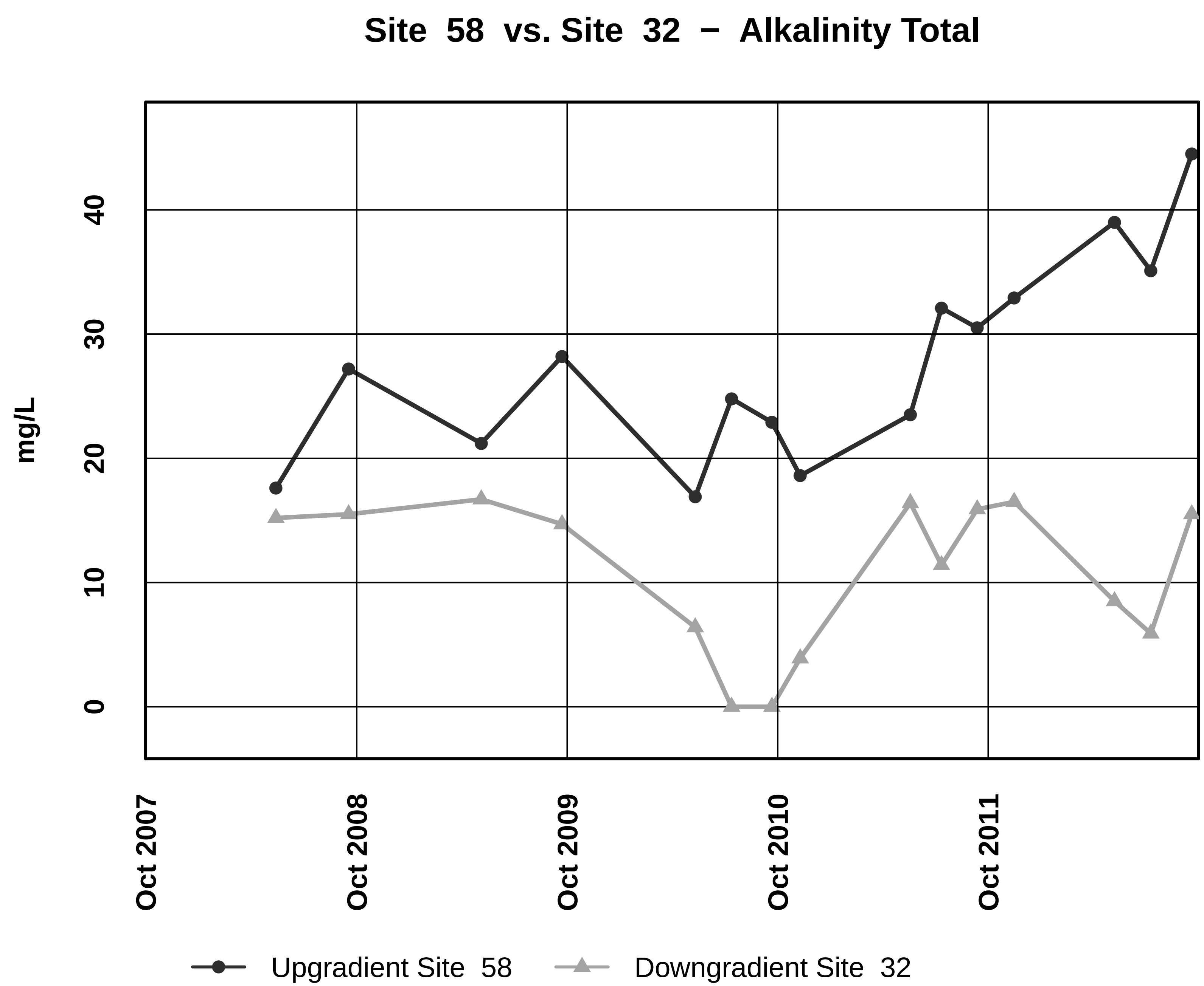
Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-3.81		1.72
0.050	-3.30	**-1.38**	0.04
0.100	-2.20		-0.01
0.200	-1.90		-0.72

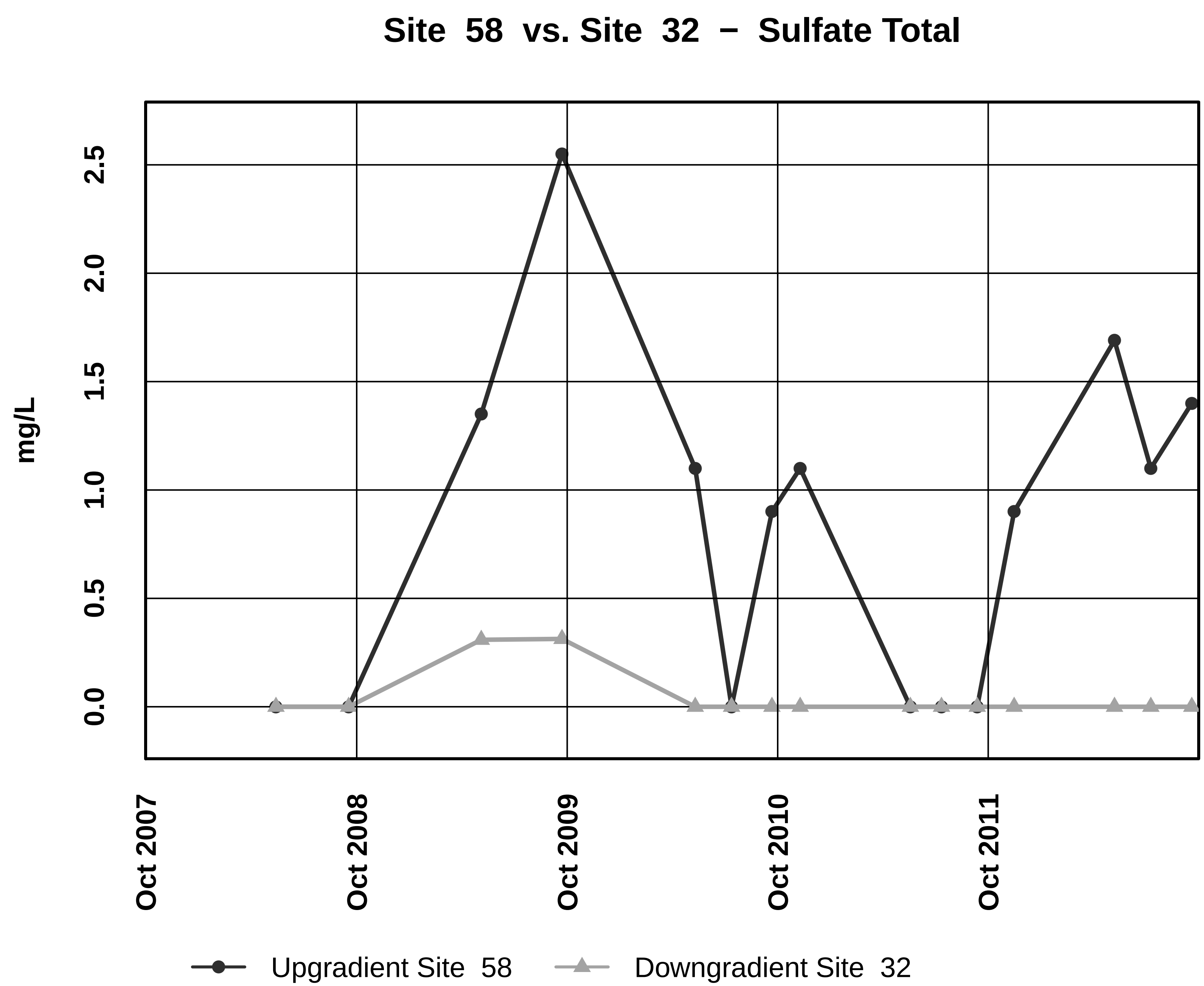

Site 58 vs. Site 32 − Conductivity Field
μS/cm
60
80
100
120
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 58
Downgradient Site 32

Site 58 vs. Site 32 − pH Field

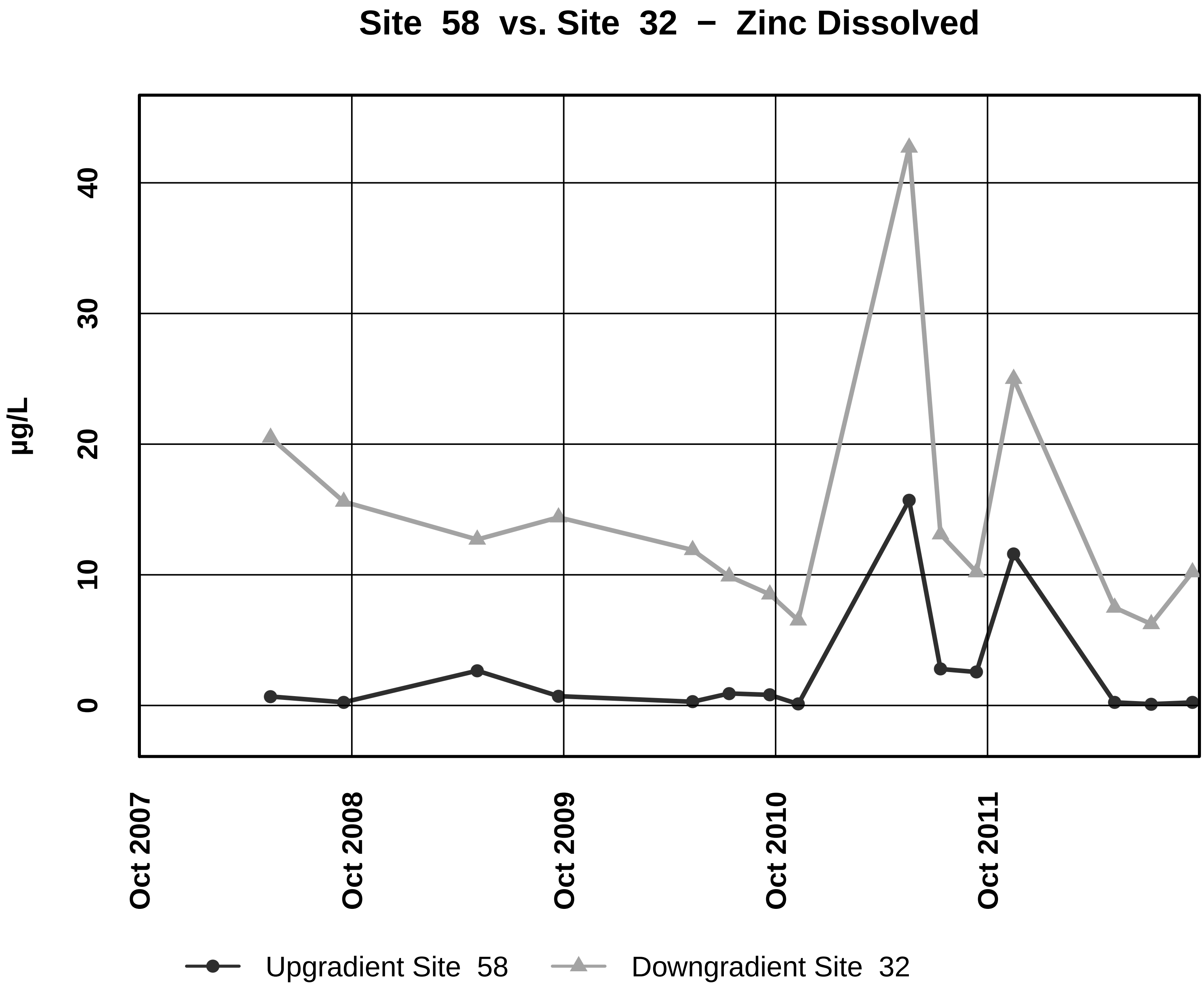




Site 58 vs. Site 32 − Alkalinity Total
mg/L
0
10
20
30
40
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 58
Downgradient Site 32



Site 58 vs. Site 32 − Sulfate Total
mg/L
0.0
0.5
1.0
1.5
2.0
2.5
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 58
Downgradient Site 32



Site 58 vs. Site 32 − Zinc Dissolved
µg/L
0
10
20
30
40
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 58
Downgradient Site 32

INTERPRETIVE REPORT
SITE 59

The data collected during the current water year are listed in the following "Table of Results for Water Year 2012" 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.

Sampling at this site was added to the FWMP in May-2002. All data collected at this site for the past six years are included in the data analyses. As shown in the table below, there were no data outliers.

Sample Date	Parameter	Value	Qualifier	Notes
No outliers have been identified by HGCMC for the period of October 2007 through September 2012.				

The data for water year 2012 have been compared to the strictest fresh water quality criterion for each applicable analyte. Out of the four sampling events, two were in exceedance for field pH. This is the third year in row that Site 59 has been in exceedance for field pH. Where as in the previous five years there were no exceedances for pH. This is similar to the changes in pH noted for Site 58. This type of exceedance happening at an upgradient background well is normally considered part of the natural variation. However over the last two years Site 59 has been in the area of the East Ridge Expansion (ERE) which underwent extensive construction. It is speculated that the construction in the area may be responsible for the decrease in pH.

Table of Exceedance for Water Year 2012

			Limits		
Sample Date	Parameter	Value	Lower	Upper	Hardness
7-May-12	pH Field	6.16 su	6.5	8.50	
18-Sep-12	pH Field	6.36 su	6.5	8.50	

X-Y plots have been generated to graphically present the data for each of the analytes requested in the Statistical Information Goals for this site. Though dissolved mercury concentration were increasing in the 2010 and elevated in 2011, by the current water year all measured values were within the historical range. A similar trend was also noted for the other upgradient well Site 58 and both were thought to be a result of the preparatory work for the East Ridge Expansion.

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-06 and Sep-12(WY2007-WY2012).

Table of Summary Statistics for Trend Analysis

	Mann-Kendall test statistics			Sen's slope estimate	
Parameter	**n***	**p****	**Trend**	**Q**	**Q(%)**
Conductivity Field	6	0.35			
pH Field	6	0.08			
Alkalinity, Total	6	0.35			
Sulfate, Total	6	0.19			
Zinc, Dissolved	6	0.19			

* Number of Years ** Significance level

There were no statistically significant trends ($\alpha/2=2.5\%$) for Site 59 during the 2012 water year.

Table of Results for Water Year 2012

Site 059FMG - 'Monitoring Well -T-00-01A'

Sample Date/Parameter	Oct 2011	Nov 2011	Dec 2011	Jan 2012	Feb 2012	Mar 2012	Apr 2012	May 2012	Jun 2012	Jul 2012	Aug 2012	Sep 2012	**Median**
Water Temp (°C)		5.3						7.6		7.9		6.2	6.9
Conductivity-Field(μmho)		98						111.4		111.8		114	111.6
Conductivity-Lab (μmho)		115						113		109		113	113
pH Lab (standard units)		6.61						5.85		6.06		6.5	6.28
pH Field (standard units)		6.74						6.16		6.66		6.36	6.51
Total Alkalinity (mg/L)		44.2						45.7		43.9		48.9	45.0
Total Sulfate (mg/L)		4						4.9		5.2		5.4	5.1
Hardness (mg/L)		46.3						46.3		47		48.3	46.7
Dissolved As (ug/L)		0.138						0.149		0.148		0.159	0.149
Dissolved Ba (ug/L)		6.9						7.1		7.3		7.2	7.2
Dissolved Cd (ug/L)		0.0155						0.011		0.0125		0.0119	0.0122
Dissolved Cr (ug/L)		4.68						4.43		4.85		5.27	4.765
Dissolved Cu (ug/L)		0.129						0.102		0.078		0.091	0.097
Dissolved Pb (ug/L)		0.0015						0.0015		0.0015		0.0015	0.0015
Dissolved Ni (ug/L)		1.05						0.851		0.87		0.844	0.861
Dissolved Ag (ug/L)		0.002						0.002		0.002		0.002	0.002
Dissolved Zn (ug/L)		0.58						0.55		0.34		0.33	0.45
Dissolved Se (ug/L)		0.258						0.338		0.245		0.18	0.252
Dissolved Hg (ug/L)		0.000178						0.000141		0.00014		0.000157	0.000149

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.

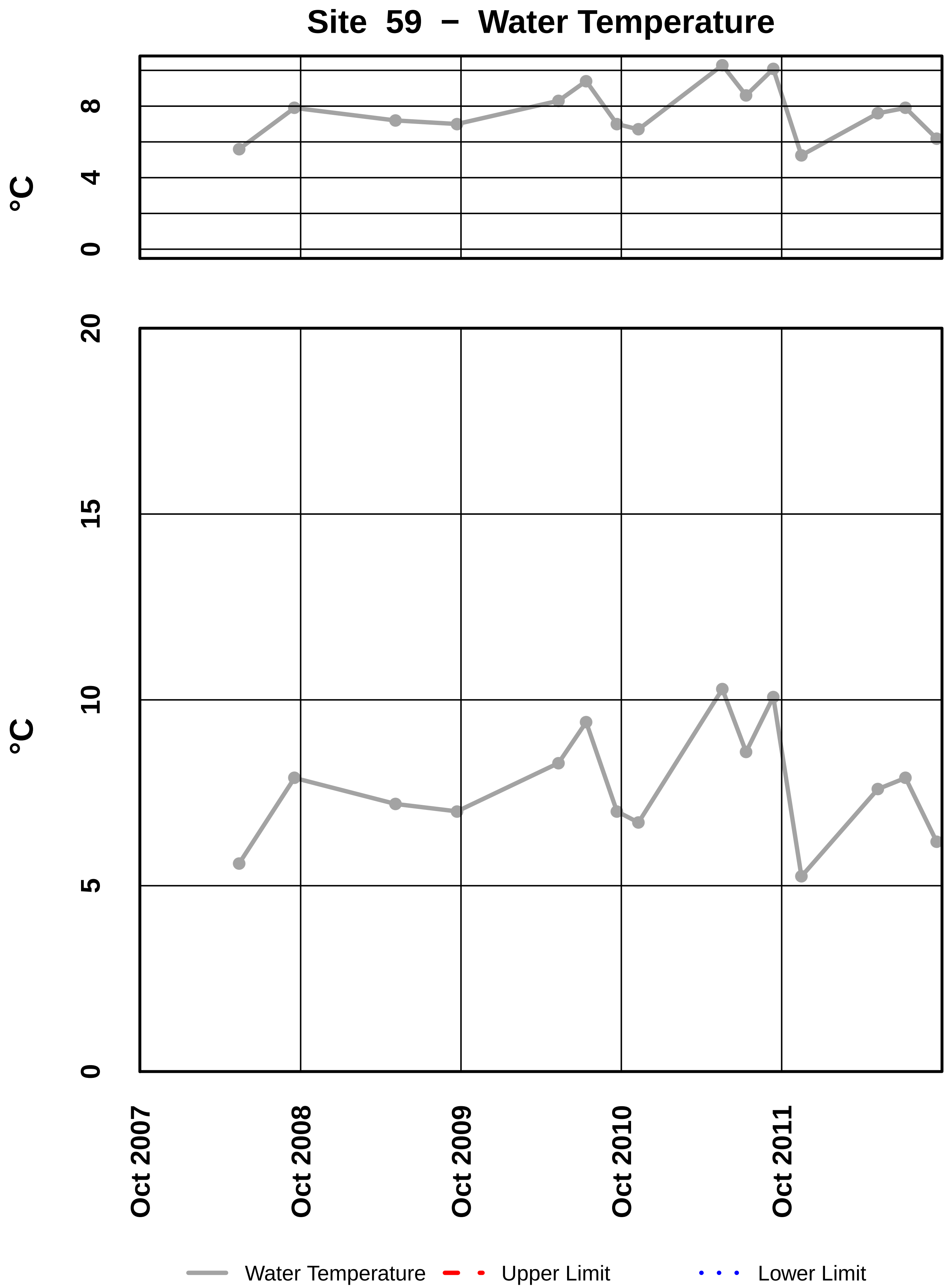
Shaded data has been qualified as an outlier by KGCMC and removed from any further analysis and is not included into the calculation of the median

Qualified Data by QA Reviewer

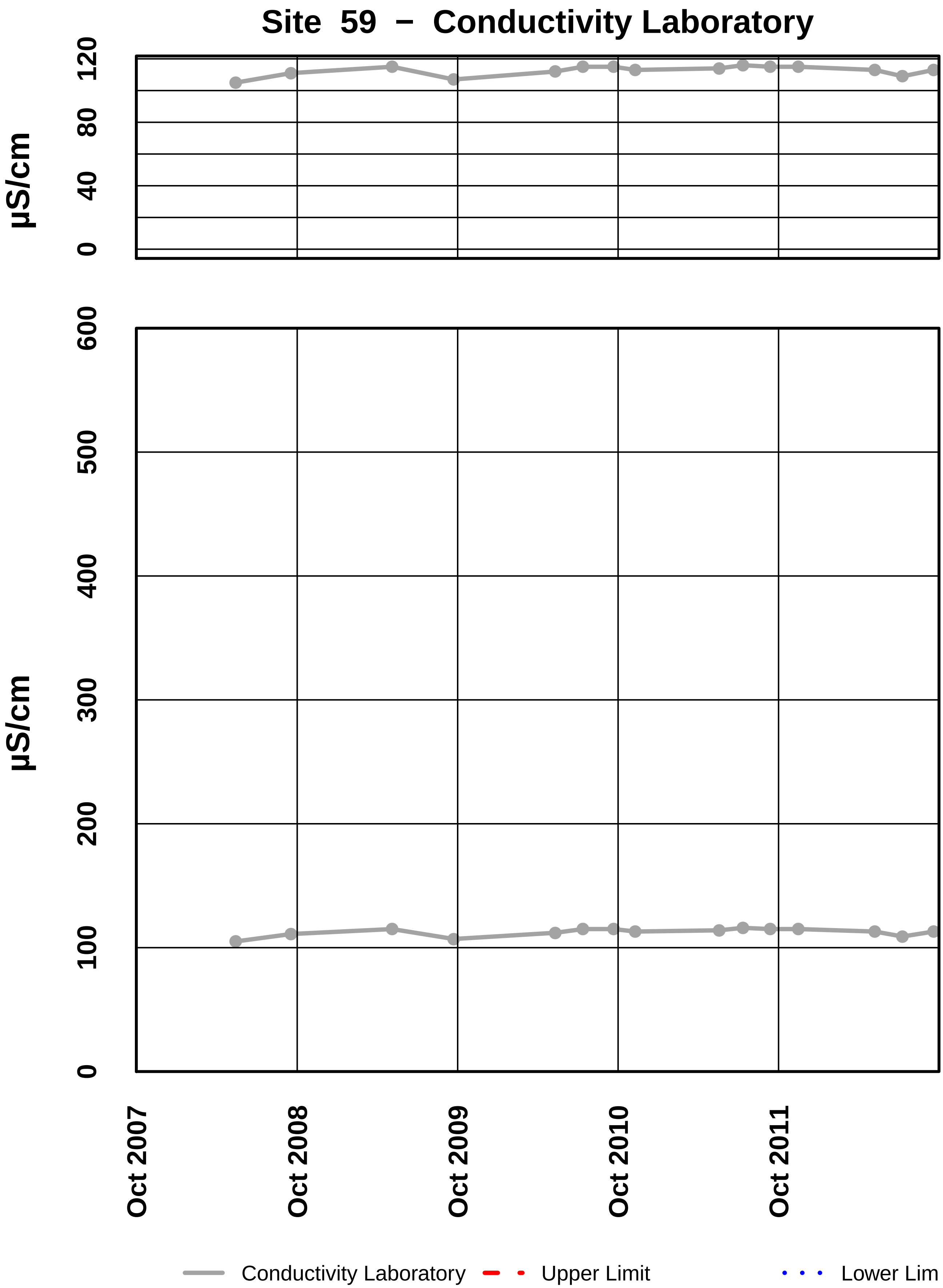
Date Range: 10/01/2011 to 09/30/2012

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
59	11/15/2011	12:00 AM	Hg diss, µg/l	0.000178	U	Field Blank Contamination
			Se diss, µg/l	0.25	J	Below Quantitative Range
59	5/7/2012	12:00 AM	Hg diss, µg/l	0.000141	U	Field Blank Contamination
			Se diss, µg/l	0.33	J	Below Quantitative Range
			Zn diss, µg/l	0.55	U	Field Blank Contamination
			SO4 Tot, mg/l	4.88	J	Sample Receipt Temperature
59	7/9/2012	12:00 AM	Hg diss, µg/l	0.00014	U	Field Blank Contamination
			Se diss, µg/l	0.24	J	Below Quantitative Range
			Zn diss, µg/l	0.33	U	Field Blank Contamination
59	9/18/2012	12:00 AM	Hg diss, µg/l	0.000157	U	Field Blank Contamination
			Se diss, µg/l	0.18	J	Below Quantitative Range
			SO4 Tot, mg/l	5.36	J	Sample Receipt Temperature

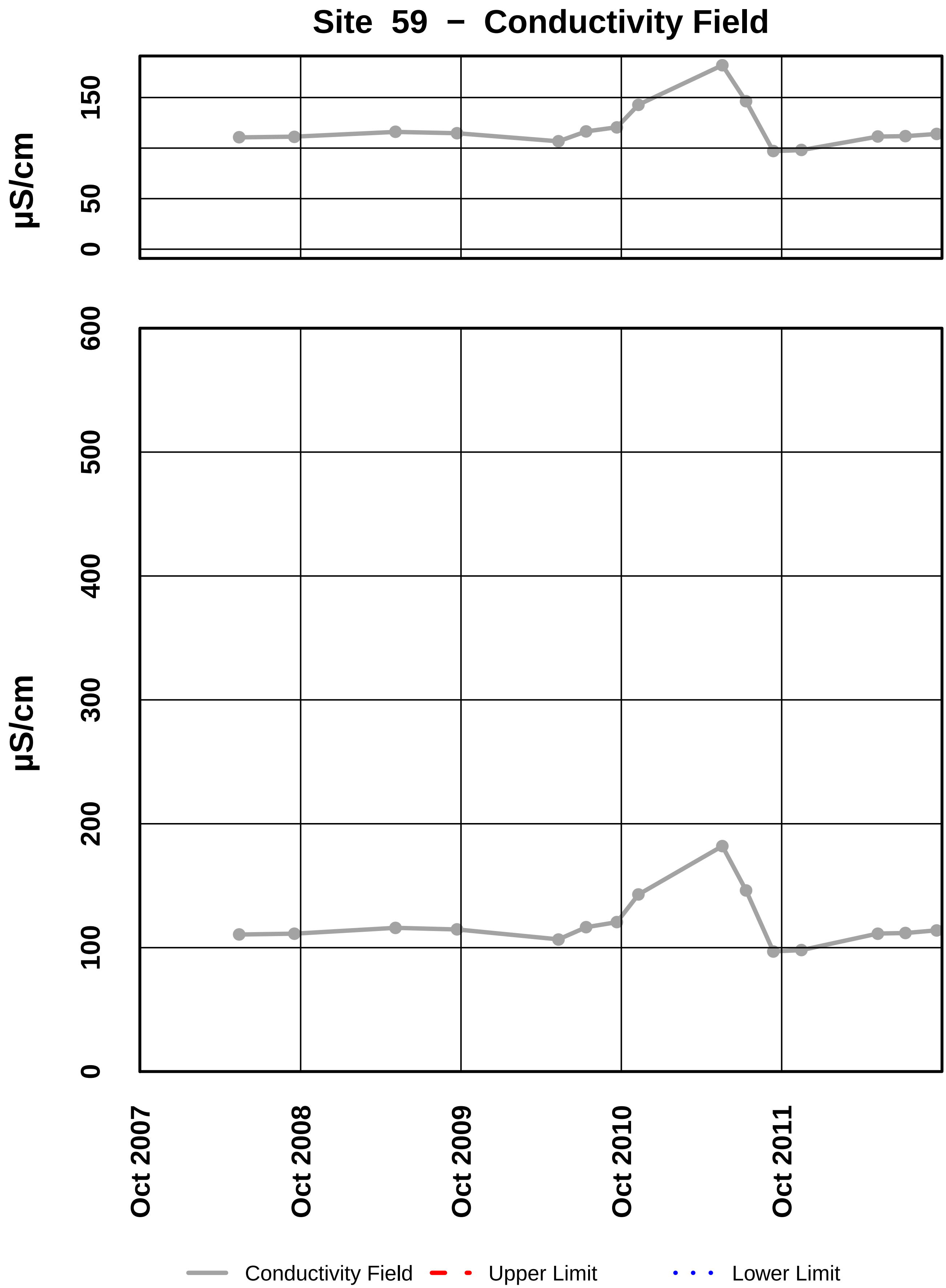
Qualifier	Description
J	Positively Identified - Approximate concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit



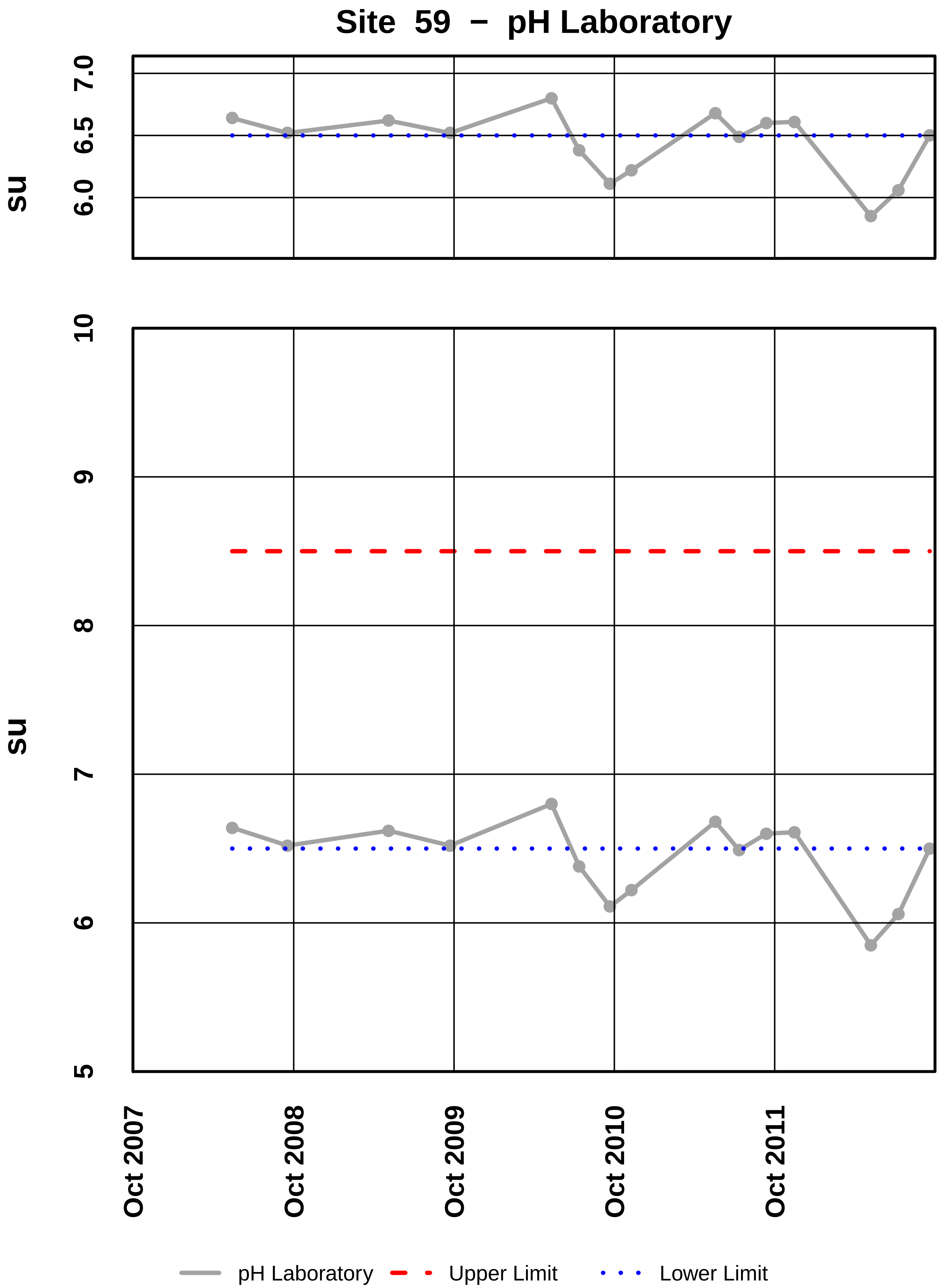
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



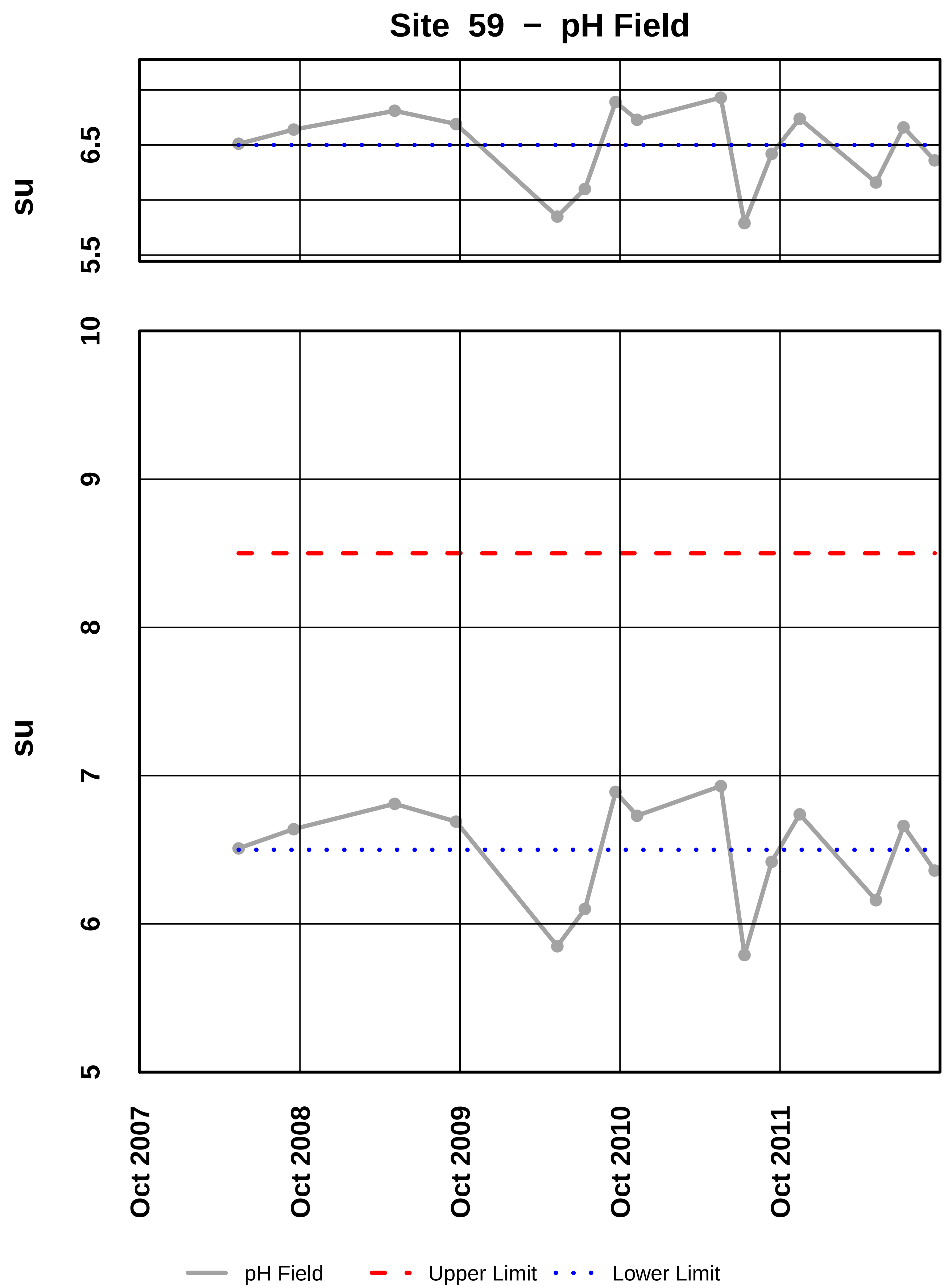
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



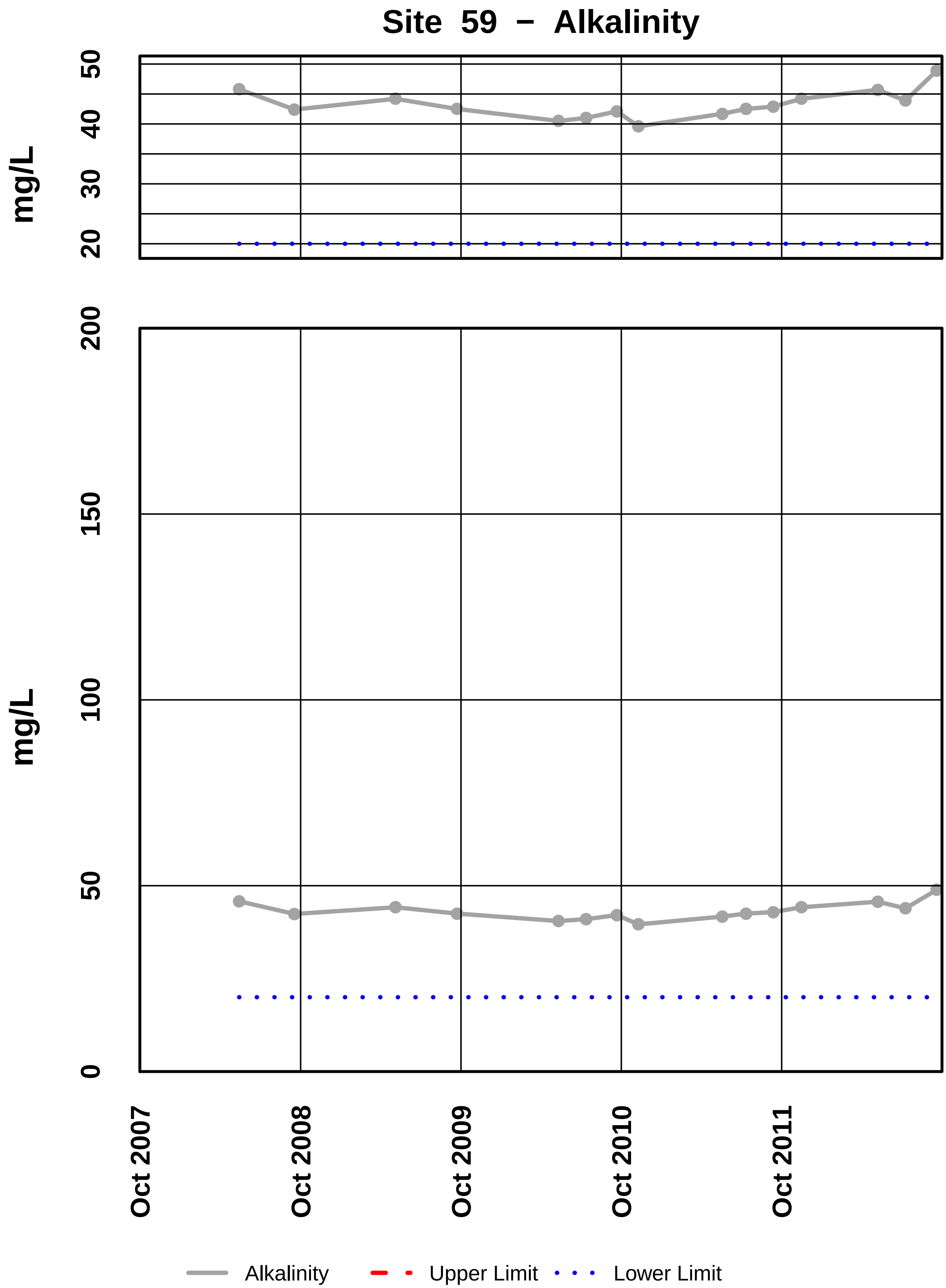
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

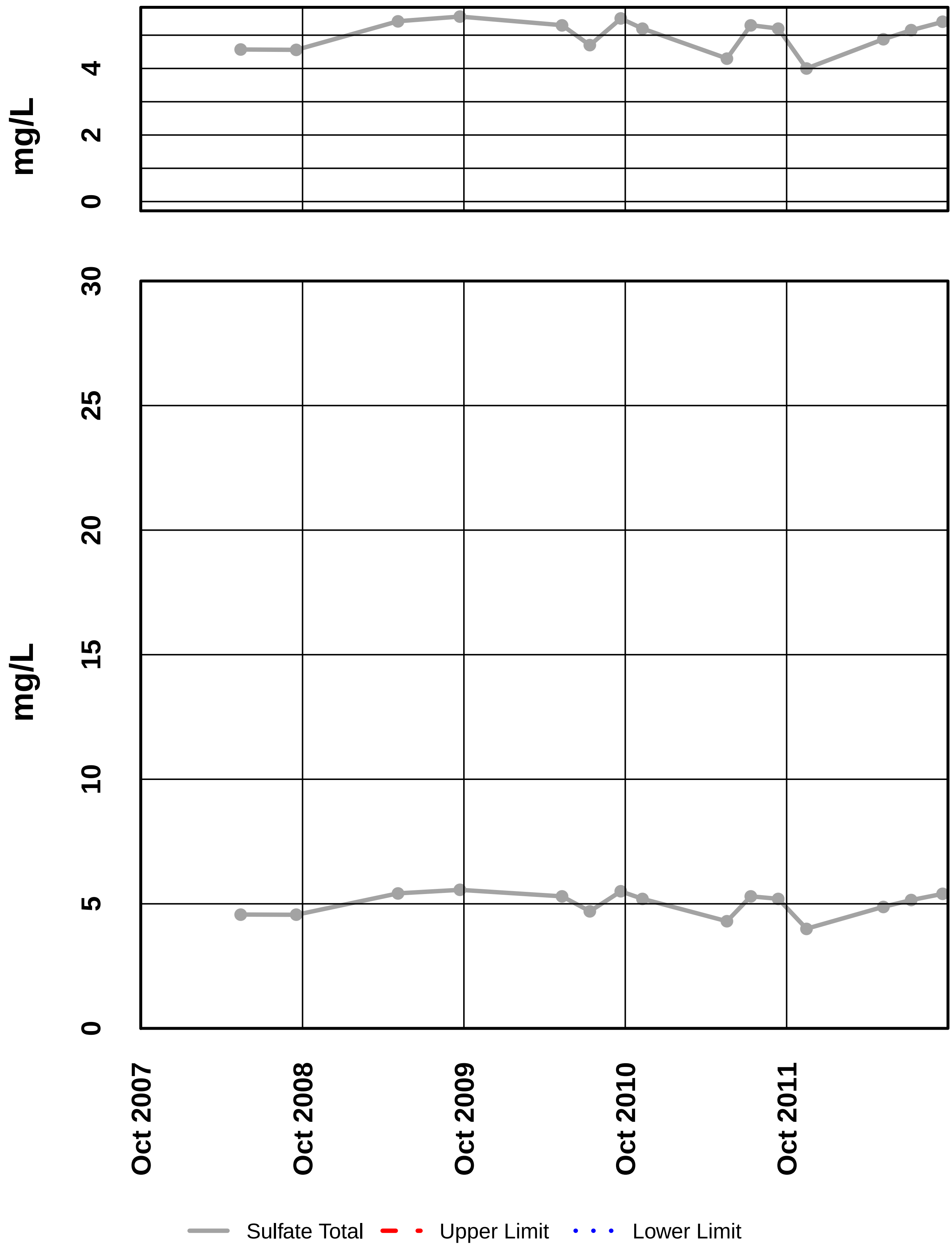


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



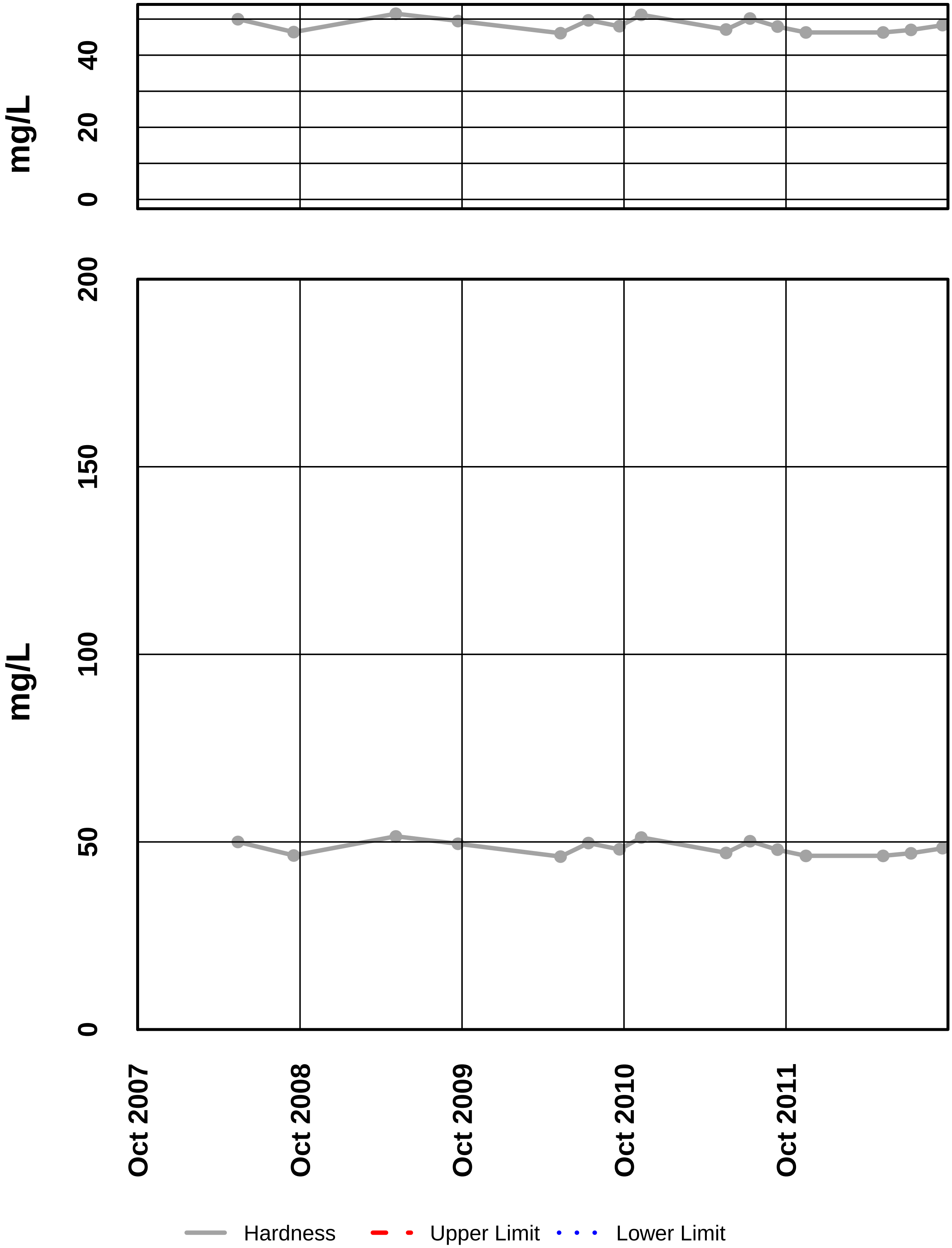
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 59 – Sulfate Total



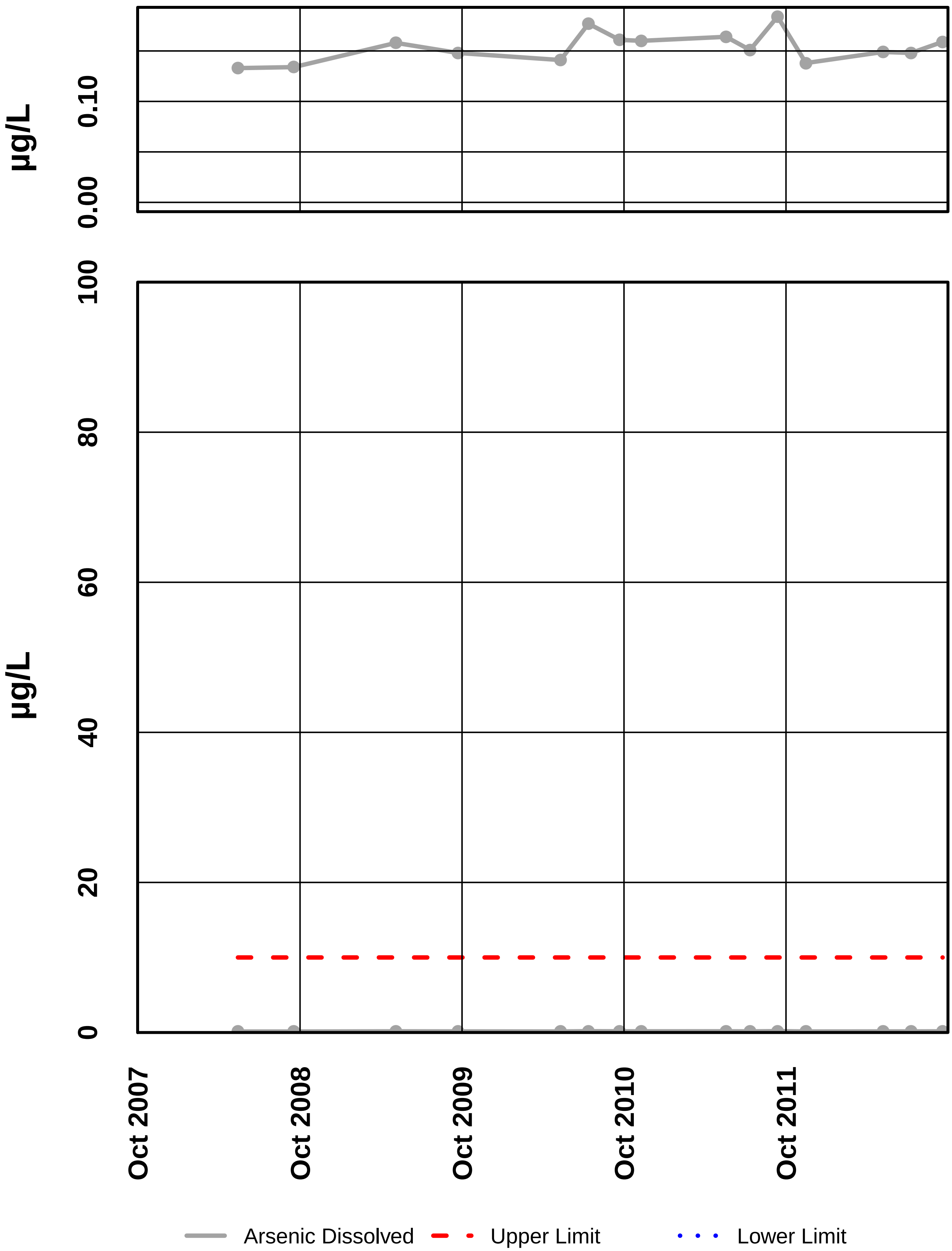
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 59 − Hardness

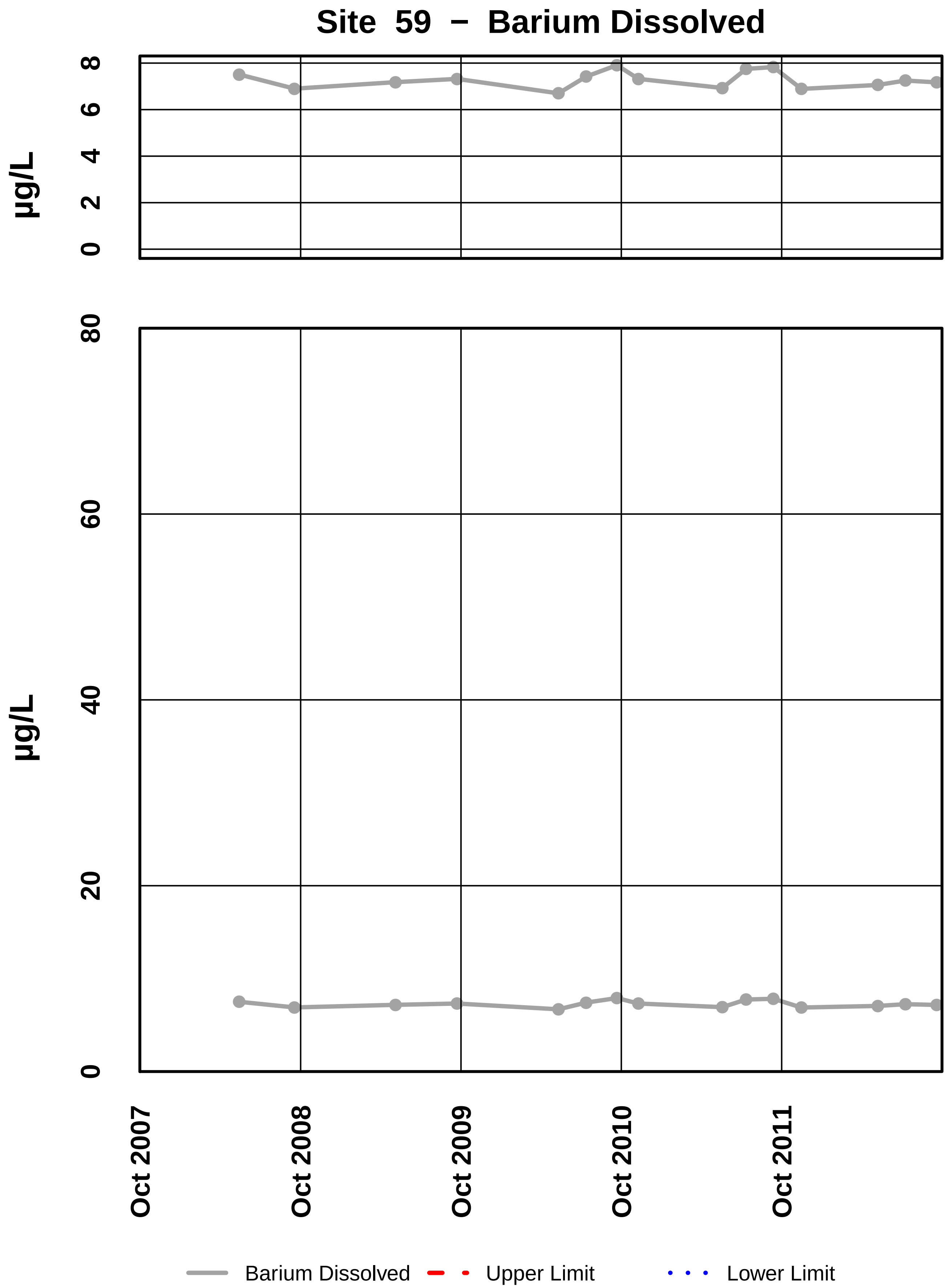


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 59 – Arsenic Dissolved

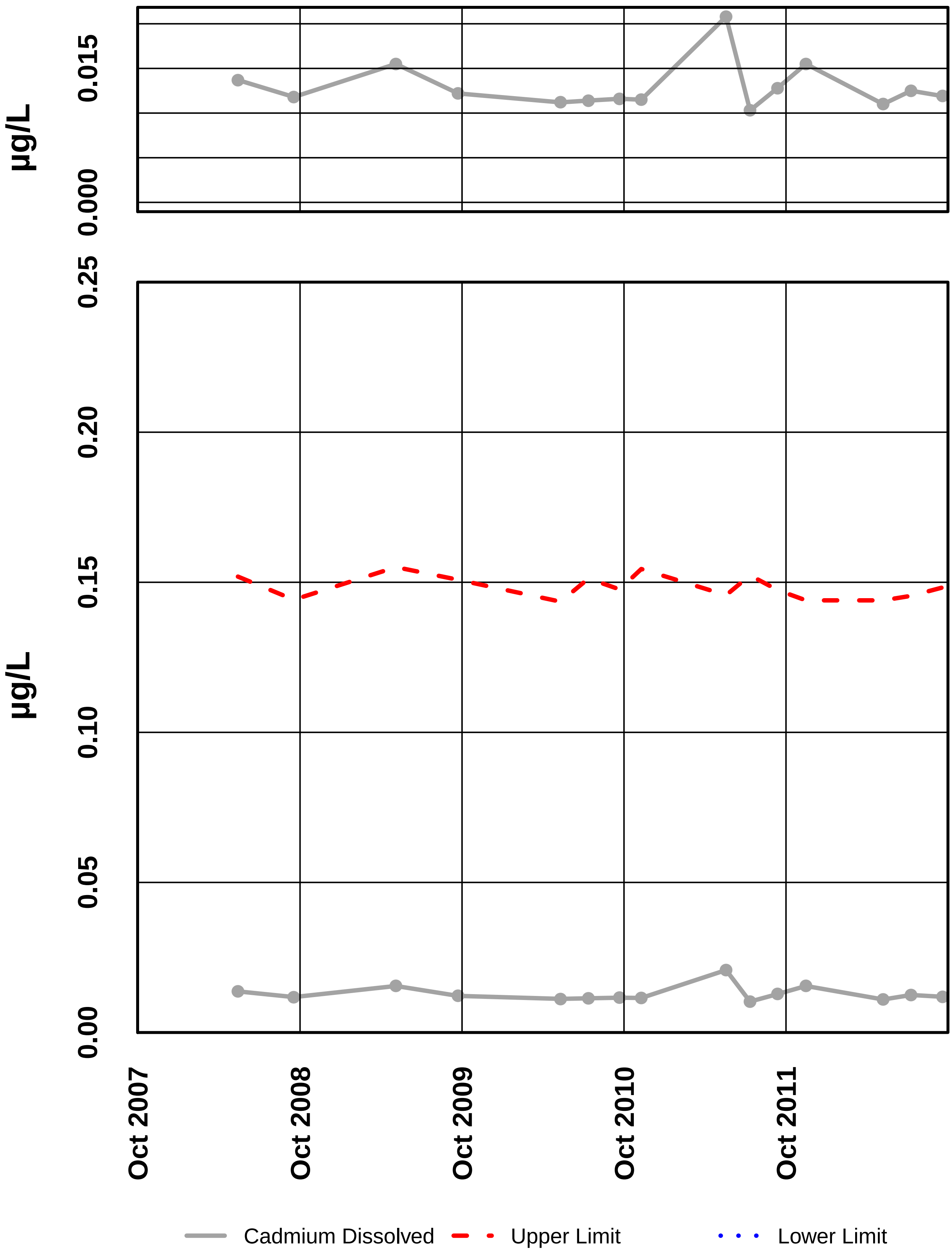


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

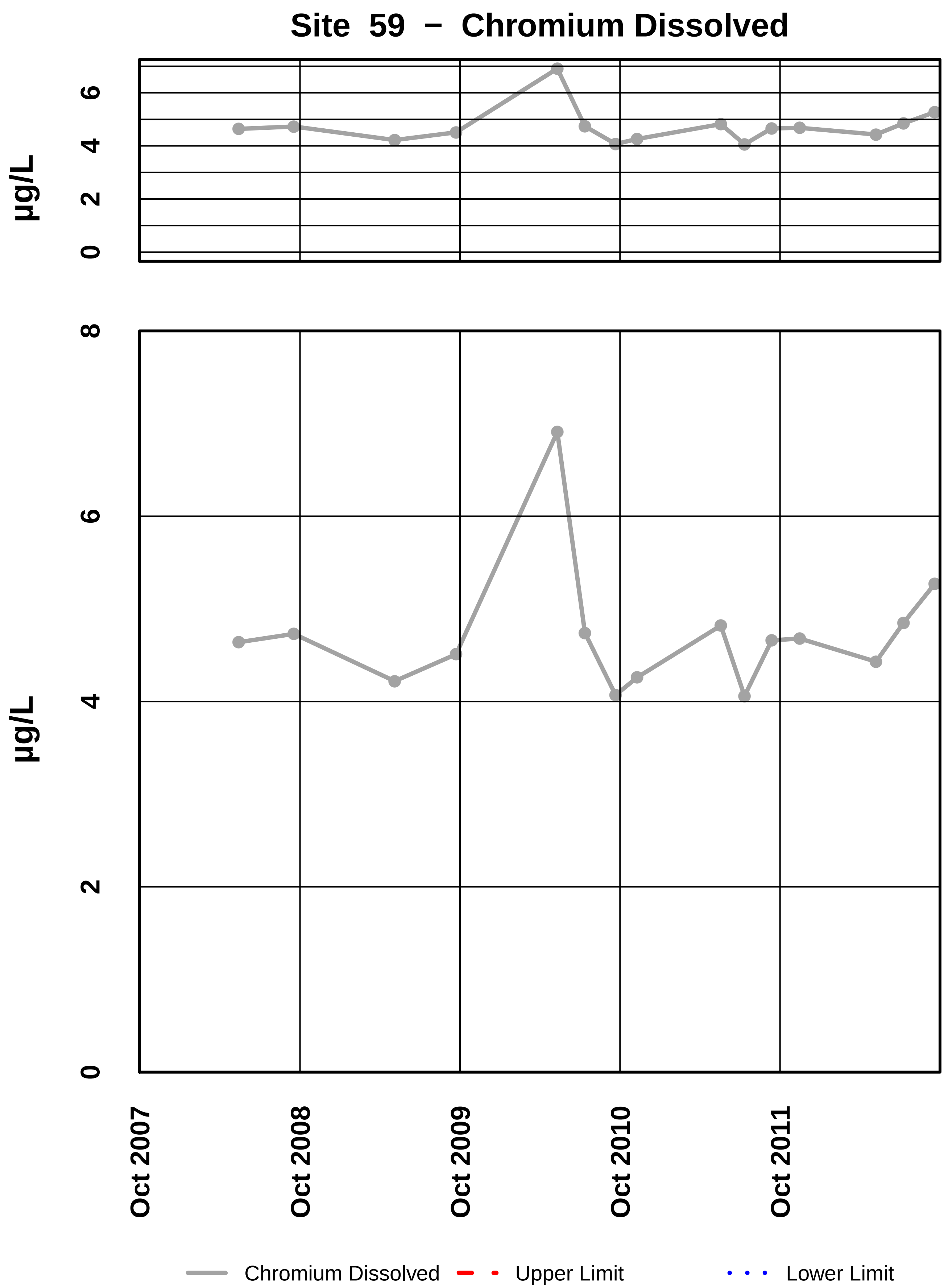


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

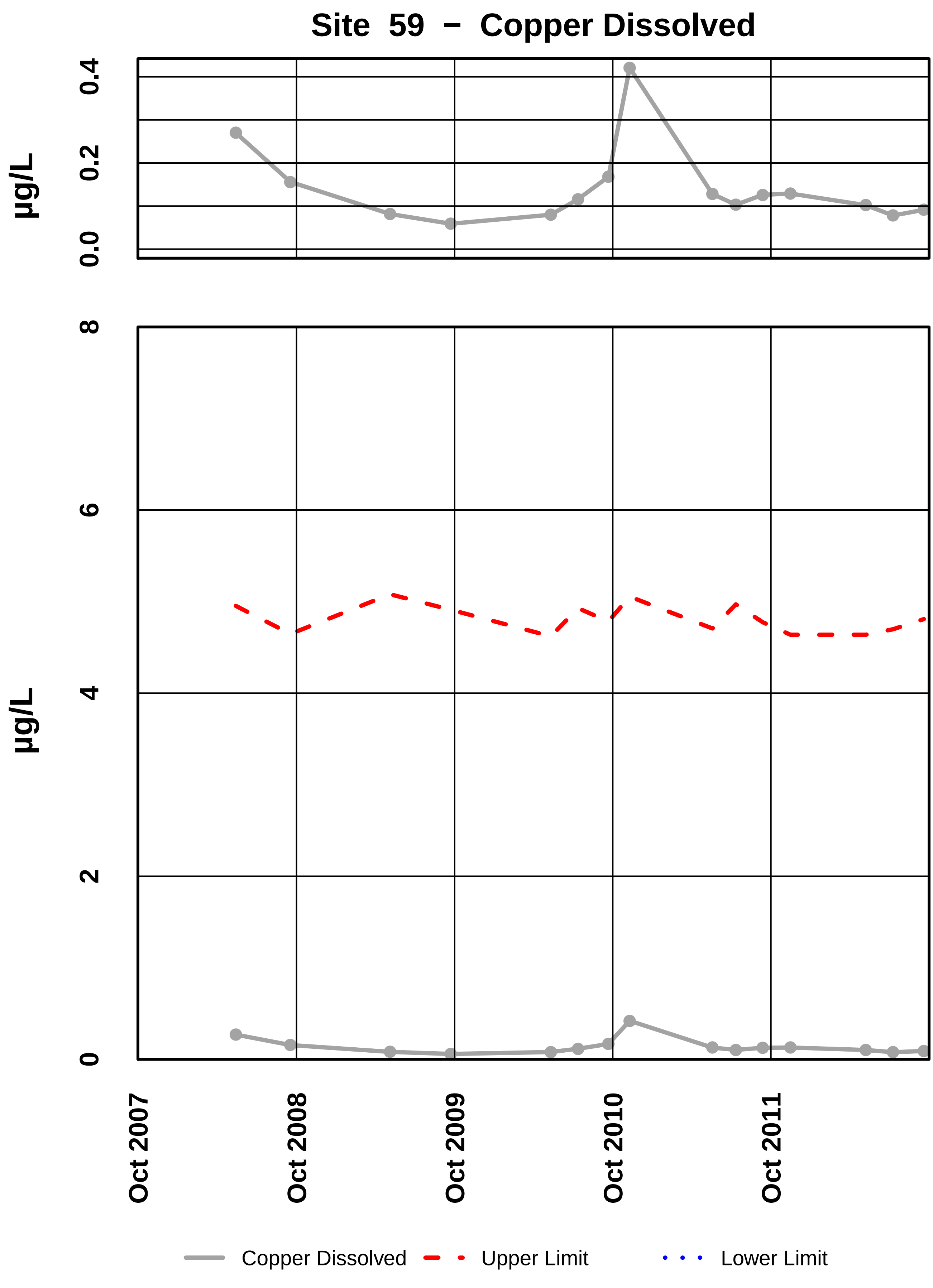
Site 59 – Cadmium Dissolved



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

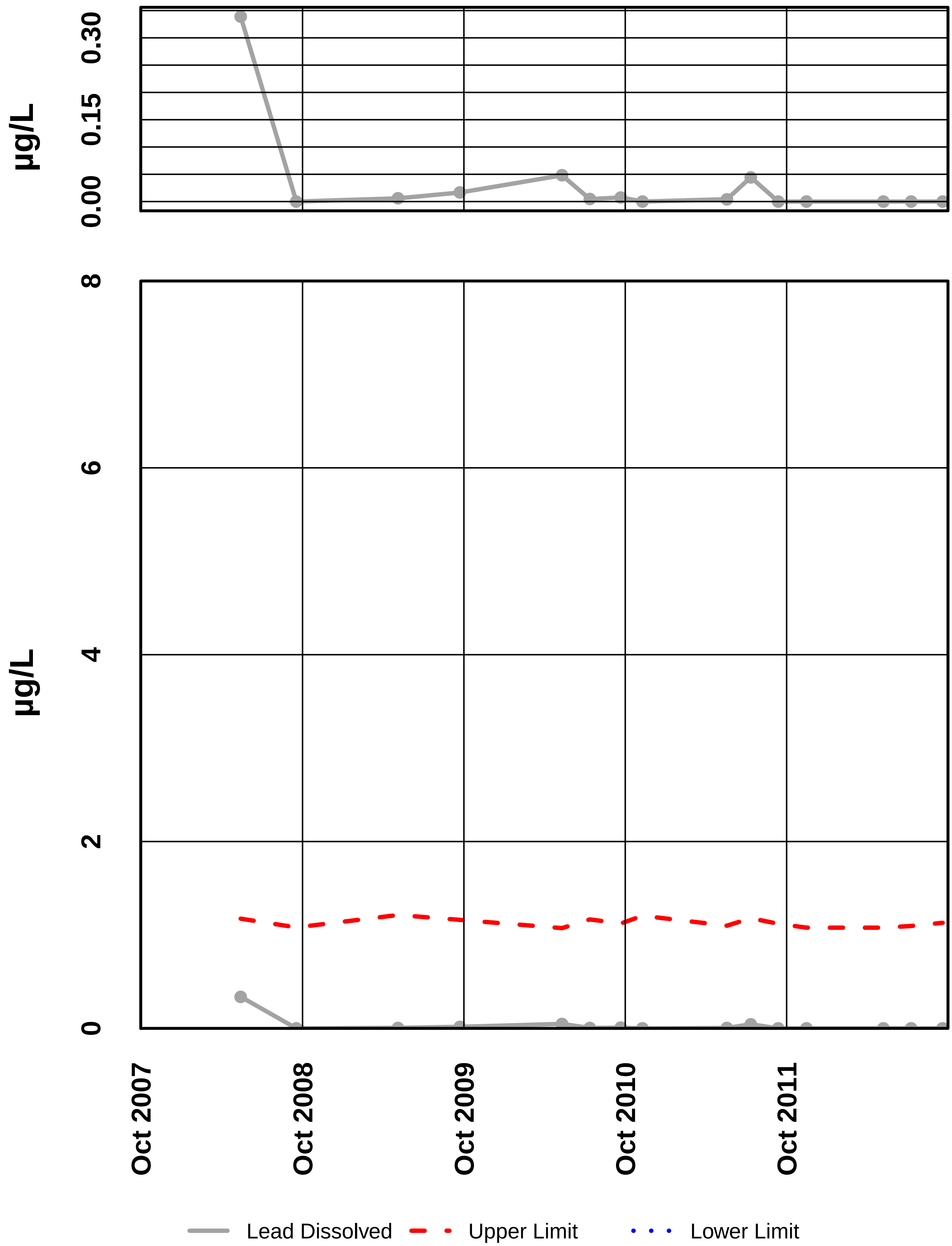


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

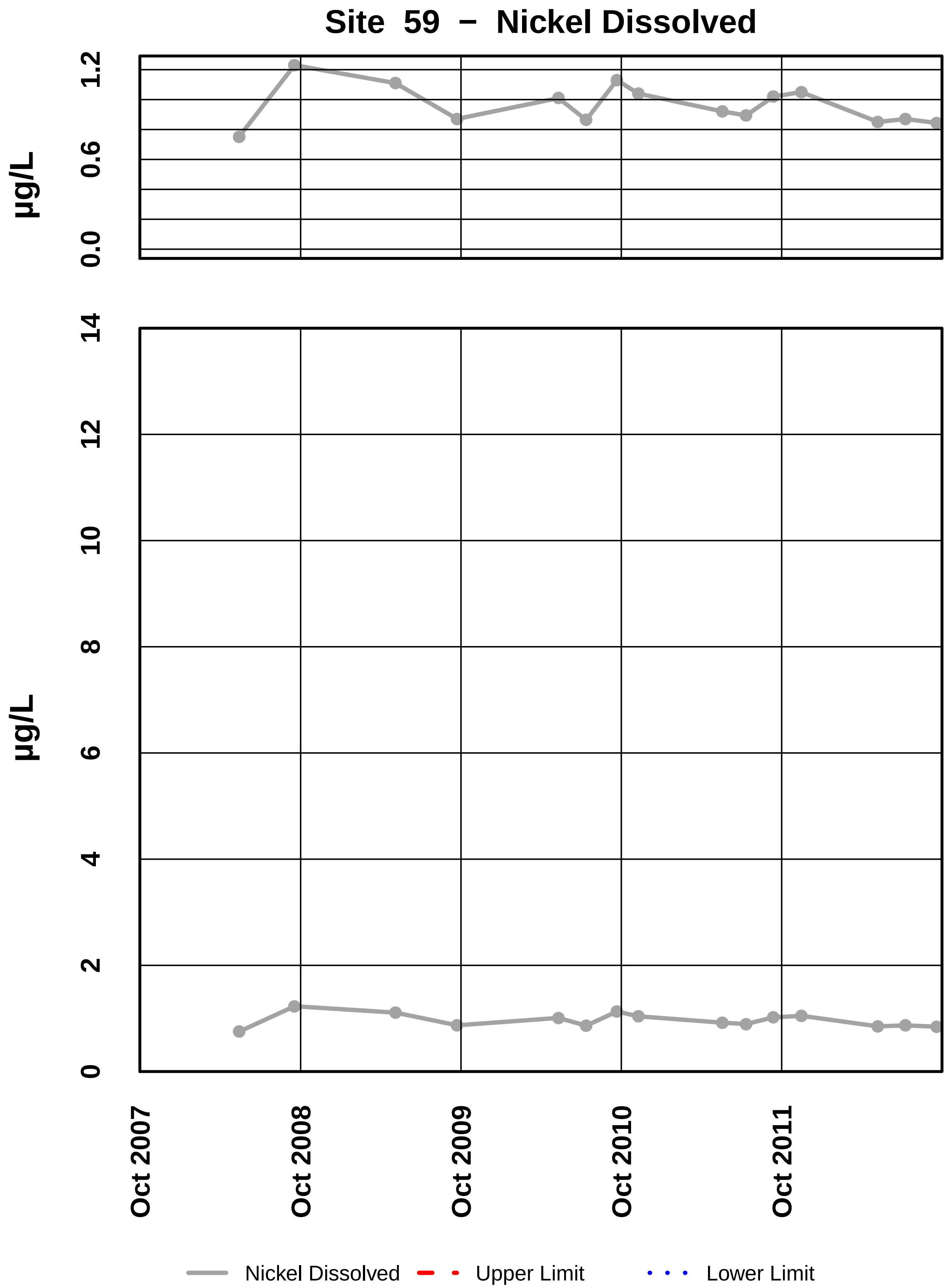


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

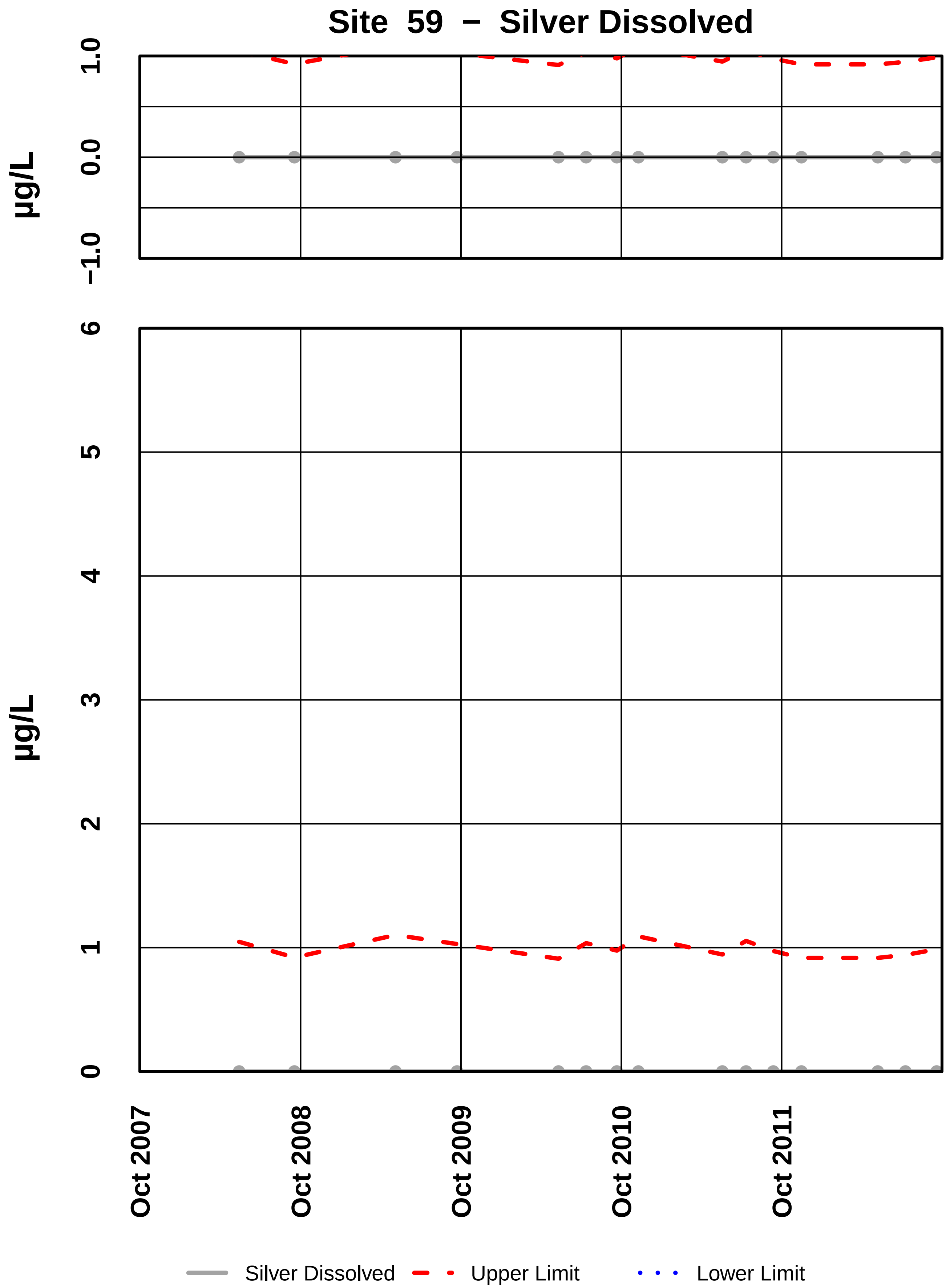
Site 59 − Lead Dissolved



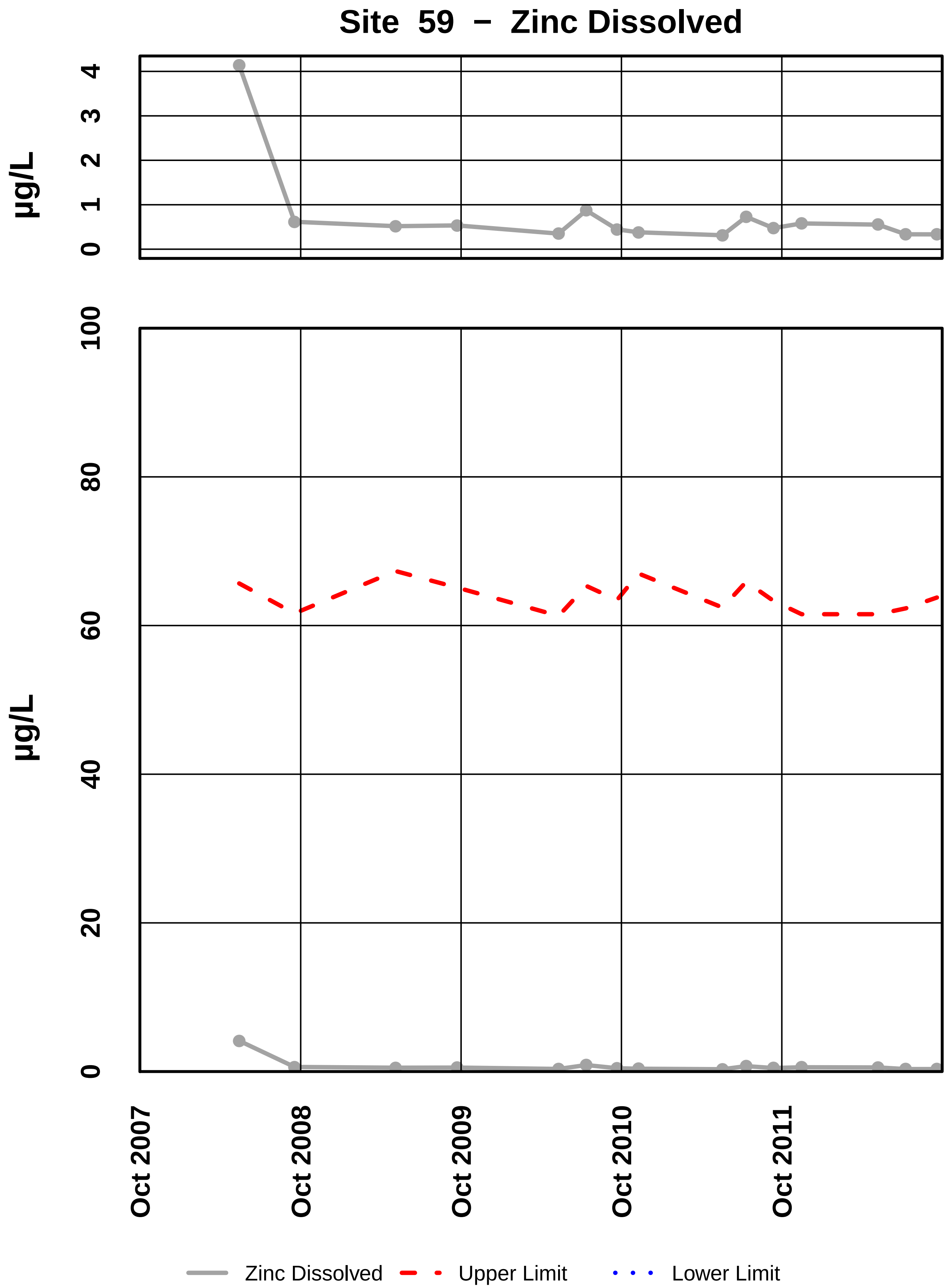
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



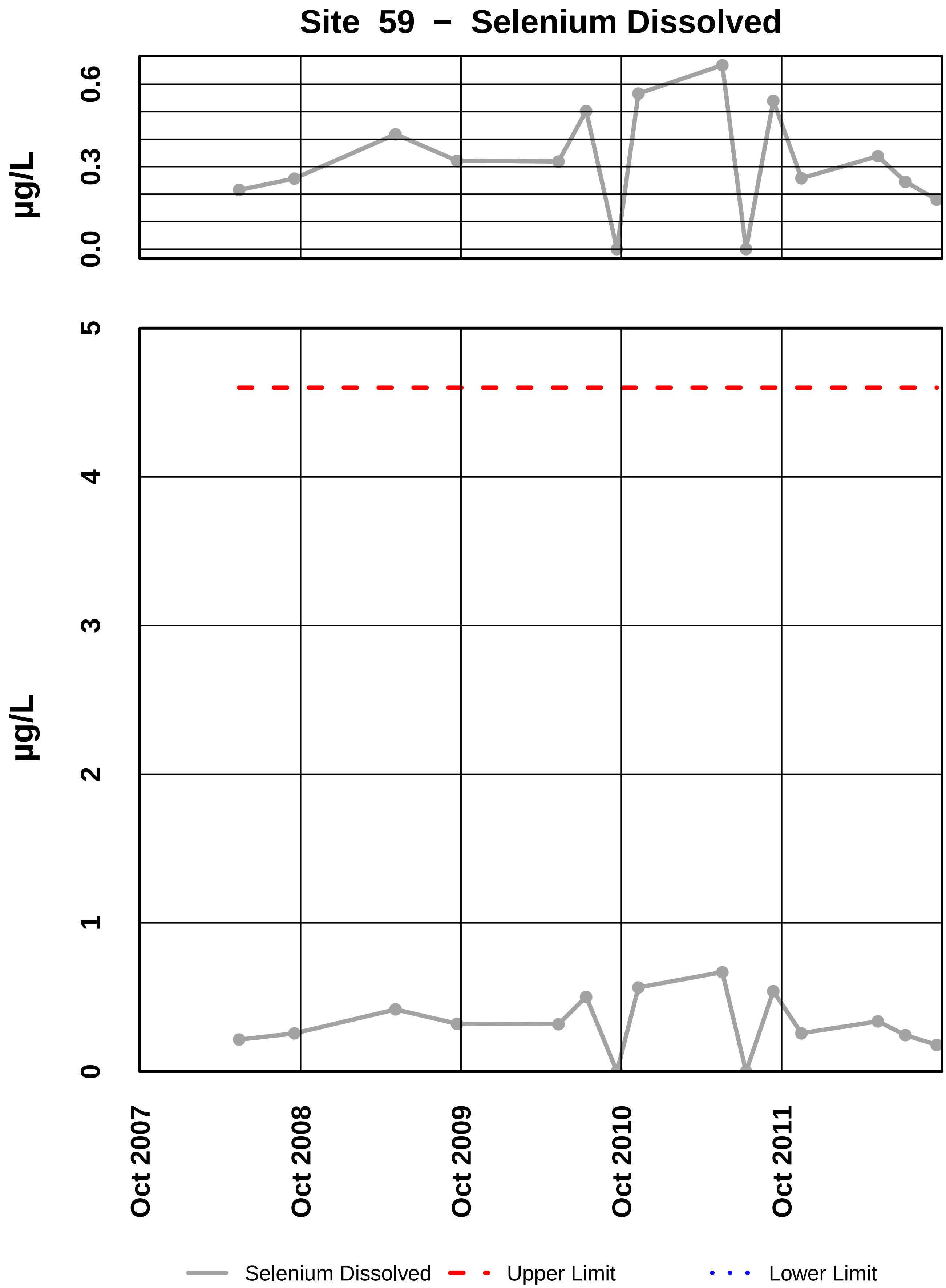
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

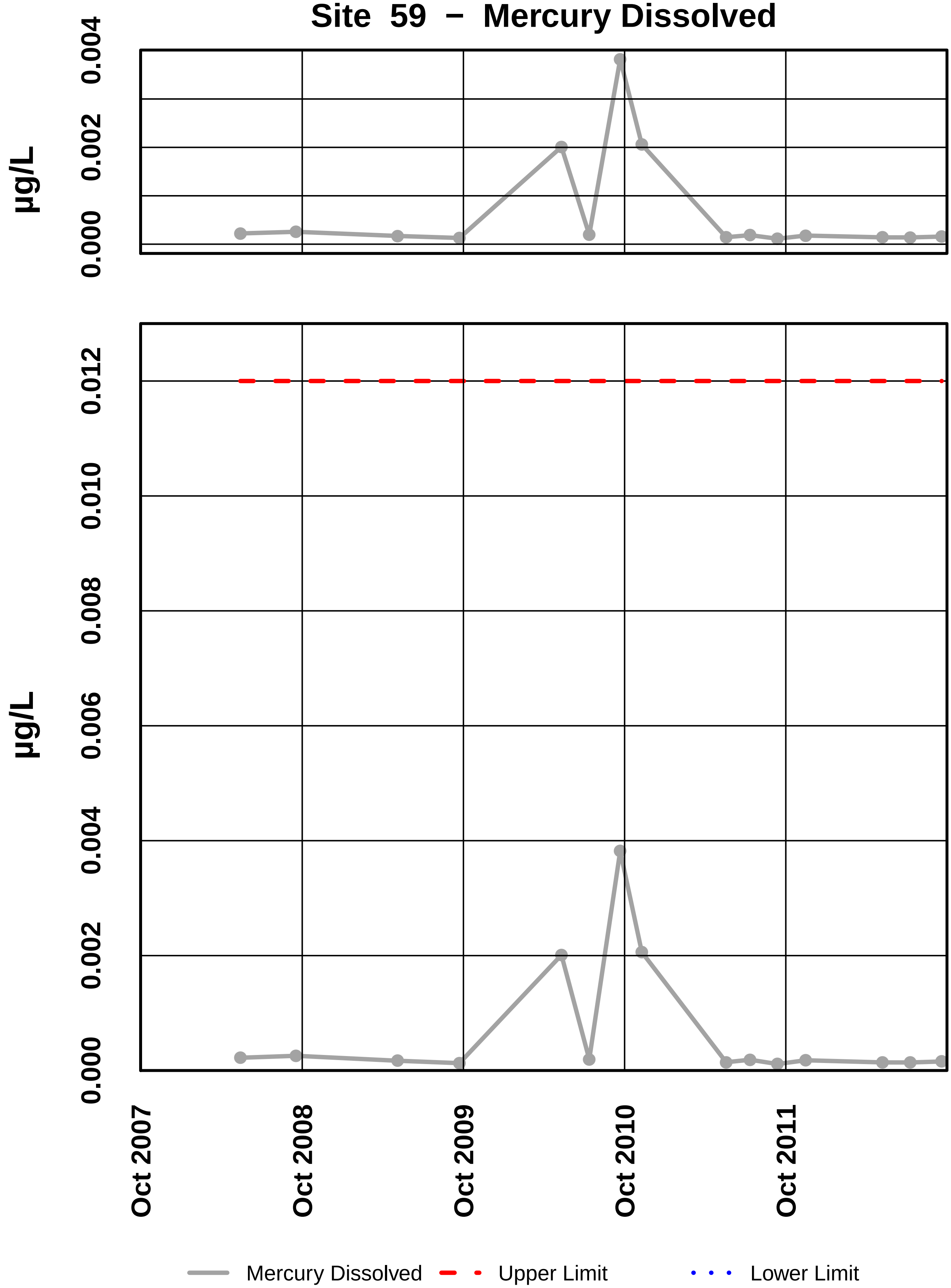


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

Site 59 – Mercury Dissolved



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

Site **#59** Seasonal Kendall analysis for Specific Conductance, Field (µS/cm)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**								111.3				110.4
b	**WY2008**								110.6				111.3
c	**WY2009**								116				114.7
d	**WY2010**								106.7		116.5		120.6
e	**WY2011**		142.9						182		146.2		97
f	**WY2012**		98						111.4		111.8		114
	n	0	2	0	0	0	0	0	6	0	3	0	6

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

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

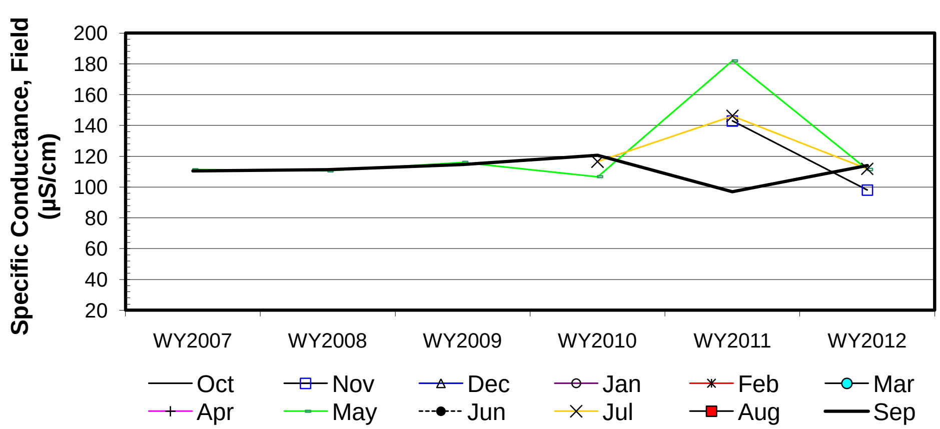
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=		1.00						28.33		3.67		28.33
$Z_k = S_k/\sigma_S$		-1.00						0.56		-0.52		0.56
Z^2_k		1.00						0.32		0.27		0.32

ΣZ_k=	-0.40
ΣZ^2_k=	1.91
Z-bar=ΣZ_k/K=	-0.10

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

Σn	17
ΣS_k	4

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=		1.87	@α=5% $\chi^2_{(K-1)}$=	7.81	Test for station homogeneity
	p	**0.600**			$\chi^2_h<\chi^2_{(K-1)}$ ACCEPT
ΣVAR(S_k)	Z_{calc}	0.38	@α/2=2.5% Z=	1.96	**H_0** (No trend) ACCEPT
61.33	p	**0.649**			**H_A** (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-3.51		4.73
0.050	-2.13	**0.44**	2.81
0.100	-1.54		2.35
0.200	-0.95		1.27

Site **#59** Seasonal Kendall analysis for pH, Field, Standard Units

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**								7.1				7.0
b	**WY2008**								6.5				6.6
c	**WY2009**								6.8				6.7
d	**WY2010**								5.9		6.1		6.9
e	**WY2011**		6.7						6.9		5.8		6.4
f	**WY2012**		6.7						6.2		6.7		6.4
	n	0	2	0	0	0	0	0	6	0	3	0	6

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

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

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=		1.00						28.33		3.67		28.33
$Z_k = S_k/\sigma_S$		1.00						-0.94		0.52		-1.69
Z^2_k		1.00						0.88		0.27		2.86

ΣZ_k= -1.11

ΣZ^2_k= 5.01

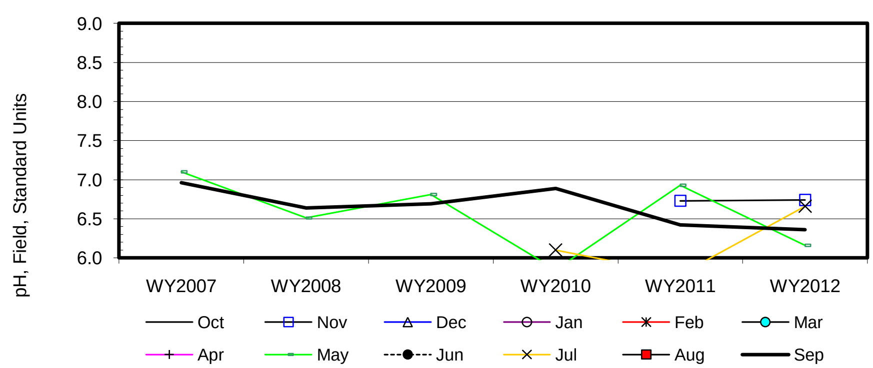
Z-bar=$\Sigma Z_k/K$= -0.28

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

Σn 17

ΣS_k -12

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	4.71	@α=5% $\chi^2_{(K-1)}$= 7.81	Test for station homogeneity	
p	**0.195**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k) 61.33	Z_{calc} -1.40	@α/2=2.5% Z= 1.96	**H_0** (No trend)	ACCEPT
	p **0.080**		**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.31		0.07
0.050	-0.20	**-0.10**	-0.01
0.100	-0.15		-0.04
0.200	-0.14		-0.07

Site **#59** Seasonal Kendall analysis for Total Alk, (mg/l)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**								44.9				44.6
b	**WY2008**								45.8				42.4
c	**WY2009**								44.2				42.5
d	**WY2010**								40.5		41.0		42.1
e	**WY2011**		39.6						41.7		42.5		42.9
f	**WY2012**		44.2						45.7		43.9		48.9
	n	0	2	0	0	0	0	0	6	0	3	0	6

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

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

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

ΣZ_k= 2.57

ΣZ^2_k= 4.09

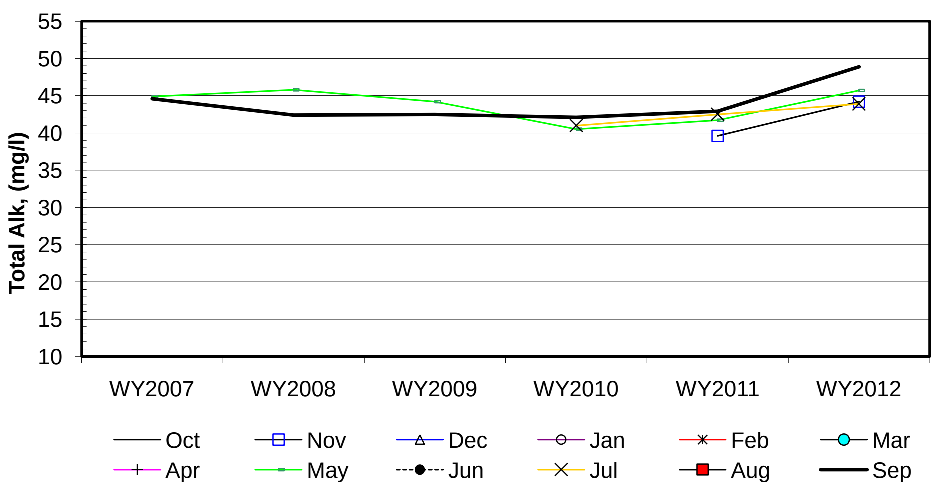
Z-bar=ΣZ_k/K= 0.64

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

Σn 17

ΣS_k 4

$\chi^2_h=\Sigma Z^2_k$-K(Z-bar)^2=	2.44	@α=5% $\chi^2_{(K-1)}$=	7.81	Test for station homogeneity	
p	**0.486**			$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc} 0.38	@α/2=2.5% Z=	1.96	**H_0** (No trend)	ACCEPT
61.33	**p** **0.649**			**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-1.07		1.46
0.050	-0.59	**0.16**	1.03
0.100	-0.40		0.86
0.200	-0.21		0.59

Site **#59** Seasonal Kendall analysis for Sulfate, Total (mg/l)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**								4.0				4.0
b	**WY2008**								4.6				4.6
c	**WY2009**								5.4				5.6
d	**WY2010**								5.3		4.7		5.5
e	**WY2011**		5.2						4.3		5.3		5.2
f	**WY2012**		4.0						4.9		5.2		5.4
	n	0	2	0	0	0	0	0	6	0	3	0	6

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

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

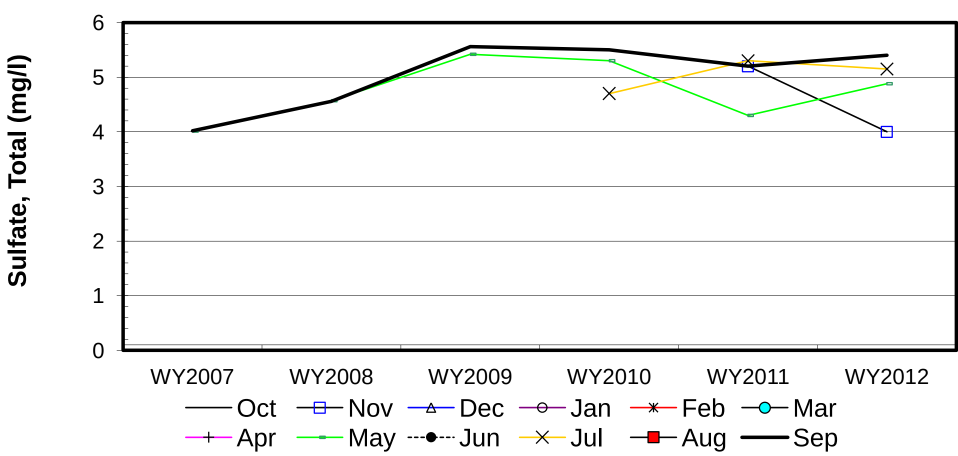
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=		1.00						28.33		3.67		28.33
$Z_k = S_k/\sigma_S$		-1.00						0.56		0.52		0.94
Z^2_k		1.00						0.32		0.27		0.88

ΣZ_k= 1.03
ΣZ^2_k= 2.47
Z-bar=ΣZ_k/K= 0.26

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

Σn 17
ΣS_k 8

$\chi^2_h=\Sigma Z^2_k$-K(Z-bar)^2=		2.21	@α=5% $\chi^2_{(K-1)}$= 7.81	Test for station homogeneity	
	p	**0.530**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc}	0.89	@α=2.5% Z= 1.96	**H_0** (No trend)	ACCEPT
61.33	**p**	**0.814**		**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.15		0.50
0.050	-0.07	**0.21**	0.39
0.100	-0.05		0.30
0.200	0.04		0.24

Site #59 Seasonal Kendall analysis for Zinc, Dissolved (ug/l)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**								0.4				0.3
b	**WY2008**								4.1				0.6
c	**WY2009**								0.5				0.5
d	**WY2010**								0.4		0.9		0.4
e	**WY2011**		0.4						0.3		0.7		0.5
f	**WY2012**		0.6						0.6		0.3		0.3
	n	0	2	0	0	0	0	0	6	0	3	0	6

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

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

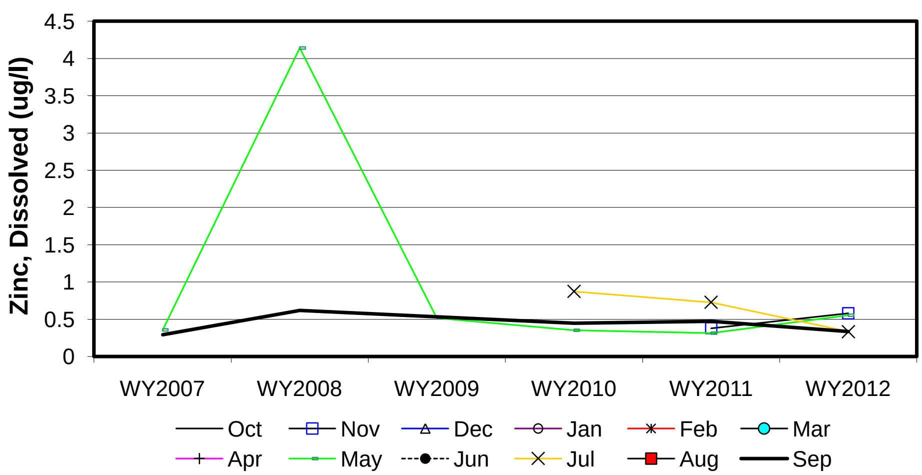
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=		1.00						28.33		3.67		28.33
$Z_k = S_k/\sigma_S$		1.00						-0.56		-1.57		-0.56
Z^2_k		1.00						0.32		2.45		0.32

ΣZ_k= -1.69
ΣZ^2_k= 4.09
Z-bar=ΣZ_k/K= -0.42

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

Σn 17
ΣS_k -8

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$= 3.37		@α=5% $\chi^2_{(K-1)}$= 7.81	Test for station homogeneity	
p	**0.338**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
$\Sigma VAR(S_k)$	Z_{calc} -0.89	@$\alpha/2$=2.5% Z= 1.96	**H_0** (No trend)	ACCEPT
61.33	**p** **0.186**		**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.15		0.05
0.050	-0.09	**-0.04**	0.02
0.100	-0.09		0.01
0.200	-0.07		-0.01

INTERPRETIVE REPORT
SITE 28

The data collected during the current water year are listed in the following “Table of Results for Water Year 2012” report. The table includes all the required FWMP analyte data (field and laboratory) collected for the current water year and a series of flags keyed to the summary report “Qualified Data by QA Reviewer”. The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of ½ MDL for the purpose of median calculation.

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

Sample Date	Parameter	Value	Qualifier	Notes
No outliers have been identified by HGCMC for the period of October 2007 through September 2012.				

The data for water year 2012 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. Dissolved arsenic was in exceedance for all four monthly FWMP sampling events. This site has routinely returned arsenic values above the AWQS and has a mean value of 75.7 µg/L based on sampling since October 1988.

Table of Exceedance for Water Year 2012

			Limits		
Sample Date	**Parameter**	**Value**	**Lower**	**Upper**	**Hardness**
15-Nov-11	Arsenic Dissolved	80.2 µg/L		10.00	
7-May-12	Arsenic Dissolved	78.4 µg/L		10.00	
9-Jul-12	Arsenic Dissolved	80.6 µg/L		10.00	
18-Sep-12	Arsenic Dissolved	77.9 µg/L		10.00	

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 was a trend in dissolved mercury similar to those noted for the upgradient background Sites 58 and 59. Dissolved mercury had a moderate increase at the beginning of the 2011 water year, but all samples from the 2012 water year were within historical levels.

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-06 and Sep-12(WY2007-WY2012).

Table of Summary Statistics for Trend Analysis

	Mann-Kendall test statistics			Sen's slope estimate	
Parameter	**n***	**p****	**Trend**	**Q**	**Q(%)**
Conductivity Field	6	0.35			
pH Field	6	0.13			
Alkalinity, Total	6	0.03			
Sulfate, Total	6	<0.01	+	0.47	4.2
Zinc, Dissolved	6	0.08			

* Number of Years ** Significance level

There was a significant increasing trend identified in total sulfate pH (<0.01) with an estimated slope of 0.47 µg/L/yr or a 4.2% increase, during the period of calculation.

Additional X-Y plots have been generated for alkalinity, pH, sulfate, conductance, and dissolved zinc that co-plot data from Site 28 and Site 59, the upgradient control site, to aid in comparison between those two sites. Field conductivity, field pH, total alkalinity, and total sulfate are all higher at Site 28 than at Site 59 while the dissolved zinc concentrations are generally similar except for water year 2006 which shows a pronounced spike of moderate amplitude for Site 28. By the end of the water year 2007 dissolved zinc was again at a typical value for Site 28. Site 59 and Site 28 are deep completion wells that are each respectively co-located with Site 58 and Site 27. A similar line of reasoning discussed in the section for Site 27 can be applied to explaining the differences in water chemistry between Site 59 and Site 28. Thus, the generally higher concentrations at Site 28 reflect the more mature nature of the groundwater sampled at this location.

Table of Results for Water Year 2012

Site 028FMG - 'Monitoring Well - 2D'

Sample Date/Parameter	Oct 2011	Nov 2011	Dec 2011	Jan 2012	Feb 2012	Mar 2012	Apr 2012	May 2012	Jun 2012	Jul 2012	Aug 2012	Sep 2012	**Median**
Water Temp (°C)		5						7.2		7.9		6.3	6.8
Conductivity-Field(μmho)		194						202		231		225	213.5
Conductivity-Lab (μmho)		222						230		220		221	222
pH Lab (standard units)		8.2						7.04		7.88		8.24	8.04
pH Field (standard units)		7.25						8.09		8.3		8.5	8.20
Total Alkalinity (mg/L)		86.5						97.5		95.5		128	96.5
Total Sulfate (mg/L)		10						11.4		11.3		11.7	11.4
Hardness (mg/L)		72.8						73.2		73.3		75.3	73.3
Dissolved As (ug/L)		80.2						78.4		80.6		77.9	79.300
Dissolved Ba (ug/L)		6.4						6.2		6.5		6.4	6.4
Dissolved Cd (ug/L)		0.0066						0.0018		0.0018		0.0018	0.0018
Dissolved Cr (ug/L)		0.313						0.224		0.314		0.594	0.314
Dissolved Cu (ug/L)		0.236						0.267		0.202		0.167	0.219
Dissolved Pb (ug/L)		0.0015						0.0015		0.0015		0.0045	0.0015
Dissolved Ni (ug/L)		0.94						0.591		0.618		0.644	0.631
Dissolved Ag (ug/L)		0.002						0.002		0.002		0.002	0.002
Dissolved Zn (ug/L)		0.66						0.37		0.14		0.47	0.42
Dissolved Se (ug/L)		0.057						0.057		0.139		0.057	0.057
Dissolved Hg (ug/L)		0.0001						0.000205		0.000112		0.000183	0.000148

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.

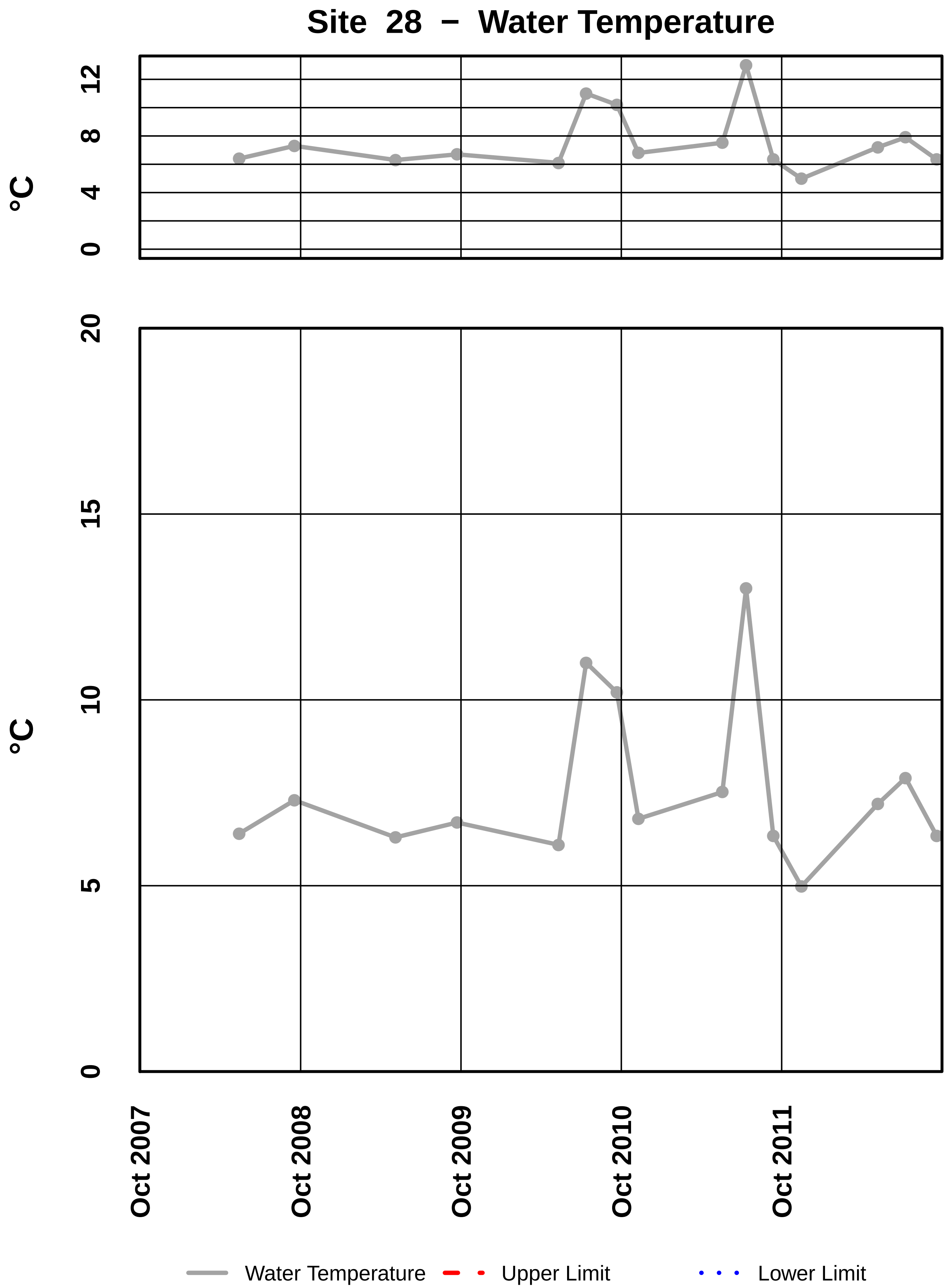
Shaded data has been qualified as an outlier by KGCMC and removed from any further analysis and is not included into the calculation of the median

Qualified Data by QA Reviewer

Date Range: 10/01/2011 to 09/30/2012

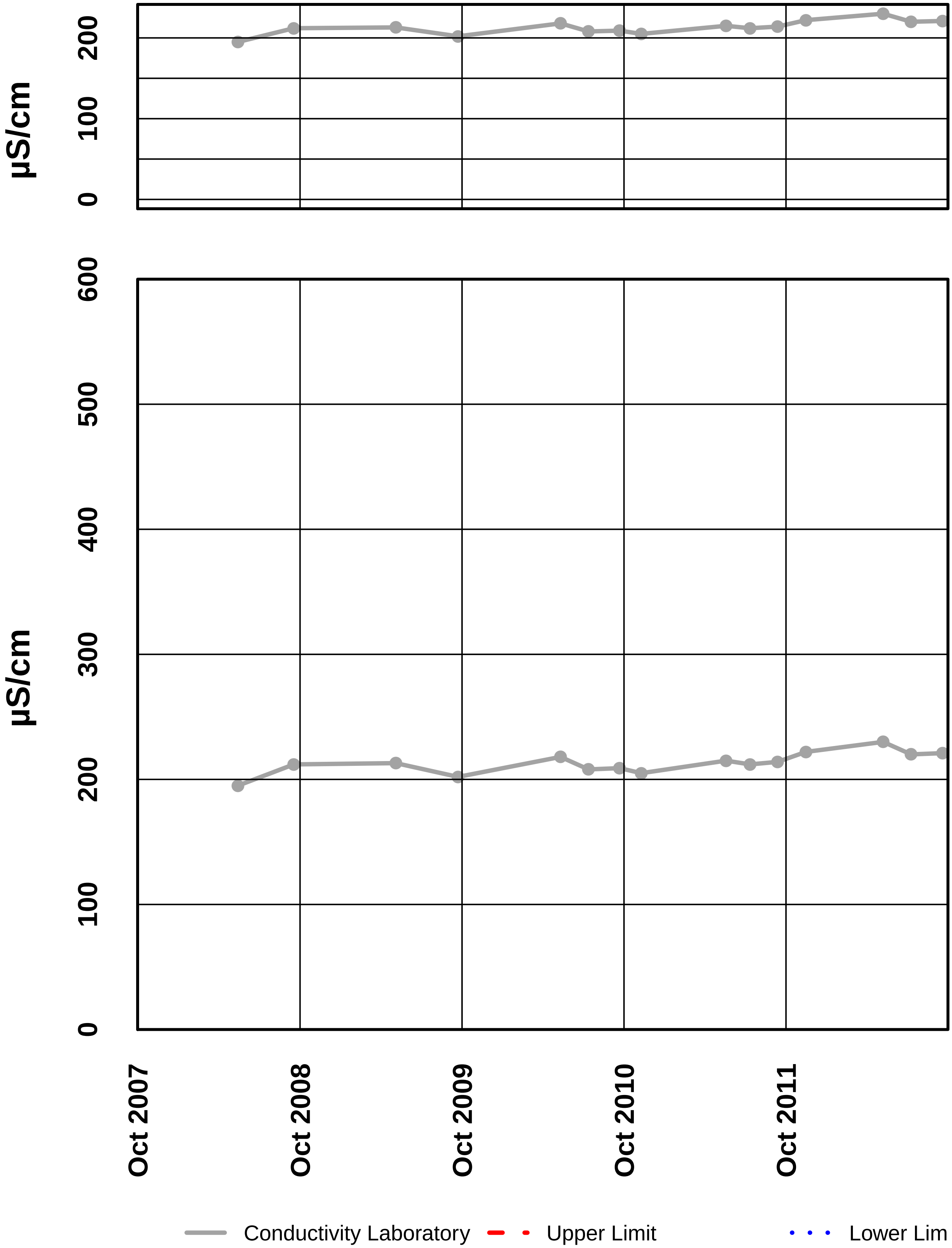
Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
28	11/15/2011	12:00 AM	Cd diss, µg/l	0.00661	J	Below Quantitative Range
			Hg diss, µg/l	0.0001	U	Field Blank Contamination
28	5/7/2012	12:00 AM	Hg diss, µg/l	0.000205	U	Field Blank Contamination
			Zn diss, µg/l	0.37	U	Field Blank Contamination
			SO4 Tot, mg/l	11.35	J	Sample Receipt Temperature
28	7/9/2012	12:00 AM	Cr diss, µg/l	0.31	U	Field Blank Contamination
			Hg diss, µg/l	0.000112	U	Field Blank Contamination
			Se diss, µg/l	0.13	J	Below Quantitative Range
			Zn diss, µg/l	0.13	U	Field Blank Contamination
28	9/18/2012	12:00 AM	Hg diss, µg/l	0.000183	U	Field Blank Contamination
			Pb diss, µg/l	0.00454	J	Below Quantitative Range
			SO4 Tot, mg/l	11.7	J	Sample Receipt Temperature

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

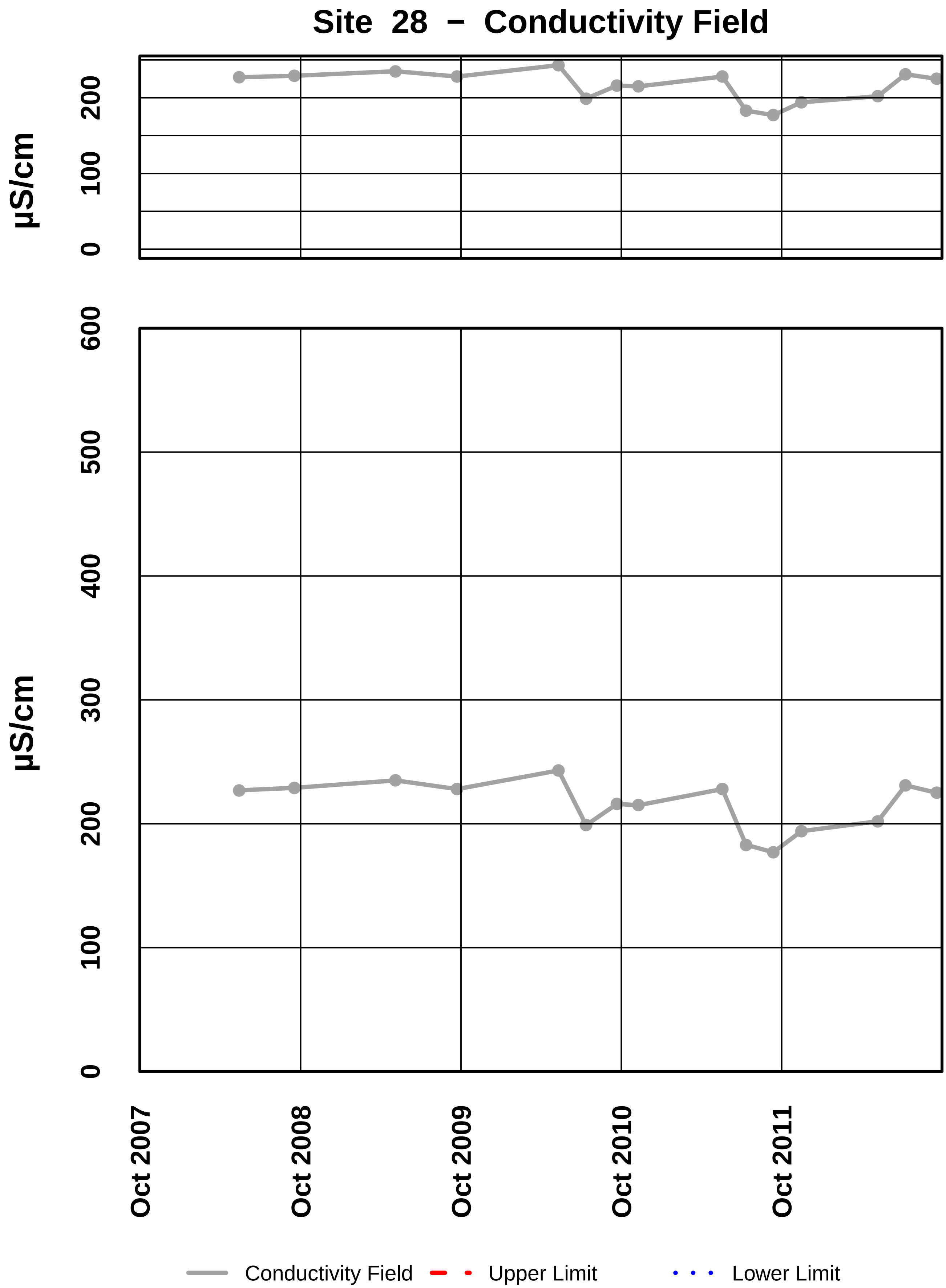


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 28 − Conductivity Laboratory

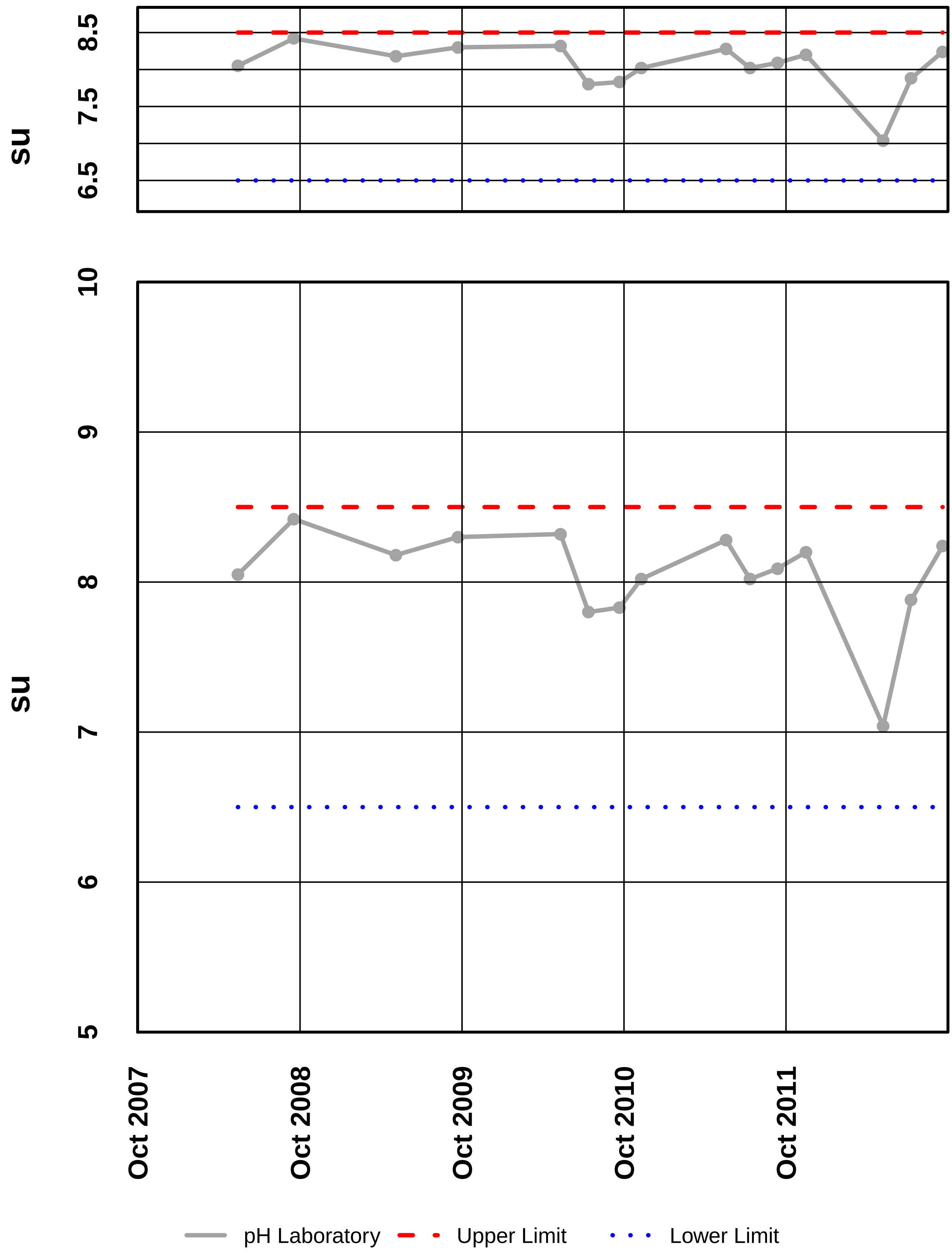


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

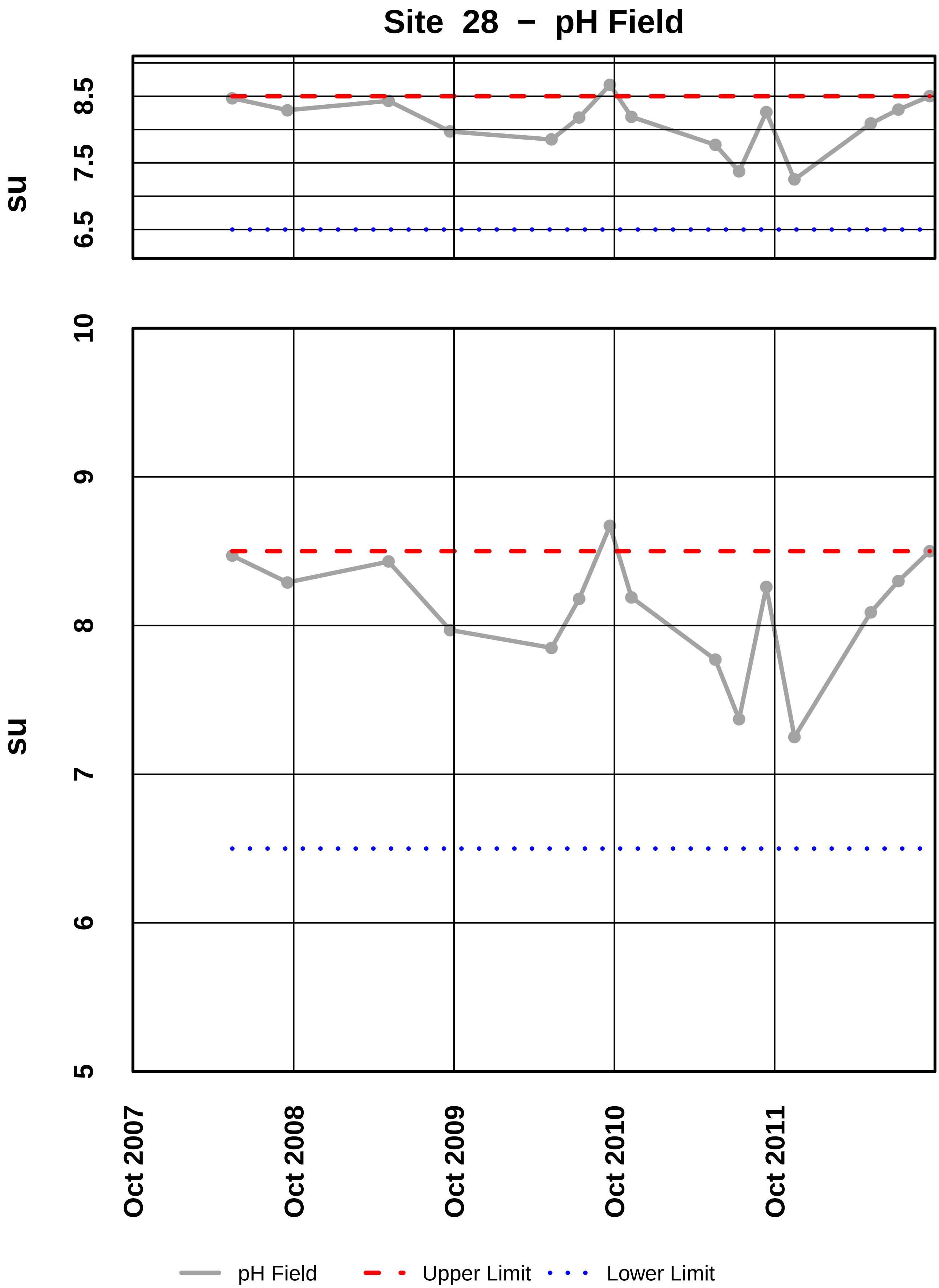


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

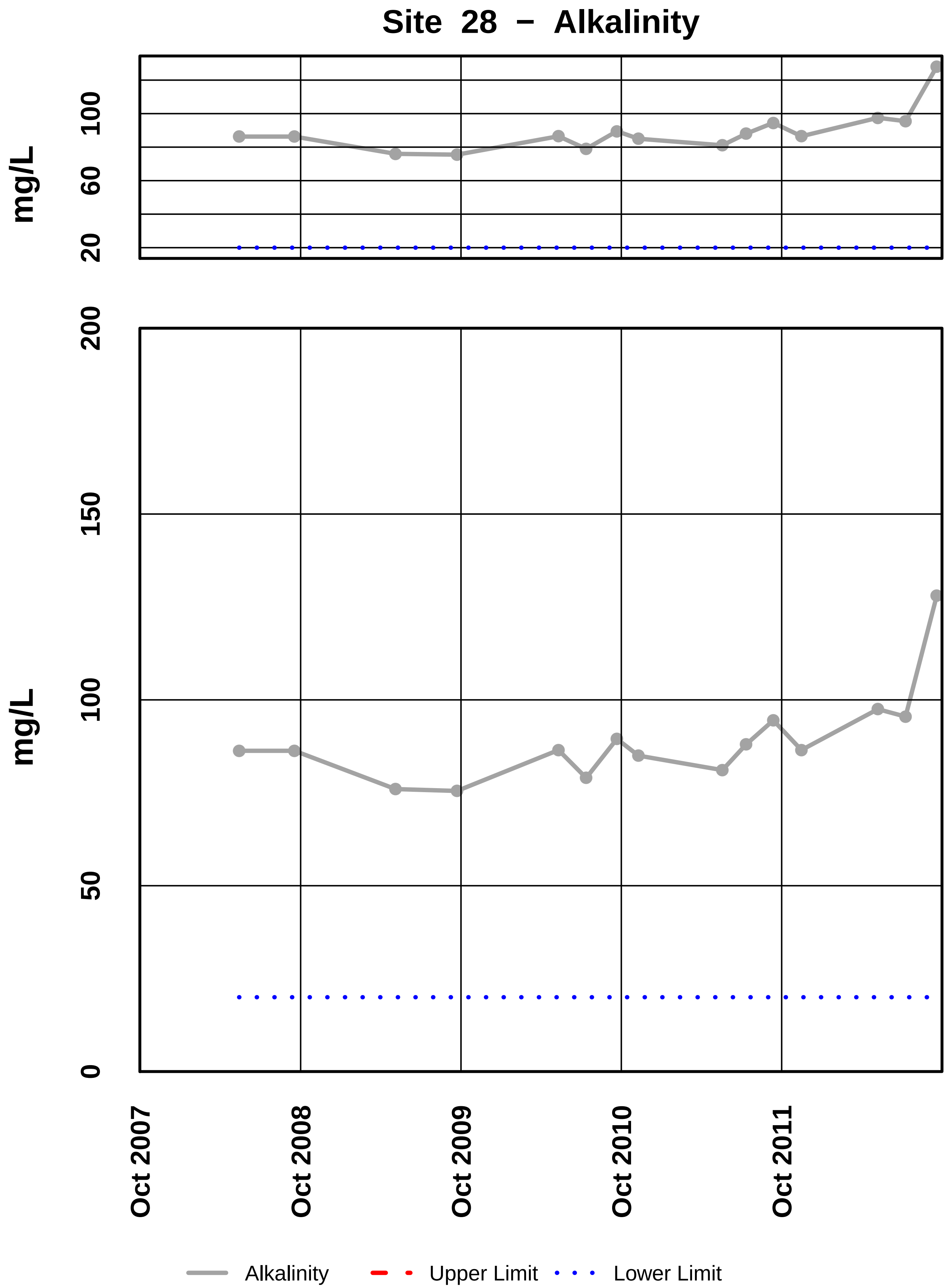
Site 28 – pH Laboratory



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

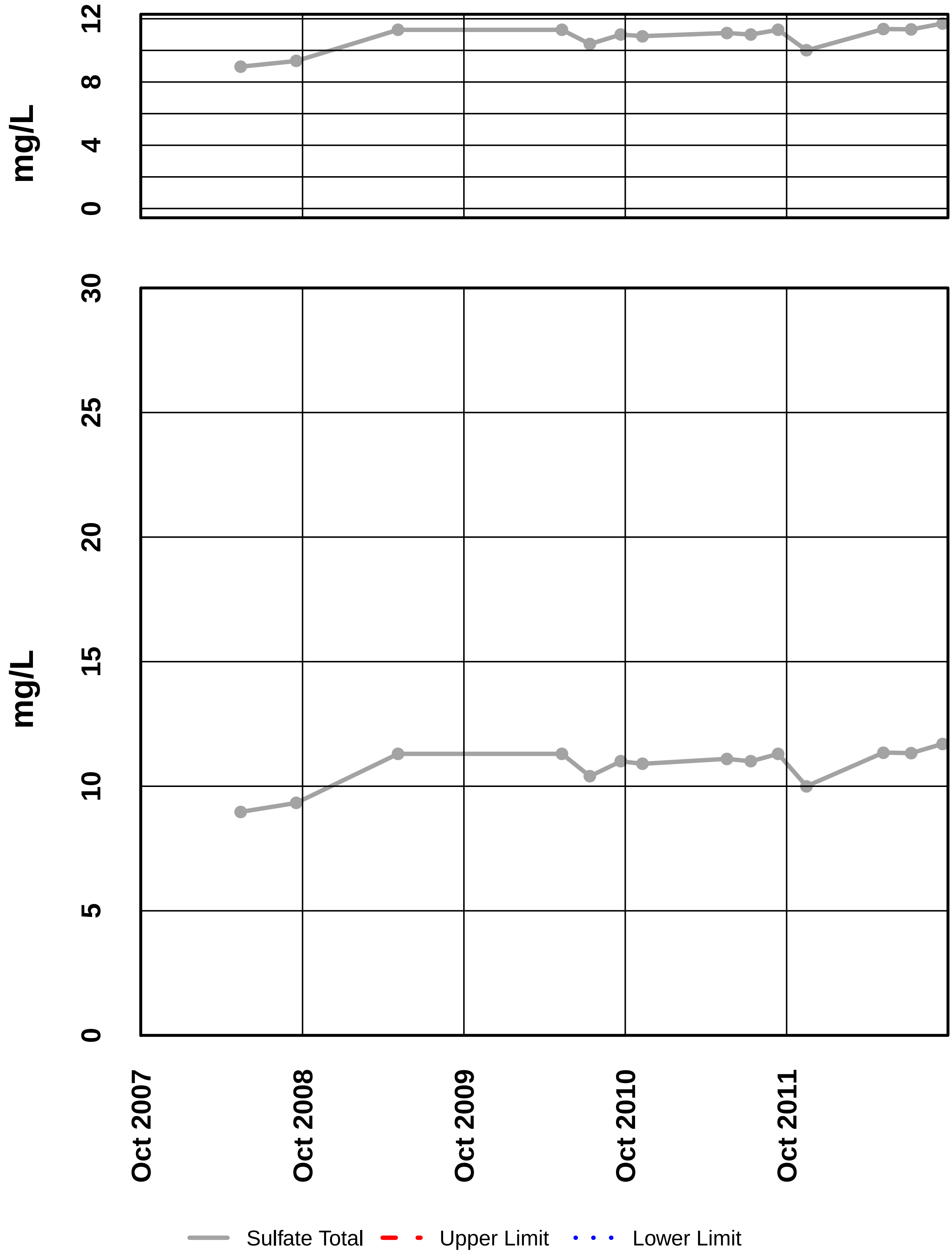


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

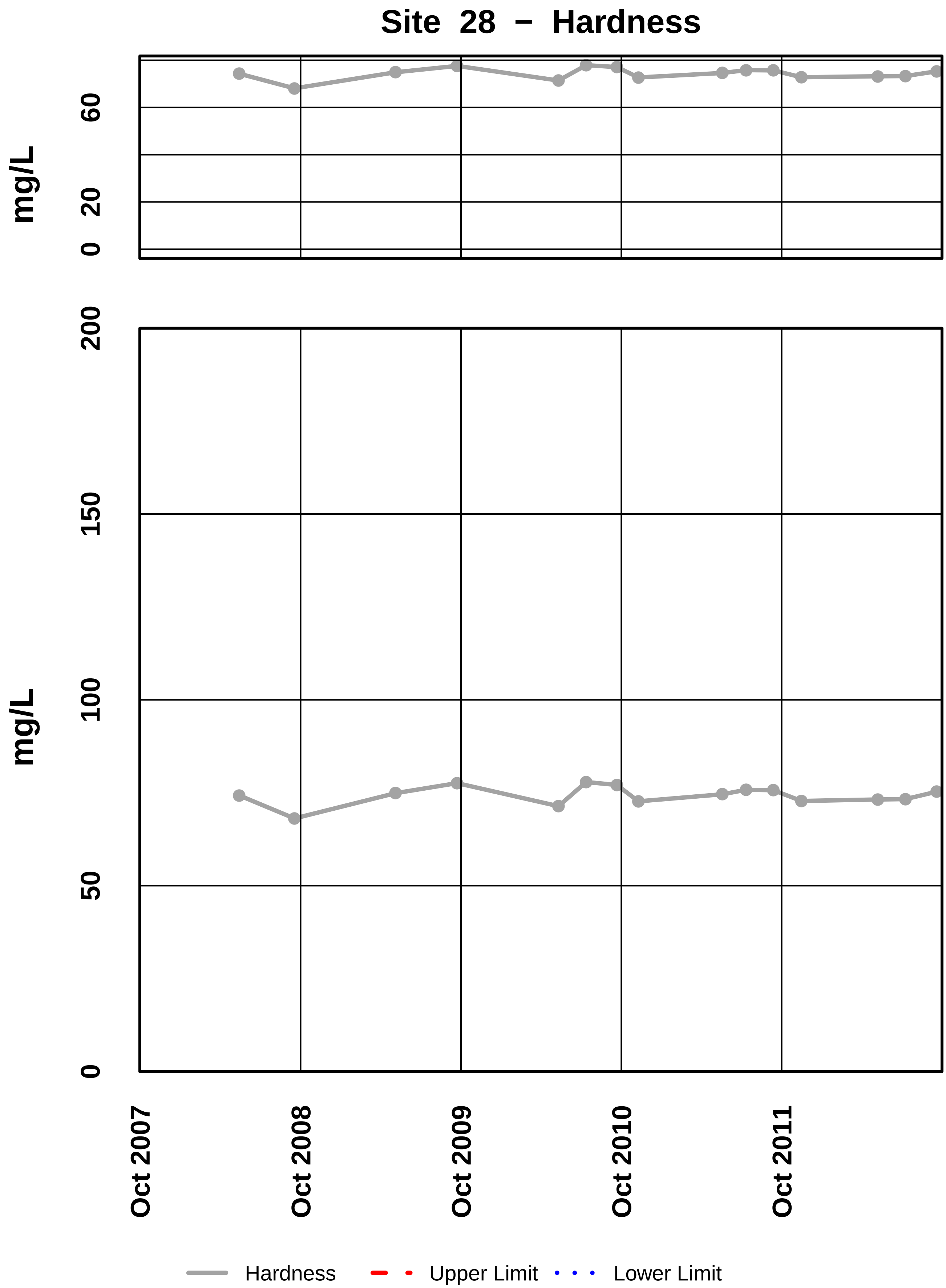


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

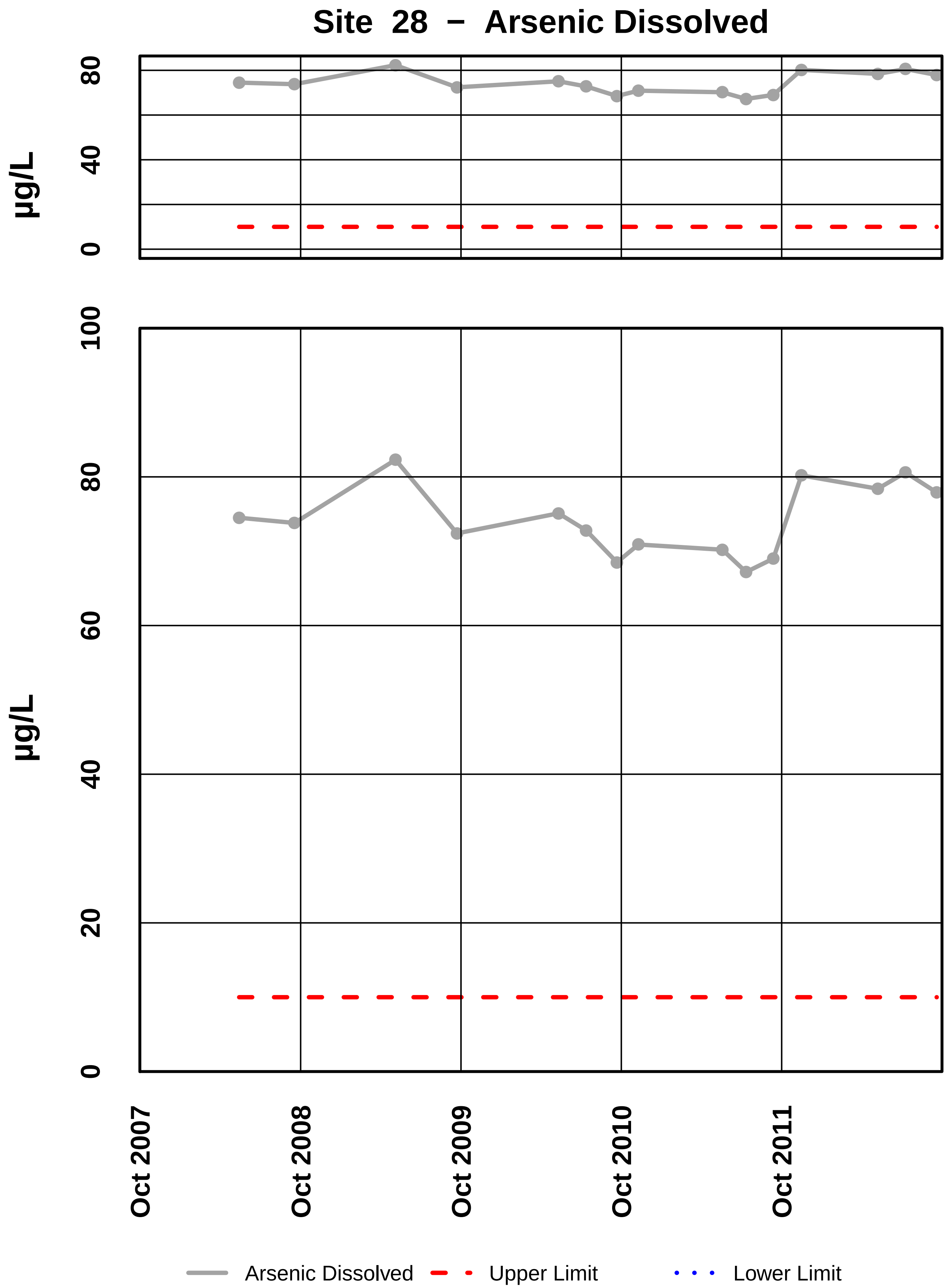
Site 28 – Sulfate Total



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

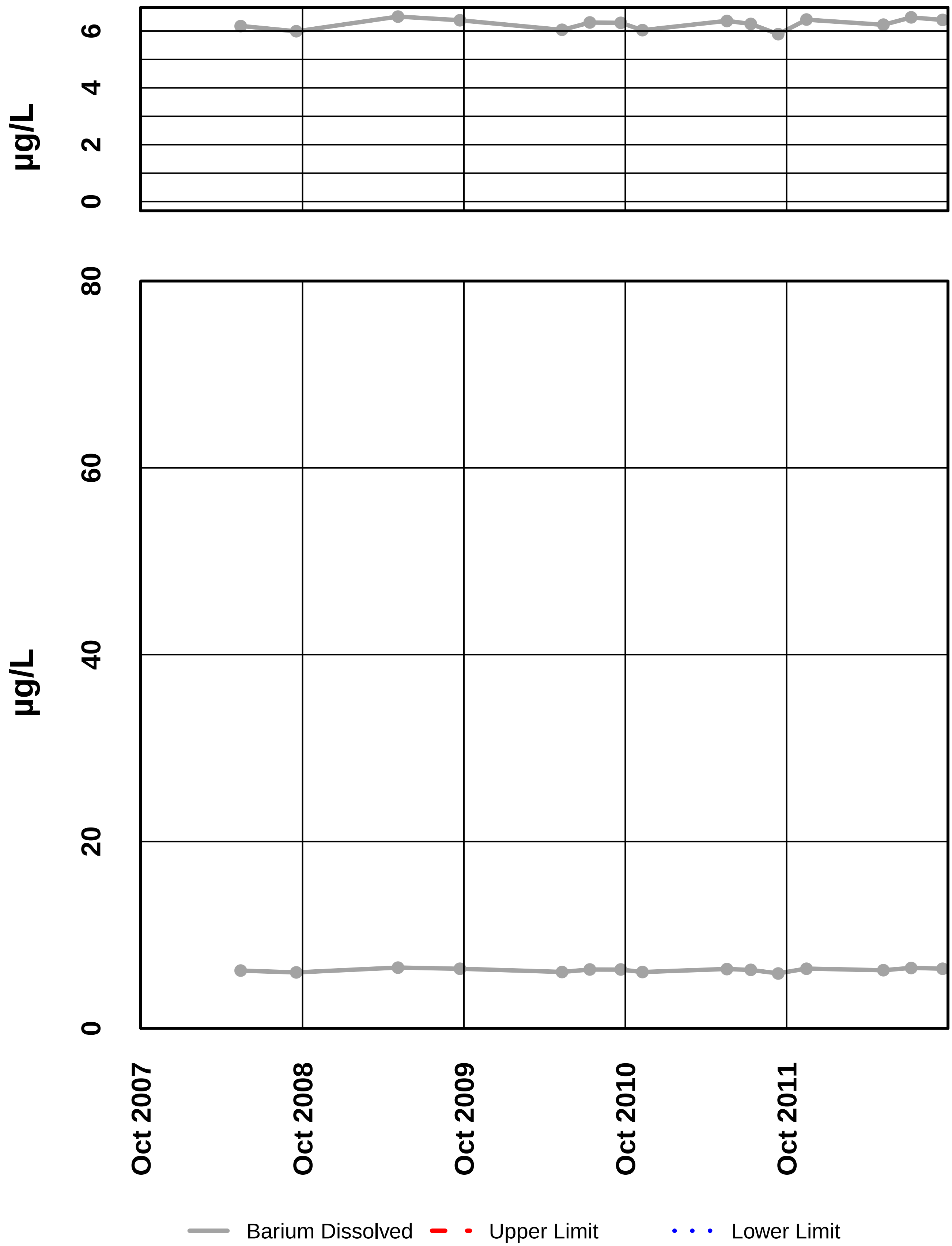


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

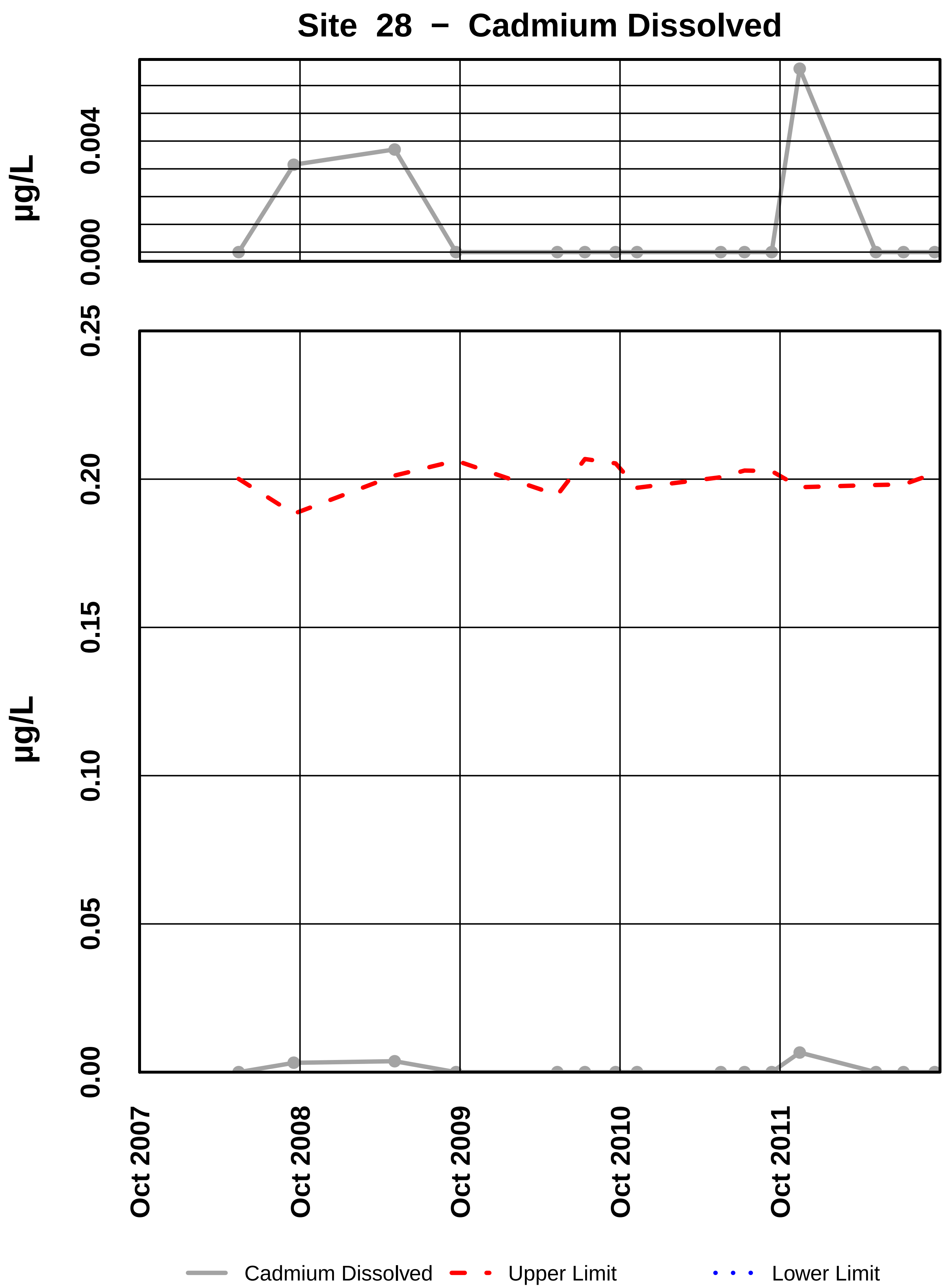


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 28 – Barium Dissolved

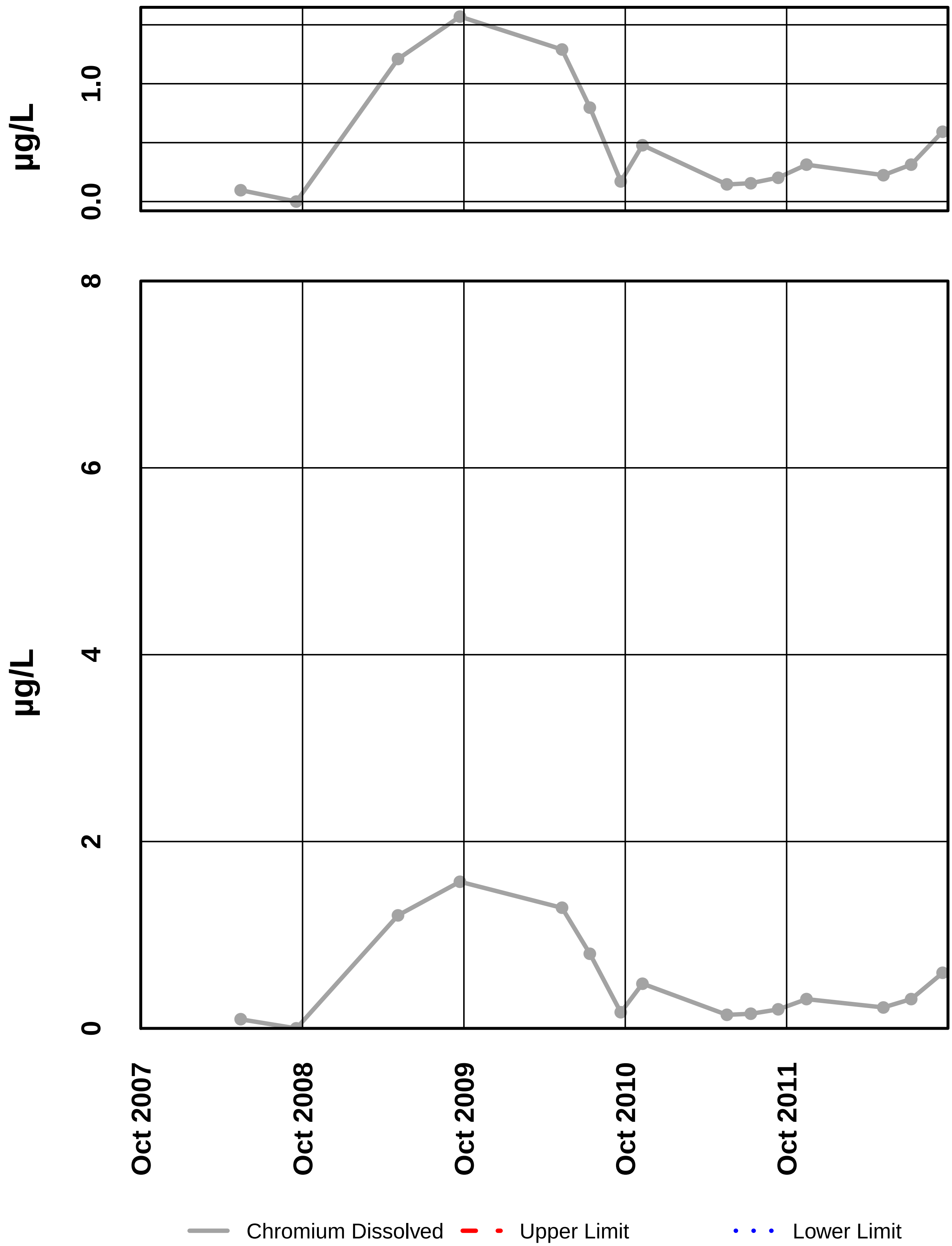


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

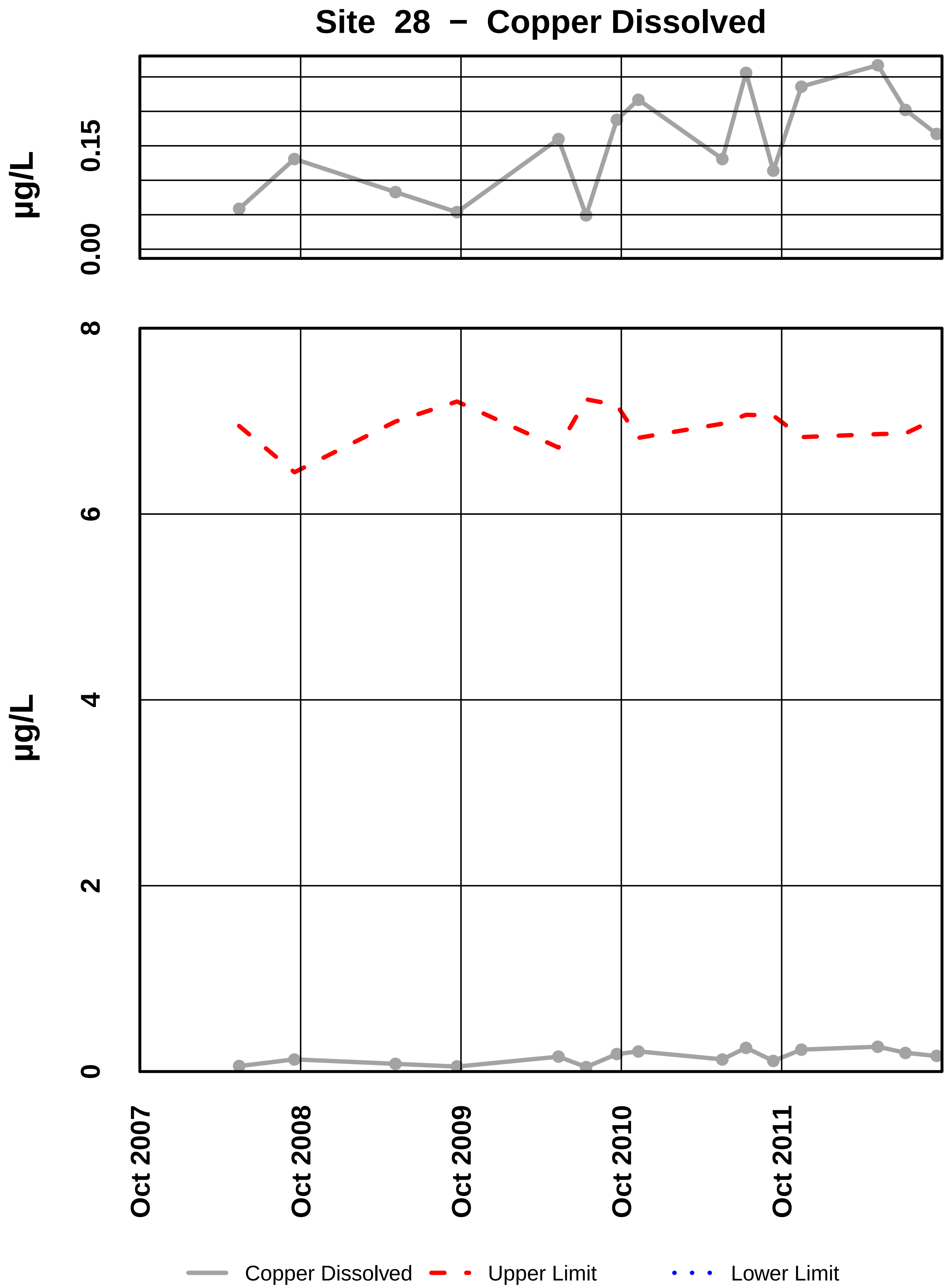


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 28 − Chromium Dissolved

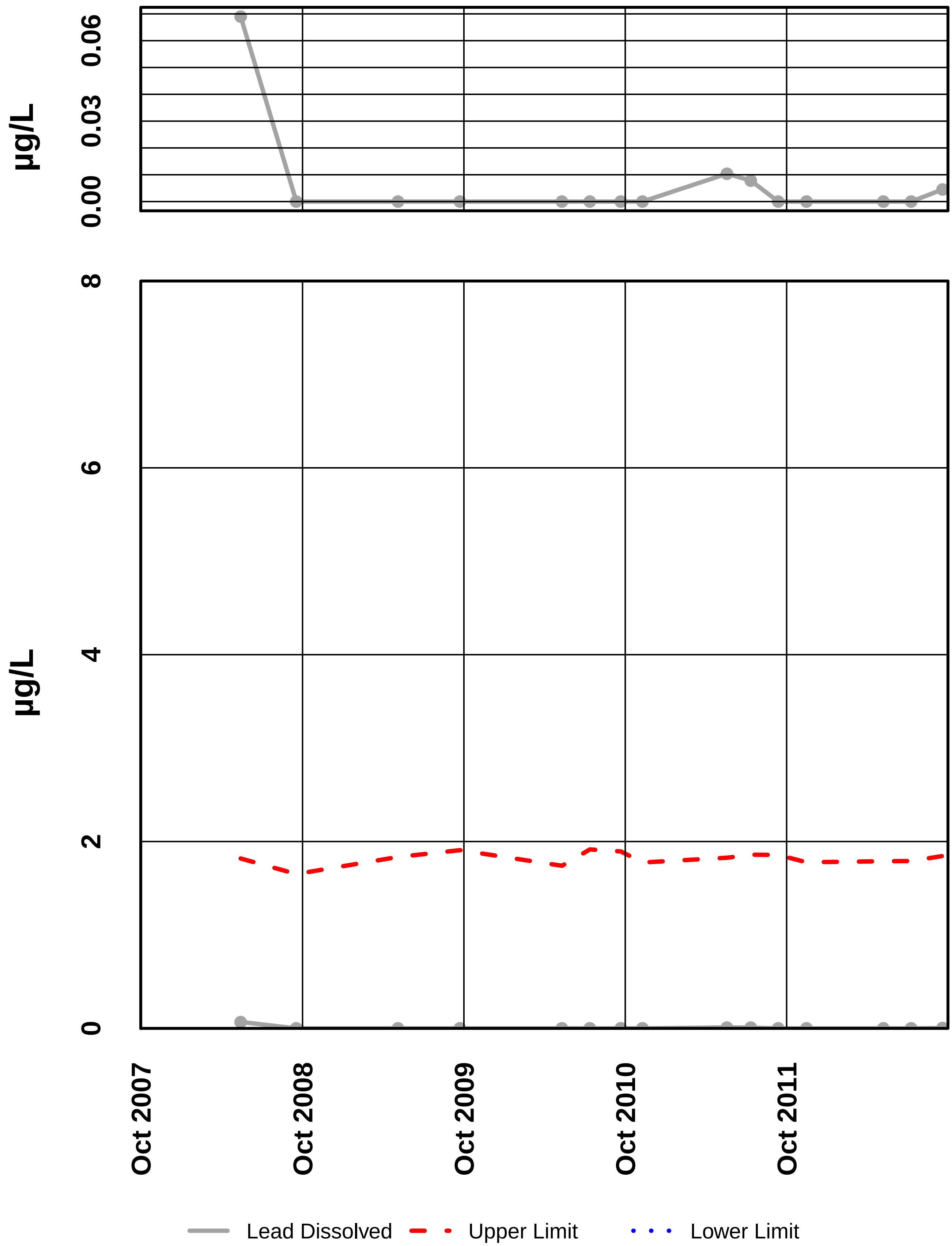


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

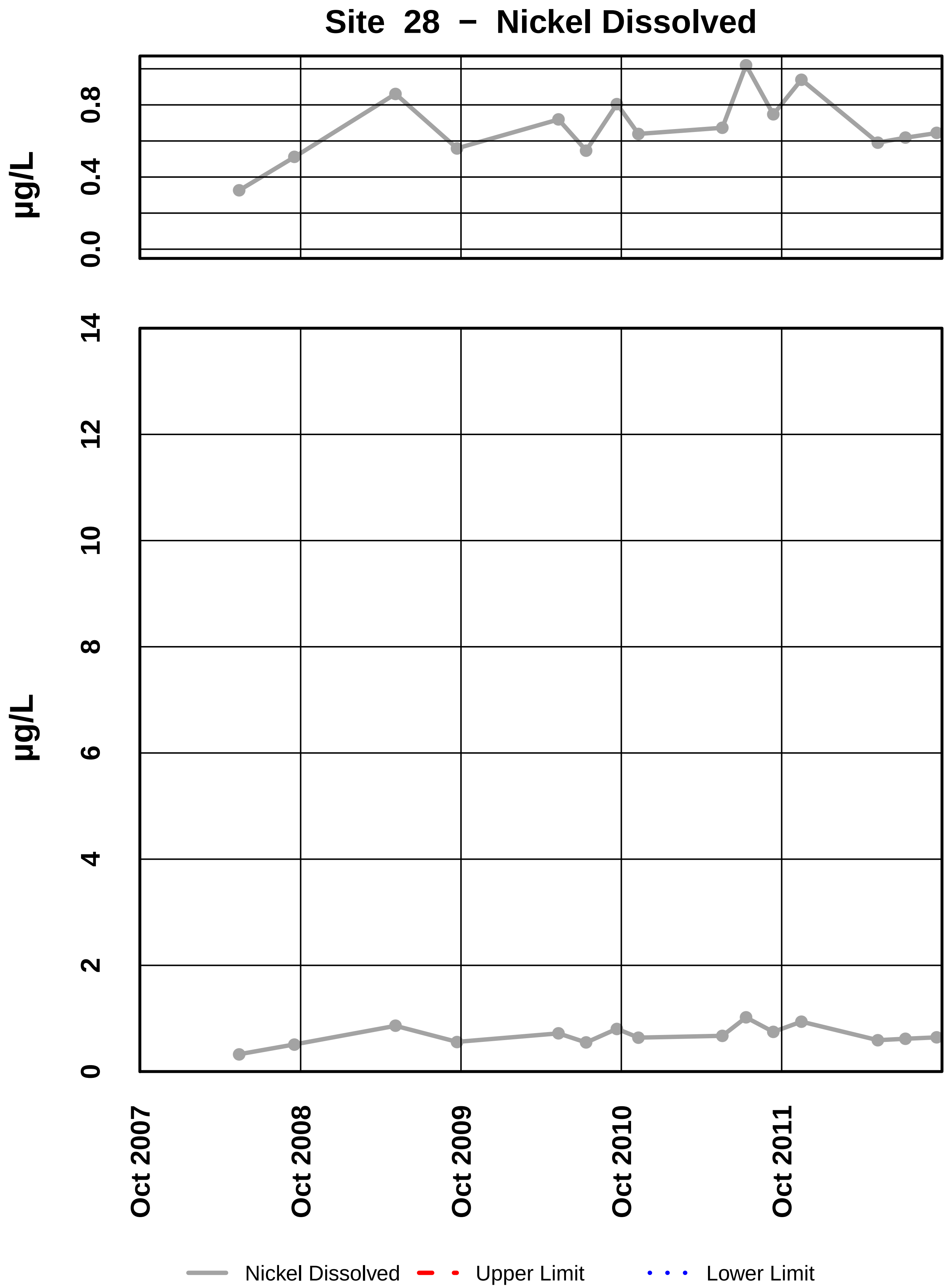


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

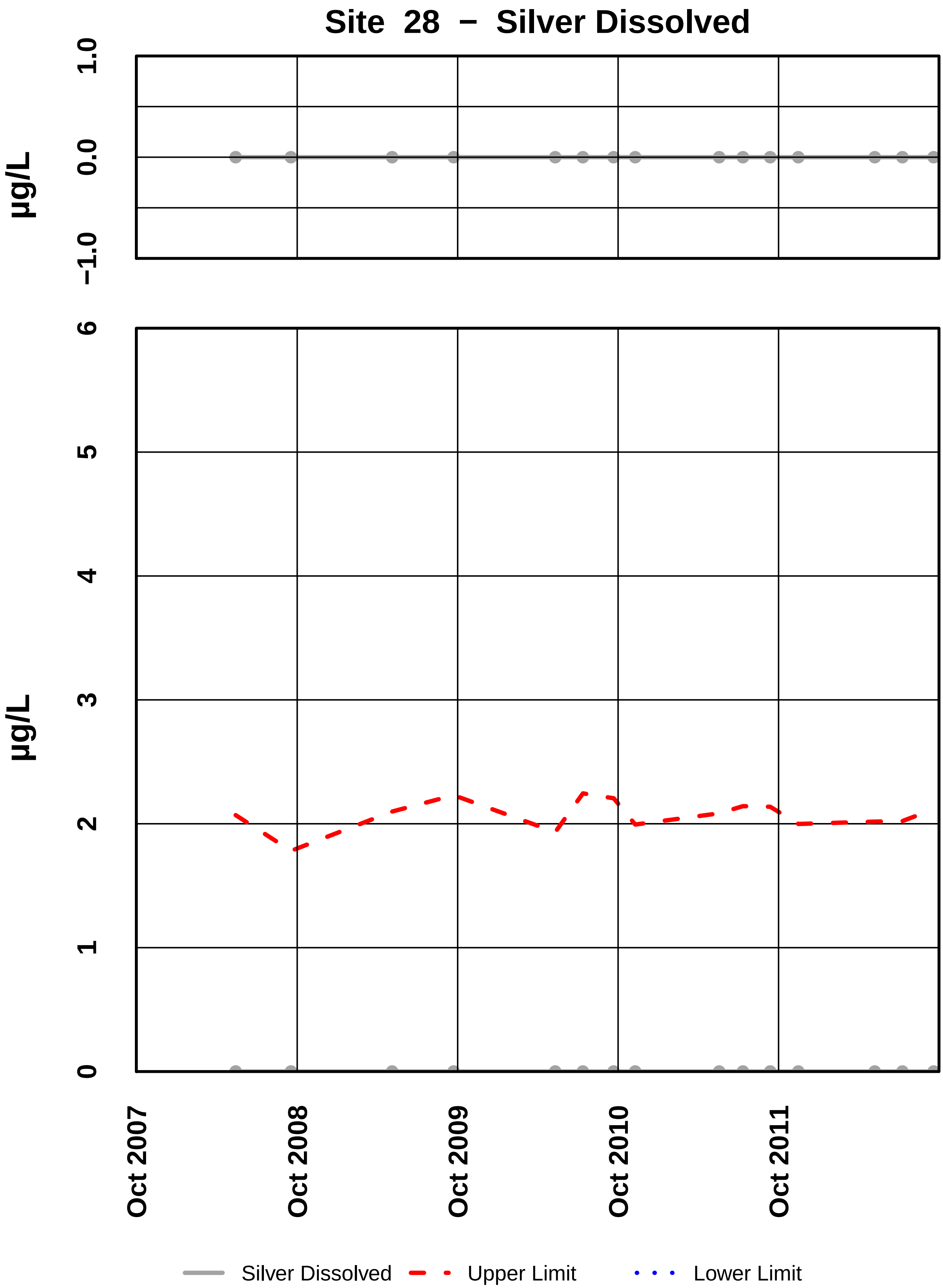
Site 28 − Lead Dissolved



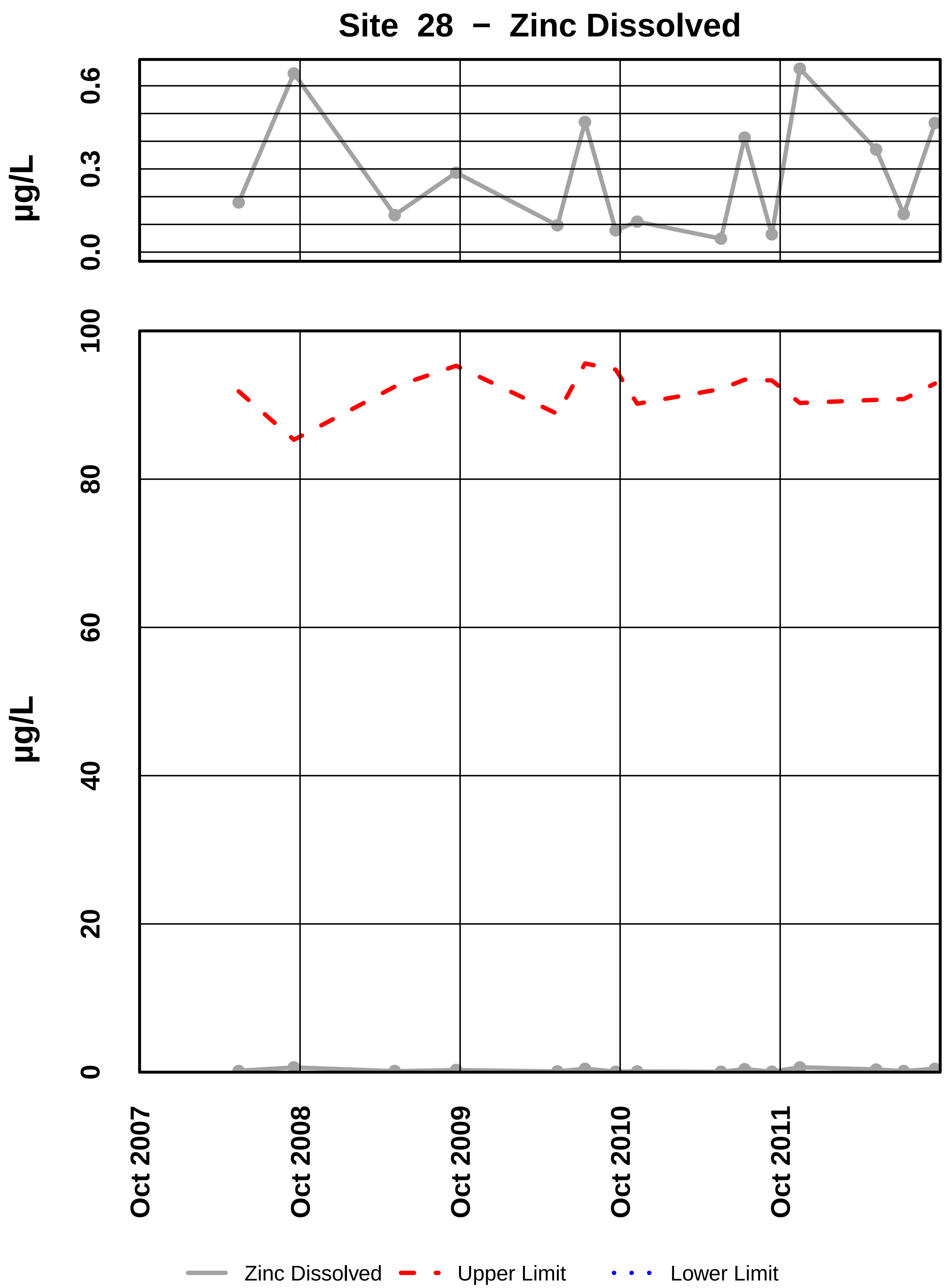
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



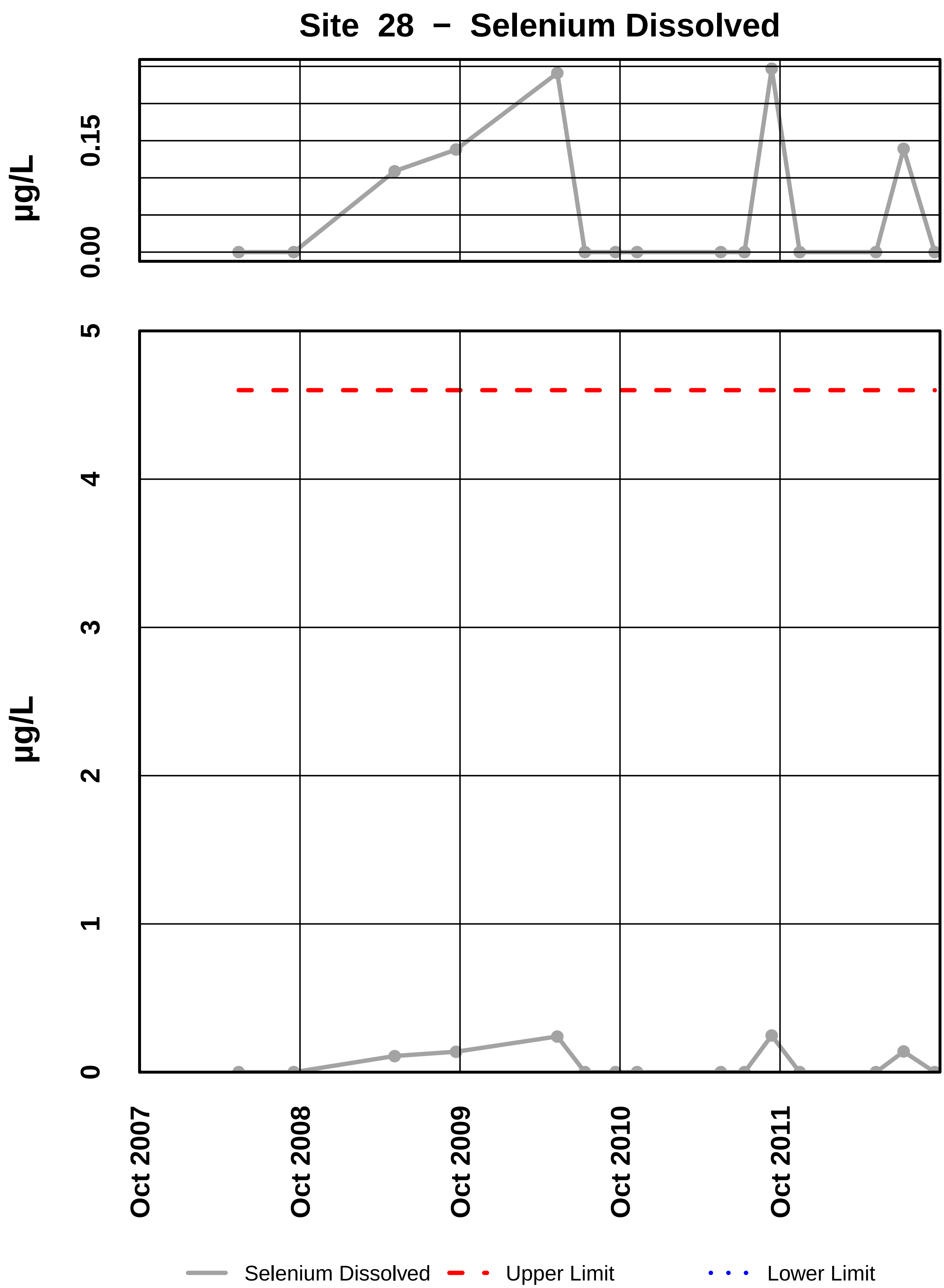
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

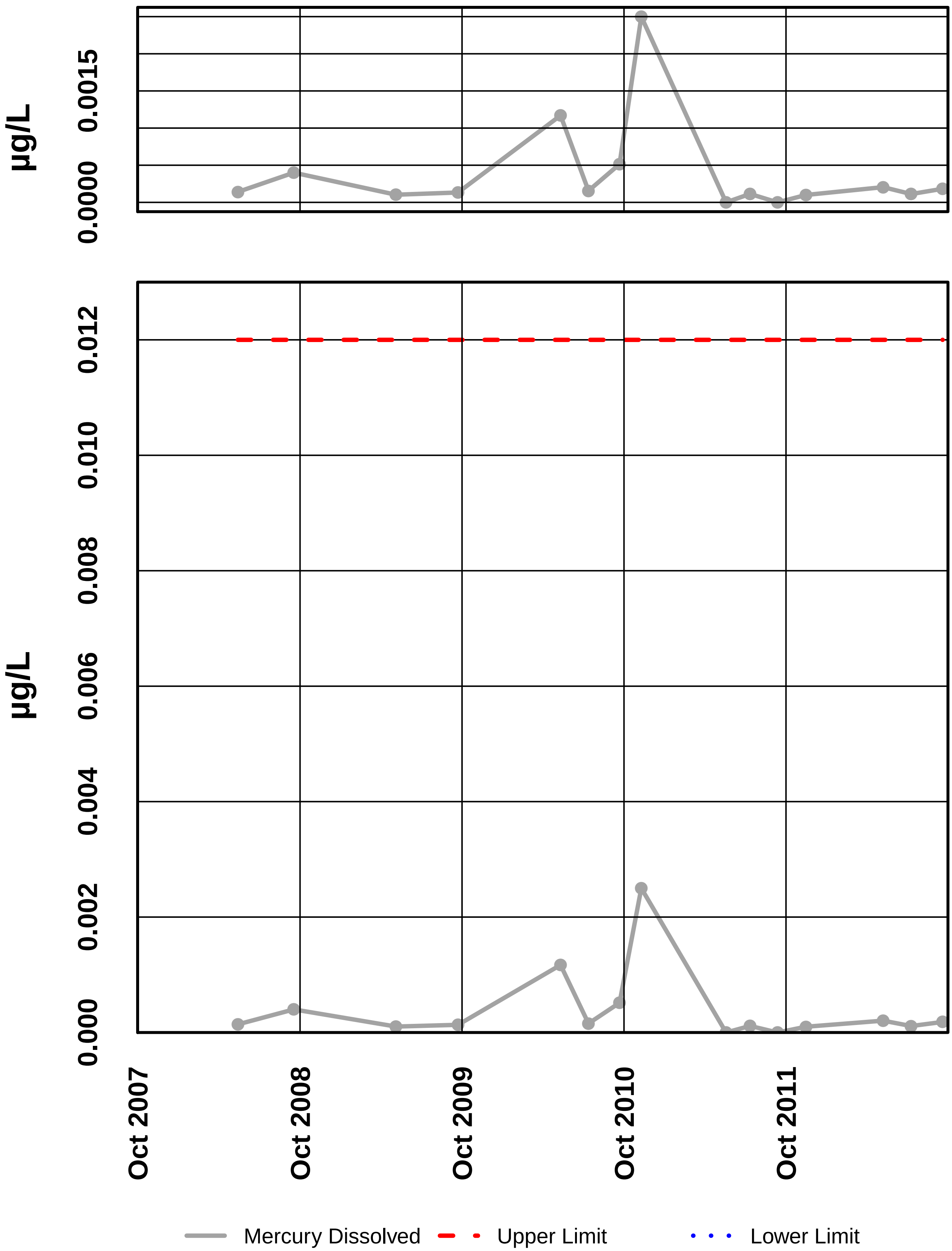


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

Site 28 − Mercury Dissolved



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

Site **#28** Seasonal Kendall analysis for Specific Conductance, Field (µS/cm)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**								217				220
b	**WY2008**								227				229
c	**WY2009**								235				228
d	**WY2010**								243		198.9		216
e	**WY2011**		215						228		183		177
f	**WY2012**		194						202		231		225
	n	0	2	0	0	0	0	0	6	0	3	0	6

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

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

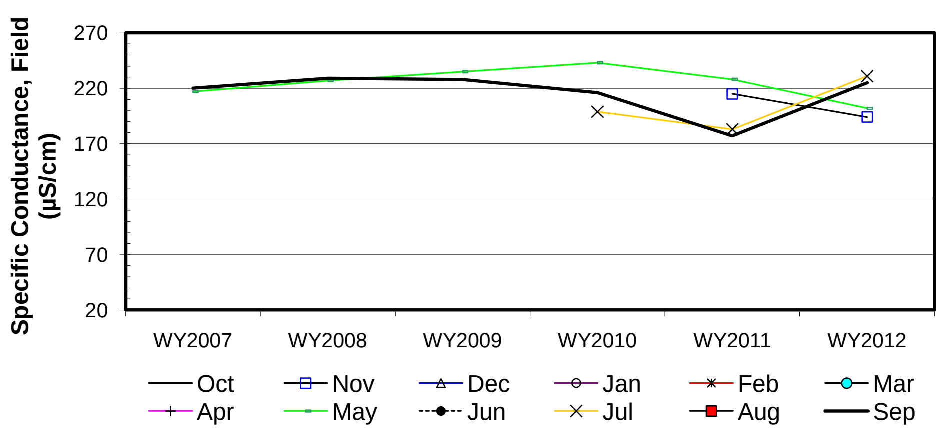
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=		1.00						28.33		3.67		28.33
$Z_k = S_k/\sigma_S$		-1.00						0.19		0.52		-0.94
Z^2_k		1.00						0.04		0.27		0.88

ΣZ_k= -1.23
ΣZ^2_k= 2.19
Z-bar=$\Sigma Z_k/K$= -0.31

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

Σn 17
ΣS_k -4

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=		1.81	@α=5% $\chi^2_{(K-1)}$=	7.81	Test for station homogeneity
	p	**0.612**			$\chi^2_h<\chi^2_{(K-1)}$ ACCEPT
ΣVAR(S_k)	Z_{calc}	-0.38	@α/2=2.5% Z=	1.96	**H_0** (No trend) ACCEPT
61.33	**p**	**0.351**			**H_A** (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-15.10		8.00
0.050	-10.86	**-1.00**	4.22
0.100	-6.58		2.77
0.200	-4.31		0.53

Site **#28** Seasonal Kendall analysis for pH, Field, Standard Units

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**								8.7				8.5
b	**WY2008**								8.5				8.3
c	**WY2009**								8.4				8.0
d	**WY2010**								7.9		8.2		8.7
e	**WY2011**		8.2						7.8		7.4		8.3
f	**WY2012**		7.3						8.1		8.3		8.5
	n	0	2	0	0	0	0	0	6	0	3	0	6

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

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

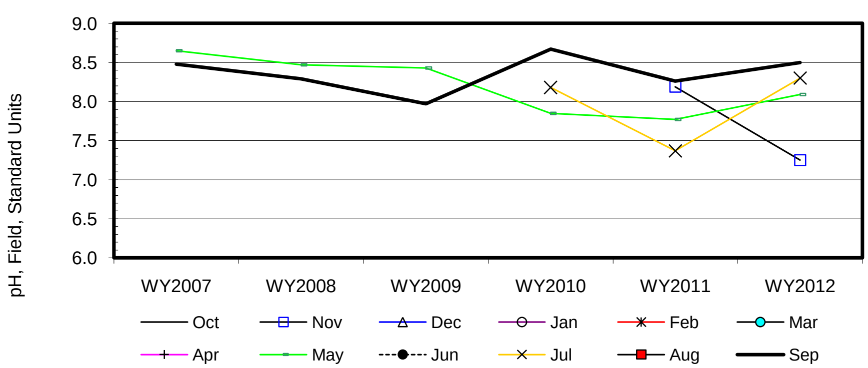
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=		1.00						28.33		3.67		28.33
$Z_k = S_k/\sigma_S$		-1.00						-2.07		0.52		0.19
Z^2_k		1.00						4.27		0.27		0.04

ΣZ_k=	-2.36
ΣZ^2_k=	5.58
Z-bar=ΣZ_k/K=	-0.59

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

Σn	17
ΣS_k	-10

$\chi^2_h=\Sigma Z^2_k$-K(Z-bar)^2=	4.19	@α=5% $\chi^2_{(K-1)}$= 7.81	Test for station homogeneity	
p	**0.242**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc} -1.15	@α/2=2.5% Z= 1.96	**H_0** (No trend)	ACCEPT
61.33	**p** **0.125**		**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.27		0.07
0.050	-0.23	**-0.09**	0.03
0.100	-0.19		-0.01
0.200	-0.13		-0.05

Site #28 — Seasonal Kendall analysis for Total Alk, (mg/l)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**								86.7				85.8
b	**WY2008**								86.3				86.3
c	**WY2009**								76.0				75.5
d	**WY2010**								86.5		79.0		89.5
e	**WY2011**		85.0						81.1		88.0		94.5
f	**WY2012**		86.5						97.5		95.5		128.0
	n	0	2	0	0	0	0	0	6	0	3	0	6

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

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

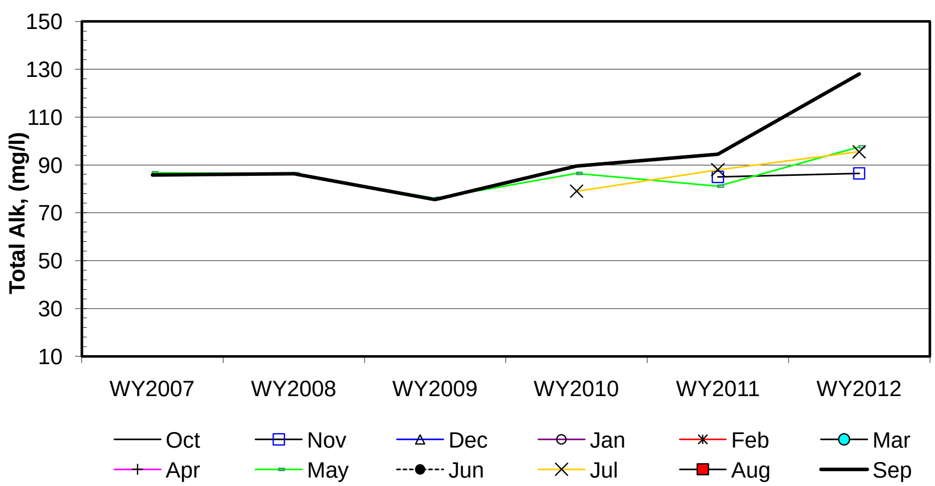
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=		1.00						28.33		3.67		28.33
$Z_k = S_k/\sigma_S$		1.00						0.19		1.57		2.07
Z^2_k		1.00						0.04		2.45		4.27

ΣZ_k= 4.82
ΣZ^2_k= 7.76
Z-bar=ΣZ_k/K= 1.21

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

Σn 17
ΣS_k 16

$\chi^2_h=\Sigma Z^2_k$-K(Z-bar)^2=	1.95	@α=5% $\chi^2_{(K-1)}$= 7.81	Test for station homogeneity	
p	**0.583**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k) Z_{calc}	1.92	@α/2=2.5% Z= 1.96	**H_0** (No trend)	ACCEPT
61.33 **p**	**0.972**		**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.51		9.05
0.050	0.32	**2.64**	7.83
0.100	1.22		7.17
0.200	1.57		5.15

Site **#28** Seasonal Kendall analysis for Sulfate, Total (mg/l)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**								9.1				9.4
b	**WY2008**								9.0				9.3
c	**WY2009**								11.3				
d	**WY2010**								11.3		10.4		11.0
e	**WY2011**		10.9						11.1		11.0		11.3
f	**WY2012**		10.0						11.4		11.3		11.7
	n	0	2	0	0	0	0	0	6	0	3	0	5

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

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

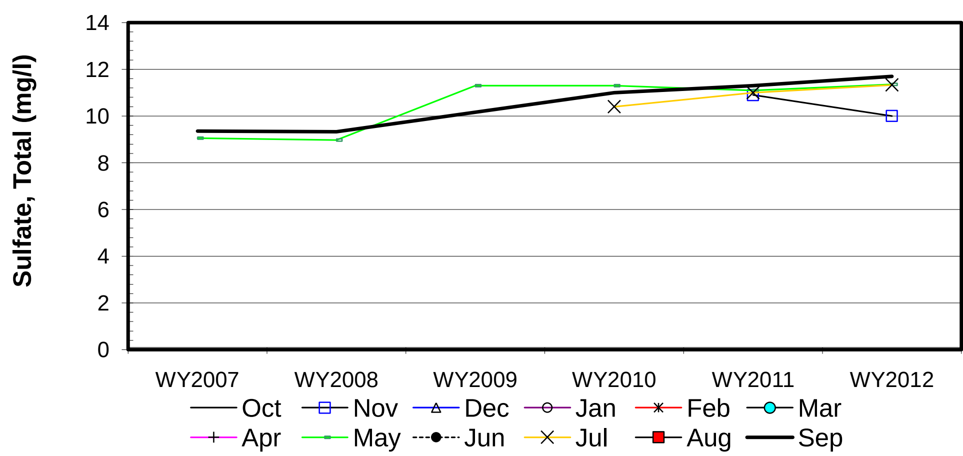
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
$\sigma^2_S=$		1.00						27.33		3.67		16.67
$Z_k = S_k/\sigma_S$		-1.00						1.53		1.57		1.96
Z^2_k		1.00						2.34		2.45		3.84

$\Sigma Z_k=$	4.06
$\Sigma Z^2_k=$	9.64
Z-bar=ΣZ_k/K=	1.01

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	14	1	0	0	0

Σn	16
ΣS_k	18

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2=$	5.52	@α=5% $\chi^2_{(K-1)}=$	7.81	Test for station homogeneity	
p	**0.137**			$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k) Z_{calc}	2.44	@α=2.5% $Z=$	1.96	**H_0** (No trend)	REJECT
48.67 **p**	**0.993**			**H_A** (± trend)	ACCEPT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	0.01		0.63
0.050	0.20	**0.47**	0.59
0.100	0.30		0.55
0.200	0.34		0.50
		4.2%	

Site **#28** Seasonal Kendall analysis for Zinc, Dissolved (ug/l)

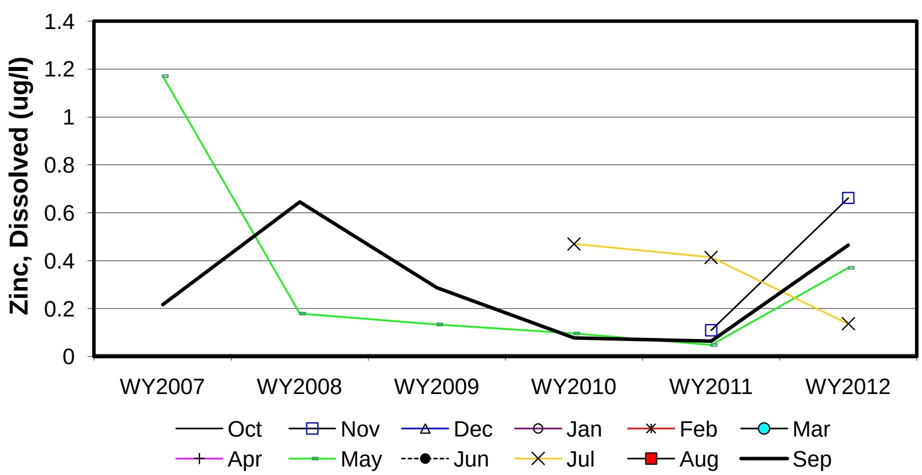
Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**								1.2				0.2
b	**WY2008**								0.2				0.6
c	**WY2009**								0.1				0.3
d	**WY2010**								0.1		0.5		0.1
e	**WY2011**		0.1						0.0		0.4		0.1
f	**WY2012**		0.7						0.4		0.1		0.5
	n	0	2	0	0	0	0	0	6	0	3	0	6
	t_1	0	2	0	0	0	0	0	6	0	3	0	6
	t_2	0	0	0	0	0	0	0	0	0	0	0	0
	t_3	0	0	0	0	0	0	0	0	0	0	0	0
	t_4	0	0	0	0	0	0	0	0	0	0	0	0
	t_5	0	0	0	0	0	0	0	0	0	0	0	0
	b-a								-1				1
	c-a								-1				1
	d-a								-1				-1
	e-a								-1				-1
	f-a								-1				1
	c-b								-1				-1
	d-b								-1				-1
	e-b								-1				-1
	f-b								1				-1
	d-c								-1				-1
	e-c								-1				-1
	f-c								1				1
	e-d								-1		-1		-1
	f-d								1		-1		1
	f-e		1						1		-1		1
	S_k	0	1	0	0	0	0	0	-7	0	-3	0	-3
	σ^2_S=		1.00						28.33		3.67		28.33
	$Z_k = S_k/\sigma_S$		1.00						-1.32		-1.57		-0.56
	Z^2_k		1.00						1.73		2.45		0.32

ΣZ_k=	-2.45
ΣZ^2_k=	5.50
Z-bar=ΣZ_k/K=	-0.61

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

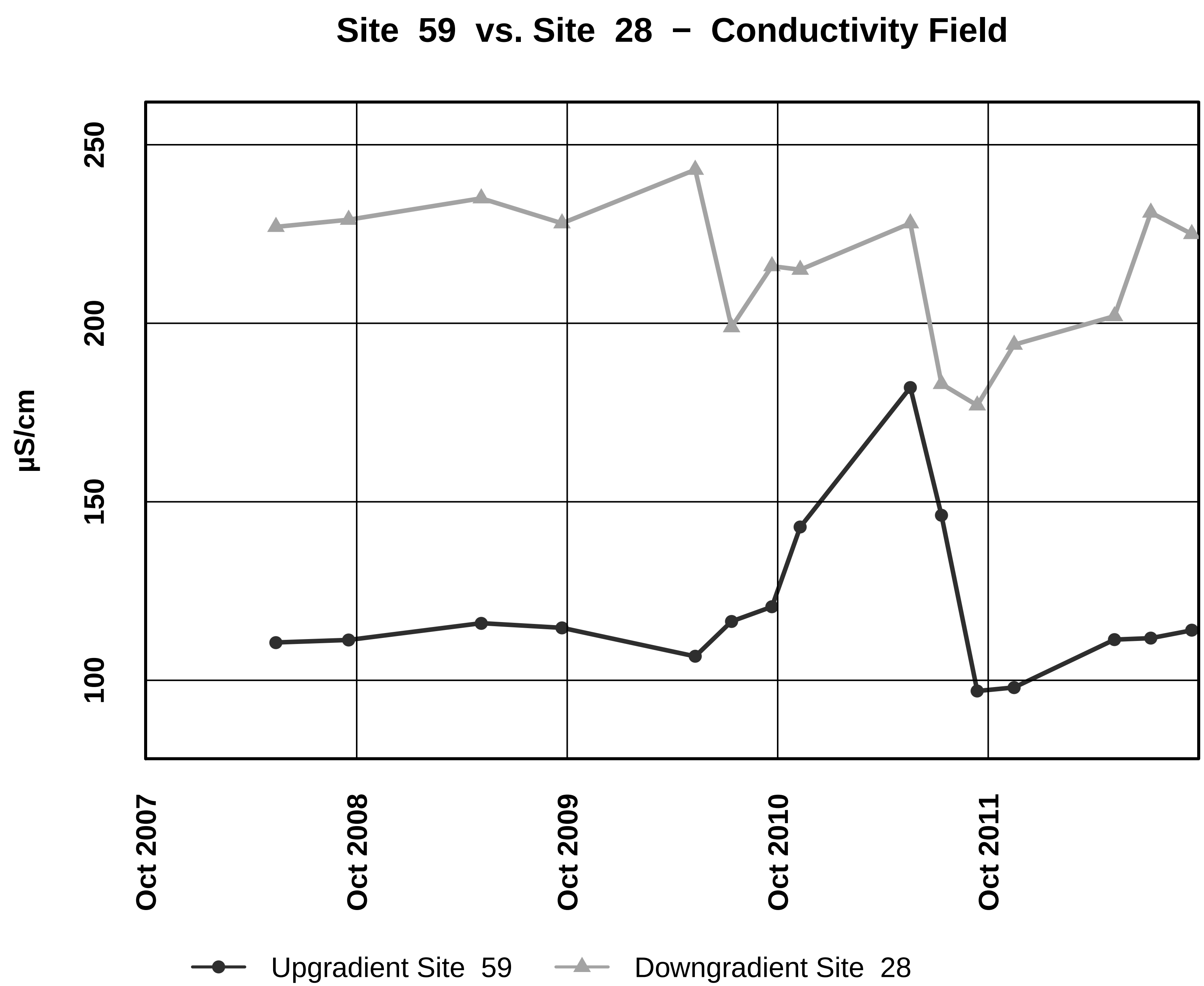
Σn	17
ΣS_k	-12

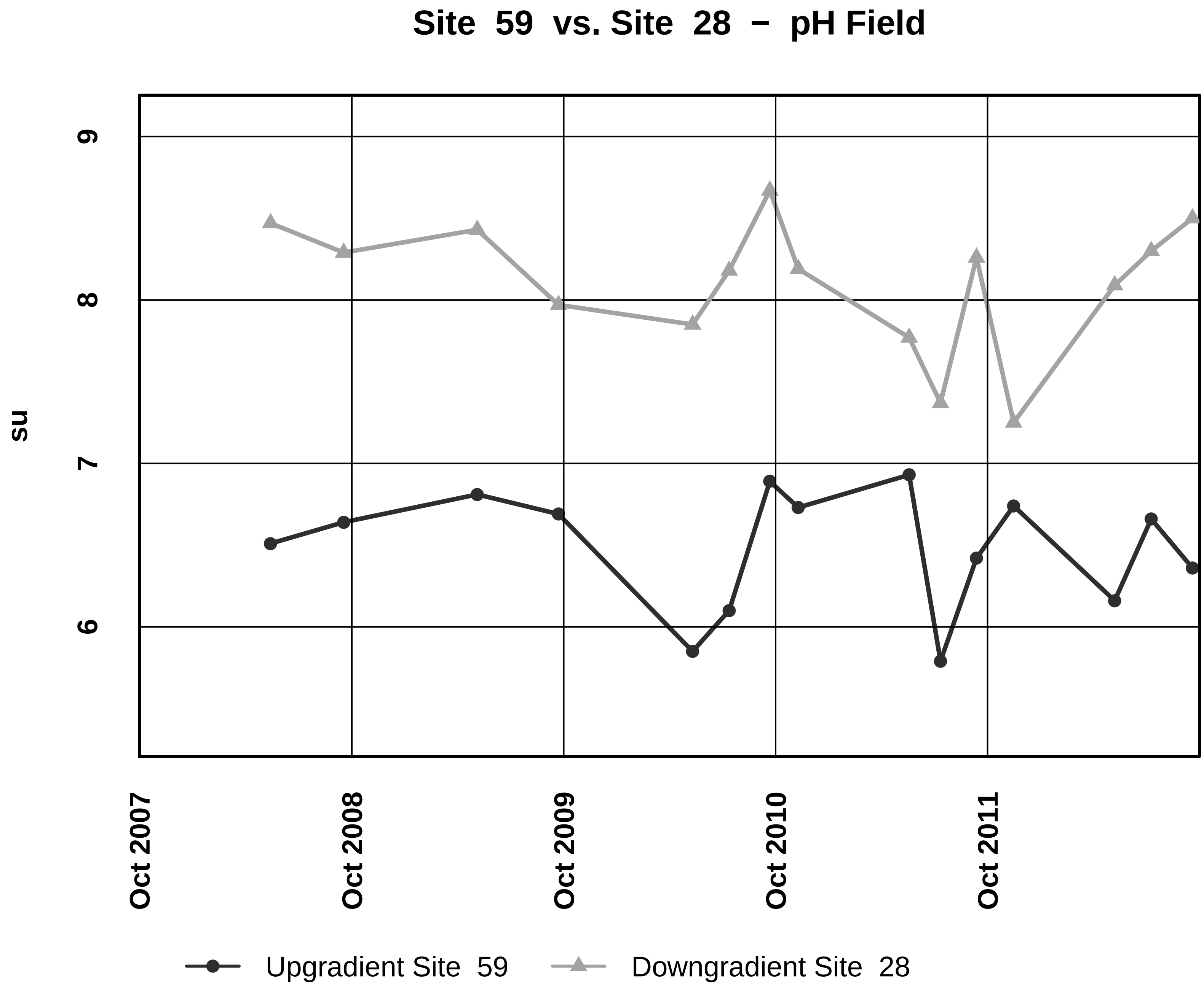
$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	4.01	@α=5% $\chi^2_{(K-1)}$= 7.81	Test for station homogeneity	
p	**0.261**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc} -1.40	@α/2=2.5% Z= 1.96	**H_0** (No trend)	ACCEPT
61.33	**p** **0.080**		**H_A** (± trend)	REJECT



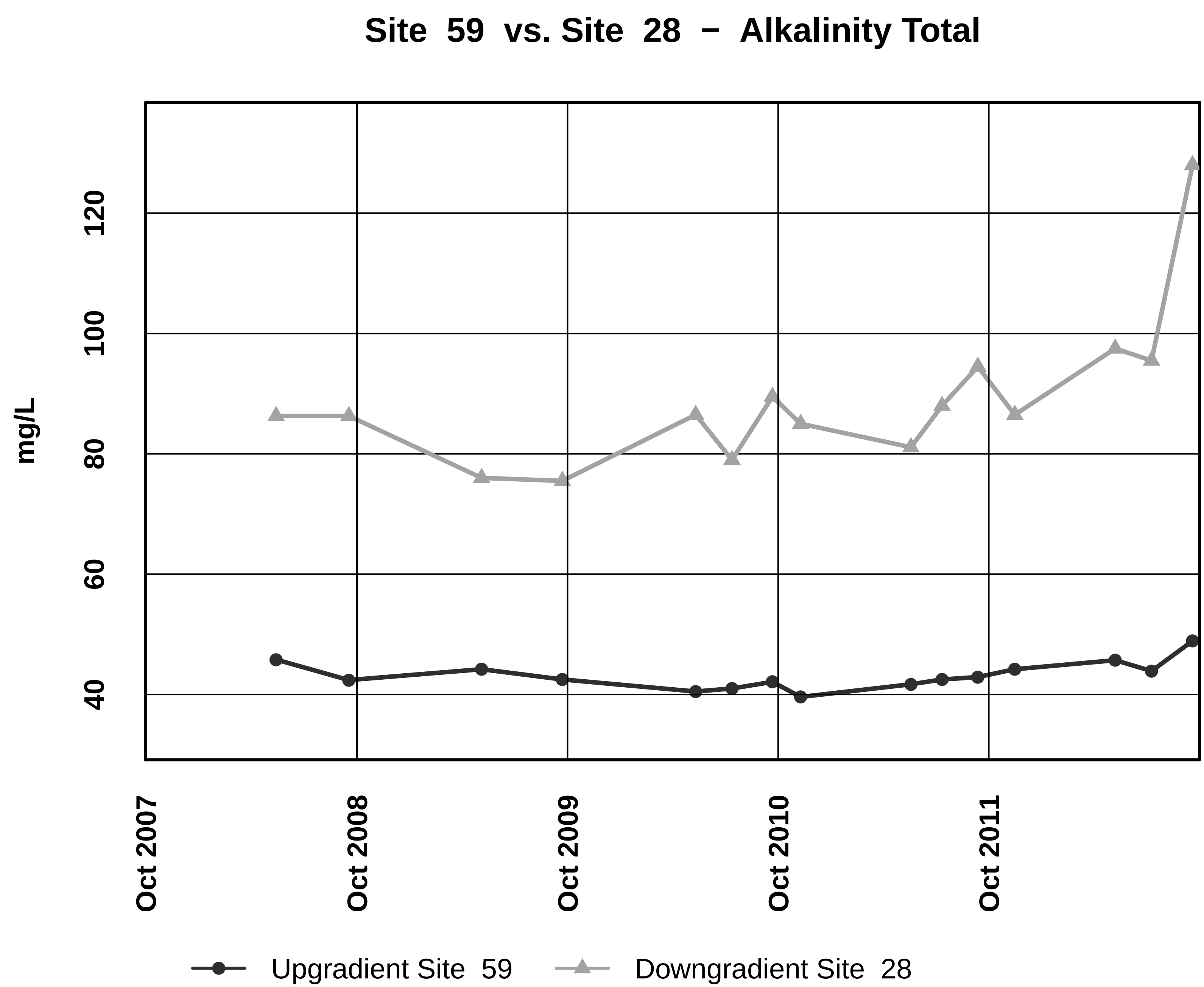
Seasonal-Kendall Slope Confidence Intervals

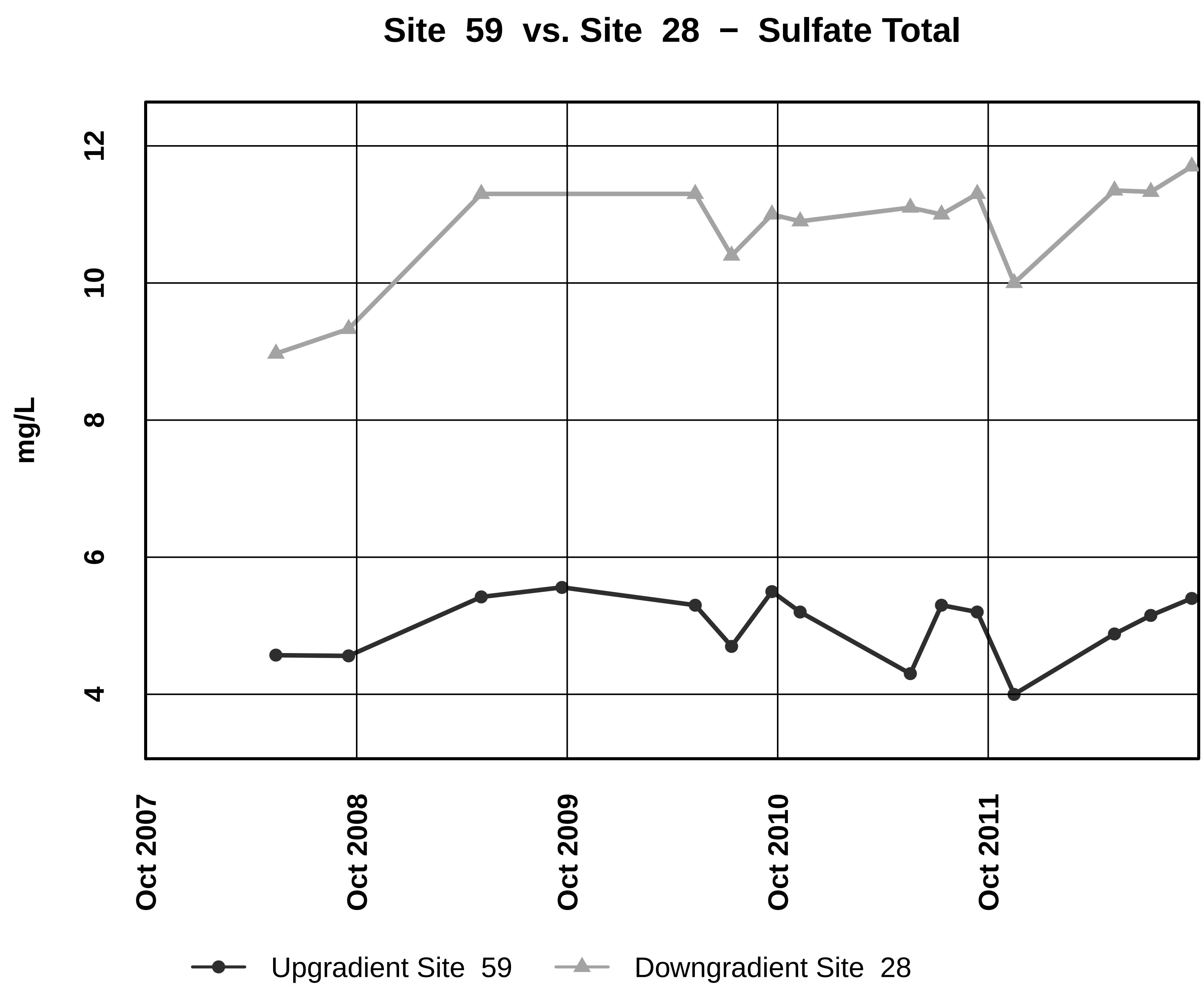
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.22		0.05
0.050	-0.16	**-0.04**	0.01
0.100	-0.11		-0.04
0.200	-0.05		-0.04


Site 59 vs. Site 28 − Conductivity Field
µS/cm
250
200
150
100
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 59
Downgradient Site 28

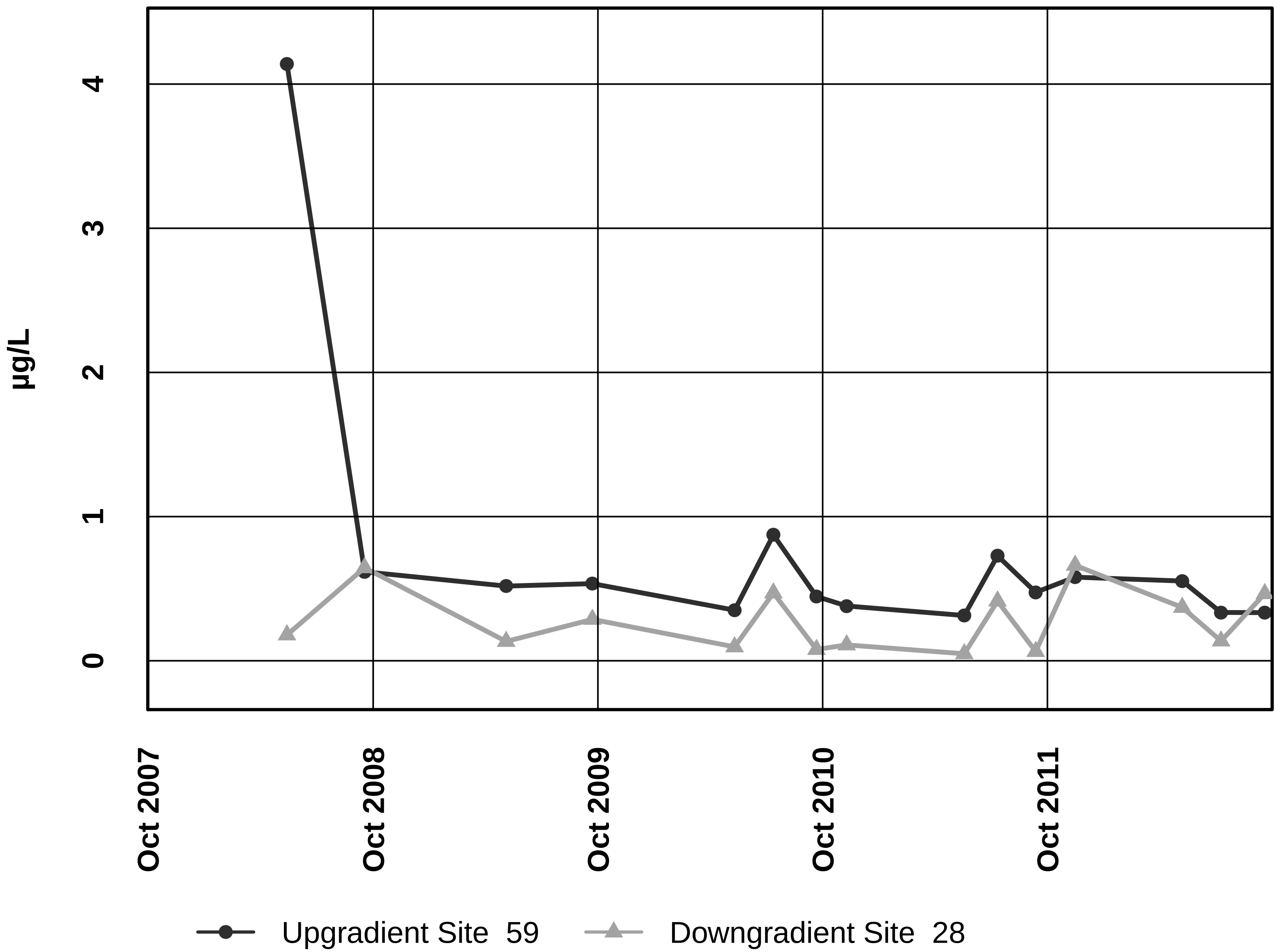


Site 59 vs. Site 28 − pH Field
su
9
8
7
6
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 59
Downgradient Site 28


Site 59 vs. Site 28 − Alkalinity Total
mg/L
40
60
80
100
120
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 59
Downgradient Site 28


Site 59 vs. Site 28 − Sulfate Total
mg/L
4
6
8
10
12
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 59
Downgradient Site 28

Site 59 vs. Site 28 − Zinc Dissolved



INTERPRETIVE REPORT
SITE 9

The Tributary Creek site was initially chosen to monitor the effects on water quality caused by the originally planned, larger slurry tailings impoundment. It is approximately one mile downstream from the present dry stack tailings site. The site was monitored from 1981 – 1993 when it was temporarily suspended by administrative agreement with the USFS. The site was re-activated in 2001 as a biological monitoring site for the Tailings Pile. HGCMC recommenced collection of water chemistry samples after receiving a suggestion to do so from ADNR personnel. It was noted that should the required annual biomonitoring show significant changes, an understanding of any related water chemistry variations would enhance the interpretation of those results. During the 2012 water year, samples were collected in conjunction with the normal monthly FWMP sampling run during the months of November, May, July, and September and analyzed for Suite Q analytes.

The data collected during the current water year are listed in the following "Table of Results for Water Year 2012" report. The table includes all the FWMP analyte data (field and laboratory) collected for the current water year and a series of flags keyed to the summary report "Qualified Data by QA Reviewer". The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of ½ MDL for the purpose of median calculation.

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

Sample Date	Parameter	Value	Qualifier	Notes
No outliers have been identified by HGCMC for the period of October 2007 through September 2012.				

The data for water year 2012 have been compared to the strictest fresh water quality criterion for each applicable analyte. Seven results exceeding these criteria have been identified, and listed in the table below. Four data points are for the total alkalinity values of 15.3 mg/L, 13.6 mg/L, 15.0 mg/L, and 11.9 mg/L for the November 2011, May 2012, July 2012, September 2012 sampling events respectively, which exceeds the AWQS lower limit of 20 mg/L. Also, the May field pH value was 6.23 su where as the AWQS is 6.5 su. The remaining two exceedances were for dissolved lead in the July 2012 and September 2012 samplings with concentrations of 1.09 µg/L and 1.49 µg/L respectively.

Table of Exceedance for Water Year 2012

			Limits		
Sample Date	**Parameter**	**Value**	**Lower**	**Upper**	**Hardness**
15-Nov-11	Alkalinity	15.3 mg/L	20		
7-May-12	Alkalinity	13.6 mg/L	20		
7-May-12	pH Field	6.23 su	6.5	8.50	
9-Jul-12	Alkalinity	15 mg/L	20		
9-Jul-12	Lead Dissolved	1.09 µg/L		0.65	29.60 mg/L
17-Sep-12	Alkalinity	11.9 mg/L	20		
17-Sep-12	Lead Dissolved	1.49 µg/L		0.54	23.00 mg/L

As stated in past reports, the currently limited dataset for this site makes definitive interpretation of these exceedances difficult. This is the first year in the last three that there were exceedances for dissolved lead. In the previous four water years to these three years there had been dissolved lead exceedances recorded in each year. This decrease is potentially a result of HGCMC placing tailings in the north end of the tailing facility for the past several years. It is only in the past year that this area has been brought up in elevation to a point that it may contribute fugitive dust to the southern end of the tailings facility.

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

A non-parametric statistical analysis for trend was performed for specific conductivity, field pH, total alkalinity, total sulfate, and dissolved zinc. Calculation details of the Seasonal Kendall analyses are presented in detail on the pages following this interpretive section. The following table summarizes the results on the data collected between Oct-06 and Sep-12 (WY2007-WY2012). There were no statistically significant ($\alpha/2=2.5\%$) trends identified for the current water year. This marks the first time that there were a sufficient number years (n=6) of data for conducting these calculations.

Table of Summary Statistics for Trend Analysis

	Mann-Kendall test statistics			Sen's slope estimate	
Parameter	**n***	**p****	**Trend**	**Q**	**Q(%)**
Conductivity Field	6	0.23			
pH Field	6	0.12			
Alkalinity, Total	6	0.23			
Sulfate, Total	6	0.12			
Zinc, Dissolved	6	0.46			

* 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 2012

Site 009FMS - 'Lower Tributary Creek'

Sample Date/Parameter	Oct 2011	Nov 2011	Dec 2011	Jan 2012	Feb 2012	Mar 2012	Apr 2012	May 2012	Jun 2012	Jul 2012	Aug 2012	Sep 2012	**Median**
Water Temp (°C)		1.5						5.2		10.6		7.3	6.3
Conductivity-Field(μmho)		82						72.1		67		53	69.6
Conductivity-Lab (μmho)		92						74		69		51	72
pH Lab (standard units)		6.72						6.44		6.19		6.4	6.42
pH Field (standard units)		7.64						6.23		6.99		6.59	6.79
Total Alkalinity (mg/L)		15.3						13.6		15		11.9	14.3
Total Sulfate (mg/L)		2.5						12.8		8.5		7.4	8.0
Hardness (mg/L)		36.4						28.7		29.6		23	29.2
Dissolved As (ug/L)		0.784						0.743		1.09		1.15	0.937
Dissolved Ba (ug/L)		34.5						31.2		39.2		35.3	34.9
Dissolved Cd (ug/L)		0.0392						0.0268		0.0431		0.0536	0.0412
Dissolved Cr (ug/L)		0.63						0.436		0.803		1.03	0.717
Dissolved Cu (ug/L)		1.61						1.75		2.47		2.66	2.110
Dissolved Pb (ug/L)		0.437						0.538		1.09		1.49	0.8140
Dissolved Ni (ug/L)		2.68						2.04		2.93		2.57	2.625
Dissolved Ag (ug/L)		0.007						0.007		0.012		0.017	0.010
Dissolved Zn (ug/L)		6.88						6.46		7.71		8.7	7.30
Dissolved Se (ug/L)		0.057						0.057		0.408		0.057	0.057
Dissolved Hg (ug/L)		0.00369						0.00415		0.00734		0.0114	0.005745

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 KGCMC and removed from any further analysis and is not included into the calculation of the median

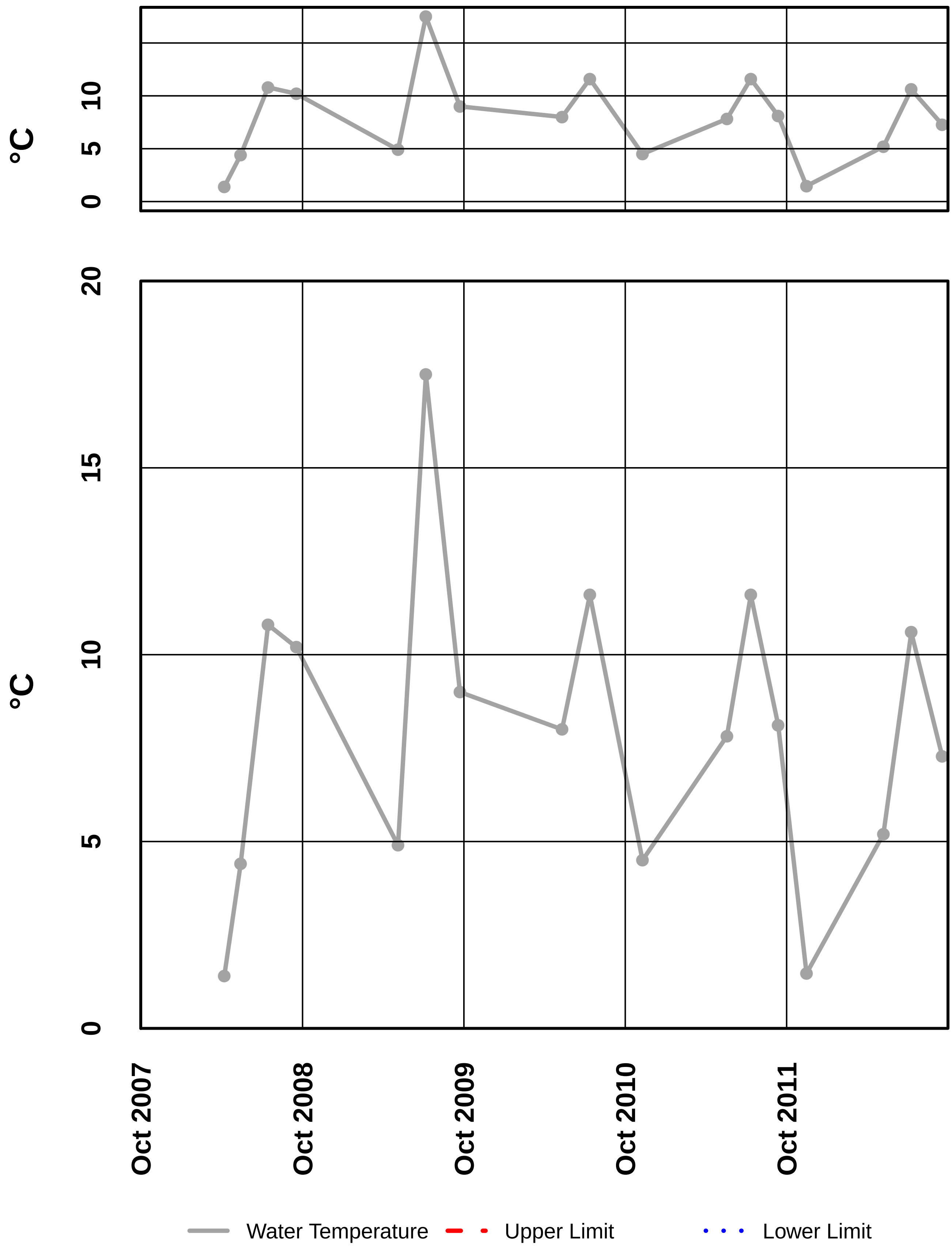
Qualified Data by QA Reviewer

Date Range: 10/01/2011 to 09/30/2012

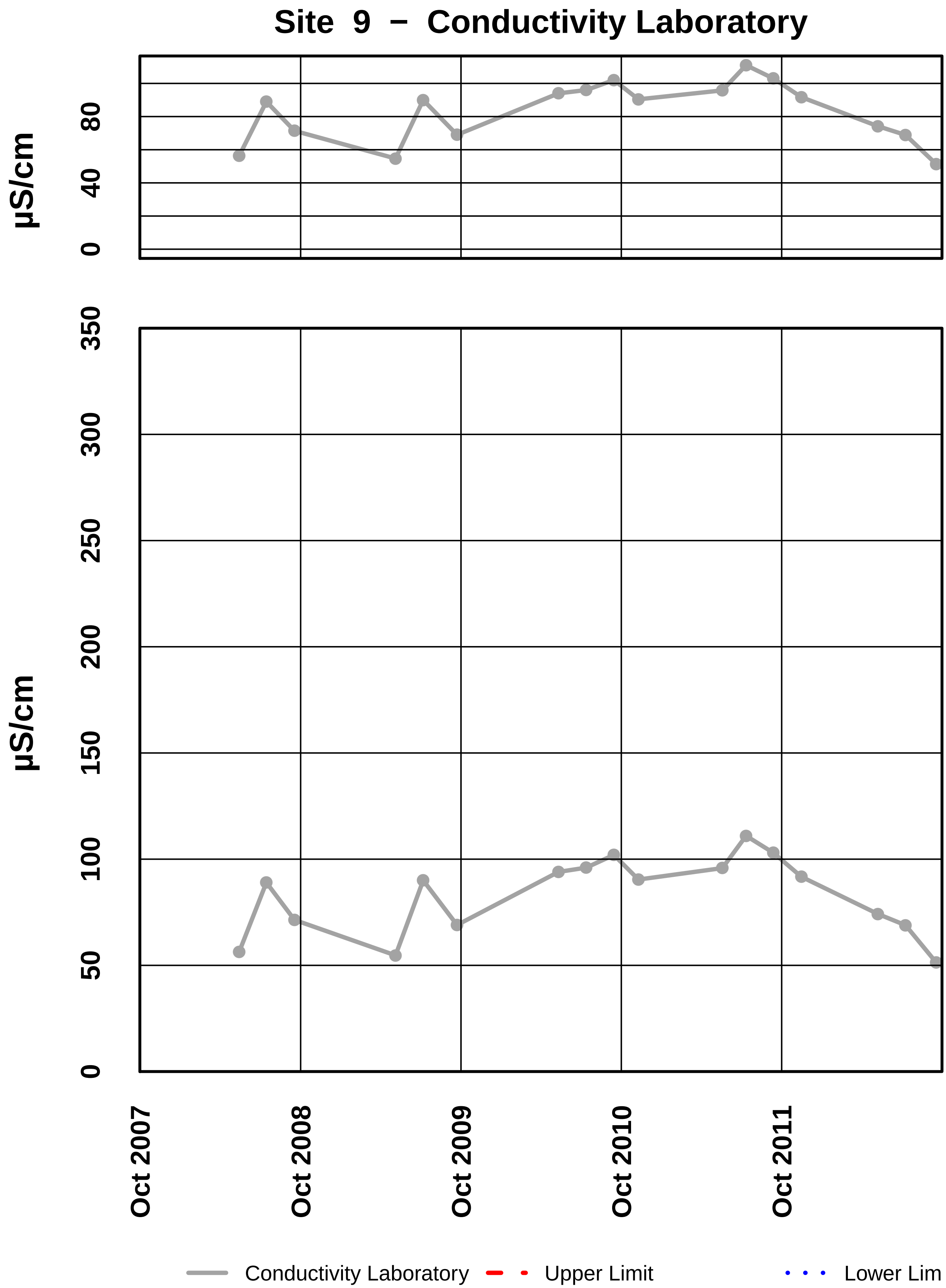
Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
9	11/15/2011	12:00 AM	Ag diss, µg/l	0.00727	U	Field Blank Contamination
9	5/7/2012	12:00 AM	Ag diss, µg/l	0.00708	J	Below Quantitative Range
			SO4 Tot, mg/l	12.77	J	Sample Receipt Temperature
9	7/9/2012	12:00 AM	SO4 Tot, mg/l	8.5	J	Below Quantitative Range
9	9/17/2012	12:00 AM	pH Lab, su	6.4	J	Hold Time Violation
			SO4 Tot, mg/l	7.35	J	Sample Receipt Temperature

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

Site 9 – Water Temperature

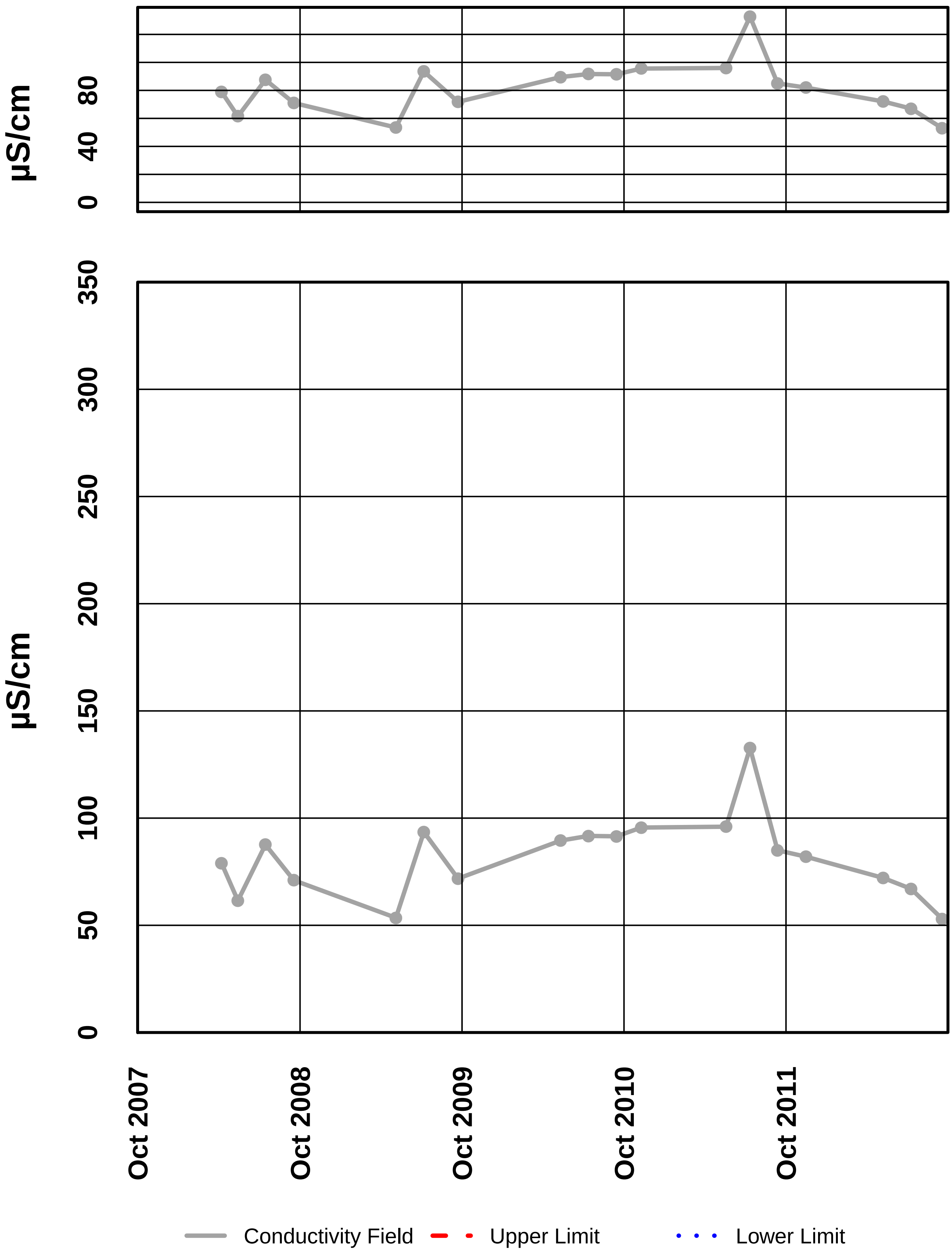


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



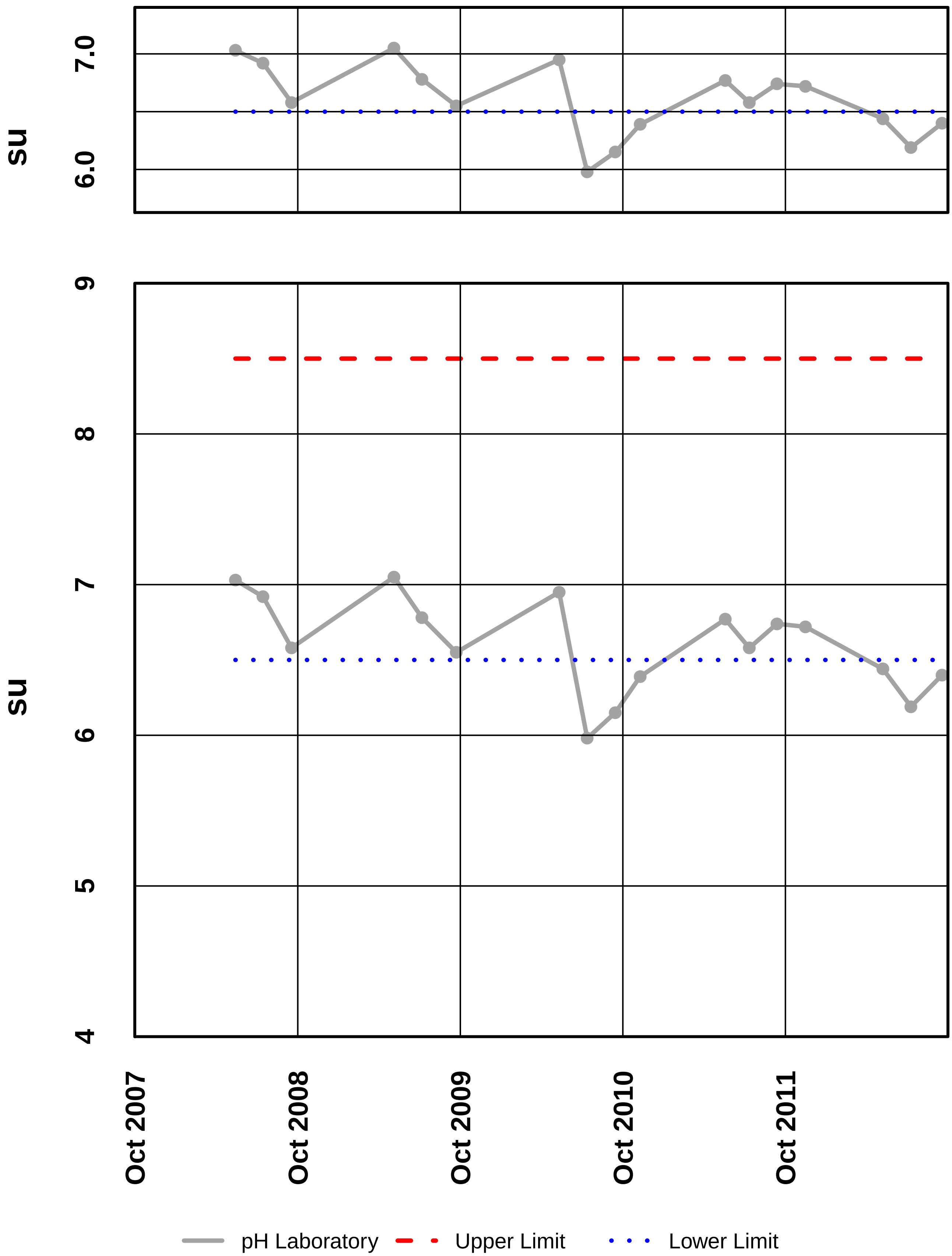
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 9 − Conductivity Field



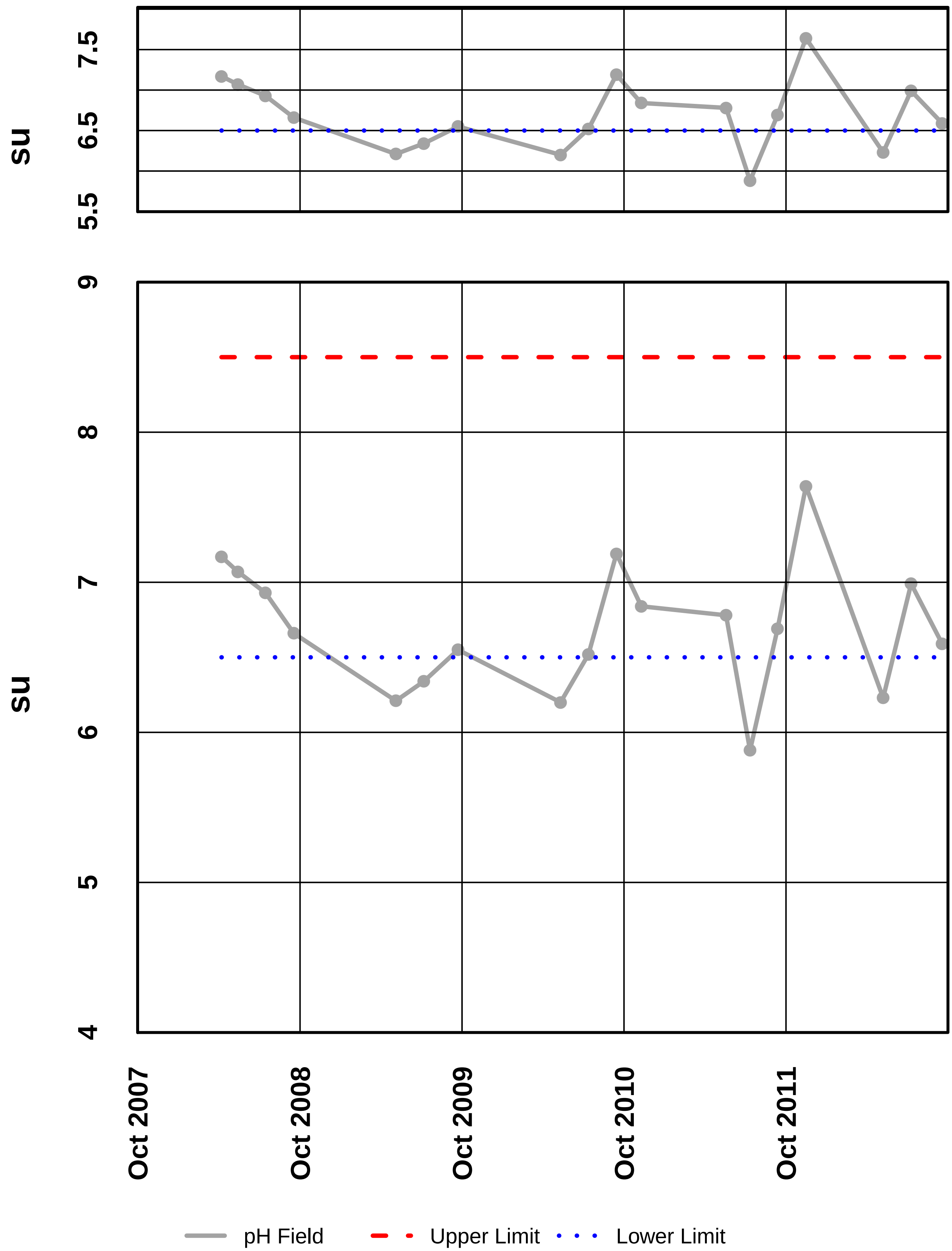
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 9 – pH Laboratory

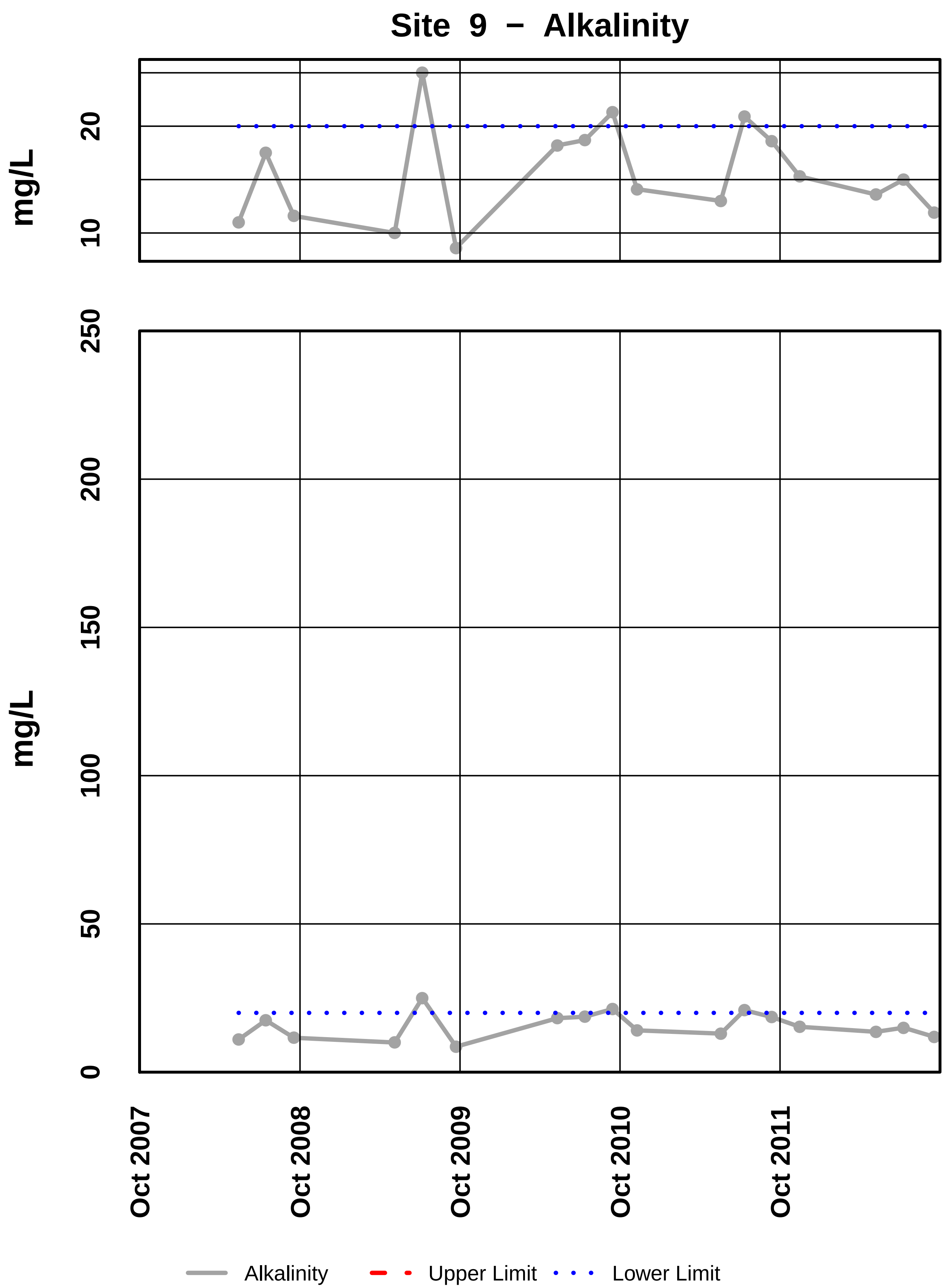


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

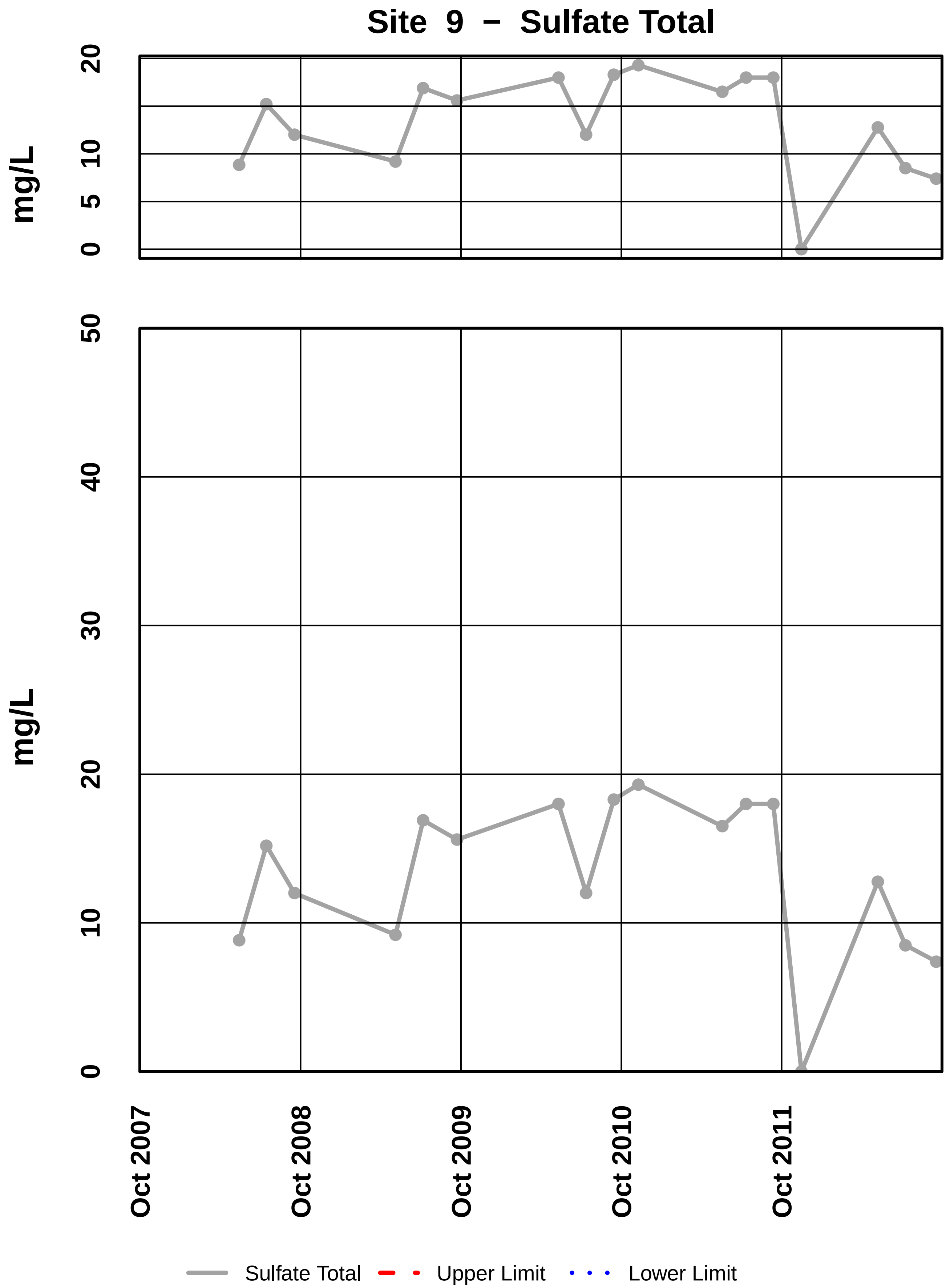
Site 9 – pH Field



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

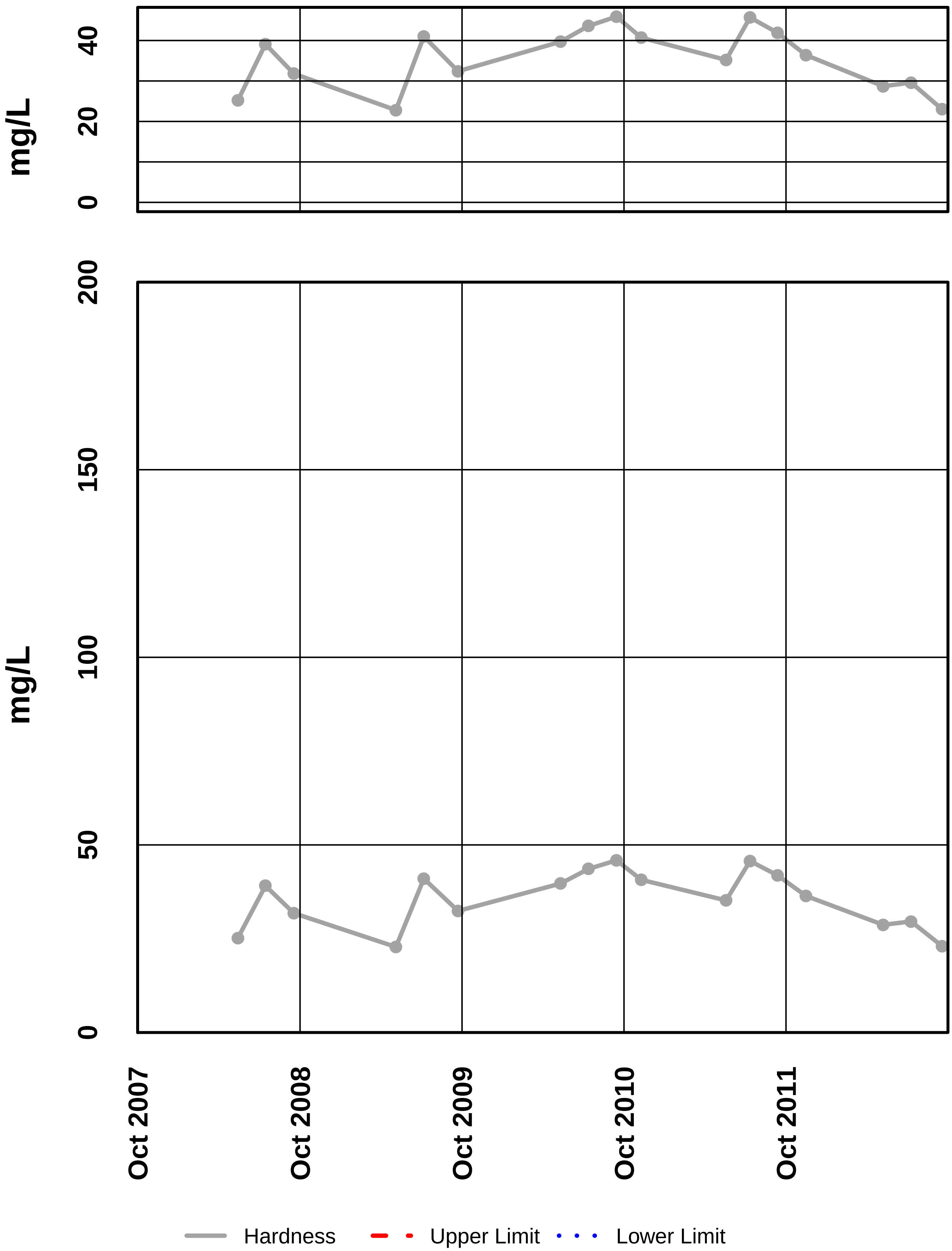


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

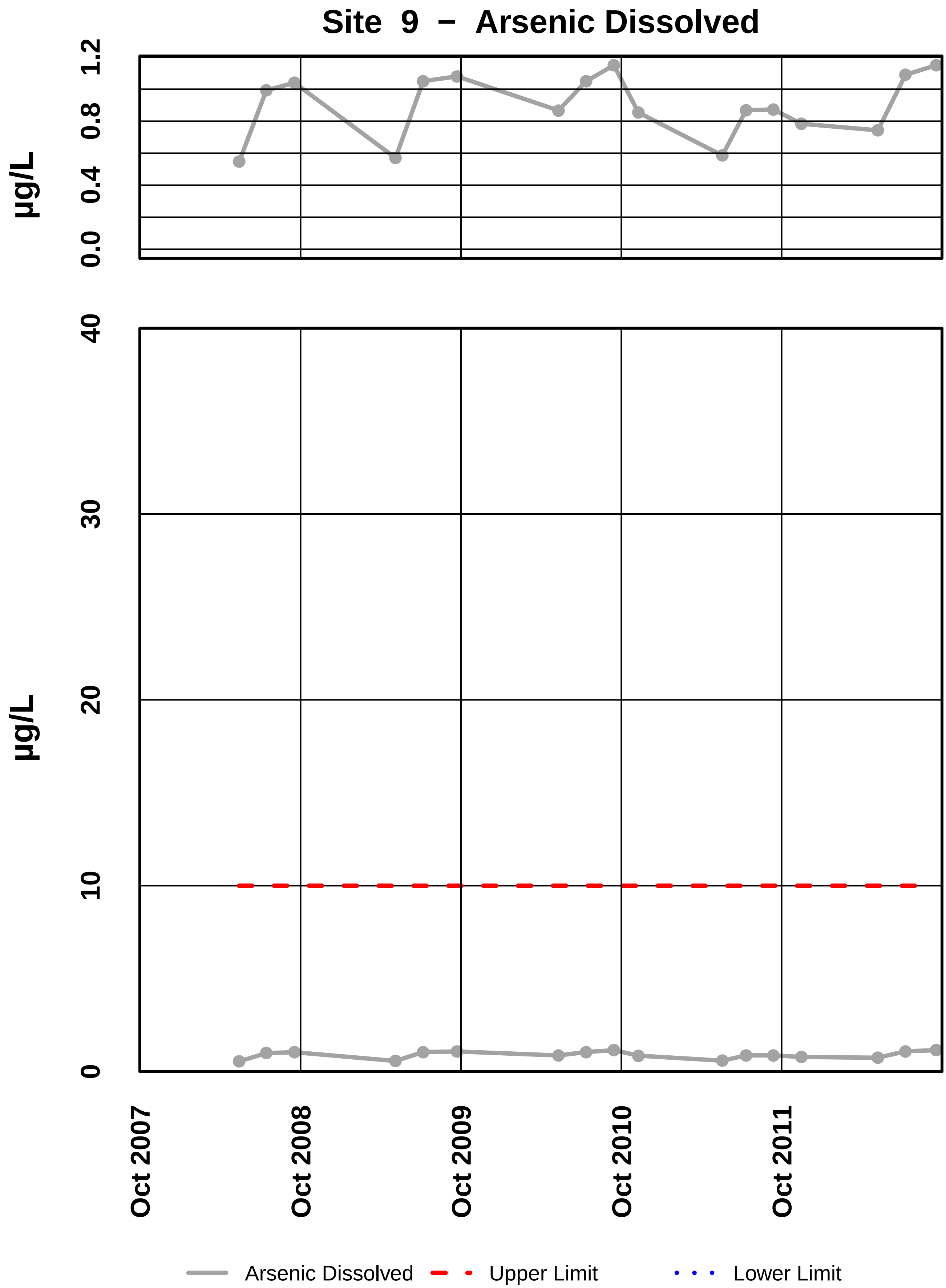


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 9 – Hardness

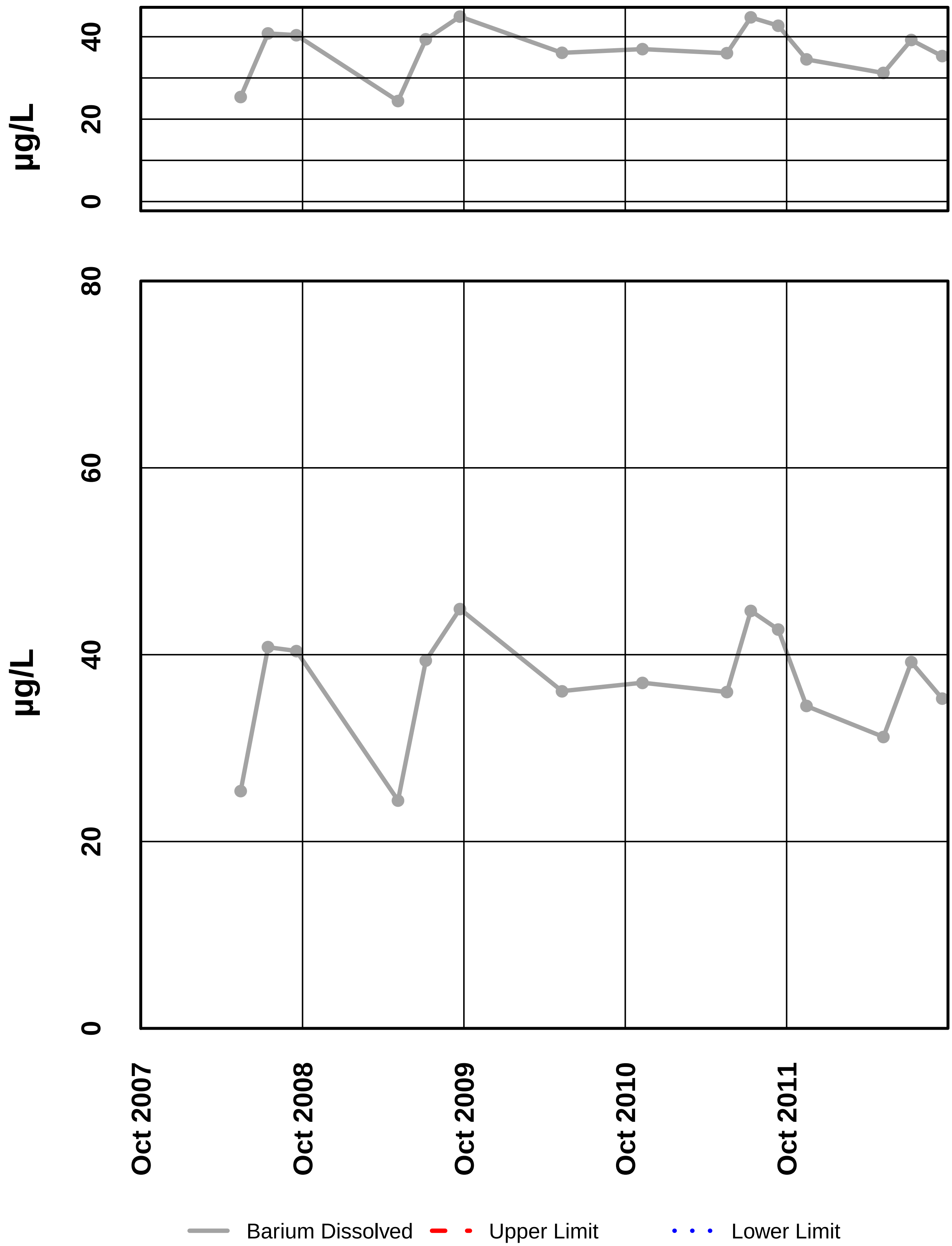


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

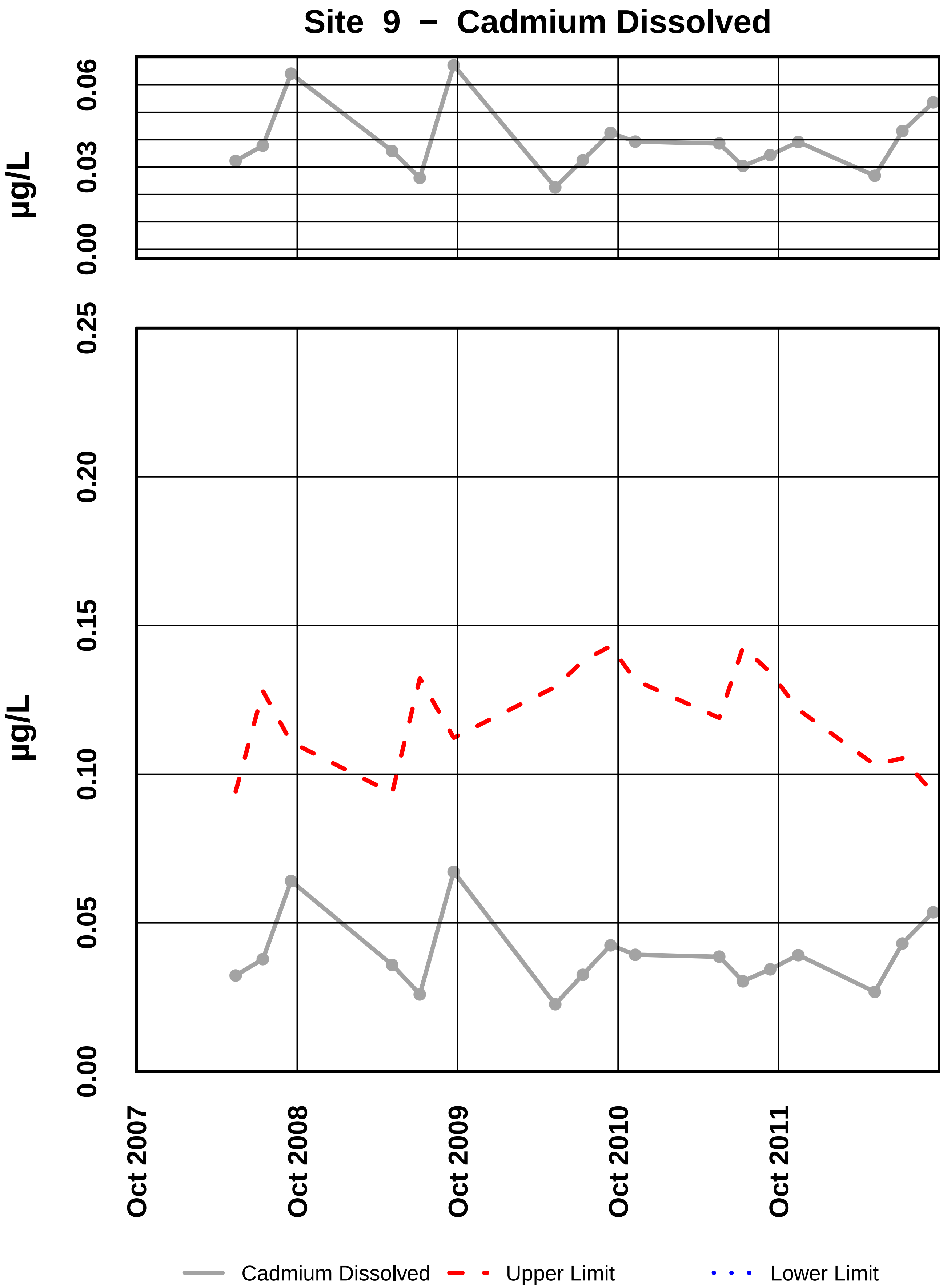


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 9 – Barium Dissolved

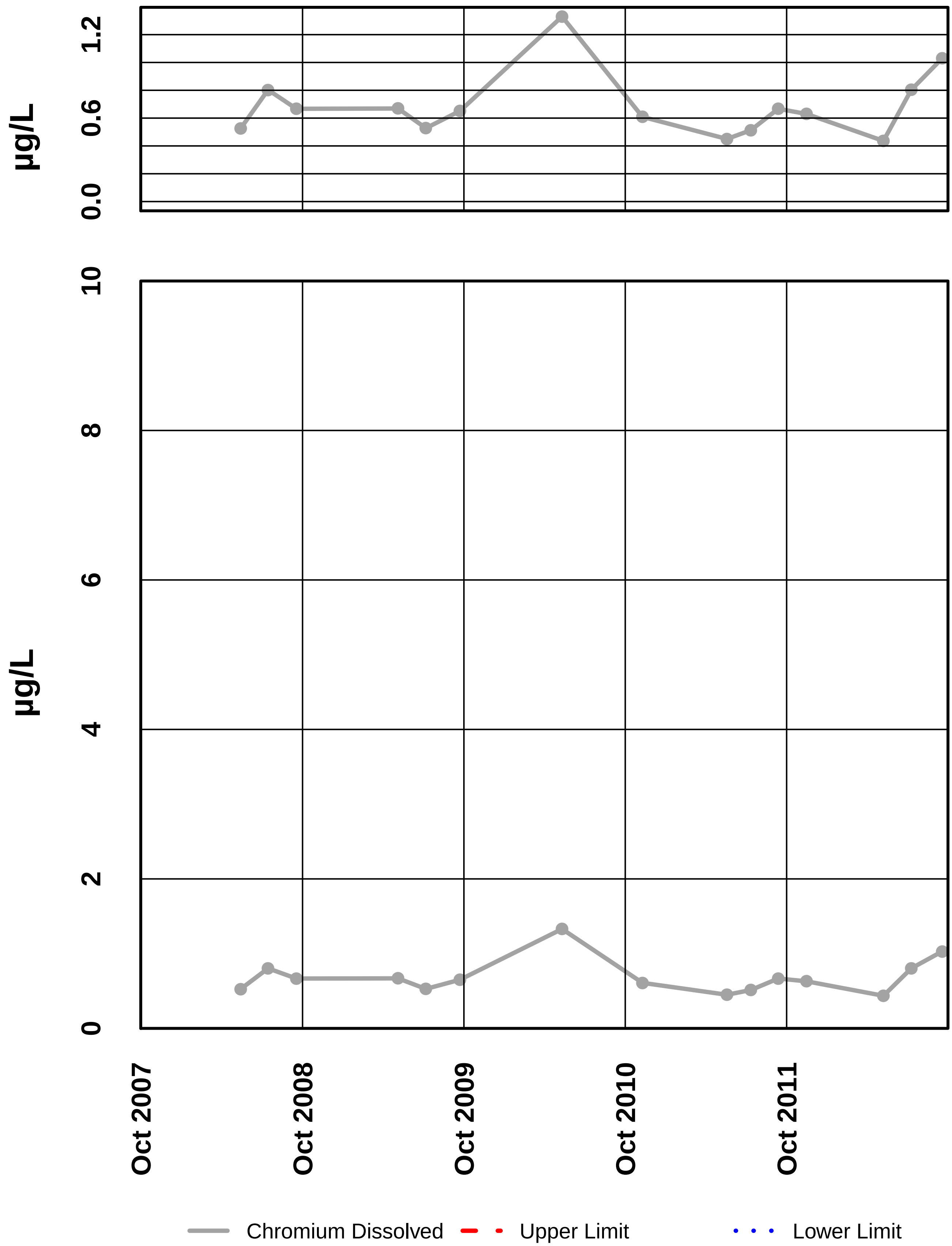


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

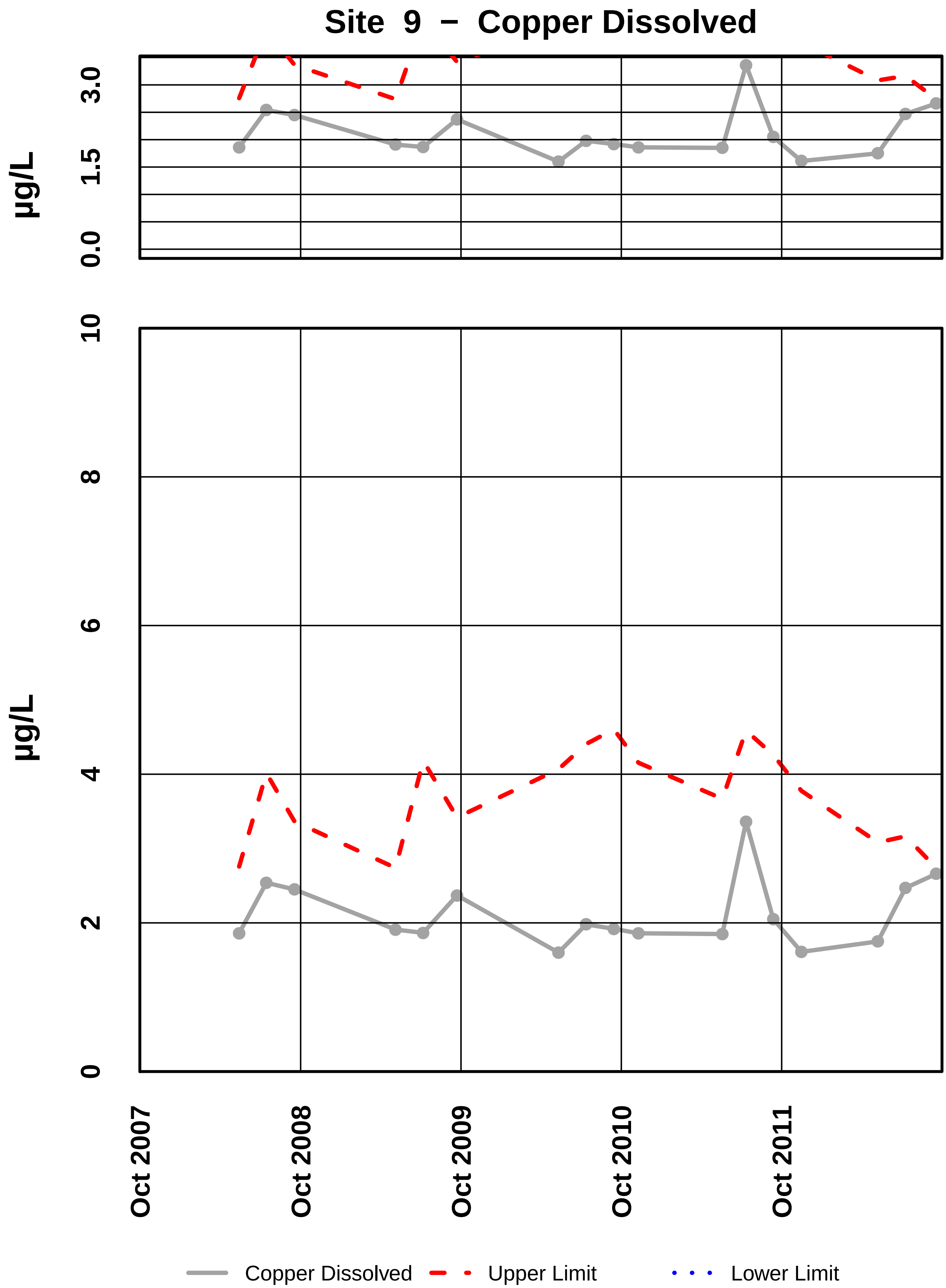


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 9 – Chromium Dissolved

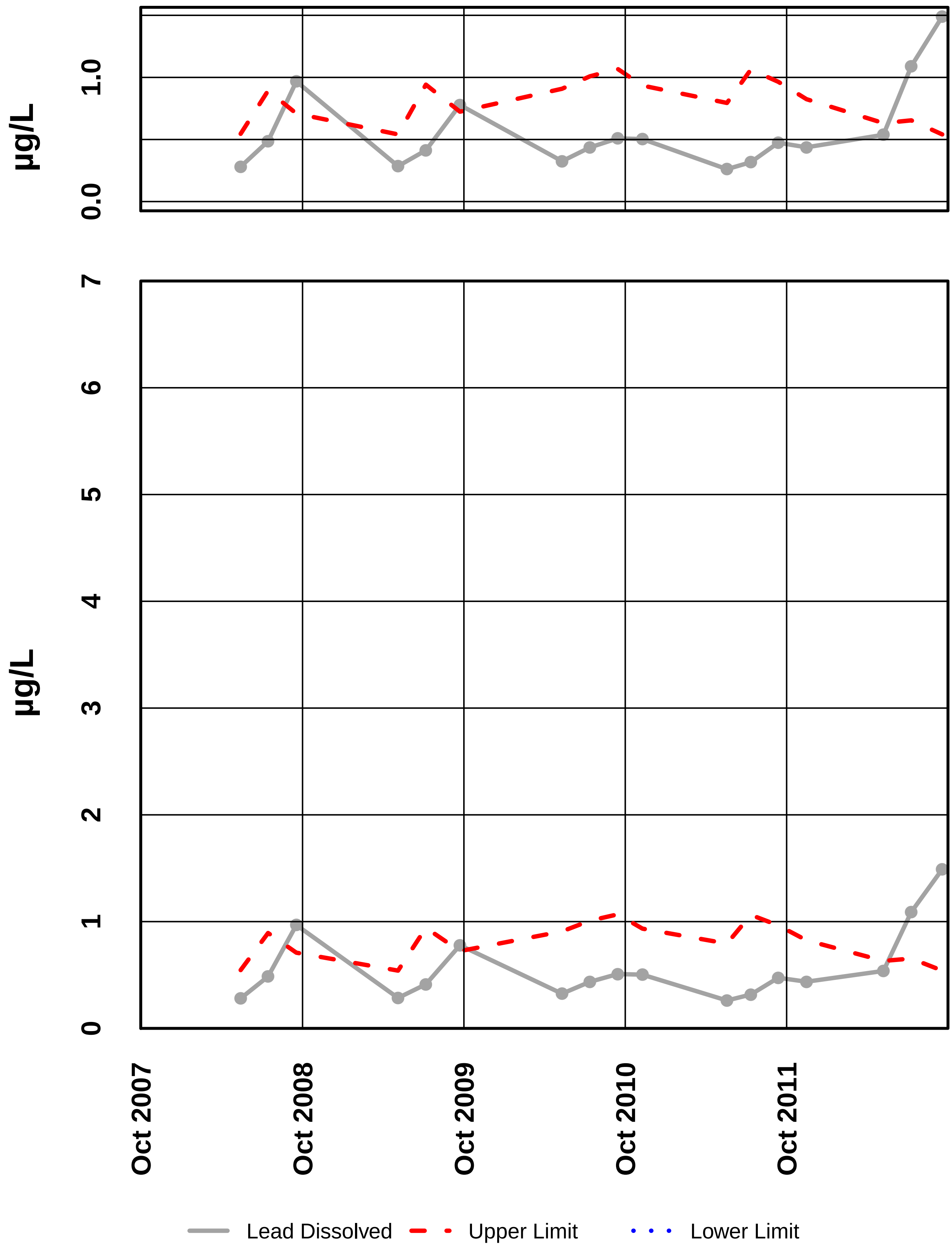


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



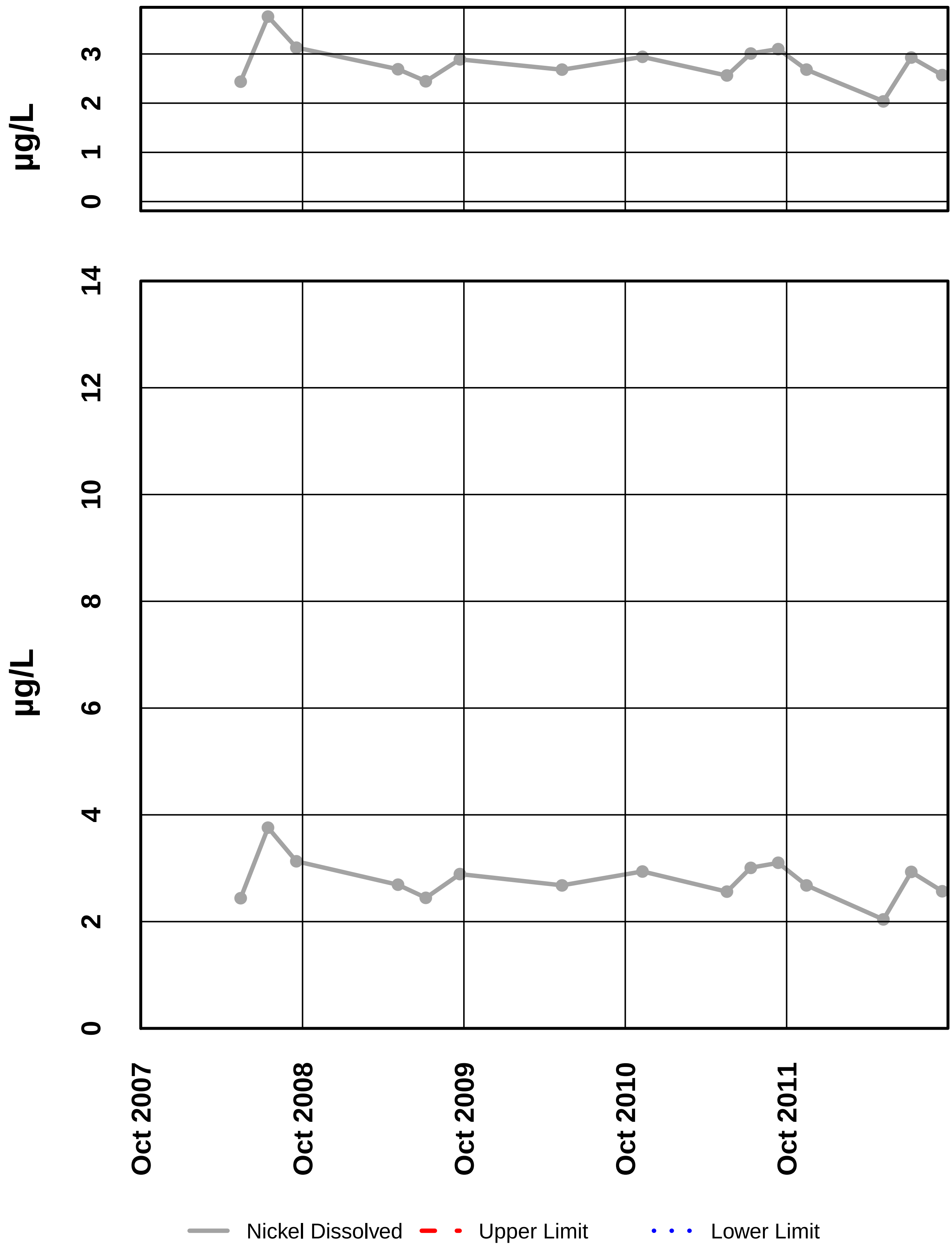
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 9 – Lead Dissolved

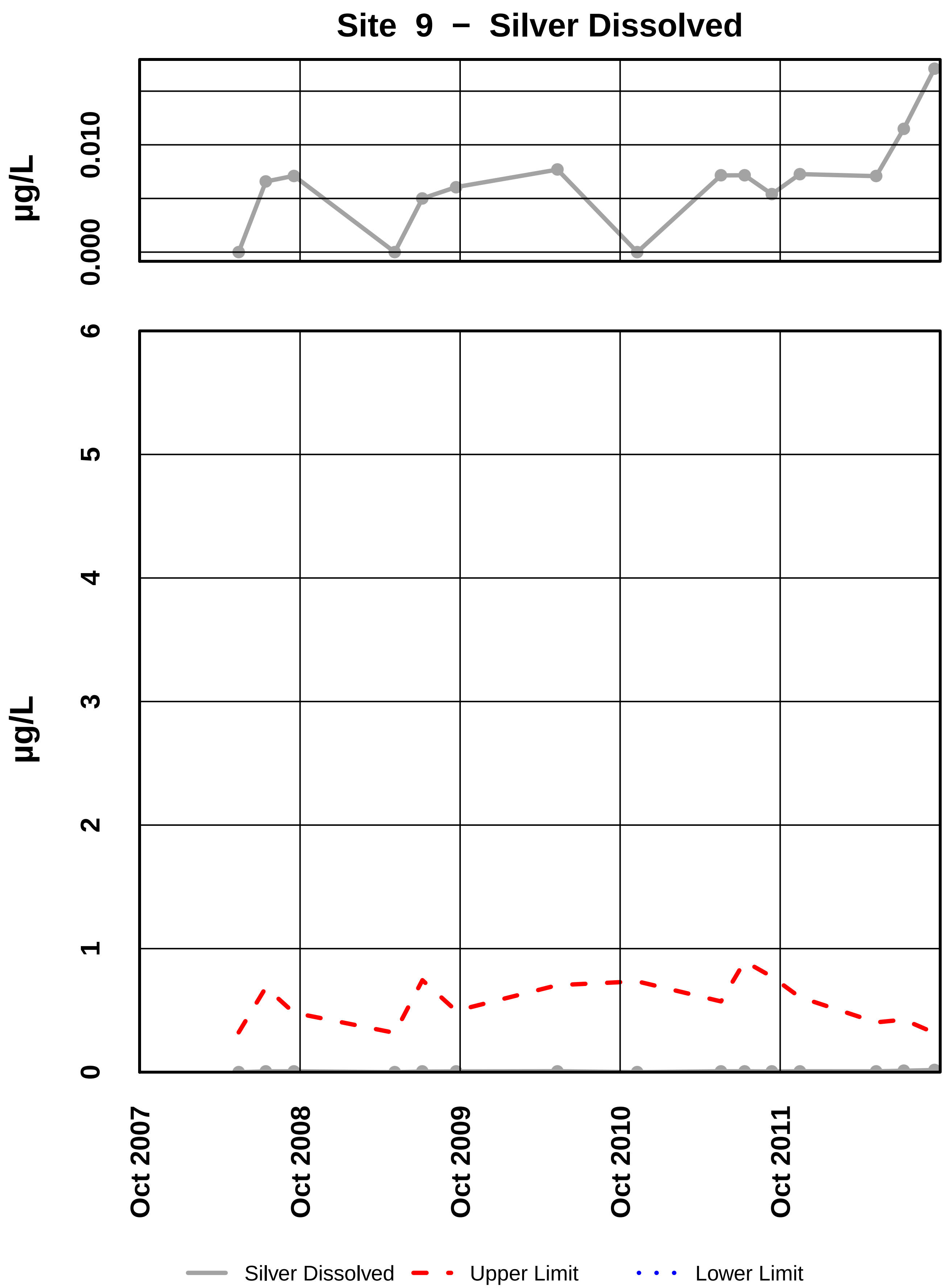


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

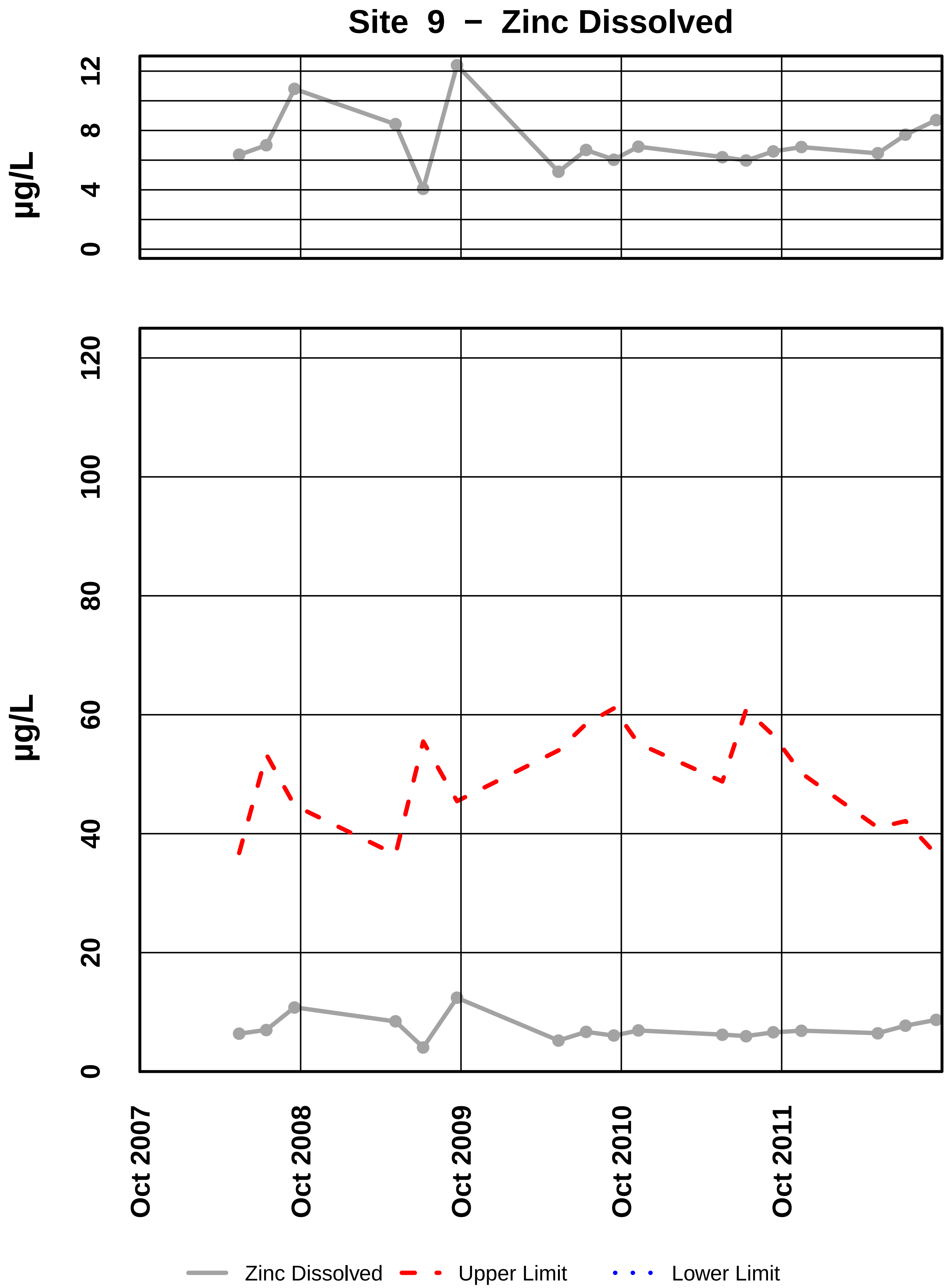
Site 9 – Nickel Dissolved



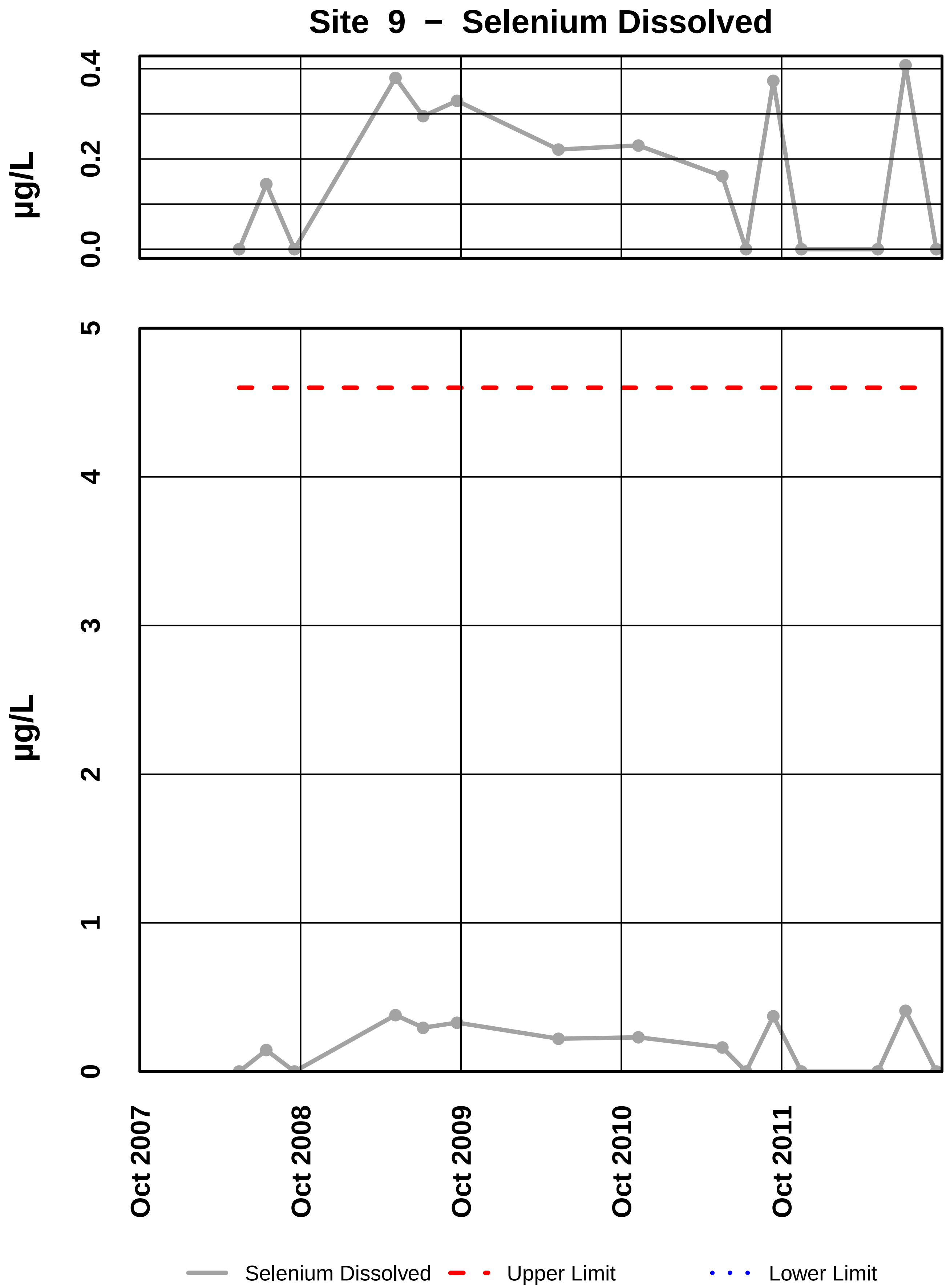
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

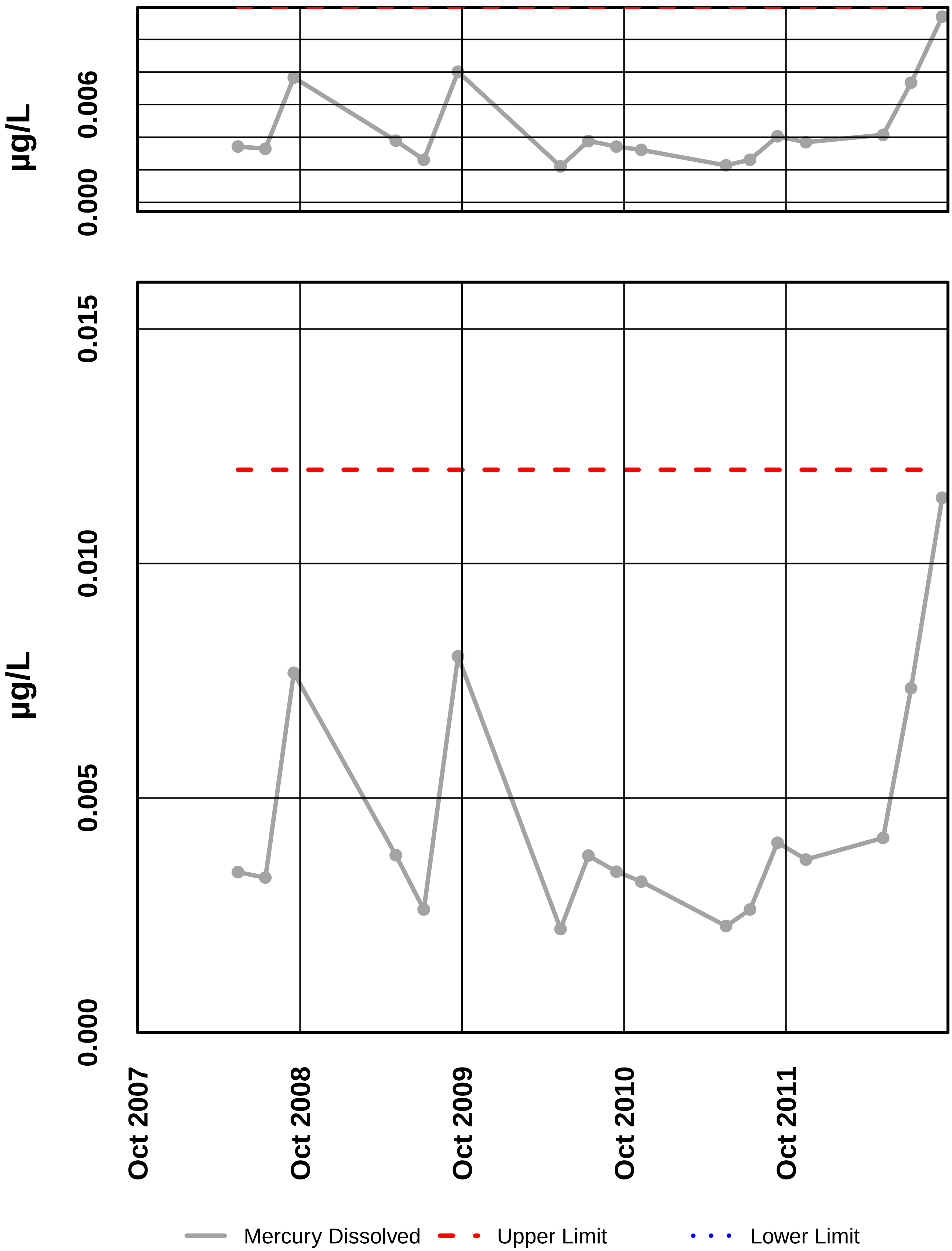


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

Site 9 – Mercury Dissolved



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

Site #9 — Seasonal Kendall analysis for Specific Conductance, Field (µS/cm)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**								53.1		76.2		89.7
b	**WY2008**							79	61.5		87.6		71
c	**WY2009**								53.5		93.5		71.8
d	**WY2010**								89.5		91.7		91.5
e	**WY2011**		95.6						96		132.7		85
f	**WY2012**		82						72.1		67		53
	n	0	2	0	0	0	0	1	6	0	6	0	6

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

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

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=		1.00						28.33		28.33		28.33
$Z_k = S_k/\sigma_S$		-1.00						1.69		0.56		-0.56
Z^2_k		1.00						2.86		0.32		0.32

ΣZ_k= 0.69

ΣZ^2_k= 4.49

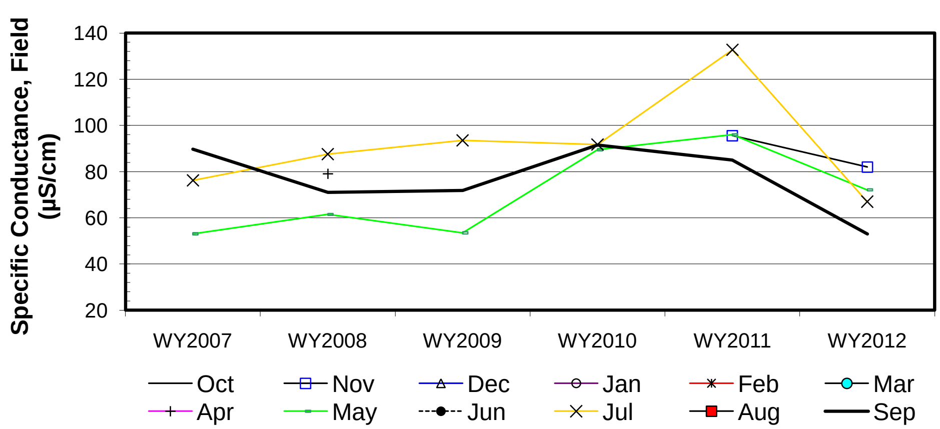
Z-bar=$\Sigma Z_k/K$= 0.17

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	21	0	0	0	0

Σn 21

ΣS_k 8

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=		4.37	@α=5% $\chi^2_{(K-1)}$=	7.81	Test for station homogeneity	
	p	**0.224**			$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc}	0.75	@α/2=2.5% Z=	1.96	**H_0** (No trend)	ACCEPT
86.00	p	**0.775**			**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-7.16		9.91
0.050	-4.91	**2.35**	6.56
0.100	-1.84		6.18
0.200	-1.04		5.12

Site **#9** Seasonal Kendall analysis for pH, Field, Standard Units

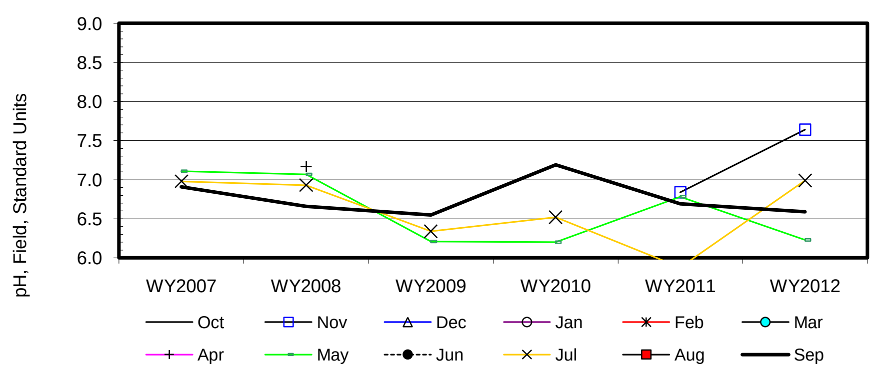
Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**								7.1		7.0		6.9
b	**WY2008**							7.2	7.1		6.9		6.7
c	**WY2009**								6.2		6.3		6.6
d	**WY2010**								6.2		6.5		7.2
e	**WY2011**		6.8						6.8		5.9		6.7
f	**WY2012**		7.6						6.2		7.0		6.6
	n	0	2	0	0	0	0	1	6	0	6	0	6
	t_1	0	2	0	0	0	0	1	6	0	6	0	6
	t_2	0	0	0	0	0	0	0	0	0	0	0	0
	t_3	0	0	0	0	0	0	0	0	0	0	0	0
	t_4	0	0	0	0	0	0	0	0	0	0	0	0
	t_5	0	0	0	0	0	0	0	0	0	0	0	0
	b-a								-1		-1		-1
	c-a								-1		-1		-1
	d-a								-1		-1		1
	e-a								-1		-1		-1
	f-a								-1		1		-1
	c-b								-1		-1		-1
	d-b								-1		-1		1
	e-b								-1		-1		1
	f-b								-1		1		-1
	d-c								-1		1		1
	e-c								1		-1		1
	f-c								1		1		1
	e-d								1		-1		-1
	f-d								1		1		-1
	f-e		1						-1		1		-1
S_k		0	1	0	0	0	0	0	-7	0	-3	0	-3
σ^2_S=			1.00						28.33		28.33		28.33
$Z_k = S_k/\sigma_S$			1.00						-1.32		-0.56		-0.56
Z^2_k			1.00						1.73		0.32		0.32

ΣZ_k=	-1.44
ΣZ^2_k=	3.36
Z-bar=ΣZ_k/K=	-0.36

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	21	0	0	0	0

Σn	21
ΣS_k	-12

$\chi^2_h=\Sigma Z^2_k$-K(Z-bar)^2=	2.84	@α=5% $\chi^2_{(K-1)}$= 7.81	Test for station homogeneity	
p	**0.416**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k) Z_{calc}	-1.19	@α/2=2.5% Z= 1.96	**H_0** (No trend)	ACCEPT
86.00 **p**	**0.118**		**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.27		0.01
0.050	-0.21	**-0.07**	0.00
0.100	-0.18		-0.01
0.200	-0.15		-0.04

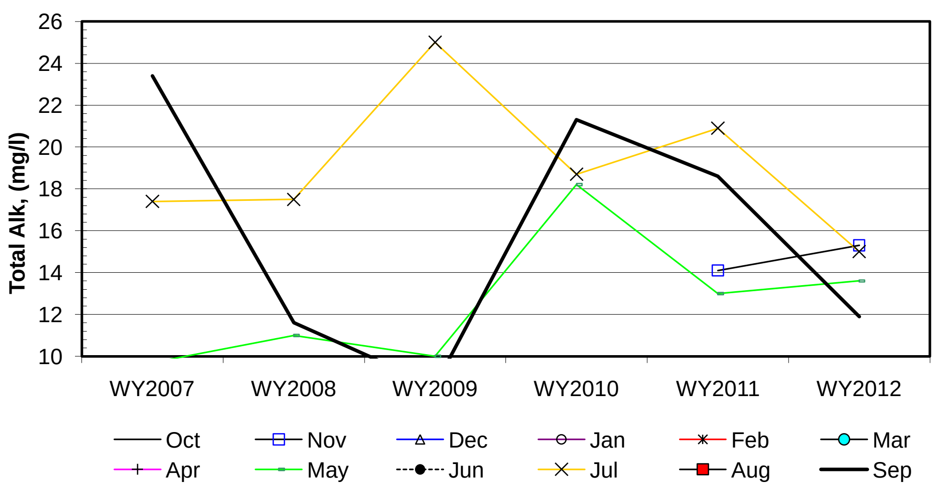
Site	#9	Seasonal Kendall analysis for Total Alk, (mg/l)											
Row label	**Water Year**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
a	**WY2007**								9.7		17.4		23.4
b	**WY2008**								11.0		17.5		11.6
c	**WY2009**								10.0		25.0		8.6
d	**WY2010**								18.2		18.7		21.3
e	**WY2011**		14.1						13.0		20.9		18.6
f	**WY2012**		15.3						13.6		15.0		11.9
	n	0	2	0	0	0	0	0	6	0	6	0	6
	t_1	0	2	0	0	0	0	0	6	0	6	0	6
	t_2	0	0	0	0	0	0	0	0	0	0	0	0
	t_3	0	0	0	0	0	0	0	0	0	0	0	0
	t_4	0	0	0	0	0	0	0	0	0	0	0	0
	t_5	0	0	0	0	0	0	0	0	0	0	0	0
	b-a								1		1		-1
	c-a								1		1		-1
	d-a								1		1		-1
	e-a								1		1		-1
	f-a								1		-1		-1
	c-b								-1		1		-1
	d-b								1		1		1
	e-b								1		1		1
	f-b								1		-1		1
	d-c								1		-1		1
	e-c								1		-1		1
	f-c								1		-1		1
	e-d								-1		1		-1
	f-d								-1		-1		-1
	f-e		1						1		-1		-1
	S_k	0	1	0	0	0	0	0	9	0	1	0	-3
	σ^2_S=		1.00						28.33		28.33		28.33
	$Z_k = S_k/\sigma_S$		1.00						1.69		0.19		-0.56
	Z^2_k		1.00						2.86		0.04		0.32

ΣZ_k=	2.32
ΣZ^2_k=	4.21
Z-bar=ΣZ_k/K=	0.58

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

Σn	20
ΣS_k	8

$\chi^2_h=\Sigma Z^2_k$-K(Z-bar)^2=		2.87	@α=5% $\chi^2_{(K-1)}$=	7.81	Test for station homogeneity	
	p	**0.412**			$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc}	0.75	@α/2=2.5% Z=	1.96	H_0 (No trend)	ACCEPT
86.00	p	**0.775**			H_A (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-2.25		1.20
0.050	-1.13	**0.52**	1.02
0.100	-0.70		0.82
0.200	-0.43		0.67

Site **#9** Seasonal Kendall analysis for Sulfate, Total (mg/l)

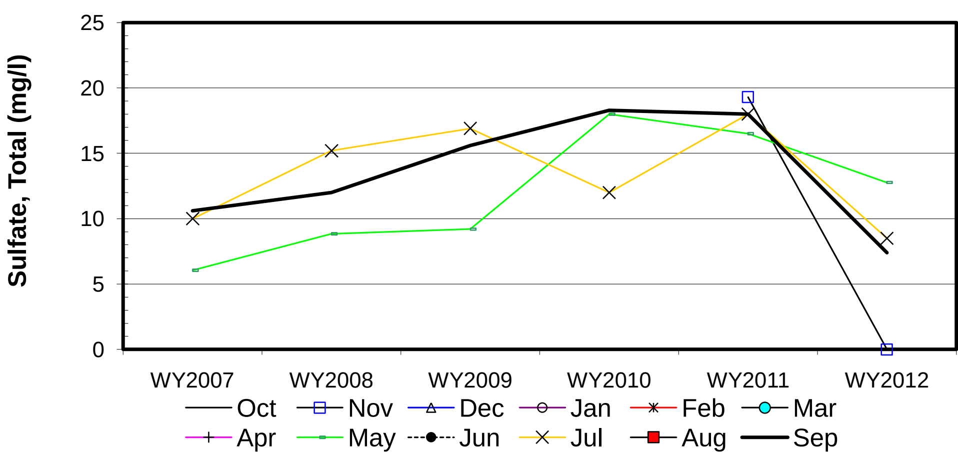
Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**								6.1		10.0		10.6
b	**WY2008**								8.8		15.2		12.0
c	**WY2009**								9.2		16.9		15.6
d	**WY2010**								18.0		12.0		18.3
e	**WY2011**		19.3						16.5		18.0		18.0
f	**WY2012**		0.0						12.8		8.5		7.4
	n	0	2	0	0	0	0	0	6	0	6	0	6
	t_1	0	2	0	0	0	0	0	6	0	6	0	6
	t_2	0	0	0	0	0	0	0	0	0	0	0	0
	t_3	0	0	0	0	0	0	0	0	0	0	0	0
	t_4	0	0	0	0	0	0	0	0	0	0	0	0
	t_5	0	0	0	0	0	0	0	0	0	0	0	0
	b-a								1		1		1
	c-a								1		1		1
	d-a								1		1		1
	e-a								1		1		1
	f-a								1		-1		-1
	c-b								1		1		1
	d-b								1		-1		1
	e-b								1		1		1
	f-b								1		-1		-1
	d-c								1		-1		1
	e-c								1		1		1
	f-c								1		-1		-1
	e-d								-1		1		-1
	f-d								-1		-1		-1
	f-e		-1						-1		-1		-1
	S_k	0	-1	0	0	0	0	0	9	0	1	0	3
	σ^2_S=		1.00						28.33		28.33		28.33
	$Z_k = S_k/\sigma_S$		-1.00						1.69		0.19		0.56
	Z^2_k		1.00						2.86		0.04		0.32

ΣZ_k=	1.44
ΣZ^2_k=	4.21
Z-bar=ΣZ_k/K=	0.36

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

Σn	20
ΣS_k	12

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=		3.69	@α=5% $\chi^2_{(K-1)}$= 7.81	Test for station homogeneity	
	p	**0.297**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc}	1.19	@α=2.5% Z= 1.96	**H_0** (No trend)	ACCEPT
86.00	p	**0.882**		**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-1.58		2.56
0.050	-0.51	**1.20**	2.00
0.100	-0.26		1.84
0.200	0.56		1.55

Site **#9** Seasonal Kendall analysis for Zinc, Dissolved (ug/l)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**								5.7		9.1		4.6
b	**WY2008**								6.4		7.0		10.8
c	**WY2009**								8.4		4.1		12.4
d	**WY2010**								5.2		6.7		6.0
e	**WY2011**		6.9						6.2		6.0		6.6
f	**WY2012**		6.9						6.5		7.7		8.7
	n	0	2	0	0	0	0	0	6	0	6	0	6

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

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

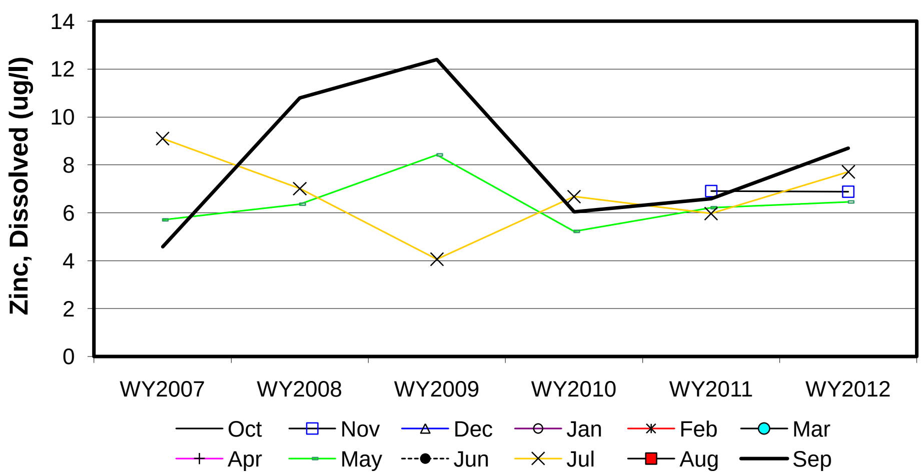
	Nov	May	Jul	Sep
σ^2_S=	1.00	28.33	28.33	28.33
$Z_k = S_k/\sigma_S$	-1.00	0.56	-0.56	0.56
Z^2_k	1.00	0.32	0.32	0.32

ΣZ_k= -0.44
ΣZ^2_k= 1.95
Z-bar=ΣZ_k/K= -0.11

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

Σn 20
ΣS_k 2

$\chi^2_h=\Sigma Z^2_k$-K(Z-bar)^2=	1.91	@α=5% $\chi^2_{(K-1)}$= 7.81	Test for station homogeneity	
p	**0.592**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k) Z_{calc}	0.11	@α/2=2.5% Z= 1.96	**H_0** (No trend)	ACCEPT
86.00 **p**	**0.543**		**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.77		0.79
0.050	-0.55	**0.08**	0.54
0.100	-0.34		0.50
0.200	-0.16		0.24

INTERPRETIVE REPORT
SITE 60

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

The data collected during the current water year are listed in the following "Table of Results for Water Year 2012" report. The table includes all the required FWMP analyte data (field and laboratory) collected for the current water year and a series of flags keyed to the summary report "Qualified Data by QA Reviewer". The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of ½ MDL for the purpose of median calculation.

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

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

Sample Date	Parameter	Value	Qualifier	Notes
No outliers have been identified by HGCMC for the period of October 2007 through September 2012.				

The data for water year 2012 have been compared to the strictest fresh water quality criterion for each applicable analyte. Twelve results exceeding these criteria have been identified, as listed in the table below. Three of the exceedances are for field pHs with values of 6.38 su (November 2011), 5.83su (May 2012) and 6.14 su (September 2012), were below the AWQS limit of 6.50 su. Historical sampling for this site in 2003, prior to any disturbance that would directly impact Althea Creek, indicates that the natural background pH ranged from 4.1 su to 4.8 su. Also, for all four sampling events total alkalinity was in exceedance at Site 60, however this is a continuation of the visual trend of decreasing alkalinity, towards pre-disturbance values. The remaining five exceedances were for dissolved mercury (see discussion below) and dissolved lead. This is the first exceedance for lead at site 60 since Pond 7 was built, however higher lead concentrations were recorded in 2003 prior to construction. The dissolution of lead is pH dependent and as the drainage returns to a natural state of acidity there would be the potential for an increase in lead concentration.

Table of Exceedance for Water Year 2012

			Limits		
Sample Date	**Parameter**	**Value**	**Lower**	**Upper**	**Hardness**
15-Nov-11	Alkalinity	9.7 mg/L	20		
7-May-12	Alkalinity	7 mg/L	20		
9-Jul-12	Alkalinity	9 mg/L	20		
17-Sep-12	Alkalinity	8.9 mg/L	20		
17-Sep-12	Lead Dissolved	0.642 µg/L		0.54	21.60 mg/L
15-Nov-11	Mercury Dissolved	0.0137 µg/L		0.01	
7-May-12	Mercury Dissolved	0.0131 µg/L		0.01	
9-Jul-12	Mercury Dissolved	0.0166 µg/L		0.01	
17-Sep-12	Mercury Dissolved	0.0213 µg/L		0.01	
15-Nov-11	pH Field	6.38 su	6.5	8.50	
7-May-12	pH Field	5.83 su	6.5	8.50	
17-Sep-12	pH Field	6.14 su	6.5	8.50	

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

The notable exception to this is the elevated dissolved mercury levels seen in the past several years. It is theorized that this too is an artifact from the construction of Pond 7. When the natural waters shifted to a more alkaline state after the disturbance caused by Pond 7 construction, this caused dissolved mercury that naturally existed at a low level to adsorb on to other particles and come out of solution. With the success of the pump back system the area is beginning to return to its natural state as previously mentioned. Because there is this fundamental chemistry shift in the pH the adsorbed mercury is now going back into solution causing the increased values. As the 'pool' of adsorbed mercury is depleted, mercury levels should return to levels recorded in 2006 (mean = 0.00395µg/L). As a result of data collected in water year 2012 the above hypothesis is being revised slightly. It is still HGCMC hypothesis that the issue is being driven by the adsorption and desorption of mercury with the change in pH. However, instead of creating a 'pool' of adsorbed mercury once and depleting it, this process has occurred several times. Though overall the pH of the system is headed to lower values there has been great fluctuations. It is believed that these fluctuations 'see saw' about the equilibrium point of the adsorption desorption mechanism.

Additional sampling in adjacent drainages during water year 2009 and water year 2012 showed that this issue was isolated to only the Althea watershed. During the water year 2013 HGCMC proposes to conduct a pH survey of the muskeg region to the west of Pond 7 and also the drainage above Site 60, in order to better understand the pH dynamics of the system. Along with this work an evaluation of the catchment and pump back system at Pond 7 will be conducted.

A non-parametric statistical analysis for trend was performed for specific conductivity, field pH, total alkalinity, total sulfate, and dissolved zinc. Calculation details of the Seasonal Kendall analyses are presented in detail on the pages following this interpretive section. The following table summarizes the results on the data collected between Oct-06 and Sep-12 (WY2007-WY2012). 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	0.02	-	-9.733	-16.331
pH Field	6	0.08			
Alkalinity, Total	6	<0.01	-	-1.93	-19.1
Sulfate, Total	6	0.04			
Zinc, Dissolved	6	<0.01	+	0.55	10.0

* Number of Years ** Significance level

There were three statistically significant ($\alpha/2=2.5\%$) trends identified for the current water year. There were statistical significant decreasing trends in field conductivity (-9.73 µS/cm/yr) and total alkalinity (-1.93 mg/L/yr). There also was a statistically significant increasing trend in dissolved zinc with a Sen's slope estimate of 0.55 µg/L/yr. The current zinc values are approximately 12% of the AWQS. HGCMC feels that the current sampling schedule adequately characterizes the water quality parameters at this site.

Table of Results for Water Year 2012

Site 060FMS - 'Lower Althea creek'

Sample Date/Parameter	Oct 2011	Nov 2011	Dec 2011	Jan 2012	Feb 2012	Mar 2012	Apr 2012	May 2012	Jun 2012	Jul 2012	Aug 2012	Sep 2012	**Median**
Water Temp (°C)		2.3						5.2		9.8		9.4	7.3
Conductivity-Field(μmho)		50						55.3		47.1		45	48.6
Conductivity-Lab (μmho)		57						53		48		44	51
pH Lab (standard units)		6.94						5.87		5.81		5.94	5.91
pH Field (standard units)		6.38						5.83		6.64		6.14	6.26
Total Alkalinity (mg/L)		9.7						7		9		8.9	9.0
Total Sulfate (mg/L)		12.5						2.5		12.5		4.1	8.3
Hardness (mg/L)		24						21.9		24.2		21.6	23.0
Dissolved As (ug/L)		2.18						1.85		2.97		3.34	2.575
Dissolved Ba (ug/L)		18.5						15.5		22.4		23.5	20.5
Dissolved Cd (ug/L)		0.0203						0.0149		0.0181		0.0207	0.0192
Dissolved Cr (ug/L)		1.28						1.03		1.45		1.31	1.295
Dissolved Cu (ug/L)		1.06						1.14		1.47		1.65	1.305
Dissolved Pb (ug/L)		0.247						0.193		0.337		0.642	0.2920
Dissolved Ni (ug/L)		1.51						1.37		1.69		1.72	1.600
Dissolved Ag (ug/L)		0.008						0.009		0.015		0.012	0.011
Dissolved Zn (ug/L)		5.81						4.83		6.26		8.03	6.04
Dissolved Se (ug/L)		0.057						0.255		0.166		0.057	0.112
Dissolved Hg (ug/L)		0.0137						0.0131		0.0166		0.0213	0.015150

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 KGCMC and removed from any further analysis and is not included into the calculation of the median

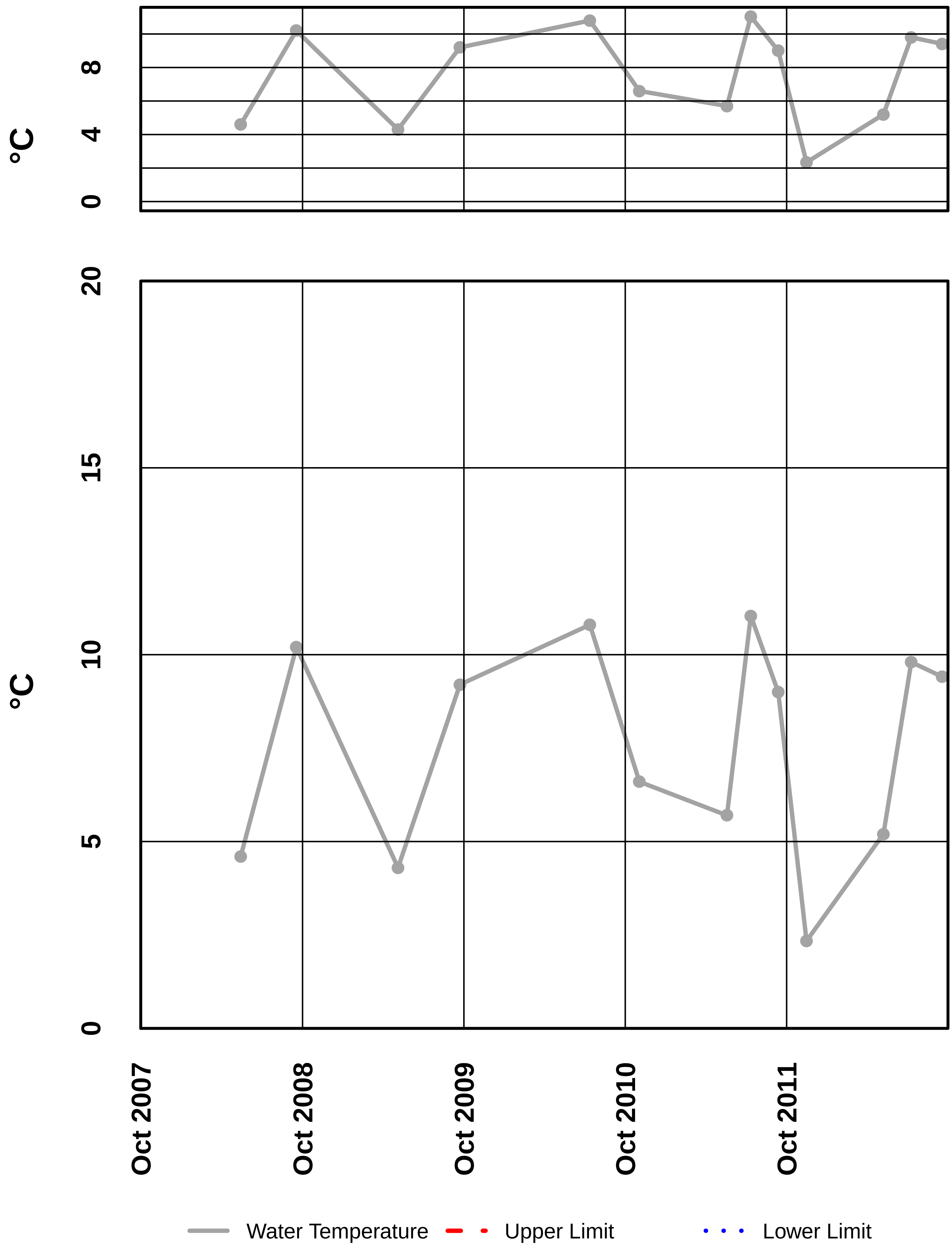
Qualified Data by QA Reviewer

Date Range: 10/01/2011 to 09/30/2012

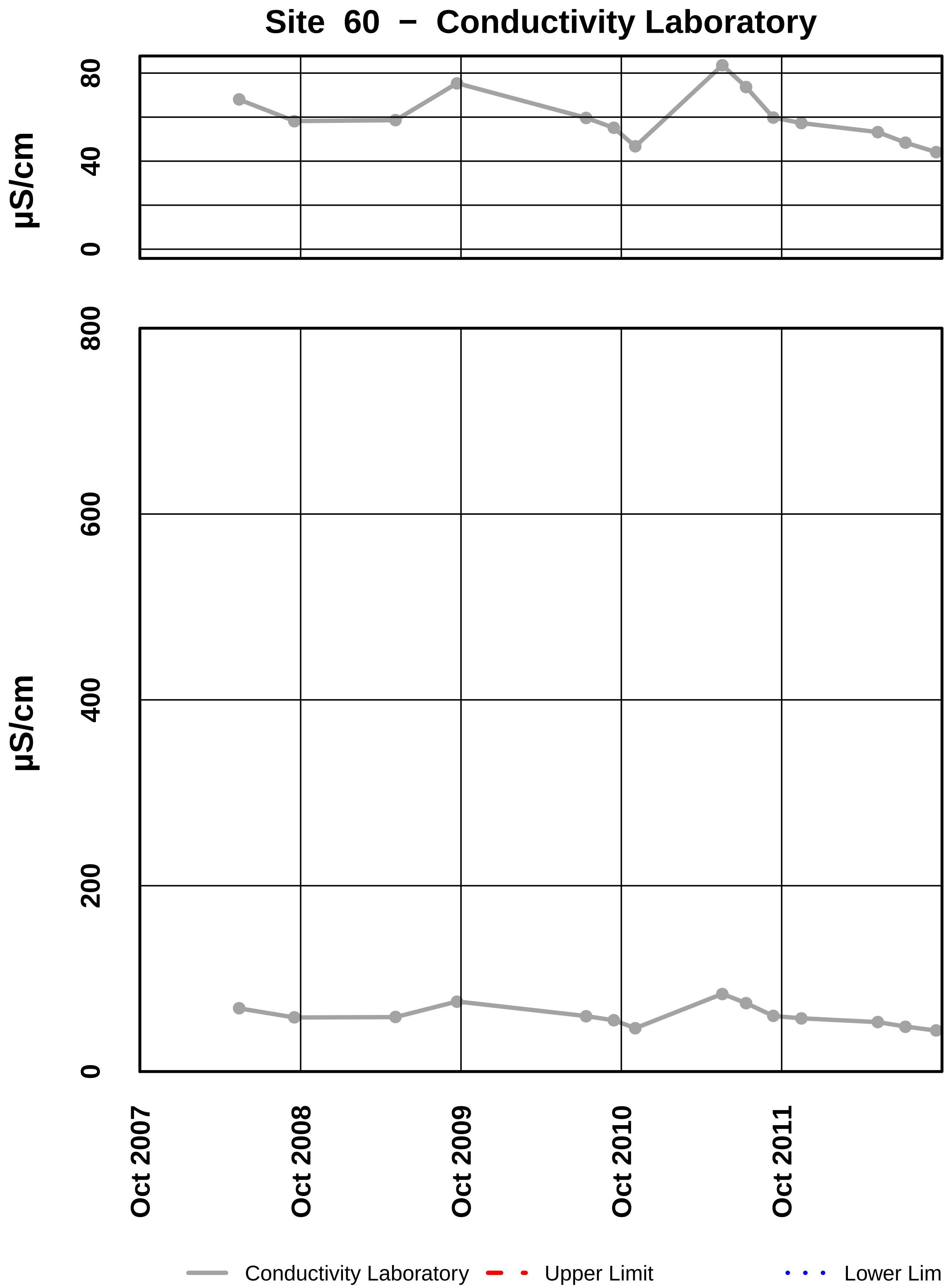
Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
60	11/15/2011	12:00 AM	Ag diss, µg/l	0.00805	U	Field Blank Contamination
60	5/7/2012	12:00 AM	Ag diss, µg/l	0.00912	J	Below Quantitative Range
			Se diss, µg/l	0.25	J	Below Quantitative Range
			SO4 Tot, mg/l	-5	UJ	Sample Receipt Temperature
60	7/9/2012	12:00 AM	Se diss, µg/l	0.16	J	Below Quantitative Range
60	9/17/2012	12:00 AM	pH Lab, su	5.94	J	Hold Time Violation
			SO4 Tot, mg/l	4.07	J	Sample Receipt Temperature

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

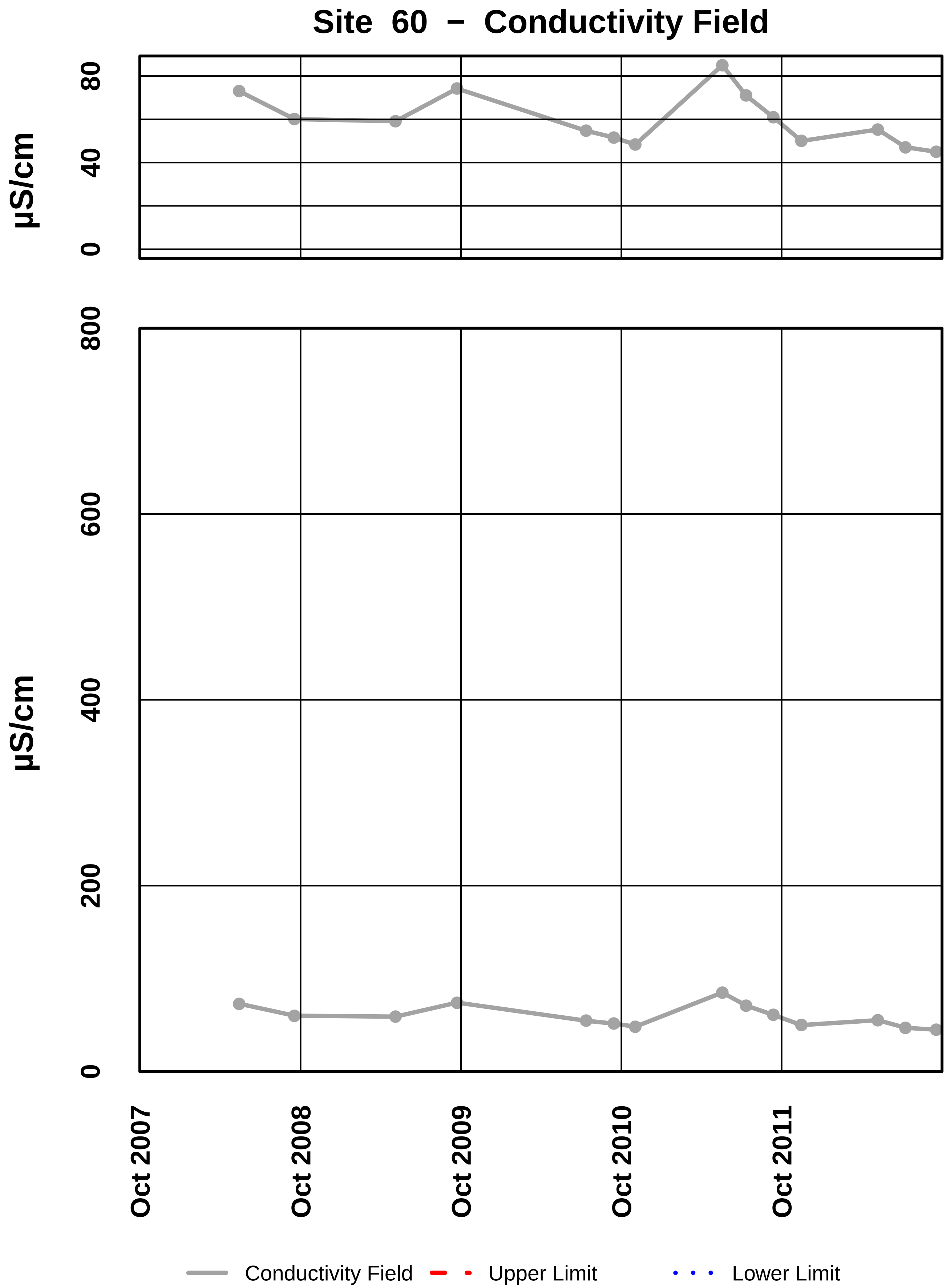
Site 60 − Water Temperature



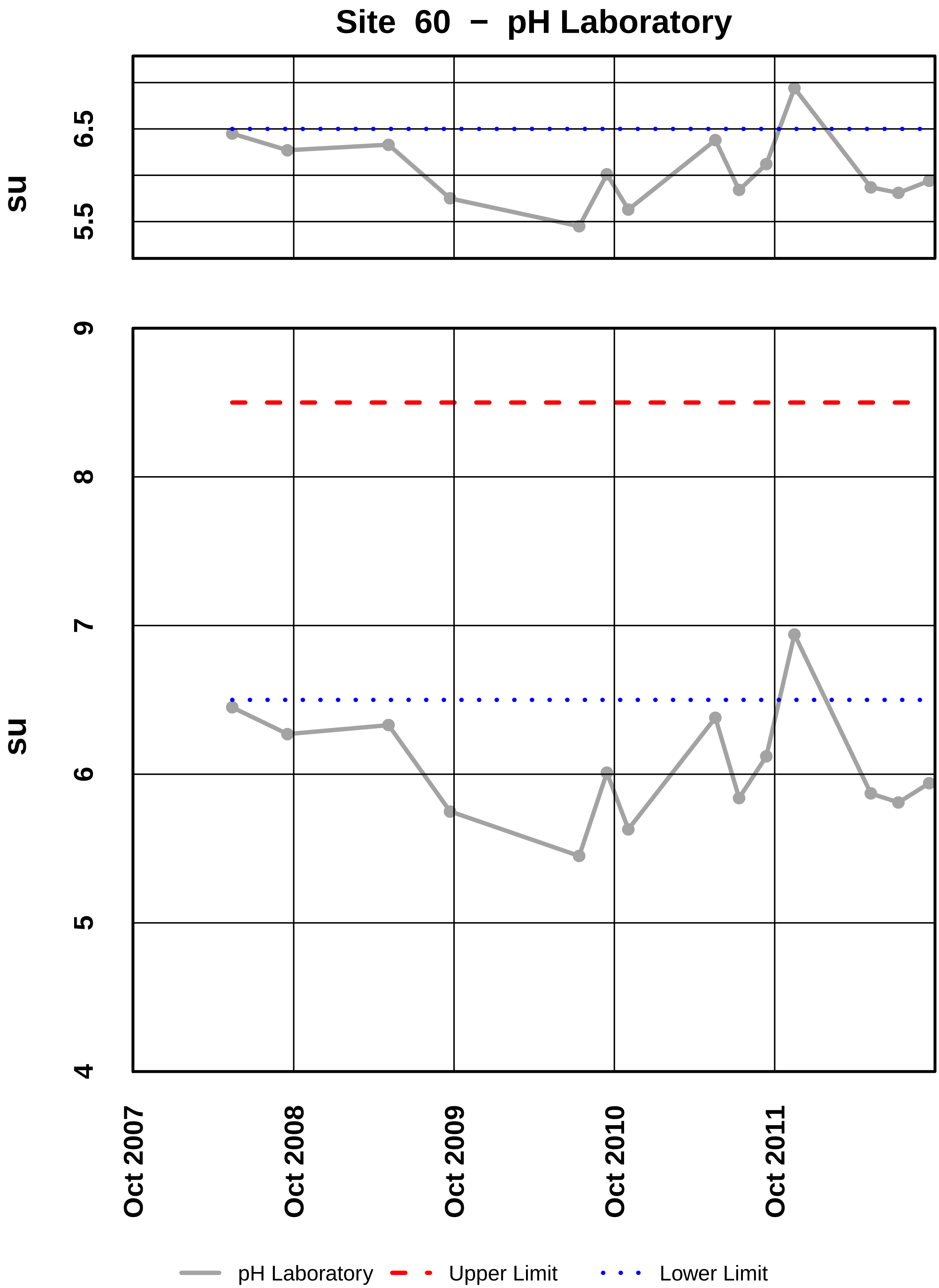
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

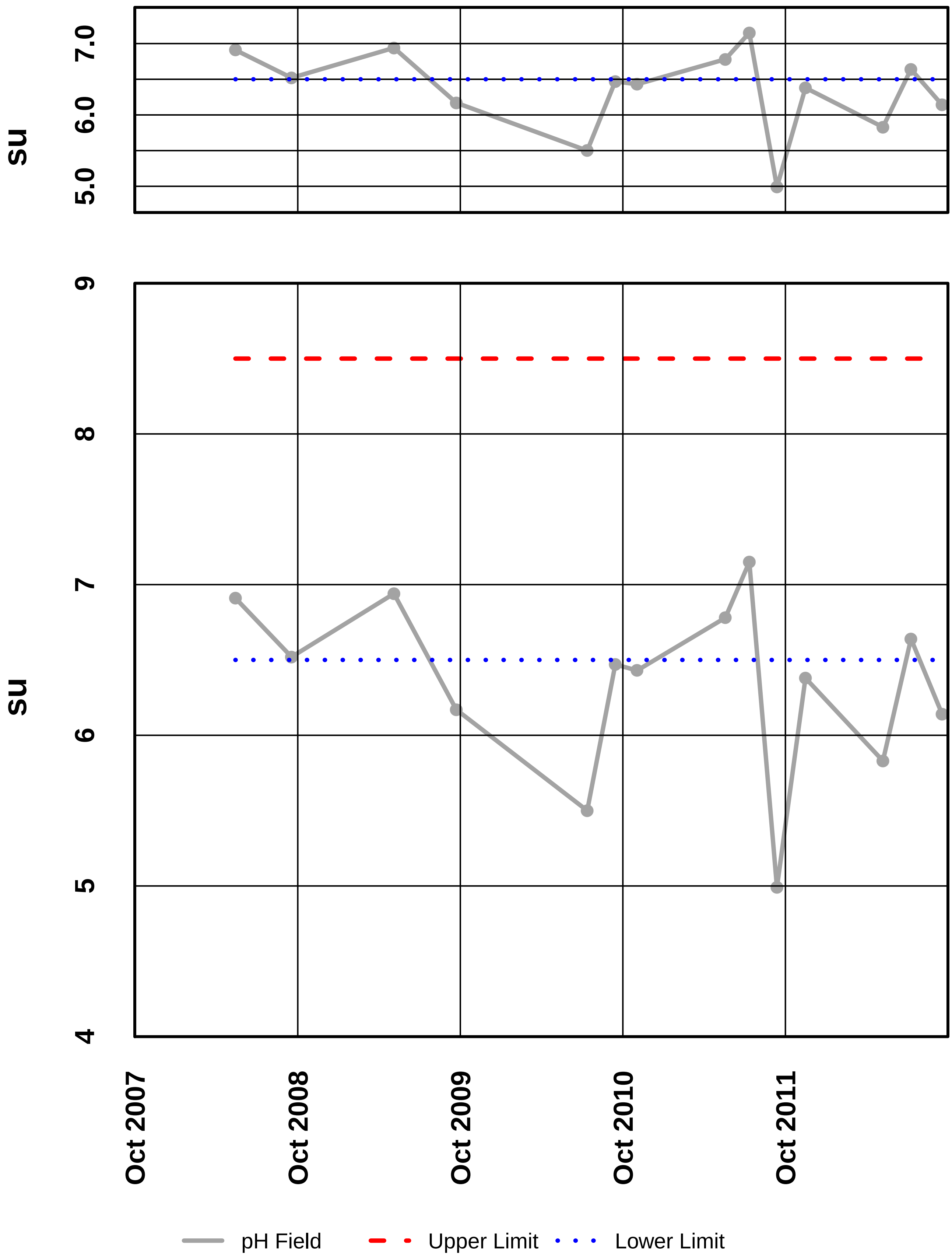


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



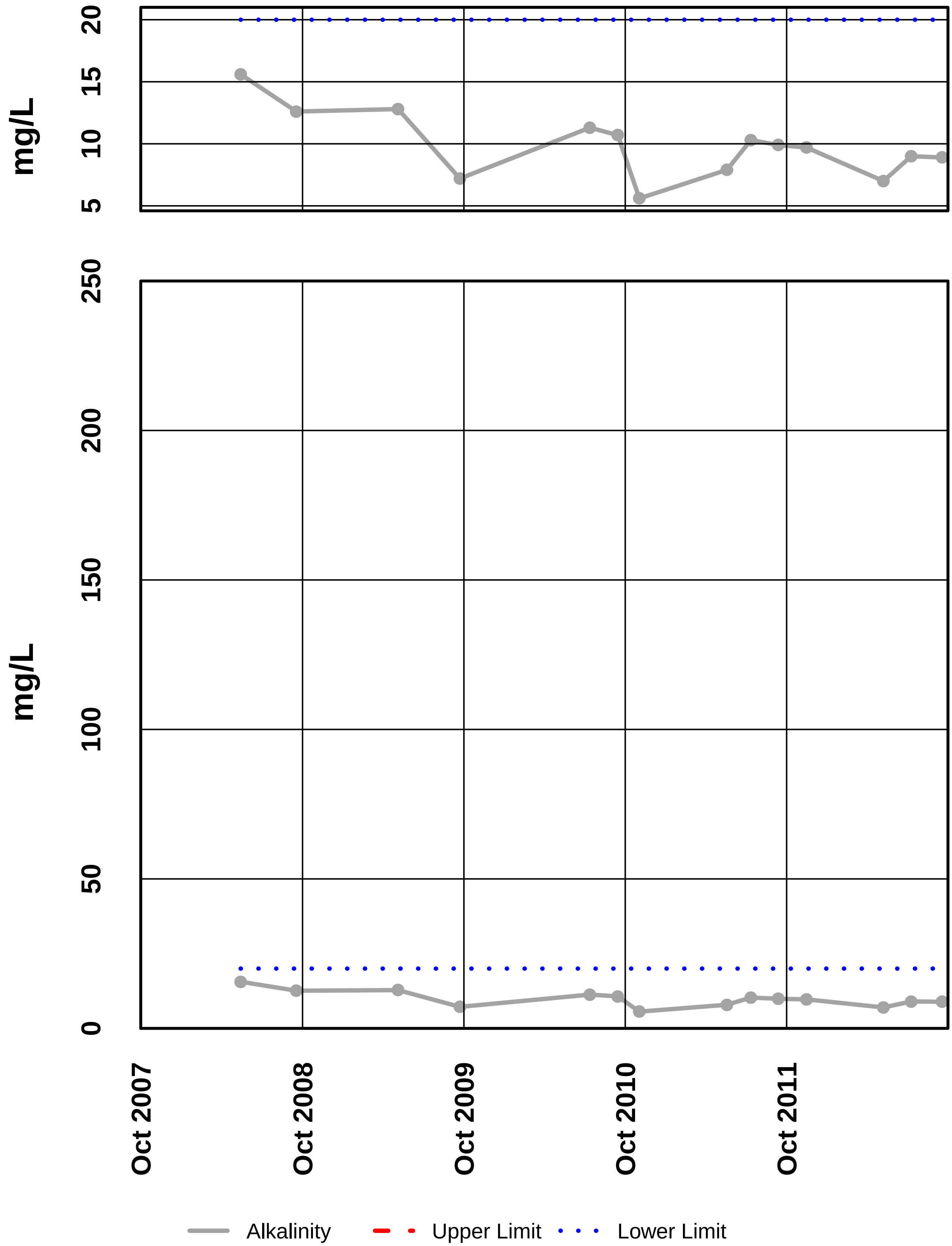
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 60 – pH Field

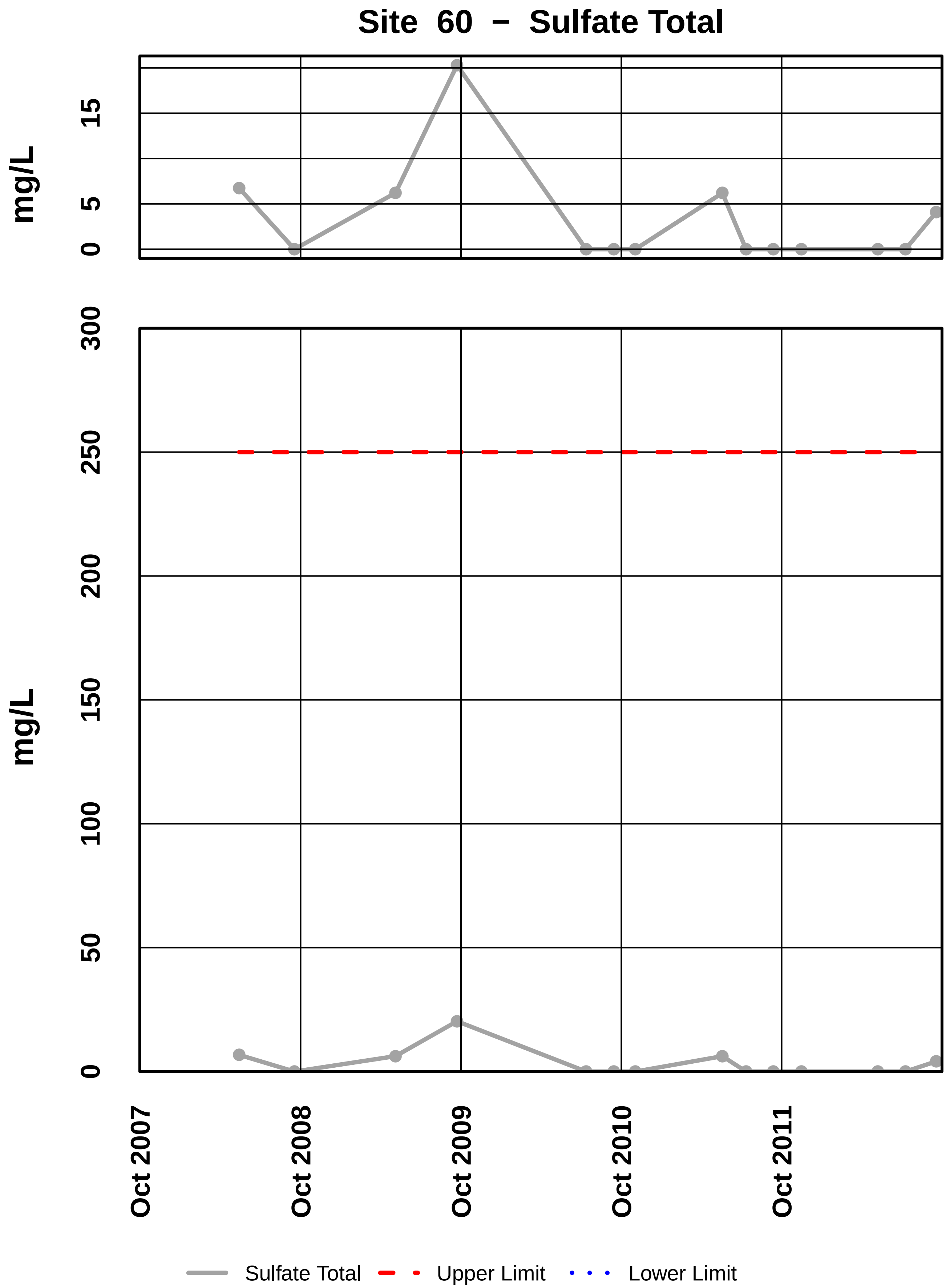


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

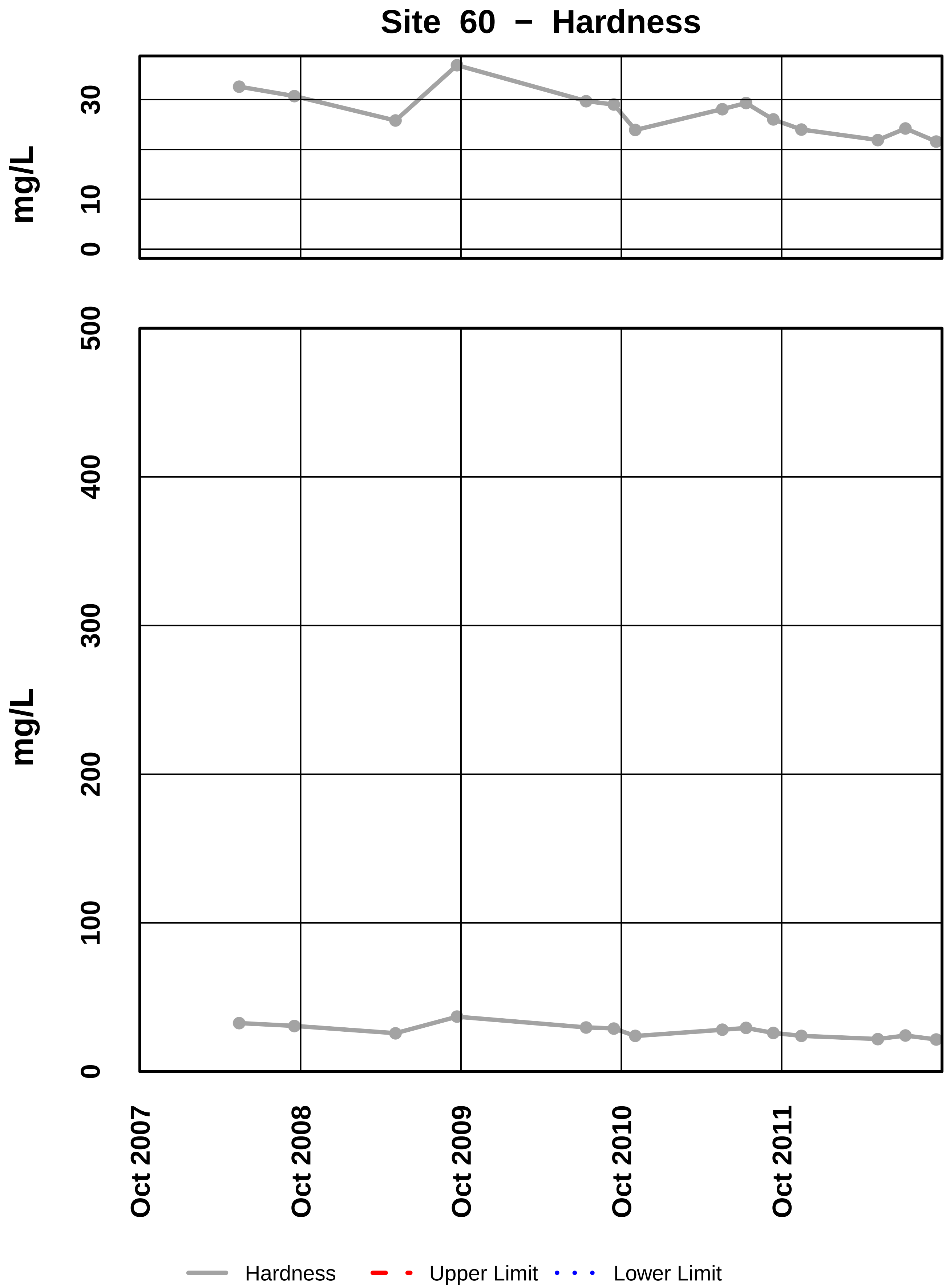
Site 60 – Alkalinity



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

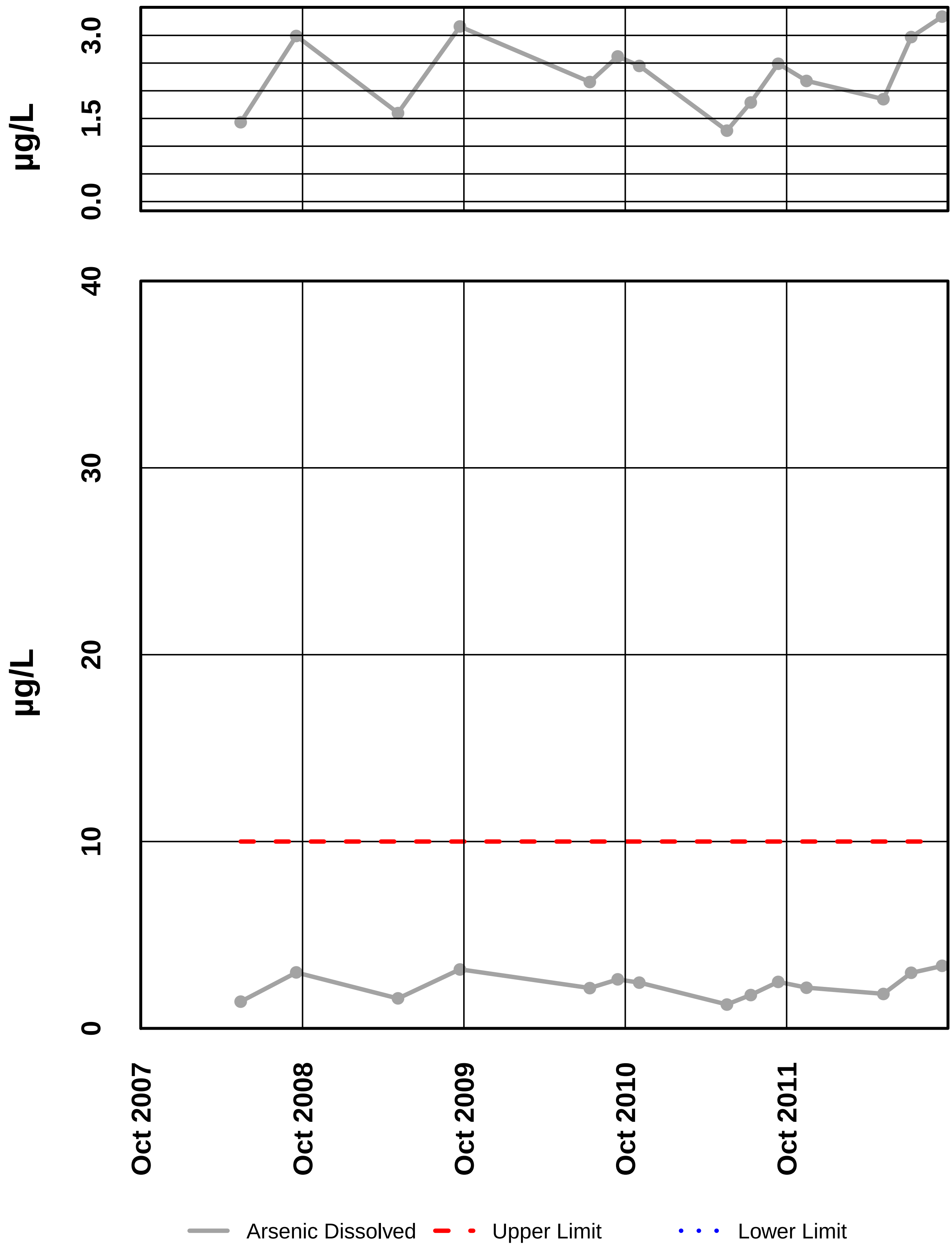


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



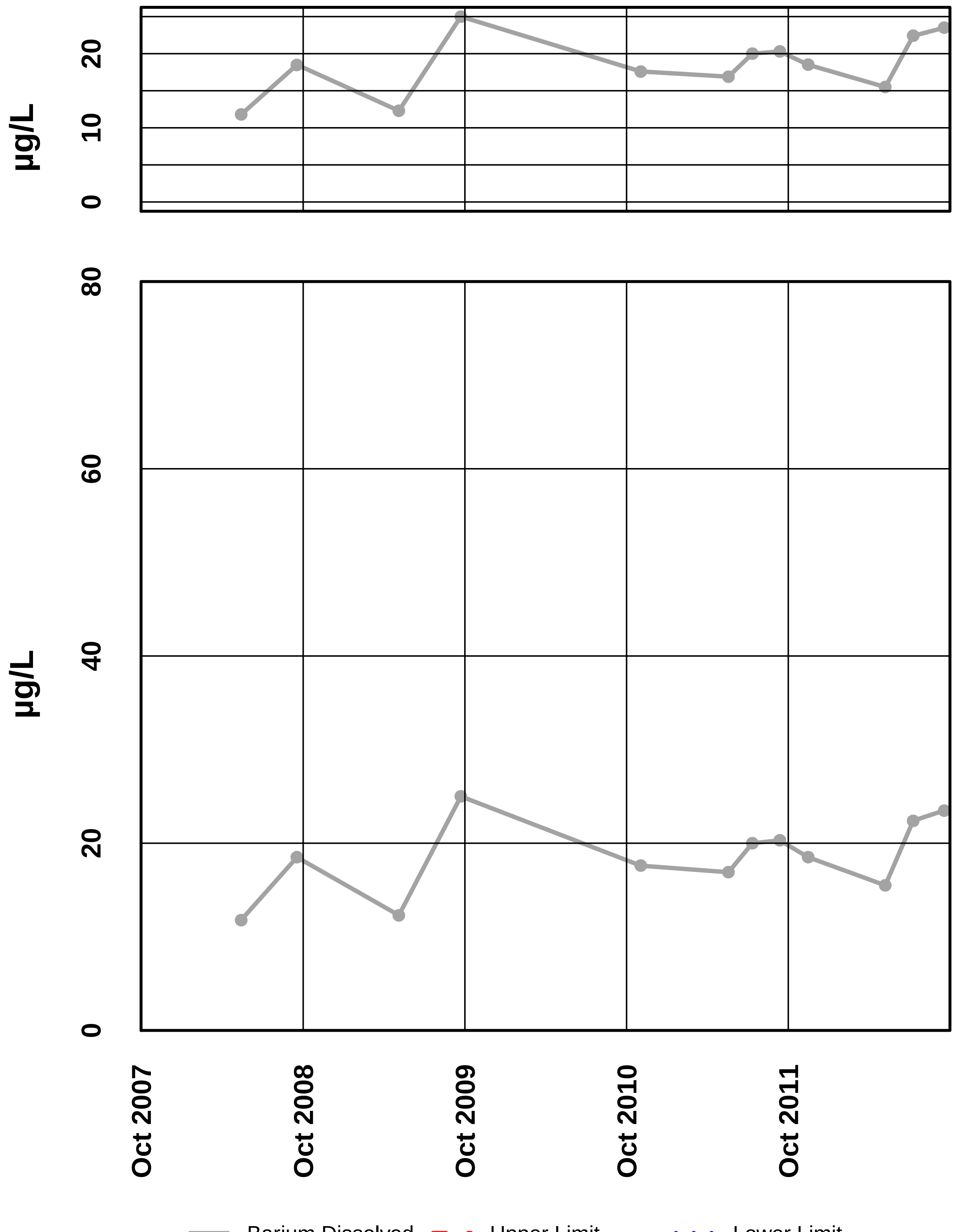
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 60 – Arsenic Dissolved



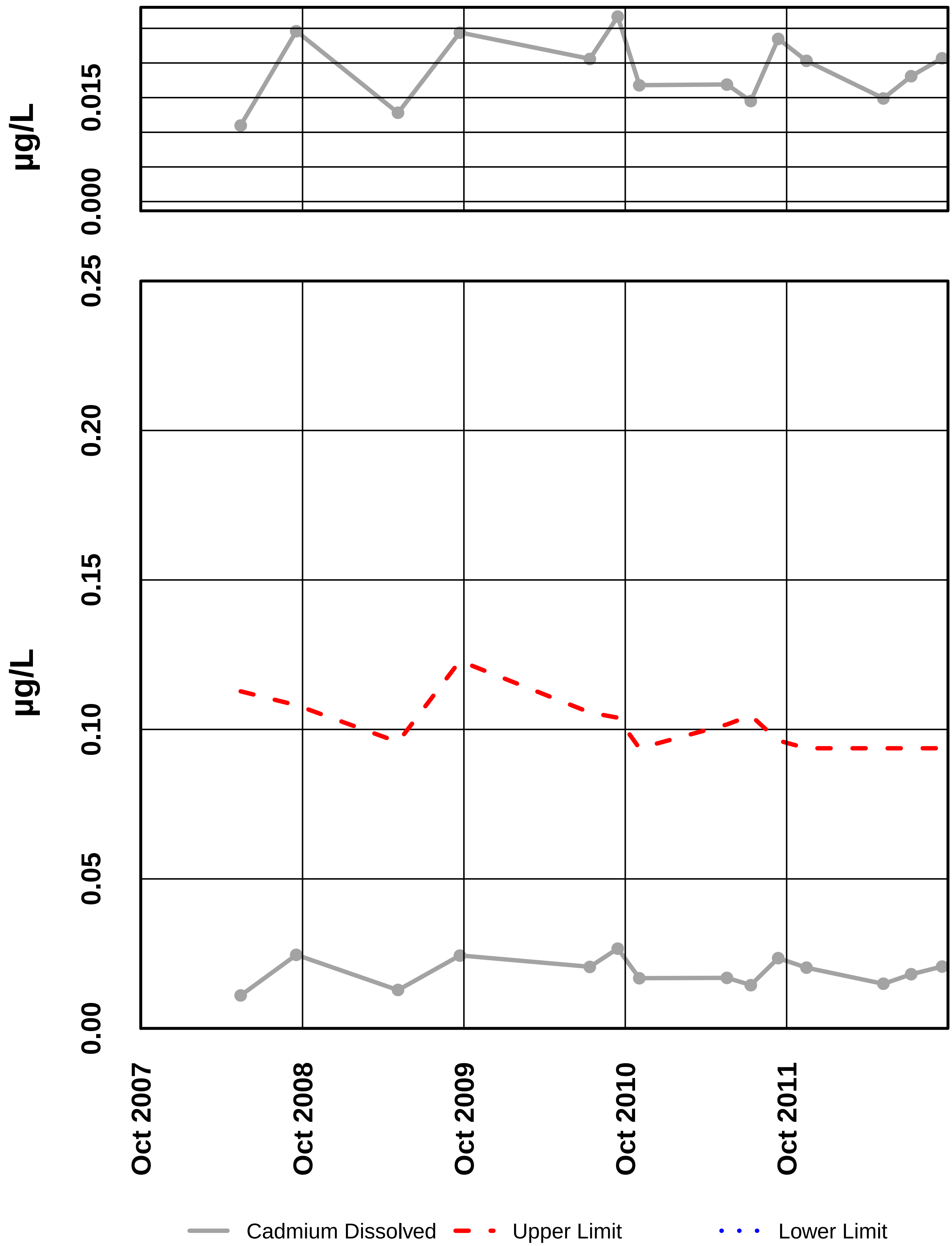
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 60 − Barium Dissolved

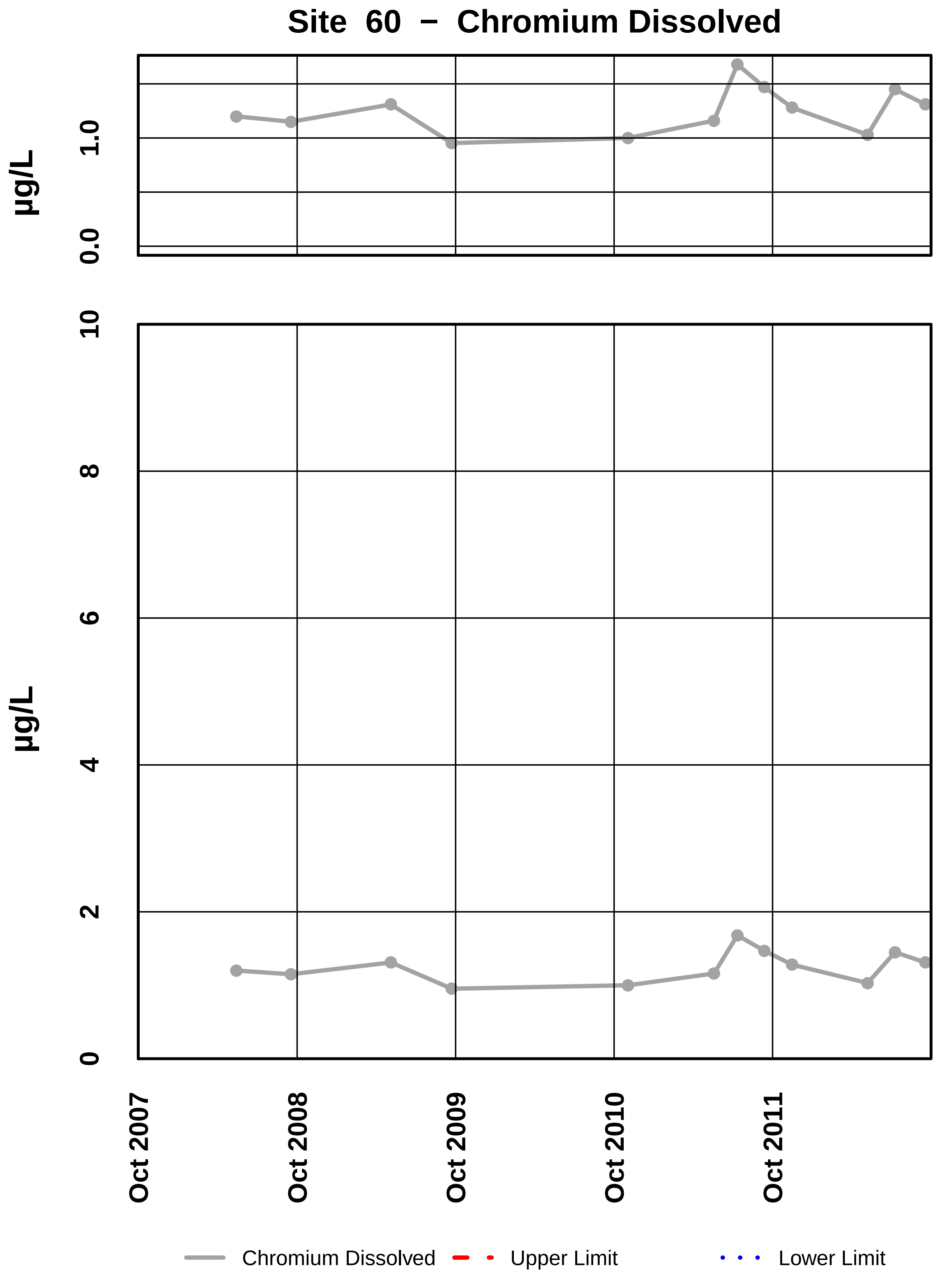


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 60 – Cadmium Dissolved

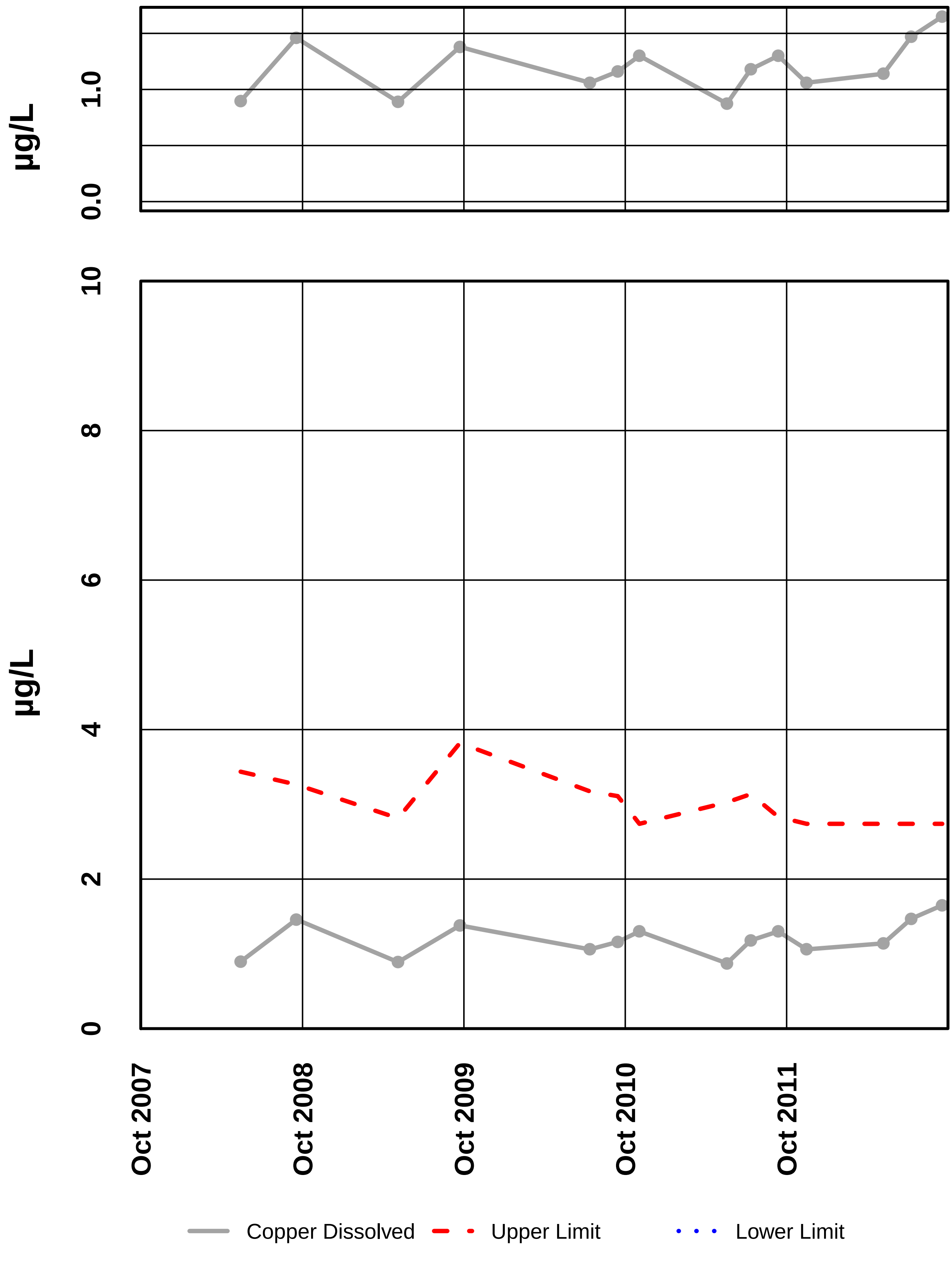


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



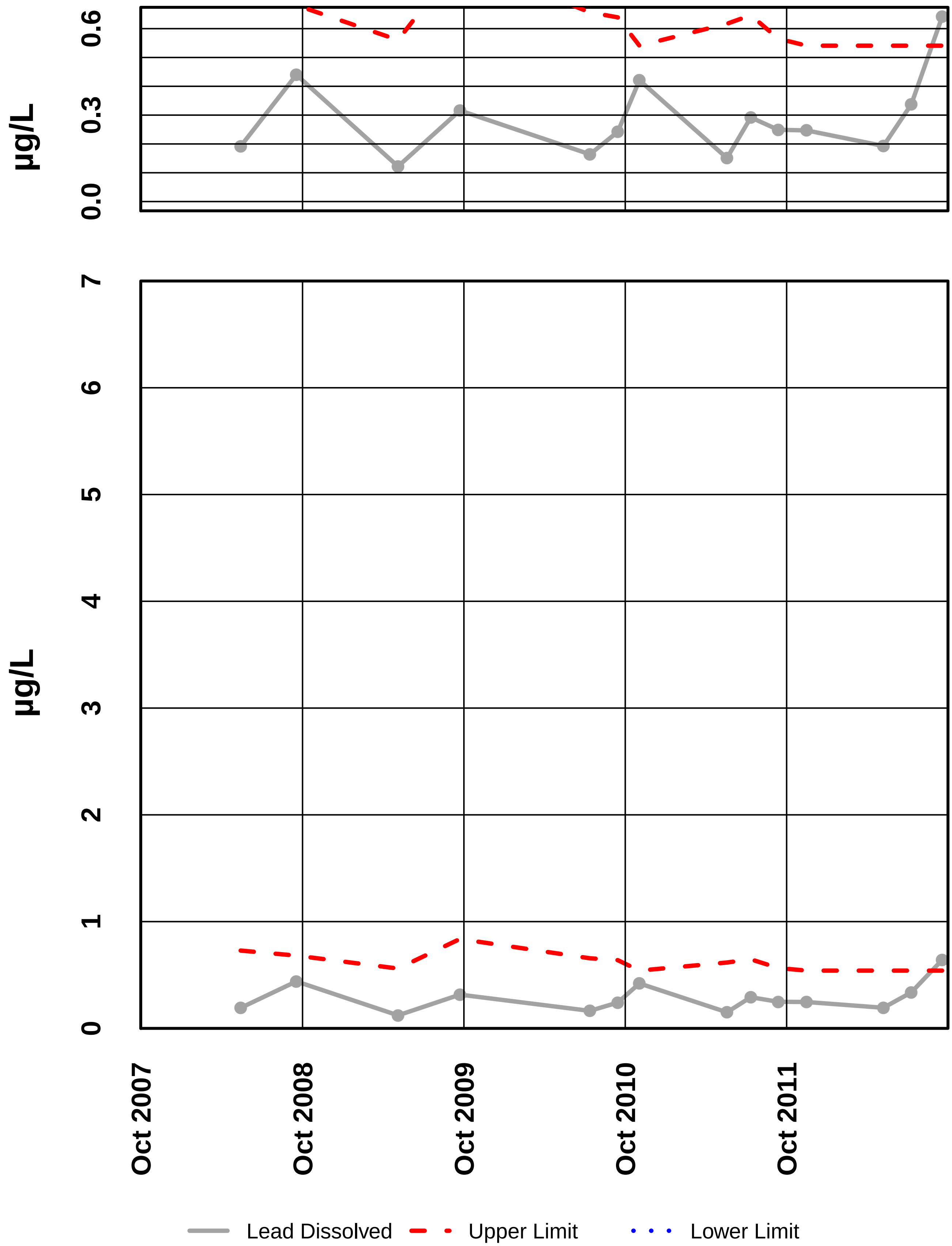
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 60 − Copper Dissolved

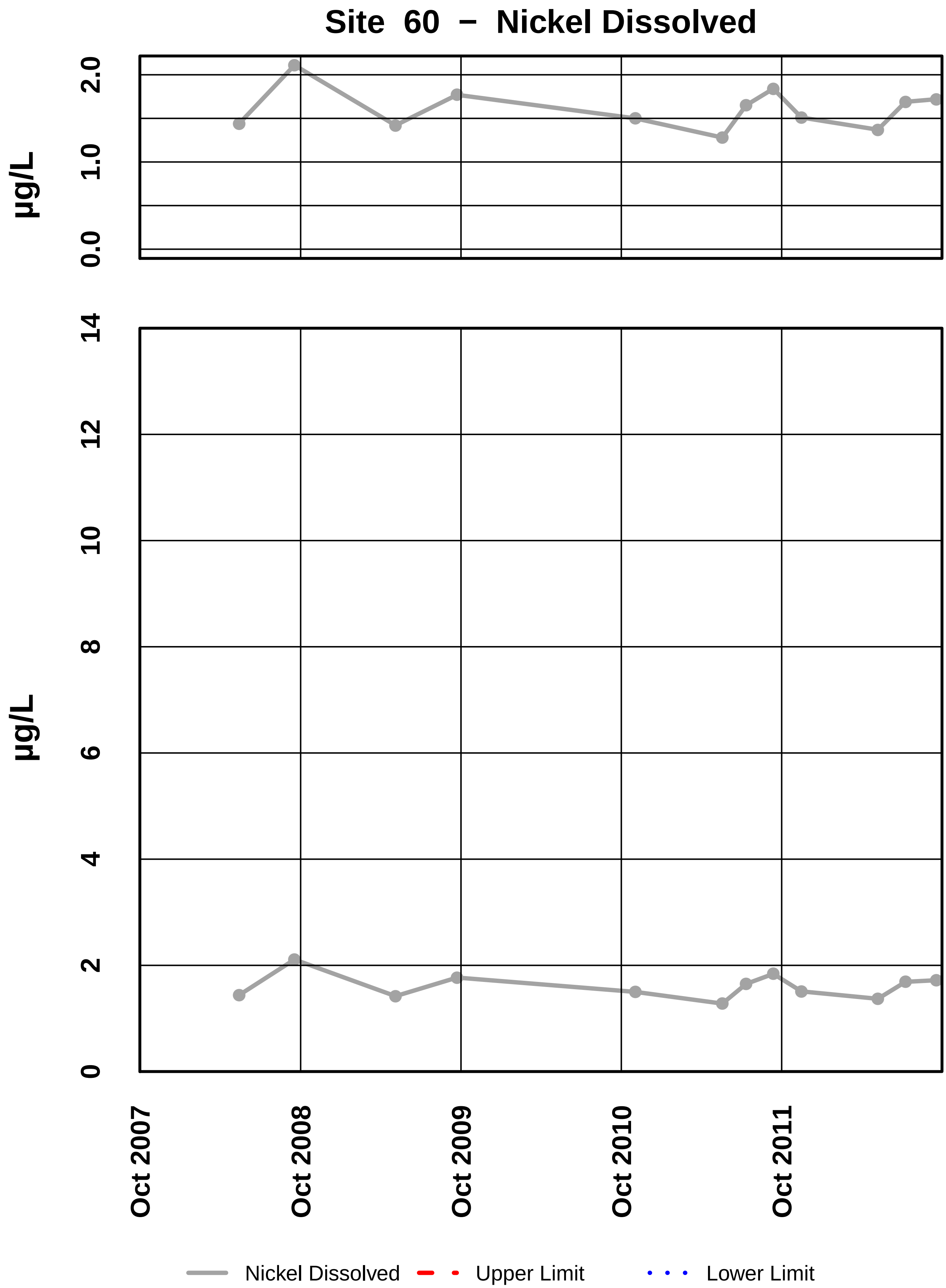


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 60 – Lead Dissolved

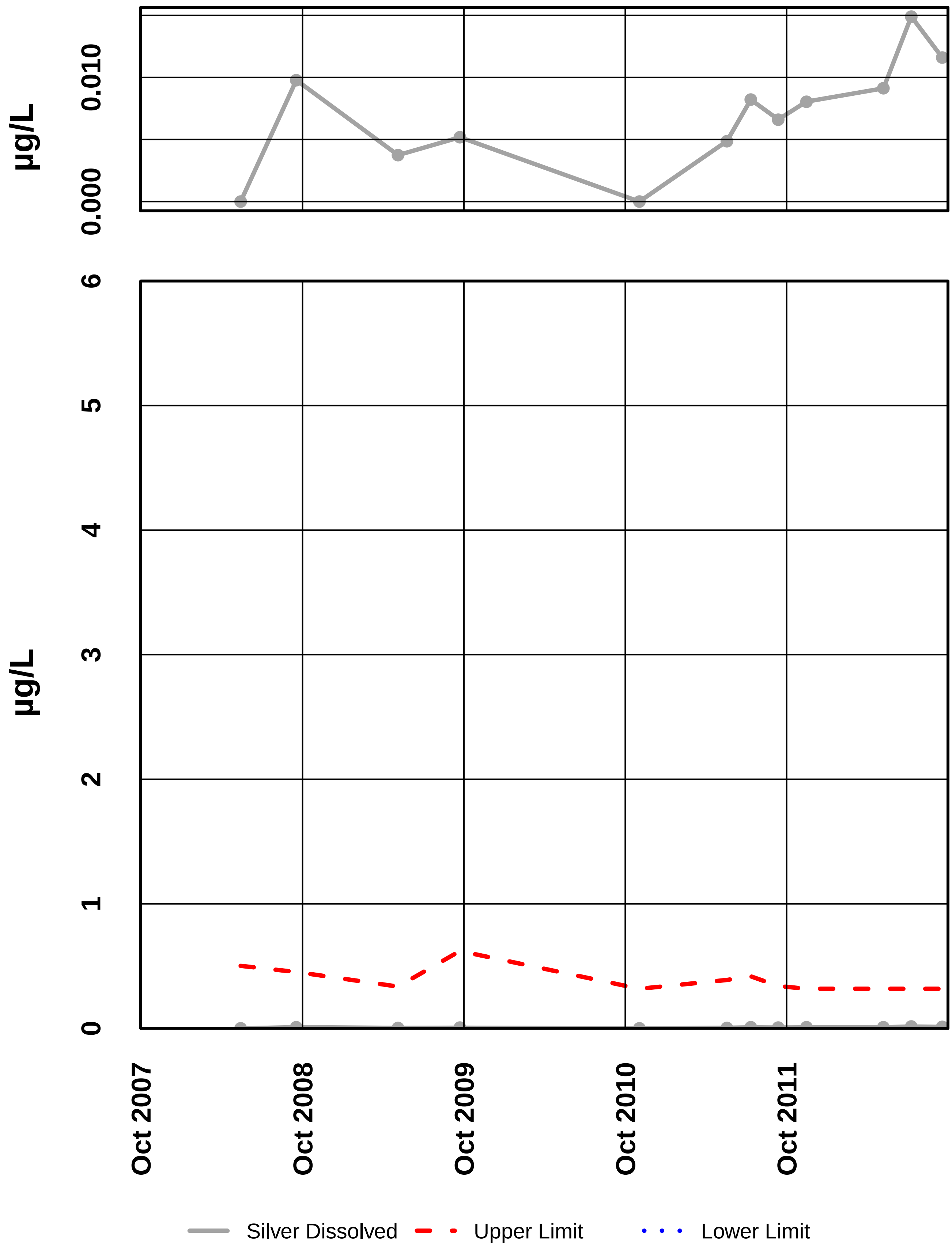


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

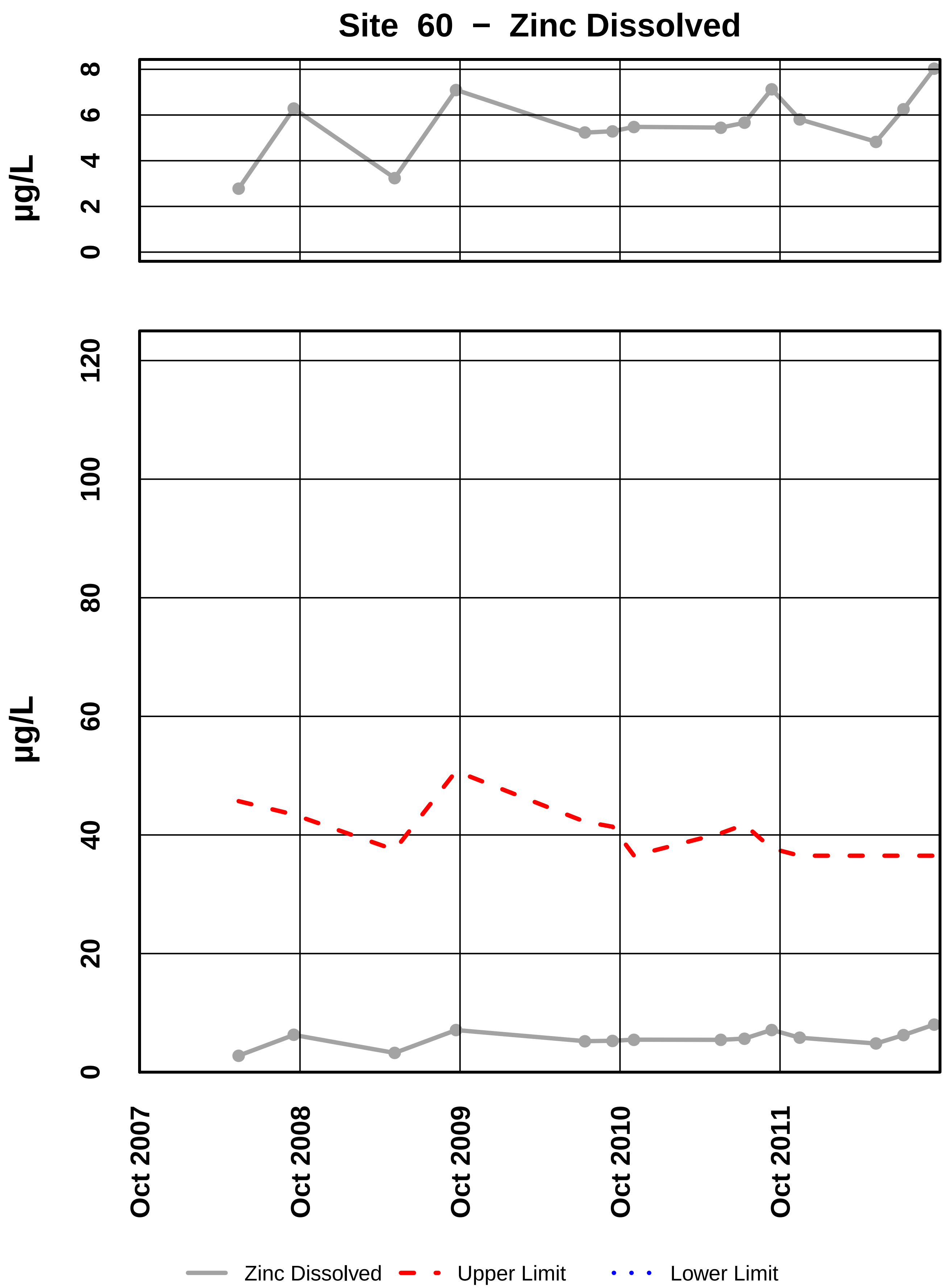


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

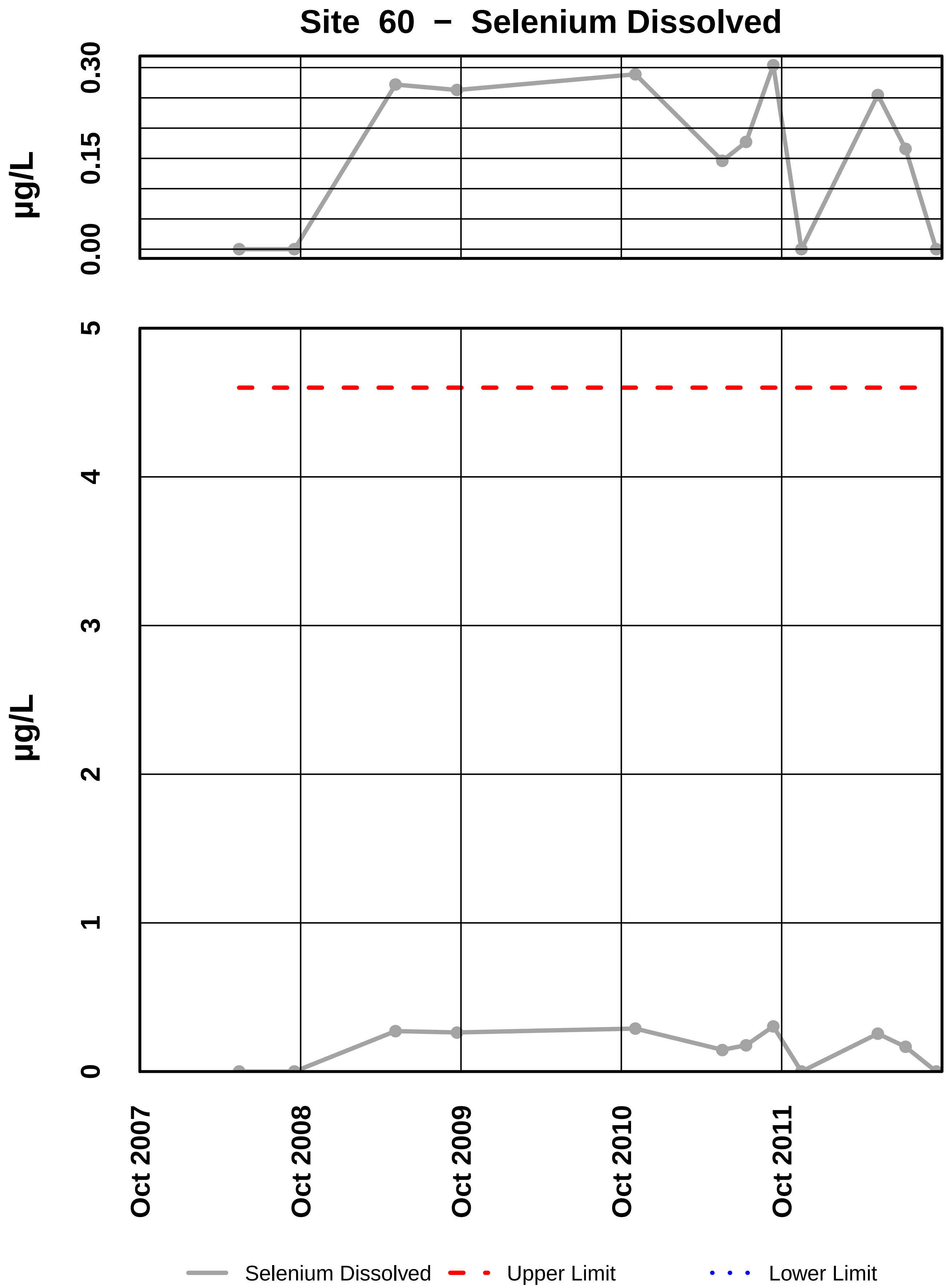
Site 60 − Silver Dissolved



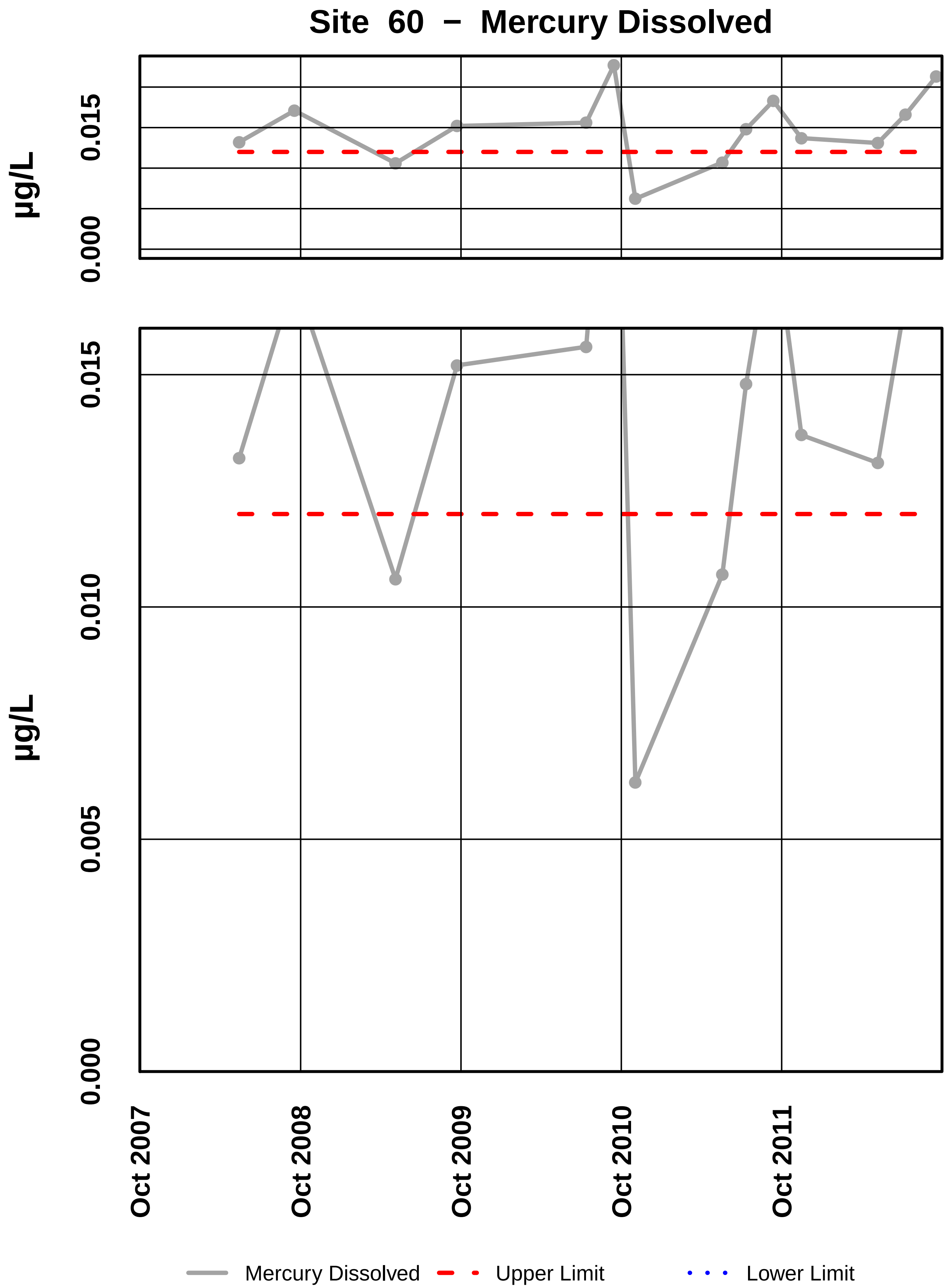
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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



Note: the AWQS may not be shown in order to allow greater visual detail of measured 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** Seasonal Kendall analysis for Specific Conductance, Field (µS/cm)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**								0				126.3
b	**WY2008**								73				60.1
c	**WY2009**								59.1				74.2
d	**WY2010**										54.7		51.6
e	**WY2011**		48.3						85		71		61
f	**WY2012**		50						55.3		47.1		45
	n	0	2	0	0	0	0	0	5	0	3	0	6

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

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

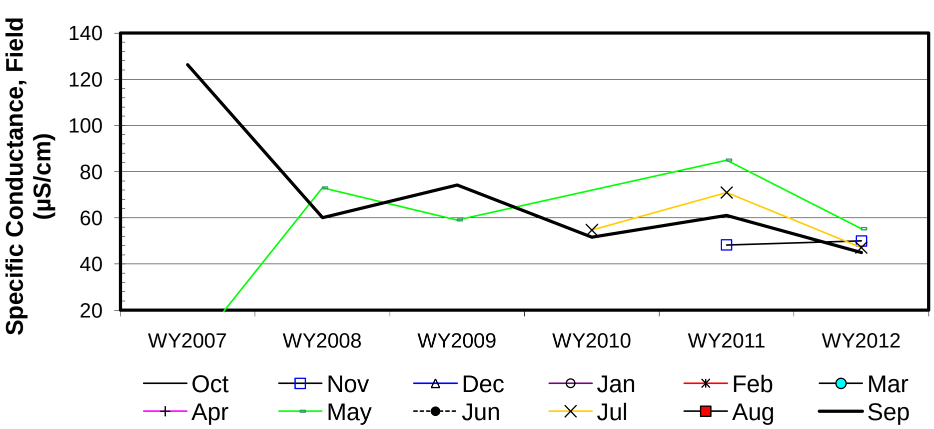
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=		1.00						16.67		3.67		28.33
$Z_k = S_k/\sigma_S$		1.00						0.49		-0.52		-1.69
Z^2_k		1.00						0.24		0.27		2.86

ΣZ_k= -0.72
ΣZ^2_k= 4.37
Z-bar=ΣZ_k/K= -0.18

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	16	0	0	0	0

Σn 16
ΣS_k -7

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=		4.24	@α=5% $\chi^2_{(K-1)}$=	7.81	Test for station homogeneity
	p	**0.237**			$\chi^2_h<\chi^2_{(K-1)}$ ACCEPT
ΣVAR(S_k)	Z_{calc}	-0.85	@α/2=2.5% Z=	1.96	**H_0** (No trend) ACCEPT
49.67	**p**	**0.197**			**H_A** (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-20.70		10.56
0.050	-16.08	**-3.80**	2.38
0.100	-13.93		0.32
0.200	-8.06		-2.35

Site **#60** Seasonal Kendall analysis for pH, Field, Standard Units

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**								0.0				5.2
b	**WY2008**								6.9				6.5
c	**WY2009**								6.9				6.2
d	**WY2010**										5.5		6.5
e	**WY2011**		6.4						6.8		7.2		5.0
f	**WY2012**		6.4						5.8		6.6		6.1
	n	0	2	0	0	0	0	0	5	0	3	0	6

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

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

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=		1.00						16.67		3.67		28.33
$Z_k = S_k/\sigma_S$		-1.00						0.00		0.52		-0.56
Z^2_k		1.00						0.00		0.27		0.32

ΣZ_k= -1.04

ΣZ^2_k= 1.59

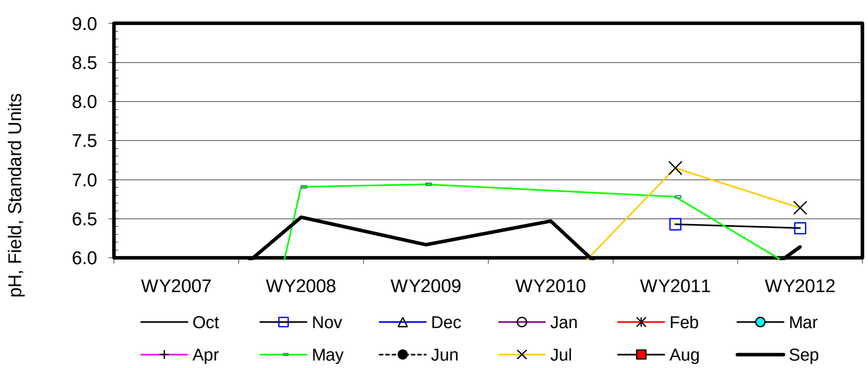
Z-bar=$\Sigma Z_k/K$= -0.26

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	16	0	0	0	0

Σn 16

ΣS_k -3

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	1.32	@α=5% $\chi^2_{(K-1)}$= 7.81	Test for station homogeneity	
p	**0.725**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k) Z_{calc}	-0.28	@α/2=2.5% Z= 1.96	**H_0** (No trend)	ACCEPT
49.67 p	**0.388**		**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.36		0.97
0.050	-0.20	**-0.02**	0.45
0.100	-0.10		0.30
0.200	-0.06		0.11

Site **#60** Seasonal Kendall analysis for Total Alk, (mg/l)

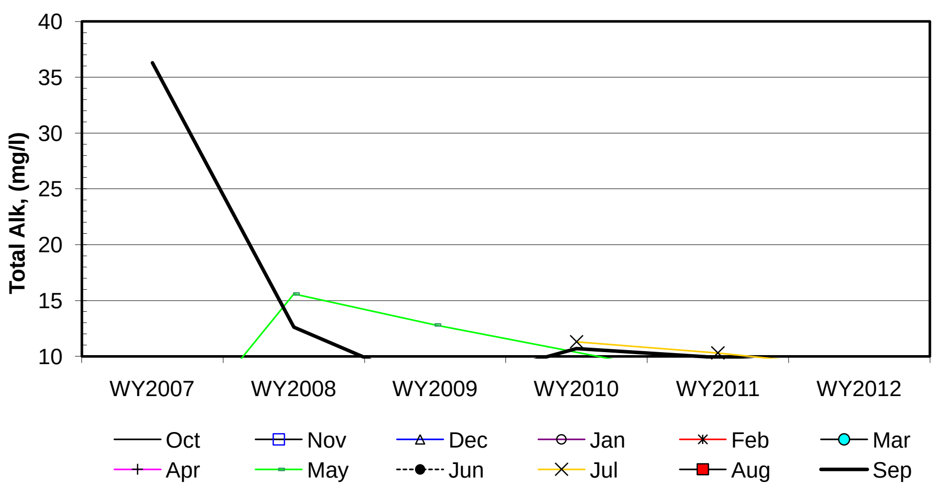
Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**								0.0				36.3
b	**WY2008**								15.6				12.6
c	**WY2009**								12.8				7.2
d	**WY2010**										11.3		10.7
e	**WY2011**		5.6						7.9		10.3		9.9
f	**WY2012**		9.7						7.0		9.0		8.9
	n	0	2	0	0	0	0	0	5	0	3	0	6
	t_1	0	2	0	0	0	0	0	5	0	3	0	6
	t_2	0	0	0	0	0	0	0	0	0	0	0	0
	t_3	0	0	0	0	0	0	0	0	0	0	0	0
	t_4	0	0	0	0	0	0	0	0	0	0	0	0
	t_5	0	0	0	0	0	0	0	0	0	0	0	0
	b-a								1				-1
	c-a								1				-1
	d-a												-1
	e-a								1				-1
	f-a								1				-1
	c-b								-1				-1
	d-b												-1
	e-b								-1				-1
	f-b								-1				-1
	d-c												1
	e-c								-1				1
	f-c								-1				1
	e-d										-1		-1
	f-d										-1		-1
	f-e		1						-1		-1		-1
	S_k	0	1	0	0	0	0	0	-2	0	-3	0	-9
	$\sigma^2_S=$		1.00						16.67		3.67		28.33
	$Z_k = S_k/\sigma_S$		1.00						-0.49		-1.57		-1.69
	Z^2_k		1.00						0.24		2.45		2.86

$\Sigma Z_k=$	-2.75
$\Sigma Z^2_k=$	6.55
Z-bar=ΣZ_k/K=	-0.69

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	16	0	0	0	0

Σn	16
ΣS_k	-13

$\chi^2_h=\Sigma Z^2_k$-K(Z-bar)^2=	4.67	@α=5% $\chi^2_{(K-1)}$=	7.81	Test for station homogeneity	
p	**0.198**			$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc} -1.70	@α/2=2.5% Z=	1.96	H_0 (No trend)	ACCEPT
49.67	p **0.044**			H_A (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-4.61		1.11
0.050	-2.48	**-1.00**	-0.87
0.100	-2.15		-0.90
0.200	-1.59		-0.91

Site #60 — Seasonal Kendall analysis for Sulfate, Total (mg/l)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**								0.0				12.6
b	**WY2008**								6.7				0.0
c	**WY2009**								6.2				20.3
d	**WY2010**										0.0		0.0
e	**WY2011**		0.0						6.2		0.0		0.0
f	**WY2012**		0.0						0.0		0.0		4.1
	n	0	2	0	0	0	0	0	5	0	3	0	6

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

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

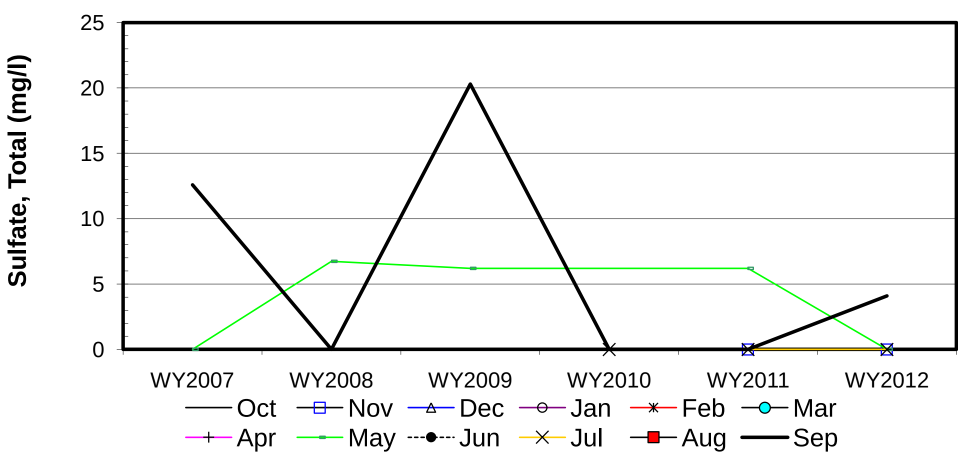
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=		0.00						15.67		0.00		24.67
$Z_k = S_k/\sigma_S$		#DIV/0!						-0.76		#DIV/0!		-0.40
Z^2_k		#DIV/0!						0.57		#DIV/0!		0.16

ΣZ_k=	#DIV/0!
ΣZ^2_k=	#DIV/0!
Z-bar=ΣZ_k/K=	#DIV/0!

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	6	2	2	0	0

Σn	16
ΣS_k	-5

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=		#DIV/0!	@α=5% $\chi^2_{(K-1)}$= 7.81	Test for station homogeneity	
	p	**#DIV/0!**		$\chi^2_h<\chi^2_{(K-1)}$	#DIV/0!
ΣVAR(S_k)	Z_{calc}	-0.63	@α=2.5% Z= 1.96	**H_0** (No trend)	ACCEPT
40.33	**p**	**0.264**		**H_A** (± trend)	#DIV/0!



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-3.03		0.91
0.050	-1.70	**0.00**	0.00
0.100	-1.18		0.00
0.200	-0.24		0.00

#DIV/0!

Site **#60** Seasonal Kendall analysis for Zinc, Dissolved (ug/l)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2007**												
b	**WY2008**								2.8				6.3
c	**WY2009**								3.2				7.1
d	**WY2010**										5.2		5.3
e	**WY2011**		5.5						5.5		5.7		7.1
f	**WY2012**		5.8						4.8		6.3		8.0
	n	0	2	0	0	0	0	0	4	0	3	0	5

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

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

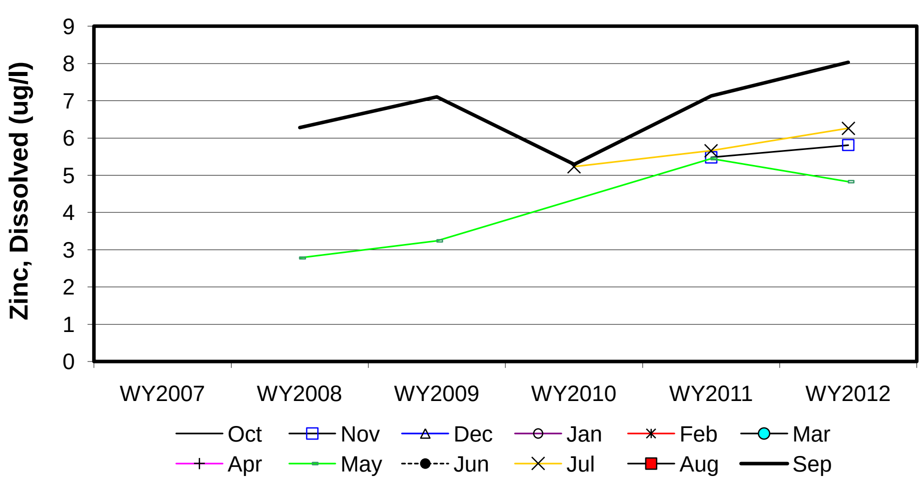
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
$\sigma^2_S=$		1.00						8.67		3.67		16.67
$Z_k = S_k/\sigma_S$		1.00						1.36		1.57		1.47
Z^2_k		1.00						1.85		2.45		2.16

$\Sigma Z_k=$ 5.40
$\Sigma Z^2_k=$ 7.46
Z-bar=$\Sigma Z_k/K=$ 1.35

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	14	0	0	0	0

Σn 14
ΣS_k 14

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2=$ 0.18	@α=5% $\chi^2_{(K-1)}=$ 7.81	Test for station homogeneity	
p **0.980**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k) 30.00	Z_{calc} 2.37	@$\alpha/2$=2.5% Z= 1.96	**H_0** (No trend)	REJECT
p **0.991**		**H_A** (± trend)	ACCEPT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.17		0.89
0.050	0.30	**0.49**	0.71
0.100	0.32		0.57
0.200	0.40		0.52

8.7%

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)

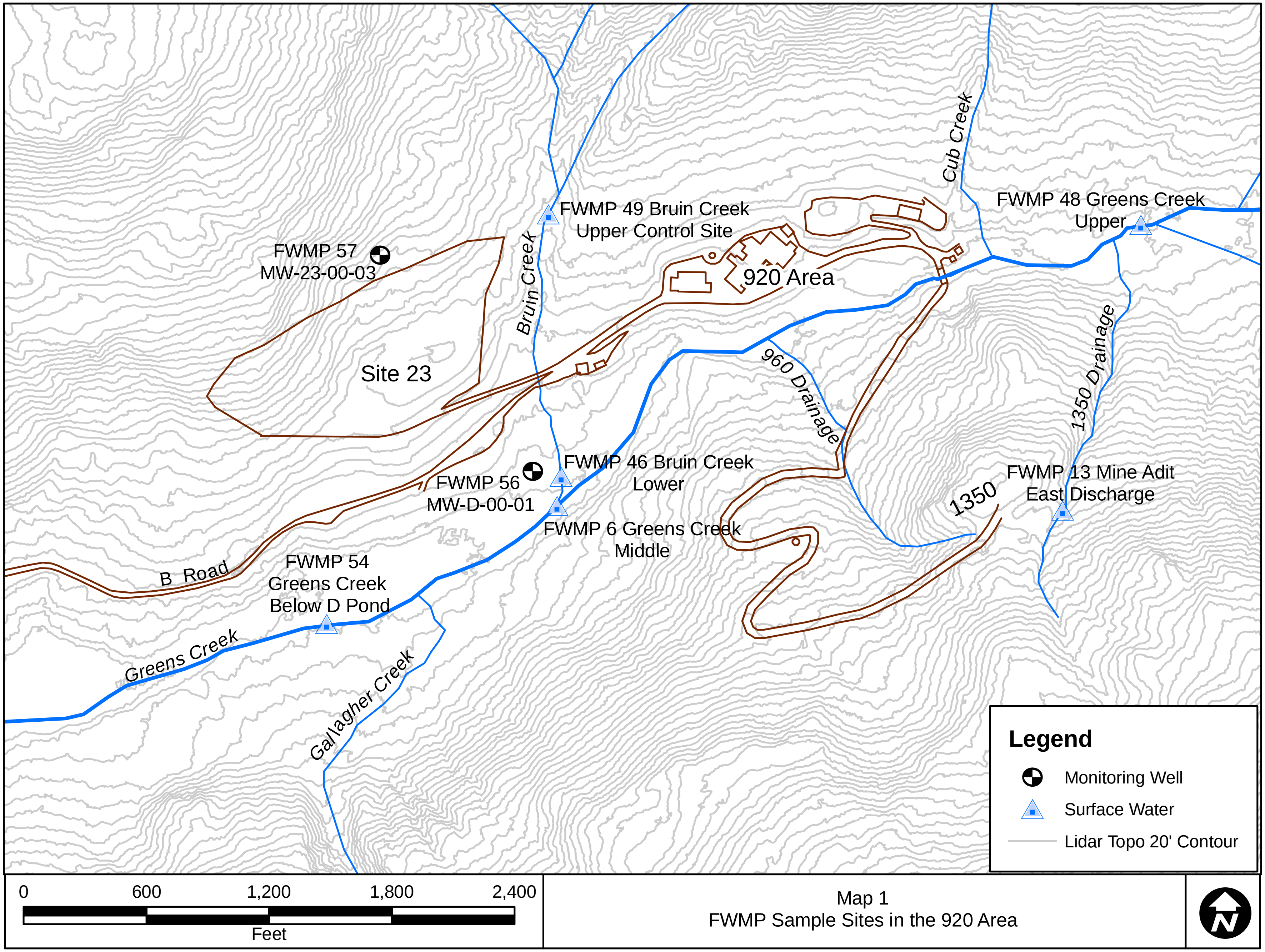
DENOTES STRICTEST CRITERIA

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

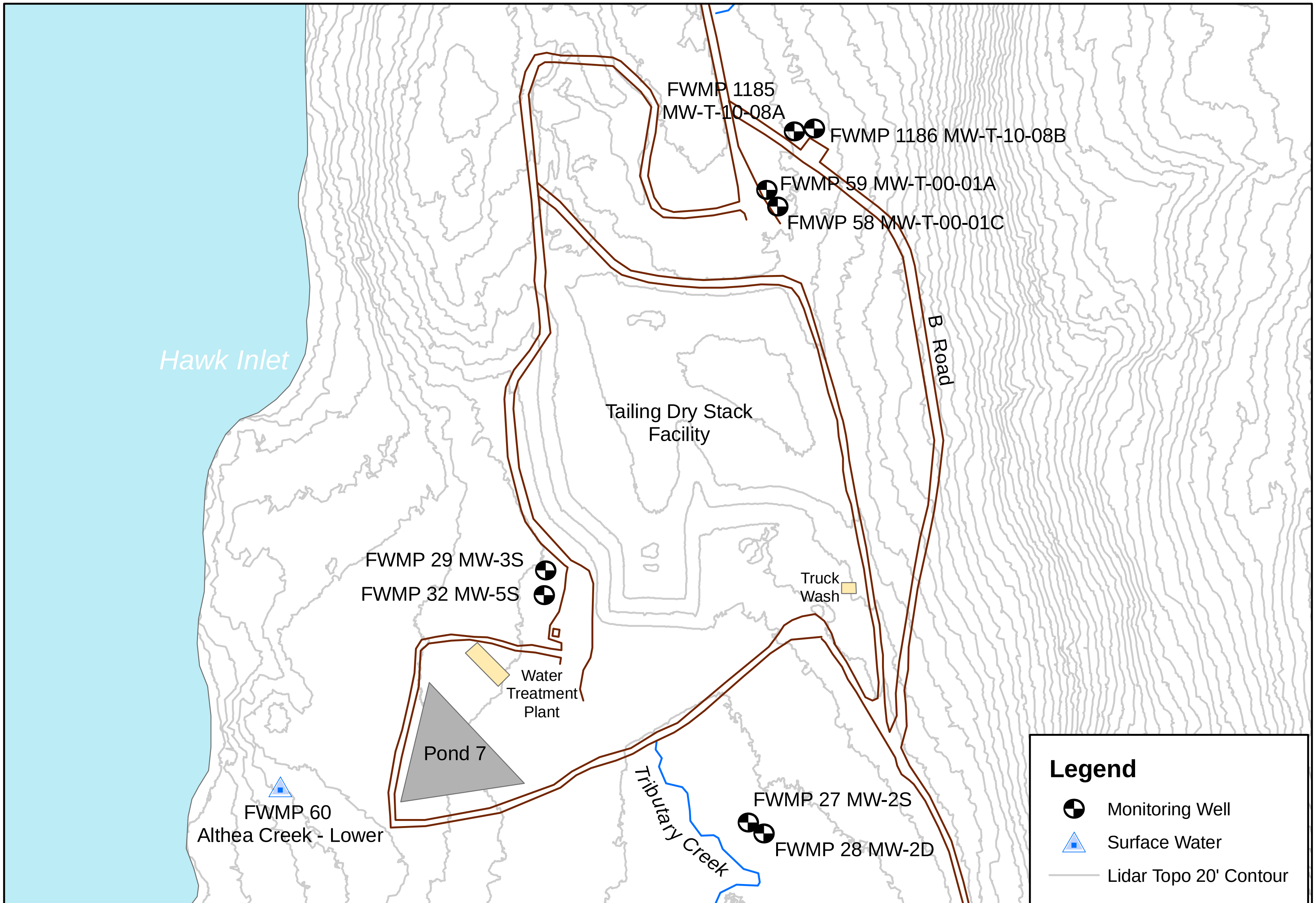
Source: http://www.dec.state.ak.us/water/wqsar/wqs/toxicsbook.xls
Table formatting was modified by HGCMC to include only parameters include in Suite P and Q and to highlight the strictest standard.

APPENDIX B

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

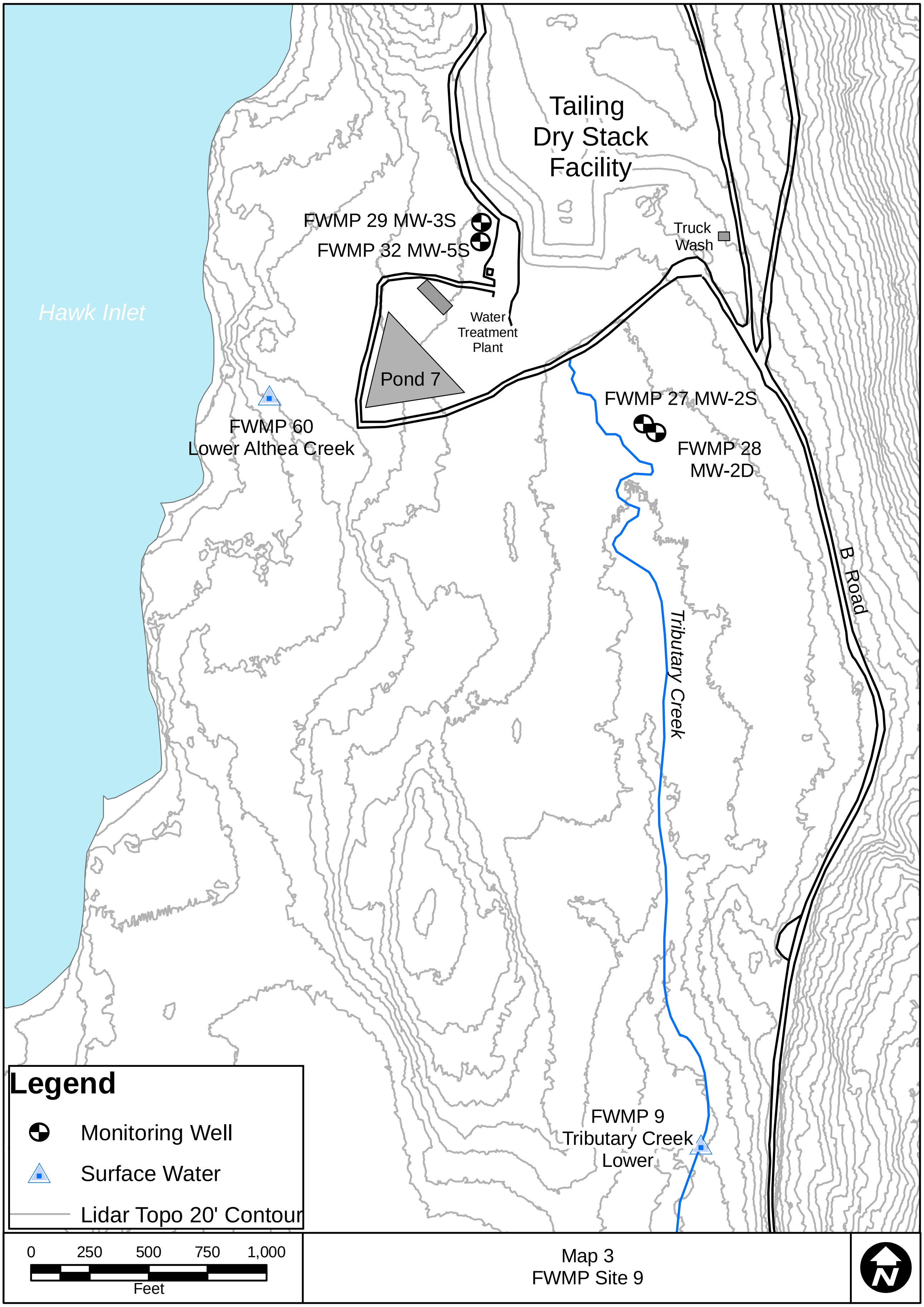


Map 1
FWMP Sample Sites in the 920 Area



0 400 800 1,200 1,600
Feet

Map 2
FWMP Sample Sites in Tailings Area



Map 3
FWMP Site 9