HECLA GREENS CREEK MINING COMPANY

FRESH WATER MONITORING PROGRAM ANNUAL REPORT

WATER YEAR 2011

(October 1, 2010 through September 30, 2011)

Greens Creek -13 July 2011

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

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 ten 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.

During water year 2011, sampling of the two new wells (MW-T-10-08A and MW-T-10-08B) at the tailings facility began with the July 2011 sampling event. Also, this was the first full year of sampling under the newly approved FWMP sampling schedule. All required sampling was accomplished as specified in the monitoring schedule and for each site the specified analytic suite (P or Q) was performed on the collected samples. Applicable holding times were achieved for all analytes, except pH, which for one of the twelve sample events was not within the applicable hold time. Furthermore, no data points were qualified as outliers.

Two exceedances of Alaska Water Quality Standards (AWQS) occurred in the 920 Area at Site 13 for total sulfate with values of 256 mg/L and 317 mg/L. These values were slightly above the AWQS limit of 250 mg/L, and comparable to data seen in previous water years. Though HGCMC removed 13,500 cubic yards of waste rock from the 1350 area during the summer of 2011 the removal activities have not yet occurred in the drainage for Site 13. It is HGCMC's intention to remove the remaining material during the 2012 summer season.

Last water year (2010) there were a number of exceedances along Greens Creek at Site 48, Site 6, and Site 54 for low pH values; however, this water year (2011) the pH values have increased at all of the above sites. It was also discussed last year that there is usually a discrepancy between the field pH and laboratory pH for many of the sites. This subject was discussed at the 2011 Annual Meeting and it was suggested that HGCMC use the field pH to meet the required holding times and for calculation purposes. Though both the laboratory and field data are reported and graphed, this report marks the first time that the statistical analyses are based on the field data.

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. Six exceedances for dissolved lead occurred at two of the three down gradient shallow wells (sites 29 and 32). These exceedances continue the recent history of low to moderate levels of lead that may in part be due to minor amounts of tailings escaping the facility due to fugitive dust or tracking. 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). The first sampling (November 2011) of this site during the current water year (2012) had a measured value of 0.0137 µg/L.

The final tailings area site, Site 9, had exceedances for low alkalinity and low pH. 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.

Graphical and non-parametric analyses for trends in the data were performed for all sites monitored. Statistically significant trends were identified for nine sites: Site 48, downward trend in pH, and upward trends in dissolved zinc and total sulfate; Site 6, downward trend in pH, and upward trends in dissolved zinc and total sulfate; Site 54, a downward trend in pH and upward trends in dissolved zinc and total sulfate; Site 49, downward trend in pH and an upward trend in dissolved zinc; Site 46, a downward trend in pH and an upward trend in dissolved zinc; Site 57, downward trend in total alkalinity; Site 27, an upward trend in total sulfate; Site 58, an upward trend in dissolved zinc; Site 57, a downward trend in total alkalinity; Site 60, a downward trend in total alkalinity and an upward trend in dissolved zinc; and Site 28, downward trend in pH.

Site 48, Site 49, Site 57, and Site 58 are considered upgradient control sites and thus the trends are likely due to natural variation. The decreasing trend in pH for Site 6 is not expected to be caused by our activities in the area. Site 54 is downstream from Site 6 and thus is expected to exhibit similar trends. Both the down gradient sites (6 and 54) had similar seasonal fluctuations in pH values as the upgradient site 48. Also, all three Greens Creek sites show a similar low magnitude increasing trend in dissolved zinc and total sulfate. The magnitude of the dissolved zinc trend for Site 46 is low. The increasing sulfate values measured at Site 27 is low in magnitude. The decreasing trends in total alkalinity and total sulfate 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. The Bruin Creek sites (49 and 46) had no significant differences in median values of the analytes. 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.

INTRODUCTION

This annual report for Water Year 2011 (October 1, 2010 through September 30, 2011) 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 a request for modification was made with the 2008 FWMP report. These modifications were approved and implemented during January and February of the Water Year 2010. 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. Copies of the Water Year 2011 sampling log are included on page 9 of this section and any variations from scheduled sampling events are noted on each site's table of results presented in the interpretive section.

Two new sites 1185 and 1186 were added to the sampling schedule for water year 2011 to serve as the potentially new background sites at the tailings facility because the existing upgradient wells (sites 59 and 58) are now no longer upgradient of all activity.

The adjacent table outlines the requested Statistical Information Goals (SIGs) for each site sampled during the Water Year 2011. 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

Site	Description	AWQS Comparison	Trend Visual	Trend Calc	Calculate Median	Median Comparison
48	Upper GC	x	x	+	x	
6	Middle GC	x	x	+	x	48 vs 6
54	Low er GC	x	x	+	x	6 vs 54
49	Upper Bruin Crk	x	x	+	x	
46	Low er Bruin Crk	x	x	+	x	49 vs 46
13	1350 Audit	x	x	+	x	
57	MW-23-00-03	x	x	+	x	
56	MW-D-00-01	x	x	+	x	57 vs 56
58	MW-T-00-01C	x	x	+	x	
27	MW-2S	x	x	+	x	**
29	MW-3S	x	x	+	x	**
32	MW-5S	x	x	+	x	**
59	MW-T-00-1A	x	x	+	x	
28	MW-2D	x	x	+	x	**
9	Tributary Crk	x				**
60	Althea crk Low er	x				**
1185	MW-T-10-08A	x	x			
1185	MW-T-10-08B	x	x			

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 calculation is shown in the annual table of results for each site. Finally, for all down gradient sites that are paired with an upgradient reference site, which are monitored with a frequency greater than 4 times per year, a comparison of medians is presented for each specific site. These down gradient sites (upgradient site in parenthesis) include Site 6 (Site 48), Site 54 (Site 6), 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.

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 2011 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 2011. 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.

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

With the expansion of the tailings facility to the east of its current position, the two upgradient monitoring wells Site 58 and Site 59 are now within the new tailings boundary. During the 2010 summer drill program two new upgradient wells (MW-T-10-08A, MW-T-10-08B) were installed approximately 400 feet upslope and to the north. HGCMC developed these wells during the fall of 2010 and the spring 2011 and subsequently sampled them in September and November of 2011. The results from this monitoring are included in this FWMP report for the first time.

FWMP SAMPLE LOG

Water Year October 2010 Through September 2011
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	10-12 P	11-02 P	12-14 Q	01-18 P	02-17 Q	03-15 P	04-12 P	05-18 P	06-13 P	07-12 P	08-10 P	09-13 P
9	Tributary Creek-Low er		11-09 Q						05-19 Q		07-12 Q		09-12 Q
13	Mine Adit Discharge East		11-02 Q						05-18 Q			08-10 Q	
27	Monitoring Well 2S		11-09 Q						05-19 Q		07-12 Q		09-12 Q
28	Monitoring Well 2D		11-09 Q						05-19 Q		07-12 Q		09-12 Q
29	Monitoring Well 3S		11-09 Q						05-19 Q		07-12 Q		09-12 Q
32	Monitoring Well 5S		11-09 Q						05-19 Q		07-12 Q		09-12 Q
46	Low er Bruin Creek		11-02 Q			02-17 Q			05-18 P			08-10 P	
48	Upper Greens Creek	10-12 P	11-02 P	12-14 Q	01-18 P	02-17 Q	03-15 P	04-12 P	05-18 P	06-13 P	07-12 P	08-10 P	09-13 P
49	Control Site Upper Bruin Creek		11-02 P			02-17 Q			05-18 P			08-10 P	
54	Greens Creek below D-Pond	10-12 P	11-02 P	12-14 Q	01-18 P	02-17 Q	03-15 P	04-12 P	05-18 P	06-13 P	07-12 P	08-10 P	09-13 P
56	Monitoring Well-D-00-01		11-02 Q						05-18 Q			08-10 Q	
57	Monitoring Well-23-00-03		11-02 Q						05-18 Q			08-10 Q	
58	Monitoring Well-T-00-01C		11-09 Q						05-19		07-12 Q		09-12 Q
59	Monitoring Well-T-00-01A		11-09 Q						05-19 Q		07-12 Q		09-12 Q
60	Althea Creek Low er		11-09 Q						05-19 Q		07-12 Q		09-12 Q
1185	Monitoring Well-T-01-08A										07-12 Q		09-12 Q
1186	Monitoring Well-T-01-08B										07-12 Q		09-12 Q
	Field Blank @ Site	54	46	6	48	49	54	6	60	48	59	57	9

Date Suite	Regular monthly sample
Date Suite	No Sample taken due to ice
Date Suite	Wrong Suite sampled
Date Suite	No Sample taken due to lack of access (snow).
Date Suite	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

Pete Schneider

Sarah Samuelson

Dave Barto

Joe Manning

Biomonitoring (Fish and Game)
James Durst

Laura Jacobs

Jackie Timothy
Ben Brewster
Kate Kanouse

Gordon Willson-Naranjo

HGCMC
Scott Hartman, General Manager
HGCMC

Jennifer Saran, Environmental Manager
HGCMC

Robin Jung, Environmental Technician
HGCMC
Ted Morales, Environmental Technician
HGCMC
Pete Condon, Petros GeoConsulting, Geochemist
Christopher Wallace, Environmental Engineer
HGCMC
Sheri Williamson, Environmental Engineer
HGCMC
Mitch Brooks, Environmental Engineer
HGCMC

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

PROPOSED PROGRAM MODIFICATIONS

HGCMC proposes no modifications to the Fresh Water Monitoring Program.

BIBLIOGRAPHY

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

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

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

INTERPRETIVE REPORT
SITE 48 “UPPER GREENS CREEK”

The data collected during the current water year are listed in the following “Table of Results for Water Year 2011” 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 2011 have been compared to the strictest fresh water quality criterion for each applicable analyte. No results exceeding these criteria have been identified (see table below).

Table of Exceedance for Water Year 2011

Site 048FMS - 'Greens Creek Upper'					
			Limits		
Sample Date	Parameter	Value	Lower	Upper	Hardness
No exceedances have been identified by HGCMC for the period of October 2010 through September 2011.					

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. In last year’s report it was noted that dissolved chromium increased an order of magnitude during water year 2010. During water year 2011 dissolved chromium decreased from a high of 1.99 µg/L (December 2010) to a low of 0.236 µg/L (June 2011). This June 2011 value is within historical measurements for this site.

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-05 and Sep-11 (WY2006-WY2011).

Table of Summary Statistics for Trend Analysis

Site 048FMS - 'Greens Creek Upper'					
	Mann-Kendall test statistics			Sen's slope estimate	
Parameter	**n***	**p****	**Trend**	**Q**	**Q(%)**
Conductivity Field	6	0.09			
pH Field	6	<0.01	-	-0.1	-1.299
Alkalinity, Total	6	0.39			
Sulfate, Total	6	<0.01	+	0.60	4.63
Zinc, Dissolved	6	<0.01	+	0.2	6.838

* 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 (2011), total sulfate has a slope estimate of 0.60 µg/L/yr, dissolved zinc showed an increasing trend with a slope estimate 0.2 µg/L/yr, and field pH was negatively trending with a slope estimate of -0.1 su/yr. 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 2011

Site 048GMS - 'Upper Greens Creek'

Sample Date/Parameter	Oct 2010	Nov 2010	Dec 2010	Jan 2011	Feb 2011	Mar 2011	Apr 2011	May 2011	Jun 2011	Jul 2011	Aug 2011	Sep 2011	**Median**
Water Temp (°C)	4.7	3.9	0.01	0.06	0.01	0.43	1.8	2.75	5.12	6.44	8.08	8.06	3.33
Conductivity-Field(μmho)	61.2	76.9	152	157	139	165	72.6	89.6	94	94	119	108	101.0
Conductivity-Lab (μmho)	65	74	147	156	142	167	158	94	84	98	122	130	126
pH Lab (standard units)	6.48	6.94	6.92	7.64	7.65	7.63	7.8	7.58	7.62	7.22	7.72	7.8	7.63
pH Field (standard units)	6.52	7.62	7.83	7.27	6.9	7.66	7.82	7.95	7.5	6.9	8.06	7.85	7.64
Total Alkalinity (mg/L)	21.6	24	47.2	52.8	46.4	50	51.4	33.7	32.5	38.2	43.5	47.3	45.0
Total Sulfate (mg/L)	5.4	7.1	19.7	21	17.5	21.8	19.5	8.2	9.7	10.1	13.6	14.6	14.1
Hardness (mg/L)	30.1	37.4	73.1	75.7	66.7	78	71.6	42.5	42.9	48.1	56.9	63.7	60.3
Dissolved As (ug/L)	0.221	0.198	0.191	0.228	0.19	0.21	0.194	0.191	0.208	0.197	0.225	0.219	0.203
Dissolved Ba (ug/L)			30.9		28.7				26.8				28.7
Dissolved Cd (ug/L)	0.0376	0.0391	0.0421	0.0466	0.0372	0.0404	0.0403	0.0269	0.0322	0.029	0.0437	0.0378	0.0385
Dissolved Cr (ug/L)			1.99		1.01				0.236				1.010
Dissolved Cu (ug/L)	0.918	1.12	0.296	0.241	0.451	0.279	0.398	0.465	0.236	0.226	0.459	0.352	0.375
Dissolved Pb (ug/L)	0.0479	0.0271	0.003	0.0031	0.0073	0.0052	0.0015	0.0095	0.0048	0.0015	0.0075	0.0015	0.0050
Dissolved Ni (ug/L)			1.2		1.53				0.756				1.200
Dissolved Ag (ug/L)			0.004		0.002				0.002				0.002
Dissolved Zn (ug/L)	3.76	4.21	4.11	3.74	3.41	3.39	3.03	2.39	2.37	2.56	2.48	3.14	3.27
Dissolved Se (ug/L)			1.25		1.4				0.79				1.250
Dissolved Hg (ug/L)	0.00362	0.00304	0.000483	0.000442	0.000811	0.000593	0.000717	0.00103	0.000478	0.000408	0.000516	0.000777	0.000655

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

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

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

Qualified Data by QA Reviewer

Date Range: 10/01/2010 to 09/30/2011

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
48	10/12/2010	12:00 AM				
			pH Lab, su	6.48	R	Hold Time Violation
			SO4 Tot, mg/l	5.4	J	Sample Receipt Temperature
48	12/14/2010	12:00 AM				
			Hg diss, µg/l	0.000483	U	Field Blank Contamination
			Hg diss, µg/l	0.000483	U	Field Blank Contamination
48	1/18/2011	12:00 AM				
			pH Lab, su	7.64	J	Hold Time Violation
			Zn diss, µg/l	3.74	U	Field Blank Contamination
			Pb diss, µg/l	0.0031	U	Field Blank Contamination
			Hg diss, µg/l	0.000442	U	Field Blank Contamination
			SO4 Tot, mg/l	21	J	Sample Reciept Temperature
48	2/17/2011	12:00 AM				
			Pb diss, µg/l	0.00729	U	Field Blank Contamination
48	3/14/2011	12:00 AM				
			pH Lab, su	7.63	J	Hold Time Violation
			SO4 Tot, mg/l	21.8	J	Sample Reciept Temperature
			Pb diss, µg/l	0.00522	U	Field Blank Contamination
48	4/12/2011	12:00 AM				
			pH Lab, su	7.8	J	Hold Time Violation
			Hg diss, µg/l	0.000717	U	Field Blank Contamination
48	5/18/2011	12:00 AM				
			SO4 Tot, mg/l	8.2	J	Sample Reciept Temperature
			pH Lab, su	7.58	J	Hold Time Violation
			Cd diss, µg/l	0.0269	U	Trip Blank Contamination
			Pb diss, µg/l	0.00947	U	Field Blank Contamination
48	6/13/2011	12:00 AM				
			SO4 Tot, mg/l	9.7	J	Sample Reciept Temperature
			Pb diss, µg/l	0.00481	J	Below Quantitative Range
			Hg diss, µg/l	0.000478	U	Field Blank Contamination
48	7/12/2011	12:00 AM				
			SO4 Tot, mg/l	10.1	J	Sample Reciept Temperature
			Cu diss, µg/l	0.22	U	Field Blank Contamination
			Zn diss, µg/l	2.56	U	Field Blank Contamination
			Hg diss, µg/l	0.000408	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 Qu

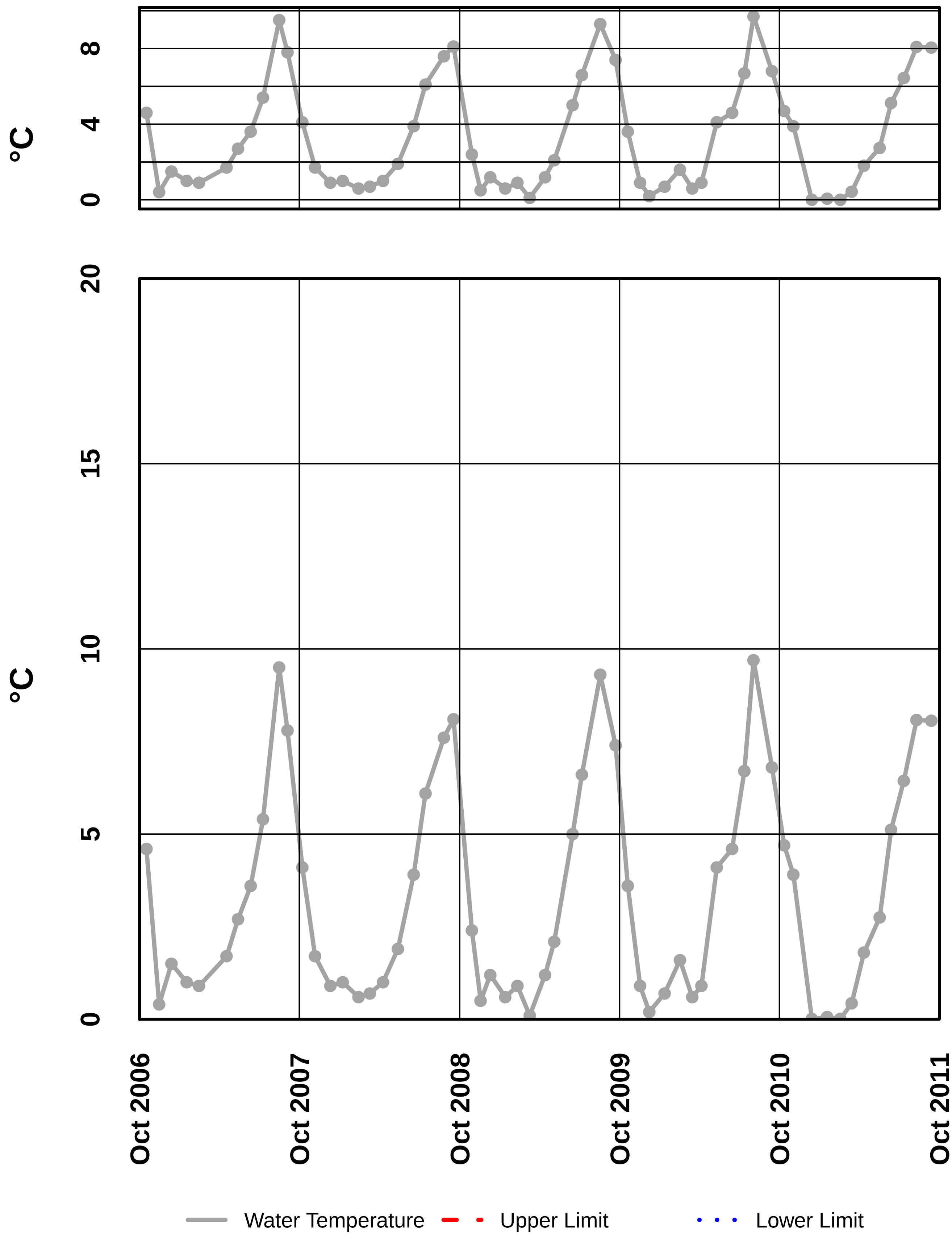
Qualified Data by QA Reviewer

Date Range: 10/01/2010 to 09/30/2011

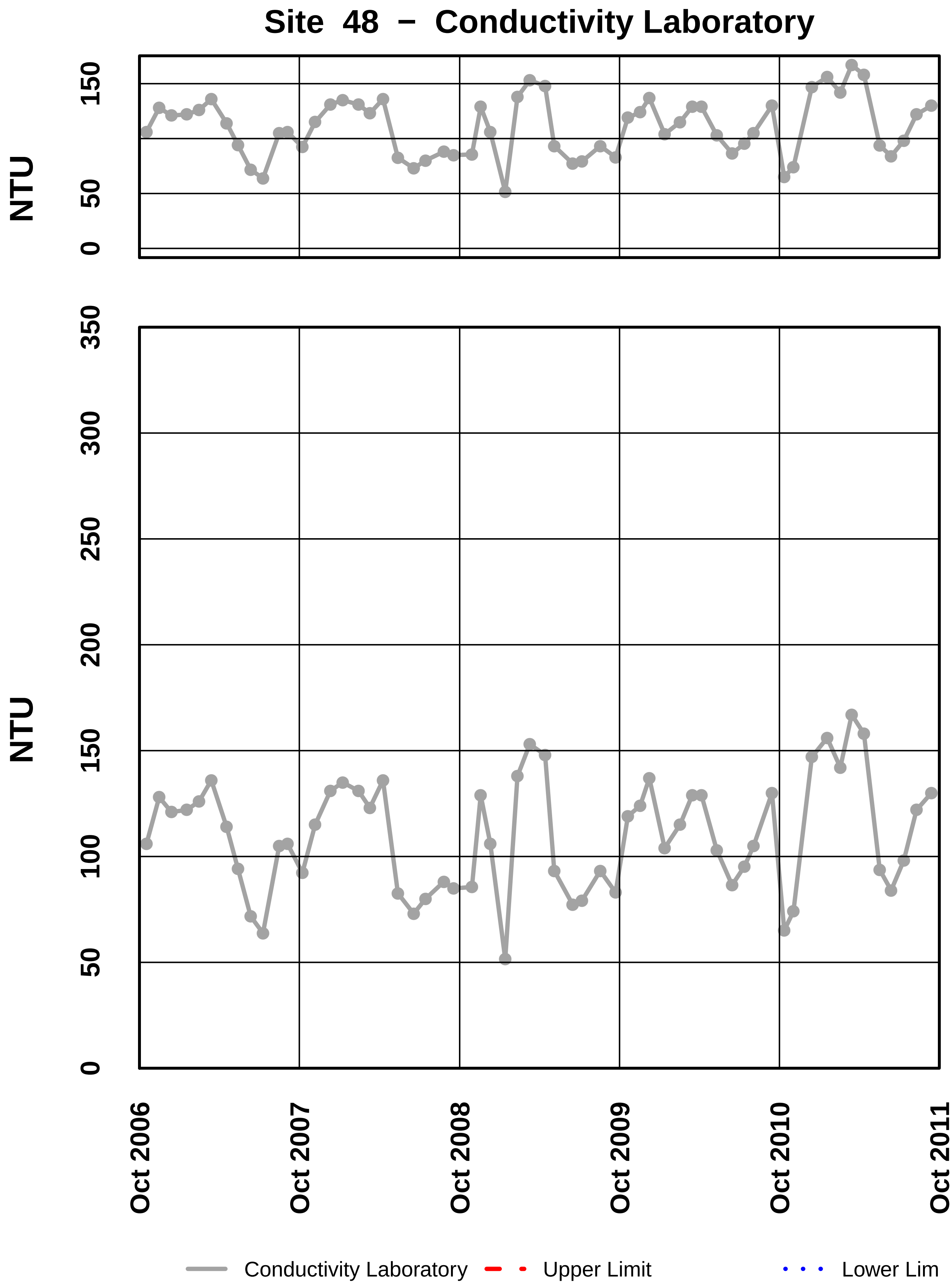
Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
48	8/10/2011	12:00 AM				
			Pb diss, µg/l	0.00753	J	Below Quantitative Range
			pH Lab, su	7.72	J	Hold Time Violation
			SO4 Tot, mg/l	13.6	J	Sample Receipt Temperature
			Hg diss, µg/l	0.000516	U	Field Blank Contamination
48	9/13/2011	12:00 AM				
			Hg diss, µg/l	0.000777	U	Field Blank Contamination

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

Site 48 – Water Temperature

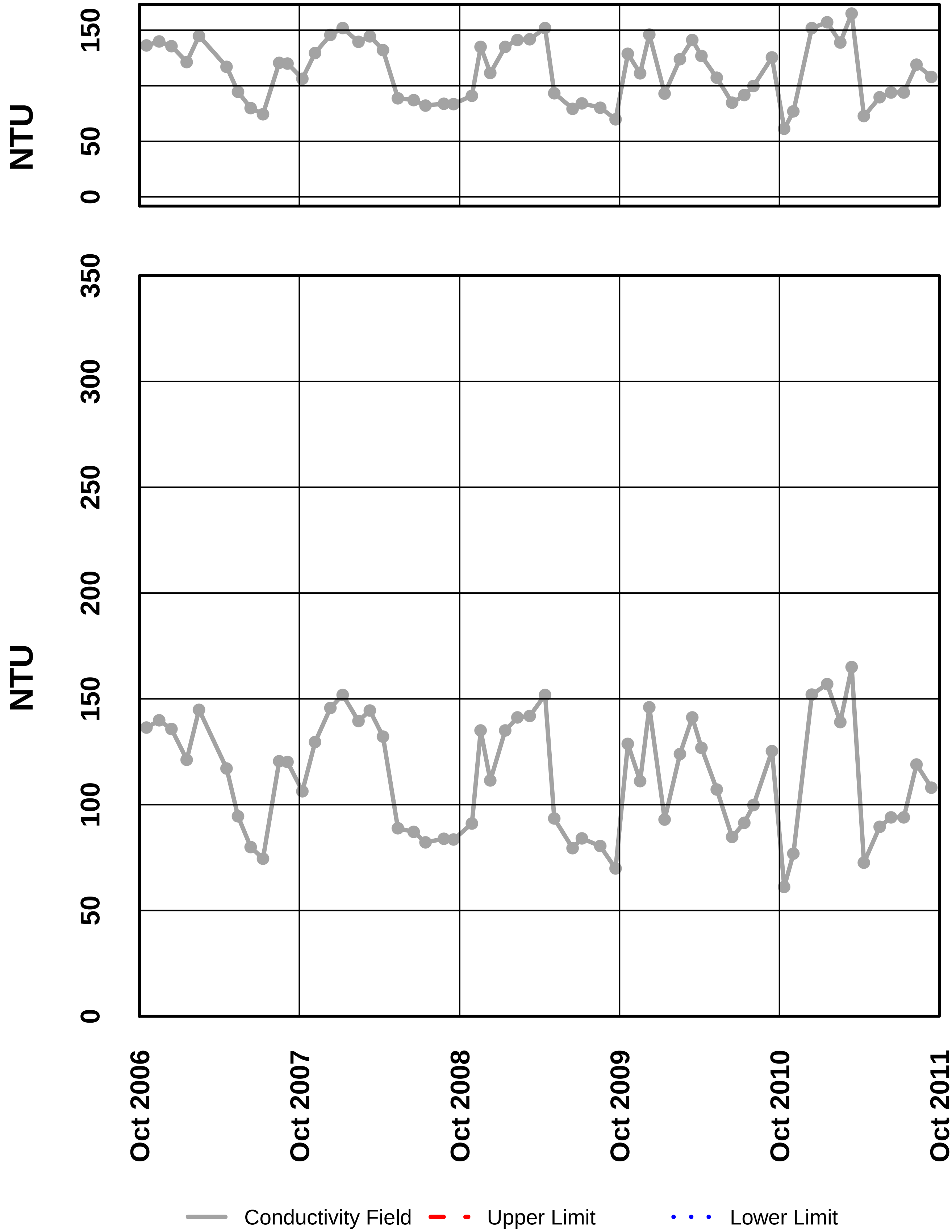


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

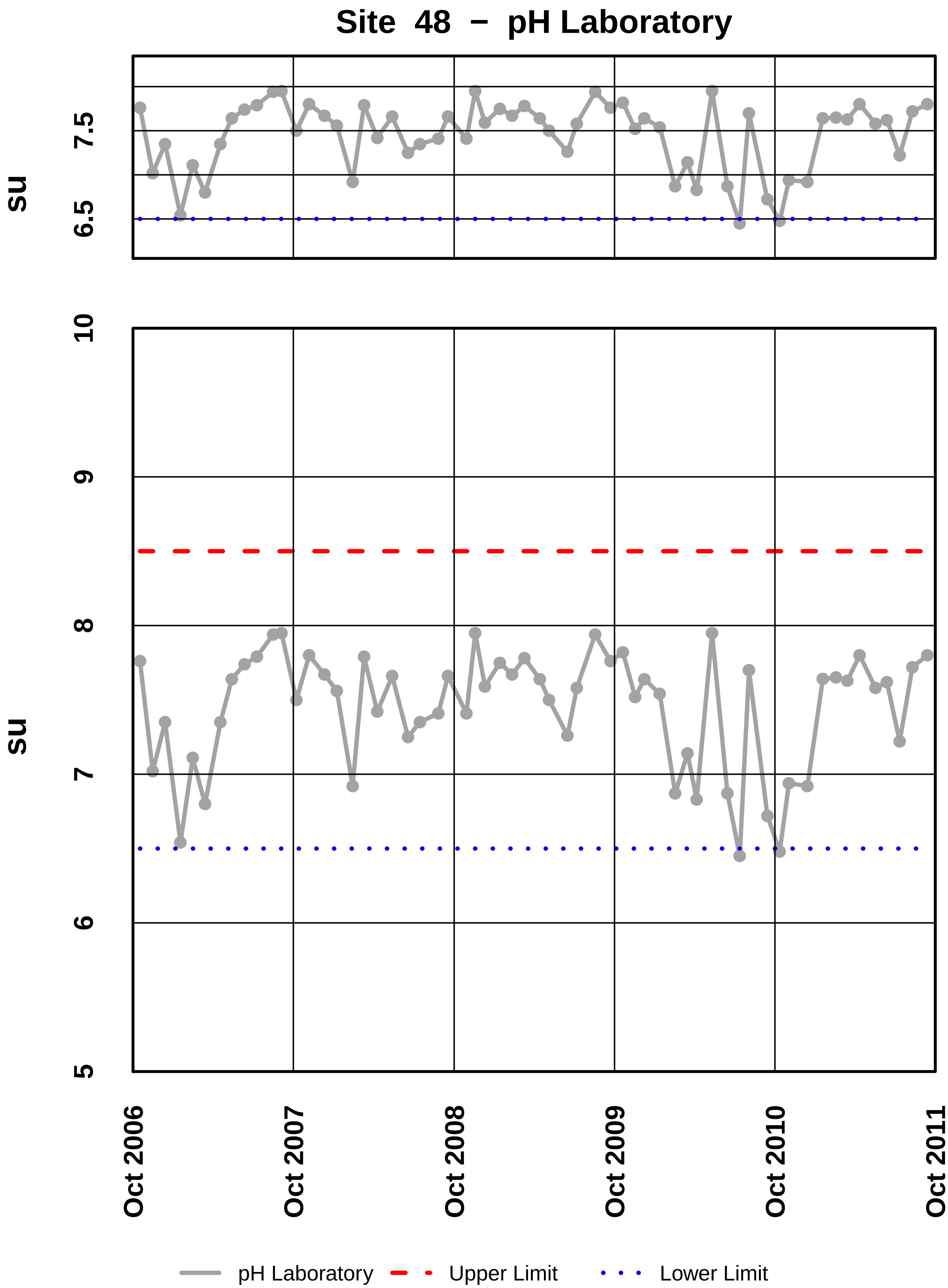


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

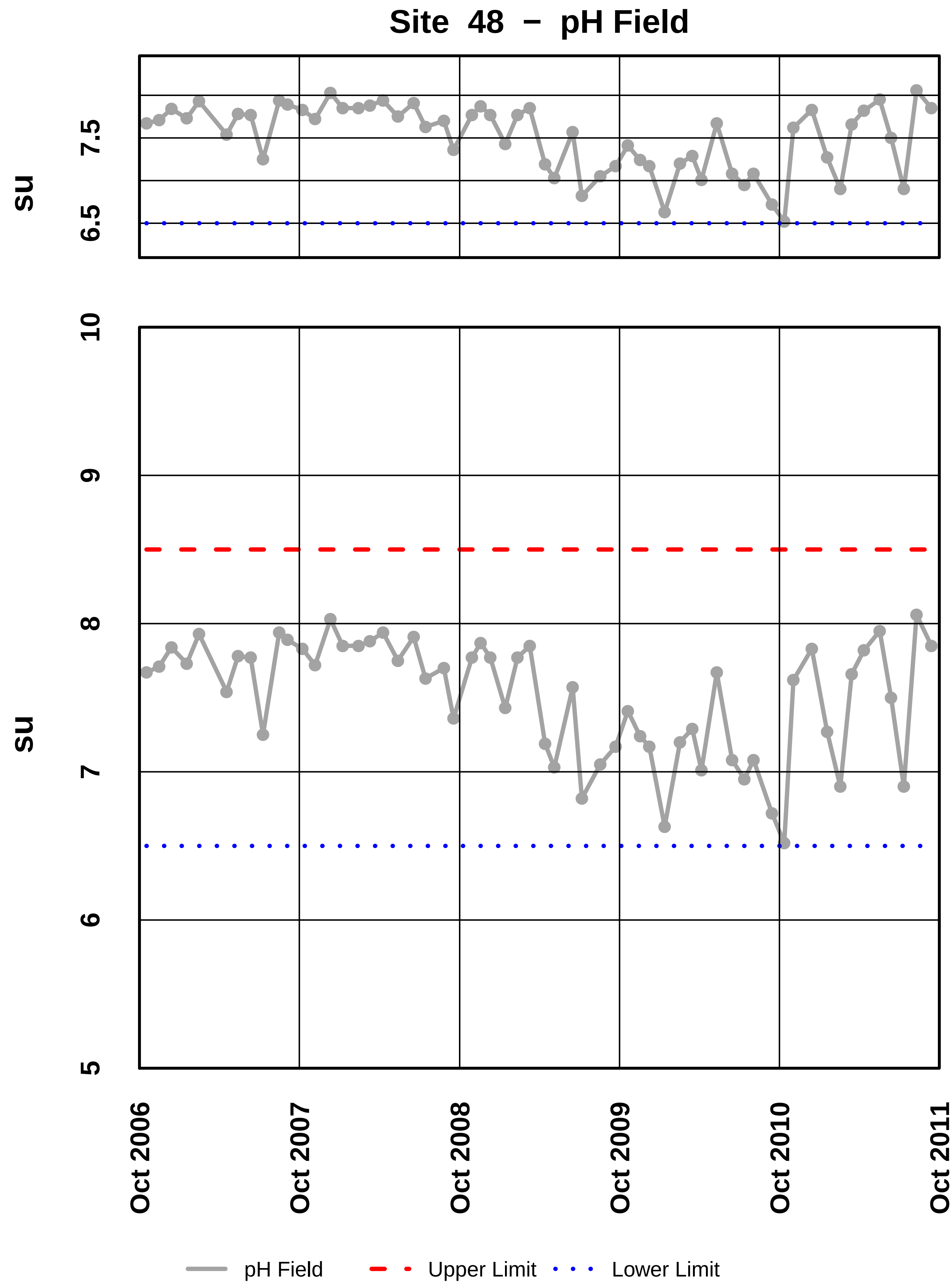
Site 48 – Conductivity Field



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

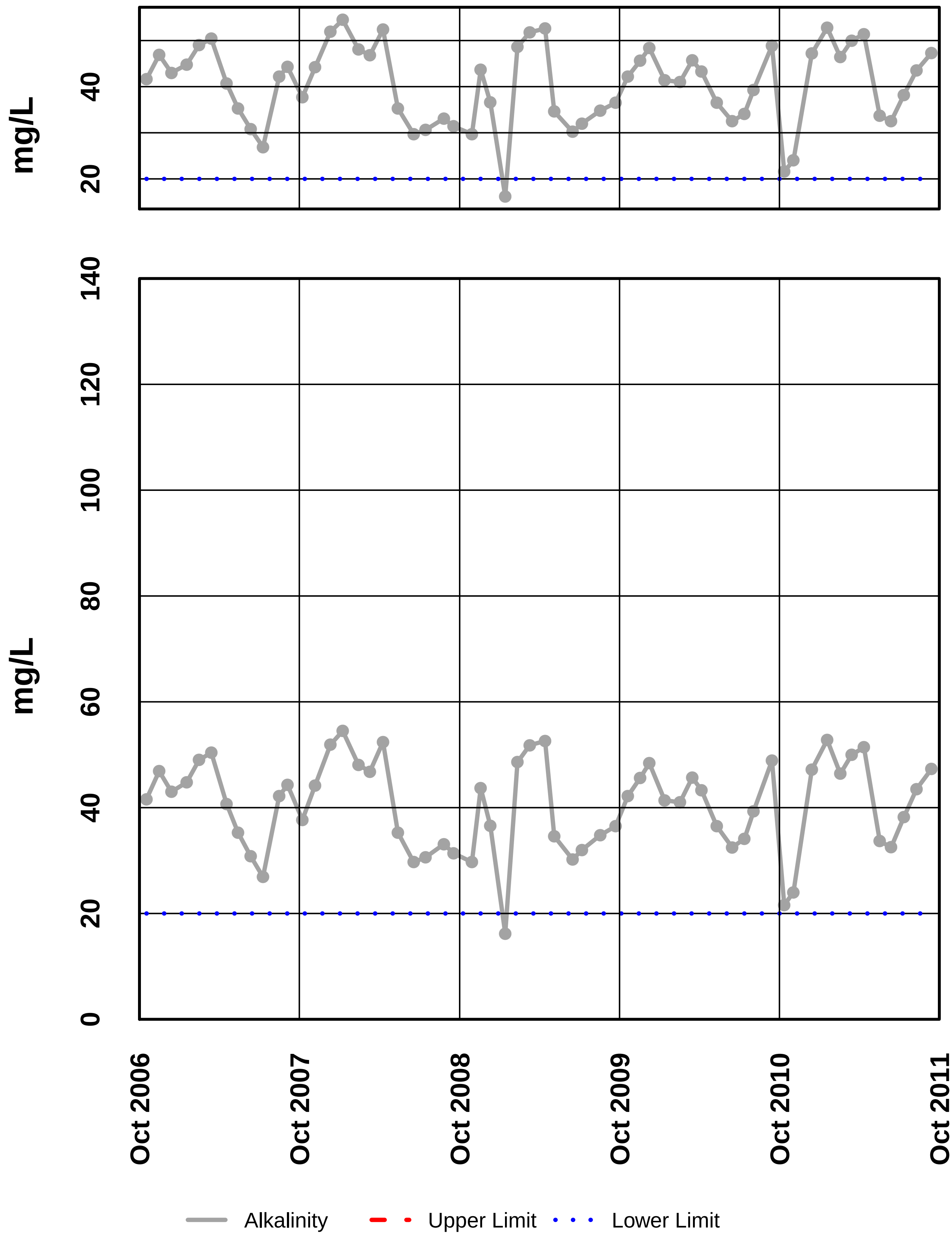


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

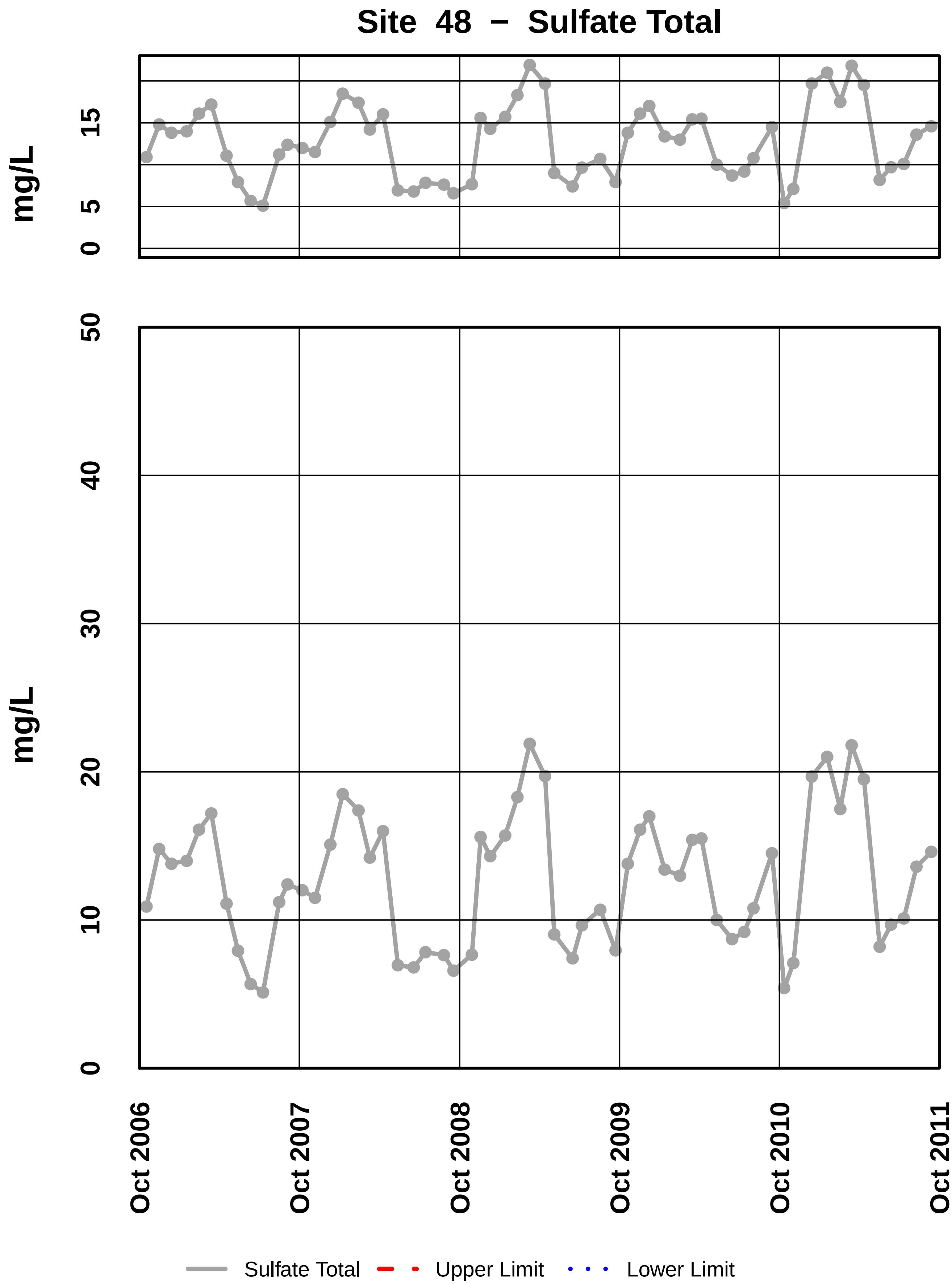


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

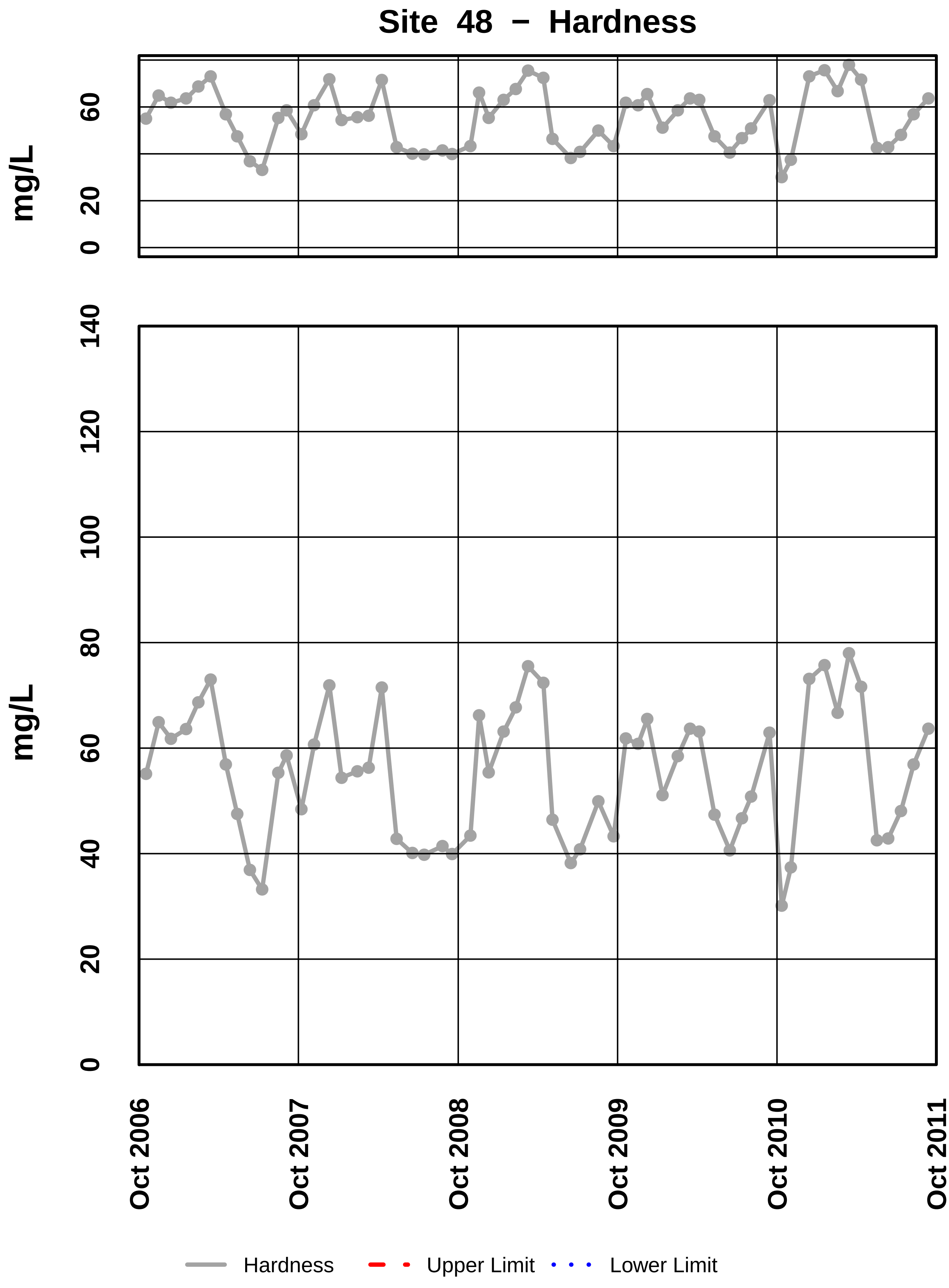
Site 48 – Alkalinity



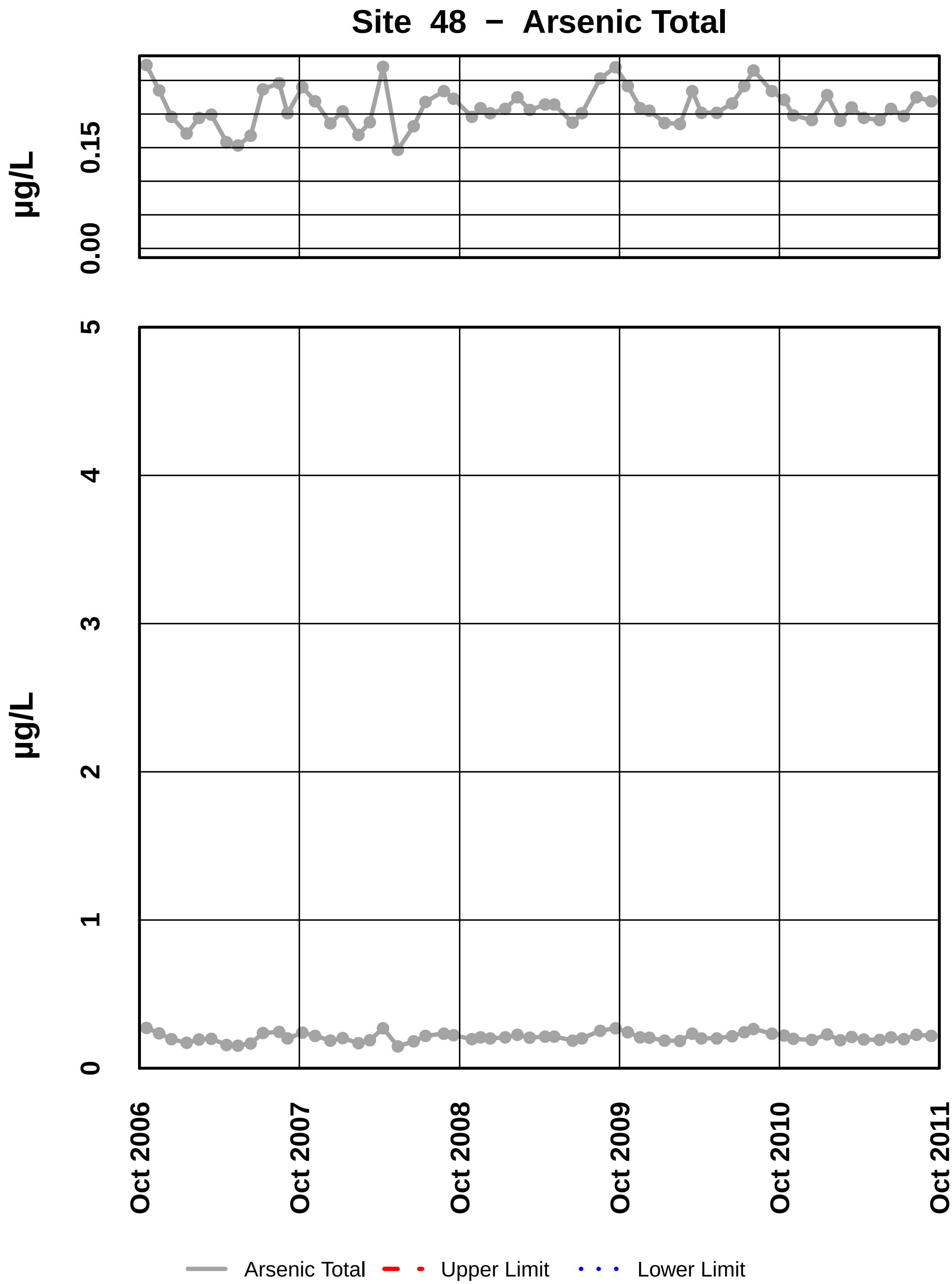
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

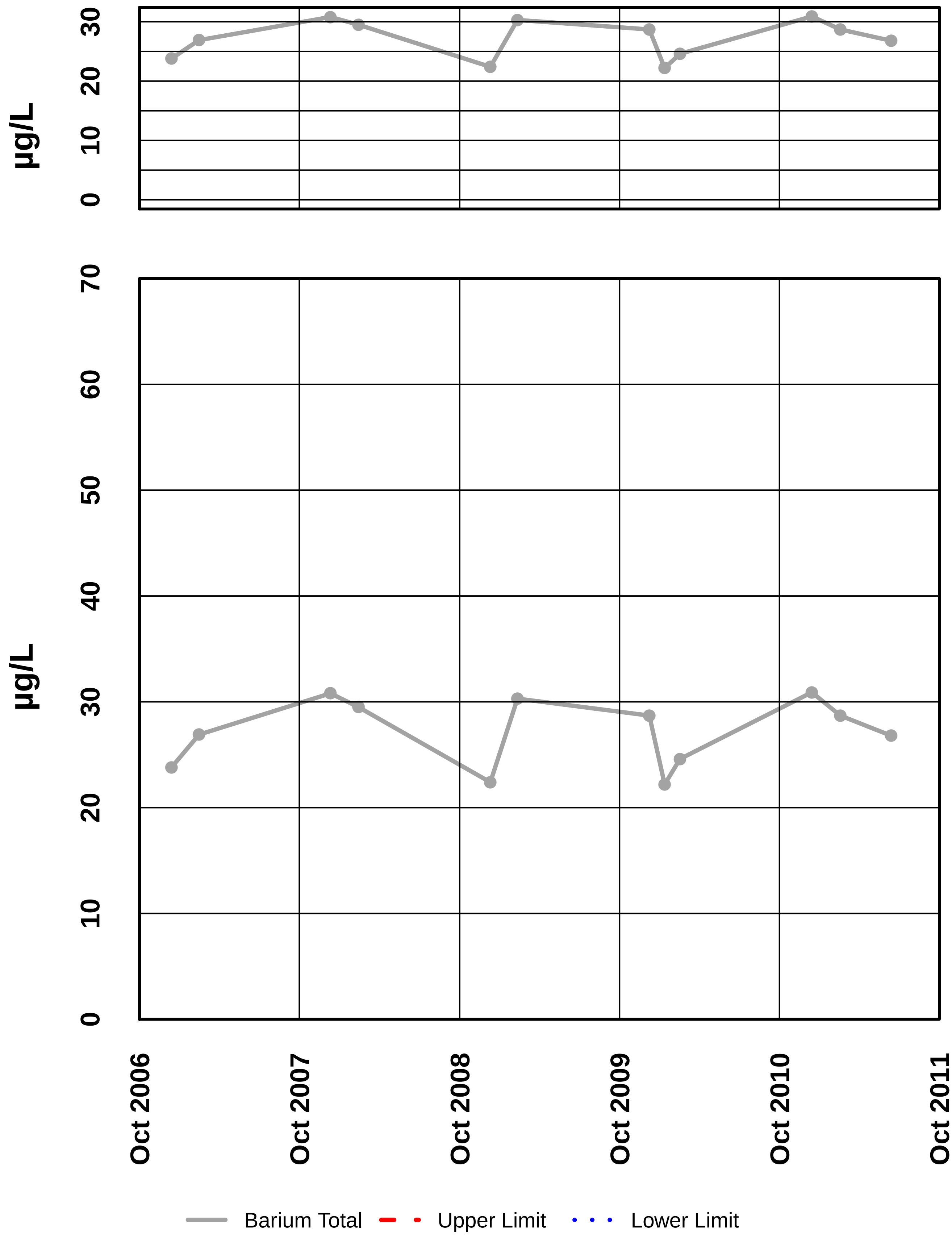


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



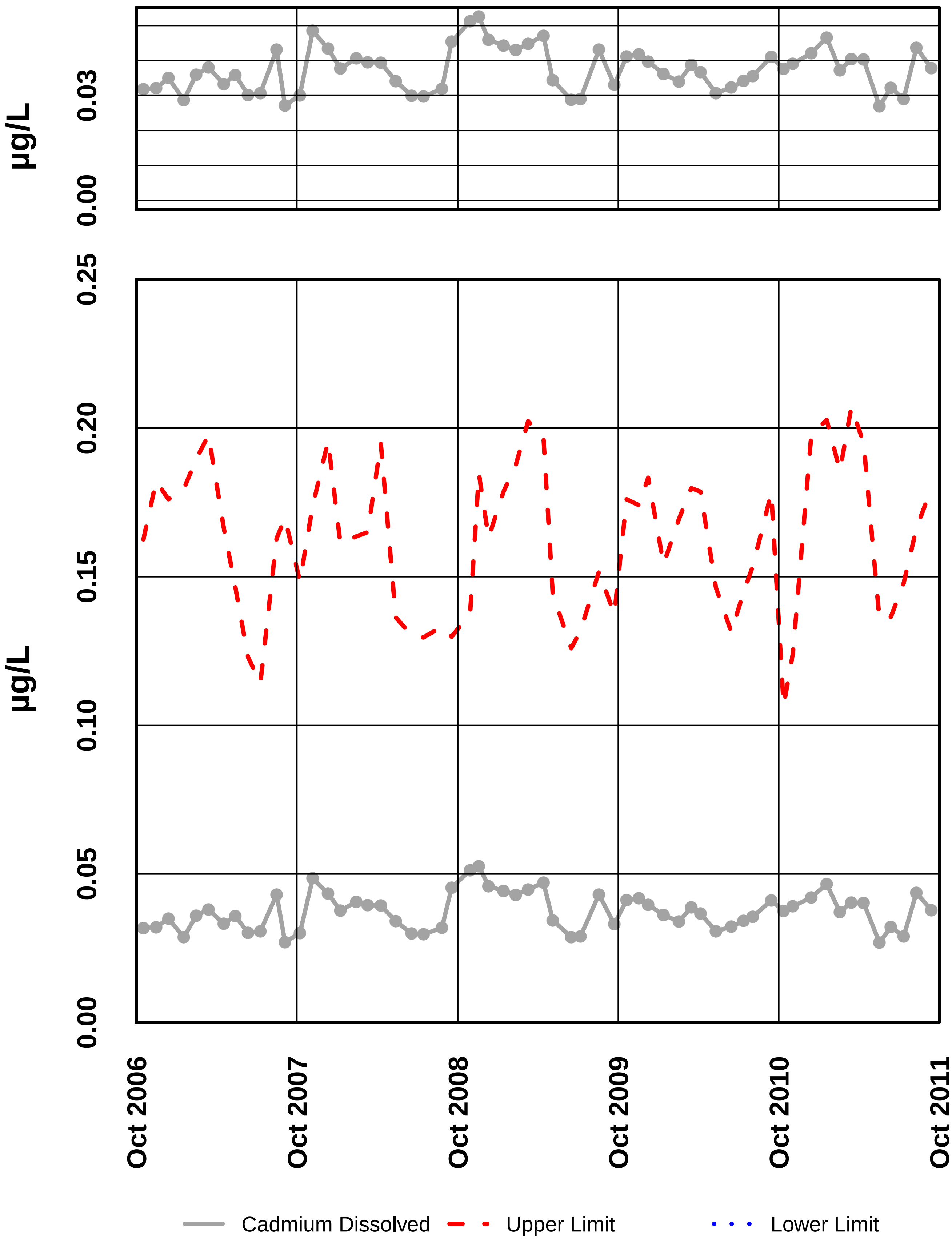
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 48 – Barium Total

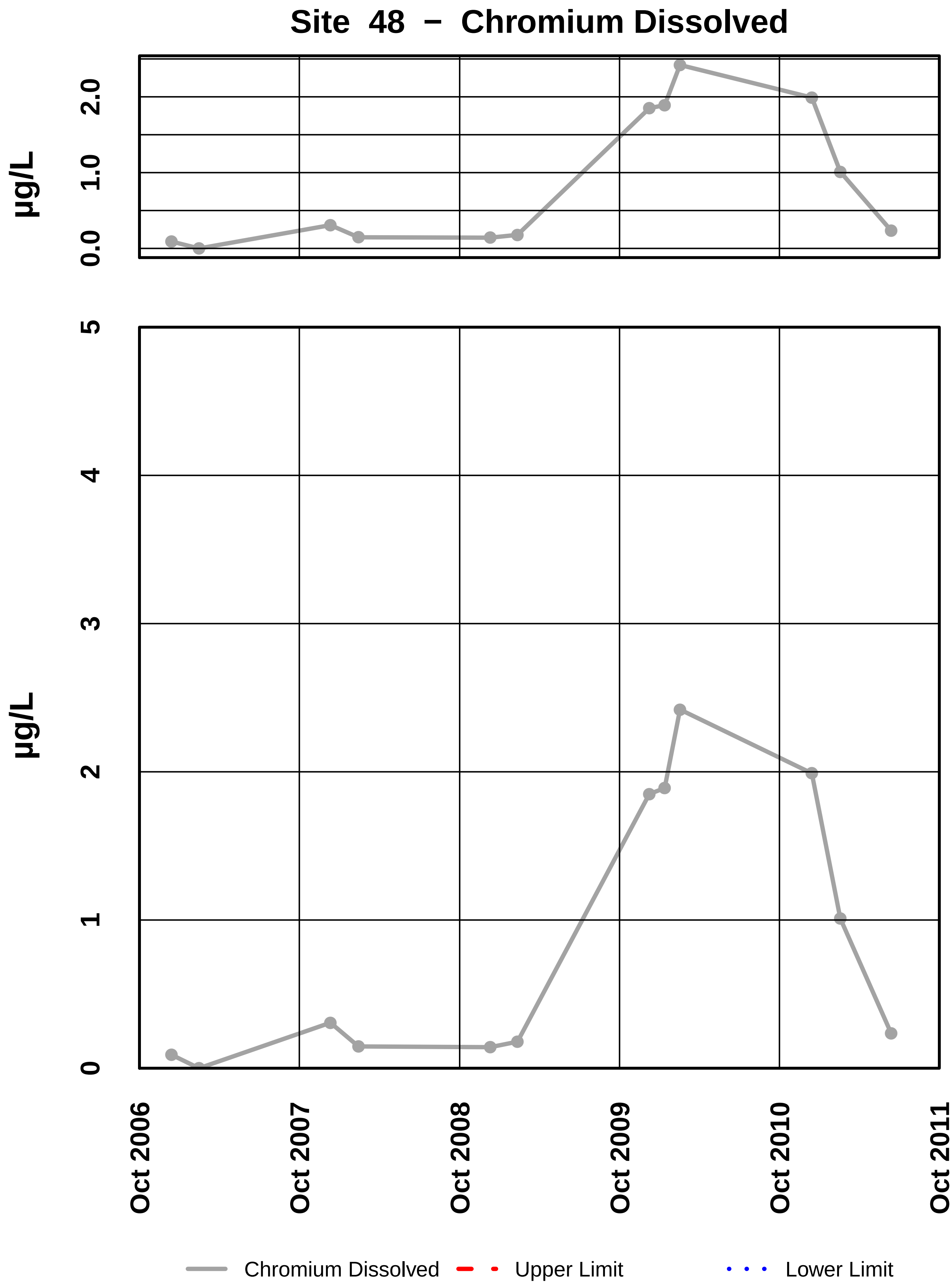


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 48 – Cadmium Dissolved

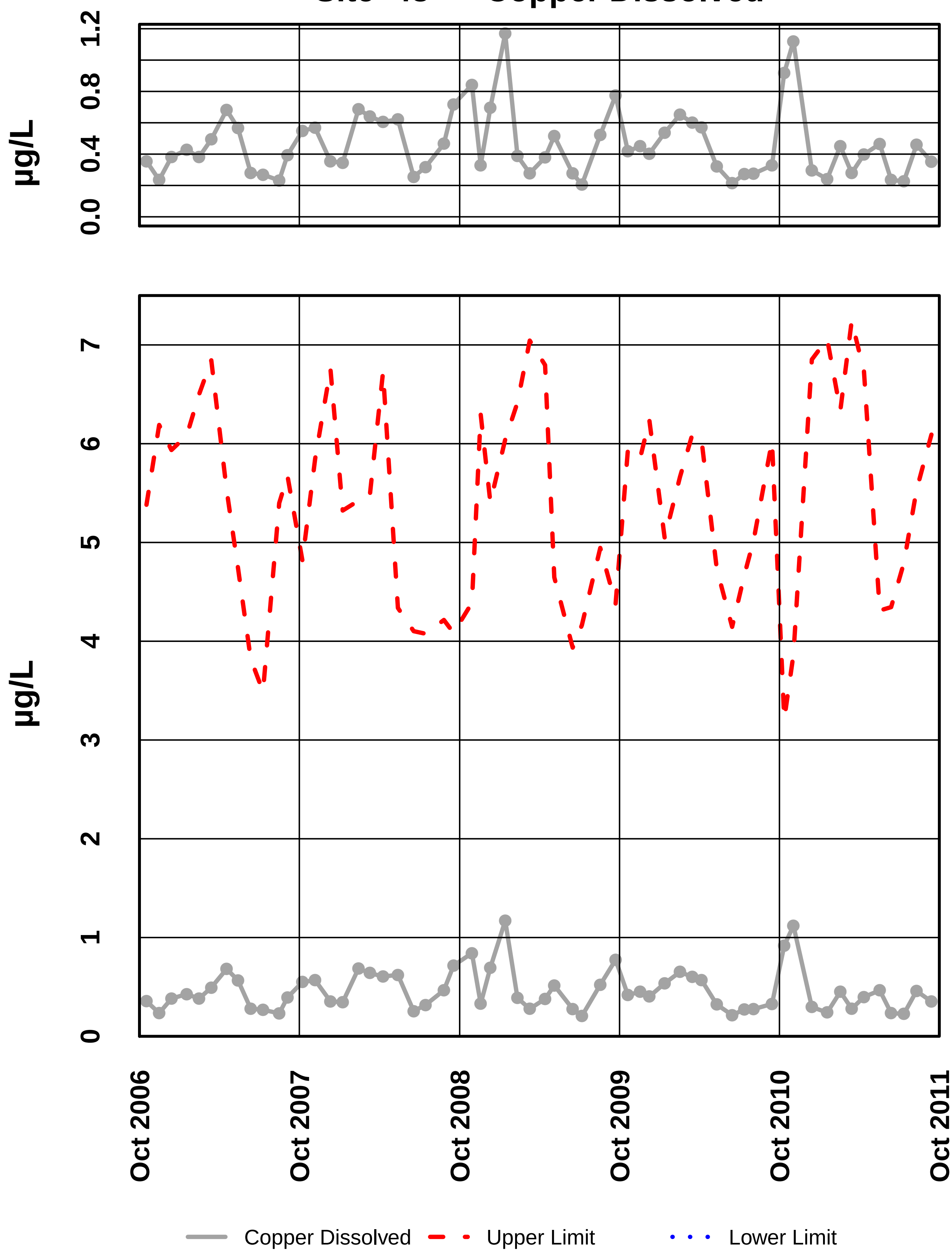


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

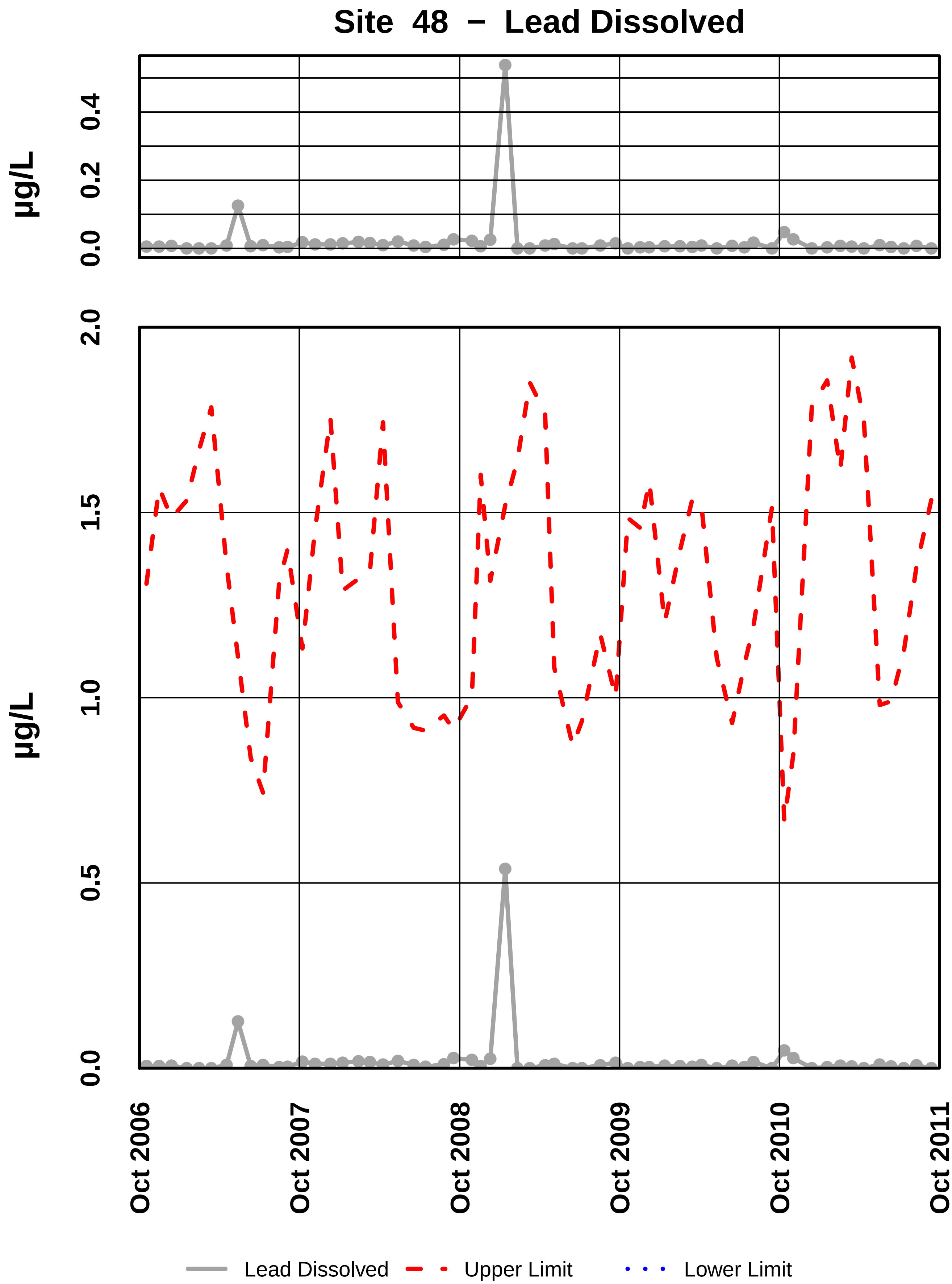


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

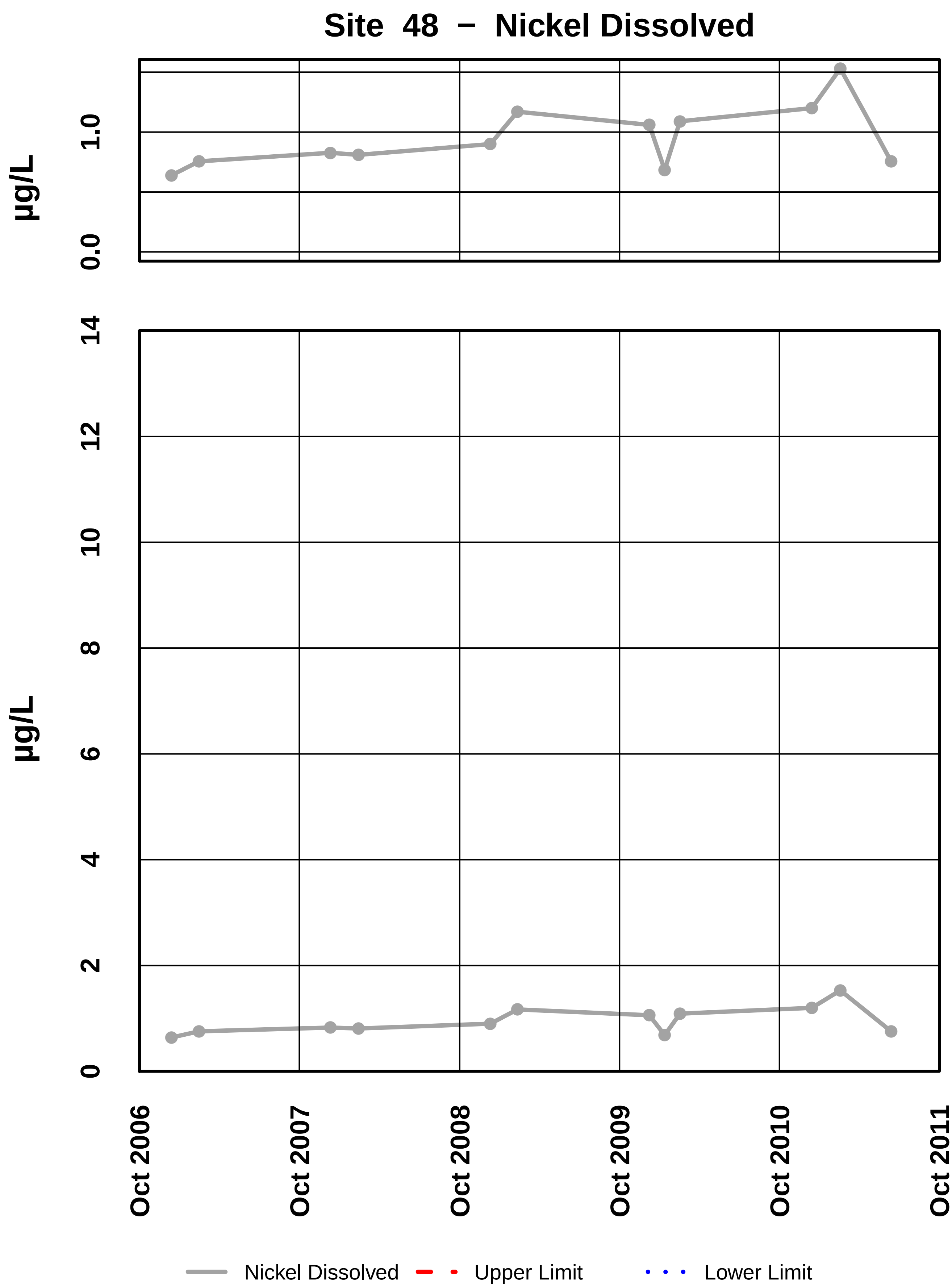
Site 48 − Copper Dissolved



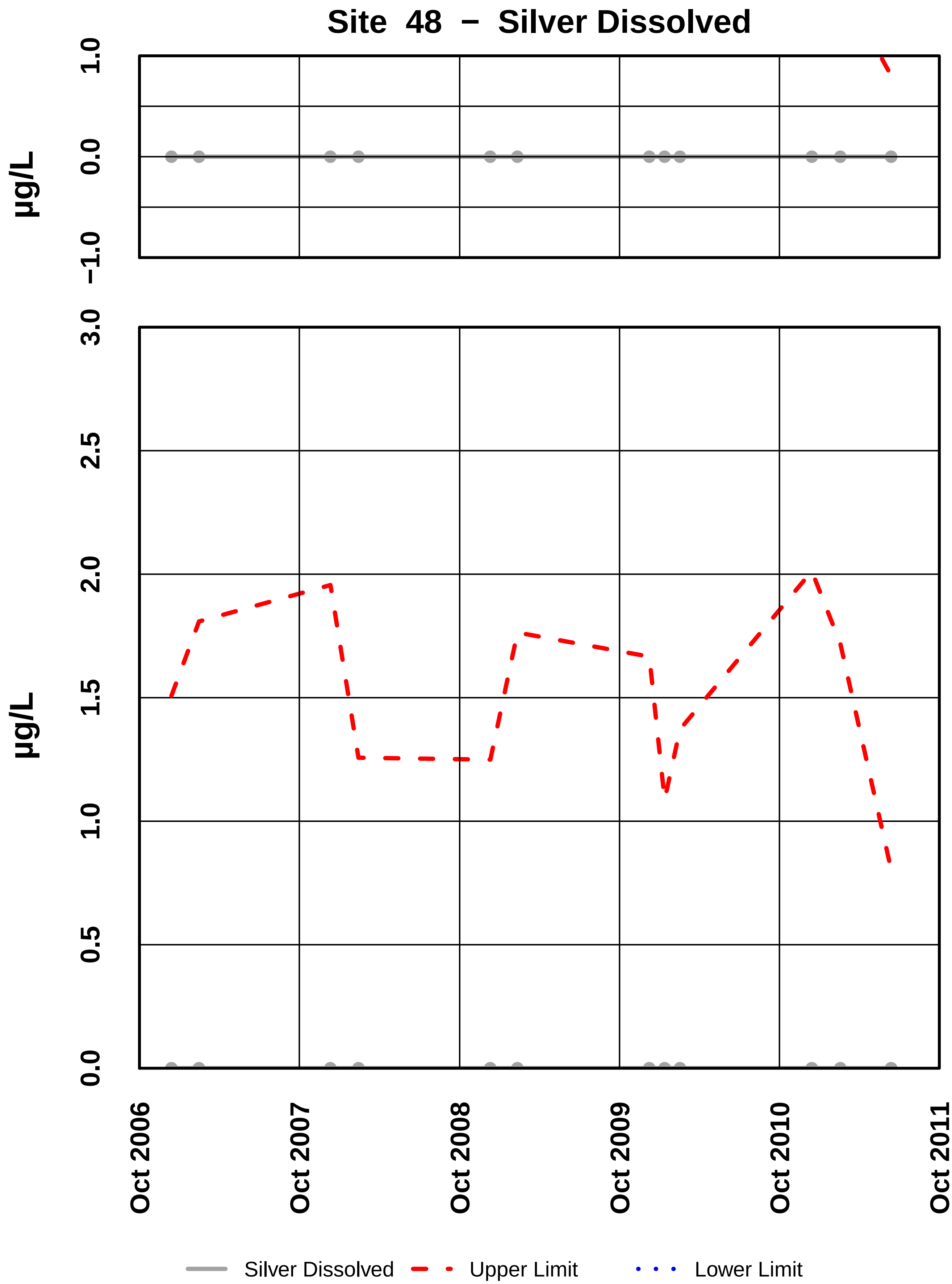
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



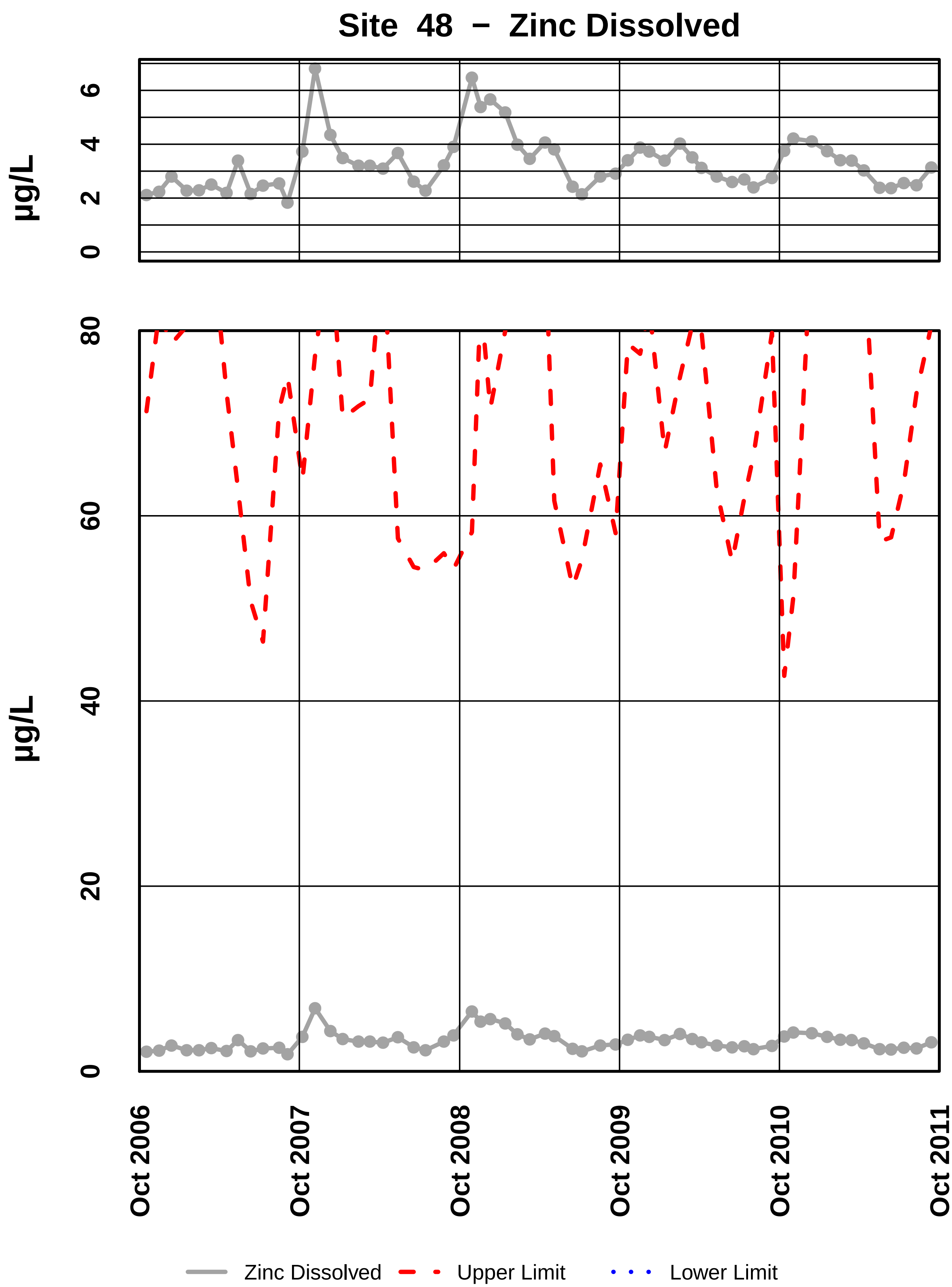
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



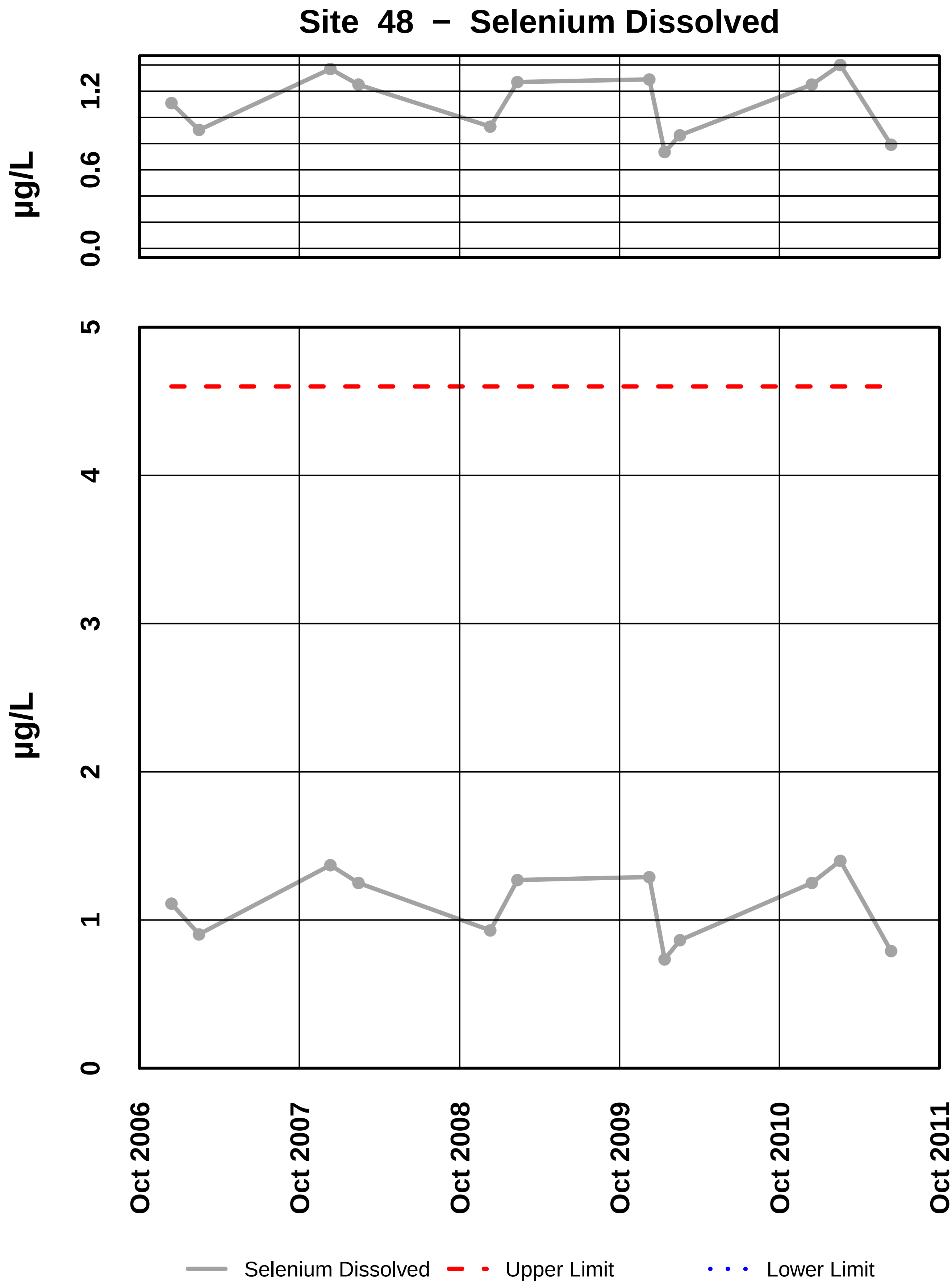
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

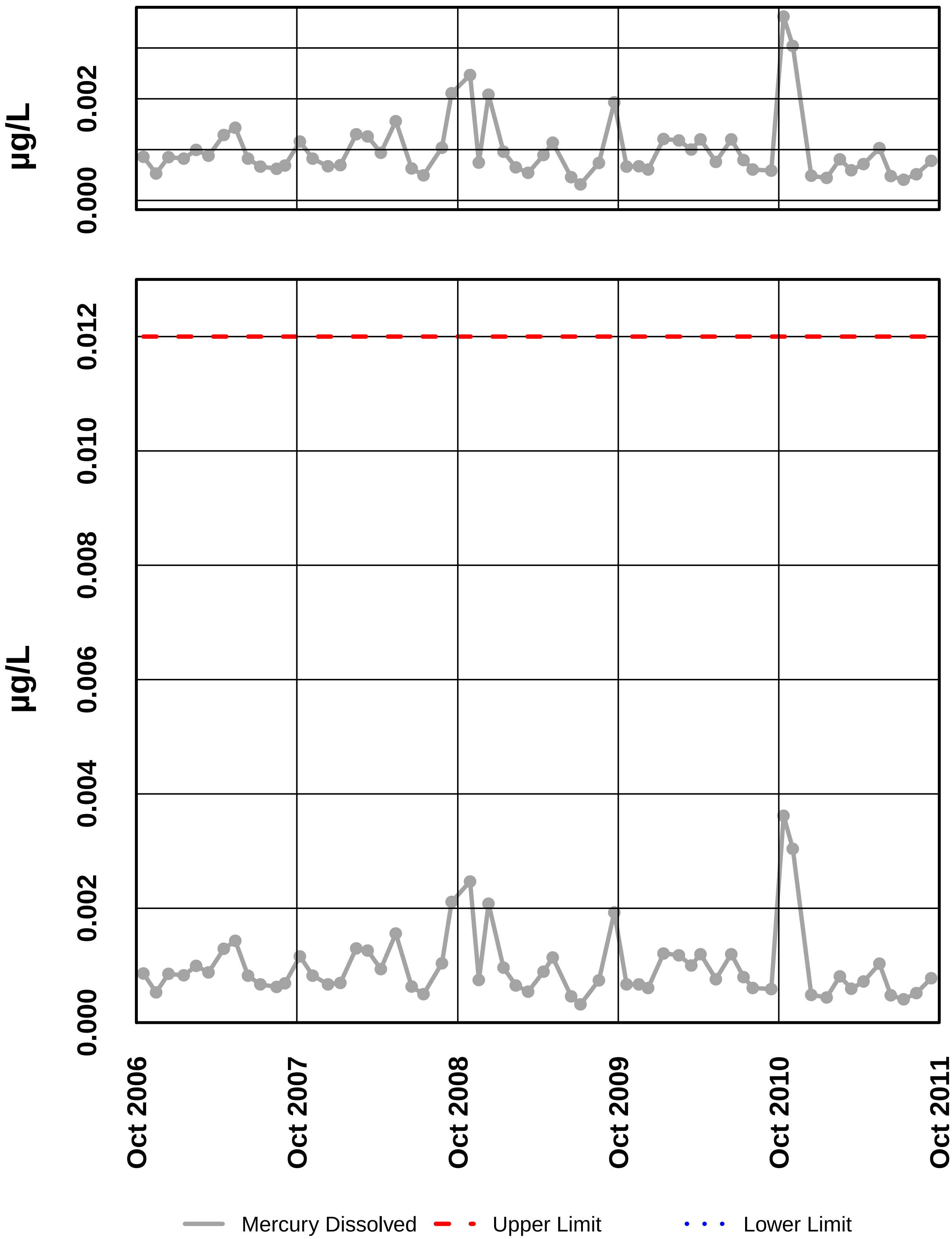


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

Site 48 − Mercury Dissolved



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

Site **#48** Seasonal Kendall analysis for Specific Conductance, Lab (uS/cm)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2006**	114.1	108.7	91.2	111.5	116.8	143.7	124.1	88.2	82.8	90.6	81.1	97.1
b	**WY2007**	136.4	139.8	135.8	121.3	144.9		117.1	94.5	80	74.5	120.6	120.1
c	**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
d	**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
e	**WY2010**	128.7	111.2	146.1	93	124	141.2	126.9	107.2	84.7	91.5	99.9	125.4
f	**WY2011**	61.2	76.9	152	157	139	165	72.6	89.6	94	94	119	108
	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	-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
e-b	-1	-1	1	-1	-1		1	1	1	1	-1	1
f-b	-1	-1	1	1	-1		-1	-1	1	1	-1	-1
d-c	-1	1	-1	-1	1	-1	1	1	-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	11	5	-1	0	-1	5	5	9	3	1

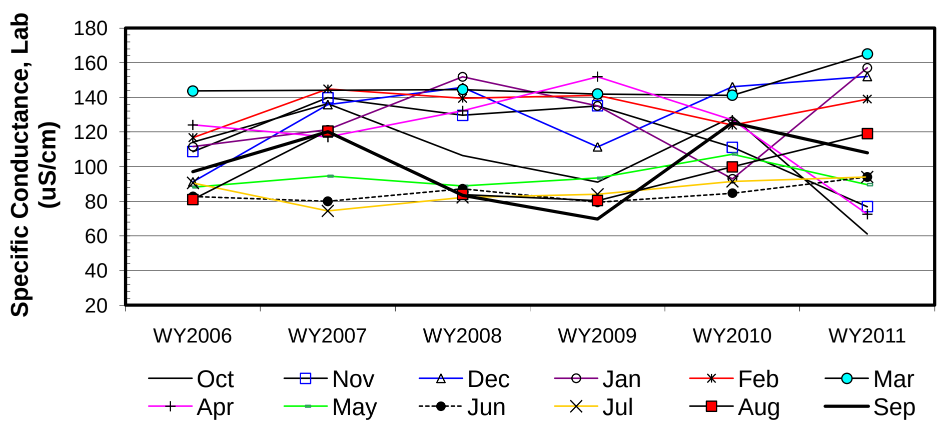
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	28.33	28.33	28.33	28.33	28.33	16.67	28.33	28.33	28.33	28.33	28.33	28.33
$Z_k = S_k/\sigma_S$	-1.32	-0.94	2.07	0.94	-0.19	0.00	-0.19	0.94	0.94	1.69	0.56	0.19
Z^2_k	1.73	0.88	4.27	0.88	0.04	0.00	0.04	0.88	0.88	2.86	0.32	0.04

ΣZ_k=	4.70
ΣZ^2_k=	12.81
Z-bar=ΣZ_k/K=	0.39

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

Σn	71
ΣS_k	25

$\chi^2_h=\Sigma Z^2_k$-K(Z-bar)^2=		10.97	@α=5% $\chi^2_{(K-1)}$=	19.68	Test for station homogeneity
	p	**0.445**			$\chi^2_h<\chi^2_{(K-1)}$ ACCEPT
ΣVAR(S_k)	Z_{calc}	1.32	@α/2=2.5% Z=	1.96	**H_0** (No trend) ACCEPT
328.33	**p**	**0.907**			**H_A** (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-1.12		4.36
0.050	-0.34	**1.70**	3.56
0.100	0.16		2.58
0.200	0.30		2.18

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2006**	7.9	7.8	7.6	7.5	7.3	7.8	7.9	7.5	8.1	8.1	8.2	7.7
b	**WY2007**	7.7	7.7	7.8	7.7	7.9		7.5	7.8	7.8	7.3	7.9	7.9
c	**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
d	**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
e	**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
f	**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
	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	-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
e-b	-1	-1	-1	-1	-1		-1	-1	-1	-1	-1	-1
f-b	-1	-1	-1	-1	-1		1	1	-1	-1	1	-1
d-c	-1	1	-1	-1	-1	-1	-1	-1	-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	-11	-5	-1	-7	-9	-4	-5	3	-11	-9	-5	-5

	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	16.67	28.33	28.33	28.33	28.33	28.33	28.33
$Z_k = S_k/\sigma_S$	-2.07	-0.94	-0.19	-1.32	-1.69	-0.98	-0.94	0.56	-2.07	-1.69	-0.94	-0.94
Z^2_k	4.27	0.88	0.04	1.73	2.86	0.96	0.88	0.32	4.27	2.86	0.88	0.88

$\Sigma Z_k=$ -13.19

$\Sigma Z^2_k=$ 20.83

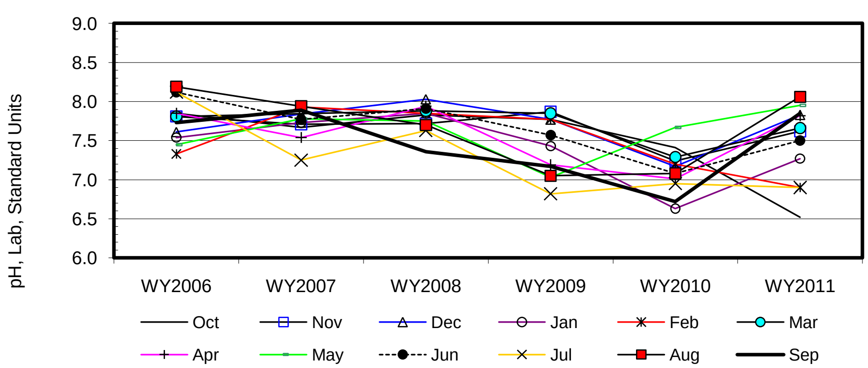
Z-bar=$\Sigma Z_k/K=$ -1.10

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

Σn 71

ΣS_k -69

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2=$		6.33	@α=5% $\chi^2_{(K-1)}=$	19.68	Test for station homogeneity	
	p	**0.850**			$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc}	-3.75	@α/2=2.5% $Z=$	1.96	**H_0** (No trend)	REJECT
328.33	**p**	**0.000**			**H_A** (± trend)	ACCEPT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.19		-0.04
0.050	-0.18	**-0.10**	-0.05
0.100	-0.14		-0.07
0.200	-0.13		-0.08

-1.3%

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	**WY2006**	43.6	42.3	38.9	44.6	41.4	54.3	43.4	40.3	30.4	39.0	39.5	46.2
b	**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
c	**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
d	**WY2009**	29.7	43.7	36.6		48.6	51.8	52.6	34.6	30.2	32.0	34.8	36.5
e	**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
f	**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
	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	-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
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	0	-1	1	-1	-1
d-b	-1	-1	-1		-1	1	1	-1	-1	1	-1	-1
e-b	1	-1	1	-1	-1	-1	1	1	1	1	-1	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	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
f-d	-1	-1	1		-1	-1	-1	-1	1	1	1	1
f-e	-1	-1	-1	1	1	1	1	-1	0	1	1	-1
S_k	-9	-3	3	2	-3	-7	3	-8	6	5	3	3

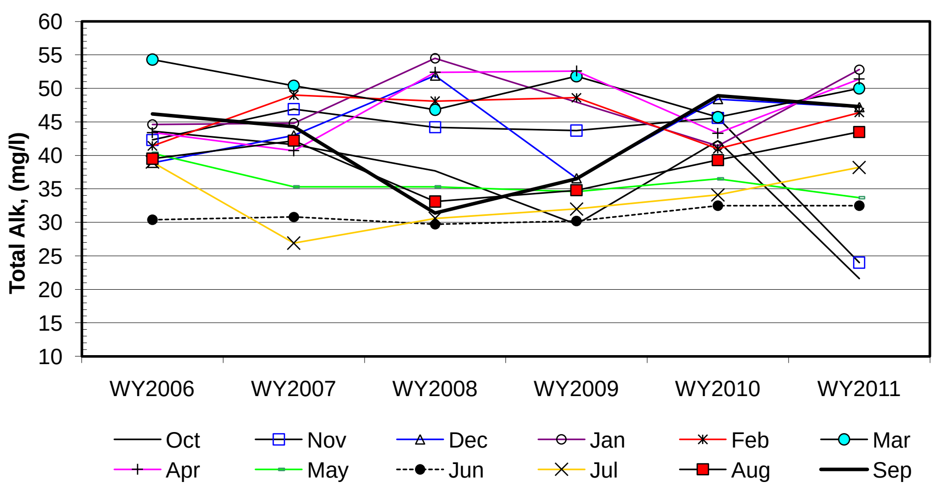
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	28.33	28.33	28.33	16.67	28.33	28.33	28.33	27.33	27.33	28.33	28.33	28.33
$Z_k = S_k/\sigma_S$	-1.69	-0.56	0.56	0.49	-0.56	-1.32	0.56	-1.53	1.15	0.94	0.56	0.56
Z^2_k	2.86	0.32	0.32	0.24	0.32	1.73	0.32	2.34	1.32	0.88	0.32	0.32

ΣZ_k= -0.83
ΣZ^2_k= 11.28
Z-bar=ΣZ_k/K= -0.07

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

Σn 71
ΣS_k -5

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	11.22	@α=5% $\chi^2_{(K-1)}$=	19.68	Test for station homogeneity
p	**0.425**			$\chi^2_h<\chi^2_{(K-1)}$ ACCEPT
$\Sigma VAR(S_k)$	Z_{calc} -0.22	@α/2=2.5% Z=	1.96	**H_0** (No trend) ACCEPT
326.33	p **0.412**			**H_A** (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.73		0.70
0.050	-0.54	**-0.05**	0.50
0.100	-0.43		0.42
0.200	-0.35		0.23

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	**WY2006**	12.2	14.0	12.3	17.5	12.9	20.0	14.1	7.7	6.3	10.1	8.6	13.9
b	**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
c	**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
d	**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
e	**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
f	**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
	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	0	1	1
c-b	1	-1	1	1	1	-1	1	-1	1	1	-1	-1
d-b	-1	1	1	1	1	1	1	1	1	1	-1	-1
e-b	1	1	1	-1	-1	-1	1	1	1	1	-1	1
f-b	-1	-1	1	1	1	1	1	1	1	1	1	1
d-c	-1	1	-1	-1	1	1	1	1	1	1	1	1
e-c	1	1	1	-1	-1	1	-1	1	1	1	1	1
f-c	-1	-1	1	1	1	1	1	1	1	1	1	1
e-d	1	1	1	-1	-1	-1	-1	1	1	-1	1	1
f-d	-1	-1	1	1	-1	-1	-1	-1	1	1	1	1
f-e	-1	-1	1	1	1	1	1	-1	1	1	1	1
S_k	-5	1	13	1	7	1	7	7	13	4	7	5

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	27.33	28.33	28.33
$Z_k = S_k/\sigma_S$	-0.94	0.19	2.44	0.19	1.32	0.19	1.32	1.32	2.44	0.77	1.32	0.94
Z^2_k	0.88	0.04	5.96	0.04	1.73	0.04	1.73	1.73	5.96	0.59	1.73	0.88

ΣZ_k= 11.47

ΣZ^2_k= 21.30

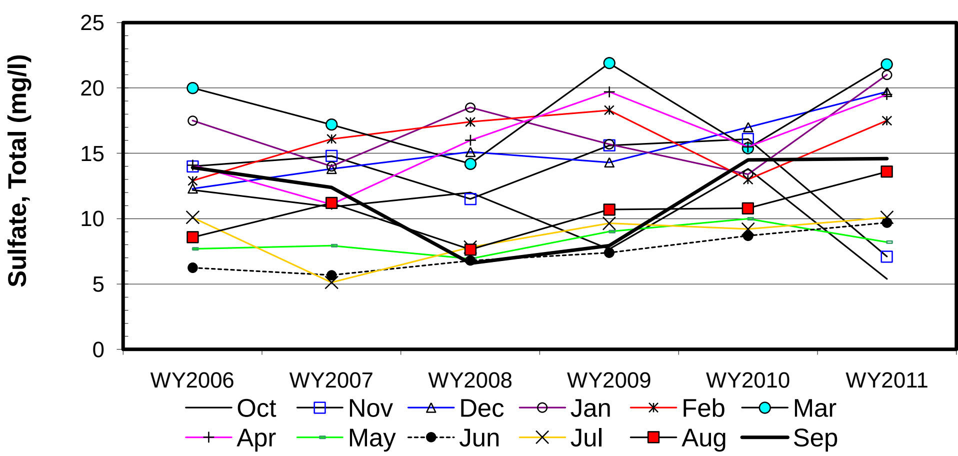
Z-bar=ΣZ_k/K= 0.96

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

Σn 72

ΣS_k 61

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	10.33	@α=5% $\chi^2_{(K-1)}$= 19.68	Test for station homogeneity
p	**0.501**		$\chi^2_h<\chi^2_{(K-1)}$ ACCEPT
ΣVAR(S_k) 339.00	Z_{calc} 3.26	@α=5% Z= 1.64	**H_0** (No trend) REJECT
	p **0.999**		**H_A** (± trend) ACCEPT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	0.20		0.95
0.050	0.36	**0.60**	0.85
0.100	0.40		0.75
0.200	0.50		0.69
		4.6%	

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	**WY2006**	3.1	2.9	2.4	2.7	2.8	2.7	2.0	1.8	1.7	1.2	2.6	2.5
b	**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
c	**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
d	**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
e	**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
f	**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
	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	3	7	7	9	9	7	1	5	7	-5	5

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

ΣZ_k= 11.65

ΣZ^2_k= 17.36

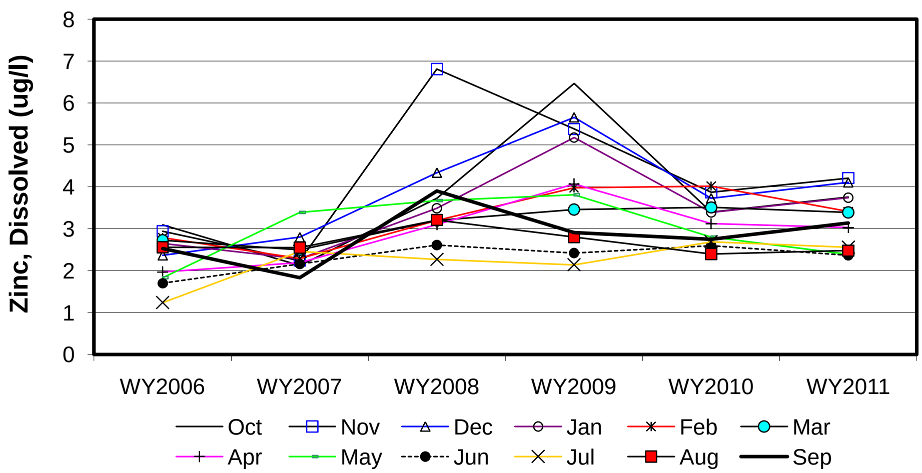
Z-bar=ΣZ_k/K= 0.97

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

Σn 72

ΣS_k 62

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	6.06	@α=5% $\chi^2_{(K-1)}$= 19.68	Test for station homogeneity	
p	**0.869**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
$\Sigma VAR(S_k)$	Z_{calc} 3.31	@α/2=2.5% Z= 1.96	**H_0** (No trend)	REJECT
340.00	p **1.000**		**H_A** (± trend)	ACCEPT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	0.07		0.29
0.050	0.11	**0.20**	0.25
0.100	0.12		0.23
0.200	0.13		0.22

6.8%

INTERPRETIVE REPORT
SITE 6 "MIDDLE GREENS CREEK"

The data collected during the current water year are listed in the following "Table of Results for Water Year 2011" 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 2006 through September 2011.				

The data for water year 2011 have been compared to the strictest fresh water quality criterion for each applicable analyte. No results exceeding these criteria have been identified.

Table of Exceedance for Water Year 2011

Site 006FMS - 'Greens Creek Middle'					
			Limits		
Sample Date	Parameter	Value	Lower	Upper	Hardness
No exceedances have been identified by HGCMC for the period of October 2010 through September 2011.					

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. Dissolved chromium increased an order of magnitude during water year 2010, however during water year 2011 dissolved chromium decreased from a high of 2.07 µg/L (December 2010) to a low of 0.615 µg/L (February 2011). This lower value is more in accordance with previous year's values. A similar decrease was also noted for Site 6, Site 13, Site 46, Site 48, Site 49, and Site 54; all sites that are located in the 920 area. Another trend that has occurred over the past few years is a decrease in the concentration of dissolved manganese.

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-05 and Sep-11 (WY2006-WY2011).

Table of Summary Statistics for Trend Analysis

	Mann-Kendall test statistics			Sen's slope estimate	
Parameter	**n***	**p****	**Trend**	**Q**	**Q(%)**
Conductivity Field	6	0.18			
pH Field	6	0.02	-	-0.05	-0.6
Alkalinity, Total	6	0.50			
Sulfate, Total	6	0.01	+	0.46	3.0
Zinc, Dissolved	6	<0.01	+	0.39	6.1

* Number of Years ** Significance level

Field pH had a statistically significant negative slope with an estimate of -0.045 su/yr Given this low magnitude, HGCMC does not feel that this decreasing trend is a significant indication of changes in water chemistry at Site 6. Dissolved zinc had a statistically significant positive slope of 0.39 µg/L/yr, which is similar to last year's slope of 0.37 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 0.46 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, 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	126	131.5	-7.5
pH Field	0.259	7.64	7.66	-0.03
Alkalinity, Total	0.01	45	46.9	-1.4
Sulfate, Total	<0.01	14.1	15.70	-2.20
Zinc, Dissolved	<0.01	3.27	7.4	-3.76

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 45 mg/L and 46.9 mg/L respectively and the median of differences, Site 48 minus Site 6, is -1.4 µS/cm.

The median values for field conductivity for Site 48 and Site 6 are 126 µs/cm and 131.5 µs/cm respectively. The median values for total sulfate for Site 48 and Site 6 are 14.1 mg/L and 15.7 mg/L respectively. Dissolved zinc results follow along in a similar manner where the median values for Site 48 and Site 6 are 3.27 µg/L and 7.40 µg/L respectively. Signed-rank test results for prior datasets for Water Years 2000 – 2010 show similar statistically significant differences with a median difference ranging from -1.7 µg/L to -4.17 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 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 2011

Site 006FMS - 'Greens Creek Middle'

Sample Date/Parameter	Oct 2010	Nov 2010	Dec 2010	Jan 2011	Feb 2011	Mar 2011	Apr 2011	May 2011	Jun 2011	Jul 2011	Aug 2011	Sep 2011	**Median**
Water Temp (°C)	4.6	3.9	0.0	0.1	7.3	0.4	1.3	2.5	4.8	6.7	8.9	8	4.3
Conductivity-Field(μmho)	78.8	81.9	163	166	151	176	84.9	91.6	98	98	155	112	105.0
Conductivity-Lab (μmho)	85	78	155	164	150	183	174	96	83	102	129	134	132
pH Lab (standard units)	6.46	6.25	6.38	7.7	7.64	7.93	7.8	7.57	7.68	7.21	7.68	7.79	7.66
pH Field (standard units)	6.71	7.66	7.92	7.49	7.27	7.67	7.74	7.63	7.4	7.66	7.88	7.79	7.66
Total Alkalinity (mg/L)	27.6	24.1	48.4	52.5	48.4	55.4	52.9	34.7	34.7	37.7	47.7	46.1	46.9
Total Sulfate (mg/L)	8	8.8	23.6	24.6	21.7	26.1	25	8.7	10.5	11.1	15.1	16.3	15.7
Hardness (mg/L)	39.3	35.9	75.5	79	73	82.8	77.8	44.2	44.4	50.6	59.2	64	61.6
Dissolved As (ug/L)	0.235	0.21	0.162	0.199	0.183	0.193	0.185	0.184	0.179	0.203	0.228	0.232	0.196
Dissolved Ba (ug/L)			31.6		30								30.8
Dissolved Cd (ug/L)	0.0526	0.0835	0.0542	0.0527	0.0618	0.0473	0.0619	0.039	0.0341	0.0352	0.0394	0.0683	0.0527
Dissolved Cr (ug/L)			2.07		0.615								1.343
Dissolved Cu (ug/L)	0.704	1.14	0.337	0.298	0.493	0.29	0.442	0.479	0.255	0.271	0.433	0.474	0.438
Dissolved Pb (ug/L)	0.154	0.113	0.0119	0.0159	0.0366	0.0119	0.0354	0.0226	0.0065	0.0187	0.0112	0.0466	0.0207
Dissolved Ni (ug/L)			1.51		1.54								1.525
Dissolved Ag (ug/L)			0.004		0.002								0.003
Dissolved Zn (ug/L)	7.33	13	7.91	7.46	10.8	7.29	10.2	3.95	3.16	3.61	4.35	7.74	7.40
Dissolved Se (ug/L)			1.35		1.14								1.245
Dissolved Hg (ug/L)	0.00229	0.00338	0.000751	0.000369	0.000758	0.000495	0.000822	0.000977	0.000643	0.000501	0.000644	0.00101	0.000755

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: 10/01/2010 to 09/30/2011

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
6	10/12/2010	12:00 AM				
			pH Lab, su	6.46	R	Hold Time Violation
			SO4 Tot, mg/l	8	J	Sample Receipt Temperature
6	12/14/2010	12:00 AM				
			Pb diss, µg/l	0.0119	U	Field Blank Contamination
			Hg diss, µg/l	0.000751	U	Field Blank Contamination
6	1/18/2011	12:00 AM				
			pH Lab, su	7.7	J	Hold Time Violation
			Pb diss, µg/l	0.01	U	Field Blank Contamination
			Hg diss, µg/l	0.000369	U	Field Blank Contamination
			SO4 Tot, mg/l	24.6	J	Sample Reciept Temperature
6	2/17/2011	12:00 AM				
			Pb diss, µg/l	0.03	U	Field Blank Contamination
6	3/14/2011	12:00 AM				
			pH Lab, su	7.93	J	Hold Time Violation
			SO4 Tot, mg/l	26.1	J	Sample Reciept Temperature
			Pb diss, µg/l	0.01	U	Field Blank Contamination
			Hg diss, µg/l	0.000495	U	Field Blank Contamination
6	4/12/2011	12:00 AM				
			pH Lab, su	7.8	J	Hold Time Violation
			Hg diss, µg/l	0.000822	U	Field Blank Contamination
6	5/18/2011	12:00 AM				
			SO4 Tot, mg/l	8.7	J	Sample Reciept Temperature
			pH Lab, su	7.57	J	Hold Time Violation
			Cd diss, µg/l	0.039	U	Trip Blank Contamination
			Pb diss, µg/l	0.0226	U	Field Blank Contamination
6	6/13/2011	12:00 AM				
			SO4 Tot, mg/l	10.5	J	Sample Reciept Temperature
			Pb diss, µg/l	0.00654	J	Below Quantitative Range
			Hg diss, µg/l	0.000643	J	LCS Recovery
6	7/12/2011	12:00 AM				
			SO4 Tot, mg/l	11.1	J	Sample Reciept Temperature
			Cu diss, µg/l	0.27	U	Field Blank Contamination

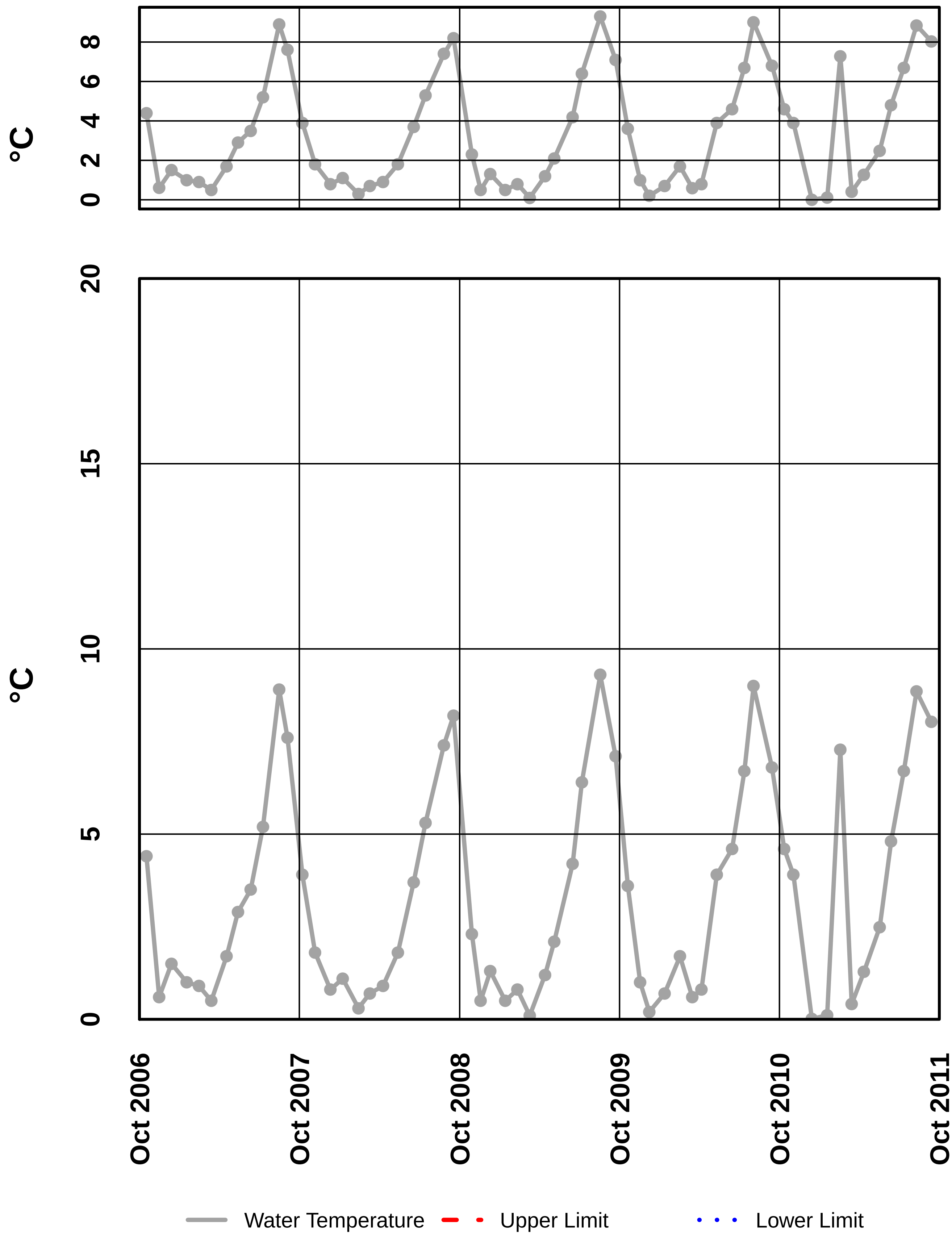
Qualifier	**Description**
J	Positively Identified - Approximate concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation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

Qualified Data by QA Reviewer

Date Range: 10/01/2010 to 09/30/2011

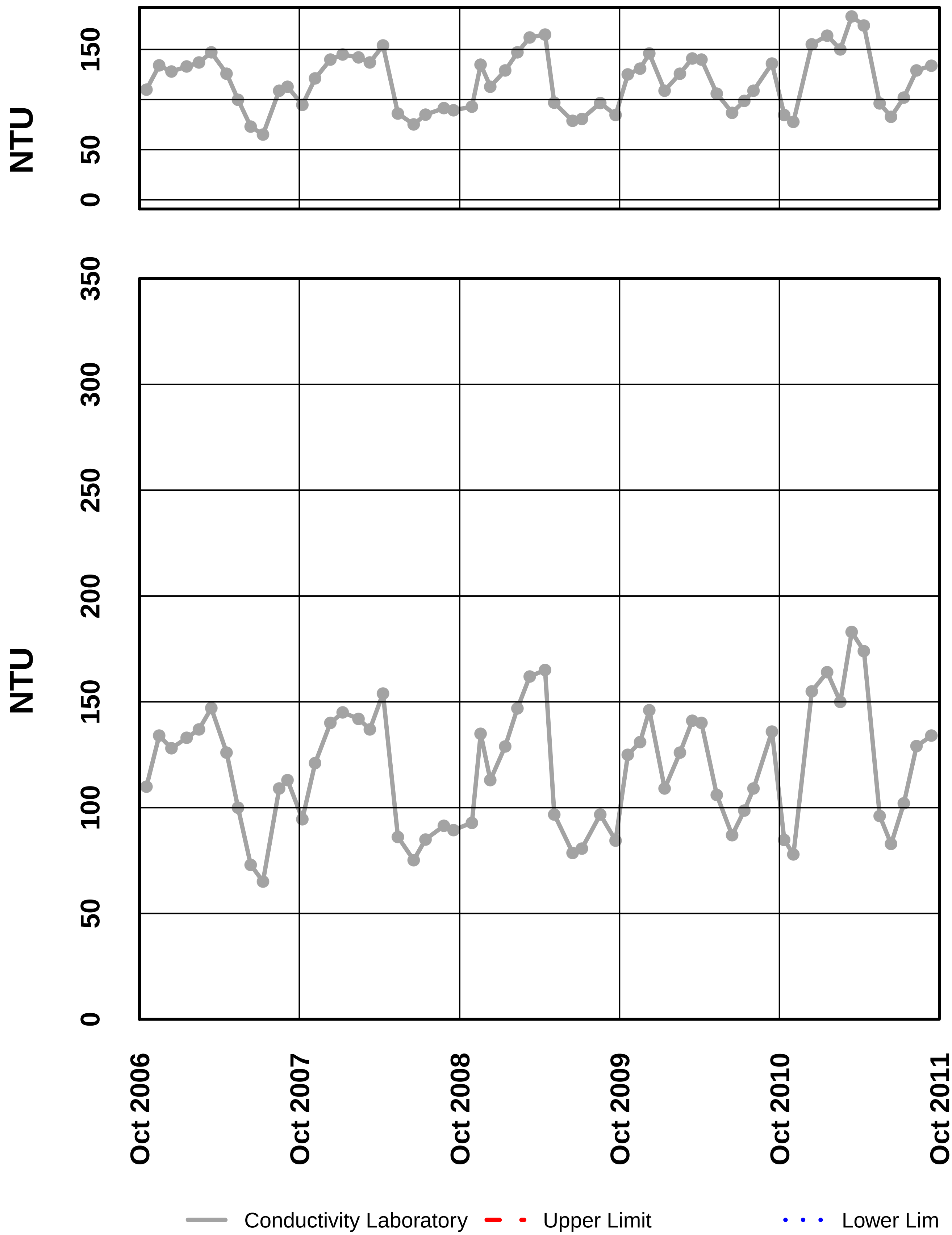
Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
6	7/12/2011	12:00 AM				
			Hg diss, µg/l	0.000501	U	Field Blank Contamination
6	8/10/2011	12:00 AM				
			SO4 Tot, mg/l	15.1	J	Sample Receipt Temperature
			pH Lab, su	7.68	J	Hold Time Violation
			Hg diss, µg/l	0.000644	U	Field Blank Contamination
6	9/13/2011	12:00 AM				
			Hg diss, µg/l	0.00101	U	Field Blank Contamination

Site 6 – Water Temperature



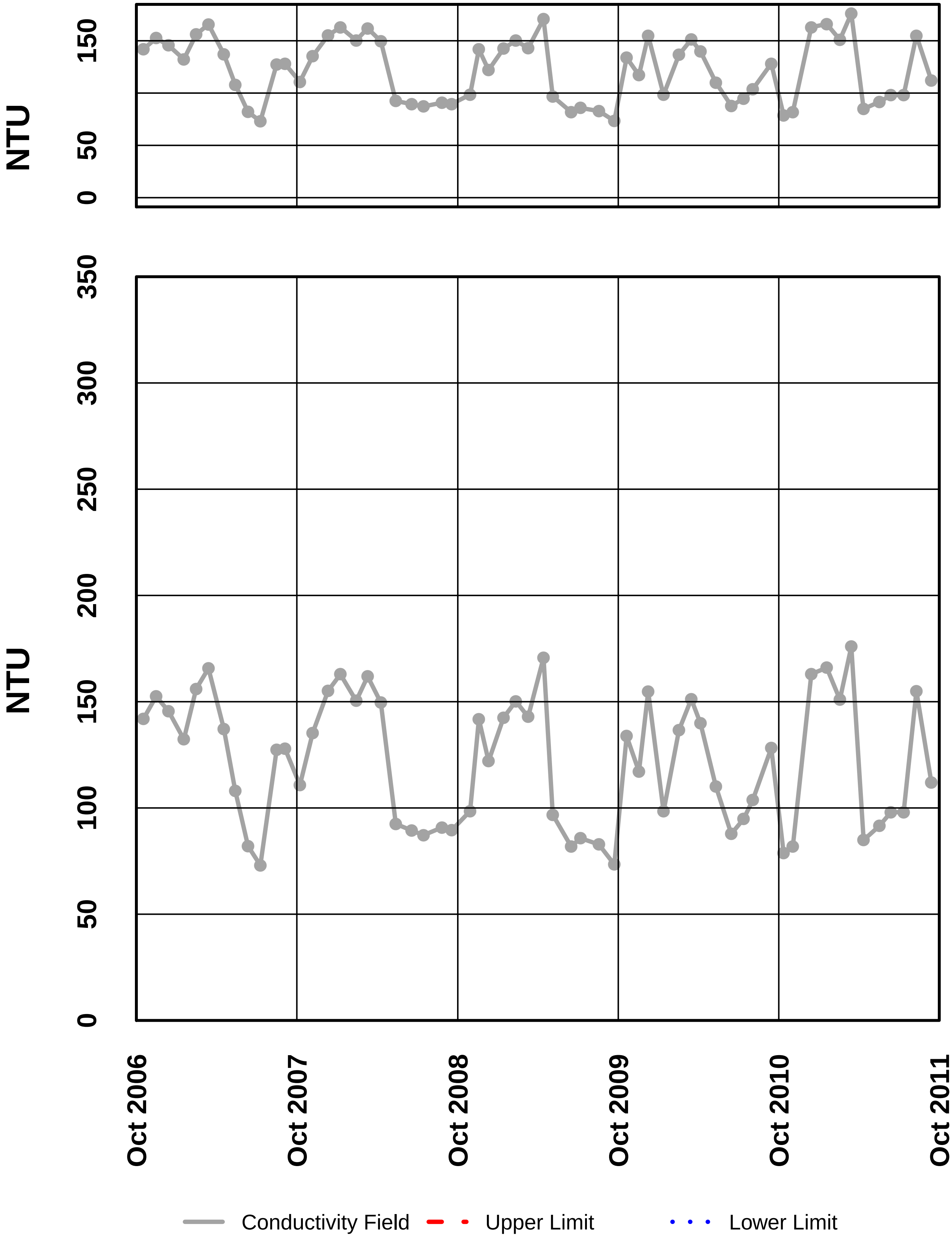
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 6 − Conductivity Laboratory

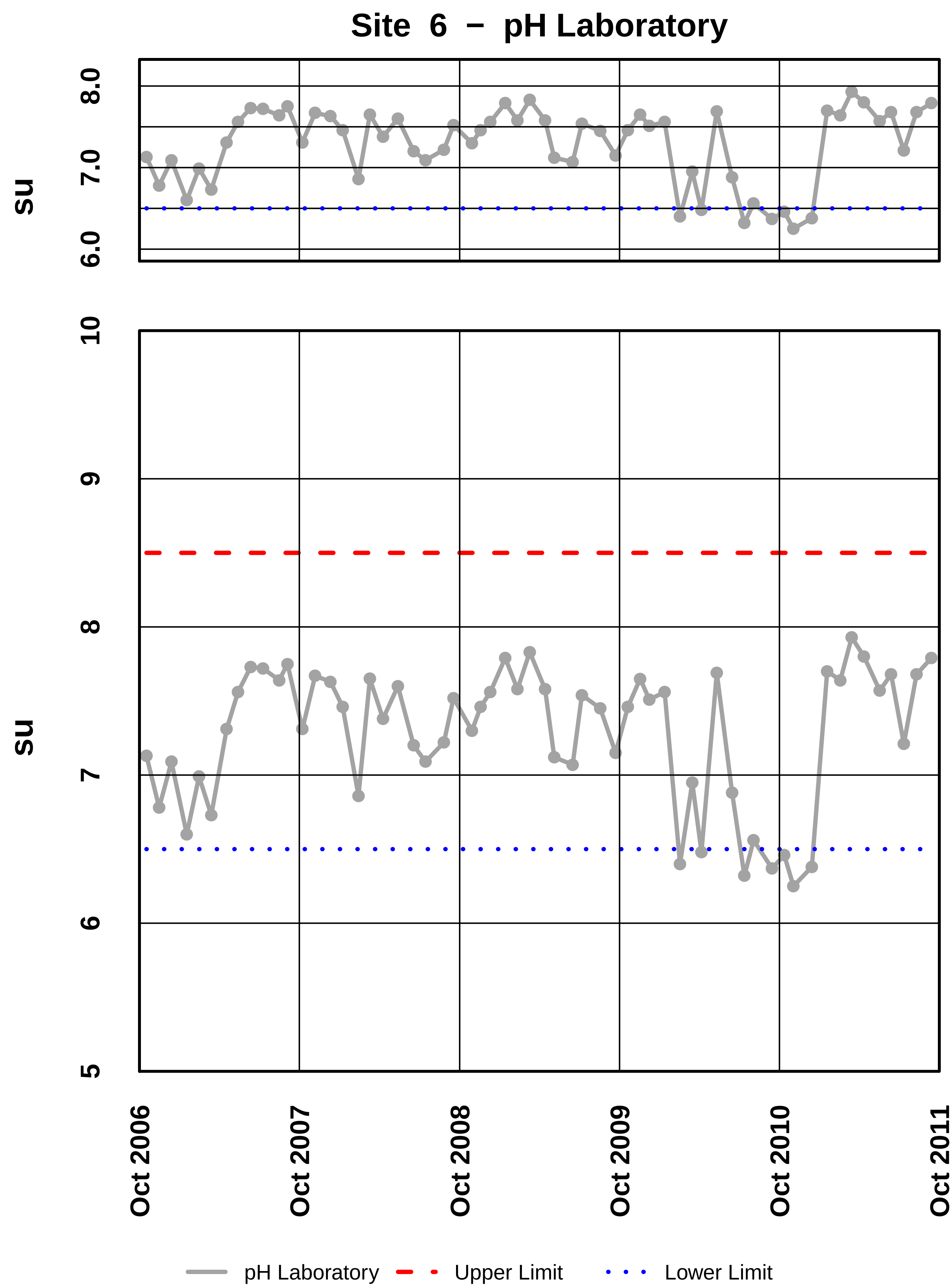


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

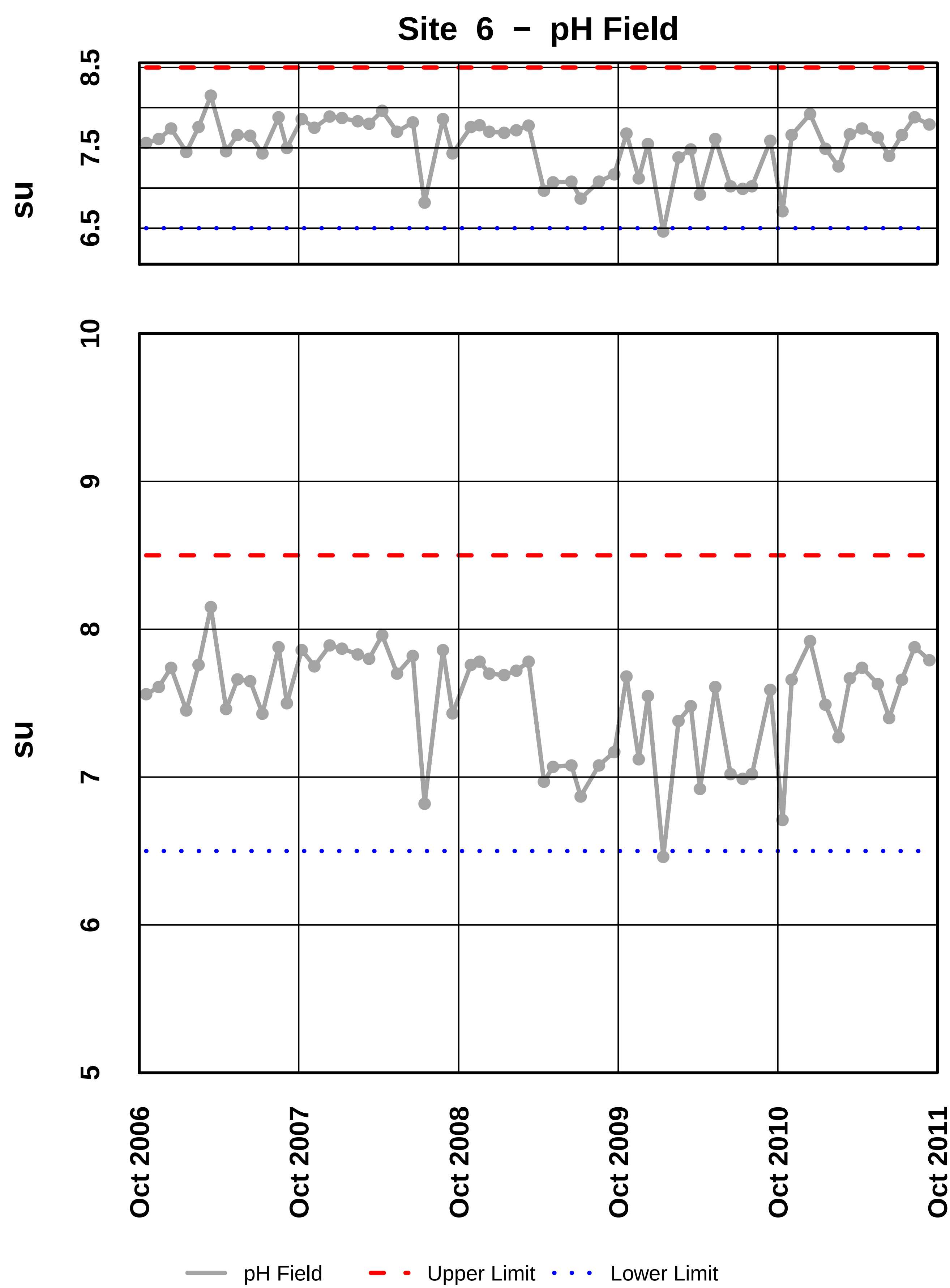
Site 6 − Conductivity Field



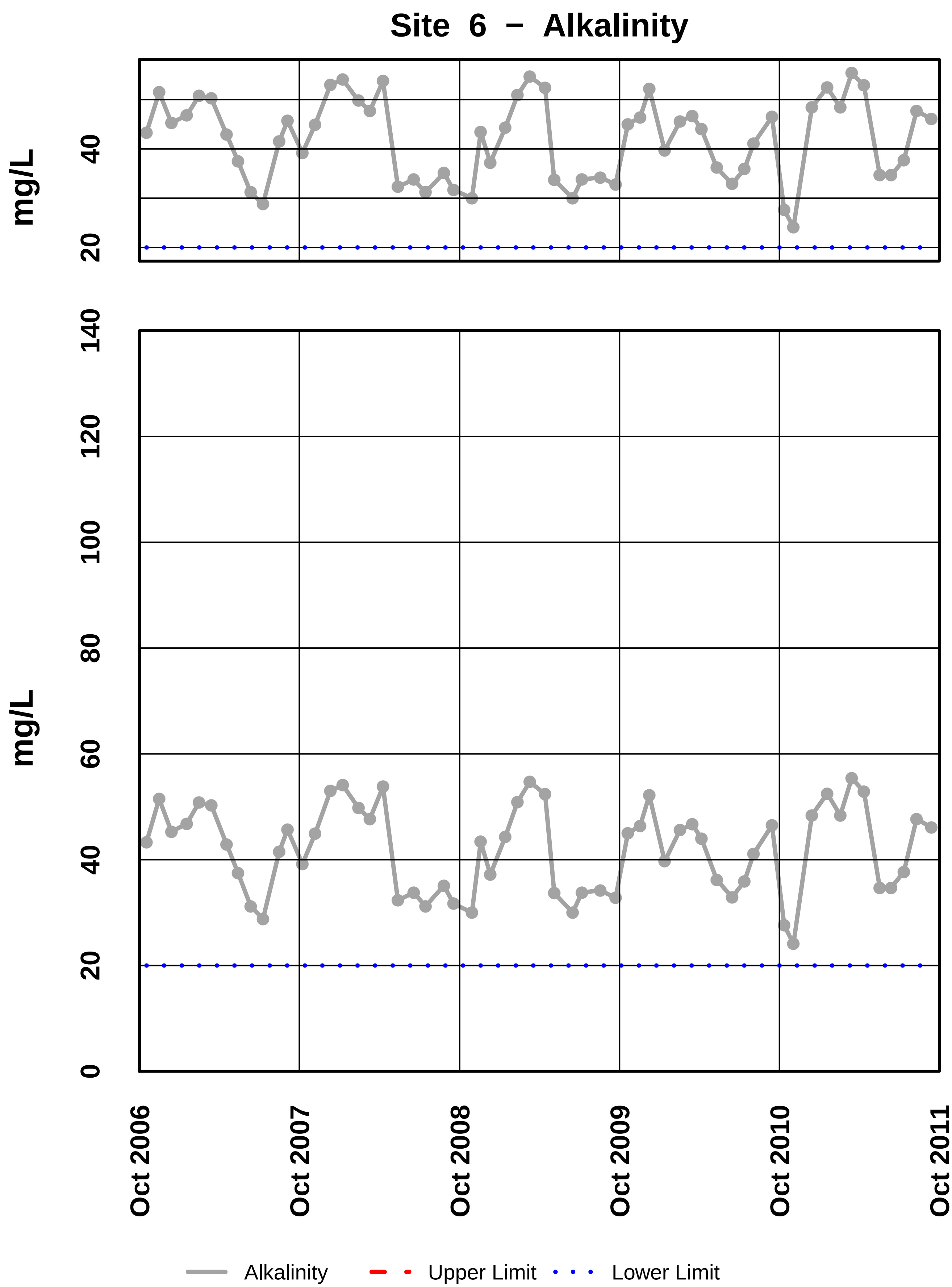
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

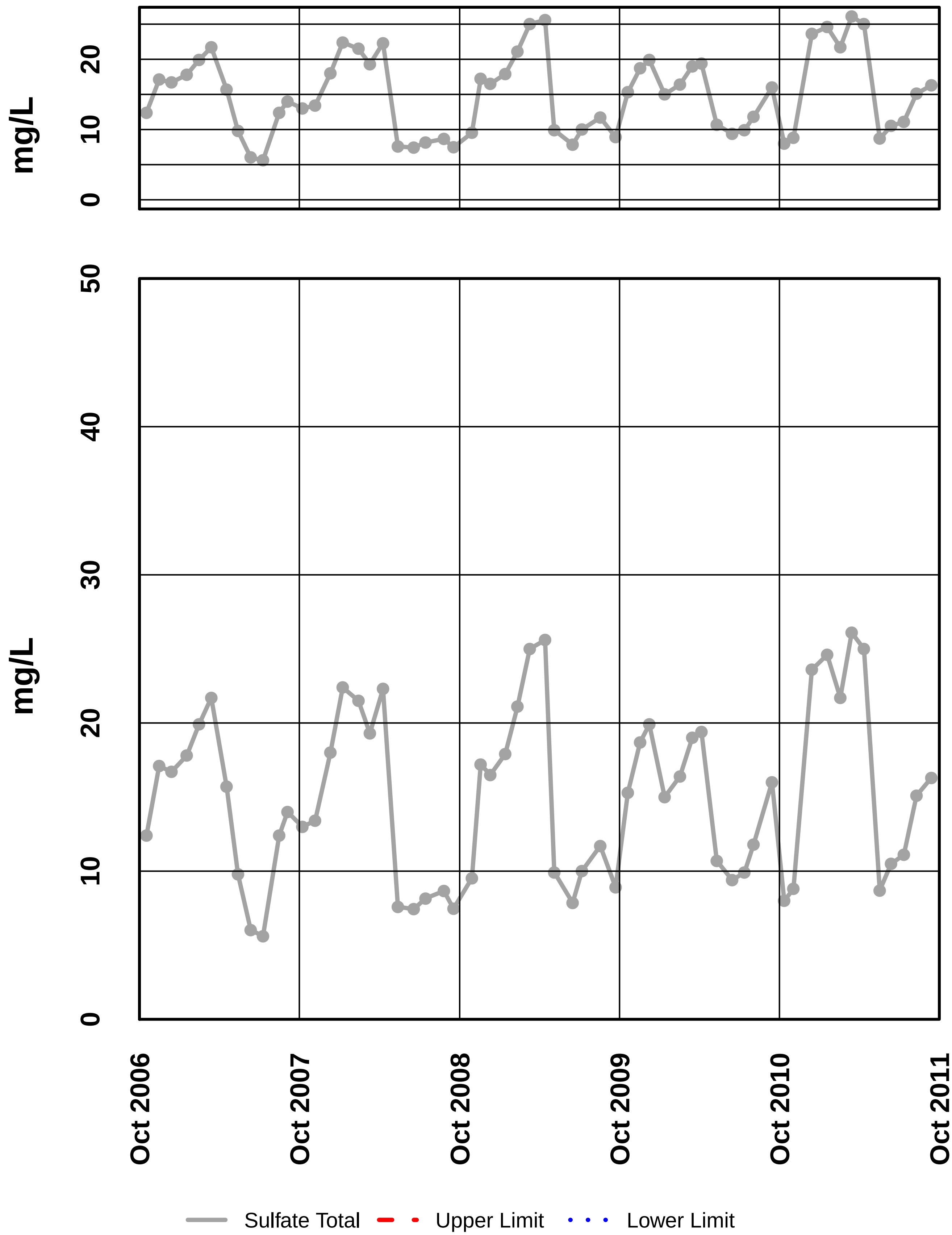


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

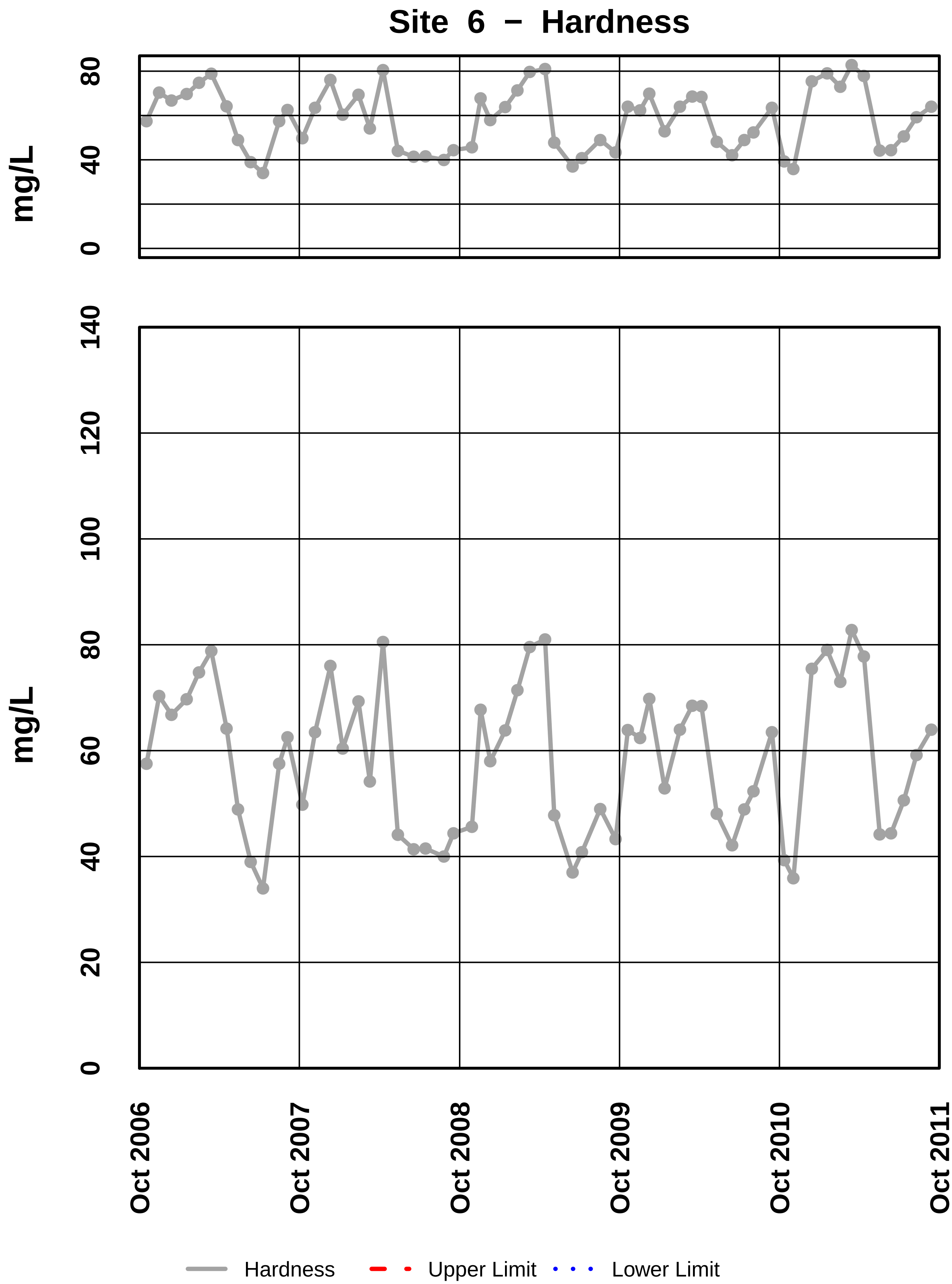


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 6 – Sulfate Total

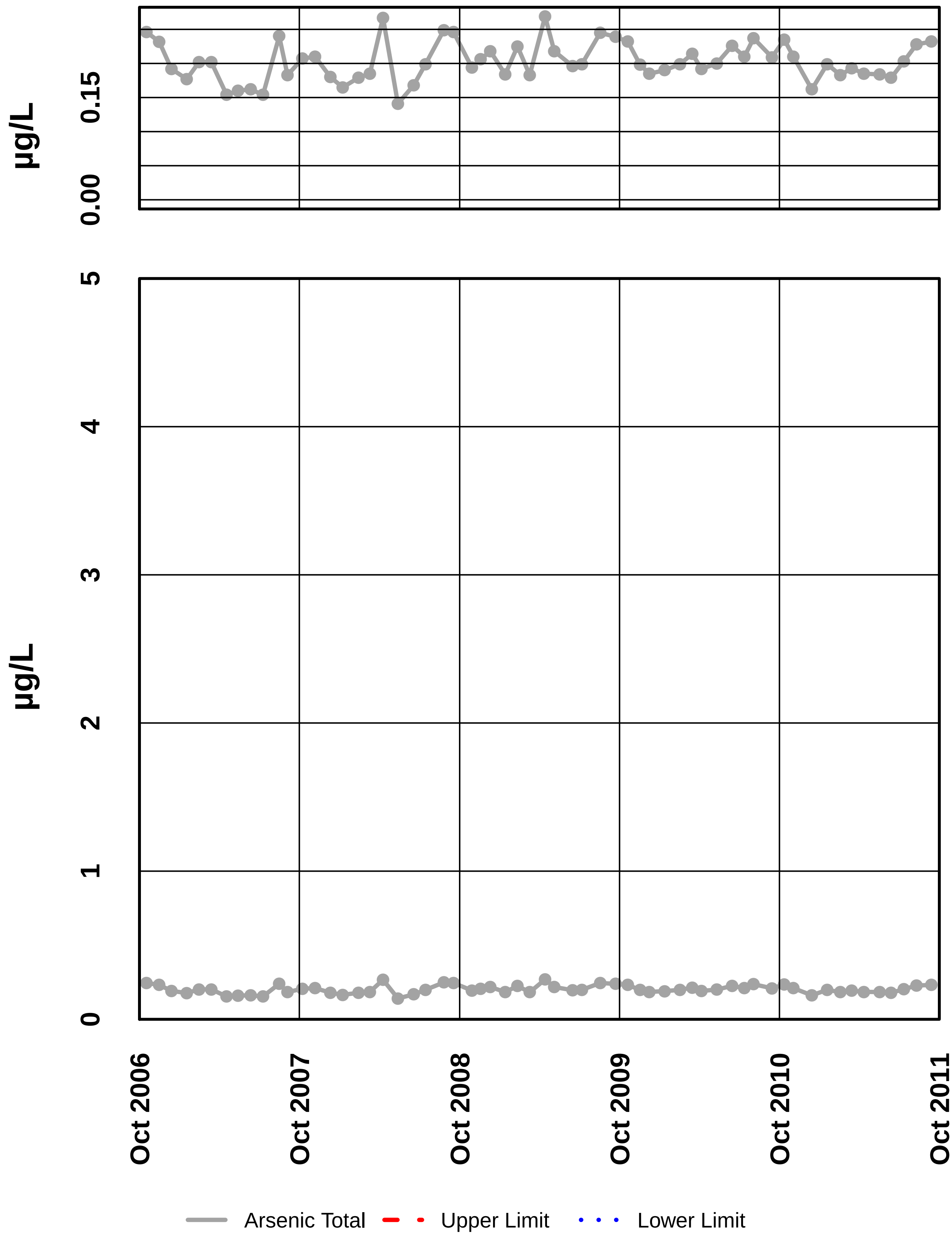


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

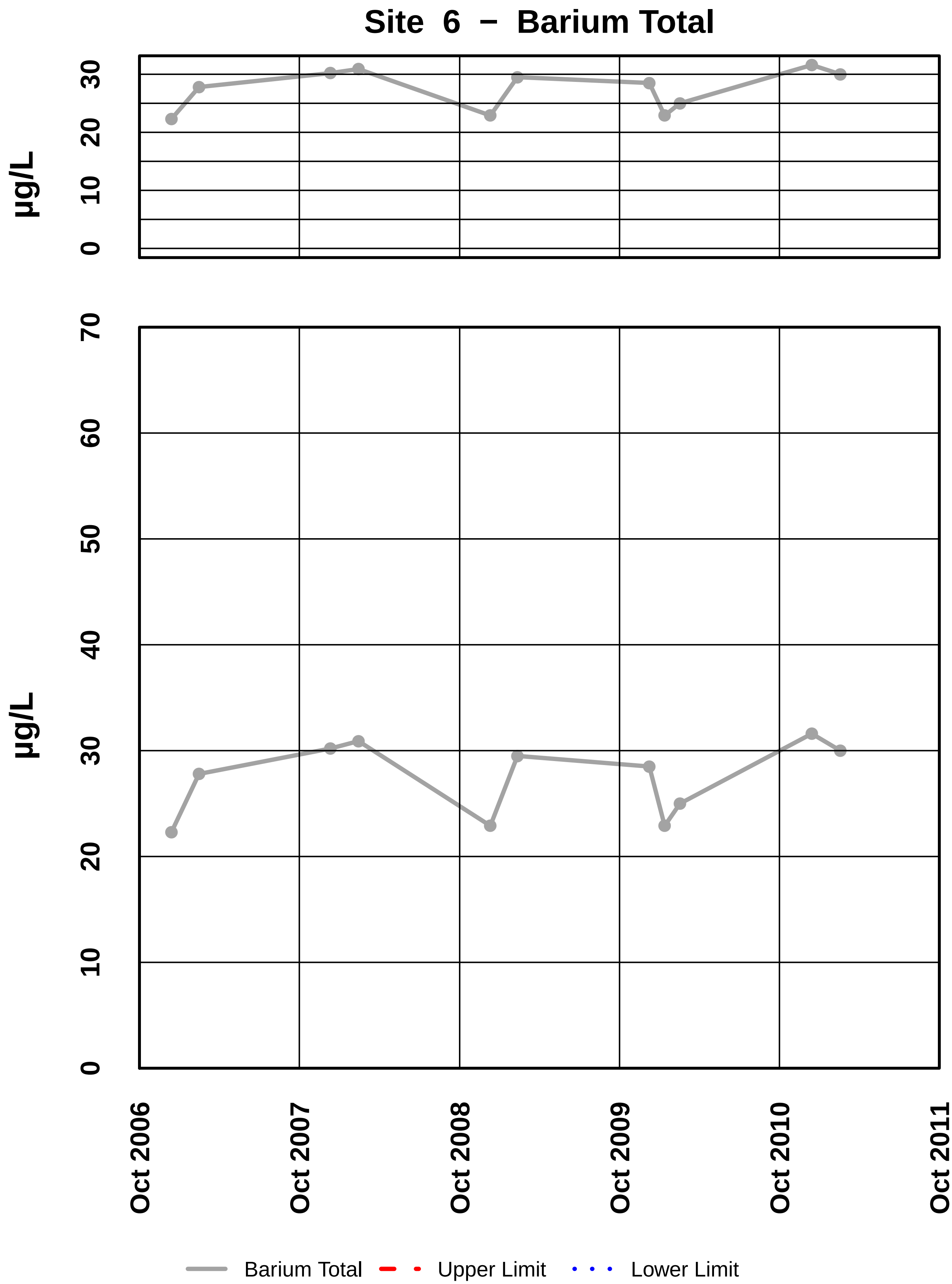


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

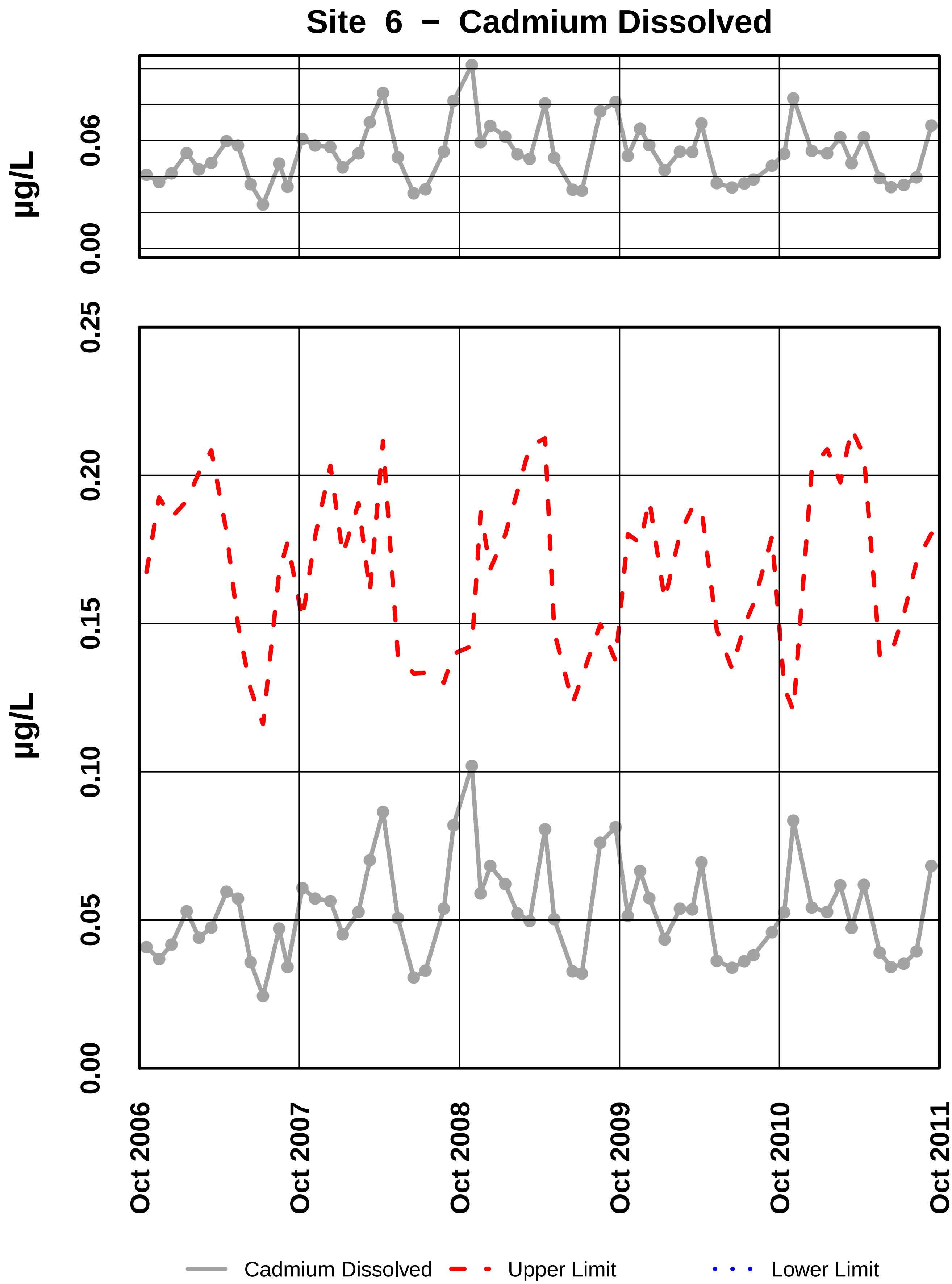
Site 6 − Arsenic Total



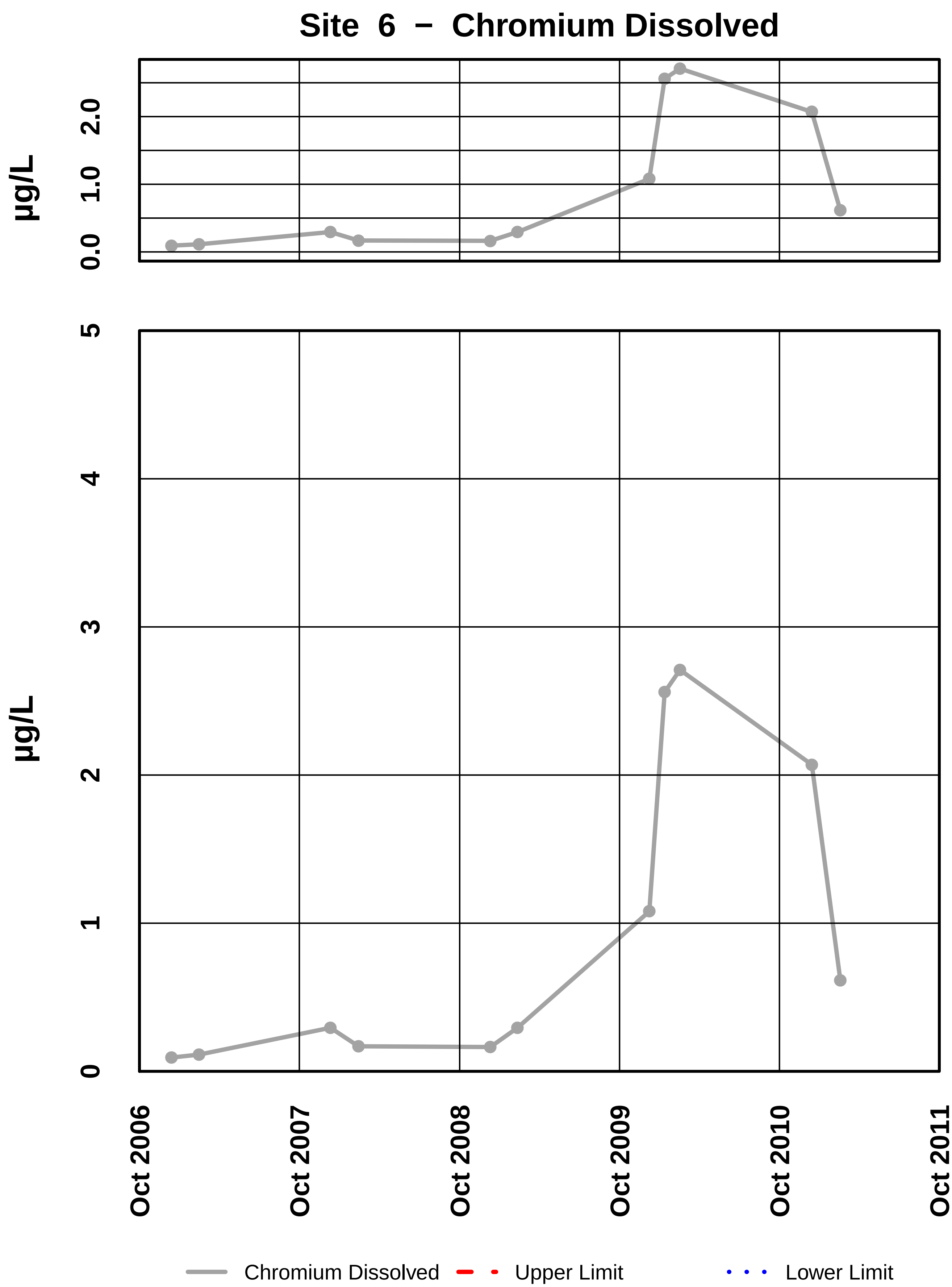
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



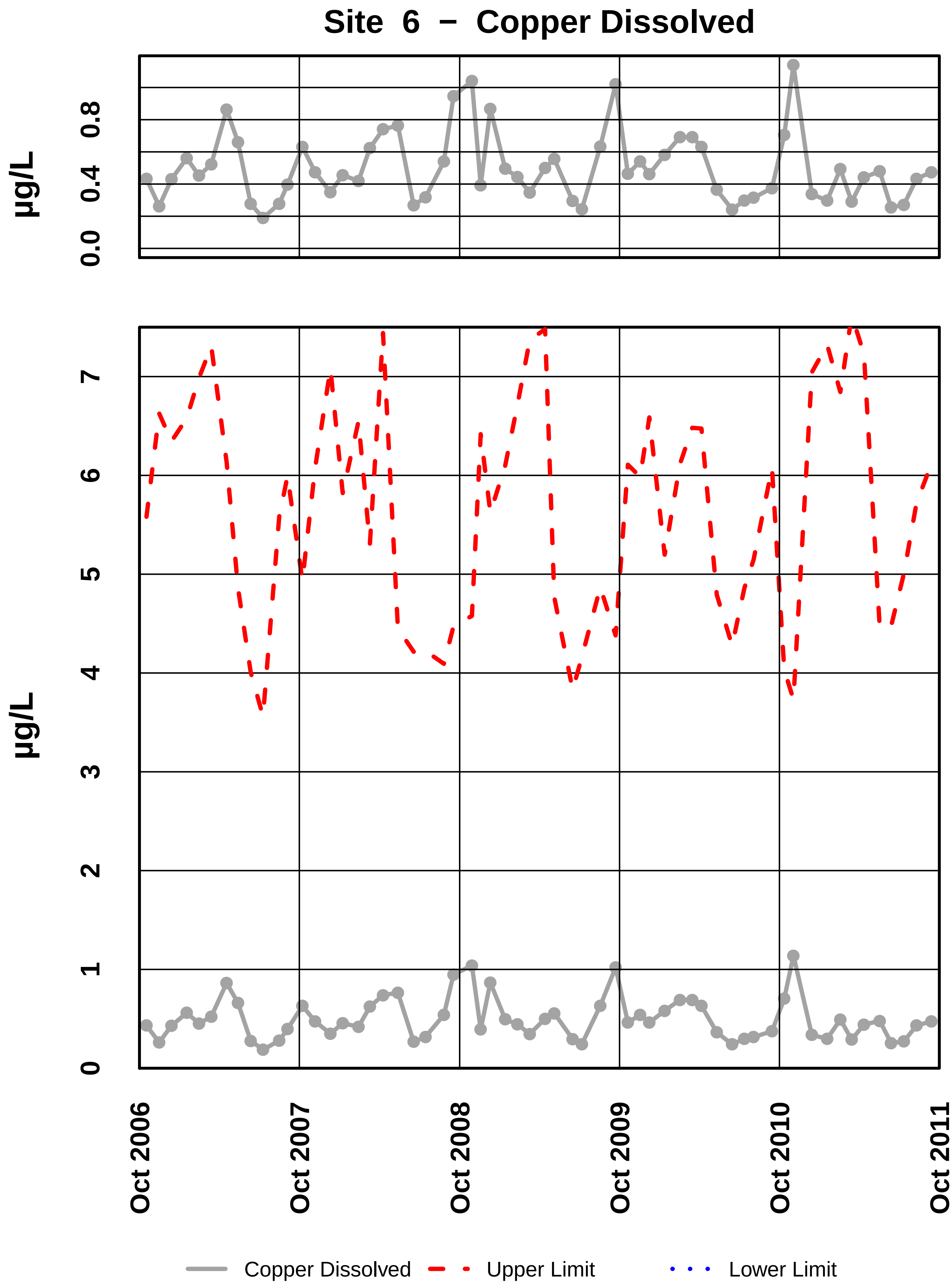
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



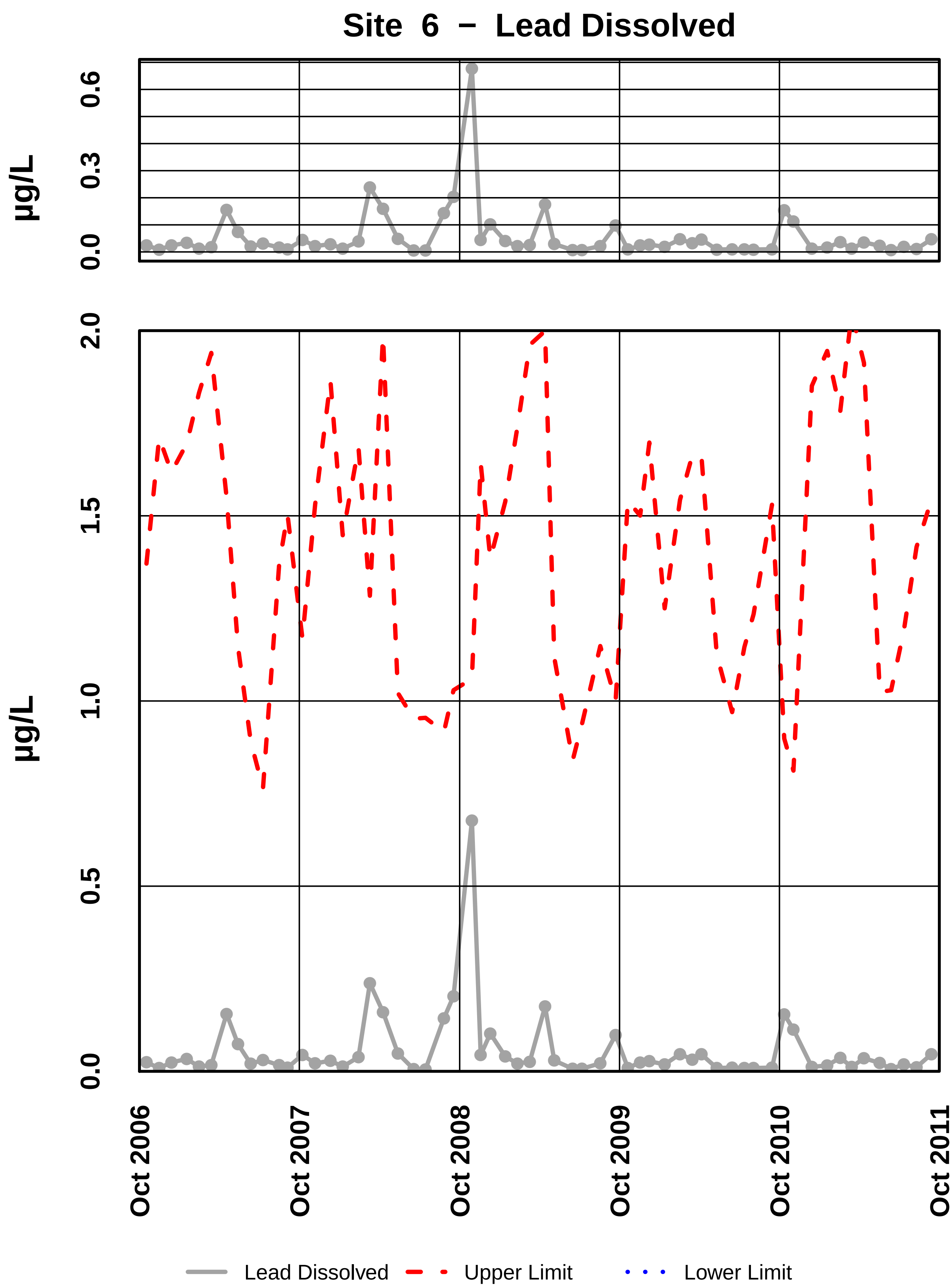
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

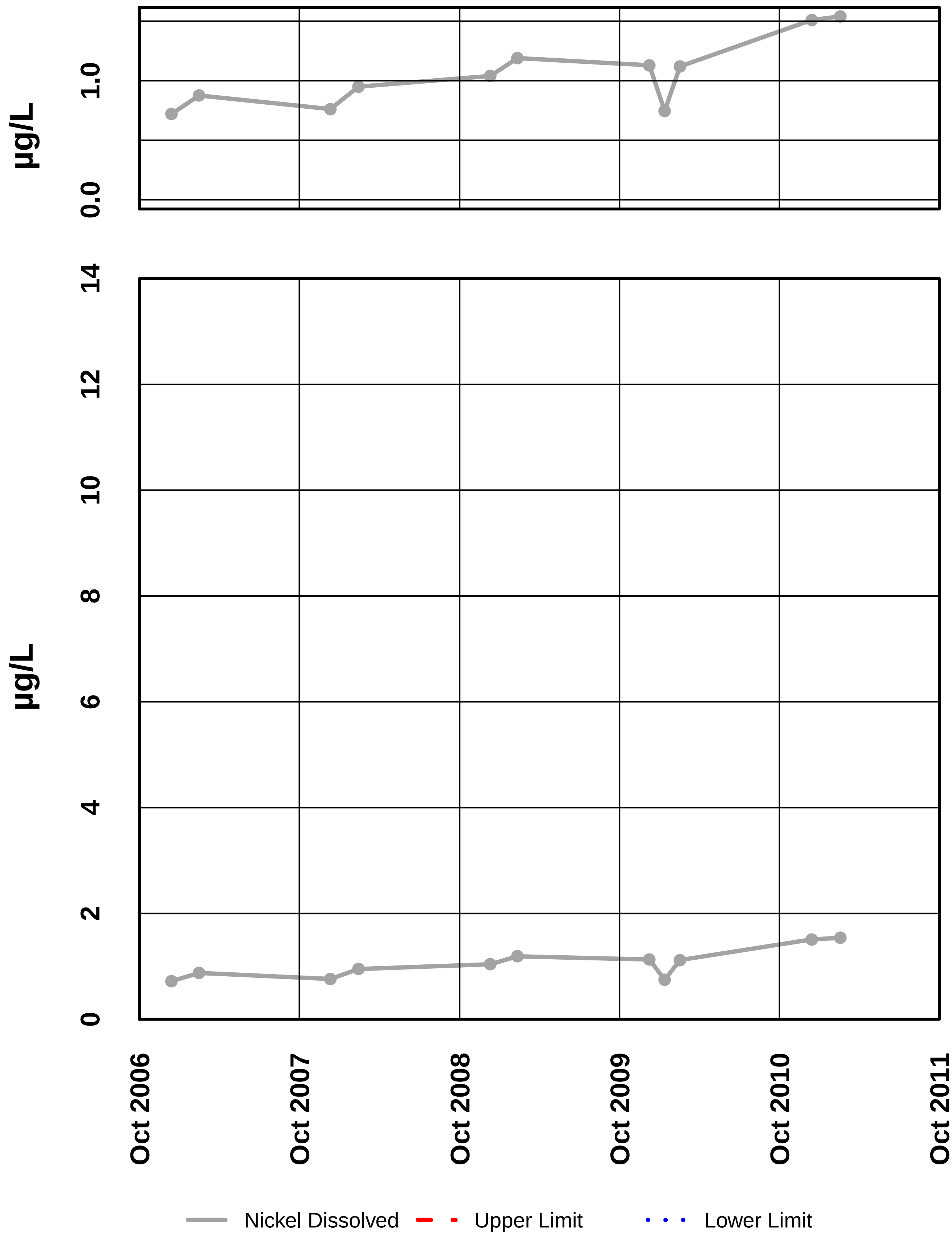


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



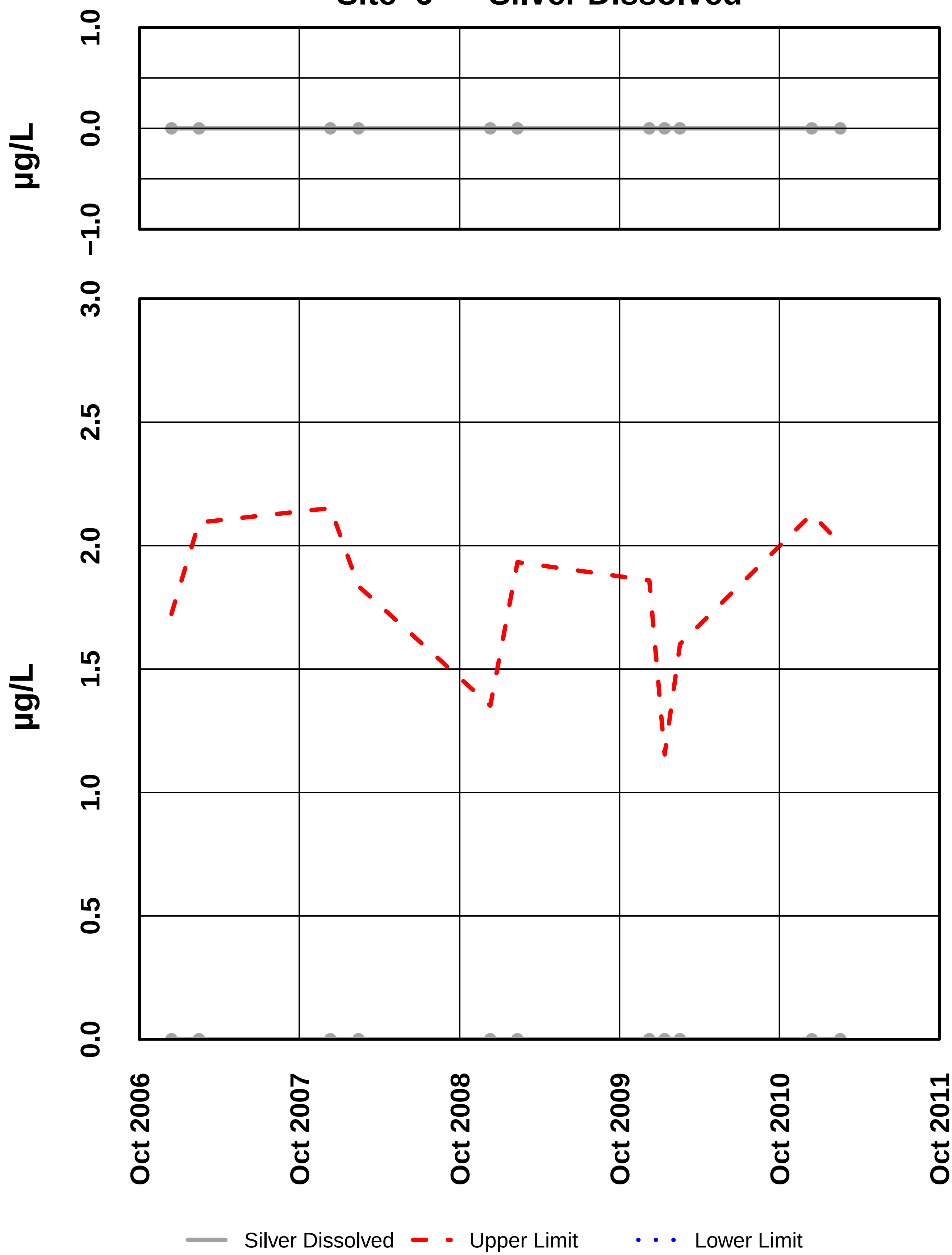
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 6 − Nickel Dissolved

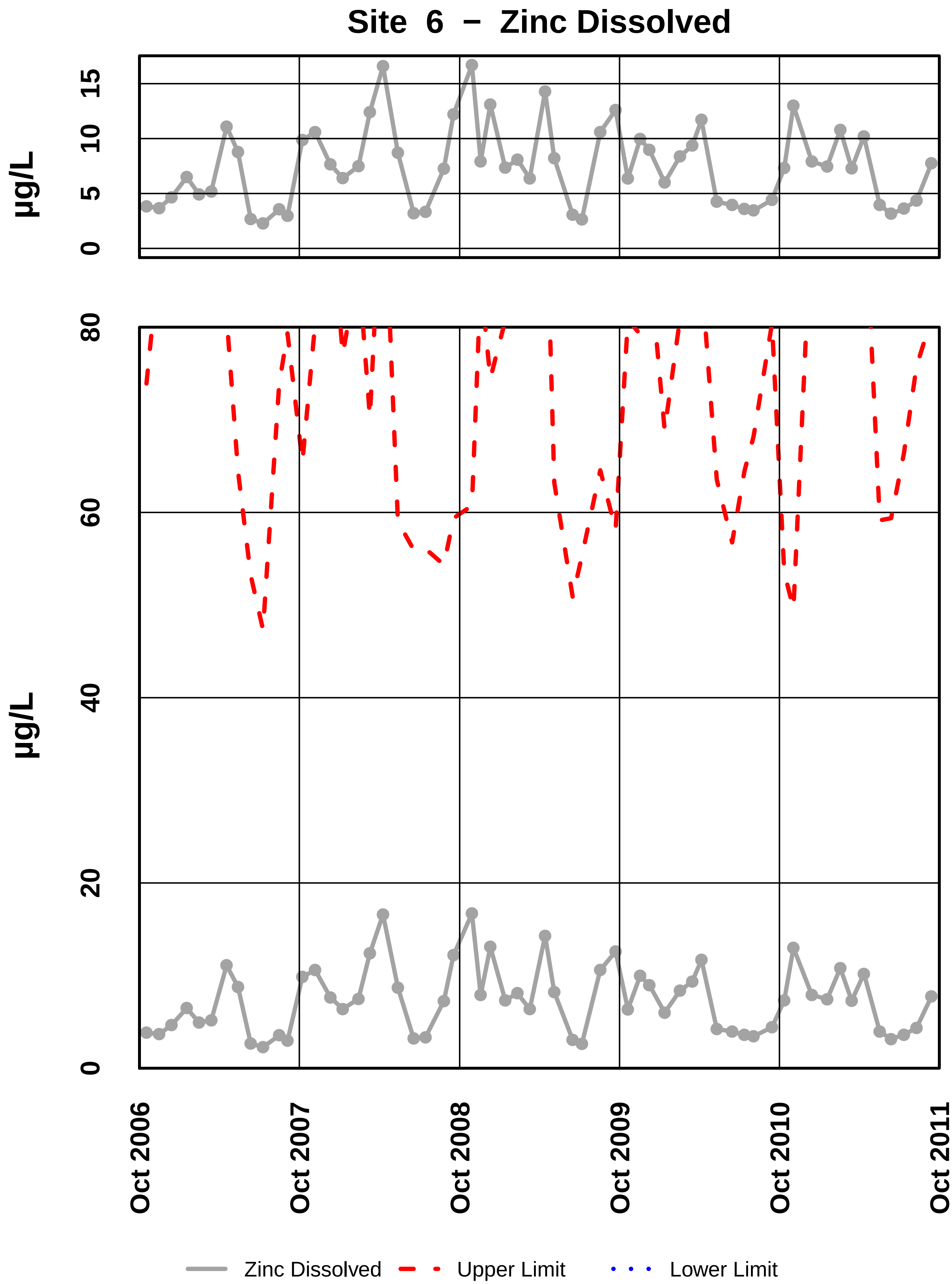


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

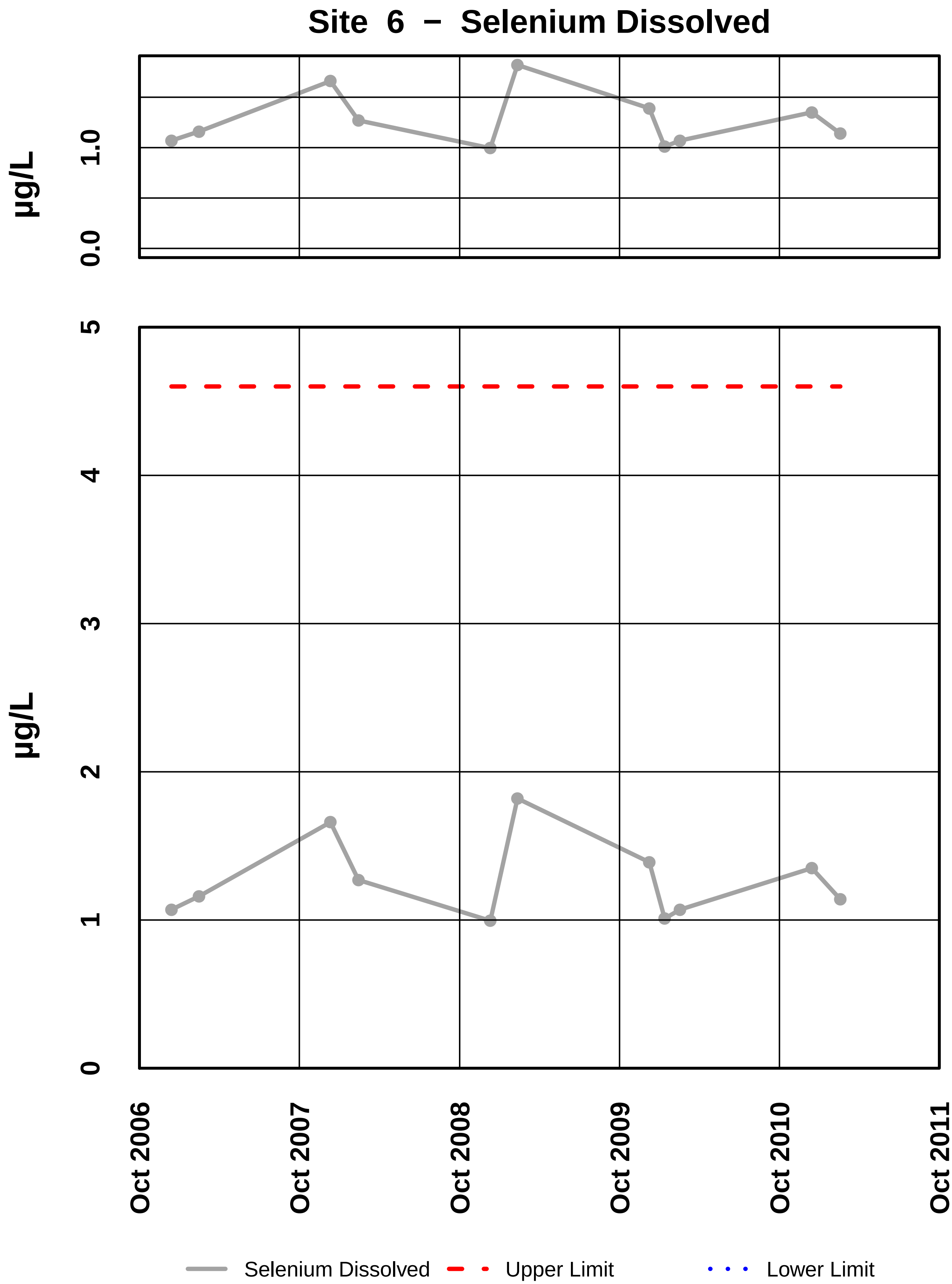
Site 6 – Silver Dissolved



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

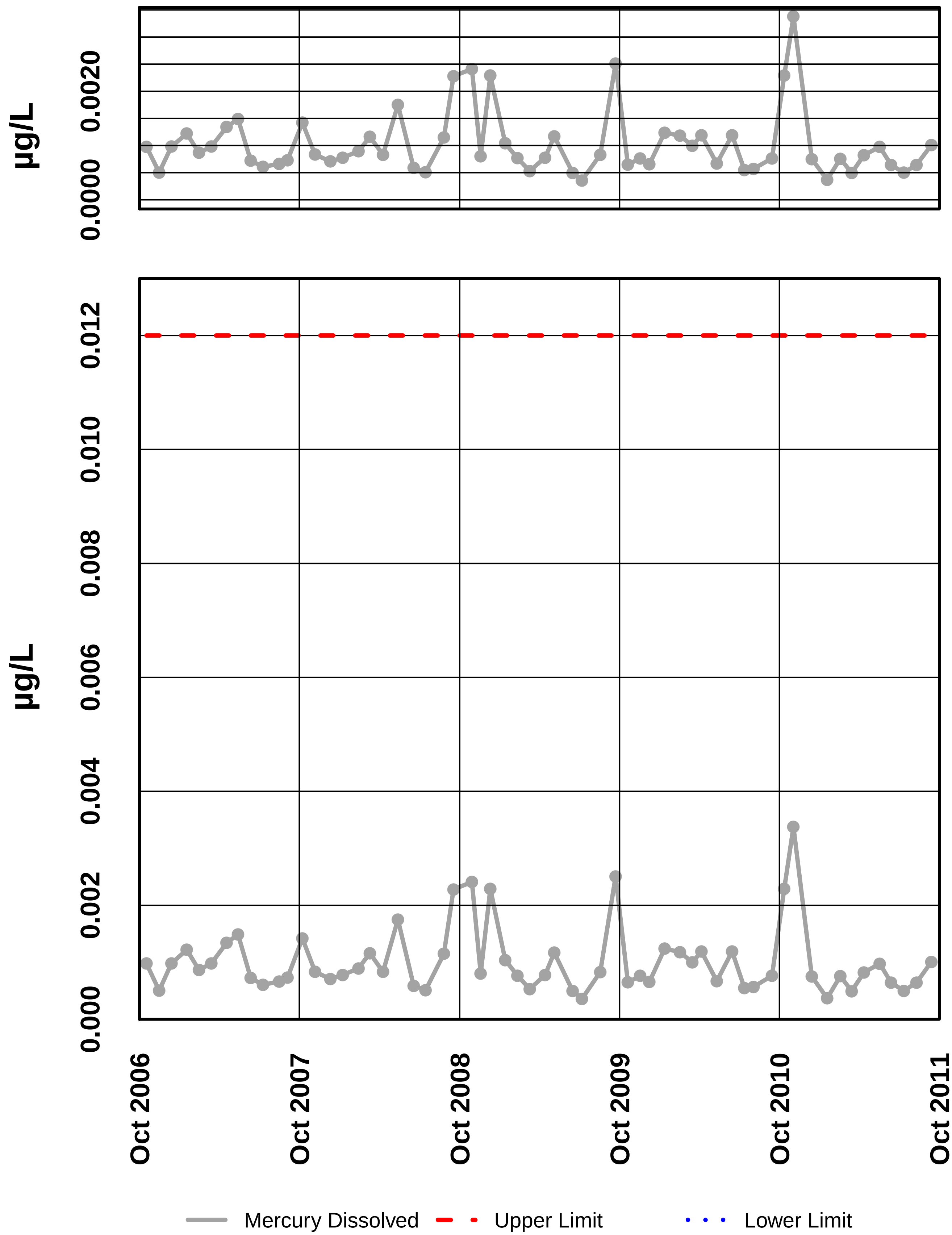


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

Site 6 − Mercury Dissolved



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

Site #6 — Seasonal Kendall analysis for Specific Conductance, Lab (uS/cm)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2006**	118.1	114.9	96.7	119.5	128	156.6	143.1	93.4	80.5	93.9	94.2	121.3
b	**WY2007**	141.9	152.5	145.6	132.3	156	165.7	137.2	108	82	73	127.4	127.9
c	**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
d	**WY2009**	98.5	141.8	122	142.5	150.2	142.9	170.7	96.8	81.8	85.8	82.8	73.4
e	**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
f	**WY2011**	78.8	81.9	163	166	151	176	84.9	91.6	98	98	155	112
	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	-5	9	5	1	1	-3	-1	9	7	3	-1

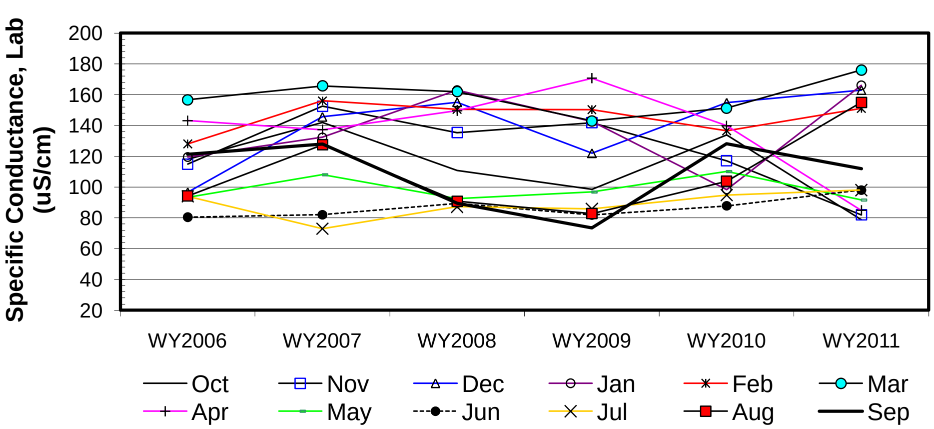
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33
$Z_k = S_k/\sigma_S$	-1.32	-0.94	1.69	0.94	0.19	0.19	-0.56	-0.19	1.69	1.32	0.56	-0.19
Z^2_k	1.73	0.88	2.86	0.88	0.04	0.04	0.32	0.04	2.86	1.73	0.32	0.04

ΣZ_k=	3.38
ΣZ^2_k=	11.72
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

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=		10.76	@α=5% $\chi^2_{(K-1)}$=	19.68	Test for station homogeneity	
	p	**0.463**			$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc}	0.92	@α/2=2.5% Z=	1.96	**H_0** (No trend)	ACCEPT
340.00	p	**0.822**			**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-2.19		4.08
0.050	-0.80	0.95	3.29
0.100	-0.28		2.83
0.200	0.12		2.34

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2006**	7.8	8.1	7.7	7.3	7.6	7.8	7.8	7.2	7.1	7.8	8.0	7.9
b	**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
c	**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
d	**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
e	**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
f	**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
	n	6	6	6	6	6	6	6	6	6	6	6	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	6	6	4	6	6	6	6	6	6	6	4	6
t_2	0	0	1	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	0	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	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	0	1	-7	-7	-5	1	-1	-1	-8	-1

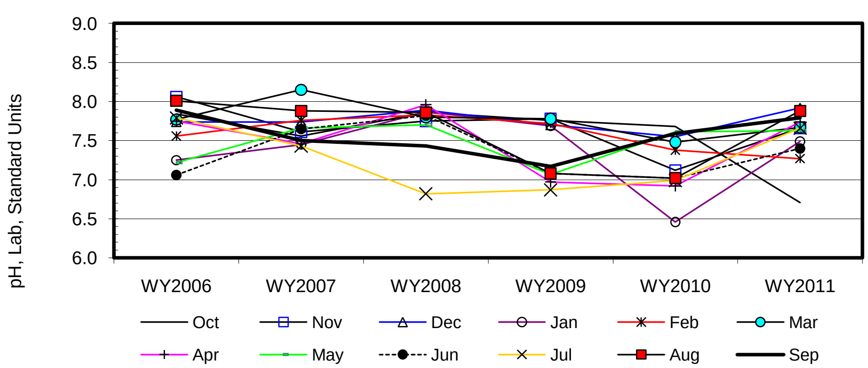
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	28.33	28.33	27.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	27.33	28.33
$Z_k = S_k/\sigma_S$	-1.32	-0.94	0.00	0.19	-1.32	-1.32	-0.94	0.19	-0.19	-0.19	-1.53	-0.19
Z^2_k	1.73	0.88	0.00	0.04	1.73	1.73	0.88	0.04	0.04	0.04	2.34	0.04

ΣZ_k= -7.54
ΣZ^2_k= 9.47
Z-bar=ΣZ_k/K= -0.63

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

Σn 72
ΣS_k -40

$\chi^2_h=\Sigma Z^2_k$-K(Z-bar)^2=	4.73	@α=5% $\chi^2_{(K-1)}$= 19.68	Test for station homogeneity	
p	**0.943**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k) Z_{calc}	-2.12	@α/2=2.5% Z= 1.96	H_0 (No trend)	REJECT
338.00 p	**0.017**		H_A (± trend)	ACCEPT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.10		0.00
0.050	-0.08	**-0.04**	-0.02
0.100	-0.07		-0.02
0.200	-0.06		-0.02

-0.6%

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	**WY2006**	43.2	43.9	38.6	47.2	42.3	53.4	44.6	37.7	30.9	40.7	41.6	46.8
b	**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
c	**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
d	**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
e	**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
f	**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
	n	6	6	6	6	6	6	6	6	6	6	6	6

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

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

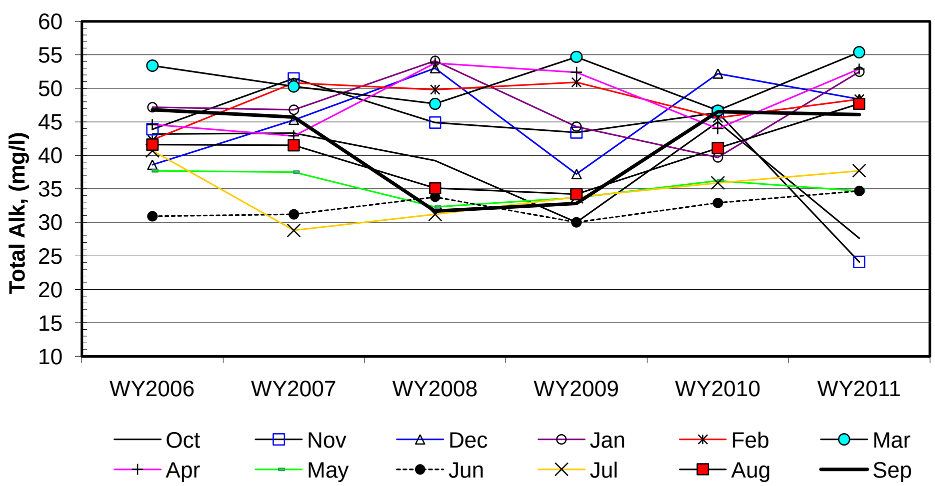
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33
$Z_k = S_k/\sigma_S$	-0.94	-0.94	0.56	-0.56	0.19	0.19	0.56	-0.94	1.32	0.94	-0.19	-0.19
Z^2_k	0.88	0.88	0.32	0.32	0.04	0.04	0.32	0.88	1.73	0.88	0.04	0.04

ΣZ_k= 0.00
ΣZ^2_k= 6.35
Z-bar=ΣZ_k/K= 0.00

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

Σn 72
ΣS_k 0

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	6.35	@α=5% $\chi^2_{(K-1)}$= 19.68	Test for station homogeneity	
p	**0.849**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc} 0.00	@α/2=2.5% Z= 1.96	**H_0** (No trend)	ACCEPT
340.00	p **0.500**		**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.60		0.79
0.050	-0.45	**-0.01**	0.51
0.100	-0.40		0.45
0.200	-0.28		0.34

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	**WY2006**	14.2	16.8	14.7	21.6	16.5	26.3	20.3	9.2	7.1	11.1	10.7	16.4
b	**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
c	**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
d	**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
e	**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
f	**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
	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	0	1	-1
c-b	1	-1	1	1	1	-1	1	-1	1	1	-1	-1
d-b	-1	1	-1	1	1	1	1	1	1	1	-1	-1
e-b	1	1	1	-1	-1	-1	1	1	1	1	-1	1
f-b	-1	-1	1	1	1	1	1	-1	1	1	1	1
d-c	-1	1	-1	-1	-1	1	1	1	1	1	1	1
e-c	1	1	1	-1	-1	-1	-1	1	1	1	1	1
f-c	-1	-1	1	1	1	1	1	1	1	1	1	1
e-d	1	1	1	-1	-1	-1	-1	1	1	-1	1	1
f-d	-1	-1	1	1	1	1	-1	-1	1	1	1	1
f-e	-1	-1	1	1	1	1	1	-1	1	1	1	1
S_k	-5	1	11	1	5	-3	5	3	13	4	7	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
$Z_k = S_k/\sigma_S$	-0.94	0.19	2.07	0.19	0.94	-0.56	0.94	0.56	2.44	0.77	1.32	0.19
Z^2_k	0.88	0.04	4.27	0.04	0.88	0.32	0.88	0.32	5.96	0.59	1.73	0.04

ΣZ_k= 8.09

ΣZ^2_k= 15.94

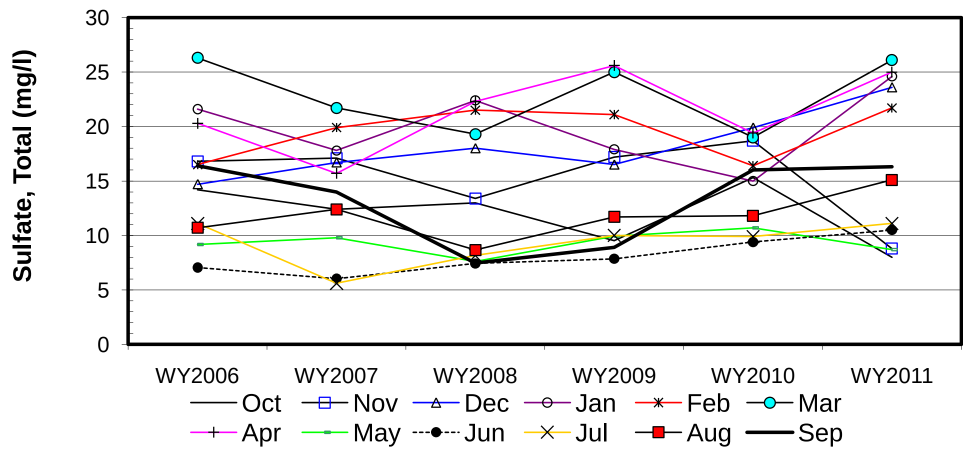
Z-bar=$\Sigma Z_k/K$= 0.67

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

Σn 72

ΣS_k 43

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	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
ΣVAR(S_k)	Z_{calc} 2.28	@α=5% Z=	1.64	**H_0** (No trend)	REJECT
339.00	p **0.989**			**H_A** (± trend)	ACCEPT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.01		0.94
0.050	0.13	**0.46**	0.74
0.100	0.27		0.66
0.200	0.30		0.60
		3.0%	

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	**WY2006**	6.2	6.4	5.9	5.4	8.0	5.0	13.8	2.9	1.7	2.1	3.8	4.7
b	**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
c	**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
d	**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
e	**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
f	**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
	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	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	0	1	1
S_k	5	9	7	7	11	7	-5	-5	9	12	1	3

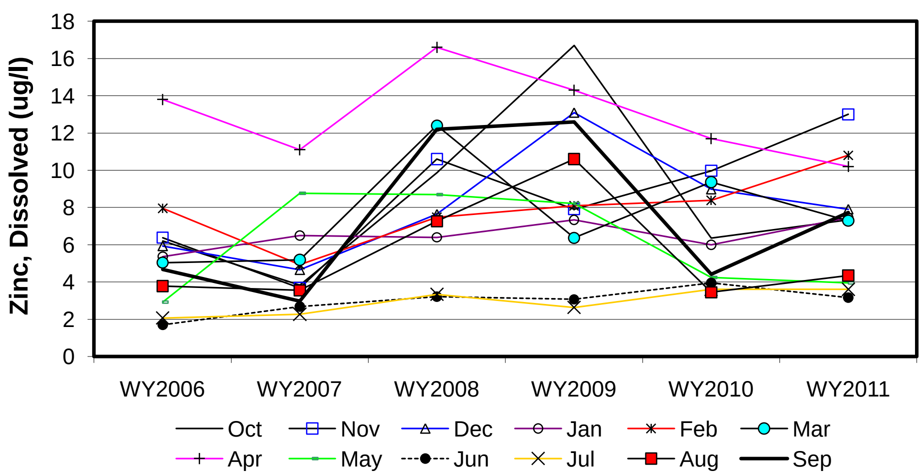
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	27.33	28.33	28.33
$Z_k = S_k/\sigma_S$	0.94	1.69	1.32	1.32	2.07	1.32	-0.94	-0.94	1.69	2.30	0.19	0.56
Z^2_k	0.88	2.86	1.73	1.73	4.27	1.73	0.88	0.88	2.86	5.27	0.04	0.32

ΣZ_k= 11.50
ΣZ^2_k= 23.44
Z-bar=ΣZ_k/K= 0.96

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

Σn 72
ΣS_k 61

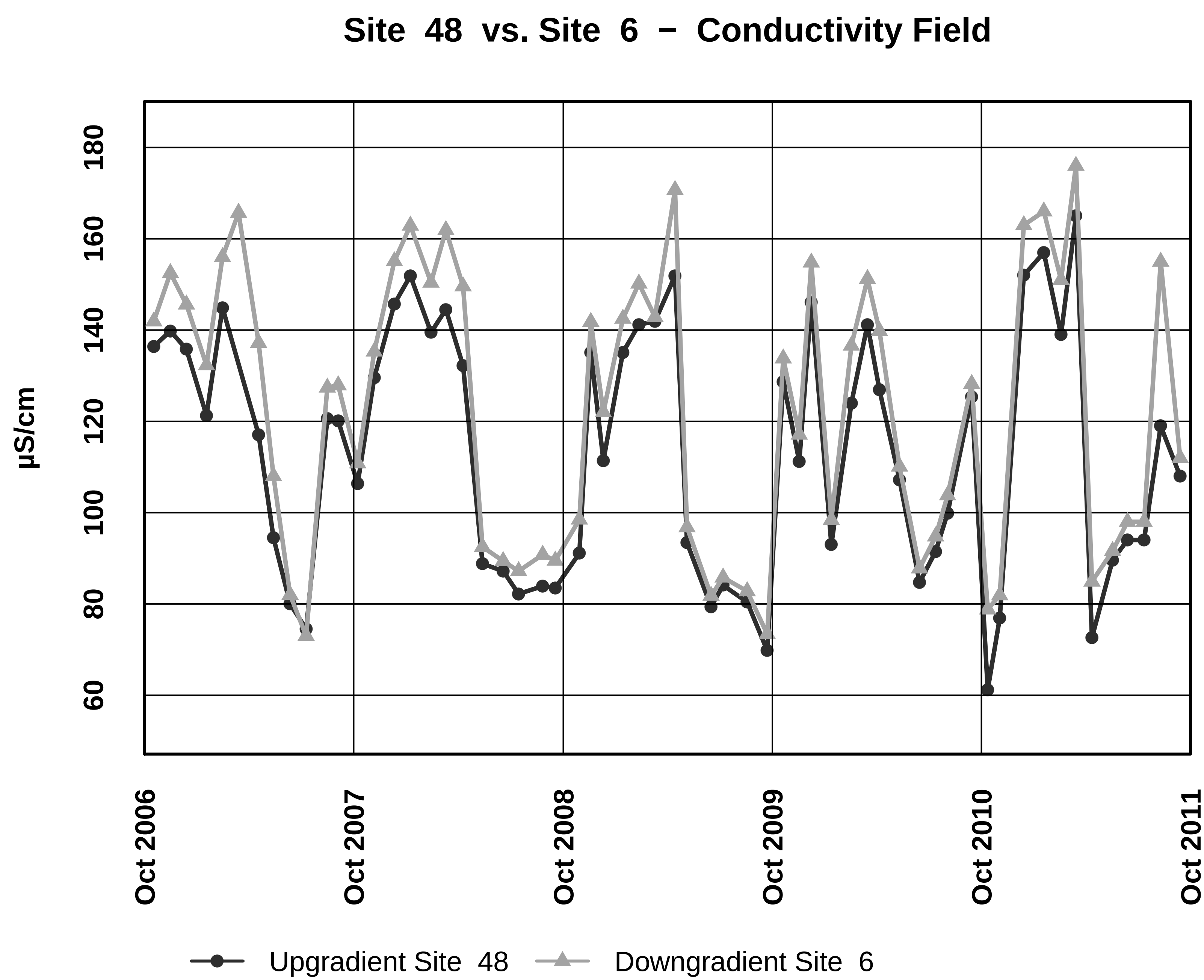
$\chi^2_h = \Sigma Z^2_k - K(\text{Z-bar})^2$=	12.42	@α=5% $\chi^2_{(K-1)}$= 19.68	Test for station homogeneity	
p	**0.333**		$\chi^2_h < \chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k) Z_{calc}	3.26	@α/2=2.5% Z= 1.96	**H_0** (No trend)	REJECT
339.00 **p**	**0.999**		**H_A** (± trend)	ACCEPT



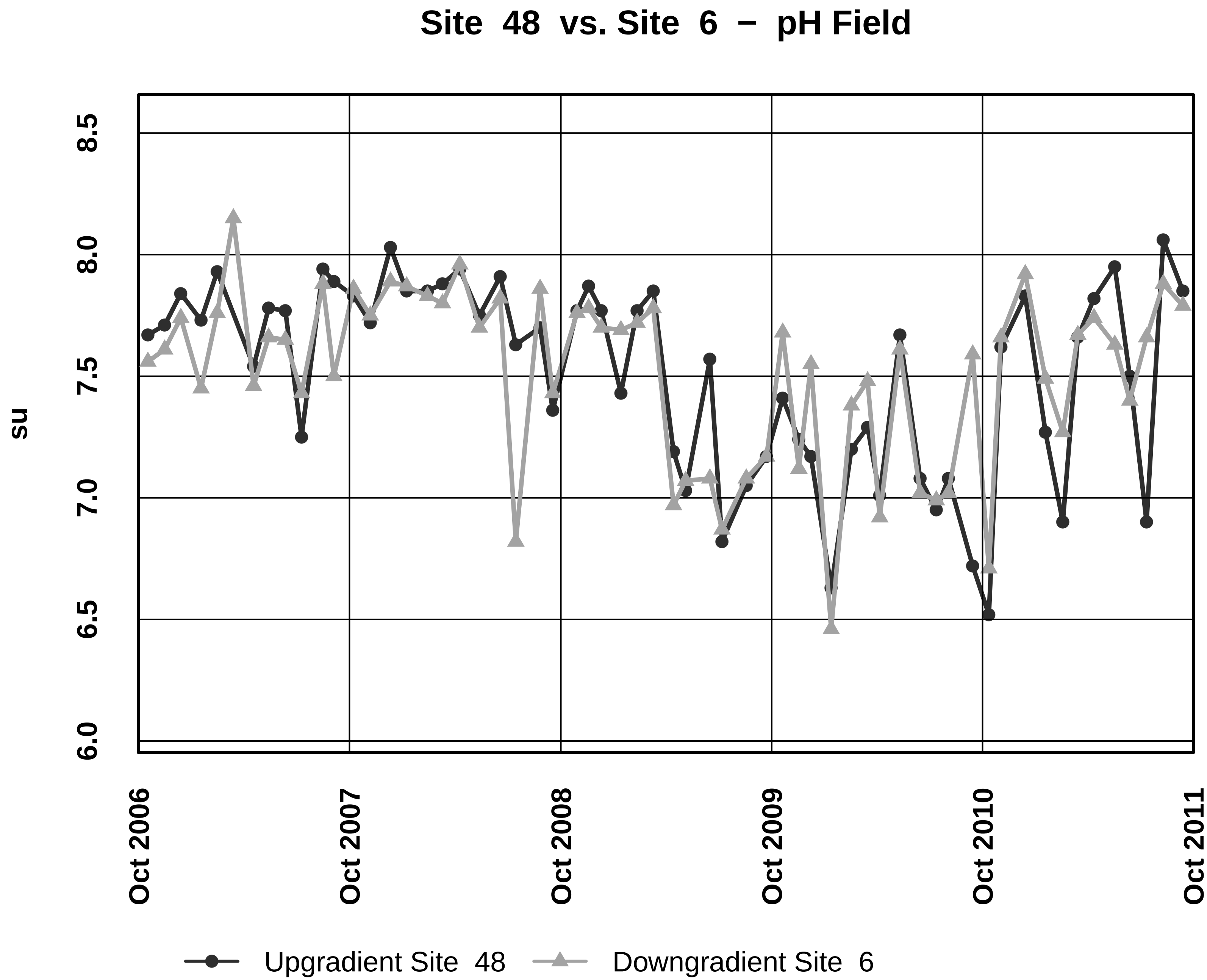
Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	0.12		0.61
0.050	0.19	**0.39**	0.52
0.100	0.20		0.48
0.200	0.25		0.45

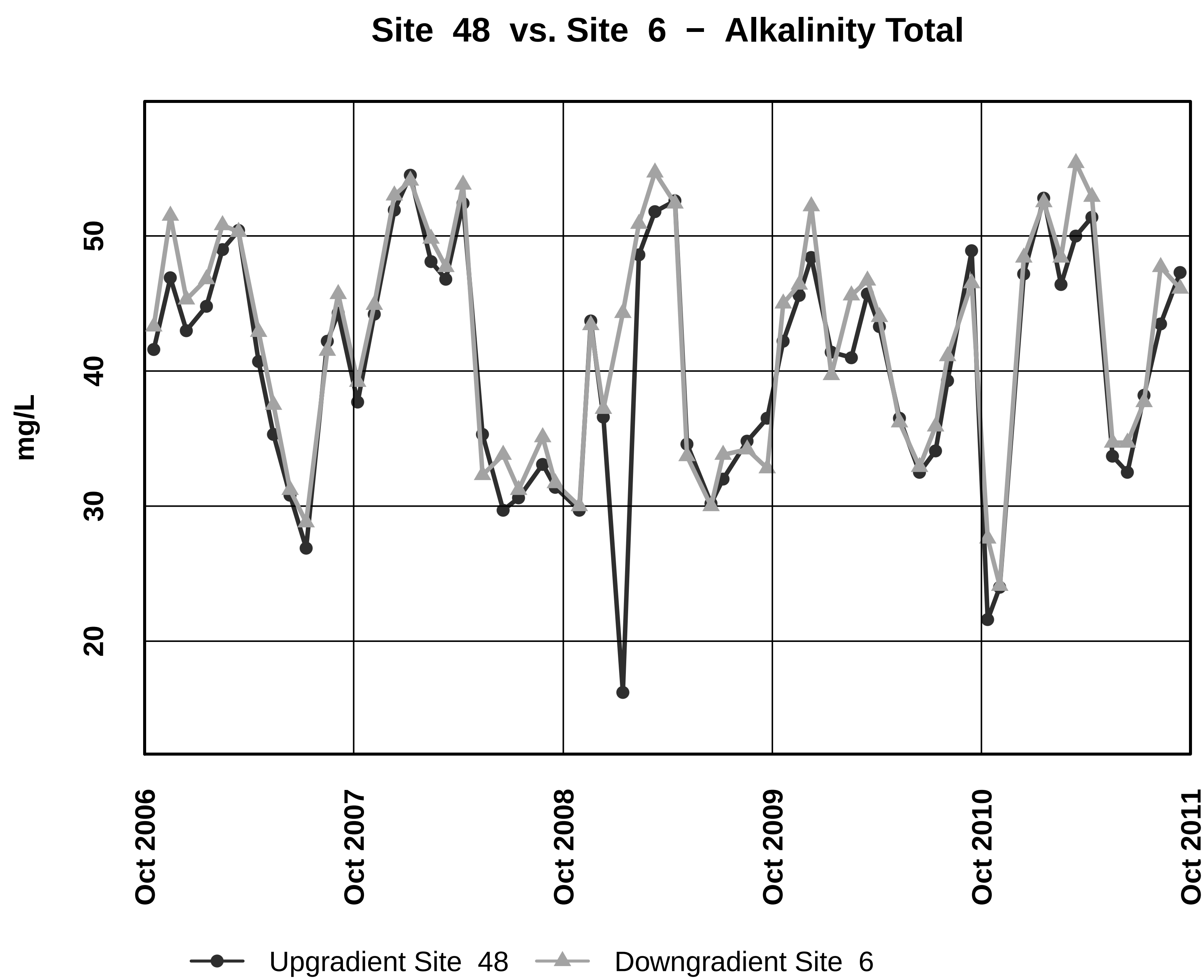
6.1%



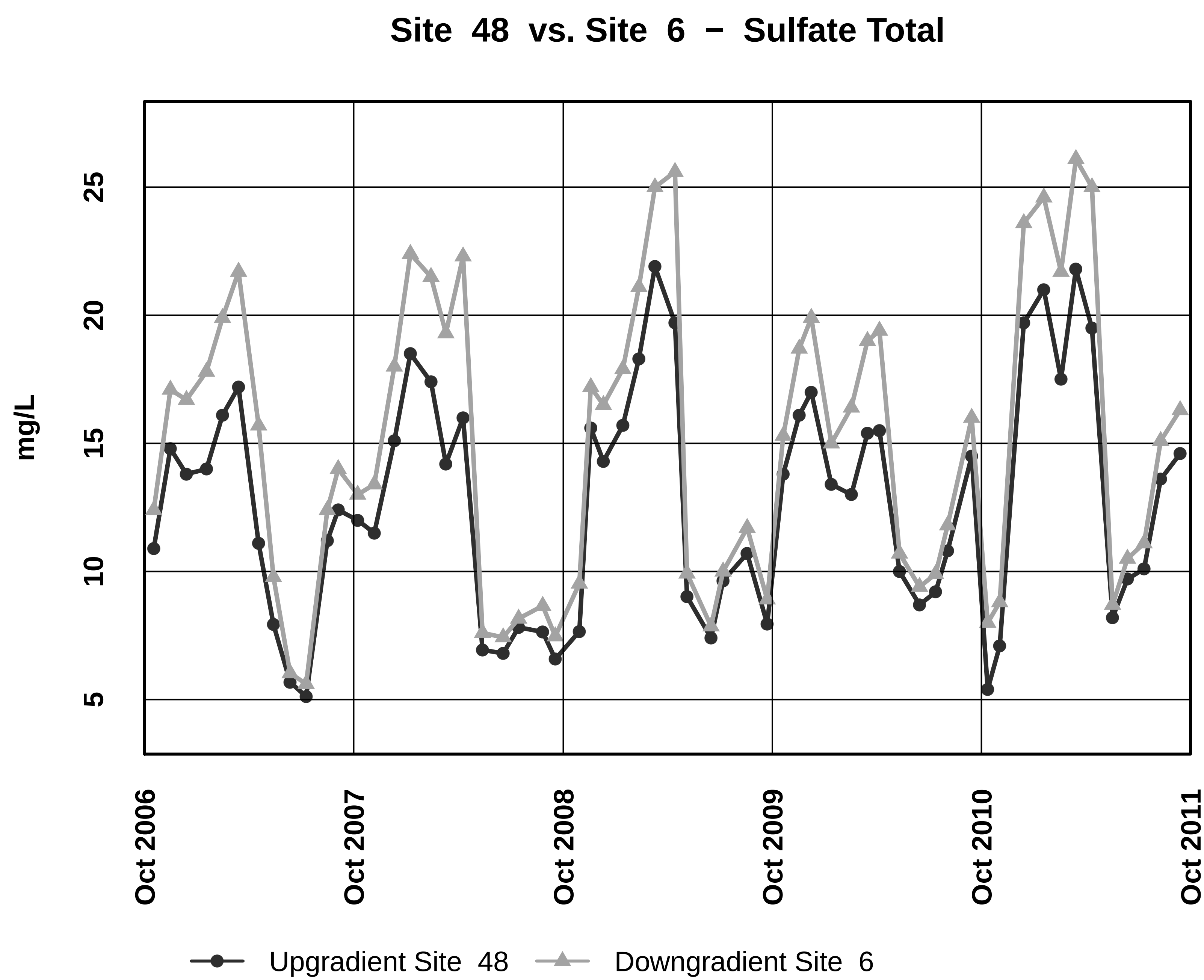
Site 48 vs. Site 6 − Conductivity Field
µS/cm
60
80
100
120
140
160
180
Oct 2006
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 48
Downgradient Site 6

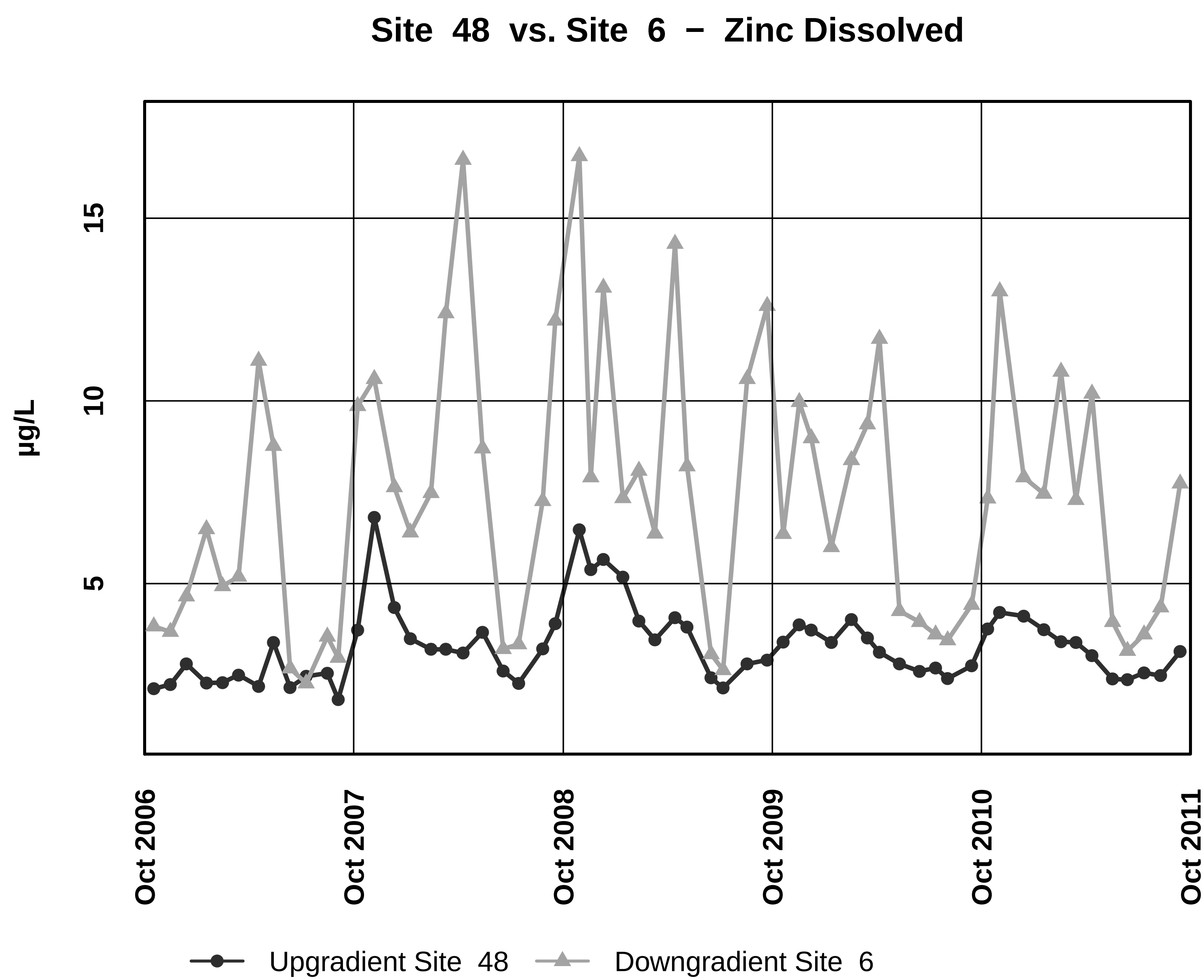


Site 48 vs. Site 6 − pH Field
su
8.5
8.0
7.5
7.0
6.5
6.0
Oct 2006
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 48
Downgradient Site 6



Site 48 vs. Site 6 − Alkalinity Total
mg/L
20
30
40
50
Oct 2006
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 2006
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 2006
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, Lab (uS/cm)**

	X	**Y**	Differences		
Site	#48	#6			
Year	WY2011	WY2011	**D**	**|D|**	**Rank**
Oct	61.2	78.8	-17.6	17.6	-11
Nov	76.9	81.9	-5.0	5.0	-5
Dec	152.0	163.0	-11.0	11.0	-7.5
Jan	157.0	166.0	-9.0	9.0	-6
Feb	139.0	151.0	-12.0	12.0	-9
Mar	165.0	176.0	-11.0	11.0	-7.5
Apr	72.6	84.9	-12.3	12.3	-10
May	89.6	91.6	-2.0	2.0	-1
Jun	94.0	98.0	-4.0	4.0	-3
Jul	94.0	98.0	-4.0	4.0	-3
Aug	119.0	155.0	-36.0	36.0	-12
Sep	108.0	112.0	-4.0	4.0	-3
Median	101.0	105.0	-10.0	10.0	

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, Lab, Standard Units**

	X	**Y**			
Site	#48	#6	Differences		
Year	WY2011	WY2011	**D**	**|D|**	**Rank**
Oct	6.52	6.71	-0.19	0.19	-8
Nov	7.62	7.66	-0.04	0.04	-2
Dec	7.83	7.92	-0.09	0.09	-5
Jan	7.27	7.49	-0.22	0.22	-9
Feb	6.90	7.27	-0.37	0.37	-11
Mar	7.66	7.67	-0.01	0.01	-1
Apr	7.82	7.74	0.08	0.08	4
May	7.95	7.63	0.32	0.32	10
Jun	7.50	7.40	0.10	0.10	6
Jul	6.90	7.66	-0.76	0.76	-12
Aug	8.06	7.88	0.18	0.18	7
Sep	7.85	7.79	0.06	0.06	3
Median	7.64	7.66	-0.03	0.14	

n	**m**
12	12

N= 12
$\Sigma R=$ -18

α
95.0%
W'$_{\alpha,n}$
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	WY2011	WY2011	**D**	**|D|**	**Rank**
Oct	21.6	27.6	-6.0	6.0	-12
Nov	24.0	24.1	-0.1	0.1	-1
Dec	47.2	48.4	-1.2	1.2	-5.5
Jan	52.8	52.5	0.3	0.3	2
Feb	46.4	48.4	-2.0	2.0	-8
Mar	50.0	55.4	-5.4	5.4	-11
Apr	51.4	52.9	-1.5	1.5	-7
May	33.7	34.7	-1.0	1.0	-4
Jun	32.5	34.7	-2.2	2.2	-9
Jul	38.2	37.7	0.5	0.5	3
Aug	43.5	47.7	-4.2	4.2	-10
Sep	47.3	46.1	1.2	1.2	5.5
Median	45.0	46.9	-1.4	1.4	

n	**m**
12	12

N= 12

$\Sigma R =$ -57

α
95.0%
W'$_{\alpha,n}$
59

$W^{+}=$
10.5
p-test
0.010

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	WY2011	WY2011	**D**	**|D|**	**Rank**
Oct	5.4	8.0	-2.6	2.6	-7
Nov	7.1	8.8	-1.7	1.7	-5.5
Dec	19.7	23.6	-3.9	3.9	-9
Jan	21.0	24.6	-3.6	3.6	-8
Feb	17.5	21.7	-4.2	4.2	-10
Mar	21.8	26.1	-4.3	4.3	-11
Apr	19.5	25.0	-5.5	5.5	-12
May	8.2	8.7	-0.5	0.5	-1
Jun	9.7	10.5	-0.8	0.8	-2
Jul	10.1	11.1	-1.0	1.0	-3
Aug	13.6	15.1	-1.5	1.5	-4
Sep	14.6	16.3	-1.7	1.7	-5.5
Median	14.1	15.7	-2.2	2.2	

n	m
12	12

N= 12
ΣR= -78

α
5.0%
W'$_{\alpha,n}$
17

W^+=
0
p-test
0.000

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

Wilcoxon-signed-ranks test

Exact Form

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

	X	**Y**	Differences		
Site	#48	#6			
Year	WY2011	WY2011	**D**	**|D|**	**Rank**
Oct	3.76	7.33	-3.57	3.57	-5
Nov	4.21	13.00	-8.79	8.79	-12
Dec	4.11	7.91	-3.80	3.80	-7
Jan	3.74	7.46	-3.72	3.72	-6
Feb	3.41	10.80	-7.39	7.39	-11
Mar	3.39	7.29	-3.90	3.90	-8
Apr	3.03	10.20	-7.17	7.17	-10
May	2.39	3.95	-1.56	1.56	-3
Jun	2.37	3.16	-0.79	0.79	-1
Jul	2.56	3.61	-1.05	1.05	-2
Aug	2.48	4.35	-1.87	1.87	-4
Sep	3.14	7.74	-4.60	4.60	-9
Median	3.27	7.40	-3.76	3.76	

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**

INTERPRETIVE REPORT
SITE 54 “LOWER GREENS CREEK”

The data collected during the current water year are listed in the following “Table of Results for Water Year 2011” 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 2006 through September 2011.				

The data for water year 2011 have been compared to the strictest fresh water quality criterion for each applicable analyte. No results exceeding these criteria have been identified.

Table of Exceedance for Water Year 2011

			Limits		
Sample Date	**Parameter**	**Value**	**Lower**	**Upper**	**Hardness**
No exceedances have been identified by HGCMC for the period of October 2010 through September 2011.					

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 identifiable trends in dissolved chromium and field pH. Dissolved chromium increased an order of magnitude during the 2010 water year; however during the 2011 water year dissolved chromium decreased to a value more in accordance with previous year’s values. A similar decrease was also noted for Site 6, Site 13, Site 46, Site 48, Site 49, and Site 54; all sites that are located in the 920 area.

A visual trend commented on last year was the decrease in field pH that began in the winter/spring of 2009. During the 2011 water year pH values generally increased to historic values and were no longer approaching the lower pH limit of 6.5 su.

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 table below summarizes the results on the data collected between Oct-05 and Sep-11 (WY2006-WY2011).

Table of Summary Statistics for Trend Analysis

	Mann-Kendall test statistics			Sen's slope estimate	
Parameter	**n***	**p****	**Trend**	**Q**	**Q(%)**
Conductivity Field	6	0.16			
pH Field	6	<0.01	-	-0.07	-0.9
Alkalinity, Total	6	0.46			
Sulfate, Total	6	0.01	+	0.40	2.6
Zinc, Dissolved	6	<0.01	+	0.33	5.2

* Number of Years ** Significance level

A statistically significant decreasing trend was calculated for field pH, with a slope estimate of -0.07 su/yr or a 0.9% decrease. Dissolved zinc had a statistically significant ($p < 0.01$) trend with a slope estimate of 0.32 µg/L/yr or a 5.2% increase. Furthermore, total sulfate had a statistically significant ($p=0.01$) trend with a slope estimate of 0.40 µg/L/yr or 2.6% 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 2011 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	0.017	105	107	-2.9
pH Field	0.897	7.66	7.52	0.11
Alkalinity, Total	0.055	46.9	47.2	-0.9
Sulfate, Total	<0.01	15.7	15.90	-0.30
Zinc, Dissolved	0.968	7.4	6.66	0.46

The median values for pH for Site 6 and Site 54 are 7.66 su and 7.52 su respectively and the median of differences, Site 6 minus Site 54, is 0.11 su. Site 54 has intermittently (6 out of 9) had statistically significantly lower pH readings for the prior nine water years (WY2002 and WY2010). 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 15.7 mg/L and 15.9 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 - WY2010 total sulfate datasets.

Along with the significant difference in total sulfate there was significant difference in field conductivity. Upgradient the median conductivity value was 105 µs/cm and the downgradient median value was 107 µs/cm, resulting in a -2.9 µs/cm median difference.
Datasets from WY2002 – WY2010 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 2011

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

Sample Date/Parameter	Oct 2010	Nov 2010	Dec 2010	Jan 2011	Feb 2011	Mar 2011	Apr 2011	May 2011	Jun 2011	Jul 2011	Aug 2011	Sep 2011	**Median**
Water Temp (°C)	4.6	3.9	0.0	0.1	0.0	0.3	1.1	2.5	4.7	6.9	8.2	8	3.2
Conductivity-Field(µmho)	86.7	84.7	167	169	157	180	98.9	93.9	99	100	127	114	107.0
Conductivity-Lab (µmho)	92	81	157	167	156	185	180	98	88	104	127	137	132
pH Lab (standard units)	6.7	5.98	5.88	7.6	8	7.71	7.76	7.59	7.62	7.26	7.64	7.78	7.61
pH Field (standard units)	6.76	7.62	7.74	7.49	7.65	7.42	7.4	7.27	6.9	7.86	7.54	7.82	7.52
Total Alkalinity (mg/L)	30.4	25.4	53.3	53.5	48.9	56.9	53.1	35.5	34	35.8	46.7	47.6	47.2
Total Sulfate (mg/L)	8.9	8.9	24.1	25	22.4	26.8	25.8	8.7	10.6	11.2	15.3	16.5	15.9
Hardness (mg/L)	42.8	38.9	77.7	76.4	75.6	84.4	80.9	45.4	45.3	51.3	61.4	67.1	64.3
Dissolved As (ug/L)	0.241	0.212	0.154	0.187	0.164	0.183	0.173	0.172	0.224	0.197	0.2	0.202	0.192
Dissolved Ba (ug/L)			31.3		30.2								30.8
Dissolved Cd (ug/L)	0.0538	0.0698	0.0563	0.0505	0.0624	0.0475	0.0635	0.0367	0.0428	0.0349	0.0453	0.0573	0.0522
Dissolved Cr (ug/L)			1.62		1.29								1.455
Dissolved Cu (ug/L)	0.663	1.1	0.318	0.344	0.49	0.28	0.475	0.471	0.386	0.284	0.424	0.405	0.415
Dissolved Pb (ug/L)	0.168	0.135	0.0126	0.0172	0.039	0.013	0.0411	0.0296	0.0824	0.0048	0.0177	0.0033	0.0237
Dissolved Ni (ug/L)			1.31		1.59								1.450
Dissolved Ag (ug/L)			0.004		0.002								0.003
Dissolved Zn (ug/L)	7.53	11.8	6.86	6.46	9.33	6.45	10.5	3.76	3.69	3.65	4.24	7.02	6.66
Dissolved Se (ug/L)			1.41		1.5								1.455
Dissolved Hg (ug/L)	0.00179	0.00324	0.000584	0.00027	0.000784	0.000503	0.000744	0.000957	0.00106	0.000475	0.000517	0.00084	0.000764

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: 10/01/2010 to 09/30/2011

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
54	10/12/2010	10:50 AM				
			pH Lab, su	6.7	R	Hold Time Violation
			SO4 Tot, mg/l	8.9	J	Sample Receipt Temperature
54	12/14/2010	12:00 AM				
			Pb diss, µg/l	0.0126	U	Field Blank Contamination
			Hg diss, µg/l	0.000584	U	Field Blank Contamination
			Pb diss, µg/l	0.0126	U	Field Blank Contamination
			Hg diss, µg/l	0.000584	U	Field Blank Contamination
54	1/18/2011	8:24 AM				
			pH Lab, su	7.6	J	Hold Time Violation
			Zn diss, µg/l	6.46	U	Field Blank Contamination
			Pb diss, µg/l	0.01	U	Field Blank Contamination
			Hg diss, µg/l	0.00027	U	Field Blank Contamination
			SO4 Tot, mg/l	25	J	Sample Reciept Temperature
54	2/17/2011	12:00 AM				
			Pb diss, µg/l	0.03	U	Field Blank Contamination
54	3/14/2011	12:00 AM				
			pH Lab, su	7.71	J	Hold Time Violation
			SO4 Tot, mg/l	26.8	J	Sample Reciept Temperature
			Pb diss, µg/l	0.01	U	Field Blank Contamination
			Hg diss, µg/l	0.000503	U	Field Blank Contamination
54	4/12/2011	12:00 AM				
			pH Lab, su	7.76	J	Hold Time Violation
			Hg diss, µg/l	0.000744	U	Field Blank Contamination
54	5/18/2011	12:00 AM				
			SO4 Tot, mg/l	8.7	J	Sample Reciept Temperature
			pH Lab, su	7.59	J	Hold Time Violation
			Cd diss, µg/l	0.0367	U	Trip Blank Contamination
			Pb diss, µg/l	0.0296	U	Field Blank Contamination
54	6/13/2011	12:00 AM				
			SO4 Tot, mg/l	10.6	J	Sample Reciept Temperature
			Hg diss, µg/l	0.00106	J	LCS Recovery

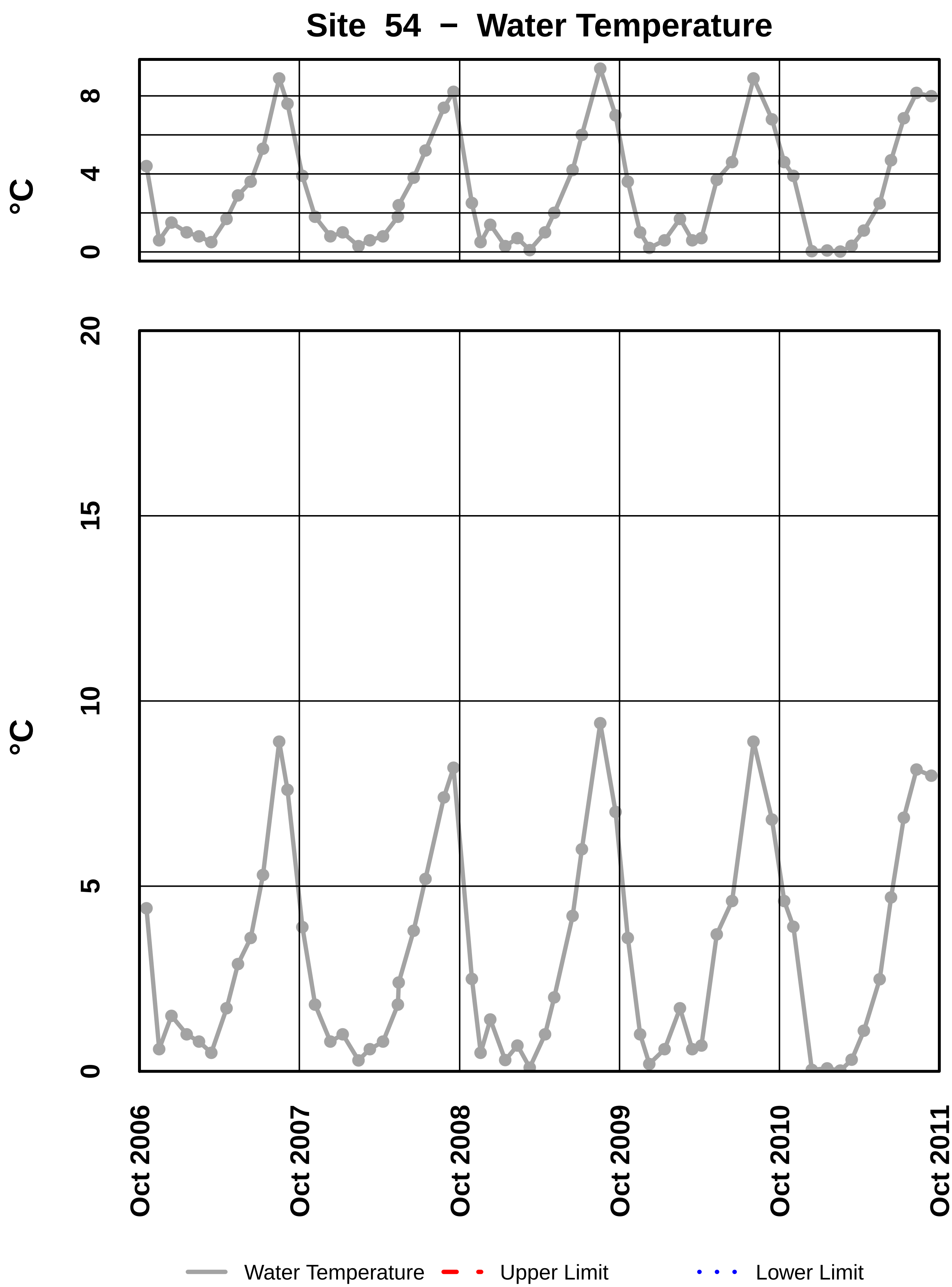
Qualifier	Description
J	Positively Identified - Approximate concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit

Qualified Data by QA Reviewer

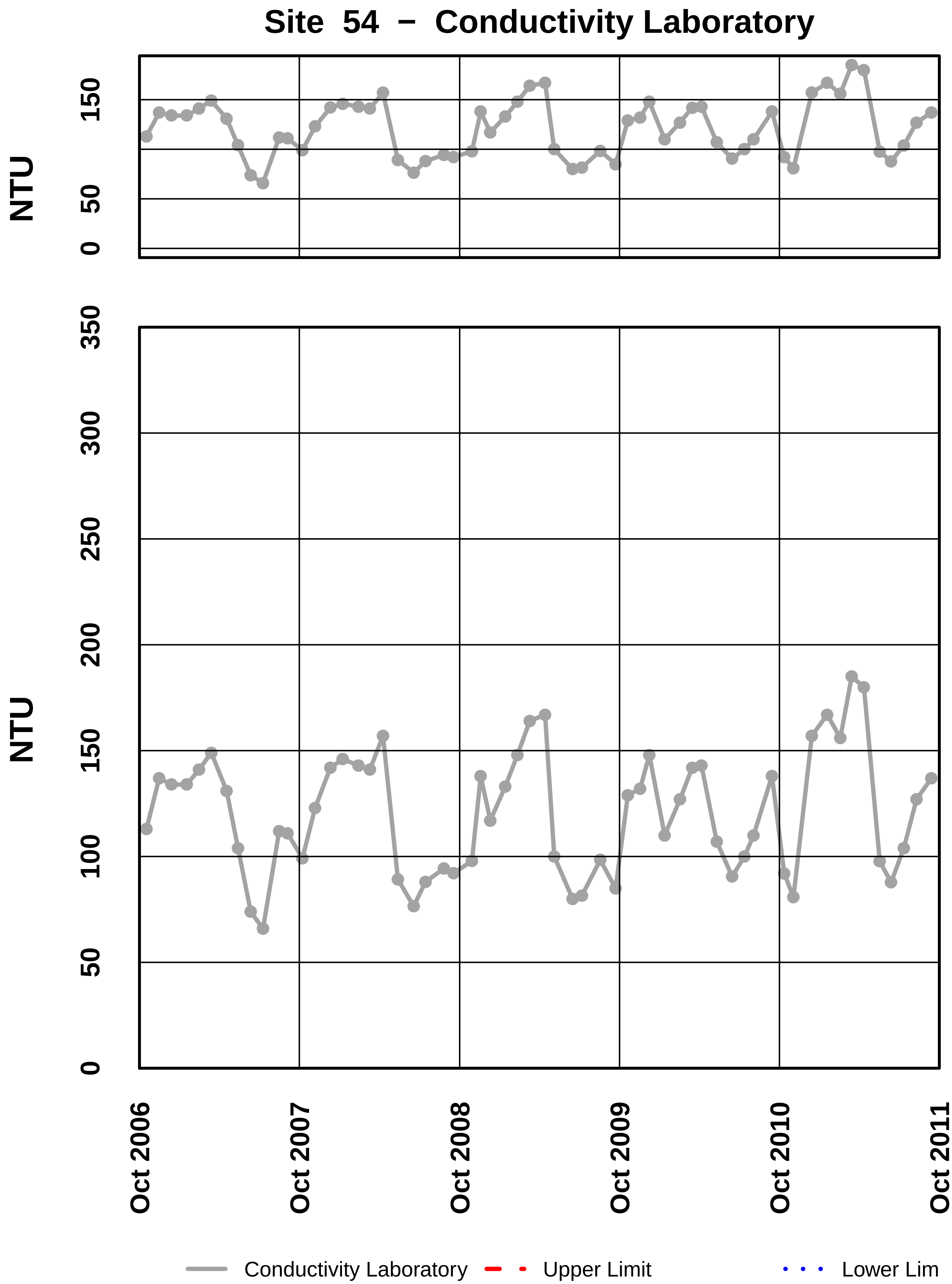
Date Range: 10/01/2010 to 09/30/2011

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
54	7/12/2011	12:00 AM				
			Pb diss, µg/l	0.0048	J	Below Quantitative Range
			SO4 Tot, mg/l	11.2	J	Sample Reciept Temperature
			Hg diss, µg/l	0.000475	U	Field Blank Contamination
54	8/10/2011	12:00 AM				
			SO4 Tot, mg/l	15.3	J	Sample Receipt Temperature
			pH Lab, su	7.64	J	Hold Time Violation
			Hg diss, µg/l	0.000517	U	Field Blank Contamination
54	9/13/2011	12:00 AM				
			Pb diss, µg/l	0.00326	U	Trip Blank Contamination
			Hg diss, µg/l	0.00084	U	Field Blank Contamination

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

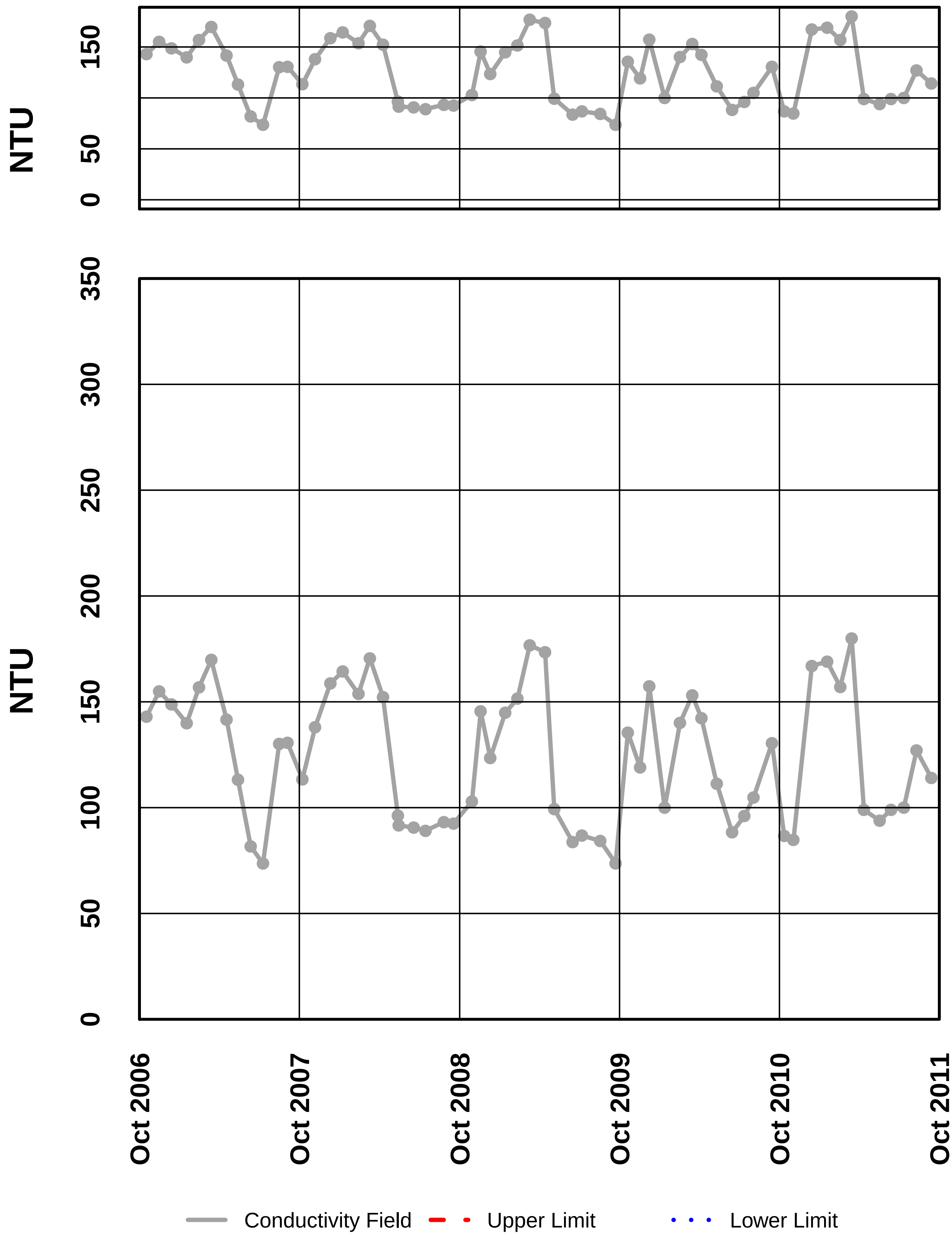


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

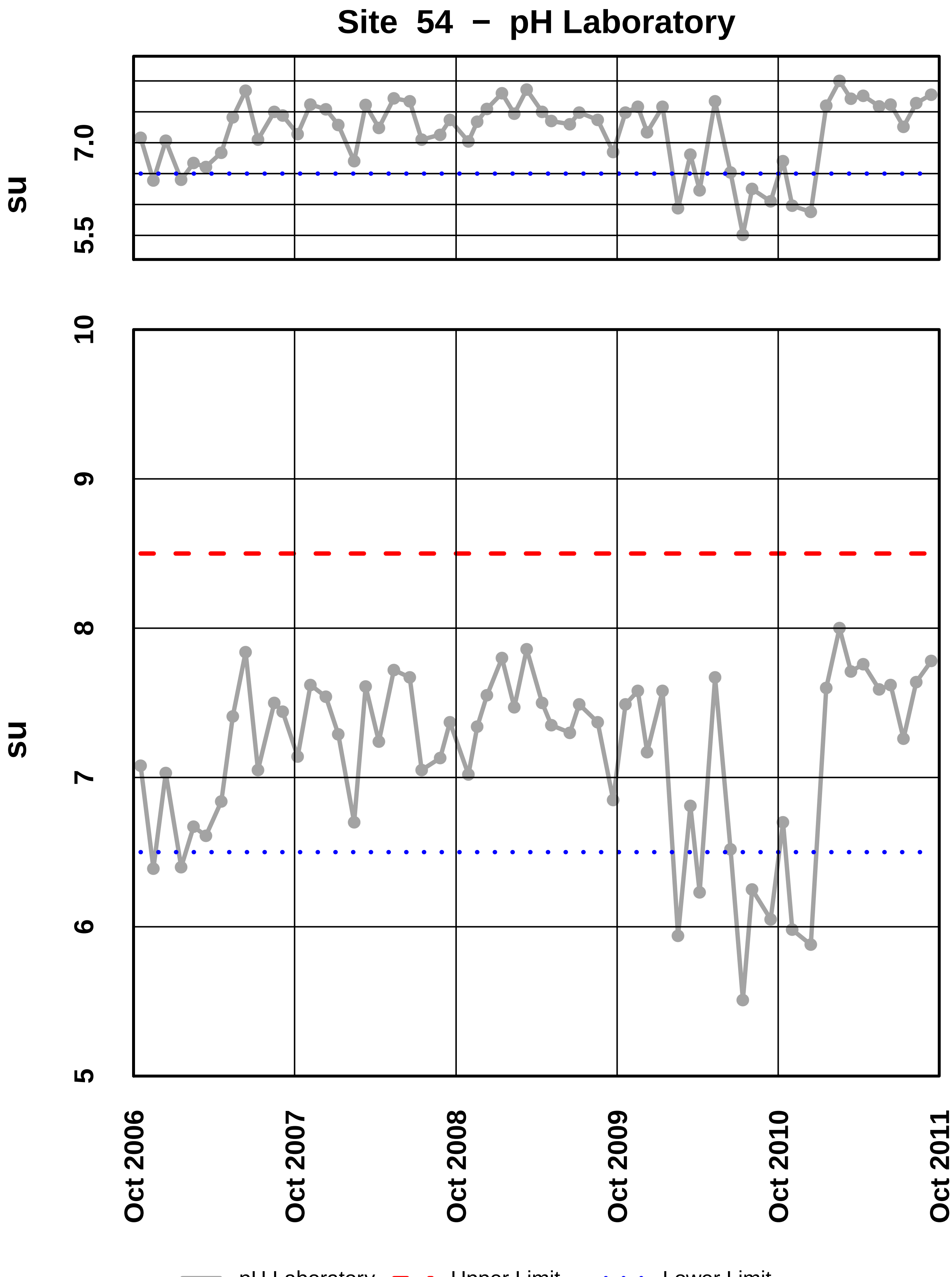


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

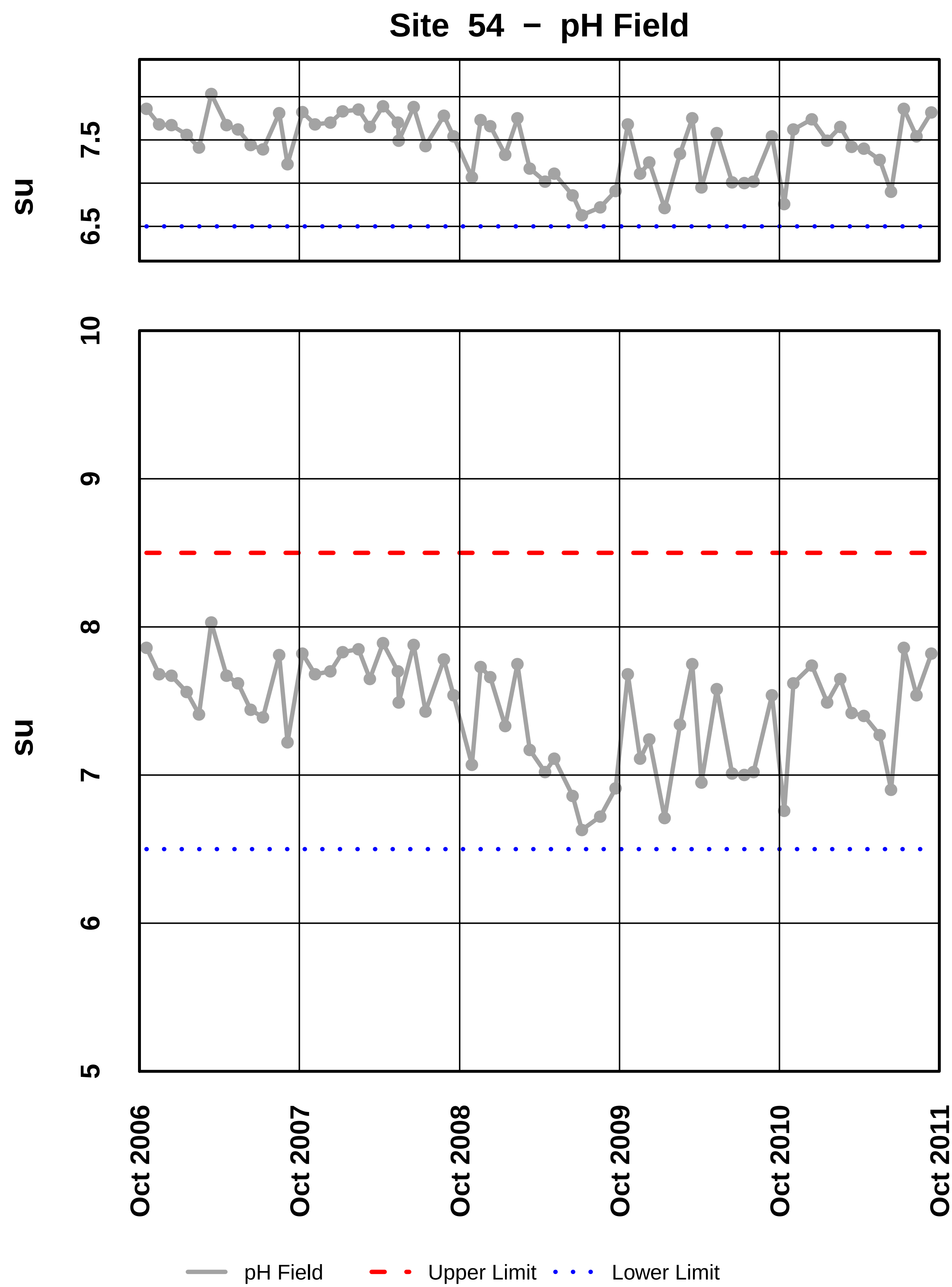
Site 54 – Conductivity Field



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

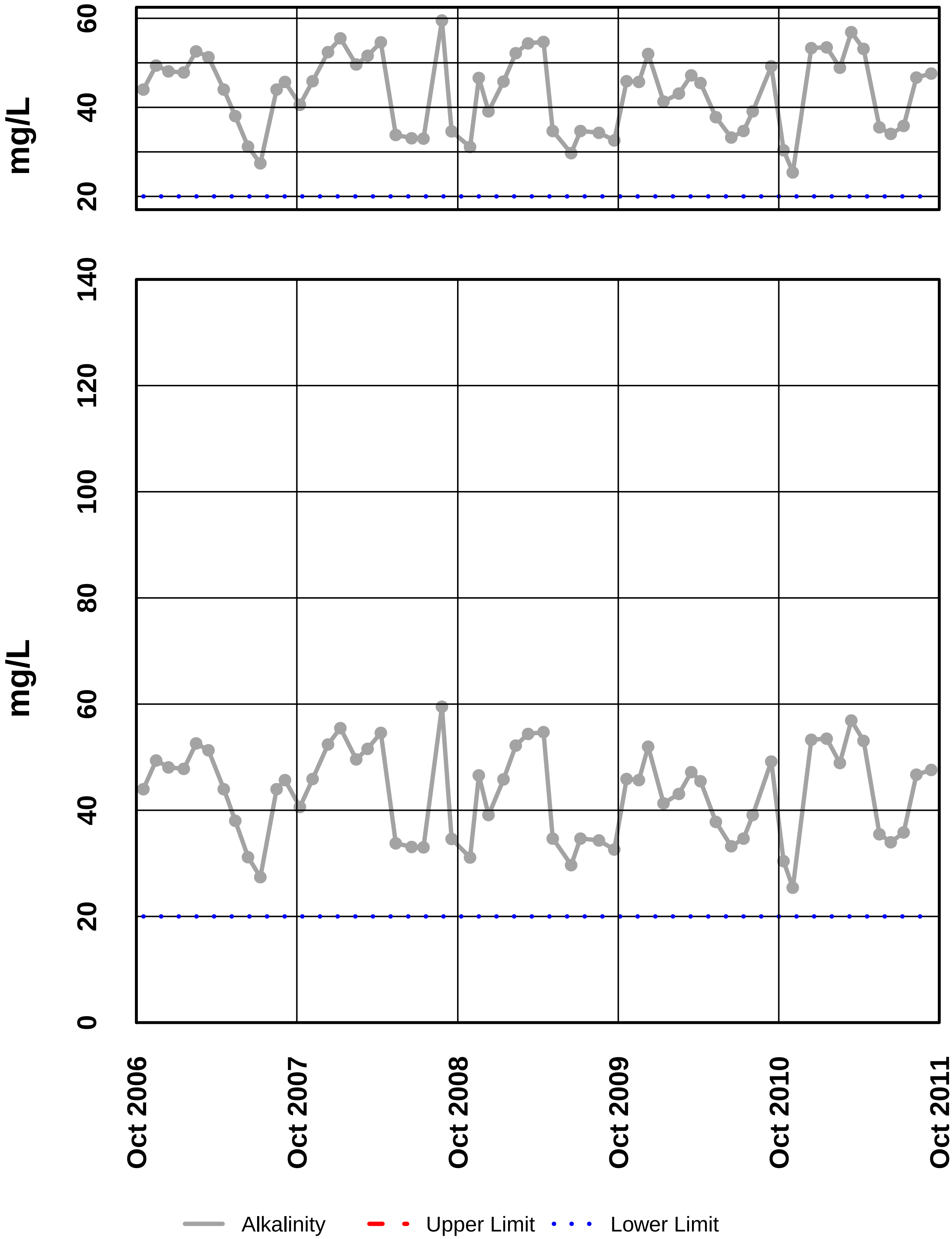


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



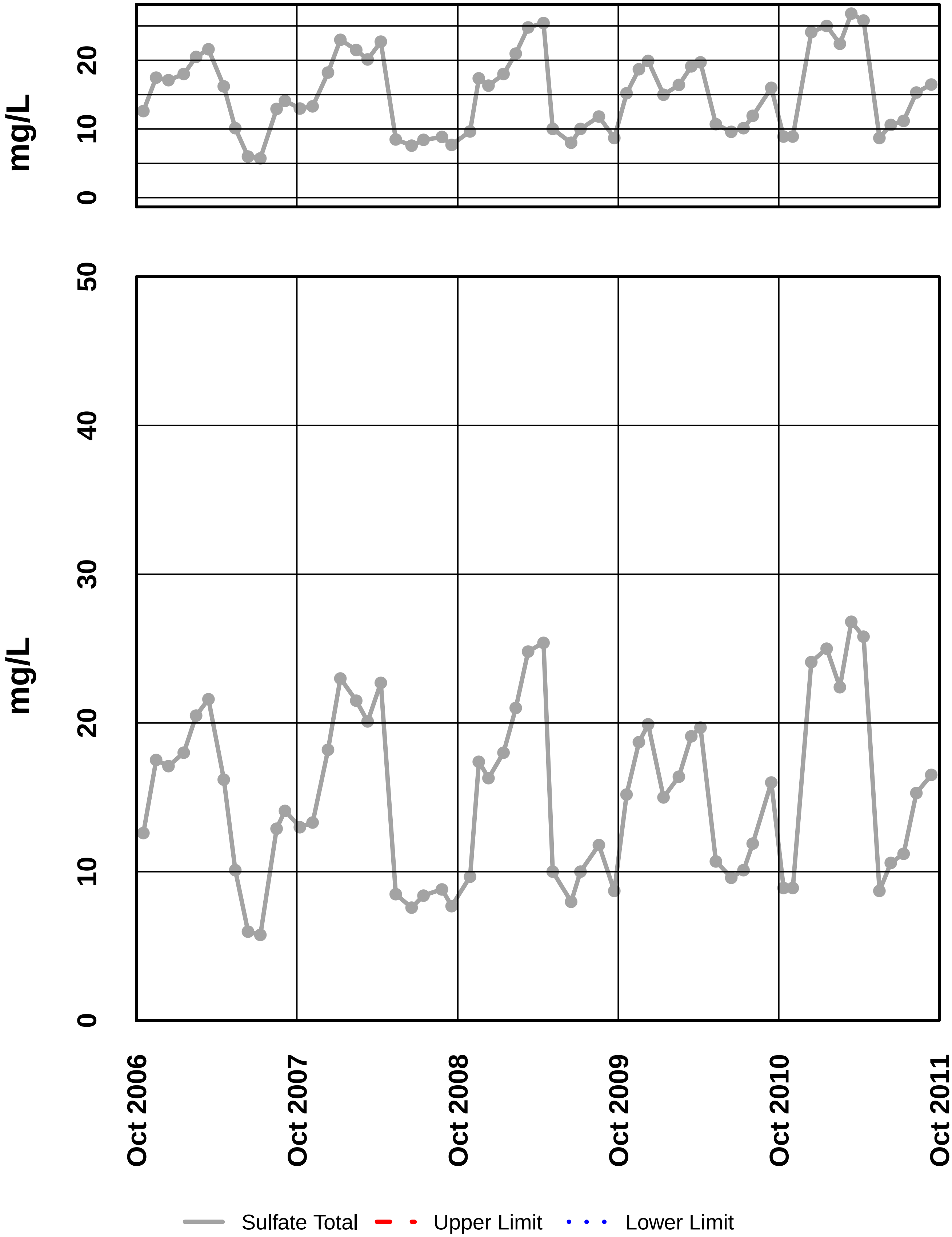
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 54 – Alkalinity



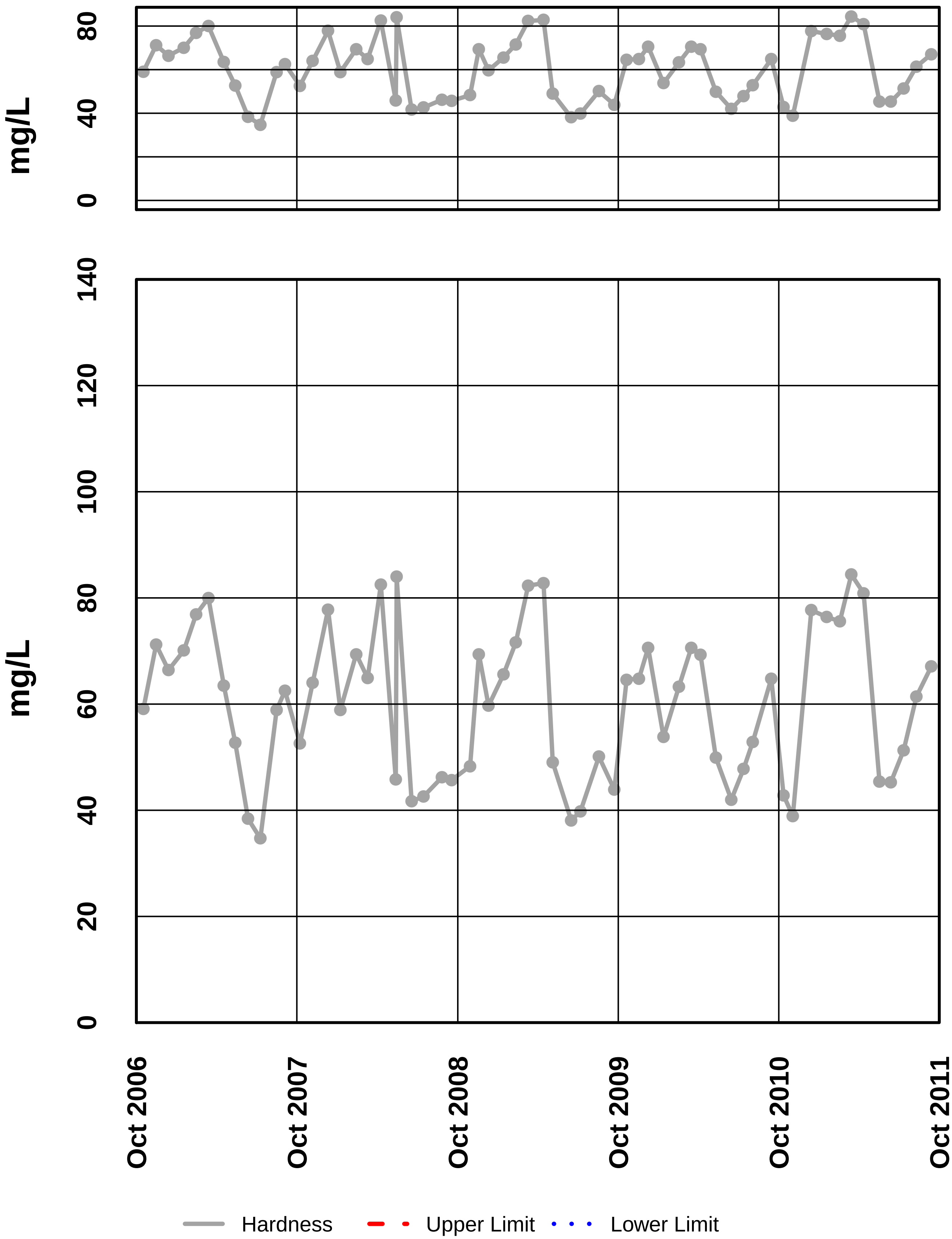
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 54 − Sulfate Total

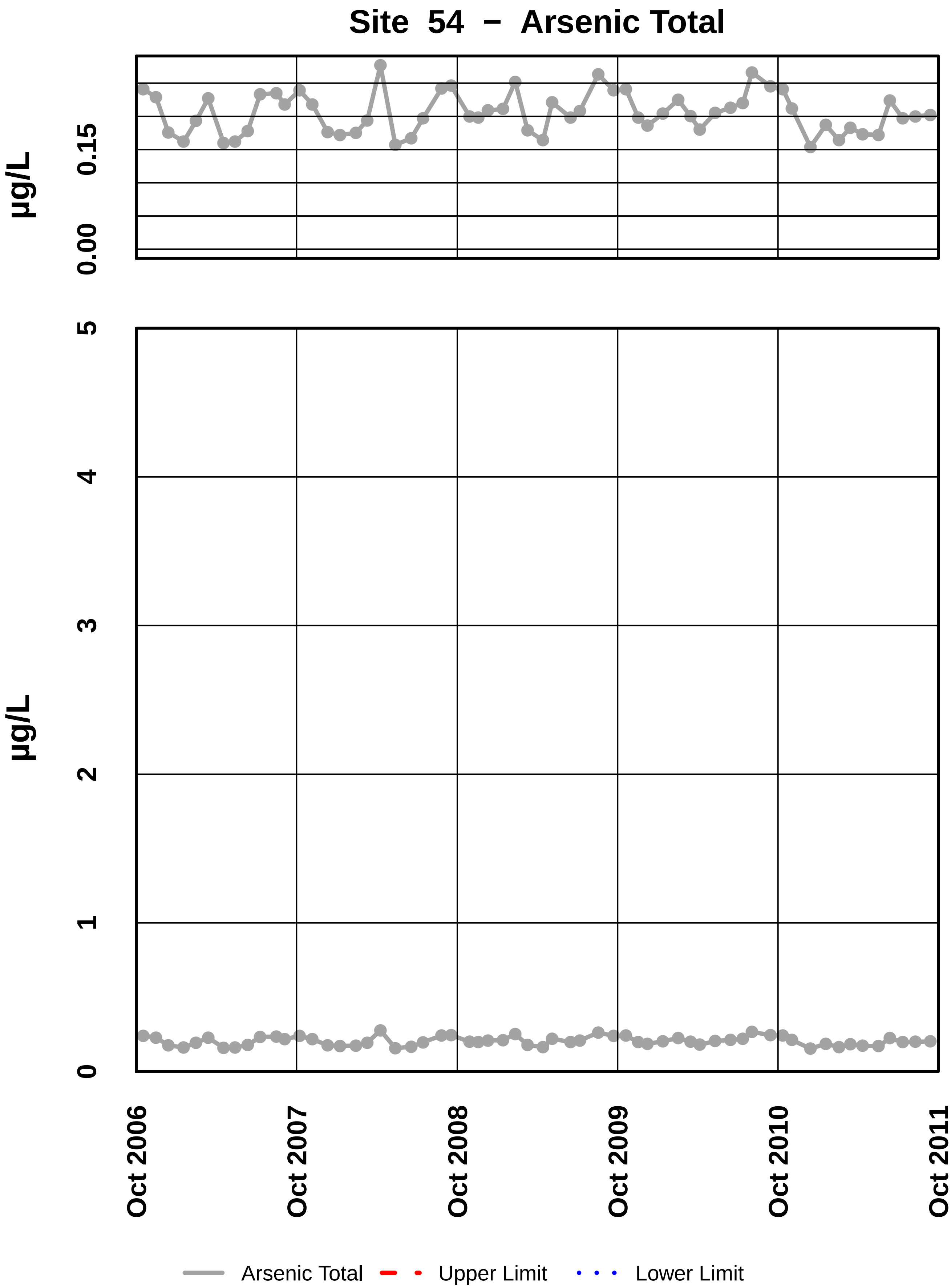


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 54 − Hardness

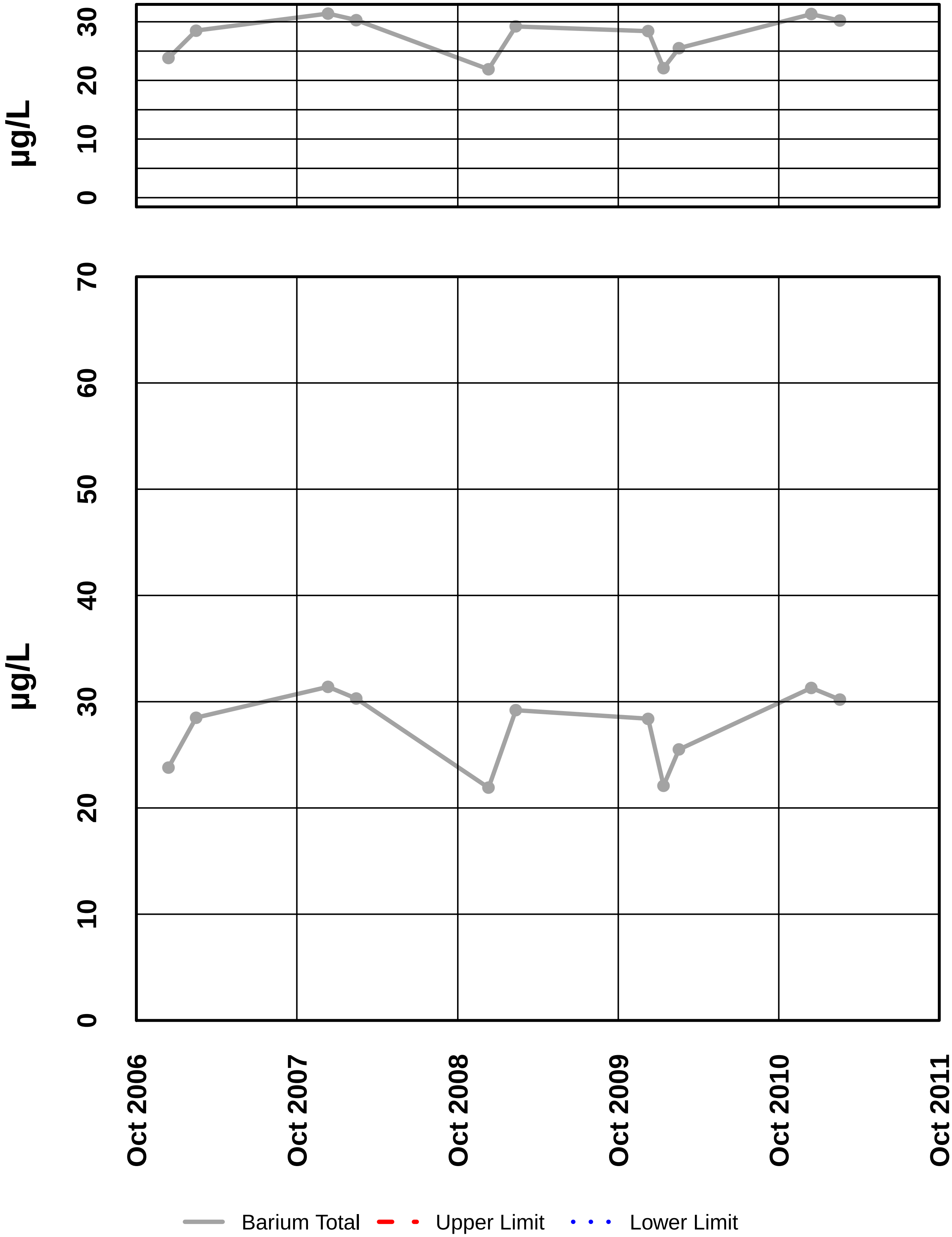


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



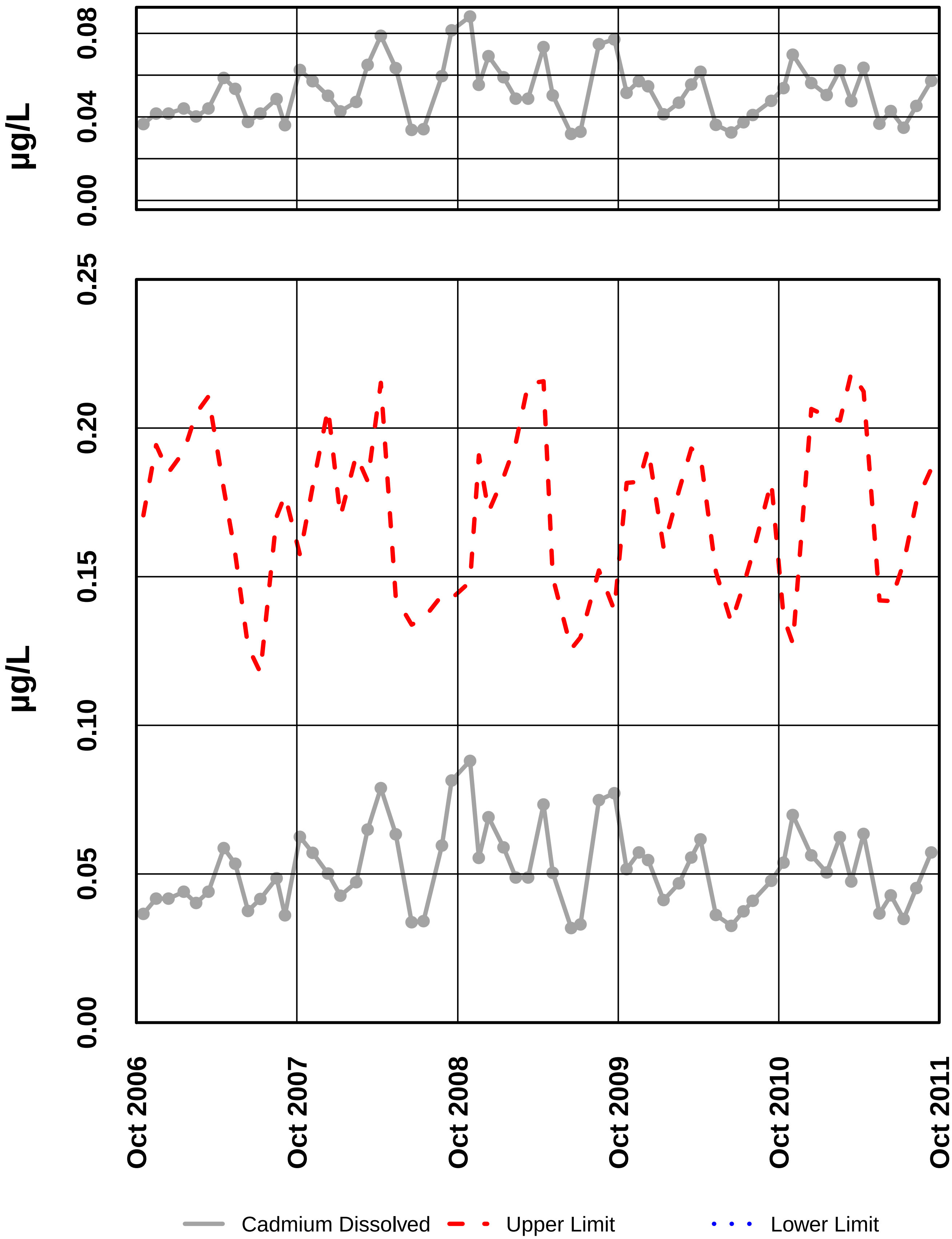
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 54 − Barium Total

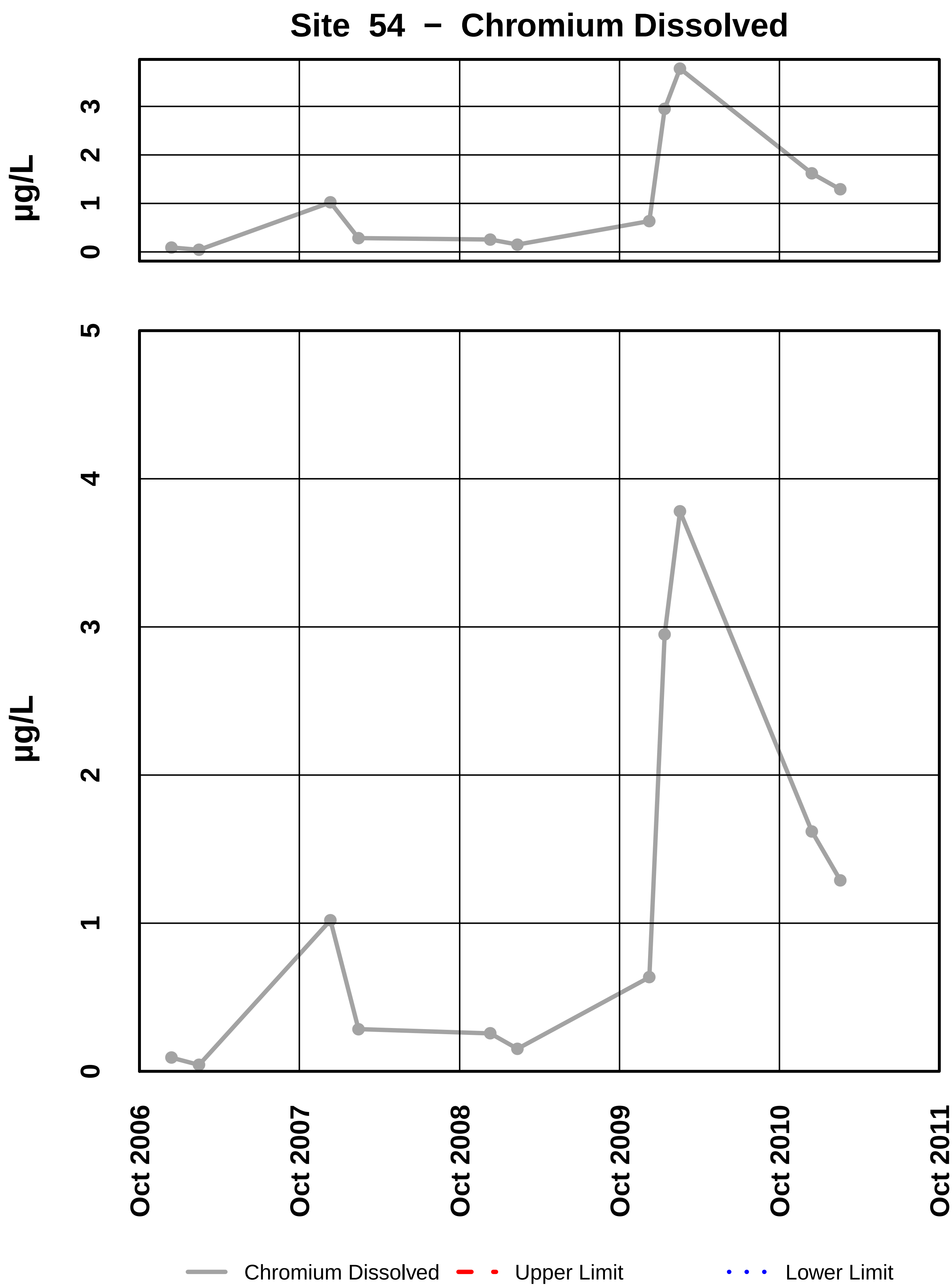


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 54 – Cadmium Dissolved

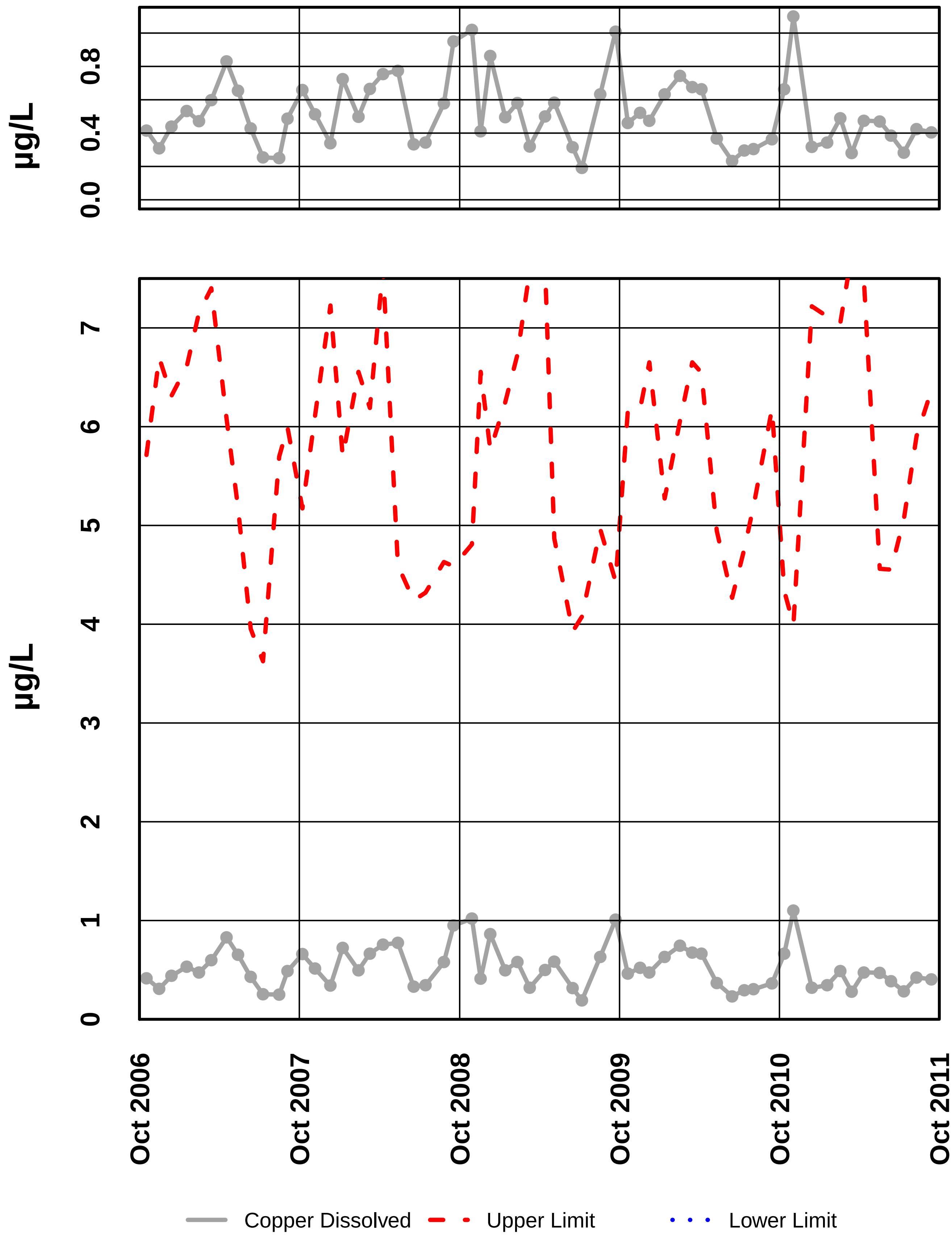


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



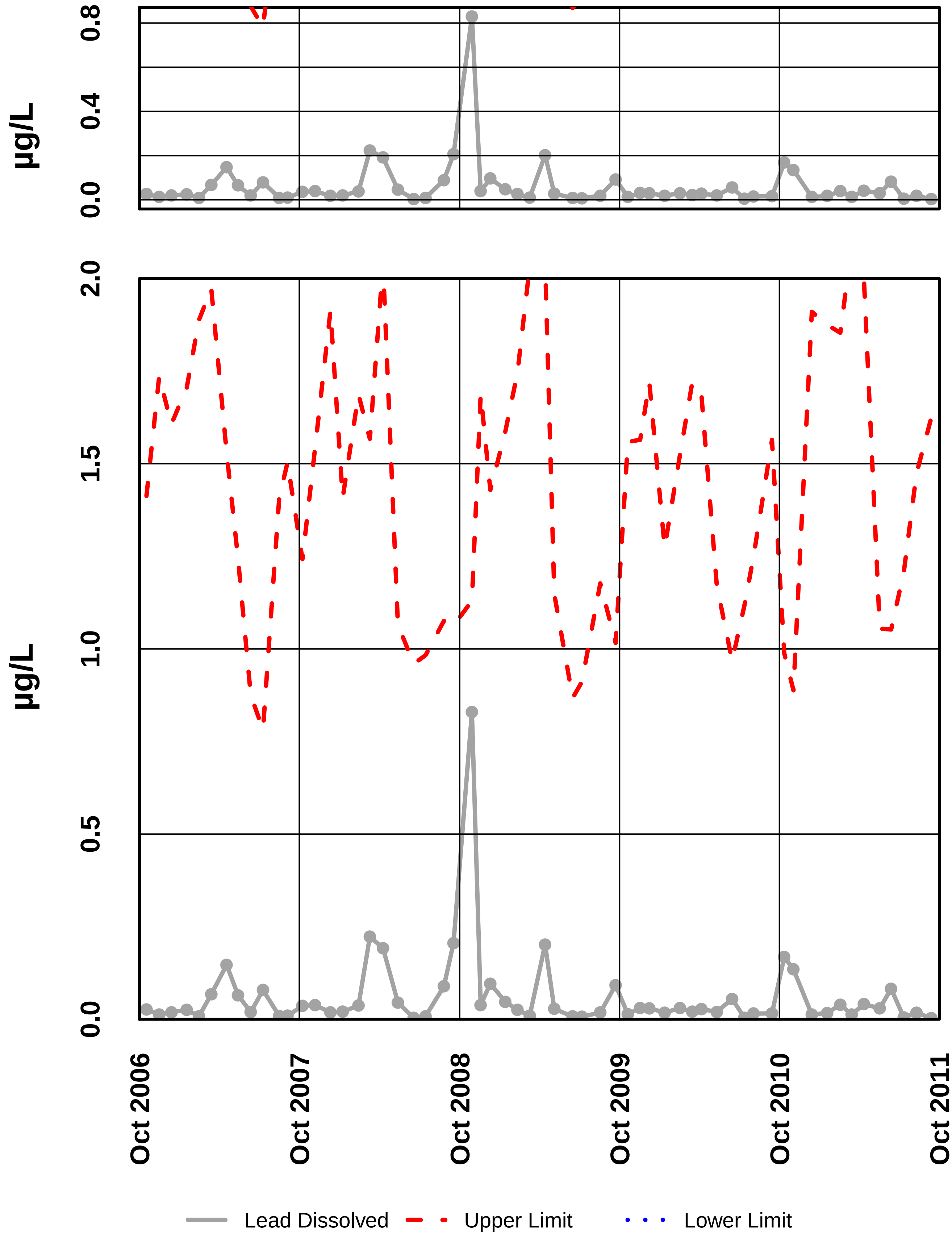
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 54 − Copper Dissolved

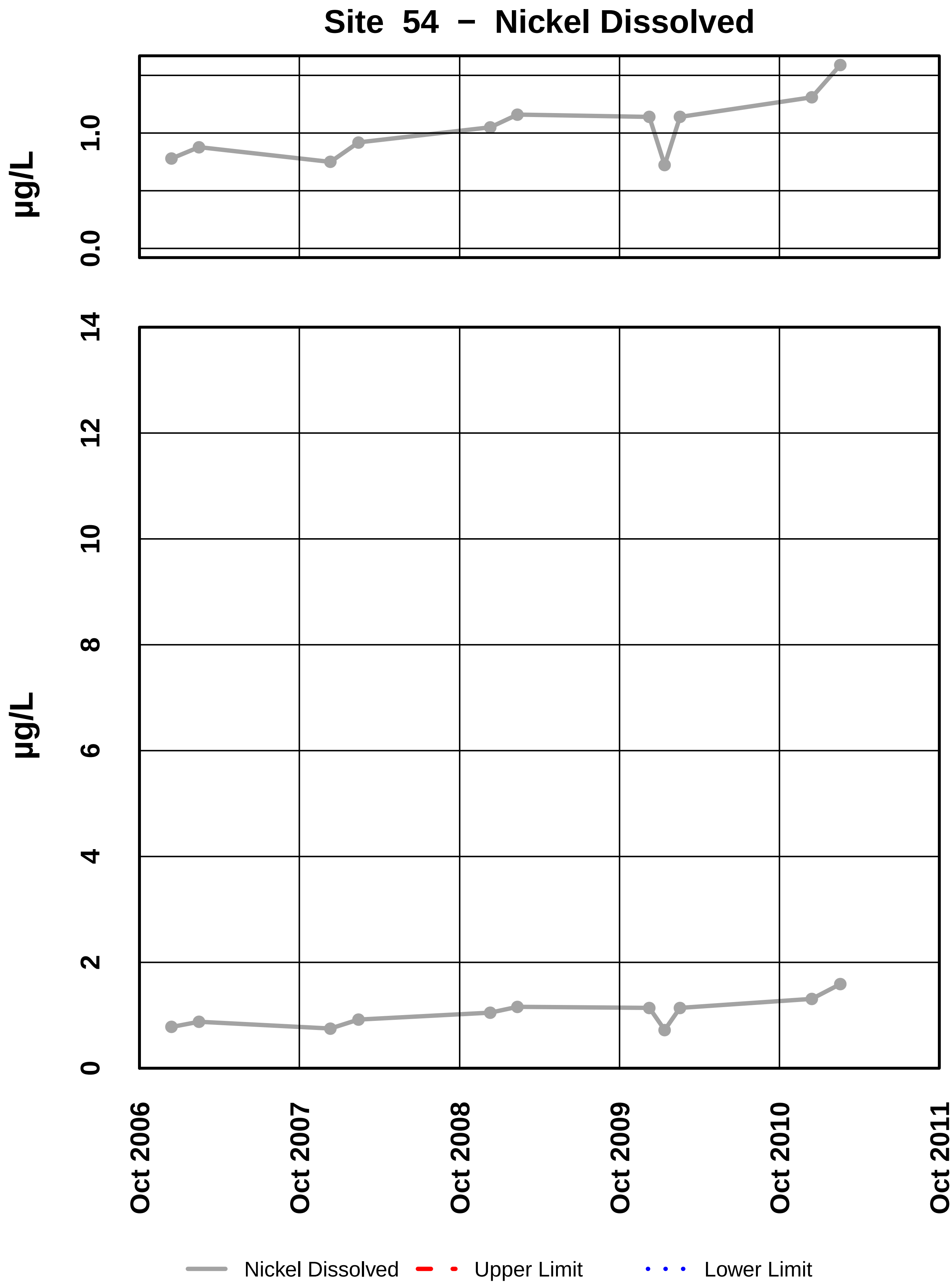


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

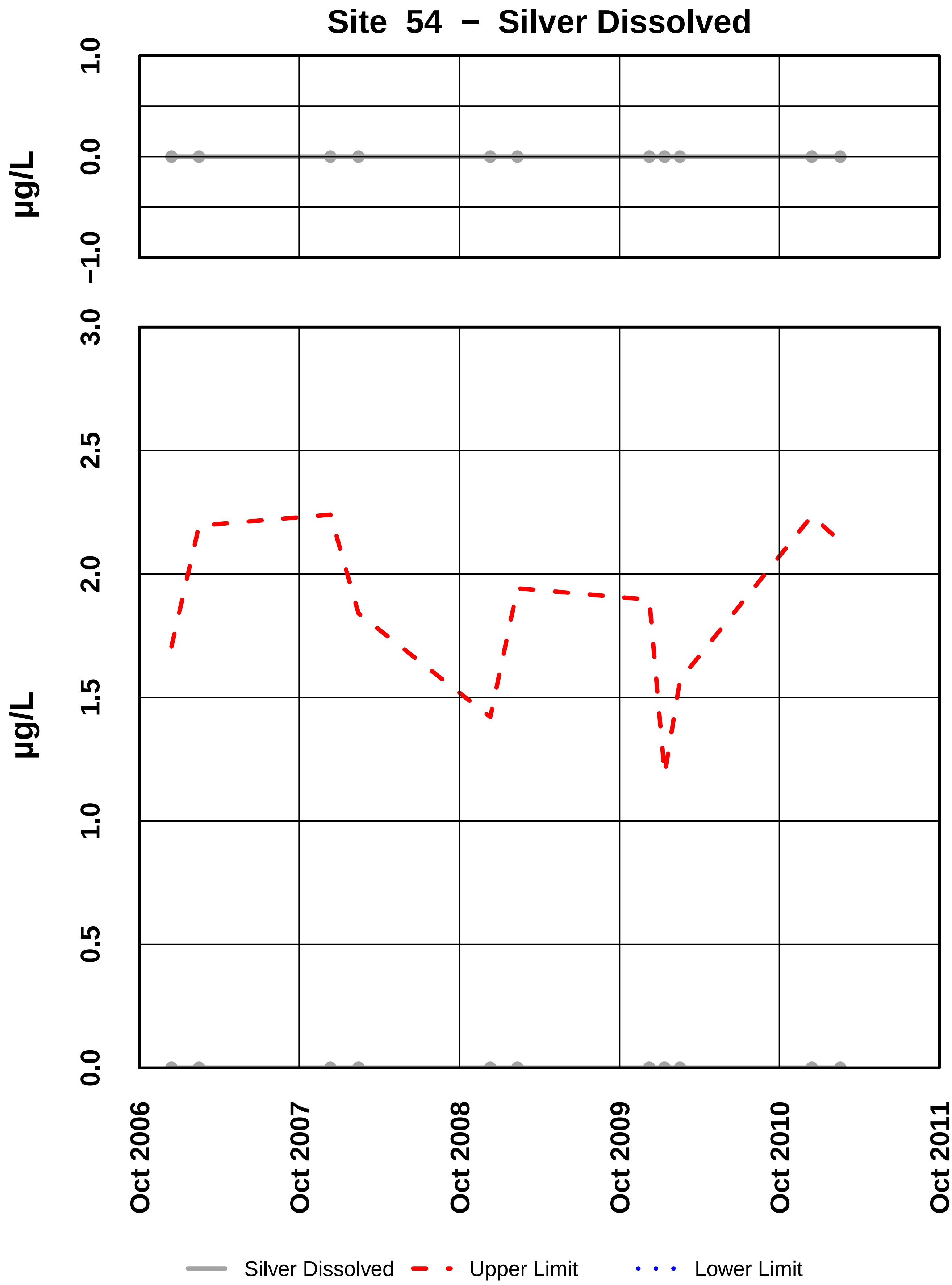
Site 54 – Lead Dissolved



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

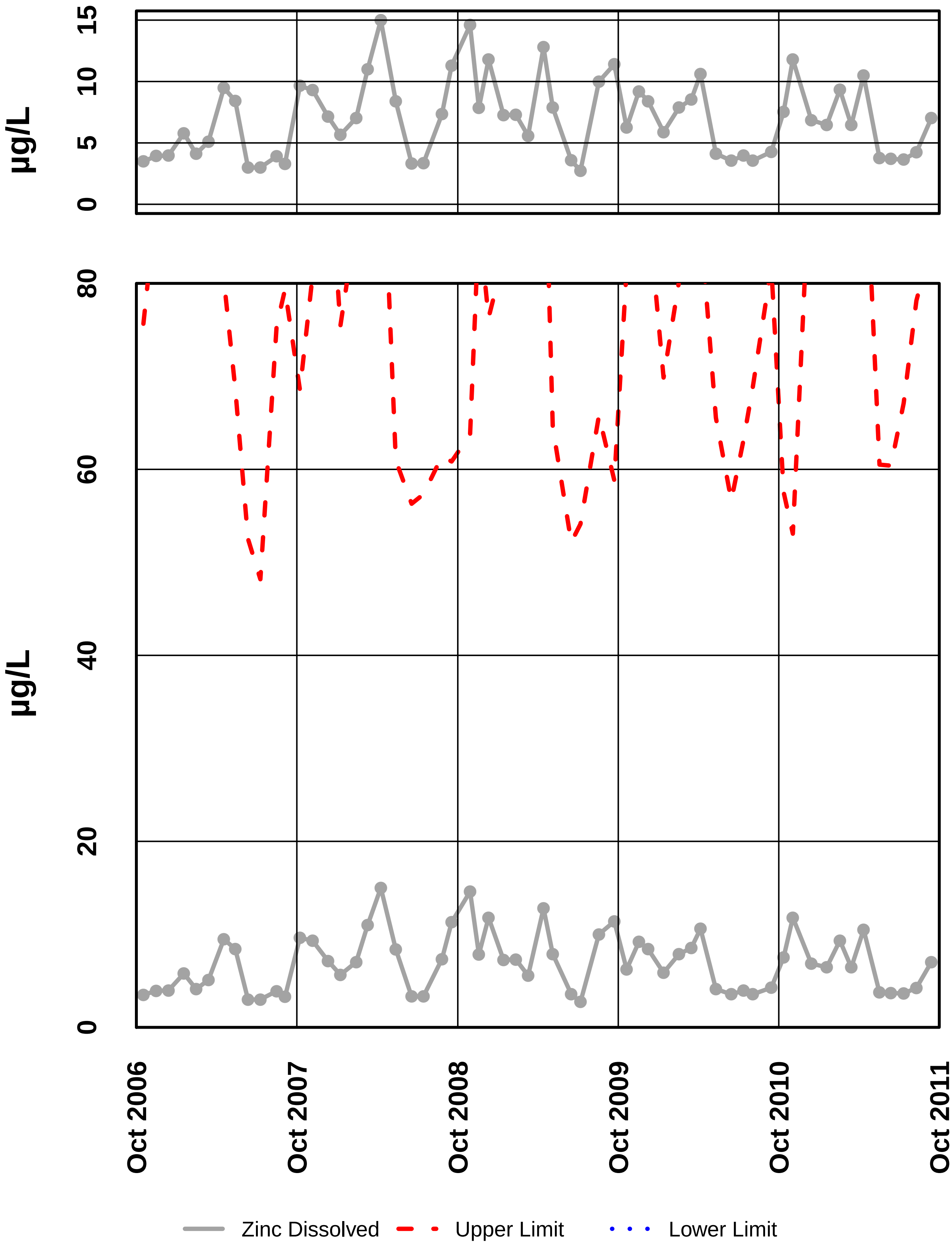


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

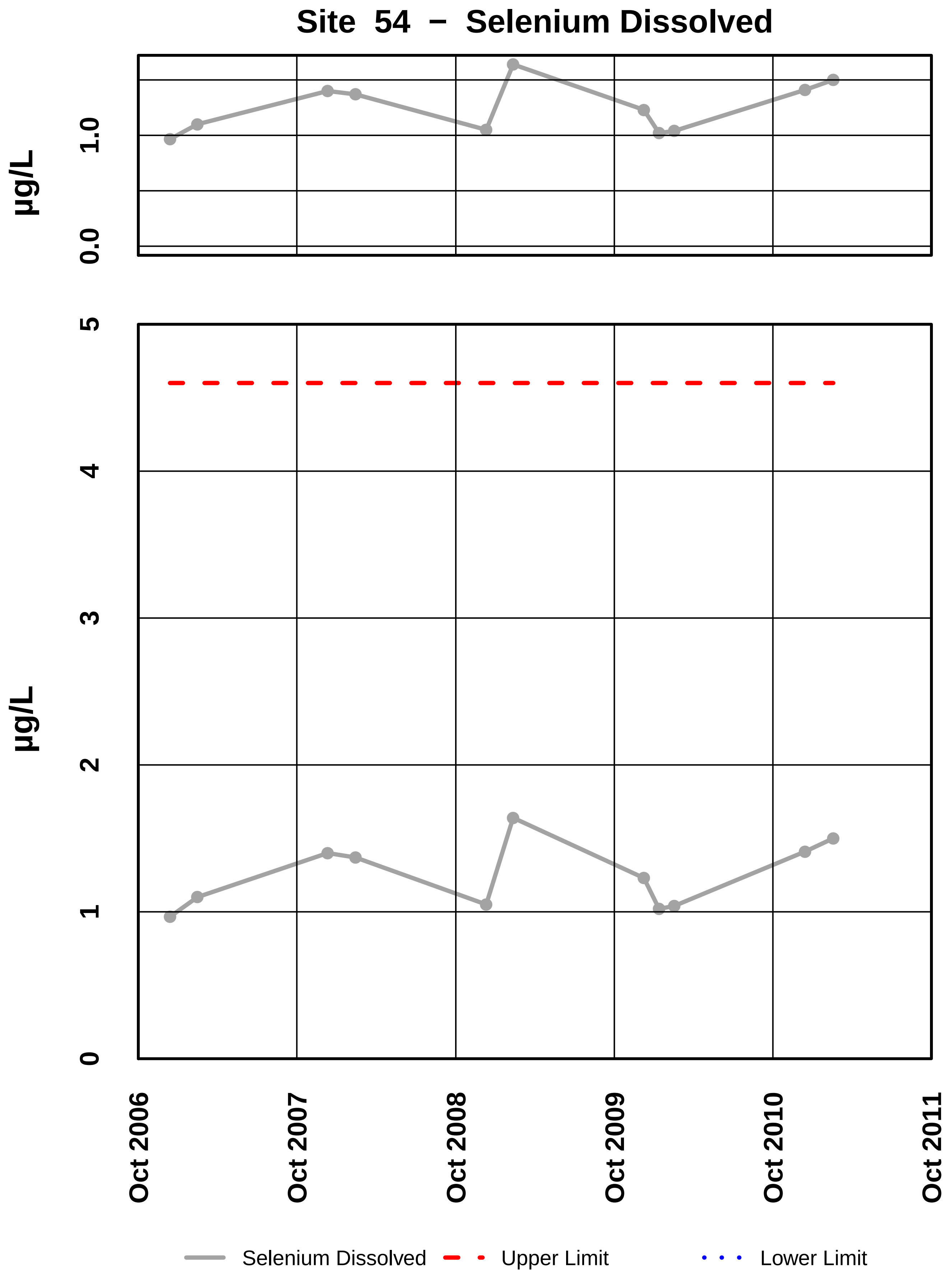


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 54 – Zinc Dissolved

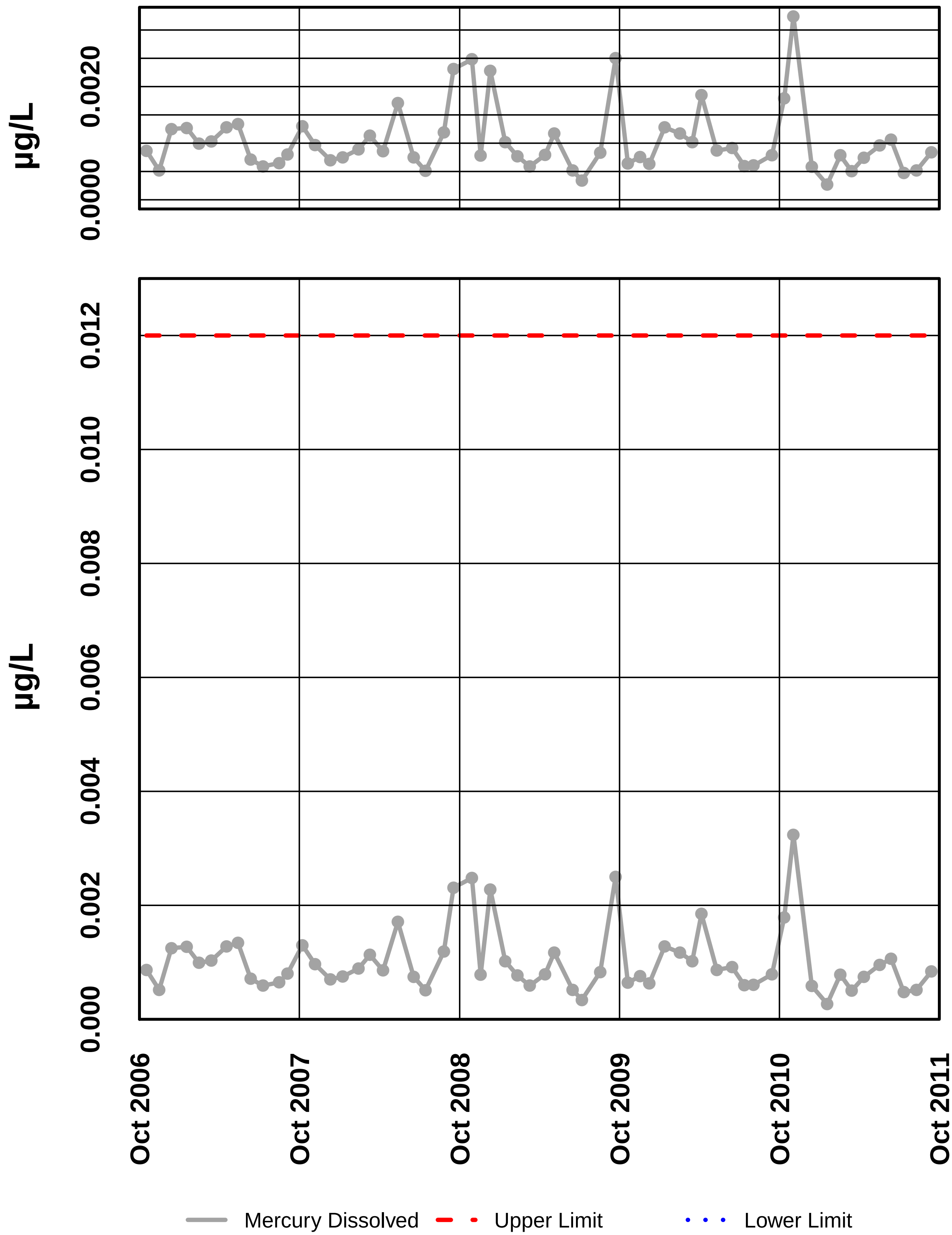


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

Site 54 – Mercury Dissolved



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

Site **#54** Seasonal Kendall analysis for Specific Conductance, Lab (uS/cm)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2006**	119.1	106.5	99.6	122.6	132.2	159.3	142.8	72.8	83	96	97.4	143
b	**WY2007**	143	154.9	148.8	139.9	156.9	169.8	141.6	113.1	81.7	73.6	130.2	130.7
c	**WY2008**	113.4	138	158.8	164.3	153.7	170.6	152.3	91.6	90.6	89.1	93.2	92.5
d	**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
e	**WY2010**	135.5	119	157.3	100	140	153.1	142.3	111.3	88.3	96	104.8	130.5
f	**WY2011**	86.7	84.7	167	169	157	180	98.9	93.9	99	100	127	114
	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	0	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	-5	9	5	3	7	-3	3	9	6	1	-7

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	27.33	28.33	28.33
$Z_k = S_k/\sigma_S$	-1.32	-0.94	1.69	0.94	0.56	1.32	-0.56	0.56	1.69	1.15	0.19	-1.32
Z^2_k	1.73	0.88	2.86	0.88	0.32	1.73	0.32	0.32	2.86	1.32	0.04	1.73

ΣZ_k= 3.97

ΣZ^2_k= 14.98

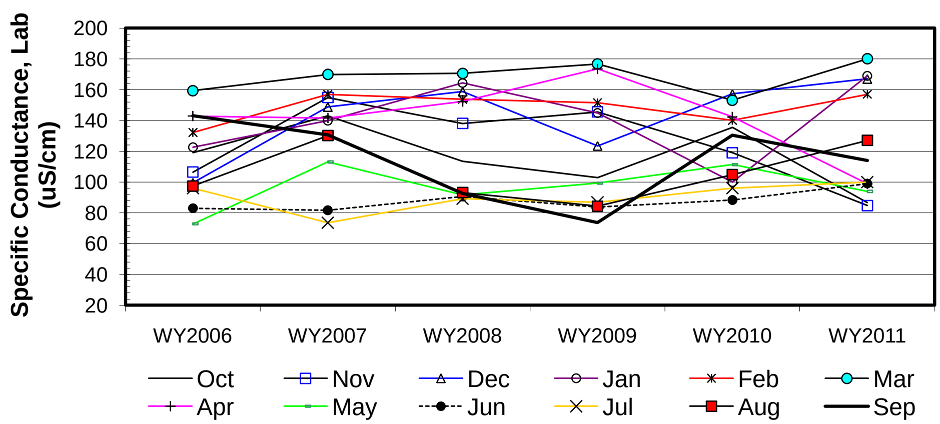
Z-bar=ΣZ_k/K= 0.33

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

Σn 72

ΣS_k 21

$\chi^2_h=\Sigma Z^2_k - K(\text{Z-bar})^2$=	13.67	@α=5% $\chi^2_{(K-1)}$=	19.68	Test for station homogeneity
p	**0.252**		$\chi^2_h<\chi^2_{(K-1)}$	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	-2.24		4.26
0.050	-0.85	**1.61**	3.48
0.100	-0.11		3.13
0.200	0.23		2.75

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2006**	8.0	7.8	7.4	7.4	7.6	8.1	7.7	7.7	7.0	7.8	7.7	7.9
b	**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
c	**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
d	**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
e	**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
f	**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
	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	6	6	6	6	6	6	6	6	6	4
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	-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	0	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	0
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	-13	-8	3	-3	-1	-9	-7	-9	-5	-1	-5	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	28.33	27.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	27.33
$Z_k = S_k/\sigma_S$	-2.44	-1.53	0.56	-0.56	-0.19	-1.69	-1.32	-1.69	-0.94	-0.19	-0.94	0.00
Z^2_k	5.96	2.34	0.32	0.32	0.04	2.86	1.73	2.86	0.88	0.04	0.88	0.00

ΣZ_k= -10.92

ΣZ^2_k= 18.22

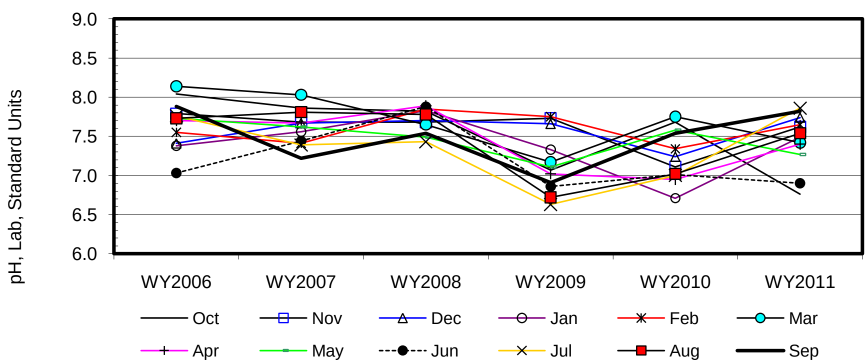
Z-bar=$\Sigma Z_k/K$= -0.91

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

Σn 72

ΣS_k -58

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	8.28	@α=5% $\chi^2_{(K-1)}$= 19.68	Test for station homogeneity	
p	**0.688**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
$\Sigma VAR(S_k)$	Z_{calc} -3.10	@$\alpha/2$=2.5% Z= 1.96	**H_0** (No trend)	REJECT
338.00	**p** **0.001**		**H_A** (± trend)	ACCEPT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.13		-0.02
0.050	-0.11	**-0.07**	-0.03
0.100	-0.10		-0.04
0.200	-0.09		-0.05
		-0.9%	

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	**WY2006**	44.4	44.3	39.7	46.4	43.7	53.3	46.2	41.3	31.0	40.7	44.2	48.5
b	**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
c	**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
d	**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
e	**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
f	**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
	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	-7	-5	7	-1	-3	3	3	-5	9	4	-1	-1

	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	27.33	28.33	28.33
$Z_k = S_k/\sigma_S$	-1.32	-0.94	1.32	-0.19	-0.56	0.56	0.56	-0.94	1.69	0.77	-0.19	-0.19
Z^2_k	1.73	0.88	1.73	0.04	0.32	0.32	0.32	0.88	2.86	0.59	0.04	0.04

$\Sigma Z_k=$ 0.58

$\Sigma Z^2_k=$ 9.73

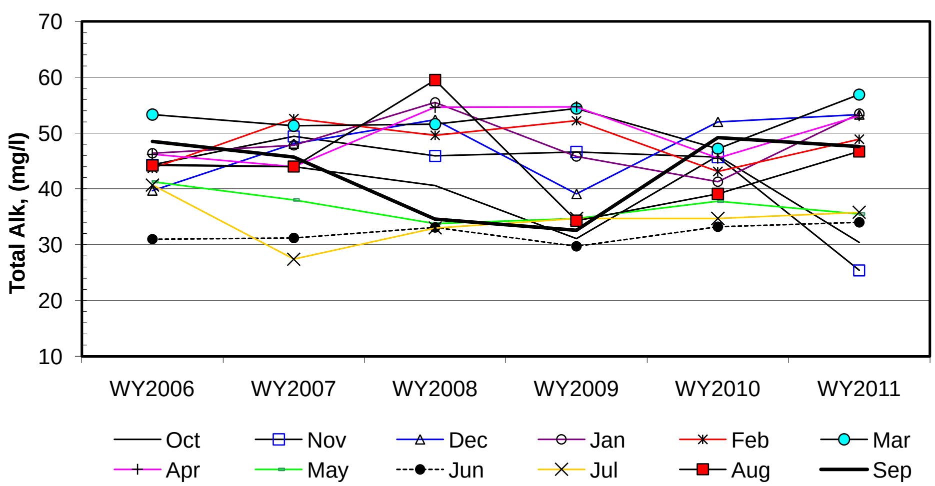
Z-bar=ΣZ_k/K= 0.05

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

Σn 72

ΣS_k 3

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2=$		9.70	@α=5% $\chi^2_{(K-1)}=$ 19.68	Test for station homogeneity	
	p	**0.558**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc}	0.11	@α/2=2.5% Z= 1.96	**H_0** (No trend)	ACCEPT
339.00	p	**0.543**		**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.86		0.70
0.050	-0.44	**0.08**	0.55
0.100	-0.23		0.49
0.200	-0.20		0.36

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	**WY2006**	14.3	17.4	15.0	21.3	17.0	26.5	20.9	9.8	6.9	11.4	10.8	16.4
b	**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
c	**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
d	**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
e	**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
f	**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
	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	6	4	6	6	6	6	6	6	6	6
t_2	0	1	0	1	0	0	0	0	0	0	0	0
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a	-1	1	1	-1	1	-1	-1	1	-1	-1	1	-1
c-a	-1	-1	1	1	1	-1	1	-1	1	-1	-1	-1
d-a	-1	0	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	0	1	1	1	-1	1	1	-1	-1
e-b	1	1	1	-1	-1	-1	1	1	1	1	-1	1
f-b	-1	-1	1	1	1	1	1	-1	1	1	1	1
d-c	-1	1	-1	-1	-1	1	1	1	1	1	1	1
e-c	1	1	1	-1	-1	-1	-1	1	1	1	1	1
f-c	-1	-1	1	1	1	1	1	1	1	1	1	1
e-d	1	1	1	-1	-1	-1	-1	1	1	1	1	1
f-d	-1	-1	1	1	1	1	1	-1	1	1	1	1
f-e	-1	-1	1	1	1	1	1	-1	1	1	1	1
S_k	-5	-2	11	0	5	-1	7	1	13	5	7	3

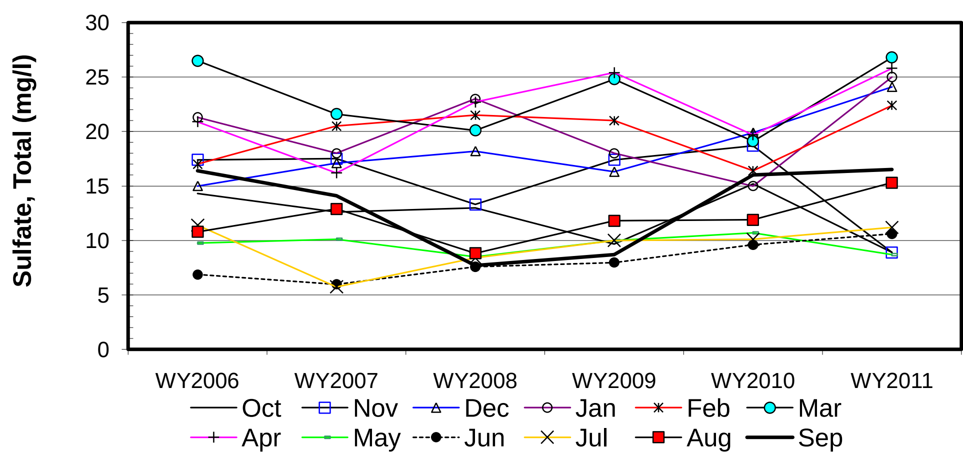
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	28.33	27.33	28.33	27.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33
$Z_k = S_k/\sigma_S$	-0.94	-0.38	2.07	0.00	0.94	-0.19	1.32	0.19	2.44	0.94	1.32	0.56
Z^2_k	0.88	0.15	4.27	0.00	0.88	0.04	1.73	0.04	5.96	0.88	1.73	0.32

ΣZ_k=	8.26
ΣZ^2_k=	16.88
Z-bar=ΣZ_k/K=	0.69

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

Σn	72
ΣS_k	44

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	11.19	@α=5% $\chi^2_{(K-1)}$=	19.68	Test for station homogeneity
p	**0.427**			$\chi^2_h<\chi^2_{(K-1)}$ ACCEPT
ΣVAR(S_k)	Z_{calc} 2.34	@α=5% Z=	1.64	**H_0** (No trend) REJECT
338.00	p **0.990**			**H_A** (± trend) ACCEPT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	0.00		0.93
0.050	0.10	**0.40**	0.85
0.100	0.21		0.70
0.200	0.28		0.62
		2.6%	

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	**WY2006**	5.6	6.2	4.7	5.4	6.8	4.2	11.0	3.2	1.8	2.1	4.1	4.3
b	**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
c	**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
d	**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
e	**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
f	**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
	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	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	-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	0
f-a	1	1	1	1	1	1	-1	1	1	1	1	1
c-b	1	1	1	-1	1	1	1	-1	1	1	1	1
d-b	1	1	1	1	1	1	1	-1	1	-1	1	1
e-b	1	1	1	1	1	1	1	-1	1	1	-1	1
f-b	1	1	1	1	1	1	1	-1	1	1	1	1
d-c	1	-1	1	1	1	-1	-1	-1	1	-1	1	1
e-c	-1	-1	1	1	1	-1	-1	-1	1	1	-1	-1
f-c	-1	1	-1	1	1	-1	-1	-1	1	1	-1	-1
e-d	-1	1	-1	-1	1	1	-1	-1	-1	1	-1	-1
f-d	-1	1	-1	-1	1	1	-1	-1	1	1	-1	-1
f-e	1	1	-1	1	1	-1	-1	-1	1	-1	1	1
S_k	5	9	5	9	13	7	-3	-5	13	9	1	4

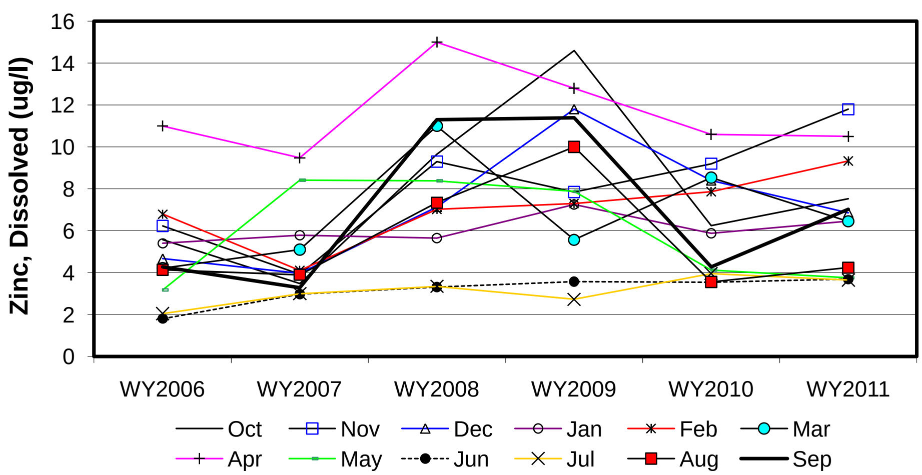
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
$\sigma^2_S=$	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	27.33
$Z_k = S_k/\sigma_S$	0.94	1.69	0.94	1.69	2.44	1.32	-0.56	-0.94	2.44	1.69	0.19	0.77
Z^2_k	0.88	2.86	0.88	2.86	5.96	1.73	0.32	0.88	5.96	2.86	0.04	0.59

$\Sigma Z_k=$ 12.60
$\Sigma Z^2_k=$ 25.82
Z-bar=ΣZ_k/K= 1.05

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

Σn 72
ΣS_k 67

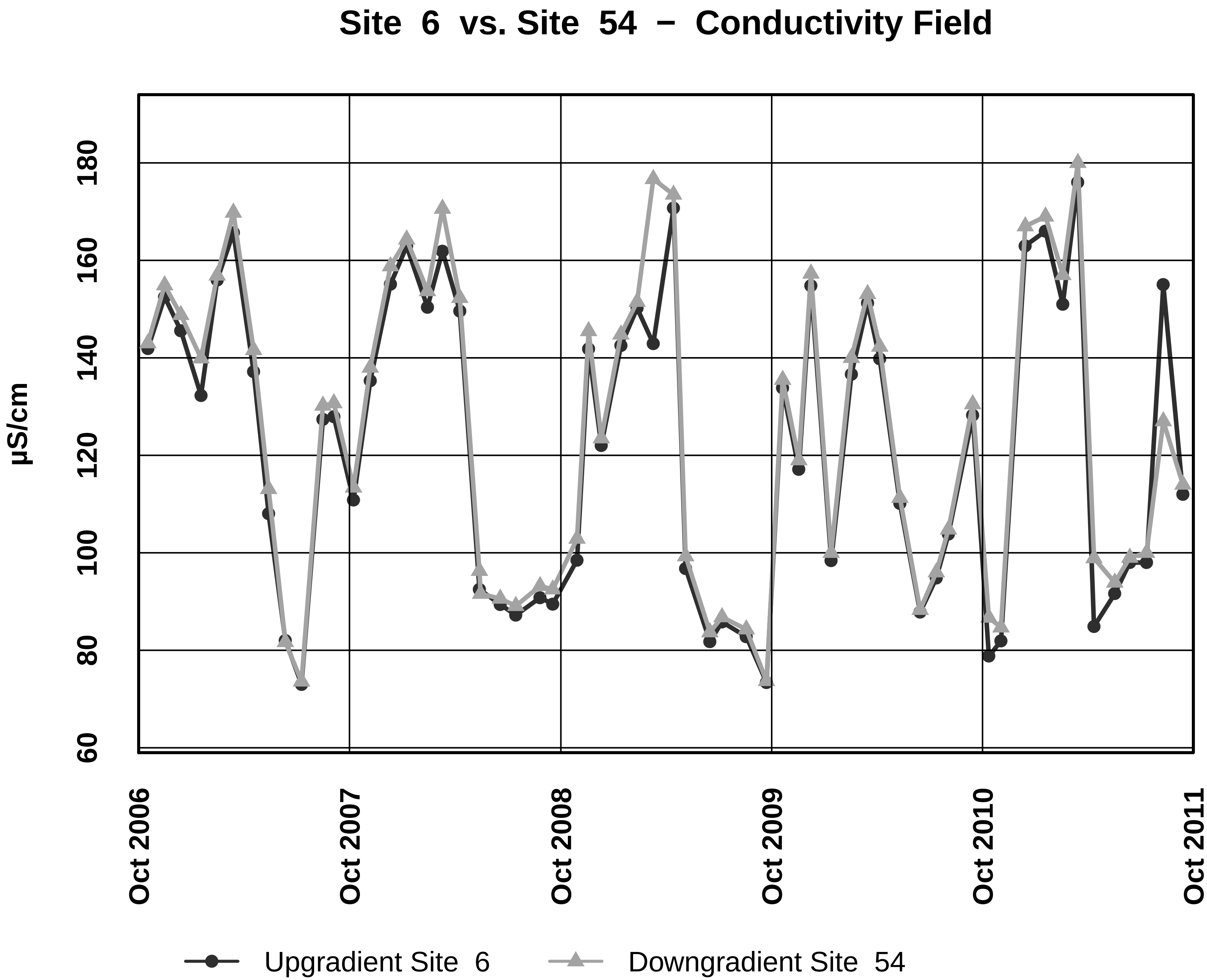
$\chi^2_h=\Sigma Z^2_k$-K(Z-bar)^2= 12.59	@α=5% $\chi^2_{(K-1)}$= 19.68	Test for station homogeneity	
p **0.321**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k) 339.00	Z_{calc} 3.58	@α/2=2.5% Z= 1.96	H_0 (No trend)	REJECT
	p **1.000**		H_A ($\pm$ trend)	ACCEPT



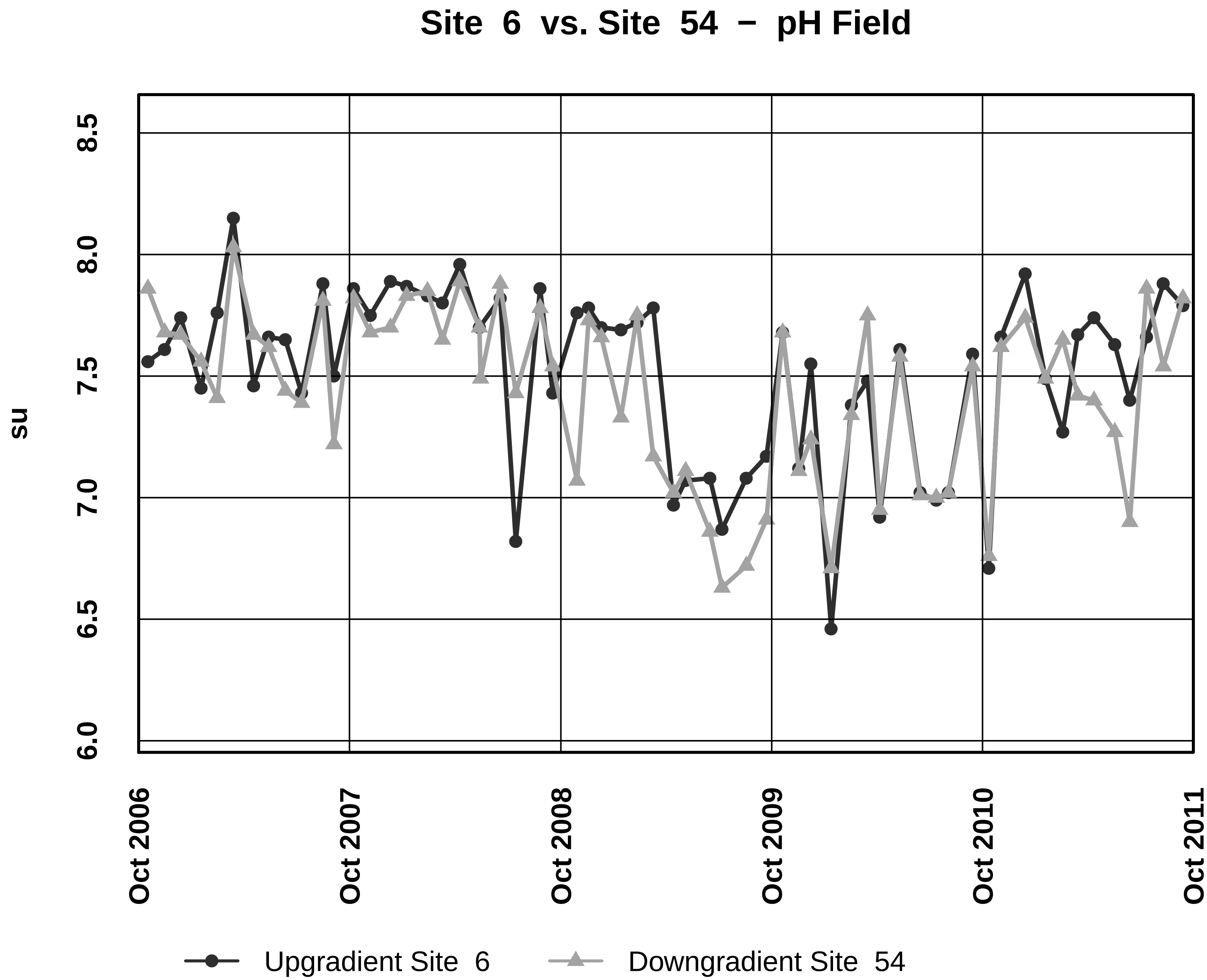
Seasonal-Kendall Slope Confidence Intervals

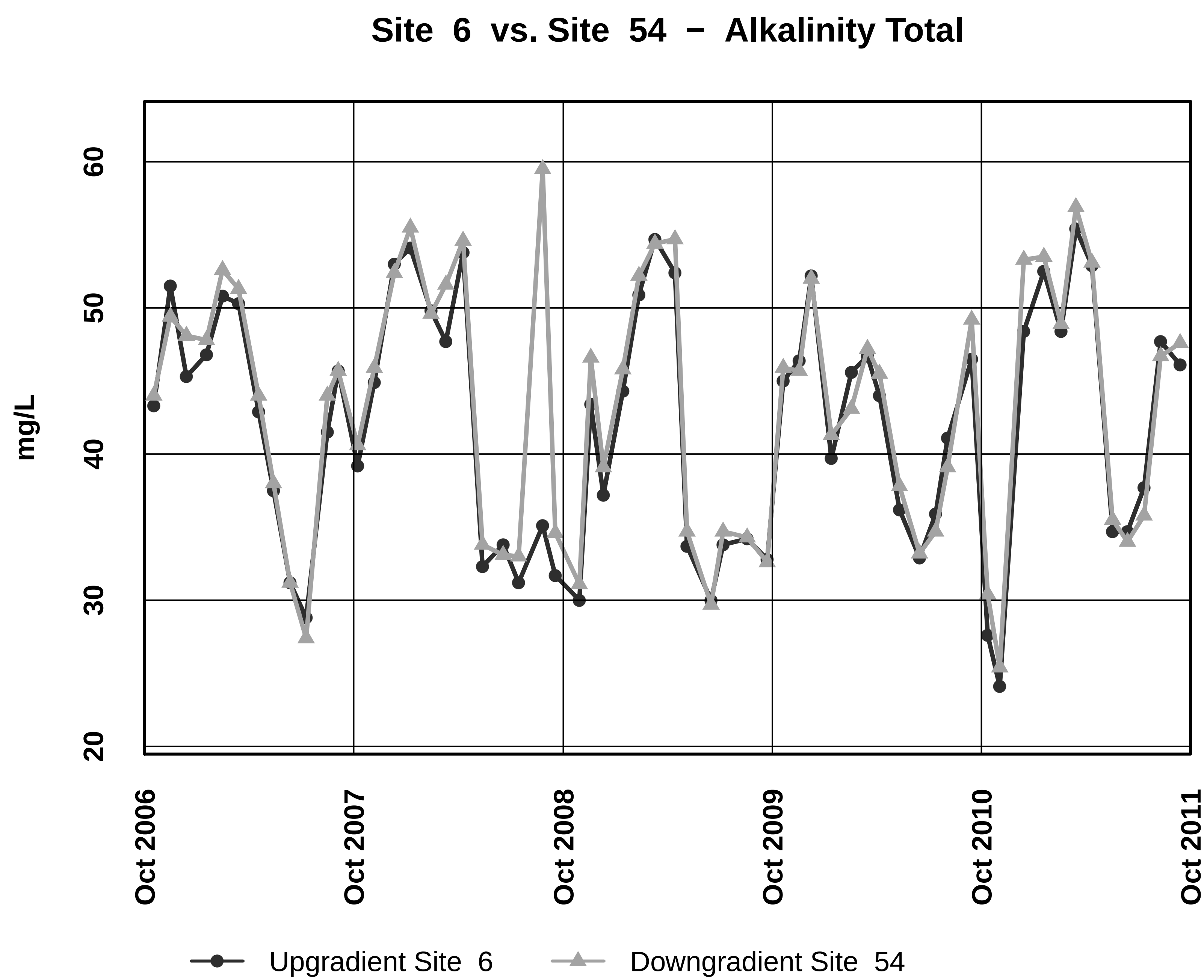
α	Lower Limit	Sen's Slope	Upper Limit
0.010	0.12		0.58
0.050	0.17	**0.33**	0.46
0.100	0.21		0.44
0.200	0.26		0.39

5.2%

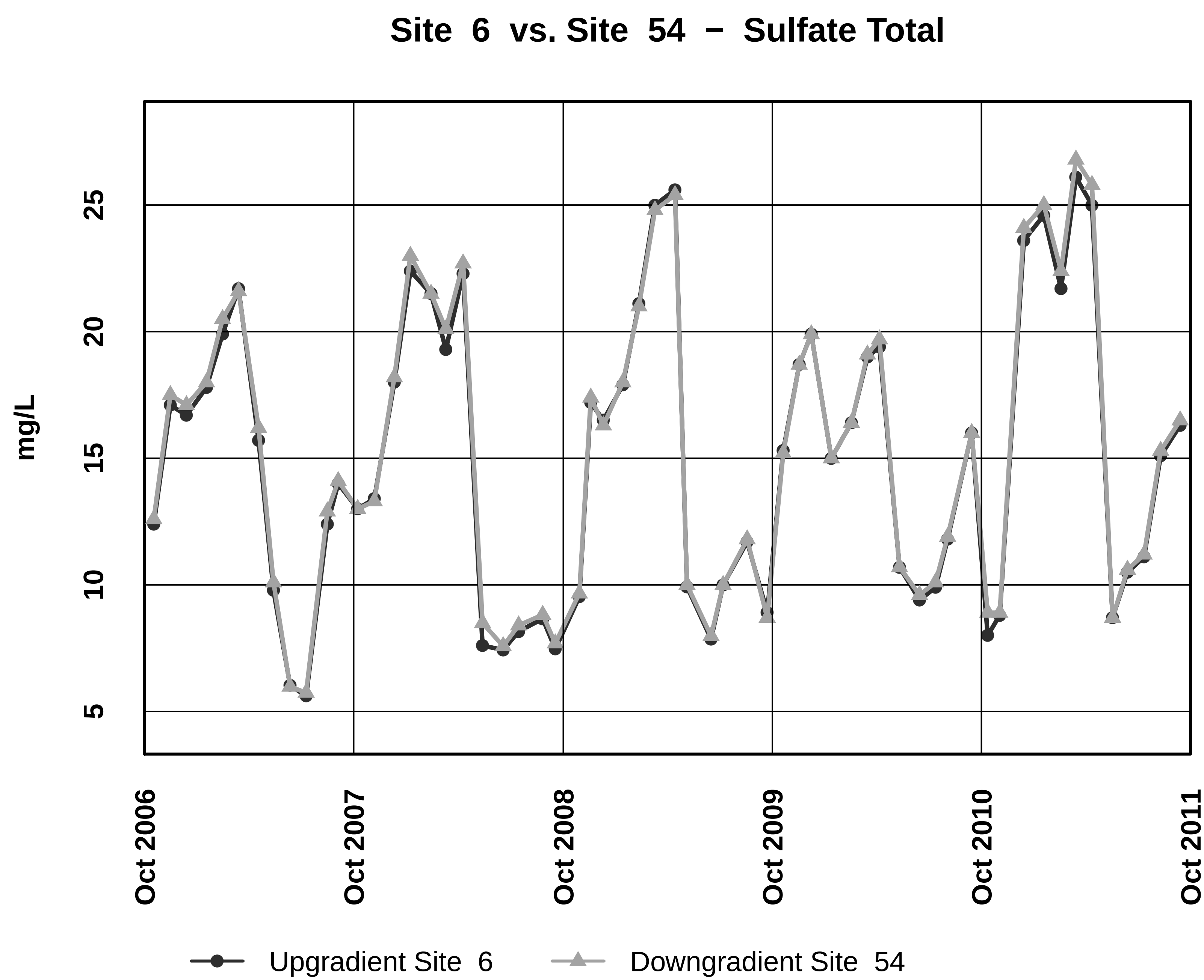


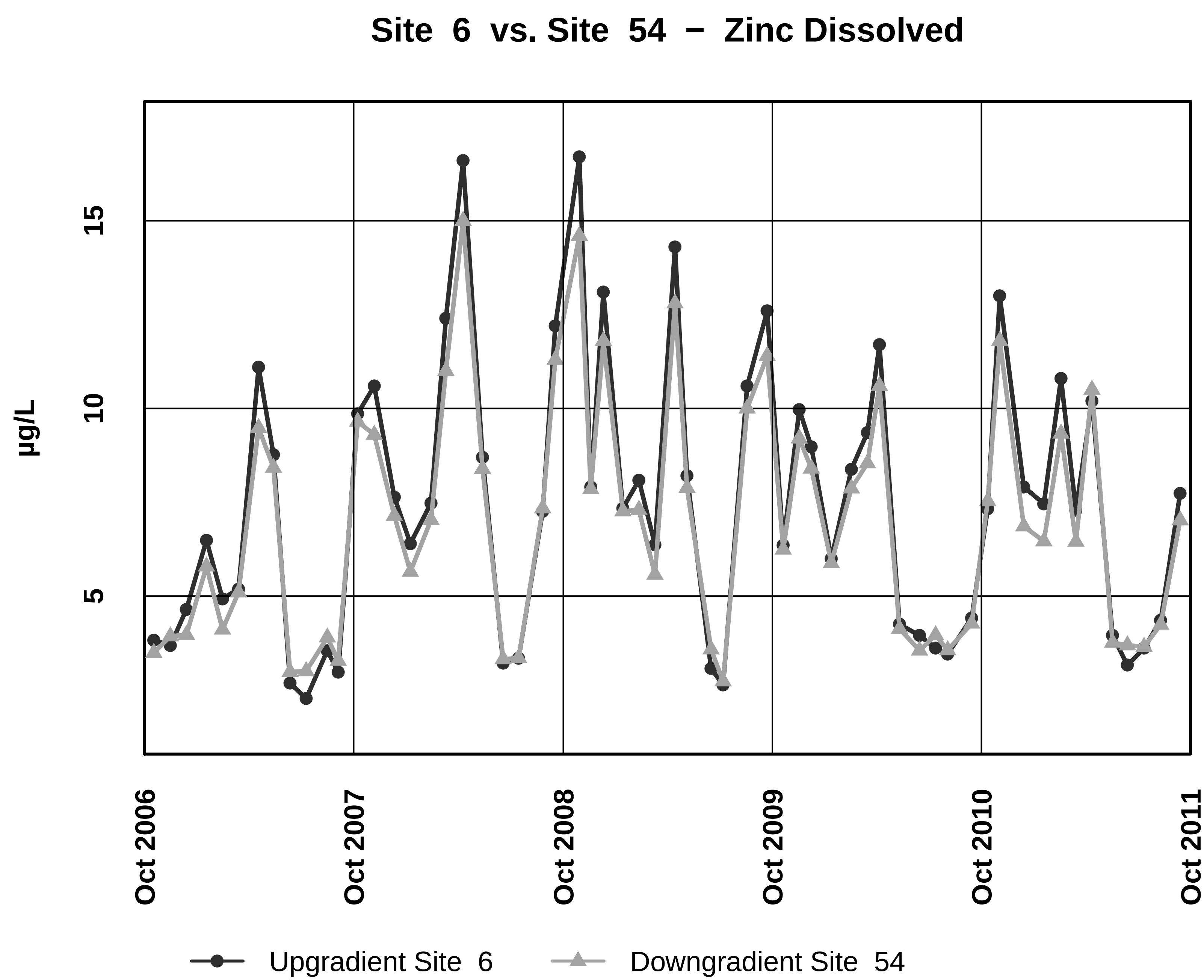
Site 6 vs. Site 54 − Conductivity Field
µS/cm
60
80
100
120
140
160
180
Oct 2006
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 6
Downgradient Site 54


Site 6 vs. Site 54 − pH Field
su
8.5
8.0
7.5
7.0
6.5
6.0
Oct 2006
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
20
30
40
50
60
Oct 2006
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
5
10
15
20
25
Oct 2006
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 2006
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, Lab (uS/cm)**

	X	Y	Differences		
Site	#6	#54			
Year	WY2011	WY2011	**D**	**|D|**	**Rank**
Oct	78.8	86.7	-7.9	7.9	-10
Nov	81.9	84.7	-2.8	2.8	-5
Dec	163.0	167.0	-4.0	4.0	-7.5
Jan	166.0	169.0	-3.0	3.0	-6
Feb	151.0	157.0	-6.0	6.0	-9
Mar	176.0	180.0	-4.0	4.0	-7.5
Apr	84.9	98.9	-14.0	14.0	-11
May	91.6	93.9	-2.3	2.3	-4
Jun	98.0	99.0	-1.0	1.0	-1
Jul	98.0	100.0	-2.0	2.0	-2.5
Aug	155.0	127.0	28.0	28.0	12
Sep	112.0	114.0	-2.0	2.0	-2.5
Median	105.0	107.0	-2.9	3.5	

n	**m**
12	12

N= 12

$\Sigma R =$ -54

α
5.0%
W'$_{\alpha,n}$
17

$W^{+}=$
12
p-test
0.017

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

Wilcoxon-signed-ranks test
Exact Form

Variable: **pH, Lab, Standard Units**

	X	**Y**			
Site	#6	#54	Differences		
Year	WY2011	WY2011	**D**	**|D|**	**Rank**
Oct	6.71	6.76	-0.05	0.05	-3
Nov	7.66	7.62	0.04	0.04	2
Dec	7.92	7.74	0.18	0.18	4
Jan	7.49	7.49	0.00		
Feb	7.27	7.65	-0.38	0.38	-10
Mar	7.67	7.42	0.25	0.25	6
Apr	7.74	7.40	0.34	0.34	7.5
May	7.63	7.27	0.36	0.36	9
Jun	7.40	6.90	0.50	0.50	11
Jul	7.66	7.86	-0.20	0.20	-5
Aug	7.88	7.54	0.34	0.34	7.5
Sep	7.79	7.82	-0.03	0.03	-1
Median	7.66	7.52	0.11	0.25	

n	**m**
12	11

N= 11

$\Sigma R=$ 28

α
95.0%
W'$_{\alpha,n}$
51

$W^{+}=$
47
p-test
0.897

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	WY2011	WY2011	**D**	**|D|**	**Rank**
Oct	27.6	30.4	-2.8	2.8	-11
Nov	24.1	25.4	-1.3	1.3	-7
Dec	48.4	53.3	-4.9	4.9	-12
Jan	52.5	53.5	-1.0	1.0	-5.5
Feb	48.4	48.9	-0.5	0.5	-2
Mar	55.4	56.9	-1.5	1.5	-8.5
Apr	52.9	53.1	-0.2	0.2	-1
May	34.7	35.5	-0.8	0.8	-4
Jun	34.7	34.0	0.7	0.7	3
Jul	37.7	35.8	1.9	1.9	10
Aug	47.7	46.7	1.0	1.0	5.5
Sep	46.1	47.6	-1.5	1.5	-8.5
Median	46.9	47.2	-0.9	1.2	

n	**m**
12	12

N= 12
$\Sigma R=$ -41

α
95.0%
W'$_{\alpha,n}$
59

$W^{+}=$
18.5
p-test
0.055

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	#6	#54			
Year	WY2011	WY2011	**D**	**|D|**	**Rank**
Oct	8.0	8.9	-0.9	0.9	-11
Nov	8.8	8.9	-0.1	0.1	-2
Dec	23.6	24.1	-0.5	0.5	-7
Jan	24.6	25.0	-0.4	0.4	-6
Feb	21.7	22.4	-0.7	0.7	-8.5
Mar	26.1	26.8	-0.7	0.7	-8.5
Apr	25.0	25.8	-0.8	0.8	-10
May	8.7	8.7	0.0		
Jun	10.5	10.6	-0.1	0.1	-2
Jul	11.1	11.2	-0.1	0.1	-2
Aug	15.1	15.3	-0.2	0.2	-5
Sep	16.3	16.5	-0.2	0.2	-4
Median	15.7	15.9	-0.3	0.4	

n	**m**
12	11

N= 11

$\Sigma R=$ -66

α
5.0%
W'α,n
13

$W^+=$
0
p-test
0.000

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

Wilcoxon-signed-ranks test
Exact Form

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

	X	**Y**			
Site	#6	#54	Differences		
Year	WY2011	WY2011	**D**	**|D|**	**Rank**
Oct	7.33	7.53	-0.20	0.20	-4
Nov	13.00	11.80	1.20	1.20	11
Dec	7.91	6.86	1.05	1.05	10
Jan	7.46	6.46	1.00	1.00	9
Feb	10.80	9.33	1.47	1.47	12
Mar	7.29	6.45	0.84	0.84	8
Apr	10.20	10.50	-0.30	0.30	-5
May	3.95	3.76	0.19	0.19	3
Jun	3.16	3.69	-0.53	0.53	-6
Jul	3.61	3.65	-0.04	0.04	-1
Aug	4.35	4.24	0.11	0.11	2
Sep	7.74	7.02	0.72	0.72	7
Median	7.40	6.66	0.46	0.63	

n	**m**
12	12

N= 12
ΣR= 46

α
5.0%
W'α,n
17

W^+=
62
p-test
0.968

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

INTERPRETIVE REPORT
SITE 49 “UPPER BRUIN CREEK”

The data collected during the current water year are listed in the following “Table of Results for Water Year 2011” 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 2011.				

The data for water year 2011 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 2011

			Limits		
Sample Date	Parameter	Value	Lower	Upper	Hardness
No exceedances have been identified by HGCMC for the period of October 2010 through September 2011.					

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. As mentioned in last year’s report dissolved chromium increased roughly an order of magnitude in water year 2010. As of this water year chromium concentrations are trending down towards historical values. A similar decrease was also noted for Site 6, Site 13, Site 46, Site 48, Site 49, and Site 54; all sites that are located in the 920 area.

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-05 and Sep-11 (WY2006-WY2011). For 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

	Mann-Kendall test statistics			Sen's slope estimate	
Parameter	**n***	**p****	**Trend**	**Q**	**Q(%)**
Conductivity Field	6	0.50			
pH Field	6	0.02	-	-0.04	-0.4
Alkalinity, Total	6	0.22			
Sulfate, Total	6	0.08			
Zinc, Dissolved	6	0.02	+	0.17	8.1

* Number of Years ** Significance level

The dataset for field pH has a statistically significant (p=0.02) negative trend with a slope estimate of -0.04 su/yr or a 0.45% decrease over the period. Also, there is a statistically significant increasing trend in dissolved zinc with a slope estimate of 0.17 µg/L/yr or an 8.137% increase over the period. Given the low magnitude of the change, the fact that Site 49 is an upgradient background site, these variations are considered a part of the natural variation that can be expected for this type of monitoring.

Table of Results for Water Year 2011

Site 049FMS - 'Upper Bruin Creek'

Sample Date/Parameter	Oct 2010	Nov 2010	Dec 2010	Jan 2011	Feb 2011	Mar 2011	Apr 2011	May 2011	Jun 2011	Jul 2011	Aug 2011	Sep 2011	**Median**
Water Temp (°C)		4.7			0.0			3.2			8.5		4.0
Conductivity-Field(µmho)		108.5			171			114.3			153		133.7
Conductivity-Lab (µmho)		104			177			121			159		140
pH Lab (standard units)		7.22			7.78			7.68			7.85		7.73
pH Field (standard units)		7.94			7.29			7.93			8.12		7.94
Total Alkalinity (mg/L)		38.8			69.5			44.9			63.2		54.1
Total Sulfate (mg/L)		7.8			15.1			7.2			12.1		10.0
Hardness (mg/L)		56.3			86.2			57.3			77.1		67.2
Dissolved As (ug/L)		0.172			0.188			0.163			0.196		0.180
Dissolved Ba (ug/L)		8.5			11.1								9.8
Dissolved Cd (ug/L)		0.0431			0.024			0.0292			0.0316		0.0304
Dissolved Cr (ug/L)		0.27			1.2								0.735
Dissolved Cu (ug/L)		1.41			0.41			0.403			0.579		0.495
Dissolved Pb (ug/L)		0.0367			0.004			0.0097			0.0135		0.0116
Dissolved Ni (ug/L)		1.77			1.82								1.795
Dissolved Ag (ug/L)		0.004			0.002								0.003
Dissolved Zn (ug/L)		4.6			2.07			2.15			1.88		2.11
Dissolved Se (ug/L)		0.677			0.876								0.777
Dissolved Hg (ug/L)		0.00476			0.00115			0.00142			0.00123		0.001325

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

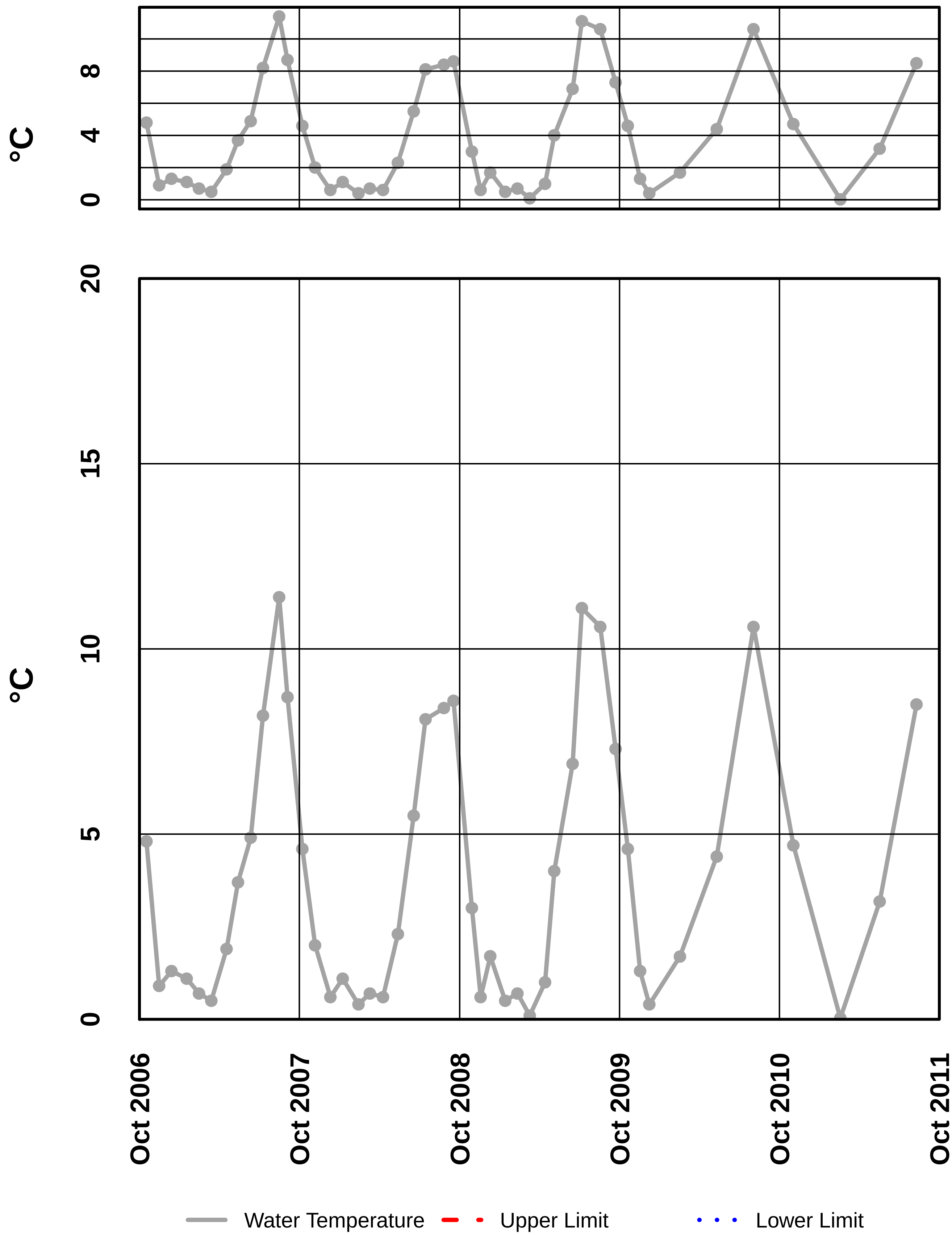
Qualified Data by QA Reviewer

Date Range: 10/01/2010 to 09/30/2011

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
49	11/2/2010	12:00 AM				
			Cr diss, µg/l	0.27	J	Below Quantitative Range
			Se diss, µg/l	0.677	J	Below Quantitative Range
49	2/17/2011	12:00 AM				
			Pb diss, µg/l	0.00398	U	Field Blank Contamination
49	5/18/2011	12:00 AM				
			SO4 Tot, mg/l	7.2	J	Sample Reciept Temperature
			pH Lab, su	7.68	J	Hold Time Violation
			Cd diss, µg/l	0.0292	U	Trip Blank Contamination
			Pb diss, µg/l	0.00969	U	Field Blank Contamination
49	8/10/2011	12:00 AM				
			SO4 Tot, mg/l	12.1	J	Sample Receipt Temperature
			pH Lab, su	7.85	J	Hold Time Violation

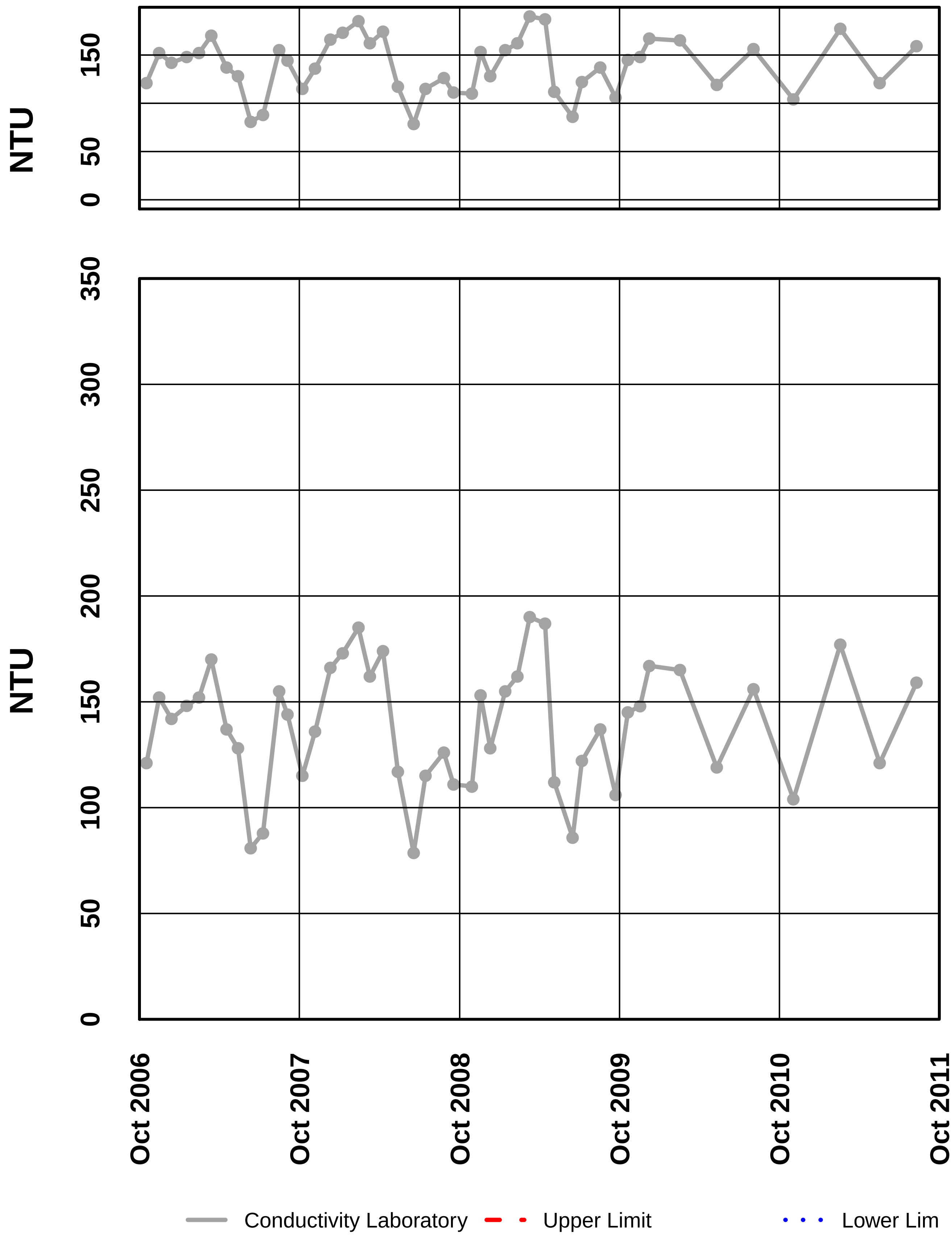
Qualifier	Description
J	Positively Identified - Approximate concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Qu

Site 49 – Water Temperature



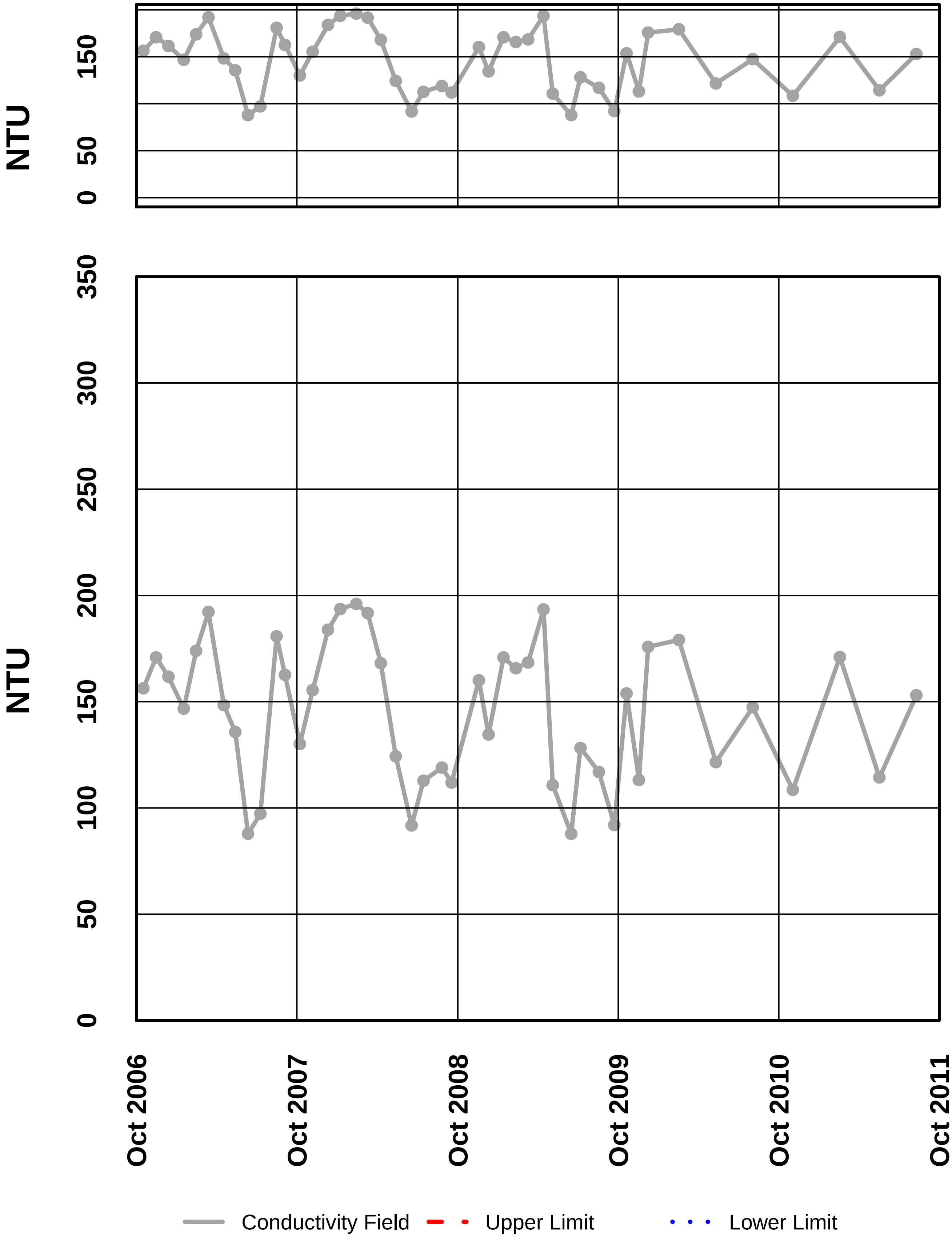
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 49 – Conductivity Laboratory

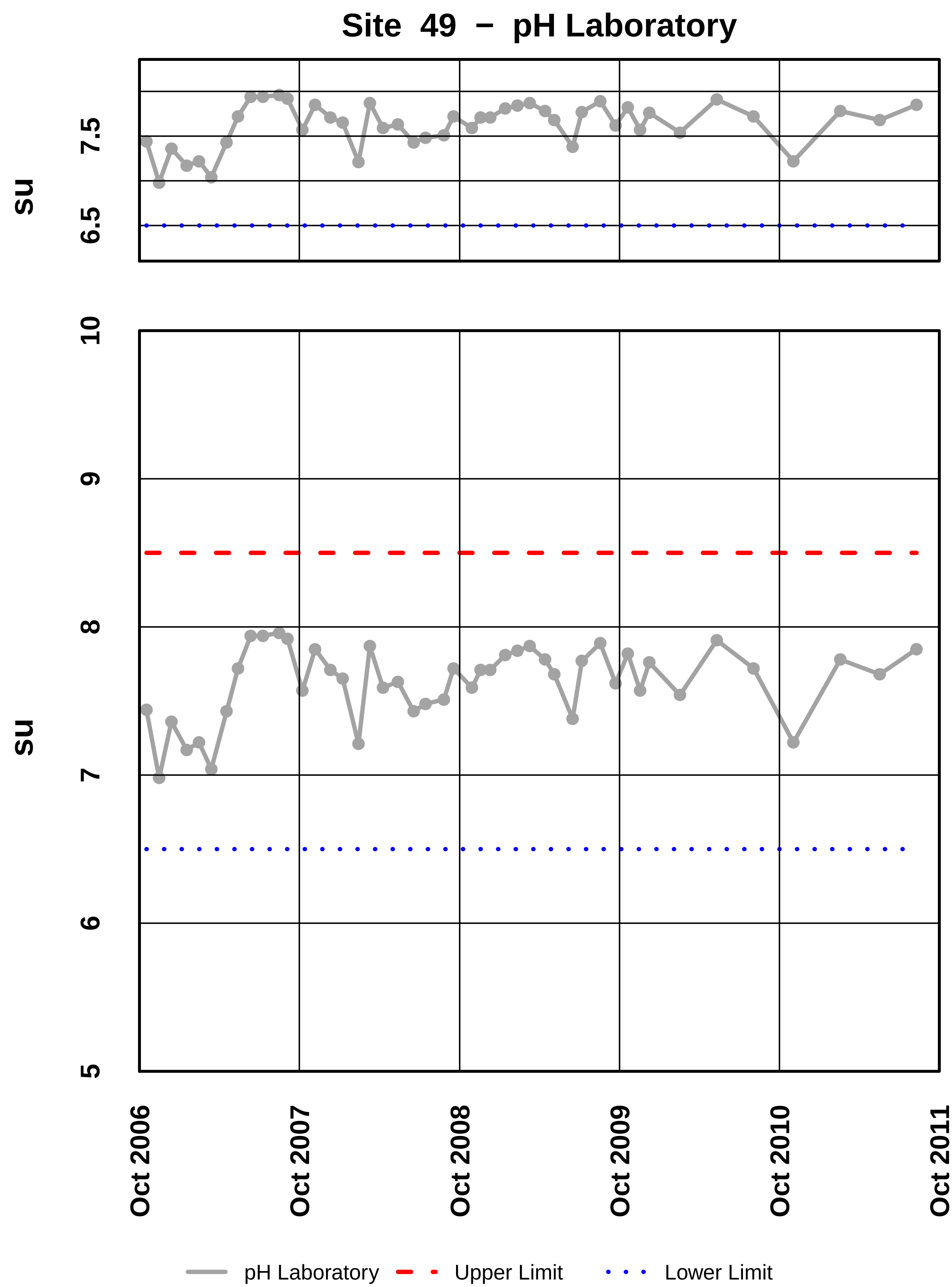


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

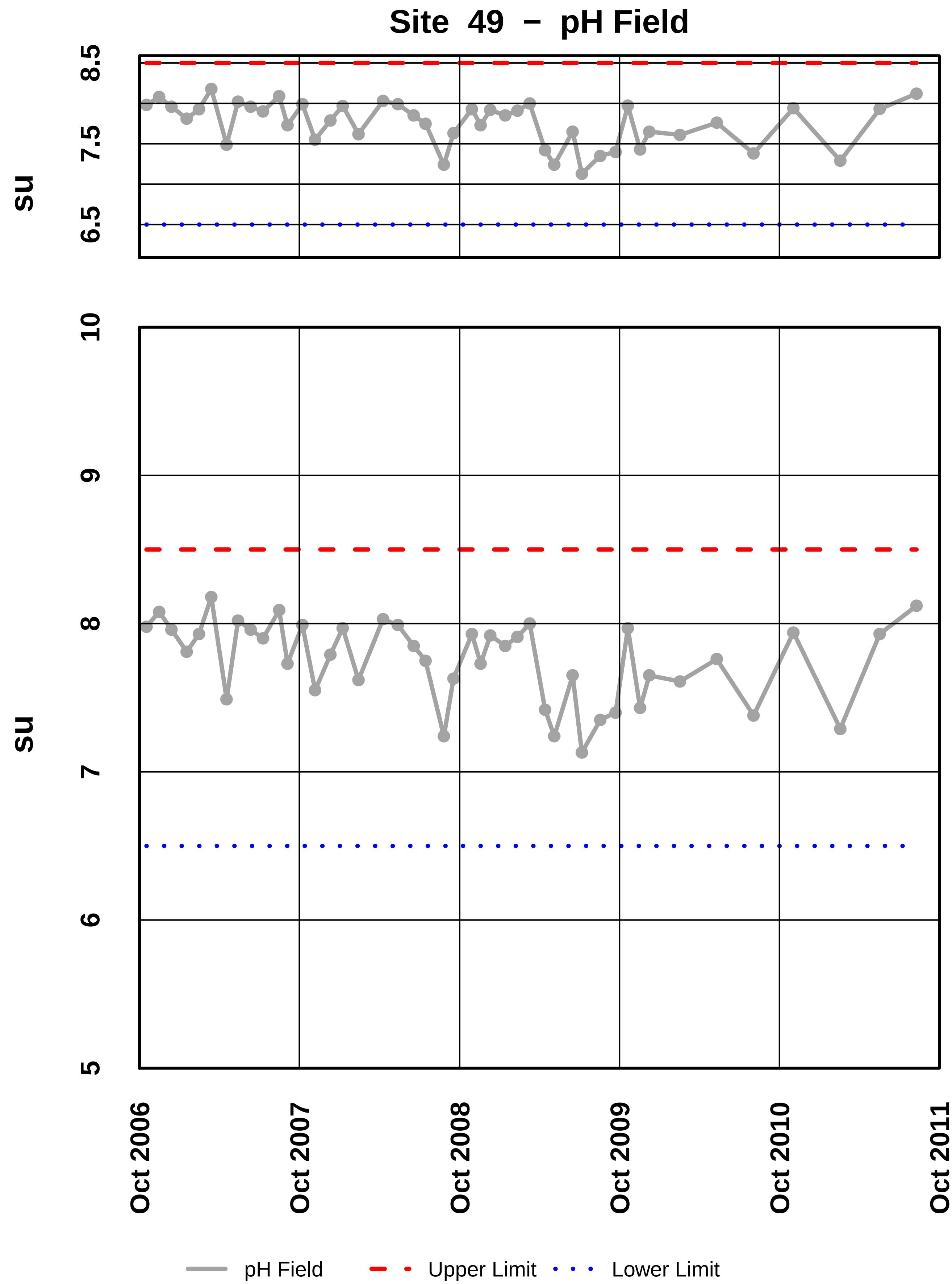
Site 49 – Conductivity Field



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

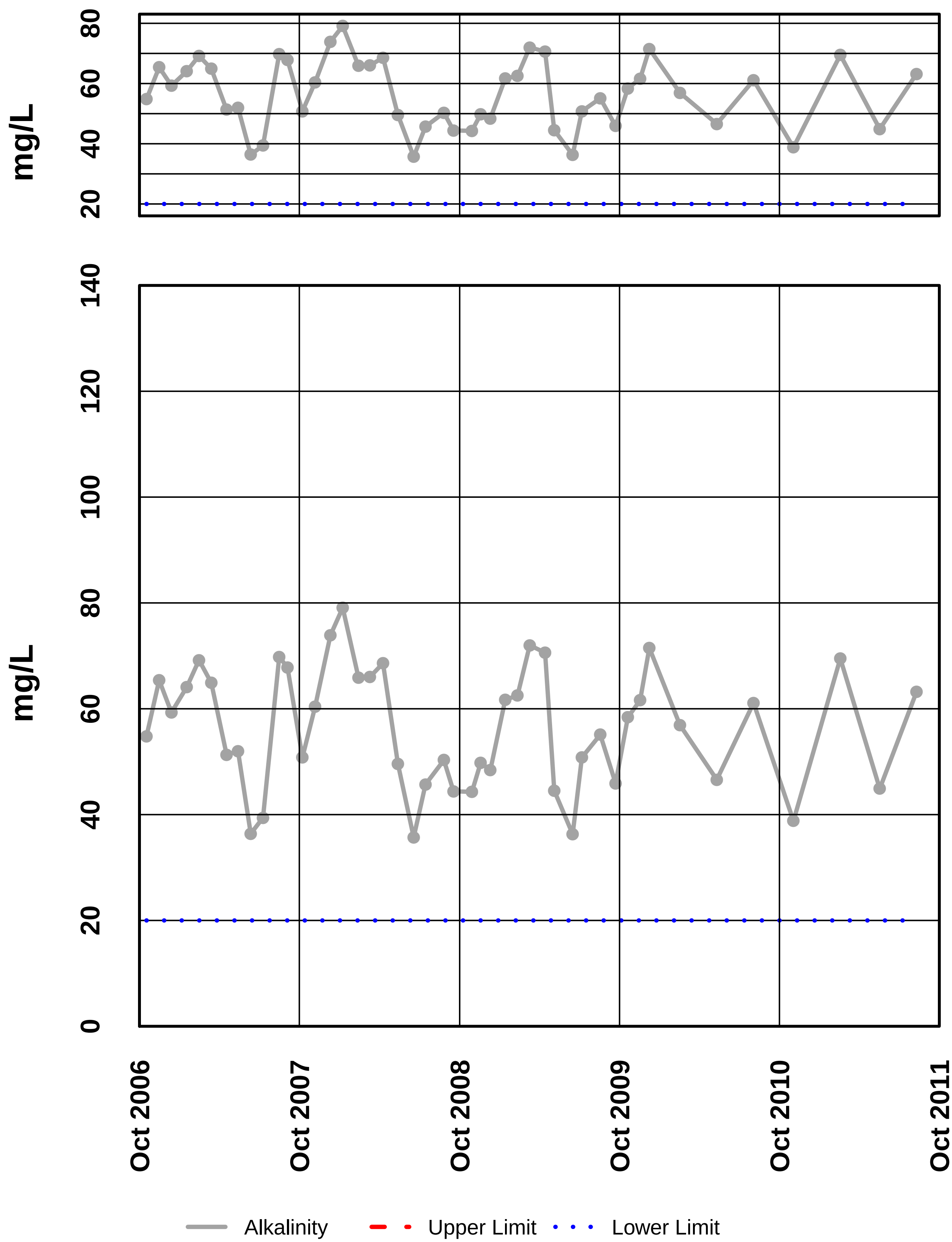


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

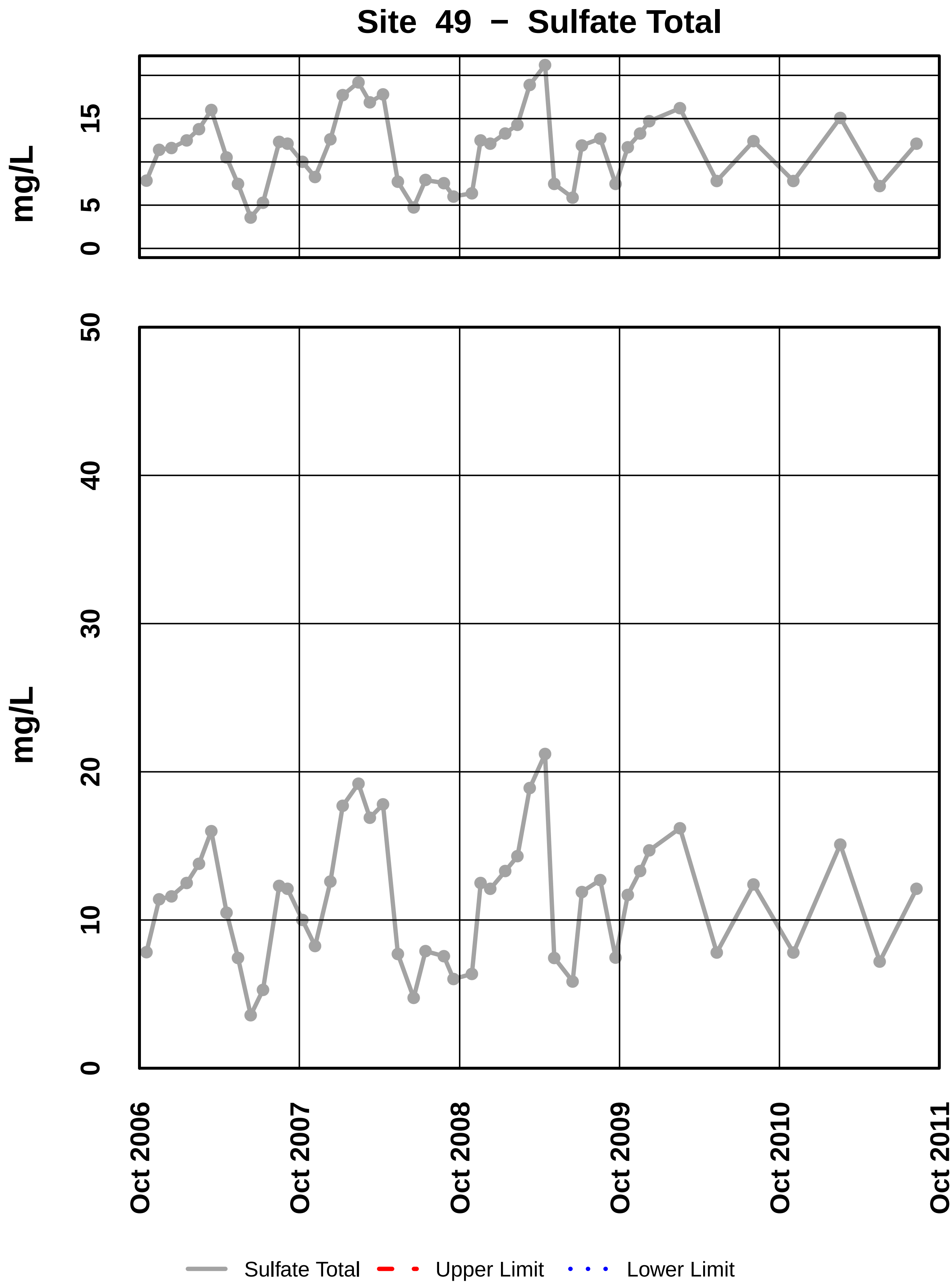


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

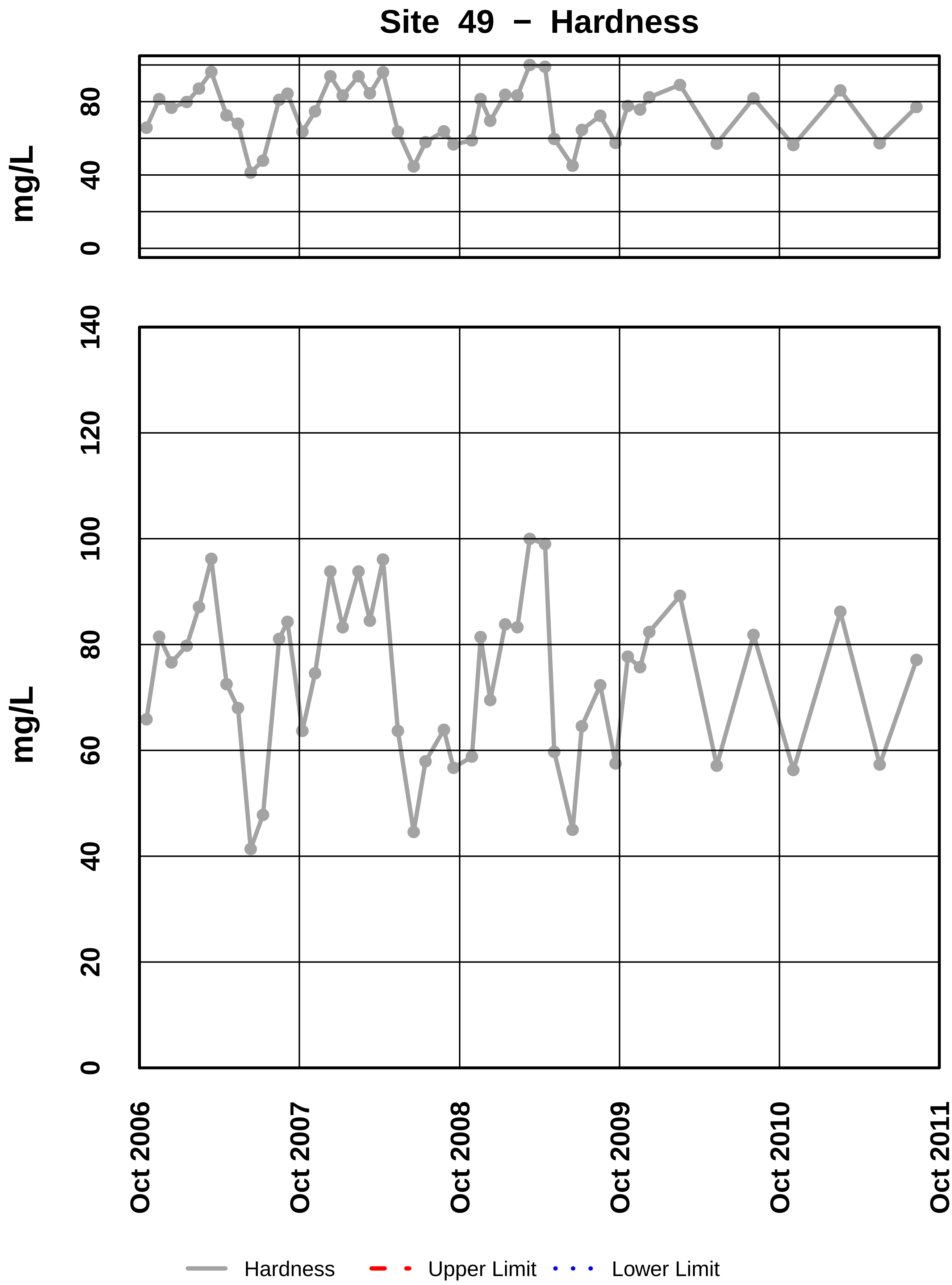
Site 49 − Alkalinity



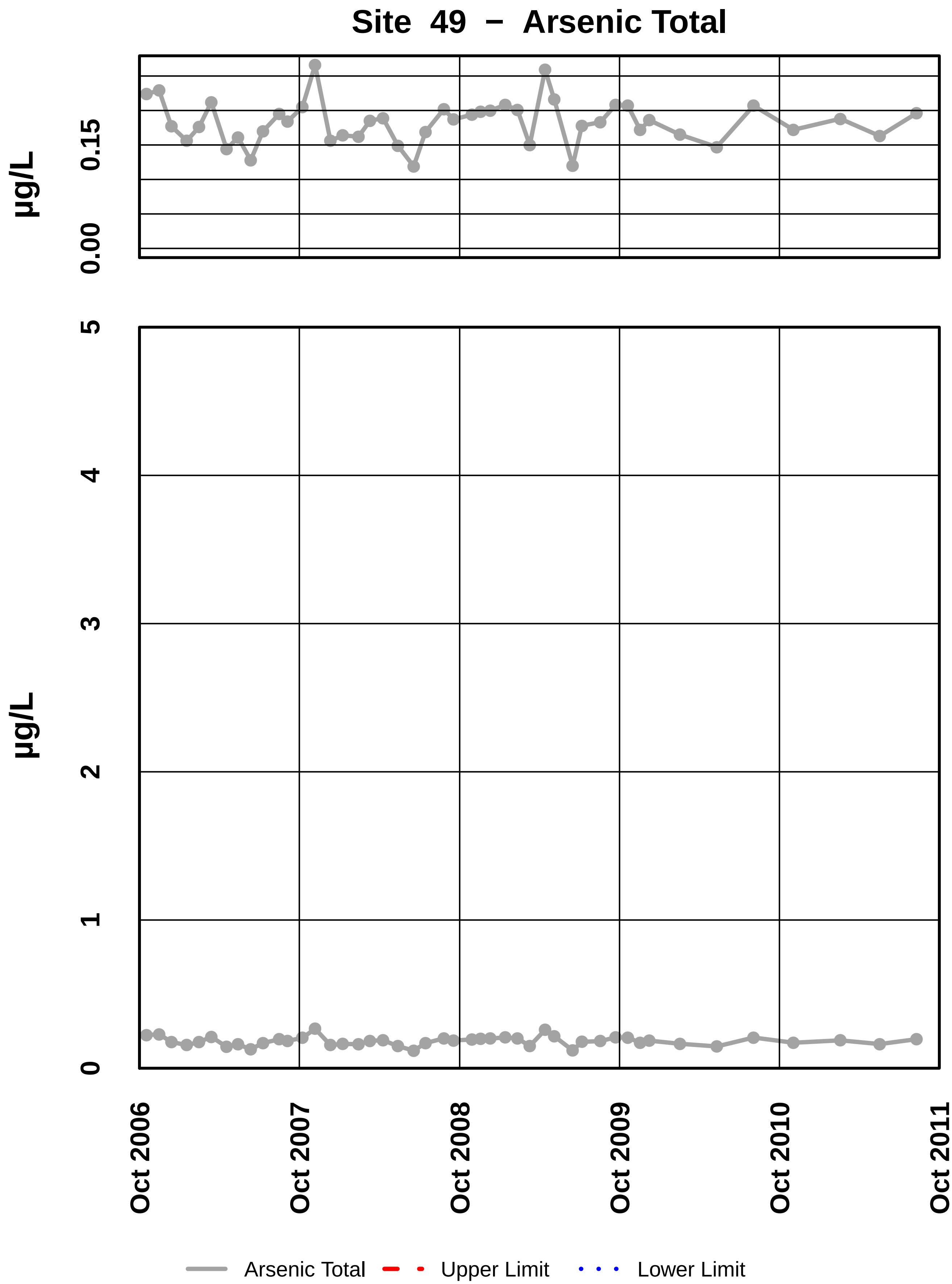
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

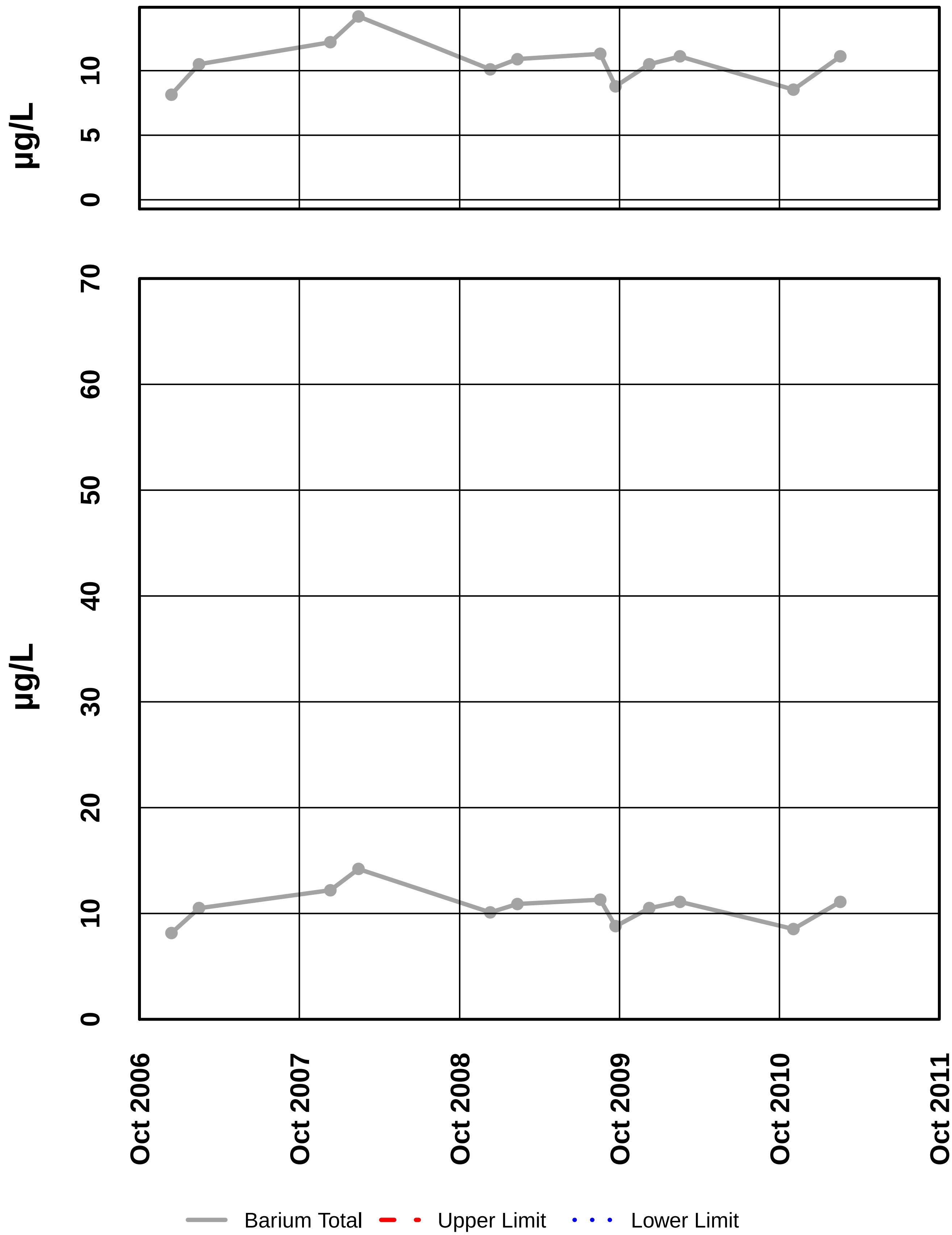


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



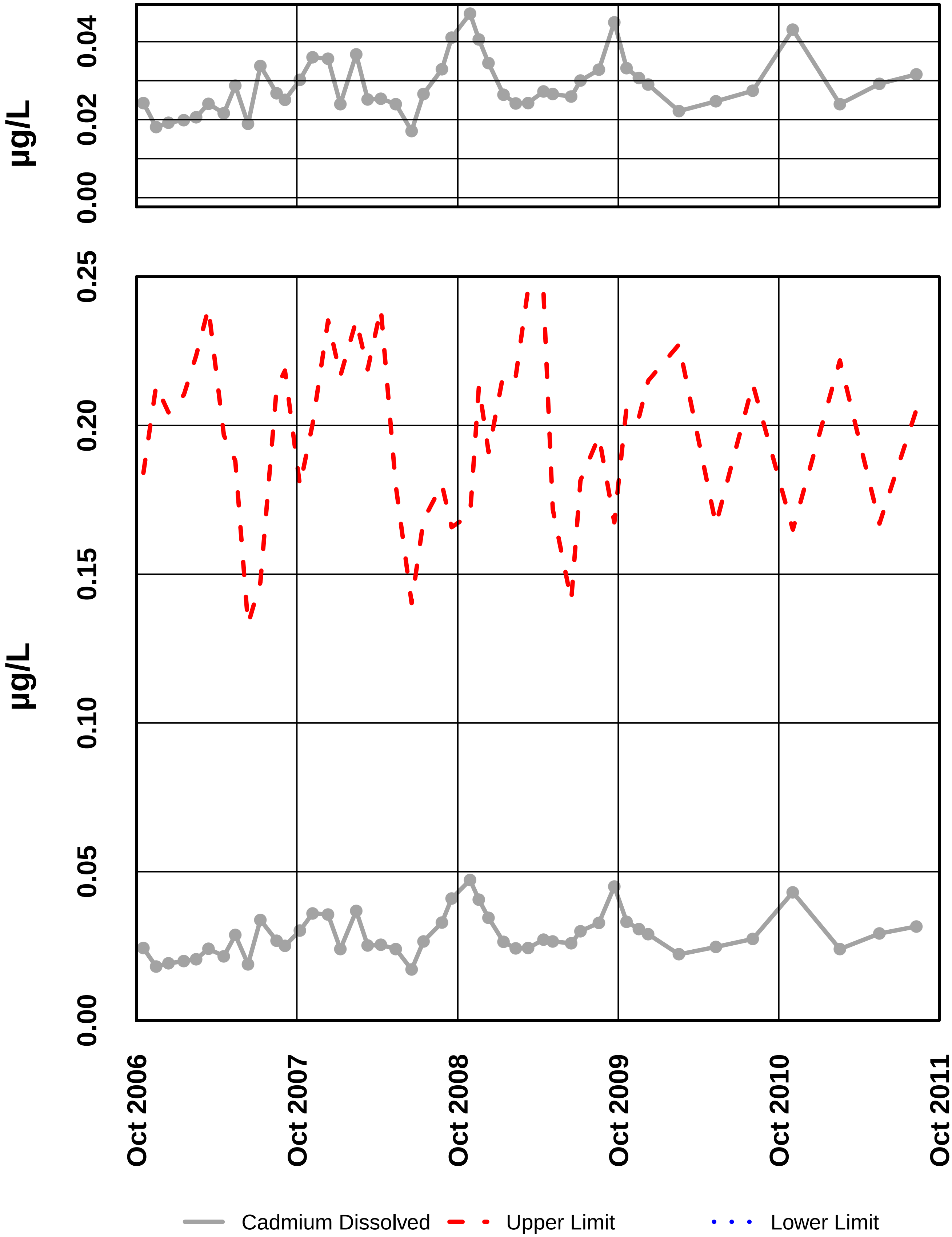
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 49 – Barium Total

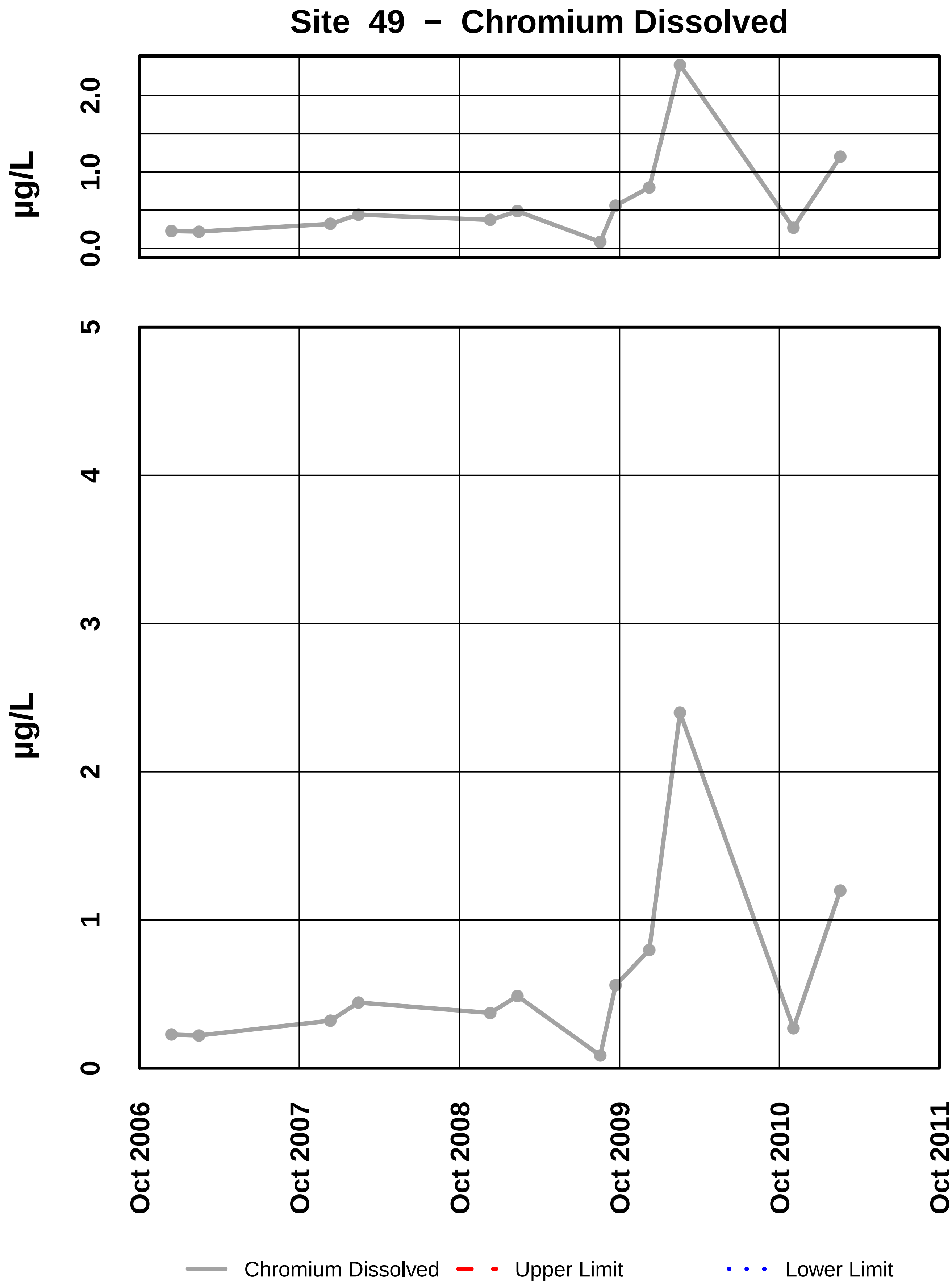


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

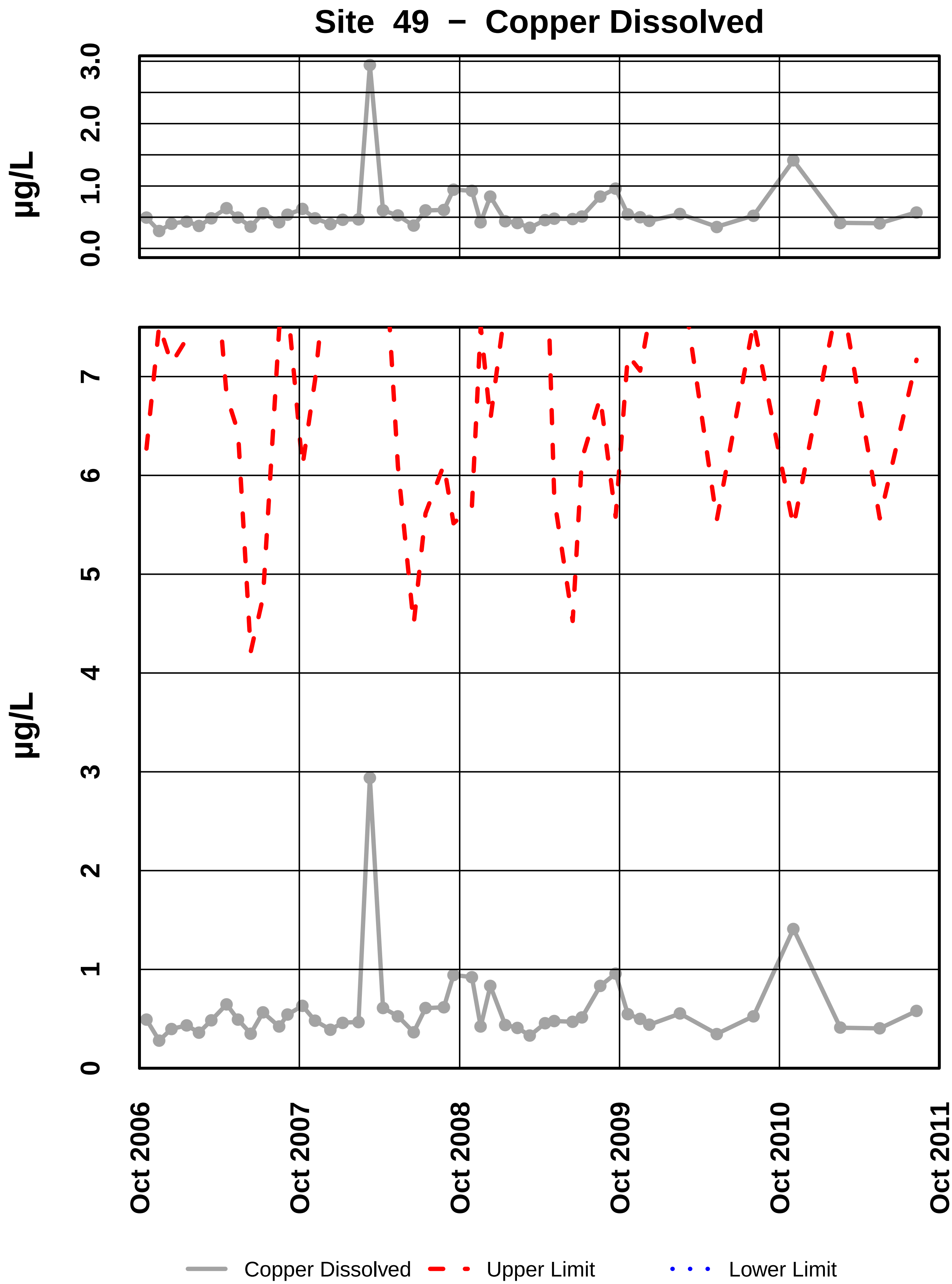
Site 49 – Cadmium Dissolved



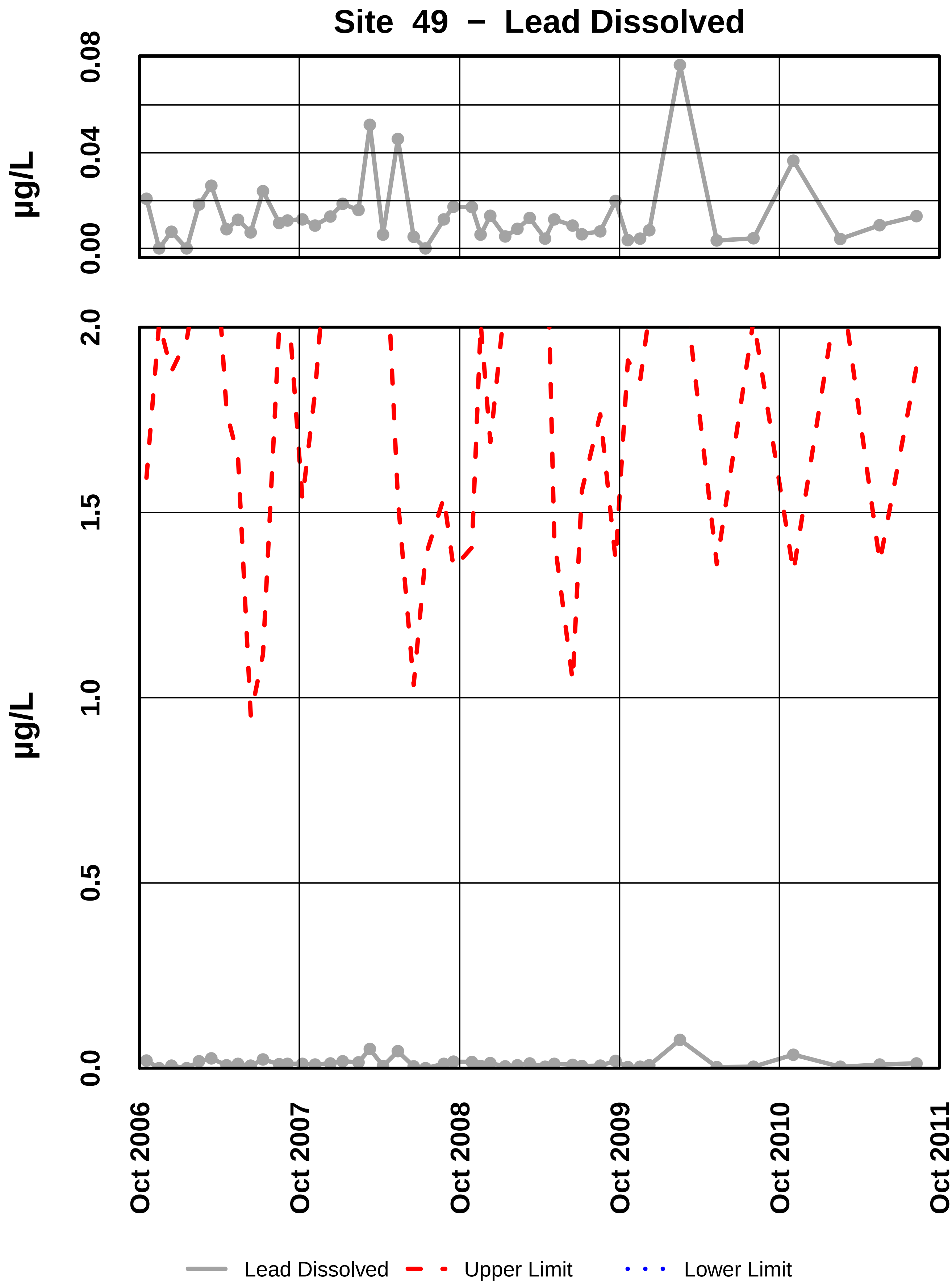
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



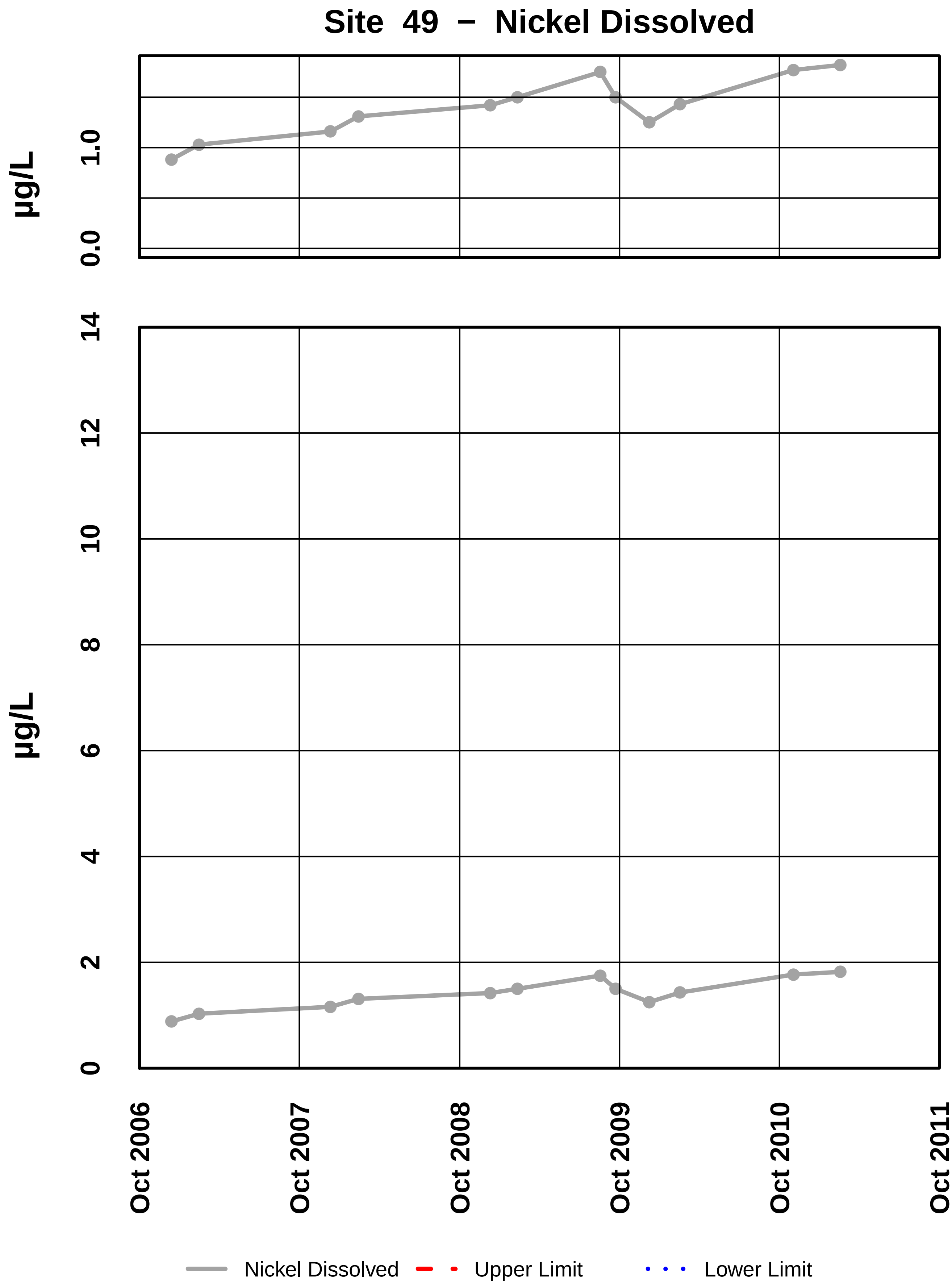
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

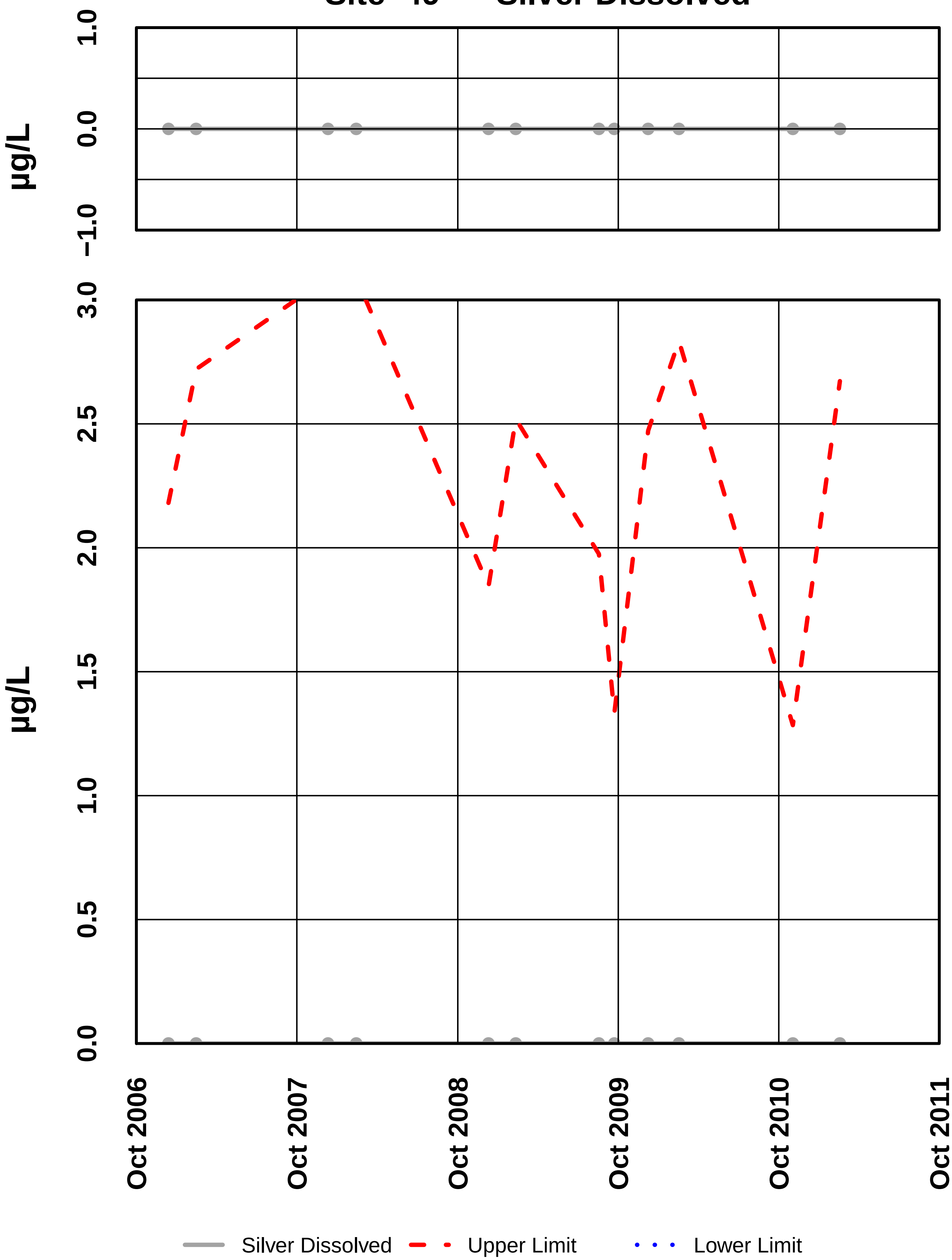


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

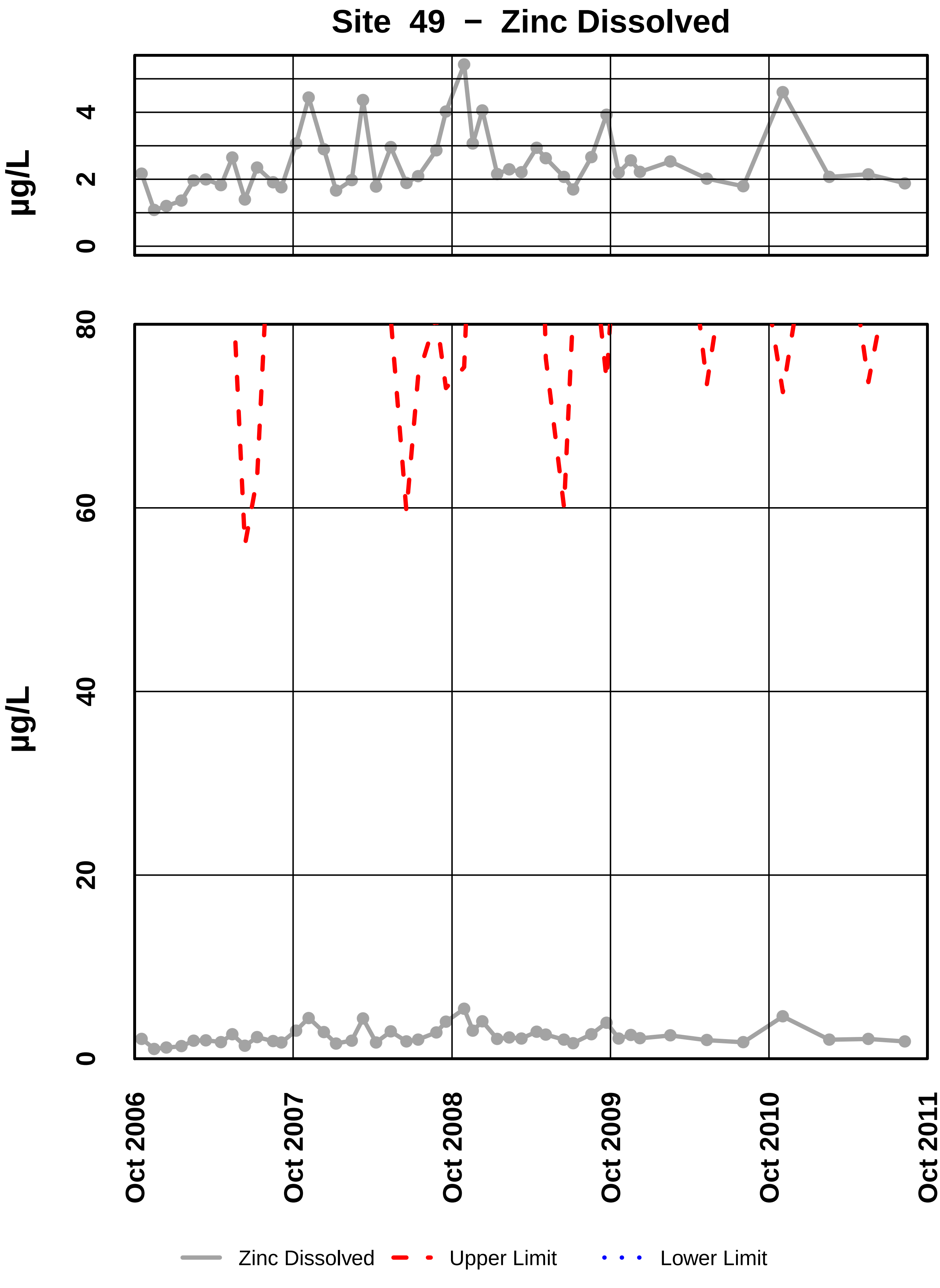


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

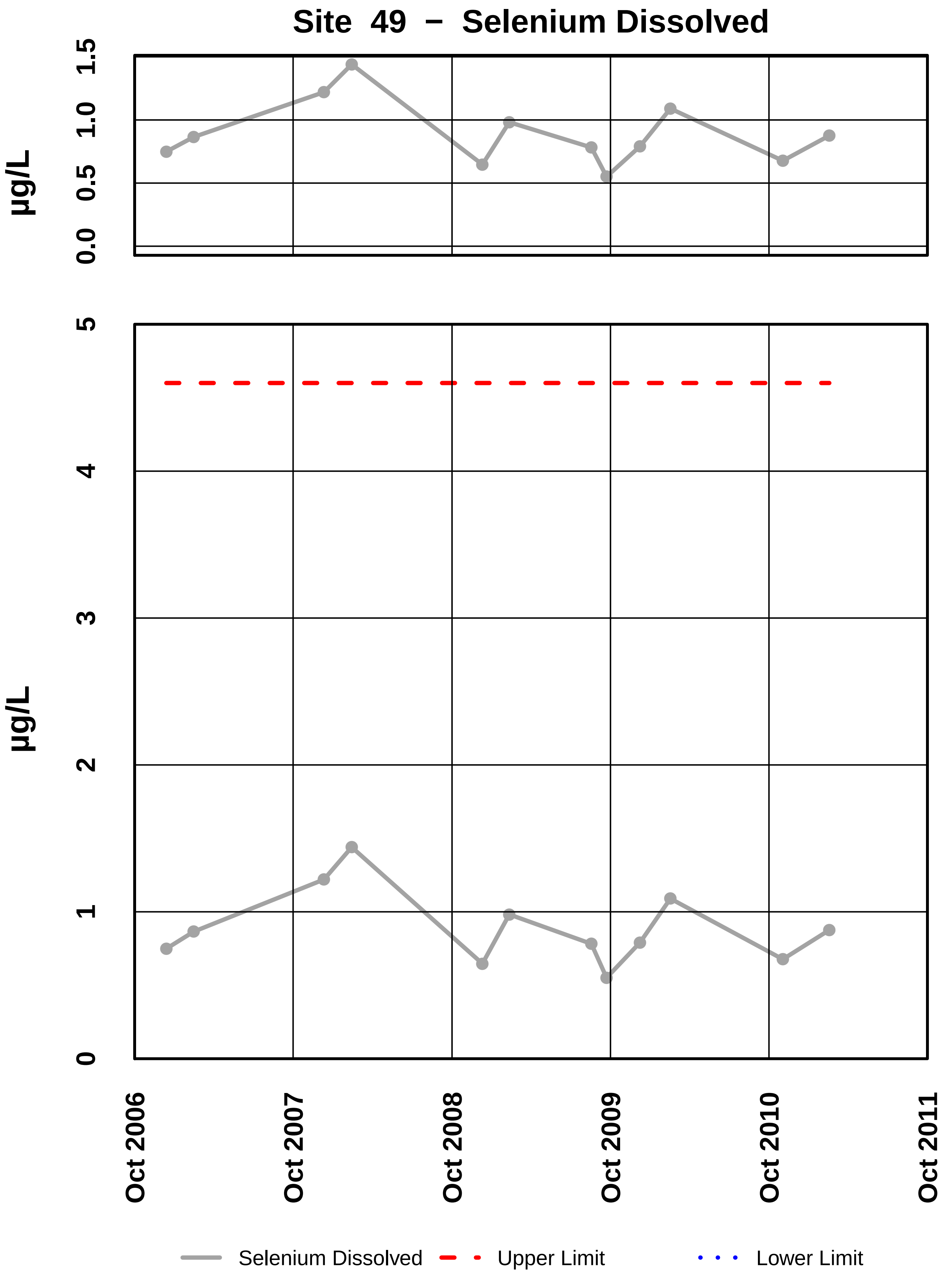
Site 49 – Silver Dissolved



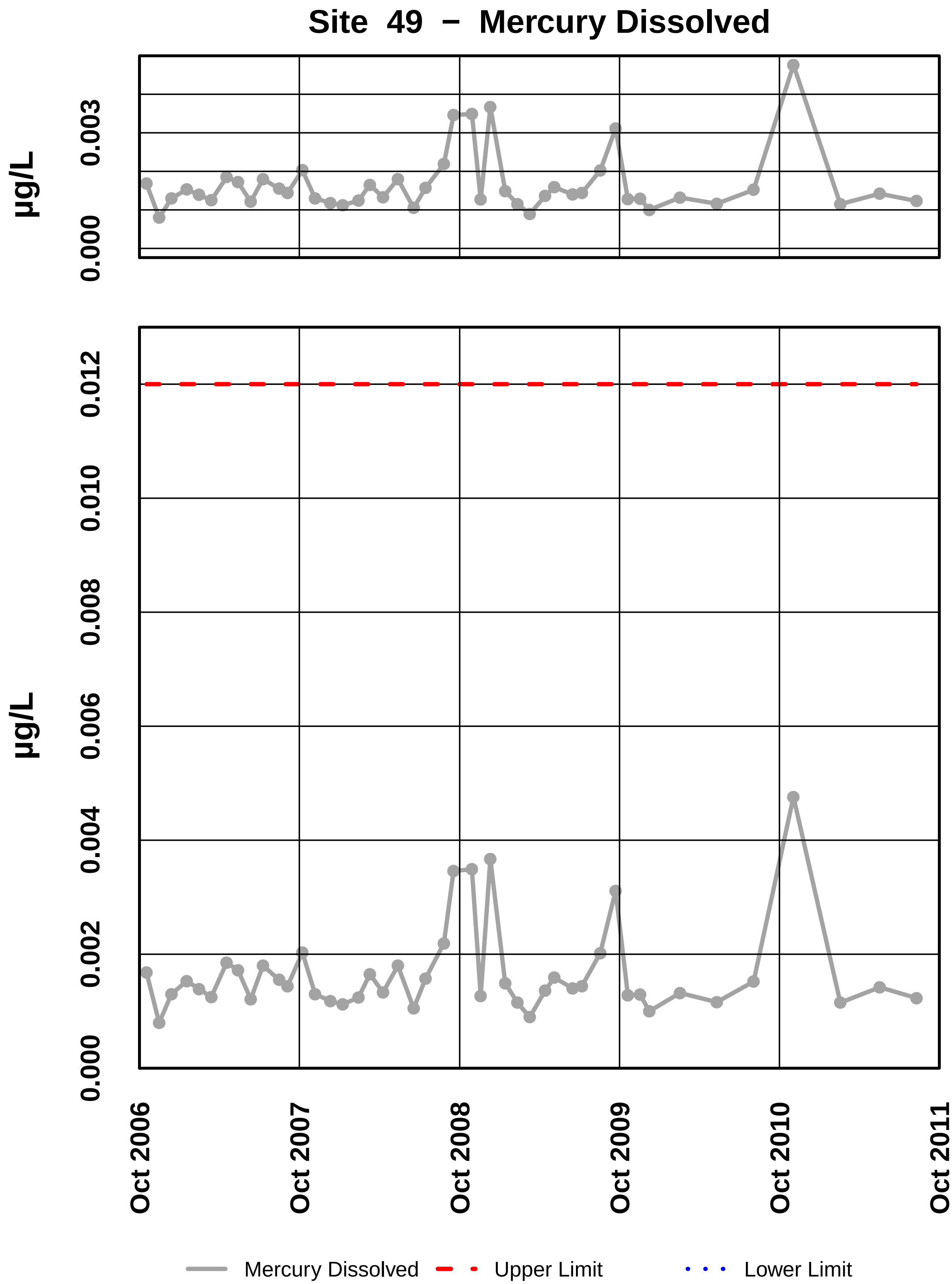
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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



Note: the AWQS may not be shown in order to allow greater visual detail of measured values 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, Lab (uS/cm)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2006**	137.7	133.3	109.4	136.3	145.5	188	159.5	116.7	120	130.9	92.3	104.8
b	**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
c	**WY2008**	130.1	155.4	183.8	193.7	196	191.8	168.1	124.3	91.7	112.8	119	112
d	**WY2009**		160.1	134.5	170.8	165.7	168.5	193.5	110.8	87.8	128.3	116.9	92
e	**WY2010**	153.9	113.2	175.8		179.1			121.6			147.4	
f	**WY2011**		108.5			171			114.3			153	
	n	4	6	5	4	6	4	4	6	4	4	6	4

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	4	6	5	4	6	4	4	6	4	4	6	4
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
e-a	1	-1	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	-1	-1	1	-1	-1
e-b	-1	-1	1		1			-1			-1	
f-b		-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	
f-c		-1			-1			-1			1	
e-d		-1	1		1			1			1	
f-d		-1			1			1			1	
f-e		-1			-1			-1			1	
S_k	0	-7	4	4	3	-2	4	-5	-4	0	5	-2

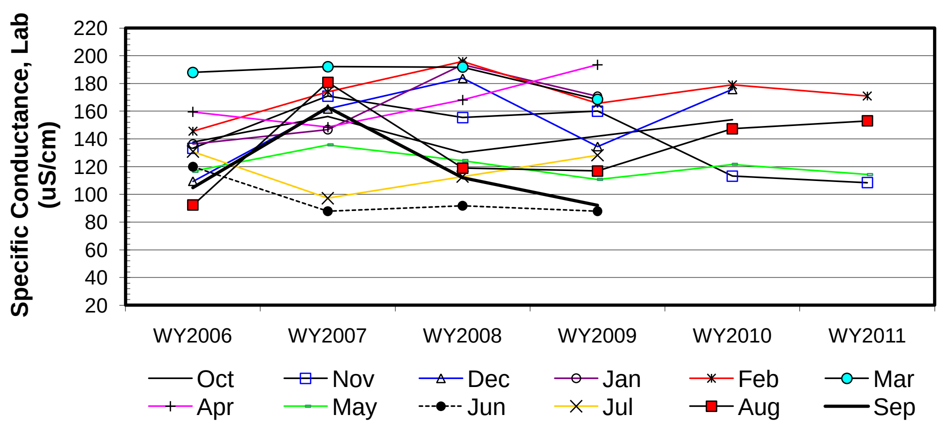
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	8.67	28.33	16.67	8.67	28.33	8.67	8.67	28.33	8.67	8.67	28.33	8.67
$Z_k = S_k/\sigma_S$	0.00	-1.32	0.98	1.36	0.56	-0.68	1.36	-0.94	-1.36	0.00	0.94	-0.68
Z^2_k	0.00	1.73	0.96	1.85	0.32	0.46	1.85	0.88	1.85	0.00	0.88	0.46

ΣZ_k= 0.23
ΣZ^2_k= 11.23
Z-bar=ΣZ_k/K= 0.02

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	57	0	0	0	0

Σn 57
ΣS_k 0

$\chi^2_h=\Sigma Z^2_k$-K(Z-bar)^2=		11.23	@α=5% $\chi^2_{(K-1)}$=	19.68	Test for station homogeneity	
	p	**0.424**			$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc}	0.00	@α/2=2.5% Z=	1.96	**H_0** (No trend)	ACCEPT
190.67	**p**	**0.500**			**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-4.72		6.82
0.050	-3.94	**0.59**	4.44
0.100	-3.15		4.01
0.200	-1.26		3.42

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2006**	8.0	7.8	7.8	7.6	7.3	8.0	7.9	7.5	7.4	8.3	8.3	8.1
b	**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
c	**WY2008**	8.0	7.6	7.8	8.0	7.6		8.0	8.0	7.9	7.8	7.2	7.6
d	**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
e	**WY2010**	8.0	7.4	7.7		7.6			7.8			7.4	
f	**WY2011**		7.9			7.3			7.9			8.1	
	n	5	6	5	4	6	3	4	6	4	4	6	4

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	5	6	5	4	6	3	4	6	4	4	6	4
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	-1	-1	1	-1	-1	-1
e-a	-1	-1	-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	-1	-1	-1	-1	-1	-1
e-b	-1	-1	-1		-1			-1			-1	
f-b		-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	
f-c		1			-1			-1			1	
e-d	1	-1	-1		-1			1			1	
f-d		1			-1			1			1	
f-e		1			-1			1			1	
S_k	-6	-3	-4	4	-3	-1	-2	-1	0	-6	-1	-6

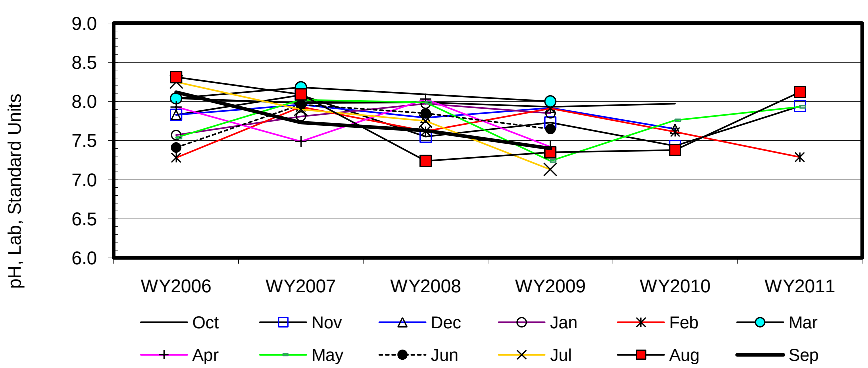
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	16.67	28.33	16.67	8.67	28.33	3.67	8.67	28.33	8.67	8.67	28.33	8.67
$Z_k = S_k/\sigma_S$	-1.47	-0.56	-0.98	1.36	-0.56	-0.52	-0.68	-0.19	0.00	-2.04	-0.19	-2.04
Z^2_k	2.16	0.32	0.96	1.85	0.32	0.27	0.46	0.04	0.00	4.15	0.04	4.15

ΣZ_k= -7.87
ΣZ^2_k= 14.71
Z-bar=ΣZ_k/K= -0.66

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	57	0	0	0	0

Σn 57
ΣS_k -29

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	9.55	@α=5% $\chi^2_{(K-1)}$= 19.68	Test for station homogeneity	
p	**0.571**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k) Z_{calc}	-2.01	@α/2=2.5% Z= 1.96	H_0 (No trend)	REJECT
193.67 **p**	**0.022**		H_A (± trend)	ACCEPT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.11		0.01
0.050	-0.10	**-0.03**	-0.01
0.100	-0.09		-0.02
0.200	-0.06		-0.02

-0.4%

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	**WY2006**	59.3	58.0	52.8	62.6	55.6	77.8	58.9	53.4	51.2	60.7	52.0	57.3
b	**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
c	**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
d	**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
e	**WY2010**	58.4	61.6	71.5		56.9			46.6			61.1	
f	**WY2011**		38.8			69.5			44.9			63.2	
	n	5	6	5	4	6	4	4	6	4	4	6	4

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	5	6	5	4	6	4	4	6	4	4	6	4
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	
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	1	-1	-1	1	-1	-1
e-b	1	-1	1		-1			-1			-1	
f-b		-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	
f-c		-1			1			-1			1	
e-d	1	1	1		-1			1			1	
f-d		-1			1			1			1	
f-e		-1			1			-1			1	
S_k	-4	-5	2	0	3	0	4	-11	-4	0	5	-2

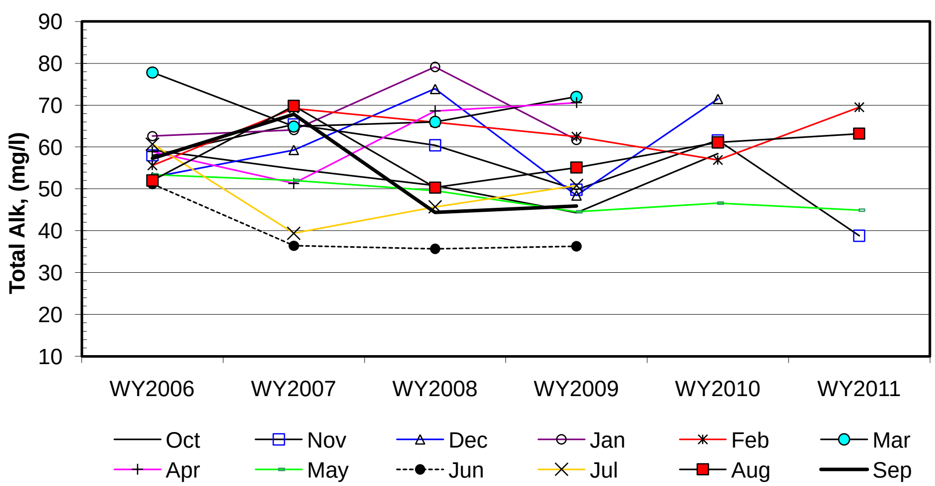
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	16.67	28.33	16.67	8.67	28.33	8.67	8.67	28.33	8.67	8.67	28.33	8.67
$Z_k = S_k/\sigma_S$	-0.98	-0.94	0.49	0.00	0.56	0.00	1.36	-2.07	-1.36	0.00	0.94	-0.68
Z^2_k	0.96	0.88	0.24	0.00	0.32	0.00	1.85	4.27	1.85	0.00	0.88	0.46

ΣZ_k= -2.67
ΣZ^2_k= 11.71
Z-bar=ΣZ_k/K= -0.22

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	58	0	0	0	0

Σn 58
ΣS_k -12

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	11.11	@α=5% $\chi^2_{(K-1)}$= 19.68	Test for station homogeneity	
p	**0.434**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k) 198.67	Z_{calc} -0.78	@α/2=2.5% Z= 1.96	H_0 (No trend)	ACCEPT
	p **0.218**		H_A (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-2.93		1.20
0.050	-1.86	**-1.20**	0.78
0.100	-1.70		0.33
0.200	-1.64		-0.06

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	**WY2006**	9.5	11.3	9.8	15.2	12.9	20.3	15.5	8.4	8.8	11.7	6.9	10.5
b	**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
c	**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
d	**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
e	**WY2010**	11.7	13.3	14.7		16.2			7.8			12.4	
f	**WY2011**		7.8			15.1			7.2			12.1	
	n	5	6	5	4	6	4	4	6	4	4	6	4

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	5	6	5	4	6	4	4	4	4	4	6	4
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	-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	
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	1	0	1	1	1	-1
e-b	1	1	1		1			1			1	
f-b		-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	
f-c		-1			-1			-1			1	
e-d	1	1	1		1			1			-1	
f-d		-1			1			-1			-1	
f-e		-1			-1			-1			-1	
S_k	2	1	8	0	7	0	4	-6	0	2	5	-2

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	16.67	28.33	16.67	8.67	28.33	8.67	8.67	27.33	8.67	8.67	28.33	8.67
$Z_k = S_k/\sigma_S$	0.49	0.19	1.96	0.00	1.32	0.00	1.36	-1.15	0.00	0.68	0.94	-0.68
Z^2_k	0.24	0.04	3.84	0.00	1.73	0.00	1.85	1.32	0.00	0.46	0.88	0.46

ΣZ_k= 5.10

ΣZ^2_k= 10.81

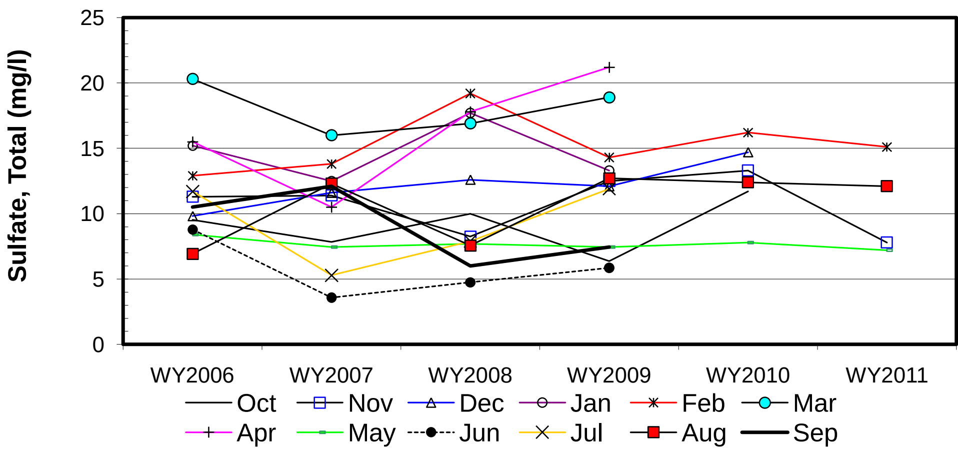
Z-bar=ΣZ_k/K= 0.43

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	56	1	0	0	0

Σn 58

ΣS_k 21

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	8.64	@α=5% $\chi^2_{(K-1)}$= 19.68	Test for station homogeneity	
p	**0.655**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
$\Sigma VAR(S_k)$	Z_{calc} 1.42	@α=5% Z= 1.64	**H_0** (No trend)	ACCEPT
197.67	**p** **0.923**		**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.19		0.83
0.050	-0.06	0.28	0.60
0.100	0.03		0.50
0.200	0.10		0.40

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	**WY2006**	3.0	2.2	1.7	1.7	1.6	1.8	1.1	1.2	1.5	1.0	3.6	2.1
b	**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
c	**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
d	**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
e	**WY2010**	2.2	2.6	2.2		2.5			2.0			1.8	
f	**WY2011**		4.6			2.1			2.2			1.9	
	n	5	6	5	4	6	4	4	6	4	4	6	4

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	5	6	5	4	6	4	4	6	4	4	6	4
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	
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	1	-1	1	-1	1	1
e-b	1	1	1		1			-1			-1	
f-b		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	
f-c		1			1			-1			-1	
e-d	-1	-1	-1		1			-1			-1	
f-d		1			-1			-1			-1	
f-e		1			-1			1			1	
S_k	2	7	4	2	11	4	4	-1	4	0	-9	2

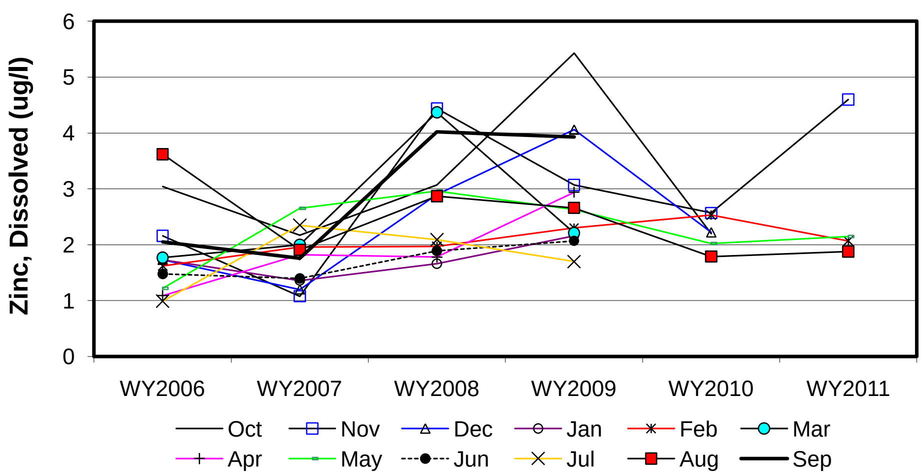
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	16.67	28.33	16.67	8.67	28.33	8.67	8.67	28.33	8.67	8.67	28.33	8.67
$Z_k = S_k/\sigma_S$	0.49	1.32	0.98	0.68	2.07	1.36	1.36	-0.19	1.36	0.00	-1.69	0.68
Z^2_k	0.24	1.73	0.96	0.46	4.27	1.85	1.85	0.04	1.85	0.00	2.86	0.46

ΣZ_k= 8.41
ΣZ^2_k= 16.56
Z-bar=$\Sigma Z_k/K$= 0.70

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	58	0	0	0	0

Σn 58
ΣS_k 30

$\chi^2_h=\Sigma Z^2_k - K(\text{Z-bar})^2$= 10.67	@α=5% $\chi^2_{(K-1)}$= 19.68	Test for station homogeneity	
p **0.472**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
$\Sigma VAR(S_k)$ 198.67 / Z_{calc} 2.06 / **p** **0.980**	@α/2=2.5% Z= 1.96	**H_0** (No trend)	REJECT
		H_A (± trend)	ACCEPT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.02		0.32
0.050	0.02	**0.17**	0.23
0.100	0.05		0.23
0.200	0.10		0.20
		8.1%	

INTERPRETIVE REPORT
SITE 46 “LOWER BRUIN CREEK”

The data collected during the current water year are listed in the following “Table of Results for Water Year 2011” 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 20011.				

The data for water year 2011 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 2011

			Limits		
Sample Date	Parameter	Value	Lower	Upper	Hardness
No exceedances have been identified by HGCMC for the period of October 2010 through September 2011.					

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. Dissolved chromium decreased to previously recorded values after roughly increasing an order of magnitude during water year 2010. A similar pattern was also noted for Site 6, Site 13, Site 46, Site 48, Site 49, and Site 54; all sites that are located in the 920 area.

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-05 and Sep-11 (WY2006-WY2011). 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

	Mann-Kendall test statistics			Sen's slope estimate	
Parameter	**n***	**p****	**Trend**	**Q**	**Q(%)**
Conductivity Field	6	0.35			
pH Field	6	<0.01	-	-0.08	-1.0
Alkalinity, Total	6	0.08			
Sulfate, Total	6	0.17			
Zinc, Dissolved	6	<0.01	+	0.18	9.6

* Number of Years ** Significance level

The dataset for field pH has a statistically significant ($p<0.01$) negative trend with a slope estimate of -0.08 su/yr or a -1% decrease over the period. Dissolved zinc has a statistically significant ($p<0.01$) positive trend with a slope estimate of 0.176 µg/L/yr or a 9.6% increase over the period. Both of these trends are similar in magnitude and direction as noted for the upgradient control Site 49 and therefore are interpreted as natural variation.

A comparison of median values for alkalinity, laboratory pH, laboratory conductivity, sulfate, and dissolved zinc between Site 49 and Site 46 has been conducted as specified in the Statistical Information Goals for Site 46. 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 46 and Site 49, 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 below table summarizes the results of the signed-rank test as performed on the water year 2011 dataset. For all of the analytes there were no statistically significant differences between the measured median values at a significance level of $\alpha=0.05$ for a one-tailed test.

Table of Summary Statistics for Median Analysis

Site 46 vs Site 49				
Parameter	**Signed Ranks p-value**	**Site 49 median**	**Site 46 median**	**Median Differences**
Conductivity Field	0.969	133.7	119.7	5
pH Field	0.938	7.94	7.85	0.09
Alkalinity, Total	0.812	54.1	52	2.1
Sulfate, Total	0.93	10	10.00	0.10
Zinc, Dissolved	0.312	2.11	2.19	-0.08

Table of Results for Water Year 2011

Site 046FMS - 'Lower Bruin Creek'

Sample Date/Parameter	Oct 2010	Nov 2010	Dec 2010	Jan 2011	Feb 2011	Mar 2011	Apr 2011	May 2011	Jun 2011	Jul 2011	Aug 2011	Sep 2011	**Median**
Water Temp (°C)		4.7			0.3			3.1			8.1		3.9
Conductivity-Field(μmho)		105.6			164			114.3			125		119.7
Conductivity-Lab (μmho)		101			170			120			163		142
pH Lab (standard units)		6.89			7.52			7.68			7.65		7.59
pH Field (standard units)		7.85			7.36			7.84			7.87		7.85
Total Alkalinity (mg/L)		36.9			61.3			42.7			65.5		52.0
Total Sulfate (mg/L)		7.7			13.5			7.1			12.2		10.0
Hardness (mg/L)		53.3			82.1			56			77.9		67.0
Dissolved As (ug/L)		0.326			0.145			0.193			0.263		0.228
Dissolved Ba (ug/L)		11			12.7								11.9
Dissolved Cd (ug/L)		0.0518			0.0264			0.0198			0.0209		0.0237
Dissolved Cr (ug/L)		0.441			1.45								0.946
Dissolved Cu (ug/L)		1.59			0.444			0.453			0.626		0.540
Dissolved Pb (ug/L)		0.273			0.0035			0.0197			0.0064		0.0131
Dissolved Ni (ug/L)		1.71			1.77								1.740
Dissolved Ag (ug/L)		0.002			0.002								0.002
Dissolved Zn (ug/L)		7.82			2.33			2.04			1.64		2.19
Dissolved Se (ug/L)		0.559			0.887								0.723
Dissolved Hg (ug/L)		0.00515			0.00106			0.00142			0.0012		0.001310

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

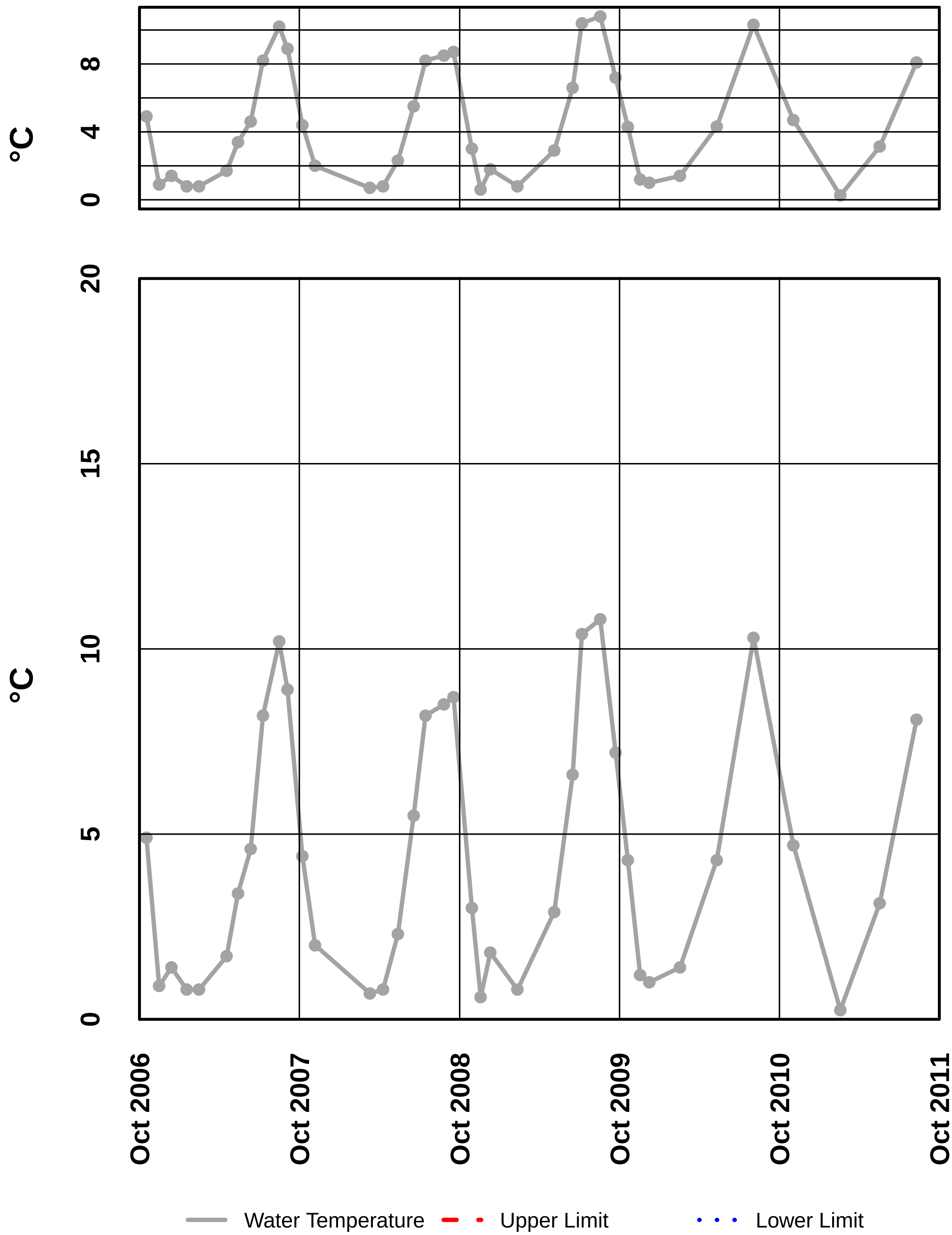
Qualified Data by QA Reviewer

Date Range: 10/01/2010 to 09/30/2011

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
46	11/2/2010	12:00 AM				
			Se diss, µg/l	0.559	J	Below Quantitative Range
46	2/17/2011	12:00 AM				
			Pb diss, µg/l	0.00349	U	Field Blank Contamination
46	5/18/2011	12:00 AM				
			SO4 Tot, mg/l	7.1	J	Sample Reciept Temperature
			pH Lab, su	7.68	J	Hold Time Violation
			Cd diss, µg/l	0.0198	U	Trip Blank Contamination
			Pb diss, µg/l	0.0197	U	Field Blank Contamination
46	8/10/2011	12:00 AM				
			SO4 Tot, mg/l	12.2	J	Sample Receipt Temperature
			Pb diss, µg/l	0.00635	J	Below Quantitative Range
			pH Lab, su	7.65	J	Hold Time Violation

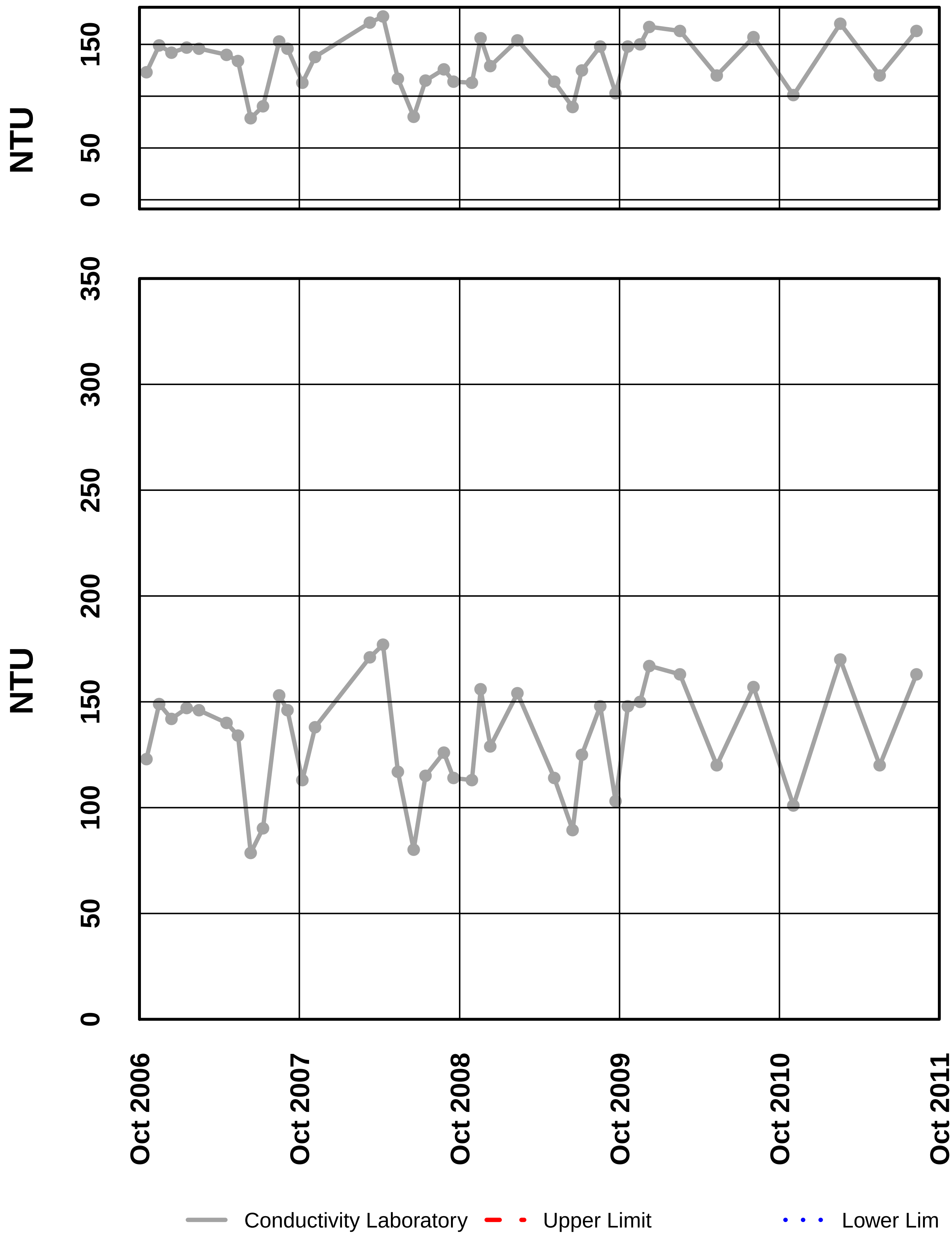
Qualifier	Description
J	Positively Identified - Approximate concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit

Site 46 – Water Temperature



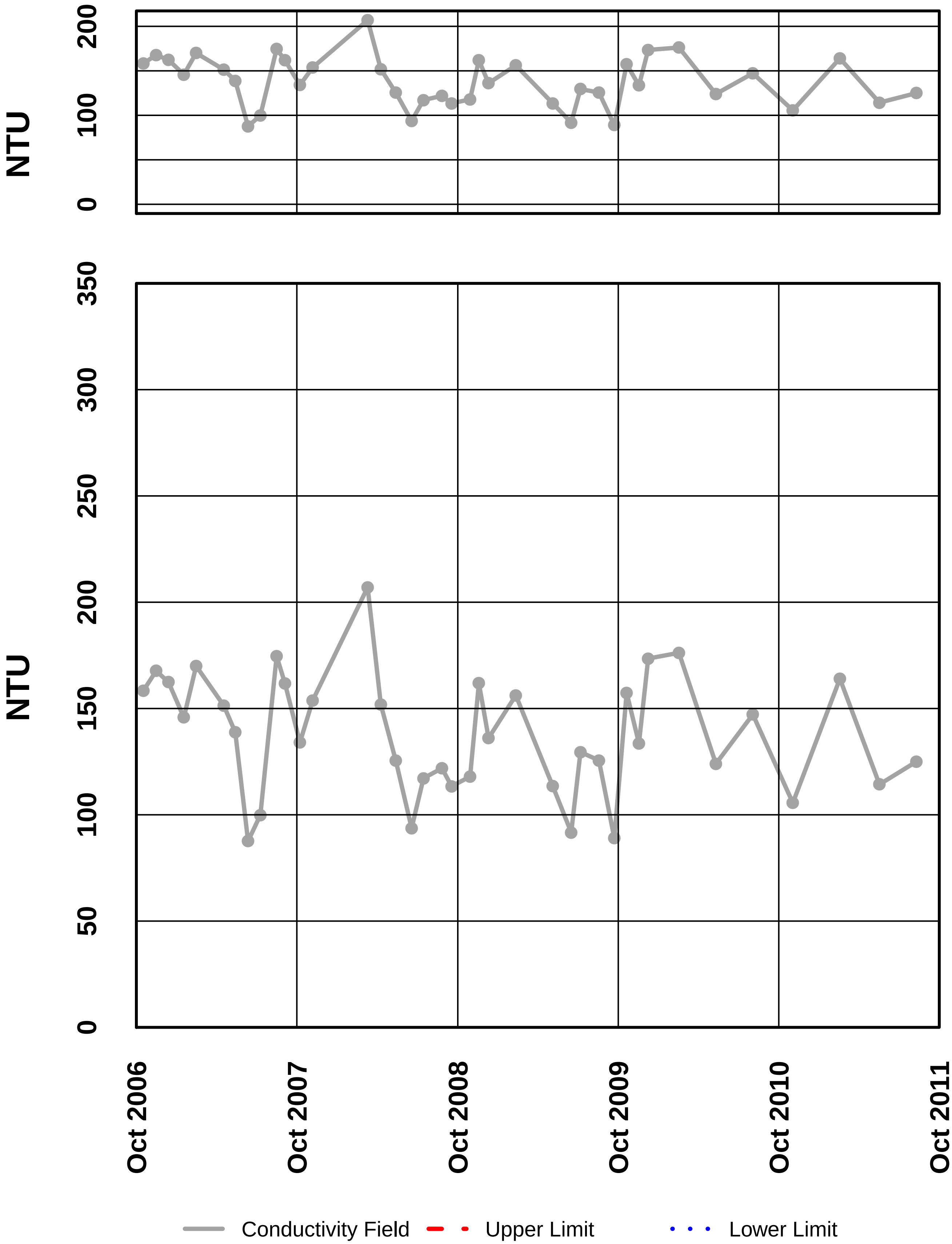
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 46 – Conductivity Laboratory



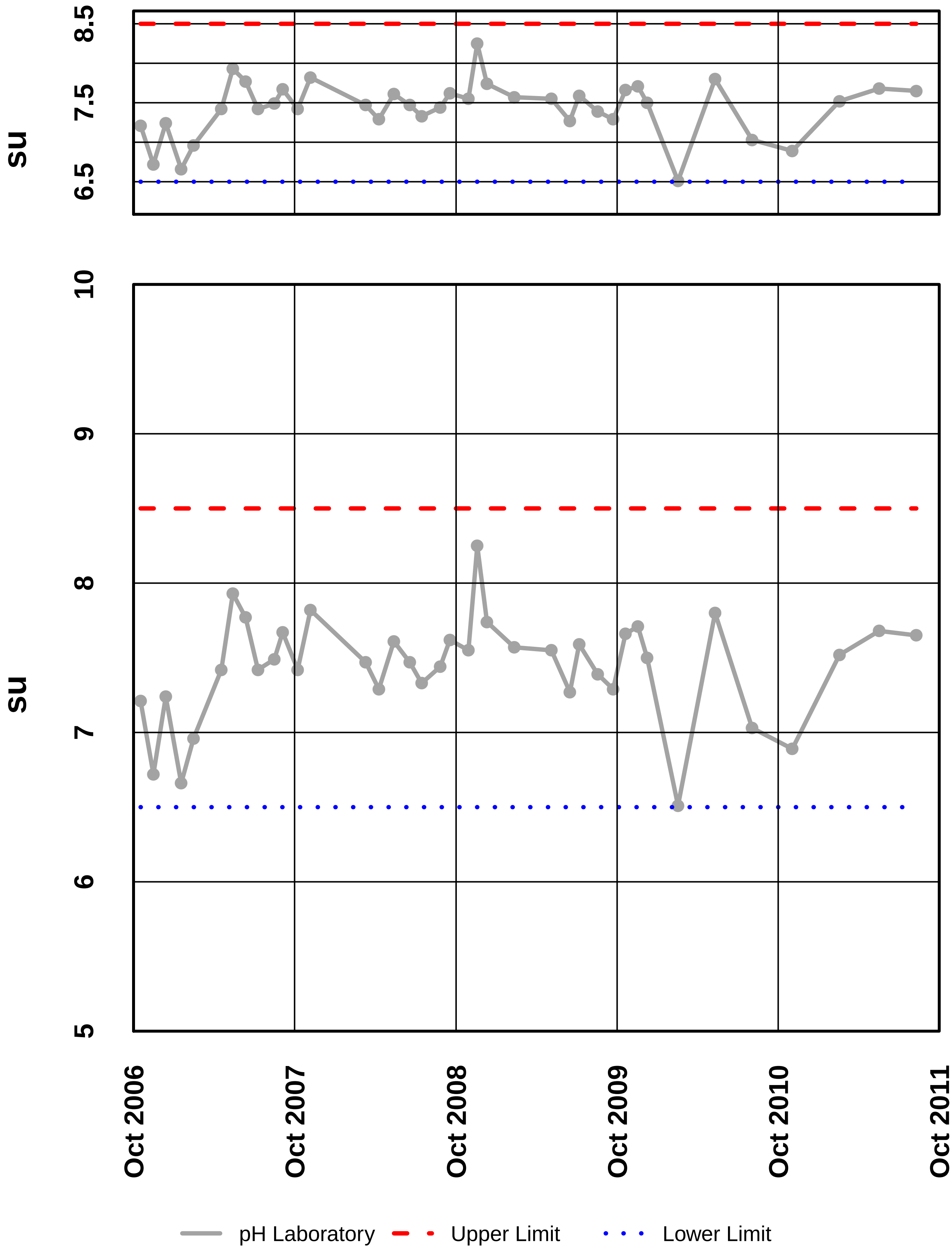
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 46 – Conductivity Field

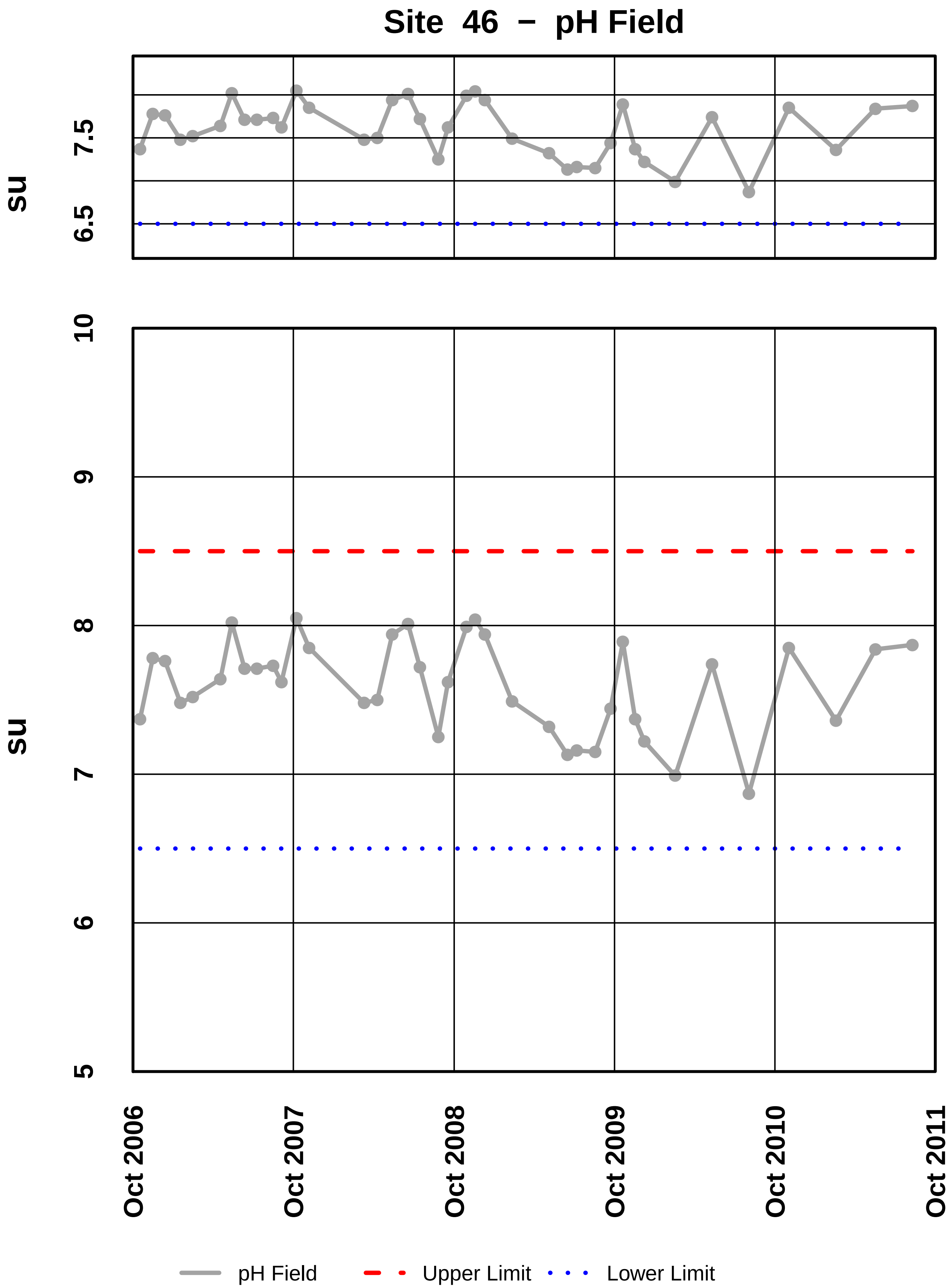


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

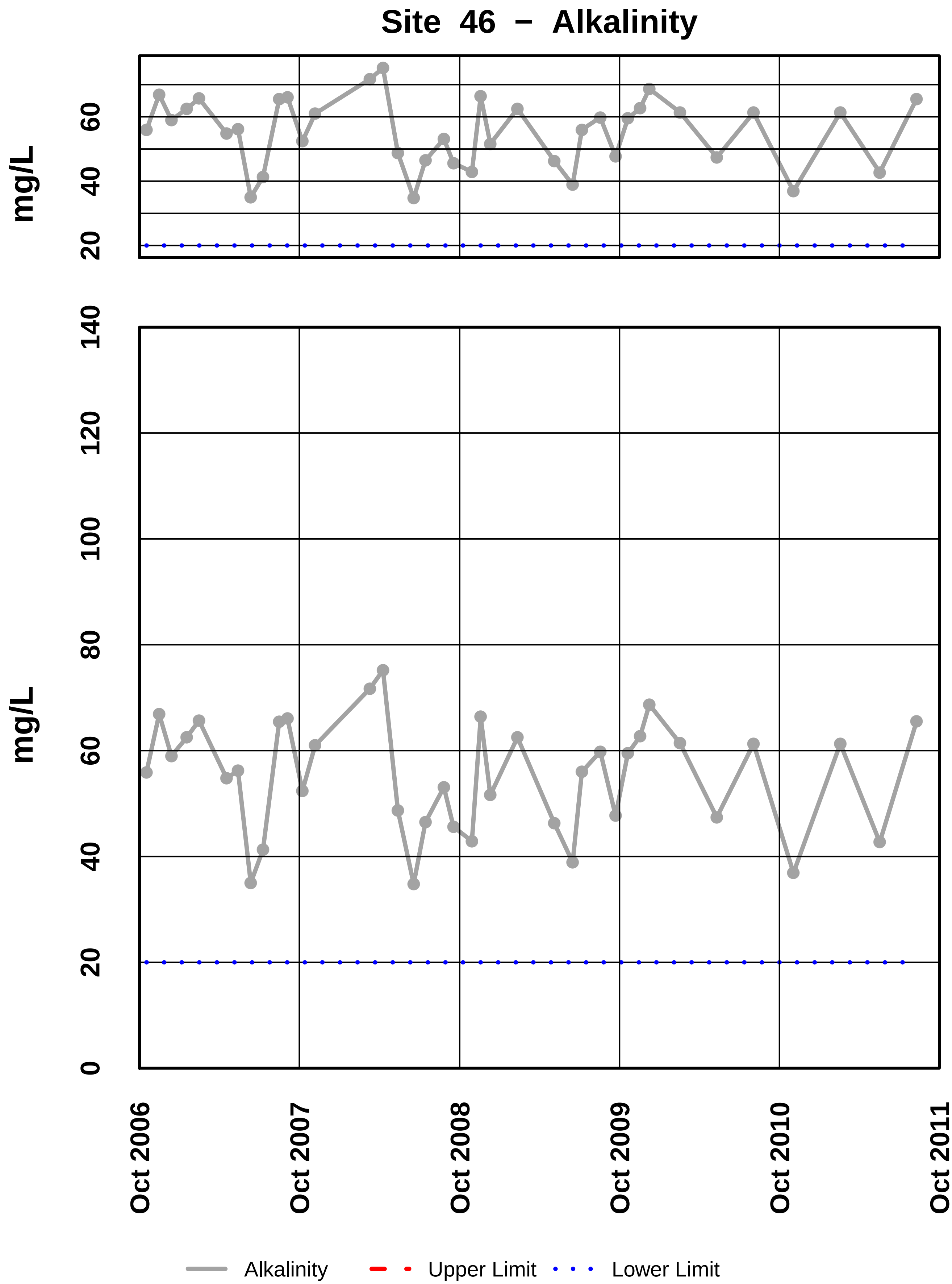
Site 46 – pH Laboratory



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

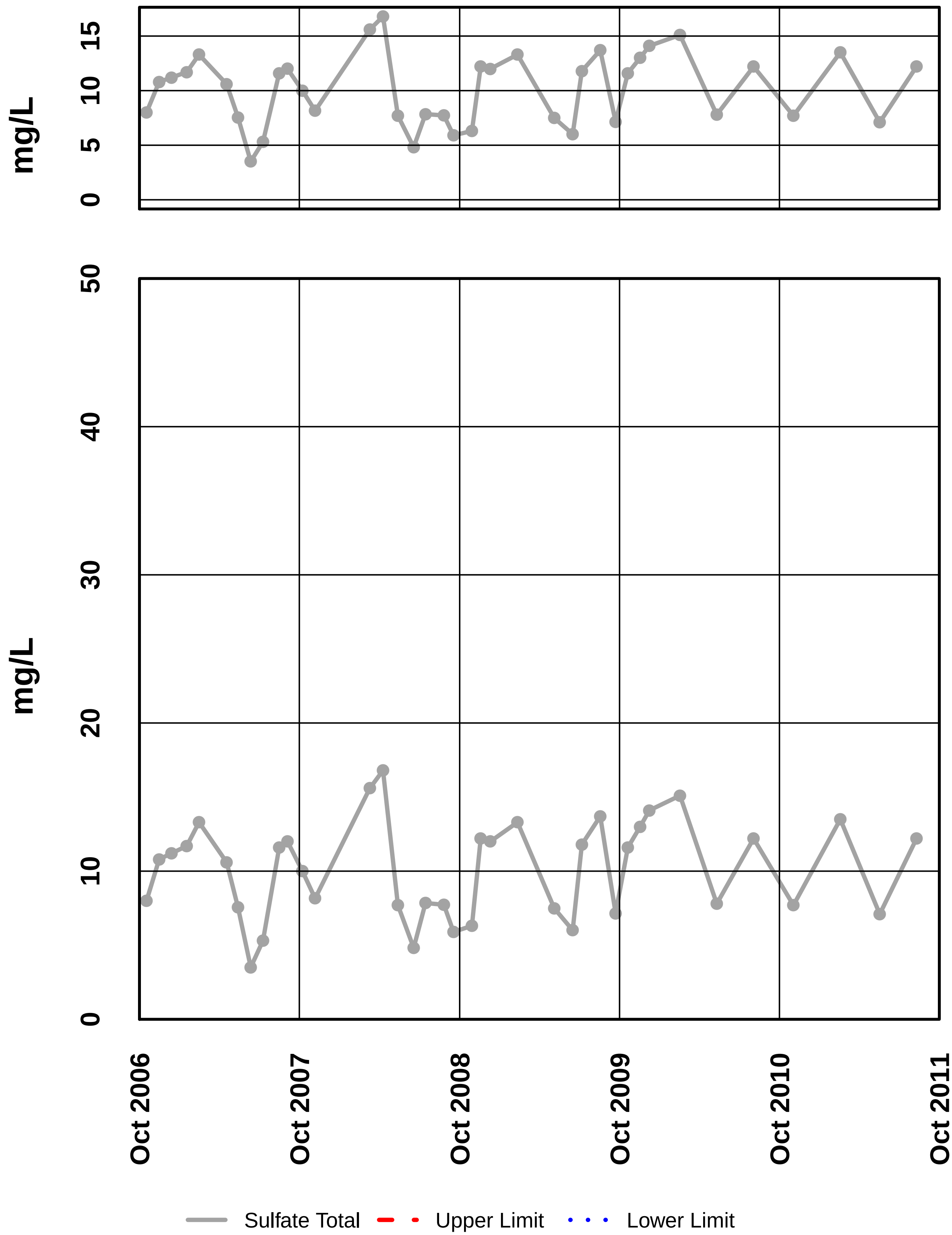


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

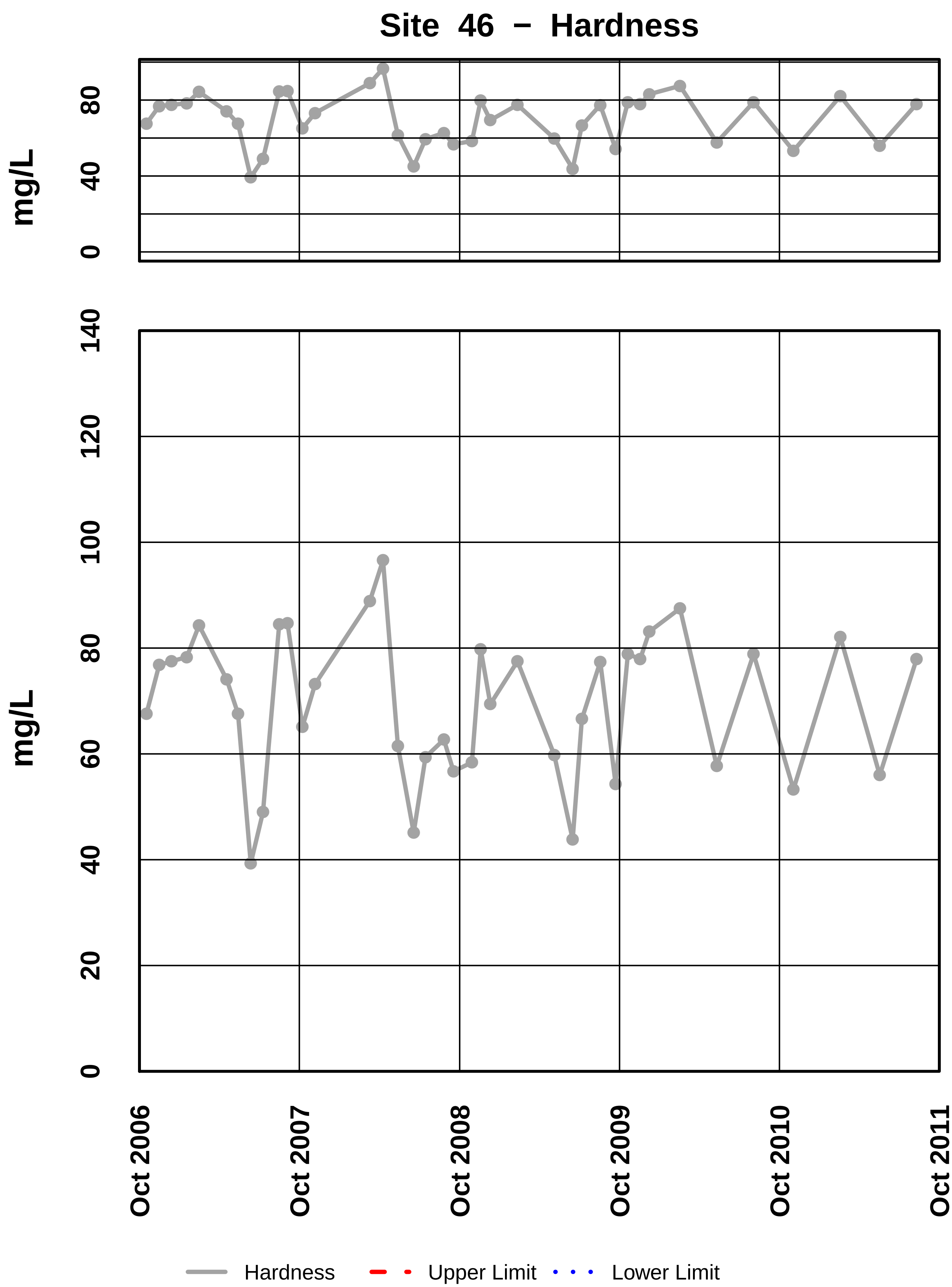


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

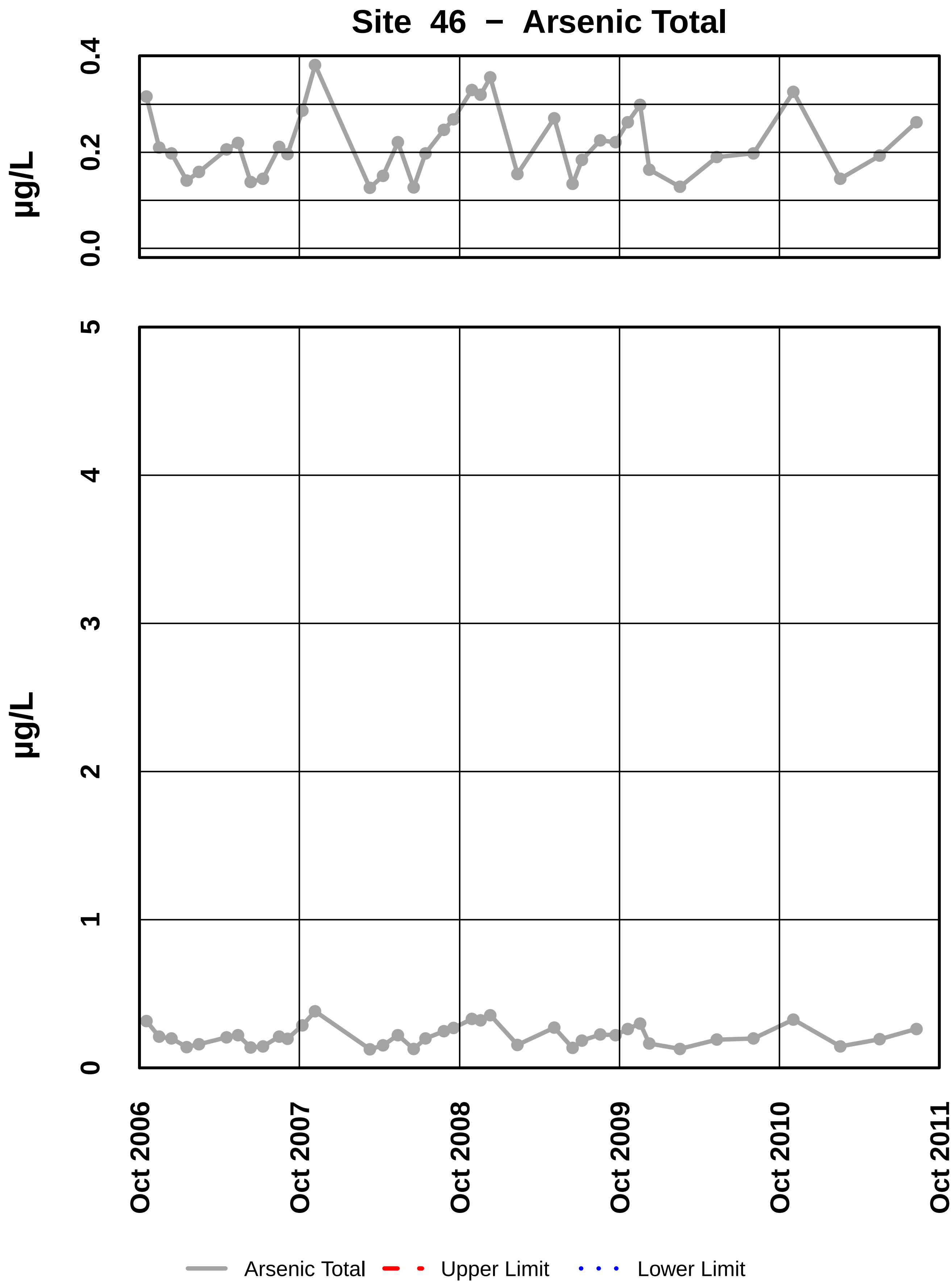
Site 46 − Sulfate Total



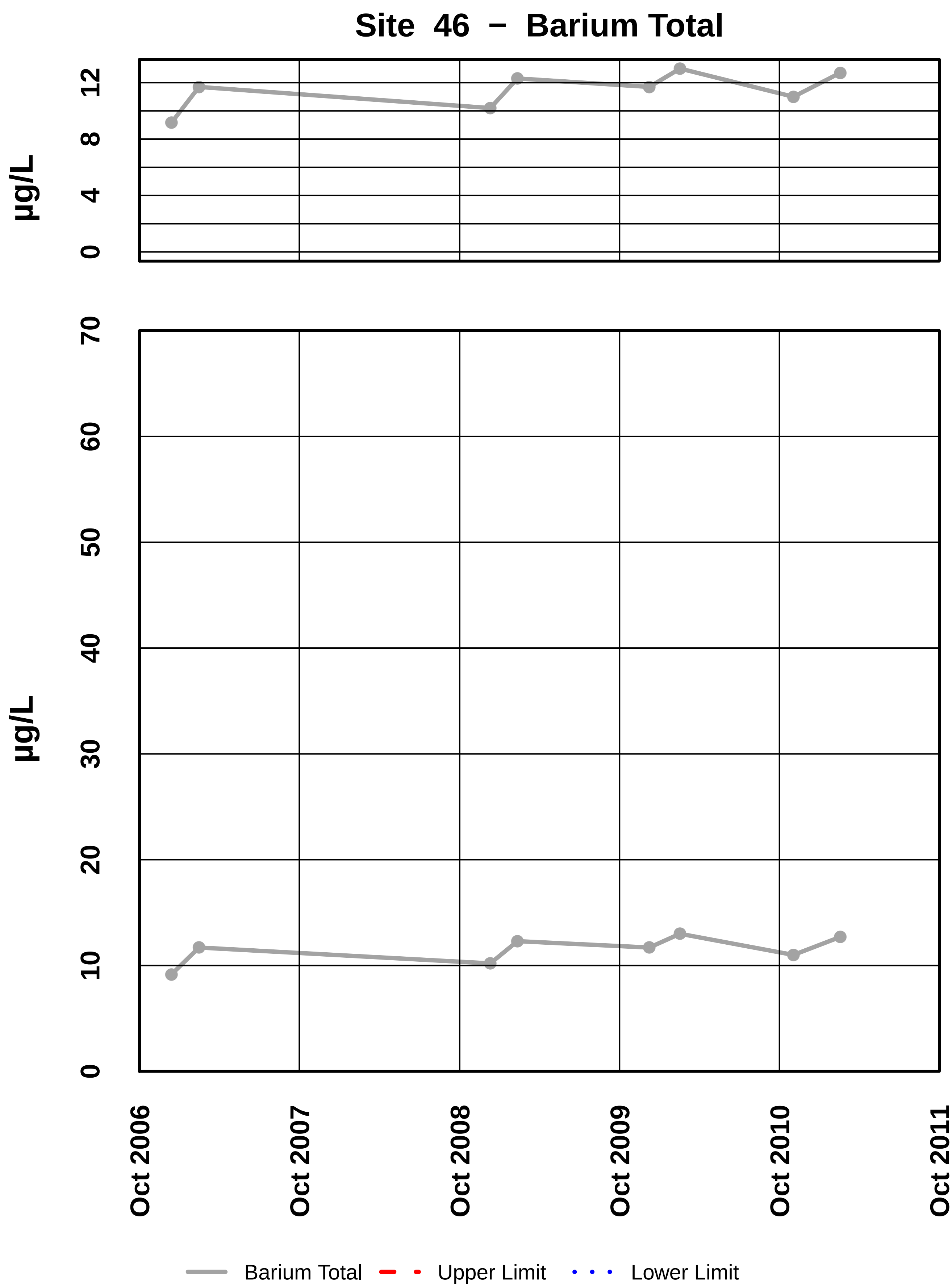
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



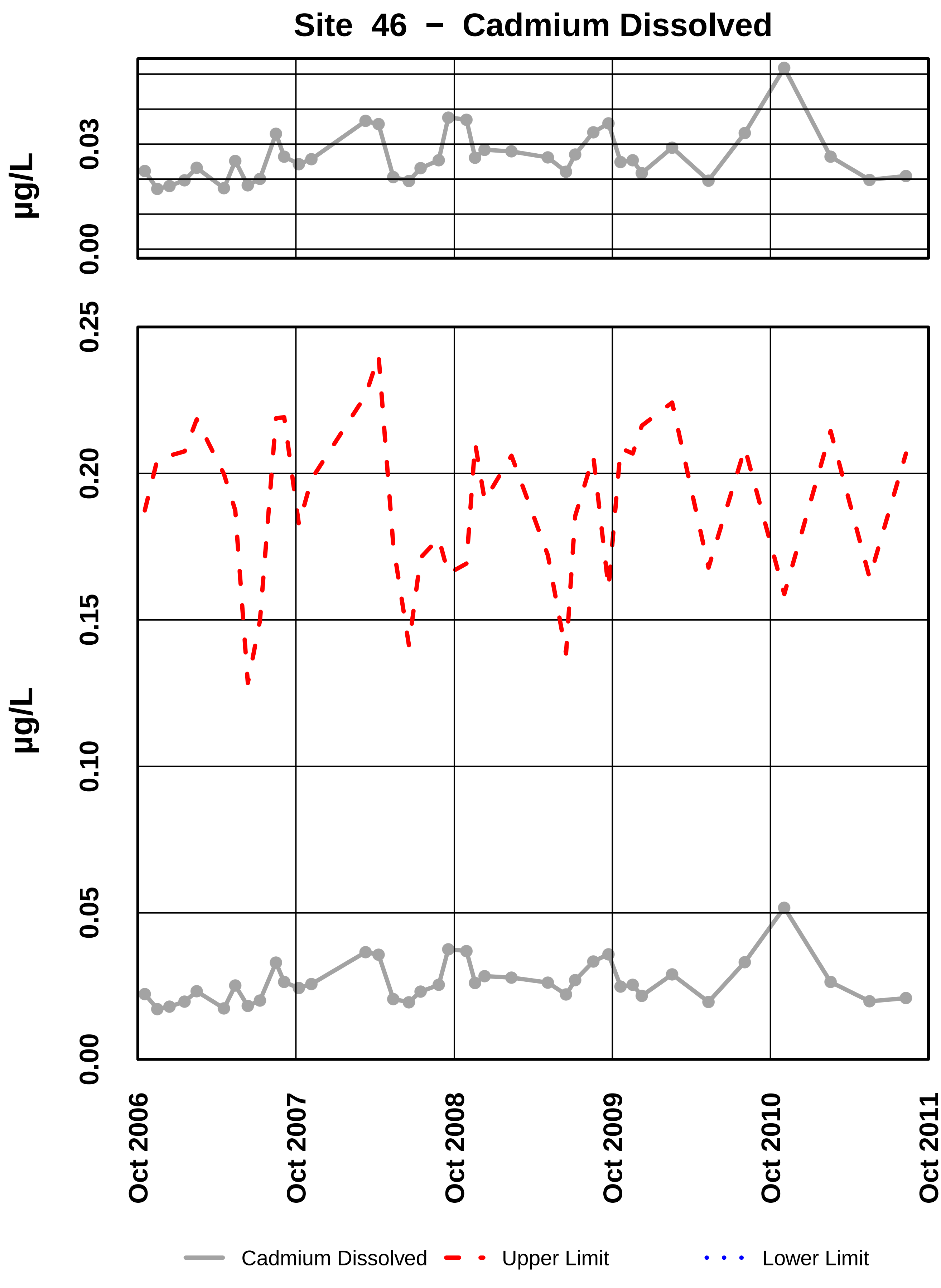
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

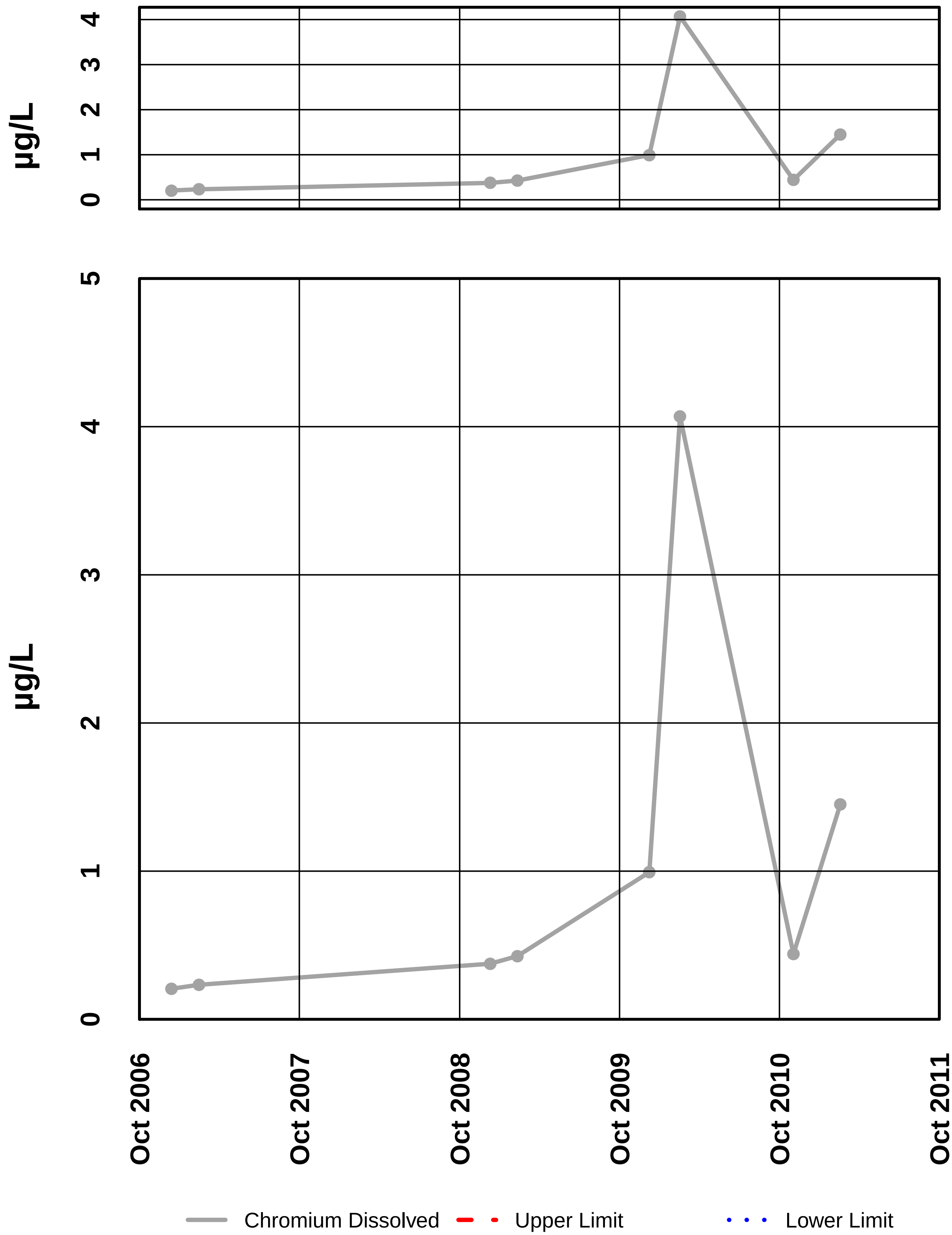


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



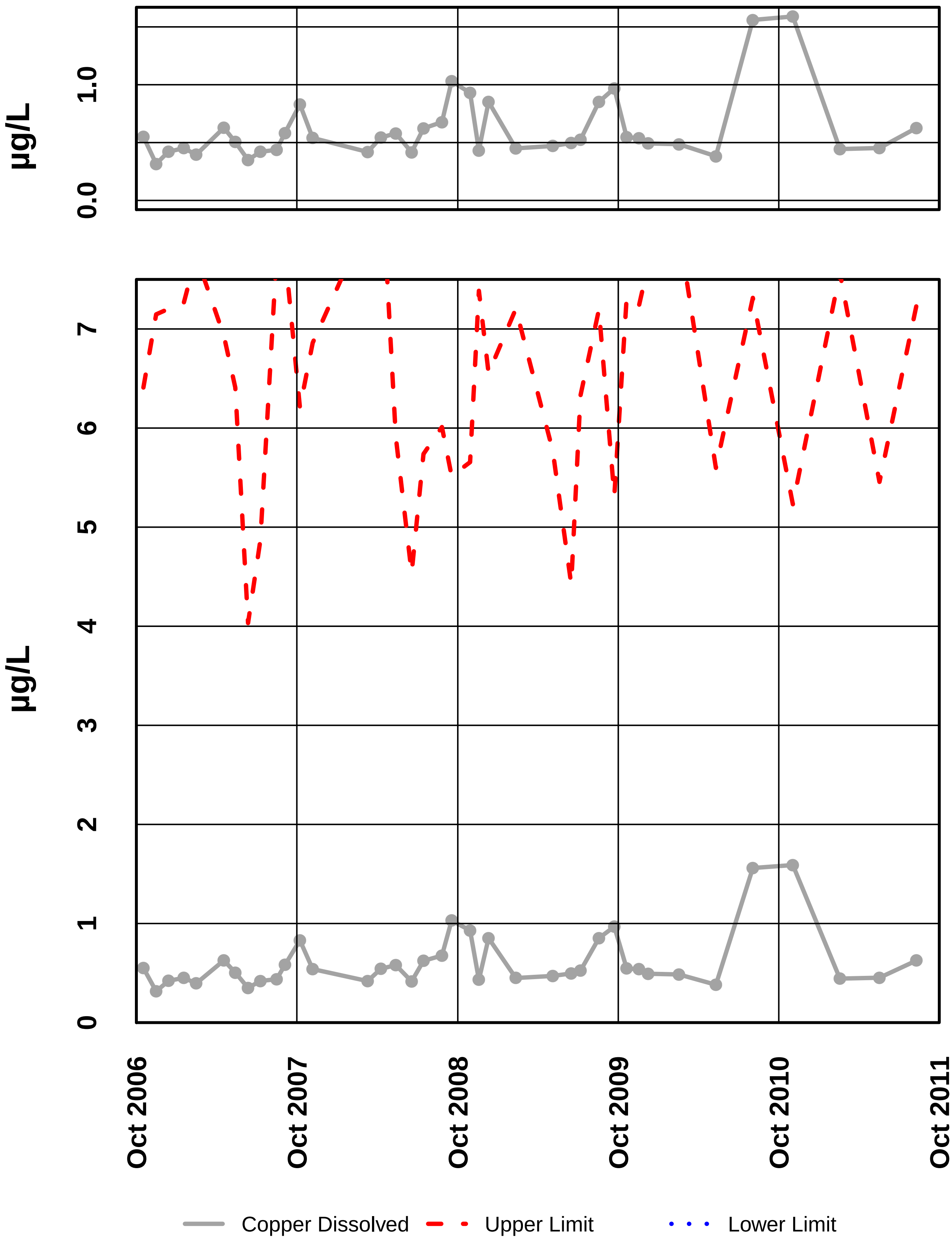
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 46 − Chromium Dissolved



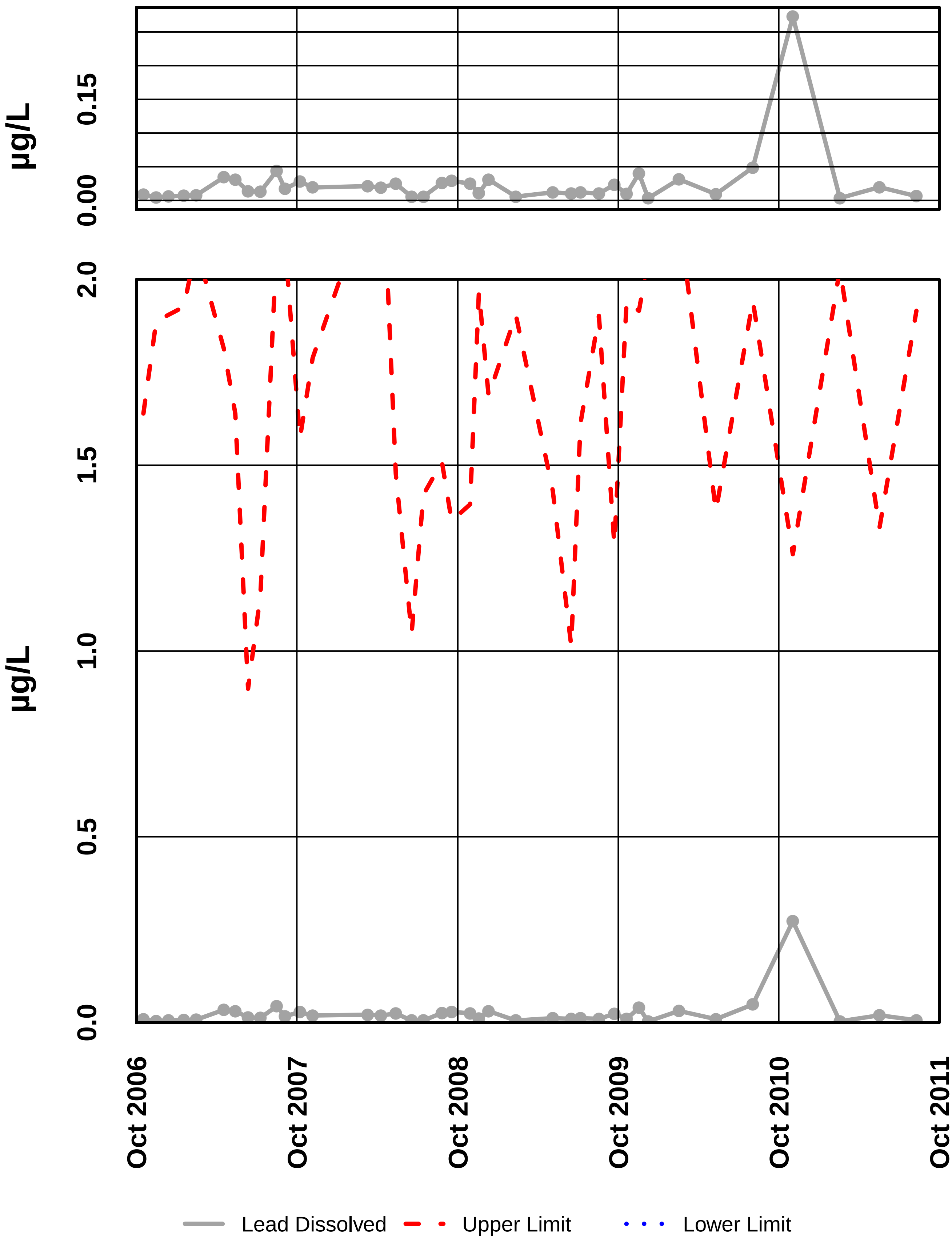
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 46 – Copper Dissolved

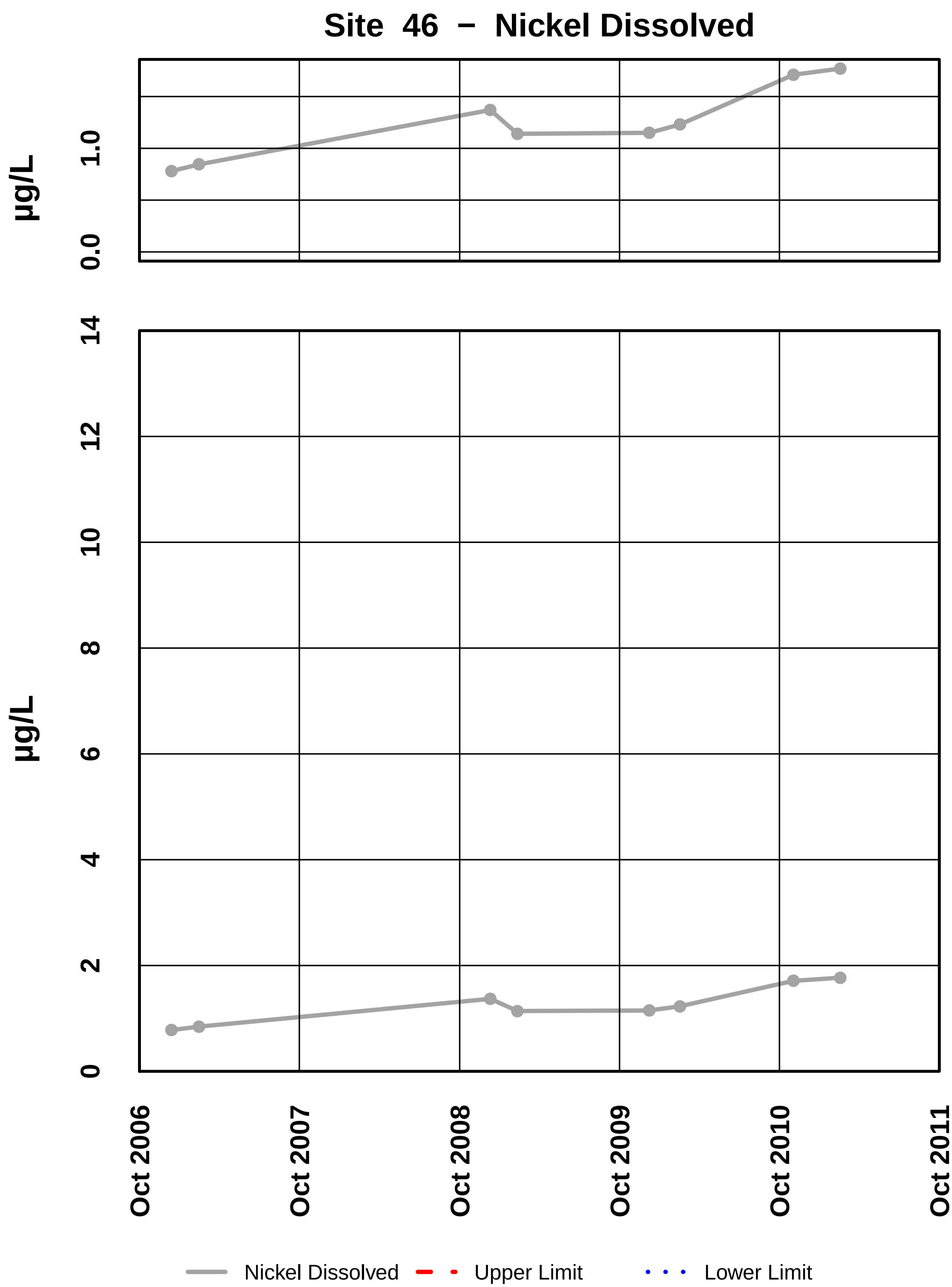


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

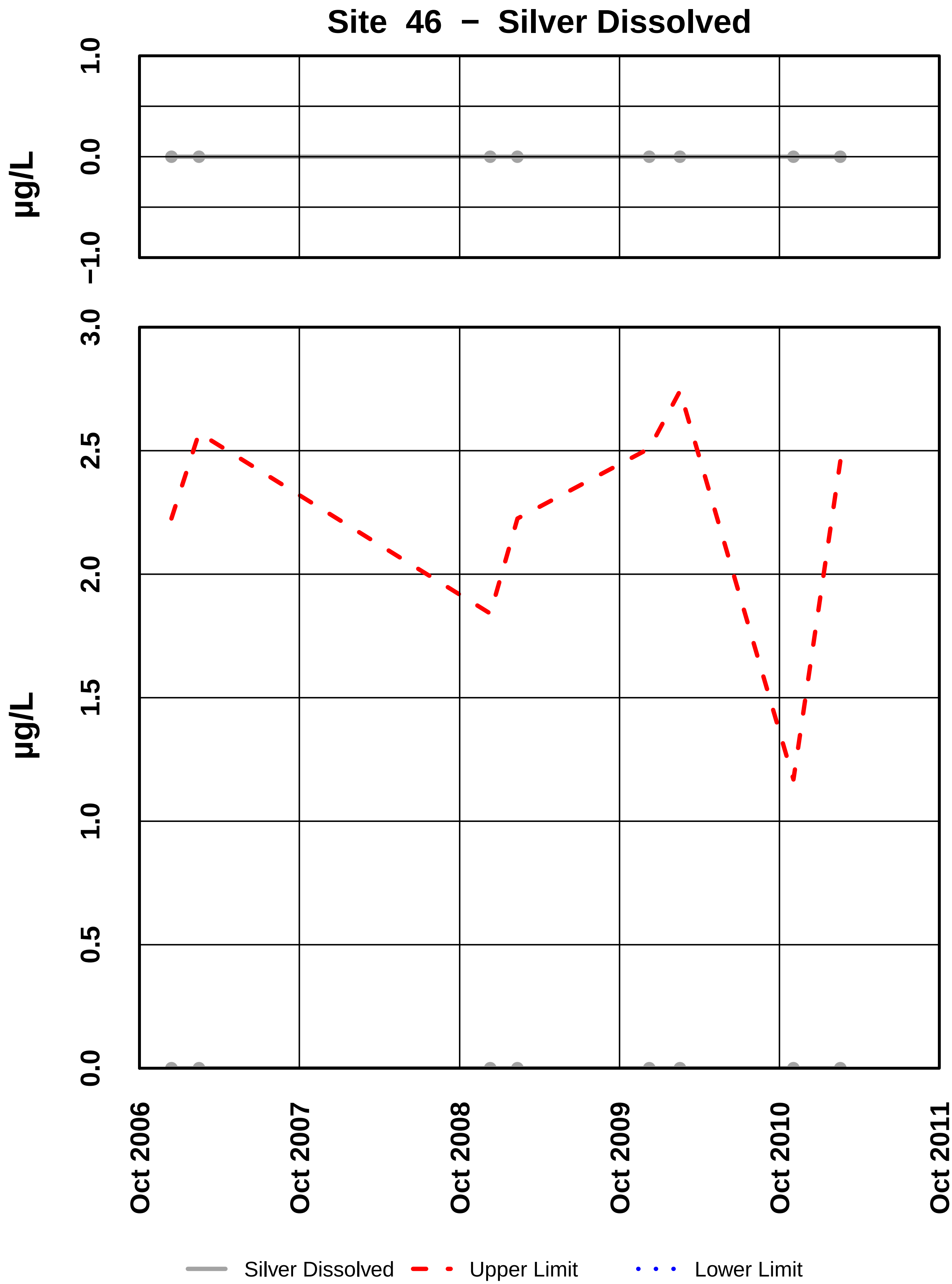
Site 46 − Lead Dissolved



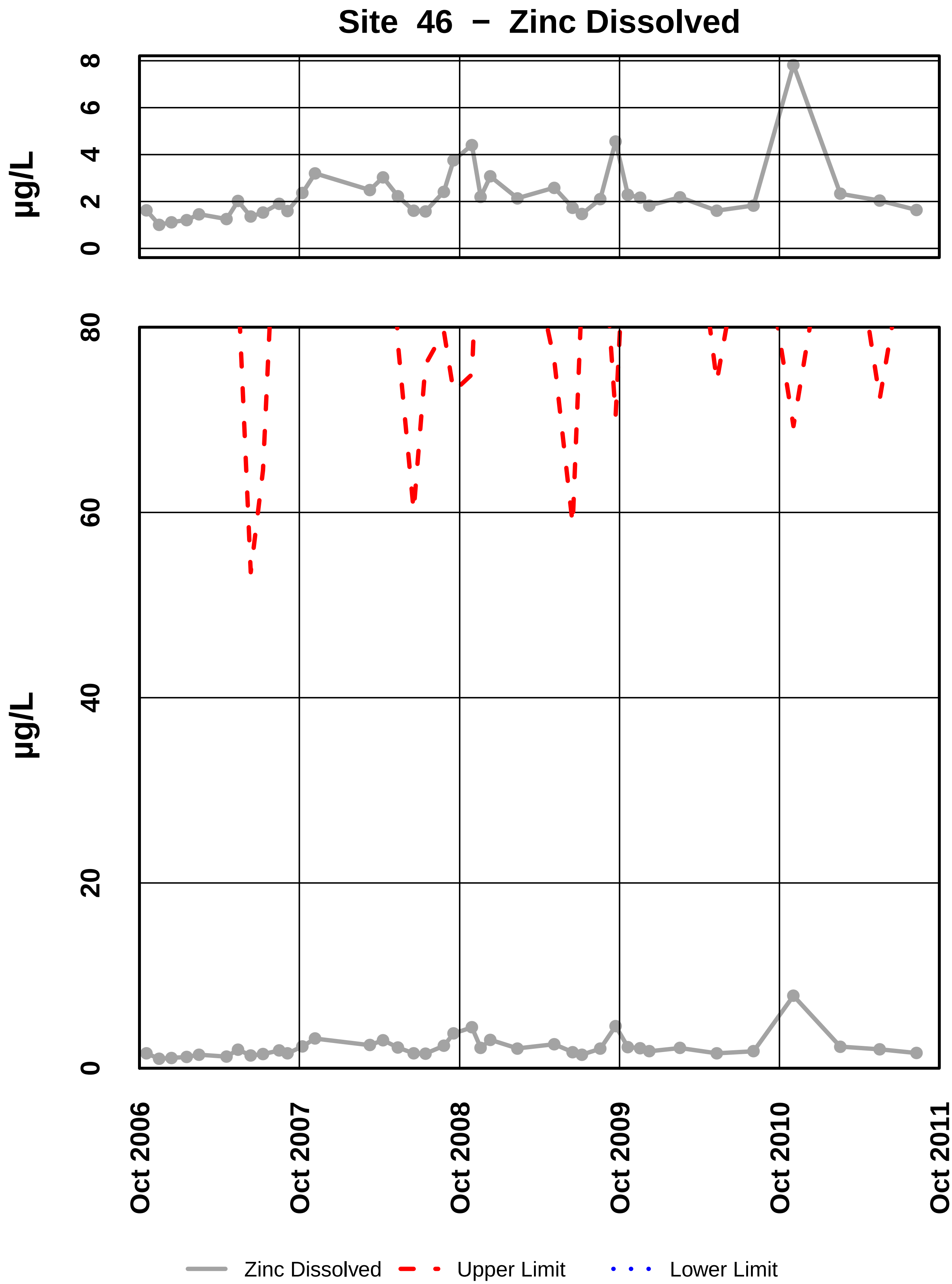
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



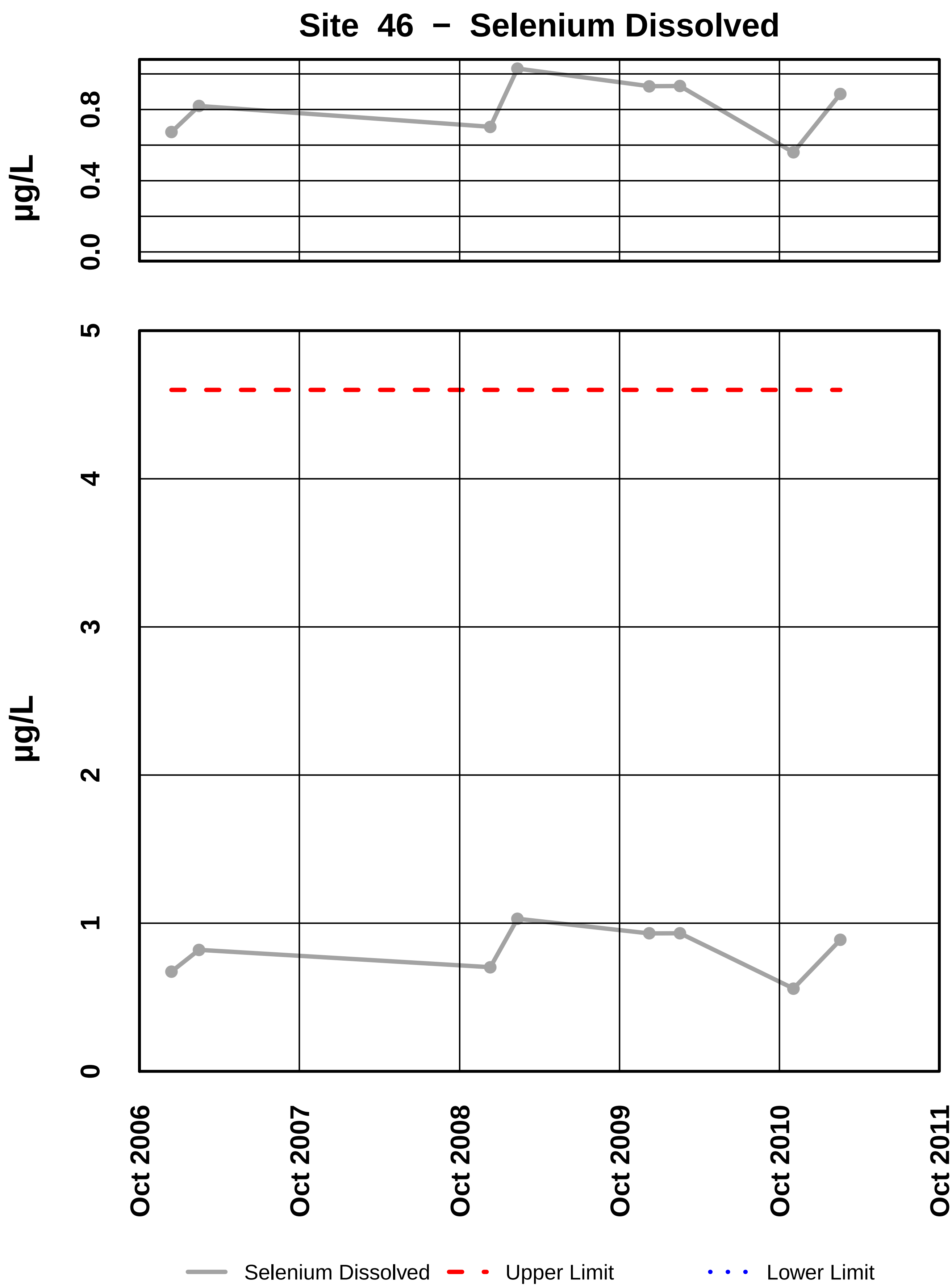
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

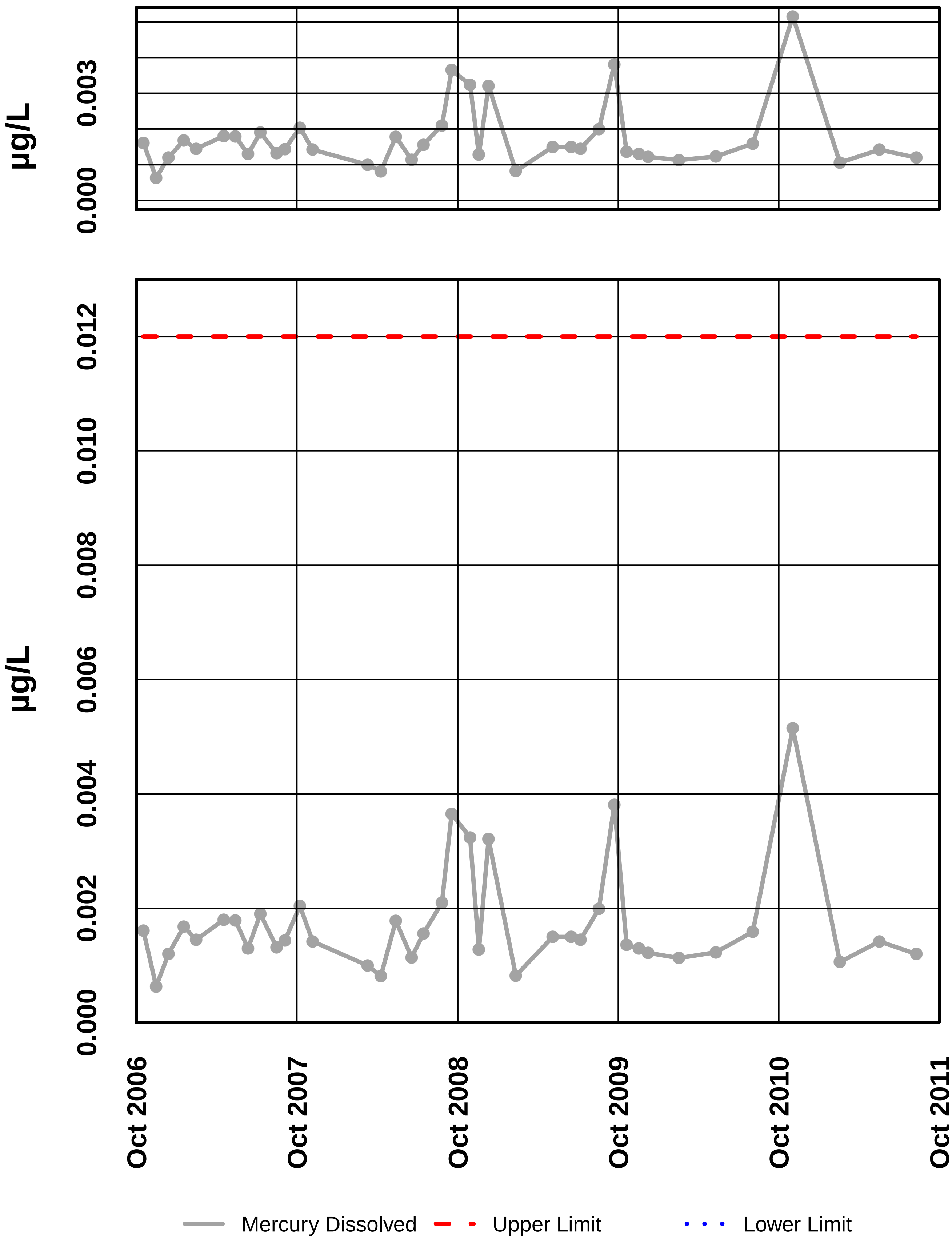


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

Site 46 − Mercury Dissolved



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

Site **#46** Seasonal Kendall analysis for Specific Conductance, Lab (uS/cm)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2006**	139.9	137	110.9	135.1	152.7	187.1	168.7	119.4	115.7	131.1	106.8	95.6
b	**WY2007**	158.4	167.7	162.4	145.8	170		151.3	138.8	87.6	99.9	174.6	161.8
c	**WY2008**	134	153.8				207	151.8	125.5	93.7	117.2	121.9	113.4
d	**WY2009**	118	161.9	136.1		156.2			113.5	91.7	129.5	125.6	89
e	**WY2010**	157.4	133.6	173.5		176.2			124			147.2	
f	**WY2011**		105.6			164			114.3			125	
	n	5	6	4	2	5	2	3	6	4	4	6	4

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	5	6	4	2	5	2	3	6	4	4	6	4
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
d-a	-1	1	1		1			-1	-1	-1	1	-1
e-a	1	-1	1		1			1			1	
f-a		-1			1			-1			1	
c-b	-1	-1					1	-1	1	1	-1	-1
d-b	-1	-1	-1		-1			-1	1	1	-1	-1
e-b	-1	-1	1		1			-1			-1	
f-b		-1			-1			-1			-1	
d-c	-1	1						-1	-1	1	1	-1
e-c	1	-1						-1			1	
f-c		-1						-1			1	
e-d	1	-1	1		1			1			1	
f-d		-1			1			1			-1	
f-e		-1			-1			-1			-1	
S_k	-2	-7	4	1	4	1	-1	-5	-2	0	3	-2

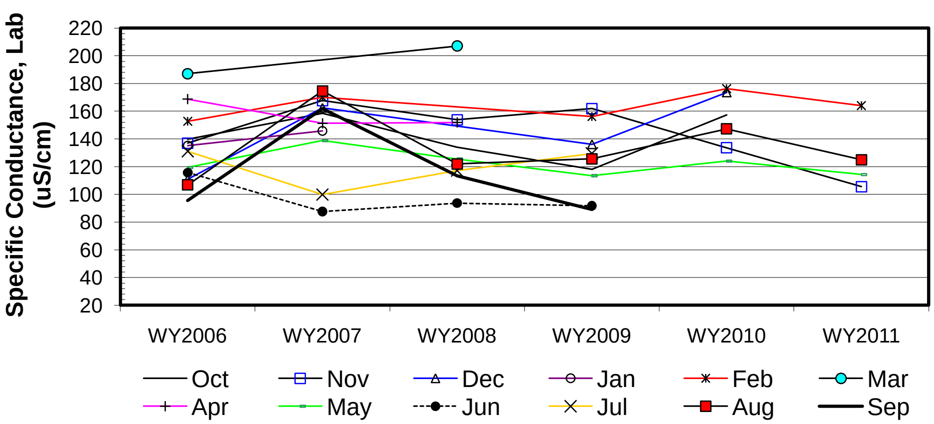
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	16.67	28.33	8.67	1.00	16.67	1.00	3.67	28.33	8.67	8.67	28.33	8.67
$Z_k = S_k/\sigma_S$	-0.49	-1.32	1.36	1.00	0.98	1.00	-0.52	-0.94	-0.68	0.00	0.56	-0.68
Z^2_k	0.24	1.73	1.85	1.00	0.96	1.00	0.27	0.88	0.46	0.00	0.32	0.46

ΣZ_k= 0.28
ΣZ^2_k= 9.17
Z-bar=ΣZ_k/K= 0.02

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	51	0	0	0	0

Σn 51
ΣS_k -6

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=		9.16	@α=5% $\chi^2_{(K-1)}$=	19.68	Test for station homogeneity
	p	**0.607**			$\chi^2_h<\chi^2_{(K-1)}$ ACCEPT
ΣVAR(S_k)	Z_{calc}	-0.40	@α/2=2.5% Z=	1.96	H_0 (No trend) ACCEPT
158.67	**p**	**0.346**			H_A (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-7.18		3.70
0.050	-5.36	**-0.64**	2.14
0.100	-3.01		1.23
0.200	-2.06		0.66

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2006**	8.2	8.1	7.8	7.3	7.6	8.0	7.7	7.3	7.4	7.8	8.3	8.2
b	**WY2007**	7.4	7.8	7.8	7.5	7.5		7.6	8.0	7.7	7.7	7.7	7.6
c	**WY2008**	8.1	7.9				7.5	7.5	7.9	8.0	7.7	7.3	7.6
d	**WY2009**	8.0	8.0	7.9		7.5			7.3	7.1	7.2	7.2	7.4
e	**WY2010**	7.9	7.4	7.2		7.0			7.7			6.9	
f	**WY2011**		7.9			7.4			7.8			7.9	
	n	5	6	4	2	5	2	3	6	4	4	6	4

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	5	4	4	2	5	2	3	6	4	4	6	2
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	1	-1	-1	-1
c-a	-1	-1				-1	-1	1	1	-1	-1	-1
d-a	-1	-1	1		-1			1	-1	-1	-1	-1
e-a	-1	-1	-1		-1			1			-1	
f-a		-1			-1			1			-1	
c-b	1	1					-1	-1	1	1	-1	0
d-b	1	1	1		-1			-1	-1	-1	-1	-1
e-b	1	-1	-1		-1			-1			-1	
f-b		1			-1			-1			1	
d-c	-1	1						-1	-1	-1	-1	-1
e-c	-1	-1						-1			-1	
f-c		0						-1			1	
e-d	-1	-1	-1		-1			1			-1	
f-d		-1			-1			1			1	
f-e		1			1			1			1	
S_k	-4	-4	-2	1	-8	-1	-3	1	0	-4	-7	-5

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	16.67	27.33	8.67	1.00	16.67	1.00	3.67	28.33	8.67	8.67	28.33	7.67
$Z_k = S_k/\sigma_S$	-0.98	-0.77	-0.68	1.00	-1.96	-1.00	-1.57	0.19	0.00	-1.36	-1.32	-1.81
Z^2_k	0.96	0.59	0.46	1.00	3.84	1.00	2.45	0.04	0.00	1.85	1.73	3.26

ΣZ_k= -10.24

ΣZ^2_k= 17.17

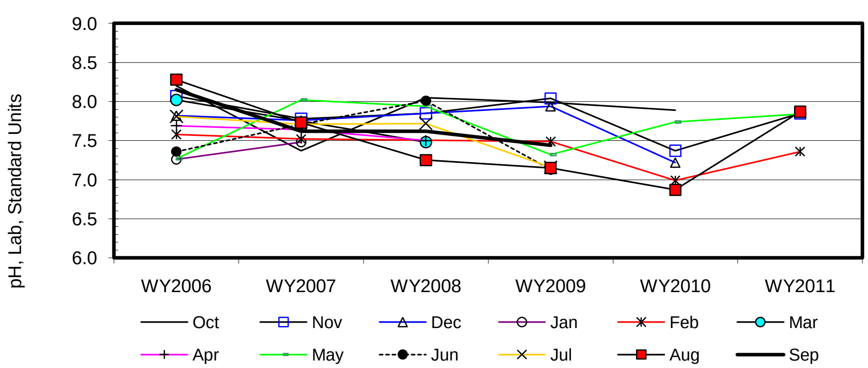
Z-bar=$\Sigma Z_k/K$= -0.85

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	47	2	0	0	0

Σn 51

ΣS_k -36

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	8.43	@α=5% $\chi^2_{(K-1)}$= 19.68	Test for station homogeneity	
p	**0.674**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
$\Sigma VAR(S_k)$	Z_{calc} -2.80	@α/2=2.5% Z= 1.96	**H_0** (No trend)	REJECT
156.67	**p** **0.003**		**H_A** (± trend)	ACCEPT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.14		-0.03
0.050	-0.10	**-0.08**	-0.04
0.100	-0.10		-0.05
0.200	-0.09		-0.06

-1.0%

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	**WY2006**	60.8	59.8	51.9	63.0	59.6	73.6	62.4	56.3	53.3	62.0	54.1	64.8
b	**WY2007**	55.9	66.9	59.0	62.5	65.7		54.8	56.2	35.0	41.3	65.5	66.1
c	**WY2008**	52.4	61.0				71.7	75.2	48.7	34.8	46.5	53.1	45.6
d	**WY2009**	42.9	66.4	51.6		62.5			46.3	38.9	56.0	59.8	47.7
e	**WY2010**	59.5	62.7	68.7		61.4			47.4			61.3	
f	**WY2011**		36.9			61.3			42.7			65.5	
	n	5	6	4	2	5	2	3	6	4	4	6	4

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	5	6	4	2	5	2	3	6	4	4	4	4
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
d-a	-1	1	-1		1			-1	-1	-1	1	-1
e-a	-1	1	1		1			-1			1	
f-a		-1			1			-1			1	
c-b	-1	-1					1	-1	-1	1	-1	-1
d-b	-1	-1	-1		-1			-1	1	1	-1	-1
e-b	1	-1	1		-1			-1			-1	
f-b		-1			-1			-1			0	
d-c	-1	1						-1	1	1	1	1
e-c	1	1						-1			1	
f-c		-1						-1			1	
e-d	1	-1	1		-1			1			1	
f-d		-1			-1			-1			1	
f-e		-1			-1			-1			1	
S_k	-4	-3	2	-1	-2	-1	1	-13	-2	0	6	-2

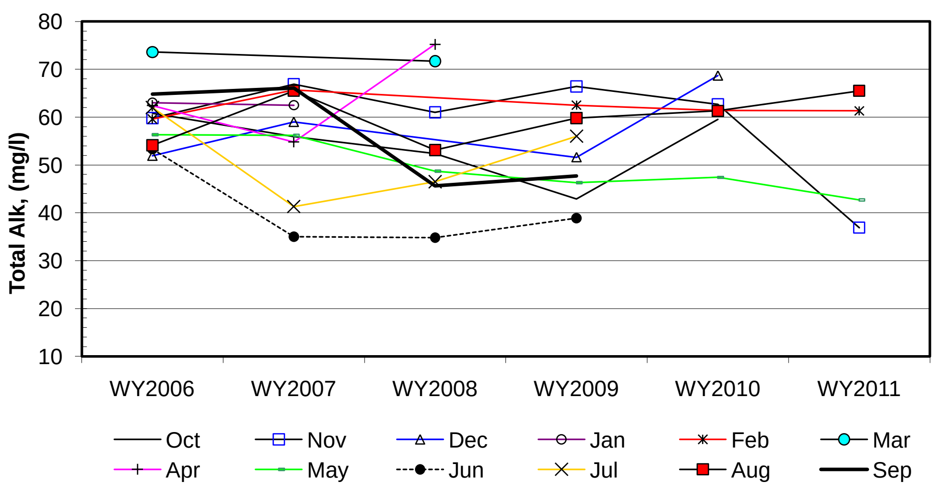
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
$\sigma^2_S=$	16.67	28.33	8.67	1.00	16.67	1.00	3.67	28.33	8.67	8.67	27.33	8.67
$Z_k = S_k/\sigma_S$	-0.98	-0.56	0.68	-1.00	-0.49	-1.00	0.52	-2.44	-0.68	0.00	1.15	-0.68
Z^2_k	0.96	0.32	0.46	1.00	0.24	1.00	0.27	5.96	0.46	0.00	1.32	0.46

$\Sigma Z_k=$	-5.49
$\Sigma Z^2_k=$	12.46
Z-bar=ΣZ_k/K=	-0.46

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	49	1	0	0	0

Σn	51
ΣS_k	-19

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2=$	9.95	@α=5% $\chi^2_{(K-1)}=$ 19.68	Test for station homogeneity	
p	**0.535**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
$\Sigma VAR(S_k)$	Z_{calc} -1.43	@α/2=2.5% Z= 1.96	H_0 (No trend)	ACCEPT
157.67	**p** **0.076**		H_A (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-2.90		0.80
0.050	-2.07	**-0.63**	0.11
0.100	-1.81		-0.10
0.200	-1.41		-0.24

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	**WY2006**	9.5	11.5	9.7	14.3	12.9	19.3	15.6	8.9	8.9	11.8	7.3	10.9
b	**WY2007**	8.0	10.8	11.2	11.7	13.3		10.6	7.6	3.5	5.3	11.6	12.0
c	**WY2008**	10.0	8.2				15.6	16.8	7.7	4.8	7.9	7.7	5.9
d	**WY2009**	6.3	12.2	12.0		13.3			7.5	6.0	11.8	13.7	7.2
e	**WY2010**	11.6	13.0	14.1		15.1			7.8			12.2	
f	**WY2011**		7.7			13.5			7.1			12.2	
	n	5	6	4	2	5	2	3	6	4	4	6	4

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	5	6	4	2	3	2	3	6	4	2	4	4
t_2	0	0	0	0	1	0	0	0	0	1	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
d-a	-1	1	1		1			-1	-1	0	1	-1
e-a	1	1	1		1			-1			1	
f-a		-1			1			-1			1	
c-b	1	-1					1	1	1	1	-1	-1
d-b	-1	1	1		0			-1	1	1	1	-1
e-b	1	1	1		1			1			1	
f-b		-1			1			-1			1	
d-c	-1	1						-1	1	1	1	1
e-c	1	1						1			1	
f-c		-1						-1			1	
e-d	1	1	1		1			1			-1	
f-d		-1			1			-1			-1	
f-e		-1			-1			-1			0	
S_k	2	-1	6	-1	7	-1	1	-7	0	1	8	-2

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	16.67	28.33	8.67	1.00	15.67	1.00	3.67	28.33	8.67	7.67	27.33	8.67
$Z_k = S_k/\sigma_S$	0.49	-0.19	2.04	-1.00	1.77	-1.00	0.52	-1.32	0.00	0.36	1.53	-0.68
Z^2_k	0.24	0.04	4.15	1.00	3.13	1.00	0.27	1.73	0.00	0.13	2.34	0.46

ΣZ_k= 2.53

ΣZ^2_k= 14.49

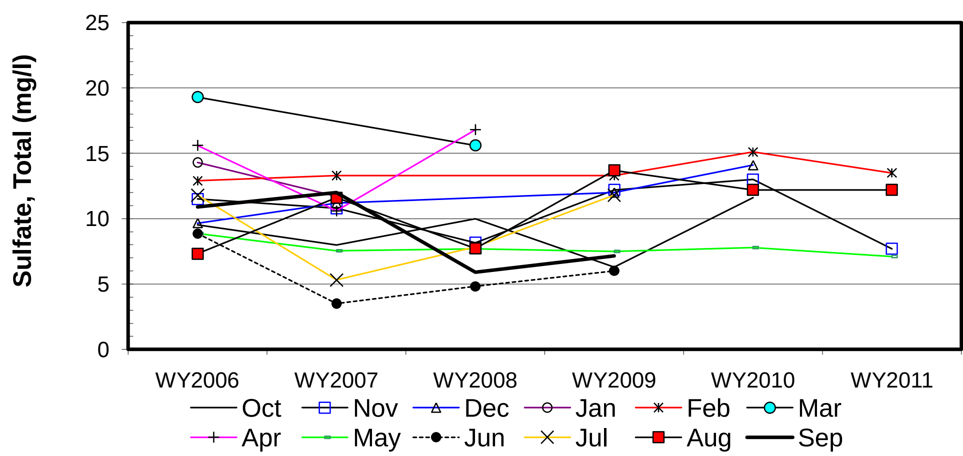
Z-bar=ΣZ_k/K= 0.21

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	45	3	0	0	0

Σn 51

ΣS_k 13

$\chi^2_h = \Sigma Z^2_k - K(\text{Z-bar})^2$=	13.96	@α=5% $\chi^2_{(K-1)}$= 19.68	Test for station homogeneity	
p	**0.235**		$\chi^2_h < \chi^2_{(K-1)}$	ACCEPT
$\Sigma VAR(S_k)$ 155.67	Z_{calc} 0.96	@α=5% Z= 1.64	H_0 (No trend)	ACCEPT
	p **0.832**		H_A (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.31		0.60
0.050	-0.16	**0.13**	0.40
0.100	-0.03		0.31
0.200	0.00		0.21

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	**WY2006**	2.5	1.8	1.3	2.1	1.4	1.6	1.5	1.1	1.2	1.1	2.0	1.5
b	**WY2007**	1.6	1.0	1.1	1.2	1.5		1.3	2.0	1.4	1.5	1.9	1.6
c	**WY2008**	2.4	3.2				2.5	3.0	2.2	1.6	1.6	2.4	3.8
d	**WY2009**	4.4	2.2	3.1		2.1			2.6	1.7	1.5	2.1	4.6
e	**WY2010**	2.3	2.2	1.8		2.2			1.6			1.8	
f	**WY2011**		7.8			2.3			2.0			1.6	
	n	5	6	4	2	5	2	3	6	4	4	6	4

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	5	6	4	2	5	2	3	6	4	4	6	4
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
d-a	1	1	1		1			1	1	1	1	1
e-a	-1	1	1		1			1			-1	
f-a		1			1			1			-1	
c-b	1	1					1	1	1	1	1	1
d-b	1	1	1		1			1	1	-1	1	1
e-b	1	1	1		1			-1			-1	
f-b		1			1			1			-1	
d-c	1	-1						1	1	-1	-1	1
e-c	-1	-1						-1			-1	
f-c		1						-1			-1	
e-d	-1	-1	-1		1			-1			-1	
f-d		1			1			-1			-1	
f-e		1			1			1			-1	
S_k	0	7	2	-1	10	1	1	5	6	2	-7	6

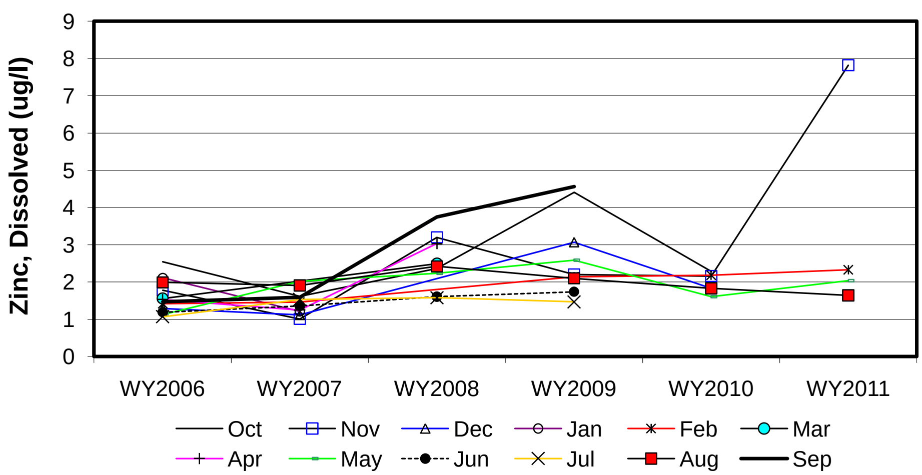
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
$\sigma^2{}_S$=	16.67	28.33	8.67	1.00	16.67	1.00	3.67	28.33	8.67	8.67	28.33	8.67
$Z_k = S_k/\sigma_S$	0.00	1.32	0.68	-1.00	2.45	1.00	0.52	0.94	2.04	0.68	-1.32	2.04
$Z^2{}_k$	0.00	1.73	0.46	1.00	6.00	1.00	0.27	0.88	4.15	0.46	1.73	4.15

ΣZ_k=	9.35
$\Sigma Z^2{}_k$=	21.84
Z-bar=ΣZ_k/K=	0.78

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	51	0	0	0	0

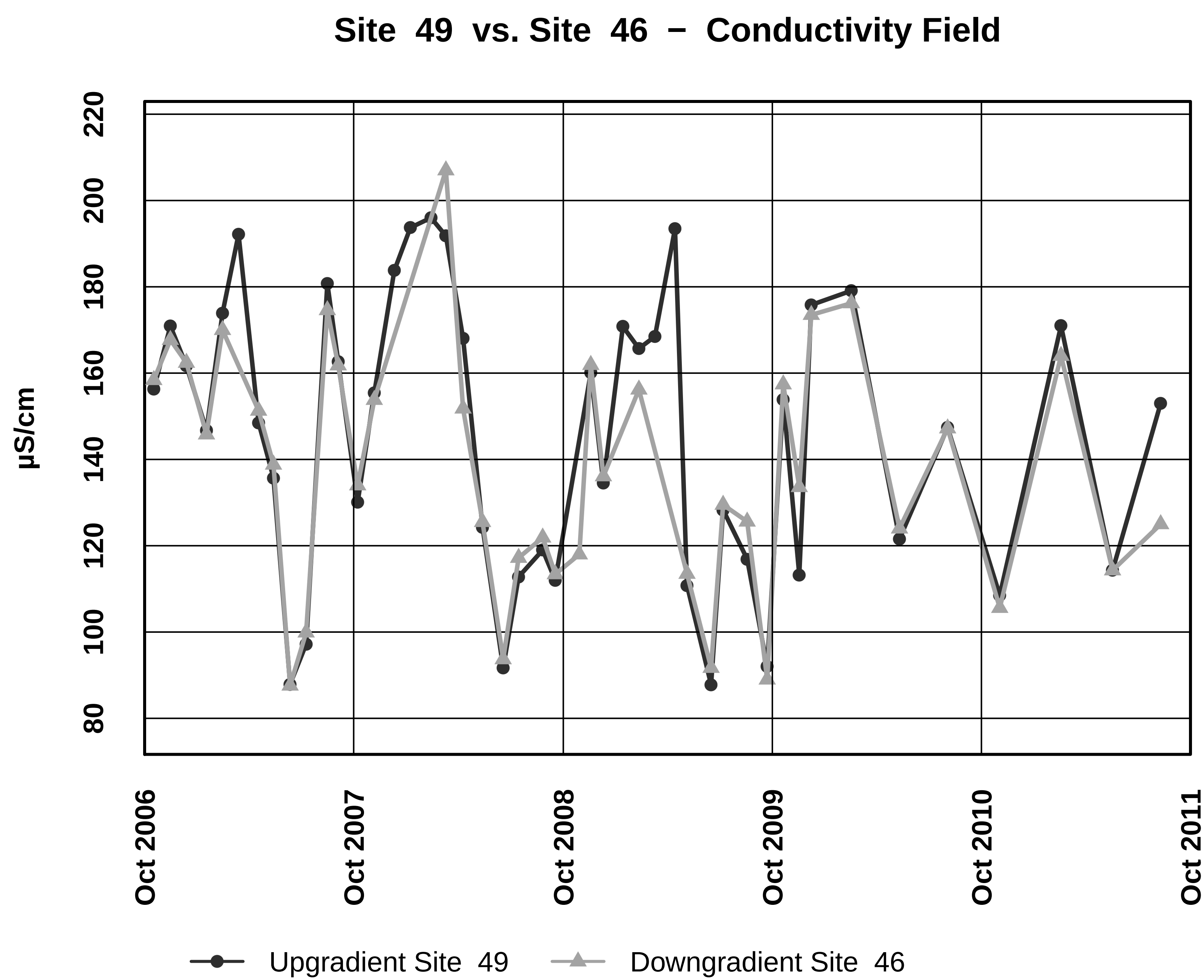
Σn	51
ΣS_k	32

$\chi^2{}_h=\Sigma Z^2{}_k$-K(Z-bar)^2=	14.57	@α=5% $\chi^2{}_{(K-1)}$= 19.68	Test for station homogeneity	
p	**0.203**		$\chi^2{}_h<\chi^2{}_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc} 2.46	@α/2=2.5% Z= 1.96	H_0 (No trend)	REJECT
158.67	**p** **0.993**		H_A (± trend)	ACCEPT

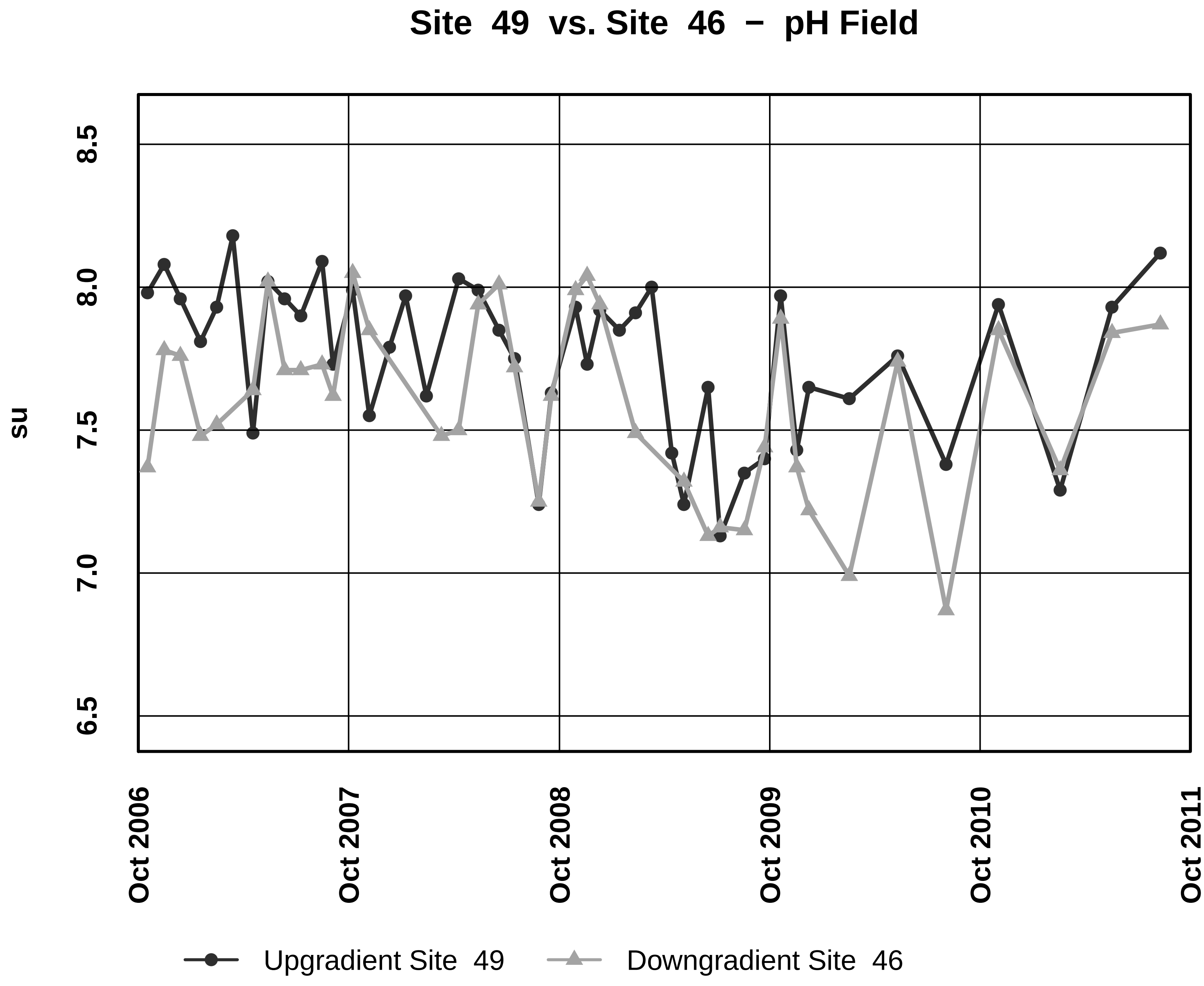


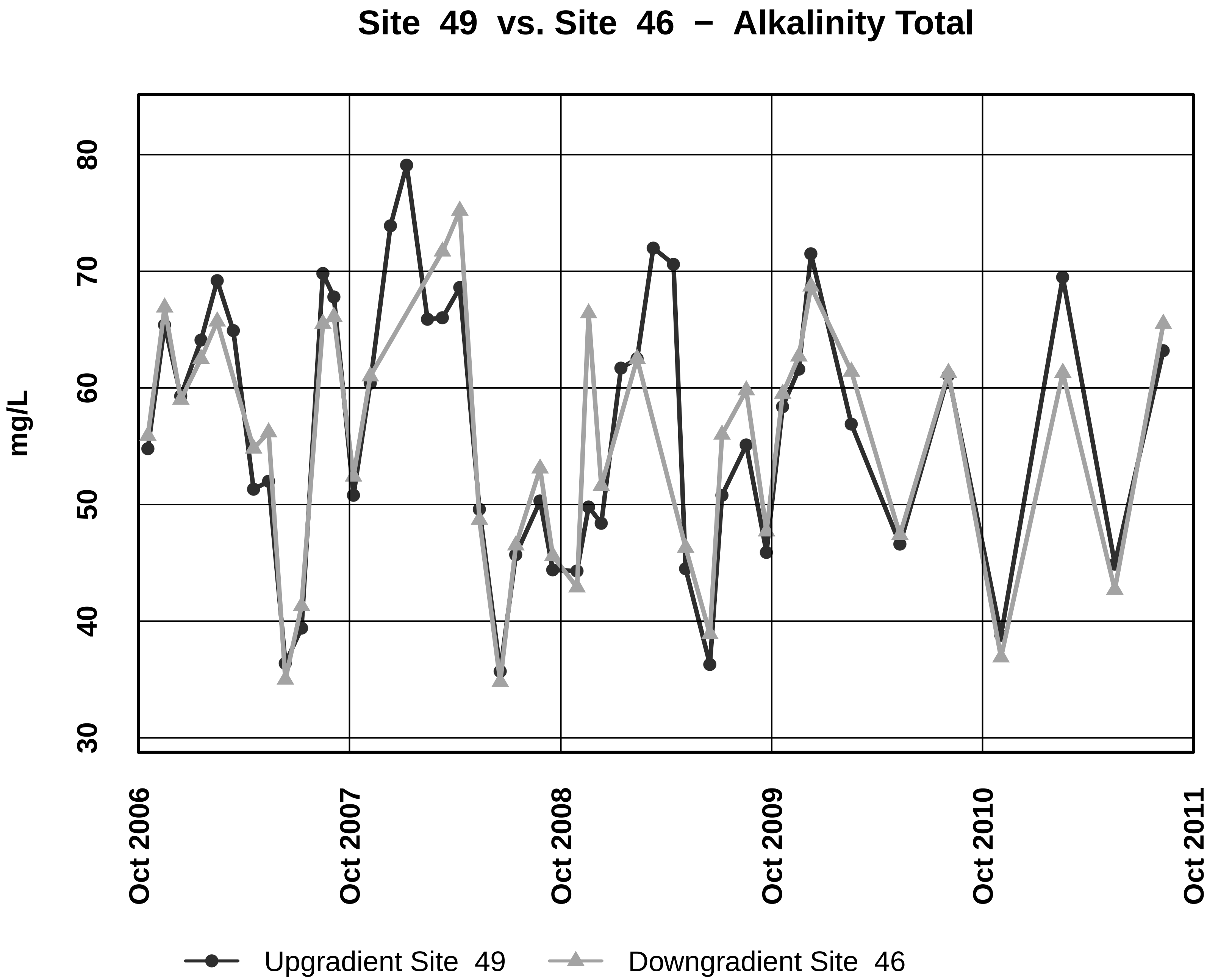
Seasonal-Kendall Slope Confidence Intervals

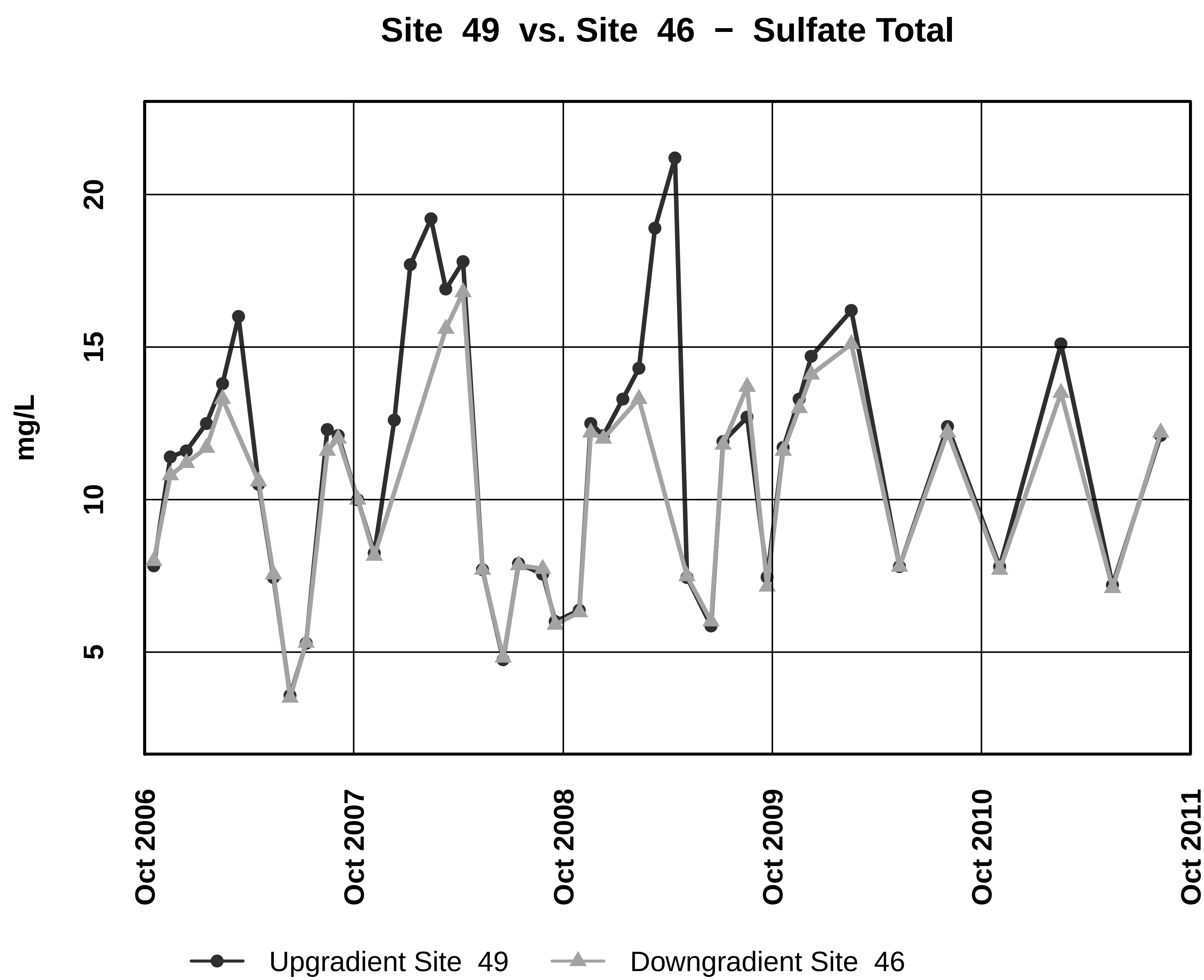
α	Lower Limit	Sen's Slope	Upper Limit
0.010	0.02		0.25
0.050	0.08	**0.18**	0.23
0.100	0.10		0.22
0.200	0.13		0.20
		9.6%	



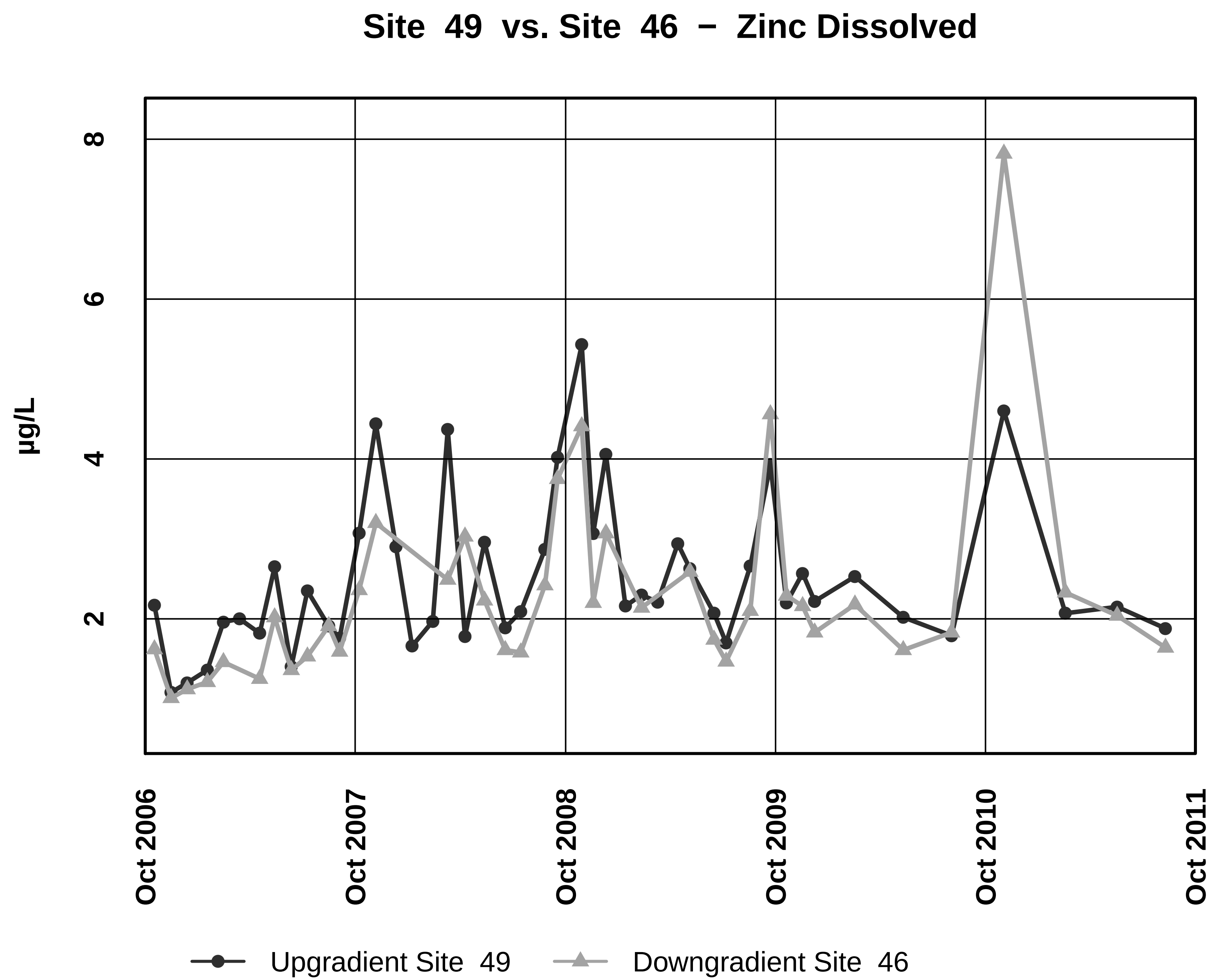
Site 49 vs. Site 46 − Conductivity Field
µS/cm
80
100
120
140
160
180
200
220
Oct 2006
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 49
Downgradient Site 46


Site 49 vs. Site 46 − pH Field
su
8.5
8.0
7.5
7.0
6.5
Oct 2006
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 2006
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 49
Downgradient Site 46



Site 49 vs. Site 46 − Sulfate Total
mg/L
20
15
10
5
Oct 2006
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 49
Downgradient Site 46



Site 49 vs. Site 46 − Zinc Dissolved
µg/L
2
4
6
8
Oct 2006
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 49
Downgradient Site 46

Wilcoxon-signed-ranks test

Exact Form

Variable: **Specific Conductance, Lab (uS/cm)**

	X	**Y**			
Site	#49	#46	Differences		
Year	WY2011	WY2011	**D**	**|D|**	**Rank**
Oct					
Nov	108.5	105.6	2.9	2.9	1
Dec					
Jan					
Feb	171.0	164.0	7.0	7.0	2
Mar					
Apr					
May	114.3	114.3	0.0		
Jun					
Jul					
Aug	153.0	125.0	28.0	28.0	3
Sep					
Median	133.7	119.7	5.0	7.0	

n	**m**
4	3

N= 3

ΣR= 6

α
5.0%
W'α,n
#N/A

W^{+}=
6
p-test
6.000

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

Wilcoxon-signed-ranks test
Exact Form

Variable: **pH, Lab, Standard Units**

	X	**Y**	Differences		
Site	#49	#46			
Year	WY2011	WY2011	**D**	**|D|**	**Rank**
Oct					
Nov	7.94	7.85	0.09	0.09	3
Dec					
Jan					
Feb	7.29	7.36	-0.07	0.07	-1
Mar					
Apr					
May	7.93	7.84	0.09	0.09	2
Jun					
Jul					
Aug	8.12	7.87	0.25	0.25	4
Sep					
Median	7.94	7.85	0.09	0.09	

n	**m**
4	4

N= 4
$\Sigma R=$ 8

α
95.0%
W'α,n
#N/A

$W^{+}=$
9
p-test
0.000

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	#49	#46			
Year	WY2011	WY2011	**D**	**|D|**	**Rank**
Oct					
Nov	38.8	36.9	1.9	1.9	1
Dec					
Jan					
Feb	69.5	61.3	8.2	8.2	4
Mar					
Apr					
May	44.9	42.7	2.2	2.2	2
Jun					
Jul					
Aug	63.2	65.5	-2.3	2.3	-3
Sep					
Median	54.1	52.0	2.1	2.3	

n	**m**
4	4

N= 4
ΣR= 4

α
95.0%
W'α,n
#N/A

W^{+}=
7
p-test
0.000

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	#49	#46			
Year	WY2011	WY2011	**D**	**|D|**	**Rank**
Oct					
Nov	7.8	7.7	0.1	0.1	1
Dec					
Jan					
Feb	15.1	13.5	1.6	1.6	4
Mar					
Apr					
May	7.2	7.1	0.1	0.1	2.5
Jun					
Jul					
Aug	12.1	12.2	-0.1	0.1	-2.5
Sep					
Median	10.0	10.0	0.1	0.1	

n	**m**
4	4

N= 4

ΣR= 5

α
5.0%
W'α,n
#N/A

W^{+}=
7.5
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	#49	#46			
Year	WY2011	WY2011	**D**	**|D|**	**Rank**
Oct					
Nov	4.60	7.82	-3.22	3.22	-4
Dec					
Jan					
Feb	2.07	2.33	-0.26	0.26	-3
Mar					
Apr					
May	2.15	2.04	0.11	0.11	1
Jun					
Jul					
Aug	1.88	1.64	0.24	0.24	2
Sep					
Median	2.11	2.19	-0.08	0.25	

n	**m**
4	4

N= 4
ΣR= -4

α
5.0%
W'$_{\alpha,n}$
#N/A

W^+=
3
p-test
0.000

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

INTERPRETIVE REPORT
SITE 57 “MONITORING WELL 23-00-03”

The data collected during the current water year are listed in the following “Table of Results for Water Year 2011” 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 2011.				

The data for Water Year 2011 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 2011

			Limits		
Sample Date	**Parameter**	**Value**	**Lower**	**Upper**	**Hardness**
No exceedances have been identified by HGCMC for the period of October 2010 through September 2011.					

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, as with the decrease in dissolved chromium noted at the other sites (site 48, site 6, site 54, site 49, site 46, and site 13), dissolved chromium was seen to decrease at this site too during 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 on the pages following this interpretive section. The following table summarizes the results on the data collected between Oct-05 and Sep-11 (WY2006-WY2011). 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

	Mann-Kendall test statistics			Sen's slope estimate	
Parameter	**n***	**p****	**Trend**	**Q**	**Q(%)**
Conductivity Field	6	0.13			
pH Field	6	0.04			
Alkalinity, Total	6	<0.01	-	-4.00	-2.9
Sulfate, Total	6	0.30			
Zinc, Dissolved	6	0.30			

* Number of Years ** Significance level

The dataset for total alkalinity shows a statistically significant ($p<0.01$) trend with a slope estimate of -4.00 mg/L/yr or a 2.9% decrease, this is similar to the value obtained in the 2010 water year of -4.88 mg/L/yr. Given that Site 57 is an upgradient reference site, this trends is interpreted by HGCMC to be part of the natural variation that characterizes this site.

Table of Results for Water Year 2011

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

Sample Date/Parameter	Oct 2010	Nov 2010	Dec 2010	Jan 2011	Feb 2011	Mar 2011	Apr 2011	May 2011	Jun 2011	Jul 2011	Aug 2011	Sep 2011	**Median**
Water Temp (°C)		5.8						5.6			7		5.8
Conductivity-Field(μmho)		384						427			407		407.0
Conductivity-Lab (μmho)		366						426			395		395
pH Lab (standard units)		7.17						7.67			7.58		7.58
pH Field (standard units)		7.72						7.61			7.74		7.72
Total Alkalinity (mg/L)		135						157			142		142.0
Total Sulfate (mg/L)		44.9						59.6			51.2		51.2
Hardness (mg/L)		198						222			203		203.0
Dissolved As (ug/L)		0.496						0.486			0.461		0.486
Dissolved Ba (ug/L)		26						31			30.2		30.2
Dissolved Cd (ug/L)		0.199						0.217			0.199		0.1990
Dissolved Cr (ug/L)		0.893						0.571			0.67		0.670
Dissolved Cu (ug/L)		0.422						1.15			1.27		1.150
Dissolved Pb (ug/L)		0.165						0.306			0.787		0.3060
Dissolved Ni (ug/L)		2.99						3.03			3.43		3.030
Dissolved Ag (ug/L)		0.004						0.002			0.002		0.002
Dissolved Zn (ug/L)		14						14.2			17.6		14.20
Dissolved Se (ug/L)		1.05						1.12			1		1.050
Dissolved Hg (ug/L)		0.000136						0.000221			0.000322		0.000221

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

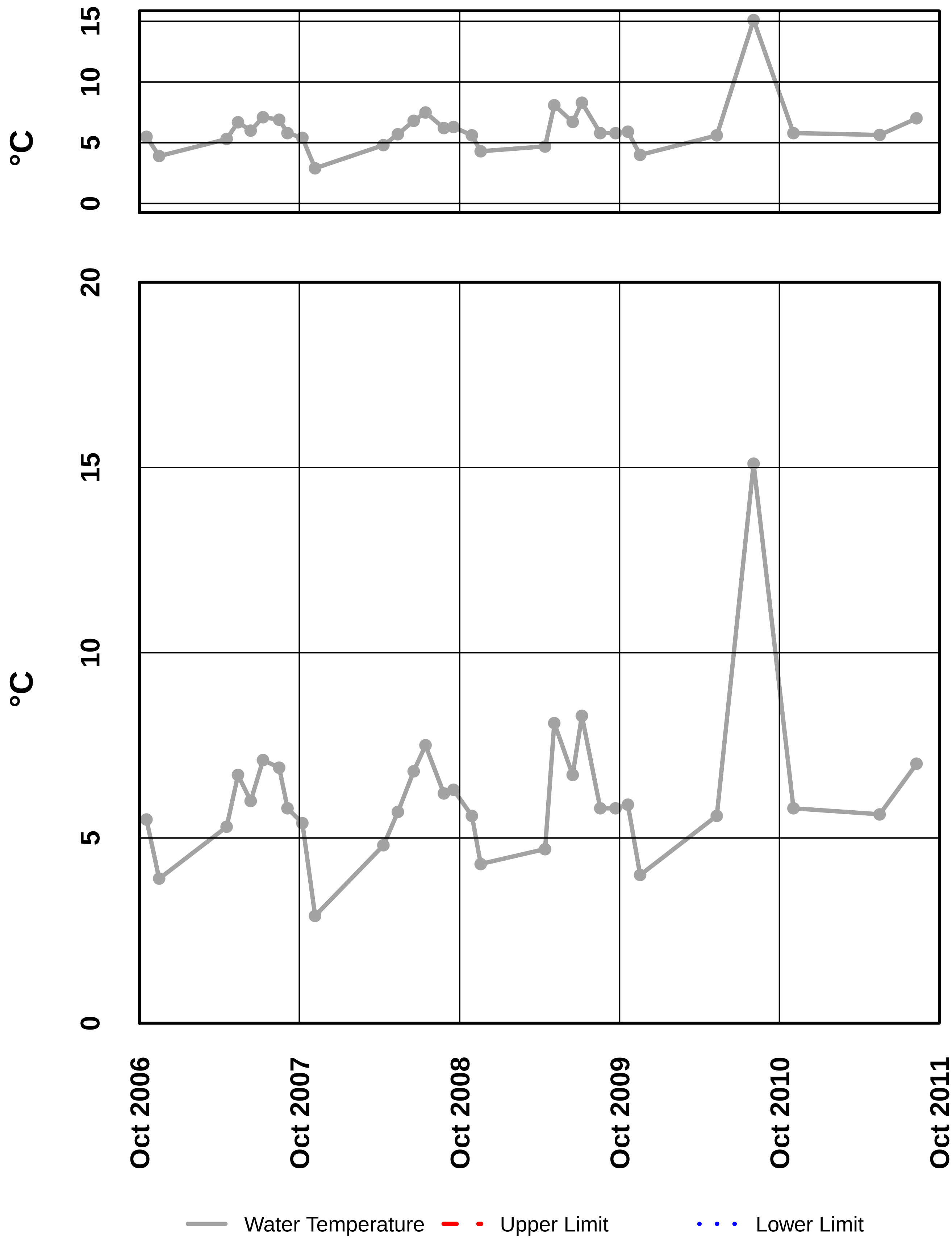
Qualified Data by QA Reviewer

Date Range: 10/01/2010 to 09/30/2011

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
57	11/2/2010	12:00 AM				
			Hg diss, µg/l	0.000136	U	Field Blank Contamination
57	5/18/2011	12:00 AM				
			SO4 Tot, mg/l	59.6	J	Sample Reciept Temperature
			pH Lab, su	7.67	J	Hold Time Violation
			Hg diss, µg/l	0.000221	U	Field Blank Contamination
57	8/10/2011	12:00 AM				
			SO4 Tot, mg/l	51.2	J	Sample Receipt Temperature
			pH Lab, su	7.58	J	Hold Time Violation
			Hg diss, µg/l	0.000322	U	Field Blank Contamination

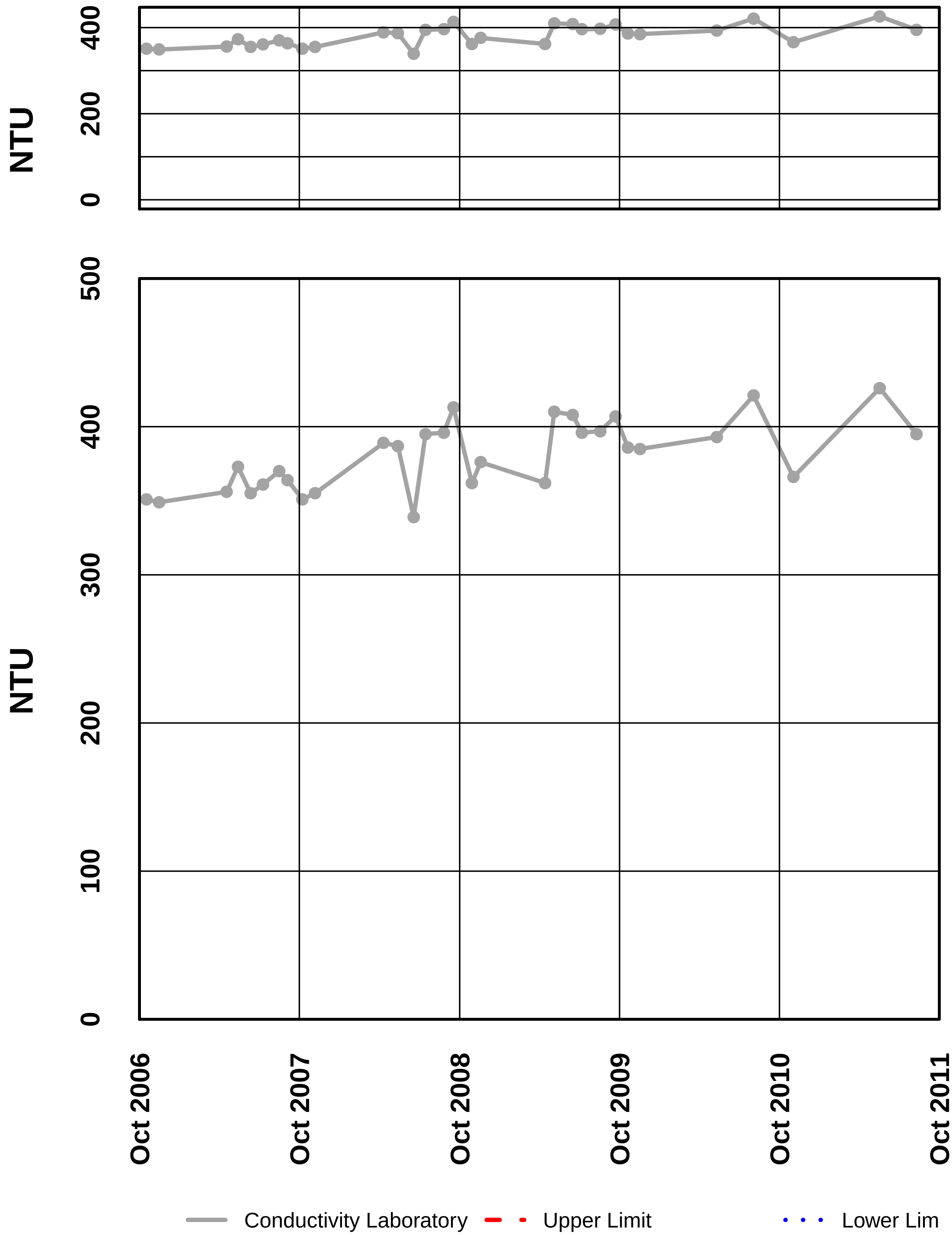
Qualifier	**Description**
J	Positively Identified - Approximate concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation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

Site 57 – Water Temperature



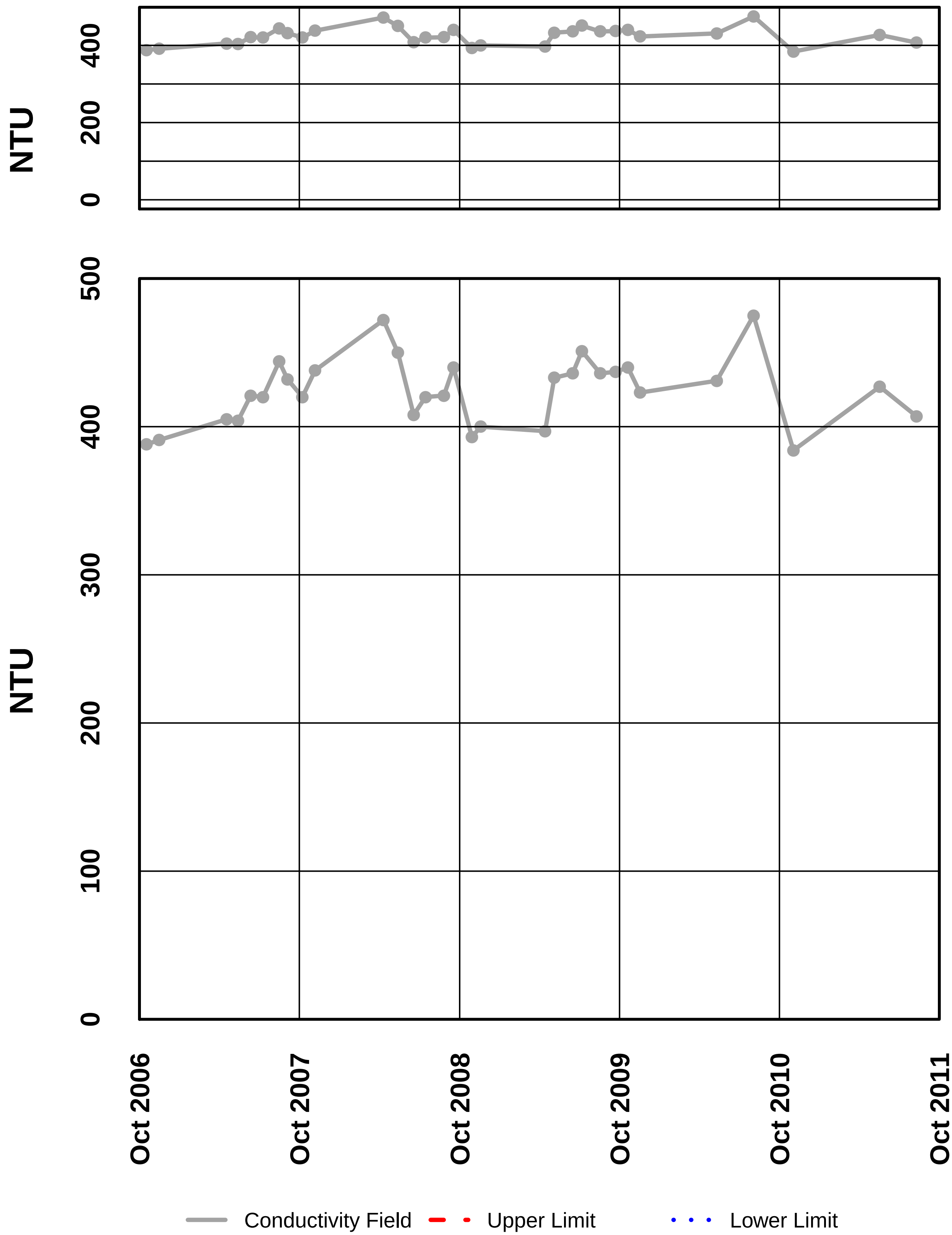
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 57 – Conductivity Laboratory

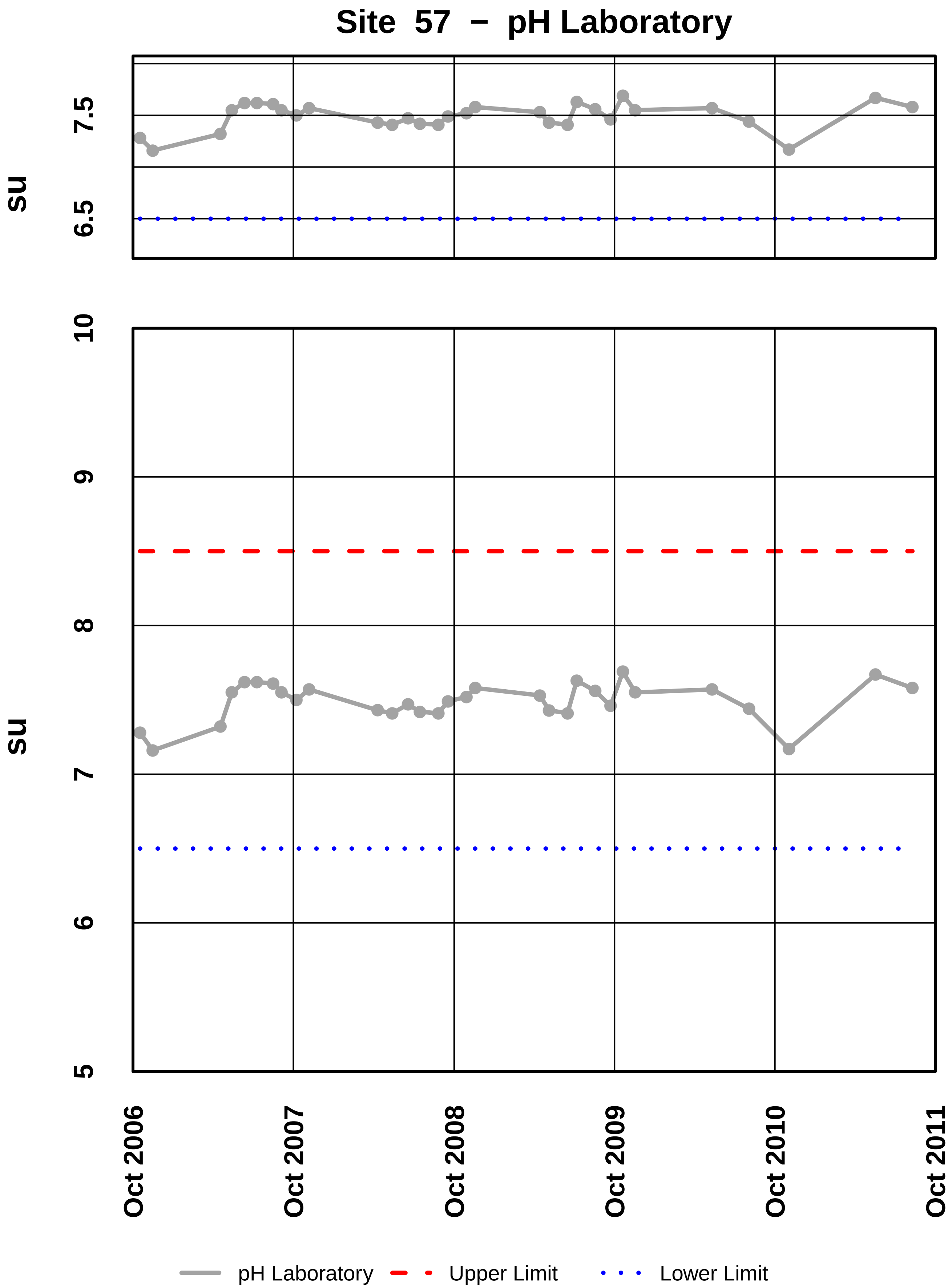


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 57 – Conductivity Field

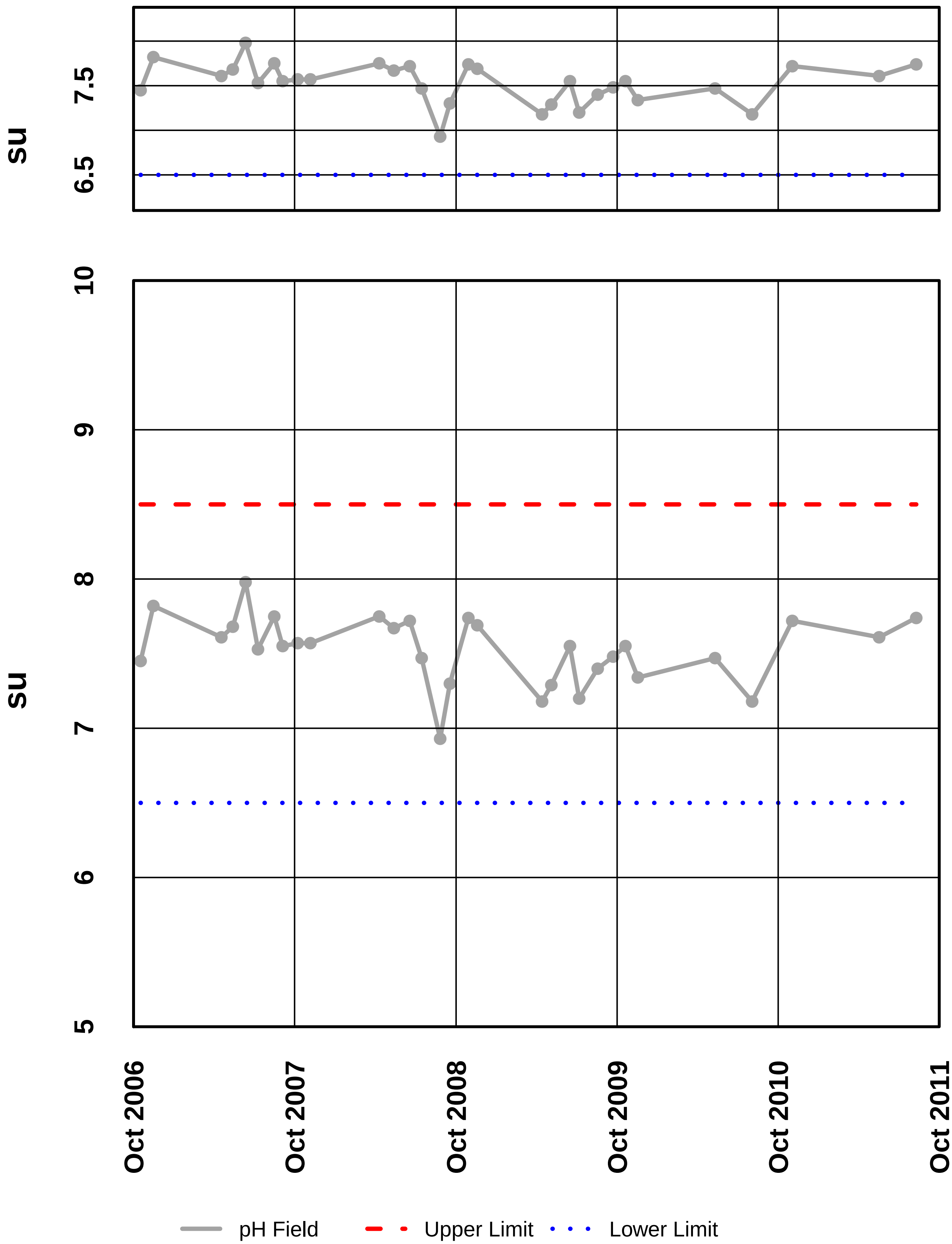


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



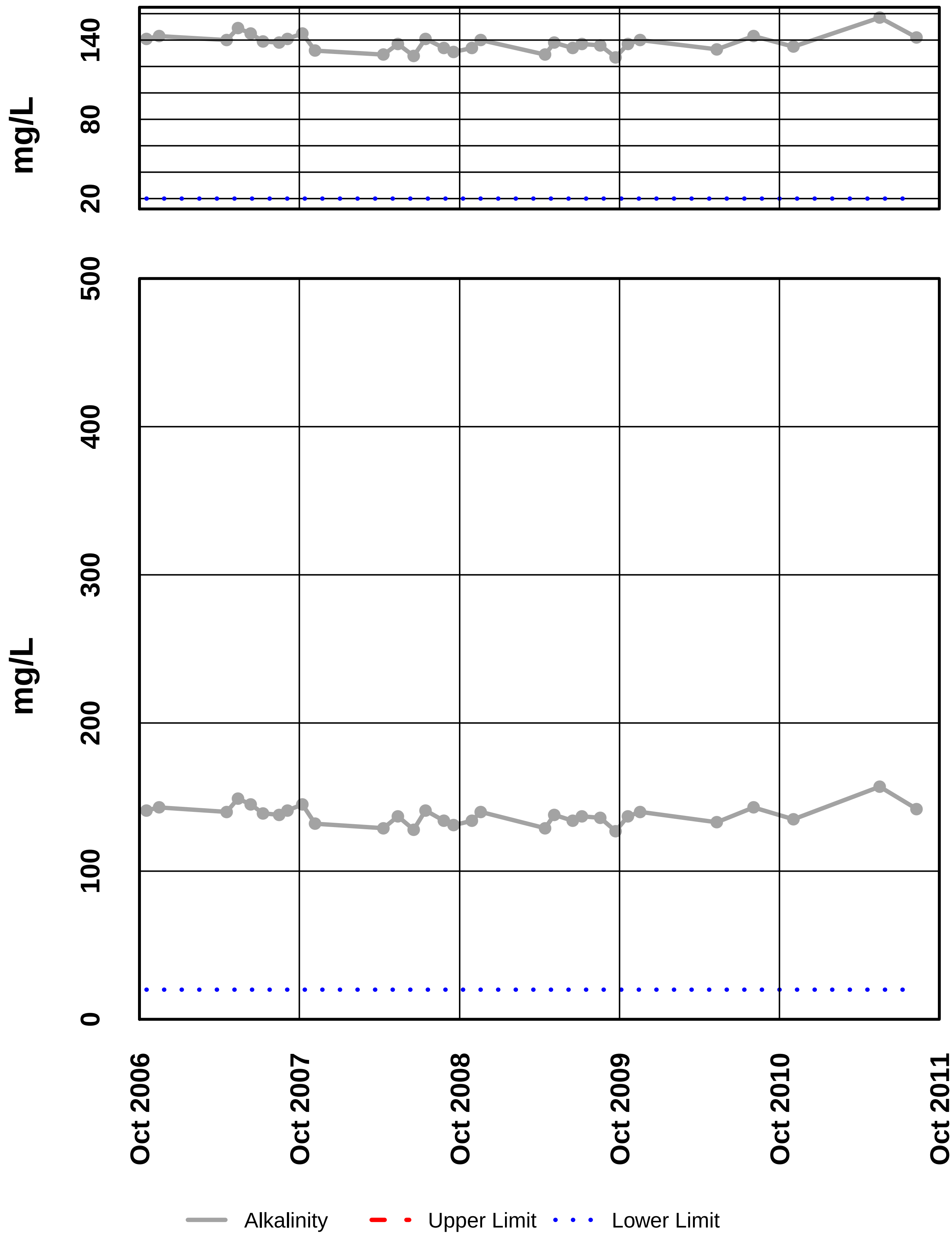
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 57 – pH Field

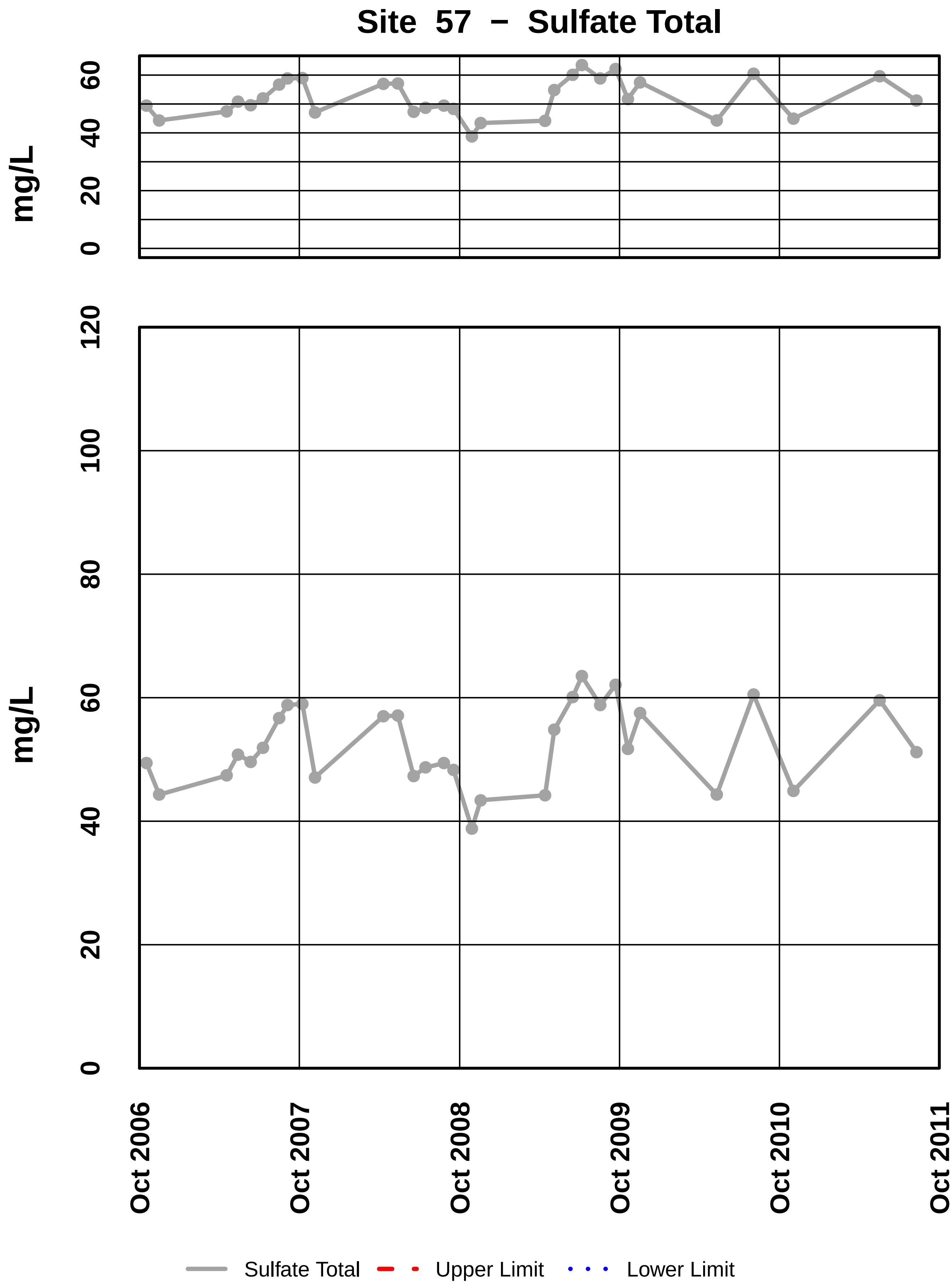


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 57 − Alkalinity

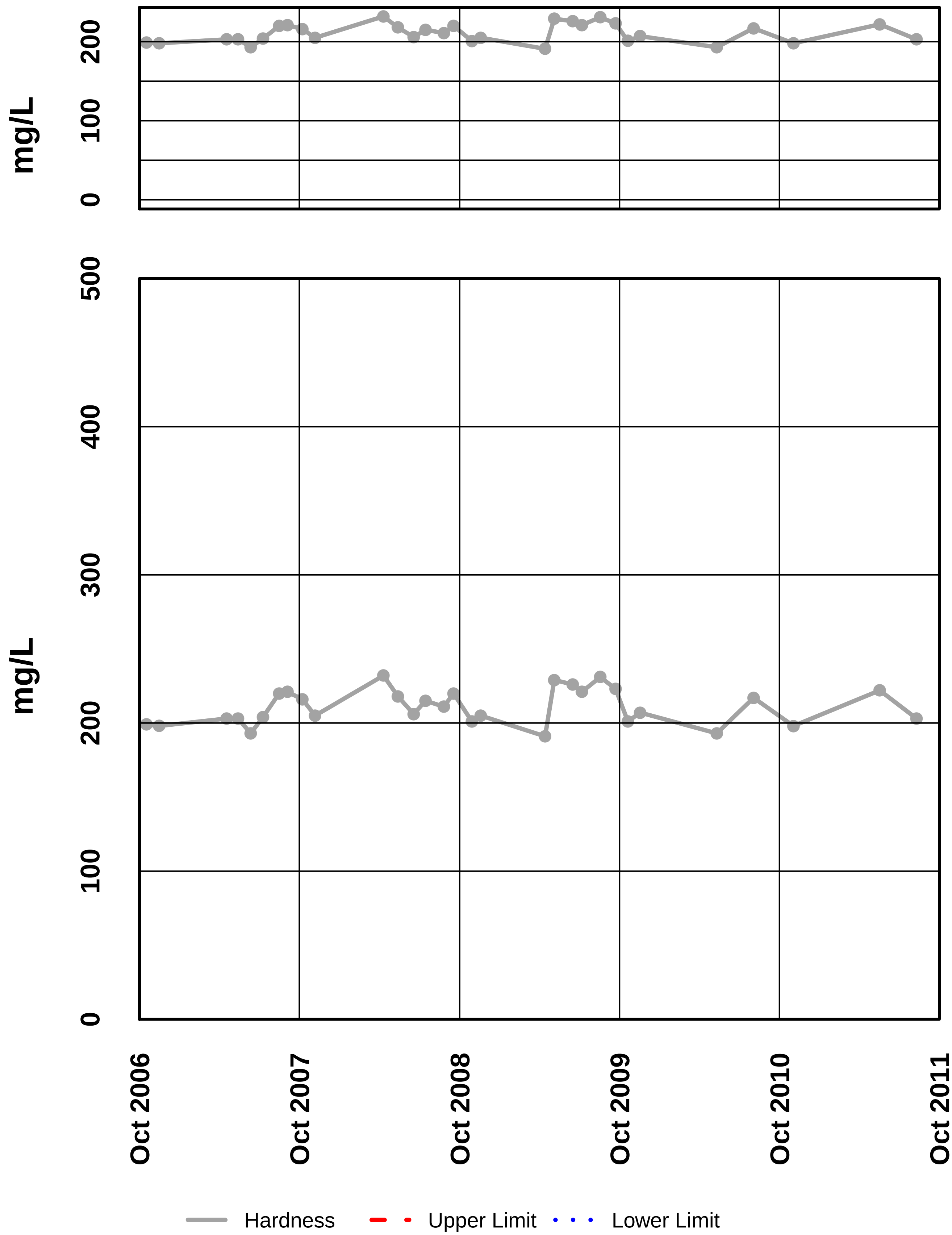


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

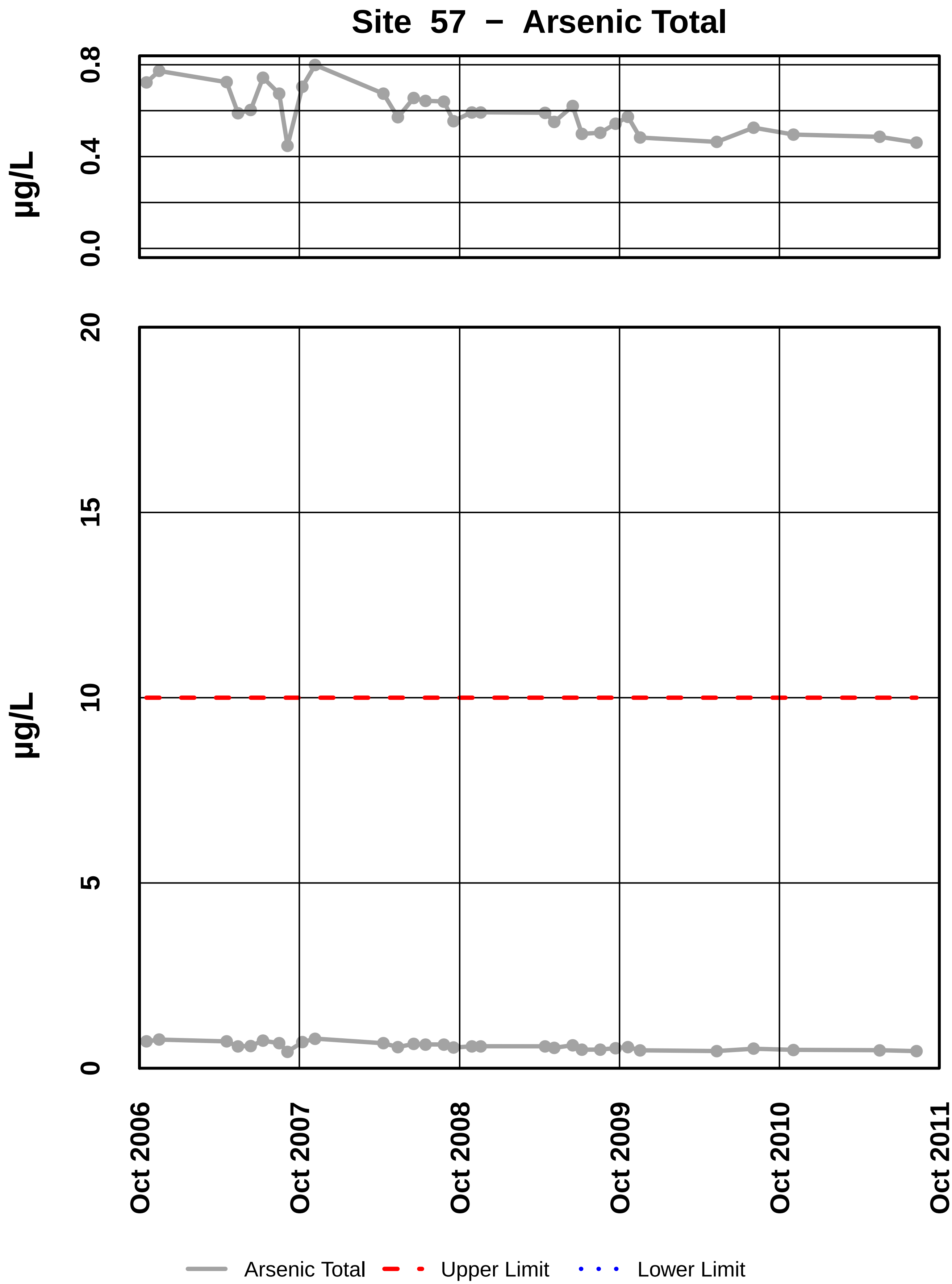


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

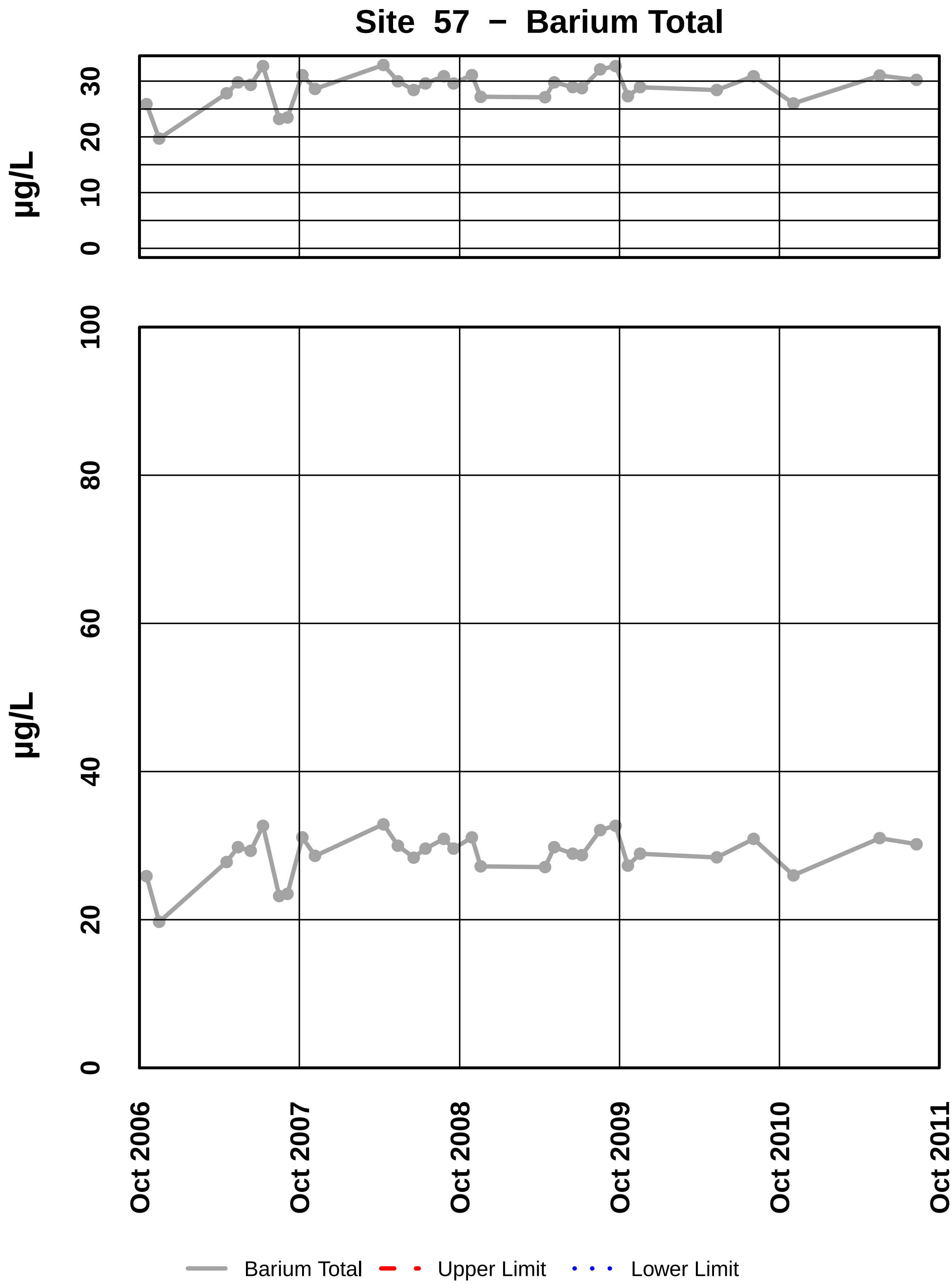
Site 57 − Hardness



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

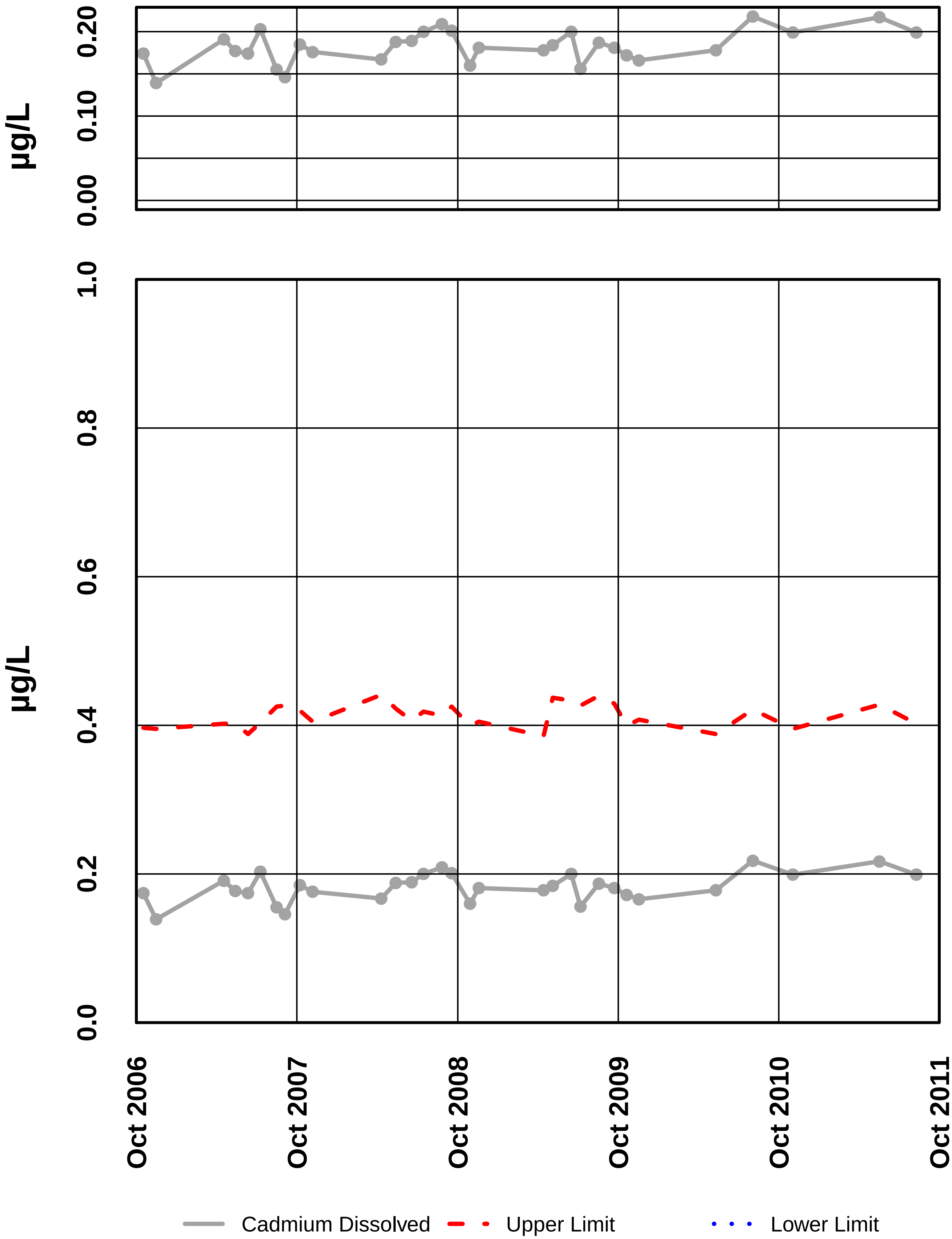


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

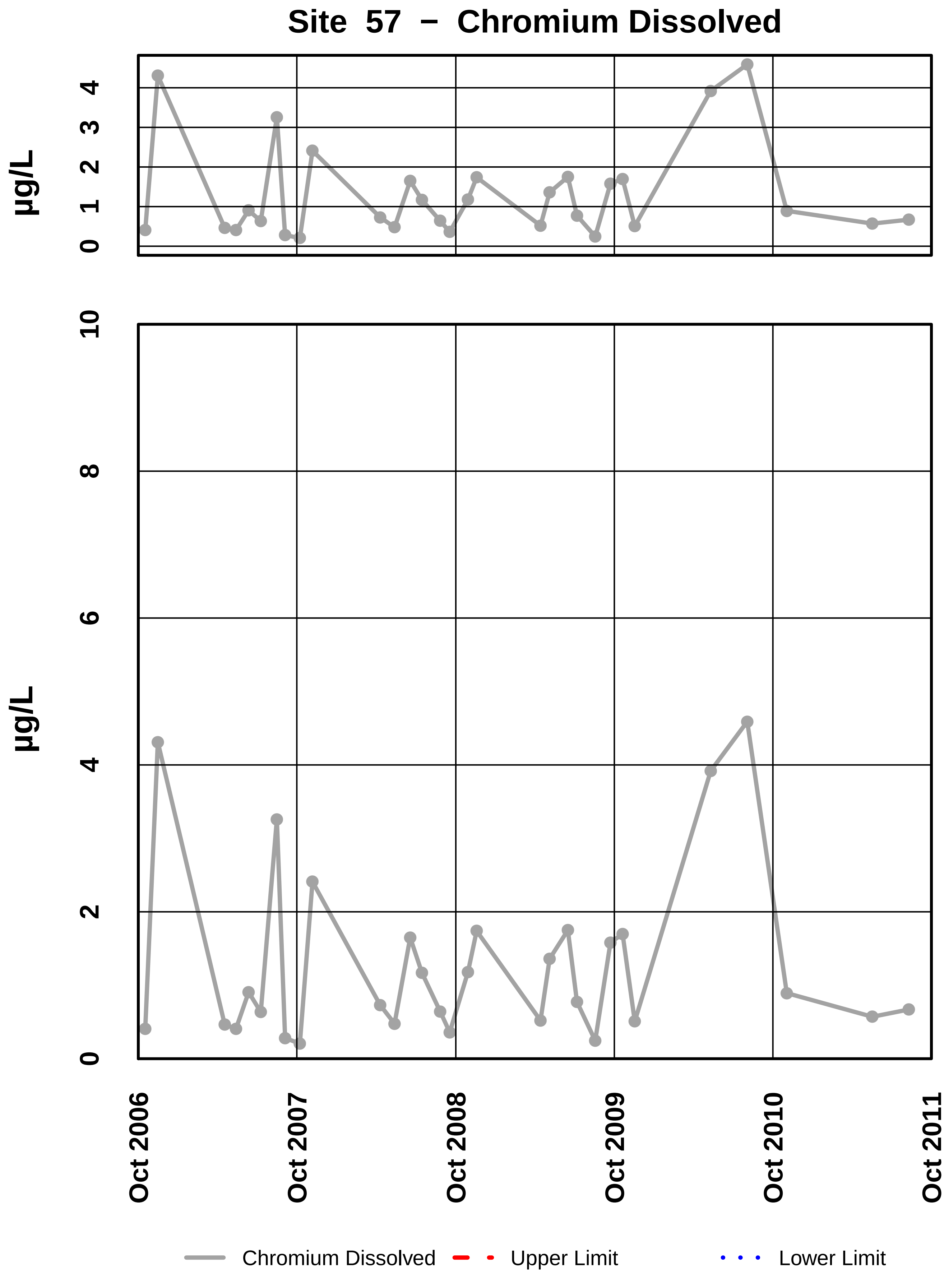


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

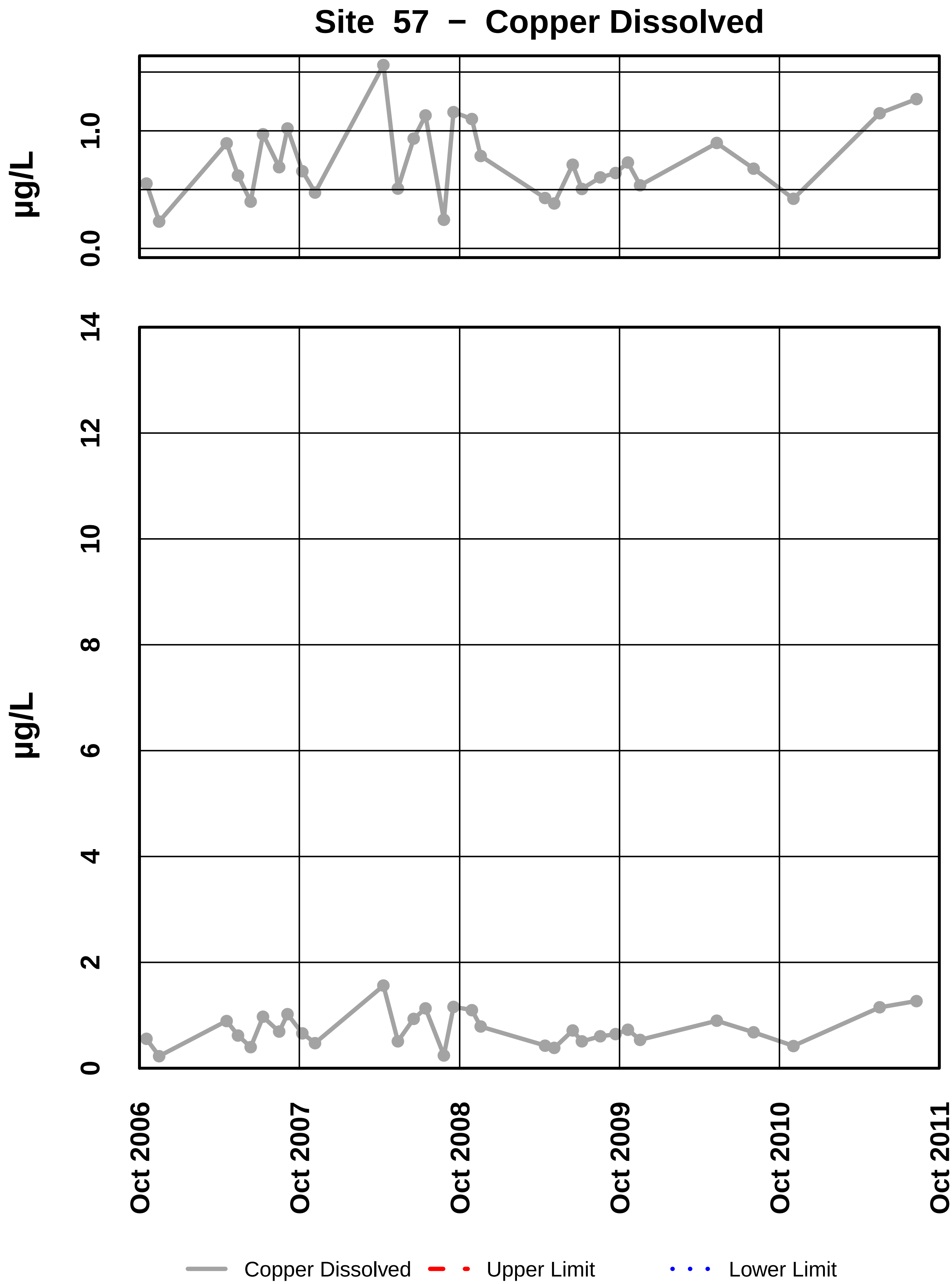
Site 57 – Cadmium Dissolved



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

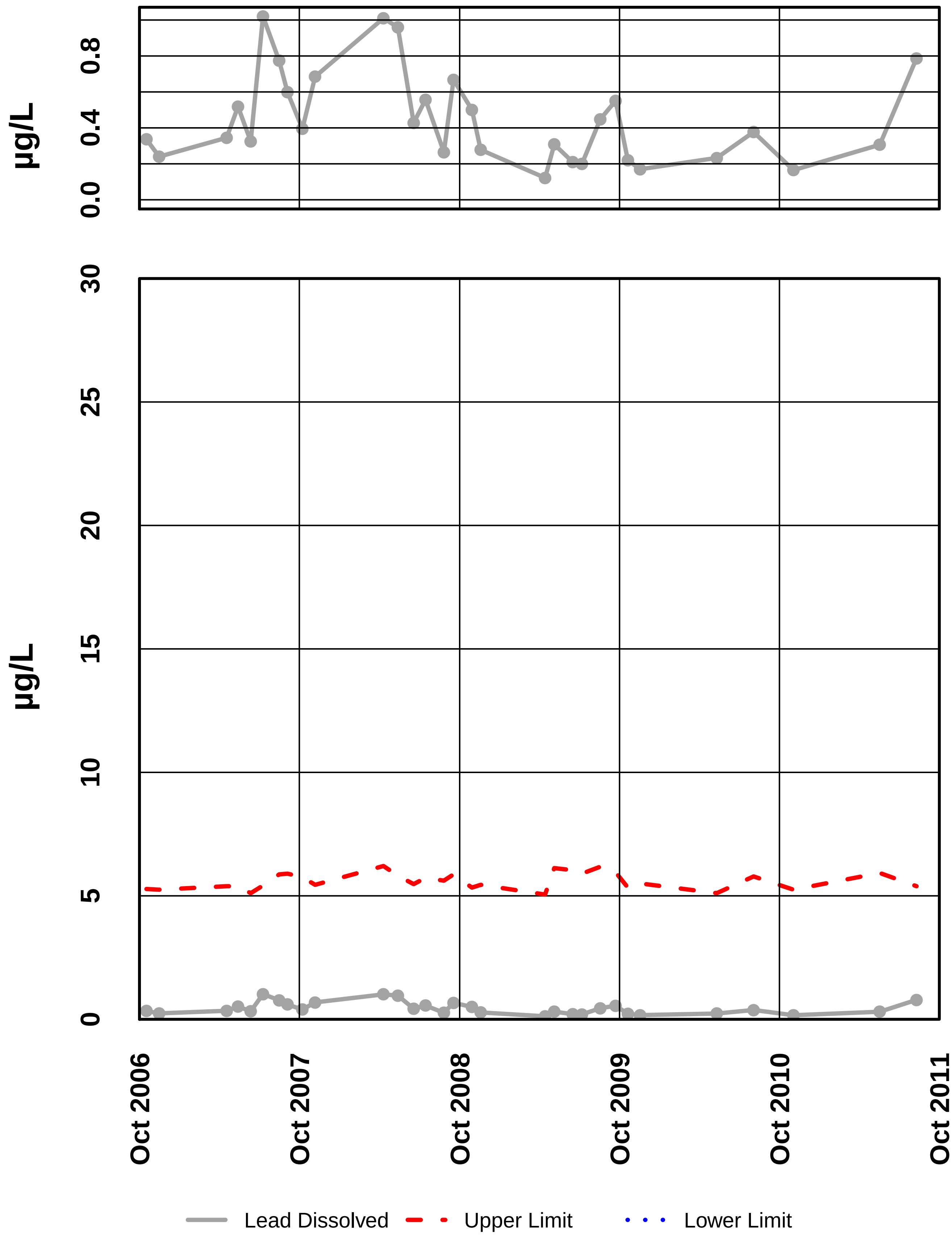


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

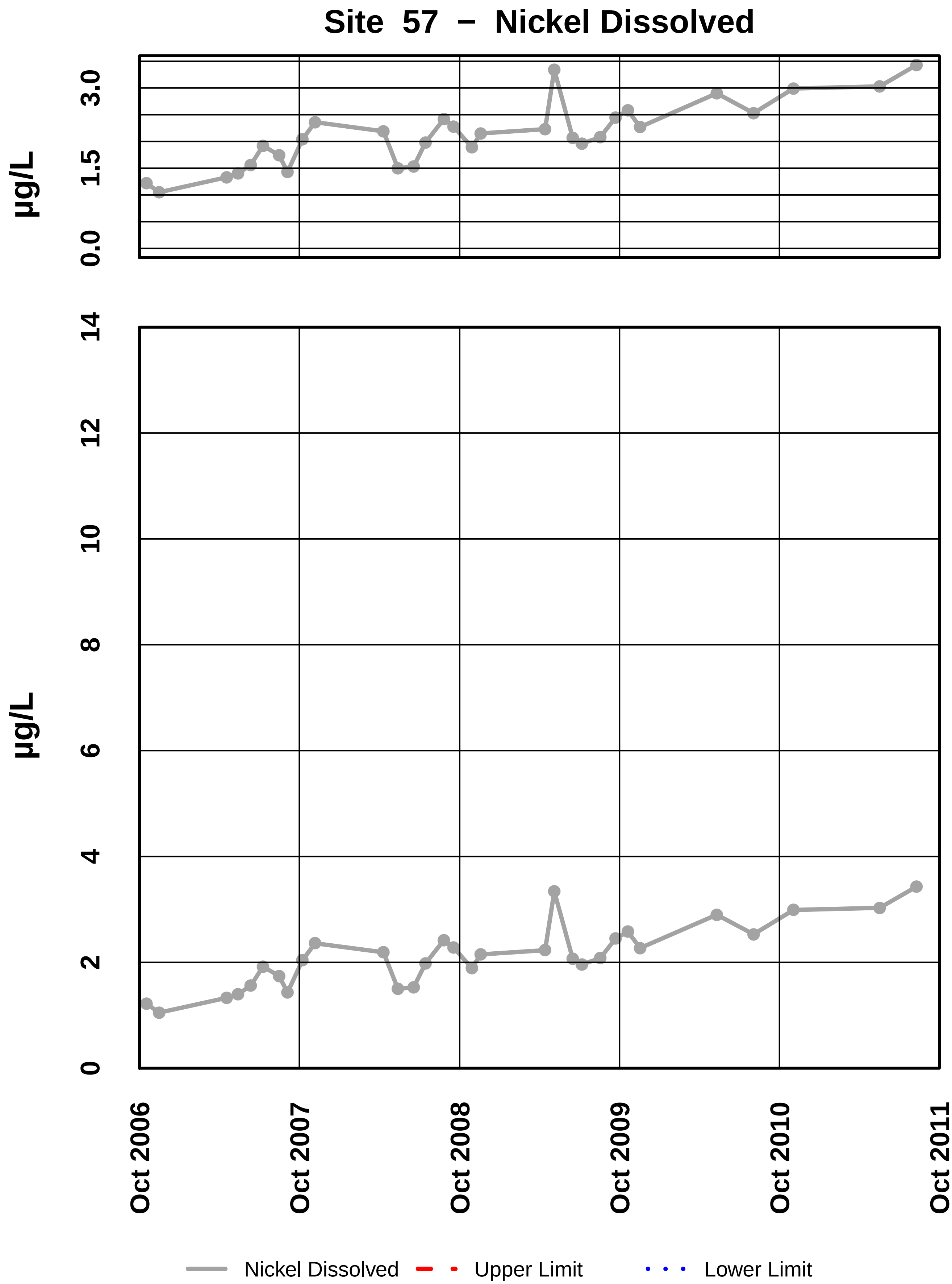


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

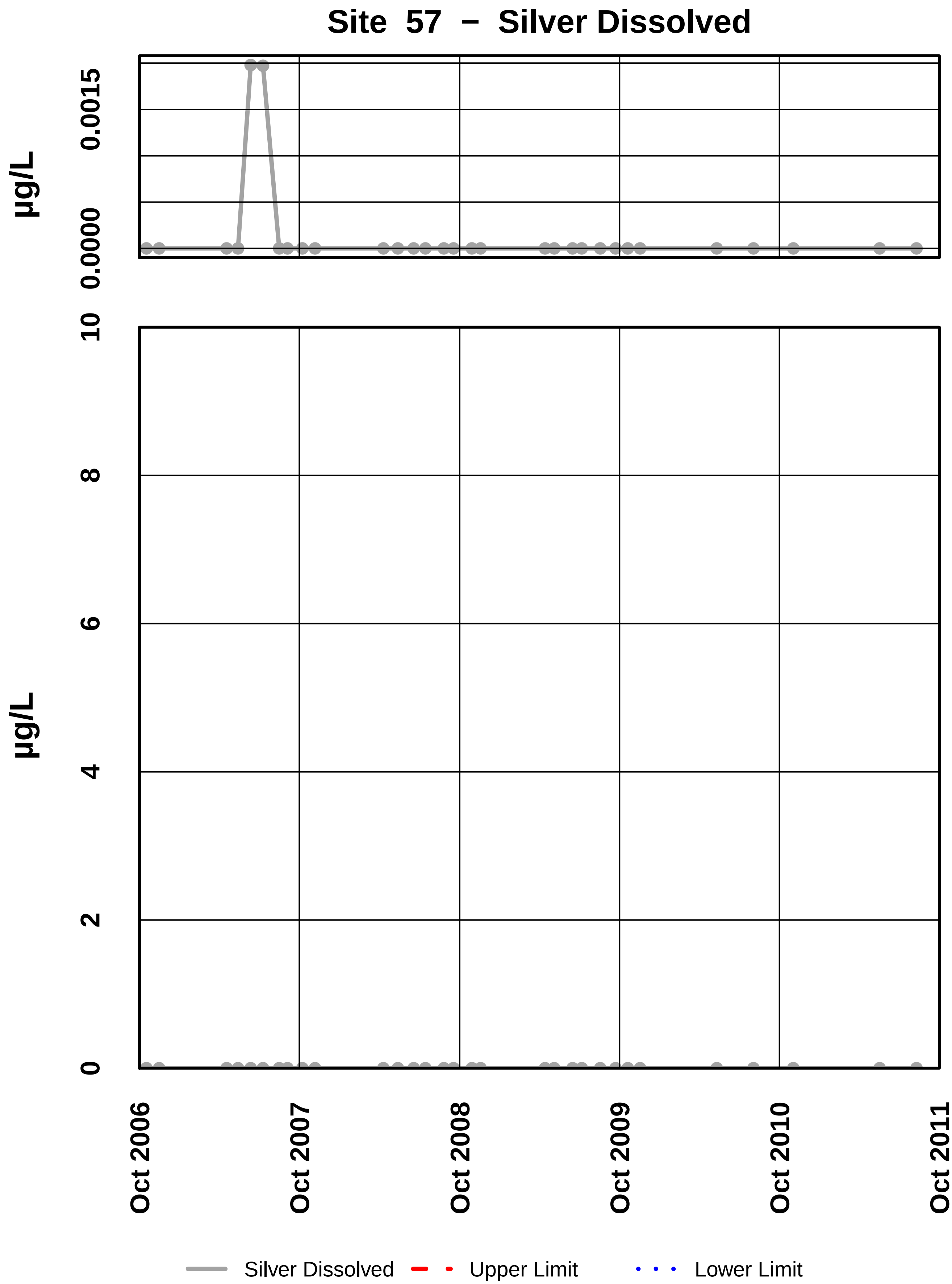
Site 57 − Lead Dissolved



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

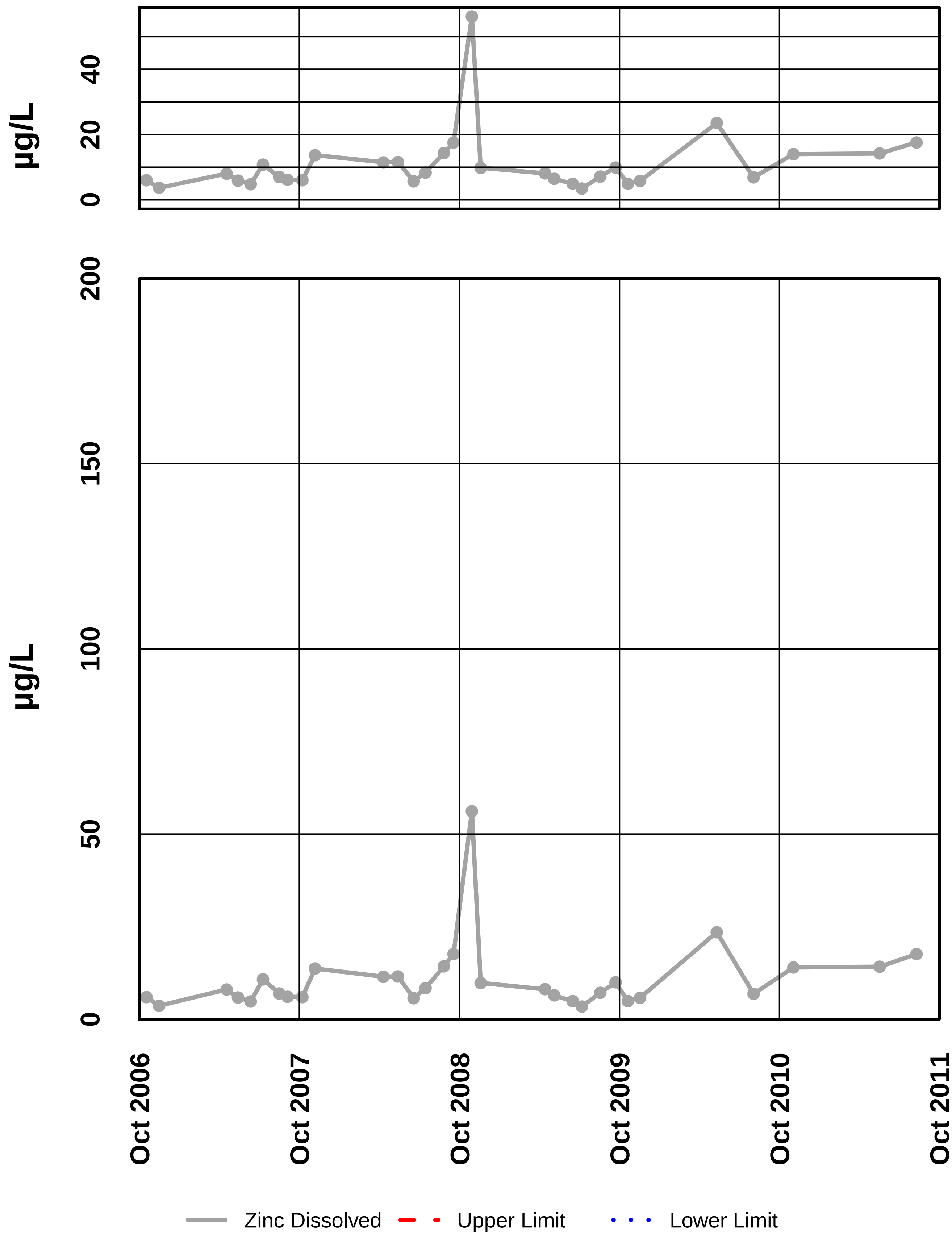


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

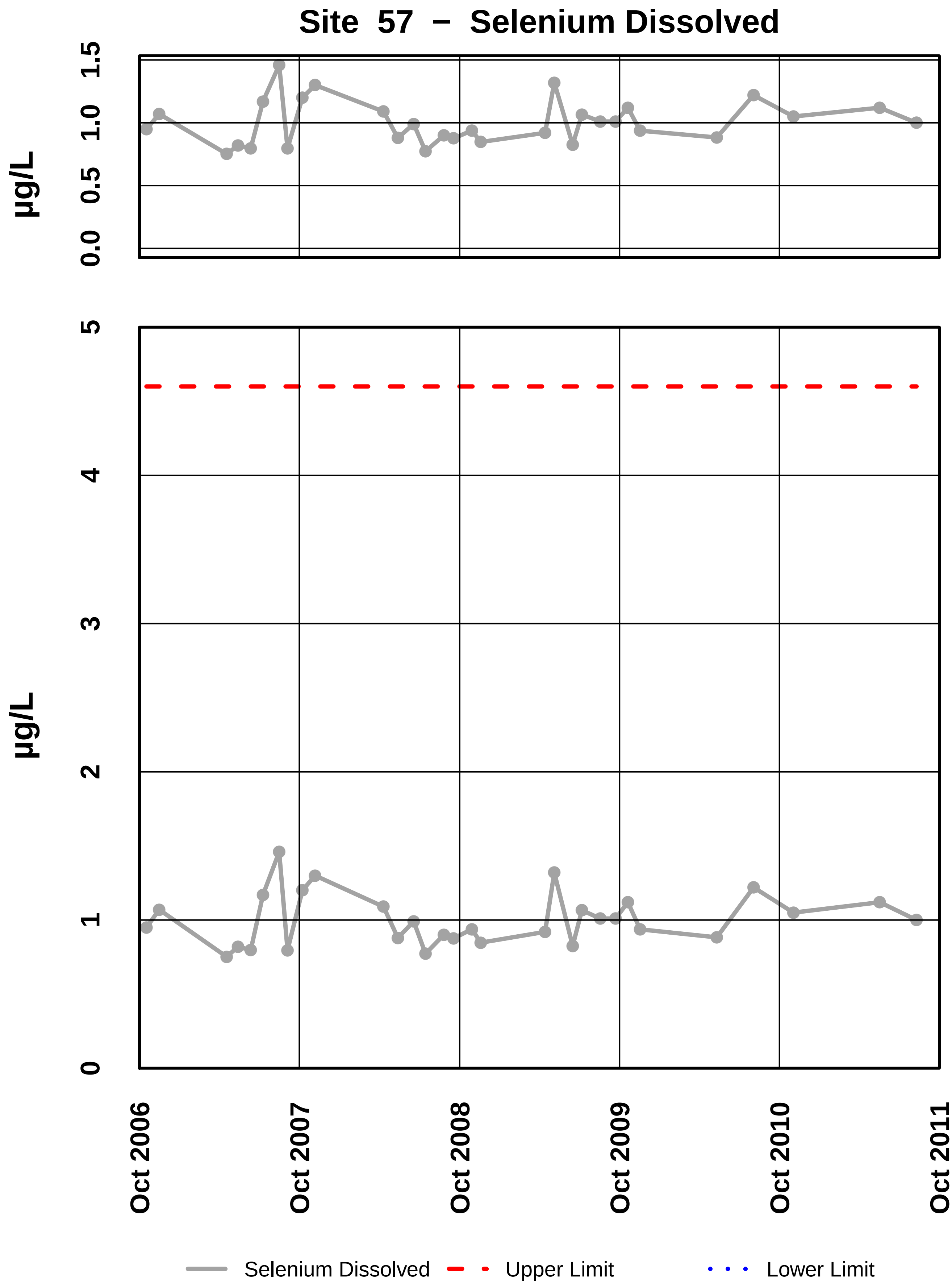


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 57 – Zinc Dissolved

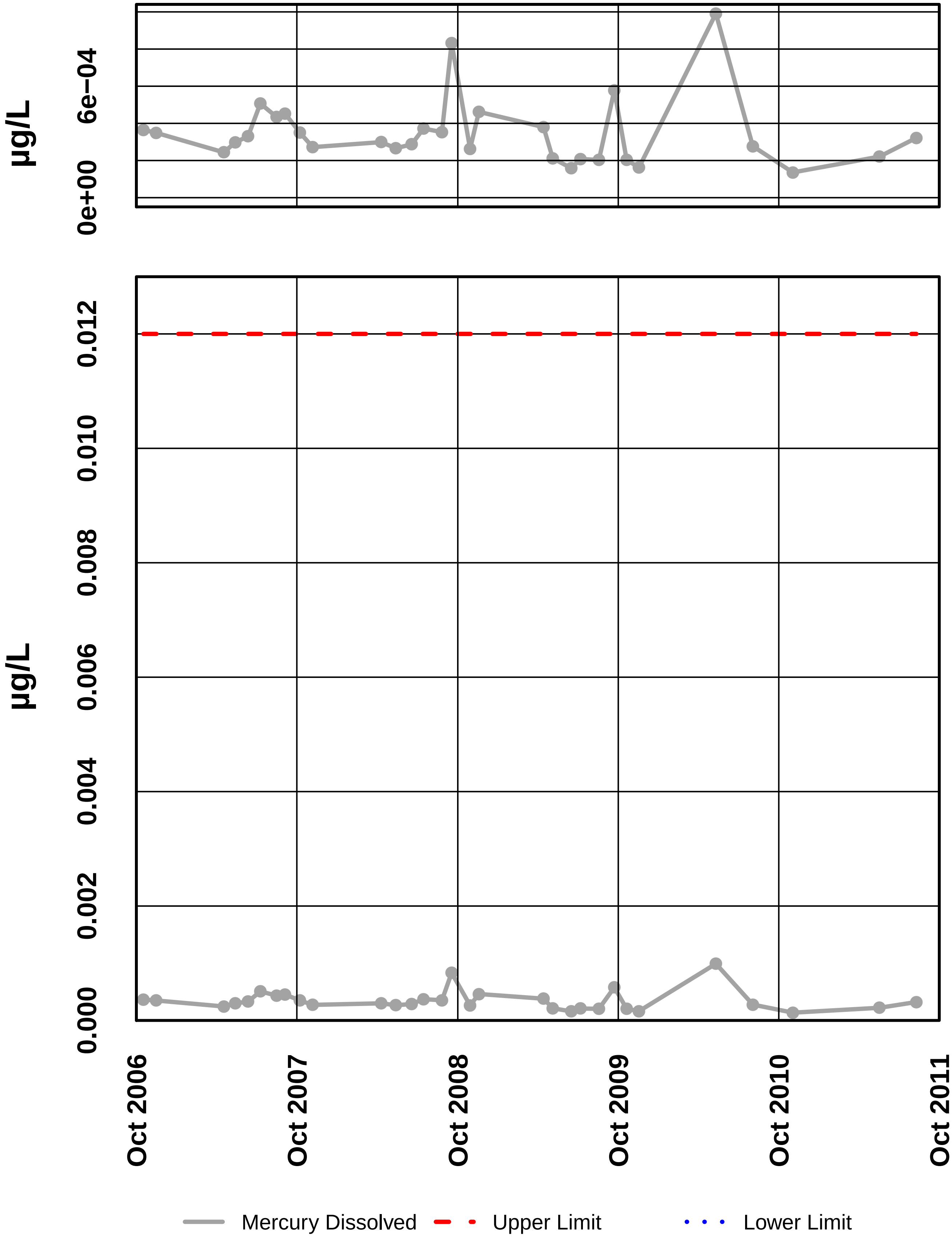


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

Site 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, Lab (uS/cm)

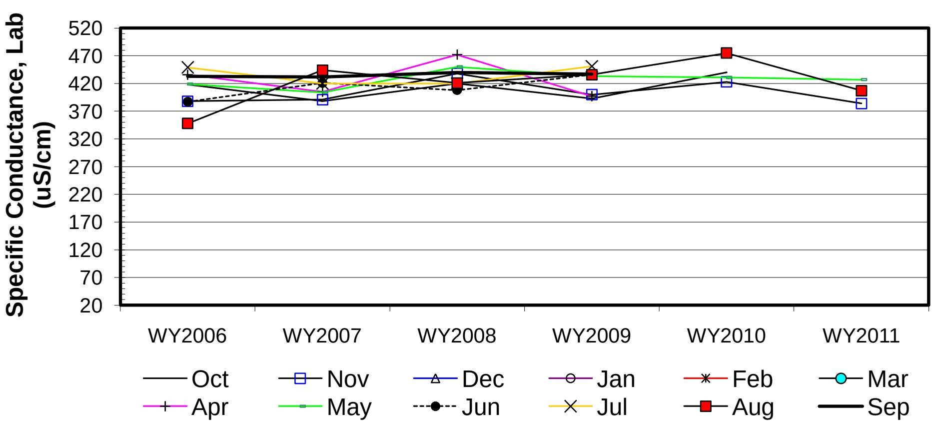
Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2006**	418	388					436	419	387	449	348	433
b	**WY2007**	388	391					405	404	421	420	444	432
c	**WY2008**	420	438					472	450	408	420	421	440
d	**WY2009**	393	400					397	433	436	451	436	437
e	**WY2010**	440	423						431			475	
f	**WY2011**		384						427			407	
	n	5	6	0	0	0	0	4	6	4	4	6	4
	t_1	5	6	0	0	0	0	4	6	4	2	6	4
	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
	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	1	1	1	1
	e-a	1	1						1			1	
	f-a		-1						1			1	
	c-b	1	1					1	1	-1	0	-1	1
	d-b	1	1					-1	1	1	1	-1	1
	e-b	1	1						1			1	
	f-b		-1						1			-1	
	d-c	-1	-1					-1	-1	1	1	1	-1
	e-c	1	-1						-1			1	
	f-c		-1						-1			-1	
	e-d	1	1						-1			1	
	f-d		-1						-1			-1	
	f-e		-1						-1			-1	
	S_k	4	1	0	0	0	0	-2	1	4	1	3	2
	σ^2_S=	16.67	28.33					8.67	28.33	8.67	7.67	28.33	8.67
	$Z_k = S_k/\sigma_S$	0.98	0.19					-0.68	0.19	1.36	0.36	0.56	0.68
	Z^2_k	0.96	0.04					0.46	0.04	1.85	0.13	0.32	0.46

ΣZ_k= 3.64
ΣZ^2_k= 4.25
Z-bar=$\Sigma Z_k/K$= 0.45

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	37	1	0	0	0

Σn 39
ΣS_k 14

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	2.59	@α=5% $\chi^2_{(K-1)}$=	14.07	Test for station homogeneity	
p	**0.920**			$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k) Z_{calc}	1.12	@$\alpha/2$=2.5% Z=	1.96	H_0 (No trend)	ACCEPT
135.33 p	**0.868**			H_A (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-4.00		10.34
0.050	-1.77	**3.00**	8.05
0.100	-0.76		5.74
0.200	0.87		4.57

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2006**	7.7	7.5					7.8	7.6	7.3	7.8	7.9	7.6
b	**WY2007**	7.5	7.8					7.6	7.7	8.0	7.5	7.8	7.6
c	**WY2008**	7.6	7.6					7.8	7.7	7.7	7.5	6.9	7.3
d	**WY2009**	7.7	7.7					7.2	7.3	7.6	7.2	7.4	7.5
e	**WY2010**	7.6	7.3						7.5			7.2	
f	**WY2011**		7.7						7.6			7.7	
	n	5	6	0	0	0	0	4	6	4	4	6	4

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	5	6	0	0	0	0	4	4	4	4	6	4
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
c-a	-1	1					-1	1	1	-1	-1	-1
d-a	1	1					-1	-1	1	-1	-1	-1
e-a	-1	-1						-1			-1	
f-a		1						0			-1	
c-b	1	-1					1	-1	-1	-1	-1	-1
d-b	1	-1					-1	-1	-1	-1	-1	-1
e-b	1	-1						-1			-1	
f-b		-1						-1			-1	
d-c	1	1					-1	-1	-1	-1	1	1
e-c	-1	-1						-1			1	
f-c		1						-1			1	
e-d	-1	-1						1			-1	
f-d		1						1			1	
f-e		1						1			1	
S_k	0	1	0	0	0	0	-4	-4	0	-6	-5	-4

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
$\sigma^2_S=$	16.67	28.33					8.67	27.33	8.67	8.67	28.33	8.67
$Z_k = S_k/\sigma_S$	0.00	0.19					-1.36	-0.77	0.00	-2.04	-0.94	-1.36
Z^2_k	0.00	0.04					1.85	0.59	0.00	4.15	0.88	1.85

$\Sigma Z_k=$ -6.27

$\Sigma Z^2_k=$ 9.35

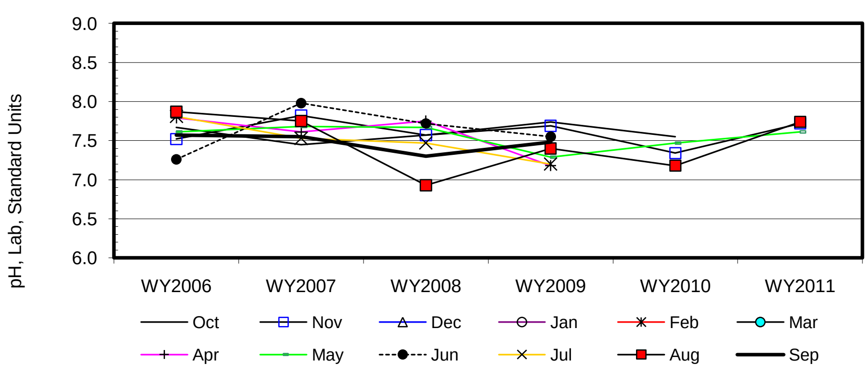
Z-bar=$\Sigma Z_k/K=$ -0.78

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	37	1	0	0	0

Σn 39

ΣS_k -22

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2=$	4.43	@α=5% $\chi^2_{(K-1)}=$ 14.07	Test for station homogeneity	
p	**0.729**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc} -1.81	@α/2=2.5% $Z=$ 1.96	**H_0** (No trend)	ACCEPT
135.33	p **0.036**		**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.16		0.02
0.050	-0.12	**-0.03**	-0.01
0.100	-0.10		-0.02
0.200	-0.06		-0.02

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	**WY2006**	160.0	144.0					151.0	152.0	159.0	149.0	154.0	146.0
b	**WY2007**	141.0	143.0					140.0	149.0	145.0	139.0	138.0	141.0
c	**WY2008**	145.0	132.0					129.0	137.0	128.0	141.0	134.0	131.0
d	**WY2009**	134.0	140.0					129.0	138.0	134.0	137.0	136.0	127.0
e	**WY2010**	137.0	140.0						133.0			143.0	
f	**WY2011**		135.0						157.0			142.0	
	n	5	6	0	0	0	0	4	6	4	4	6	4

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

	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	-1	-1	-1	-1
e-a	-1	-1						-1			-1	
f-a		-1						1			-1	
c-b	1	-1					-1	-1	-1	1	-1	-1
d-b	-1	-1					-1	-1	-1	-1	-1	-1
e-b	-1	-1						-1			1	
f-b		-1						1			1	
d-c	-1	1					0	1	1	-1	1	-1
e-c	-1	1						-1			1	
f-c		1						1			1	
e-d	1	0						-1			1	
f-d		-1						1			1	
f-e		-1						1			-1	
S_k	-6	-8	0	0	0	0	-5	-3	-4	-4	-1	-6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
$\sigma^2_S=$	16.67	27.33					7.67	28.33	8.67	8.67	28.33	8.67
$Z_k = S_k/\sigma_S$	-1.47	-1.53					-1.81	-0.56	-1.36	-1.36	-0.19	-2.04
Z^2_k	2.16	2.34					3.26	0.32	1.85	1.85	0.04	4.15

$\Sigma Z_k=$ -10.31

$\Sigma Z^2_k=$ 15.96

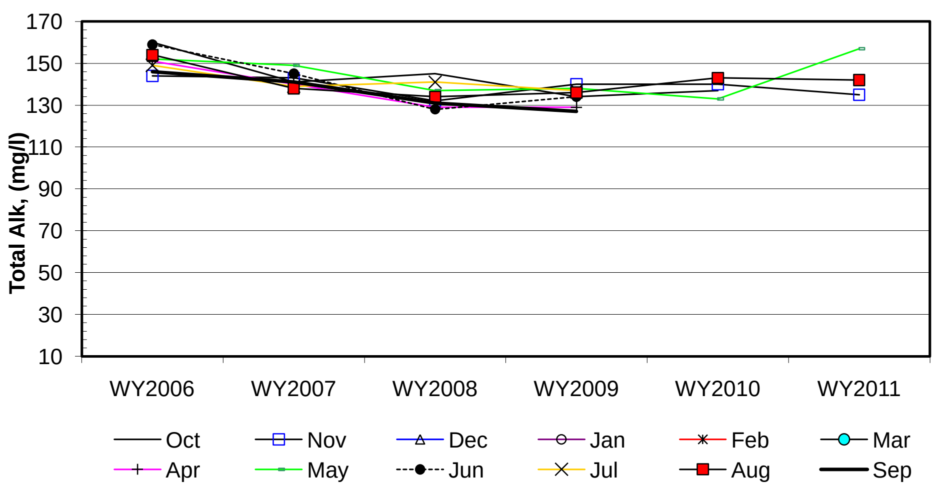
$\text{Z-bar}=\Sigma Z_k/K=$ -1.29

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	35	2	0	0	0

Σn 39

ΣS_k -37

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2=$ 2.67	@α=5% $\chi^2_{(K-1)}=$ 14.07	Test for station homogeneity	
p **0.914**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
$\Sigma VAR(S_k)$ 134.33 / Z_{calc} -3.11	@$\alpha/2$=2.5% $Z=$ 1.96	H_0 (No trend)	REJECT
p **0.001**		H_A (± trend)	ACCEPT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-5.50		-1.00
0.050	-5.01	**-4.00**	-1.49
0.100	-4.98		-2.00
0.200	-4.25		-2.46

-2.9%

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	**WY2006**	52.2	52.4					61.7	59.4	66.0	60.1	58.5	50.0
b	**WY2007**	49.4	44.3					47.4	50.8	49.6	51.9	56.7	58.8
c	**WY2008**	59.0	47.1					57.0	57.1	47.3	48.7	49.4	48.3
d	**WY2009**	38.8	43.4					44.2	54.8	60.1	63.5	58.8	62.1
e	**WY2010**	51.7	57.5						44.3			60.5	
f	**WY2011**		44.9						59.6			51.2	
	n	5	6	0	0	0	0	4	6	4	4	6	4

t_1	5	6	0	0	0	0	4	6	4	4	6	4
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	-1	1	1	1
e-a	-1	1						-1			1	
f-a		-1						1			-1	
c-b	1	1					1	1	-1	-1	-1	-1
d-b	-1	-1					-1	1	1	1	1	1
e-b	1	1						-1			1	
f-b		1						1			-1	
d-c	-1	-1					-1	-1	1	1	1	1
e-c	-1	1						-1			1	
f-c		-1						1			1	
e-d	1	1						-1			1	
f-d		1						1			-1	
f-e		-1						1			-1	
S_k	-2	-1	0	0	0	0	-4	-1	-2	0	1	2

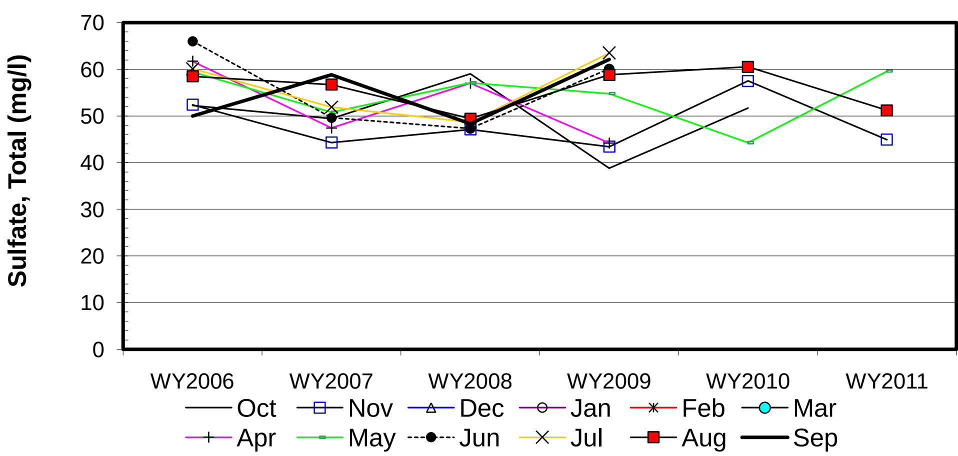
σ^2_S=	16.67	28.33					8.67	28.33	8.67	8.67	28.33	8.67
$Z_k = S_k/\sigma_S$	-0.49	-0.19					-1.36	-0.19	-0.68	0.00	0.19	0.68
Z^2_k	0.24	0.04					1.85	0.04	0.46	0.00	0.04	0.46

ΣZ_k= -2.04
ΣZ^2_k= 3.12
Z-bar=$\Sigma Z_k/K$= -0.25

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

Σn 39
ΣS_k -7

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=		2.60	@α=5% $\chi^2_{(K-1)}$= 14.07	Test for station homogeneity	
	p	**0.920**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc}	-0.51	@α=5% Z= 1.64	H_0 (No trend)	ACCEPT
136.33	p	**0.304**		H_A ($\pm$ trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-2.82		1.14
0.050	-2.30	**-0.85**	0.75
0.100	-1.96		0.49
0.200	-1.56		0.06

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	**WY2006**	10.3	9.5					6.0	22.7	8.1	11.3	12.4	5.8
b	**WY2007**	6.0	3.7					8.1	5.9	4.8	10.8	7.0	6.1
c	**WY2008**	6.0	13.7					11.5	11.6	5.7	8.4	14.3	17.6
d	**WY2009**	56.2	9.8					8.1	6.5	4.9	3.5	7.1	10.0
e	**WY2010**	4.9	5.8						23.5			6.9	
f	**WY2011**		14.0						14.2			17.6	
	n	5	6	0	0	0	0	4	6	4	4	6	4

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	5	6	0	0	0	0	4	6	4	4	6	4
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	-1	-1	-1	1
e-a	-1	-1						1			-1	
f-a		1						-1			1	
c-b	1	1					1	1	1	-1	1	1
d-b	1	1					1	1	1	-1	1	1
e-b	-1	1						1			-1	
f-b		1						1			1	
d-c	1	-1					-1	-1	-1	-1	-1	-1
e-c	-1	-1						1			-1	
f-c		1						1			1	
e-d	-1	-1						1			-1	
f-d		1						1			1	
f-e		1						-1			1	
S_k	-2	5	0	0	0	0	4	3	-2	-6	1	4

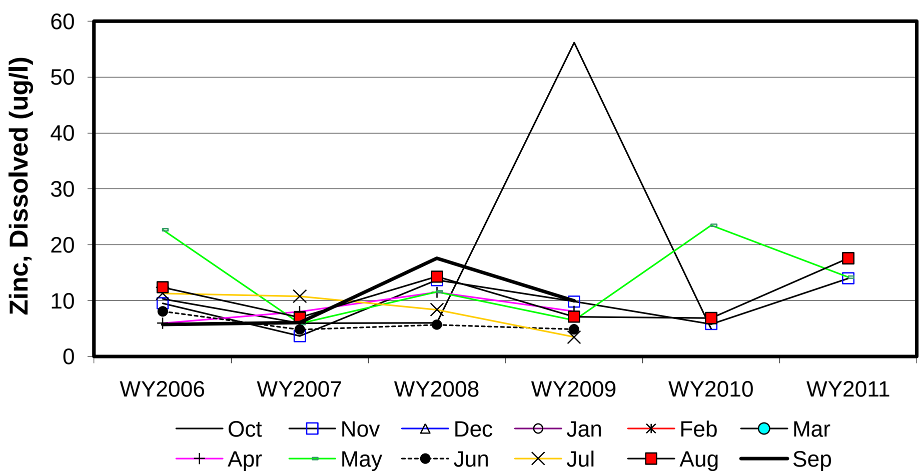
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	16.67	28.33					8.67	28.33	8.67	8.67	28.33	8.67
$Z_k = S_k/\sigma_S$	-0.49	0.94					1.36	0.56	-0.68	-2.04	0.19	1.36
Z^2_k	0.24	0.88					1.85	0.32	0.46	4.15	0.04	1.85

ΣZ_k= 1.20
ΣZ^2_k= 9.78
Z-bar=ΣZ_k/K= 0.15

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

Σn 39
ΣS_k 7

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$= 9.60	@α=5% $\chi^2_{(K-1)}$= 14.07	Test for station homogeneity	
p **0.212**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k) 136.33	Z_{calc} 0.51 **p** **0.696**	@α/2=2.5% Z= 1.96	**H_0** (No trend) ACCEPT
			H_A (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-1.39		1.12
0.050	-0.95	**0.08**	0.87
0.100	-0.55		0.71
0.200	-0.30		0.31

INTERPRETIVE REPORT
SITE 56 “MONITORING WELL D-00-01”

The data collected during the current water year are listed in the following “Table of Results for Water Year 2011” 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 2006 through September 2011.				

The data for Water Year 2011 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 2011

			Limits		
Sample Date	**Parameter**	**Value**	**Lower**	**Upper**	**Hardness**
No exceedances have been identified by HGCMC for the period of October 2010 through September 2011.					

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. As with the decrease in dissolved chromium seen at the other sites (site 48, site 6, site 54, site 49, site 46, and site 13), dissolved chromium was seen to decrease at this site also.

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 (WY2006-WY2011). There were no statistically significant ($\alpha/2=2.5\%$) trends identified for 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	0.30			
pH Field	6	0.50			
Alkalinity, Total	6	0.04			
Sulfate, Total	6	0.25			
Zinc, Dissolved	6	0.04			

* Number of Years ** Significance level

A comparison of median values for total alkalinity, laboratory pH, laboratory conductivity, total sulfate, and dissolved zinc between Site 56 and Site 57 has been conducted as specified in the Statistical Information Goals for Site 56. Additional X-Y plots have been generated for total alkalinity, field pH, specific conductivity, total sulfate, and dissolved zinc that co-plot data from Site 56 and Site 57, the up-gradient control site, to aid in the comparison between those two 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 56 vs Site 57

Parameter	**Signed Ranks p-value**	**Site 57 median**	**Site 56 median**	**Median Differences**
Conductivity Field	1	407.0	156.2	250.0
pH Field	0.625	7.7	7.7	0.0
Alkalinity, Total	1	142.0	57.8	78.3
Sulfate, Total	1	51.2	10.0	39.3
Zinc, Dissolved	1	14.2	0.2	14.0

The only significant difference identified by the typical one-tailed test was for total alkalinity. Median values for alkalinity for Site 49 and Site 46 are 142 mg/L and 57.8 mg/L respectively. The median difference, Site 49 minus Site 46, is 78.3 mg/L. It should be noted that if a two-tailed signed-rank test was applied to the dataset for these sites a very significant (p=1.00) difference would exist with respect to the other parameters included in the signed-ranks analysis. Specifically, conductivity, sulfate, and dissolved zinc fail to meet the null hypothesis of no significant difference between medians when the alternative hypothesis is cast in terms without regard to the direction of the difference (H_a: median [D]≠0). The obvious differences of the major water-quality parameters at these sites are likely the result of several inherent hydrological/geological differences between the two sites.

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.

Because of the differences in the completions of these well the statistical analysis of the inter-comparison is prone to failure if not misinterpretation. An attempt was made this season to analyze this well data 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 3.3 recorded for total sulfate. 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 second 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

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**

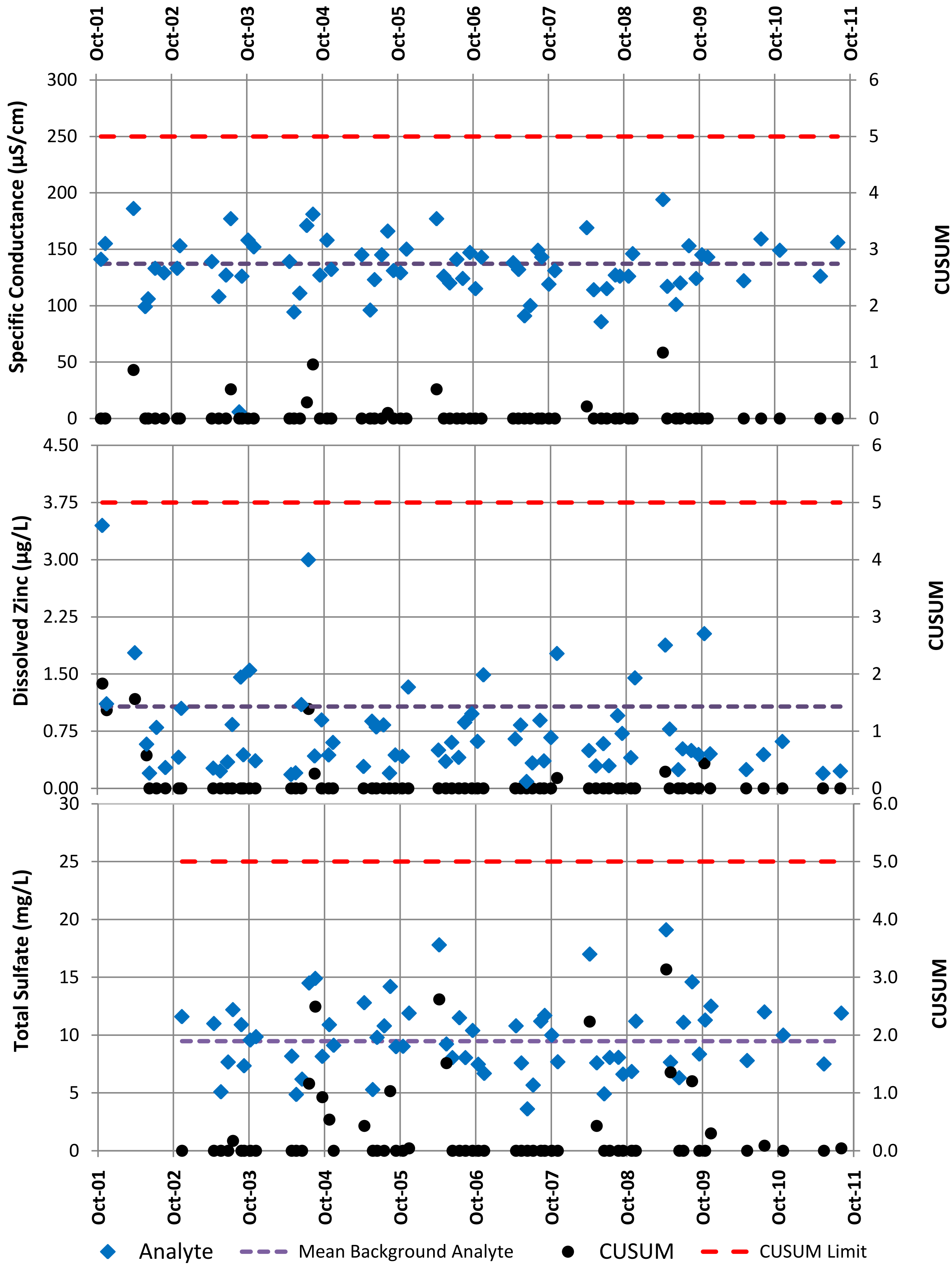


Table of Results for Water Year 2011

Site 056FMG - 'Monitoring Well -D-00-01'													
Sample Date/Parameter	Oct 2010	Nov 2010	Dec 2010	Jan 2011	Feb 2011	Mar 2011	Apr 2011	May 2011	Jun 2011	Jul 2011	Aug 2011	Sep 2011	**Median**
Water Temp (°C)		5.9						4.6			9.3		5.9
Conductivity-Field(μmho)		156.2						135			157		156.2
Conductivity-Lab (μmho)		149						126			156		149
pH Lab (standard units)		6.82						7.56			7.39		7.39
pH Field (standard units)		7.5						7.65			7.8		7.65
Total Alkalinity (mg/L)		57.8						46.1			63.7		57.8
Total Sulfate (mg/L)		10						7.5			11.9		10.0
Hardness (mg/L)		70.6						60			74.4		70.6
Dissolved As (ug/L)		0.156						0.151			0.188		0.156
Dissolved Ba (ug/L)		10.6						9.2			13		10.6
Dissolved Cd (ug/L)		0.018						0.0142			0.0083		0.0142
Dissolved Cr (ug/L)		0.506						0.278			0.468		0.468
Dissolved Cu (ug/L)		0.676						0.579			0.647		0.647
Dissolved Pb (ug/L)		0.0146						0.0081			0.0053		0.0081
Dissolved Ni (ug/L)		1.05						0.777			1.18		1.050
Dissolved Ag (ug/L)		0.002						0.002			0.002		0.002
Dissolved Zn (ug/L)		0.62						0.2			0.23		0.23
Dissolved Se (ug/L)		0.674						0.413			0.558		0.558
Dissolved Hg (ug/L)		0.00168						0.00175			0.000707		0.001680

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.

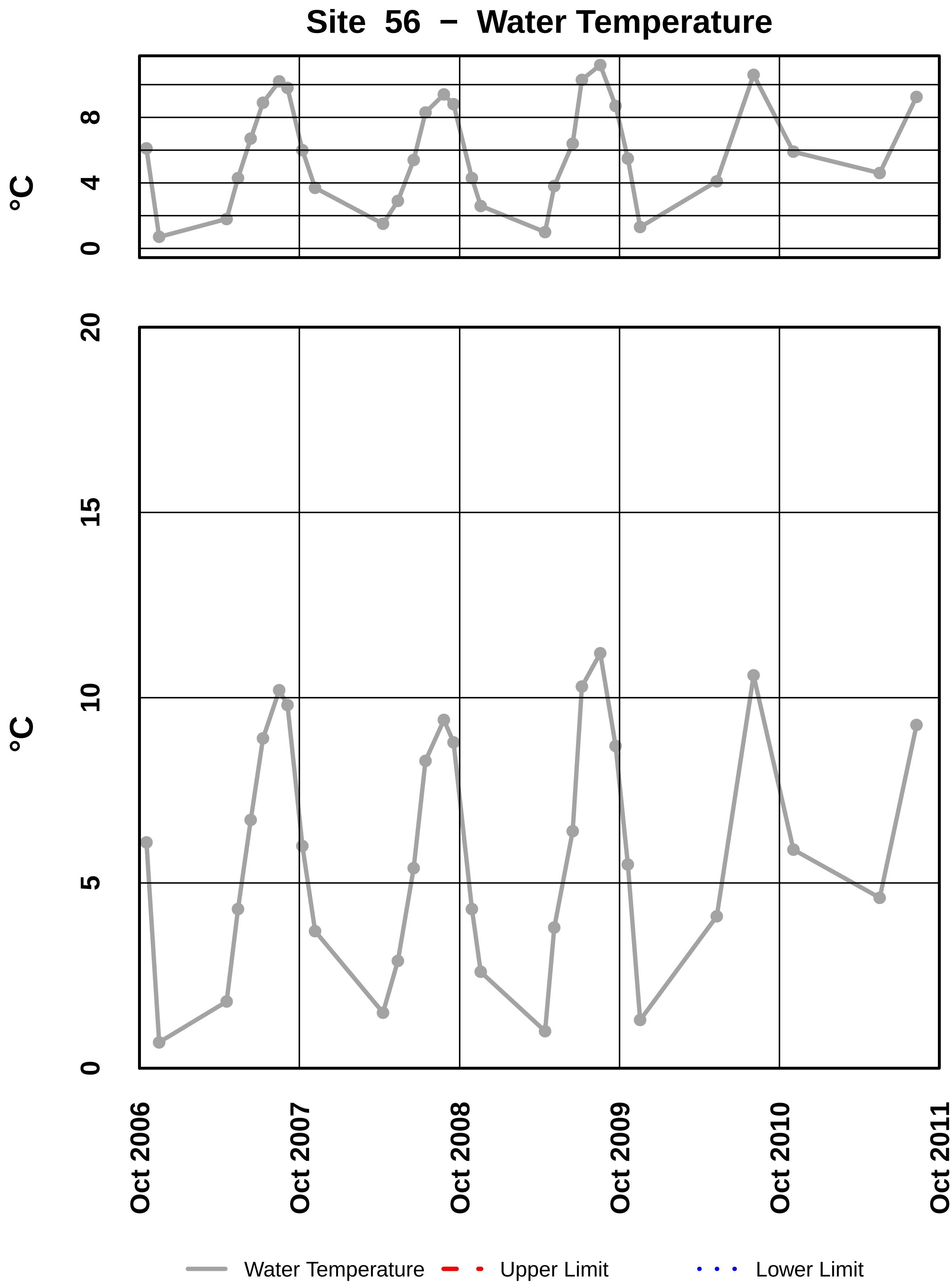
Shaded data has been qualified as an outlier by KGCMC and removed from any further analysis and is not included into the calculation of the median

Qualified Data by QA Reviewer

Date Range: 10/01/2010 to 09/30/2011

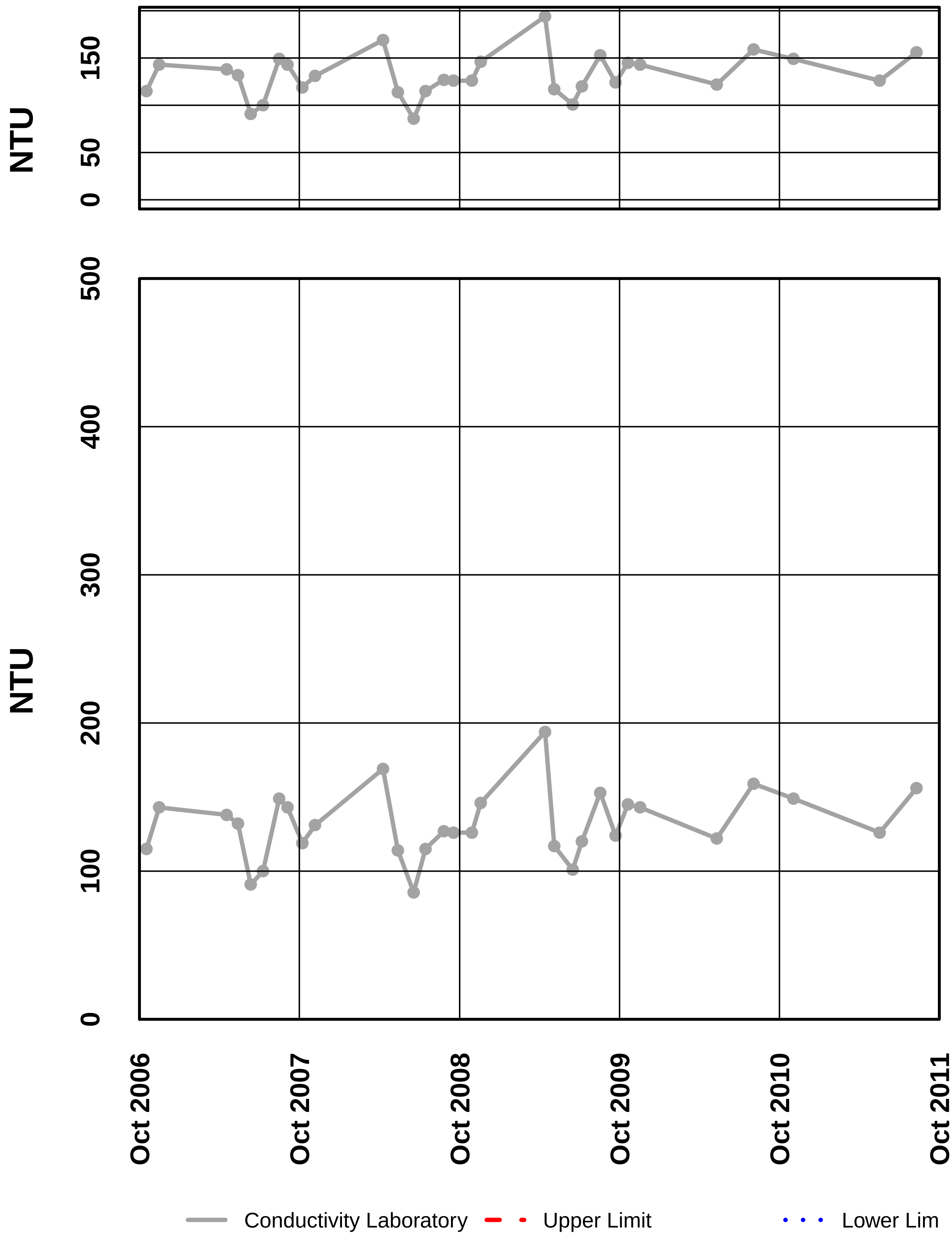
Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
56	11/2/2010	12:00 AM				
			SO4 Tot, mg/l	10	J	Below Quantitative Range
			Se diss, µg/l	0.674	J	Below Quantitative Range
			Cd diss, µg/l	0.018	J	Below Quantitative Range
			Pb diss, µg/l	0.0146	U	Field Blank Contamination
56	5/18/2011	12:00 AM				
			SO4 Tot, mg/l	7.5	J	Sample Reciept Temperature
			pH Lab, su	7.56	J	Hold Time Violation
			Ni diss, µg/l	0.777	U	Field Blank Contamination
			Cd diss, µg/l	0.0142	U	Trip Blank Contamination
			Pb diss, µg/l	0.00811	U	Field Blank Contamination
56	8/10/2011	12:00 AM				
			SO4 Tot, mg/l	11.9	J	Sample Receipt Temperature
			Cd diss, µg/l	0.00827	J	Below Quantitative Range
			Pb diss, µg/l	0.00531	J	Below Quantitative Range
			pH Lab, su	7.39	J	Hold Time Violation
			Hg diss, µg/l	0.000707	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

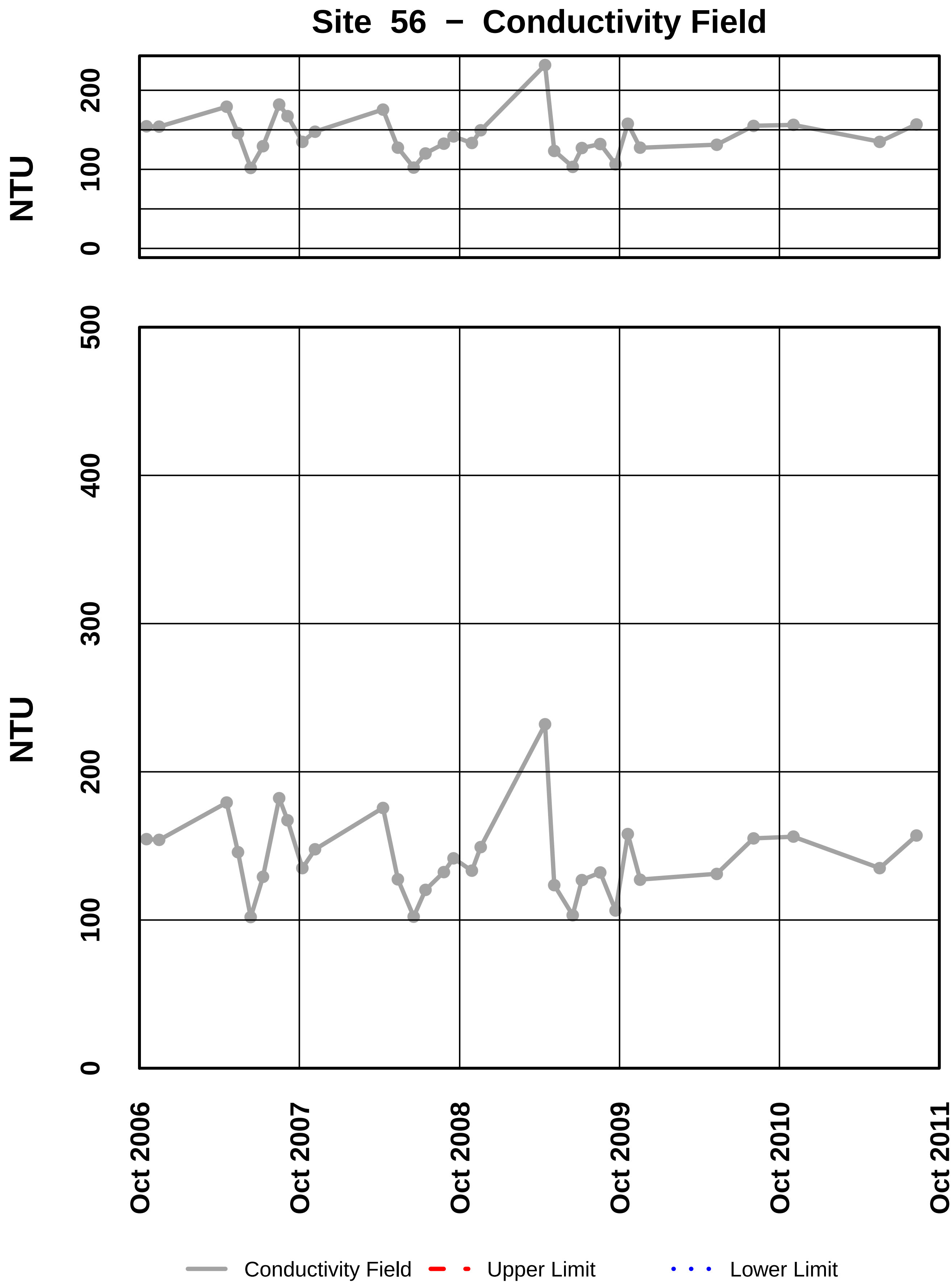


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 56 – Conductivity Laboratory

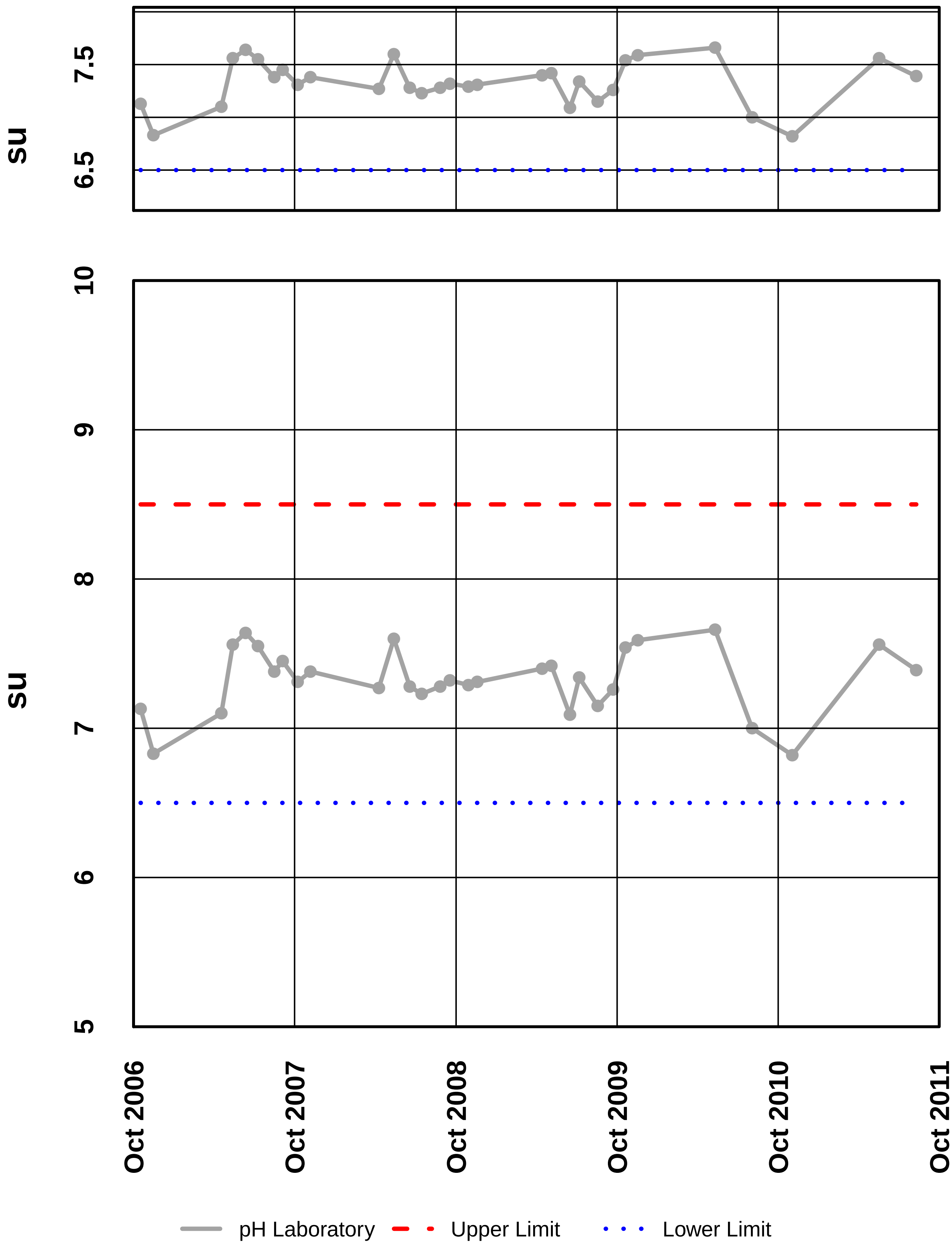


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

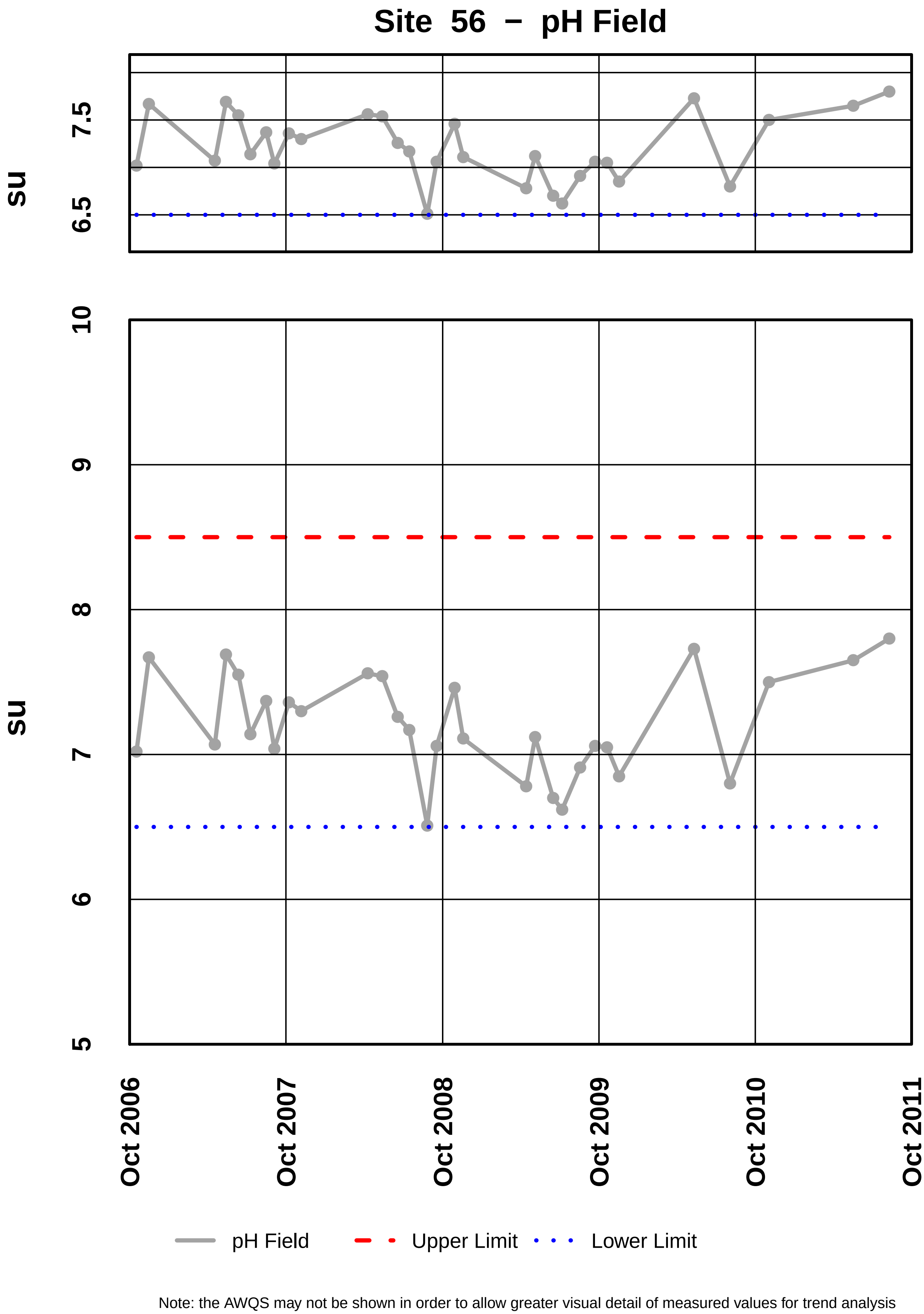


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 56 − pH Laboratory

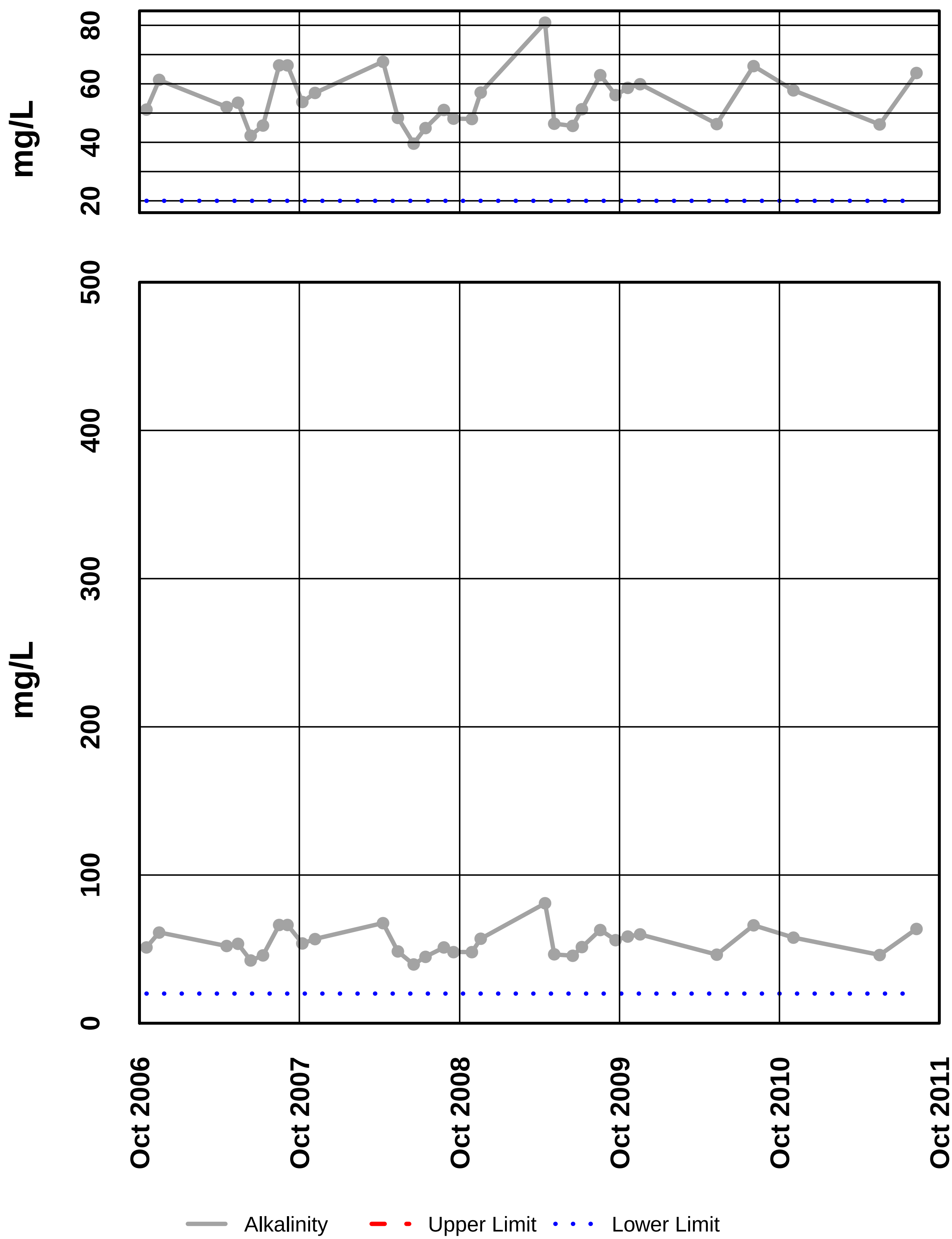


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

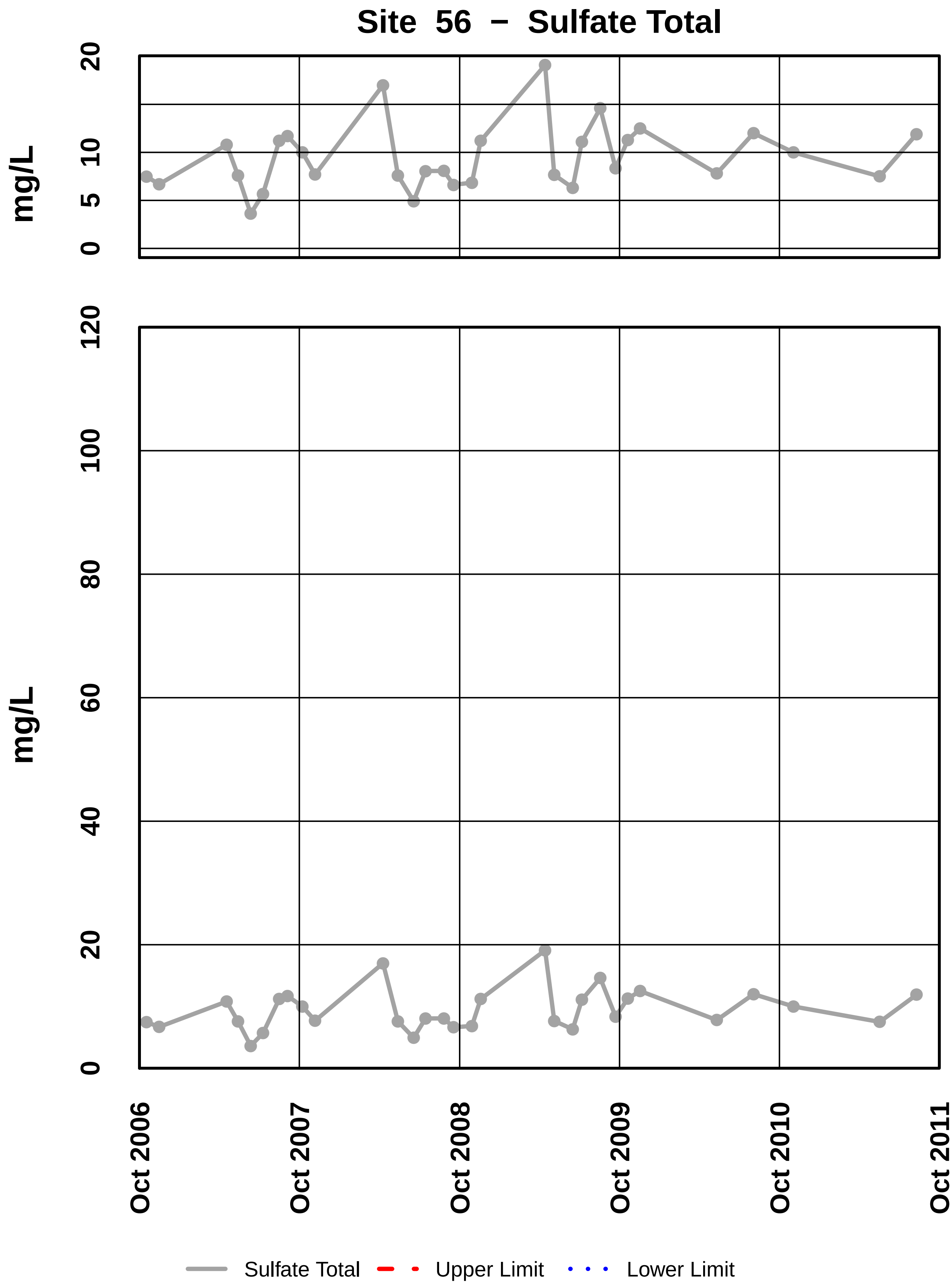


Site 56 – pH Field
su
7.5
6.5
su
10
9
8
7
6
5
Oct 2006
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
pH Field
Upper Limit
Lower Limit
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 56 − Alkalinity

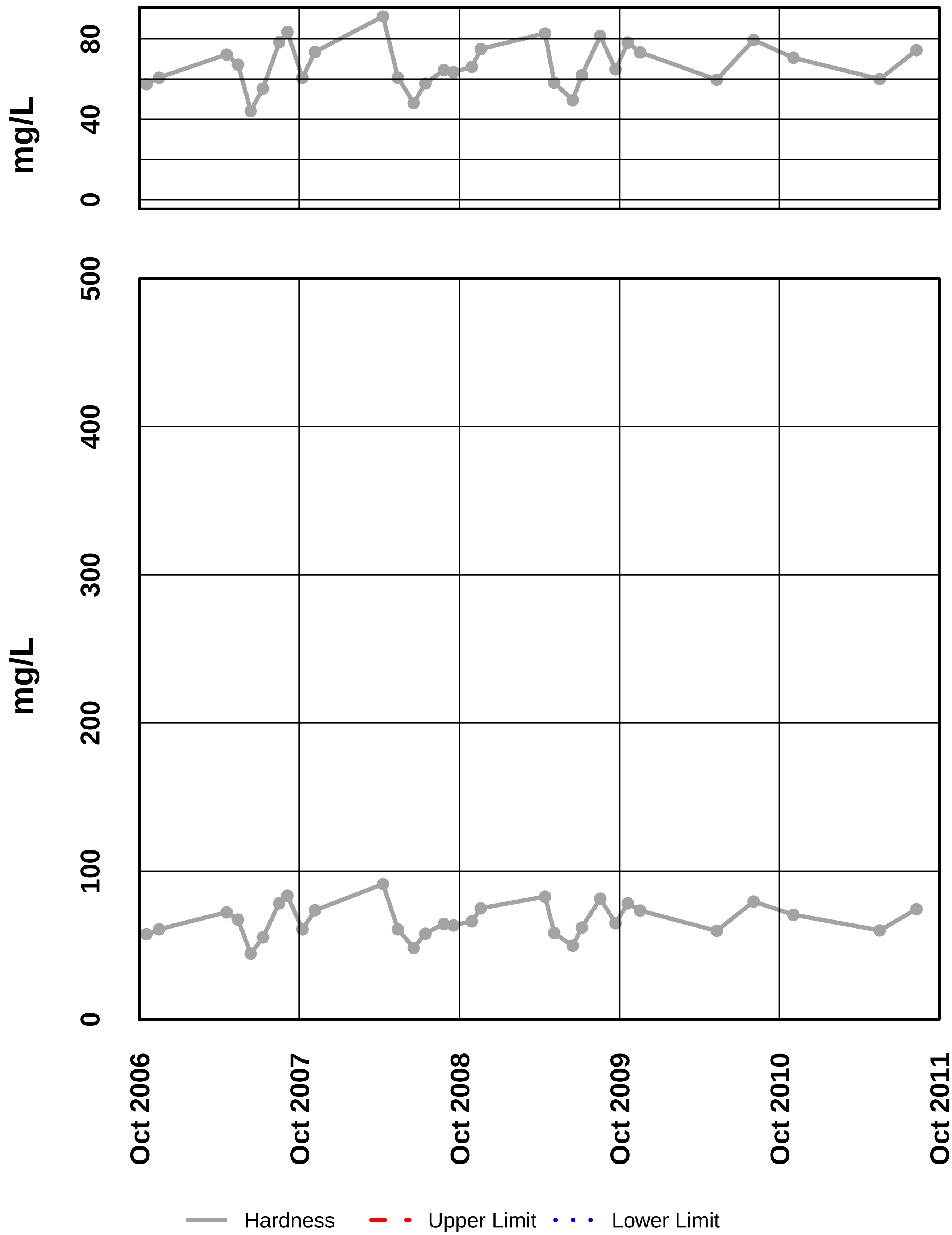


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

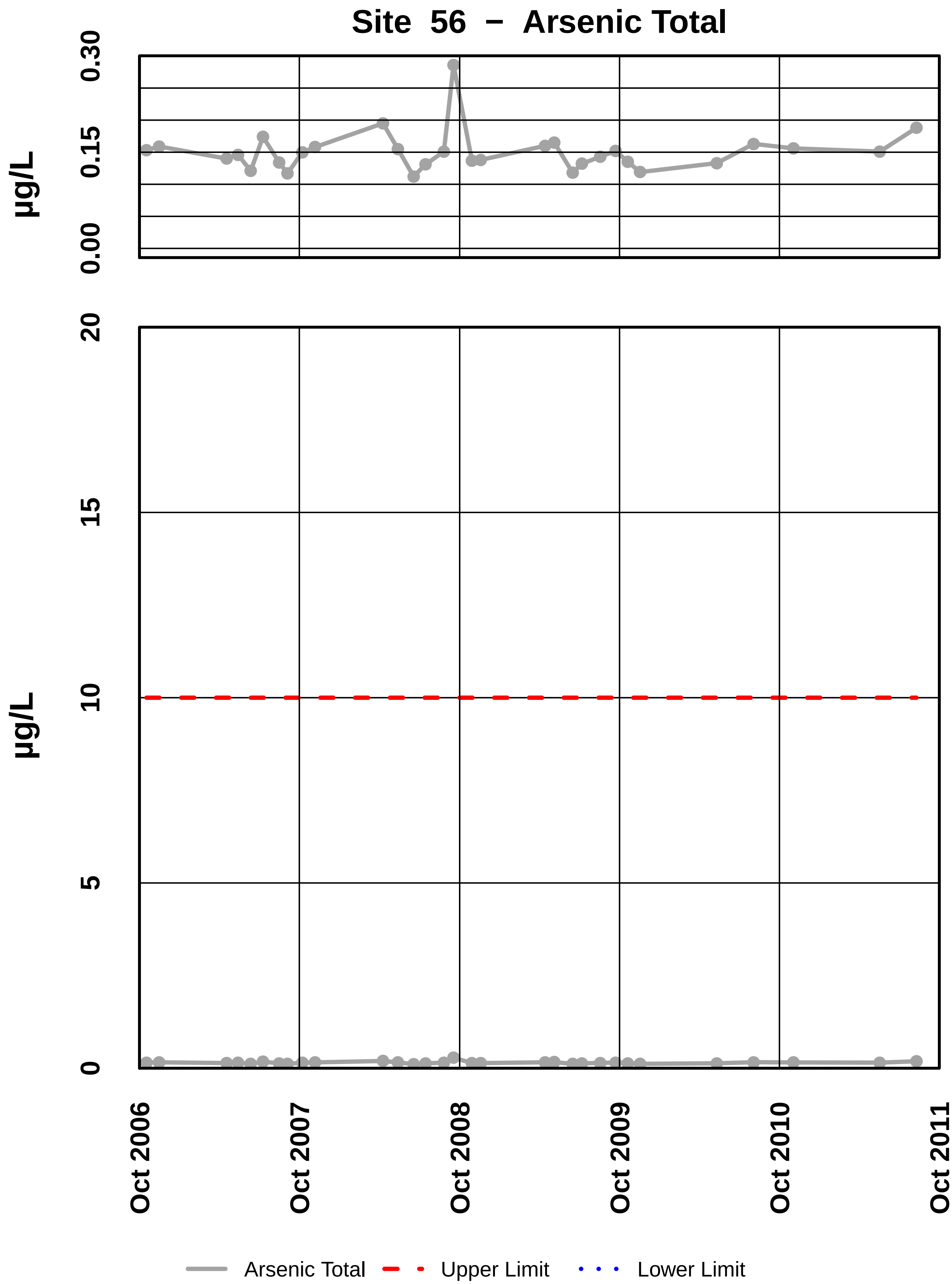


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

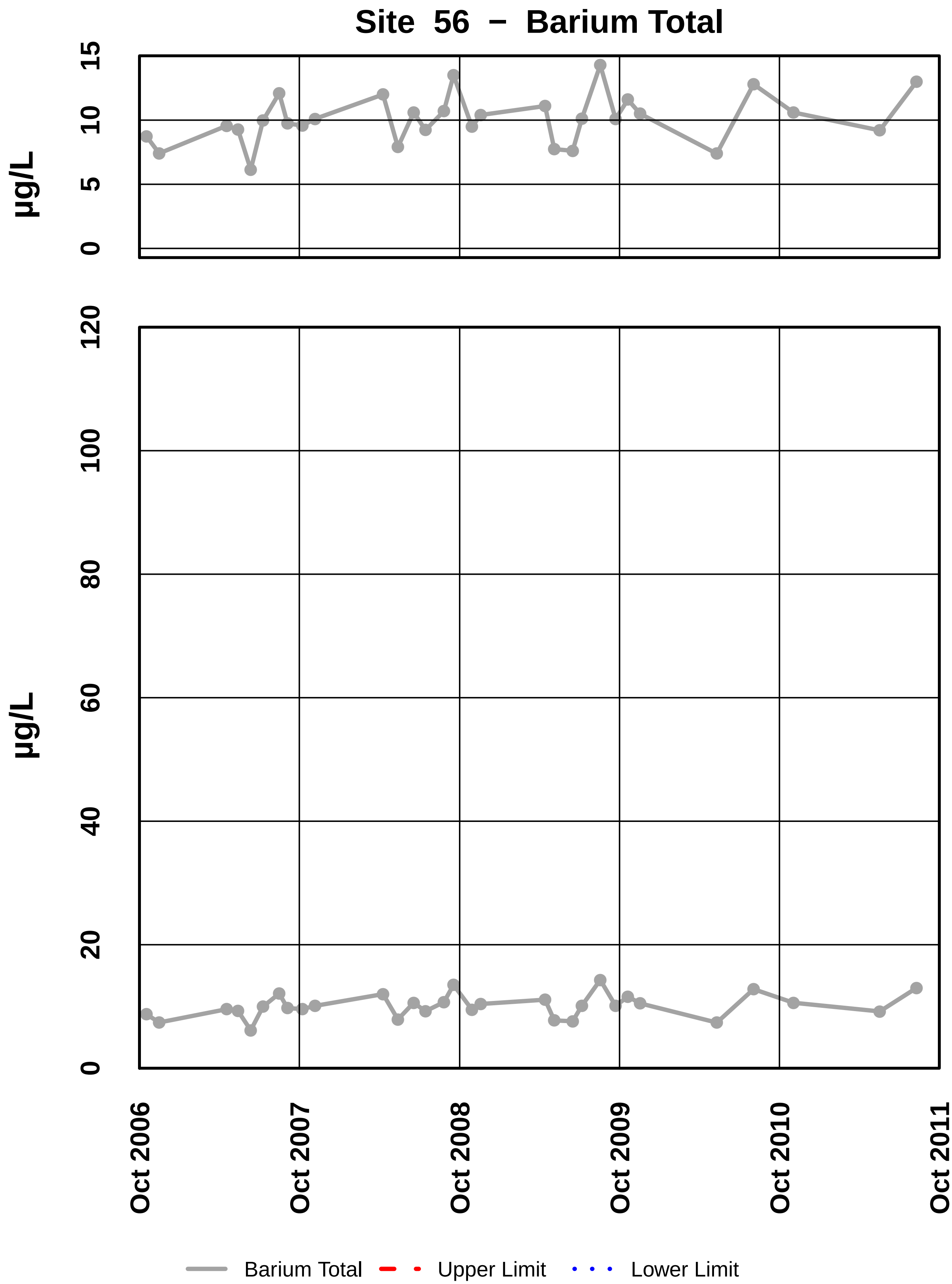
Site 56 – Hardness



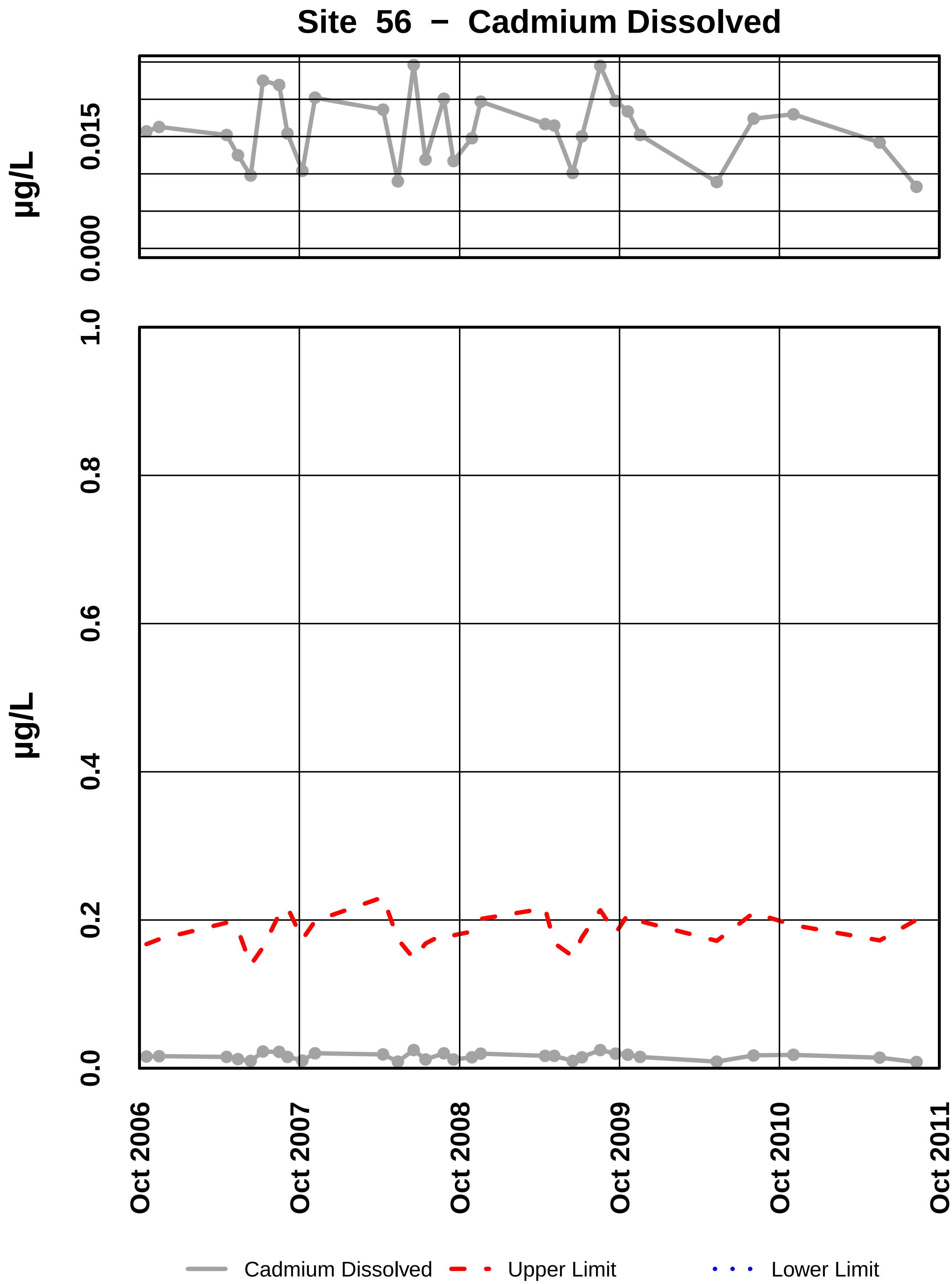
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



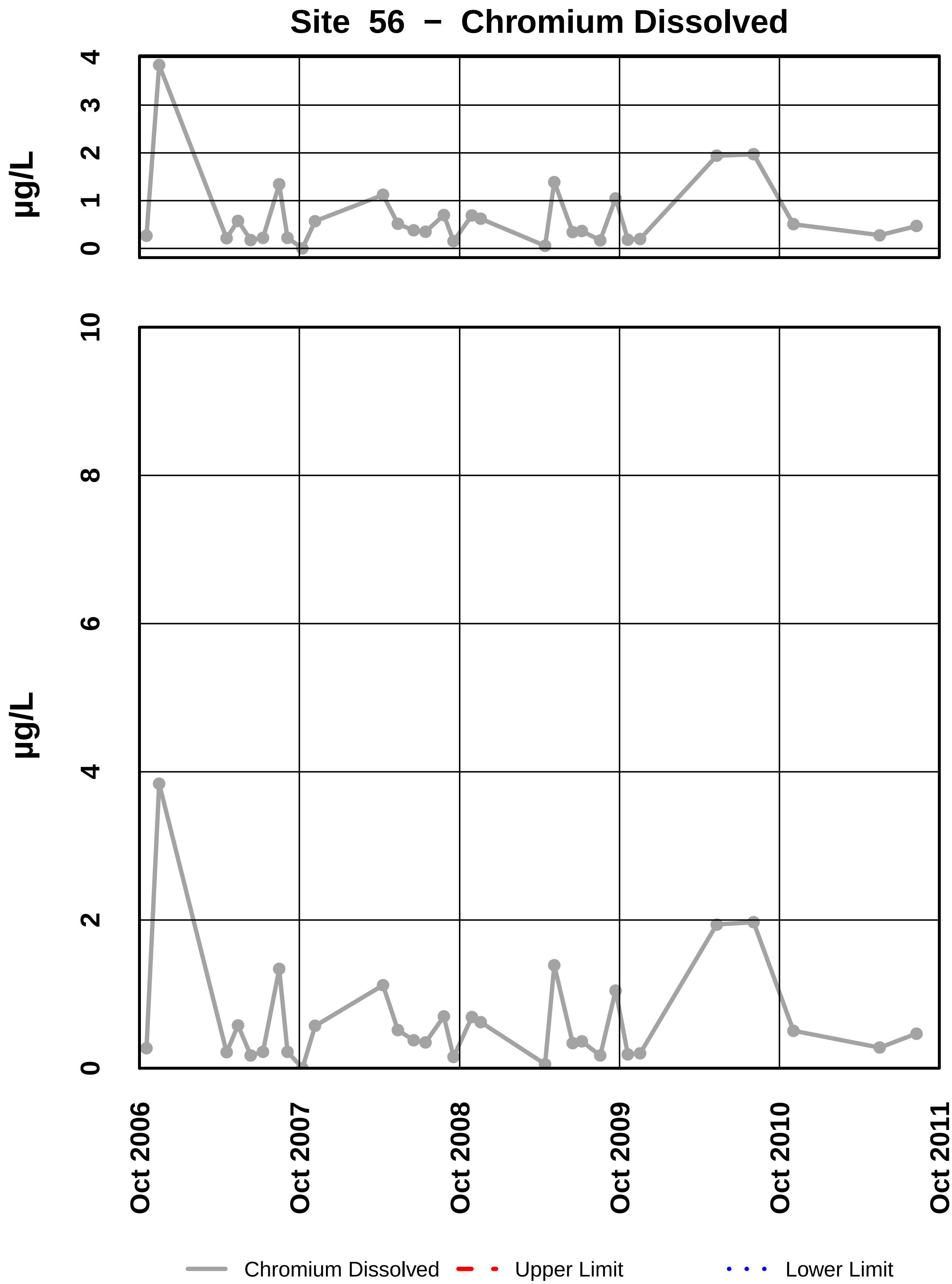
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



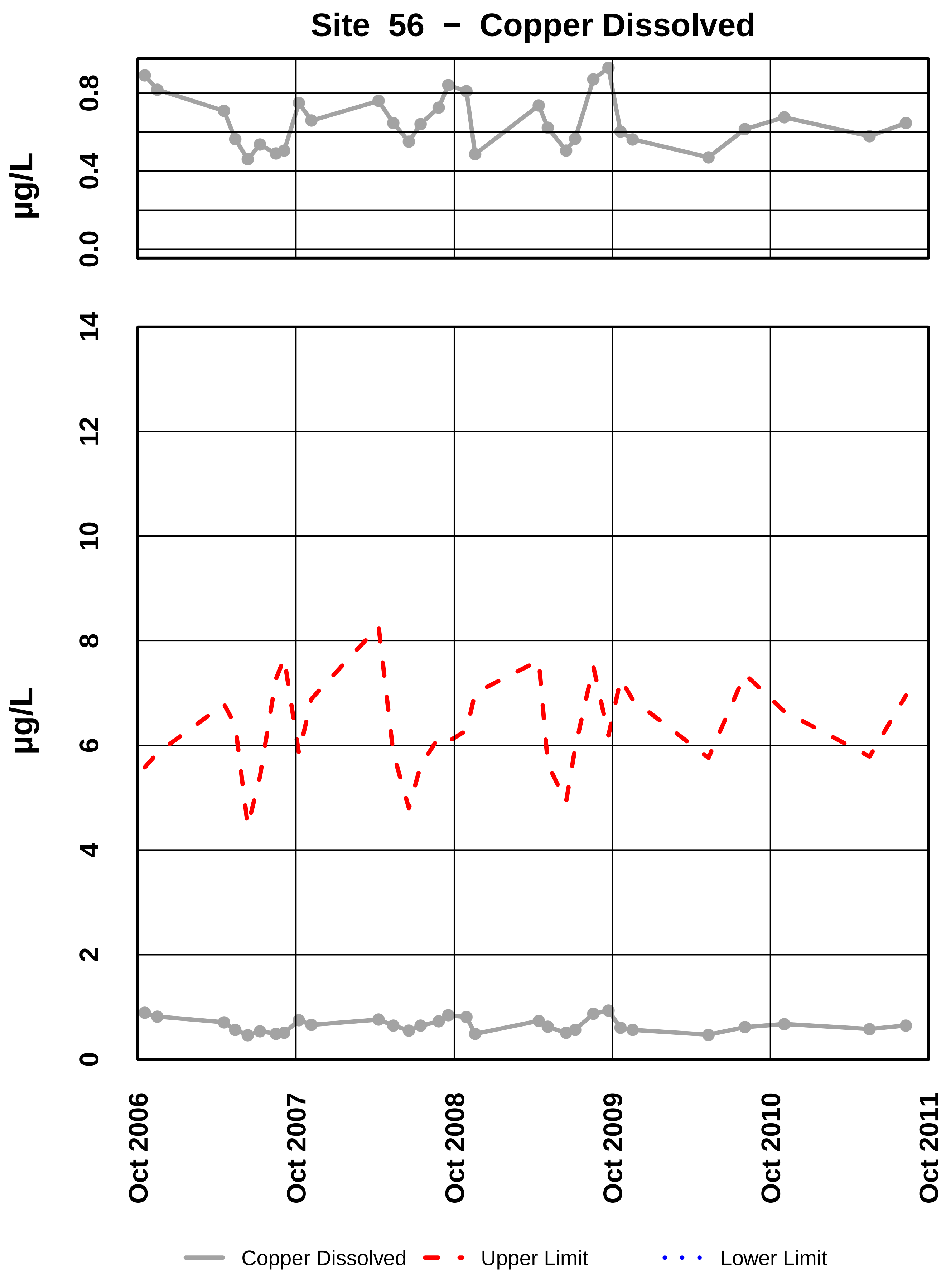
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



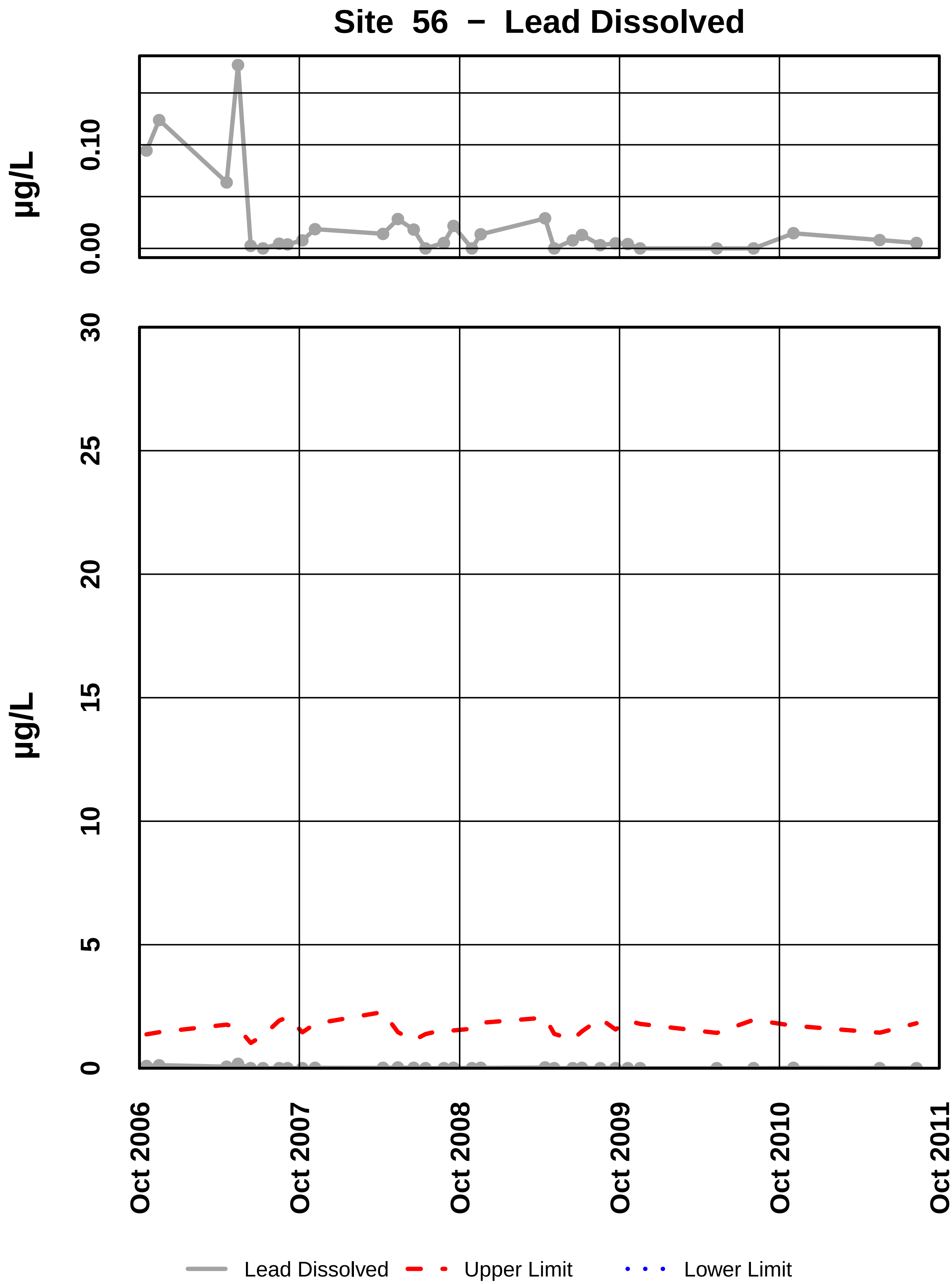
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



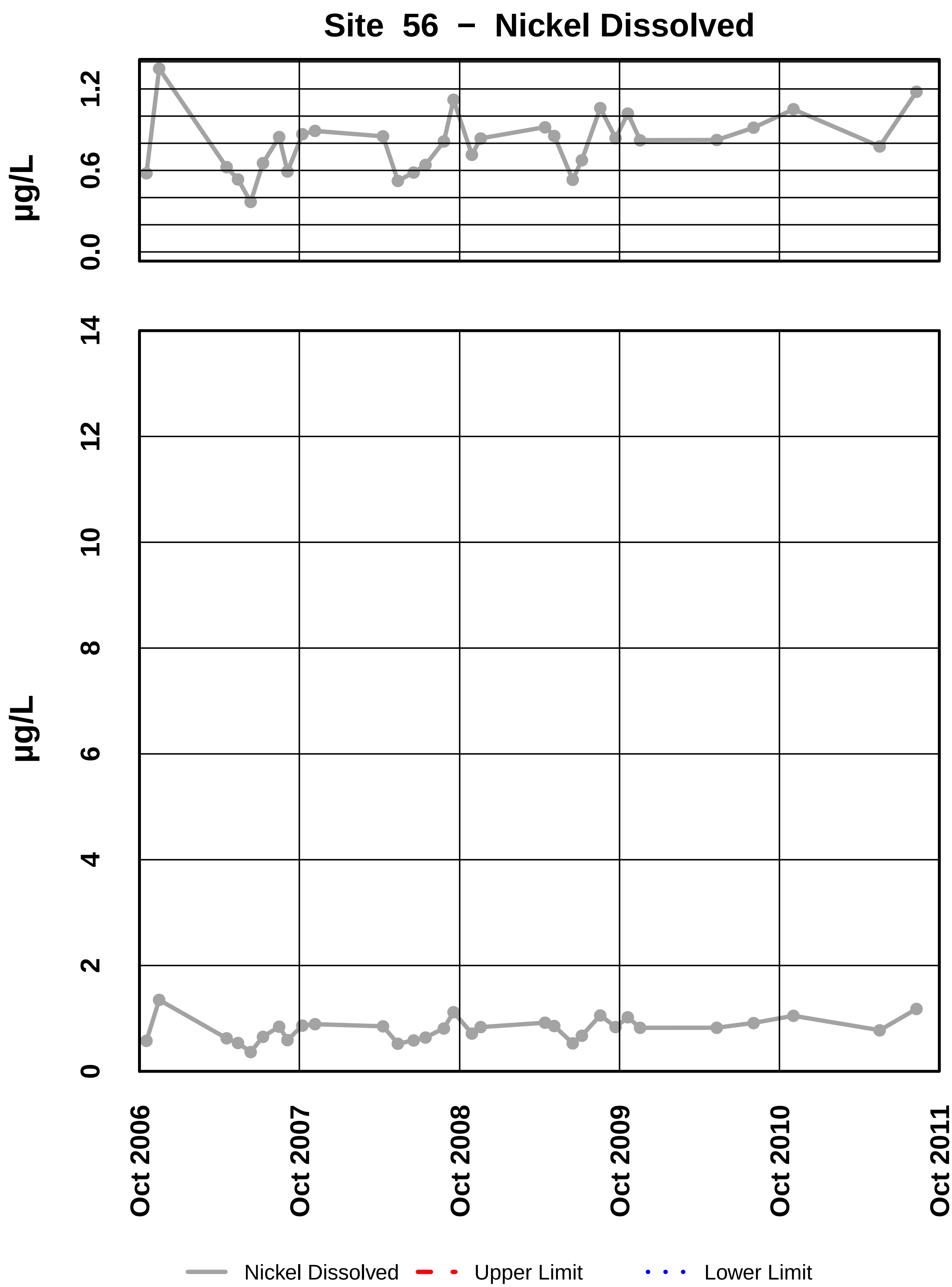
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

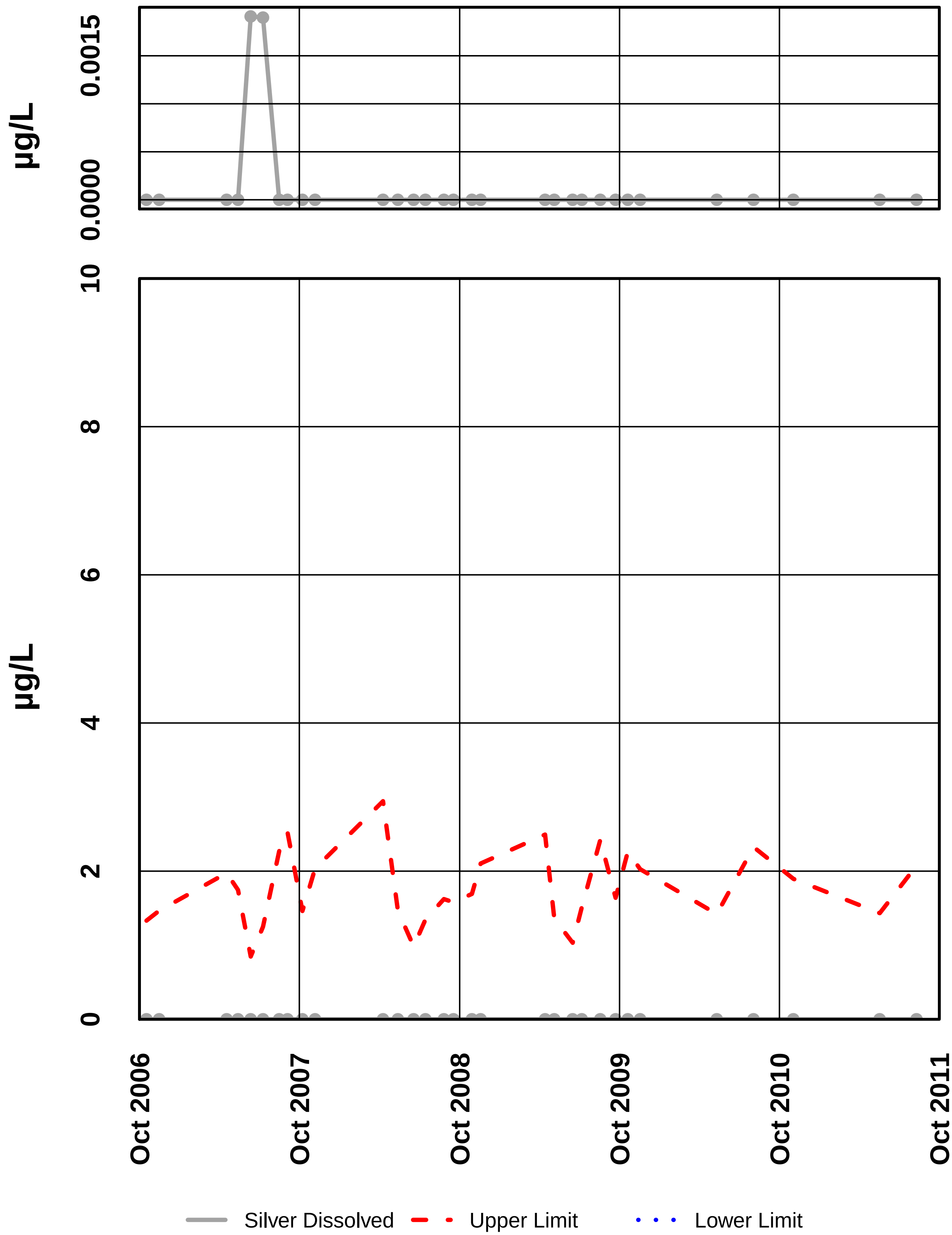


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

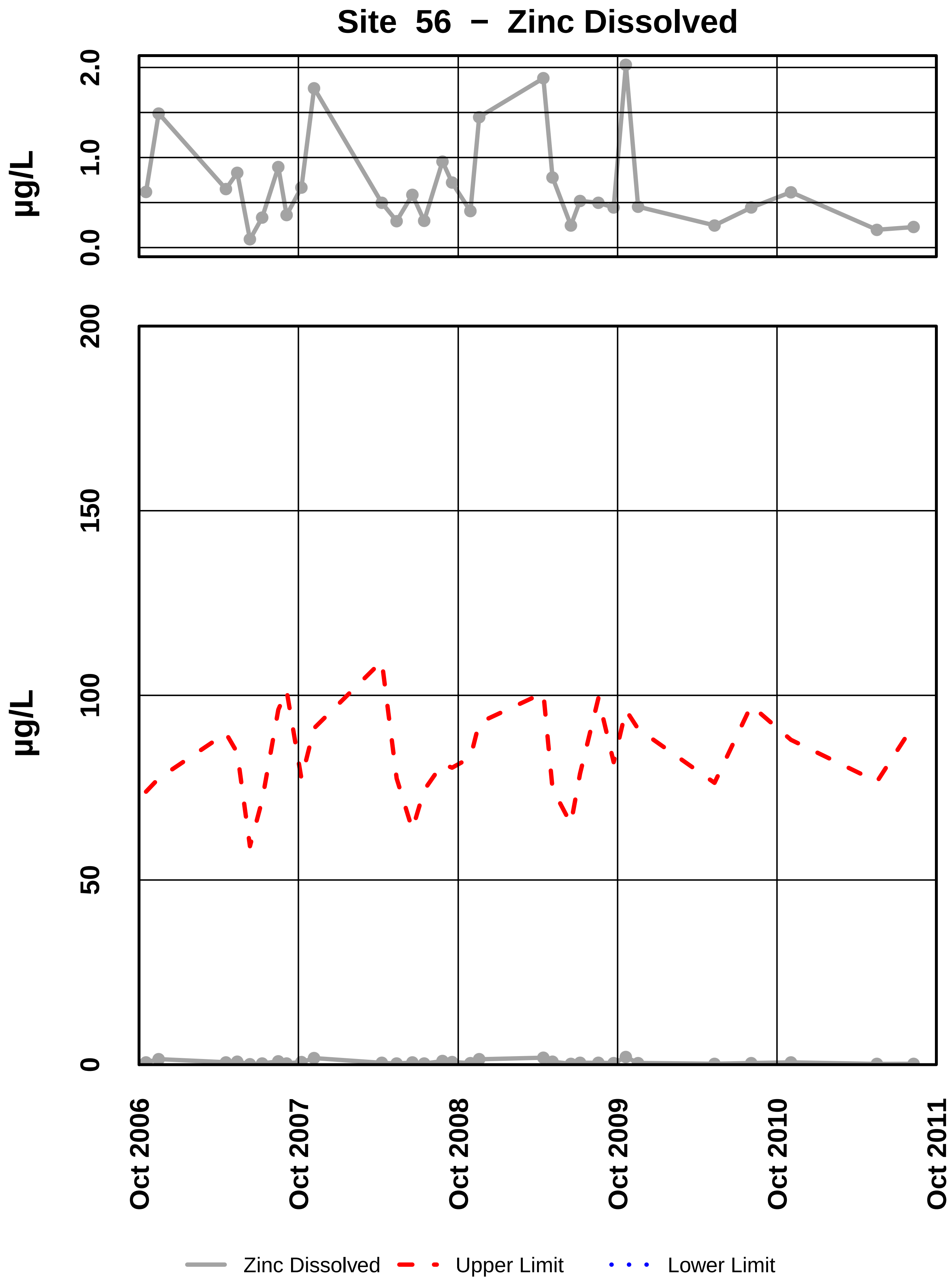


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 56 – Silver Dissolved

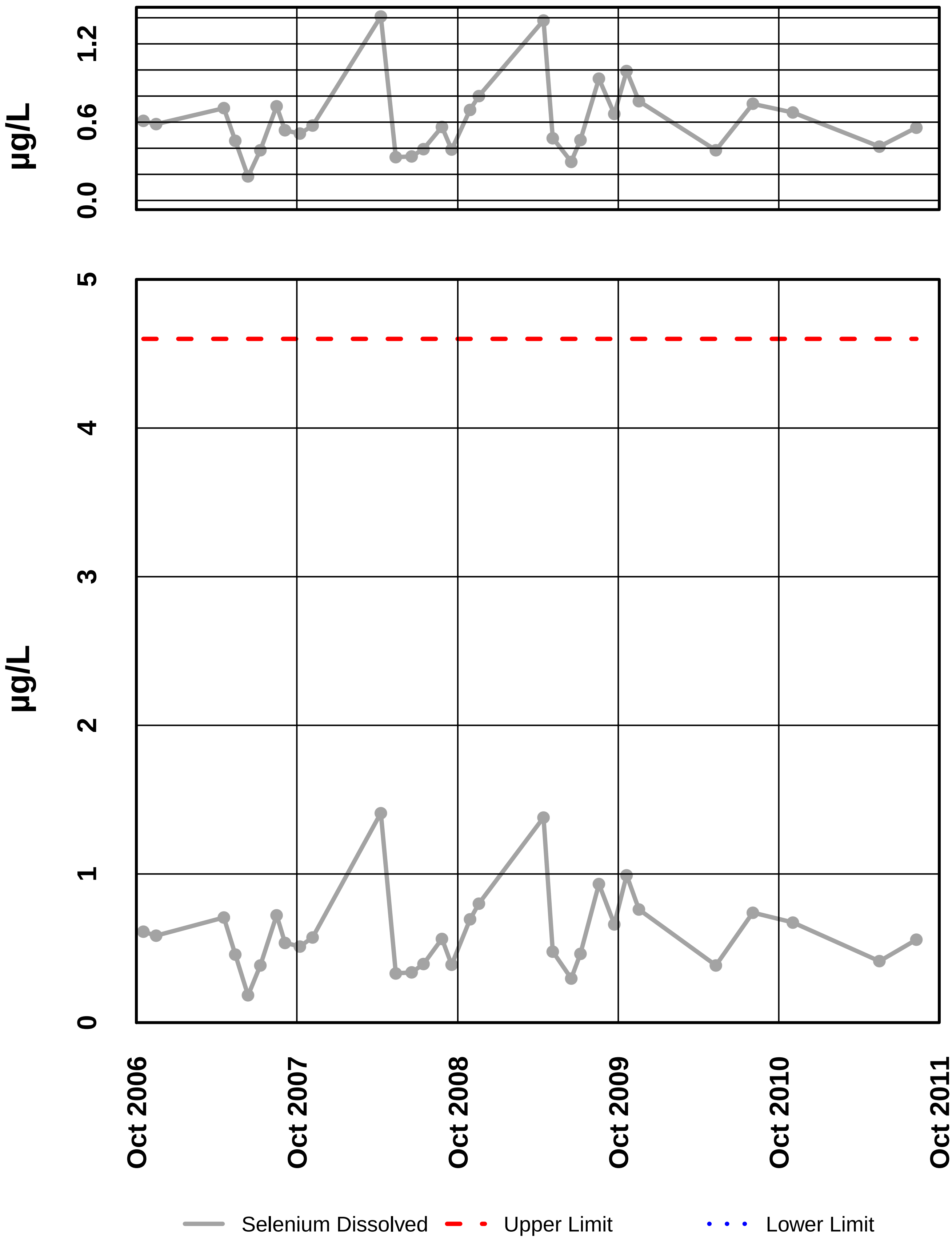


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

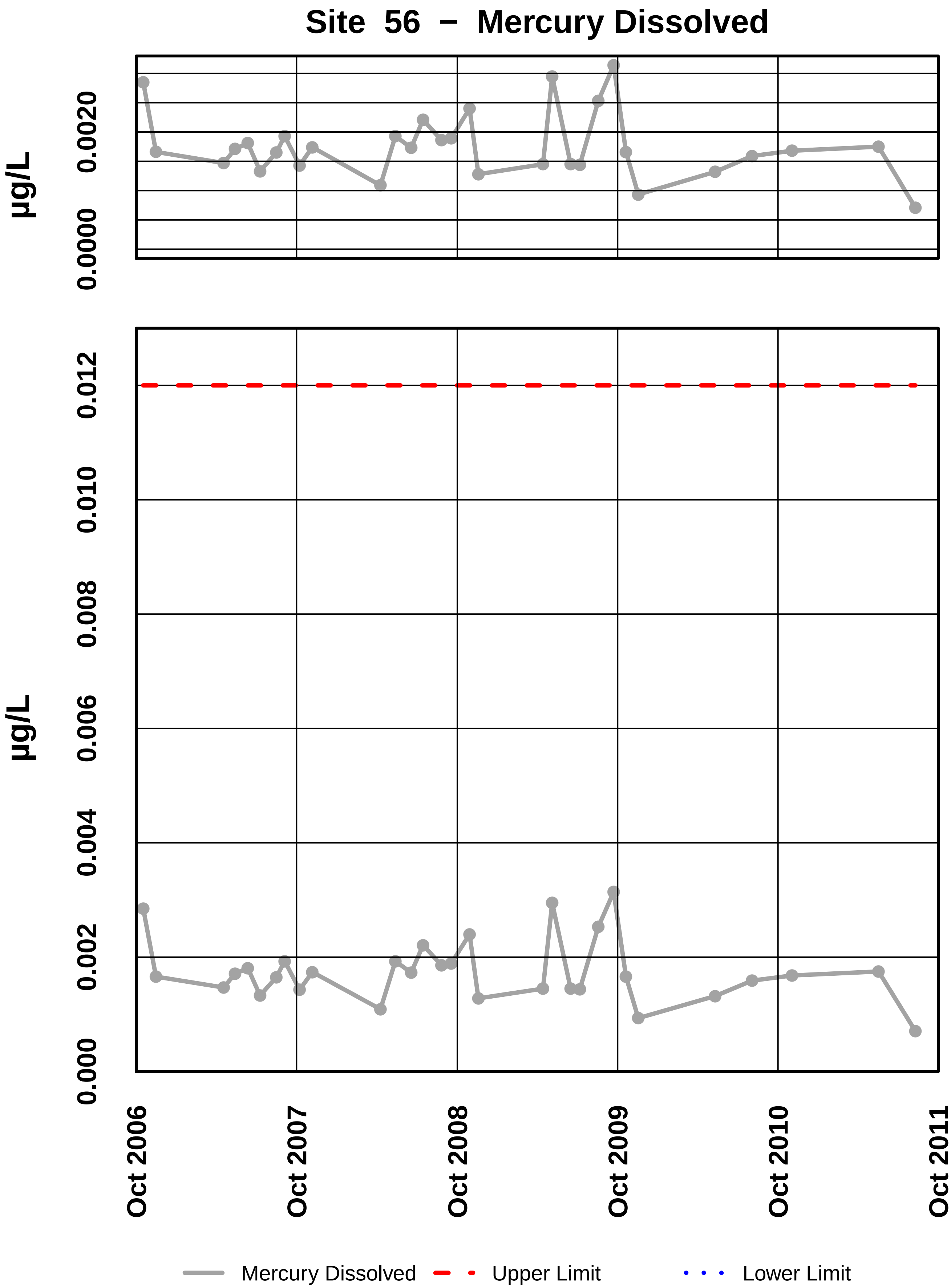


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 56 − 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 **#56** Seasonal Kendall analysis for Specific Conductance, Lab (uS/cm)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2006**	131.1	139.7					248	123.6	120.7	128.2	112.9	150.4
b	**WY2007**	154.7	154					179.2	145.8	101.9	129.2	182.2	167.4
c	**WY2008**	135	147.7					175.7	127.4	102.3	120.3	132.4	141.7
d	**WY2009**	133.2	149.3					232	123.5	103.3	127	132	106.4
e	**WY2010**	157.9	127.3						131.2			155.1	
f	**WY2011**		156.2						135			157	
	n	5	6	0	0	0	0	4	6	4	4	6	4

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	5	6	0	0	0	0	4	6	4	4	6	4
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	-1	-1	1	-1
e-a	1	-1						1			1	
f-a		1						1			1	
c-b	-1	-1					-1	-1	1	-1	-1	-1
d-b	-1	-1					1	-1	1	-1	-1	-1
e-b	1	-1						-1			-1	
f-b		1						-1			-1	
d-c	-1	1					1	-1	1	1	-1	-1
e-c	1	-1						1			1	
f-c		1						1			1	
e-d	1	-1						1			1	
f-d		1						1			1	
f-e		1						1			1	
S_k	4	3	0	0	0	0	-2	3	0	-2	5	-4

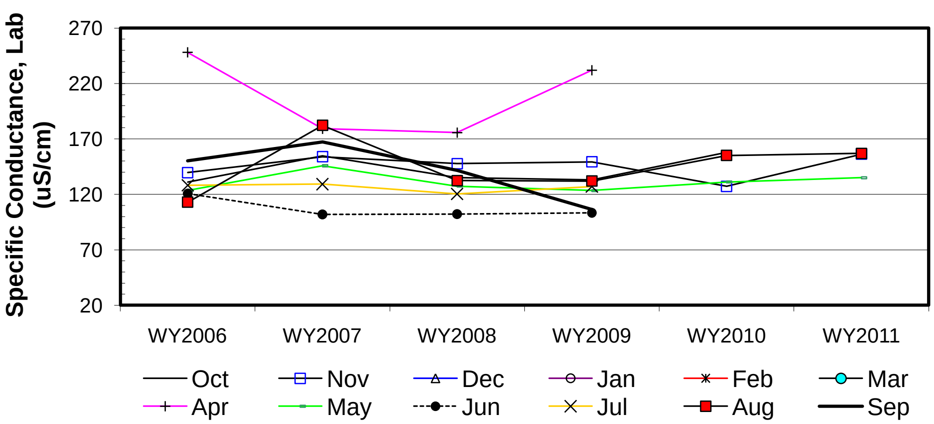
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	16.67	28.33					8.67	28.33	8.67	8.67	28.33	8.67
$Z_k = S_k/\sigma_S$	0.98	0.56					-0.68	0.56	0.00	-0.68	0.94	-1.36
Z^2_k	0.96	0.32					0.46	0.32	0.00	0.46	0.88	1.85

ΣZ_k= 0.33
ΣZ^2_k= 5.25
Z-bar=$\Sigma Z_k/K$= 0.04

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

Σn 39
ΣS_k 7

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=		5.23	@α=5% $\chi^2_{(K-1)}$=	14.07	Test for station homogeneity	
	p	**0.632**			$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc}	0.51	@α/2=2.5% Z=	1.96	H_0 (No trend)	ACCEPT
136.33	p	**0.696**			H_A (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-3.98		3.21
0.050	-2.74	0.70	1.98
0.100	-1.79		1.90
0.200	-0.40		1.72

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2006**	7.2	7.3					7.4	6.8	6.9	7.4	7.8	7.0
b	**WY2007**	7.0	7.7					7.1	7.7	7.6	7.1	7.4	7.0
c	**WY2008**	7.4	7.3					7.6	7.5	7.3	7.2	6.5	7.1
d	**WY2009**	7.5	7.1					6.8	7.1	6.7	6.6	6.9	7.1
e	**WY2010**	7.1	6.9						7.7			6.8	
f	**WY2011**		7.5						7.7			7.8	
	n	5	6	0	0	0	0	4	6	4	4	6	4

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	5	6	0	0	0	0	4	6	4	4	4	2
t_2	0	0	0	0	0	0	0	0	0	0	1	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	-1	-1	-1	1
e-a	-1	-1						1			-1	
f-a		1						1			0	
c-b	1	-1					1	-1	-1	1	-1	1
d-b	1	-1					-1	-1	-1	-1	-1	1
e-b	1	-1						1			-1	
f-b		-1						-1			1	
d-c	1	-1					-1	-1	-1	-1	1	0
e-c	-1	-1						1			1	
f-c		1						1			1	
e-d	-1	-1						1			-1	
f-d		1						1			1	
f-e		1						-1			1	
S_k	2	-3	0	0	0	0	-2	5	-2	-4	-2	5

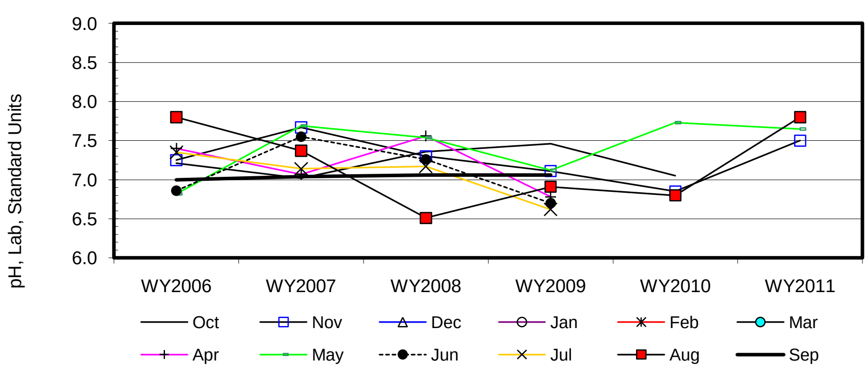
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	16.67	28.33					8.67	28.33	8.67	8.67	27.33	7.67
$Z_k = S_k/\sigma_S$	0.49	-0.56					-0.68	0.94	-0.68	-1.36	-0.38	1.81
Z^2_k	0.24	0.32					0.46	0.88	0.46	1.85	0.15	3.26

ΣZ_k= -0.43
ΣZ^2_k= 7.62
Z-bar=$\Sigma Z_k/K$= -0.05

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	35	2	0	0	0

Σn 39
ΣS_k -1

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	7.59	@α=5% $\chi^2_{(K-1)}$= 14.07	Test for station homogeneity	
p	**0.370**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
$\Sigma VAR(S_k)$	Z_{calc} 0.00	@$\alpha/2$=2.5% Z= 1.96	H_0 (No trend)	ACCEPT
134.33	**p** **0.500**		H_A ($\pm$ trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.19		0.07
0.050	-0.15	**0.00**	0.03
0.100	-0.10		0.02
0.200	-0.06		0.02

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	**WY2006**	56.8	62.8					76.3	57.4	49.1	60.3	57.9	61.0
b	**WY2007**	51.2	61.3					52.1	53.5	42.3	45.8	66.3	66.3
c	**WY2008**	53.8	56.9					67.6	48.4	39.6	44.9	51.1	48.1
d	**WY2009**	48.0	57.0					80.9	46.4	45.6	51.3	63.0	56.1
e	**WY2010**	58.6	59.9						46.3			66.1	
f	**WY2011**		57.8						46.1			63.7	
	n	5	6	0	0	0	0	4	6	4	4	6	4

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	5	6	0	0	0	0	4	6	4	4	6	4
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	-1	-1	1	-1
e-a	1	-1						-1			1	
f-a		-1						-1			1	
c-b	1	-1					1	-1	-1	-1	-1	-1
d-b	-1	-1					1	-1	1	1	-1	-1
e-b	1	-1						-1			-1	
f-b		-1						-1			-1	
d-c	-1	1					1	-1	1	1	1	1
e-c	1	1						-1			1	
f-c		1						-1			1	
e-d	1	1						-1			1	
f-d		1						-1			1	
f-e		-1						-1			-1	
S_k	0	-5	0	0	0	0	2	-15	-2	-2	3	-2

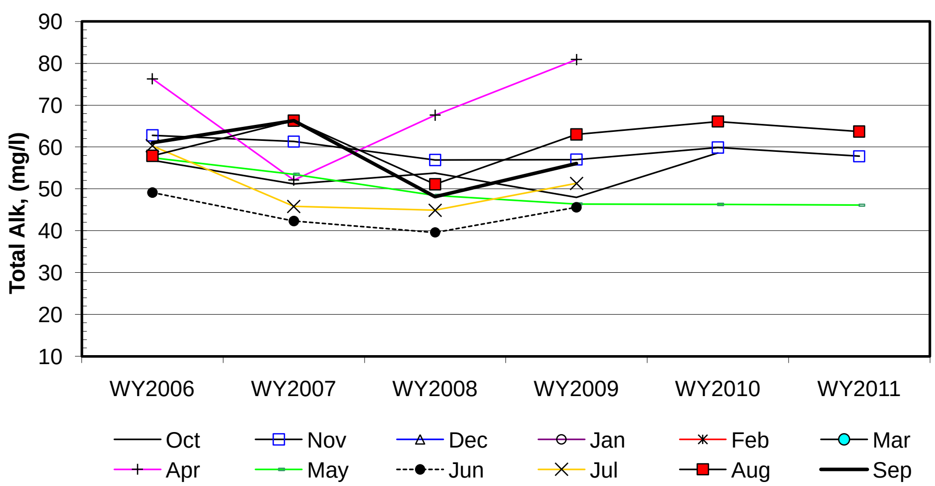
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	16.67	28.33					8.67	28.33	8.67	8.67	28.33	8.67
$Z_k = S_k/\sigma_S$	0.00	-0.94					0.68	-2.82	-0.68	-0.68	0.56	-0.68
Z^2_k	0.00	0.88					0.46	7.94	0.46	0.46	0.32	0.46

ΣZ_k=	-4.55
ΣZ^2_k=	10.99
Z-bar=ΣZ_k/K=	-0.57

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

Σn	39
ΣS_k	-21

$\chi^2_h=\Sigma Z^2_k$-K(Z-bar)^2=	8.40	@α=5% $\chi^2_{(K-1)}$=	14.07	Test for station homogeneity	
p	**0.299**			$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc} -1.71	@α/2=2.5% Z=	1.96	**H_0** (No trend)	ACCEPT
136.33	p **0.043**			**H_A** ($\pm$ trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-2.40		0.35
0.050	-2.01	**-1.00**	-0.10
0.100	-1.85		-0.20
0.200	-1.61		-0.69

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	**WY2006**	9.0	11.9					17.8	9.2	8.1	11.5	8.1	10.4
b	**WY2007**	7.5	6.7					10.8	7.6	3.6	5.7	11.2	11.7
c	**WY2008**	10.0	7.7					17.0	7.6	4.9	8.1	8.1	6.6
d	**WY2009**	6.9	11.2					19.1	7.7	6.3	11.1	14.6	8.4
e	**WY2010**	11.3	12.5						7.8			12.0	
f	**WY2011**		10.0						7.5			11.9	
	n	5	6	0	0	0	0	4	6	4	4	6	4

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	5	6	0	0	0	0	4	6	4	4	6	4
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	-1	-1	1	-1
e-a	1	1						-1			1	
f-a		-1						-1			1	
c-b	1	1					1	1	1	1	-1	-1
d-b	-1	1					1	1	1	1	1	-1
e-b	1	1						1			1	
f-b		1						-1			1	
d-c	-1	1					1	1	1	1	1	1
e-c	1	1						1			1	
f-c		1						-1			1	
e-d	1	1						1			-1	
f-d		-1						-1			-1	
f-e		-1						-1			-1	
S_k	2	3	0	0	0	0	2	-3	0	0	7	-2

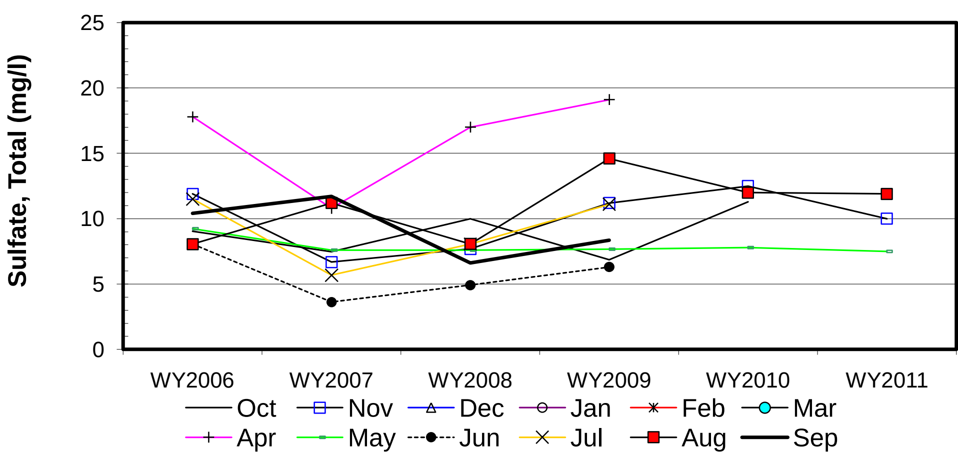
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	16.67	28.33					8.67	28.33	8.67	8.67	28.33	8.67
$Z_k = S_k/\sigma_S$	0.49	0.56					0.68	-0.56	0.00	0.00	1.32	-0.68
Z^2_k	0.24	0.32					0.46	0.32	0.00	0.00	1.73	0.46

ΣZ_k=	1.80
ΣZ^2_k=	3.53
Z-bar=ΣZ_k/K=	0.23

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

Σn	39
ΣS_k	9

$\chi^2_h=\Sigma Z^2_k$-K(Z-bar)^2=		3.12	@α=5% $\chi^2_{(K-1)}$= 14.07	Test for station homogeneity	
	p	**0.874**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc}	0.69	@α=5% Z= 1.64	**H_0** (No trend)	ACCEPT
136.33	p	**0.753**		**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.36		0.99
0.050	-0.24	**0.07**	0.66
0.100	-0.10		0.48
0.200	-0.03		0.21

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	**WY2006**	0.4	1.3					0.5	0.4	0.6	0.4	0.9	1.0
b	**WY2007**	0.6	1.5					0.7	0.8	0.1	0.3	0.9	0.4
c	**WY2008**	0.7	1.8					0.5	0.3	0.6	0.3	1.0	0.7
d	**WY2009**	0.4	1.5					1.9	0.8	0.2	0.5	0.5	0.4
e	**WY2010**	2.0	0.5						0.2			0.4	
f	**WY2011**		0.6						0.2			0.2	
	n	5	6	0	0	0	0	4	6	4	4	6	4

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	5	6	0	0	0	0	4	6	4	4	6	4
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	-1	1	-1	-1
e-a	1	-1						-1			-1	
f-a		-1						-1			-1	
c-b	1	1					-1	-1	1	-1	1	1
d-b	-1	-1					1	-1	1	1	-1	1
e-b	1	-1						-1			-1	
f-b		-1						-1			-1	
d-c	-1	-1					1	1	-1	1	-1	-1
e-c	1	-1						-1			-1	
f-c		-1						-1			-1	
e-d	1	-1						-1			-1	
f-d		-1						-1			-1	
f-e		1						-1			-1	
S_k	4	-5	0	0	0	0	2	-9	-2	0	-9	-2

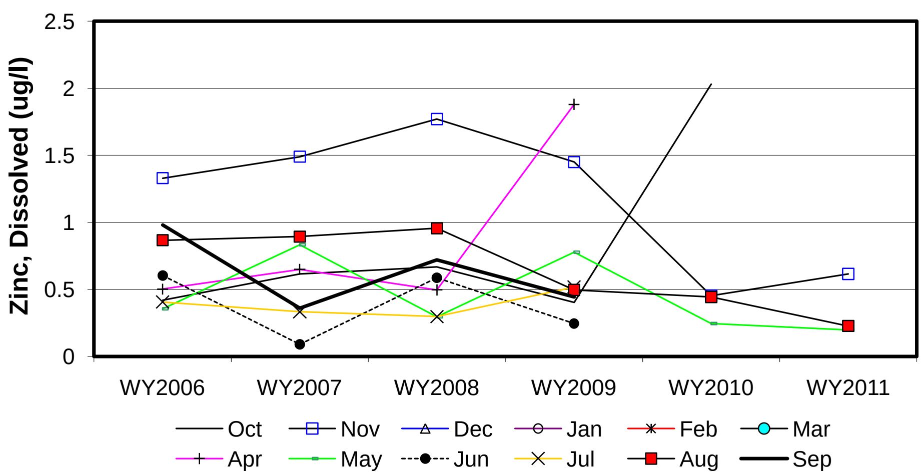
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	16.67	28.33					8.67	28.33	8.67	8.67	28.33	8.67
$Z_k = S_k/\sigma_S$	0.98	-0.94					0.68	-1.69	-0.68	0.00	-1.69	-0.68
Z^2_k	0.96	0.88					0.46	2.86	0.46	0.00	2.86	0.46

ΣZ_k= -4.02
ΣZ^2_k= 8.94
Z-bar=$\Sigma Z_k/K$= -0.50

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

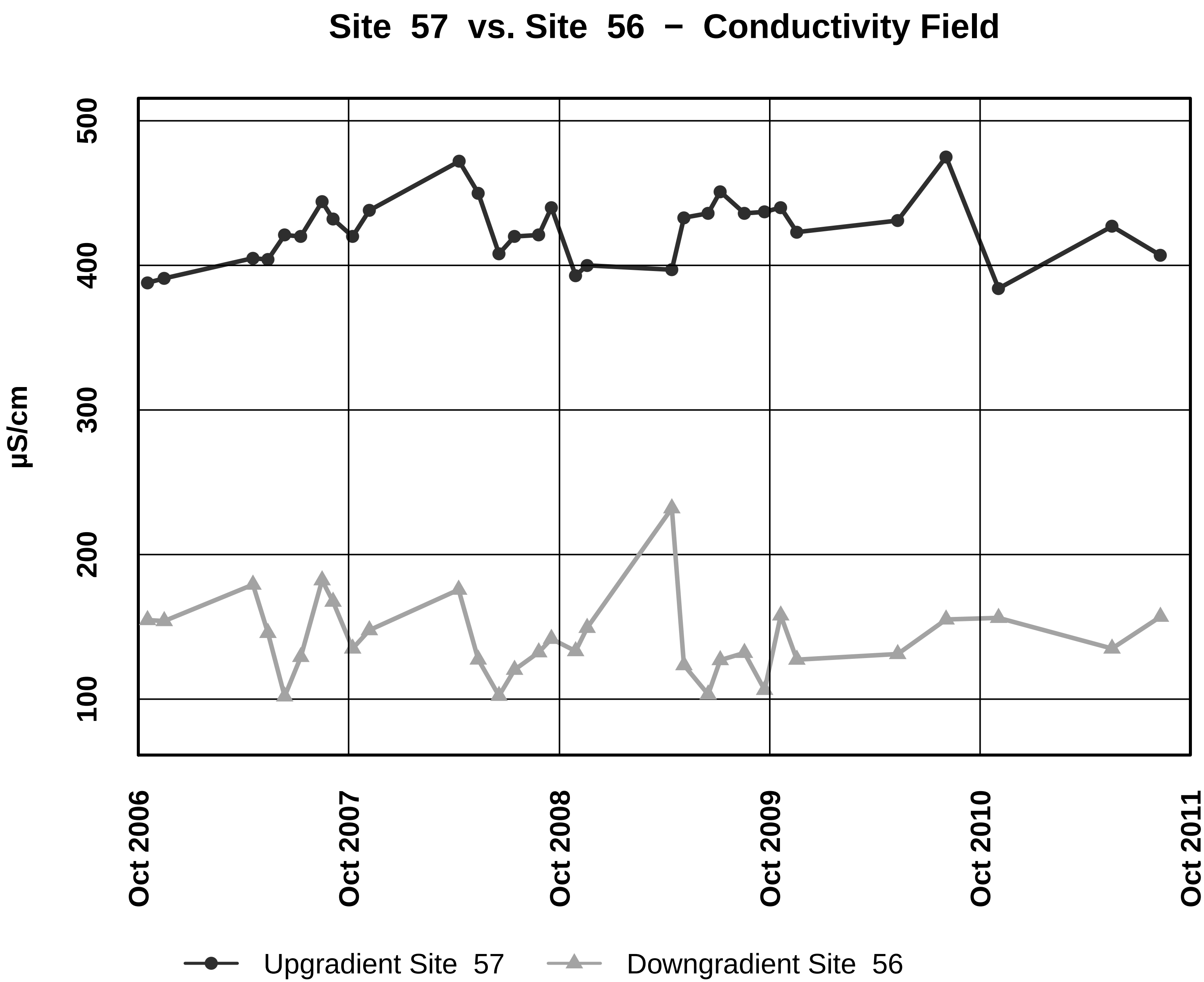
Σn 39
ΣS_k -21

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$= 6.92	@α=5% $\chi^2_{(K-1)}$= 14.07	Test for station homogeneity	
p **0.437**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
$\Sigma VAR(S_k)$ Z_{calc} -1.71	@α/2=2.5% Z= 1.96	**H_0** (No trend)	ACCEPT
136.33 **p** **0.043**		**H_A** (± trend)	REJECT

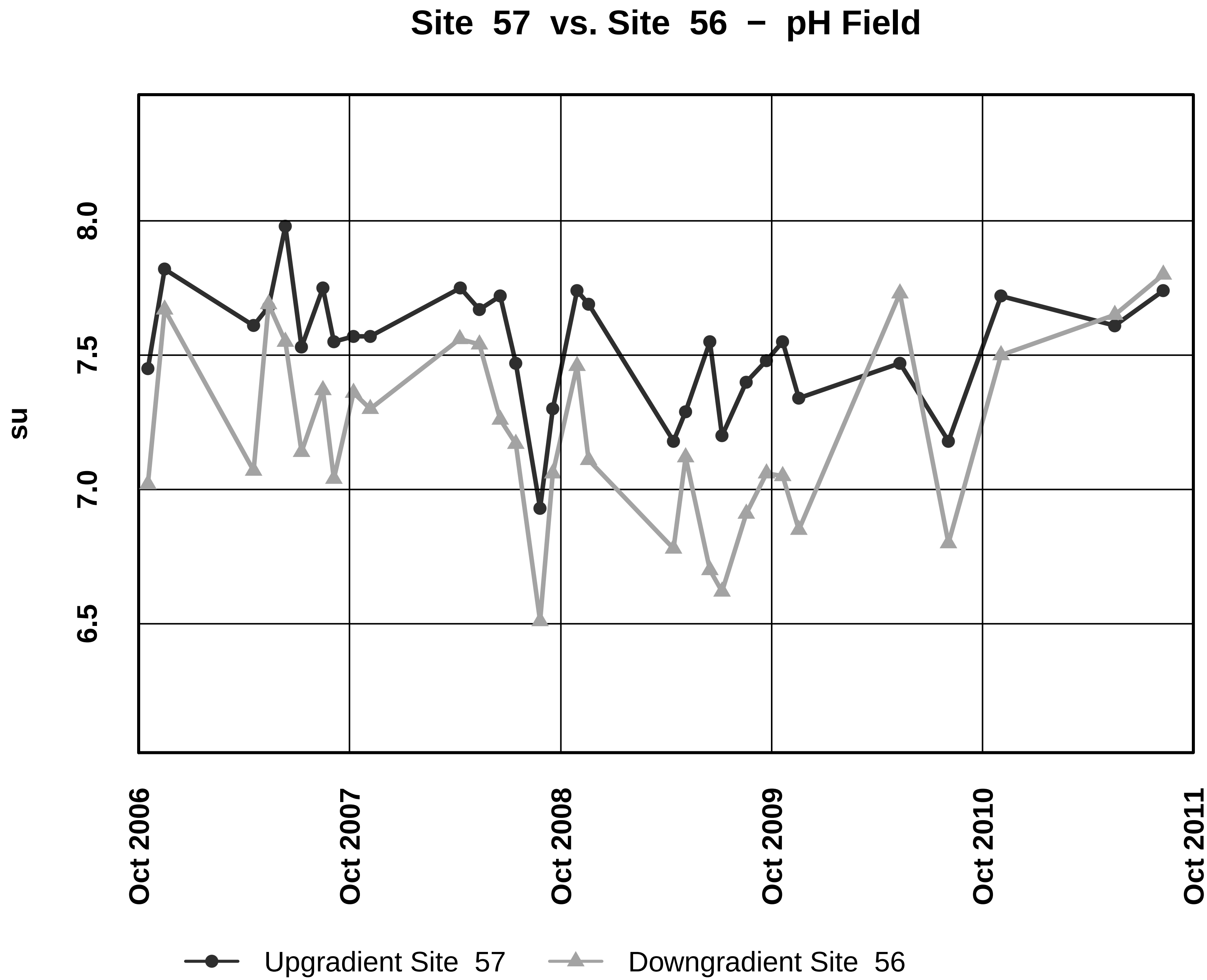


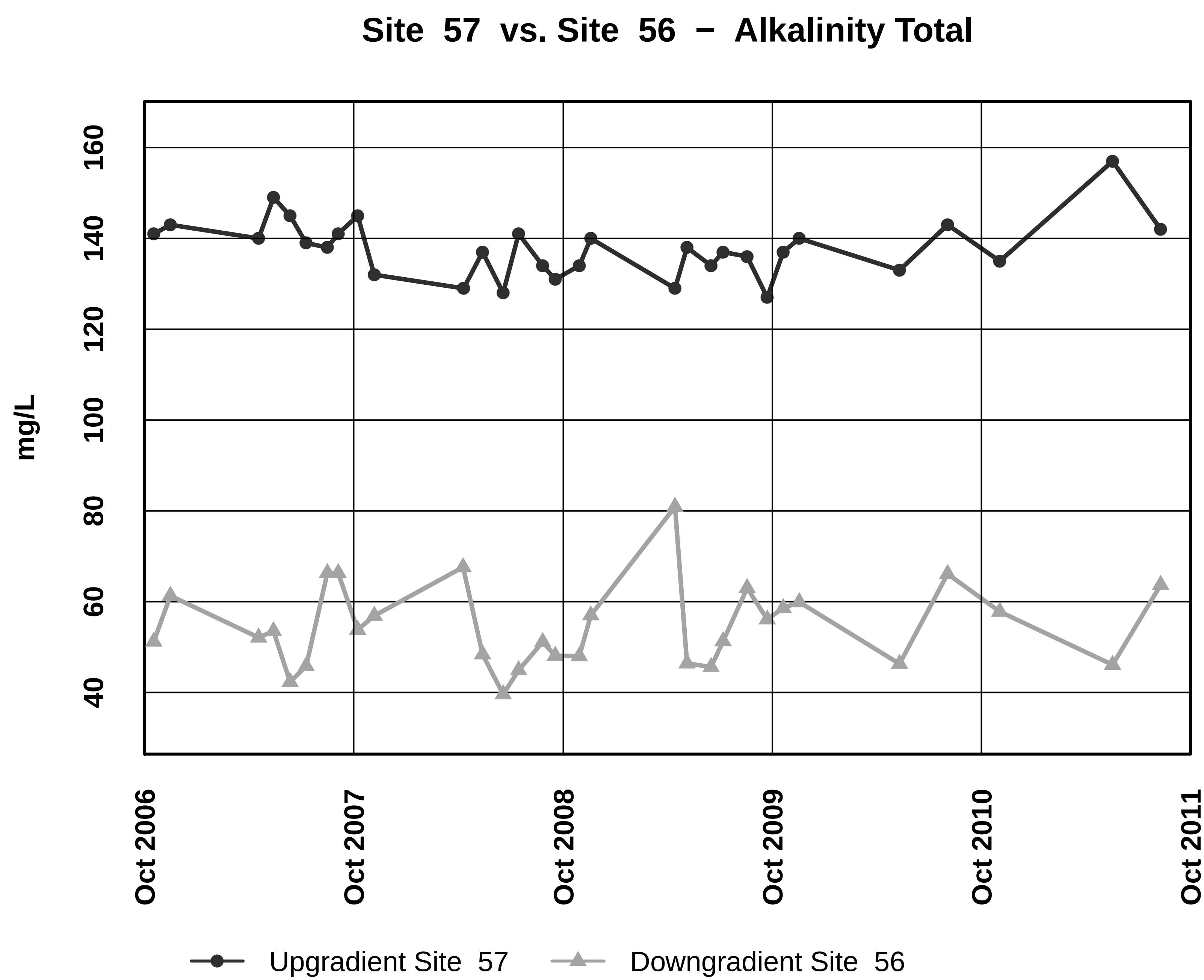
Seasonal-Kendall Slope Confidence Intervals

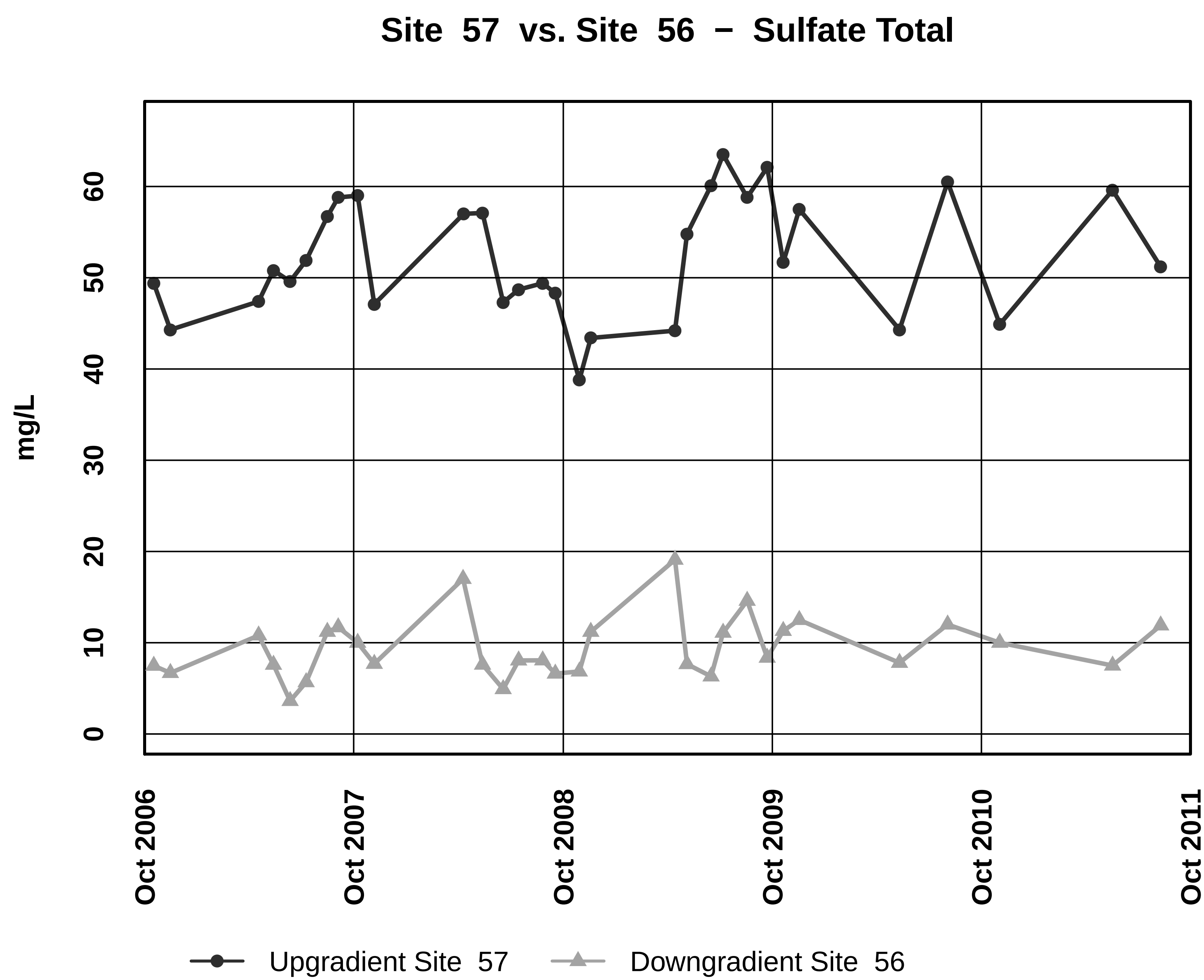
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.15		0.04
0.050	-0.13	**-0.04**	-0.01
0.100	-0.12		-0.02
0.200	-0.11		-0.03



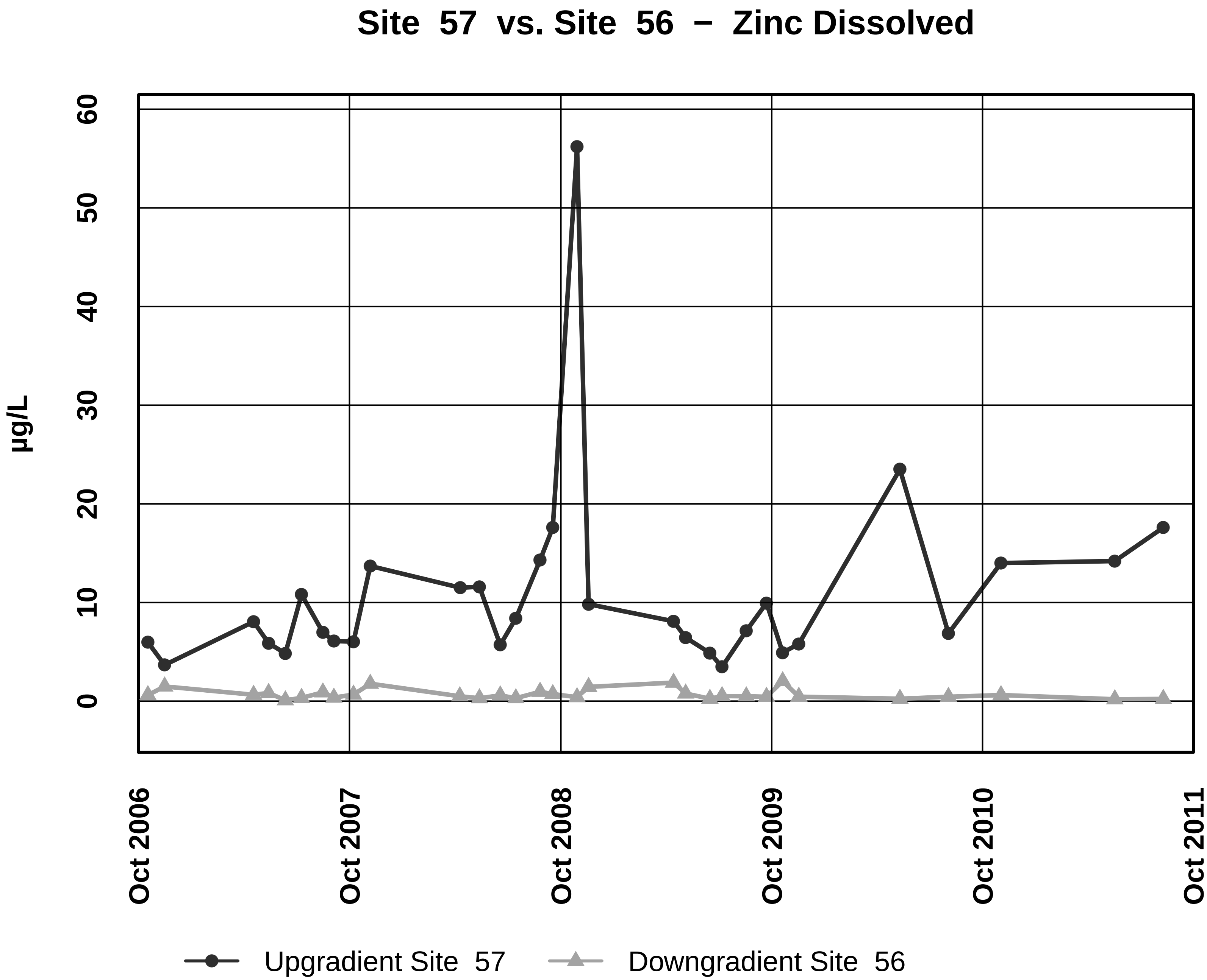
Site 57 vs. Site 56 − Conductivity Field
µS/cm
500
400
300
200
100
Oct 2006
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 57
Downgradient Site 56


Site 57 vs. Site 56 − pH Field
su
8.0
7.5
7.0
6.5
Oct 2006
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 2006
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 2006
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 2006
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 57
Downgradient Site 56

Wilcoxon-signed-ranks test

Exact Form

Variable: **Specific Conductance, Lab (uS/cm)**

	X	**Y**			
Site	#57	#56	Differences		
Year	WY2011	WY2011	**D**	**|D|**	**Rank**
Oct					
Nov	384.0	156.2	227.8	227.8	1
Dec					
Jan					
Feb					
Mar					
Apr					
May	427.0	135.0	292.0	292.0	3
Jun					
Jul					
Aug	407.0	157.0	250.0	250.0	2
Sep					
Median	407.0	156.2	250.0	250.0	

n	**m**
3	3

N= 3

ΣR= 6

α
5.0%
W'$_{\alpha,n}$
#N/A

W^+=
6
p-test
6.000

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

Wilcoxon-signed-ranks test

Exact Form

Variable: **pH, Lab, Standard Units**

	X	**Y**	Differences		
Site	#57	#56			
Year	WY2011	WY2011	**D**	**|D|**	**Rank**
Oct					
Nov	7.72	7.50	0.22	0.22	3
Dec					
Jan					
Feb					
Mar					
Apr					
May	7.61	7.65	-0.04	0.04	-1
Jun					
Jul					
Aug	7.74	7.80	-0.06	0.06	-2
Sep					
Median	7.72	7.65	-0.04	0.06	

n	**m**
3	3

N= 3

$\Sigma R=$ 0

α
95.0%
W'$_{\alpha,n}$
#N/A

$W^{+}=$
3
p-test
3.000

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

Wilcoxon-signed-ranks test
Exact Form

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

	X	**Y**			
Site	#57	#56	Differences		
Year	WY2011	WY2011	**D**	**|D|**	**Rank**
Oct					
Nov	135.0	57.8	77.2	77.2	1
Dec					
Jan					
Feb					
Mar					
Apr					
May	157.0	46.1	110.9	110.9	3
Jun					
Jul					
Aug	142.0	63.7	78.3	78.3	2
Sep					
Median	142.0	57.8	78.3	78.3	

n	**m**
3	3

N= 3
ΣR= 6

α
95.0%
W'α,n
#N/A

W^{+}=
6
p-test
6.000

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

Wilcoxon-signed-ranks test
Exact Form

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

	X	**Y**			
Site	#57	#56	Differences		
Year	WY2011	WY2011	**D**	**|D|**	**Rank**
Oct					
Nov	44.9	10.0	34.9	34.9	1
Dec					
Jan					
Feb					
Mar					
Apr					
May	59.6	7.5	52.1	52.1	3
Jun					
Jul					
Aug	51.2	11.9	39.3	39.3	2
Sep					
Median	51.2	10.0	39.3	39.3	

n	**m**
3	3

N= 3
ΣR= 6

α
5.0%
W'α,n
#N/A

W^+=
6
p-test
6.000

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

Wilcoxon-signed-ranks test
Exact Form

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

	X	**Y**	Differences		
Site	#57	#56			
Year	WY2011	WY2011	**D**	**|D|**	**Rank**
Oct					
Nov	14.00	0.62	13.38	13.38	1
Dec					
Jan					
Feb					
Mar					
Apr					
May	14.20	0.20	14.00	14.00	2
Jun					
Jul					
Aug	17.60	0.23	17.37	17.37	3
Sep					
Median	14.20	0.23	14.00	14.00	

n	**m**
3	3

N= 3
ΣR= 6

α
5.0%
W'α,n
#N/A

W^{+}=
6
p-test
6.000

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

INTERPRETIVE REPORT
SITE 13 "MINE ADIT DISCHARGE EAST"

The data collected during the current water year are listed in the following "Table of Results for Water Year 2011" 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 2011.				

The data for water year 2011 have been compared to the strictest fresh water quality criterion for each applicable analyte. Two results exceeding these criteria have been identified, as listed in the table below. The data are for total sulfate from the May-2011 and Aug-2011 samplings with values of 256 mg/L and 317 mg/L respectively. 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. It is expected that during the 2012 construction season that the majority of the remaining material (East Lobe) will be removed. When this removal is completed, water quality at this site is expected to improve.

Table of Exceedance for Water Year 2011

			Limits		
Sample Date	**Parameter**	**Value**	**Lower**	**Upper**	**Hardness**
18-May-11	Sulfate Total	256 mg/L	0	250	0 mg/L
10-Aug-11	Sulfate Total	317 mg/L	0	250	0 mg/L

X-Y plots have been generated to graphically present the data for each of the analytes requested in the Statistical Information Goals for this site. As with the other sites in the 920 Area, there was a substantial decrease in the dissolved chromium concentration at Site 13, after last year's abrupt increase.

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-05 and Sep-11 (WY2006-WY2011). 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	0.14			
pH Field	6	0.12			
Alkalinity, Total	6	0.17			
Sulfate, Total	6	0.23			
Zinc, Dissolved	6	0.50			

* Number of Years ** Significance level

There were no statistically significant trends ($\alpha/2=2.5\%$) for Site 13 during the 2011 water year. HGCMC feels the current FWMP program is sufficient to monitor any future increases at Site 13 before any water quality values are impaired.

Table of Results for Water Year 2011

Site 013FMS - '1350 East Drainage'

Sample Date/Parameter	Oct 2010	Nov 2010	Dec 2010	Jan 2011	Feb 2011	Mar 2011	Apr 2011	May 2011	Jun 2011	Jul 2011	Aug 2011	Sep 2011	**Median**
Water Temp (°C)		4.9						5			9.7		5.0
Conductivity-Field(μmho)		357						744			877		744.0
Conductivity-Lab (μmho)		341						751			902		751
pH Lab (standard units)		6.96						7.8			7.81		7.80
pH Field (standard units)		7.69						7.68			7.75		7.69
Total Alkalinity (mg/L)		58						114			215		114.0
Total Sulfate (mg/L)		101						256			317		256.0
Hardness (mg/L)		195						420			511		420.0
Dissolved As (ug/L)		0.108						0.12			0.131		0.120
Dissolved Ba (ug/L)		13.6						19.6			24.4		19.6
Dissolved Cd (ug/L)		0.074						0.0267			0.0038		0.0267
Dissolved Cr (ug/L)		0.386						0.225			0.598		0.386
Dissolved Cu (ug/L)		1.77						0.506			1.2		1.200
Dissolved Pb (ug/L)		0.122						0.0195			0.0067		0.0195
Dissolved Ni (ug/L)		1.91						2.72			3.76		2.720
Dissolved Ag (ug/L)		0.004						0.002			0.002		0.002
Dissolved Zn (ug/L)		58.6						10.6			6.2		10.60
Dissolved Se (ug/L)		0.114						0.362			0.451		0.362
Dissolved Hg (ug/L)		0.00318						0.000642			0.000718		0.000718

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.

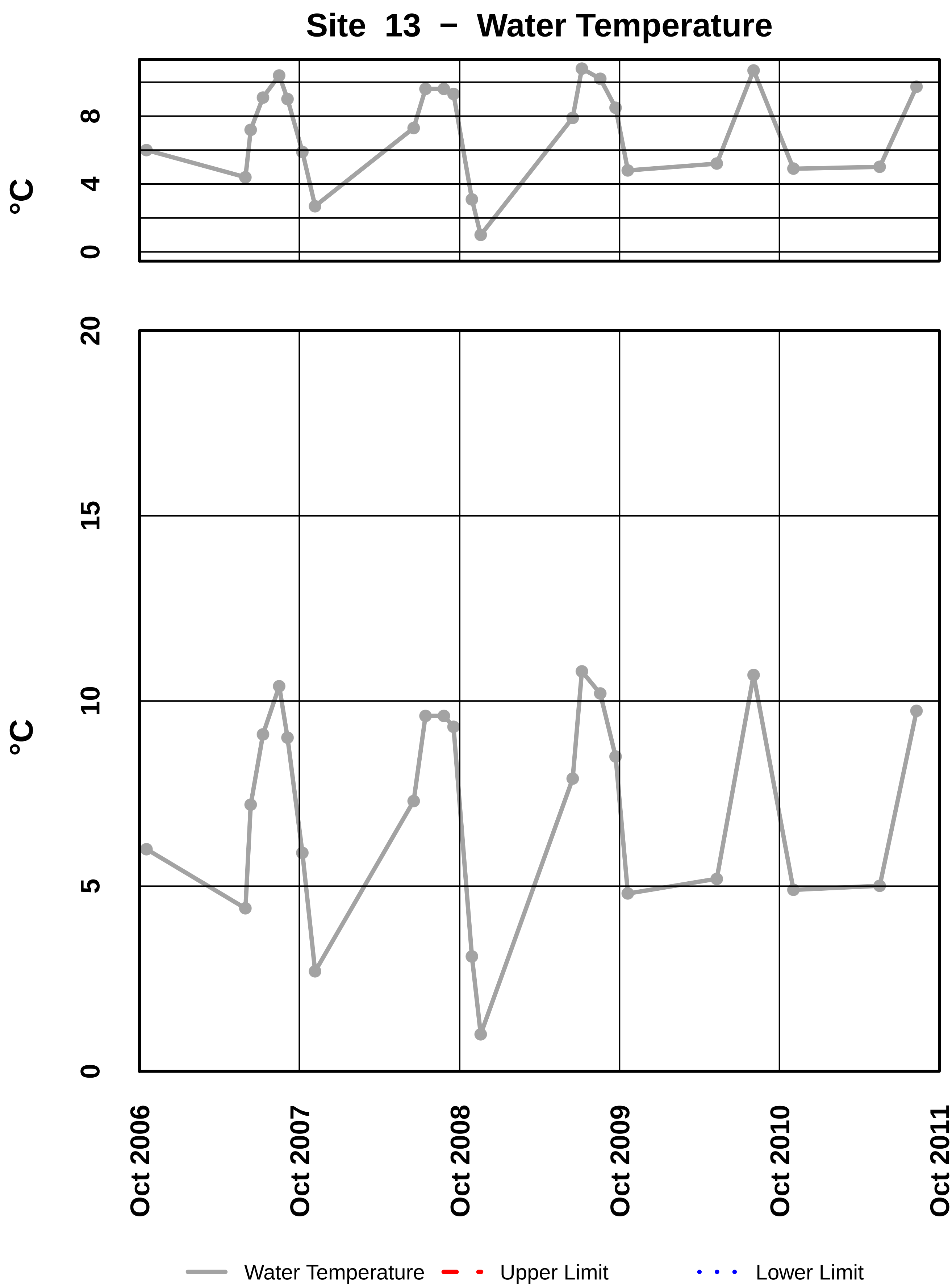
Shaded data has been qualified as an outlier by KGCMC and removed from any further analysis and is not included into the calculation of the median

Qualified Data by QA Reviewer

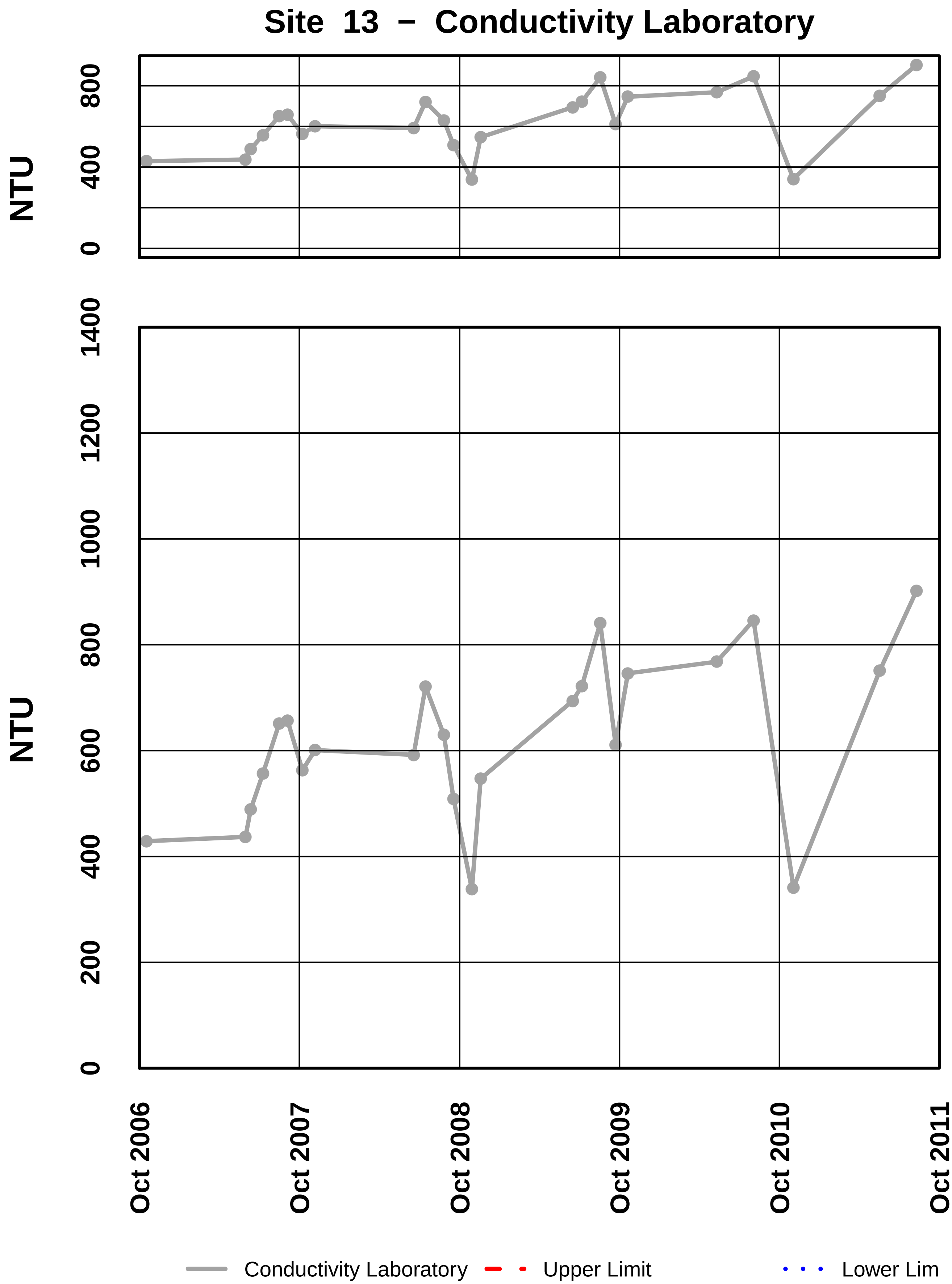
Date Range: 10/01/2010 to 09/30/2011

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
13	5/18/2011	12:00 AM				
			SO4 Tot, mg/l	256	J	Sample Reciept Temperature
			pH Lab, su	7.8	J	Hold Time Violation
			Cd diss, µg/l	0.0267	U	Trip Blank Contamination
			Pb diss, µg/l	0.0195	U	Field Blank Contamination
13	8/10/2011	12:00 AM				
			SO4 Tot, mg/l	317	J	Sample Receipt Temperature
			Cd diss, µg/l	0.0038	J	Below Quantitative Range
			Pb diss, µg/l	0.00674	J	Below Quantitative Range
			pH Lab, su	7.81	J	Hold Time Violation
			Hg diss, µg/l	0.000718	U	Field Blank Contamination

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

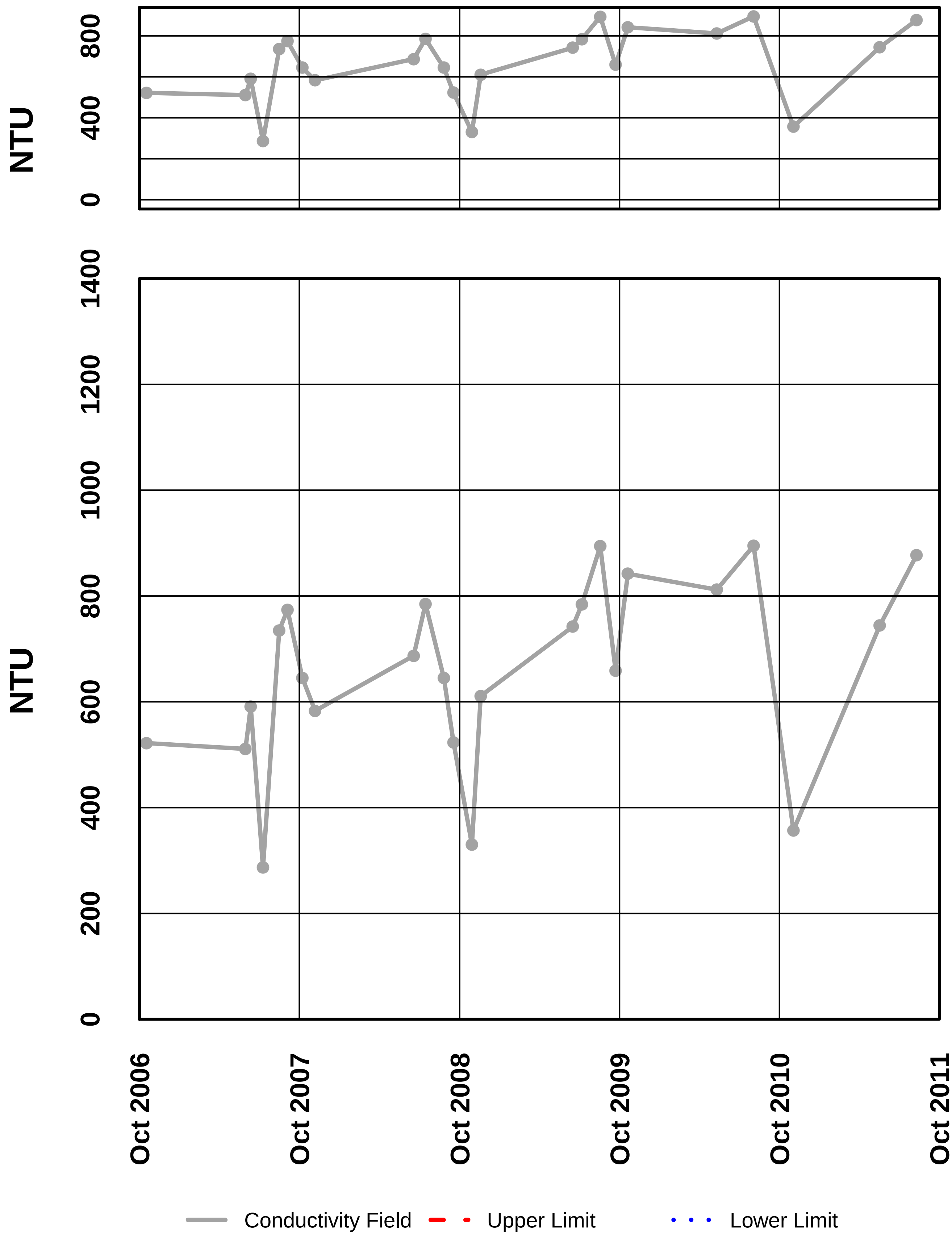


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



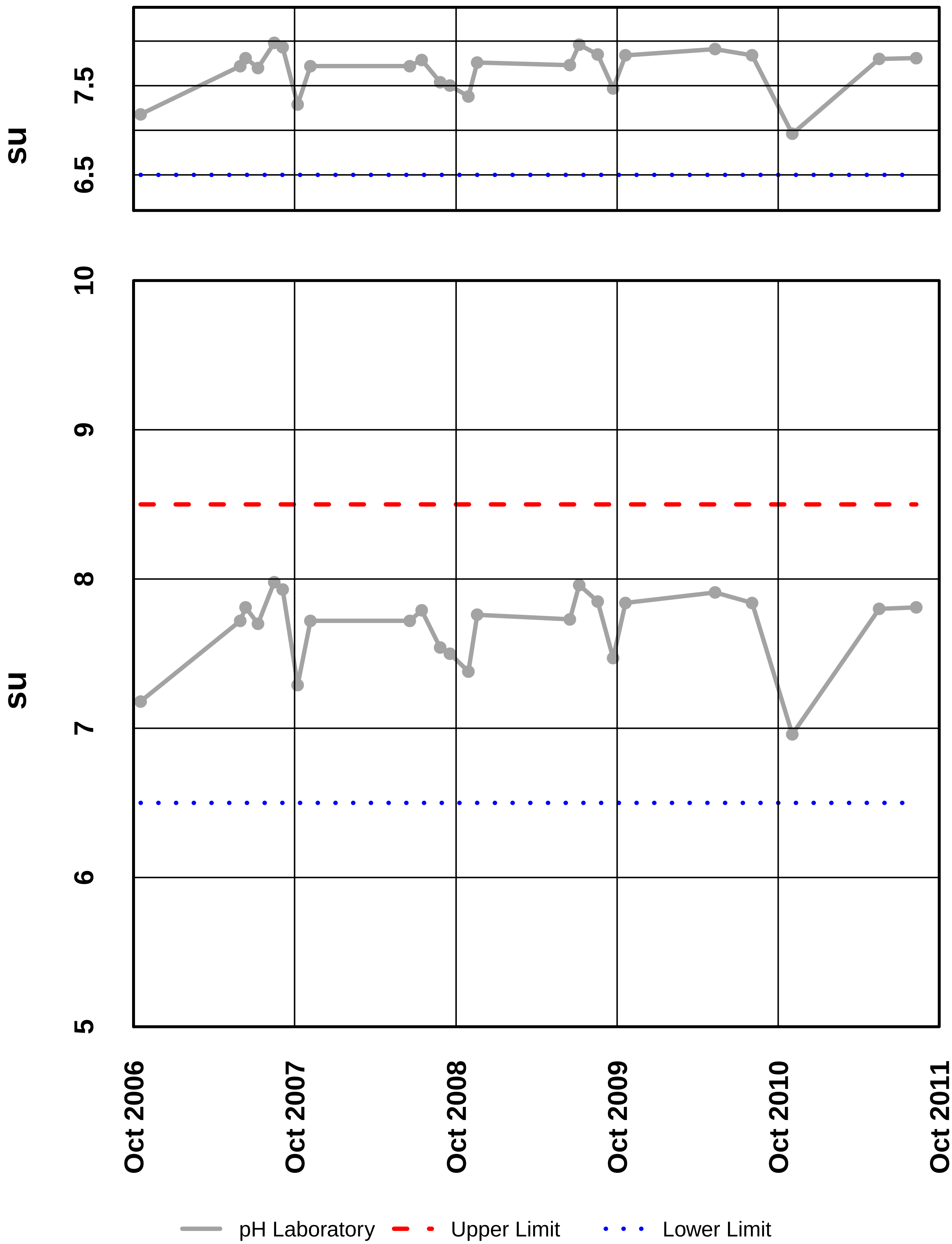
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 13 – Conductivity Field



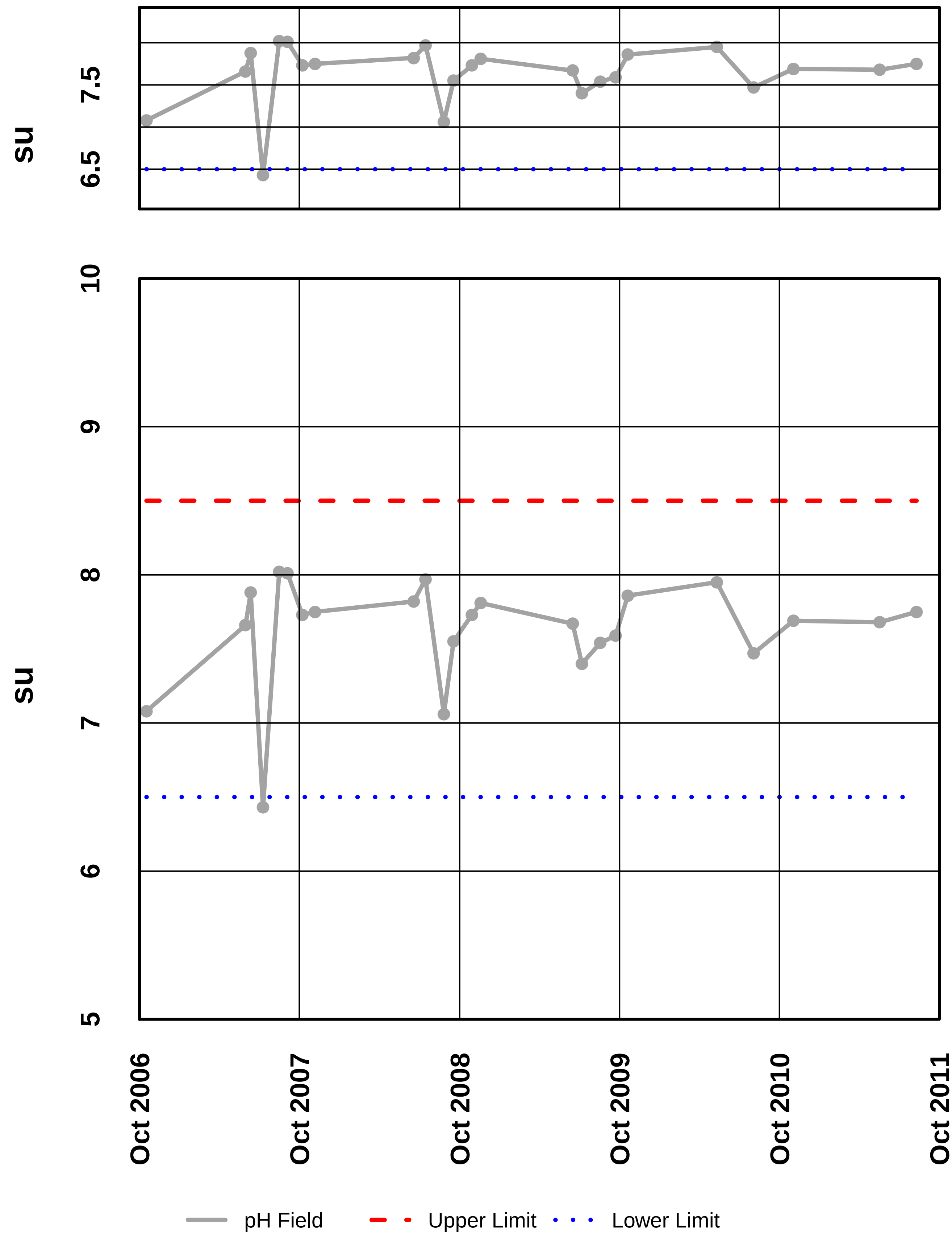
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 13 − pH Laboratory

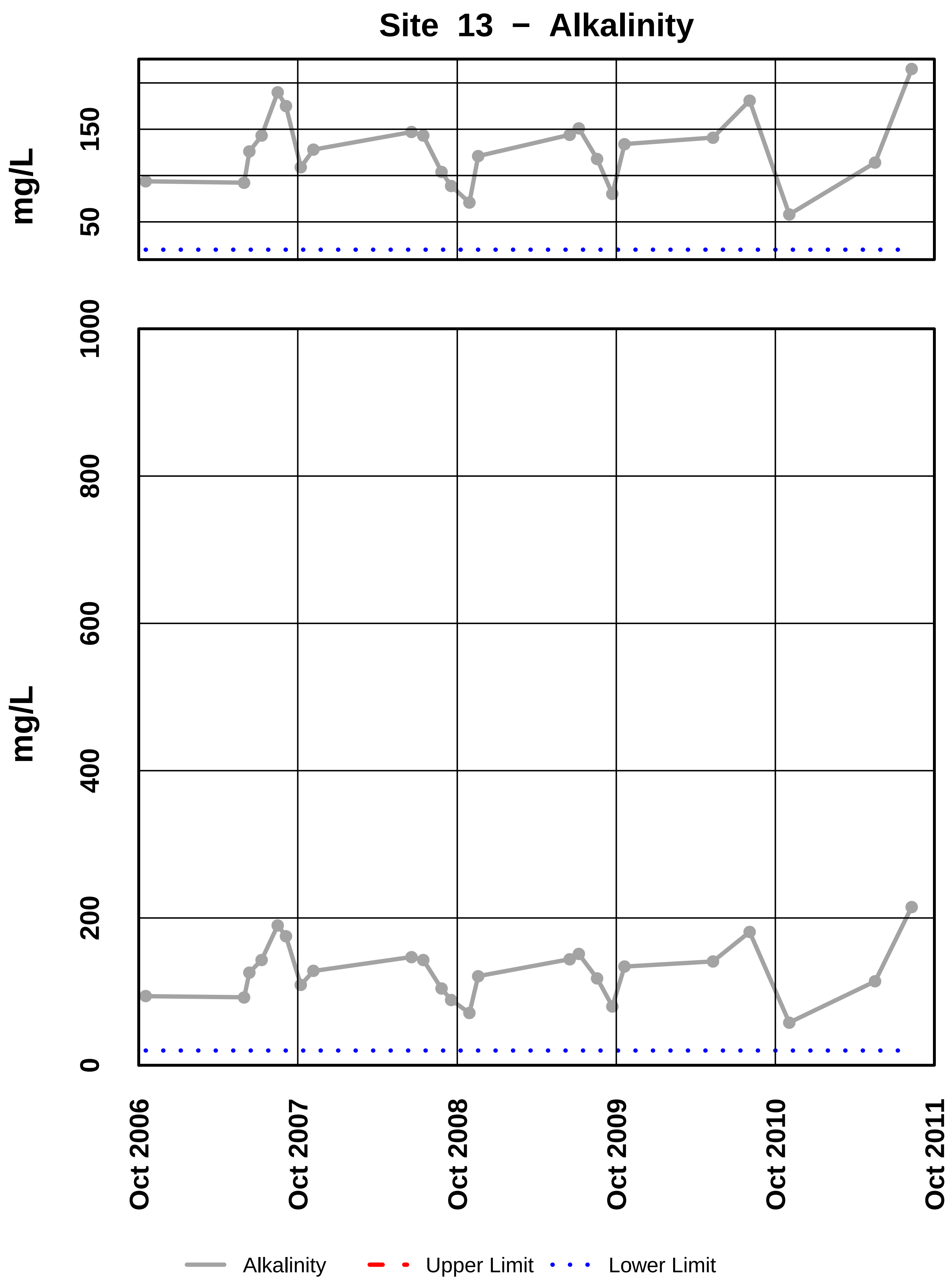


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 13 – pH Field

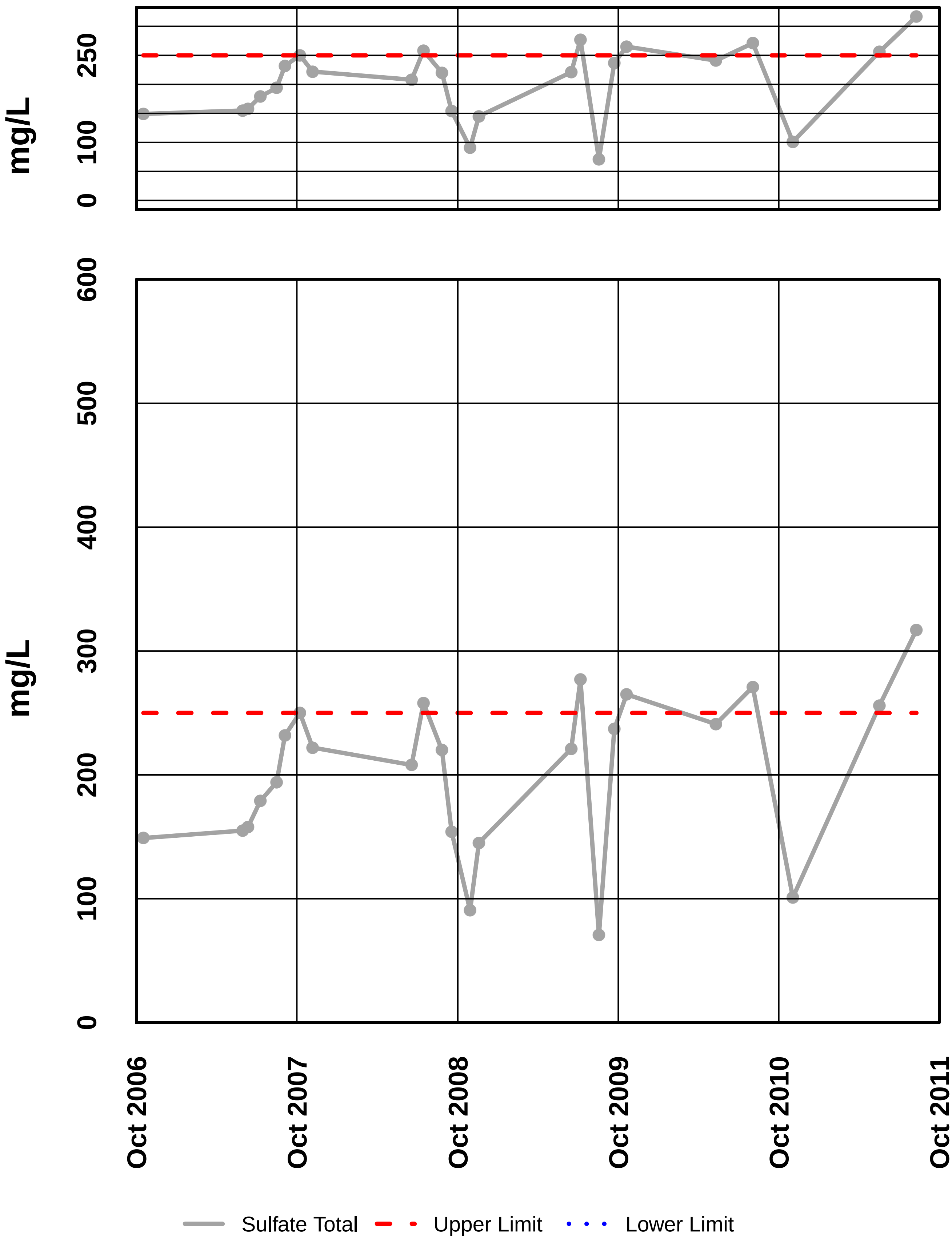


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



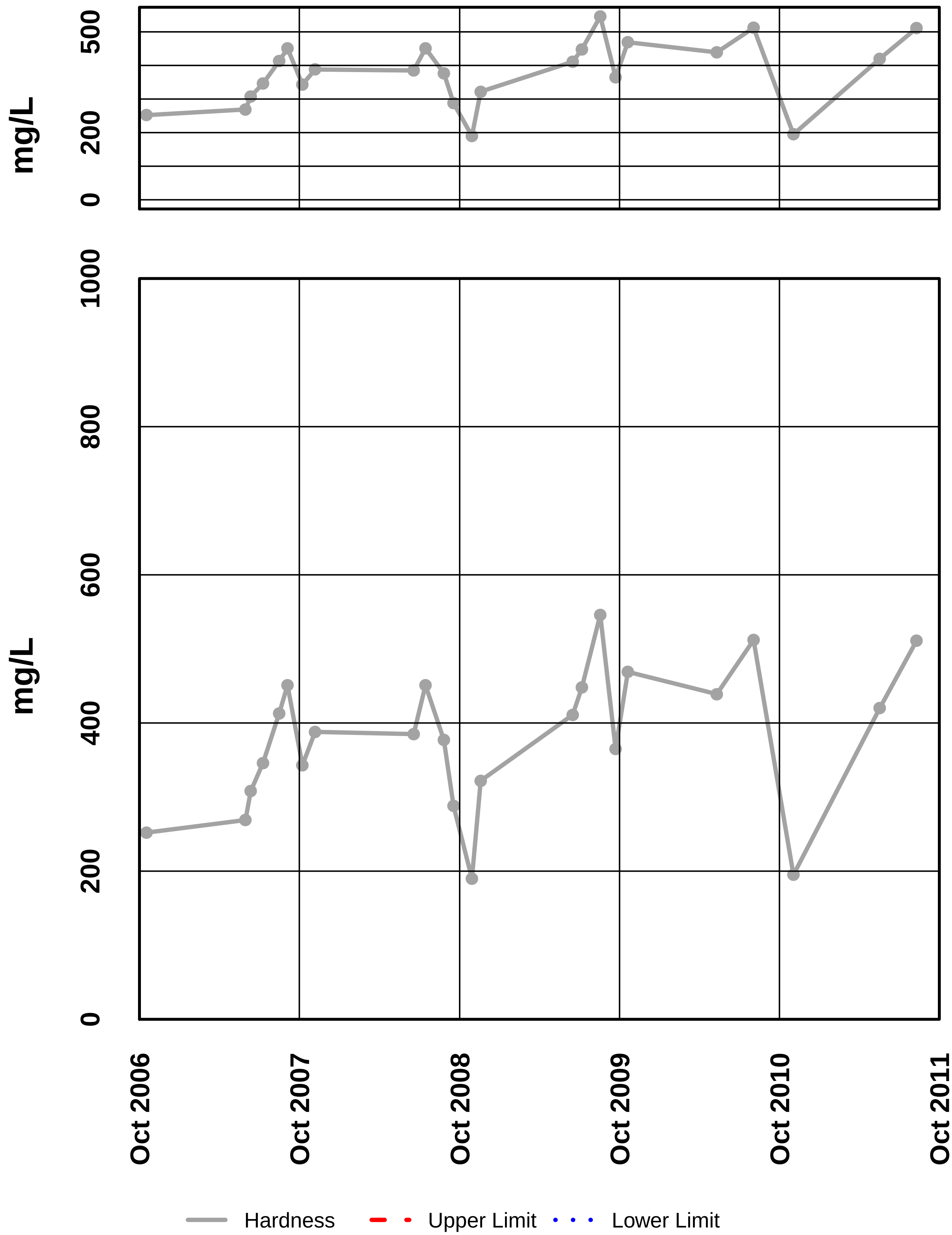
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 13 – Sulfate Total



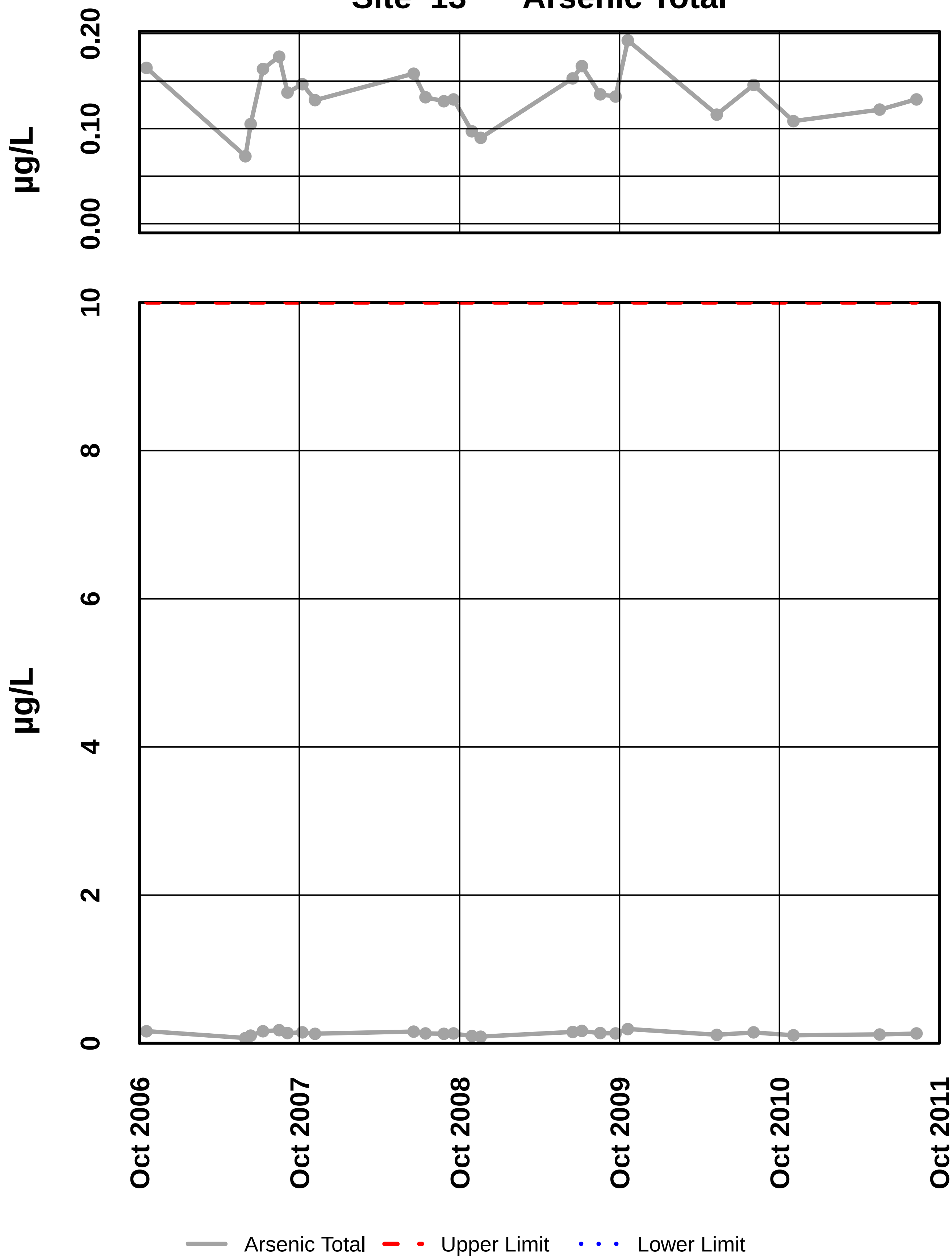
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 13 – Hardness

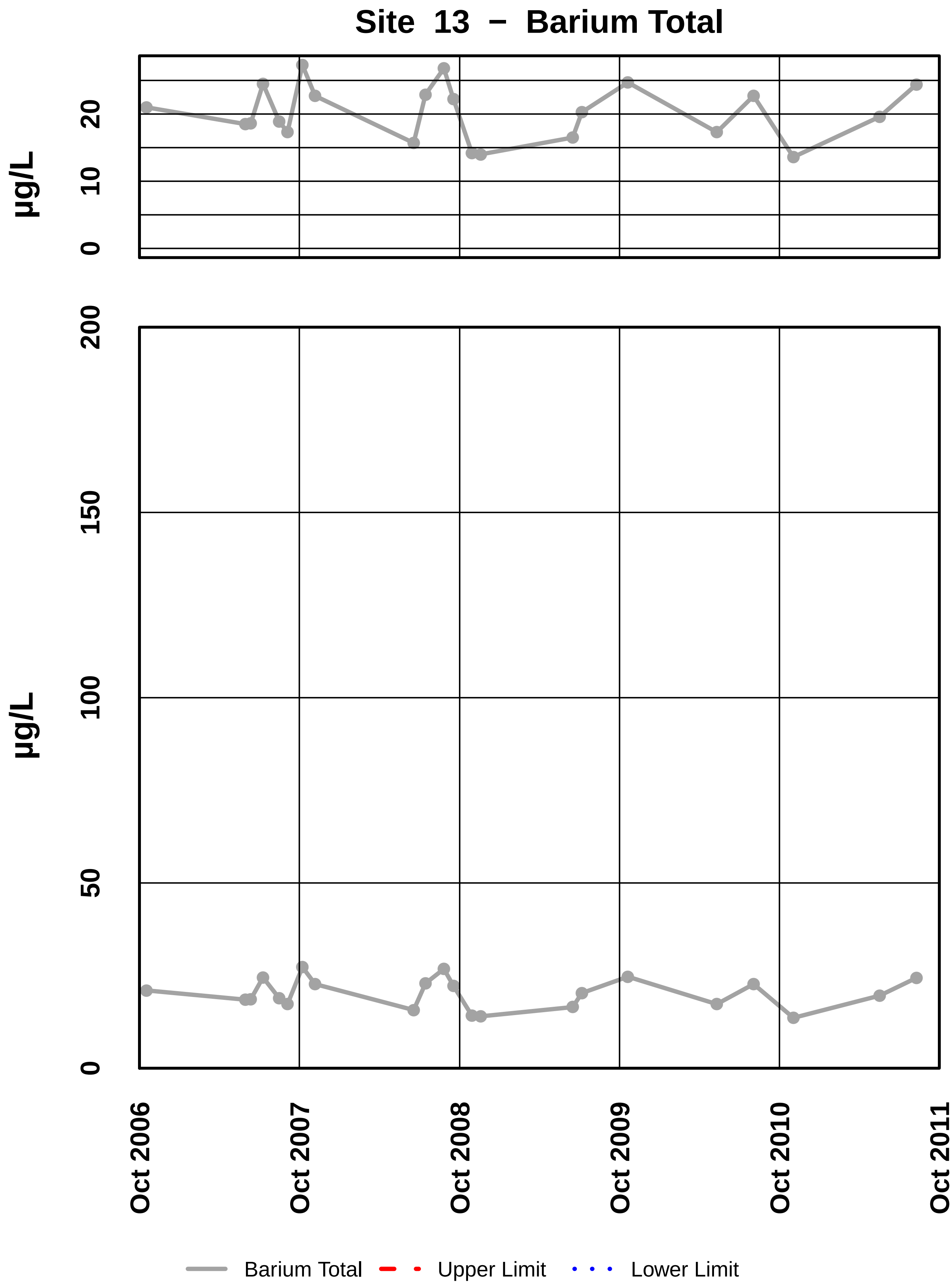


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

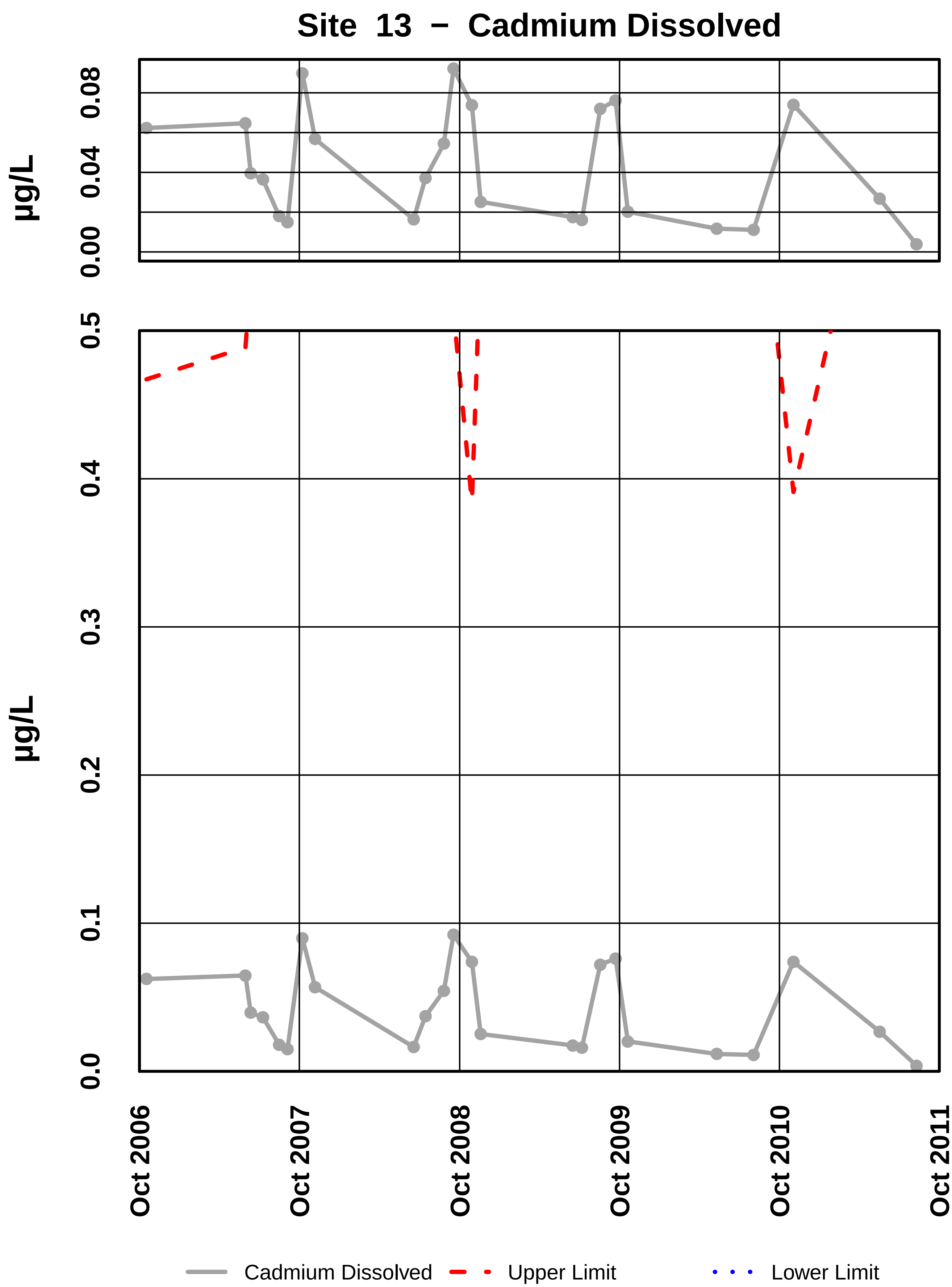
Site 13 – Arsenic Total



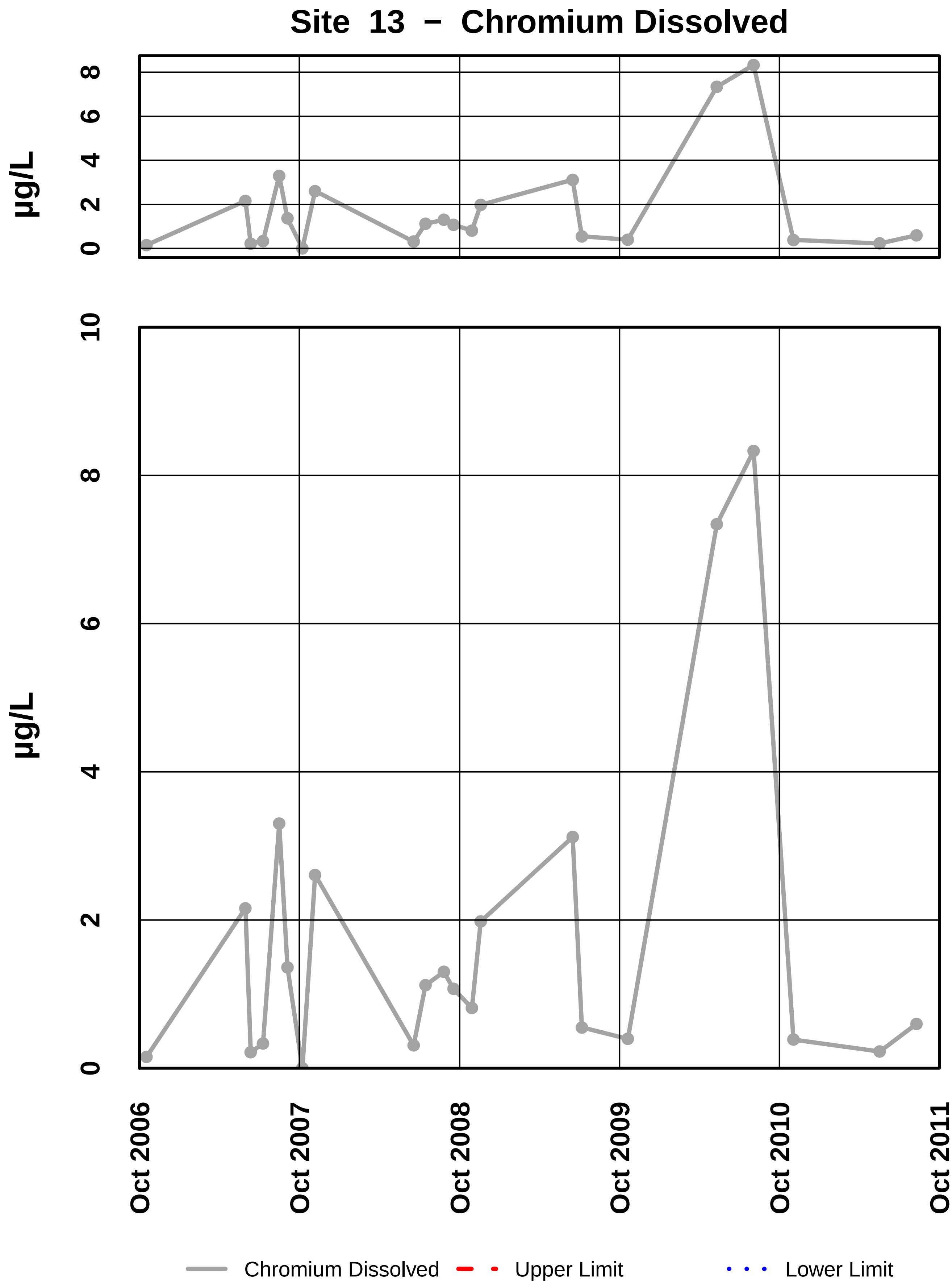
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



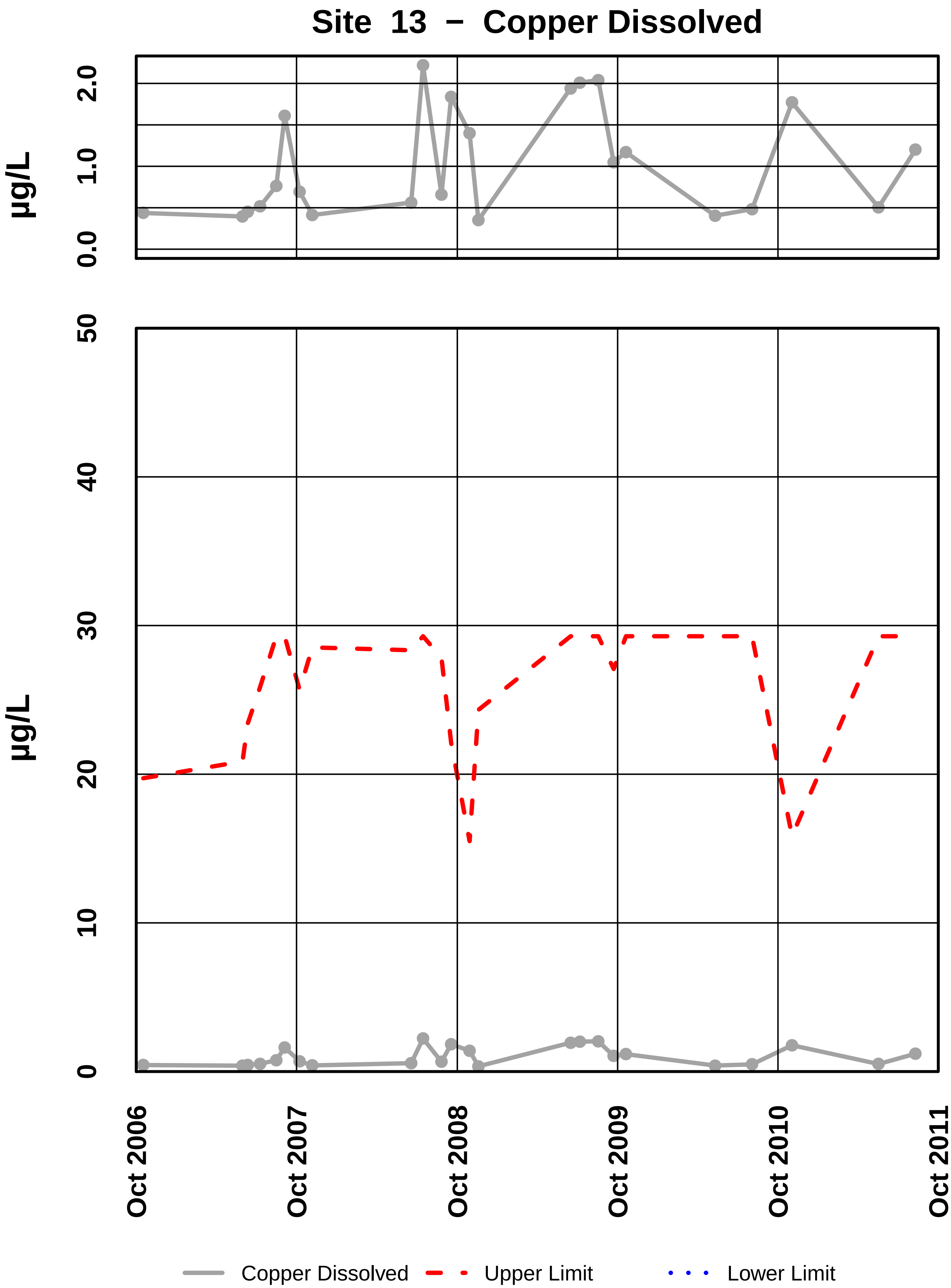
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



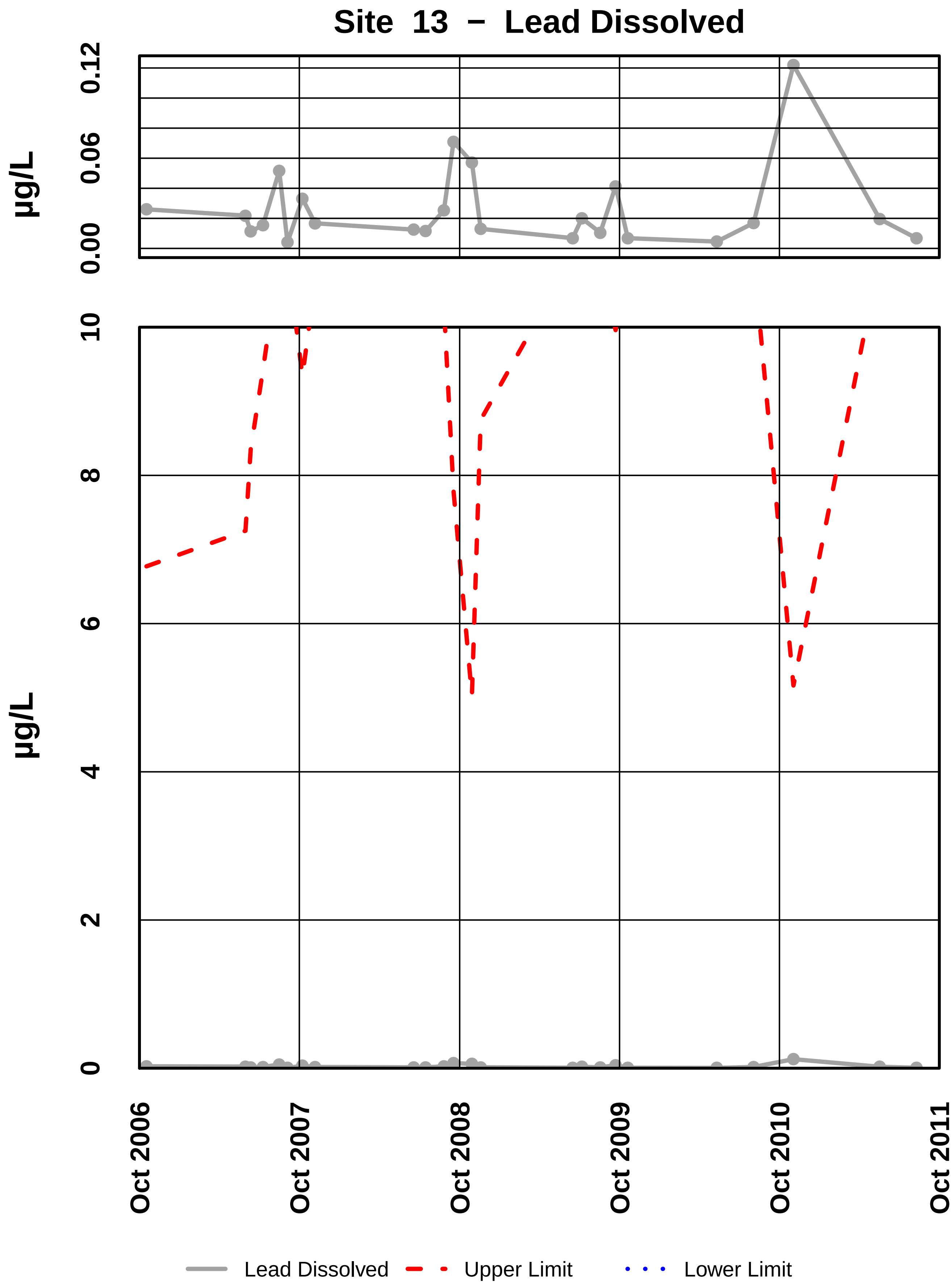
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

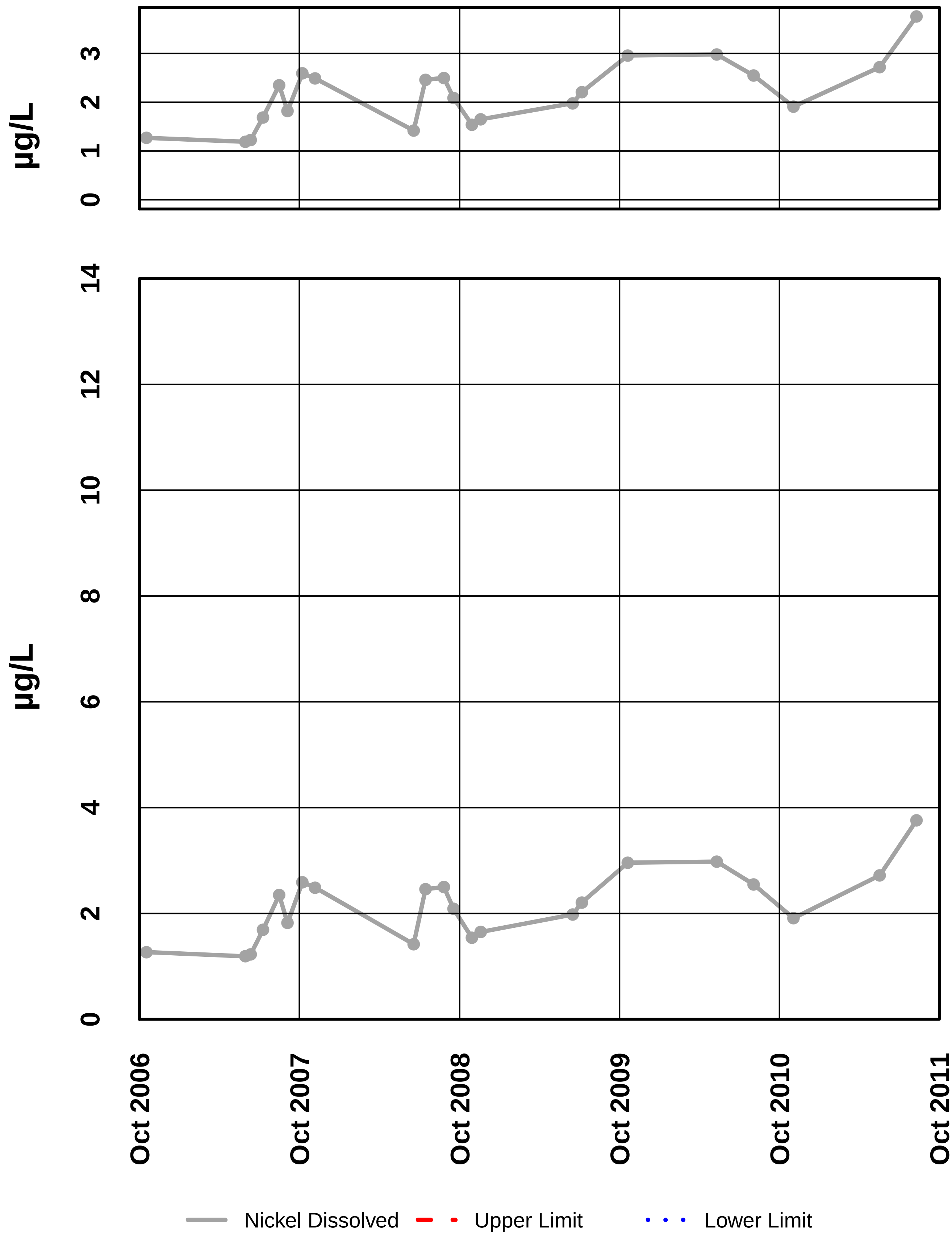


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

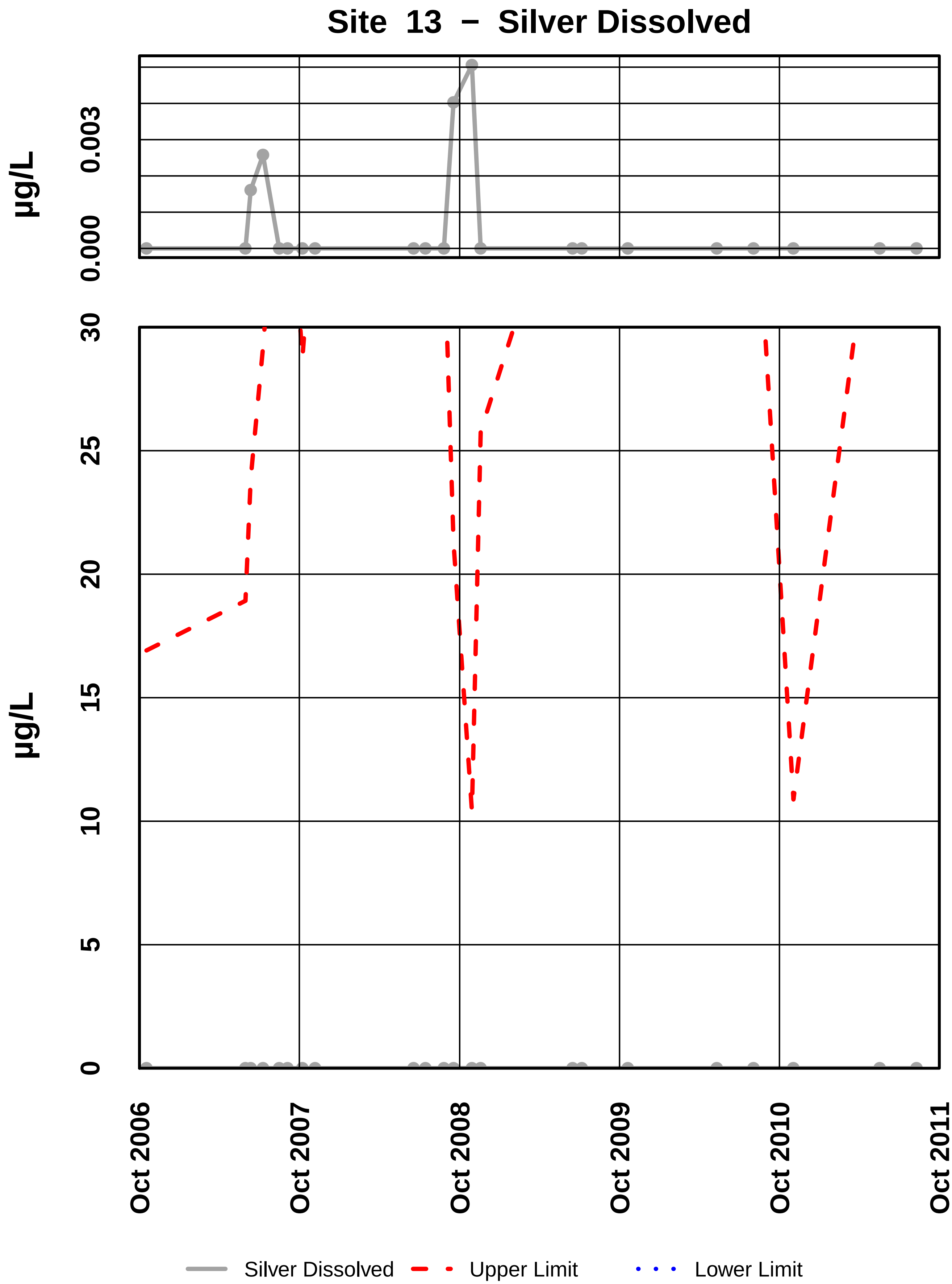


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 13 − Nickel Dissolved

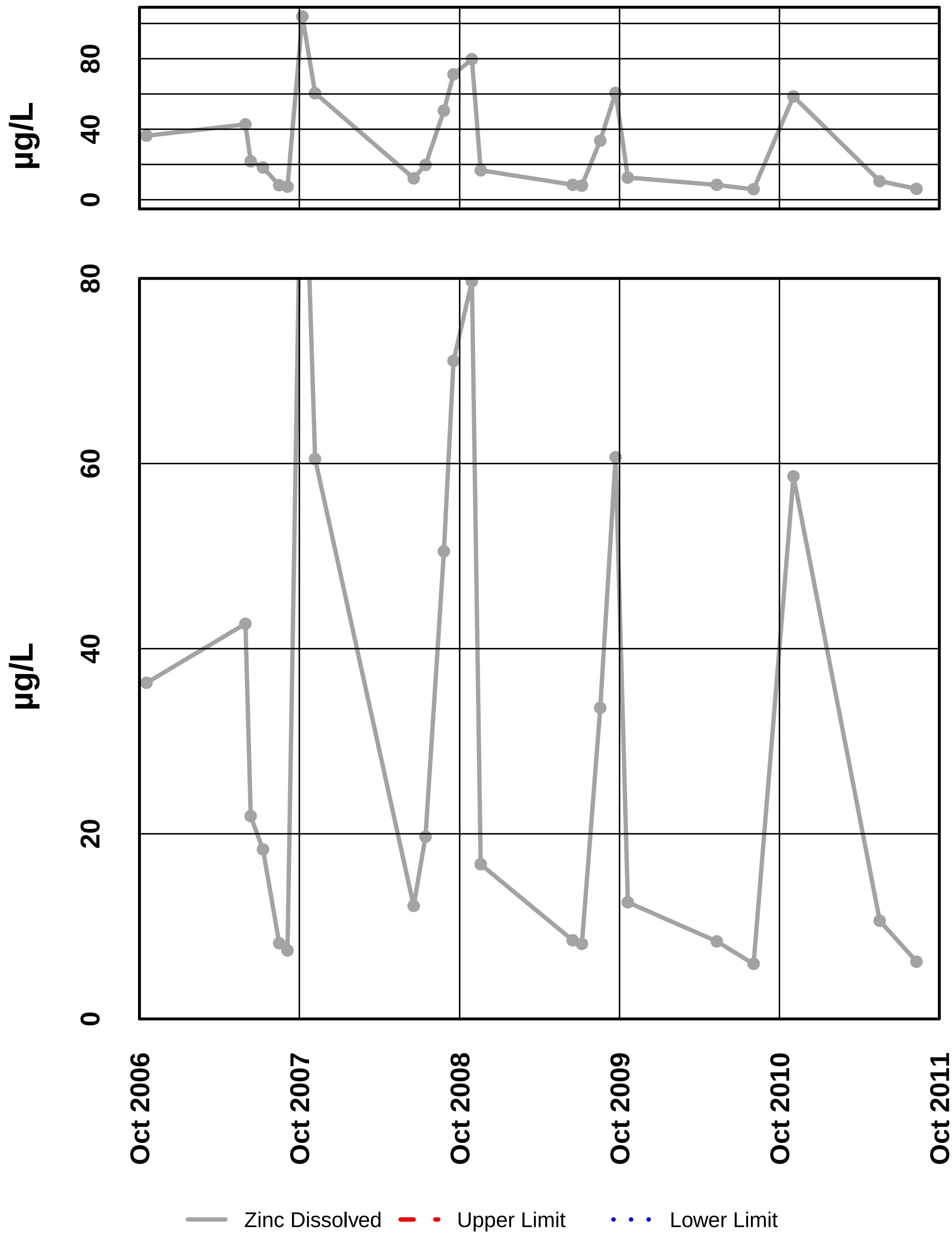


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



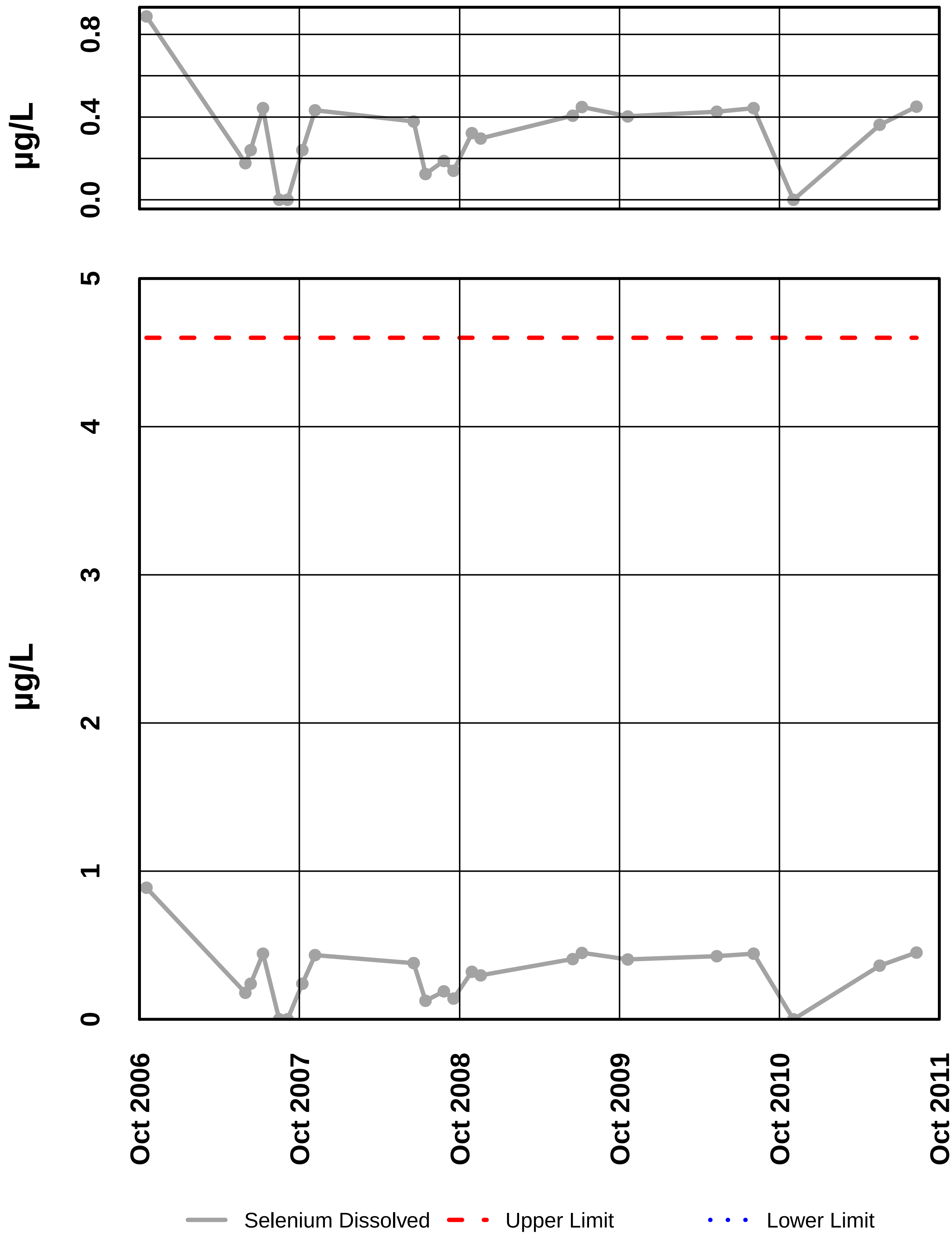
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 13 − Zinc Dissolved

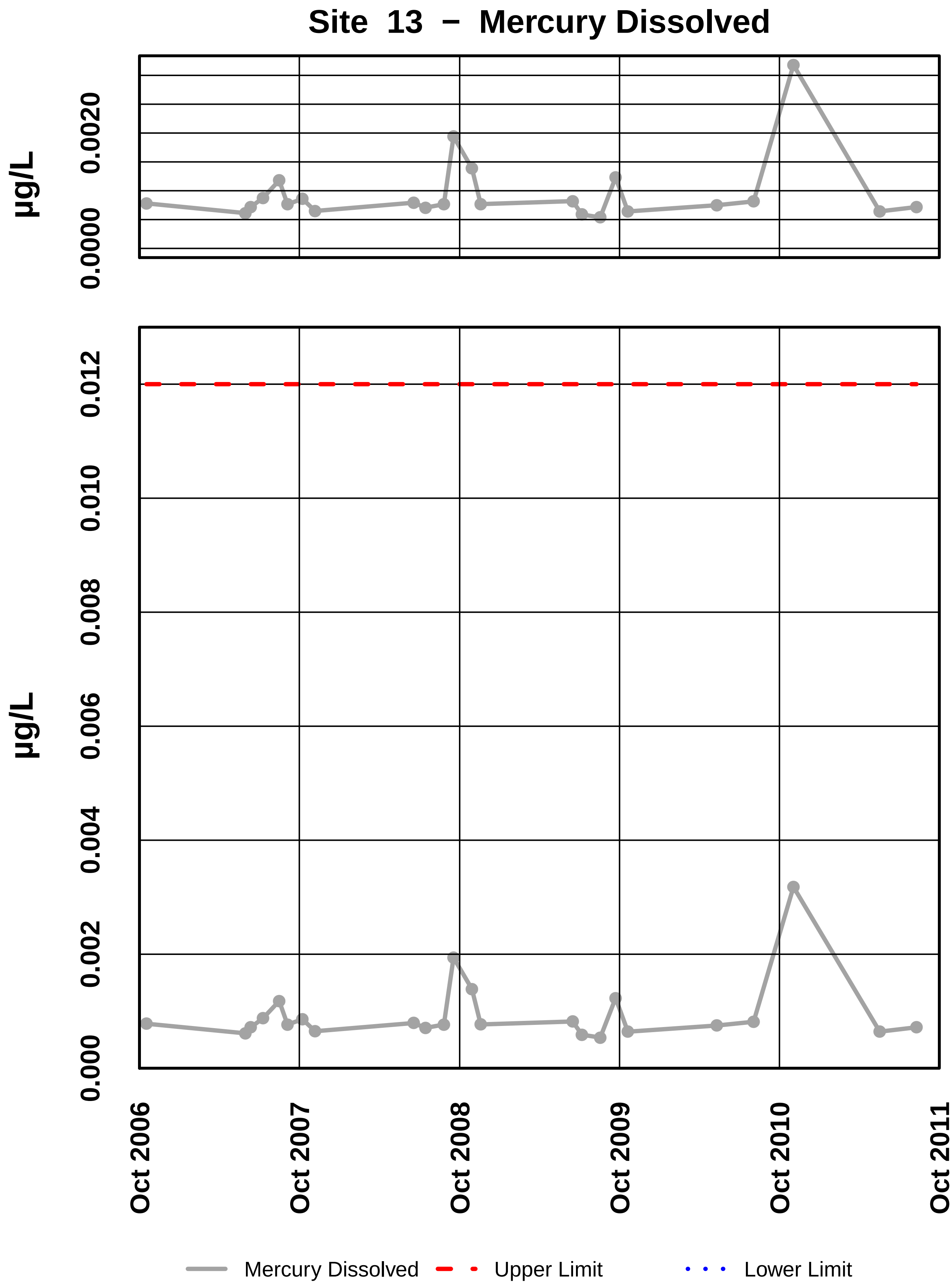


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 13 – 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 **#13** Seasonal Kendall analysis for Specific Conductance, Lab (uS/cm)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2006**	671	644						762	710	752	569	359
b	**WY2007**	522							511	591	287	735	774
c	**WY2008**	645	583							687	785	645	523
d	**WY2009**	330	611							742	784	894	659
e	**WY2010**	842							812			895	
f	**WY2011**		357						744			877	
	n	5	4	0	0	0	0	0	4	4	4	6	4

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

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

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	16.67	8.67						8.67	8.67	8.67	28.33	8.67
$Z_k = S_k/\sigma_S$	0.00	-1.36						0.00	0.68	0.68	1.69	0.68
Z^2_k	0.00	1.85						0.00	0.46	0.46	2.86	0.46

ΣZ_k= 2.37

ΣZ^2_k= 6.09

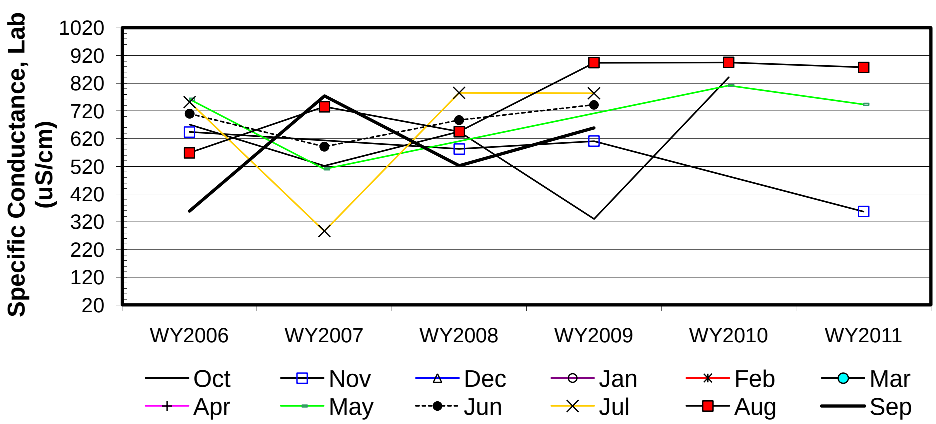
Z-bar=ΣZ_k/K= 0.34

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	31	0	0	0	0

Σn 31

ΣS_k 11

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	5.29	@α=5% $\chi^2_{(K-1)}$=	12.59	Test for station homogeneity	
p	**0.508**			$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
$\Sigma VAR(S_k)$	Z_{calc} 1.06	@α/2=2.5% Z=	1.96	**H_0** (No trend)	ACCEPT
88.33	**p** **0.856**			**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-15.16		80.36
0.050	-9.07	**28.00**	64.79
0.100	-2.36		56.70
0.200	6.27		47.57

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

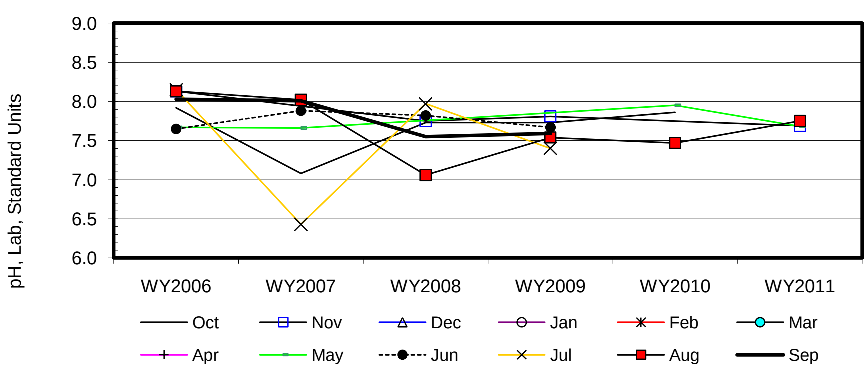
Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2006**	7.9	8.1						7.7	7.7	8.2	8.1	8.0
b	**WY2007**	7.1							7.7	7.9	6.4	8.0	8.0
c	**WY2008**	7.7	7.8							7.8	8.0	7.1	7.6
d	**WY2009**	7.7	7.8							7.7	7.4	7.5	7.6
e	**WY2010**	7.9							8.0			7.5	
f	**WY2011**		7.7						7.7			7.8	
	n	5	4	0	0	0	0	0	4	4	4	6	4
	t_1	3	4	0	0	0	0	0	4	4	4	6	4
	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	-1
	c-a	-1	-1							1	-1	-1	-1
	d-a	-1	-1							1	-1	-1	-1
	e-a	-1							1			-1	
	f-a		-1						1			-1	
	c-b	1								-1	1	-1	-1
	d-b	1								-1	1	-1	-1
	e-b	1							1			-1	
	f-b								1			-1	
	d-c	0	1							-1	-1	1	1
	e-c	1										1	
	f-c		-1									1	
	e-d	1										-1	
	f-d		-1									1	
	f-e								-1			1	
	S_k	1	-4	0	0	0	0	0	2	0	-2	-5	-4
	σ^2_S=	15.67	8.67						8.67	8.67	8.67	28.33	8.67
	$Z_k = S_k/\sigma_S$	0.25	-1.36						0.68	0.00	-0.68	-0.94	-1.36
	Z^2_k	0.06	1.85						0.46	0.00	0.46	0.88	1.85

ΣZ_k=	-3.40
ΣZ^2_k=	5.56
Z-bar=ΣZ_k/K=	-0.49

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	29	1	0	0	0

Σn	31
ΣS_k	-12

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=		3.91	@α=5% $\chi^2_{(K-1)}$=	12.59	Test for station homogeneity	
	p	**0.689**			$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc}	-1.18	@α/2=2.5% Z=	1.96	**H_0** (No trend)	ACCEPT
87.33	**p**	**0.120**			**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	-0.11	**-0.06**	0.00
0.100	-0.09		-0.01
0.200	-0.08		-0.02

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	**WY2006**	132.0	134.0						162.0	171.0	174.0	120.0	160.0
b	**WY2007**	93.8							92.3	126.0	143.0	190.0	175.0
c	**WY2008**	109.0	128.0							147.0	143.0	104.0	88.8
d	**WY2009**	70.9	121.0							144.0	151.0	118.0	80.0
e	**WY2010**	134.0							141.0			181.0	
f	**WY2011**		58.0						114.0			215.0	
	n	5	4	0	0	0	0	0	4	4	4	6	4

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	5	4	0	0	0	0	0	4	4	2	6	4
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
c-a	-1	-1							-1	-1	-1	-1
d-a	-1	-1							-1	-1	-1	-1
e-a	1							-1			1	
f-a		-1						-1			1	
c-b	1								1	0	-1	-1
d-b	-1								1	1	-1	-1
e-b	1							1			-1	
f-b								1			1	
d-c	-1	-1							-1	1	1	-1
e-c	1										1	
f-c		-1									1	
e-d	1										1	
f-d		-1									1	
f-e								-1			1	
S_k	0	-6	0	0	0	0	0	-2	-2	-1	5	-4

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	16.67	8.67						8.67	8.67	7.67	28.33	8.67
$Z_k = S_k/\sigma_S$	0.00	-2.04						-0.68	-0.68	-0.36	0.94	-1.36
Z^2_k	0.00	4.15						0.46	0.46	0.13	0.88	1.85

ΣZ_k= -4.18

ΣZ^2_k= 7.94

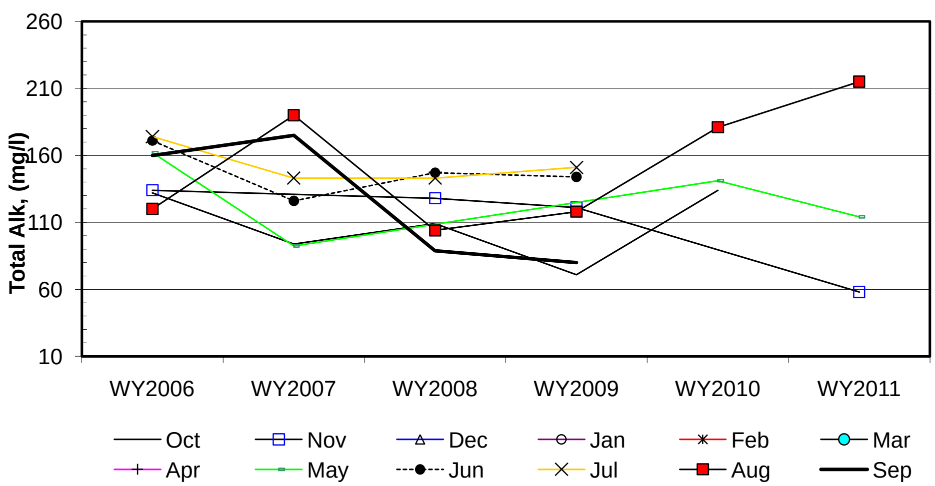
Z-bar=ΣZ_k/K= -0.60

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	29	1	0	0	0

Σn 31

ΣS_k -10

$\chi^2_h = \Sigma Z^2_k - K(\text{Z-bar})^2$=	5.44	@α=5% $\chi^2_{(K-1)}$=	12.59	Test for station homogeneity	
p	**0.488**			$\chi^2_h < \chi^2_{(K-1)}$	ACCEPT
$\Sigma VAR(S_k)$ / 87.33	Z_{calc} -0.96	@α/2=2.5% Z=	1.96	**H_0** (No trend)	ACCEPT
p	**0.168**			**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-15.31		8.37
0.050	-11.46	**-4.33**	4.26
0.100	-9.29		0.24
0.200	-8.35		-1.99

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	**WY2006**	239.0	222.0						252.0	245.0	230.0	212.0	247.0
b	**WY2007**	149.0							155.0	158.0	179.0	194.0	232.0
c	**WY2008**	250.0	222.0							208.0	258.0	220.0	154.0
d	**WY2009**	90.6	145.0							221.0	277.0	70.8	237.0
e	**WY2010**	265.0							241.0			271.0	
f	**WY2011**		101.0						256.0			317.0	
	n	5	4	0	0	0	0	0	4	4	4	6	4

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

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

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	16.67	7.67						8.67	8.67	8.67	28.33	8.67
$Z_k = S_k/\sigma_S$	0.49	-1.81						0.68	0.00	1.36	1.32	-0.68
Z^2_k	0.24	3.26						0.46	0.00	1.85	1.73	0.46

ΣZ_k= 1.36

ΣZ^2_k= 8.00

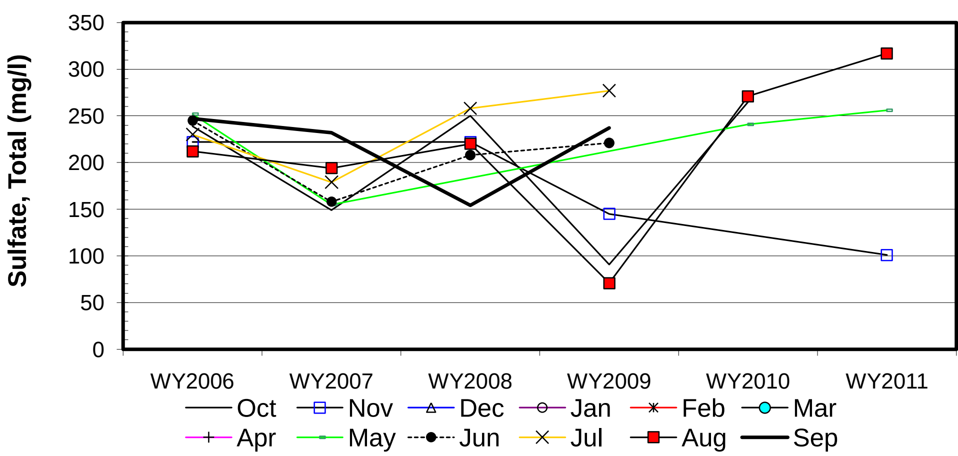
Z-bar=ΣZ_k/K= 0.19

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	29	1	0	0	0

Σn 31

ΣS_k 8

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	7.74	@α=5% $\chi^2_{(K-1)}$= 12.59	Test for station homogeneity	
p	**0.258**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k) 87.33	Z_{calc} 0.75	@α=5% Z= 1.64	**H_0** (No trend)	ACCEPT
	p **0.773**		**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-22.81		25.34
0.050	-15.56	**5.50**	16.29
0.100	-5.61		14.87
0.200	-1.19		13.43

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	**WY2006**	18.5	12.7						10.3	1.2	5.8	27.4	9.0
b	**WY2007**	36.3							42.7	21.9	18.3	8.2	7.4
c	**WY2008**	104.0	60.5							12.2	19.7	50.5	71.1
d	**WY2009**	79.7	16.7							8.5	8.1	33.6	60.7
e	**WY2010**	12.6							8.4			5.9	
f	**WY2011**		58.6						10.6			6.2	
	n	5	4	0	0	0	0	0	4	4	4	6	4

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

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

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	16.67	8.67						8.67	8.67	8.67	28.33	8.67
$Z_k = S_k/\sigma_S$	0.00	0.68						0.00	0.00	0.68	-0.94	0.68
Z^2_k	0.00	0.46						0.00	0.00	0.46	0.88	0.46

ΣZ_k= 1.10

ΣZ^2_k= 2.27

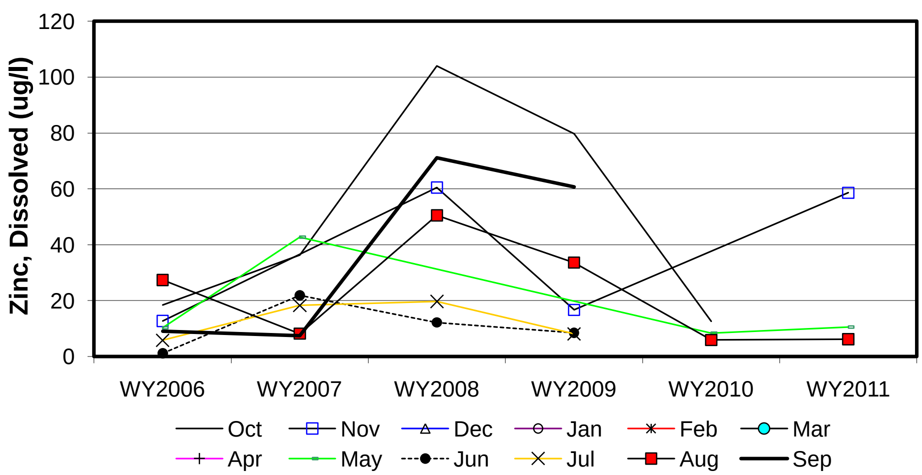
Z-bar=ΣZ_k/K= 0.16

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	31	0	0	0	0

Σn 31

ΣS_k 1

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	2.09	@α=5% $\chi^2_{(K-1)}$= 12.59	Test for station homogeneity	
p	**0.911**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
$\Sigma VAR(S_k)$	Z_{calc} 0.00	@α/2=2.5% Z= 1.96	**H_0** (No trend)	ACCEPT
88.33	**p** **0.500**		**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-7.22		10.20
0.050	-4.44	**0.06**	3.14
0.100	-2.70		2.15
0.200	-1.08		1.36

INTERPRETIVE REPORT
SITE 58 “MONITORING WELL T-00-01C”

The data collected during the current water year are listed in the following “Table of Results for Water Year 2011” 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 2006 through September 2011.				

The data for water year 2011 have been compared to the strictest fresh water quality criterion for each applicable analyte. Six values exceeding these criteria have been identified, as listed in the table below. Four of these values were for field pH. 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). Likewise, total alkalinity for organic, peat rich completions are typically at or below the 20 mg/L AWQS.

Table of Exceedance for Water Year 2011

			Limits		
Sample Date	**Parameter**	**Value**	**Lower**	**Upper**	**Hardness**
9-Nov-10	Alkalinity	18.6 mg/L	20		
9-Nov-10	pH Field	6.3 su	6.5	8.50	
19-May-11	pH Field	6.22 su	6.5	8.50	
12-Jul-11	pH Field	5.25 su	6.5	8.50	
12-Sep-11	pH Field	5.76 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 dissolved manganese appears to be increasing over the past few years. Though it appears to be increasing the values are still ~1/2 the AWQS (200 µg/L). As noted in last year’s report there was a moderate increase in the dissolved mercury concentration measured at the end of the of the 2010 water year. This increase was thought to be a result of the preparatory work for the East Ridge Expansion project which started in the spring of 2010. During the 2011 water year the dissolved mercury values returned to within historical 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-05 and Sep-11 (WY2006-WY2011).

Table of Summary Statistics for Trend Analysis

	Mann-Kendall test statistics			Sen's slope estimate	
Parameter	**n***	**p****	**Trend**	**Q**	**Q(%)**
Conductivity Field	6	0.15			
pH Field	6	0.09			
Alkalinity, Total	6	0.40			
Sulfate, Total	6	0.07			
Zinc, Dissolved	6	<0.01	+	0.32	46.1

* Number of Years ** Significance level

There was one statistically significant ($p<0.01$) increasing trend with dissolved zinc identified at site 58 for the current water year. The Sen's slope estimate was 0.32 µg/L/yr or 46.1% increase over the period. As with the spike in mercury last year, it is thought that this trend is also a result of the activities concerning the building of the East Ridge Expansion during the spring and summer of 2011. Currently, HGCMC believes the current FWMP program is sufficient to monitor future changes at Site 58 before water quality values are impaired.

Table of Results for Water Year 2011

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

Sample Date/Parameter	Oct 2010	Nov 2010	Dec 2010	Jan 2011	Feb 2011	Mar 2011	Apr 2011	May 2011	Jun 2011	Jul 2011	Aug 2011	Sep 2011	**Median**
Water Temp (°C)		7.1						8.1		10.6		11.3	9.4
Conductivity-Field(μmho)		62.5						86		114.4		98	92.0
Conductivity-Lab (μmho)		59						79		92		115	86
pH Lab (standard units)		5.69						6.1		5.84		5.99	5.92
pH Field (standard units)		6.3						6.22		5.25		5.76	5.99
Total Alkalinity (mg/L)		18.6						23.5		32.1		30.5	27.0
Total Sulfate (mg/L)		1.1						5		1.5		2.5	2.0
Hardness (mg/L)		24.9						26.7		35		39.5	30.9
Dissolved As (ug/L)		0.28						0.33		0.241		0.306	0.293
Dissolved Ba (ug/L)		17.7						22.1		32.4		33.6	27.3
Dissolved Cd (ug/L)		0.004						0.059		0.0018		0.0047	0.0044
Dissolved Cr (ug/L)		0.694						0.79		0.891		1.22	0.841
Dissolved Cu (ug/L)		0.185						0.484		0.287		0.36	0.324
Dissolved Pb (ug/L)		0.0362						0.214		0.267		0.462	0.2405
Dissolved Ni (ug/L)		0.477						0.769		0.679		1.81	0.724
Dissolved Ag (ug/L)		0.004						0.002		0.002		0.002	0.002
Dissolved Zn (ug/L)		0.11						15.7		2.79		2.56	2.68
Dissolved Se (ug/L)		0.114						0.442		0.057		0.416	0.265
Dissolved Hg (ug/L)		0.00113						0.00101		0.000632		0.000892	0.000951

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

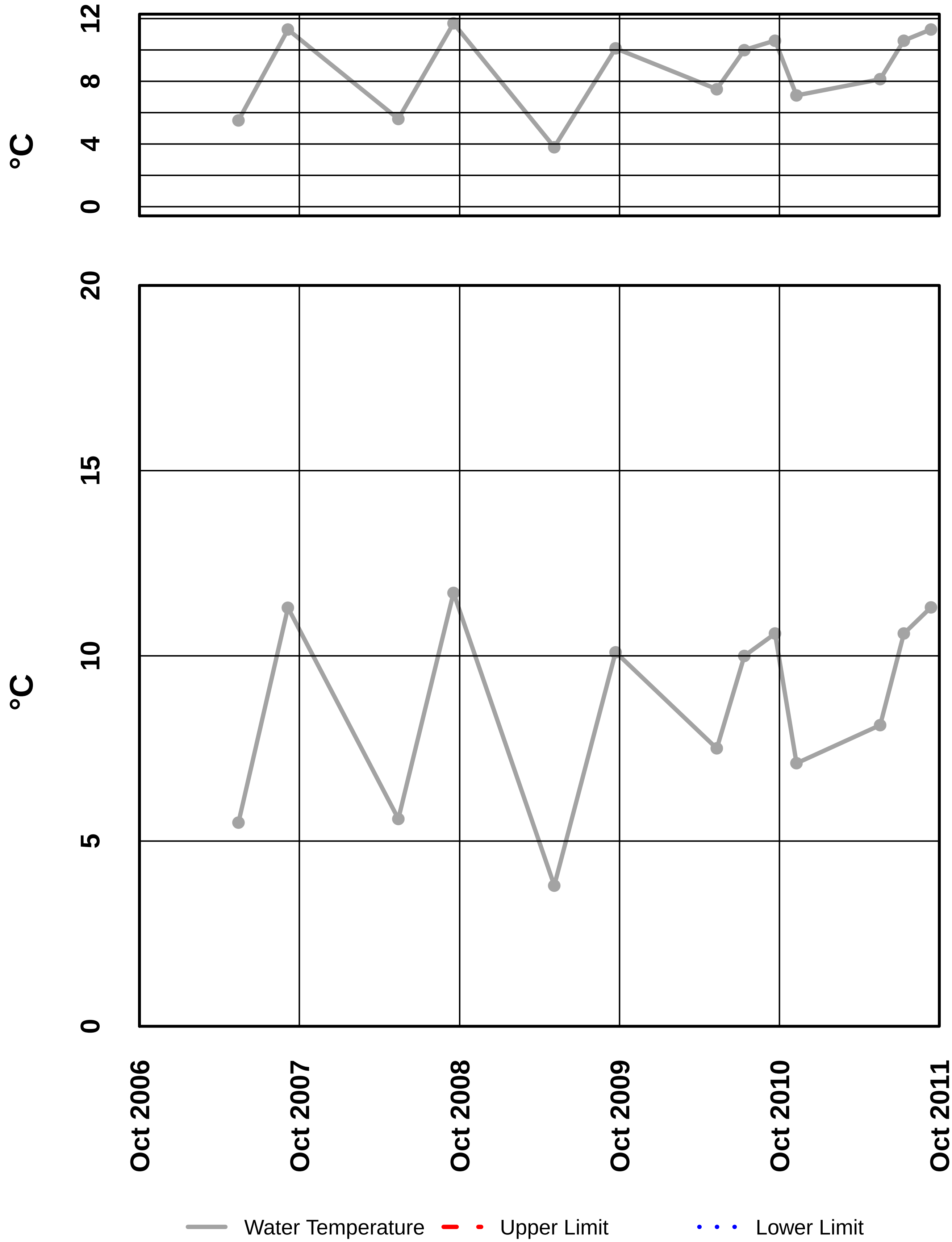
Qualified Data by QA Reviewer

Date Range: 10/01/2010 to 09/30/2011

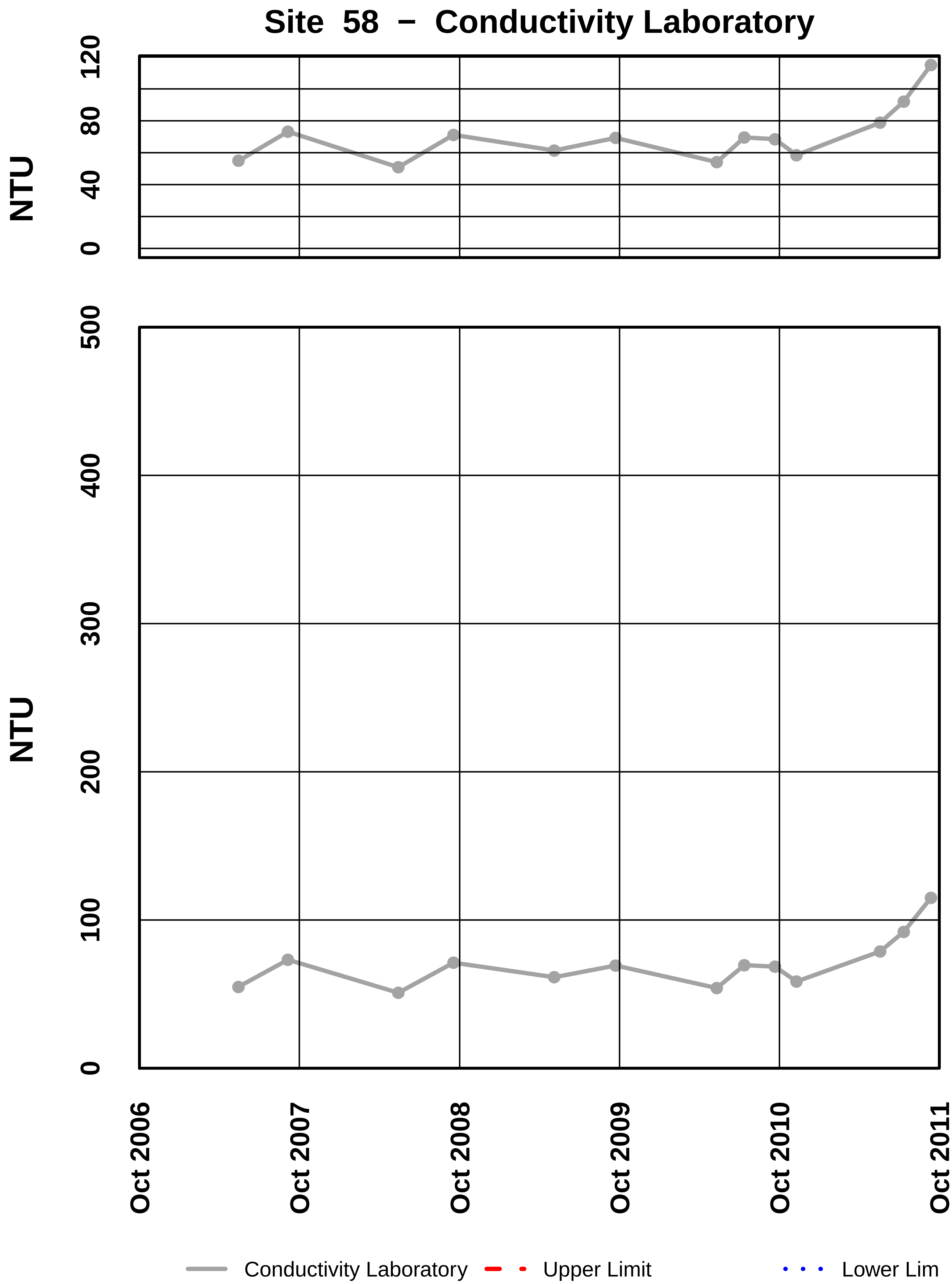
Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
58	11/9/2010	12:00 AM				
			Zn diss, µg/l	0.105	J	Below Quantitative Range
			SO4 Tot, mg/l	1.1	J	Below Quantitative Range
58	4/12/2011	12:00 AM				
			Hg diss, µg/l	0.00121	U	Field Blank Contamination
58	5/19/2011	12:00 AM				
			pH Lab, su	6.1	J	Hold Time Violation
			SO4 Tot, mg/l	-10	R	Sample Reciept Temperature
			Ni diss, µg/l	0.769	U	Field Blank Contamination
58	7/12/2011	12:00 AM				
			SO4 Tot, mg/l	-3	R	Sample Reciept Temperature
			Ni diss, µg/l	0.67	U	Field Blank Contamination
			Zn diss, µg/l	2.79	U	Field Blank Contamination
			Ag diss, µg/l	0.00401	J	Below Quantitative Range
58	9/12/2011	12:00 AM				
			Cd diss, µg/l	0.00468	J	Below Quantitative Range
			Hg diss, µg/l	0.000892	U	Field Blank Contamination
			SO4 Tot, mg/l	0	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

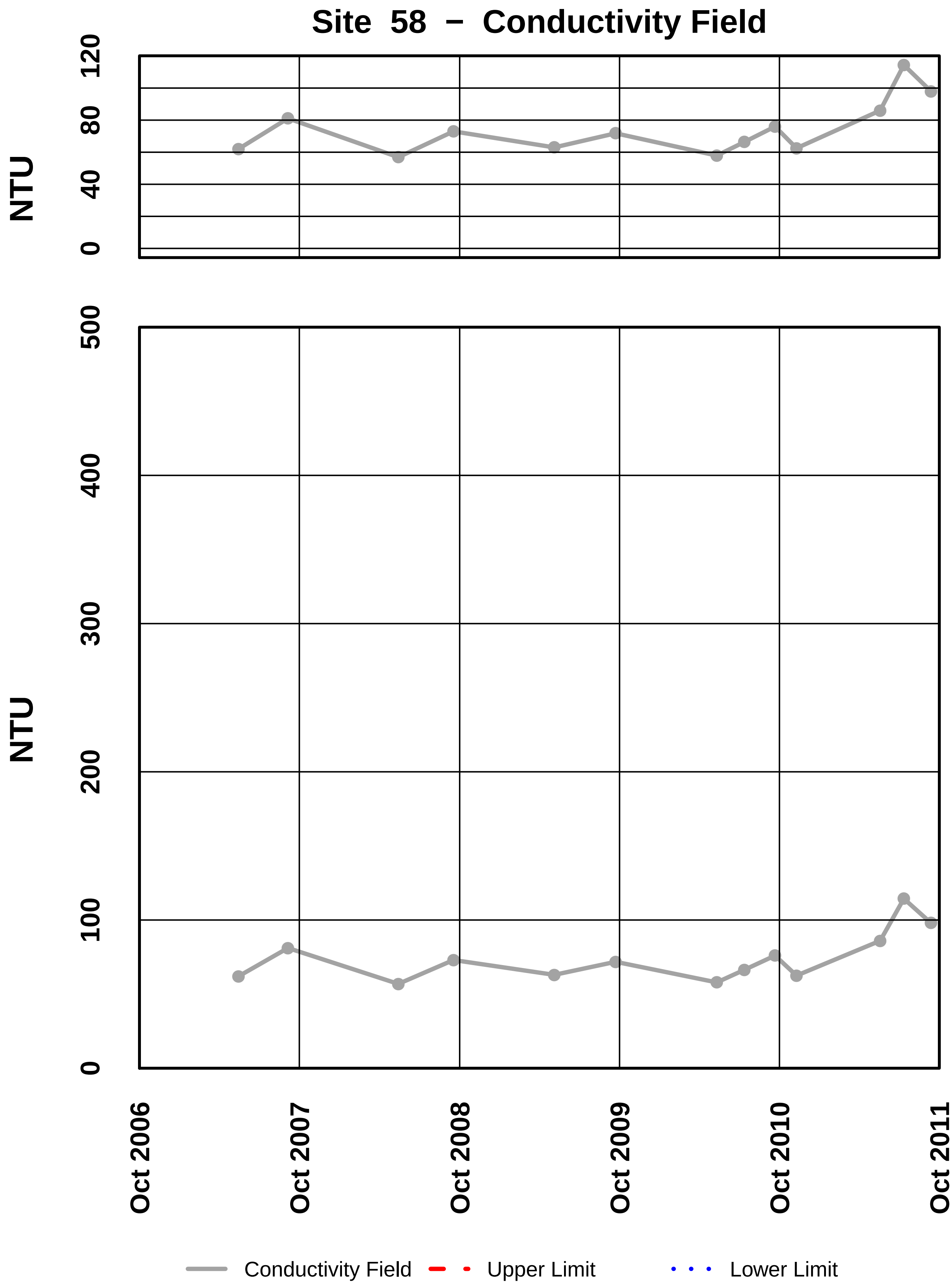
Site 58 – Water Temperature



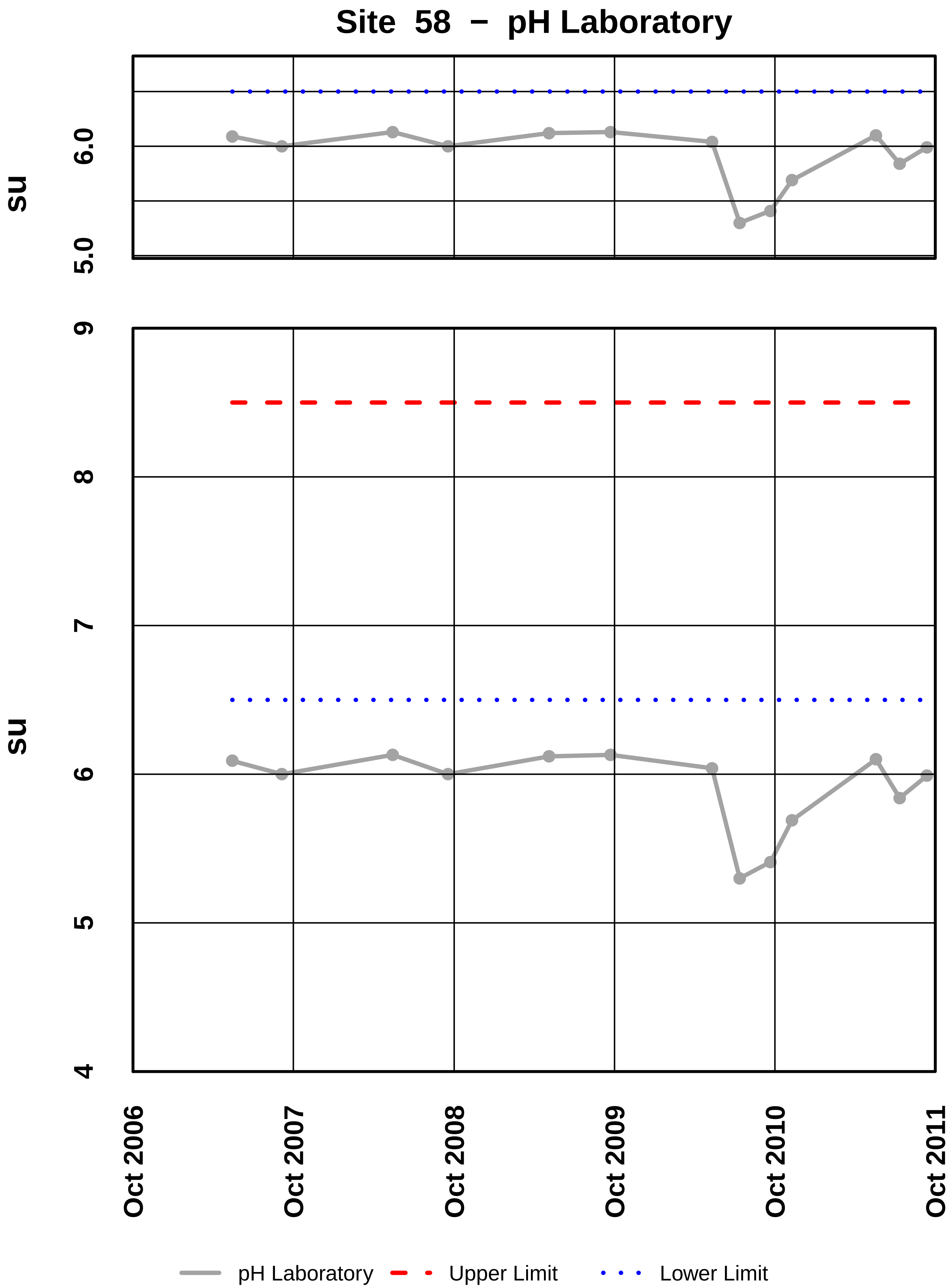
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



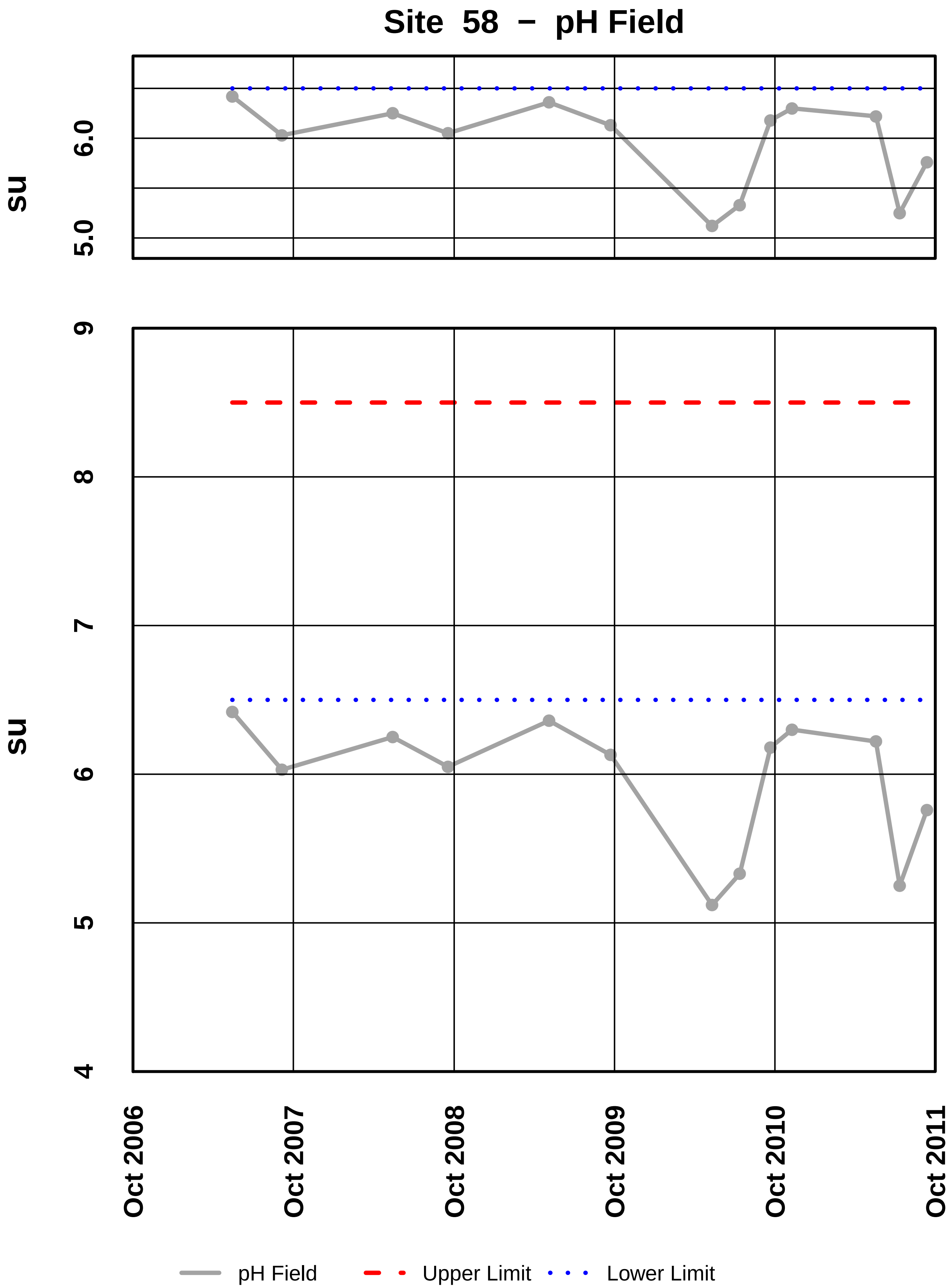
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



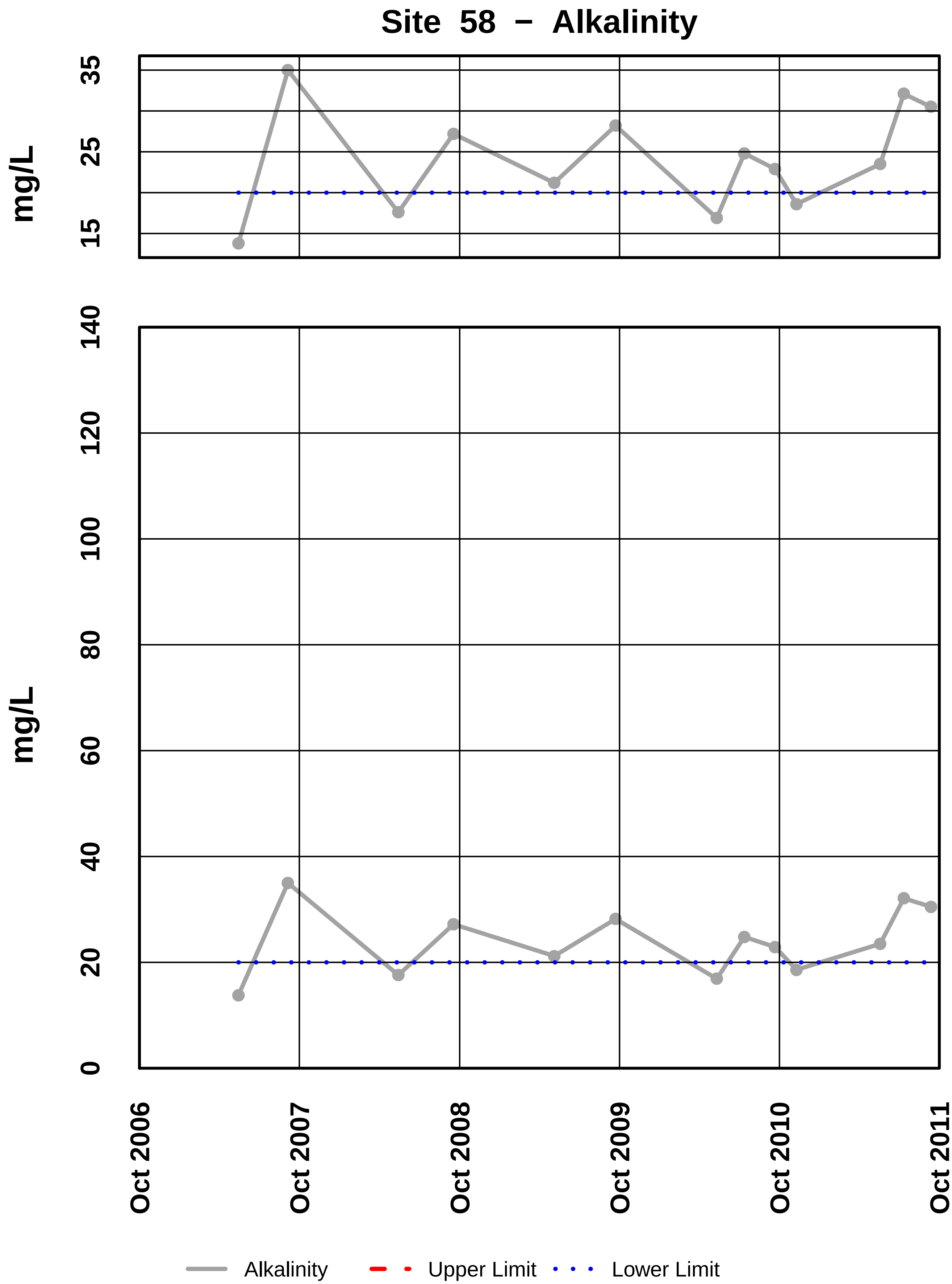
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

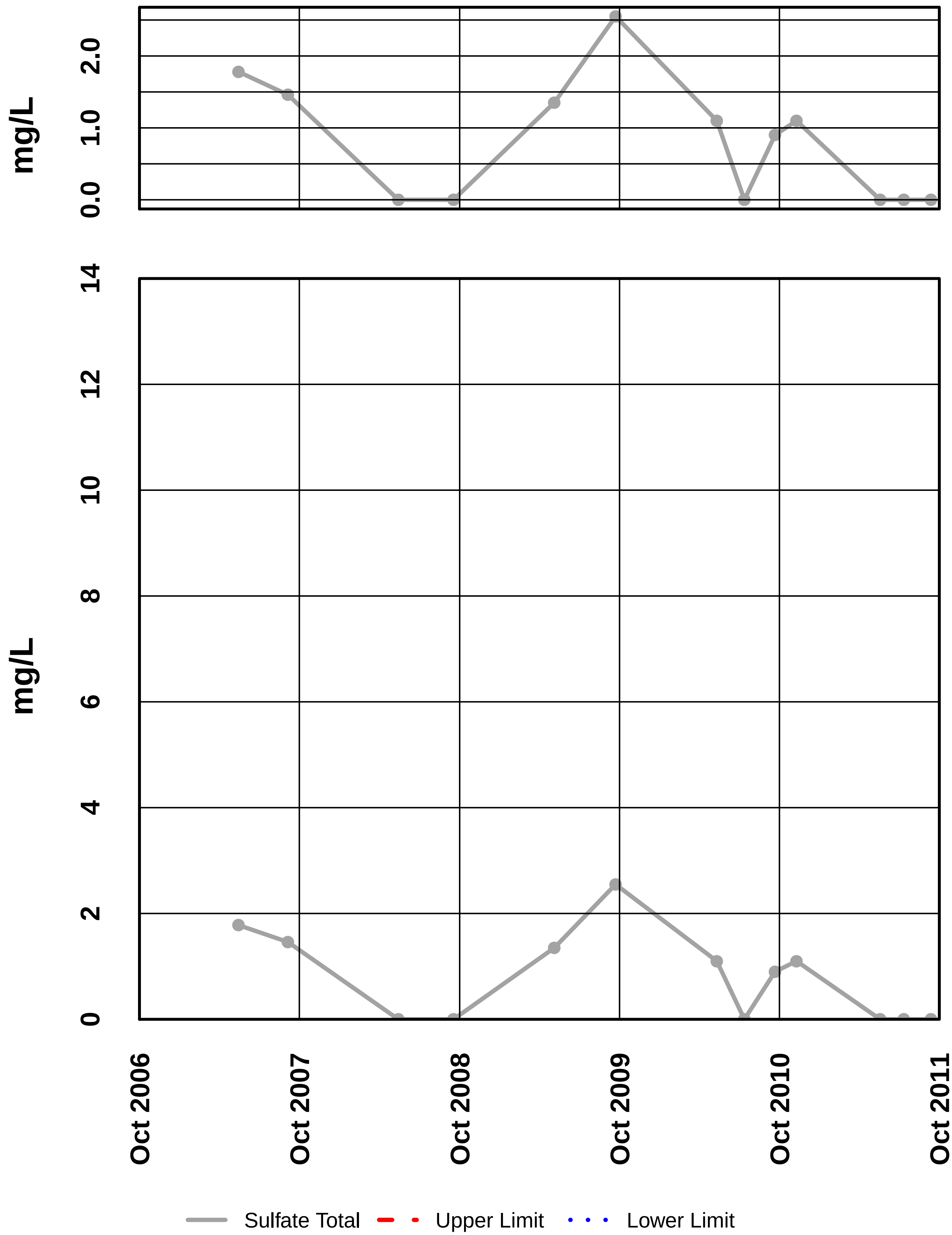


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

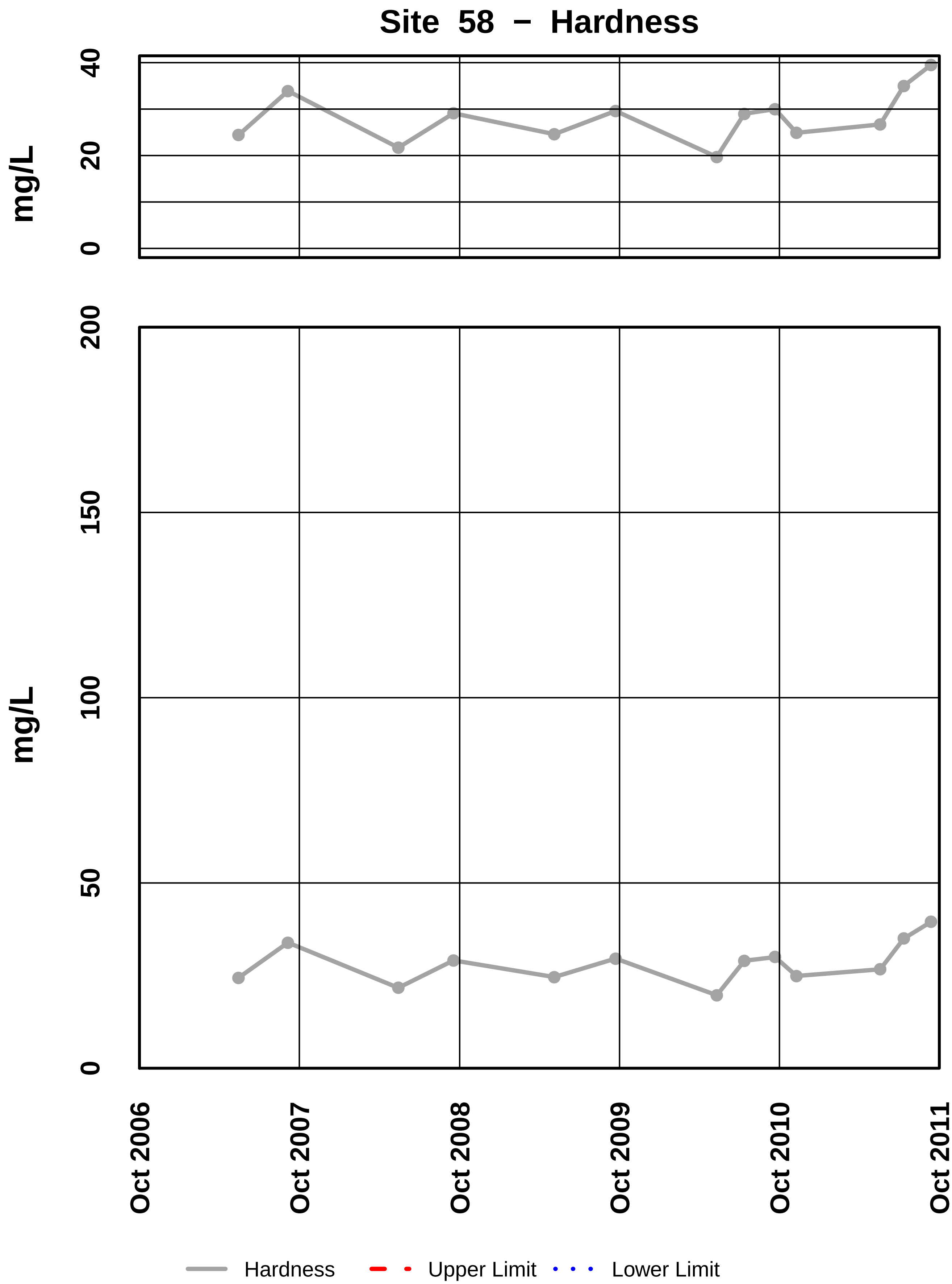


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 58 – Sulfate Total

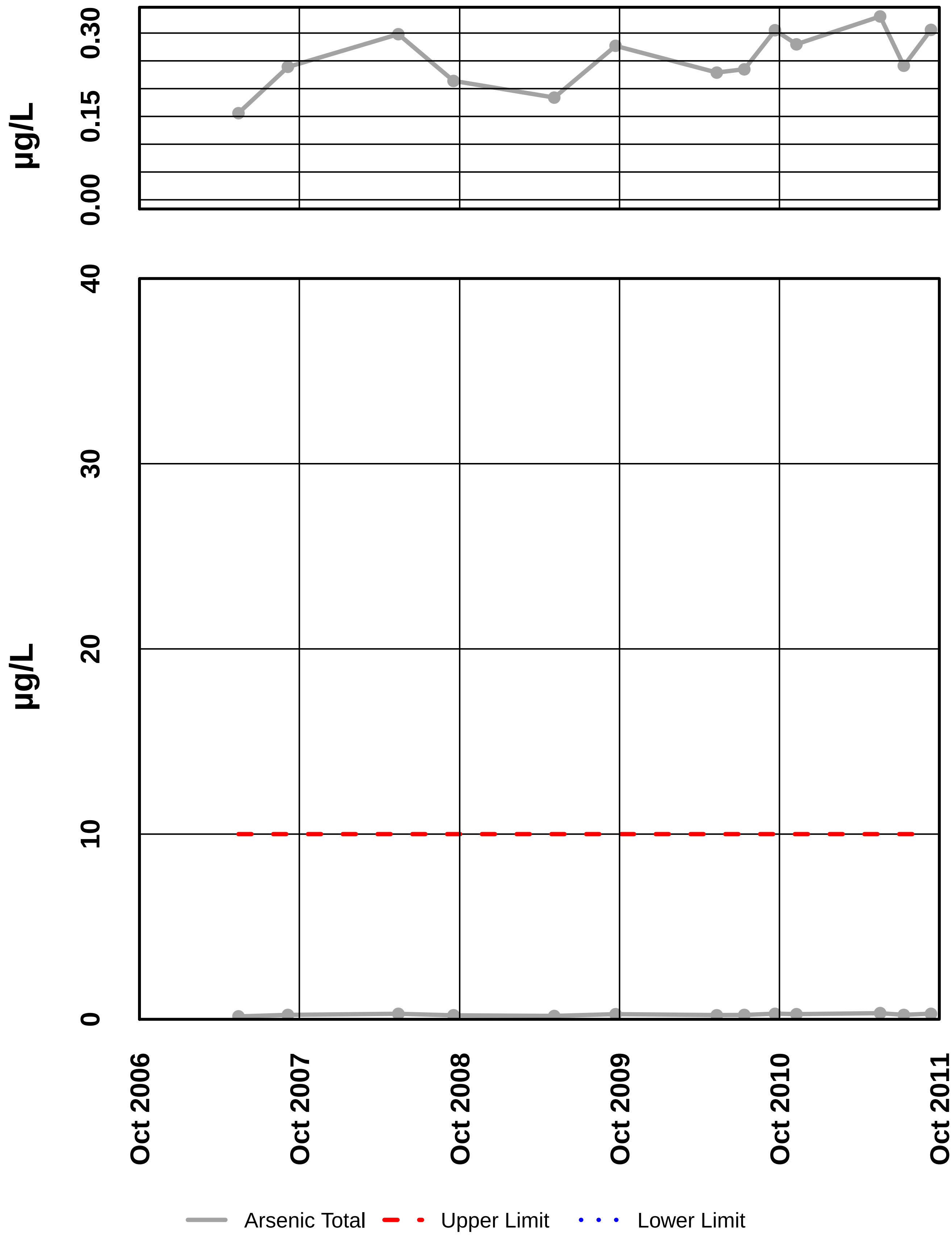


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

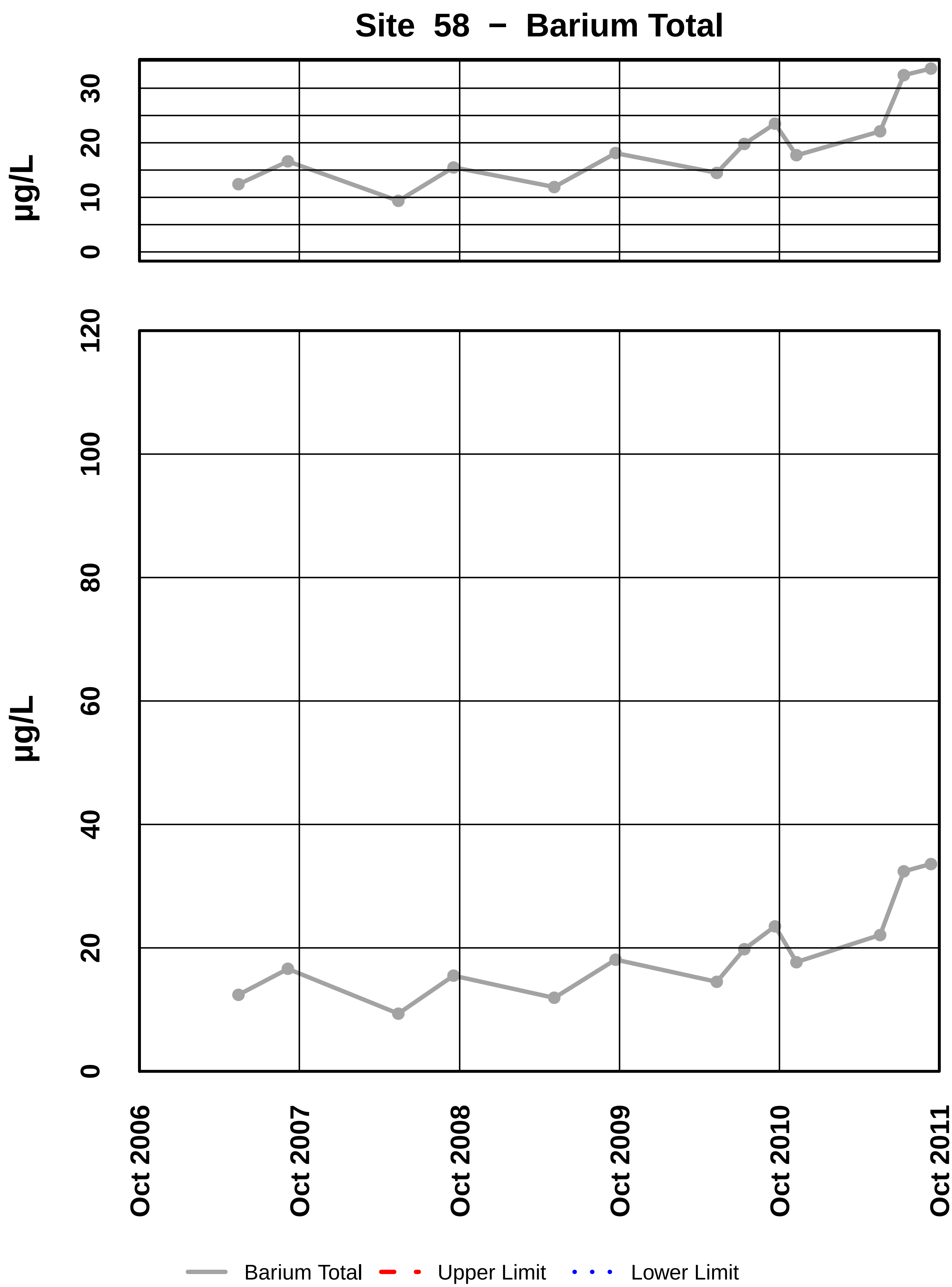


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

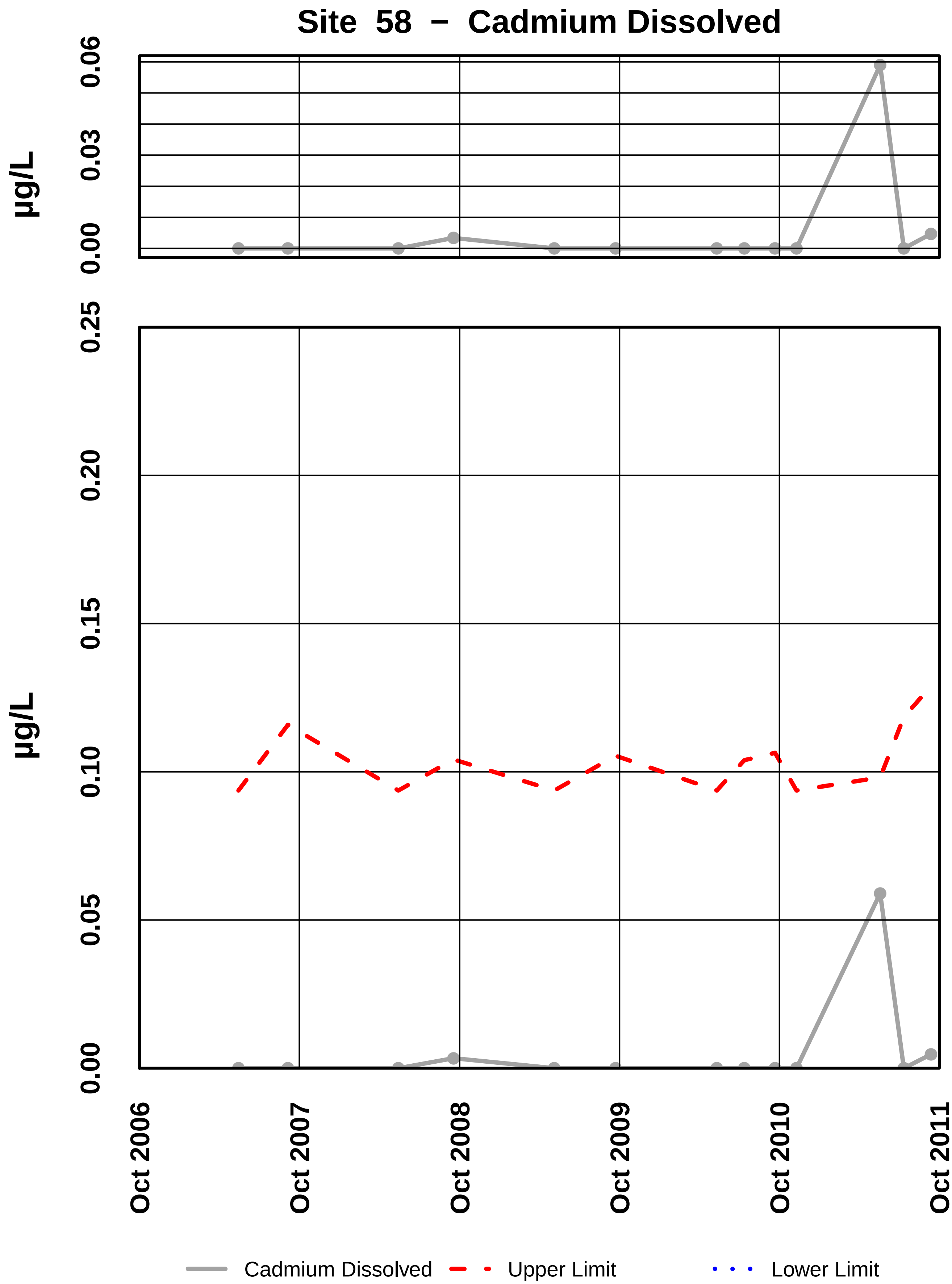
Site 58 − Arsenic Total



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

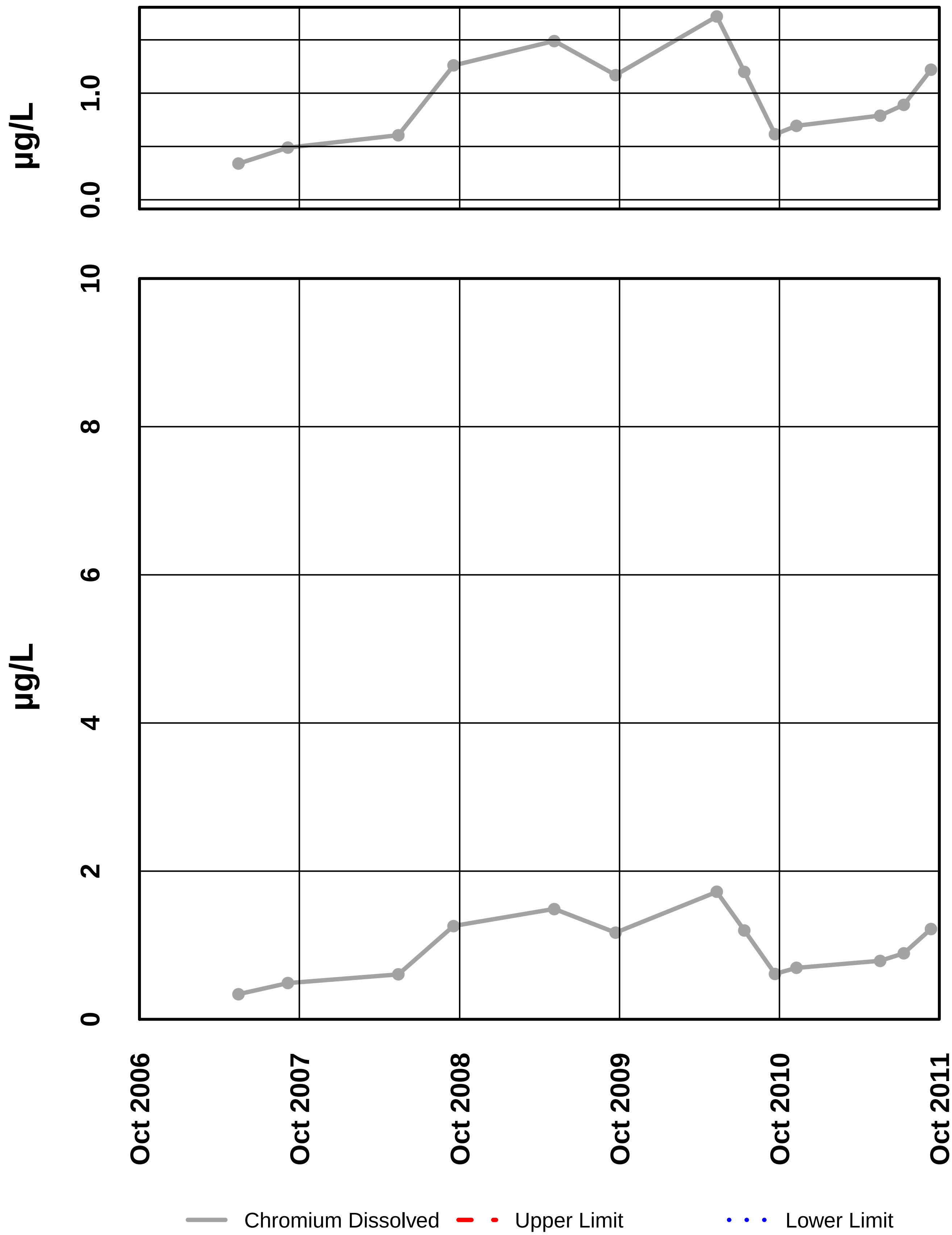


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

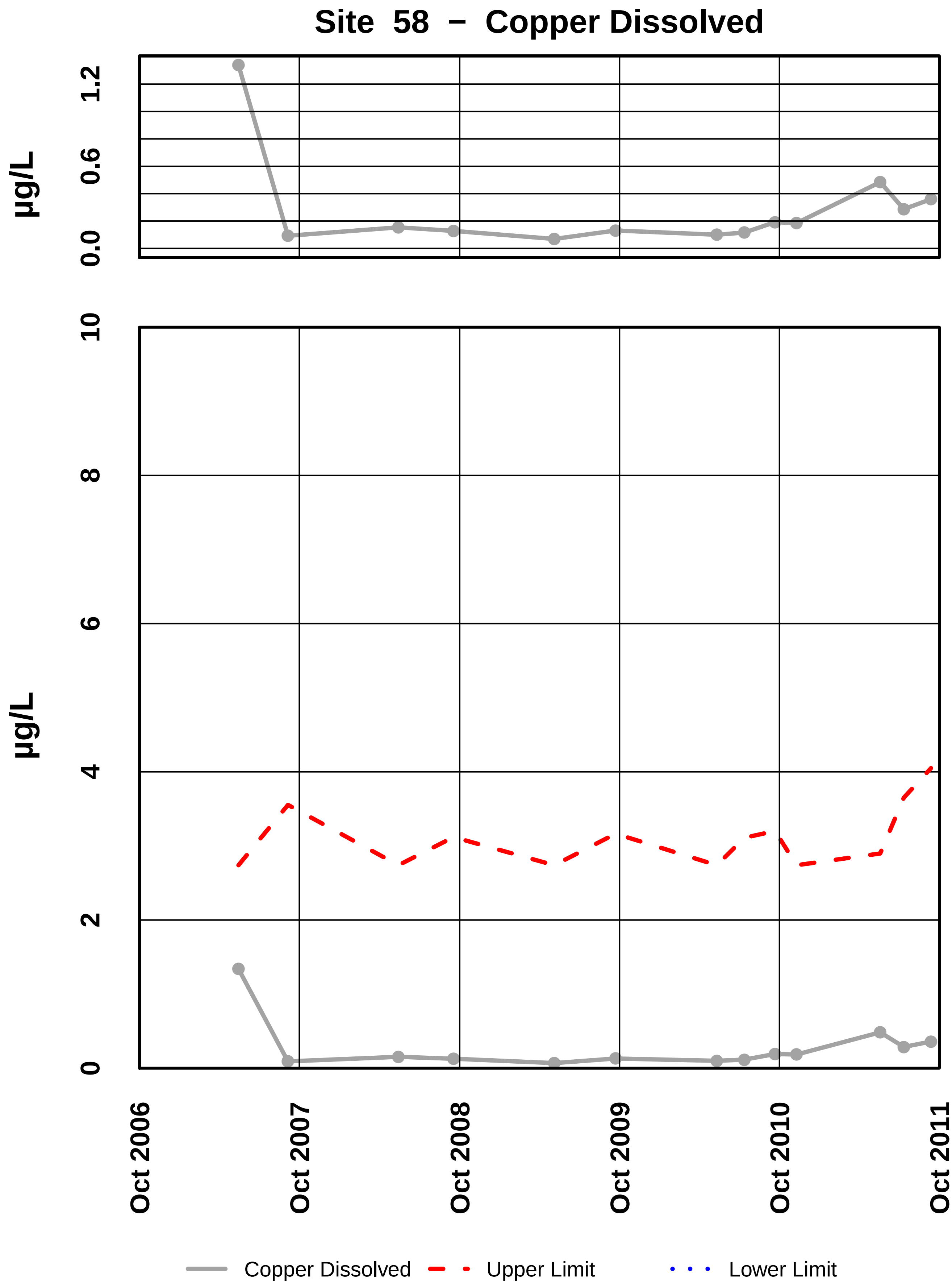


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

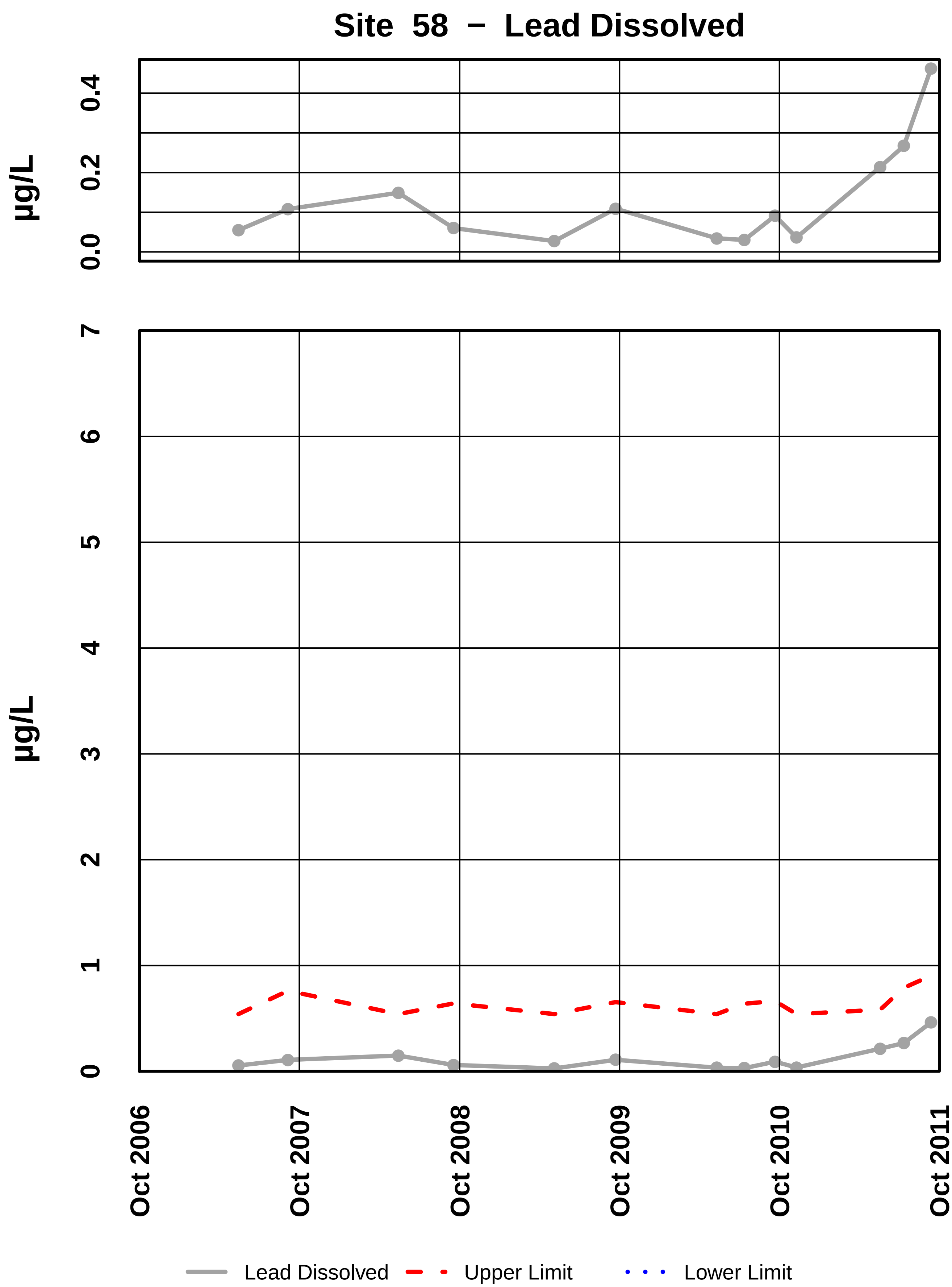
Site 58 – Chromium Dissolved



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

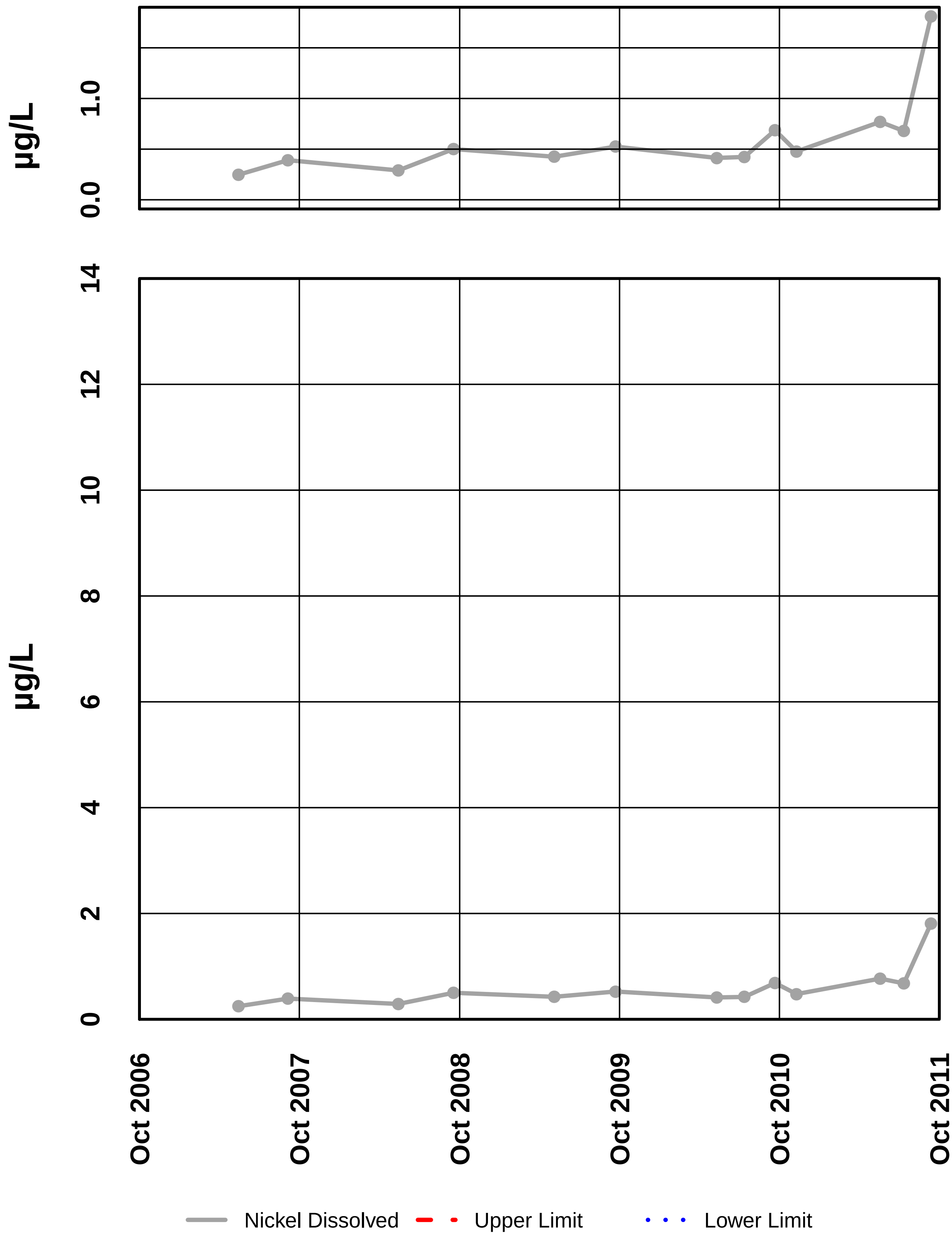


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

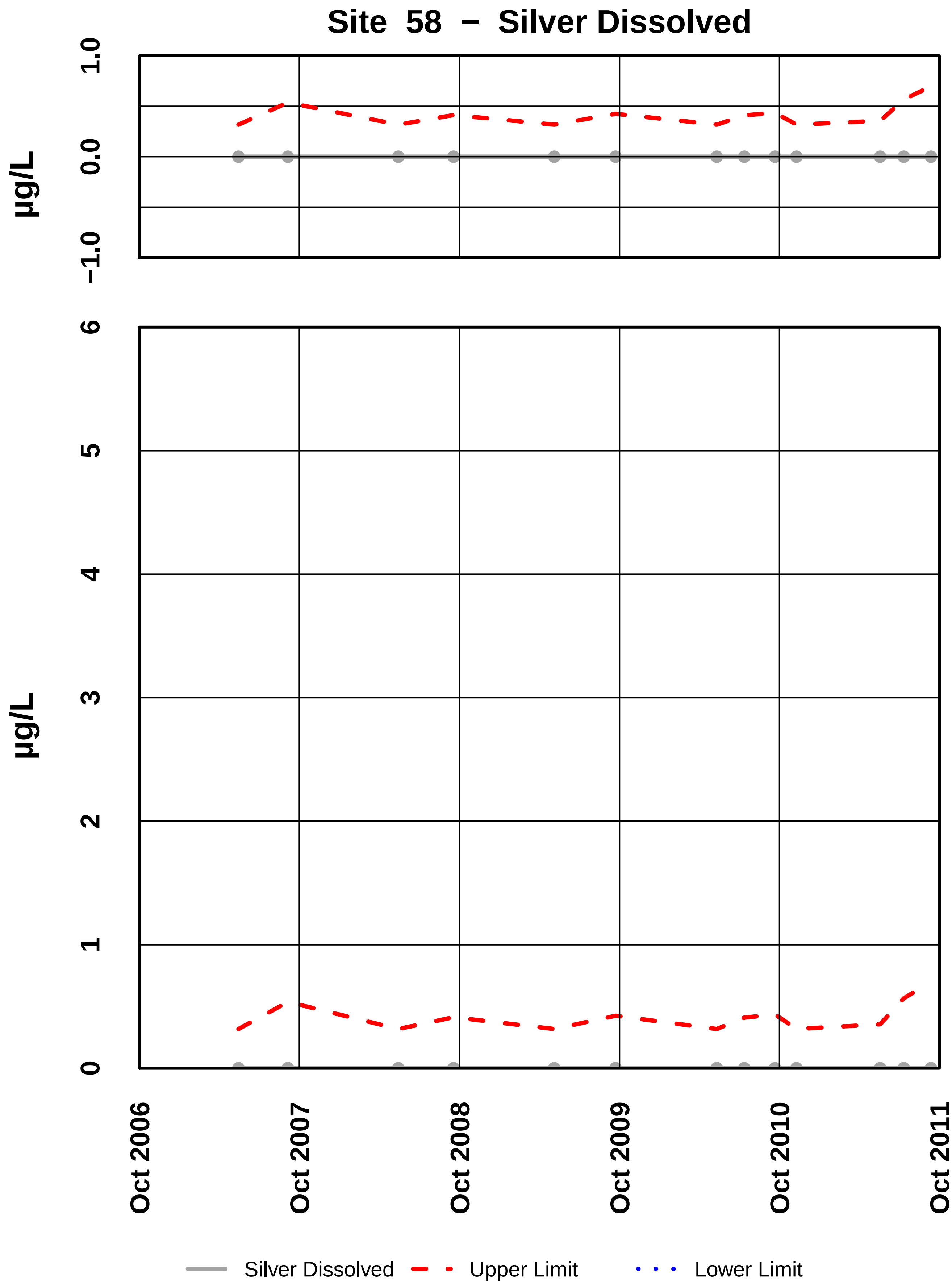


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

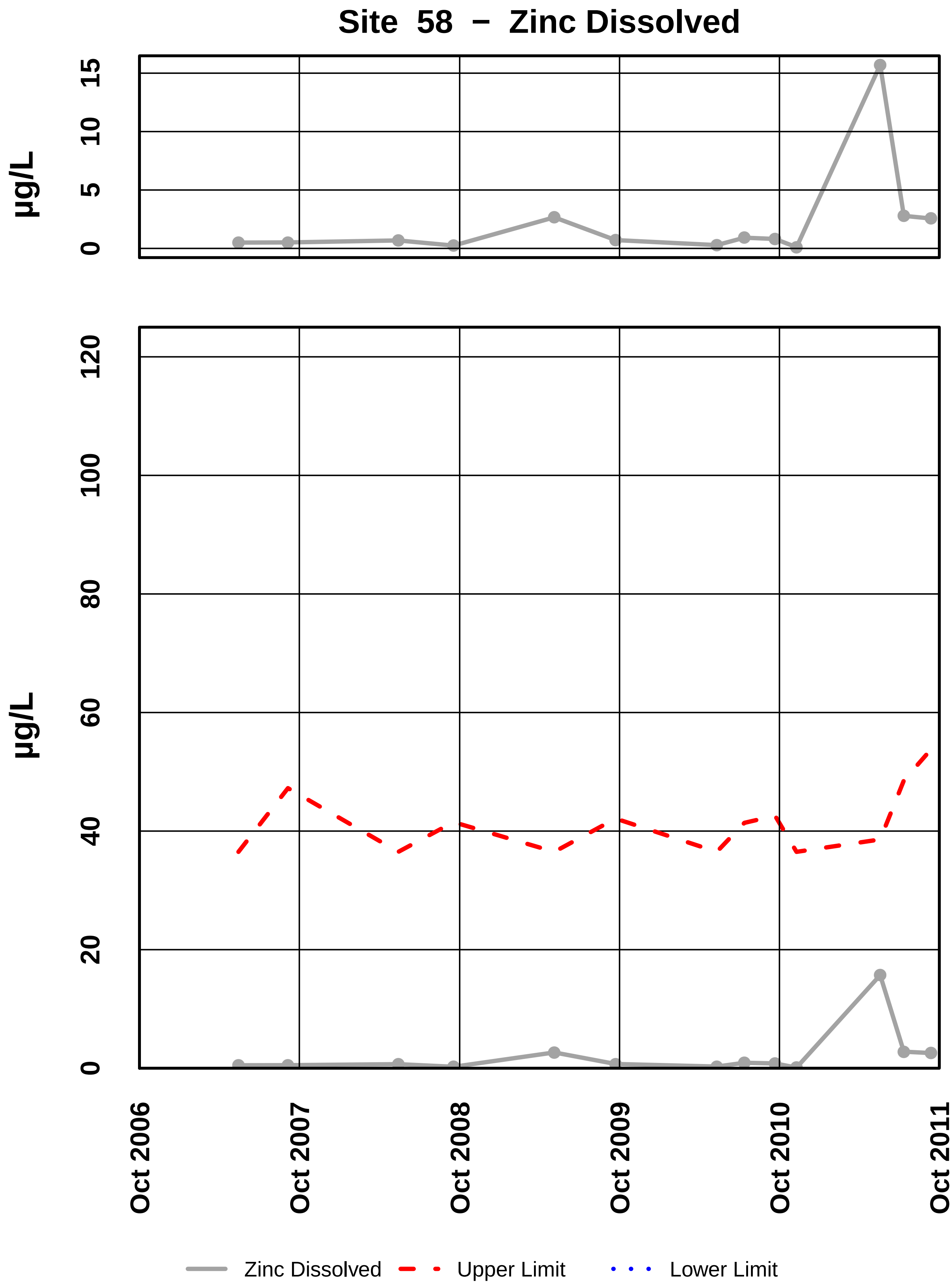
Site 58 – Nickel Dissolved



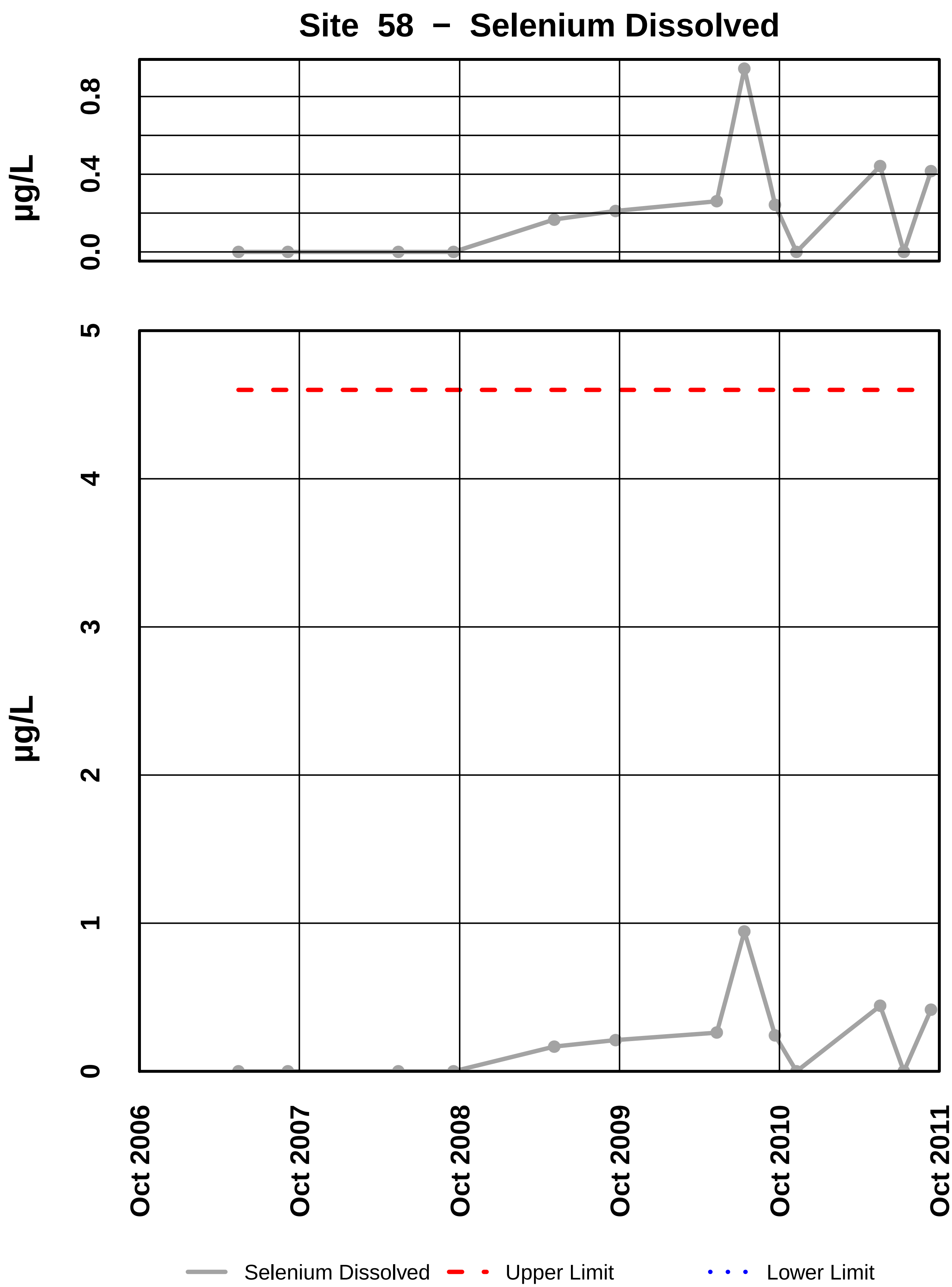
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



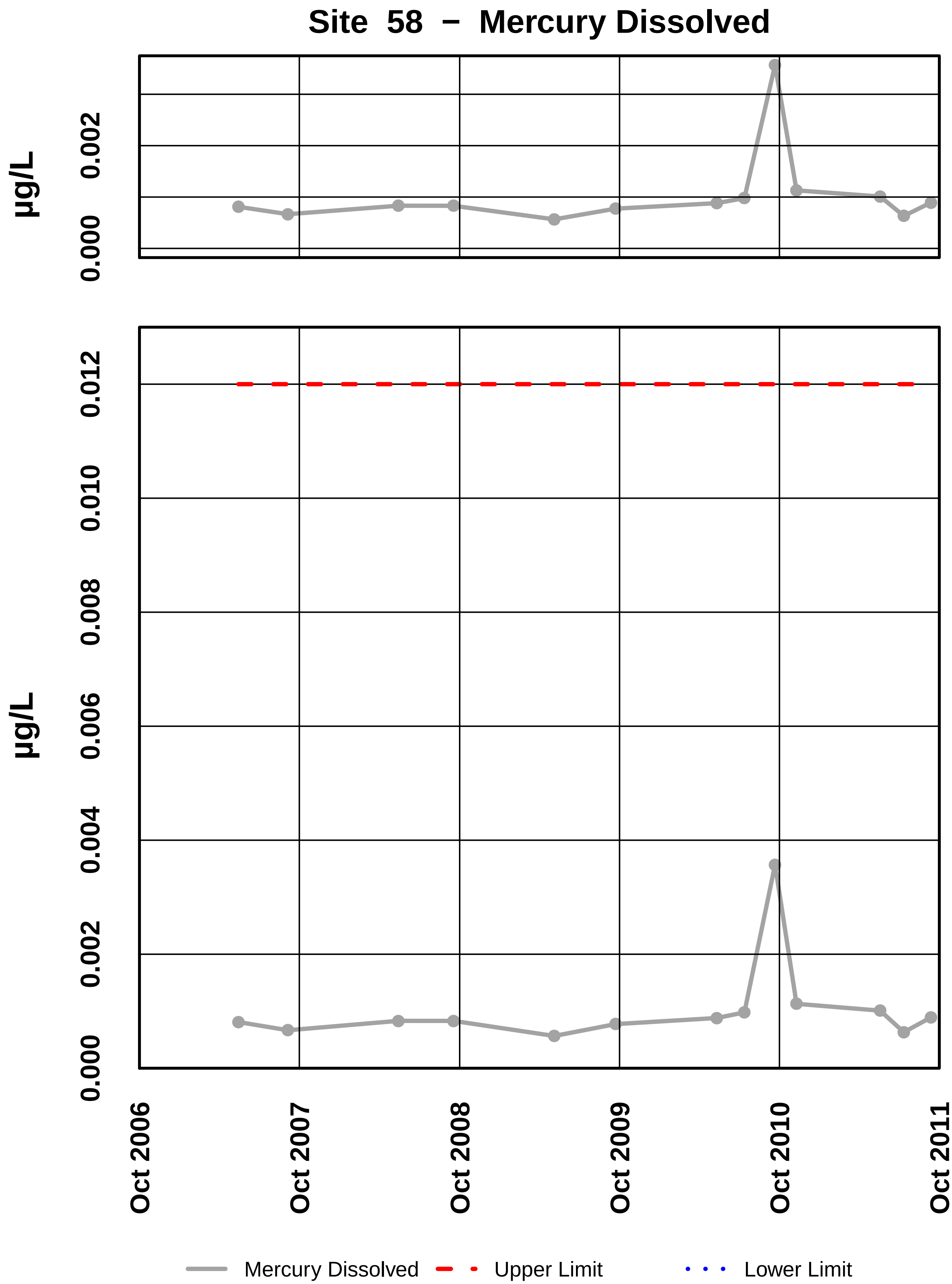
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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



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, Lab (uS/cm)

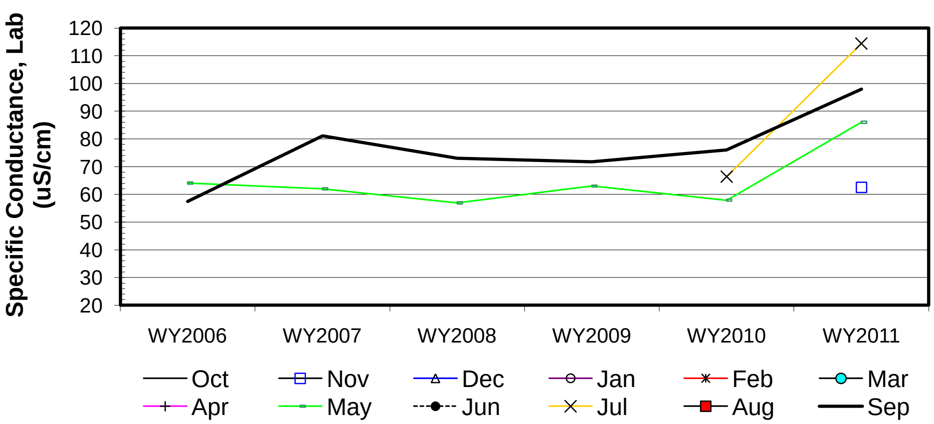
Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2006**								64.1				57.4
b	**WY2007**								62				81.1
c	**WY2008**								56.9				73
d	**WY2009**								63				71.8
e	**WY2010**								57.9		66.4		76
f	**WY2011**		62.5						86		114.4		98
	n	0	1	0	0	0	0	0	6	0	2	0	6
	t_1	0	1	0	0	0	0	0	6	0	2	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
	f-d								1				1
	f-e								1		1		1
	S_k	0	0	0	0	0	0	0	1	0	1	0	7
	σ^2_S=								28.33		1.00		28.33
	$Z_k = S_k/\sigma_S$								0.19		1.00		1.32
	Z^2_k								0.04		1.00		1.73

ΣZ_k=	2.50
ΣZ^2_k=	2.76
Z-bar=$\Sigma Z_k/K$=	0.83

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	15	0	0	0	0

Σn	15
ΣS_k	9

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=		0.68	@α=5% $\chi^2_{(K-1)}$= 5.99	Test for station homogeneity	
	p	**0.713**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc}	1.05	@α/2=2.5% Z= 1.96	**H_0** (No trend)	ACCEPT
57.67	p	**0.854**		**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-1.83		8.79
0.050	-1.32	**4.23**	7.37
0.100	-0.67		6.04
0.200	0.50		4.75

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2006**								6.3				6.2
b	**WY2007**								6.4				6.0
c	**WY2008**								6.3				6.1
d	**WY2009**								6.4				6.1
e	**WY2010**								5.1		5.3		6.2
f	**WY2011**		6.3						6.2		5.3		5.8
	n	0	1	0	0	0	0	0	6	0	2	0	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	0	1	0	0	0	0	0	6	0	2	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
f-d								-1				-1
f-e								1		-1		-1
S_k	0	0	0	0	0	0	0	-7	0	-1	0	-3

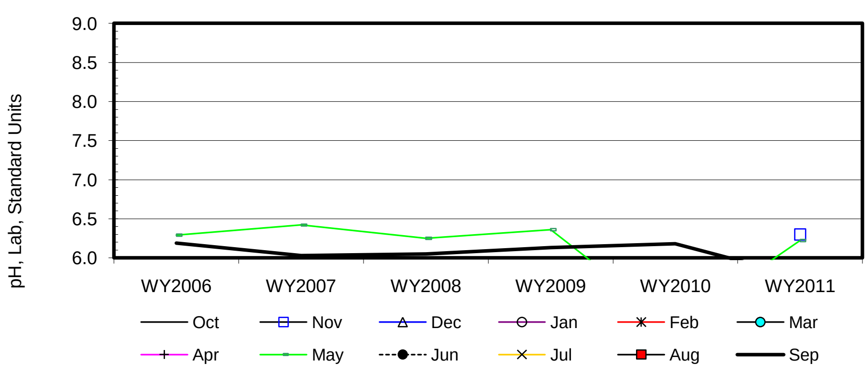
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=								28.33		1.00		28.33
$Z_k = S_k/\sigma_S$								-1.32		-1.00		-0.56
Z^2_k								1.73		1.00		0.32

ΣZ_k= -2.88
ΣZ^2_k= 3.05
Z-bar=$\Sigma Z_k/K$= -0.96

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	15	0	0	0	0

Σn 15
ΣS_k -11

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	0.28	@α=5% $\chi^2_{(K-1)}$= 5.99	Test for station homogeneity	
p	**0.867**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k) Z_{calc}	-1.32	@α/2=2.5% Z= 1.96	H_0 (No trend)	ACCEPT
57.67 **p**	**0.094**		H_A (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.17		0.05
0.050	-0.09	**-0.03**	0.01
0.100	-0.08		-0.01
0.200	-0.07		-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	**WY2006**								24.5				25.0
b	**WY2007**								13.8				35.0
c	**WY2008**								17.6				27.2
d	**WY2009**								21.2				28.2
e	**WY2010**								16.9		24.8		22.9
f	**WY2011**		18.6						23.5		32.1		30.5
	n	0	1	0	0	0	0	0	6	0	2	0	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	0	1	0	0	0	0	0	6	0	2	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
f-d								1				1
f-e								1		1		1
S_k	0	0	0	0	0	0	0	1	0	1	0	1

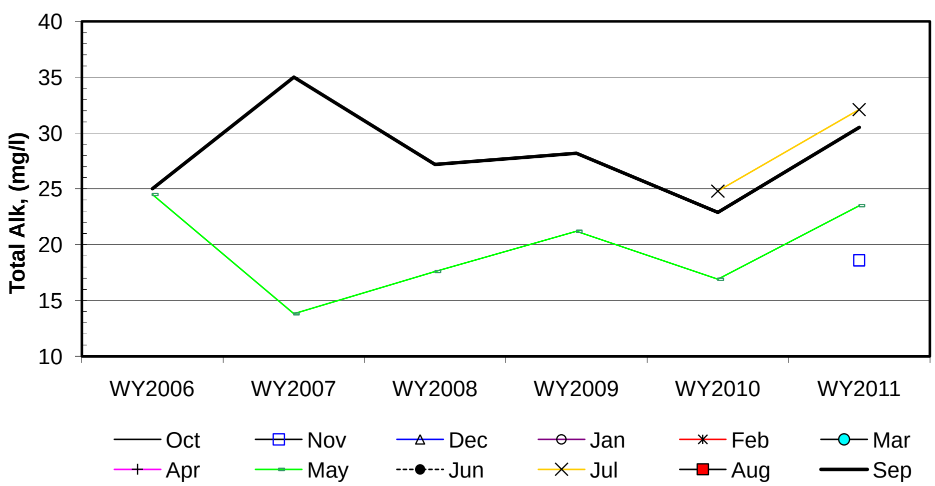
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=								28.33		1.00		28.33
$Z_k = S_k/\sigma_S$								0.19		1.00		0.19
Z^2_k								0.04		1.00		0.04

ΣZ_k= 1.38
ΣZ^2_k= 1.07
Z-bar=ΣZ_k/K= 0.46

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	15	0	0	0	0

Σn 15
ΣS_k 3

$\chi^2_h=\Sigma Z^2_k$-K(Z-bar)^2=	0.44	@α=5% $\chi^2_{(K-1)}$=	5.99	Test for station homogeneity	
p	**0.803**			$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc} 0.26	@α/2=2.5% Z=	1.96	**H_0** (No trend)	ACCEPT
57.67	**p** **0.604**			**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-3.42		2.82
0.050	-1.70	**1.03**	1.15
0.100	-1.11		1.12
0.200	-0.47		1.10

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	**WY2006**								1.5				1.2
b	**WY2007**								1.8				1.5
c	**WY2008**								0.0				0.0
d	**WY2009**								1.4				2.6
e	**WY2010**								1.1		0.0		0.9
f	**WY2011**		1.1						0.0		0.0		0.0
	n	0	1	0	0	0	0	0	6	0	2	0	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	0	1	0	0	0	0	0	4	0	0	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								-1				-1
f-b								-1				-1
d-c								1				1
e-c								1				1
f-c								0				0
e-d								-1				-1
f-d								-1				-1
f-e								-1		0		-1
S_k	0	0	0	0	0	0	0	-8	0	0	0	-4

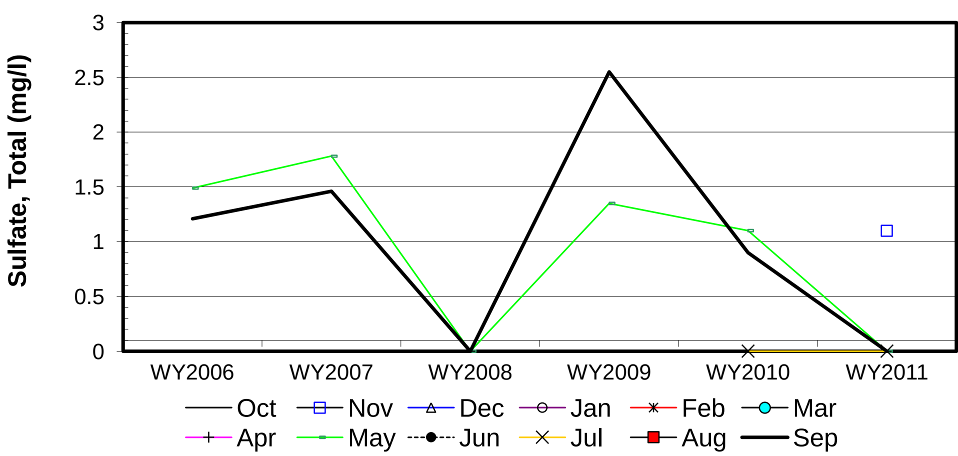
	May	Jul	Sep
σ^2_S=	27.33	0.00	27.33
$Z_k = S_k/\sigma_S$	-1.53	#DIV/0!	-0.77
Z^2_k	2.34	#DIV/0!	0.59

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	9	3	0	0	0

Σn 15
ΣS_k -12

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	#DIV/0!	@α=5% $\chi^2_{(K-1)}$= 5.99	Test for station homogeneity	
p	**#DIV/0!**		$\chi^2_h<\chi^2_{(K-1)}$	#DIV/0!
ΣVAR(S_k)	Z_{calc} -1.49	@α=5% Z= 1.64	H_0 (No trend)	ACCEPT
54.67	**p** **0.068**		H_A (± trend)	#DIV/0!



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.76		0.25
0.050	-0.54	**-0.22**	0.00
0.100	-0.38		-0.04
0.200	-0.28		-0.09

#DIV/0!

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	**WY2006**								0.2				0.3
b	**WY2007**								0.5				0.5
c	**WY2008**								0.7				0.2
d	**WY2009**								2.7				0.7
e	**WY2010**								0.3		0.9		0.8
f	**WY2011**		0.1						15.7		2.8		2.6
	n	0	1	0	0	0	0	0	6	0	2	0	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	0	1	0	0	0	0	0	6	0	2	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
f-d								1				1
f-e								1		1		1
S_k	0	0	0	0	0	0	0	9	0	1	0	11

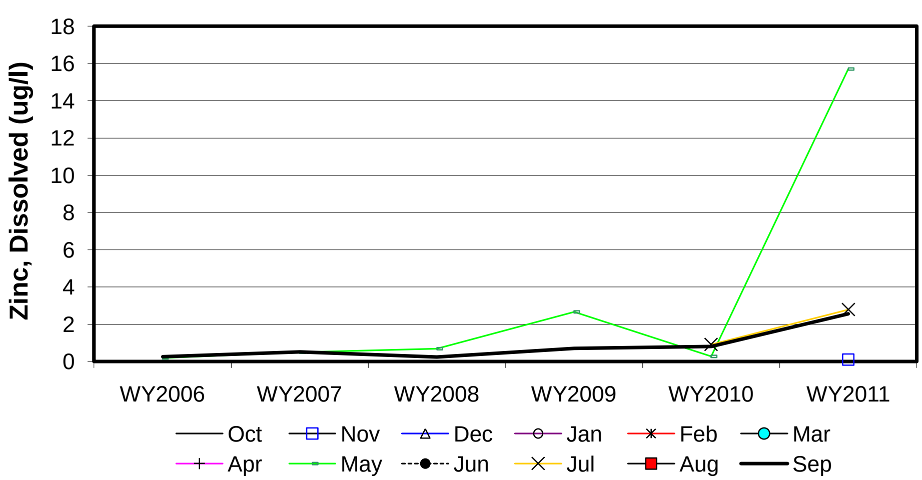
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
$\sigma^2_S=$								28.33		1.00		28.33
$Z_k = S_k/\sigma_S$								1.69		1.00		2.07
Z^2_k								2.86		1.00		4.27

$\Sigma Z_k=$	4.76
$\Sigma Z^2_k=$	8.13
Z-bar$=\Sigma Z_k/K=$	1.59

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	15	0	0	0	0

Σn	15
ΣS_k	21

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2=$		0.59	@α=5% $\chi^2_{(K-1)}=$ 5.99	Test for station homogeneity	
	p	**0.746**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
$\Sigma VAR(S_k)$	Z_{calc}	2.63	@α/2=2.5% $Z=$ 1.96	H_0 (No trend)	REJECT
57.67	**p**	**0.996**		H_A (± trend)	ACCEPT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	0.07		1.79
0.050	0.11	**0.32**	0.90
0.100	0.15		0.79
0.200	0.21		0.50

46.1%

INTERPRETIVE REPORT
SITE 27 “MONITORING WELL 2S”

The data collected during the current water year are listed in the following “Table of Results for Water Year 2011” 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 2011.				

The data for water year2011 have been compared to the strictest fresh water quality criterion for each applicable analyte. Five samples exceeding these criteria have been identified, as listed in the table below. Four of these exceedances were for field pH values which are below the lower limit of 6.5 su listed in the AWQS. Values for field and laboratory 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). The other exceedance was for the May sampling of dissolved zinc which had a value of 54.5 µg/L, exceeding the upper limit of 45.8 µg/L by 8.7 µg/L; prior to this dissolved zinc had not been in exceedance since the May 2007 sampling. By the July 2011 sampling the dissolved zinc (4.3µg/L) had dropped well below upper limit value.   All of the other analytes were within AWQS for the current water year.

Table of Exceedance for Water Year 2011

			Limits		
Sample Date	**Parameter**	**Value**	**Lower**	**Upper**	**Hardness**
9-Nov-10	pH Field	6.21 su	6.5	8.50	
19-May-11	pH Field	6.16 su	6.5	8.50	
12-Jul-11	pH Field	5.28 su	6.5	8.50	
12-Sep-11	pH Field	6.19 su	6.5	8.50	
19-May-11	Zinc Dissolved	54.5 µg/L		45.82	32.70 mg/L

X-Y plots have been generated to graphically present the data for each of the analytes requested in the Statistical Information Goals for this site. These plots have been visually analyzed for the appearance of any trend in concentration. 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 June 2011, which is slightly more than an order of magnitude of increase from the 2006 through 2008 water years. This trend is supported by the non-parametric statistical analyses that 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-05 and Sep-11 (WY2006-WY2011).

Table of Summary Statistics for Trend Analysis

	Mann-Kendall test statistics			Sen's slope estimate	
Parameter	**n***	**p****	**Trend**	**Q**	**Q(%)**
Conductivity Field	6	0.09			
pH Field	6	0.12			
Alkalinity, Total	6	0.45			
Sulfate, Total	6	<0.01	+	3.68	28.28
Zinc, Dissolved	6	0.30			

* 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 sulfate has a statistically significant ($p<0.01$) trend with a slope estimate of 3.68mg/L/yr or a 28.3% increase over the last 6 years. These values are similar to those calculated for the 2010 report of 3.52 mg/L/yr or an increase of 35.2%. The percent increase over time should decrease as the site reaches a new equilibrium. Sulfate results at this site prior to 1996 are highly variable and typically ranged between 1 to 10 mg/L. WY2009 – WY2011 results indicate a substantial increase in sulfate concentration at Site 27 over the previous five years. Though total sulfate has increased at site 27 it is still ~1/8 of the AWQS of 250mg/L. 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.

Table of Results for Water Year 2011

Site 027FMG - 'Monitoring Well - 2S'

Sample Date/Parameter	Oct 2010	Nov 2010	Dec 2010	Jan 2011	Feb 2011	Mar 2011	Apr 2011	May 2011	Jun 2011	Jul 2011	Aug 2011	Sep 2011	**Median**
Water Temp (°C)		7.1						8.1		10.4		8.4	8.3
Conductivity-Field(μmho)		108.8						155		186.8		96	131.9
Conductivity-Lab (μmho)		101						128		155		107	118
pH Lab (standard units)		5.57						5.98		5.73		5.72	5.73
pH Field (standard units)		6.21						6.16		5.28		6.19	6.18
Total Alkalinity (mg/L)		22						22		34.8		26.1	24.1
Total Sulfate (mg/L)		16.4						25		15		13	15.7
Hardness (mg/L)		35.9						32.7		46.7		34.1	35.0
Dissolved As (ug/L)		3.42						3.84		2.18		3.08	3.250
Dissolved Ba (ug/L)		36.7						41.2		48.2		45.2	43.2
Dissolved Cd (ug/L)		0.004						0.0131		0.0018		0.0018	0.0029
Dissolved Cr (ug/L)		0.824						0.368		0.608		0.574	0.591
Dissolved Cu (ug/L)		0.253						1.49		0.288		0.199	0.271
Dissolved Pb (ug/L)		0.188						0.17		0.141		0.224	0.1790
Dissolved Ni (ug/L)		1.11						1.23		1.23		1.63	1.230
Dissolved Ag (ug/L)		0.004						0.002		0.002		0.002	0.002
Dissolved Zn (ug/L)		1.13						54.5		4.25		2.45	3.35
Dissolved Se (ug/L)		0.297						0.154		0.127		0.343	0.226
Dissolved Hg (ug/L)		0.00306						0.000594		0.00164		0.00134	0.001490

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

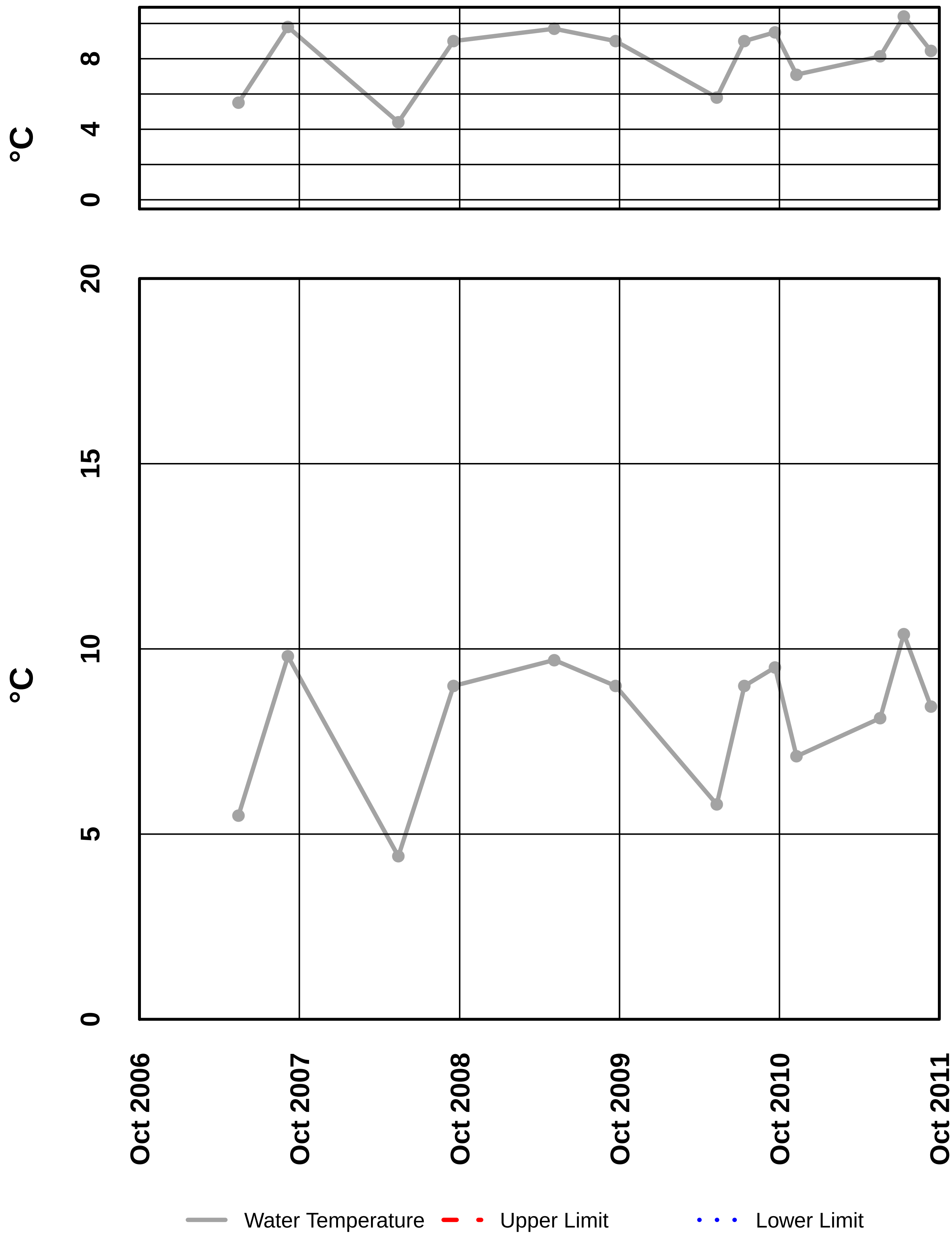
Qualified Data by QA Reviewer

Date Range: 10/01/2010 to 09/30/2011

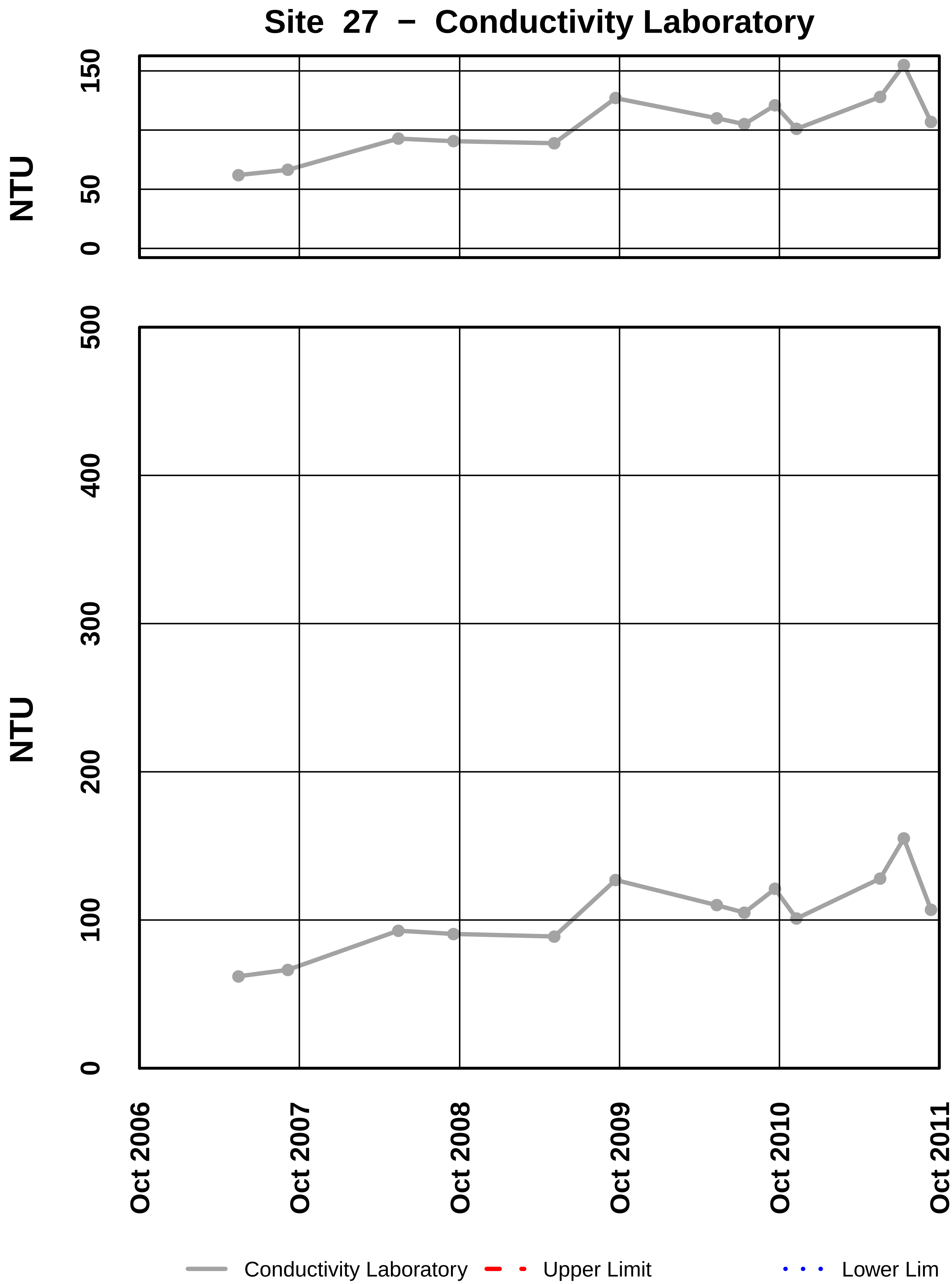
Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
27	11/9/2010	12:00 AM				
			Se diss, µg/l	0.297	J	Below Quantitative Range
27	5/19/2011	12:00 AM				
			SO4 Tot, mg/l	25	J	Sample Reciept Temperature
			Se diss, µg/l	0.154	J	Below Quantitative Range
			pH Lab, su	5.98	J	Hold Time Violation
			Cd diss, µg/l	0.0131	U	Trip Blank Contamination
27	7/12/2011	12:00 AM				
			Se diss, µg/l	0.12	J	Below Quantitative Range
			SO4 Tot, mg/l	-30	R	Sample Reciept Temperature
27	9/12/2011	12:00 AM				
			SO4 Tot, mg/l	13	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

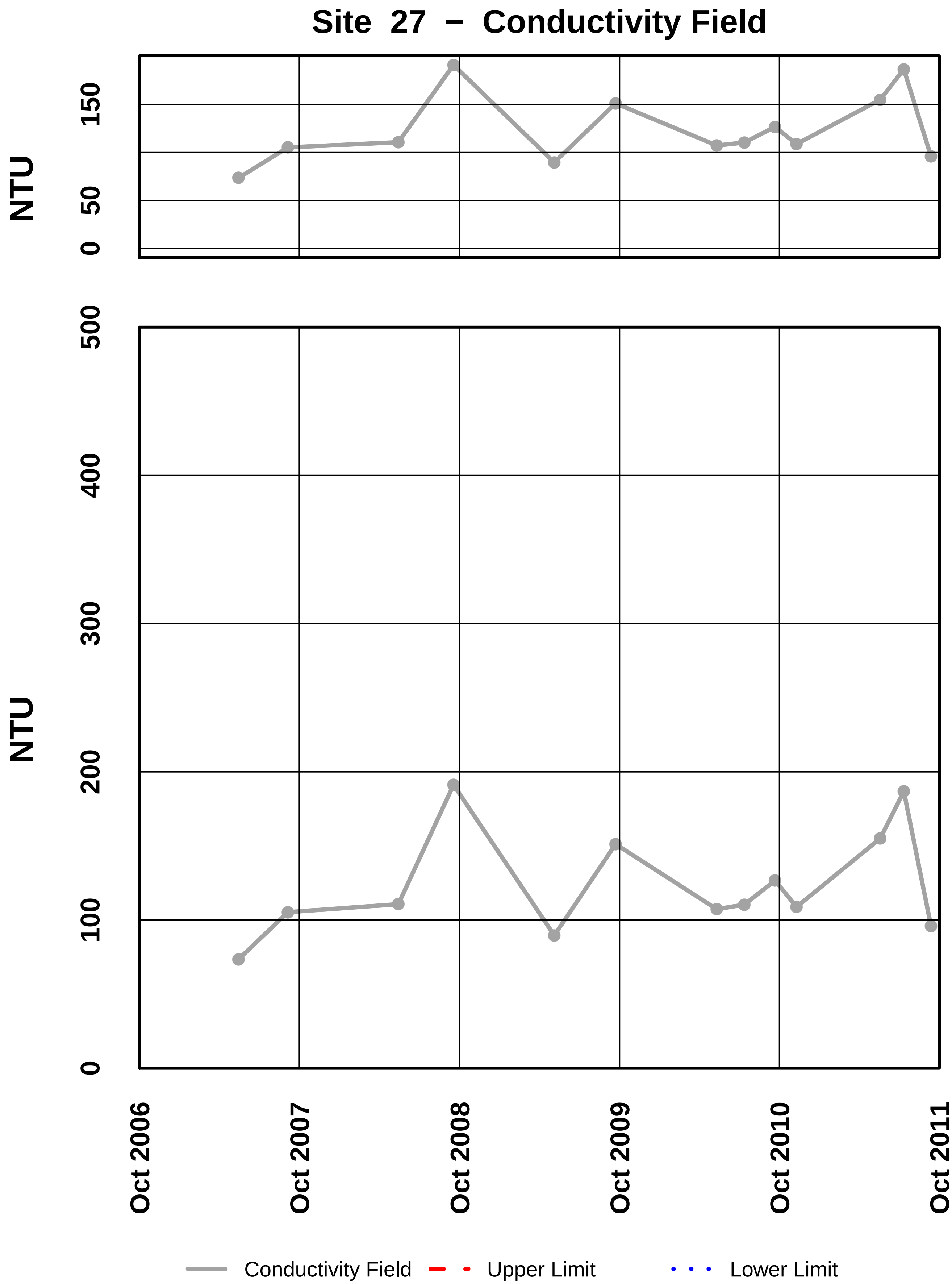
Site 27 − Water Temperature



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

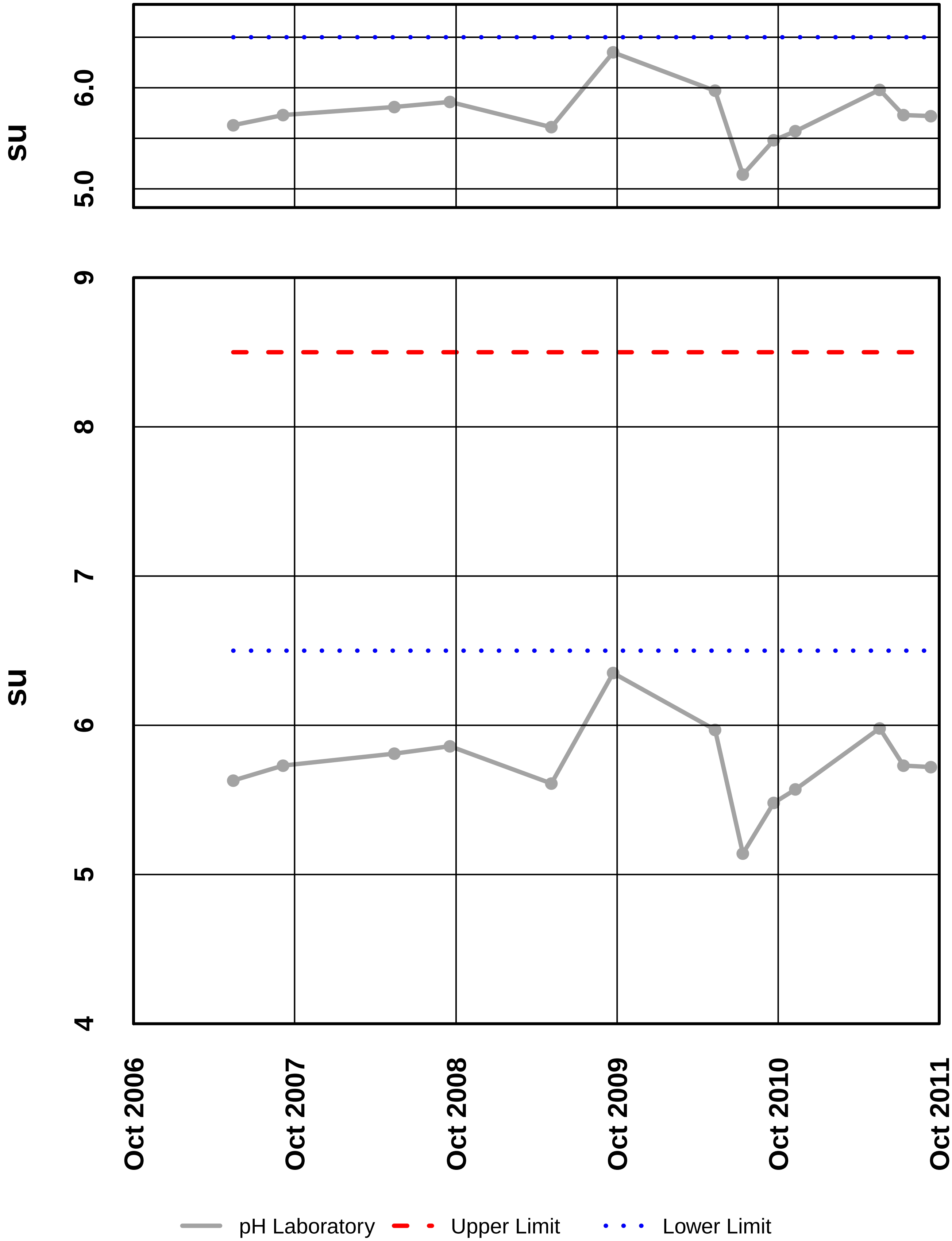


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

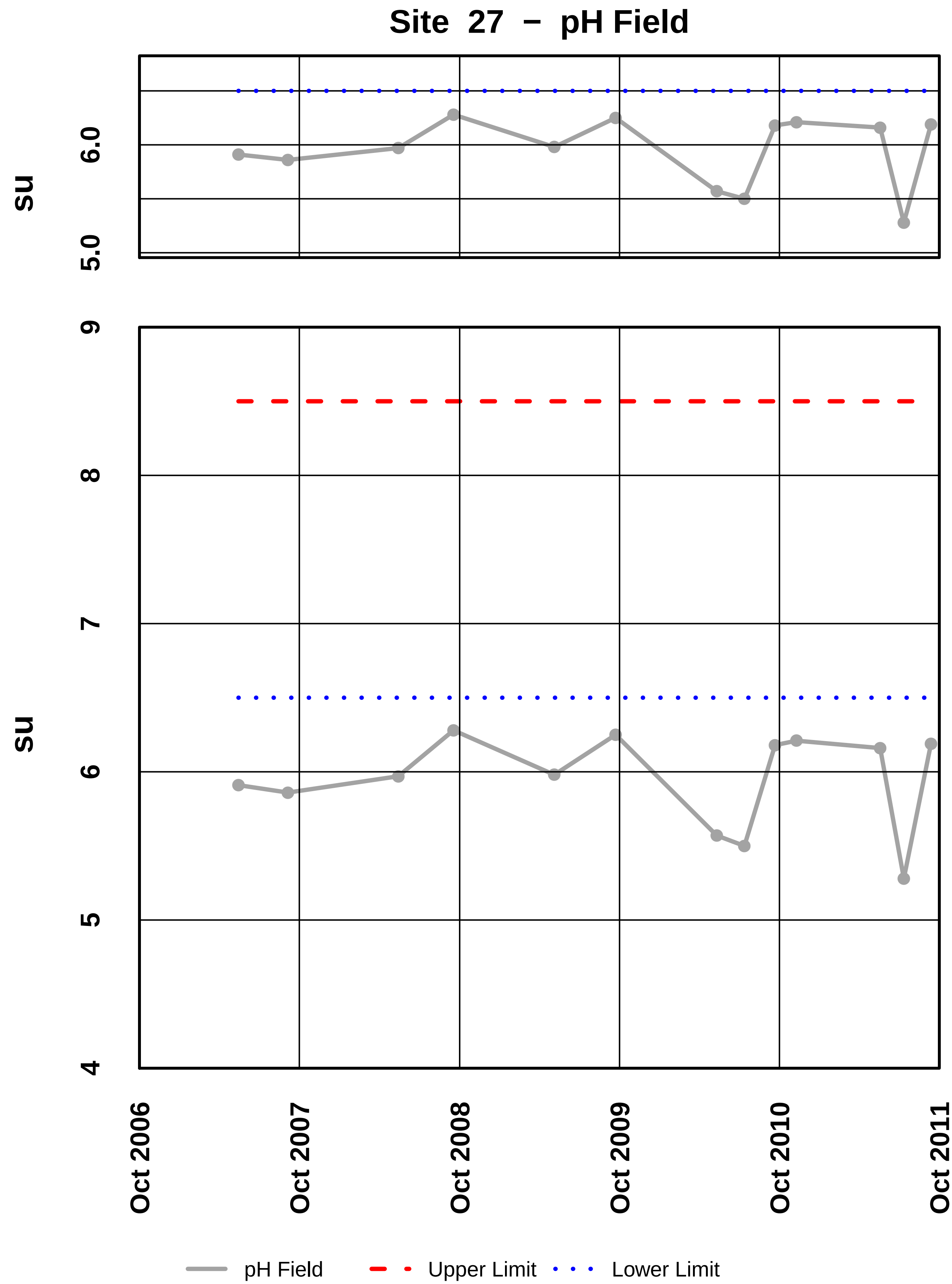


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

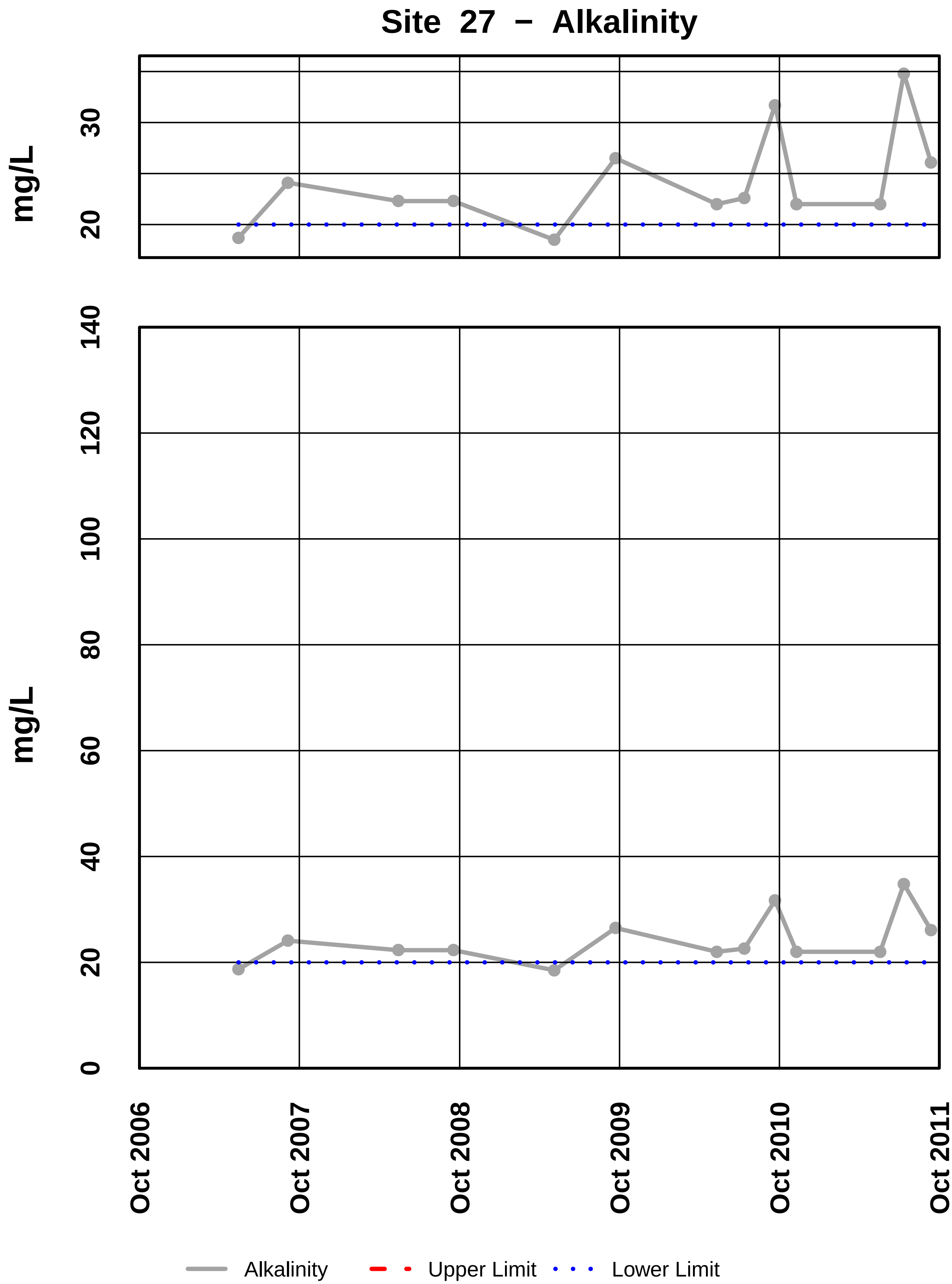
Site 27 – pH Laboratory



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

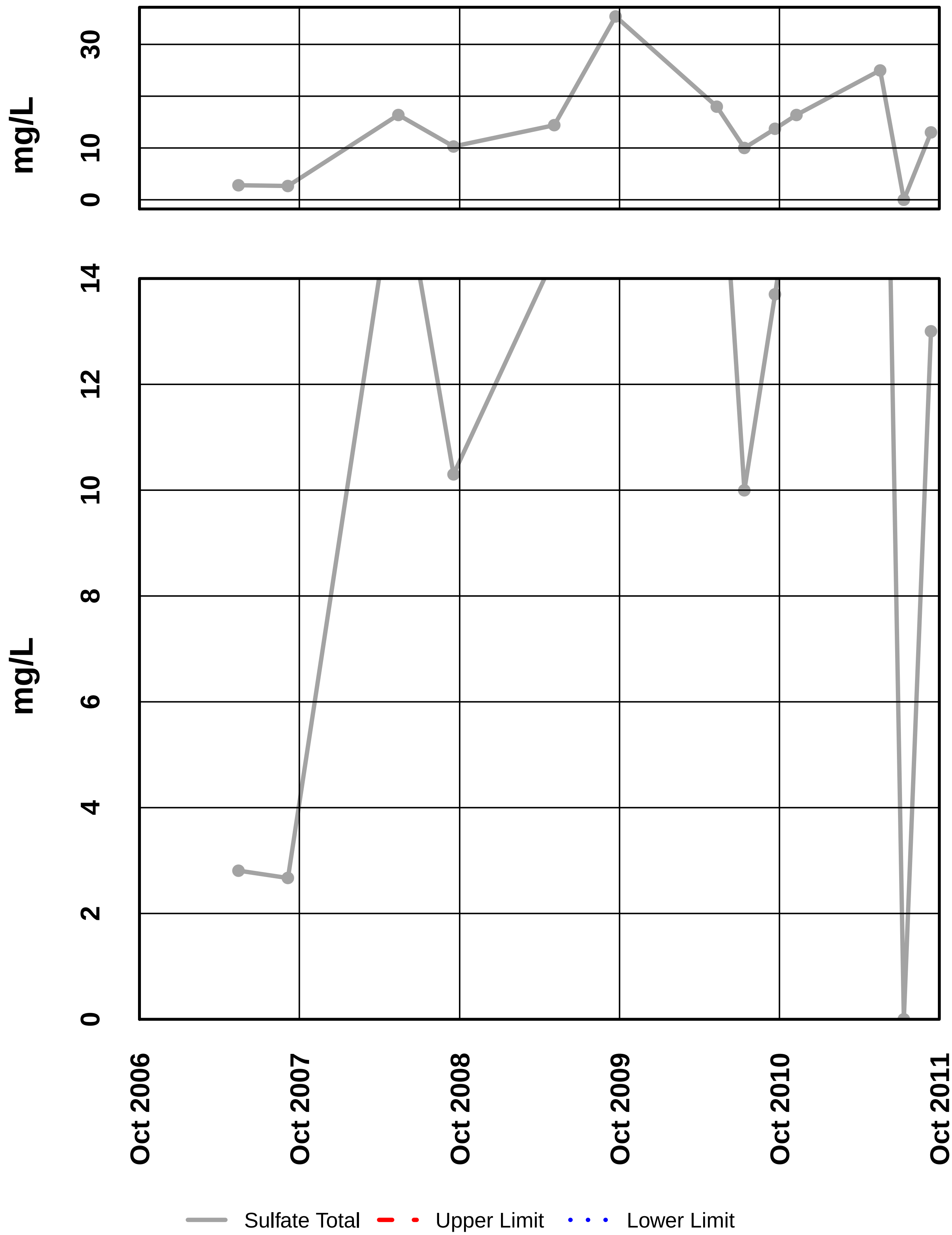


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



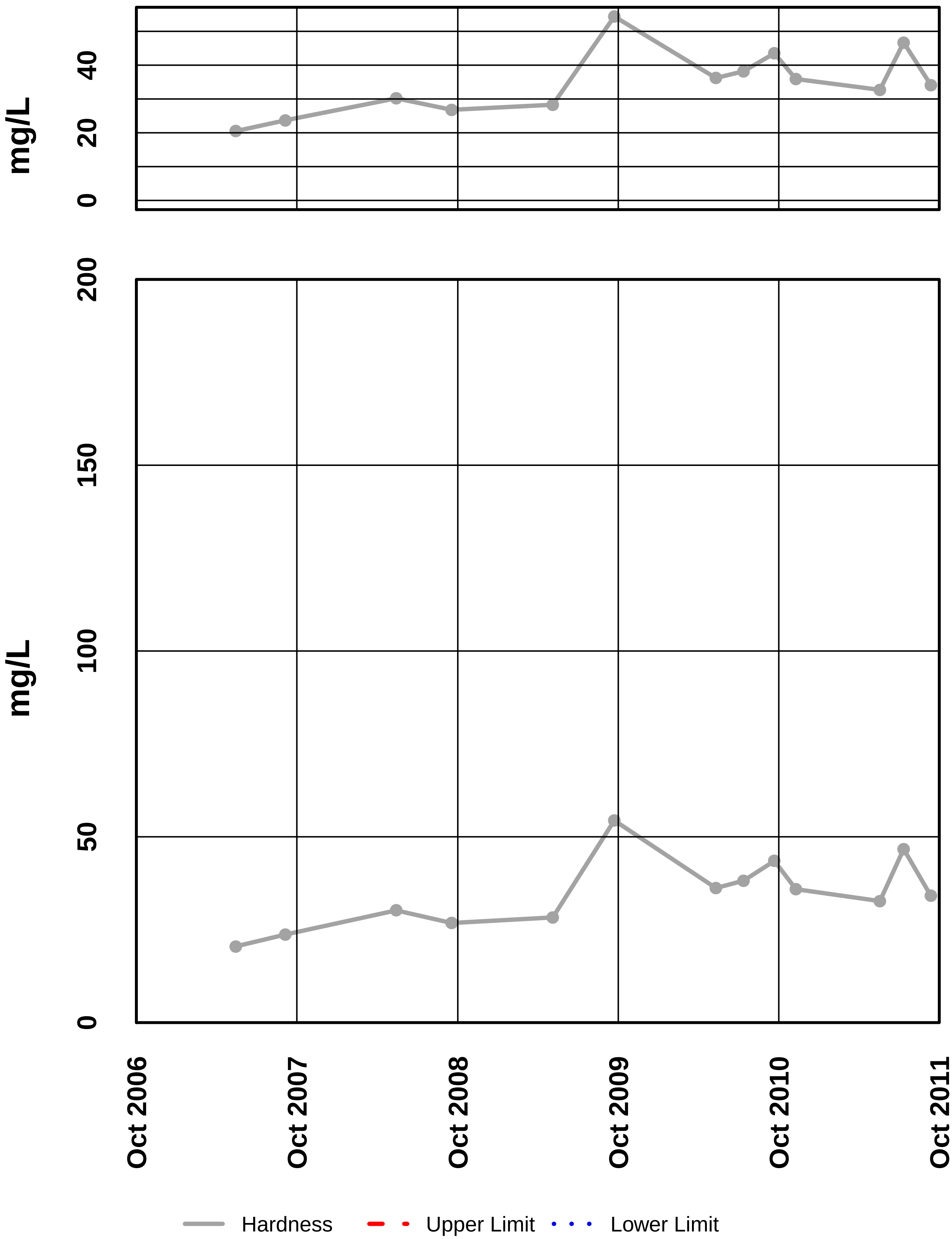
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 27 − Sulfate Total

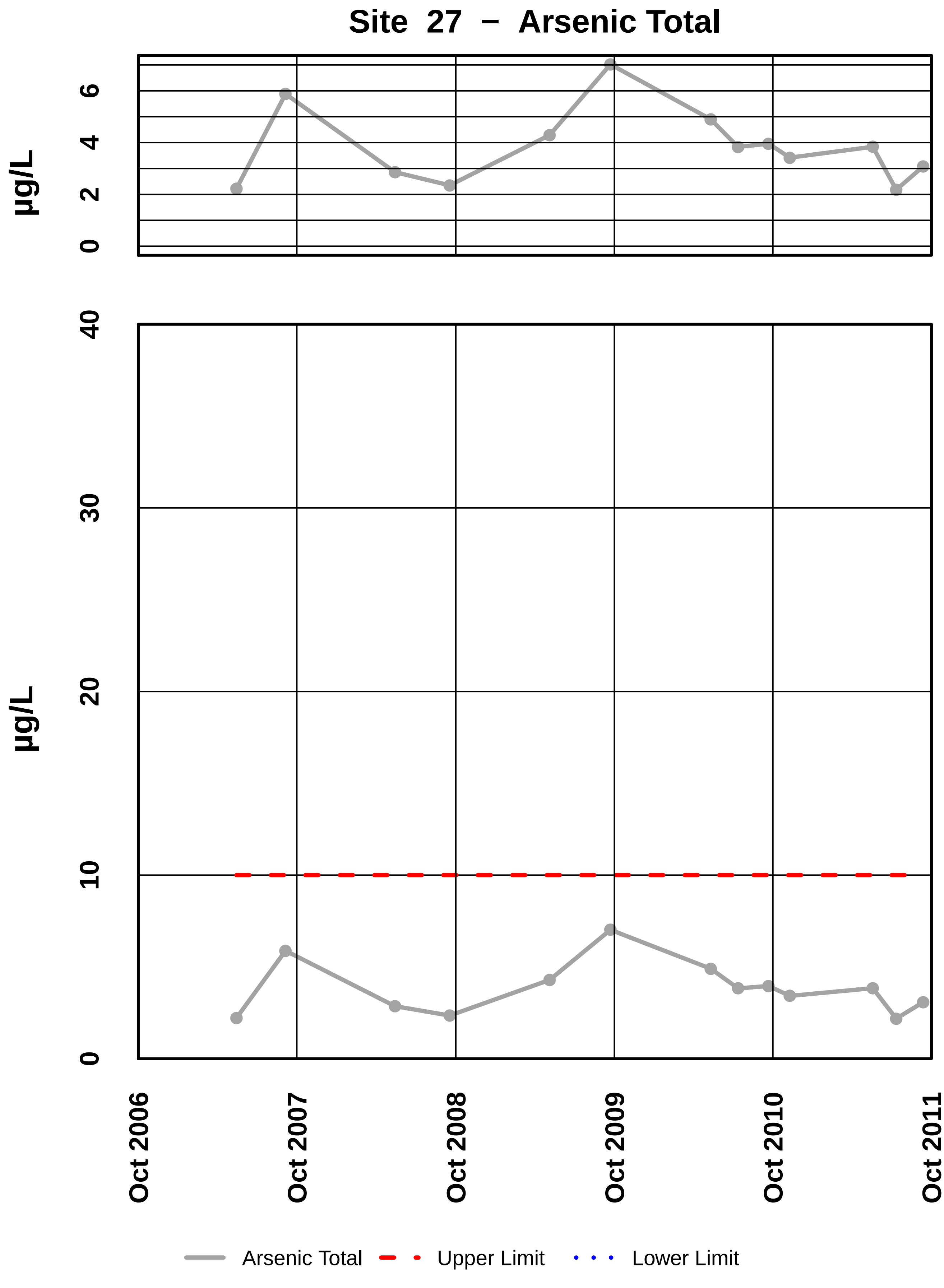


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

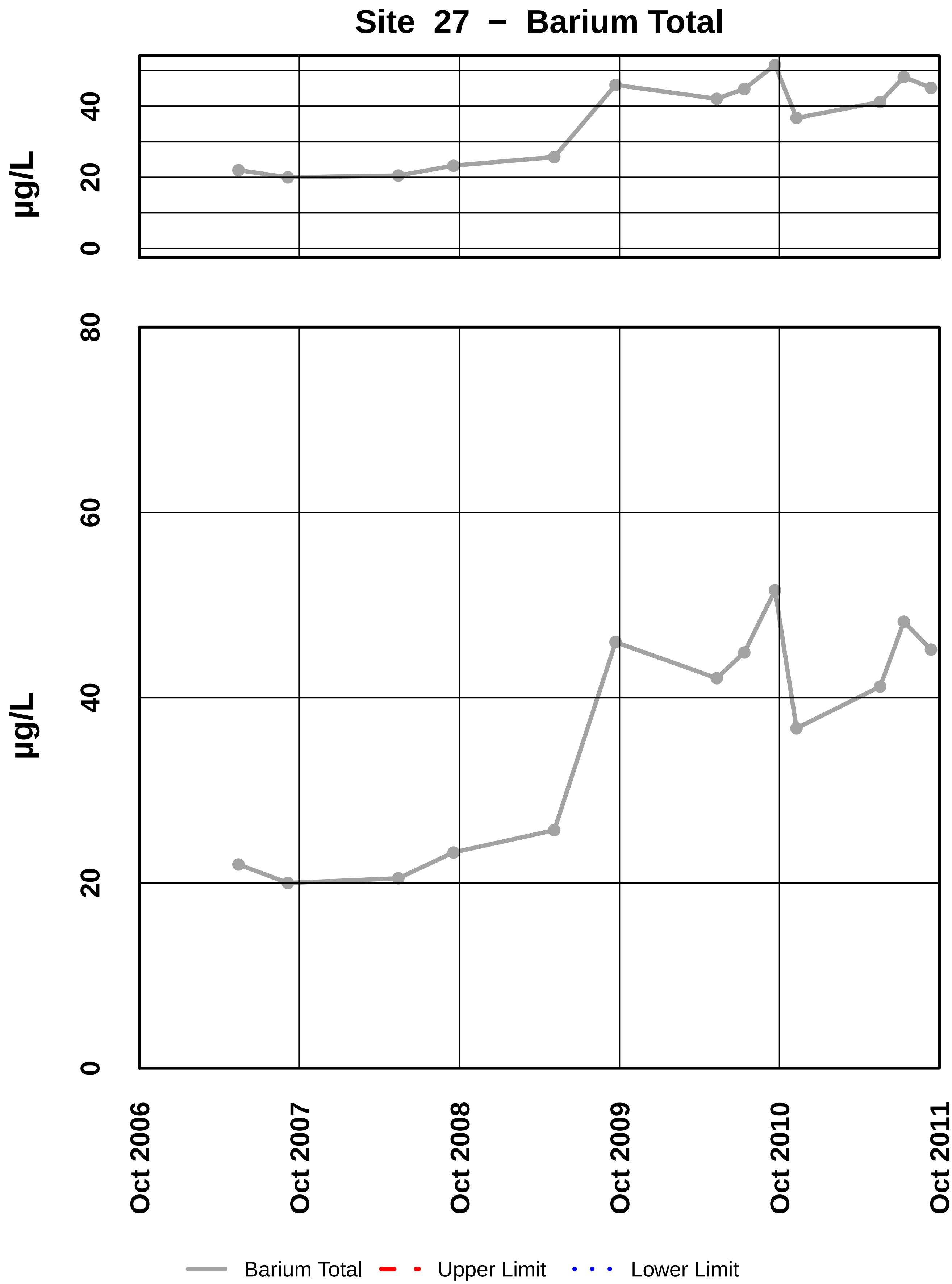
Site 27 – Hardness



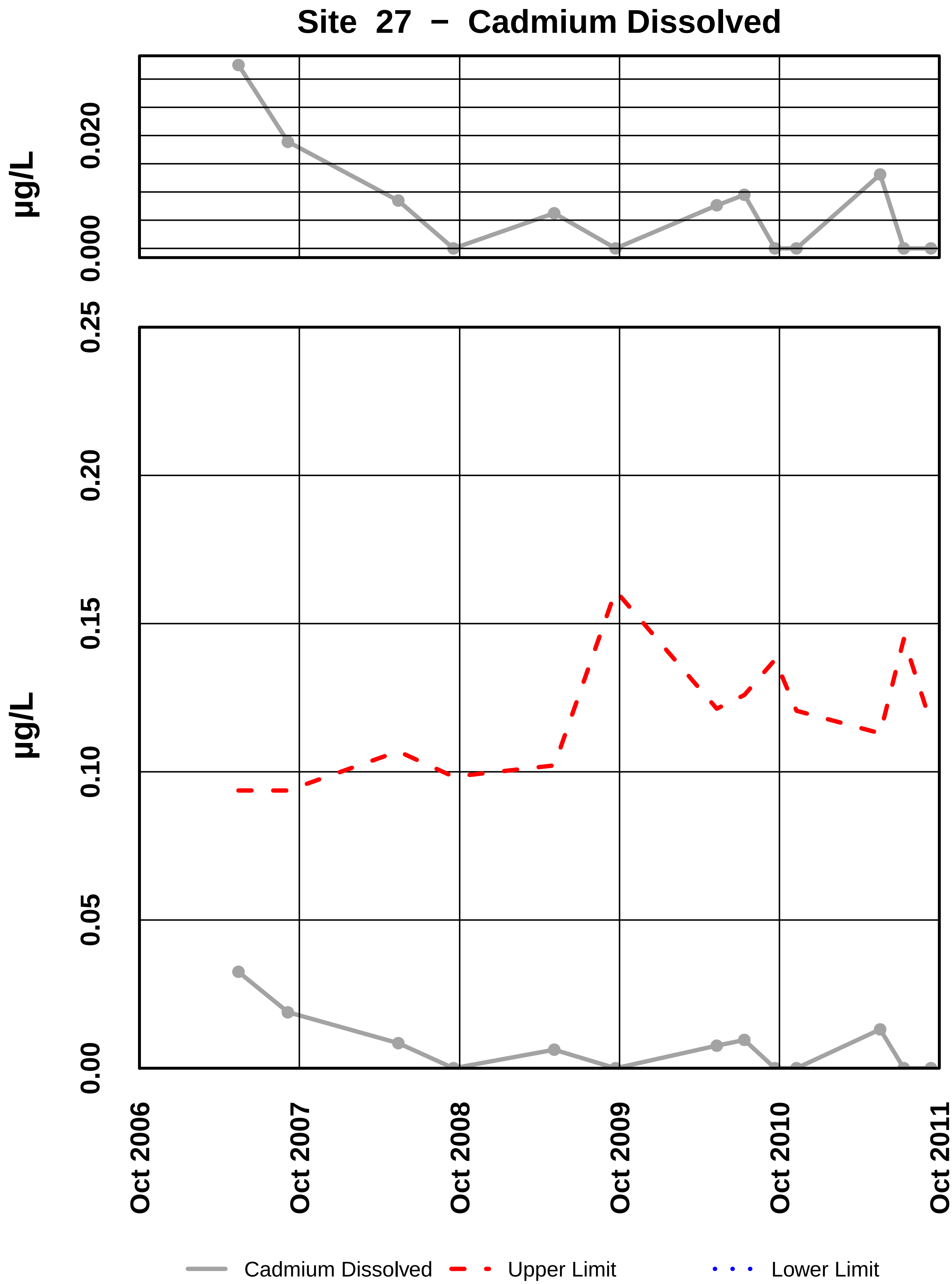
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



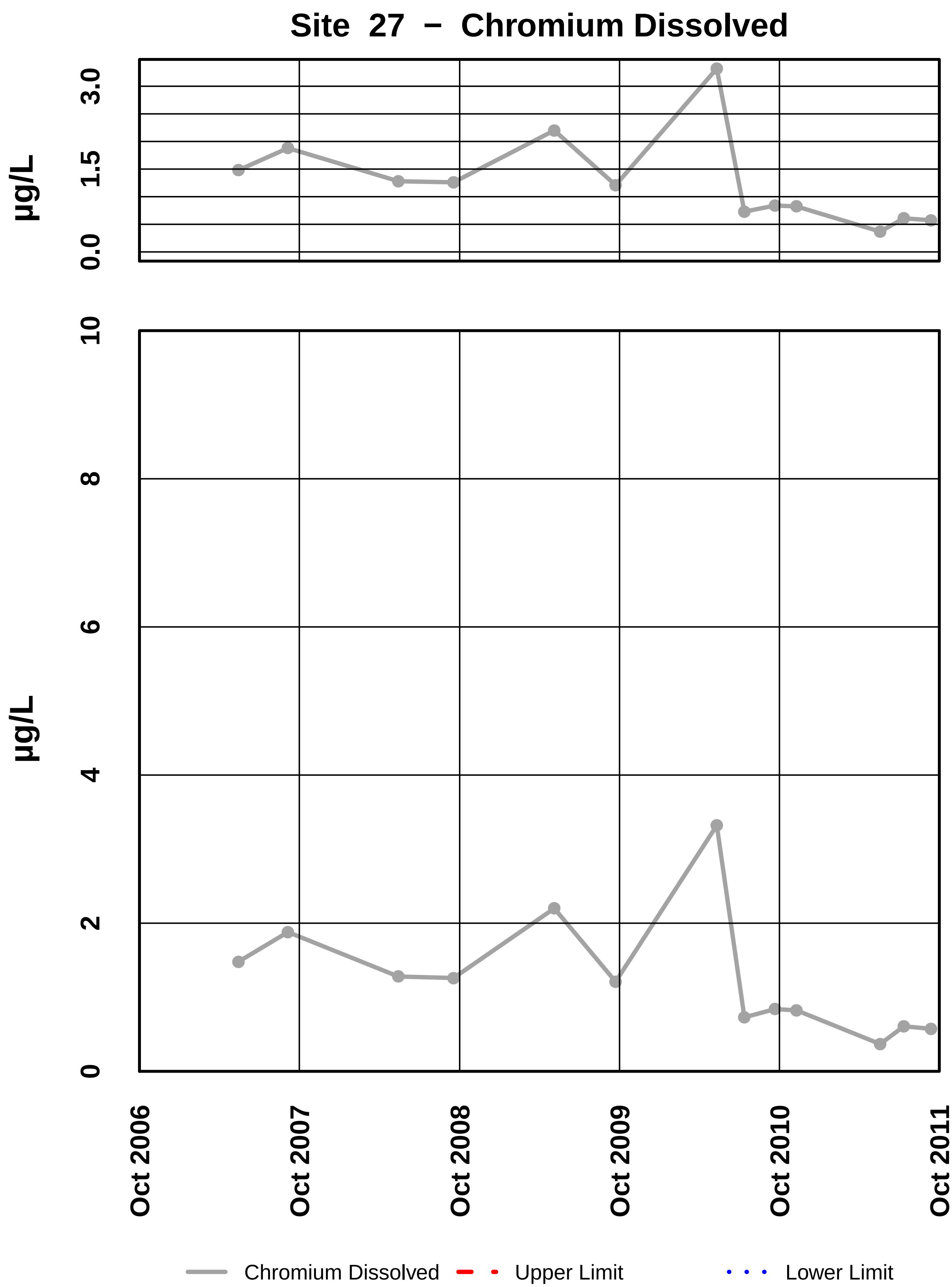
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



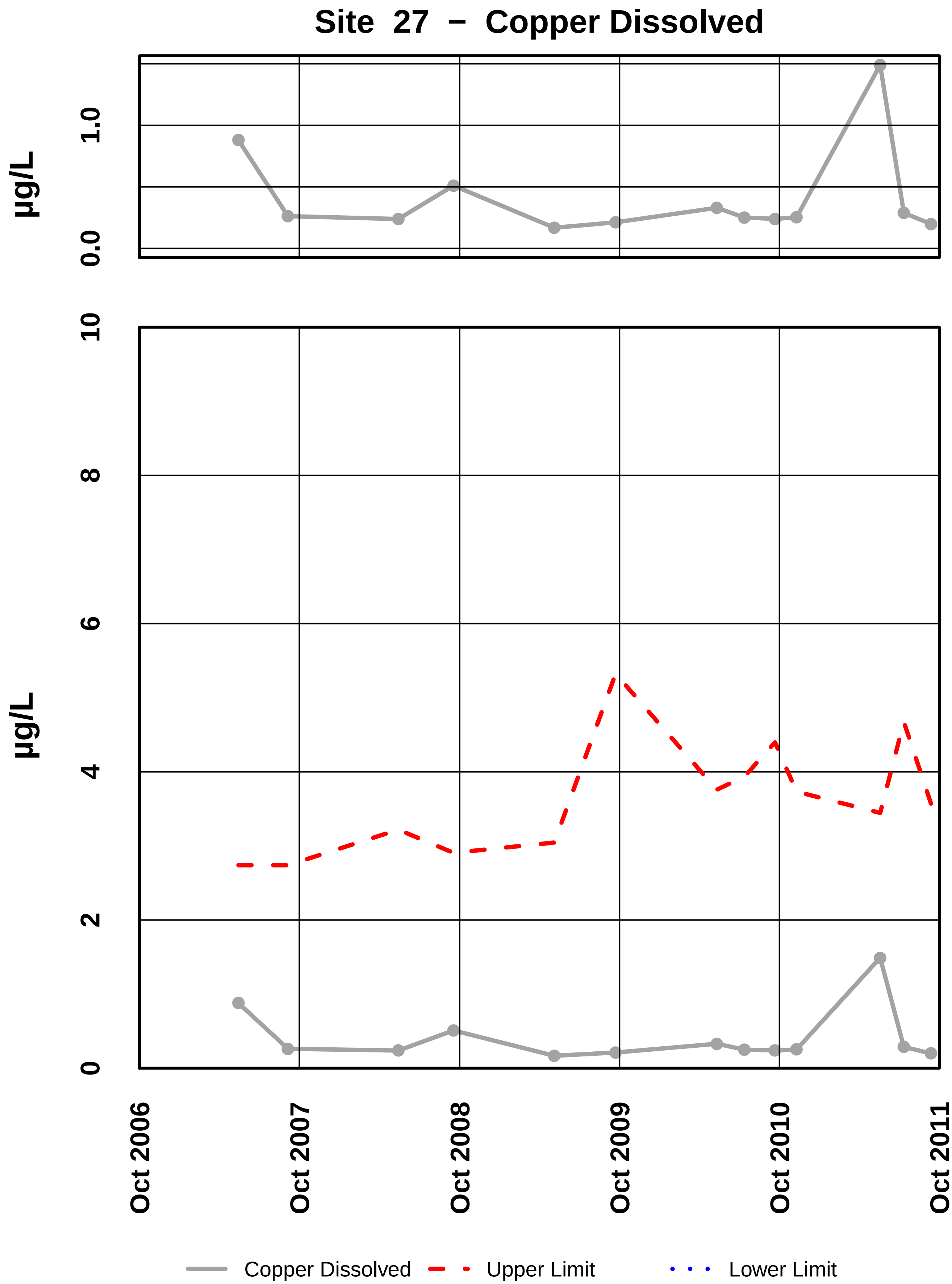
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



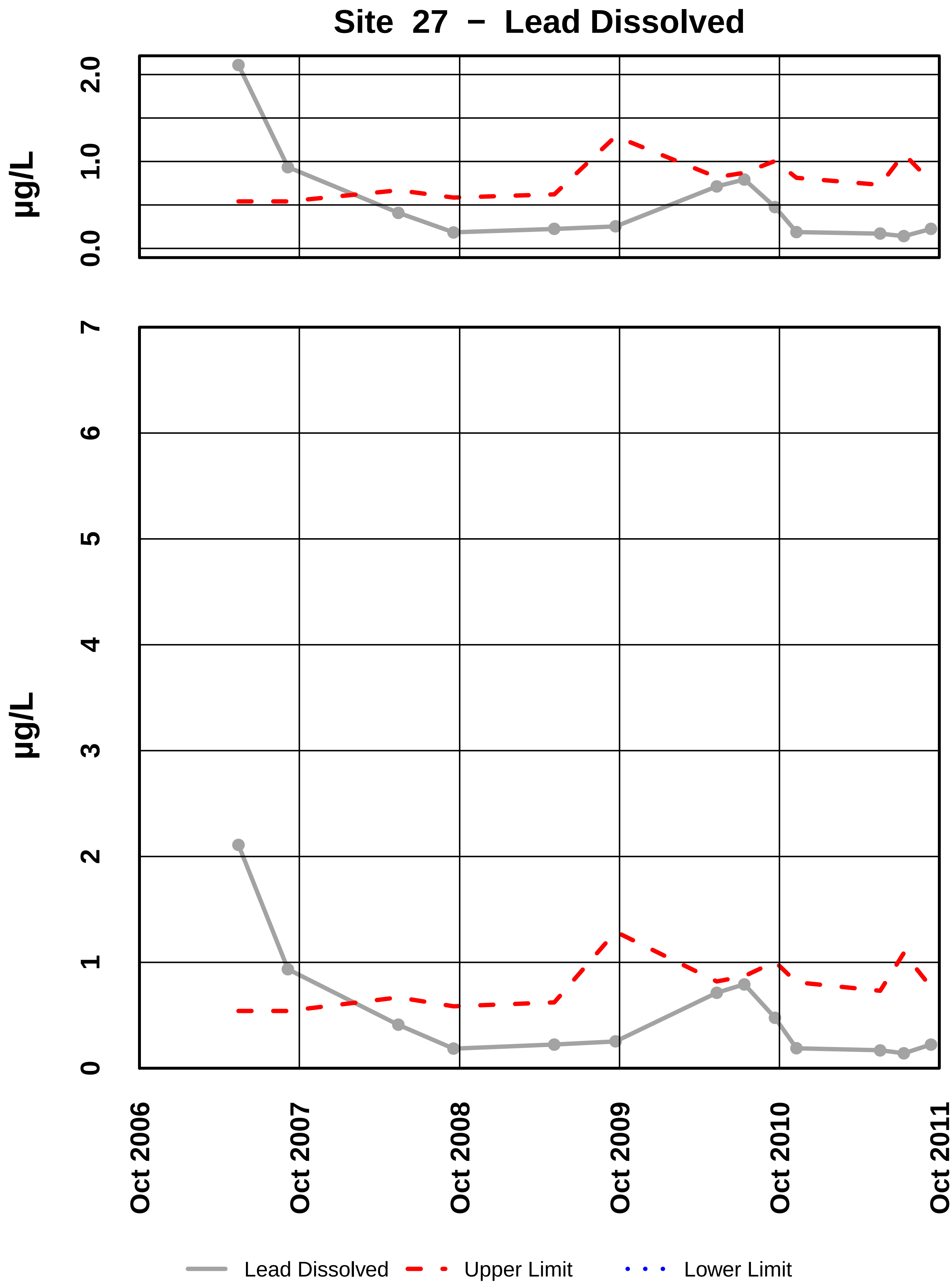
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



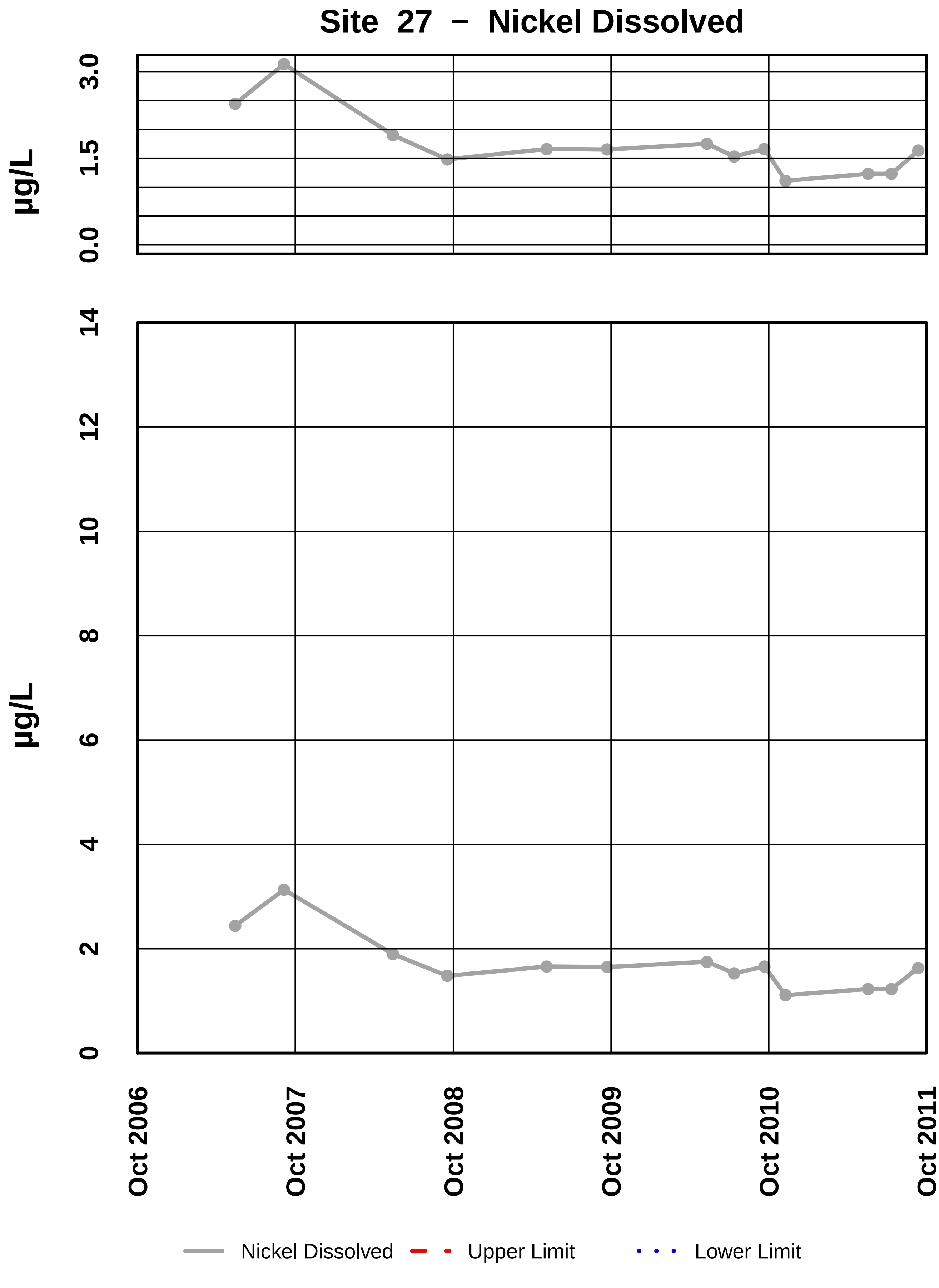
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



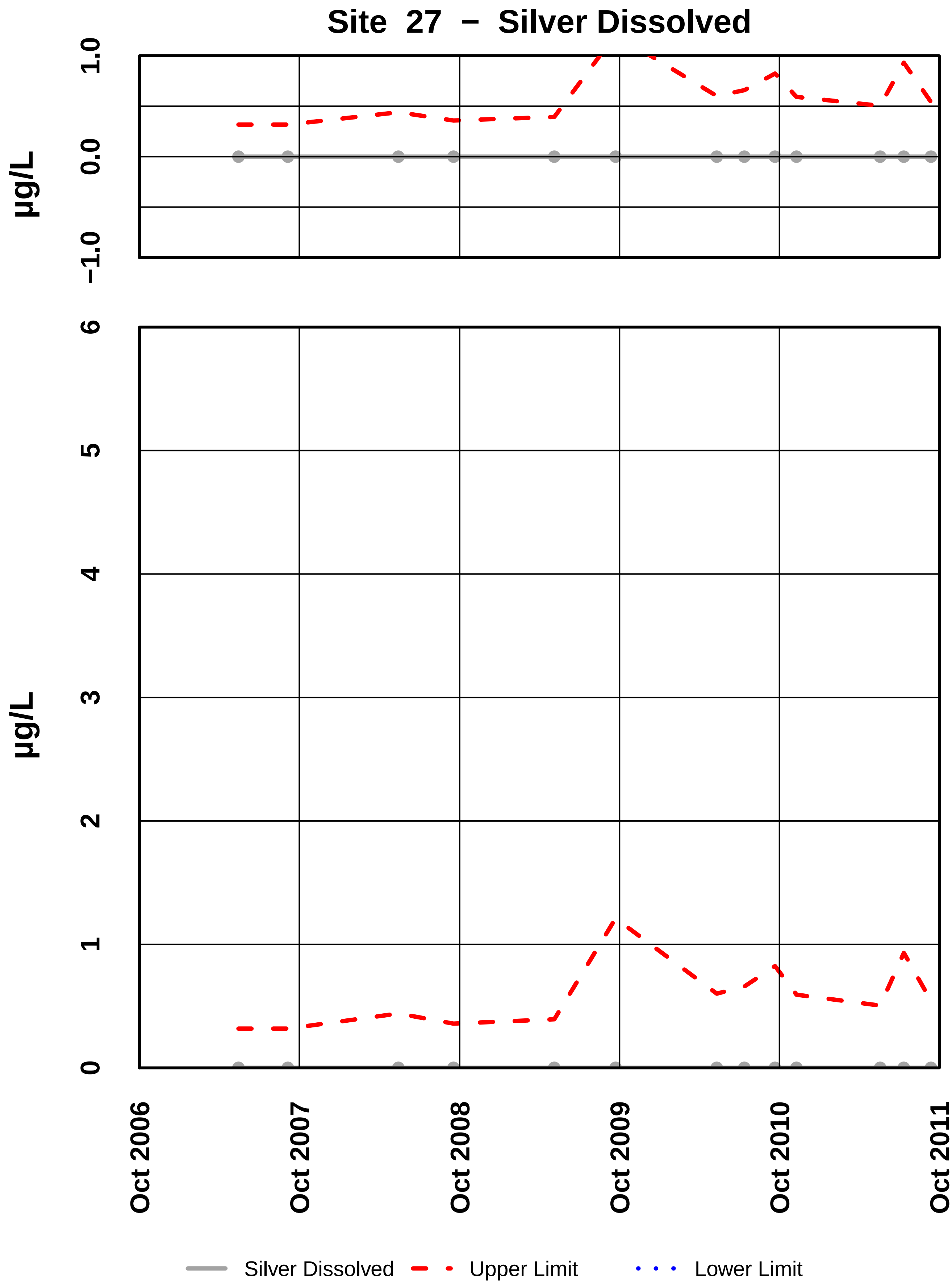
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



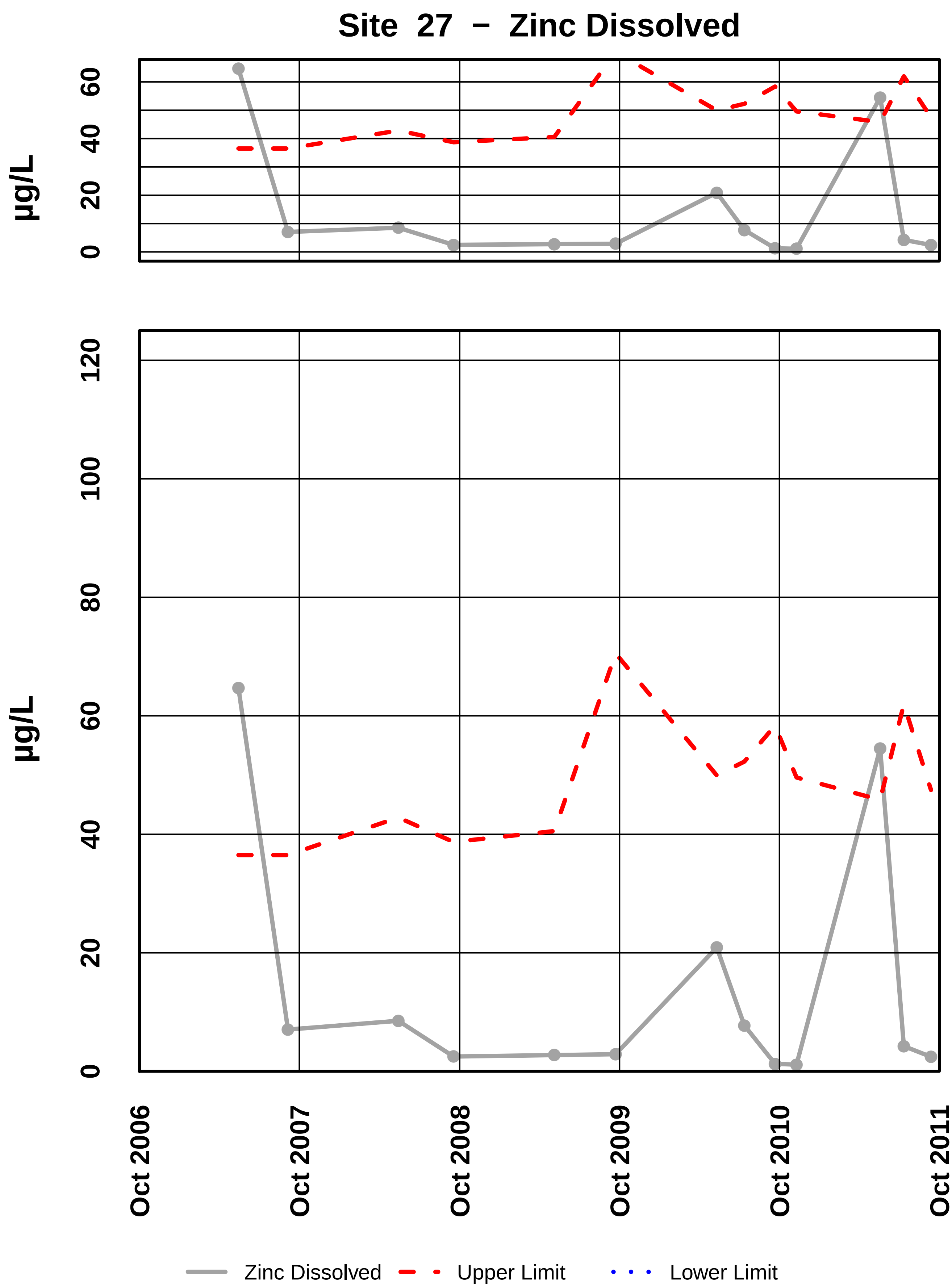
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



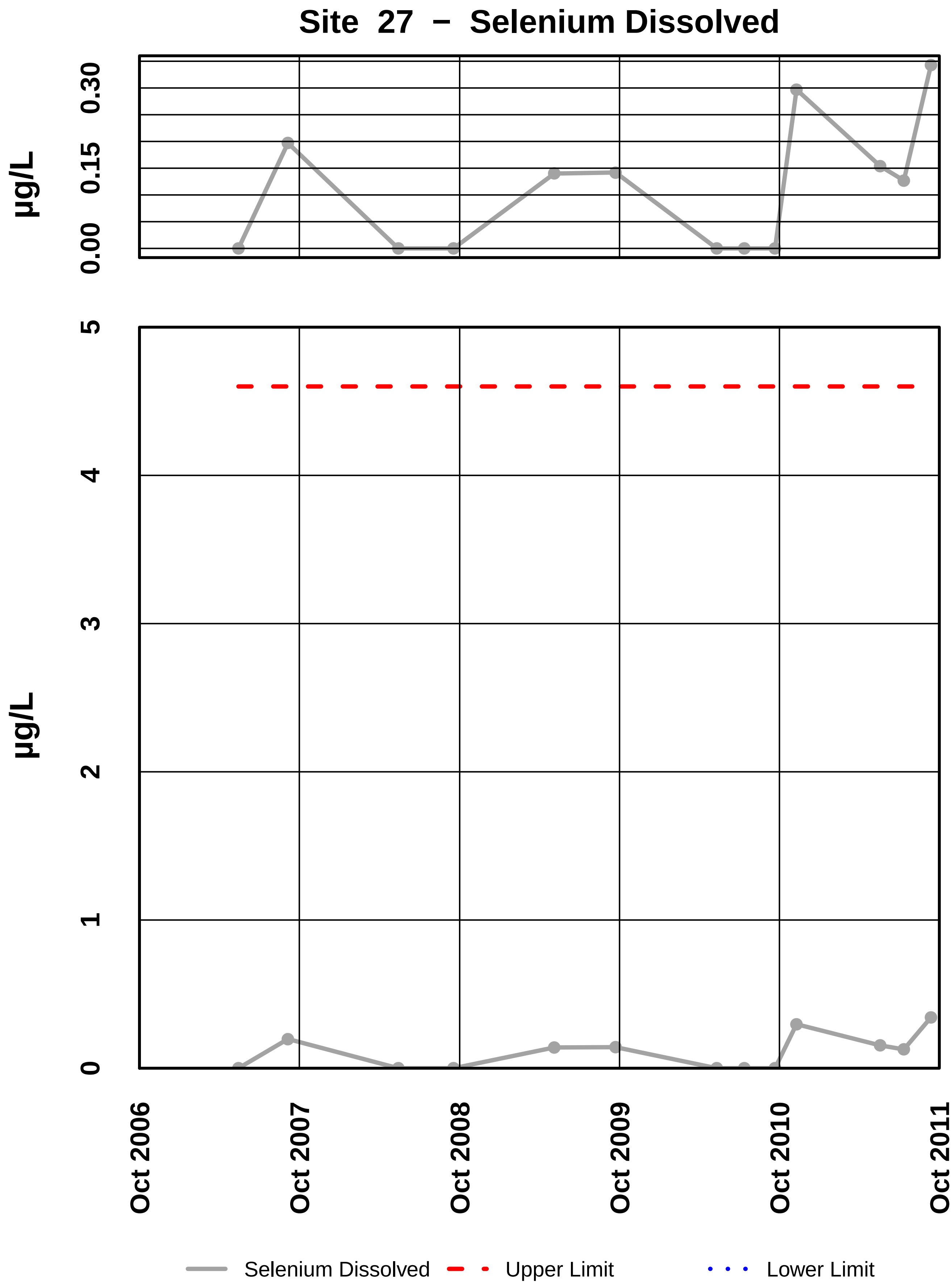
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



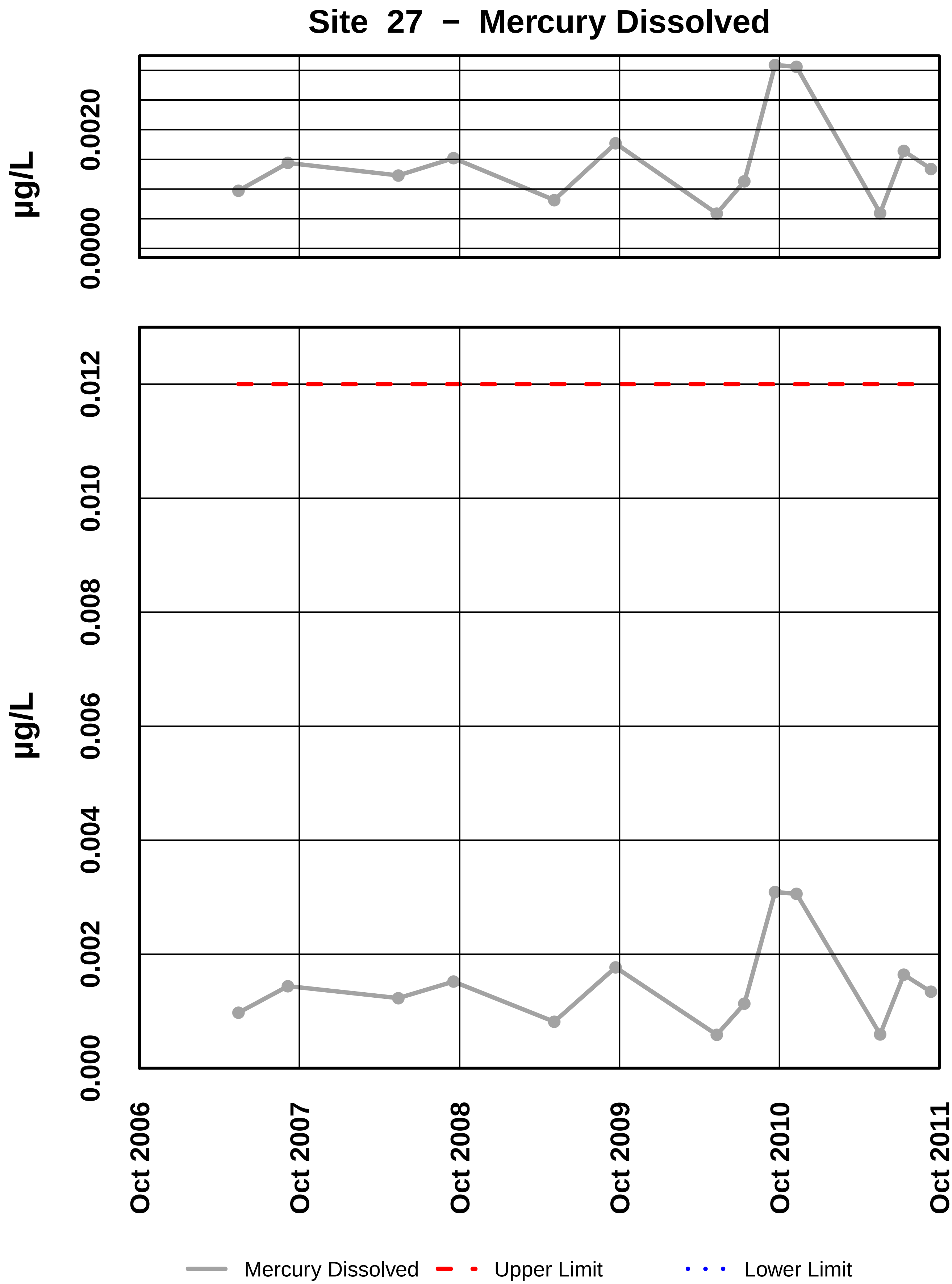
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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



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



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

Site **#27** Seasonal Kendall analysis for Specific Conductance, Lab (uS/cm)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2006**								77.2				61.7
b	**WY2007**								73.5				105.3
c	**WY2008**								110.7				191.2
d	**WY2009**								89.6				151.2
e	**WY2010**								107.3		110.4		126.7
f	**WY2011**		108.8						155		186.8		96
	n	0	1	0	0	0	0	0	6	0	2	0	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	0	1	0	0	0	0	0	6	0	2	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
f-d								1				-1
f-e								1		1		-1
S_k	0	0	0	0	0	0	0	9	0	1	0	1

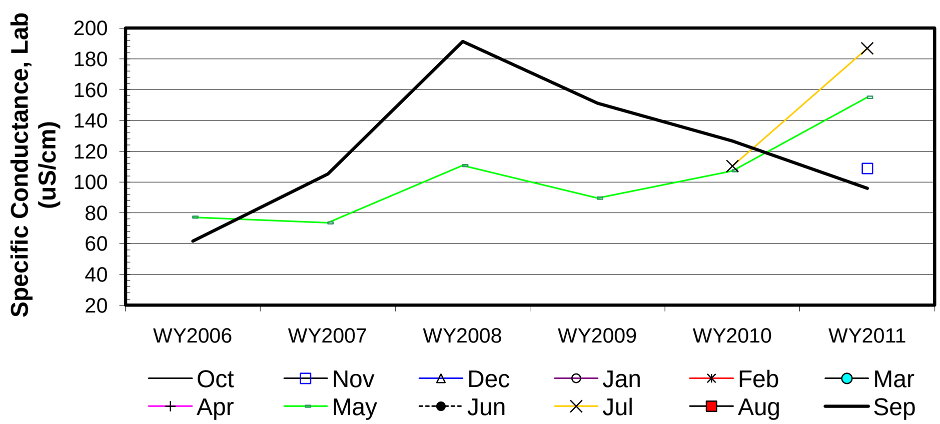
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=								28.33		1.00		28.33
$Z_k = S_k/\sigma_S$								1.69		1.00		0.19
Z^2_k								2.86		1.00		0.04

ΣZ_k= 2.88
ΣZ^2_k= 3.89
Z-bar=$\Sigma Z_k/K$= 0.96

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	15	0	0	0	0

Σn 15
ΣS_k 11

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=		1.13	@α=5% $\chi^2_{(K-1)}$=	5.99	Test for station homogeneity
	p	**0.568**			$\chi^2_h<\chi^2_{(K-1)}$ ACCEPT
ΣVAR(S_k)	Z_{calc}	1.32	@α/2=2.5% Z=	1.96	**H_0** (No trend) ACCEPT
57.67	p	**0.906**			**H_A** (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals

α	**Lower Limit**	**Sen's Slope**	**Upper Limit**
0.010	-22.23		30.79
0.050	-2.17	**11.27**	19.69
0.100	2.00		17.10
0.200	6.94		16.04

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2006**								5.9				5.6
b	**WY2007**								5.9				5.9
c	**WY2008**								6.0				6.3
d	**WY2009**								6.0				6.3
e	**WY2010**								5.6		5.5		6.2
f	**WY2011**		6.2						6.2		5.3		6.2
	n	0	1	0	0	0	0	0	6	0	2	0	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	0	1	0	0	0	0	0	4	0	2	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								0				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
f-d								1				-1
f-e								1		-1		1
S_k	0	0	0	0	0	0	0	6	0	-1	0	5

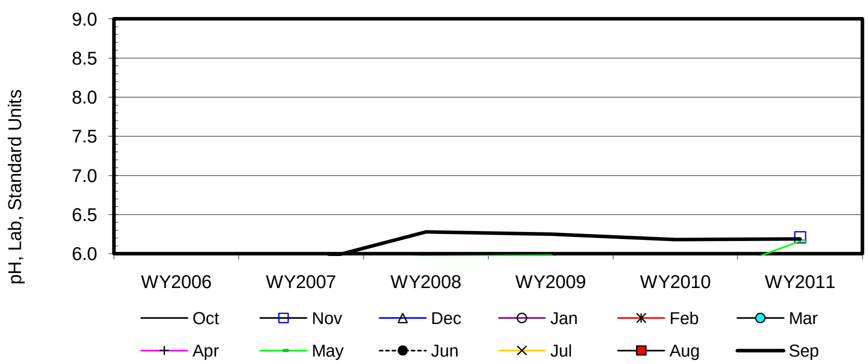
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=								27.33		1.00		28.33
$Z_k = S_k/\sigma_S$								1.15		-1.00		0.94
Z^2_k								1.32		1.00		0.88

ΣZ_k=	1.09
ΣZ^2_k=	3.20
Z-bar=ΣZ_k/K=	0.36

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	13	1	0	0	0

Σn	15
ΣS_k	10

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	2.81	@α=5% $\chi^2_{(K-1)}$= 5.99	Test for station homogeneity	
p	**0.246**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k) / 56.67	Z_{calc} 1.20	@α/2=2.5% Z= 1.96	H_0 (No trend)	ACCEPT
p	**0.884**		H_A (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.06		0.12
0.050	-0.03	**0.04**	0.09
0.100	-0.01		0.07
0.200	0.01		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	**WY2006**								25.2				25.8
b	**WY2007**								18.7				24.1
c	**WY2008**								22.3				22.3
d	**WY2009**								18.5				26.5
e	**WY2010**								22.0		22.6		31.7
f	**WY2011**		22.0						22.0		34.8		26.1
	n	0	1	0	0	0	0	0	6	0	2	0	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	0	1	0	0	0	0	0	4	0	2	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								1				1
f-d								1				-1
f-e								0		1		-1
S_k	0	0	0	0	0	0	0	-4	0	1	0	5

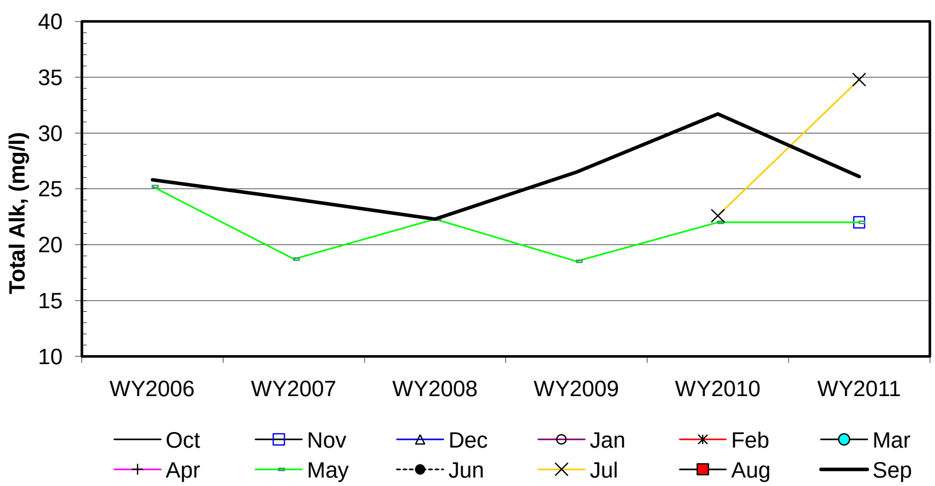
	May	Jul	Sep
σ^2_S=	27.33	1.00	28.33
$Z_k = S_k/\sigma_S$	-0.77	1.00	0.94
Z^2_k	0.59	1.00	0.88

ΣZ_k= 1.17
ΣZ^2_k= 2.47
Z-bar=ΣZ_k/K= 0.39

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	13	1	0	0	0

Σn 15
ΣS_k 2

$\chi^2_h=\Sigma Z^2_k$-K(Z-bar)^2=	2.01	@α=5% $\chi^2_{(K-1)}$= 5.99	Test for station homogeneity
p	**0.366**		$\chi^2_h<\chi^2_{(K-1)}$ ACCEPT
ΣVAR(S_k) 56.67	Z_{calc} 0.13	@α/2=2.5% Z= 1.96	H_0 (No trend) ACCEPT
	p **0.553**		H_A (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-1.71		1.95
0.050	-0.75	**0.06**	1.25
0.100	-0.34		1.13
0.200	-0.13		0.72

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	**WY2006**								1.8				2.2
b	**WY2007**								2.8				2.7
c	**WY2008**								16.4				10.3
d	**WY2009**								14.4				35.4
e	**WY2010**								18.0		10.0		13.7
f	**WY2011**		16.4						25.0		0.0		13.0
	n	0	1	0	0	0	0	0	6	0	2	0	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	0	1	0	0	0	0	0	6	0	2	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
f-d								1				-1
f-e								1		-1		-1
S_k	0	0	0	0	0	0	0	13	0	-1	0	9

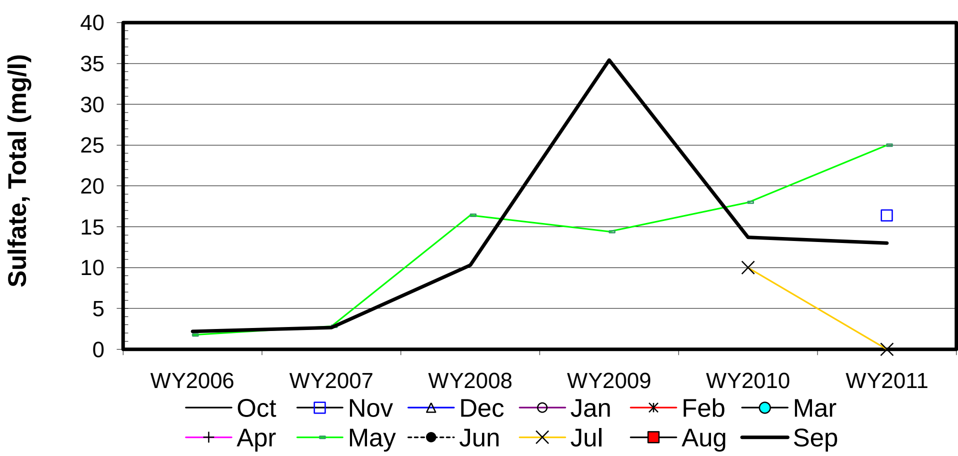
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=								28.33		1.00		28.33
$Z_k = S_k/\sigma_S$								2.44		-1.00		1.69
Z^2_k								5.96		1.00		2.86

ΣZ_k=	3.13
ΣZ^2_k=	9.82
Z-bar=$\Sigma Z_k/K$=	1.04

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	15	0	0	0	0

Σn	15
ΣS_k	21

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=		6.55	@α=5% $\chi^2_{(K-1)}$= 5.99	Test for station homogeneity	
	p	**0.038**		$\chi^2_h<\chi^2_{(K-1)}$	REJECT
ΣVAR(S_k)	Z_{calc}	2.63	@α=5% Z= 1.64	H_0 (No trend)	REJECT
57.67	p	**0.996**		H_A (± trend)	NA



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	0.69		6.20
0.050	1.20	**3.68**	5.24
0.100	1.99		4.80
0.200	2.67		4.16

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	**WY2006**								0.4				4.1
b	**WY2007**								64.7				7.1
c	**WY2008**								8.5				2.5
d	**WY2009**								2.7				2.9
e	**WY2010**								20.9		7.7		1.3
f	**WY2011**		1.1						54.5		4.3		2.5
	n	0	1	0	0	0	0	0	6	0	2	0	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	0	1	0	0	0	0	0	6	0	2	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
f-d								1				-1
f-e								1		-1		1
S_k	0	0	0	0	0	0	0	5	0	-1	0	-9

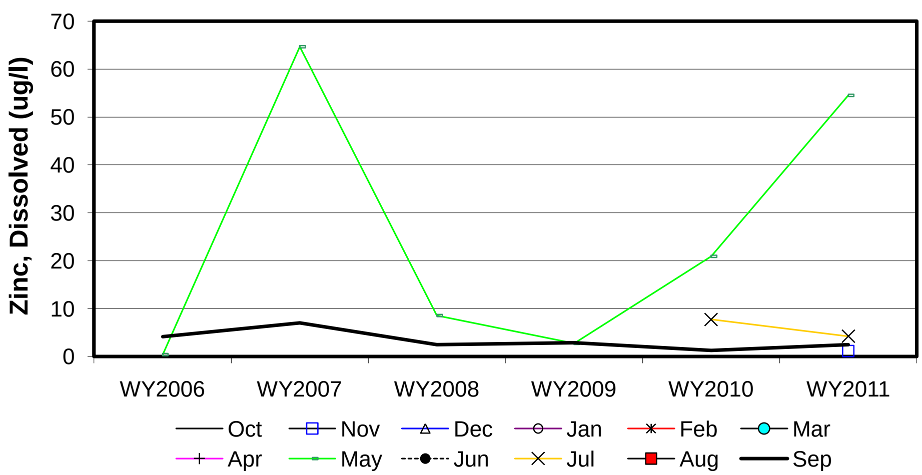
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
$\sigma^2_S=$								28.33		1.00		28.33
$Z_k = S_k/\sigma_S$								0.94		-1.00		-1.69
Z^2_k								0.88		1.00		2.86

$\Sigma Z_k=$ -1.75
$\Sigma Z^2_k=$ 4.74
Z-bar=ΣZ_k/K= -0.58

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	15	0	0	0	0

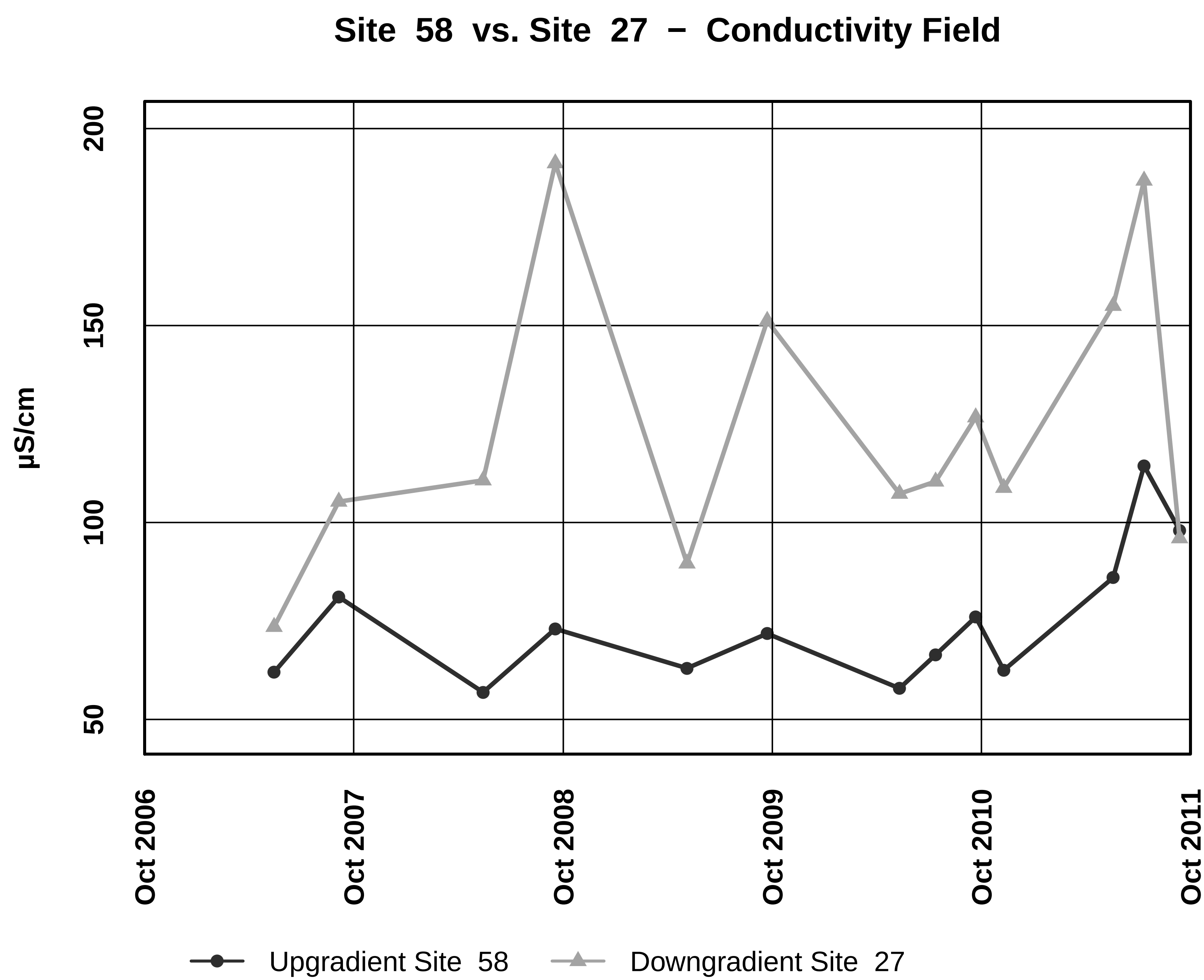
Σn 15
ΣS_k -5

$\chi^2_h=\Sigma Z^2_k$-K(Z-bar)^2=	3.72	@α=5% $\chi^2_{(K-1)}$=	5.99	Test for station homogeneity	
p	**0.156**			$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k) / 57.67	Z_{calc} -0.53	@α/2=2.5% Z=	1.96	**H_0** (No trend)	ACCEPT
	p **0.299**			**H_A** (± trend)	REJECT

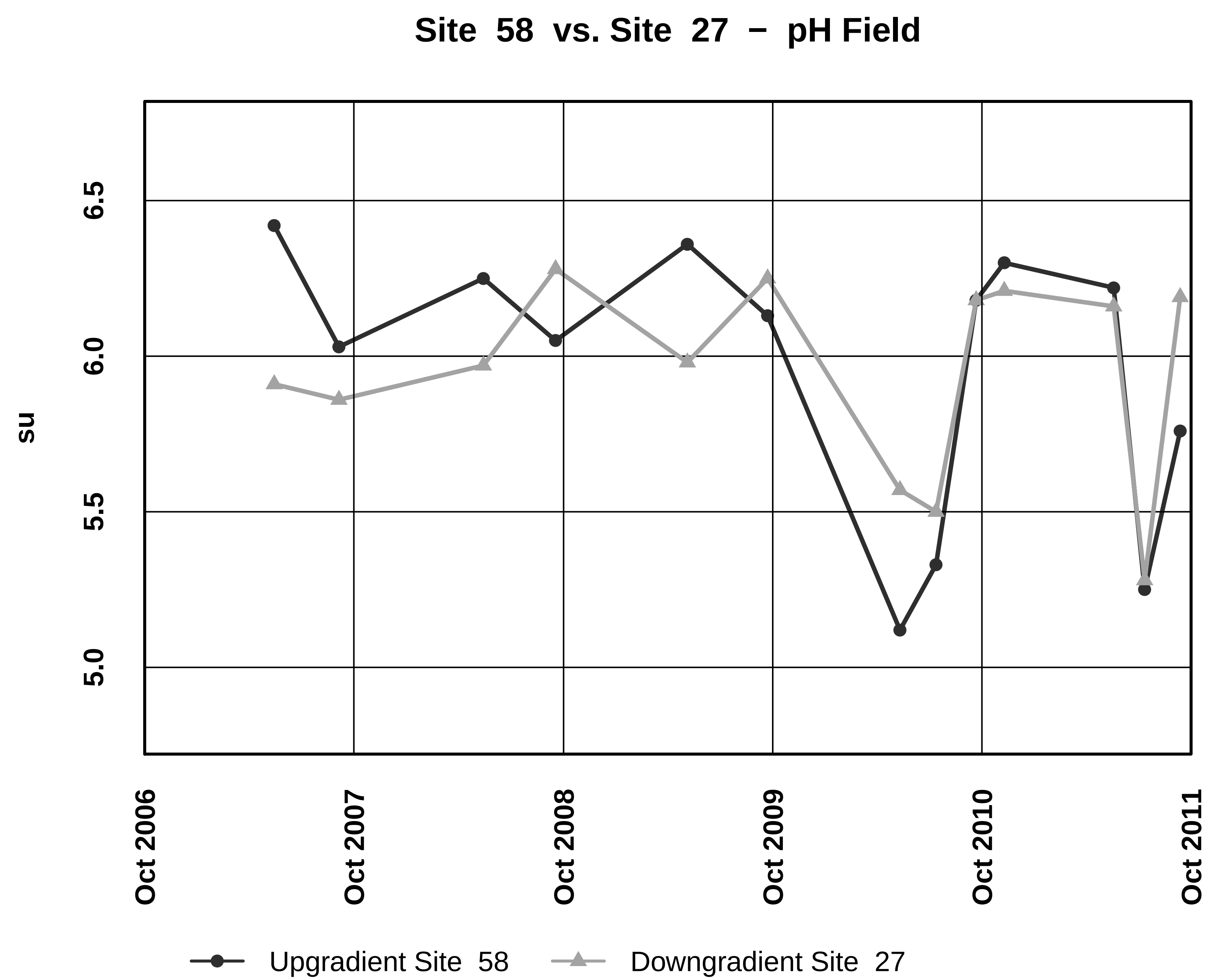


Seasonal-Kendall Slope Confidence Intervals

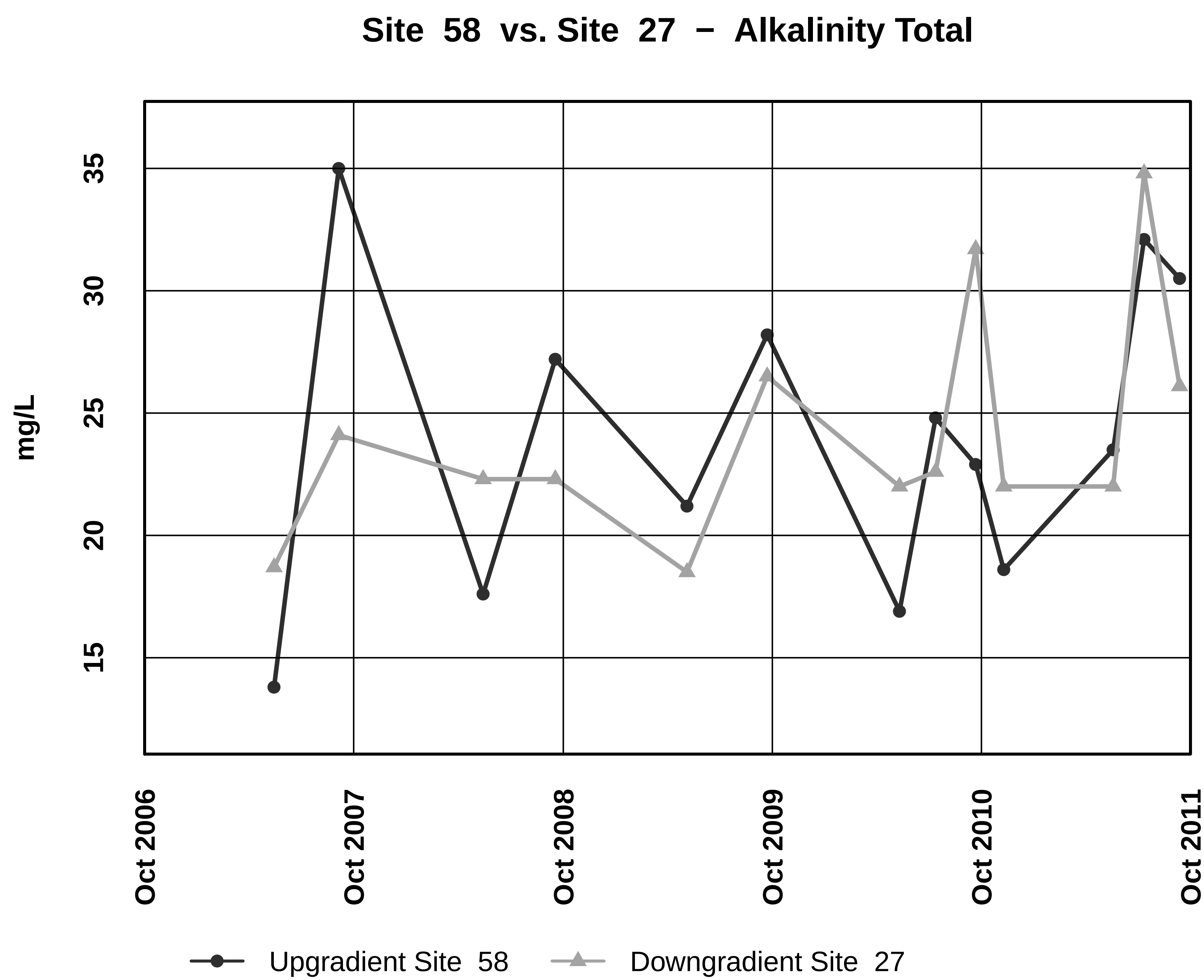
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-2.86		5.47
0.050	-1.85	**-0.34**	2.47
0.100	-1.33		0.93
0.200	-0.79		0.27



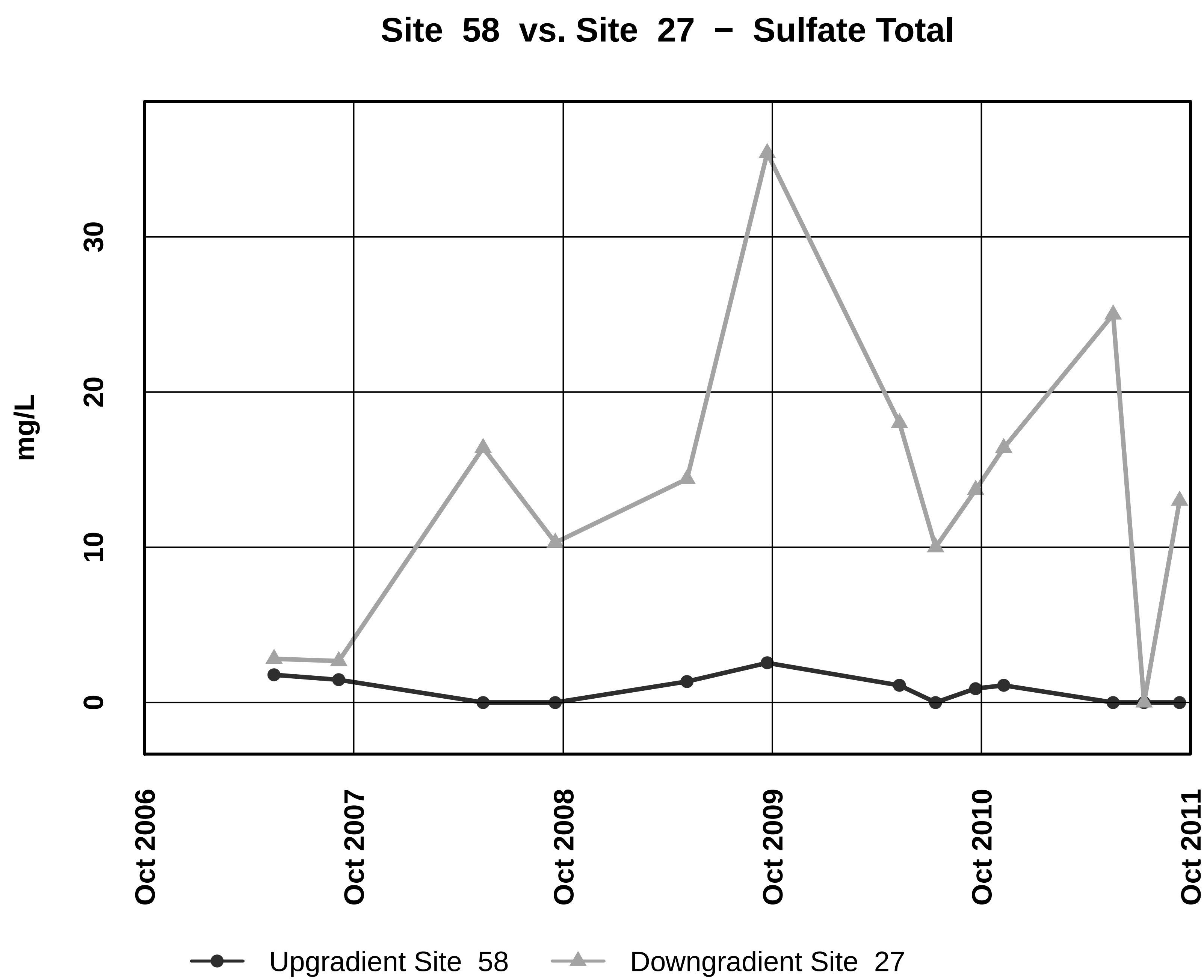
Site 58 vs. Site 27 − Conductivity Field
µS/cm
50
100
150
200
Oct 2006
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 58
Downgradient Site 27

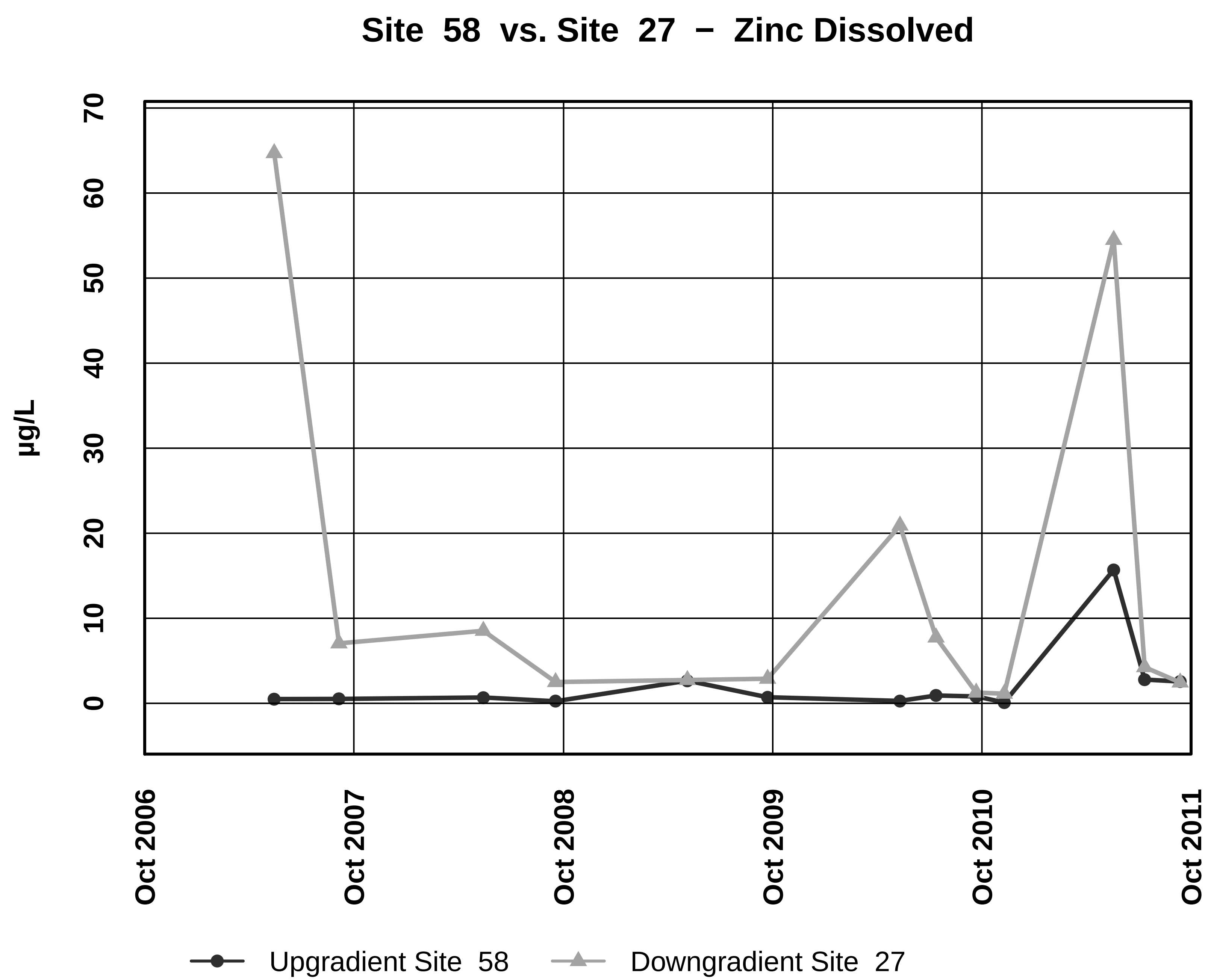


Site 58 vs. Site 27 − pH Field
su
6.5
6.0
5.5
5.0
Oct 2006
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 58
Downgradient Site 27



Site 58 vs. Site 27 − Alkalinity Total
mg/L
15
20
25
30
35
Oct 2006
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 2006
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
60
70
Oct 2006
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 58
Downgradient Site 27

INTERPRETIVE REPORT
SITE 29 “MONITORING WELL 3S”

The data collected during the current water year are listed in the following “Table of Results for Water Year 2011” 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 2011.				

The data for water year 2011 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 2011

				Limits		
Sample Date	**Parameter**	**Value**		**Lower**	**Upper**	**Hardness**
9-Nov-10	Alkalinity	0	mg/L	20		
19-May-11	Alkalinity	19.1	mg/L	20		
12-Jul-11	Alkalinity	0	mg/L	20		
12-Jul-11	Copper Dissolved	4.54	µg/L		2.74	25.00 mg/L
19-May-11	Lead Dissolved	2.37	µg/L		0.54	25.00 mg/L
12-Jul-11	Lead Dissolved	7.13	µg/L		0.54	25.00 mg/L
9-Nov-10	pH Field	4.85	su	6.5	8.50	
19-May-11	pH Field	5.13	su	6.5	8.50	
12-Jul-11	pH Field	4.13	su	6.5	8.50	
12-Sep-11	pH Field	5.22	su	6.5	8.50	
19-May-11	Zinc Dissolved	51.3	µg/L		36.50	25.00 mg/L
12-Jul-11	Zinc Dissolved	36.7	µg/L		36.50	25.00 mg/L

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 exceedances were for dissolved lead and dissolved zinc in the months of May 2011 and July

2011. Three more exceedances were for total alkalinity and the remaining exceedance was for the July 2011 dissolved copper result.

Though dissolved lead has routinely been in exceedance at Site 29 over the past several years the sharp increase in the May 2011 and then July 2011 sampling results is notable. Furthermore, dissolved zinc and dissolved copper have not been in exceedance for any of the other five years used for this year's analysis. 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 sharp increase 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 2012, but was switched to a weekly sampling during the winter months to increase the temporal resolution of the dataset. Results from this monitoring are summarized in the 2011 Tailings and Waste Rock Annual Report and will also be presented at the annual meeting in June 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 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, dissolved manganese, 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-05 and Sep-11 (WY2006-WY2011).

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	-	-11.68	-16.4
pH Field	6	0.03			
Alkalinity, Total	6	0.06			
Sulfate, Total	6	Inconsistent detection limits			
Zinc, Dissolved	6	0.40			

* 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 -11.7 µs/cm/yr or a 16.4% decrease.

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 are within similar ranges at both sites. 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 MDL). Site 29 routinely has dissolved zinc values that are ~5 µg/L higher than values found at Site 58. These results are similar in magnitude and range to what was noted previously for Site 27 with respect to the comparison with Site 58. The 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 2011

Site 029FMG - 'Monitoring Well - 3S'

Sample Date/Parameter	Oct 2010	Nov 2010	Dec 2010	Jan 2011	Feb 2011	Mar 2011	Apr 2011	May 2011	Jun 2011	Jul 2011	Aug 2011	Sep 2011	**Median**
Water Temp (°C)		8.2						6.9		8.6		8.6	8.4
Conductivity-Field(μmho)		46.5						64		51.6		46	49.1
Conductivity-Lab (μmho)		33						57		37		78	47
pH Lab (standard units)		4.35						5.23		4.42		5.37	4.83
pH Field (standard units)		4.85						5.13		4.13		5.22	4.99
Total Alkalinity (mg/L)		0.5						19.1		0.5		31	9.8
Total Sulfate (mg/L)		2.5						2.5		25		2.5	2.5
Hardness (mg/L)		9.2						20.1		10.1		20.7	15.1
Dissolved As (ug/L)		3.59						7.91		3.61		9.36	5.760
Dissolved Ba (ug/L)		5.8						10.5		12.6		8.7	9.6
Dissolved Cd (ug/L)		0.004						0.0273		0.0502		0.0052	0.0163
Dissolved Cr (ug/L)		1.39						1.09		1.06		1.35	1.220
Dissolved Cu (ug/L)		0.309						1.07		4.54		0.252	0.690
Dissolved Pb (ug/L)		0.465						2.37		7.13		0.306	1.4175
Dissolved Ni (ug/L)		0.862						1.53		1.76		1.44	1.485
Dissolved Ag (ug/L)		0.004						0.002		0.004		0.002	0.003
Dissolved Zn (ug/L)		6.01						51.3		36.7		5.62	21.36
Dissolved Se (ug/L)		0.114						0.384		0.057		0.203	0.159
Dissolved Hg (ug/L)		0.00139						0.00112		0.00122		0.000654	0.001170

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.

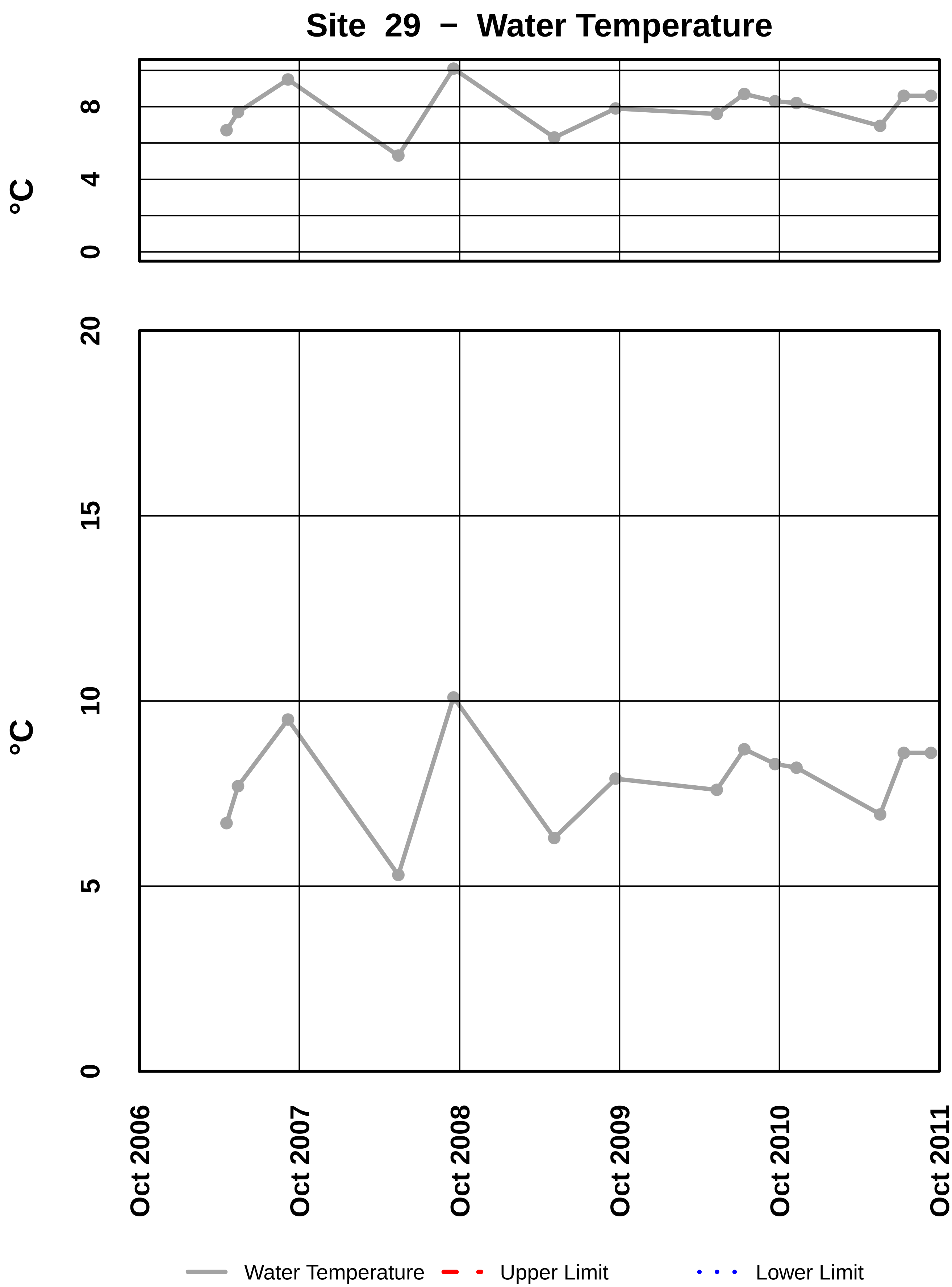
Shaded data has been qualified as an outlier by KGCMC and removed from any further analysis and is not included into the calculation of the median

Qualified Data by QA Reviewer

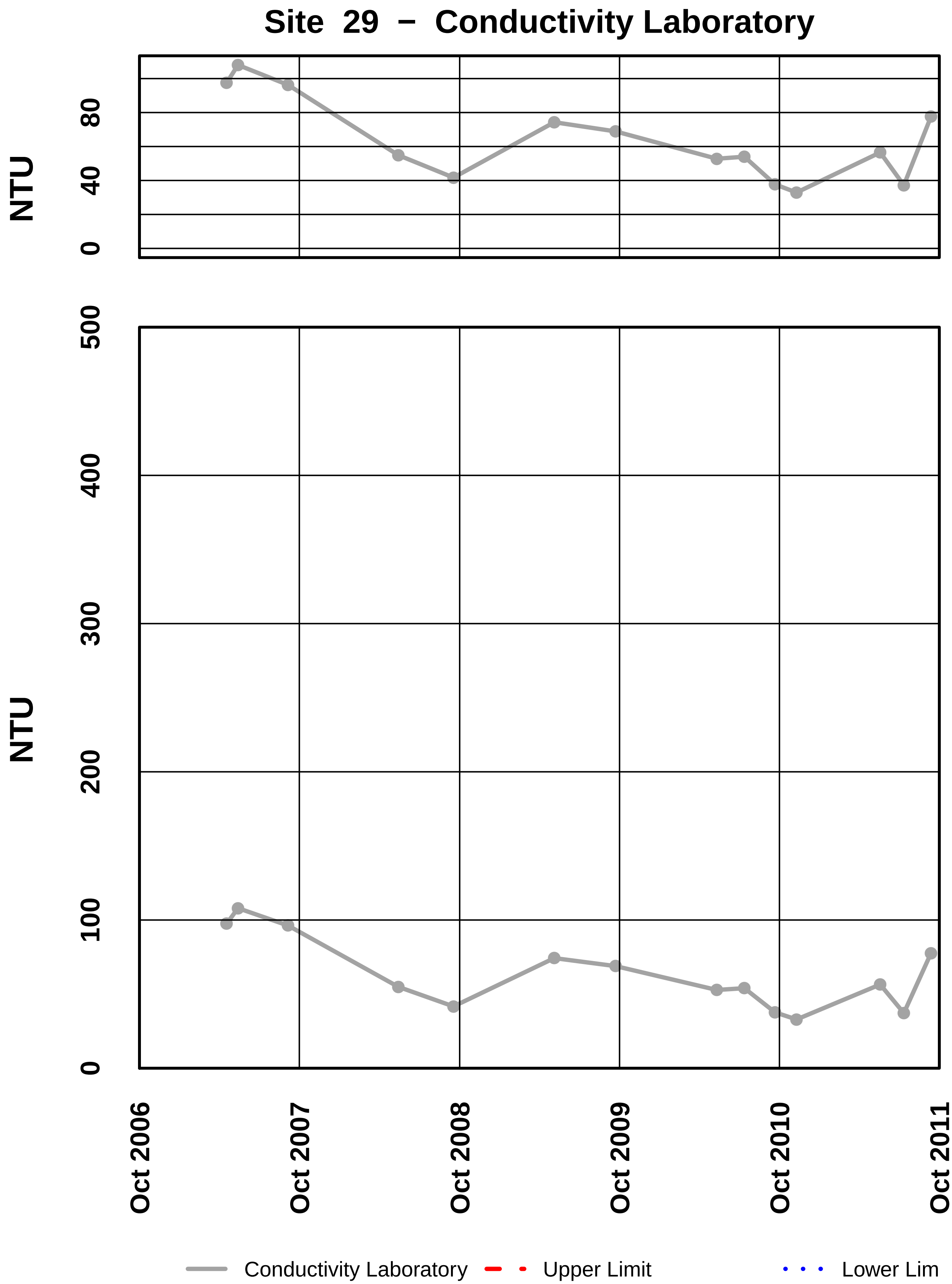
Date Range: 10/01/2010 to 09/30/2011

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
29	5/19/2011	12:00 AM				
			pH Lab, su	5.23	J	Hold Time Violation
			SO4 Tot, mg/l	-5	R	Sample Reciept Temperature
			Cd diss, µg/l	0.0273	U	Trip Blank Contamination
29	7/12/2011	12:00 AM				
			SO4 Tot, mg/l	-50	R	Sample Reciept Temperature
29	9/12/2011	12:00 AM				
			Se diss, µg/l	0.2	J	Below Quantitative Range
			Cd diss, µg/l	0.00517	J	Below Quantitative Range
			Hg diss, µg/l	0.000654	U	Field Blank Contamination
			SO4 Tot, mg/l	0	UJ	Sample Receipt Temperature

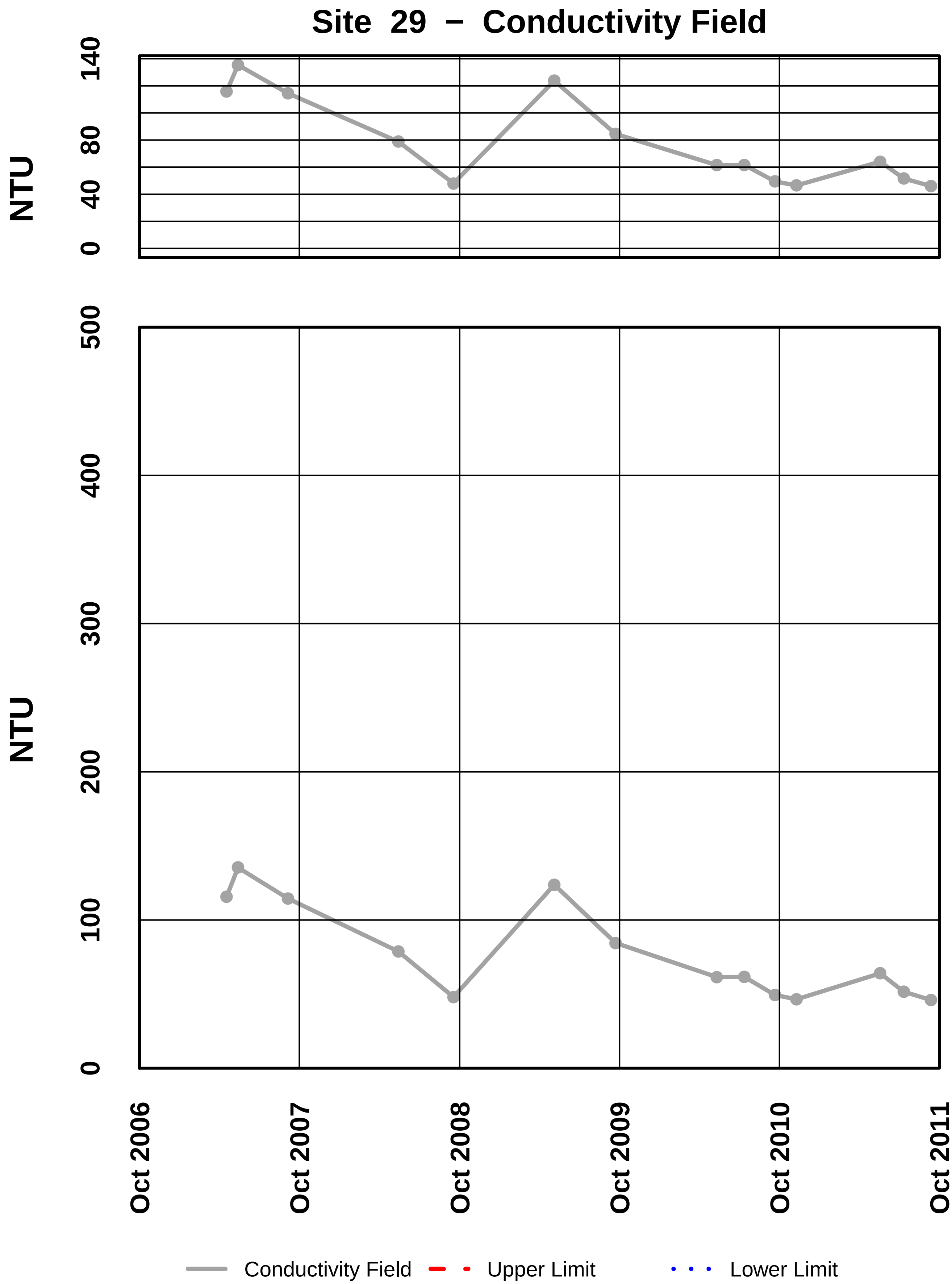
Qualifier	Description
J	Positively Identified - Approximate concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit



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

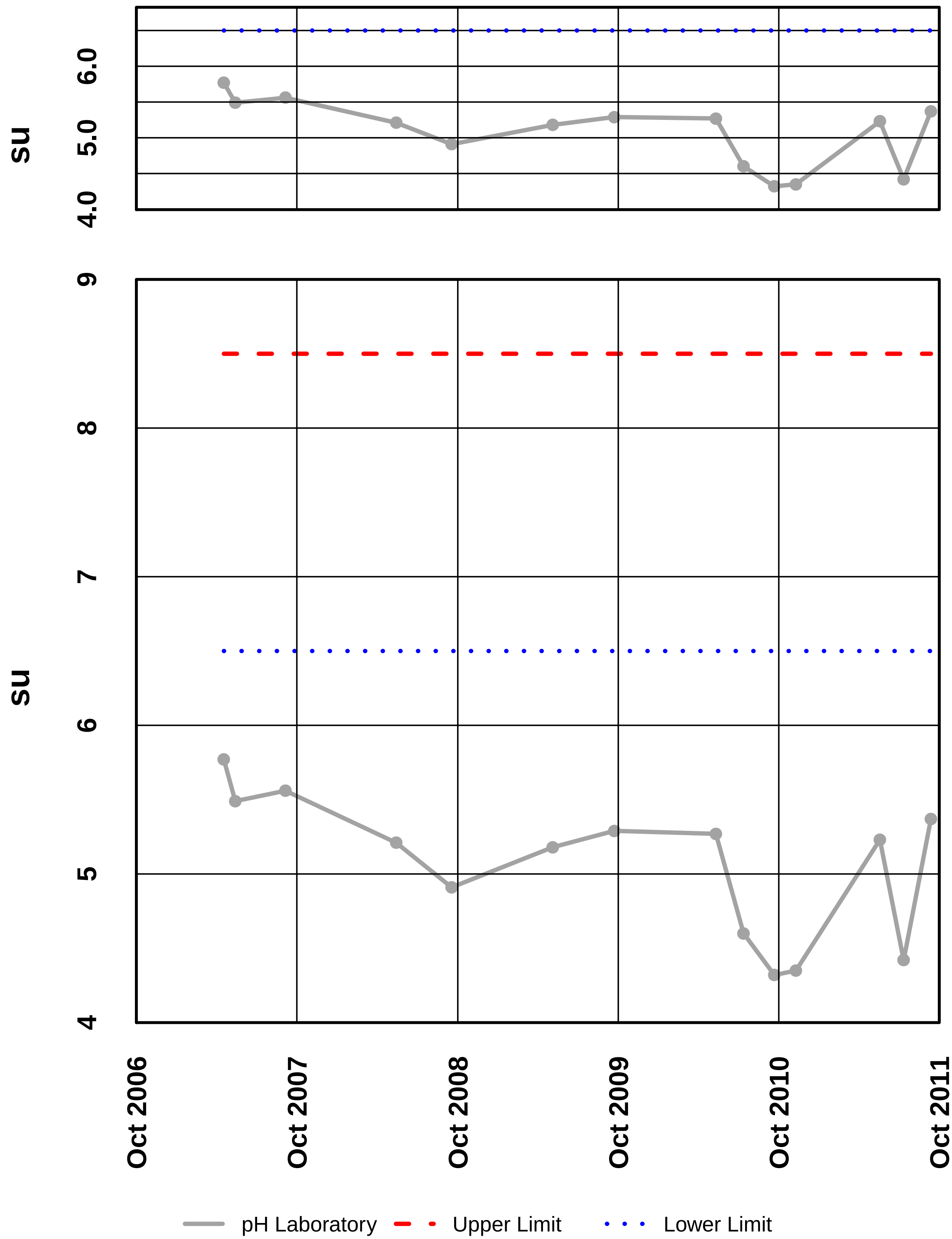


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



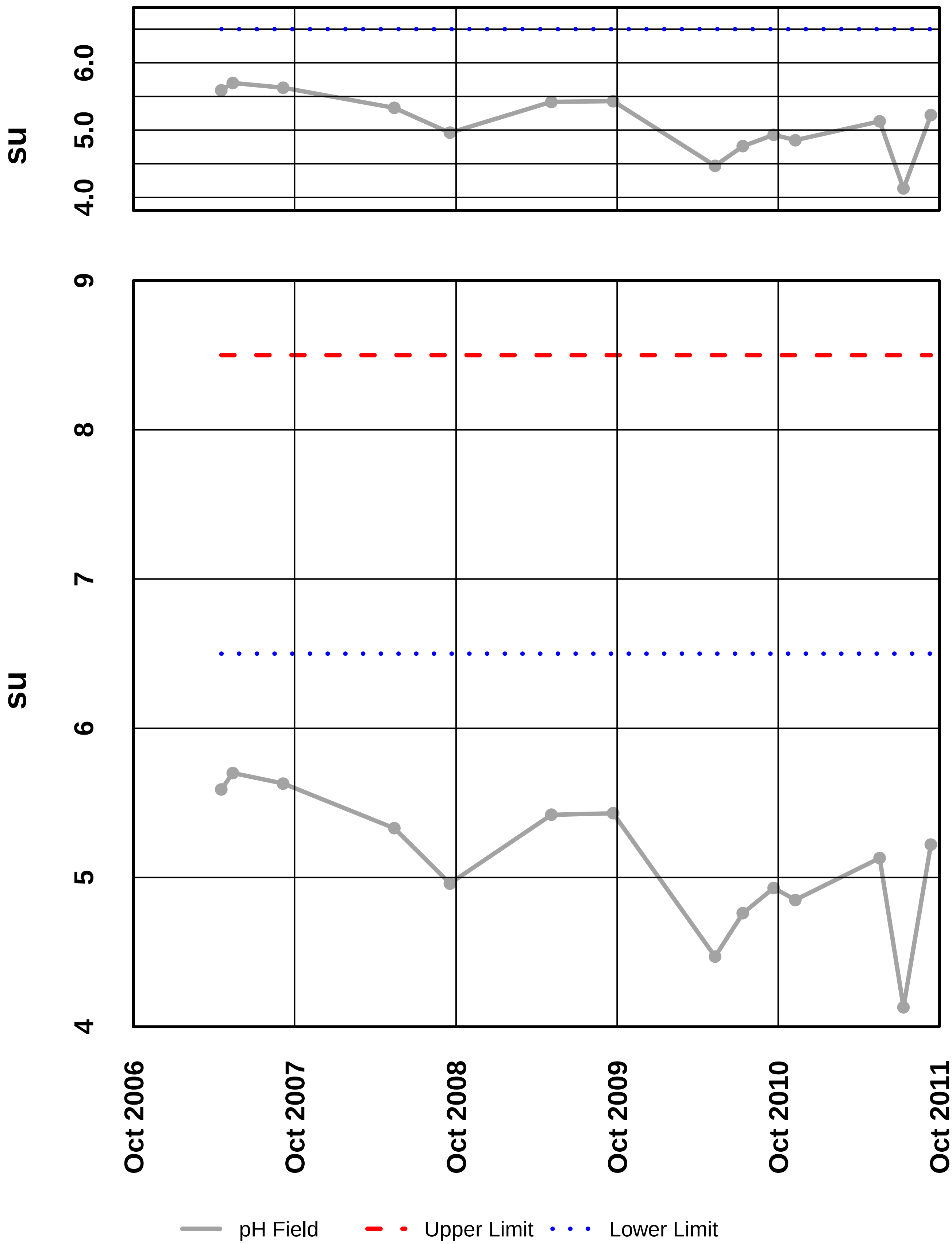
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 29 – pH Laboratory



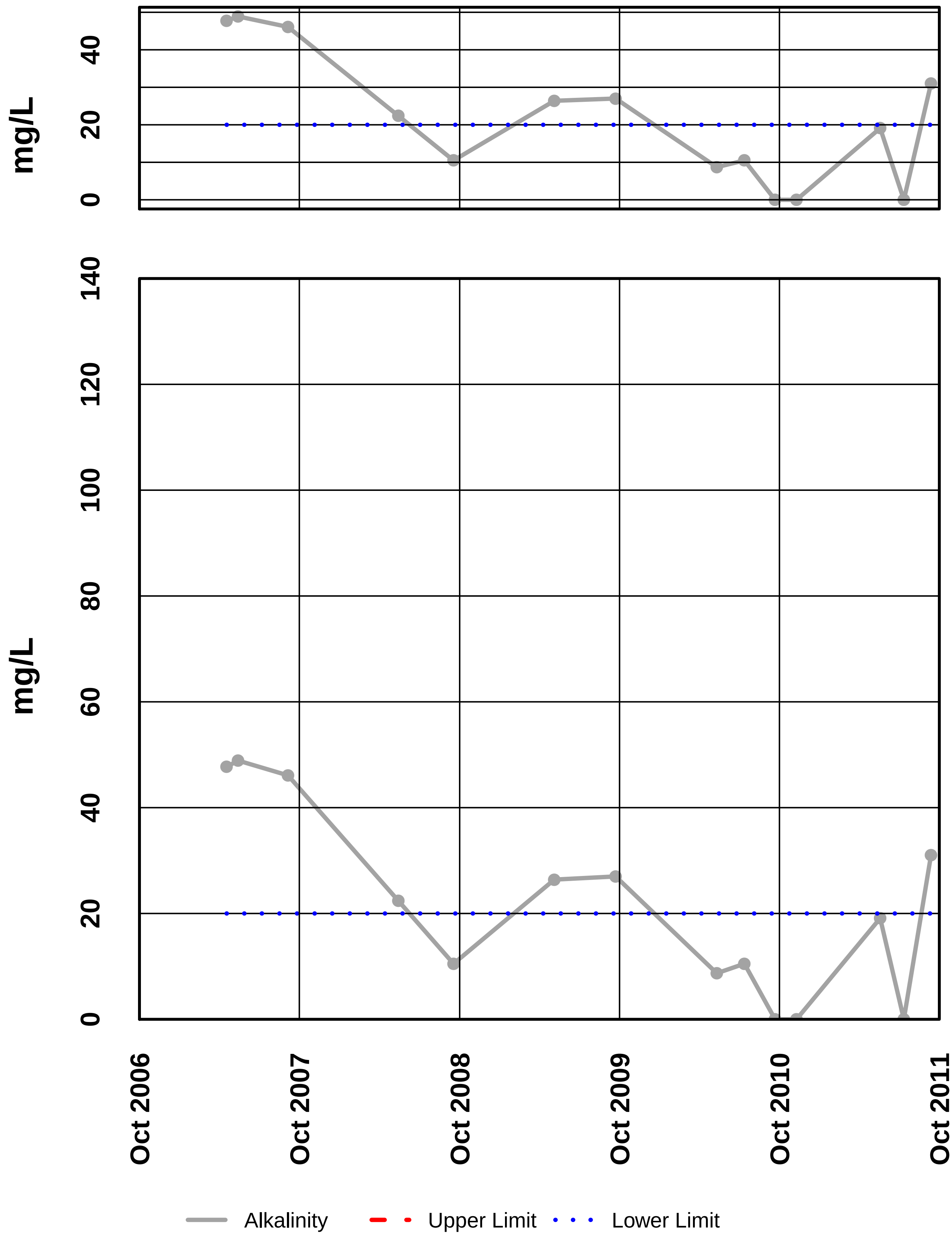
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 29 – pH Field



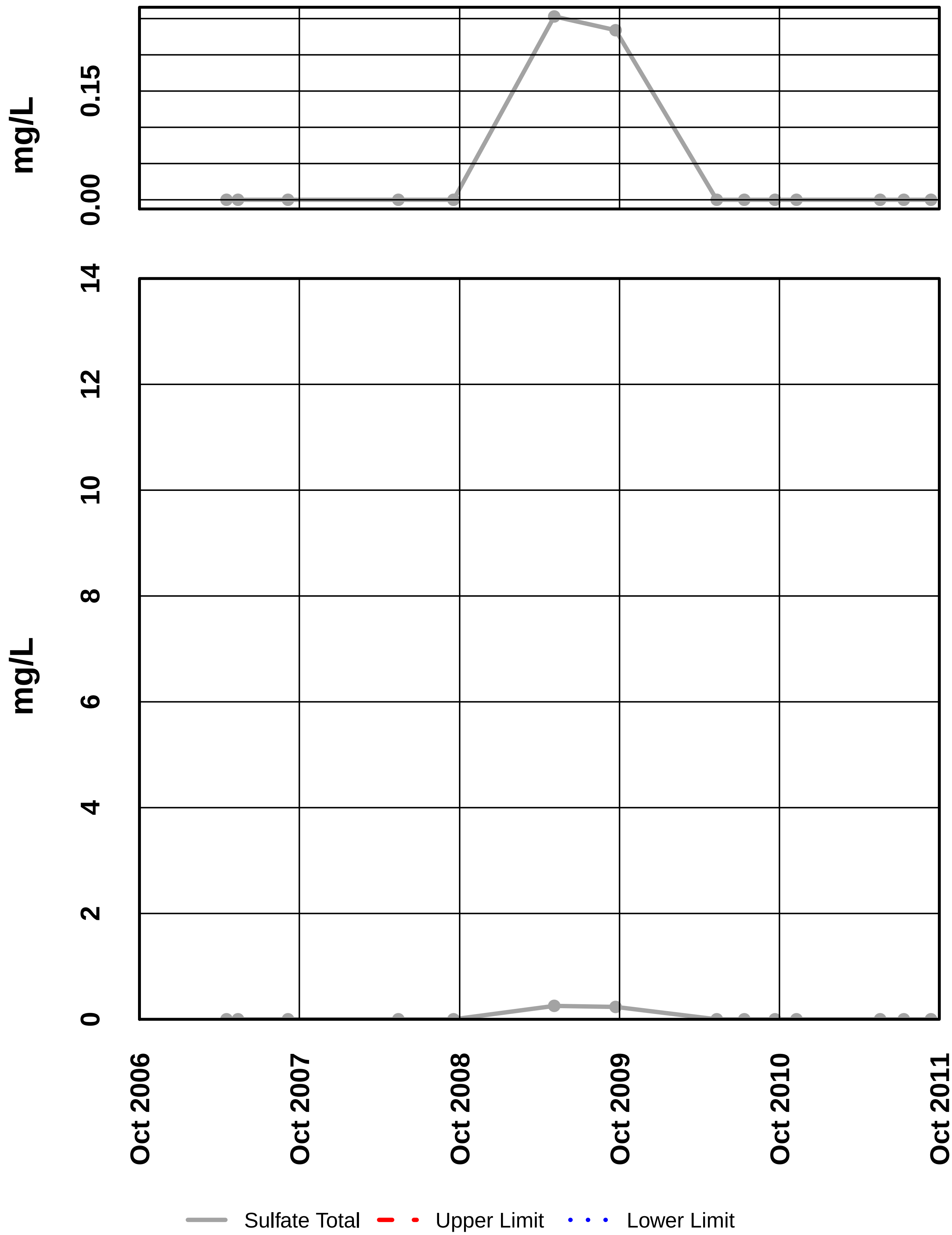
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 29 − Alkalinity

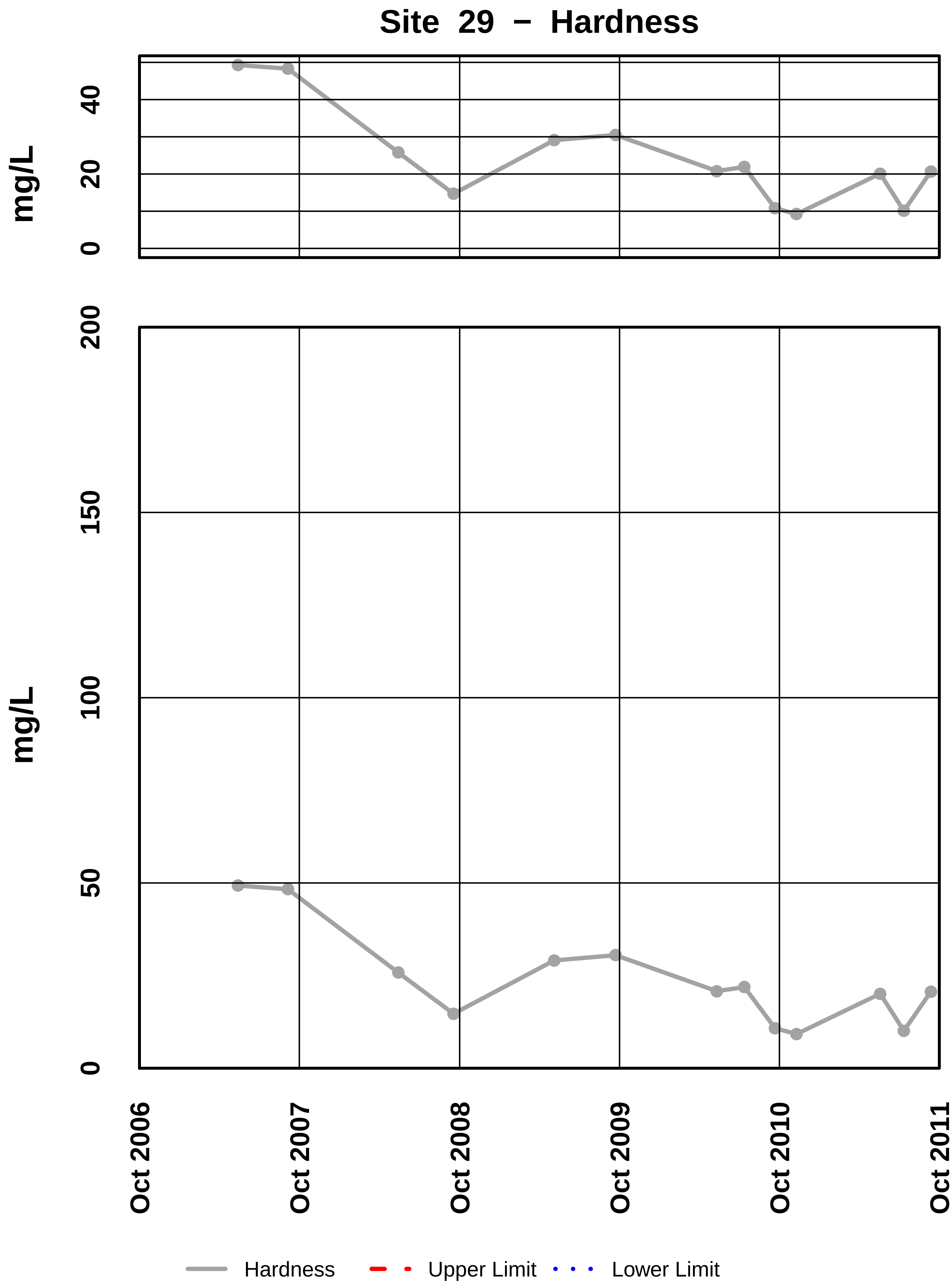


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

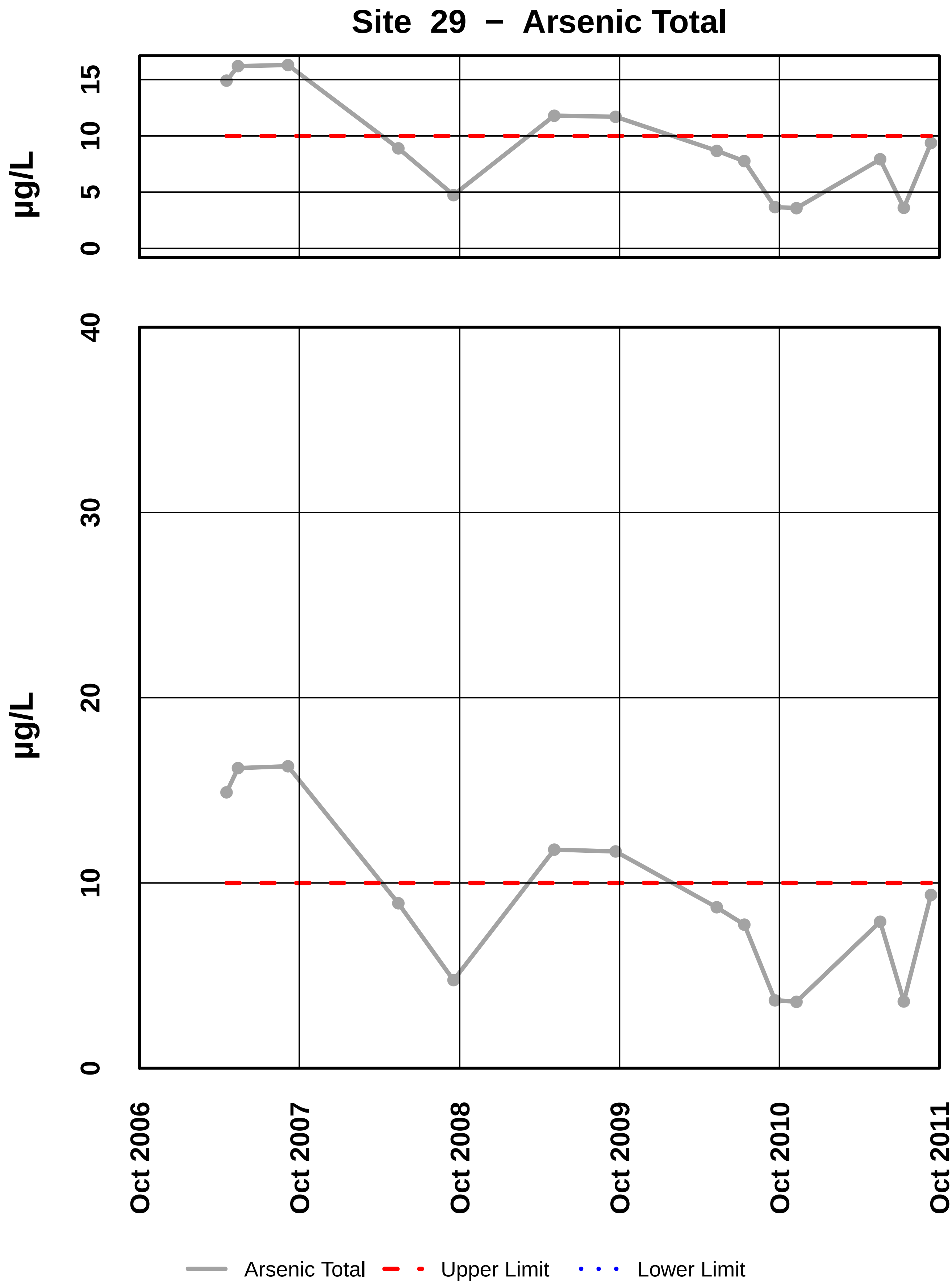
Site 29 − Sulfate Total



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

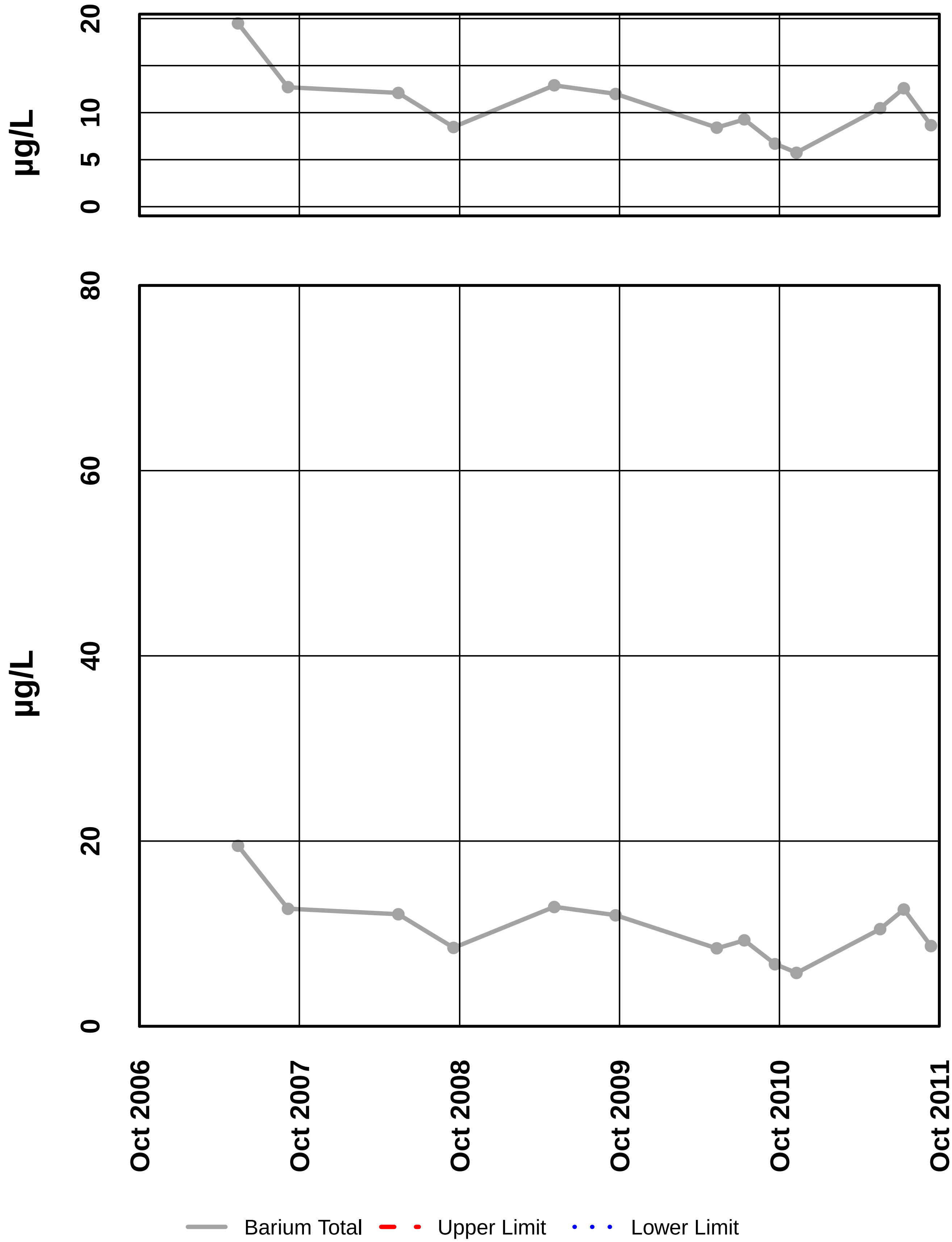


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

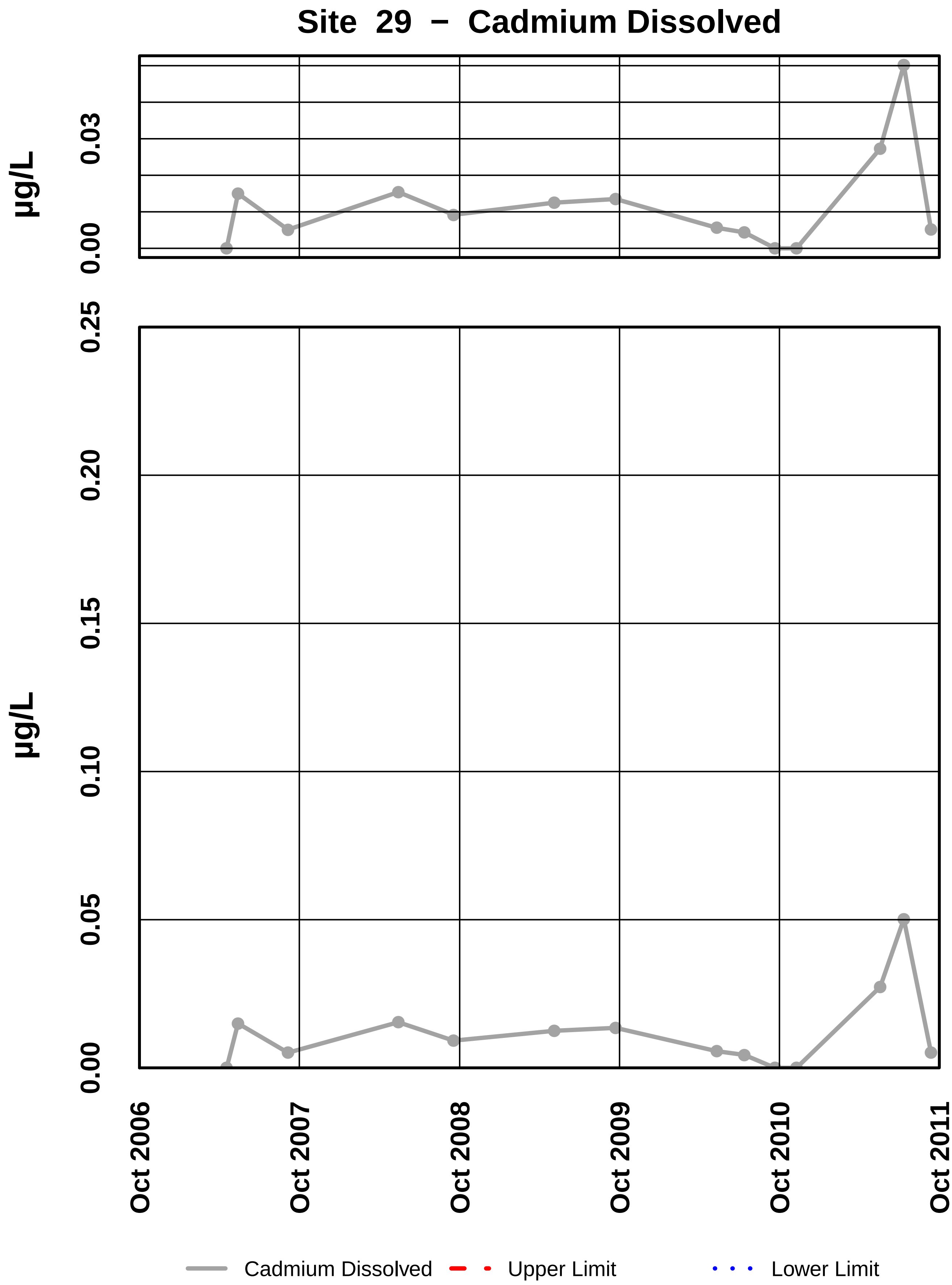


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

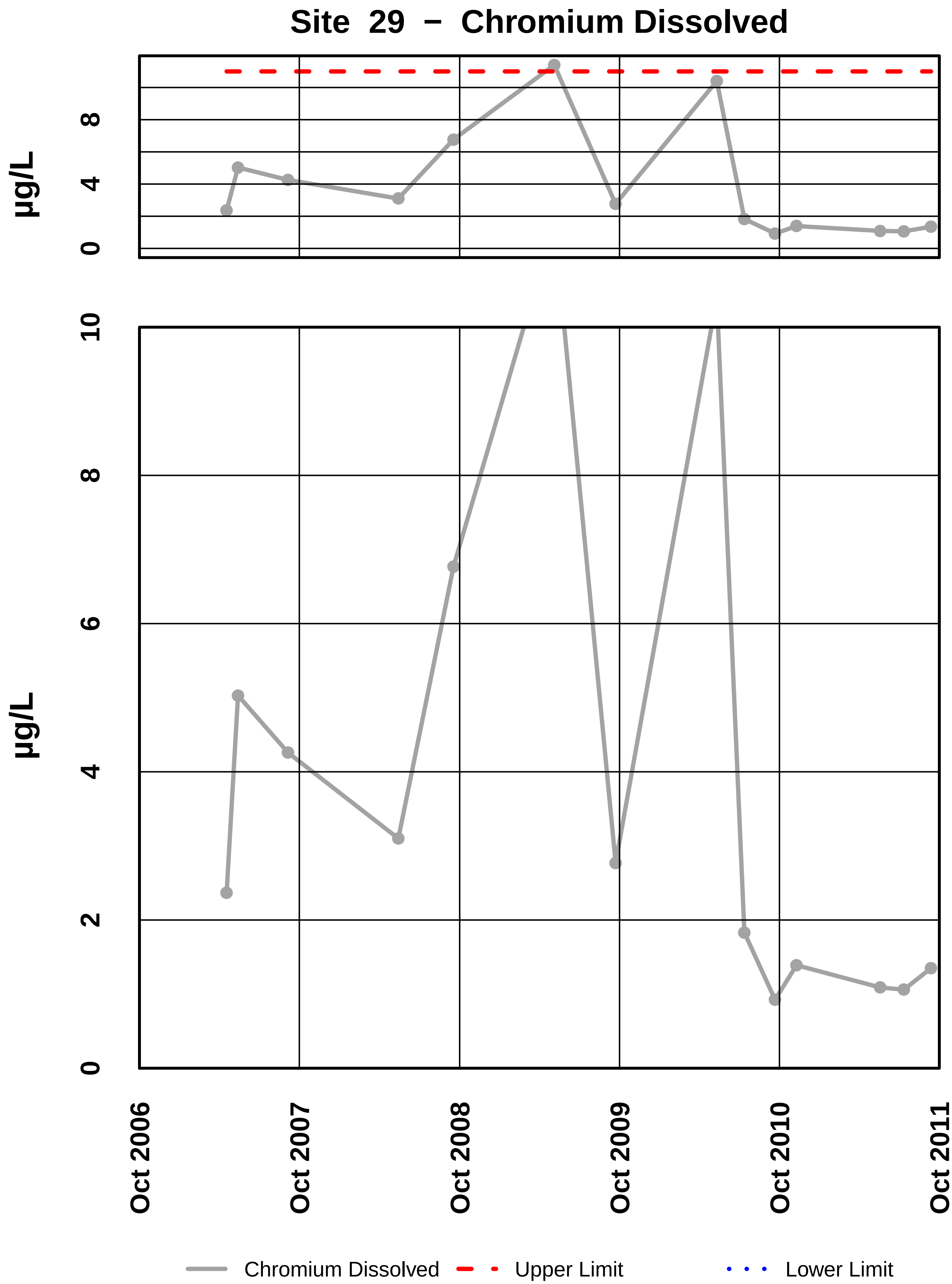
Site 29 – Barium Total



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

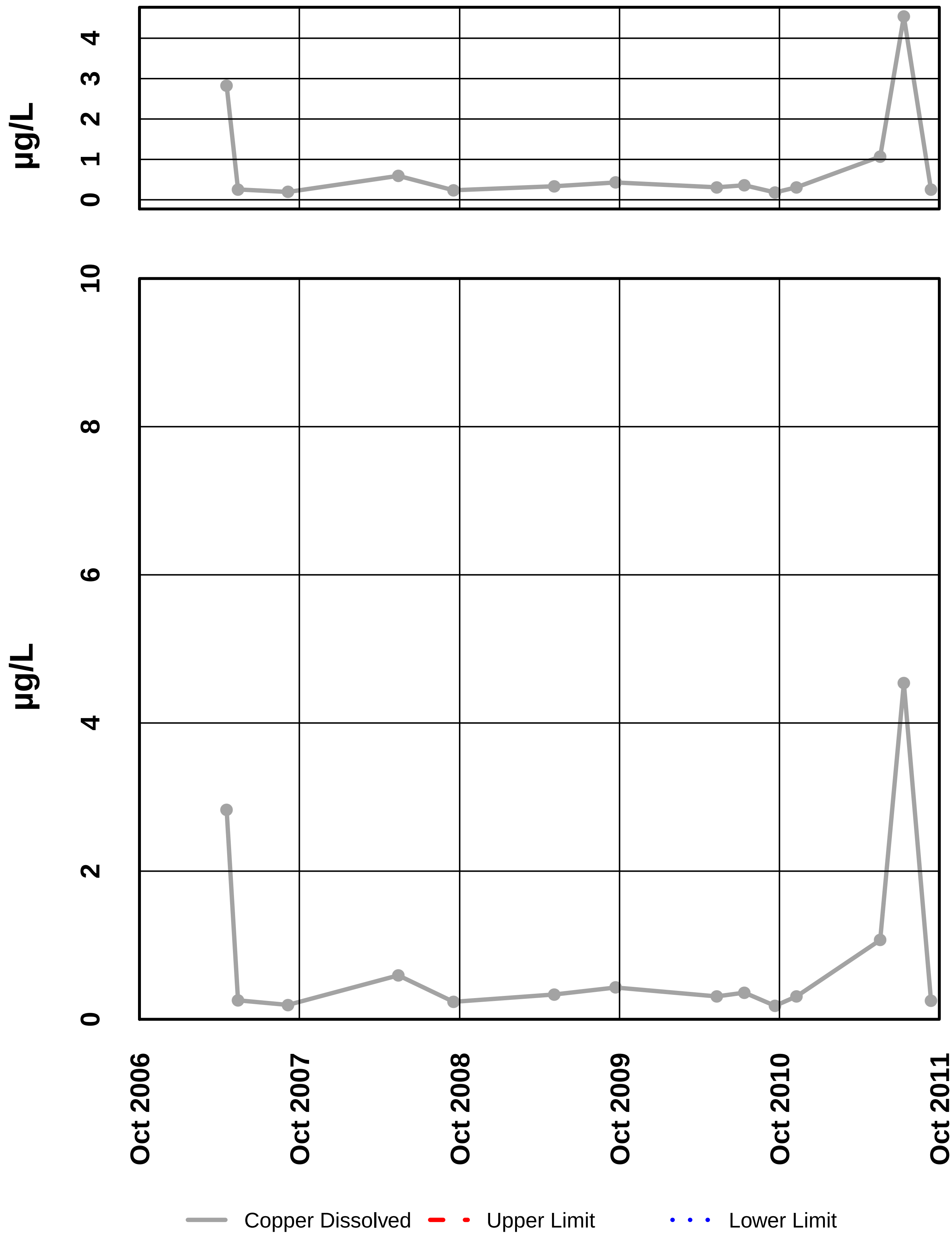


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

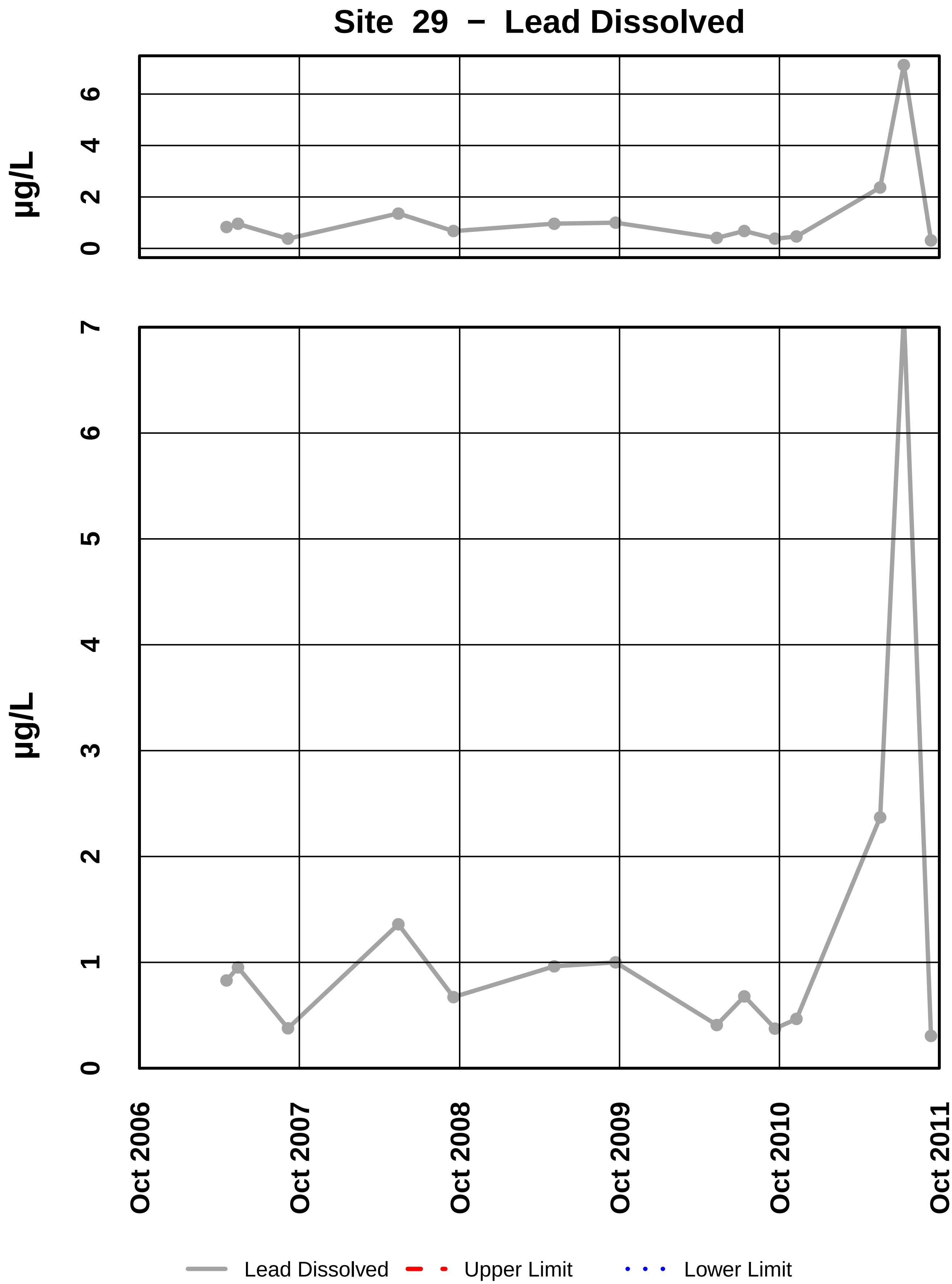


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 29 − Copper Dissolved

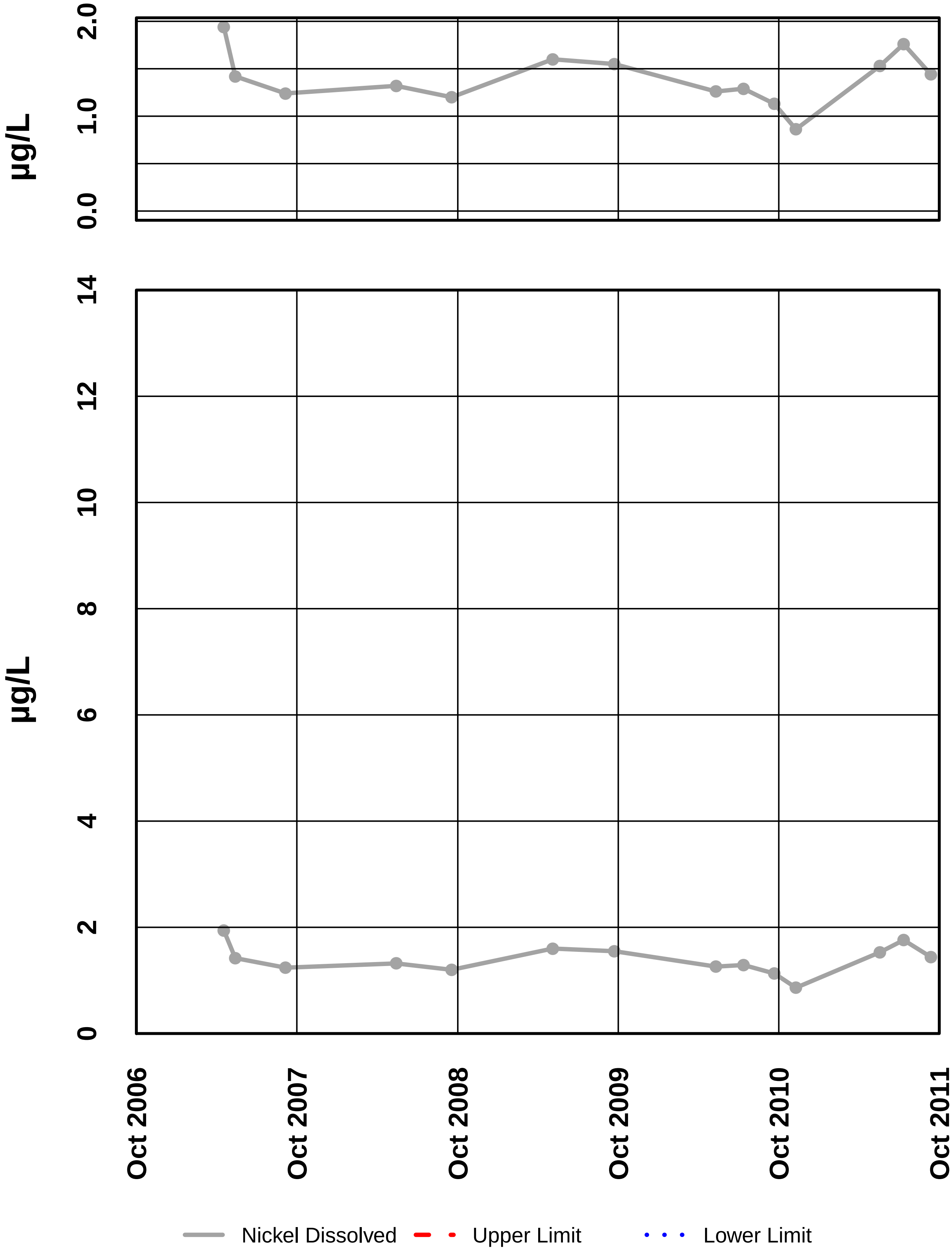


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

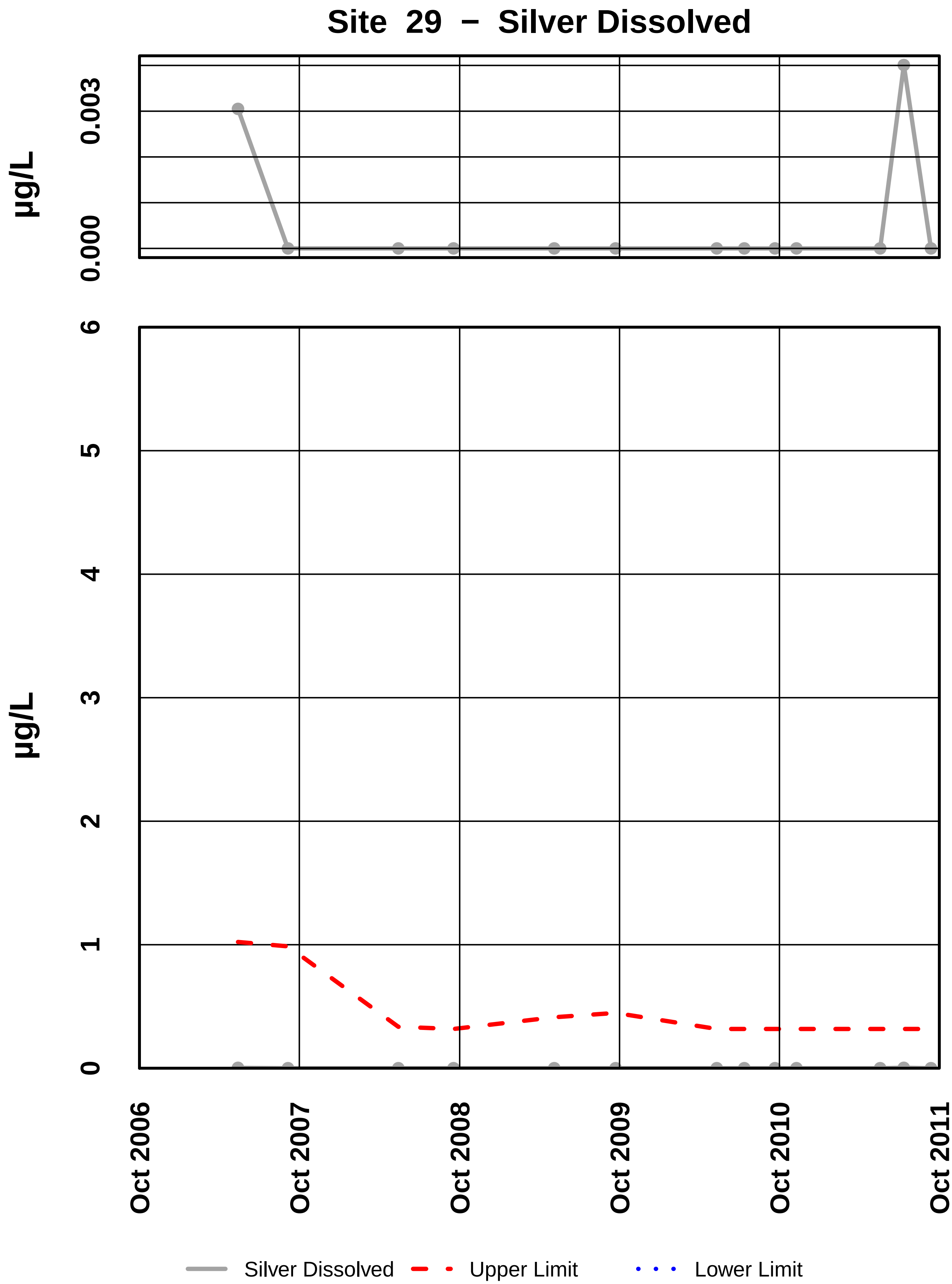


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 29 − Nickel Dissolved

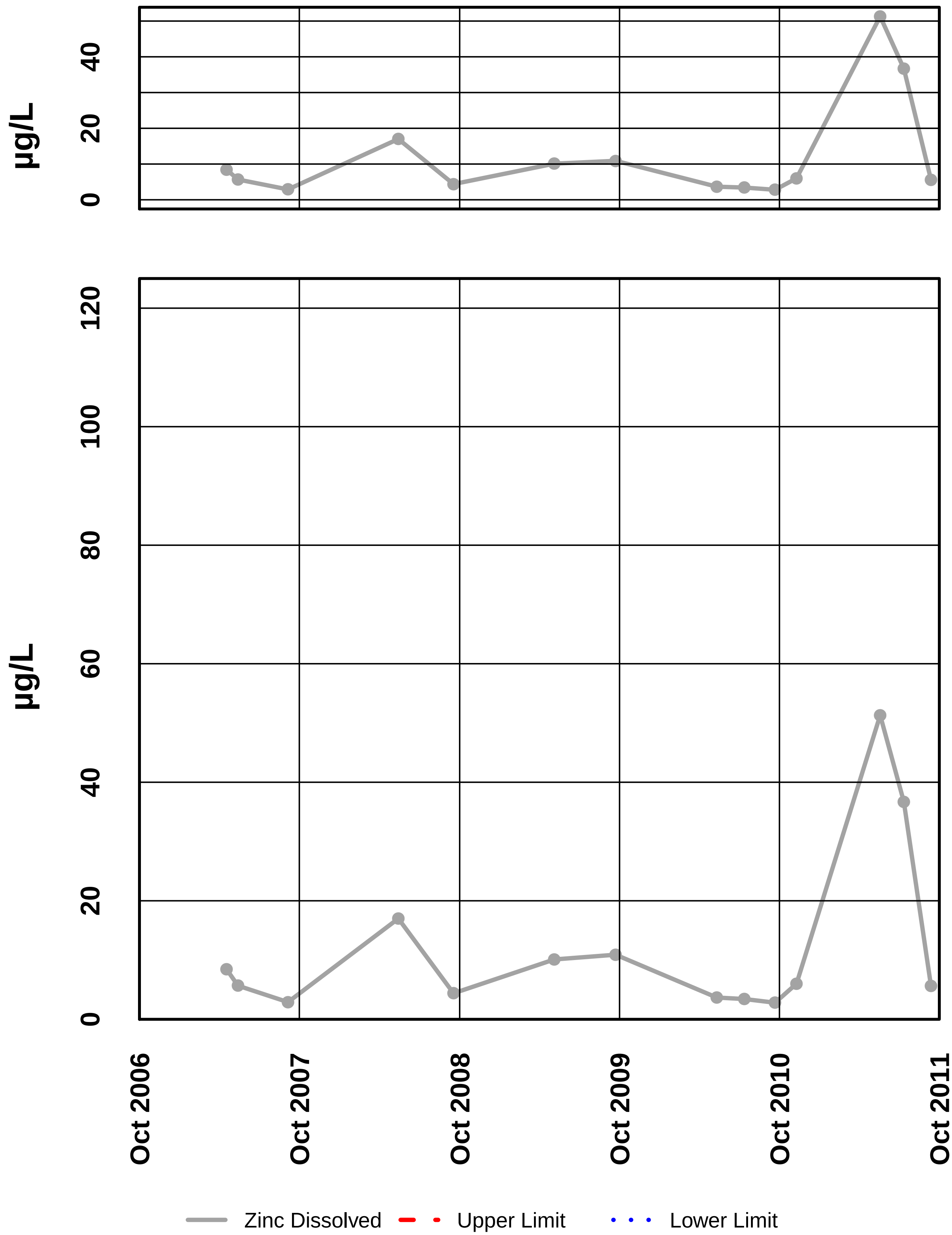


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



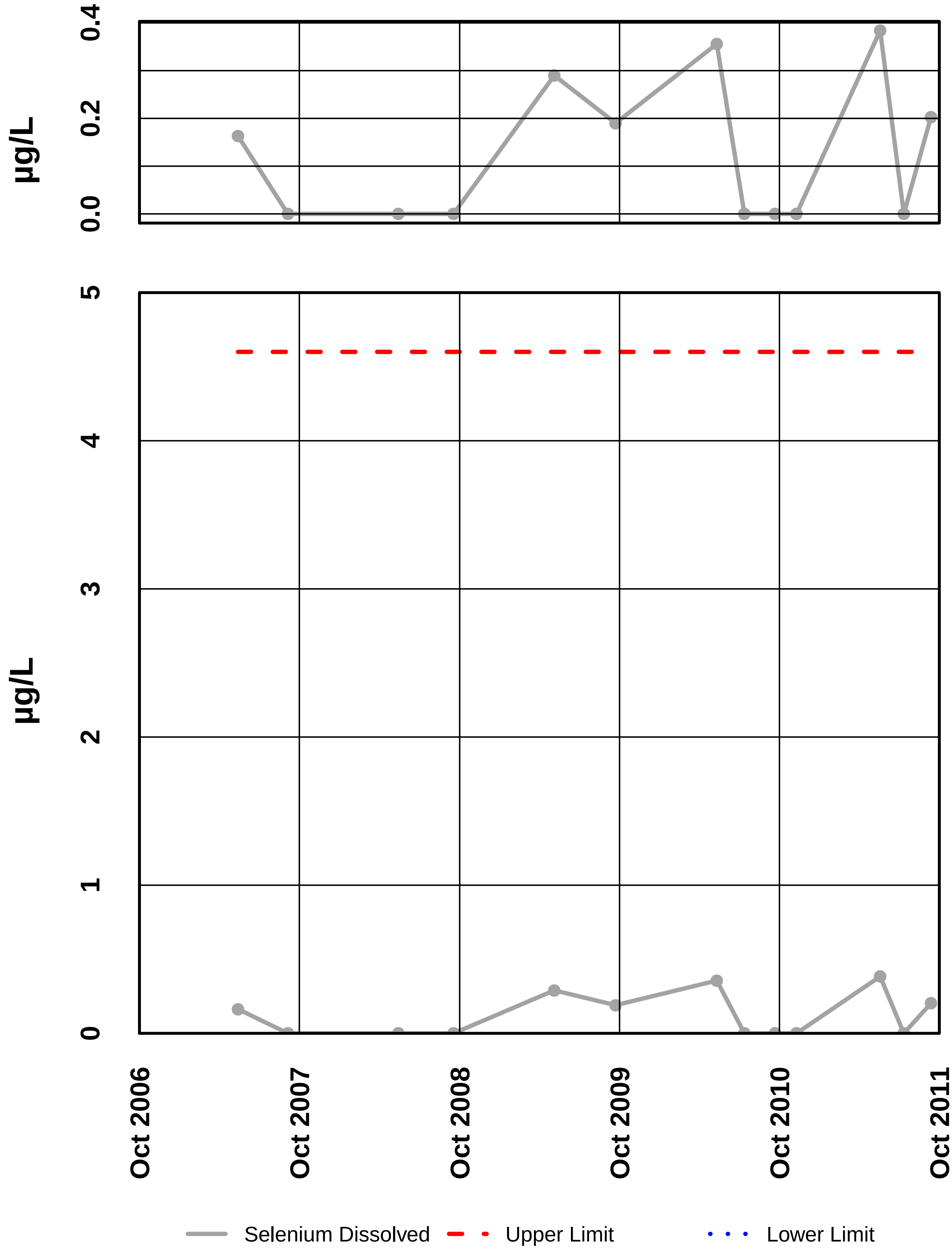
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 29 − Zinc Dissolved



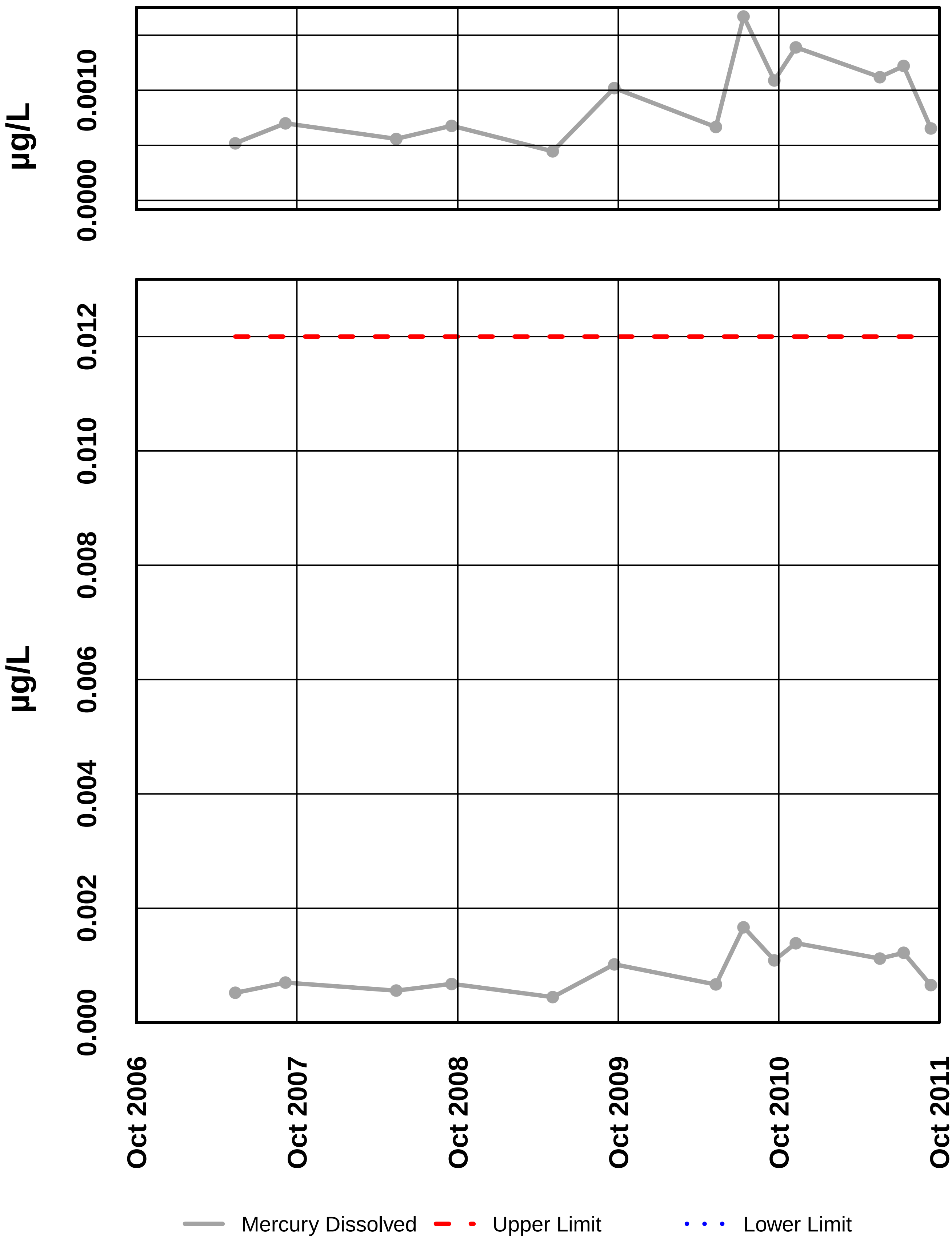
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 29 − Selenium Dissolved



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

Site 29 – Mercury Dissolved



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

Site **#29** Seasonal Kendall analysis for Specific Conductance, Lab (uS/cm)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2006**								123.7				96.1
b	**WY2007**							115.8	135.4				114.5
c	**WY2008**								78.8				48
d	**WY2009**								123.8				84.5
e	**WY2010**								61.5		61.6		49.4
f	**WY2011**		46.5						64		51.6		46
	n	0	1	0	0	0	0	1	6	0	2	0	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	0	1	0	0	0	0	1	6	0	2	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
f-d								-1				-1
f-e								1		-1		-1
S_k	0	0	0	0	0	0	0	-7	0	-1	0	-9

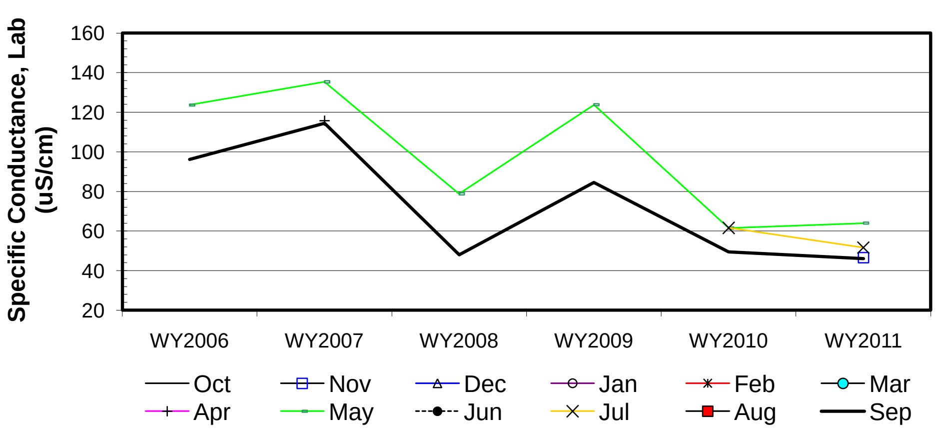
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=								28.33		1.00		28.33
$Z_k = S_k/\sigma_S$								-1.32		-1.00		-1.69
Z^2_k								1.73		1.00		2.86

ΣZ_k=	-4.01
ΣZ^2_k=	5.59
Z-bar=$\Sigma Z_k/K$=	-1.34

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	16	0	0	0	0

Σn	16
ΣS_k	-17

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=		0.24	@α=5% $\chi^2_{(K-1)}$=	5.99	Test for station homogeneity	
	p	**0.887**			$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc}	-2.11	@α/2=2.5% Z=	1.96	**H_0** (No trend)	REJECT
57.67	p	**0.018**			**H_A** ($\pm$ trend)	ACCEPT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-24.24		-0.43
0.050	-21.08	**-11.68**	-4.14
0.100	-18.36		-5.48
0.200	-16.65		-9.06
		-16.4%	

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2006**								5.6				5.2
b	**WY2007**							5.6	5.7				5.6
c	**WY2008**								5.3				5.0
d	**WY2009**								5.4				5.4
e	**WY2010**								4.5		4.8		4.9
f	**WY2011**		4.9						5.1		4.1		5.2
	n	0	1	0	0	0	0	1	6	0	2	0	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	0	1	0	0	0	0	1	6	0	2	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
f-d								-1				-1
f-e								1		-1		1
S_k	0	0	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=								28.33		1.00		28.33
$Z_k = S_k/\sigma_S$								-1.69		-1.00		-0.94
Z^2_k								2.86		1.00		0.88

ΣZ_k= -3.63

ΣZ^2_k= 4.74

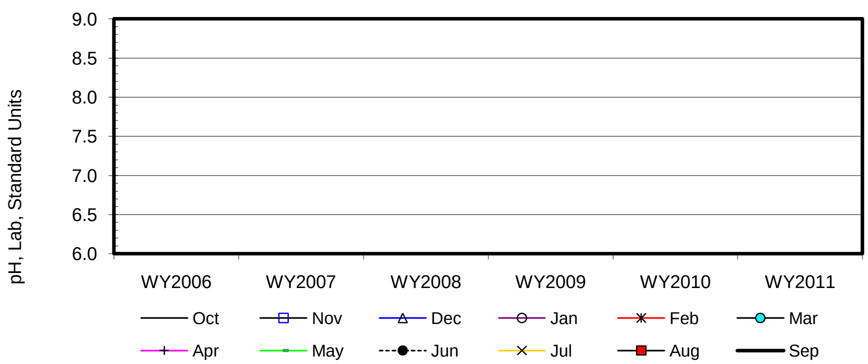
Z-bar=$\Sigma Z_k/K$= -1.21

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	16	0	0	0	0

Σn 16

ΣS_k -15

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$= 0.35	**p** **0.840**	@α=5% $\chi^2_{(K-1)}$= 5.99	Test for station homogeneity $\chi^2_h<\chi^2_{(K-1)}$ ACCEPT
$\Sigma VAR(S_k)$ 57.67	Z_{calc} -1.84 **p** **0.033**	@$\alpha/2$=2.5% Z= 1.96	H_0 (No trend) ACCEPT; H_A (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.38		0.07
0.050	-0.21	**-0.10**	-0.02
0.100	-0.14		-0.06
0.200	-0.14		-0.08

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	**WY2006**								55.0				12.4
b	**WY2007**								48.9				46.1
c	**WY2008**								22.4				10.5
d	**WY2009**								26.4				27.0
e	**WY2010**								8.7		10.5		0.0
f	**WY2011**		0.0						19.1		0.0		31.0
	n	0	1	0	0	0	0	0	6	0	2	0	6

		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
	t_1	0	1	0	0	0	0	0	6	0	2	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
	f-d								-1				1
	f-e								1		-1		1
	S_k	0	0	0	0	0	0	0	-11	0	-1	0	-1

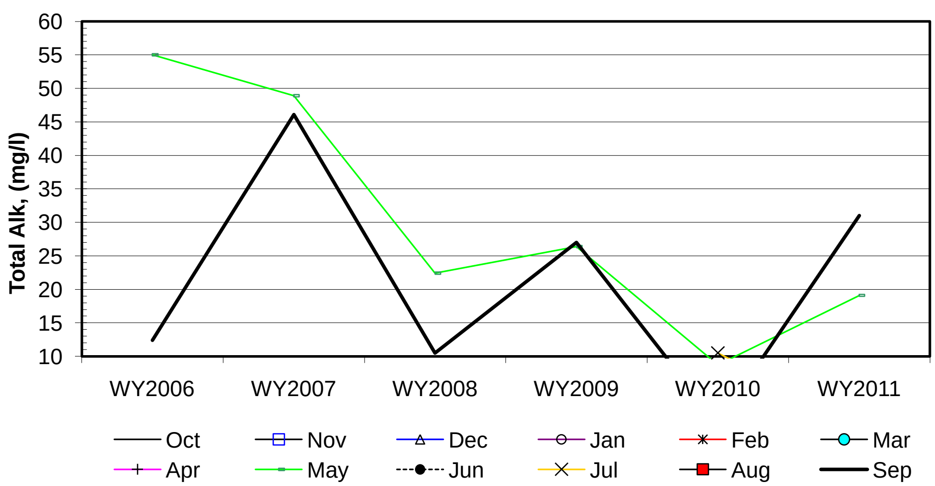
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=								28.33		1.00		28.33
$Z_k = S_k/\sigma_S$								-2.07		-1.00		-0.19
Z^2_k								4.27		1.00		0.04

ΣZ_k= -3.25
ΣZ^2_k= 5.31
Z-bar=ΣZ_k/K= -1.08

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	15	0	0	0	0

Σn 15
ΣS_k -13

$\chi^2_h=\Sigma Z^2_k$-K(Z-bar)^2=	1.78	@α=5% $\chi^2_{(K-1)}$= 5.99	Test for station homogeneity	
p	**0.412**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k) 57.67	Z_{calc} -1.58	@α/2=2.5% Z= 1.96	**H_0** (No trend)	ACCEPT
p	**0.057**		**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-14.05		3.81
0.050	-11.06	**-6.10**	-0.99
0.100	-9.90		-2.37
0.200	-8.90		-3.69

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	**WY2006**								0.0				0.5
b	**WY2007**								0.0				0.0
c	**WY2008**								0.0				0.0
d	**WY2009**								0.3				0.2
e	**WY2010**								0.0		0.0		0.0
f	**WY2011**		0.0						0.0		0.0		0.0
	n	0	1	0	0	0	0	0	6	0	2	0	6

		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
	t_1	0	1	0	0	0	0	0	1	0	0	0	2
	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	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								0				-1
	d-a								1				-1
	e-a								0				-1
	f-a								0				-1
	c-b								0				0
	d-b								1				1
	e-b								0				0
	f-b								0				0
	d-c								1				1
	e-c								0				0
	f-c								0				0
	e-d								-1				-1
	f-d								-1				-1
	f-e								0		0		0
	S_k	0	0	0	0	0	0	0	1	0	0	0	-5

	May	Jul	Sep
σ^2_S=	11.67	0.00	19.67
$Z_k = S_k/\sigma_S$	0.29	#DIV/0!	-1.13
Z^2_k	0.09	#DIV/0!	1.27

ΣZ_k= #DIV/0!

ΣZ^2_k= #DIV/0!

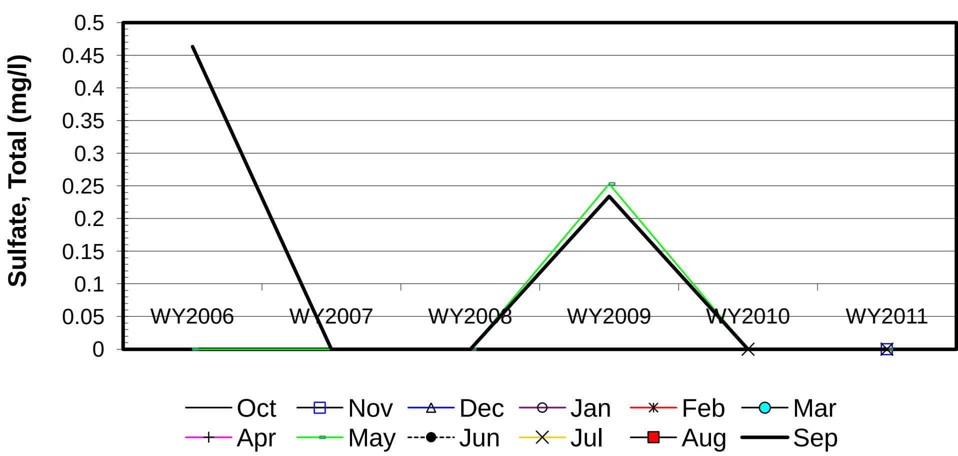
Z-bar=ΣZ_k/K= #DIV/0!

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	4	1	0	1	1

Σn 15

ΣS_k -4

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	#DIV/0!	@α=5% $\chi^2_{(K-1)}$= 5.99	Test for station homogeneity	
p	**#DIV/0!**		$\chi^2_h<\chi^2_{(K-1)}$	#DIV/0!
$\Sigma VAR(S_k)$	Z_{calc} -0.54	@α=5% Z= 1.64	H_0 (No trend)	ACCEPT
31.33	p **0.296**		H_A (± trend)	#DIV/0!



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.08		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	**WY2006**								7.3				7.4
b	**WY2007**								5.7				2.9
c	**WY2008**								17.0				4.4
d	**WY2009**								10.1				10.9
e	**WY2010**								3.7		3.4		2.8
f	**WY2011**		6.0						51.3		36.7		5.6
	n	0	1	0	0	0	0	0	6	0	2	0	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	0	1	0	0	0	0	0	6	0	2	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
f-d								1				-1
f-e								1		1		1
S_k	0	0	0	0	0	0	0	3	0	1	0	-1

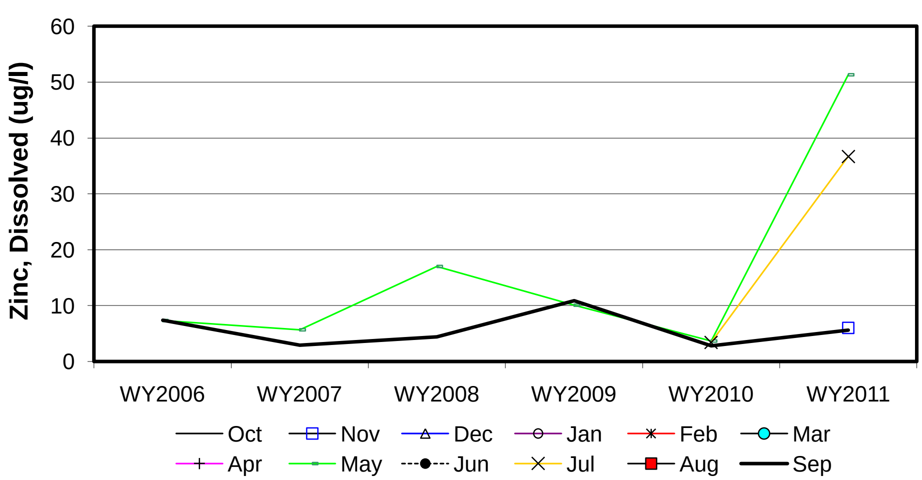
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=								28.33		1.00		28.33
$Z_k = S_k/\sigma_S$								0.56		1.00		-0.19
Z^2_k								0.32		1.00		0.04

ΣZ_k= 1.38
ΣZ^2_k= 1.35
Z-bar=ΣZ_k/K= 0.46

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	15	0	0	0	0

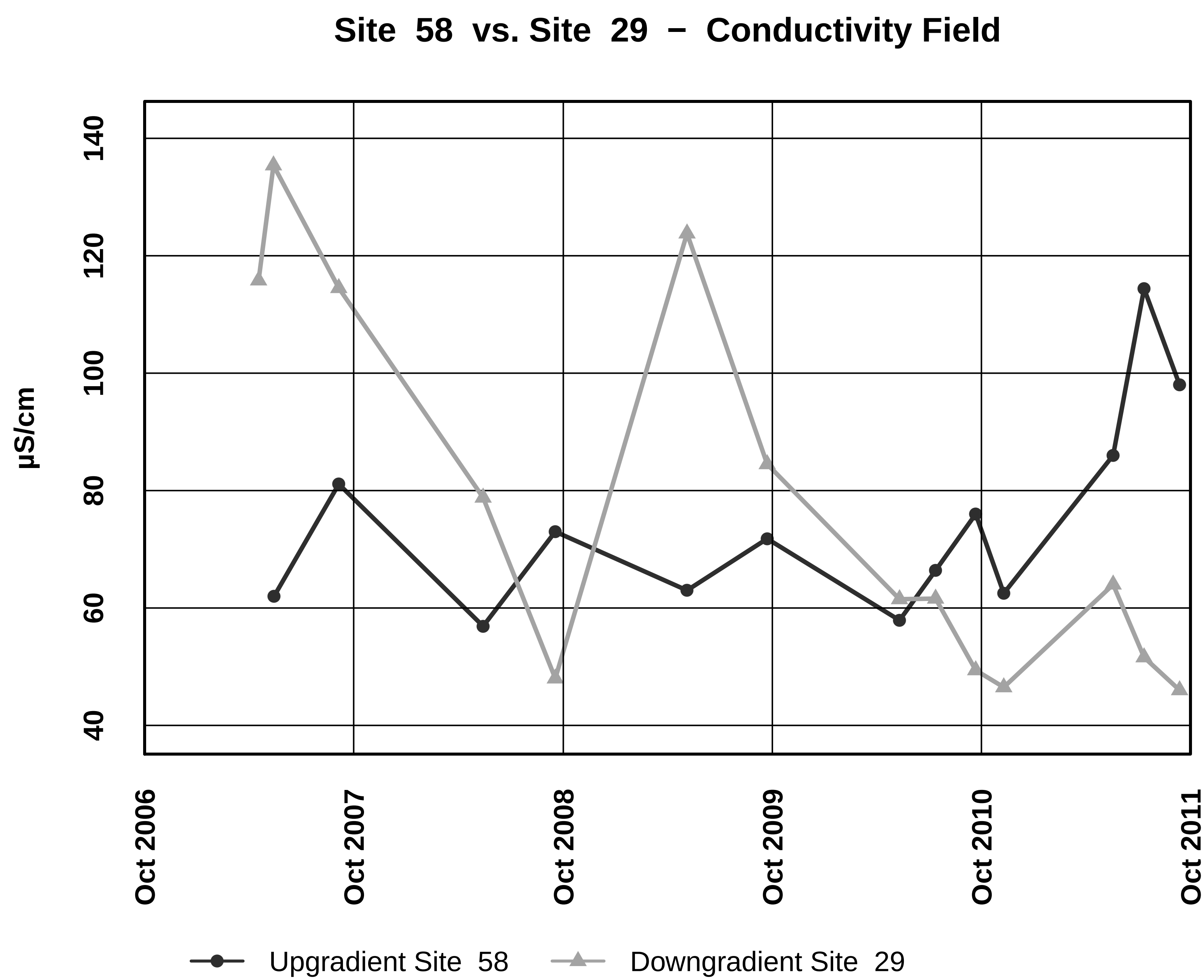
Σn 15
ΣS_k 3

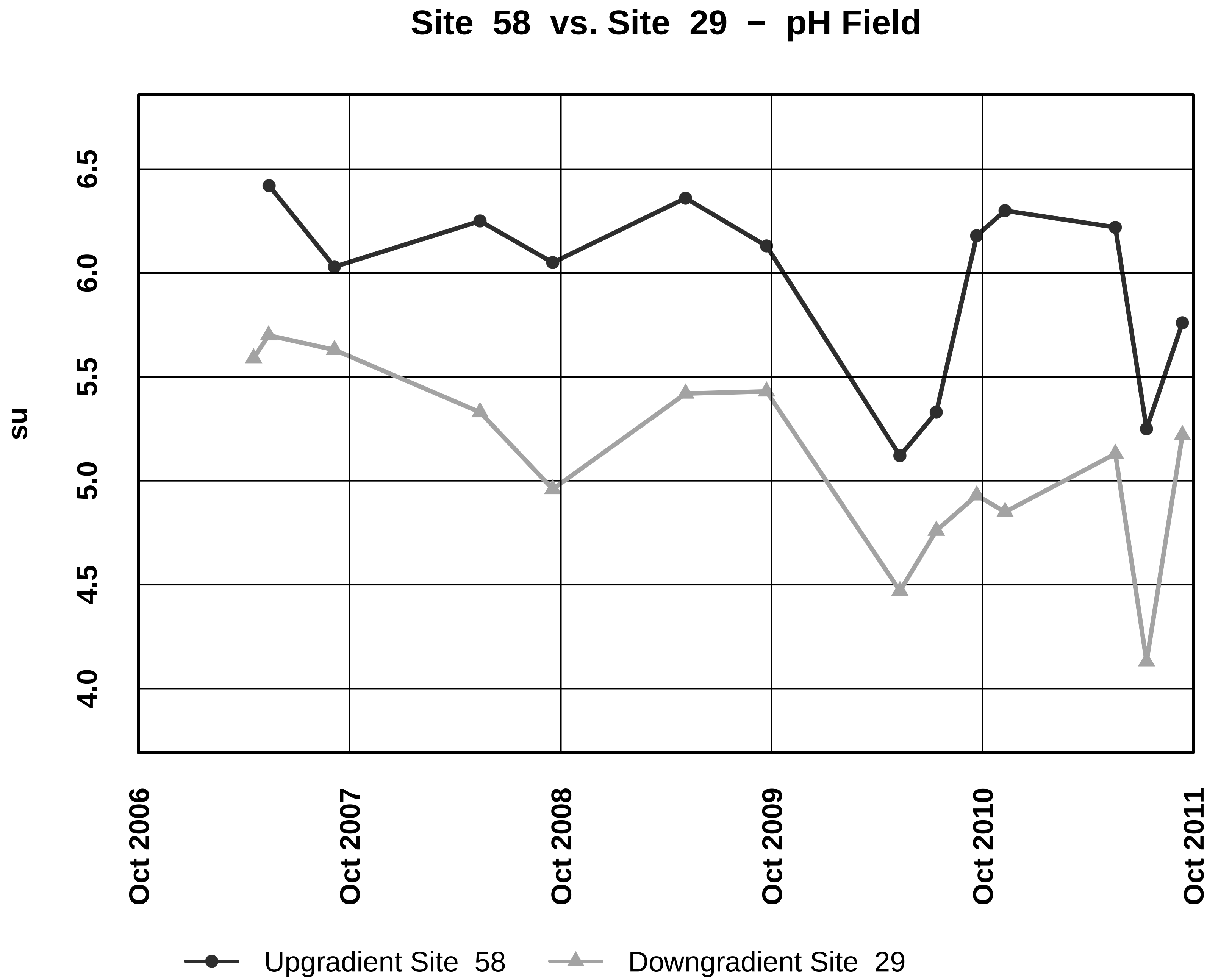
$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$= 0.72		@α=5% $\chi^2_{(K-1)}$= 5.99	Test for station homogeneity	
p	**0.697**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc} 0.26	@α/2=2.5% Z= 1.96	H_0 (No trend)	ACCEPT
57.67	**p** **0.604**		H_A (± trend)	REJECT



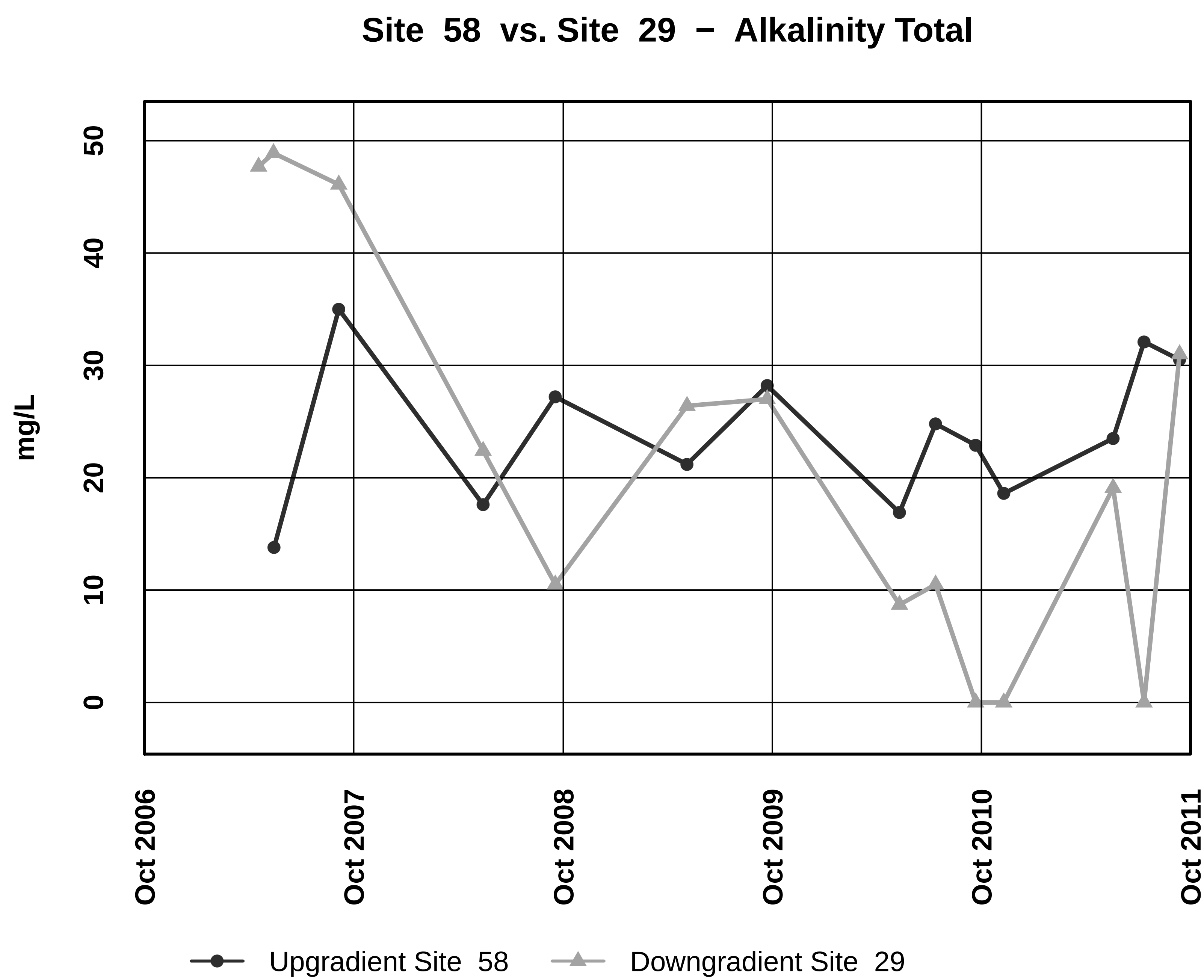
Seasonal-Kendall Slope Confidence Intervals

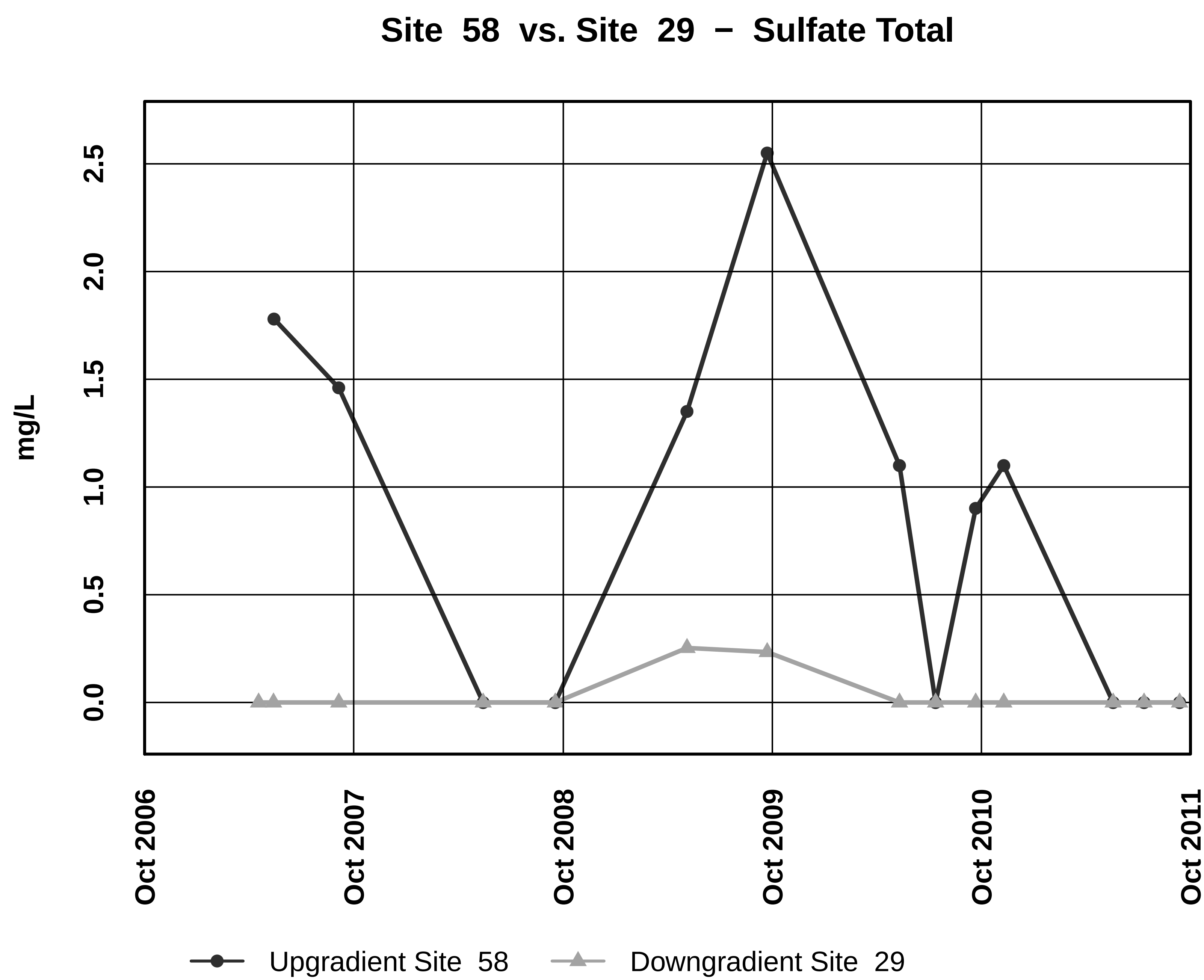
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-1.98		7.27
0.050	-1.09	**0.68**	3.70
0.100	-0.84		2.44
0.200	-0.57		1.39

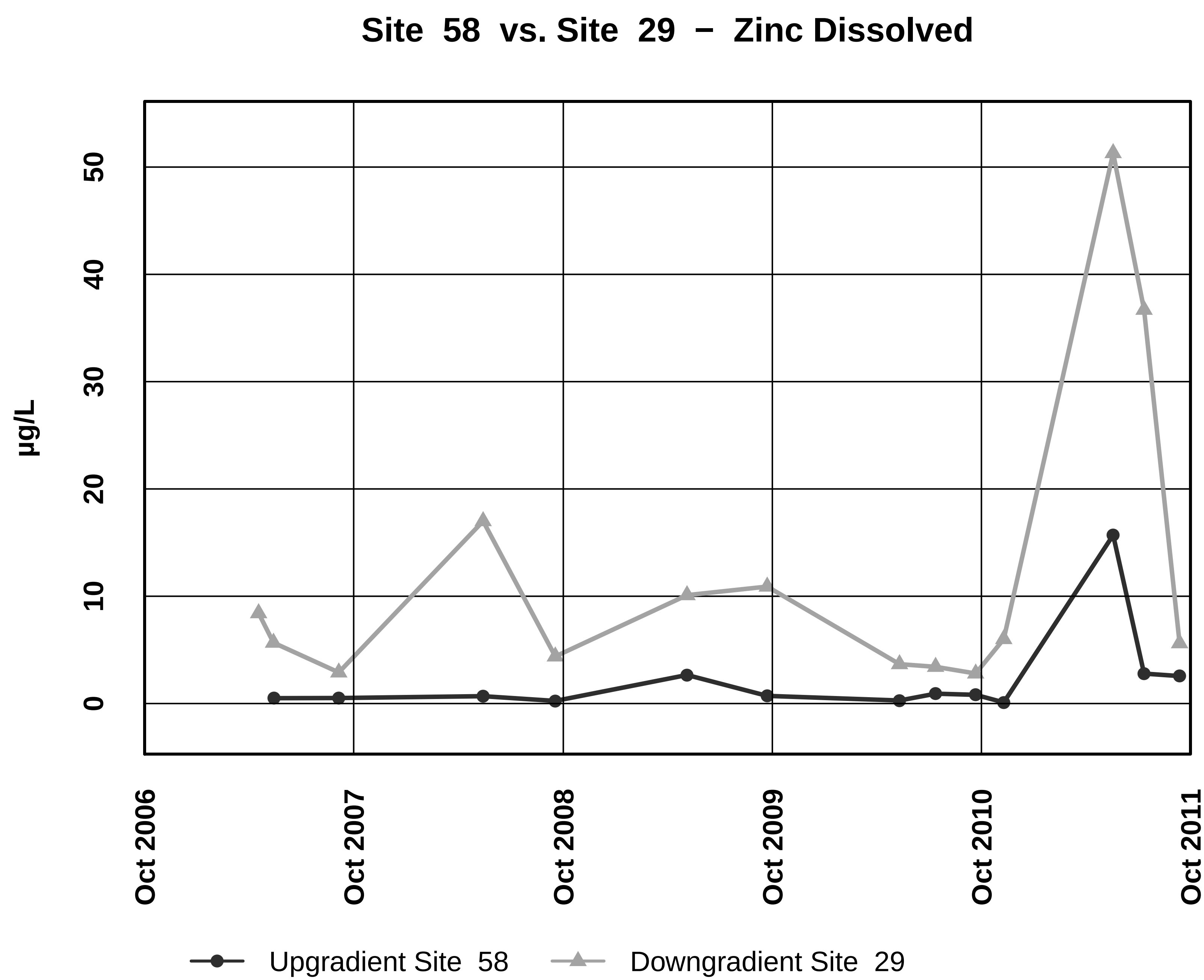

Site 58 vs. Site 29 − Conductivity Field
µS/cm
140
120
100
80
60
40
Oct 2006
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 58
Downgradient Site 29



Site 58 vs. Site 29 − pH Field
su
6.5
6.0
5.5
5.0
4.5
4.0
Oct 2006
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
50
Oct 2006
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 2006
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 2006
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 58
Downgradient Site 29

INTERPRETIVE REPORT
SITE 32 "MONITORING WELL 5S"

The data collected during the current water year are listed in the following "Table of Results for Water Year 2011" 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 2011.				

The data for water year 2011 have been compared to the strictest fresh water quality criterion for each applicable analyte. Thirteen results exceeding these criteria have been identified as listed in the table below.

Table of Exceedance for Water Year 2011

			Limits		
Sample Date	**Parameter**	**Value**	**Lower**	**Upper**	**Hardness**
9-Nov-10	Alkalinity	3.9 mg/L	20		
19-May-11	Alkalinity	16.4 mg/L	20		
12-Jul-11	Alkalinity	11.4 mg/L	20		
12-Sep-11	Alkalinity	15.9 mg/L	20		
9-Nov-10	Lead Dissolved	1.12 µg/L		0.54	25.00 mg/L
19-May-11	Lead Dissolved	3.79 µg/L		0.54	25.00 mg/L
12-Jul-11	Lead Dissolved	2.28 µg/L		0.54	25.00 mg/L
12-Sep-11	Lead Dissolved	1.52 µg/L		0.54	25.00 mg/L
9-Nov-10	pH Field	5.23 su	6.5	8.50	
19-May-11	pH Field	5.16 su	6.5	8.50	
12-Jul-11	pH Field	4.51 su	6.5	8.50	
12-Sep-11	pH Field	5.02 su	6.5	8.50	
19-May-11	Zinc Dissolved	42.7 µg/L		36.50	25.00 mg/L

All four of the annual sampling events were in exceedance for total alkalinity, dissolved lead, and field pH. The final exceedance was for dissolved zinc (42.7 µ g/L) in the May 2011 sampling. Due to the low hardness for this site, 34 of the past 35 samples have returned lead values higher than the AWQS. Similar to Site 29 an exceedance for dissolved zinc had not been recorded in the previous five years of data used for this reports analysis. 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 some of the lowest values recorded over the past 6 years. A mechanism has yet to be established to explain the two elevated chromium results in the preceding years. Also, HGCMC had the dissolved chromium sample speciated for CrVI. The total chromium value was1.77 µg/L and the CrVI result was2.28 µg/L, indicating that at least during this sampling event the dissolved chromium was all in the CrVI form. Though this sample is all CrVI the value was well below the AWQS. HGCMC plans to have the May 2012 sample for this site speciated again for CrVI.

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-05 and Sep-11 (WY2006-WY2011).

Table of Summary Statistics for Trend Analysis

	Mann-Kendall test statistics			Sen's slope estimate	
Parameter	**n***	**p****	**Trend**	**Q**	**Q(%)**
Conductivity Field	6	0.30			
pH Field	6	0.06			
Alkalinity, Total	6	0.35			
Sulfate, Total	6		Inconsistent detection limits		
Zinc, Dissolved	6	0.50			

* Number of Years ** Significance level

No significant trends were identified with 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 couple of measurements from the 2011 water year. The increase in conductivity seen in the July 2011 and September 2011 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 2011

Site 032FMG - 'Monitoring Well - 5S'

Sample Date/Parameter	Oct 2010	Nov 2010	Dec 2010	Jan 2011	Feb 2011	Mar 2011	Apr 2011	May 2011	Jun 2011	Jul 2011	Aug 2011	Sep 2011	**Median**
Water Temp (°C)		8.2						9.5		9.4		10.5	9.5
Conductivity-Field(µmho)		73.8						74		78.1		58	73.9
Conductivity-Lab (µmho)		57						63		61		61	61
pH Lab (standard units)		4.55						5.18		4.73		5.07	4.90
pH Field (standard units)		5.23						5.16		4.51		5.02	5.09
Total Alkalinity (mg/L)		3.9						16.4		11.4		15.9	13.7
Total Sulfate (mg/L)		5						5		25		5	5.0
Hardness (mg/L)		7.5						9.6		9		9	9.0
Dissolved As (ug/L)		3.33						5.43		5.28		5.69	5.355
Dissolved Ba (ug/L)		12.6						20.2		16.7		15.4	16.1
Dissolved Cd (ug/L)		0.0142						0.0589		0.0252		0.0202	0.0227
Dissolved Cr (ug/L)		2.27						1.77		2.02		2.29	2.145
Dissolved Cu (ug/L)		0.974						2.51		1.63		1.08	1.355
Dissolved Pb (ug/L)		1.12						3.79		2.28		1.52	1.9000
Dissolved Ni (ug/L)		2.56						3.95		3.59		3.82	3.705
Dissolved Ag (ug/L)		0.004						0.009		0.006		0.002	0.005
Dissolved Zn (ug/L)		6.51						42.7		13.1		10.2	11.65
Dissolved Se (ug/L)		0.114						0.598		0.057		0.771	0.356
Dissolved Hg (ug/L)		0.00186						0.0016		0.0017		0.00137	0.001650

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.

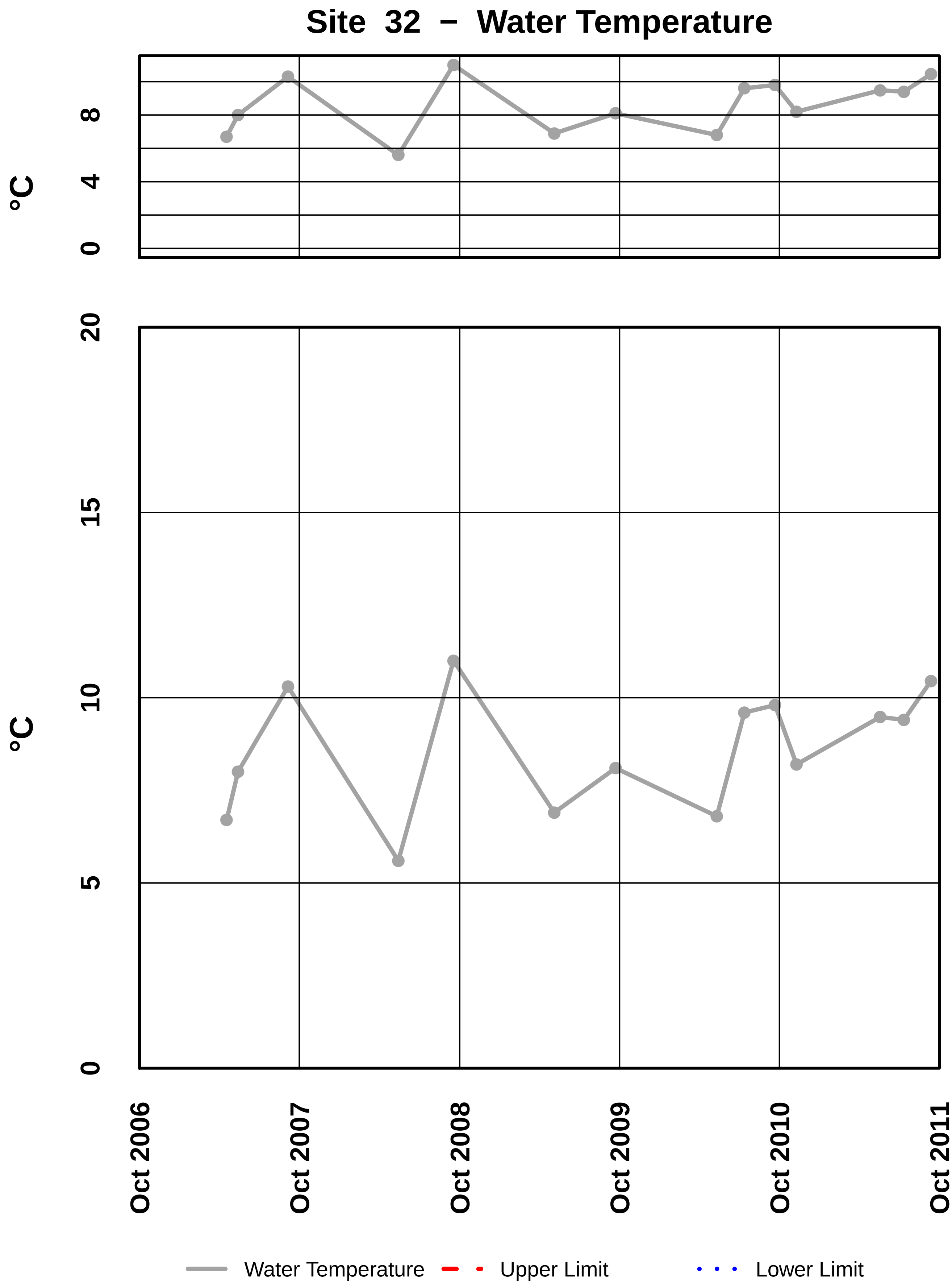
Shaded data has been qualified as an outlier by KGCMC and removed from any further analysis and is not included into the calculation of the median

Qualified Data by QA Reviewer

Date Range: 10/01/2010 to 09/30/2011

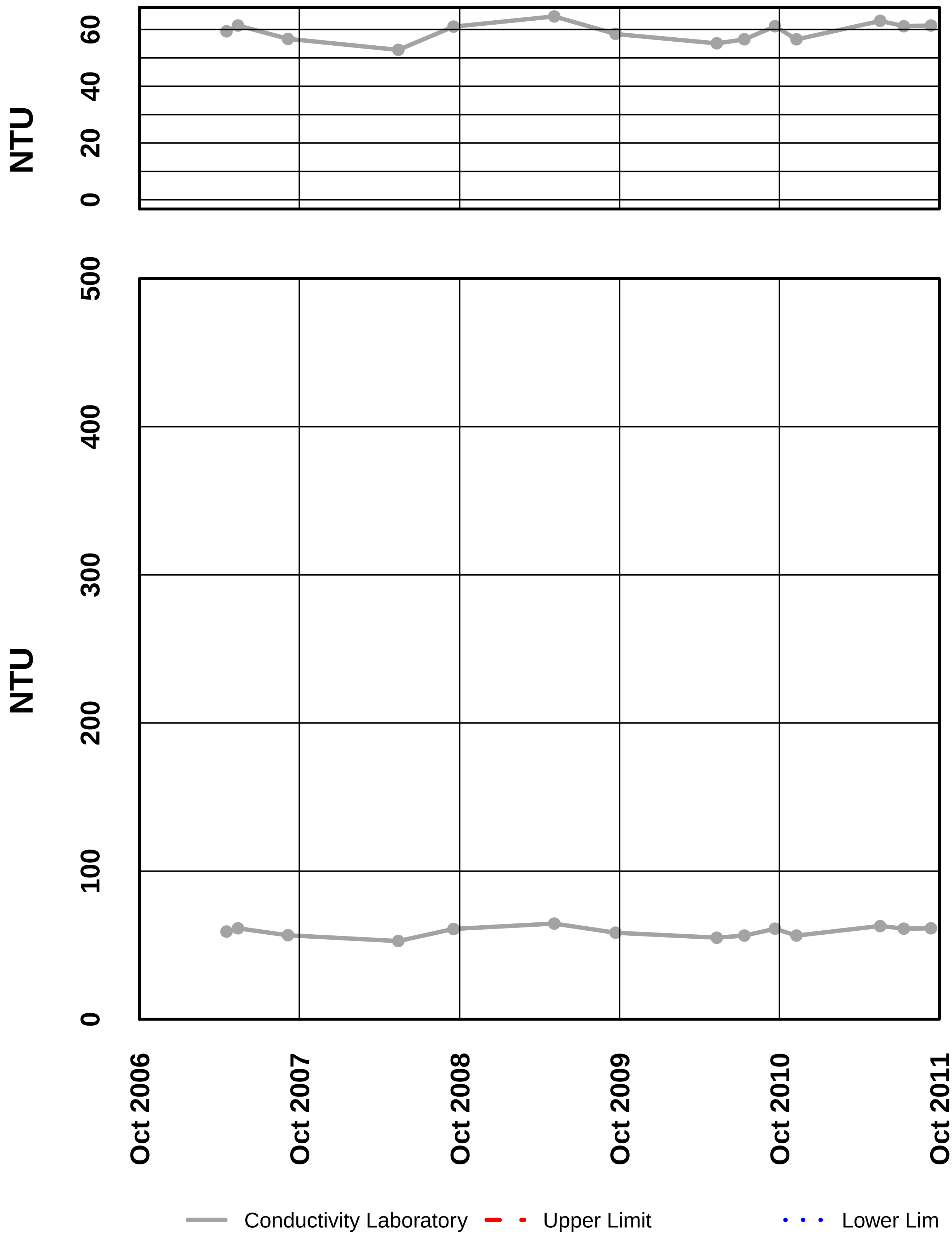
Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
32	11/9/2010	12:00 AM				
			Cd diss, µg/l	0.0142	J	Below Quantitative Range
32	5/19/2011	12:00 AM				
			Ag diss, µg/l	0.00898	J	Below Quantitative Range
			pH Lab, su	5.18	J	Hold Time Violation
			SO4 Tot, mg/l	-10	R	Sample Reciept Temperature
32	7/12/2011	12:00 AM				
			Ag diss, µg/l	0.00616	J	Below Quantitative Range
			SO4 Tot, mg/l	-50	R	Sample Reciept Temperature
32	9/12/2011	12:00 AM				
			SO4 Tot, mg/l	0	UJ	Sample Receipt Temperature

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



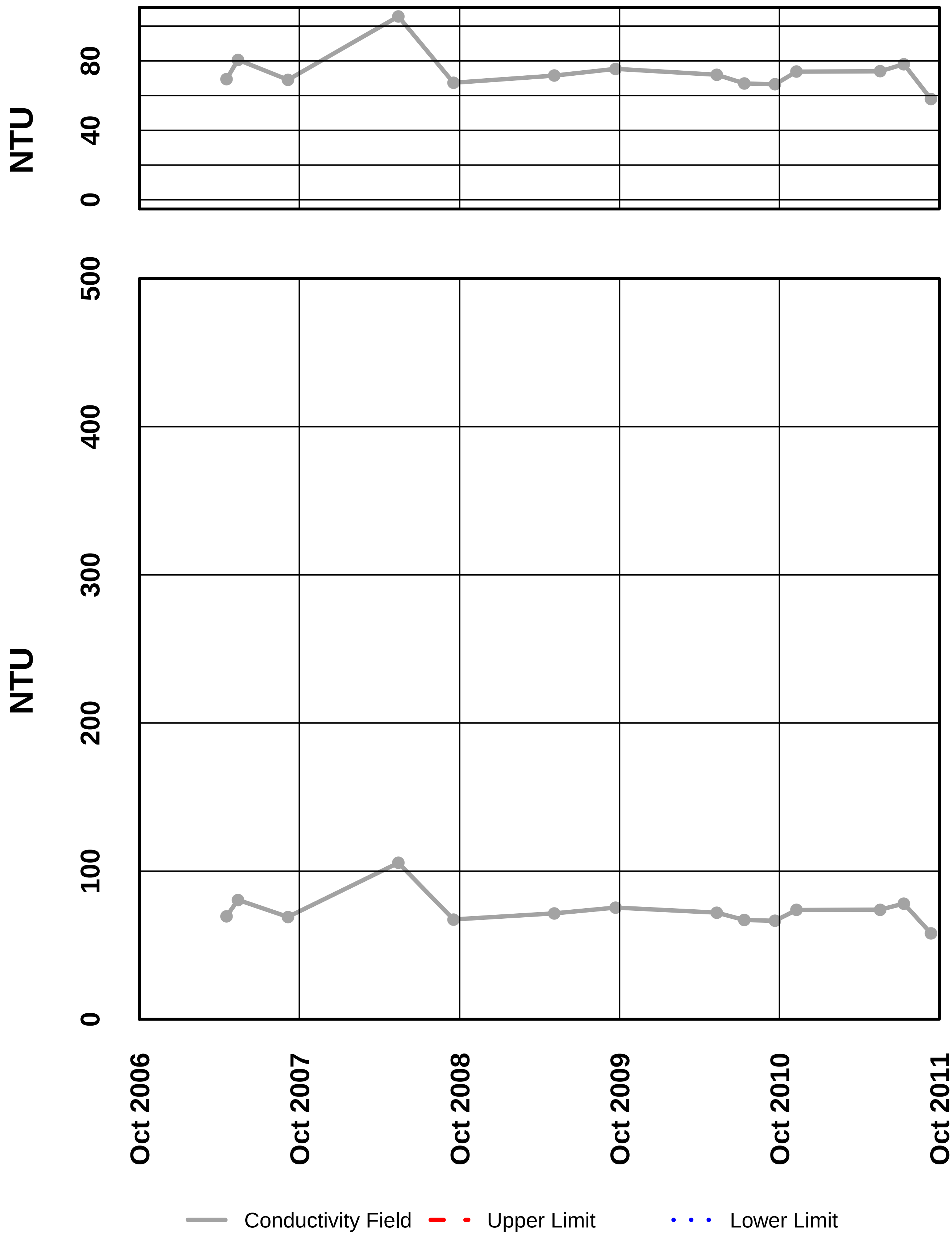
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 32 − Conductivity Laboratory



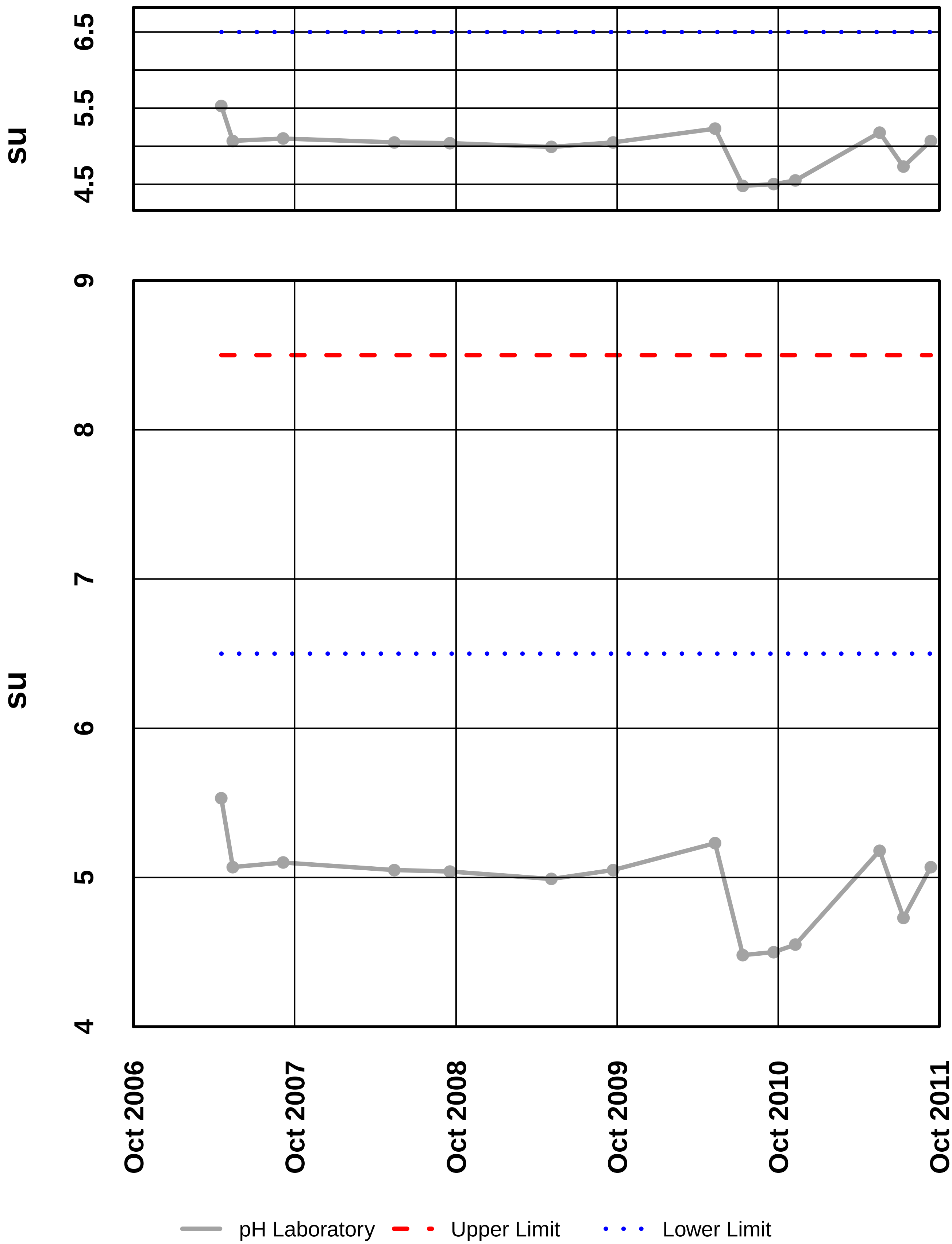
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 32 – Conductivity Field



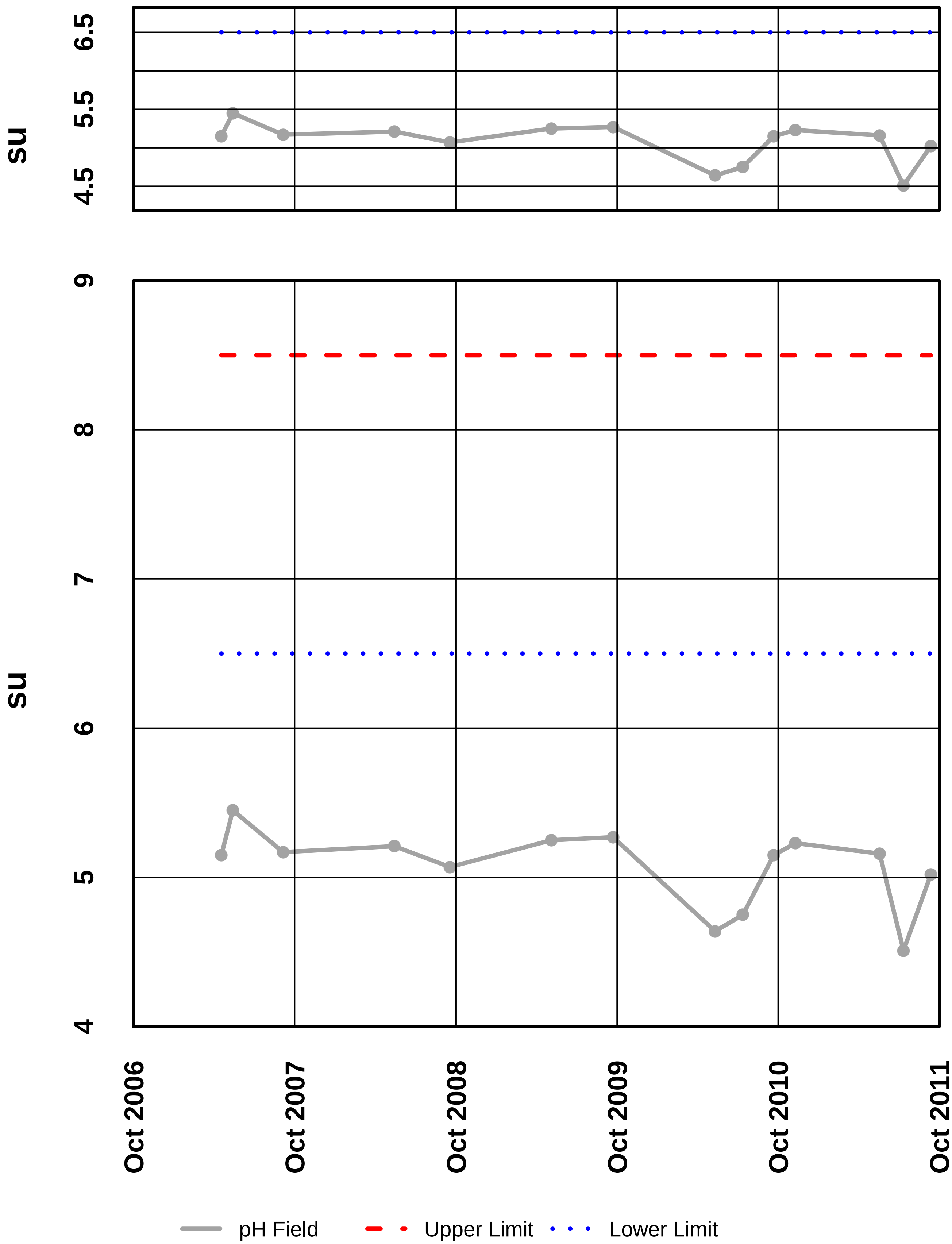
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 32 − pH Laboratory



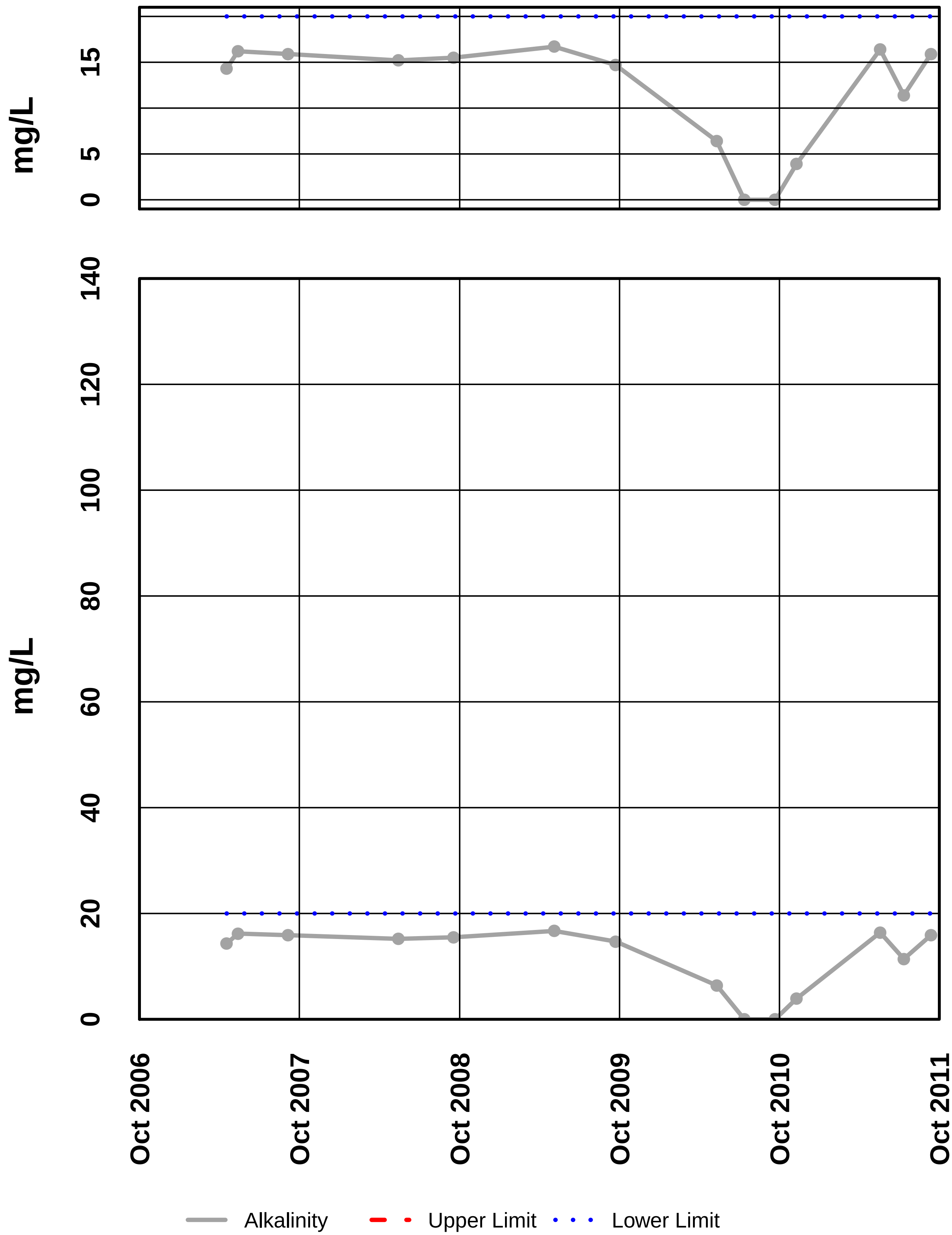
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 32 – pH Field

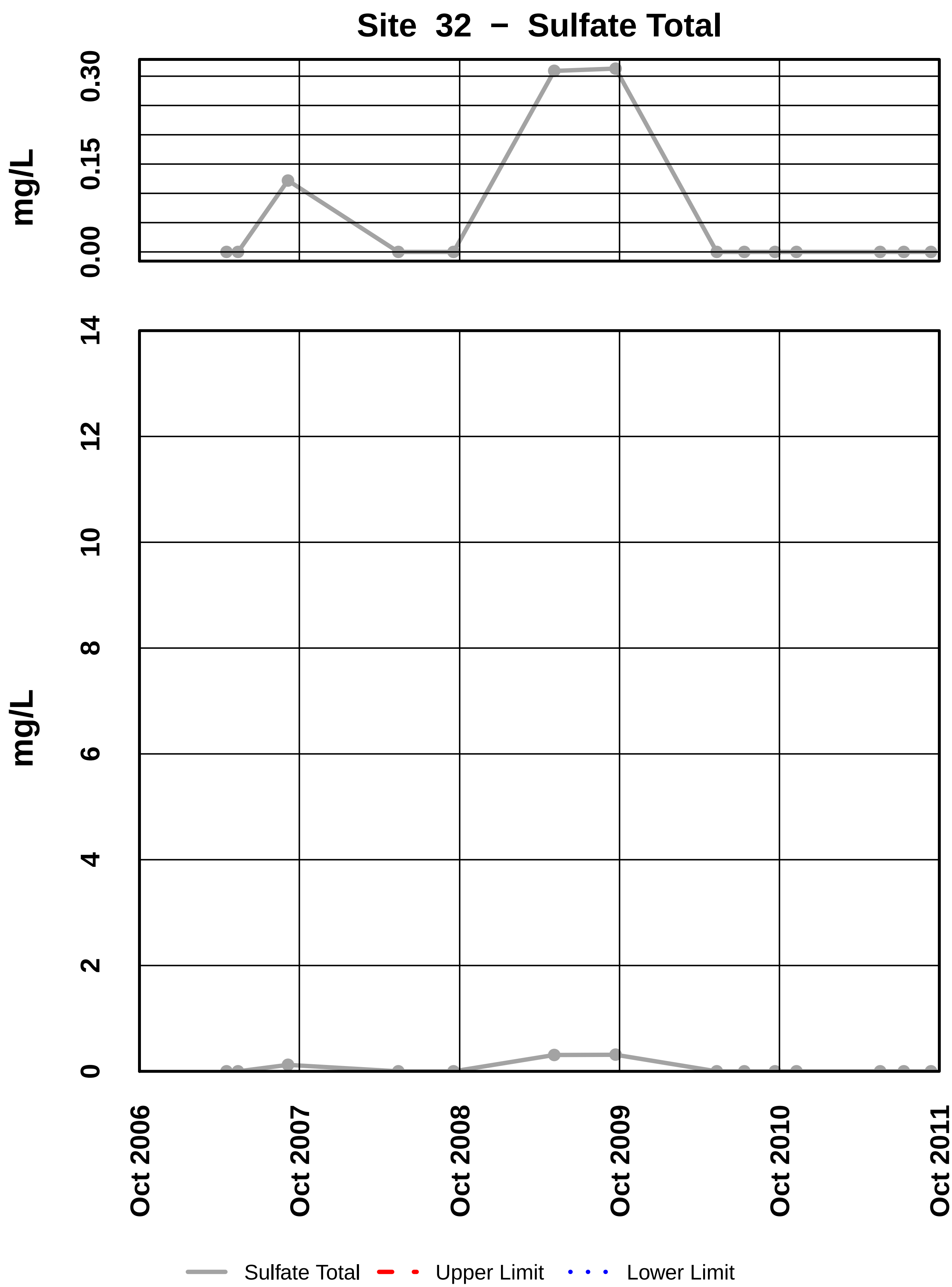


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 32 – Alkalinity

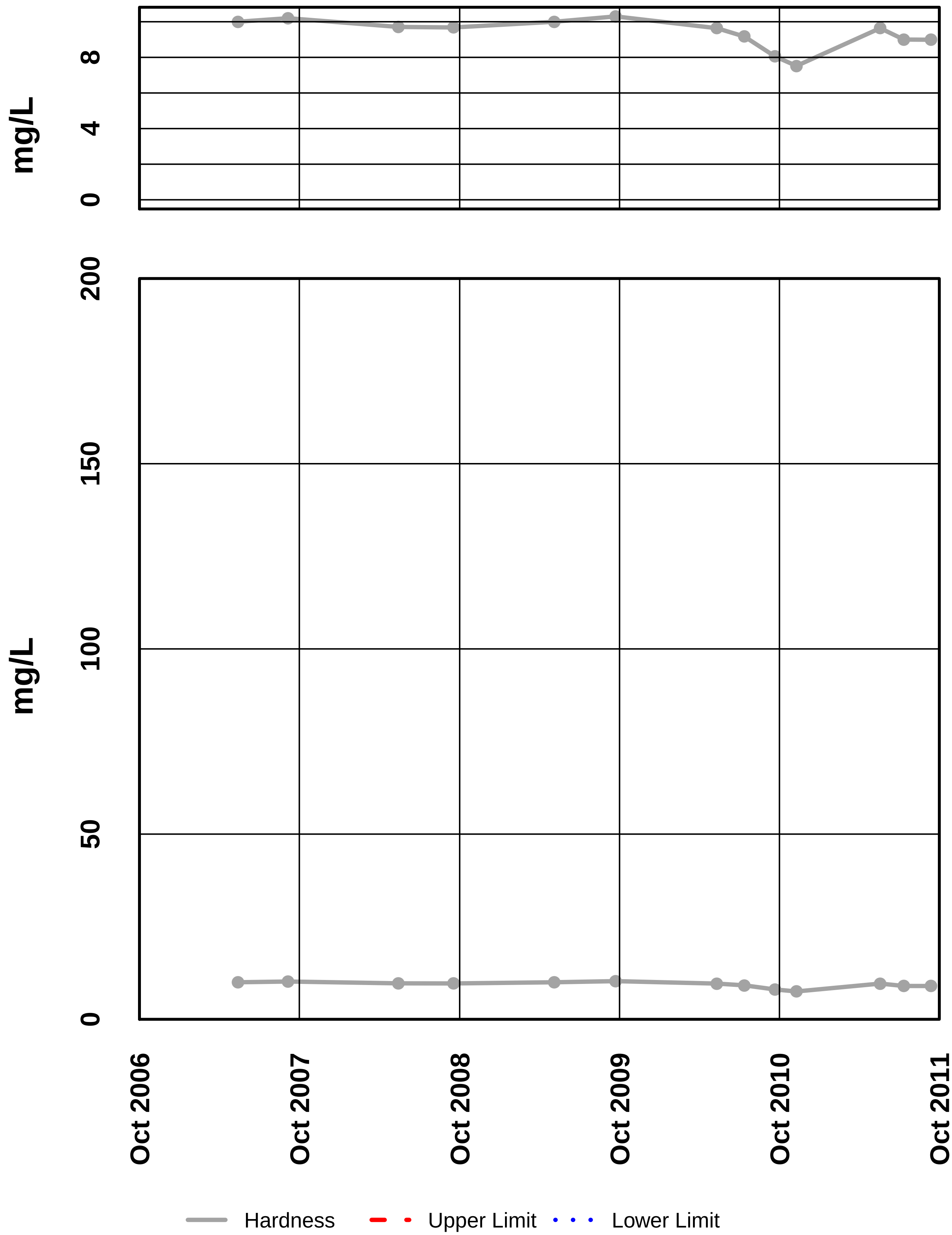


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



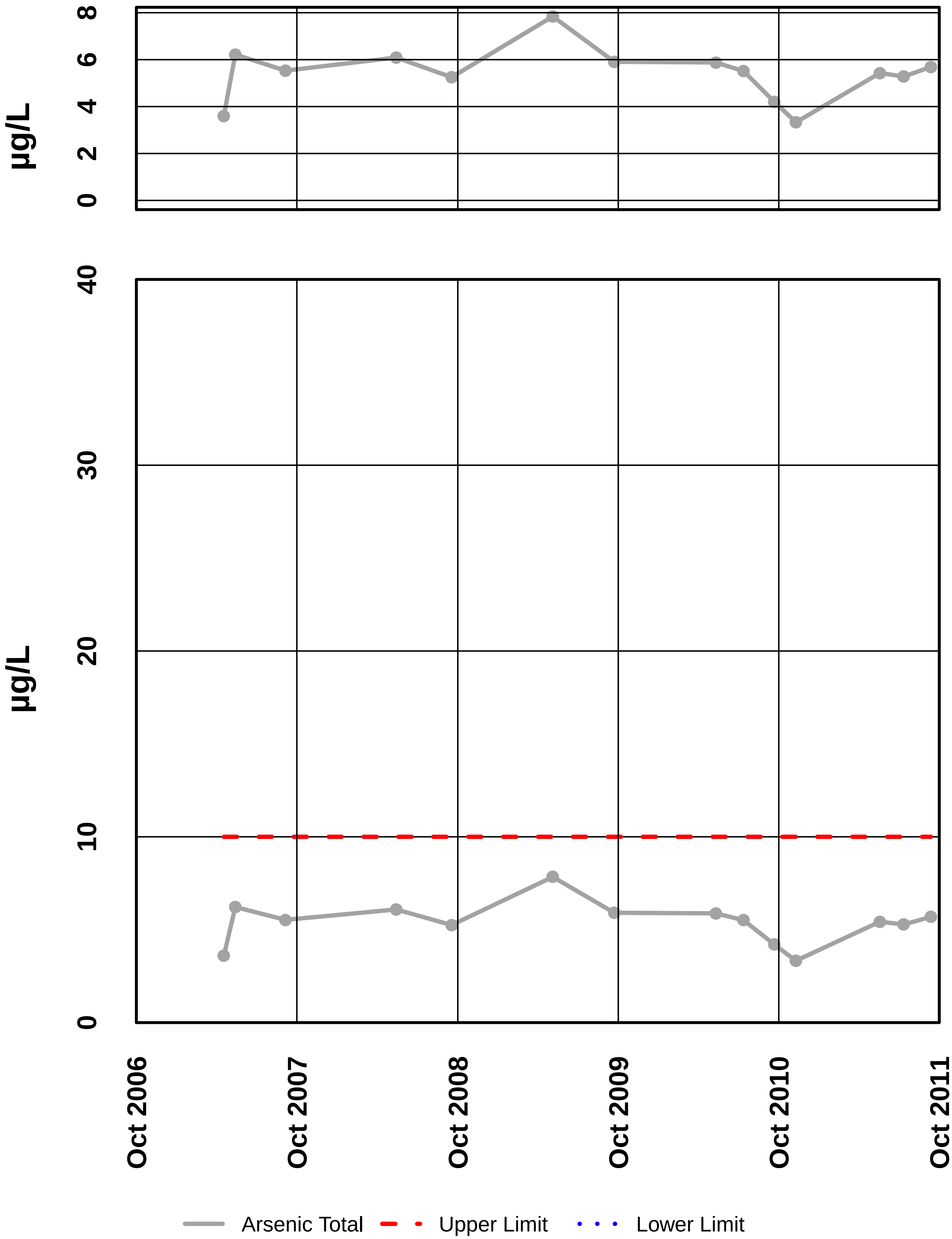
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 32 − Hardness



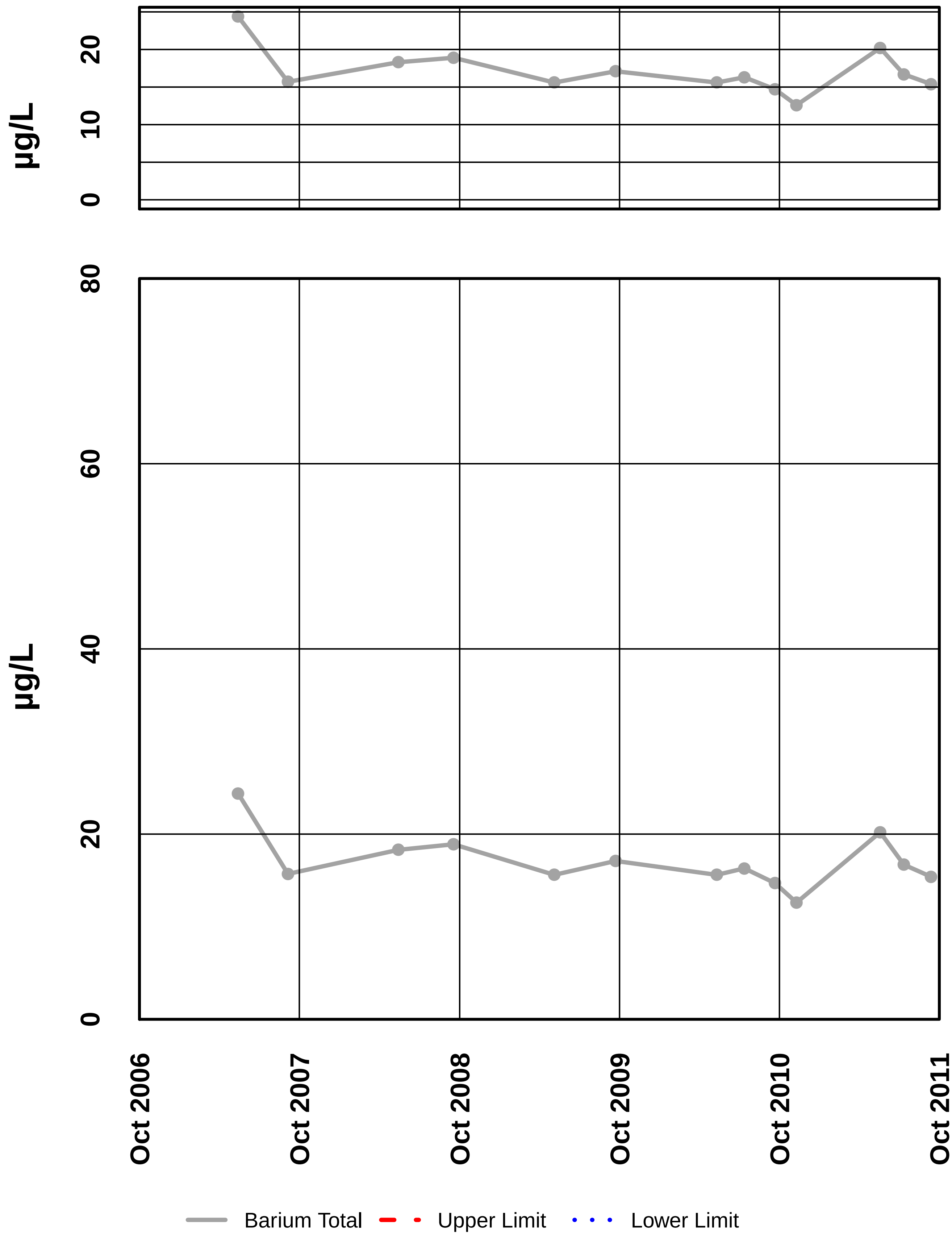
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 32 − Arsenic Total



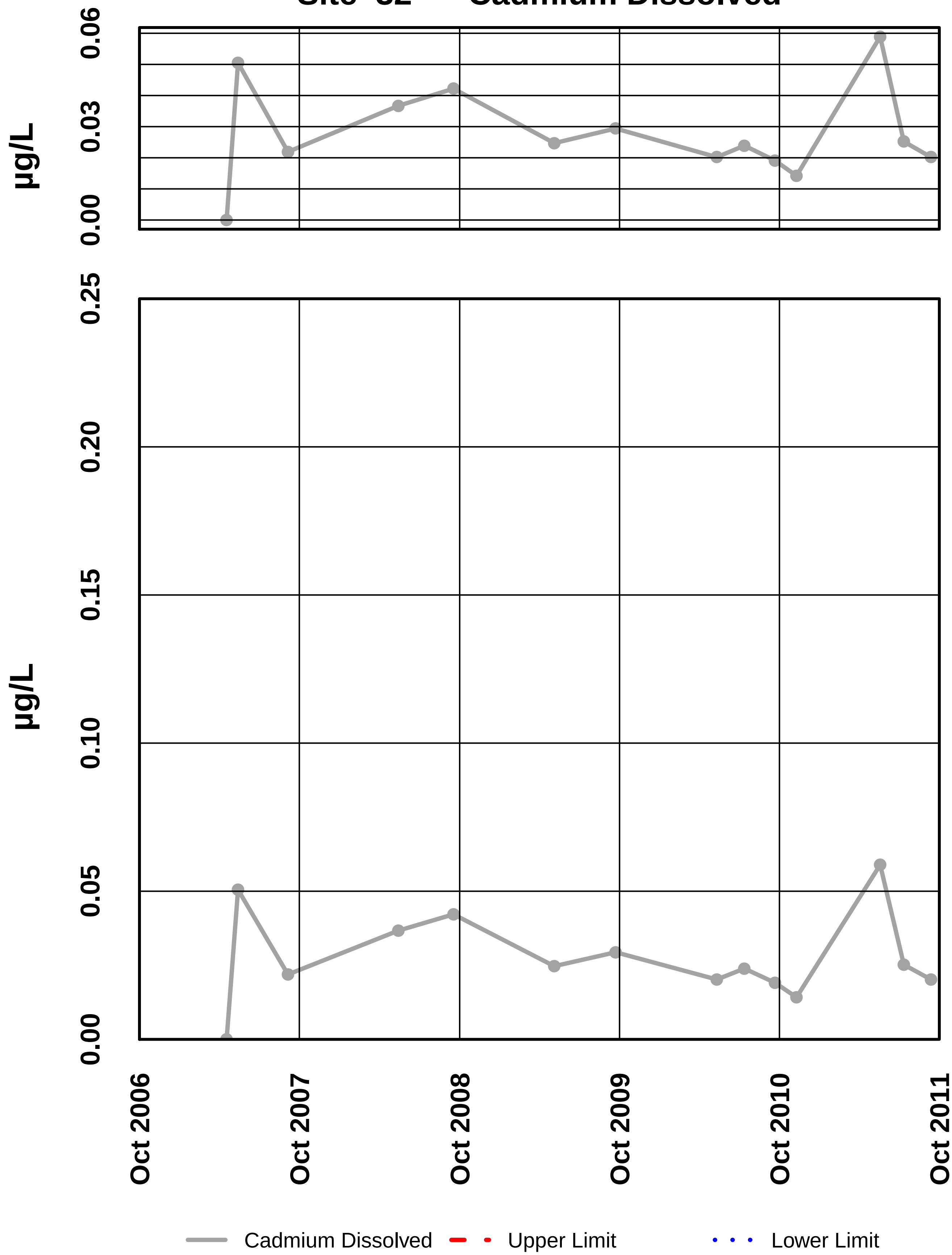
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 32 – Barium Total

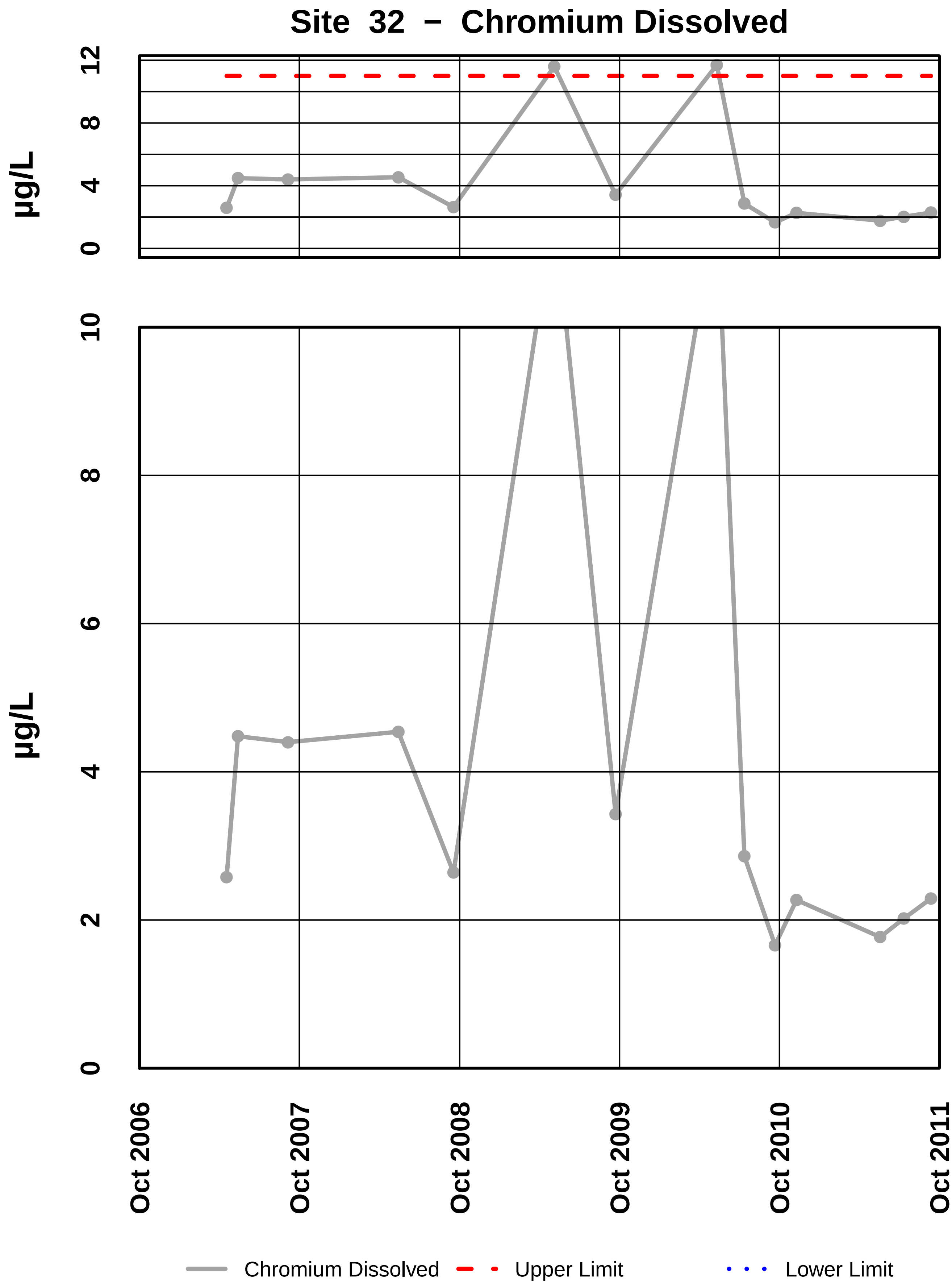


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 32 − Cadmium Dissolved

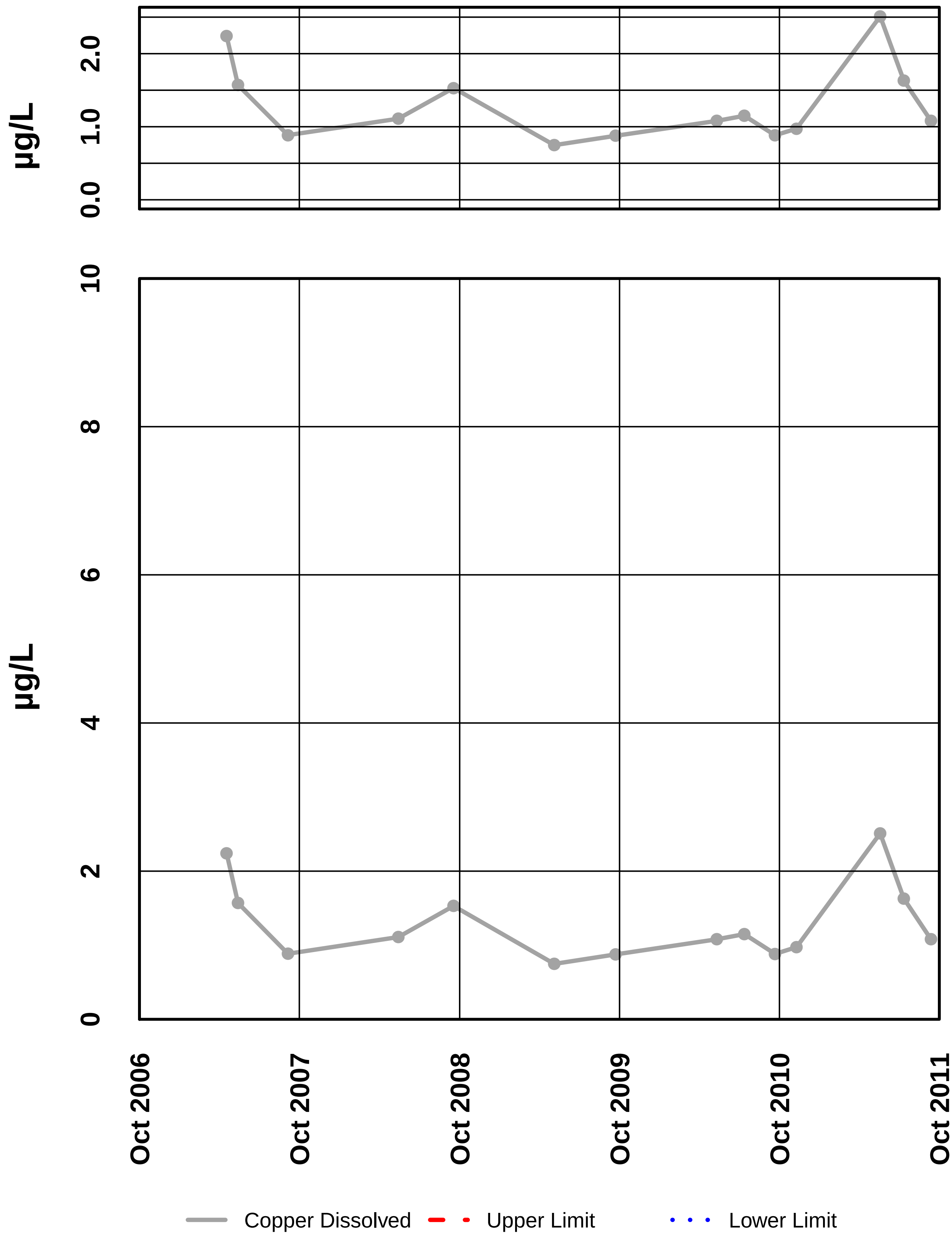


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



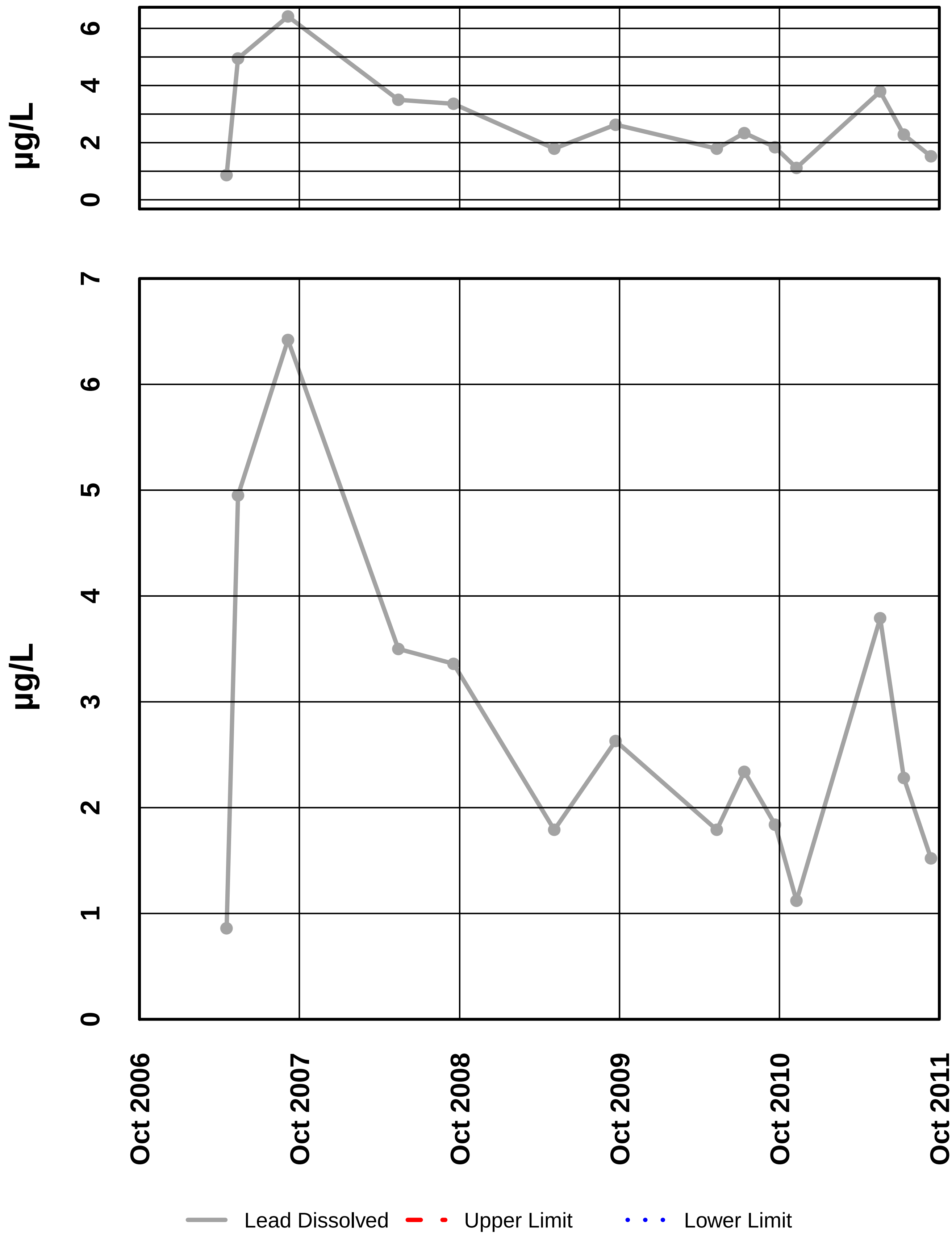
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 32 – Copper Dissolved



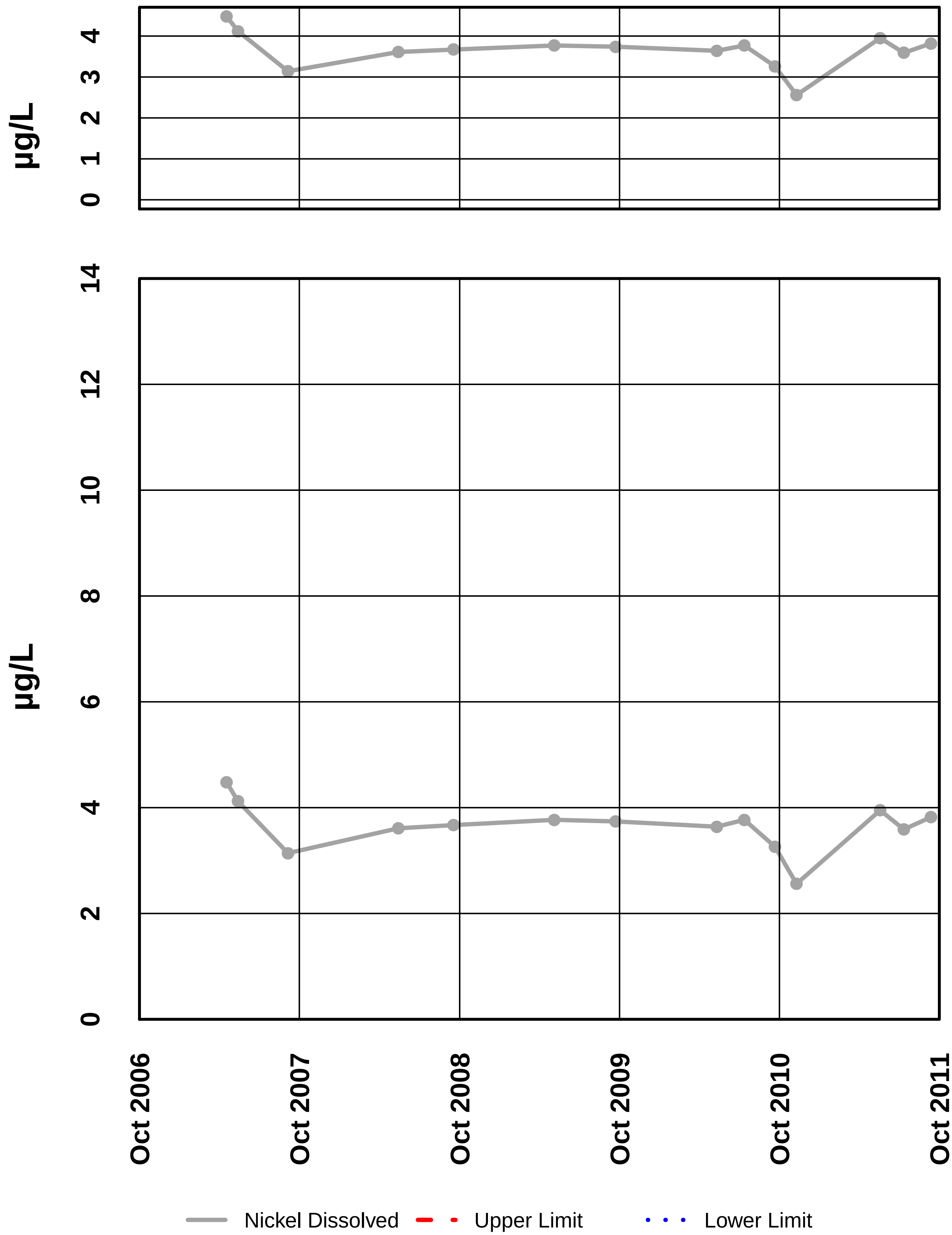
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 32 − Lead Dissolved



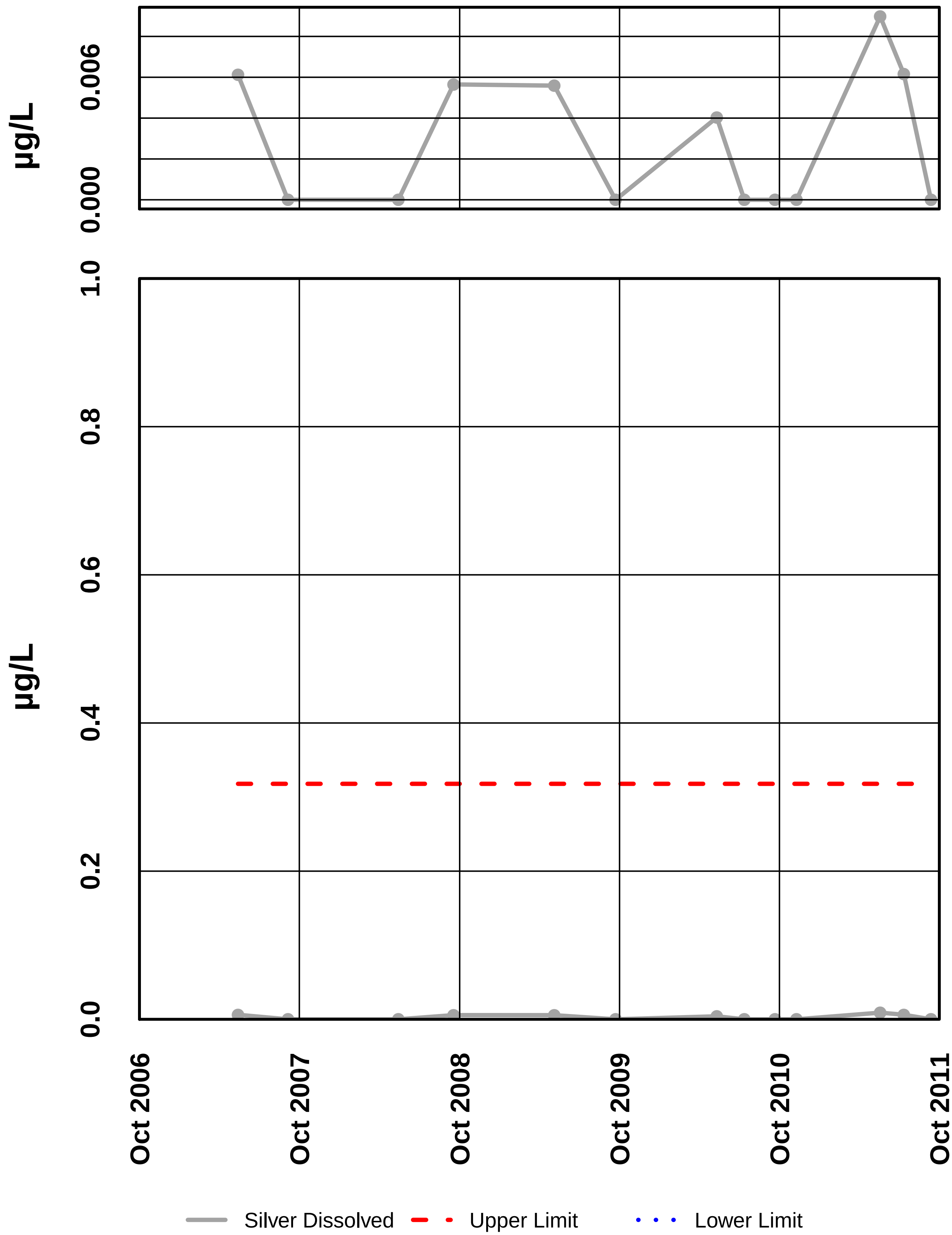
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 32 − Nickel Dissolved

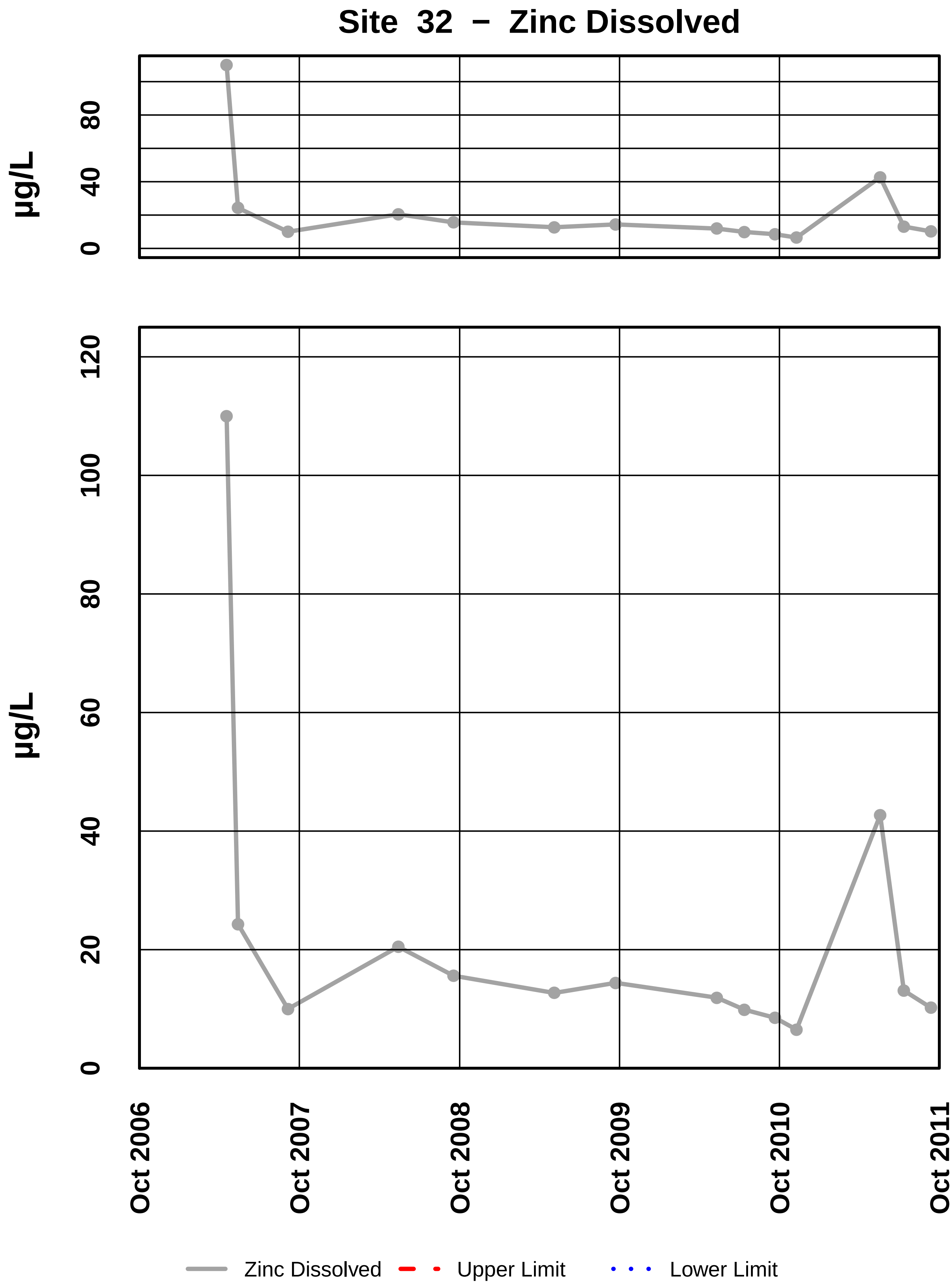


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

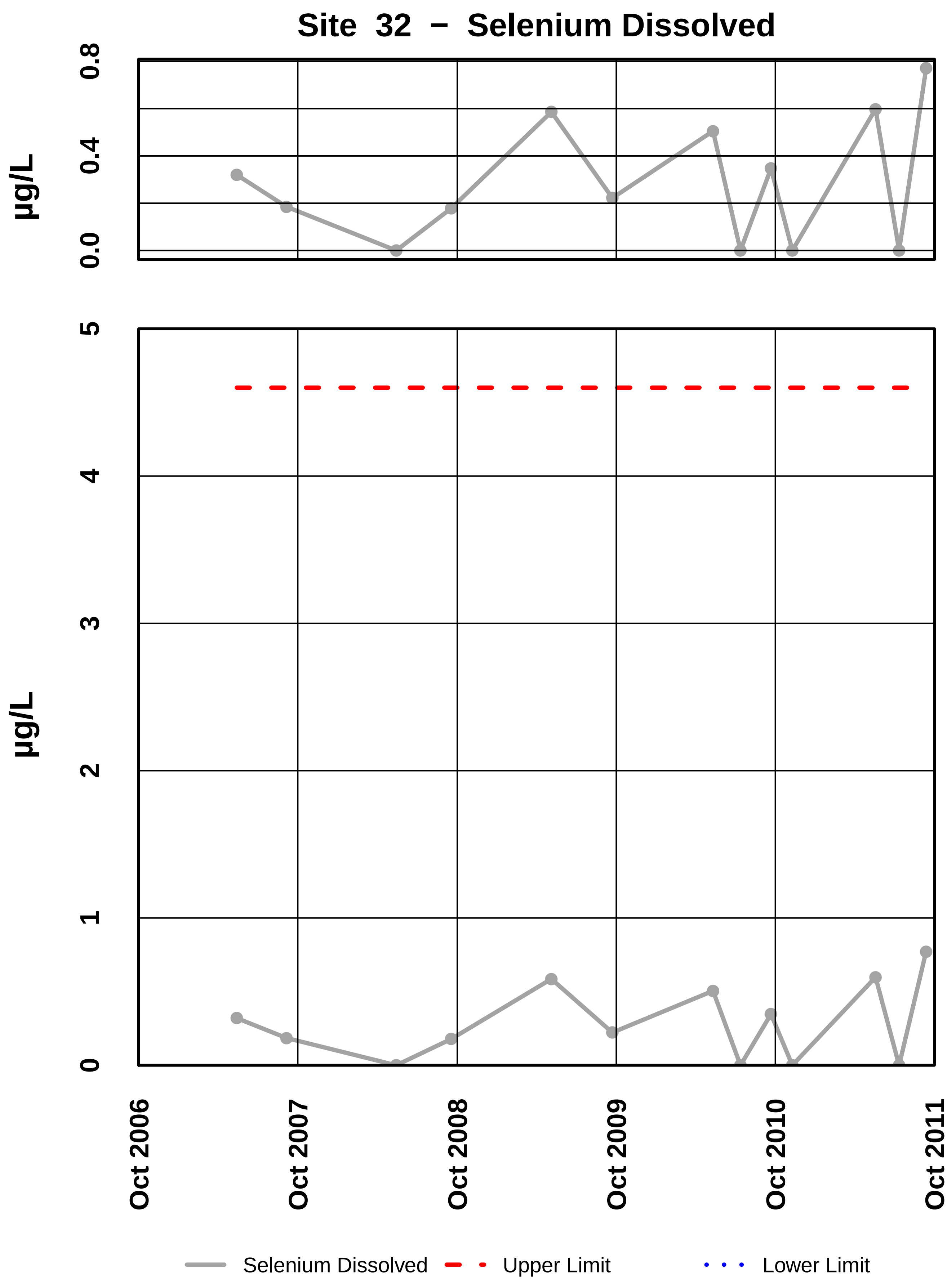
Site 32 – Silver Dissolved



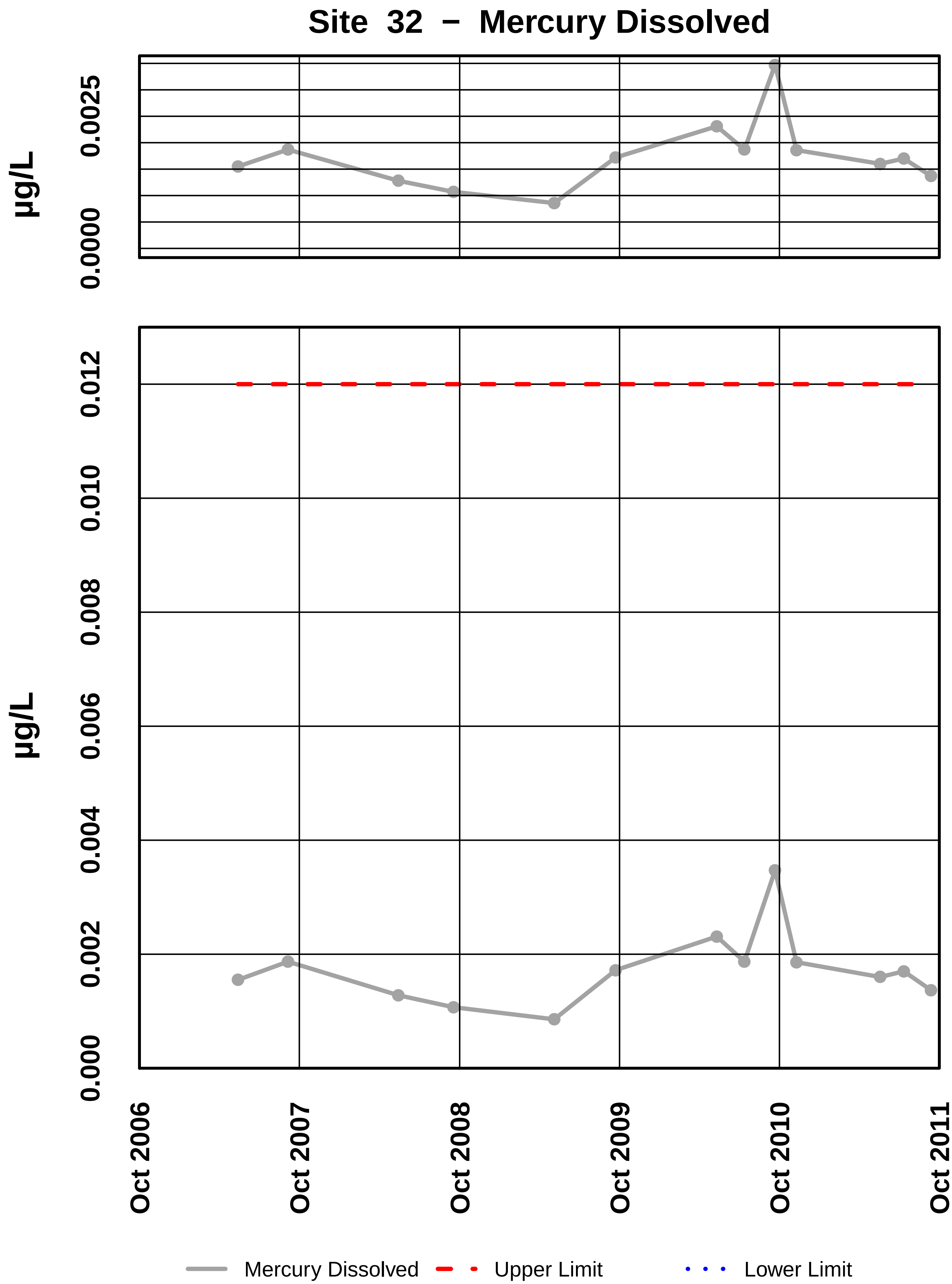
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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 **#32** Seasonal Kendall analysis for Specific Conductance, Lab (uS/cm)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2006**								69.9				70.2
b	**WY2007**							69.6	80.6				69.1
c	**WY2008**								105.6				67.4
d	**WY2009**								71.5				75.4
e	**WY2010**								72		67		66.5
f	**WY2011**		73.8						74		78.1		58
	n	0	1	0	0	0	0	1	6	0	2	0	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	0	1	0	0	0	0	1	6	0	2	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
f-d								1				-1
f-e								1		1		-1
S_k	0	0	0	0	0	0	0	3	0	1	0	-9

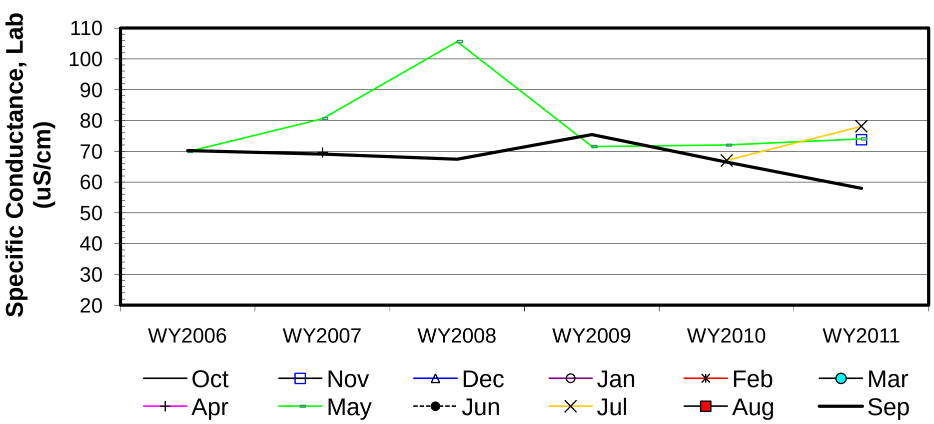
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=								28.33		1.00		28.33
$Z_k = S_k/\sigma_S$								0.56		1.00		-1.69
Z^2_k								0.32		1.00		2.86

ΣZ_k=	-0.13
ΣZ^2_k=	4.18
Z-bar=$\Sigma Z_k/K$=	-0.04

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	16	0	0	0	0

Σn	16
ΣS_k	-5

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=		4.17	@α=5% $\chi^2_{(K-1)}$=	5.99	Test for station homogeneity	
	p	**0.124**			$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc}	-0.53	@α/2=2.5% Z=	1.96	**H_0** (No trend)	ACCEPT
57.67	p	**0.299**			**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-5.87		1.82
0.050	-2.84	**-0.93**	0.75
0.100	-2.56		0.53
0.200	-1.68		0.21

Site **#32** Seasonal Kendall analysis for pH, Lab, Standard Units

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2006**								5.4				5.1
b	**WY2007**							5.2	5.5				5.2
c	**WY2008**								5.2				5.1
d	**WY2009**								5.3				5.3
e	**WY2010**								4.6		4.8		5.2
f	**WY2011**		5.2						5.2		4.5		5.0
	n	0	1	0	0	0	0	1	6	0	2	0	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	0	1	0	0	0	0	1	6	0	2	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
f-d								-1				-1
f-e								1		-1		-1
S_k	0	0	0	0	0	0	0	-9	0	-1	0	-3

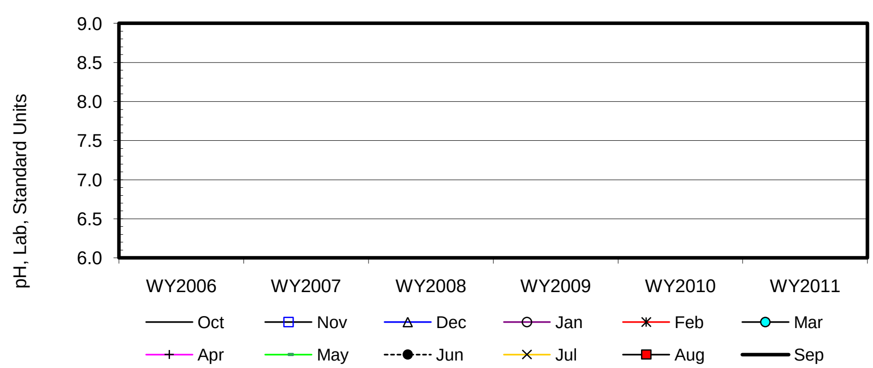
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=								28.33		1.00		28.33
$Z_k = S_k/\sigma_S$								-1.69		-1.00		-0.56
Z^2_k								2.86		1.00		0.32

ΣZ_k=	-3.25
ΣZ^2_k=	4.18
Z-bar=ΣZ_k/K=	-1.08

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=	0.65	@α=5% $\chi^2_{(K-1)}$=	5.99	Test for station homogeneity	
p	**0.724**			$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc} -1.58	@α/2=2.5% Z=	1.96	H_0 (No trend)	ACCEPT
57.67	**p** **0.057**			H_A (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.15		0.04
0.050	-0.11	**-0.04**	-0.01
0.100	-0.10		-0.02
0.200	-0.09		-0.02

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	**WY2006**								13.1				2.0
b	**WY2007**								16.2				15.9
c	**WY2008**								15.2				15.5
d	**WY2009**								16.7				14.7
e	**WY2010**								6.4		0.0		0.0
f	**WY2011**		3.9						16.4		11.4		15.9
	n	0	1	0	0	0	0	0	6	0	2	0	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	0	1	0	0	0	0	0	6	0	2	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				0
d-c								1				-1
e-c								-1				-1
f-c								1				1
e-d								-1				-1
f-d								-1				1
f-e								1		1		1
S_k	0	0	0	0	0	0	0	3	0	1	0	0

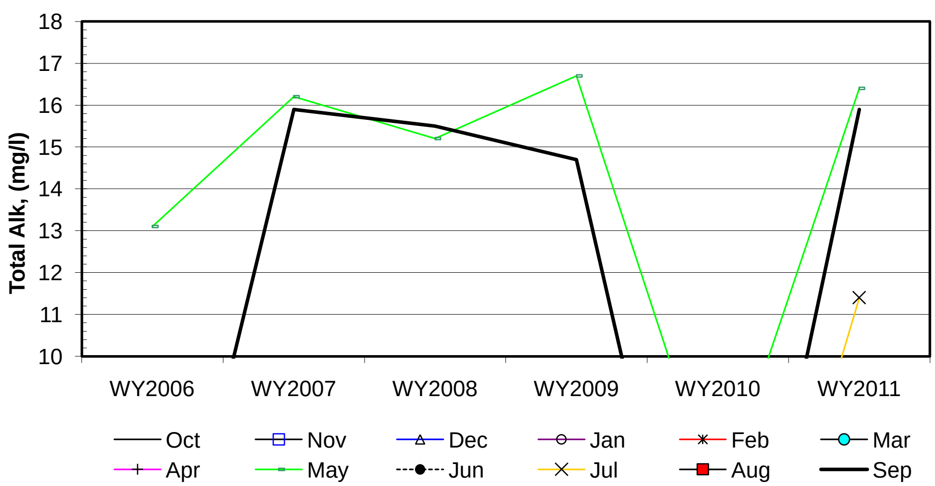
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=								28.33		1.00		27.33
$Z_k = S_k/\sigma_S$								0.56		1.00		0.00
Z^2_k								0.32		1.00		0.00

ΣZ_k= 1.56
ΣZ^2_k= 1.32
Z-bar=ΣZ_k/K= 0.52

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	13	1	0	0	0

Σn 15
ΣS_k 4

$\chi^2_h=\Sigma Z^2_k$-K(Z-bar)^2= 0.50	@α=5% $\chi^2_{(K-1)}$= 5.99	Test for station homogeneity	
p **0.778**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k) 56.67 — Z_{calc} 0.40	@α/2=2.5% Z= 1.96	**H_0** (No trend)	ACCEPT
p **0.655**		**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-2.08		2.86
0.050	-0.74	**0.13**	1.15
0.100	-0.53		0.79
0.200	-0.32		0.53

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	**WY2006**								0.0				0.1
b	**WY2007**								0.0				0.1
c	**WY2008**								0.0				0.0
d	**WY2009**								0.3				0.3
e	**WY2010**								0.0		0.0		0.0
f	**WY2011**		0.0						0.0		0.0		0.0
	n	0	1	0	0	0	0	0	6	0	2	0	6

t_1	0	1	0	0	0	0	0	1	0	0	0	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	1
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	0

b-a								0				-1
c-a								0				-1
d-a								1				1
e-a								0				-1
f-a								0				-1
c-b								0				-1
d-b								1				1
e-b								0				-1
f-b								0				-1
d-c								1				1
e-c								0				0
f-c								0				0
e-d								-1				-1
f-d								-1				-1
f-e								0		0		0
S_k	0	0	0	0	0	0	0	1	0	0	0	-6

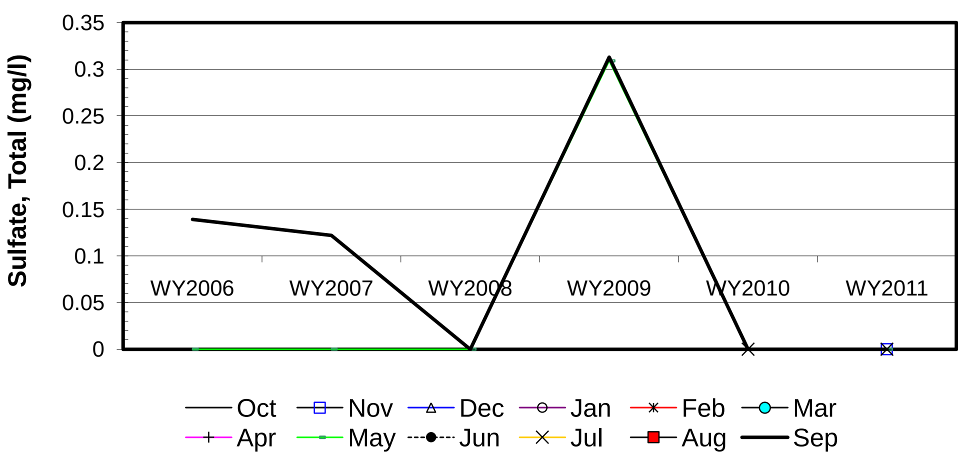
σ^2_S=								11.67		0.00		24.67
$Z_k = S_k/\sigma_S$								0.29		#DIV/0!		-1.21
Z^2_k								0.09		#DIV/0!		1.46

ΣZ_k= #DIV/0!
ΣZ^2_k= #DIV/0!
Z-bar=ΣZ_k/K= #DIV/0!

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	5	1	1	0	1

Σn 15
ΣS_k -5

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	#DIV/0!	@α=5% $\chi^2_{(K-1)}$= 5.99	Test for station homogeneity	
p	**#DIV/0!**		$\chi^2_h<\chi^2_{(K-1)}$	#DIV/0!
ΣVAR(S_k)	Z_{calc} -0.66	@α=5% Z= 1.64	H_0 (No trend)	ACCEPT
36.33	**p** **0.253**		H_A (± trend)	#DIV/0!



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.03		0.00
0.050	-0.02	**0.00**	0.00
0.100	-0.01		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	WY2006								10.8				15.3
b	WY2007								24.3				10.0
c	WY2008								20.5				15.6
d	WY2009								12.7				14.4
e	WY2010								11.9		9.9		8.5
f	WY2011		6.5						42.7		13.1		10.2
	n	0	1	0	0	0	0	0	6	0	2	0	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	0	1	0	0	0	0	0	6	0	2	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
f-d								1				-1
f-e								1		1		1
S_k	0	0	0	0	0	0	0	3	0	1	0	-5

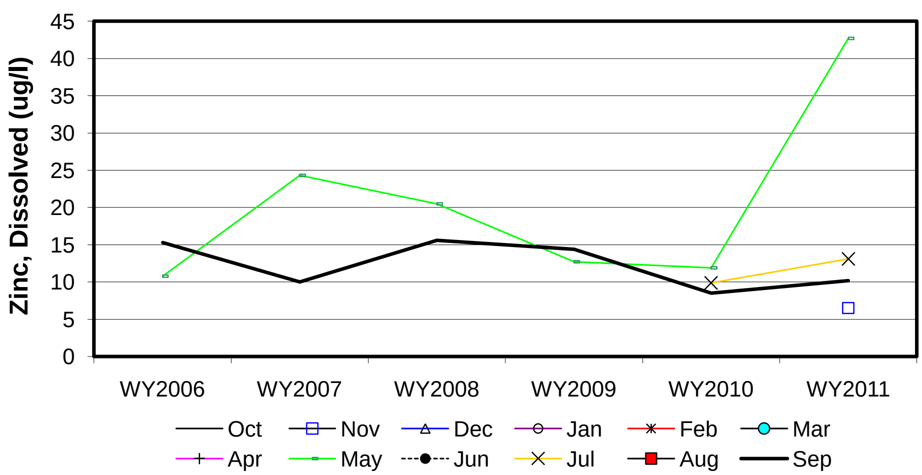
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=								28.33		1.00		28.33
$Z_k = S_k/\sigma_S$								0.56		1.00		-0.94
Z^2_k								0.32		1.00		0.88

ΣZ_k= 0.62
ΣZ^2_k= 2.20
Z-bar=ΣZ_k/K= 0.21

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	15	0	0	0	0

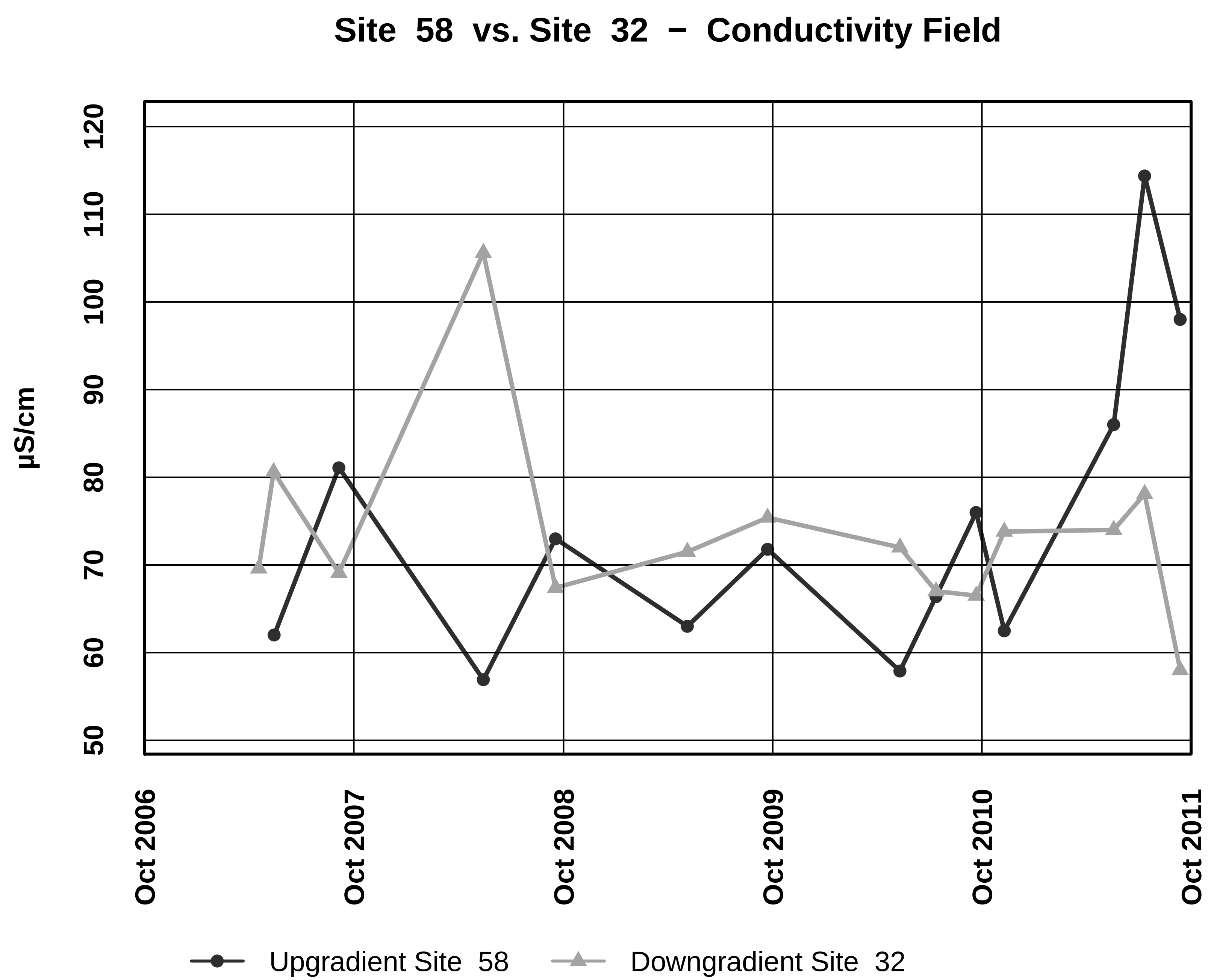
Σn 15
ΣS_k -1

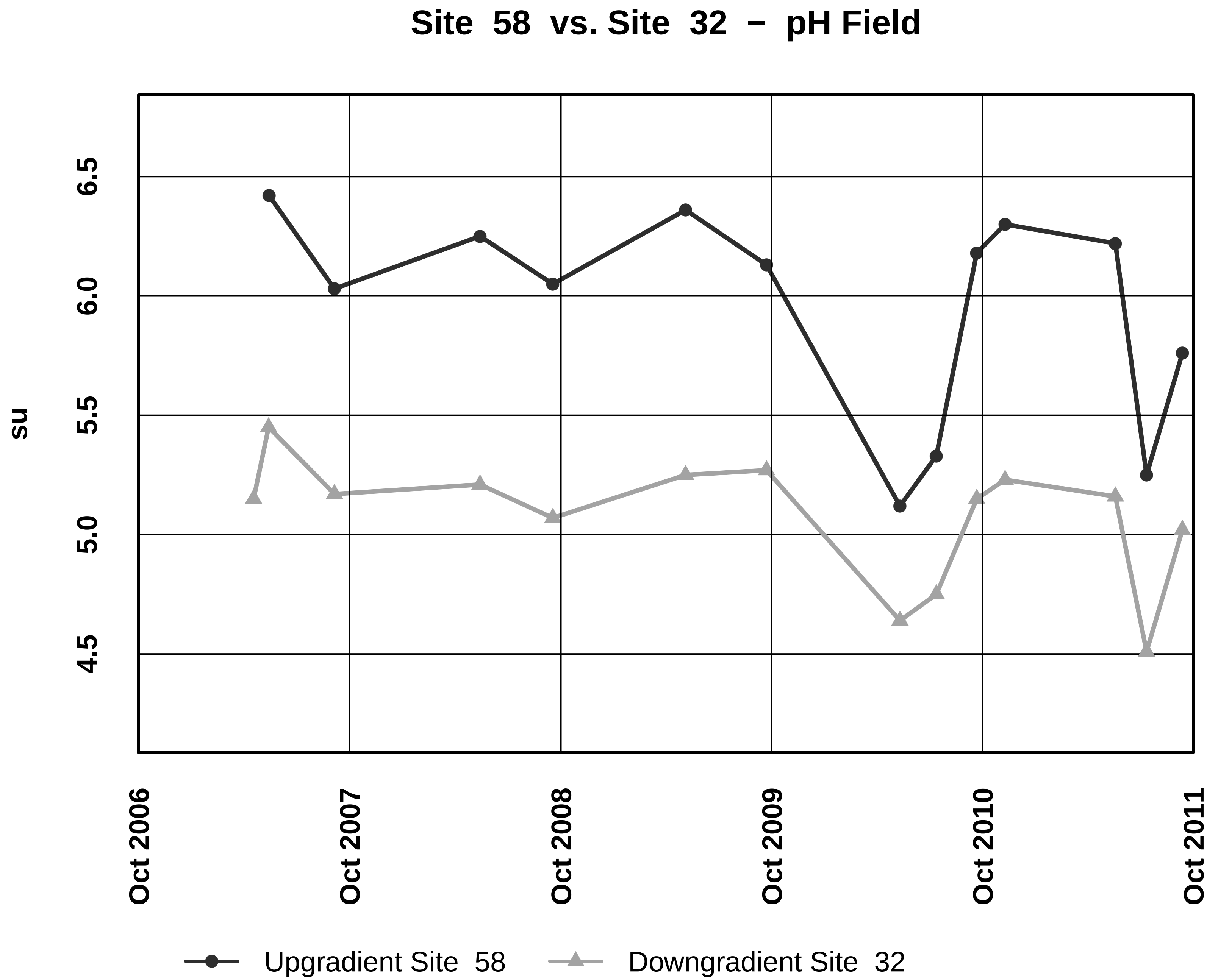
$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	2.07	@α=5% $\chi^2_{(K-1)}$= 5.99	Test for station homogeneity	
p	**0.355**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
$\Sigma VAR(S_k)$ / Z_{calc}	0.00	@α/2=2.5% Z= 1.96	H_0 (No trend)	ACCEPT
57.67 / **p**	**0.500**		H_A (± trend)	REJECT

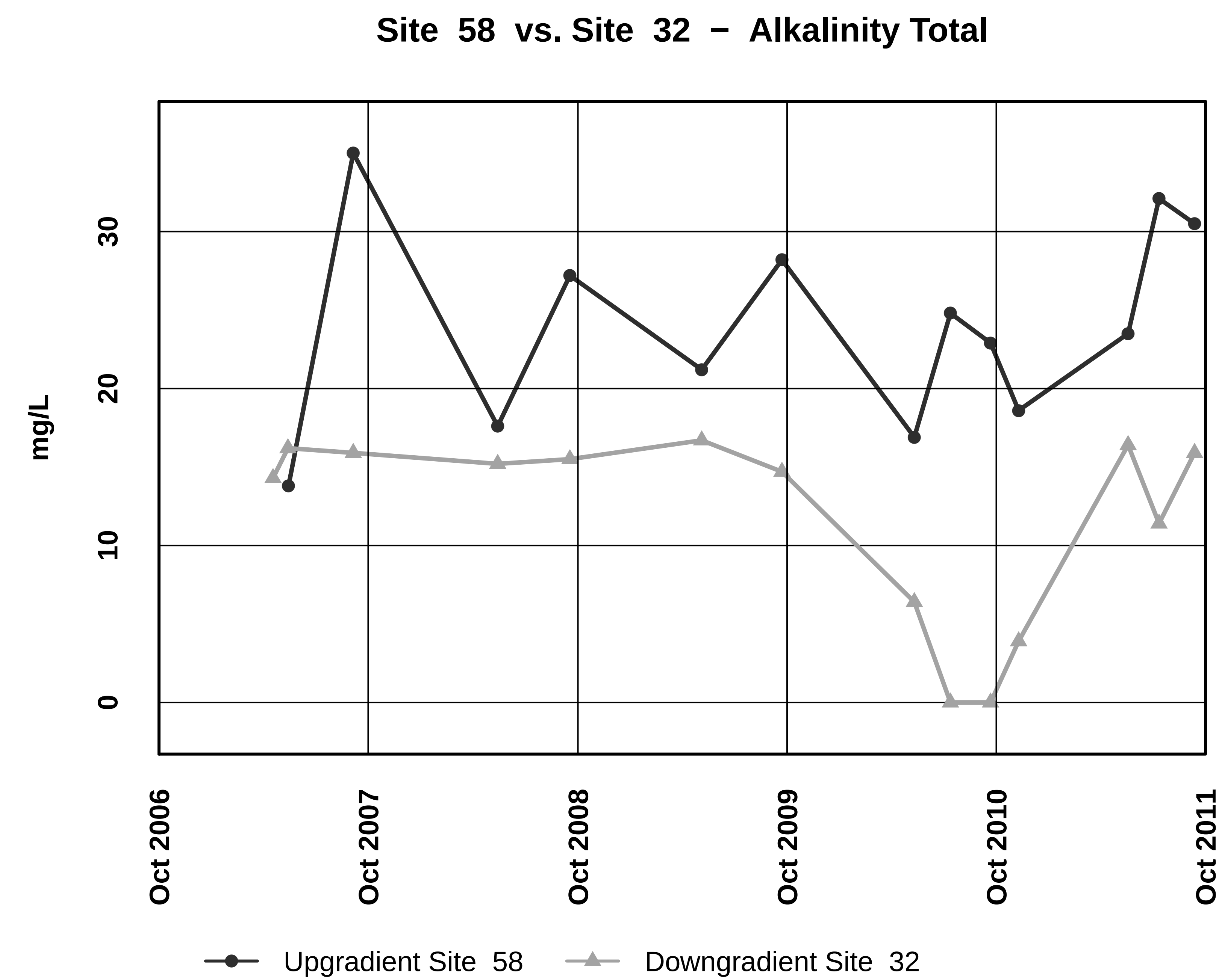


Seasonal-Kendall Slope Confidence Intervals

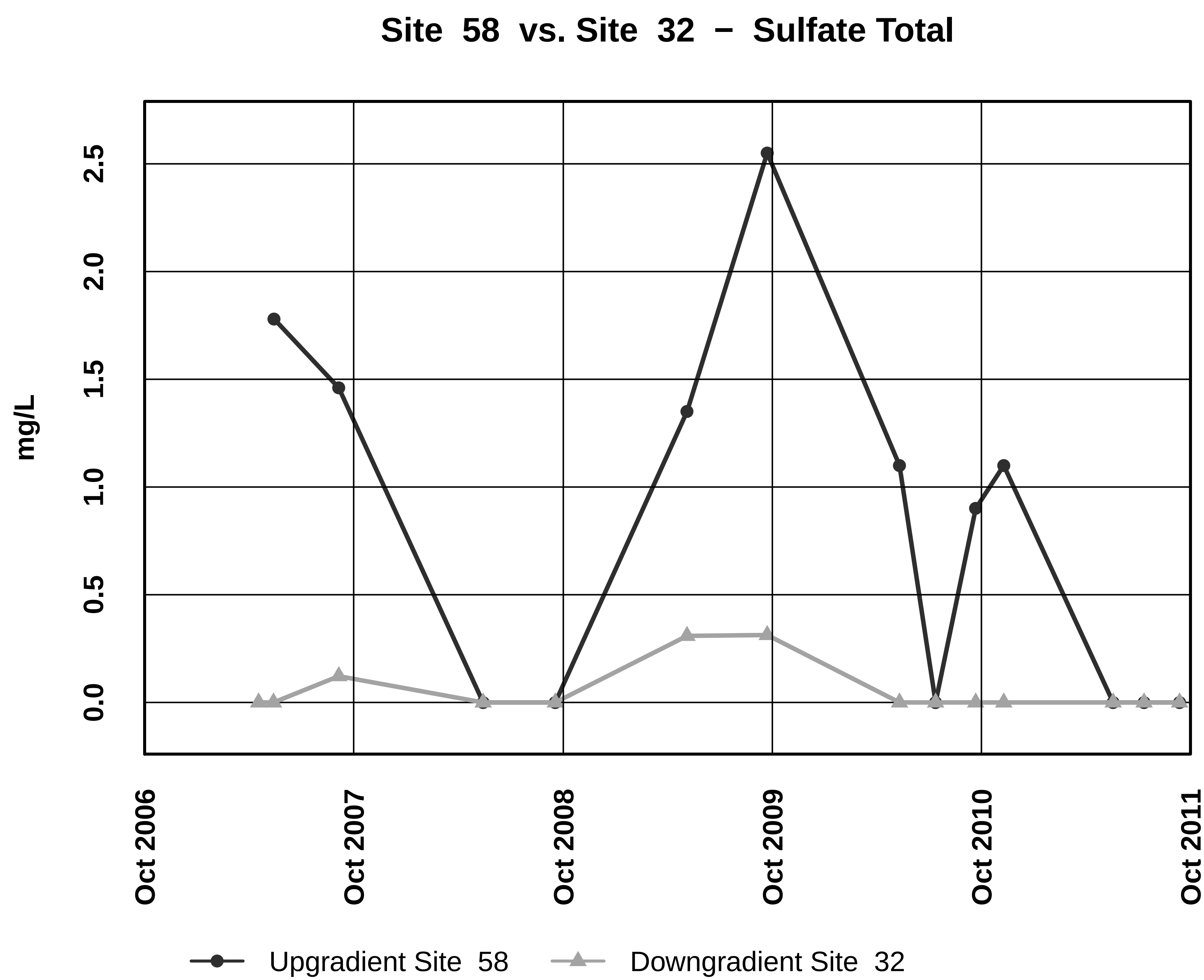
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-3.91		4.68
0.050	-2.02	**-0.30**	2.07
0.100	-1.74		1.02
0.200	-1.15		0.24

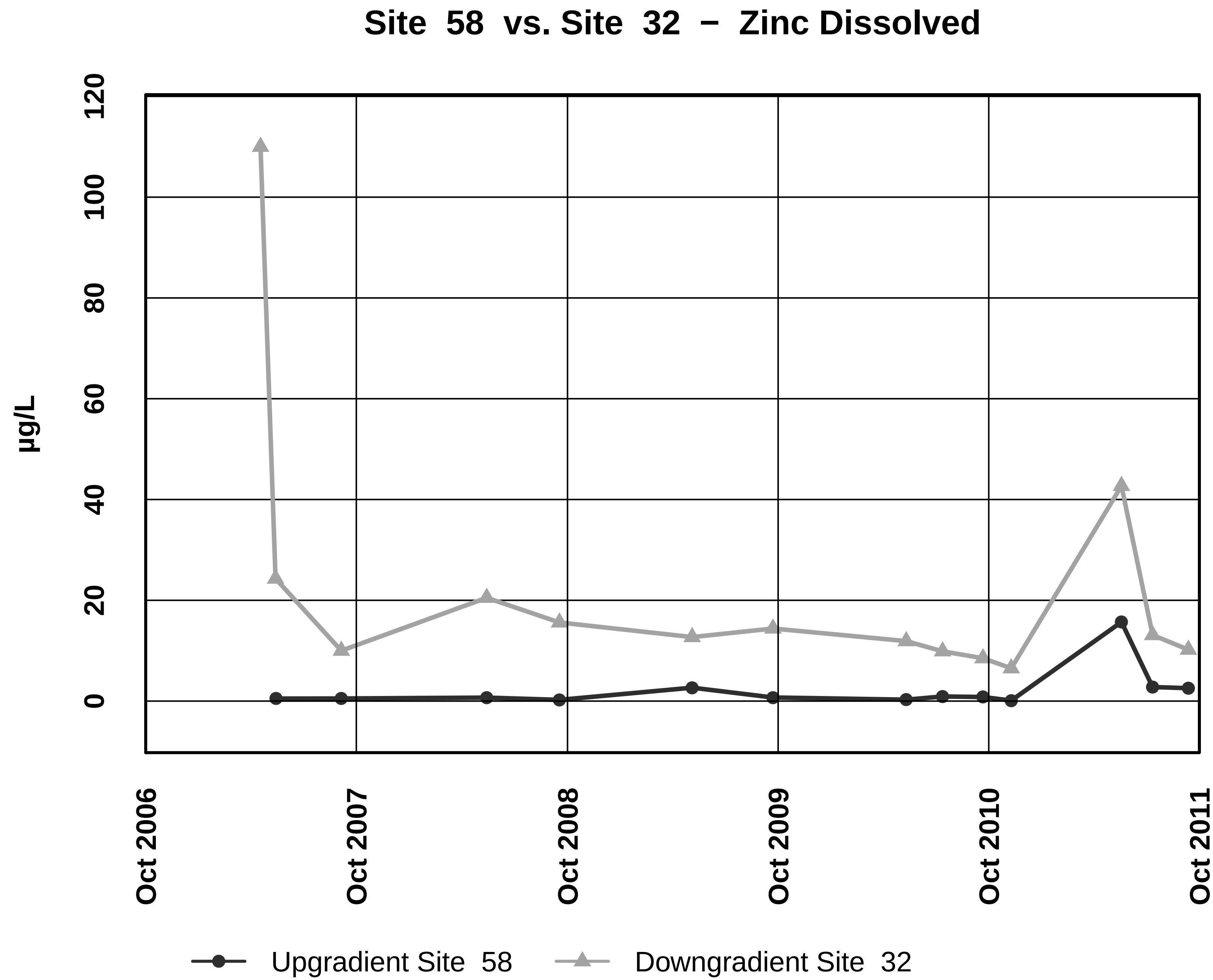

Site 58 vs. Site 32 − Conductivity Field
µS/cm
50
60
70
80
90
100
110
120
Oct 2006
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 58
Downgradient Site 32


Site 58 vs. Site 32 − pH Field
su
6.5
6.0
5.5
5.0
4.5
Oct 2006
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 58
Downgradient Site 32



Site 58 vs. Site 32 − Alkalinity Total
mg/L
0
10
20
30
Oct 2006
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 2006
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
20
40
60
80
100
120
Oct 2006
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 58
Downgradient Site 32

INTERPRETIVE REPORT
SITE 59 “MONITORING WELL T-00-01A”

The data collected during the current water year are listed in the following “Table of Results for Water Year 2011” 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 2006 through September 2011.				

The data for water year 2011 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 second 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 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 2011

			Limits		
Sample Date	**Parameter**	**Value**	**Lower**	**Upper**	**Hardness**
12-Jul-11	pH Field	5.79 su	6.5	8.50	
12-Sep-11	pH Field	6.42 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. A visual trend in dissolved mercury concentration was noted in the previous FWMP report, which stated that “there was a moderate increase in the dissolved mercury concentration”. By the May 2011 sampling event the dissolved mercury concentration had returned to historical levels. 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-05 and Sep-11 (WY2006-WY2011).

Table of Summary Statistics for Trend Analysis

	Mann-Kendall test statistics			Sen's slope estimate	
Parameter	**n***	**p****	**Trend**	**Q**	**Q(%)**
Conductivity Field	6	0.06			
pH Field	6	0.40			
Alkalinity, Total	6	0.40			
Sulfate, Total	6	0.03			
Zinc, Dissolved	6	0.22			

* Number of Years ** Significance level

There were no statistically significant trends ($\alpha/2=2.5\%$) for Site 59 during the 2011 water year. HGCMC feels the current FWMP program is sufficient to monitor any future increases at Site 59 before any water quality values are impaired.

Table of Results for Water Year 2011

Site 059FMG - 'Monitoring Well -T-00-01A'

Sample Date/Parameter	Oct 2010	Nov 2010	Dec 2010	Jan 2011	Feb 2011	Mar 2011	Apr 2011	May 2011	Jun 2011	Jul 2011	Aug 2011	Sep 2011	**Median**
Water Temp (°C)		6.7						10.3		8.6		10.1	9.4
Conductivity-Field(μmho)		142.9						182		146.2		97	144.6
Conductivity-Lab (μmho)		113						114		116		115	115
pH Lab (standard units)		6.22						6.68		6.49		6.6	6.55
pH Field (standard units)		6.73						6.93		5.79		6.42	6.58
Total Alkalinity (mg/L)		39.6						41.7		42.5		42.9	42.1
Total Sulfate (mg/L)		5.2						4.3		5.3		5.2	5.2
Hardness (mg/L)		51.2						47.1		50.2		47.9	49.1
Dissolved As (ug/L)		0.16						0.164		0.151		0.184	0.162
Dissolved Ba (ug/L)		7.3						6.9		7.8		7.8	7.6
Dissolved Cd (ug/L)		0.0115						0.0208		0.0103		0.0128	0.0122
Dissolved Cr (ug/L)		4.26						4.82		4.06		4.66	4.460
Dissolved Cu (ug/L)		0.421						0.128		0.103		0.126	0.127
Dissolved Pb (ug/L)		0.003						0.0043		0.0445		0.0015	0.0037
Dissolved Ni (ug/L)		1.04						0.921		0.894		1.02	0.971
Dissolved Ag (ug/L)		0.004						0.002		0.002		0.002	0.002
Dissolved Zn (ug/L)		0.38						0.31		0.73		0.48	0.43
Dissolved Se (ug/L)		0.566						0.669		0.057		0.54	0.553
Dissolved Hg (ug/L)		0.00206						0.000144		0.000187		0.000113	0.000166

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

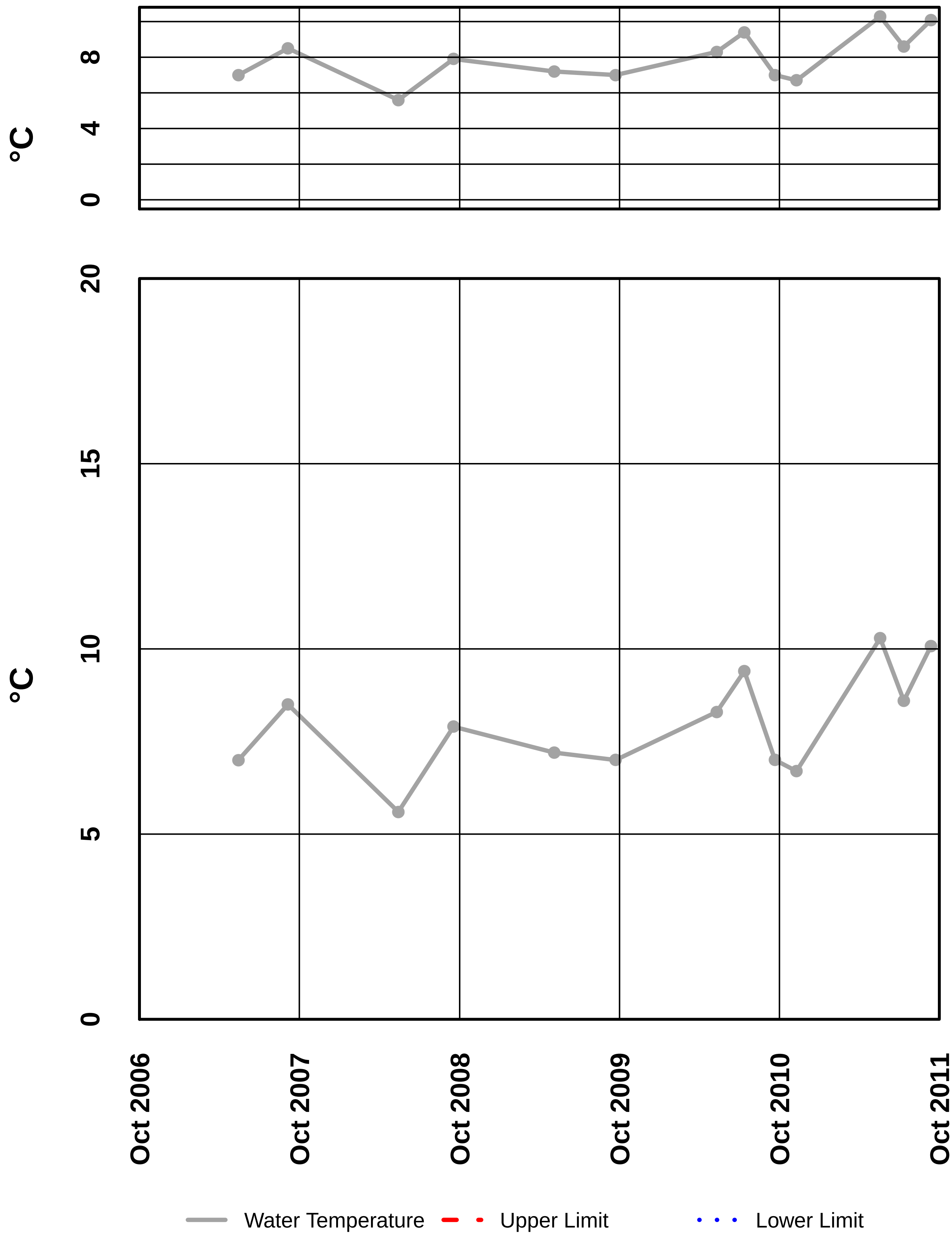
Qualified Data by QA Reviewer

Date Range: 10/01/2010 to 09/30/2011

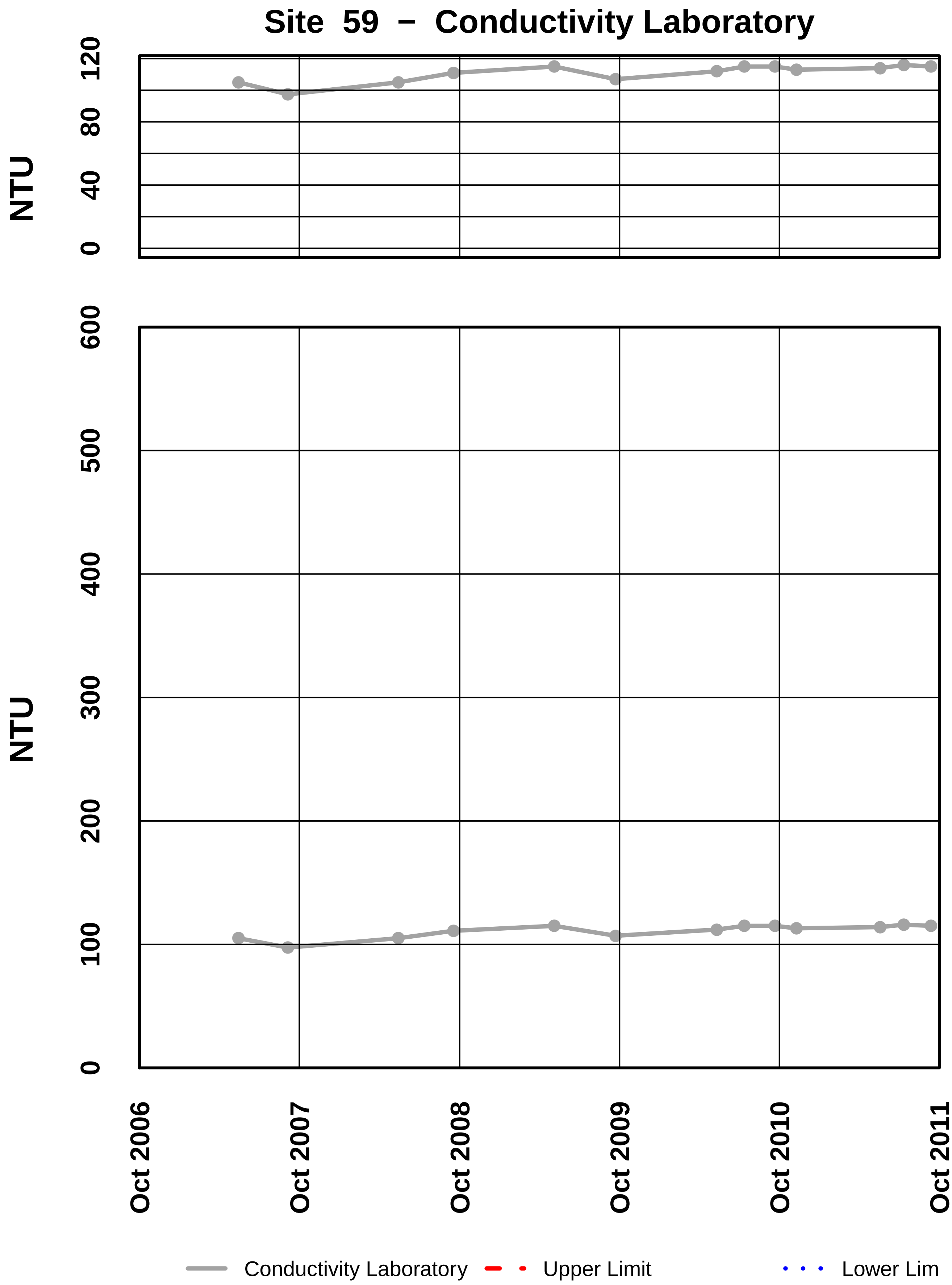
Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
59	11/9/2010	12:00 AM				
			Se diss, µg/l	0.566	J	Below Quantitative Range
			Cd diss, µg/l	0.0115	J	Below Quantitative Range
59	4/12/2011	12:00 AM				
			Hg diss, µg/l	0.000128	U	Field Blank Contamination
59	5/19/2011	12:00 AM				
			SO4 Tot, mg/l	4.3	J	Sample Reciept Temperature
			pH Lab, su	6.68	J	Hold Time Violation
			Cu diss, µg/l	0.128	U	Field Blank Contamination
			Cd diss, µg/l	0.0208	U	Trip Blank Contamination
			Pb diss, µg/l	0.0043	U	Field Blank Contamination
			Hg diss, µg/l	0.000144	U	Field Blank Contamination
59	7/12/2011	12:00 AM				
			Cd diss, µg/l	0.01	J	Below Quantitative Range
			SO4 Tot, mg/l	5.3	J	Sample Reciept Temperature
			Cu diss, µg/l	0.1	U	Field Blank Contamination
			Zn diss, µg/l	0.72	U	Field Blank Contamination
			Hg diss, µg/l	0.000187	UJ	Field Blank Contamination
59	9/12/2011	12:00 AM				
			SO4 Tot, mg/l	5.2	J	Sample Receipt Temperature
			Zn diss, µg/l	0.47	U	Trip Blank Contamination
			Hg diss, µg/l	0.000113	U	Field Blank Contamination

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

Site 59 – Water Temperature

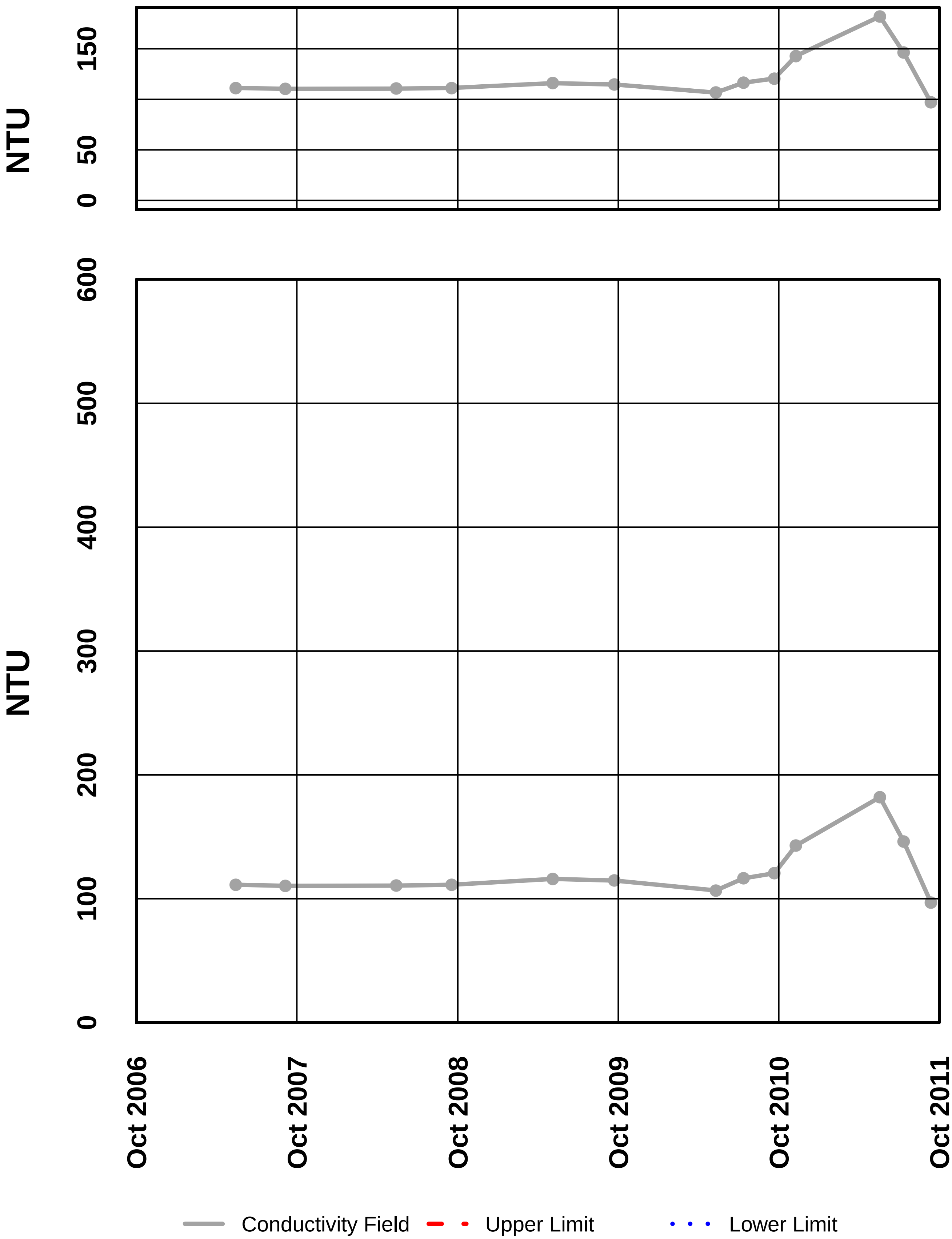


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

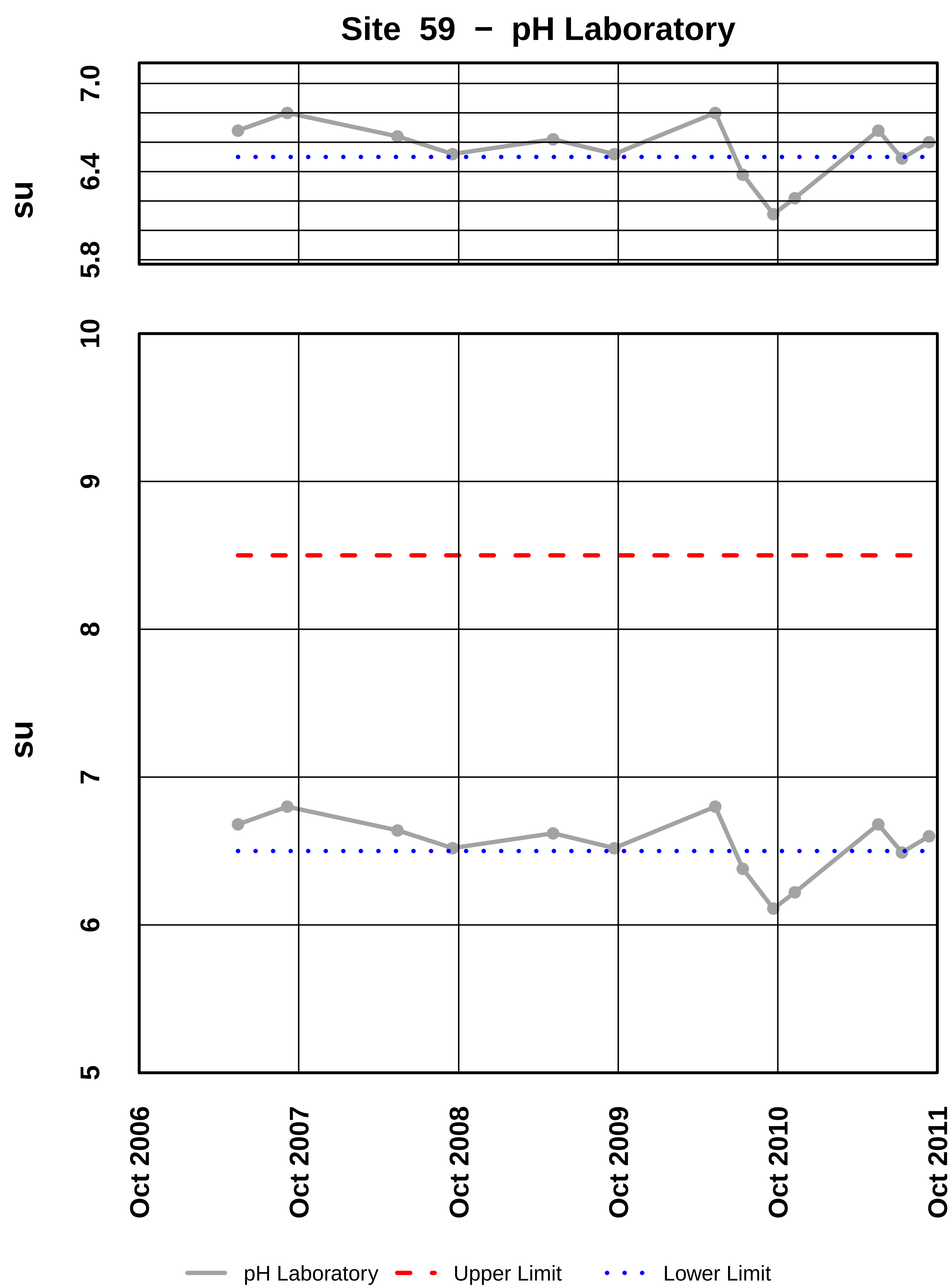


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

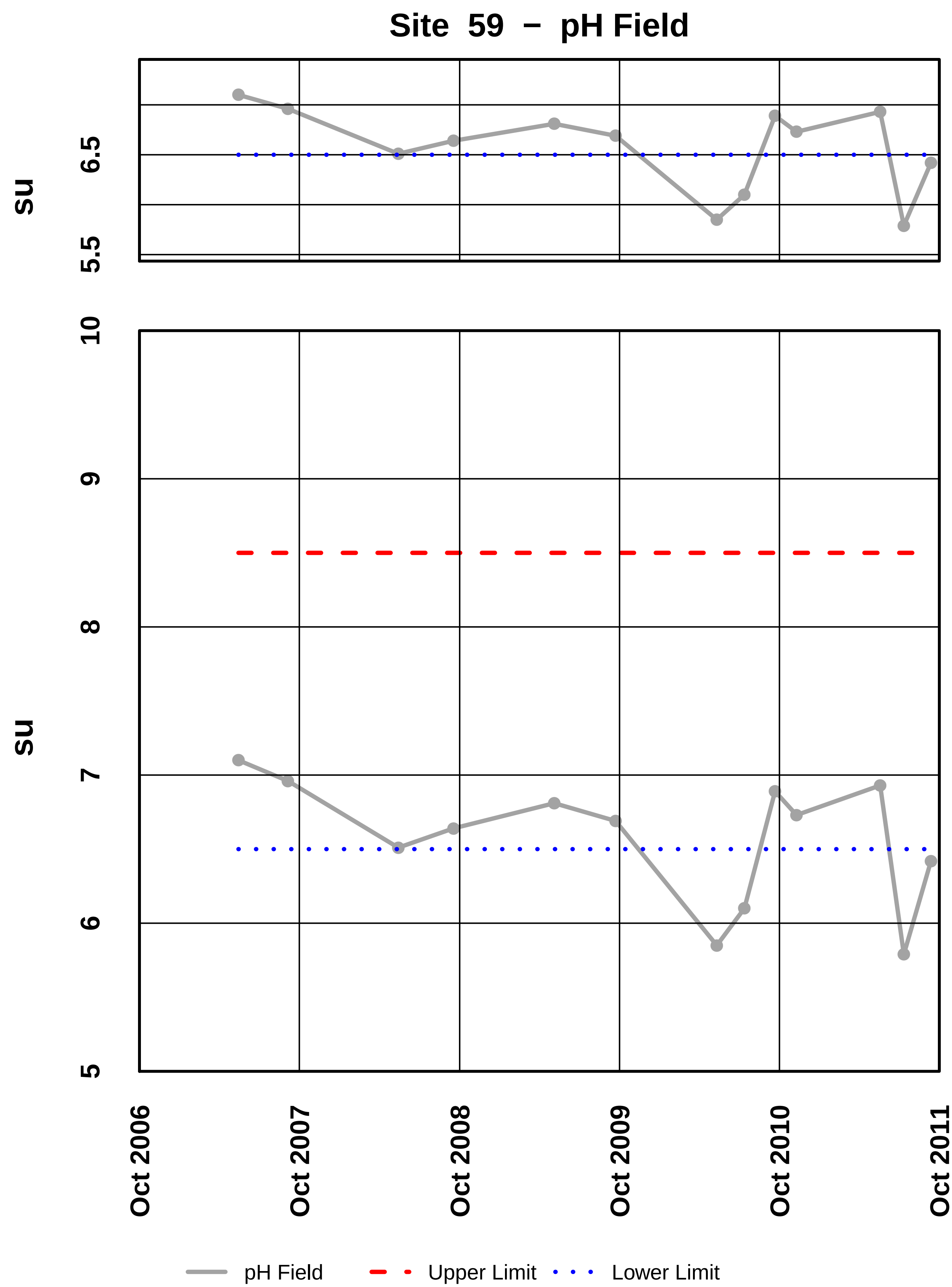
Site 59 – Conductivity Field



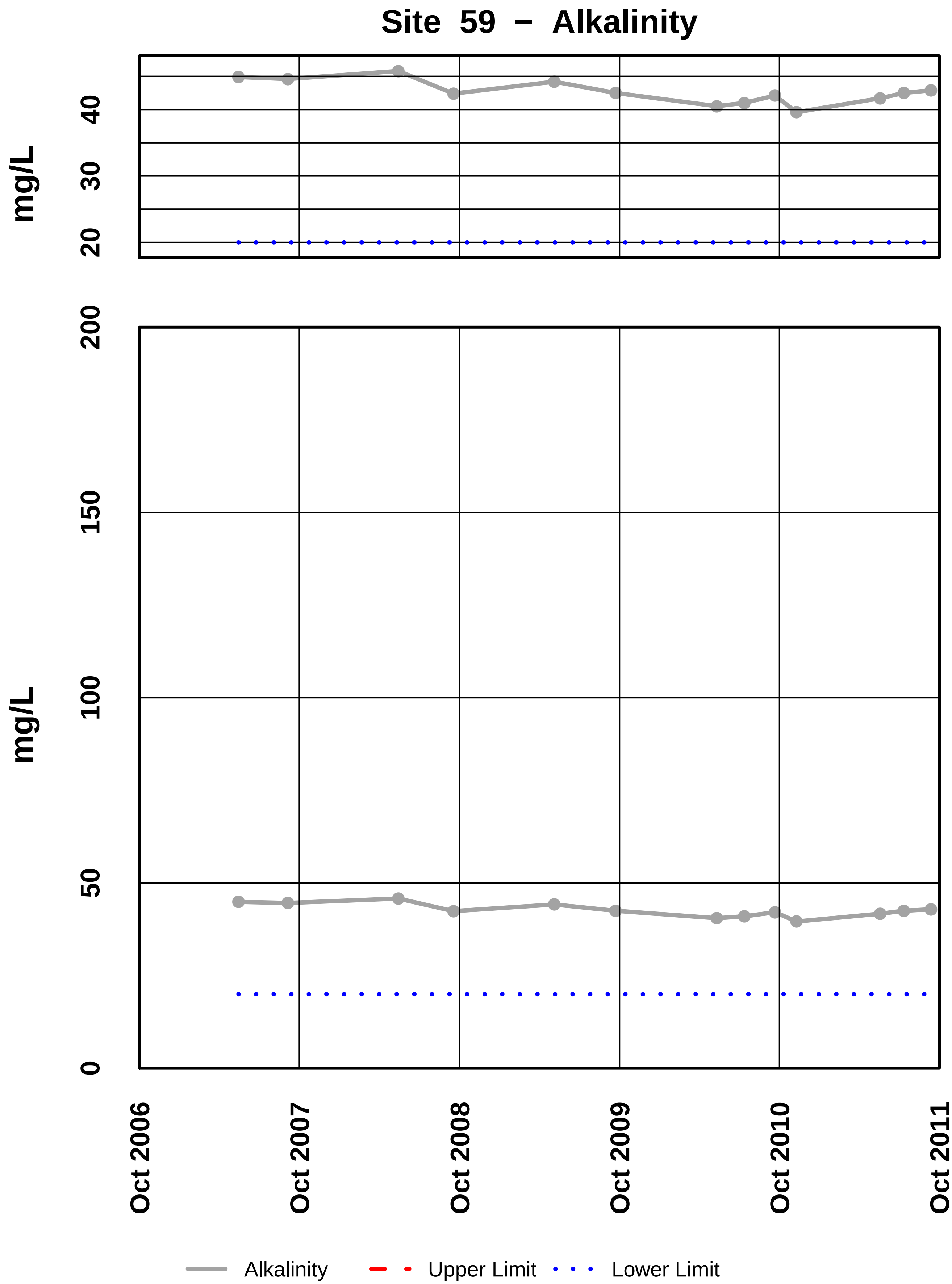
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

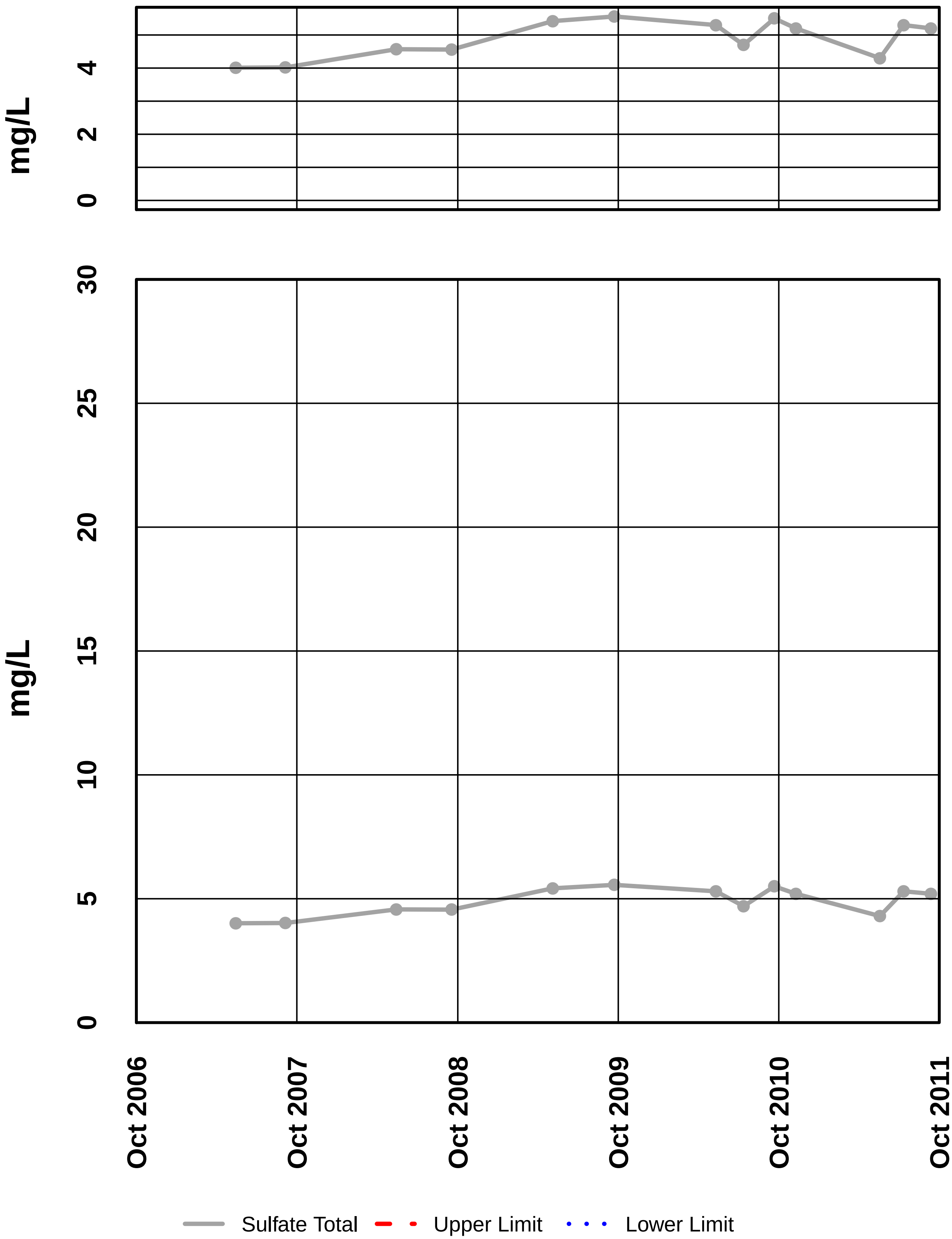


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



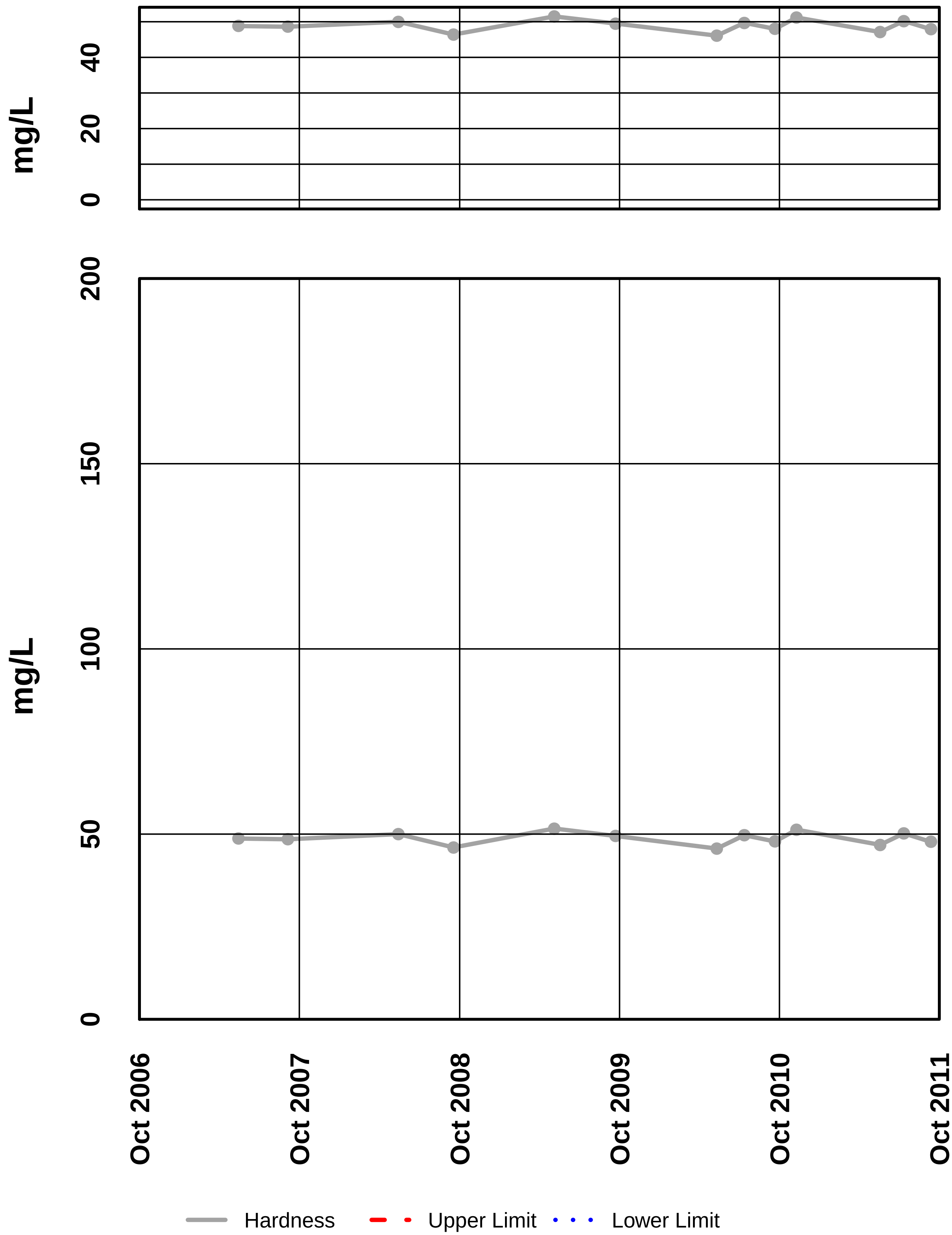
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 59 – Sulfate Total

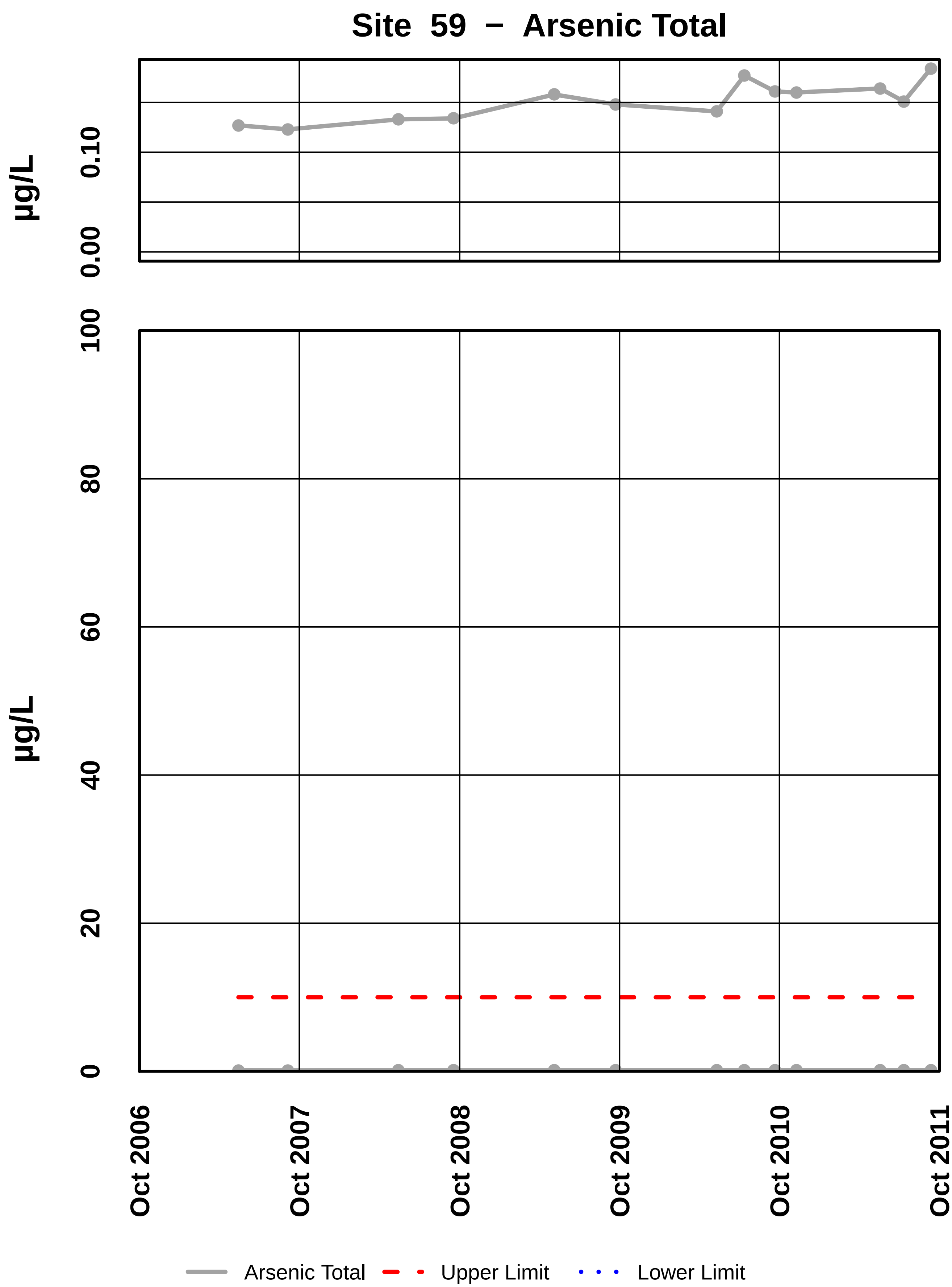


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 59 − Hardness

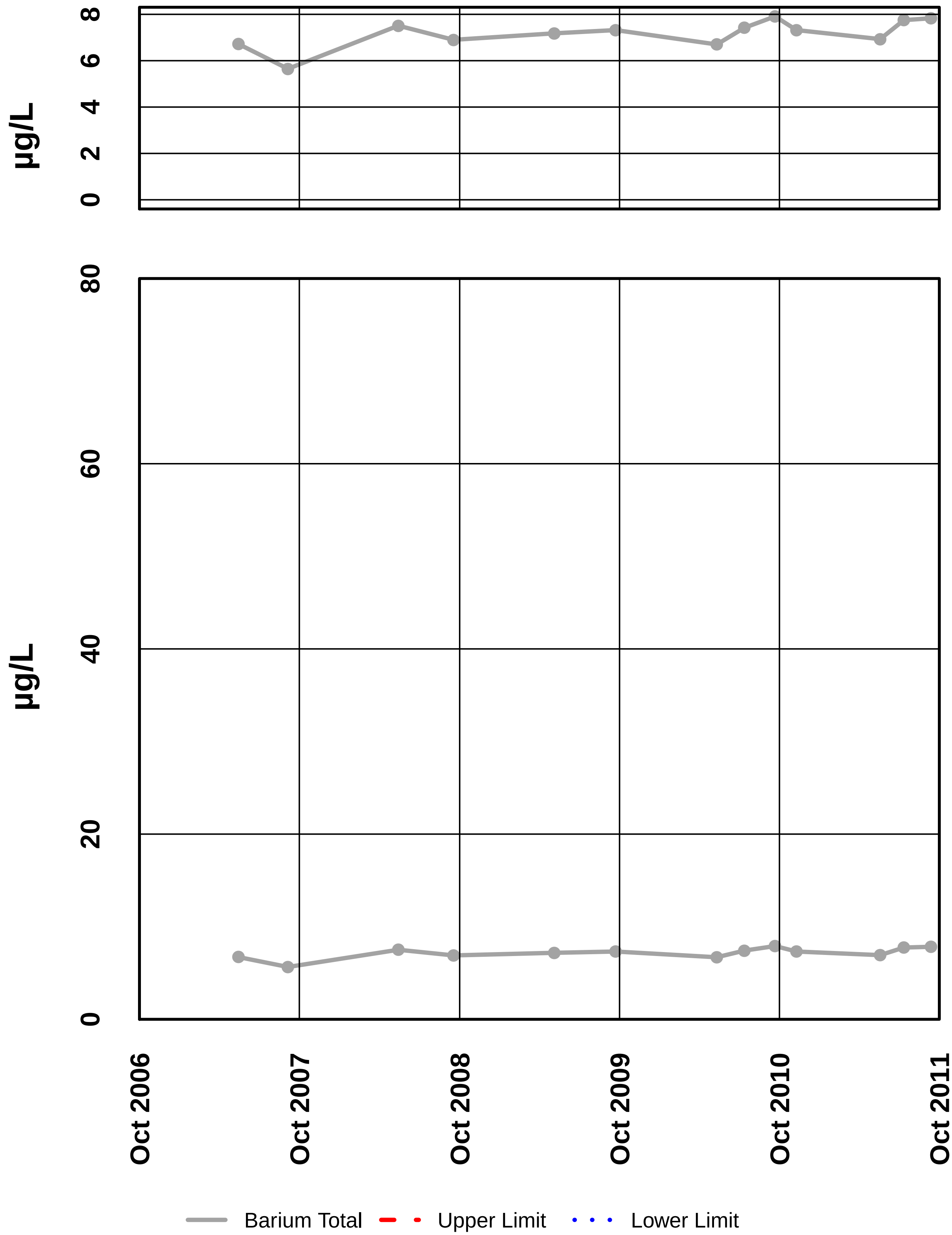


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



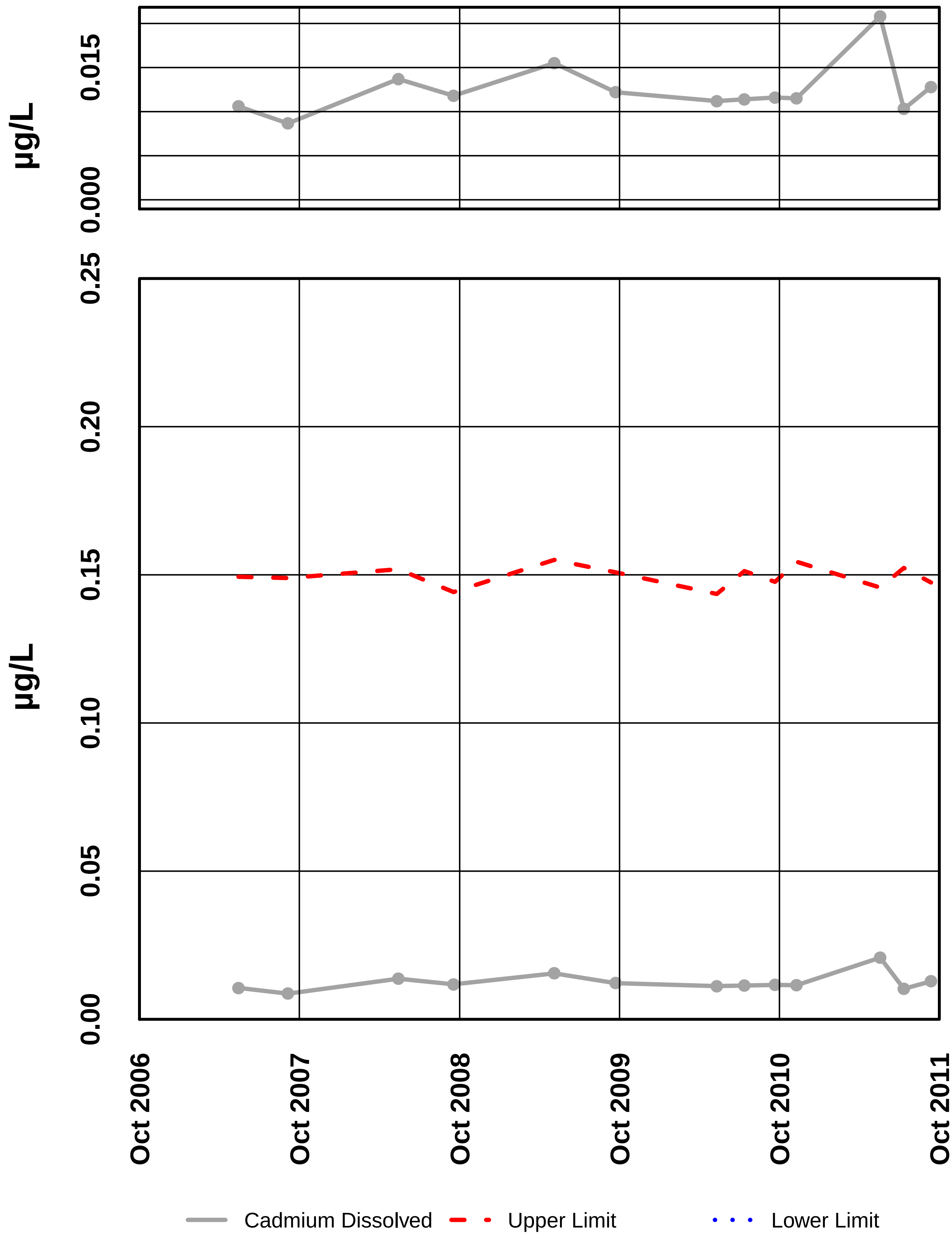
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 59 – Barium Total

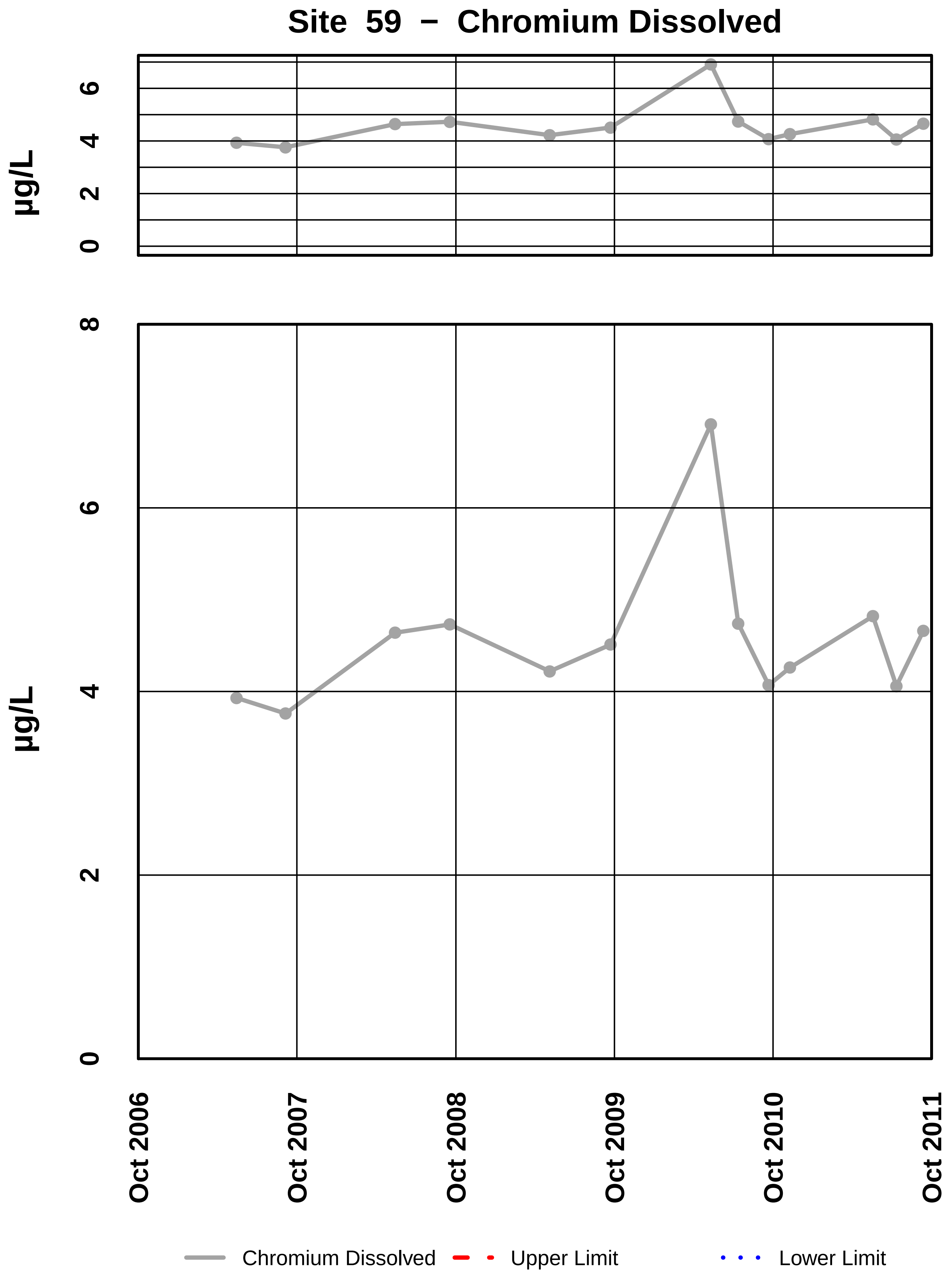


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

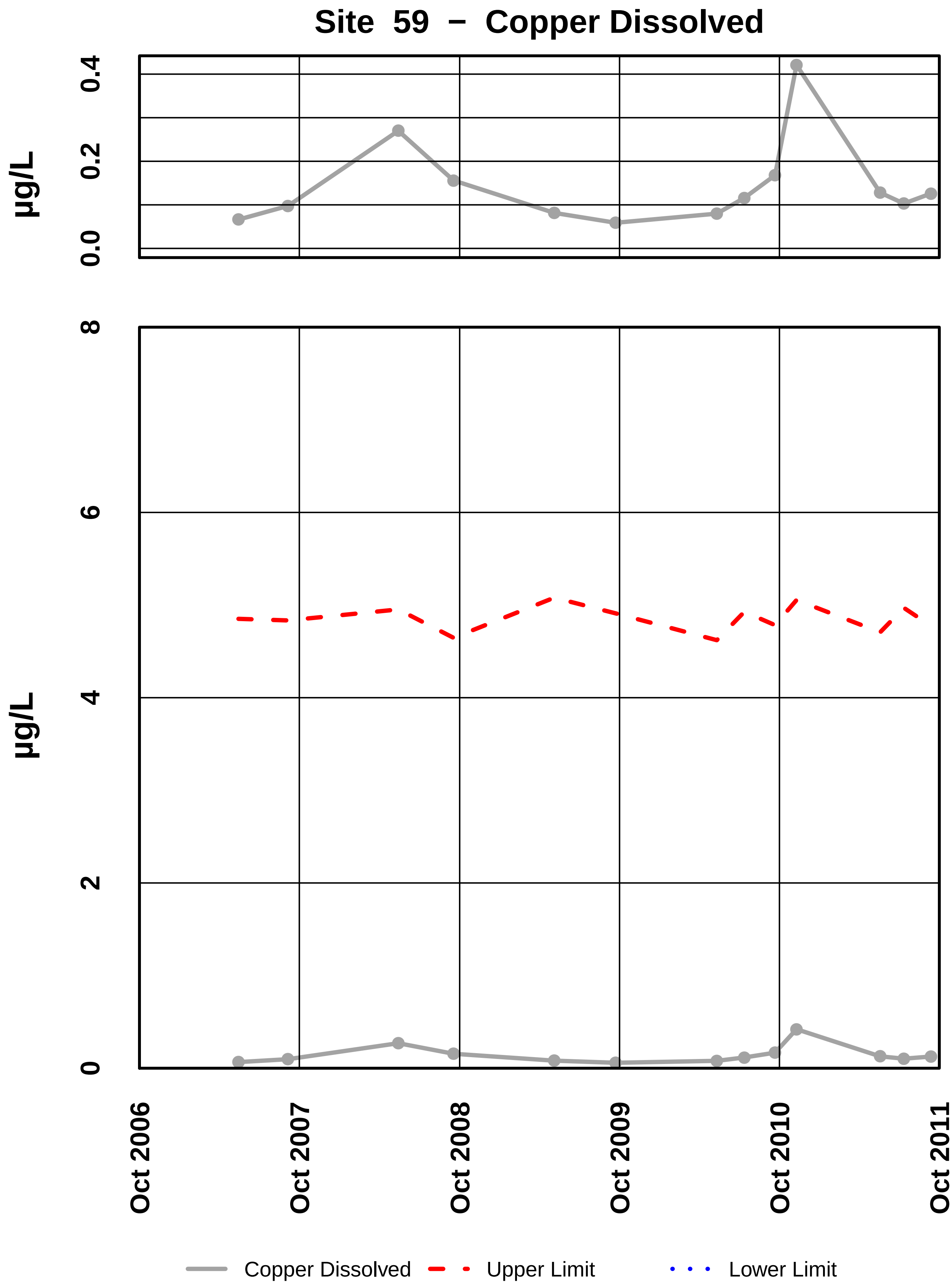
Site 59 – Cadmium Dissolved



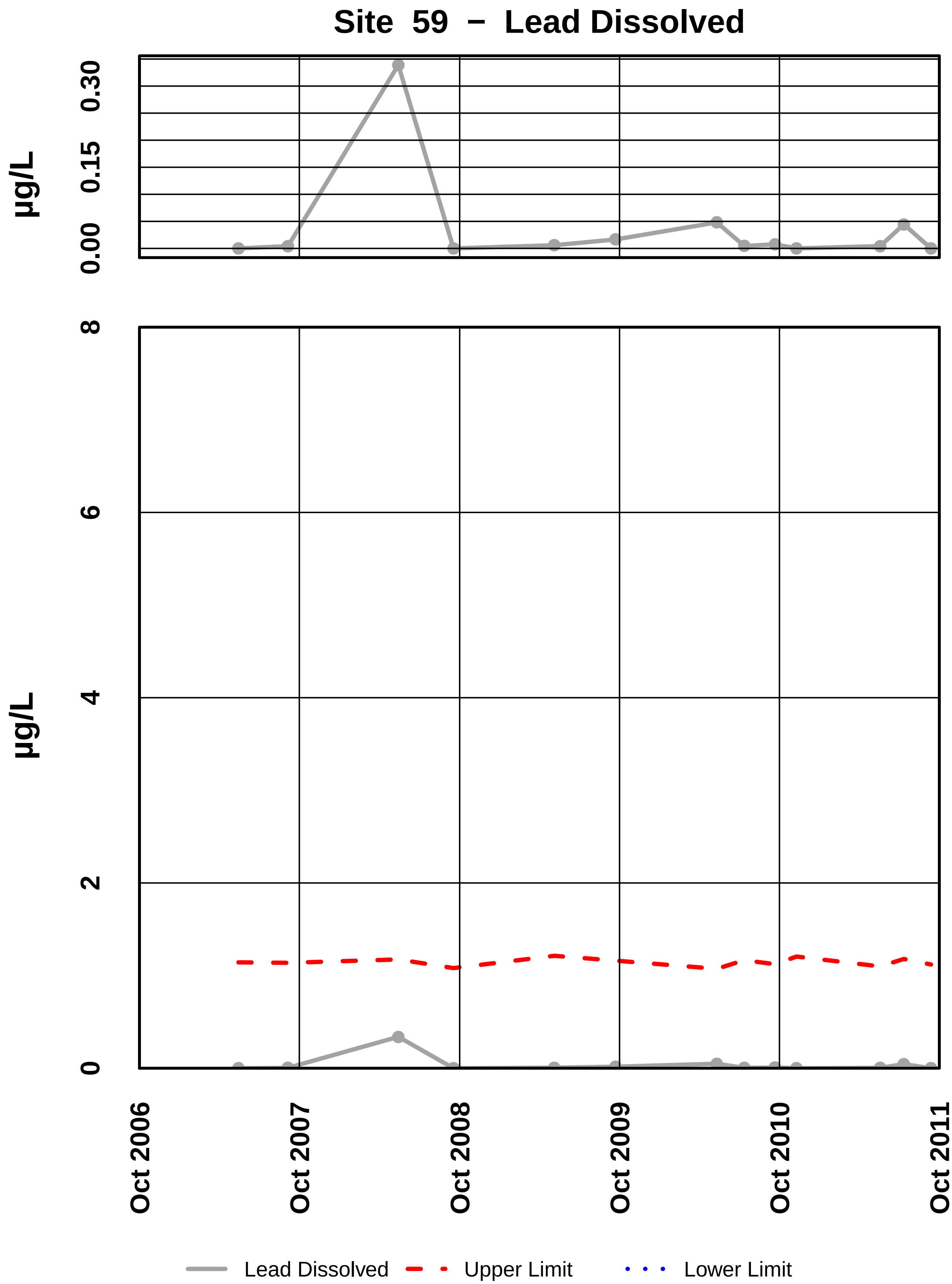
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



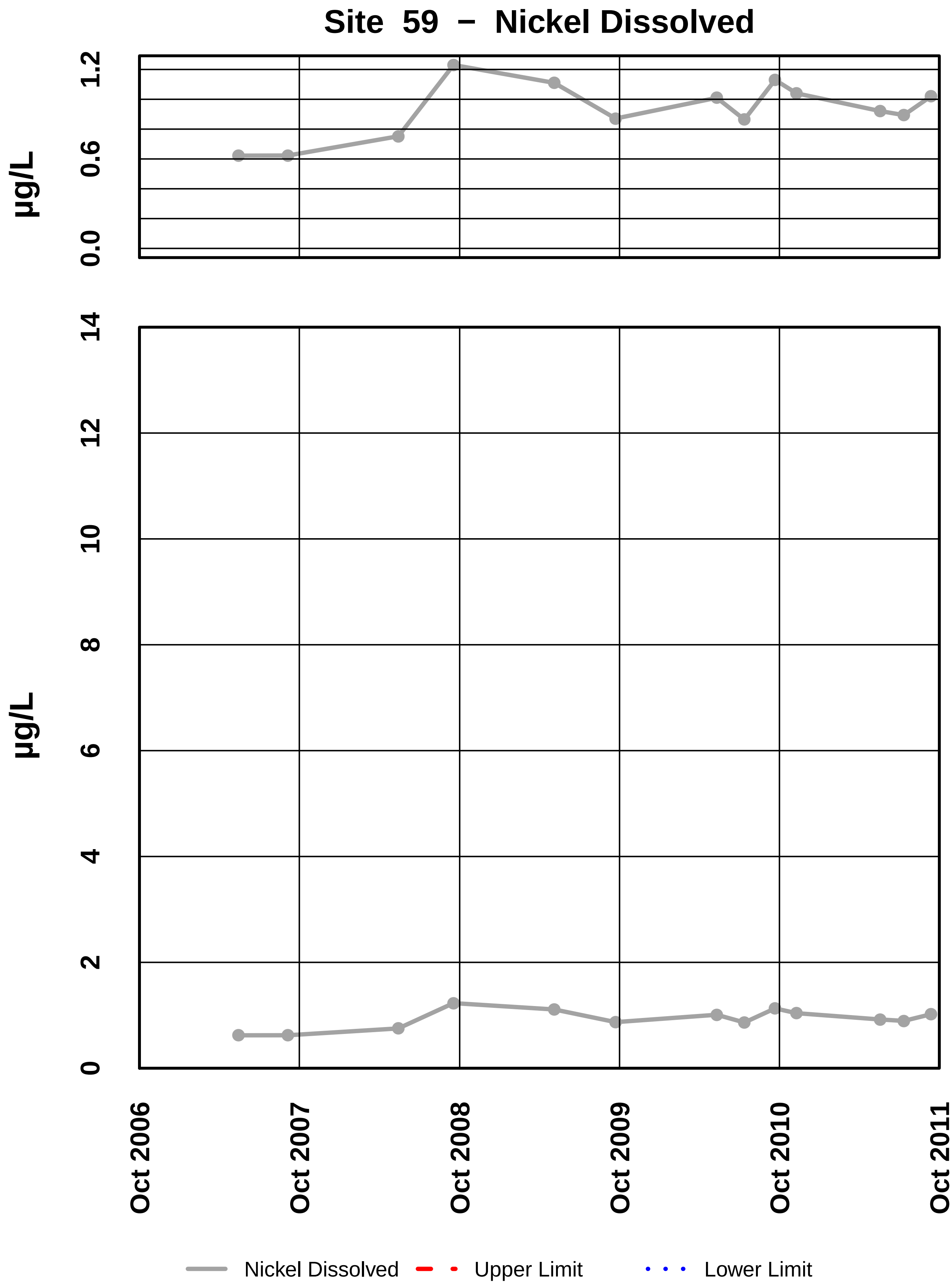
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



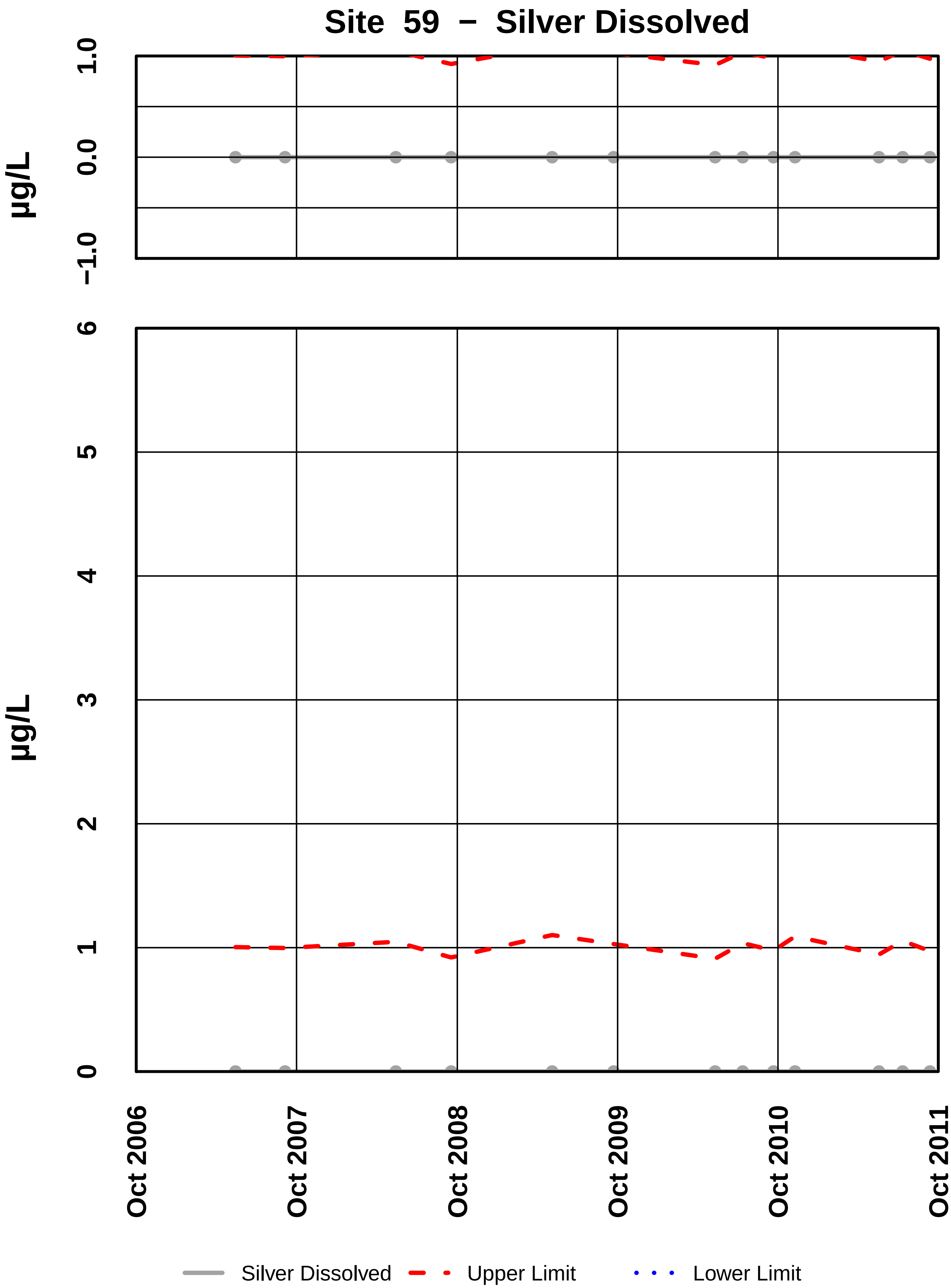
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

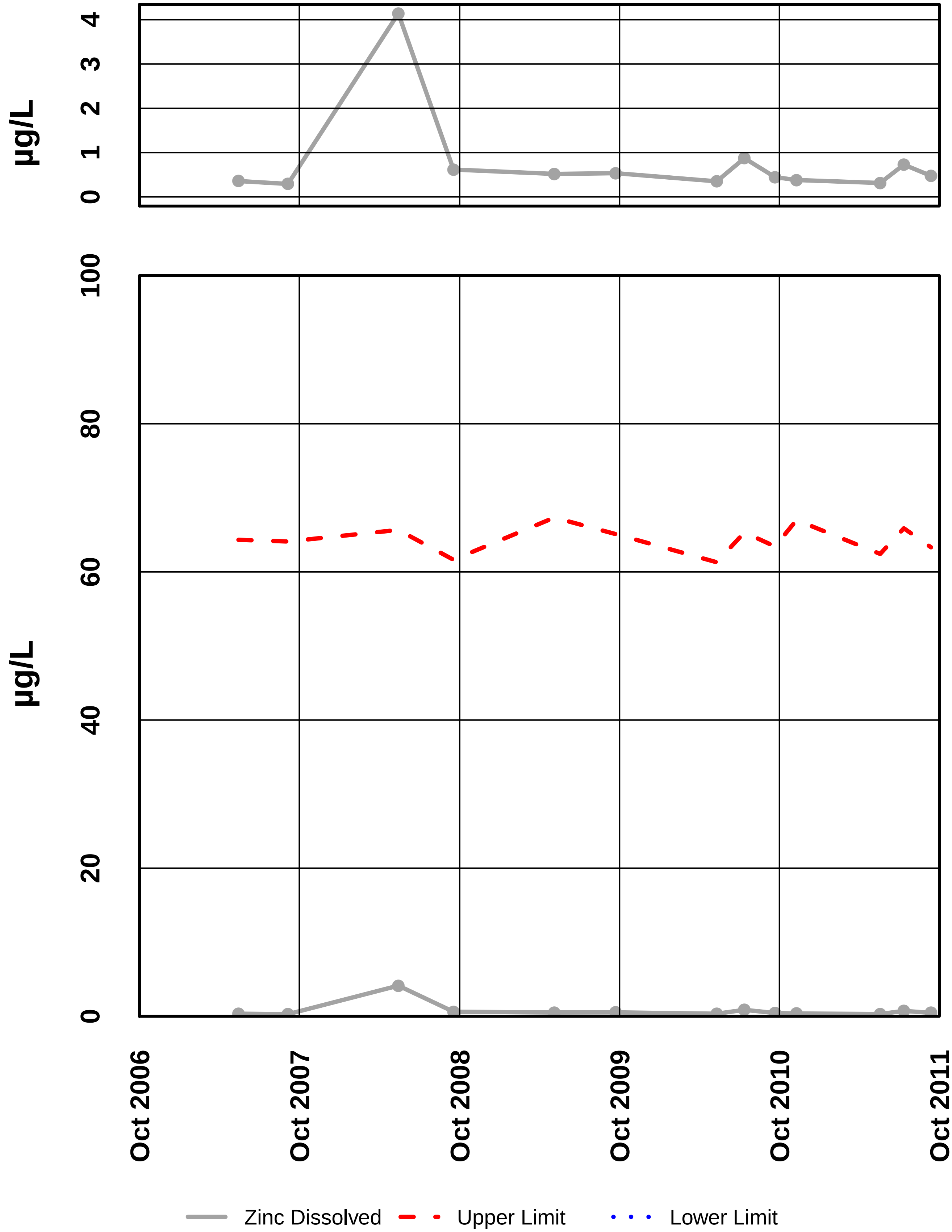


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

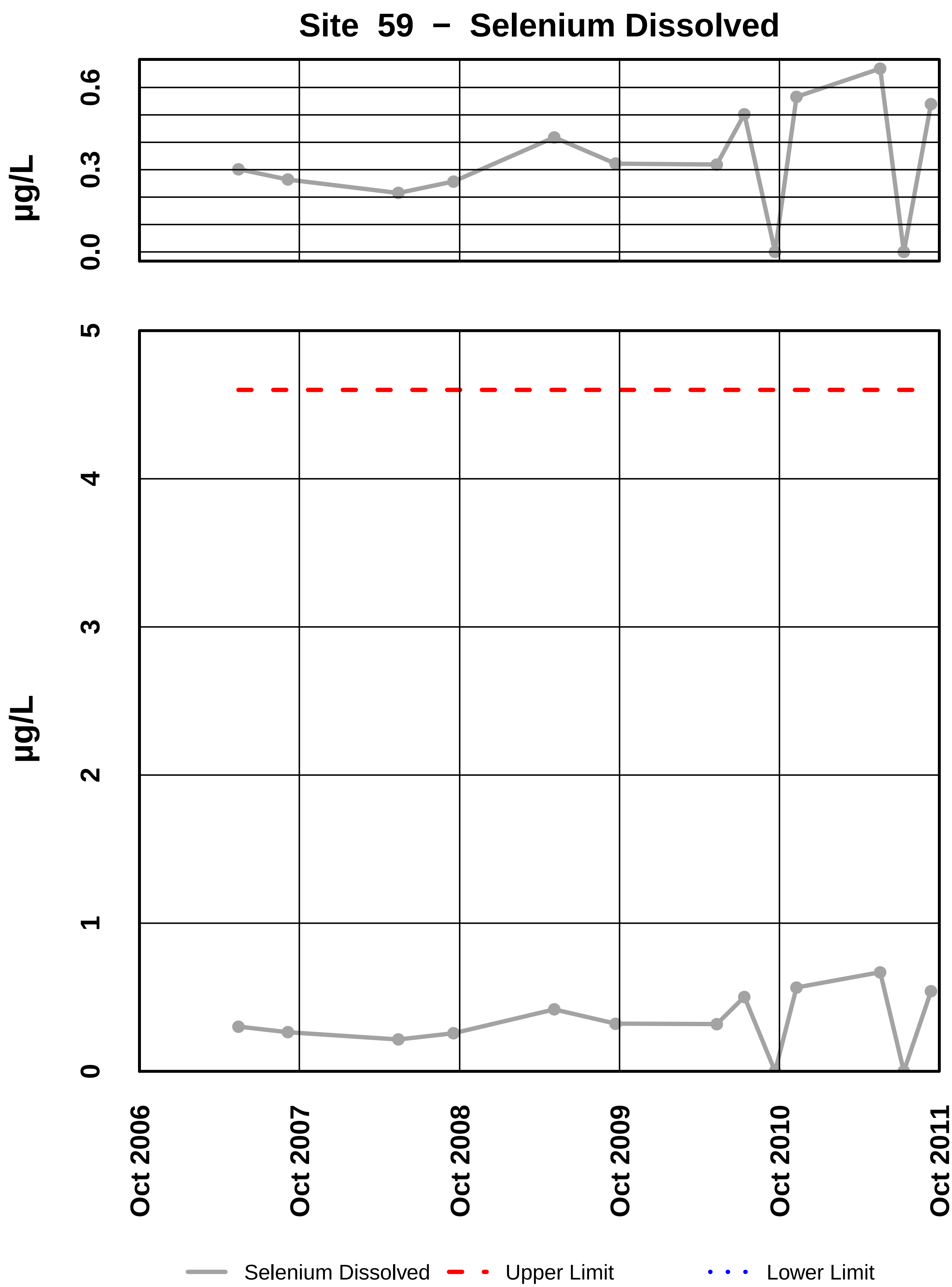


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

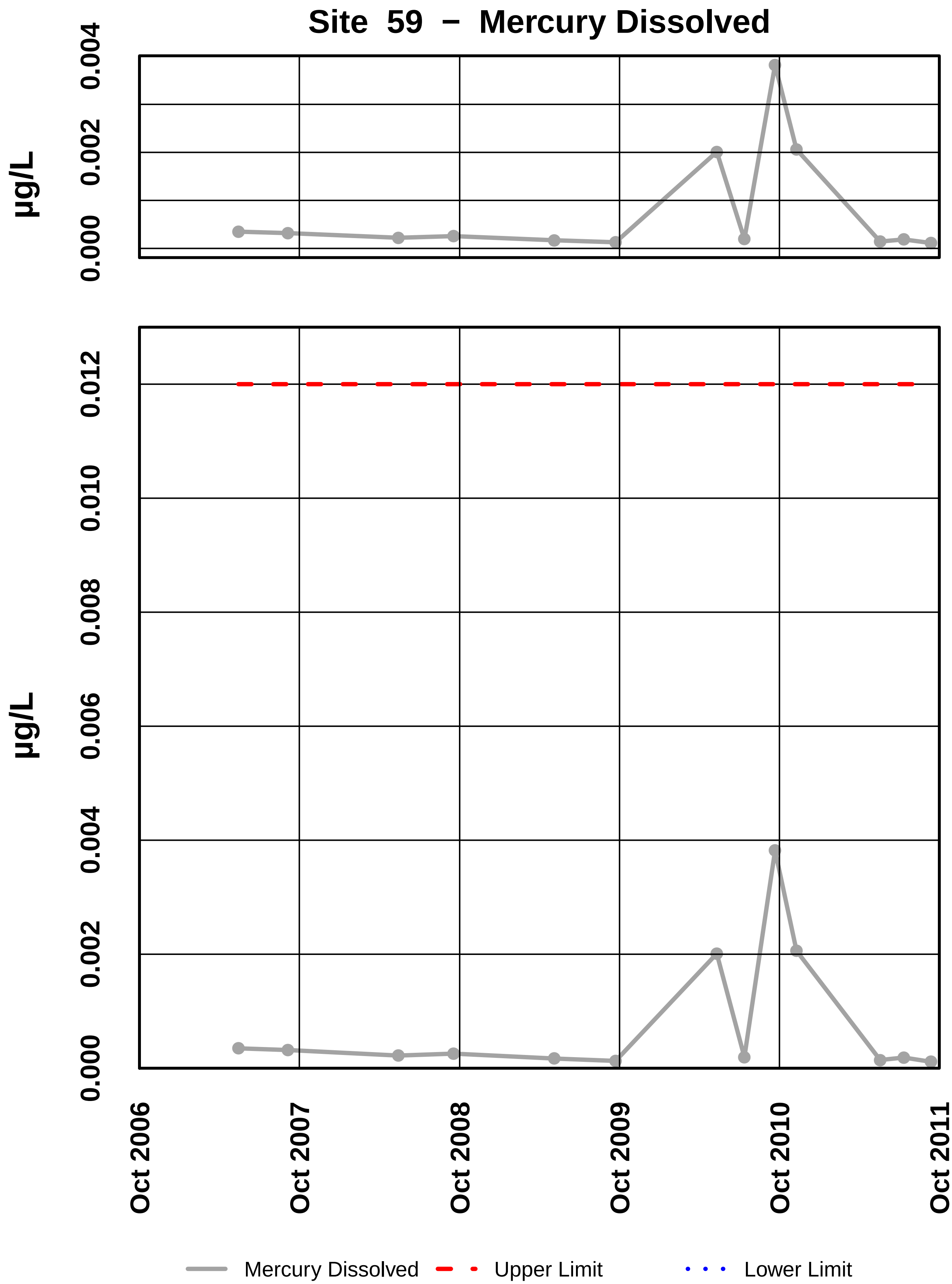
Site 59 – Zinc Dissolved



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 **#59** Seasonal Kendall analysis for Specific Conductance, Lab (uS/cm)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2006**								95.5				106.7
b	**WY2007**								111.3				110.4
c	**WY2008**								110.6				111.3
d	**WY2009**								116				114.7
e	**WY2010**								106.7		116.5		120.6
f	**WY2011**		142.9						182		146.2		97
	n	0	1	0	0	0	0	0	6	0	2	0	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	0	1	0	0	0	0	0	6	0	2	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
f-d								1				-1
f-e								1		1		-1
S_k	0	0	0	0	0	0	0	7	0	1	0	5

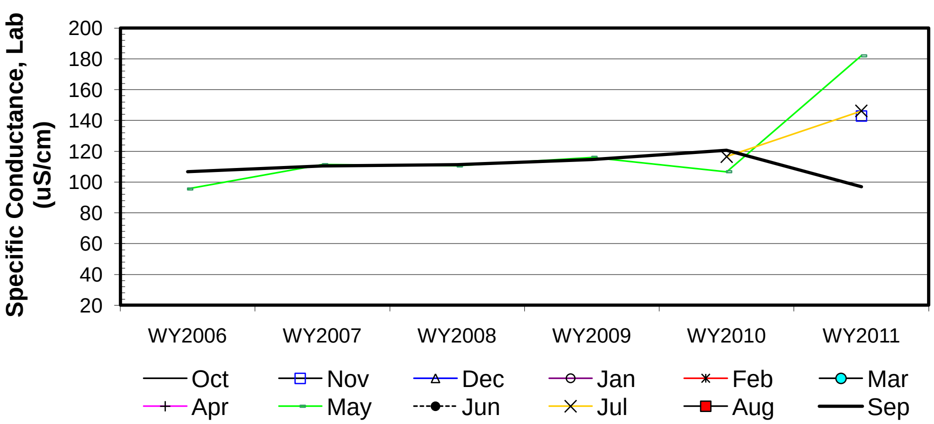
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=								28.33		1.00		28.33
$Z_k = S_k/\sigma_S$								1.32		1.00		0.94
Z^2_k								1.73		1.00		0.88

ΣZ_k= 3.25
ΣZ^2_k= 3.61
Z-bar=ΣZ_k/K= 1.08

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	15	0	0	0	0

Σn 15
ΣS_k 13

$\chi^2_h=\Sigma Z^2_k$-K(Z-bar)^2=		0.08	@α=5% $\chi^2_{(K-1)}$= 5.99	Test for station homogeneity	
	p	**0.960**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc}	1.58	@α/2=2.5% Z= 1.96	H_0 (No trend)	ACCEPT
57.67	p	**0.943**		H_A (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-1.94		10.30
0.050	-0.29	**3.40**	5.77
0.100	1.69		4.92
0.200	2.32		3.63

Site **#59** Seasonal Kendall analysis for pH, Lab, Standard Units

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2006**								6.6				6.6
b	**WY2007**								7.1				7.0
c	**WY2008**								6.5				6.6
d	**WY2009**								6.8				6.7
e	**WY2010**								5.9		6.1		6.9
f	**WY2011**		6.7						6.9		5.8		6.4
	n	0	1	0	0	0	0	0	6	0	2	0	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	0	1	0	0	0	0	0	6	0	2	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
f-d								1				-1
f-e								1		-1		-1
S_k	0	0	0	0	0	0	0	-1	0	-1	0	-1

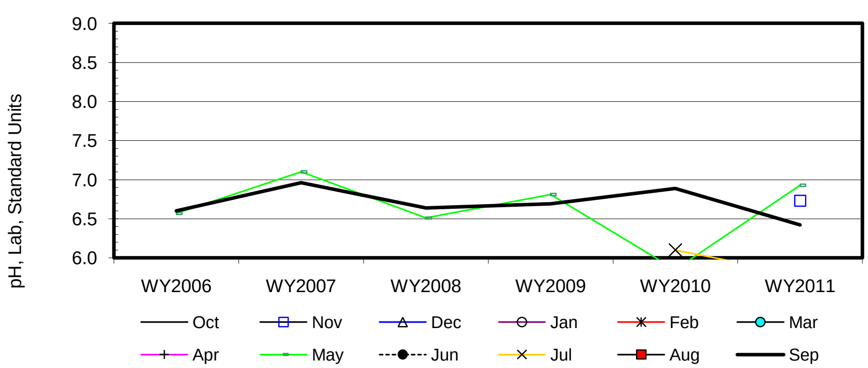
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=								28.33		1.00		28.33
$Z_k = S_k/\sigma_S$								-0.19		-1.00		-0.19
Z^2_k								0.04		1.00		0.04

ΣZ_k= -1.38
ΣZ^2_k= 1.07
Z-bar=$\Sigma Z_k/K$= -0.46

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	15	0	0	0	0

Σn 15
ΣS_k -3

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	0.44	@α=5% $\chi^2_{(K-1)}$= 5.99	Test for station homogeneity	
p	**0.803**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
$\Sigma VAR(S_k)$ / Z_{calc}	-0.26	@$\alpha/2$=2.5% Z= 1.96	H_0 (No trend)	ACCEPT
57.67 **p**	**0.396**		H_A (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

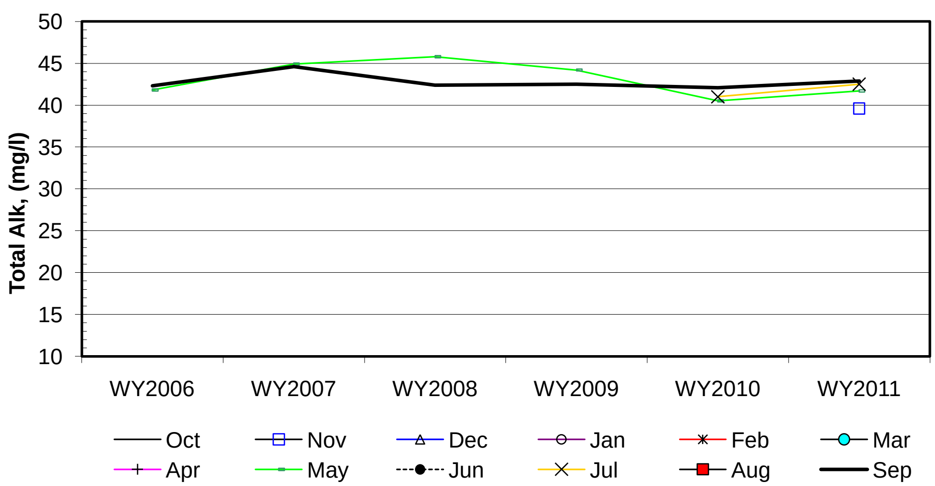
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.31		0.09
0.050	-0.14	**-0.03**	0.07
0.100	-0.14		0.05
0.200	-0.12		0.03

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	**WY2006**								41.8				42.3
b	**WY2007**								44.9				44.6
c	**WY2008**								45.8				42.4
d	**WY2009**								44.2				42.5
e	**WY2010**								40.5		41.0		42.1
f	**WY2011**		39.6						41.7		42.5		42.9
	n	0	1	0	0	0	0	0	6	0	2	0	6
	t_1	0	1	0	0	0	0	0	6	0	2	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
	f-d								-1				1
	f-e								1		1		1
	S_k	0	0	0	0	0	0	0	-5	0	1	0	1
σ^2_S=									28.33		1.00		28.33
$Z_k = S_k/\sigma_S$									-0.94		1.00		0.19
Z^2_k									0.88		1.00		0.04

ΣZ_k=	0.25	Tie Extent	t_1	t_2	t_3	t_4	t_5	Σn	15
ΣZ^2_k=	1.92	Count	15	0	0	0	0	ΣS_k	-3
Z-bar=ΣZ_k/K=	0.08								

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	1.90	@α=5% $\chi^2_{(K-1)}$=	5.99	Test for station homogeneity	
p	**0.387**			$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc} -0.26	@α/2=2.5% Z=	1.96	**H_0** (No trend)	ACCEPT
57.67	p **0.396**			**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-1.29		0.80
0.050	-0.82	**-0.05**	0.15
0.100	-0.56		0.11
0.200	-0.38		0.06

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	**WY2006**								4.0				4.1
b	**WY2007**								4.0				4.0
c	**WY2008**								4.6				4.6
d	**WY2009**								5.4				5.6
e	**WY2010**								5.3		4.7		5.5
f	**WY2011**		5.2						4.3		5.3		5.2
	n	0	1	0	0	0	0	0	6	0	2	0	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	0	1	0	0	0	0	0	6	0	2	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
f-d								-1				-1
f-e								-1		1		-1
S_k	0	0	0	0	0	0	0	7	0	1	0	7

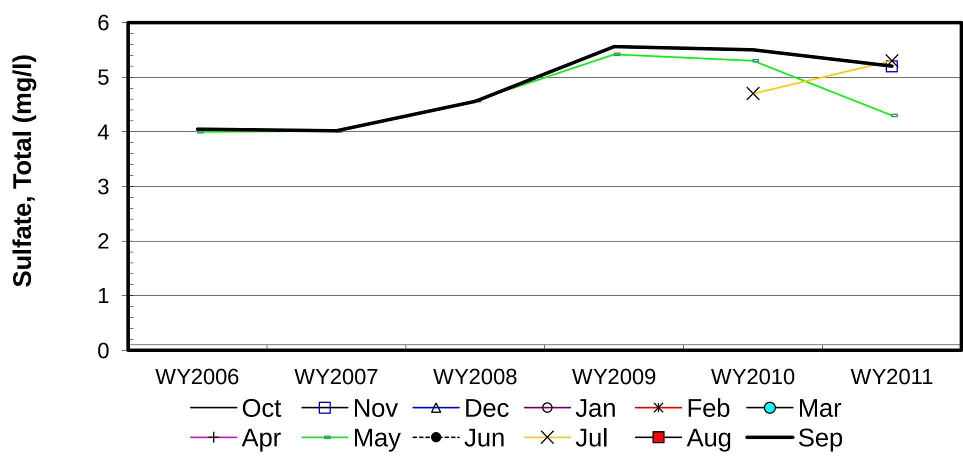
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=								28.33		1.00		28.33
$Z_k = S_k/\sigma_S$								1.32		1.00		1.32
Z^2_k								1.73		1.00		1.73

ΣZ_k=	3.63
ΣZ^2_k=	4.46
Z-bar=ΣZ_k/K=	1.21

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	15	0	0	0	0

Σn	15
ΣS_k	15

$\chi^2_h=\Sigma Z^2_k$-K(Z-bar)^2=		0.07	@α=5% $\chi^2_{(K-1)}$= 5.99	Test for station homogeneity	
	p	**0.967**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc}	1.84	@α=2.5% Z= 1.96	**H_0** (No trend)	ACCEPT
57.67	p	**0.967**		**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.07		0.52
0.050	0.02	**0.30**	0.47
0.100	0.07		0.44
0.200	0.22		0.36

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	**WY2006**								1.0				0.4
b	**WY2007**								0.4				0.3
c	**WY2008**								4.1				0.6
d	**WY2009**								0.5				0.5
e	**WY2010**								0.4		0.9		0.4
f	**WY2011**		0.4						0.3		0.7		0.5
	n	0	1	0	0	0	0	0	6	0	2	0	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	0	1	0	0	0	0	0	6	0	2	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
f-d								-1				-1
f-e								-1		-1		1
S_k	0	0	0	0	0	0	0	-9	0	-1	0	3

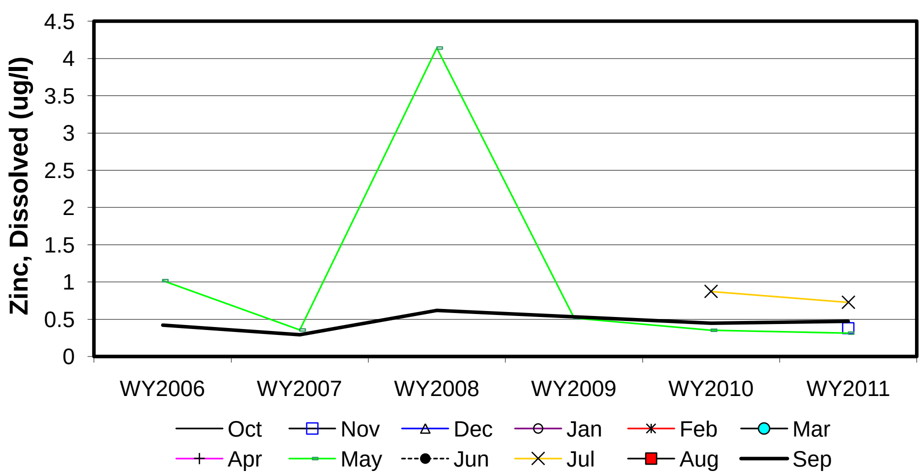
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=								28.33		1.00		28.33
$Z_k = S_k/\sigma_S$								-1.69		-1.00		0.56
Z^2_k								2.86		1.00		0.32

ΣZ_k=	-2.13
ΣZ^2_k=	4.18
Z-bar=ΣZ_k/K=	-0.71

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	15	0	0	0	0

Σn	15
ΣS_k	-7

$\chi^2_h=\Sigma Z^2_k - K(\text{Z-bar})^2$=	2.67	@α=5% $\chi^2_{(K-1)}$= 5.99	Test for station homogeneity	
p	**0.263**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k) 57.67	Z_{calc} -0.79	@α/2=2.5% Z= 1.96	H_0 (No trend)	ACCEPT
	p **0.215**		H_A (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.17		0.05
0.050	-0.14	**-0.04**	0.02
0.100	-0.11		0.01
0.200	-0.09		0.00

INTERPRETIVE REPORT
SITE 28 “MONITORING WELL 2D”

The data collected during the current water year are listed in the following “Table of Results for Water Year 2011” 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 2011.				

The data for water year 2011 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 73.6 µg/L based on sampling since October 1988.

Table of Exceedance for Water Year 2011

			Limits		
Sample Date	**Parameter**	**Value**	**Lower**	**Upper**	**Hardness**
9-Nov-10	Arsenic Total	70.9 µg/L		10.00	
19-May-11	Arsenic Total	70.2 µg/L		10.00	
12-Jul-11	Arsenic Total	67.2 µg/L		10.00	
12-Sep-11	Arsenic Total	69 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 water year, but returned to within historical values by the May 2011 sampling event.

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-05 and Sep-11 (WY2006-WY2011).

Table of Summary Statistics for Trend Analysis

Parameter	Mann-Kendall test statistics n*	p**	Trend	Sen's slope estimate Q	Q(%)
Conductivity Field	6	0.45			
pH Field	6	<0.01	-	-0.16	-1.9
Alkalinity, Total	6	0.50			
Sulfate, Total	6	0.04			
Zinc, Dissolved	6	<0.01	-	-0.28	-129.2

* Number of Years ** Significance level

There was a significant decreasing trend identified in field pH (<0.01) with an estimated slope of -0.16 su/yr or a -1.93% decrease, during the period of calculation. Secondly, there was a significant decreasing trend in dissolved zinc with an estimated slope of -0.28 µg/L/yr or a -129% decrease over the calculation period.

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. Laboratory 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 2011

Site 028FMG - 'Monitoring Well - 2D'

Sample Date/Parameter	Oct 2010	Nov 2010	Dec 2010	Jan 2011	Feb 2011	Mar 2011	Apr 2011	May 2011	Jun 2011	Jul 2011	Aug 2011	Sep 2011	**Median**
Water Temp (°C)		6.8						7.5		13		6.3	7.2
Conductivity-Field(μmho)		215						228		183		177	199.0
Conductivity-Lab (μmho)		205						215		212		214	213
pH Lab (standard units)		8.02						8.28		8.02		8.09	8.06
pH Field (standard units)		8.19						7.77		7.37		8.26	7.98
Total Alkalinity (mg/L)		85						81.1		88		94.5	86.5
Total Sulfate (mg/L)		10.9						11.1		11		11.3	11.1
Hardness (mg/L)		72.7						74.6		75.8		75.7	75.2
Dissolved As (ug/L)		70.9						70.2		67.2		69	69.600
Dissolved Ba (ug/L)		6						6.4		6.3		5.9	6.2
Dissolved Cd (ug/L)		0.004						0.0018		0.0018		0.0018	0.0018
Dissolved Cr (ug/L)		0.479						0.145		0.156		0.203	0.180
Dissolved Cu (ug/L)		0.217						0.131		0.256		0.114	0.174
Dissolved Pb (ug/L)		0.003						0.0104		0.0078		0.0015	0.0054
Dissolved Ni (ug/L)		0.639						0.673		1.02		0.747	0.710
Dissolved Ag (ug/L)		0.004						0.002		0.002		0.002	0.002
Dissolved Zn (ug/L)		0.11						0.05		0.41		0.06	0.09
Dissolved Se (ug/L)		0.112						0.057		0.057		0.247	0.085
Dissolved Hg (ug/L)		0.0025						0.00005		0.000114		0.00005	0.000082

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.

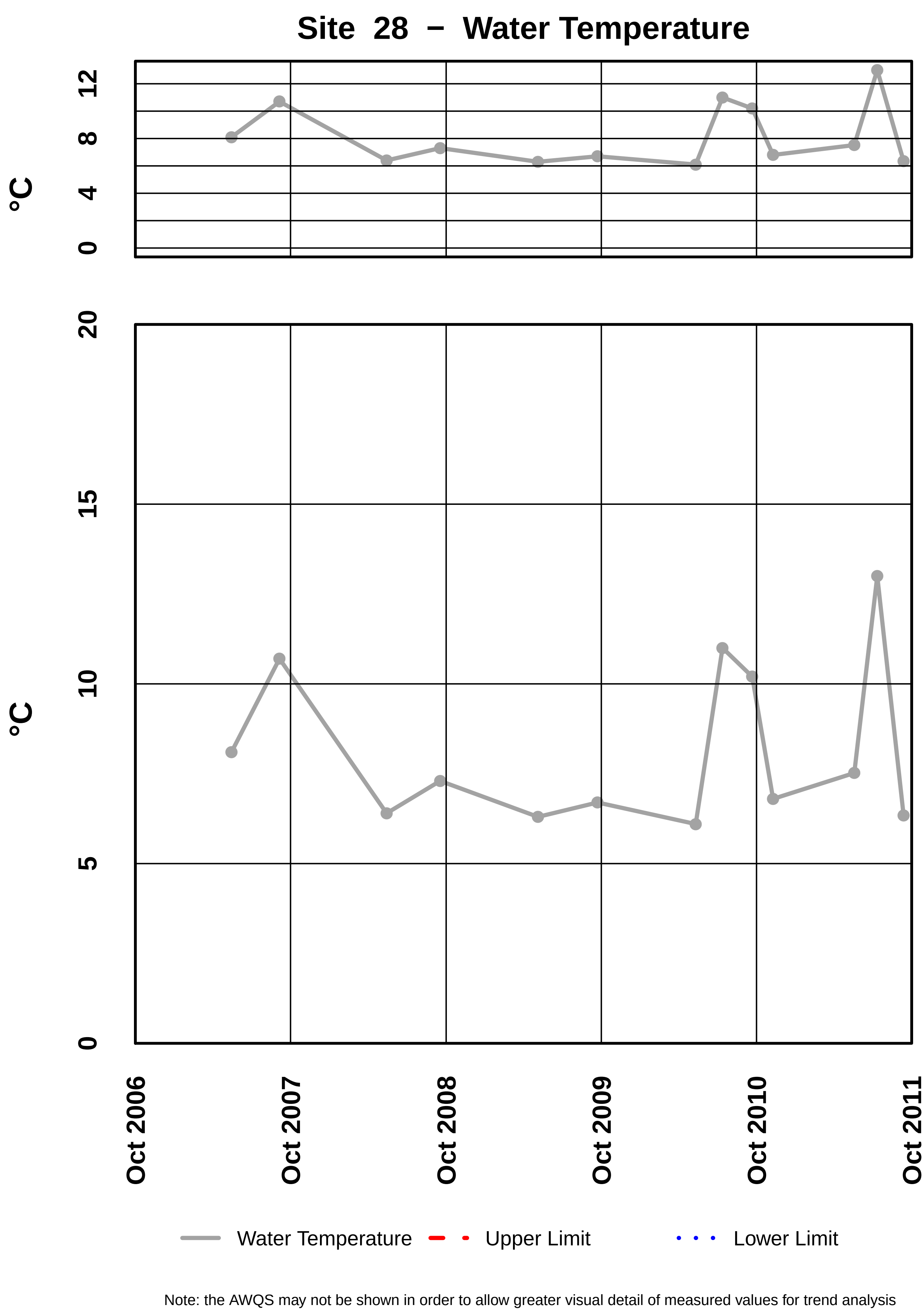
Shaded data has been qualified as an outlier by KGCMC and removed from any further analysis and is not included into the calculation of the median

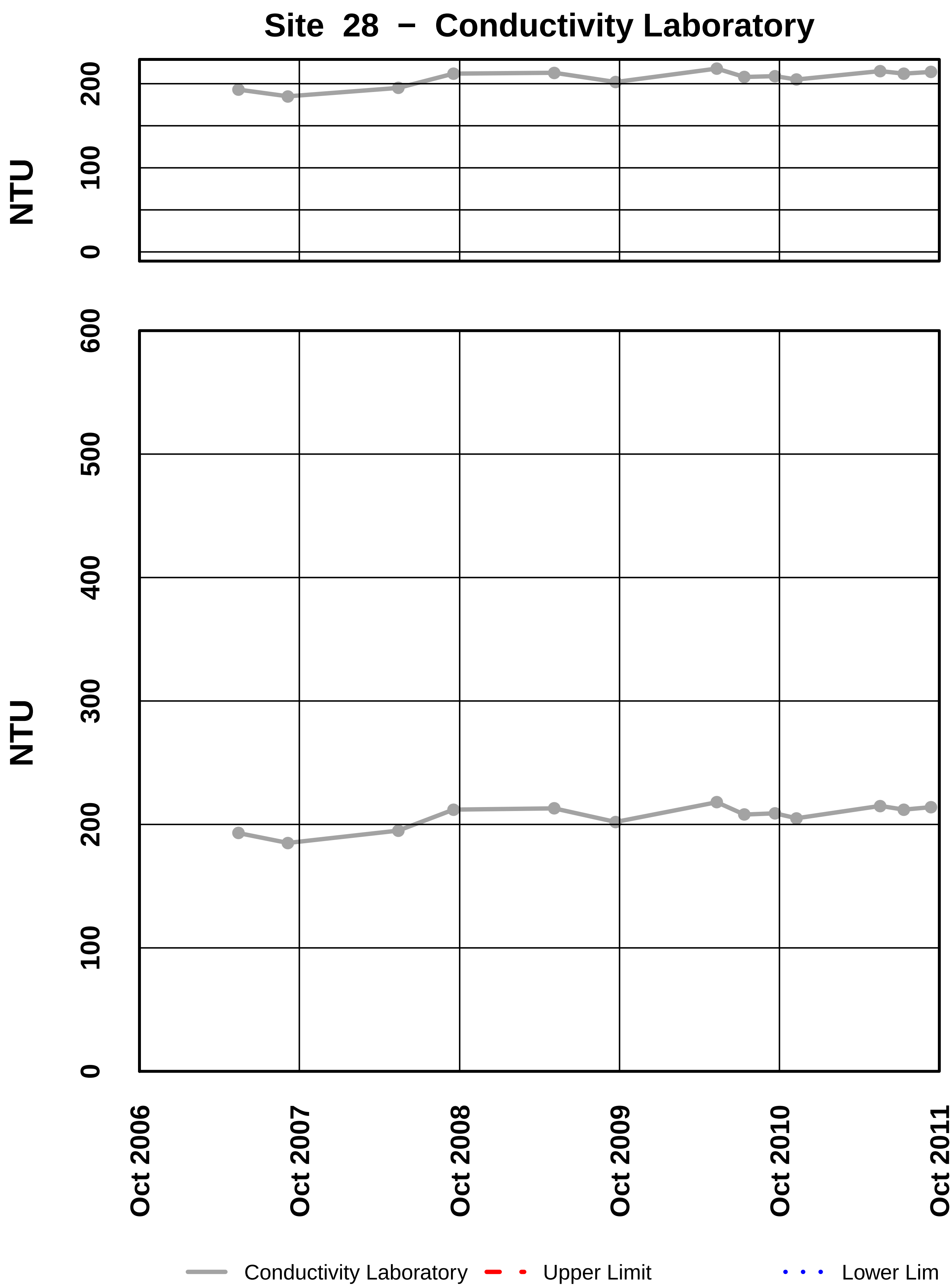
Qualified Data by QA Reviewer

Date Range: 10/01/2010 to 09/30/2011

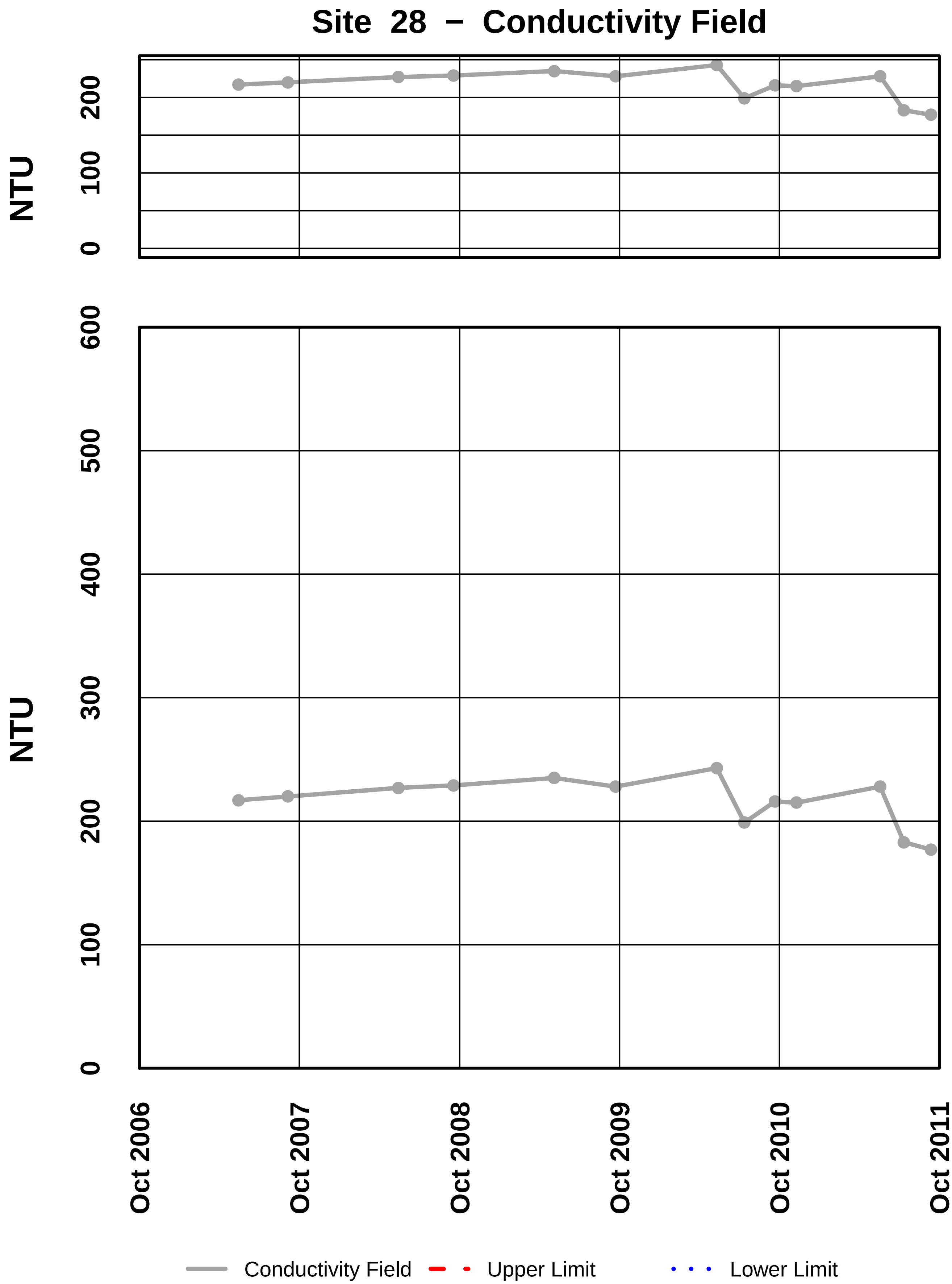
Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
28	11/9/2010	12:00 AM				
			Zn diss, µg/l	0.11	J	Below Quantitative Range
28	5/19/2011	12:00 AM				
			SO4 Tot, mg/l	11.1	J	Sample Reciept Temperature
			Cr diss, µg/l	0.145	J	Below Quantitative Range
			Zn diss, µg/l	0.0485	J	Below Quantitative Range
			pH Lab, su	8.28	J	Hold Time Violation
			Ni diss, µg/l	0.673	U	Field Blank Contamination
			Cu diss, µg/l	0.131	U	Field Blank Contamination
			Pb diss, µg/l	0.0104	U	Field Blank Contamination
28	7/12/2011	12:00 AM				
			Cr diss, µg/l	0.15	J	Below Quantitative Range
			Pb diss, µg/l	0.00782	J	Below Quantitative Range
			SO4 Tot, mg/l	11	J	Sample Reciept Temperature
			Cu diss, µg/l	0.25	U	Field Blank Contamination
			Zn diss, µg/l	0.41	U	Field Blank Contamination
			Hg diss, µg/l	0.000114	U	Field Blank Contamination
28	9/12/2011	12:00 AM				
			Se diss, µg/l	0.24	J	Below Quantitative Range
			SO4 Tot, mg/l	11.3	J	Sample Receipt Temperature
			Zn diss, µg/l	0.06	U	Trip Blank Contamination

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


Site 28 – Water Temperature
°C
0
4
8
12
°C
0
5
10
15
20
Oct 2006
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Water Temperature
Upper Limit
Lower Limit
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

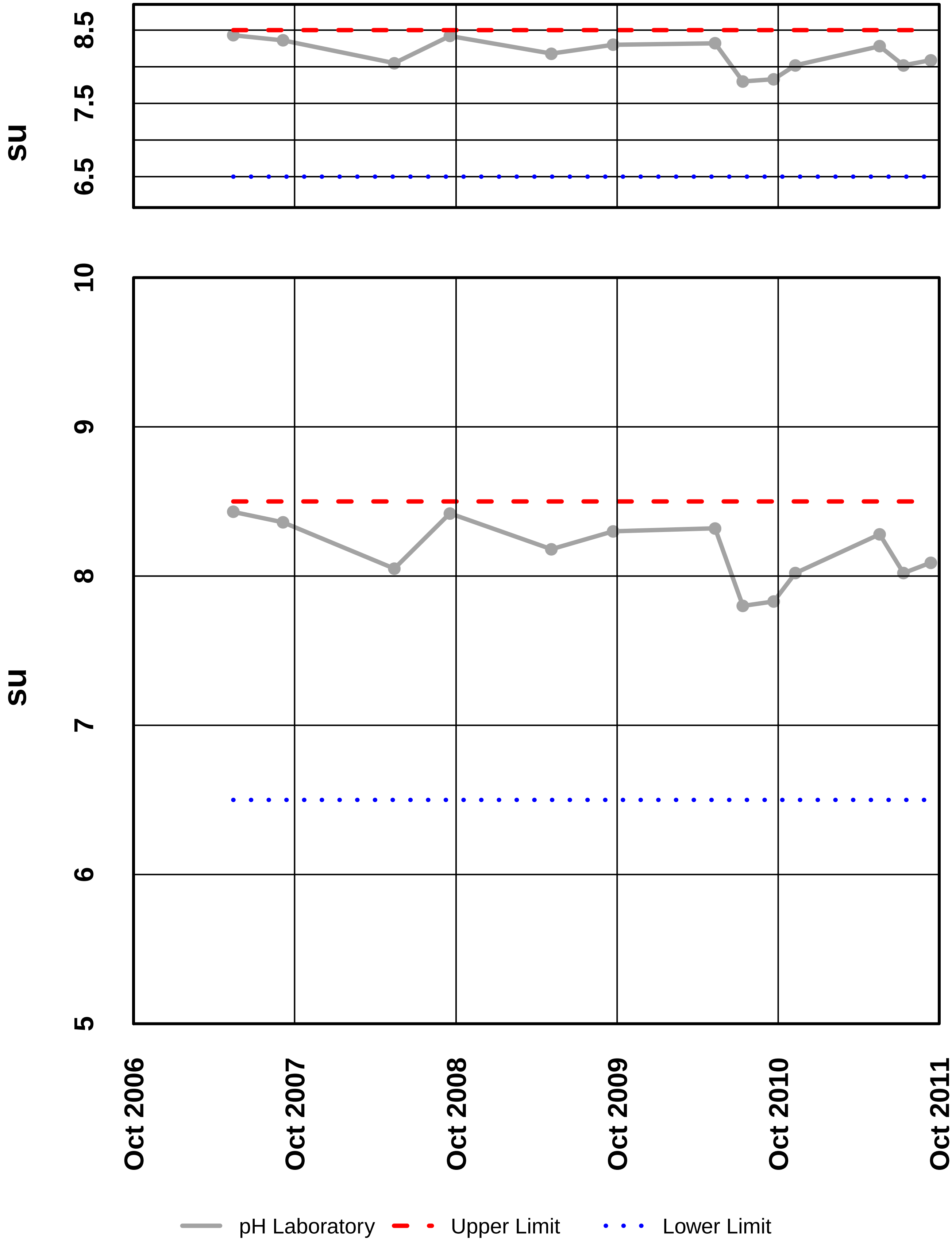


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

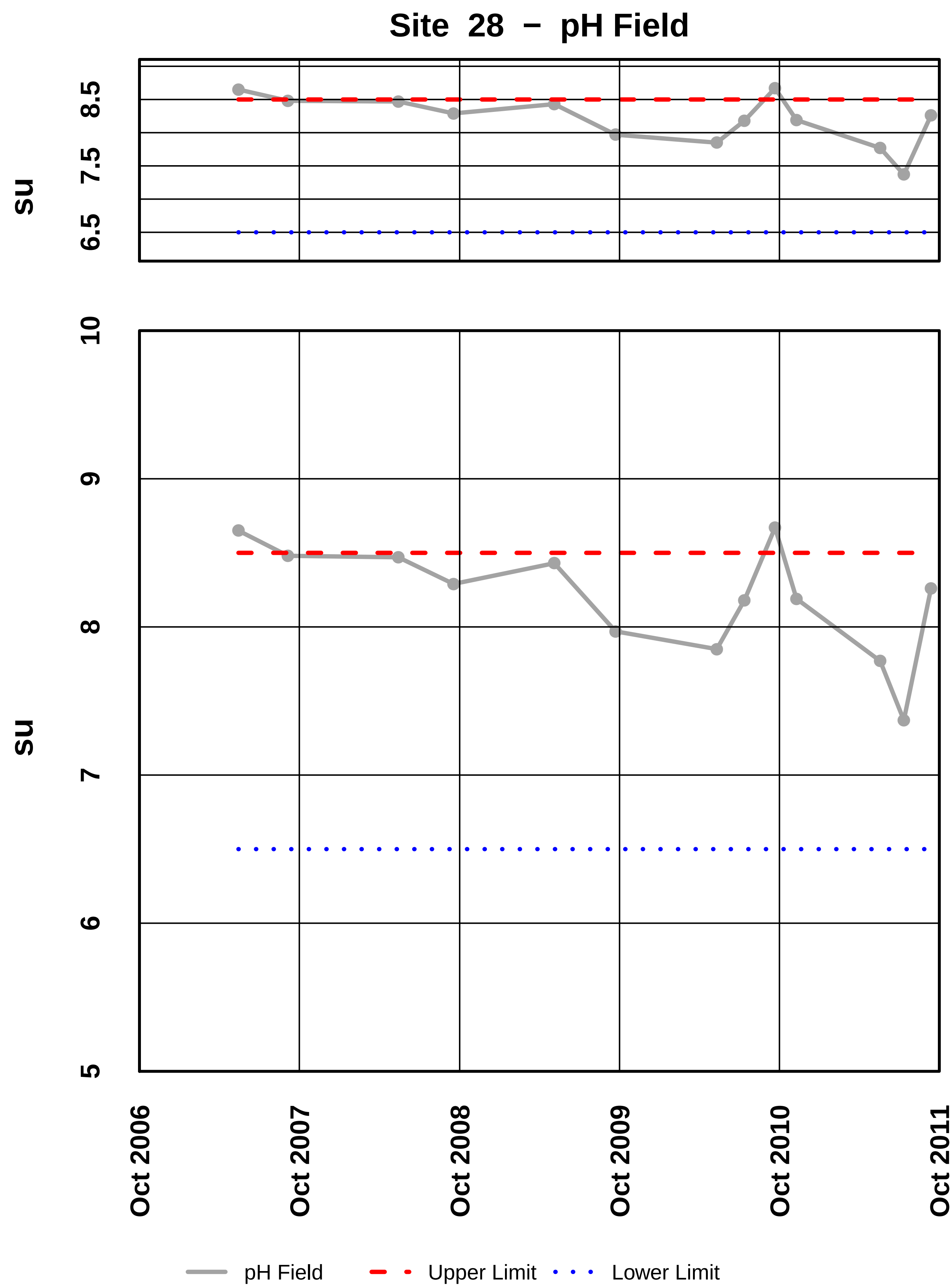


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

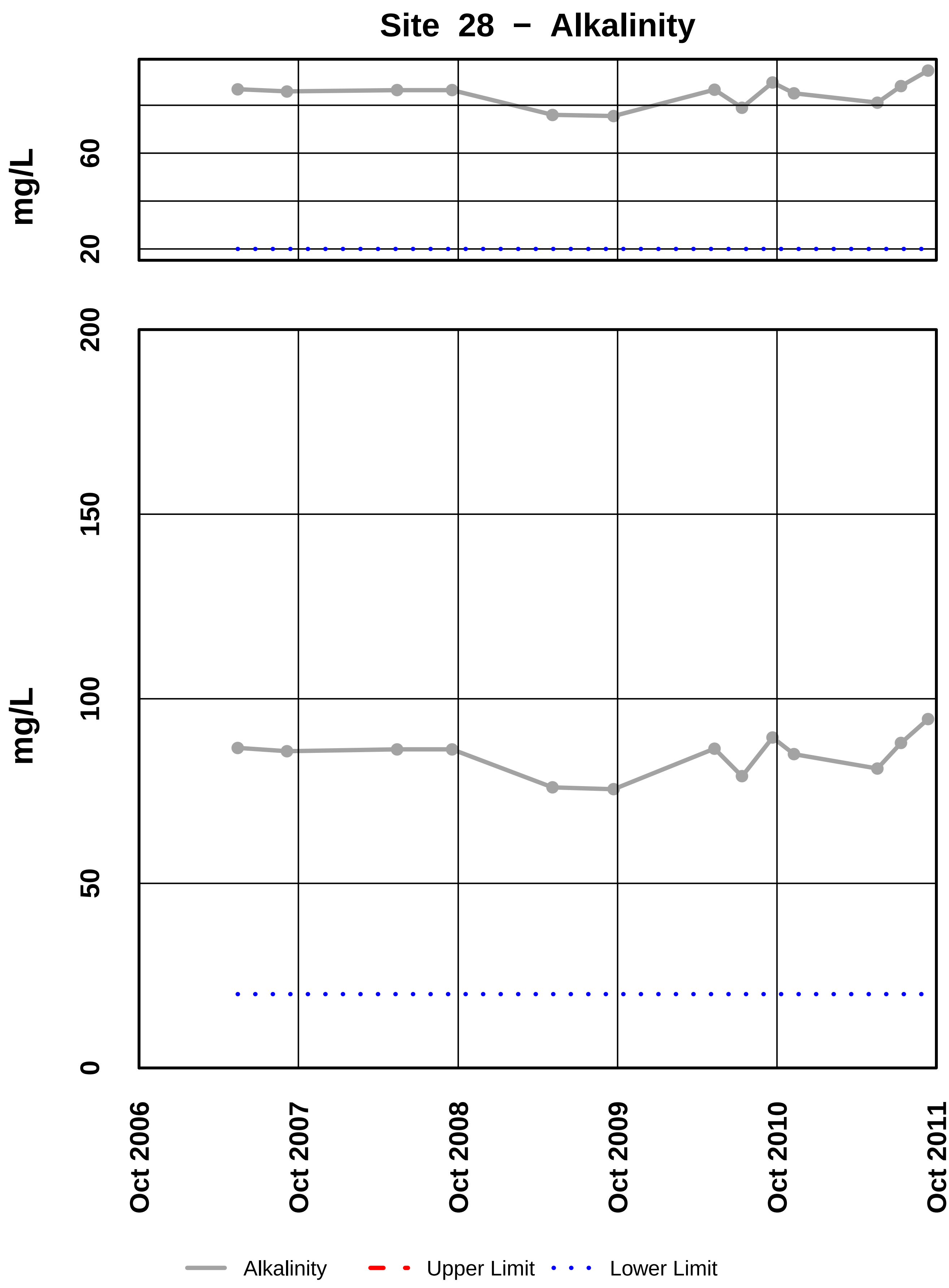
Site 28 – pH Laboratory



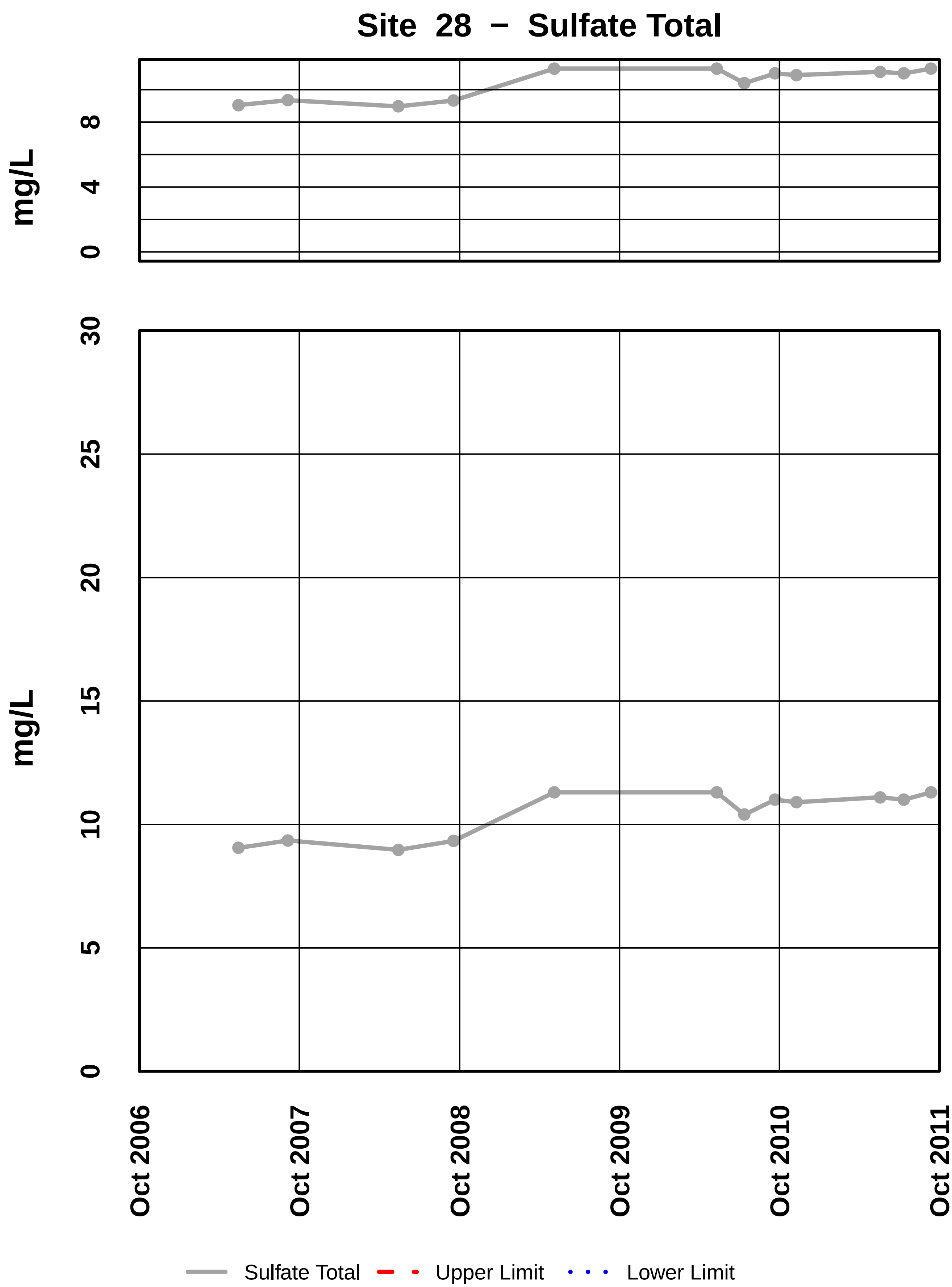
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



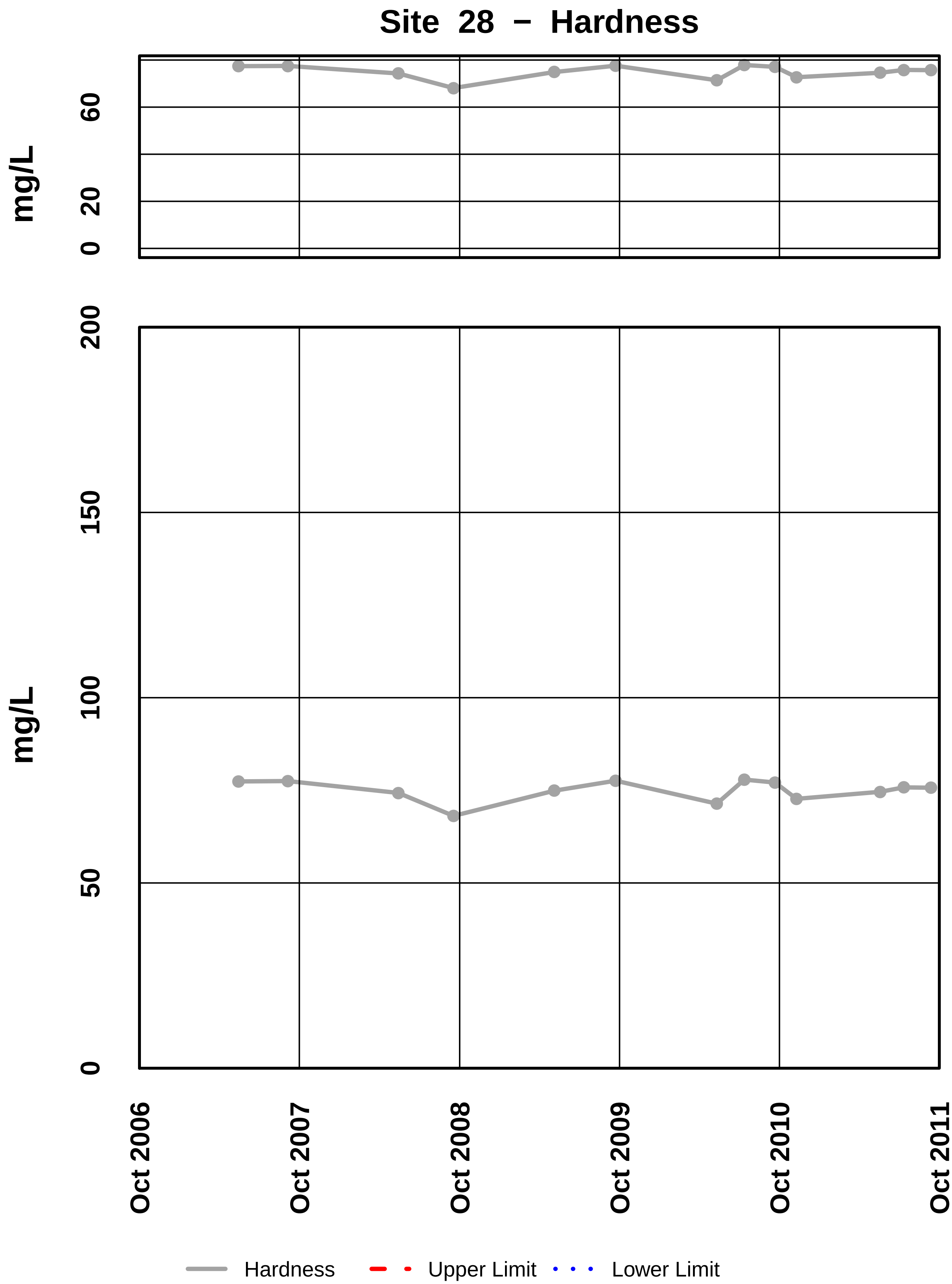
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



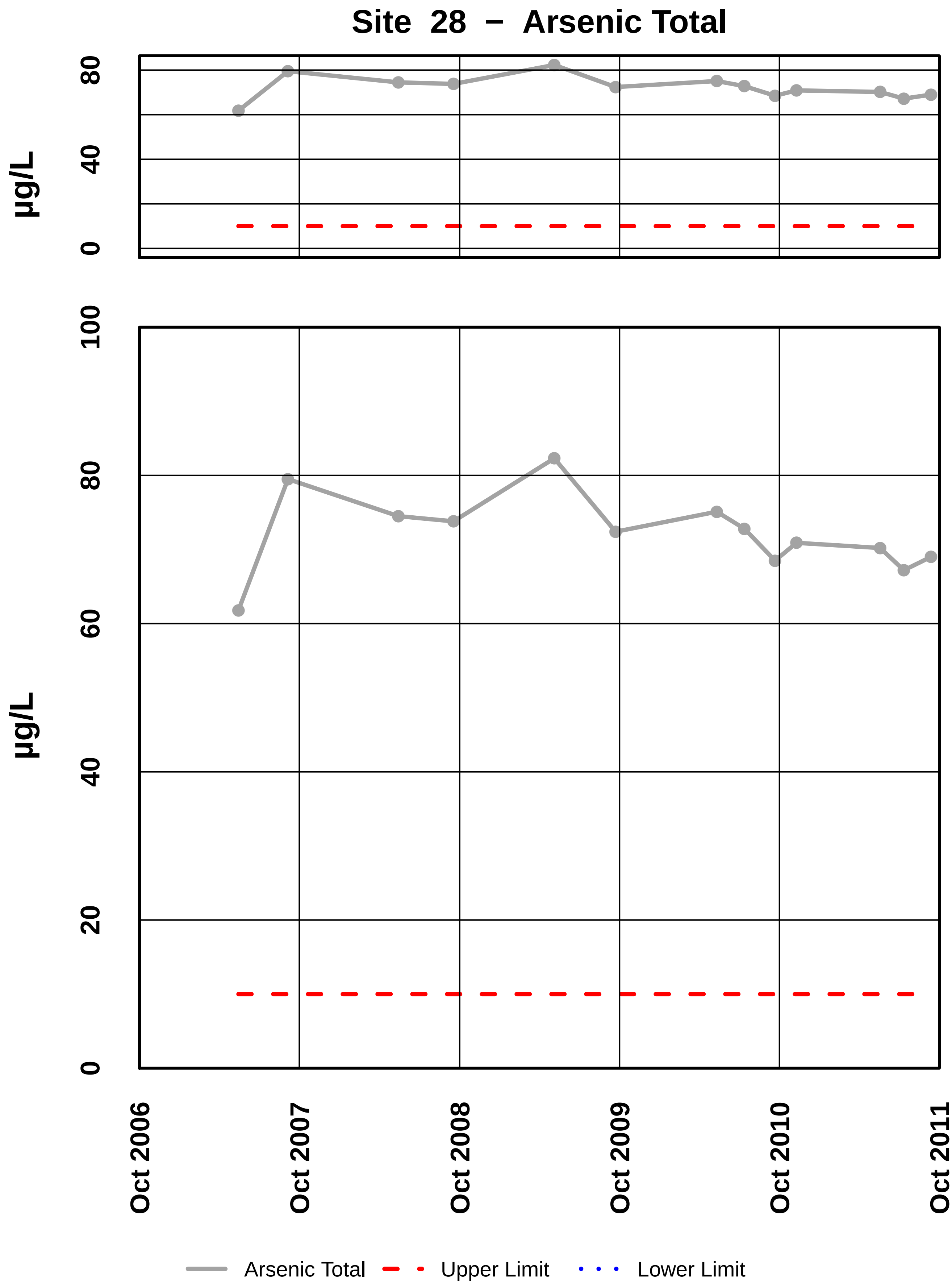
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



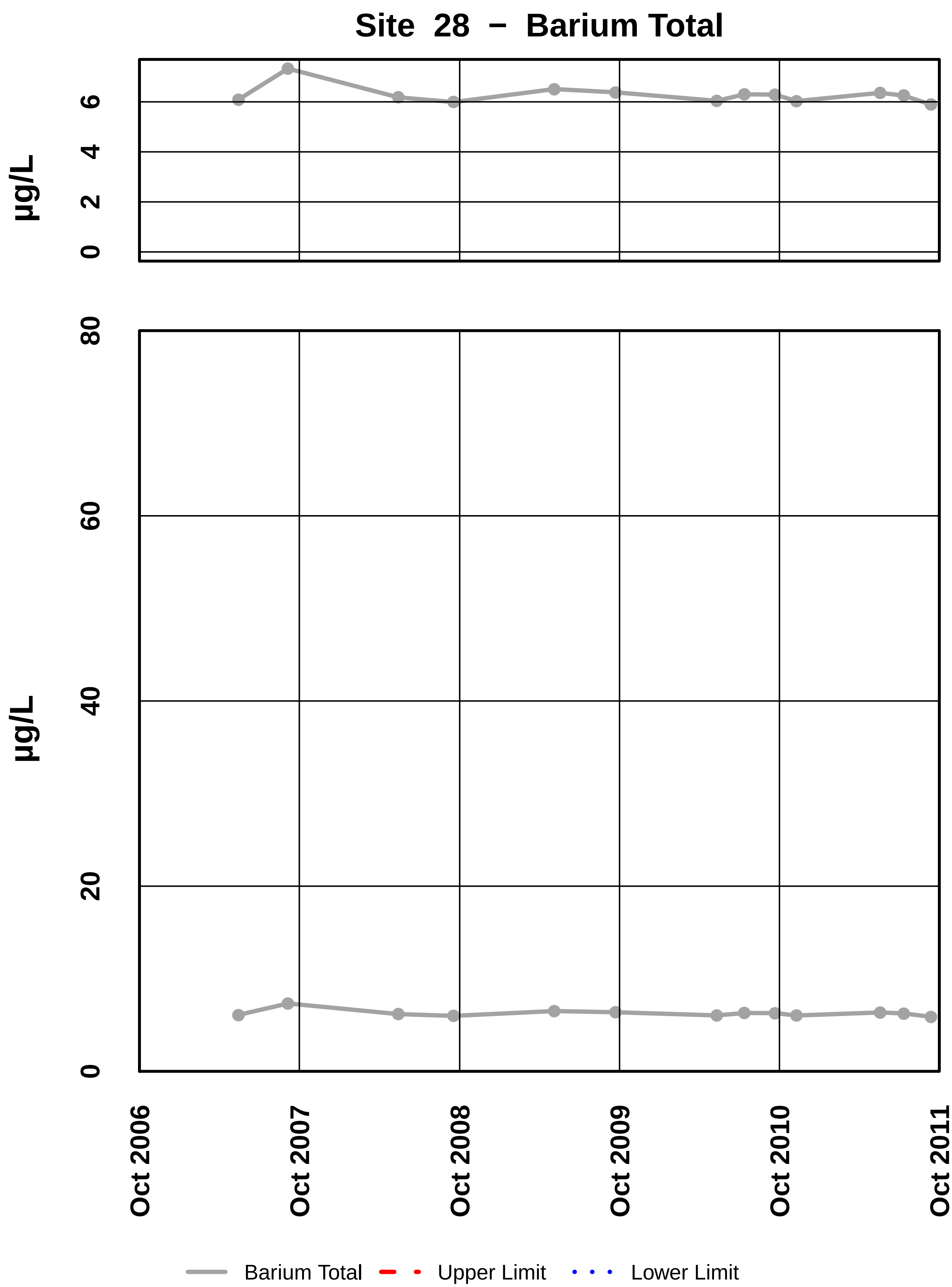
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



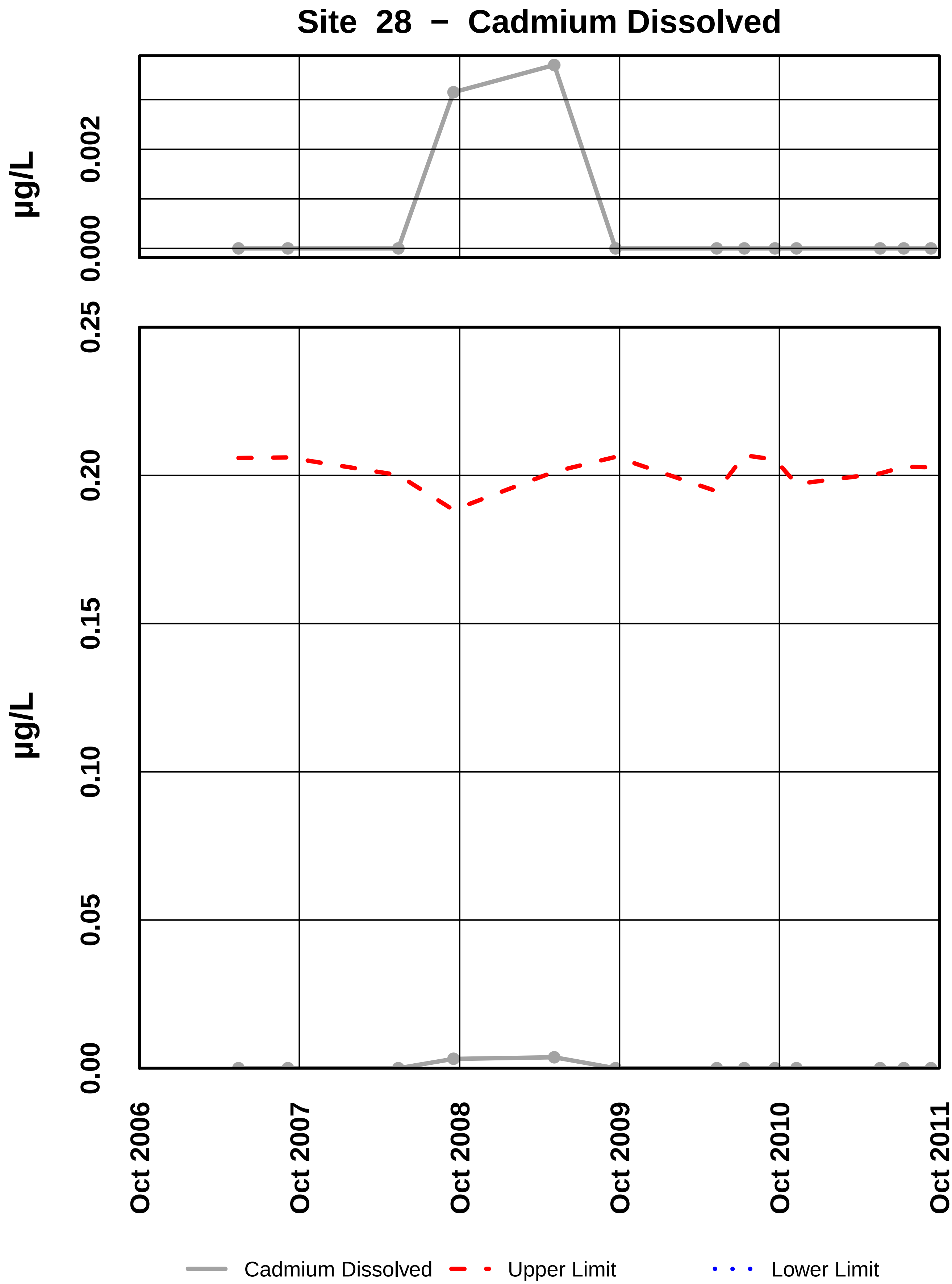
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



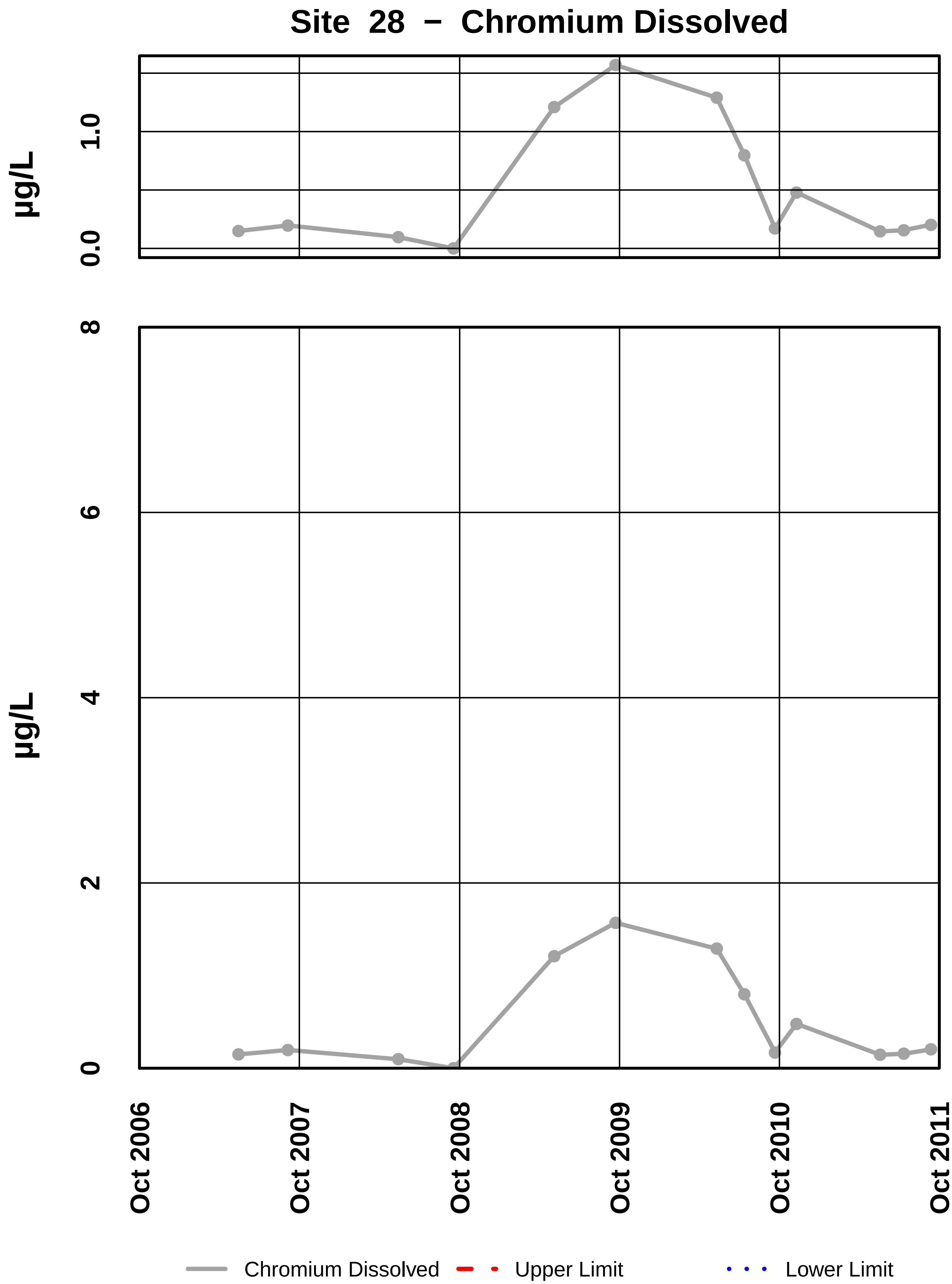
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



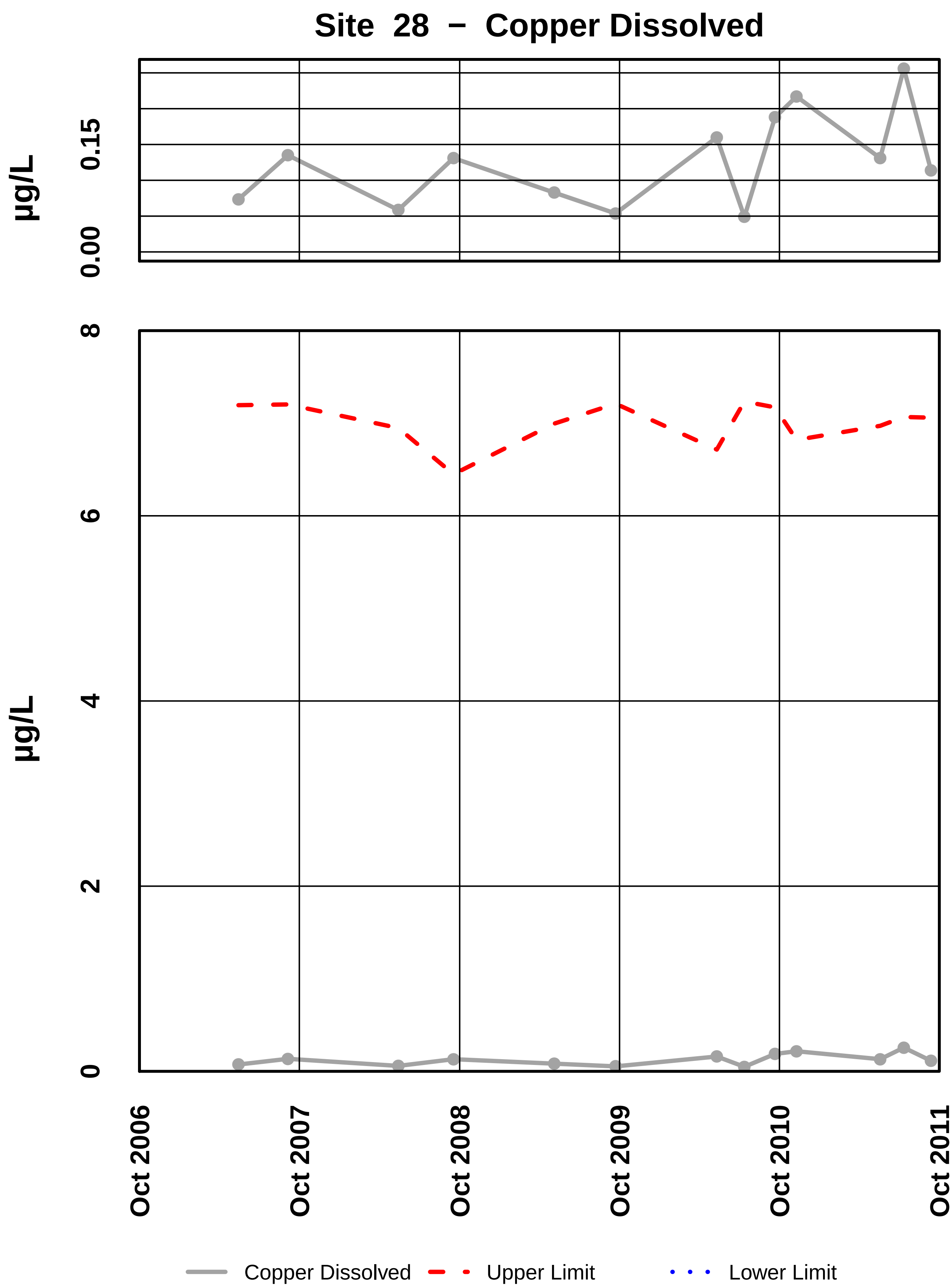
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



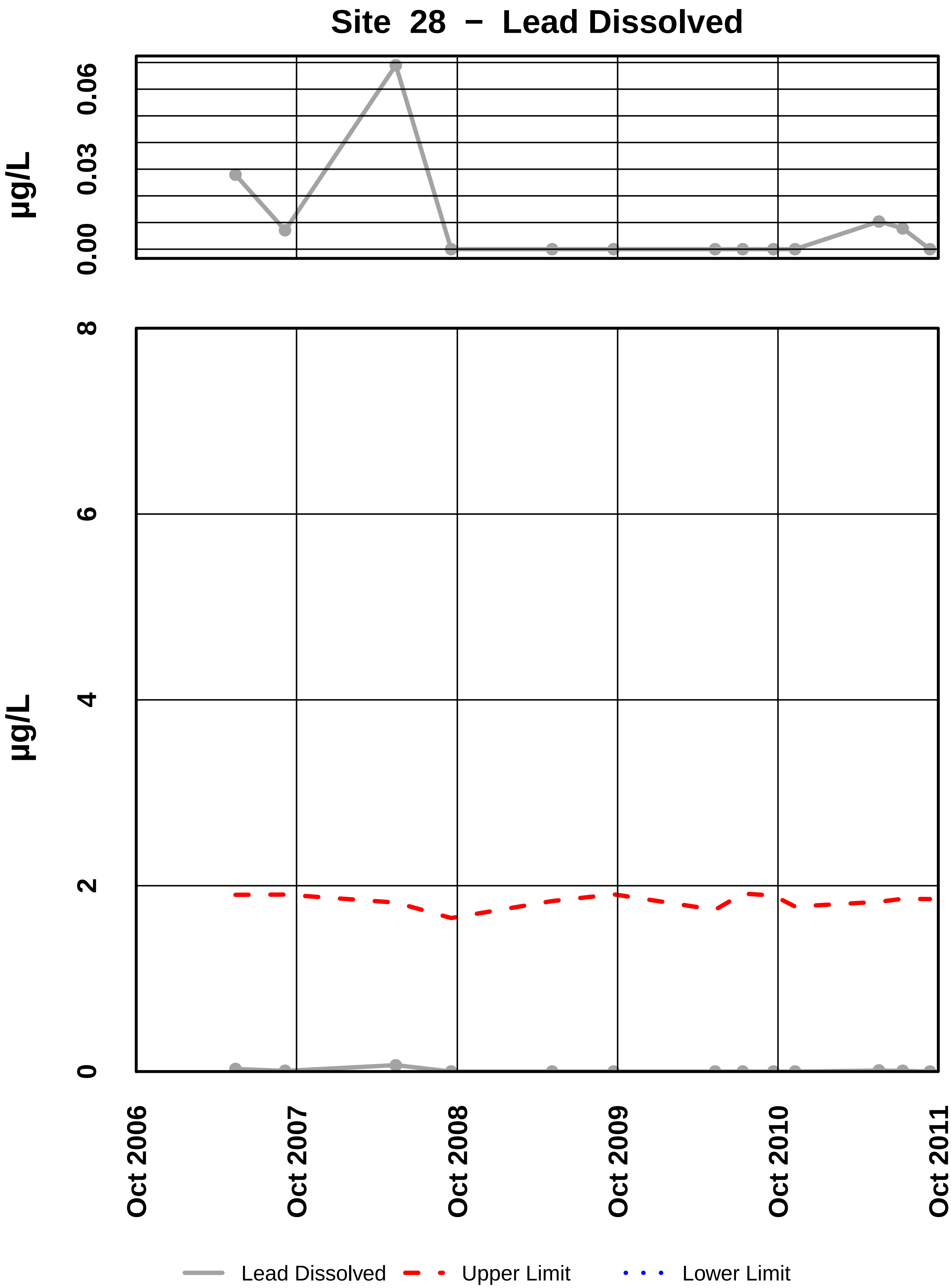
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



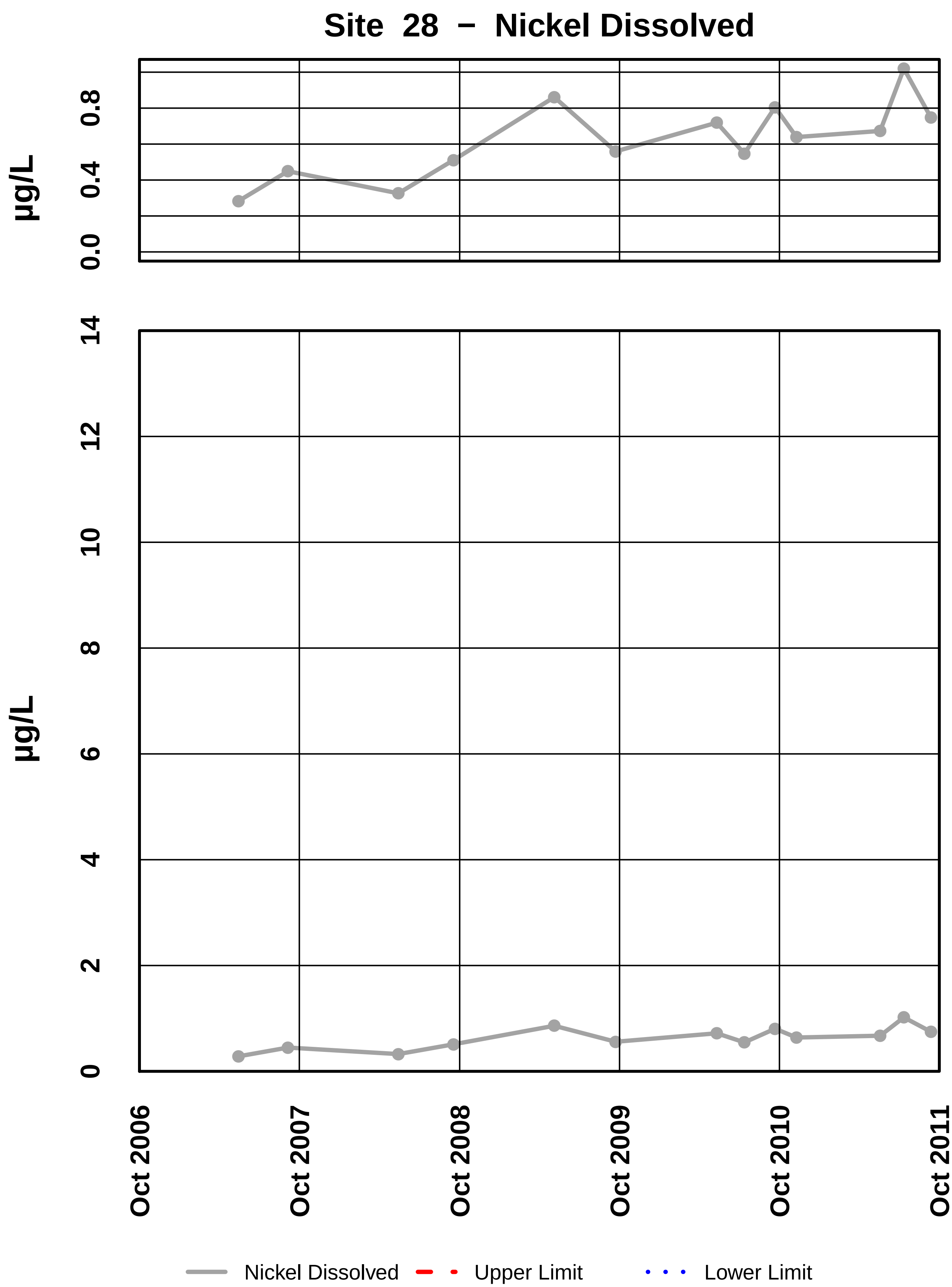
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

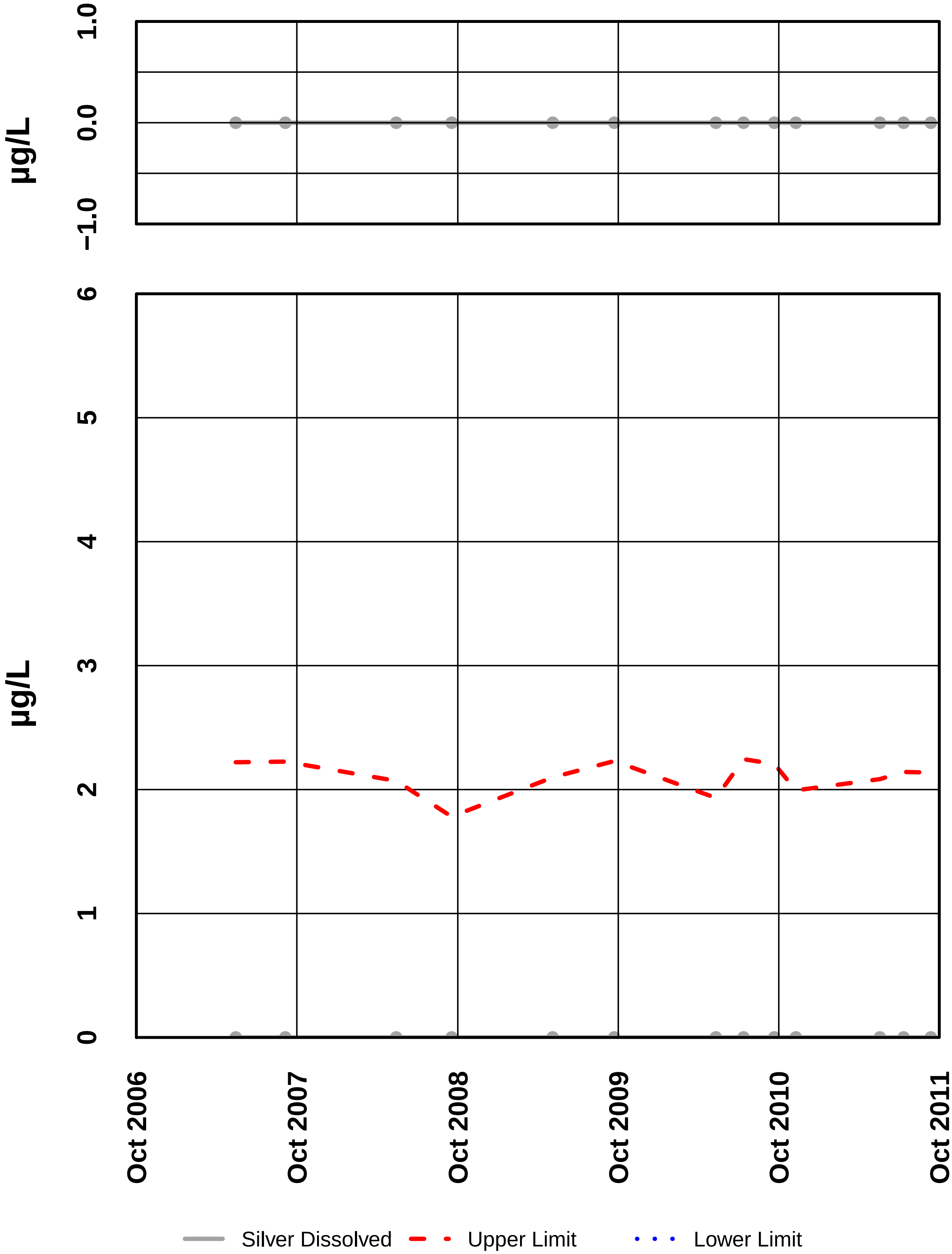


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

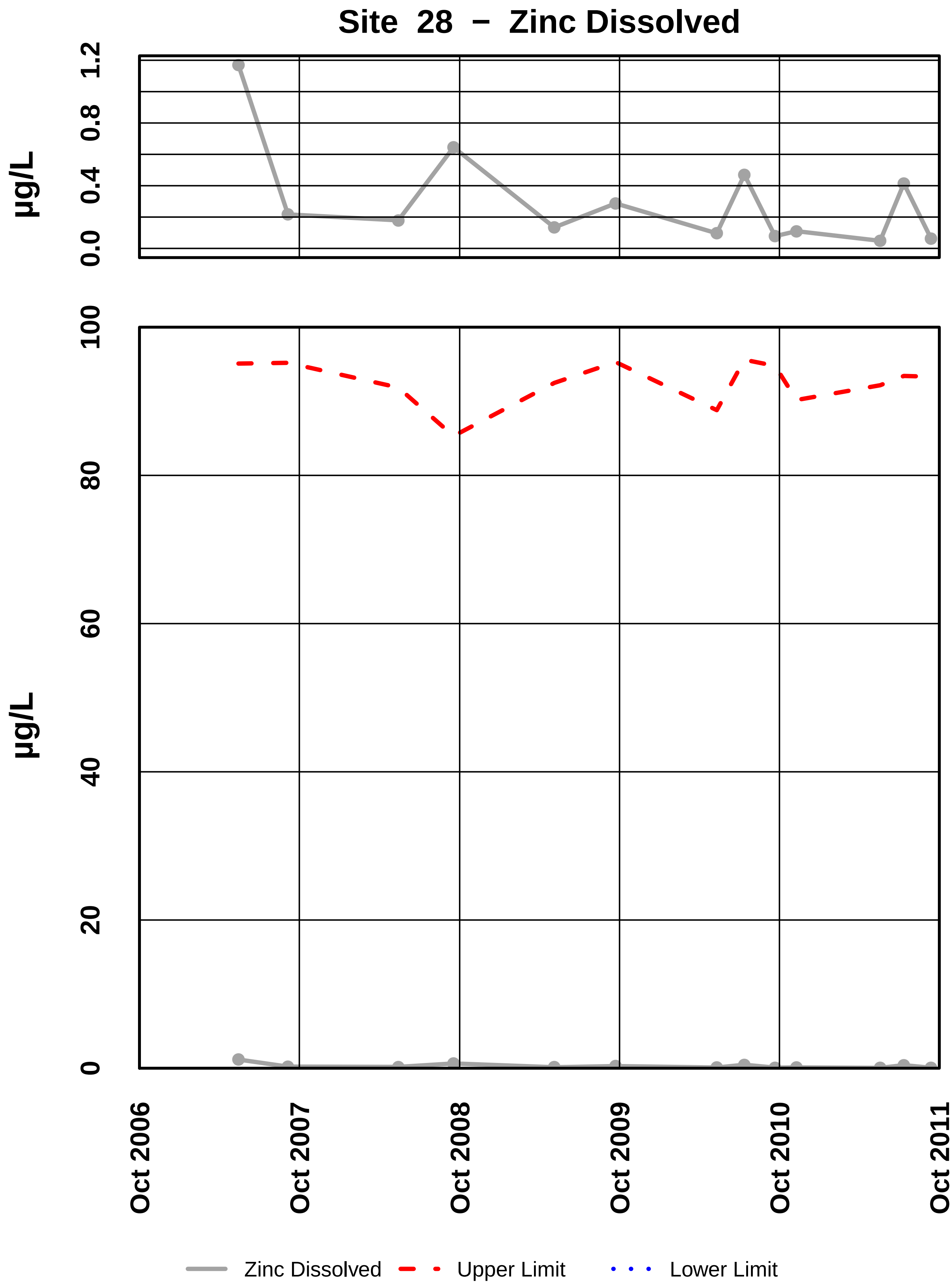


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

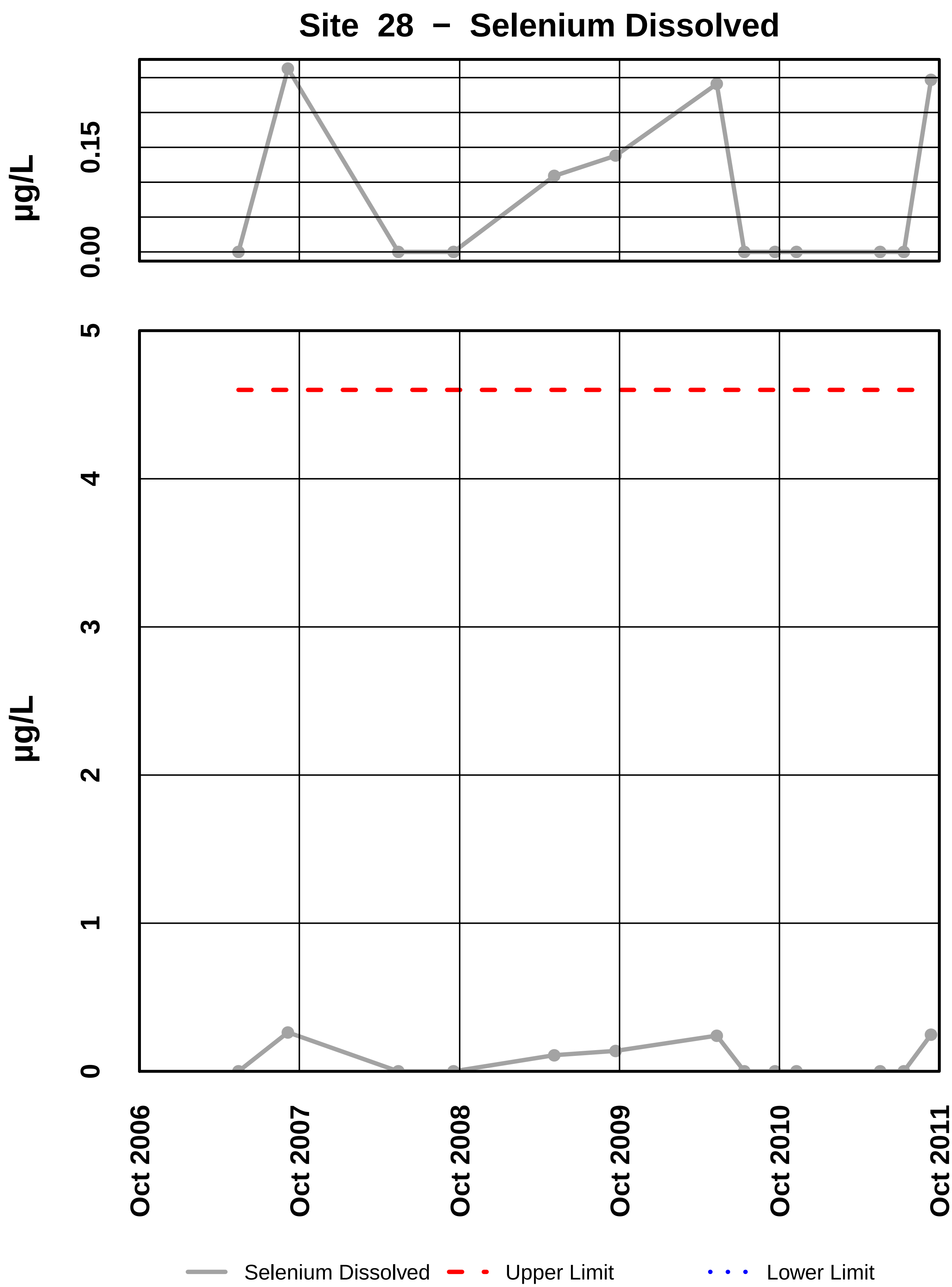
Site 28 – Silver Dissolved



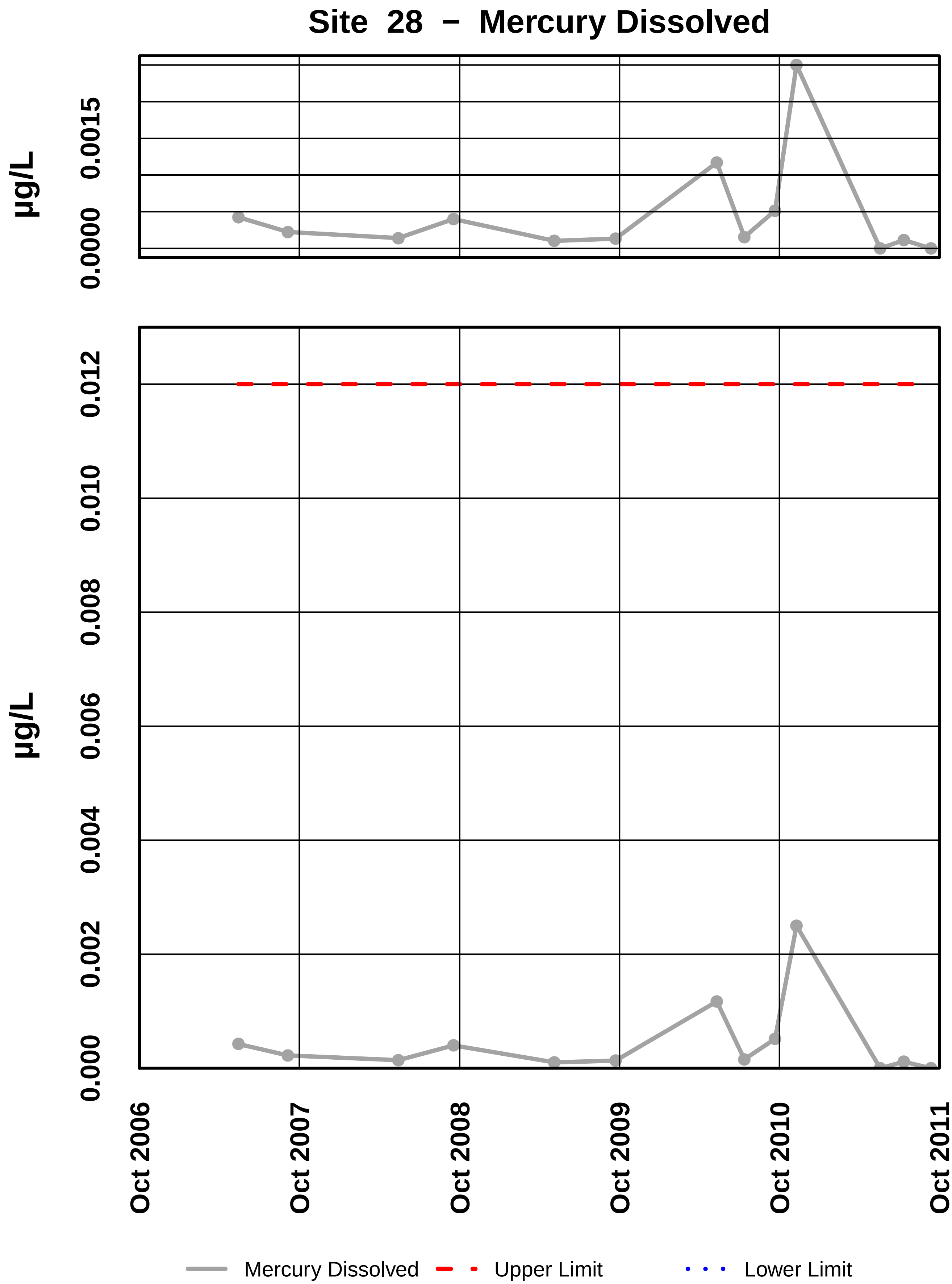
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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 #28 Seasonal Kendall analysis for Specific Conductance, Lab (uS/cm)

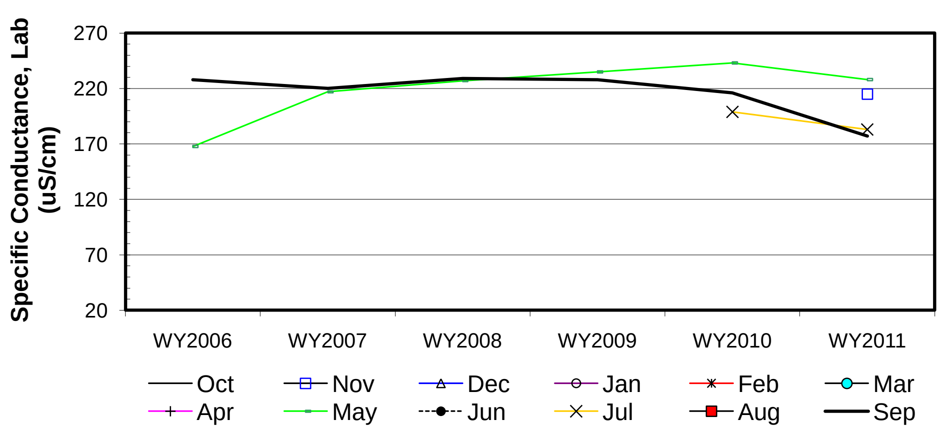
Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2006**								167.7				228
b	**WY2007**								217				220
c	**WY2008**								227				229
d	**WY2009**								235				228
e	**WY2010**								243		198.9		216
f	**WY2011**		215						228		183		177
	n	0	1	0	0	0	0	0	6	0	2	0	6
	t_1	0	1	0	0	0	0	0	6	0	2	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
	b-a								1				-1
	c-a								1				1
	d-a								1				0
	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
	f-d								-1				-1
	f-e								-1		-1		-1
	S_k	0	0	0	0	0	0	0	11	0	-1	0	-8
	Qm								8.7				
	σ^2_S=								28.33		1.00		27.33
	$Z_k = S_k/\sigma_S$								2.07		-1.00		-1.53
	Z^2_k								4.27		1.00		2.34

ΣZ_k= -0.46
ΣZ^2_k= 7.61
Z-bar=$\Sigma Z_k/K$= -0.15

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	13	1	0	0	0

Σn 15
ΣS_k 2

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	7.54	@α=5% $\chi^2_{(K-1)}$= 5.99	Test for station homogeneity	
p	**0.023**		$\chi^2_h<\chi^2_{(K-1)}$	**REJECT**
$\Sigma VAR(S_k)$ Z_{calc}	0.13	@α/2=2.5% Z= 1.96	**H_0** (No trend)	NA
56.67 p	**0.553**		**H_A** (± trend)	NA



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-11.07		9.00
0.050	-7.54	**0.33**	8.00
0.100	-4.47		8.00
0.200	-2.45		3.58

Site **#28** Seasonal Kendall analysis for pH, Lab, Standard Units

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2006**								8.7				8.6
b	**WY2007**								8.7				8.5
c	**WY2008**								8.5				8.3
d	**WY2009**								8.4				8.0
e	**WY2010**								7.9		8.2		8.7
f	**WY2011**		8.2						7.8		7.4		8.3
	n	0	1	0	0	0	0	0	6	0	2	0	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	0	1	0	0	0	0	0	6	0	2	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
f-d								-1				1
f-e								-1		-1		-1
S_k	0	0	0	0	0	0	0	-15	0	-1	0	-5

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=								28.33		1.00		28.33
$Z_k = S_k/\sigma_S$								-2.82		-1.00		-0.94
Z^2_k								7.94		1.00		0.88

ΣZ_k= -4.76

ΣZ^2_k= 9.82

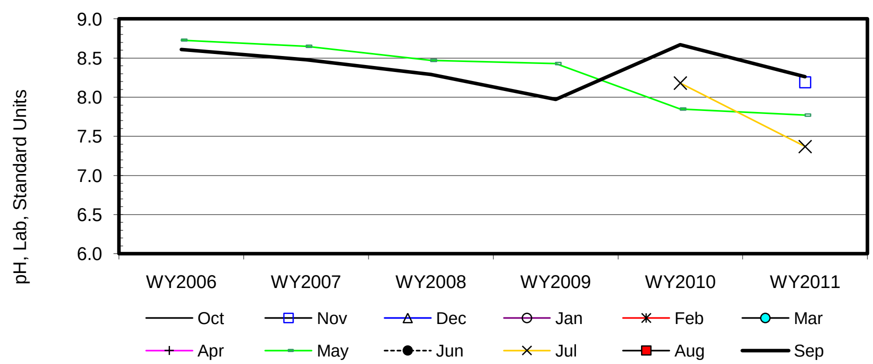
Z-bar=$\Sigma Z_k/K$= -1.59

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	15	0	0	0	0

Σn 15

ΣS_k -21

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	2.28	@α=5% $\chi^2_{(K-1)}$= 5.99	Test for station homogeneity	
p	**0.320**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc} -2.63	@α/2=2.5% Z= 1.96	H_0 (No trend)	REJECT
57.67	**p** **0.004**		H_A (± trend)	ACCEPT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.28		-0.05
0.050	-0.23	**-0.16**	-0.08
0.100	-0.22		-0.09
0.200	-0.21		-0.12

-1.9%

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	**WY2006**								88.3				86.2
b	**WY2007**								86.7				85.8
c	**WY2008**								86.3				86.3
d	**WY2009**								76.0				75.5
e	**WY2010**								86.5		79.0		89.5
f	**WY2011**		85.0						81.1		88.0		94.5
	n	0	1	0	0	0	0	0	6	0	2	0	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	0	1	0	0	0	0	0	6	0	2	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
f-d								1				1
f-e								-1		1		1
S_k	0	0	0	0	0	0	0	-9	0	1	0	7

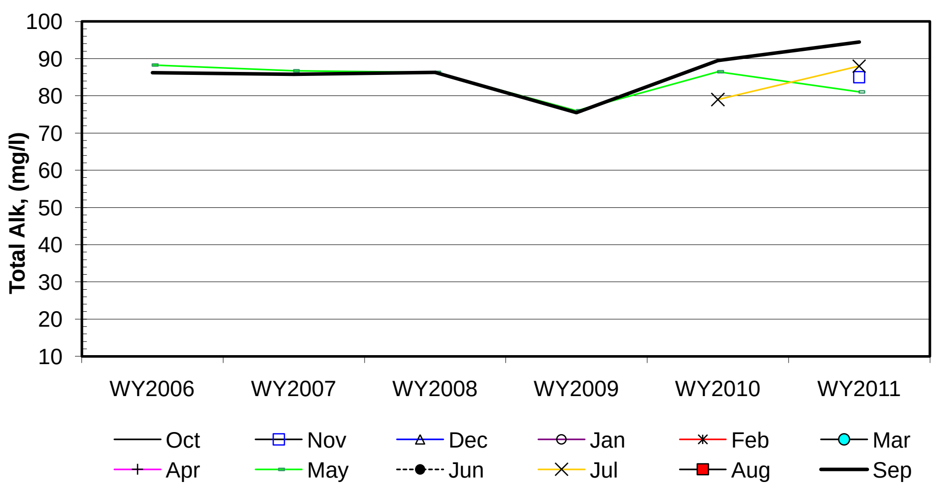
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=								28.33		1.00		28.33
$Z_k = S_k/\sigma_S$								-1.69		1.00		1.32
Z^2_k								2.86		1.00		1.73

ΣZ_k=	0.62
ΣZ^2_k=	5.59
Z-bar=ΣZ_k/K=	0.21

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	15	0	0	0	0

Σn	15
ΣS_k	-1

$\chi^2_h=\Sigma Z^2_k$-K(Z-bar)^2=		5.46	@α=5% $\chi^2_{(K-1)}$=	5.99	Test for station homogeneity
	p	**0.065**			$\chi^2_h<\chi^2_{(K-1)}$ ACCEPT
ΣVAR(S_k)	Z_{calc}	0.00	@α/2=2.5% Z=	1.96	**H_0** (No trend) ACCEPT
57.67	**p**	**0.500**			**H_A** (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-3.74		2.30
0.050	-1.56	**-0.07**	1.51
0.100	-1.41		0.97
0.200	-0.83		0.38

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	**WY2006**								8.7				9.4
b	**WY2007**								9.1				9.4
c	**WY2008**								9.0				9.3
d	**WY2009**								11.3				
e	**WY2010**								11.3		10.4		11.0
f	**WY2011**		10.9						11.1		11.0		11.3
	n	0	1	0	0	0	0	0	6	0	2	0	5

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	0	1	0	0	0	0	0	4	0	2	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				-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								0				
f-d								-1				
f-e								-1		1		1
S_k	0	0	0	0	0	0	0	8	0	1	0	4

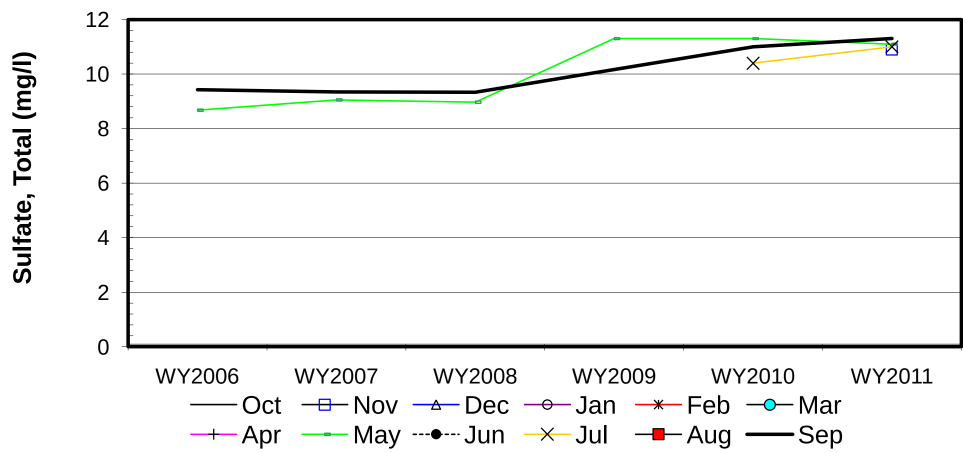
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=								27.33		1.00		16.67
$Z_k = S_k/\sigma_S$								1.53		1.00		0.98
Z^2_k								2.34		1.00		0.96

ΣZ_k=	3.51
ΣZ^2_k=	4.30
Z-bar=ΣZ_k/K=	1.17

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	12	1	0	0	0

Σn	14
ΣS_k	13

$\chi^2_h = \Sigma Z^2_k - K(\text{Z-bar})^2$=		0.19	@α=5% $\chi^2_{(K-1)}$= 5.99	Test for station homogeneity	
	p	**0.907**		$\chi^2_h < \chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc}	1.79	@α=5% Z= 1.64	**H_0** (No trend)	REJECT
45.00	p	**0.963**		**H_A** (± trend)	ACCEPT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.04		0.74
0.050	0.07	**0.49**	0.66
0.100	0.25		0.62
0.200	0.37		0.54
		4.6%	

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	WY2006								14.1				3.5
b	WY2007								1.2				0.2
c	WY2008								0.2				0.6
d	WY2009								0.1				0.3
e	WY2010								0.1		0.5		0.1
f	WY2011		0.1						0.0		0.4		0.1
	n	0	1	0	0	0	0	0	6	0	2	0	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	0	1	0	0	0	0	0	6	0	2	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
f-d								-1				-1
f-e								-1		-1		-1
S_k	0	0	0	0	0	0	0	-15	0	-1	0	-11

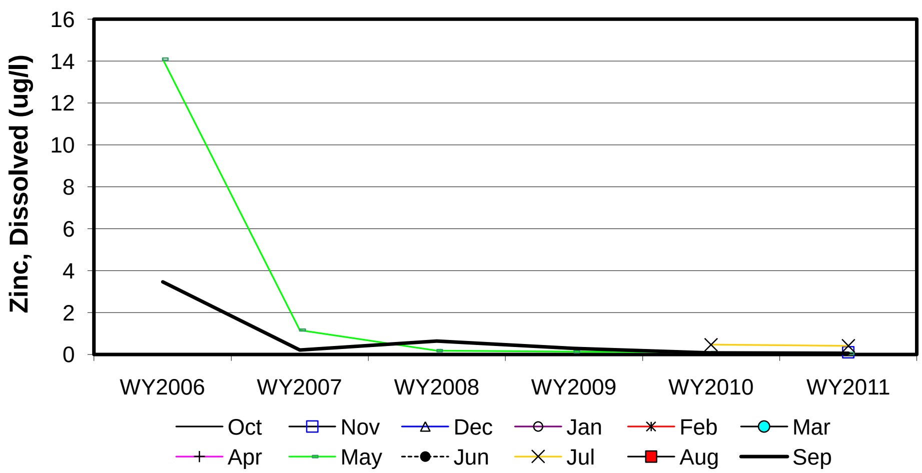
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=								28.33		1.00		28.33
$Z_k = S_k/\sigma_S$								-2.82		-1.00		-2.07
Z^2_k								7.94		1.00		4.27

ΣZ_k= -5.88
ΣZ^2_k= 13.21
Z-bar=$\Sigma Z_k/K$= -1.96

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	15	0	0	0	0

Σn 15
ΣS_k -27

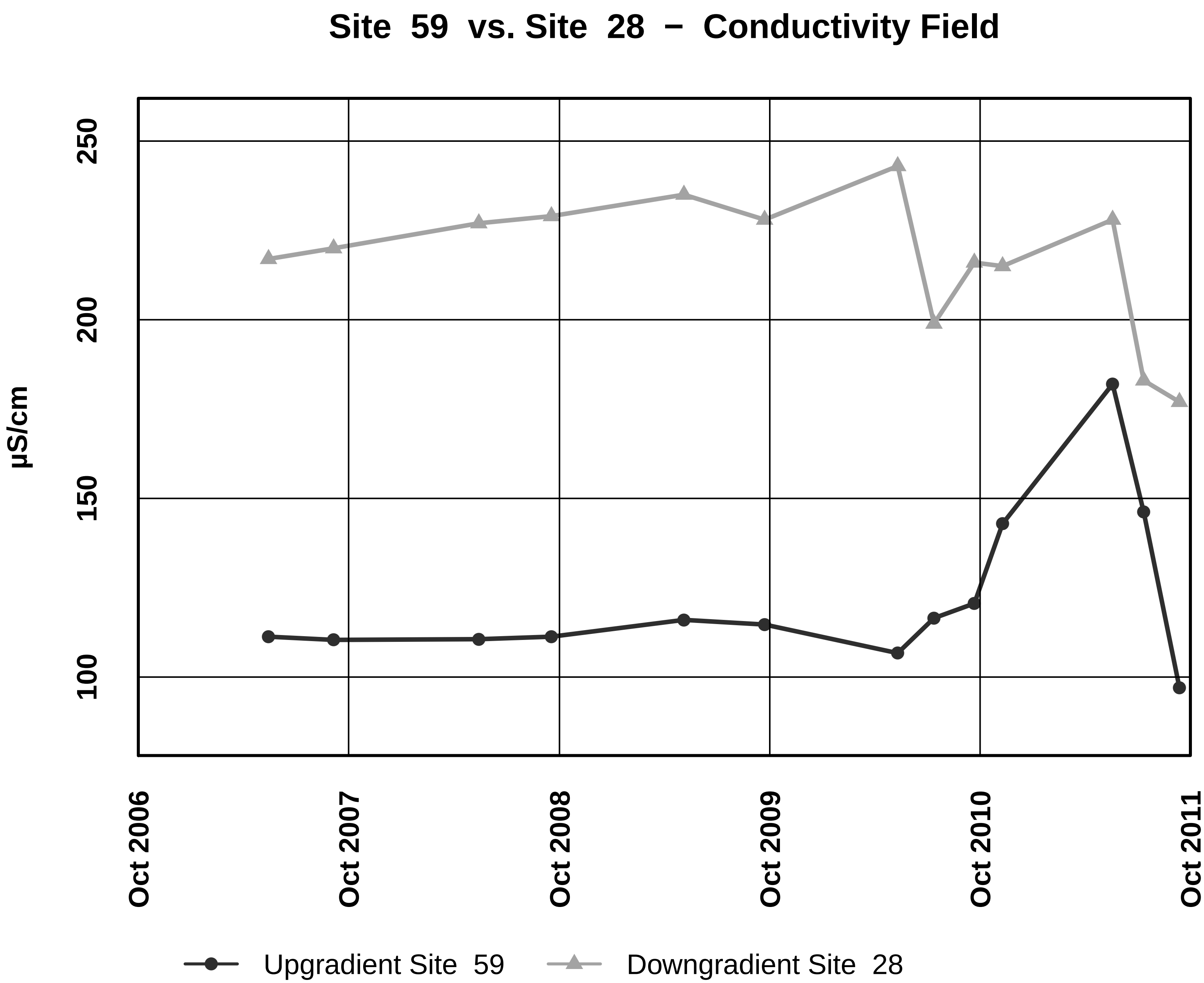
$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$= 1.67	@α=5% $\chi^2_{(K-1)}$= 5.99	Test for station homogeneity	
p 0.434		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
$\Sigma VAR(S_k)$ 57.67	Z_{calc} -3.42	@$\alpha/2$=2.5% Z= 1.96	**H_0** (No trend) REJECT
	p 0.000		**H_A** (± trend) ACCEPT

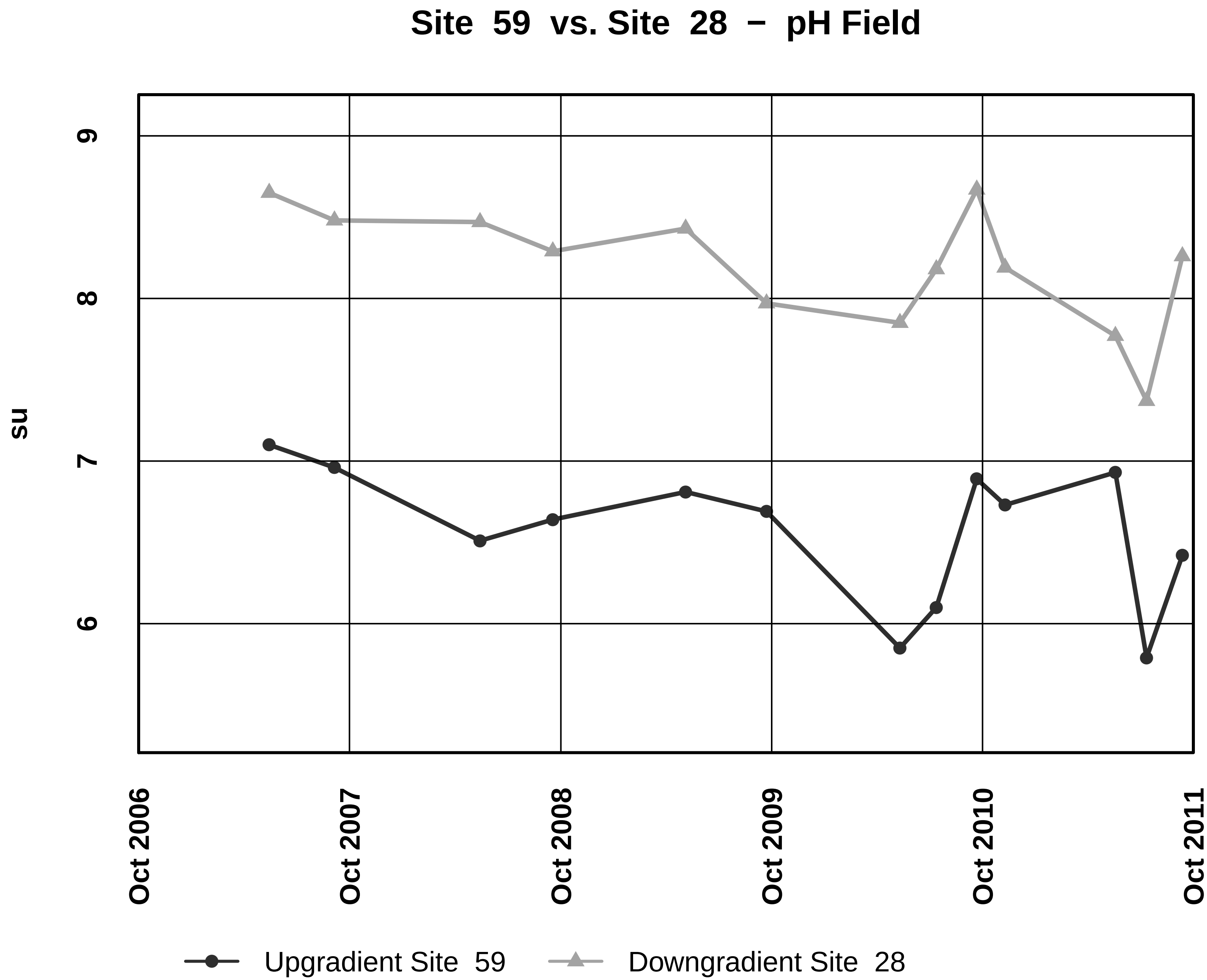


Seasonal-Kendall Slope Confidence Intervals

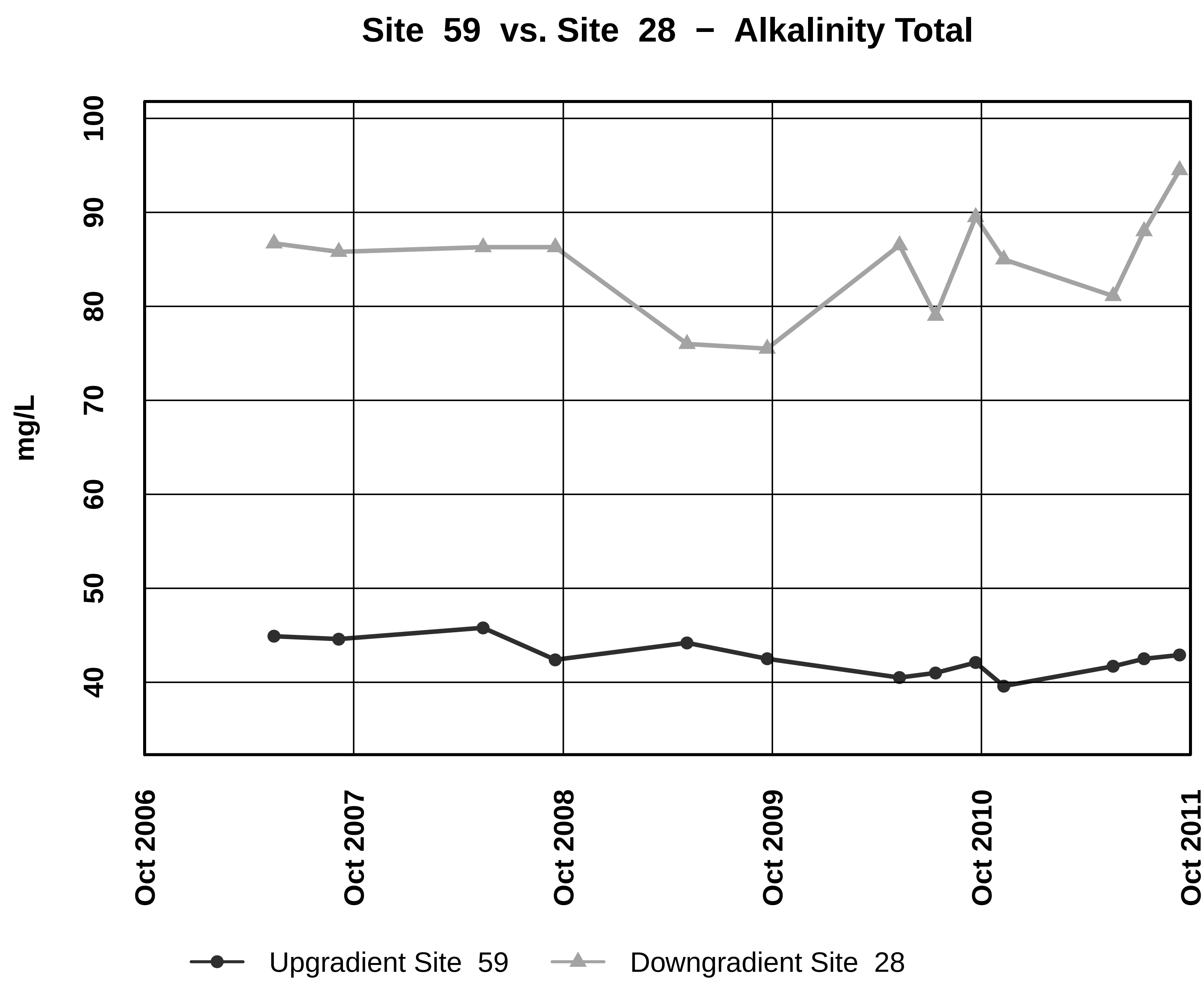
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-1.88		-0.04
0.050	-0.95	**-0.28**	-0.05
0.100	-0.74		-0.05
0.200	-0.47		-0.14

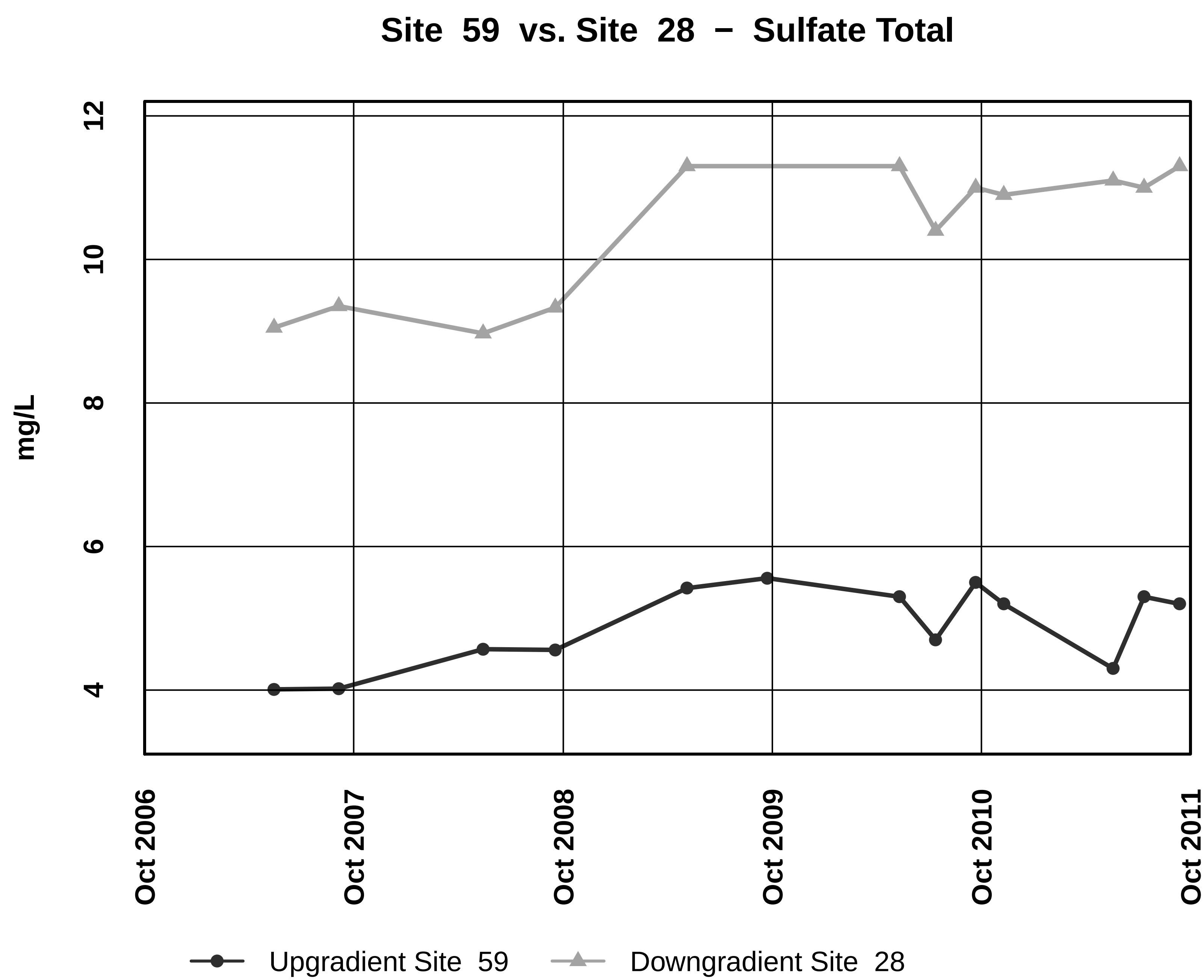
-129.2%


Site 59 vs. Site 28 − Conductivity Field
µS/cm
100
150
200
250
Oct 2006
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 59
Downgradient Site 28

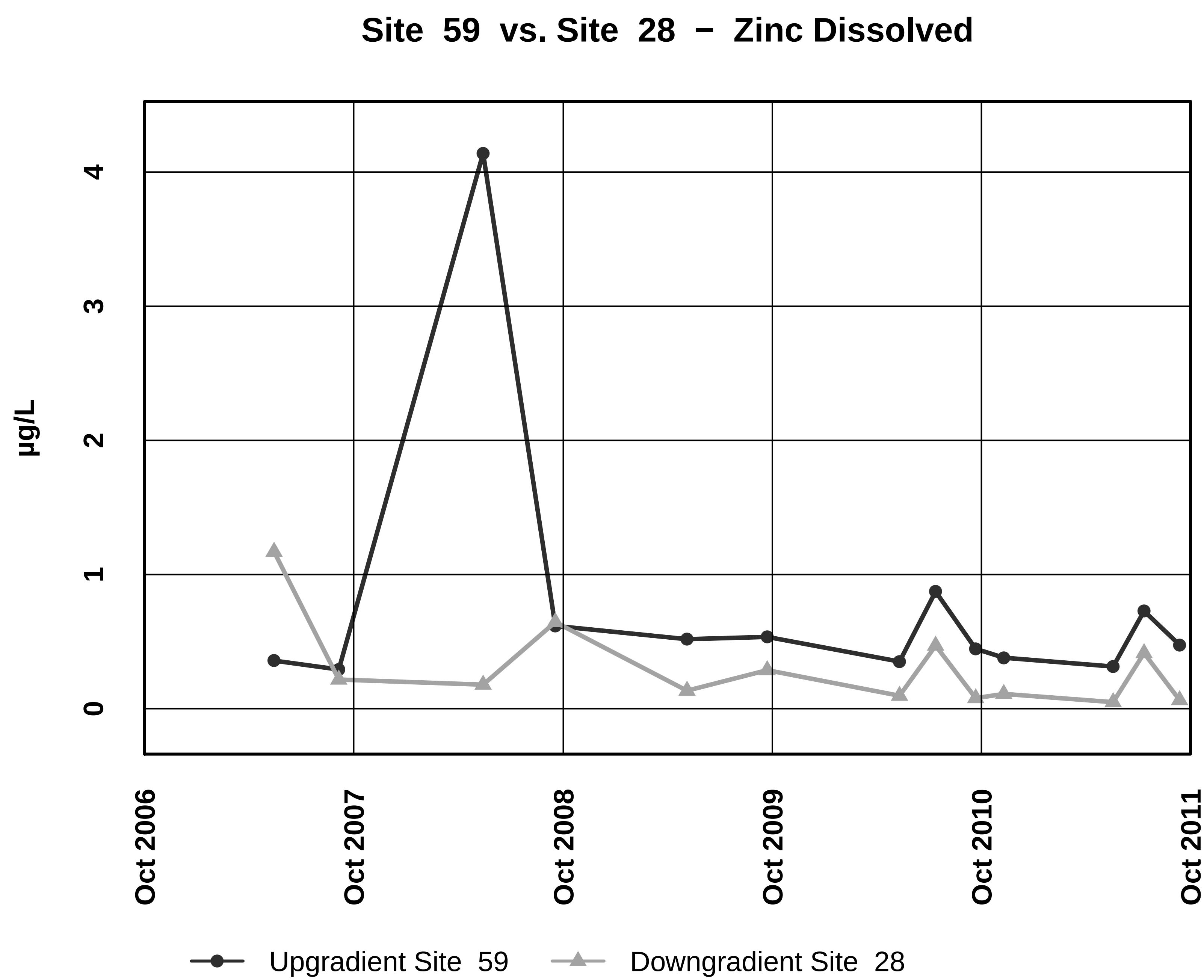


Site 59 vs. Site 28 − pH Field
su
9
8
7
6
Oct 2006
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 59
Downgradient Site 28


Site 59 vs. Site 28 − Alkalinity Total
mg/L
100
90
80
70
60
50
40
Oct 2006
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 2006
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 59
Downgradient Site 28


Site 59 vs. Site 28 − Zinc Dissolved
µg/L
0
1
2
3
4
Oct 2006
Oct 2007
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Upgradient Site 59
Downgradient Site 28

INTERPRETIVE REPORT
SITE 9 “TRIBUTARY CREEK”

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 2011 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 2011” 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 2006 through September 2011.				

The data for water year 2011 have been compared to the strictest fresh water quality criterion for each applicable analyte. Four results exceeding these criteria have been identified, and listed in the table below. Three data points are for the total alkalinity values of 14.1 mg/L, 13.0 mg/L, and 18.6 mg/L for the November 2010, May 2011 and September 2011 sampling events respectively, which exceeds the AWQS lower limit of 20 mg/L. Also, the July field pH value was 5.88 su where as the AWQS is 6.5 su.

Table of Exceedance for Water Year 2011

				Limits		
Sample Date	**Parameter**	**Value**		**Lower**	**Upper**	**Hardness**
9-Nov-10	Alkalinity	14.1	mg/L	20		
19-May-11	Alkalinity	13.0	mg/L	20		
12-Sep-11	Alkalinity	18.6	mg/L	20		
12-Jul-11	pH Field	5.88	su	6.5	8.50	

As stated in past reports, the currently limited dataset for this site makes definitive interpretation of these exceedances difficult. Site 29 (MW-3S), located in the headwaters of Tributary Creek, also had exceedances for these two analytes. For the second consecutive year there have been no dissolved lead exceedances. In the previous four water years there had been dissolved lead exceedances recorded in each year. This water year all of the dissolved lead values were approximately half the AWQS, which was ~1.0 µg/L.

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-05 and Sep-11 (WY2006-WY2011). 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	0.06			
pH Field	6	0.06			
Alkalinity, Total	6	0.41			
Sulfate, Total	6	0.06			
Zinc, Dissolved	6	0.33			

* 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 2011

Site 009FMS - 'Lower Tributary Creek'

Sample Date/Parameter	Oct 2010	Nov 2010	Dec 2010	Jan 2011	Feb 2011	Mar 2011	Apr 2011	May 2011	Jun 2011	Jul 2011	Aug 2011	Sep 2011	**Median**
Water Temp (°C)		4.5						7.8		11.6		8.1	8.0
Conductivity-Field(μmho)		95.6						96		132.7		85	95.8
Conductivity-Lab (μmho)		90						96		111		103	100
pH Lab (standard units)		6.39						6.77		6.58		6.74	6.66
pH Field (standard units)		6.84						6.78		5.88		6.69	6.74
Total Alkalinity (mg/L)		14.1						13		20.9		18.6	16.4
Total Sulfate (mg/L)		19.3						16.5		18		18	18.0
Hardness (mg/L)		40.7						35.2		45.7		41.9	41.3
Dissolved As (ug/L)		0.854						0.586		0.869		0.873	0.862
Dissolved Ba (ug/L)		37						36		44.7		42.7	39.9
Dissolved Cd (ug/L)		0.0393						0.0386		0.0304		0.0344	0.0365
Dissolved Cr (ug/L)		0.609						0.45		0.513		0.667	0.561
Dissolved Cu (ug/L)		1.86						1.85		3.36		2.05	1.955
Dissolved Pb (ug/L)		0.503						0.261		0.317		0.474	0.3955
Dissolved Ni (ug/L)		2.94						2.56		3.01		3.1	2.975
Dissolved Ag (ug/L)		0.004						0.007		0.007		0.005	0.006
Dissolved Zn (ug/L)		6.91						6.21		5.97		6.59	6.40
Dissolved Se (ug/L)		0.23						0.162		0.057		0.373	0.196
Dissolved Hg (ug/L)		0.00322						0.00227		0.00262		0.00405	0.002920

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

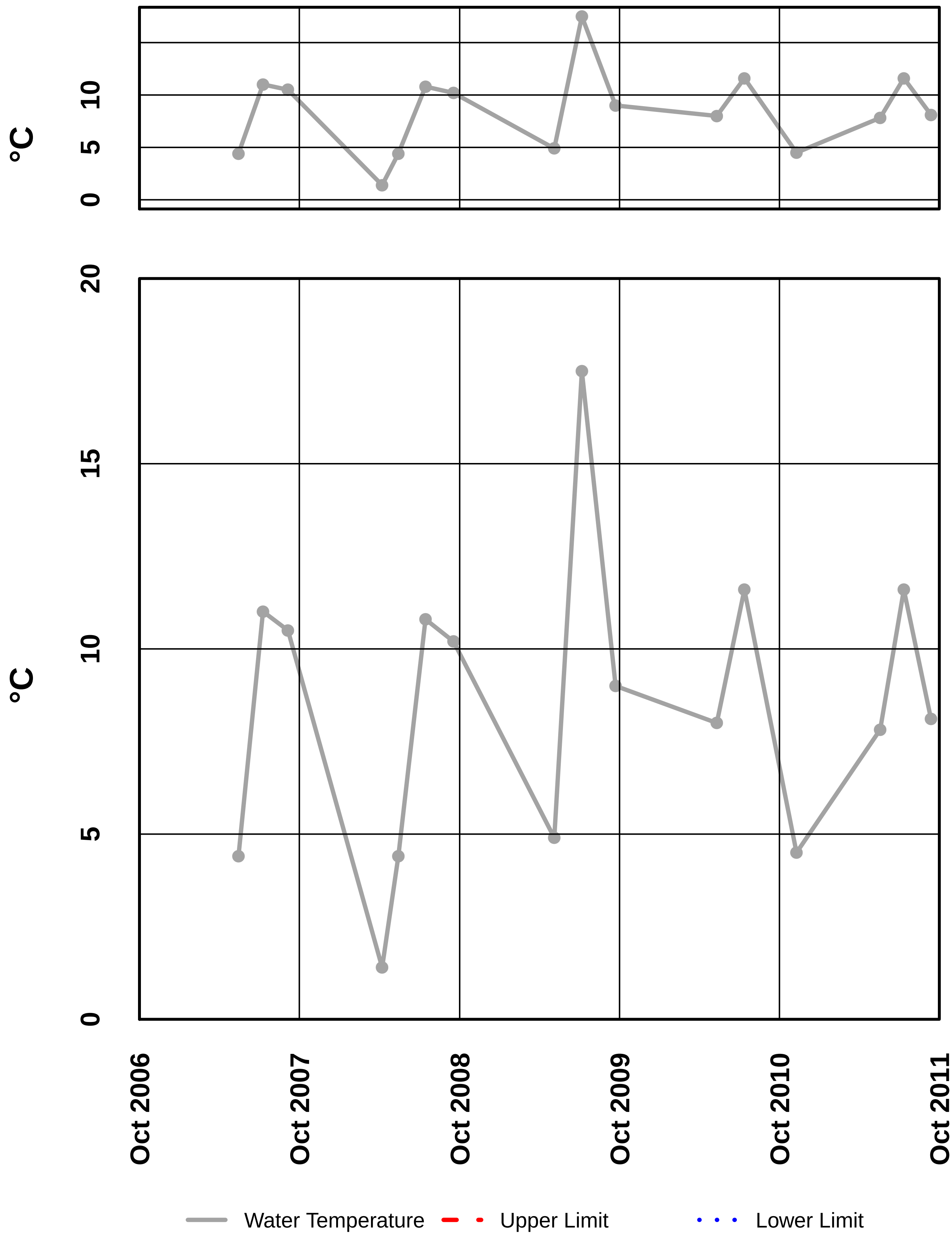
Qualified Data by QA Reviewer

Date Range: 10/01/2010 to 09/30/2011

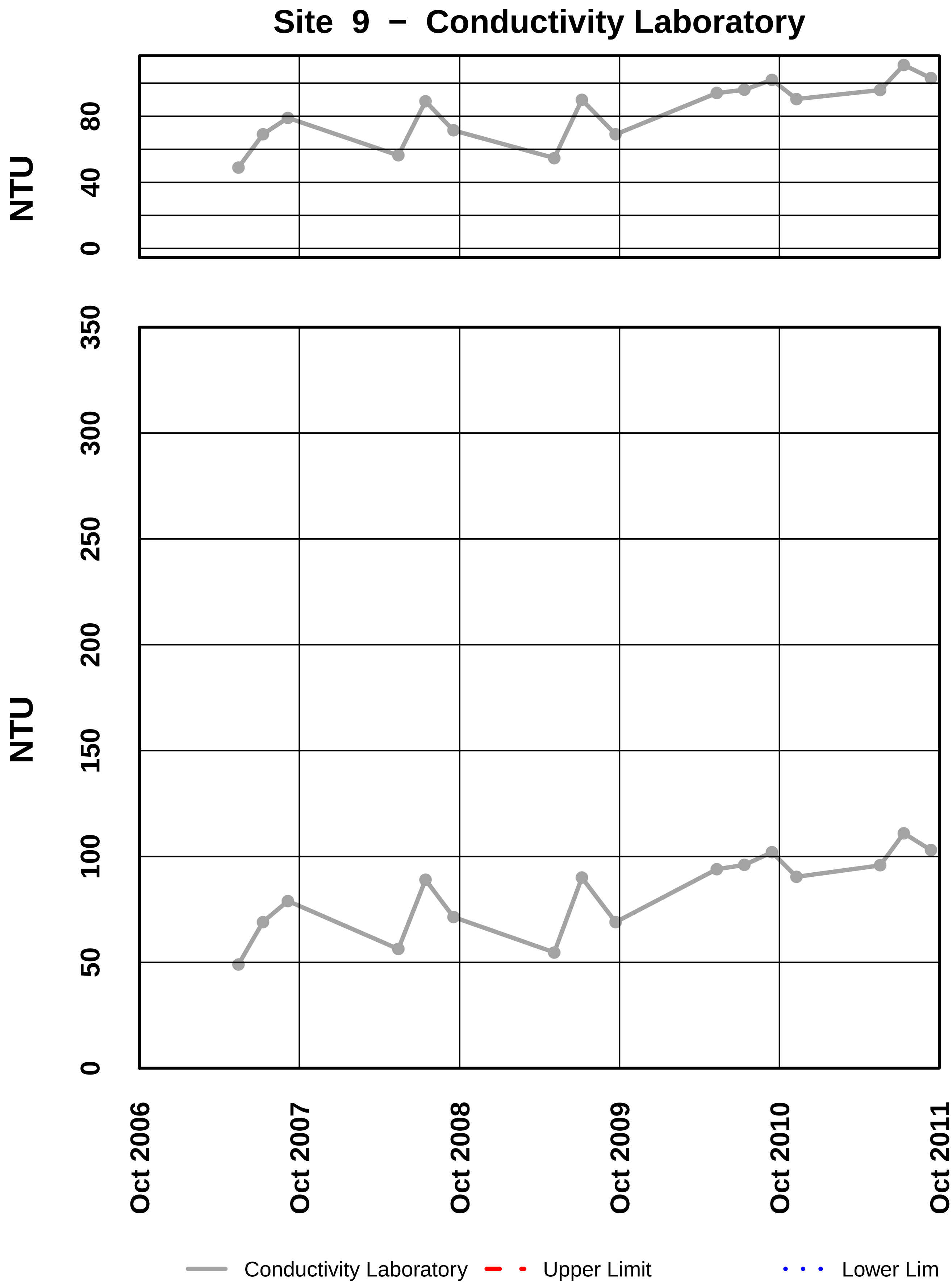
Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
9	11/9/2010	12:00 AM				
			Se diss, µg/l	0.23	J	Below Quantitative Range
9	5/19/2011	12:00 AM				
			SO4 Tot, mg/l	16.5	J	Sample Reciept Temperature
			Se diss, µg/l	0.162	J	Below Quantitative Range
			Ag diss, µg/l	0.00715	J	Below Quantitative Range
			pH Lab, su	6.77	J	Hold Time Violation
			Cd diss, µg/l	0.0386	U	Trip Blank Contamination
9	7/12/2011	12:00 AM				
			Ag diss, µg/l	0.00716	J	Below Quantitative Range
			SO4 Tot, mg/l	18	J	Sample Reciept Temperature
9	9/12/2011	12:00 AM				
			Ag diss, µg/l	0.0054	J	Below Quantitative Range
			SO4 Tot, mg/l	18	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 Qu

Site 9 – Water Temperature

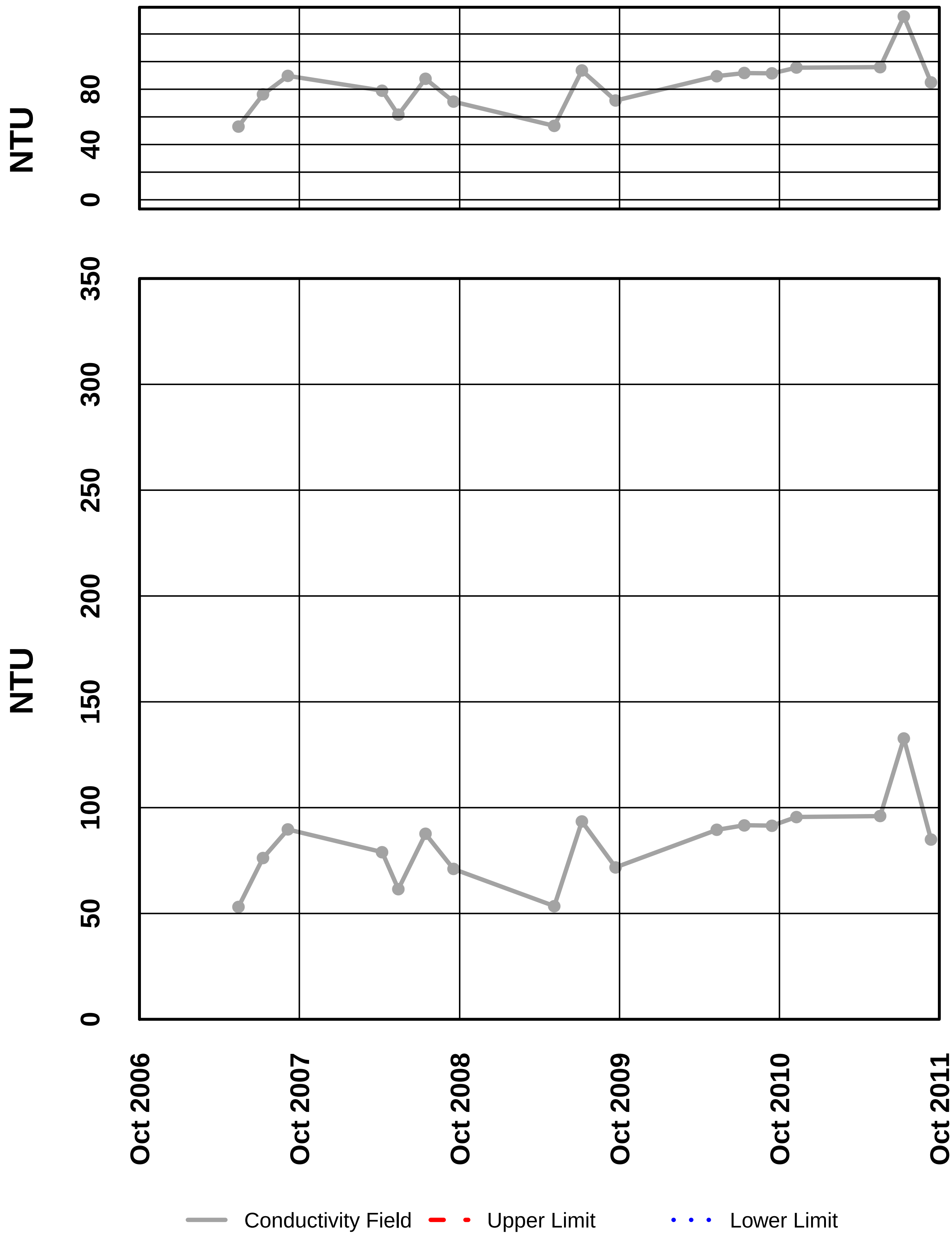


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

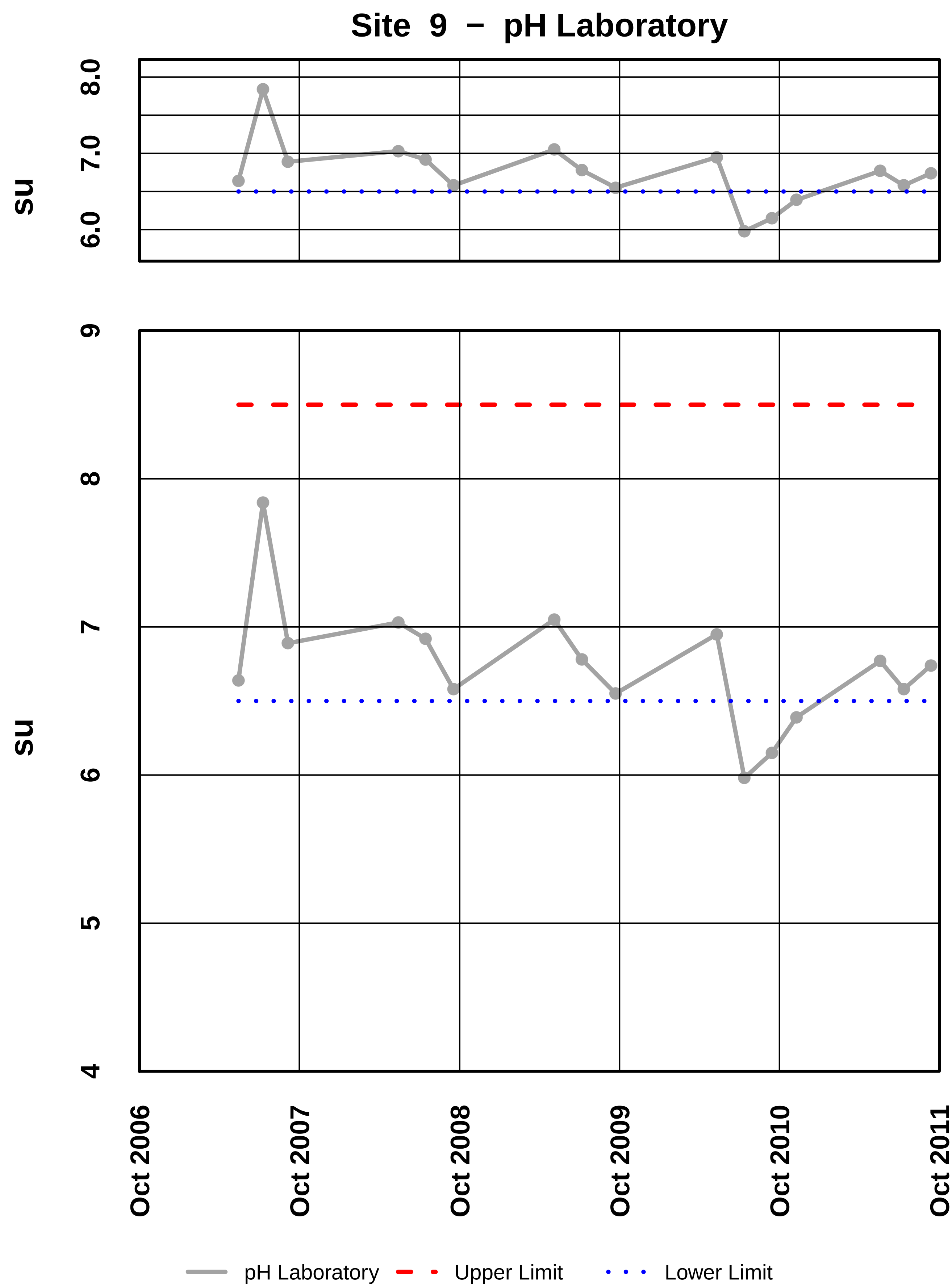


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 9 – Conductivity Field

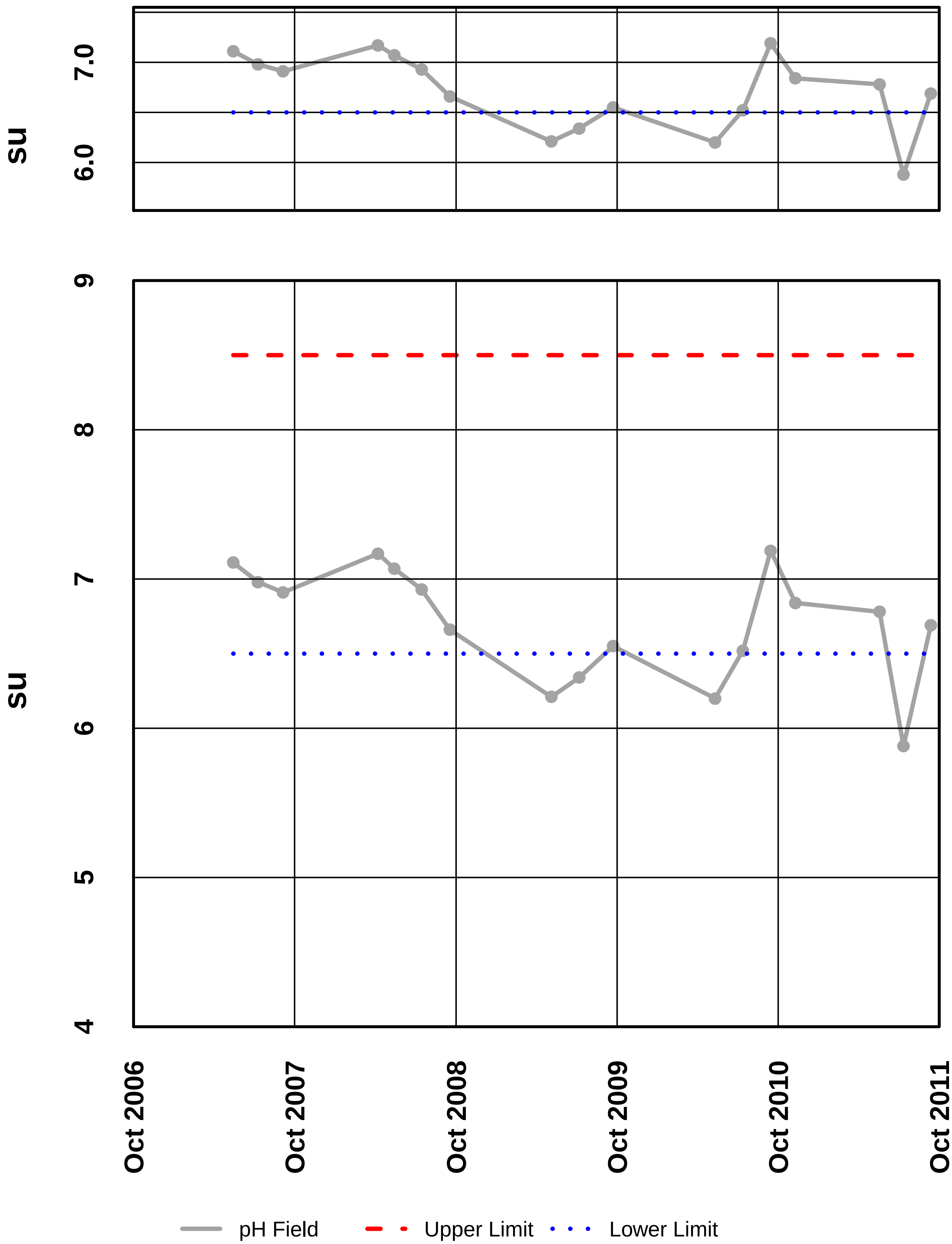


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



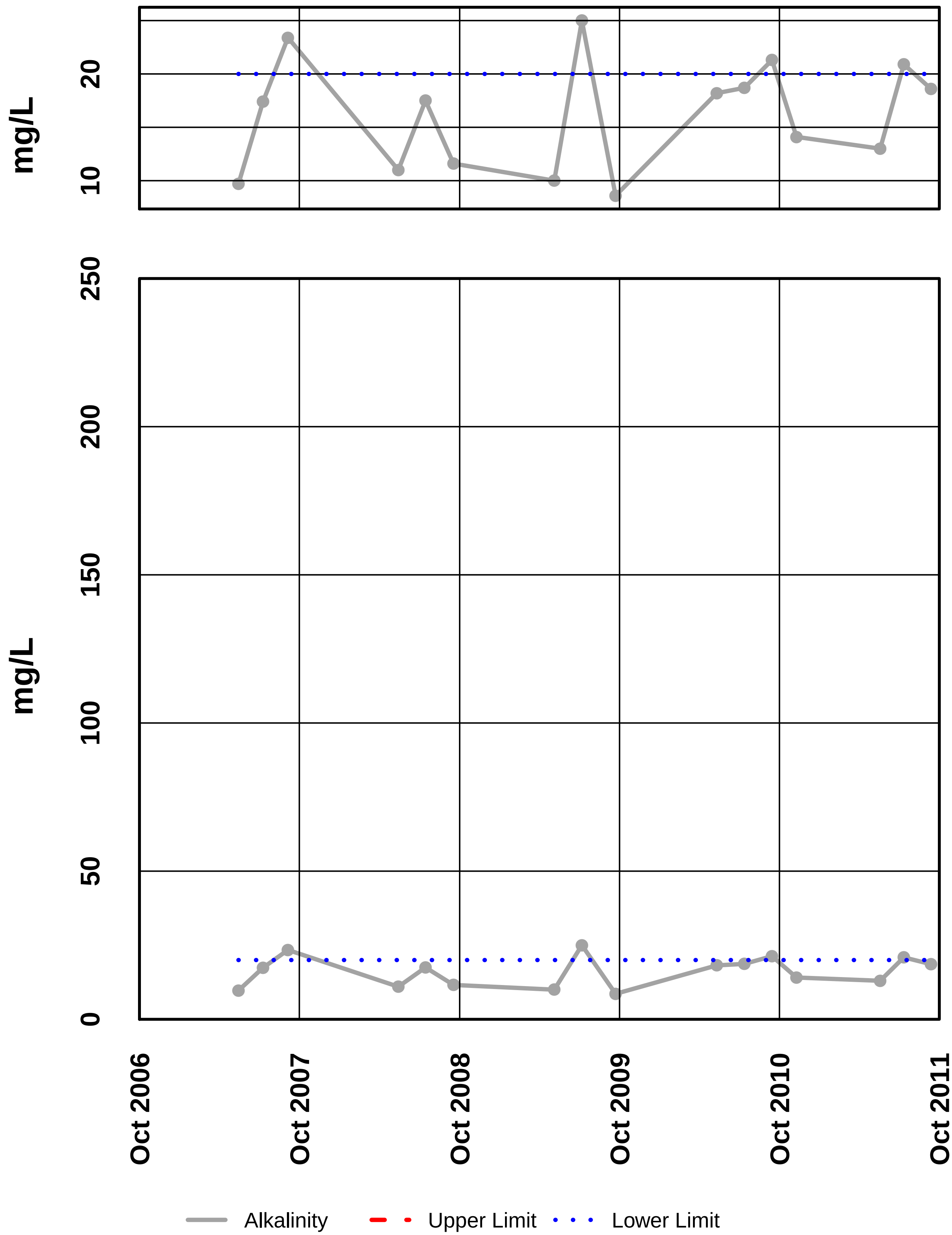
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 9 – pH Field

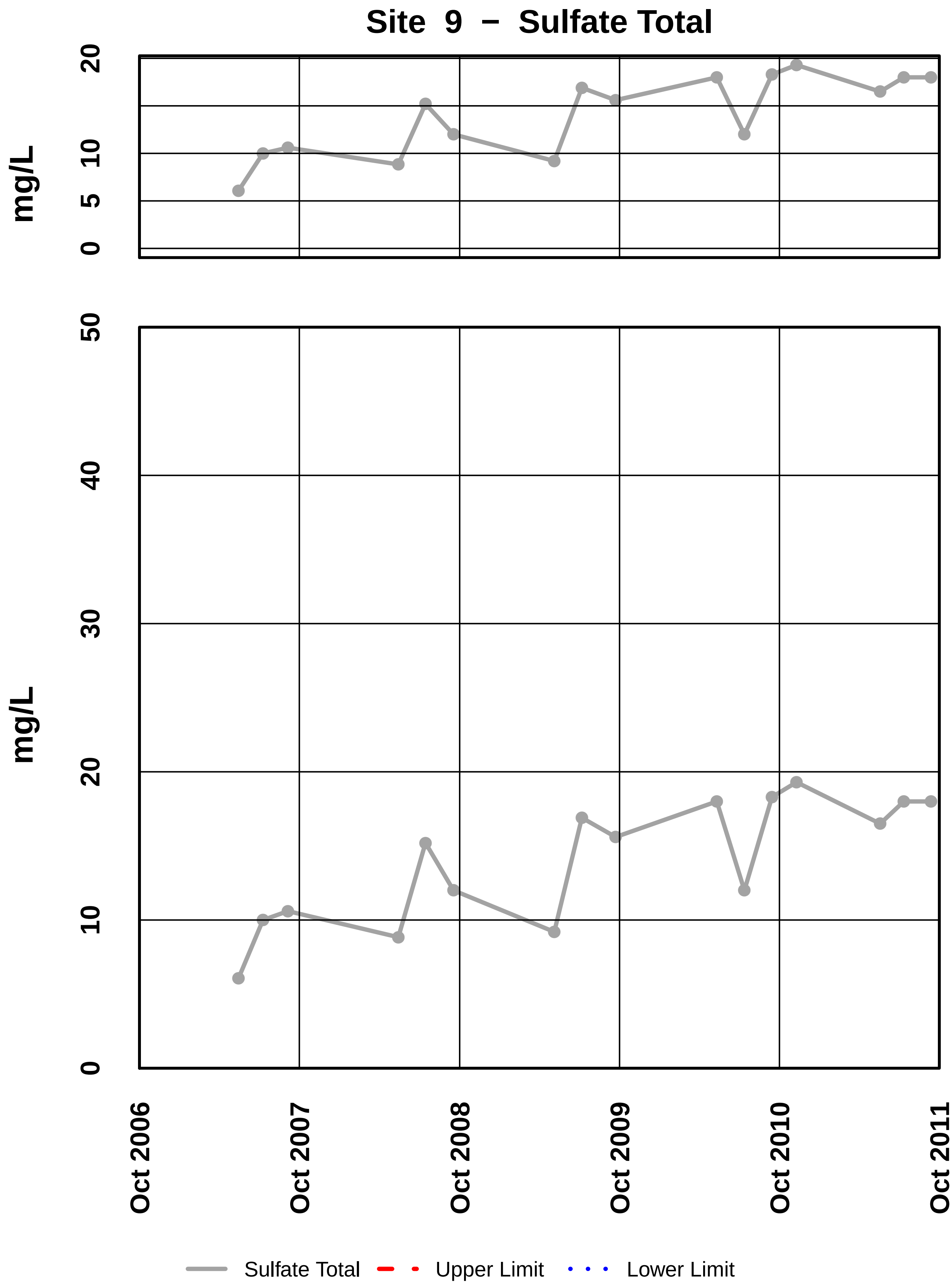


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

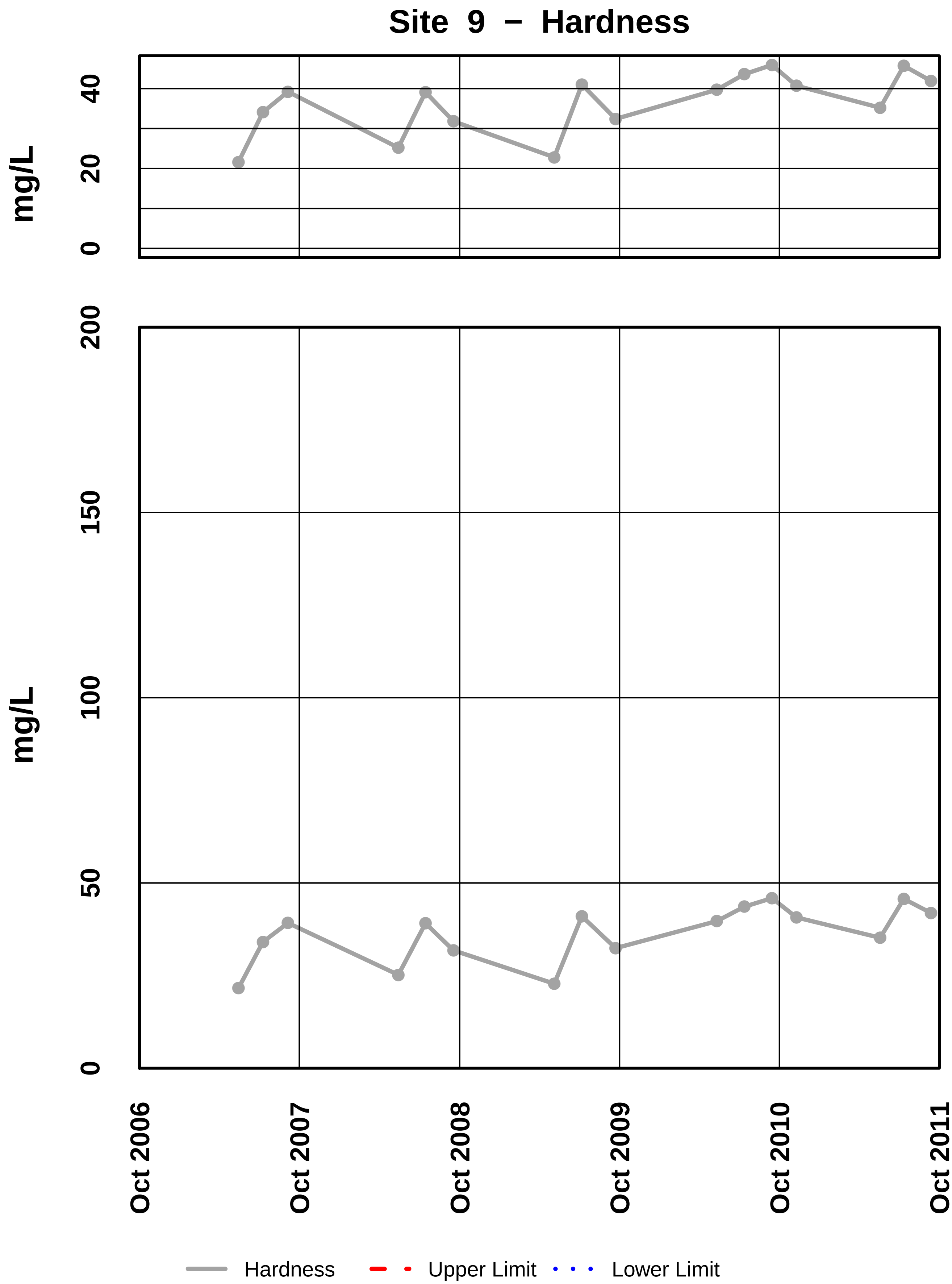
Site 9 – Alkalinity



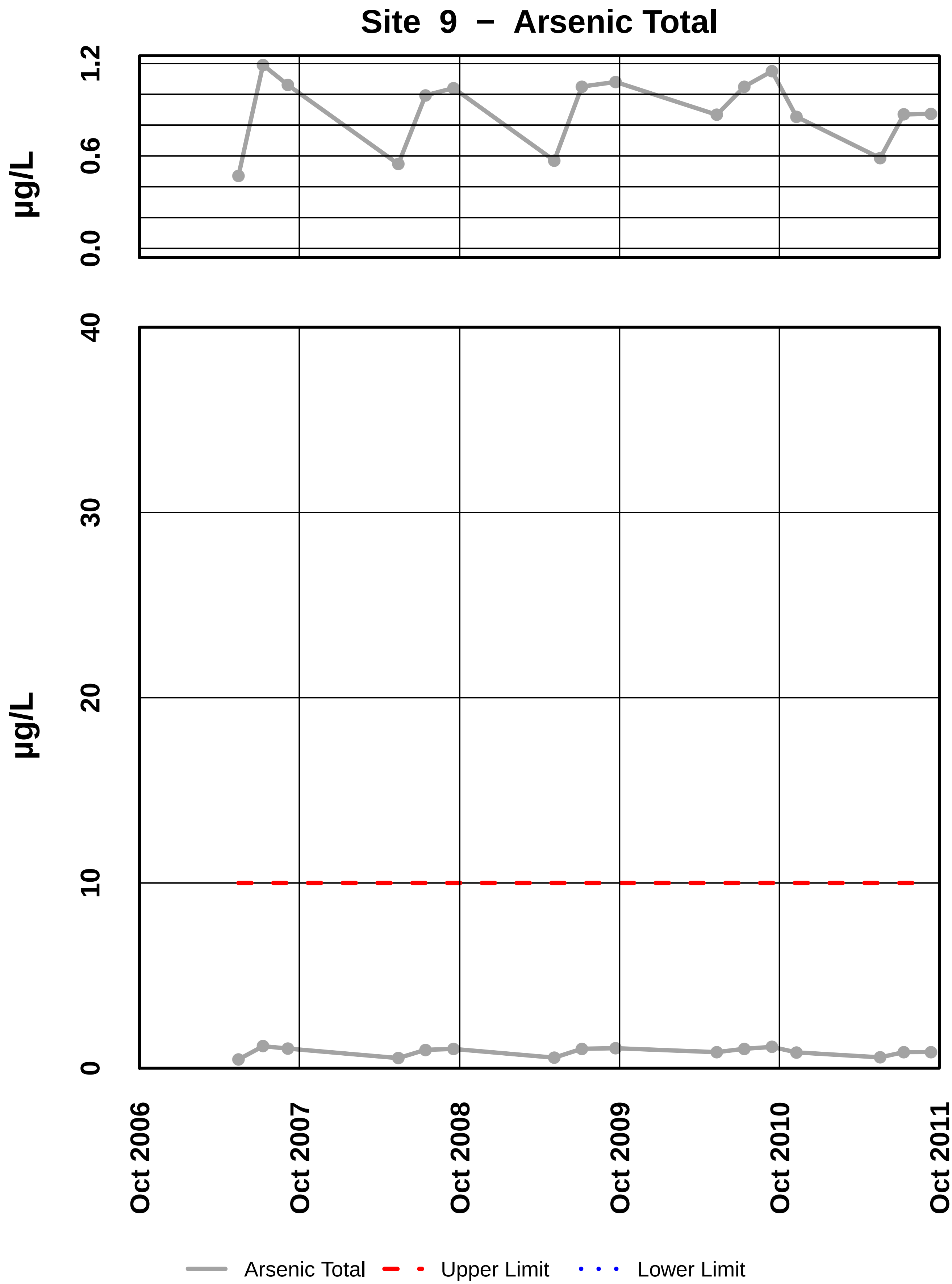
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



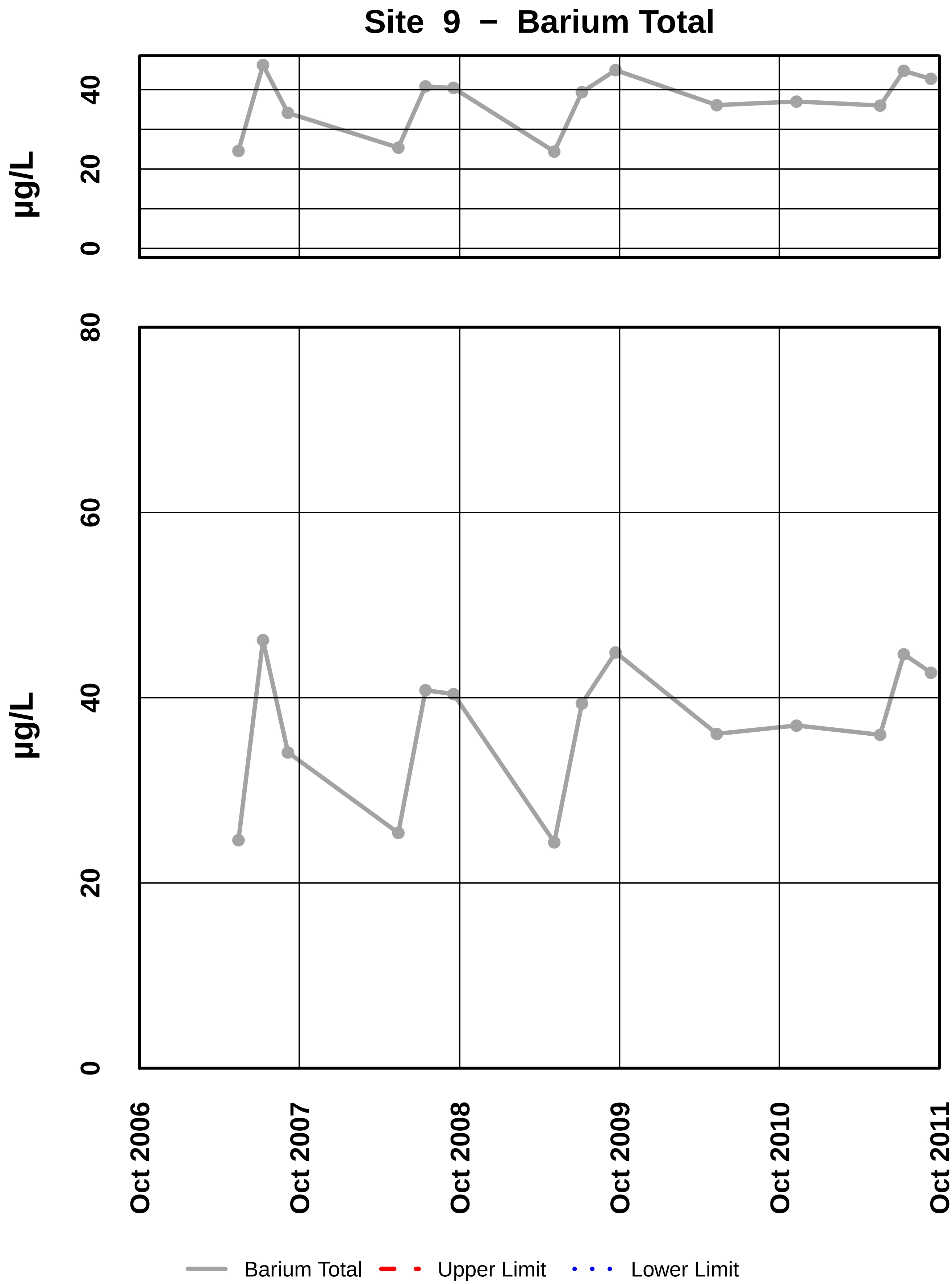
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



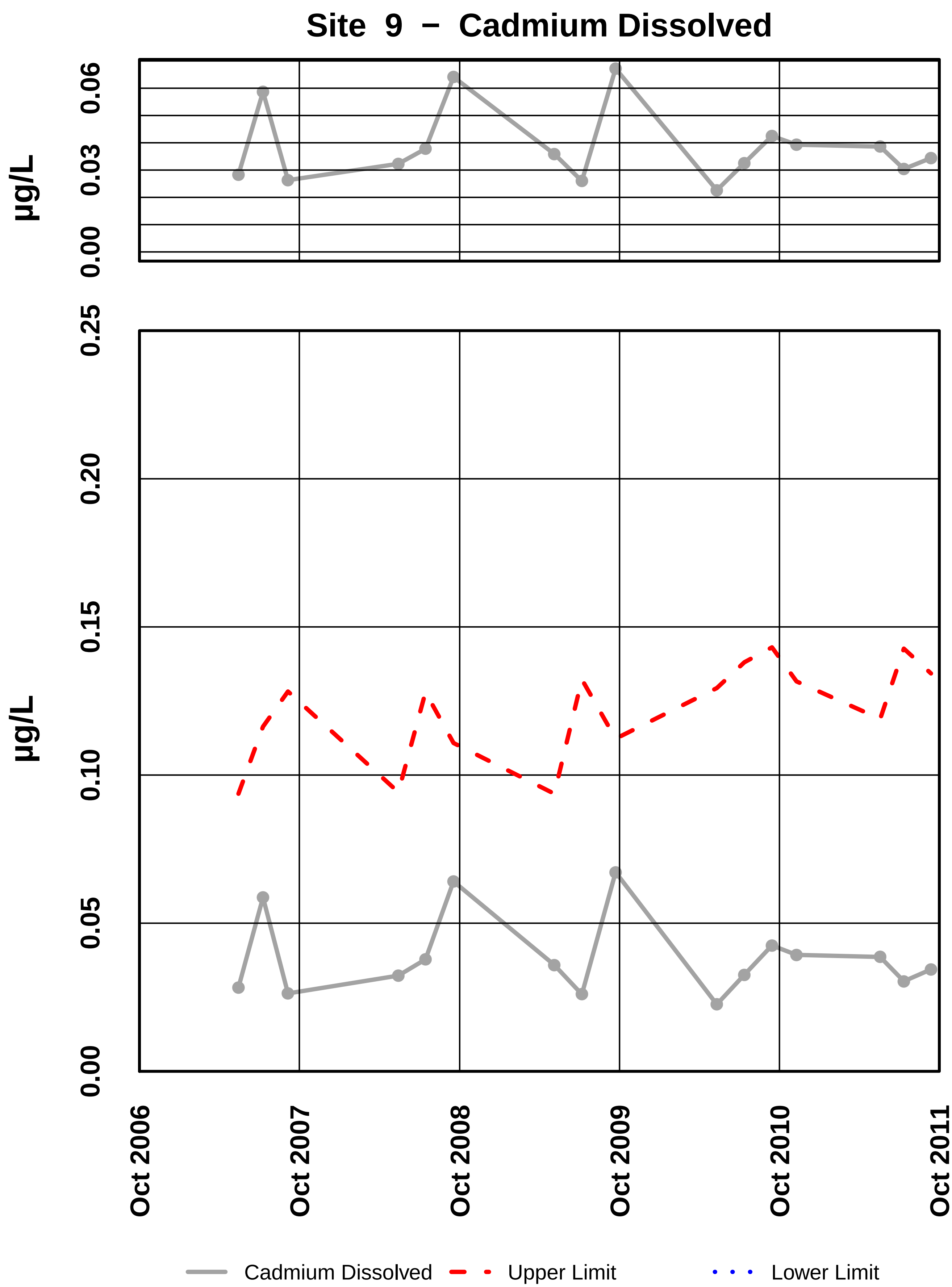
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



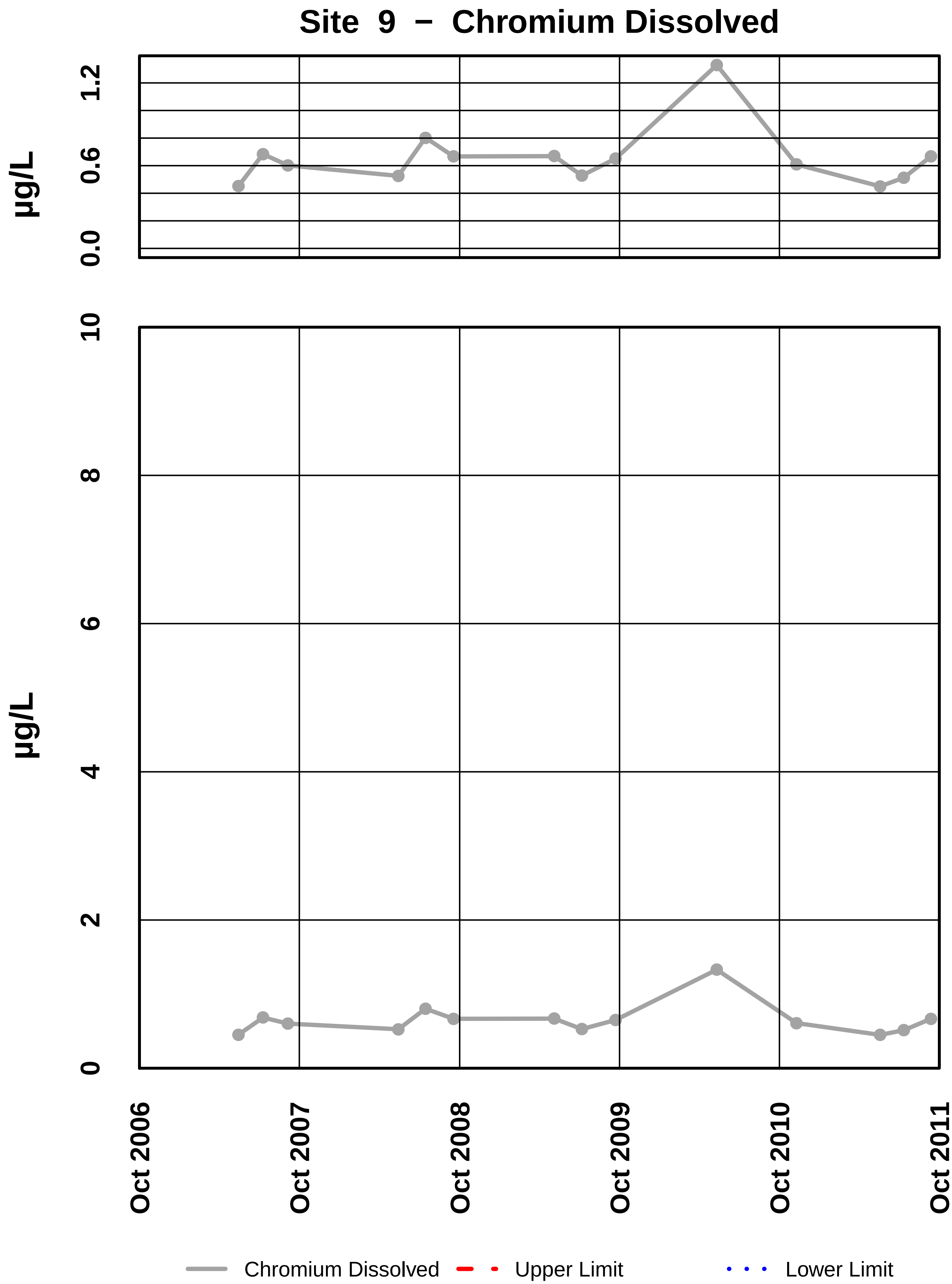
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



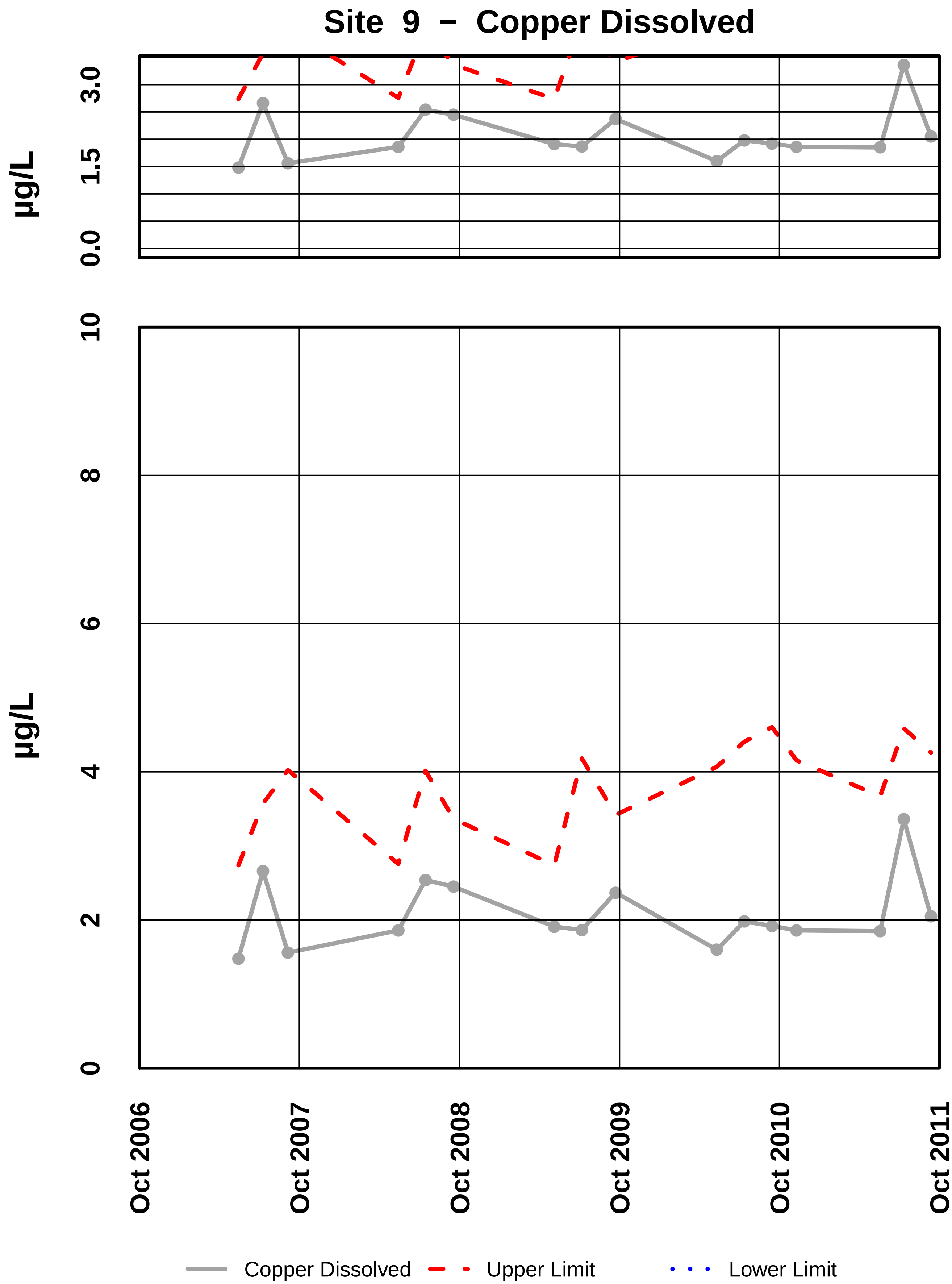
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



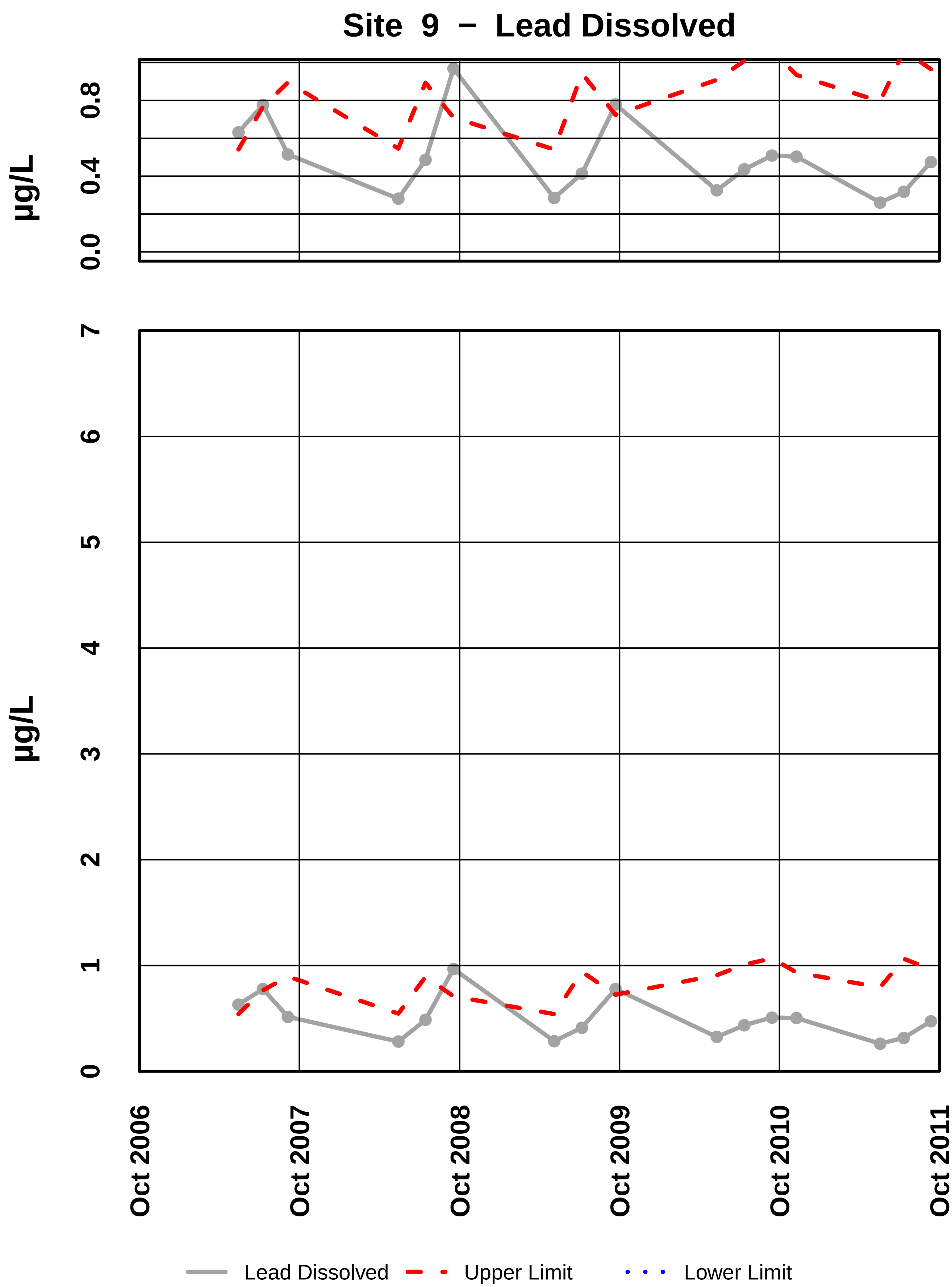
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



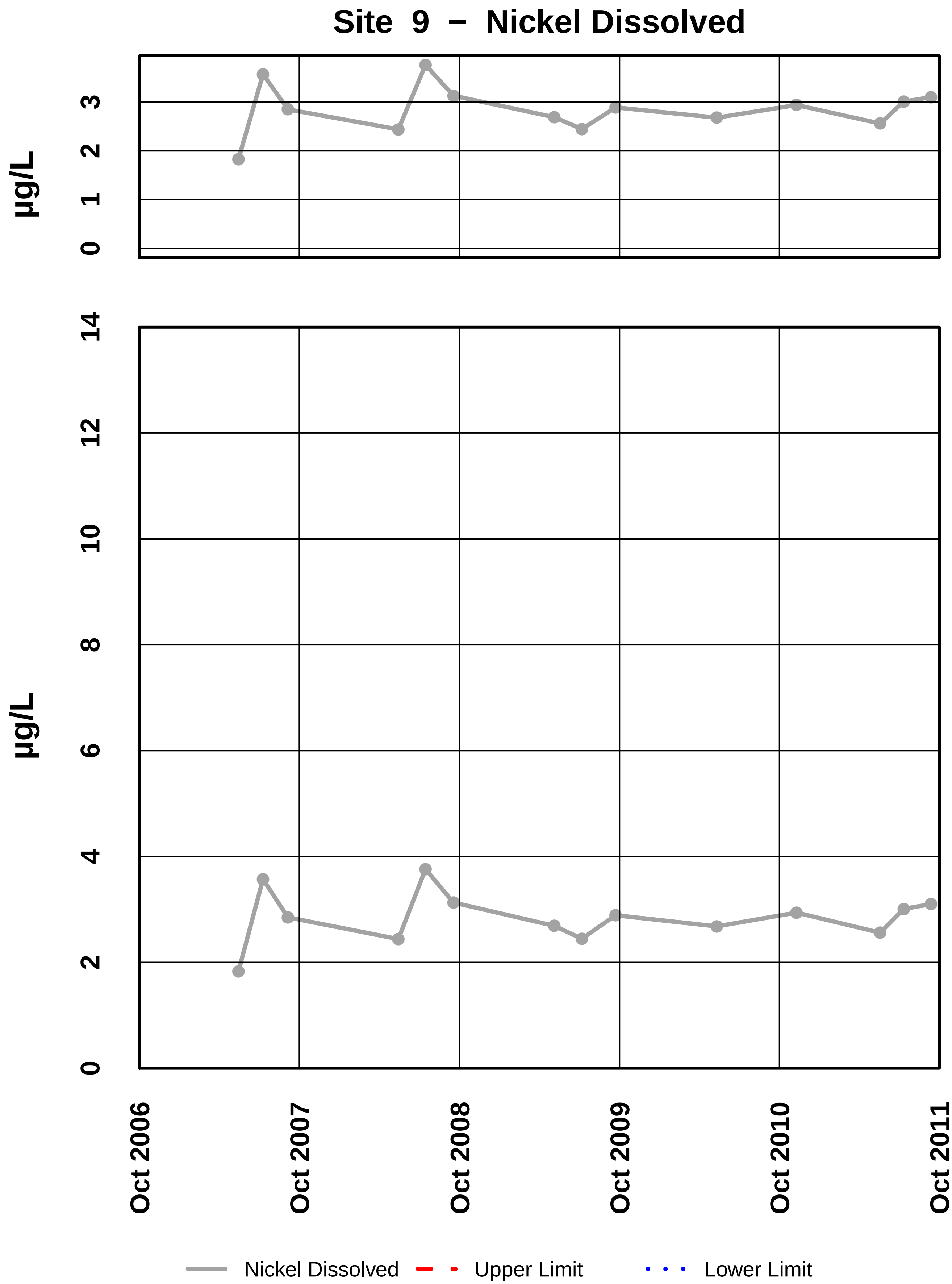
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



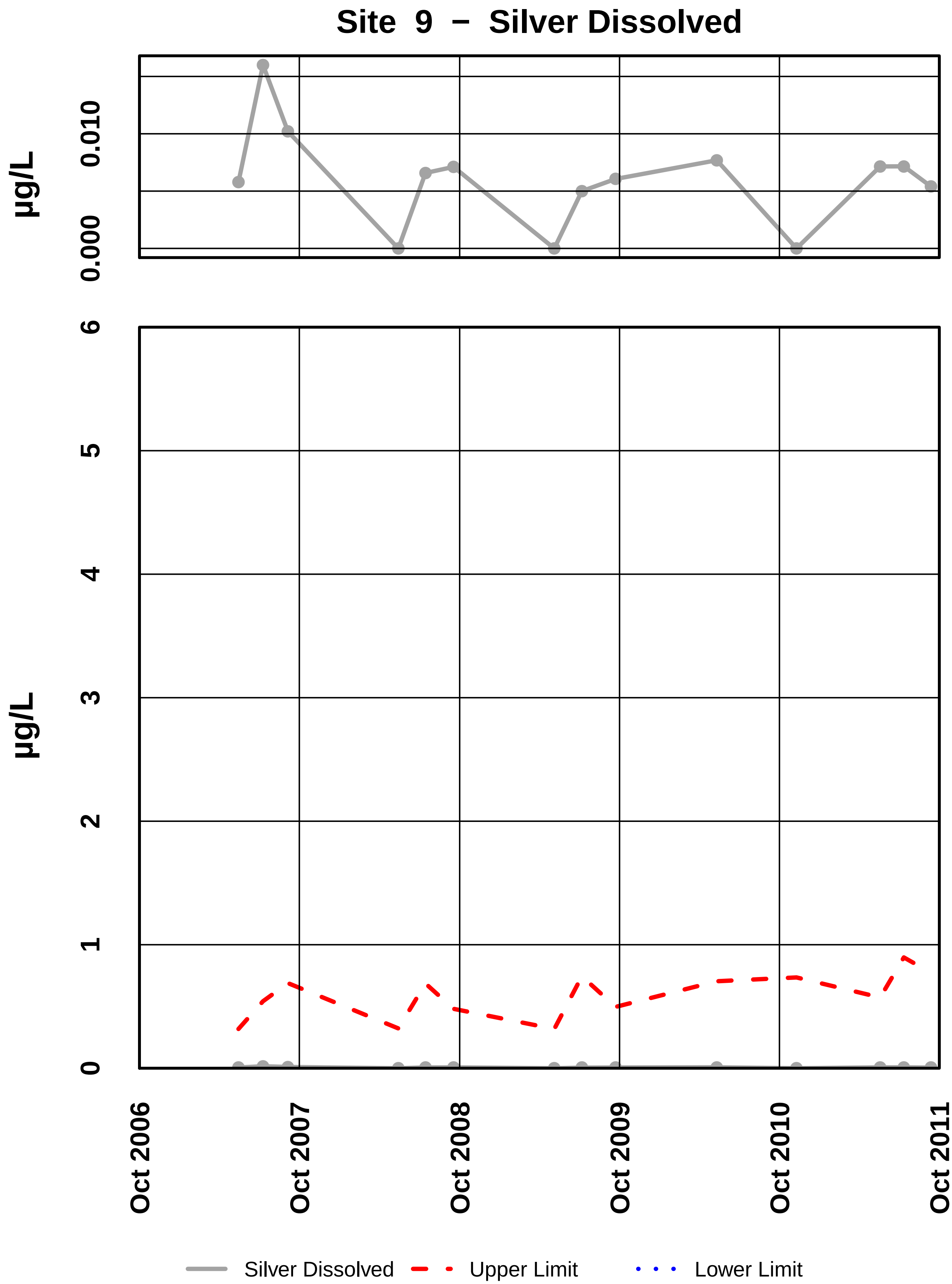
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



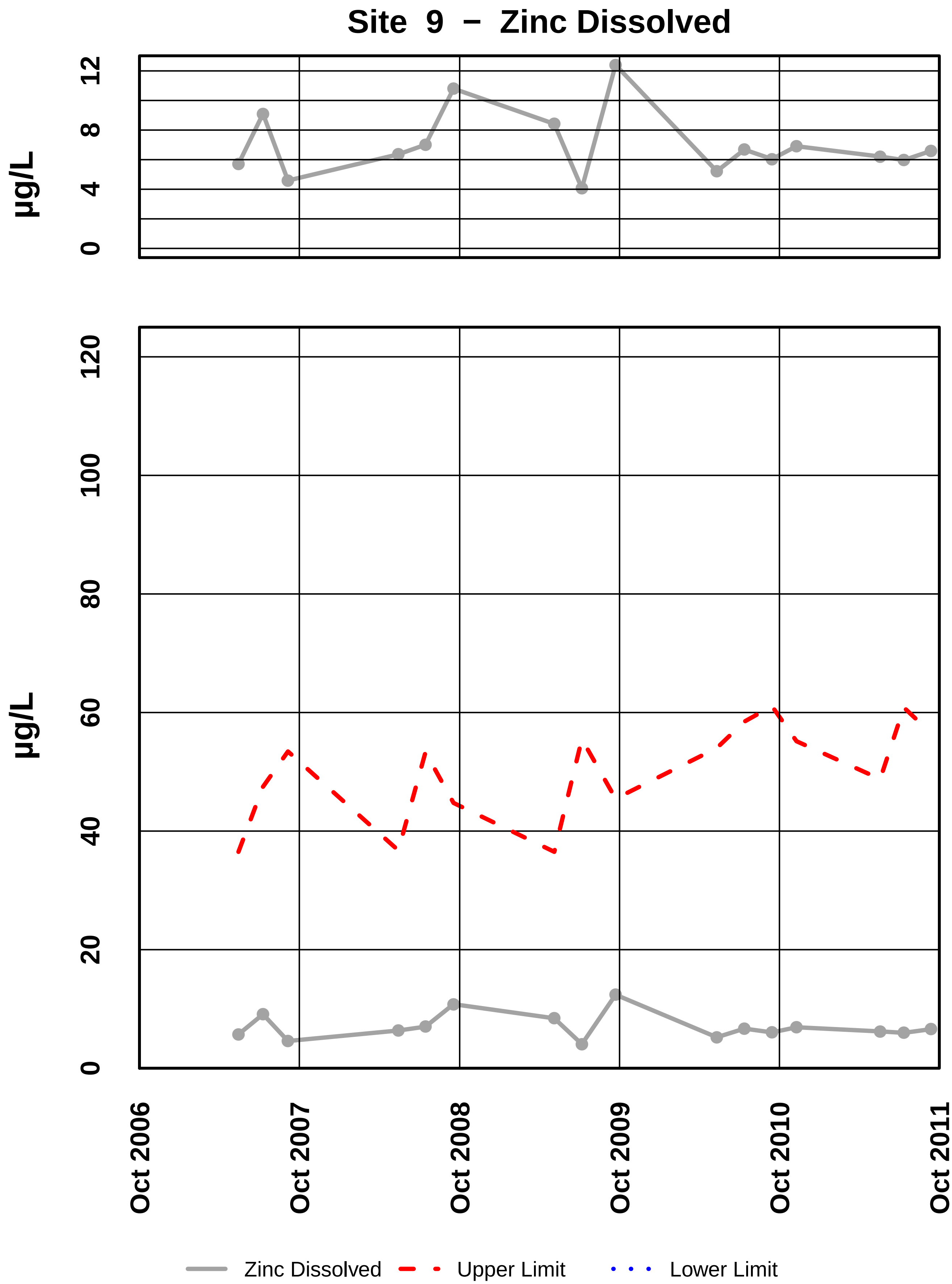
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



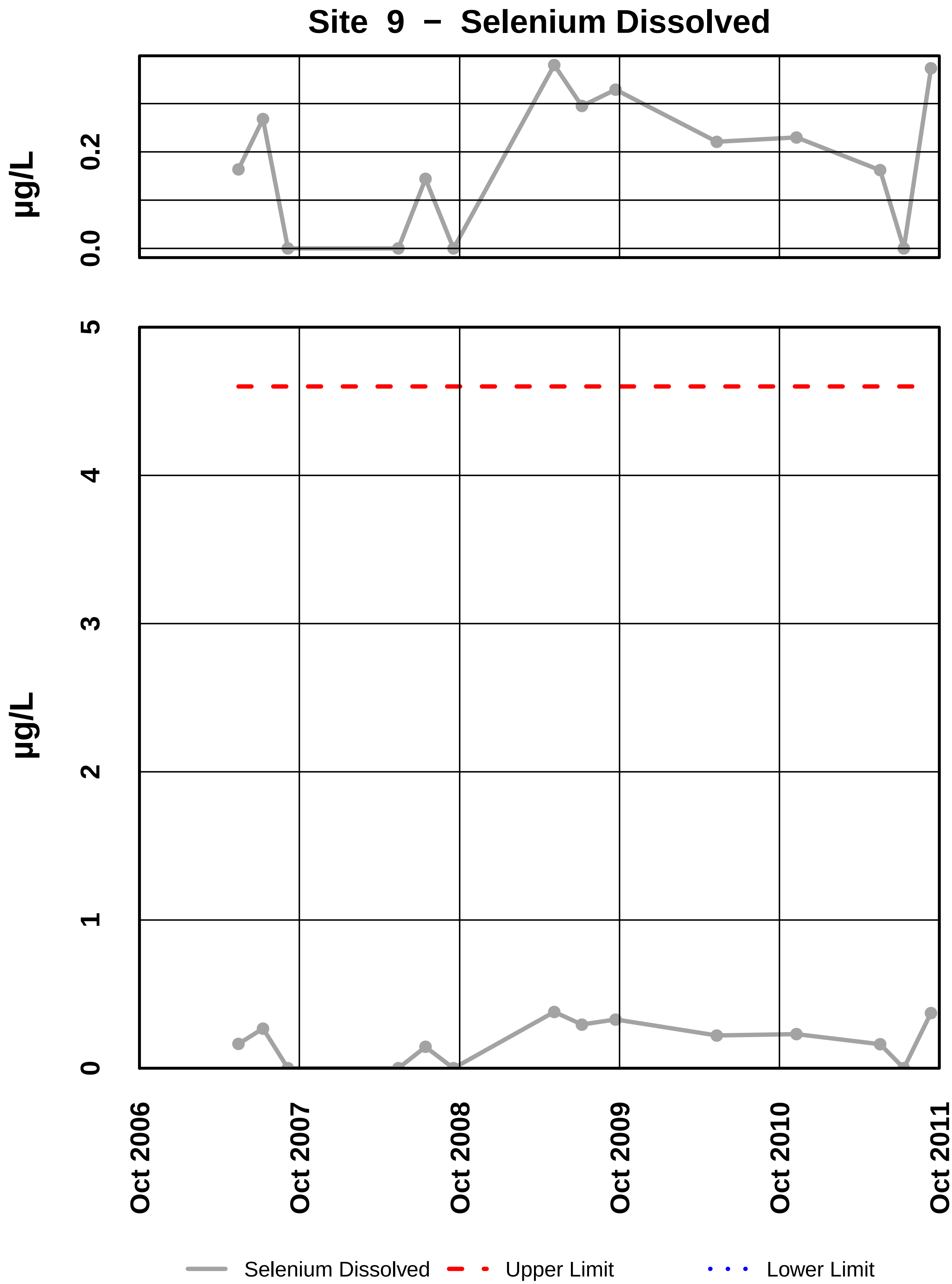
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



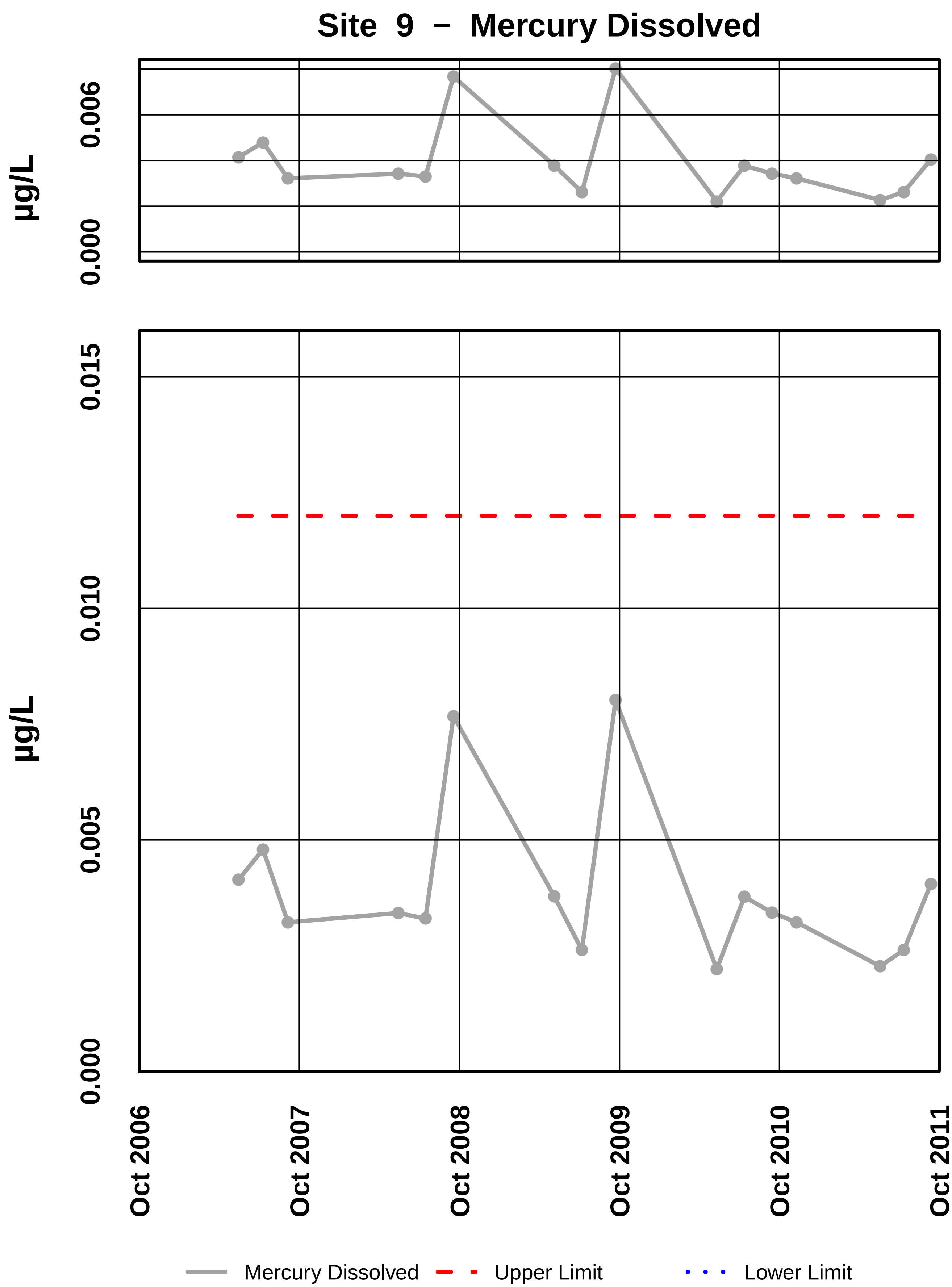
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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



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



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

Site #9 — Seasonal Kendall analysis for Specific Conductance, Lab (uS/cm)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2006**								81.4		82.5		116.6
b	**WY2007**								53.1		76.2		89.7
c	**WY2008**							79	61.5		87.6		71
d	**WY2009**								53.5		93.5		71.8
e	**WY2010**								89.5		91.7		91.5
f	**WY2011**		95.6						96		132.7		85
	n	0	1	0	0	0	0	1	6	0	6	0	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	0	1	0	0	0	0	1	6	0	6	0	6
t_2	0	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
S_k	0	0	0	0	0	0	0	7	0	11	0	-3

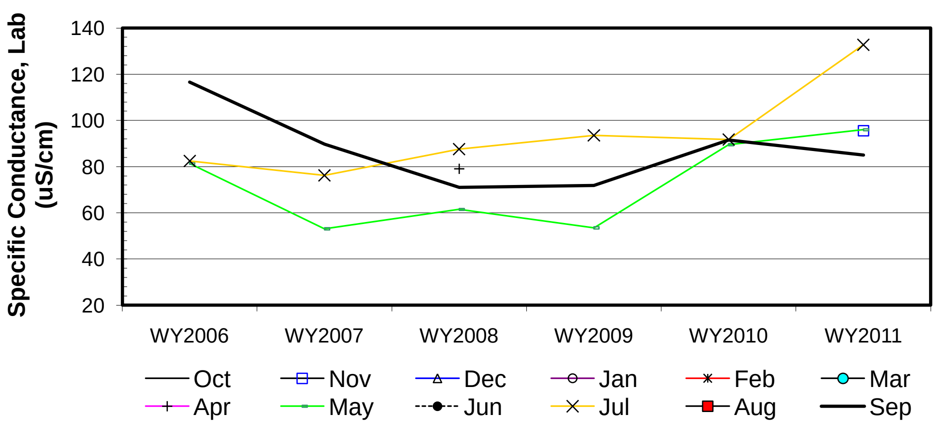
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=								28.33		28.33		28.33
$Z_k = S_k/\sigma_S$								1.32		2.07		-0.56
Z^2_k								1.73		4.27		0.32

ΣZ_k=	2.82
ΣZ^2_k=	6.32
Z-bar=$\Sigma Z_k/K$=	0.94

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

Σn	20
ΣS_k	15

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=		3.67	@α=5% $\chi^2_{(K-1)}$=	5.99	Test for station homogeneity
	p	**0.160**			$\chi^2_h<\chi^2_{(K-1)}$ ACCEPT
ΣVAR(S_k)	Z_{calc}	1.52	@α/2=2.5% Z=	1.96	**H_0** (No trend) ACCEPT
85.00	p	**0.936**			**H_A** (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-6.30		10.36
0.050	-1.23	**2.92**	8.42
0.100	0.44		6.54
0.200	1.56		5.45

Site **#9** Seasonal Kendall analysis for pH, Lab, Standard Units

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2006**								6.9		7.1		6.5
b	**WY2007**								7.1		7.0		6.9
c	**WY2008**							7.2	7.1		6.9		6.7
d	**WY2009**								6.2		6.3		6.6
e	**WY2010**								6.2		6.5		7.2
f	**WY2011**		6.8						6.8		5.9		6.7
	n	0	1	0	0	0	0	1	6	0	6	0	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	0	1	0	0	0	0	1	6	0	6	0	6
t_2	0	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
S_k	0	0	0	0	0	0	0	-7	0	-13	0	5

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

ΣZ_k= -2.82

ΣZ^2_k= 8.58

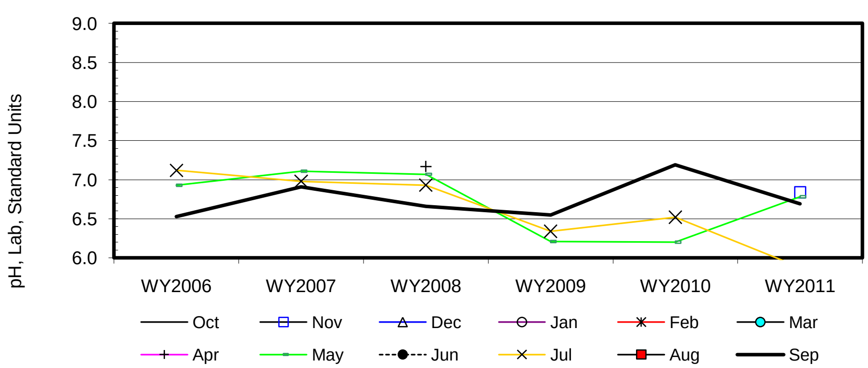
Z-bar=$\Sigma Z_k/K$= -0.94

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

Σn 20

ΣS_k -15

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=	5.93	@α=5% $\chi^2_{(K-1)}$= 5.99	Test for station homogeneity	
p	**0.052**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
$\Sigma VAR(S_k)$ / Z_{calc}	-1.52	@α/2=2.5% Z= 1.96	H_0 (No trend)	ACCEPT
85.00 / **p**	**0.064**		H_A (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.25		0.04
0.050	-0.23	**-0.10**	-0.01
0.100	-0.19		-0.04
0.200	-0.16		-0.05

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	**WY2006**								14.1		24.5		20.2
b	**WY2007**								9.7		17.4		23.4
c	**WY2008**								11.0		17.5		11.6
d	**WY2009**								10.0		25.0		8.6
e	**WY2010**								18.2		18.7		21.3
f	**WY2011**		14.1						13.0		20.9		18.6
	n	0	1	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	1	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
S_k	0	0	0	0	0	0	0	3	0	3	0	-3

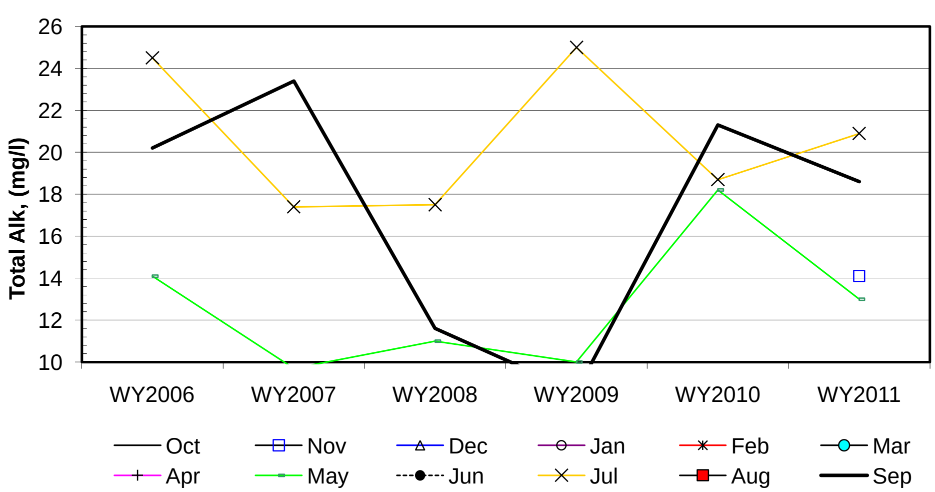
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=								28.33		28.33		28.33
$Z_k = S_k/\sigma_S$								0.56		0.56		-0.56
Z^2_k								0.32		0.32		0.32

ΣZ_k= 0.56
ΣZ^2_k= 0.95
Z-bar=ΣZ_k/K= 0.19

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

Σn 19
ΣS_k 3

$\chi^2_h=\Sigma Z^2_k$-K(Z-bar)^2= 0.85	@α=5% $\chi^2_{(K-1)}$= 5.99	Test for station homogeneity	
p **0.655**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k) 85.00	Z_{calc} 0.22, **p** **0.586**	@α/2=2.5% Z= 1.96	**H_0** (No trend) ACCEPT
			H_A (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-2.20		1.34
0.050	-1.37	**0.15**	0.89
0.100	-1.08		0.73
0.200	-0.71		0.50

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	**WY2006**								18.9		15.9		16.0
b	**WY2007**								6.1		10.0		10.6
c	**WY2008**								8.8		15.2		12.0
d	**WY2009**								9.2		16.9		15.6
e	**WY2010**								18.0		12.0		18.3
f	**WY2011**		19.3						16.5		18.0		18.0
	n	0	1	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	1	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
S_k	0	0	0	0	0	0	0	3	0	5	0	7

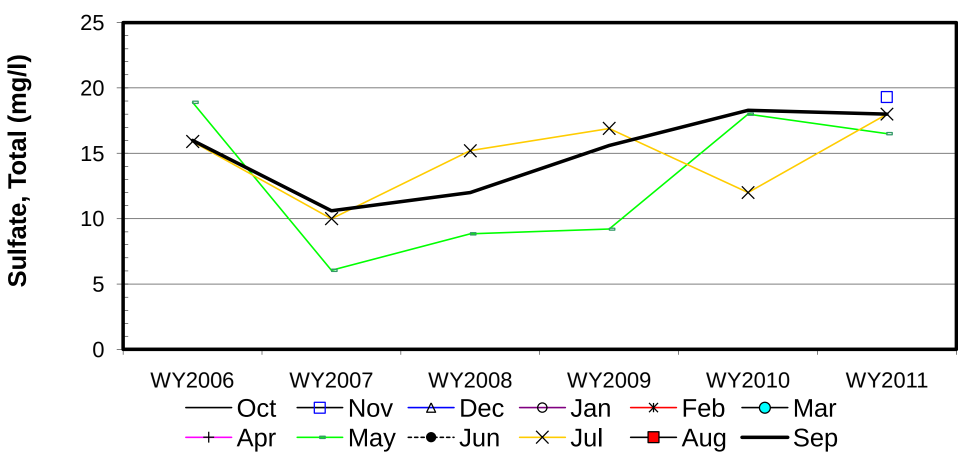
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=								28.33		28.33		28.33
$Z_k = S_k/\sigma_S$								0.56		0.94		1.32
Z^2_k								0.32		0.88		1.73

ΣZ_k=	2.82
ΣZ^2_k=	2.93
Z-bar=ΣZ_k/K=	0.94

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

Σn	19
ΣS_k	15

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=		0.28	@α=5% $\chi^2_{(K-1)}$= 5.99	Test for station homogeneity	
	p	**0.868**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc}	1.52	@α=5% Z= 1.64	**H_0** (No trend)	ACCEPT
85.00	p	**0.936**		**H_A** (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.38		2.58
0.050	-0.14	**0.93**	2.04
0.100	0.35		1.91
0.200	0.41		1.62

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	**WY2006**								5.5		3.7		6.2
b	**WY2007**								5.7		9.1		4.6
c	**WY2008**								6.4		7.0		10.8
d	**WY2009**								8.4		4.1		12.4
e	**WY2010**								5.2		6.7		6.0
f	**WY2011**		6.9						6.2		6.0		6.6
	n	0	1	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	1	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
S_k	0	0	0	0	0	0	0	3	0	-1	0	3

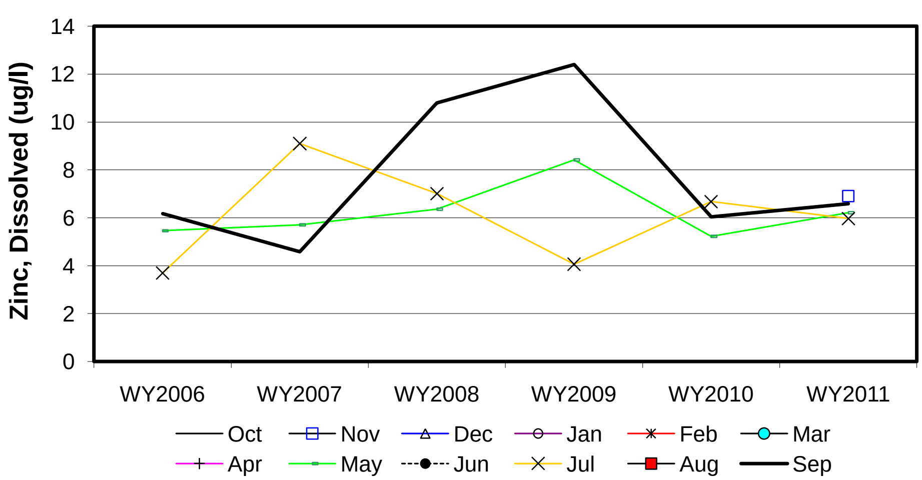
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=								28.33		28.33		28.33
$Z_k = S_k/\sigma_S$								0.56		-0.19		0.56
Z^2_k								0.32		0.04		0.32

ΣZ_k= 0.94
ΣZ^2_k= 0.67
Z-bar=$\Sigma Z_k/K$= 0.31

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

Σn 19
ΣS_k 5

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=		0.38	@α=5% $\chi^2_{(K-1)}$= 5.99	Test for station homogeneity	
	p	**0.828**		$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
$\Sigma VAR(S_k)$	Z_{calc}	0.43	@$\alpha/2$=2.5% Z= 1.96	$\mathbf{H_0}$ (No trend)	ACCEPT
85.00	**p**	**0.668**		$\mathbf{H_A}$ (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.79		0.96
0.050	-0.37	**0.13**	0.56
0.100	-0.16		0.49
0.200	-0.05		0.45

INTERPRETIVE REPORT
SITE 60 “–LOWER ALTHEA CREEK”

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 2011” 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 2006 through September 2011.				

The data for water year 2011 have been compared to the strictest fresh water quality criterion for each applicable analyte. Eight results exceeding these criteria have been identified, as listed in the table below. Two of the datum are for field pHs with values of 6.43 su (November 2010) and 4.99 su (September 2011), both of which are 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. 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.

Table of Exceedance for Water Year 2011

Sample Date	Parameter	Value		Limits Lower	Limits Upper	Hardness
2-Nov-10	Alkalinity	5.6	mg/L	20		
19-May-11	Alkalinity	7.9	mg/L	20		
12-Jul-11	Alkalinity	10.3	mg/L	20		
12-Sep-11	Alkalinity	9.9	mg/L	20		
12-Jul-11	Mercury Dissolved	0.0148	µg/L		0.01	
12-Sep-11	Mercury Dissolved	0.0183	µg/L		0.01	
2-Nov-10	pH Field	6.43	su	6.5	8.50	
12-Sep-11	pH Field	4.99	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 – 2011. 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).

Though two of the four sampling events from the 2011water year had dissolved mercury levels that were below the AWQS, the other two samples were above the AWQS. The highest concentration reached during the current water year was 0.0183 µg/L in September 2011 which was less than the highest value ever recorded of 0.0227µg/L from September 2010. Additional sampling in adjacent drainages during WY2009 showed that this issue was isolated to only the Althea watershed.

A non-parametric statistical analysis for trend was performed for specific conductivity, field pH, total alkalinity, total sulfate, and dissolved zinc. Calculation details of the Seasonal Kendall analyses are presented in detail on the pages following this interpretive section. The following table summarizes the results on the data collected between Oct-05 and Sep-11 (WY2006-WY2011). This marks the first 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	0.03			
pH Field	6	0.05			
Alkalinity, Total	6	<0.01	-	-12.64	-105.8
Sulfate, Total	6	<0.01	-	-16.45	-265.1
Zinc, Dissolved	6	<0.01	+	0.68	12.8

* Number of Years ** Significance level

There were three statistically significant ($\alpha/2=2.5\%$) trends identified for the current water year. The statistical analysis for trends in field pH and total sulfate supports the visual observations of trends discussed previously. There also was a statistically significant increasing trend in dissolved zinc with a Sen's slope estimate of 0.675 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 2011

Site 060FMS - 'Lower Althea creek'

Sample Date/Parameter	Oct 2010	Nov 2010	Dec 2010	Jan 2011	Feb 2011	Mar 2011	Apr 2011	May 2011	Jun 2011	Jul 2011	Aug 2011	Sep 2011	**Median**
Water Temp (°C)		6.6						5.7		11		9	7.8
Conductivity-Field(µmho)		48.3						85		71		61	66.0
Conductivity-Lab (µmho)		47						84		74		60	67
pH Lab (standard units)		5.63						6.38		5.84		6.12	5.98
pH Field (standard units)		6.43						6.78		7.15		4.99	6.61
Total Alkalinity (mg/L)		5.6						7.9		10.3		9.9	8.9
Total Sulfate (mg/L)		2.5						6.2		15		5	5.6
Hardness (mg/L)		23.9						28.1		29.3		26	27.1
Dissolved As (ug/L)		2.45						1.28		1.79		2.49	2.120
Dissolved Ba (ug/L)		17.6						16.9		20		20.3	18.8
Dissolved Cd (ug/L)		0.0168						0.0169		0.0145		0.0235	0.0169
Dissolved Cr (ug/L)		1						1.16		1.68		1.47	1.315
Dissolved Cu (ug/L)		1.3						0.874		1.18		1.3	1.240
Dissolved Pb (ug/L)		0.421						0.151		0.292		0.249	0.2705
Dissolved Ni (ug/L)		1.5						1.28		1.65		1.84	1.575
Dissolved Ag (ug/L)		0.004						0.005		0.008		0.007	0.006
Dissolved Zn (ug/L)		5.48						5.45		5.66		7.13	5.57
Dissolved Se (ug/L)		0.289						0.146		0.177		0.304	0.233
Dissolved Hg (ug/L)		0.00622						0.0107		0.0148		0.0183	0.012750

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.

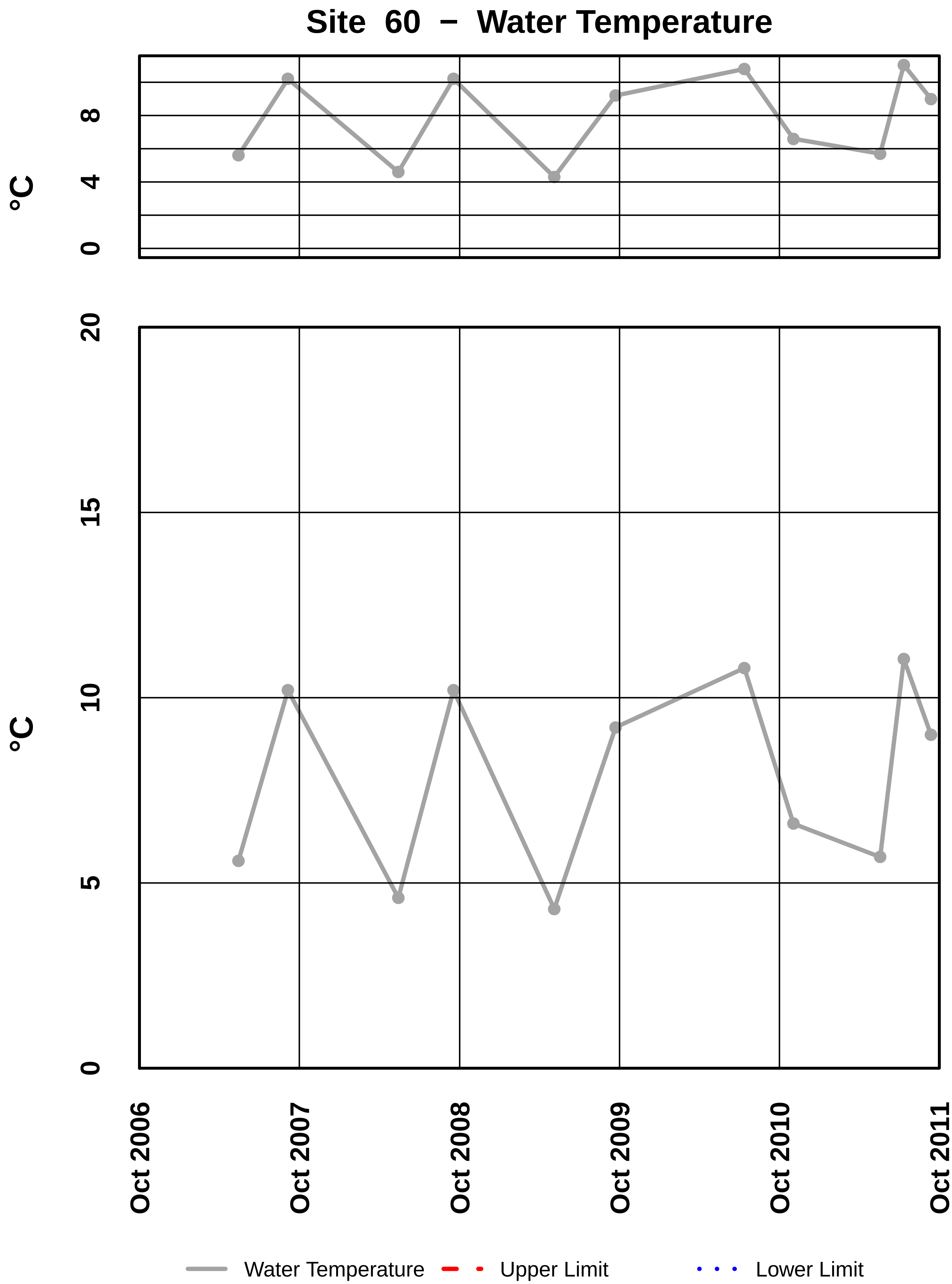
Shaded data has been qualified as an outlier by KGCMC and removed from any further analysis and is not included into the calculation of the median

Qualified Data by QA Reviewer

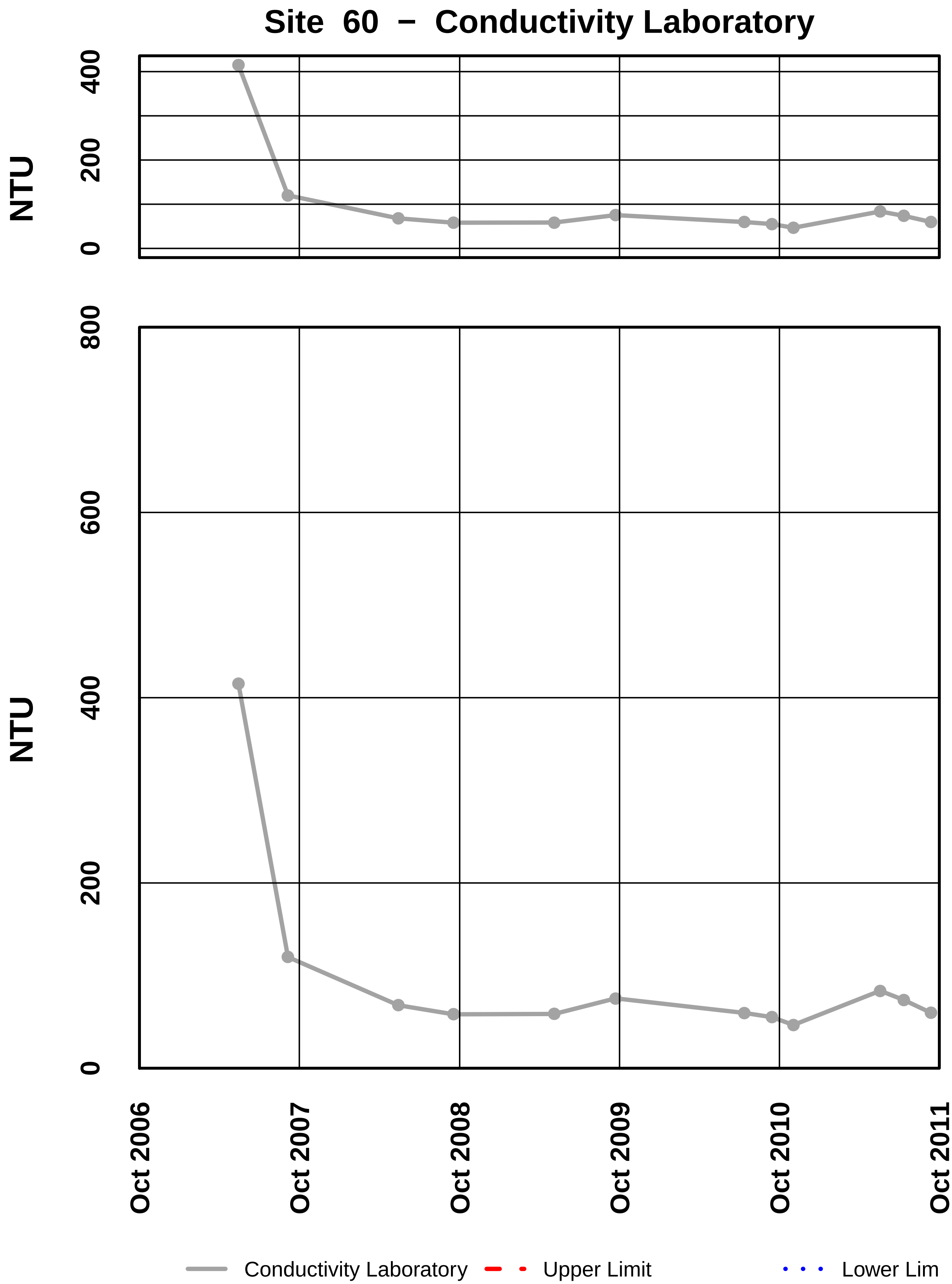
Date Range: 10/01/2010 to 09/30/2011

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
60	11/2/2010	12:00 AM				
			Se diss, µg/l	0.289	J	Below Quantitative Range
			Cd diss, µg/l	0.0168	J	Below Quantitative Range
60	5/19/2011	12:00 AM				
			SO4 Tot, mg/l	6.2	J	Sample Reciept Temperature
			Se diss, µg/l	0.146	J	Below Quantitative Range, Duplicate RPD
			Ag diss, µg/l	0.00487	J	Below Quantitative Range
			pH Lab, su	6.38	J	Hold Time Violation
			Cd diss, µg/l	0.0169	U	Trip Blank Contamination
			Pb diss, µg/l	0.151	U	Field Blank Contamination
60	7/12/2011	12:00 AM				
			Se diss, µg/l	0.17	J	Below Quantitative Range
			Ag diss, µg/l	0.00821	J	Below Quantitative Range
			SO4 Tot, mg/l	-30	R	Sample Reciept Temperature
60	9/12/2011	12:00 AM				
			Se diss, µg/l	0.3	J	Below Quantitative Range
			Ag diss, µg/l	0.00661	J	Below Quantitative Range
			SO4 Tot, mg/l	0	UJ	Sample Receipt Temperature

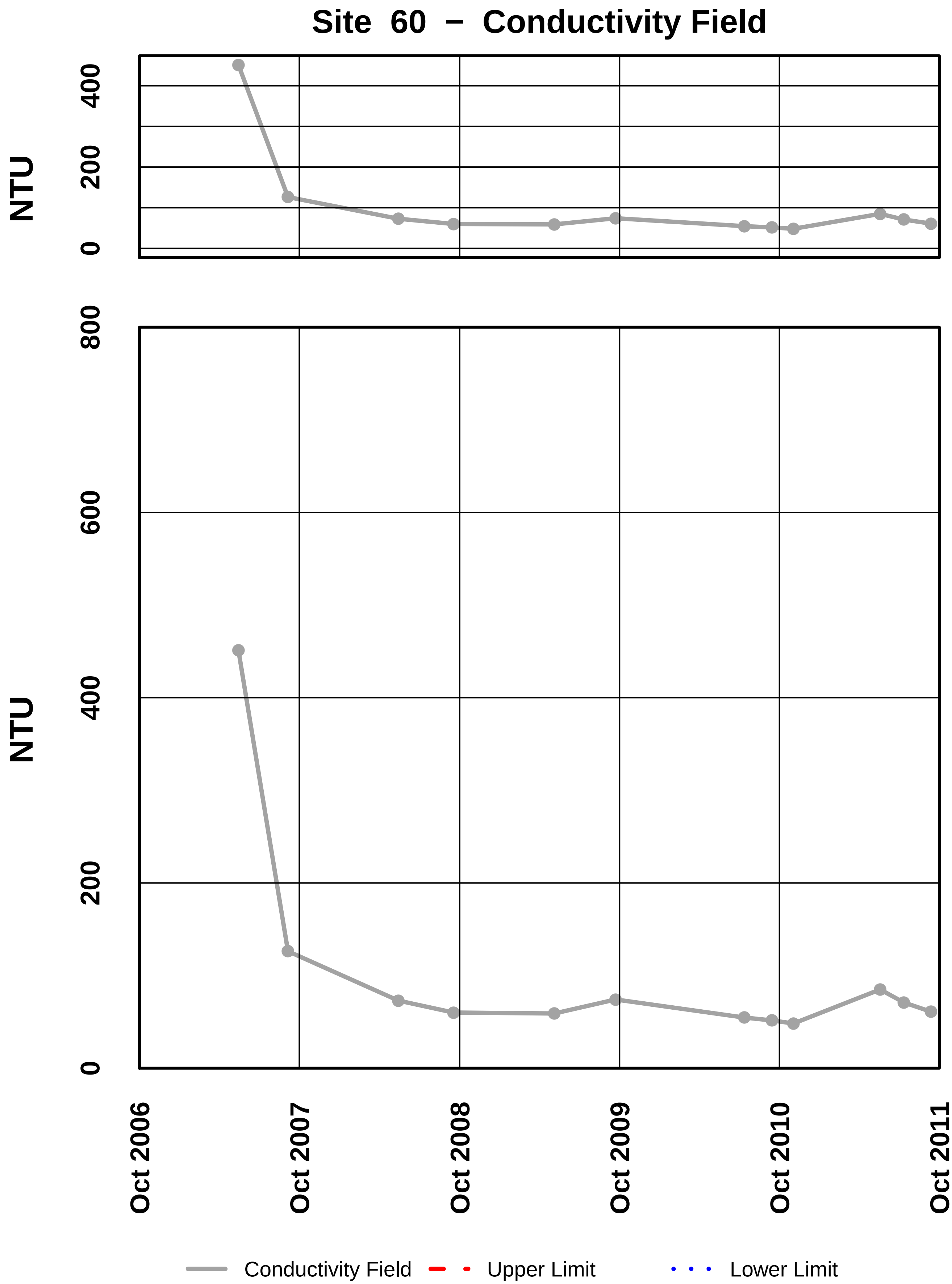
Qualifier	**Description**
J	Positively Identified - Approximate concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation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



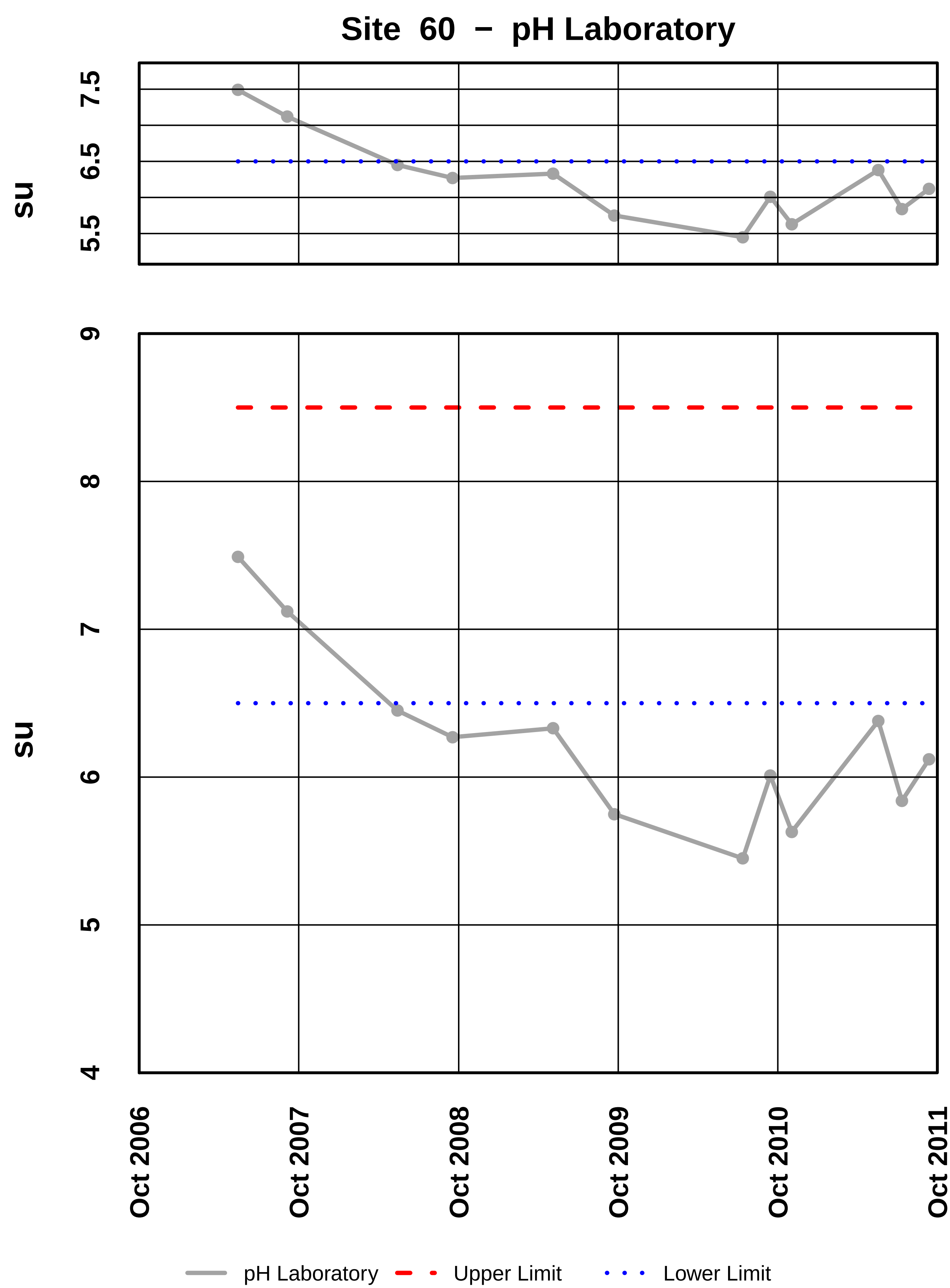
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

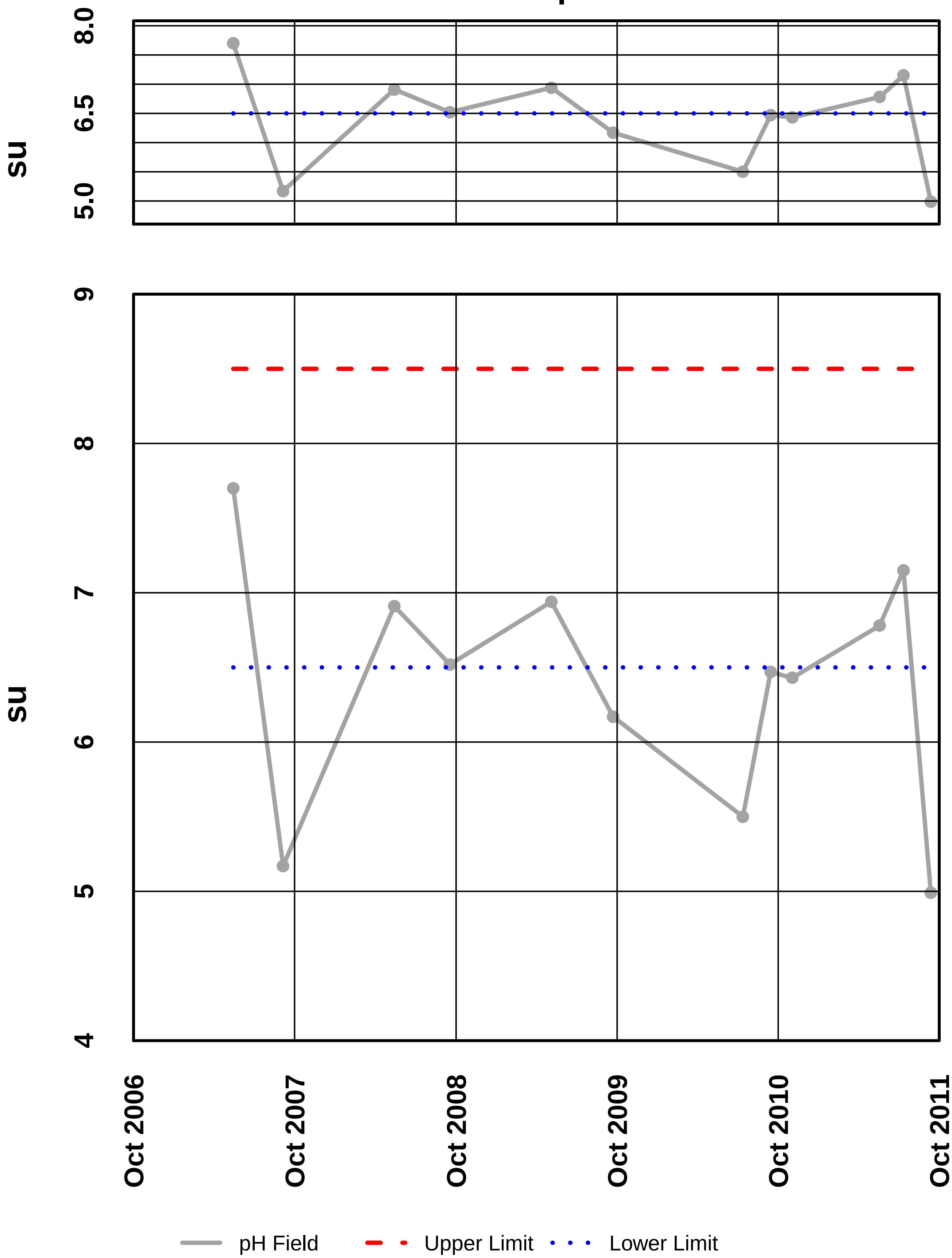


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

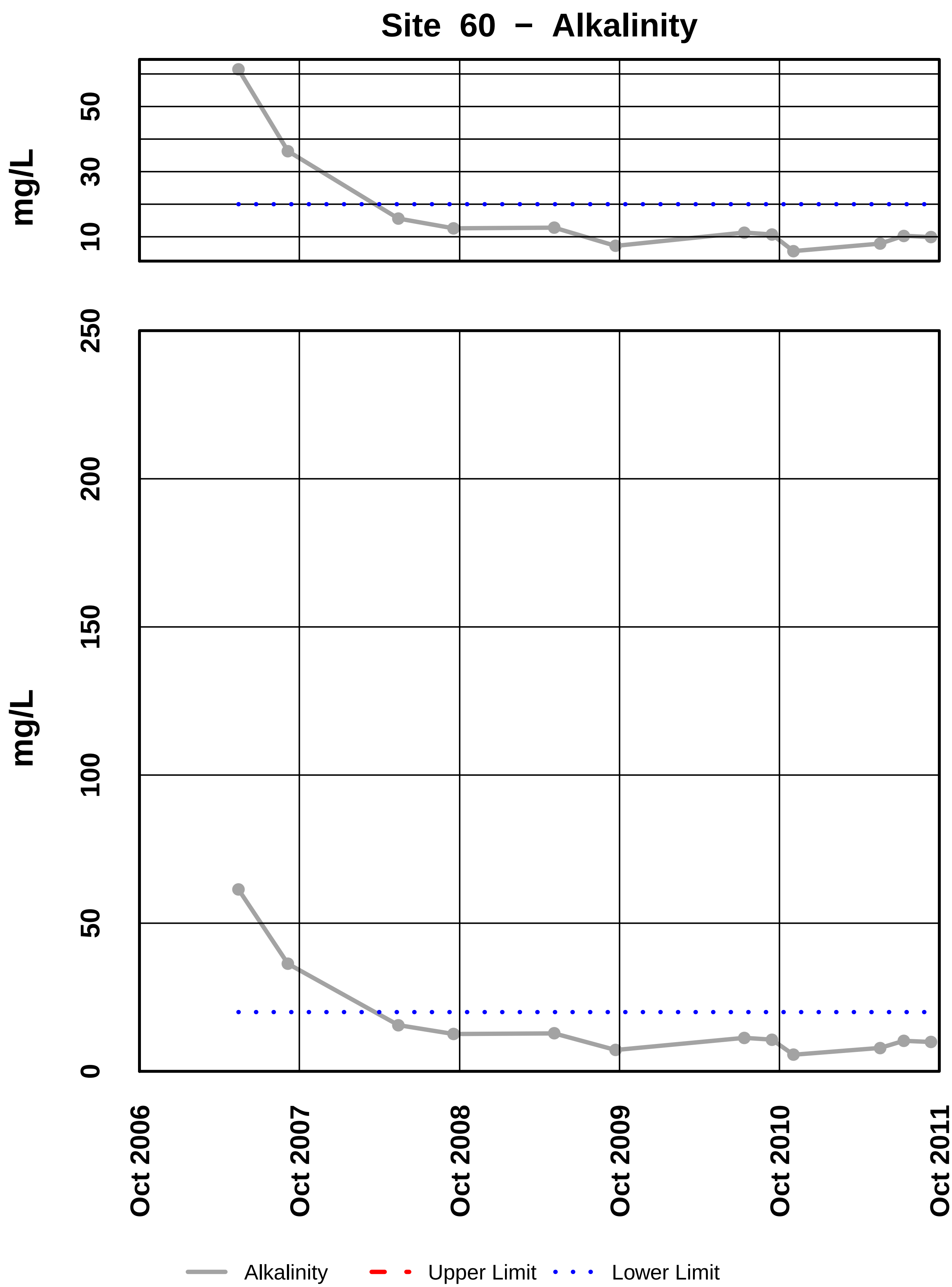


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

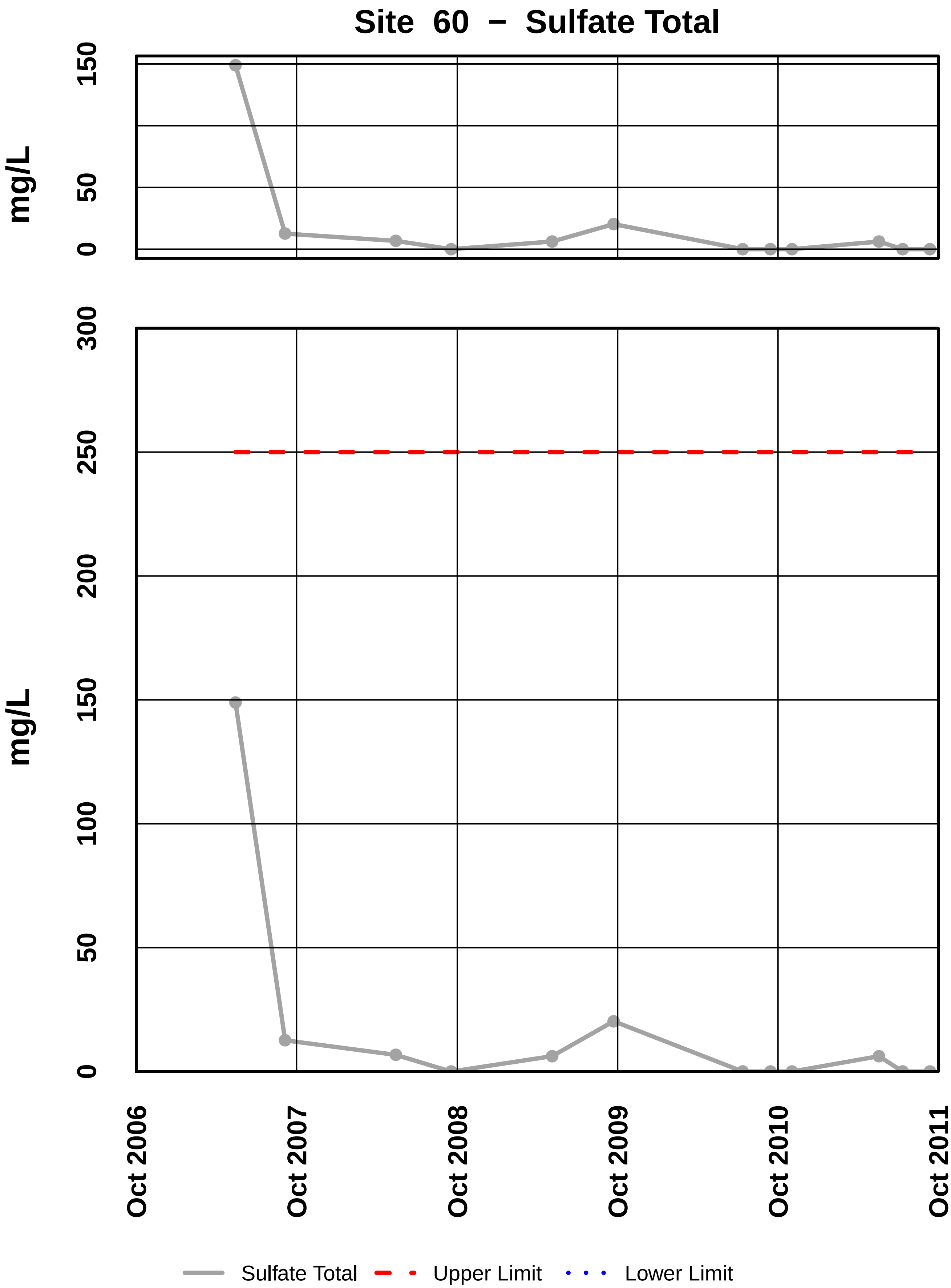
Site 60 – pH Field



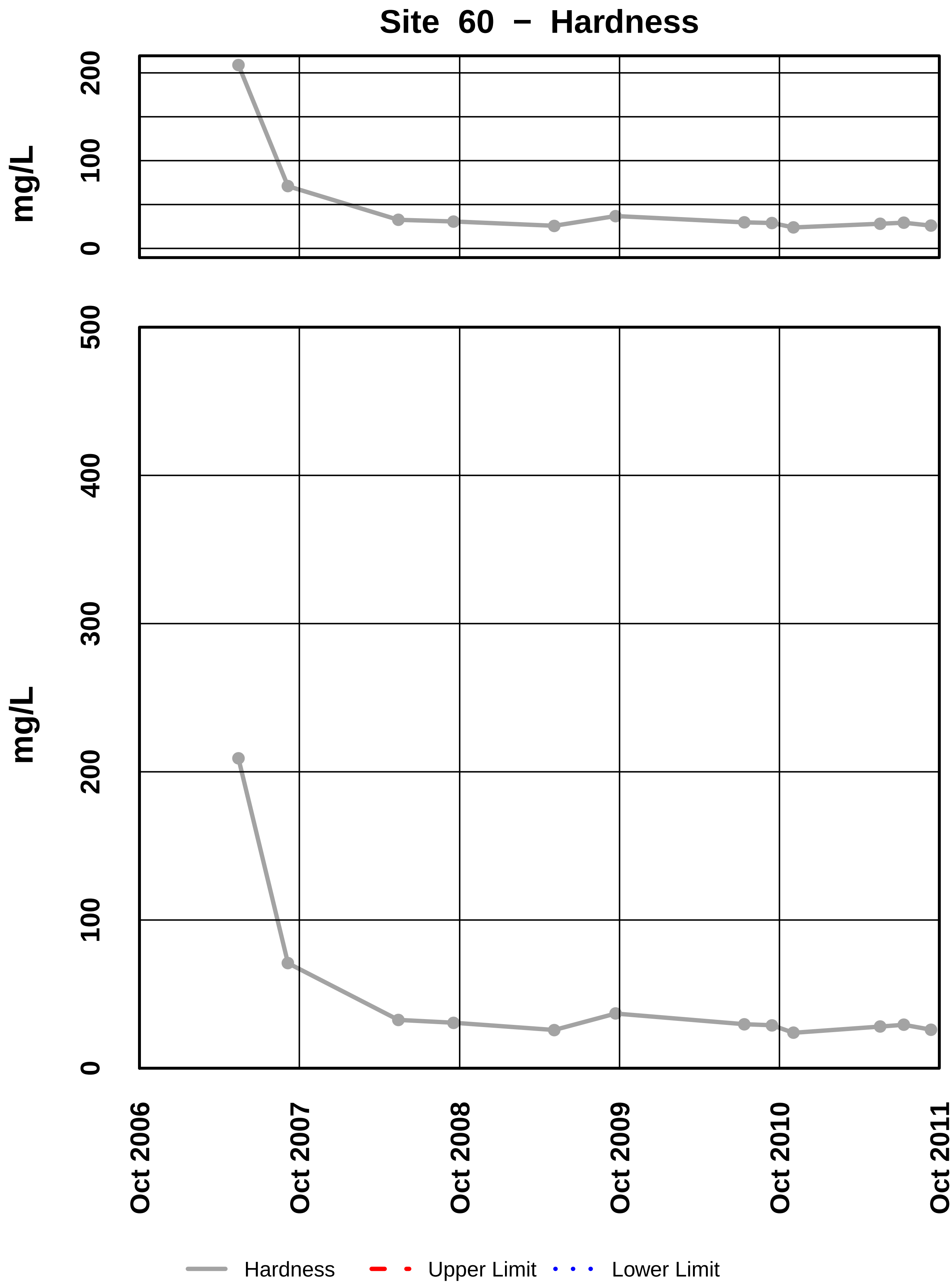
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



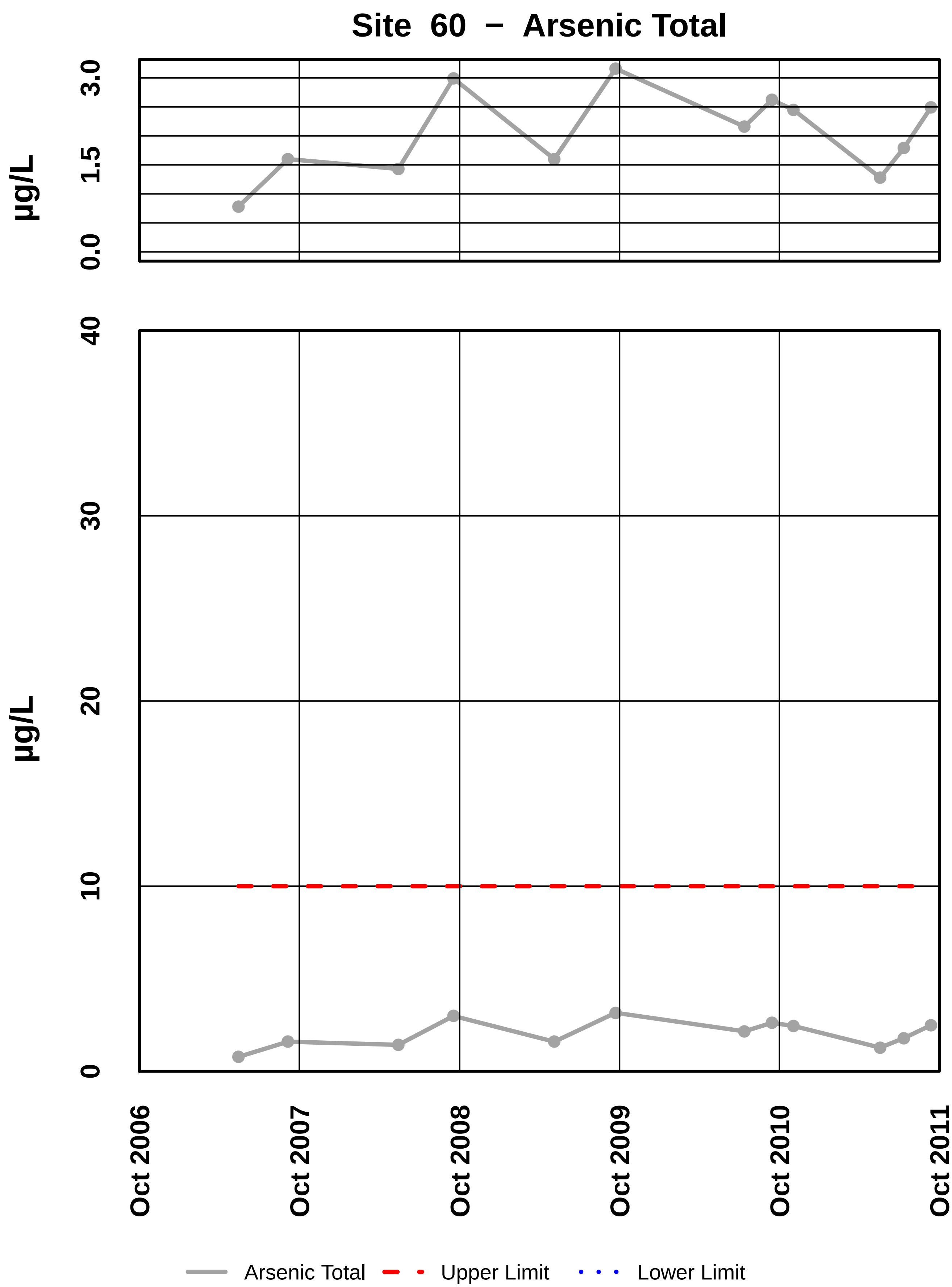
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



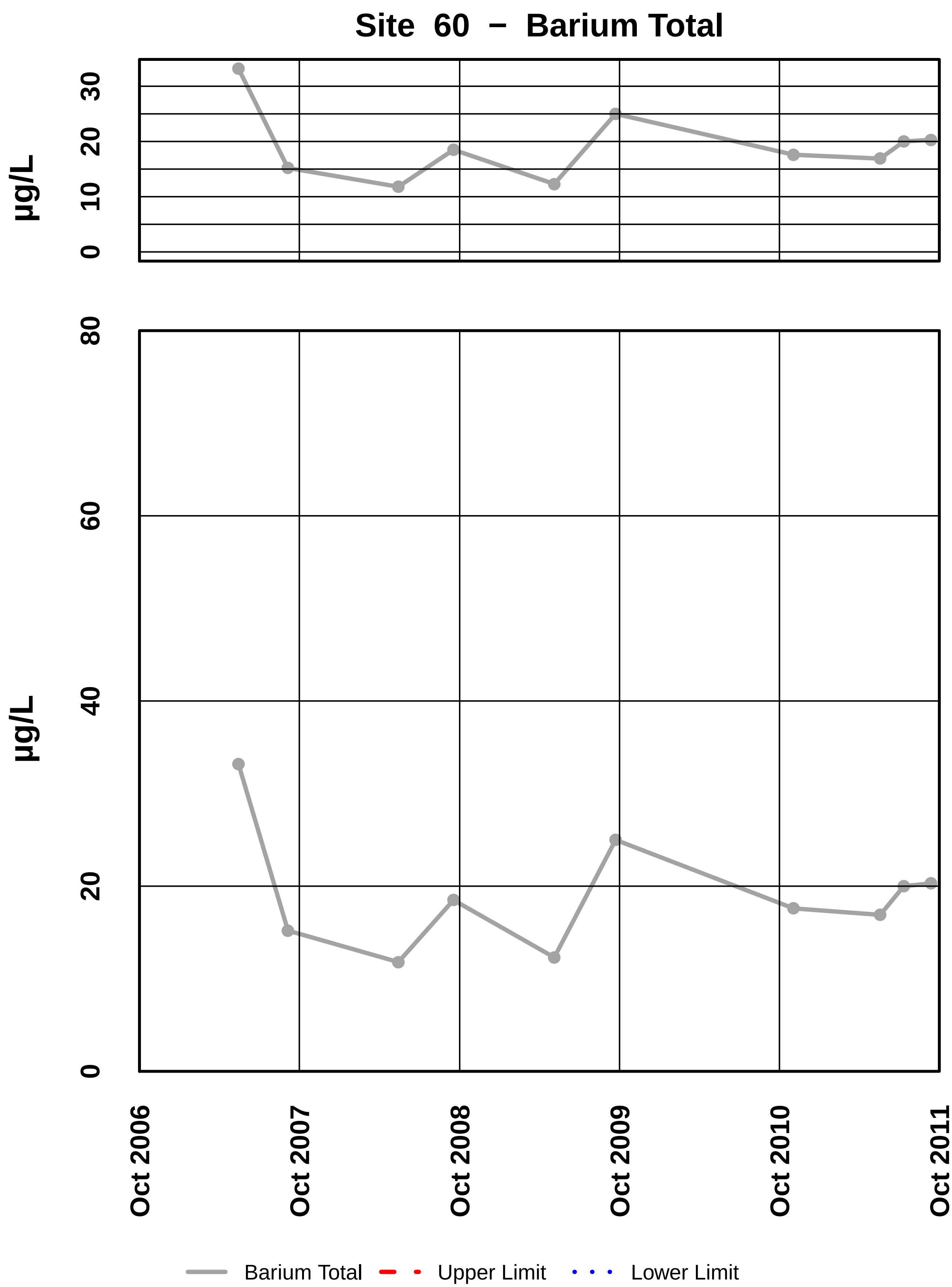
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



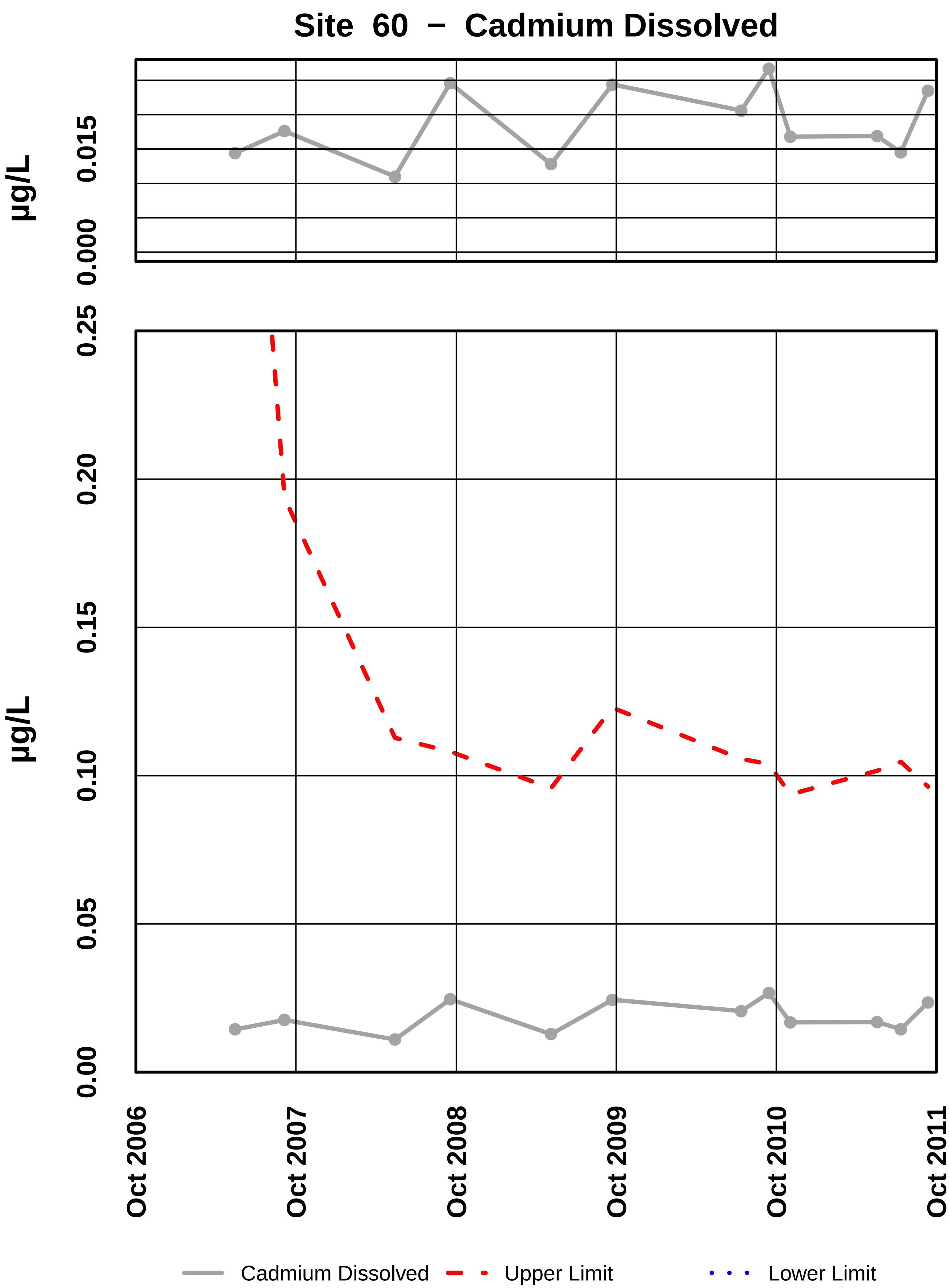
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



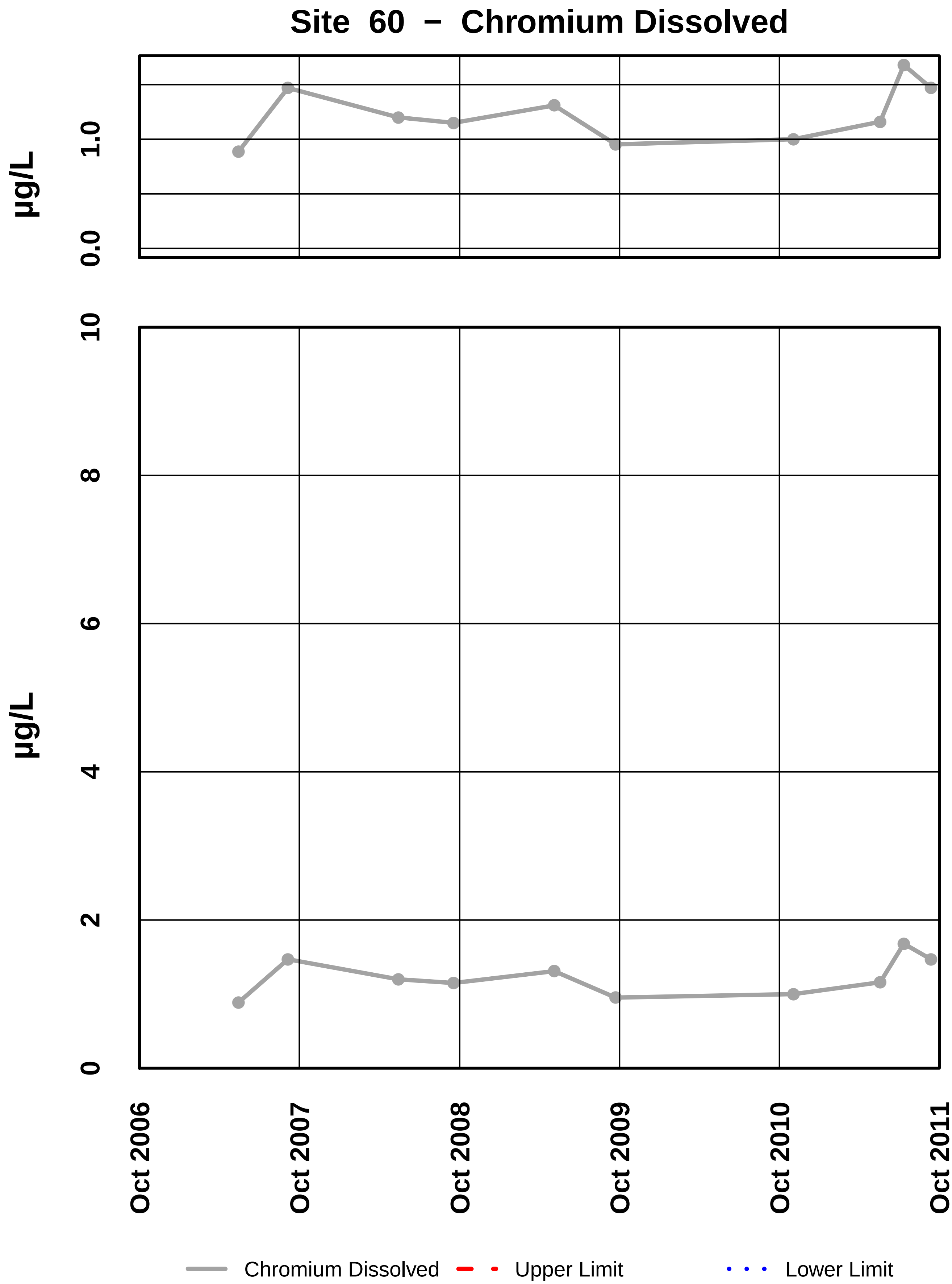
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



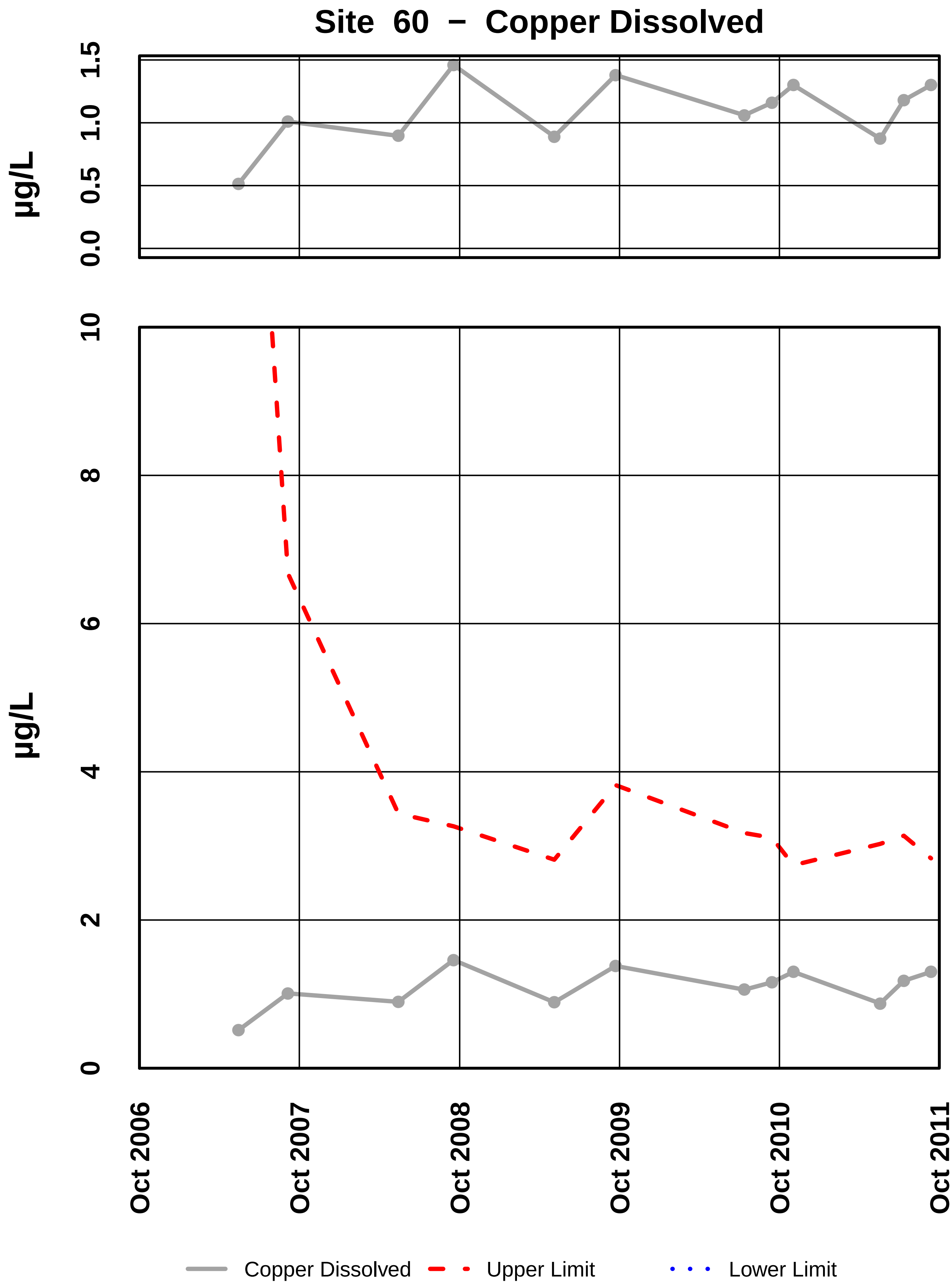
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



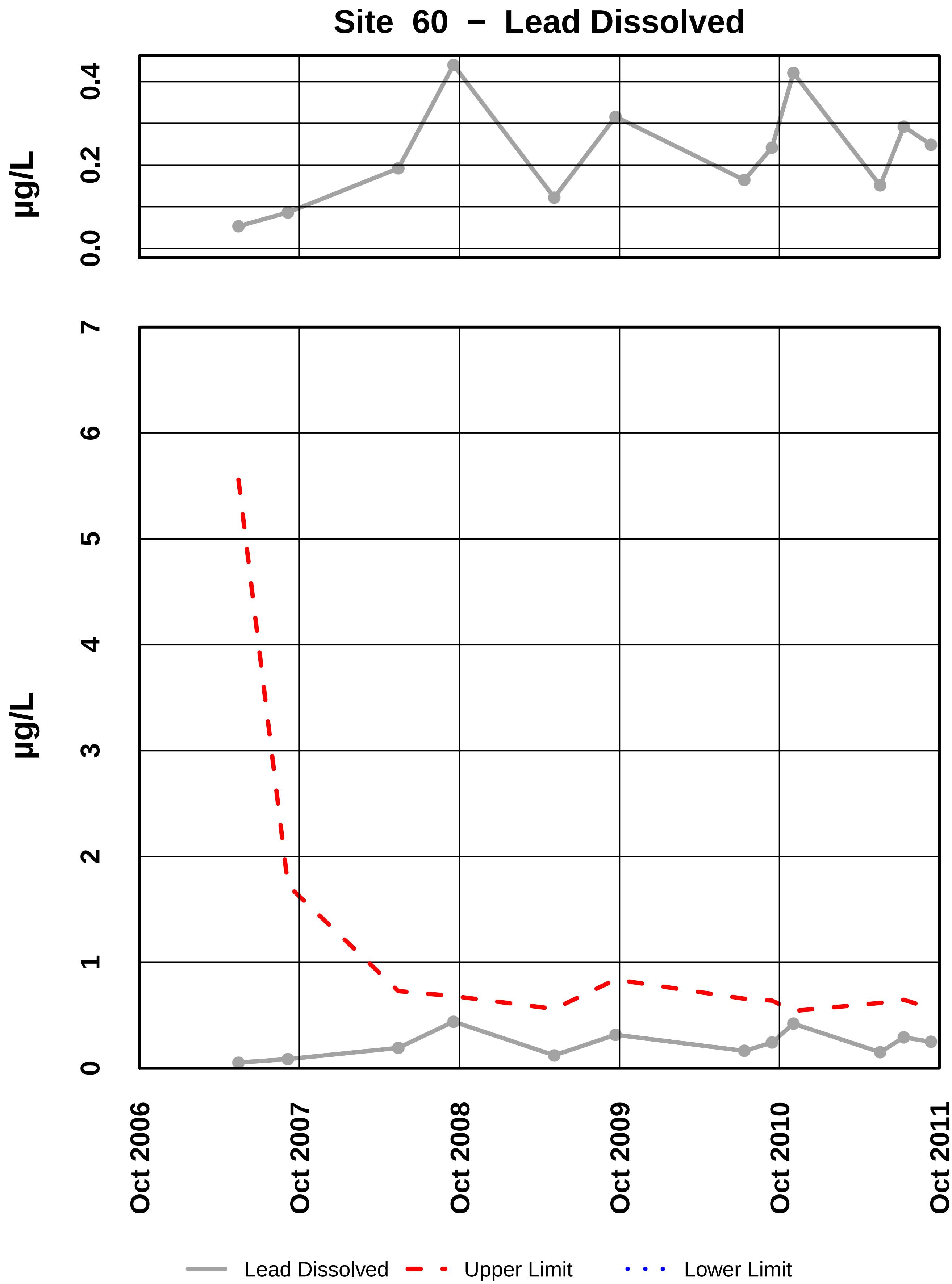
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



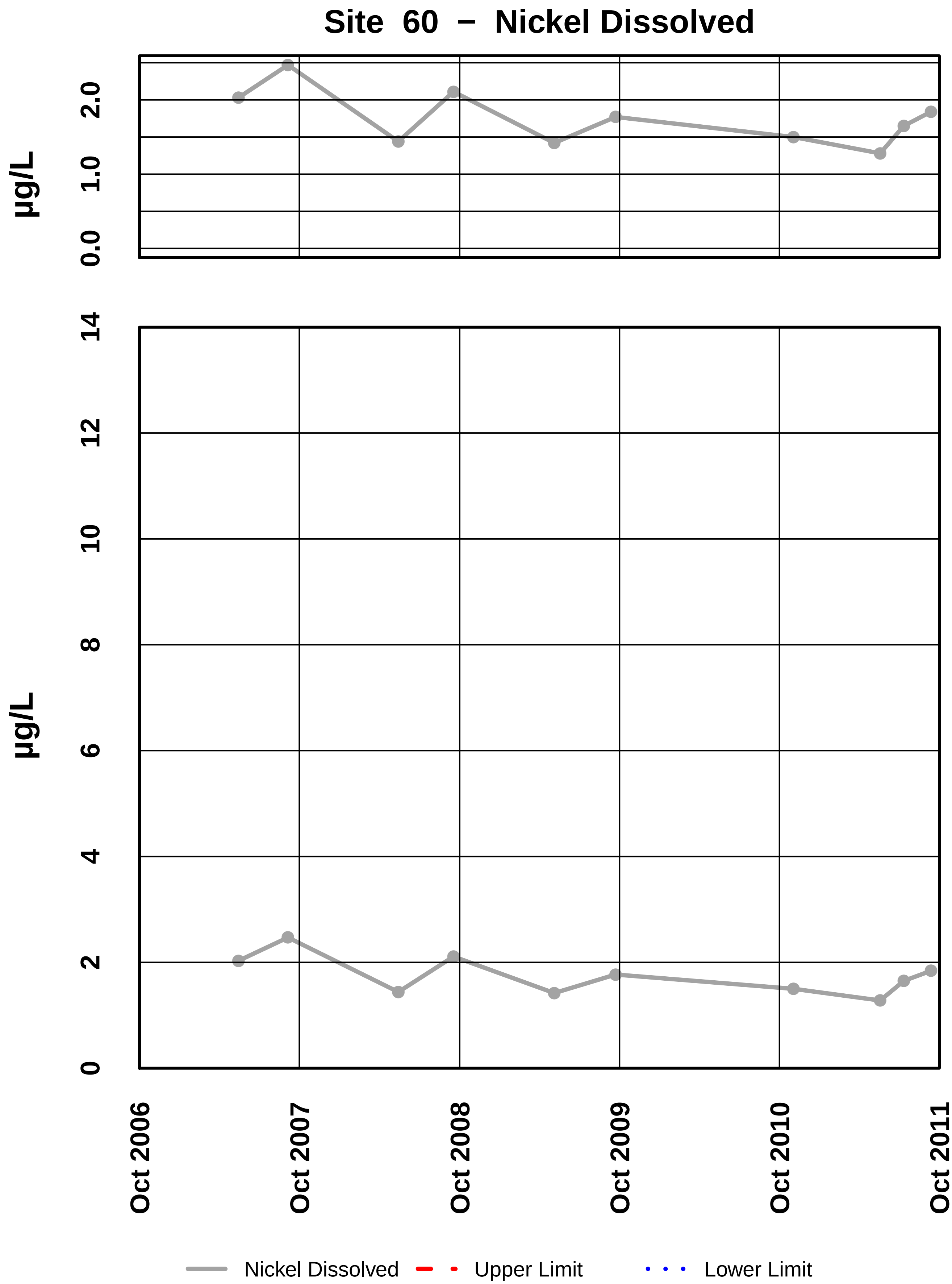
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

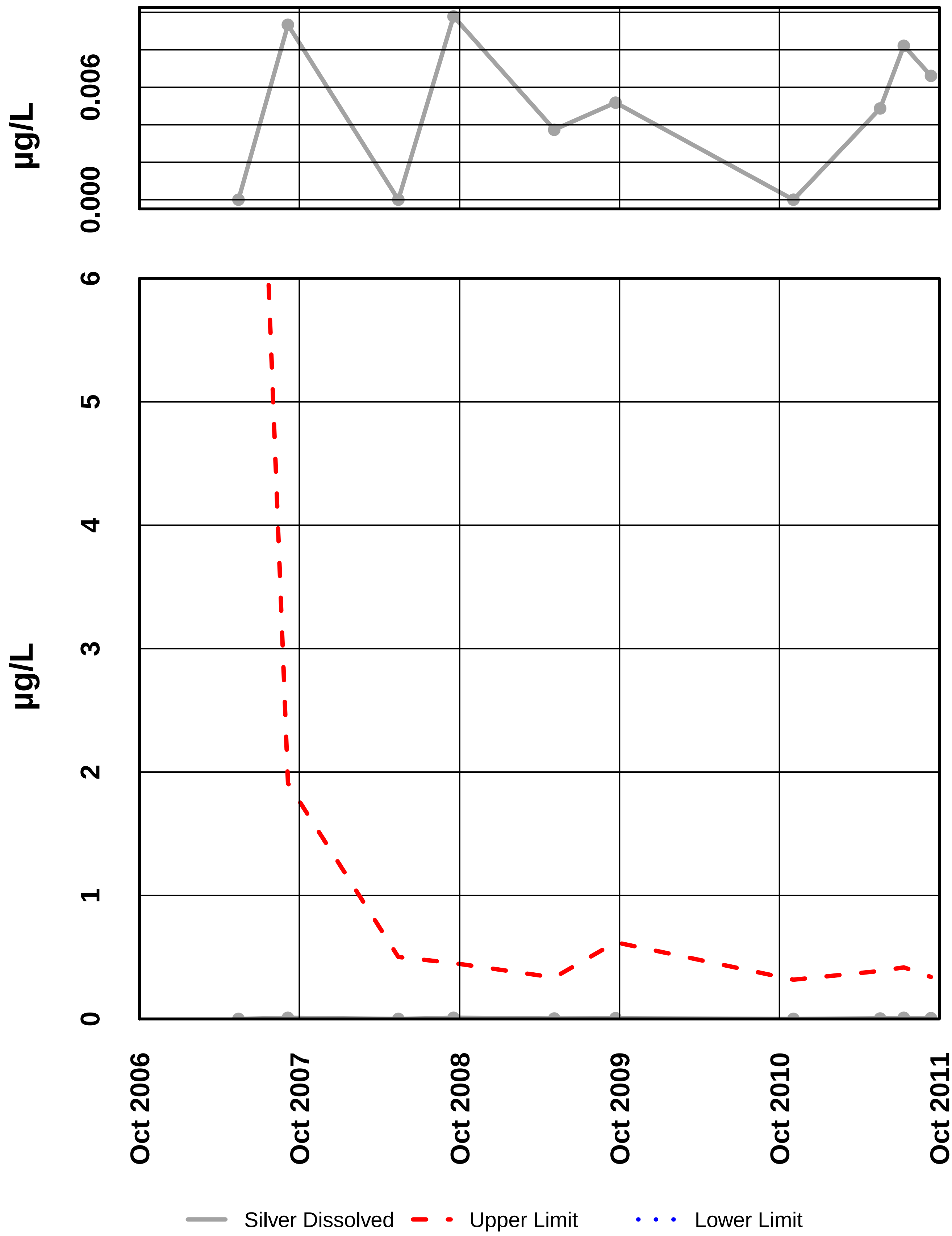


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



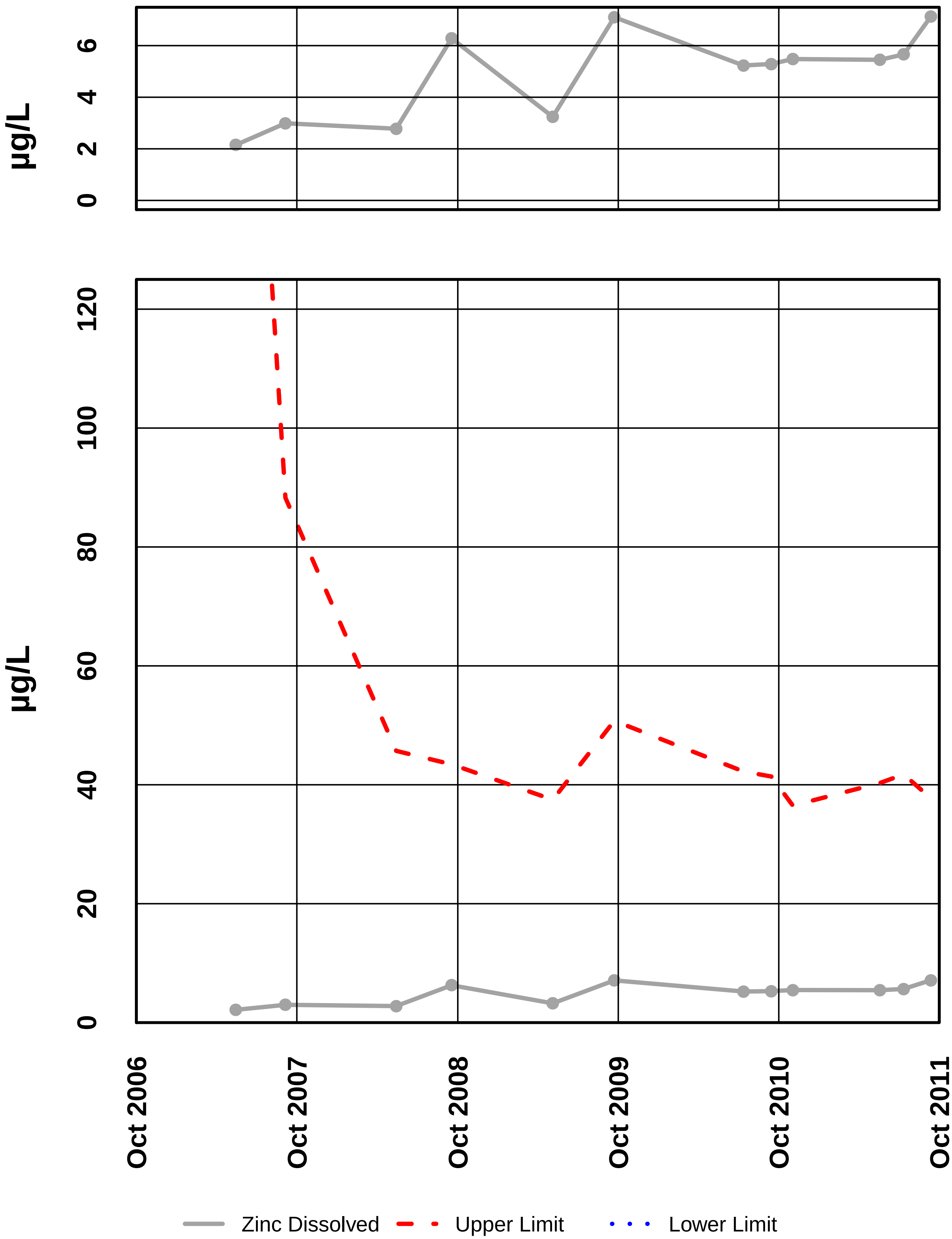
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 60 – Silver Dissolved

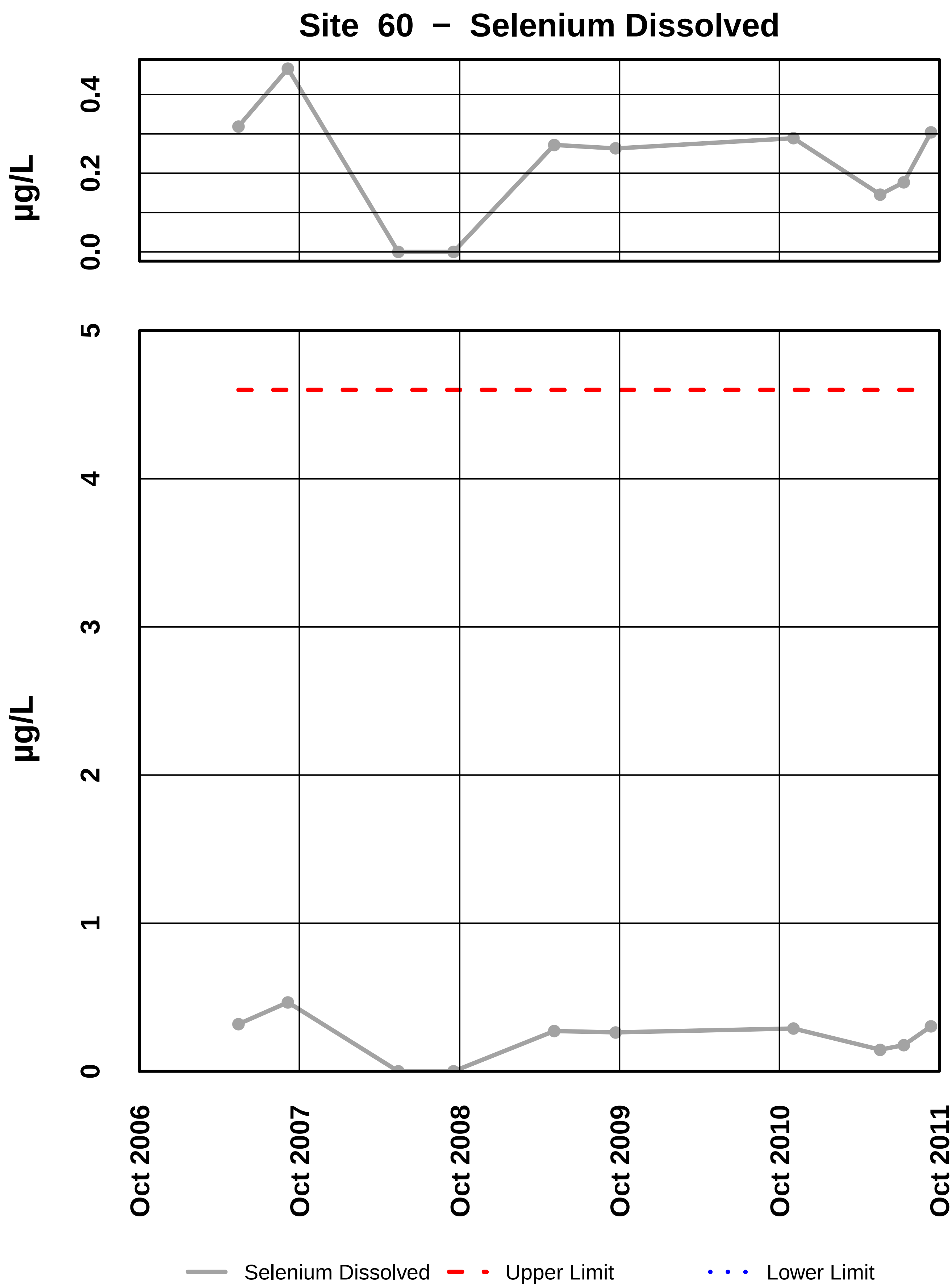


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

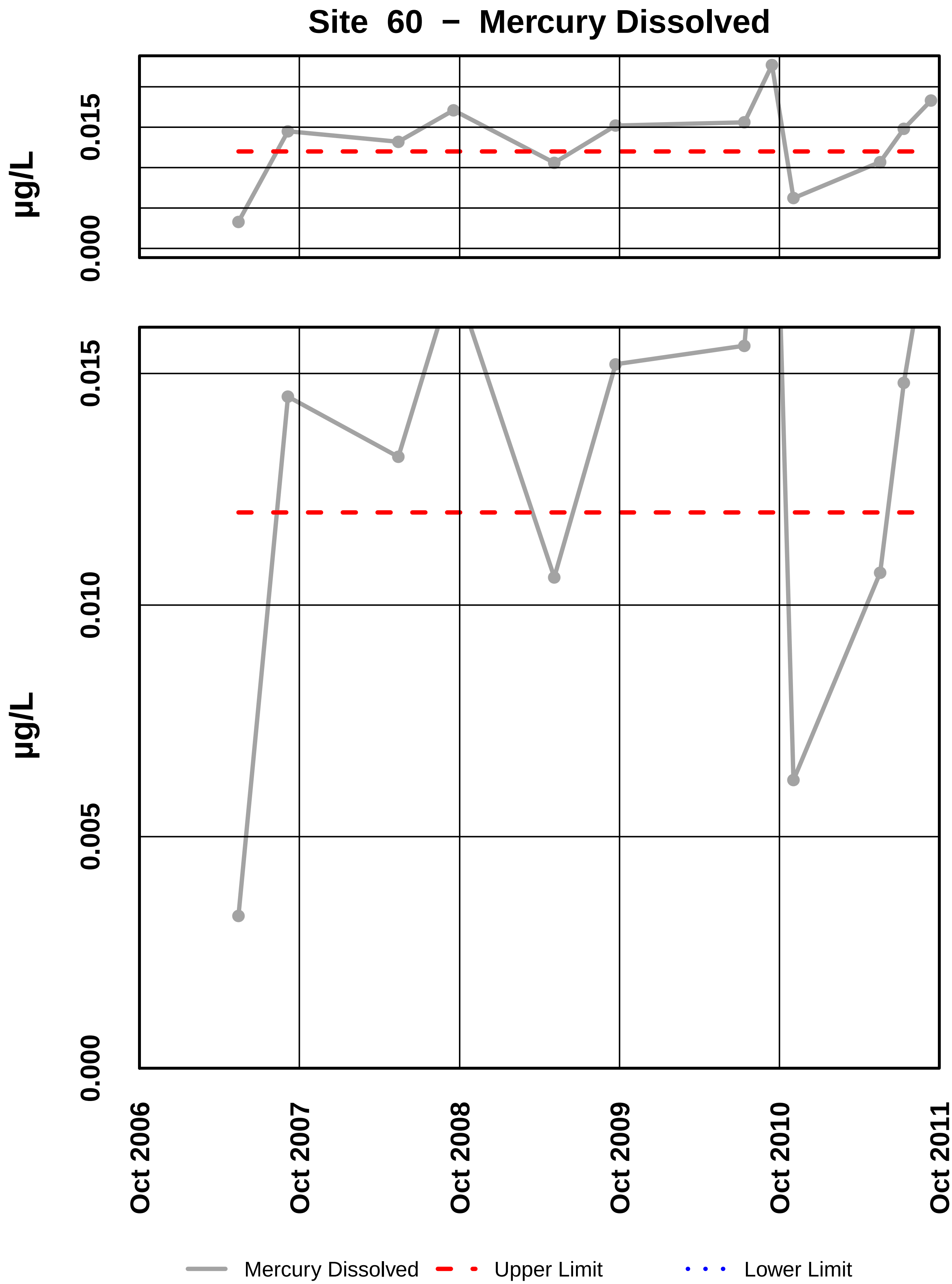
Site 60 – Zinc Dissolved



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 **#60** Seasonal Kendall analysis for pH, Lab, Standard Units

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY2006**								7.2				7.3
b	**WY2007**								7.7				5.2
c	**WY2008**								6.9				6.5
d	**WY2009**								6.9				6.2
e	**WY2010**										5.5		6.5
f	**WY2011**		6.4						6.8		7.2		5.0
	n	0	1	0	0	0	0	0	5	0	2	0	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	0	1	0	0	0	0	0	5	0	2	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
f-a								-1				-1
c-b								-1				1
d-b								-1				1
e-b												1
f-b								-1				-1
d-c								1				-1
e-c												-1
f-c								-1				-1
e-d												1
f-d								-1				-1
f-e										1		-1
S_k	0	0	0	0	0	0	0	-6	0	1	0	-7

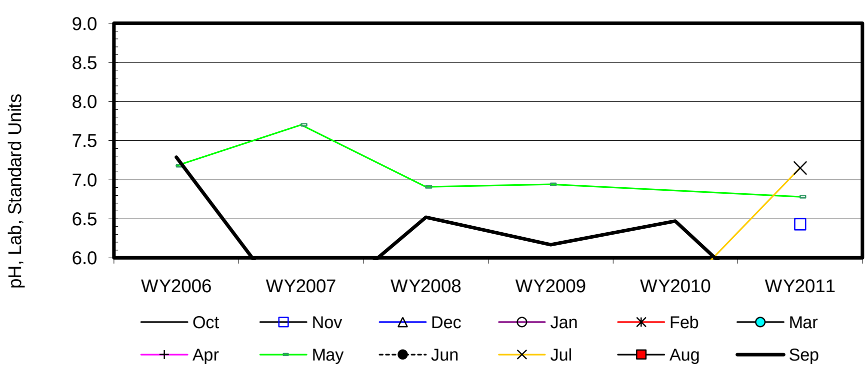
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=								16.67		1.00		28.33
$Z_k = S_k/\sigma_S$								-1.47		1.00		-1.32
Z^2_k								2.16		1.00		1.73

ΣZ_k=	-1.78
ΣZ^2_k=	4.89
Z-bar=$\Sigma Z_k/K$=	-0.59

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	14	0	0	0	0

Σn	14
ΣS_k	-12

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$=		3.83	@α=5% $\chi^2_{(K-1)}$=	5.99	Test for station homogeneity	
	p	**0.148**			$\chi^2_h<\chi^2_{(K-1)}$	ACCEPT
$\Sigma VAR(S_k)$	Z_{calc}	-1.62	@α/2=2.5% Z=	1.96	H_0 (No trend)	ACCEPT
46.00	p	**0.052**			H_A (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.50		0.27
0.050	-0.38	**-0.11**	-0.03
0.100	-0.38		-0.04
0.200	-0.33		-0.08

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	**WY2006**								203.0				69.4
b	**WY2007**								61.4				36.3
c	**WY2008**								15.6				12.6
d	**WY2009**								12.8				7.2
e	**WY2010**										11.3		10.7
f	**WY2011**		5.6						7.9		10.3		9.9
	n	0	1	0	0	0	0	0	5	0	2	0	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	0	1	0	0	0	0	0	5	0	2	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
f-a								-1				-1
c-b								-1				-1
d-b								-1				-1
e-b												-1
f-b								-1				-1
d-c								-1				-1
e-c												-1
f-c								-1				-1
e-d												1
f-d								-1				1
f-e										-1		-1
S_k	0	0	0	0	0	0	0	-10	0	-1	0	-11

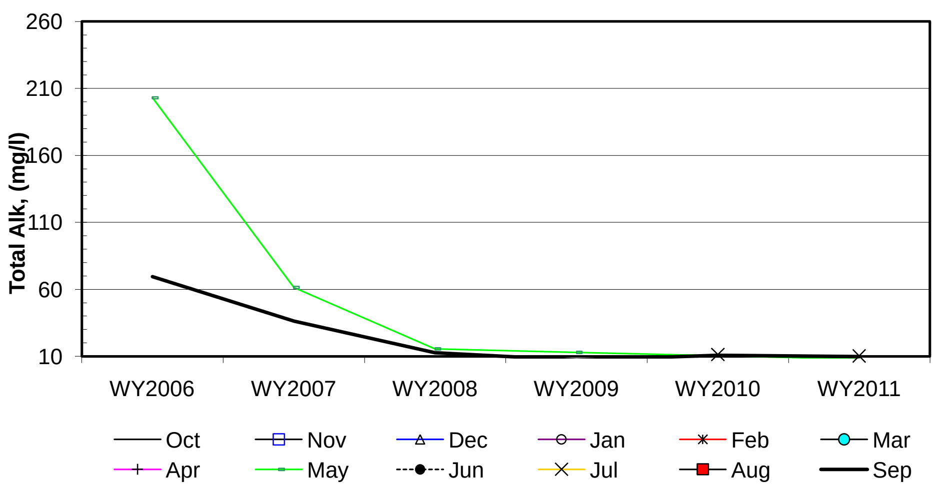
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
$\sigma^2{}_S$=								16.67		1.00		28.33
$Z_k = S_k/\sigma_S$								-2.45		-1.00		-2.07
$Z^2{}_k$								6.00		1.00		4.27

ΣZ_k=	-5.52
$\Sigma Z^2{}_k$=	11.27
Z-bar=$\Sigma Z_k/K$=	-1.84

Tie Extent	t_1	t_2	t_3	t_4	t_5
Count	14	0	0	0	0

Σn	14
ΣS_k	-22

$\chi^2{}_h=\Sigma Z^2{}_k-K(\text{Z-bar})^2$=	1.13	@α=5% $\chi^2{}_{(K-1)}$=	5.99	Test for station homogeneity	
p	**0.569**			$\chi^2{}_h<\chi^2{}_{(K-1)}$	ACCEPT
ΣVAR(S_k)	Z_{calc} -3.10	@α/2=2.5% Z=	1.96	H_0 (No trend)	REJECT
46.00	p **0.001**			H_A (± trend)	ACCEPT



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-38.36		-1.16
0.050	-26.67	**-12.64**	-2.67
0.100	-23.91		-4.50
0.200	-19.85		-6.88

-105.8%

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	**WY2006**								217.0				285.0
b	**WY2007**								149.0				12.6
c	**WY2008**								6.7				0.0
d	**WY2009**								6.2				20.3
e	**WY2010**										0.0		0.0
f	**WY2011**		0.0						6.2		0.0		0.0
	n	0	1	0	0	0	0	0	5	0	2	0	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	0	1	0	0	0	0	0	5	0	0	0	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	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				-1
e-a												-1
f-a								-1				-1
c-b								-1				-1
d-b								-1				1
e-b												-1
f-b								-1				-1
d-c								-1				1
e-c												0
f-c								-1				0
e-d												-1
f-d								-1				-1
f-e										0		0
S_k	0	0	0	0	0	0	0	-10	0	0	0	-8

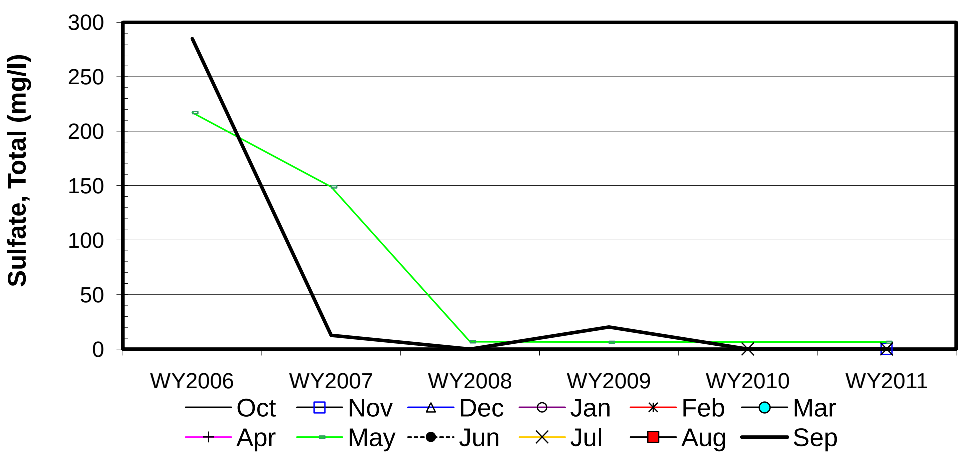
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=								16.67		0.00		24.67
Z_k = S_k/σ_S								-2.45		#DIV/0!		-1.61
Z^2_k								6.00		#DIV/0!		2.59

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	9	1	1	0	0

Σn	14
ΣS_k	-18

$\chi^2_h=\Sigma Z^2_k$-K(Z-bar)^2=		#DIV/0!	@α=5% $\chi^2_{(K-1)}$=	5.99	Test for station homogeneity	
	p	**#DIV/0!**			$\chi^2_h<\chi^2_{(K-1)}$	#DIV/0!
ΣVAR(S_k)	Z_{calc}	-2.64	@α=2.5% Z=	1.96	**H_0** (No trend)	REJECT
41.33	**p**	**0.004**			**H_A** (± trend)	#DIV/0!



Seasonal-Kendall Slope Confidence Intervals

α	Lower Limit	Sen's Slope	Upper Limit
0.010	-79.45		0.00
0.050	-70.55	**-16.45**	-0.42
0.100	-68.27		-2.84
0.200	-52.63		-5.95
		#DIV/0!	

INTERPRETIVE REPORT
SITE 1185 "–MONITORING WELL -T-10-08A"

Sampling at this site was initiated during the summer of the water year 2011. Site 1185 was drilled in the summer of 2010 and then developed over the next year. Sampling began in July 2011, and it is scheduled to be sampled in November, May, July, and September of the current water year 2012. This well may serve as the new upgradient background site to the tailings facility and is analogous to Site 59FMG (MW-T-00-01A). The upgradient nature of Site 59FMG was compromised during the East Ridge Expansion, because it is now located between the old B road and the new B road location. Also, there has been a material (i.e. road rock) pad built upgradient to Site 59FMG.

The data collected during the current water year are listed in the following "Table of Results for Water Year 2011" 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.

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 2010 through September 2011.				

The data for Water Year 2011 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 2011

			Limits		
Sample Date	**Parameter**	**Value**	**Lower**	**Upper**	**Hardness**
No exceedances have been identified by HGCMC for the period of October 2010 through September 2011.					

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

Table of Results for Water Year 2011

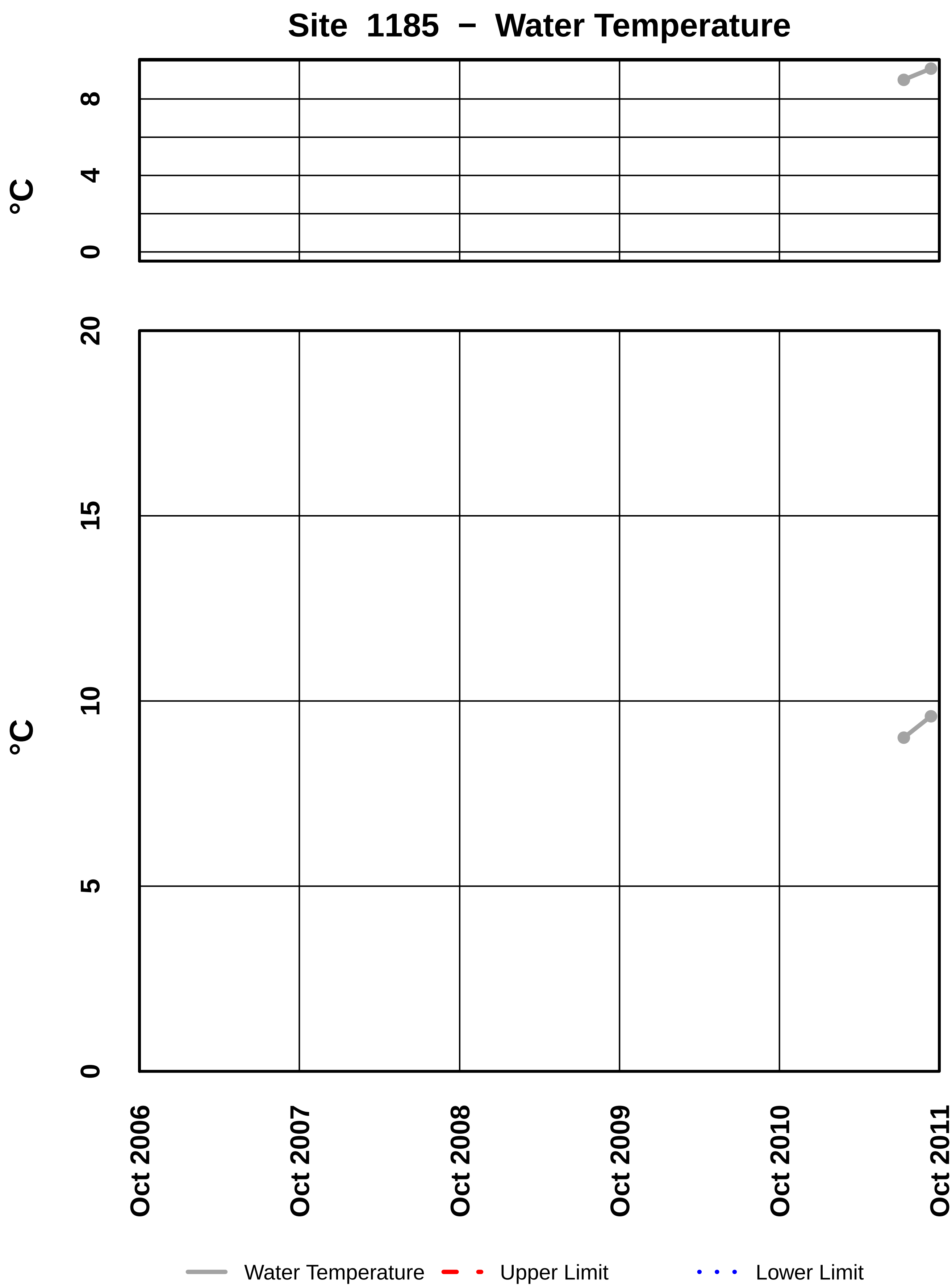
Site 1185 - 'Monitoring Well -T-10-08A'

Sample Date/Parameter	Oct 2010	Nov 2010	Dec 2010	Jan 2011	Feb 2011	Mar 2011	Apr 2011	May 2011	Jun 2011	Jul 2011	Aug 2011	Sep 2011	**Median**
Water Temp (°C)										9		9.6	9.3
Conductivity-Field(µmho)										415		406	410.5
Conductivity-Lab (µmho)										464		462	463
pH Lab (standard units)										7.28		7.39	7.34
pH Field (standard units)										7.57		6.84	7.21
Total Alkalinity (mg/L)										189		240	214.5
Total Sulfate (mg/L)										39.6		38.9	39.3
Hardness (mg/L)										206		210	208.0
Dissolved As (ug/L)										0.327		0.628	0.478
Dissolved Ba (ug/L)										26.8		25.3	26.1
Dissolved Cd (ug/L)										0.0767		0.0338	0.0553
Dissolved Cr (ug/L)										0.562		0.655	0.609
Dissolved Cu (ug/L)										2.77		1.69	2.230
Dissolved Pb (ug/L)										0.332		0.0566	0.1943
Dissolved Ni (ug/L)										4.06		7.09	5.575
Dissolved Ag (ug/L)										0.002		0.002	0.002
Dissolved Zn (ug/L)										34.7		47.5	41.10
Dissolved Se (ug/L)										0.013		0.38	0.197
Dissolved Hg (ug/L)										0.000471		0.000196	0.000334

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

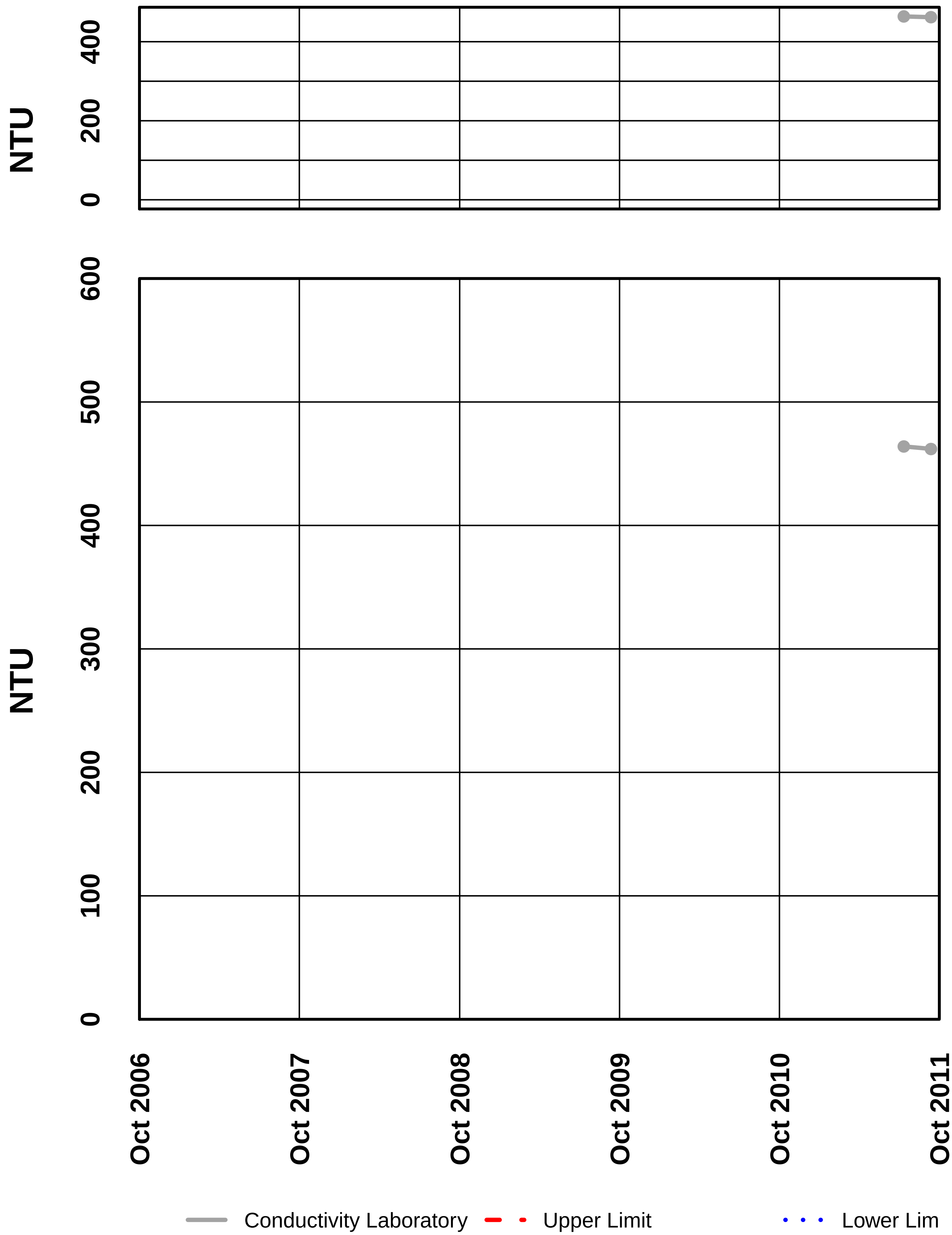
Values reported as less than MDL are replaced by 1/2 MDL for median calculation purposes.

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

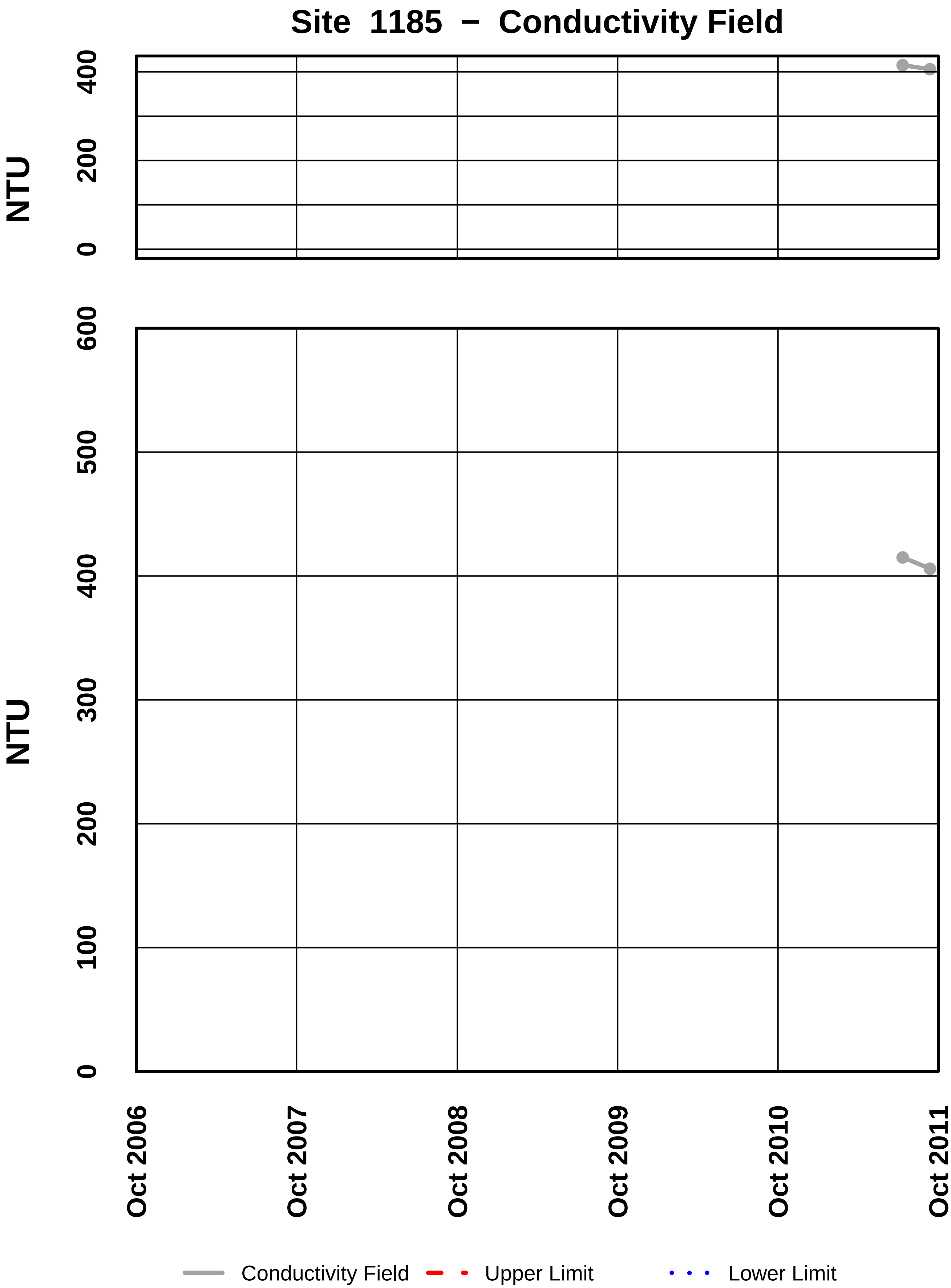


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

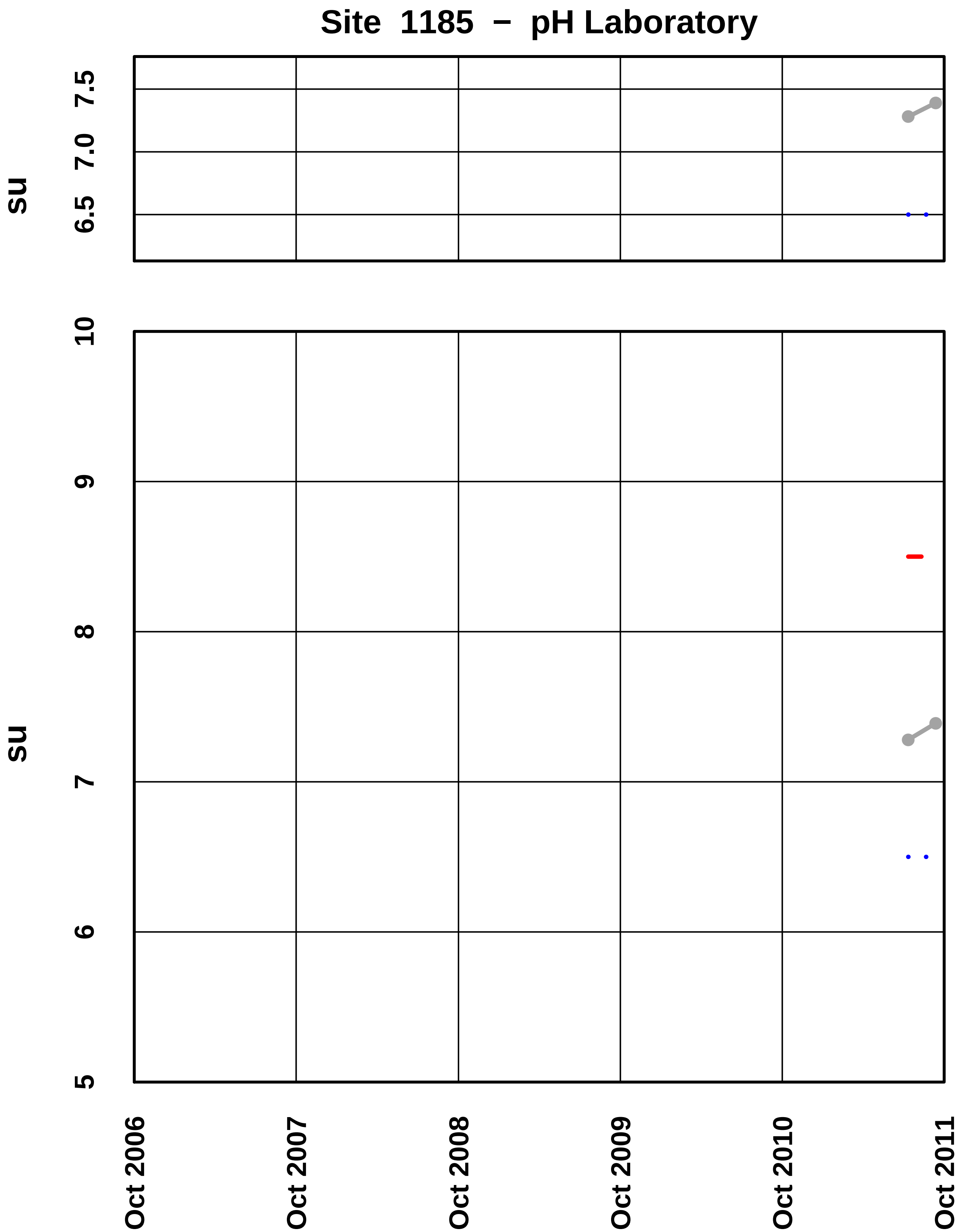
Site 1185 – Conductivity Laboratory



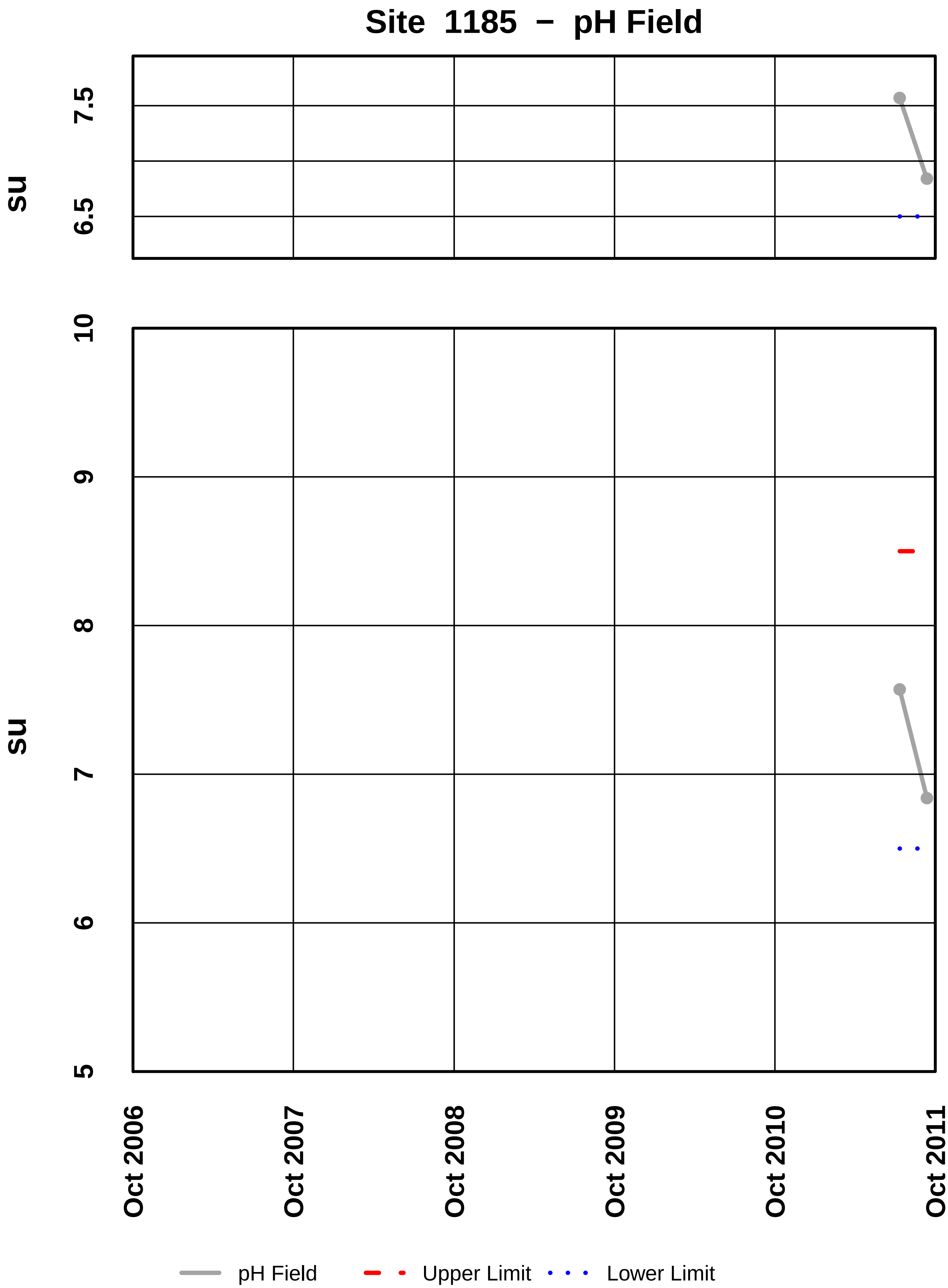
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



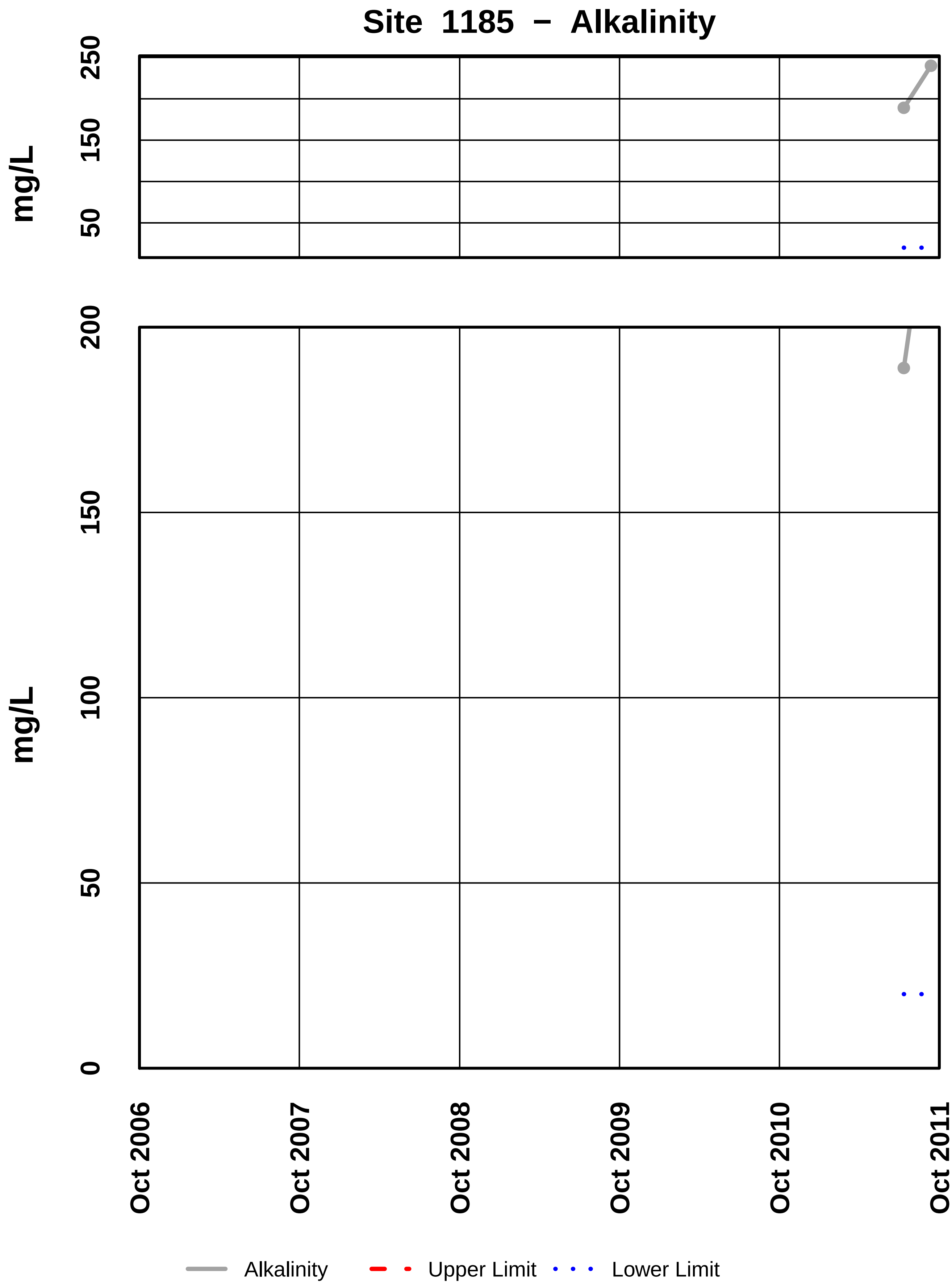
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

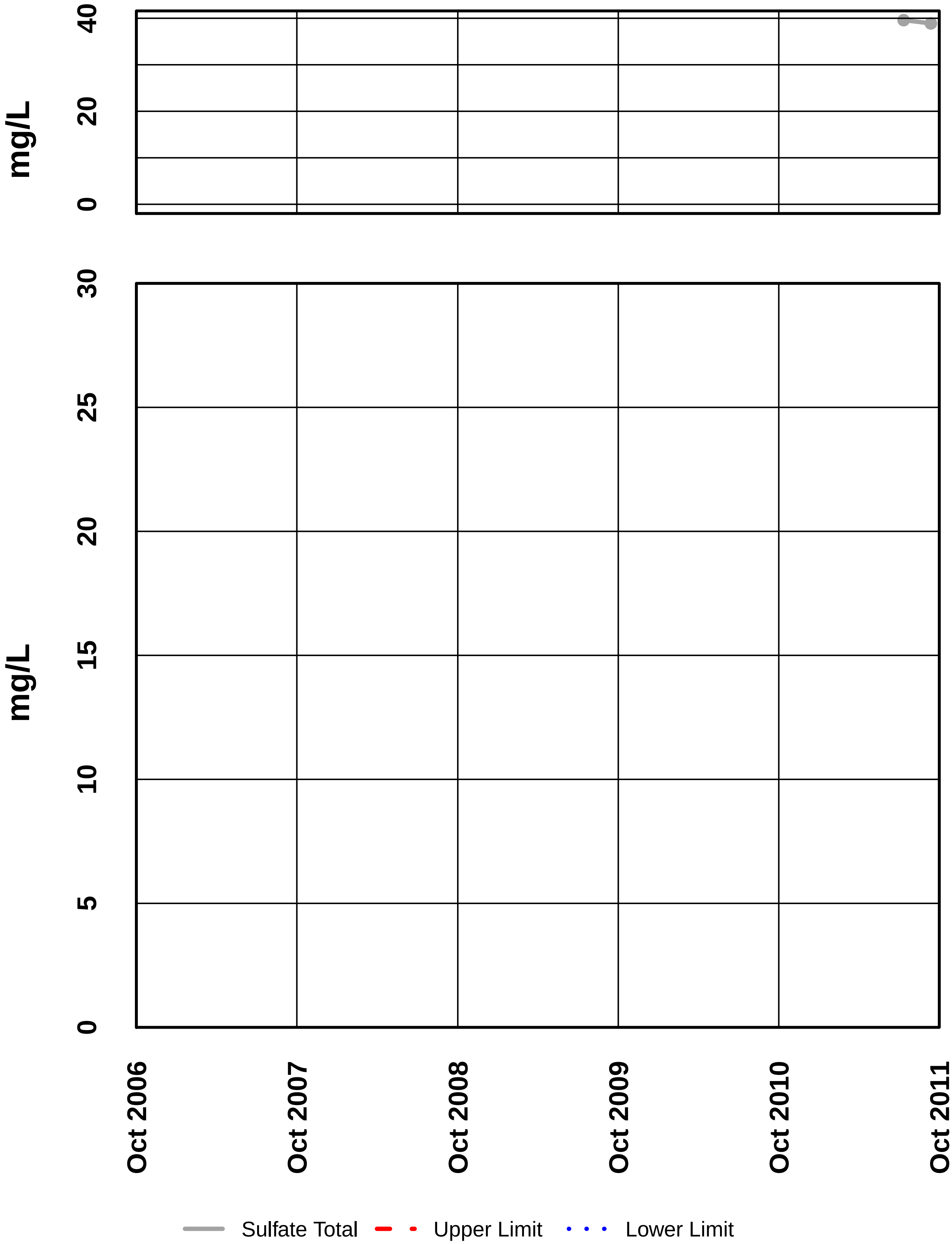


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



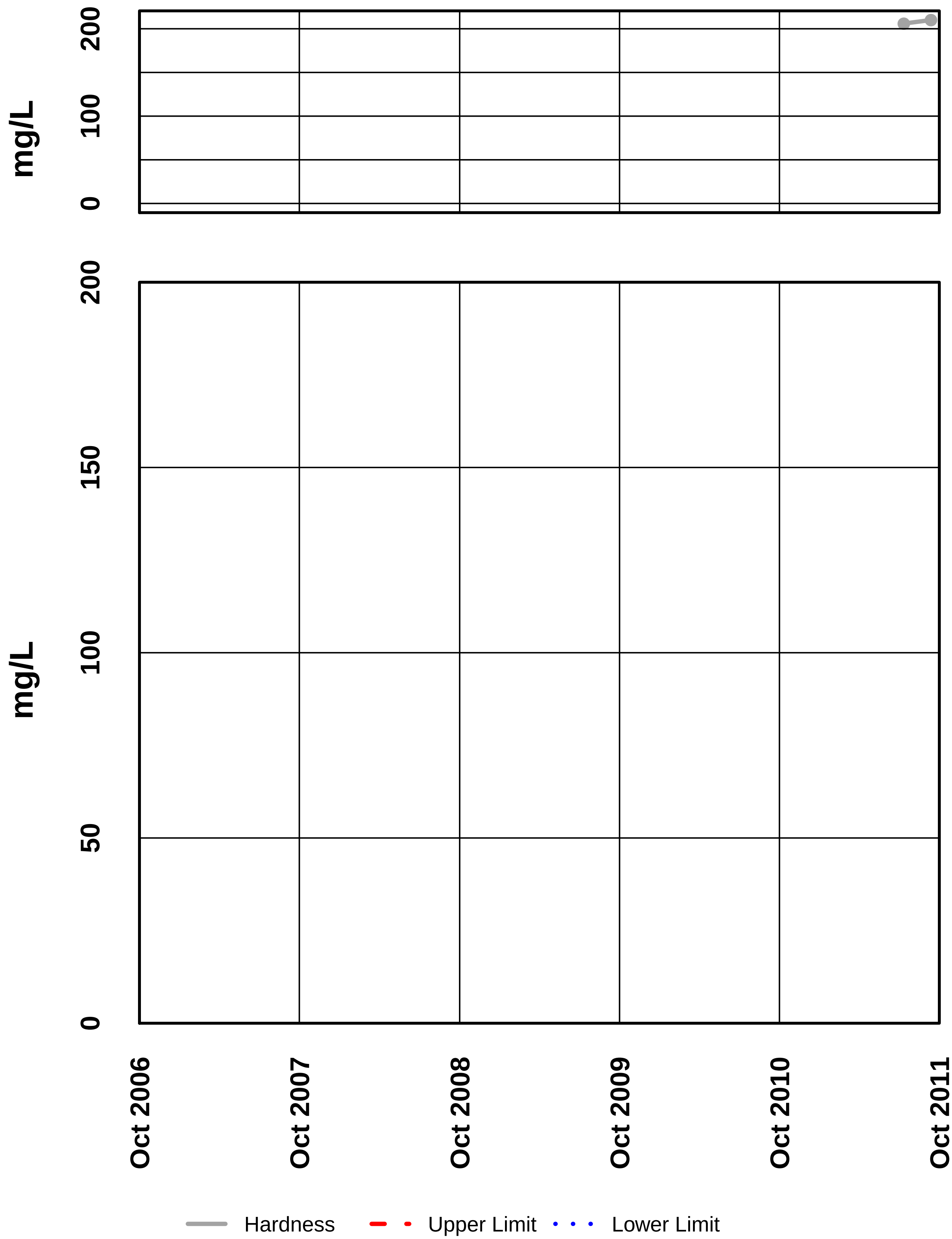
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 1185 – Sulfate Total

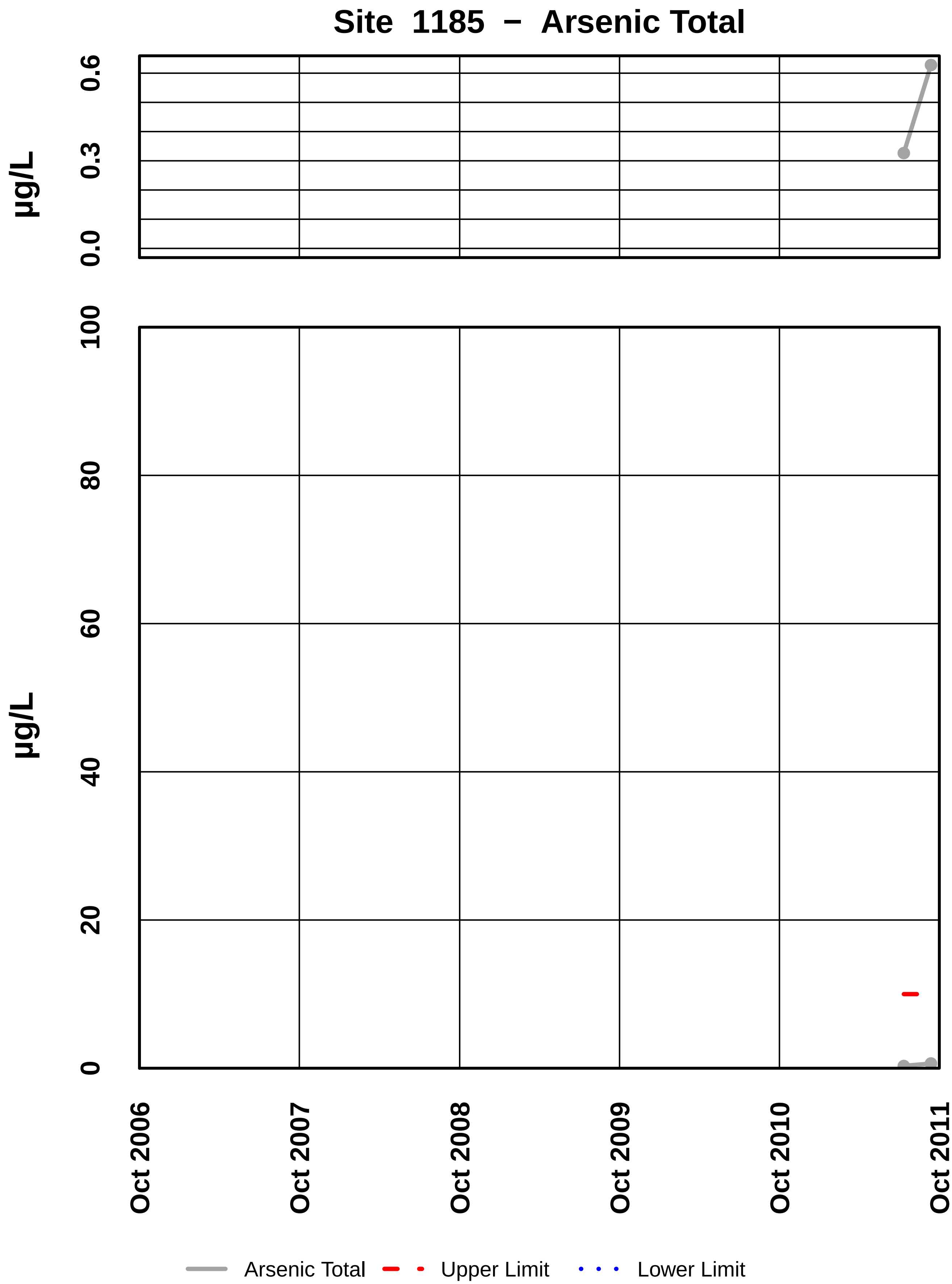


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

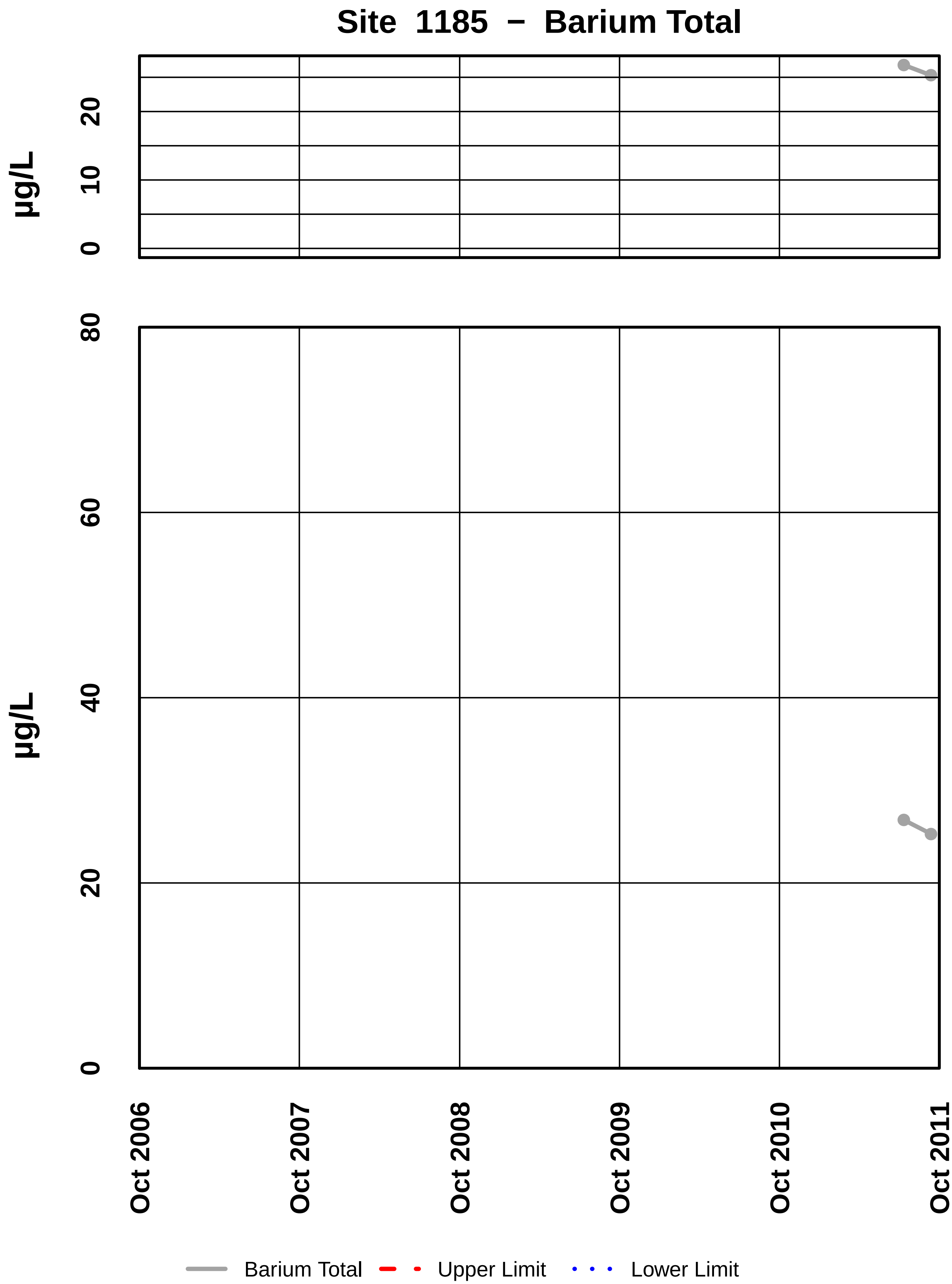
Site 1185 – Hardness



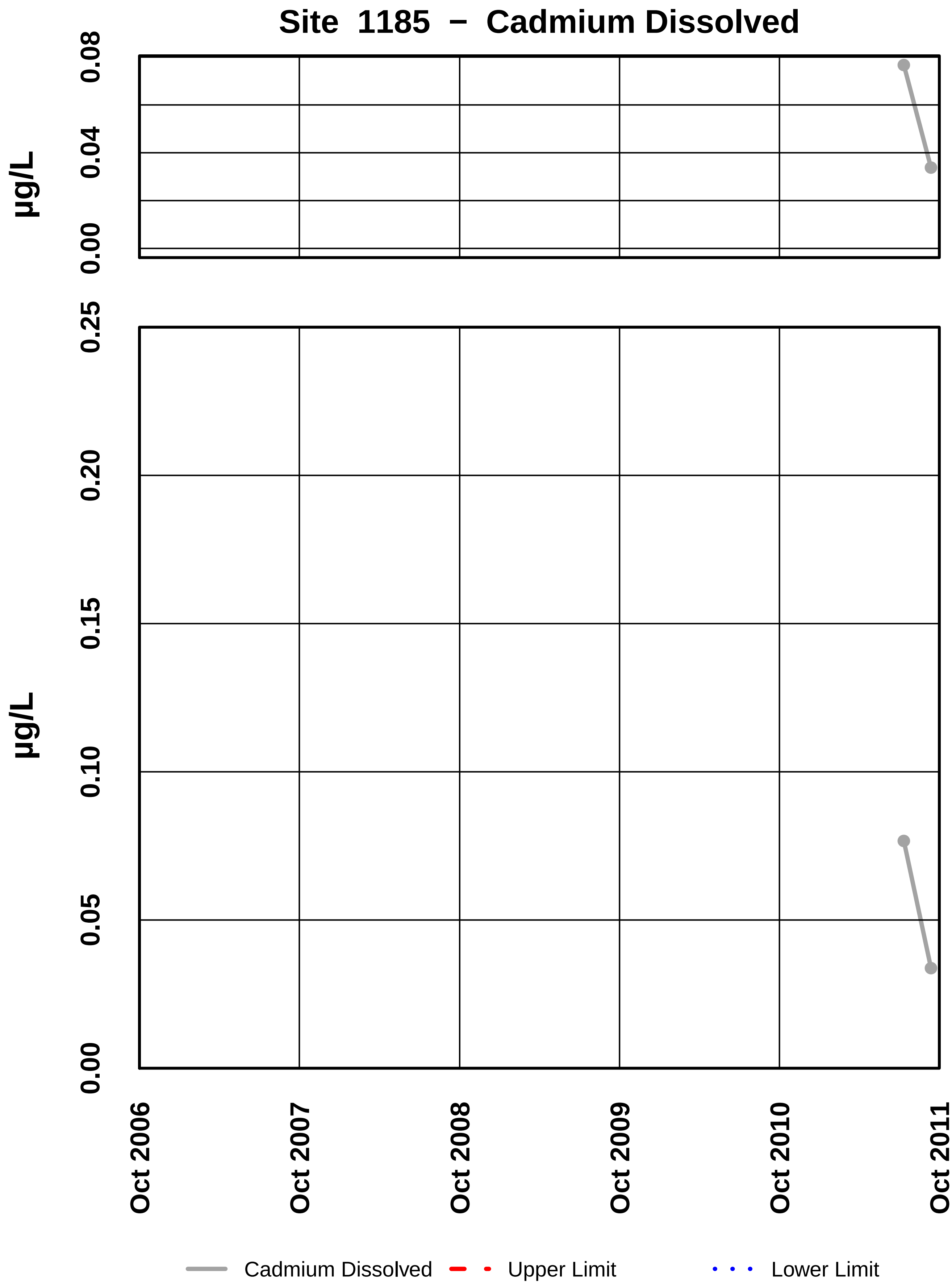
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



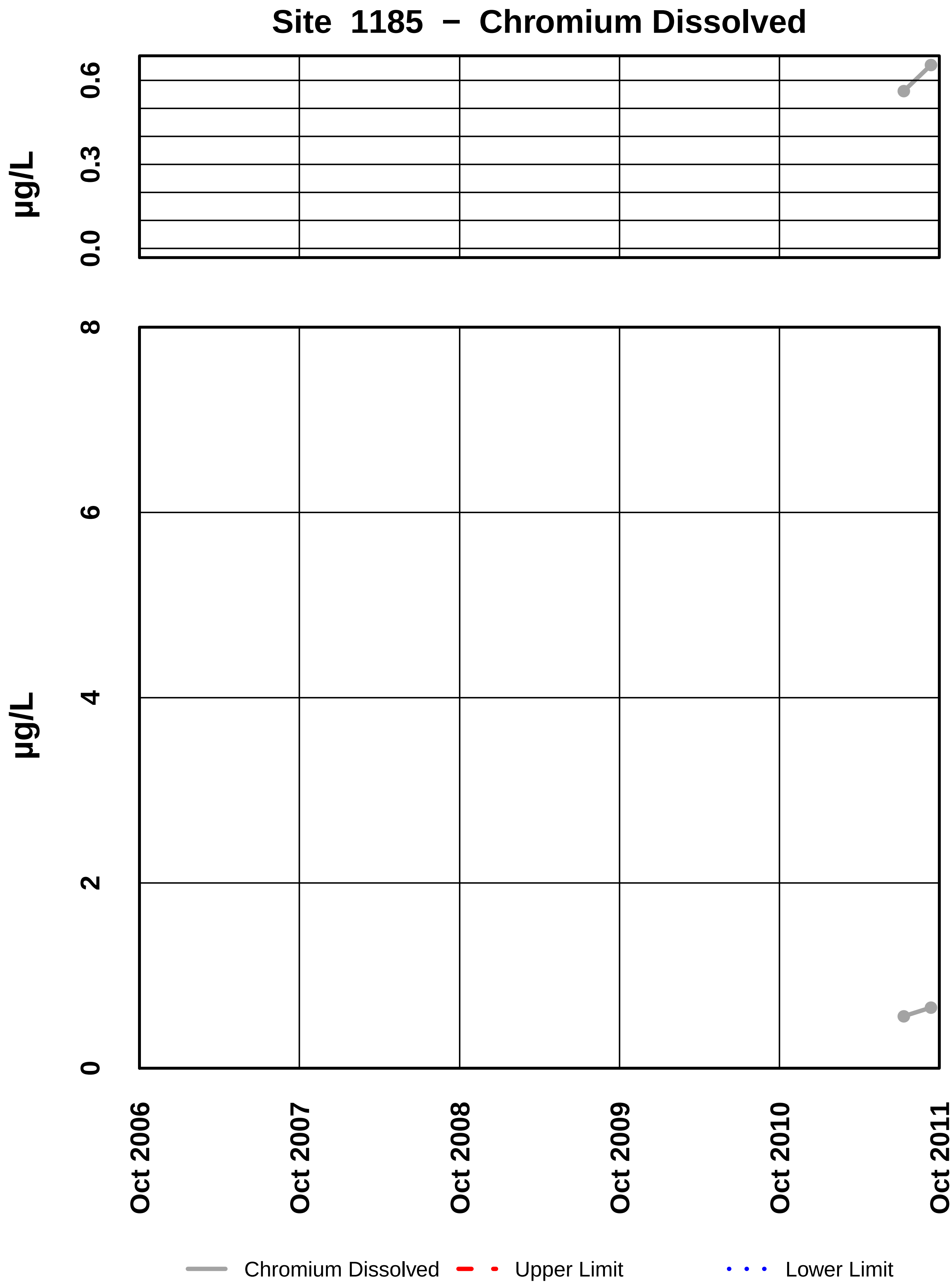
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

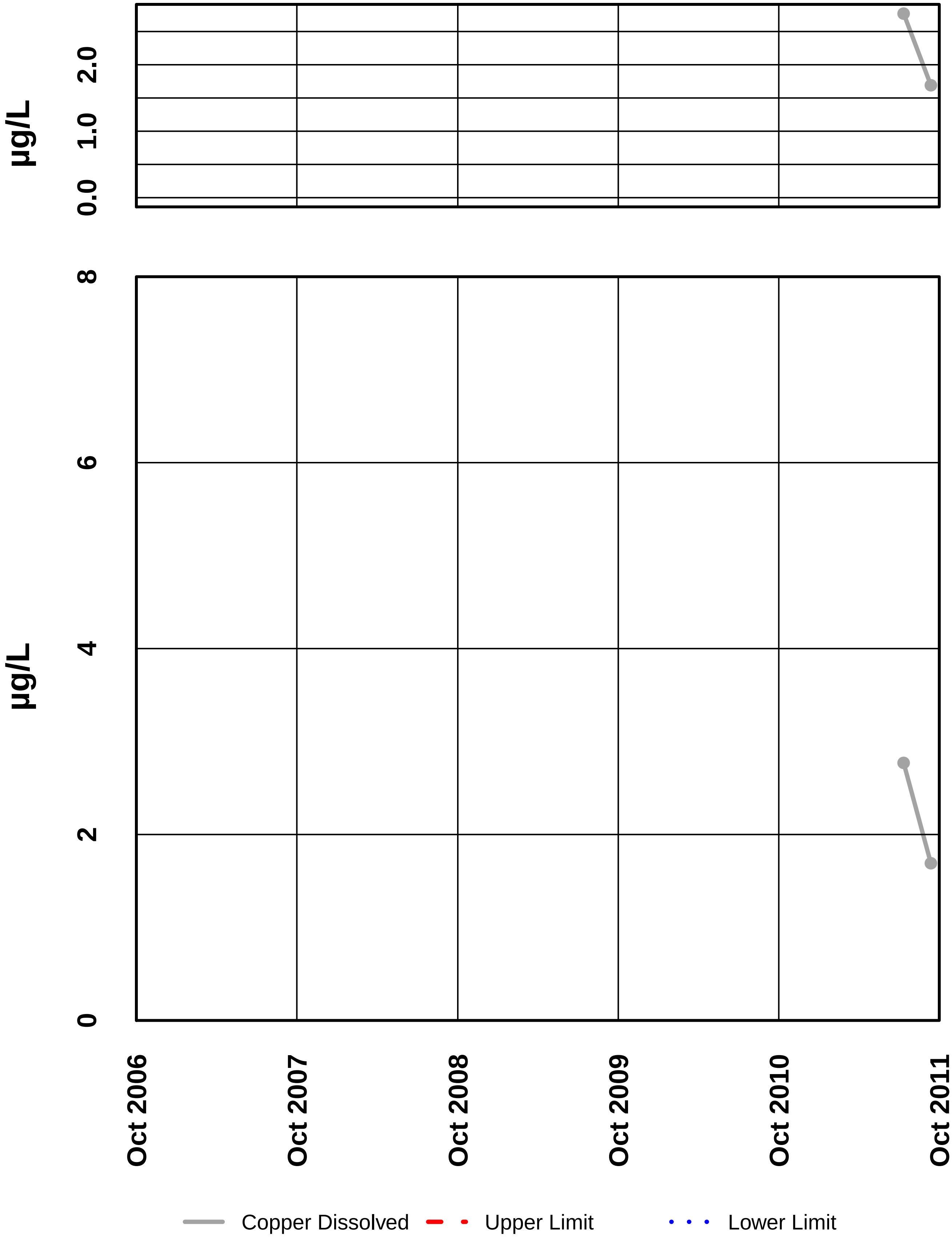


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

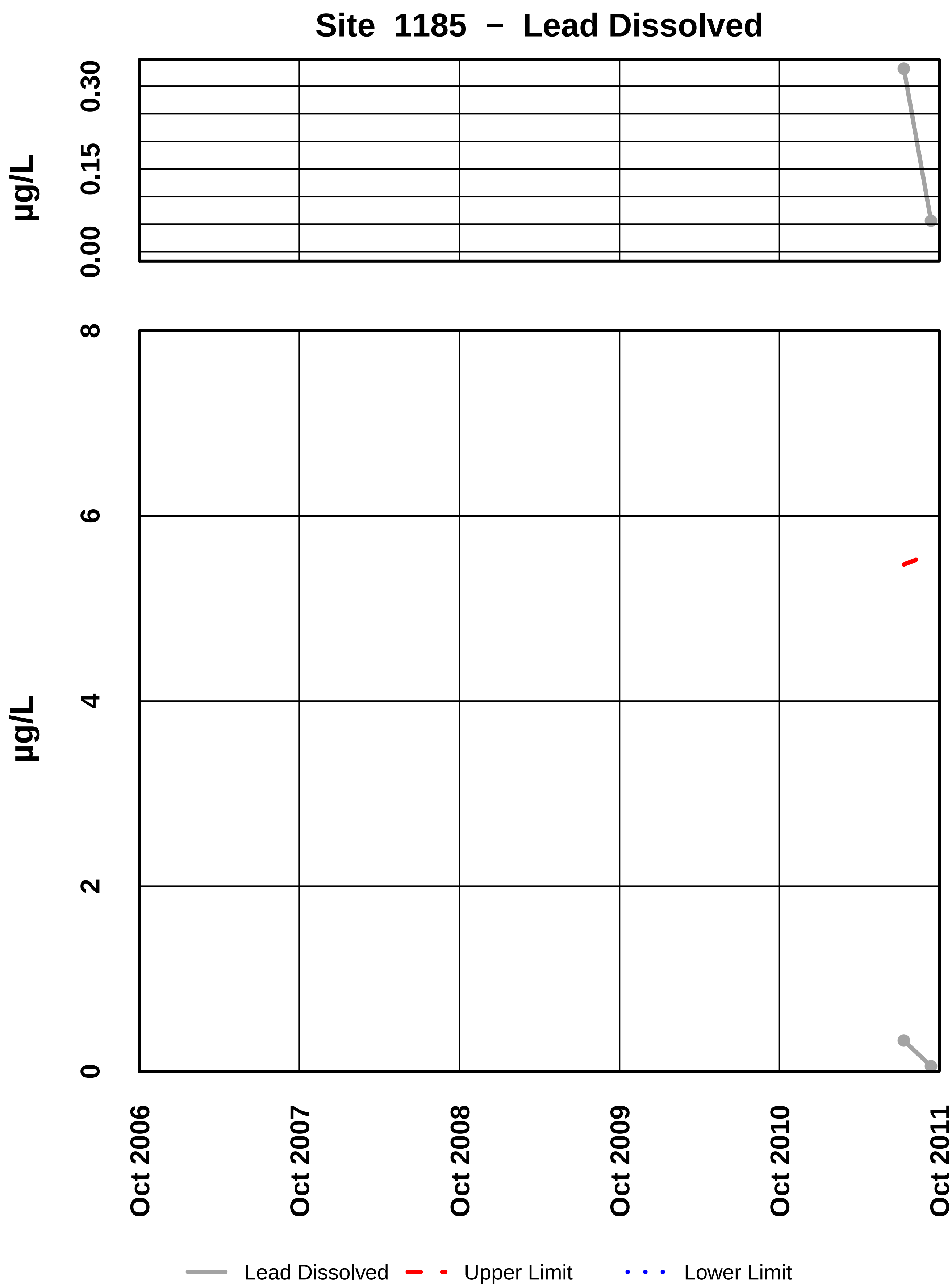


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 1185 − Copper Dissolved

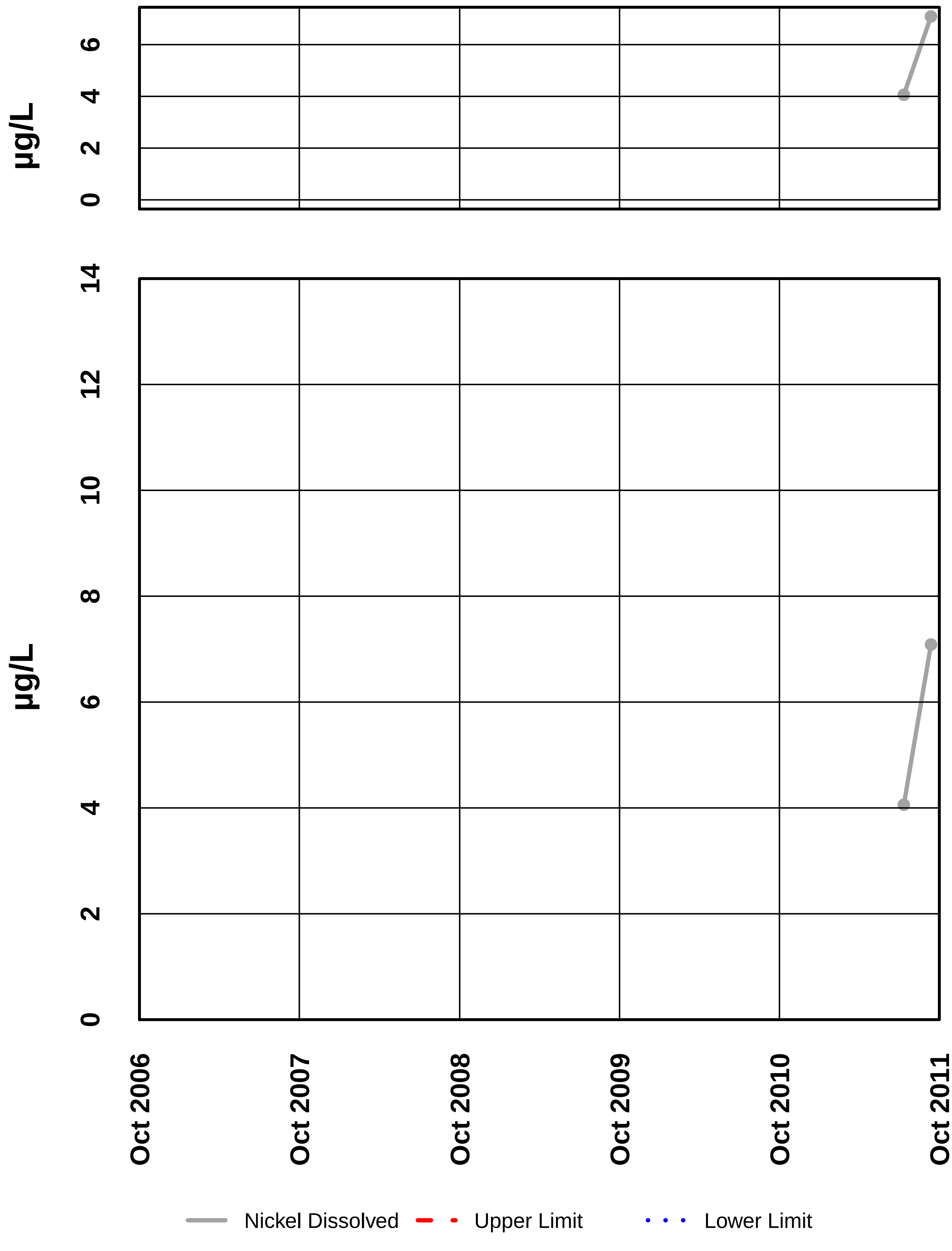


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



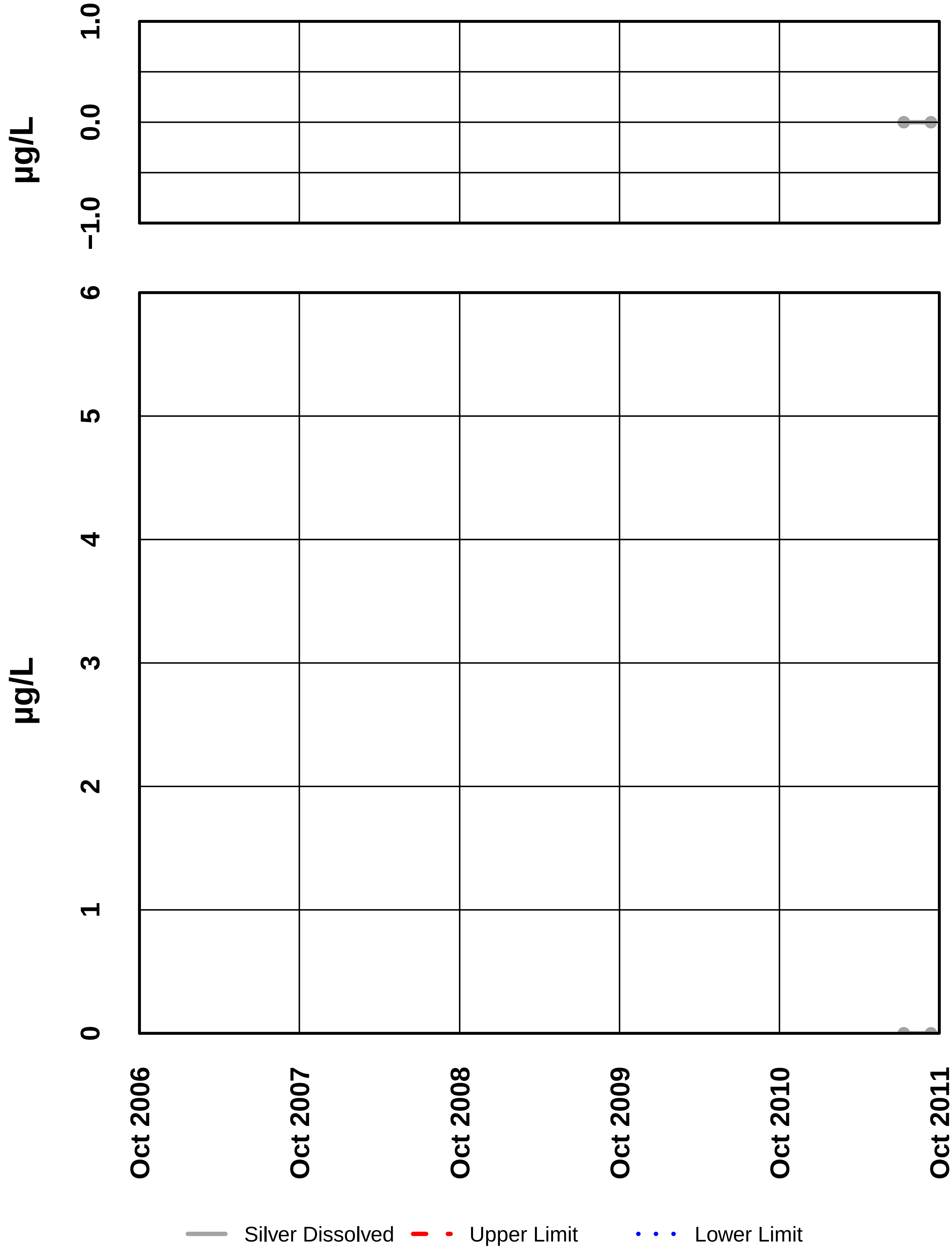
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 1185 – Nickel Dissolved



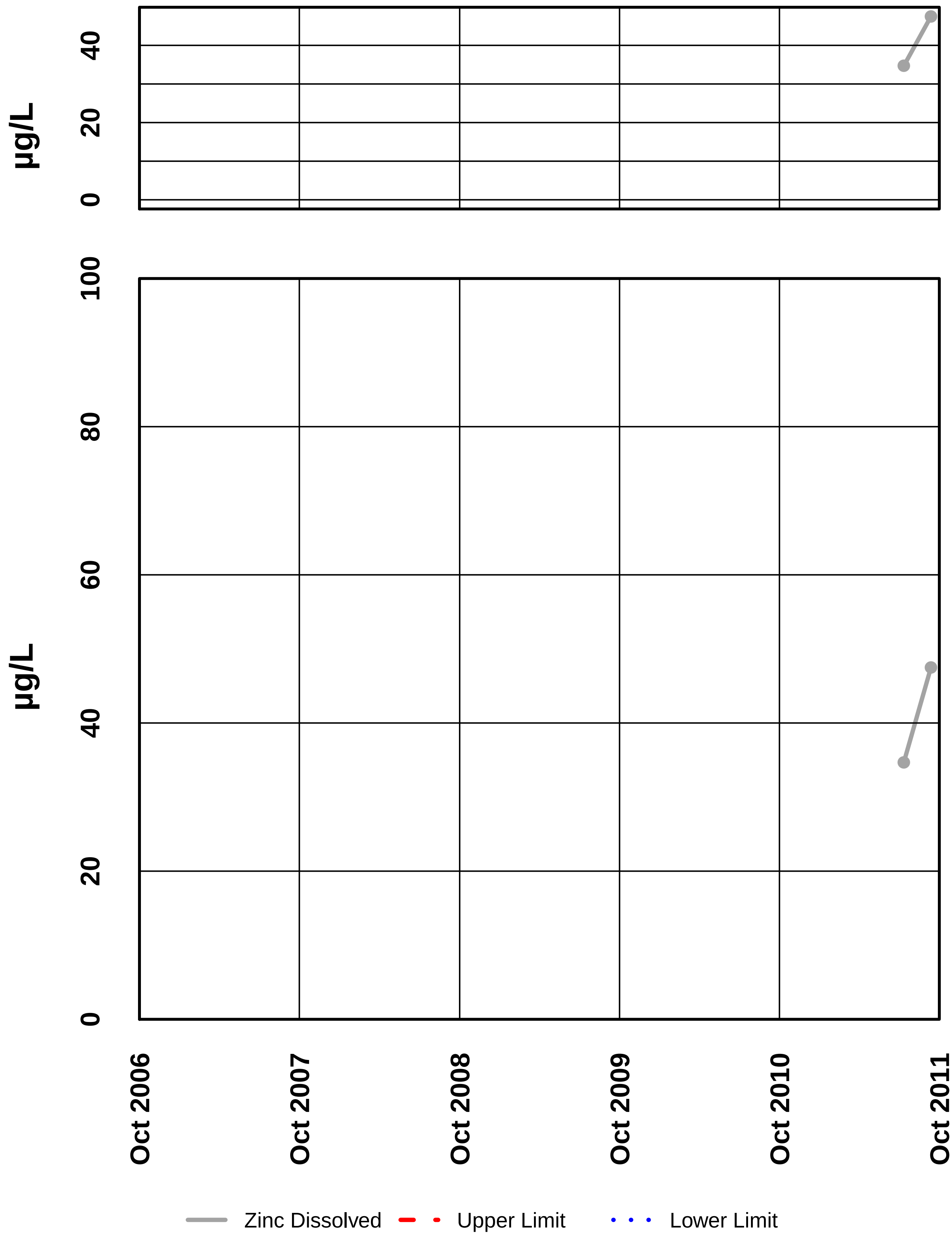
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 1185 – Silver Dissolved



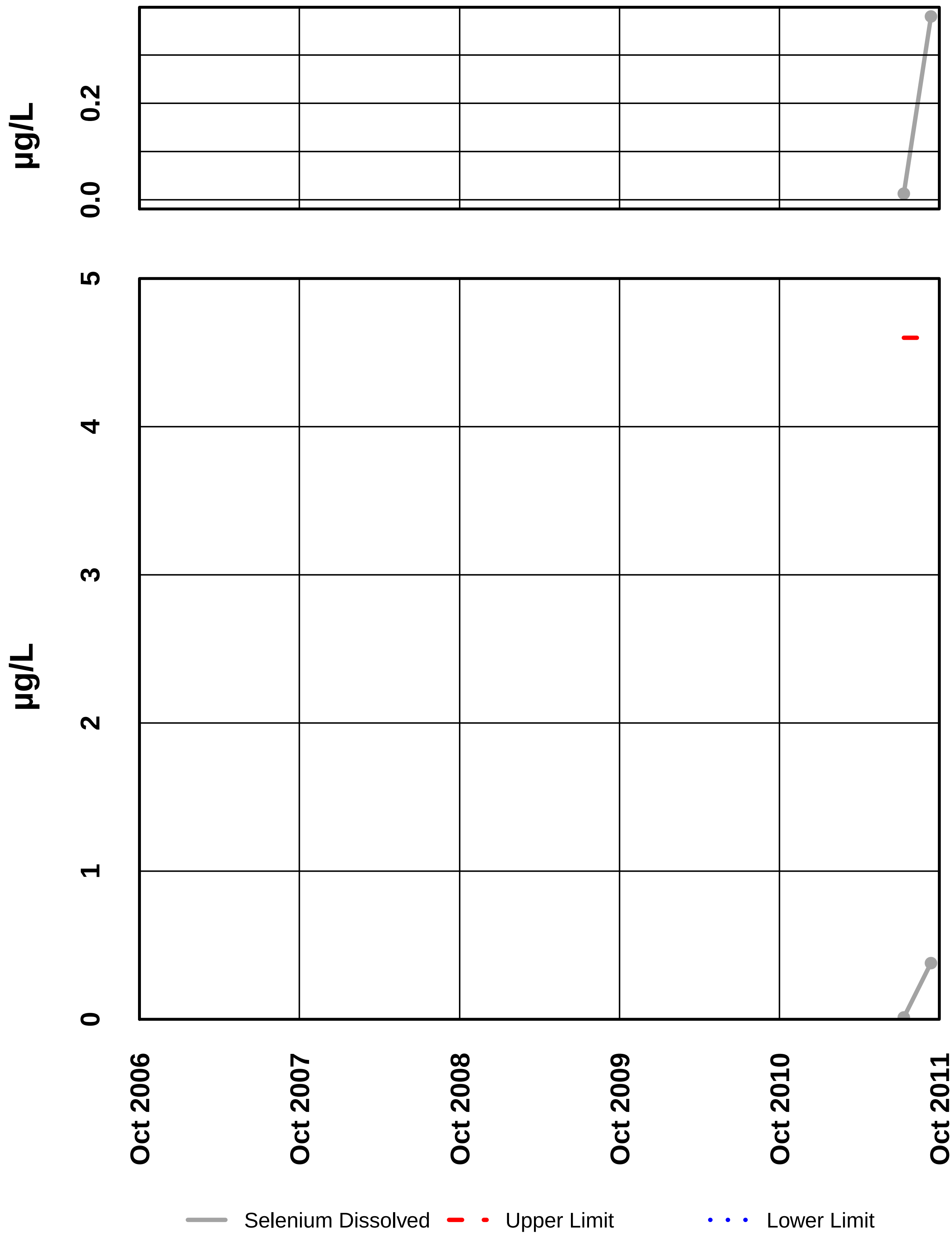
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 1185 – Zinc Dissolved



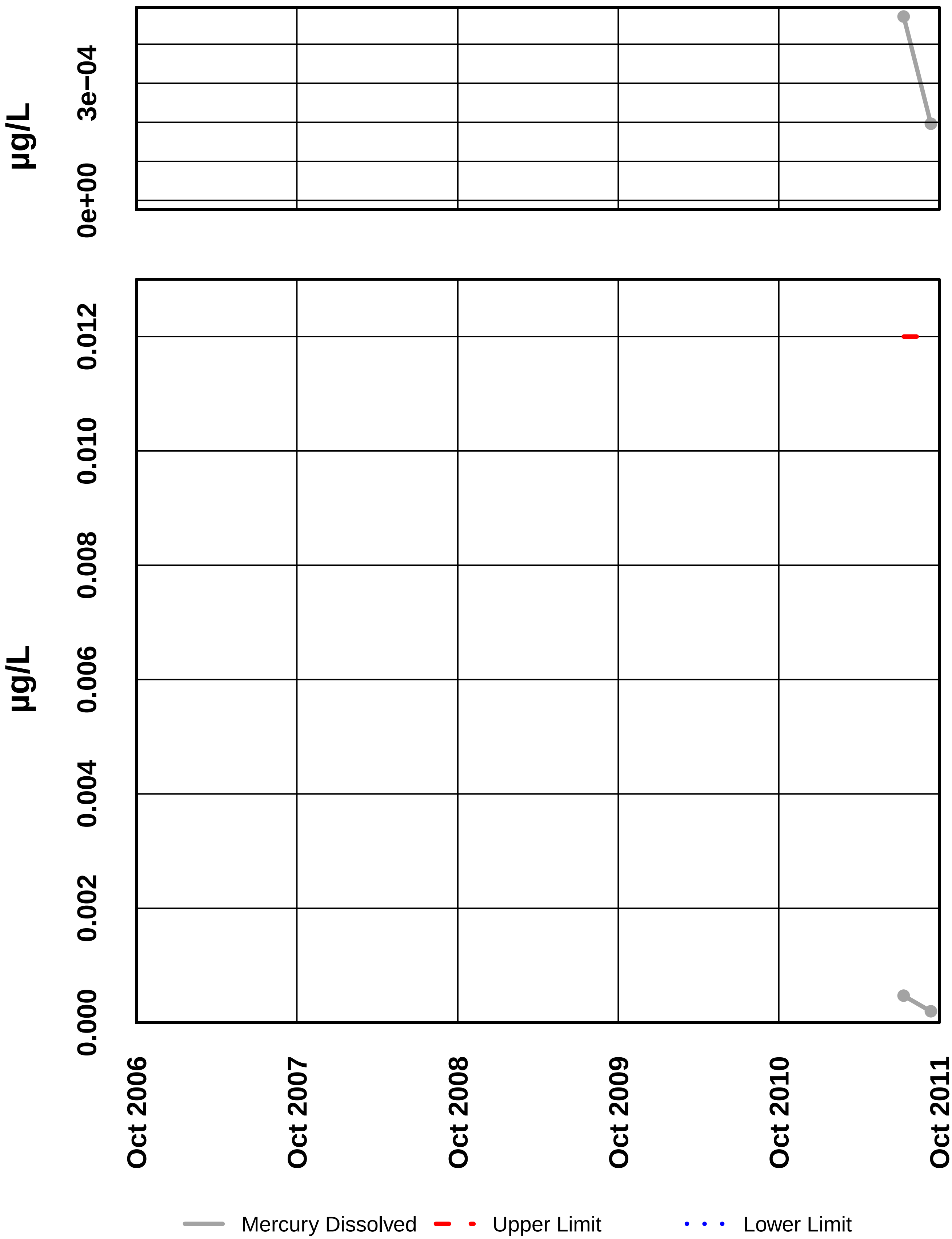
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 1185 – Selenium Dissolved



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

Site 1185 – Mercury Dissolved



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

INTERPRETIVE REPORT
SITE 1186 “–MONITORING WELL -T-10-08B”

Sampling at this site was initiated during the summer of the water year 2011. Site 1186 was drilled in the summer of 2010 and then developed over the next year. Sampling began in July 2011, and it is to be sampled in November, May, July, and September of the current water year 2012. This well may serve as the new shallow upgradient background site to the tailings facility and is analogous to Site 58FMG (MW-T-00-01C). The upgradient nature of Site 58FMG was compromised during the East Ridge Expansion, because it is now located between the old B road and the new B road location. Also, there has been a material (i.e. road rock) pad built upgradient to Site 58FMG.

The data collected during the current water year are listed in the following “Table of Results for Water Year 2011” 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.

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 2010 through September 2011.				

The data for Water Year 2011 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 2011

			Limits		
Sample Date	**Parameter**	**Value**	**Lower**	**Upper**	**Hardness**
No exceedances have been identified by HGCMC for the period of October 2010 through September 2011.					

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

Table of Results for Water Year 2011

Site 1186 - 'Monitoring Well -T-10-08B'

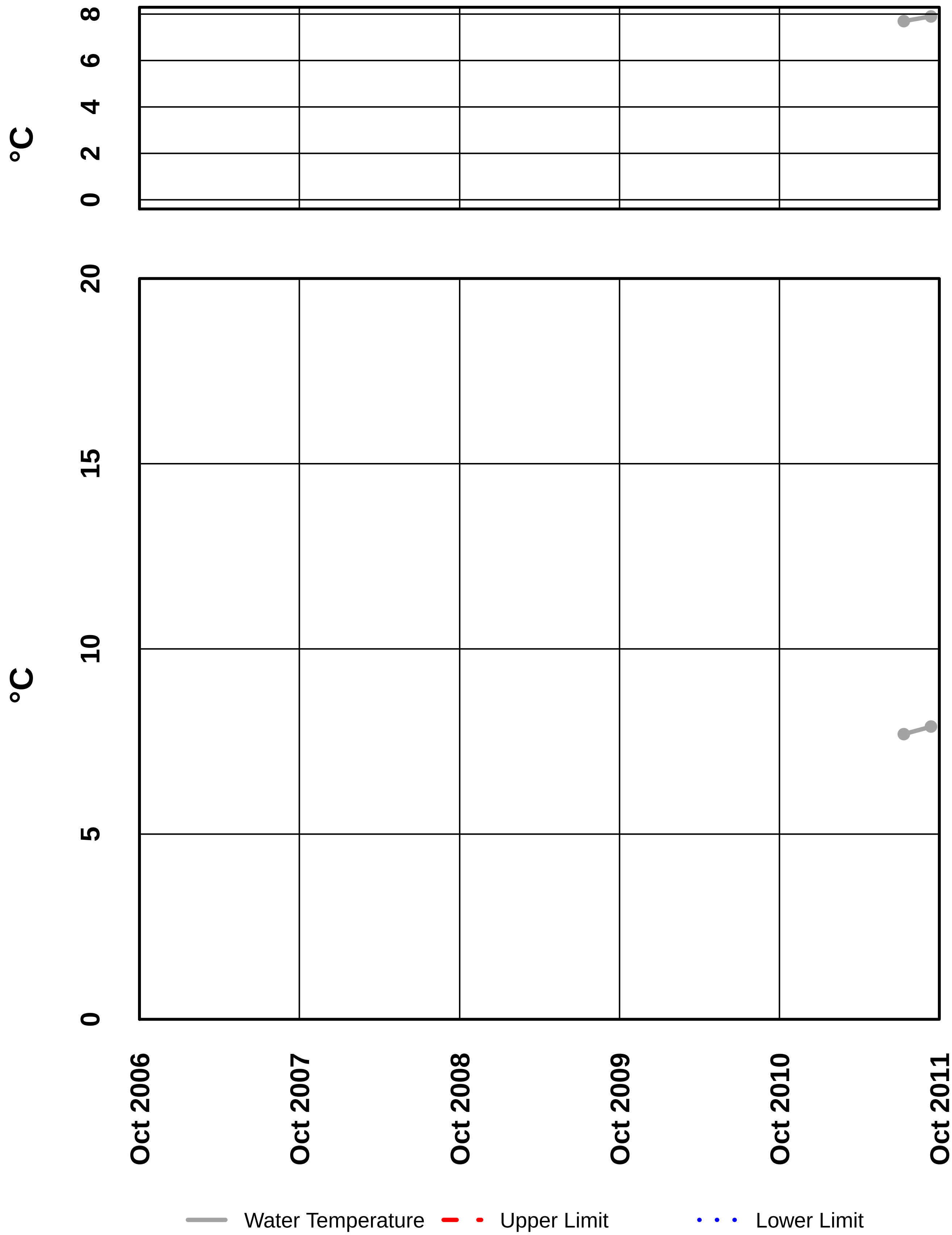
Sample Date/Parameter	Oct 2010	Nov 2010	Dec 2010	Jan 2011	Feb 2011	Mar 2011	Apr 2011	May 2011	Jun 2011	Jul 2011	Aug 2011	Sep 2011	**Median**
Water Temp (°C)										7.7		7.9	7.8
Conductivity-Field(µmho)										102		90	96.0
Conductivity-Lab (µmho)										101		104	103
pH Lab (standard units)										6.34		6.43	6.39
pH Field (standard units)										7.5		7.48	7.49
Total Alkalinity (mg/L)										40.8		36.4	38.6
Total Sulfate (mg/L)										2.5		2.5	2.5
Hardness (mg/L)										21.6		40	30.8
Dissolved As (ug/L)										0.229		0.125	0.177
Dissolved Ba (ug/L)										14.8		35.4	25.1
Dissolved Cd (ug/L)										0.0131		0.0152	0.0142
Dissolved Cr (ug/L)										0.449		0.744	0.597
Dissolved Cu (ug/L)										0.673		0.736	0.705
Dissolved Pb (ug/L)										0.0667		0.0161	0.0414
Dissolved Ni (ug/L)										0.97		1.75	1.360
Dissolved Ag (ug/L)										0.002		0.002	0.002
Dissolved Zn (ug/L)										3.13		8.47	5.80
Dissolved Se (ug/L)										0.381		0.481	0.431
Dissolved Hg (ug/L)										0.000338		0.000374	0.000356

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.

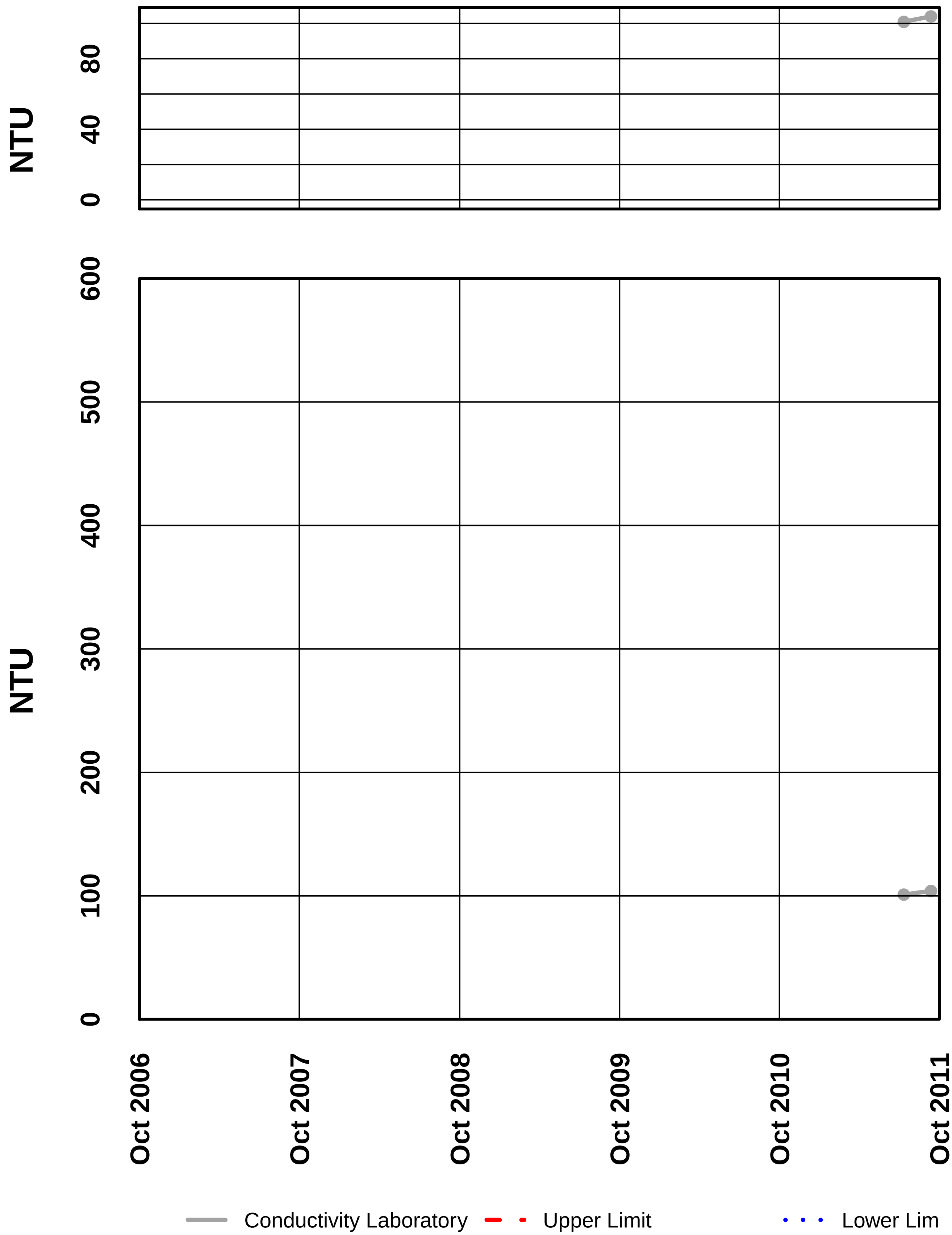
Shaded data has been qualified as an outlier by KGCMC and removed from any further analysis and is not included into the calculation of the median

Site 1186 – Water Temperature

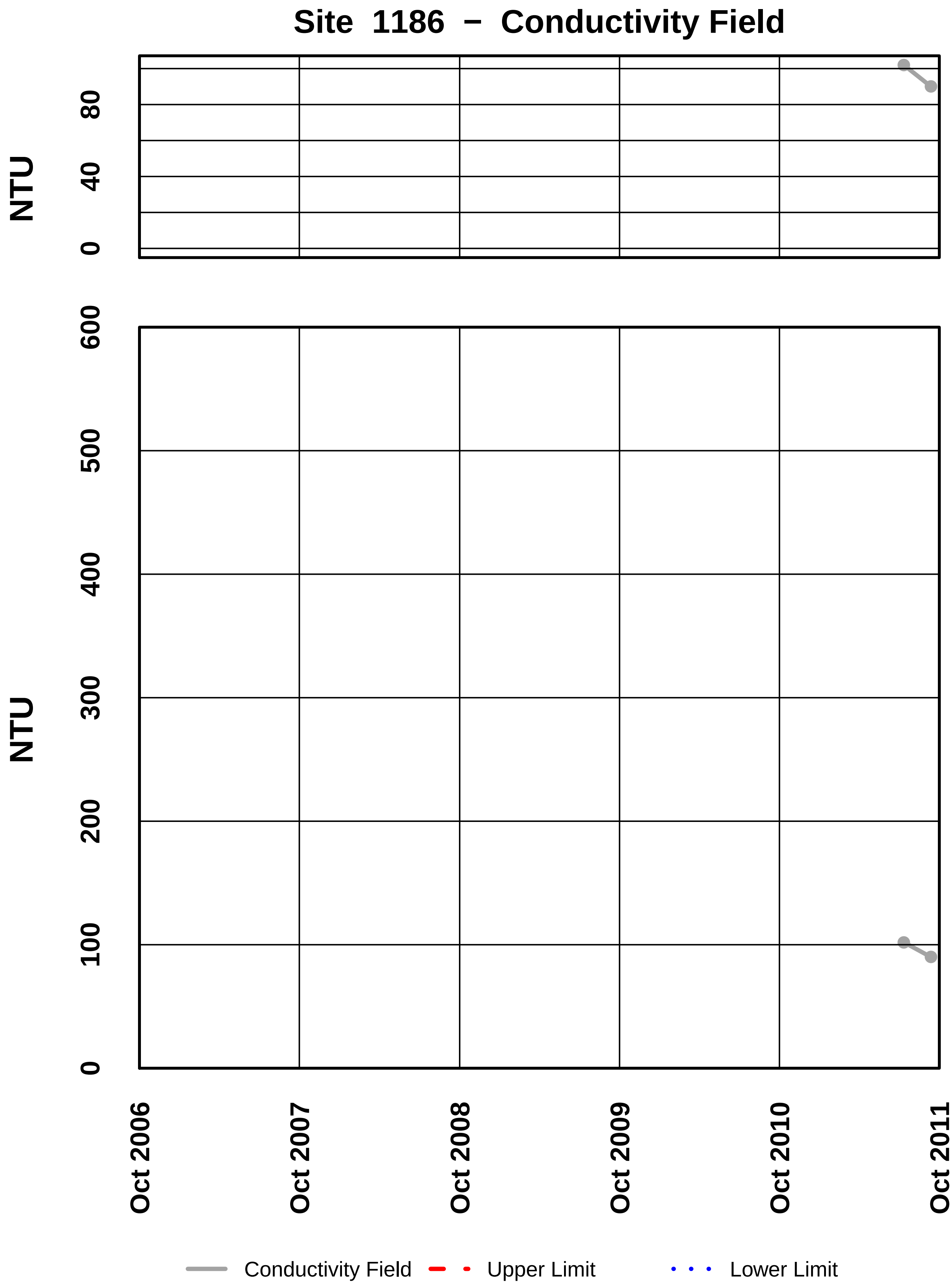


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 1186 – Conductivity Laboratory

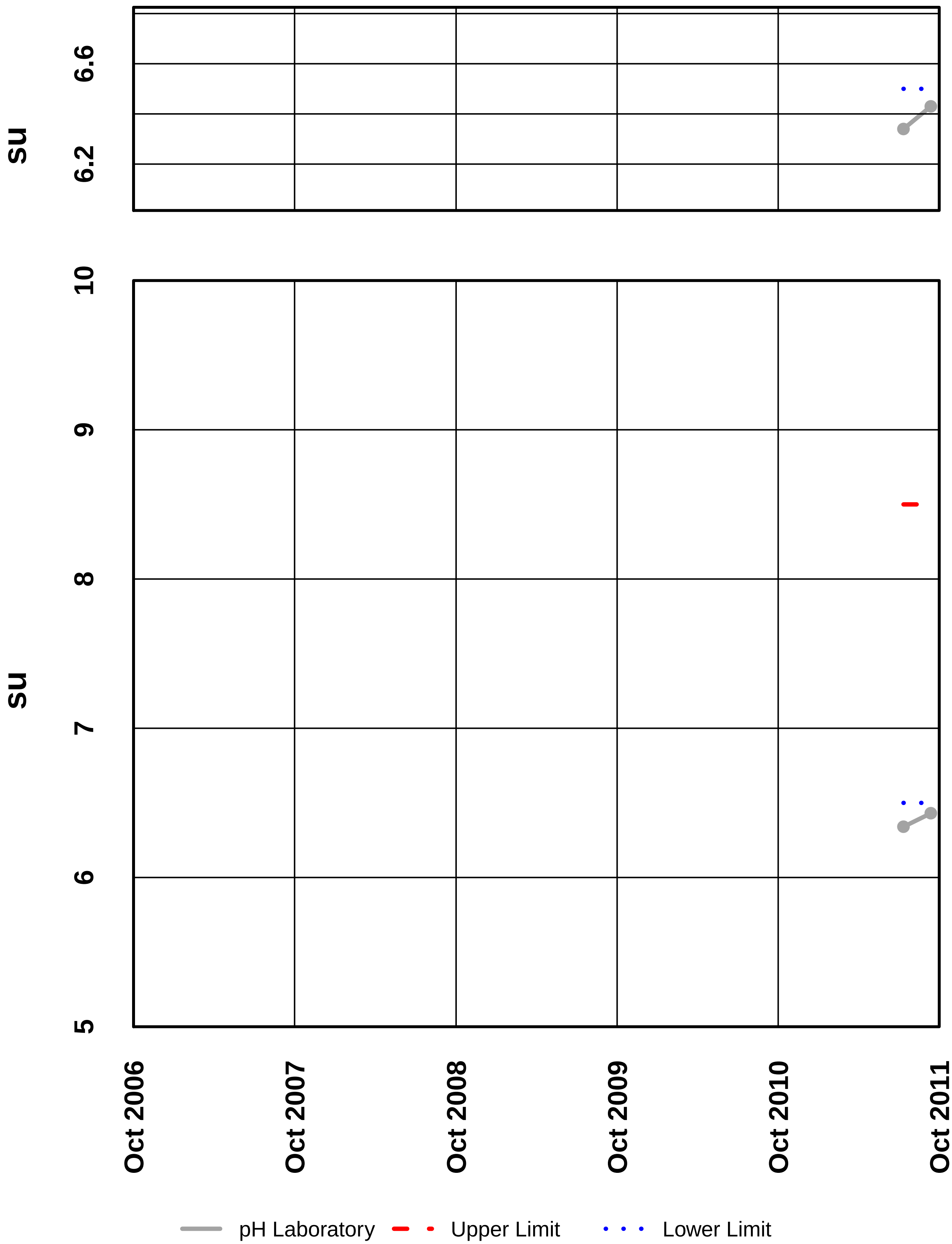


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

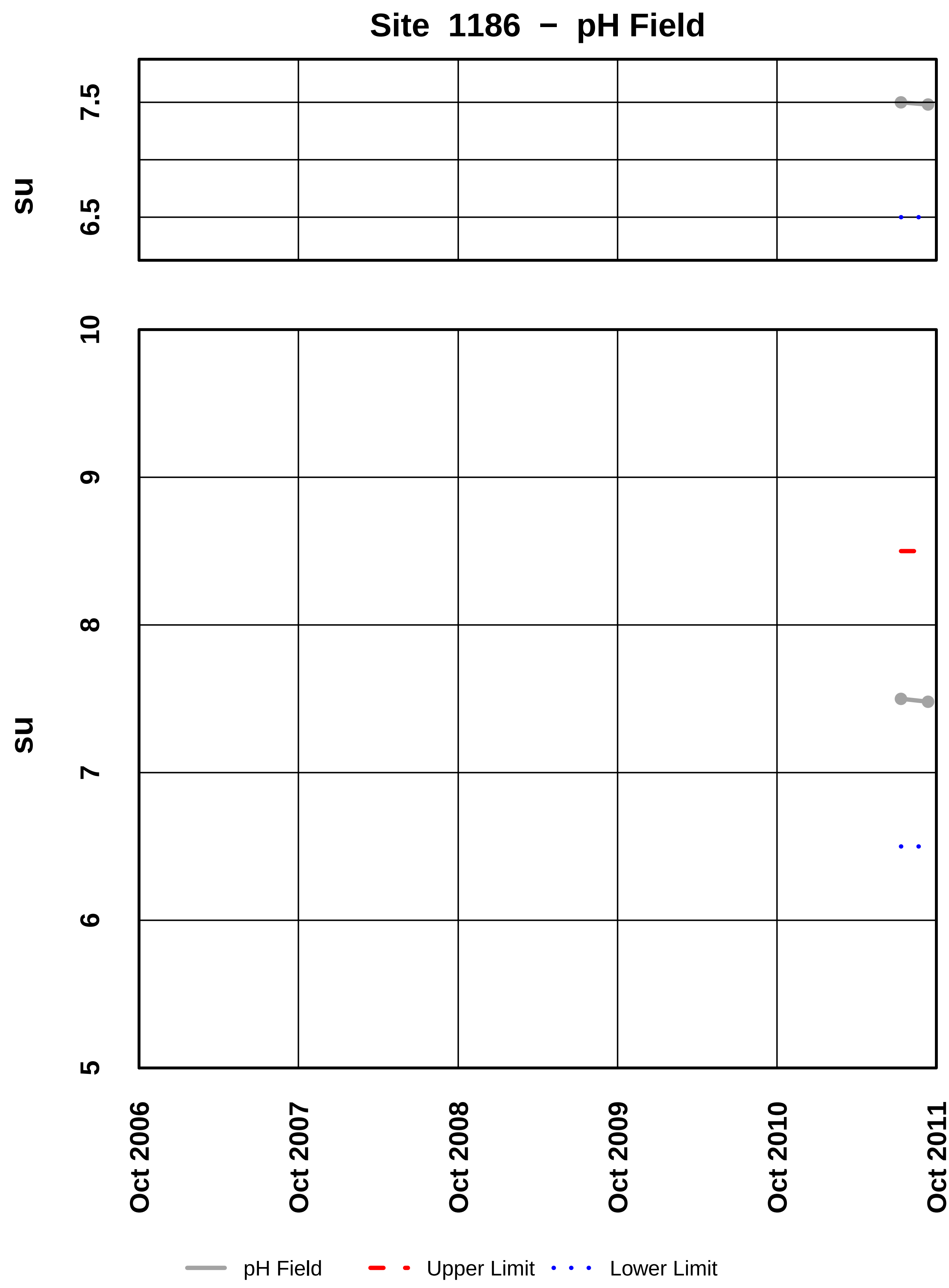


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 1186 − pH Laboratory

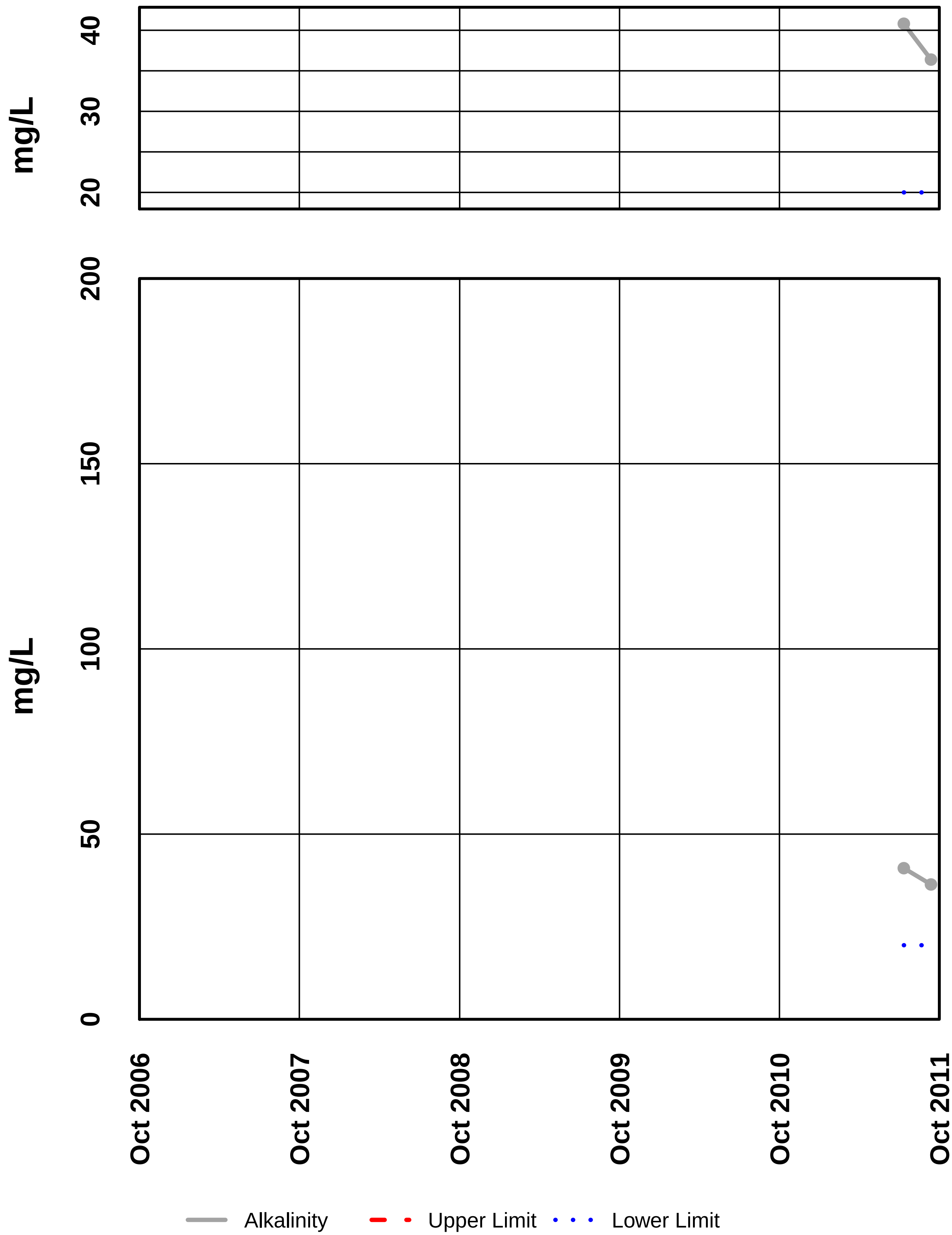


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

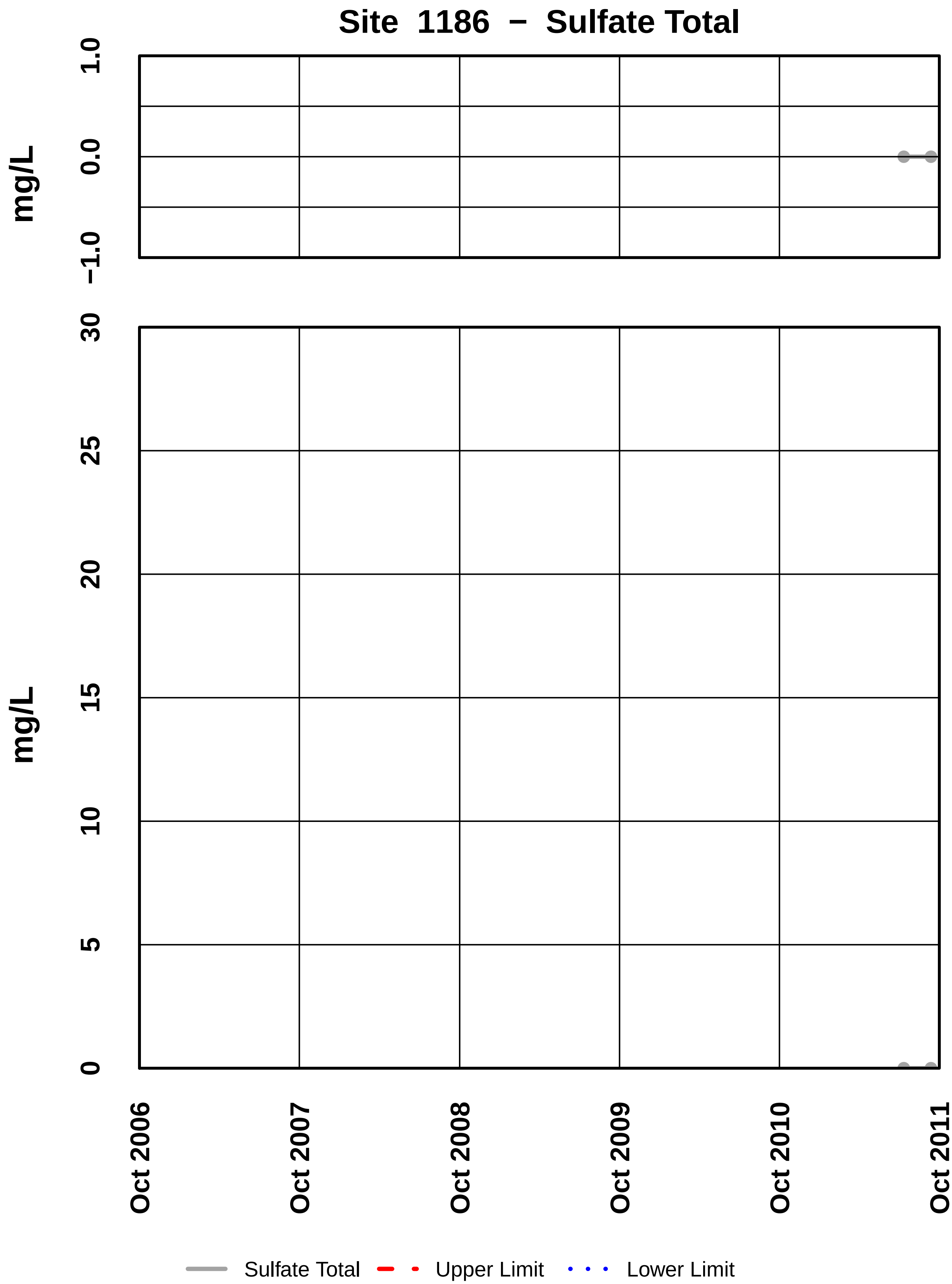


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 1186 – Alkalinity

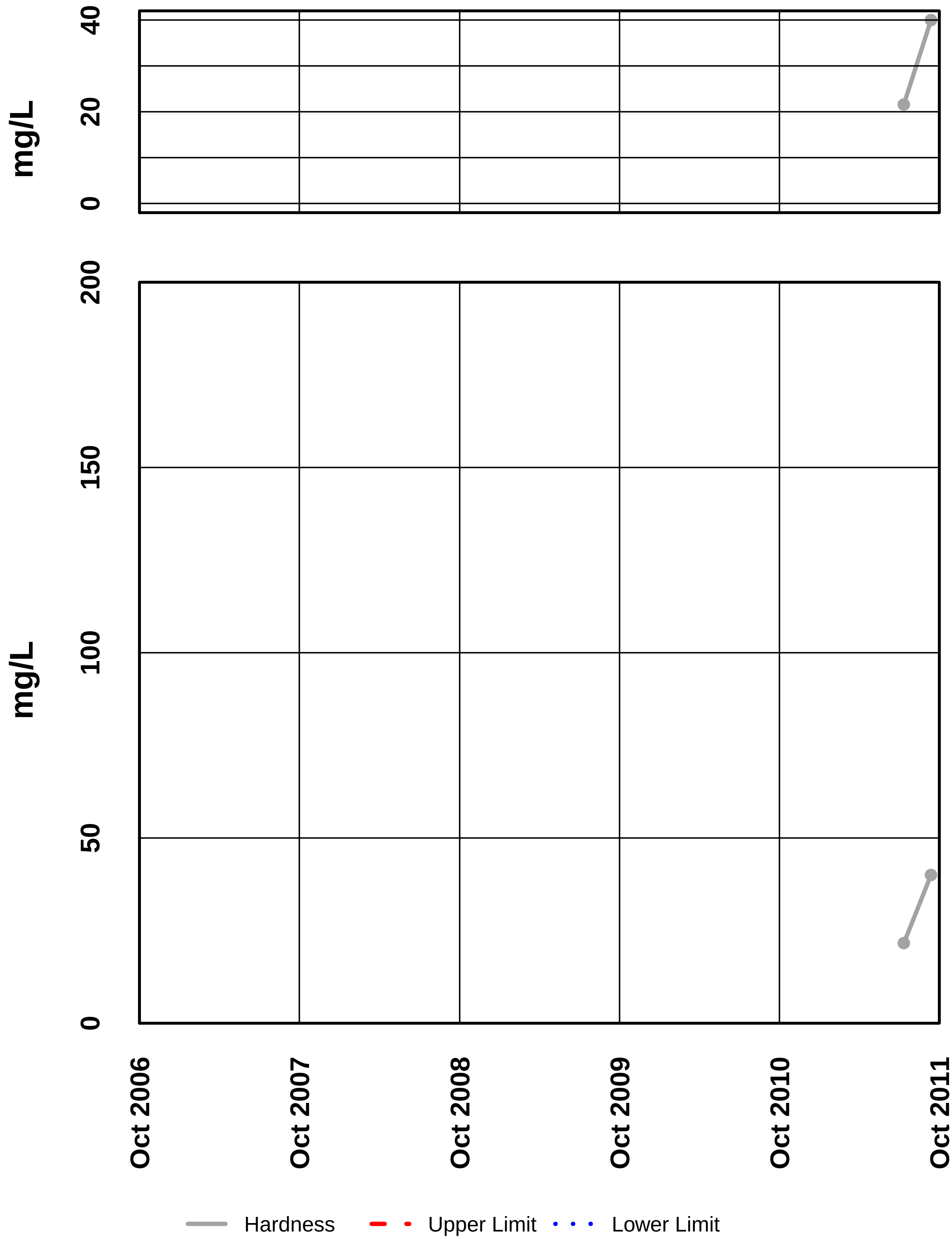


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

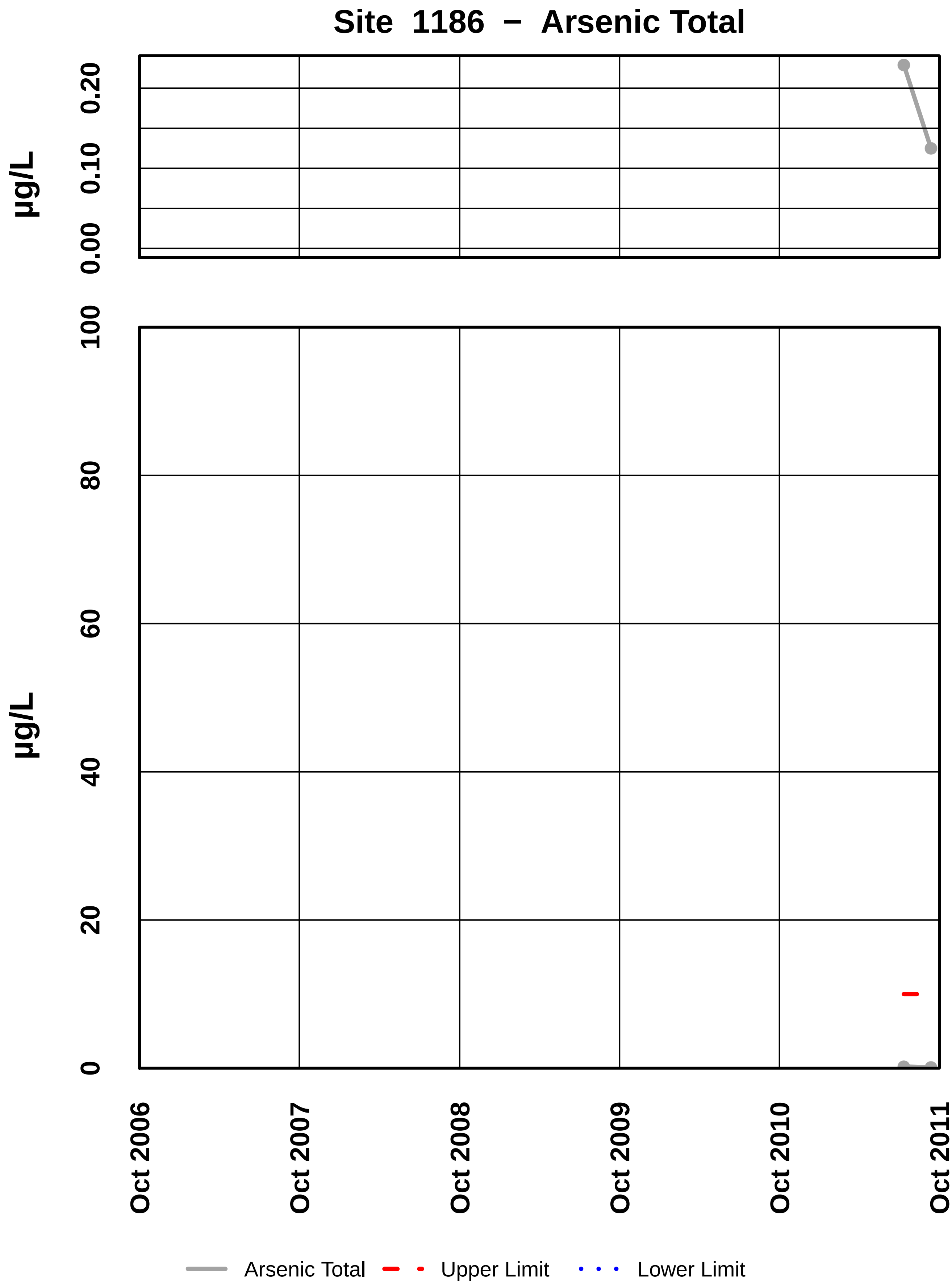


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 1186 − Hardness

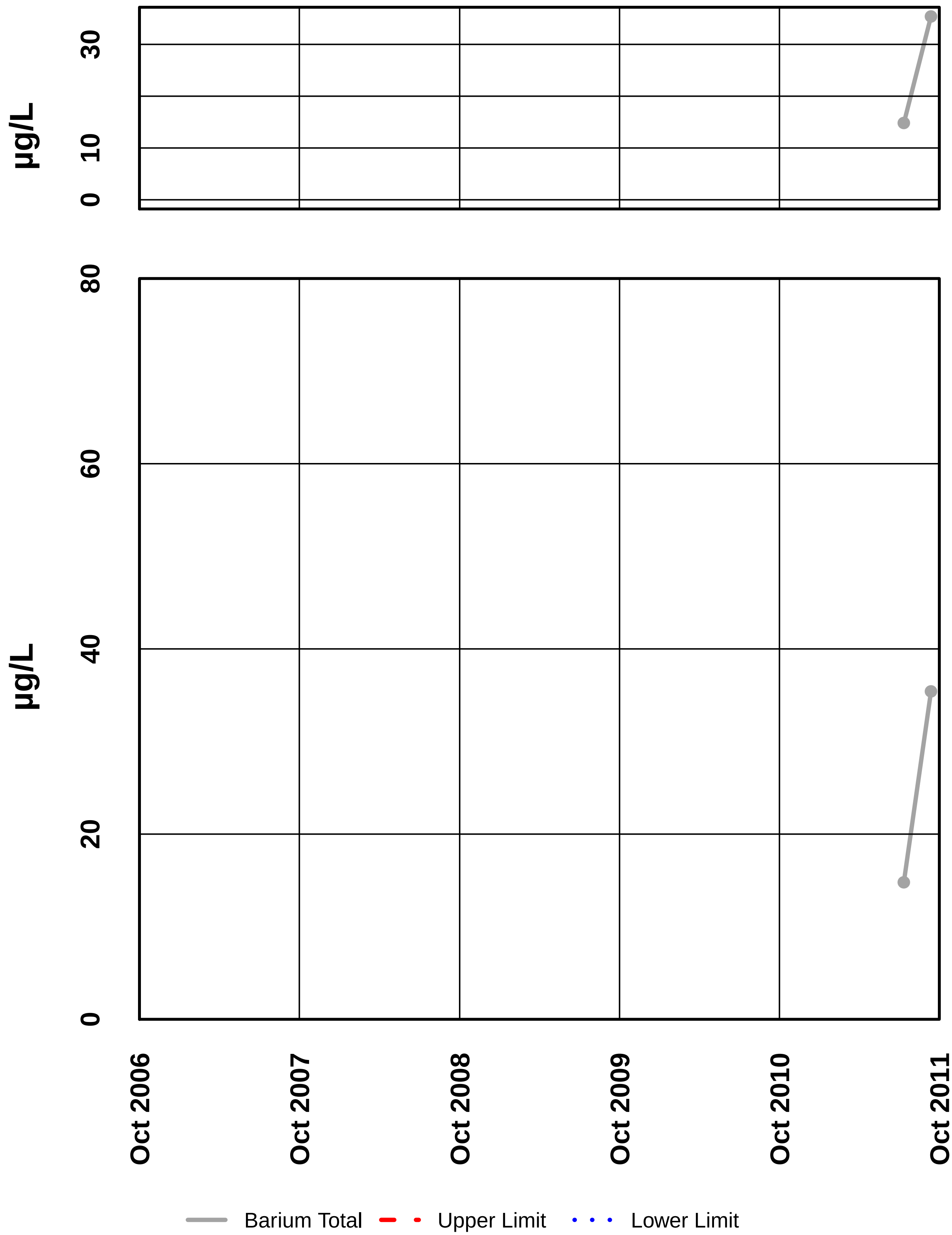


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



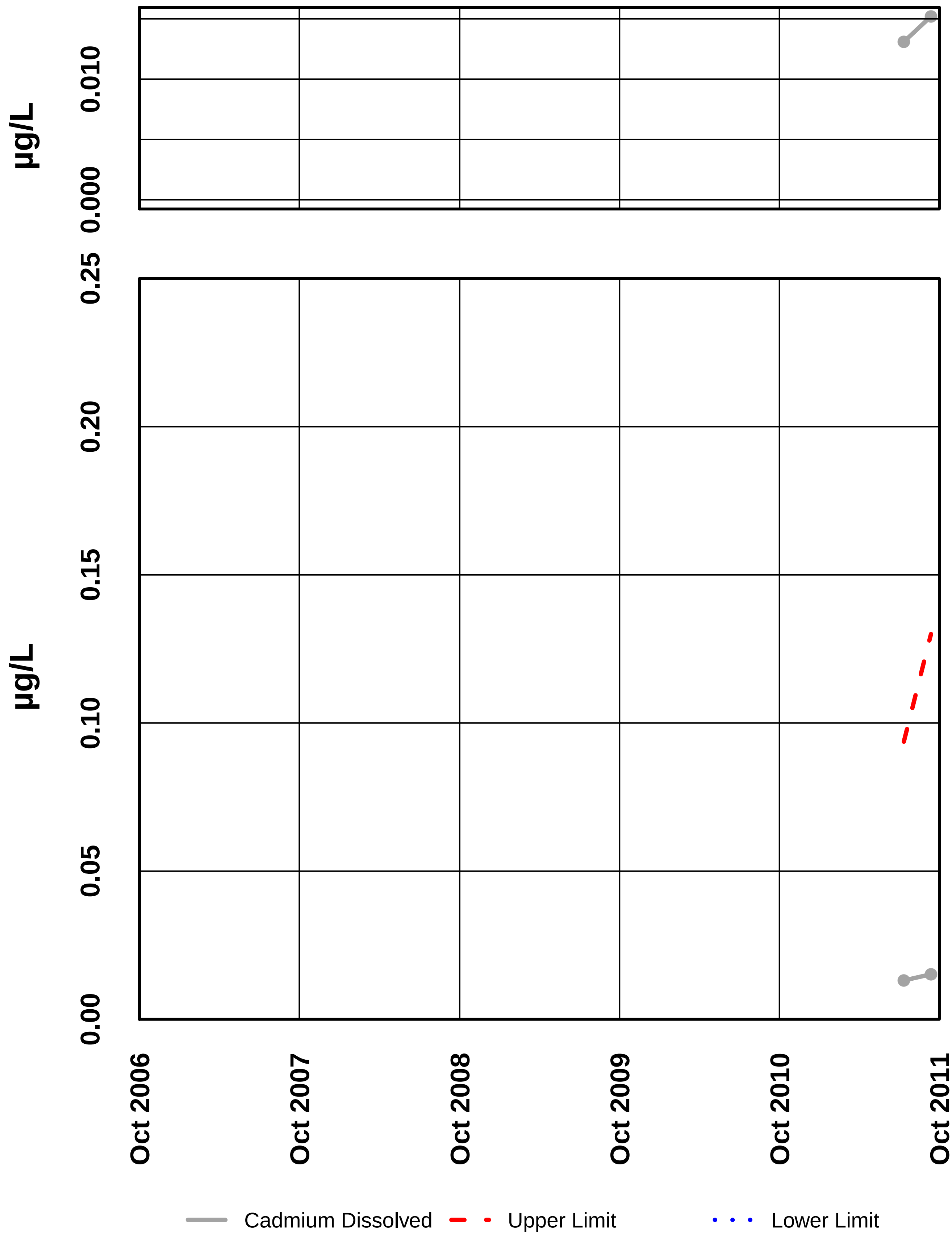
Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 1186 − Barium Total

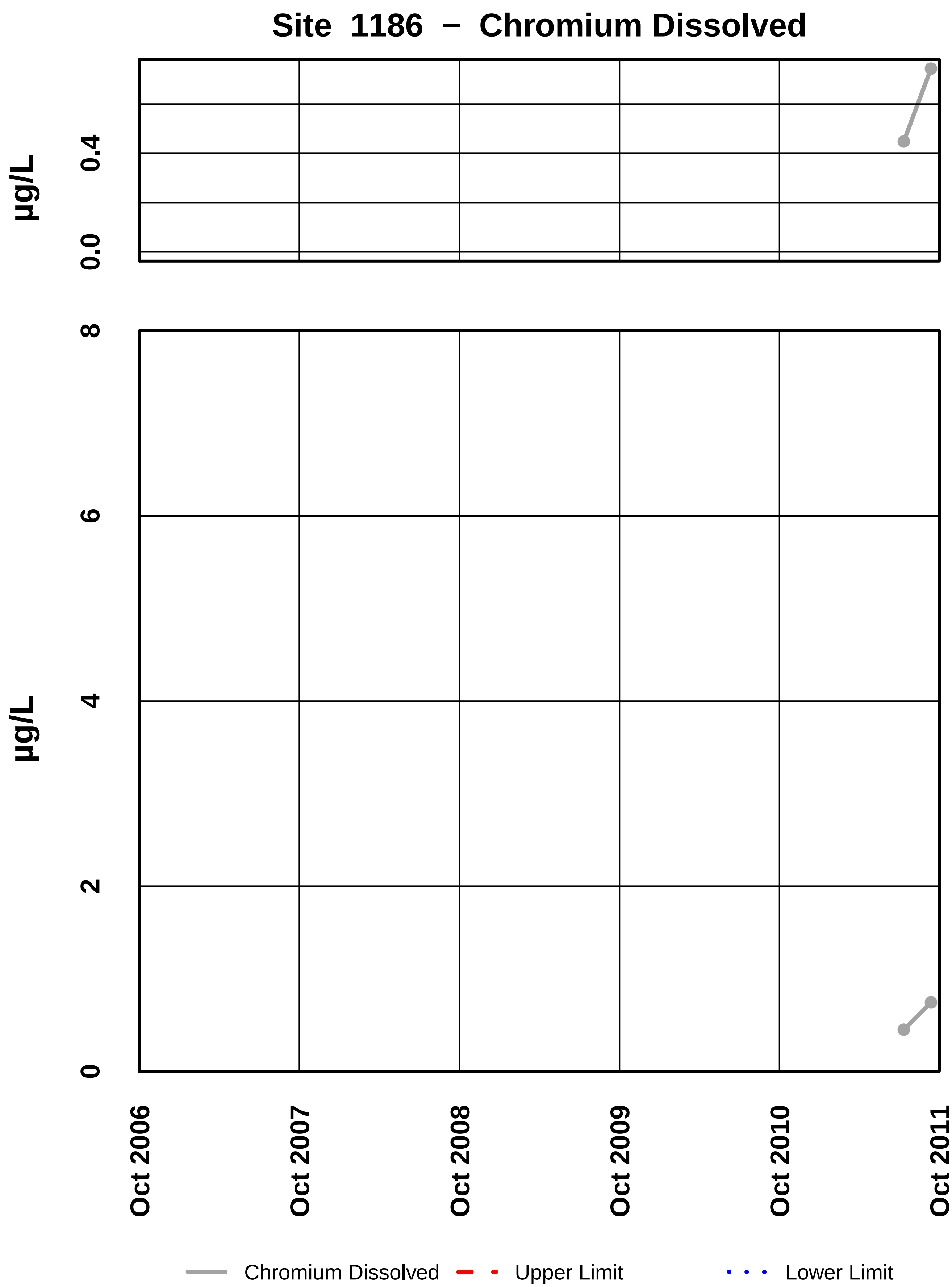


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 1186 – Cadmium Dissolved

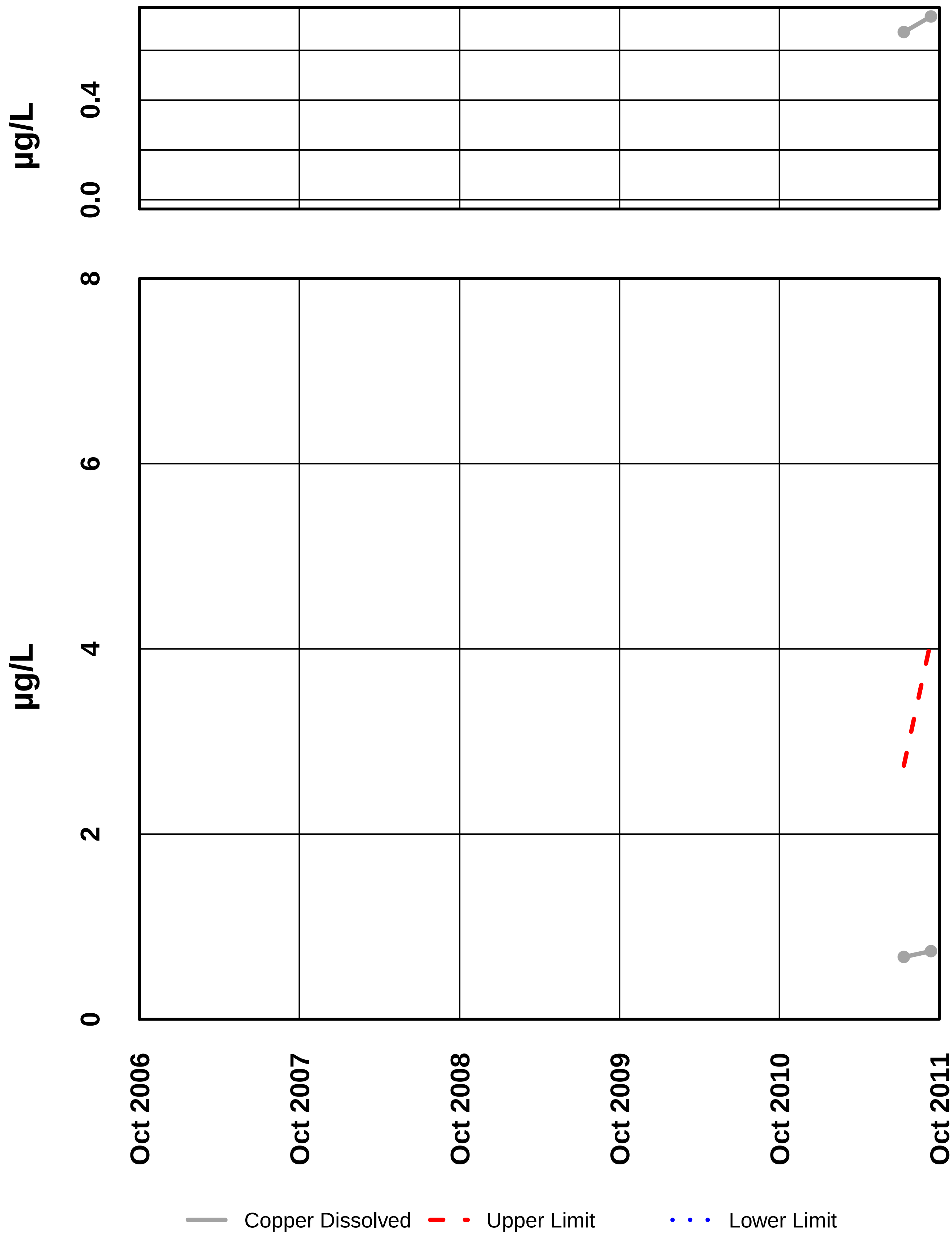


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

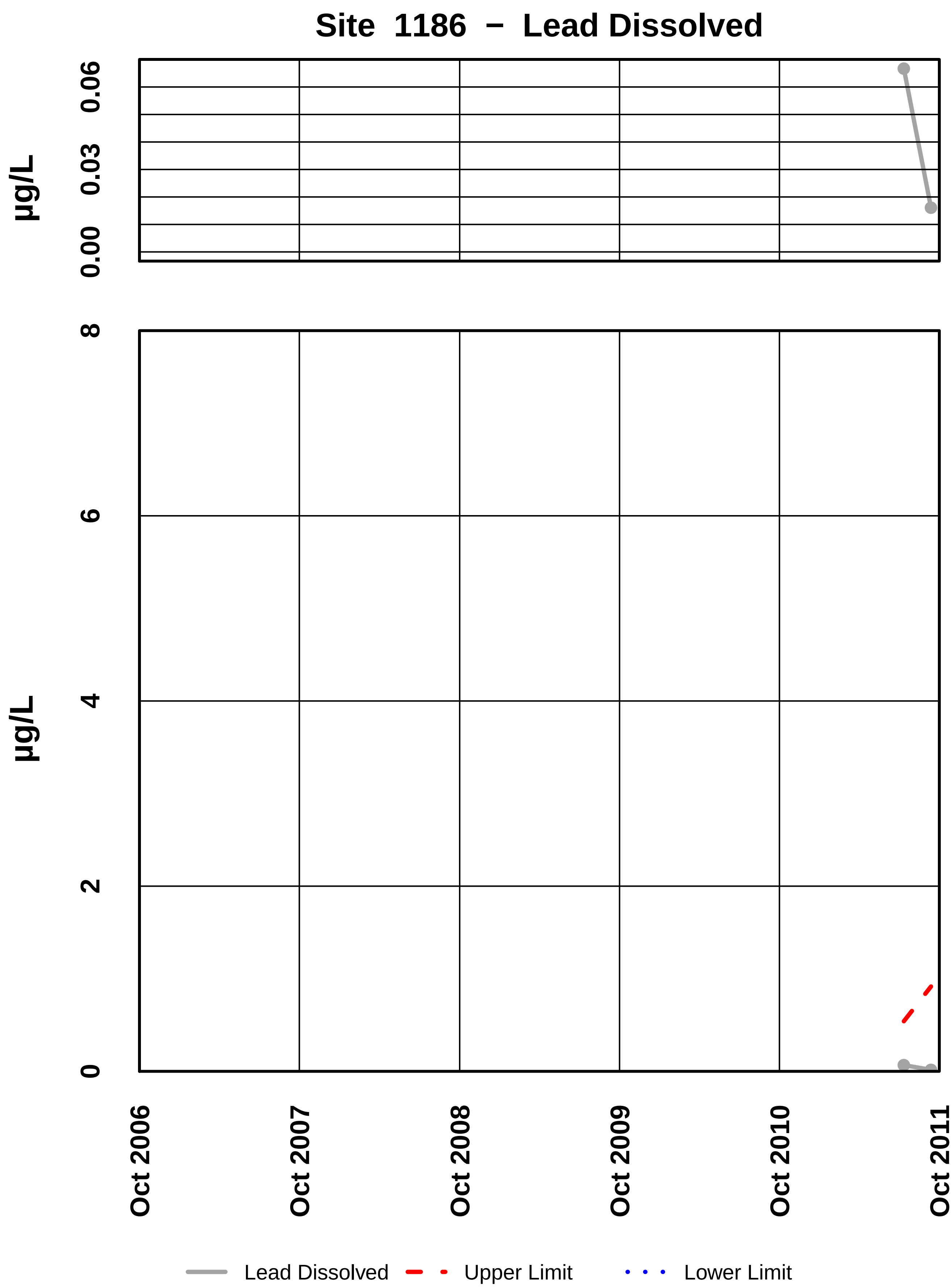


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 1186 − Copper Dissolved

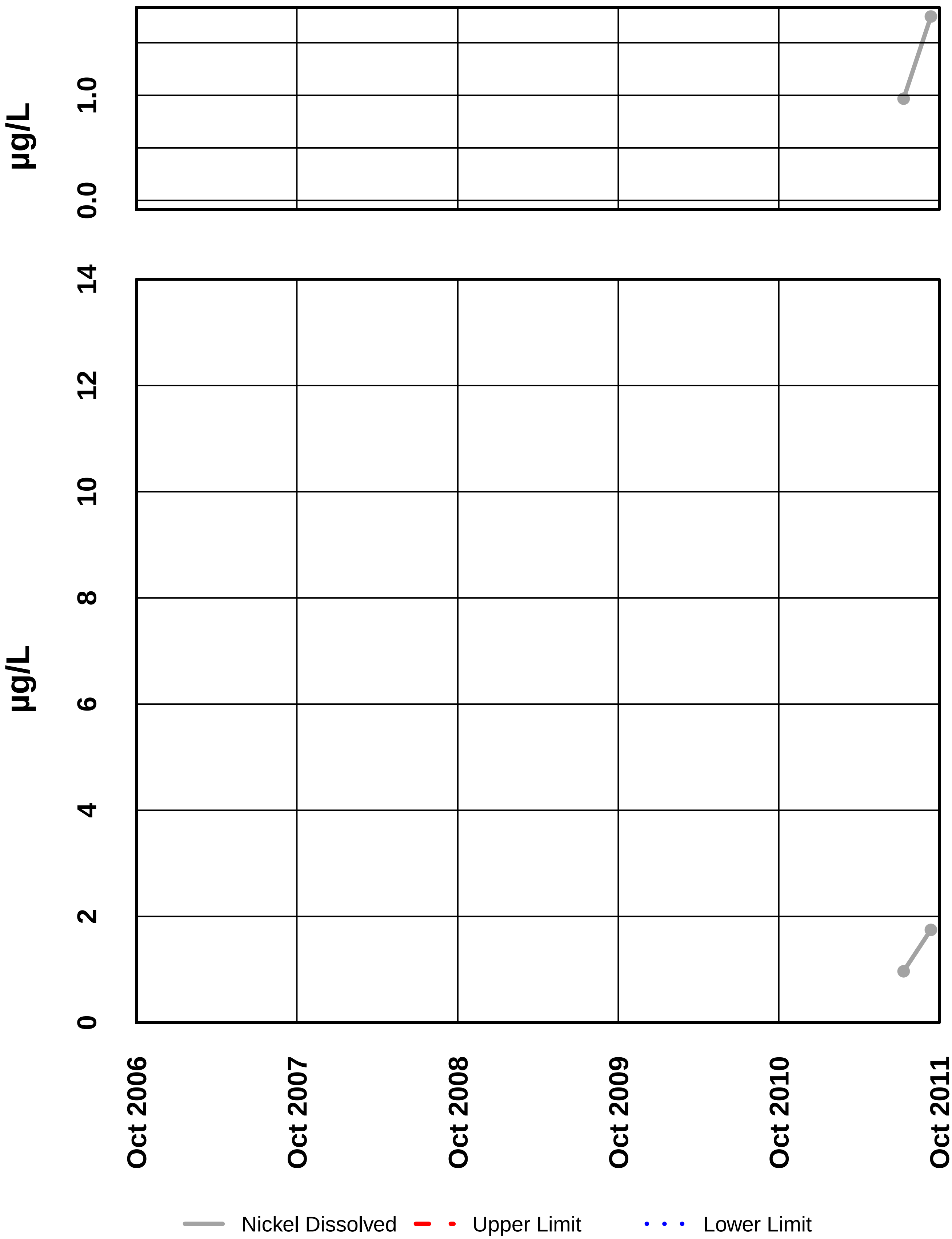


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

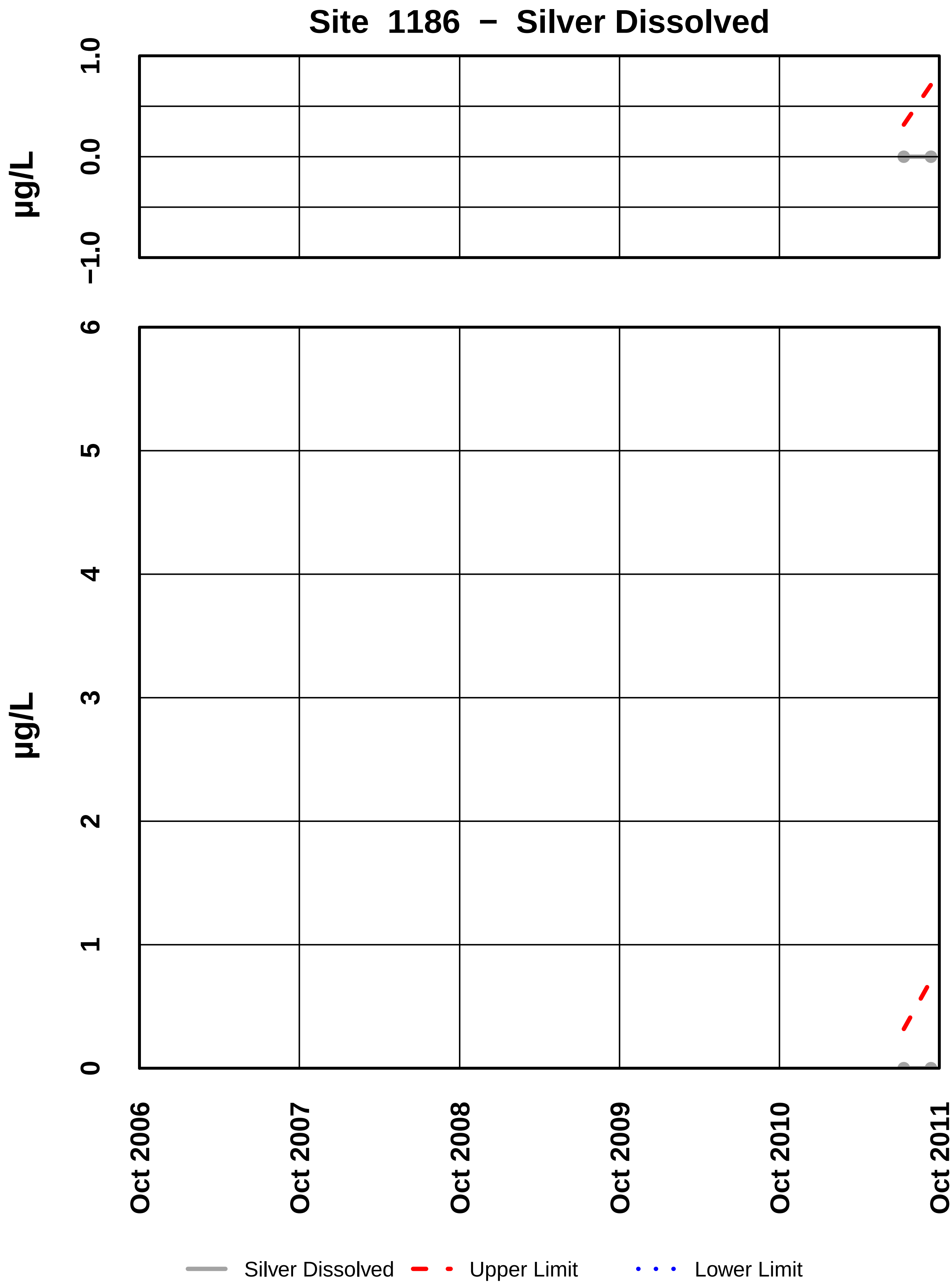


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 1186 − Nickel Dissolved

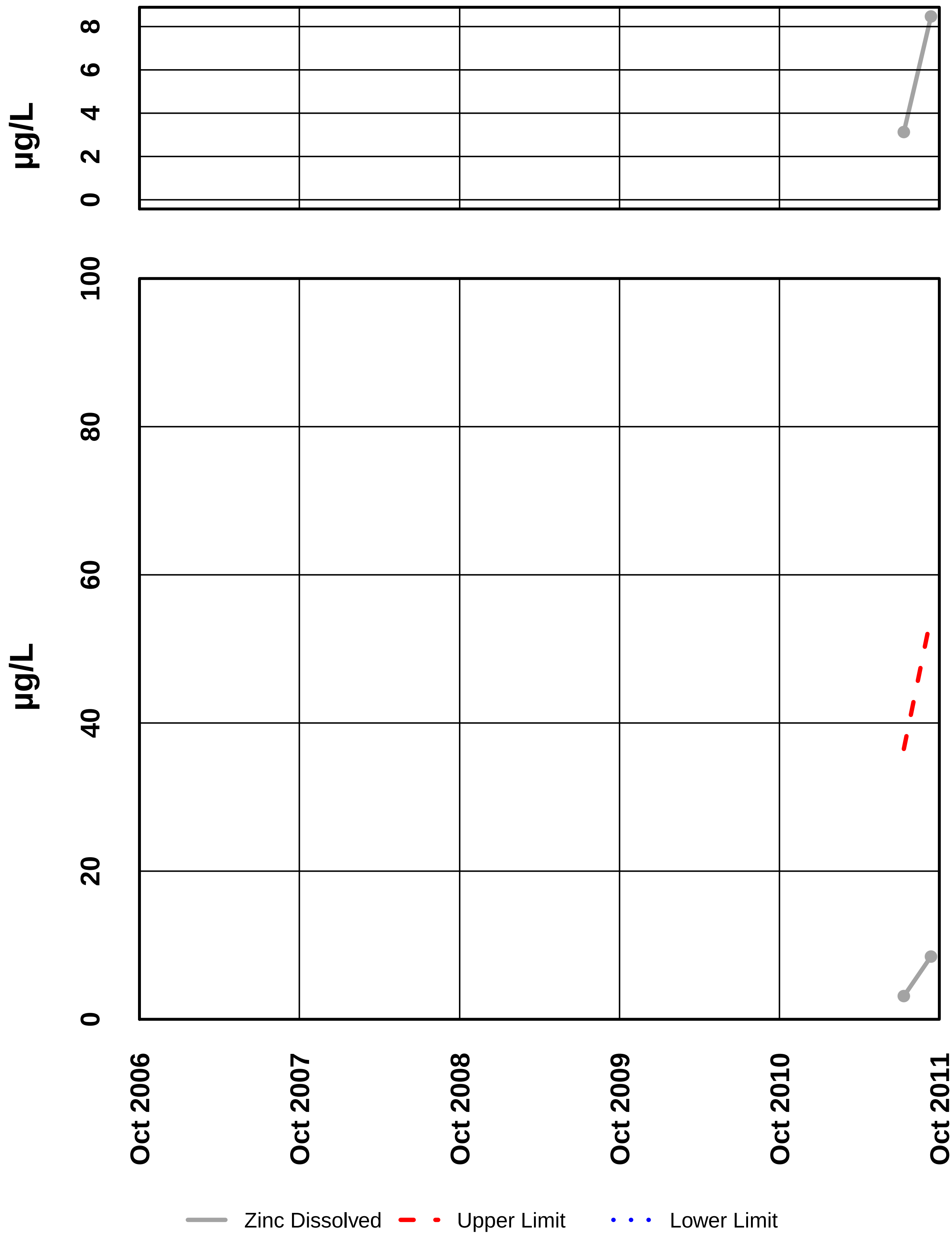


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

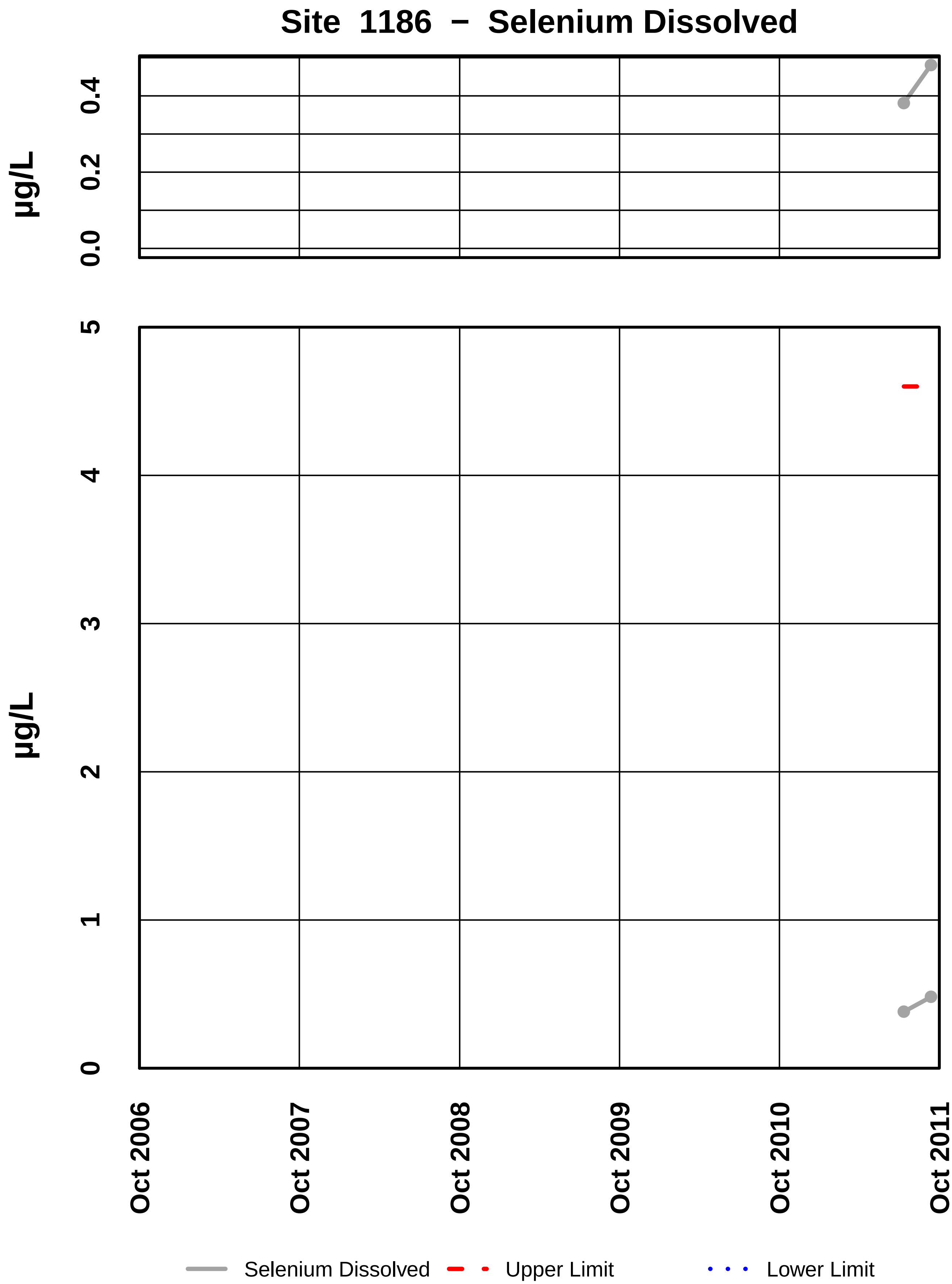


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis

Site 1186 – Zinc Dissolved

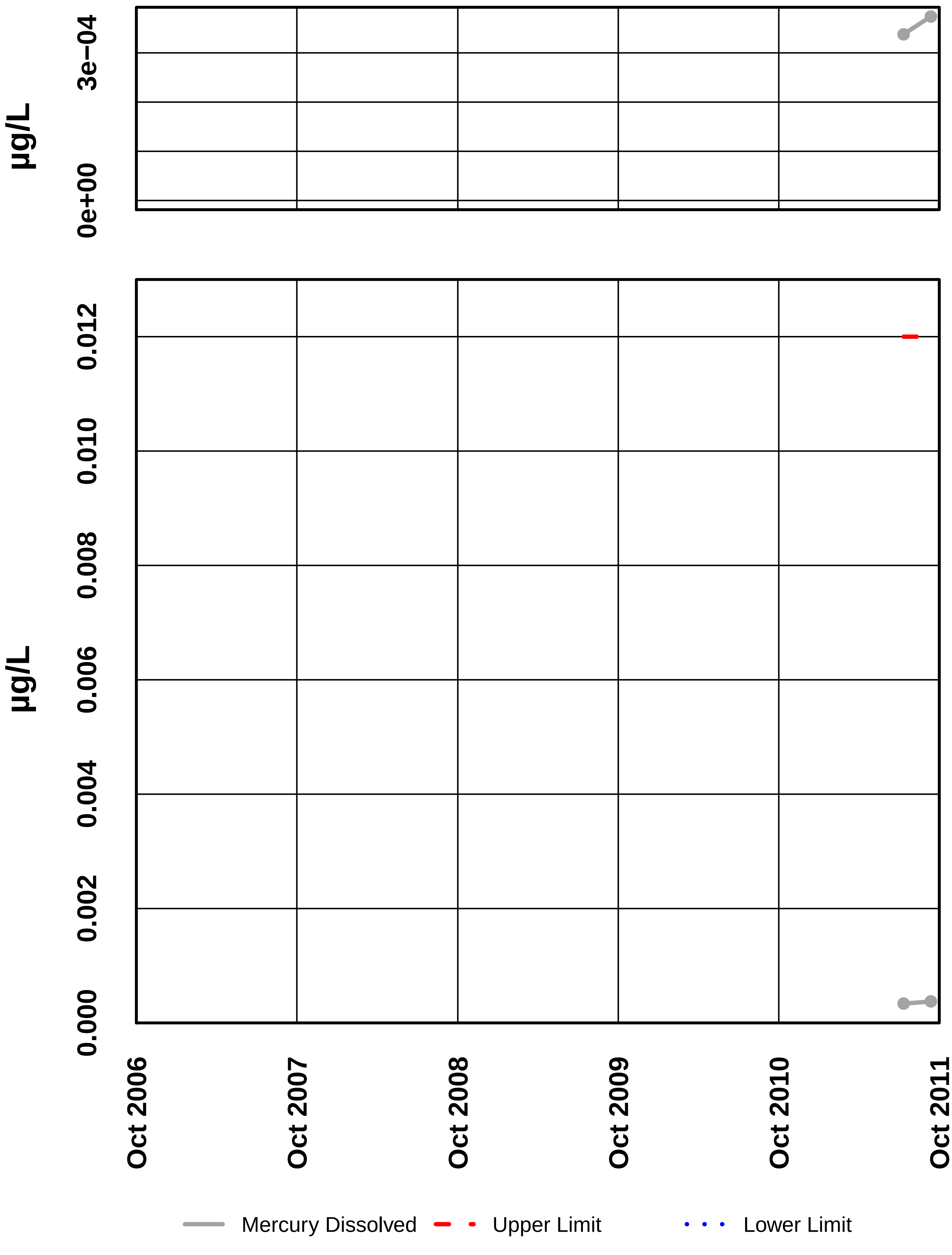


Note: the AWQS may not be shown in order to allow greater visual detail of measured values for trend analysis



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

Site 1186 – Mercury Dissolved



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

APPENDIX A

Parameter	Drinking Water	Stockwater	Irrigation Water	Aquatic Life-Fresh Water								Human Health Criteria for NonCarcinogens	
				Acute				Chronic					
				criteria	as	multilply by conversion factor	to convert to	criteria	as	multiply by conversion factor	to convert to	Water + Aquatic Organisms	Aquatic Organisms Only
alkalinity								**20,000 minimum**					
As	**10**	50	100	340	TR	1	D	150	TR	1	D		
Ba	**2,000**												
Cd	5	10	10	e^1.0166(ln hardness)-3.924	TR	1.136672-[(ln hardness)(0.041838)]	D	e^0.7409(ln hardness)-4.719	TR	1.101672-[(ln hardness)(0.041838)]	**D**		
Cr	100												
Cr(total)			100										
Cr(III)				e^0.819(ln hardness)+3.7256	TR	0.316	D	e^0.819(ln hardness)+0.6848	TR	0.860	D		
Cr(VI)		50		16	D			**11**	**D**				
Cu			200	e^0.9422(ln hardness)-1.700	TR	0.960	D	e^0.8545(ln hardness)-1.702	TR	**0.960**	**D**	1,300	
Pb		50	5,000	e^1.273(ln hardness)-1.460	TR	1.46203-[(ln hardness)(0.145712)]	D	e^1.273(ln hardness)-4.705	TR	1.46203-[(ln hardness)(0.145712)]	**D**		
Hg	2			1.4	D			**0.012**	TR			0.05	0.051
Ni	100		200	e^0.846(ln hardness)+2.255	TR	0.998	D	e^0.846(ln hardness)+0.0584	TR	0.997	D	610	4,600
Se	50	10	20	1/[([selenite]/185.9)+([selenate]/12.83]	TR	0.922	D	**5**	**TR**	**0.922**	**D**	170	11,000
Ag				**e^1.72(ln hardness)-6.52**	**TR**	**0.850**	**D**						
Zn			2,000	e^0.8473(ln hardness)+0.884	TR	0.978	D	e^0.8473(ln hardness)+0.884	TR	**0.986**	**D**	9,100	69,000

all units in micrograms per liter (ug/L)

DENOTES STRICTEST CRITERIA

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

Source: http://www.dec.state.ak.us/water/wqsar/wqs/toxicsbook.xls

Table formatting was modified by HGCMC to include only parameters include in Suite P and Q and to highlight the strictest standard.

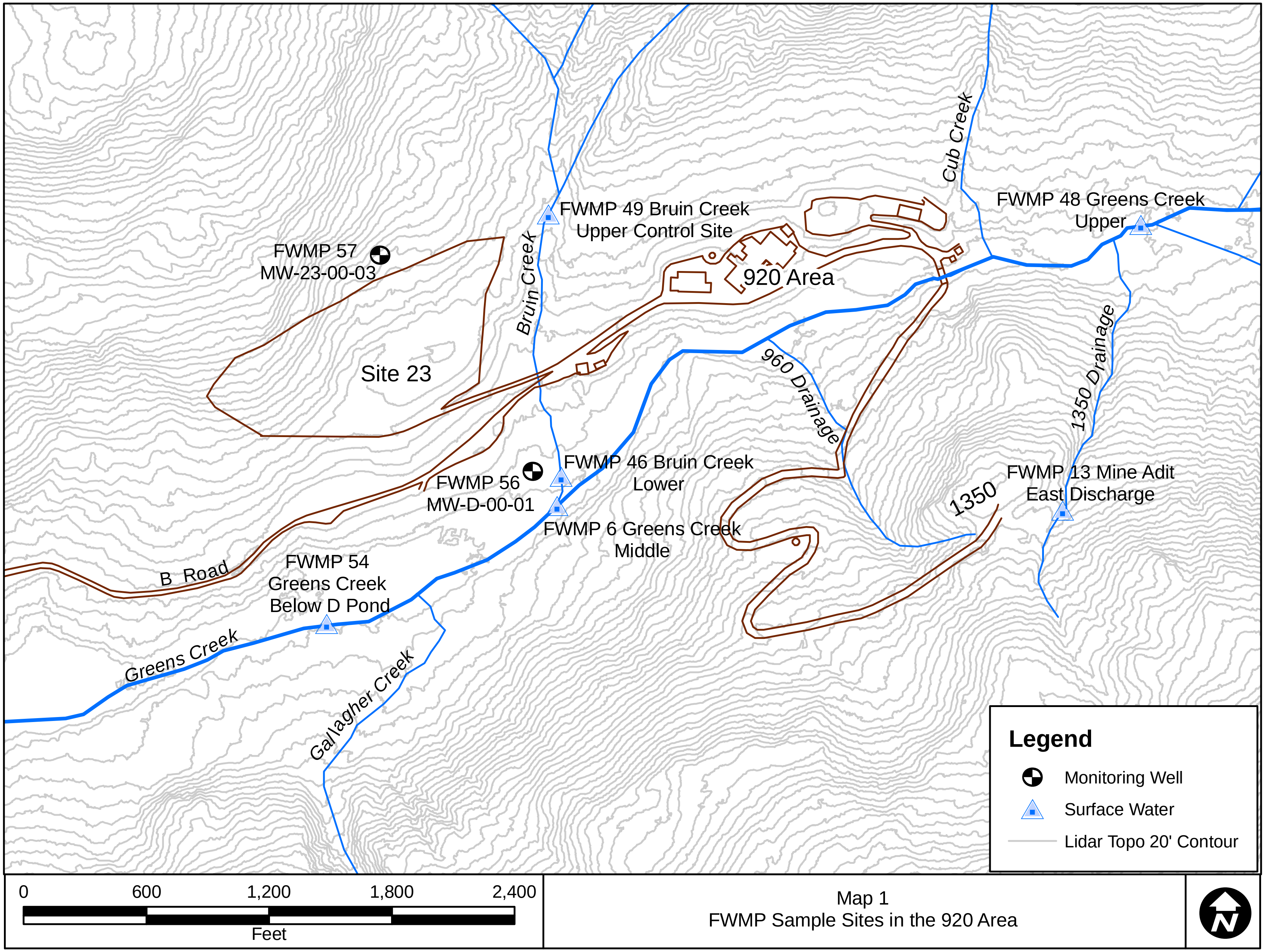
APPENDIX B

Map Sheets

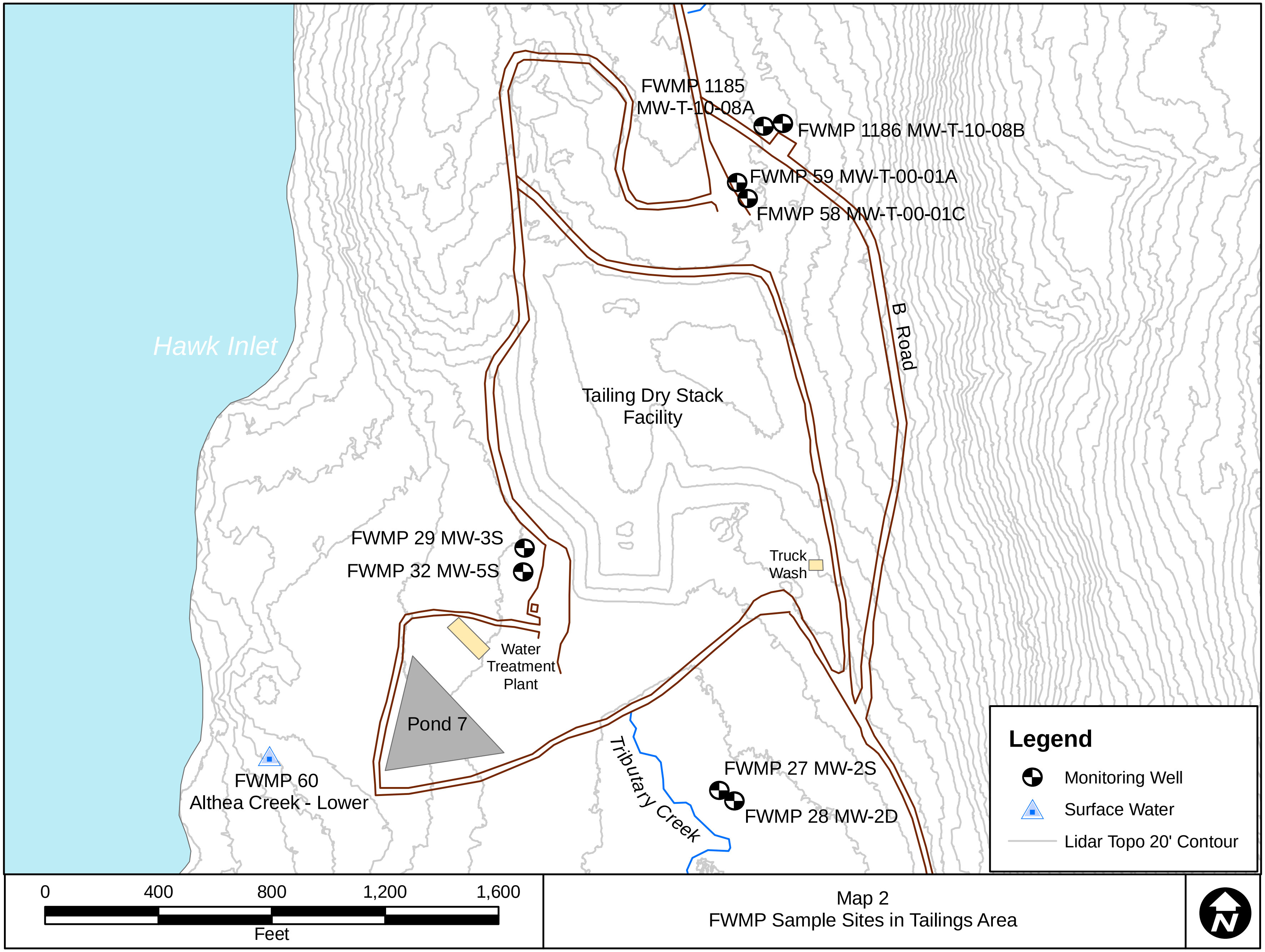
Map 1-920 Area FWMP Sites

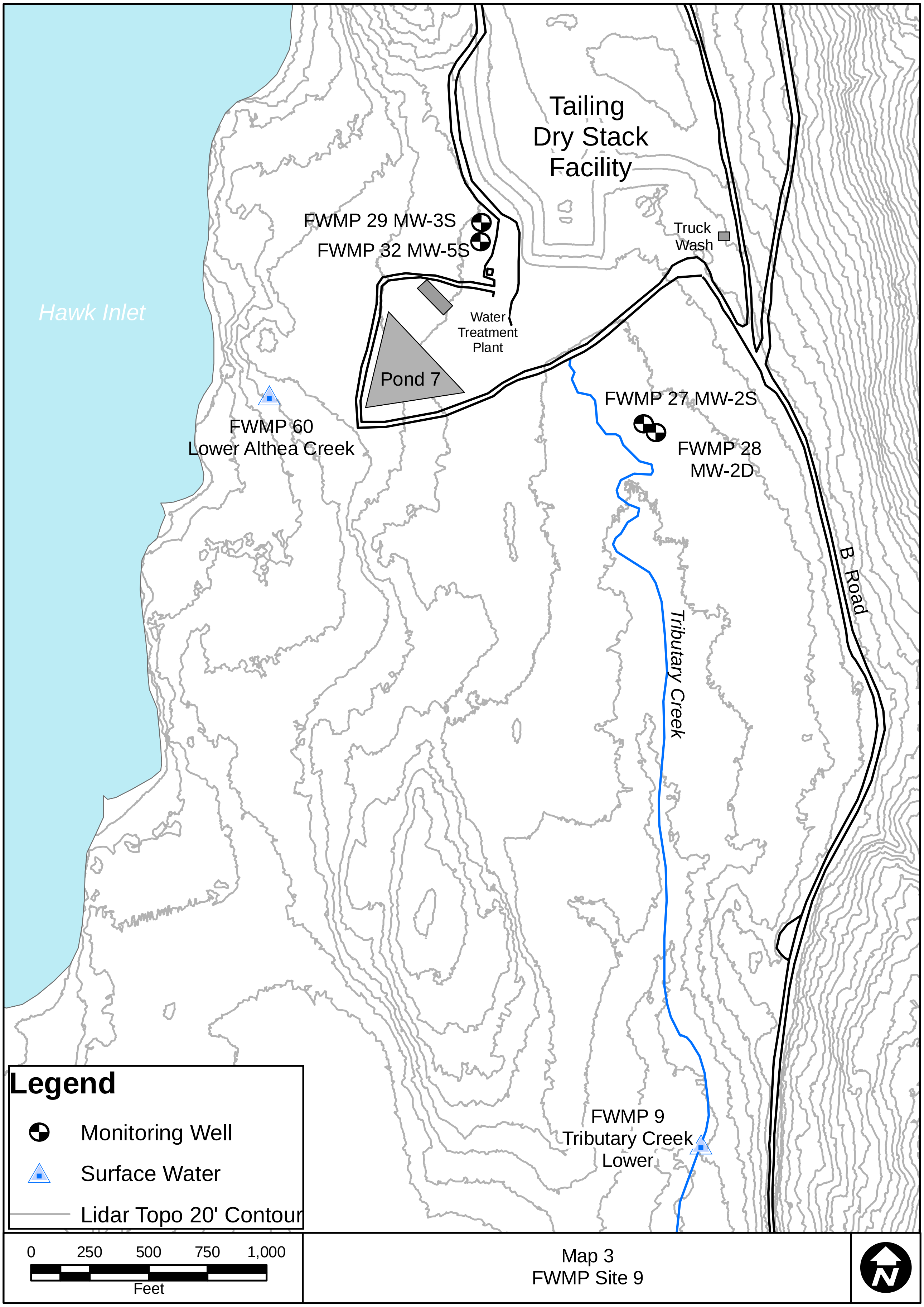
Map 2-Tailings Area FWMP Sites

Map 3-Site 9, Tributary Creek



Map 1
FWMP Sample Sites in the 920 Area


Hawk Inlet
FWMP 1185
MW-T-10-08A
FWMP 1186 MW-T-10-08B
FWMP 59 MW-T-00-01A
FMWP 58 MW-T-00-01C
B Road
Tailing Dry Stack
Facility
FWMP 29 MW-3S
FWMP 32 MW-5S
Truck
Wash
Water
Treatment
Plant
Pond 7
FWMP 60
Althea Creek - Lower
Tributary Creek
FWMP 27 MW-2S
FWMP 28 MW-2D
Legend
Monitoring Well
Surface Water
Lidar Topo 20' Contour
0
400
800
1,200
1,600
Feet
Map 2
FWMP Sample Sites in Tailings Area
N



Map 3
FWMP Site 9