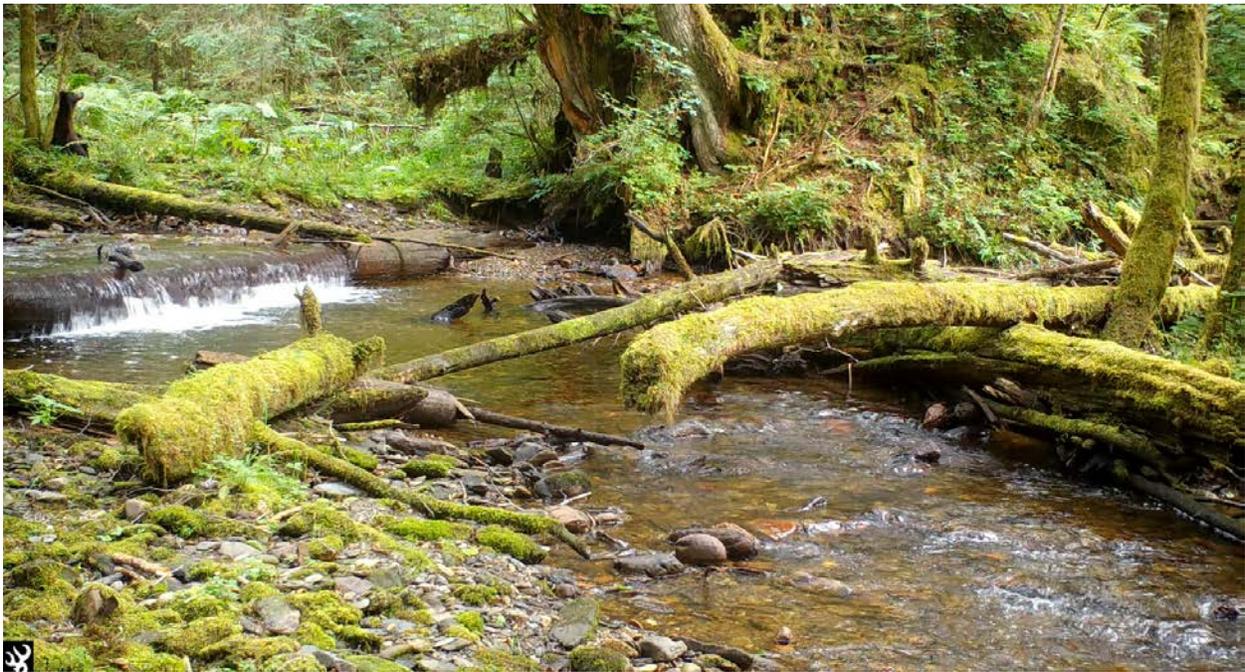




FRESH WATER MONITORING PROGRAM ANNUAL REPORT



WATER YEAR 2018

(October 1, 2017 through September 30, 2018)

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EXECUTIVE SUMMARY

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

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

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, and no data points were qualified as outliers.

No exceedances of Alaska Water Quality Standards (AWQS) occurred along Greens Creek at the four monitoring points (Site 48 (background), Site 6, Site 54, and Site 62) or the one floodplain monitoring site (Site 61) during Water Year 2018.

Site 13 was in exceedance, three times, for dissolved cadmium and dissolved zinc. HGCMC removed 11,200 bank cubic yards of material from the 1350 during the 2014 summer season. It was after this disturbance that the exceedances started to occur. This has been seen before with other reclamation projects and with those the increased concentrations were short lived. In 2015 HGCMC removed additional material at the 1350 from the access to the raised bore ventilation shafts. Late in August 2016 a collection system was installed at the base of the remaining material to be reclaimed. A reduction in zinc and cadmium concentrations in 2018 is attributed to installation of the collection system and natural attenuation of the stored metal load in the reclaimed area. HGCMC will continue to monitor the area as it stabilizes and matures.

No exceedances of AWQS were recorded for Bruin Creek, during Water Year 2018; monitored at the up-gradient Site 49 (background) and downgradient Site 46. There were no exceedances recorded at the background Site 57, located upgradient from the mine operations near the waste rock facility Site 23.

Exceedances in the tailings area were noted for low pH and low alkalinity. The shallow wells (Site 27, Site 29, and Site 32) continued to express the natural condition of low pH and low alkalinity that characterize these sites located in organic rich peat sediments.

Site 60 had exceedances for low alkalinity, low pH, and elevated mercury. Dissolution of tailings dust particles, which contain small amounts of mercury, and atmospheric deposition of mercury from natural (e.g. volcanoes) and anthropogenic sources (e.g. coal fired power plants in Asia) are potential sources of this metal in the drainage area. Three of the four samples collected during the current water year were within AWQS, the other sample (0.0123 µg/L) was slightly above

the AWQS of 0.012 µg/L. Sampling in adjacent drainages during water year 2009 and water year 2013 showed that this issue was isolated to only the Site 60 watershed.

Site 9 on Tributary Creek south of the facility had exceedances for low alkalinity, low pH, and elevated levels of lead. Low alkalinity and pH values are expected given the naturally occurring acidic muskeg conditions in the headwaters near Site 27 and Site 29. Site 9 had one sample that was slightly above the AWQS for lead. Site 609 had an exceedance for total sulfate (274 mg/L), however the other 3 samples taken at the site were not in exceedance.

Graphical and non-parametric analyses for trends in the data were performed for all sites when sufficient data was available. It takes six years of monitoring a new site (Site 609, Site 711, Site 712, Site 61, Site 62, Site 1913 and Site 1914) before all relevant statistical analyses can be performed. Statistically significant trends were identified as follows: Site 48, decreasing trend in dissolved zinc; Site 57, increasing trend in total alkalinity and decreasing trend in dissolved zinc; Site 13, decreasing trend in conductivity, field pH, total alkalinity, and total sulfate; Site 60, upward trend in total sulfate; Site 27, upward trend in total alkalinity and conductivity; Site 32, upward trend in conductivity; Site 9, decreasing trend in pH.

During the fall of 2017 Greens Creek carved a new channel segment, beginning just below the mouth of the Big Sore Creek, that bypassed Site 48. The confluence of the new channel and the existing channel is located approximately 40 meters downstream of Site 48. Due to the lack of flow at Site 48, water quality sampling since November 2017 has occurred just below the confluence of the new channel with the existing channel. The new sample location is still representative of natural background water quality, and samples have continued to be identified as Site 48.

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

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

Site 27, Site 29, and Site 32 are analyzed using the combined Shewhart-CUSUM control charts. From this evaluation it is recognized that Site 27 has experienced changes over time. Primarily the specific conductance and total sulfate charts begin to go out of control in early 2008. This is attributed to the building of the rock-fill pad east of Pond 7. Both parameters are trending towards pre-pad disturbance levels, however with the construction of the tailings expansion (2015-2018) occurring immediately upgradient of the monitoring site, some fluctuation in the water chemistry is occurring. It is expected that once the construction is completed and the area

has stabilized that the fluctuations in water chemistry will stabilize. The other control chart for dissolved zinc first went out of control during water year 2007, a high fugitive dust year. Twice since zinc concentrations have been above the control limits, also associated with fugitive dust loading. However, after each of these events the values return to the historical range. Control charts for Site 32 indicate conductivity and alkalinity went out of control in the 2017 water year. This is likely a result of construction-related changes to the near-surface hydrology near the well.

INTRODUCTION

This annual report for Water Year 2018 (October 1, 2017 through September 30, 2018) provides the information required by the Fresh Water Monitoring Program (FWMP). It is separated into several sections, the first of which provides general information applicable to the entire program, followed by a comprehensive analysis of the data for each specific site.

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

The monitoring schedule varies from site to site and different sites are monitored for different analytes on different months of the year. Occasionally, sites scheduled for sampling may not be available due to weather or more rarely operational reasons. A copy of the Water Year 2018 sampling log is included in this section and any variations from scheduled sampling events are noted on each site's table of results presented in the interpretive section.

The following table outlines the Statistical Information Goals for each site sampled during the Water Year 2018.

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

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

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

Statistical Tests

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

The advantages of the Seasonal Kendall trend test is that it is a rank-based procedure especially suitable for non-normally distributed data, censored data, data containing outliers and non-linear trends. The null hypothesis (H_0) states that the data (x_1, \dots, 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). Statistically significant trends ($\alpha/2 = 2.5\%$) are noted for p -values ≥ 0.975 or ≤ 0.025 . 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 $D_i = x_i - y_i, i=1 \dots N$ are computed for each pair. The absolute values of the differences $|D_i|, i=1 \dots N$ 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. For a significant difference to be noted, the difference must be in the direction indicated in the table and at a significance level of $\alpha=0.05$ (p-value less than or equal to 0.05).

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	$X's < Y's$	$W^+(calc) < W(table)_{\alpha,n}$
Field-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 buffering capacity due to H^+ produced by pyrite oxidation, associated with waste rock.	>0	$X's > Y's$	$W^+(calc) > W(table)_{\alpha,n}$
Total Alkalinity	Total alkalinity increase by the weathering of carbonate mineralogy, associated with tailings	<0	$X's < Y's$	$W^+(calc) < W(table)_{\alpha,n}$
Total Sulfate	Total sulfate increases due to oxidation of sulfides	<0	$X's < Y's$	$W^+(calc) < W(table)_{\alpha,n}$
Dissolved Zinc	Dissolved zinc increases due to sulfide oxidation and is more readily soluble at neutral pH than other metals.	<0	$X's < Y's$	$W^+(calc) < W(table)_{\alpha,n}$

X: Upgradient Site

Y: Downgradient Site

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

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

the QA Reviewer for Water Year 2018 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 2018. 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.

- All required sampling was accomplished during the 2019 Water Year as specified in the monitoring schedule, except there was no flow at Site 46 during the February 2018 and August 2018 sampling events.
- Total sulfate samples in August 2018 were collected a week after the rest of the analytes.

MID-YEAR MODIFICATIONS

There were no mid-year modifications.

GENERAL HISTORY

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

It was noted, during the annual meeting in 2012, that the units on the conductivity graphs were expressed as 'NTU' and not ' $\mu\text{S}/\text{cm}$ '. This error was corrected in the 2012 FWMP Report.

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

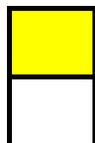
During the 2014 Water Year sampling at Site 61 was increased to monthly beginning in June 2014. This modification was initiated because of the exceedances recorded with the first sampling. After conducting this additional sampling for over a year, and with no further exceedances, the frequency of sampling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

While compiling the 2018 Water Year report, it was noted that reports for the 2016 and 2017 Water Years did not include comparison graphs for the Greens Creek monitoring points.

FWMP SAMPLE LOG

2018 Water Year October 2017 Through September 2018 Annual Water Quality Monitoring Schedule-Laboratory Samples

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



Sample not taken

Regular sample

SAMPLE SUITES

Suite P

(Surface water only)

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

Suite Q

(Groundwater and surface water)

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

PERSONNEL INVOLVED

USFS

Chad Van Ormer, Monument Ranger

Matt Reece
Curtis Caton
Edward Gazzetti
Richard Dudek

Biomonitoring (Fish and Game)

Kate Kanouse
Jackie Timothy
Johnny Zutz

Consultants

Pete Condon, Geochemist
Petros GeoConsulting

Laboratory Analysis

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Admiralty Environmental

Nicholas Ward, Project Coordinator
Battelle Marine Sciences Laboratory

Sue Weber, Project Manager
ACZ

HGCMC

Keith Malone, General Manager

Christopher Wallace, Environmental Manager
Cameron Sell, Environmental Engineer
David Landes, Environmental Engineer

Douglas Maller, Environmental Specialist
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Evin McKinney, Senior Scientist
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Leticia Sangalang, Senior Scientist
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SITE COORDINATES

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

PROPOSED PROGRAM MODIFICATIONS

HGCMC is not proposing changes to the FWMP during the 2019 Water Year.

BIBLIOGRAPHY

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

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

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

INTERPRETIVE REPORT

SITE 48

The data collected during the current water year are listed in the following “Table of Results for Water Year 2018” 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 one-half of the 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 data points were flagged as outliers, after review by HGCMC.

Sample Date	Parameter	Value	Qualifier	Notes
No outliers, in the past six years, have been identified by HGCMC.				

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

Table of Exceedance for Water Year 2018

Sample Date	Parameter	Value	Limits		Hardness
			Lower	Upper	
No exceedances have been identified by HGCMC for the period of October 2017 through September 2018.					

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

A non-parametric statistical analysis for trend was performed for specific conductivity, field pH, total alkalinity, total sulfate, and dissolved zinc. Calculation details of the Seasonal Kendall analyses are presented in detail on the pages following this interpretive section. The following table summarizes the results on the data collected between Oct-12 and Sep-18 (WY2013-WY2018).

Site 48 - Table of Summary Statistics for Trend Analysis

Parameter	<u>Mann-Kendall test statistics</u>			<u>Sen's slope estimate</u>	
	n*	p**	Trend	Q	Q(%)
Conductivity Field	6	0.48			
pH Field	6	0.04			
Alkalinity, Total	6	0.54			
Sulfate, Total	6	0.11			
Zinc, Dissolved	6	<0.01	-	-0.15	-5.1

* 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 dissolved zinc had a slope estimate of $-0.15 \mu\text{g/l/year}$.

Table of Results for Water Year 2018

Site 048FMS - 'Upper Greens Creek'

Sample Date/Parameter	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018	Median
Water Temp (°C)		2.2	0.20	1.6	0.00	0	1.1	4.5	5.7	8.3	11	8.7	2.20
Conductivity-Field(µmho)	101.2	118	118.3	76.1	166.5	130.6	118.8	85.6	95.4	110.3	152.8	159	118.2
Conductivity-Lab (µmho)	96	115	114	72	127	122	106	77	87	107	147	146	111
pH Lab (standard units)	7.02	6.96	7.49	7.36	7.25	7.2	7.11	7.3	7.1	6.77	7.09	7.35	7.16
pH Field (standard units)	7.77	7.68	7.81	7.63	7.66	7.69	7.69	7.52	7.66	7.69	7.72	7.89	7.69
Total Alkalinity (mg/L)	44	50.6	48.4	30.5	56	43.8	44	33.1	38.1	36.8	53.7	57.7	44.0
Total Sulfate (mg/L)	9.9	10.6	12.8	9.1	17.5	15.1	13	7.8	9.7	10.7	14.4	17.2	11.8
Hardness (mg/L)	49.2	60.3	58.5	35.4	78.7	61	56.7	40.5	46.8	50.5	71	68.6	57.6
Dissolved As (ug/L)	0.227	0.144	0.196	0.189	0.173	0.175	0.186	0.178	0.196	0.217	0.246	0.231	0.193
Dissolved Ba (ug/L)			25.1		31.6								28.4
Dissolved Cd (ug/L)	0.0349	0.0364	0.0314	0.0238	0.0367	0.0341	0.0285	0.0224	0.0289	0.0296	0.0381	0.037	0.0328
Dissolved Cr (ug/L)			0.071		0.18								0.126
Dissolved Cu (ug/L)	0.52	0.57	0.417	0.455	0.297	0.378	0.498	0.416	0.424	0.643	0.385	0.344	0.421
Dissolved Pb (ug/L)	0.0061	0.0037	0.0052	0.0154	0.0053	0.0118	0.0127	0.0047	0.0051	0.0055	0.003	0.0015	0.0053
Dissolved Ni (ug/L)			0.294		0.74								0.517
Dissolved Ag (ug/L)			0.002		0.002								0.002
Dissolved Zn (ug/L)	2.55	2.88	3.22	1.98	3.93	3.38	2.95	1.71	2.38	2.13	2.34	2.38	2.47
Dissolved Se (ug/L)			0.969		1.14								1.055
Dissolved Hg (ug/L)	0.00116	0.00114	0.000754	0.000909	0.000328	0.000797	0.000894	0.000858	0.000814	0.000532	0.000826	0.0005	0.000820

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

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

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

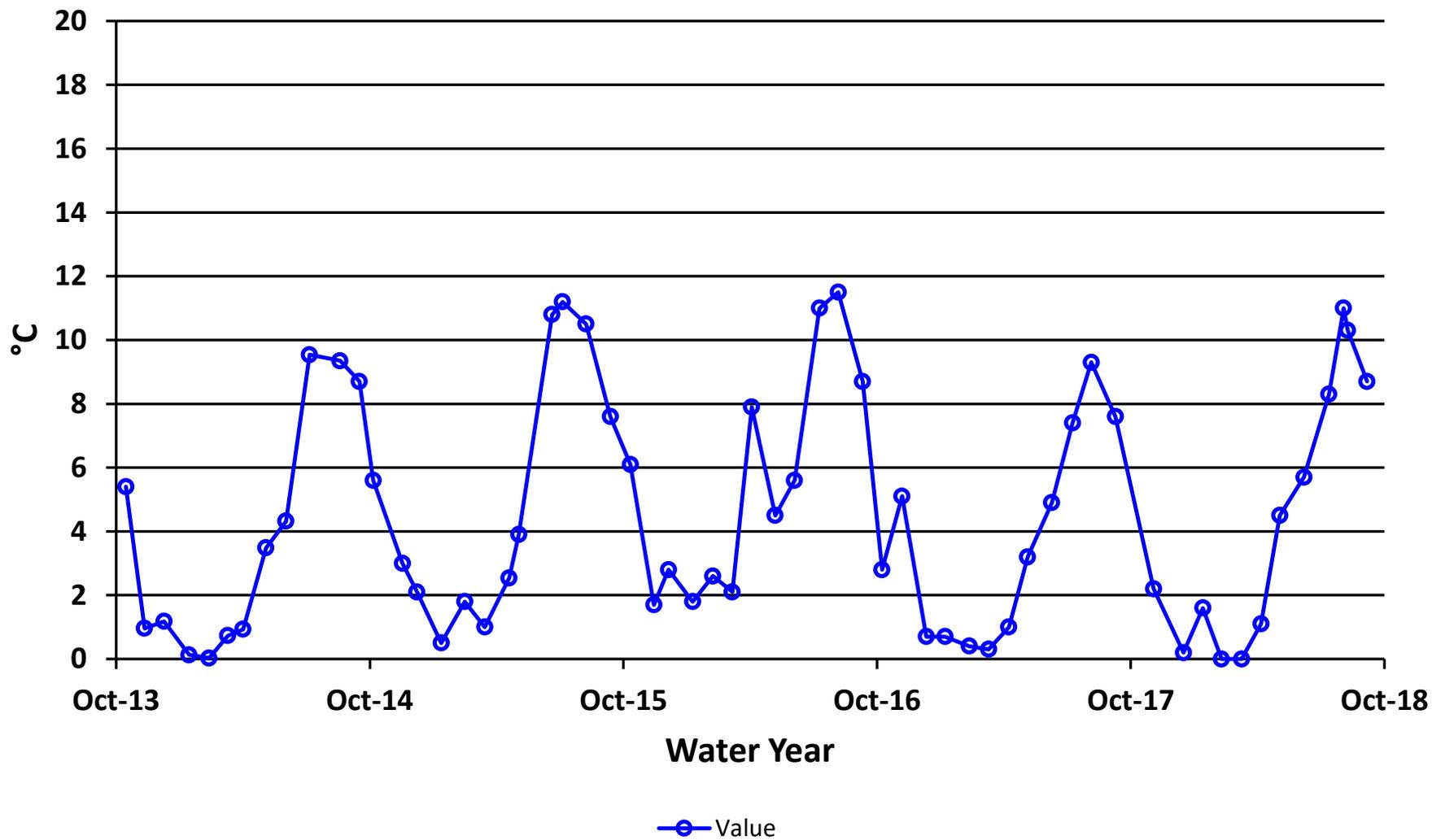
Qualified Data by QA Reviewer

Date Range: 10/01/2017 to 09/30/2018

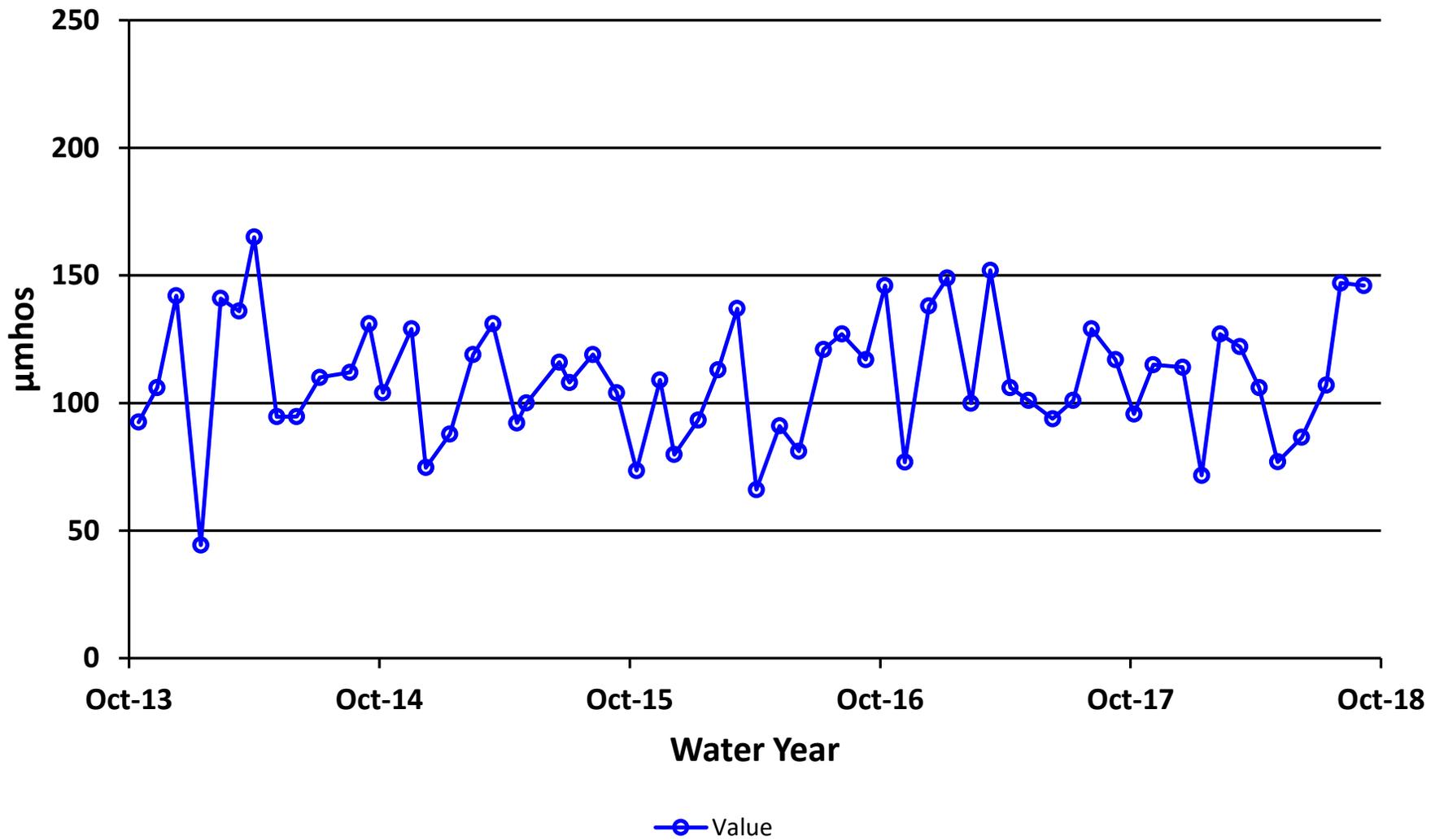
Site No.	Sample Date	Parameter	Value	Units	Qualifier	Reason for Qualifier
048FMS	10/9/2017	Diss. Pb-ICP/MS	6.10E-03	µg/L	U	Field Blank Contamination
		Total Sulfate	9.9	mg/L	J	Hold Time Violation, Temperature Excedance
	11/6/2017	Diss. Mn-ICP/OES	0.14	µg/L	J	Below Quantitative Range
		Diss. Pb-ICP/MS	0.0037	µg/L	J	Below Quantitative Range
	12/19/2017	Diss. Cr-ICP/MS	0.07	µg/L	J	Below Quantitative Range
		Diss. Pb-ICP/MS	0.0052	µg/L	U	Field Blank Contamination
	2/12/2018	Diss. Pb-ICP/MS	0.0053	µg/L	J	Below Quantitative Range
		pH	7.25	pH units	J	Hold Time Violation
	3/13/2018	Diss. Pb-ICP/MS	0.01	µg/L	U	Field Blank Contamination
		pH	7.2	pH units	J	Hold Time Violation
	4/10/2018	pH	7.11	pH units	J	Hold Time Violation
		Total Sulfate	13	mg/L	J	Sample Receipt Temperature
	5/7/2018	Diss. Pb-ICP/MS	0.0047	µg/L	J	Below Quantitative Range
		pH	7.3	pH units	J	Hold Time Violation
	6/11/2018	Diss. Pb-ICP/MS	0.0051	µg/L	J	Below Quantitative Range
		Total Sulfate	9.71	mg/L	J	Hold Time Violation, Temperature Excedance
	7/17/2018	Diss. Pb-ICP/MS	0.0055	µg/L	J	Below Quantitative Range
		pH	6.77	pH units	J	Hold time Violation
		Total Sulfate	10.7	mg/L	J	Sample Reciept Temperature
	8/7/2018	Diss. Pb-ICP/MS	0.0030	µg/L	J	Below Quantitative Range
		Diss. Zn-ICP/MS	2.34	µg/L	U	Field Blank Contamination
		pH	7.09	pH units	J	Hold Time Violation
	9/10/2018	Diss. Zn-ICP/MS	2.38	µg/L	U	Field Blank Contamination
		pH	7.35	pH units	J	Hold Time Violation
		Total Sulfate	17.2	mg/L	J	Sample Receipt Temperature

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

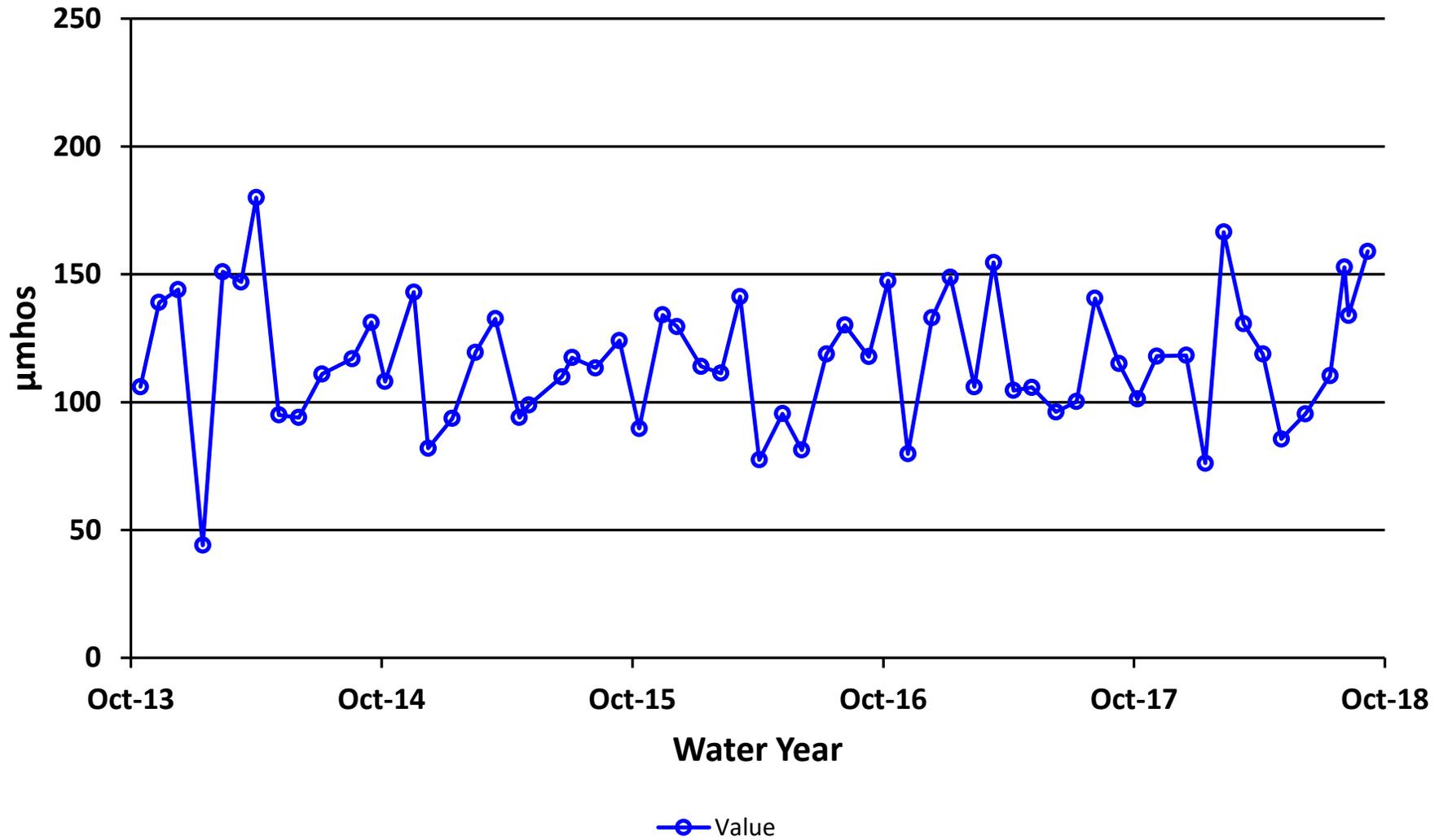
Site 48 - Water Temperature



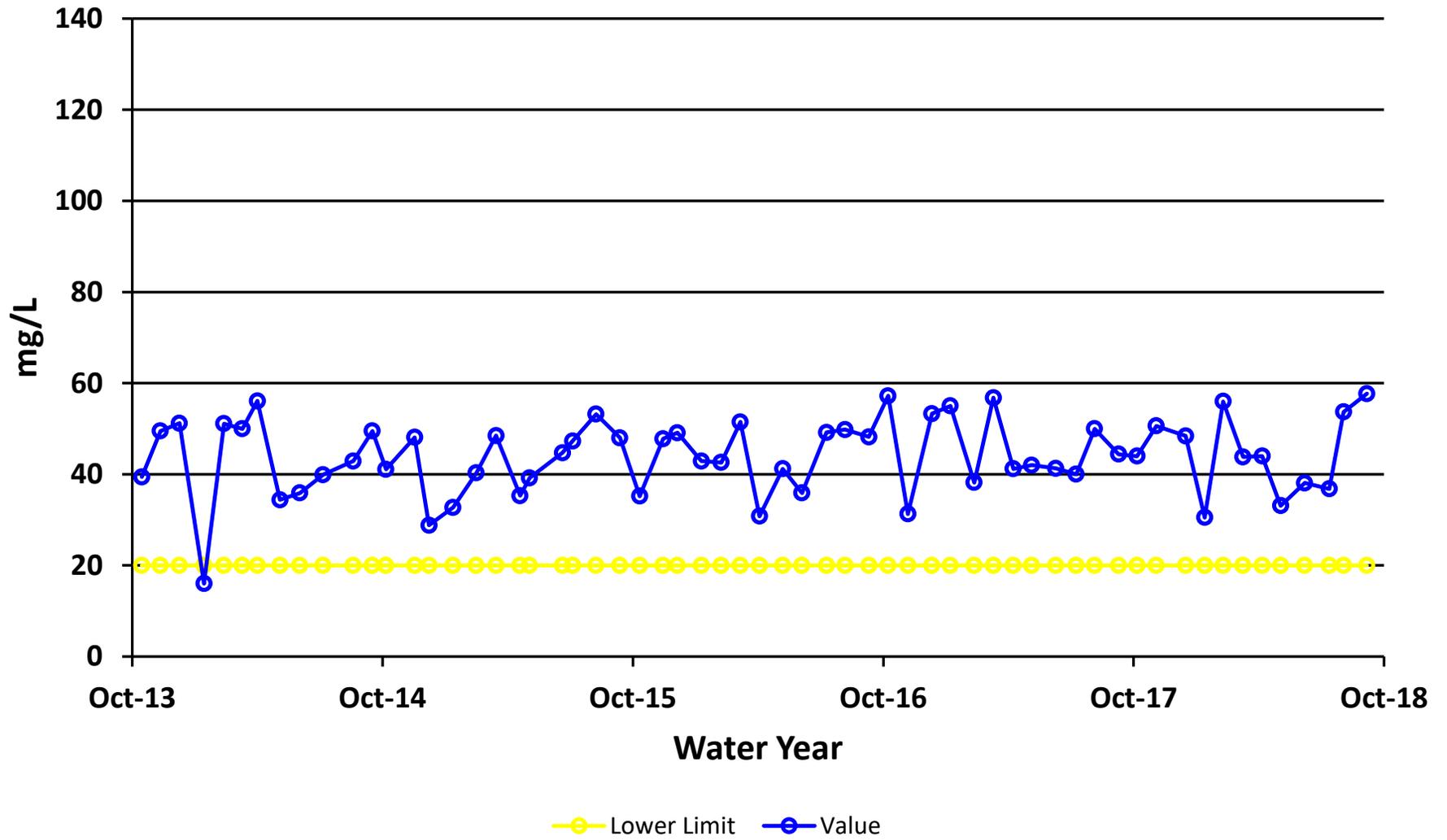
Site 48 - Conductivity Laboratory



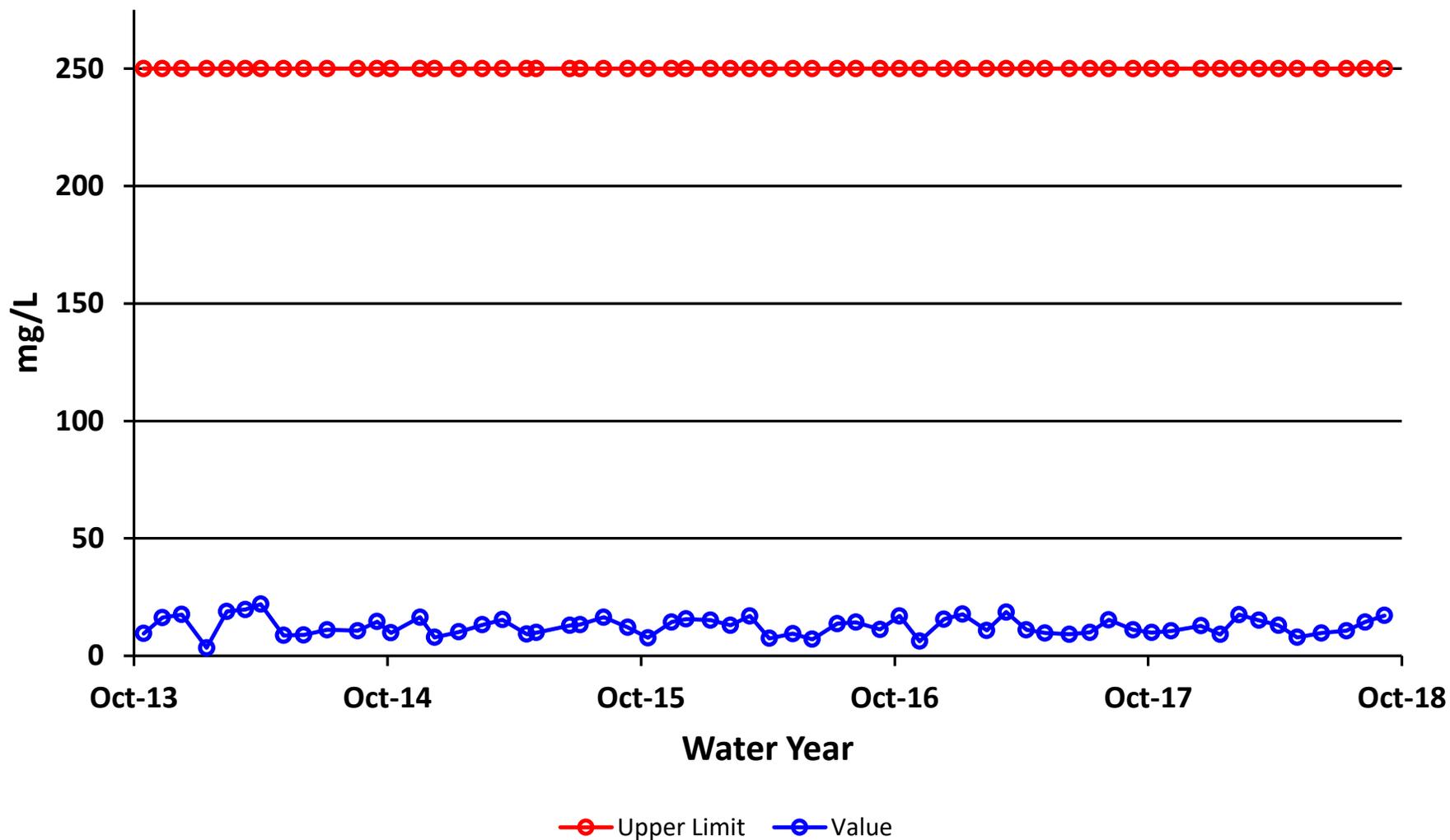
Site 48 - Conductivity Field



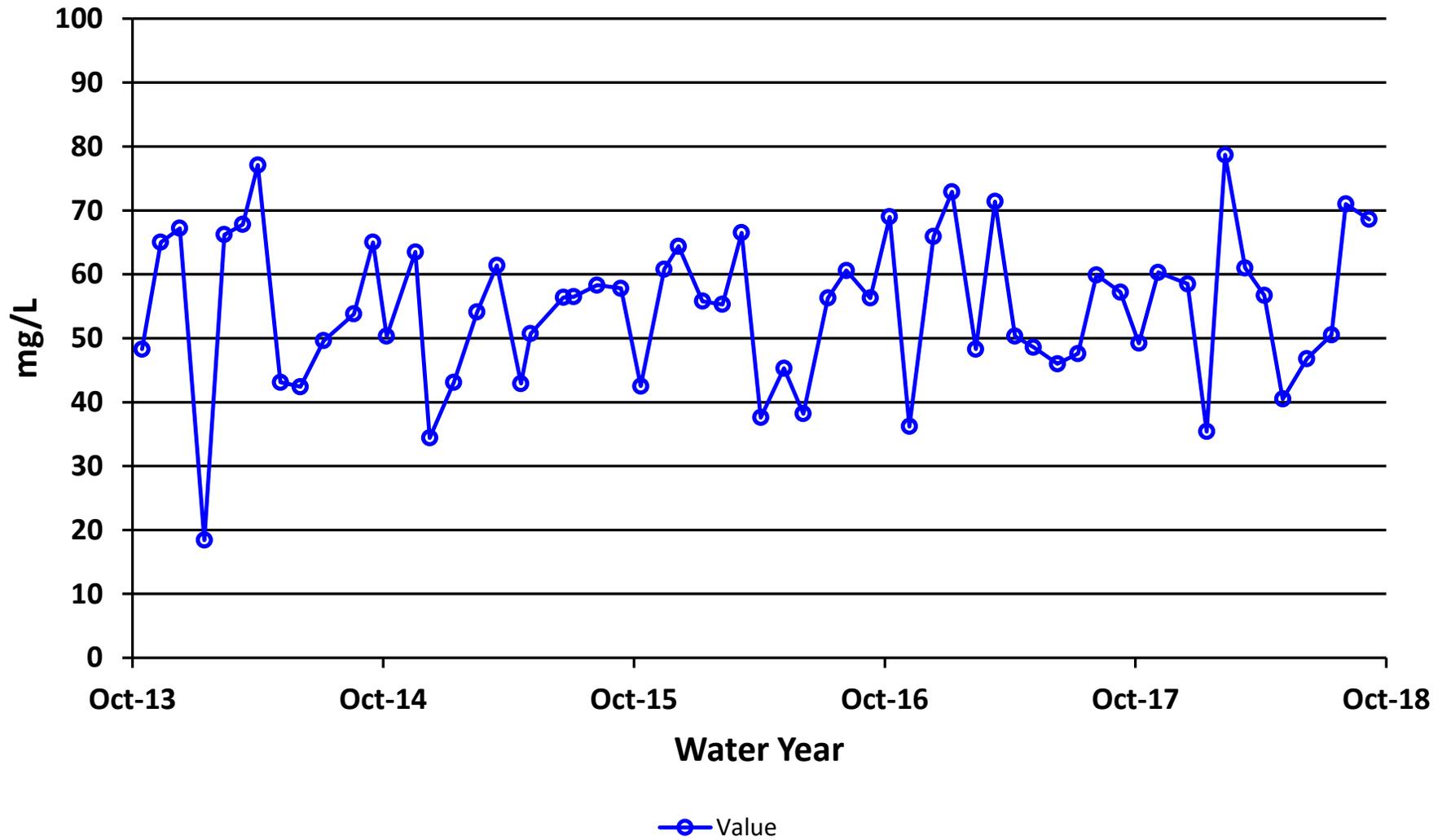
Site 48 - Alkalinity



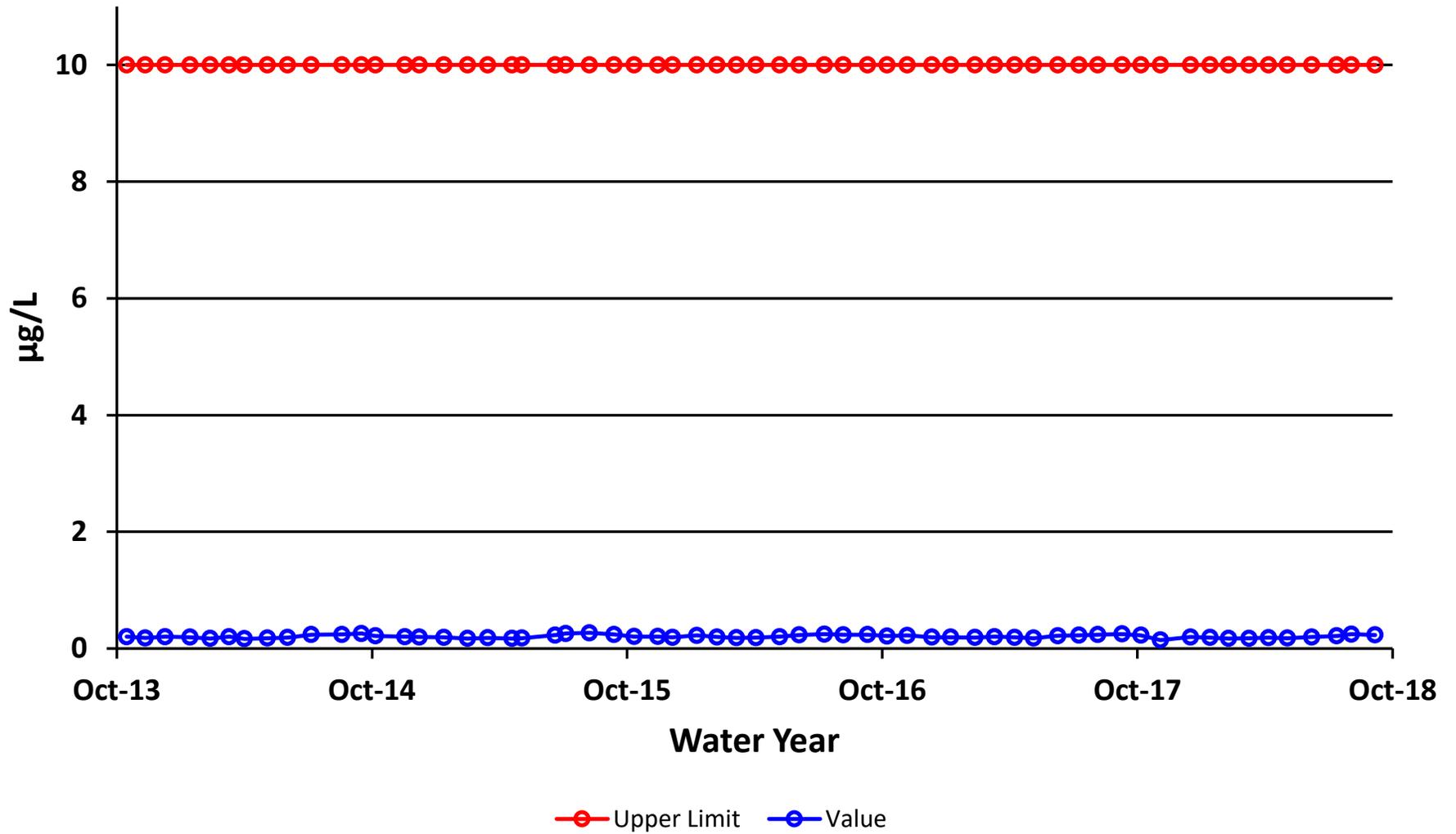
Site 48 - Sulfate



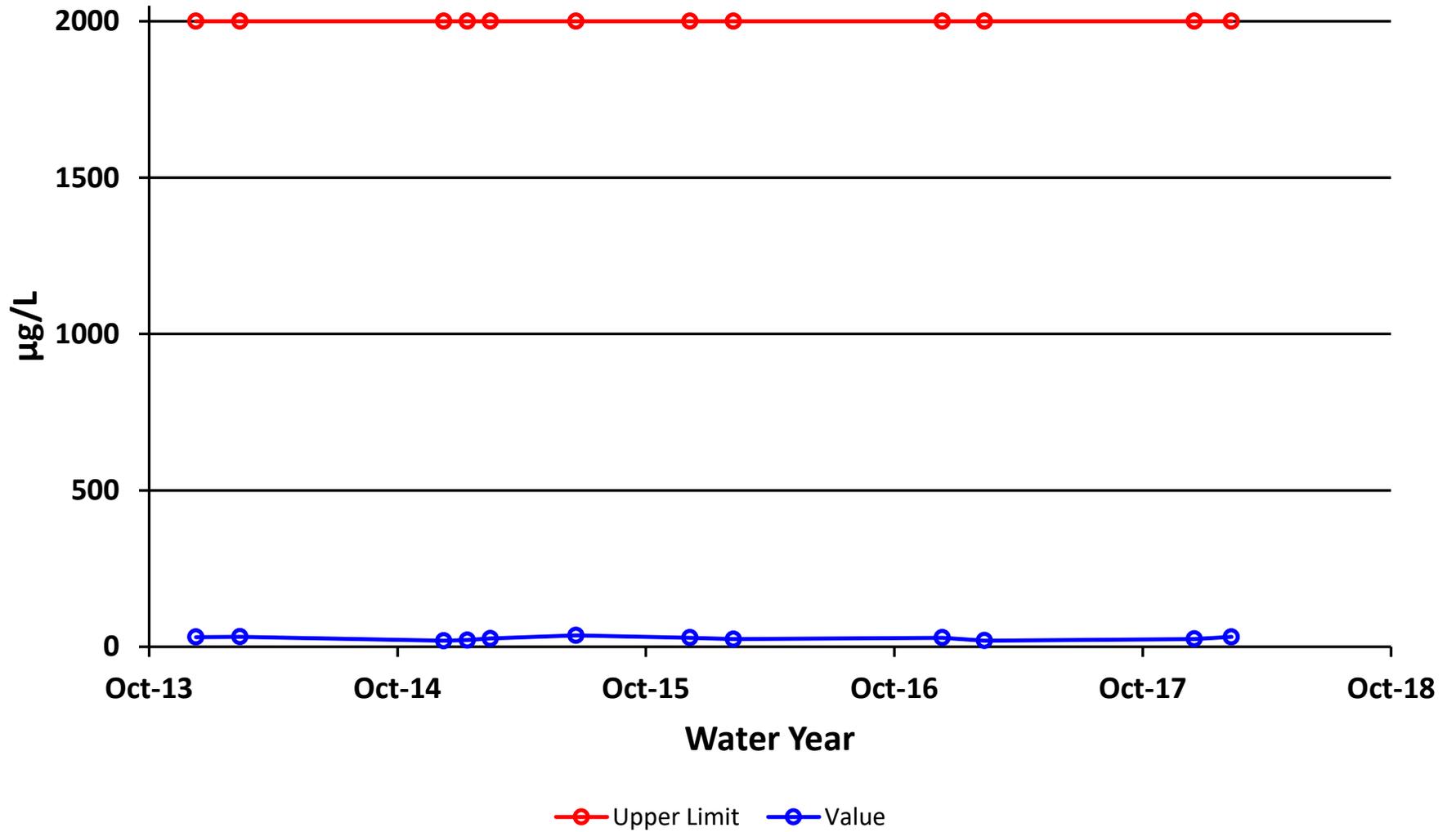
Site 48 - Hardness



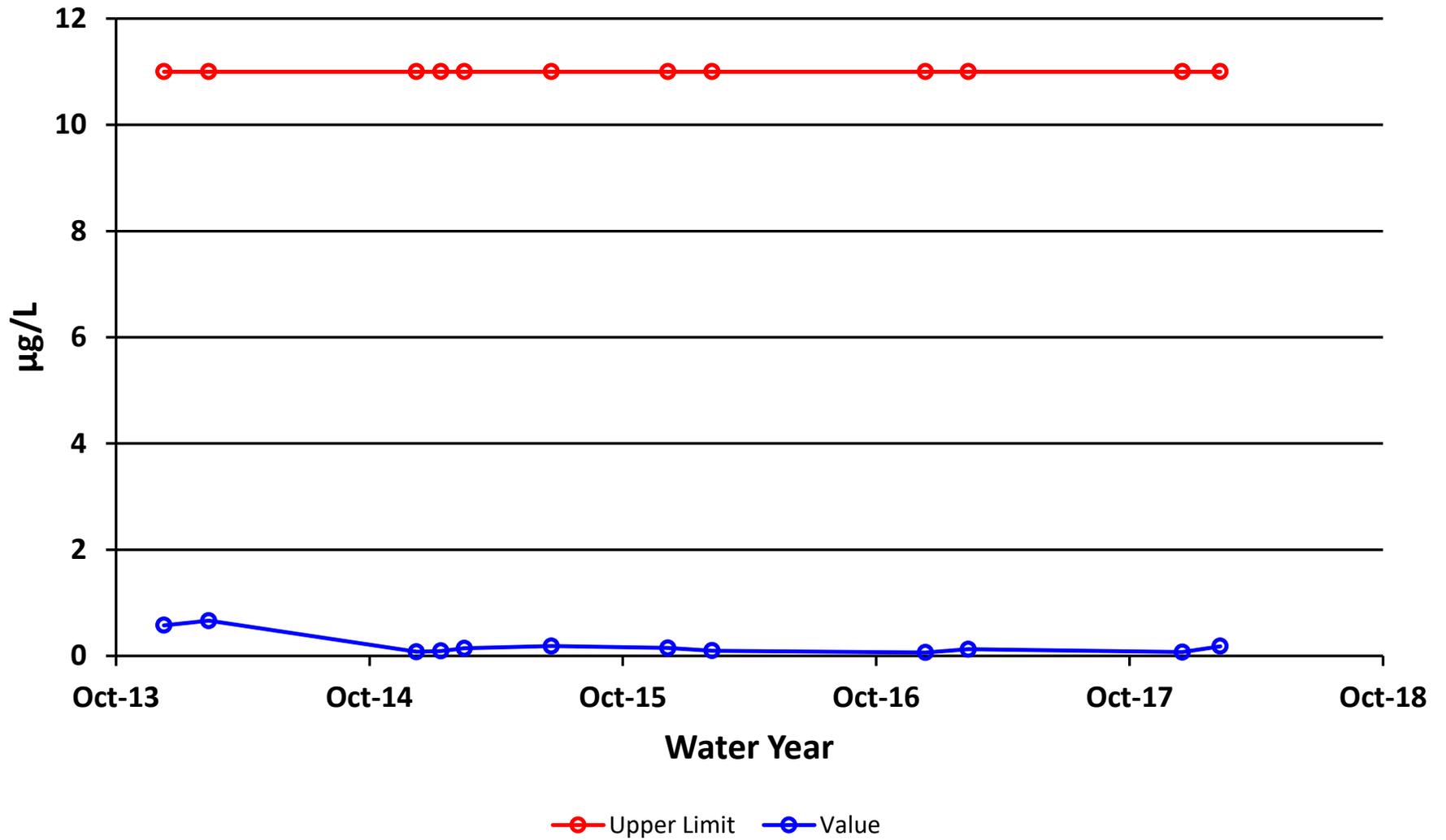
Site 48 - Arsenic Dissolved



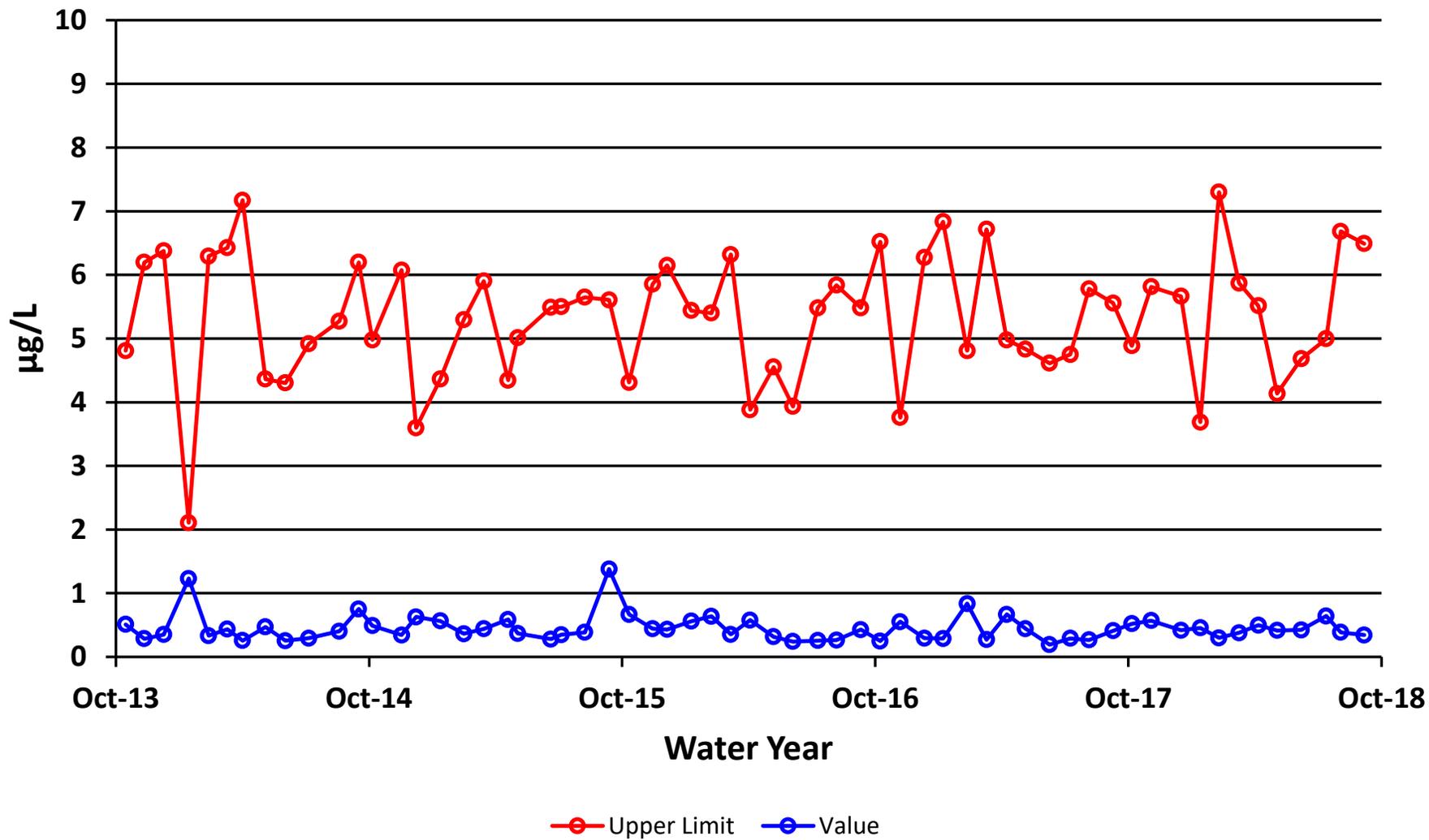
Site 48 - Barium Dissolved



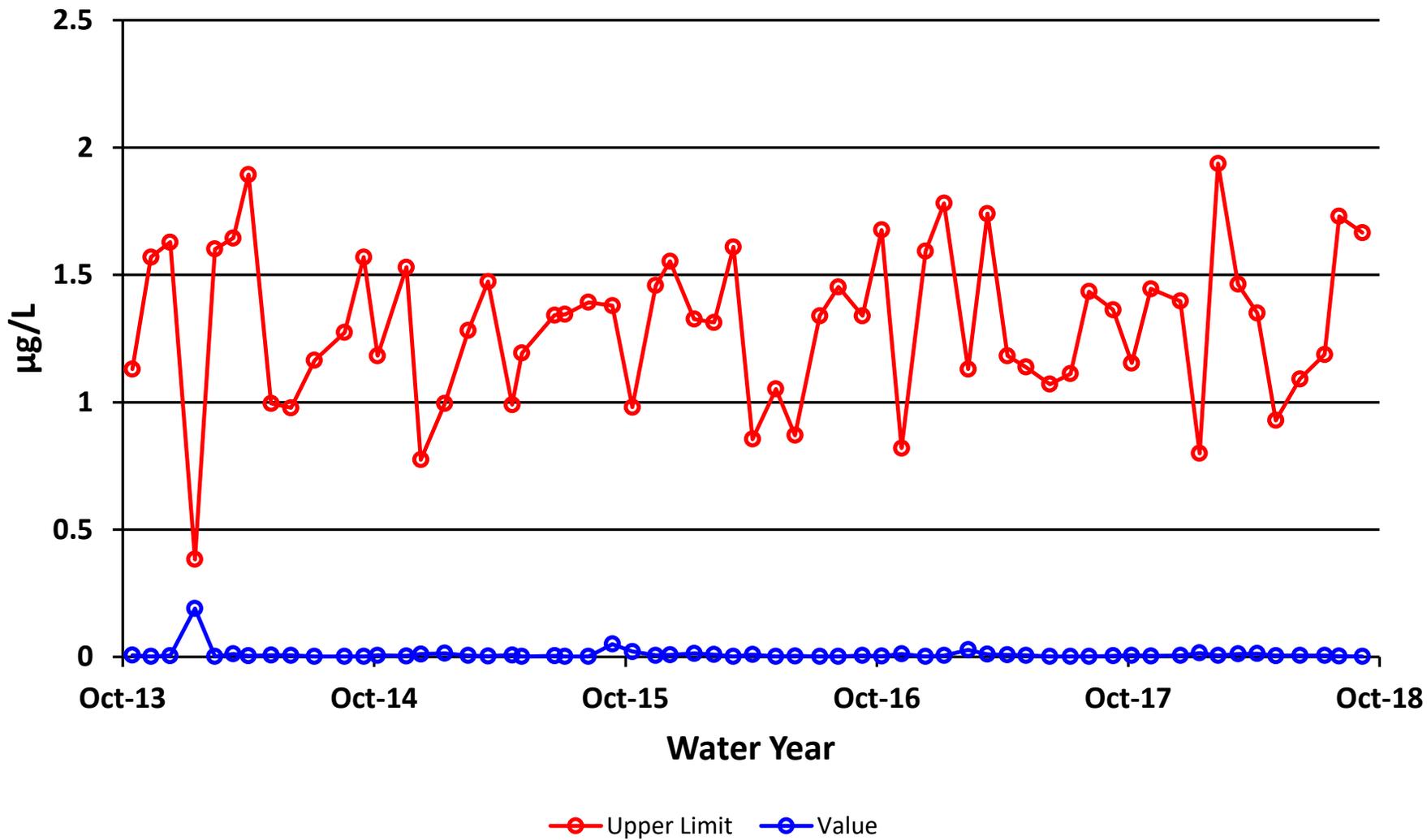
Site 48 - Chromium Dissolved



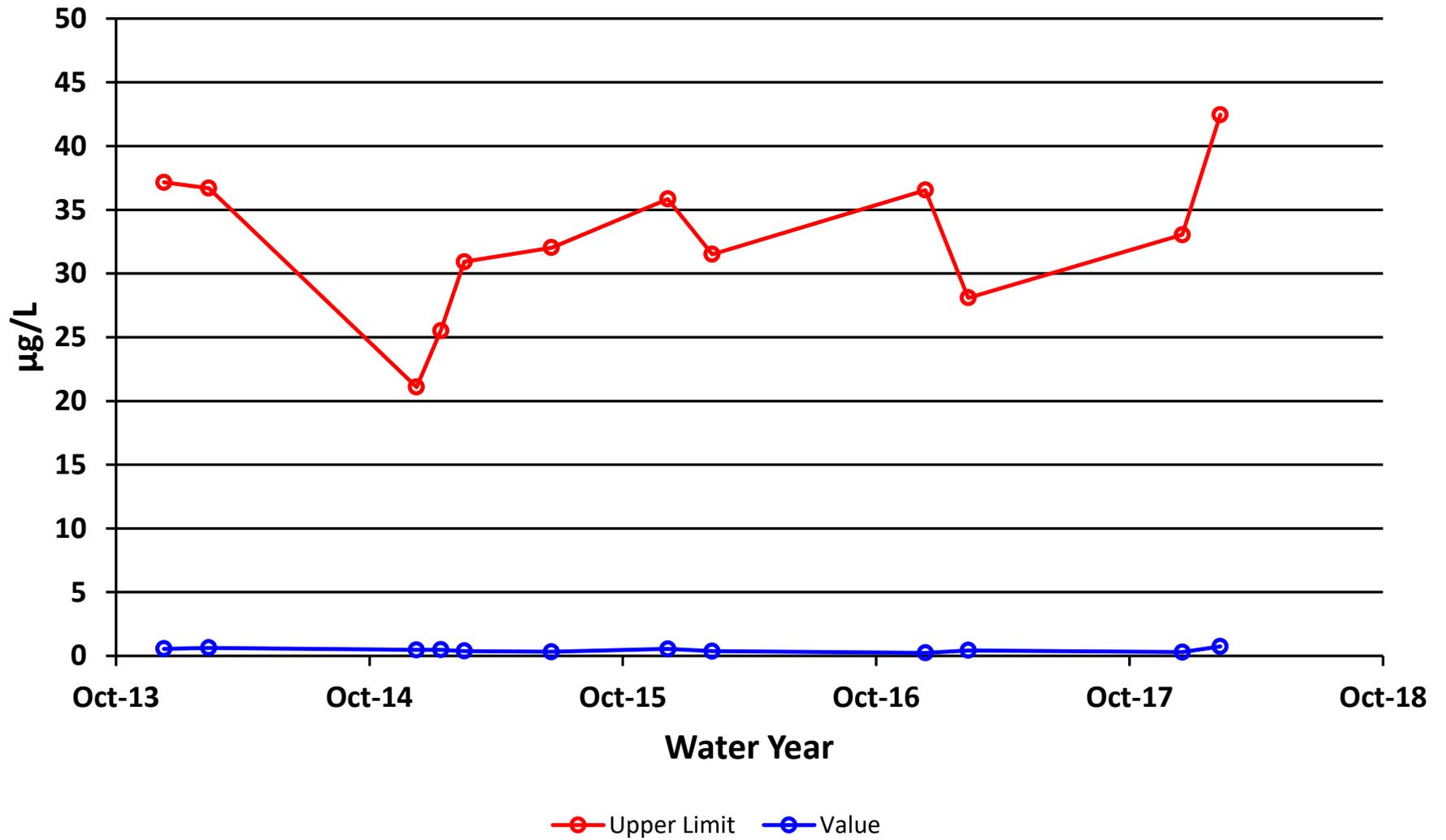
Site 48 - Copper Dissolved



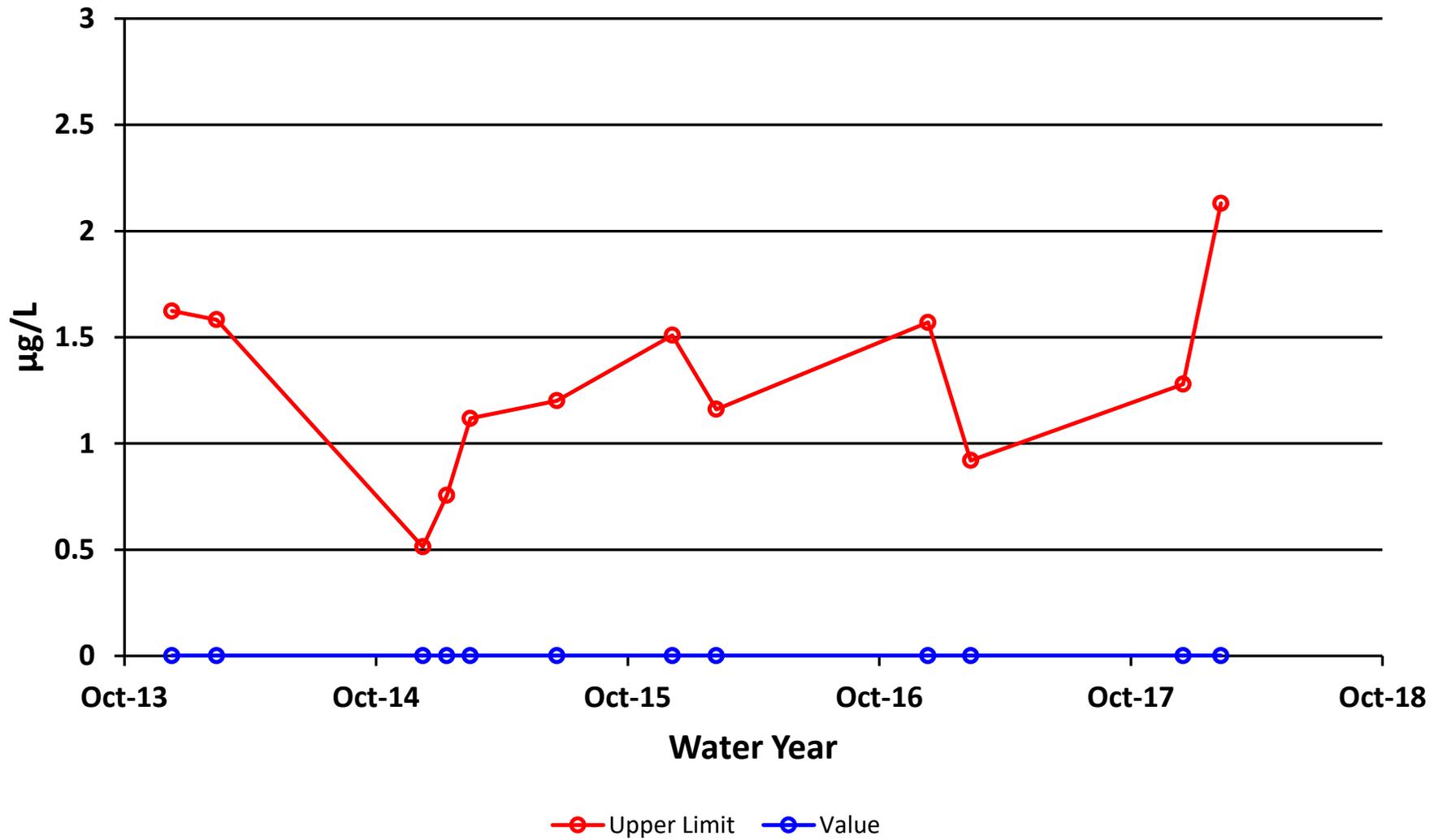
Site 48 - Lead Dissolved



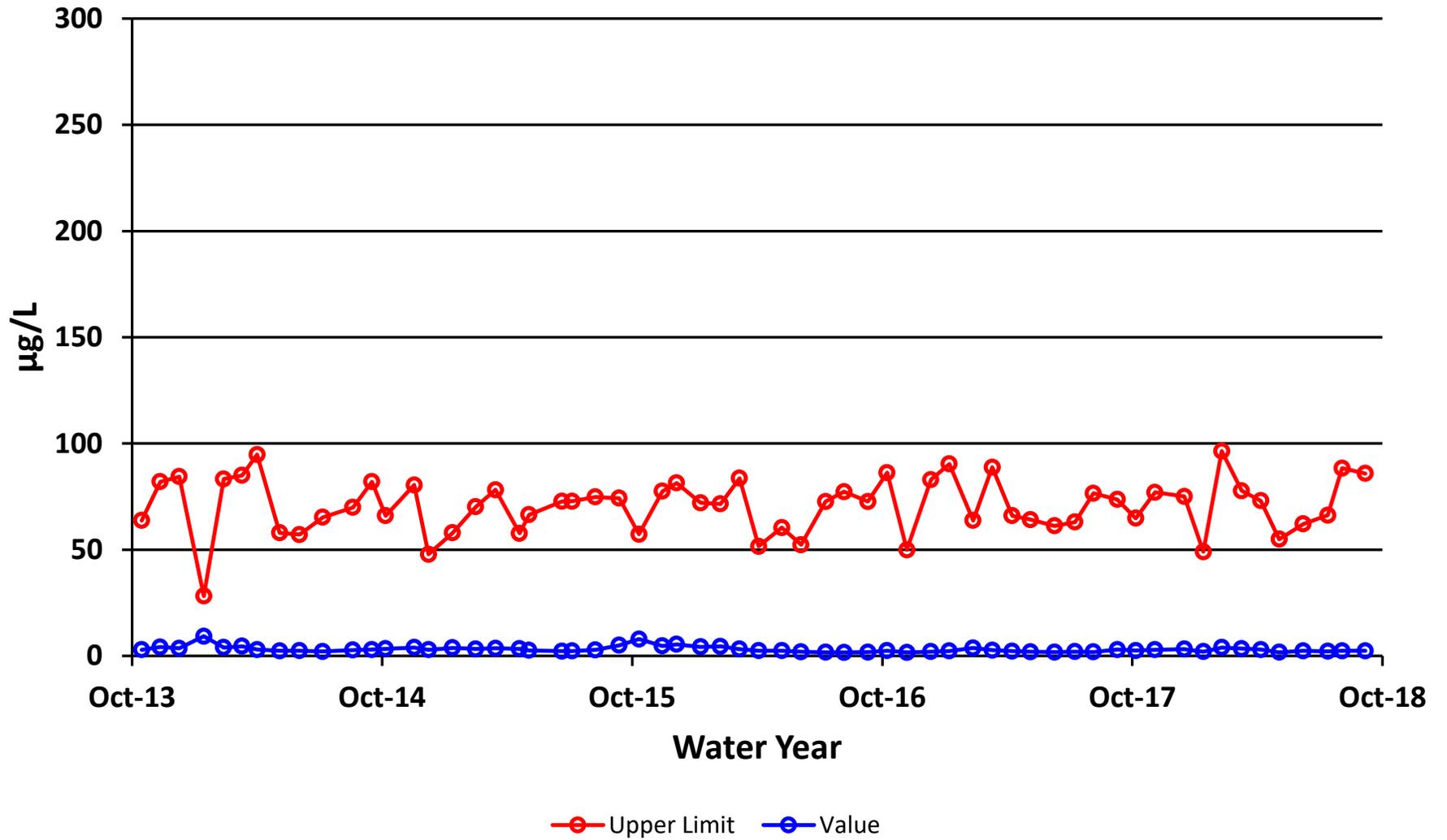
Site 48 - Nickel Dissolved



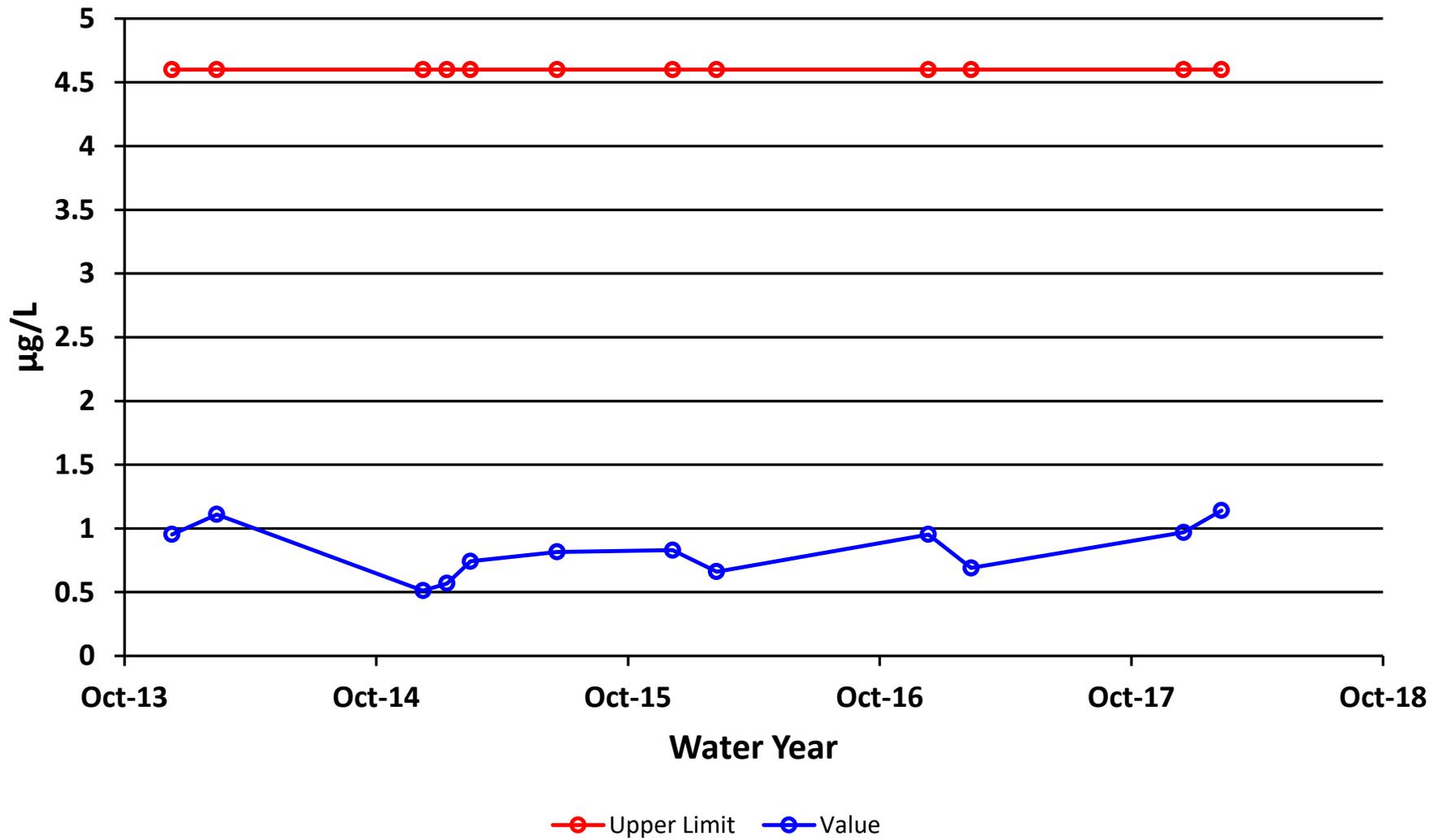
Site 48 - Silver Dissolved



Site 48 - Zinc Dissolved



Site 48 - Selenium Dissolved



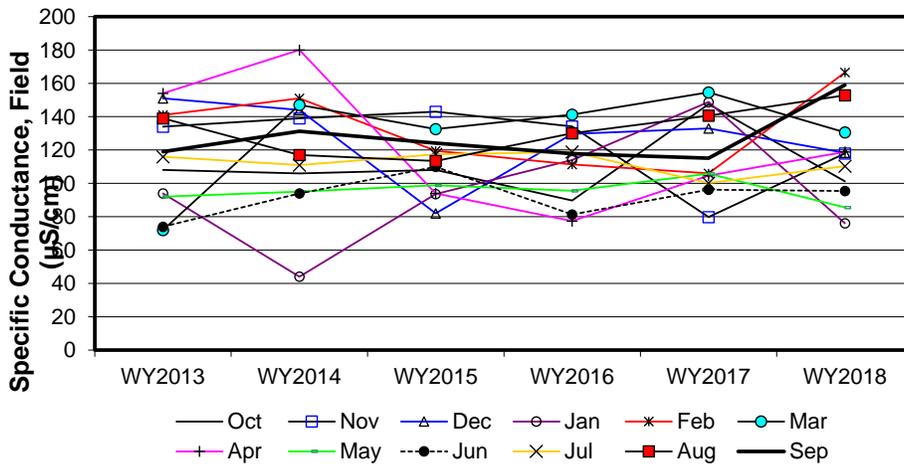
Site #48

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	WY2013	108.0	134.0	151.0	94.0	141.0	72.0	154.0	92.0	74.0	116.0	139.0	119.0
b	WY2014	106.0	139.0	144.0	44.0	151.0	147.0	180.0	95.0	94.0	111.0	117.0	131.2
c	WY2015	108.1	143.0	82.0	93.6	119.5	132.6	94.0	98.9	109.9	117.4	113.4	124.1
d	WY2016	89.7	134.1	129.6	114.0	111.3	141.3	77.4	95.5	81.3	118.8	130.1	117.8
e	WY2017	147.5	79.8	133.0	148.8	106.0	154.6	104.6	105.8	96.2	100.2	140.6	115.1
f	WY2018	101.2	118.0	118.3	76.1	166.5	130.6	118.8	85.6	95.4	110.3	152.8	159.0
n		6	6	6	6	6	6	6	6	6	6	6	6
t ₁		6	6	6	6	6	6	6	6	6	6	6	6
t ₂		0	0	0	0	0	0	0	0	0	0	0	0
t ₃		0	0	0	0	0	0	0	0	0	0	0	0
t ₄		0	0	0	0	0	0	0	0	0	0	0	0
t ₅		0	0	0	0	0	0	0	0	0	0	0	0
b-a		-1	1	-1	-1	1	1	1	1	1	-1	-1	1
c-a		1	1	-1	-1	-1	1	-1	1	1	1	-1	1
d-a		-1	1	-1	1	-1	1	-1	1	1	1	-1	-1
e-a		1	-1	-1	1	-1	1	-1	1	1	-1	1	-1
f-a		-1	-1	-1	-1	1	1	-1	-1	-1	-1	1	1
c-b		1	1	-1	1	-1	-1	-1	1	1	1	-1	-1
d-b		-1	-1	-1	1	-1	-1	-1	1	-1	1	1	-1
e-b		1	-1	-1	1	-1	1	-1	1	1	-1	1	-1
f-b		-1	-1	-1	1	1	-1	-1	-1	1	-1	1	1
d-c		-1	-1	1	1	-1	1	-1	-1	-1	1	1	-1
e-c		1	-1	1	1	-1	1	1	1	-1	-1	1	-1
f-c		-1	-1	1	-1	1	-1	1	-1	-1	-1	1	1
e-d		1	-1	1	1	-1	1	1	1	1	-1	1	-1
f-d		1	-1	-1	-1	1	-1	1	-1	1	-1	1	1
f-e		-1	1	-1	-1	1	-1	1	-1	-1	1	1	1
S _k		-1	-5	-7	3	-3	3	-3	3	5	-3	7	-1
σ _S ² =		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 /σ _S		-0.19	-0.94	-1.32	0.56	-0.56	0.56	-0.56	0.56	0.94	-0.56	1.32	-0.19
Z _k ²		0.04	0.88	1.73	0.32	0.32	0.32	0.32	0.32	0.88	0.32	1.73	0.04

ΣZ _k =	-0.38	Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅	Σn	72
ΣZ _k ² =	7.20	Count	72	0	0	0	0	ΣS _k	-2
Z-bar=ΣZ _k /K=	-0.03								

$\chi^2_{h,n} = \sum Z_k^2 - K(Z\text{-bar})^2 =$	7.19	@α=5% $\chi^2_{(K-1)} =$	19.68	Test for station homogeneity
p	0.784			$\chi^2_h < \chi^2_{(K-1)}$ ACCEPT
ΣVAR(S _k)	Z _{calc} -0.05	@α/2=2.5% Z=	1.96	H ₀ (No trend) ACCEPT
340.00	p 0.478			H _A (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals			
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-3.63	-0.19	3.52
0.050	-2.87		2.58
0.100	-2.36		1.97
0.200	-1.34		0.73

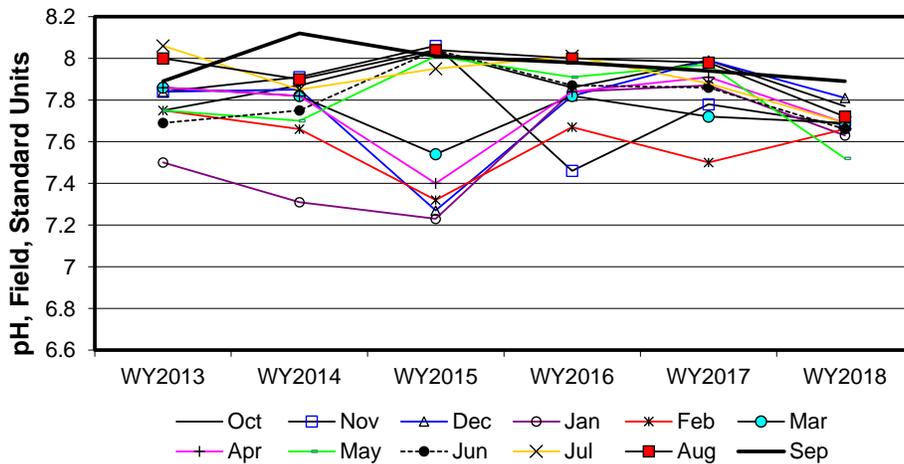
Site #48

Seasonal Kendall analysis for pH, Field, Standard Units

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	WY2013	7.8	7.8	7.8	7.5	7.8	7.9	7.9	7.8	7.7	8.1	8.0	7.9
b	WY2014	7.9	7.9	7.9	7.3	7.7	7.8	7.8	7.7	7.8	7.9	7.9	8.1
c	WY2015	8.0	8.1	7.3	7.2	7.3	7.5	7.4	8.0	8.0	8.0	8.0	8.0
d	WY2016	7.9	7.5	7.8	7.8	7.7	7.8	7.8	7.9	7.9	8.0	8.0	8.0
e	WY2017	8.0	7.8	8.0	7.9	7.5	7.7	7.9	8.0	7.9	7.9	8.0	7.9
f	WY2018	7.8	7.7	7.8	7.6	7.7	7.7	7.7	7.5	7.7	7.7	7.7	7.9
n		6	6	6	6	6	6	6	6	6	6	6	6
t ₁		6	6	6	6	4	4	6	6	6	6	4	4
t ₂		0	0	0	0	1	1	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
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	0	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	0
c-b		1	1	-1	-1	-1	-1	-1	1	1	1	1	-1
d-b		-1	-1	-1	1	1	0	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	0	-1	-1	-1	-1	-1	-1	-1
d-c		-1	-1	1	1	1	1	1	-1	-1	1	-1	-1
e-c		-1	-1	1	1	1	1	1	-1	-1	-1	-1	-1
f-c		-1	-1	1	1	1	1	1	-1	-1	-1	-1	-1
e-d		1	1	1	1	-1	-1	1	1	-1	-1	-1	-1
f-d		-1	1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
f-e		-1	1	-1	-1	1	-1	-1	-1	-1	-1	-1	-1
S _k		1	-5	-1	5	-4	-8	-1	-1	-1	-7	-6	-6
σ _S ² =		28.33	28.33	28.33	28.33	27.33	27.33	28.33	28.33	28.33	28.33	27.33	27.33
Z _k = S _k /σ _S		0.19	-0.94	-0.19	0.94	-0.77	-1.53	-0.19	-0.19	-0.19	-1.32	-1.15	-1.15
Z _k ²		0.04	0.88	0.04	0.88	0.59	2.34	0.04	0.04	0.04	1.73	1.32	1.32

ΣZ _k =	-6.47	Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅	Σn	72
ΣZ _k ² =	9.23	Count	64	4	0	0	0	ΣS _k	-34
Z-bar=ΣZ _k /K=	-0.54								

$\chi^2_{h1} = \sum Z_k^2 - K(Z\text{-bar})^2 =$	5.74	@α=5% $\chi^2_{(K-1)} =$	19.68	Test for station homogeneity
p	0.890			$\chi^2_h < \chi^2_{(K-1)}$ ACCEPT
ΣVAR(S _k)	Z _{calc} -1.80	@α/2=2.5% Z=	1.96	H ₀ (No trend) ACCEPT
336.00	p 0.036			H _A (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals			
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.04		0.01
0.050	-0.03		0.00
0.100	-0.03	-0.02	-0.01
0.200	-0.03		-0.01

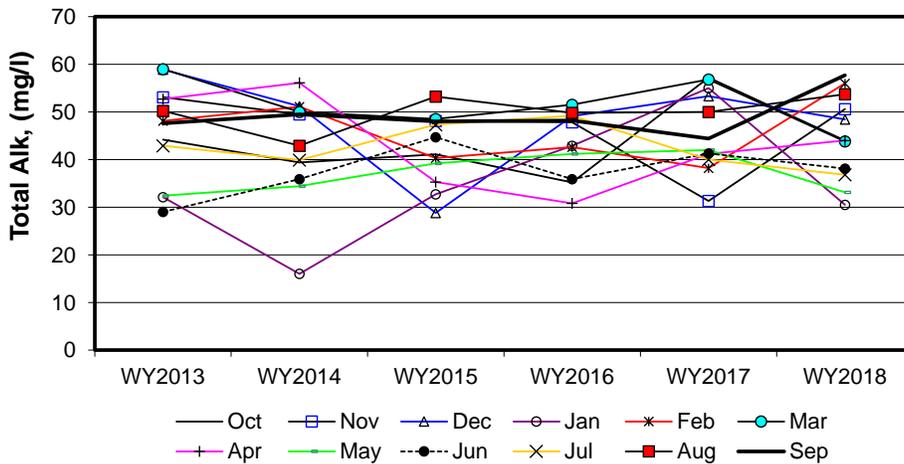
Site #48

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	WY2013	44.2	53.1	58.9	32.1	48.1	59.0	52.7	32.4	29.0	42.9	50.2	47.6
b	WY2014	39.4	49.5	51.2	16.0	51.1	50.0	56.1	34.4	35.9	39.9	42.9	49.5
c	WY2015	41.1	48.1	28.8	32.7	40.3	48.5	35.3	39.2	44.7	47.3	53.2	48.0
d	WY2016	35.2	47.8	49.1	42.9	42.6	51.5	30.8	41.2	35.9	49.2	49.8	48.2
e	WY2017	57.2	31.3	53.3	55.0	38.2	56.8	41.2	42.0	41.3	40.0	50.0	44.4
f	WY2018	44.0	50.6	48.4	30.5	56.0	43.8	44.0	33.1	38.1	36.8	53.7	57.7
n		6	6	6	6	6	6	6	6	6	6	6	6
t ₁		6	6	6	6	6	6	6	6	4	6	6	6
t ₂		0	0	0	0	0	0	0	0	1	0	0	0
t ₃		0	0	0	0	0	0	0	0	0	0	0	0
t ₄		0	0	0	0	0	0	0	0	0	0	0	0
t ₅		0	0	0	0	0	0	0	0	0	0	0	0
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	0	1	1	-1
e-b		1	-1	1	1	-1	1	-1	1	1	1	1	-1
f-b		1	1	-1	1	1	-1	-1	-1	1	-1	1	1
d-c		-1	-1	1	1	1	1	-1	1	-1	1	-1	1
e-c		1	-1	1	1	-1	1	1	1	-1	-1	-1	-1
f-c		1	1	1	-1	1	-1	1	-1	-1	-1	1	1
e-d		1	-1	1	1	-1	1	1	1	1	-1	1	-1
f-d		1	1	-1	-1	1	-1	1	-1	1	-1	1	1
f-e		-1	1	-1	-1	1	-1	1	-1	-1	-1	1	1
S _k		1	-7	-5	5	-1	-5	-3	7	6	-3	5	3
σ _S ² =		28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	27.33	28.33	28.33	28.33
Z _k = S _k /σ _S		0.19	-1.32	-0.94	0.94	-0.19	-0.94	-0.56	1.32	1.15	-0.56	0.94	0.56
Z _k ²		0.04	1.73	0.88	0.88	0.04	0.88	0.32	1.73	1.32	0.32	0.88	0.32

ΣZ _k =	0.58	Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅	Σn	72
ΣZ _k ² =	9.33	Count	70	1	0	0	0	ΣS _k	3
Z-bar=ΣZ _k /K=	0.05								

χ _h ² =ΣZ _k ² -K(Z-bar) ² =	9.30	@α=5% χ _(K-1) ² =	19.68	Test for station homogeneity
p	0.594			χ _h ² < χ _(K-1) ² 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	-1.40		1.53
0.050	-0.78		0.99
0.100	-0.69	0.09	0.74
0.200	-0.34		0.29

Site #48

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

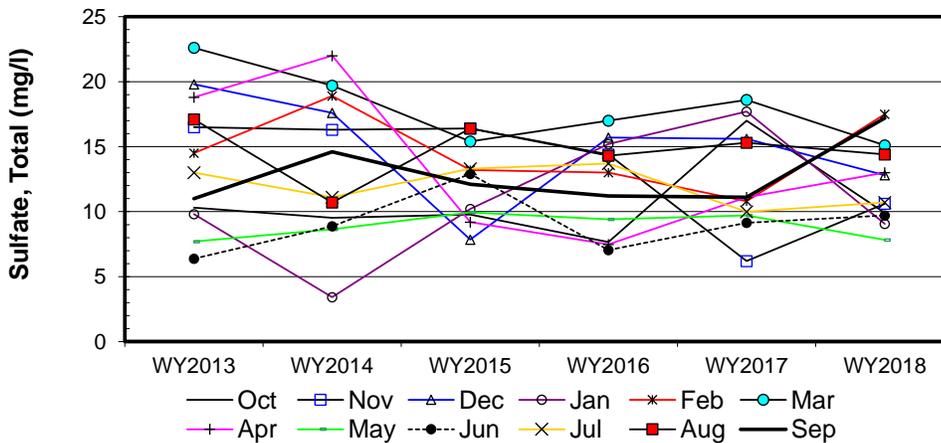
Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	WY2013	10.3	16.5	19.8	9.8	14.5	22.6	18.8	7.7	6.4	13.0	17.1	11.0
b	WY2014	9.5	16.3	17.6	3.4	18.9	19.7	22.0	8.7	8.9	11.1	10.7	14.6
c	WY2015	9.8	16.4	7.9	10.2	13.2	15.4	9.2	9.9	12.9	13.3	16.4	12.1
d	WY2016	7.7	14.4	15.7	15.2	13.0	17.0	7.5	9.4	7.1	13.7	14.3	11.2
e	WY2017	17.0	6.2	15.6	17.7	10.8	18.6	11.1	9.7	9.2	10.0	15.3	11.1
f	WY2018	9.9	10.6	12.8	9.1	17.5	15.1	13.0	7.8	9.7	10.7	14.4	17.2
n		6	6	6	6	6	6	6	6	6	6	6	6
t ₁		6	6	6	6	6	6	6	6	6	6	6	6
t ₂		0	0	0	0	0	0	0	0	0	0	0	0
t ₃		0	0	0	0	0	0	0	0	0	0	0	0
t ₄		0	0	0	0	0	0	0	0	0	0	0	0
t ₅		0	0	0	0	0	0	0	0	0	0	0	0
b-a		-1	-1	-1	-1	1	-1	1	1	1	-1	-1	1
c-a		-1	-1	-1	1	-1	-1	-1	1	1	1	-1	1
d-a		-1	-1	-1	1	-1	-1	-1	1	1	1	-1	1
e-a		1	-1	-1	1	-1	-1	-1	1	1	-1	-1	1
f-a		-1	-1	-1	-1	1	-1	-1	1	1	-1	-1	1
c-b		1	1	-1	1	-1	-1	-1	1	1	1	1	-1
d-b		-1	-1	-1	1	-1	-1	-1	1	-1	1	1	-1
e-b		1	-1	-1	1	-1	-1	-1	1	1	-1	1	-1
f-b		1	-1	-1	1	-1	-1	-1	-1	1	-1	1	1
d-c		-1	-1	1	1	-1	1	-1	-1	-1	1	-1	-1
e-c		1	-1	1	1	-1	1	1	-1	-1	-1	-1	-1
f-c		1	-1	1	-1	1	-1	1	-1	-1	-1	-1	1
e-d		1	-1	-1	1	-1	1	1	1	1	-1	1	-1
f-d		1	-1	-1	-1	1	-1	1	-1	1	-1	1	1
f-e		-1	1	-1	-1	1	-1	1	-1	1	1	-1	1
S _k		1	-11	-9	5	-5	-9	-3	3	7	-3	-3	3
σ _s ² =		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 /σ _s		0.19	-2.07	-1.69	0.94	-0.94	-1.69	-0.56	0.56	1.32	-0.56	-0.56	0.56
Z _k ²		0.04	4.27	2.86	0.88	0.88	2.86	0.32	0.32	1.73	0.32	0.32	0.32

ΣZ_k= -4.51
 ΣZ_k²= 15.11
 Z-bar=ΣZ_k/K= -0.38

Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅
Count	72	0	0	0	0

Σn = 72
 ΣS_k = -24

χ _n ² =ΣZ _k ² -K(Z-bar) ² =	13.41	@α=5% χ _(K-1) ² =	19.68	Test for station homogeneity
p	0.267	χ _h ² <χ _(K-1) ²	ACCEPT	
ΣVAR(S _k)	Z _{calc} -1.25	@α=2.5% Z=	1.96	H ₀ (No trend) ACCEPT
340.00	p 0.106			H _A (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals			
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.89		0.17
0.050	-0.70		0.04
0.100	-0.63	-0.31	-0.06
0.200	-0.50		-0.10

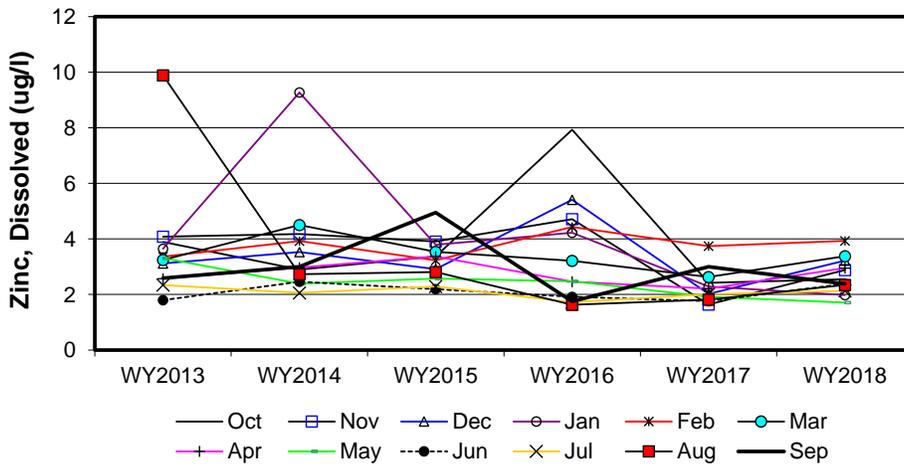
Site #48

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	WY2013	3.9	4.1	3.1	3.7	3.4	3.2	2.6	3.3	1.8	2.3	9.9	2.6
b	WY2014	2.9	4.2	3.5	9.3	3.9	4.5	3.0	2.4	2.5	2.1	2.7	3.0
c	WY2015	3.4	3.9	2.9	3.8	3.2	3.5	3.4	2.6	2.2	2.3	2.8	5.0
d	WY2016	7.9	4.7	5.4	4.2	4.4	3.2	2.5	2.5	1.9	1.7	1.6	1.8
e	WY2017	2.4	1.6	2.0	2.3	3.7	2.6	2.2	1.9	1.8	2.0	1.8	3.0
f	WY2018	2.6	2.9	3.2	2.0	3.9	3.4	3.0	1.7	2.4	2.1	2.3	2.4
n		6	6	6	6	6	6	6	6	6	6	6	6
t ₁		6	6	6	6	6	6	6	6	6	6	6	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	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	0
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	-1	-7	5	-5	-3	-11	-1	-5	-7	-2
σ _S ² =		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 /σ _S		-0.94	-0.94	-0.19	-1.32	0.94	-0.94	-0.56	-2.07	-0.19	-0.94	-1.32	-0.38
Z _k ²		0.88	0.88	0.04	1.73	0.88	0.88	0.32	4.27	0.04	0.88	1.73	0.15

ΣZ _k =	-8.84	Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅	Σn	72
ΣZ _k ² =	12.68	Count	70	1	0	0	0	ΣS _k	-47
Z-bar=ΣZ _k /K=	-0.74								

$\chi^2_{h} = \sum Z_k^2 - K(Z\text{-bar})^2 =$	6.17	@α=5% $\chi^2_{(K-1)} =$	19.68	Test for station homogeneity
p	0.862	$\chi^2_{h} < \chi^2_{(K-1)}$		ACCEPT
ΣVAR(S _k)	Z _{calc} -2.50	@α/2=2.5% Z=	1.96	H ₀ (No trend) REJECT
339.00	p 0.006			H _A (± trend) ACCEPT



Seasonal-Kendall Slope Confidence Intervals			
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.27		-0.01
0.050	-0.25	-0.15	-0.04
0.100	-0.24		-0.06
0.200	-0.20		-0.09
		-5.1%	

INTERPRETIVE REPORT

SITE 6

The data collected during the current water year are listed in the following “Table of Results for Water Year 2018” 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 one-half of the 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 data points were flagged as outliers after review by HGCMC.

Sample Date	Parameter	Value	Qualifier	Notes
No outliers, in the past six years, have been identified by HGCMC.				

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

Table of Exceedance for Water Year 2018

Sample Date	Parameter	Value	Limits		Hardness
			Lower	Upper	
No exceedances have been identified by HGCMC for the period of October 2017 through September 2018.					

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 obvious trends.

A non-parametric statistical analysis for trend was performed for specific conductivity, field pH, total alkalinity, total sulfate, and dissolved zinc. Calculation details of the Seasonal Kendall analyses are presented in detail on the pages following this interpretive section. The following table summarizes the results of the data collected between Oct-12 and Sep-18 (WY2013-WY2018).

Site 6 - Table of Summary Statistics for Trend Analysis

Parameter	Mann-Kendall test statistics			Sen's slope estimate	
	n*	p**	Trend	Q	Q(%)
Conductivity Field	6	0.28			
pH Field	6	0.41			
Alkalinity, Total	6	0.69			
Sulfate, Total	6	0.08			
Zinc, Dissolved	6	0.15			

* 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. There were no statistically significant trends identified at Site 6 during the reporting period.

A comparison of median values for alkalinity, laboratory pH, lab conductivity, total sulfate, and dissolved zinc between Site 6 and Site 48 has been conducted as specified in the Statistical Information Goals for Site 6. Additionally, X-Y plots have been generated for total alkalinity, field pH, specific conductance, total sulfate, and dissolved zinc that co-plot data from Site 6 and Site 48, the upstream control site, to aid in the comparison between those sites. Calculation details of the non-parametric signed-rank tests are presented in detail on the pages following this interpretive section. The table below summarizes the results of the signed-rank test as performed on the Water Year 2018 dataset.

Table of Summary Statistics for Median Analysis

Site 6 vs Site 48				
Parameter	Signed Ranks	Site 48	Site 6	Median
	p-value	median	median	Differences
Conductivity Field	0.01	118.15	120.45	-3.83
pH Field	<0.01	7.69	7.76	-0.05
Alkalinity, Total	<0.01	44.00	44.90	-0.65
Sulfate, Total	0.013	11.80	14.20	-1.10
Zinc, Dissolved	<0.01	2.47	4.74	-2.24

The median values for field conductivity for Site 48 and Site 6 are 118.15 $\mu\text{S}/\text{cm}$ and 120.45 $\mu\text{S}/\text{cm}$ respectively. Median values for total alkalinity for Site 48 and Site 6 are 44.0 mg/L and 44.9 mg/L respectively. The median values for total sulfate for Site 48 and Site 6 are 11.8 mg/L and 14.2 mg/L respectively.

Dissolved zinc results are similar to those observed in previous years. The current median values for Site 48 and Site 6 are 2.47 $\mu\text{g}/\text{L}$ and 4.74 $\mu\text{g}/\text{L}$ respectively, with a median difference of

-2.24 µg/L. Signed-rank test results for prior datasets for Water Years 2000 – 2017 show similar statistically significant differences with a median difference ranging from -1.7 µg/L to -4.77 µg/L dissolved zinc.

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

Table of Results for Water Year 2018

Site 006FMS - 'Greens Creek Middle'

Sample Date/Parameter	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018	Median
Water Temp (°C)	5.2	1.2	0.0	1.8	0.0	0	1.2	3.3	5.7	8.4	11.1	8.9	2.6
Conductivity-Field(µmho)	105.6	134	129.1	79.7	172.3	120.6	120.3	90	99.2	113	155.1	162.9	120.5
Conductivity-Lab (µmho)	99	131	117	74	127	127	108	81	89	109	152	150	113
pH Lab (standard units)	7.19	7.22	7.4	7.33	7.34	7.21	7.01	7.15	7.04	6.81	7.06	7.54	7.20
pH Field (standard units)	7.77	7.86	7.85	7.68	7.89	7.74	7.75	7.53	7.68	7.7	7.8	7.91	7.76
Total Alkalinity (mg/L)	44.7	52	48.2	31	56.7	45.1	43.7	35	37.8	37.6	53.9	58.3	44.9
Total Sulfate (mg/L)	11	15.4	13.8	7	19.2	16.5	14.5	8.6	10	11.8	14.9	18.6	14.2
Hardness (mg/L)	51.7	67.4	61.3	36.5	77.9	64.3	58.7	42.5	47.7	47.9	73.8	71.3	60.0
Dissolved As (ug/L)	0.217	0.197	0.188	0.196	0.155	0.176	0.176	0.171	0.178	0.22	0.249	0.221	0.192
Dissolved Ba (ug/L)			25.5		31.8								28.7
Dissolved Cd (ug/L)	0.0493	0.0447	0.0439	0.0309	0.0447	0.0385	0.0348	0.0321	0.0413	0.0389	0.0412	0.039	0.0401
Dissolved Cr (ug/L)			0.089		0.059								0.074
Dissolved Cu (ug/L)	0.608	0.333	0.47	0.504	0.237	0.405	0.53	0.438	0.482	0.695	0.404	0.397	0.454
Dissolved Pb (ug/L)	0.0159	0.007	0.0084	0.0369	0.0039	0.022	0.0163	0.0086	0.009	0.0097	0.0159	0.009	0.0094
Dissolved Ni (ug/L)			0.36		0.29								0.325
Dissolved Ag (ug/L)			0.002		0.002								0.002
Dissolved Zn (ug/L)	7.65	5.57	6.63	3.79	6.63	4.64	4.6	3.65	4.84	4.15	4.05	5.09	4.74
Dissolved Se (ug/L)			0.99		1.11								1.050
Dissolved Hg (ug/L)	0.00129	0.0005	0.000694	0.000934	0.000384	0.000805	0.000931	0.000868	0.000896	0.00117	0.00106	0.000543	0.000882

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

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

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

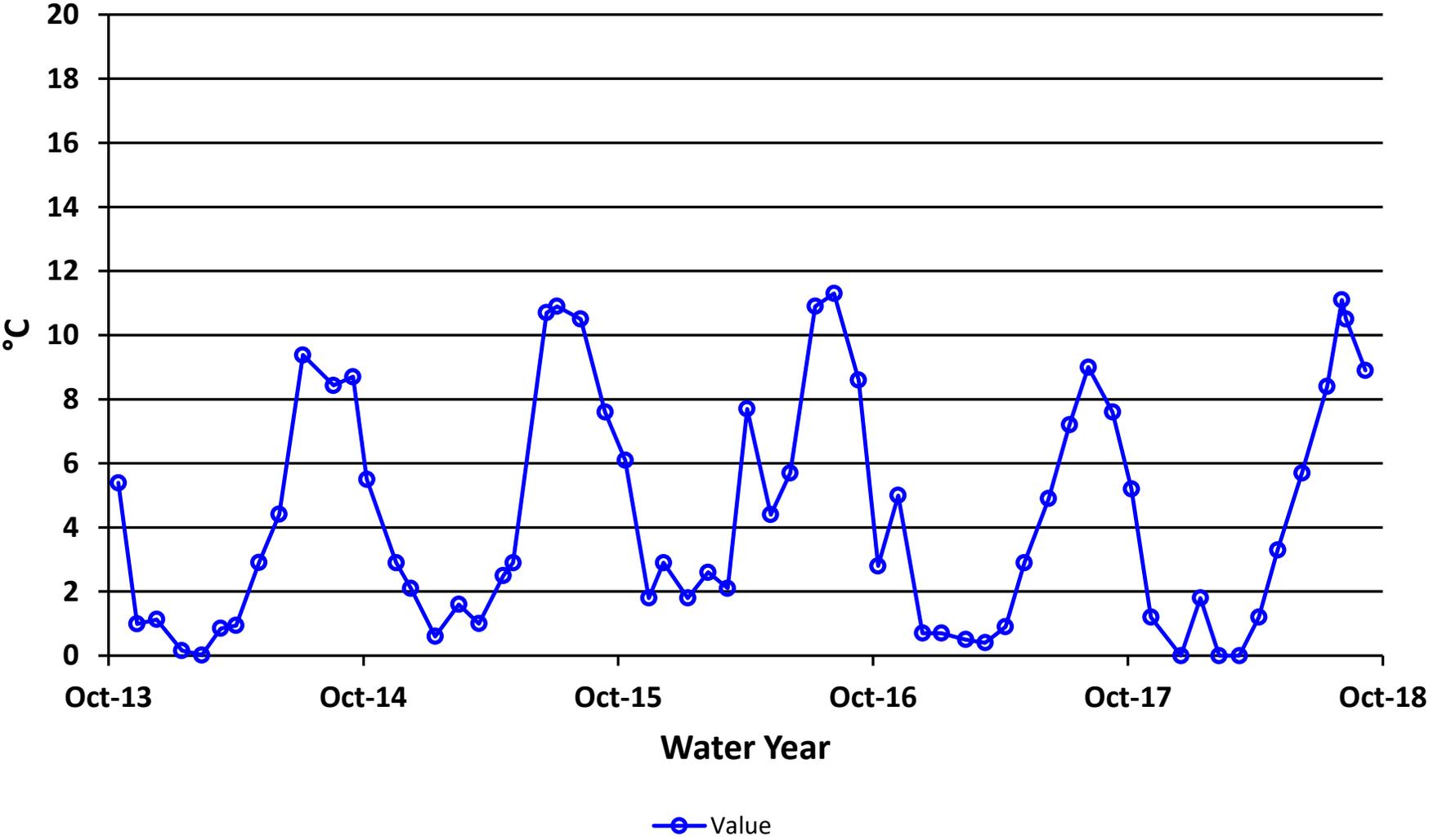
Qualified Data by QA Reviewer

Date Range: 10/01/2017 to 09/30/2018

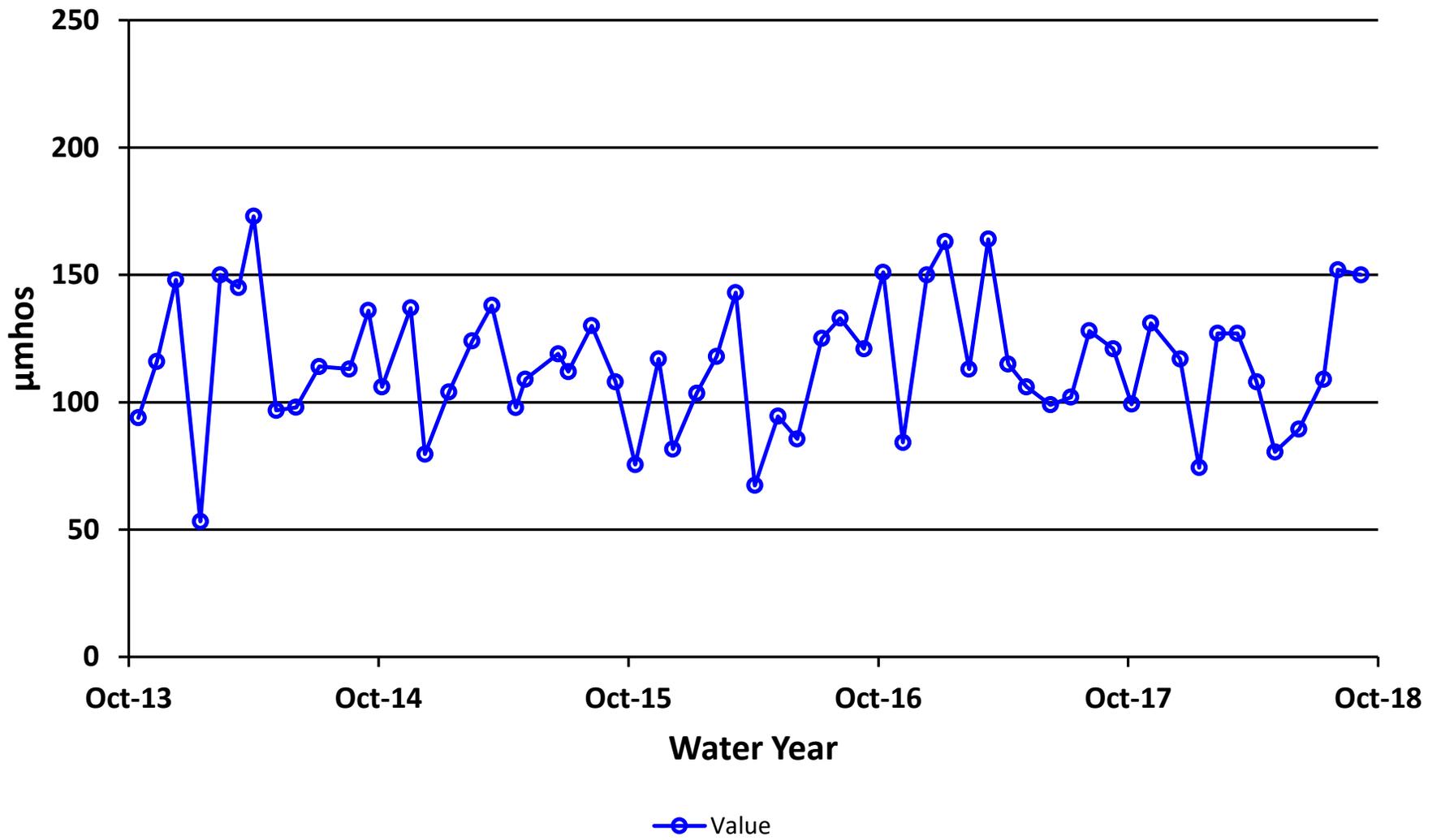
Site No.	Sample Date	Parameter	Value		Qualifier	Reason for Qualifier
006FMS	10/9/2017	Diss. Pb-ICP/MS	0.01	µg/L	U	Field Blank Contamination
		Total Sulfate	11	mg/L	J	Hold Time Violation, Temperature Excedance
	11/6/2017	Diss. Pb-ICP/MS	0.0070	µg/L	J	Below Quantitative Range
12/19/2017		Diss. Cr-ICP/MS	0.08	µg/L	J	Below Quantitative Range
		Diss. Pb-ICP/MS	0.0084	µg/L	U	Field Blank Contamination
2/12/2018		Diss. Cr-ICP/MS	0.05	µg/L	J	Below Quantitative Range
		Diss. Pb-ICP/MS	0.0039	µg/L	J	Below Quantitative Range
		pH	7.34	pH units	J	Hold Time Violation
3/13/2018		Diss. Pb-ICP/MS	0.02	µg/L	U	Field Blank Contamination
		pH	7.21	pH units	J	Hold Time Violation
4/10/2018		pH	7.01	pH units	J	Hold Time Violation
		Total Sulfate	14.5	mg/L	J	Sample Receipt Temperature
5/7/2018		Diss. Pb-ICP/MS	0.0086	µg/L	J	Below Quantitative Range
		pH	7.15	pH units	J	Hold Time Violation
6/11/2018		Diss. Pb-ICP/MS	0.0090	µg/L	J	Below Quantitative Range
		Total Sulfate	10	mg/L	J	Hold Time Violation, Temperature Excedance
7/17/2018		pH	6.81	pH units	J	Hold time Violation
		Total Sulfate	11.8	mg/L	J	Sample Reciept Temperature
8/7/2018		Diss. Zn-ICP/MS	4.05	µg/L	U	Field Blank Contamination
		pH	7.06	pH units	J	Hold Time Violation
9/10/2018		Diss. Pb-ICP/MS	0.0090	µg/L	J	Below Quantitative Range
		Diss. Zn-ICP/MS	5.09	µg/L	U	Field Blank Contamination
		pH	7.54	pH units	J	Hold Time Violation
		Total Sulfate	18.6	mg/L	J	Sample Receipt Temperature

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

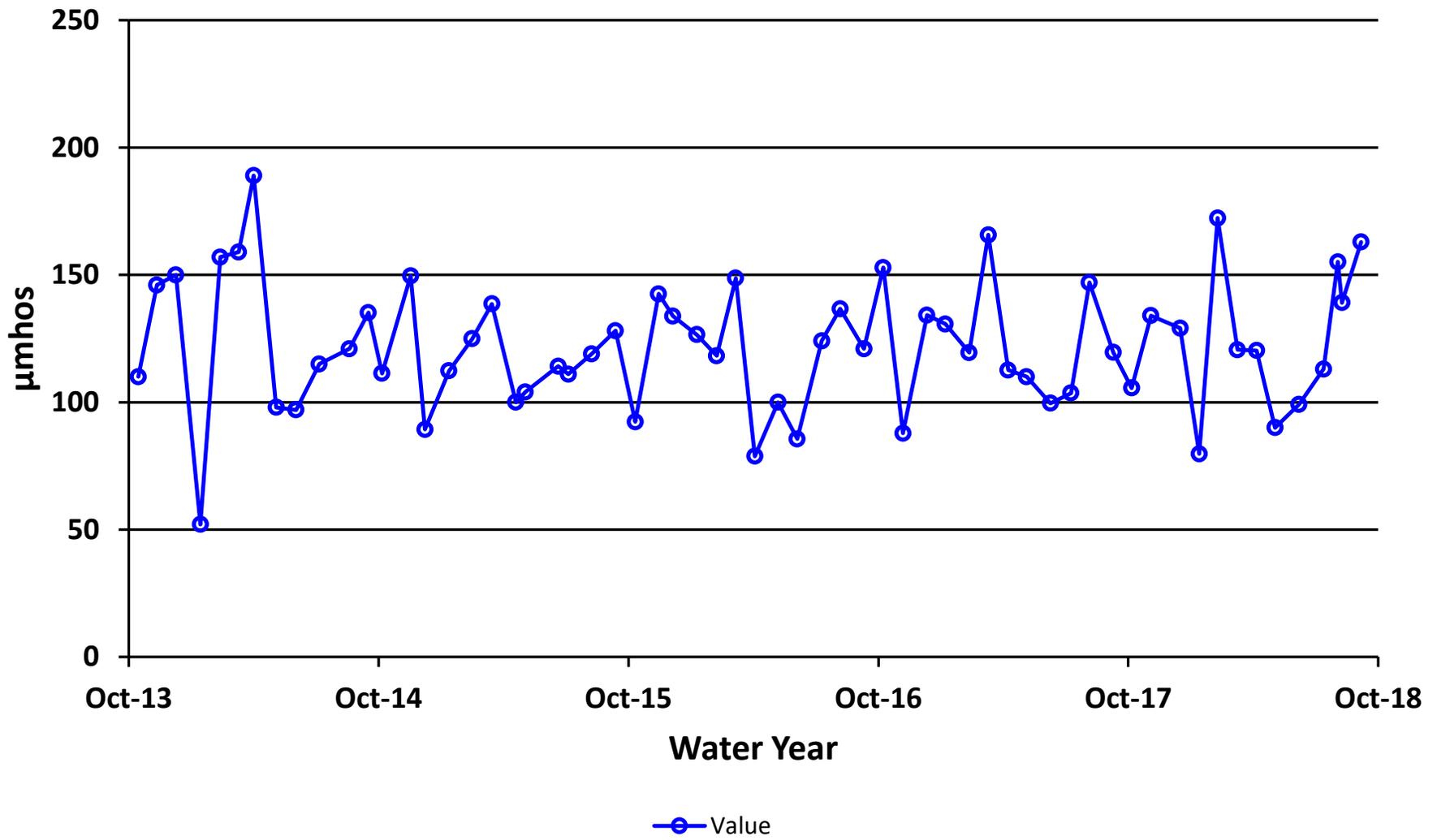
Site 6 - Water Temperature



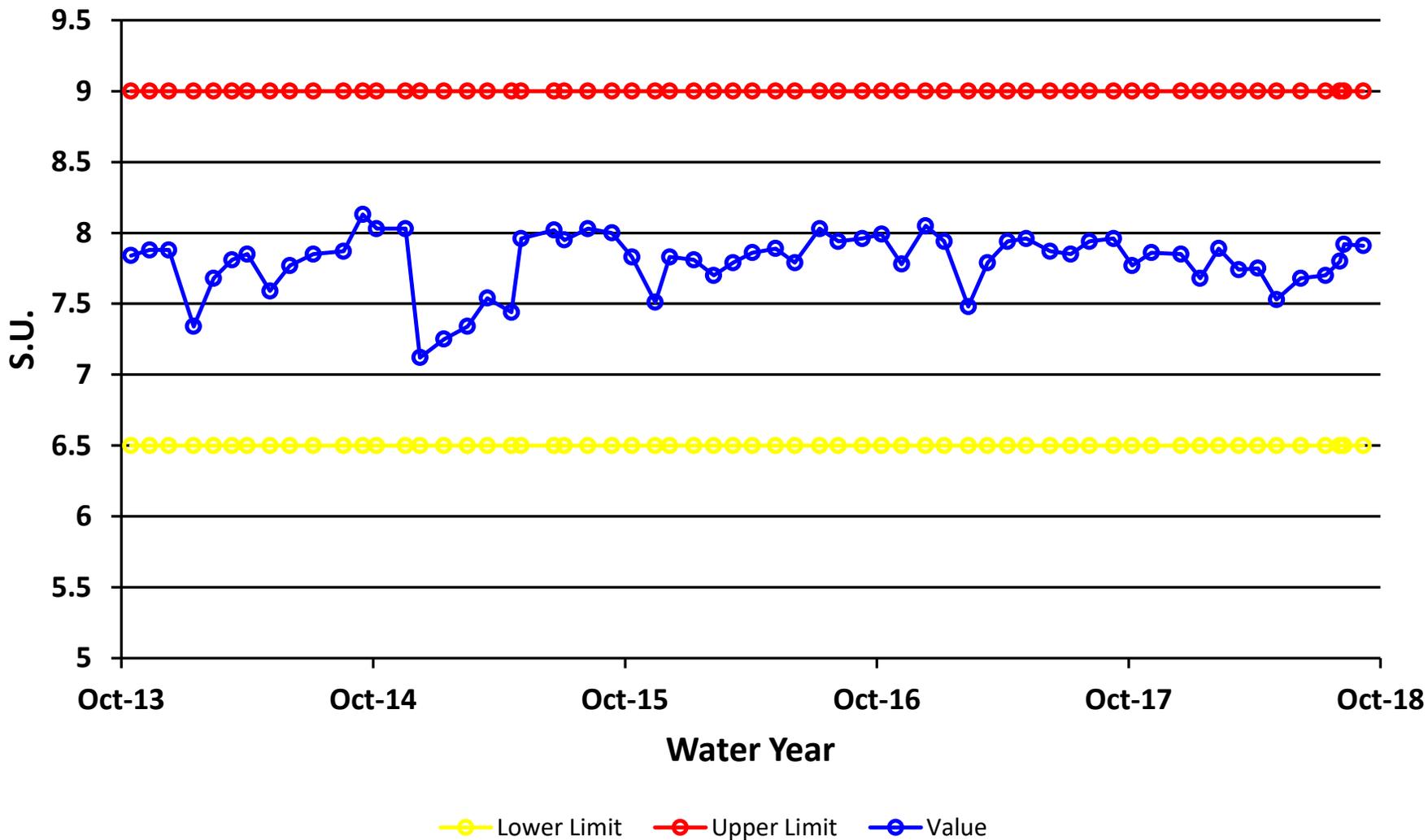
Site 6 - Conductivity Laboratory



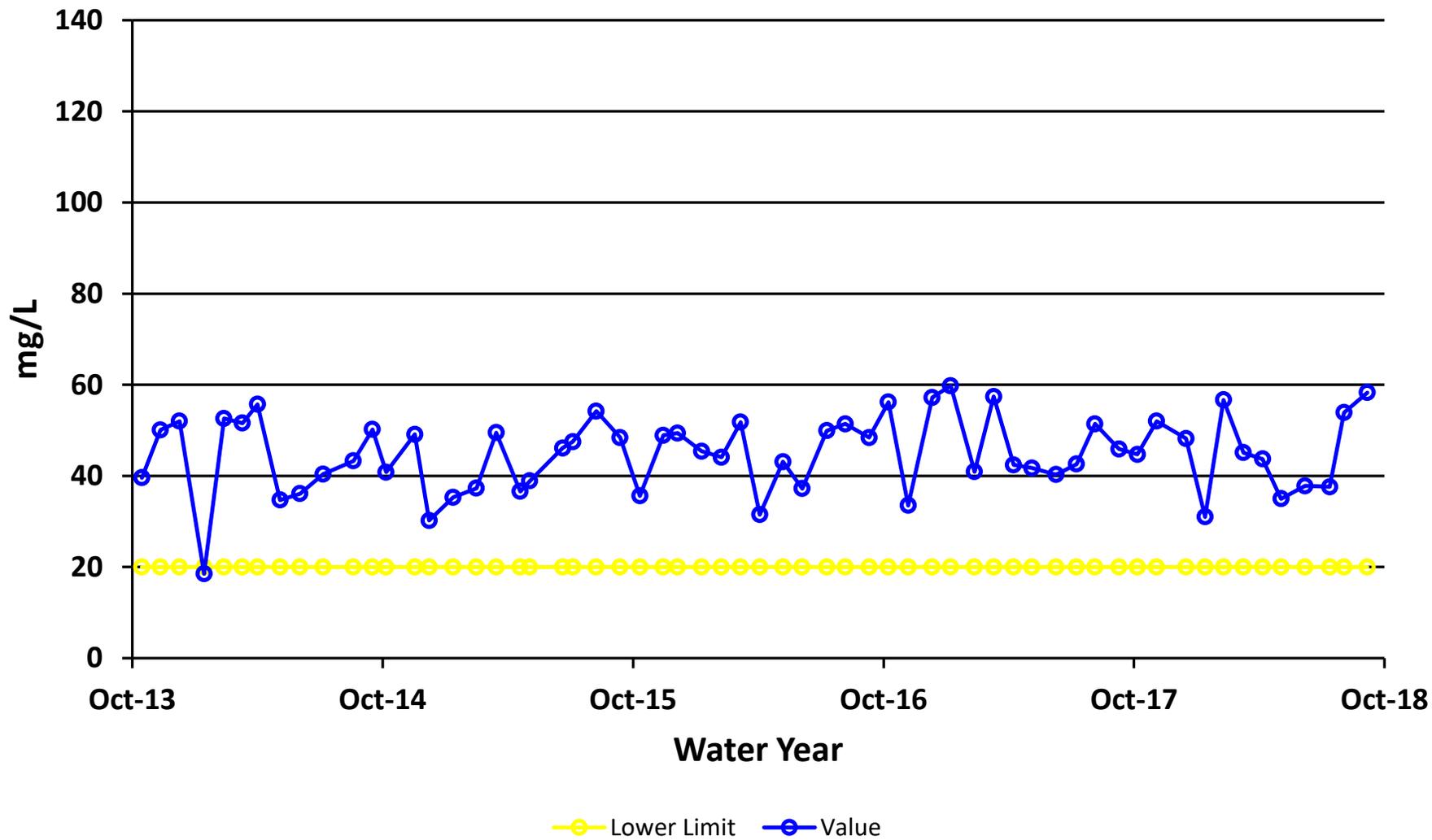
Site 6 - Conductivity Field



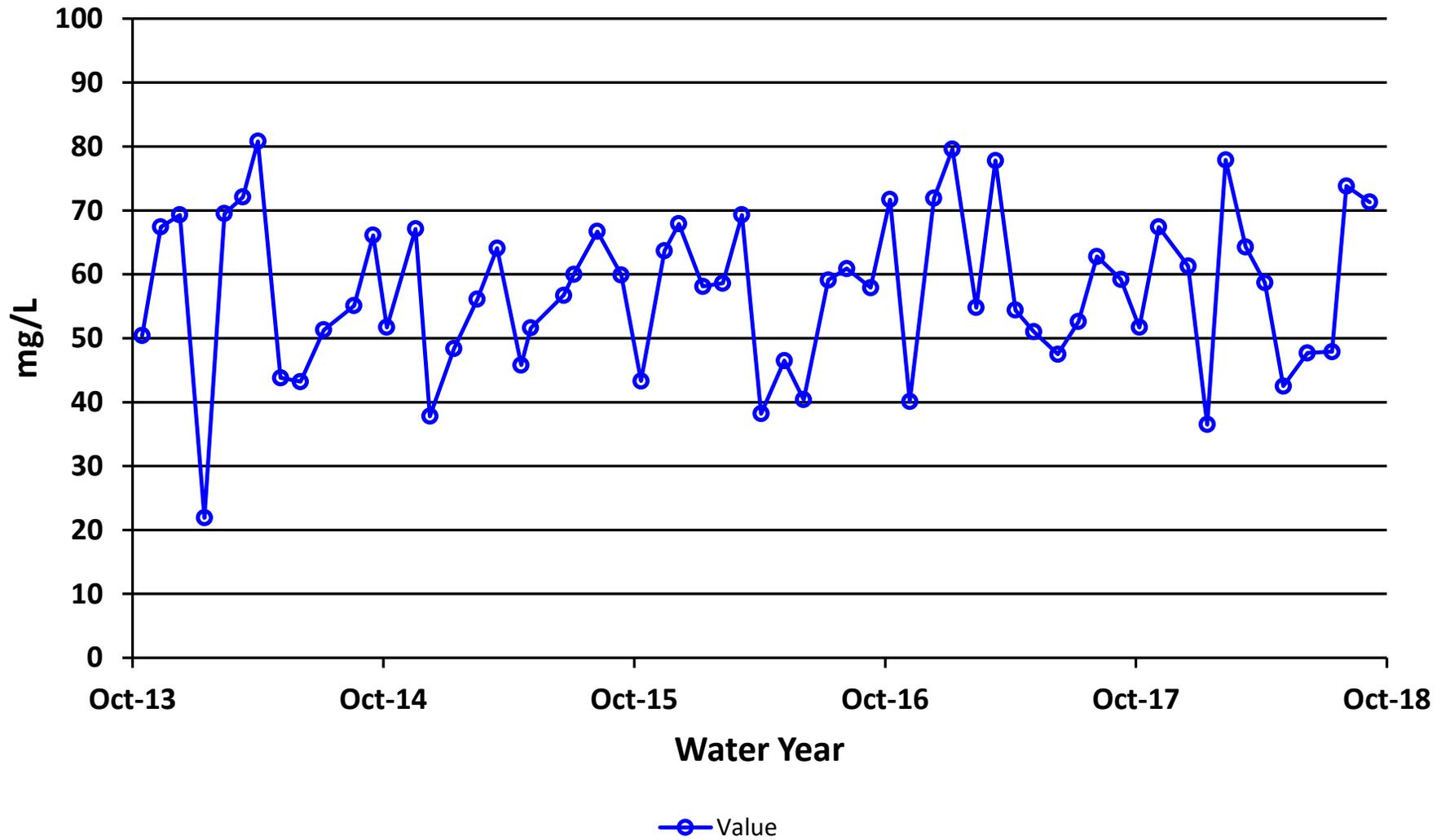
Site 6 - pH Field



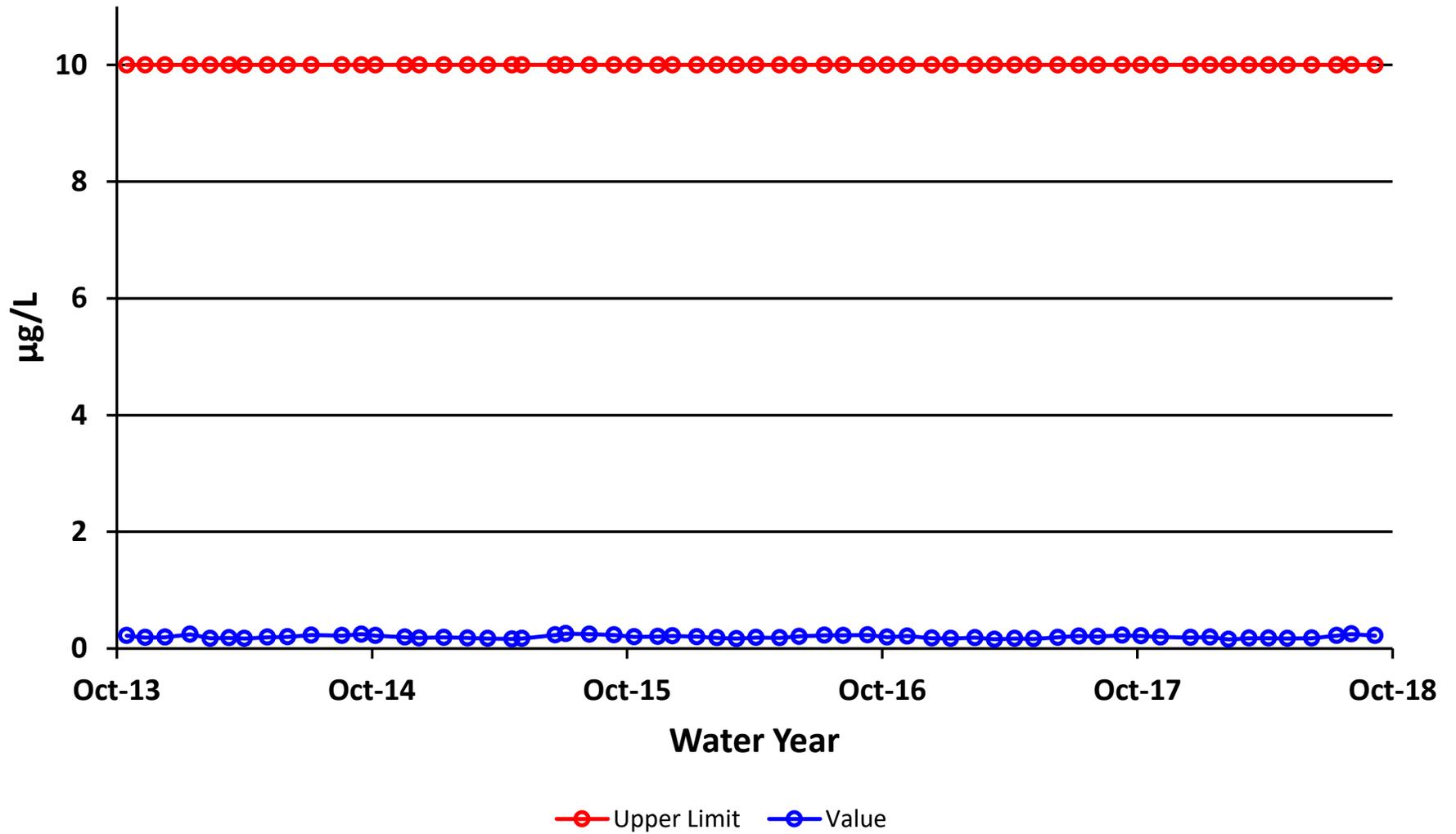
Site 6 - Alkalinity



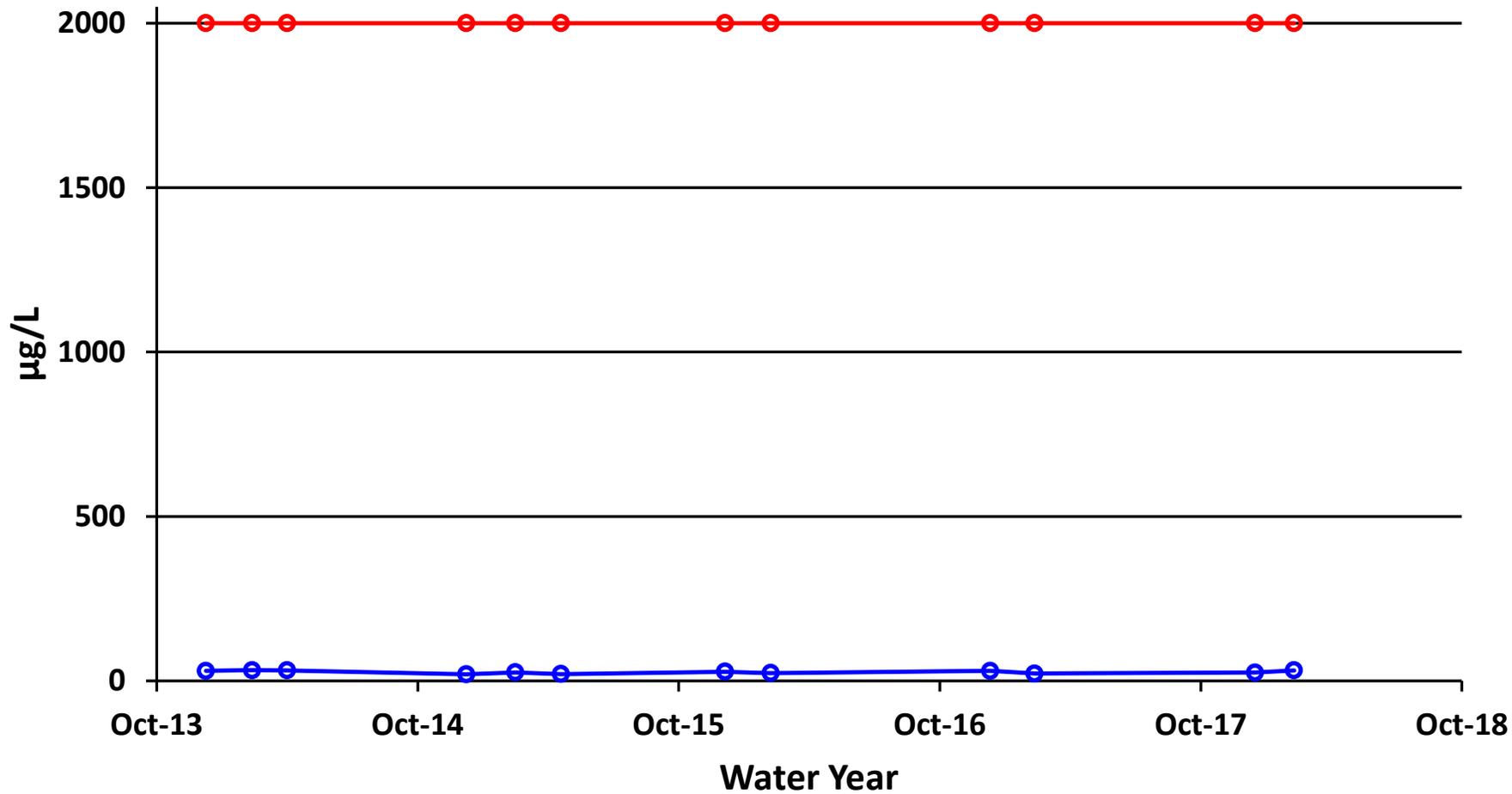
Site 6 - Hardness



Site 6 - Arsenic Dissolved

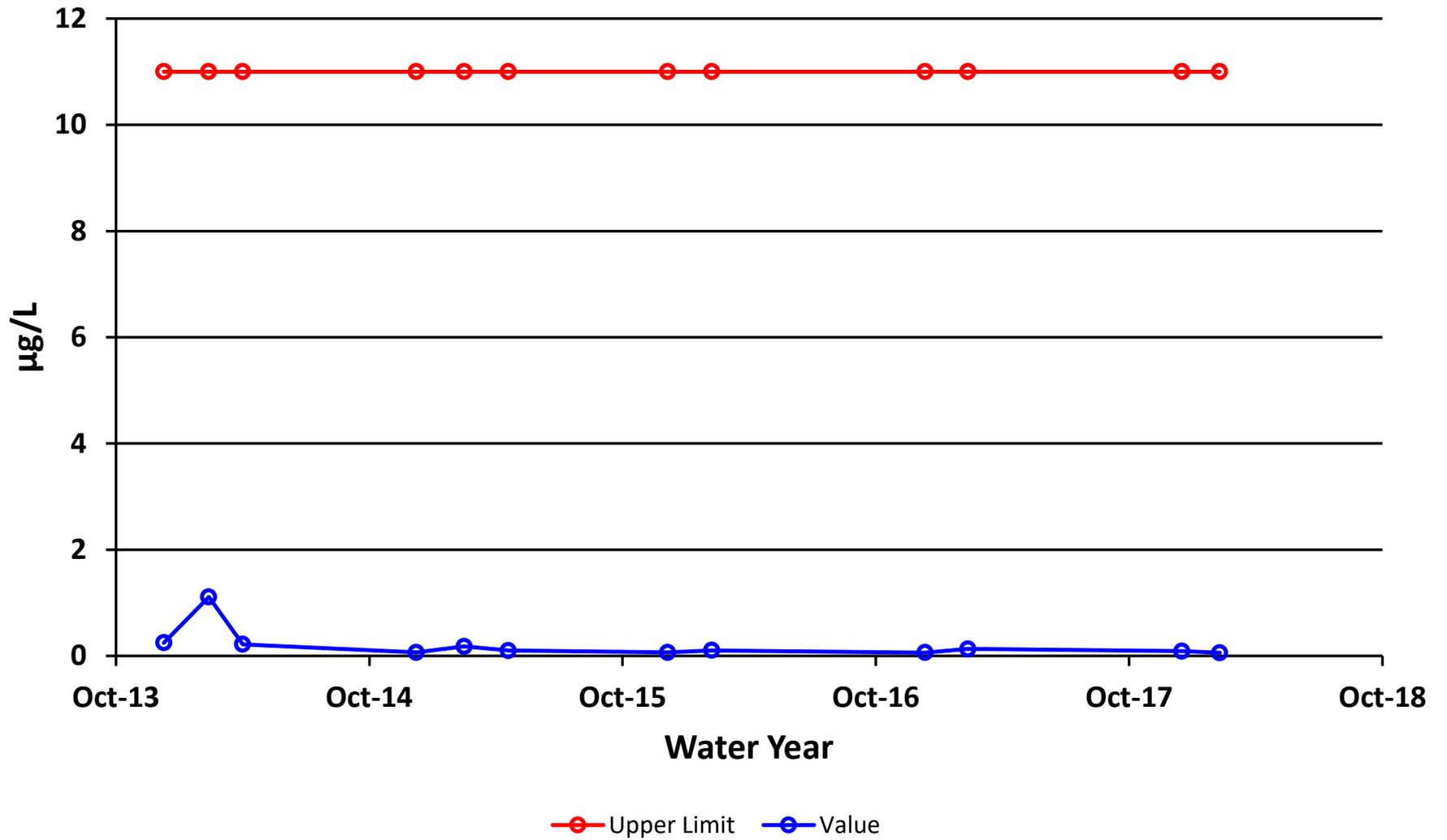


Site 6 - Barium Dissolved

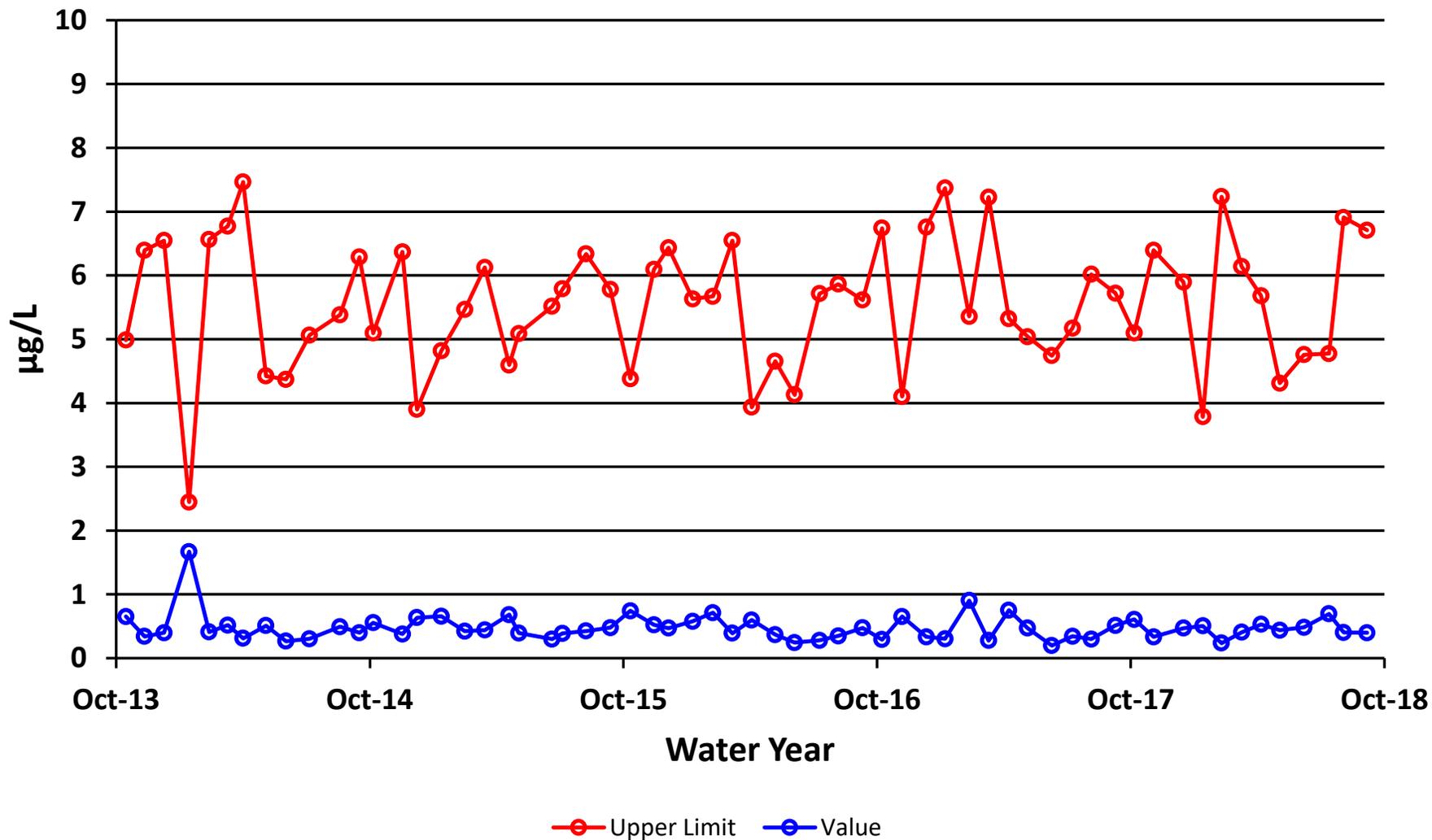


—○— Upper Limit —○— Value

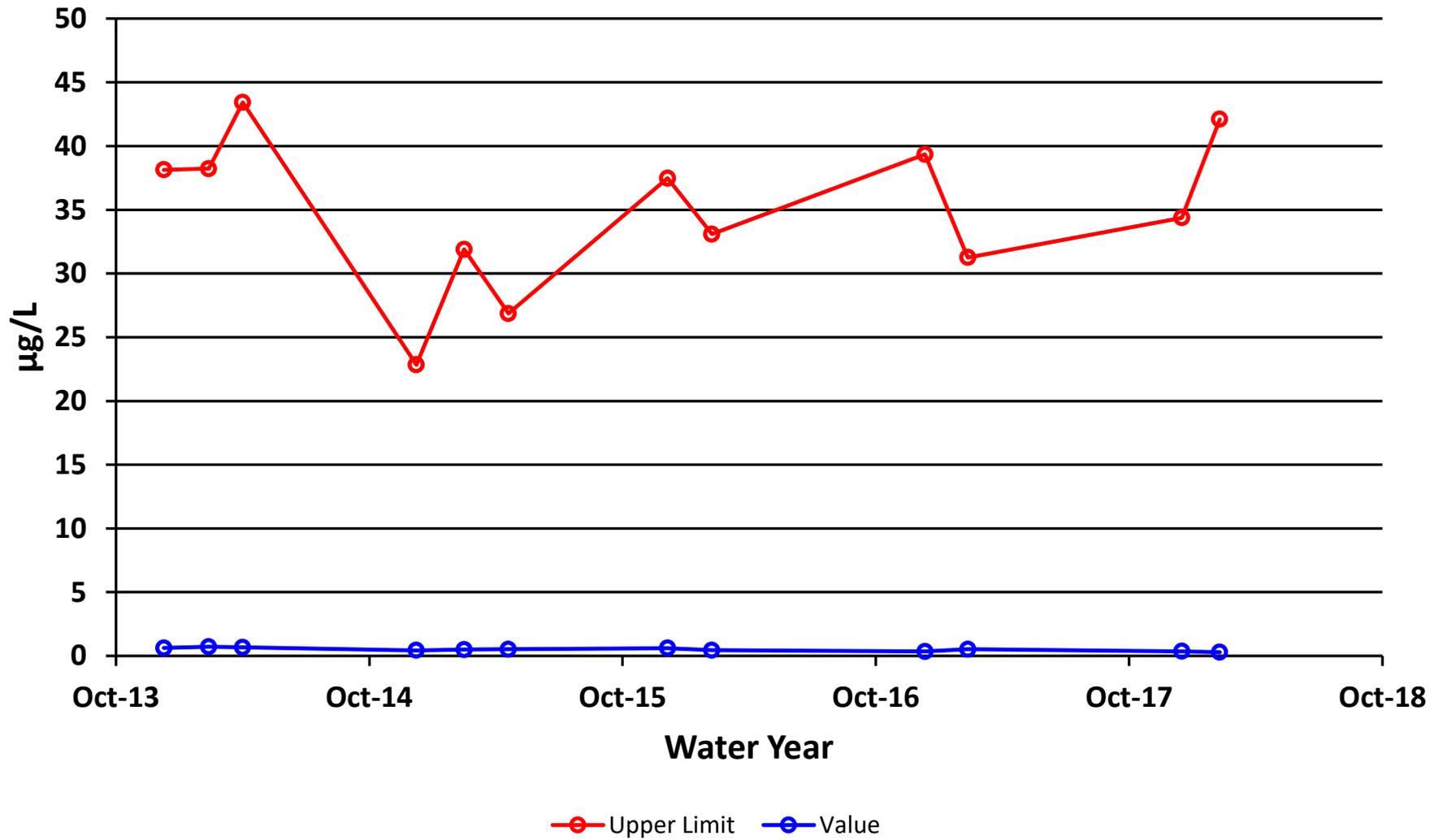
Site 6 - Chromium Dissolved



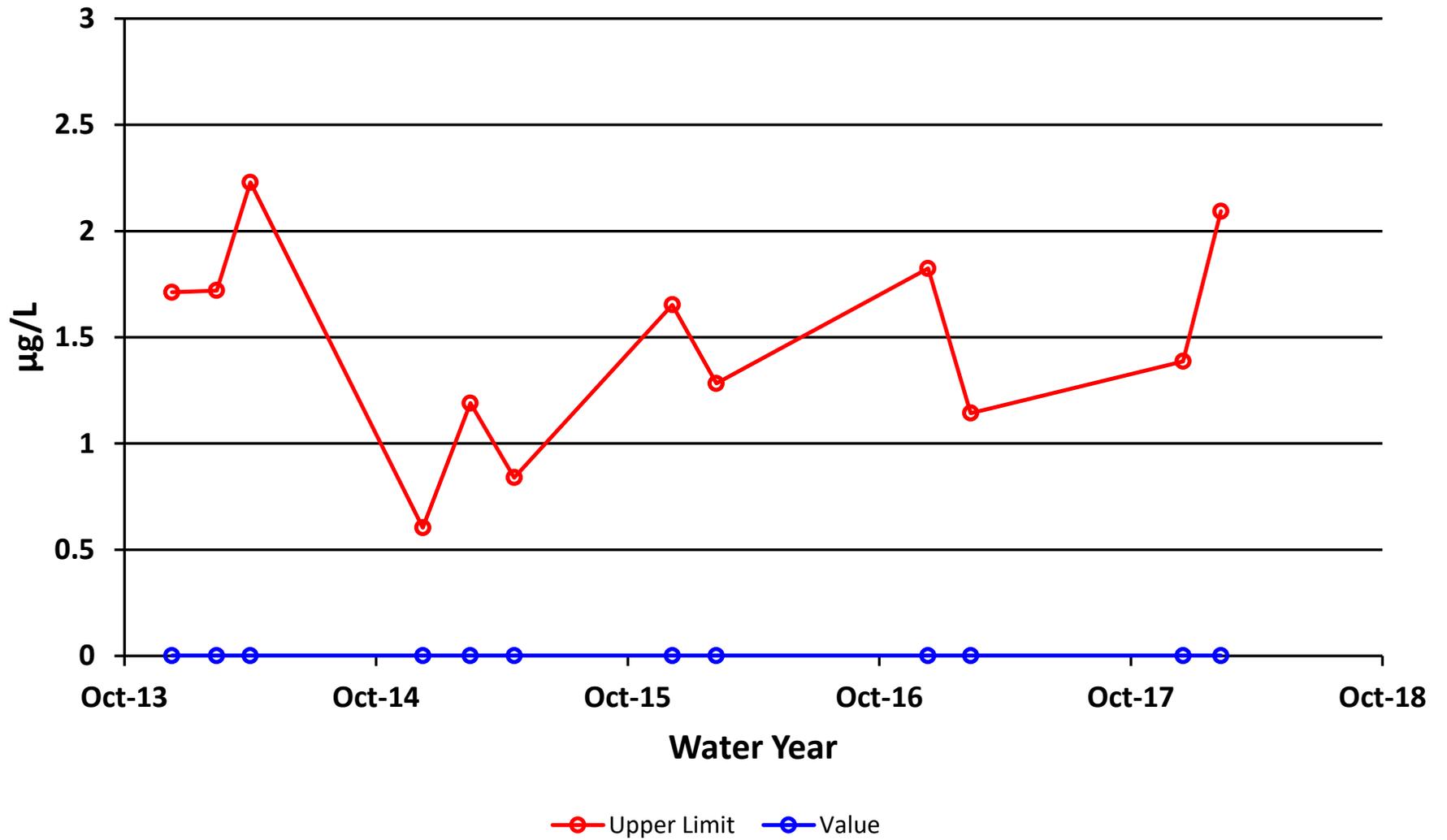
Site 6 - Copper Dissolved



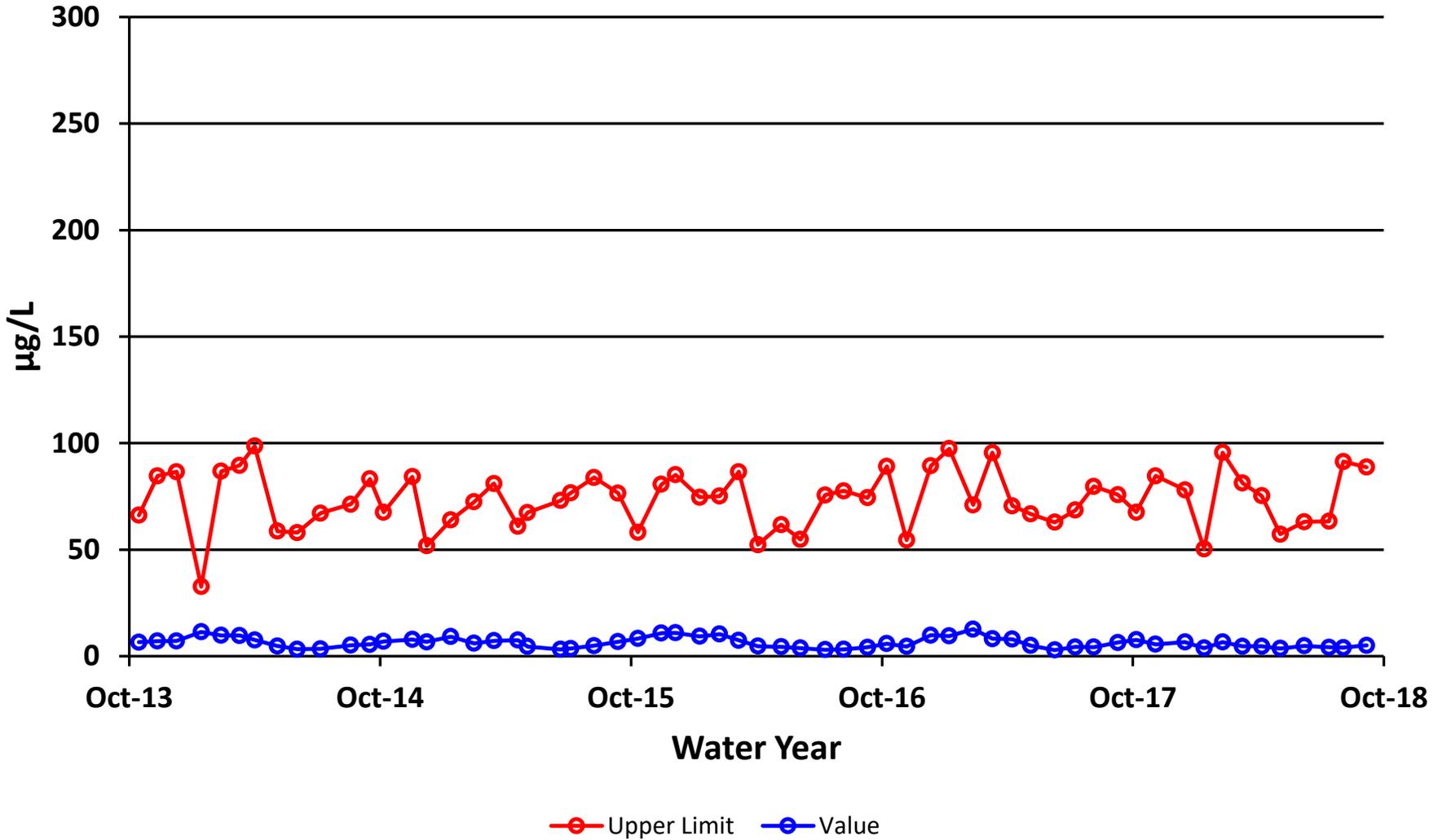
Site 6 - Nickel Dissolved



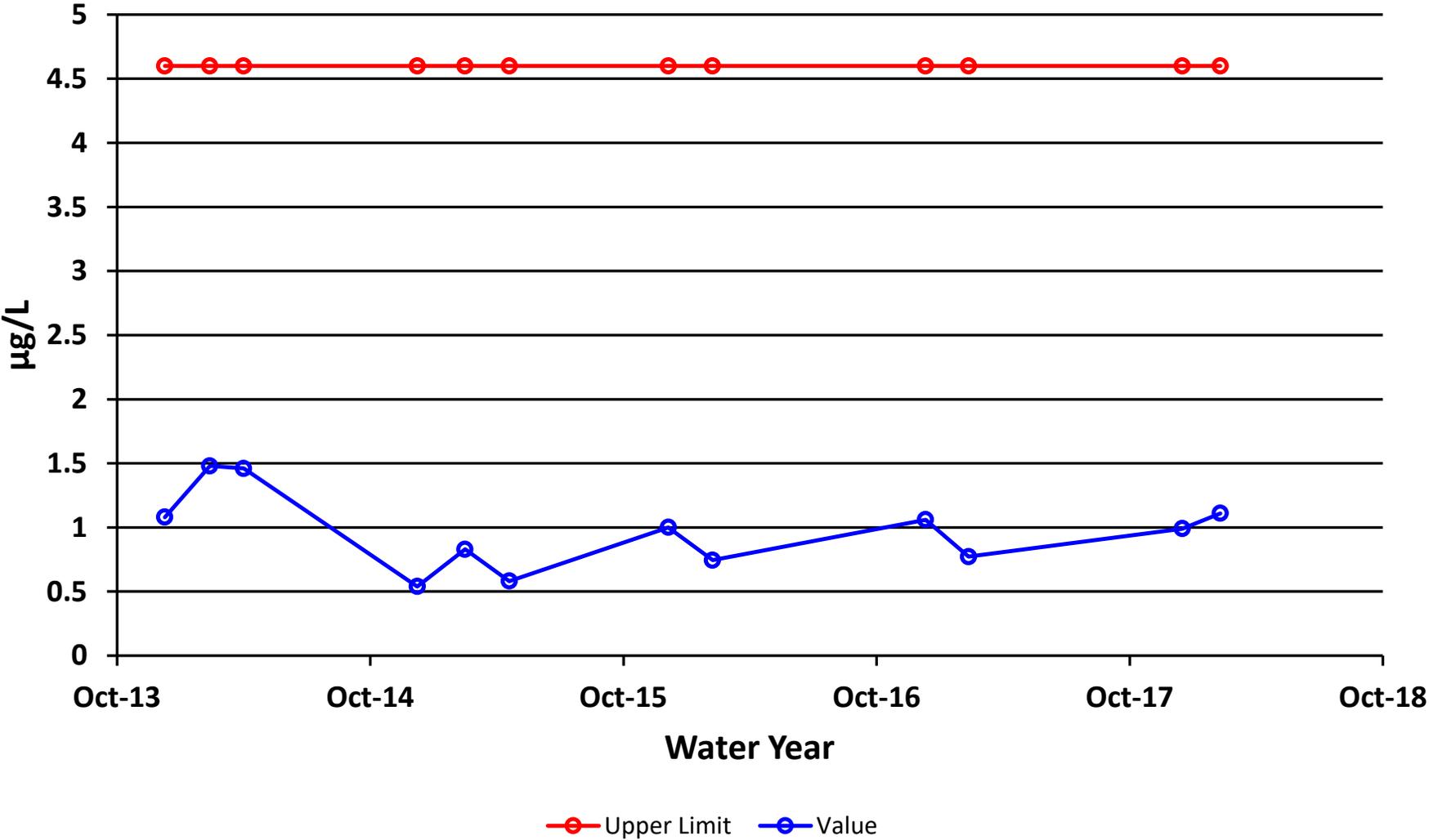
Site 6 - Silver Dissolved



Site 6 - Zinc Dissolved



Site 6 - Selenium Dissolved

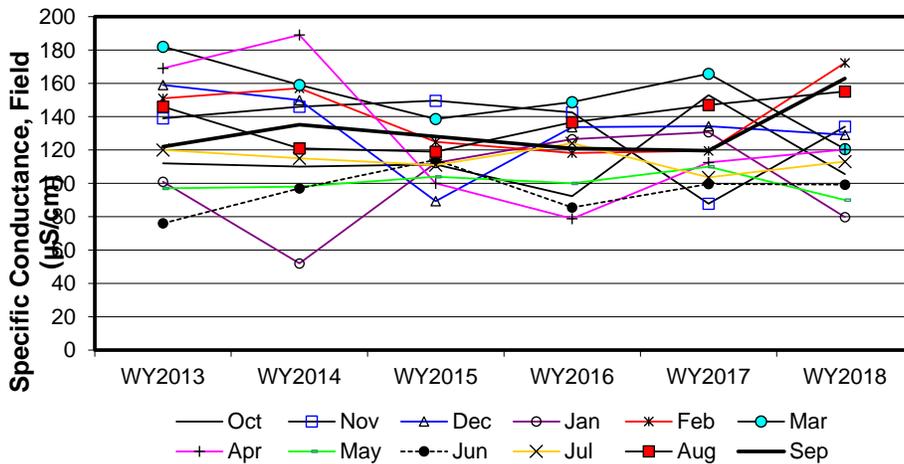


Site #6 Seasonal Kendall analysis for Specific Conductance, Field (µS/cm)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	WY2013	112.0	139.0	159.0	101.0	151.0	182.0	169.0	97.0	76.0	120.0	146.0	122.0
b	WY2014	110.0	146.0	150.0	52.0	157.0	159.0	189.0	98.0	97.0	115.0	121.0	135.2
c	WY2015	111.3	149.6	89.3	112.3	124.9	138.6	100.0	104.0	114.1	111.0	119.0	128.1
d	WY2016	92.3	142.5	133.8	126.5	118.2	148.7	78.8	100.0	85.6	124.1	136.7	121.0
e	WY2017	152.9	87.8	134.2	130.7	119.5	165.7	112.6	110.0	99.6	103.6	147.0	119.6
f	WY2018	105.6	134.0	129.1	79.7	172.3	120.6	120.3	90.0	99.2	113.0	155.1	162.9
n		6	6	6	6	6	6	6	6	6	6	6	6
t ₁		6	6	6	6	6	6	6	6	6	6	6	6
t ₂		0	0	0	0	0	0	0	0	0	0	0	0
t ₃		0	0	0	0	0	0	0	0	0	0	0	0
t ₄		0	0	0	0	0	0	0	0	0	0	0	0
t ₅		0	0	0	0	0	0	0	0	0	0	0	0
b-a		-1	1	-1	-1	1	-1	1	1	1	-1	-1	1
c-a		-1	1	-1	1	-1	-1	-1	1	1	-1	-1	1
d-a		-1	1	-1	1	-1	-1	-1	1	1	1	-1	-1
e-a		1	-1	-1	1	-1	-1	-1	1	1	-1	1	-1
f-a		-1	-1	-1	-1	1	-1	-1	-1	1	-1	1	1
c-b		1	1	-1	1	-1	-1	-1	1	1	-1	-1	-1
d-b		-1	-1	-1	1	-1	-1	-1	1	-1	1	1	-1
e-b		1	-1	-1	1	-1	1	-1	1	1	-1	1	-1
f-b		-1	-1	-1	1	1	-1	-1	-1	1	-1	1	1
d-c		-1	-1	1	1	-1	1	-1	-1	-1	1	1	-1
e-c		1	-1	1	1	-1	1	1	1	-1	-1	1	-1
f-c		-1	-1	1	-1	1	-1	1	-1	-1	1	1	1
e-d		1	-1	1	1	1	1	1	1	1	-1	1	-1
f-d		1	-1	-1	-1	1	-1	1	-1	1	-1	1	1
f-e		-1	1	-1	-1	1	-1	1	-1	-1	1	1	1
S _k		-3	-5	-7	5	-1	-7	-3	3	5	-5	7	-1
σ _S ² =		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 /σ _S		-0.56	-0.94	-1.32	0.94	-0.19	-1.32	-0.56	0.56	0.94	-0.94	1.32	-0.19
Z _k ²		0.32	0.88	1.73	0.88	0.04	1.73	0.32	0.32	0.88	0.88	1.73	0.04

ΣZ _k =	-2.25	Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅	Σn	72
ΣZ _k ² =	9.74	Count	72	0	0	0	0	ΣS _k	-12
Z-bar=ΣZ _k /K=	-0.19								

$\chi^2_{h1} = \sum Z_k^2 - K(Z\text{-bar})^2 =$	9.32	@α=5% $\chi^2_{(K-1)} =$	19.68	Test for station homogeneity
p	0.593	$\chi^2_{h1} < \chi^2_{(K-1)}$		ACCEPT
ΣVAR(S _k)	Z _{calc} -0.60	@α/2=2.5% Z=	1.96	H ₀ (No trend) ACCEPT
340.00	p 0.275			H _A (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals			
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-4.25		3.02
0.050	-3.83	-1.05	1.19
0.100	-2.94		0.98
0.200	-2.00		0.36

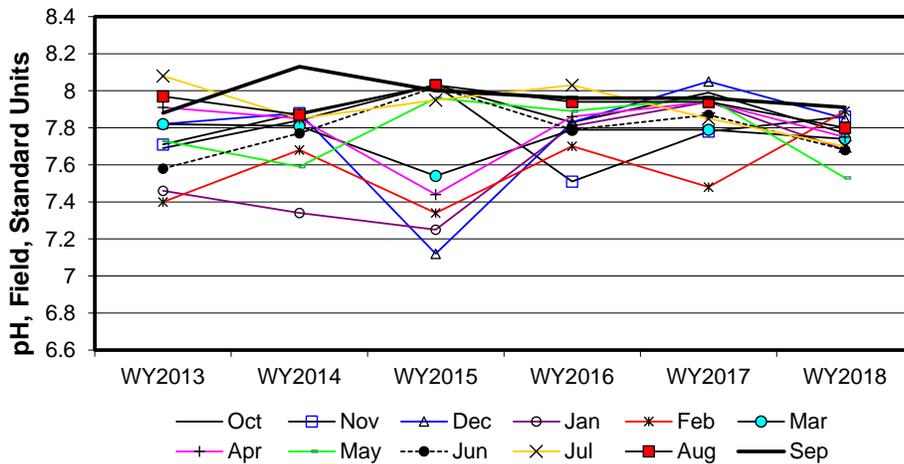
Site #6

Seasonal Kendall analysis for pH, Field, Standard Units

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	WY2013	7.7	7.7	7.8	7.5	7.4	7.8	7.9	7.7	7.6	8.1	8.0	7.9
b	WY2014	7.8	7.9	7.9	7.3	7.7	7.8	7.9	7.6	7.8	7.9	7.9	8.1
c	WY2015	8.0	8.0	7.1	7.3	7.3	7.5	7.4	8.0	8.0	8.0	8.0	8.0
d	WY2016	7.8	7.5	7.8	7.8	7.7	7.8	7.9	7.9	7.8	8.0	7.9	8.0
e	WY2017	8.0	7.8	8.1	7.9	7.5	7.8	7.9	8.0	7.9	7.9	7.9	8.0
f	WY2018	7.8	7.9	7.9	7.7	7.9	7.7	7.8	7.5	7.7	7.7	7.8	7.9
n		6	6	6	6	6	6	6	6	6	6	6	6
t ₁		6	6	6	6	6	4	6	4	6	4	4	4
t ₂		0	0	0	0	0	1	0	1	0	1	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
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	0	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	0	-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	0	1	1	1	-1	0	0
f-d		-1	1	1	-1	1	-1	-1	-1	-1	-1	-1	-1
f-e		-1	1	-1	-1	1	-1	-1	-1	-1	-1	-1	-1
S _k		1	1	5	5	7	-8	-1	0	3	-8	-6	-4
σ _S ² =		28.33	28.33	28.33	28.33	28.33	27.33	28.33	27.33	28.33	27.33	27.33	27.33
Z _k = S _k /σ _S		0.19	0.19	0.94	0.94	1.32	-1.53	-0.19	0.00	0.56	-1.53	-1.15	-0.77
Z _k ²		0.04	0.04	0.88	0.88	1.73	2.34	0.04	0.00	0.32	2.34	1.32	0.59

ΣZ _k =	-1.03	Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅	Σn	72
ΣZ _k ² =	10.50	Count	62	5	0	0	0	ΣS _k	-5
Z-bar=ΣZ _k /K=	-0.09								

$\chi^2_{h} = \sum Z_k^2 - K(Z\text{-bar})^2 =$	10.41	@α=5% $\chi^2_{(K-1)} =$	19.68	Test for station homogeneity
p	0.493			$\chi^2_h < \chi^2_{(K-1)}$ ACCEPT
ΣVAR(S _k)	Z _{calc} -0.22	@α/2=2.5% Z=	1.96	H ₀ (No trend) ACCEPT
335.00	p 0.414			H _A (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals			
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.02		0.03
0.050	-0.02		0.02
0.100	-0.02	0.00	0.01
0.200	-0.01		0.01

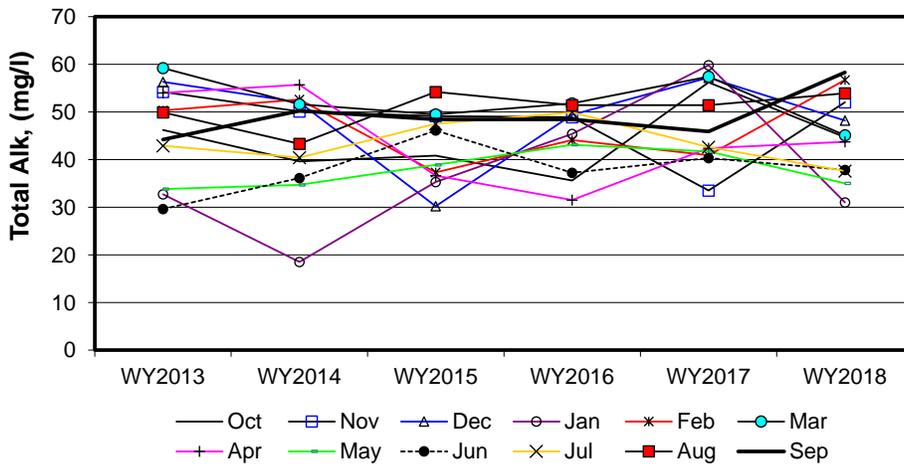
Site #6

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	WY2013	46.2	54.2	56.3	32.7	50.3	59.2	54.0	33.8	29.6	42.9	49.9	44.2
b	WY2014	39.6	50.1	52.0	18.5	52.6	51.6	55.7	34.7	36.1	40.4	43.3	50.2
c	WY2015	40.8	49.1	30.2	35.3	37.3	49.5	36.6	38.9	46.1	47.5	54.2	48.4
d	WY2016	35.6	48.9	49.4	45.4	44.1	51.8	31.5	43.1	37.2	49.9	51.4	48.4
e	WY2017	56.2	33.5	57.2	59.8	40.9	57.4	42.4	41.7	40.3	42.6	51.4	45.9
f	WY2018	44.7	52.0	48.2	31.0	56.7	45.1	43.7	35.0	37.8	37.6	53.9	58.3
n		6	6	6	6	6	6	6	6	6	6	6	6
t ₁		6	6	6	6	6	6	6	6	6	6	4	4
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
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	0
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	0	-1
f-d		1	1	-1	-1	1	-1	1	-1	1	-1	1	1
f-e		-1	1	-1	-1	1	-1	1	-1	-1	-1	1	1
S _k		1	-7	-3	5	1	-5	-3	7	7	-3	6	4
σ _S ² =		28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	27.33	27.33
Z _k = S _k /σ _S		0.19	-1.32	-0.56	0.94	0.19	-0.94	-0.56	1.32	1.32	-0.56	1.15	0.77
Z _k ²		0.04	1.73	0.32	0.88	0.04	0.88	0.32	1.73	1.73	0.32	1.32	0.59

ΣZ _k =	1.91	Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅	Σn	72
ΣZ _k ² =	9.88	Count	68	2	0	0	0	ΣS _k	10
Z-bar=ΣZ _k /K=	0.16								

$\chi^2_{h} = \sum Z_k^2 - K(Z\text{-bar})^2 =$	9.57	@α=5% $\chi^2_{(K-1)} =$	19.68	Test for station homogeneity
p	0.569	$\chi^2_h < \chi^2_{(K-1)}$		ACCEPT
ΣVAR(S _k)	Z _{calc} 0.49	@α/2=2.5% Z=	1.96	H ₀ (No trend) ACCEPT
338.00	p 0.688			H _A (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals			
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-1.30	0.27	1.40
0.050	-0.72		1.28
0.100	-0.45		1.01
0.200	-0.17		0.69

Site #6

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

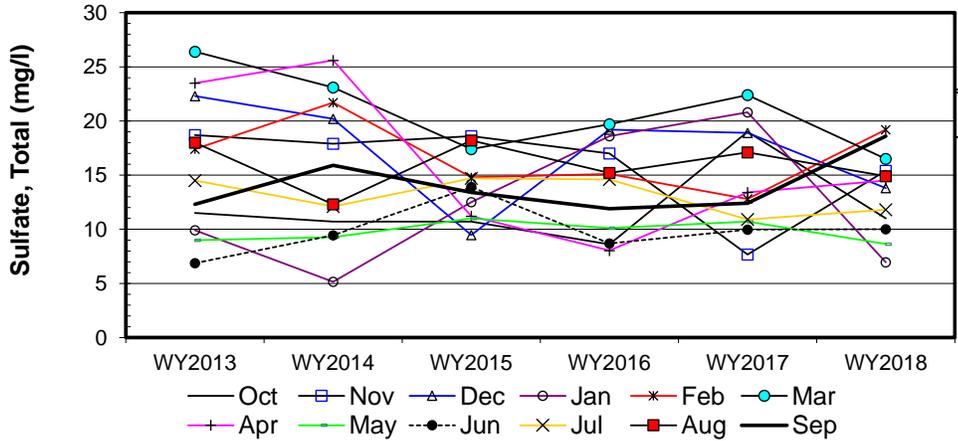
Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	WY2013	11.5	18.7	22.3	9.9	17.4	26.4	23.5	9.0	6.9	14.5	18.0	12.3
b	WY2014	10.7	17.9	20.2	5.2	21.7	23.1	25.6	9.3	9.5	12.1	12.3	15.9
c	WY2015	10.7	18.6	9.5	12.5	14.8	17.4	11.2	11.0	13.9	14.7	18.2	13.4
d	WY2016	8.6	17.0	19.2	18.6	15.1	19.7	8.0	10.1	8.7	14.6	15.2	11.9
e	WY2017	19.0	7.7	18.9	20.8	12.8	22.4	13.4	10.7	10.0	10.9	17.1	12.4
f	WY2018	11.0	15.4	13.8	7.0	19.2	16.5	14.5	8.6	10.0	11.8	14.9	18.6
n		6	6	6	6	6	6	6	6	6	6	6	6
t ₁		4	6	6	6	6	6	6	6	6	6	6	6
t ₂		1	0	0	0	0	0	0	0	0	0	0	0
t ₃		0	0	0	0	0	0	0	0	0	0	0	0
t ₄		0	0	0	0	0	0	0	0	0	0	0	0
t ₅		0	0	0	0	0	0	0	0	0	0	0	0
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		0	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		0	-11	-9	5	-3	-9	-3	1	7	-5	-3	3
σ _s ² =		27.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33
Z _k = S _k /σ _s		0.00	-2.07	-1.69	0.94	-0.56	-1.69	-0.56	0.19	1.32	-0.94	-0.56	0.56
Z _k ²		0.00	4.27	2.86	0.88	0.32	2.86	0.32	0.04	1.73	0.88	0.32	0.32

ΣZ_k= -5.07
 ΣZ_k²= 14.79
 Z-bar=ΣZ_k/K= -0.42

Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅
Count	70	1	0	0	0

Σn = 72
 ΣS_k = -27

χ _n ² =ΣZ _k ² -K(Z-bar) ² =	12.64	@α=5% χ _(K-1) ² =	19.68	Test for station homogeneity
p	0.317	χ _h ² <χ _(K-1) ²	ACCEPT	
ΣVAR(S _k)	Z _{calc} -1.41	@α=2.5% Z=	1.96	H ₀ (No trend) ACCEPT
339.00	p 0.079			H _A (± trend) REJECT



α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.87		0.11
0.050	-0.74		0.03
0.100	-0.62	-0.34	-0.07
0.200	-0.55		-0.14

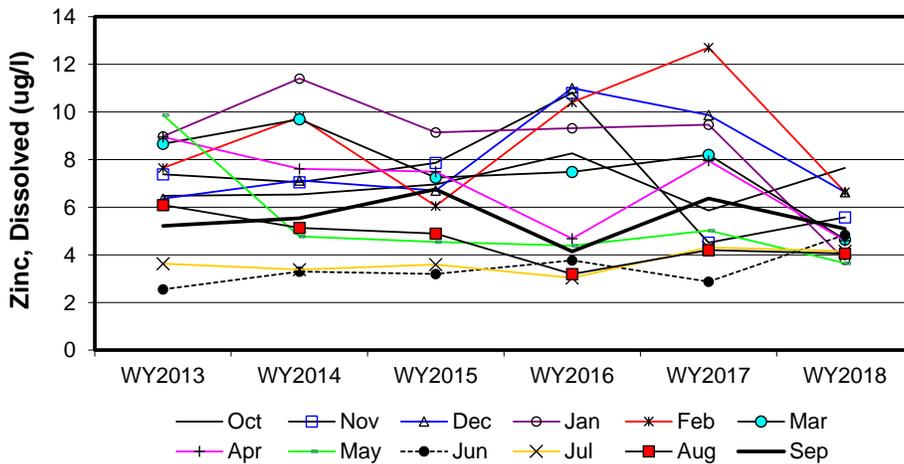
Site #6

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	WY2013	6.5	7.4	6.4	9.0	7.7	8.7	9.0	9.9	2.6	3.6	6.1	5.2
b	WY2014	6.5	7.1	7.1	11.4	9.8	9.7	7.6	4.8	3.3	3.4	5.1	5.5
c	WY2015	7.0	7.9	6.7	9.1	6.1	7.2	7.5	4.5	3.2	3.6	4.9	6.8
d	WY2016	8.3	10.8	11.0	9.3	10.4	7.5	4.7	4.4	3.8	3.0	3.2	4.1
e	WY2017	5.9	4.5	9.9	9.5	12.7	8.2	8.0	5.0	2.9	4.3	4.2	6.4
f	WY2018	7.7	5.6	6.6	3.8	6.6	4.6	4.6	3.7	4.8	4.2	4.1	5.1
n		6	6	6	6	6	6	6	6	6	6	6	6
t ₁		6	6	6	6	6	6	6	6	6	6	6	6
t ₂		0	0	0	0	0	0	0	0	0	0	0	0
t ₃		0	0	0	0	0	0	0	0	0	0	0	0
t ₄		0	0	0	0	0	0	0	0	0	0	0	0
t ₅		0	0	0	0	0	0	0	0	0	0	0	0
b-a		1	-1	1	1	1	1	-1	-1	1	-1	-1	1
c-a		1	1	1	1	-1	-1	-1	-1	1	-1	-1	1
d-a		1	1	1	1	1	-1	-1	-1	1	-1	-1	-1
e-a		-1	-1	1	1	1	-1	-1	-1	1	1	-1	1
f-a		1	-1	1	-1	-1	-1	-1	-1	-1	1	-1	-1
c-b		1	1	-1	-1	-1	-1	-1	-1	-1	1	-1	1
d-b		1	1	1	-1	1	-1	-1	-1	1	-1	-1	-1
e-b		-1	-1	1	-1	1	-1	1	1	-1	1	-1	1
f-b		1	-1	-1	-1	-1	-1	-1	-1	1	1	-1	-1
d-c		1	1	1	1	1	1	-1	-1	1	-1	-1	-1
e-c		-1	-1	1	1	1	1	1	1	-1	1	-1	-1
f-c		1	-1	-1	-1	1	-1	-1	-1	1	1	-1	-1
e-d		-1	-1	-1	1	1	1	1	1	-1	1	1	1
f-d		-1	-1	-1	-1	-1	-1	-1	-1	1	1	1	1
f-e		1	1	-1	-1	-1	-1	-1	-1	1	-1	-1	-1
S _k		5	-3	3	-1	3	-7	-9	-9	7	3	-11	-1
σ _S ² =		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 /σ _S		0.94	-0.56	0.56	-0.19	0.56	-1.32	-1.69	-1.69	1.32	0.56	-2.07	-0.19
Z _k ²		0.88	0.32	0.32	0.04	0.32	1.73	2.86	2.86	1.73	0.32	4.27	0.04

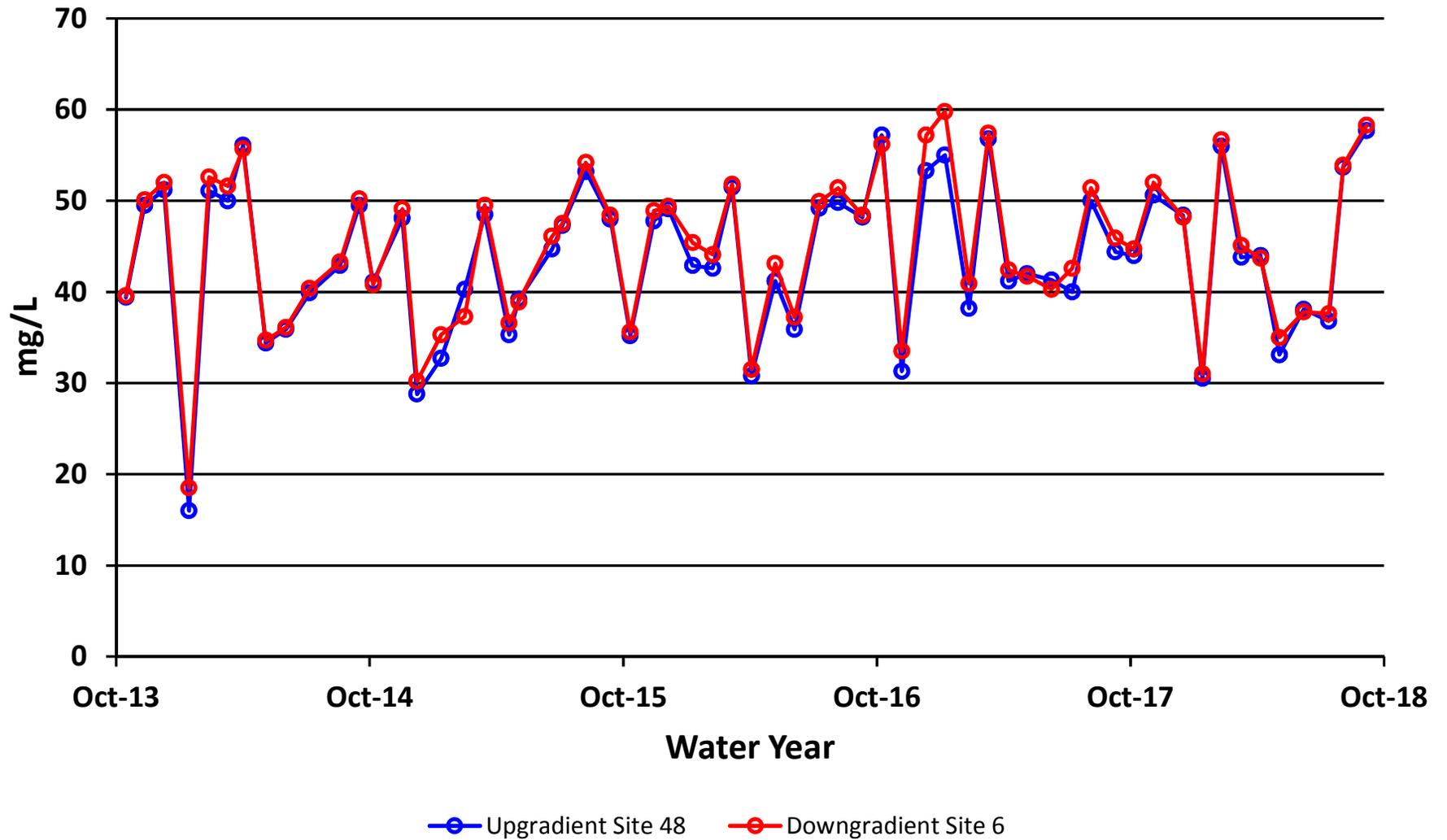
ΣZ _k =	-3.76	Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅	Σn	72
ΣZ _k ² =	15.67	Count	72	0	0	0	0	ΣS _k	-20
Z-bar=ΣZ _k /K=	-0.31								

χ _n ² =ΣZ _k ² -K(Z-bar) ² =	14.49	@α=5% χ _(K-1) ² =	19.68	Test for station homogeneity
p	0.207			χ _n ² <χ _(K-1) ² ACCEPT
ΣVAR(S _k)	Z _{calc} -1.03	@α/2=2.5% Z=	1.96	H ₀ (No trend) ACCEPT
340.00	p 0.151			H _A (± trend) REJECT

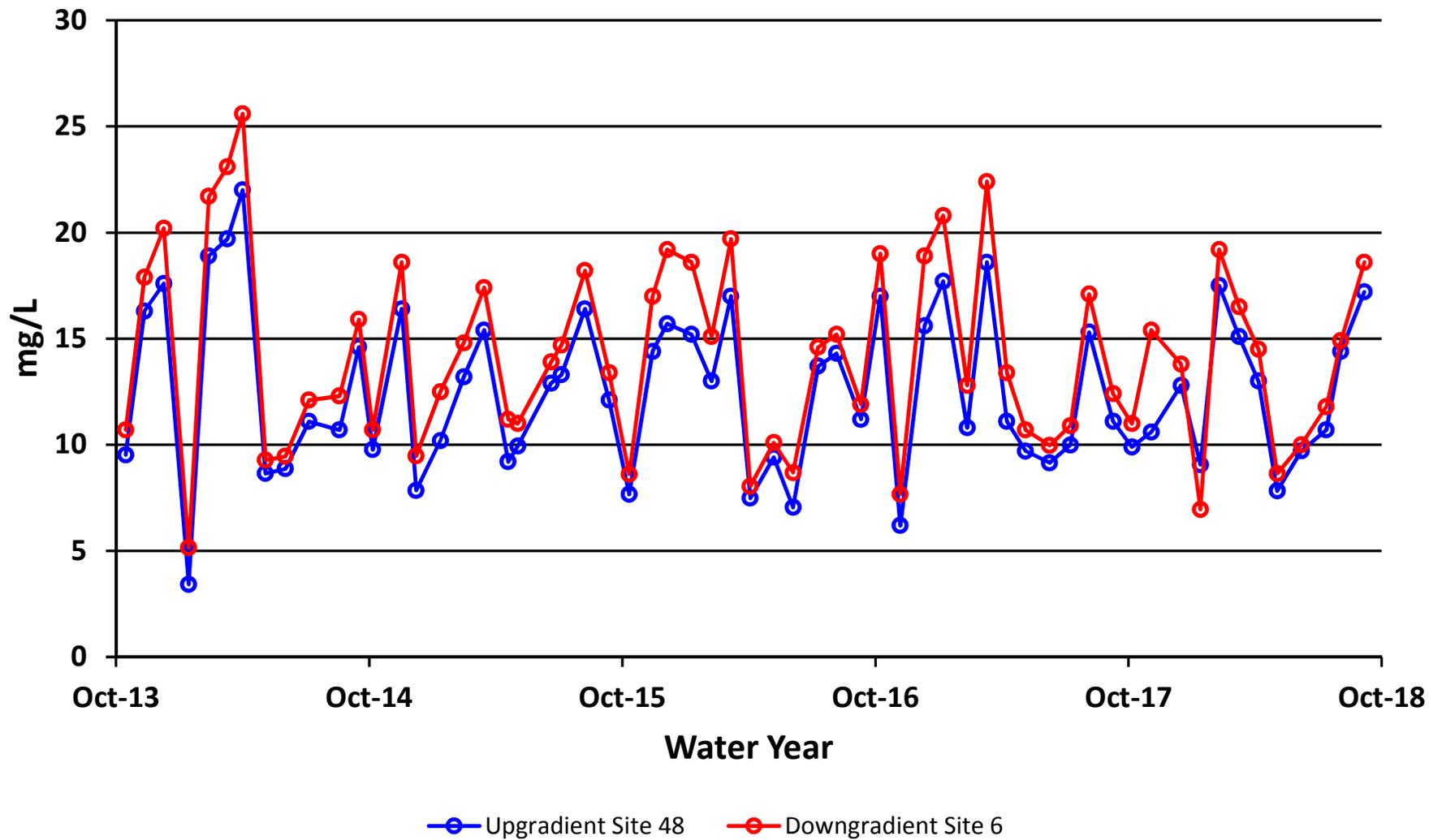


Seasonal-Kendall Slope Confidence Intervals			
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.34	-0.15	0.16
0.050	-0.27		0.09
0.100	-0.24		0.05
0.200	-0.20		-0.03

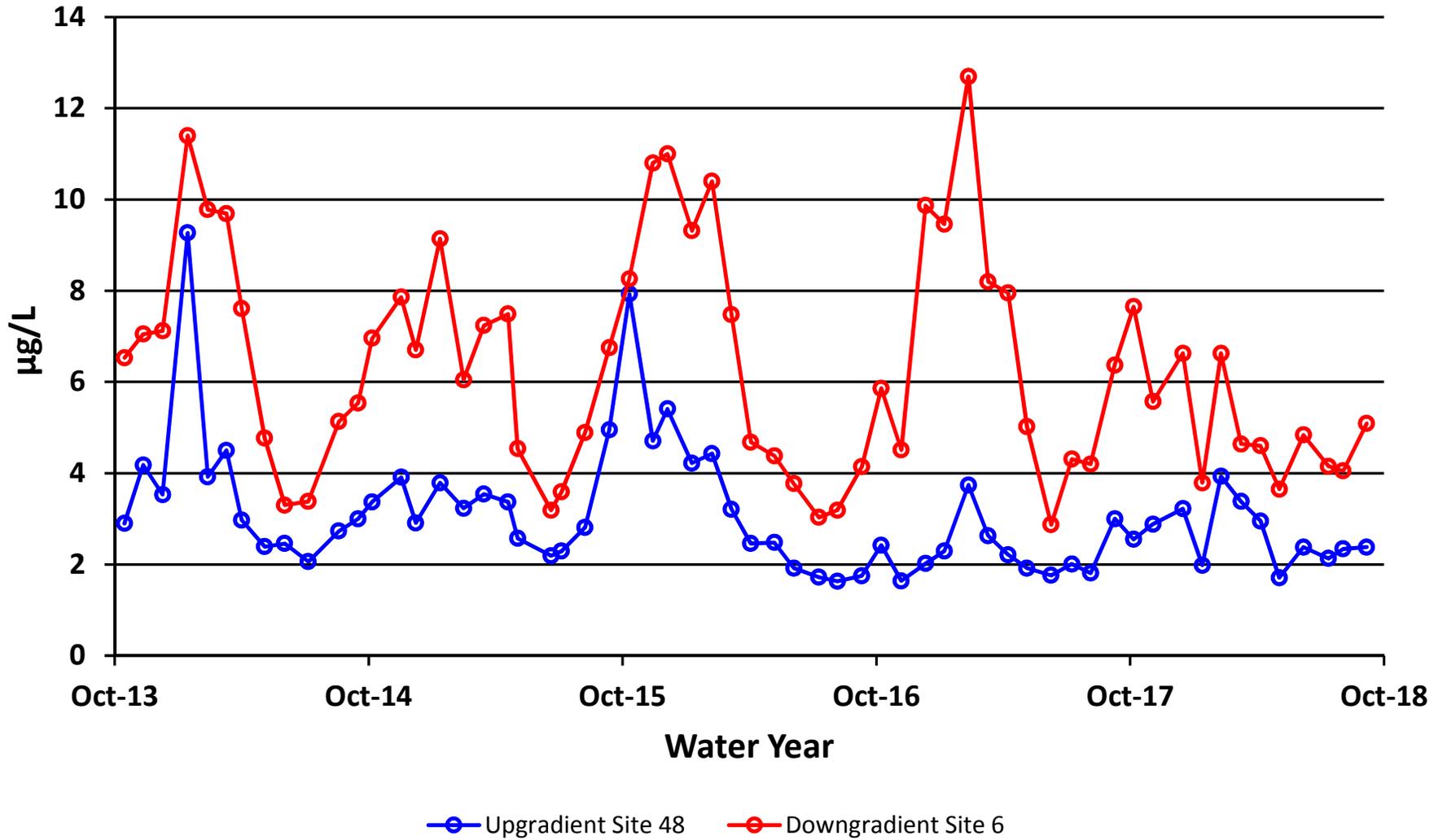
Site 48 vs. Site 6 – Alkalinity



Site 48 vs. Site 6 – Sulfate



Site 48 vs. Site 6 - Zinc



Wilcoxon-signed-ranks test

Exact Form

Variable: **Specific Conductance, Field ($\mu\text{S}/\text{cm}$)**

X Y

Site	#48	#6	Differences		
Year	WY2018	WY2018	D	 D 	Rank
Oct	101.20	105.60	-4.40	4.40	-7
Nov	118.00	134.00	-16.00	16.00	-12
Dec	118.30	129.10	-10.80	10.80	-11
Jan	76.10	79.70	-3.60	3.60	-4
Feb	166.50	172.30	-5.80	5.80	-9
Mar	130.60	120.60	10.00	10.00	10
Apr	118.80	120.30	-1.50	1.50	-1
May	85.60	90.00	-4.40	4.40	-8
Jun	95.43	99.19	-3.76	3.76	-5
Jul	110.30	113.00	-2.70	2.70	-3
Aug	152.80	155.10	-2.30	2.30	-2
Sep	159.00	162.90	-3.90	3.90	-6
Median	118.15	120.45	-3.83	4.15	

n	m
12	12

N= 12
 $\Sigma R = -58$

α
0.05
$W'_{\alpha,n}$
17

$W^+_{=}$
10
p-test
0.010

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

Wilcoxon-signed-ranks test

Exact Form

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

X Y

Site	#48	#6	Differences		
Year	WY2018	WY2018	D	 D 	Rank
Oct	7.77	7.77	0.00		
Nov	7.68	7.86	-0.18	0.18	-10
Dec	7.81	7.85	-0.04	0.04	-5
Jan	7.63	7.68	-0.05	0.05	-6.5
Feb	7.66	7.89	-0.23	0.23	-11
Mar	7.69	7.74	-0.05	0.05	-6.5
Apr	7.69	7.75	-0.06	0.06	-8
May	7.52	7.53	-0.01	0.01	-2
Jun	7.66	7.68	-0.02	0.02	-3
Jul	7.69	7.70	-0.01	0.01	-1
Aug	7.72	7.80	-0.08	0.08	-9
Sep	7.89	7.91	-0.02	0.02	-4
Median	7.69	7.76	-0.05	0.05	

n	m
12	11

N= 11
ΣR= -66

α
0.05
$W'_{\alpha,n}$
13

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

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

Wilcoxon-signed-ranks test

Exact Form

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

X Y

Site	#48	#6	Differences		
Year	WY2018	WY2018	D	 D 	Rank
Oct	44.00	44.70	-0.70	0.70	-7.5
Nov	50.60	52.00	-1.40	1.40	-11
Dec	48.40	48.20	0.20	0.20	1
Jan	30.50	31.00	-0.50	0.50	-5
Feb	56.00	56.70	-0.70	0.70	-7.5
Mar	43.80	45.10	-1.30	1.30	-10
Apr	44.00	43.70	0.30	0.30	3
May	33.10	35.00	-1.90	1.90	-12
Jun	38.10	37.80	0.30	0.30	4
Jul	36.80	37.60	-0.80	0.80	-9
Aug	53.70	53.90	-0.20	0.20	-2
Sep	57.70	58.30	-0.60	0.60	-6
Median	44.00	44.90	-0.65	0.65	

n	m
12	12

N= 12
ΣR= -62

α
0.05
$W'_{\alpha,n}$
17

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

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

Wilcoxon-signed-ranks test

Exact Form

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

X Y

Site	#48	#6	Differences		
Year	WY2018	WY2018	D	 D 	Rank
Oct	9.9	11.0	-1.1	1.1	-5.5
Nov	10.6	15.4	-4.8	4.8	-12
Dec	12.8	13.8	-1.0	1.0	-4
Jan	9.1	7.0	2.1	2.1	11
Feb	17.5	19.2	-1.7	1.7	-10
Mar	15.1	16.5	-1.4	1.4	-7.5
Apr	13.0	14.5	-1.5	1.5	-9
May	7.8	8.6	-0.8	0.8	-3
Jun	9.7	10.0	-0.3	0.3	-1
Jul	10.7	11.8	-1.1	1.1	-5.5
Aug	14.4	14.9	-0.5	0.5	-2
Sep	17.2	18.6	-1.4	1.4	-7.5
Median	11.8	14.2	-1.1	1.3	

n	m
12	12

N= 12
ΣR= -56

α
0.05
$W'_{\alpha,n}$
17

$W^+_{=}$
11
p-test
0.013

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

Wilcoxon-signed-ranks test

Exact Form

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

X Y

Site	#48	#6	Differences		
Year	WY2018	WY2018	D	 D 	Rank
Oct	2.55	7.65	-5.10	5.10	-12
Nov	2.88	5.57	-2.69	2.69	-8
Dec	3.22	6.63	-3.41	3.41	-11
Jan	1.98	3.79	-1.81	1.81	-4
Feb	3.93	6.63	-2.70	2.70	-9
Mar	3.38	4.64	-1.26	1.26	-1
Apr	2.95	4.60	-1.65	1.65	-2
May	1.71	3.65	-1.94	1.94	-5
Jun	2.38	4.84	-2.46	2.46	-7
Jul	2.13	4.15	-2.02	2.02	-6
Aug	2.34	4.05	-1.71	1.71	-3
Sep	2.38	5.09	-2.71	2.71	-10
Median	2.47	4.74	-2.24	2.24	

n	m
12	12

N= 12
ΣR= -78

α
0.05
$W'_{\alpha,n}$
17

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

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

INTERPRETIVE REPORT

SITE 54

The data collected during the current water year are listed in the following “Table of Results for Water Year 2018” 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 one-half of the 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 data points were flagged as outliers after review by HGCMC.

Sample Date	Parameter	Value	Qualifier	Notes
No outliers, in the past six years, have been identified by HGCMC.				

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

Table of Exceedance for Water Year 2018

Sample Date	Parameter	Value	Limits		Hardness
			Lower	Upper	
No exceedances have been identified by HGCMC for the period of October 2017 through September 2018.					

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 obvious trends.

A non-parametric statistical analysis for trend was performed for specific conductivity, field pH, total alkalinity, total sulfate, and dissolved zinc. Calculation details of the Seasonal Kendall analyses are presented in detail on the pages following this interpretive section. The following table summarizes the results on the data collected between Oct-12 and Sep-18 (WY2013-WY2018).

Site 54 - Table of Summary Statistics for Trend Analysis

Parameter	Mann-Kendall test statistics			Sen's slope estimate	
	n*	p**	Trend	Q	Q(%)
Conductivity Field	6	0.13			
pH Field	6	0.57			
Alkalinity, Total	6	0.61			
Sulfate, Total	6	0.03			
Zinc, Dissolved	6	0.14			

* 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. There were no statistically significant trends identified at Site 54 during the reporting period.

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 2018 dataset.

Table of Summary Statistics for Median Analysis

Site 54 vs Site 6				
Parameter	Signed Ranks	Site 6	Site 54	Median
	p-value	median	median	Differences
Conductivity Field	0.013	120.45	127.40	-1.90
pH Field	<0.01	7.76	7.71	0.03
Alkalinity, Total	0.013	44.90	46.25	-0.80
Sulfate, Total	0.019	14.20	14.30	-0.10
Zinc, Dissolved	<0.01	4.74	4.52	0.20

Unlike the previous year, there was a significant difference in field pH observed in the current year. It was not accompanied by a statistically significant decreasing trend at Site 54 or decreasing trend at Site 6.

There was also a significant difference in sulfate and field conductivity observed in the current year. HGCMC feels the current FWMP program is adequate to measure and quantify future changes that may occur between Site 6 and Site 54, given the small magnitude of the differences and the consistency of the variations over the past several years.

Table of Results for Water Year 2018

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

Sample Date/Parameter	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018	Median
Water Temp (°C)	5.2	1.5	0.0	1.8	0.1	0.1	1.1	3.3	5.7	8.4	11.1	8.8	2.6
Conductivity-Field(µmho)	107.4	138	131.4	80.2	174.3	140.3	123.4	91.5	92.8	114.6	157.3	164	127.4
Conductivity-Lab (µmho)	100	131	114	76	129	132	112	81	91	112	155	152	113
pH Lab (standard units)	7.08	7.12	7.41	7.38	7.22	7.09	6.79	7.14	6.89	6.45	7.05	7.31	7.11
pH Field (standard units)	7.7	7.66	7.79	7.6	7.88	7.72	7.71	7.53	7.68	7.68	7.77	7.91	7.71
Total Alkalinity (mg/L)	46.6	52.8	50.4	32.3	56.1	45.9	43	35.2	37.4	38	57.1	59.1	46.3
Total Sulfate (mg/L)	11	15.2	13.9	7.9	19.5	17.1	14.7	8.6	10.1	11.9	15.1	18.6	14.3
Hardness (mg/L)	53.1	68.5	62.7	27.8	77.7	65.9	60.1	43.6	49.2	52.7	75.2	72.5	61.4
Dissolved As (ug/L)	0.209	0.184	0.193	0.196	0.152	0.167	0.164	0.172	0.19	0.217	0.233	0.215	0.192
Dissolved Ba (ug/L)			25.2		31.4								28.3
Dissolved Cd (ug/L)	0.0505	0.0449	0.0427	0.0292	0.0433	0.0397	0.0343	0.033	0.039	0.0395	0.0421	0.0393	0.0396
Dissolved Cr (ug/L)			0.09		0.029								0.060
Dissolved Cu (ug/L)	0.62	0.323	0.463	0.49	0.239	0.4	0.576	0.431	0.492	0.7	0.394	0.361	0.447
Dissolved Pb (ug/L)	0.0146	0.0062	0.008	0.0257	0.0038	0.0269	0.0173	0.0084	0.0097	0.0124	0.0194	0.0089	0.0111
Dissolved Ni (ug/L)			0.373		0.29								0.332
Dissolved Ag (ug/L)			0.002		0.002								0.002
Dissolved Zn (ug/L)	7.09	5.27	6.58	3.58	6.13	4.62	4.41	3.5	4.79	4.14	3.67	3.98	4.52
Dissolved Se (ug/L)			0.979		1.21								1.095
Dissolved Hg (ug/L)	0.00132	0.000547	0.000707	0.000979	0.000401	0.000768	0.000898	0.000951	0.00089	0.00121	0.000709	0.000531	0.000829

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

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

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

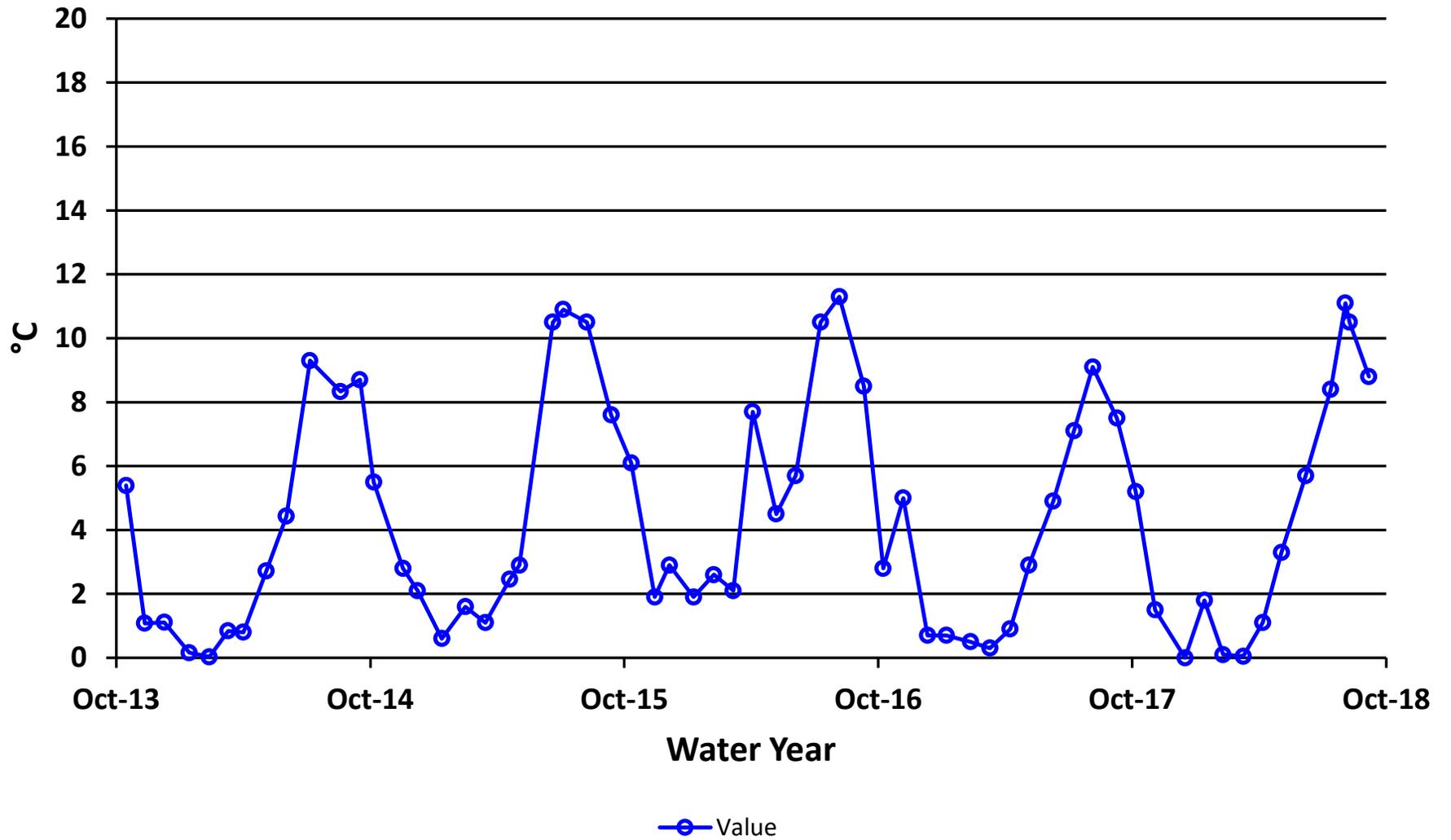
Qualified Data by QA Reviewer

Date Range: 10/01/2017 to 09/30/2018

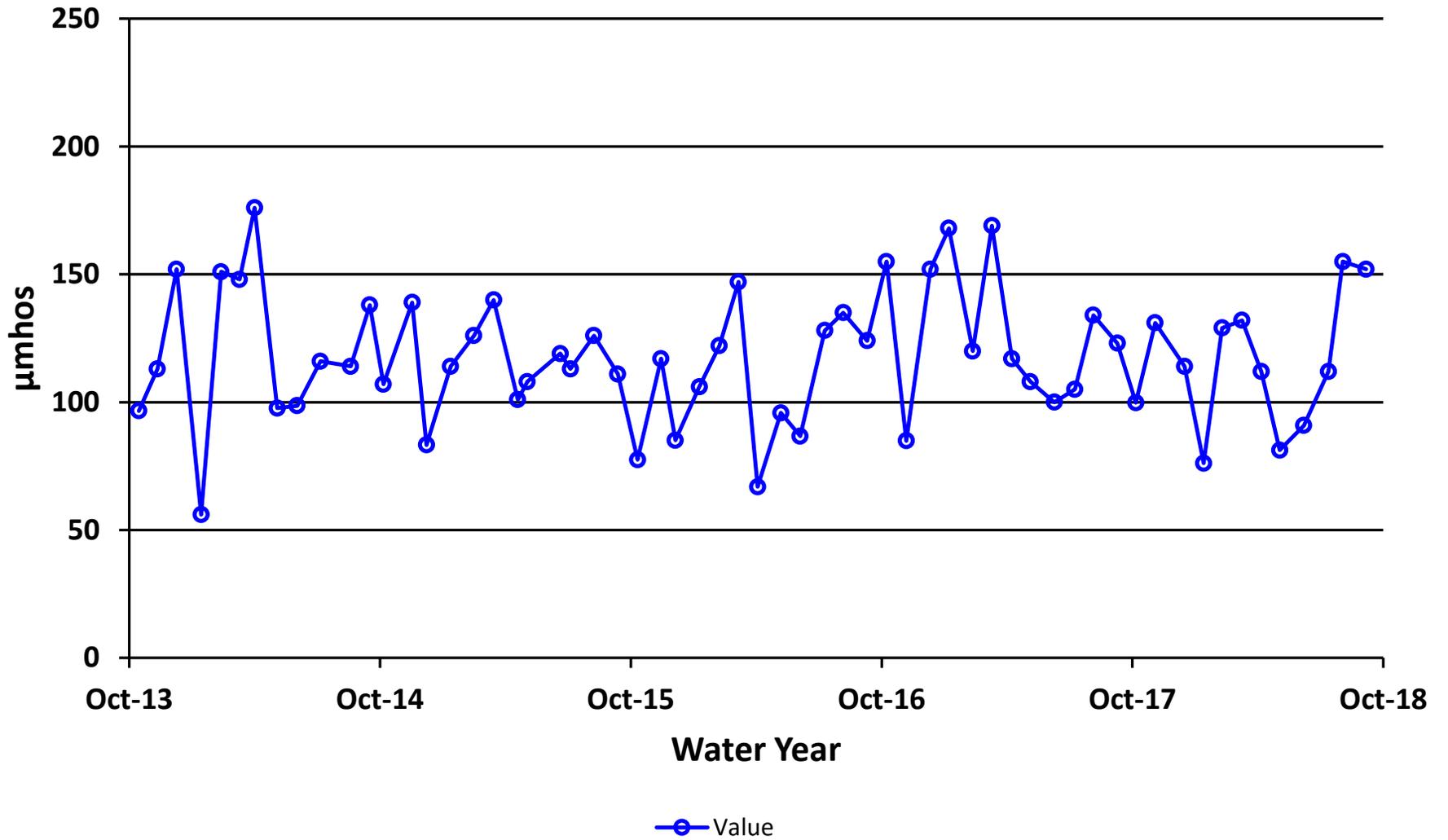
Site No.	Sample Date	Parameter	Value	Qualifier	Reason for Qualifier	
054FMS	10/9/2017	Diss. Pb-ICP/MS	0.01	µg/L	U	Field Blank Contamination
		Total Sulfate	11	mg/L	J	Hold Time Violation, Temperature Excedance
	11/6/2017	Diss. Pb-ICP/MS	0.0062	µg/L	J	Below Quantitative Range
12/19/2017		Diss. Cr-ICP/MS	0.09	µg/L	J	Below Quantitative Range
		Diss. Pb-ICP/MS	0.0080	µg/L	U	Field Blank Contamination
2/12/2018		Diss. Pb-ICP/MS	0.0038	µg/L	J	Below Quantitative Range
		pH	7.22	pH units	J	Hold Time Violation
3/13/2018		pH	7.09	pH units	J	Hold Time Violation
4/10/2018		pH	6.79	pH units	J	Hold Time Violation
		Total Sulfate	14.7	mg/L	J	Sample Receipt Temperature
5/7/2018		Diss. Pb-ICP/MS	0.0084	µg/L	J	Below Quantitative Range
		pH	7.14	pH units	J	Hold Time Violation
6/11/2018		Total Sulfate	10.1	mg/L	J	Hold Time Violation, Temperature Excedance
7/17/2018		pH	6.45	pH units	J	Hold time Violation
		Total Sulfate	11.9	mg/L	J	Sample Reciept Temperature
8/7/2018		Diss. Zn-ICP/MS	3.67	µg/L	U	Field Blank Contamination
		pH	7.05	pH units	J	Hold Time Violation
9/10/2018		Diss. Pb-ICP/MS	0.0089	µg/L	J	Below Quantitative Range
		Diss. Zn-ICP/MS	3.98	µg/L	U	Field Blank Contamination
		pH	7.31	pH units	J	Hold Time Violation
		Total Sulfate	18.6	mg/L	J	Sample Receipt Temperature

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

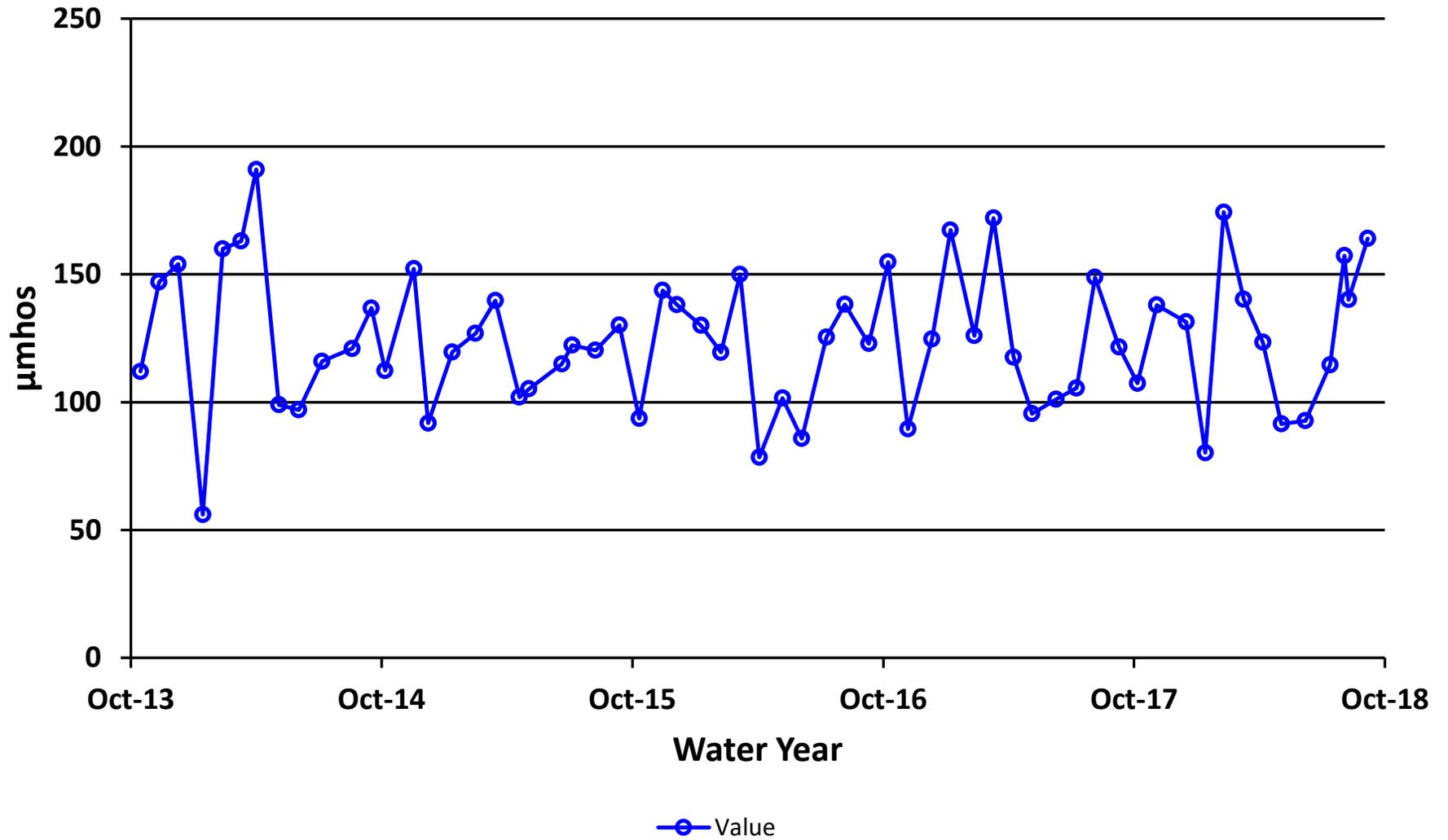
Site 54 - Water Temperature



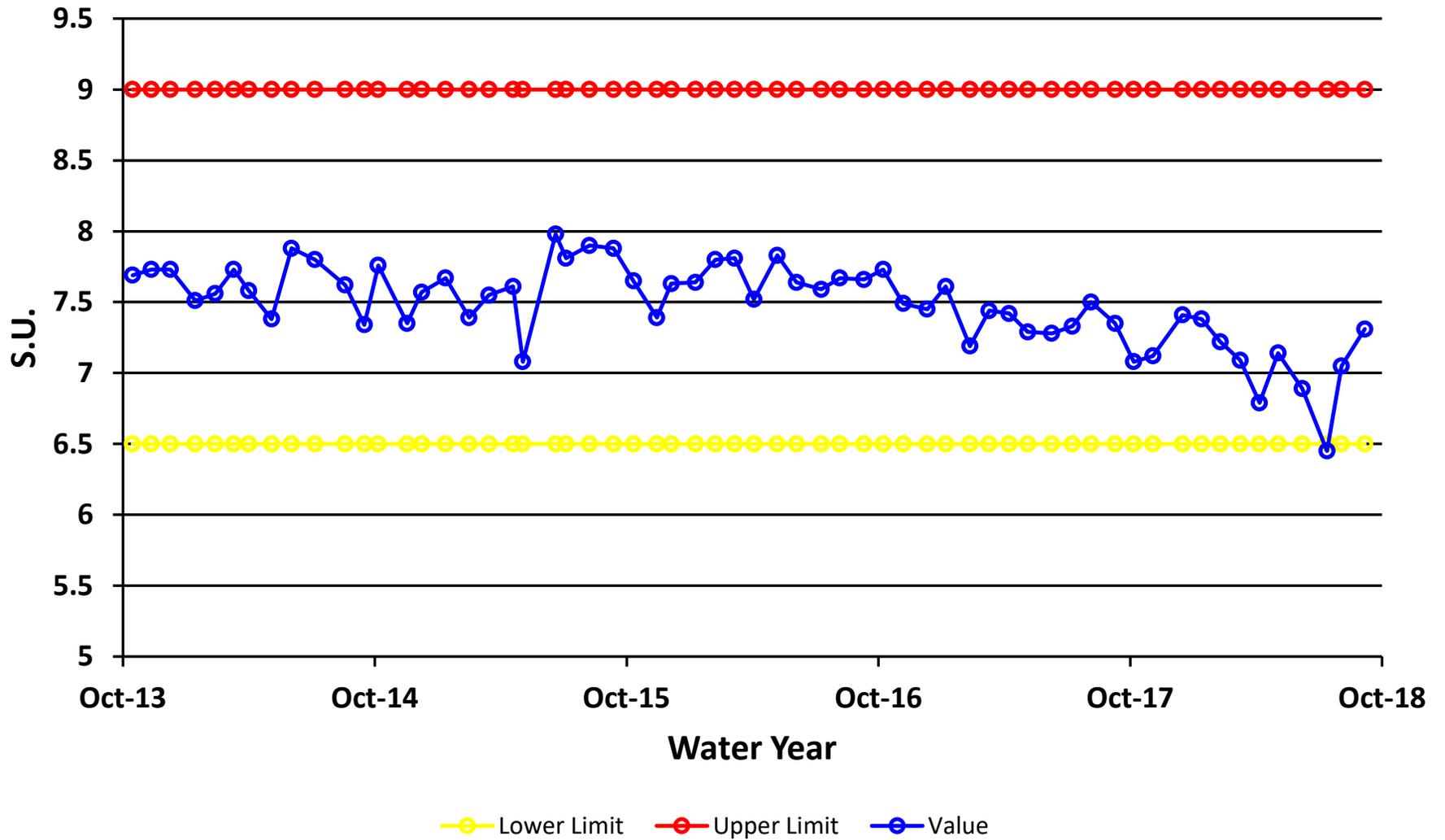
Site 54 - Conductivity Laboratory



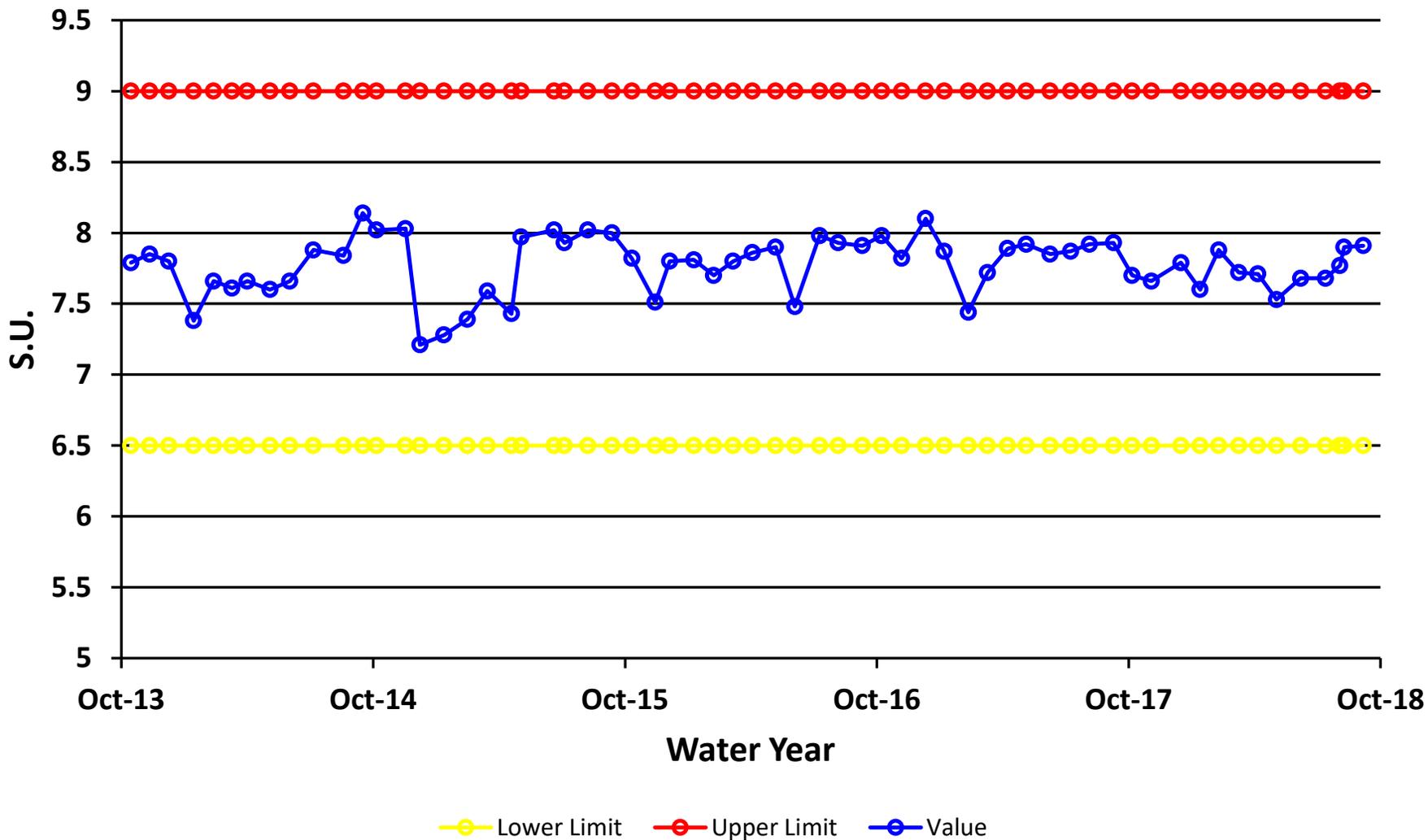
Site 54 - Conductivity Field



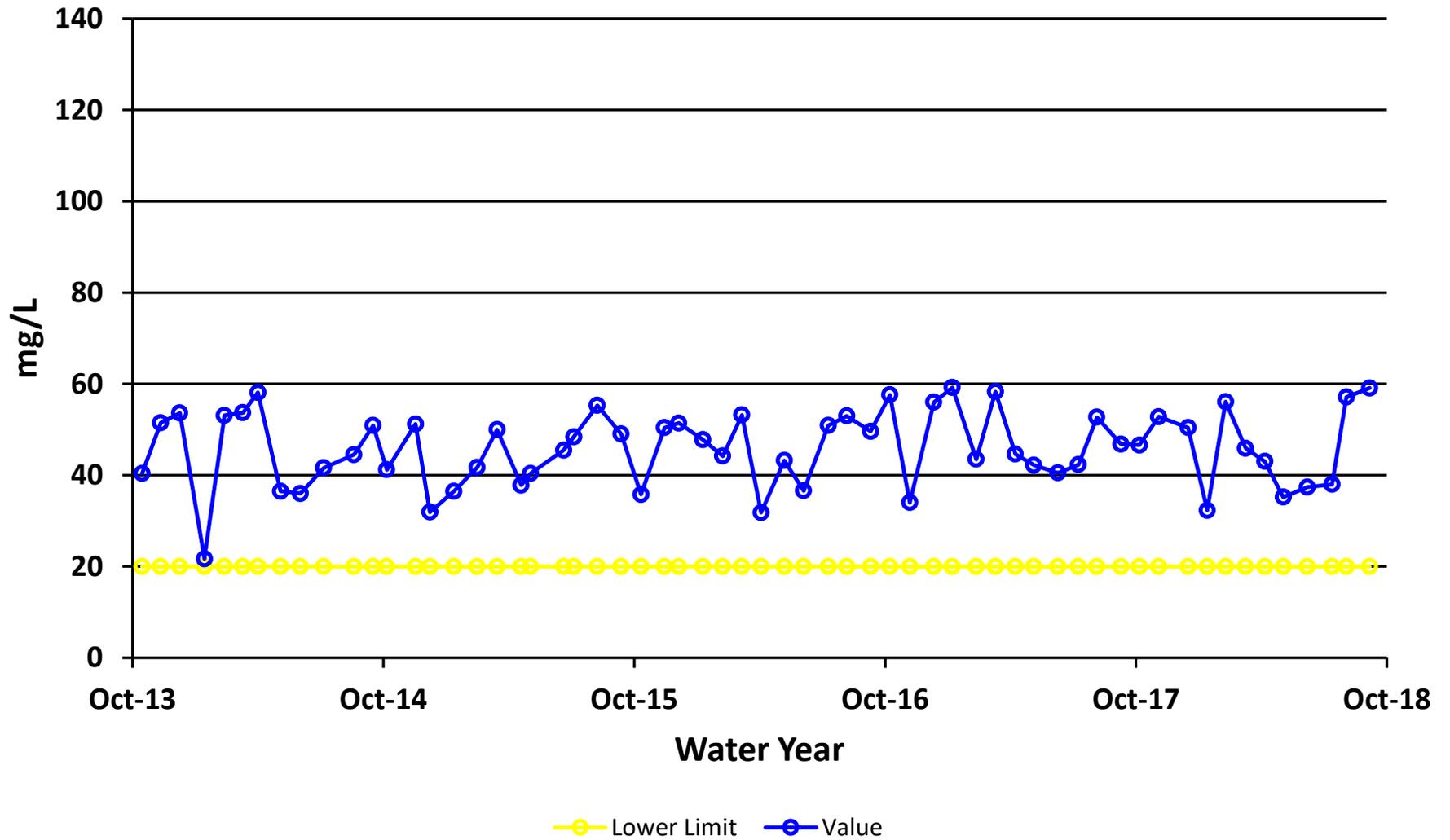
Site 54 - pH Laboratory



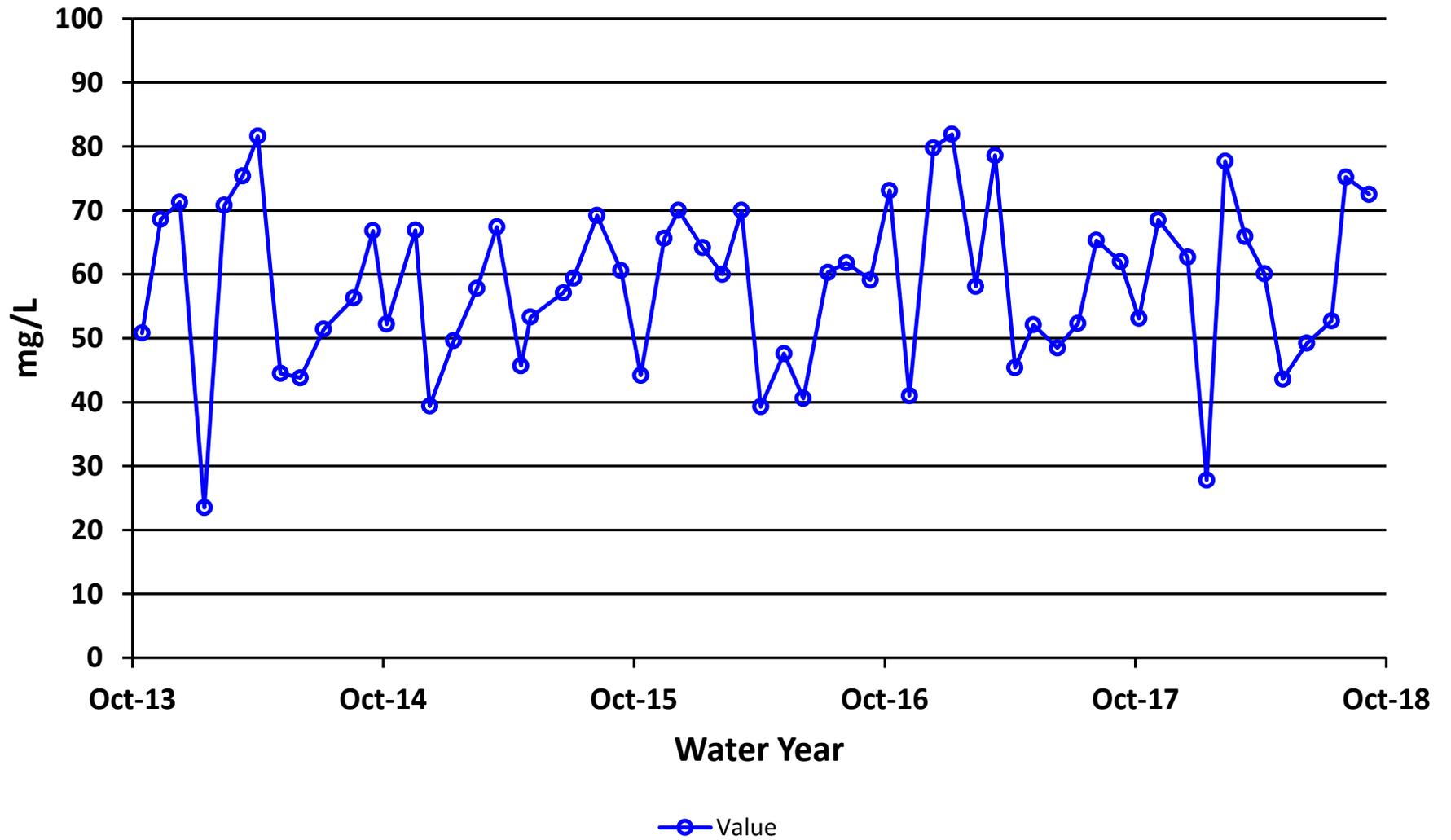
Site 54 - pH Field



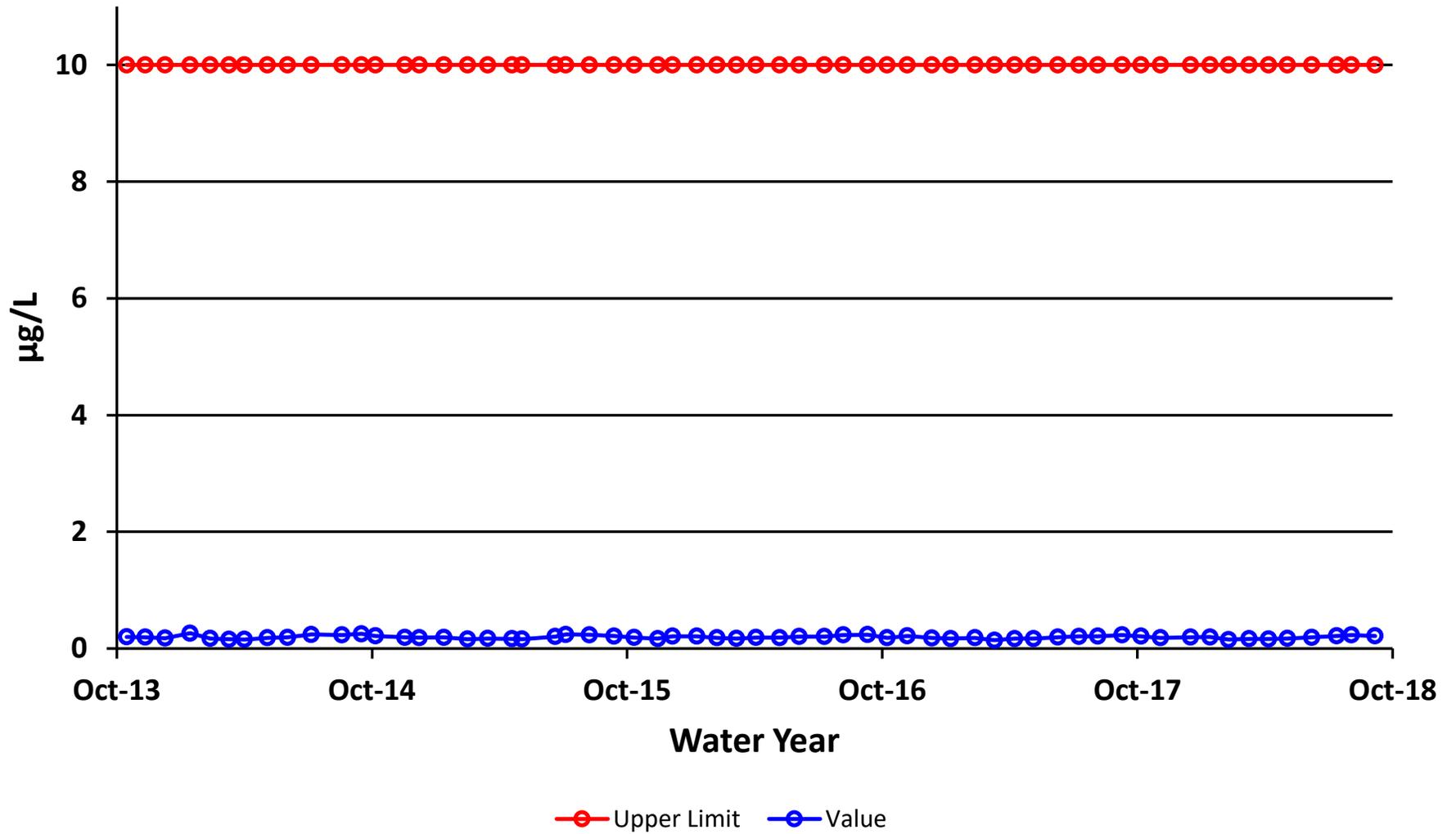
Site 54 - Alkalinity



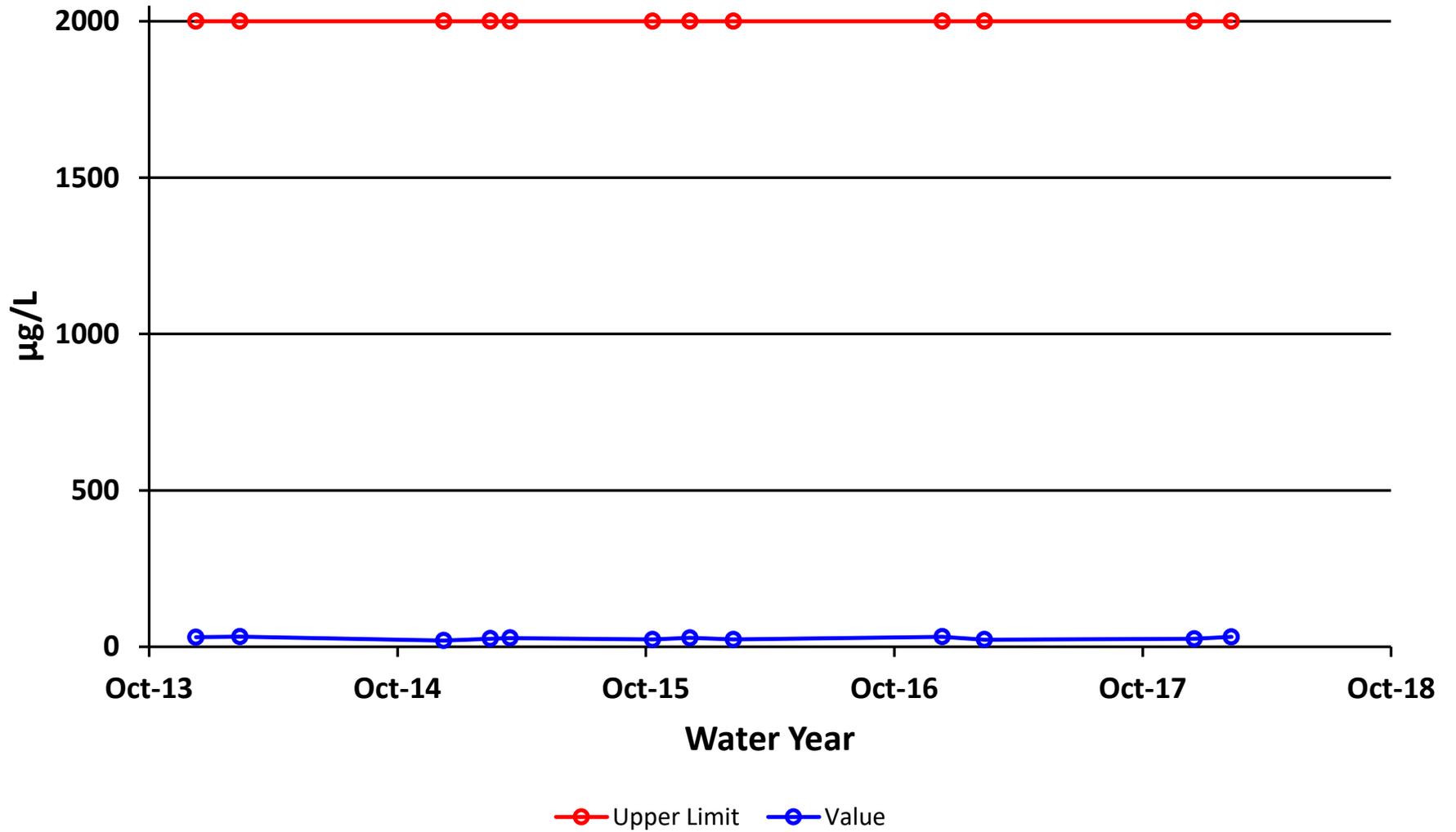
Site 54 - Hardness



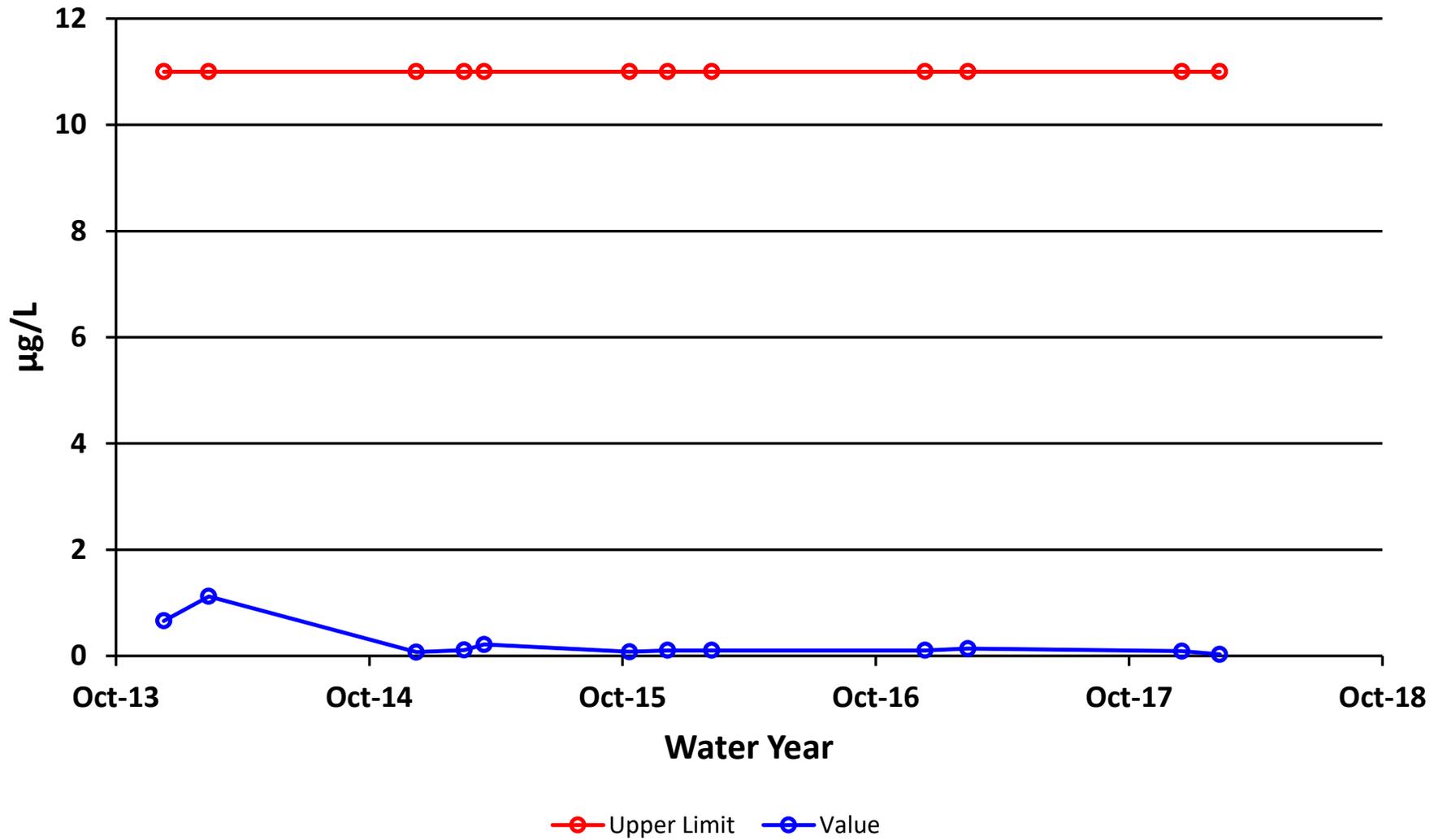
Site 54 - Arsenic Dissolved



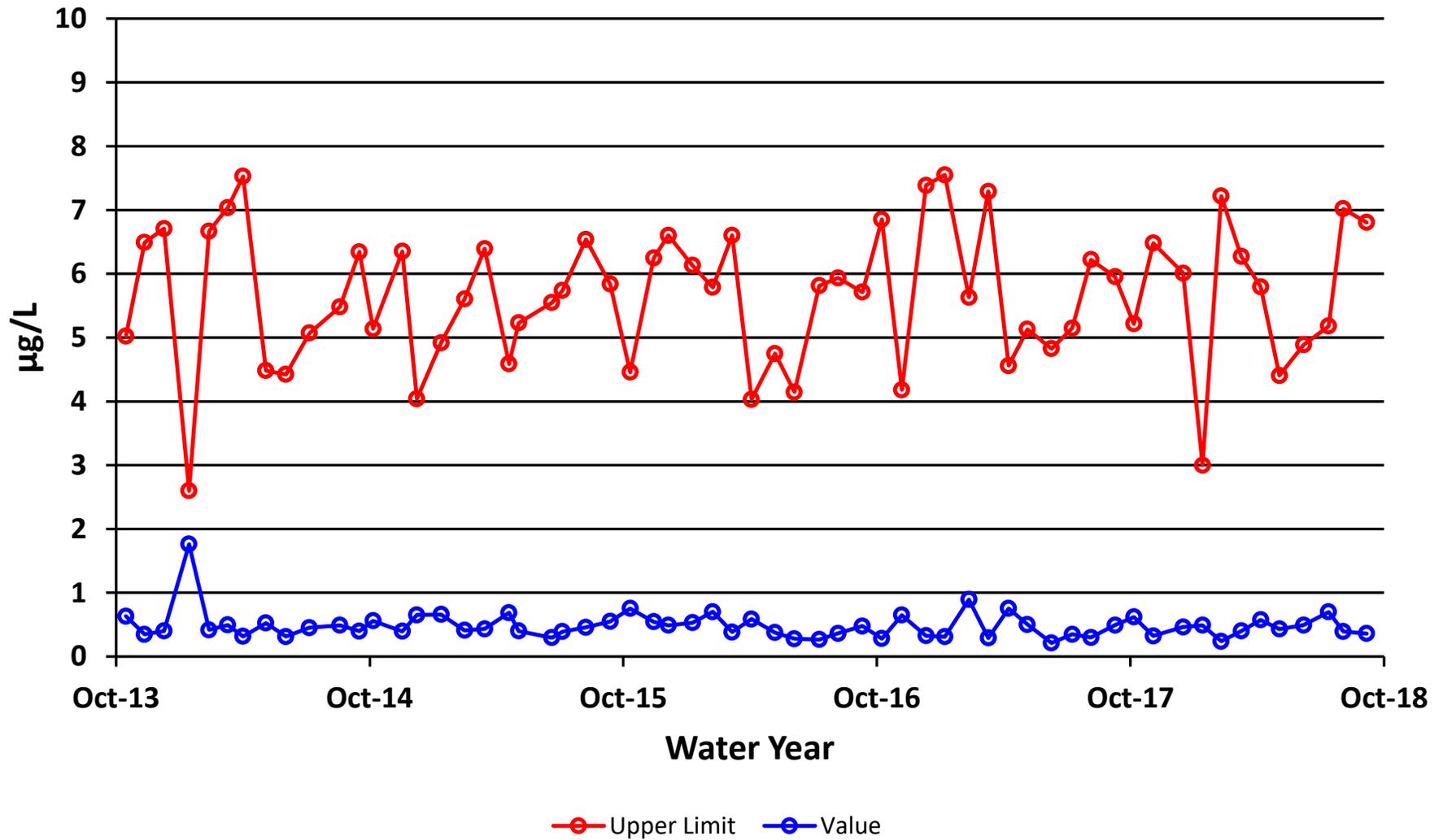
Site 54 - Barium Dissolved



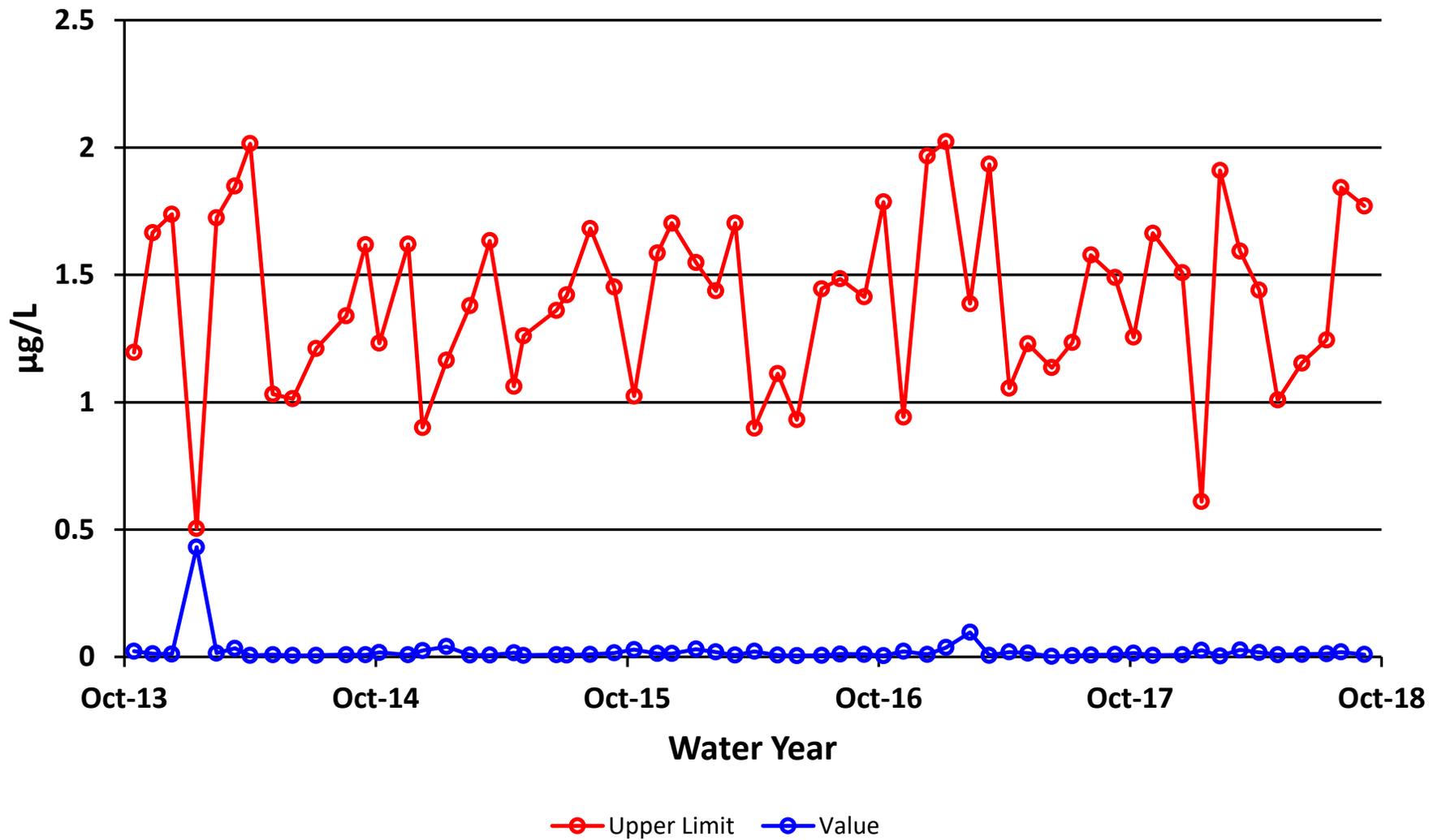
Site 54 - Chromium Dissolved



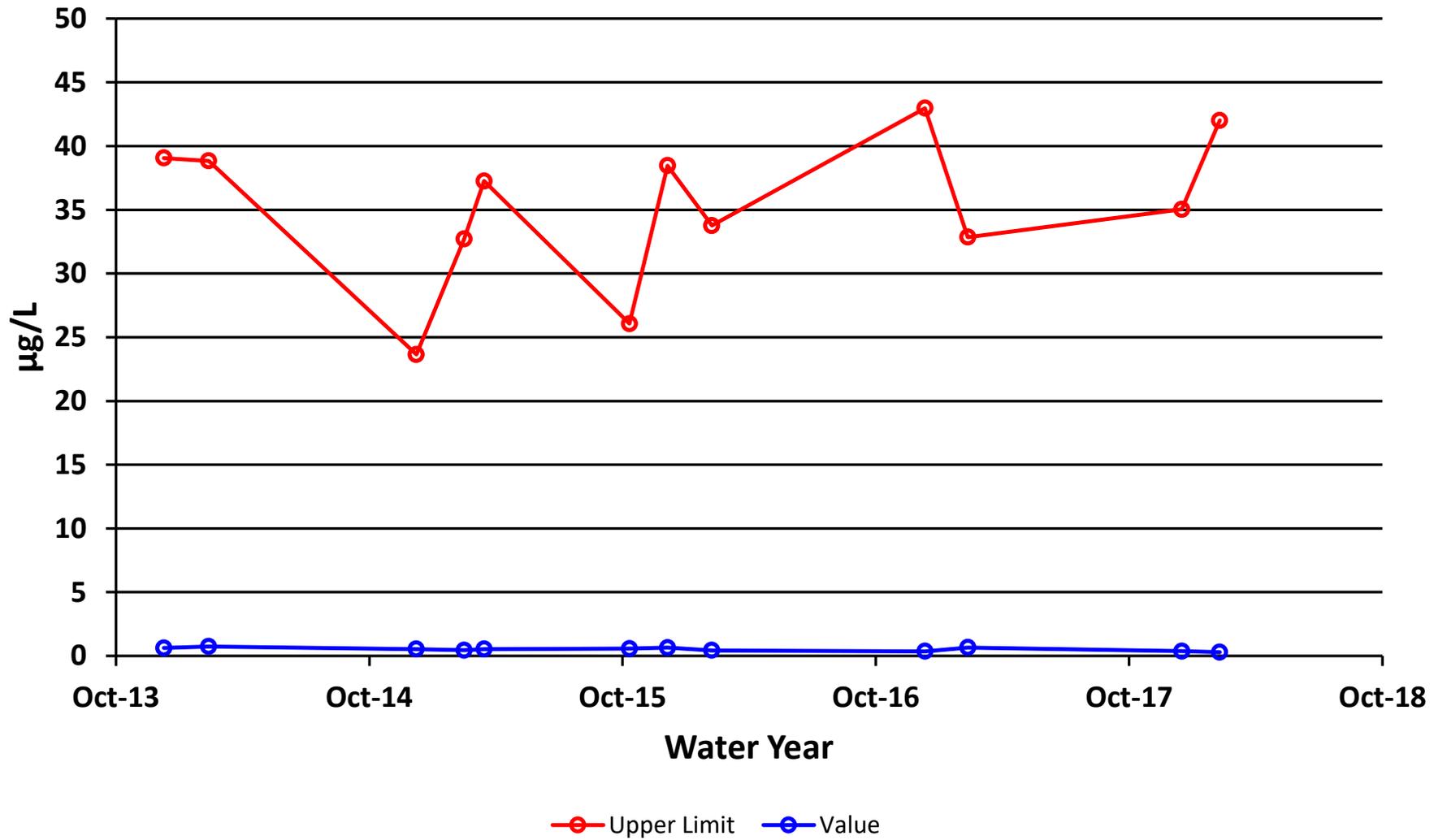
Site 54 - Copper Dissolved



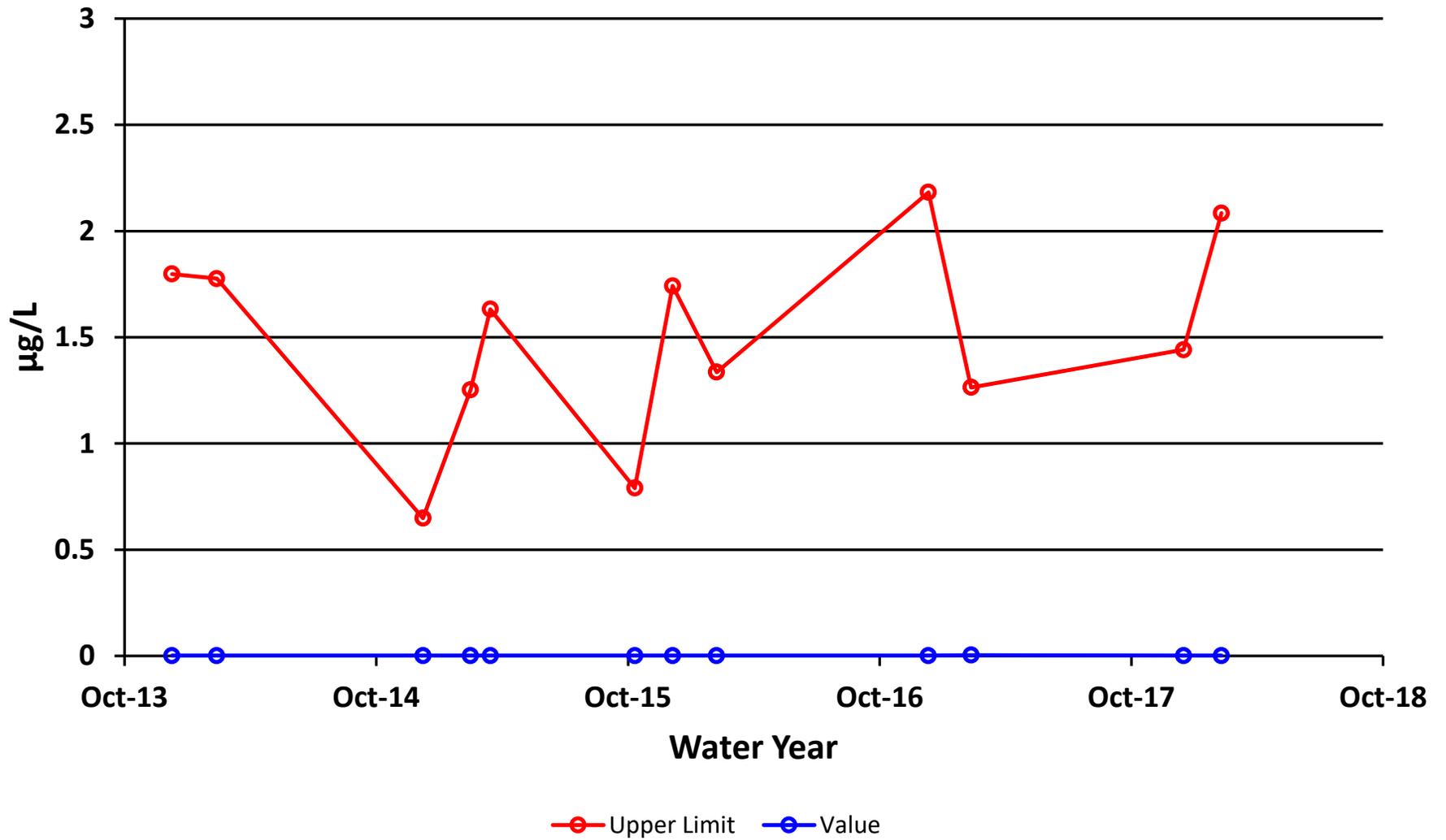
Site 54 - Lead Dissolved



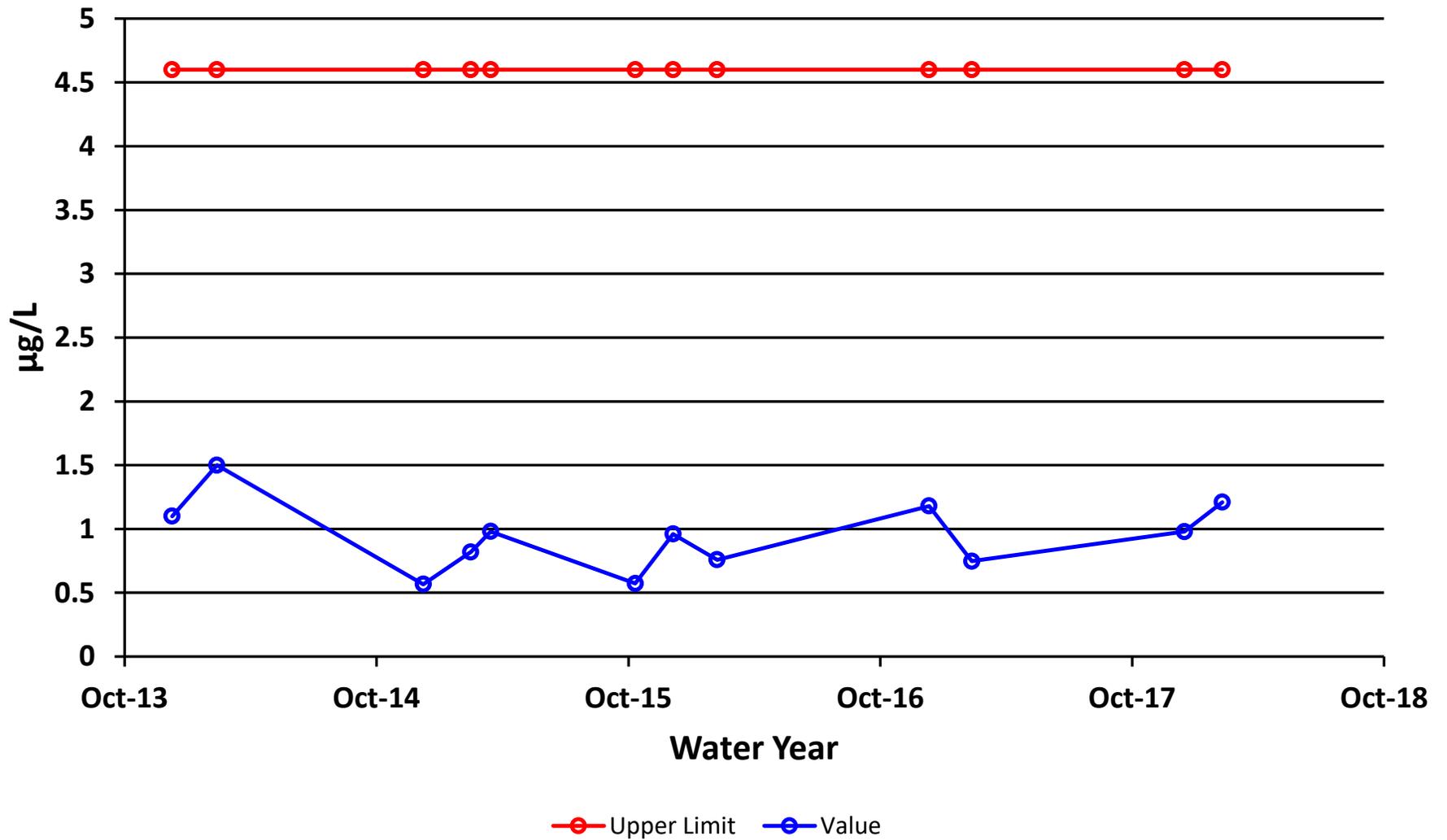
Site 54 - Nickel Dissolved



Site 54 - Silver Dissolved



Site 54 - Selenium Dissolved



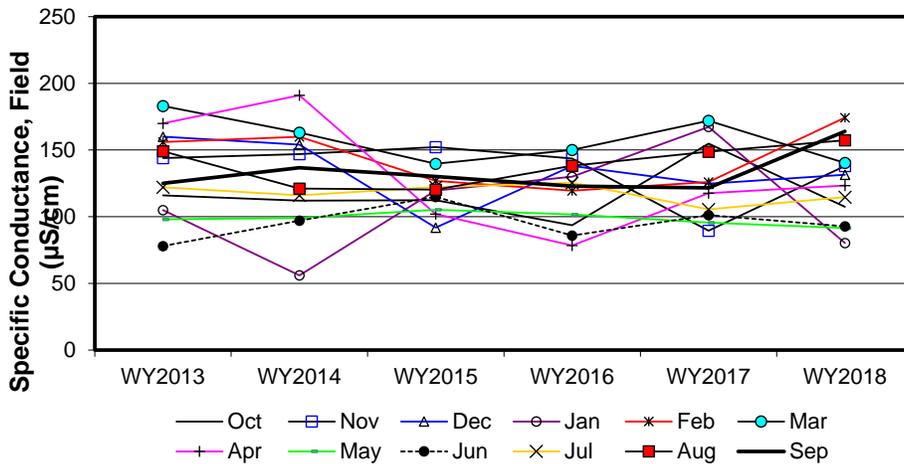
Site #54

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	WY2013	116.0	144.0	160.0	105.0	156.0	183.0	170.0	98.0	78.0	122.0	149.0	125.0
b	WY2014	112.0	147.0	154.0	56.0	160.0	163.0	191.0	99.0	97.0	116.0	121.0	136.8
c	WY2015	112.4	152.2	91.8	119.6	126.9	139.7	102.0	105.2	114.9	122.3	120.3	130.1
d	WY2016	93.6	143.7	138.1	130.0	119.5	150.0	78.4	101.6	85.8	125.4	138.2	122.9
e	WY2017	154.8	89.5	124.7	167.3	126.0	172.0	117.6	95.5	101.1	105.5	148.8	121.6
f	WY2018	107.4	138.0	131.4	80.2	174.3	140.3	123.4	91.5	92.8	114.6	157.3	164.0
n		6	6	6	6	6	6	6	6	6	6	6	6
t ₁		6	6	6	6	6	6	6	6	6	6	6	6
t ₂		0	0	0	0	0	0	0	0	0	0	0	0
t ₃		0	0	0	0	0	0	0	0	0	0	0	0
t ₄		0	0	0	0	0	0	0	0	0	0	0	0
t ₅		0	0	0	0	0	0	0	0	0	0	0	0
b-a		-1	1	-1	-1	1	-1	1	1	1	-1	-1	1
c-a		-1	1	-1	1	-1	-1	-1	1	1	1	-1	1
d-a		-1	-1	-1	1	-1	-1	-1	1	1	1	-1	-1
e-a		1	-1	-1	1	-1	-1	-1	-1	1	-1	-1	-1
f-a		-1	-1	-1	-1	1	-1	-1	-1	1	-1	1	1
c-b		1	1	-1	1	-1	-1	-1	1	1	1	-1	-1
d-b		-1	-1	-1	1	-1	-1	-1	1	-1	1	1	-1
e-b		1	-1	-1	1	-1	1	-1	-1	1	-1	1	-1
f-b		-1	-1	-1	1	1	-1	-1	-1	-1	-1	1	1
d-c		-1	-1	1	1	-1	1	-1	-1	-1	1	1	-1
e-c		1	-1	1	1	-1	1	1	-1	-1	-1	1	-1
f-c		-1	-1	1	-1	1	1	1	-1	-1	-1	1	1
e-d		1	-1	-1	1	1	1	1	-1	1	-1	1	-1
f-d		1	-1	-1	-1	1	-1	1	-1	1	-1	1	1
f-e		-1	1	1	-1	1	-1	1	-1	-1	1	1	1
S _k		-3	-7	-7	5	-1	-5	-3	-5	3	-3	5	-1
σ _S ² =		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 /σ _S		-0.56	-1.32	-1.32	0.94	-0.19	-0.94	-0.56	-0.94	0.56	-0.56	0.94	-0.19
Z _k ²		0.32	1.73	1.73	0.88	0.04	0.88	0.32	0.88	0.32	0.32	0.88	0.04

ΣZ _k =	-4.13	Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅	Σn	72
ΣZ _k ² =	8.33	Count	72	0	0	0	0	ΣS _k	-22
Z-bar=ΣZ _k /K=	-0.34								

χ _n ² =ΣZ _k ² -K(Z-bar) ² =	6.91	@α=5% χ _(K-1) ² =	19.68	Test for station homogeneity
p	0.807			χ _n ² <χ _(K-1) ² ACCEPT
ΣVAR(S _k)	Z _{calc} -1.14	@α/2=2.5% Z=	1.96	H ₀ (No trend) ACCEPT
340.00	p 0.127			H _A (± trend) REJECT



α	Lower Limit	Sen's Slope	Upper Limit
0.010	-4.64	-1.18	2.57
0.050	-3.60		1.02
0.100	-2.83		0.11
0.200	-1.86		-0.49

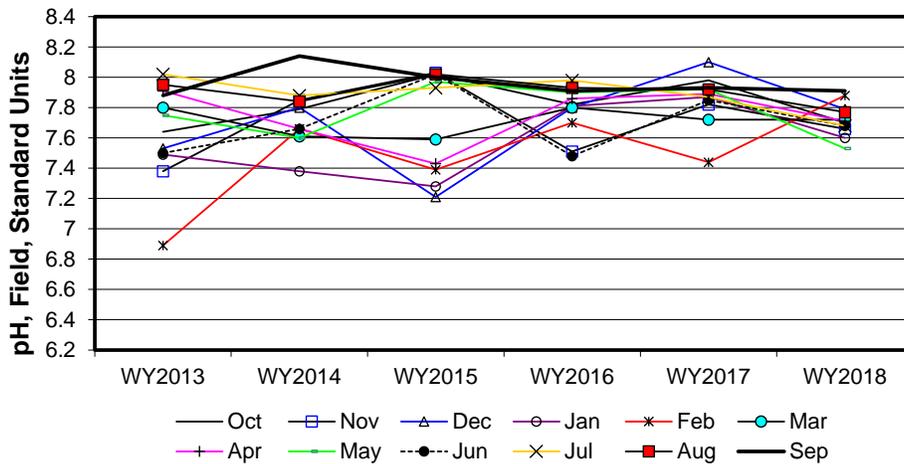
Site #54

Seasonal Kendall analysis for pH, Field, Standard Units

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	WY2013	7.6	7.4	7.5	7.5	6.9	7.8	7.9	7.8	7.5	8.0	8.0	7.9
b	WY2014	7.8	7.9	7.8	7.4	7.7	7.6	7.7	7.6	7.7	7.9	7.8	8.1
c	WY2015	8.0	8.0	7.2	7.3	7.4	7.6	7.4	8.0	8.0	7.9	8.0	8.0
d	WY2016	7.8	7.5	7.8	7.8	7.7	7.8	7.9	7.9	7.5	8.0	7.9	7.9
e	WY2017	8.0	7.8	8.1	7.9	7.4	7.7	7.9	7.9	7.9	7.9	7.9	7.9
f	WY2018	7.7	7.7	7.8	7.6	7.9	7.7	7.7	7.5	7.7	7.7	7.8	7.9
n		6	6	6	6	6	6	6	6	6	6	6	6
t ₁		6	6	4	6	6	2	6	6	6	6	6	4
t ₂		0	0	1	0	0	2	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	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	0	-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	0	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	0
f-e		-1	-1	-1	-1	1	0	-1	-1	-1	-1	-1	-1
S _k		3	1	4	5	9	-1	-1	-1	3	-9	-7	-2
σ _S ² =		28.33	28.33	27.33	28.33	28.33	26.33	28.33	28.33	28.33	28.33	28.33	27.33
Z _k = S _k /σ _S		0.56	0.19	0.77	0.94	1.69	-0.19	-0.19	-0.19	0.56	-1.69	-1.32	-0.38
Z _k ²		0.32	0.04	0.59	0.88	2.86	0.04	0.04	0.04	0.32	2.86	1.73	0.15

ΣZ _k =	0.75	Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅	Σn	72
ΣZ _k ² =	9.84	Count	64	4	0	0	0	ΣS _k	4
Z-bar=ΣZ _k /K=	0.06								

$\chi^2_{h} = \sum Z_k^2 - K(Z\text{-bar})^2 =$	9.79	@α=5% $\chi^2_{(K-1)} =$	19.68	Test for station homogeneity
p	0.549			$\chi^2_h < \chi^2_{(K-1)}$ ACCEPT
ΣVAR(S _k)	Z _{calc} 0.16	@α/2=2.5% Z=	1.96	H ₀ (No trend) ACCEPT
336.00	p 0.565			H _A (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals			
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.02		0.04
0.050	-0.02		0.03
0.100	-0.01	0.00	0.02
0.200	-0.01		0.02

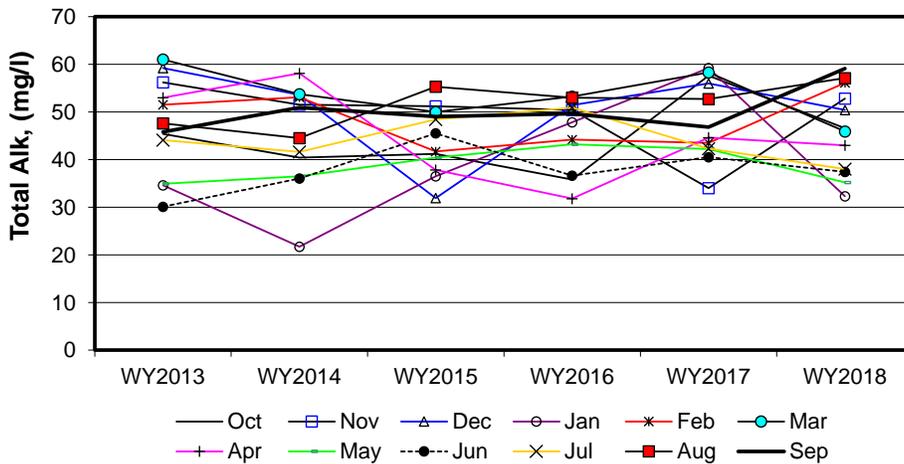
Site #54

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	WY2013	45.4	56.2	59.2	34.6	51.5	61.0	53.0	34.9	30.1	44.1	47.6	45.8
b	WY2014	40.4	51.5	53.6	21.7	53.1	53.7	58.1	36.5	36.0	41.6	44.5	50.9
c	WY2015	41.2	51.2	31.9	36.5	41.7	50.0	37.8	40.4	45.5	48.4	55.3	49.0
d	WY2016	35.8	50.4	51.4	47.8	44.2	53.2	31.8	43.2	36.6	50.9	53.0	49.6
e	WY2017	57.6	34.0	56.0	59.2	43.5	58.3	44.6	42.2	40.5	42.3	52.7	46.8
f	WY2018	46.6	52.8	50.4	32.3	56.1	45.9	43.0	35.2	37.4	38.0	57.1	59.1
n		6	6	6	6	6	6	6	6	6	6	6	6
t ₁		6	6	6	6	6	6	6	6	6	6	6	6
t ₂		0	0	0	0	0	0	0	0	0	0	0	0
t ₃		0	0	0	0	0	0	0	0	0	0	0	0
t ₄		0	0	0	0	0	0	0	0	0	0	0	0
t ₅		0	0	0	0	0	0	0	0	0	0	0	0
b-a		-1	-1	-1	-1	1	-1	1	1	1	-1	-1	1
c-a		-1	-1	-1	1	-1	-1	-1	1	1	1	1	1
d-a		-1	-1	-1	1	-1	-1	-1	1	1	1	1	1
e-a		1	-1	-1	1	-1	-1	-1	1	1	-1	1	1
f-a		1	-1	-1	-1	1	-1	-1	1	1	-1	1	1
c-b		1	-1	-1	1	-1	-1	-1	1	1	1	1	-1
d-b		-1	-1	-1	1	-1	-1	-1	1	1	1	1	-1
e-b		1	-1	1	1	-1	1	-1	1	1	1	1	-1
f-b		1	1	-1	1	1	-1	-1	-1	1	-1	1	1
d-c		-1	-1	1	1	1	1	-1	1	-1	1	-1	1
e-c		1	-1	1	1	1	1	1	1	-1	-1	-1	-1
f-c		1	1	1	-1	1	-1	1	-1	-1	-1	1	1
e-d		1	-1	1	1	-1	1	1	-1	1	-1	-1	-1
f-d		1	1	-1	-1	1	-1	1	-1	1	-1	1	1
f-e		-1	1	-1	-1	1	-1	-1	-1	-1	-1	1	1
S _k		3	-7	-5	5	1	-7	-5	5	7	-3	7	5
σ _S ² =		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 /σ _S		0.56	-1.32	-0.94	0.94	0.19	-1.32	-0.94	0.94	1.32	-0.56	1.32	0.94
Z _k ²		0.32	1.73	0.88	0.88	0.04	1.73	0.88	0.88	1.73	0.32	1.73	0.88

ΣZ _k =	1.13	Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅	Σn	72
ΣZ _k ² =	12.00	Count	72	0	0	0	0	ΣS _k	6
Z-bar=ΣZ _k /K=	0.09								

$\chi^2_{h,n} = \sum Z_k^2 - K(Z\text{-bar})^2 =$	11.89	@α=5% $\chi^2_{(K-1)} =$	19.68	Test for station homogeneity
p	0.372	$\chi^2_h < \chi^2_{(K-1)}$		ACCEPT
ΣVAR(S _k)	Z _{calc} 0.27	@α/2=2.5% Z=	1.96	H ₀ (No trend) ACCEPT
340.00	p 0.607			H _A (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals			
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-1.15		1.54
0.050	-0.80		0.99
0.100	-0.67	0.25	0.88
0.200	-0.46		0.60

Site #54

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

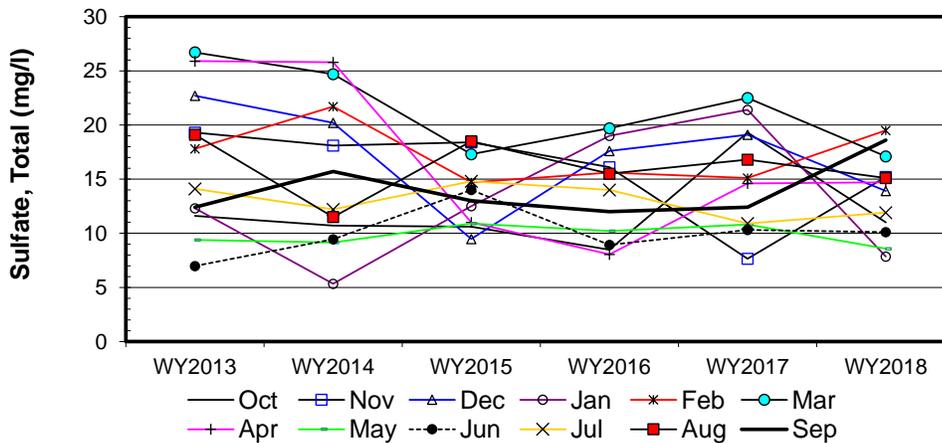
Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	WY2013	11.6	19.3	22.7	12.3	17.8	26.7	25.9	9.4	7.0	14.1	19.1	12.4
b	WY2014	10.7	18.1	20.2	5.3	21.7	24.7	25.8	9.2	9.5	12.2	11.5	15.7
c	WY2015	10.6	18.4	9.5	12.5	14.7	17.3	11.0	10.9	14.0	14.8	18.5	13.0
d	WY2016	8.5	16.1	17.6	19.0	15.6	19.7	8.1	10.2	8.9	14.0	15.5	12.0
e	WY2017	19.3	7.7	19.1	21.4	15.1	22.5	14.6	10.8	10.3	10.9	16.8	12.4
f	WY2018	11.0	15.2	13.9	7.9	19.5	17.1	14.7	8.6	10.1	11.9	15.1	18.6
n		6	6	6	6	6	6	6	6	6	6	6	6
t ₁		6	6	6	6	6	6	6	6	6	6	6	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	-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		-1	-11	-7	5	-1	-9	-5	-1	5	-7	-5	2
σ _s ² =		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 /σ _s		-0.19	-2.07	-1.32	0.94	-0.19	-1.69	-0.94	-0.19	0.94	-1.32	-0.94	0.38
Z _k ²		0.04	4.27	1.73	0.88	0.04	2.86	0.88	0.04	0.88	1.73	0.88	0.15

ΣZ_k= -6.57
 ΣZ_k²= 14.37
 Z-bar=ΣZ_k/K= -0.55

Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅
Count	70	1	0	0	0

Σn = 72
 ΣS_k = -35

χ _n ² =ΣZ _k ² -K(Z-bar) ² =	10.77	@α=5% χ _(K-1) ² =	19.68	Test for station homogeneity
p	0.462	χ _h ² <χ _(K-1) ²	ACCEPT	
ΣVAR(S _k)	Z _{calc} -1.85	@α=2.5% Z=	1.96	H ₀ (No trend) ACCEPT
339.00	p 0.032			H _A (± trend) REJECT



α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.90		0.11
0.050	-0.80	-0.40	-0.06
0.100	-0.73		-0.10
0.200	-0.65		-0.17

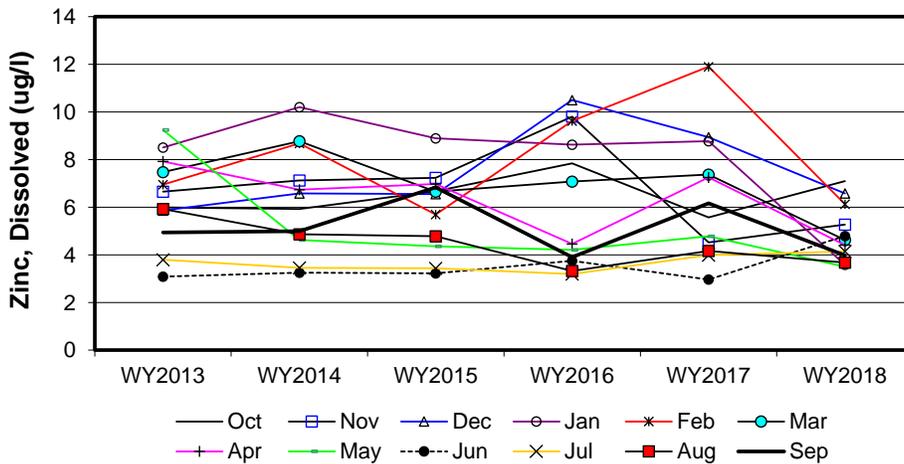
Site #54

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	WY2013	6.0	6.7	5.9	8.5	7.0	7.5	7.9	9.2	3.1	3.8	5.9	4.9
b	WY2014	5.9	7.1	6.6	10.2	8.7	8.8	6.7	4.6	3.3	3.5	4.9	5.0
c	WY2015	6.7	7.2	6.6	8.9	5.7	6.7	7.0	4.4	3.2	3.4	4.8	6.8
d	WY2016	7.8	9.8	10.5	8.6	9.6	7.1	4.5	4.2	3.8	3.2	3.3	3.9
e	WY2017	5.6	4.5	8.9	8.8	11.9	7.4	7.3	4.8	3.0	4.0	4.2	6.2
f	WY2018	7.1	5.3	6.6	3.6	6.1	4.6	4.4	3.5	4.8	4.1	3.7	4.0
n		6	6	6	6	6	6	6	6	6	6	6	6
t ₁		6	6	4	6	6	6	6	6	6	6	6	6
t ₂		0	0	1	0	0	0	0	0	0	0	0	0
t ₃		0	0	0	0	0	0	0	0	0	0	0	0
t ₄		0	0	0	0	0	0	0	0	0	0	0	0
t ₅		0	0	0	0	0	0	0	0	0	0	0	0
b-a		-1	1	1	1	1	1	-1	-1	1	-1	-1	1
c-a		1	1	1	1	-1	-1	-1	-1	1	-1	-1	1
d-a		1	1	1	1	1	-1	-1	-1	1	-1	-1	-1
e-a		-1	-1	1	1	1	-1	-1	-1	-1	1	-1	1
f-a		1	-1	1	-1	-1	-1	-1	-1	1	1	-1	-1
c-b		1	1	-1	-1	-1	-1	1	-1	-1	-1	-1	1
d-b		1	1	1	-1	1	-1	-1	-1	1	-1	-1	-1
e-b		-1	-1	1	-1	1	-1	1	1	-1	1	-1	1
f-b		1	-1	0	-1	-1	-1	-1	-1	1	1	-1	-1
d-c		1	1	1	-1	1	1	-1	-1	1	-1	-1	-1
e-c		-1	-1	1	-1	1	1	1	1	-1	1	-1	-1
f-c		1	-1	1	-1	1	-1	-1	-1	1	1	-1	-1
e-d		-1	-1	-1	1	1	1	1	1	-1	1	1	1
f-d		-1	-1	-1	-1	-1	-1	-1	-1	1	1	1	1
f-e		1	1	-1	-1	-1	-1	-1	-1	1	1	-1	-1
S _k		3	-1	6	-5	3	-7	-7	-9	5	3	-11	-1
σ _S ² =		28.33	28.33	27.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33
Z _k = S _k /σ _S		0.56	-0.19	1.15	-0.94	0.56	-1.32	-1.32	-1.69	0.94	0.56	-2.07	-0.19
Z _k ²		0.32	0.04	1.32	0.88	0.32	1.73	1.73	2.86	0.88	0.32	4.27	0.04

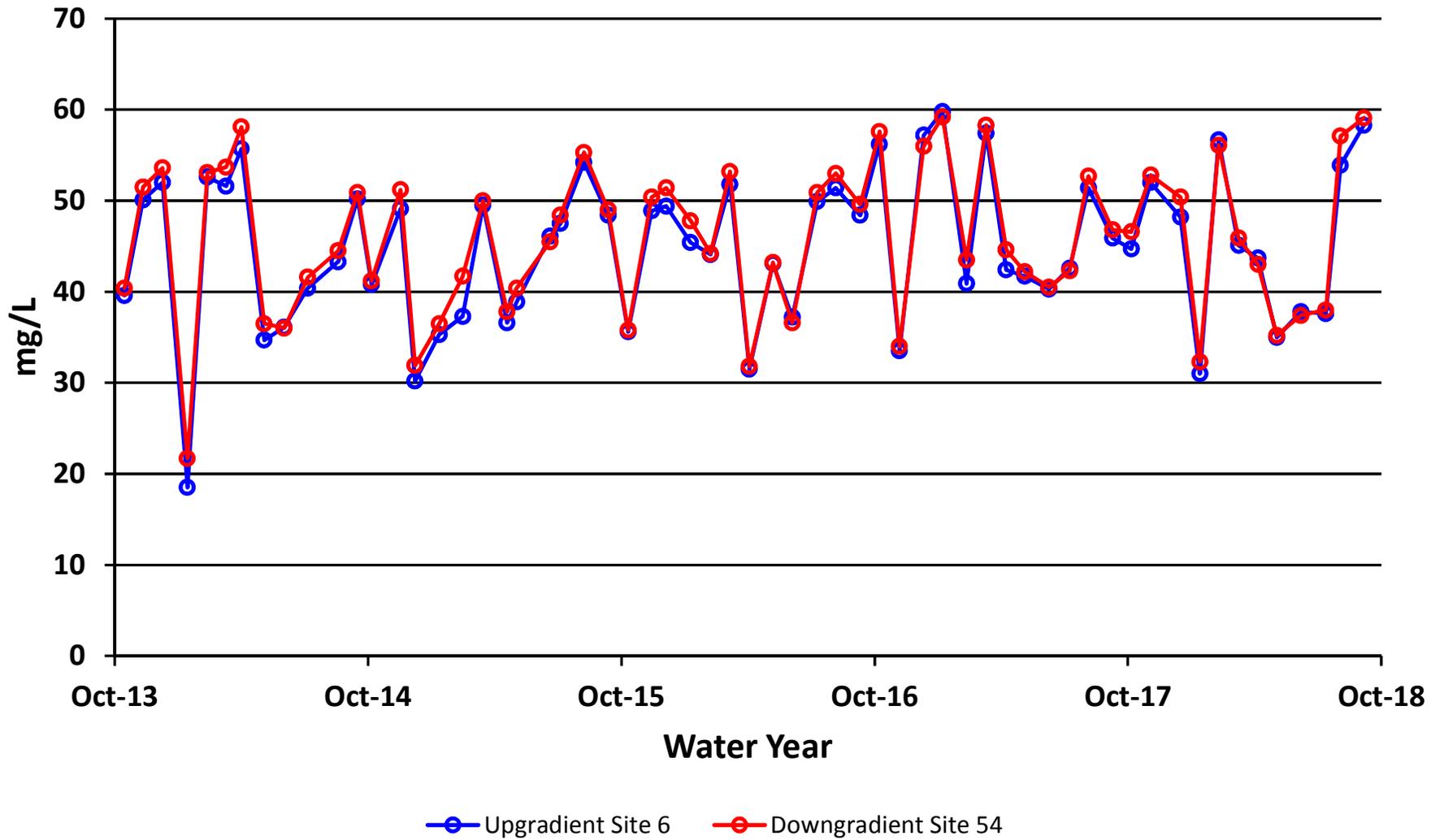
ΣZ _k =	-3.92	Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅	Σn	72
ΣZ _k ² =	14.69	Count	70	1	0	0	0	ΣS _k	-21
Z-bar=ΣZ _k /K=	-0.33								

χ _n ² =ΣZ _k ² -K(Z-bar) ² =	13.41	@α=5% χ _(K-1) ² =	19.68	Test for station homogeneity	
p	0.267			χ _n ² <χ _(K-1) ²	ACCEPT
ΣVAR(S _k)	Z _{calc} -1.09	@α/2=2.5% Z=	1.96	H ₀ (No trend)	ACCEPT
339.00	p 0.139			H _A (± trend)	REJECT

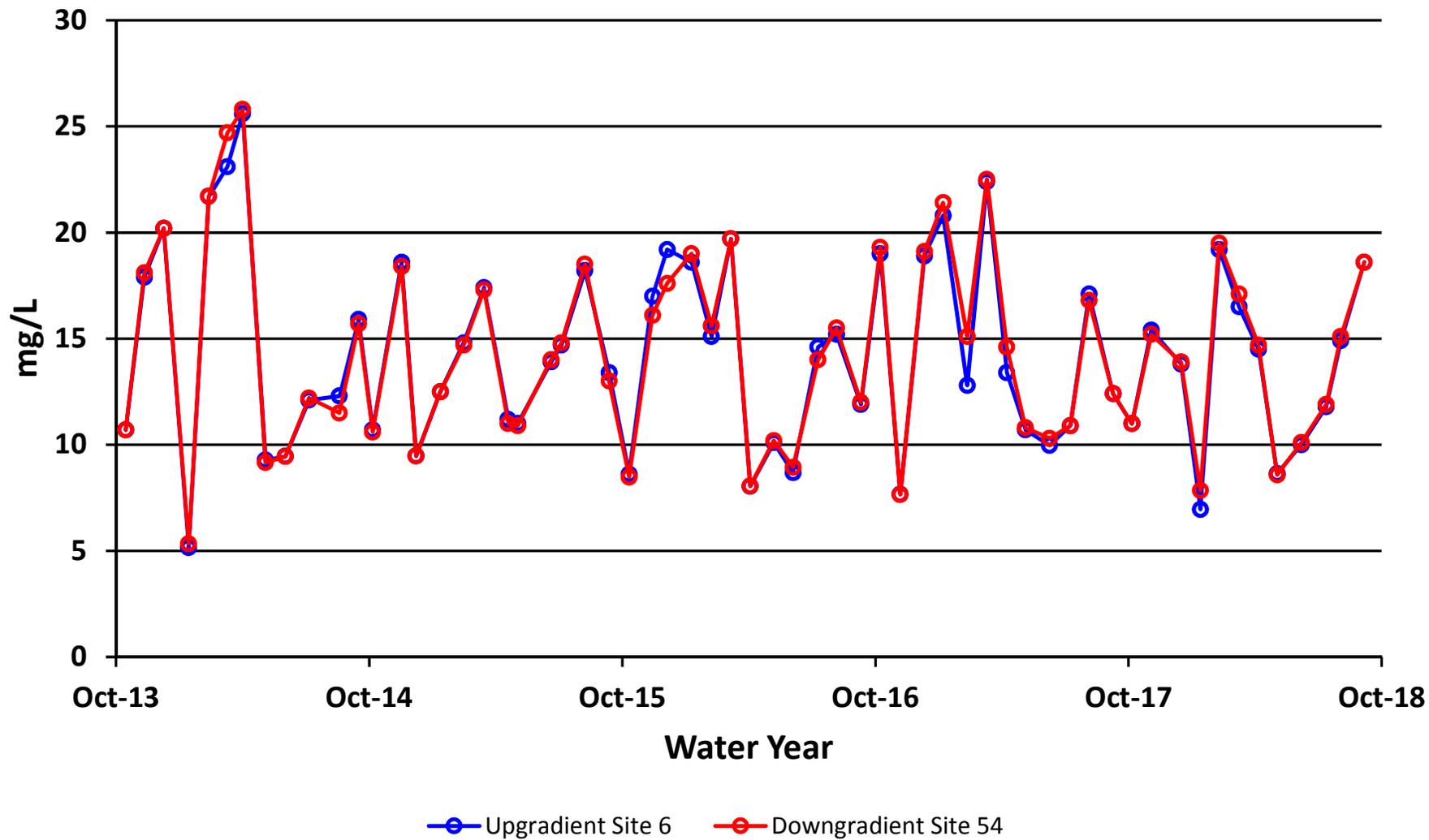


Seasonal-Kendall Slope Confidence Intervals			
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.32		0.12
0.050	-0.26		0.05
0.100	-0.23	-0.10	0.01
0.200	-0.18		-0.03

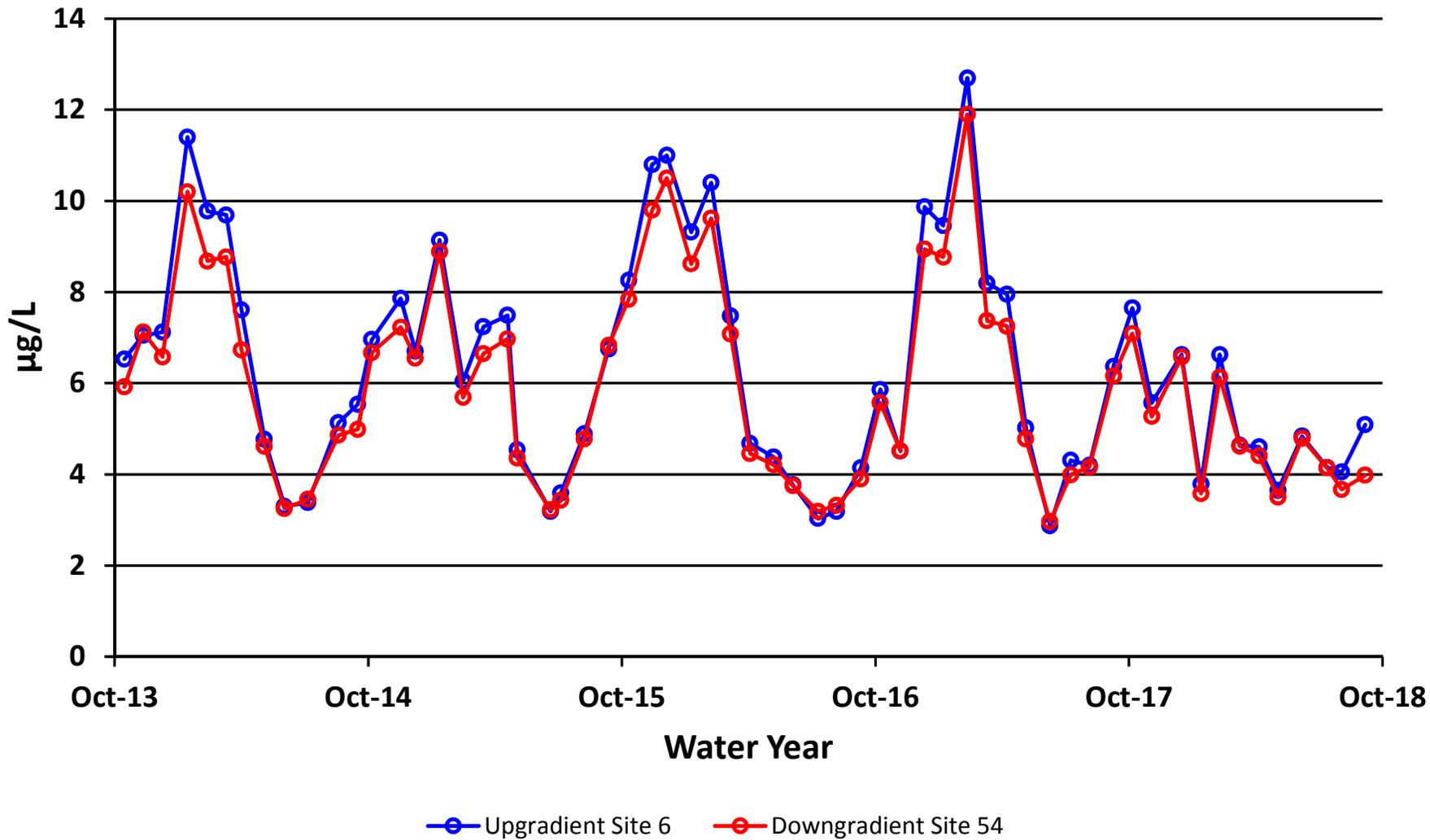
Site 6 vs. Site 54 - Alkalinity



Site 6 vs. Site 54 – Sulfate



Site 6 vs. Site 54 - Zinc



Wilcoxon-signed-ranks test

Exact Form

Variable: **Specific Conductance, Field ($\mu\text{S}/\text{cm}$)**

Site	X	Y	Differences		
	#6	#54	D	 D 	Rank
Year	WY2018	WY2018			
Oct	105.60	107.40	-1.80	1.80	-5
Nov	134.00	138.00	-4.00	4.00	-10
Dec	129.10	131.40	-2.30	2.30	-8
Jan	79.70	80.20	-0.50	0.50	-1
Feb	172.30	174.30	-2.00	2.00	-6
Mar	120.60	140.30	-19.70	19.70	-12
Apr	120.30	123.40	-3.10	3.10	-9
May	90.00	91.50	-1.50	1.50	-3
Jun	99.19	92.77	6.42	6.42	11
Jul	113.00	114.60	-1.60	1.60	-4
Aug	155.10	157.30	-2.20	2.20	-7
Sep	162.90	164.00	-1.10	1.10	-2
Median	120.45	127.40	-1.90	2.10	

n	m
12	12

N= 12
 $\Sigma R= -56$

α
0.05
$W'_{\alpha,n}$
17

$W^+_{=}$
11
p-test
0.013

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

Wilcoxon-signed-ranks test

Exact Form

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

Site	X	Y	Differences		
	#6	#54	D	 D 	Rank
Year	WY2018	WY2018			
Oct	7.77	7.70	0.07	0.07	7
Nov	7.86	7.66	0.20	0.20	9
Dec	7.85	7.79	0.06	0.06	6
Jan	7.68	7.60	0.08	0.08	8
Feb	7.89	7.88	0.01	0.01	1
Mar	7.74	7.72	0.02	0.02	2.5
Apr	7.75	7.71	0.04	0.04	5
May	7.53	7.53	0.00		
Jun	7.68	7.68	0.00		
Jul	7.70	7.68	0.02	0.02	2.5
Aug	7.80	7.77	0.03	0.03	4
Sep	7.91	7.91	0.00		
Median	7.76	7.71	0.03	0.04	

n	m
12	9

N= 9
ΣR= 45

α
0.05
$W'_{\alpha,n}$
8

$W^+_{=}$
0
p-test
0.002

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

Wilcoxon-signed-ranks test

Exact Form

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

X Y

Site	#6	#54	Differences		
Year	WY2018	WY2018	D	 D 	Rank
Oct	44.70	46.60	-1.90	1.90	-10
Nov	52.00	52.80	-0.80	0.80	-6.5
Dec	48.20	50.40	-2.20	2.20	-11
Jan	31.00	32.30	-1.30	1.30	-9
Feb	56.70	56.10	0.60	0.60	4
Mar	45.10	45.90	-0.80	0.80	-6.5
Apr	43.70	43.00	0.70	0.70	5
May	35.00	35.20	-0.20	0.20	-1
Jun	37.80	37.40	0.40	0.40	2
Jul	37.60	38.00	-0.40	0.40	-3
Aug	53.90	57.10	-3.20	3.20	-12
Sep	58.30	59.10	-0.80	0.80	-8
Median	44.90	46.25	-0.80	0.80	

n	m
12	12

N= 12
ΣR= -56

α
0.05
$W'_{\alpha,n}$
17

$W^+_{=}$
11
p-test
0.013

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

Wilcoxon-signed-ranks test

Exact Form

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

Site	X	Y	Differences		
	#6	#54	D	 D 	Rank
Year	WY2018	WY2018			
Oct	11.0	11.0	0.0		
Nov	15.4	15.2	0.2	0.2	6
Dec	13.8	13.9	-0.1	0.1	-3
Jan	7.0	7.9	-0.9	0.9	-10
Feb	19.2	19.5	-0.3	0.3	-8
Mar	16.5	17.1	-0.6	0.6	-9
Apr	14.5	14.7	-0.2	0.2	-6
May	8.6	8.6	0.1	0.1	1
Jun	10.0	10.1	-0.1	0.1	-3
Jul	11.8	11.9	-0.1	0.1	-3
Aug	14.9	15.1	-0.2	0.2	-6
Sep	18.6	18.6	0.0		
Median	14.2	14.3	-0.1	0.2	

n	m
12	10

N= 10
ΣR= -41

α
0.05
$W'_{\alpha,n}$
10

$W^+_{=}$
7
p-test
0.019

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	WY2018	WY2018	D	 D 	Rank
Oct	7.65	7.09	0.56	0.56	11
Nov	5.57	5.27	0.30	0.30	8
Dec	6.63	6.58	0.05	0.05	3.5
Jan	3.79	3.58	0.21	0.21	7
Feb	6.63	6.13	0.50	0.50	10
Mar	4.64	4.62	0.02	0.02	2
Apr	4.60	4.41	0.19	0.19	6
May	3.65	3.50	0.15	0.15	5
Jun	4.84	4.79	0.05	0.05	3.5
Jul	4.15	4.14	0.01	0.01	1
Aug	4.05	3.67	0.38	0.38	9
Sep	5.09	3.98	1.11	1.11	12
Median	4.74	4.52	0.20	0.20	

n	m
12	12

N= 12
ΣR= 78

α
0.05
$W'_{\alpha,n}$
17

$W^+ =$
0
p-test
0.000

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

INTERPRETIVE REPORT

SITE 62

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

The data collected during the current water year are listed in the following “Table of Results for Water Year 2018” 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 one-half of the for the purpose of median calculation.

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

Sample Date	Parameter	Value	Qualifier	Notes
No outliers, in the past six years, have been identified by HGCMC.				

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

Table of Exceedance for Water Year 2018

Sample Date	Parameter	Value	Limits		
			Lower	Upper	Hardness
No exceedances have been identified by HGCMC for the period of October 2017 through September 2018.					

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

A comparison of median values for total alkalinity, field pH, field conductivity, total sulfate, and dissolved zinc between Site 62 and Site 54 has been conducted. Additionally, X-Y plots have been generated for total alkalinity, field pH, specific conductance, total sulfate, and dissolved zinc that co-plot data from Site 62 and Site 54, the upstream control site, to aid in the comparison between those sites. Calculation details of the non-parametric signed-rank tests are presented in detail on the pages following this interpretive section. The table below summarizes the results of the signed-rank test as performed on the Water Year 2018 dataset.

Table of Summary Statistics for Median Analysis

Site 62 vs Site 54				
Parameter	Signed Ranks p-value	Site 54 median	Site 62 median	Median Differences
Conductivity Field	<0.01	127.40	136.00	-9.00
pH Field	0.039	7.71	7.62	0.14
Alkalinity, Total	<0.01	46.25	48.80	-2.75
Sulfate, Total	<0.01	14.30	15.00	-1.00
Zinc, Dissolved	0.285	4.52	4.41	-0.09

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

Table of Results for Water Year 2018

Site 062FMS - 'Greens Creek Below Site 54'

Sample Date/Parameter	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018	Median
Water Temp (°C)	5.2	1.3	0.1	1.9	0.1	0	0.9	3	5.7	8.3	10.9	8.7	2.5
Conductivity-Field(µmho)	116.4	156	140.8	89.2	185.5	148.6	131.2	96.9	104.9	122.1	168.7	173.3	136.0
Conductivity-Lab (µmho)	111	142	121	84	119	133	118	85	95	118	165	159	119
pH Lab (standard units)	7.13	7.17	7.29	7.23	6.81	6.8	6.69	6.56	6.77	6.39	6.82	7.42	6.82
pH Field (standard units)	7.53	7.65	7.67	7.45	7.74	7.59	7.54	7.31	7.74	7.77	6.97	8.13	7.62
Total Alkalinity (mg/L)	49.4	63.4	54.5	36	60.5	48.2	45.1	36.6	38.6	41.4	55.9	61.8	48.8
Total Sulfate (mg/L)	12.1	16.4	14.5	7.8	20.8	18.1	15.5	9.7	14	12.6	16.2	19.6	15.0
Hardness (mg/L)	54.3	74.8	67.8	42.3	83.1	70.3	64	46.6	51.9	57	80.6	76.5	65.9
Dissolved As (ug/L)	0.228	0.194	0.191	0.197	0.155	0.167	0.168	0.176	0.191	0.225	0.232	0.212	0.193
Dissolved Ba (ug/L)			25.8		32.2					29.9			29.9
Dissolved Cd (ug/L)	0.0509	0.046	0.0451	0.0334	0.0461	0.0428	0.0379	0.031	0.0401	0.0395	0.0436	0.0429	0.0429
Dissolved Cr (ug/L)			0.105		0.089					0.087			0.089
Dissolved Cu (ug/L)	0.575	0.309	0.432	0.481	0.238	0.392	0.529	0.425	0.475	0.692	0.399	0.394	0.429
Dissolved Pb (ug/L)	0.0187	0.0082	0.0112	0.0164	0.0052	0.029	0.0178	0.0137	0.009	0.012	0.0236	0.0114	0.0129
Dissolved Ni (ug/L)			0.352		0.34					0.337			0.340
Dissolved Ag (ug/L)			0.002		0.002					0.002			0.002
Dissolved Zn (ug/L)	7.65	5.48	6.21	3.64	6.25	4.87	4.39	3.35	4.42	4.04	3.83	4.12	4.41
Dissolved Se (ug/L)			1.09		1.23					0.699			1.090
Dissolved Hg (ug/L)	0.00129	0.000502	0.000739	0.00105	0.000349	0.000759	0.000896	0.000919	0.000888	0.00118	0.00101	0.000486	0.000892

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

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

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

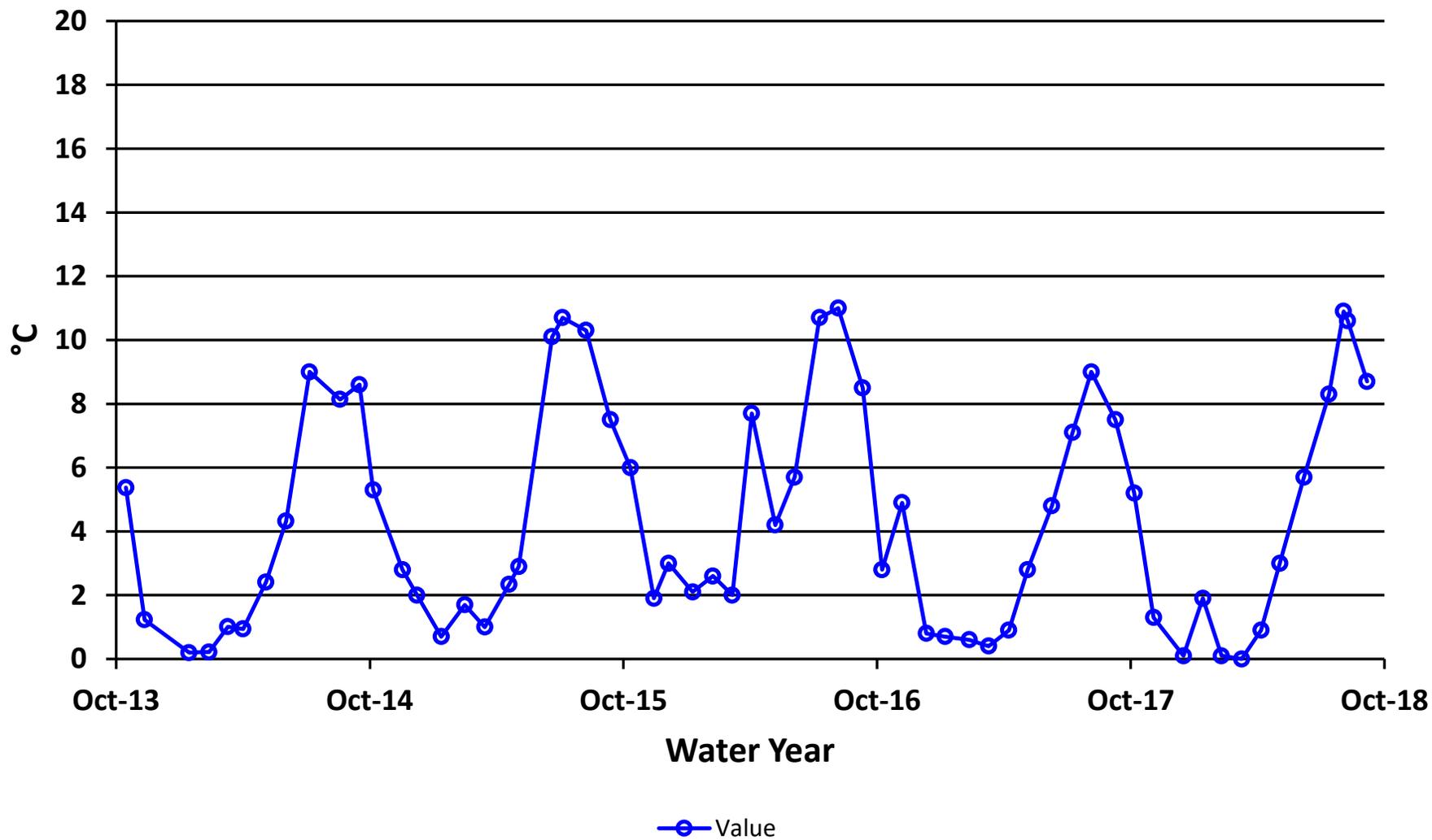
Qualified Data by QA Reviewer

Date Range: 10/01/2017 to 09/30/2018

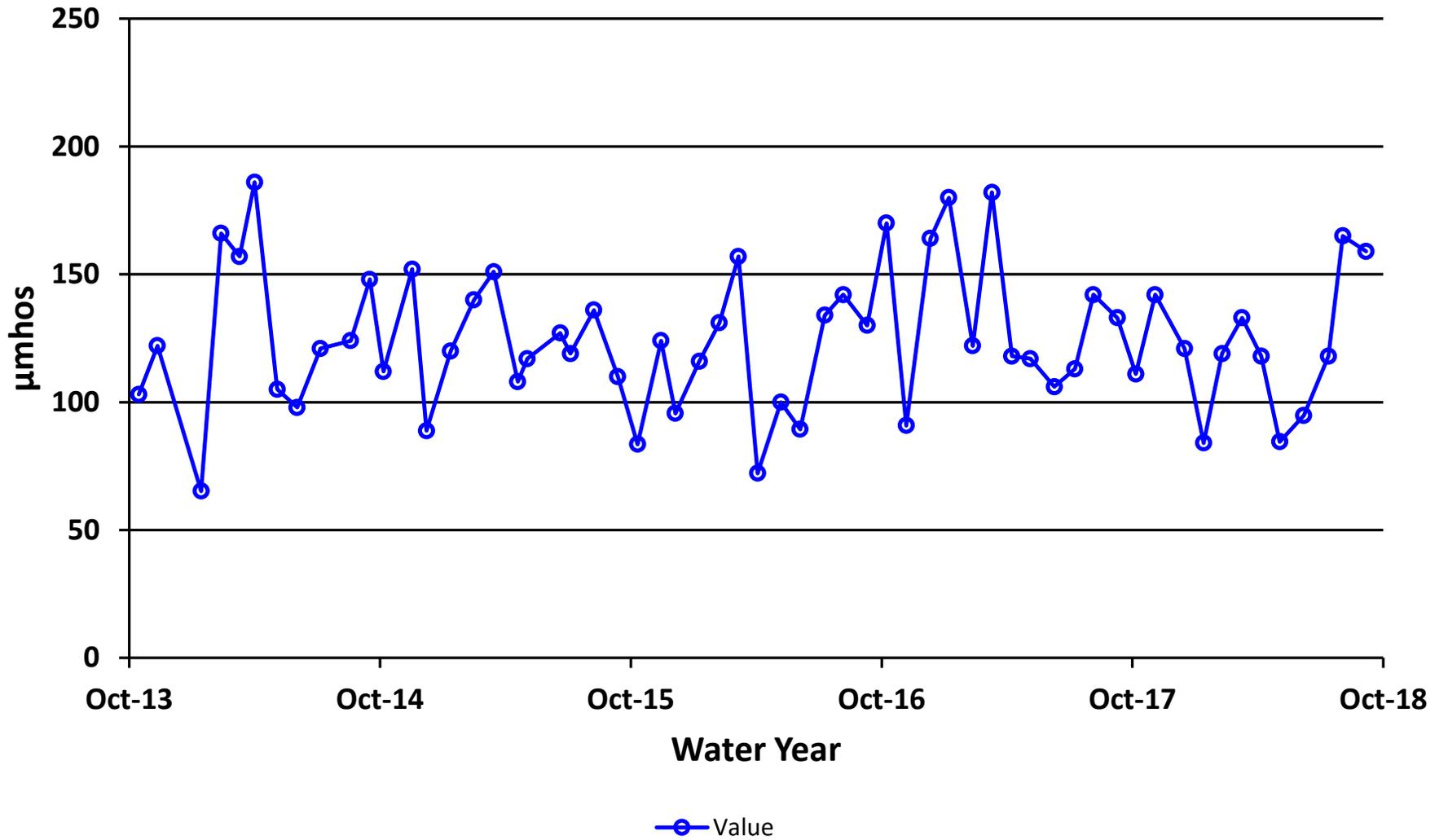
Site No.	Sample Date	Parameter	Value		Qualifier	Reason for Qualifier
062FMS	10/9/2017	Diss. Pb-ICP/MS	0.01	µg/L	U	Field Blank Contamination
		Total Sulfate	12.1	mg/L	J	Hold Time Violation, Temperature Excedance
	11/6/2017	Diss. Pb-ICP/MS	0.0082	µg/L	J	Below Quantitative Range
12/19/2017		Diss. Cr-ICP/MS	0.1	µg/L	J	Below Quantitative Range
		Diss. Pb-ICP/MS	0.01	µg/L	U	Field Blank Contamination
2/12/2018		Diss. Cr-ICP/MS	0.08	µg/L	J	Below Quantitative Range
		Diss. Pb-ICP/MS	0.0052	µg/L	J	Below Quantitative Range
		pH	6.81	pH units	J	Hold Time Violation
3/13/2018		pH	6.8	pH units	J	Hold Time Violation
4/10/2018		pH	6.69	pH units	J	Hold Time Violation
		Total Sulfate	15.5	mg/L	J	Sample Receipt Temperature
5/7/2018		pH	6.56	pH units	J	Hold Time Violation
6/11/2018		Diss. Pb-ICP/MS	0.0090	µg/L	J	Below Quantitative Range
		Total Sulfate	14	mg/L	J	Hold Time Violation, Temperature Excedance
7/17/2018		Diss. Cr-ICP/MS	0.08	µg/L	J	Below Quantitative Range
		pH	6.39	pH units	J	Hold time Violation
		Total Sulfate	12.6	mg/L	J	Sample Reciept Temperature
8/7/2018		Diss. Zn-ICP/MS	3.83	µg/L	U	Field Blank Contamination
		pH	6.82	pH units	J	Hold Time Violation
9/10/2018		Diss. Zn-ICP/MS	4.12	µg/L	U	Field Blank Contamination
		pH	7.42	pH units	J	Hold Time Violation
		Total Sulfate	19.6	mg/L	J	Sample Receipt Temperature

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

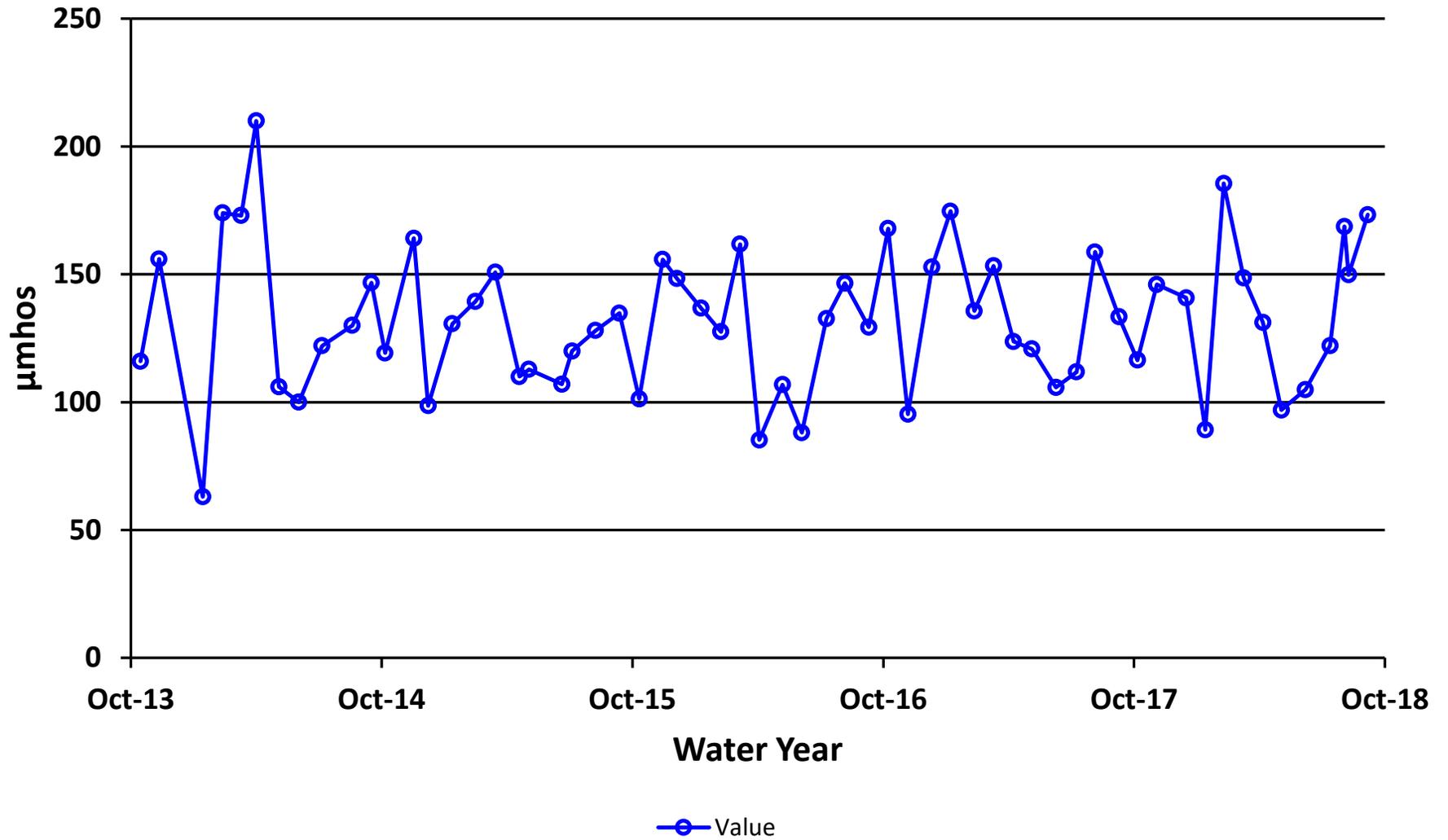
Site 62 - Water Temperature



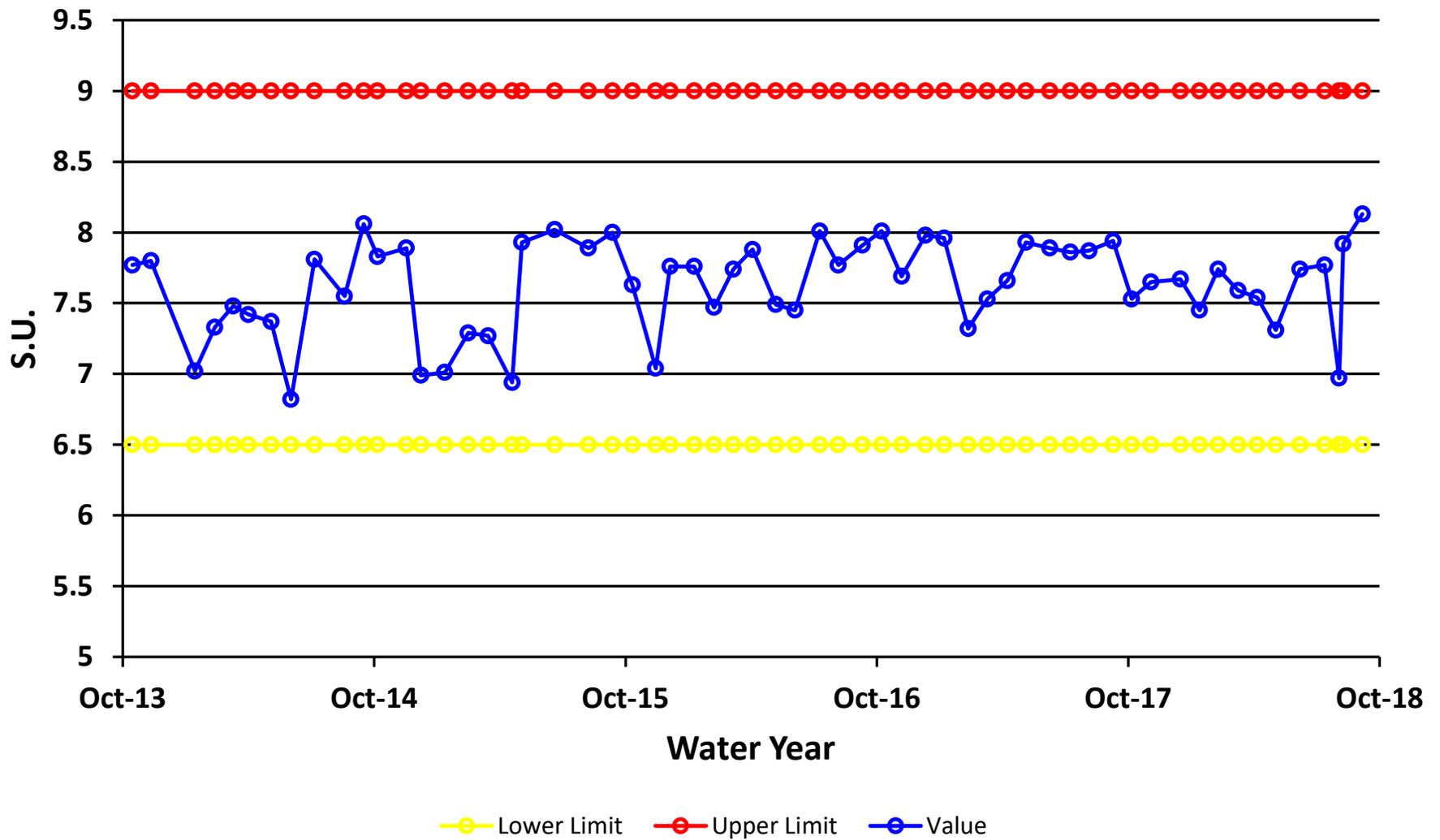
Site 62 - Conductivity Laboratory



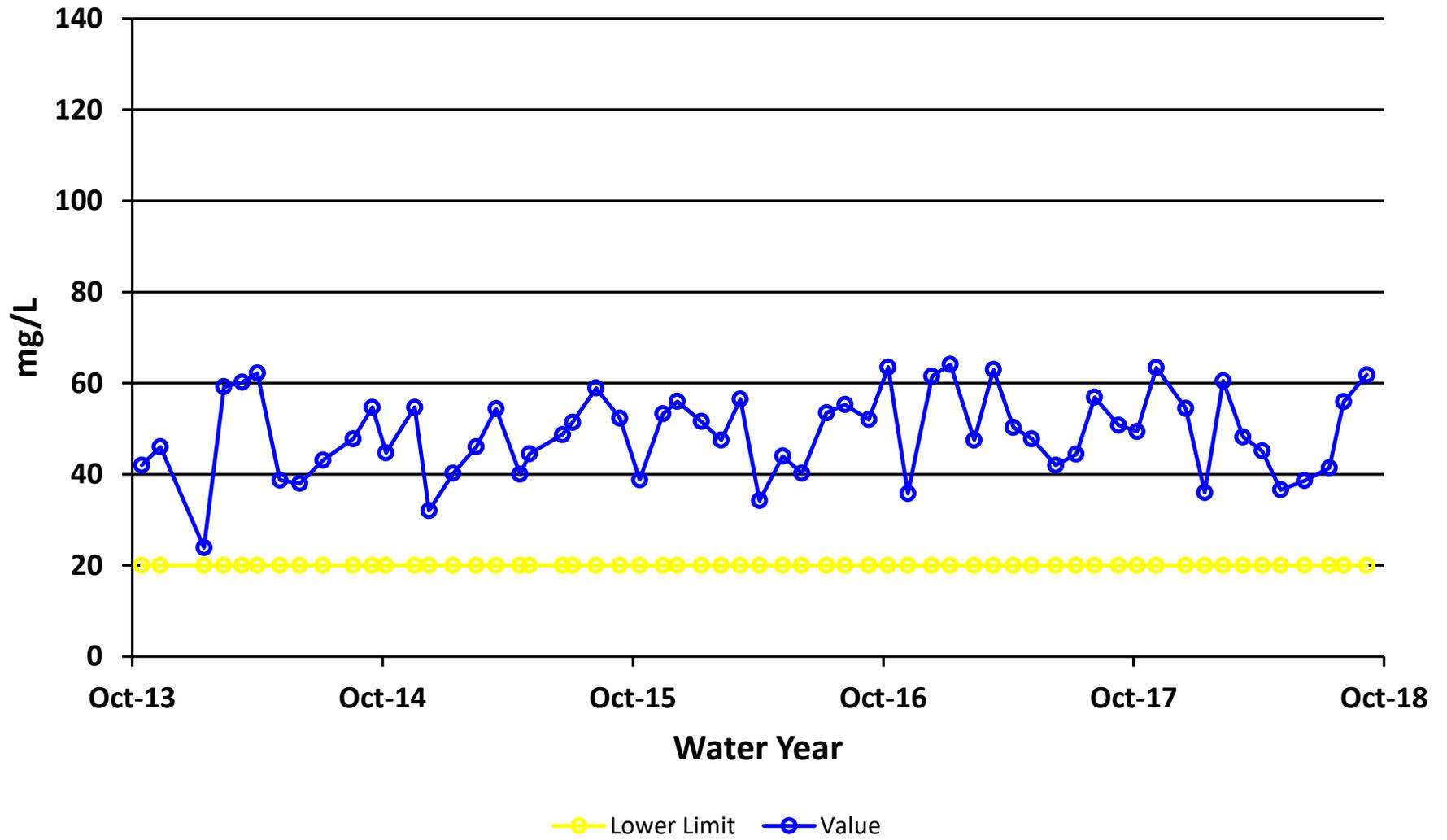
Site 62 - Conductivity Field



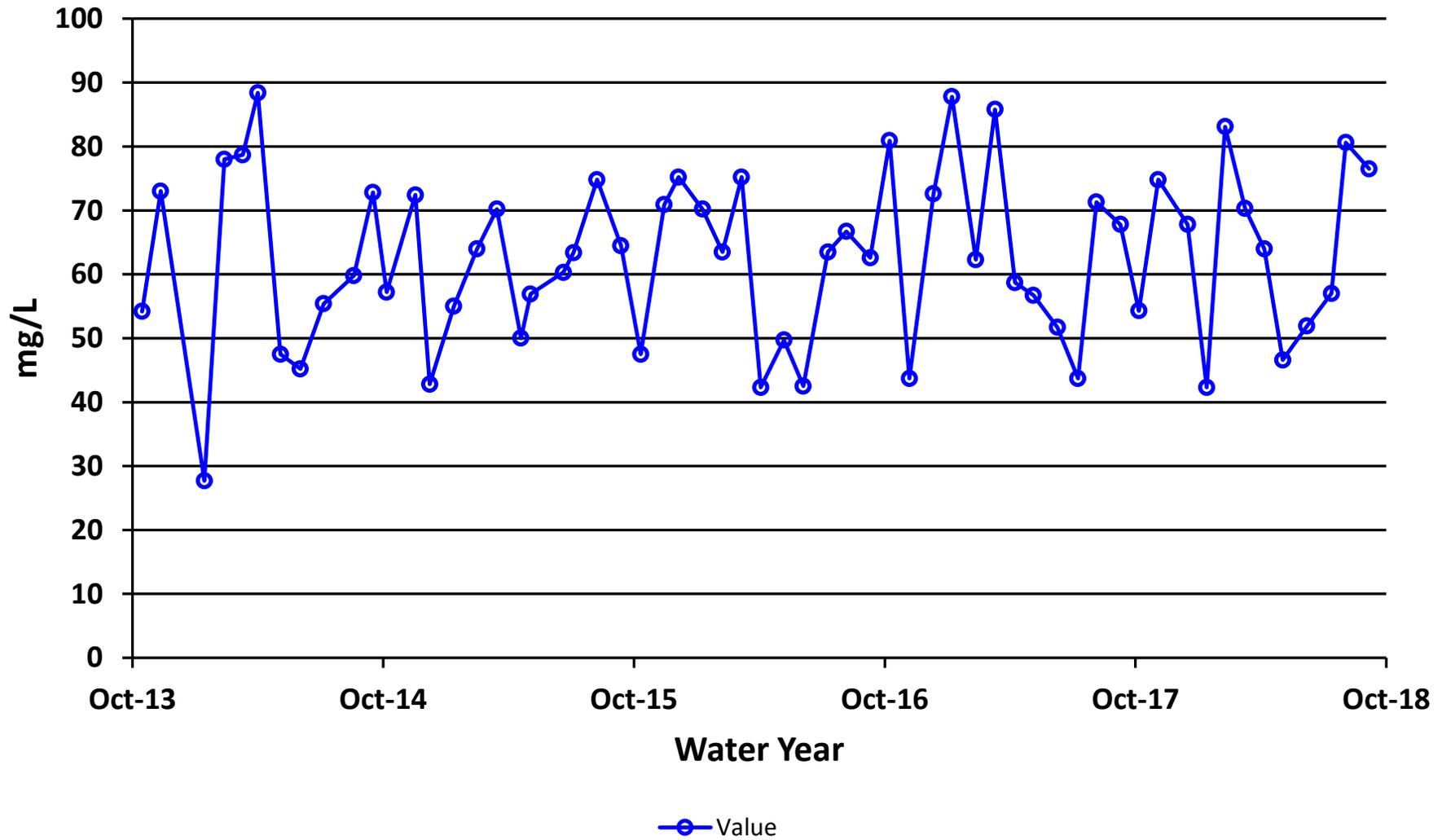
Site 62 - pH Field



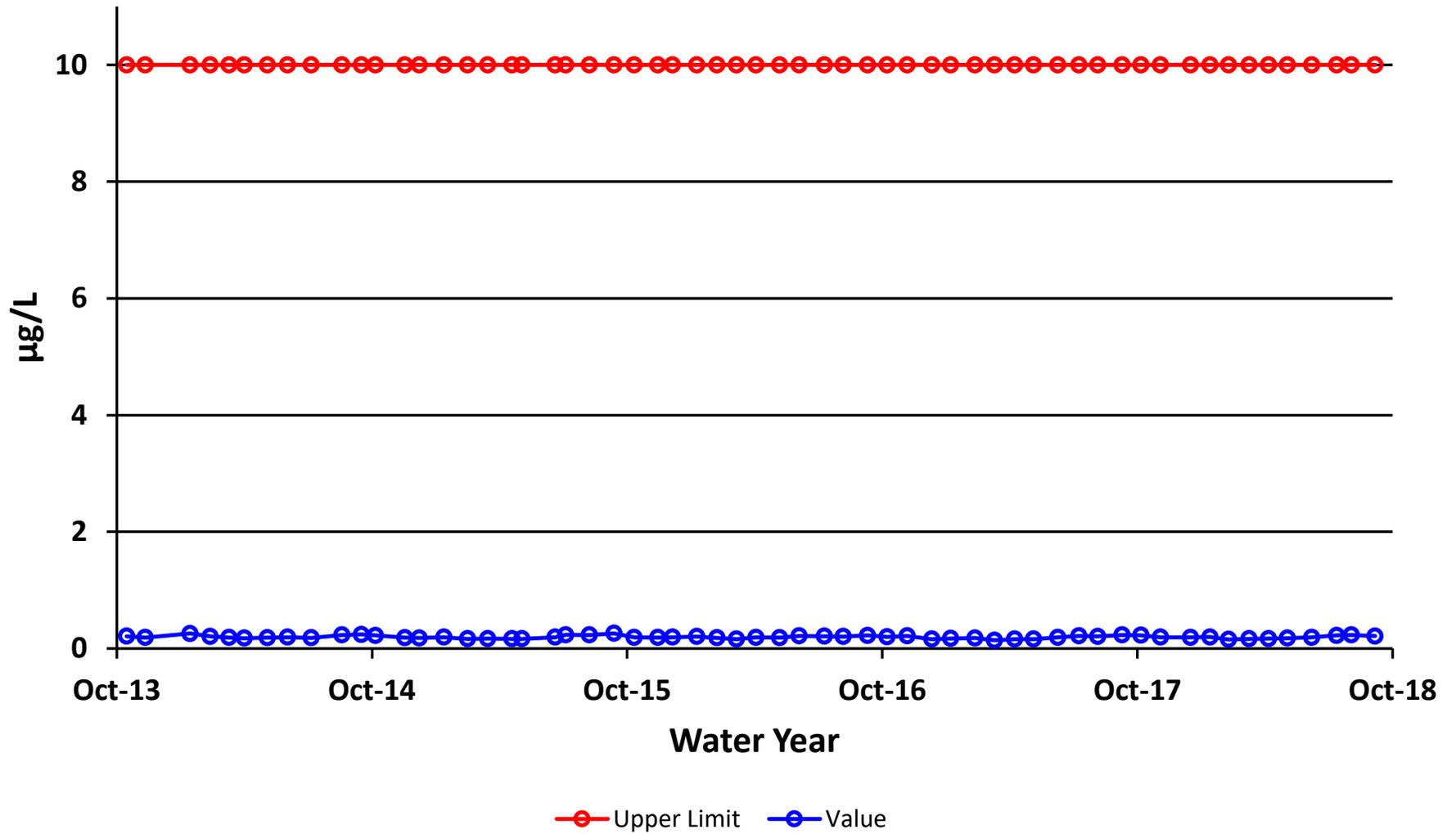
Site 62 - Alkalinity



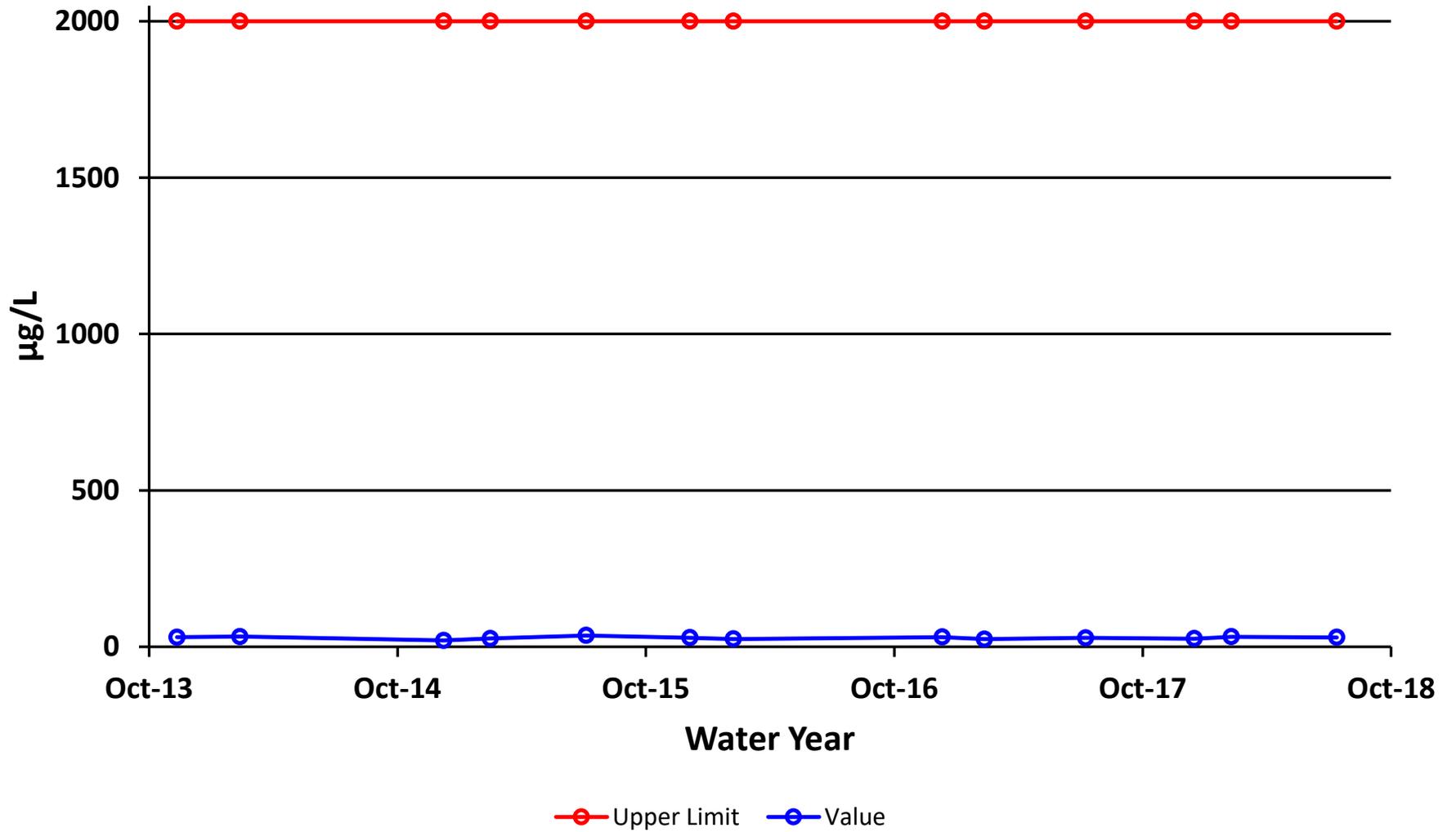
Site 62 - Hardness



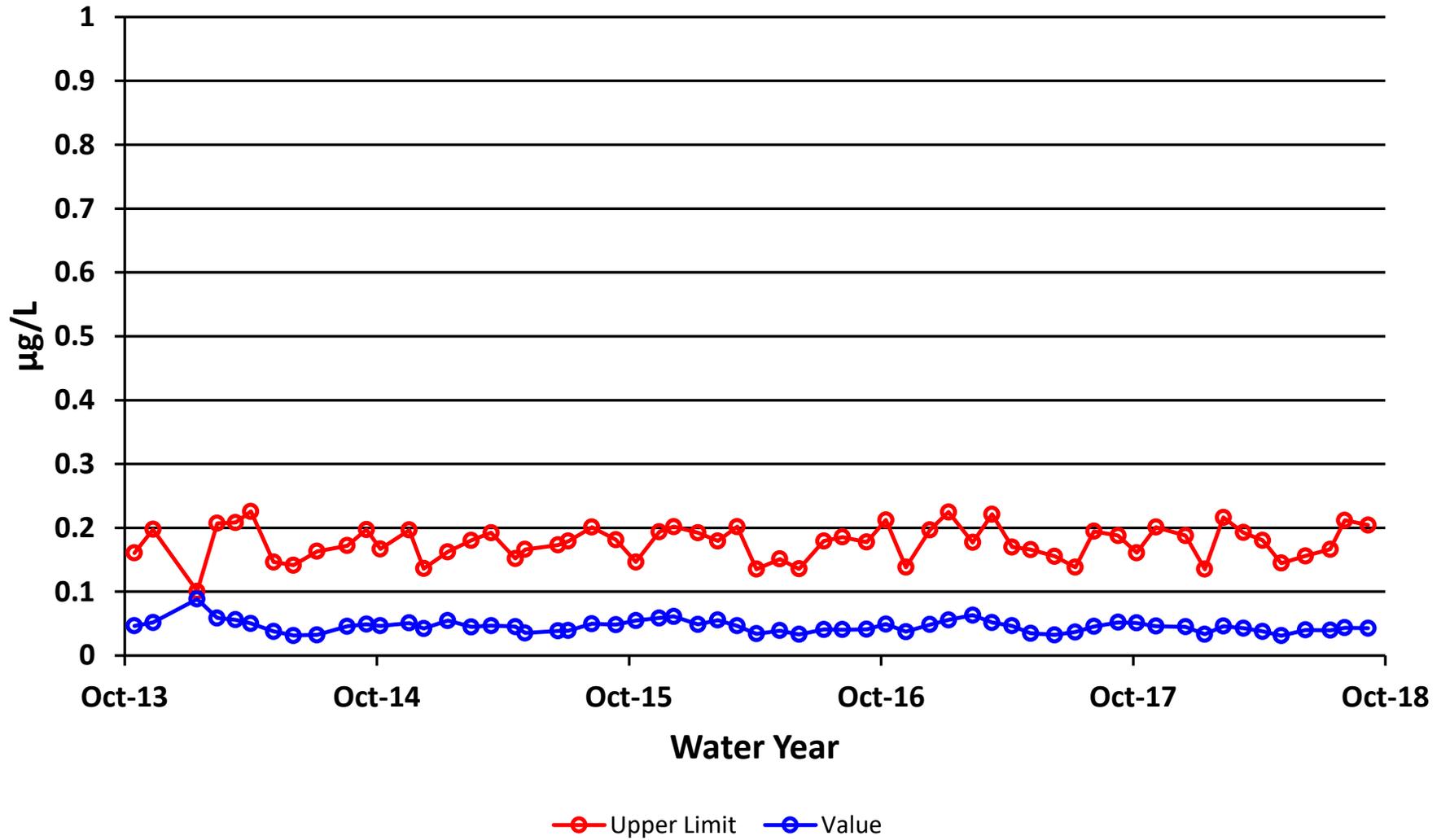
Site 62 - Arsenic Dissolved



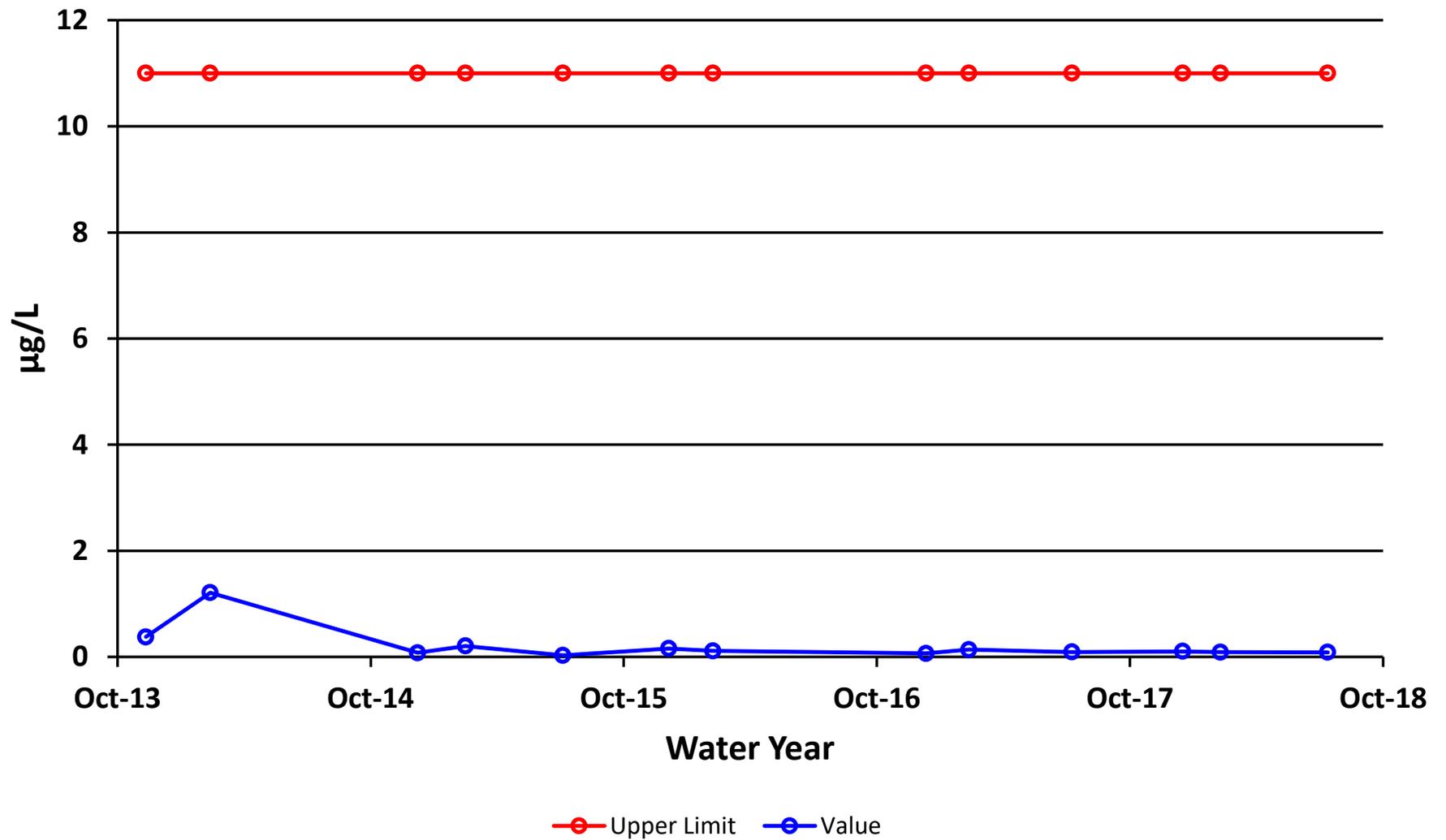
Site 62 - Barium Dissolved



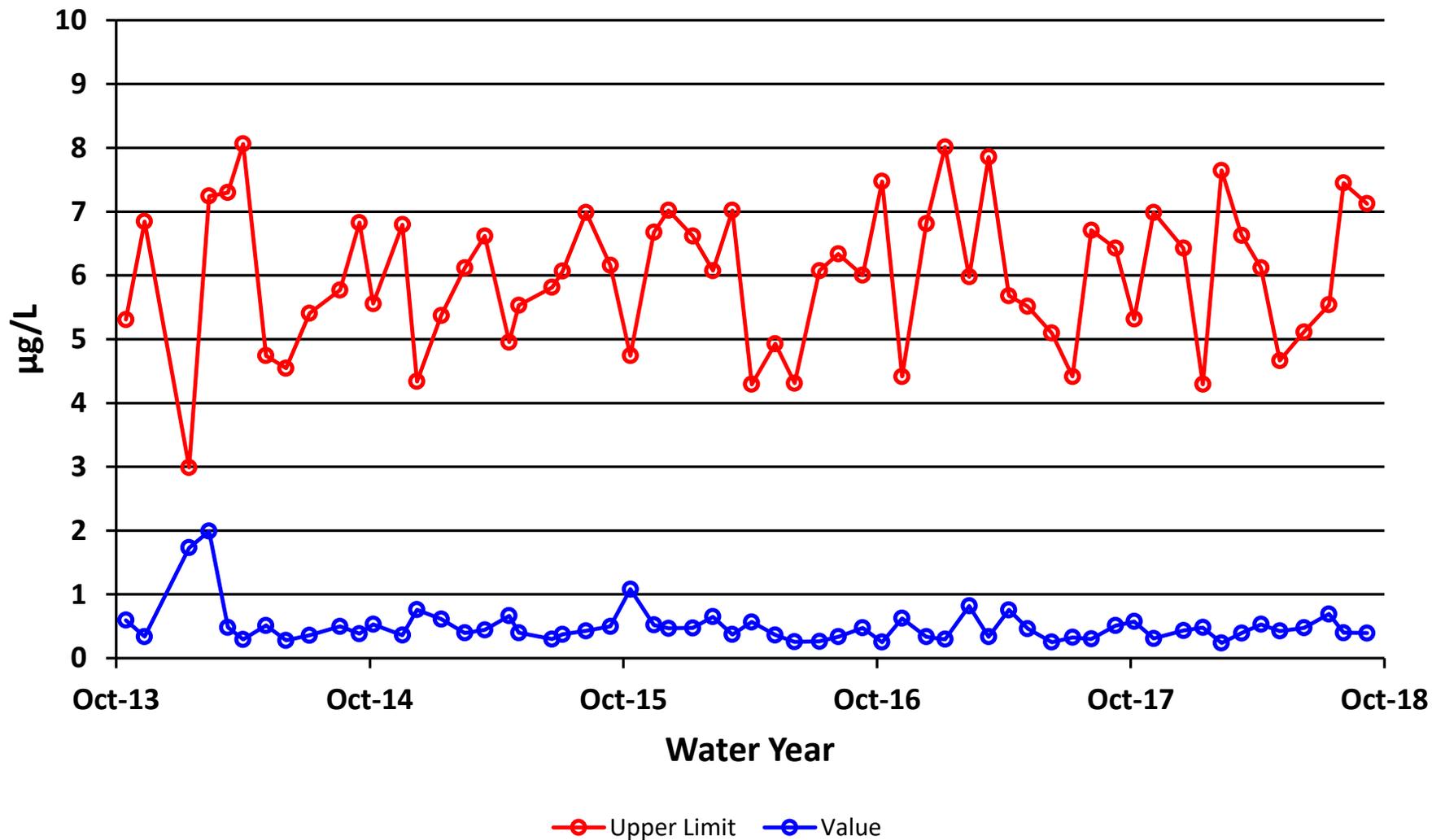
Site 62 - Cadmium Dissolved



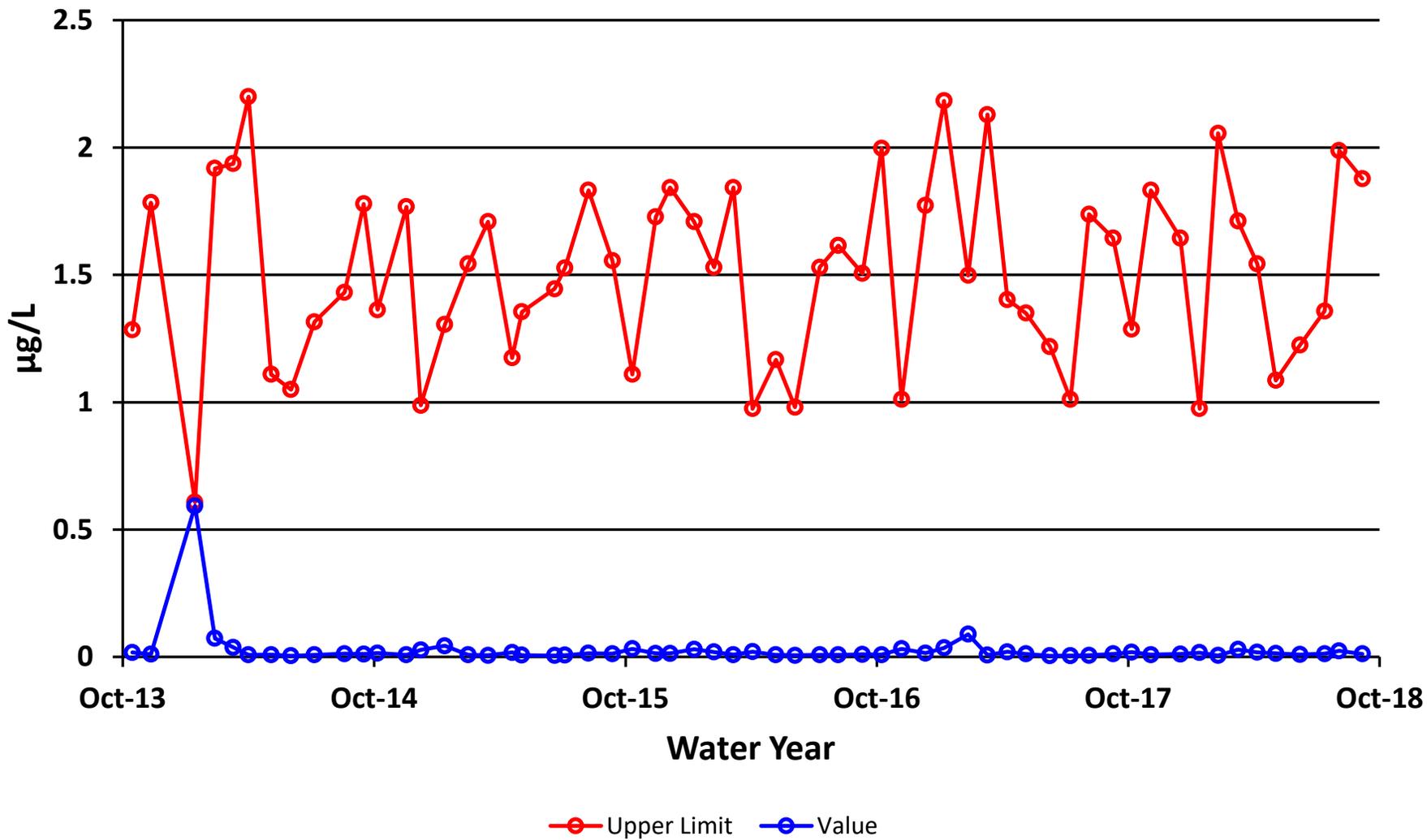
Site 62 - Chromium Dissolved



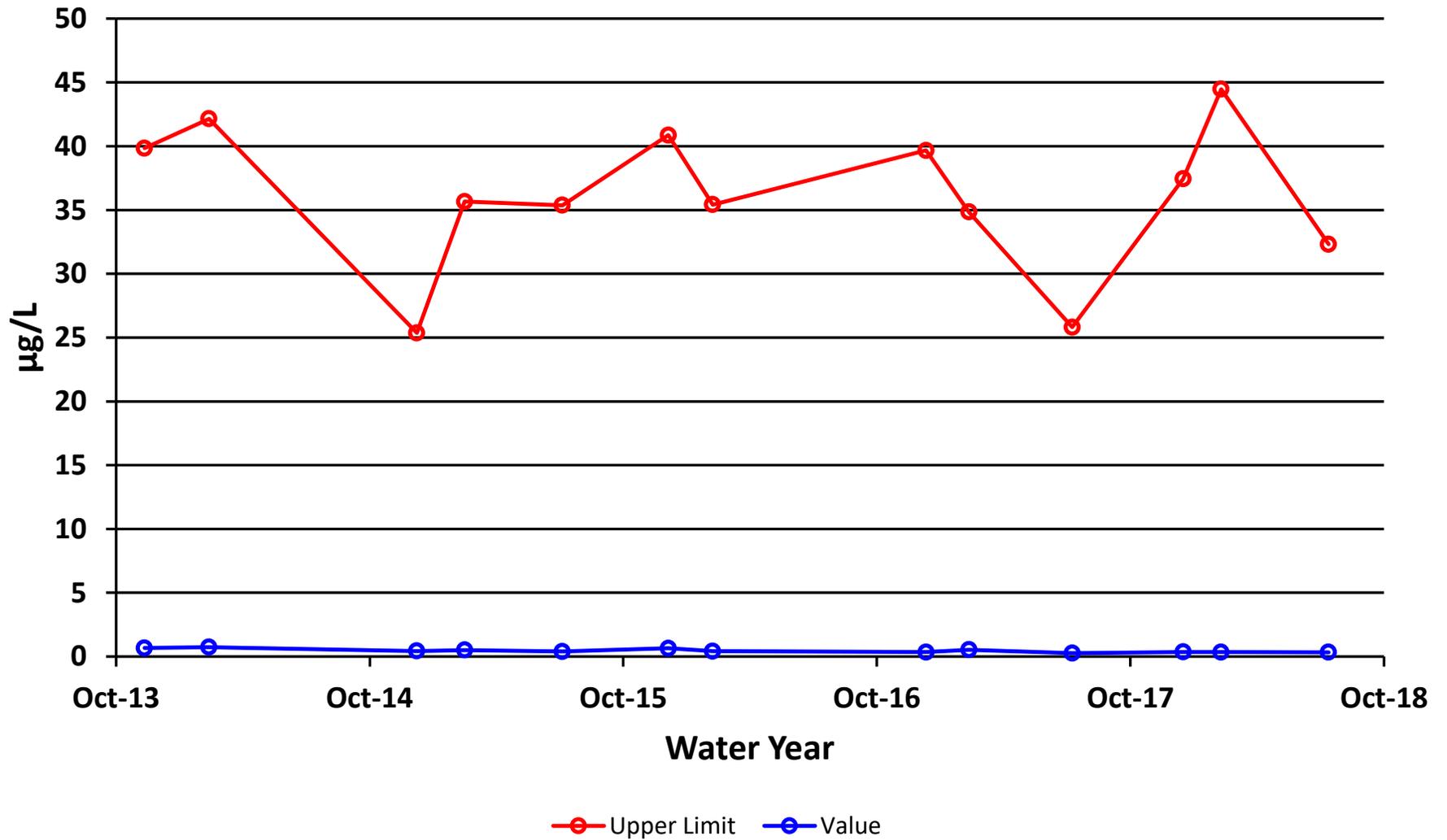
Site 62 - Copper Dissolved



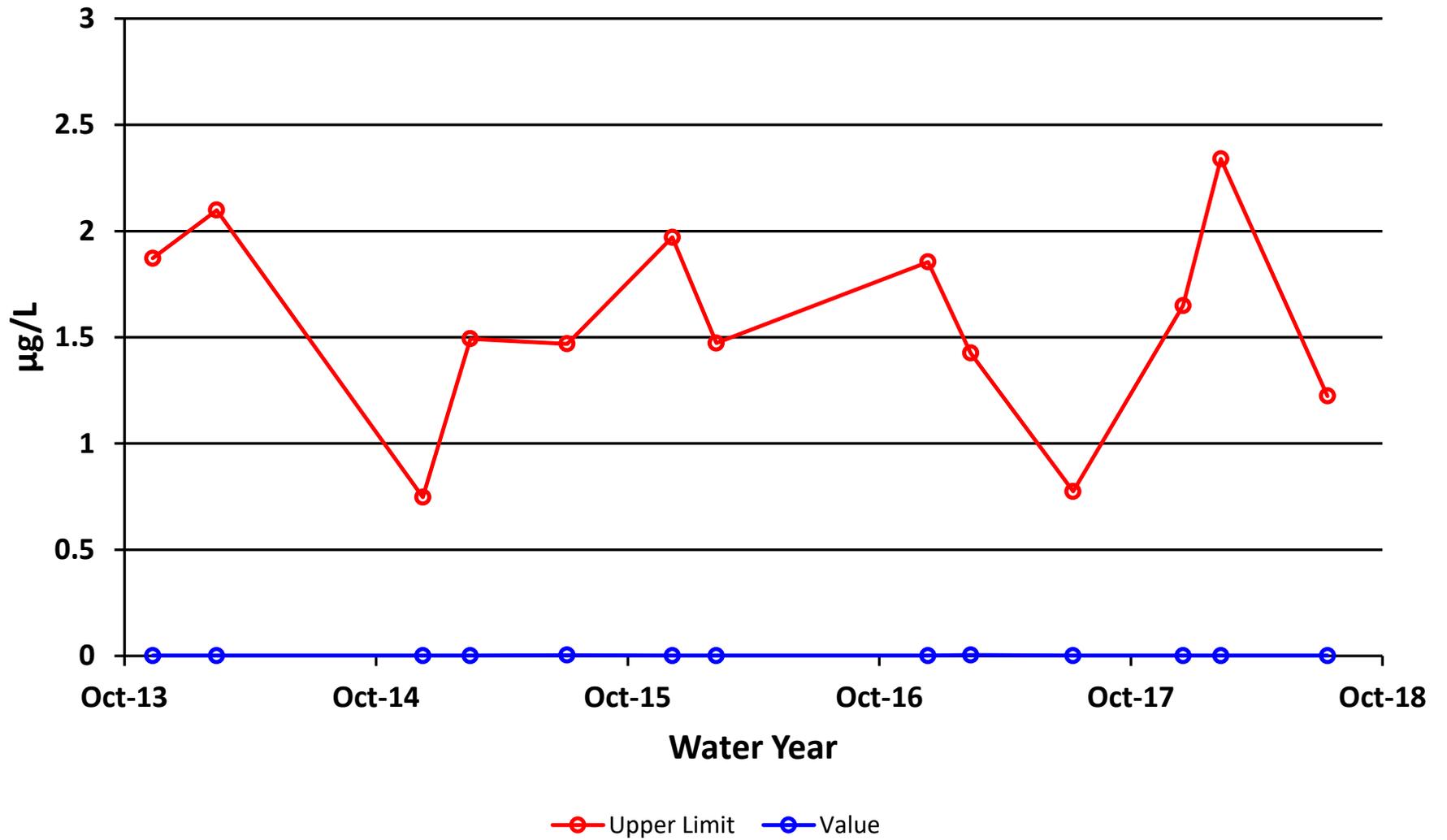
Site 62 - Lead Dissolved



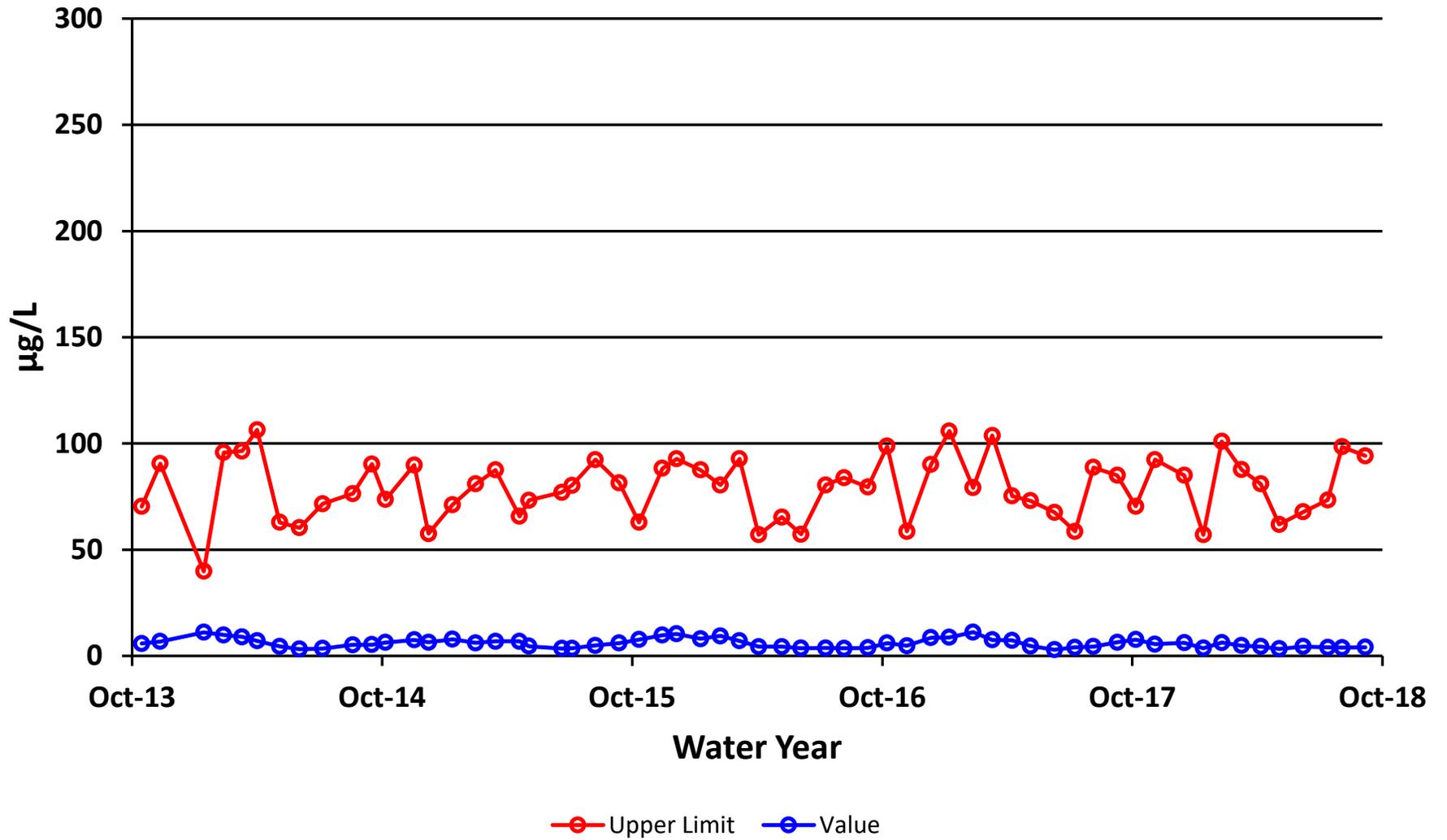
Site 62 - Nickel Dissolved



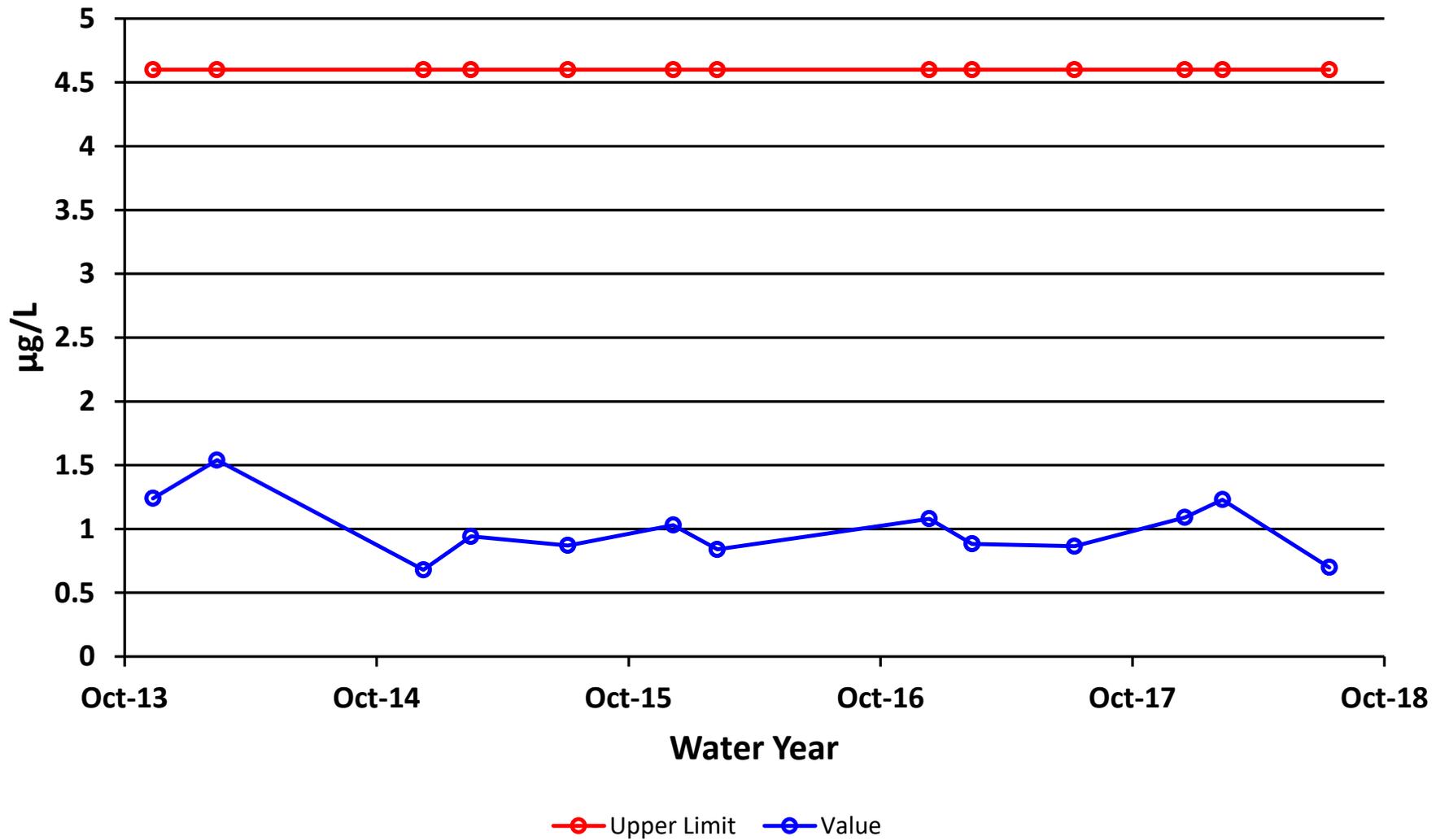
Site 62 - Silver Dissolved



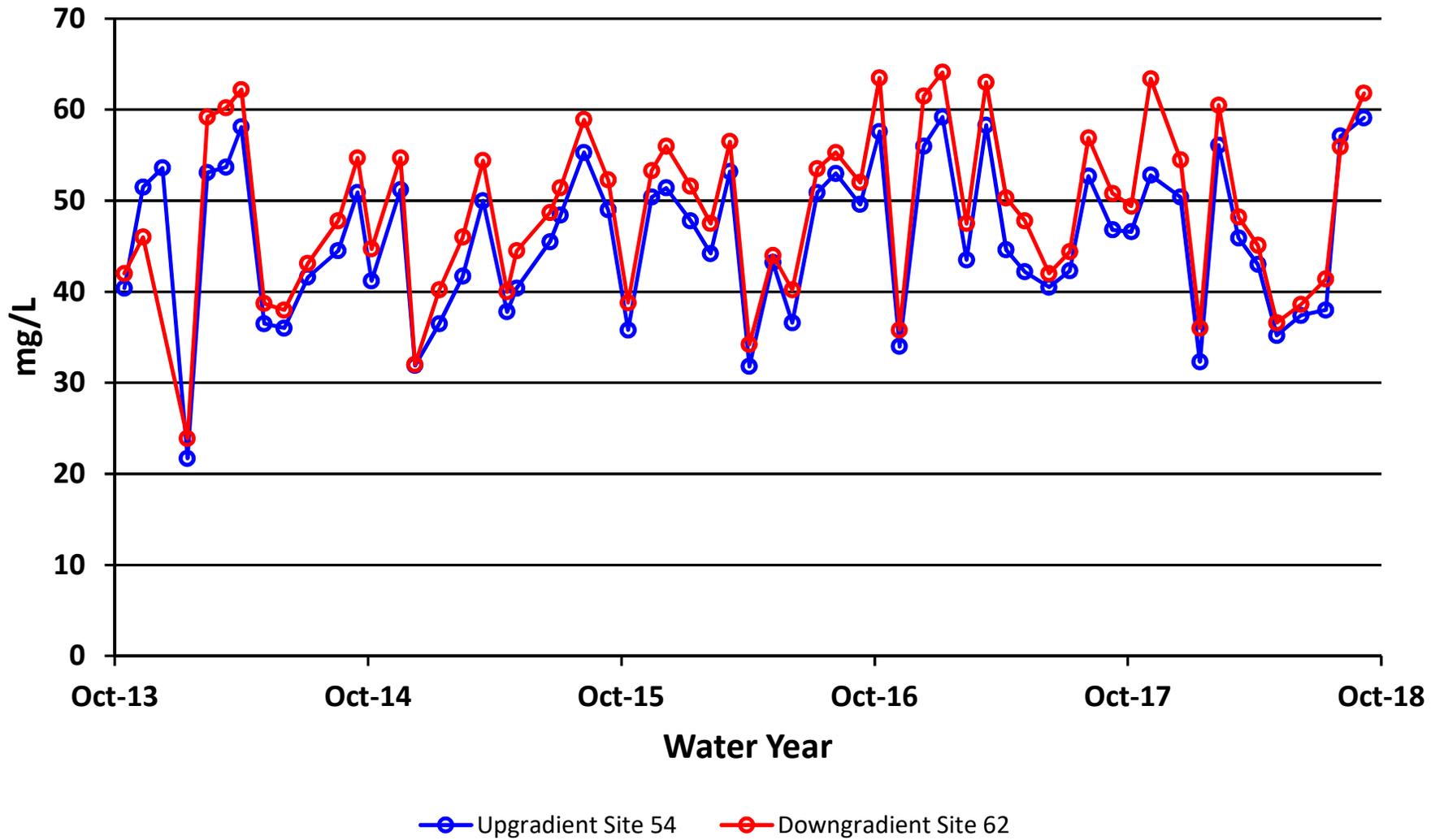
Site 62 - Zinc Dissolved



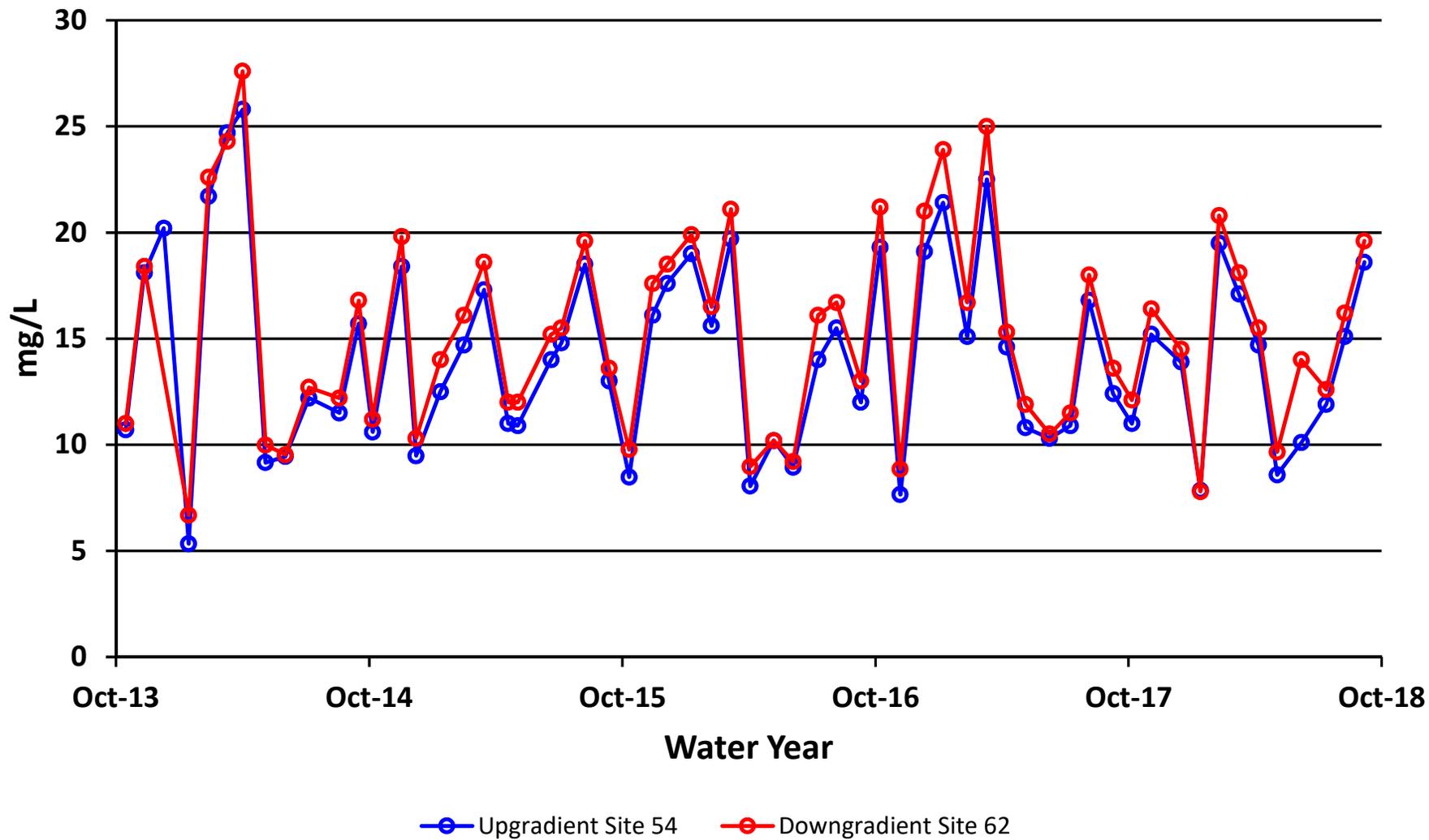
Site 62 - Selenium Dissolved



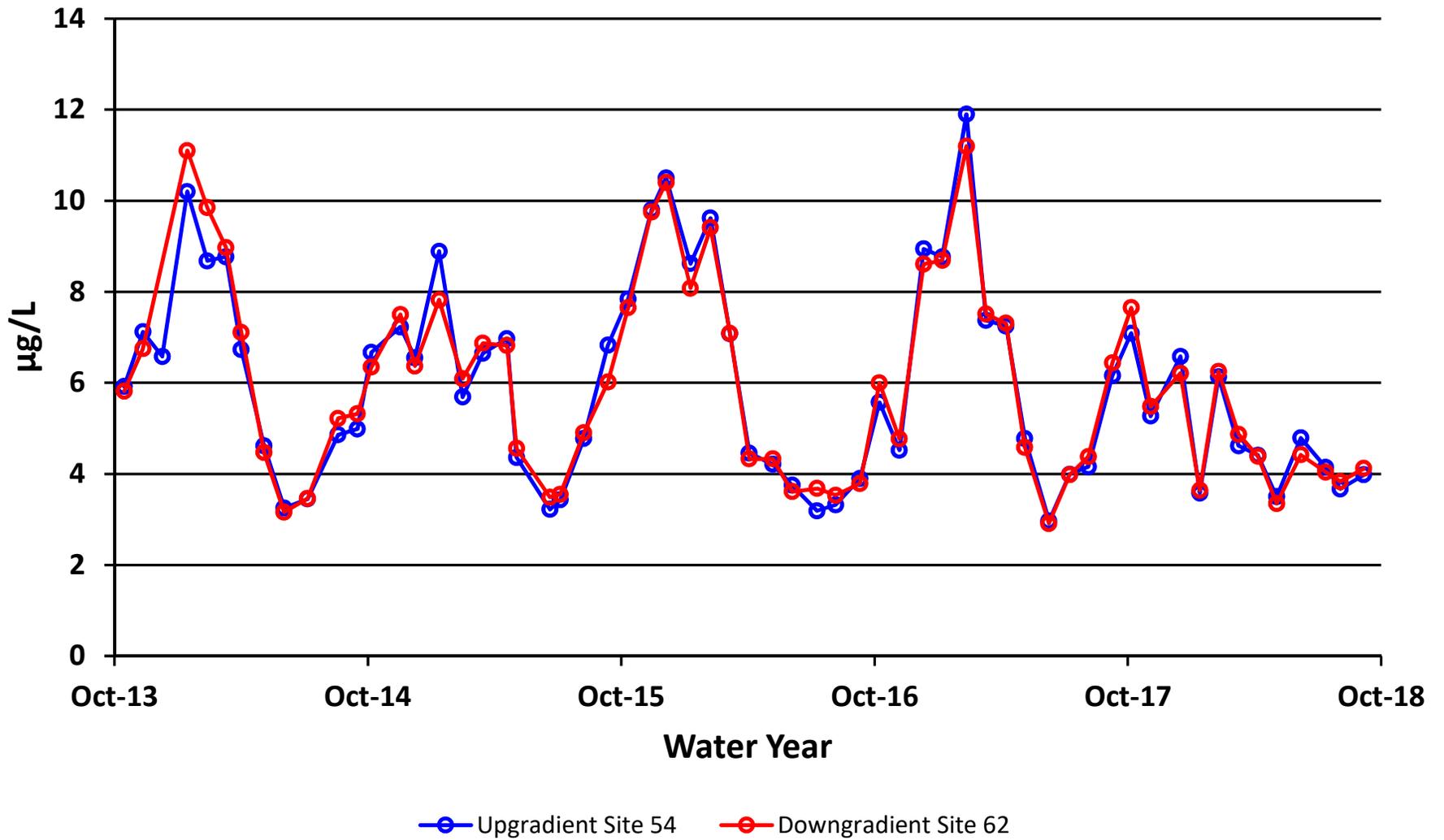
Site 54 vs. Site 62 – Alkalinity



Site 54 vs. Site 62 – Sulfate



Site 54 vs. Site 62 - Zinc



Wilcoxon-signed-ranks test

Exact Form

Variable: **Specific Conductance, Field ($\mu\text{S}/\text{cm}$)**

X Y

Site	#54	#62	Differences		
Year	WY2018	WY2018	D	 D 	Rank
Oct	107.40	116.40	-9.00	9.00	-6.5
Nov	138.00	146.00	-8.00	8.00	-4
Dec	131.40	140.80	-9.40	9.40	-9
Jan	80.20	89.20	-9.00	9.00	-6.5
Feb	174.30	185.50	-11.20	11.20	-10
Mar	140.30	148.60	-8.30	8.30	-5
Apr	123.40	131.20	-7.80	7.80	-3
May	91.50	96.90	-5.40	5.40	-1
Jun	92.77	104.90	-12.13	12.13	-12
Jul	114.60	122.10	-7.50	7.50	-2
Aug	157.30	168.70	-11.40	11.40	-11
Sep	164.00	173.30	-9.30	9.30	-8
Median	127.40	136.00	-9.00	9.00	

n	m
12	12

N= 12
 $\Sigma R = -78$

α
0.05
$W'_{\alpha,n}$
17

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

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

Wilcoxon-signed-ranks test

Exact Form

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

X Y

Site	#54	#62	Differences		
Year	WY2018	WY2018	D	 D 	Rank
Oct	7.70	7.53	0.17	0.17	8.5
Nov	7.66	7.65	0.01	0.01	1
Dec	7.79	7.67	0.12	0.12	4
Jan	7.60	7.45	0.15	0.15	7
Feb	7.88	7.74	0.14	0.14	6
Mar	7.72	7.59	0.13	0.13	5
Apr	7.71	7.54	0.17	0.17	8.5
May	7.53	7.31	0.22	0.22	10
Jun	7.68	7.74	-0.06	0.06	-2
Jul	7.68	7.77	-0.09	0.09	-3
Aug	7.77	6.97	0.80	0.80	12
Sep	7.91	8.13	-0.22	0.22	-11
Median	7.71	7.62	0.14	0.14	

n	m
12	12

N= 12
ΣR= 46

α
0.05
$W'_{\alpha,n}$
17

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

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

Wilcoxon-signed-ranks test

Exact Form

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

X Y

Site	#54	#62	Differences		
Year	WY2018	WY2018	D	 D 	Rank
Oct	46.60	49.40	-2.80	2.80	-7
Nov	52.80	63.40	-10.60	10.60	-12
Dec	50.40	54.50	-4.10	4.10	-10
Jan	32.30	36.00	-3.70	3.70	-9
Feb	56.10	60.50	-4.40	4.40	-11
Mar	45.90	48.20	-2.30	2.30	-5
Apr	43.00	45.10	-2.10	2.10	-4
May	35.20	36.60	-1.40	1.40	-3
Jun	37.40	38.60	-1.20	1.20	-1.5
Jul	38.00	41.40	-3.40	3.40	-8
Aug	57.10	55.90	1.20	1.20	1.5
Sep	59.10	61.80	-2.70	2.70	-6
Median	46.25	48.80	-2.75	2.75	

n	m
12	12

N= 12
ΣR= -75

α
0.05
$W'_{\alpha,n}$
17

$W^+_{=}$
1.5
p-test
0.000

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

Wilcoxon-signed-ranks test

Exact Form

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

Site	X	Y	Differences		
	#54	#62	D	 D 	Rank
Year	WY2018	WY2018			
Oct	11.0	12.1	-1.1	1.1	-8.5
Nov	15.2	16.4	-1.2	1.2	-10
Dec	13.9	14.5	-0.6	0.6	-2
Jan	7.9	7.8	0.1	0.1	1
Feb	19.5	20.8	-1.3	1.3	-11
Mar	17.1	18.1	-1.0	1.0	-5.5
Apr	14.7	15.5	-0.8	0.8	-4
May	8.6	9.7	-1.1	1.1	-7
Jun	10.1	14.0	-3.9	3.9	-12
Jul	11.9	12.6	-0.7	0.7	-3
Aug	15.1	16.2	-1.1	1.1	-8.5
Sep	18.6	19.6	-1.0	1.0	-5.5
Median	14.3	15.0	-1.0	1.0	

n	m
12	12

N= 12
ΣR= -76

α
0.05
$W'_{\alpha,n}$
17

$W^+_{=}$
1
p-test
0.000

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

Wilcoxon-signed-ranks test

Exact Form

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

X Y

Site	#54	#62	Differences		
Year	WY2018	WY2018	D	 D 	Rank
Oct	7.09	7.65	-0.56	0.56	-12
Nov	5.27	5.48	-0.21	0.21	-8
Dec	6.58	6.21	0.37	0.37	10.5
Jan	3.58	3.64	-0.06	0.06	-2
Feb	6.13	6.25	-0.12	0.12	-4
Mar	4.62	4.87	-0.25	0.25	-9
Apr	4.41	4.39	0.02	0.02	1
May	3.50	3.35	0.15	0.15	6
Jun	4.79	4.42	0.37	0.37	10.5
Jul	4.14	4.04	0.10	0.10	3
Aug	3.67	3.83	-0.16	0.16	-7
Sep	3.98	4.12	-0.14	0.14	-5
Median	4.52	4.41	-0.09	0.16	

n	m
12	12

N= 12
ΣR= -16

α
0.05
$W'_{\alpha,n}$
17

$W^+_{=}$
31
p-test
0.285

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

INTERPRETIVE REPORT

SITE 61

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

The data collected during the current water year are listed in the following “Table of Results for Water Year 2018” 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 one-half of the for the purpose of median calculation.

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

Sample Date	Parameter	Value	Qualifier	Notes
No outliers, in the past six years, have been identified by HGCMC.				

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

Table of Exceedance for Water Year 2018

Sample Date	Parameter	Value	Limits		Hardness
			Lower	Upper	
No exceedances have been identified by HGCMC for the period of October 2017 through September 2018.					

As a result of the monitoring and reporting for Water Year 2013, HGCMC increased the sample frequency to monthly for Site 61. The first sample collected at Site 61 (6 May 2013) was in exceedance for cadmium, mercury, selenium, and zinc. The level of metal loading observed in that initial sampling has not been observed since then. HGCMC returned to sampling Site 61 on a quarterly basis after the August 2015 sampling event. Two exceedances for dissolved cadmium in 2016 were slightly above the hardness based AWQS, however cadmium concentrations decreased in 2017 and were below the AWQS. The down gradient monitoring site (Site 62) that receives the water monitored at Site 61 was well below the AWQS for monitored analytes.

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 (less than 6 years) amount of data, visual trend analysis and statistical analysis of the data was not performed.

Table of Results for Water Year 2018

Site 061FMS - 'Greens Creek Floodplain'

Sample Date/Parameter	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018	Median
Water Temp (°C)		3.4			0.4			5.2			8.3		4.3
Conductivity-Field(µmho)		398			459			521.2			433.5		446.3
Conductivity-Lab (µmho)		354			296			475			397		376
pH Lab (standard units)		7.29			7.08			6.93			7.17		7.13
pH Field (standard units)		7.56			7.33			7.17			7.27		7.30
Total Alkalinity (mg/L)		123			123			126			120		123.0
Total Sulfate (mg/L)		73.9			89.7			148			85.9		87.8
Hardness (mg/L)		200			222			281			207		214.5
Dissolved As (ug/L)		0.203			0.163			0.21			0.227		0.207
Dissolved Ba (ug/L)		46.3			51.8								49.1
Dissolved Cd (ug/L)		0.379			0.29			0.21			0.355		0.3225
Dissolved Cr (ug/L)		0.29			0.194								0.242
Dissolved Cu (ug/L)		0.245			0.245			0.342			0.435		0.294
Dissolved Pb (ug/L)		0.0532			0.0327			0.0094			0.025		0.0289
Dissolved Ni (ug/L)		1.94			2.16								2.050
Dissolved Ag (ug/L)		0.002			0.002								0.002
Dissolved Zn (ug/L)		111			107			52			84.3		95.65
Dissolved Se (ug/L)		1.09			1.04								1.065
Dissolved Hg (ug/L)		0.000151			0.000163			0.000366			0.000398		0.000265

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

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

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

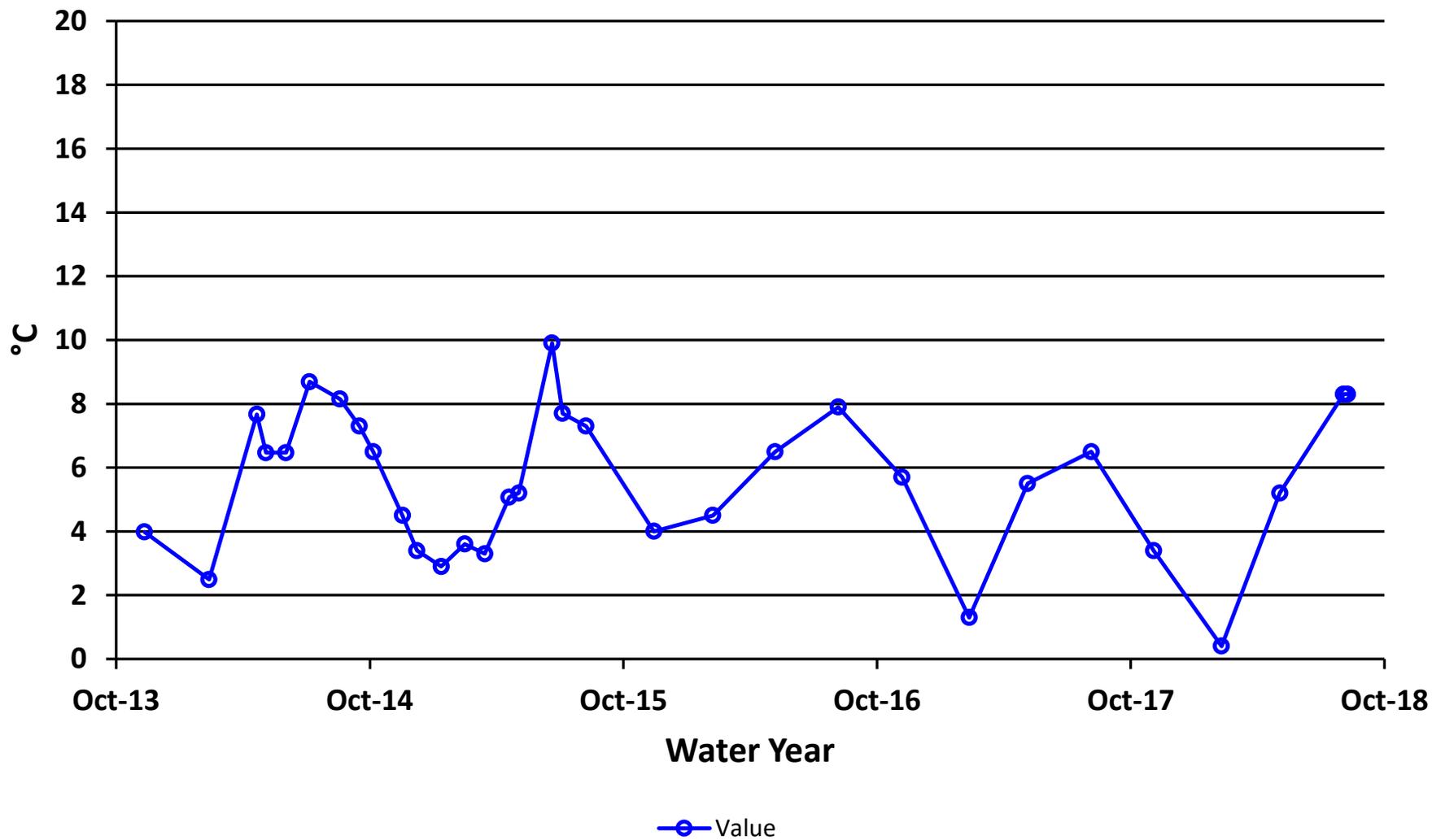
Qualified Data by QA Reviewer

Date Range: 10/01/2017 to 09/30/2018

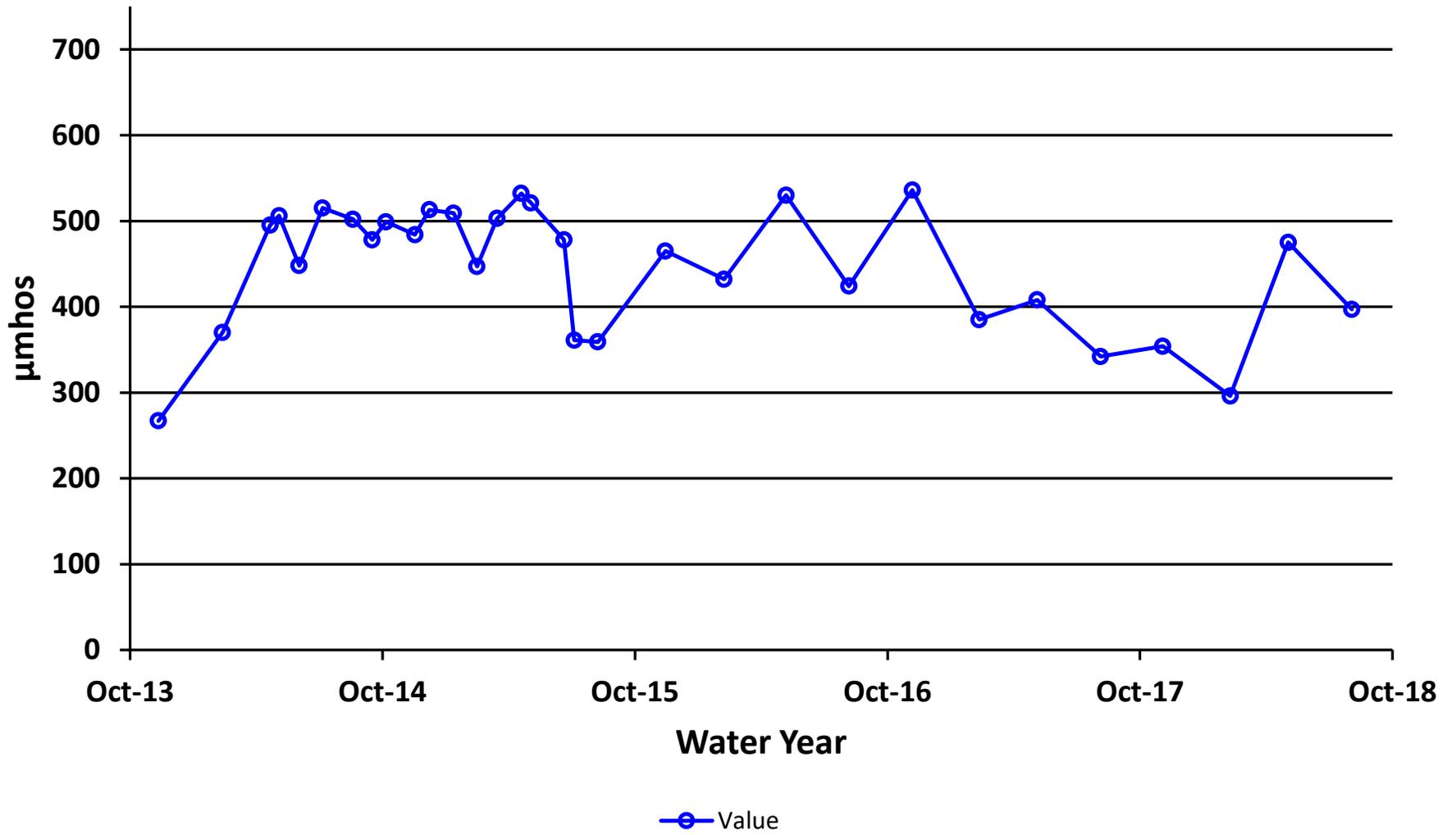
Site No.	Sample Date	Parameter	Value		Qualifier	Reason for Qualifier
061FMS	11/6/2017	Diss. Hg-CVAF	0.0002	µg/L	J	Below Quantitative Range
	2/12/2018	Diss. Hg-CVAF	0.0002	µg/L	J	Below Quantitative Range
		pH	7.08	pH units	J	Hold Time Violation
	5/7/2018	pH	6.93	pH units	J	Hold Time Violation
8/7/2018	pH	7.17	pH units	J	Hold Time Violation	

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

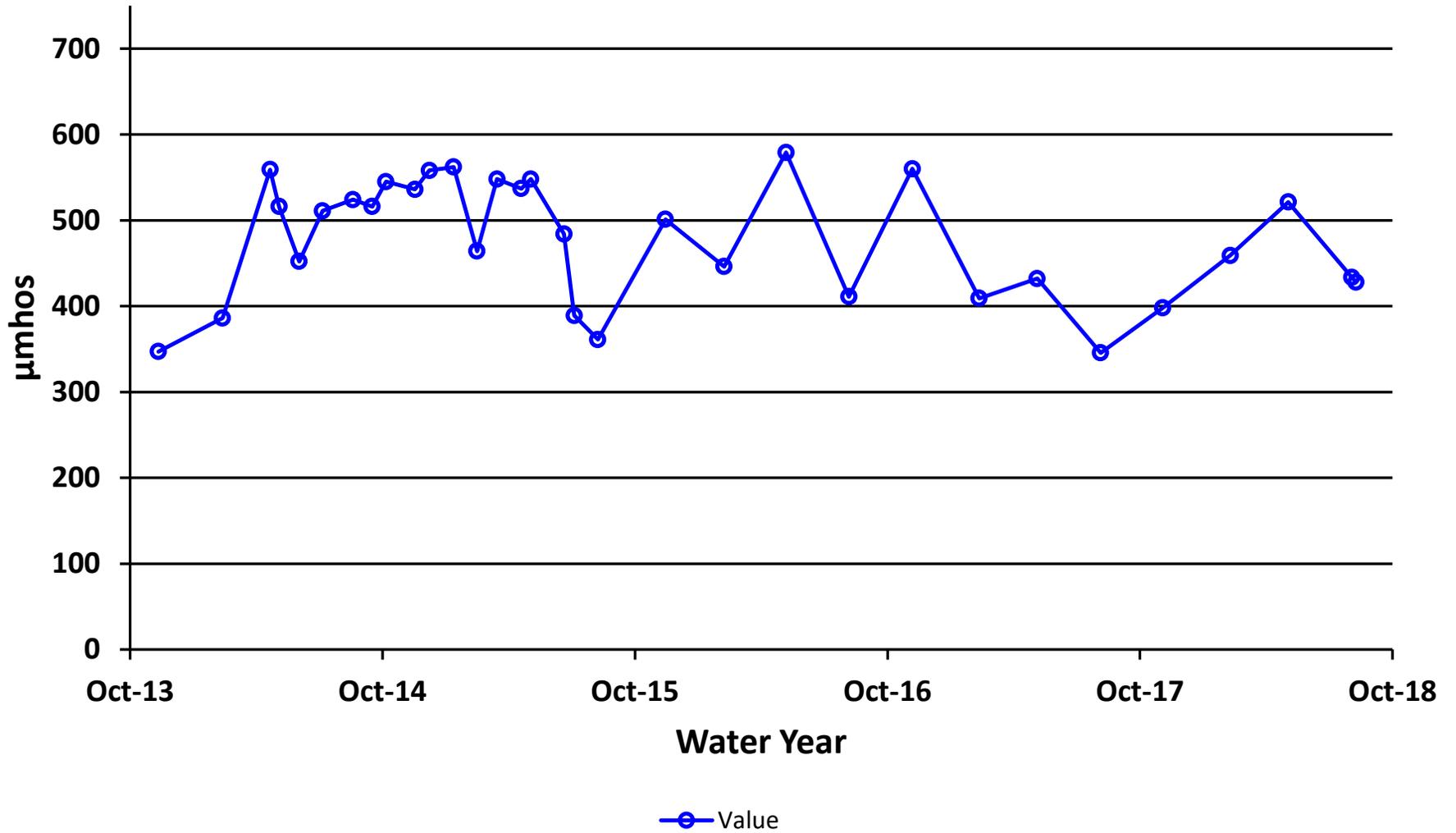
Site 61 - Water Temperature



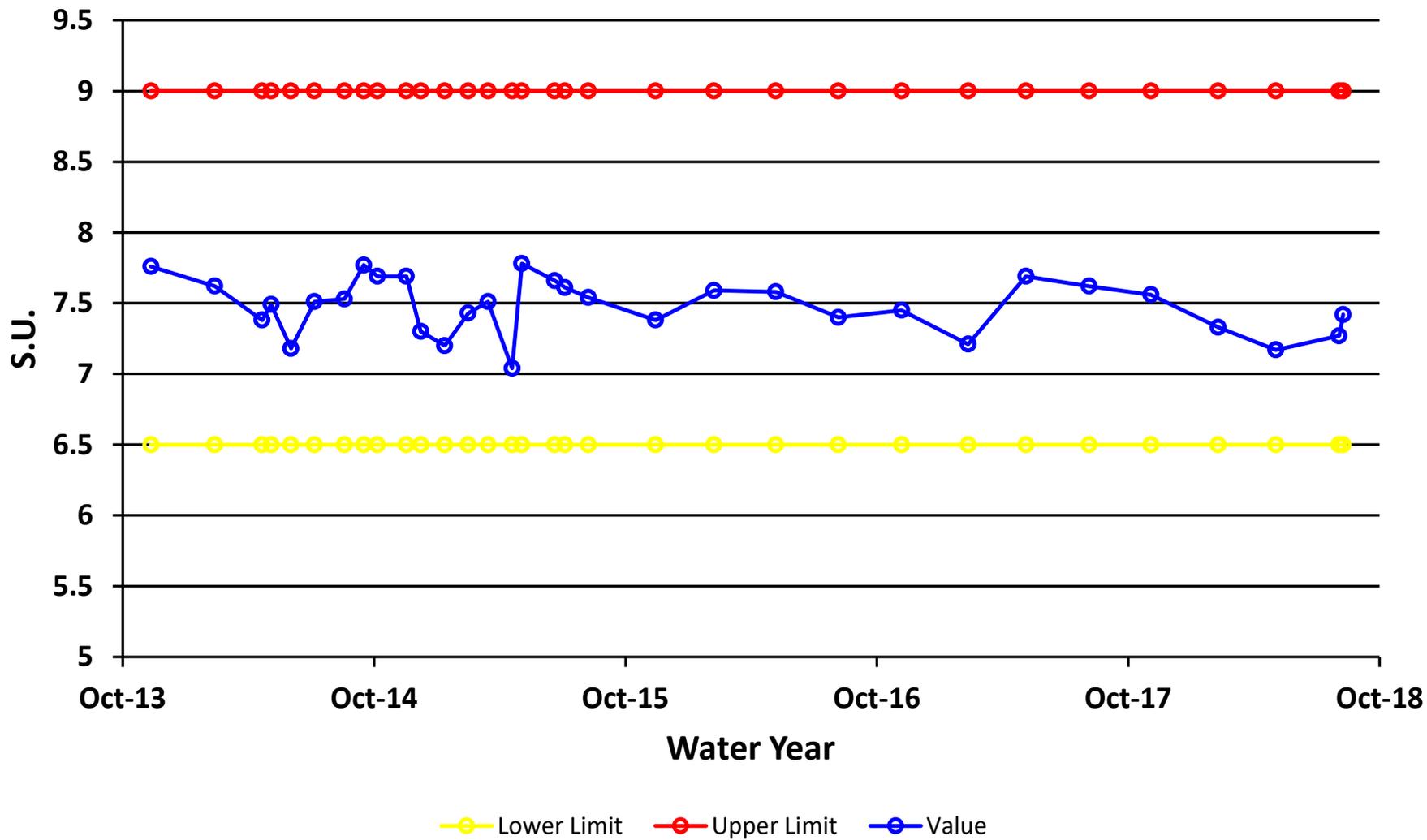
Site 61 - Conductivity Laboratory



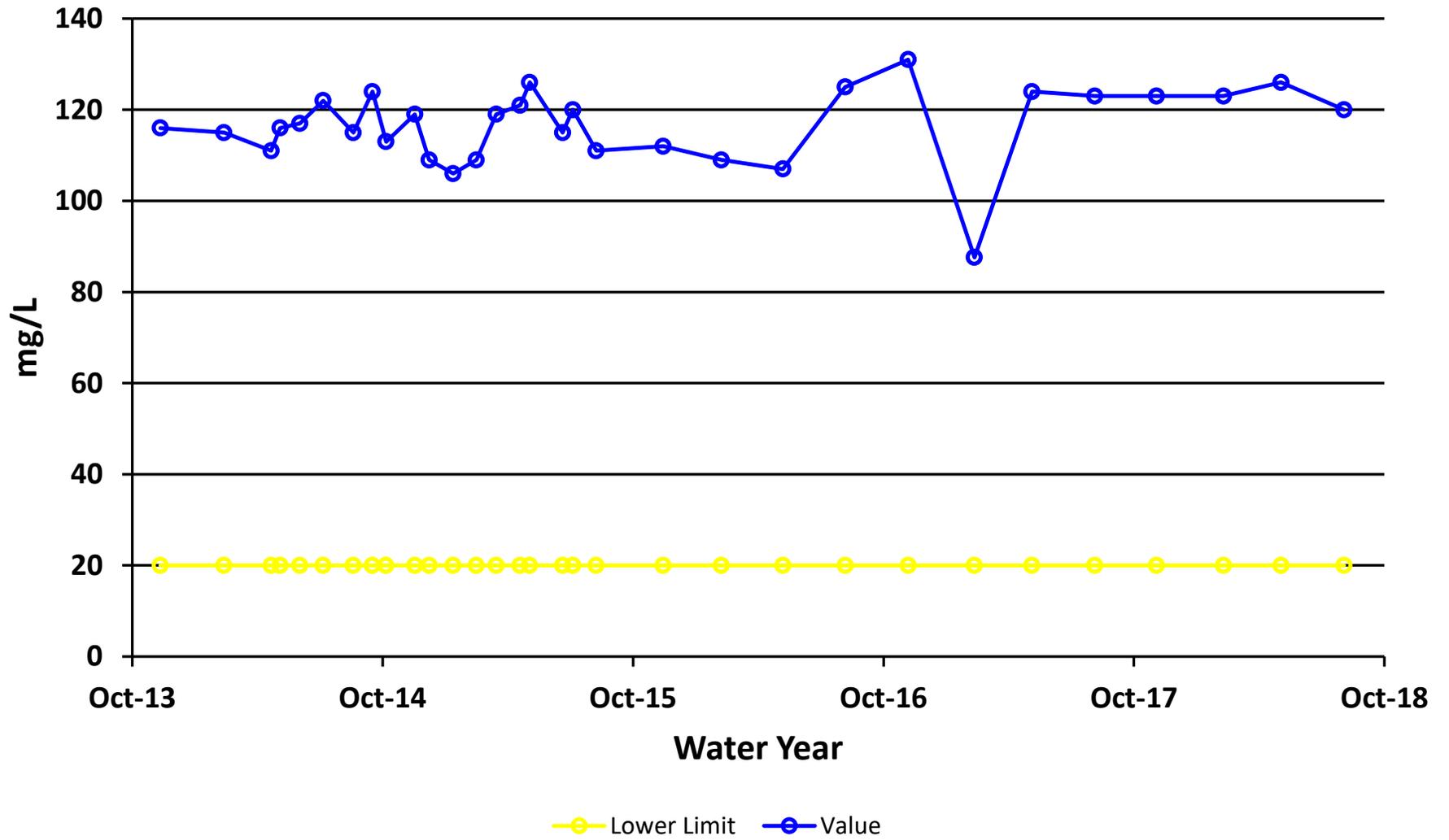
Site 61 - Conductivity Field



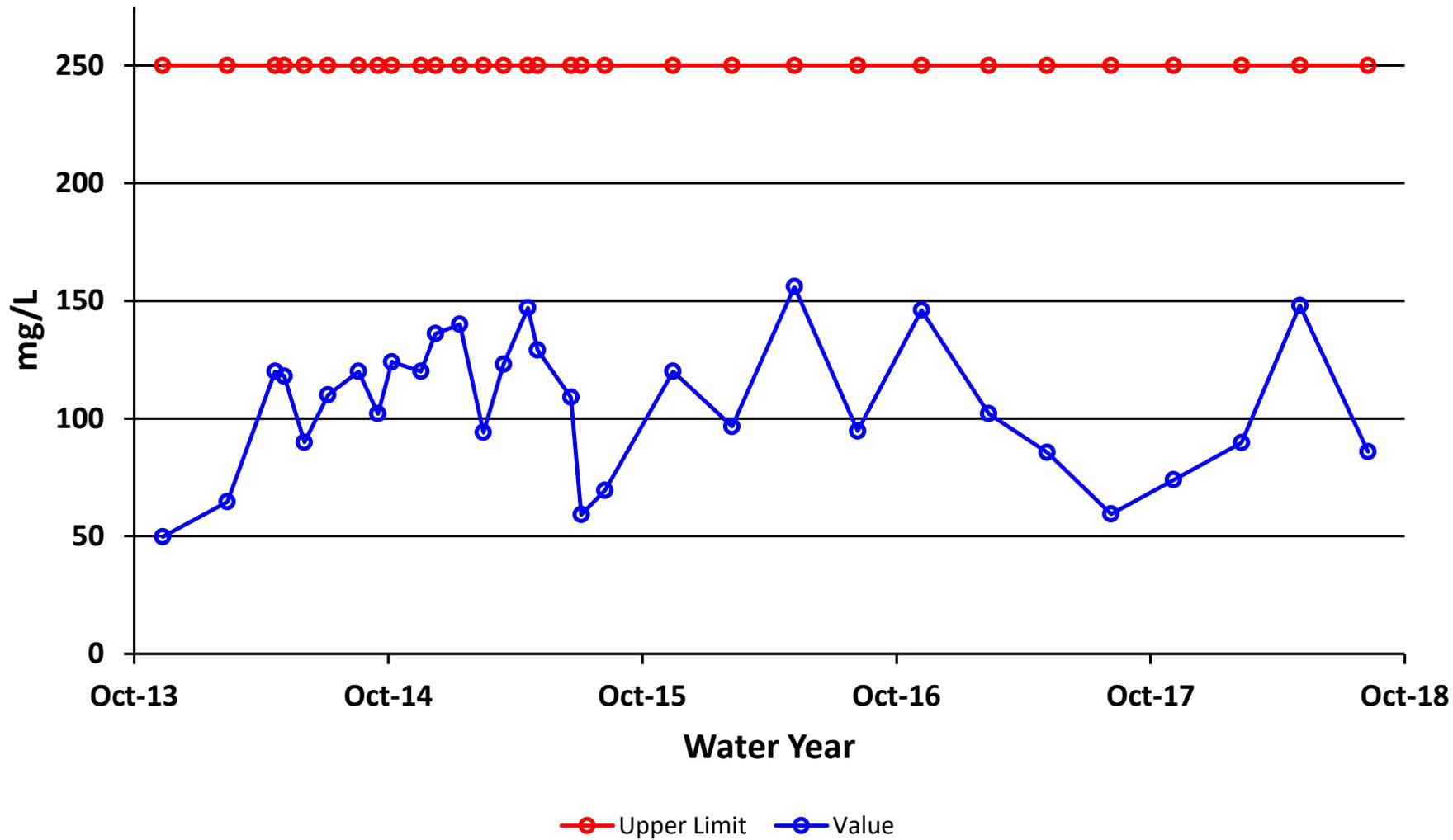
Site 61 - pH Field



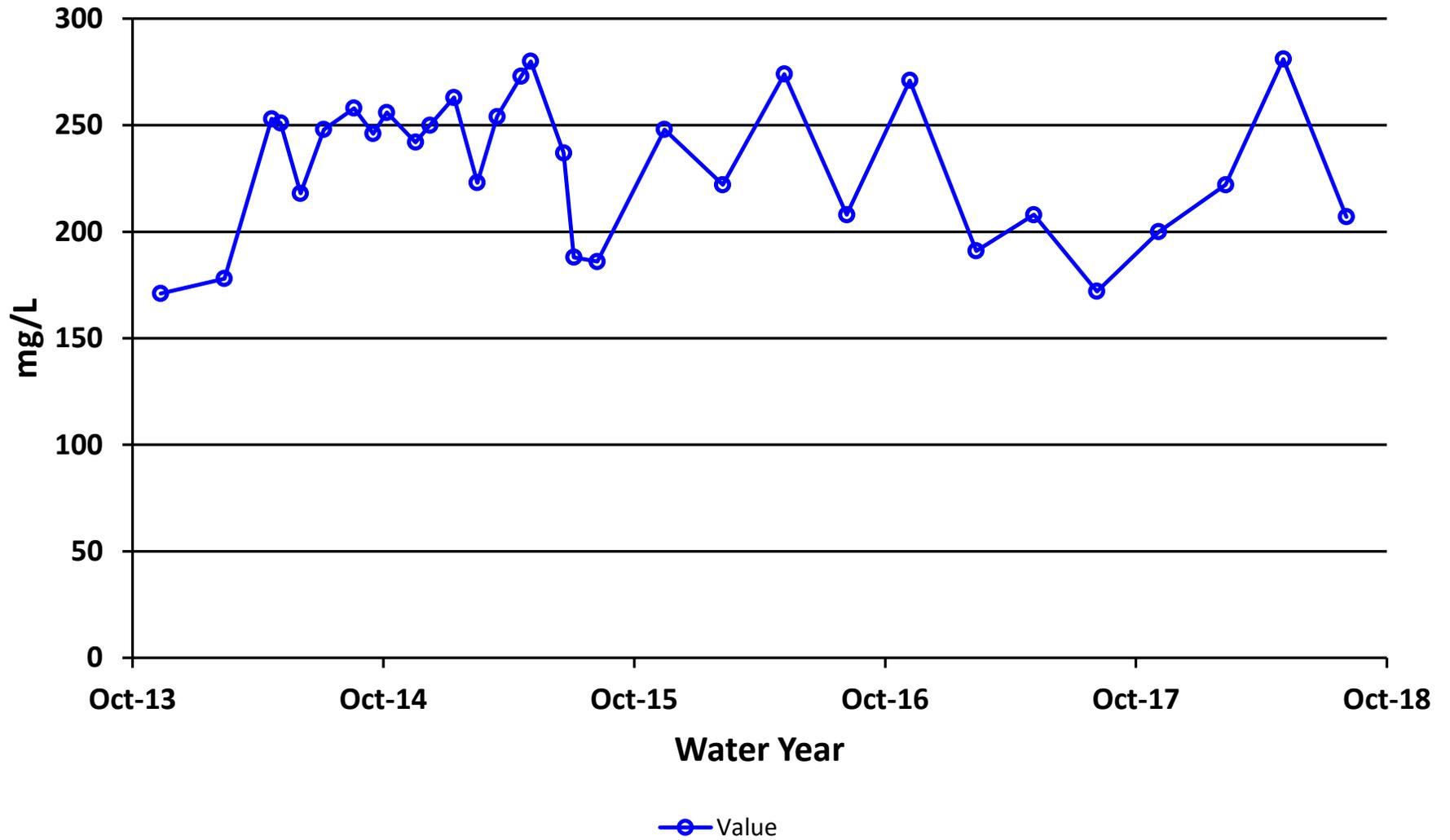
Site 61 - Alkalinity



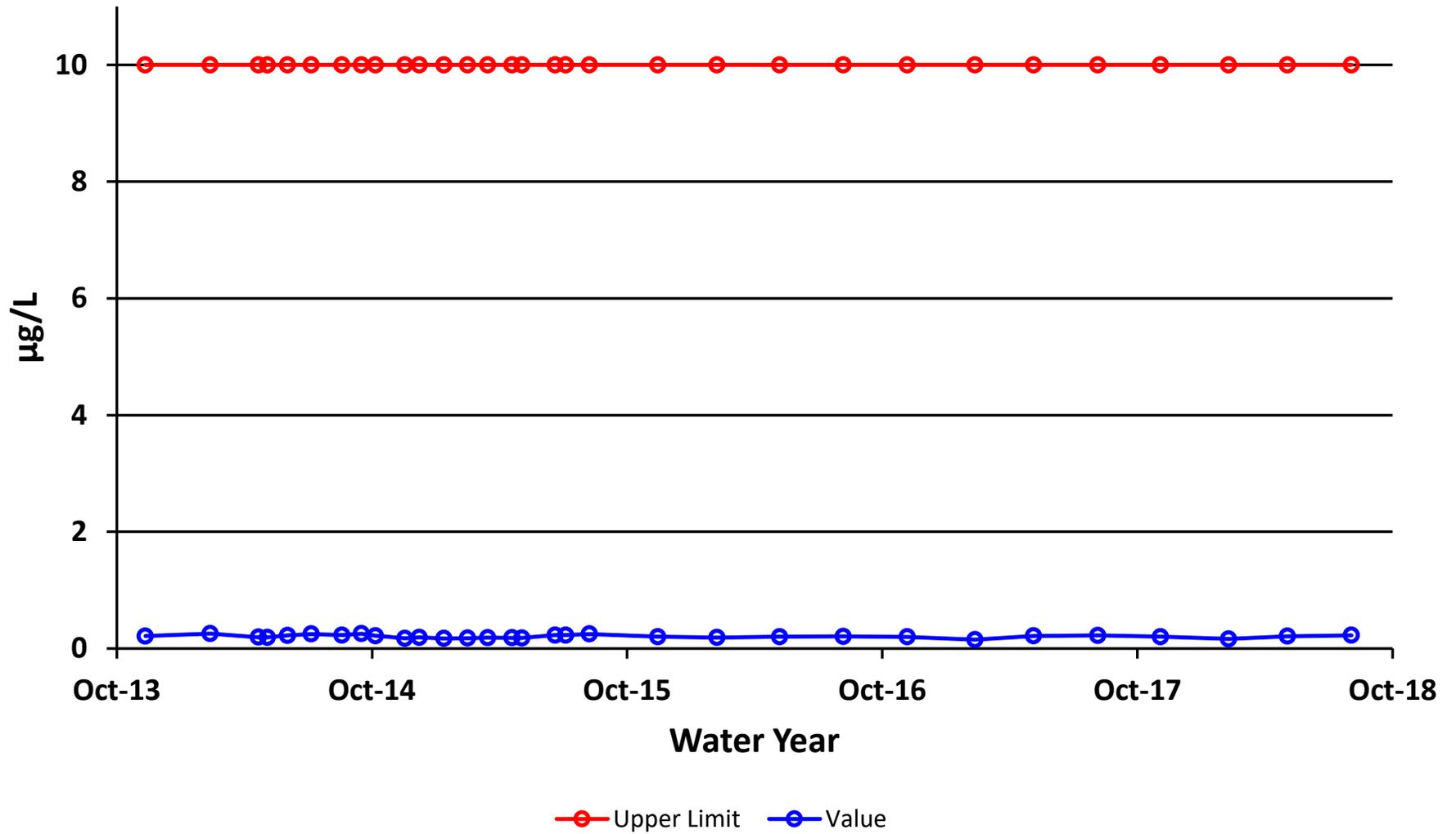
Site 61 - Sulfate



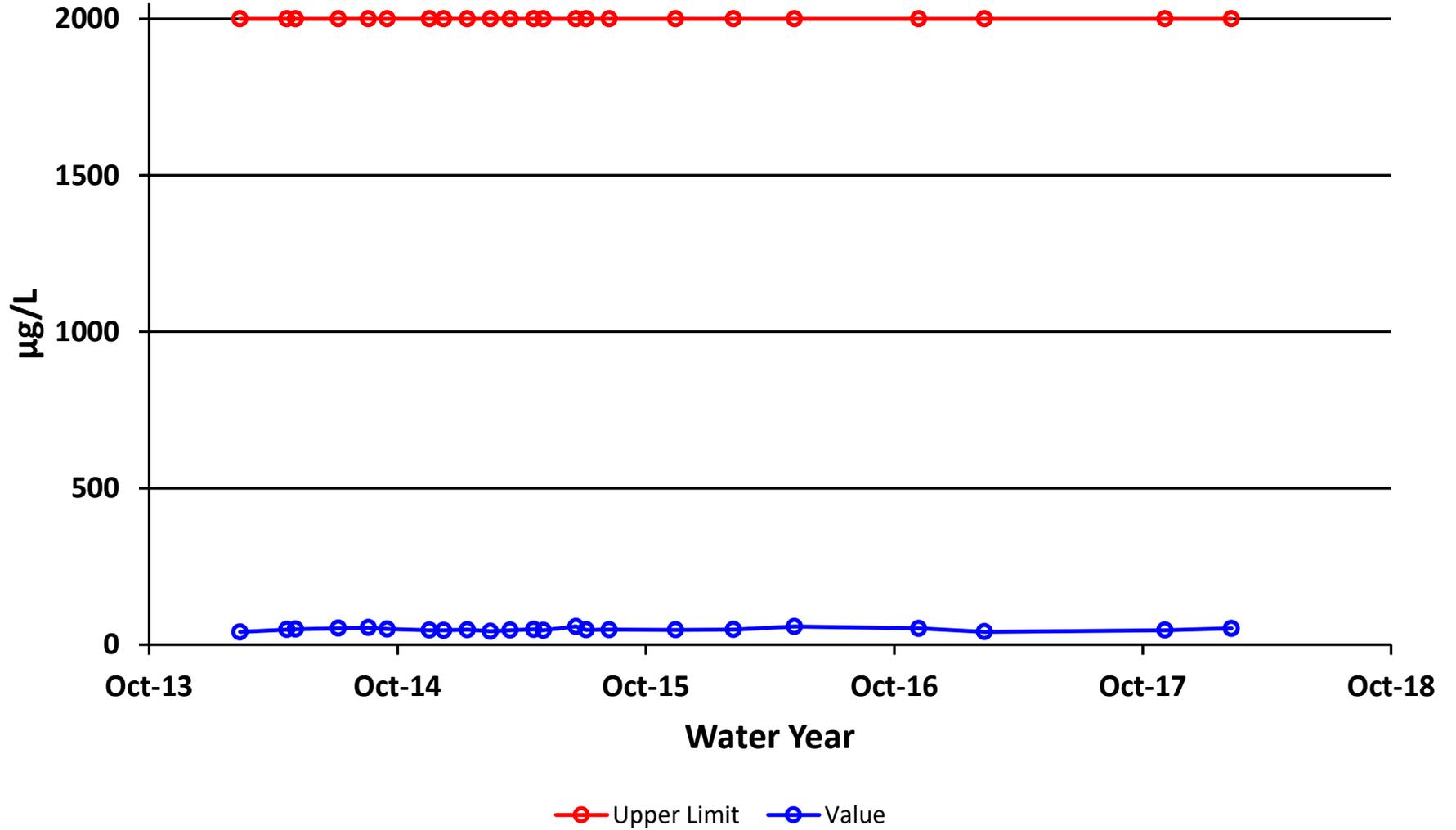
Site 61 - Hardness



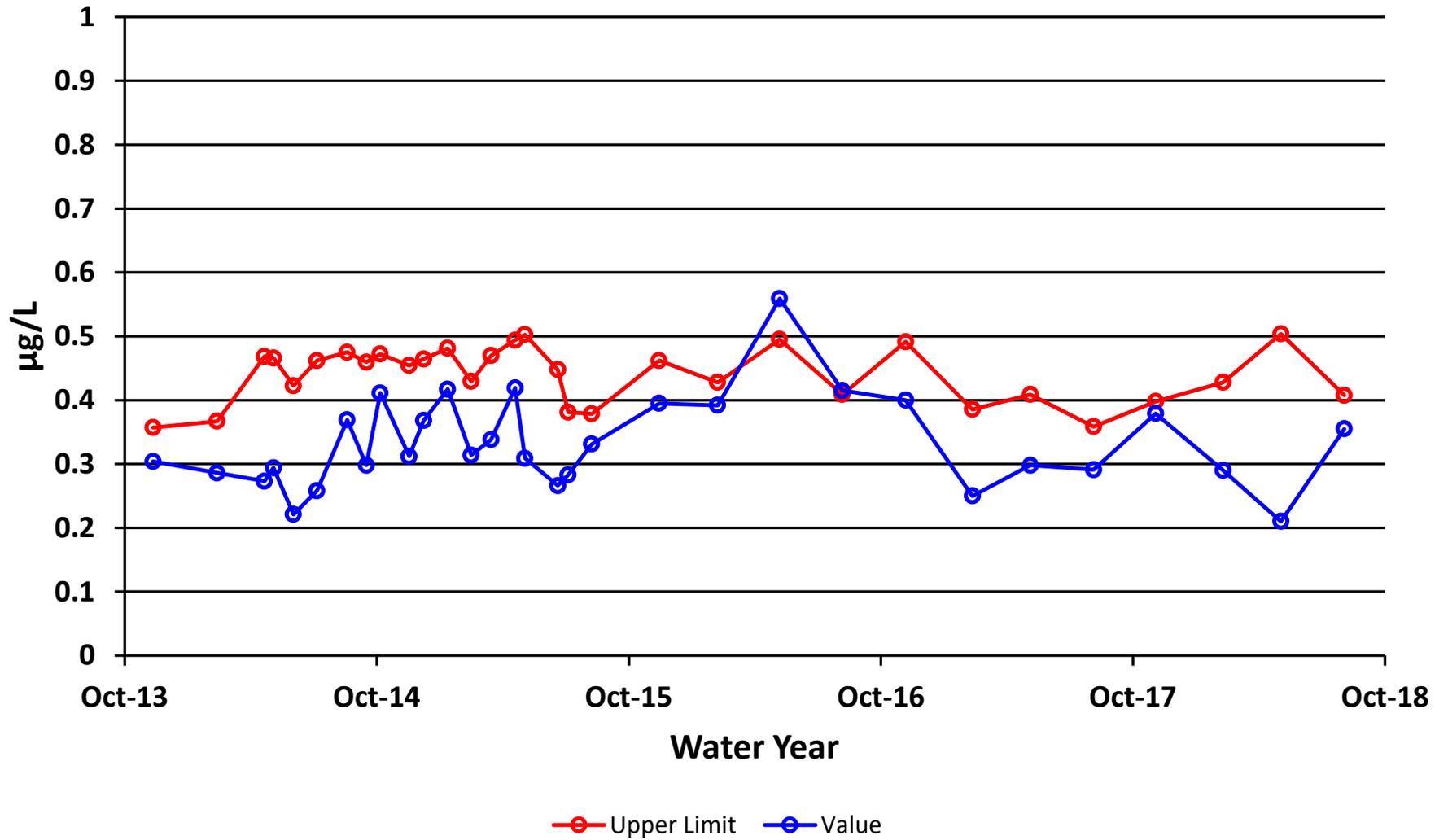
Site 61 - Arsenic Dissolved



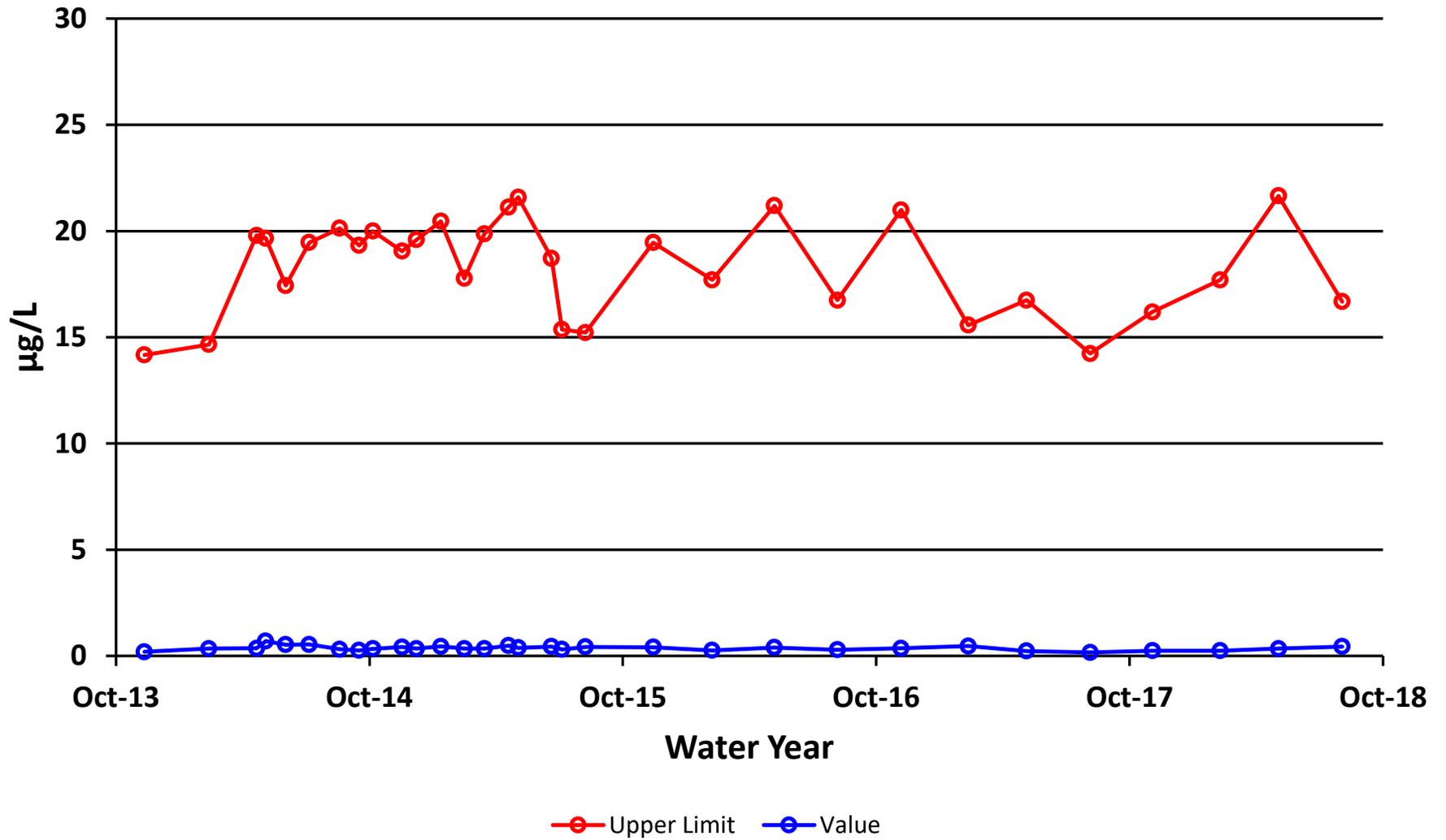
Site 61 - Barium Dissolved



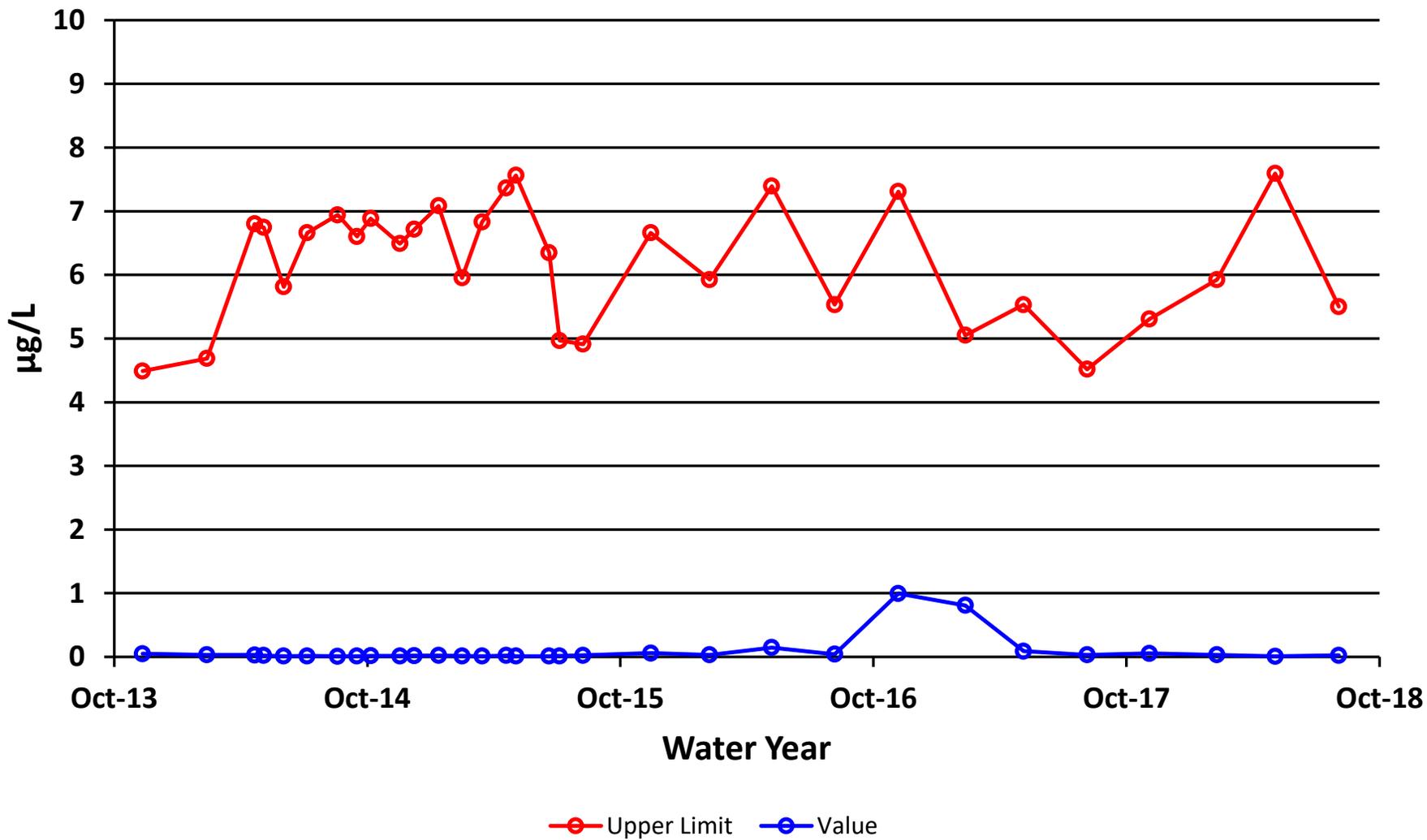
Site 61 - Cadmium Dissolved



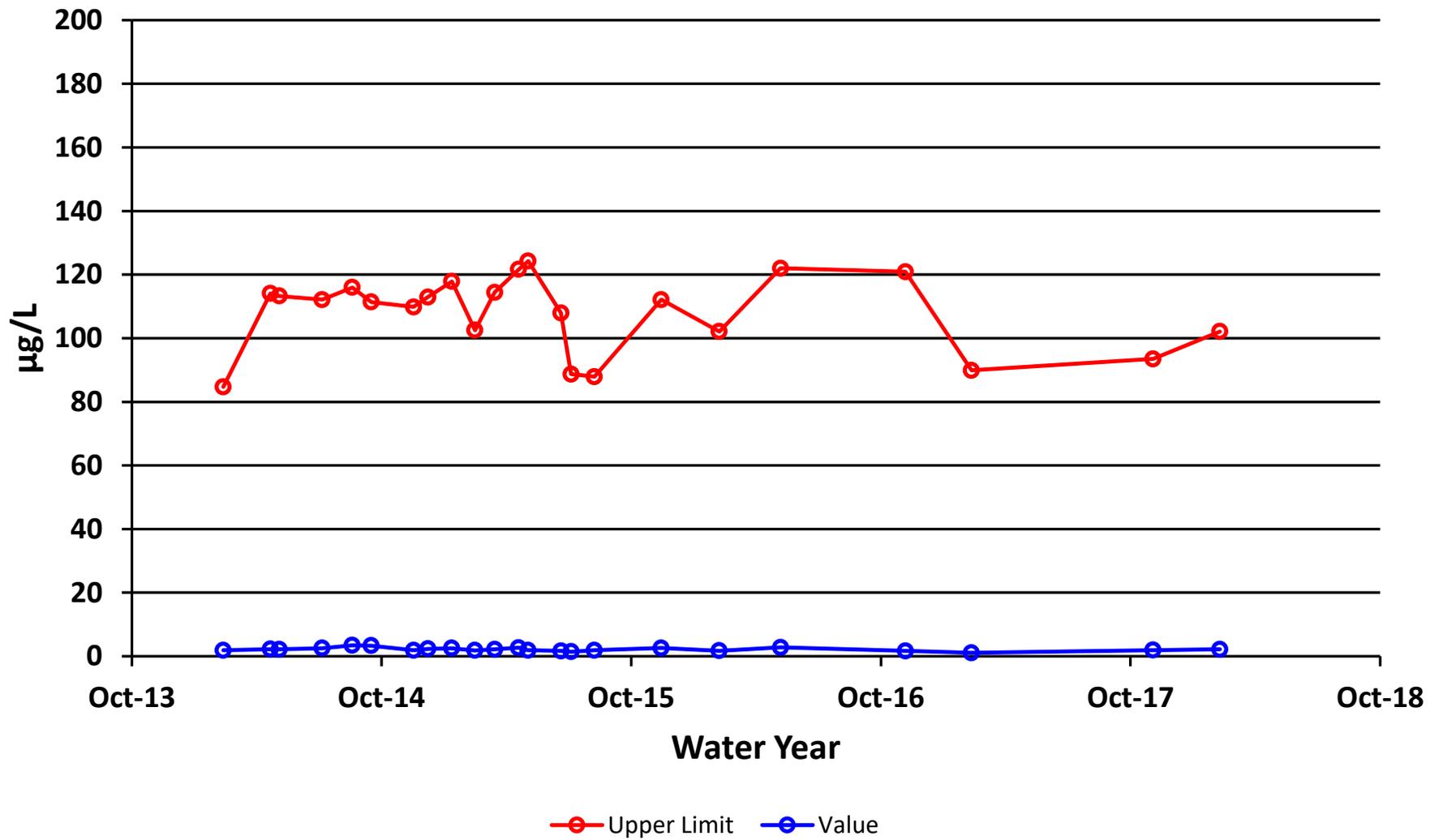
Site 61 - Copper Dissolved



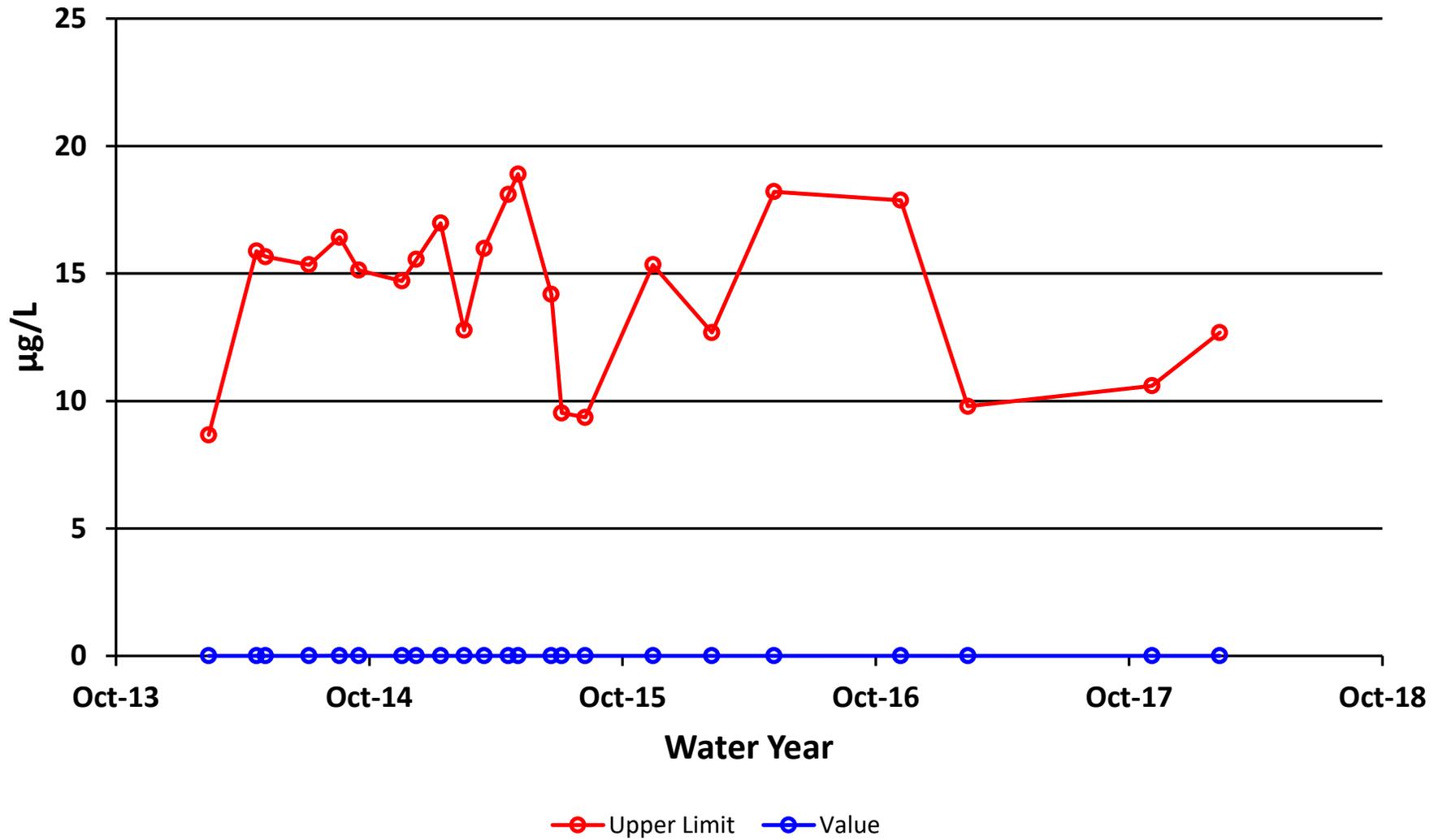
Site 61 - Lead Dissolved



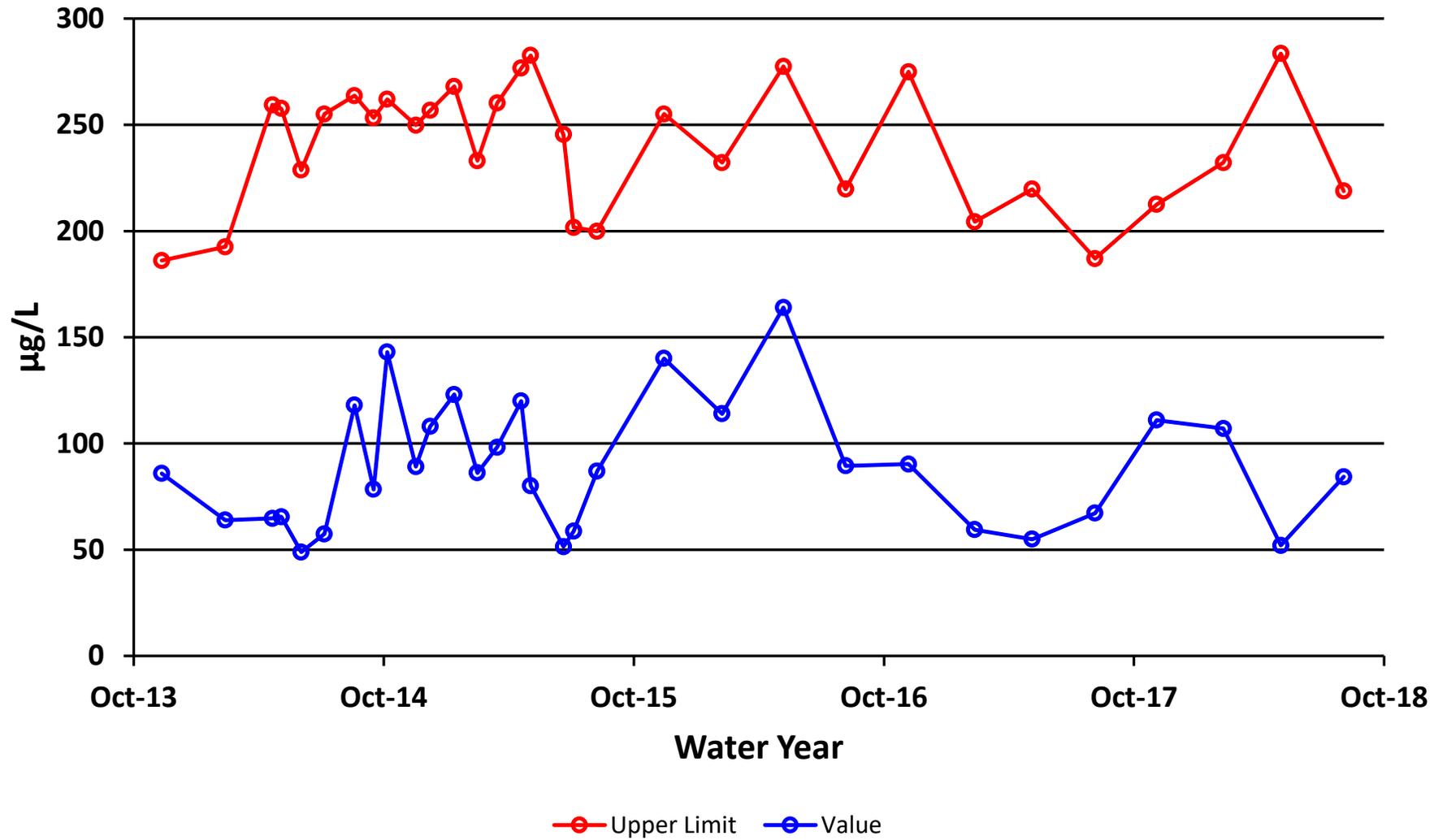
Site 61 - Nickel Dissolved



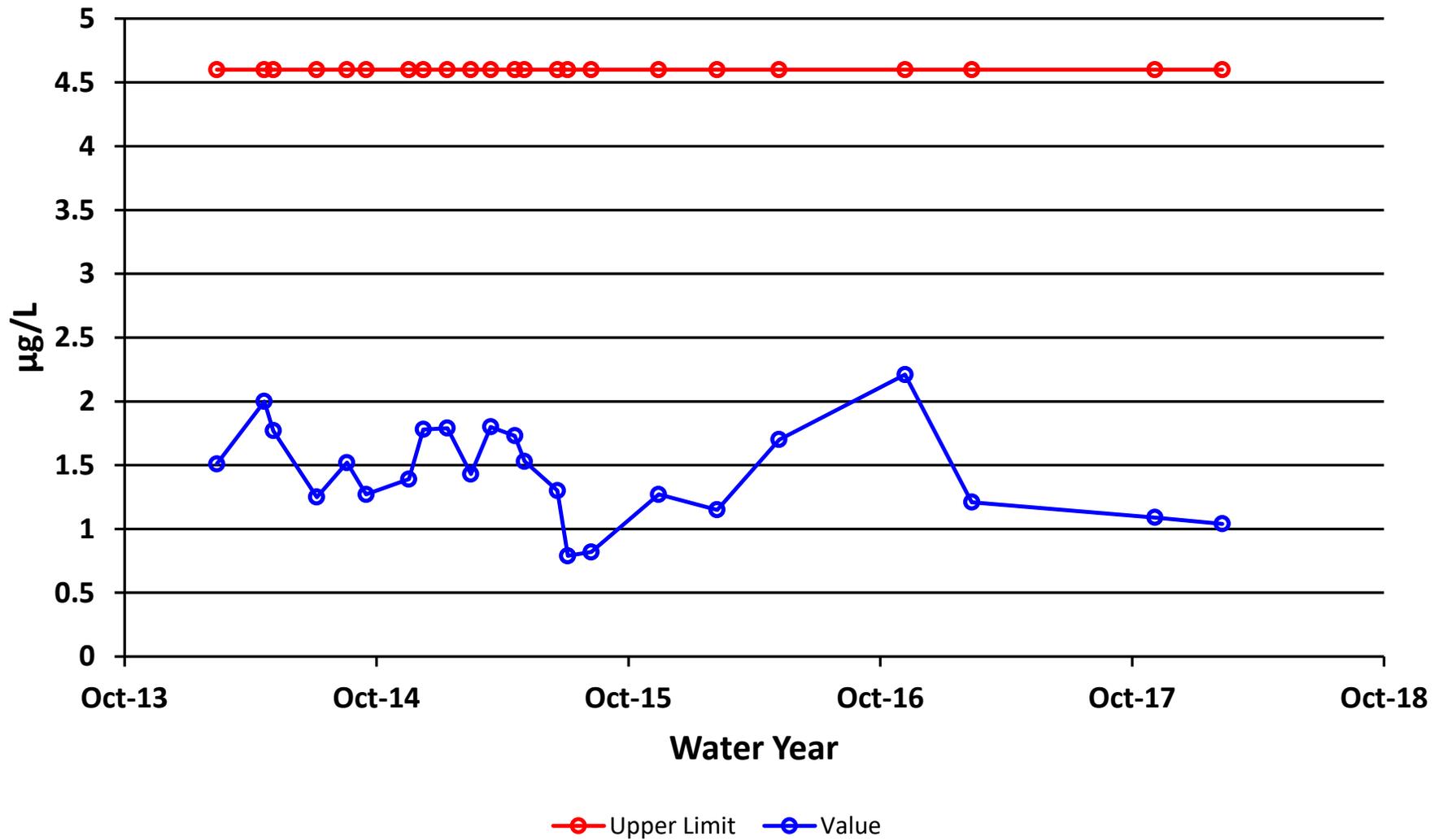
Site 61 - Silver Dissolved



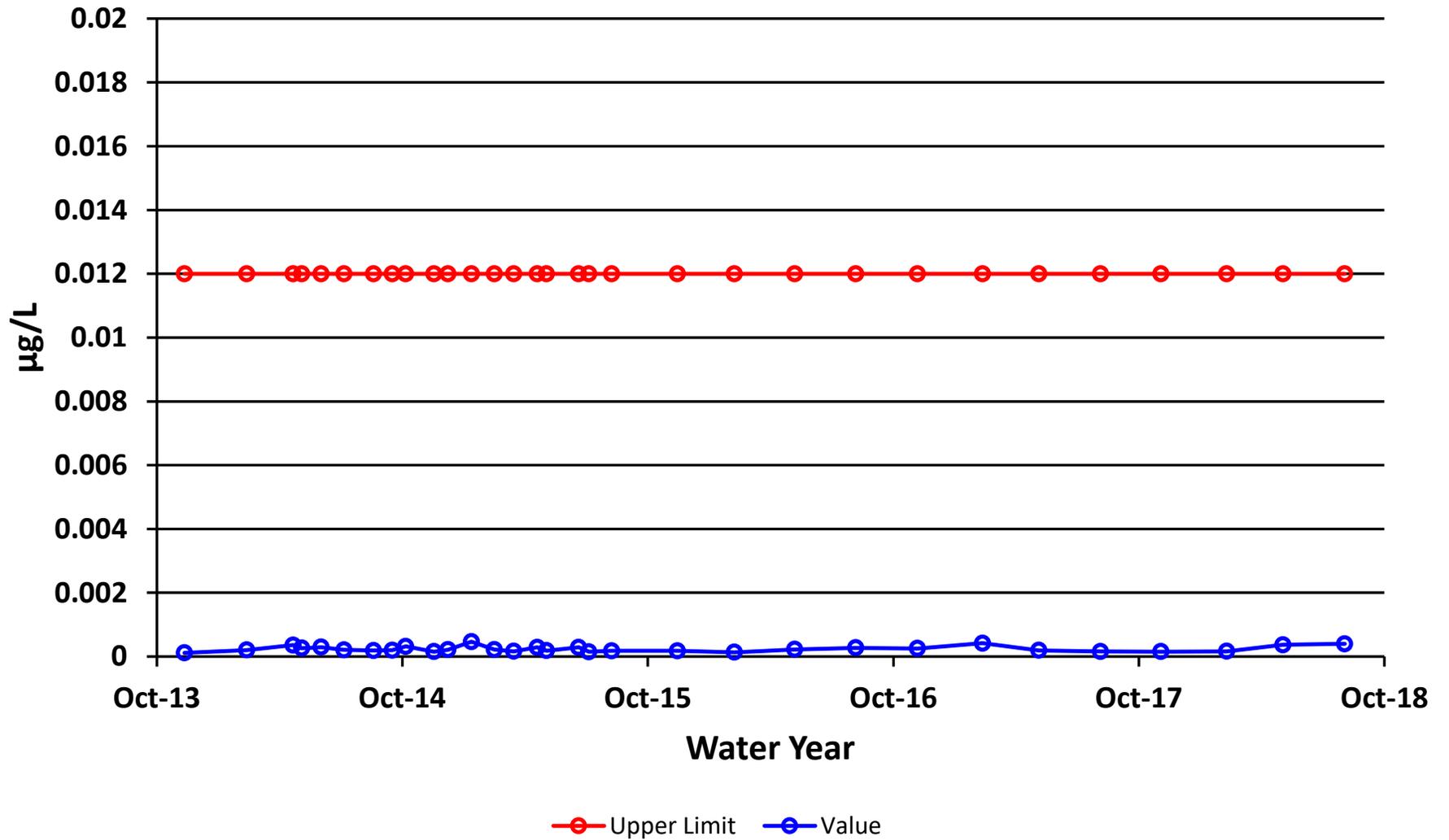
Site 61 - Zinc Dissolved



Site 61 - Selenium Dissolved



Site 61 - Mercury Dissolved



INTERPRETIVE REPORT

SITE 49

The data collected during the current water year are listed in the following “Table of Results for Water Year 2018” 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 one-half of the for the purpose of median calculation.

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

Sample Date	Parameter	Value	Qualifier	Notes
No outliers, in the past six years, have been identified by HGCMC.				

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

Table of Exceedance for Water Year 2018

Sample Date	Parameter	Value	Limits		
			Lower	Upper	Hardness
No exceedances have been identified by HGCMC for the period of October 2017 through September 2018.					

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 obvious trends identified.

A non-parametric statistical analysis for trend was performed for specific conductivity, field pH, total alkalinity, total sulfate, and dissolved zinc. Calculation details of the Seasonal Kendall analyses are presented in detail on the pages following this interpretive section. The below table summarizes the results on the data collected between Oct-12 and Sep-18 (WY2013-WY2018).

Site 49 - Table of Summary Statistics for Trend Analysis

Parameter	<u>Mann-Kendall test statistics</u>			<u>Sen's slope estimate</u>	
	n*	p**	Trend	Q	Q(%)
Conductivity Field	6	0.26			
pH Field	6	0.39			
Alkalinity, Total	6	0.61			
Sulfate, Total	6	0.17			
Zinc, Dissolved	6	0.17			

* 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. There were no statistically significant trends identified at Site 49 during the reporting period.

Table of Results for Water Year 2018

Site 049FMS - 'Upper Bruin Creek'

Sample Date/Parameter	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018	Median
Water Temp (°C)		1.4			0.1			4.4			11.3		2.9
Conductivity-Field(µmho)		150			216.1			103.4			200.5		175.3
Conductivity-Lab (µmho)		147			202			94			198		173
pH Lab (standard units)		7.29			7.32			7.49			7.26		7.31
pH Field (standard units)		8			7.65			7.7			7.85		7.78
Total Alkalinity (mg/L)		67.7			80			43			77.7		72.7
Total Sulfate (mg/L)		10.5			19			6.5			13.1		11.8
Hardness (mg/L)		78.7			111			50.8			100		89.4
Dissolved As (ug/L)		0.189			0.142			0.137			0.21		0.166
Dissolved Ba (ug/L)		9.6			13.1								11.4
Dissolved Cd (ug/L)		0.0269			0.0305			0.0228			0.0329		0.0287
Dissolved Cr (ug/L)		0.173			0.128								0.151
Dissolved Cu (ug/L)		0.375			0.252			0.457			0.527		0.416
Dissolved Pb (ug/L)		0.0055			0.0015			0.0041			0.0092		0.0048
Dissolved Ni (ug/L)		0.644			0.703								0.674
Dissolved Ag (ug/L)		0.002			0.002								0.002
Dissolved Zn (ug/L)		2.26			2.07			1.64			1.67		1.87
Dissolved Se (ug/L)		0.482			1.05								0.766
Dissolved Hg (ug/L)		0.00108			0.000651			0.00178			0.00129		0.001185

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

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

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

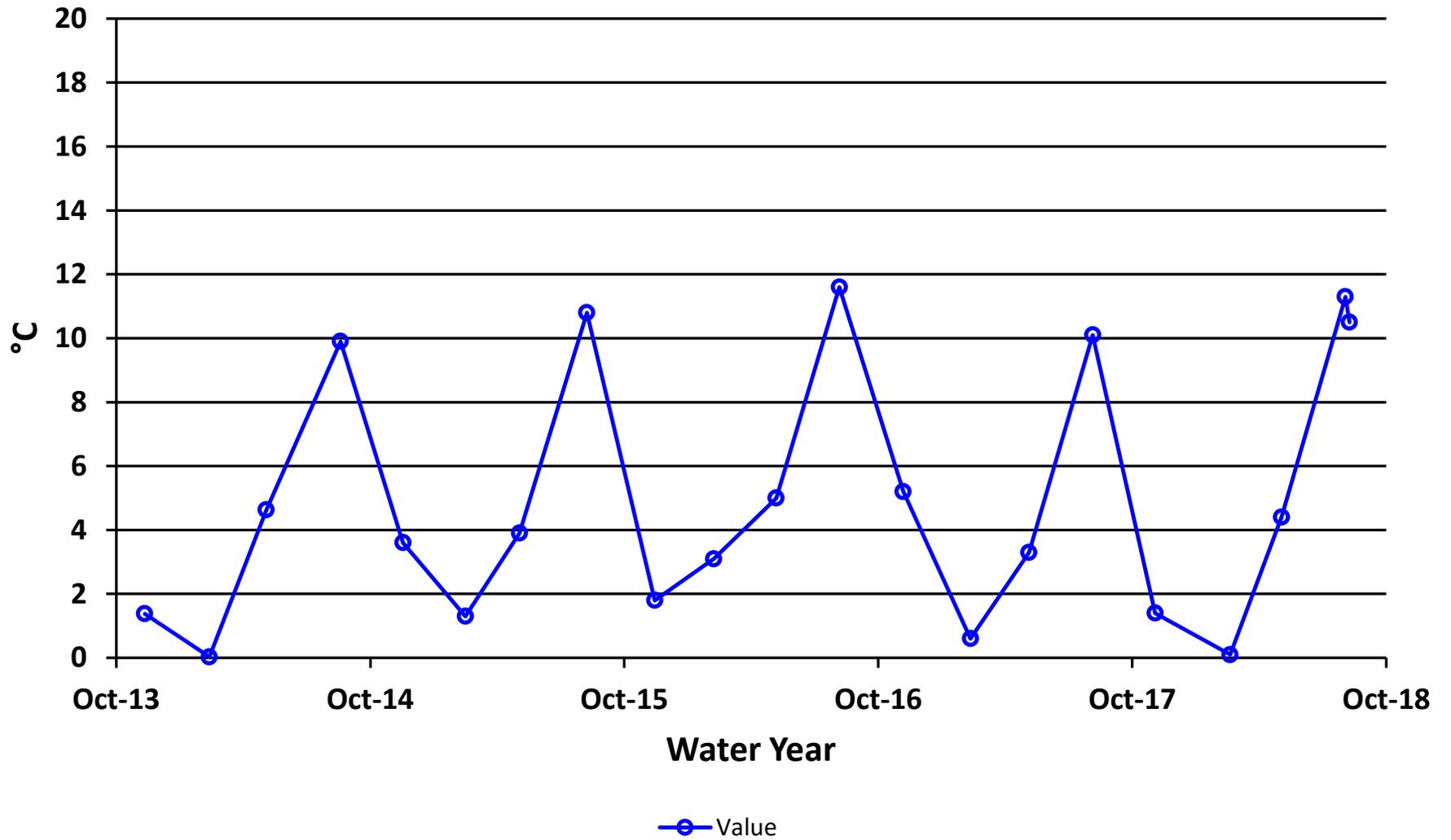
Qualified Data by QA Reviewer

Date Range: 10/01/2017 to 09/30/2018

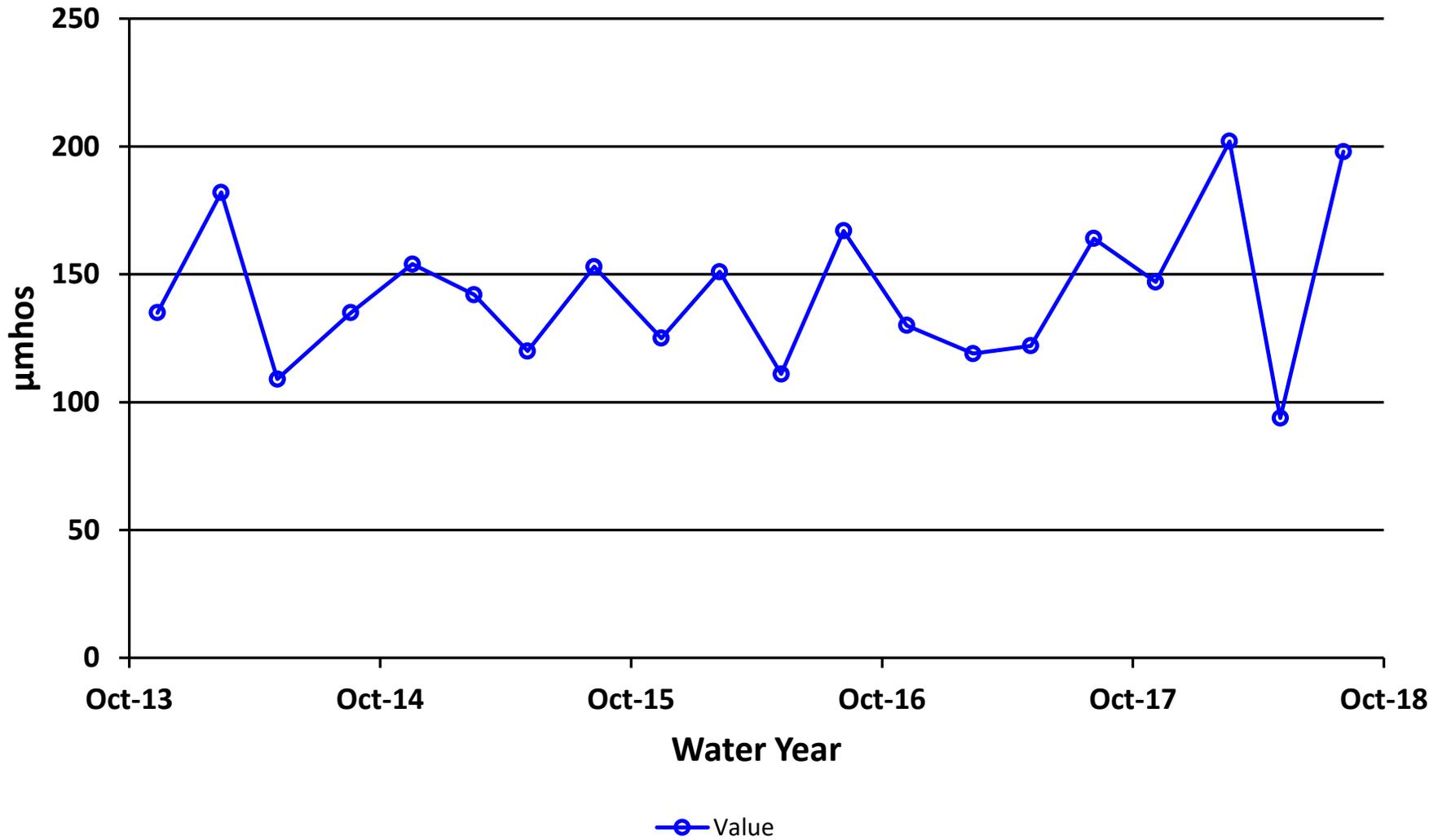
Site No.	Sample Date	Parameter	Value		Qualifier	Reason for Qualifier
049FMS	11/6/2017	Diss. Cr-ICP/MS	0.17	µg/L	J	Below Quantitative Range
		Diss. Pb-ICP/MS	0.0055	µg/L	J	Below Quantitative Range
	2/22/2018	Diss. Cr-ICP/MS	0.12	µg/L	J	Below Quantitative Range
		pH	7.32	pH units	J	Hold Time Violation
	5/7/2018	Diss. Pb-ICP/MS	0.0041	µg/L	J	Below Quantitative Range
		pH	7.49	pH units	J	Hold Time Violation
	8/7/2018	Diss. Zn-ICP/MS	1.67	µg/L	U	Field Blank Contamination
		pH	7.26	pH units	J	Hold Time Violation

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

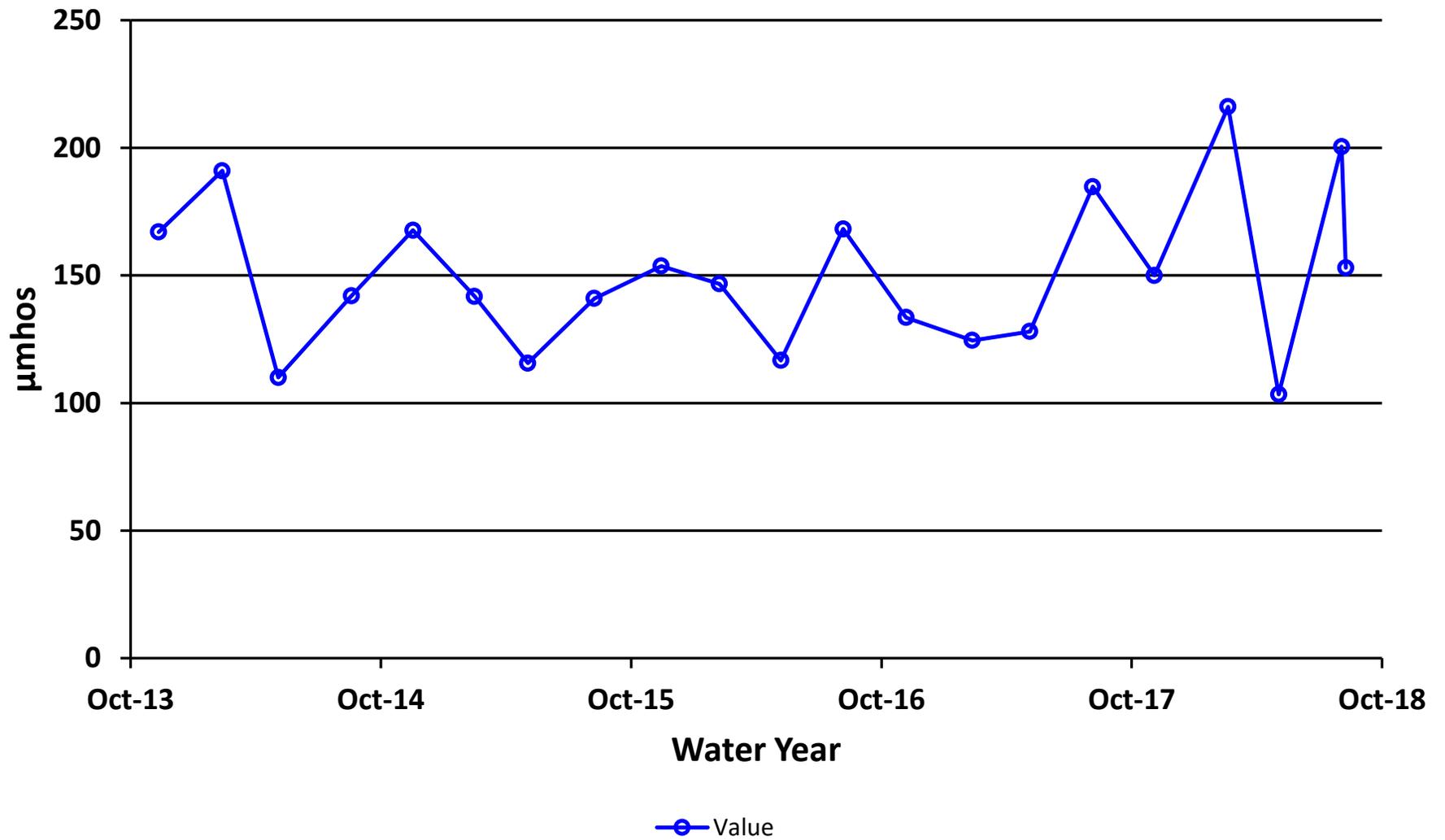
Site 49 - Water Temperature



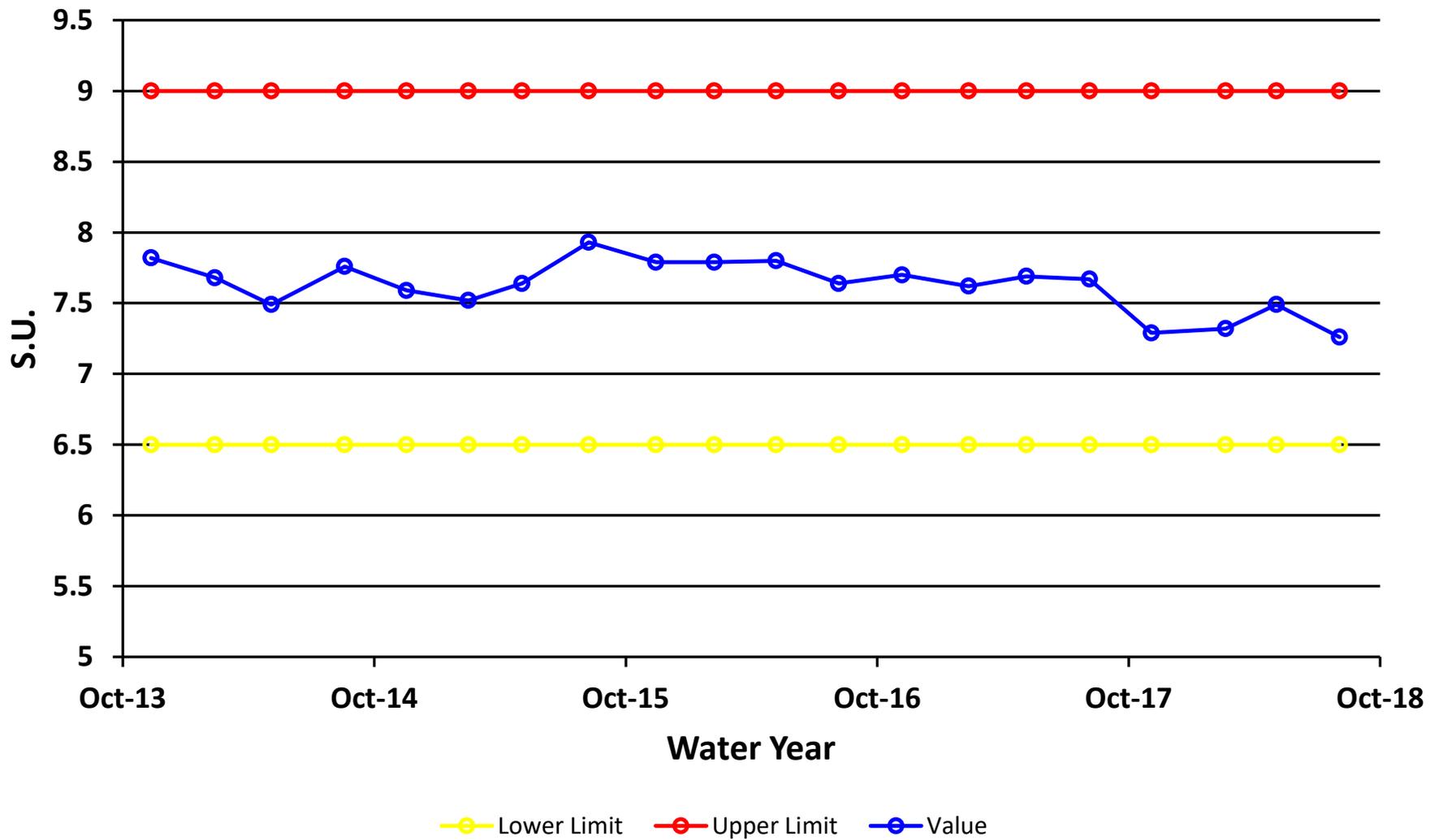
Site 49 - Conductivity Laboratory



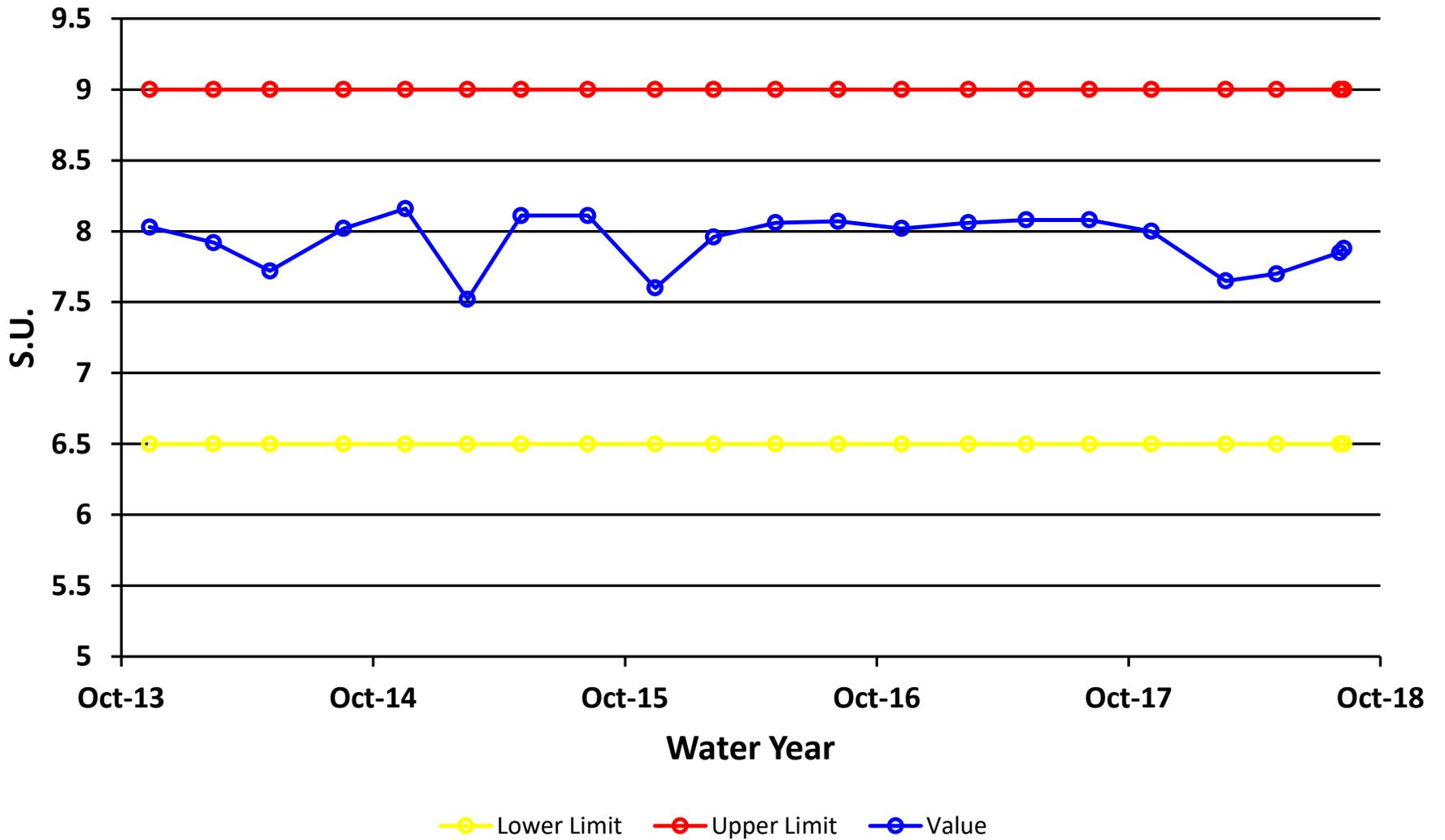
Site 49 - Conductivity Field



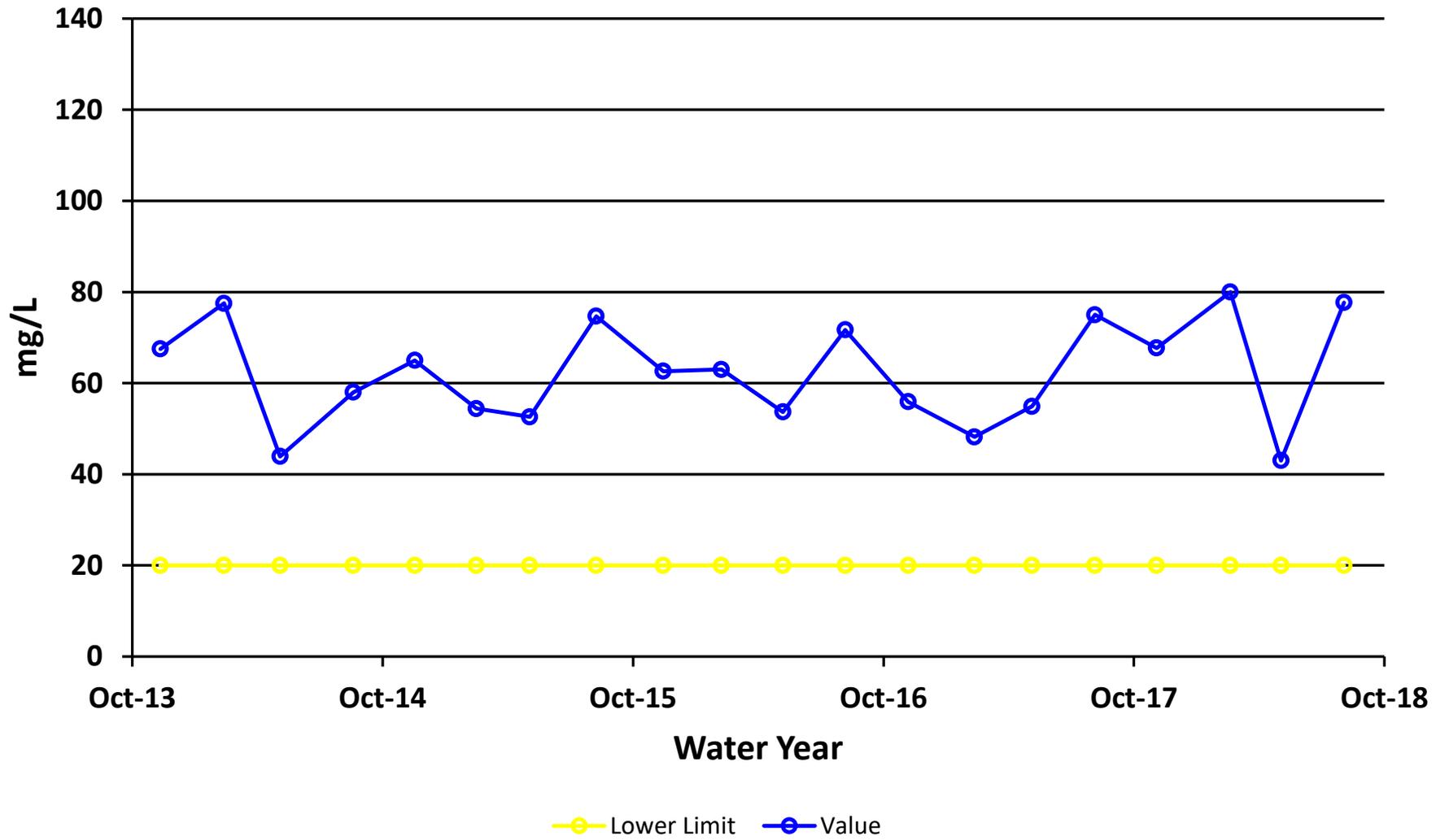
Site 49 - pH Laboratory



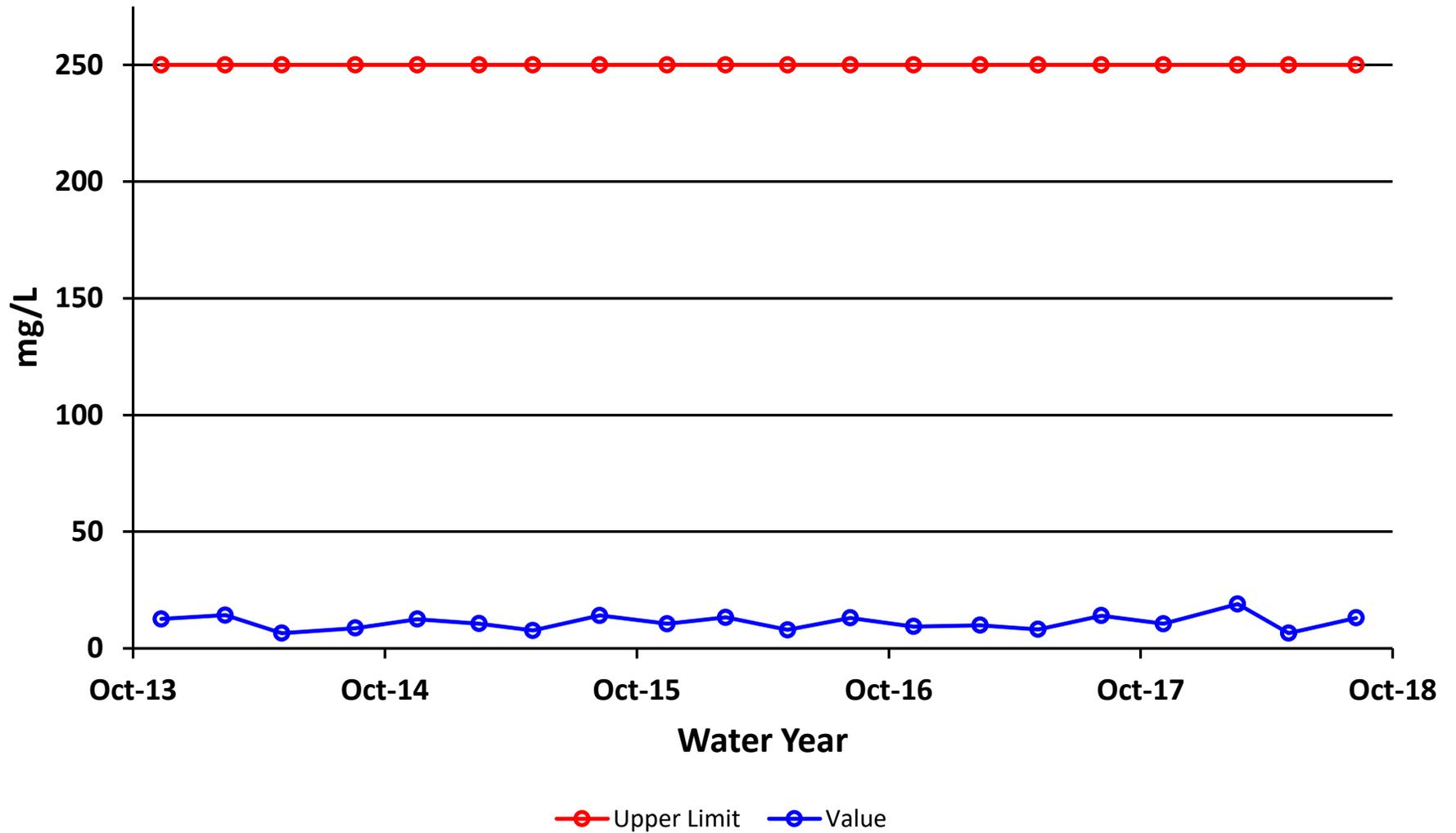
Site 49 - pH Field



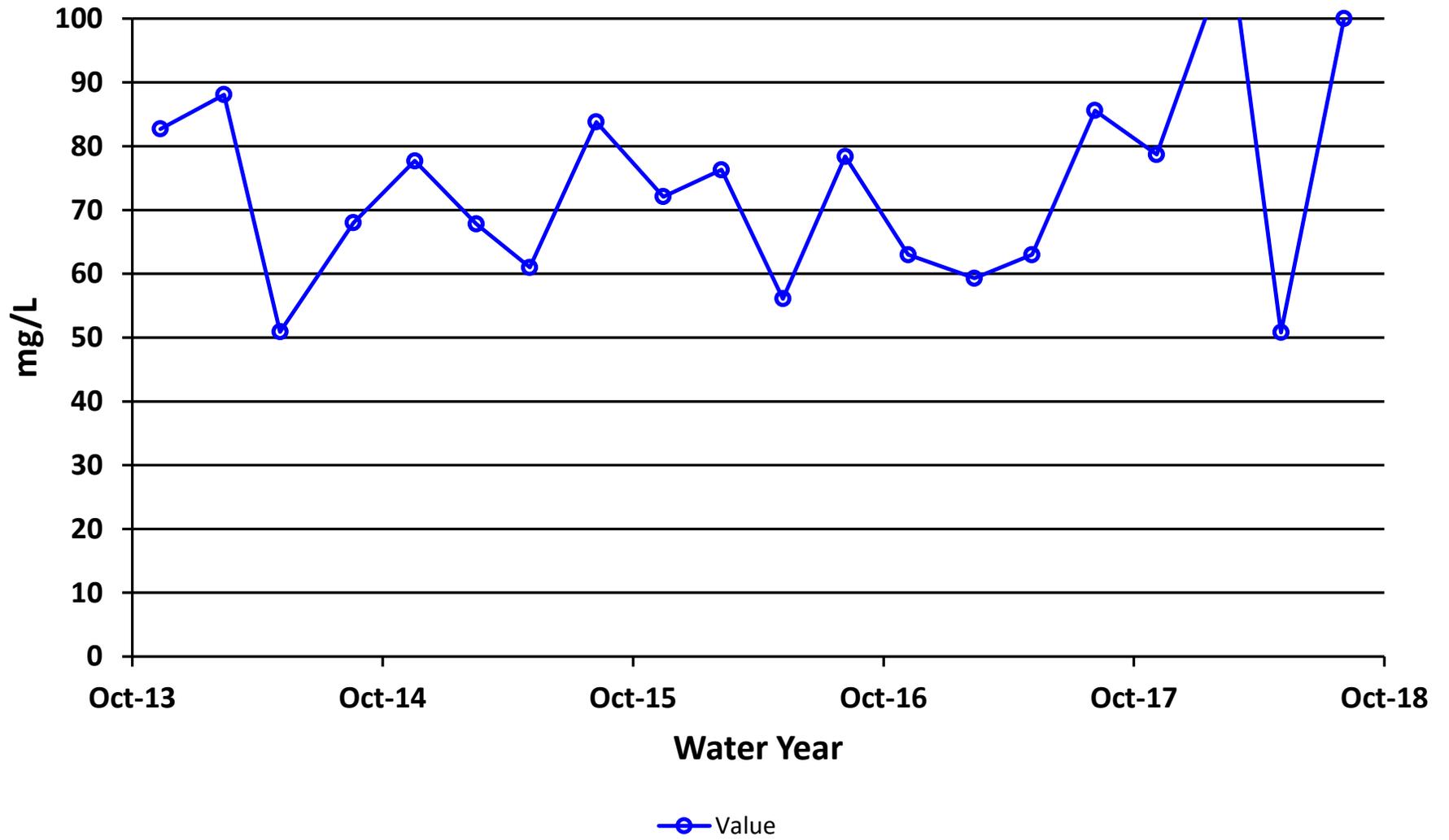
Site 49 - Alkalinity



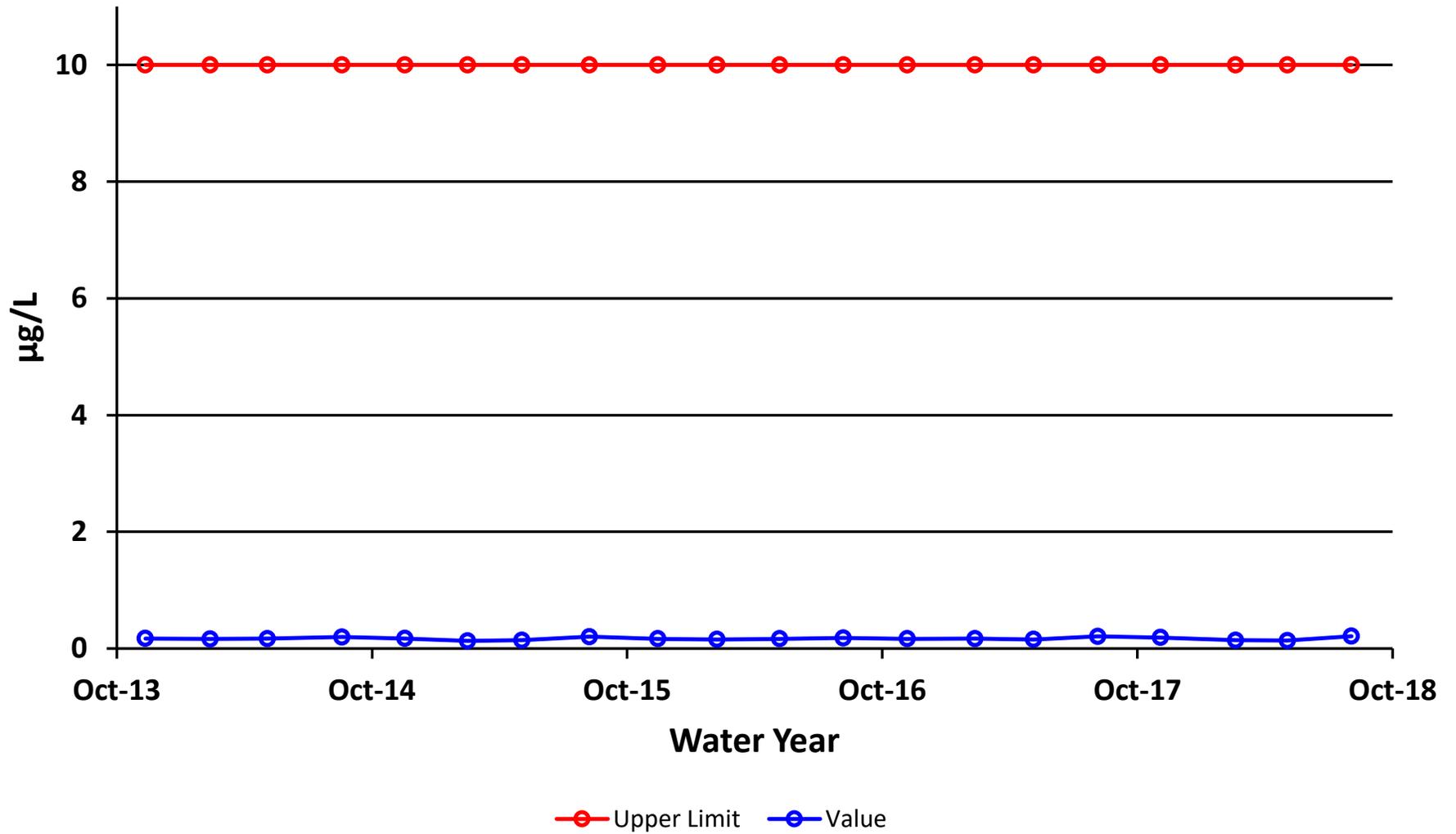
Site 49 - Sulfate



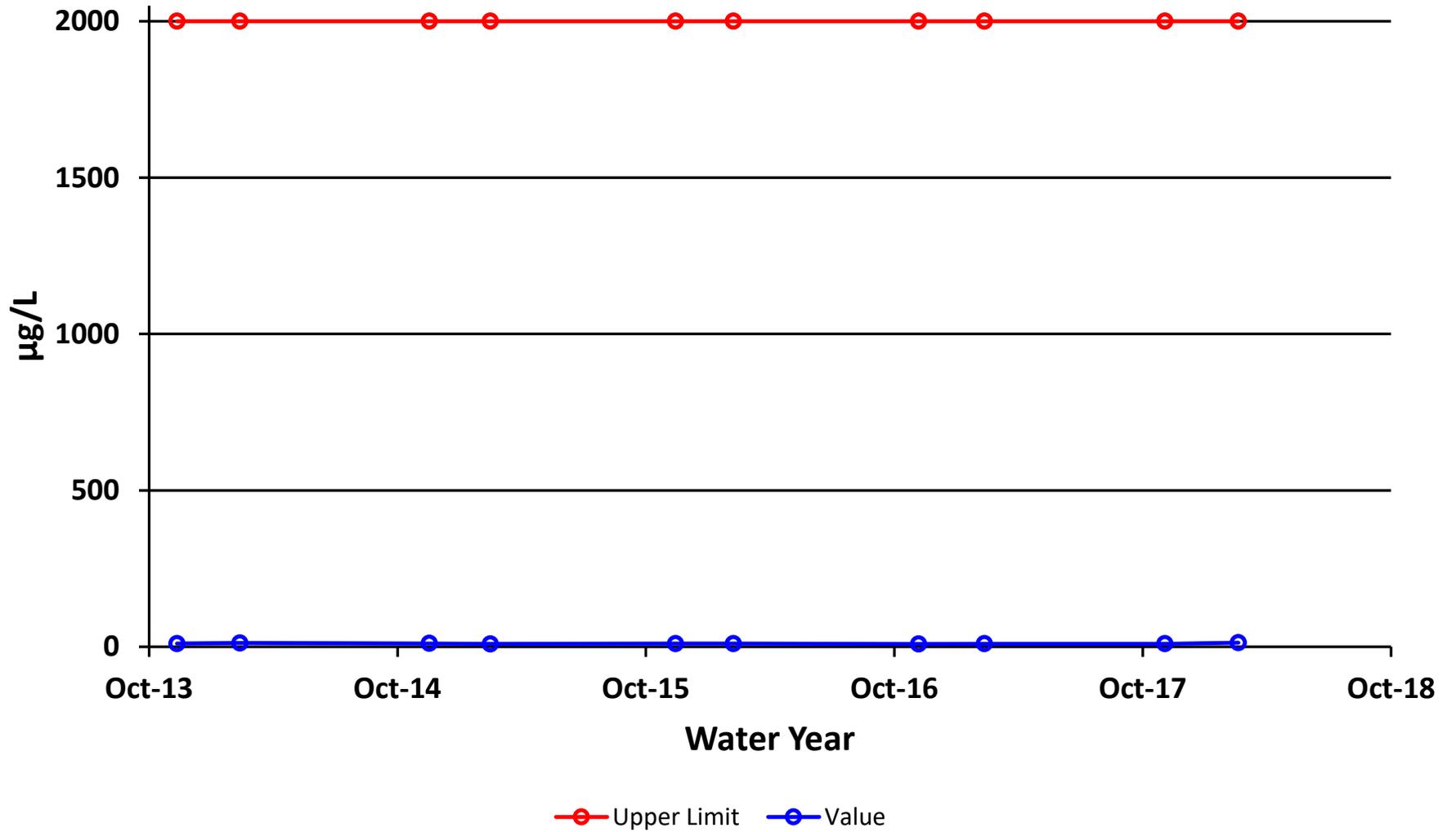
Site 49 - Hardness



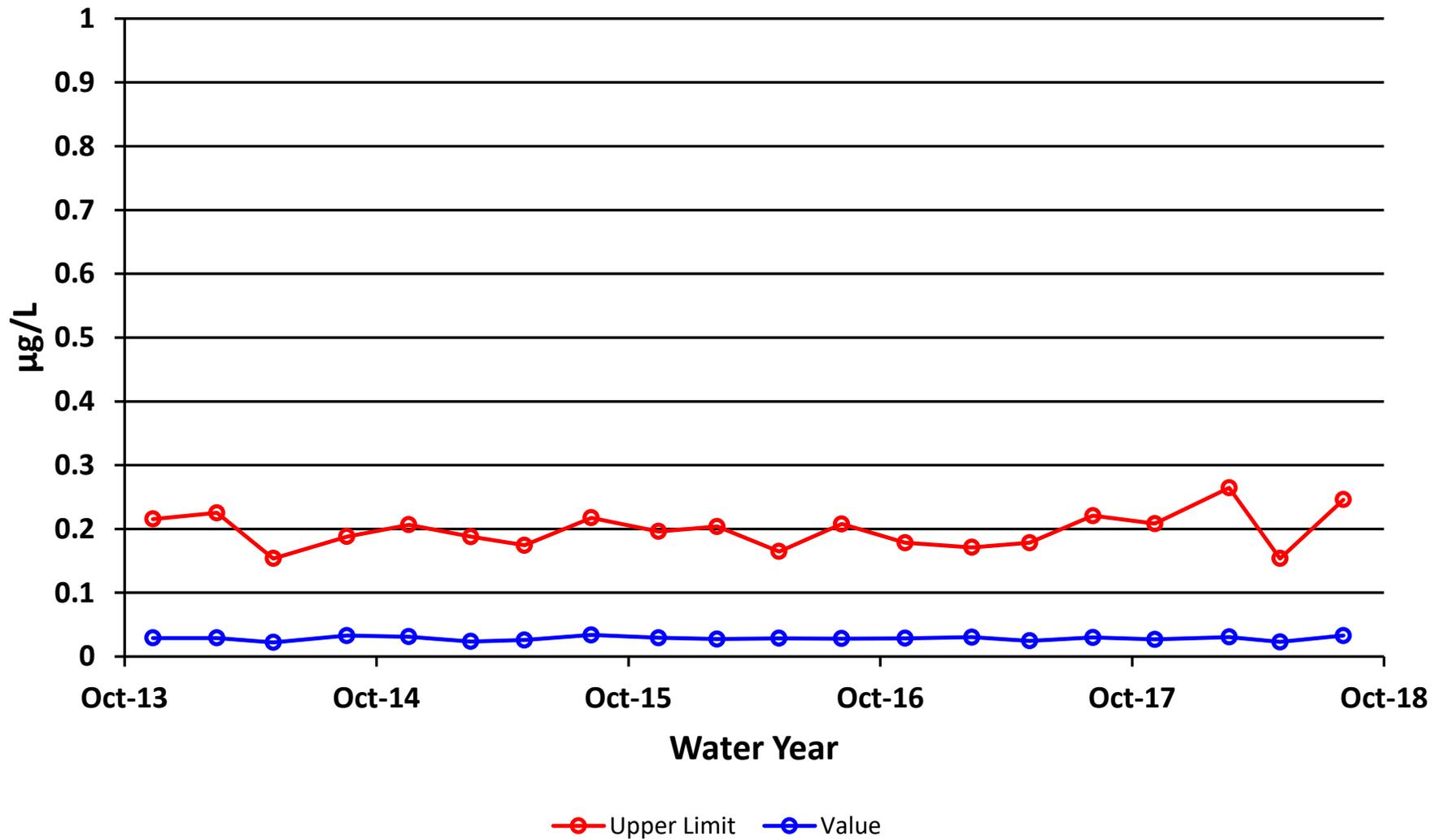
Site 49 - Arsenic Dissolved



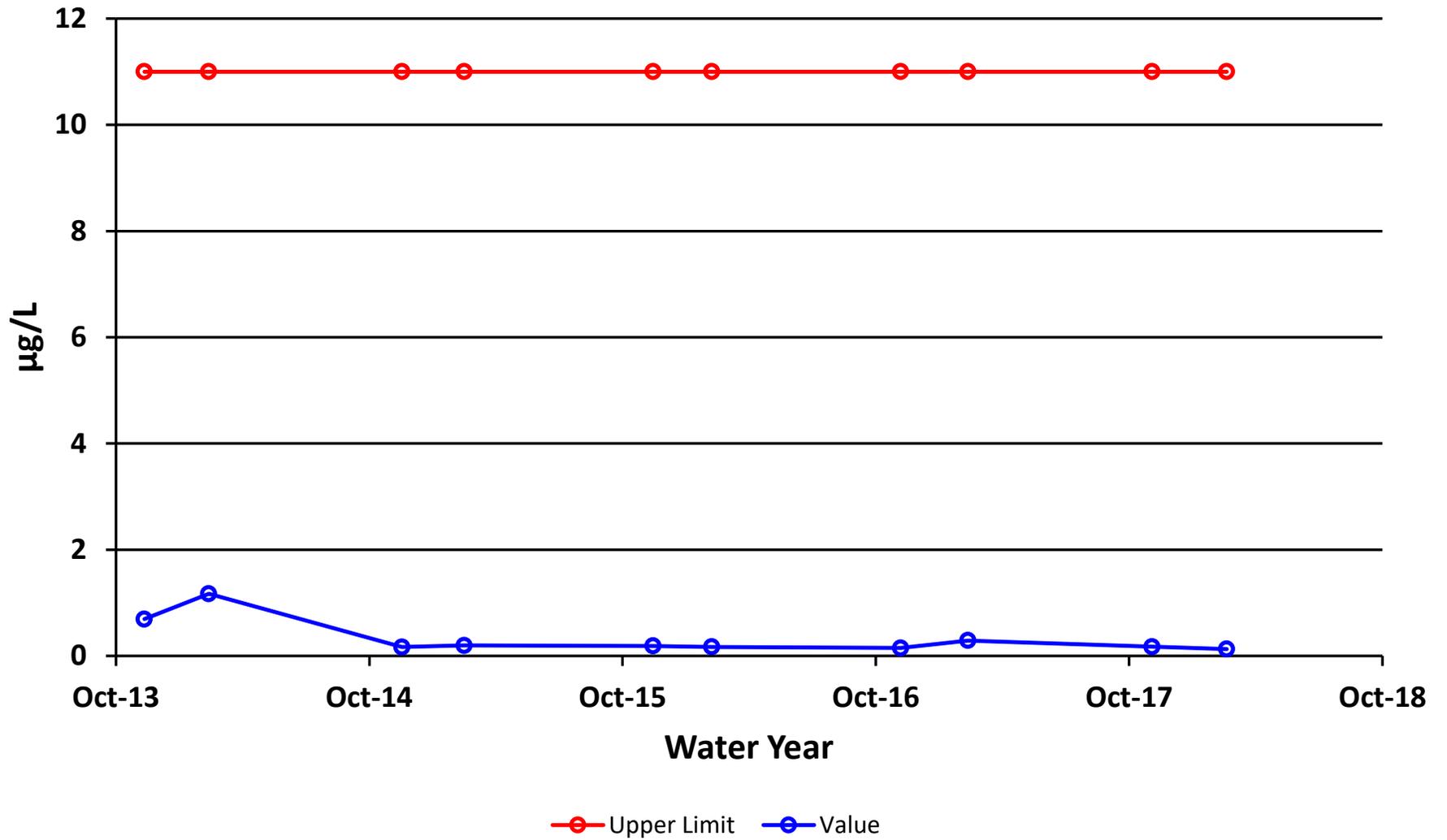
Site 49 - Barium Dissolved



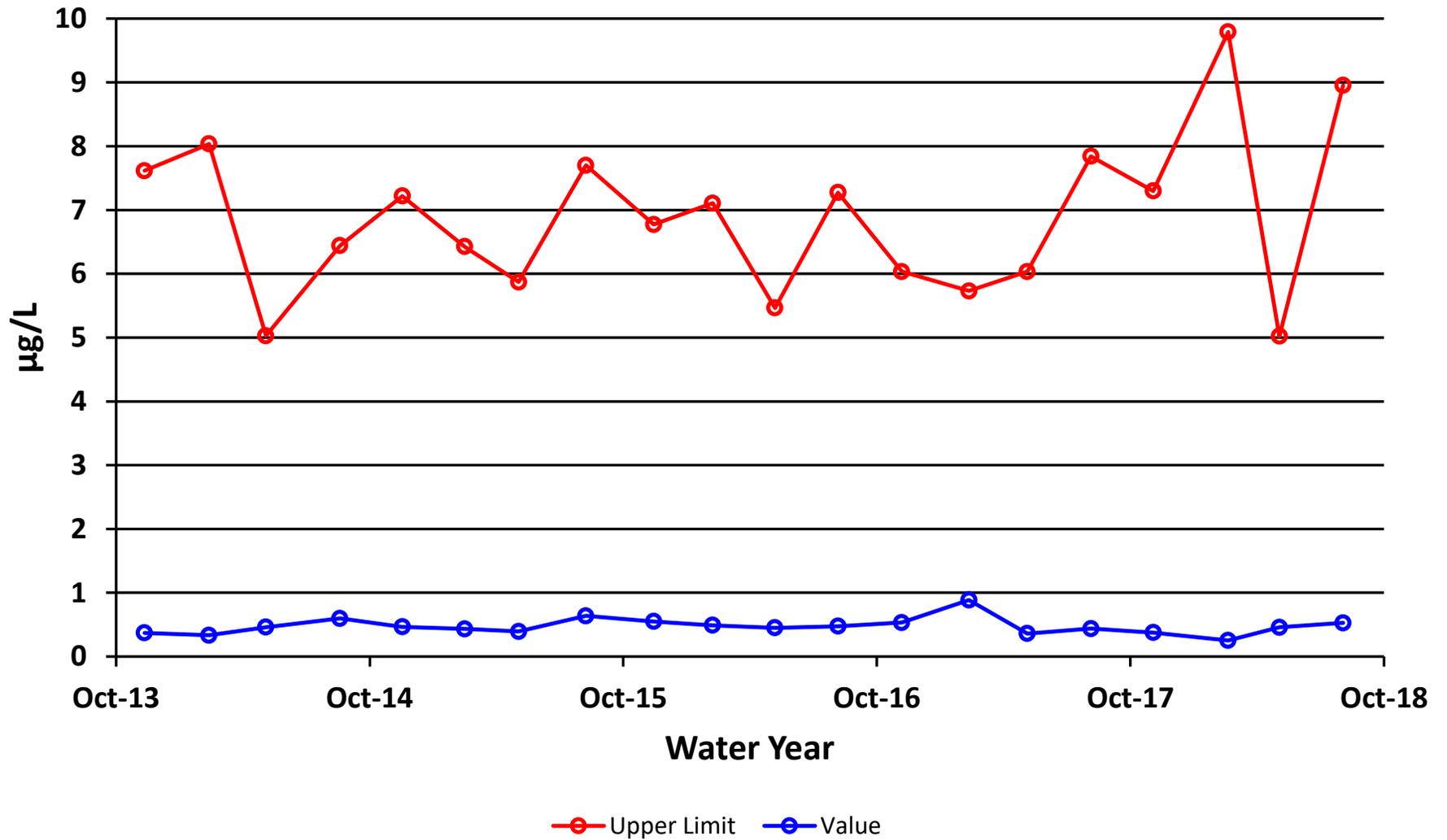
Site 49 - Cadmium Dissolved



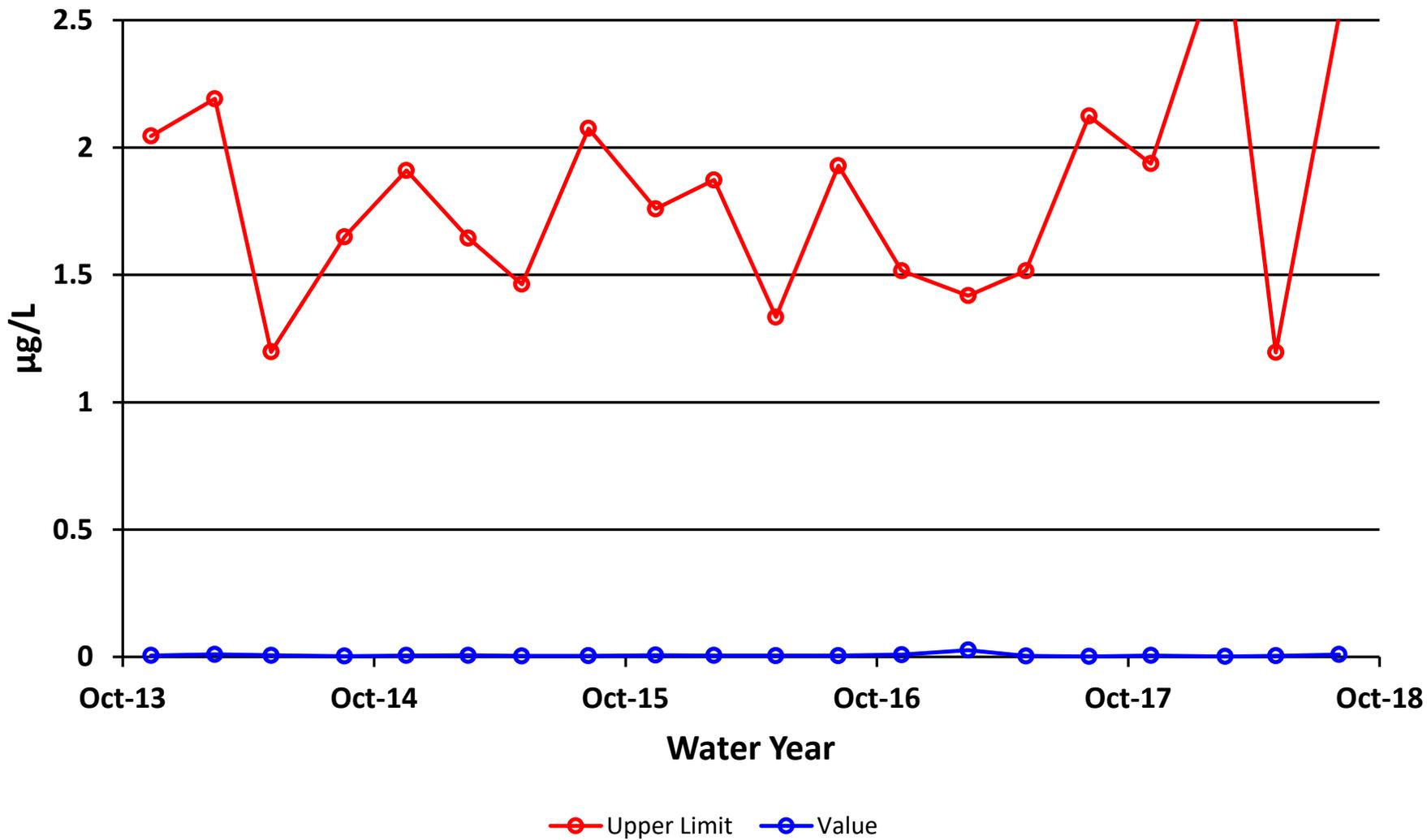
Site 49 - Chromium Dissolved



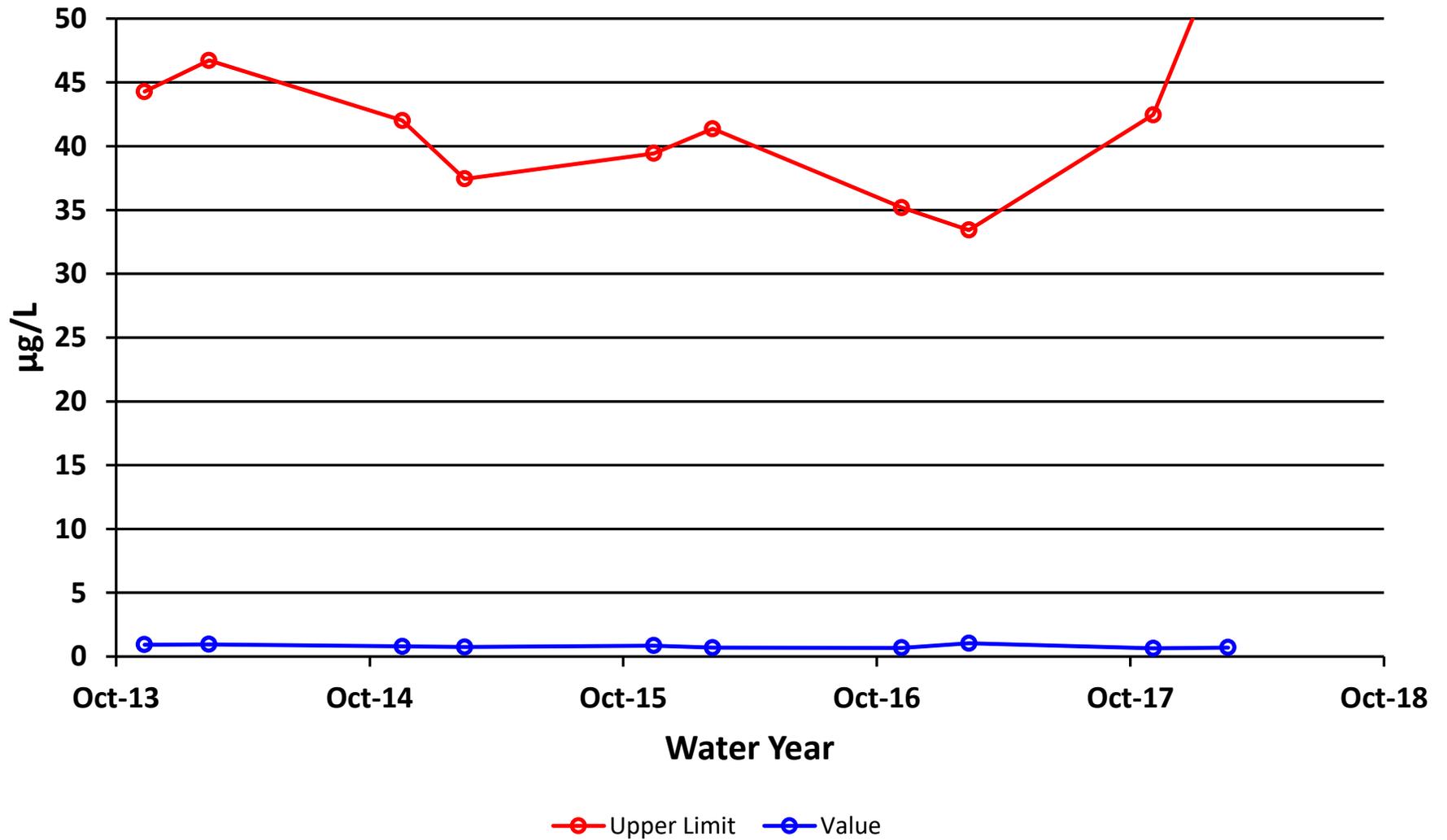
Site 49 - Copper Dissolved



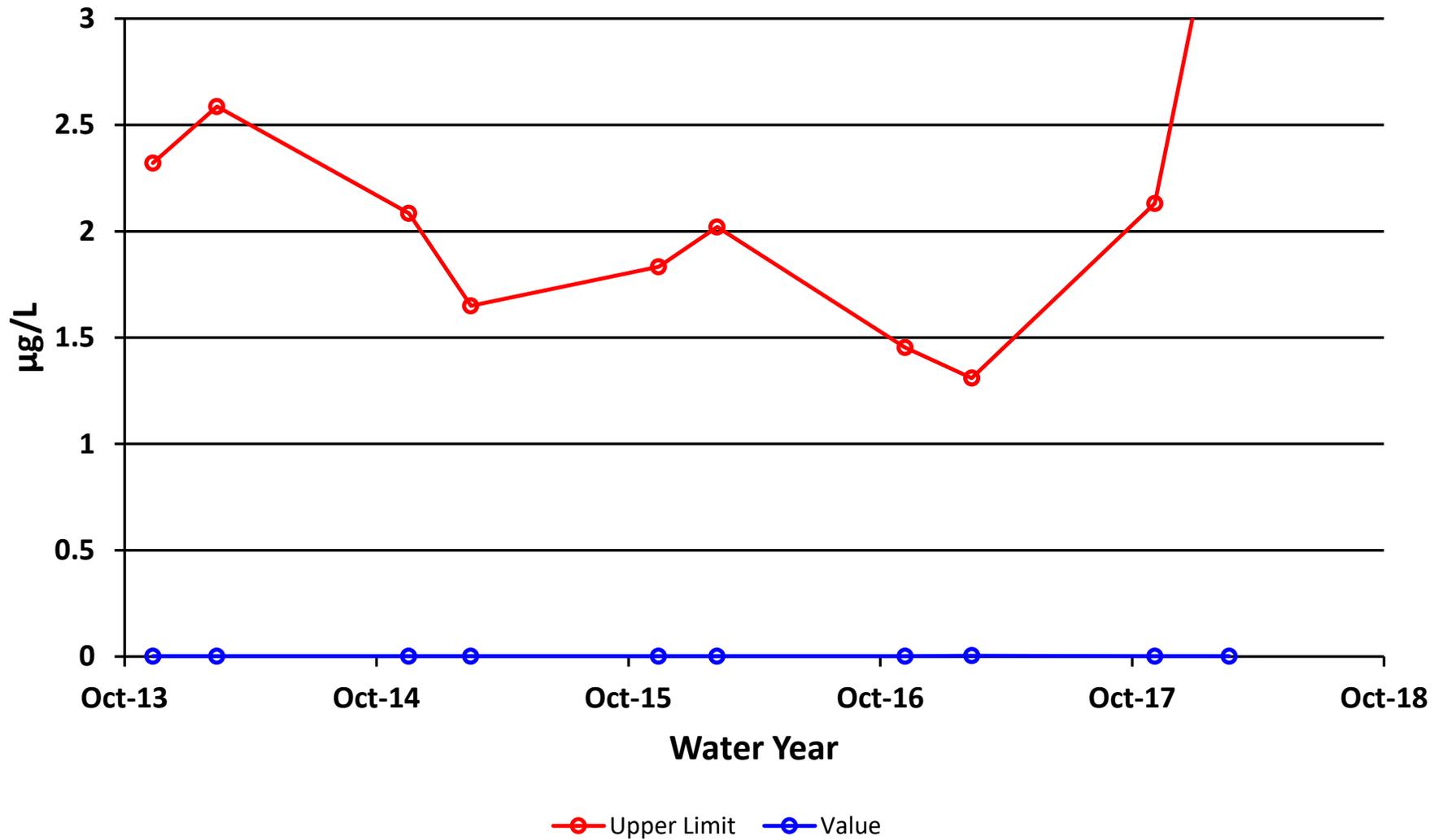
Site 49 - Lead Dissolved



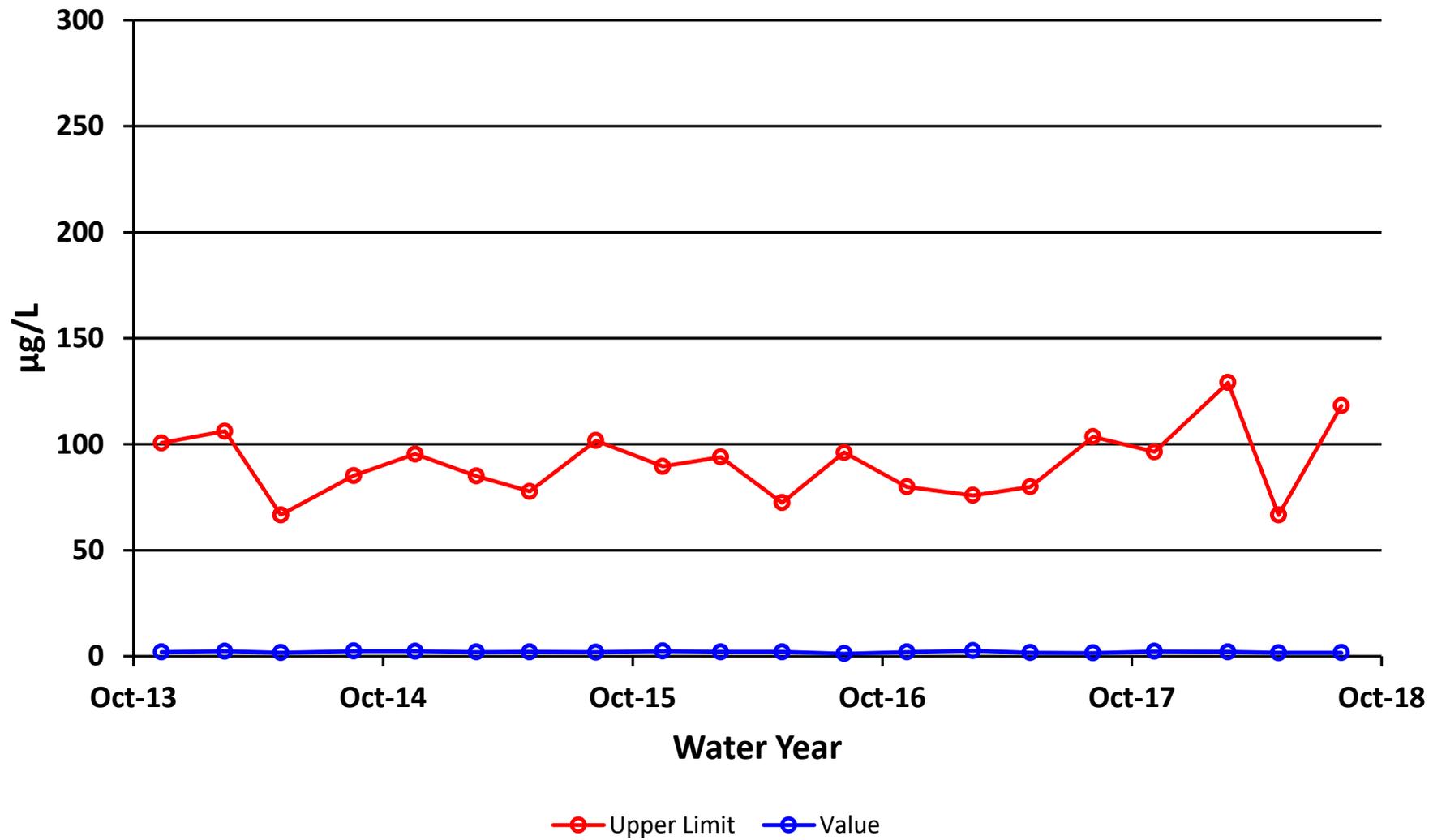
Site 49 - Nickel Dissolved



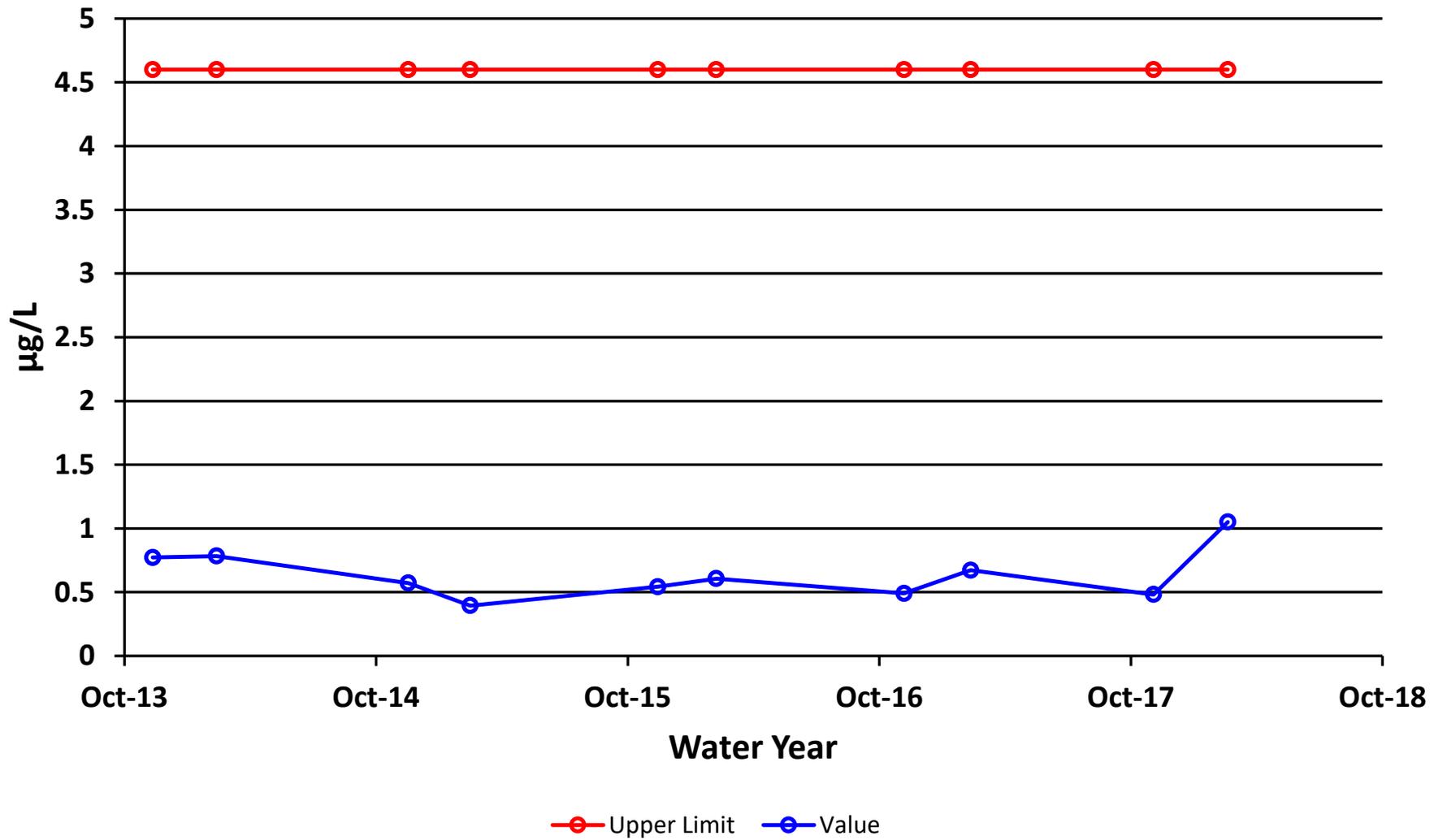
Site 49 - Silver Dissolved



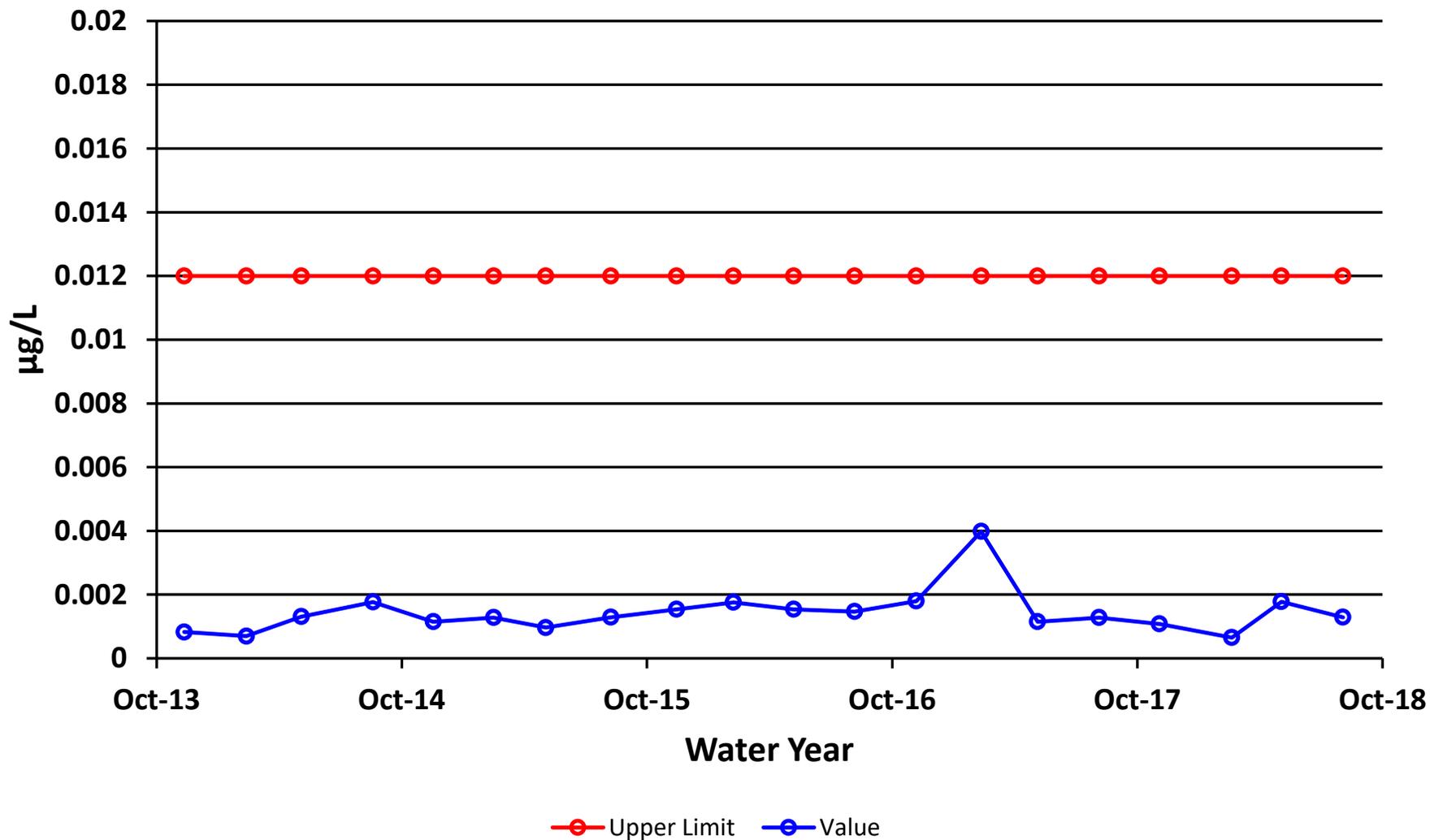
Site 49 - Zinc Dissolved



Site 49 - Selenium Dissolved



Site 49 - Mercury Dissolved



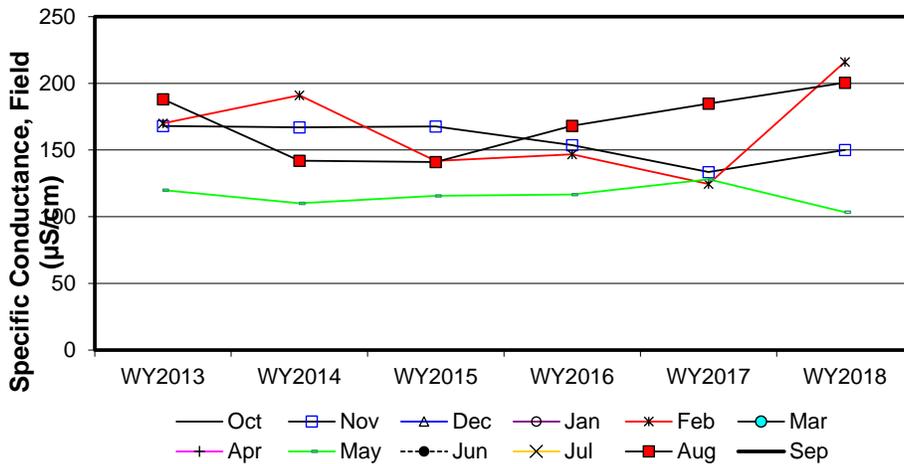
Site #49

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	WY2013		168.0			170.0			120.0			188.0	
b	WY2014		167.0			191.0			110.0			142.0	
c	WY2015		167.7			141.8			115.6			141.0	
d	WY2016		153.7			146.7			116.7			168.2	
e	WY2017		133.5			124.5			128.0			184.8	
f	WY2018		150.0			216.1			103.4			200.5	
n		0	6	0	0	6	0	0	6	0	0	6	0
t ₁		0	6	0	0	6	0	0	6	0	0	6	0
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	
c-a			-1			-1			-1			-1	
d-a			-1			-1			-1			-1	
e-a			-1			-1			1			-1	
f-a			-1			1			-1			1	
c-b			1			-1			1			-1	
d-b			-1			-1			1			1	
e-b			-1			-1			1			1	
f-b			-1			1			-1			1	
d-c			-1			1			1			1	
e-c			-1			-1			1			1	
f-c			-1			1			-1			1	
e-d			-1			-1			1			1	
f-d			-1			1			-1			1	
f-e			1			1			-1			1	
S _k		0	-11	0	0	-1	0	0	-1	0	0	5	0
σ _S ² =			28.33			28.33			28.33			28.33	
Z _k = S _k /σ _S			-2.07			-0.19			-0.19			0.94	
Z _k ²			4.27			0.04			0.04			0.88	

ΣZ _k =	-1.50	Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅	Σn	24
ΣZ _k ² =	5.22	Count	24	0	0	0	0	ΣS _k	-8
Z-bar=ΣZ _k /K=	-0.38								

χ _n ² =ΣZ _k ² -K(Z-bar) ² =	4.66	@α=5% χ _(K-1) ² =	7.81	Test for station homogeneity
p	0.199			χ _n ² < χ _(K-1) ² ACCEPT
ΣVAR(S _k)	Z _{calc} -0.66	@α/2=2.5% Z=	1.96	H ₀ (No trend) ACCEPT
113.33	p 0.255			H _A (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals			
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-7.08		6.08
0.050	-5.62		3.14
0.100	-4.22	-1.05	1.84
0.200	-3.45		0.26

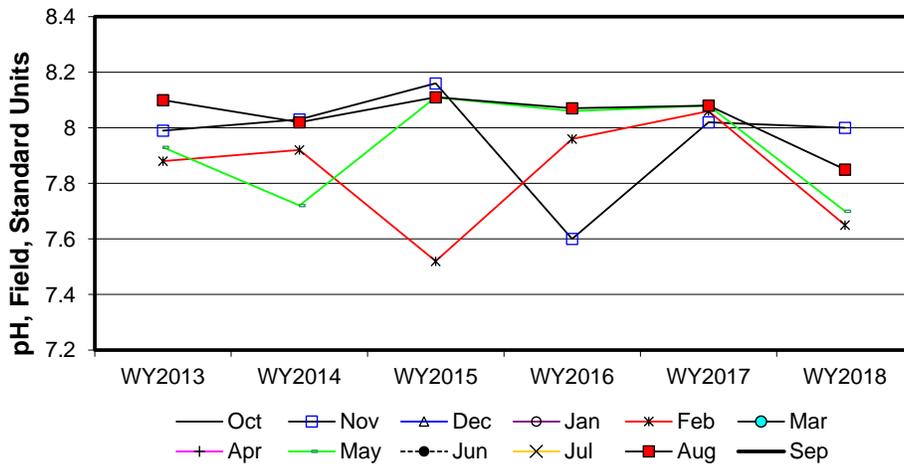
Site #49

Seasonal Kendall analysis for pH, Field, Standard Units

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	WY2013		8.0			7.9			7.9			8.1	
b	WY2014		8.0			7.9			7.7			8.0	
c	WY2015		8.2			7.5			8.1			8.1	
d	WY2016		7.6			8.0			8.1			8.1	
e	WY2017		8.0			8.1			8.1			8.1	
f	WY2018		8.0			7.7			7.7			7.9	
n		0	6	0	0	6	0	0	6	0	0	6	0
t ₁		0	6	0	0	6	0	0	6	0	0	6	0
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	
c-a			1			-1			1			1	
d-a			-1			1			1			-1	
e-a			1			1			1			-1	
f-a			1			-1			-1			-1	
c-b			1			-1			1			1	
d-b			-1			1			1			1	
e-b			-1			1			1			1	
f-b			-1			-1			-1			-1	
d-c			-1			1			-1			-1	
e-c			-1			1			-1			-1	
f-c			-1			1			-1			-1	
e-d			1			1			1			1	
f-d			1			-1			-1			-1	
f-e			-1			-1			-1			-1	
S _k		0	-1	0	0	3	0	0	-1	0	0	-5	0
σ _S ² =			28.33			28.33			28.33			28.33	
Z _k = S _k /σ _S			-0.19			0.56			-0.19			-0.94	
Z _k ²			0.04			0.32			0.04			0.88	

ΣZ _k =	-0.75	Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅	Σn	24
ΣZ _k ² =	1.27	Count	24	0	0	0	0	ΣS _k	-4
Z-bar=ΣZ _k /K=	-0.19								

χ _n ² =ΣZ _k ² -K(Z-bar) ² =	1.13	@α=5% χ _(K-1) ² =	7.81	Test for station homogeneity
p	0.770			χ _n ² < χ _(K-1) ² ACCEPT
ΣVAR(S _k)	Z _{calc} -0.28	@α/2=2.5% Z=	1.96	H ₀ (No trend) ACCEPT
113.33	p 0.389			H _A (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals			
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.06	0.00	0.04
0.050	-0.05		0.02
0.100	-0.04		0.02
0.200	-0.02		0.01

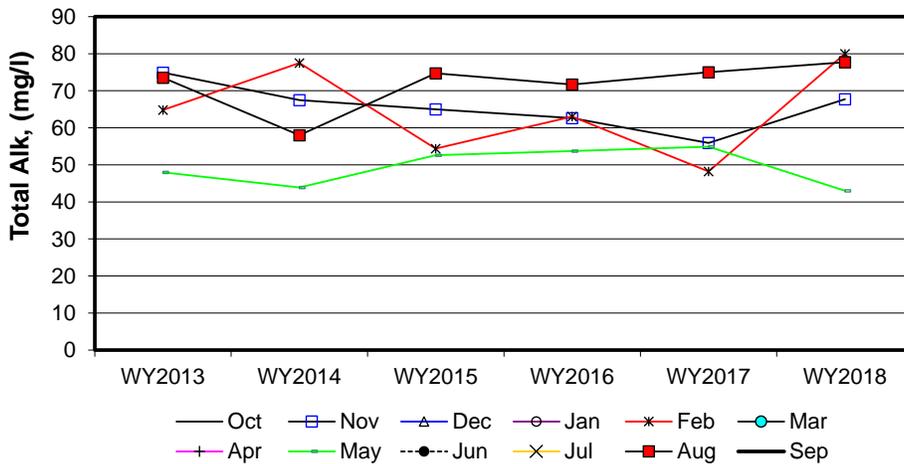
Site #49

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	WY2013		74.9			64.8			48.0			73.5	
b	WY2014		67.5			77.5			43.9			58.0	
c	WY2015		65.0			54.4			52.6			74.7	
d	WY2016		62.6			63.0			53.7			71.7	
e	WY2017		55.9			48.2			54.9			75.0	
f	WY2018		67.7			80.0			43.0			77.7	
n		0	6	0	0	6	0	0	6	0	0	6	0
t ₁		0	6	0	0	6	0	0	6	0	0	6	0
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	
c-a			-1			-1			1			1	
d-a			-1			-1			1			-1	
e-a			-1			-1			1			1	
f-a			-1			1			-1			1	
c-b			-1			-1			1			1	
d-b			-1			-1			1			1	
e-b			-1			-1			1			1	
f-b			1			1			-1			1	
d-c			-1			1			1			-1	
e-c			-1			-1			1			1	
f-c			1			1			-1			1	
e-d			-1			-1			1			1	
f-d			1			1			-1			1	
f-e			1			1			-1			1	
S _k		0	-7	0	0	-1	0	0	3	0	0	9	0
σ _S ² =			28.33			28.33			28.33			28.33	
Z _k = S _k /σ _S			-1.32			-0.19			0.56			1.69	
Z _k ²			1.73			0.04			0.32			2.86	

ΣZ _k =	0.75	Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅	Σn	24
ΣZ _k ² =	4.94	Count	24	0	0	0	0	ΣS _k	4
Z-bar=ΣZ _k /K=	0.19								

$\chi^2_{h1} = \sum Z_k^2 - K(Z\text{-bar})^2 =$	4.80	@α=5% $\chi^2_{(K-1)} =$	7.81	Test for station homogeneity
p	0.187	$\chi^2_{h1} < \chi^2_{(K-1)}$		ACCEPT
ΣVAR(S _k)	Z _{calc} 0.28	@α/2=2.5% Z=	1.96	H ₀ (No trend) ACCEPT
113.33	p 0.611			H _A (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals			
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-3.46	0.26	2.40
0.050	-2.49		1.19
0.100	-2.23		1.08
0.200	-0.79		0.87

Site #49

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

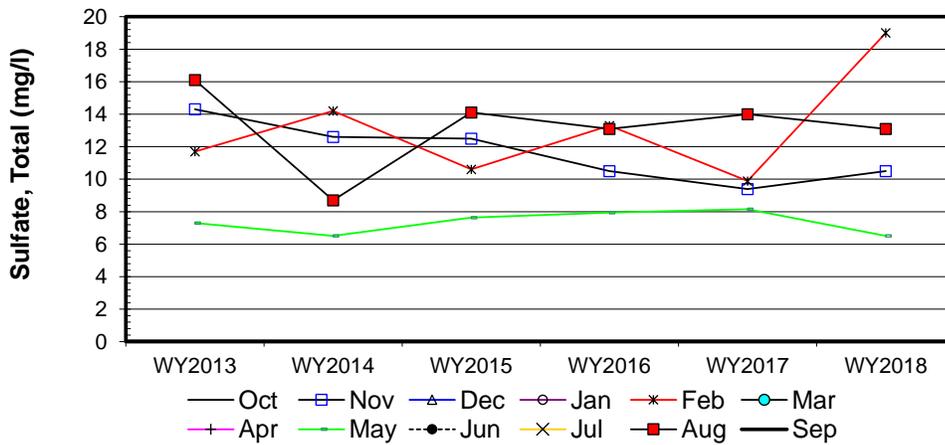
Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	WY2013		14.3			11.7			7.3			16.1	
b	WY2014		12.6			14.2			6.5			8.7	
c	WY2015		12.5			10.6			7.6			14.1	
d	WY2016		10.5			13.3			7.9			13.1	
e	WY2017		9.4			9.9			8.2			14.0	
f	WY2018		10.5			19.0			6.5			13.1	
n		0	6	0	0	6	0	0	6	0	0	6	0
t ₁		0	4	0	0	6	0	0	4	0	0	4	0
t ₂		0	1	0	0	0	0	0	1	0	0	1	0
t ₃		0	0	0	0	0	0	0	0	0	0	0	0
t ₄		0	0	0	0	0	0	0	0	0	0	0	0
t ₅		0	0	0	0	0	0	0	0	0	0	0	0
b-a			-1			1			-1			-1	
c-a			-1			-1			1			-1	
d-a			-1			1			1			-1	
e-a			-1			-1			1			-1	
f-a			-1			1			-1			-1	
c-b			-1			-1			1			1	
d-b			-1			-1			1			1	
e-b			-1			-1			1			1	
f-b			-1			1			0			1	
d-c			-1			1			1			-1	
e-c			-1			-1			1			-1	
f-c			-1			1			-1			-1	
e-d			-1			-1			1			1	
f-d			0			1			-1			0	
f-e			1			1			-1			-1	
S _k		0	-12	0	0	1	0	0	4	0	0	-4	0
σ _s ² =			27.33			28.33			27.33			27.33	
Z _k = S _k /σ _s			-2.30			0.19			0.77			-0.77	
Z _k ²			5.27			0.04			0.59			0.59	

ΣZ_k= -2.11
 ΣZ_k²= 6.47
 Z-bar=ΣZ_k/K= -0.53

Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅
Count	18	3	0	0	0

Σn = 24
 ΣS_k = -11

χ _n ² =ΣZ _k ² -K(Z-bar) ² =	5.36	@α=5% χ _(K-1) ² =	7.81	Test for station homogeneity
p	0.147	χ _h ² <χ _(K-1) ²		ACCEPT
ΣVAR(S _k)	Z _{calc} -0.95	@α=2.5% Z=	1.96	H ₀ (No trend) ACCEPT
110.33	p 0.171			H _A (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals			
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.90		0.26
0.050	-0.70		0.20
0.100	-0.59	-0.34	0.00
0.200	-0.53		-0.03

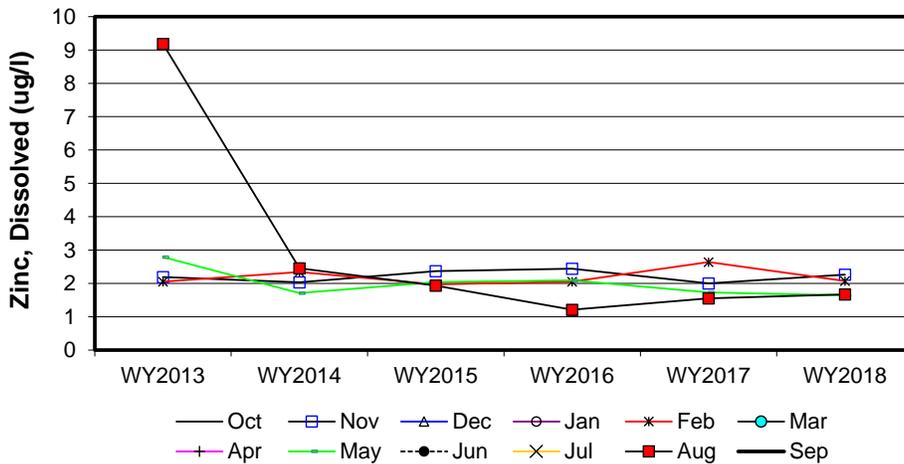
Site #49

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	WY2013		2.2			2.1			2.8			9.2	
b	WY2014		2.0			2.3			1.7			2.5	
c	WY2015		2.4			2.0			2.0			1.9	
d	WY2016		2.4			2.1			2.1			1.2	
e	WY2017		2.0			2.6			1.7			1.6	
f	WY2018		2.3			2.1			1.6			1.7	
n		0	6	0	0	6	0	0	6	0	0	6	0
t ₁		0	6	0	0	4	0	0	6	0	0	6	0
t ₂		0	0	0	0	1	0	0	0	0	0	0	0
t ₃		0	0	0	0	0	0	0	0	0	0	0	0
t ₄		0	0	0	0	0	0	0	0	0	0	0	0
t ₅		0	0	0	0	0	0	0	0	0	0	0	0
b-a			-1			1			-1			-1	
c-a			1			-1			-1			-1	
d-a			1			0			-1			-1	
e-a			-1			1			-1			-1	
f-a			1			1			-1			-1	
c-b			1			-1			1			-1	
d-b			1			-1			1			-1	
e-b			-1			1			-1			-1	
f-b			1			-1			-1			-1	
d-c			1			1			1			-1	
e-c			-1			1			-1			-1	
f-c			-1			1			-1			-1	
e-d			-1			1			-1			1	
f-d			-1			1			-1			1	
f-e			1			-1			-1			1	
S _k		0	1	0	0	4	0	0	-7	0	0	-9	0
σ _S ² =			28.33			27.33			28.33			28.33	
Z _k = S _k /σ _S			0.19			0.77			-1.32			-1.69	
Z _k ²			0.04			0.59			1.73			2.86	

ΣZ _k =	-2.05	Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅	Σn	24
ΣZ _k ² =	5.21	Count	22	1	0	0	0	ΣS _k	-11
Z-bar=ΣZ _k /K=	-0.51								

$\chi^2_{h} = \sum Z_k^2 - K(Z\text{-bar})^2 =$	4.16	@α=5% $\chi^2_{(K-1)} =$	7.81	Test for station homogeneity
p	0.245	$\chi^2_{h} < \chi^2_{(K-1)}$		ACCEPT
ΣVAR(S _k)	Z _{calc} -0.94	@α/2=2.5% Z=	1.96	H ₀ (No trend) ACCEPT
112.33	p 0.173			H _A (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals			
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.23		0.05
0.050	-0.19		0.01
0.100	-0.16	-0.06	0.00
0.200	-0.14		-0.01

INTERPRETIVE REPORT

SITE 46

The data collected during the current water year are listed in the following “Table of Results for Water Year 2018” 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 one-half of the for the purpose of median calculation.

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

Sample Date	Parameter	Value	Qualifier	Notes
No outliers, in the past six years, have been identified by HGCMC.				

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

Table of Exceedance for Water Year 2018

Sample Date	Parameter	Value	Limits		
			Lower	Upper	Hardness
No exceedances have been identified by HGCMC for the period of October 2017 through September 2018.					

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 identified.

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-12 and Sep-18 (WY2013-WY2018).

Site 46 - Table of Summary Statistics for Trend Analysis

Parameter	<u>Mann-Kendall test statistics</u>			<u>Sen's slope estimate</u>	
	n*	p**	Trend	Q	Q(%)
Conductivity Field	6	0.22			
pH Field	6	0.91			
Alkalinity, Total	6	0.45			
Sulfate, Total	6	0.13			
Zinc, Dissolved	6	0.37			

* Number of Years ** Significance level

Datasets with a statistically significant trend ($\alpha/2=2.5\%$) a Seasonal-Sen's Slope estimate statistic has also been calculated. There were no statistically significant trends identified at Site 46 during the reporting period.

Analytical results from Site 46 were analyzed using combined Shewhart-CUSUM charts. The Shewhart-CUSUM is a sequential analysis technique to determine changes in a variable. For a detailed explanation of the Shewhart-CUSUM calculations, see the corresponding section in the 2015 FWMP report.

For this year's FWMP report the combined Shewhart-CUSUM control chart statistical analysis was carried out on the specific conductance, dissolved zinc, and total sulfate data from Site 46. In order to use the analysis, background values were calculated for each of the analytes. The first several years of sampling were chosen for these calculations, summarized in the Table 1.

The visual representations of these calculations are graphed in Figure 1. All three of the analytes have previously reached the lowest control limit (SCL=2). Each of the sites were below the EPA recommend control limit of SCL=4.5. Values for the CUSUM statistic ranged from a low of 0, observed in each analysis to a high of 3.7 recorded for total sulfate. None of the analyses exceed the established limit of $h=5$ (dotted redlines). In order for a process to be considered 'out of control' both metrics (Shewhart & CUSUM) need to be 'out of control'. Note (Figure 1) that none of the analytes went out of control during the monitoring period. This supports the conclusion drawn in the previous FWMP reports that HGCMC activities in the Site23 / D Pile area are not having a measurable effect on Bruin Creek.

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

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

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

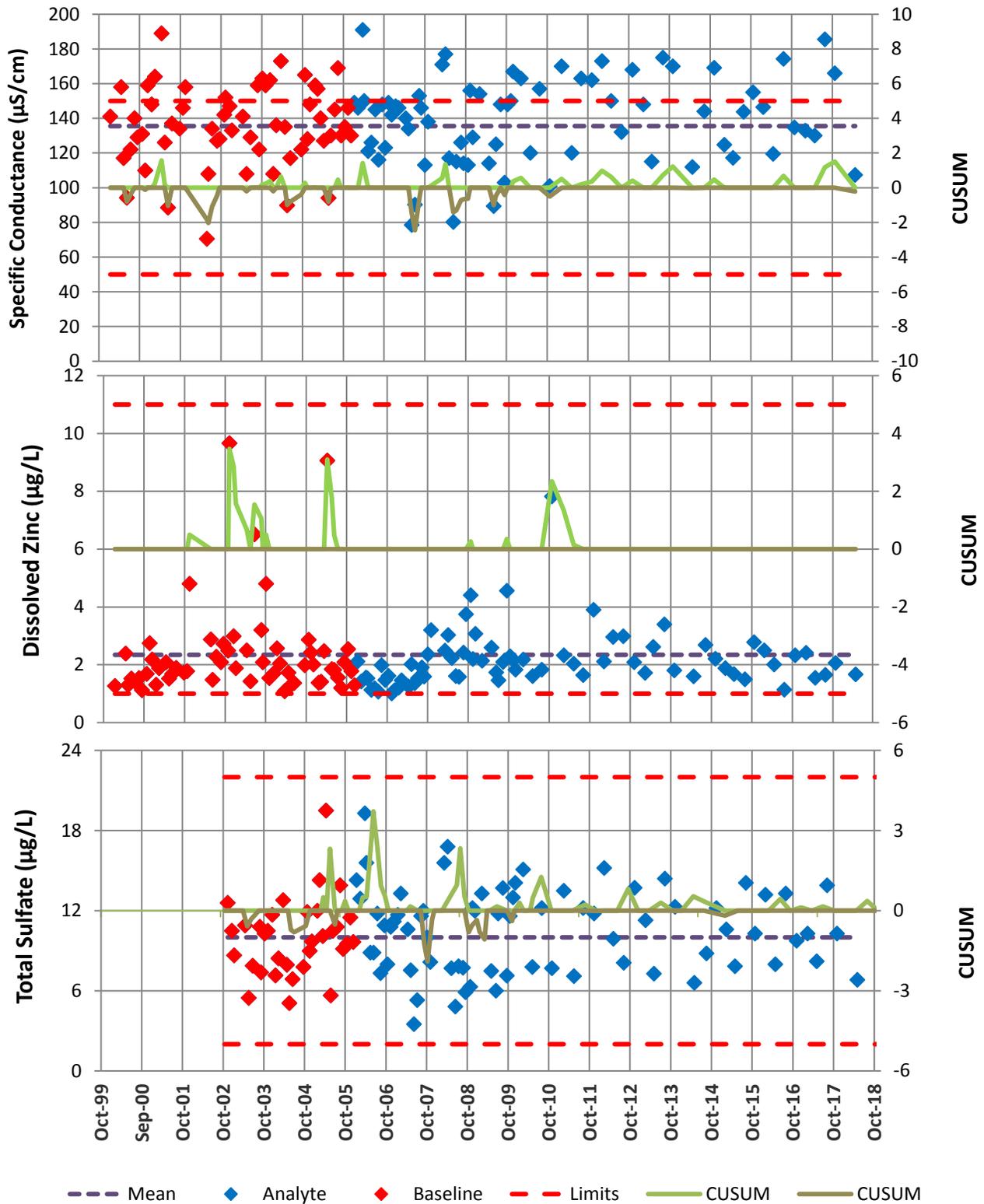


Table of Results for Water Year 2018

Site 046FMS - 'Lower Bruin Creek'

Sample Date/Parameter	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018	Median		
Water Temp (°C)		1.3						4.1					2.7		
Conductivity-Field(µmho)		166						107.4					136.7		
Conductivity-Lab (µmho)		148						97					123		
pH Lab (standard units)		7.36						7.4					7.38		
pH Field (standard units)		8.06						7.69					7.88		
Total Alkalinity (mg/L)		69.6						44.8					57.2		
Total Sulfate (mg/L)		10.3						6.8					8.6		
Hardness (mg/L)		79						52					65.5		
Dissolved As (ug/L)		0.298			Not sampled Q = 0 gpm			0.162			Not sampled Q = 0 gpm		0.230		
Dissolved Ba (ug/L)		10.9													10.9
Dissolved Cd (ug/L)		0.0239							0.0195						0.0217
Dissolved Cr (ug/L)		0.183													0.183
Dissolved Cu (ug/L)		0.415							0.486						0.451
Dissolved Pb (ug/L)		0.0121							0.0078						0.0100
Dissolved Ni (ug/L)		0.631													0.631
Dissolved Ag (ug/L)		0.002													0.002
Dissolved Zn (ug/L)		2.06							1.67						1.87
Dissolved Se (ug/L)		0.472													0.472
Dissolved Hg (ug/L)		0.00109						0.00176					0.001425		

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

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

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

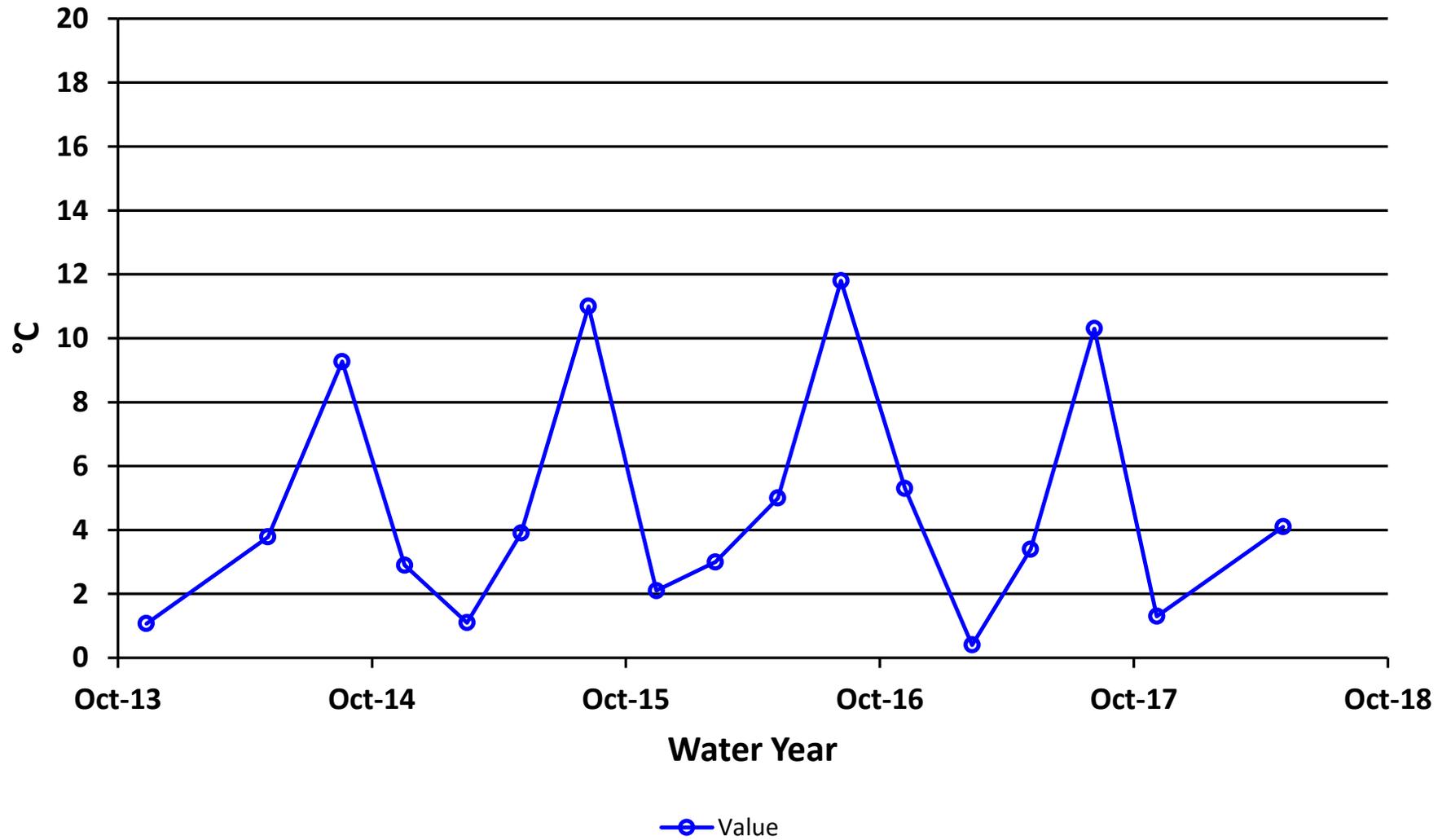
Qualified Data by QA Reviewer

Date Range: 10/01/2017 to 09/30/2018

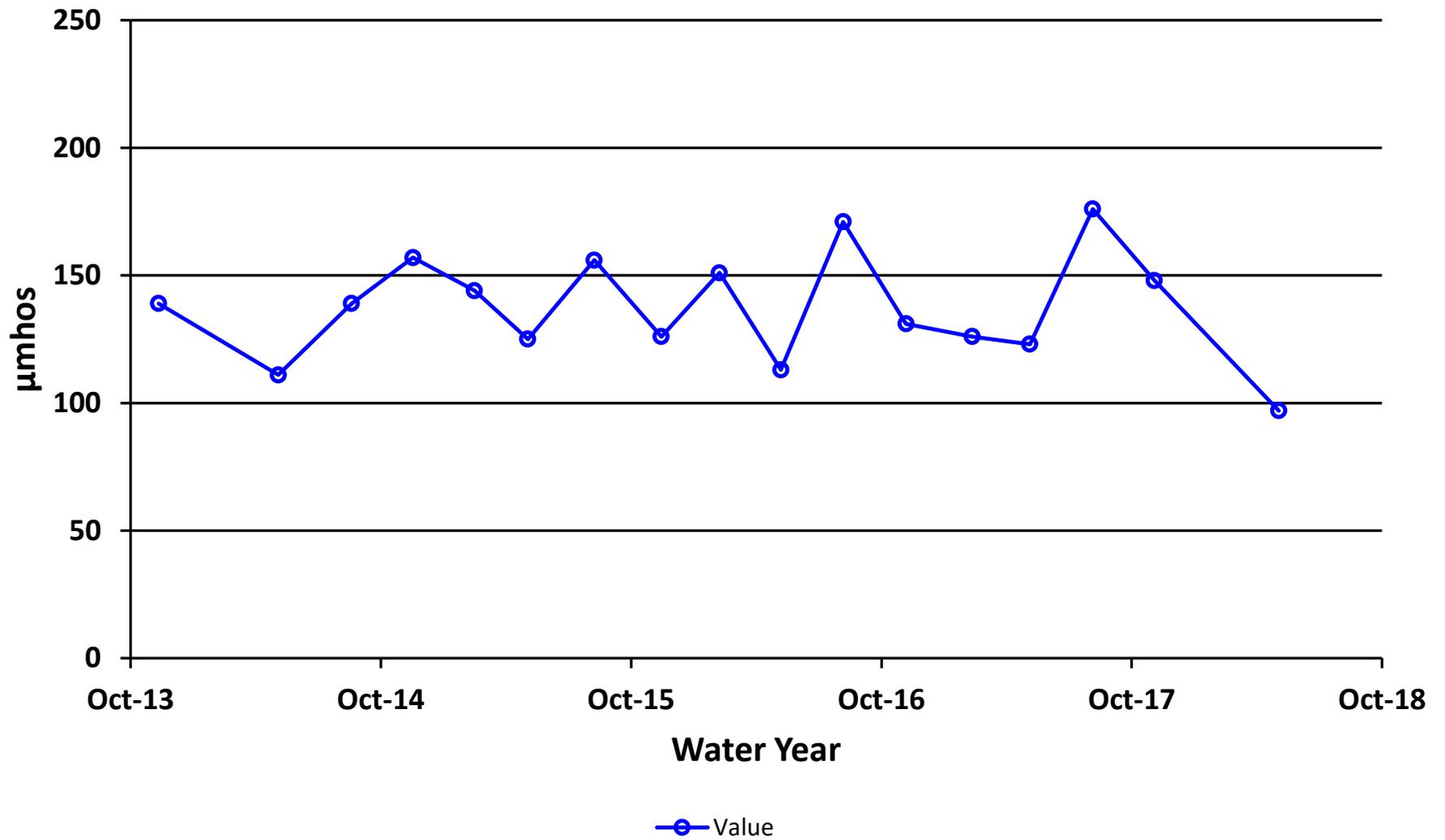
Site No.	Sample Date	Parameter	Value	Qualifier	Reason for Qualifier	
046FMS	5/7/2018	Diss. Pb-ICP/MS	0.0078	µg/L	J	Below Quantitative Range
		pH	7.4	pH units	J	Hold Time Violation

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

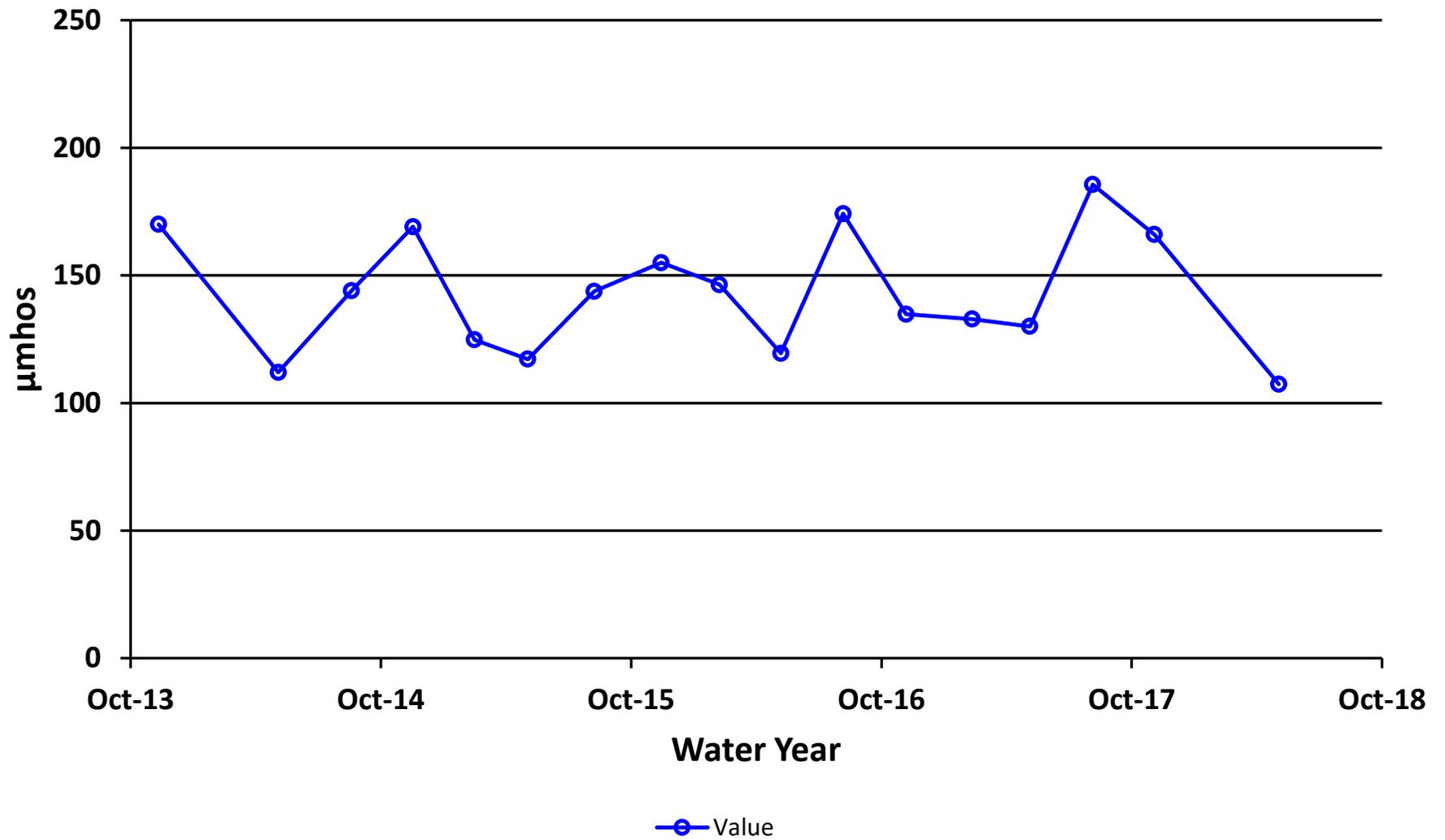
Site 46 - Water Temperature



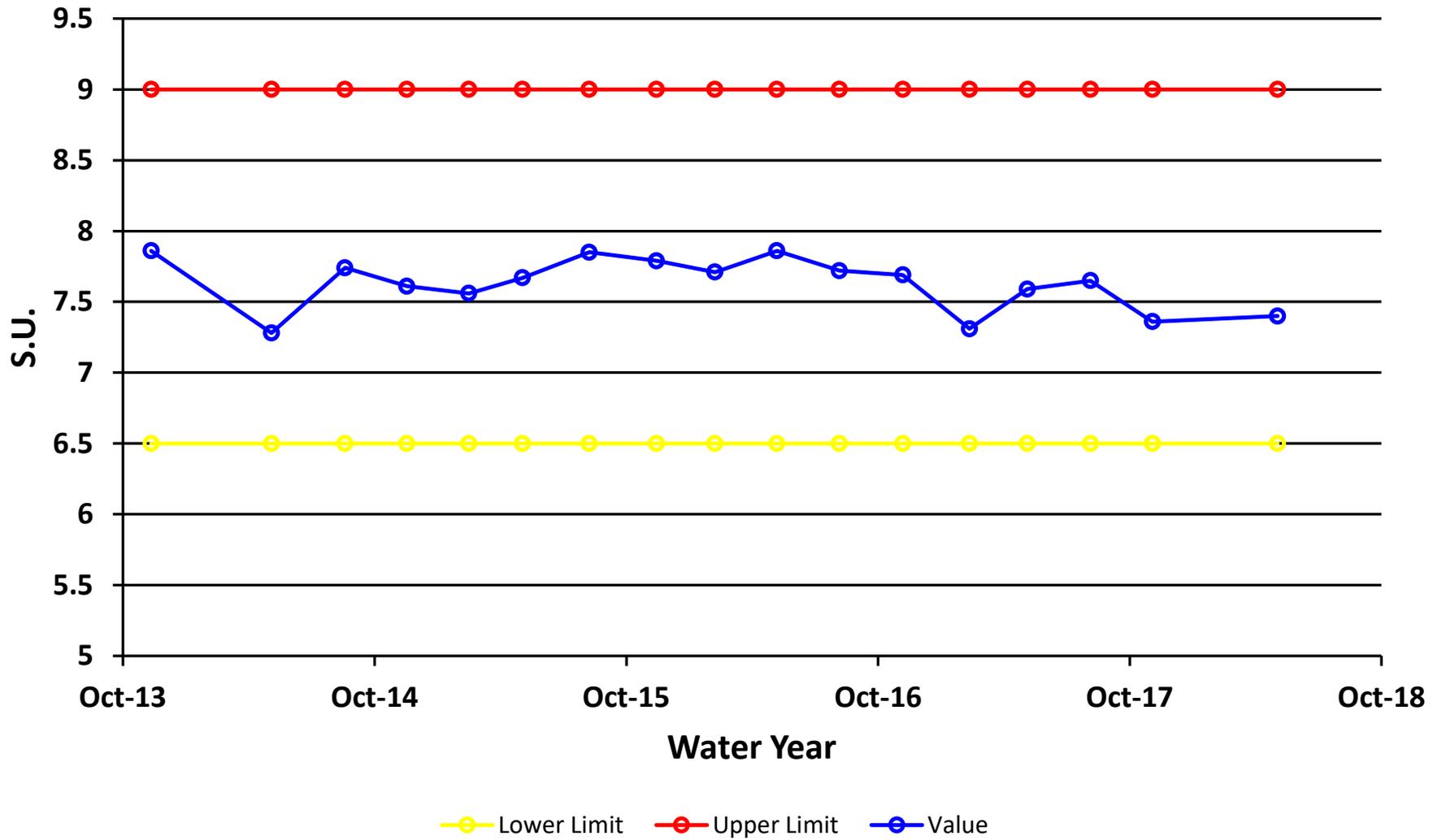
Site 46 - Conductivity Laboratory



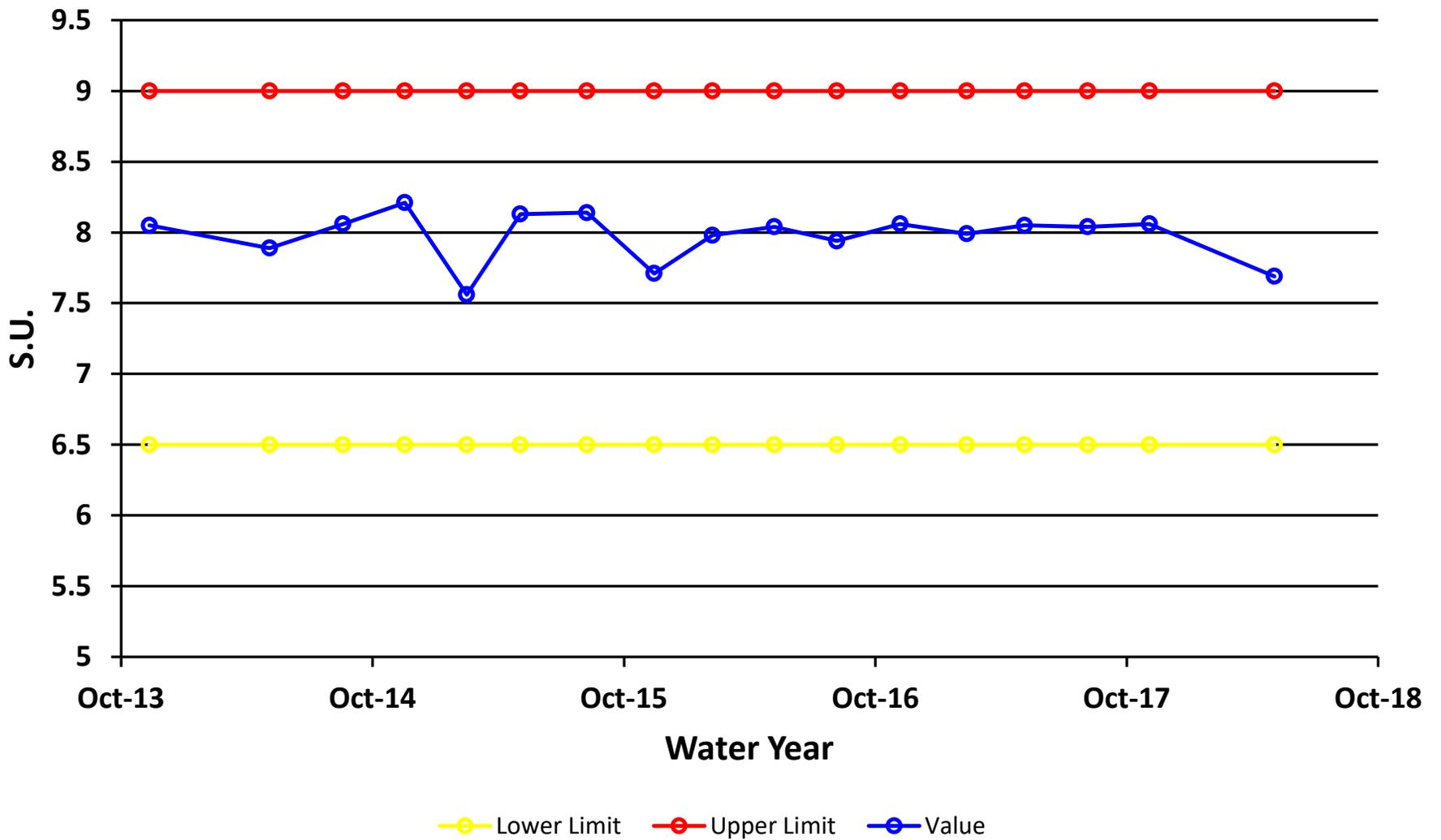
Site 46 - Conductivity Field



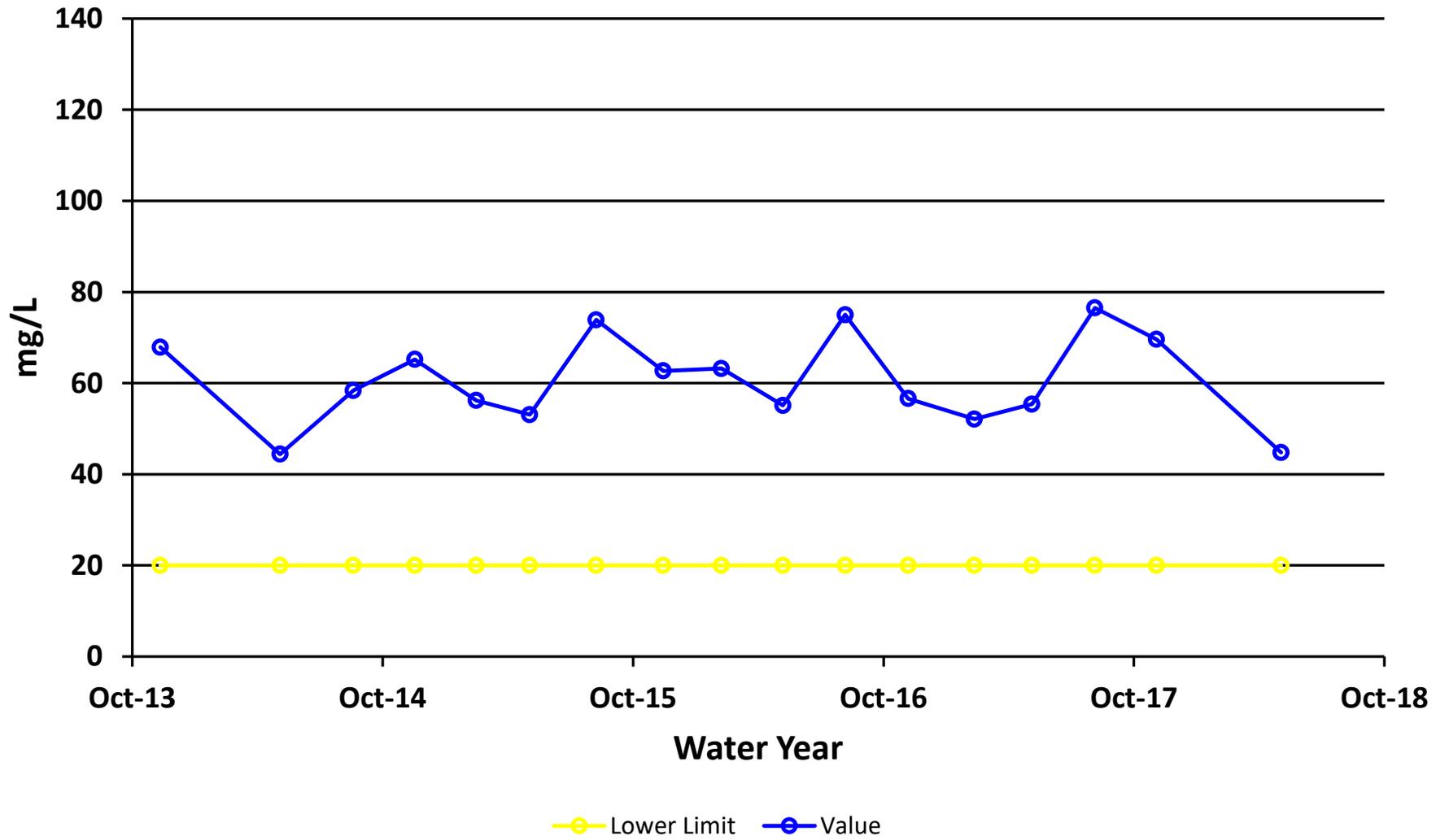
Site 46 - pH Laboratory



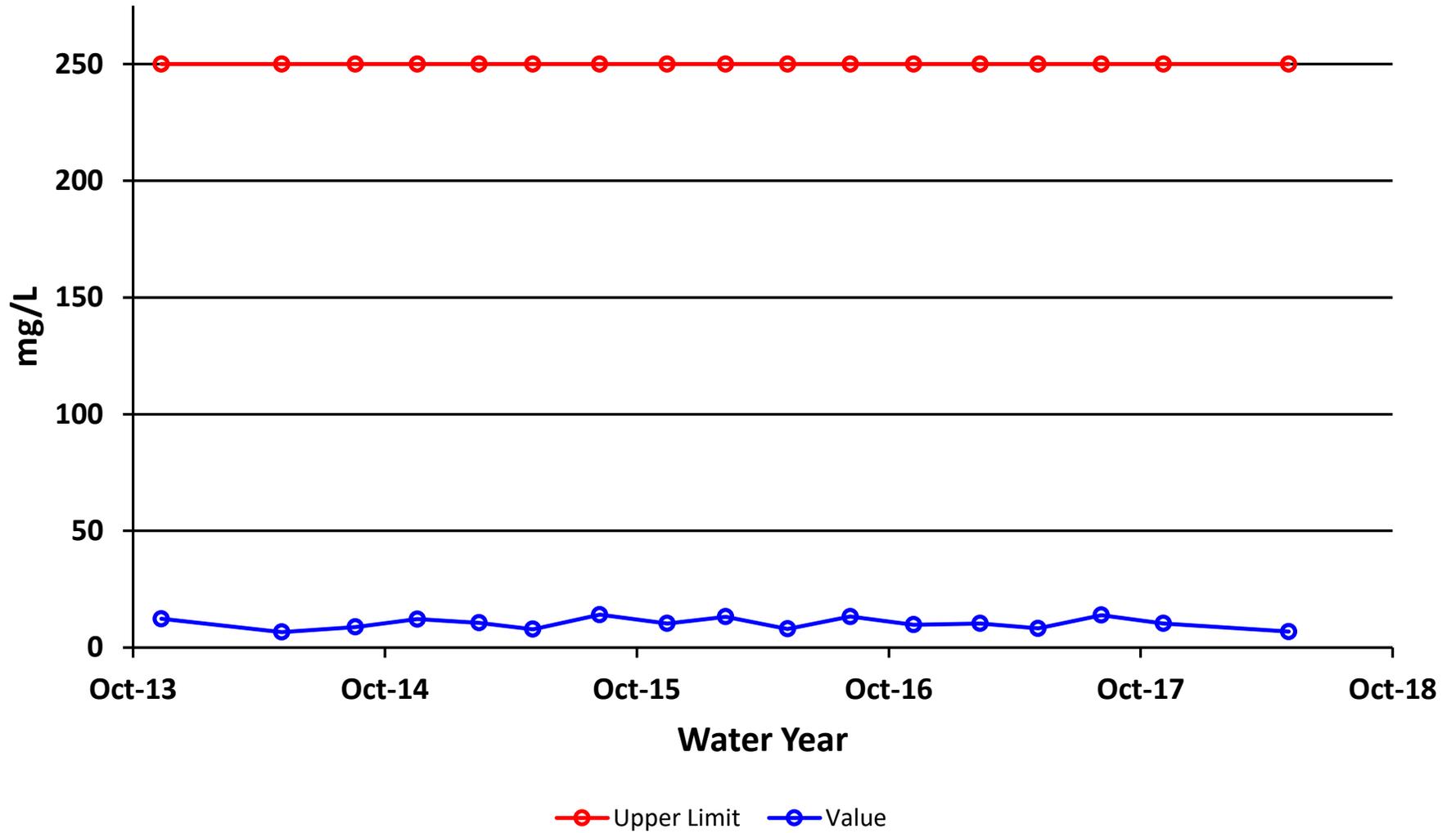
Site 46 - pH Field



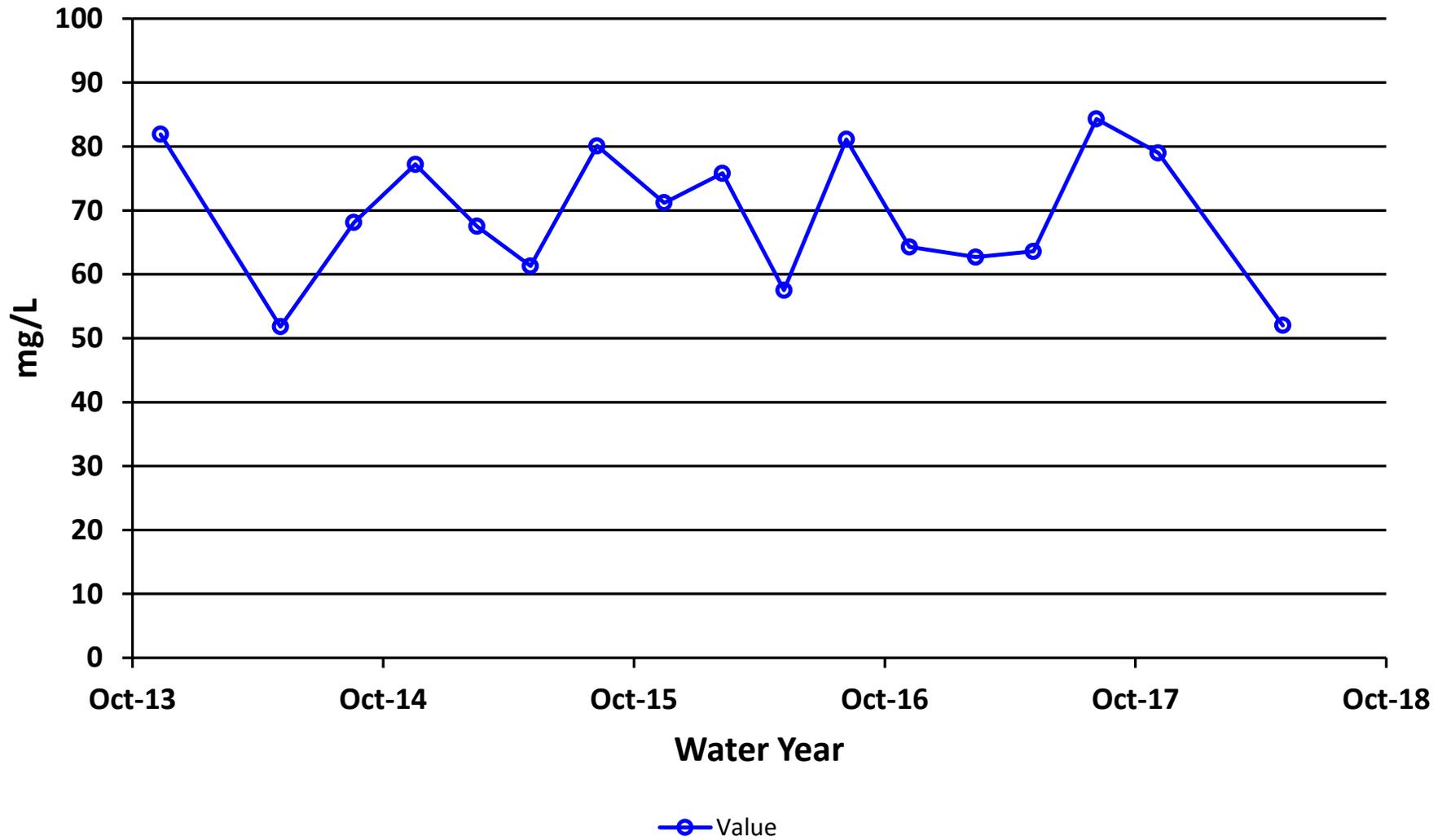
Site 46 - Alkalinity



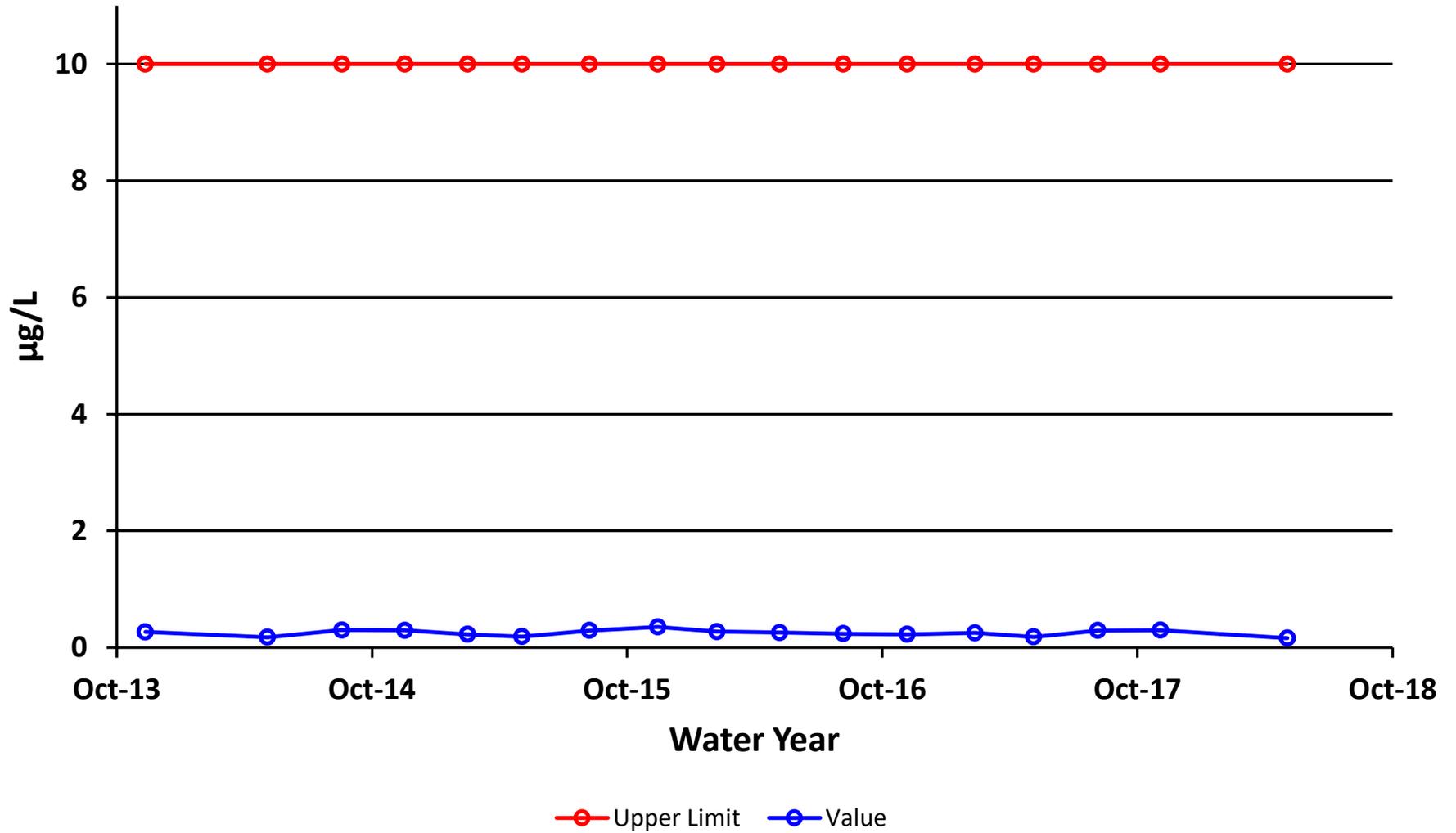
Site 46 - Sulfate



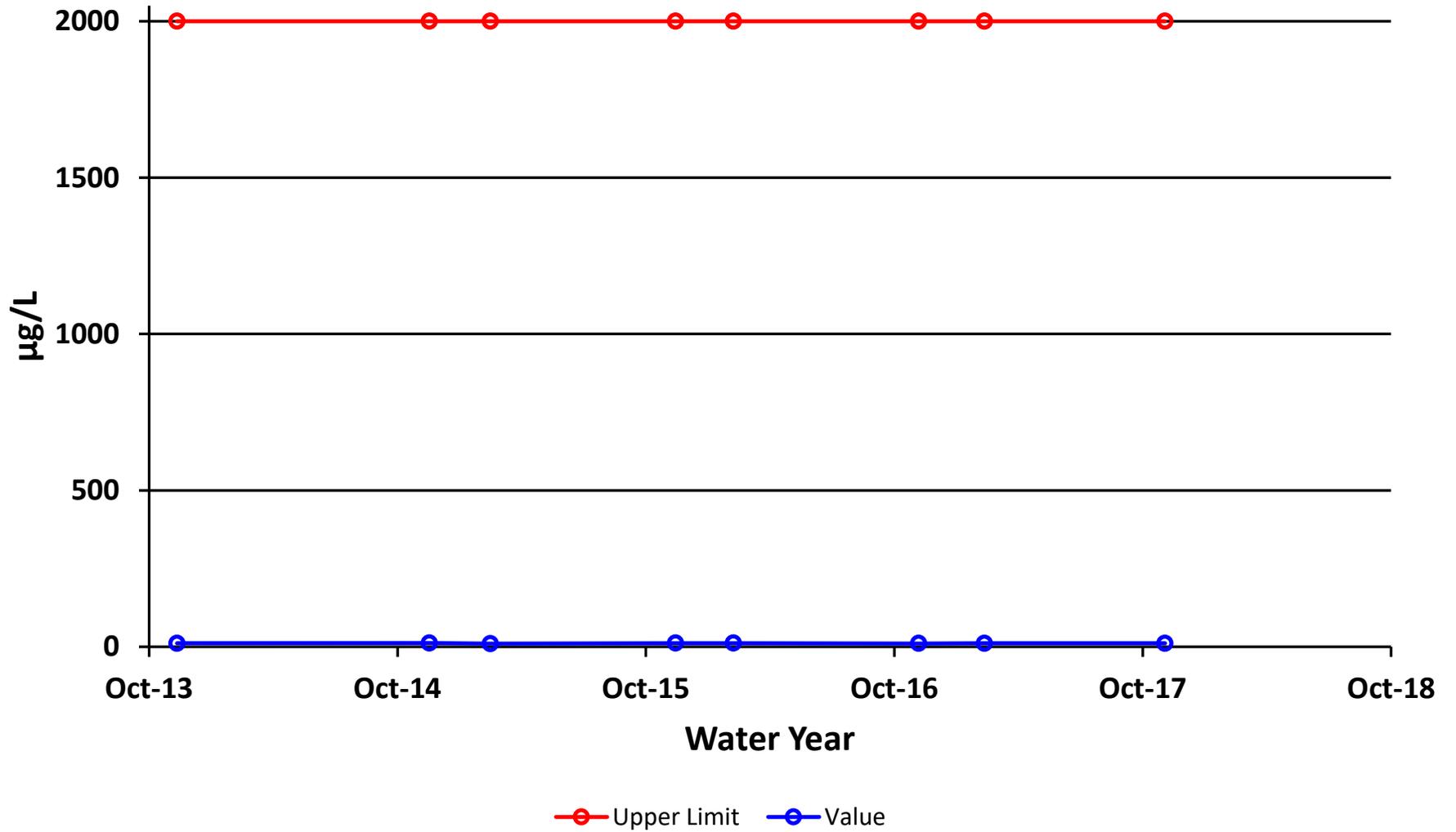
Site 46 - Hardness



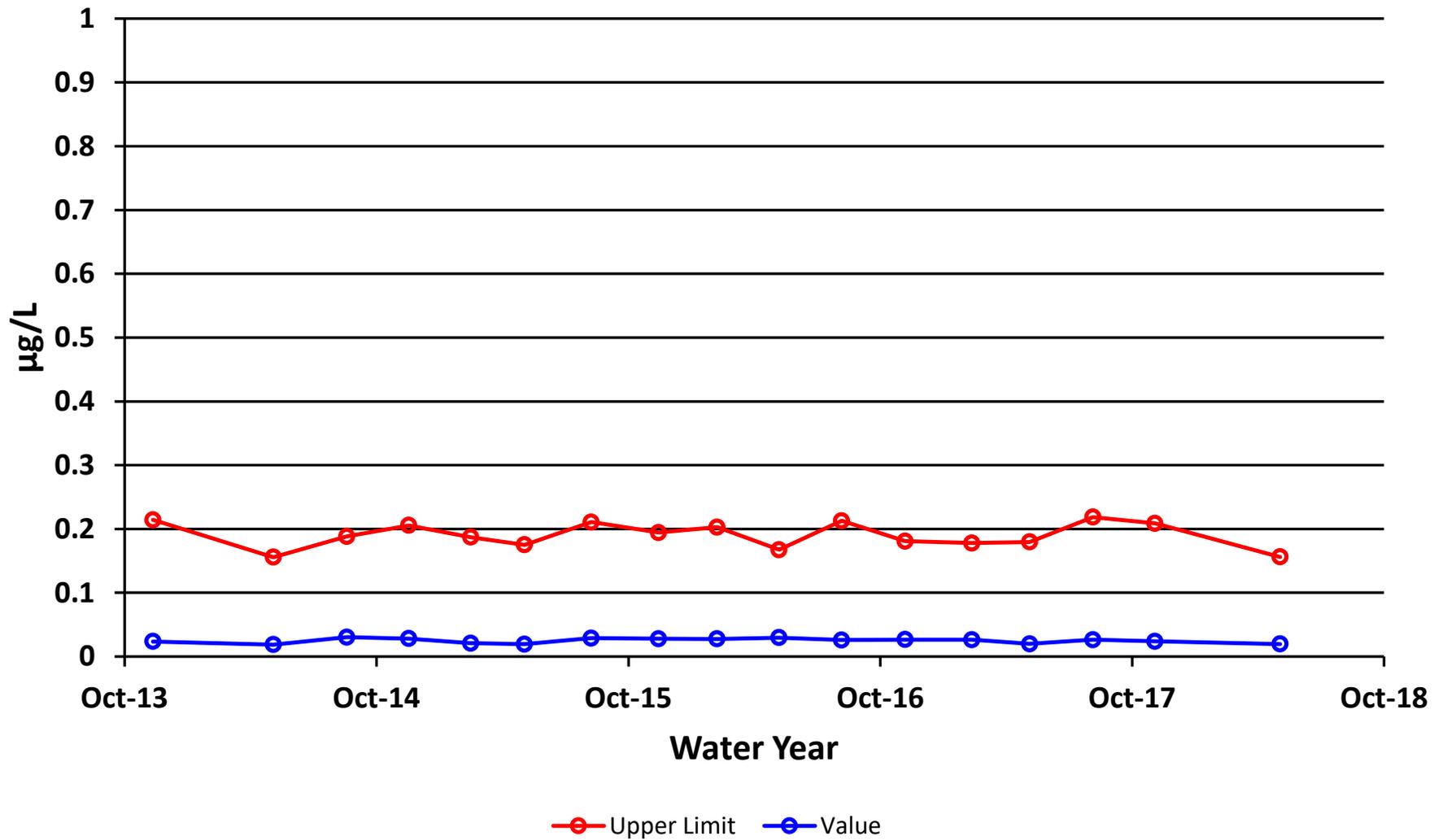
Site 46 - Arsenic Dissolved



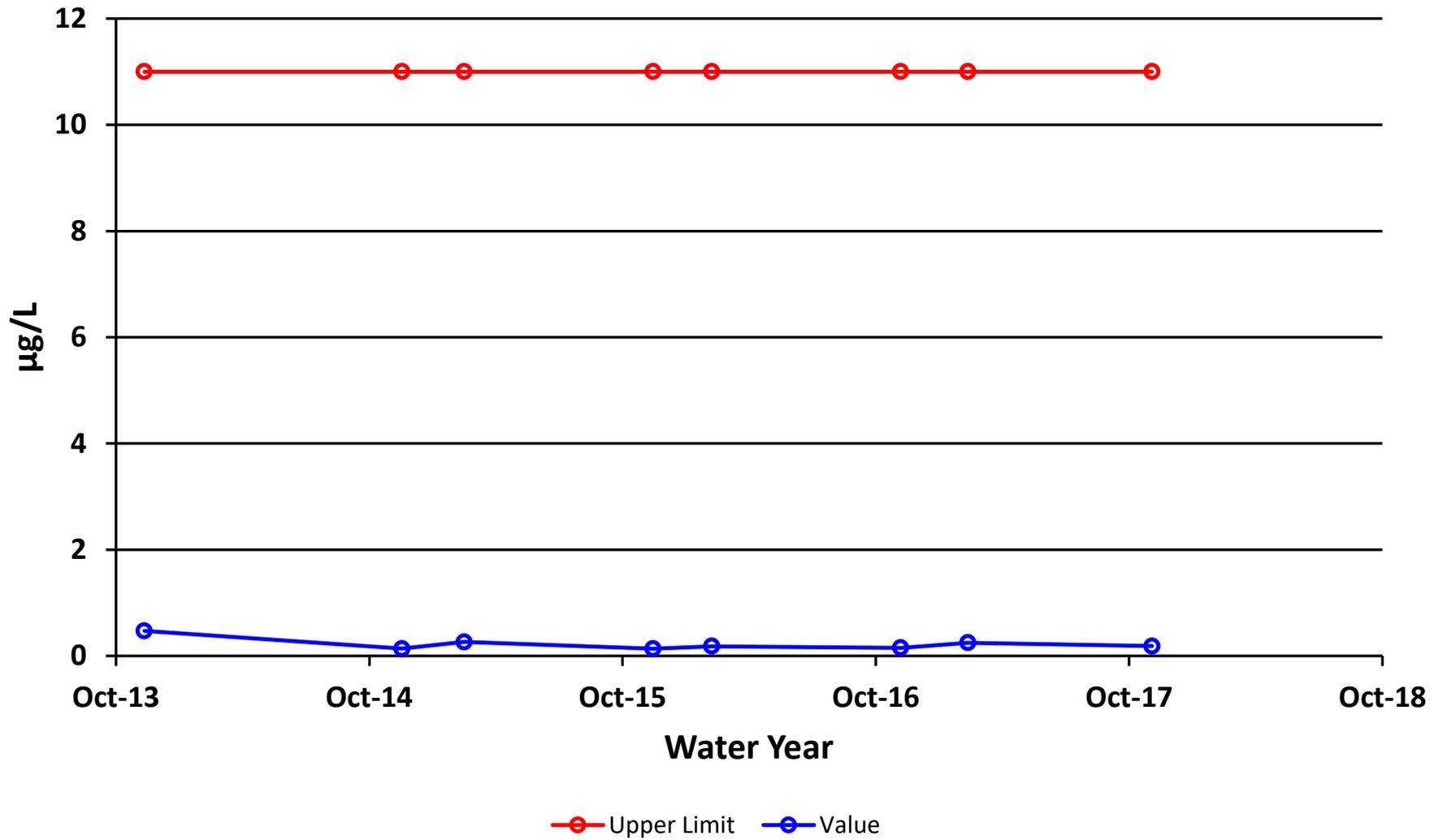
Site 46 - Barium Dissolved



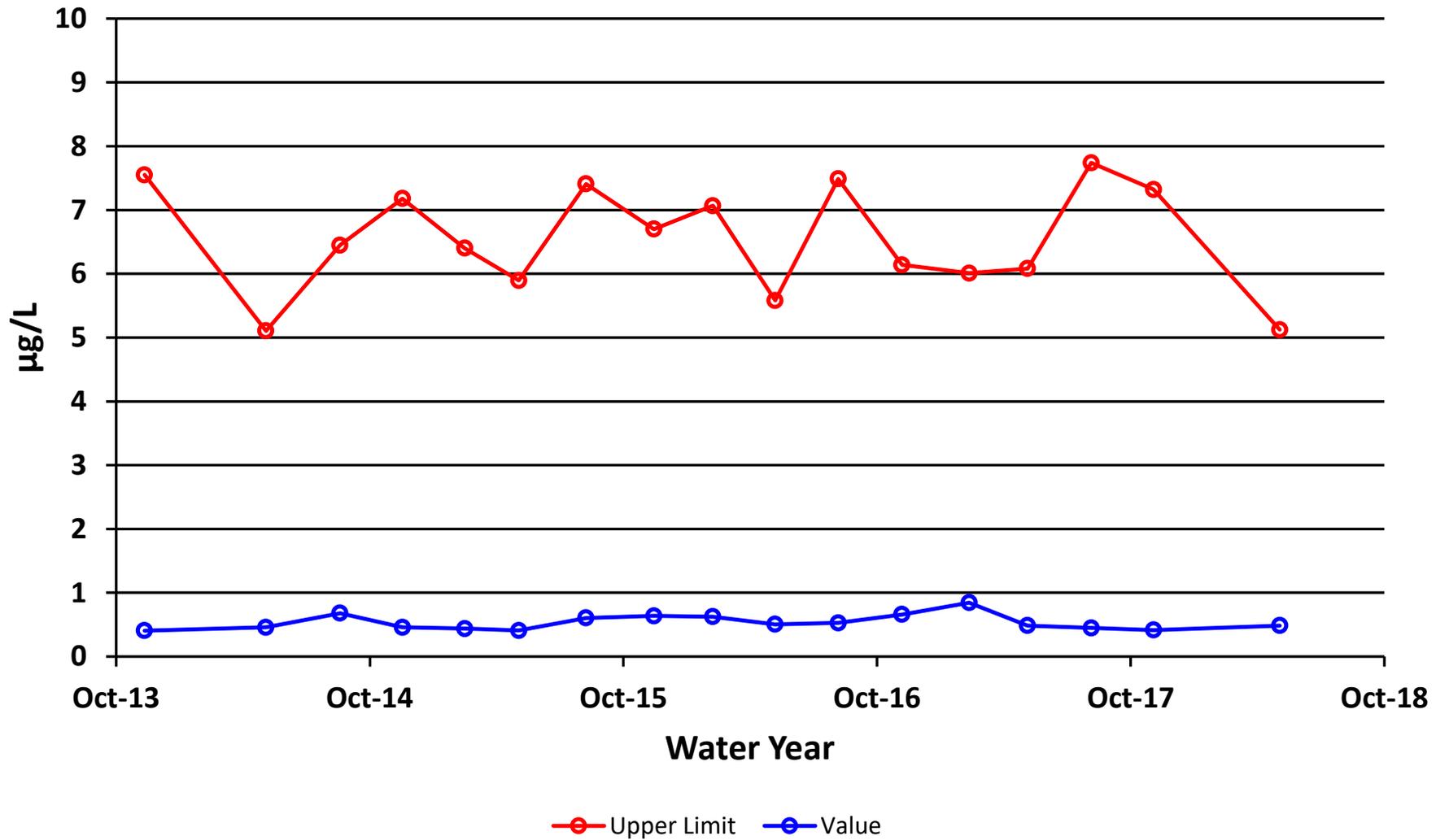
Site 46 - Cadmium Dissolved



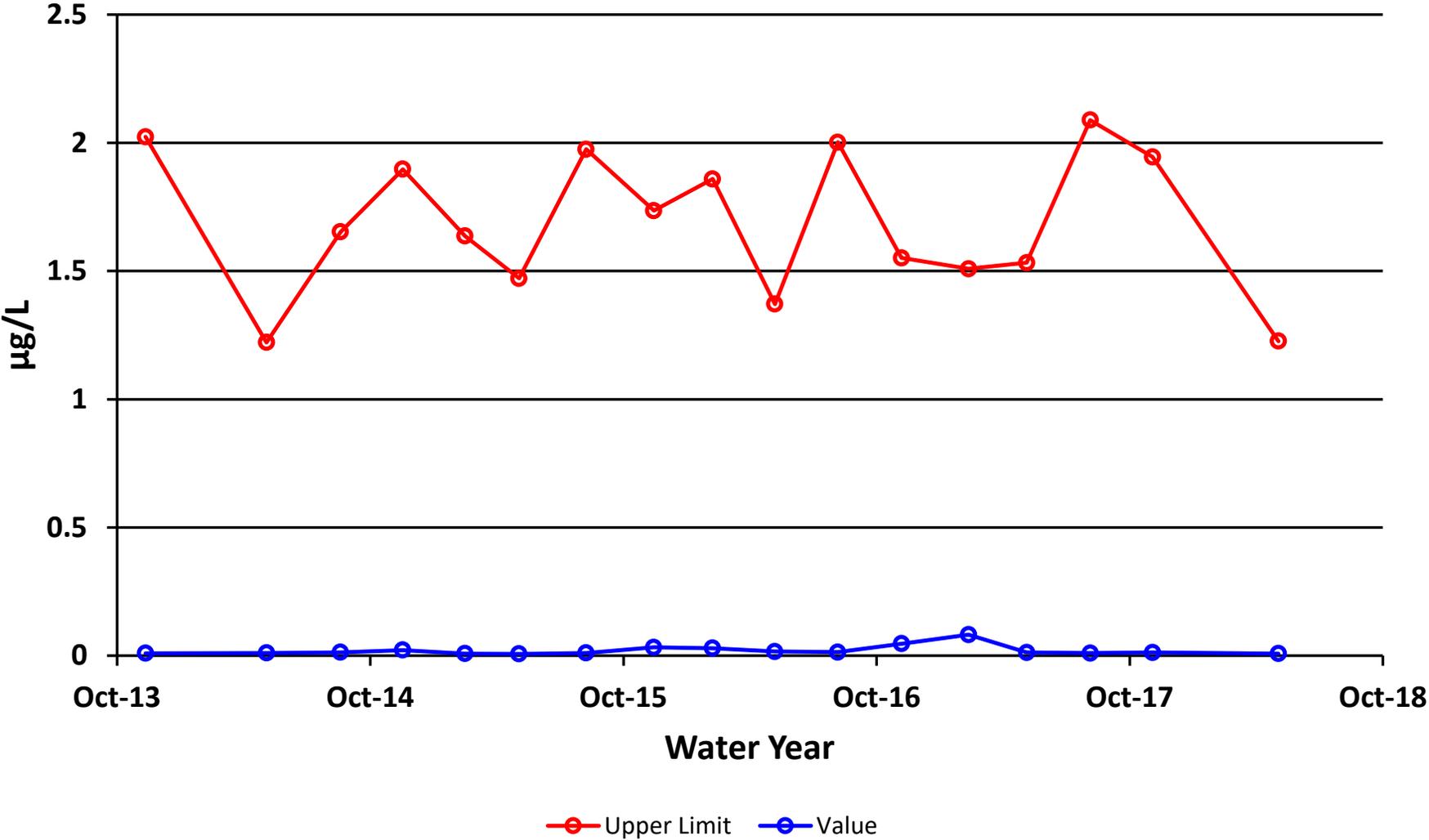
Site 46 - Chromium Dissolved



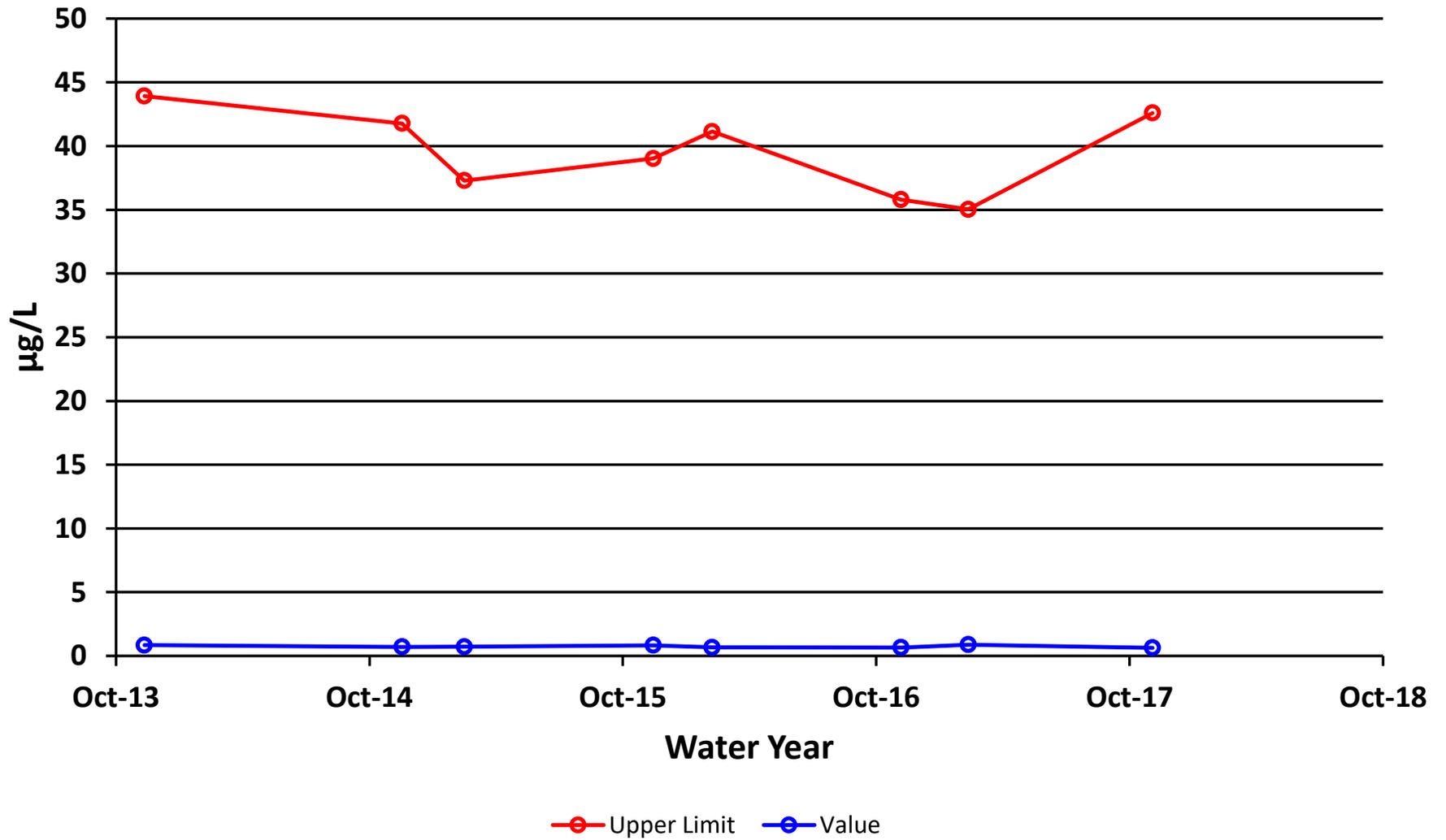
Site 46 - Copper Dissolved



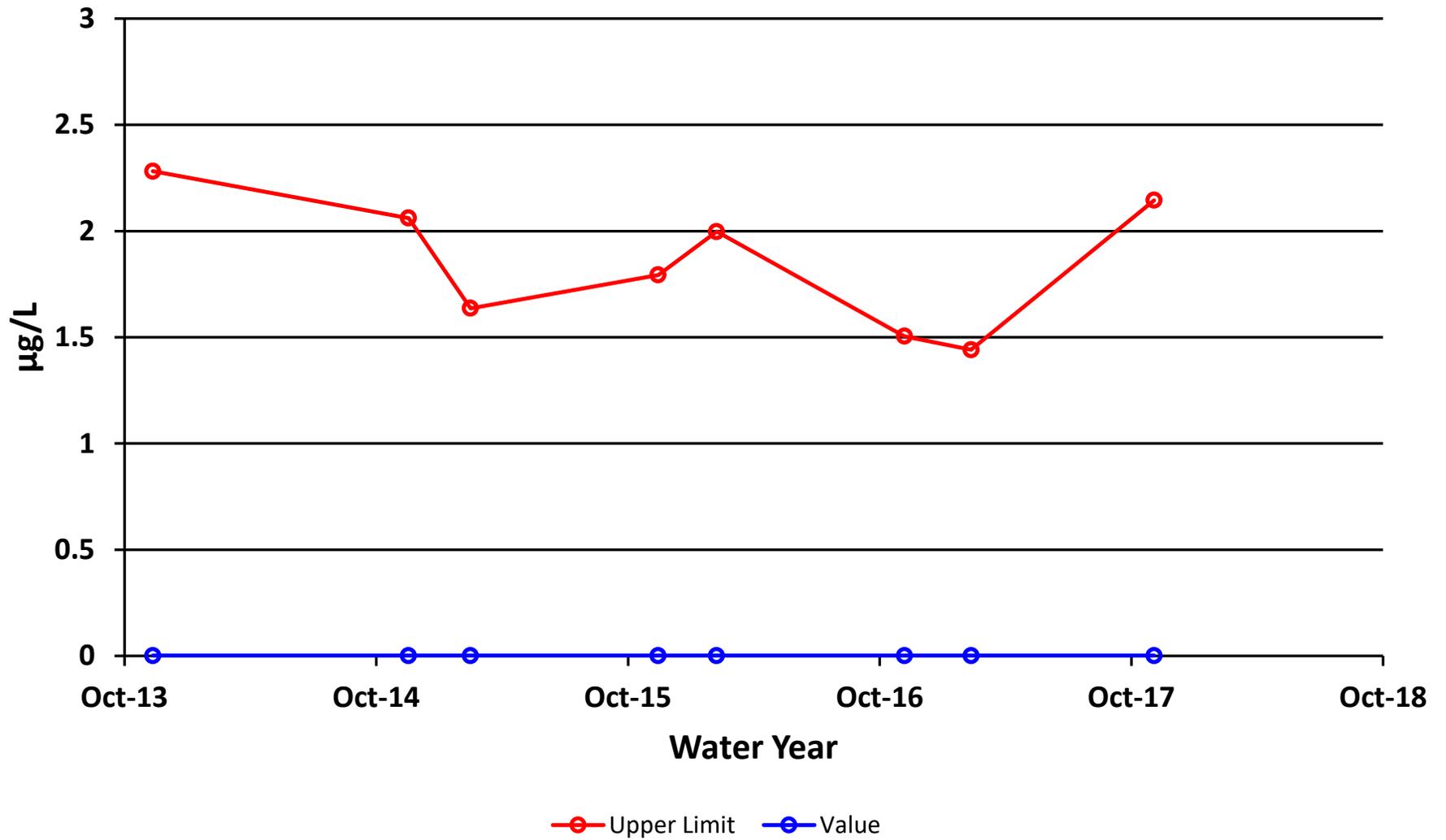
Site 46 - Lead Dissolved



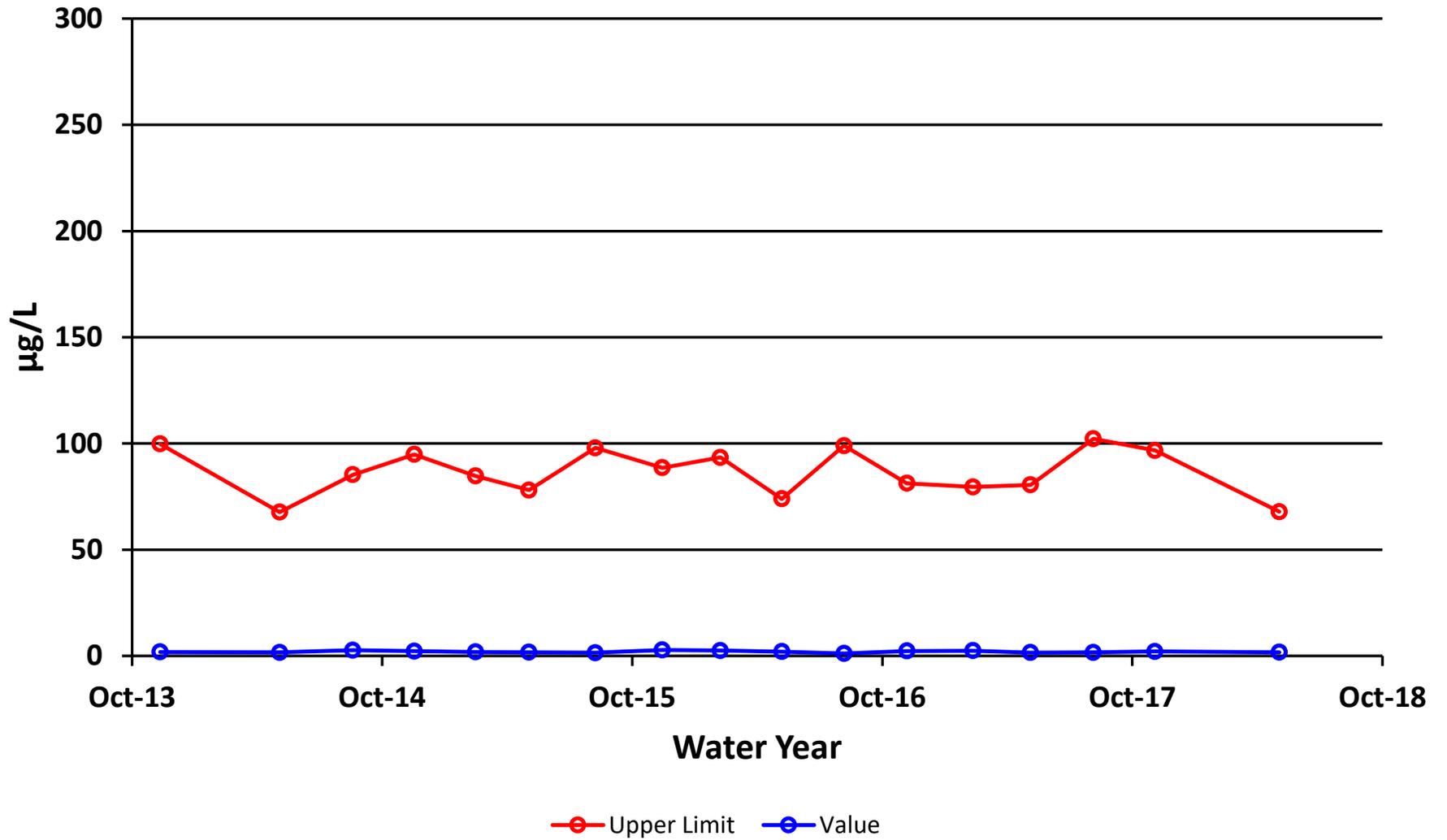
Site 46 - Nickel Dissolved



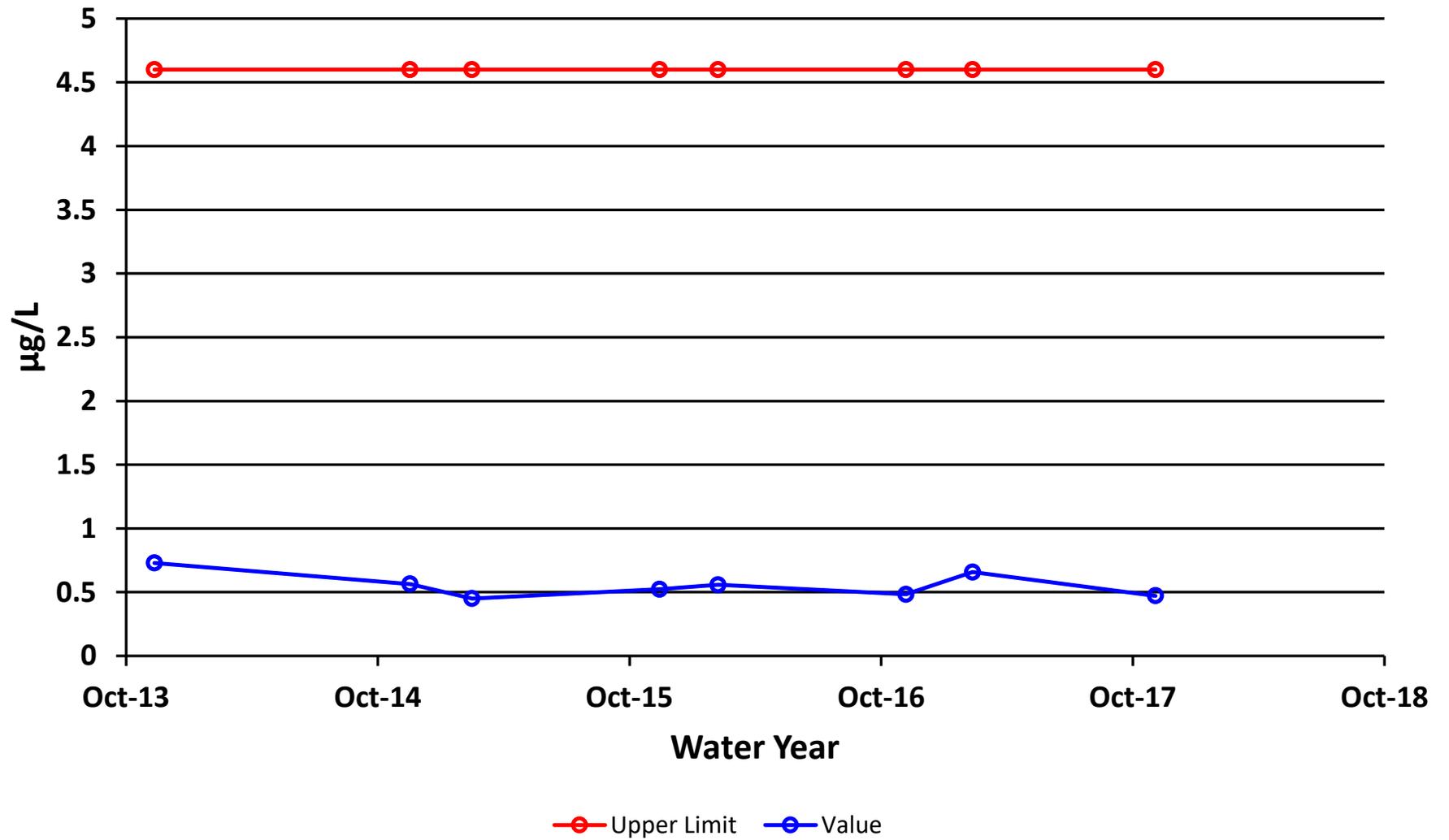
Site 46 - Silver Dissolved



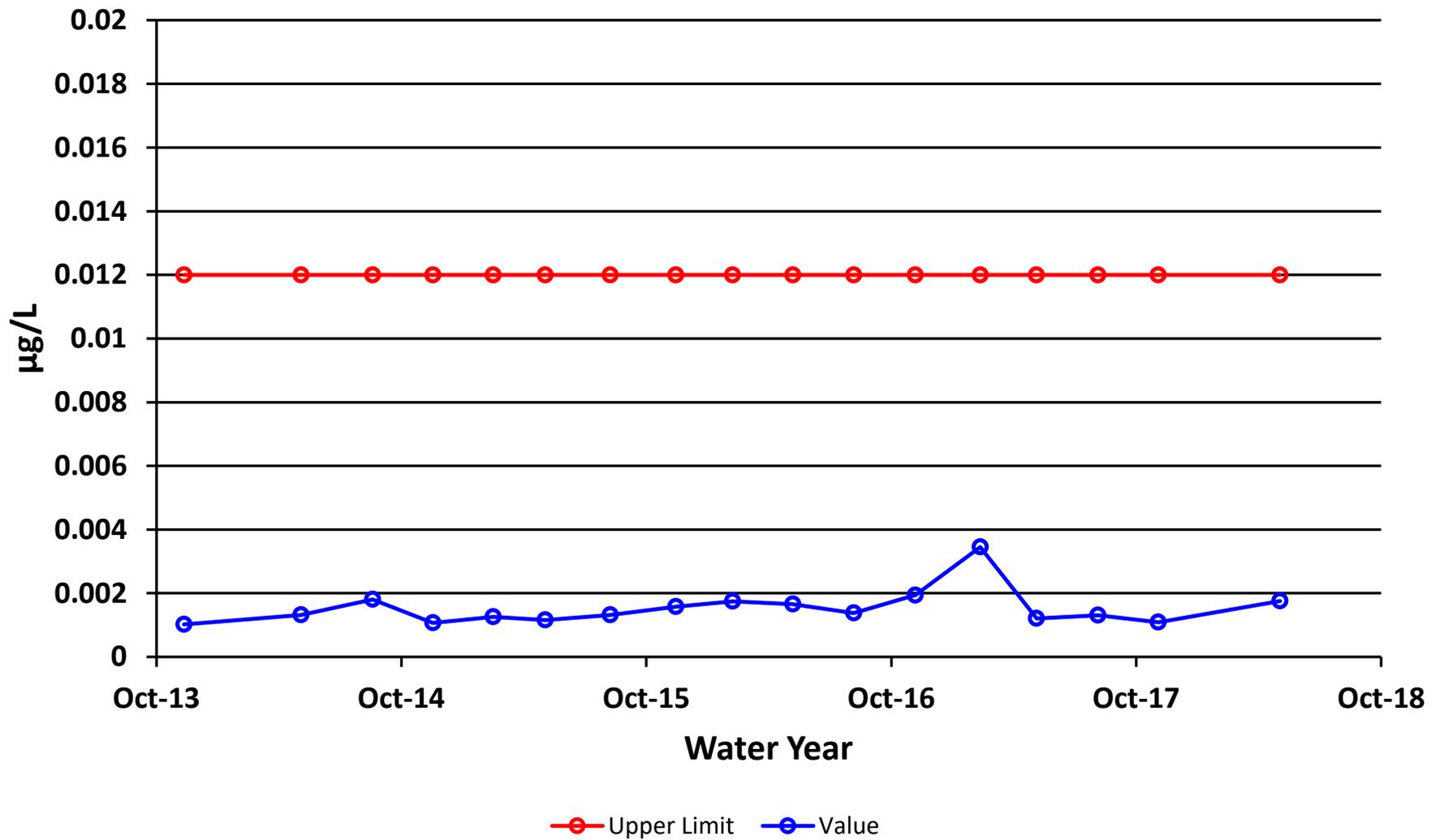
Site 46 - Zinc Dissolved



Site 46 - Selenium Dissolved



Site 46 - Mercury Dissolved



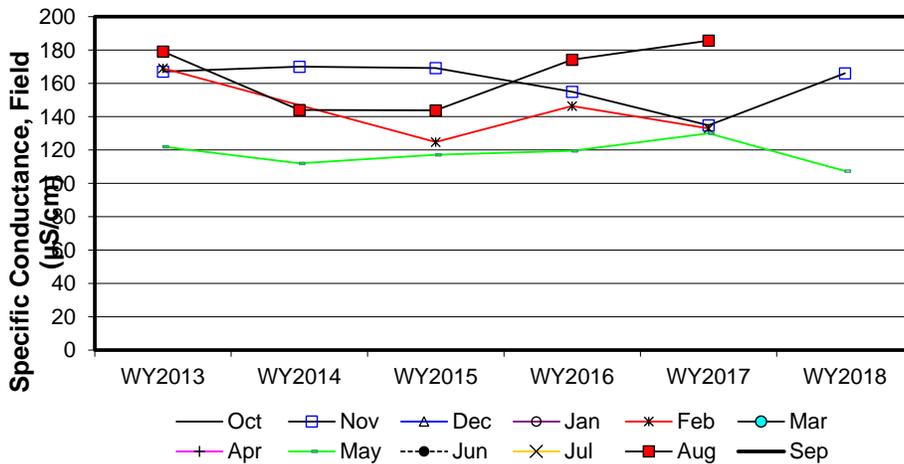
Site #46

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	WY2013		167.0			169.0			122.0			179.0	
b	WY2014		170.0						112.0			144.0	
c	WY2015		169.1			124.8			117.2			143.8	
d	WY2016		155.0			146.4			119.5			174.2	
e	WY2017		134.8			132.9			130.0			185.6	
f	WY2018		166.0						107.4				
n		0	6	0	0	4	0	0	6	0	0	5	0
t ₁		0	6	0	0	4	0	0	6	0	0	5	0
t ₂		0	0	0	0	0	0	0	0	0	0	0	0
t ₃		0	0	0	0	0	0	0	0	0	0	0	0
t ₄		0	0	0	0	0	0	0	0	0	0	0	0
t ₅		0	0	0	0	0	0	0	0	0	0	0	0
b-a			1						-1			-1	
c-a			1			-1			-1			-1	
d-a			-1			-1			-1			-1	
e-a			-1			-1			1			1	
f-a			-1						-1				
c-b			-1						1			-1	
d-b			-1						1			1	
e-b			-1						1			1	
f-b			-1						-1				
d-c			-1			1			1			1	
e-c			-1			1			1			1	
f-c			-1						-1				
e-d			-1			-1			1			1	
f-d			1						-1				
f-e			1						-1				
S _k		0	-7	0	0	-2	0	0	-1	0	0	2	0
σ _S ² =			28.33			8.67			28.33			16.67	
Z _k = S _k /σ _S			-1.32			-0.68			-0.19			0.49	
Z _k ²			1.73			0.46			0.04			0.24	

ΣZ _k =	-1.69	Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅	Σn	21
ΣZ _k ² =	2.47	Count	21	0	0	0	0	ΣS _k	-8
Z-bar=ΣZ _k /K=	-0.42								

χ _n ² =ΣZ _k ² -K(Z-bar) ² =	1.75	@α=5% χ _(K-1) ² =	7.81	Test for station homogeneity
p	0.626			χ _n ² <χ _(K-1) ² ACCEPT
ΣVAR(S _k)	Z _{calc} -0.77	@α/2=2.5% Z=	1.96	H ₀ (No trend) ACCEPT
82.00	p 0.220			H _A (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals			
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-7.81		3.91
0.050	-4.92	-0.95	2.13
0.100	-3.20		1.53
0.200	-2.25		-0.20

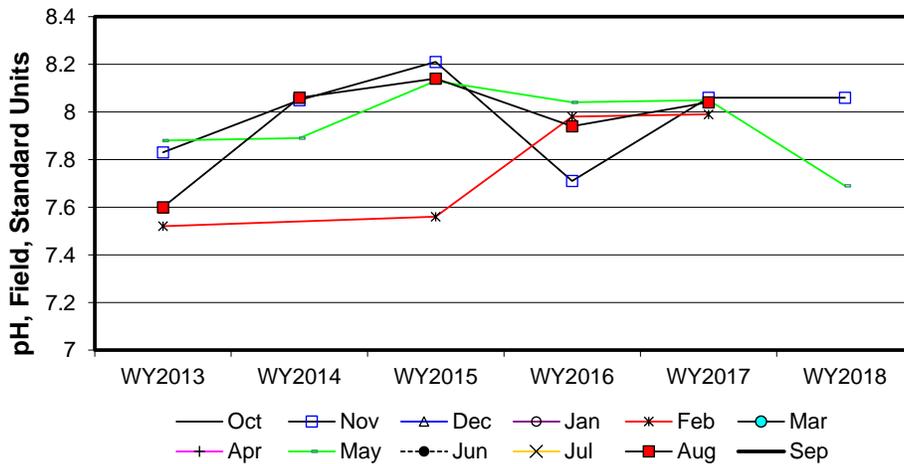
Site #46

Seasonal Kendall analysis for pH, Field, Standard Units

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	WY2013		7.8			7.5			7.9			7.6	
b	WY2014		8.1						7.9			8.1	
c	WY2015		8.2			7.6			8.1			8.1	
d	WY2016		7.7			8.0			8.0			7.9	
e	WY2017		8.1			8.0			8.1			8.0	
f	WY2018		8.1						7.7				
n		0	6	0	0	4	0	0	6	0	0	5	0
t ₁		0	4	0	0	4	0	0	6	0	0	5	0
t ₂		0	1	0	0	0	0	0	0	0	0	0	0
t ₃		0	0	0	0	0	0	0	0	0	0	0	0
t ₄		0	0	0	0	0	0	0	0	0	0	0	0
t ₅		0	0	0	0	0	0	0	0	0	0	0	0
b-a			1						1			1	
c-a			1			1			1			1	
d-a			-1			1			1			1	
e-a			1			1			1			1	
f-a			1						-1				
c-b			1						1			1	
d-b			-1						1			-1	
e-b			1						1			1	
f-b			1						-1				
d-c			-1			1			-1			-1	
e-c			-1			1			-1			-1	
f-c			-1						-1				
e-d			1			1			1			1	
f-d			1						-1				
f-e			0						-1				
S _k		0	4	0	0	6	0	0	1	0	0	2	0
σ _S ² =			27.33			8.67			28.33			16.67	
Z _k = S _k /σ _S			0.77			2.04			0.19			0.49	
Z _k ²			0.59			4.15			0.04			0.24	

ΣZ _k =	3.48	Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅	Σn	21
ΣZ _k ² =	5.01	Count	19	1	0	0	0	ΣS _k	13
Z-bar=ΣZ _k /K=	0.87								

$\chi^2_{h} = \sum Z_k^2 - K(Z\text{-bar})^2 =$	1.99	@α=5% $\chi^2_{(K-1)} =$	7.81	Test for station homogeneity	
p	0.575			$\chi^2_h < \chi^2_{(K-1)}$	ACCEPT
ΣVAR(S _k)	Z _{calc} 1.33	@α/2=2.5% Z=	1.96	H ₀ (No trend)	ACCEPT
81.00	p 0.909			H _A (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals			
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.04		0.12
0.050	-0.02		0.09
0.100	0.00	0.03	0.07
0.200	0.00		0.05

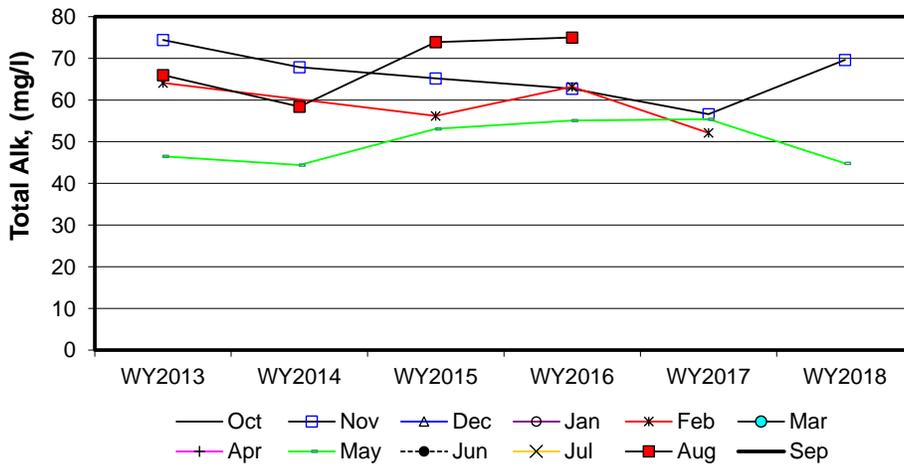
Site #46

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	WY2013		74.4			64.1			46.5			66.0	
b	WY2014		67.9						44.4			58.4	
c	WY2015		65.2			56.2			53.1			73.9	
d	WY2016		62.7			63.2			55.1			75.0	
e	WY2017		56.6			52.1			55.4				
f	WY2018		69.6						44.8				
n		0	6	0	0	4	0	0	6	0	0	4	0
t ₁		0	6	0	0	4	0	0	6	0	0	4	0
t ₂		0	0	0	0	0	0	0	0	0	0	0	0
t ₃		0	0	0	0	0	0	0	0	0	0	0	0
t ₄		0	0	0	0	0	0	0	0	0	0	0	0
t ₅		0	0	0	0	0	0	0	0	0	0	0	0
b-a			-1						-1			-1	
c-a			-1			-1			1			1	
d-a			-1			-1			1			1	
e-a			-1			-1			1				
f-a			-1						-1				
c-b			-1						1			1	
d-b			-1						1			1	
e-b			-1						1				
f-b			1						1				
d-c			-1			1			1			1	
e-c			-1			-1			1				
f-c			1						-1				
e-d			-1			-1			1				
f-d			1						-1				
f-e			1						-1				
S _k		0	-7	0	0	-4	0	0	5	0	0	4	0
σ _S ² =			28.33			8.67			28.33			8.67	
Z _k = S _k /σ _S			-1.32			-1.36			0.94			1.36	
Z _k ²			1.73			1.85			0.88			1.85	

ΣZ _k =	-0.38	Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅	Σn	20
ΣZ _k ² =	6.30	Count	20	0	0	0	0	ΣS _k	-2
Z-bar=ΣZ _k /K=	-0.09								

χ _n ² =ΣZ _k ² -K(Z-bar) ² =	6.27	@α=5% χ _(K-1) ² =	7.81	Test for station homogeneity
p	0.099			χ _n ² <χ _(K-1) ² ACCEPT
ΣVAR(S _k)	Z _{calc} -0.12	@α/2=2.5% Z=	1.96	H ₀ (No trend) ACCEPT
74.00	p 0.454			H _A (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals			
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-3.90		2.87
0.050	-2.78		1.51
0.100	-2.65	-0.32	1.13
0.200	-2.35		0.38

Site #46

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

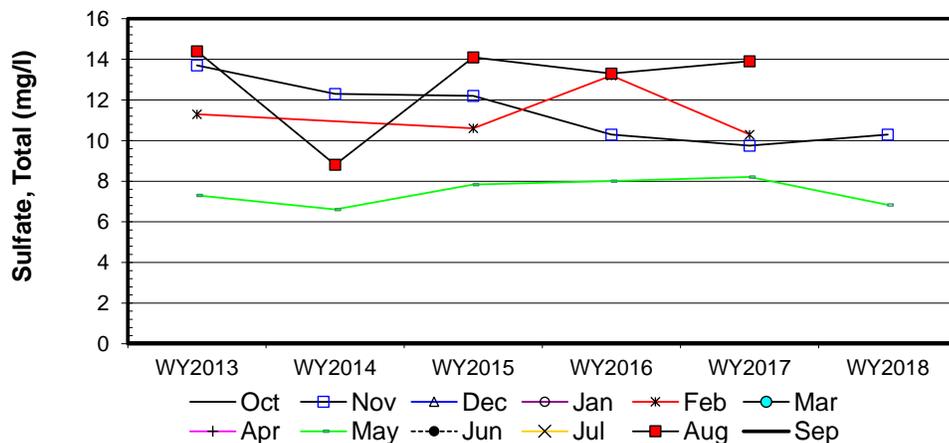
Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	WY2013		13.7			11.3			7.3			14.4	
b	WY2014		12.3						6.6			8.8	
c	WY2015		12.2			10.6			7.8			14.1	
d	WY2016		10.3			13.2			8.0			13.3	
e	WY2017		9.8			10.3			8.2			13.9	
f	WY2018		10.3						6.8				
n		0	6	0	0	4	0	0	6	0	0	5	0
t ₁		0	4	0	0	4	0	0	6	0	0	5	0
t ₂		0	1	0	0	0	0	0	0	0	0	0	0
t ₃		0	0	0	0	0	0	0	0	0	0	0	0
t ₄		0	0	0	0	0	0	0	0	0	0	0	0
t ₅		0	0	0	0	0	0	0	0	0	0	0	0
b-a			-1						-1			-1	
c-a			-1			-1			1			-1	
d-a			-1			1			1			-1	
e-a			-1			-1			1			-1	
f-a			-1						-1				
c-b			-1						1			1	
d-b			-1						1			1	
e-b			-1						1			1	
f-b			-1						1				
d-c			-1			1			1			-1	
e-c			-1			-1			1			-1	
f-c			-1						-1				
e-d			-1			-1			1			1	
f-d			0						-1				
f-e			1						-1				
S _k		0	-12	0	0	-2	0	0	5	0	0	-2	0
σ _s ²			27.33			8.67			28.33			16.67	
Z _k = S _k /σ _s			-2.30			-0.68			0.94			-0.49	
Z _k ²			5.27			0.46			0.88			0.24	

ΣZ_k= -2.53
 ΣZ_k²= 6.85
 Z-bar=ΣZ_k/K= -0.63

Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅
Count	19	1	0	0	0

Σn = 21
 ΣS_k = -11

χ _n ² =ΣZ _k ² -K(Z-bar) ² =	5.26	@α=5% χ _(K-1) ² =	7.81	Test for station homogeneity
p	0.154	χ _h ² <χ _(K-1) ²		ACCEPT
ΣVAR(S _k)	Z _{calc} -1.11	@α=2.5% Z=	1.96	H ₀ (No trend) ACCEPT
81.00	p 0.133			H _A (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals			
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.72		0.21
0.050	-0.61	-0.15	0.10
0.100	-0.54		-0.02
0.200	-0.36		-0.10

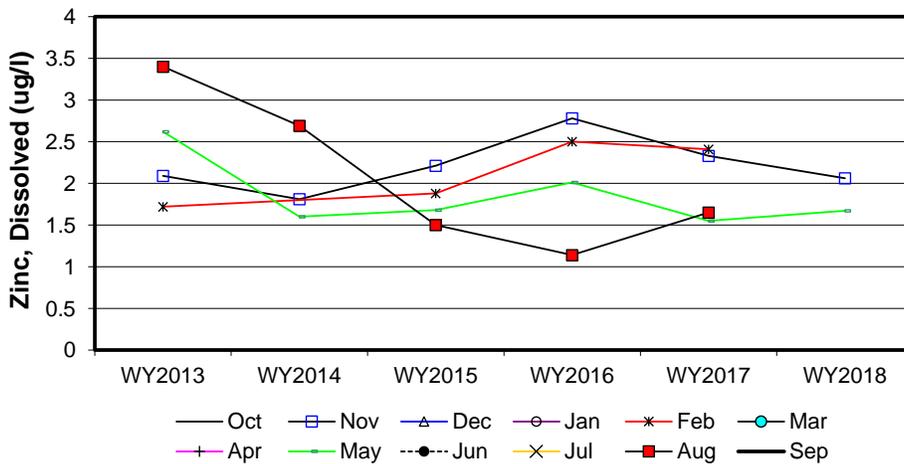
Site #46

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	WY2013		2.1			1.7			2.6			3.4	
b	WY2014		1.8						1.6			2.7	
c	WY2015		2.2			1.9			1.7			1.5	
d	WY2016		2.8			2.5			2.0			1.1	
e	WY2017		2.3			2.4			1.6			1.7	
f	WY2018		2.1						1.7				
n		0	6	0	0	4	0	0	6	0	0	5	0
t ₁		0	6	0	0	4	0	0	6	0	0	5	0
t ₂		0	0	0	0	0	0	0	0	0	0	0	0
t ₃		0	0	0	0	0	0	0	0	0	0	0	0
t ₄		0	0	0	0	0	0	0	0	0	0	0	0
t ₅		0	0	0	0	0	0	0	0	0	0	0	0
b-a			-1						-1			-1	
c-a			1			1			-1			-1	
d-a			1			1			-1			-1	
e-a			1			1			-1			-1	
f-a			-1						-1				
c-b			1						1			-1	
d-b			1						1			-1	
e-b			1						-1			-1	
f-b			1						1				
d-c			1			1			1			-1	
e-c			1			1			-1			1	
f-c			-1						-1				
e-d			-1			-1			-1			1	
f-d			-1						-1				
f-e			-1						1				
S _k		0	3	0	0	4	0	0	-5	0	0	-6	0
σ _S ² =			28.33			8.67			28.33			16.67	
Z _k = S _k /σ _S			0.56			1.36			-0.94			-1.47	
Z _k ²			0.32			1.85			0.88			2.16	

ΣZ _k =	-0.49	Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅	Σn	21
ΣZ _k ² =	5.21	Count	21	0	0	0	0	ΣS _k	-4
Z-bar=ΣZ _k /K=	-0.12								

χ _h ² =ΣZ _k ² -K(Z-bar) ² =	5.15	@α=5% χ _(K-1) ² =	7.81	Test for station homogeneity
p	0.161			χ _h ² < χ _(K-1) ² ACCEPT
ΣVAR(S _k)	Z _{calc} -0.33	@α/2=2.5% Z=	1.96	H ₀ (No trend) ACCEPT
82.00	p 0.370			H _A (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals			
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.35	-0.01	0.10
0.050	-0.27		0.07
0.100	-0.20		0.06
0.200	-0.15		0.05

INTERPRETIVE REPORT

SITE 57

The data collected during the current water year are listed in the following “Table of Results for Water Year 2018” 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 one-half of the for the purpose of median calculation.

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

Sample Date	Parameter	Value	Qualifier	Notes
No outliers, in the past six years, have been identified by HGCMC.				

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

Table of Exceedance for Water Year 2018

Sample Date	Parameter	Value	Limits		
			Lower	Upper	Hardness
No exceedances have been identified by HGCMC for the period of October 2017 through September 2018.					

X-Y plots have been generated to graphically present the data for each of the analytes requested in the Statistical Information Goals for this site. These plots have been visually analyzed for the appearance of any trend in concentration. Though hardness and conductivity had been trending down gradually during the 2013 and 2014 Water Years, in the 2015 Water Year both parameters dropped sharply but rebounded and have remained at historical levels. The decrease in conductivity was accompanied by a small increase in some metals (e.g. arsenic and zinc). Dissolved cadmium and dissolved zinc have shown large variation in the past. Site 57 is upgradient to the mining operations (background monitoring) and demonstrates that there can be large natural variation in water quality.

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-12 and Sep-18 (WY2013-WY2018).

Site 57 - Table of Summary Statistics for Trend Analysis

Parameter	<u>Mann-Kendall test statistics</u>			<u>Sen's slope estimate</u>	
	n*	p**	Trend	Q	Q(%)
Conductivity Field	6	0.89			
pH Field	6	0.50			
Alkalinity, Total	6	0.99	+	4.00	2.8
Sulfate, Total	6	0.50			
Zinc, Dissolved	6	0.02	-	-3.39	-17.8

* Number of Years ** Significance level

Datasets with a statistically significant trend ($\alpha/2=2.5\%$) a Seasonal-Sen's Slope estimate statistic has also been calculated. There were 2 parameters with statistically significant trends calculated for these parameters this water year. There is a significant increasing trend (4.00 mg/L/yr) in alkalinity and a decreasing trend (-3.39 $\mu\text{g/L/yr}$) in zinc.

Table of Results for Water Year 2018

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

Sample Date/Parameter	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018	Median
Water Temp (°C)		4.9			4.9			5.2			5.2		5.1
Conductivity-Field(µmho)		395			421.5			411.4			400		405.7
Conductivity-Lab (µmho)		357			403			375			402		389
pH Lab (standard units)		7.34			7.39			7.65			6.88		7.37
pH Field (standard units)		7.76			7.41			7.49			7.85		7.63
Total Alkalinity (mg/L)		158			180			167			150		162.5
Total Sulfate (mg/L)		48.1			53.9			62.7			55.5		54.7
Hardness (mg/L)		203			227			224			217		220.5
Dissolved As (ug/L)		0.664			0.633			0.72			0.629		0.649
Dissolved Ba (ug/L)		27.6			28.8			30.2			30.5		29.5
Dissolved Cd (ug/L)		0.161			0.164			0.0693			0.159		0.1600
Dissolved Cr (ug/L)		0.376			0.338			0.329			0.331		0.335
Dissolved Cu (ug/L)		0.157			0.078			0.019			0.067		0.073
Dissolved Pb (ug/L)		0.0015			0.0015			0.0015			0.0015		0.0015
Dissolved Ni (ug/L)		0.255			0.228			0.232			0.236		0.234
Dissolved Ag (ug/L)		0.002			0.002			0.002			0.002		0.002
Dissolved Zn (ug/L)		1.87			1.88			2.05			2.11		1.97
Dissolved Se (ug/L)		0.773			0.82			0.795			0.596		0.784
Dissolved Hg (ug/L)		0.00005			0.00005			0.00005			0.000117		0.000050

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

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

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

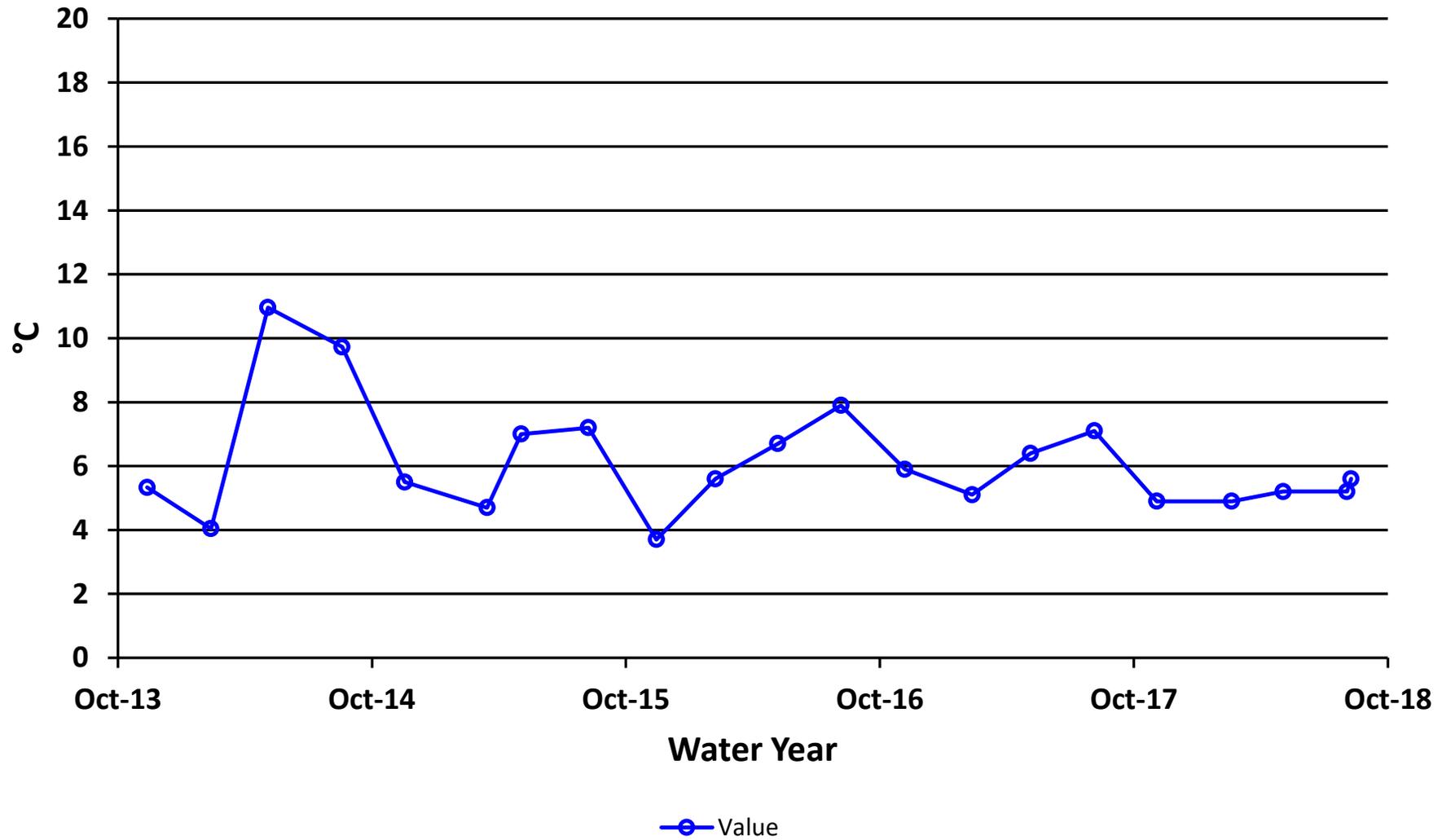
Qualified Data by QA Reviewer

Date Range: 10/01/2017 to 09/30/2018

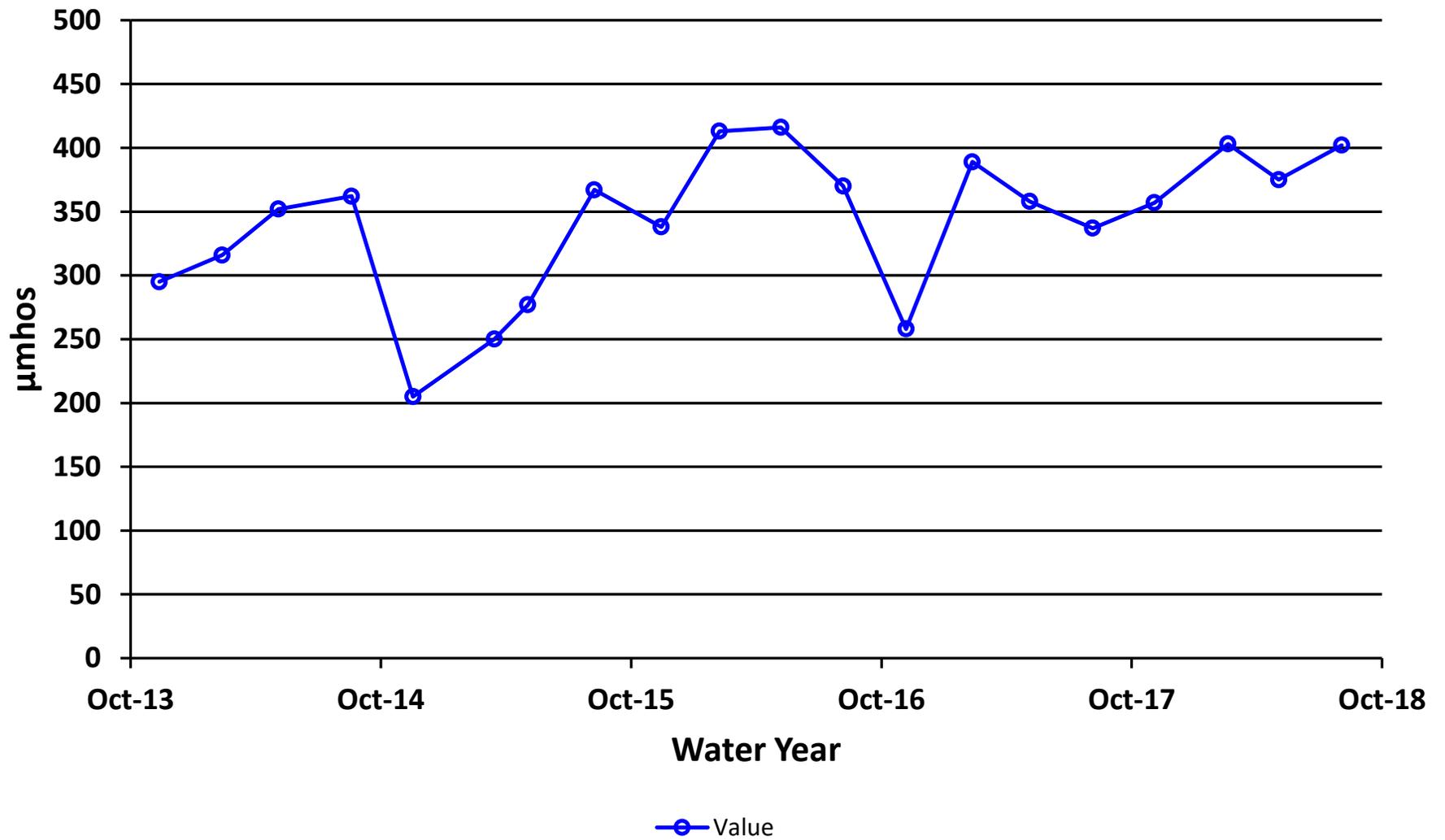
Site No.	Sample Date	Parameter	Value	Qualifier	Reason for Qualifier	
057FMG	2/22/2018	pH	7.39	pH units	J	Hold Time Violation
	5/7/2018	Diss. Cu-ICP/MS	0.01	µg/L	U	Trip Blank Contamination
		pH	7.65	pH units	J	Hold Time Violation
8/7/2018	8/7/2018	Diss. Hg-CVAF	0.0001	µg/L	J	Below Quantitative Range
		Diss. Zn-ICP/MS	2.11	µg/L	U	Field Blank Contamination
		pH	6.88	pH units	J	Hold Time Violation

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

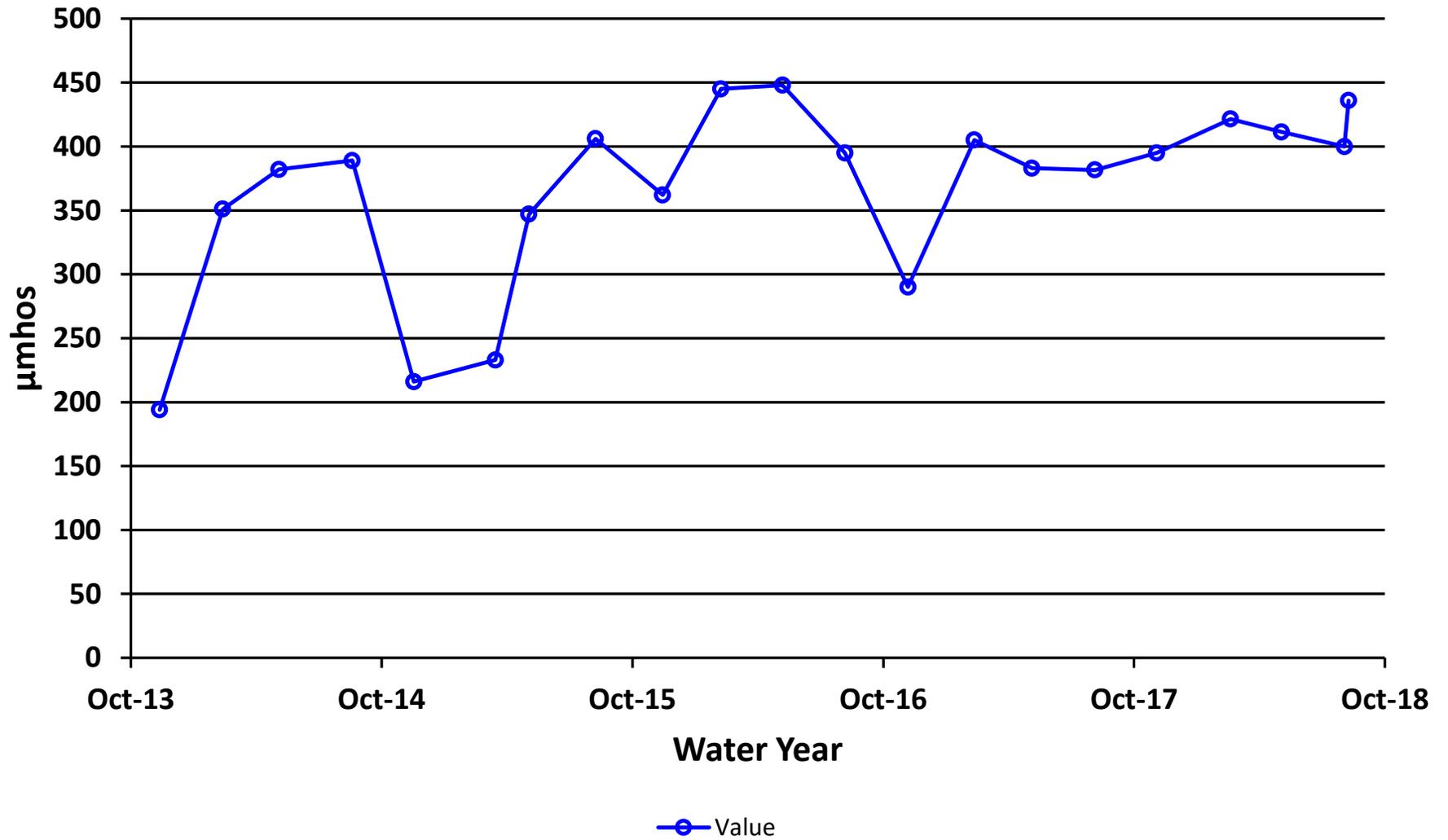
Site 57 - Water Temperature



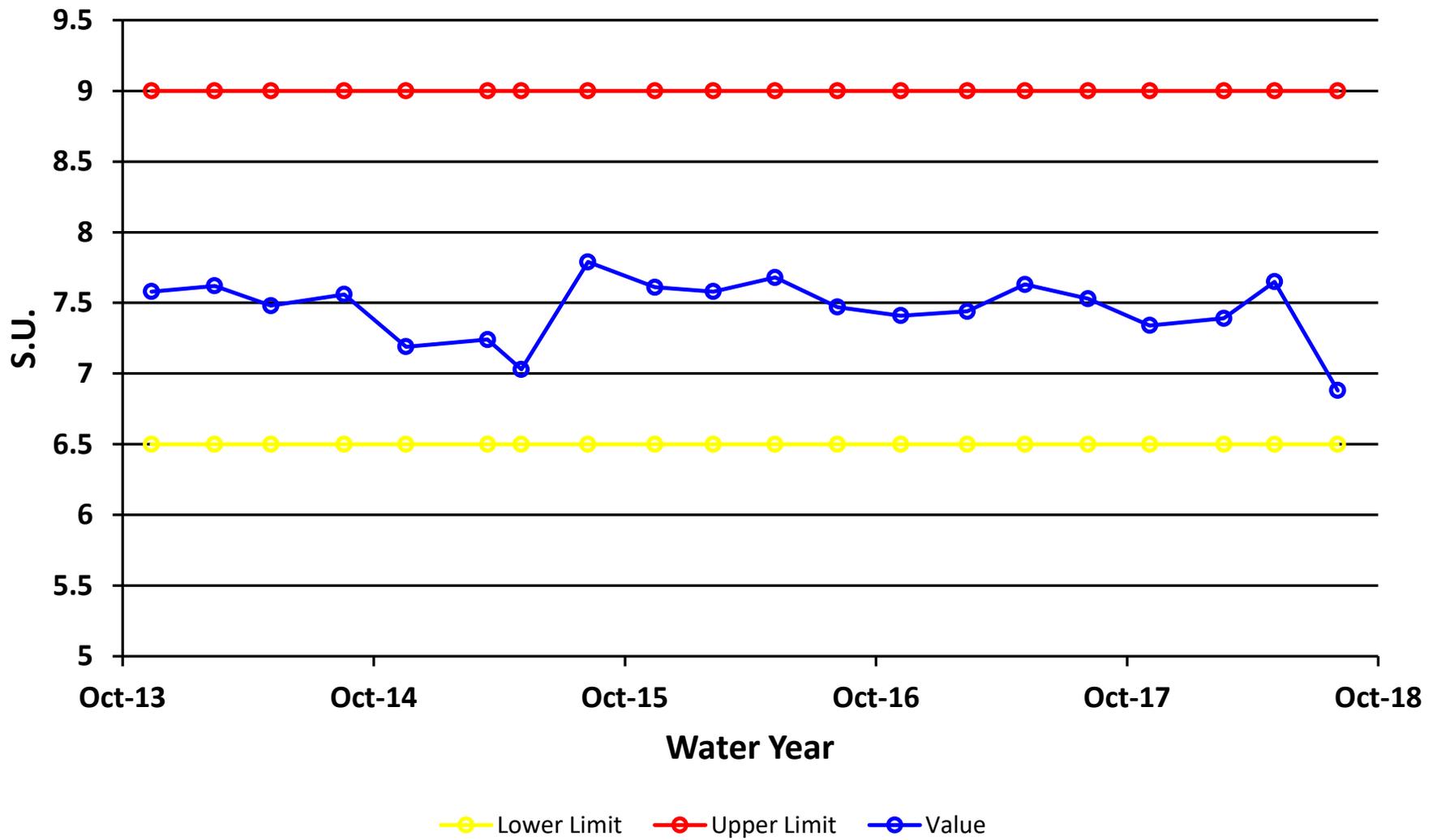
Site 57 - Conductivity Laboratory



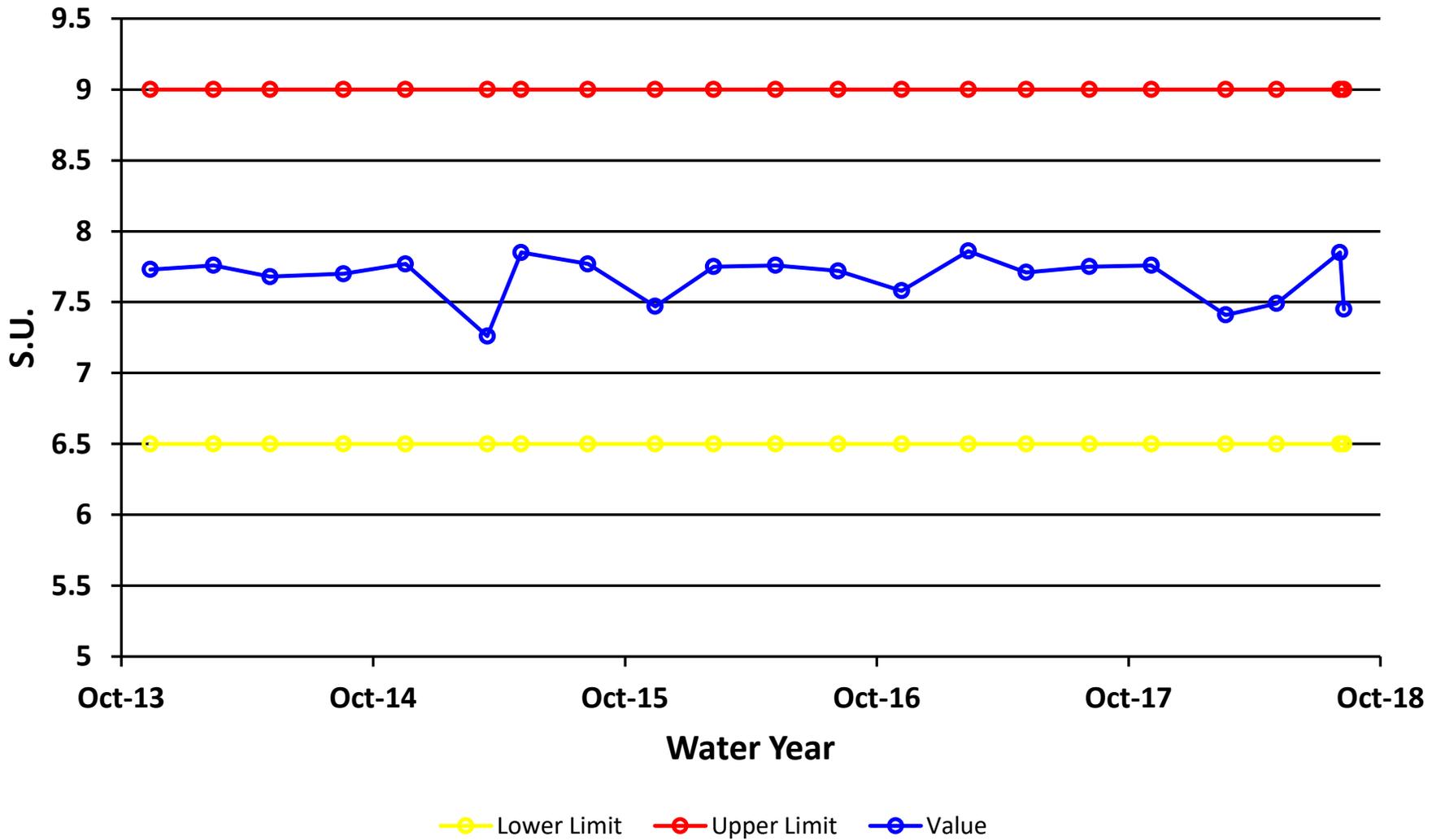
Site 57 - Conductivity Field



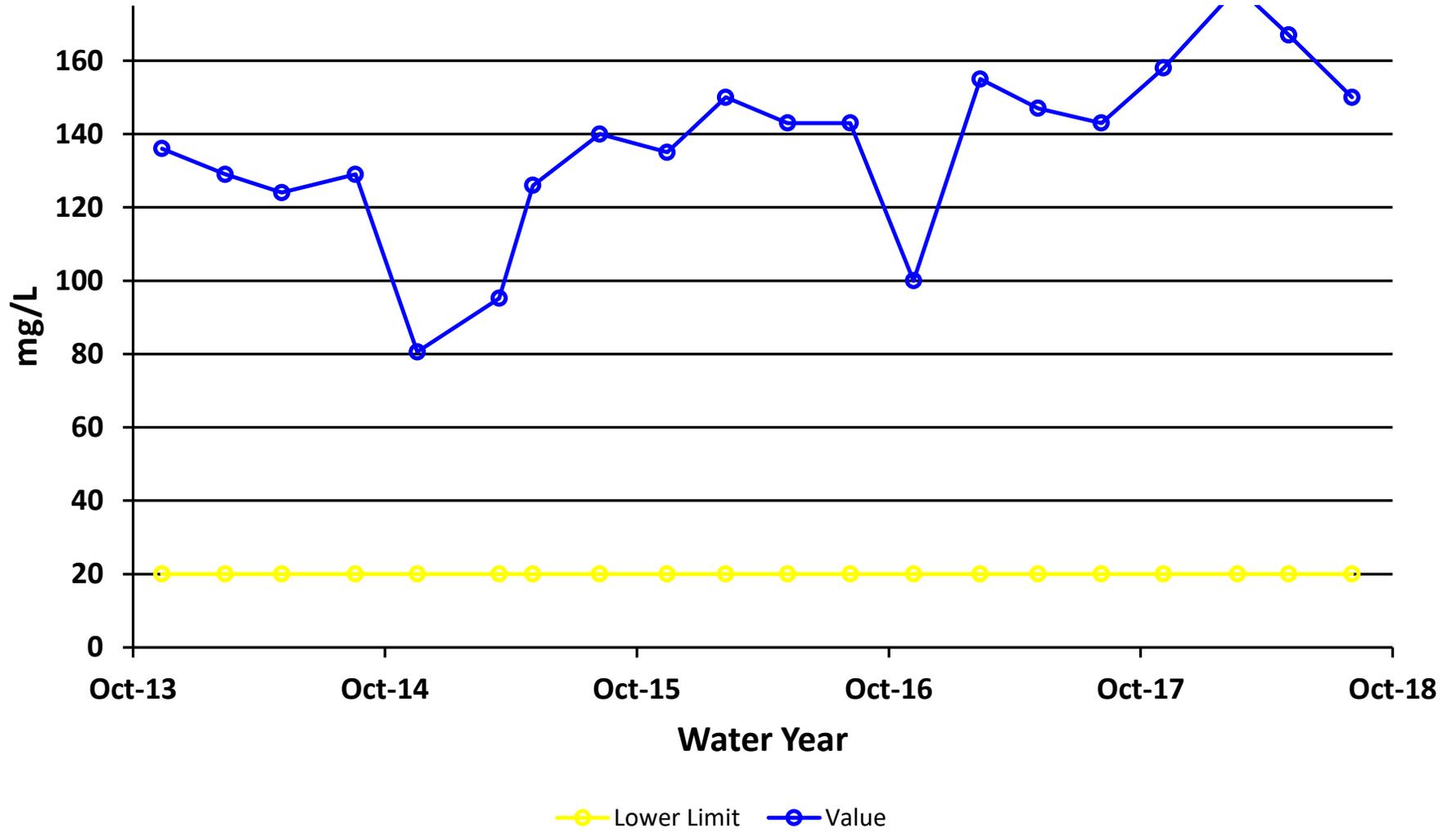
Site 57 - pH Laboratory



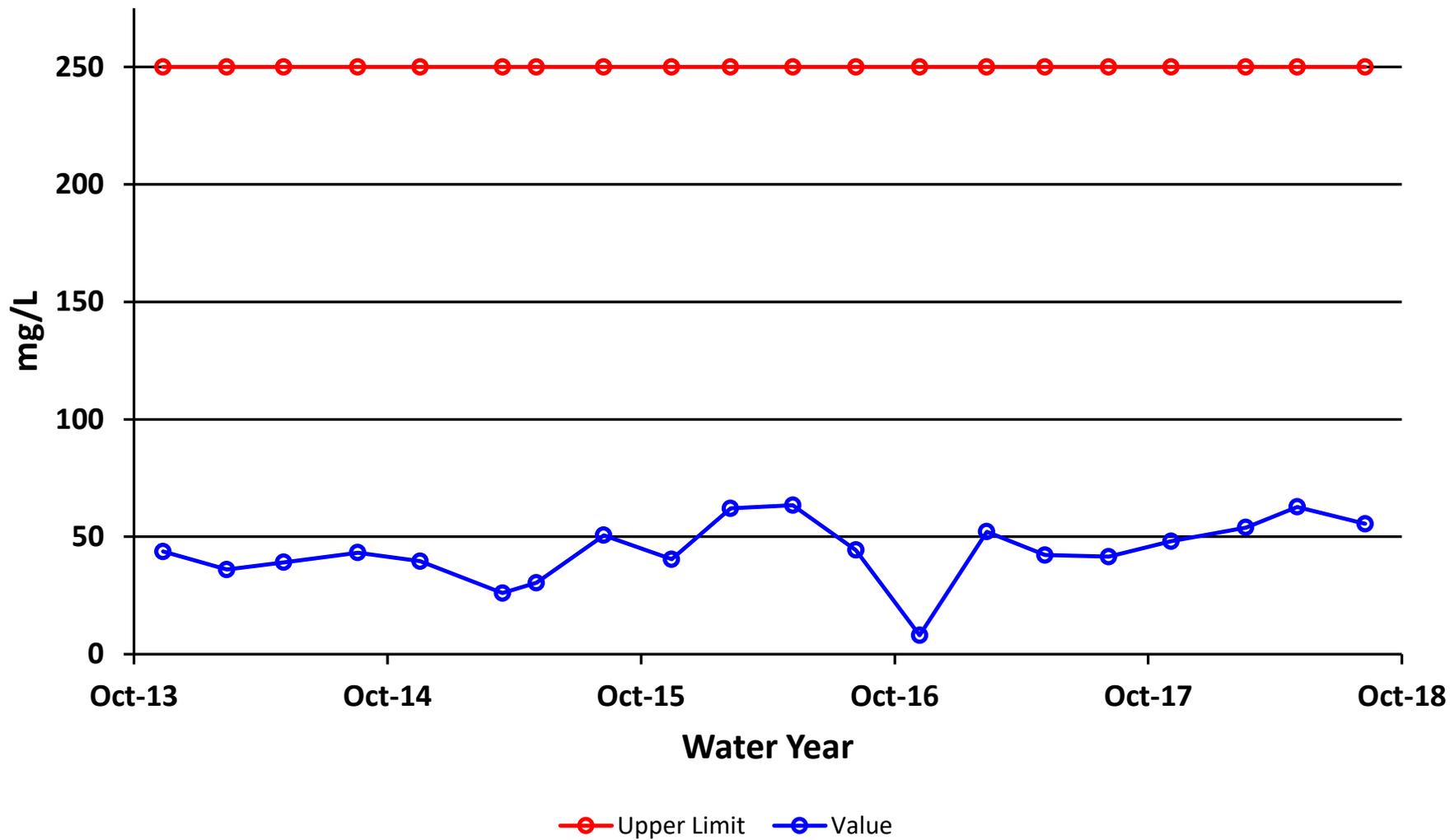
Site 57 - pH Field



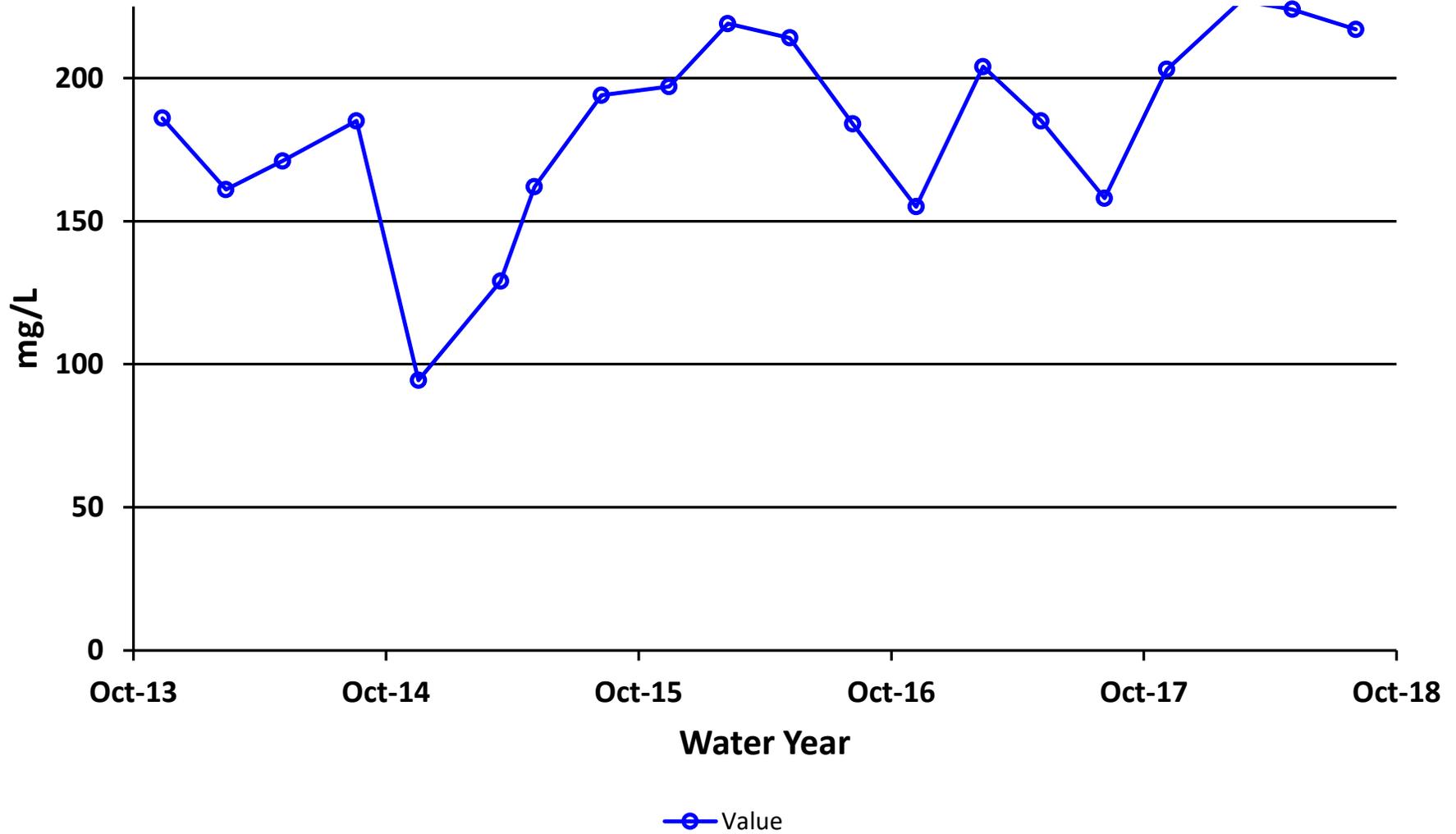
Site 57 - Alkalinity



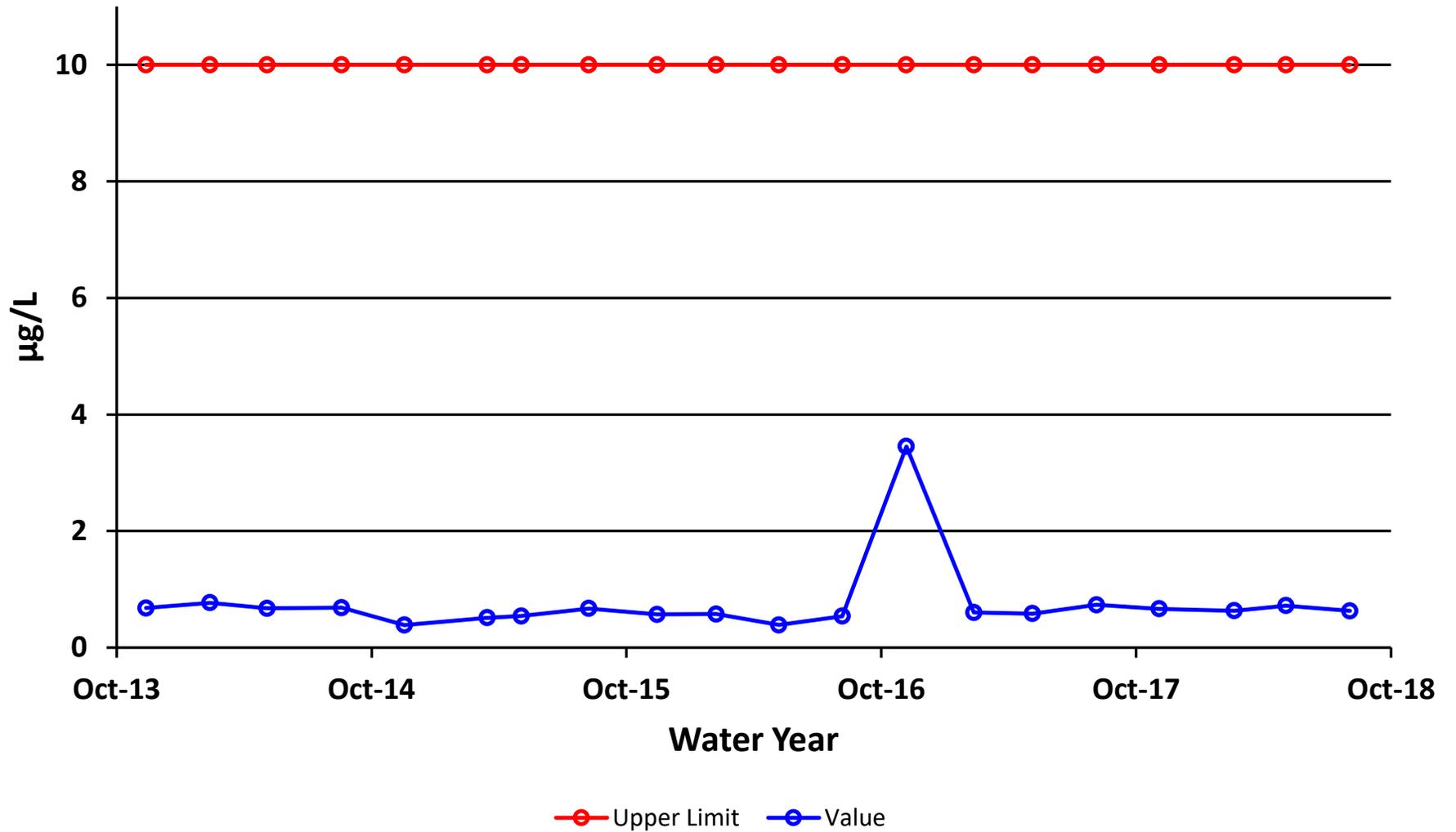
Site 57 - Sulfate



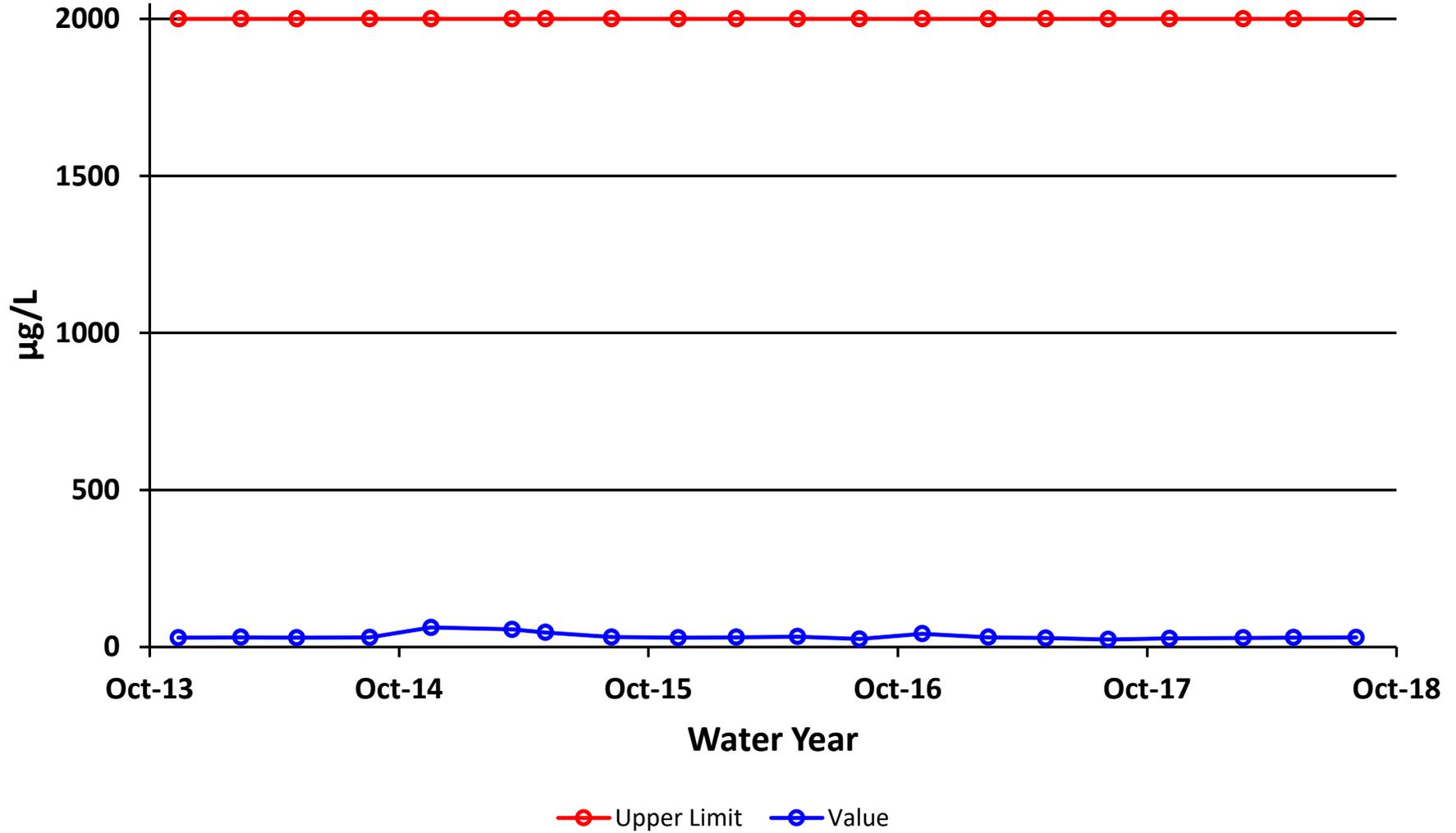
Site 57 - Hardness



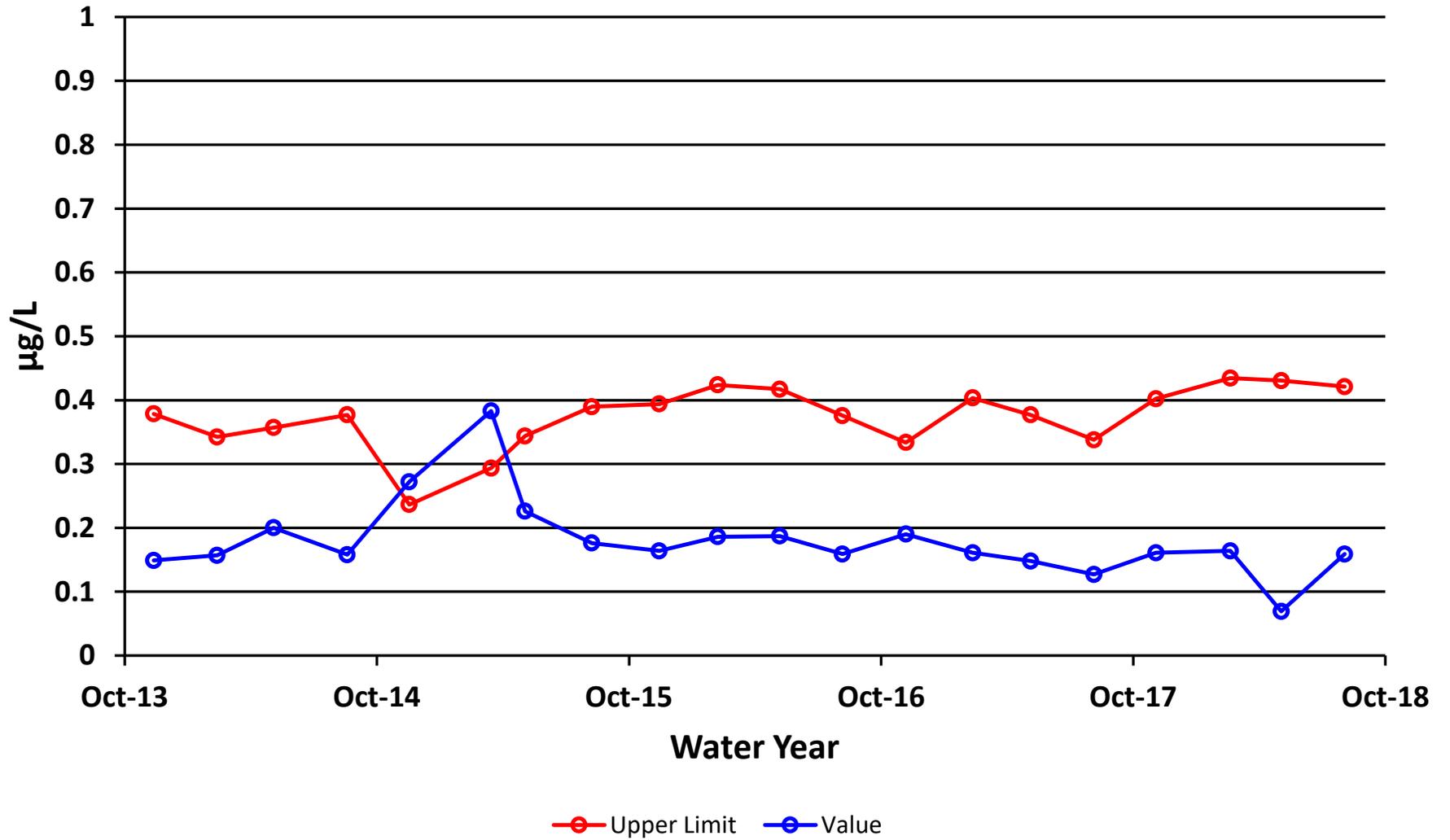
Site 57 - Arsenic Dissolved



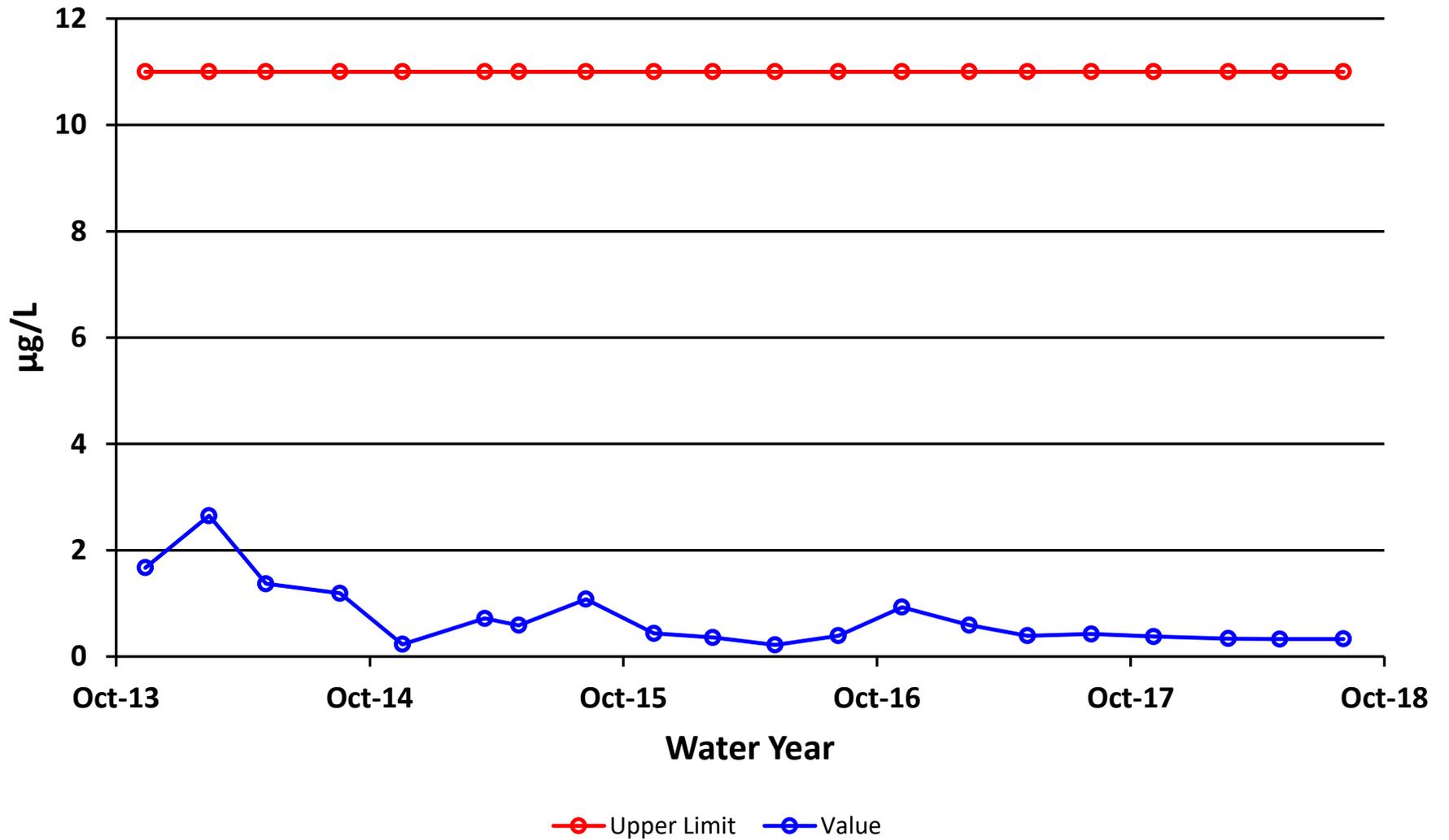
Site 57 - Barium Dissolved



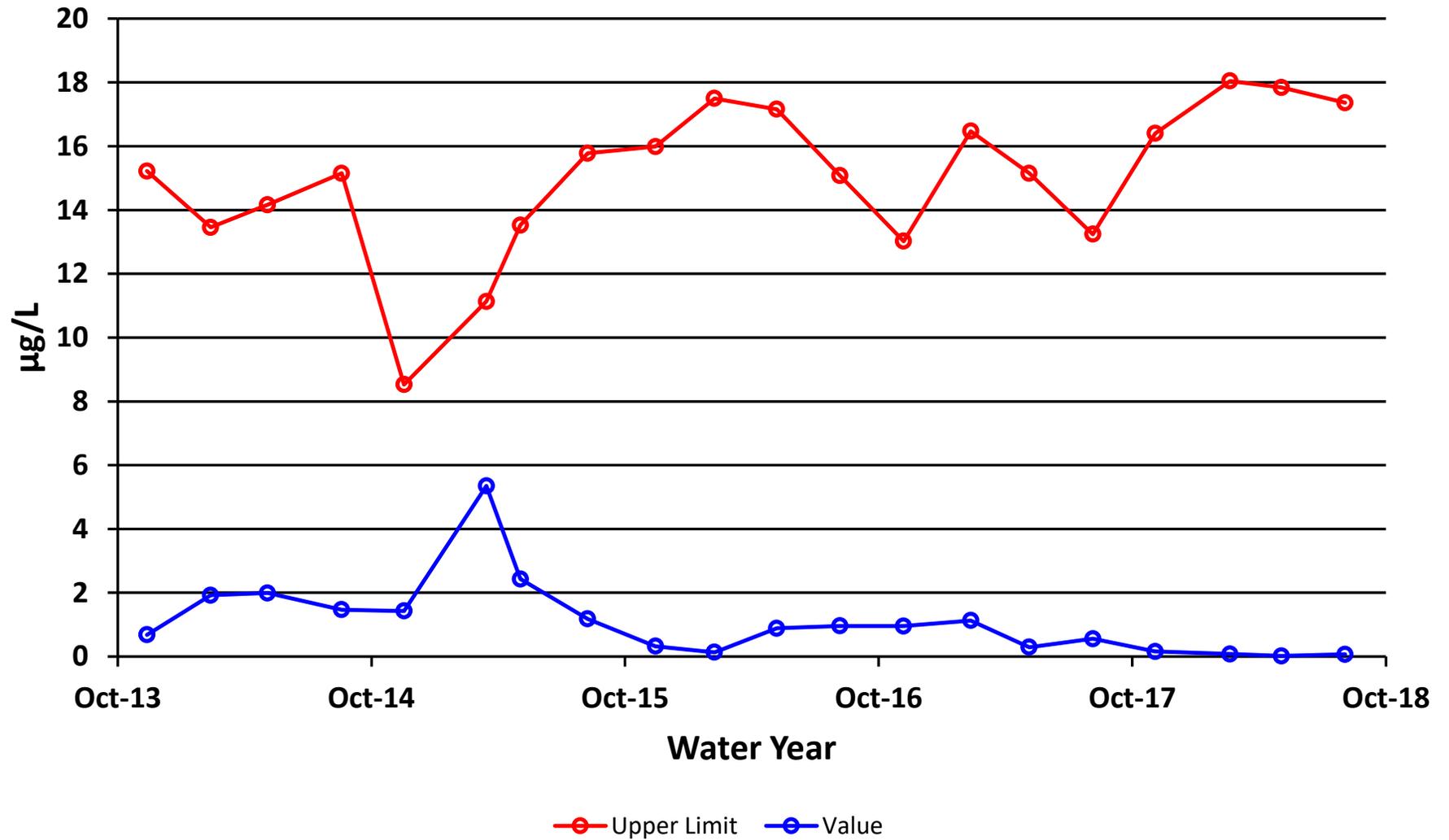
Site 57 - Cadmium Dissolved



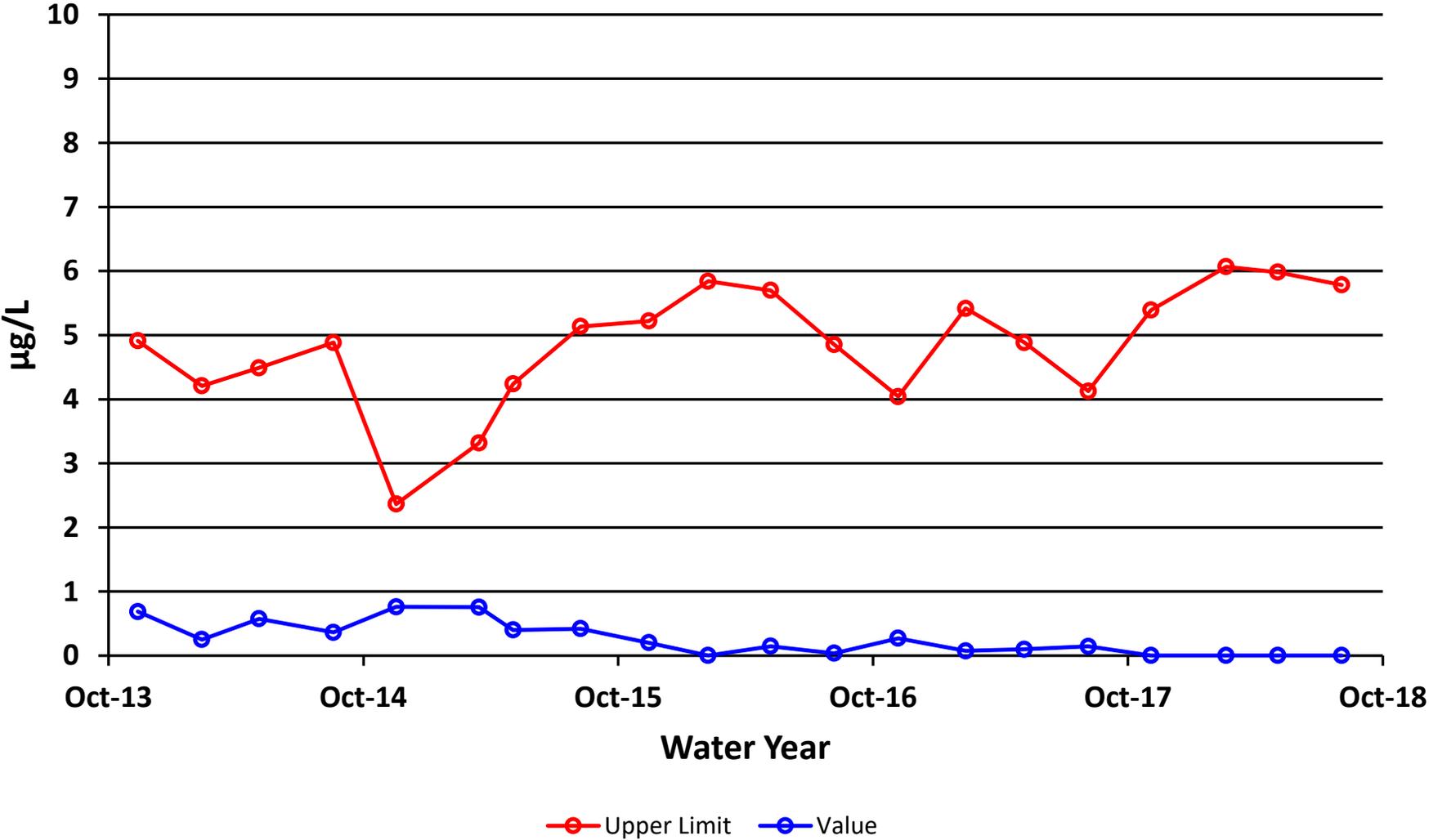
Site 57 - Chromium Dissolved



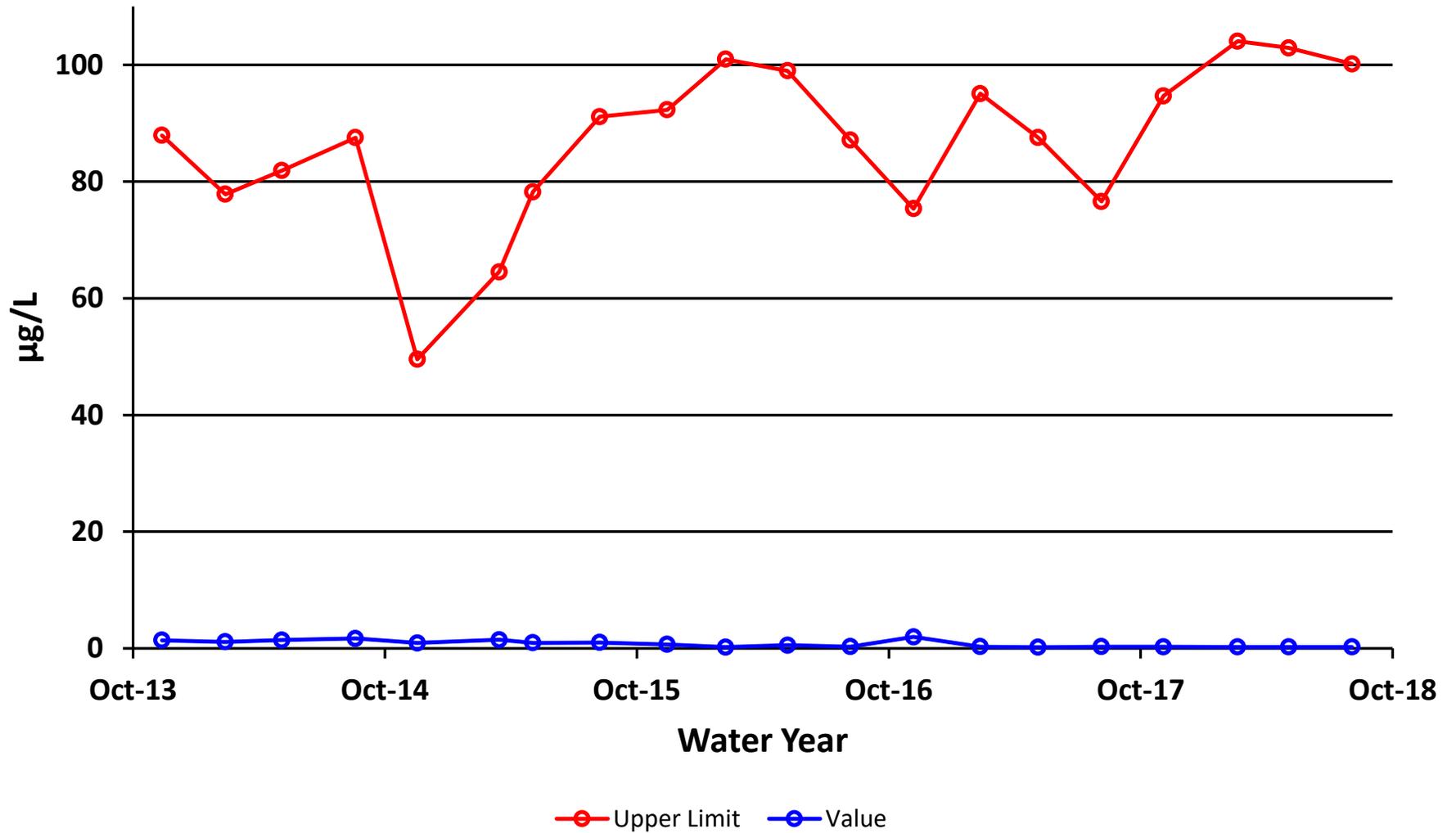
Site 57 - Copper Dissolved



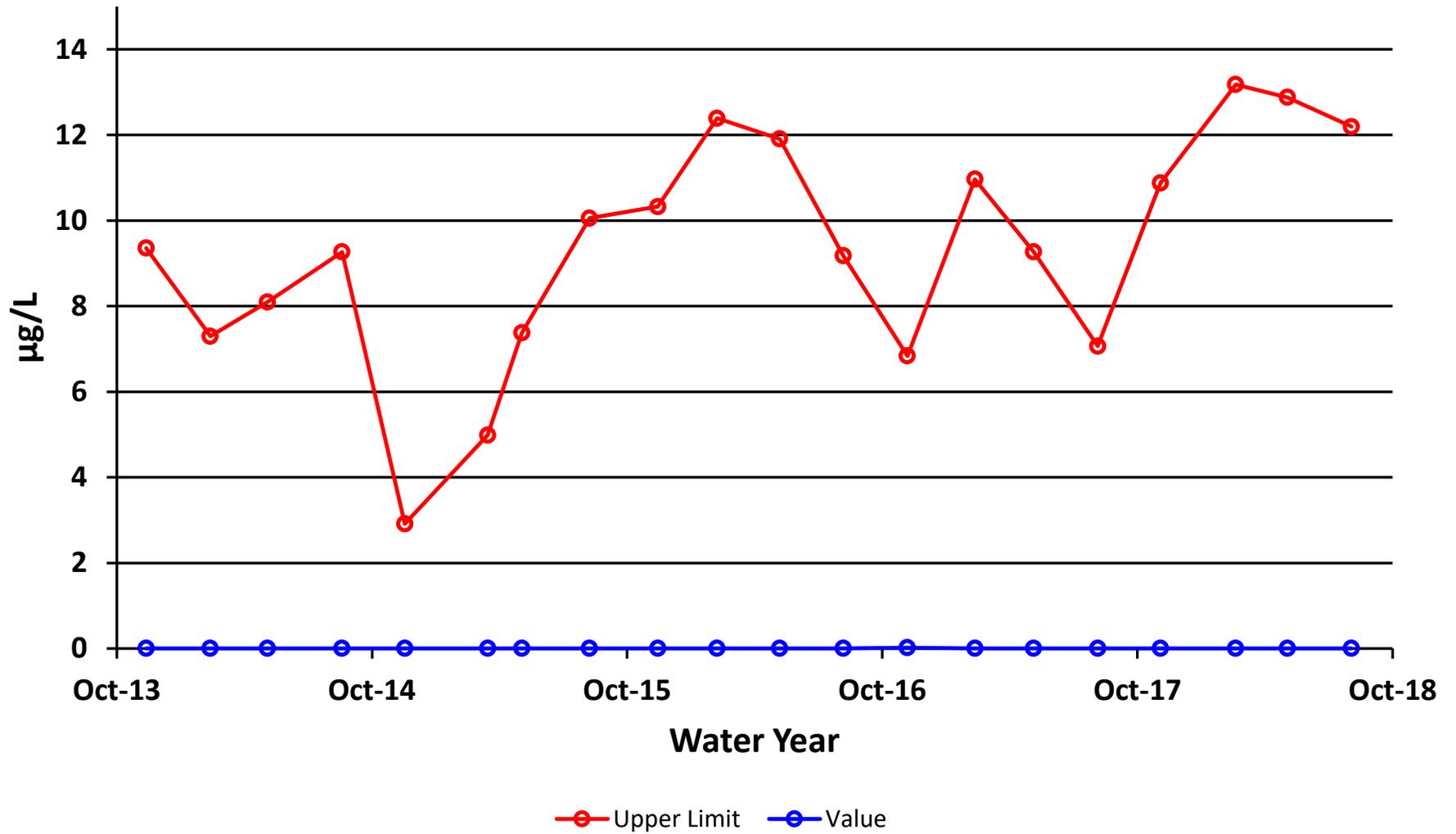
Site 57 - Lead Dissolved



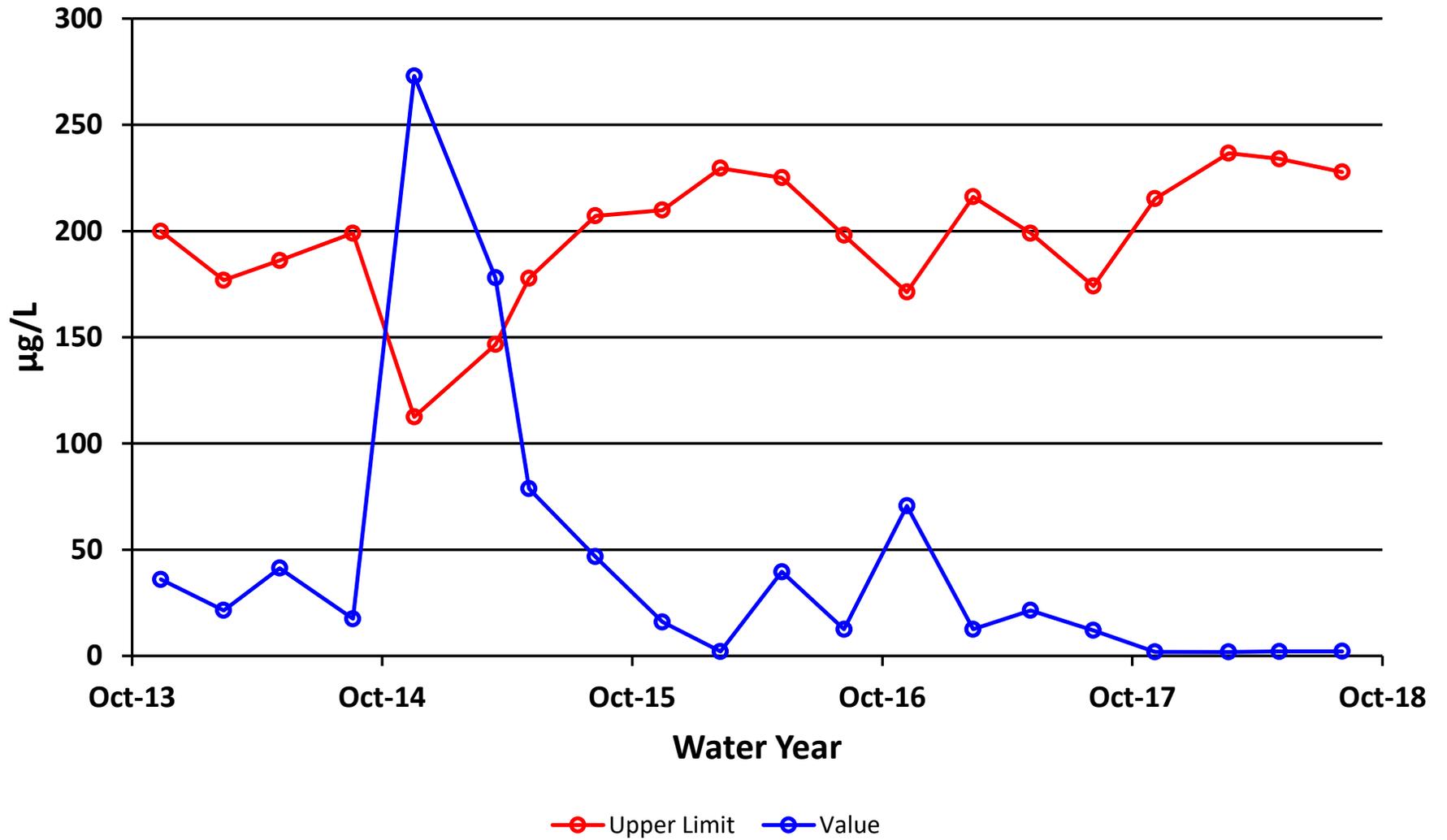
Site 57 - Nickel Dissolved



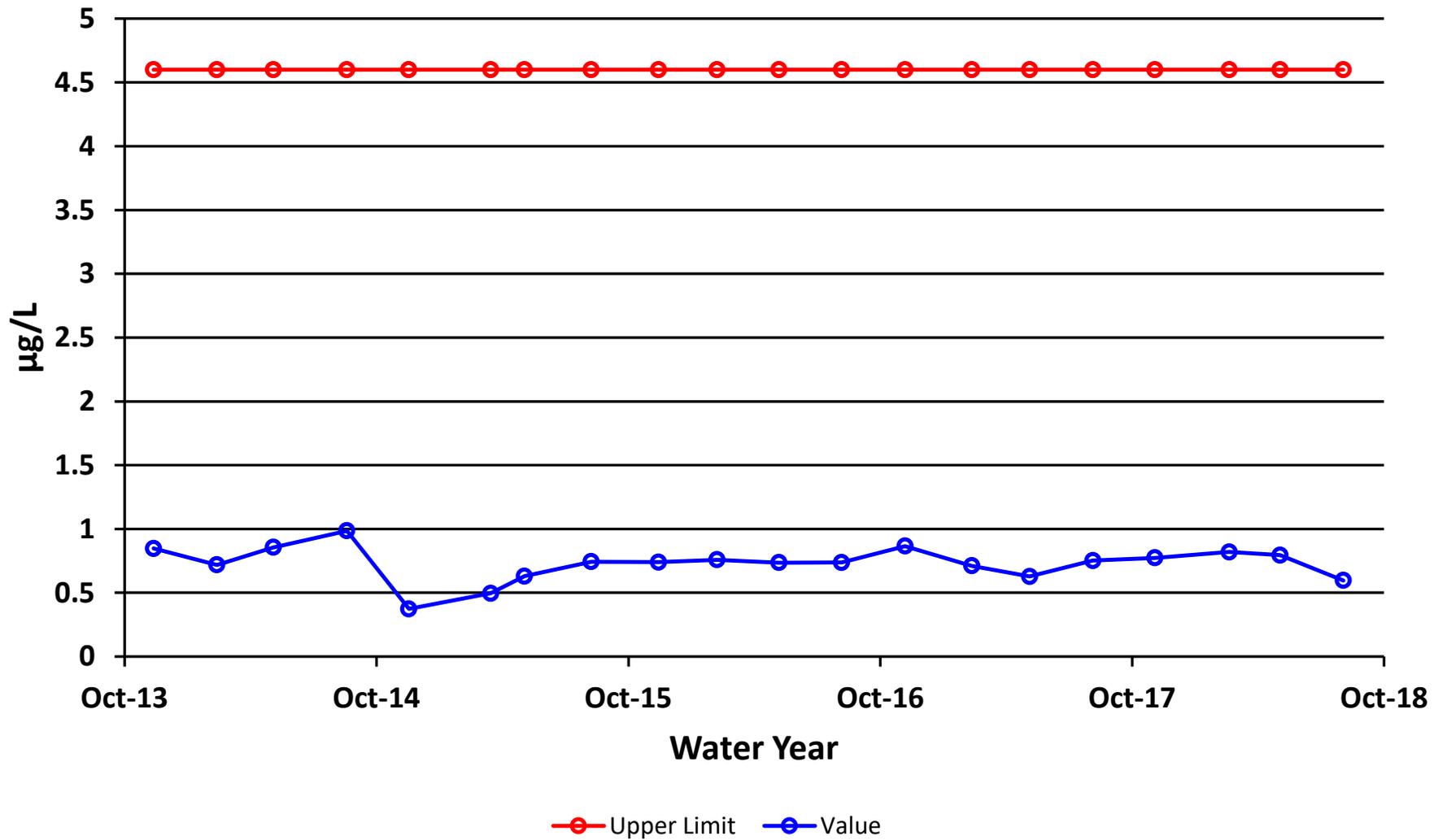
Site 57 - Silver Dissolved



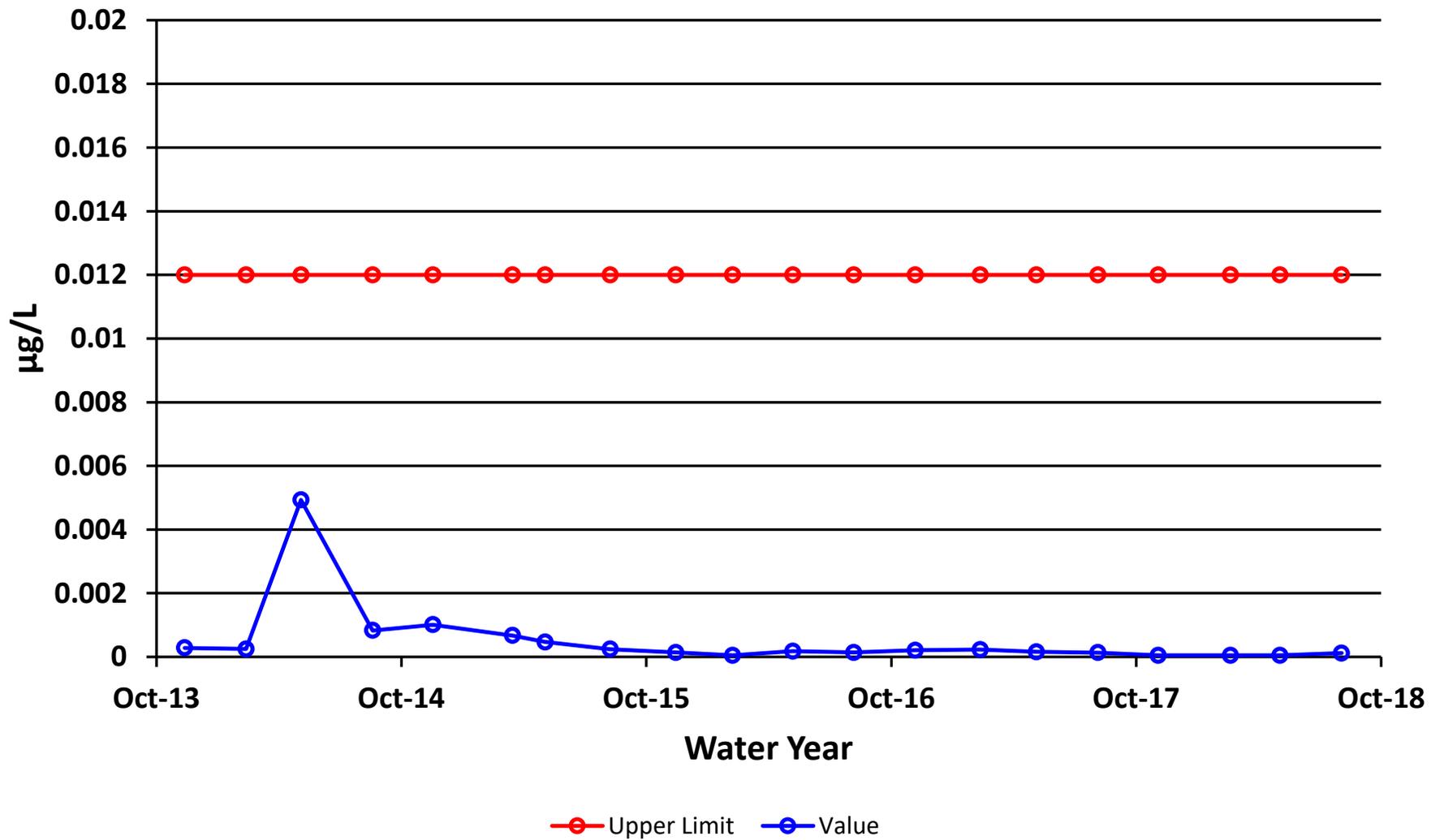
Site 57 - Zinc Dissolved



Site 57 - Selenium Dissolved



Site 57 - Mercury Dissolved



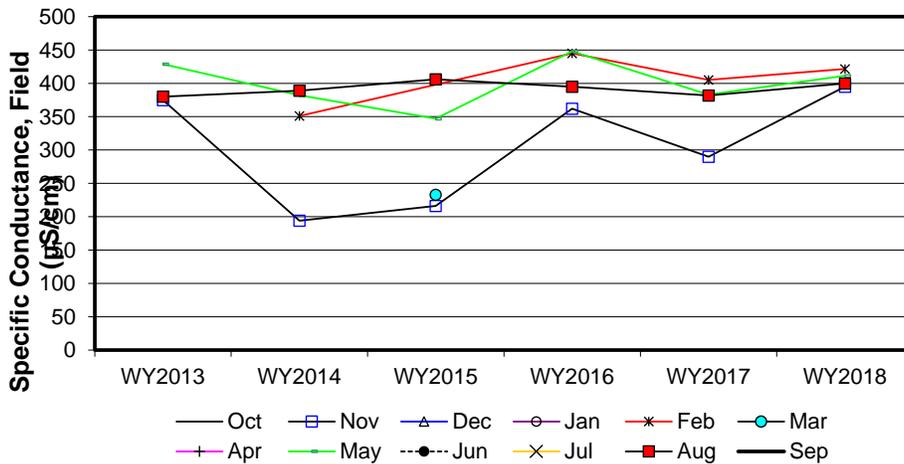
Site #57

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	WY2013		375.0						429.0			380.0	
b	WY2014		194.0			351.0			382.0			389.0	
c	WY2015		216.0				233.0		347.0			406.0	
d	WY2016		362.0			445.0			448.0			395.0	
e	WY2017		290.0			405.0			383.0			381.6	
f	WY2018		395.0			421.5			411.4			400.0	
n		0	6	0	0	4	1	0	6	0	0	6	0
t ₁		0	6	0	0	4	1	0	6	0	0	6	0
t ₂		0	0	0	0	0	0	0	0	0	0	0	0
t ₃		0	0	0	0	0	0	0	0	0	0	0	0
t ₄		0	0	0	0	0	0	0	0	0	0	0	0
t ₅		0	0	0	0	0	0	0	0	0	0	0	0
b-a			-1						-1			1	
c-a			-1						-1			1	
d-a			-1						1			1	
e-a			-1						-1			1	
f-a			1						-1			1	
c-b			1						-1			1	
d-b			1			1			1			1	
e-b			1			1			1			-1	
f-b			1			1			1			1	
d-c			1						1			-1	
e-c			1						1			-1	
f-c			1						1			-1	
e-d			-1			-1			-1			-1	
f-d			1			-1			-1			1	
f-e			1			1			1			1	
S _k		0	5	0	0	2	0	0	1	0	0	5	0
σ _S ² =			28.33			8.67			28.33			28.33	
Z _k = S _k /σ _S			0.94			0.68			0.19			0.94	
Z _k ²			0.88			0.46			0.04			0.88	

ΣZ _k =	2.75	Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅	Σn	23
ΣZ _k ² =	2.26	Count	23	0	0	0	0	ΣS _k	13
Z-bar=ΣZ _k /K=	0.69								

$\chi^2_{h} = \sum Z_k^2 - K(Z\text{-bar})^2 =$	0.38	@α=5% $\chi^2_{(K-1)} =$	7.81	Test for station homogeneity	
p	0.945			$\chi^2_h < \chi^2_{(K-1)}$	ACCEPT
ΣVAR(S _k)	Z _{calc} 1.24	@α/2=2.5% Z=	1.96	H ₀ (No trend)	ACCEPT
93.67	p 0.892			H _A (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals			
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-11.38	4.00	18.00
0.050	-2.95		16.73
0.100	-1.30		15.46
0.200	1.30		8.29

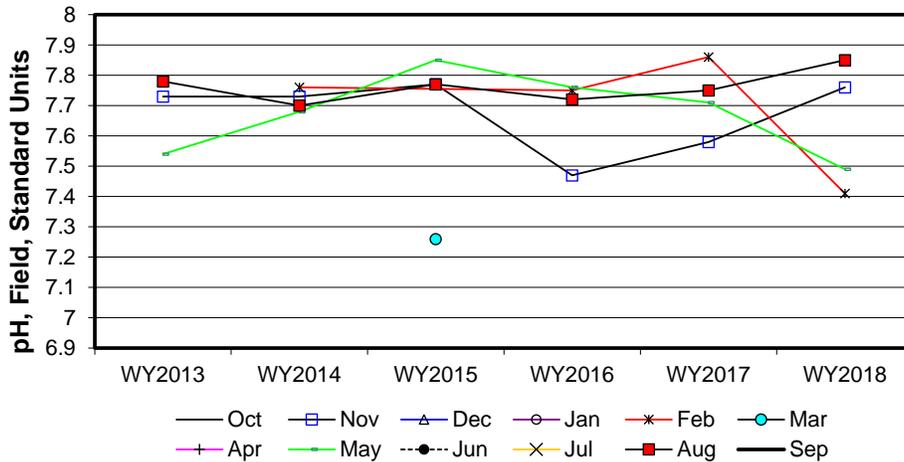
Site #57

Seasonal Kendall analysis for pH, Field, Standard Units

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	WY2013		7.7						7.5			7.8	
b	WY2014		7.7			7.8			7.7			7.7	
c	WY2015		7.8				7.3		7.9			7.8	
d	WY2016		7.5			7.8			7.8			7.7	
e	WY2017		7.6			7.9			7.7			7.8	
f	WY2018		7.8			7.4			7.5			7.9	
n		0	6	0	0	4	1	0	6	0	0	6	0
t ₁		0	4	0	0	4	1	0	6	0	0	6	0
t ₂		0	1	0	0	0	0	0	0	0	0	0	0
t ₃		0	0	0	0	0	0	0	0	0	0	0	0
t ₄		0	0	0	0	0	0	0	0	0	0	0	0
t ₅		0	0	0	0	0	0	0	0	0	0	0	0
b-a			0						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			1	
e-b			-1			1			1			1	
f-b			1			-1			-1			1	
d-c			-1						-1			-1	
e-c			-1						-1			-1	
f-c			-1						-1			1	
e-d			1			1			-1			1	
f-d			1			-1			-1			1	
f-e			1			-1			-1			1	
S _k		0	0	0	0	-2	0	0	-1	0	0	3	0
σ _S ² =			27.33			8.67			28.33			28.33	
Z _k = S _k /σ _S			0.00			-0.68			-0.19			0.56	
Z _k ²			0.00			0.46			0.04			0.32	

ΣZ _k =	-0.30	Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅	Σn	23
ΣZ _k ² =	0.81	Count	21	1	0	0	0	ΣS _k	0
Z-bar=ΣZ _k /K=	-0.08								

χ _n ² =ΣZ _k ² -K(Z-bar) ² =	0.79	@α=5% χ _(K-1) ² =	7.81	Test for station homogeneity
p	0.852			χ _n ² <χ _(K-1) ² ACCEPT
ΣVAR(S _k)	Z _{calc} 0.00	@α/2=2.5% Z=	1.96	H ₀ (No trend) ACCEPT
92.67	p 0.500			H _A (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals			
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.05		0.04
0.050	-0.04		0.02
0.100	-0.02	0.00	0.02
0.200	-0.01		0.01

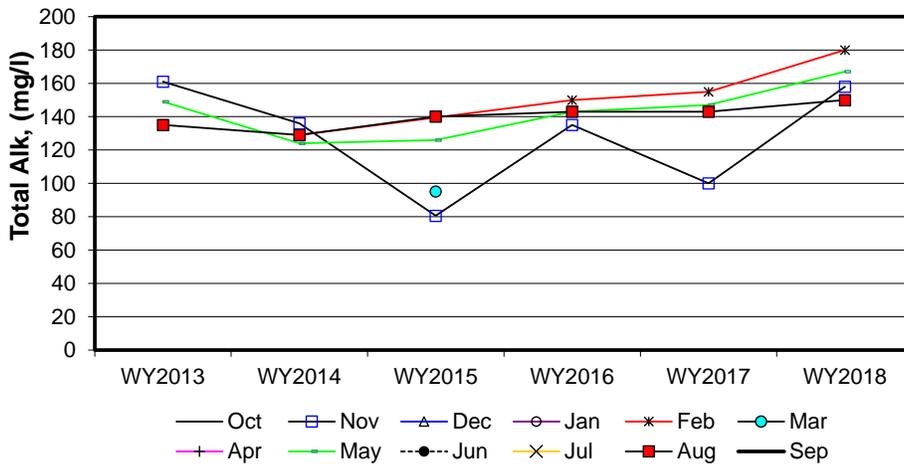
Site #57

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	WY2013		161.0						149.0			135.0	
b	WY2014		136.0			129.0			124.0			129.0	
c	WY2015		80.6				95.2		126.0			140.0	
d	WY2016		135.0			150.0			143.0			143.0	
e	WY2017		100.0			155.0			147.0			143.0	
f	WY2018		158.0			180.0			167.0			150.0	
n		0	6	0	0	4	1	0	6	0	0	6	0
t ₁		0	6	0	0	4	1	0	6	0	0	4	0
t ₂		0	0	0	0	0	0	0	0	0	0	1	0
t ₃		0	0	0	0	0	0	0	0	0	0	0	0
t ₄		0	0	0	0	0	0	0	0	0	0	0	0
t ₅		0	0	0	0	0	0	0	0	0	0	0	0
b-a			-1						-1			-1	
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			1	
e-b			-1			1			1			1	
f-b			1			1			1			1	
d-c			1						1			1	
e-c			1						1			1	
f-c			1						1			1	
e-d			-1			1			1			0	
f-d			1			1			1			1	
f-e			1			1			1			1	
S _k		0	-3	0	0	6	0	0	7	0	0	12	0
σ _S ² =			28.33			8.67			28.33			27.33	
Z _k = S _k /σ _S			-0.56			2.04			1.32			2.30	
Z _k ²			0.32			4.15			1.73			5.27	

ΣZ _k =	5.08	Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅	Σn	23
ΣZ _k ² =	11.47	Count	21	1	0	0	0	ΣS _k	22
Z-bar=ΣZ _k /K=	1.27								

$\chi^2_{h} = \sum Z_k^2 - K(Z\text{-bar})^2 =$	5.01	@α=5% $\chi^2_{(K-1)} =$	7.81	Test for station homogeneity	
p	0.171			$\chi^2_h < \chi^2_{(K-1)}$	ACCEPT
ΣVAR(S _k)	Z _{calc} 2.18	@α/2=2.5% Z=	1.96	H ₀ (No trend)	REJECT
92.67	p 0.985			H _A (± trend)	ACCEPT



Seasonal-Kendall Slope Confidence Intervals			
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.35		10.26
0.050	2.00		8.08
0.100	2.56	4.00	7.00
0.200	3.00		5.39
		2.8%	

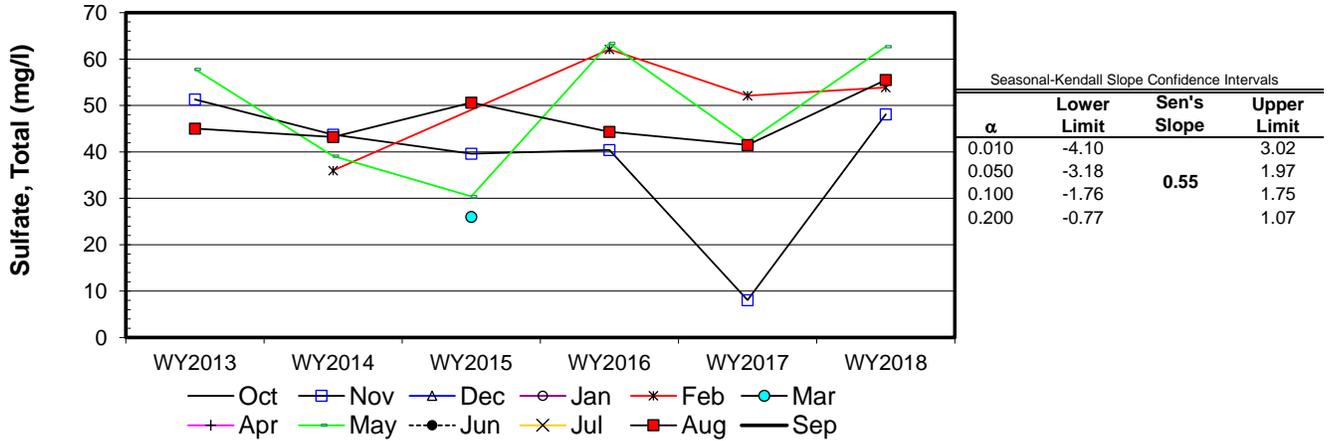
Site #57

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	WY2013		51.3						57.8			45.0	
b	WY2014		43.7			36.0			39.1			43.2	
c	WY2015		39.6				26.0		30.4			50.6	
d	WY2016		40.4			62.1			63.4			44.3	
e	WY2017		8.1			52.1			42.2			41.5	
f	WY2018		48.1			53.9			62.7			55.5	
n		0	6	0	0	4	1	0	6	0	0	6	0
t ₁		0	6	0	0	4	1	0	6	0	0	6	0
t ₂		0	0	0	0	0	0	0	0	0	0	0	0
t ₃		0	0	0	0	0	0	0	0	0	0	0	0
t ₄		0	0	0	0	0	0	0	0	0	0	0	0
t ₅		0	0	0	0	0	0	0	0	0	0	0	0
b-a			-1						-1			-1	
c-a			-1						-1			1	
d-a			-1						1			-1	
e-a			-1						-1			-1	
f-a			-1						1			1	
c-b			-1						-1			1	
d-b			-1			1			1			1	
e-b			-1			1			1			-1	
f-b			1			1			1			1	
d-c			1						1			-1	
e-c			-1						1			-1	
f-c			1						1			1	
e-d			-1			-1			-1			-1	
f-d			1			-1			-1			1	
f-e			1			1			1			1	
S _k		0	-5	0	0	2	0	0	3	0	0	1	0
σ _s ² =			28.33			8.67			28.33			28.33	
Z _k = S _k /σ _s			-0.94			0.68			0.56			0.19	
Z _k ²			0.88			0.46			0.32			0.04	

ΣZ _k =	0.49	Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅	Σn	23
ΣZ _k ² =	1.70	Count	23	0	0	0	0	ΣS _k	1
Z-bar=ΣZ _k /K=	0.12								

χ _n ² =ΣZ _k ² -K(Z-bar) ² =	1.64	@α=5% χ _(K-1) ² =	7.81	Test for station homogeneity
p	0.651			χ _h ² <χ _(K-1) ² ACCEPT
ΣVAR(S _k)	Z _{calc} 0.00	@α=2.5% Z=	1.96	H ₀ (No trend) ACCEPT
93.67	p 0.500			H _A (± trend) REJECT



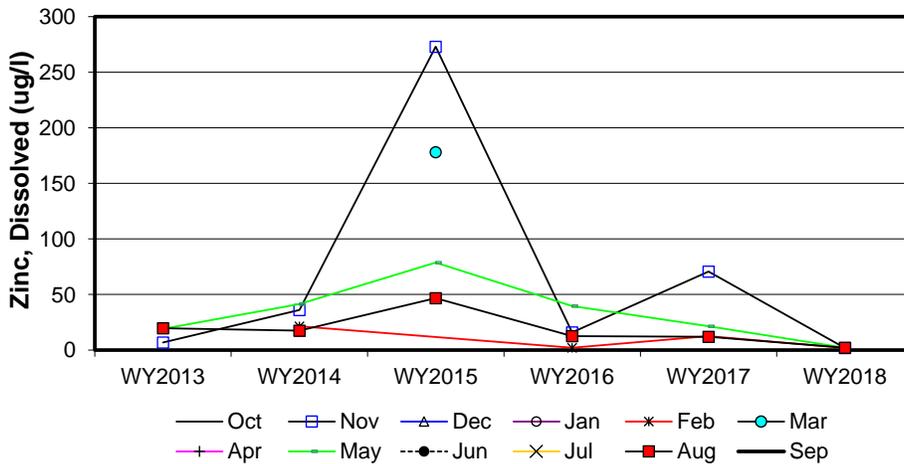
Site #57

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	WY2013		6.9						19.0			19.6	
b	WY2014		36.0			21.4			41.3			17.5	
c	WY2015		273.0				178.0		78.7			46.7	
d	WY2016		16.0			2.1			39.6			12.5	
e	WY2017		70.6			12.5			21.4			12.0	
f	WY2018		1.9			1.9			2.1			2.1	
n		0	6	0	0	4	1	0	6	0	0	6	0
t ₁		0	6	0	0	4	1	0	6	0	0	6	0
t ₂		0	0	0	0	0	0	0	0	0	0	0	0
t ₃		0	0	0	0	0	0	0	0	0	0	0	0
t ₄		0	0	0	0	0	0	0	0	0	0	0	0
t ₅		0	0	0	0	0	0	0	0	0	0	0	0
b-a			1						1			-1	
c-a			1						1			1	
d-a			1						1			-1	
e-a			1						1			-1	
f-a			-1						-1			-1	
c-b			1						1			1	
d-b			-1			-1			-1			-1	
e-b			1			-1			-1			-1	
f-b			-1			-1			-1			-1	
d-c			-1						-1			-1	
e-c			-1						-1			-1	
f-c			-1						-1			-1	
e-d			1			1			-1			-1	
f-d			-1			-1			-1			-1	
f-e			-1			-1			-1			-1	
S _k		0	-1	0	0	-4	0	0	-5	0	0	-11	0
σ _S ² =			28.33			8.67			28.33			28.33	
Z _k = S _k /σ _S			-0.19			-1.36			-0.94			-2.07	
Z _k ²			0.04			1.85			0.88			4.27	

ΣZ _k =	-4.55	Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅	Σn	23
ΣZ _k ² =	7.03	Count	23	0	0	0	0	ΣS _k	-21
Z-bar=ΣZ _k /K=	-1.14								

χ _h ² =ΣZ _k ² -K(Z-bar) ² =	1.85	@α=5% χ _(K-1) ² =	7.81	Test for station homogeneity	
p	0.603			χ _h ² <χ _(K-1) ²	ACCEPT
ΣVAR(S _k)	Z _{calc} -2.07	@α/2=2.5% Z=	1.96	H ₀ (No trend)	REJECT
93.67	p 0.019			H _A (± trend)	ACCEPT



Seasonal-Kendall Slope Confidence Intervals			
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-10.47		0.43
0.050	-9.72	-3.39	-0.94
0.100	-8.09		-1.85
0.200	-6.02		-2.21
		-17.8%	

INTERPRETIVE REPORT

SITE 13

The data collected during the current water year are listed in the following “Table of Results for Water Year 2018” 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 one-half of the for the purpose of median calculation.

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

Sample Date	Parameter	Value	Qualifier	Notes
No outliers, in the past six years, have been identified by HGCMC.				

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

Table of Exceedance for Water Year 2018

Sample Date	Parameter	Value	Limits		Hardness
			Lower	Upper	
7-May-18	Alkalinity, Total	16.90 mg/L	20		91.1 mg/L
6-Nov-17	Cadmium, Dissolved	0.29 µg/L		0.20	75.4 mg/L
7-May-18	Cadmium, Dissolved	0.42 µg/L		0.23	91.1 mg/L
7-Aug-18	Cadmium, Dissolved	0.41 µg/L		0.30	135 mg/L
6-Nov-17	Zinc, Dissolved	176 µg/L		93	75.4 mg/L
7-May-18	Zinc, Dissolved	334 µg/L		109	91.1 mg/L
7-Aug-18	Zinc, Dissolved	255 µg/L		152	135 mg/L

Over several years waste rock material has been removed from the 1350 Area. It was not until 2011 that any material was removed from the Eastern Lobe, the area that contributes to the Site 13 drainage; however, the material removed was not in the direct flow path for Site 13. HGCMC removed most of the remaining material in 2014. Only the material in the road access was left and it will be removed during final reclamation.

X-Y plots have been generated to graphically present the data for each of the analytes requested in the Statistical Information Goals for this site. Cadmium, nickel, lead, and zinc all sharply increased at Site 13 after waste rock material was removed in 2014. Lead levels were well below

the AWQS in Water Year 2016, however dissolved zinc and dissolved cadmium continued to have measurements above the respective AWQS in the 2016 Water Year. As seen with other reclamation projects (e.g. the 960) there is usually an initial increase in metals concentration. HGCMC had expected to see these elevated levels attenuate throughout, as they had appeared to be doing in the 2015 Water Year. Though HGCMC expects these elevated concentrations will attenuate with time, a collection system was installed in late August 2016 at the toe of the material left in place. Monitoring conducted in Water Year 2017 showed a substantial improvement in water quality following installation of the collection system, particularly with lower sulfate, cadmium and zinc concentrations. Despite these improvements, cadmium and zinc were still marginally above the AWQS during the reporting period.

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-12 and Sep-18 (WY2013-WY2018).

Site 13 - Table of Summary Statistics for Trend Analysis

Parameter	Mann-Kendall test statistics			Sen's slope estimate	
	n*	p**	Trend	Q	Q(%)
Conductivity Field	6	<0.01	-	-87.3	-26.1
pH Field	6	0.02	-	-0.1	-1.6
Alkalinity, Total	6	0.02	-	-11.5	-24.7
Sulfate, Total	6	<0.01	-	-41.2	-35.2
Zinc, Dissolved	6	0.77			

* Number of Years ** Significance level

For datasets with a statistically significant trend a Seasonal-Sen’s Slope estimate statistic has also been calculated. There is a statistically significant ($\alpha/2=2.5\%$) decreasing trends for field conductivity (-87.3 $\mu\text{S}/\text{cm}/\text{yr}$), sulfate (-41.2 mg/l), alkalinity (-11.5 mg/L), and field pH (-0.1 su/yr) analyzed from Site 13. These changes are a result of material removal and installation of the collection system. HGCMC feels the current FWMP program is sufficient to monitor current and future changes at Site 13 before water quality values are impaired long term.

Table of Results for Water Year 2018

Site 013FMS - '1350 East Drainage'

Sample Date/Parameter	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018	Median
Water Temp (°C)		0.7						5.4			12.6		5.4
Conductivity-Field(µmho)		143						186.2			294.5		186.2
Conductivity-Lab (µmho)		134						169			269		169
pH Lab (standard units)		6.97						6.77			6.77		6.77
pH Field (standard units)		7.64						7.28			7.3		7.30
Total Alkalinity (mg/L)		43.6						16.9			46		43.6
Total Sulfate (mg/L)		27.4						65.8			80.7		65.8
Hardness (mg/L)		75.4						91.1			135		91.1
Dissolved As (ug/L)		0.12						0.277			0.279		0.277
Dissolved Ba (ug/L)		6						13			12.7		12.7
Dissolved Cd (ug/L)		0.3						0.4			0.4		0.4
Dissolved Cr (ug/L)		0.102						0.092			0.1		0.100
Dissolved Cu (ug/L)		0.62						0.89			1.07		0.89
Dissolved Pb (ug/L)		0.051						0.045			0.018		0.045
Dissolved Ni (ug/L)		0.8						1.8			1.2		1.2
Dissolved Ag (ug/L)		0.002						0.007			0.002		0.002
Dissolved Zn (ug/L)		176						334			255		255
Dissolved Se (ug/L)		0.057						0.057			0.057		0.057
Dissolved Hg (ug/L)		0.000939						0.000967			0.000832		0.000939

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

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

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

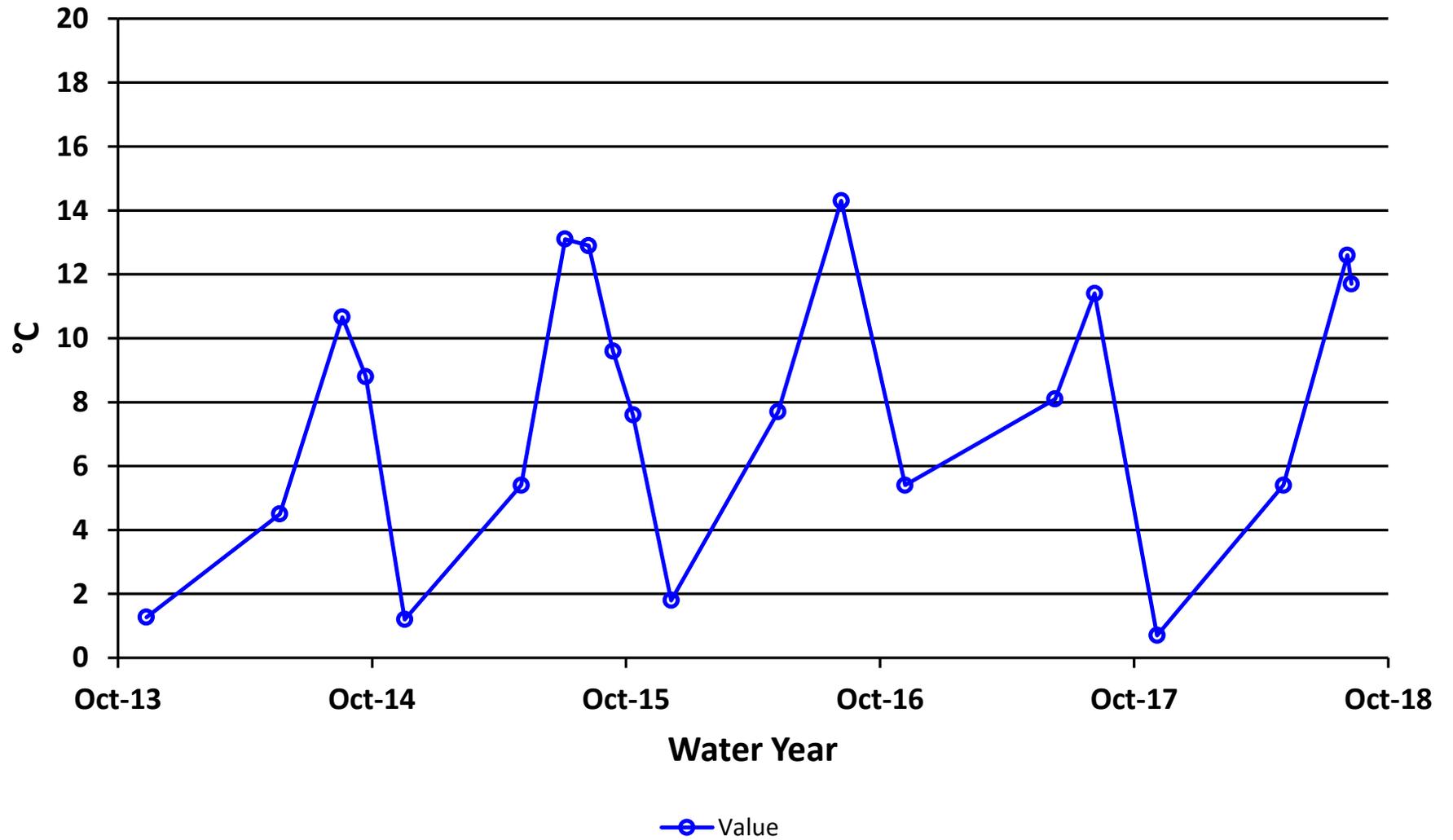
Qualified Data by QA Reviewer

Date Range: 10/01/2017 to 09/30/2018

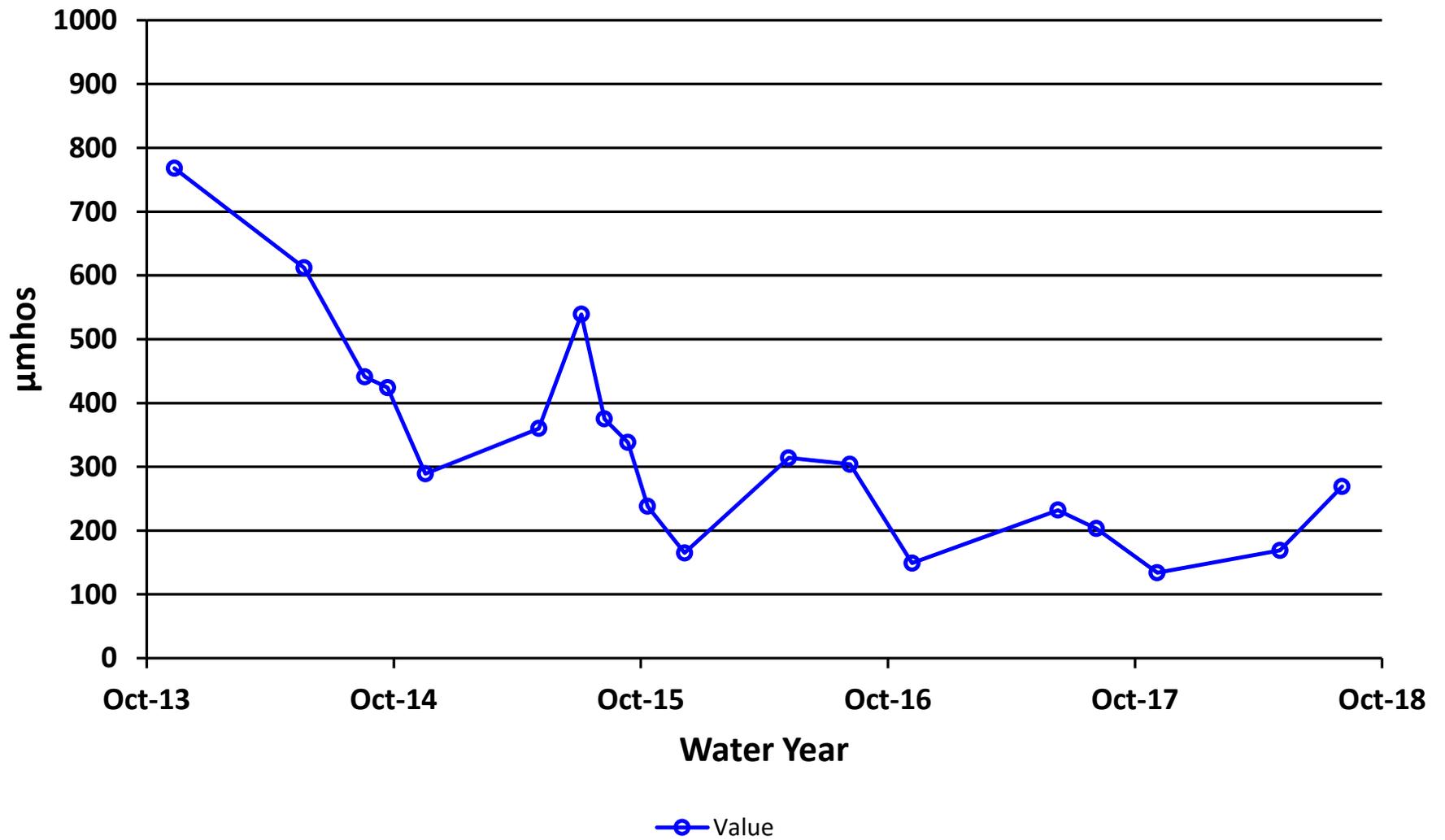
Site No.	Sample Date	Parameter	Value		Qualifier	Reason for Qualifier
013FMS	11/6/2017	Diss. Cr-ICP/MS	0.1	µg/L	J	Below Quantitative Range
	5/7/2018	Diss. Ag-ICP/MS	0.0065	µg/L	J	Below Quantitative Range
		Diss. Cr-ICP/MS	0.09	µg/L	J	Below Quantitative Range
		pH	6.77	pH units	J	Hold Time Violation
	8/7/2018	Diss. Cr-ICP/MS	0.09	µg/L	J	Below Quantitative Range
		pH	6.77	pH units	J	Hold Time Violation

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

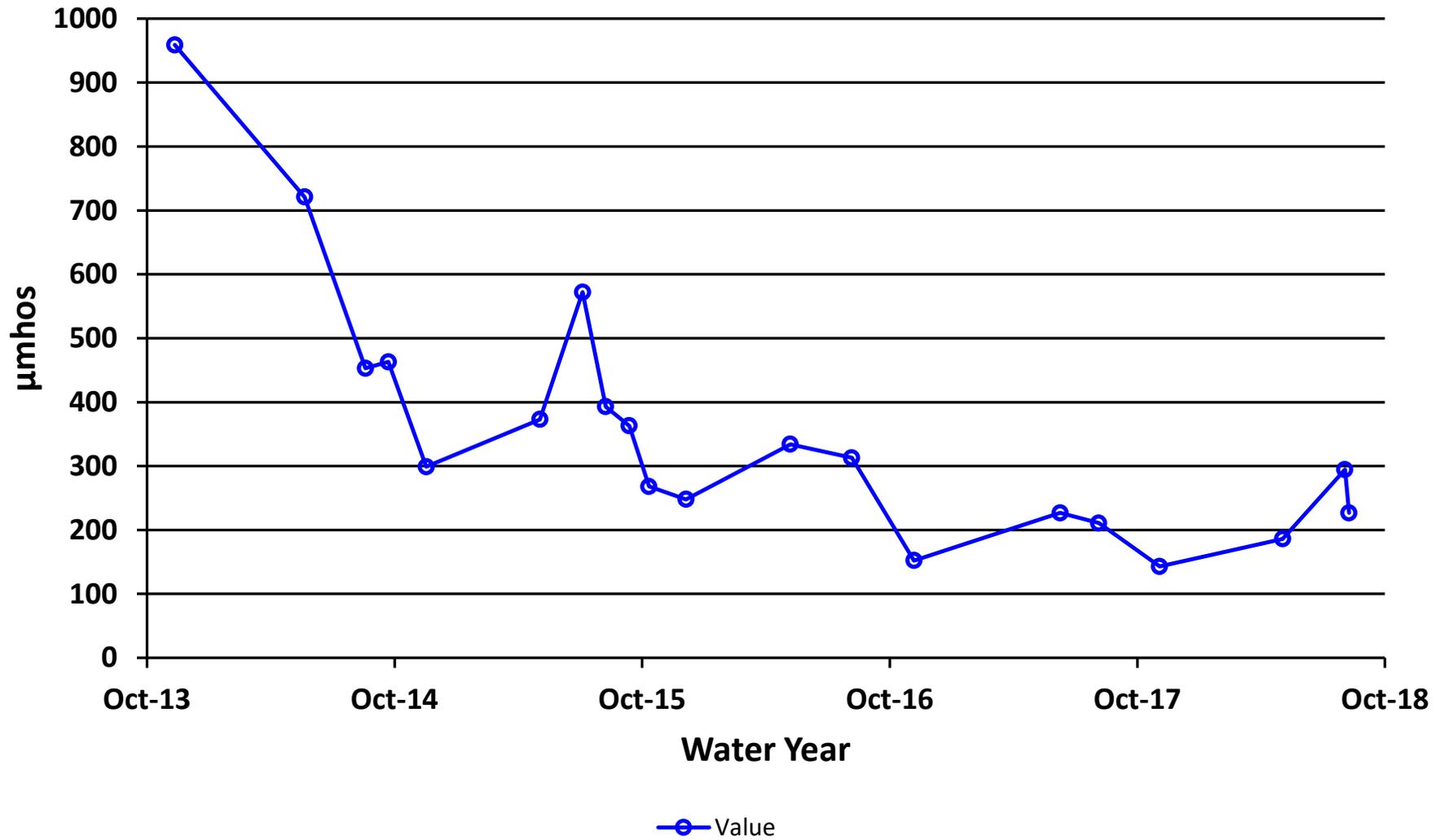
Site 13 - Water Temperature



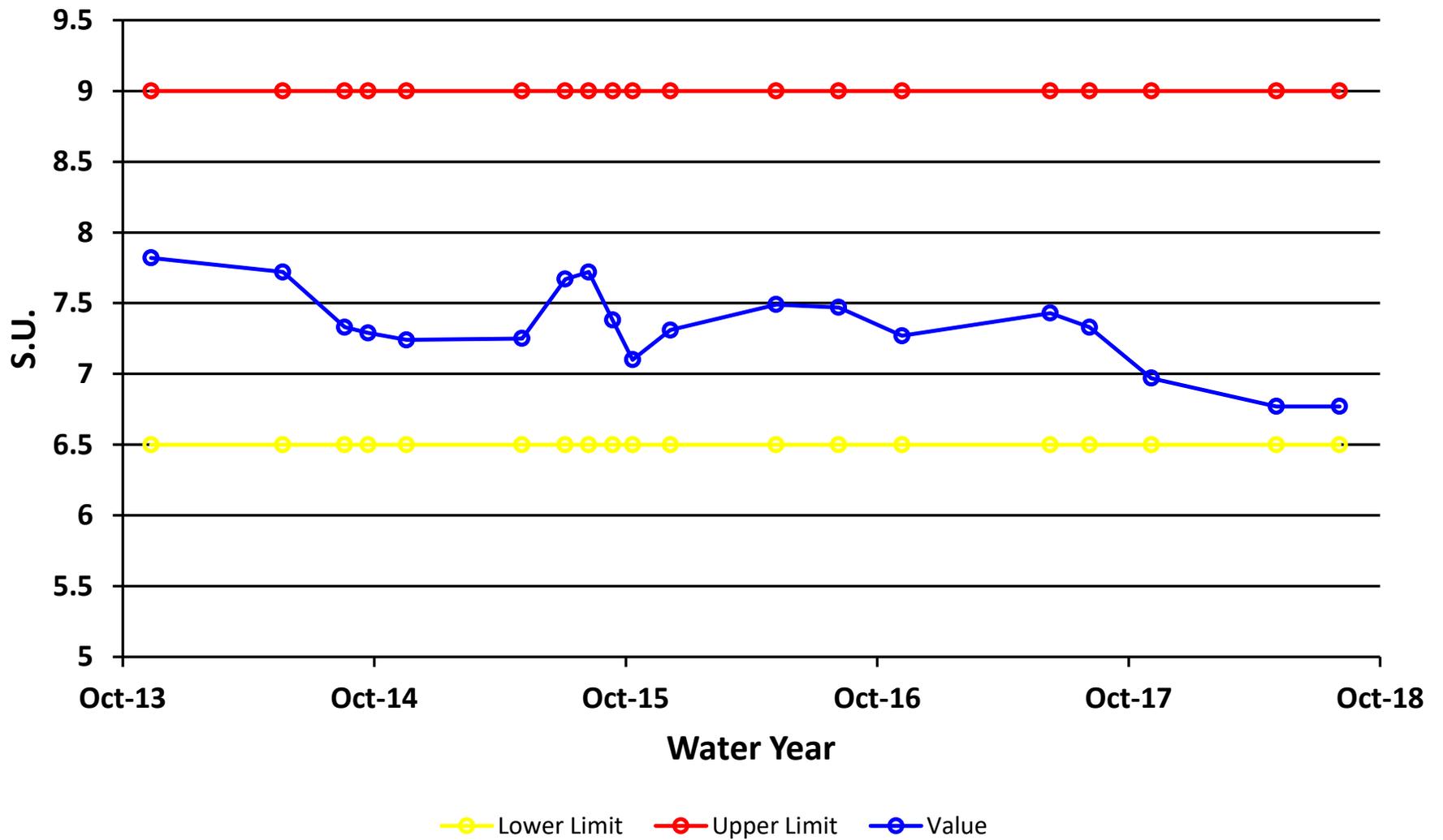
Site 13 - Conductivity Laboratory



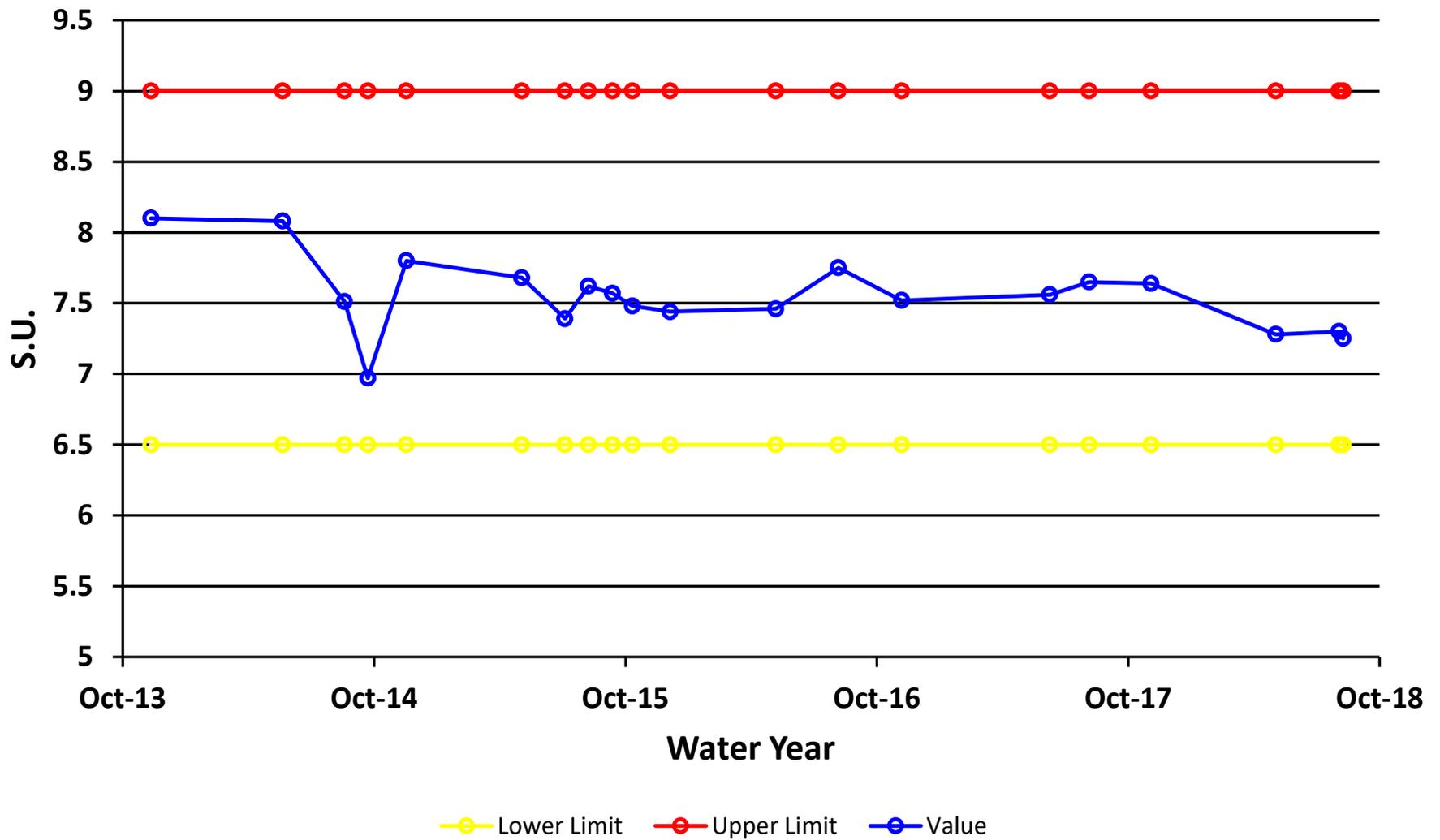
Site 13 - Conductivity Field



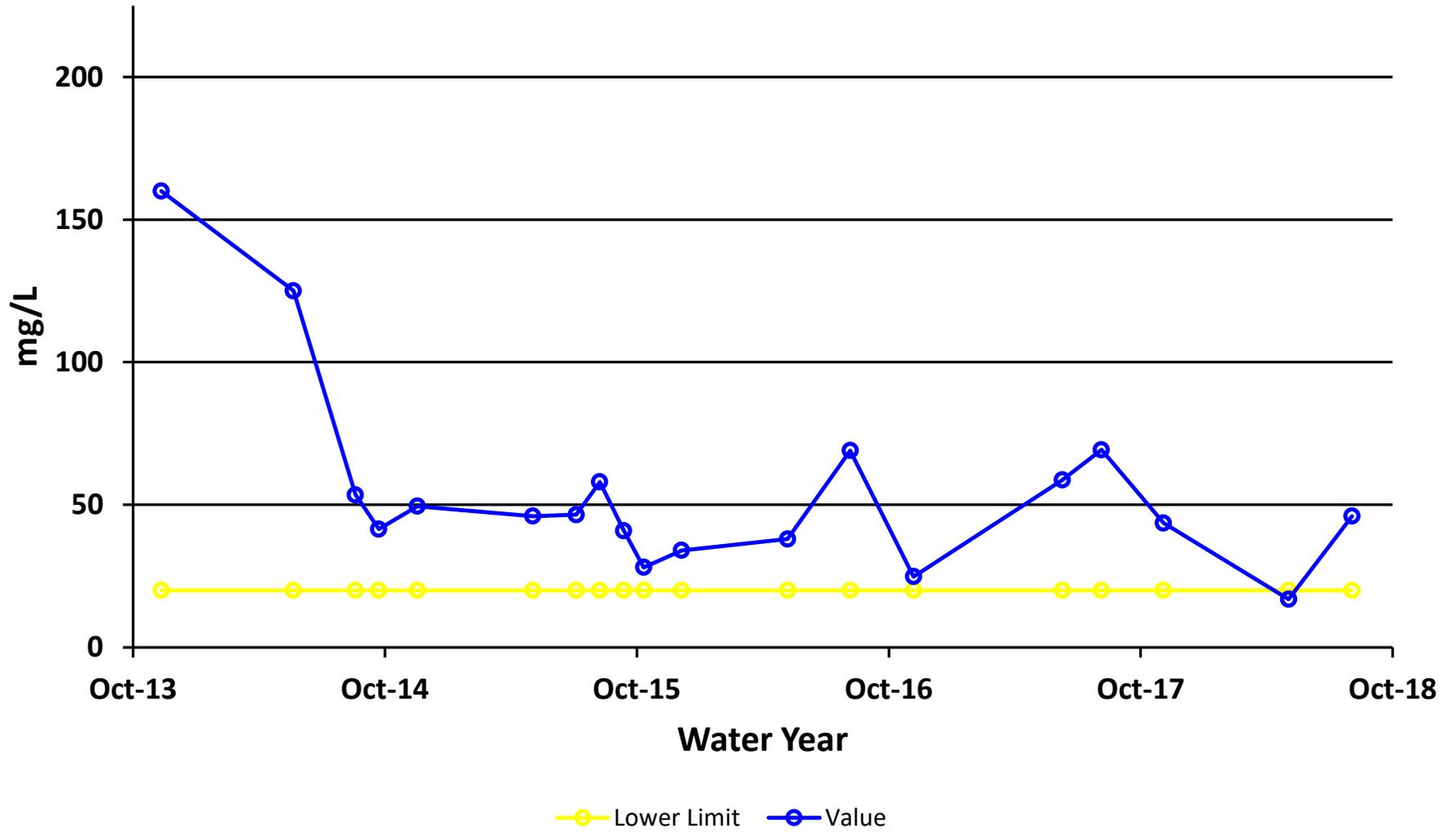
Site 13 - pH Laboratory



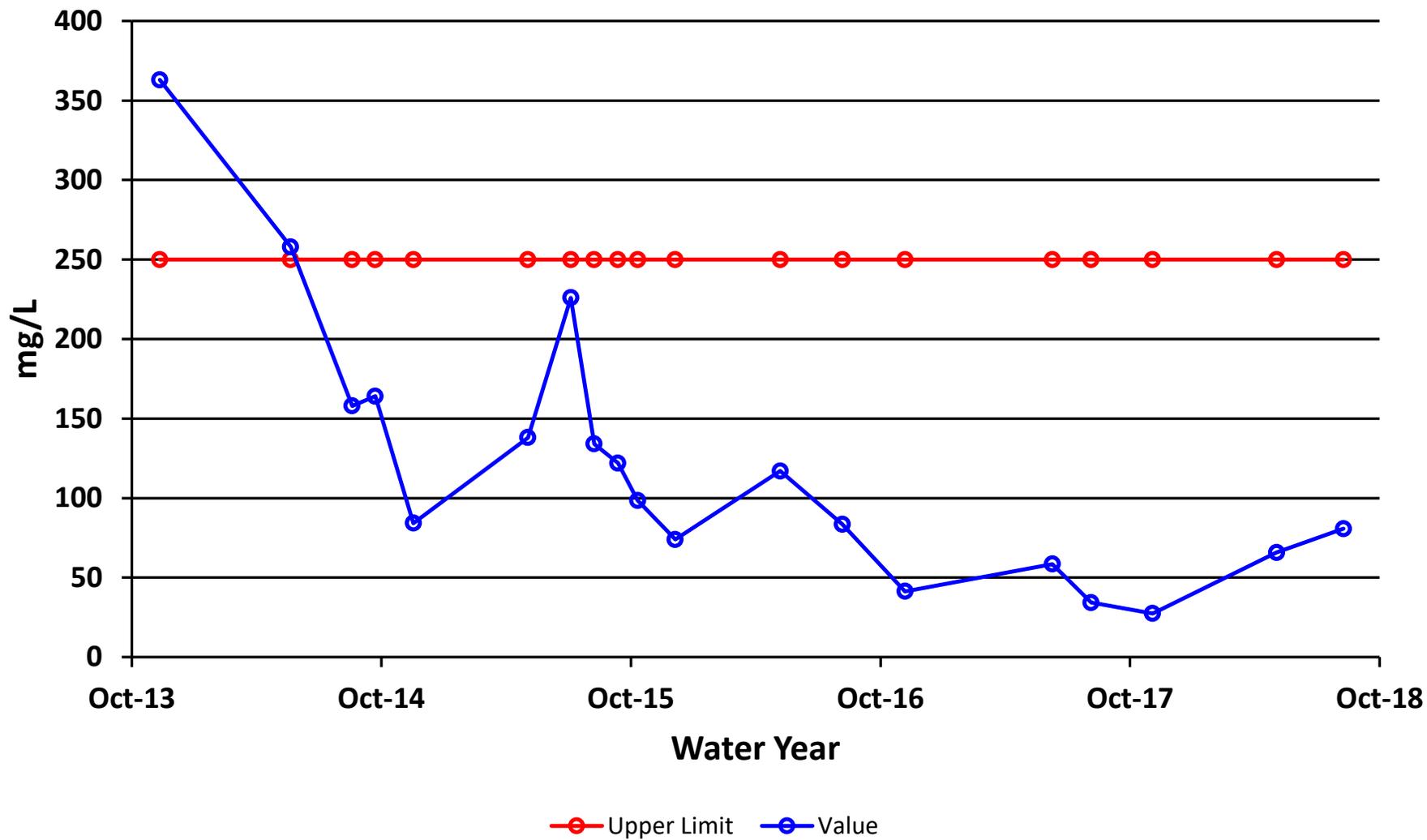
Site 13 - pH Field



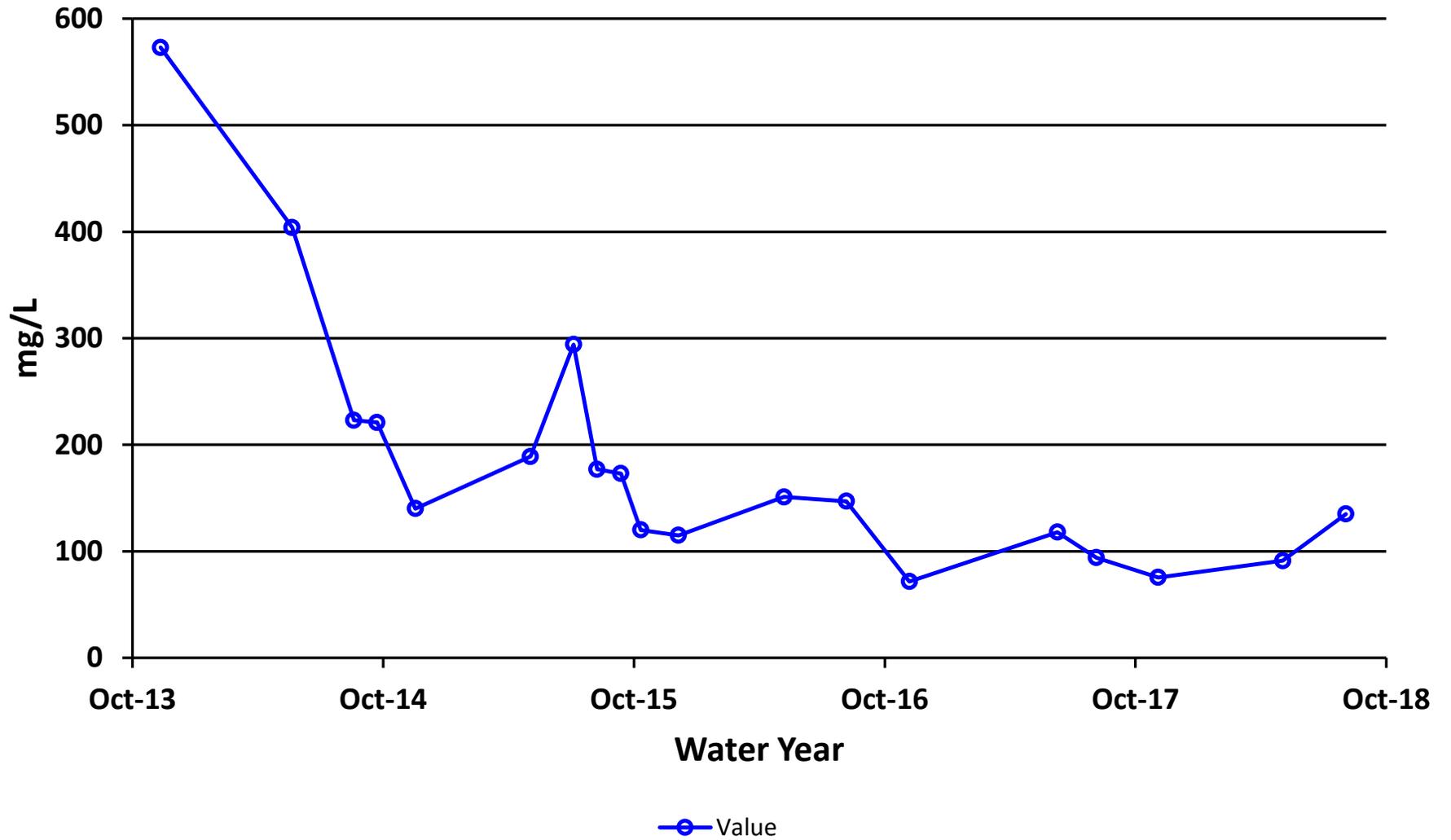
Site 13 - Alkalinity



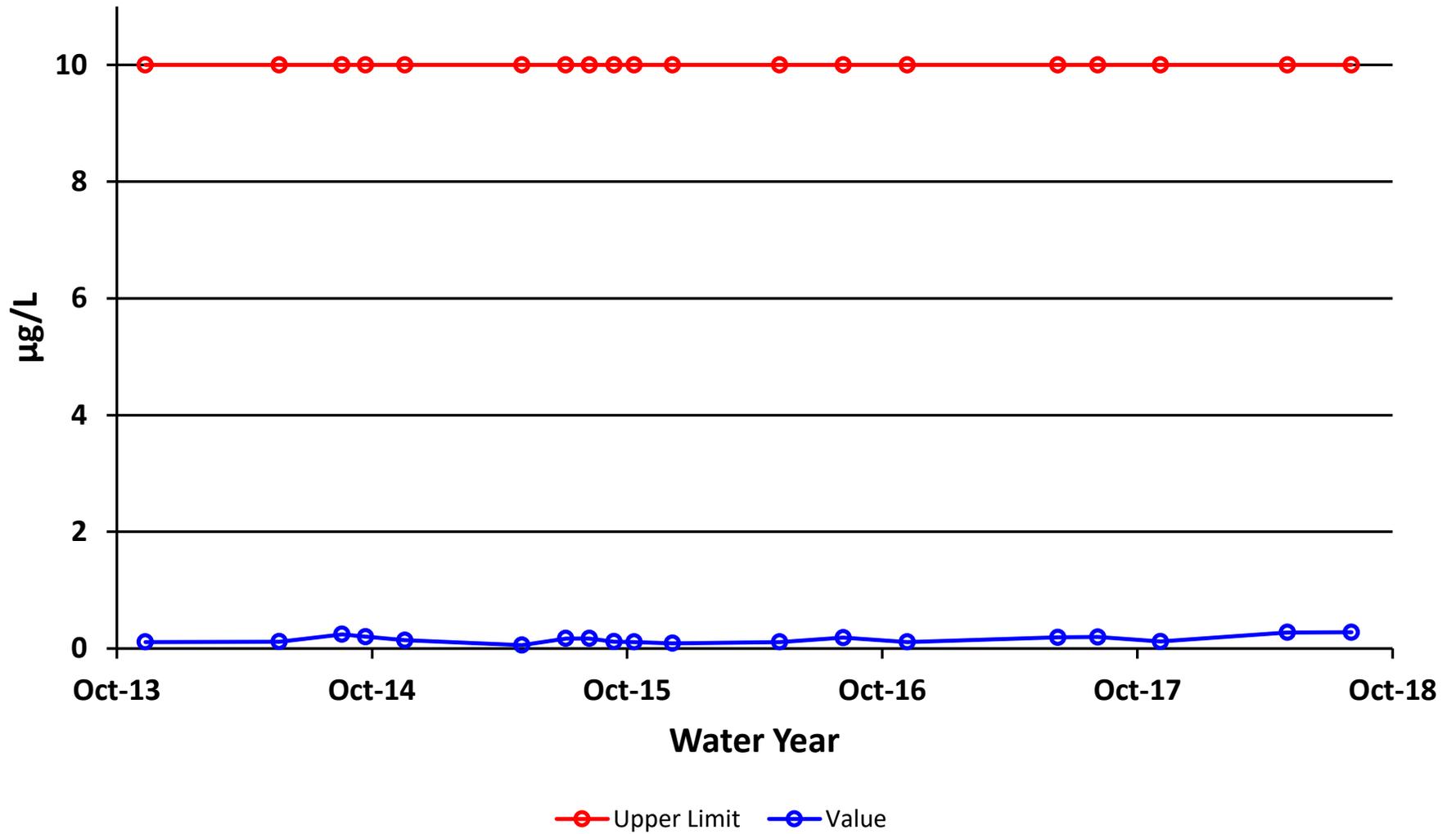
Site 13 - Sulfate



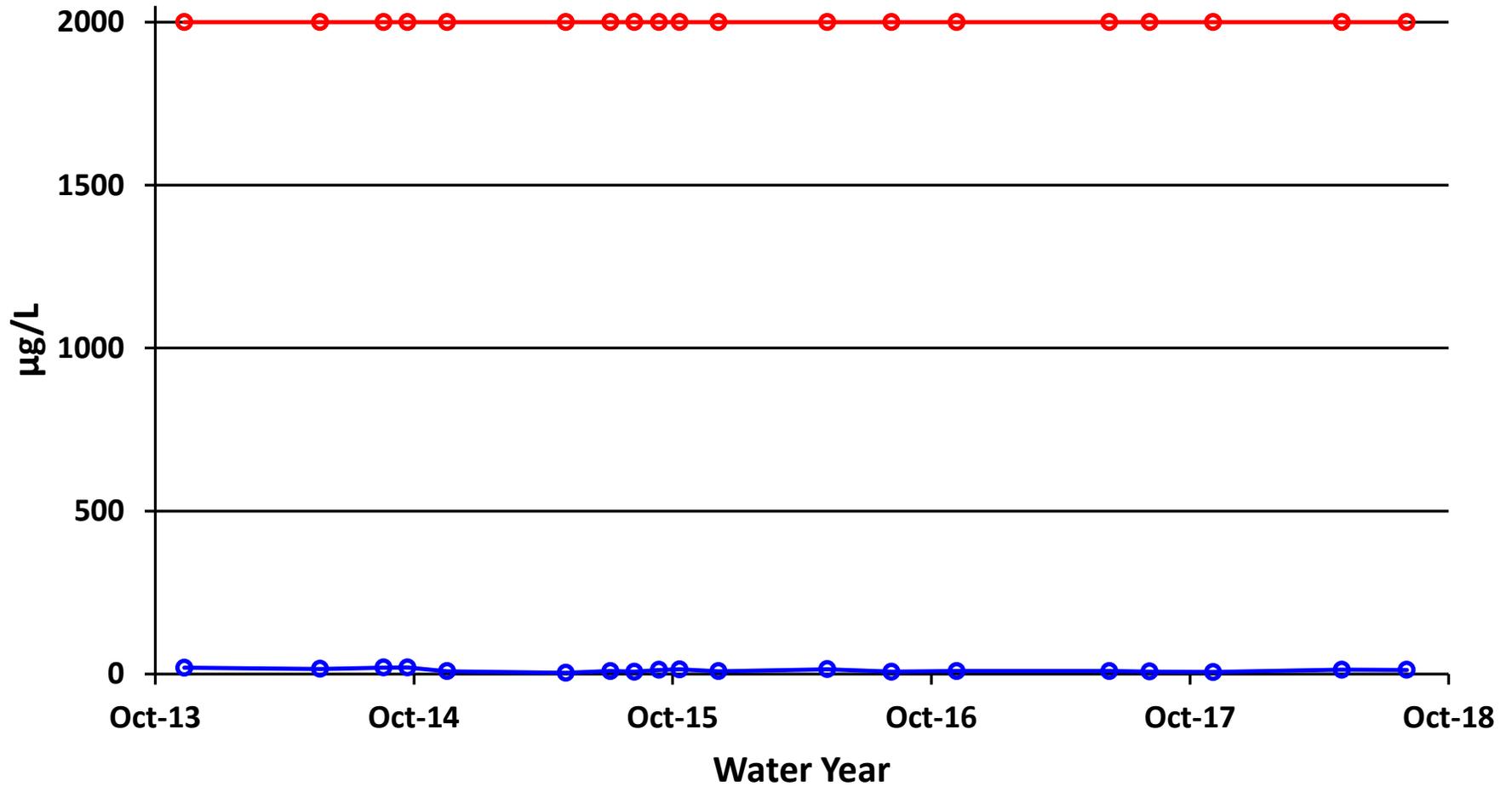
Site 13 - Hardness



Site 13 - Arsenic Dissolved

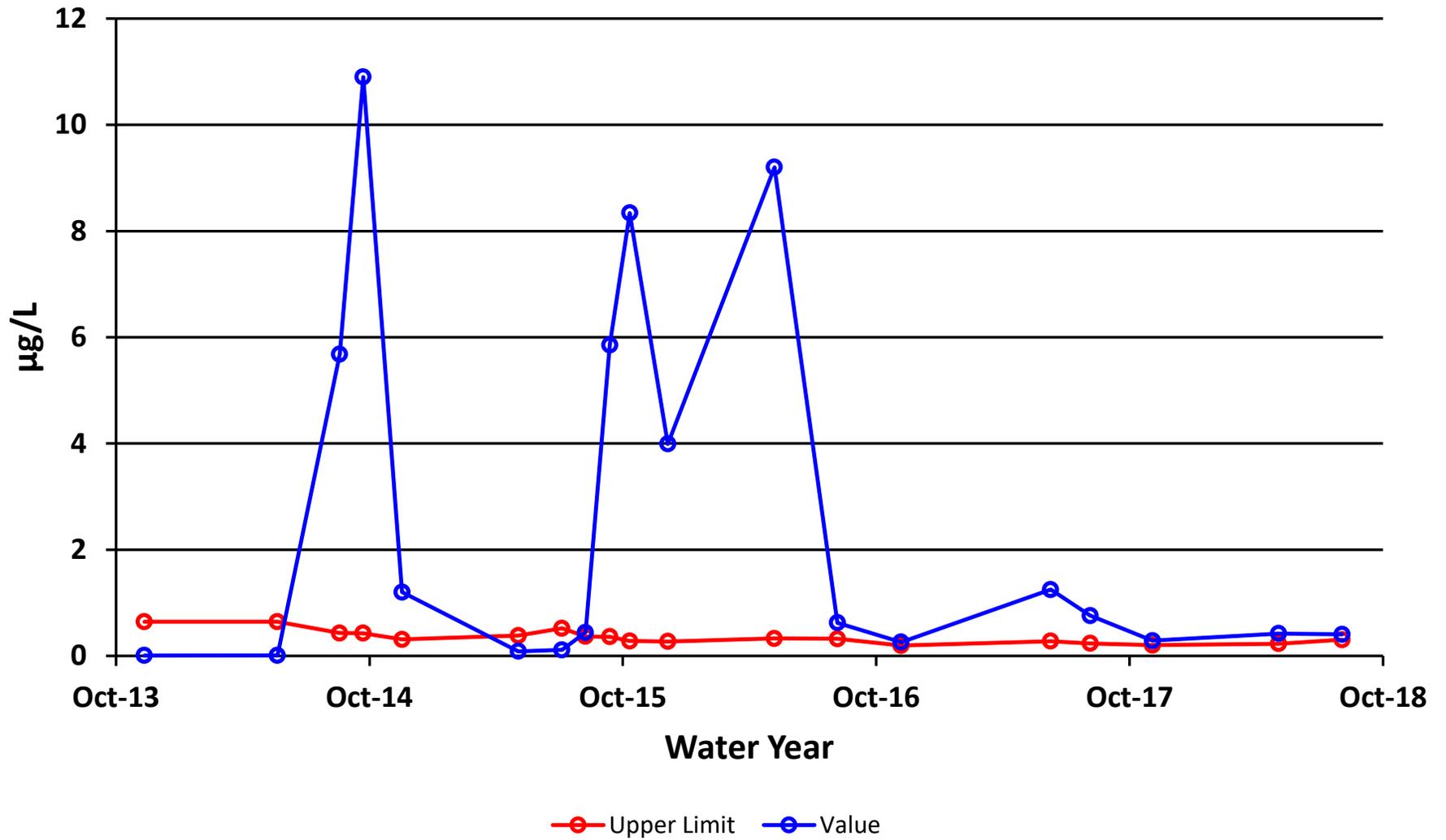


Site 13 - Barium Dissolved

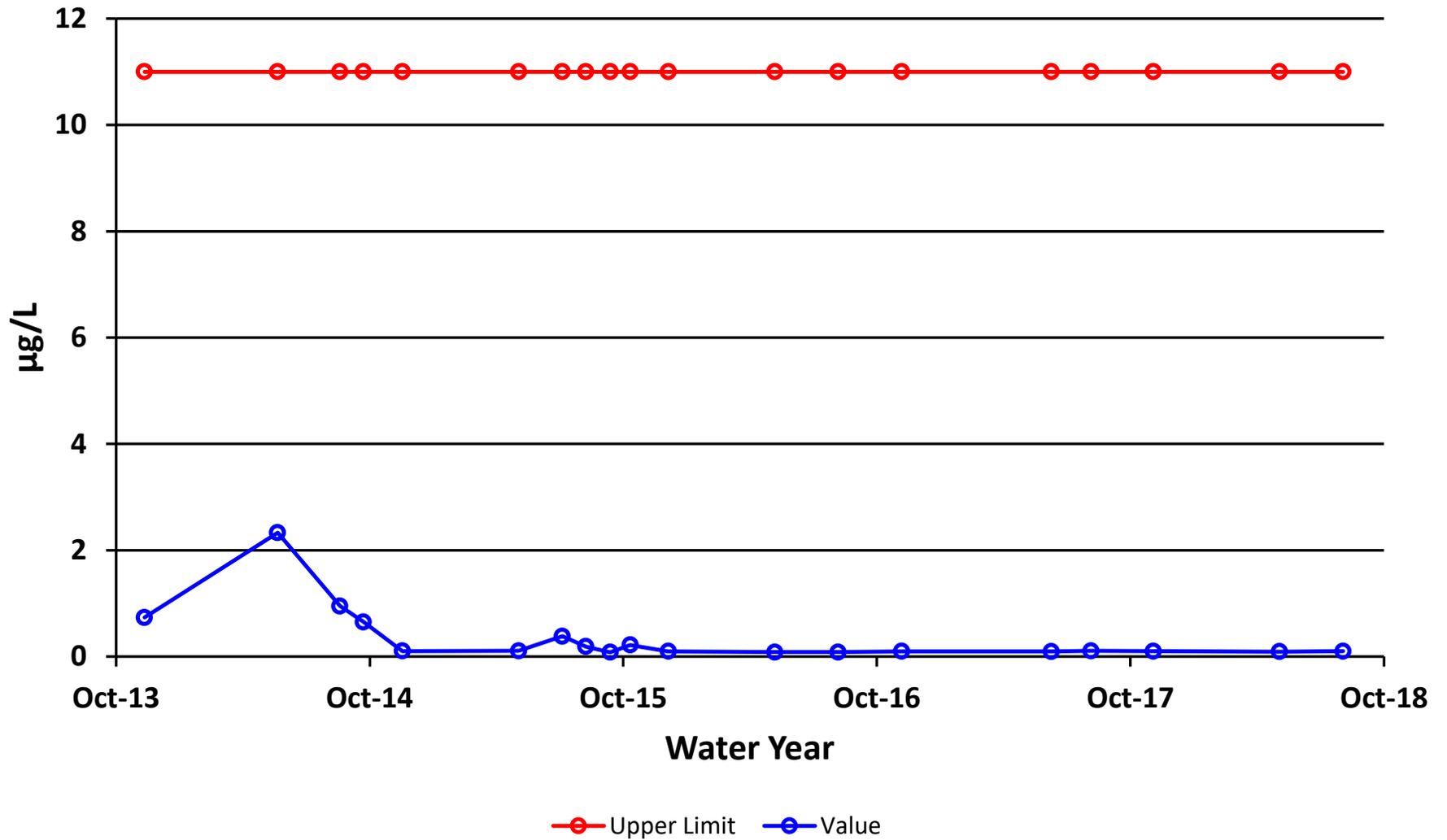


—○— Upper Limit —○— Value

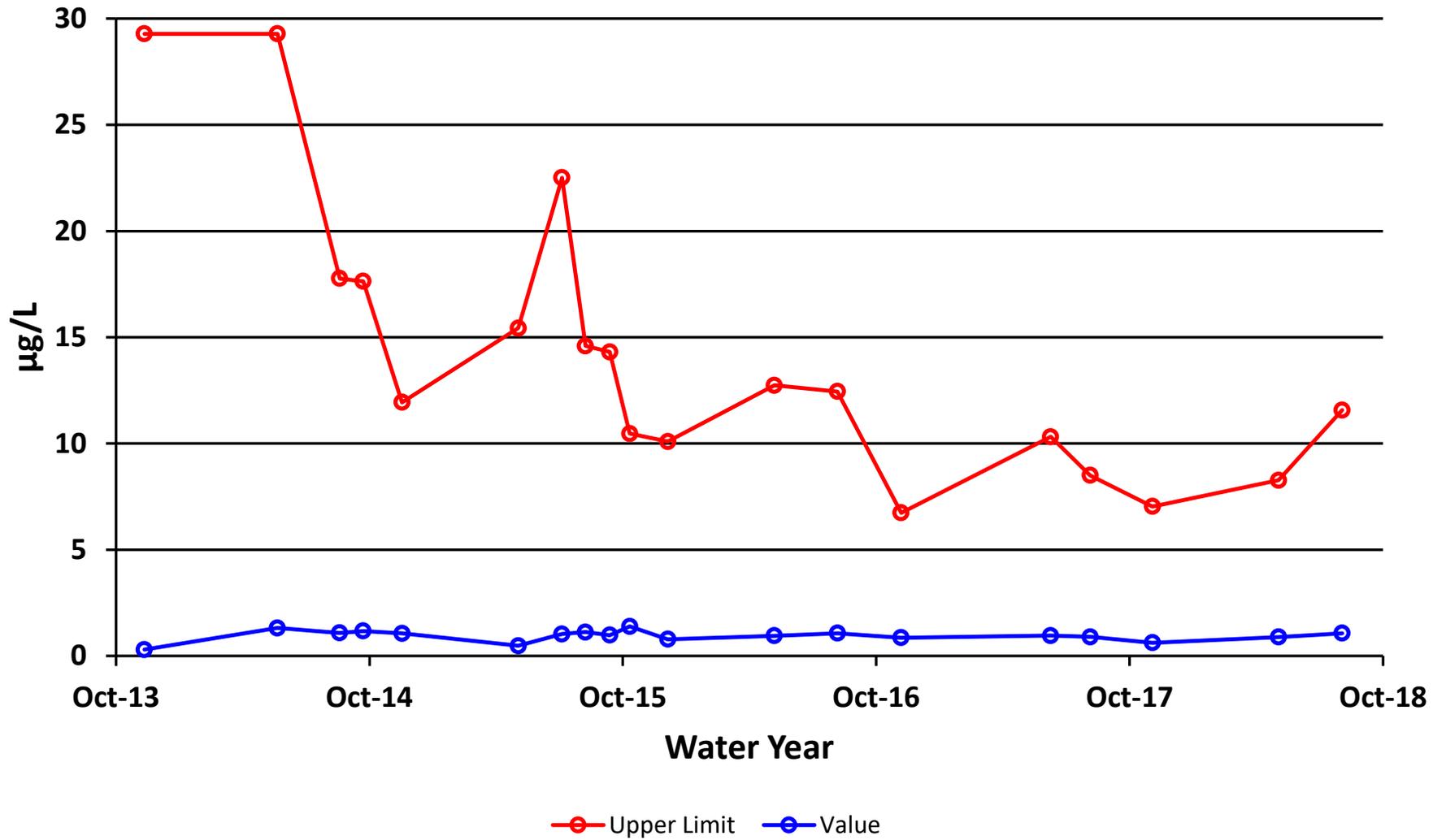
Site 13 - Cadmium Dissolved



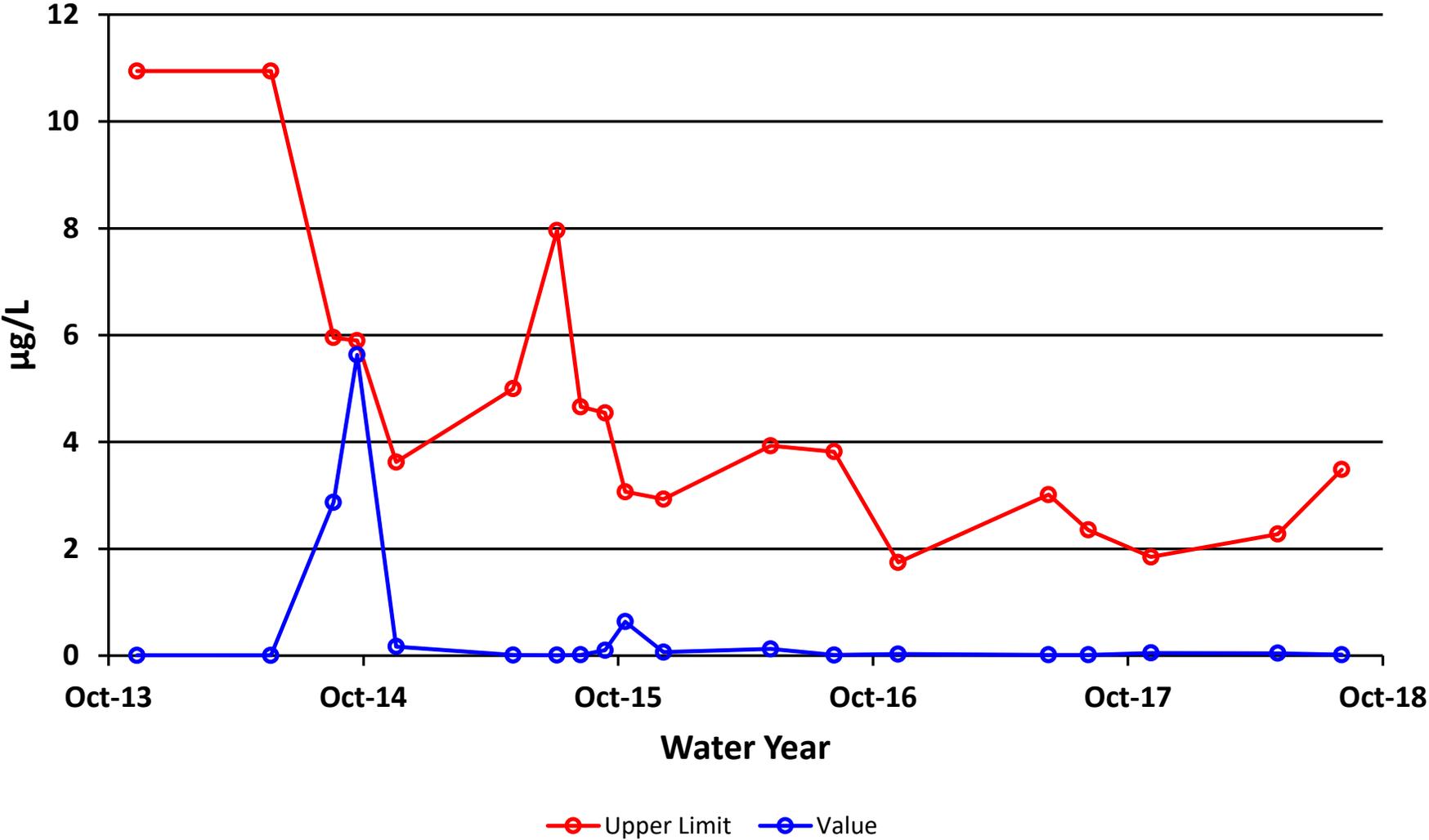
Site 13 - Chromium Dissolved



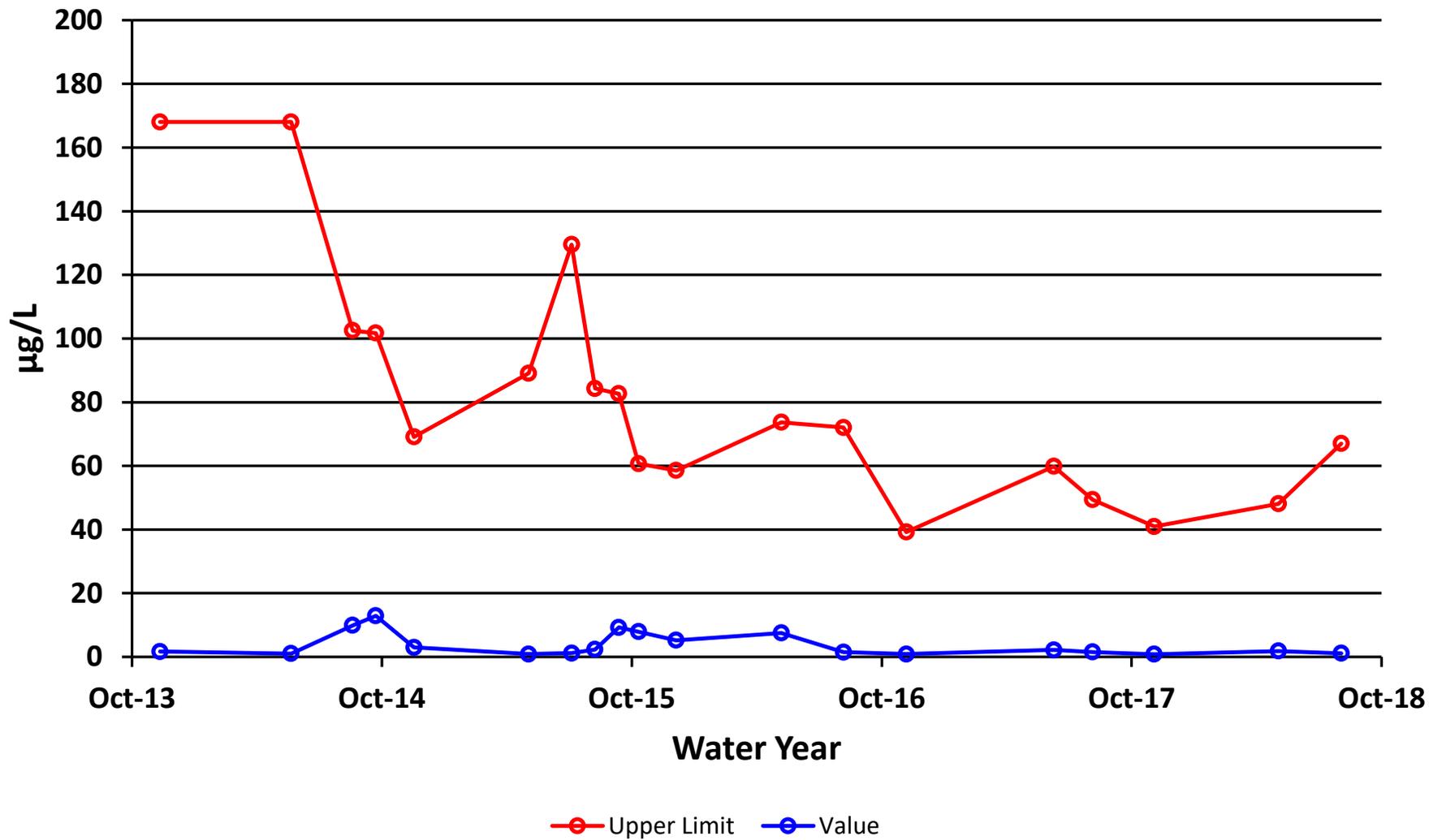
Site 13 - Copper Dissolved



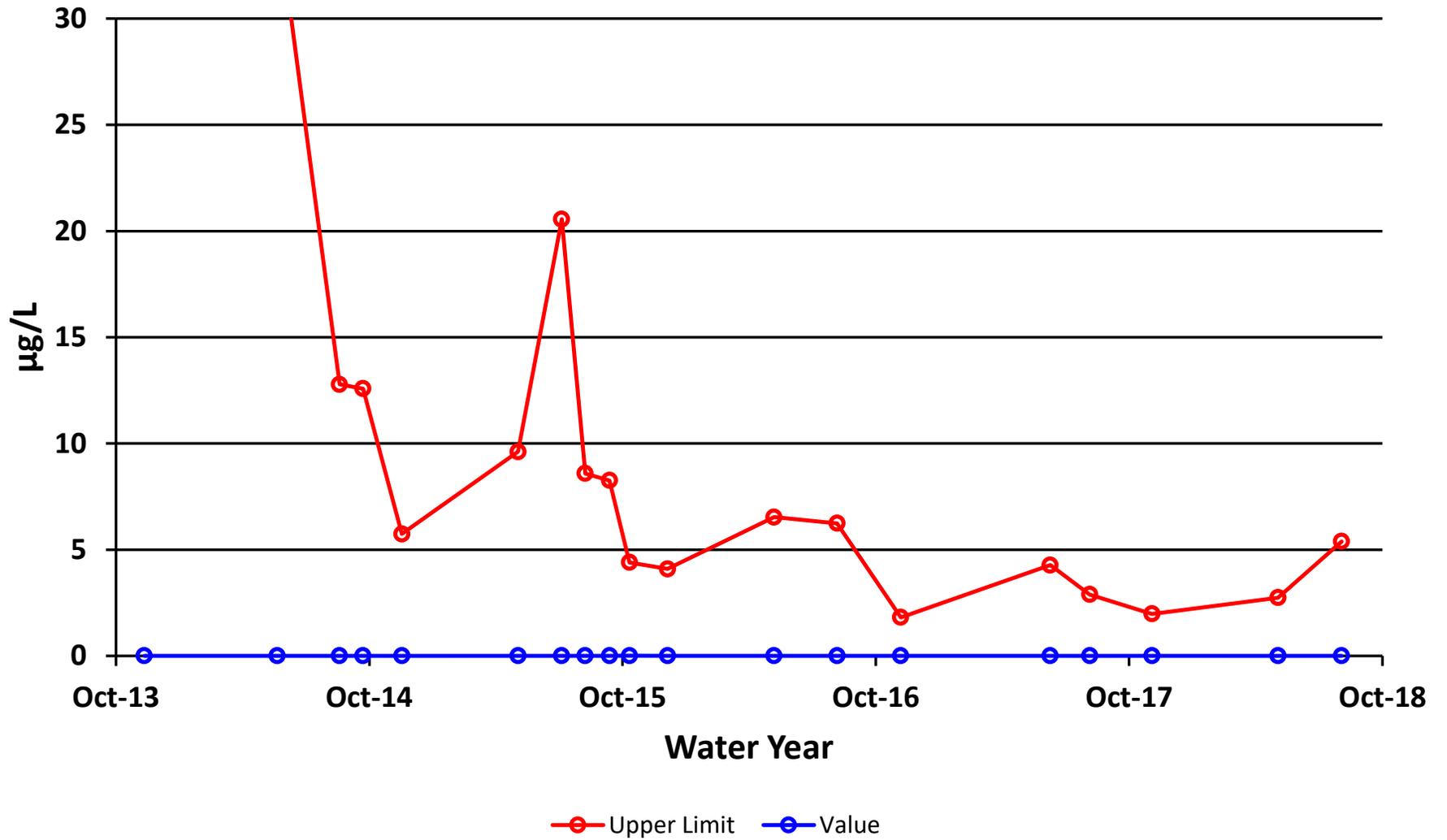
Site 13 - Lead Dissolved



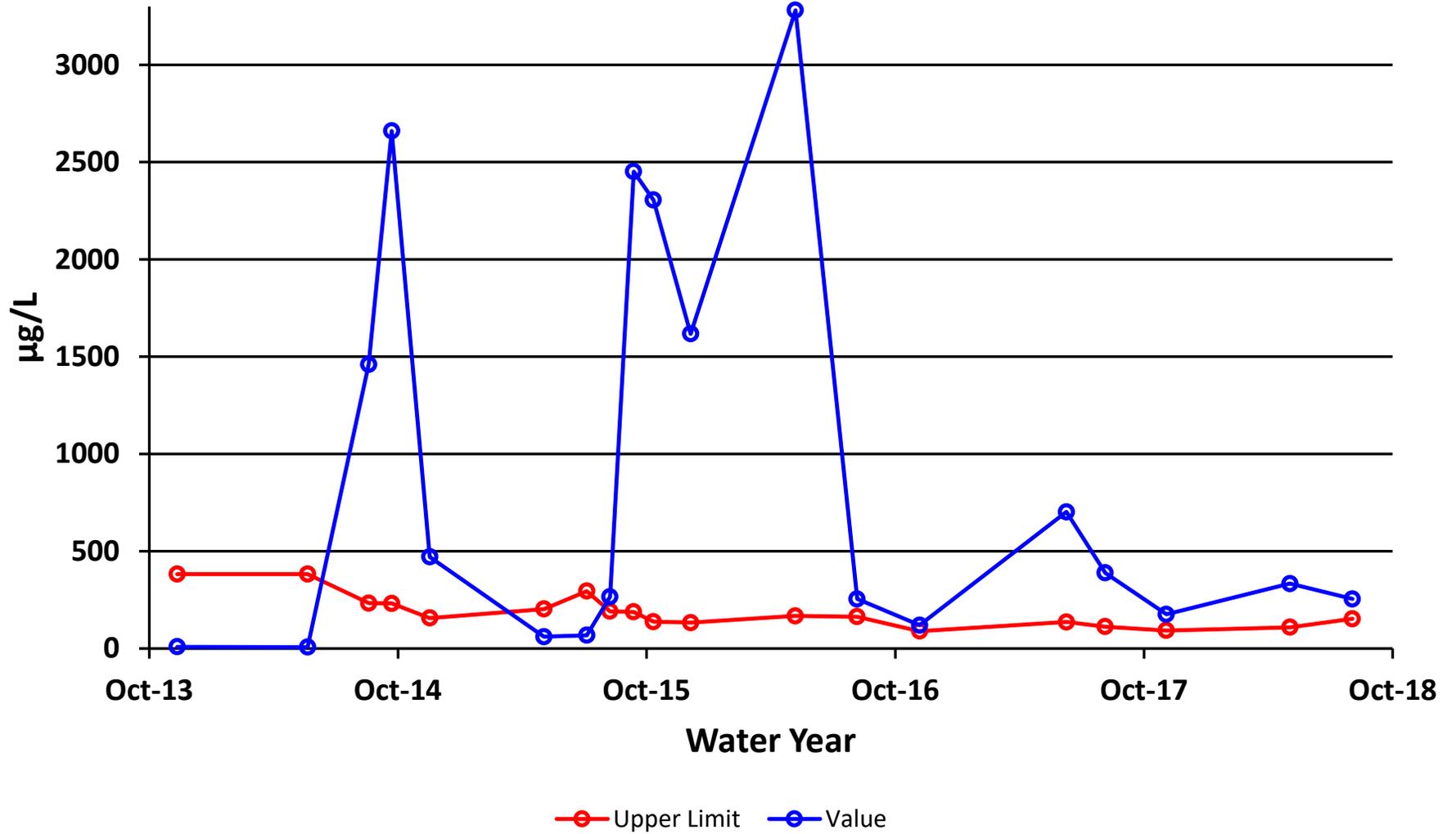
Site 13 - Nickel Dissolved



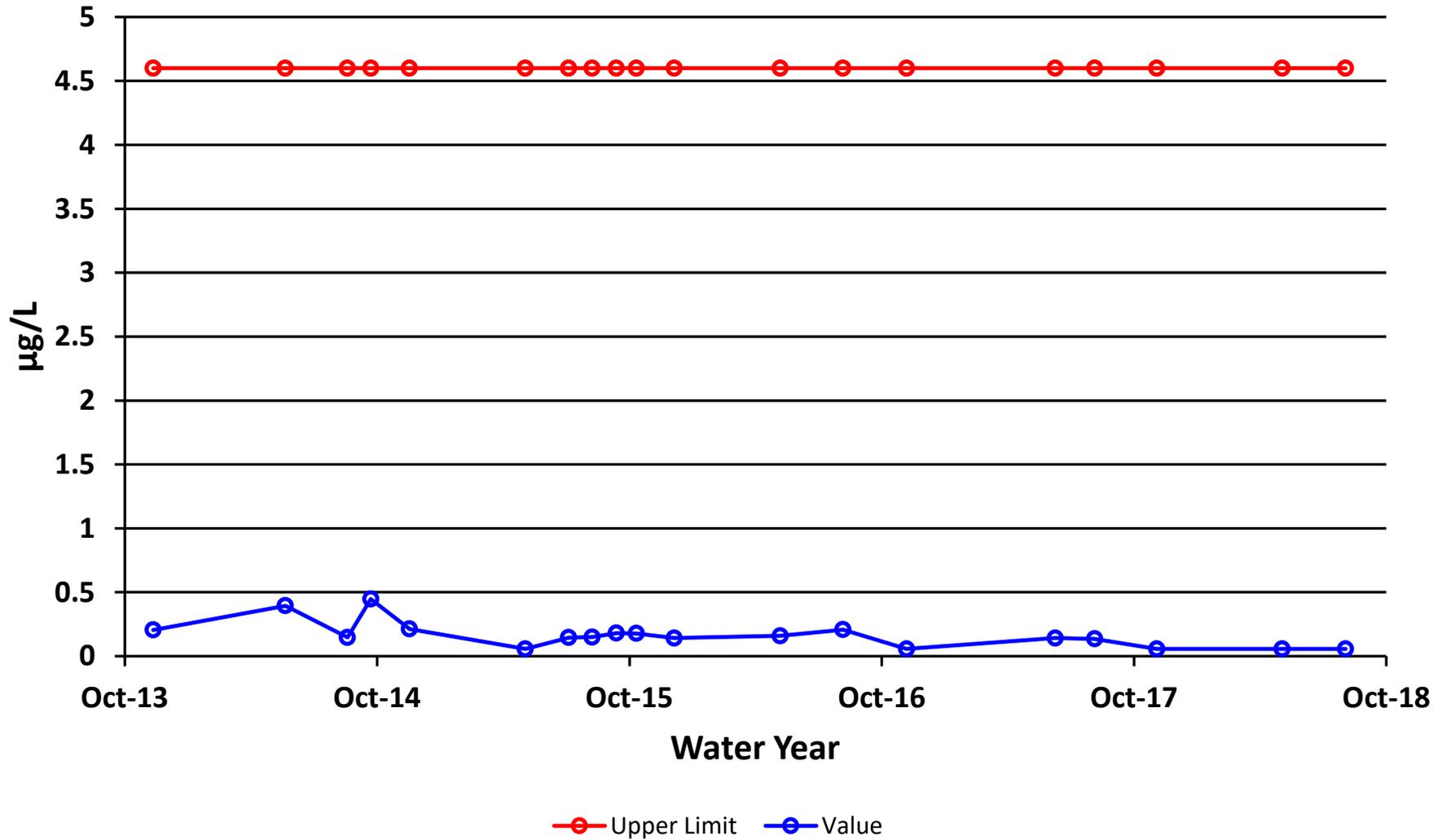
Site 13 - Silver Dissolved



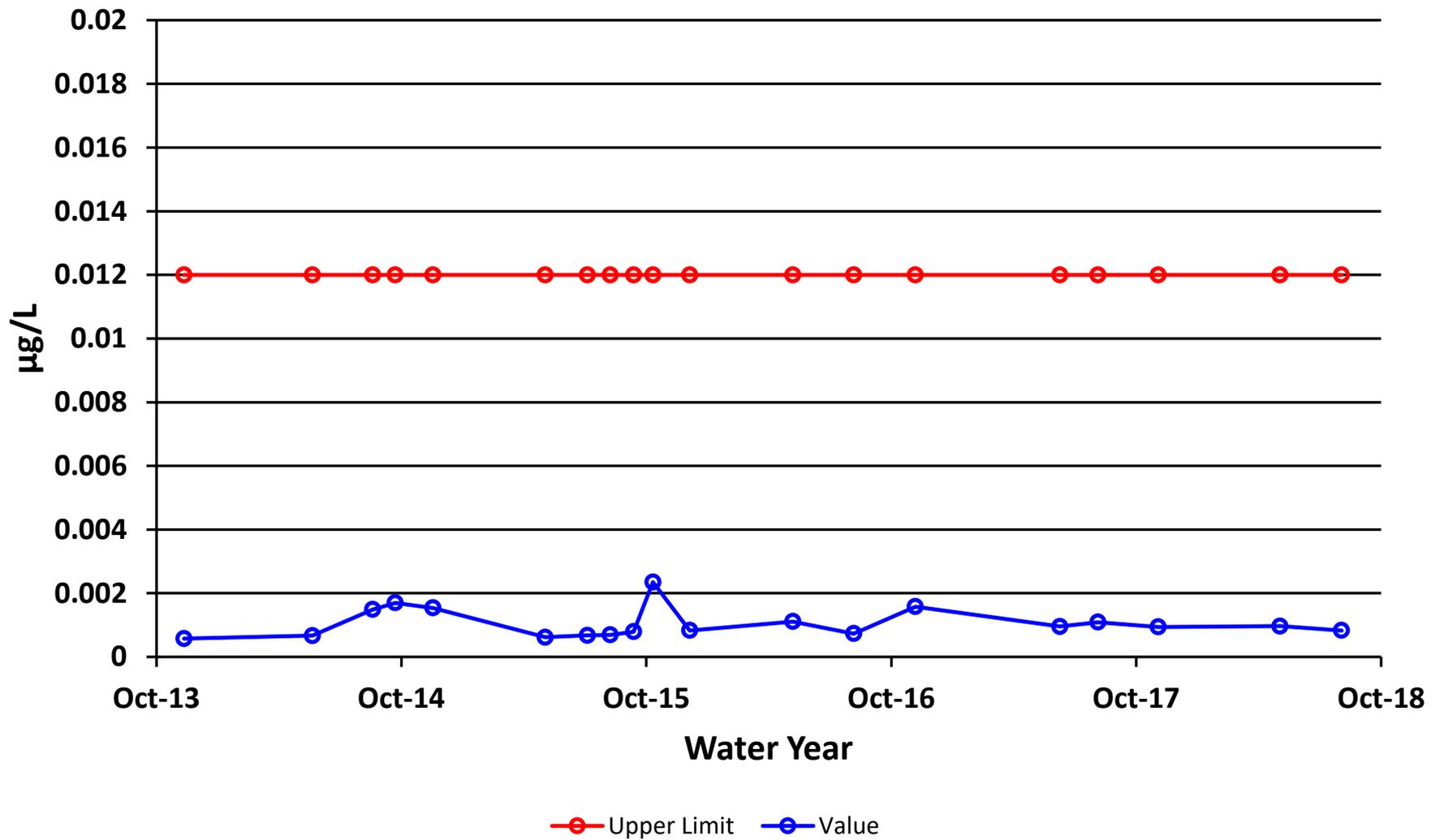
Site 13 - Zinc Dissolved



Site 13 - Selenium Dissolved



Site 13 - Mercury Dissolved



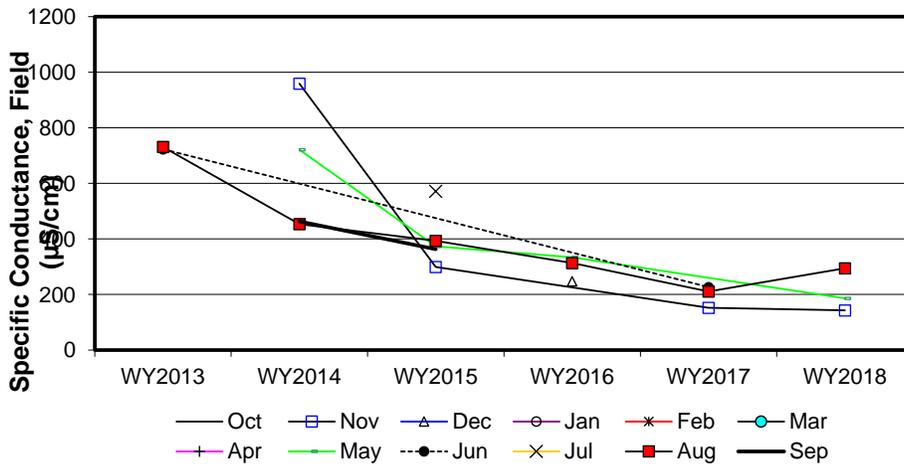
Site #13

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	WY2013									723.0		731.0	
b	WY2014		959.0						721.0			453.0	463.0
c	WY2015		299.0						373.0		572.0	393.0	363.0
d	WY2016	268.0		248.0					334.0			313.0	
e	WY2017		152.3							226.7		210.8	
f	WY2018		143.0						186.2			294.5	
n		1	4	1	0	0	0	0	4	2	1	6	2
t ₁		1	4	1	0	0	0	0	4	2	1	6	2
t ₂		0	0	0	0	0	0	0	0	0	0	0	0
t ₃		0	0	0	0	0	0	0	0	0	0	0	0
t ₄		0	0	0	0	0	0	0	0	0	0	0	0
t ₅		0	0	0	0	0	0	0	0	0	0	0	0
b-a													-1
c-a													-1
d-a													-1
e-a										-1			-1
f-a													-1
c-b			-1						-1				-1
d-b									-1				-1
e-b			-1										-1
f-b			-1						-1				-1
d-c									-1				-1
e-c			-1										-1
f-c			-1						-1				-1
e-d													-1
f-d									-1				-1
f-e			-1										1
S _k		0	-6	0	0	0	0	0	-6	-1	0	-13	-1
σ _S ² =			8.67						8.67	1.00		28.33	1.00
Z _k = S _k /σ _S			-2.04						-2.04	-1.00		-2.44	-1.00
Z _k ²			4.15						4.15	1.00		5.96	1.00

ΣZ _k =	-8.52	Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅	Σn	21
ΣZ _k ² =	16.27	Count	21	0	0	0	0	ΣS _k	-27
Z-bar=ΣZ _k /K=	-1.70								

χ _n ² =ΣZ _k ² -K(Z-bar) ² =	1.76	@α=5% χ _(K-1) ² =	9.49	Test for station homogeneity	
p	0.780			χ _n ² <χ _(K-1) ²	ACCEPT
ΣVAR(S _k)	Z _{calc} -3.77	@α/2=2.5% Z=	1.96	H ₀ (No trend)	REJECT
47.67	p	0.000		H _A (± trend)	ACCEPT



Seasonal-Kendall Slope Confidence Intervals			
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-182.00	-87.30	-55.75
0.050	-134.70		-68.62
0.100	-129.60		-73.39
0.200	-111.07		-77.53
		-26.1%	

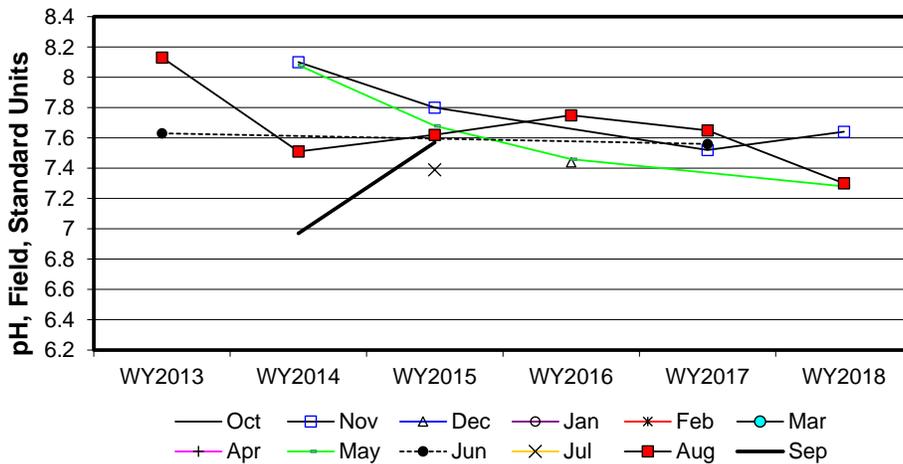
Site #13

Seasonal Kendall analysis for pH, Field, Standard Units

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	WY2013									7.6		8.1	
b	WY2014		8.1						8.1			7.5	7.0
c	WY2015		7.8						7.7		7.4	7.6	7.6
d	WY2016	7.5		7.4					7.5			7.8	
e	WY2017		7.5							7.6		7.7	
f	WY2018		7.6						7.3			7.3	
n		1	4	1	0	0	0	0	4	2	1	6	2
t ₁		1	4	1	0	0	0	0	4	2	1	6	2
t ₂		0	0	0	0	0	0	0	0	0	0	0	0
t ₃		0	0	0	0	0	0	0	0	0	0	0	0
t ₄		0	0	0	0	0	0	0	0	0	0	0	0
t ₅		0	0	0	0	0	0	0	0	0	0	0	0
b-a												-1	
c-a												-1	
d-a												-1	
e-a										-1		-1	
f-a												-1	
c-b			-1						-1			1	1
d-b									-1			1	
e-b			-1									1	
f-b			-1						-1			-1	
d-c									-1			1	
e-c			-1									1	
f-c			-1						-1			-1	
e-d												-1	
f-d									-1			-1	
f-e			1									-1	
S _k		0	-4	0	0	0	0	0	-6	-1	0	-5	1
σ _S ² =			8.67						8.67	1.00		28.33	1.00
Z _k = S _k /σ _S			-1.36						-2.04	-1.00		-0.94	1.00
Z _k ²			1.85						4.15	1.00		0.88	1.00

ΣZ _k =	-4.34	Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅	Σn	21
ΣZ _k ² =	8.88	Count	21	0	0	0	0	ΣS _k	-15
Z-bar=ΣZ _k /K=	-0.87								

χ _n ² =ΣZ _k ² -K(Z-bar) ² =	5.12	@α=5% χ _(K-1) ² =	9.49	Test for station homogeneity
p	0.275			χ _n ² < χ _(K-1) ² ACCEPT
ΣVAR(S _k)	Z _{calc} -2.03	@α/2=2.5% Z=	1.96	H ₀ (No trend) REJECT
47.67	p 0.021			H _A (± trend) ACCEPT



Seasonal-Kendall Slope Confidence Intervals			
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.24		0.00
0.050	-0.20		-0.05
0.100	-0.19	-0.12	-0.09
0.200	-0.15		-0.10
		-1.6%	

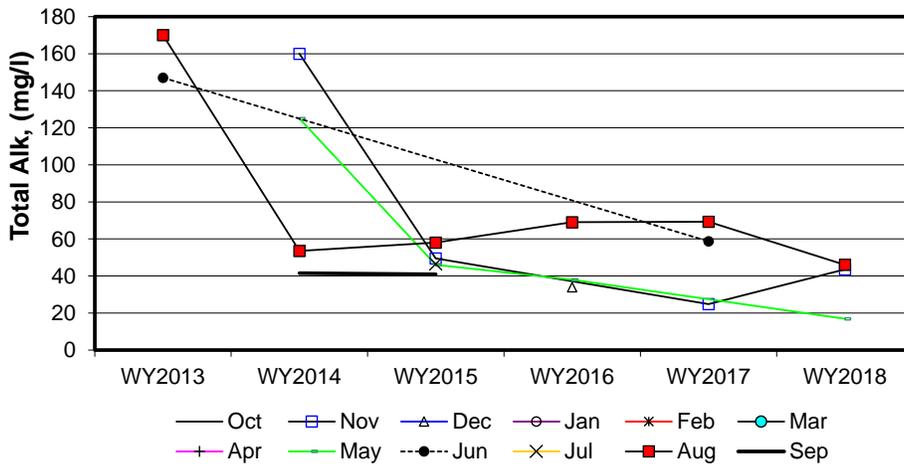
Site #13

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	WY2013									147.0		170.0	
b	WY2014		160.0						125.0			53.5	41.5
c	WY2015		49.5						46.0		46.5	58.0	40.9
d	WY2016	28.1		34.0					38.0			69.0	
e	WY2017		24.8							58.7		69.3	
f	WY2018		43.6						16.9			46.0	
n		1	4	1	0	0	0	0	4	2	1	6	2
t ₁		1	4	1	0	0	0	0	4	2	1	6	2
t ₂		0	0	0	0	0	0	0	0	0	0	0	0
t ₃		0	0	0	0	0	0	0	0	0	0	0	0
t ₄		0	0	0	0	0	0	0	0	0	0	0	0
t ₅		0	0	0	0	0	0	0	0	0	0	0	0
b-a													-1
c-a													-1
d-a													-1
e-a										-1			-1
f-a													-1
c-b			-1						-1			1	-1
d-b									-1			1	
e-b			-1									1	
f-b			-1						-1			-1	
d-c									-1			1	
e-c			-1									1	
f-c			-1						-1			-1	
e-d												1	
f-d									-1			-1	
f-e			1									-1	
S _k		0	-4	0	0	0	0	0	-6	-1	0	-3	-1
σ _S ² =			8.67						8.67	1.00		28.33	1.00
Z _k = S _k /σ _S			-1.36						-2.04	-1.00		-0.56	-1.00
Z _k ²			1.85						4.15	1.00		0.32	1.00

ΣZ _k =	-5.96	Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅	Σn	21
ΣZ _k ² =	8.32	Count	21	0	0	0	0	ΣS _k	-15
Z-bar=ΣZ _k /K=	-1.19								

χ _h ² =ΣZ _k ² -K(Z-bar) ² =	1.21	@α=5% χ _(K-1) ² =	9.49	Test for station homogeneity	
p	0.876			χ _h ² <χ _(K-1) ²	ACCEPT
ΣVAR(S _k)	Z _{calc} -2.03	@α/2=2.5% Z=	1.96	H ₀ (No trend)	REJECT
47.67	p	0.021		H _A (± trend)	ACCEPT



Seasonal-Kendall Slope Confidence Intervals			
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-38.88		-0.12
0.050	-27.39		-1.95
0.100	-25.15	-11.50	-4.30
0.200	-23.91		-9.01
		-24.7%	

Site #13

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

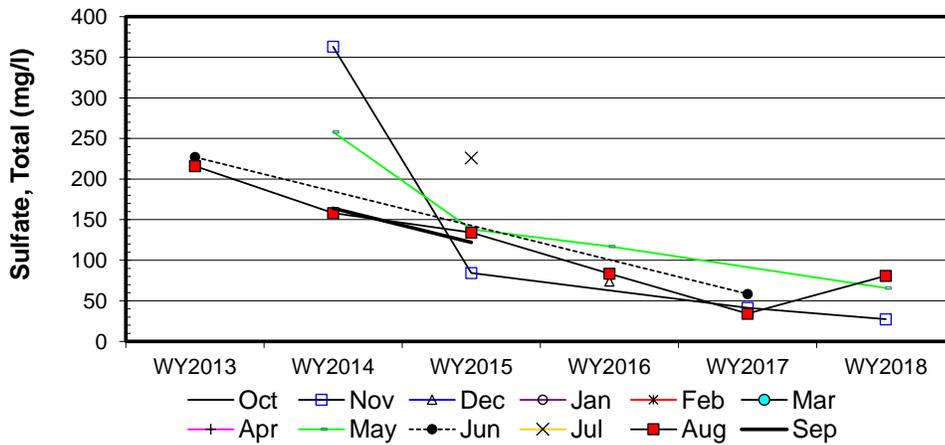
Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	WY2013									227.0		216.0	
b	WY2014		363.0						258.0			158.0	164.0
c	WY2015		84.2						138.0		226.0	134.0	122.0
d	WY2016	98.5		73.9					117.0			83.5	
e	WY2017		41.3							65.8	58.5	34.3	
f	WY2018		27.4									80.7	
n		1	4	1	0	0	0	0	4	2	1	6	2
t ₁		1	4	1	0	0	0	0	4	2	1	6	2
t ₂		0	0	0	0	0	0	0	0	0	0	0	0
t ₃		0	0	0	0	0	0	0	0	0	0	0	0
t ₄		0	0	0	0	0	0	0	0	0	0	0	0
t ₅		0	0	0	0	0	0	0	0	0	0	0	0
b-a													-1
c-a													-1
d-a													-1
e-a										-1			-1
f-a													-1
c-b			-1						-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				-1
e-d													-1
f-d									-1				-1
f-e			-1										1
S _k		0	-6	0	0	0	0	0	-6	-1	0	-13	-1
σ _s ² =			8.67						8.67	1.00		28.33	1.00
Z _k = S _k /σ _s			-2.04						-2.04	-1.00		-2.44	-1.00
Z _k ²			4.15						4.15	1.00		5.96	1.00

ΣZ_k= -8.52
 ΣZ_k²= 16.27
 Z-bar=ΣZ_k/K= -1.70

Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅
Count	21	0	0	0	0

Σn = 21
 ΣS_k = -27

χ _n ² =ΣZ _k ² -K(Z-bar) ² =	1.76	@α=5% χ _(K-1) ² =	9.49	Test for station homogeneity
p	0.780	χ _h ² <χ _(K-1) ²	ACCEPT	
ΣVAR(S _k)	Z _{calc} -3.77	@α=2.5% Z=	1.96	H ₀ (No trend) REJECT
47.67	p 0.000			H _A (± trend) ACCEPT



Seasonal-Kendall Slope Confidence Intervals			
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-54.48		-21.21
0.050	-49.32	-41.23	-24.05
0.100	-47.85		-25.71
0.200	-44.68		-33.12
		-35.2%	

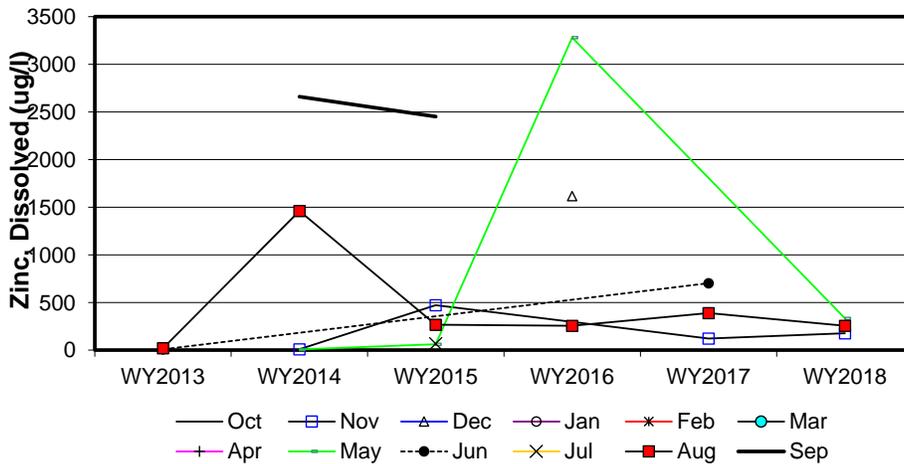
Site #13

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	WY2013									8.0		19.2	
b	WY2014		8.5						7.0			1460.0	2660.0
c	WY2015		471.0						60.5		67.9	266.0	2451.0
d	WY2016	2305.0		1617.0					3280.0			255.0	
e	WY2017		120.0							702.0		389.0	
f	WY2018		176.0						334.0			255.0	
n		1	4	1	0	0	0	0	4	2	1	6	2
t ₁		1	4	1	0	0	0	0	4	2	1	4	2
t ₂		0	0	0	0	0	0	0	0	0	0	1	0
t ₃		0	0	0	0	0	0	0	0	0	0	0	0
t ₄		0	0	0	0	0	0	0	0	0	0	0	0
t ₅		0	0	0	0	0	0	0	0	0	0	0	0
b-a													1
c-a													1
d-a													1
e-a										1			1
f-a													1
c-b			1						1			-1	-1
d-b									1			-1	-1
e-b			1									-1	-1
f-b			1						1			-1	-1
d-c									1			-1	-1
e-c			-1									1	1
f-c			-1						1			-1	-1
e-d												1	1
f-d									-1			0	0
f-e			1									-1	-1
S _k		0	2	0	0	0	0	0	4	1	0	0	-1
σ _S ² =			8.67						8.67	1.00		27.33	1.00
Z _k = S _k /σ _S			0.68						1.36	1.00		0.00	-1.00
Z _k ²			0.46						1.85	1.00		0.00	1.00

ΣZ _k =	2.04	Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅	Σn	21
ΣZ _k ² =	4.31	Count	19	1	0	0	0	ΣS _k	6
Z-bar=ΣZ _k /K=	0.41								

χ _n ² =ΣZ _k ² -K(Z-bar) ² =	3.48	@α=5% χ _(K-1) ² =	9.49	Test for station homogeneity
p	0.481			χ _n ² < χ _(K-1) ² ACCEPT
ΣVAR(S _k)	Z _{calc} 0.73	@α/2=2.5% Z=	1.96	H ₀ (No trend) ACCEPT
46.67	p 0.768			H _A (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals			
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-190.44	47.16	106.25
0.050	-102.55		82.87
0.100	-10.10		76.50
0.200	-1.37		58.06

INTERPRETIVE REPORT

SITE 27

The data collected during the current water year are listed in the following “Table of Results for Water Year 2018” 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 one-half of the for the purpose of median calculation.

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

Sample Date	Parameter	Value	Qualifier	Notes
No outliers, in the past six years, have been identified by HGCMC.				

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

Table of Exceedance for Water Year 2018

Sample Date	Parameter	Value	Limits		
			Lower	Upper	Hardness
7-Nov-17	pH	6.25 su	6.5	9.0	43.4 mg/L
17-Jul-18	pH	6.4 su	6.5	9.0	38.1 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 34.8 mg/L in October 2009. During the current water year, the median total sulfate value was 3.1 mg/L. Over the past two water years there has been a slight increase in alkalinity, and conductivity. This is likely a result of influences from recent construction activity on the near-surface hydrology in the vicinity of the well.

Non-parametric statistical analyses were performed for specific conductivity, field pH, total alkalinity, total sulfate, and dissolved zinc. Calculation details of the Seasonal Kendall analyses are presented in detail on the pages following this interpretive section. The below table summarizes the results on the data collected between Oct-12 and Sep-18 (WY2013-WY2018).

Site 27 - Table of Summary Statistics for Trend Analysis

Parameter	Mann-Kendall test statistics			Sen's slope estimate	
	n*	p**	Trend	Q	Q(%)
Conductivity Field	6	1.00	+	16	10.8
pH Field	6	0.84			
Alkalinity, Total	6	0.99	+	4.0	7.9
Sulfate, Total	6	0.28			
Zinc, Dissolved	6	0.23			

* 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 has a statistically significant increasing trend for total alkalinity (4.0 mg/L/yr) and field conductivity (16 μ S/cm/yr) over the last 6 years.

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

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

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

Figure 1 shows the three analytes examined eventually went out of control. Total sulfate went out of control during the Water Year 2008. This has been discussed in previous reports and is related to the material that was placed to the east of Pond 7 to form a pad. The fill material originated from the northern expansion of the tailings facility and from the figure it appears that there was some easily weathered sulfide mineralogy in the freshly blasted material. Total sulfate concentration initially were decreasing through Water Year 2015, however there was an increase in late 2016 and early 2017 likely caused by the recent disturbance (tailings expansion) in the vicinity of the monitoring well. The median concentration decreased to near-baseline level in 2017.

Specific conductance also went out of control in water year 2008 as would be expected with the increase in dissolved constituents driving the increase in conductivity. Specific conductivity increased during late 2015 and remained elevated during the 2018 Water Year, this correlates with the excavation and construction of the Stage 3 Phase 1 tailings expansion that began in May 2015. Now that the construction (disturbance) is completed the conductivity values are expected to drop as the area stabilizes.

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

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

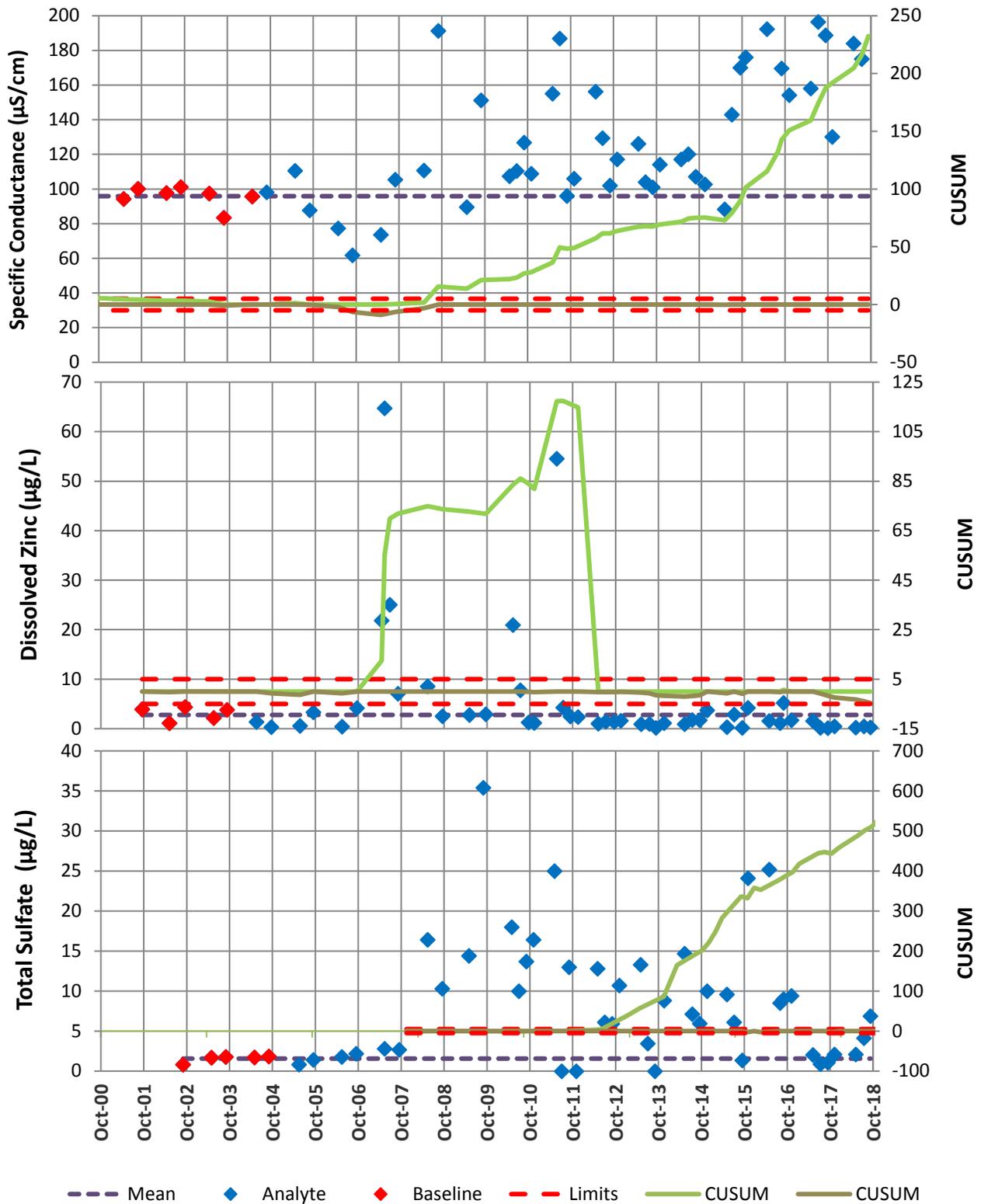


Table of Results for Water Year 2018

Site 027FMG - 'Monitoring Well - 2S'

Sample Date/Parameter	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018	Median
Water Temp (°C)		5.8						3.7		8.7		8.8	7.3
Conductivity-Field(µmho)		130						183.9		175		208.6	179.5
Conductivity-Lab (µmho)		108						122		138		142	130
pH Lab (standard units)		5.49						6.13		5.47		5.74	5.62
pH Field (standard units)		6.25						6.6		6.4		6.5	6.45
Total Alkalinity (mg/L)		45.9						51.7		50.5		59.6	51.1
Total Sulfate (mg/L)		2.1						2.1		4.1		6.9	3.1
Hardness (mg/L)		43.4						35.5		38.1		44.5	40.8
Dissolved As (ug/L)		0.822						0.69		1.21		0.992	0.907
Dissolved Ba (ug/L)		49.7						40.8		46.5		55.3	48.1
Dissolved Cd (ug/L)		0.0018						0.0018		0.0018		0.0018	0.0018
Dissolved Cr (ug/L)		0.422						0.312		0.474		0.536	0.448
Dissolved Cu (ug/L)		0.069						0.062		0.097		0.066	0.068
Dissolved Pb (ug/L)		0.0102						0.0098		0.018		0.0366	0.0141
Dissolved Ni (ug/L)		0.243						0.172		0.226		0.263	0.235
Dissolved Ag (ug/L)		0.002						0.002		0.002		0.002	0.002
Dissolved Zn (ug/L)		0.45						0.2		0.44		0.27	0.36
Dissolved Se (ug/L)		0.057						0.057		0.057		0.057	0.057
Dissolved Hg (ug/L)		0.000493						0.000326		0.00607		0.000322	0.000410

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

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

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

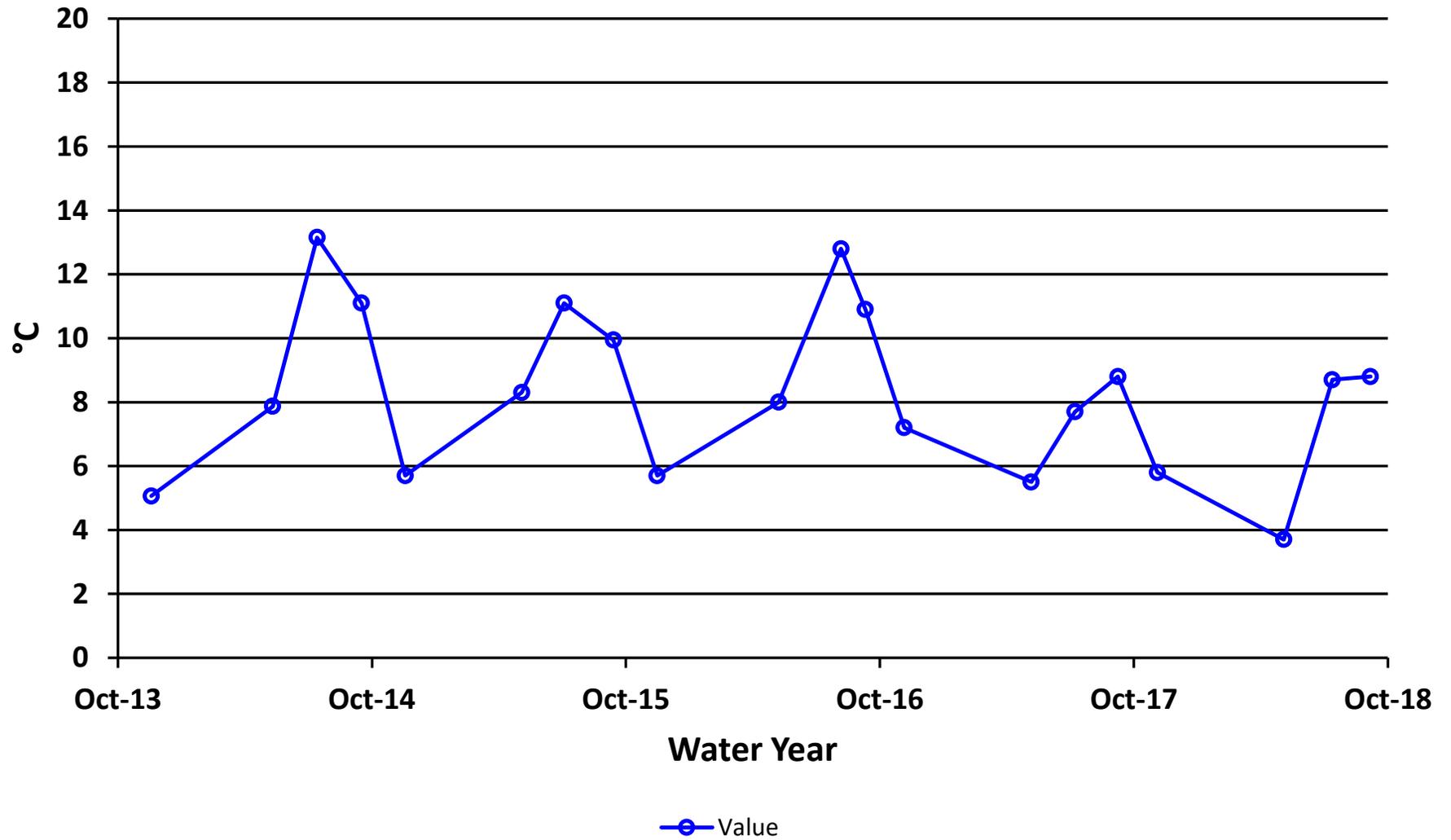
Qualified Data by QA Reviewer

Date Range: 10/01/2017 to 09/30/2018

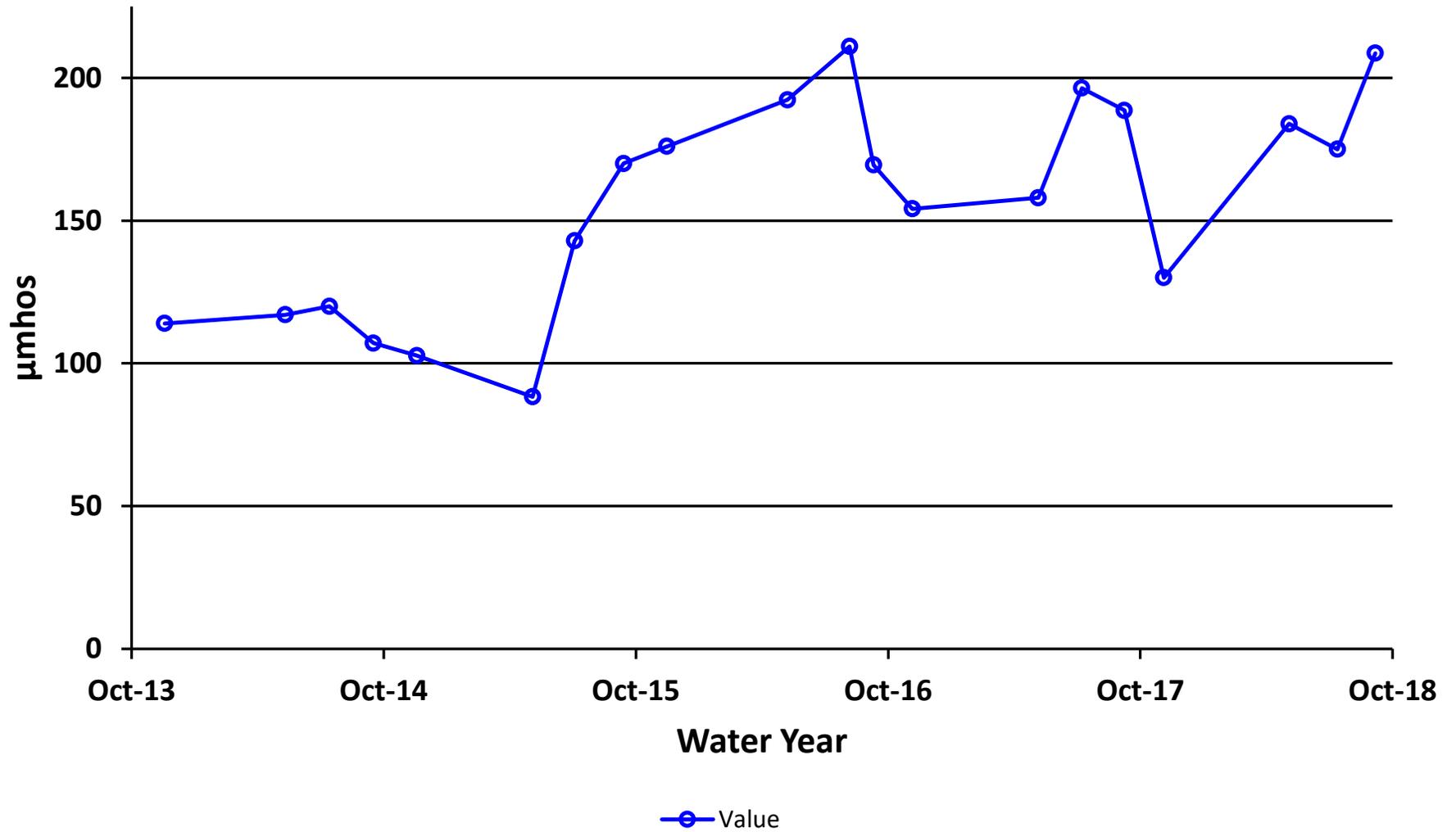
Site No.	Sample Date	Parameter	Value		Qualifier	Reason for Qualifier
027FMG	11/7/2017	Diss. Cu-ICP/MS	0.06	µg/L	U	Field Blank Contamination
		Diss. Pb-ICP/MS	0.01	µg/L	U	Field Blank Contamination
	5/8/2018	Diss. Cu-ICP/MS	0.06	µg/L	U	Trip Blank Contamination
7/17/2018		pH	5.47	pH units	J	Hold time Violation
		Total Sulfate	4.12	mg/L	J	Sample Receipt Temperature
9/10/2018		Diss. Cu-ICP/MS	0.06	µg/L	U	Field Blank Contamination
		Diss. Ni-ICP/MS	0.26	µg/L	U	Field Blank Contamination
		Diss. Zn-ICP/MS	0.27	µg/L	U	Field Blank Contamination
		pH	5.74	pH units	J	Hold Time Violation
9/10/2018		Total Sulfate	6.88	mg/L	J	Sample Receipt Temperature

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

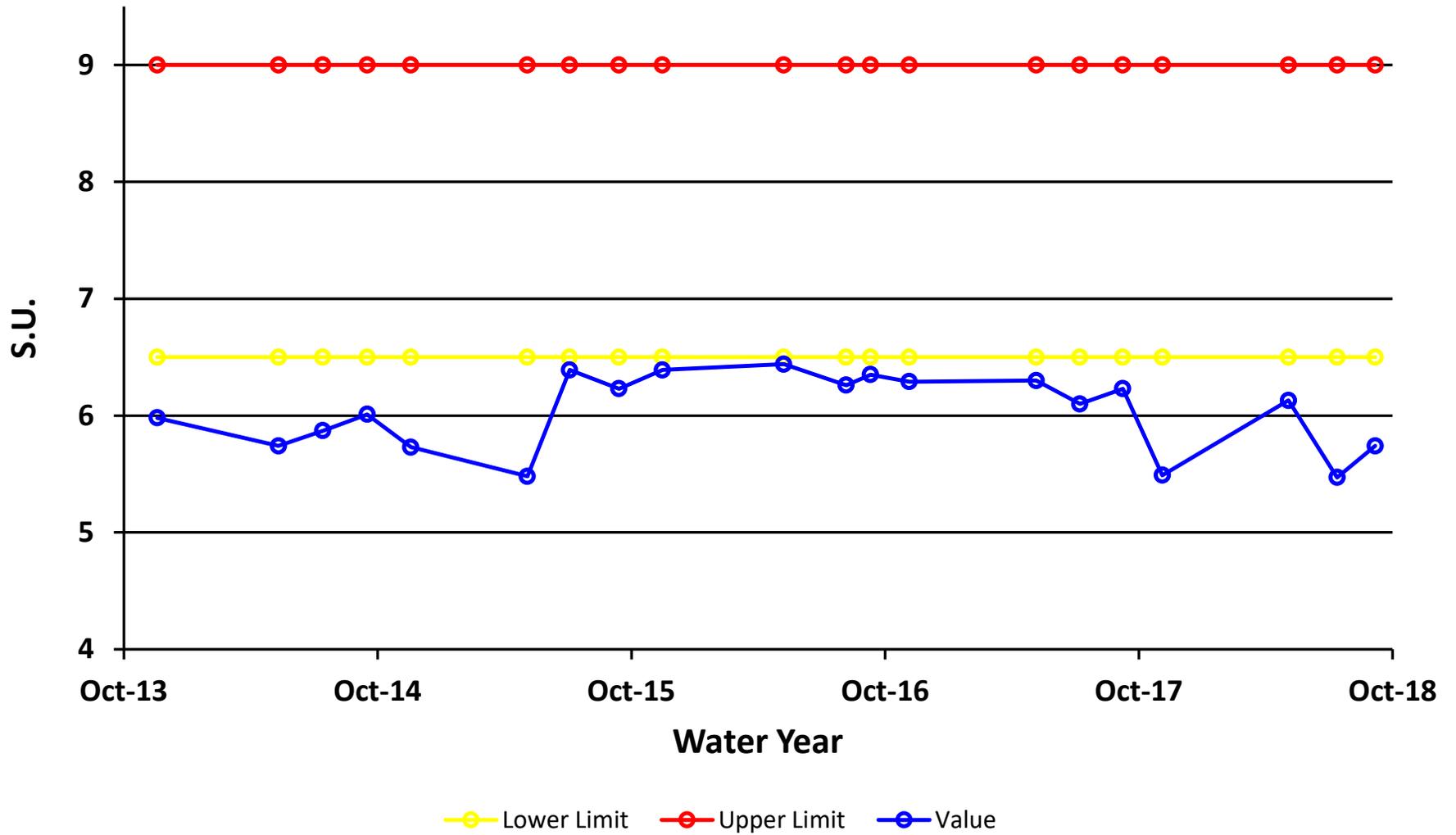
Site 27 - Water Temperature



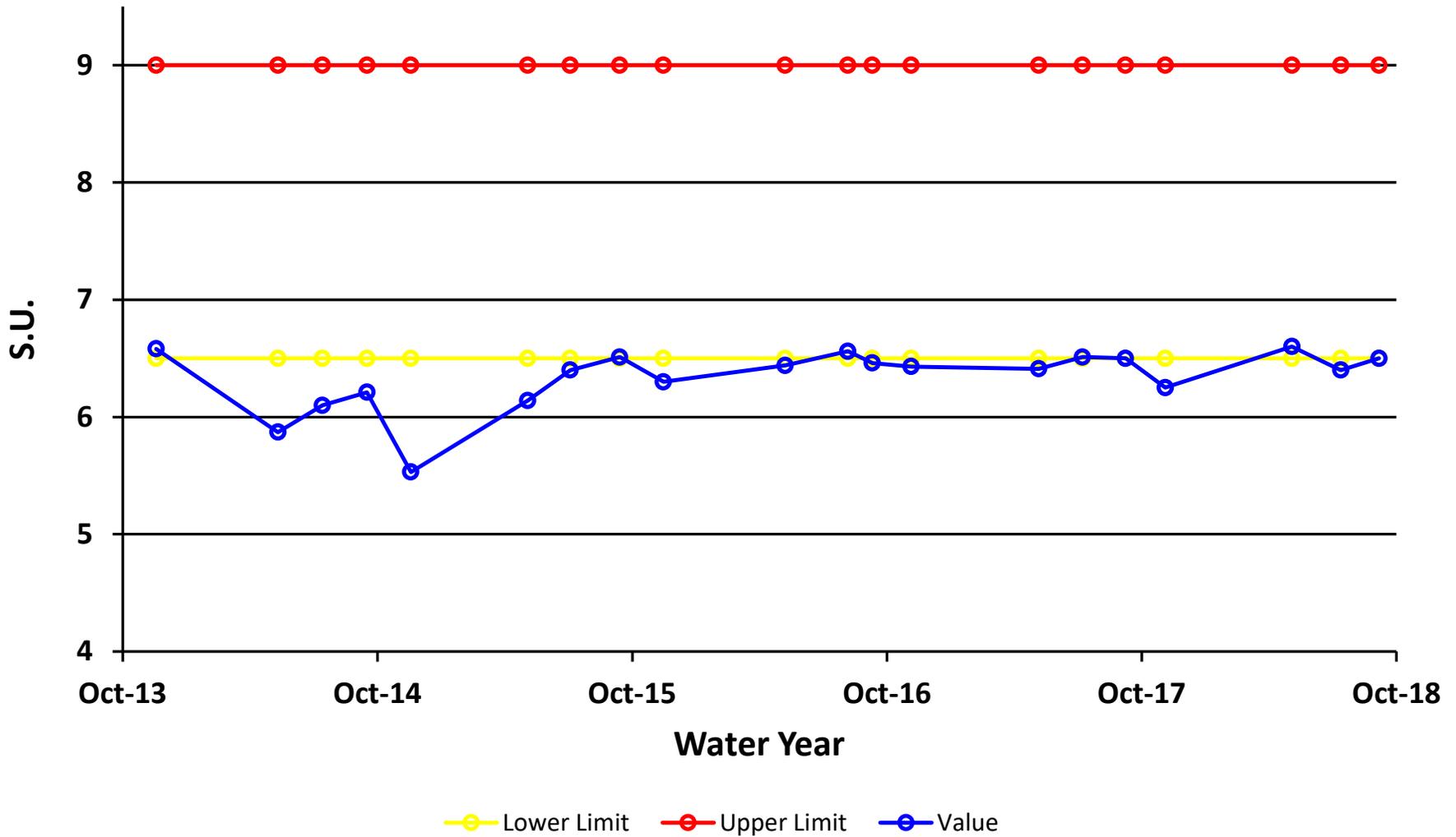
Site 27 - Conductivity Field



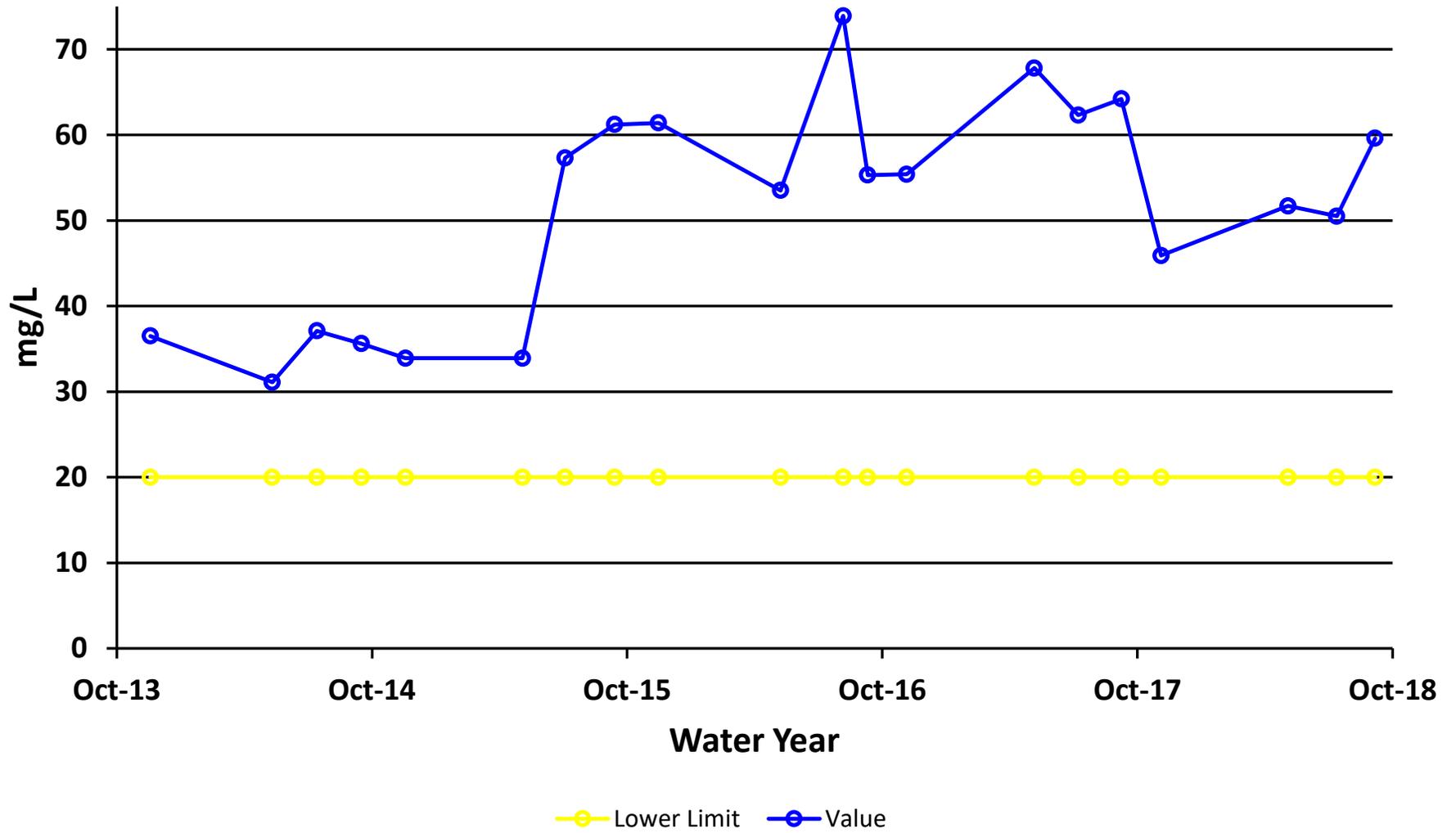
Site 27 - pH Laboratory



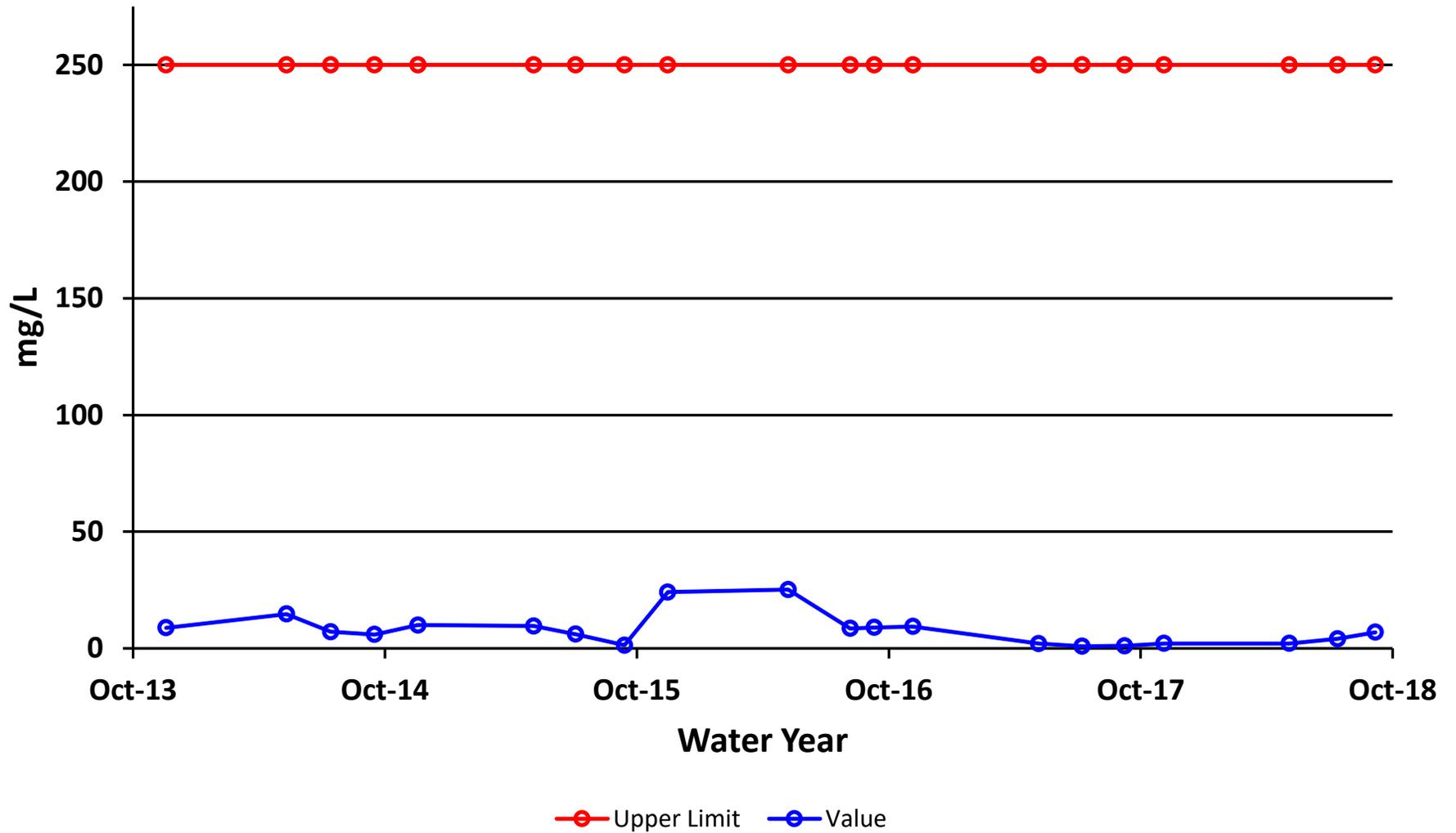
Site 27 - pH Field



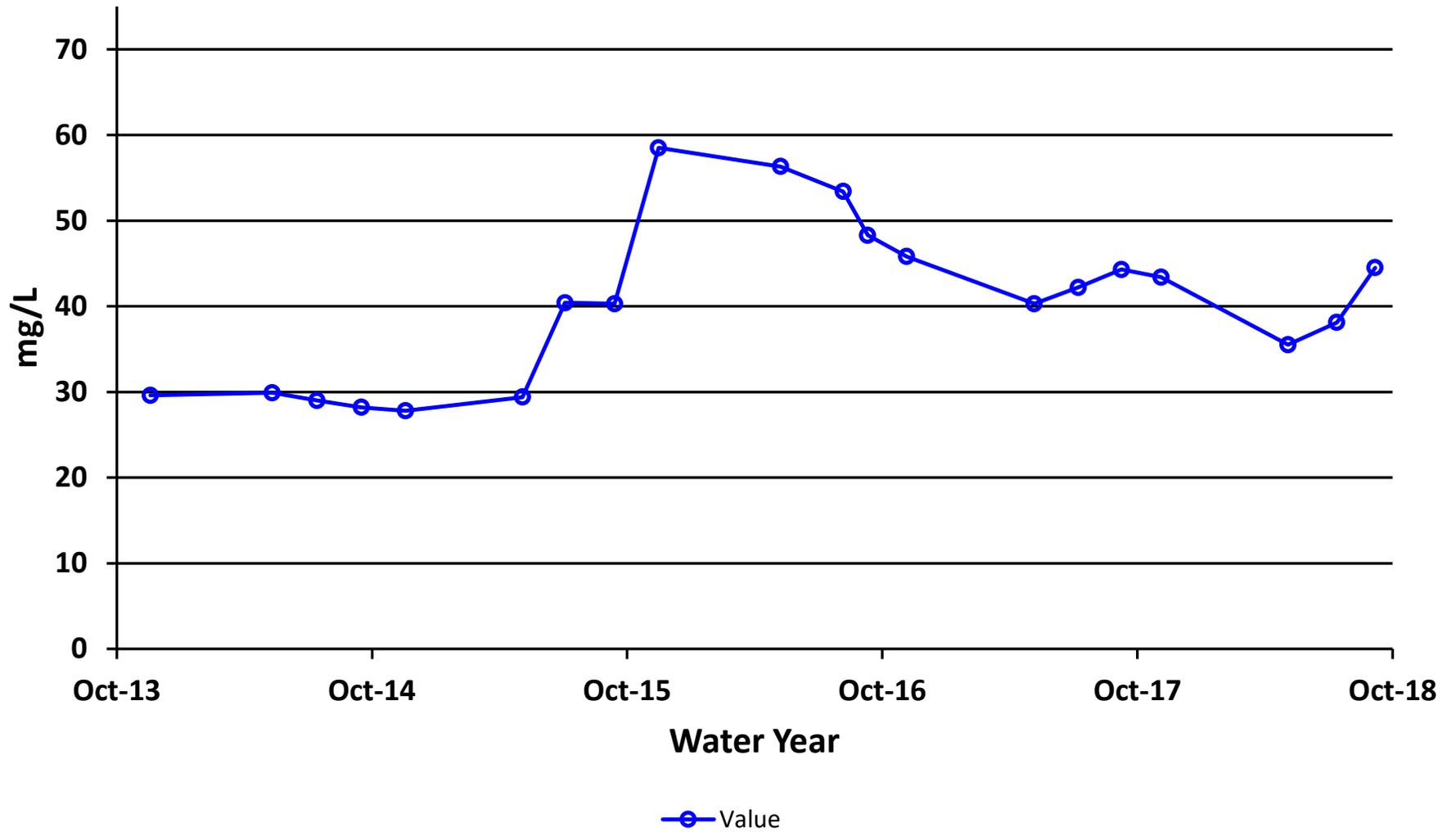
Site 27 - Alkalinity



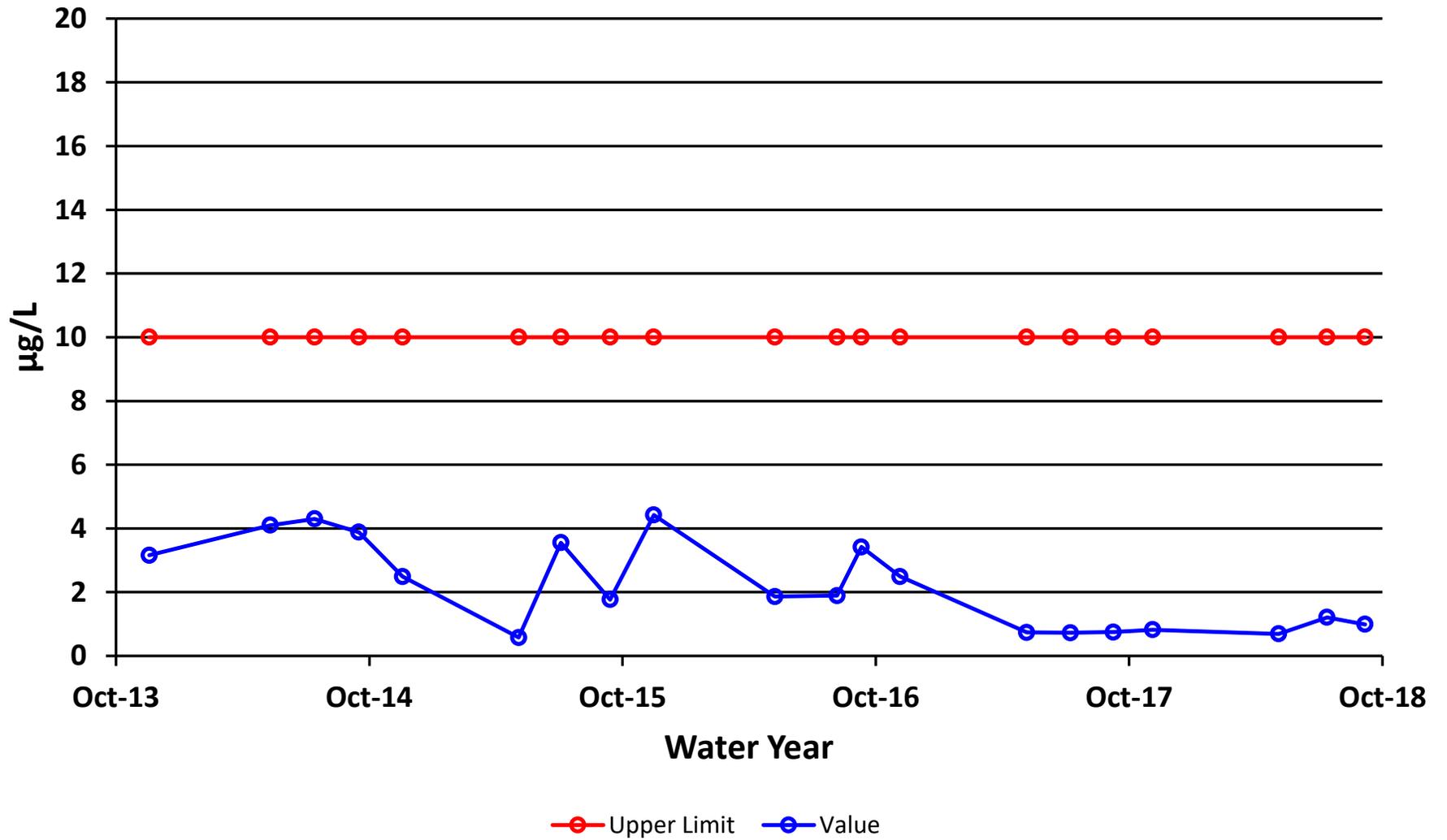
Site 27 - Sulfate



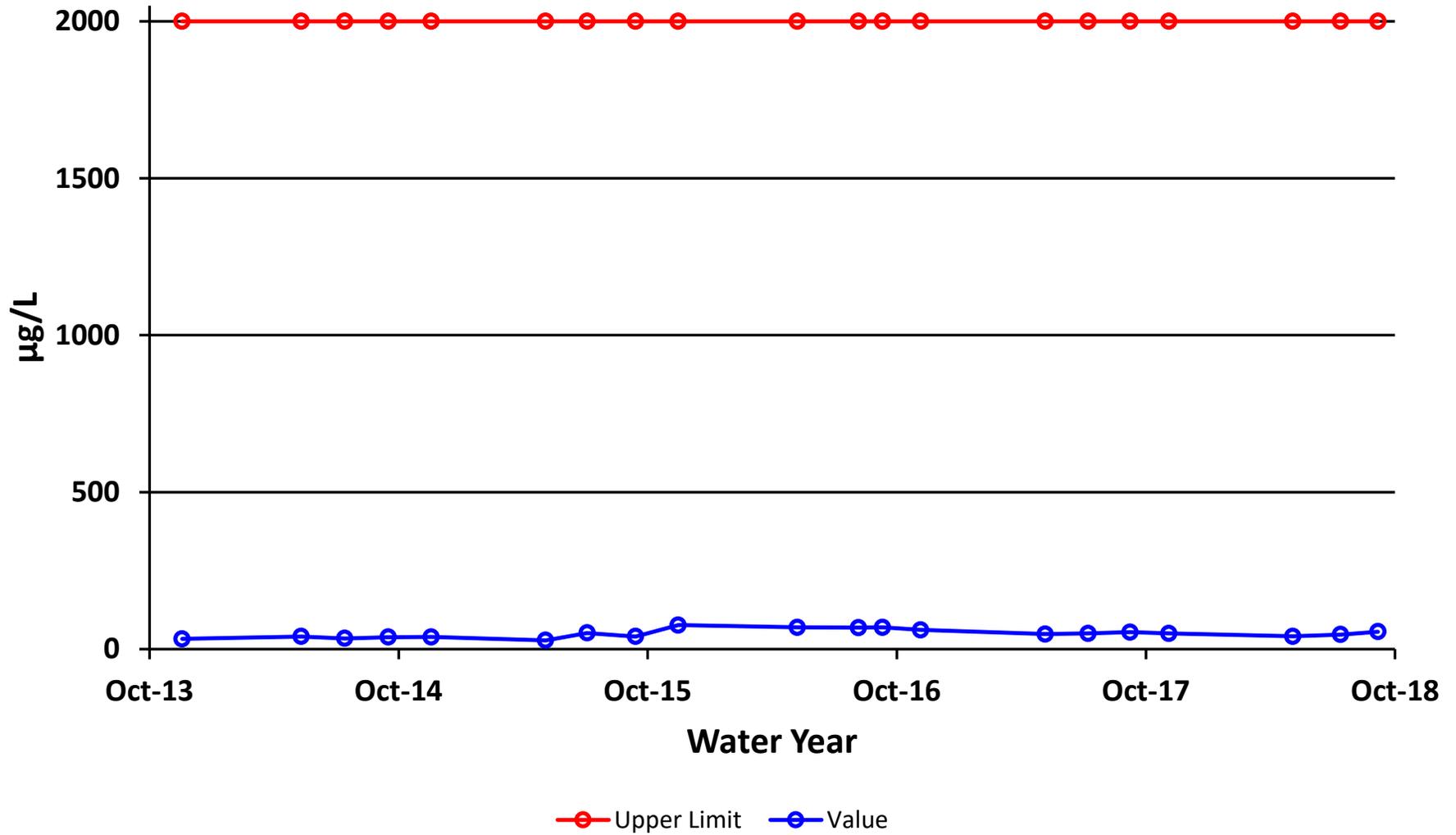
Site 27 - Hardness



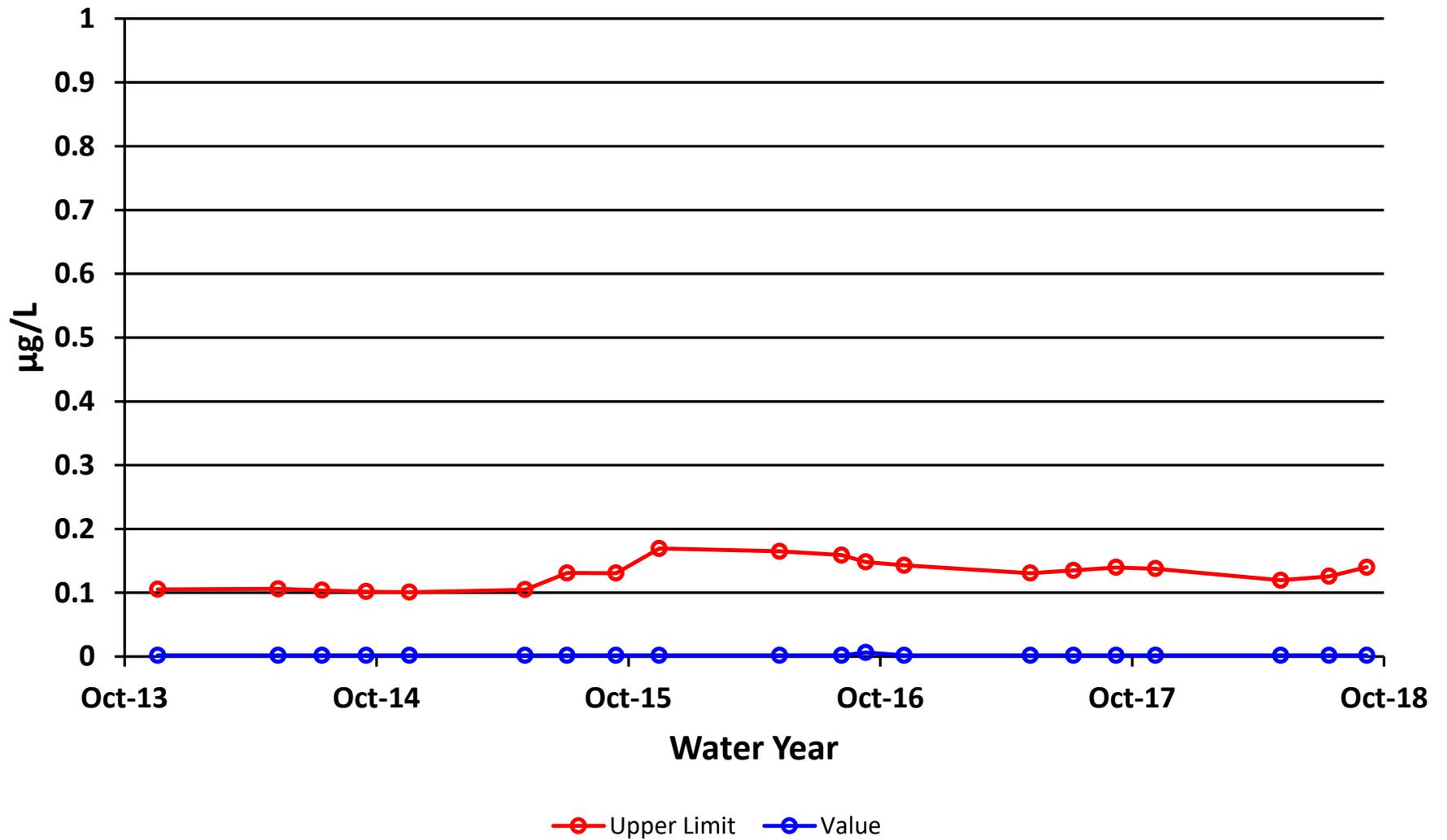
Site 27 - Arsenic Dissolved



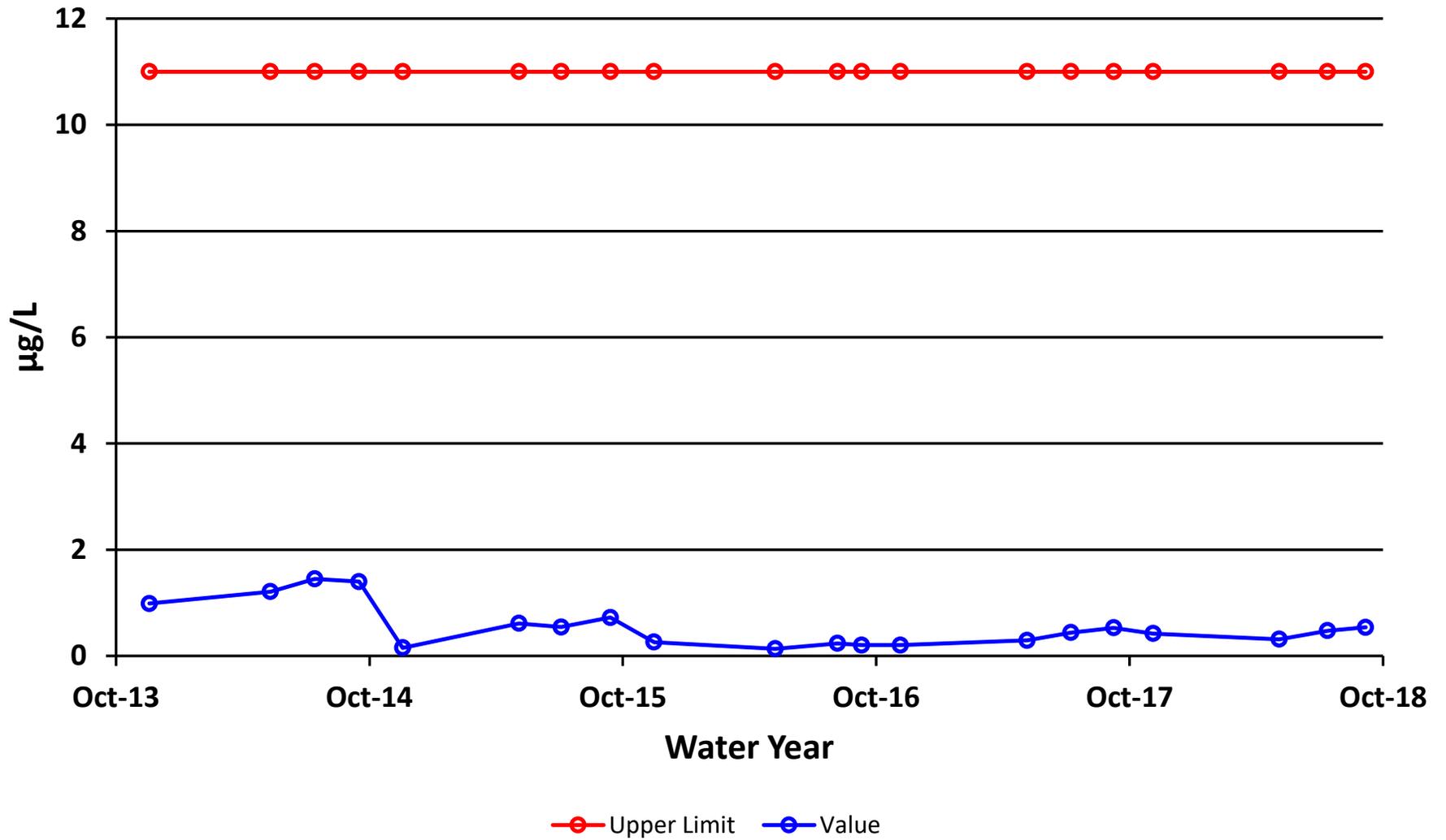
Site 27 - Barium Dissolved



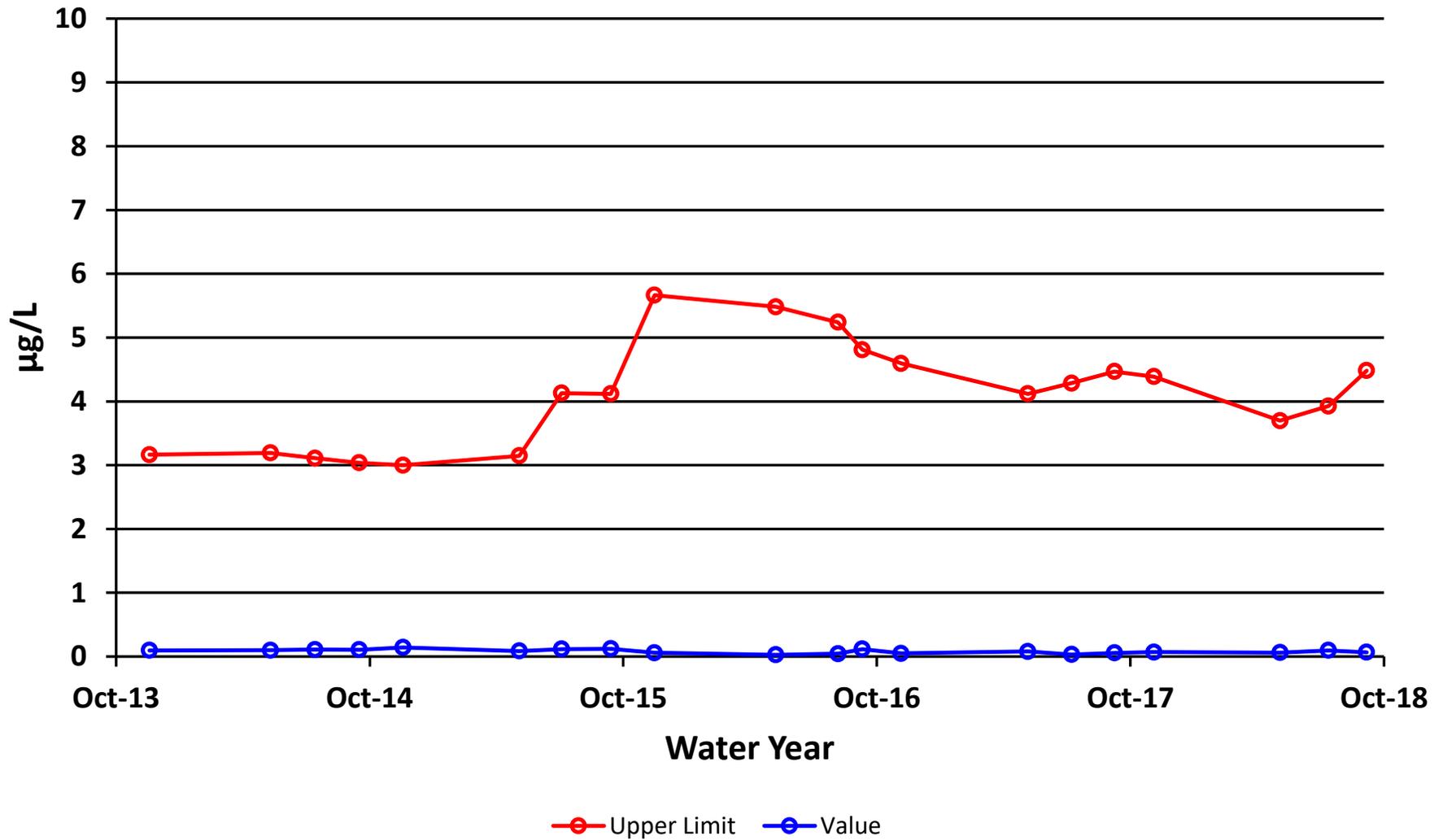
Site 27 - Cadmium Dissolved



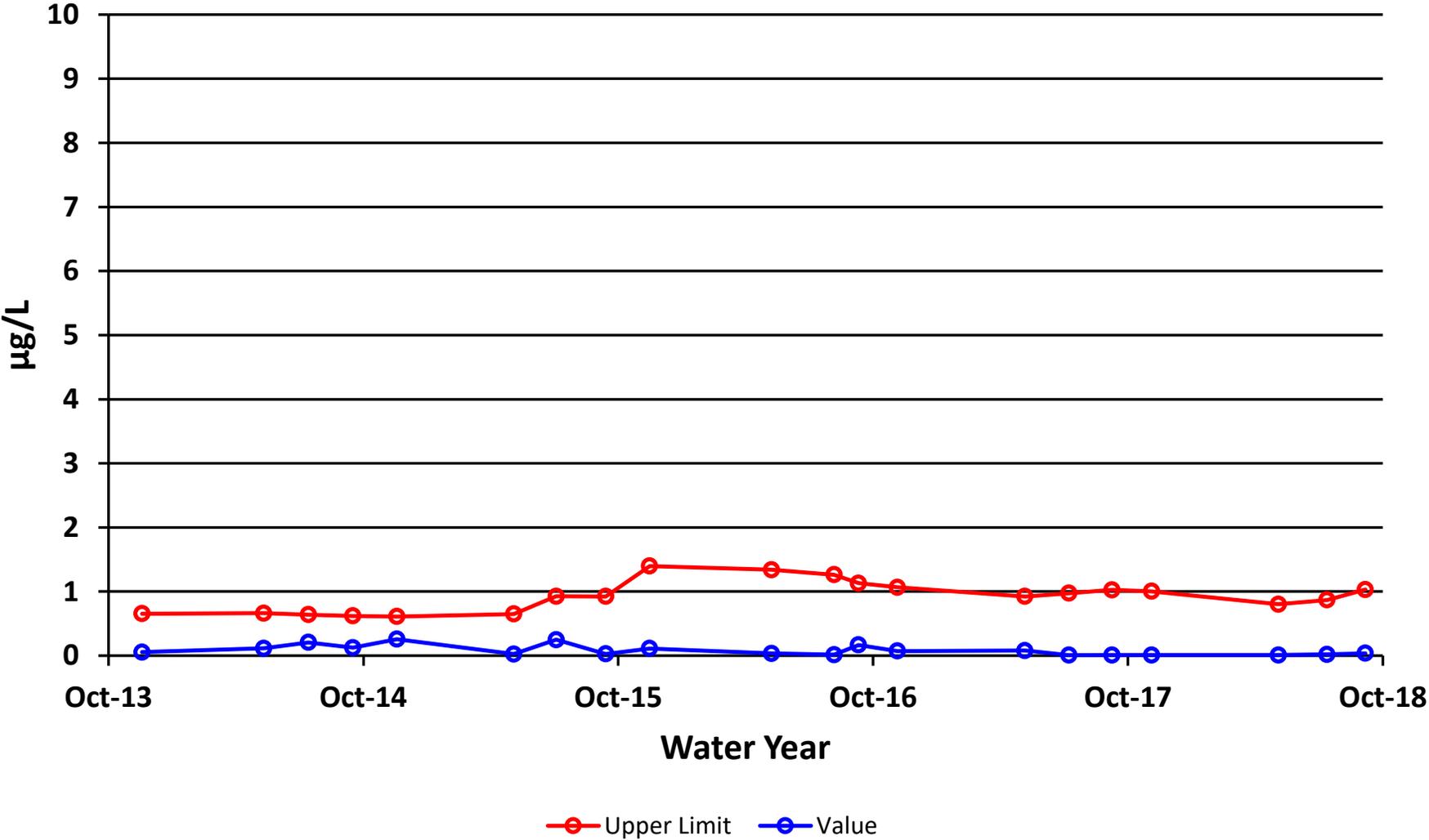
Site 27 - Chromium Dissolved



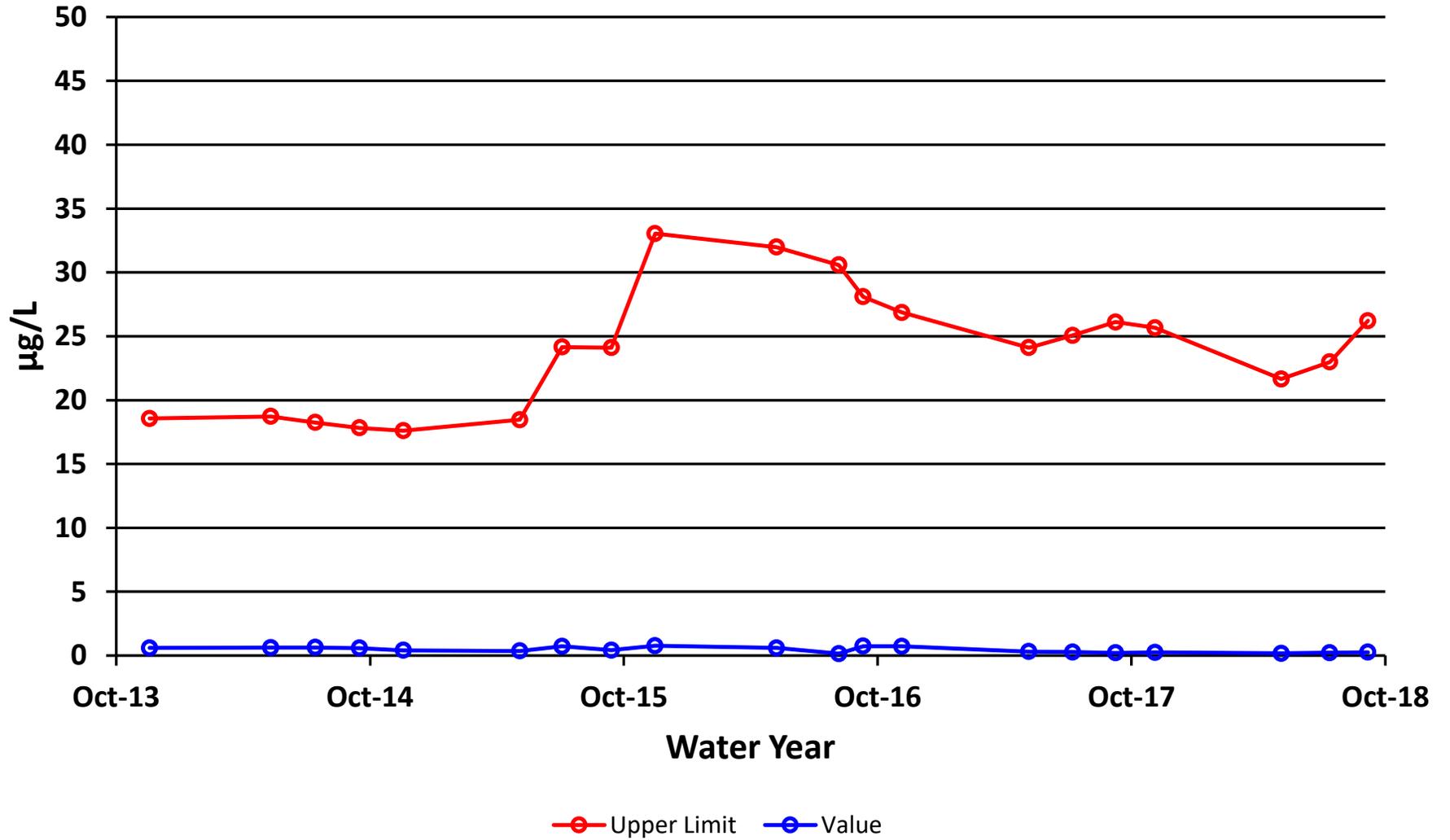
Site 27 - Copper Dissolved



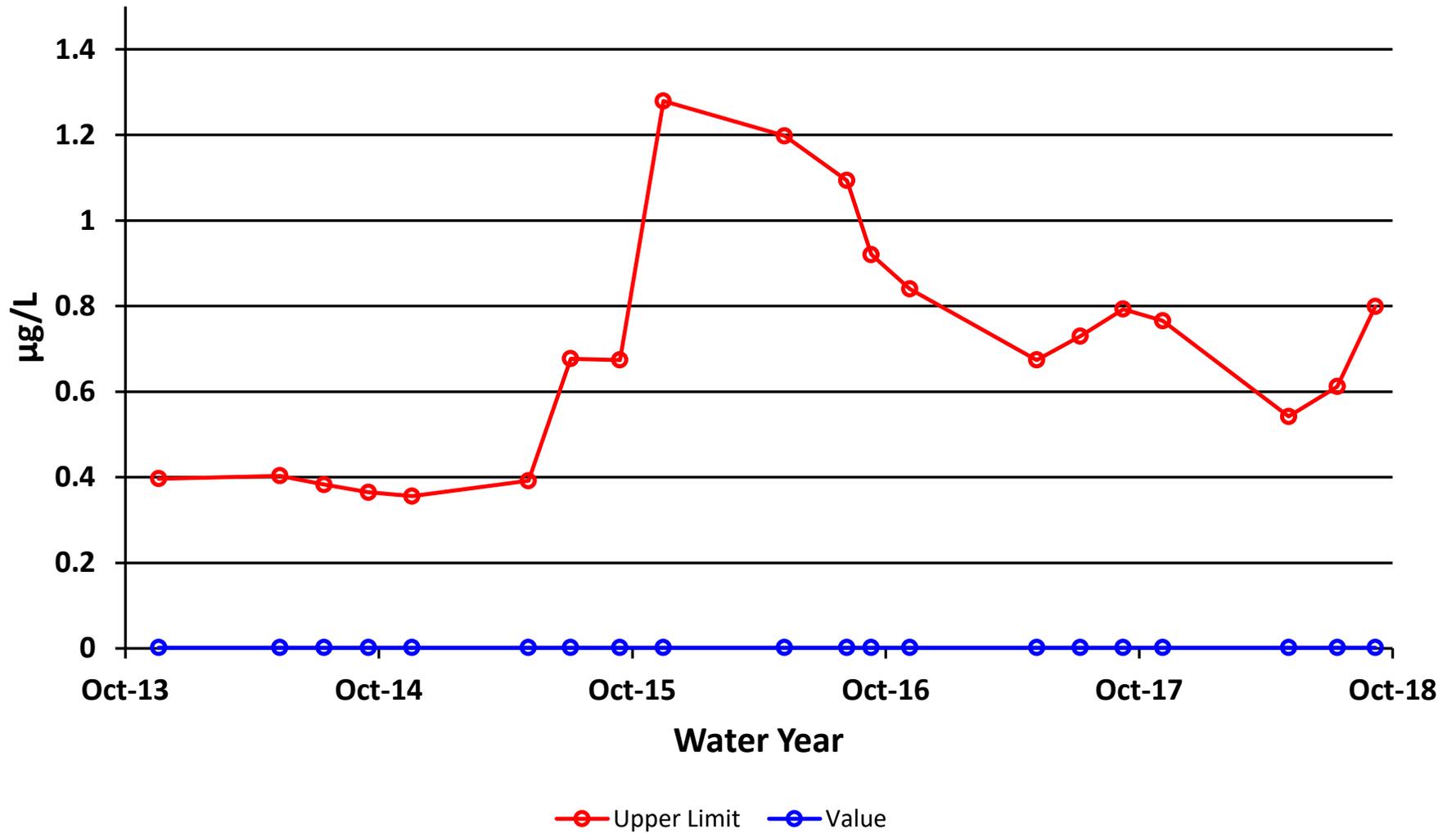
Site 27 - Lead Dissolved



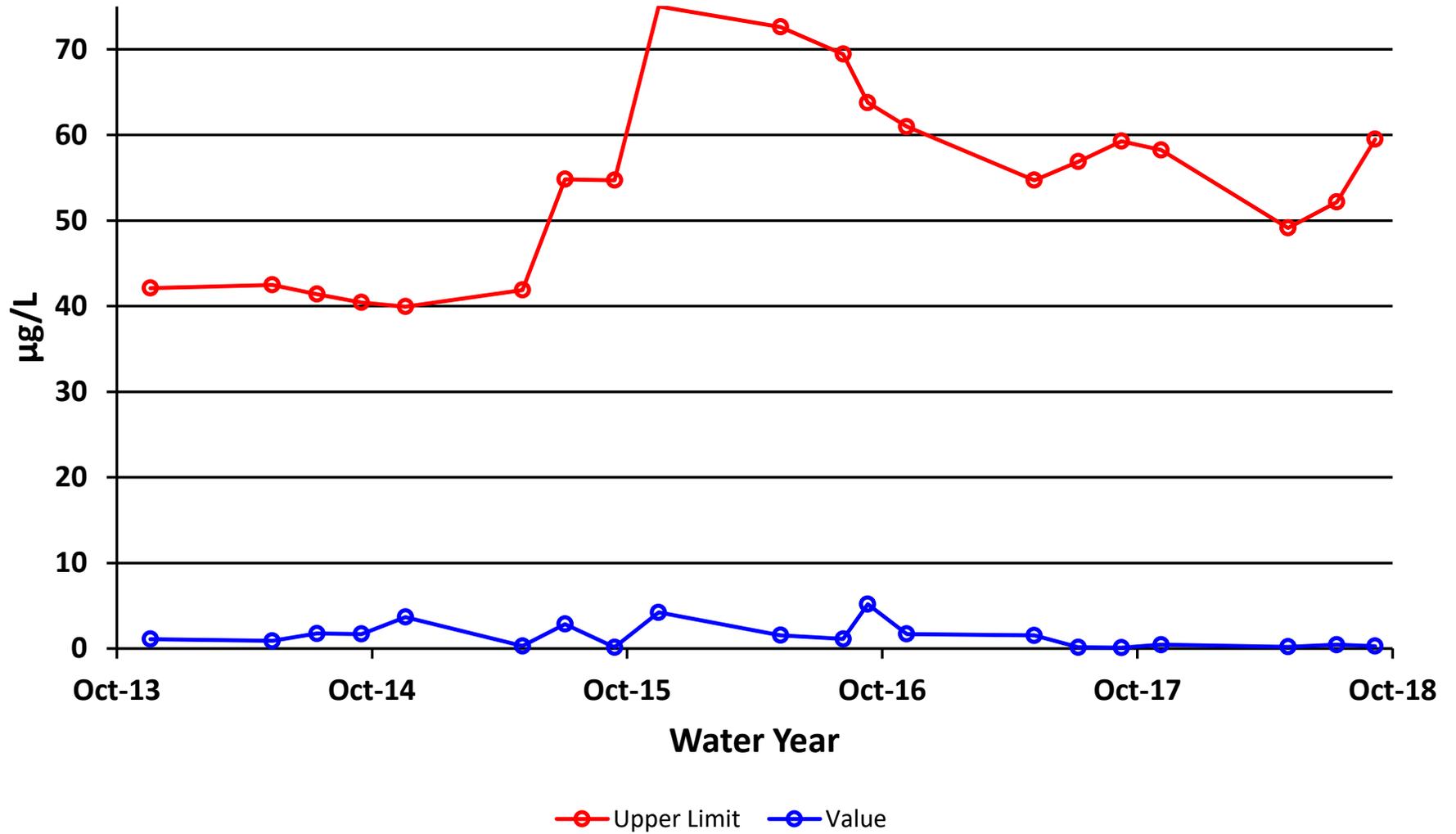
Site 27 - Nickel Dissolved



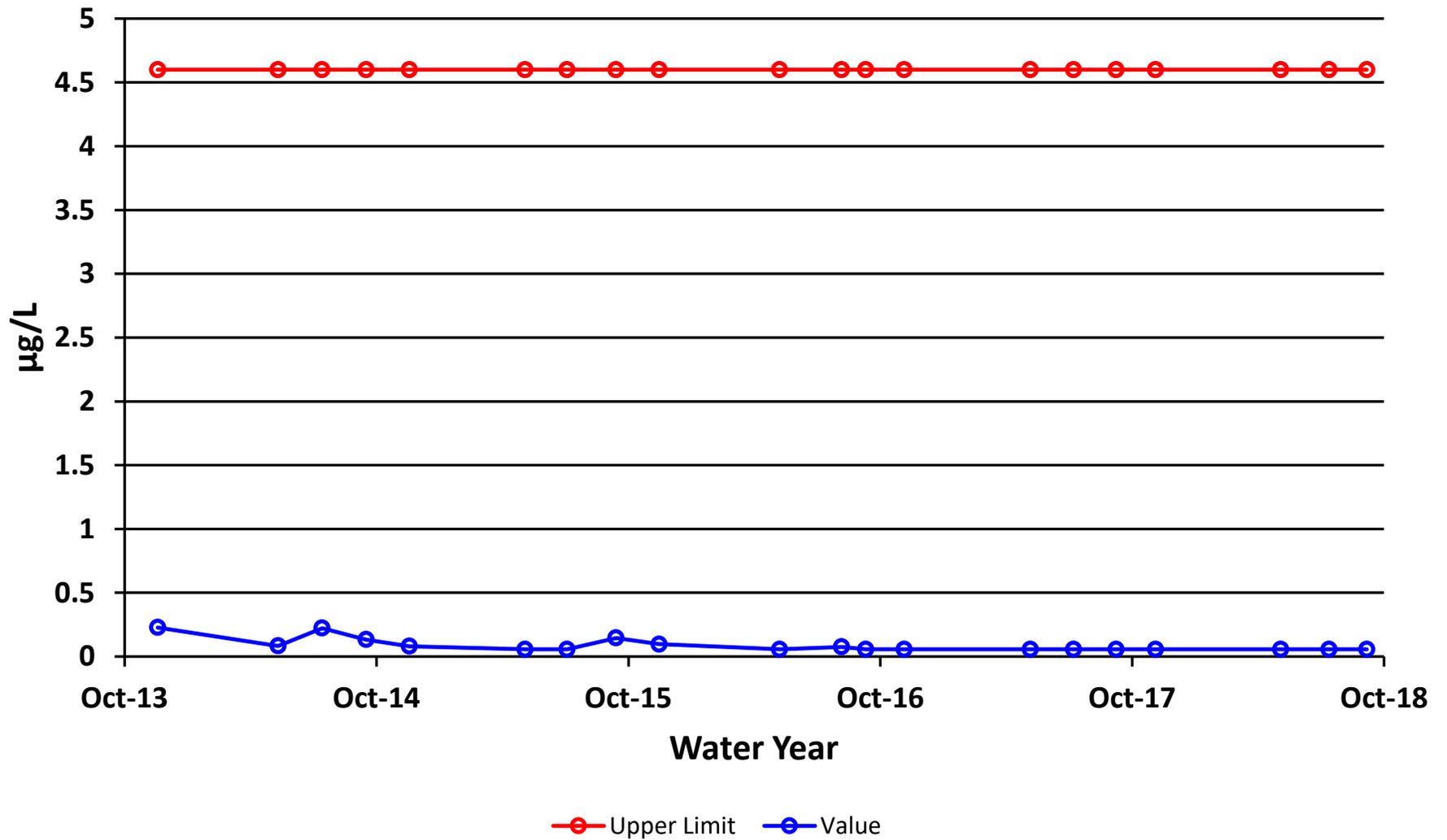
Site 27 - Silver Dissolved



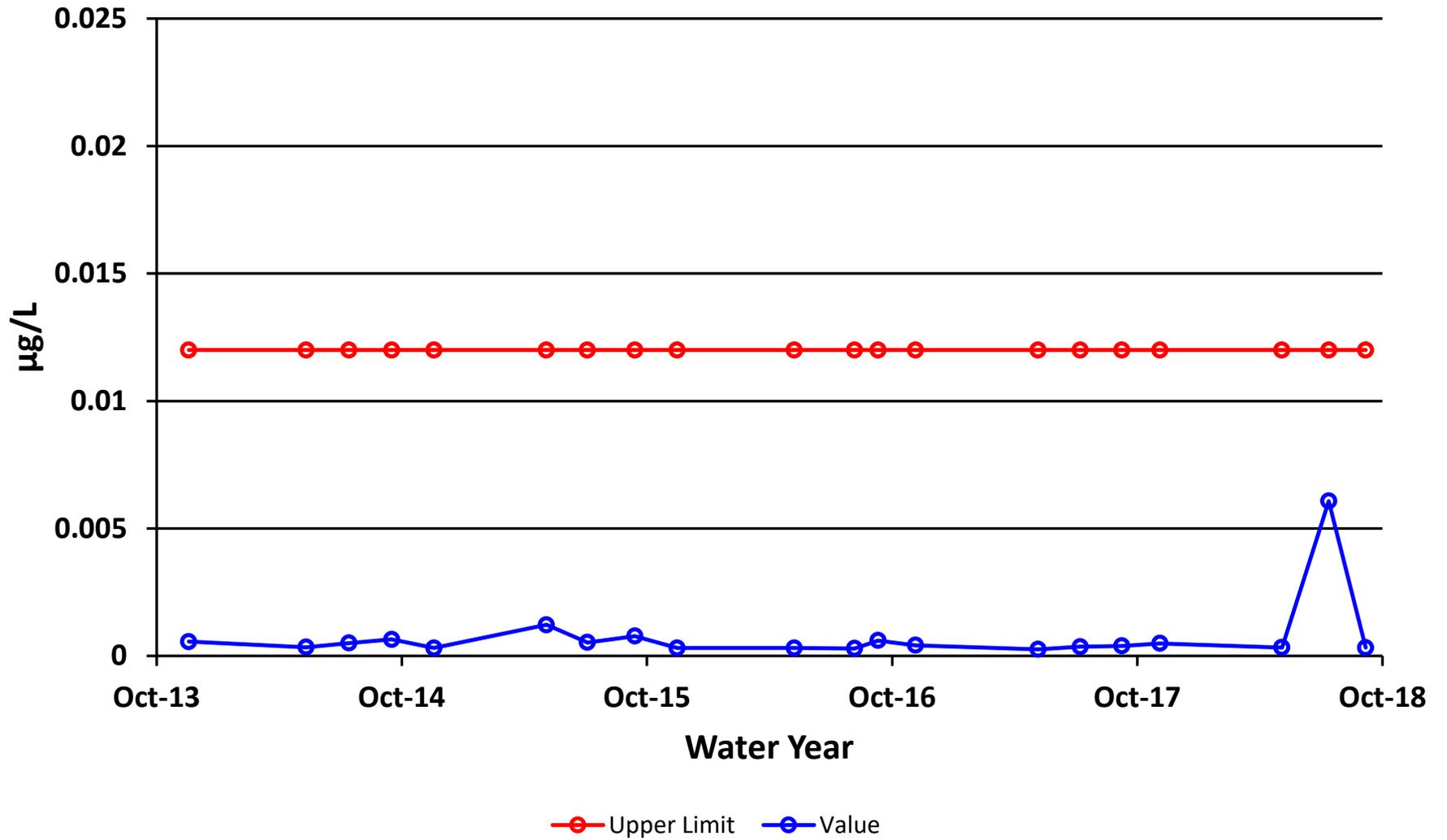
Site 27 - Zinc Dissolved



Site 27 - Selenium Dissolved



Site 27 - Mercury Dissolved



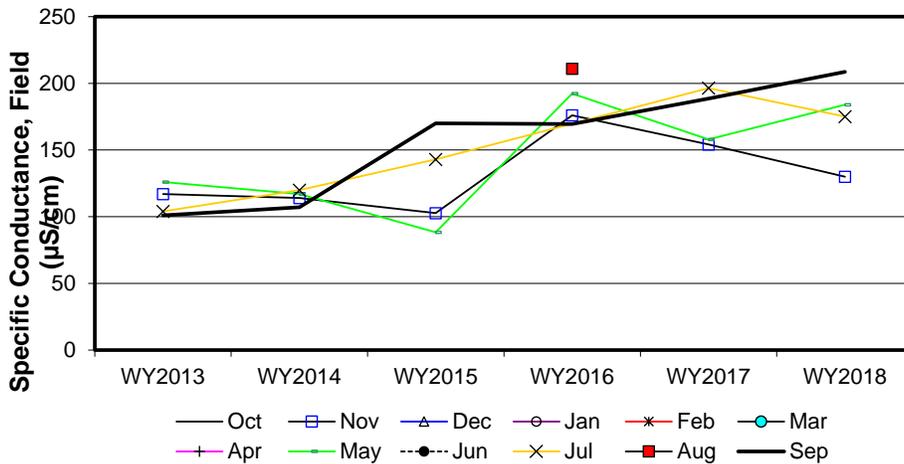
Site #27

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	WY2013		117.0						126.0		104.0		101.0
b	WY2014		114.0						117.0		120.0		107.1
c	WY2015		102.7						88.3		142.9		170.0
d	WY2016		176.0						192.3			211.0	169.5
e	WY2017		154.1						158.0		196.4		188.6
f	WY2018		130.0						183.9		175.0		208.6
n		0	6	0	0	0	0	0	6	0	5	1	6
t ₁		0	6	0	0	0	0	0	6	0	5	1	6
t ₂		0	0	0	0	0	0	0	0	0	0	0	0
t ₃		0	0	0	0	0	0	0	0	0	0	0	0
t ₄		0	0	0	0	0	0	0	0	0	0	0	0
t ₅		0	0	0	0	0	0	0	0	0	0	0	0
b-a			-1						-1		1		1
c-a			-1						-1		1		1
d-a			1						1				1
e-a			1						1		1		1
f-a			1						1		1		1
c-b			-1						-1		1		1
d-b			1						1				1
e-b			1						1		1		1
f-b			1						1		1		1
d-c			1						1				-1
e-c			1						1		1		1
f-c			1						1		1		1
e-d			-1						-1				1
f-d			-1						-1				1
f-e			-1						1		-1		1
S _k		0	3	0	0	0	0	0	5	0	8	0	13
σ _S ² =			28.33						28.33		16.67		28.33
Z _k = S _k /σ _S			0.56						0.94		1.96		2.44
Z _k ²			0.32						0.88		3.84		5.96

ΣZ _k =	5.90	Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅	Σn	24
ΣZ _k ² =	11.00	Count	24	0	0	0	0	ΣS _k	29
Z-bar=ΣZ _k /K=	1.48								

χ _n ² =ΣZ _k ² -K(Z-bar) ² =	2.29	@α=5% χ _(K-1) ² =	7.81	Test for station homogeneity	
p	0.515			χ _n ² <χ _(K-1) ²	ACCEPT
ΣVAR(S _k)	Z _{calc} 2.78	@α/2=2.5% Z=	1.96	H ₀ (No trend)	REJECT
101.67	p 0.997			H _A (± trend)	ACCEPT



Seasonal-Kendall Slope Confidence Intervals			
α	Lower Limit	Sen's Slope	Upper Limit
0.010	5.62		22.95
0.050	9.28		21.82
0.100	10.73	16.00	19.99
0.200	13.00		19.52
		10.8%	

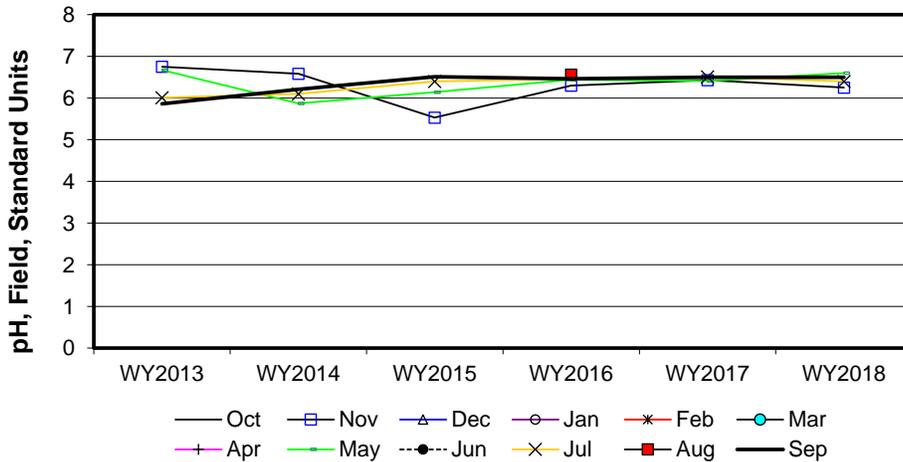
Site #27

Seasonal Kendall analysis for pH, Field, Standard Units

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	WY2013		6.8						6.7		6.0		5.9
b	WY2014		6.6						5.9		6.1		6.2
c	WY2015		5.5						6.1		6.4		6.5
d	WY2016		6.3						6.4			6.6	6.5
e	WY2017		6.4						6.4		6.5		6.5
f	WY2018		6.3						6.6		6.4		6.5
n		0	6	0	0	0	0	0	6	0	5	1	6
t ₁		0	6	0	0	0	0	0	6	0	3	1	4
t ₂		0	0	0	0	0	0	0	0	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
b-a			-1						-1		1		1
c-a			-1						-1		1		1
d-a			-1						-1				1
e-a			-1						-1		1		1
f-a			-1						-1		1		1
c-b			-1						1		1		1
d-b			-1						1				1
e-b			-1						1		1		1
f-b			-1						1		1		1
d-c			1						1				-1
e-c			1						1		1		-1
f-c			1						1		0		-1
e-d			1						-1				1
f-d			-1						1				1
f-e			-1						1		-1		0
S _k		0	-7	0	0	0	0	0	3	0	7	0	8
σ _S ² =			28.33						28.33		15.67		27.33
Z _k = S _k /σ _S			-1.32						0.56		1.77		1.53
Z _k ²			1.73						0.32		3.13		2.34

ΣZ _k =	2.55	Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅	Σn	24
ΣZ _k ² =	7.52	Count	20	2	0	0	0	ΣS _k	11
Z-bar=ΣZ _k /K=	0.64								

χ _h ² =ΣZ _k ² -K(Z-bar) ² =	5.89	@α=5% χ _(K-1) ² =	7.81	Test for station homogeneity
p	0.117			χ _h ² < χ _(K-1) ² ACCEPT
ΣVAR(S _k)	Z _{calc} 1.00	@α/2=2.5% Z=	1.96	H ₀ (No trend) ACCEPT
99.67	p 0.842			H _A (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals			
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.05		0.15
0.050	-0.01	0.08	0.13
0.100	0.00		0.13
0.200	0.01		0.09

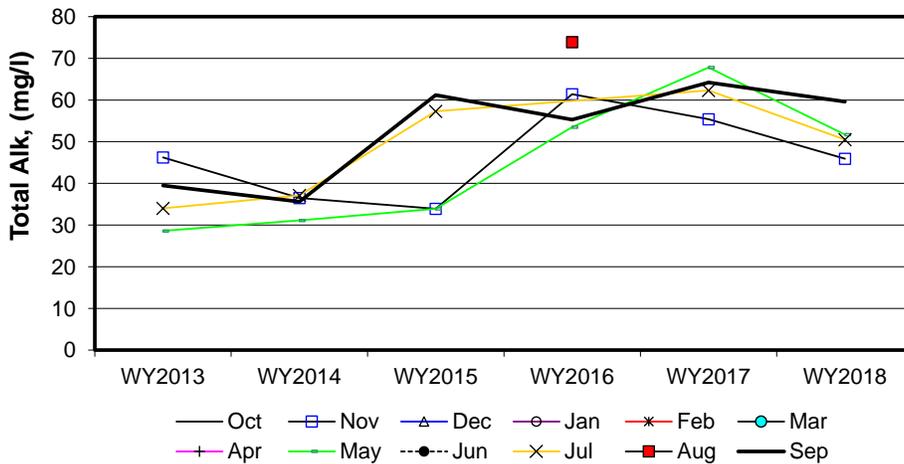
Site #27

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	WY2013		46.2						28.6		34.0		39.5
b	WY2014		36.5						31.1		37.1		35.6
c	WY2015		33.9						33.9		57.3		61.2
d	WY2016		61.4						53.5			73.9	55.3
e	WY2017		55.4						67.8		62.3		64.2
f	WY2018		45.9						51.7		50.5		59.6
n		0	6	0	0	0	0	0	6	0	5	1	6
t ₁		0	6	0	0	0	0	0	6	0	5	1	6
t ₂		0	0	0	0	0	0	0	0	0	0	0	0
t ₃		0	0	0	0	0	0	0	0	0	0	0	0
t ₄		0	0	0	0	0	0	0	0	0	0	0	0
t ₅		0	0	0	0	0	0	0	0	0	0	0	0
b-a			-1						1		1		-1
c-a			-1						1		1		1
d-a			1						1				1
e-a			1						1		1		1
f-a			-1						1		1		1
c-b			-1						1		1		1
d-b			1						1				1
e-b			1						1		1		1
f-b			1						1		1		1
d-c			1						1				-1
e-c			1						1		1		1
f-c			1						1		-1		-1
e-d			-1						1				1
f-d			-1						-1				1
f-e			-1						-1		-1		-1
S _k		0	1	0	0	0	0	0	11	0	6	0	7
σ _S ² =			28.33						28.33		16.67		28.33
Z _k = S _k /σ _S			0.19						2.07		1.47		1.32
Z _k ²			0.04						4.27		2.16		1.73

ΣZ _k =	5.04	Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅	Σn	24
ΣZ _k ² =	8.20	Count	24	0	0	0	0	ΣS _k	25
Z-bar=ΣZ _k /K=	1.26								

χ _h ² =ΣZ _k ² -K(Z-bar) ² =	1.85	@α=5% χ _(K-1) ² =	7.81	Test for station homogeneity	
p	0.605			χ _h ² < χ _(K-1) ²	ACCEPT
ΣVAR(S _k)	Z _{calc} 2.38	@α/2=2.5% Z=	1.96	H ₀ (No trend)	REJECT
101.67	p 0.991			H _A (± trend)	ACCEPT



Seasonal-Kendall Slope Confidence Intervals			
α	Lower Limit	Sen's Slope	Upper Limit
0.010	1.14		8.51
0.050	2.38		6.27
0.100	2.51	4.02	6.00
0.200	2.88		5.24
		7.9%	

Site #27

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

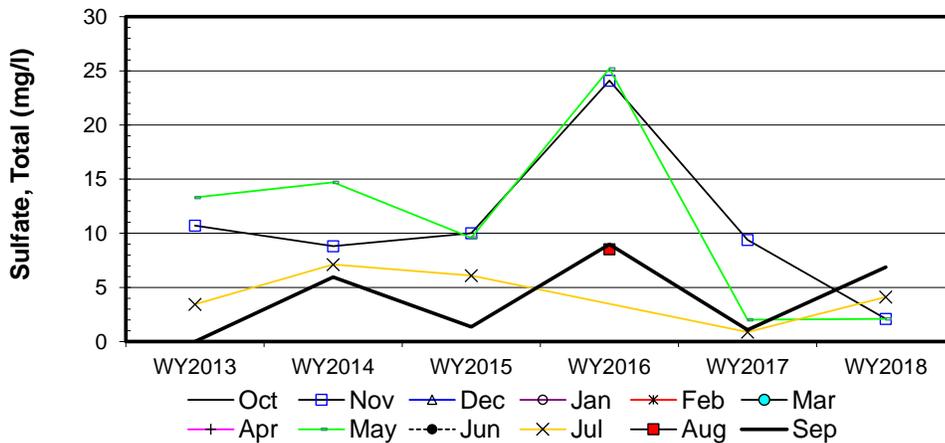
Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	WY2013		10.7						13.3		3.4		0.0
b	WY2014		8.8						14.7		7.1		6.0
c	WY2015		10.0						9.6		6.1		1.4
d	WY2016		24.1						25.2			8.5	9.0
e	WY2017		9.4						2.0		0.9		1.1
f	WY2018		2.1						2.1		4.1		6.9
n		0	6	0	0	0	0	0	6	0	5	1	6
t ₁		0	6	0	0	0	0	0	6	0	5	1	6
t ₂		0	0	0	0	0	0	0	0	0	0	0	0
t ₃		0	0	0	0	0	0	0	0	0	0	0	0
t ₄		0	0	0	0	0	0	0	0	0	0	0	0
t ₅		0	0	0	0	0	0	0	0	0	0	0	0
b-a			-1						1		1		1
c-a			-1						-1		1		1
d-a			1						1				1
e-a			-1						-1		-1		1
f-a			-1						-1		1		1
c-b			1						-1		-1		-1
d-b			1						1				1
e-b			1						-1		-1		-1
f-b			-1						-1		-1		1
d-c			1						1				1
e-c			-1						-1		-1		-1
f-c			-1						-1		-1		1
e-d			-1						-1				-1
f-d			-1						-1				-1
f-e			-1						1		1		1
S _k		0	-5	0	0	0	0	0	-5	0	-2	0	5
σ _s ² =			28.33						28.33		16.67		28.33
Z _k = S _k /σ _s			-0.94						-0.94		-0.49		0.94
Z _k ²			0.88						0.88		0.24		0.88

ΣZ_k= -1.43
 ΣZ_k²= 2.89
 Z-bar=ΣZ_k/K= -0.36

Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅
Count	24	0	0	0	0

Σn = 24
 ΣS_k = -7

χ _n ² =ΣZ _k ² -K(Z-bar) ² =	2.38	@α=5% χ _(K-1) ² =	7.81	Test for station homogeneity
p	0.498	χ _n ² <χ _(K-1) ²		ACCEPT
ΣVAR(S _k)	Z _{calc} -0.60	@α=2.5% Z=	1.96	H ₀ (No trend) ACCEPT
101.67	p 0.276			H _A (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals			
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-2.30		1.34
0.050	-1.83	-0.35	0.26
0.100	-1.68		0.19
0.200	-1.04		0.02

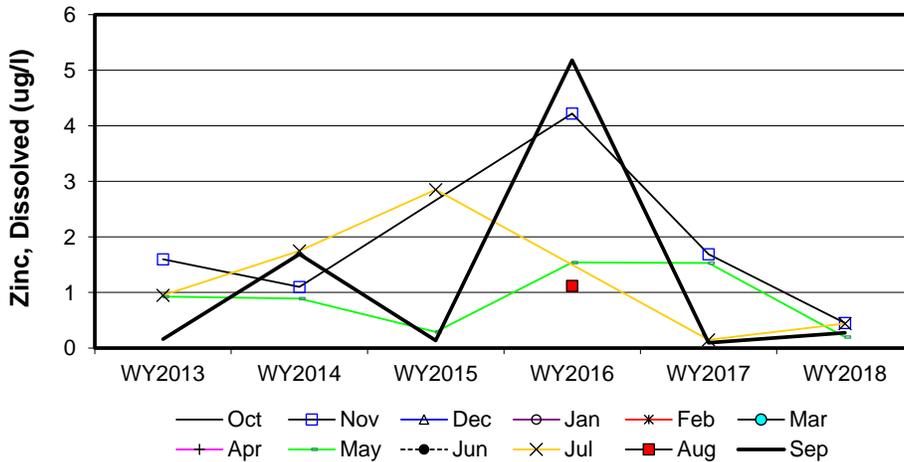
Site #27

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	WY2013		1.6						0.9		1.0		0.2
b	WY2014		1.1						0.9		1.8		1.7
c	WY2015								0.3		2.9		0.1
d	WY2016		4.2						1.5			1.1	5.2
e	WY2017		1.7						1.5		0.1		0.1
f	WY2018		0.5						0.2		0.4		0.3
n		0	5	0	0	0	0	0	6	0	5	1	6
t ₁		0	5	0	0	0	0	0	6	0	5	1	6
t ₂		0	0	0	0	0	0	0	0	0	0	0	0
t ₃		0	0	0	0	0	0	0	0	0	0	0	0
t ₄		0	0	0	0	0	0	0	0	0	0	0	0
t ₅		0	0	0	0	0	0	0	0	0	0	0	0
b-a			-1						-1		1		1
c-a									-1		1		-1
d-a			1						1				1
e-a			1						1		-1		-1
f-a			-1						-1		-1		1
c-b									-1		1		-1
d-b			1						1				1
e-b			1						1		-1		-1
f-b			-1						-1		-1		-1
d-c									1				1
e-c									1		-1		-1
f-c									-1		-1		1
e-d			-1						-1				-1
f-d			-1						-1				-1
f-e			-1						-1		1		1
S _k		0	-2	0	0	0	0	0	-3	0	-2	0	-1
σ _S ² =			16.67						28.33		16.67		28.33
Z _k = S _k /σ _S			-0.49						-0.56		-0.49		-0.19
Z _k ²			0.24						0.32		0.24		0.04

ΣZ _k =	-1.73	Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅	Σn	23
ΣZ _k ² =	0.83	Count	23	0	0	0	0	ΣS _k	-8
Z-bar=ΣZ _k /K=	-0.43								

χ _h ² =ΣZ _k ² -K(Z-bar) ² =	0.08	@α=5% χ _(K-1) ² =	7.81	Test for station homogeneity
p	0.994			χ _h ² <χ _(K-1) ² ACCEPT
ΣVAR(S _k)	Z _{calc} -0.74	@α/2=2.5% Z=	1.96	H ₀ (No trend) ACCEPT
90.00	p 0.230			H _A (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals			
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.50		0.20
0.050	-0.30		0.13
0.100	-0.20	-0.03	0.02
0.200	-0.16		-0.01

INTERPRETIVE REPORT

SITE 29

The data collected during the current water year are listed in the following “Table of Results for Water Year 2018” 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 one-half of the for the purpose of median calculation.

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

Sample Date	Parameter	Value	Qualifier	Notes
No outliers, in the past six years, have been identified by HGCMC.				

The data for the current water year 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 2018

Sample Date	Parameter	Value	Limits		Hardness
			Lower	Upper	
7-Nov-17	Alkalinity, Total	7.1 mg/L	20		17.7 mg/L
17-Jul-18	Alkalinity, Total	2.4 mg/L	20		24.2 mg/L
10-Sep-18	Alkalinity, Total	6.4 mg/L	20		22.1 mg/L
7-Nov-17	pH	5.0 su	6.5	9.0	17.7 mg/L
8-May-18	pH	5.04 su	6.5	9.0	24.5 mg/L
17-Jul-18	pH	5.3 su	6.5	9.0	24.2 mg/L
10-Sep-18	pH	4.95 su	6.5	9.0	22.1 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.* Site 27 and 32). Another three exceedances were for total alkalinity below the lower limit of 20 mg/L, also in the historical range recorded for organic rich peat waters.

There were no exceedances for lead during the current water year but lead exceedances have occurred in the past at Site 29. The most probable mechanism for dispersal of the lead, and potentially other metals away from the tailings pile, would be as fugitive tailings dust transported during cold, desiccating winds during winter or due to dust induced by truck traffic during dry summer conditions.

The temporal changes in some analytes (e.g. dissolved lead and zinc) may reflect the changing topography of the tails dry stack facility. After the northwest expansion was completed in 2008 HGCMC commenced to place the majority of the tailings in the northwest region. For a couple of years the northwest area was mostly bowl shaped and below the tree line. Over time this area has been brought up in elevation. With the increase in elevation this area is not as protected from the winds that predominantly prevail from the northeast. Dispersal of fugitive dust from this region would be to the southwest towards Site 29 and Site 32, which likely explains the increase in lead observed during water year 2014. In Water Year 2015 tailings were not placed in the northwest, but primarily in the central and eastern portion of the facility. This would result in less fugitive dust around Site 29 and may explain the lower lead values in the 2015 samples. The northern end of the TDF now has an interim cover that greatly limits the fugitive tailings.

In 2011 HGCMC implemented a biweekly dust monitoring program to support the snow monitoring program. This program has continued into 2018 and the results from this monitoring are summarized in the 2018 Tailings and Waste Rock Annual Report.

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

A non-parametric statistical analysis for trend was performed for specific conductivity, field pH, total alkalinity, total sulfate, and dissolved zinc. Calculation details of the Seasonal Kendall analyses are presented in detail on the pages following this interpretive section. The following table summarizes the results on the data collected between Oct-12 and Sep-18 (WY2013-WY2018).

Site 29 - Table of Summary Statistics for Trend Analysis

Parameter	Mann-Kendall test statistics			Sen's slope estimate	
	n*	p**	Trend	Q	Q(%)
Conductivity Field	6	0.20			
pH Field	6	0.32			
Alkalinity, Total	6	0.11			
Sulfate, Total	6		Inconsistent detection limits		
Zinc, Dissolved	6	0.32			

* Number of Years ** Significance level

No statistically significant trends were found with the trend analysis. Trend analysis was not performed on the total sulfate dataset because of a change in the method detection limit used by the analytical laboratories. A primary assumption of the Mann-Kendall test is "... only one censoring threshold exists. When more than one detection limit exists, the Mann-Kendall test cannot be performed without further censoring the data." In order to prevent this from occurring HGCMC has worked to establish a consistent MDL for sulfate from the laboratory.

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

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

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

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

All three of the parameters examined (Figure 1) eventually went out of control with respects to the chosen baseline data statistics. If the pore/contact water from inside the tailings facility was not contained, the well water would have high conductivity, high dissolved zinc, and high alkalinity. Two of the three charts in Figure 1 have long term decreasing trends; it is dissolved zinc that has periodically had higher values. As previously discussed it is hypothesized that the increase in dissolved zinc results from the accumulation of fugitive dust in the snow pack during

the winter. In the spring when the snow pack melts this material is released as a pulse. Most years the deposited material is not present by the fall sampling. With the implementation of additional best management practices, HGCMC expects to decrease the amount of fugitive dust leaving the tailings disposal facility.

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

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

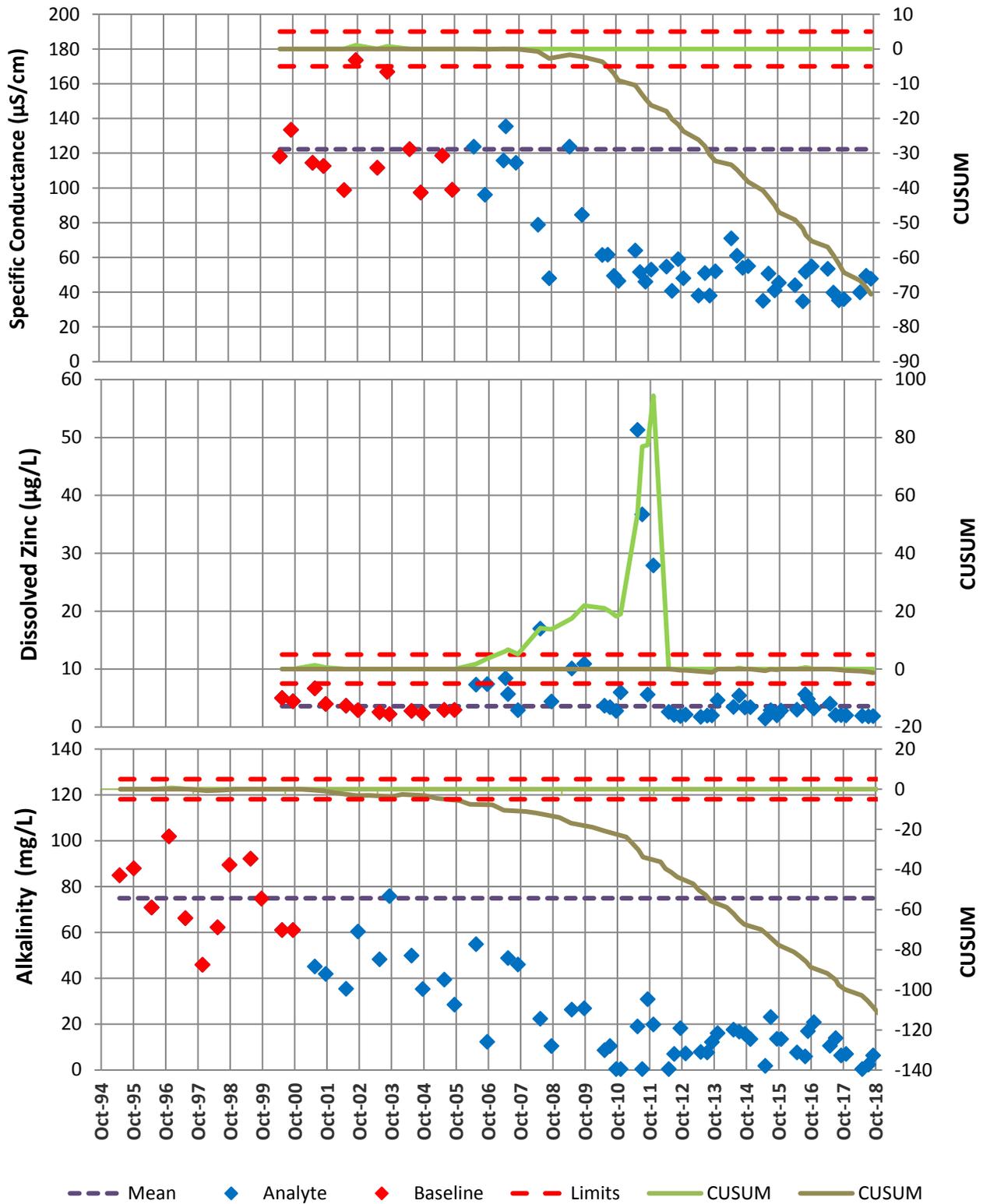


Table of Results for Water Year 2018

Site 029FMG - 'Monitoring Well - 3S'

Sample Date/Parameter	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018	Median
Water Temp (°C)		6.7						6		6.5		6.9	6.6
Conductivity-Field(µmho)		36						40		49.4		47.7	43.9
Conductivity-Lab (µmho)		42						42		50		41	42
pH Lab (standard units)		4.58						4.71		4.62		4.8	4.67
pH Field (standard units)		4.99						5.04		5.26		4.95	5.02
Total Alkalinity (mg/L)		7.1						0.5		2.4		6.4	4.4
Total Sulfate (mg/L)		0.2						0.4				0.2	0.2
Hardness (mg/L)		17.7						24.5		24.2		22.1	23.2
Dissolved As (ug/L)		6.79						8.28		7.84		7.67	7.755
Dissolved Ba (ug/L)		5.3						6.1		6.2		5.9	6.0
Dissolved Cd (ug/L)		0.0018						0.0018		0.0018		0.0018	0.0018
Dissolved Cr (ug/L)		0.588						0.627		0.631		0.614	0.621
Dissolved Cu (ug/L)		0.116						0.14		0.146		0.141	0.141
Dissolved Pb (ug/L)		0.0838						0.103		0.108		0.0869	0.0950
Dissolved Ni (ug/L)		1.05						1.06		1.11		1.07	1.065
Dissolved Ag (ug/L)		0.002						0.002		0.002		0.002	0.002
Dissolved Zn (ug/L)		2.03						1.91		1.84		1.9	1.91
Dissolved Se (ug/L)		0.057						0.057		0.057		0.057	0.057
Dissolved Hg (ug/L)		0.000618						0.000863		0.000757		0.000738	0.000748

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

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

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

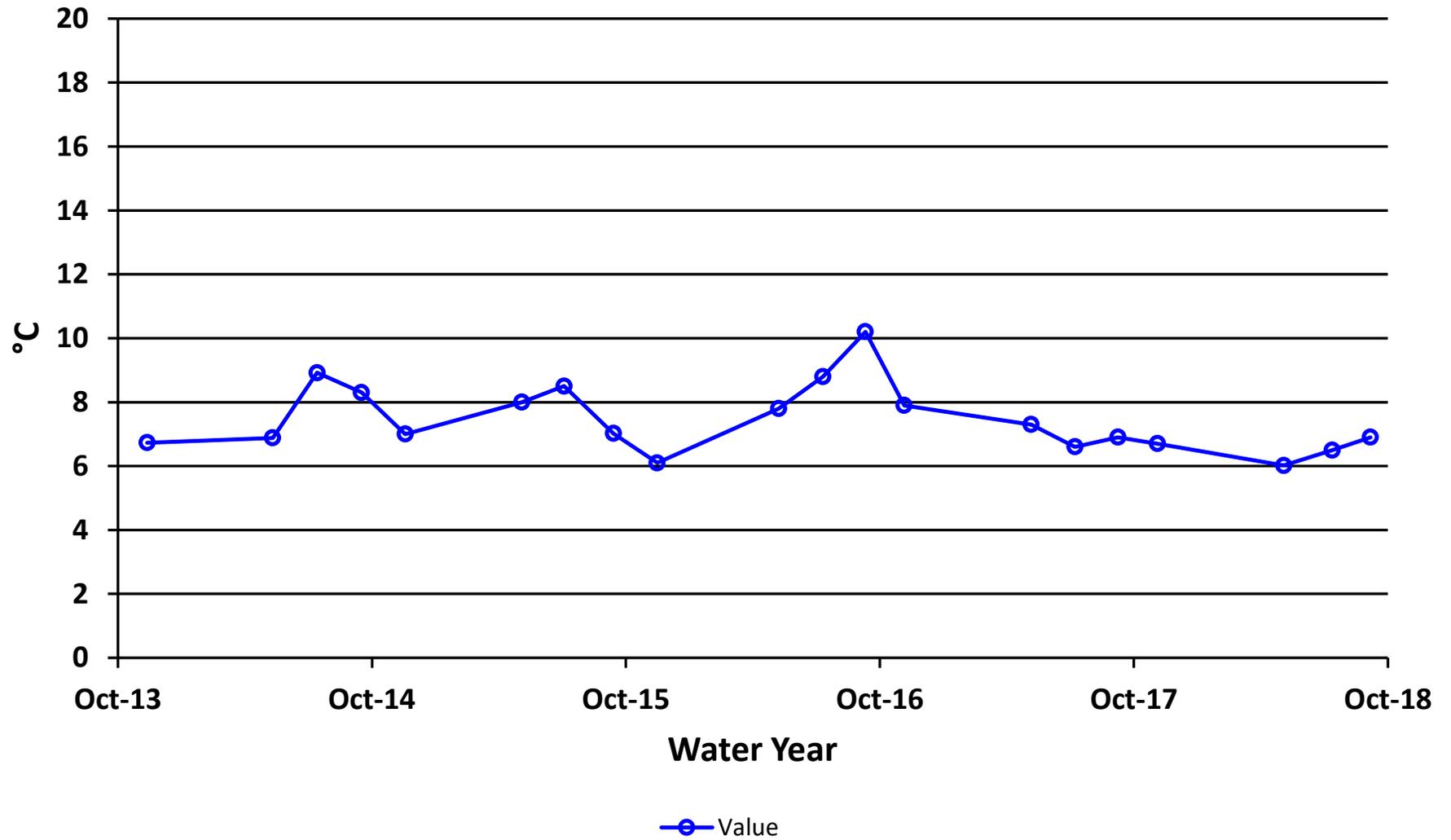
Qualified Data by QA Reviewer

Date Range: 10/01/2017 to 09/30/2018

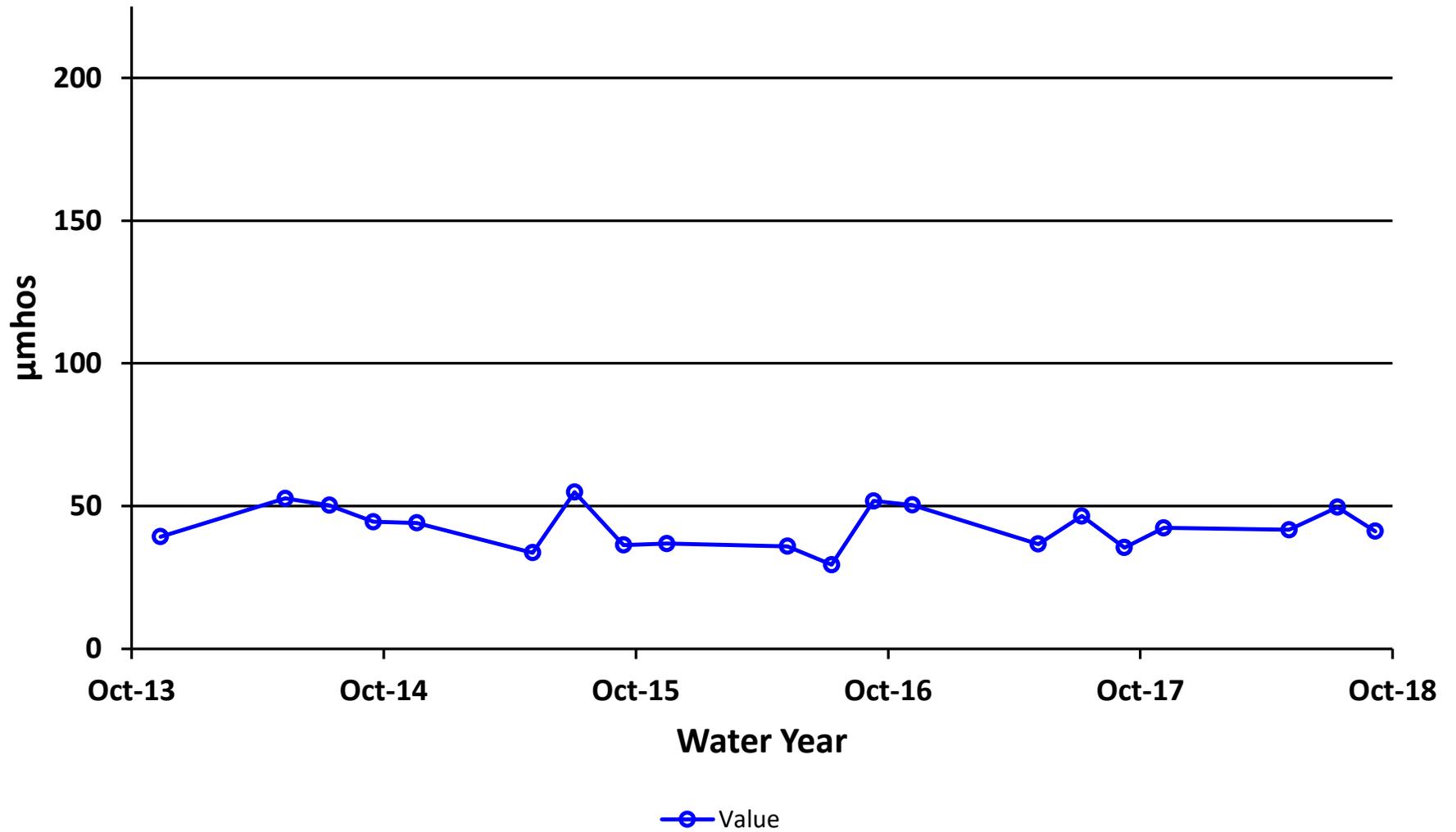
Site No.	Sample Date	Parameter	Value		Qualifier	Reason for Qualifier
029FMG	11/7/2017	Diss. Cu-ICP/MS	0.11	µg/L	U	Field Blank Contamination
	5/8/2018	Diss. Cu-ICP/MS	0.14	µg/L	U	Trip Blank Contamination
Total Sulfate		0.43	mg/L	J	Below Quantitative Range	
7/17/2018	Alkalinity	2.4	mg/L	J	Below Quantitative Range	
	pH	4.62	pH units	J	Hold time Violation	
9/10/2018	Diss. Cu-ICP/MS	0.14	µg/L	U	Field Blank Contamination	
	Diss. Zn-ICP/MS	1.9	µg/L	U	Field Blank Contamination	
	pH	4.8	pH units	J	Hold Time Violation	
	Total Sulfate	-0.4	mg/L	UJ	Sample Receipt Temperature	

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

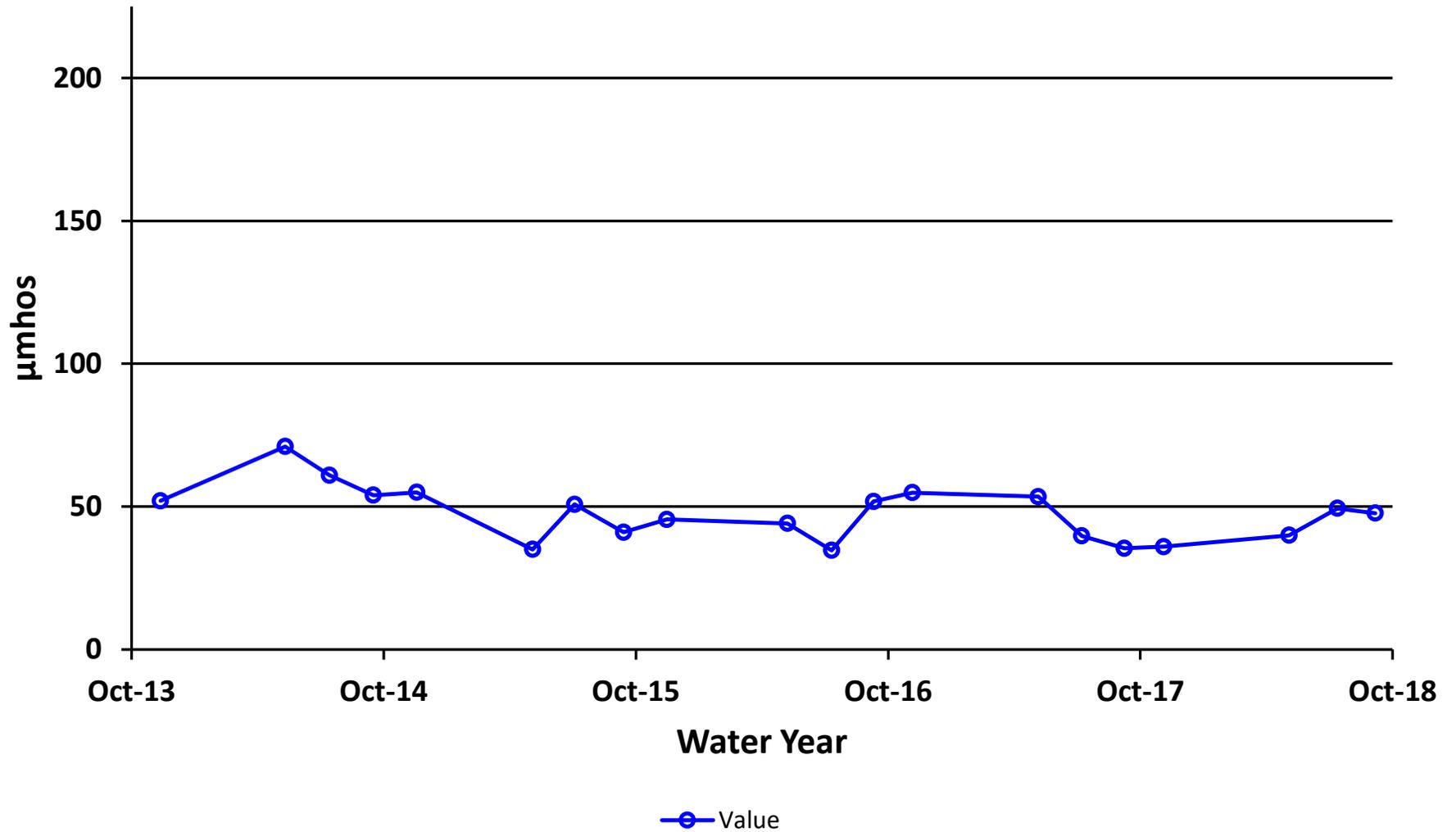
Site 29 - Water Temperature



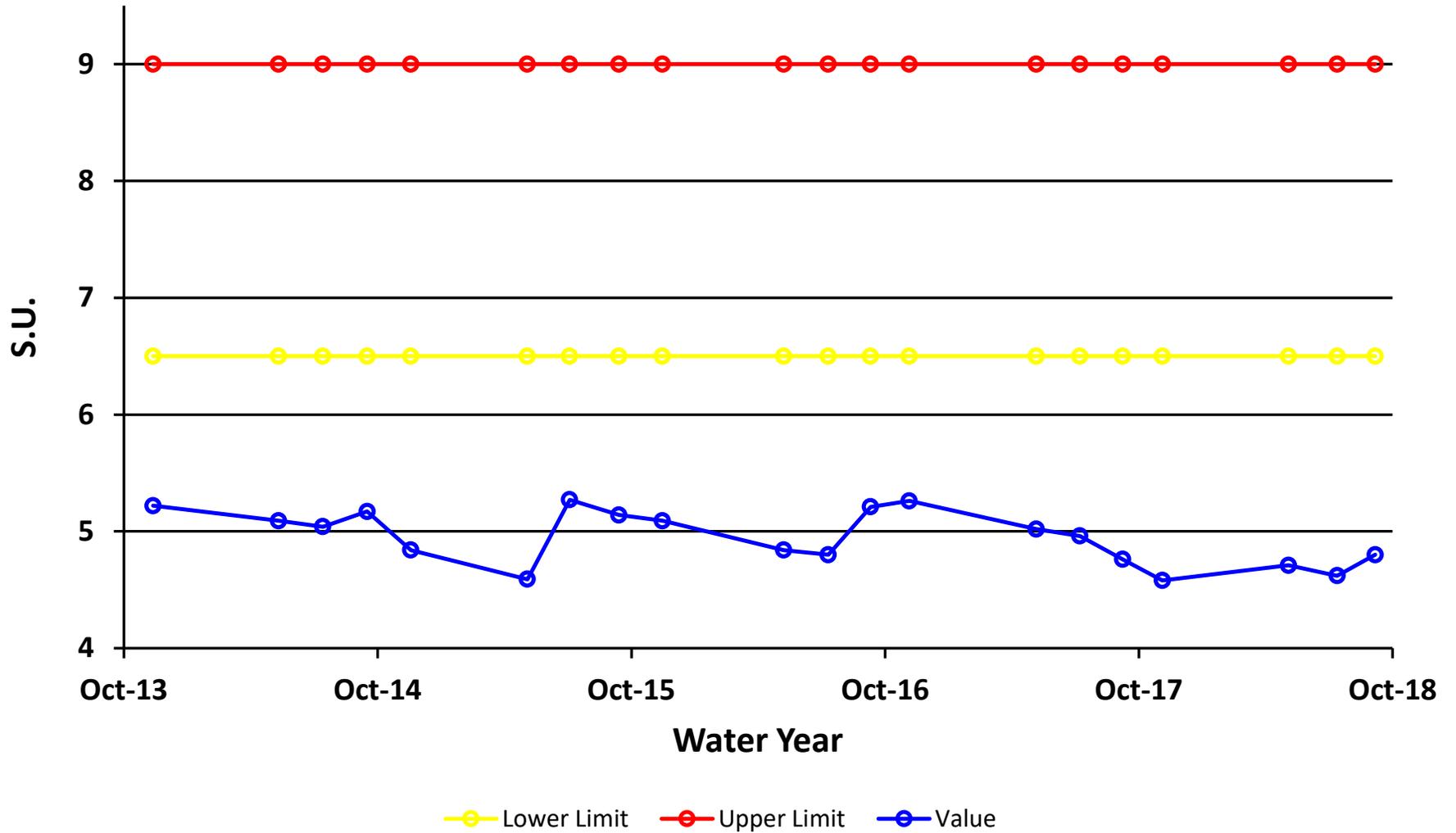
Site 29 - Conductivity Laboratory



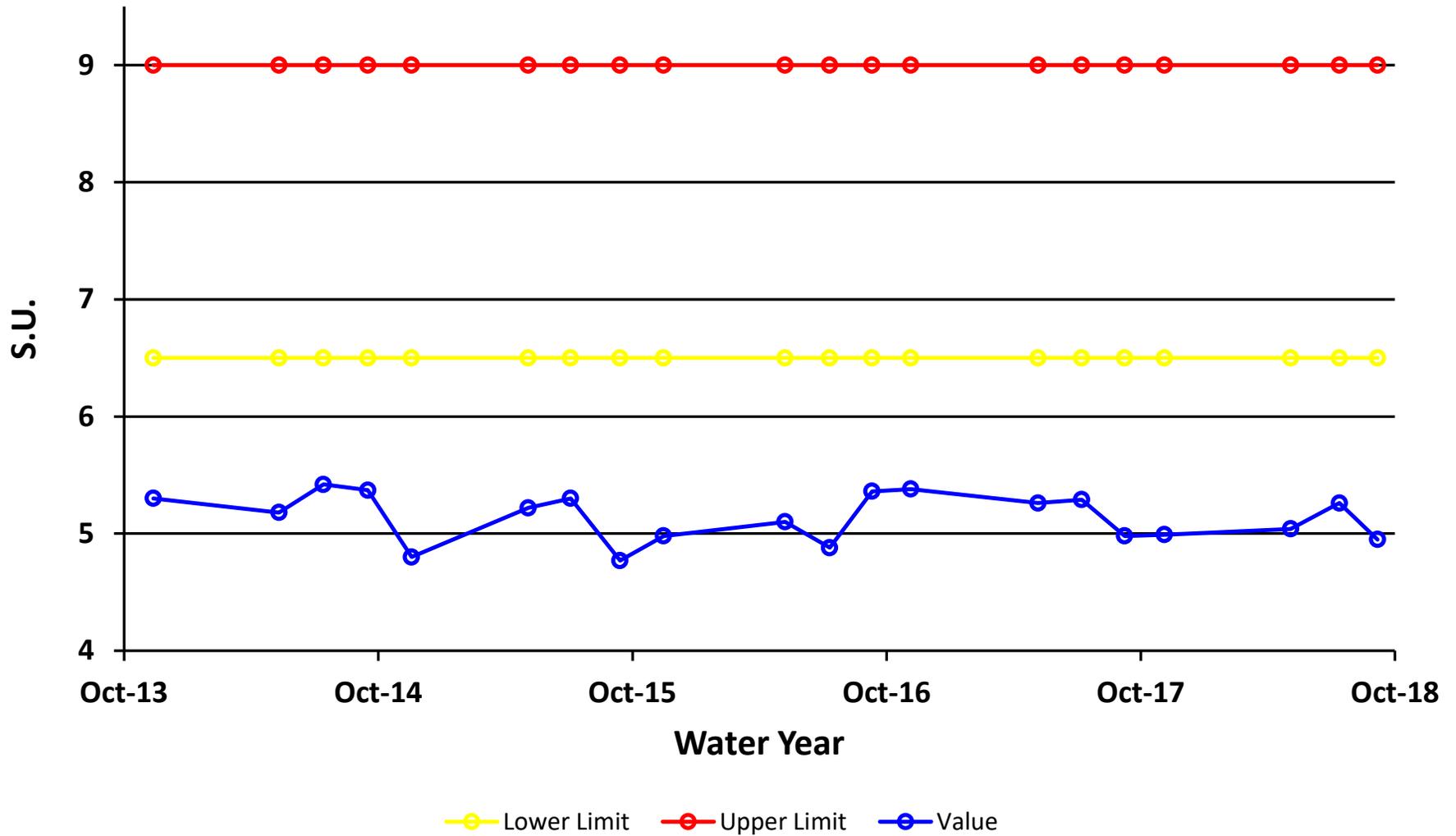
Site 29 - Conductivity Field



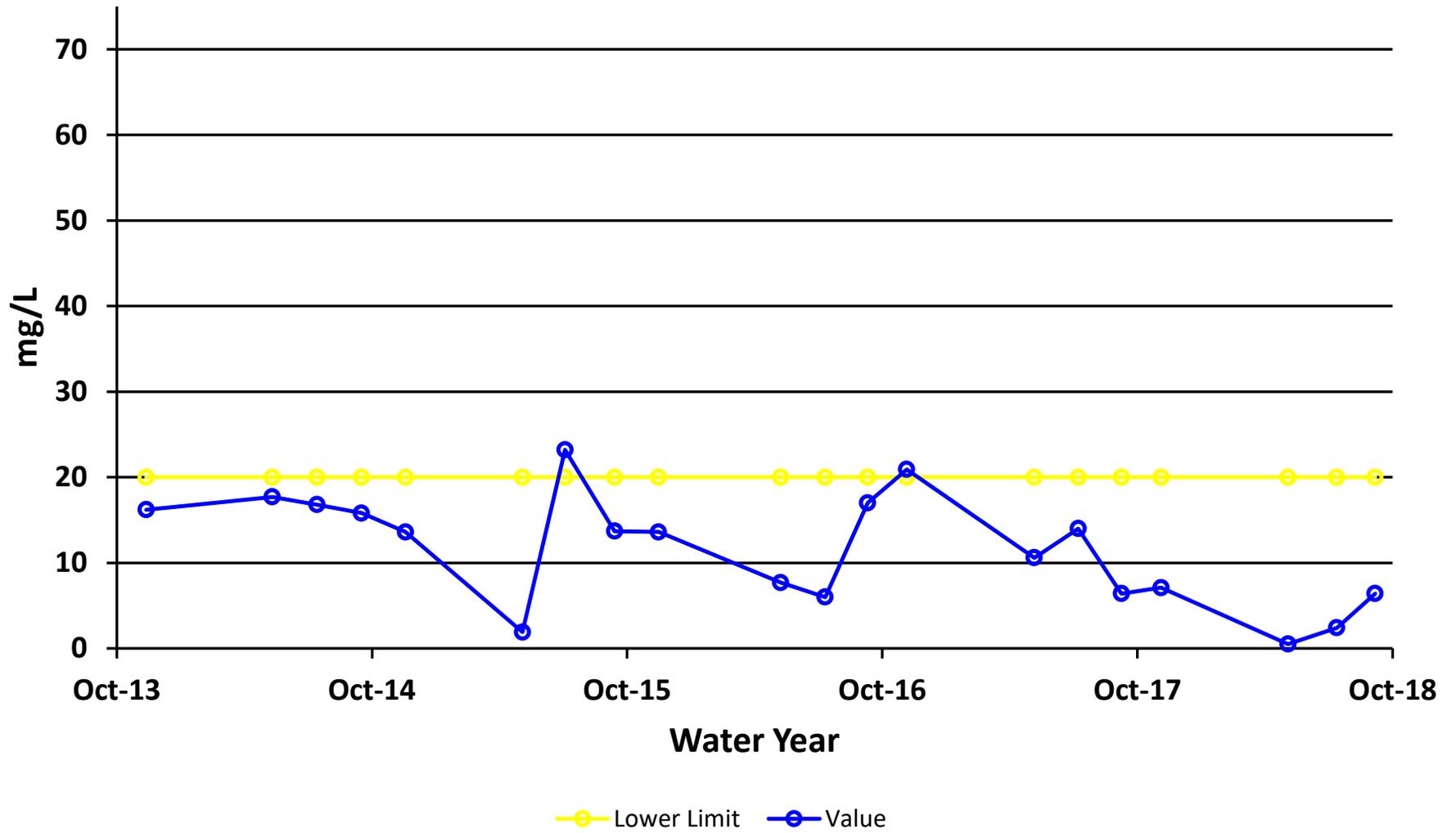
Site 29 - pH Laboratory



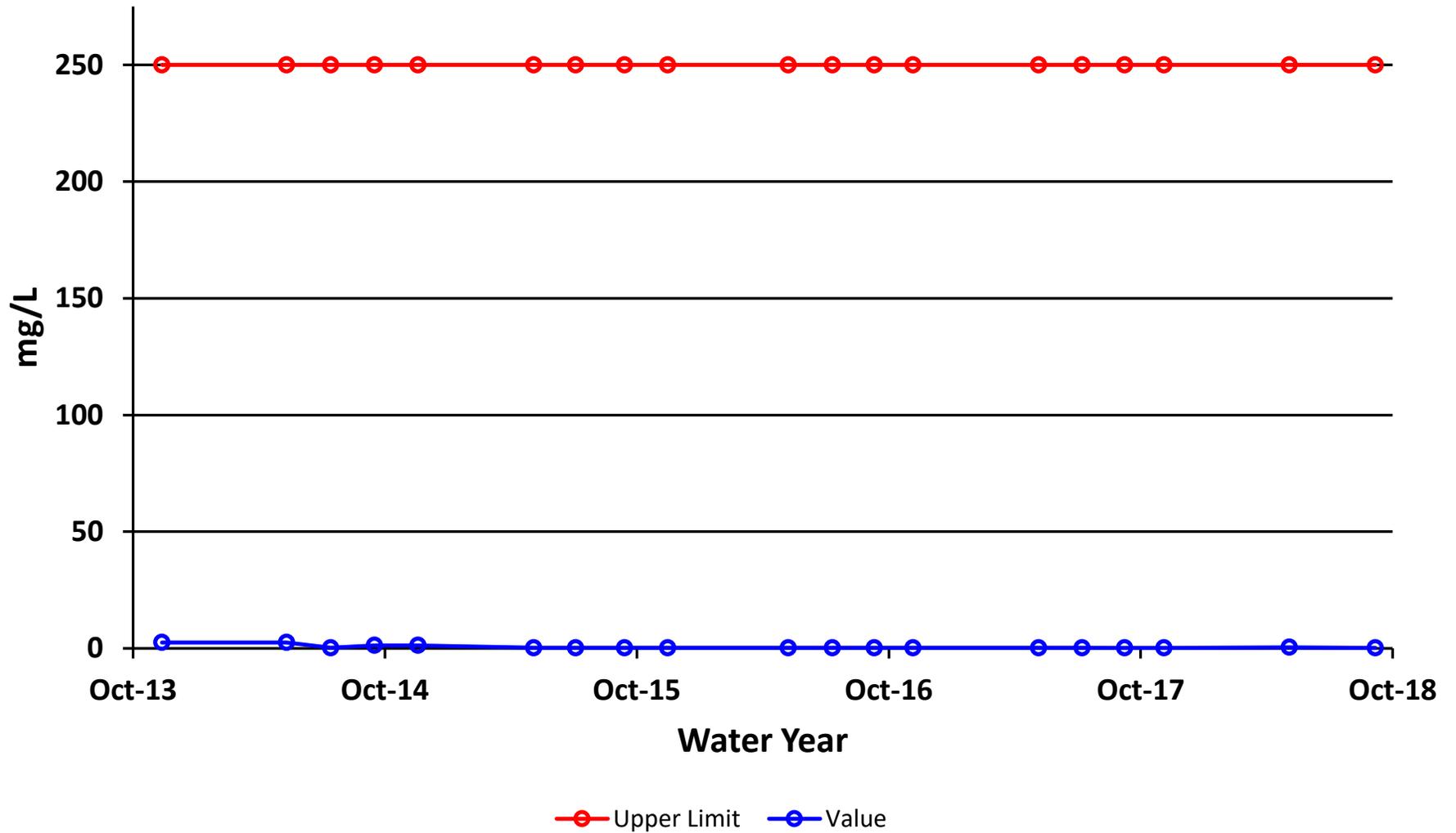
Site 29 - pH Field



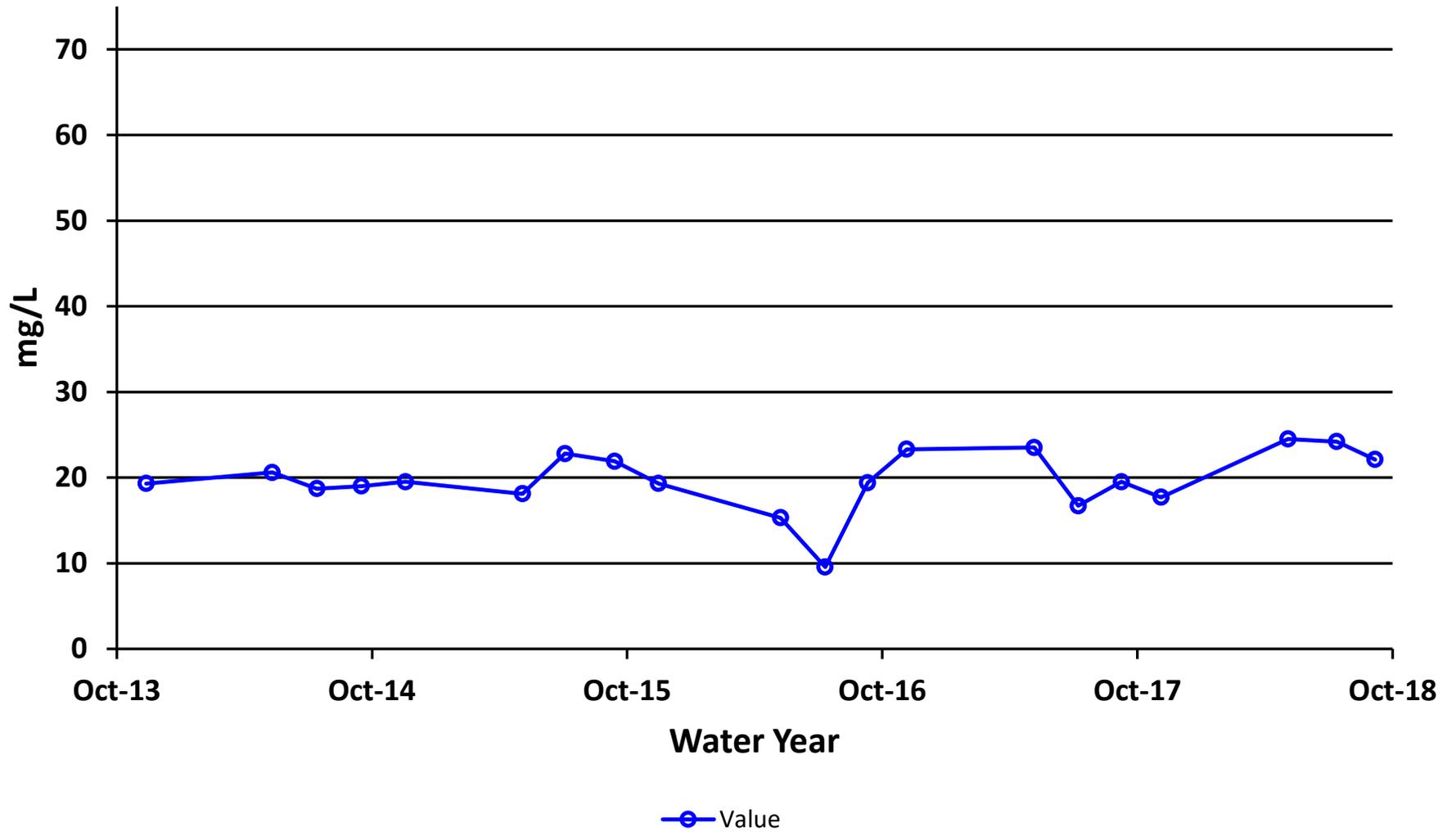
Site 29 - Alkalinity



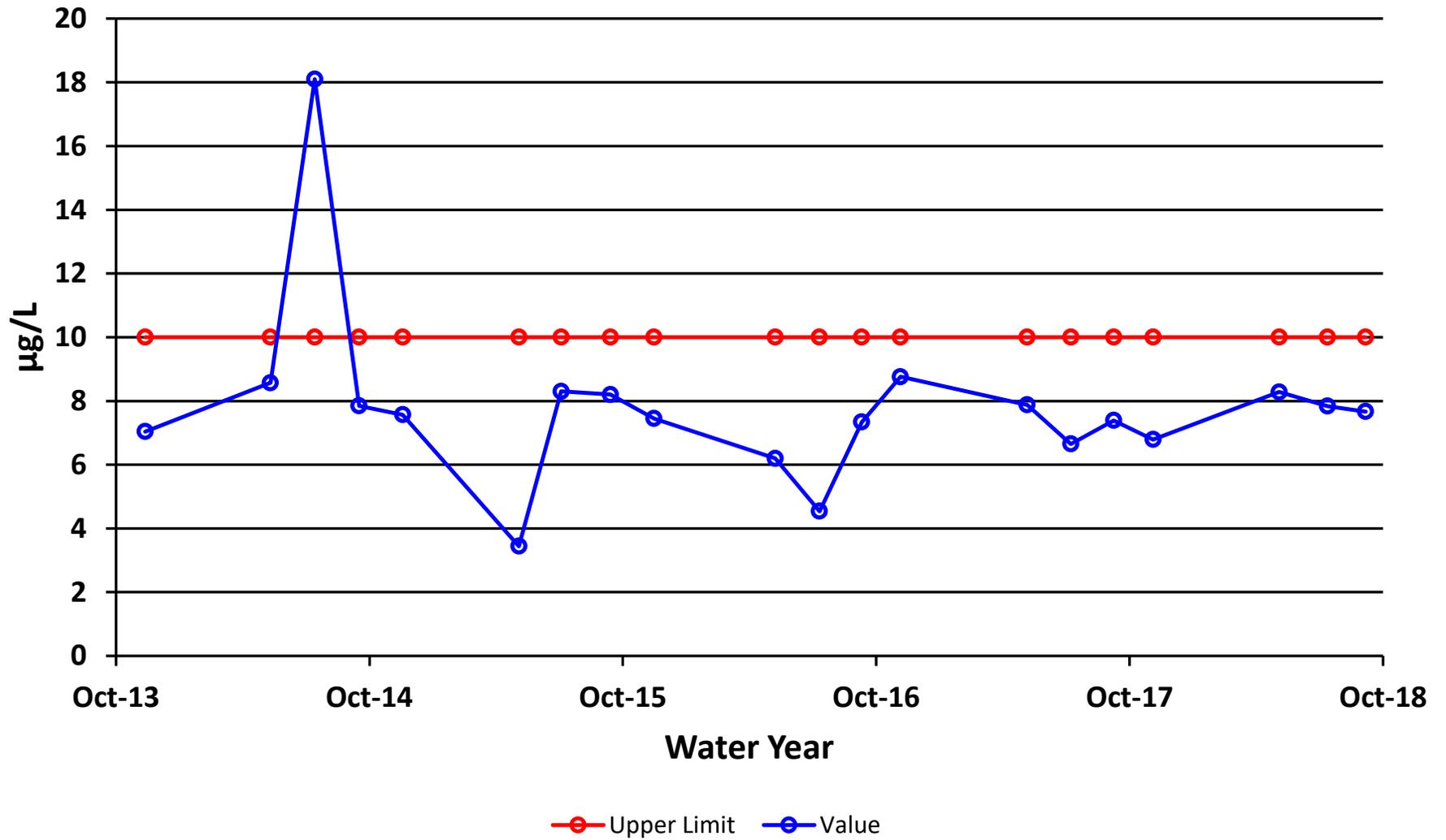
Site 29 - Sulfate



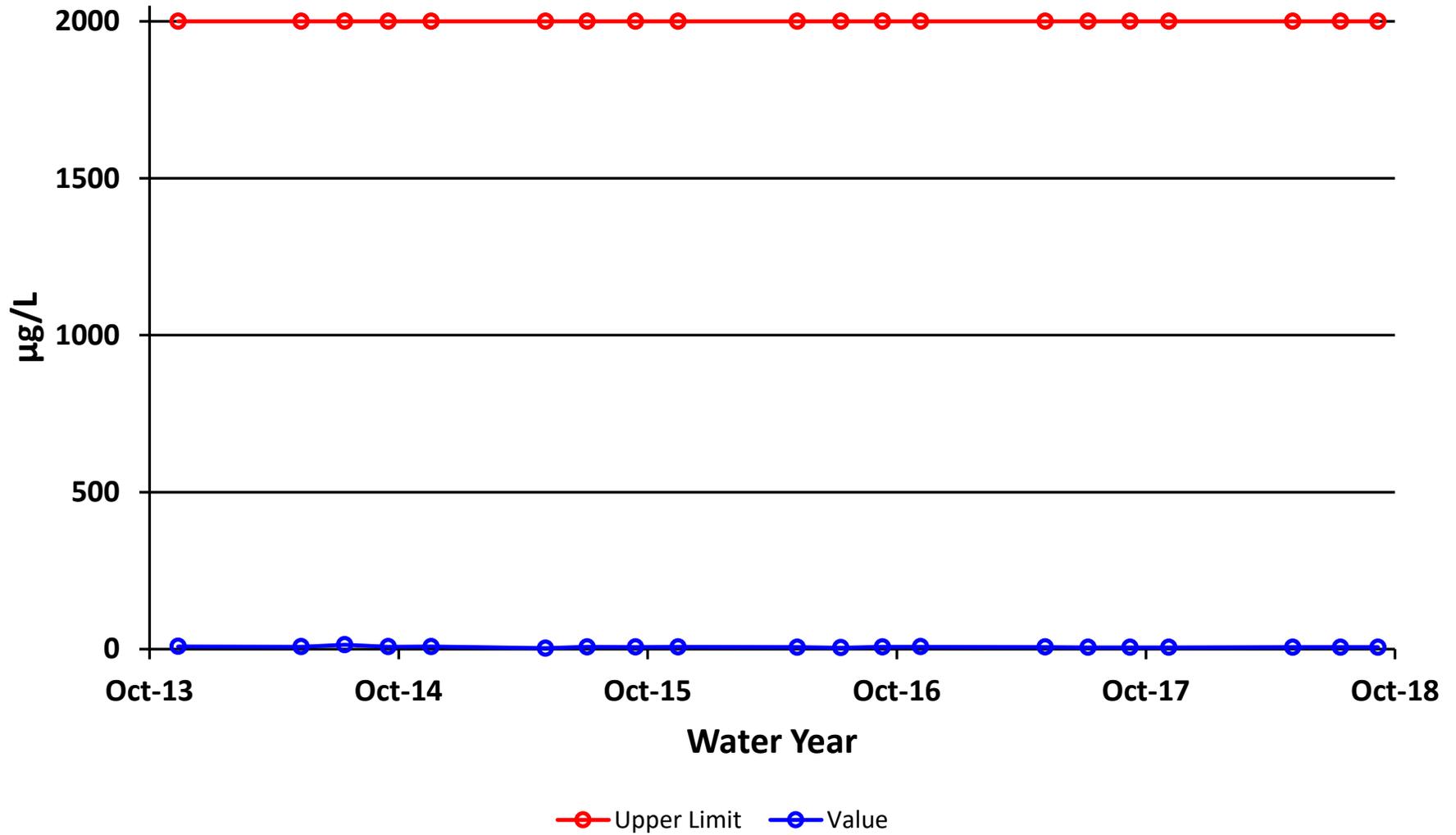
Site 29 - Hardness



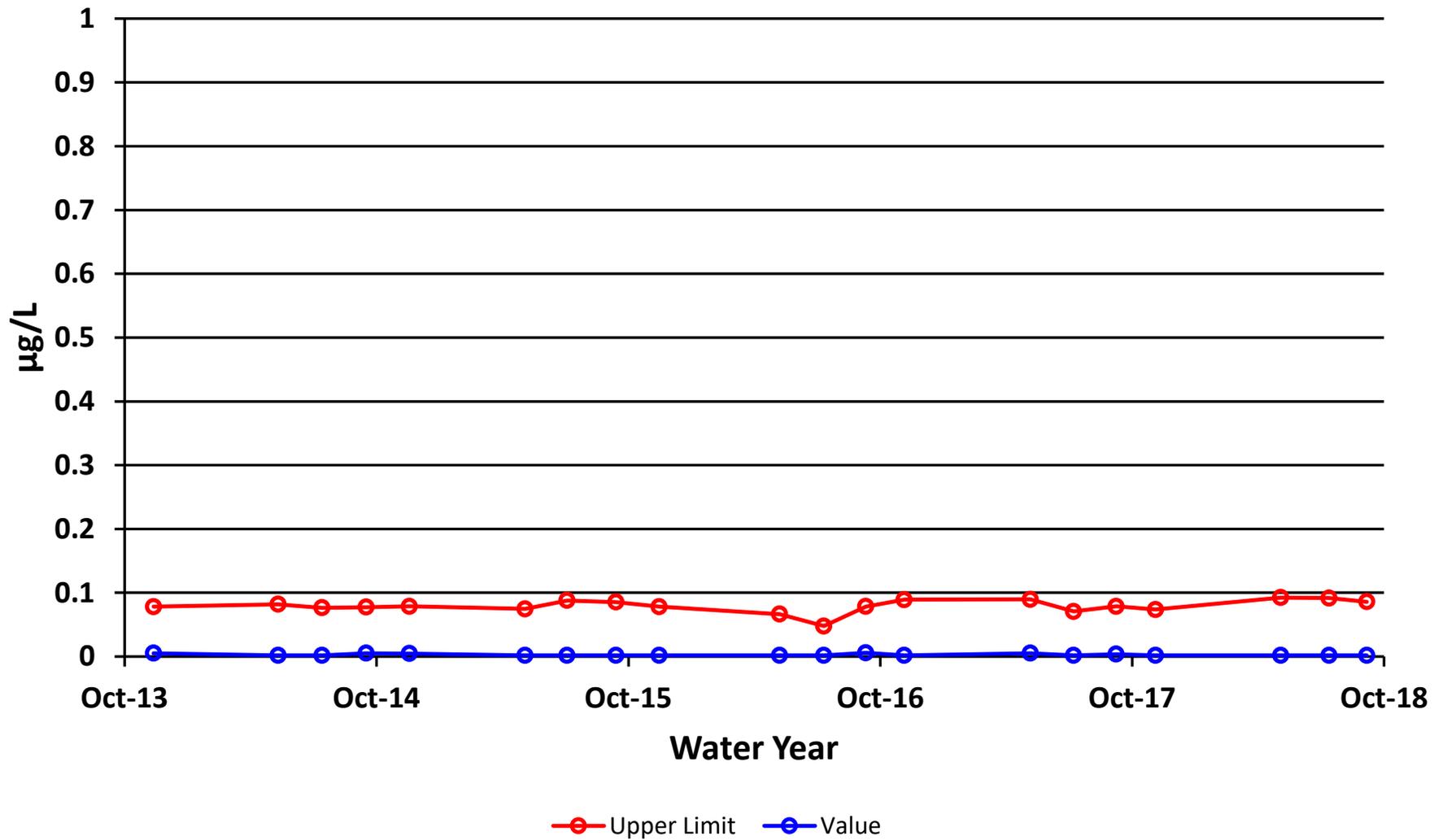
Site 29 - Arsenic Dissolved



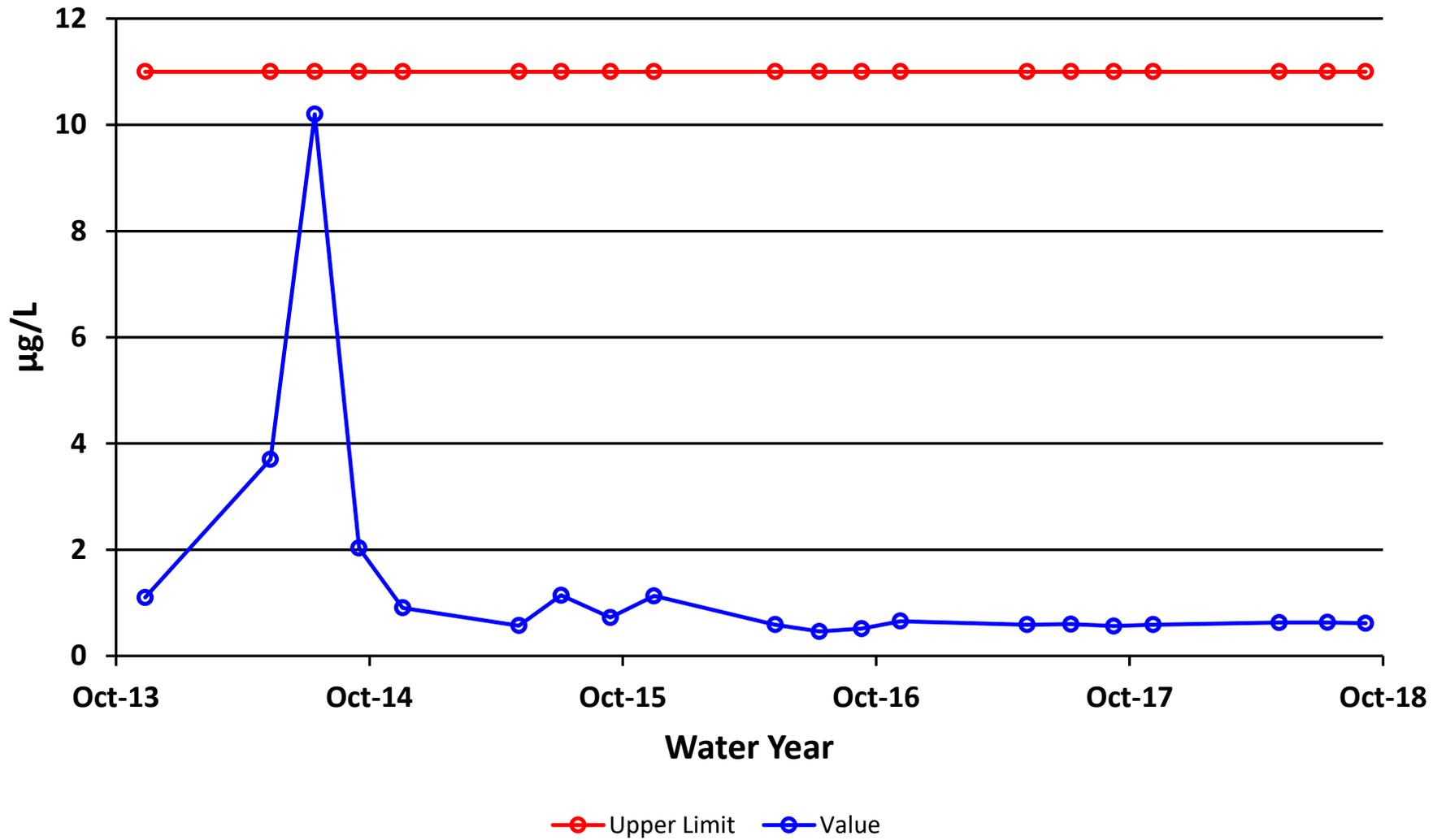
Site 29 - Barium Dissolved



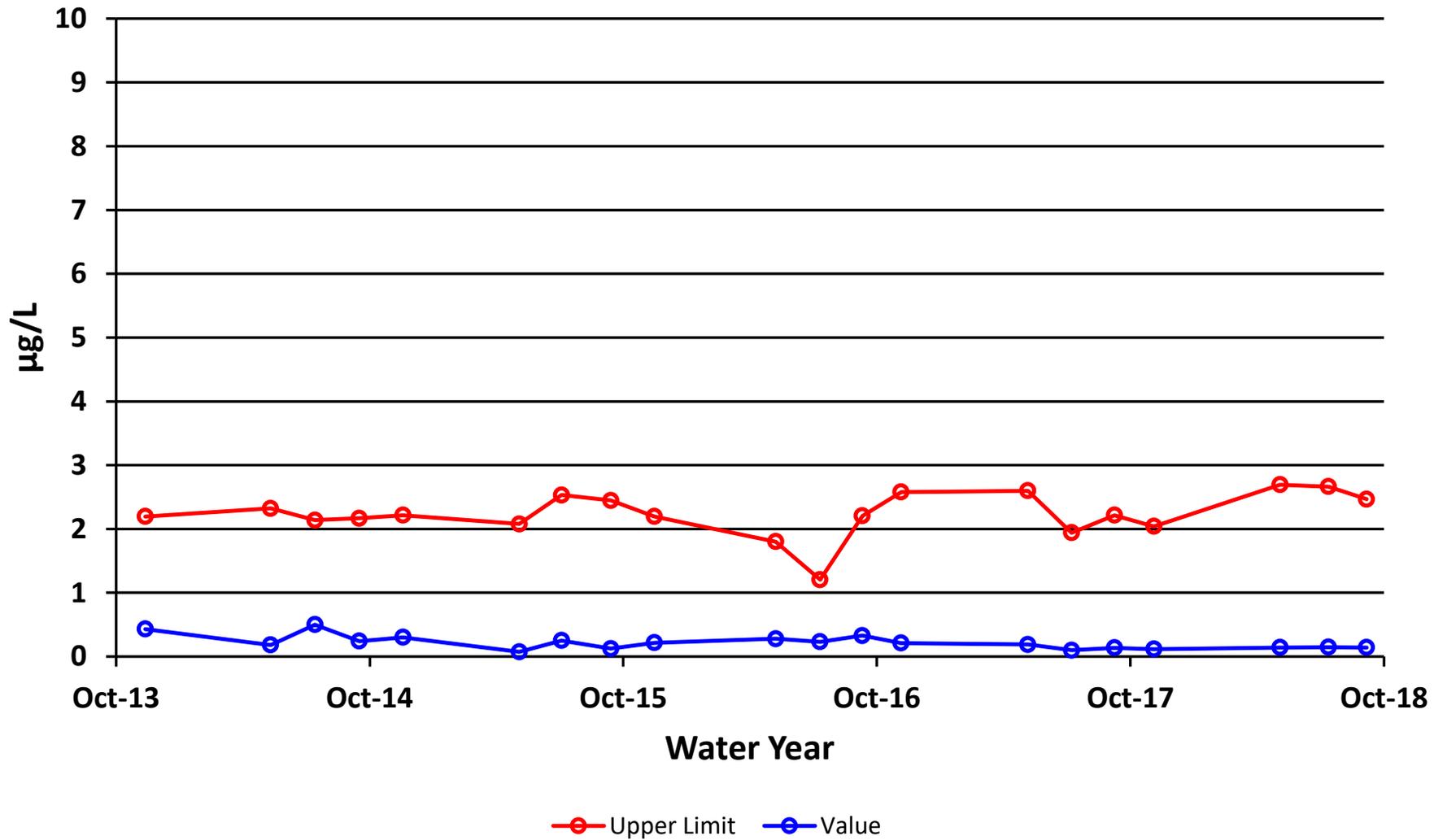
Site 29 - Cadmium Dissolved



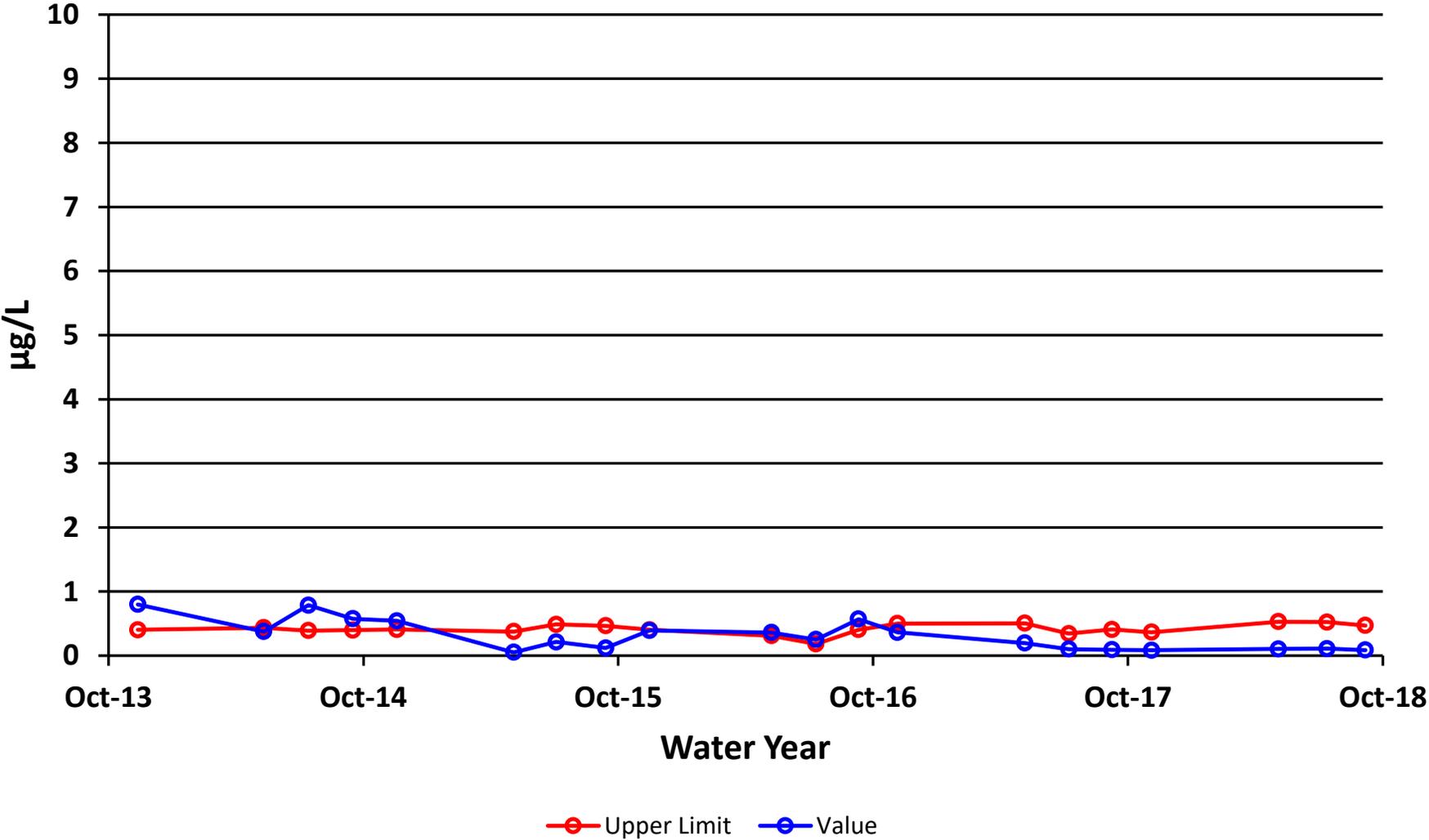
Site 29 - Chromium Dissolved



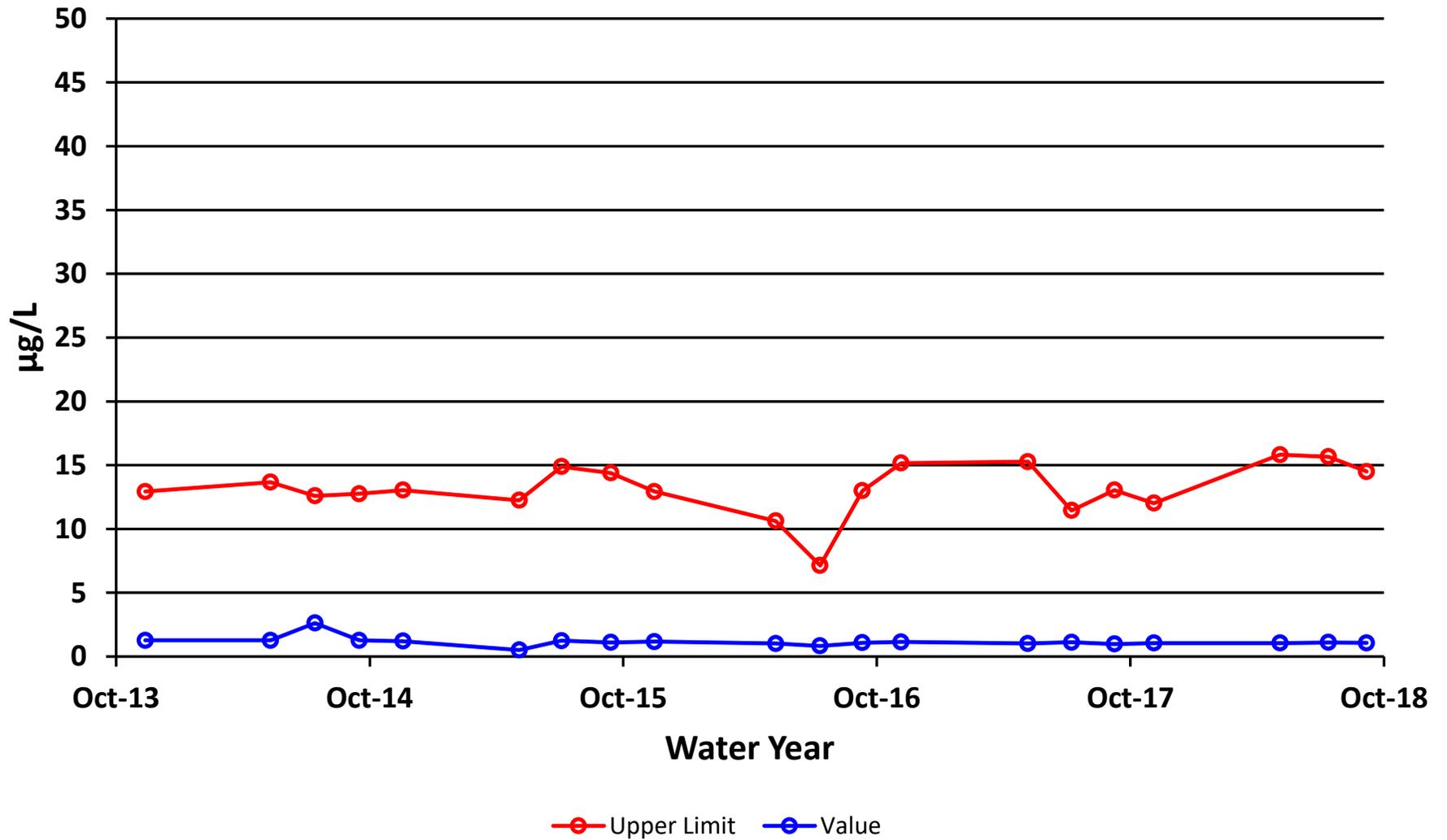
Site 29 - Copper Dissolved



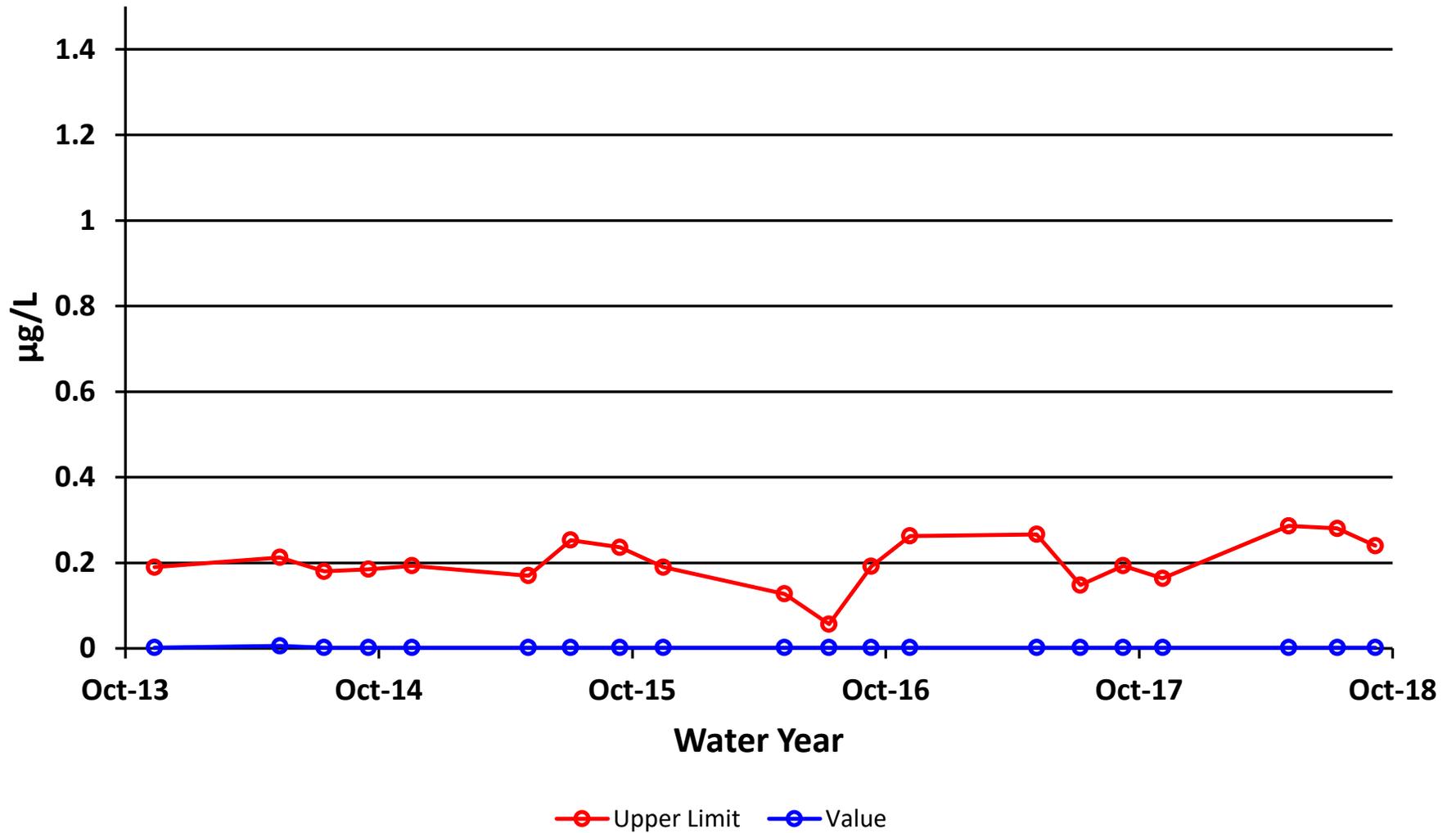
Site 29 - Lead Dissolved



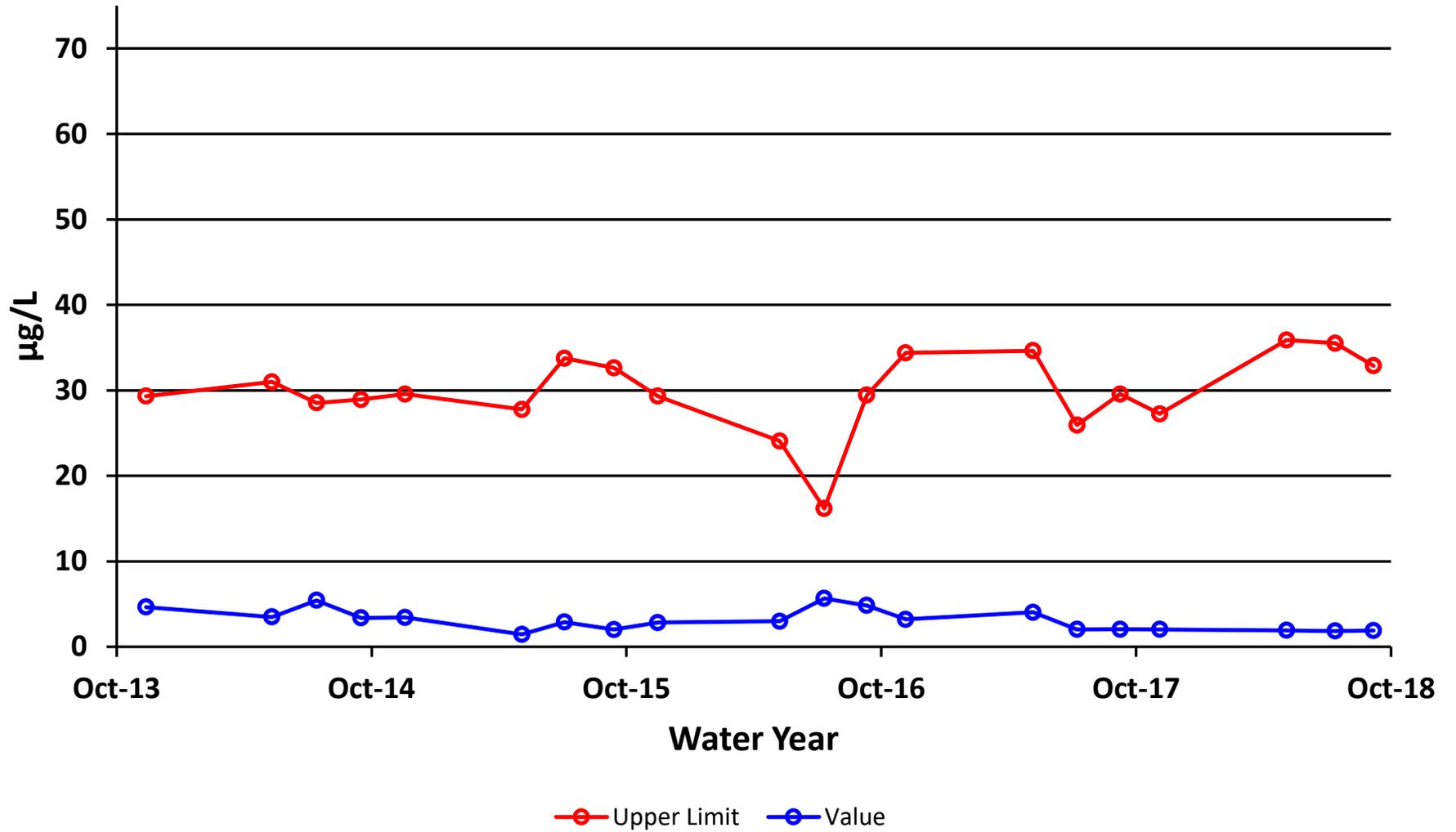
Site 29 - Nickel Dissolved



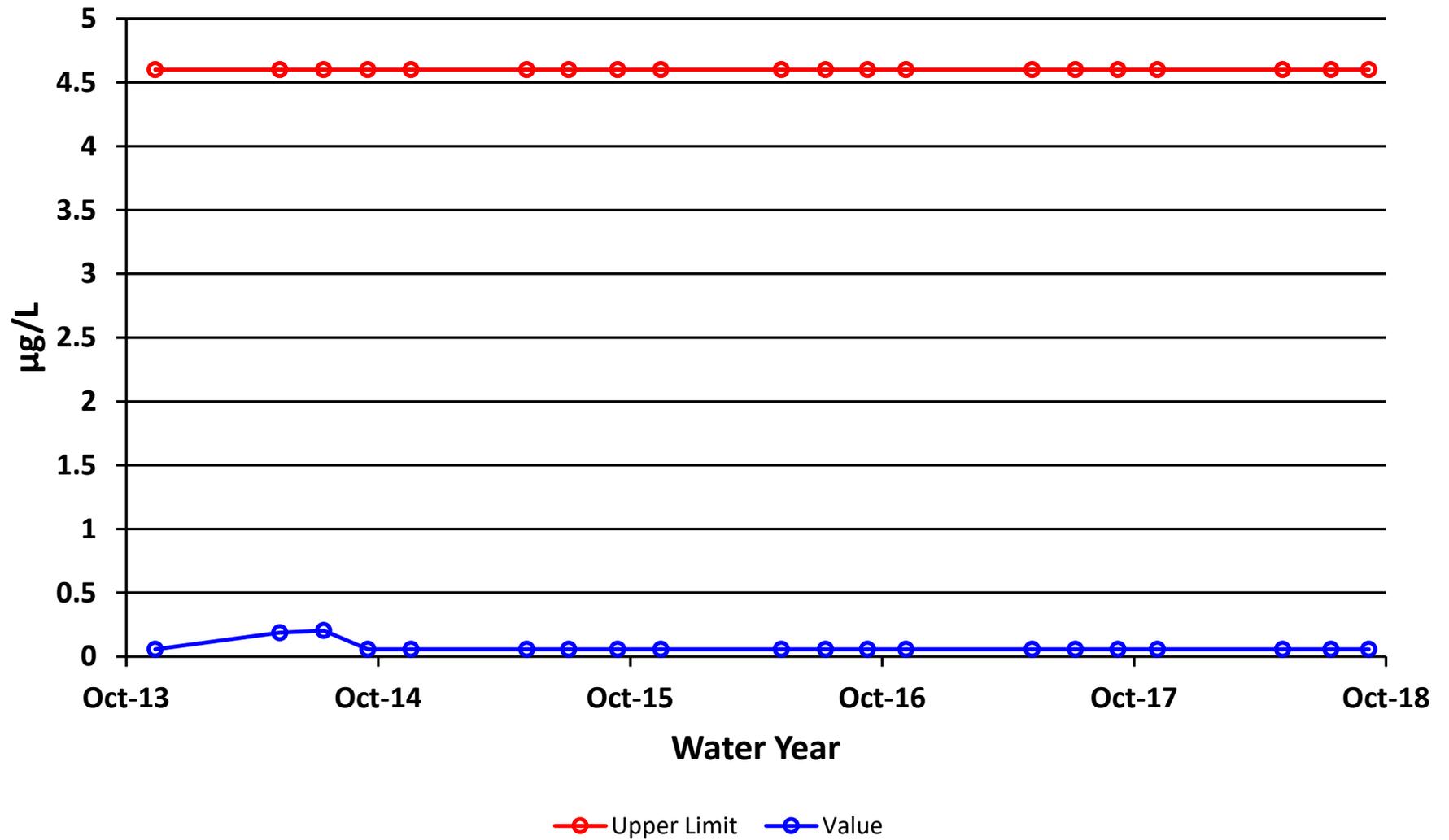
Site 29 - Silver Dissolved



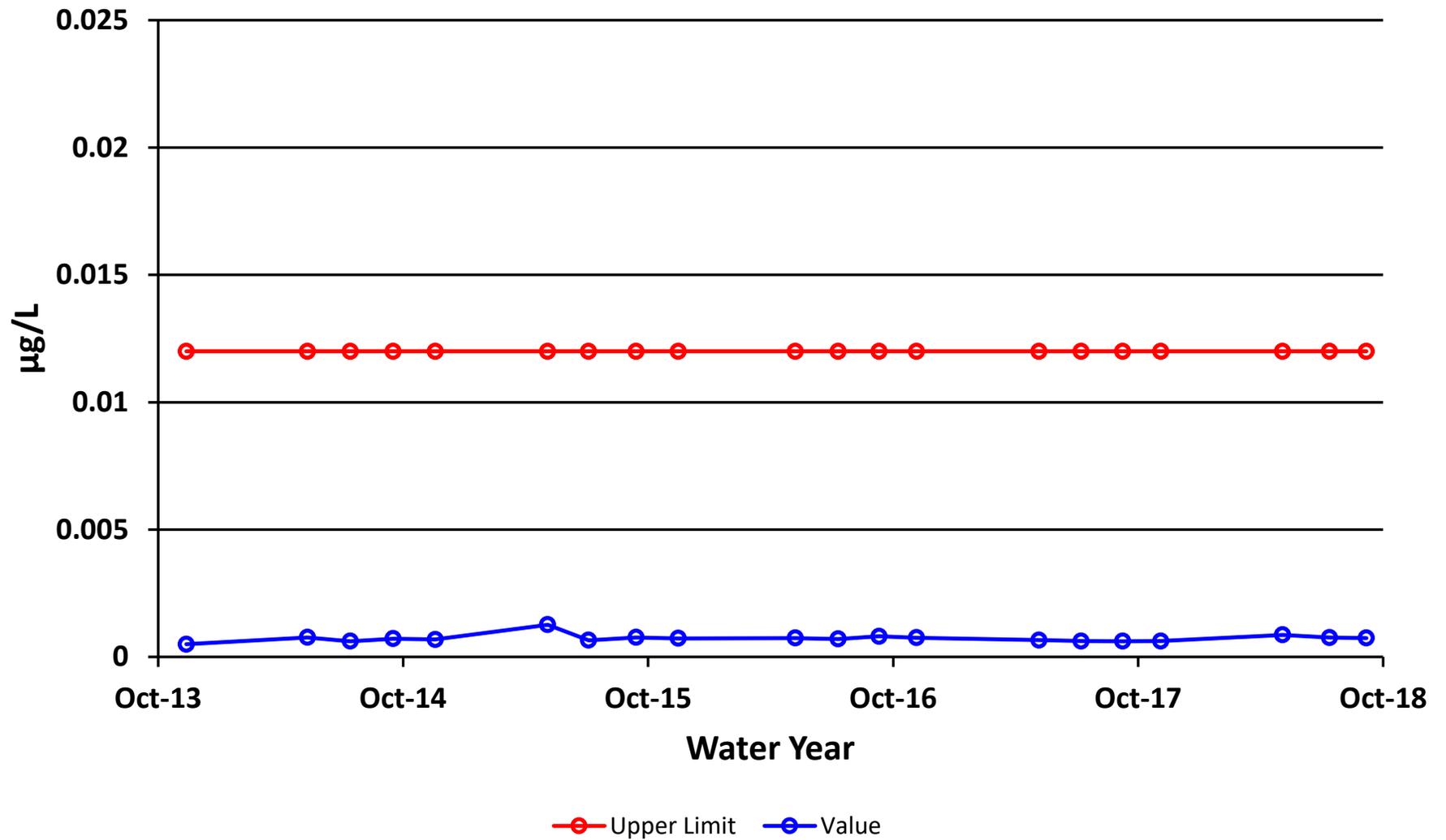
Site 29 - Zinc Dissolved



Site 29 - Selenium Dissolved



Site 29 - Mercury Dissolved



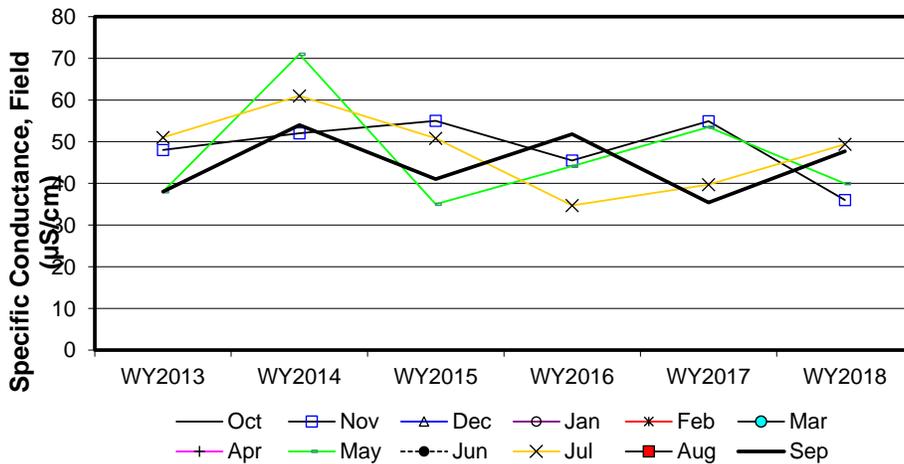
Site #29

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	WY2013		48.0						38.0		51.0		38.0
b	WY2014		52.0						71.0		61.0		54.0
c	WY2015		55.0						35.0		50.8		41.0
d	WY2016		45.5						44.1		34.7		51.8
e	WY2017		54.9						53.5		39.7		35.4
f	WY2018		36.0						40.0		49.4		47.7
n		0	6	0	0	0	0	0	6	0	6	0	6
t ₁		0	6	0	0	0	0	0	6	0	6	0	6
t ₂		0	0	0	0	0	0	0	0	0	0	0	0
t ₃		0	0	0	0	0	0	0	0	0	0	0	0
t ₄		0	0	0	0	0	0	0	0	0	0	0	0
t ₅		0	0	0	0	0	0	0	0	0	0	0	0
b-a			1						1		1		1
c-a			1						-1		-1		1
d-a			-1						1		-1		1
e-a			1						1		-1		-1
f-a			-1						1		-1		1
c-b			1						-1		-1		-1
d-b			-1						-1		-1		-1
e-b			1						-1		-1		-1
f-b			-1						-1		-1		-1
d-c			-1						1		-1		1
e-c			-1						1		-1		-1
f-c			-1						1		-1		1
e-d			1						1		1		-1
f-d			-1						-1		1		-1
f-e			-1						-1		1		1
S _k		0	-3	0	0	0	0	0	1	0	-7	0	-1
σ _S ² =			28.33						28.33		28.33		28.33
Z _k = S _k /σ _S			-0.56						0.19		-1.32		-0.19
Z _k ²			0.32						0.04		1.73		0.04

ΣZ _k =	-1.88	Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅	Σn	24
ΣZ _k ² =	2.12	Count	24	0	0	0	0	ΣS _k	-10
Z-bar=ΣZ _k /K=	-0.47								

χ _h ² =ΣZ _k ² -K(Z-bar) ² =	1.24	@α=5% χ _(K-1) ² =	7.81	Test for station homogeneity
p	0.745			χ _h ² < χ _(K-1) ² ACCEPT
ΣVAR(S _k)	Z _{calc} -0.85	@α/2=2.5% Z=	1.96	H ₀ (No trend) ACCEPT
113.33	p 0.199			H _A (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals			
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-5.01		2.11
0.050	-2.88		1.62
0.100	-2.73	-0.74	0.86
0.200	-2.06		-0.08

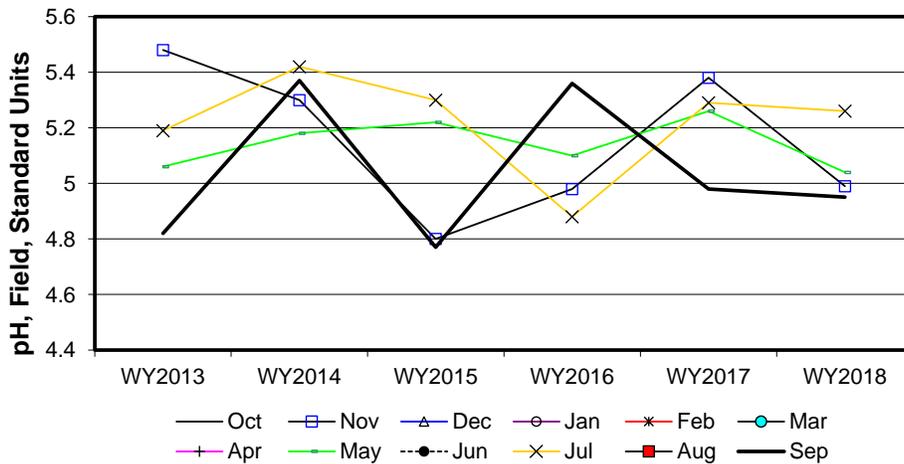
Site #29

Seasonal Kendall analysis for pH, Field, Standard Units

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	WY2013		5.5						5.1		5.2		4.8
b	WY2014		5.3						5.2		5.4		5.4
c	WY2015		4.8						5.2		5.3		4.8
d	WY2016		5.0						5.1		4.9		5.4
e	WY2017		5.4						5.3		5.3		5.0
f	WY2018		5.0						5.0		5.3		5.0
n		0	6	0	0	0	0	0	6	0	6	0	6
t ₁		0	6	0	0	0	0	0	6	0	6	0	6
t ₂		0	0	0	0	0	0	0	0	0	0	0	0
t ₃		0	0	0	0	0	0	0	0	0	0	0	0
t ₄		0	0	0	0	0	0	0	0	0	0	0	0
t ₅		0	0	0	0	0	0	0	0	0	0	0	0
b-a			-1						1		1		1
c-a			-1						1		1		-1
d-a			-1						1		-1		1
e-a			-1						1		1		1
f-a			-1						-1		1		1
c-b			-1						1		-1		-1
d-b			-1						-1		-1		-1
e-b			1						1		-1		-1
f-b			-1						-1		-1		-1
d-c			1						-1		-1		1
e-c			1						1		-1		1
f-c			1						-1		-1		1
e-d			1						1		1		-1
f-d			1						-1		1		-1
f-e			-1						-1		-1		-1
S _k		0	-3	0	0	0	0	0	1	0	-3	0	-1
σ _S ² =			28.33						28.33		28.33		28.33
Z _k = S _k /σ _S			-0.56						0.19		-0.56		-0.19
Z _k ²			0.32						0.04		0.32		0.04

ΣZ _k =	-1.13	Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅	Σn	24
ΣZ _k ² =	0.71	Count	24	0	0	0	0	ΣS _k	-6
Z-bar=ΣZ _k /K=	-0.28								

$\chi^2_{h} = \sum Z_k^2 - K(Z\text{-bar})^2 =$	0.39	@α=5% $\chi^2_{(K-1)} =$	7.81	Test for station homogeneity
p	0.943			$\chi^2_h < \chi^2_{(K-1)}$ ACCEPT
ΣVAR(S _k)	Z _{calc} -0.47	@α/2=2.5% Z=	1.96	H ₀ (No trend) ACCEPT
113.33	p 0.319			H _A (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals			
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.10	-0.01	0.04
0.050	-0.04		0.03
0.100	-0.04		0.02
0.200	-0.03		0.01

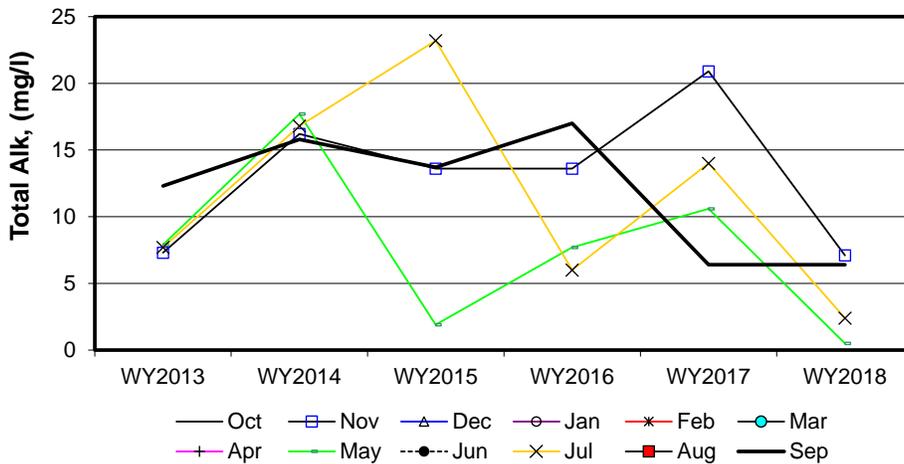
Site #29

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	WY2013		7.3						7.9		7.7		12.3
b	WY2014		16.2						17.7		16.8		15.8
c	WY2015		13.6						1.9		23.2		13.7
d	WY2016		13.6						7.7		6.0		17.0
e	WY2017		20.9						10.6		14.0		6.4
f	WY2018		7.1						0.5		2.4		6.4
n		0	6	0	0	0	0	0	6	0	6	0	6
t ₁		0	4	0	0	0	0	0	6	0	6	0	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
b-a			1						1		1		1
c-a			1						-1		1		1
d-a			1						-1		-1		1
e-a			1						1		1		-1
f-a			-1						-1		-1		-1
c-b			-1						-1		1		-1
d-b			-1						-1		-1		1
e-b			1						-1		-1		-1
f-b			-1						-1		-1		-1
d-c			0						1		-1		1
e-c			1						1		-1		-1
f-c			-1						-1		-1		-1
e-d			1						1		1		-1
f-d			-1						-1		-1		-1
f-e			-1						-1		-1		0
S _k		0	0	0	0	0	0	0	-5	0	-5	0	-4
σ _S ² =			27.33						28.33		28.33		27.33
Z _k = S _k /σ _S			0.00						-0.94		-0.94		-0.77
Z _k ²			0.00						0.88		0.88		0.59

ΣZ _k =	-2.64	Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅	Σn	24
ΣZ _k ² =	2.35	Count	20	2	0	0	0	ΣS _k	-14
Z-bar=ΣZ _k /K=	-0.66								

χ _n ² =ΣZ _k ² -K(Z-bar) ² =	0.60	@α=5% χ _(K-1) ² =	7.81	Test for station homogeneity	
p	0.896			χ _n ² <χ _(K-1) ²	ACCEPT
ΣVAR(S _k)	Z _{calc} -1.23	@α/2=2.5% Z=	1.96	H ₀ (No trend)	ACCEPT
111.33	p 0.109			H _A (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals			
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-3.04	-1.12	1.57
0.050	-2.36		0.41
0.100	-2.25		-0.01
0.200	-1.93		-0.29

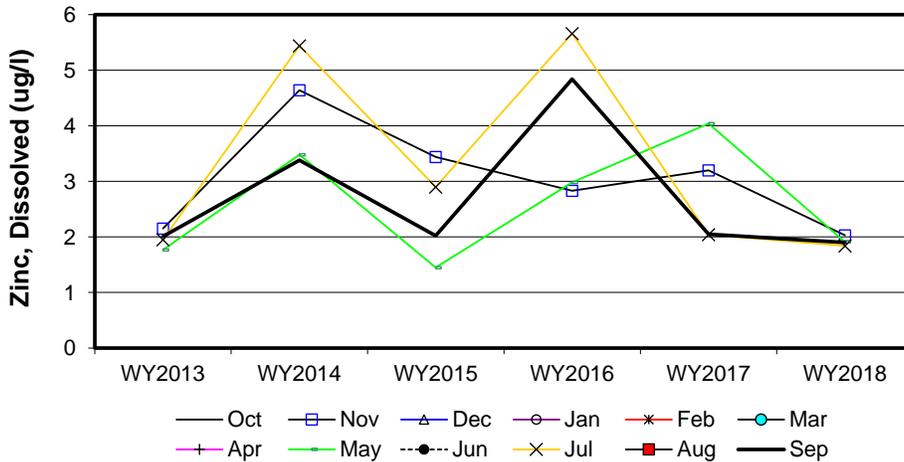
Site #29

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	WY2013		2.2						1.8		2.0		2.0
b	WY2014		4.6						3.5		5.4		3.4
c	WY2015		3.4						1.5		2.9		2.0
d	WY2016		2.8						3.0		5.7		4.8
e	WY2017		3.2						4.0		2.0		2.1
f	WY2018		2.0						1.9		1.8		1.9
n		0	6	0	0	0	0	0	6	0	6	0	6
t ₁		0	6	0	0	0	0	0	6	0	6	0	6
t ₂		0	0	0	0	0	0	0	0	0	0	0	0
t ₃		0	0	0	0	0	0	0	0	0	0	0	0
t ₄		0	0	0	0	0	0	0	0	0	0	0	0
t ₅		0	0	0	0	0	0	0	0	0	0	0	0
b-a			1						1		1		1
c-a			1						-1		1		1
d-a			1						1		1		1
e-a			1						1		1		1
f-a			-1						1		-1		-1
c-b			-1						-1		-1		-1
d-b			-1						-1		1		1
e-b			-1						1		-1		-1
f-b			-1						-1		-1		-1
d-c			-1						1		1		1
e-c			-1						1		-1		1
f-c			-1						1		-1		-1
e-d			1						1		-1		-1
f-d			-1						-1		-1		-1
f-e			-1						-1		-1		-1
S _k		0	-5	0	0	0	0	0	3	0	-3	0	-1
σ _S ² =			28.33						28.33		28.33		28.33
Z _k = S _k /σ _S			-0.94						0.56		-0.56		-0.19
Z _k ²			0.88						0.32		0.32		0.04

ΣZ _k =	-1.13	Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅	Σn	24
ΣZ _k ² =	1.55	Count	24	0	0	0	0	ΣS _k	-6
Z-bar=ΣZ _k /K=	-0.28								

χ _h ² =ΣZ _k ² -K(Z-bar) ² =	1.24	@α=5% χ _(K-1) ² =	7.81	Test for station homogeneity
p	0.745			χ _h ² < χ _(K-1) ² ACCEPT
ΣVAR(S _k)	Z _{calc} -0.47	@α/2=2.5% Z=	1.96	H ₀ (No trend) ACCEPT
113.33	p 0.319			H _A (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals			
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.47		0.24
0.050	-0.40		0.09
0.100	-0.37	-0.03	0.02
0.200	-0.22		0.01

INTERPRETIVE REPORT

SITE 32

The data collected during the current water year are listed in the following “Table of Results for Water Year 2018” 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 one-half of the for the purpose of median calculation.

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

Sample Date	Parameter	Value	Qualifier	Notes
No outliers, in the past six years, have been identified by HGCMC.				

The data for the current water year 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 2018

Sample Date	Parameter	Value	Limits		
			Lower	Upper	Hardness
7-Nov-17	pH	5.8 su	6.5	9.0	48.7 mg/L
8-May-18	pH	6.16 su	6.5	9.0	67.3 mg/L
17-Jul-18	pH	5.93 su	6.5	9.0	51 mg/L
10-Sep-18	pH	5.6 su	6.5	9.0	40.1 mg/L

All four of the annual sampling events for field pH were in exceedance. Well completion in organic rich peat, as discussed for Sites 27 and 29, is a reasonable explanation for the low pH values.

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 substantial increases in conductivity, alkalinity, hardness, and pH during the current water year. Lead concentrations decreased. As discussed in the interpretive section for Site 27, recent construction-related influences on the near-surface hydrology are likely affecting the pore water chemistry in the vicinity of the well.

The lack of a concurrent increase in sulfate, zinc, and other metals suggests that these changes are not a result of loss of contact water from the tailings facility.

A non-parametric statistical analysis for trend was performed for specific conductivity. 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-12 and Sep-18 (WY2013-WY2018).

Site 32 - Table of Summary Statistics for Trend Analysis

Parameter	Mann-Kendall test statistics			Sen's slope estimate	
	n*	p**	Trend	Q	Q(%)
Conductivity Field	6	0.98	+	8.55	13.2
pH Field	6	0.96			
Alkalinity, Total	6	0.96			
Sulfate, Total	6		Inconsistent detection limits		
Zinc, Dissolved	6	0.09			

* Number of Years ** Significance level

A significant trend for field conductivity (8.55 $\mu\text{S}/\text{cm}/\text{yr}$) was identified at Site 32 for the six-year period. Trend analysis was not performed on the total sulfate dataset because of a change in the method detection limit used by analytical laboratories. A primary assumption of the Mann-Kendall test is "... only one censoring threshold exists. When more than one detection limit exists, the Mann-Kendall test cannot be performed without further censoring the data." In order to prevent this from occurring HGC MC has worked to establish a consistent MDL for sulfate from the laboratory.

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

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

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

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

The construction-related influences on near-surface hydrology discussed previously caused specific conductance and alkalinity to go out of control during the 2017 water year. A gradual stabilization of values is expected over the coming years. Dissolved zinc has periodically had higher values than the mean. As previously discussed, it is hypothesized that the increase in dissolved zinc results from the accumulation of fugitive dust in the snow pack during the winter. In the spring when the snow pack melts this material is released as a pulse. Most years the deposited material is not present by the fall sampling. With the implementation of additional best management practices, HGCMC expects to decrease the amount of fugitive dust leaving the tailings disposal facility.

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

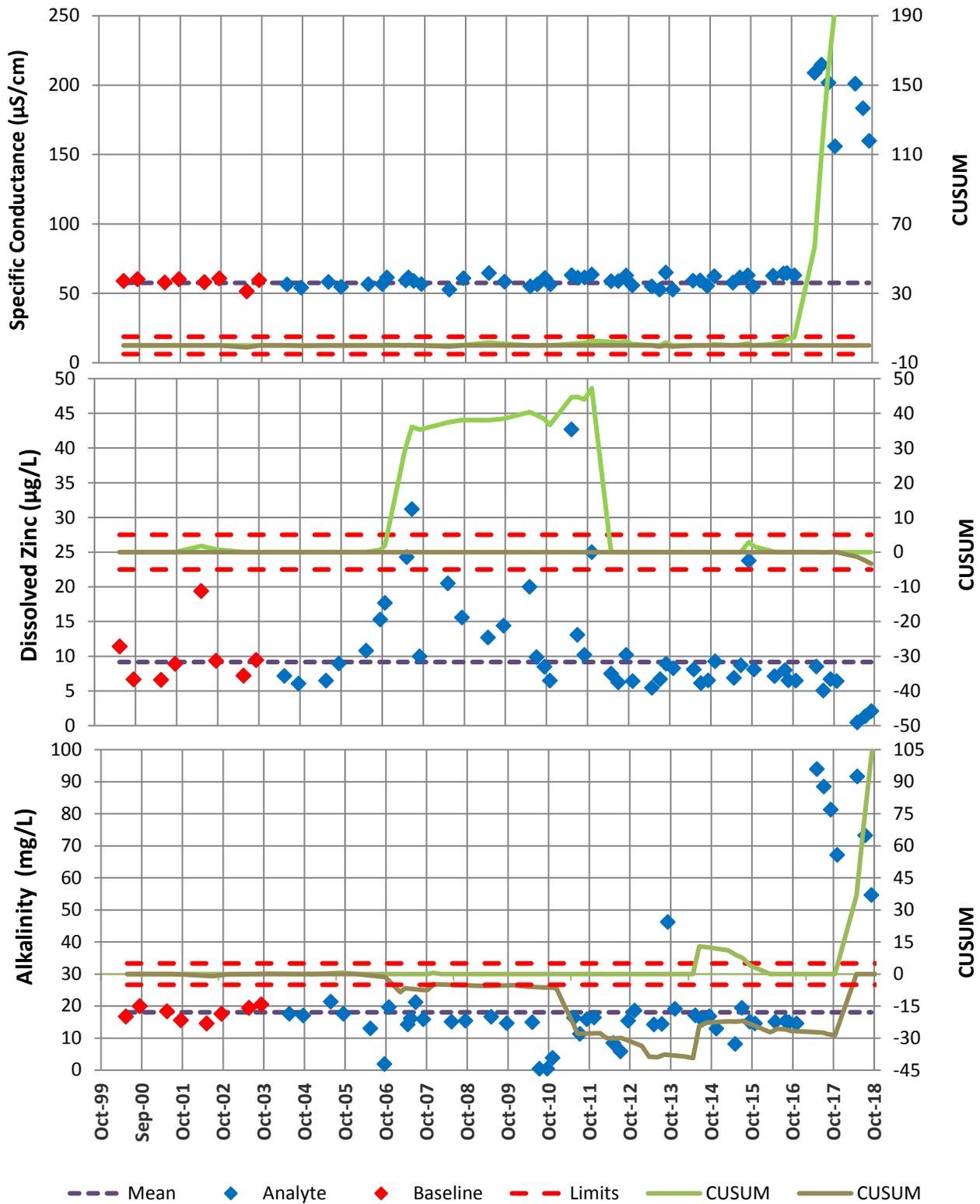


Table of Results for Water Year 2018

Site 032FMG - 'Monitoring Well - 5S'

Sample Date/Parameter	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018	Median
Water Temp (°C)		7.8						6.2		6.8		8.1	7.3
Conductivity-Field(µmho)		156						201.1		183.5		159.8	171.7
Conductivity-Lab (µmho)		135						176		165		137	151
pH Lab (standard units)		5.47						6.08		5.48		5.19	5.48
pH Field (standard units)		5.84						6.16		5.93		5.6	5.89
Total Alkalinity (mg/L)		67.2						91.7		73.3		54.7	70.3
Total Sulfate (mg/L)		0.2						0.7		0.2		0.2	0.2
Hardness (mg/L)		48.7						67.3		51		40.1	49.9
Dissolved As (ug/L)		3.04						2.92		2.57		2.79	2.855
Dissolved Ba (ug/L)		43.2						37.7		42.2		38.9	40.6
Dissolved Cd (ug/L)		0.0018						0.0018		0.0018		0.0018	0.0018
Dissolved Cr (ug/L)		0.73						0.514		0.565		0.802	0.648
Dissolved Cu (ug/L)		0.24						0.163		0.219		0.324	0.230
Dissolved Pb (ug/L)		0.172						0.0527		0.093		0.154	0.1235
Dissolved Ni (ug/L)		3.74						1.64		2.82		2.97	2.895
Dissolved Ag (ug/L)		0.002						0.006		0.004		0.002	0.003
Dissolved Zn (ug/L)		6.42						0.48		1.36		2.12	1.74
Dissolved Se (ug/L)		0.16						0.057		0.057		0.057	0.057
Dissolved Hg (ug/L)		0.000595						0.000962		0.000535		0.000694	0.000645

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

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

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

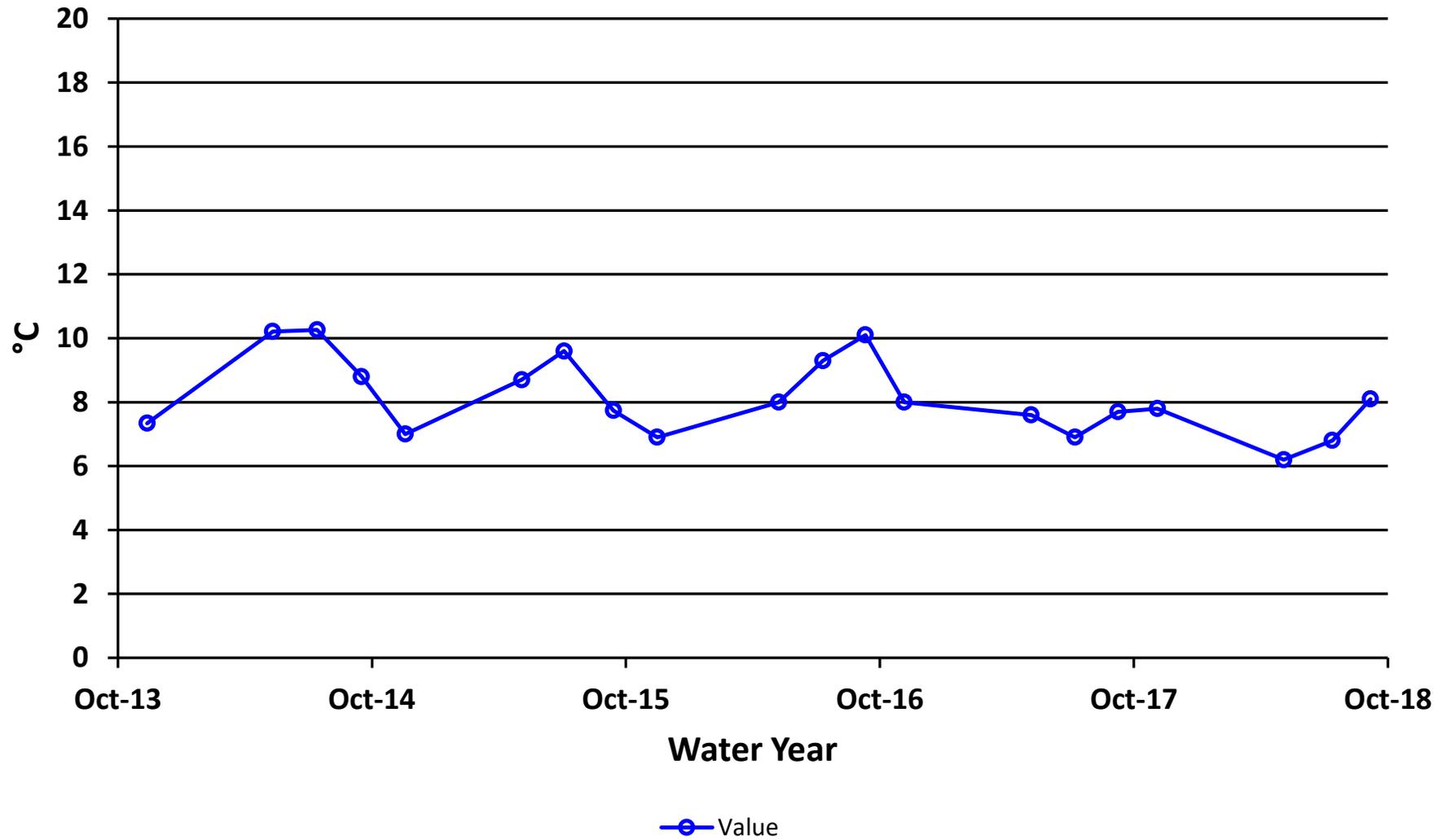
Qualified Data by QA Reviewer

Date Range: 10/01/2017 to 09/30/2018

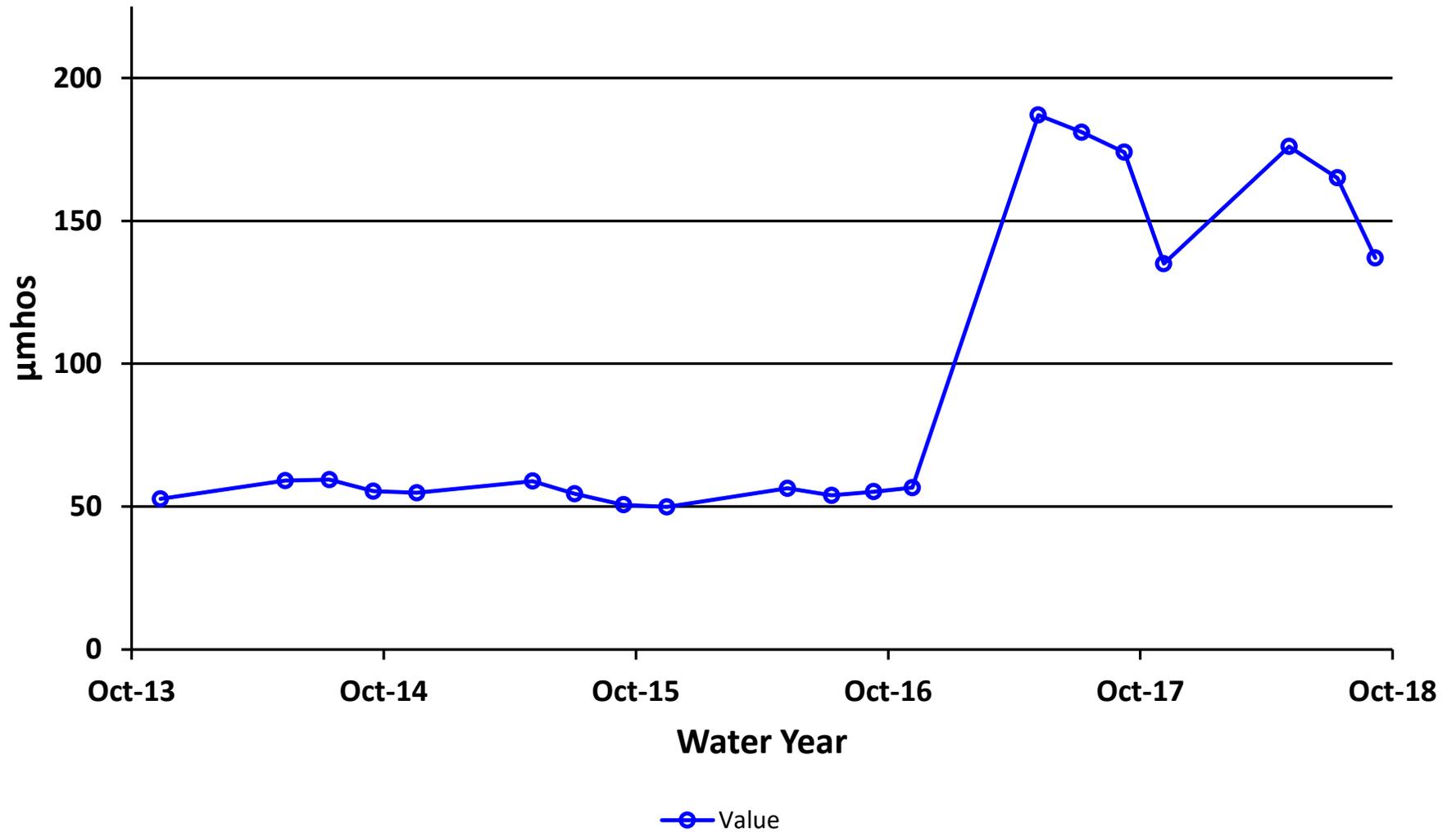
Site No.	Sample Date	Parameter	Value		Qualifier	Reason for Qualifier
032FMG	11/7/2017	Diss. Cu-ICP/MS	0.24	µg/L	U	Field Blank Contamination
		Diss. Se-ICP/MS	0.16	µg/L	J	Below Quantitative Range
	5/8/2018	Diss. Ag-ICP/MS	0.0055	µg/L	J	Below Quantitative Range
		Diss. Cu-ICP/MS	0.16	µg/L	U	Trip Blank Contamination
		Total Sulfate	0.65	mg/L	J	Below Quantitative Range
	7/17/2018	Diss. Ag-ICP/MS	3.87E-03	µg/L	J	Below Quantitative Range
		pH	5.48	pH units	J	Hold time Violation
		Total Sulfate	-0.4	mg/L	J	Sample Receipt Temperature
	9/10/2018	Diss. Zn-ICP/MS	2.12	µg/L	U	Field Blank Contamination
		pH	5.19	pH units	J	Hold Time Violation
		Total Sulfate	-0.4	mg/L	UJ	Sample Receipt Temperature

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

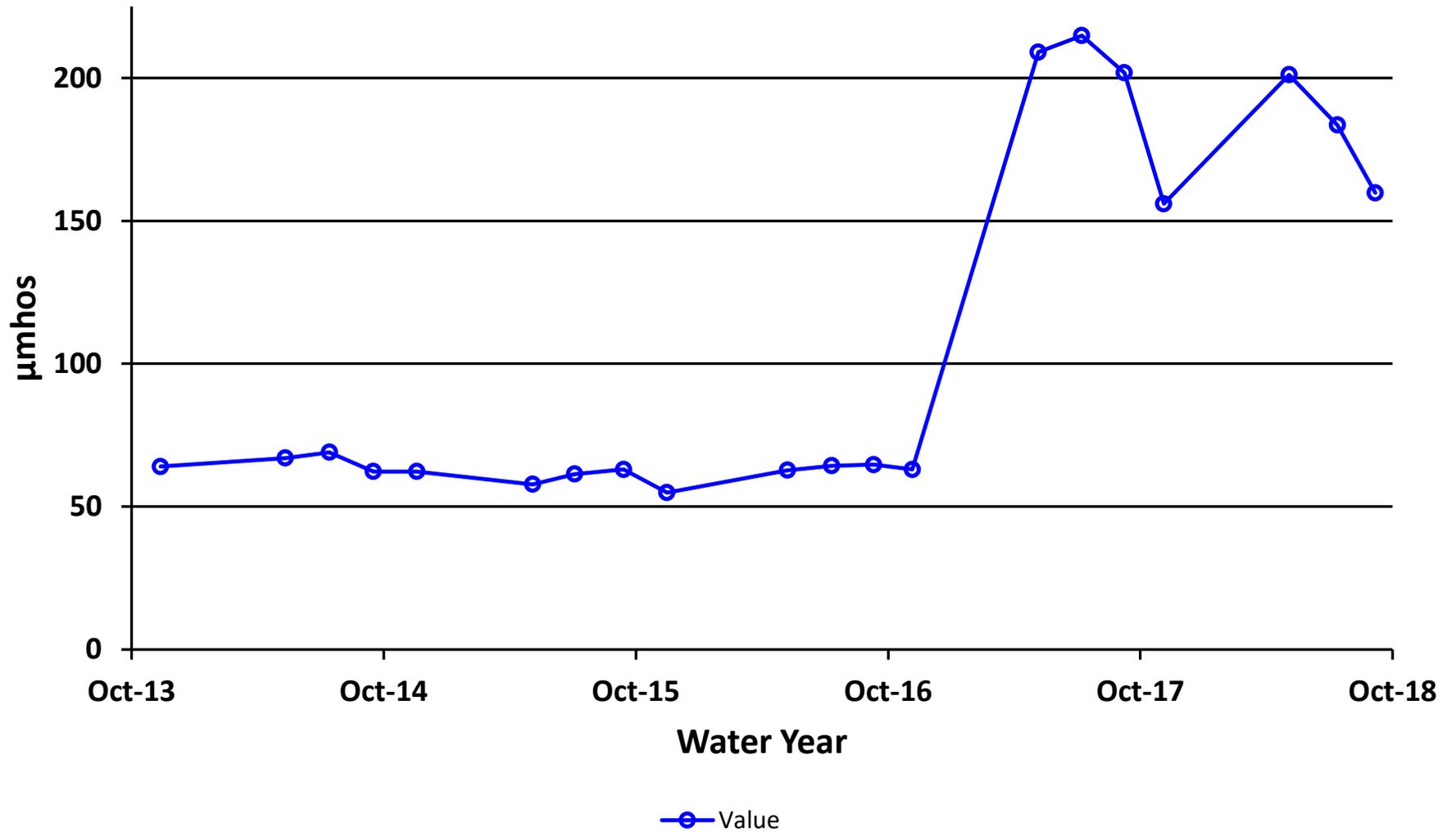
Site 32 - Water Temperature



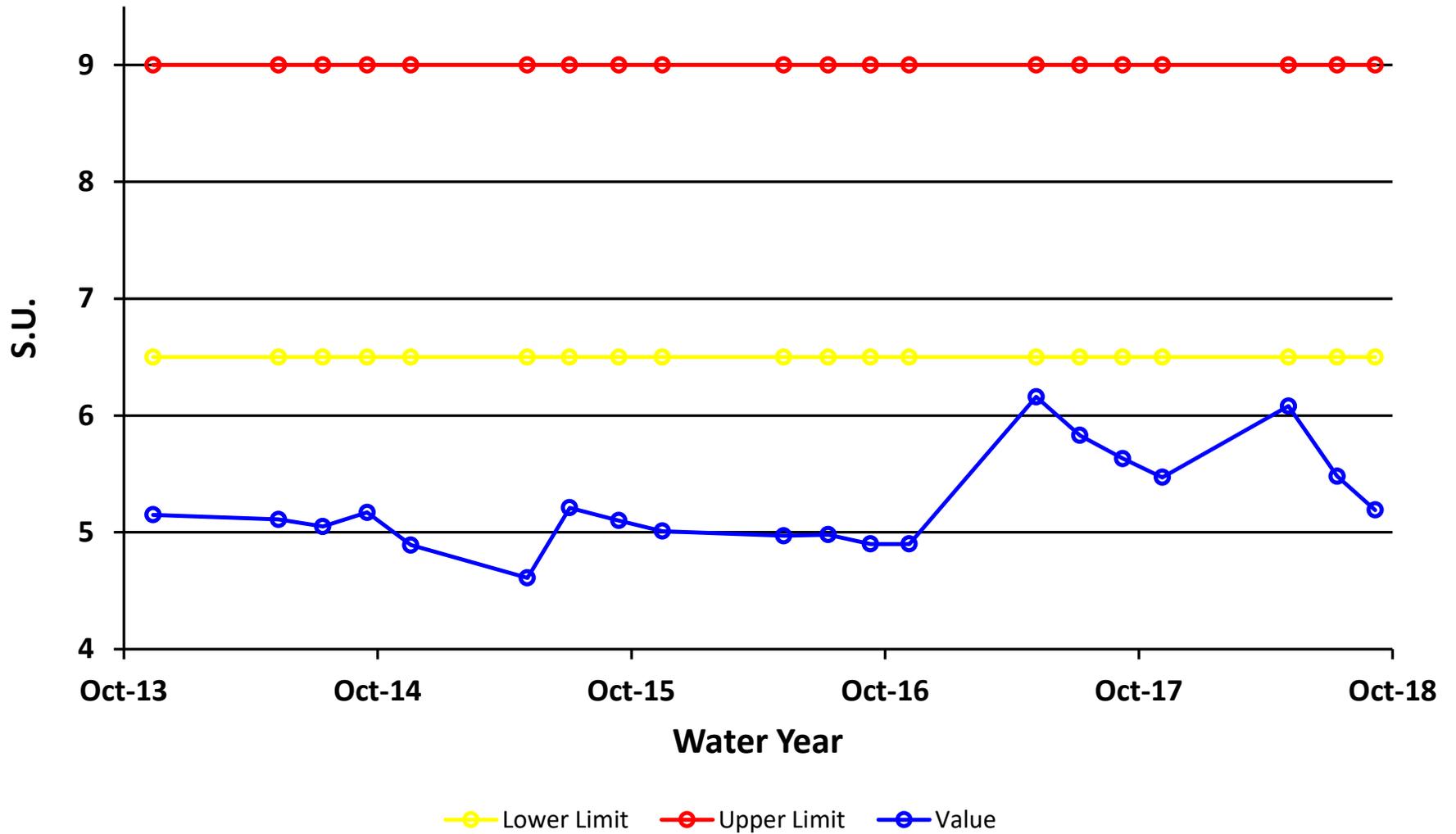
Site 32 - Conductivity Laboratory



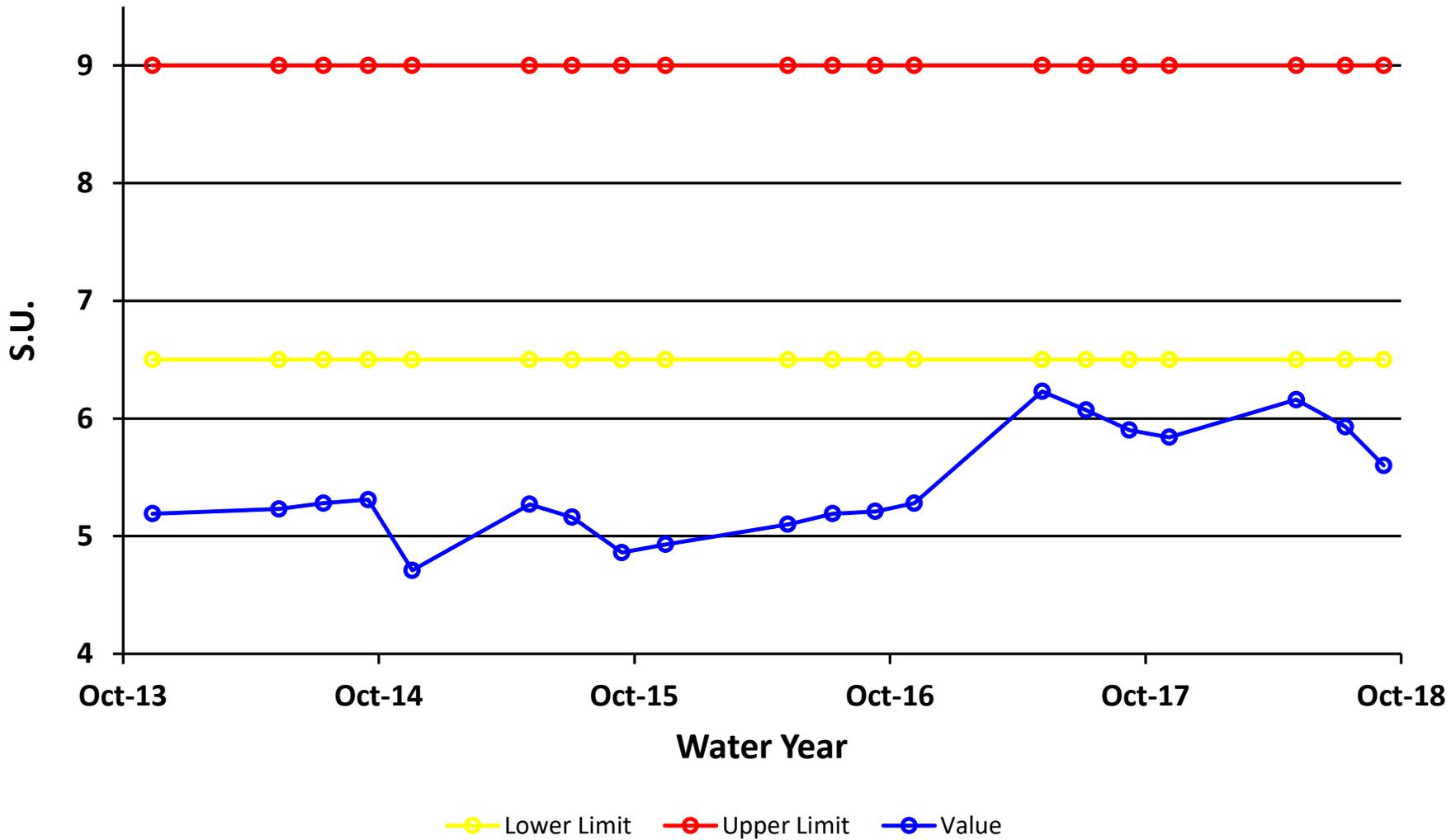
Site 32 - Conductivity Field



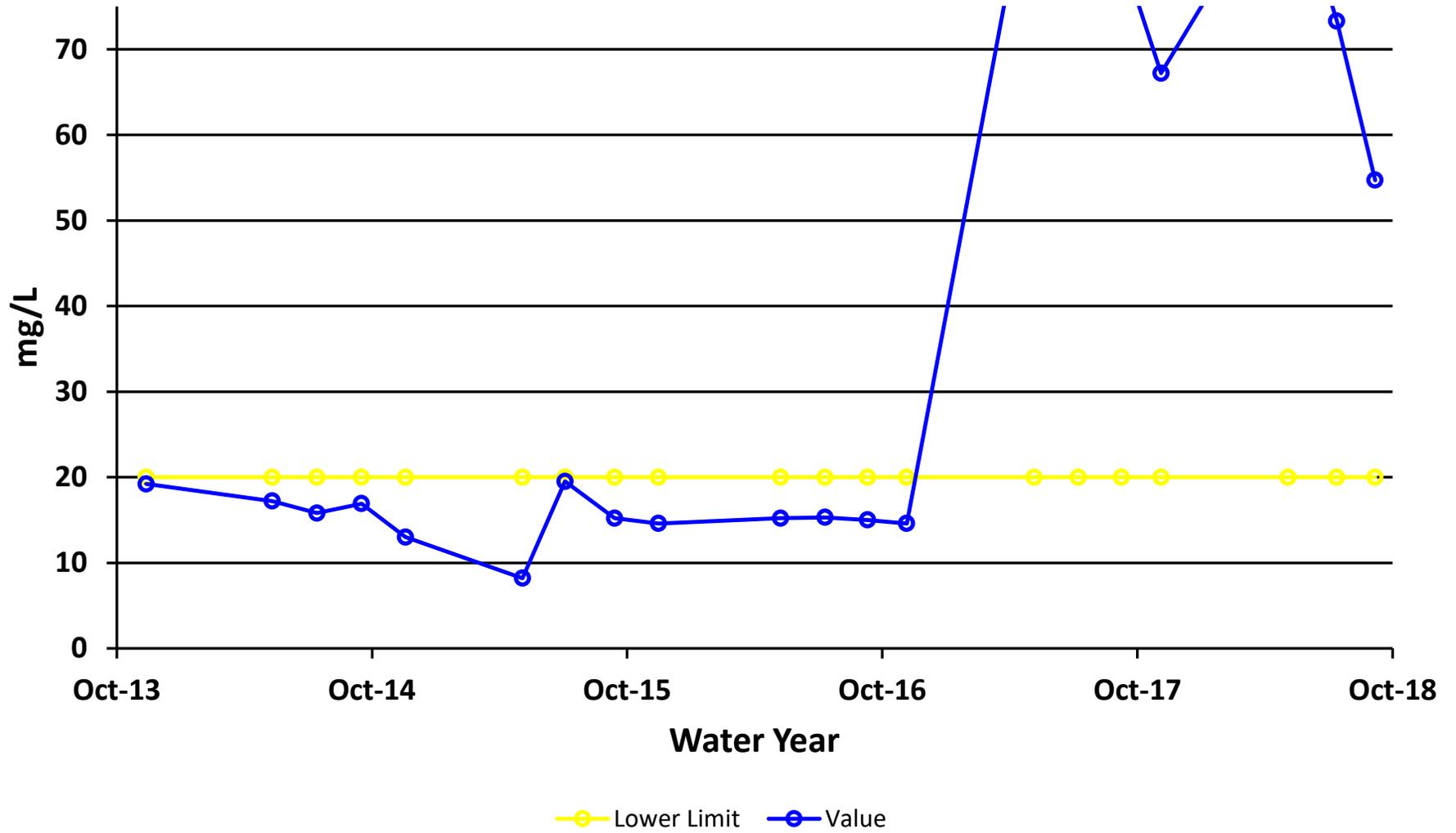
Site 32 - pH Laboratory



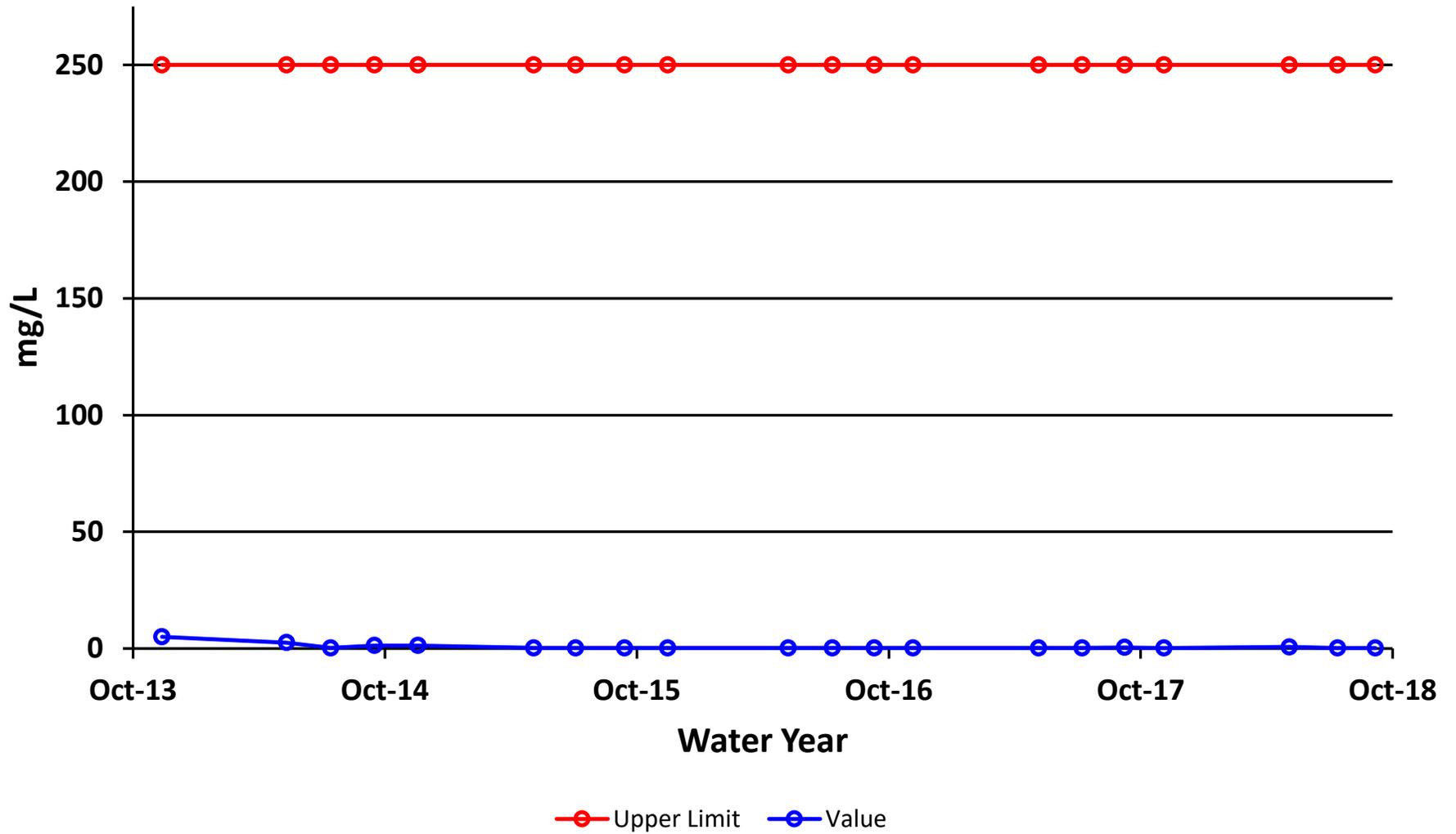
Site 32 - pH Field



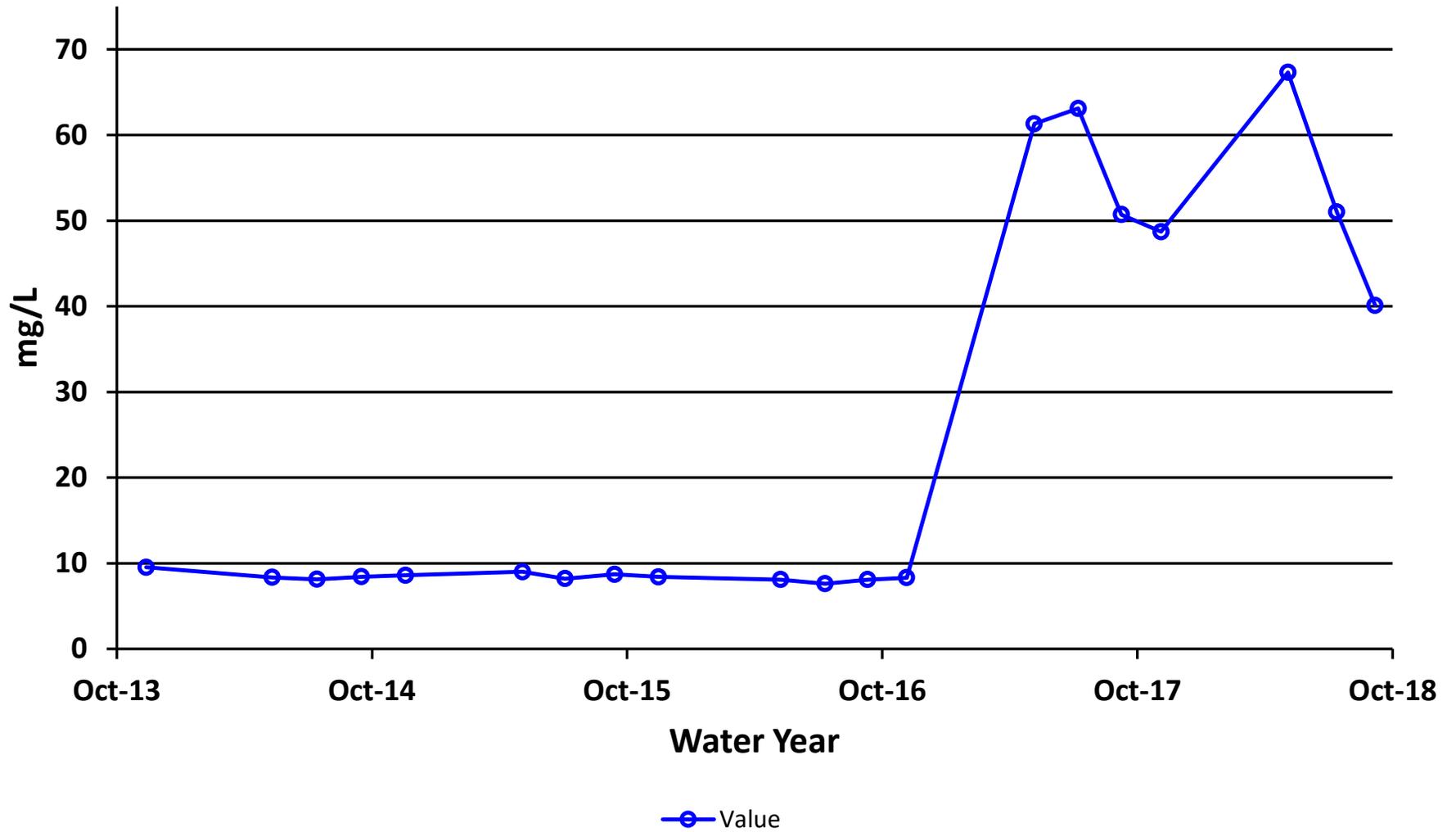
Site 32 - Alkalinity



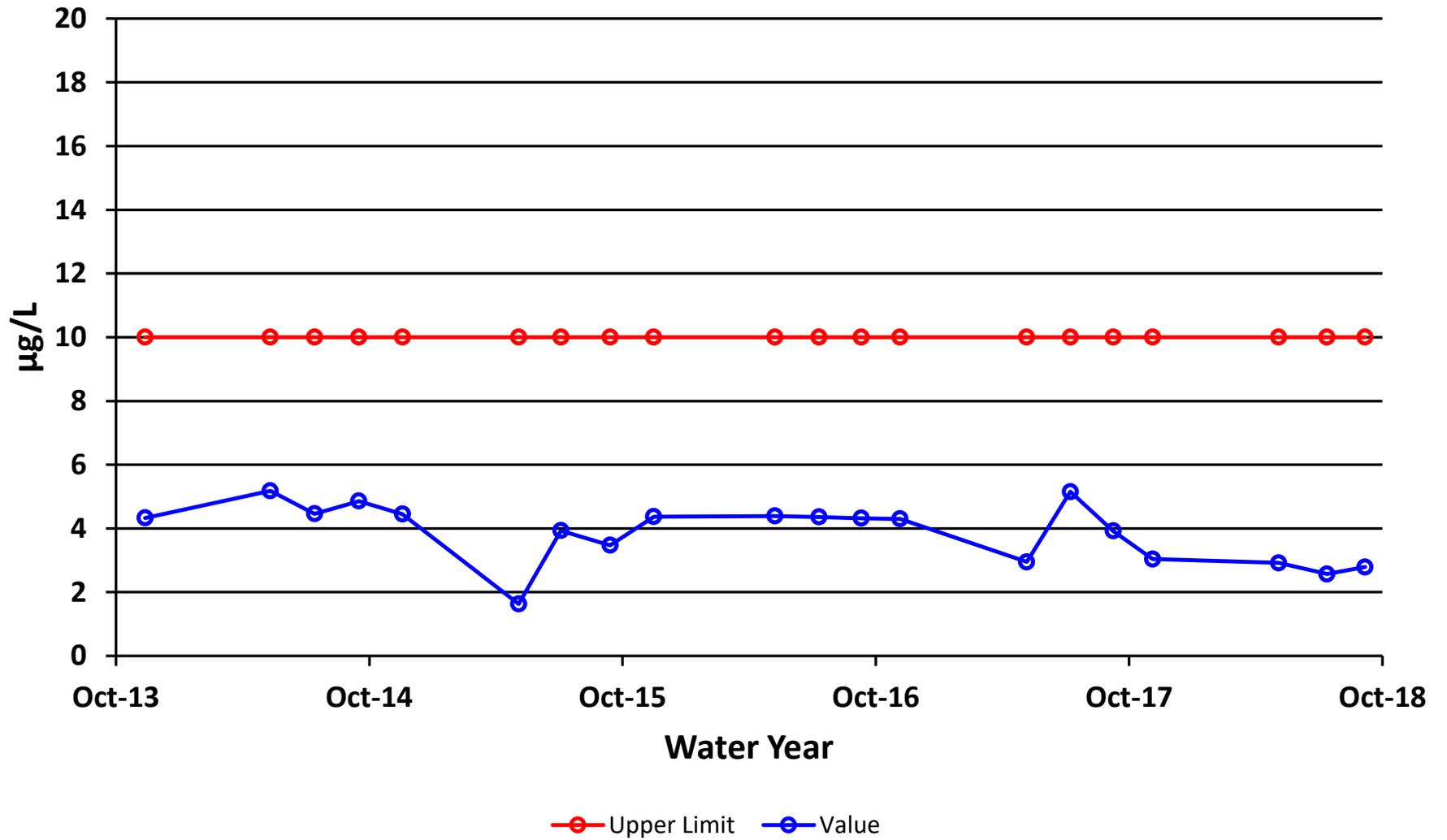
Site 32 - Sulfate



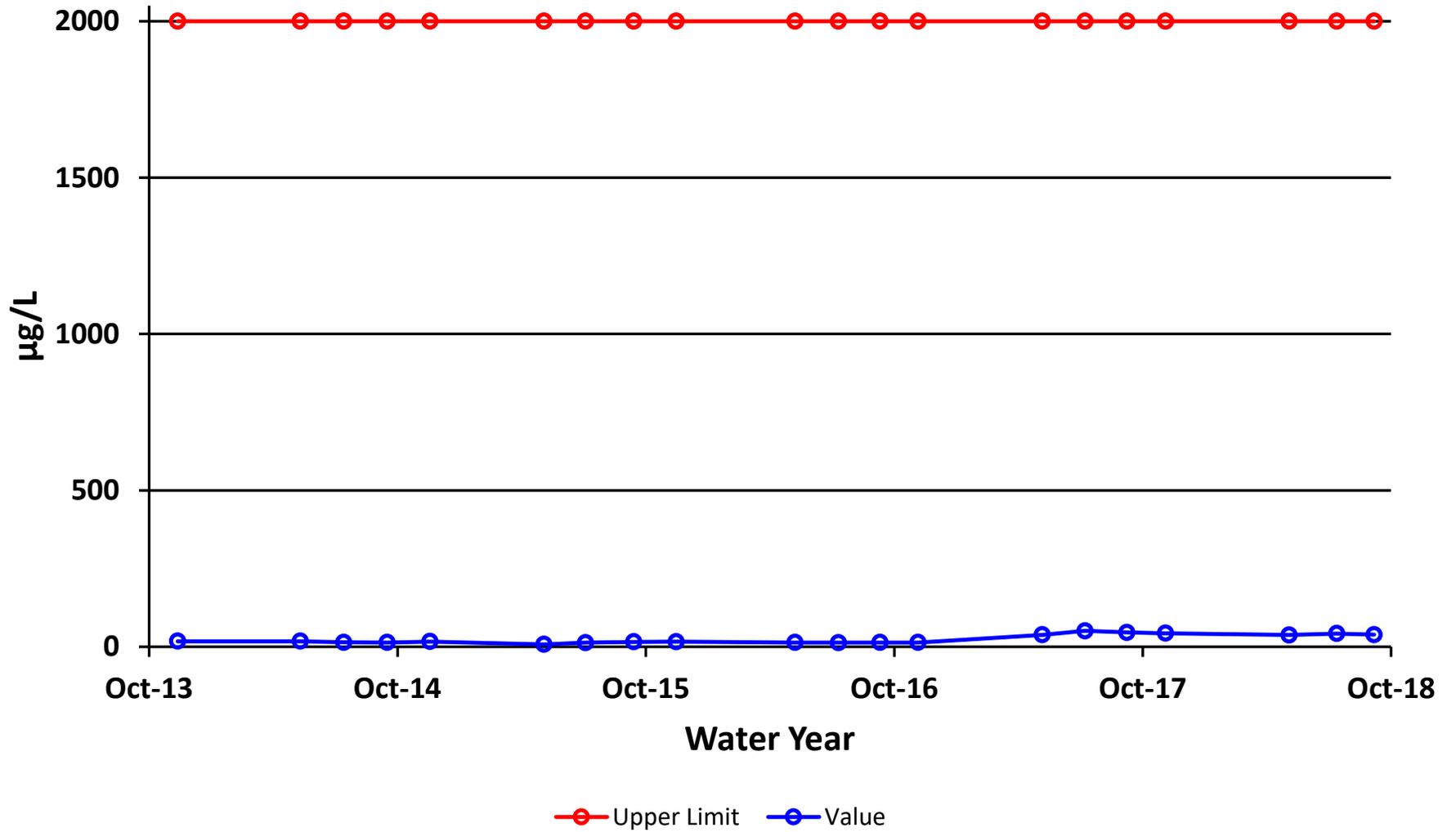
Site 32 - Hardness



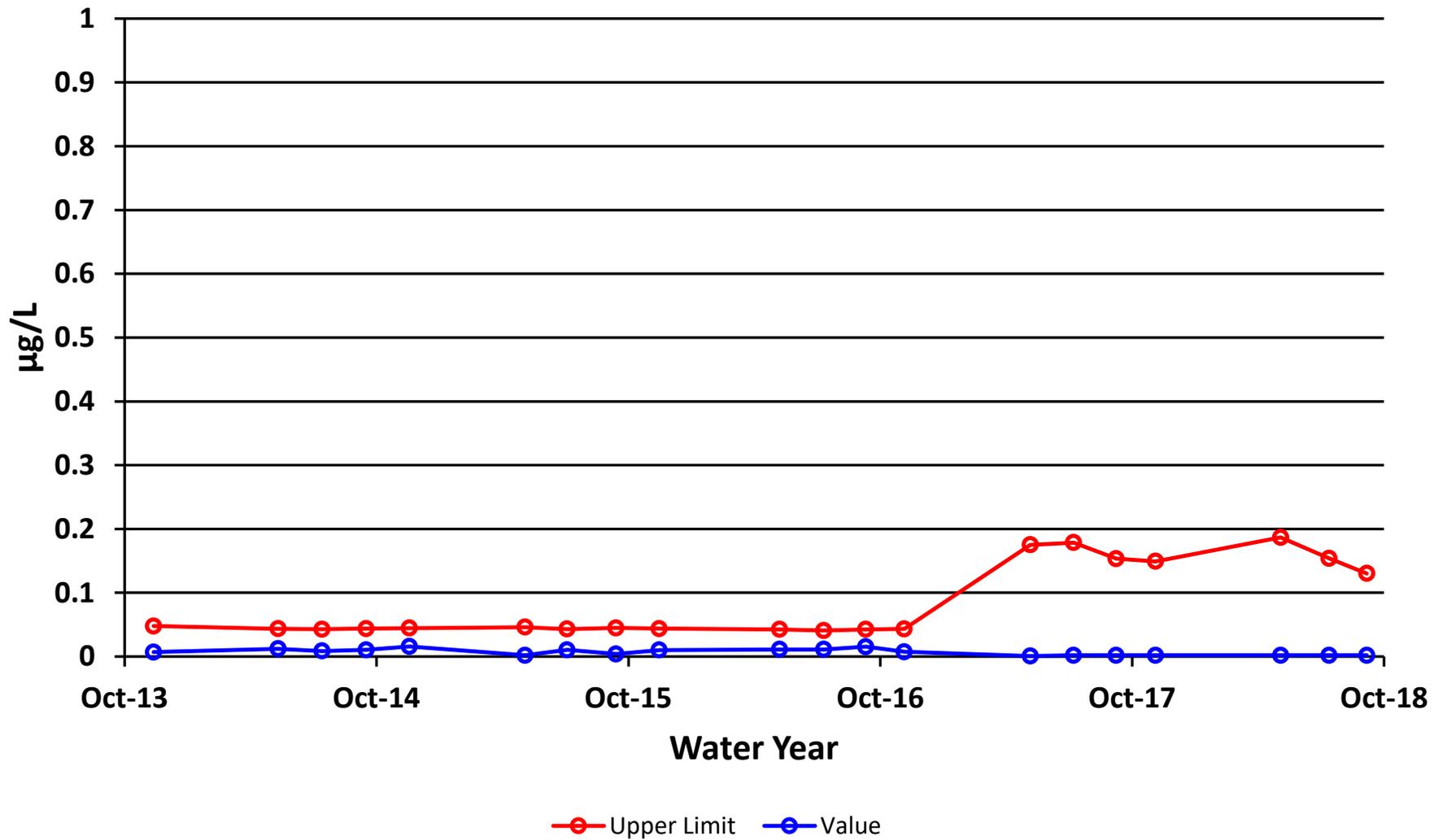
Site 32 - Arsenic Dissolved



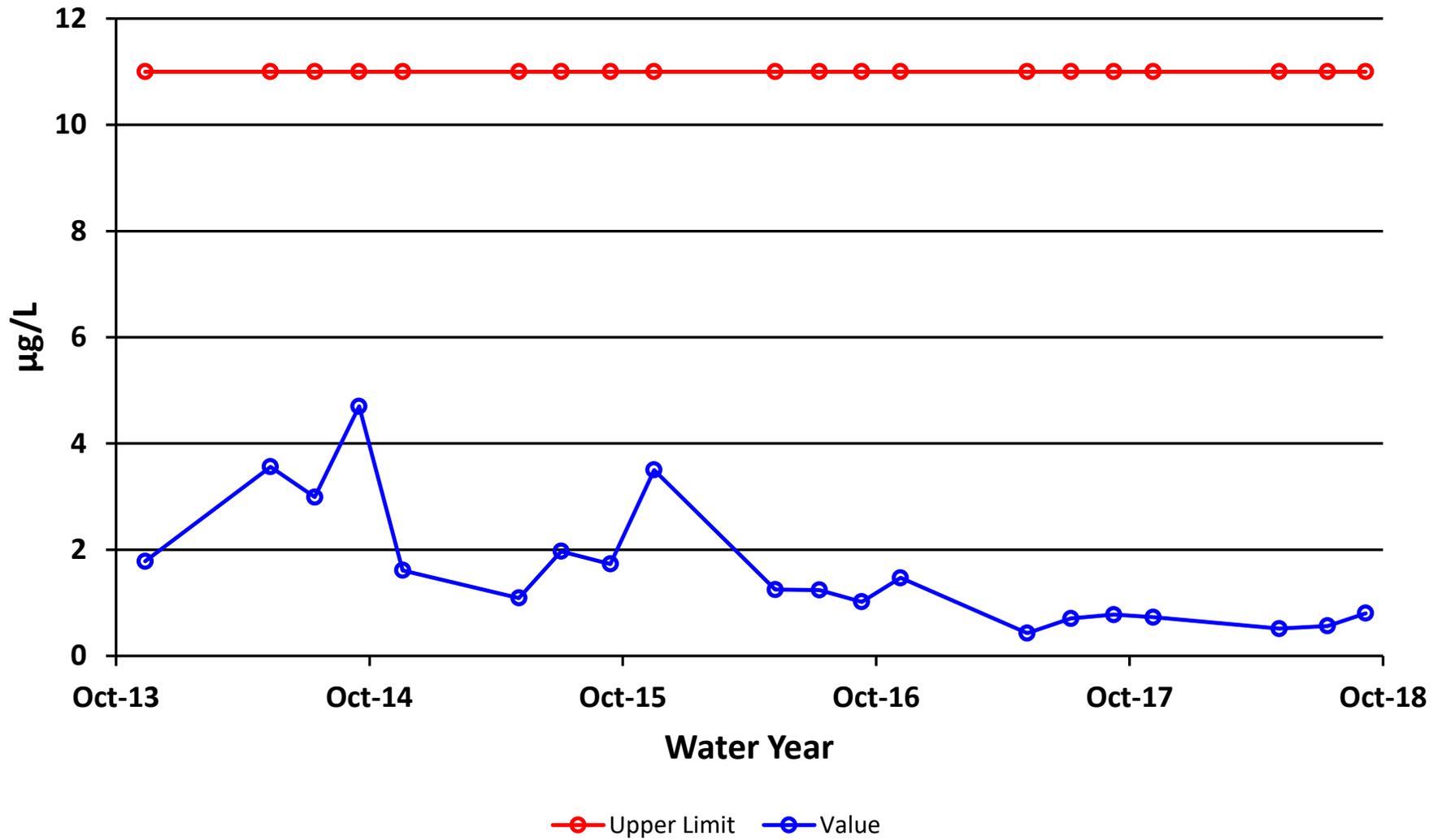
Site 32 - Barium Dissolved



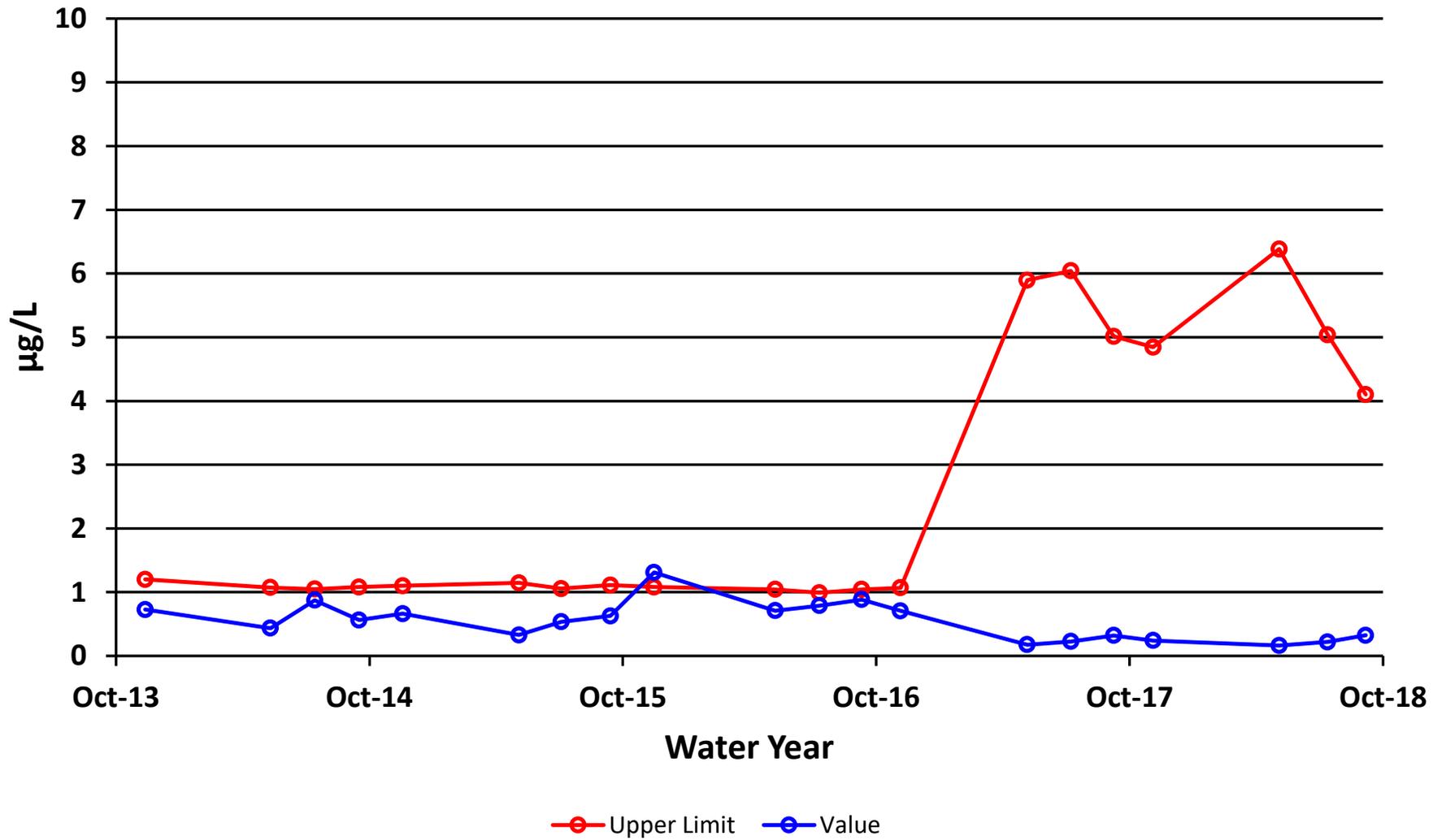
Site 32 - Cadmium Dissolved



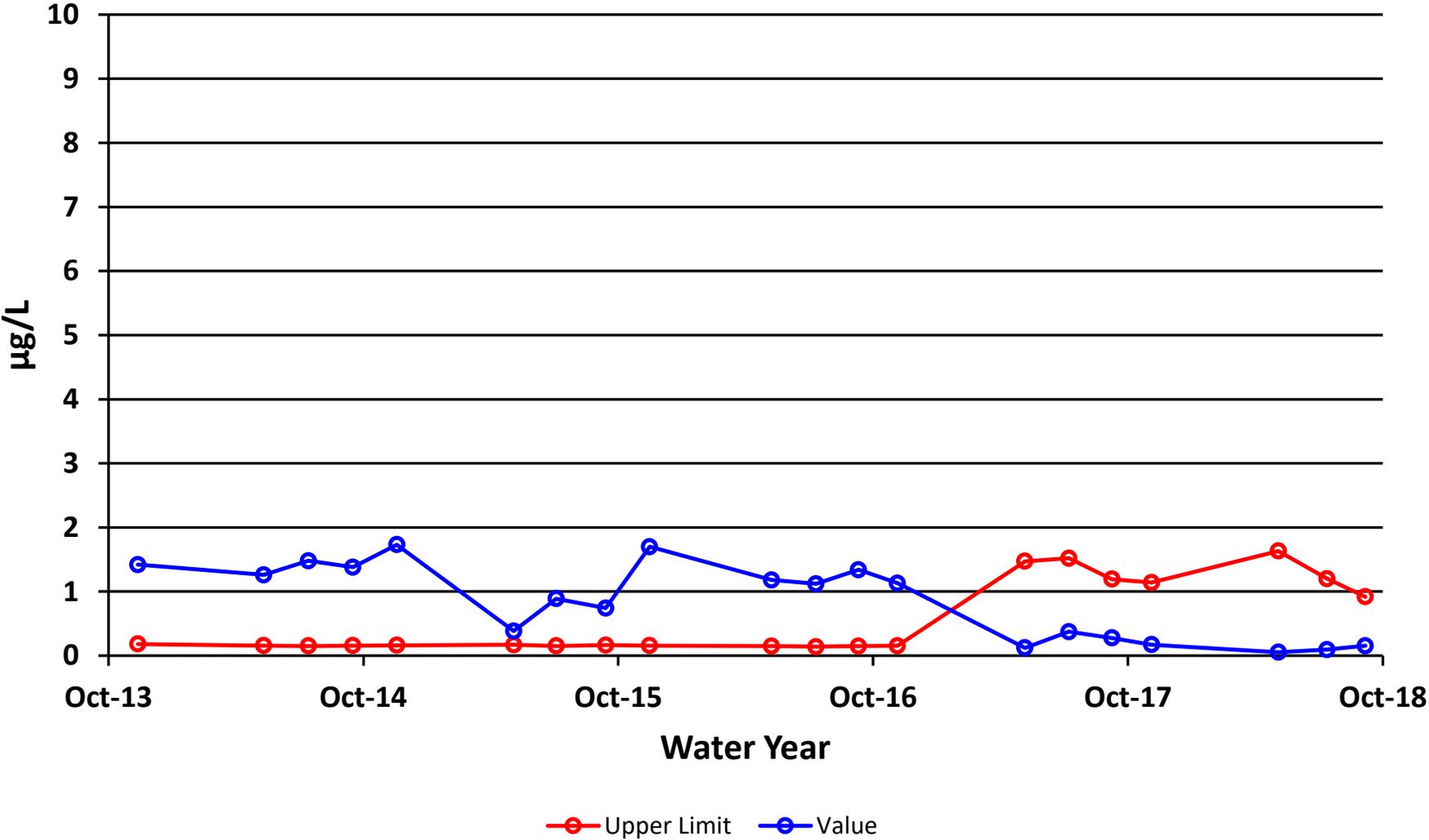
Site 32 - Chromium Dissolved



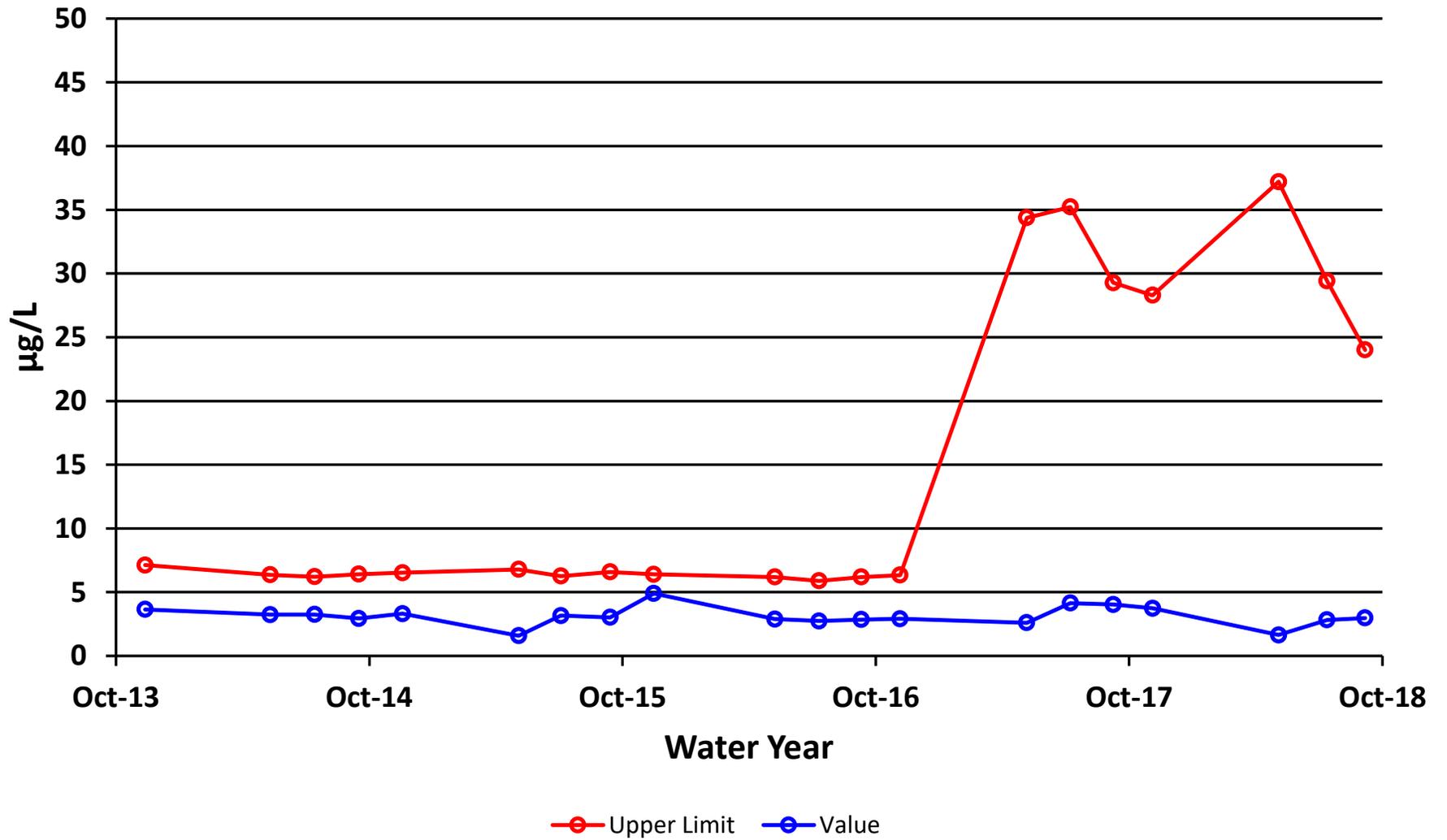
Site 32 - Copper Dissolved



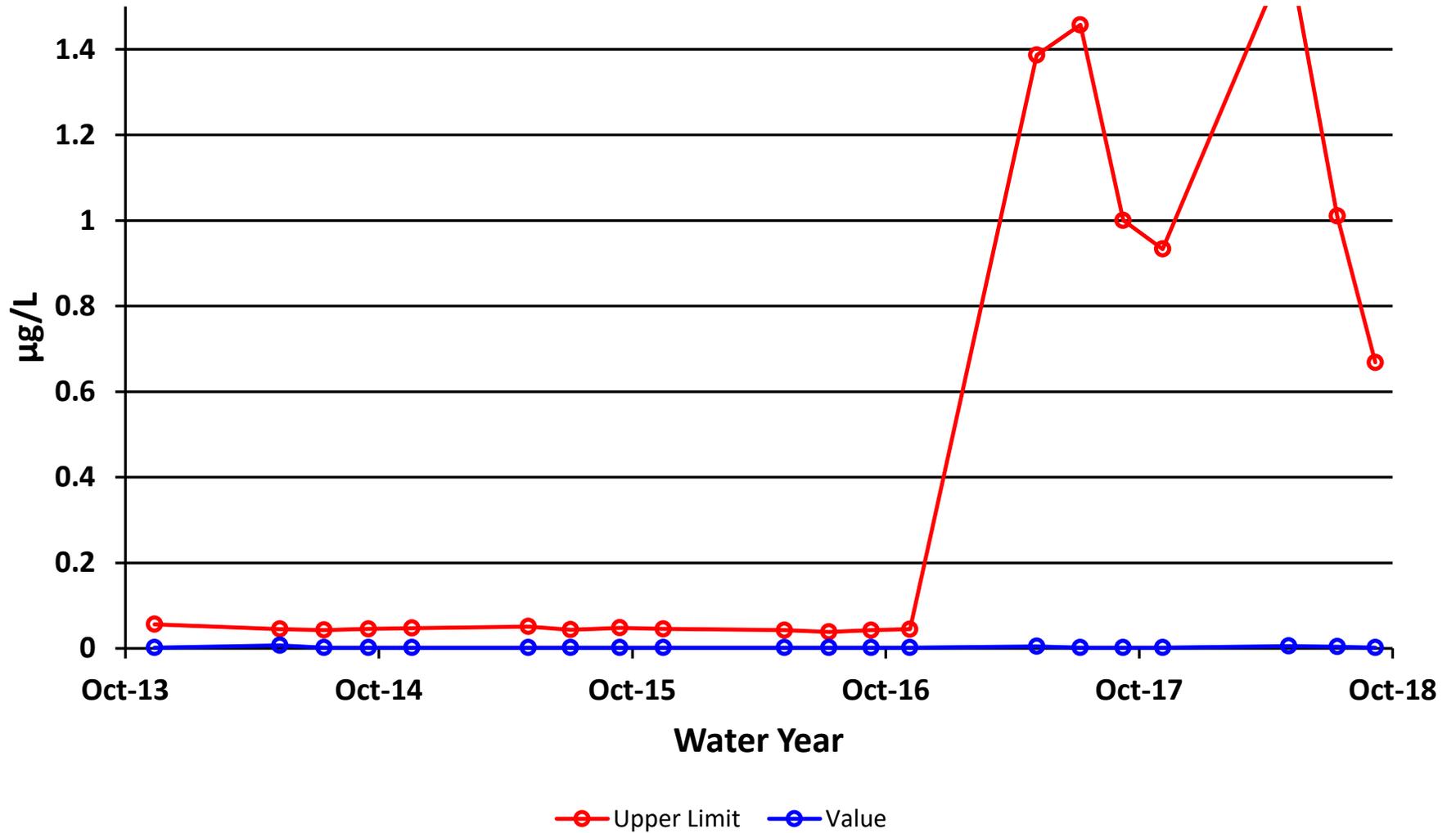
Site 32 - Lead Dissolved



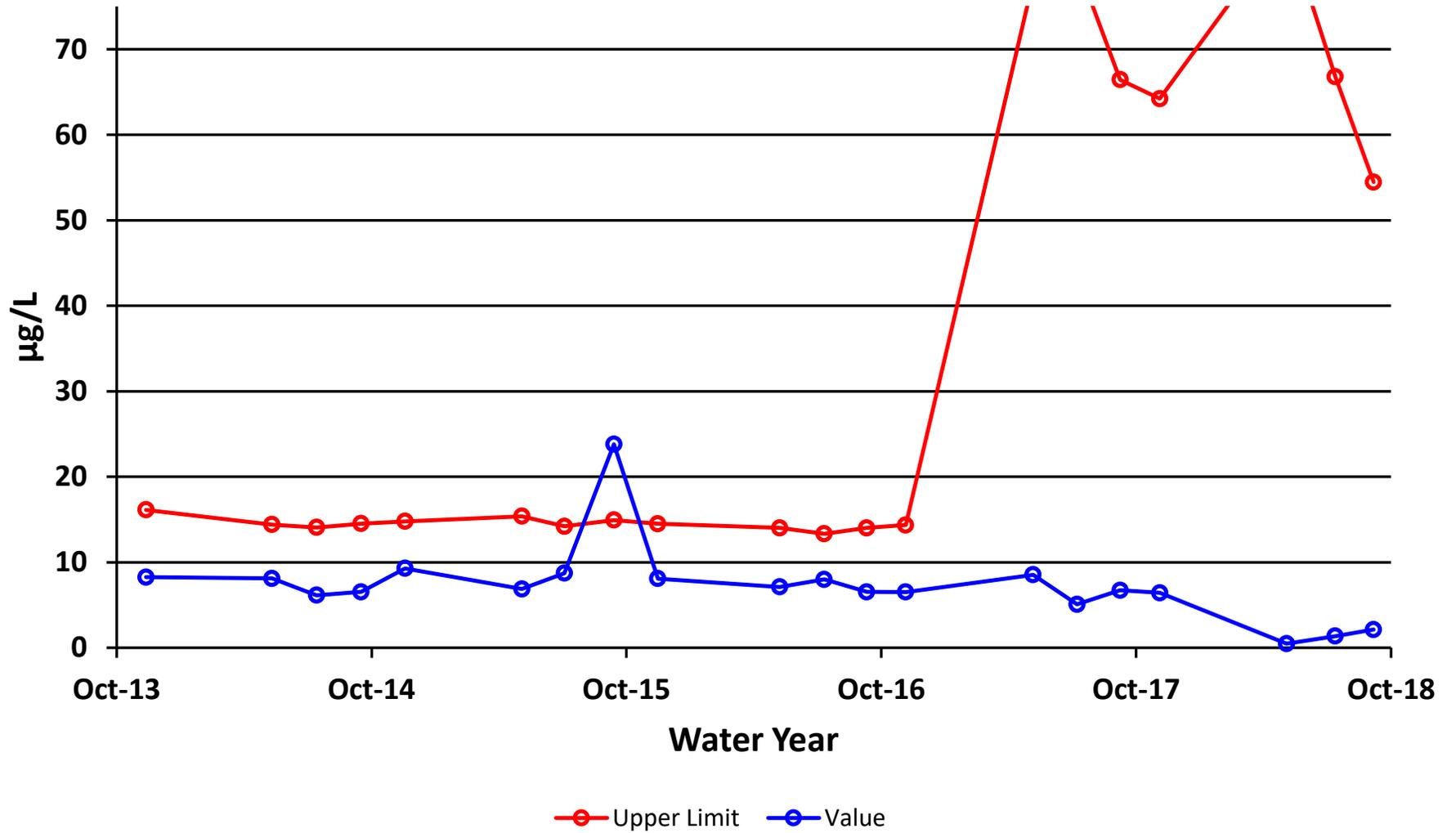
Site 32 - Nickel Dissolved



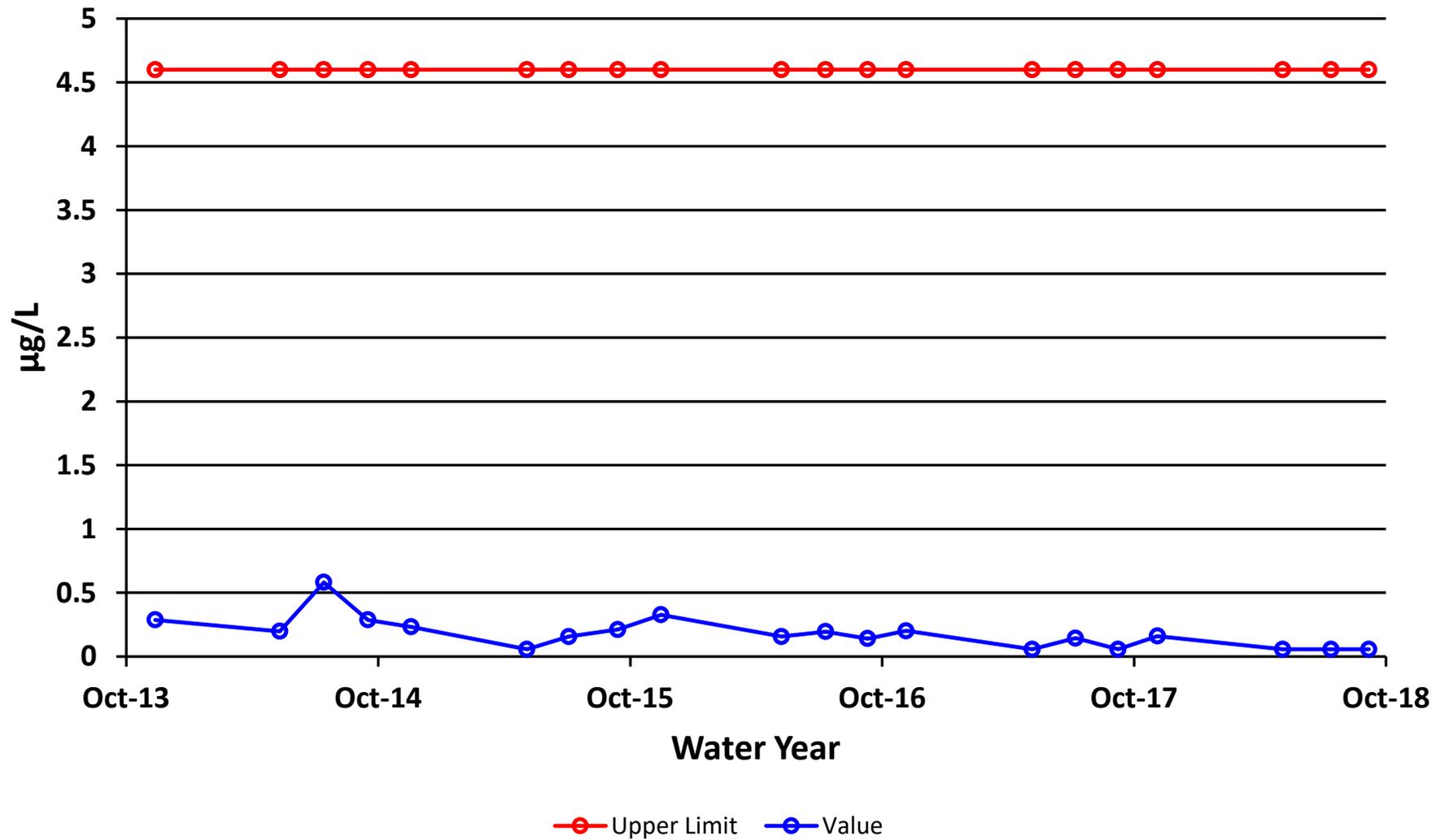
Site 32 - Silver Dissolved



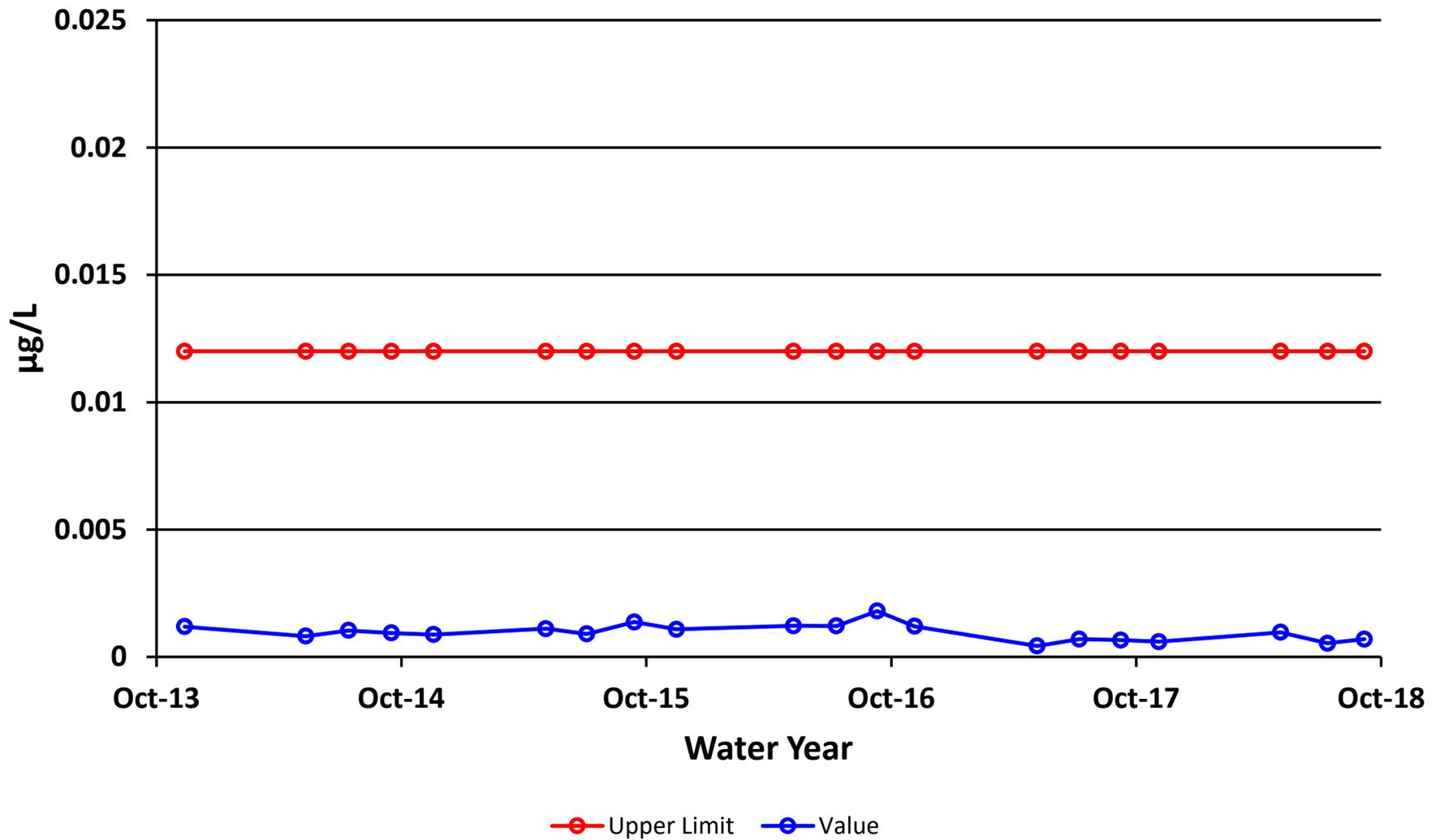
Site 32 - Zinc Dissolved



Site 32 - Selenium Dissolved



Site 32 - Mercury Dissolved



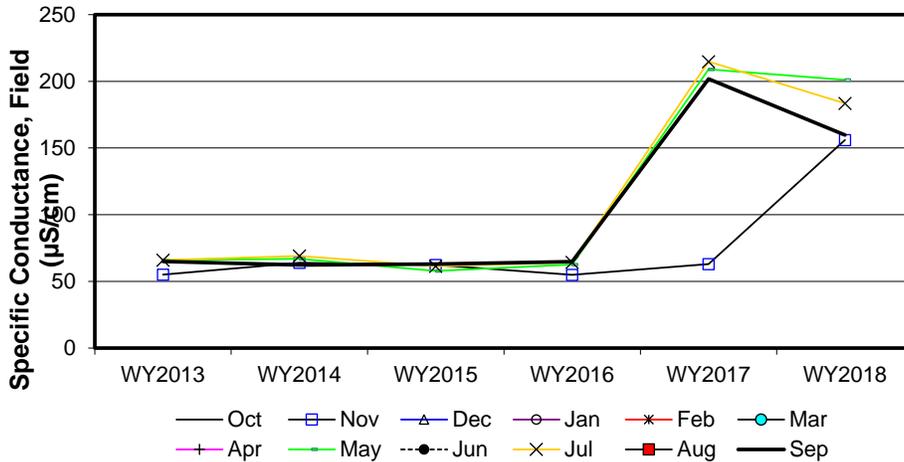
Site #32

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	WY2013		55.0						66.0		66.0		65.0
b	WY2014		64.0						67.0		69.0		62.3
c	WY2015		62.3						57.8		61.4		63.0
d	WY2016		54.9						62.7		64.3		64.7
e	WY2017		63.0						209.0		214.8		201.8
f	WY2018		156.0						201.1		183.5		159.8
n		0	6	0	0	0	0	0	6	0	6	0	6
t ₁		0	6	0	0	0	0	0	6	0	6	0	6
t ₂		0	0	0	0	0	0	0	0	0	0	0	0
t ₃		0	0	0	0	0	0	0	0	0	0	0	0
t ₄		0	0	0	0	0	0	0	0	0	0	0	0
t ₅		0	0	0	0	0	0	0	0	0	0	0	0
b-a			1						1		1		-1
c-a			1						-1		-1		-1
d-a			-1						-1		-1		-1
e-a			1						1		1		1
f-a			1						1		1		1
c-b			-1						-1		-1		1
d-b			-1						-1		-1		1
e-b			-1						1		1		1
f-b			1						1		1		1
d-c			-1						1		1		1
e-c			1						1		1		1
f-c			1						1		1		1
e-d			1						1		1		1
f-d			1						1		1		1
f-e			1						-1		-1		-1
S _k		0	5	0	0	0	0	0	5	0	5	0	7
σ _S ² =			28.33						28.33		28.33		28.33
Z _k = S _k /σ _S			0.94						0.94		0.94		1.32
Z _k ²			0.88						0.88		0.88		1.73

ΣZ _k =	4.13	Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅	Σn	24
ΣZ _k ² =	4.38	Count	24	0	0	0	0	ΣS _k	22
Z-bar=ΣZ _k /K=	1.03								

χ _h ² =ΣZ _k ² -K(Z-bar) ² =	0.11	@α=5% χ _(K-1) ² =	7.81	Test for station homogeneity	
p	0.991			χ _h ² <χ _(K-1) ²	ACCEPT
ΣVAR(S _k)	Z _{calc} 1.97	@α/2=2.5% Z=	1.96	H ₀ (No trend)	REJECT
113.33	p 0.976			H _A (± trend)	ACCEPT



Seasonal-Kendall Slope Confidence Intervals			
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.19		34.79
0.050	0.77	8.55	30.60
0.100	1.29		26.55
0.200	2.47		23.24
		13.2%	

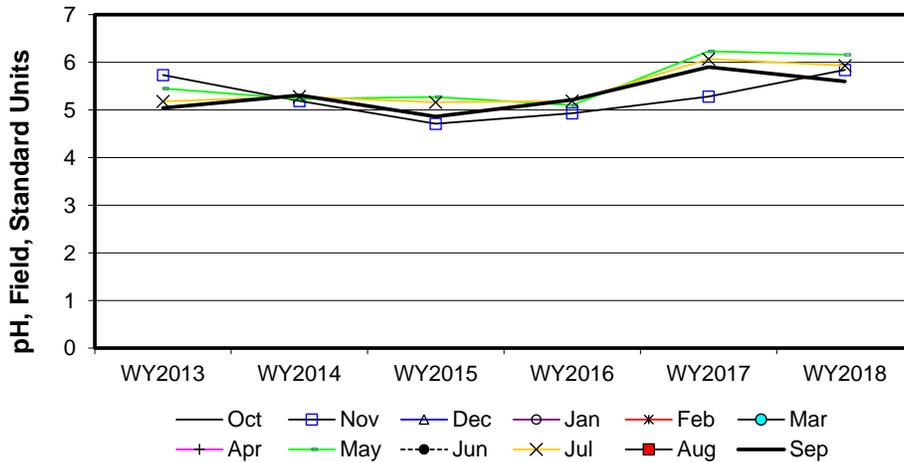
Site #32

Seasonal Kendall analysis for pH, Field, Standard Units

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	WY2013		5.7						5.5		5.2		5.0
b	WY2014		5.2						5.2		5.3		5.3
c	WY2015		4.7						5.3		5.2		4.9
d	WY2016		4.9						5.1		5.2		5.2
e	WY2017		5.3						6.2		6.1		5.9
f	WY2018		5.8						6.2		5.9		5.6
n		0	6	0	0	0	0	0	6	0	6	0	6
t ₁		0	6	0	0	0	0	0	6	0	6	0	6
t ₂		0	0	0	0	0	0	0	0	0	0	0	0
t ₃		0	0	0	0	0	0	0	0	0	0	0	0
t ₄		0	0	0	0	0	0	0	0	0	0	0	0
t ₅		0	0	0	0	0	0	0	0	0	0	0	0
b-a			-1						-1		1		1
c-a			-1						-1		-1		-1
d-a			-1						-1		1		1
e-a			-1						1		1		1
f-a			1						1		1		1
c-b			-1						1		-1		-1
d-b			-1						-1		-1		-1
e-b			1						1		1		1
f-b			1						1		1		1
d-c			1						-1		1		1
e-c			1						1		1		1
f-c			1						1		1		1
e-d			1						1		1		1
f-d			1						1		1		1
f-e			1						-1		-1		-1
S _k		0	3	0	0	0	0	0	3	0	7	0	7
σ _S ² =			28.33						28.33		28.33		28.33
Z _k = S _k /σ _S			0.56						0.56		1.32		1.32
Z _k ²			0.32						0.32		1.73		1.73

ΣZ _k =	3.76	Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅	Σn	24
ΣZ _k ² =	4.09	Count	24	0	0	0	0	ΣS _k	20
Z-bar=ΣZ _k /K=	0.94								

χ _h ² =ΣZ _k ² -K(Z-bar) ² =	0.56	@α=5% χ _(K-1) ² =	7.81	Test for station homogeneity
p	0.904			χ _h ² < χ _(K-1) ² ACCEPT
ΣVAR(S _k)	Z _{calc} 1.78	@α/2=2.5% Z=	1.96	H ₀ (No trend) ACCEPT
113.33	p 0.963			H _A (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals			
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.06	0.15	0.26
0.050	0.01		0.22
0.100	0.03		0.21
0.200	0.05		0.20

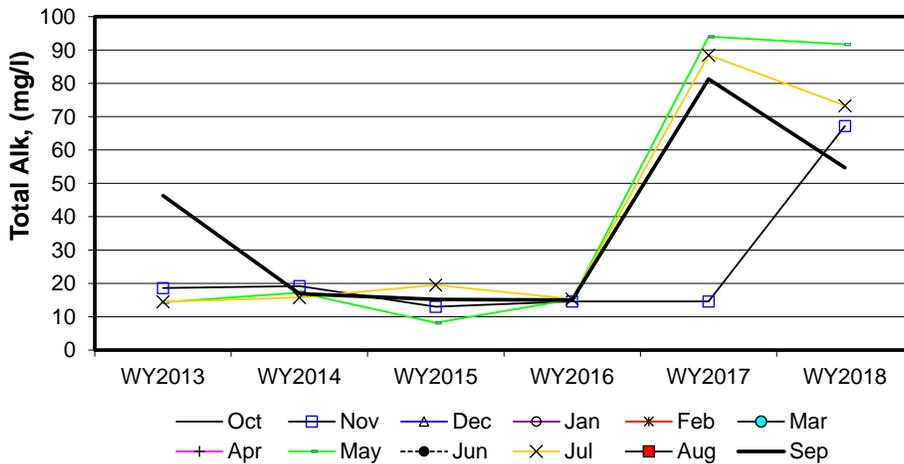
Site #32

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	WY2013		18.6						14.3		14.5		46.3
b	WY2014		19.2						17.2		15.8		16.9
c	WY2015		13.0						8.2		19.5		15.2
d	WY2016		14.6						15.2		15.3		15.0
e	WY2017		14.6						94.0		88.5		81.3
f	WY2018		67.2						91.7		73.3		54.7
n		0	6	0	0	0	0	0	6	0	6	0	6
t ₁		0	4	0	0	0	0	0	6	0	6	0	6
t ₂		0	1	0	0	0	0	0	0	0	0	0	0
t ₃		0	0	0	0	0	0	0	0	0	0	0	0
t ₄		0	0	0	0	0	0	0	0	0	0	0	0
t ₅		0	0	0	0	0	0	0	0	0	0	0	0
b-a			1						1		1		-1
c-a			-1						-1		1		-1
d-a			-1						1		1		-1
e-a			-1						1		1		1
f-a			1						1		1		1
c-b			-1						-1		1		-1
d-b			-1						-1		-1		-1
e-b			-1						1		1		1
f-b			1						1		1		1
d-c			1						1		-1		-1
e-c			1						1		1		1
f-c			1						1		1		1
e-d			0						1		1		1
f-d			1						1		1		1
f-e			1						-1		-1		-1
S _k		0	2	0	0	0	0	0	7	0	9	0	1
σ _S ² =			27.33						28.33		28.33		28.33
Z _k = S _k /σ _S			0.38						1.32		1.69		0.19
Z _k ²			0.15						1.73		2.86		0.04

ΣZ _k =	3.58	Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅	Σn	24
ΣZ _k ² =	4.77	Count	22	1	0	0	0	ΣS _k	19
Z-bar=ΣZ _k /K=	0.89								

χ _h ² =ΣZ _k ² -K(Z-bar) ² =	1.57	@α=5% χ _(K-1) ² =	7.81	Test for station homogeneity
p	0.666			χ _h ² <χ _(K-1) ² ACCEPT
ΣVAR(S _k)	Z _{calc} 1.70	@α/2=2.5% Z=	1.96	H ₀ (No trend) ACCEPT
112.33	p 0.955			H _A (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals			
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.97	3.30	18.21
0.050	0.08		14.03
0.100	0.36		11.95
0.200	1.07		9.57

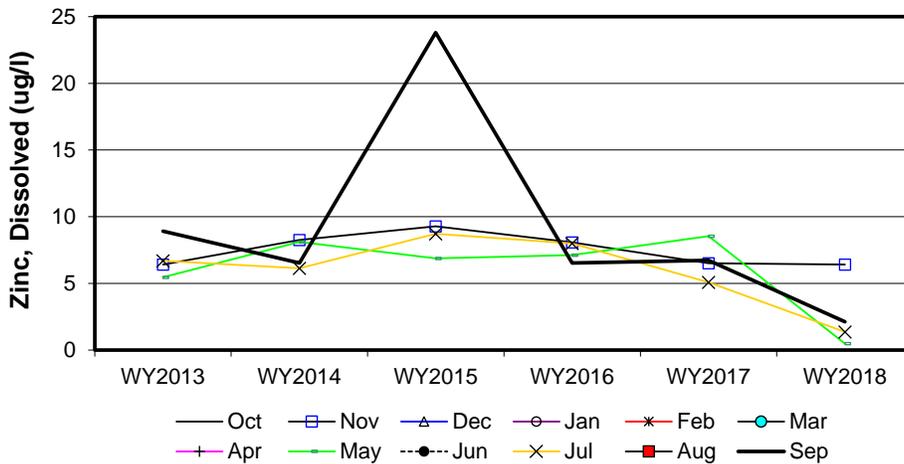
Site #32

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	WY2013		6.4						5.5		6.7		8.9
b	WY2014		8.3						8.1		6.1		6.5
c	WY2015		9.3						6.9		8.7		23.8
d	WY2016		8.1						7.1		8.0		6.5
e	WY2017		6.5						8.5		5.1		6.7
f	WY2018		6.4						0.5		1.4		2.1
n		0	6	0	0	0	0	0	6	0	6	0	6
t ₁		0	6	0	0	0	0	0	6	0	6	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		-1		-1
c-a			1						1		1		1
d-a			1						1		1		-1
e-a			1						1		-1		-1
f-a			1						-1		-1		-1
c-b			1						-1		1		1
d-b			-1						-1		1		0
e-b			-1						1		-1		1
f-b			-1						-1		-1		-1
d-c			-1						1		-1		-1
e-c			-1						1		-1		-1
f-c			-1						-1		-1		-1
e-d			-1						1		-1		1
f-d			-1						-1		-1		-1
f-e			-1						-1		-1		-1
S _k		0	-3	0	0	0	0	0	1	0	-7	0	-6
σ _S ² =			28.33						28.33		28.33		27.33
Z _k = S _k /σ _S			-0.56						0.19		-1.32		-1.15
Z _k ²			0.32						0.04		1.73		1.32

ΣZ _k =	-2.84	Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅	Σn	24
ΣZ _k ² =	3.40	Count	22	1	0	0	0	ΣS _k	-15
Z-bar=ΣZ _k /K=	-0.71								

χ _h ² =ΣZ _k ² -K(Z-bar) ² =	1.39	@α=5% χ _(K-1) ² =	7.81	Test for station homogeneity
p	0.709			χ _h ² <χ _(K-1) ² ACCEPT
ΣVAR(S _k)	Z _{calc} -1.32	@α/2=2.5% Z=	1.96	H ₀ (No trend) ACCEPT
112.33	p 0.093			H _A (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals			
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-1.37	-0.55	0.16
0.050	-1.17		0.00
0.100	-1.05		-0.09
0.200	-0.89		-0.38

INTERPRETIVE REPORT

SITE 9

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

The data collected during the current water year are listed in the following “Table of Results for Water Year 2018” 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 one-half of the for the purpose of median calculation.

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

Sample Date	Parameter	Value	Qualifier	Notes
No outliers, in the past six years, have been identified by HGCMC.				

The data for current water year have been compared to the strictest fresh water quality criterion for each applicable analyte. Four results exceeding these criteria has been identified and are listed in the table below.

Table of Exceedance for Water Year 2018

Sample Date	Parameter	Value	Limits		Hardness
			Lower	Upper	
8-May-18	Alkalinity, Total	9.8 mg/L	20		26.3 mg/L
17-Jul-18	Alkalinity, Total	9.2 mg/L	20		29.3 mg/L
17-Jul-18	Lead, Dissolved	0.71 µg/L		0.65	29.3 mg/L
8-May-18	pH	6.49 su	6.5	9.0	26.3 mg/L

Two samples were below the lower limit for alkalinity, and one was slightly below the lower limit for pH. Low alkalinity and pH values routinely occur at Site 9 and are expected because Tributary Creek drains a large area of peat muskeg that produces dilute, low-alkalinity water. One sample was above the AWQS for lead. As noted in the interpretive section for Site 29 fugitive tailings dust may be contributing to the elevated lead levels monitored at Site 9.

X-Y plots have been generated to graphically present the data for each of the analytes that are listed in Suite Q. No obvious visual trends were observed for the report period.

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-12 and Sep-18 (WY2013-WY2018).

Site 9 - Table of Summary Statistics for Trend Analysis

Parameter	Mann-Kendall test statistics			Sen's slope estimate	
	n*	p**	Trend	Q	Q(%)
Conductivity Field	6	0.39			
pH Field	6	<0.01	-	-0.08	-1.1
Alkalinity, Total	6	0.50			
Sulfate, Total	6	0.50			
Zinc, Dissolved	6	0.08			

* Number of Years ** Significance level

A statistically significant ($\alpha/2=2.5\%$) decreasing trend for pH was observed during the current water year. HGCMC continues 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 continue to 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 2018

Site 009FMS - 'Lower Tributary Creek'

Sample Date/Parameter	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018	Median
Water Temp (°C)		1.7						5.7		10.9		10.8	8.3
Conductivity-Field(µmho)		97.5						69.3		67.8		96.5	82.9
Conductivity-Lab (µmho)		87						64		63		88	76
pH Lab (standard units)		6.03						5.76		5.74		6.14	5.90
pH Field (standard units)		7.01						6.49		6.69		6.77	6.73
Total Alkalinity (mg/L)		21.6						9.8		9.2		23.4	15.7
Total Sulfate (mg/L)		15.1						10		10.5		10.3	10.4
Hardness (mg/L)		41.5						26.3		29.3		36.7	33.0
Dissolved As (ug/L)		0.815						0.628		1.05		1.38	0.933
Dissolved Ba (ug/L)		39.7						28.4		37.3		41.2	38.5
Dissolved Cd (ug/L)		0.0238						0.0152		0.0339		0.0289	0.0264
Dissolved Cr (ug/L)		0.512						0.407		0.618		0.687	0.565
Dissolved Cu (ug/L)		1.22						1.45		2.2		1.58	1.515
Dissolved Pb (ug/L)		0.383						0.221		0.713		0.556	0.470
Dissolved Ni (ug/L)		1.87						1.49		2.15		2.21	2.010
Dissolved Ag (ug/L)		0.01						0.006		0.009		0.014	0.010
Dissolved Zn (ug/L)		3.47						2.97		4.89		3.08	3.28
Dissolved Se (ug/L)		0.145						0.057		0.125		0.139	0.132
Dissolved Hg (ug/L)		0.0032						0.0033		0.0011		0.0042	0.0033

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

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

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

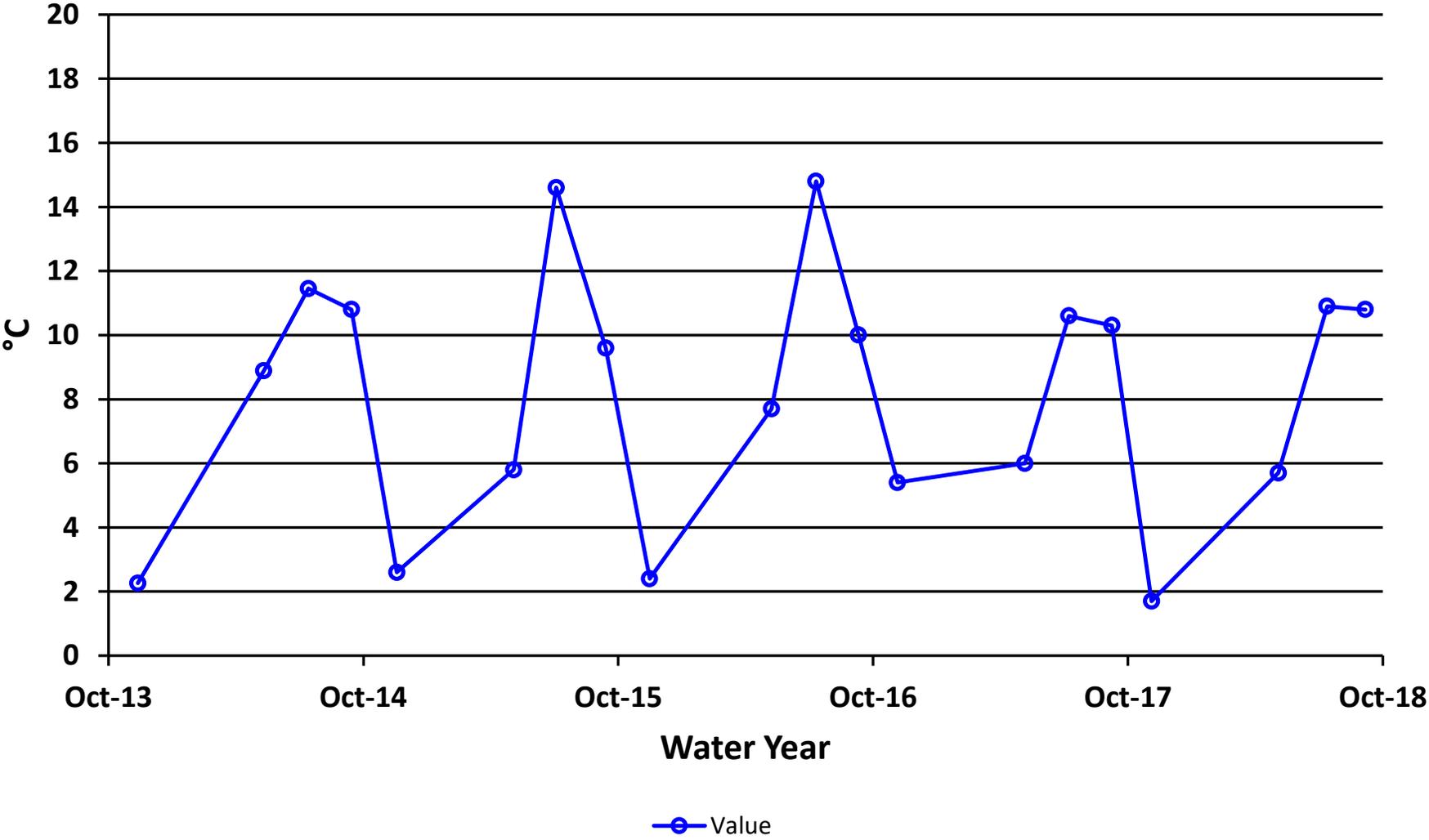
Qualified Data by QA Reviewer

Date Range: 10/01/2017 to 09/30/2018

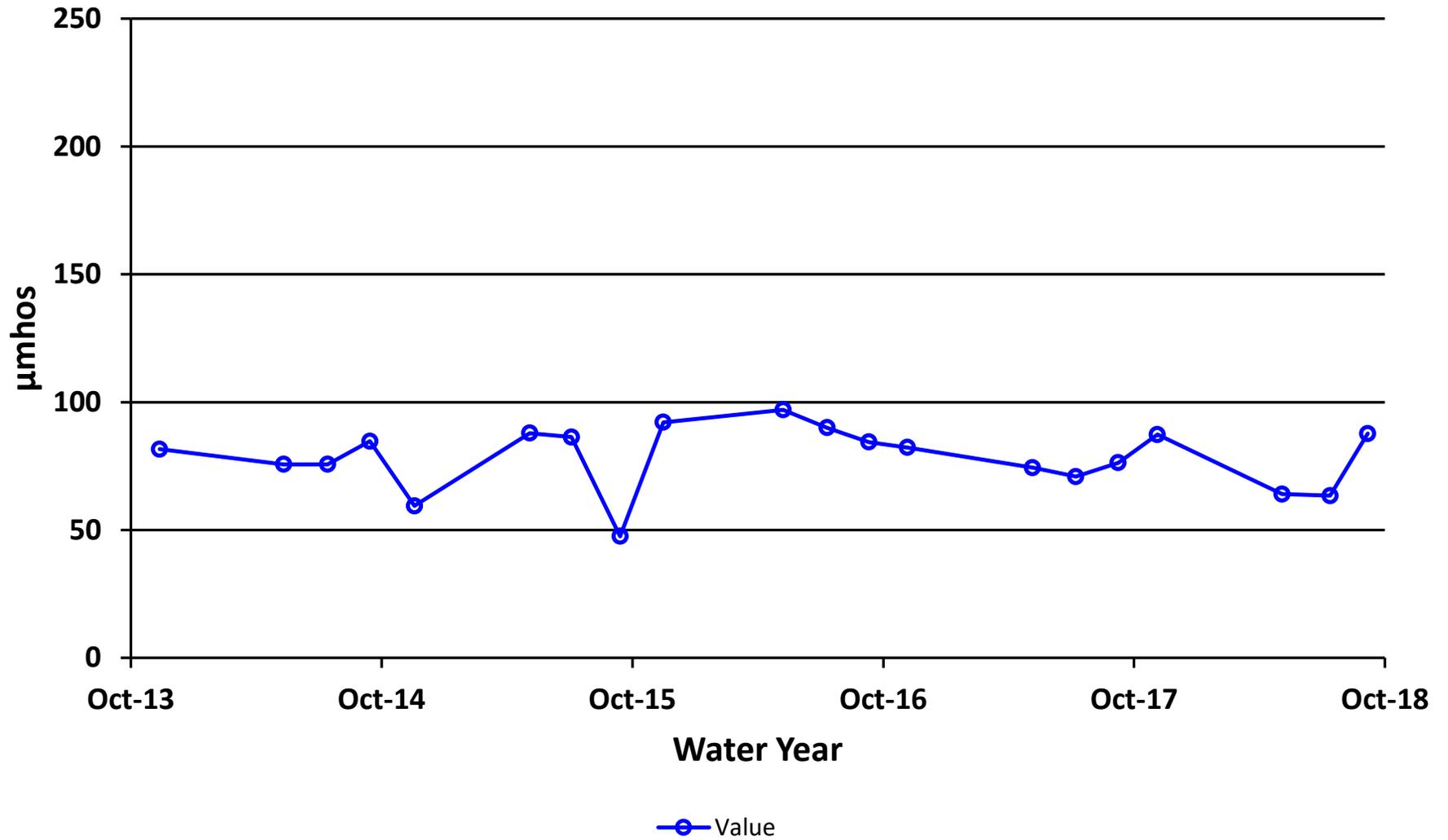
Site No.	Sample Date	Parameter	Value	Qualifier	Reason for Qualifier	
009FMS	11/7/2017	Diss. Ag-ICP/MS	0.0095	µg/L	J	Below Quantitative Range
		Diss. Se-ICP/MS	0.14	µg/L	J	Below Quantitative Range
	5/8/2018	Diss. Ag-ICP/MS	0.0057	µg/L	J	Below Quantitative Range
7/17/2018		Diss. Ag-ICP/MS	0.0092	µg/L	J	Below Quantitative Range
		Diss. Se-ICP/MS	0.12	µg/L	J	Below Quantitative Range
		pH	5.74	pH units	J	Hold time Violation
		Total Sulfate	10.5	mg/L	J	Sample Receipt Temperature
9/10/2018		Diss. Se-ICP/MS	0.13	µg/L	J	Below Quantitative Range
		Diss. Zn-ICP/MS	3.08	µg/L	U	Field Blank Contamination
		pH	6.14	pH units	J	Hold Time Violation
		Total Sulfate	10.3	mg/L	J	Sample Receipt Temperature

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

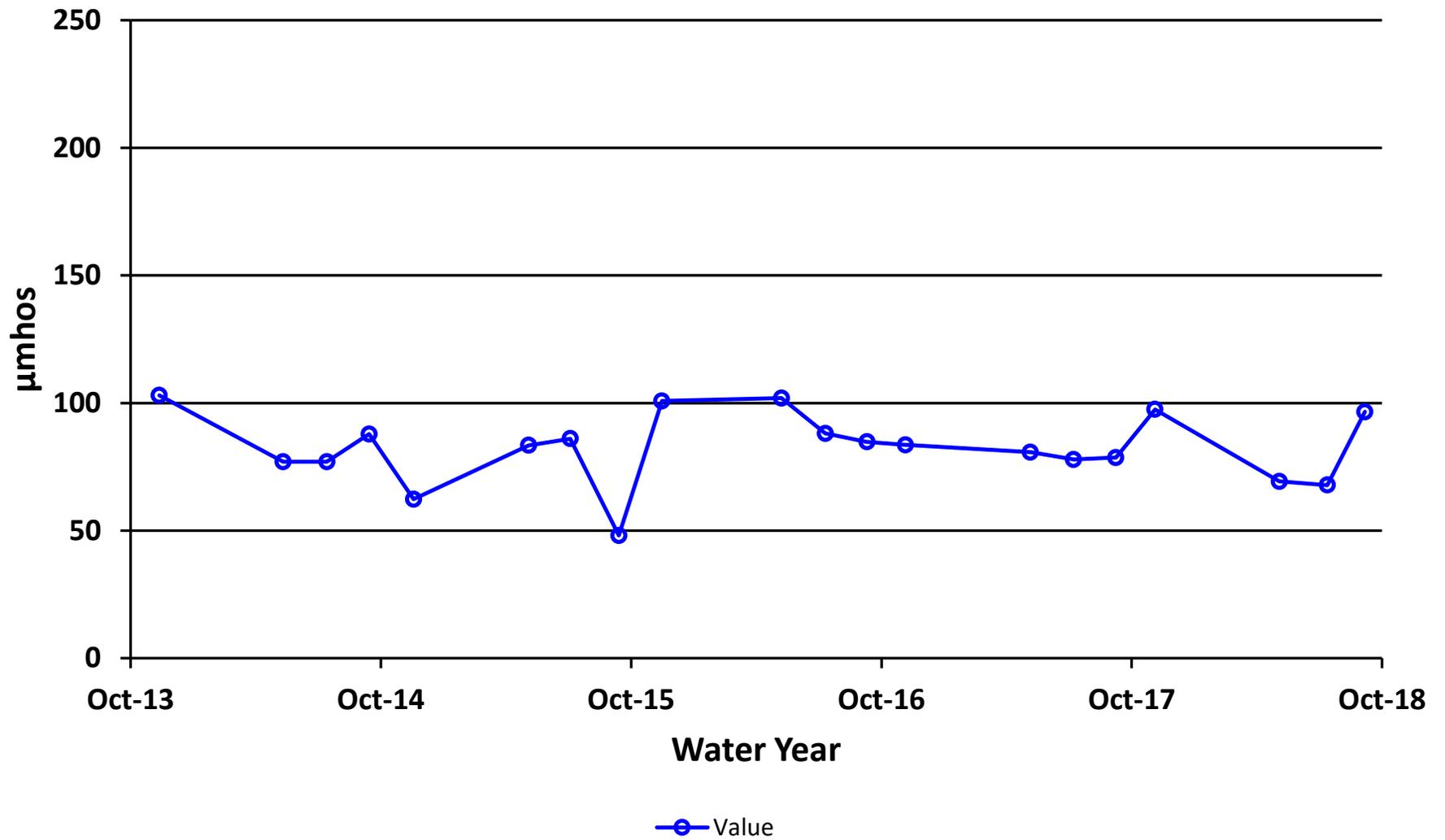
Site 9 - Water Temperature



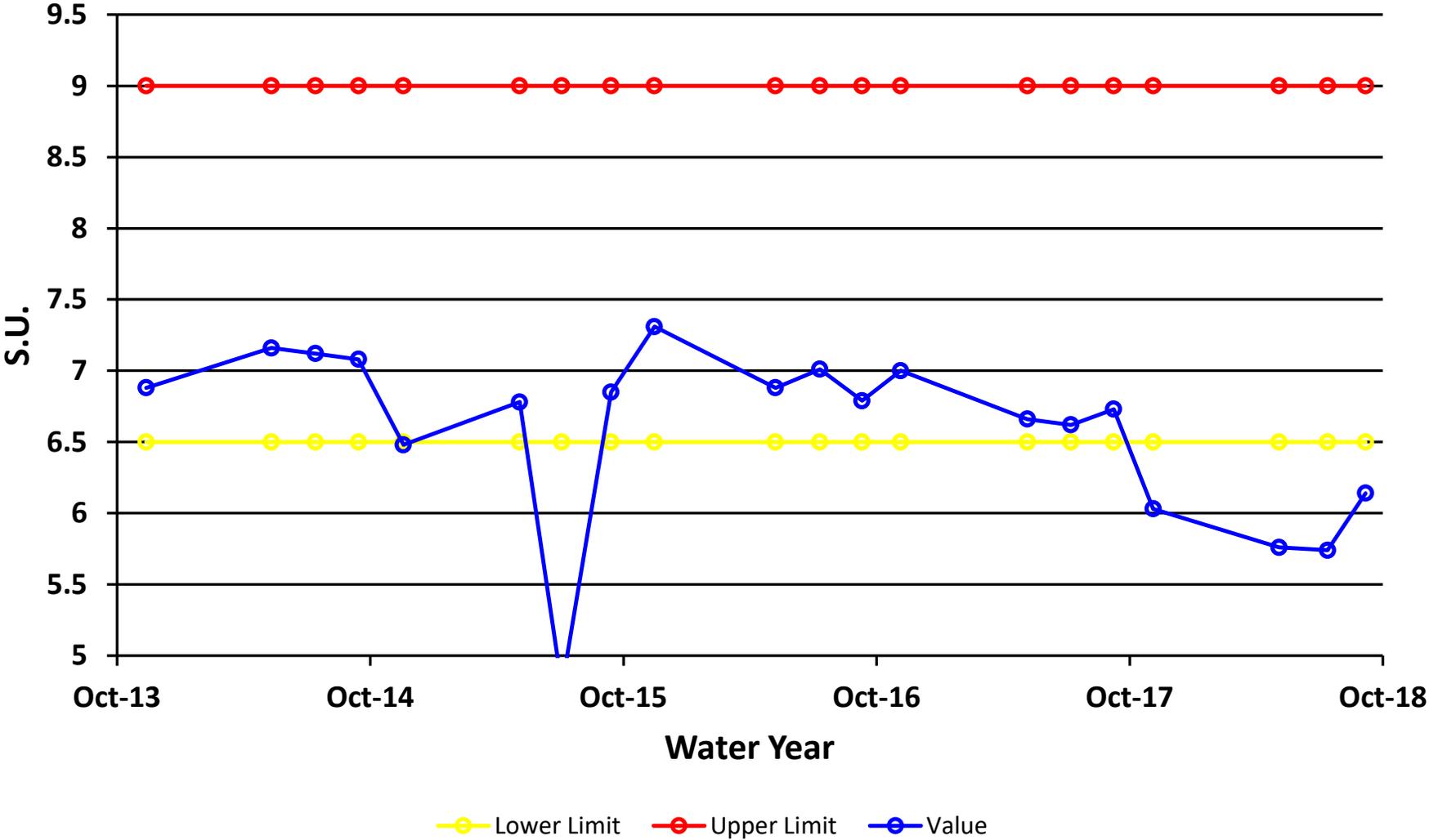
Site 9 - Conductivity Laboratory



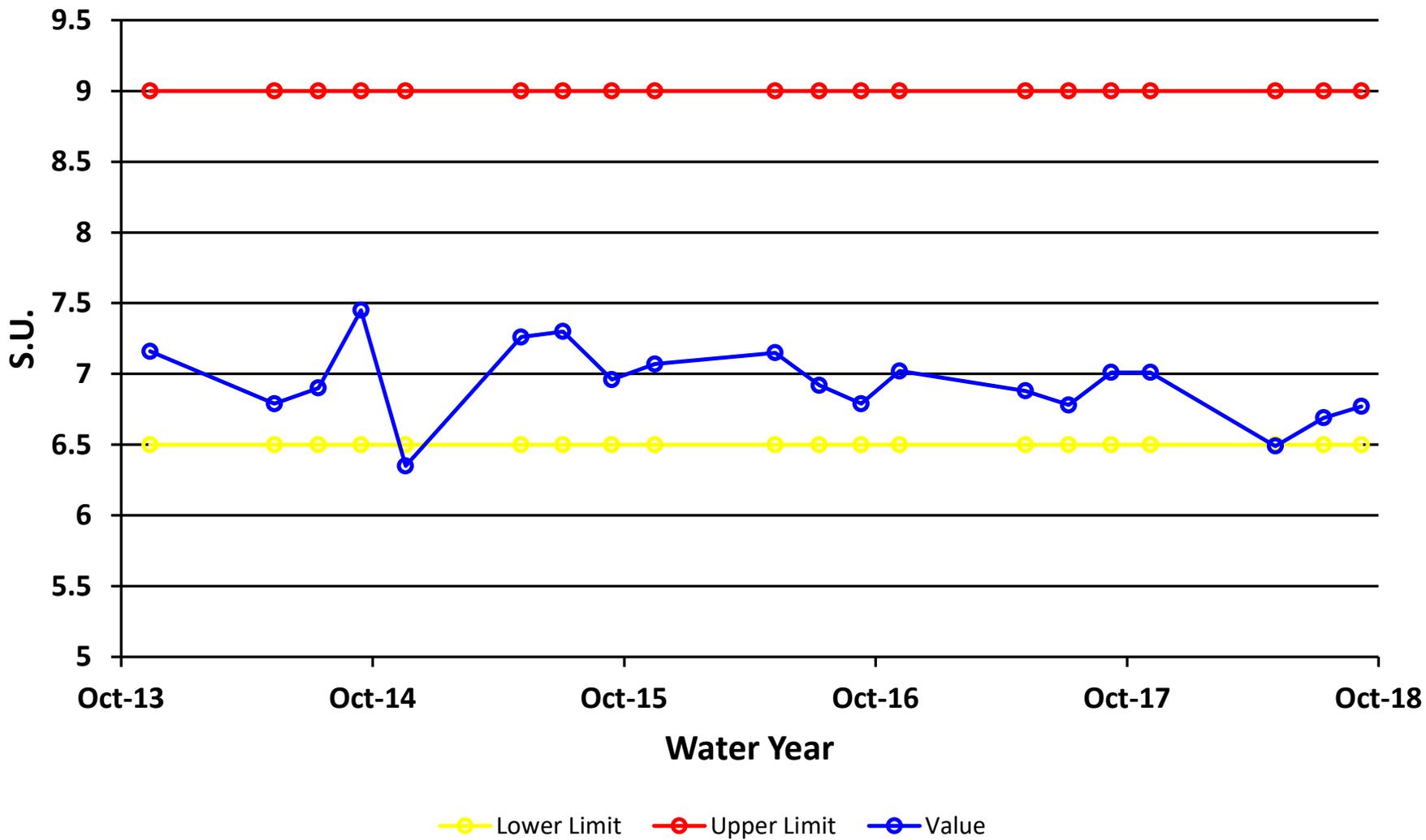
Site 9 - Conductivity Field



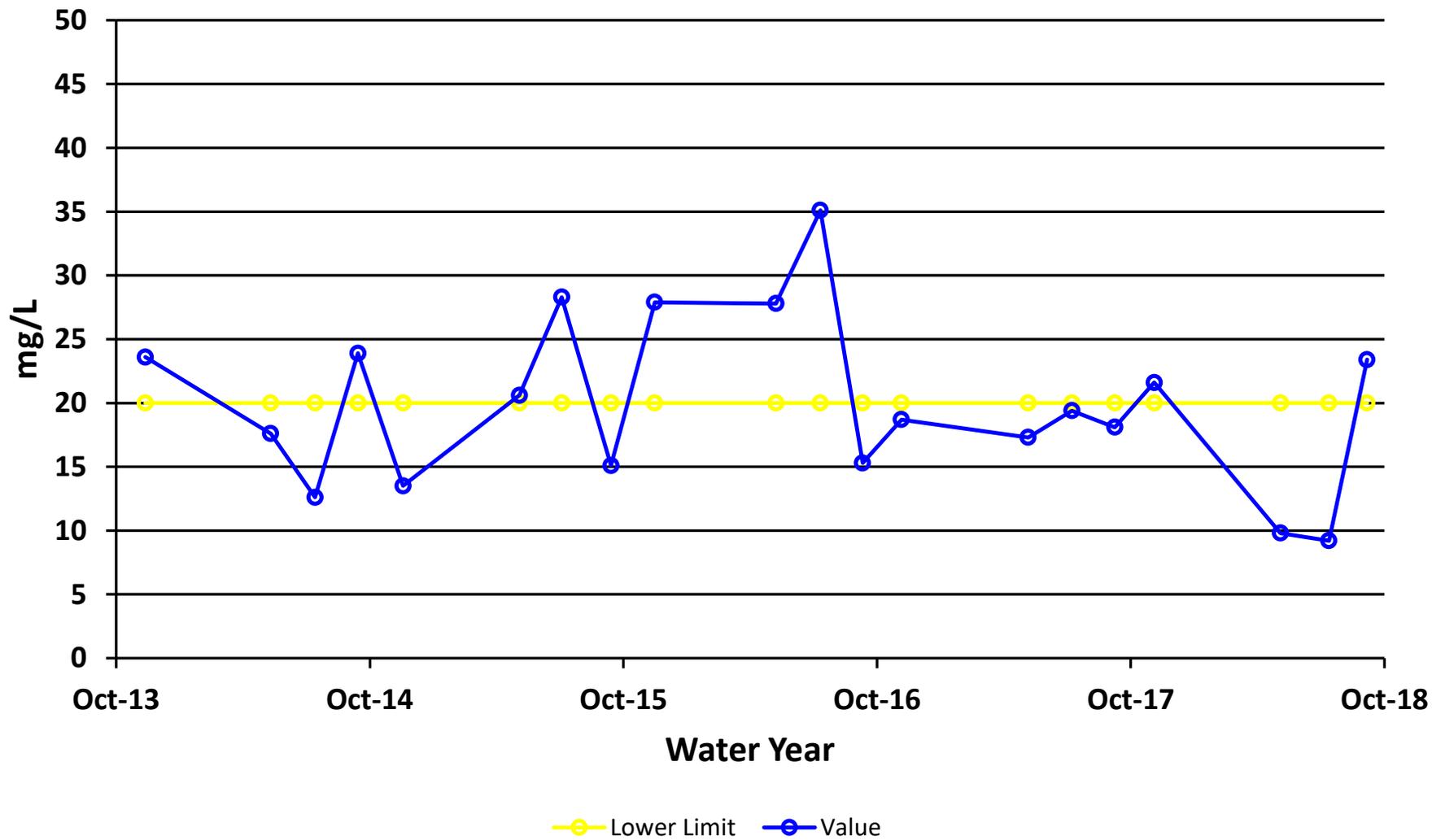
Site 9 - pH Laboratory



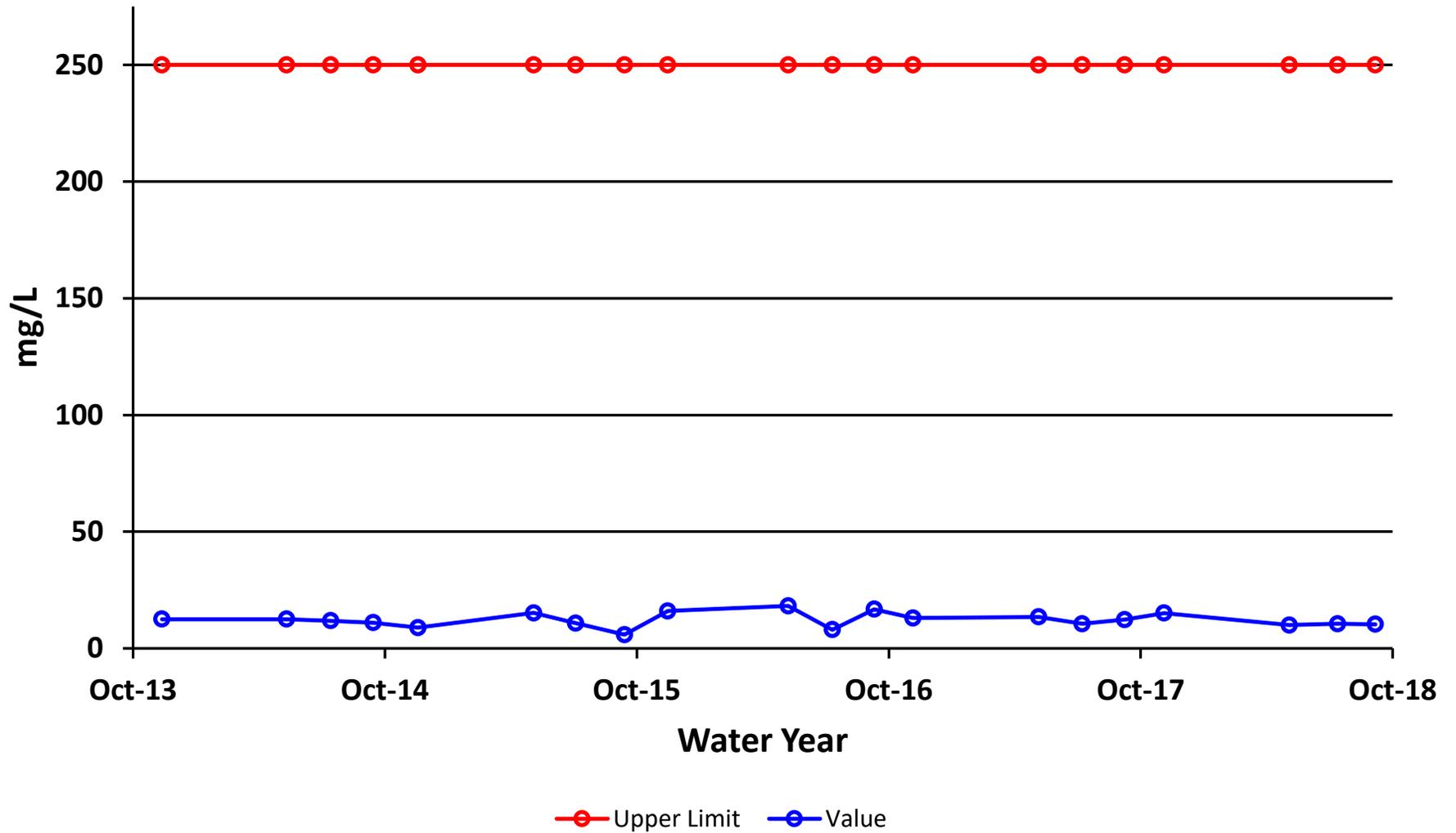
Site 9 - pH Field



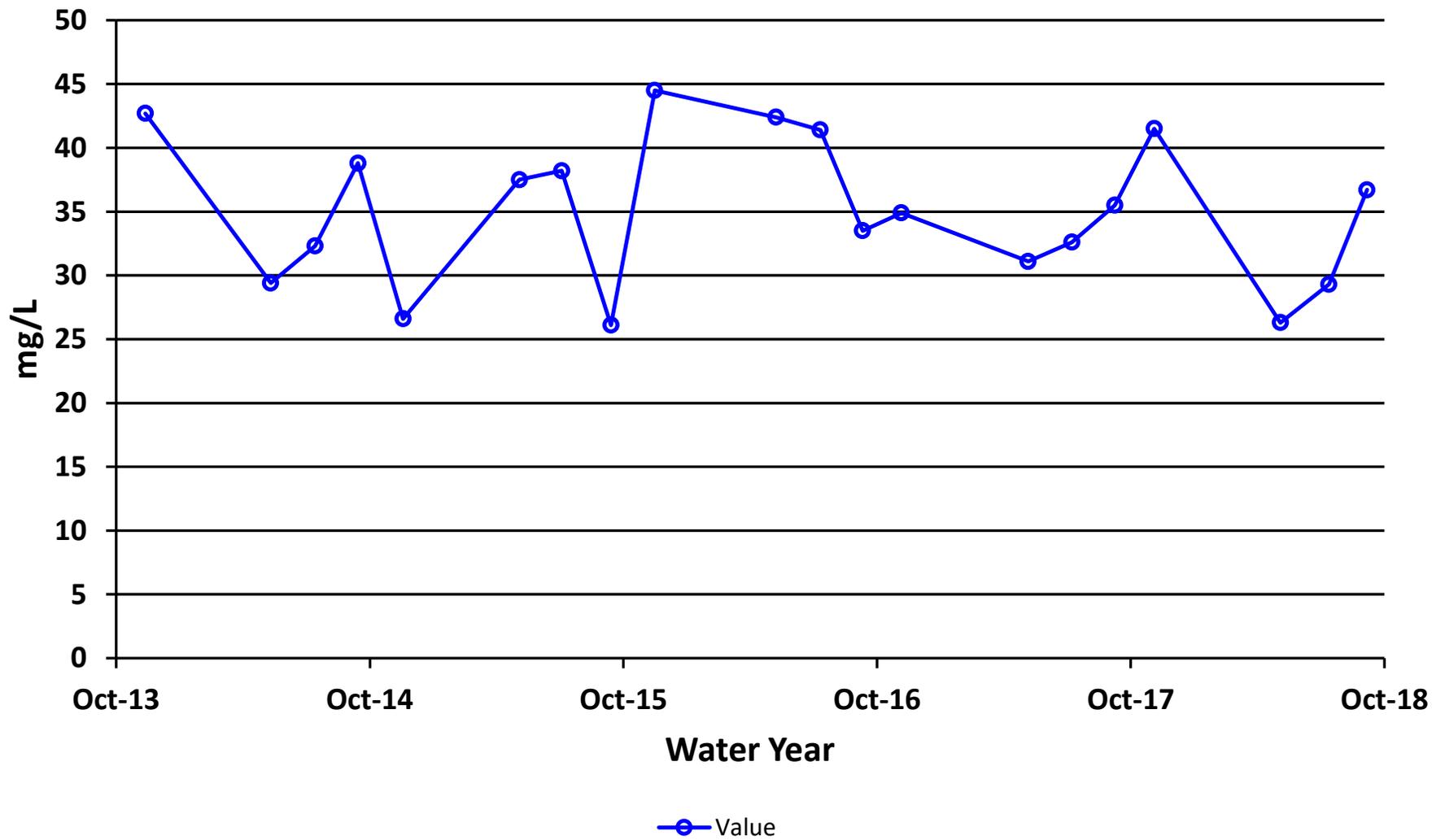
Site 9 - Alkalinity



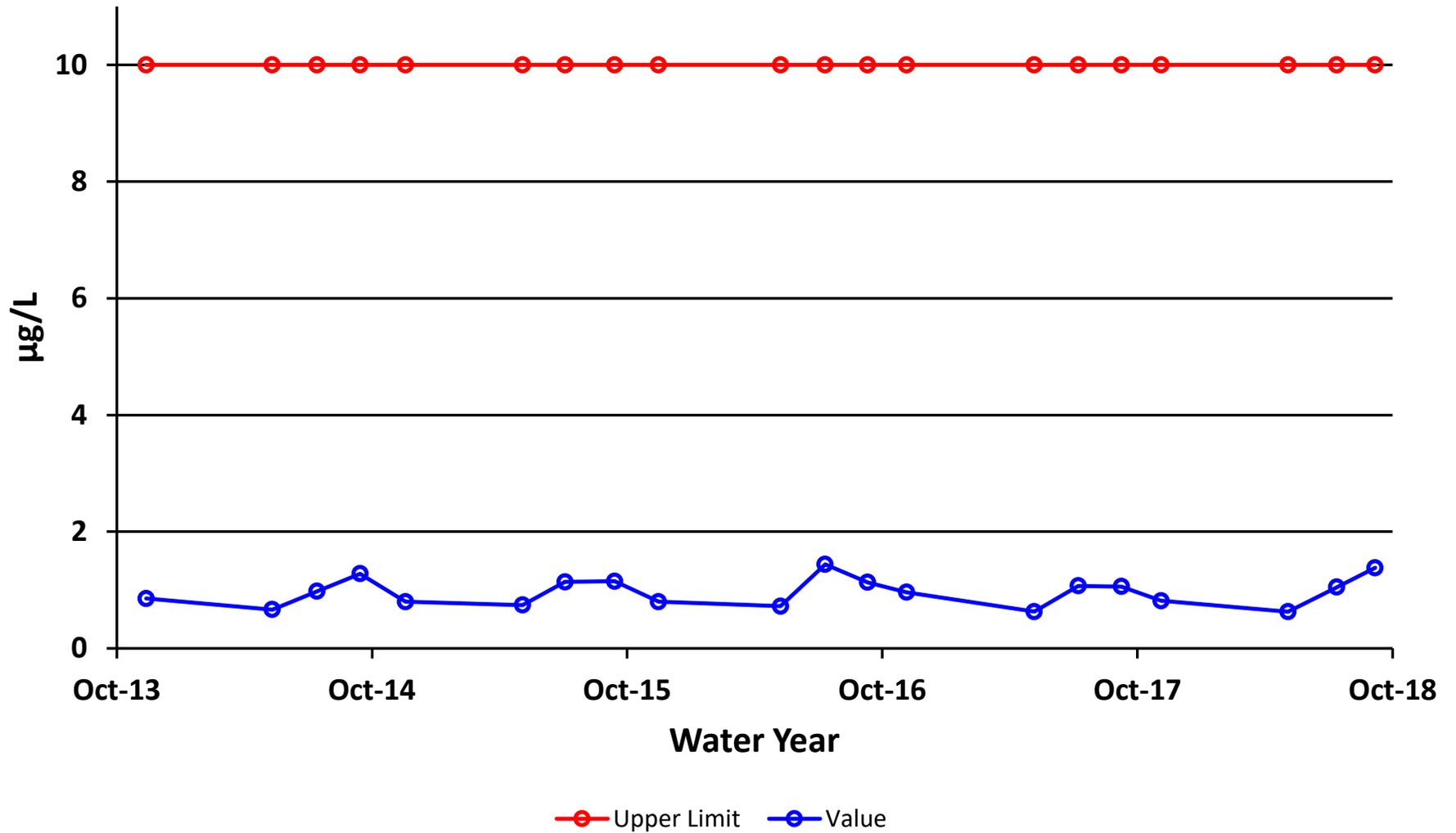
Site 9 - Sulfate



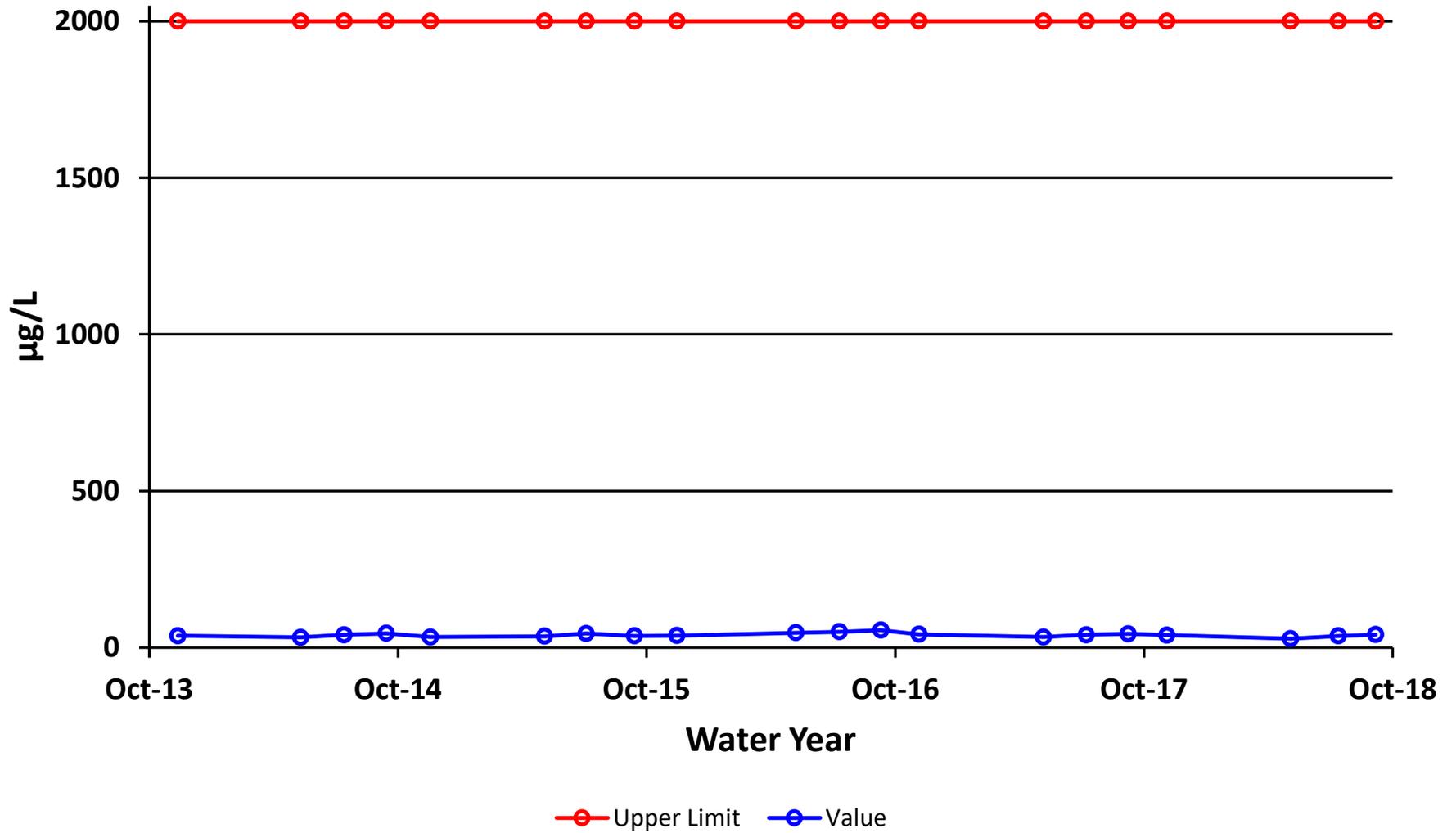
Site 9 - Hardness



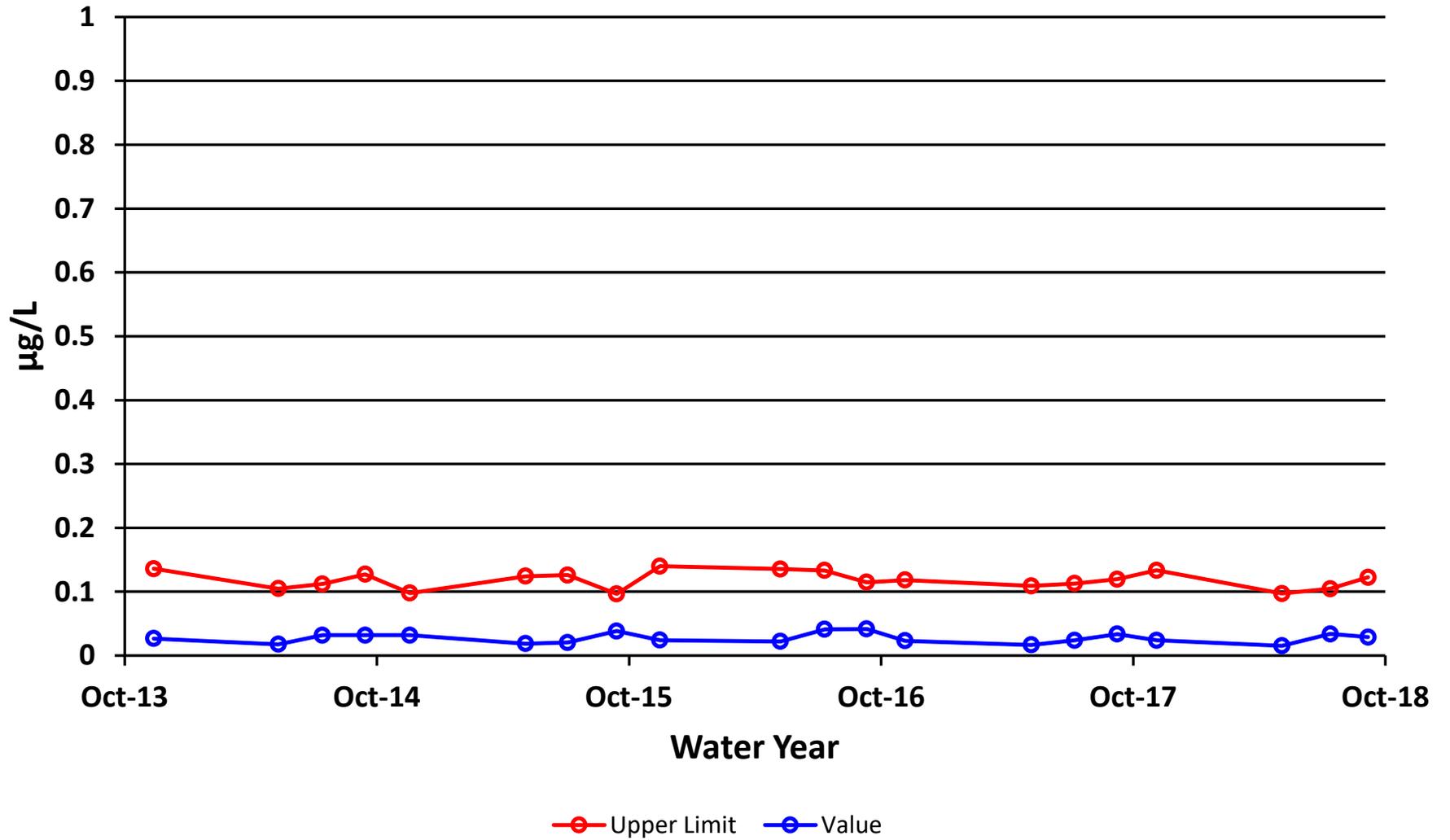
Site 9 - Arsenic Dissolved



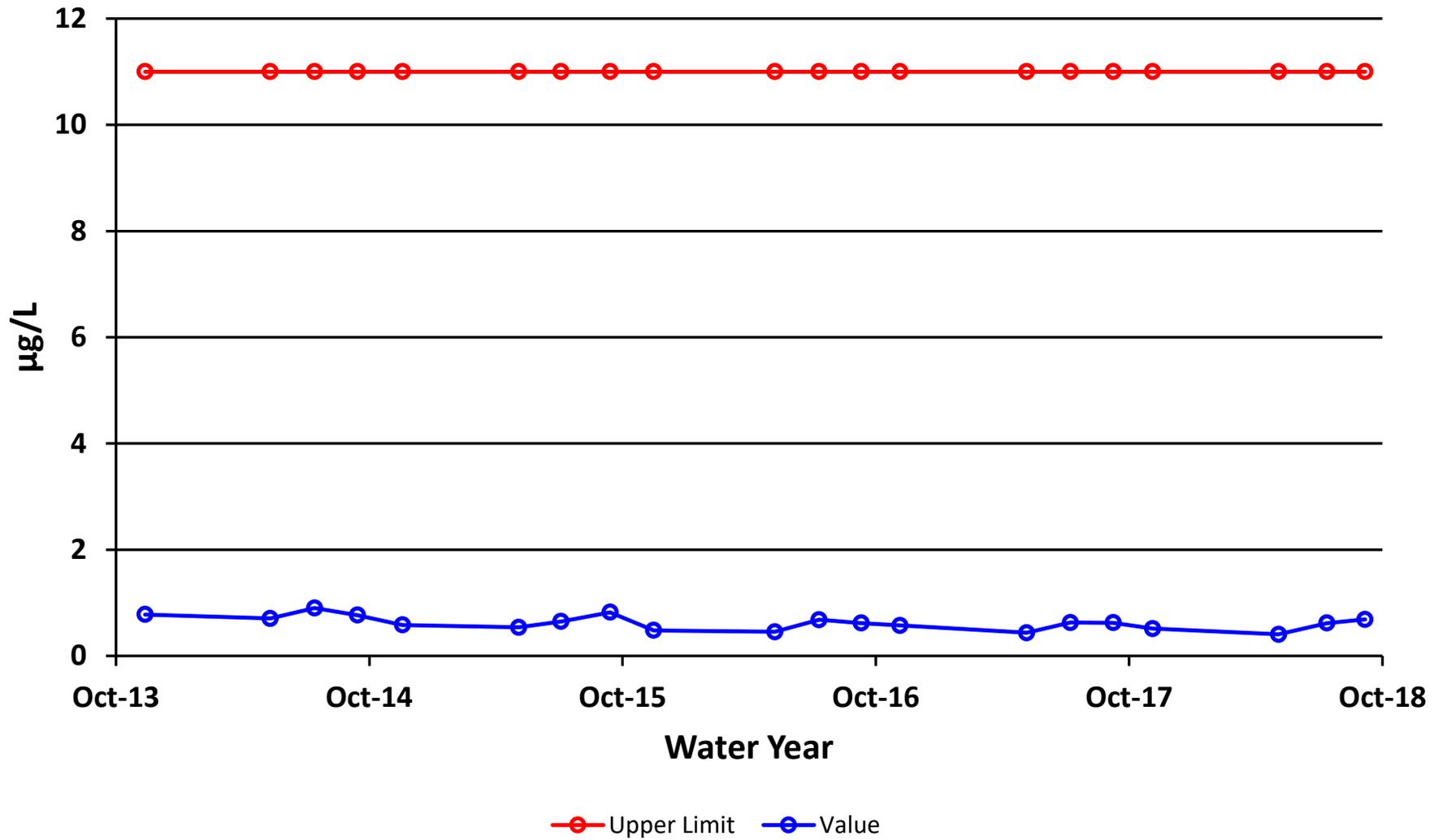
Site 9 - Barium Dissolved



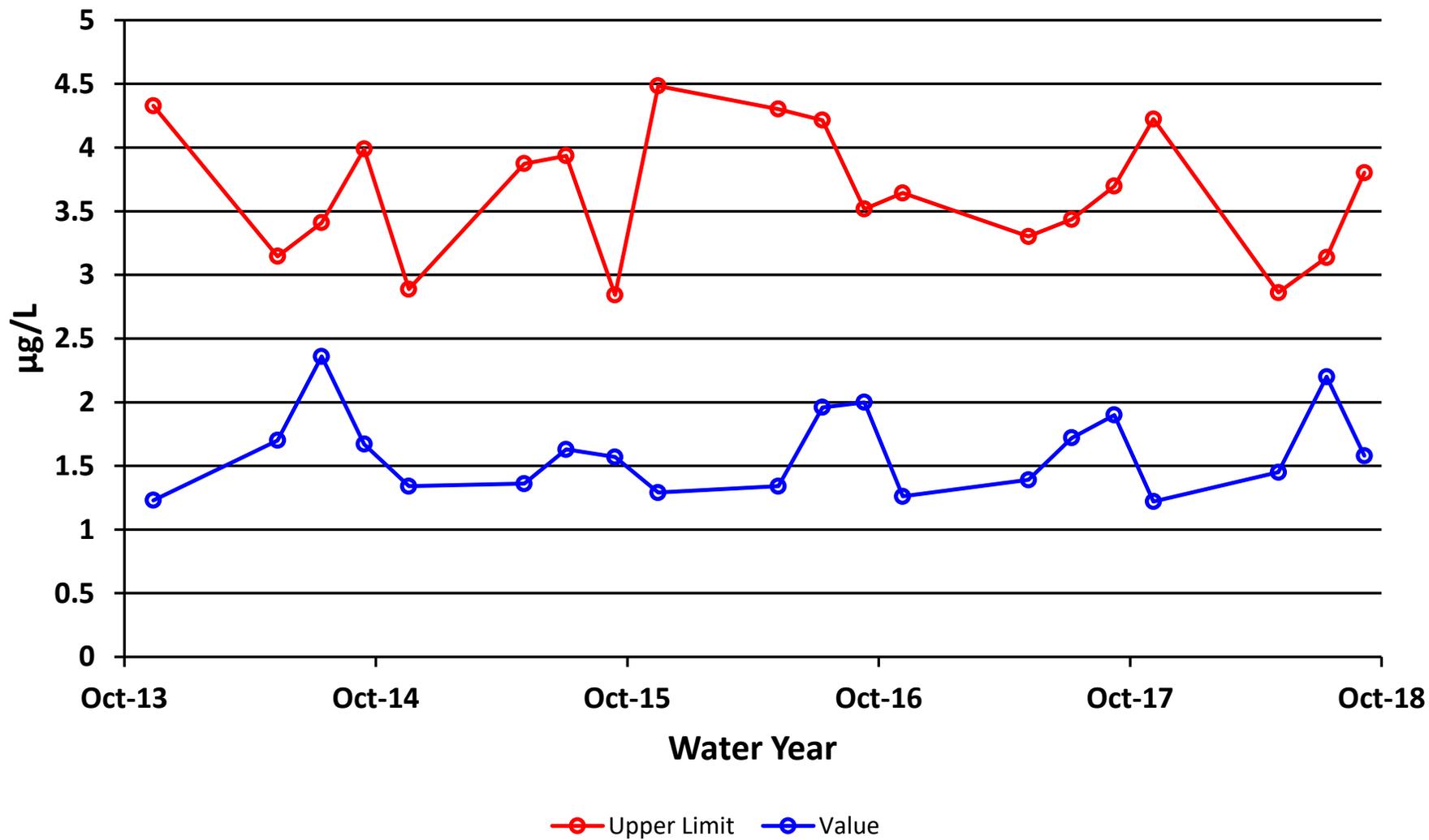
Site 9 - Cadmium Dissolved



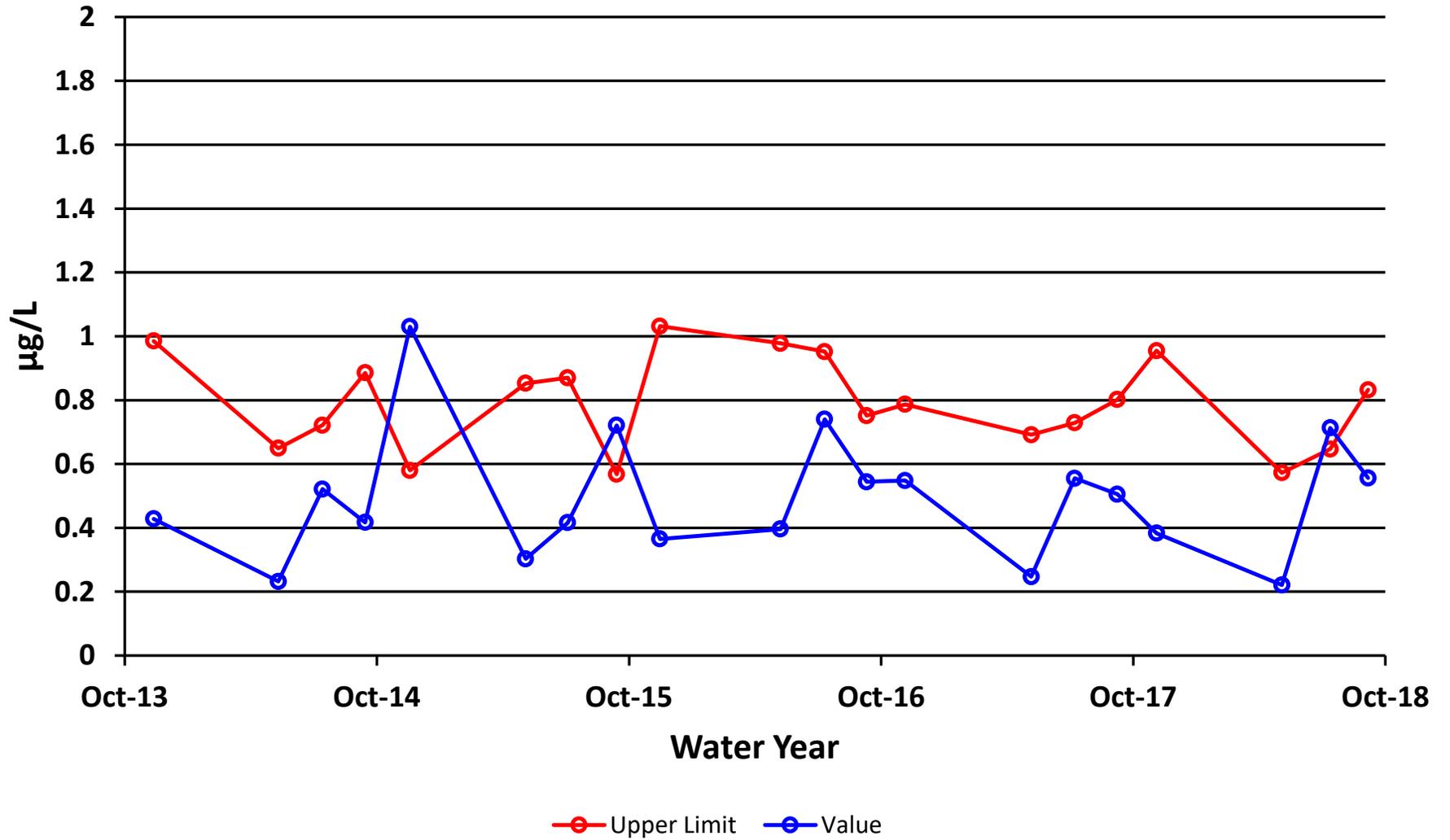
Site 9 - Chromium Dissolved



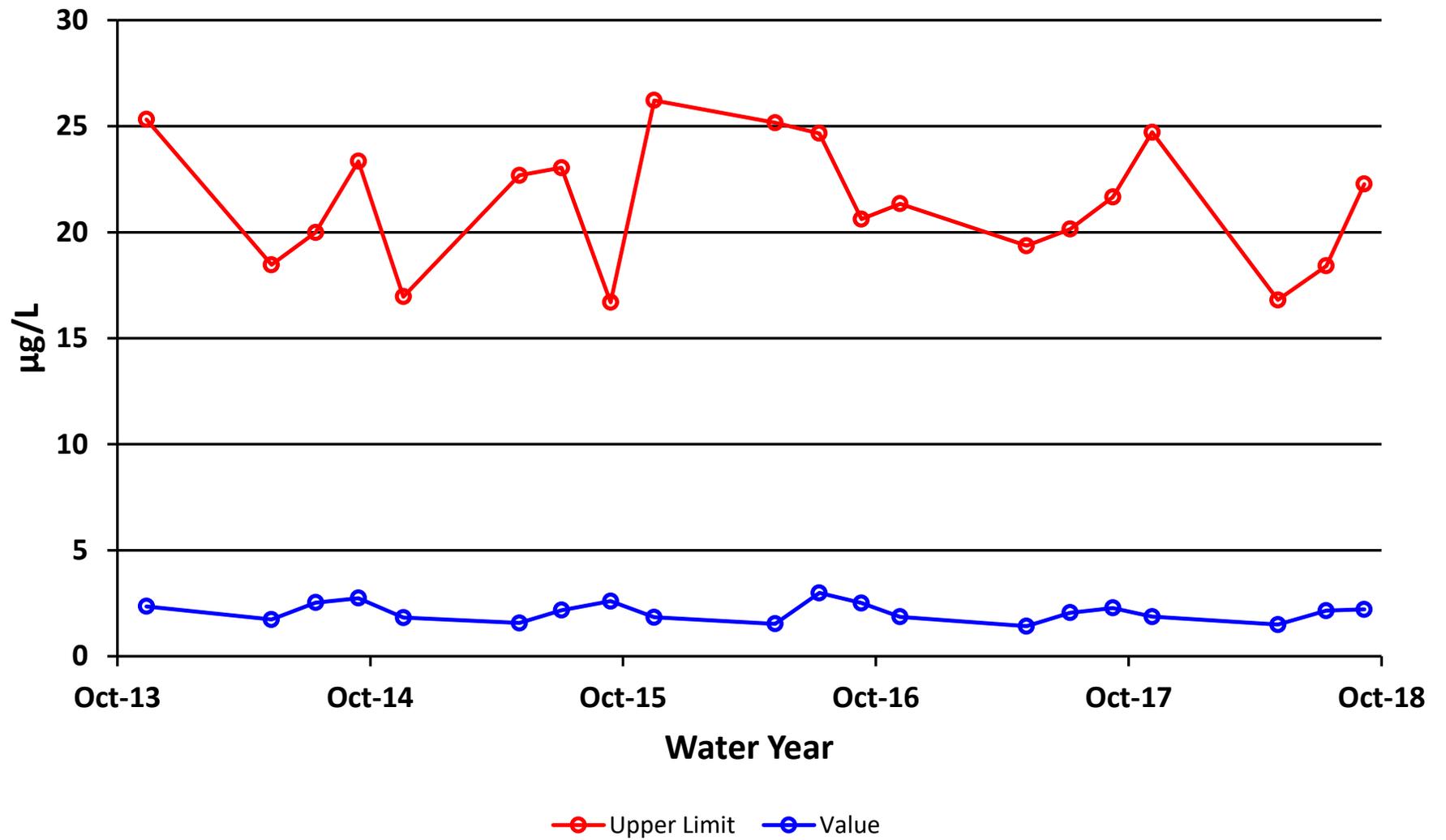
Site 9 - Copper Dissolved



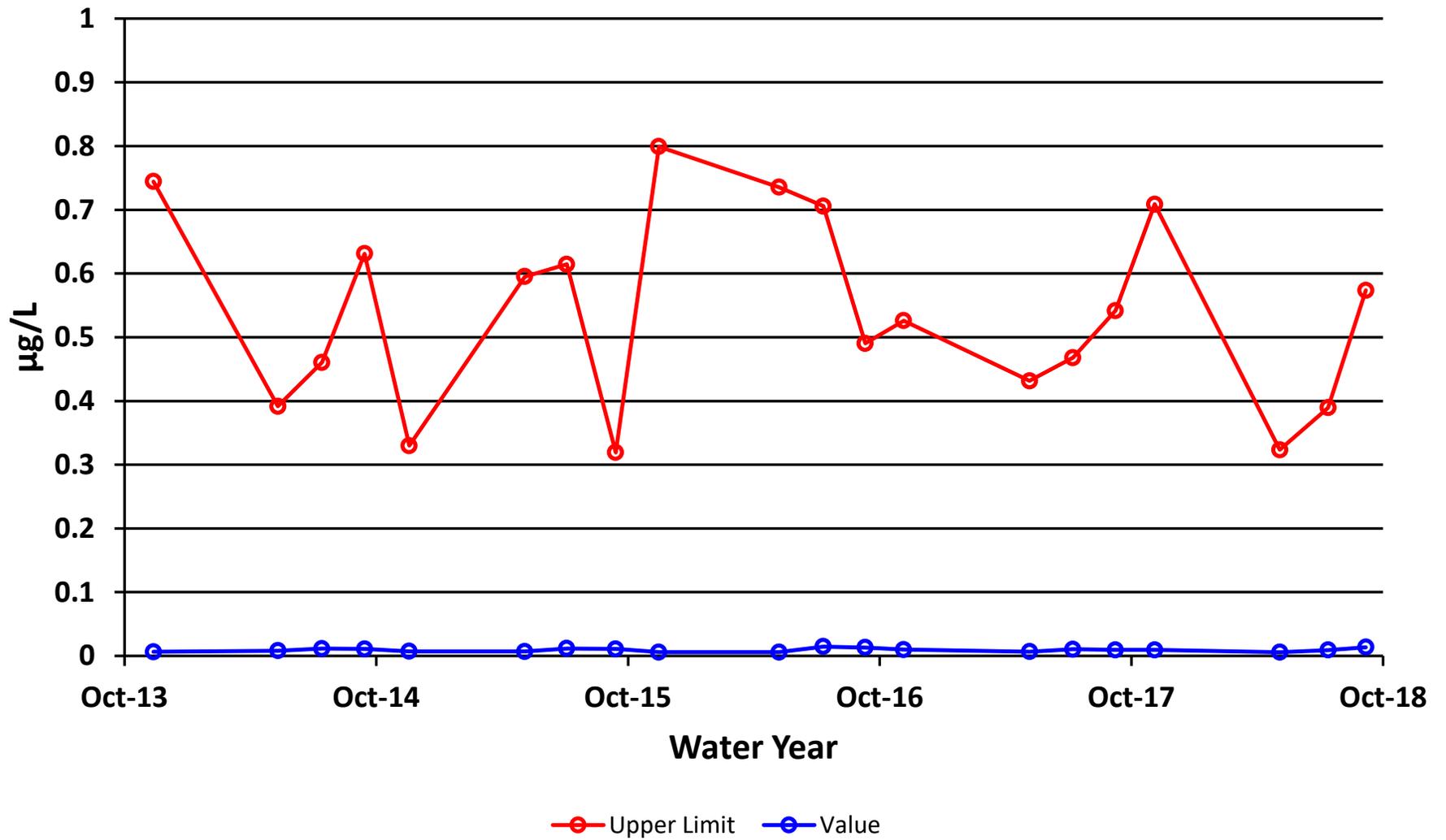
Site 9 - Lead Dissolved



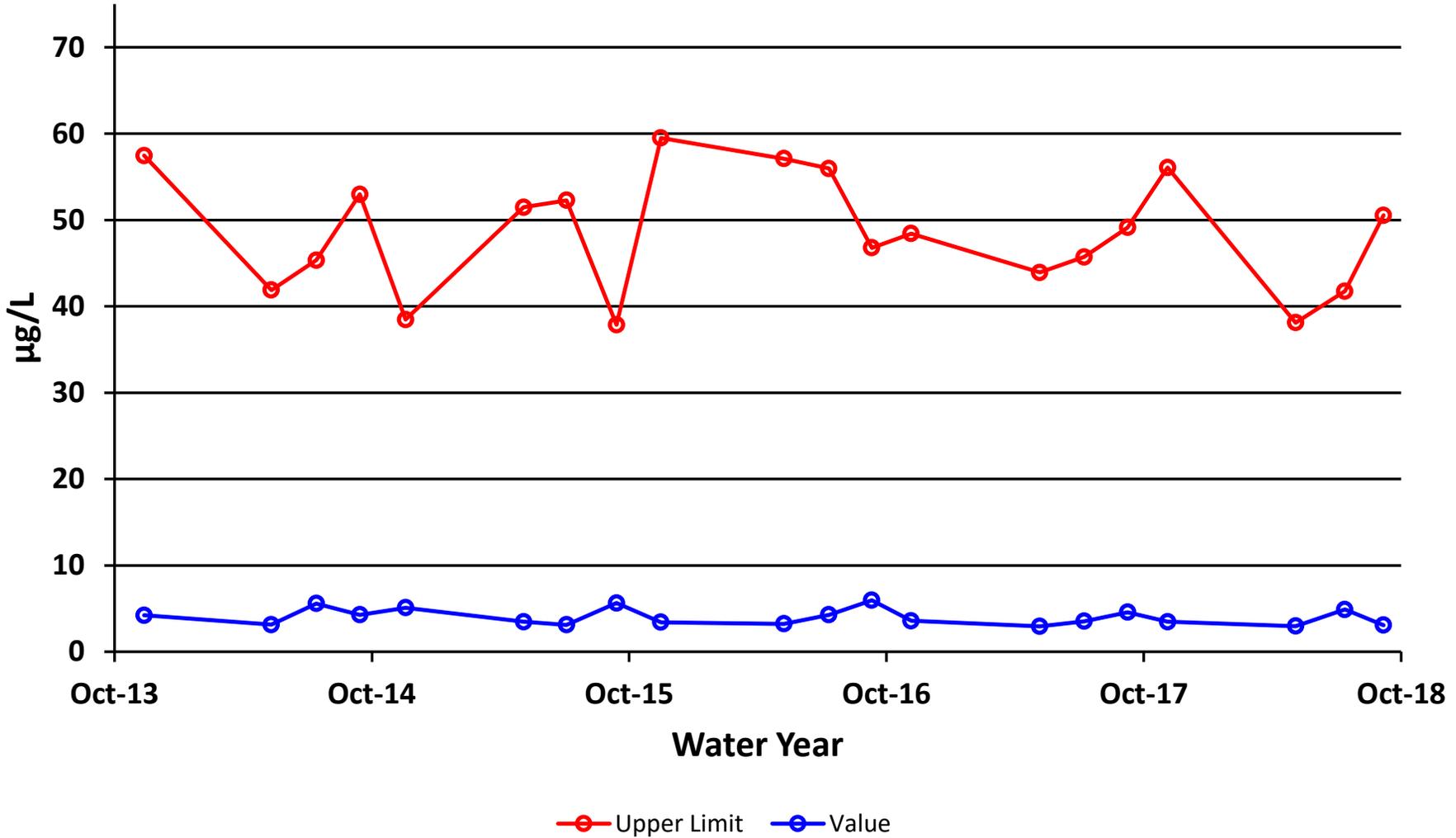
Site 9 - Nickel Dissolved



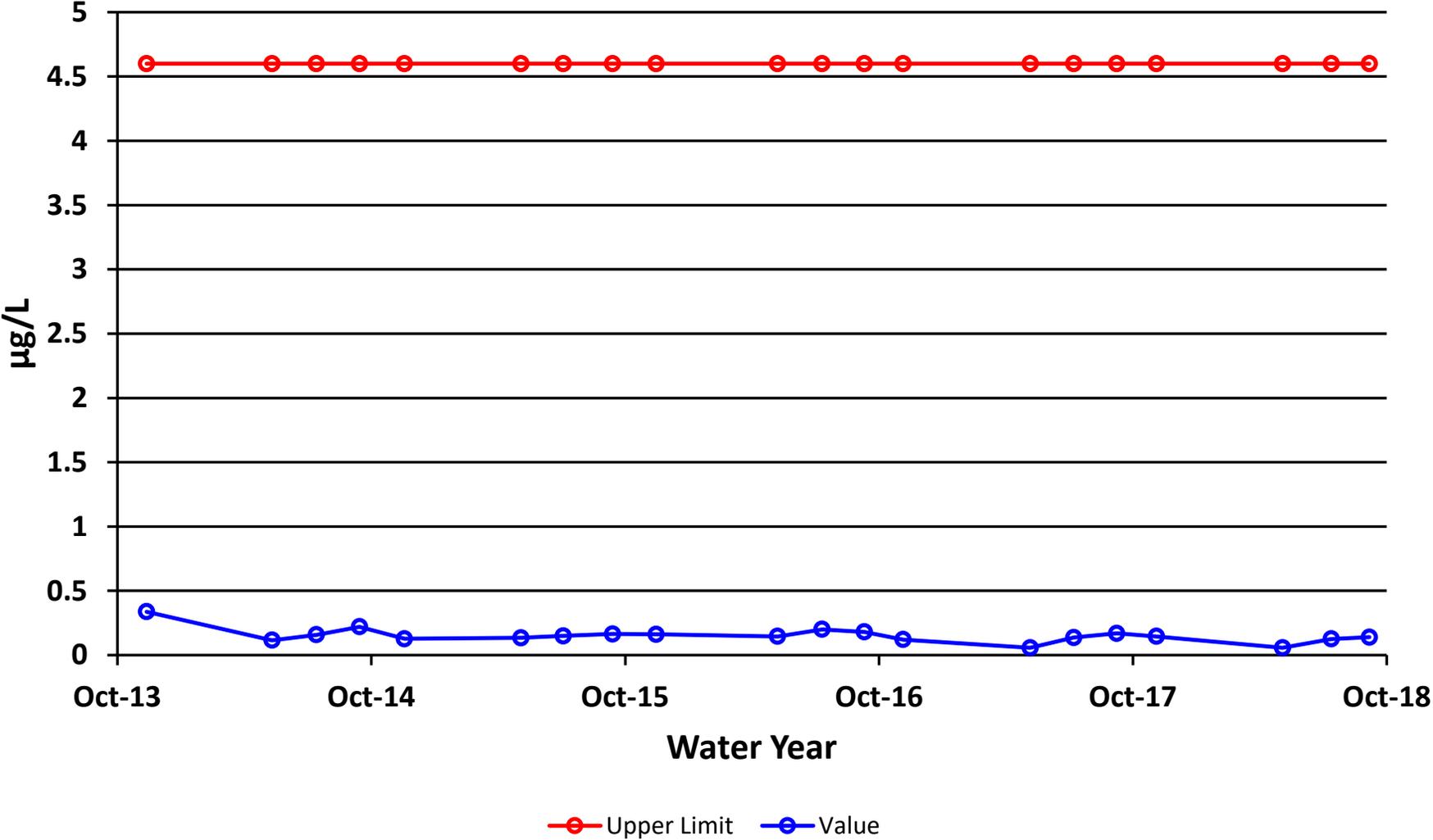
Site 9 - Silver Dissolved



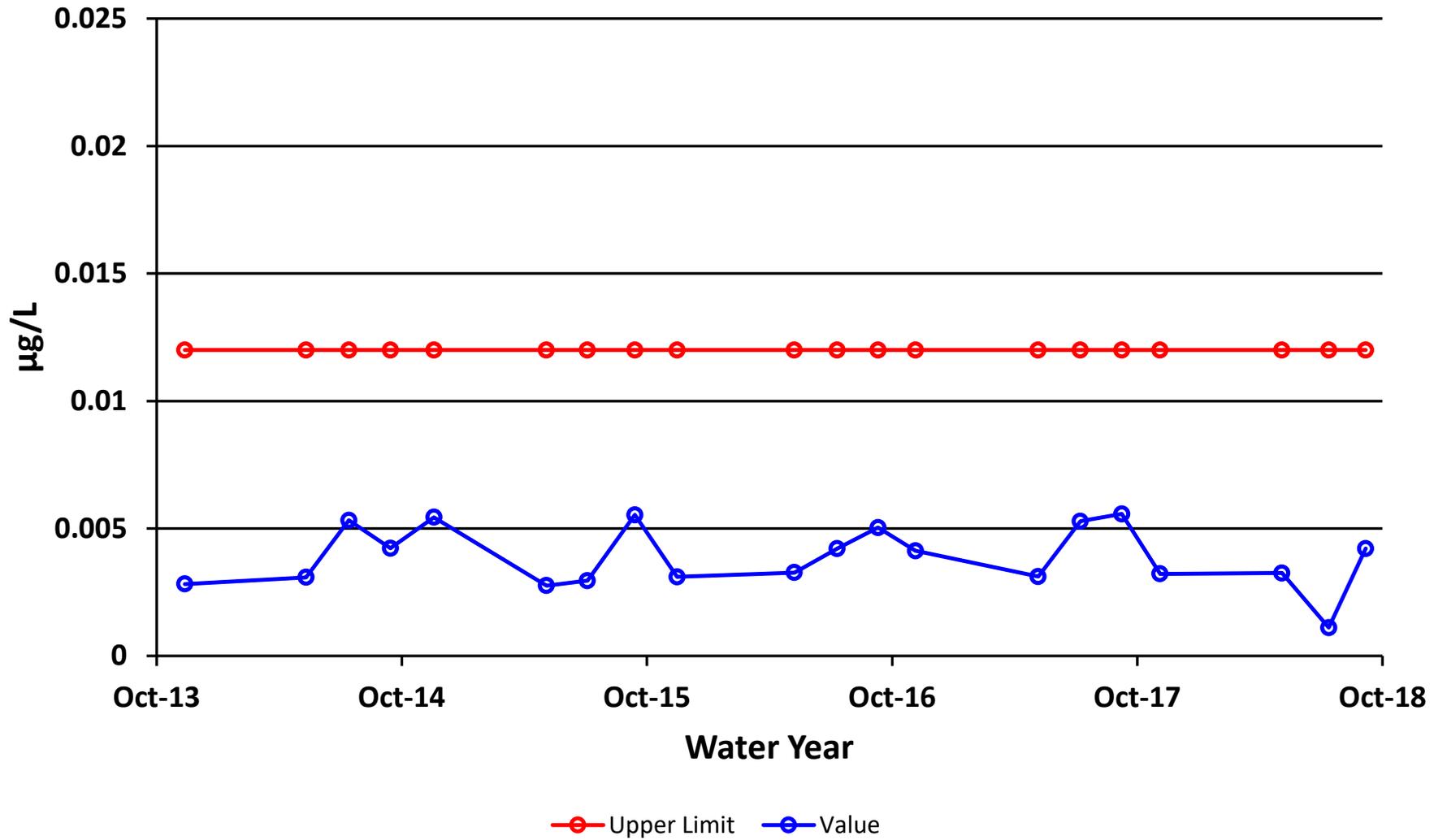
Site 9 - Zinc Dissolved



Site 9 - Selenium Dissolved



Site 9 - Mercury Dissolved



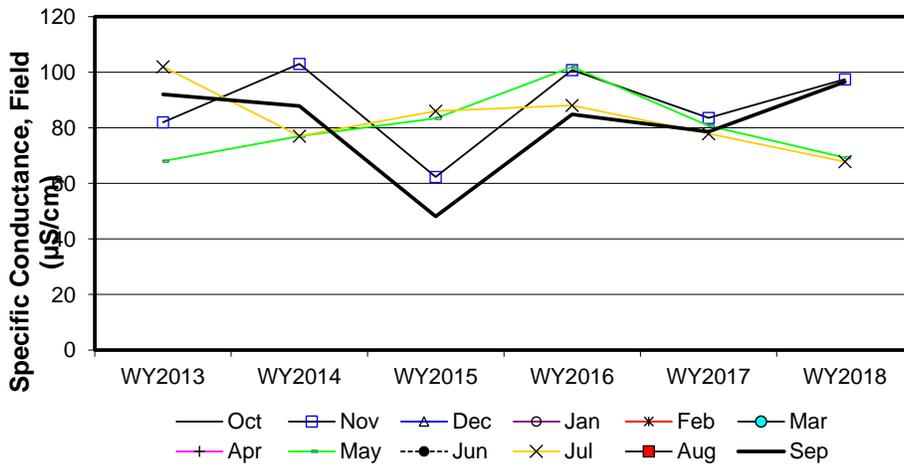
Site #9

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	WY2013		82.0						68.0		102.0		92.0
b	WY2014		103.0						77.0		77.0		87.8
c	WY2015		62.3						83.4		86.0		48.1
d	WY2016		100.8						101.9		88.1		84.8
e	WY2017		83.6						80.7		77.9		78.6
f	WY2018		97.5						69.3		67.8		96.5
n		0	6	0	0	0	0	0	6	0	6	0	6
t ₁		0	6	0	0	0	0	0	6	0	6	0	6
t ₂		0	0	0	0	0	0	0	0	0	0	0	0
t ₃		0	0	0	0	0	0	0	0	0	0	0	0
t ₄		0	0	0	0	0	0	0	0	0	0	0	0
t ₅		0	0	0	0	0	0	0	0	0	0	0	0
b-a			1						1		-1		-1
c-a			-1						1		-1		-1
d-a			1						1		-1		-1
e-a			1						1		-1		-1
f-a			1						1		-1		1
c-b			-1						1		1		-1
d-b			-1						1		1		-1
e-b			-1						1		1		-1
f-b			-1						-1		-1		1
d-c			1						1		1		1
e-c			1						-1		-1		1
f-c			1						-1		-1		1
e-d			-1						-1		-1		-1
f-d			-1						-1		-1		1
f-e			1						-1		-1		1
S _k		0	1	0	0	0	0	0	3	0	-7	0	-1
σ _S ² =			28.33						28.33		28.33		28.33
Z _k = S _k /σ _S			0.19						0.56		-1.32		-0.19
Z _k ²			0.04						0.32		1.73		0.04

ΣZ _k =	-0.75	Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅	Σn	24
ΣZ _k ² =	2.12	Count	24	0	0	0	0	ΣS _k	-4
Z-bar=ΣZ _k /K=	-0.19								

χ _h ² =ΣZ _k ² -K(Z-bar) ² =	1.98	@α=5% χ _(K-1) ² =	7.81	Test for station homogeneity
p	0.577			χ _h ² < χ _(K-1) ² ACCEPT
ΣVAR(S _k)	Z _{calc} -0.28	@α/2=2.5% Z=	1.96	H ₀ (No trend) ACCEPT
113.33	p 0.389			H _A (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals			
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-6.05		5.67
0.050	-4.17	-1.36	2.16
0.100	-3.30		1.18
0.200	-2.35		0.34

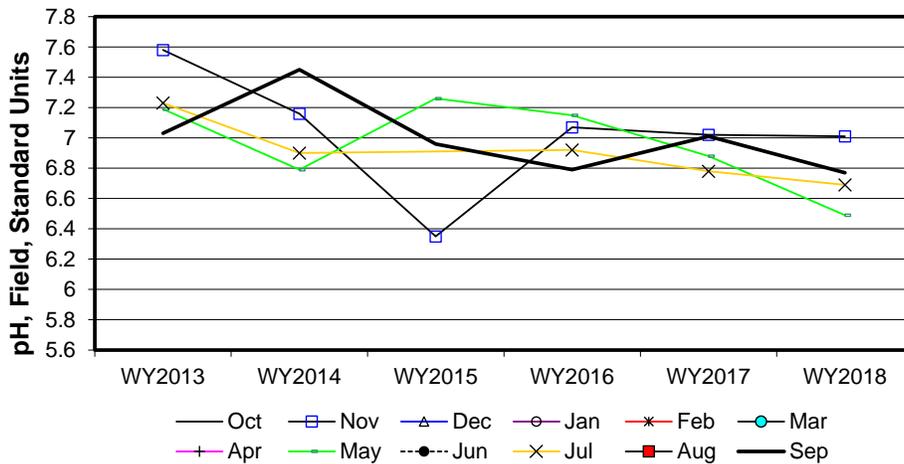
Site #9

Seasonal Kendall analysis for pH, Field, Standard Units

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	WY2013		7.6						7.2		7.2		7.0
b	WY2014		7.2						6.8		6.9		7.5
c	WY2015		6.4						7.3				7.0
d	WY2016		7.1						7.2		6.9		6.8
e	WY2017		7.0						6.9		6.8		7.0
f	WY2018		7.0						6.5		6.7		6.8
n		0	6	0	0	0	0	0	6	0	5	0	6
t ₁		0	6	0	0	0	0	0	6	0	5	0	6
t ₂		0	0	0	0	0	0	0	0	0	0	0	0
t ₃		0	0	0	0	0	0	0	0	0	0	0	0
t ₄		0	0	0	0	0	0	0	0	0	0	0	0
t ₅		0	0	0	0	0	0	0	0	0	0	0	0
b-a			-1						-1		-1		1
c-a			-1						1				-1
d-a			-1						-1		-1		-1
e-a			-1						-1		-1		-1
f-a			-1						-1		-1		-1
c-b			-1						1				-1
d-b			-1						1		1		-1
e-b			-1						1		-1		-1
f-b			-1						-1		-1		-1
d-c			1						-1				-1
e-c			1						-1				1
f-c			1						-1				-1
e-d			-1						-1		-1		1
f-d			-1						-1		-1		-1
f-e			-1						-1		-1		-1
S _k		0	-9	0	0	0	0	0	-7	0	-8	0	-9
σ _S ² =			28.33						28.33		16.67		28.33
Z _k = S _k /σ _S			-1.69						-1.32		-1.96		-1.69
Z _k ²			2.86						1.73		3.84		2.86

ΣZ _k =	-6.66	Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅	Σn	23
ΣZ _k ² =	11.29	Count	23	0	0	0	0	ΣS _k	-33
Z-bar=ΣZ _k /K=	-1.66								

χ _h ² =ΣZ _k ² -K(Z-bar) ² =	0.21	@α=5% χ _(K-1) ² =	7.81	Test for station homogeneity	
p	0.976			χ _h ² <χ _(K-1) ²	ACCEPT
ΣVAR(S _k)	Z _{calc} -3.17	@α/2=2.5% Z=	1.96	H ₀ (No trend)	REJECT
101.67	p	0.001		H _A (± trend)	ACCEPT



Seasonal-Kendall Slope Confidence Intervals			
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.17		-0.03
0.050	-0.14		-0.05
0.100	-0.11	-0.08	-0.05
0.200	-0.11		-0.06
		-1.1%	

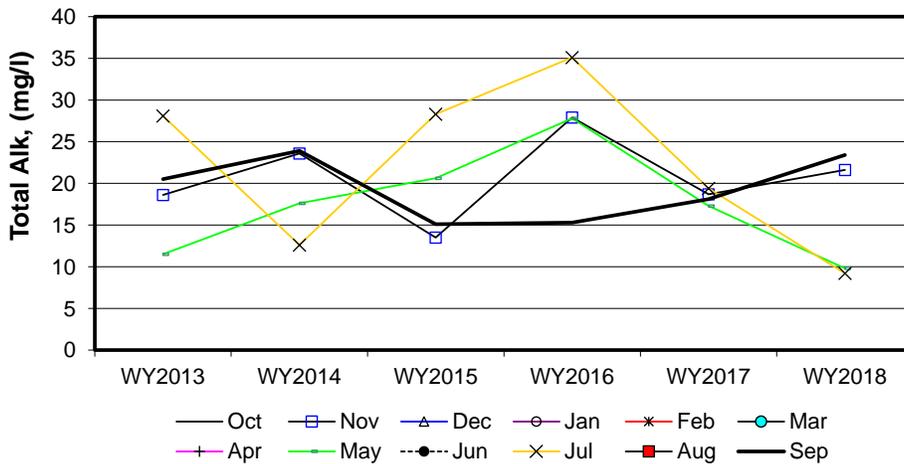
Site #9

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	WY2013		18.6						11.5		28.1		20.5
b	WY2014		23.6						17.6		12.6		23.9
c	WY2015		13.5						20.6		28.3		15.1
d	WY2016		27.9						27.8		35.1		15.3
e	WY2017		18.7						17.3		19.4		18.1
f	WY2018		21.6						9.8		9.2		23.4
n		0	6	0	0	0	0	0	6	0	6	0	6
t ₁		0	6	0	0	0	0	0	6	0	6	0	6
t ₂		0	0	0	0	0	0	0	0	0	0	0	0
t ₃		0	0	0	0	0	0	0	0	0	0	0	0
t ₄		0	0	0	0	0	0	0	0	0	0	0	0
t ₅		0	0	0	0	0	0	0	0	0	0	0	0
b-a			1						1		-1		1
c-a			-1						1		1		-1
d-a			1						1		1		-1
e-a			1						1		-1		-1
f-a			1						-1		-1		1
c-b			-1						1		1		-1
d-b			1						1		1		-1
e-b			-1						-1		1		-1
f-b			-1						-1		-1		-1
d-c			1						1		1		1
e-c			1						-1		-1		1
f-c			1						-1		-1		1
e-d			-1						-1		-1		1
f-d			-1						-1		-1		1
f-e			1						-1		-1		1
S _k		0	3	0	0	0	0	0	-1	0	-3	0	1
σ _S ² =			28.33						28.33		28.33		28.33
Z _k = S _k /σ _S			0.56						-0.19		-0.56		0.19
Z _k ²			0.32						0.04		0.32		0.04

ΣZ _k =	0.00	Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅	Σn	24
ΣZ _k ² =	0.71	Count	24	0	0	0	0	ΣS _k	0
Z-bar=ΣZ _k /K=	0.00								

χ _n ² =ΣZ _k ² -K(Z-bar) ² =	0.71	@α=5% χ _(K-1) ² =	7.81	Test for station homogeneity
p	0.872			χ _n ² < χ _(K-1) ² ACCEPT
ΣVAR(S _k)	Z _{calc} 0.00	@α/2=2.5% Z=	1.96	H ₀ (No trend) ACCEPT
113.33	p 0.500			H _A (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals			
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-2.61		2.73
0.050	-1.88		2.24
0.100	-1.65	-0.04	1.49
0.200	-0.72		0.59

Site #9

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

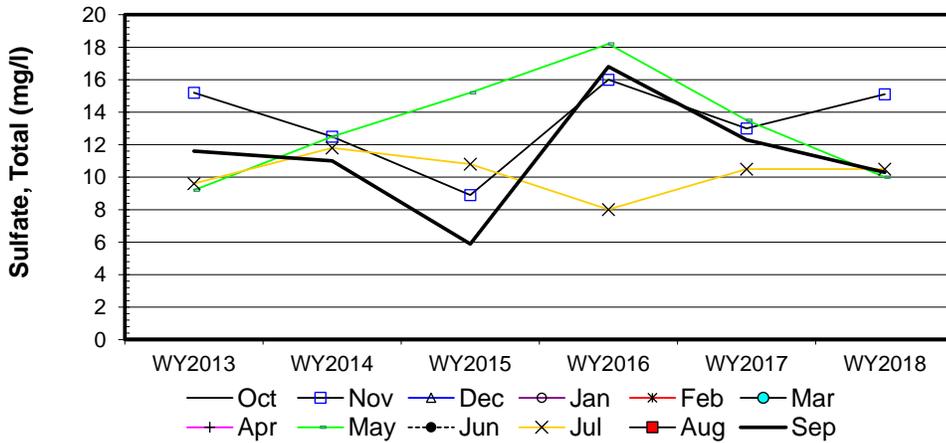
Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	WY2013		15.2						9.2		9.6		11.6
b	WY2014		12.5						12.5		11.8		11.0
c	WY2015		8.9						15.2		10.8		5.9
d	WY2016		16.0						18.2		8.0		16.8
e	WY2017		13.0						13.5		10.5		12.3
f	WY2018		15.1						10.0		10.5		10.3
n		0	6	0	0	0	0	0	6	0	6	0	6
t ₁		0	6	0	0	0	0	0	6	0	4	0	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
b-a			-1						1		1		-1
c-a			-1						1		1		-1
d-a			1						1		-1		1
e-a			-1						1		1		1
f-a			-1						1		1		-1
c-b			-1						1		-1		-1
d-b			1						1		-1		1
e-b			1						1		-1		1
f-b			1						-1		-1		-1
d-c			1						1		-1		1
e-c			1						-1		-1		1
f-c			1						-1		-1		1
e-d			-1						-1		1		-1
f-d			-1						-1		1		-1
f-e			1						-1		0		-1
S _k		0	1	0	0	0	0	0	3	0	-2	0	-1
σ _s ² =			28.33						28.33		27.33		28.33
Z _k = S _k /σ _s			0.19						0.56		-0.38		-0.19
Z _k ²			0.04						0.32		0.15		0.04

ΣZ_k= 0.18
 ΣZ_k²= 0.53
 Z-bar=ΣZ_k/K= 0.05

Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅
Count	22	1	0	0	0

Σn = 24
 ΣS_k = 1

χ _n ² =ΣZ _k ² -K(Z-bar) ² =	0.53	@α=5% χ _(K-1) ² =	7.81	Test for station homogeneity
p	0.913			χ _h ² <χ _(K-1) ² ACCEPT
ΣVAR(S _k)	Z _{calc} 0.00	@α=2.5% Z=	1.96	H ₀ (No trend) ACCEPT
112.33	p 0.500			H _A (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals			
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.70		1.32
0.050	-0.51	0.08	0.55
0.100	-0.41		0.32
0.200	-0.21		0.20

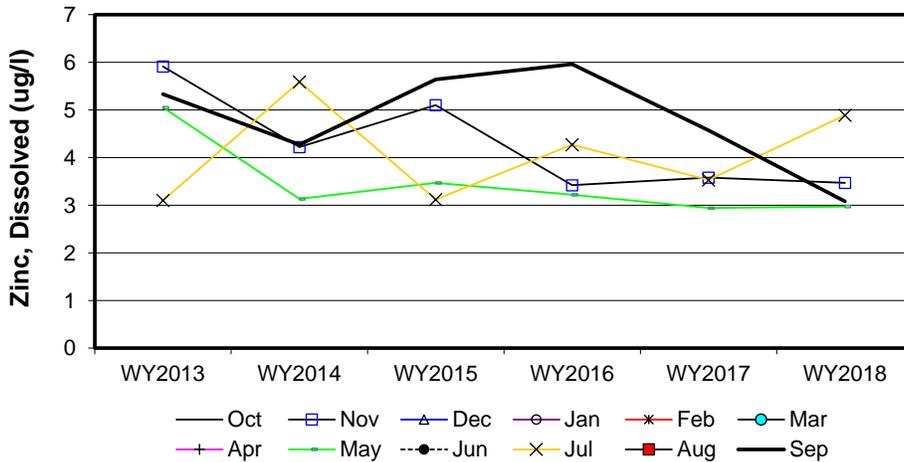
Site #9

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	WY2013		5.9						5.1		3.1		5.3
b	WY2014		4.2						3.1		5.6		4.3
c	WY2015		5.1						3.5		3.1		5.6
d	WY2016		3.4						3.2		4.3		6.0
e	WY2017		3.6						2.9		3.5		4.6
f	WY2018		3.5						3.0		4.9		3.1
n		0	6	0	0	0	0	0	6	0	6	0	6
t ₁		0	6	0	0	0	0	0	6	0	6	0	6
t ₂		0	0	0	0	0	0	0	0	0	0	0	0
t ₃		0	0	0	0	0	0	0	0	0	0	0	0
t ₄		0	0	0	0	0	0	0	0	0	0	0	0
t ₅		0	0	0	0	0	0	0	0	0	0	0	0
b-a			-1						-1		1		-1
c-a			-1						-1		1		1
d-a			-1						-1		1		1
e-a			-1						-1		1		-1
f-a			-1						-1		1		-1
c-b			1						1		-1		1
d-b			-1						1		-1		1
e-b			-1						-1		-1		1
f-b			-1						-1		-1		-1
d-c			-1						-1		1		1
e-c			-1						-1		1		-1
f-c			-1						-1		1		-1
e-d			1						-1		-1		-1
f-d			1						-1		1		-1
f-e			-1						1		1		-1
S _k		0	-9	0	0	0	0	0	-9	0	5	0	-3
σ _S ² =			28.33						28.33		28.33		28.33
Z _k = S _k /σ _S			-1.69						-1.69		0.94		-0.56
Z _k ²			2.86						2.86		0.88		0.32

ΣZ _k =	-3.01	Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅	Σn	24
ΣZ _k ² =	6.92	Count	24	0	0	0	0	ΣS _k	-16
Z-bar=ΣZ _k /K=	-0.75								

χ _h ² =ΣZ _k ² -K(Z-bar) ² =	4.66	@α=5% χ _(K-1) ² =	7.81	Test for station homogeneity
p	0.199			χ _h ² <χ _(K-1) ² ACCEPT
ΣVAR(S _k)	Z _{calc} -1.41	@α/2=2.5% Z=	1.96	H ₀ (No trend) ACCEPT
113.33	p 0.079			H _A (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals			
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.56		0.07
0.050	-0.48		0.00
0.100	-0.41	-0.20	-0.07
0.200	-0.35		-0.15

INTERPRETIVE REPORT

SITE 60

Sampling at this site was initiated during background investigations conducted by HGCMC for the Stage II Tailings EIS. Both ADEC and the USFS requested during the WY2006 annual meeting that an additional monitoring point be added to monitor potential impacts from Pond 7 on the western downgradient drainage. Greens Creek proposed the current site and after review by ADEC and USFS during a site visit (June 2, 2007 – USFS Inspection #259) the new site was added to the routine monitoring schedule.

The data collected during the current water year are listed in the following “Table of Results for Water Year 2018” 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 one-half of the 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, in the past six years, have been identified by HGCMC.				

The data for the current water year have been compared to the strictest fresh water quality criterion for each applicable analyte. Nine results exceeding these criteria have been identified, as listed in the table below. All four samples for field pH and total alkalinity were below the lower limits. These values are similar to those recorded prior to disturbance activities. The remaining exceedance was for dissolved mercury and is discussed below.

Table of Exceedance for Water Year 2018

Sample Date	Parameter	Value	Limits		Hardness
			Lower	Upper	
7-Nov-17	Alkalinity, Total	9.9 mg/L	20		24 mg/L
8-May-18	Alkalinity, Total	4.9 mg/L	20		24.6 mg/L
17-Jul-18	Alkalinity, Total	3.8 mg/L	20		25.8 mg/L
10-Sep-18	Alkalinity, Total	7.6 mg/L	20		32.6 mg/L
17-Jul-18	Mercury, Dissolved	0.012 µg/L		0.012	25.8 mg/L
7-Nov-17	pH	6.4 su	6.5	9.0	24 mg/L
8-May-18	pH	6.0 su	6.5	9.0	24.6 mg/L
17-Jul-18	pH	6.2 su	6.5	9.0	25.8 mg/L
10-Sep-18	pH	5.9 su	6.5	9.0	32.6 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. Site 60 was added to the FWMP as a monitoring point for potential impacts from Pond 7. Hardness, conductivity and sulfate appear to have increased in the past two years.

Dissolved mercury levels have been elevated slightly above the AWQS of 0.012 µg/L, intermittently for the past several years. Dissolution of tailings dust particles, which contain small amounts of mercury, and atmospheric deposition of mercury from natural (e.g. volcanoes) and anthropogenic sources (e.g. coal fired power plants in Asia) are potential sources of this metal in the drainage area. Additional sampling in adjacent drainages during water year 2009 and Water Year 2012 showed that this issue was isolated to only the Site 60 watershed.

A non-parametric statistical analysis for trend was performed for specific conductivity, field pH, total alkalinity, total sulfate, and dissolved zinc. Calculation details of the Seasonal Kendall analyses are presented in detail on the pages following this interpretive section. The following table summarizes the results on the data collected between Oct-12 and Sep-18 (WY2013-WY2018).

Site 60 - Table of Summary Statistics for Trend Analysis

Parameter	Mann-Kendall test statistics			Sen's slope estimate	
	n*	p**	Trend	Q	Q(%)
Conductivity Field	6	0.92			
pH Field	6	0.07			
Alkalinity, Total	6	0.08			
Sulfate, Total	6	1.00	+	1.39	29.0
Zinc, Dissolved	6	0.50			

* Number of Years ** Significance level

A statistically significant ($\alpha/2=2.5\%$) trend was identified for sulfate for the current water year. A Sen's slope estimate of 1.39 mg/L/yr was estimated. Sulfate values were approximately 4% of the AWQS. Increases in sulfate, hardness and conductivity observed at Site 60 are likely related to construction-related disturbances in the area. HGCMC feels that the current sampling schedule adequately characterizes the water quality parameters at this site.

Table of Results for Water Year 2018

Site 060FMS - 'Lower Althea creek'

Sample Date/Parameter	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018	Median
Water Temp (°C)		3						4.8		10.1		10.7	7.5
Conductivity-Field(µmho)		50.4						66		61.5		90.1	63.8
Conductivity-Lab (µmho)		46						62		57		79	60
pH Lab (standard units)		5.51						5.32		5.18		5.24	5.28
pH Field (standard units)		6.43						6.02		6.15		5.92	6.09
Total Alkalinity (mg/L)		9.9						4.9		3.8		7.6	6.3
Total Sulfate (mg/L)		4.2						7.2		7		16.3	7.1
Hardness (mg/L)		24						24.6		25.8		32.6	25.2
Dissolved As (ug/L)		2.11						1.58		2.95		1.36	1.845
Dissolved Ba (ug/L)		23.4						21.9		30		30	26.7
Dissolved Cd (ug/L)		0.0187						0.0127		0.0211		0.0136	0.0162
Dissolved Cr (ug/L)		1.44						0.863		1.19		1.41	1.300
Dissolved Cu (ug/L)		0.995						1.03		1.65		0.754	1.013
Dissolved Pb (ug/L)		0.27						0.137		0.287		0.138	0.2040
Dissolved Ni (ug/L)		1.03						0.756		1.18		1.11	1.070
Dissolved Ag (ug/L)		0.012						0.006		0.01		0.006	0.008
Dissolved Zn (ug/L)		5.37						4.62		7.12		5.7	5.54
Dissolved Se (ug/L)		0.174						0.057		0.136		0.122	0.129
Dissolved Hg (ug/L)		0.012						0.00875		0.0123		0.00819	0.010375

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

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

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

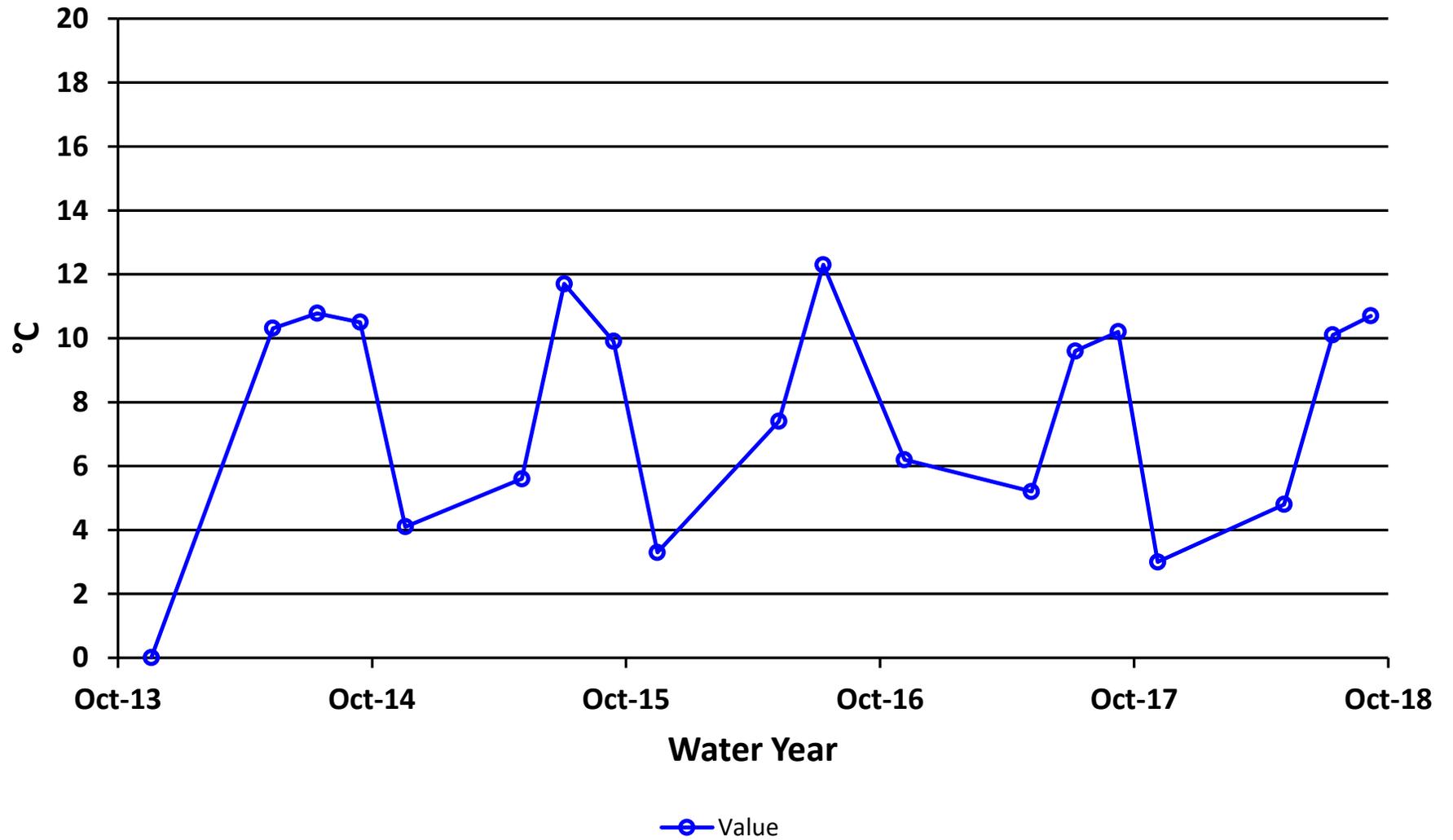
Qualified Data by QA Reviewer

Date Range: 10/01/2017 to 09/30/2018

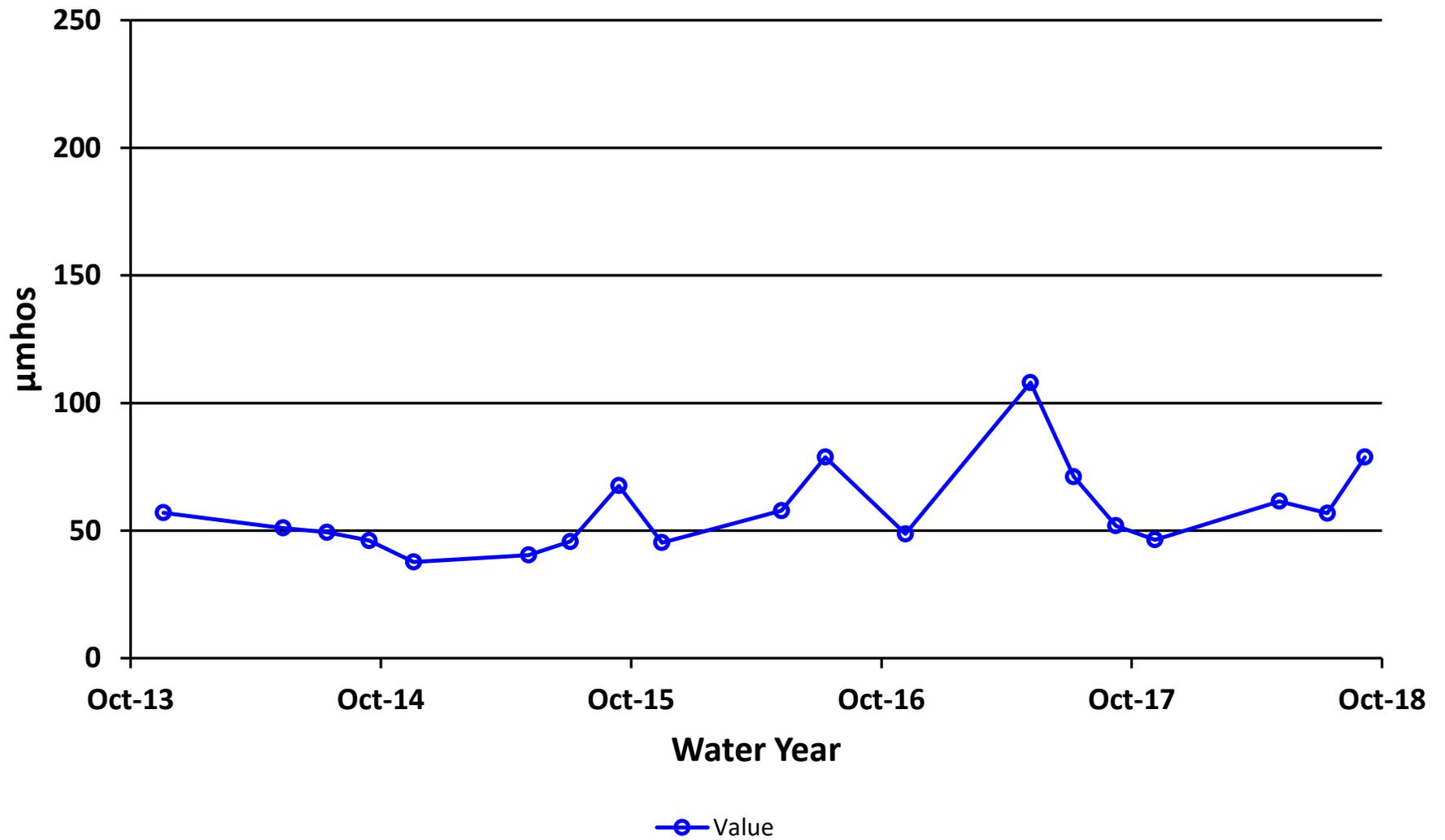
Site No.	Sample Date	Parameter	Value	Qualifier	Reason for Qualifier	
060FMS	11/7/2017	Diss. Se-ICP/MS	0.17	µg/L	J	Below Quantitative Range
	5/8/2018	Diss. Ag-ICP/MS	0.0055	µg/L	J	Below Quantitative Range
7/17/2018		Diss. Se-ICP/MS	0.13	µg/L	J	Below Quantitative Range
		pH	5.18	pH units	J	Hold time Violation
		Total Sulfate	7.03	mg/L	J	Sample Receipt Temperature
9/10/2018		Diss. Ag-ICP/MS	0.0058	µg/L	J	Below Quantitative Range
		Diss. Se-ICP/MS	0.12	µg/L	J	Below Quantitative Range
		Diss. Zn-ICP/MS	5.7	µg/L	U	Field Blank Contamination
		pH	5.24	pH units	J	Hold Time Violation
		Total Sulfate	16.3	mg/L	J	Sample Receipt Temperature

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

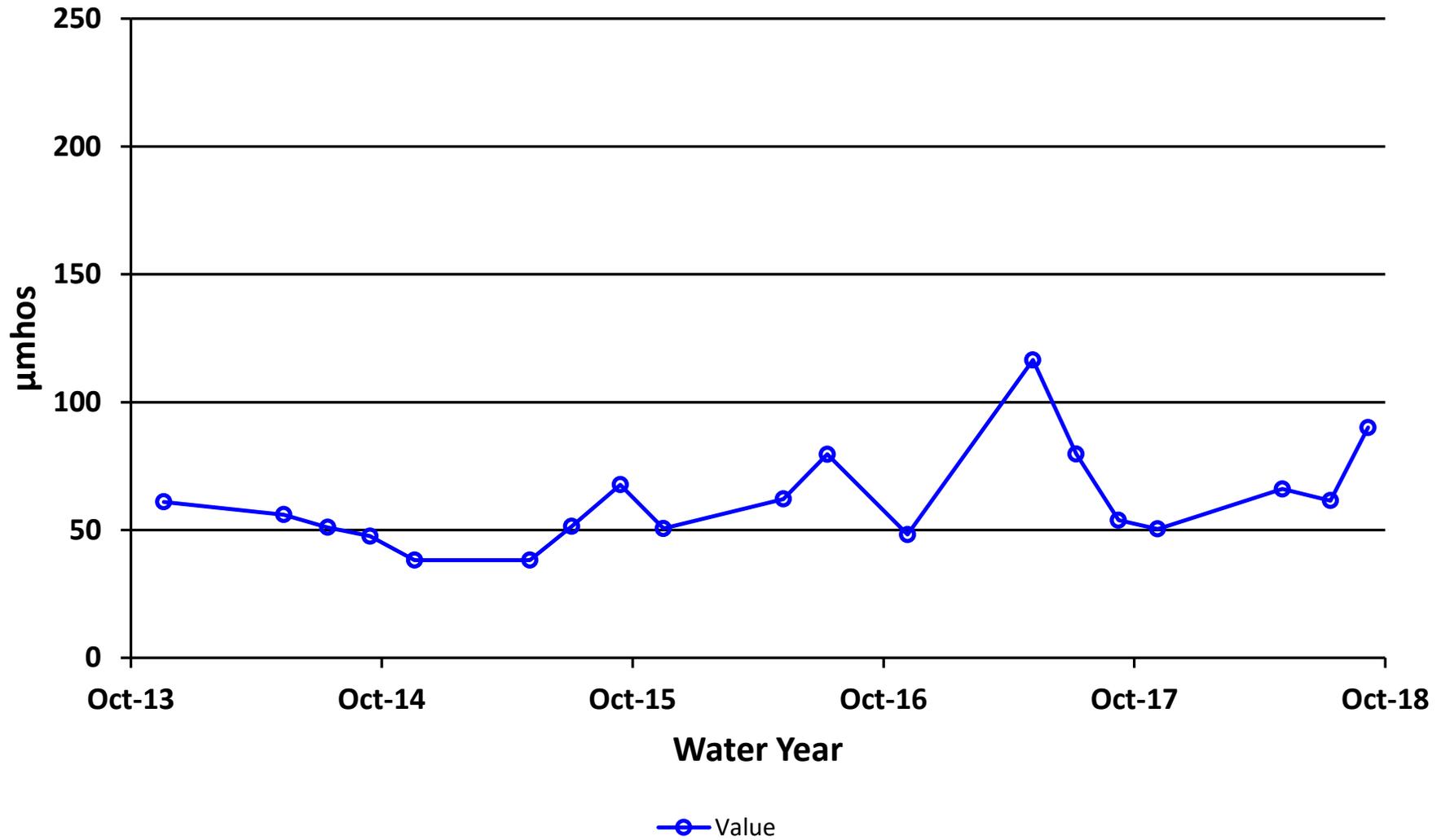
Site 60 - Water Temperature



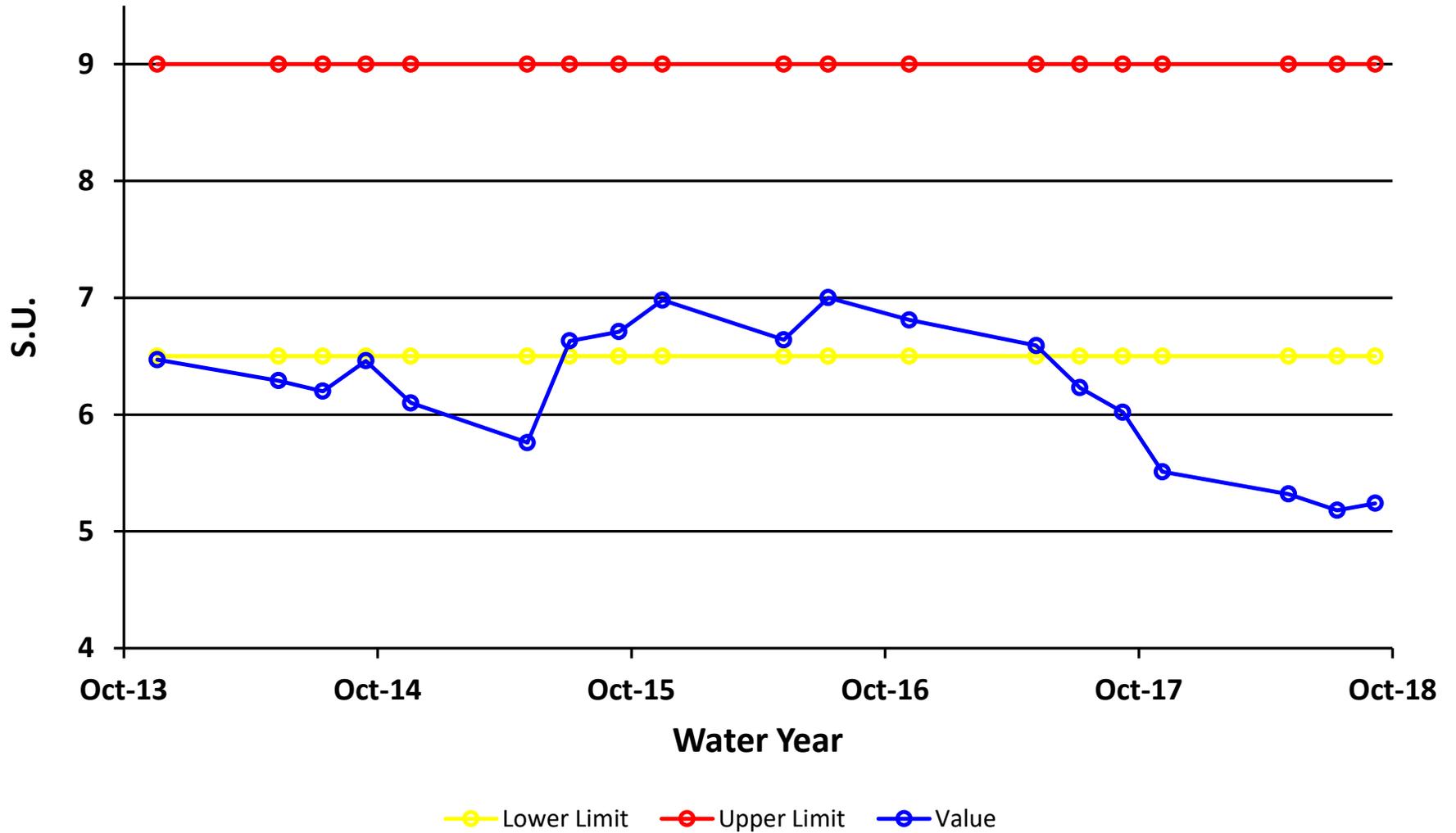
Site 60 - Conductivity Laboratory



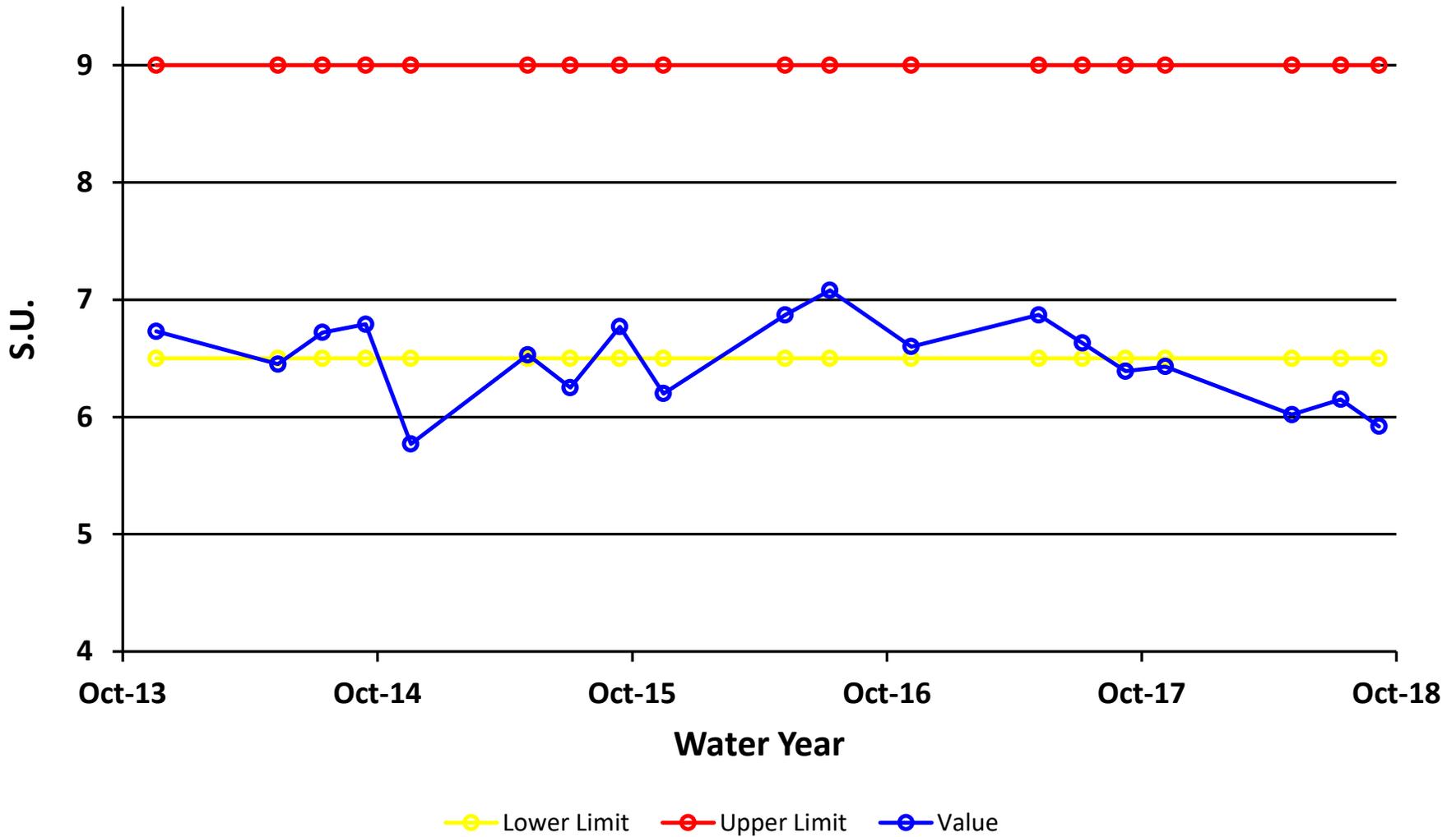
Site 60 - Conductivity Field



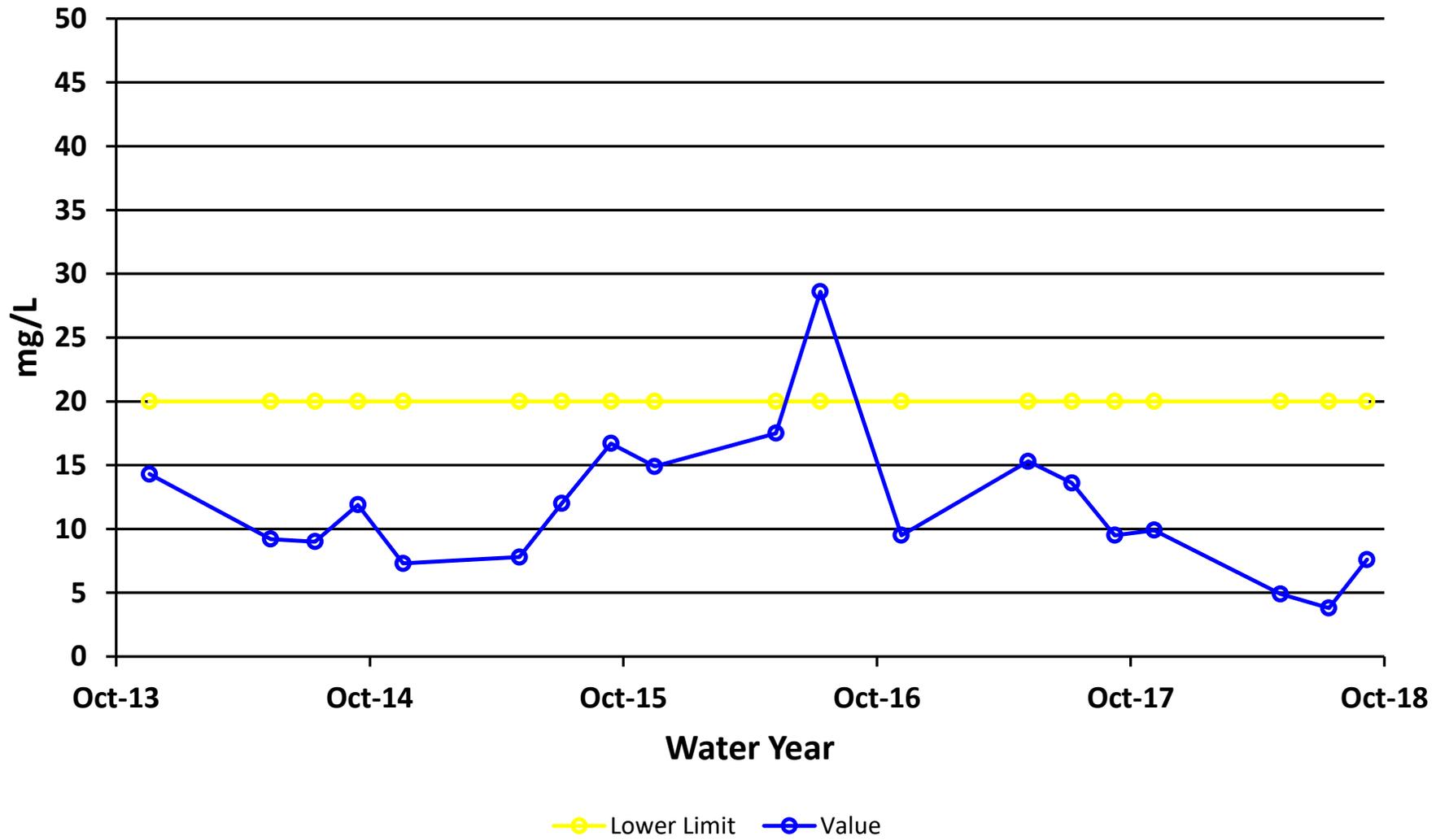
Site 60 - pH Laboratory



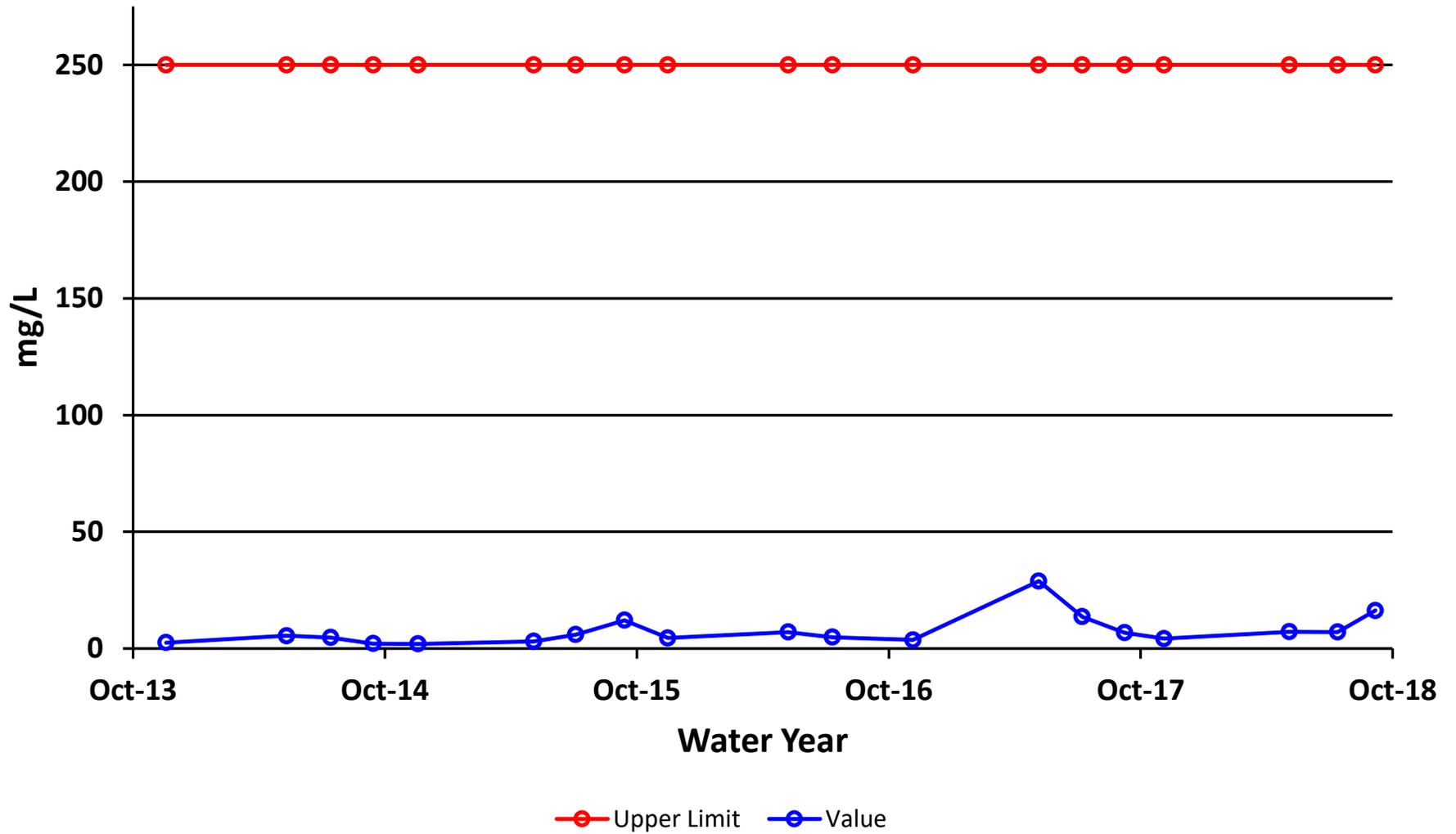
Site 60 - pH Field



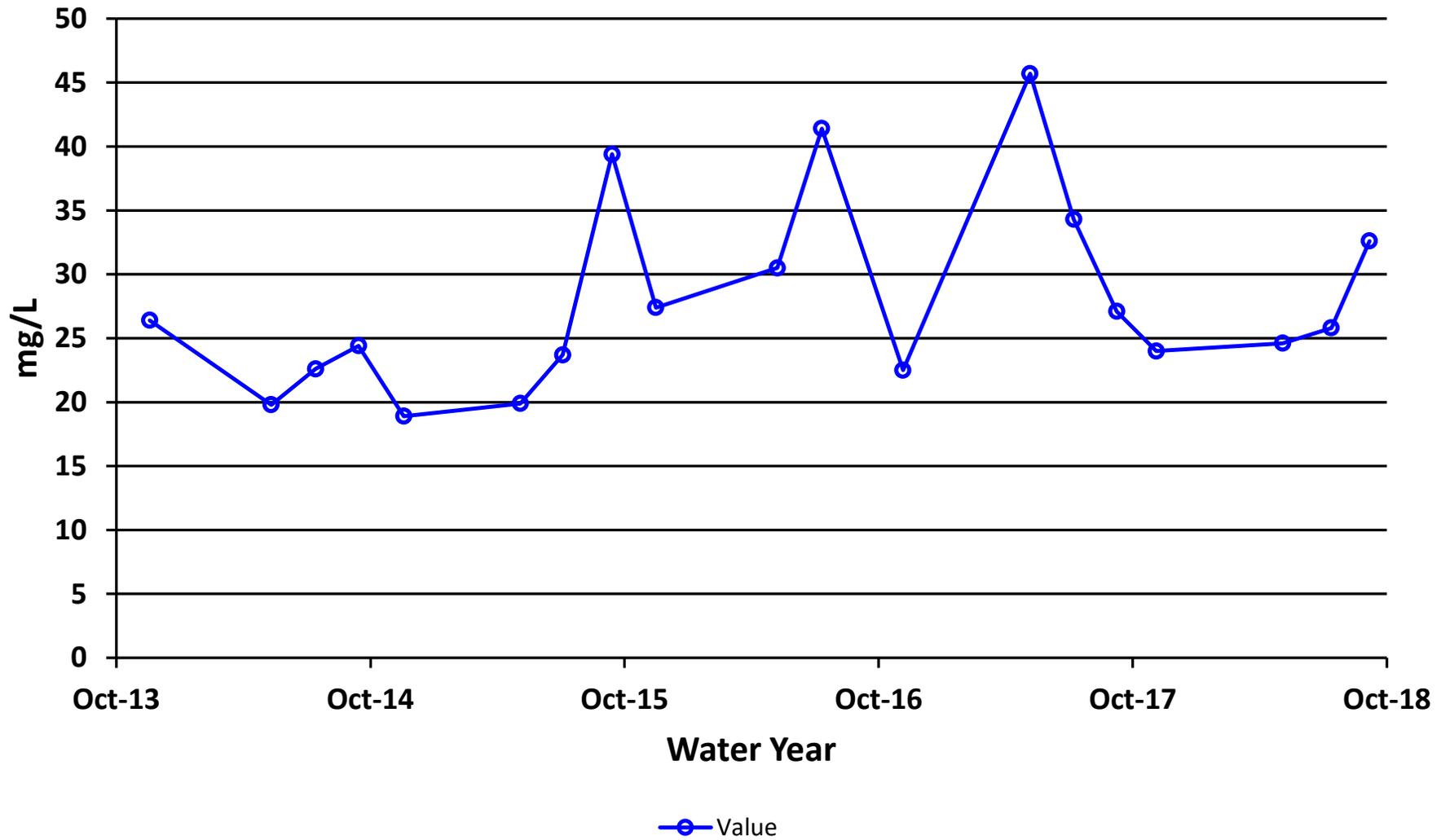
Site 60 - Alkalinity



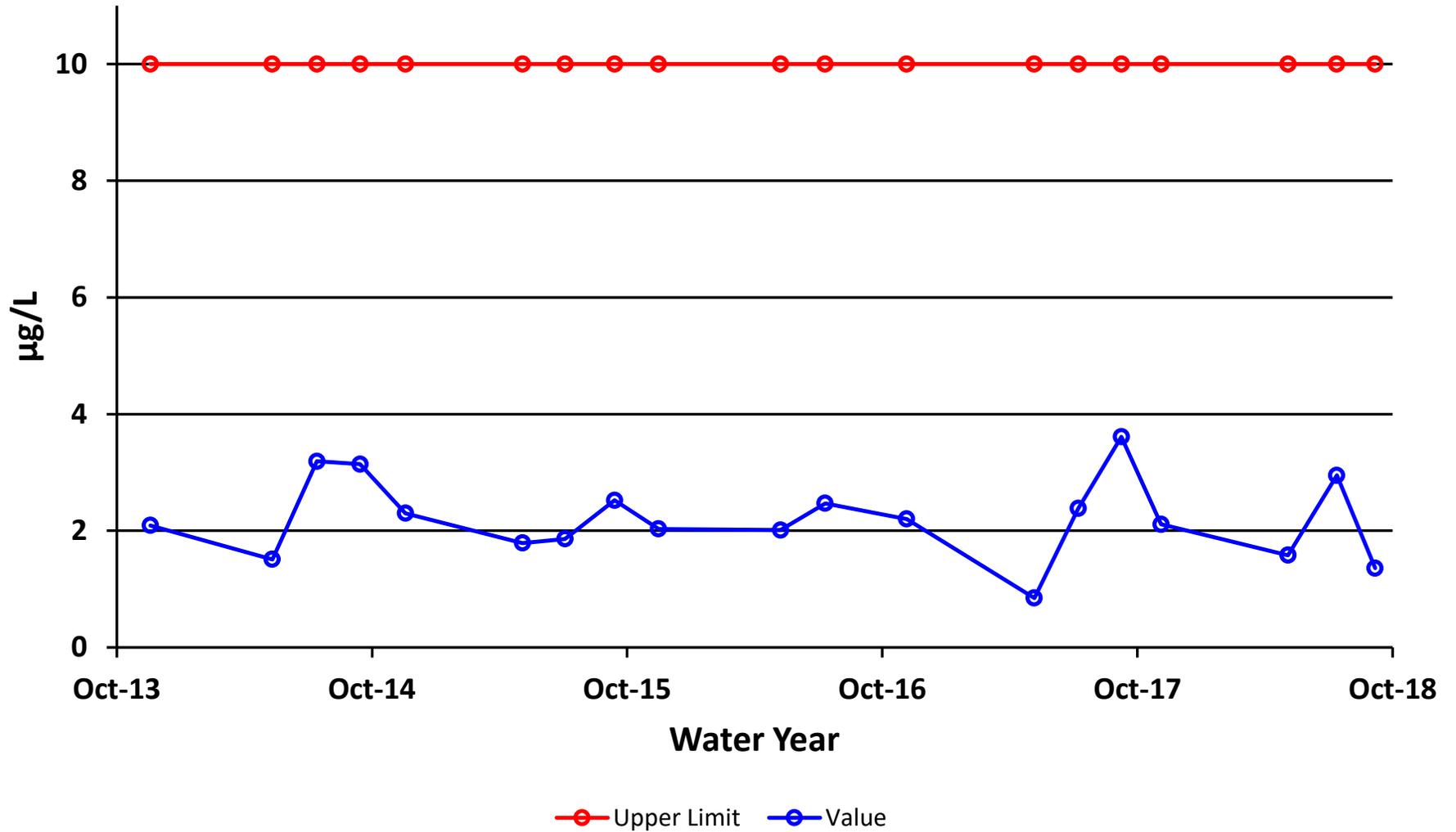
Site 60 - Sulfate



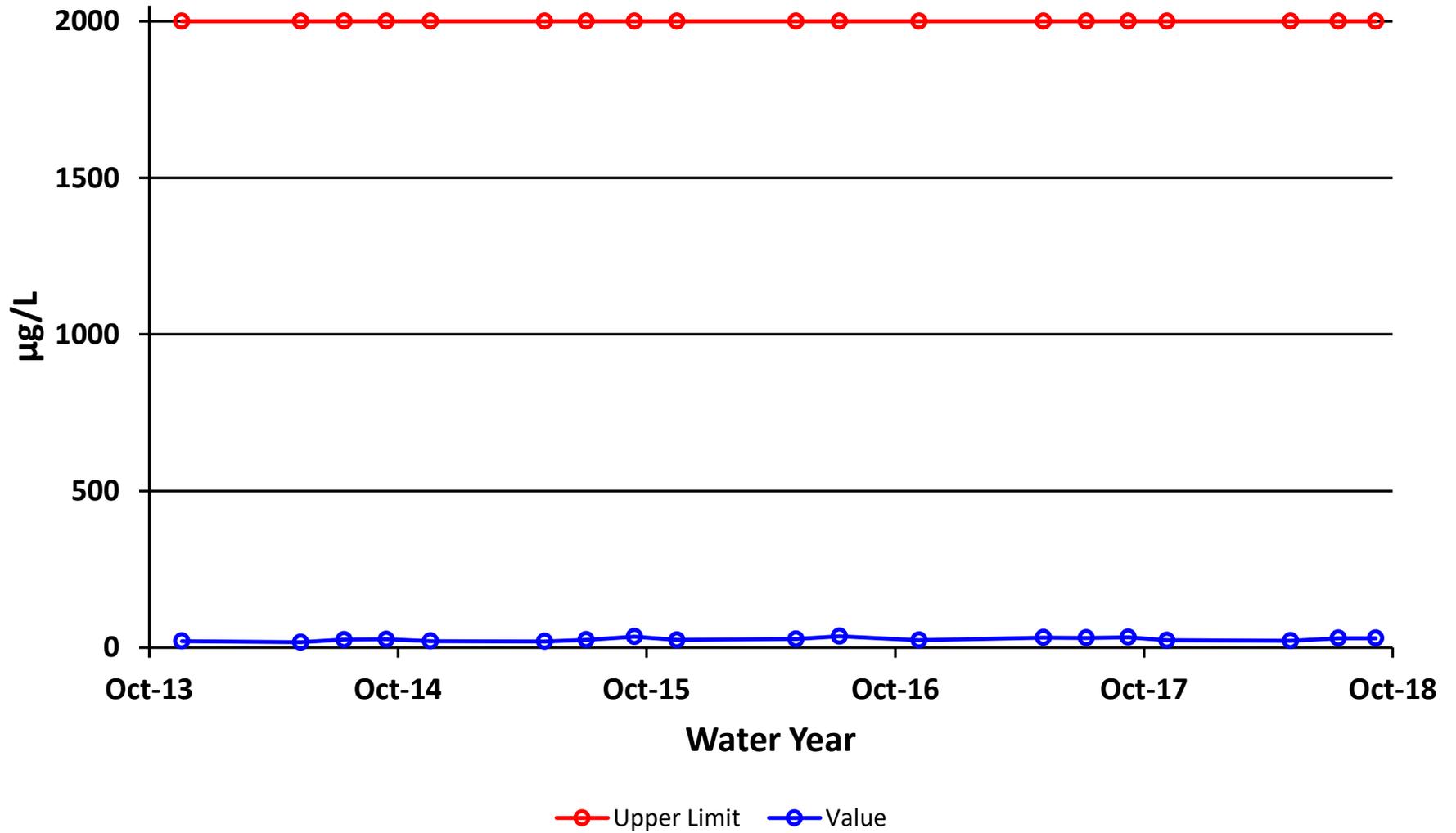
Site 60 - Hardness



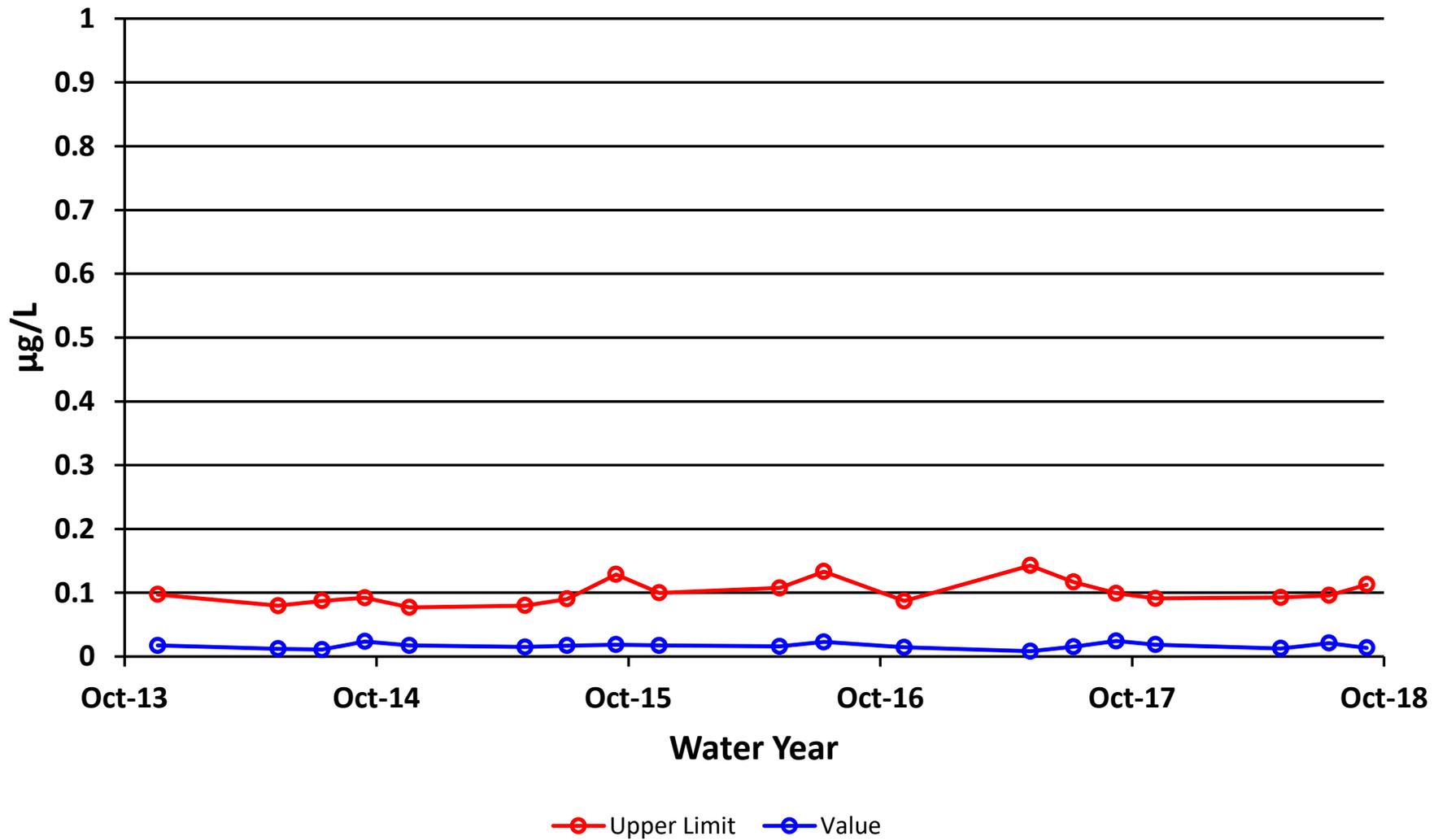
Site 60 - Arsenic Dissolved



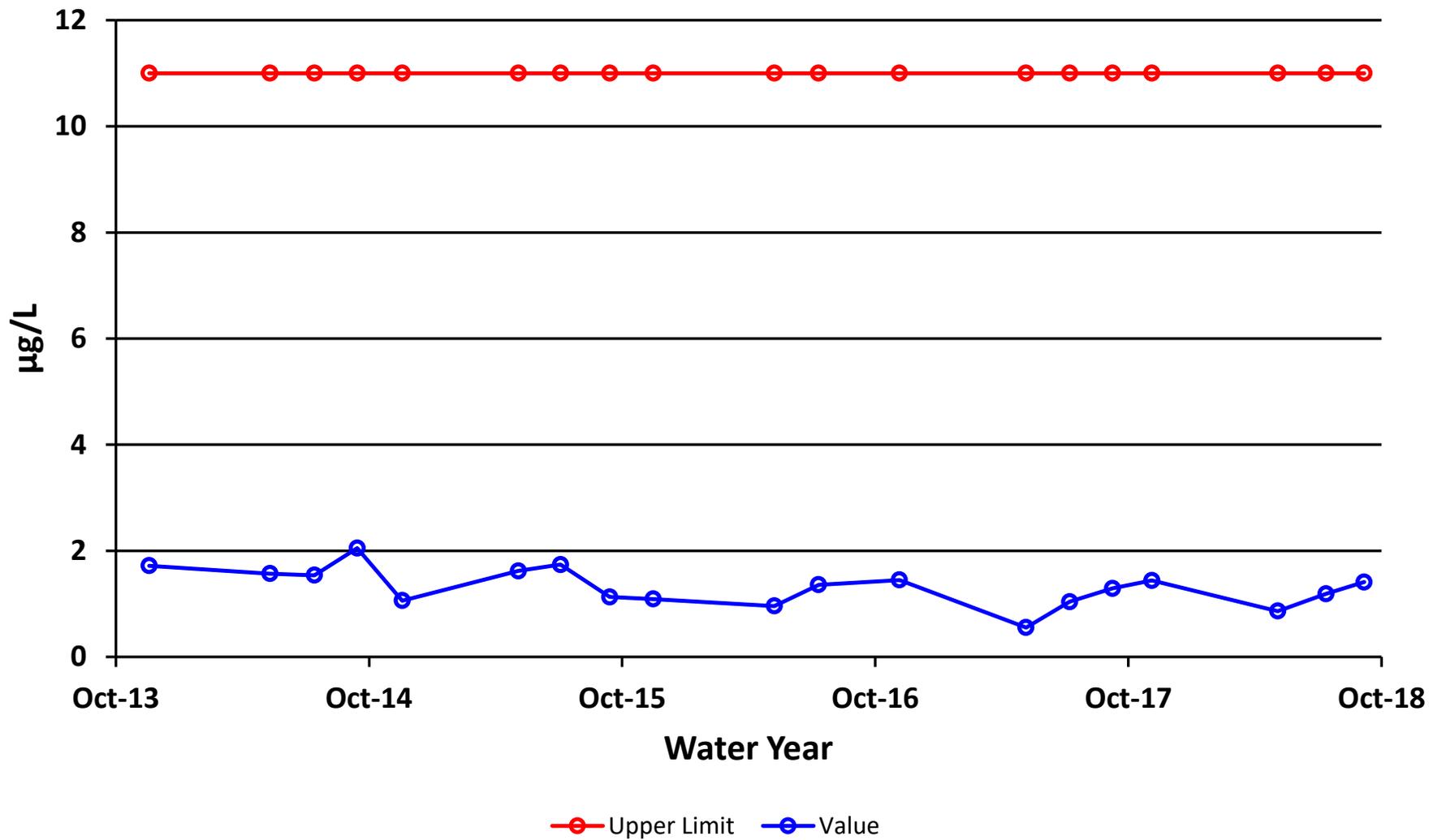
Site 60 - Barium Dissolved



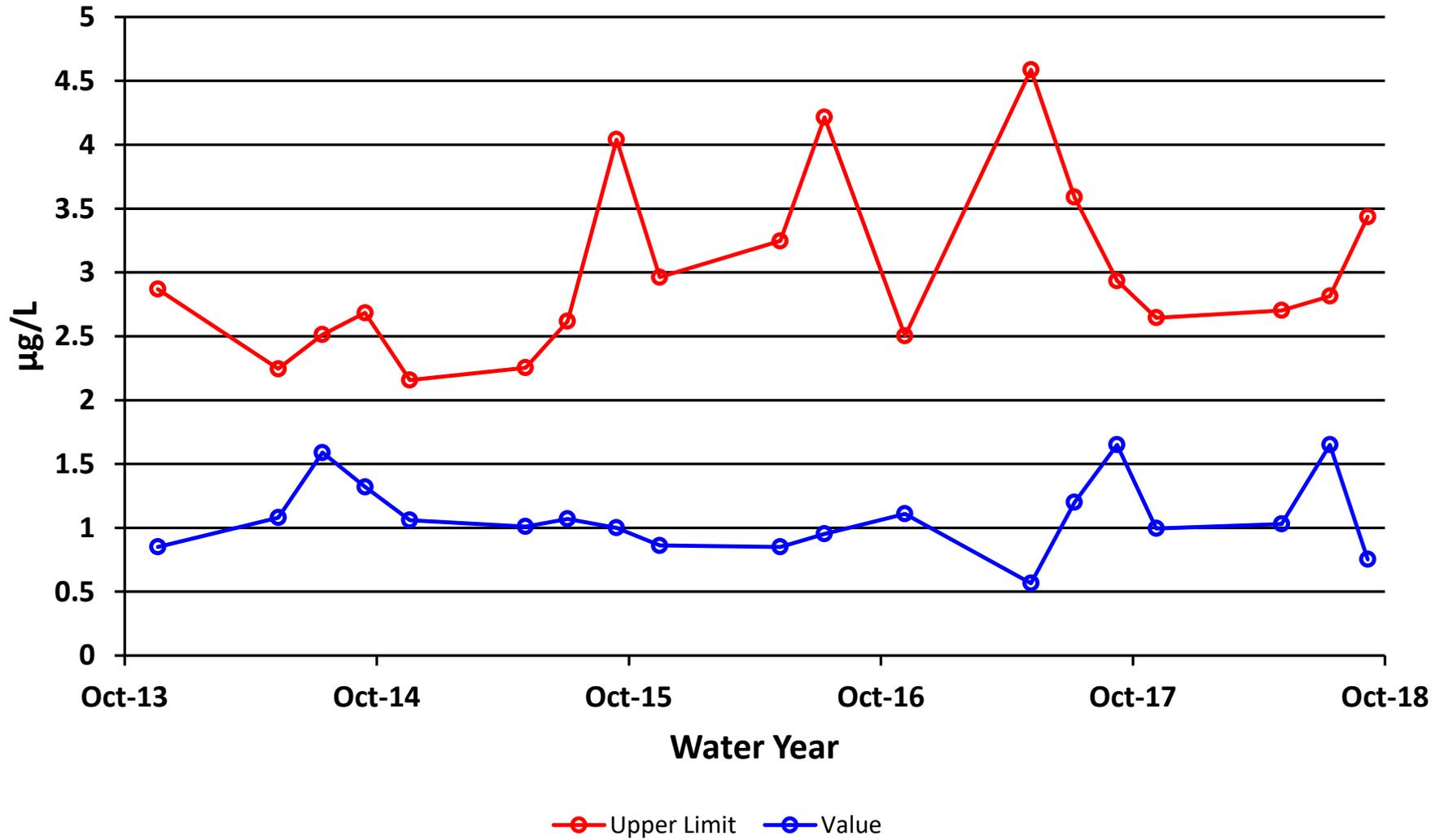
Site 60 - Cadmium Dissolved



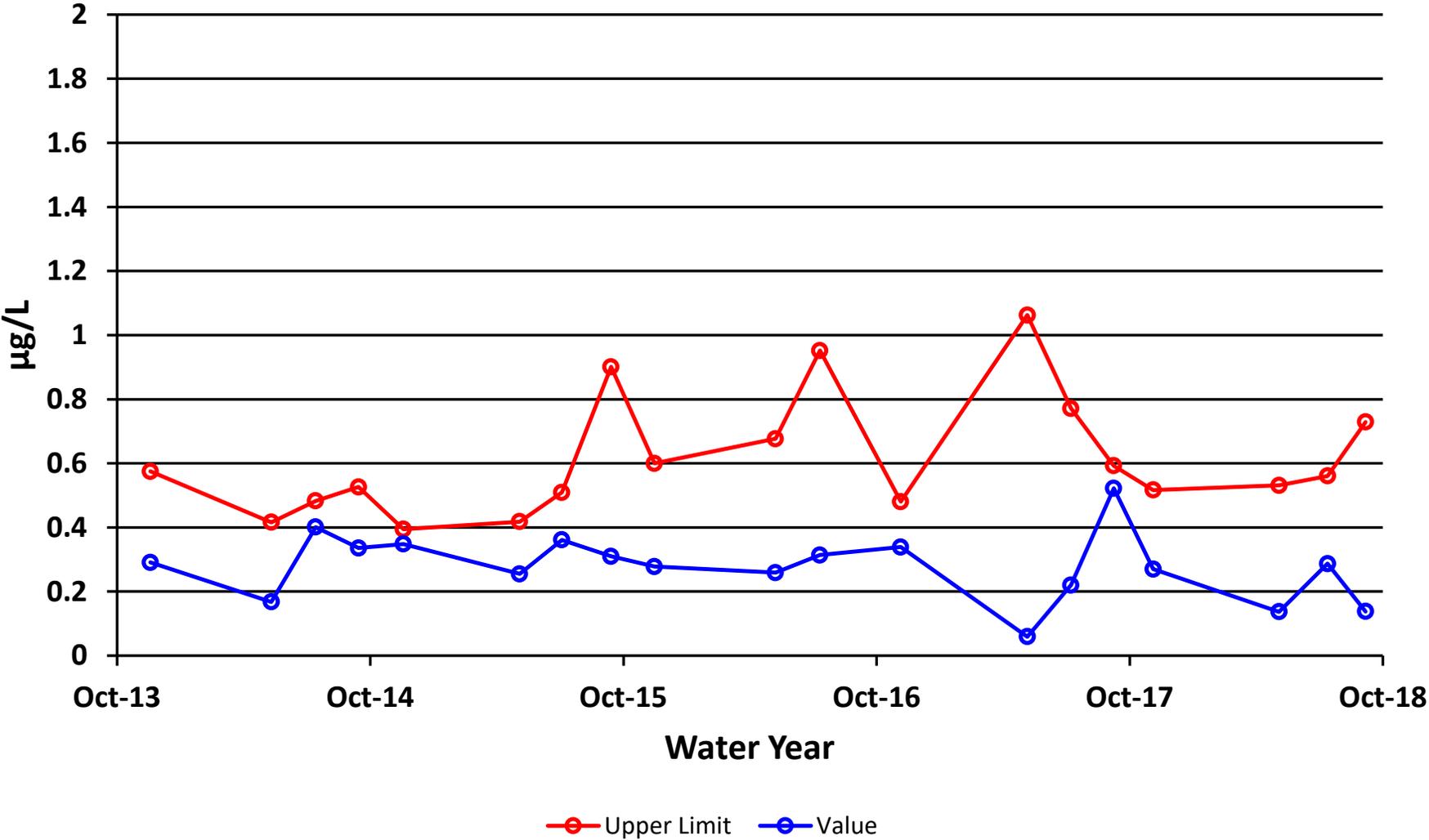
Site 60 - Chromium Dissolved



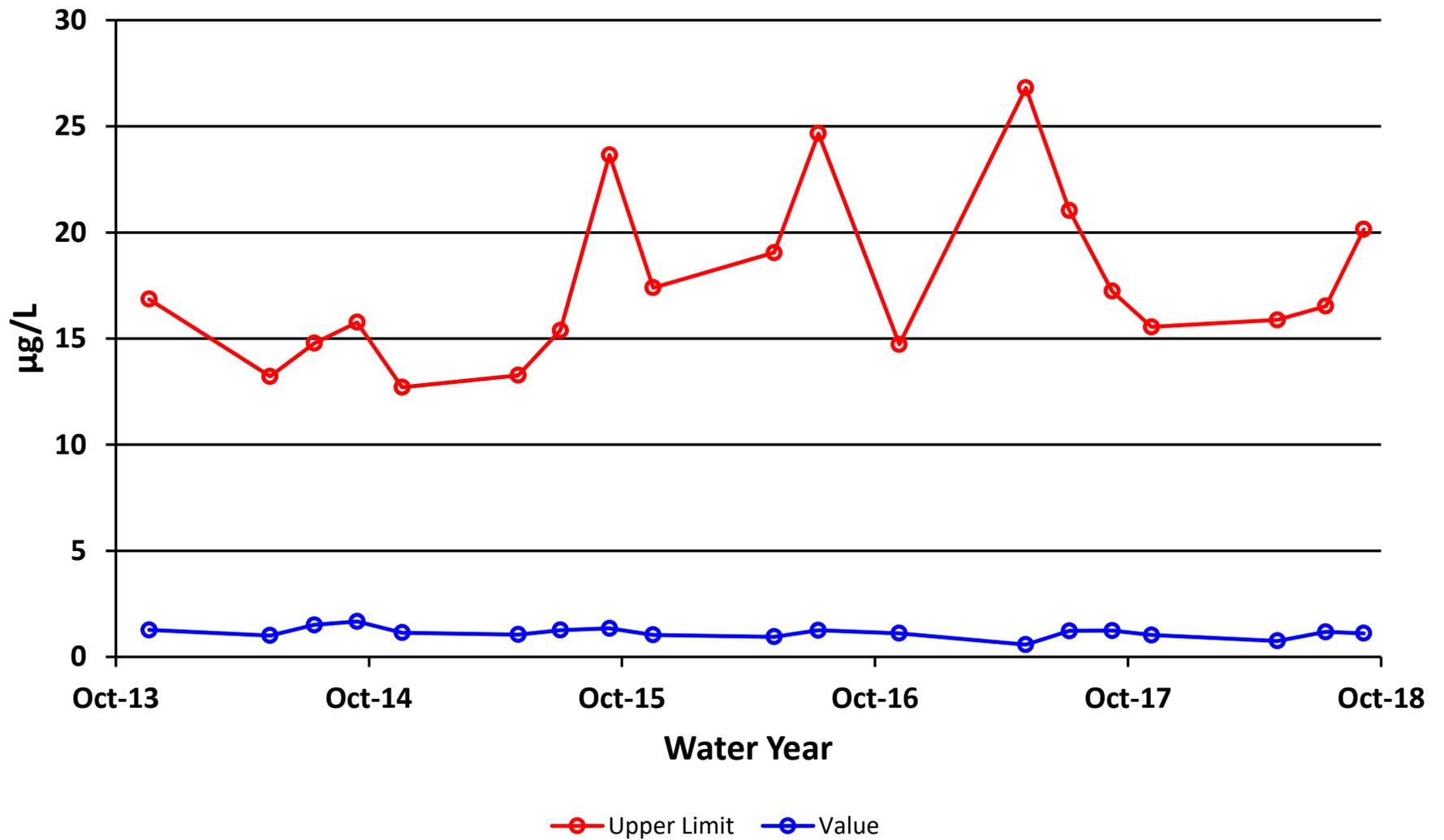
Site 60 - Copper Dissolved



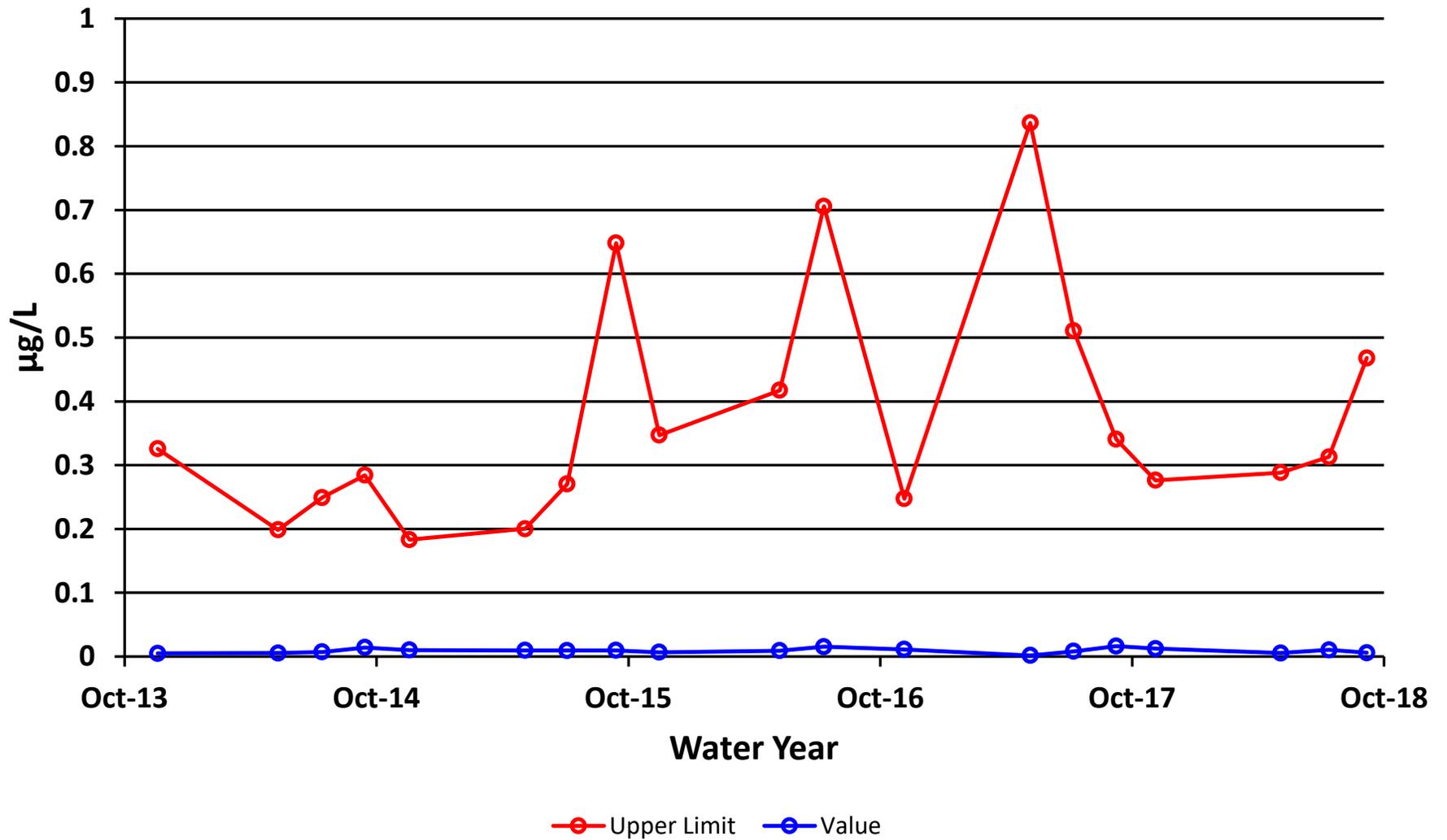
Site 60 - Lead Dissolved



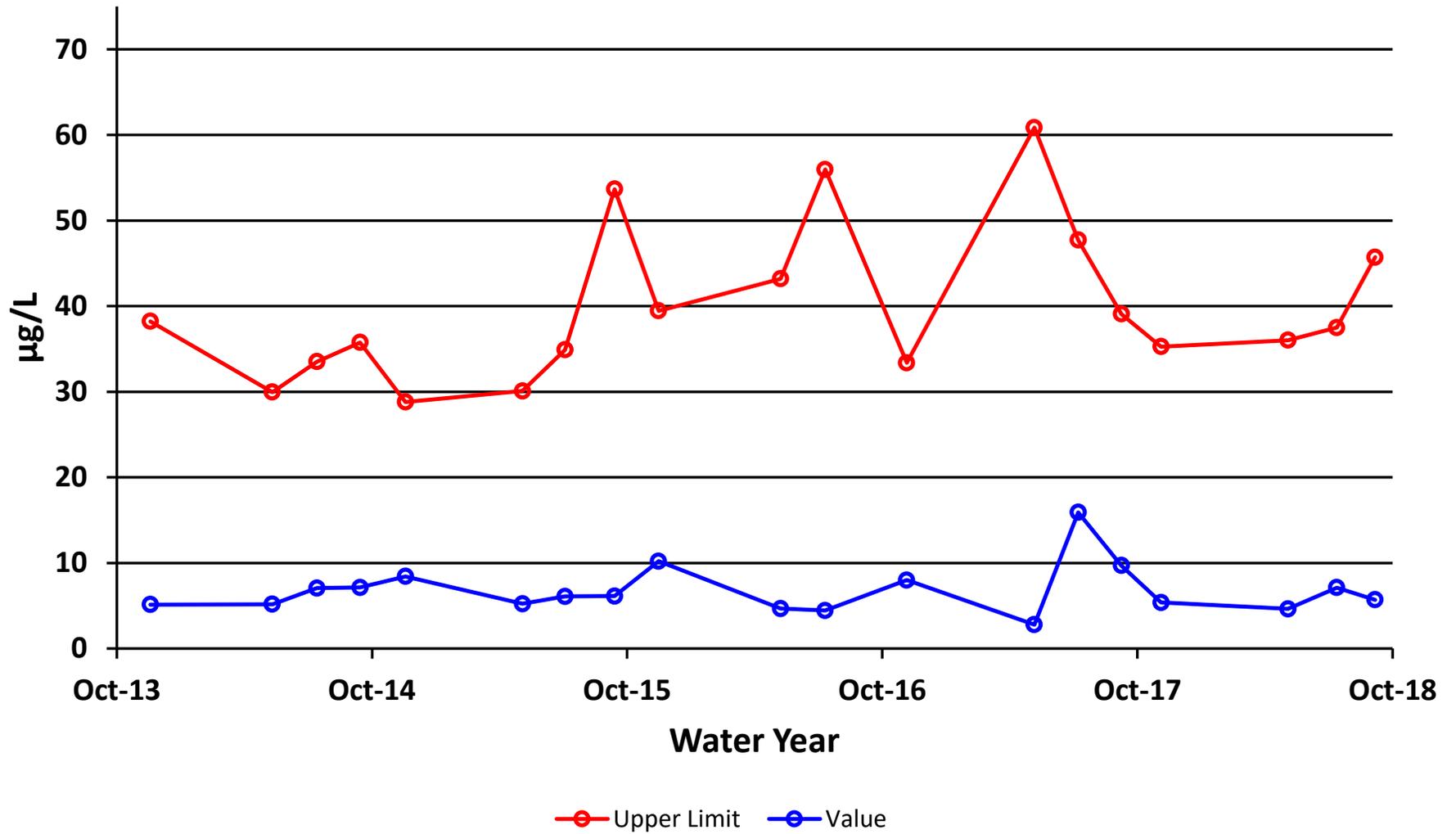
Site 60 - Nickel Dissolved



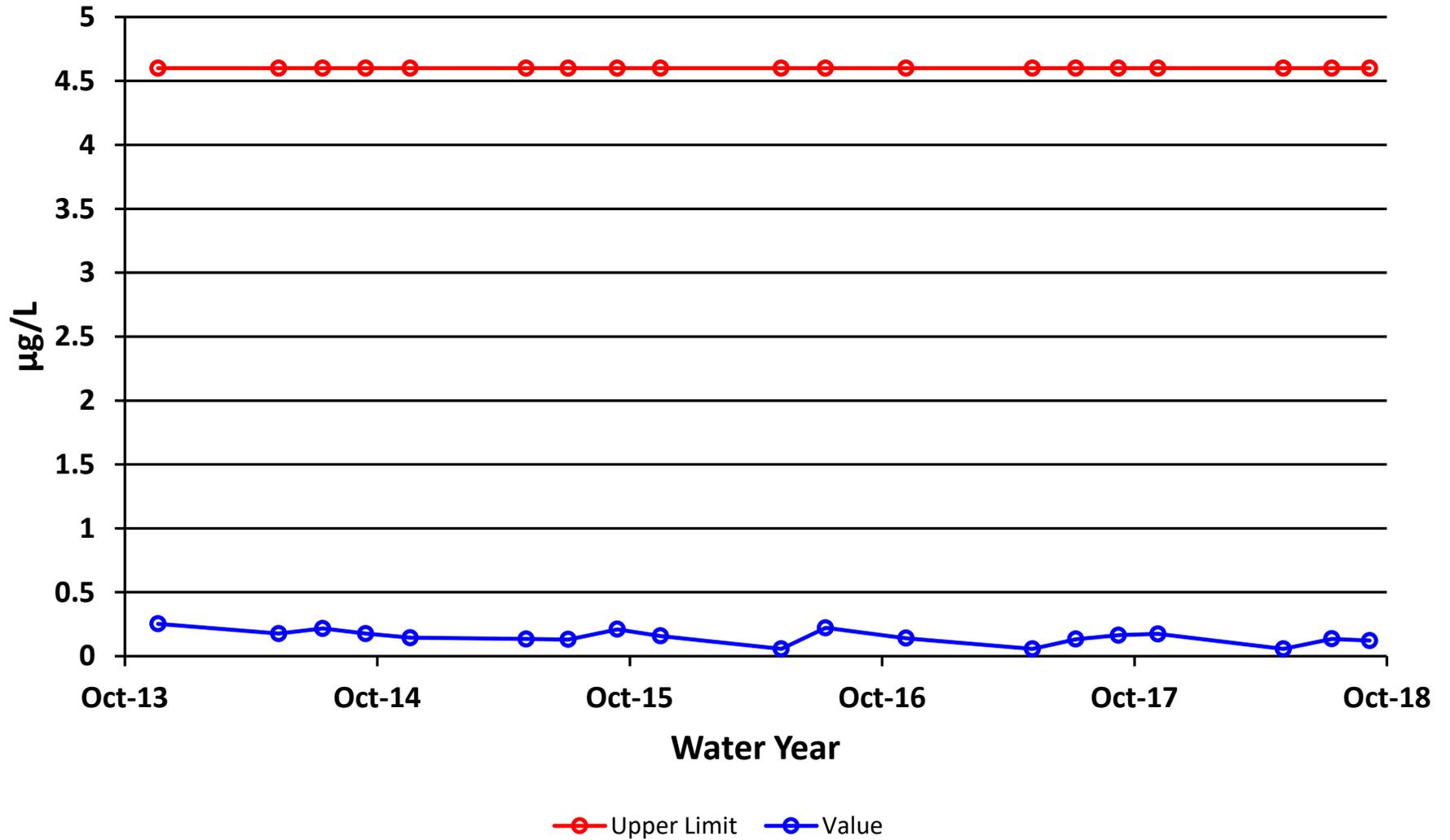
Site 60 - Silver Dissolved



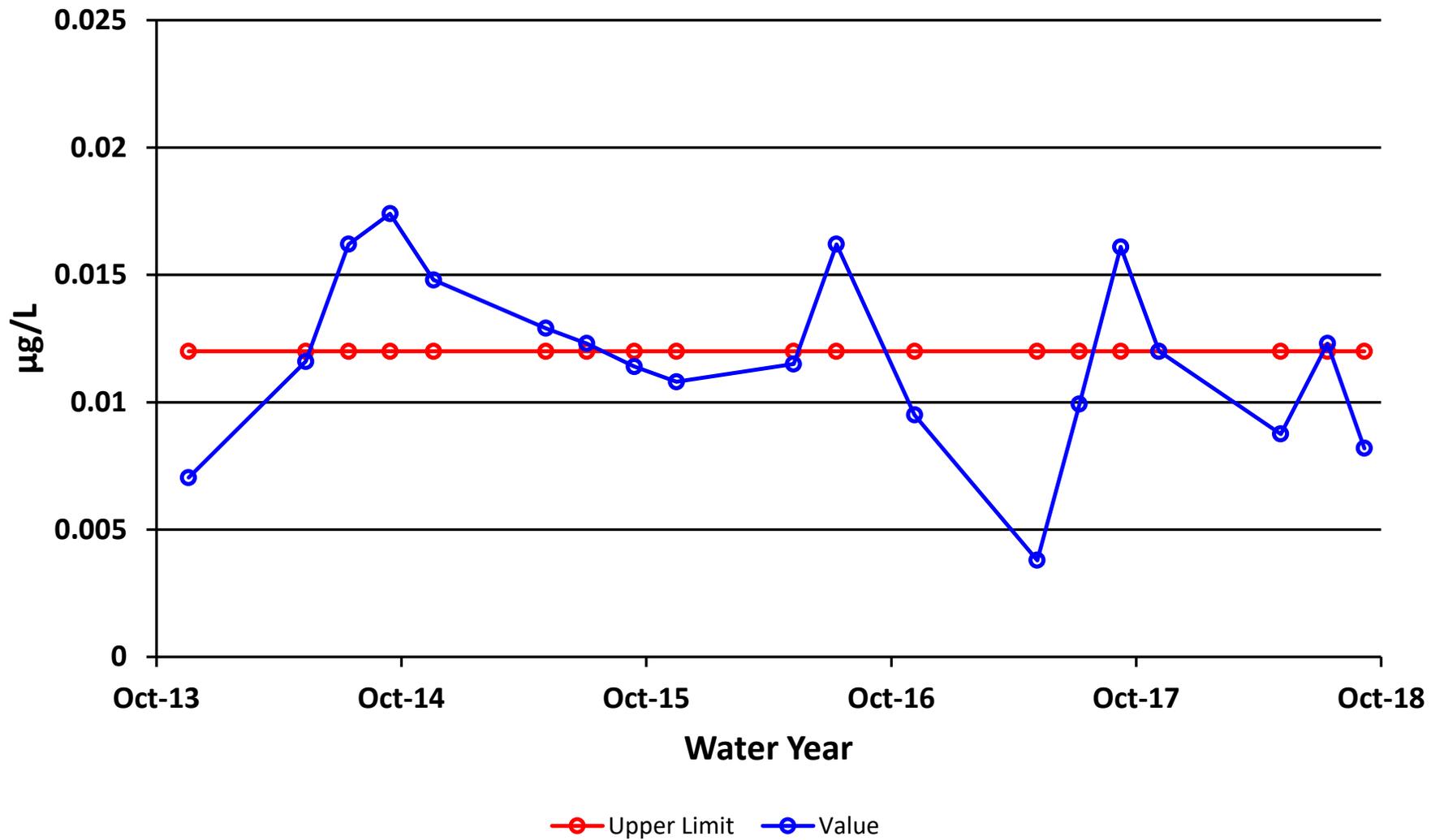
Site 60 - Zinc Dissolved



Site 60 - Selenium Dissolved



Site 60 - Mercury Dissolved



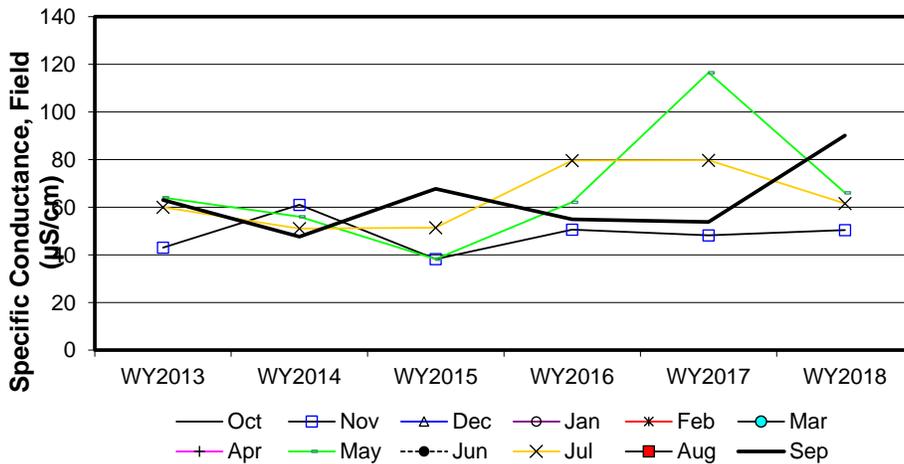
Site #60

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	WY2013		43.0						64.0		60.0		63.0
b	WY2014		61.0						56.0		51.0		47.6
c	WY2015		38.2						38.2		51.4		67.7
d	WY2016		50.6						62.1		79.6		54.9
e	WY2017		48.2						116.5		79.7		53.8
f	WY2018		50.4						66.0		61.5		90.1
n		0	6	0	0	0	0	0	6	0	6	0	6
t ₁		0	6	0	0	0	0	0	6	0	6	0	6
t ₂		0	0	0	0	0	0	0	0	0	0	0	0
t ₃		0	0	0	0	0	0	0	0	0	0	0	0
t ₄		0	0	0	0	0	0	0	0	0	0	0	0
t ₅		0	0	0	0	0	0	0	0	0	0	0	0
b-a			1						-1		-1		-1
c-a			-1						-1		-1		1
d-a			1						-1		1		-1
e-a			1						1		1		-1
f-a			1						1		1		1
c-b			-1						-1		1		1
d-b			-1						1		1		1
e-b			-1						1		1		1
f-b			-1						1		1		1
d-c			1						1		1		-1
e-c			1						1		1		-1
f-c			1						1		1		1
e-d			-1						1		1		-1
f-d			-1						1		-1		1
f-e			1						-1		-1		1
S _k		0	1	0	0	0	0	0	5	0	7	0	3
σ _S ² =			28.33						28.33		28.33		28.33
Z _k = S _k /σ _S			0.19						0.94		1.32		0.56
Z _k ²			0.04						0.88		1.73		0.32

ΣZ _k =	3.01	Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅	Σn	24
ΣZ _k ² =	2.96	Count	24	0	0	0	0	ΣS _k	16
Z-bar=ΣZ _k /K=	0.75								

χ _h ² =ΣZ _k ² -K(Z-bar) ² =	0.71	@α=5% χ _(K-1) ² =	7.81	Test for station homogeneity	
p	0.872			χ _h ² <χ _(K-1) ²	ACCEPT
ΣVAR(S _k)	Z _{calc} 1.41	@α/2=2.5% Z=	1.96	H ₀ (No trend)	ACCEPT
113.33	p 0.921			H _A (± trend)	REJECT



Seasonal-Kendall Slope Confidence Intervals			
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-2.40	2.13	5.85
0.050	-0.50		3.96
0.100	0.16		3.31
0.200	0.40		2.58

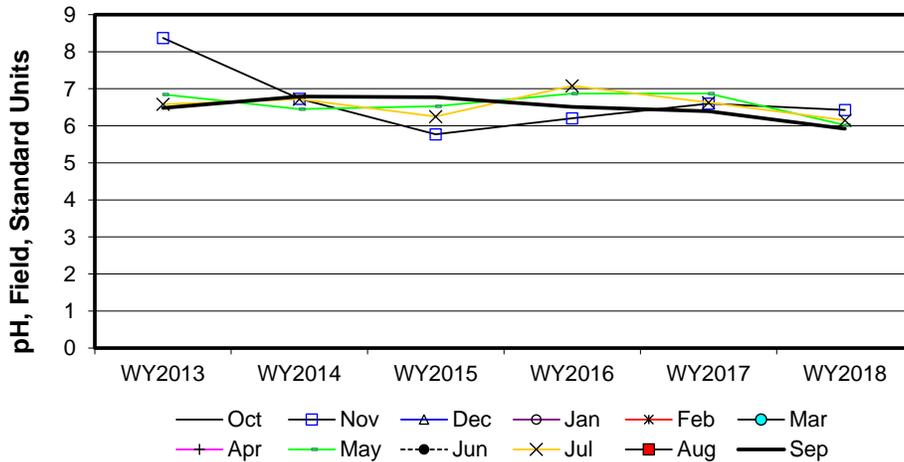
Site #60

Seasonal Kendall analysis for pH, Field, Standard Units

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	WY2013		8.4						6.9		6.6		6.5
b	WY2014		6.7						6.5		6.7		6.8
c	WY2015		5.8						6.5		6.3		6.8
d	WY2016		6.2						6.9		7.1		6.5
e	WY2017		6.6						6.9		6.6		6.4
f	WY2018		6.4						6.0		6.2		5.9
n		0	6	0	0	0	0	0	6	0	6	0	6
t ₁		0	6	0	0	0	0	0	4	0	6	0	6
t ₂		0	0	0	0	0	0	0	1	0	0	0	0
t ₃		0	0	0	0	0	0	0	0	0	0	0	0
t ₄		0	0	0	0	0	0	0	0	0	0	0	0
t ₅		0	0	0	0	0	0	0	0	0	0	0	0
b-a			-1						-1		1		1
c-a			-1						-1		-1		1
d-a			-1						1		1		1
e-a			-1						1		1		-1
f-a			-1						-1		-1		-1
c-b			-1						1		-1		-1
d-b			-1						1		1		-1
e-b			-1						1		-1		-1
f-b			-1						-1		-1		-1
d-c			1						1		1		-1
e-c			1						1		1		-1
f-c			1						-1		-1		-1
e-d			1						0		-1		-1
f-d			1						-1		-1		-1
f-e			-1						-1		-1		-1
S _k		0	-5	0	0	0	0	0	0	0	-3	0	-9
σ _S ² =			28.33						27.33		28.33		28.33
Z _k = S _k /σ _S			-0.94						0.00		-0.56		-1.69
Z _k ²			0.88						0.00		0.32		2.86

ΣZ _k =	-3.19	Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅	Σn	24
ΣZ _k ² =	4.06	Count	22	1	0	0	0	ΣS _k	-17
Z-bar=ΣZ _k /K=	-0.80								

χ _h ² =ΣZ _k ² -K(Z-bar) ² =	1.51	@α=5% χ _(K-1) ² =	7.81	Test for station homogeneity
p	0.680			χ _h ² < χ _(K-1) ² ACCEPT
ΣVAR(S _k)	Z _{calc} -1.51	@α/2=2.5% Z=	1.96	H ₀ (No trend) ACCEPT
112.33	p 0.066			H _A (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals			
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.26		0.01
0.050	-0.17	-0.11	-0.01
0.100	-0.17		-0.02
0.200	-0.15		-0.04

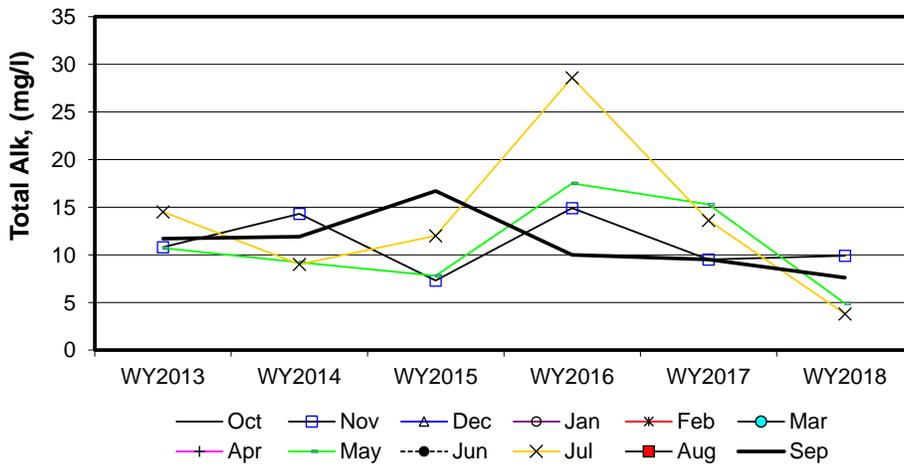
Site #60

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	WY2013		10.8						10.7		14.5		11.7
b	WY2014		14.3						9.2		9.0		11.9
c	WY2015		7.3						7.8		12.0		16.7
d	WY2016		14.9						17.5		28.6		10.0
e	WY2017		9.5						15.3		13.6		9.5
f	WY2018		9.9						4.9		3.8		7.6
n		0	6	0	0	0	0	0	6	0	6	0	6
t ₁		0	6	0	0	0	0	0	6	0	6	0	6
t ₂		0	0	0	0	0	0	0	0	0	0	0	0
t ₃		0	0	0	0	0	0	0	0	0	0	0	0
t ₄		0	0	0	0	0	0	0	0	0	0	0	0
t ₅		0	0	0	0	0	0	0	0	0	0	0	0
b-a			1						-1		-1		1
c-a			-1						-1		-1		1
d-a			1						1		1		-1
e-a			-1						1		-1		-1
f-a			-1						-1		-1		-1
c-b			-1						-1		1		1
d-b			1						1		1		-1
e-b			-1						1		1		-1
f-b			-1						-1		-1		-1
d-c			1						1		1		-1
e-c			1						1		1		-1
f-c			1						-1		-1		-1
e-d			-1						-1		-1		-1
f-d			-1						-1		-1		-1
f-e			1						-1		-1		-1
S _k		0	-1	0	0	0	0	0	-3	0	-3	0	-9
σ _S ² =			28.33						28.33		28.33		28.33
Z _k = S _k /σ _S			-0.19						-0.56		-0.56		-1.69
Z _k ²			0.04						0.32		0.32		2.86

ΣZ _k =	-3.01	Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅	Σn	24
ΣZ _k ² =	3.53	Count	24	0	0	0	0	ΣS _k	-16
Z-bar=ΣZ _k /K=	-0.75								

χ _n ² =ΣZ _k ² -K(Z-bar) ² =	1.27	@α=5% χ _(K-1) ² =	7.81	Test for station homogeneity
p	0.736			χ _n ² <χ _(K-1) ² ACCEPT
ΣVAR(S _k)	Z _{calc} -1.41	@α/2=2.5% Z=	1.96	H ₀ (No trend) ACCEPT
113.33	p 0.079			H _A (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals			
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-1.66	-0.89	0.83
0.050	-1.38		0.11
0.100	-1.24		-0.24
0.200	-1.13		-0.53

Site #60

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

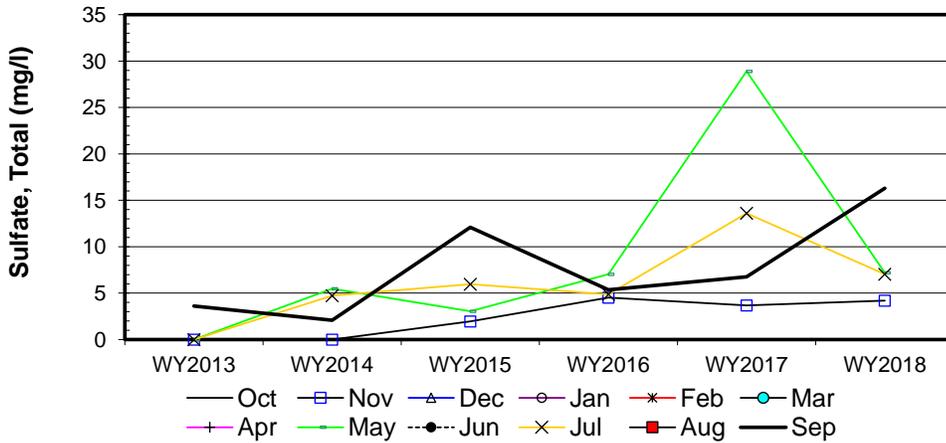
Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	WY2013		0.0						0.0		0.0		3.6
b	WY2014		0.0						5.5		4.7		2.1
c	WY2015		2.0						3.1		6.0		12.1
d	WY2016		4.5						7.0		4.9		5.4
e	WY2017		3.7						28.9		13.6		6.8
f	WY2018		4.2						7.2		7.0		16.3
n		0	6	0	0	0	0	0	6	0	6	0	6
t ₁		0	4	0	0	0	0	0	6	0	6	0	6
t ₂		0	1	0	0	0	0	0	0	0	0	0	0
t ₃		0	0	0	0	0	0	0	0	0	0	0	0
t ₄		0	0	0	0	0	0	0	0	0	0	0	0
t ₅		0	0	0	0	0	0	0	0	0	0	0	0
b-a			0						1		1		-1
c-a			1						1		1		1
d-a			1						1		1		1
e-a			1						1		1		1
f-a			1						1		1		1
c-b			1						-1		1		1
d-b			1						1		1		1
e-b			1						1		1		1
f-b			1						1		1		1
d-c			1						1		-1		-1
e-c			1						1		1		-1
f-c			1						1		1		1
e-d			-1						1		1		1
f-d			-1						1		1		1
f-e			1						-1		-1		1
S _k		0	10	0	0	0	0	0	11	0	11	0	9
σ _s ² =			27.33						28.33		28.33		28.33
Z _k = S _k /σ _s			1.91						2.07		2.07		1.69
Z _k ²			3.66						4.27		4.27		2.86

ΣZ_k= 7.74
 ΣZ_k²= 15.06
 Z-bar=ΣZ_k/K= 1.93

Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅
Count	22	1	0	0	0

Σn = 24
 ΣS_k = 41

χ _n ² =ΣZ _k ² -K(Z-bar) ² =	0.09	@α=5% χ _(K-1) ² =	7.81	Test for station homogeneity
p	0.992	χ _h ² <χ _(K-1) ²	ACCEPT	
ΣVAR(S _k)	Z _{calc} 3.77	@α=2.5% Z=	1.96	H ₀ (No trend) REJECT
112.33	p 1.000			H _A (± trend) ACCEPT



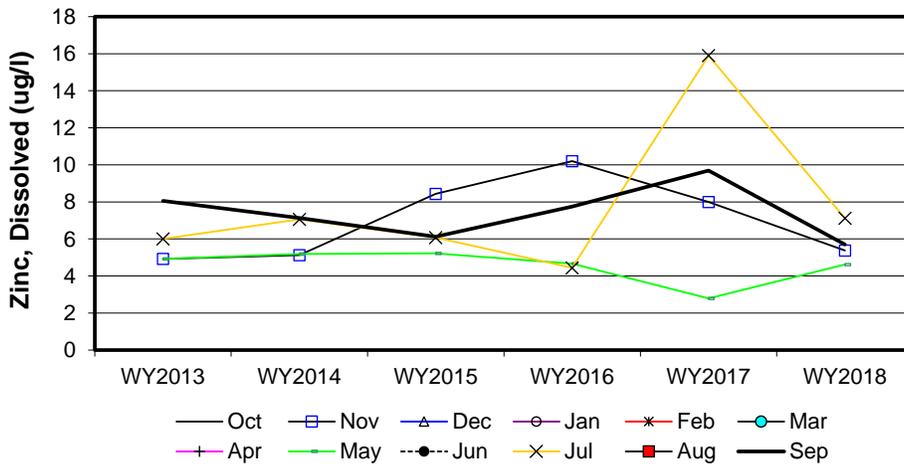
Site #60

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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	WY2013		4.9						4.9		6.0		8.1
b	WY2014		5.1						5.2		7.1		7.1
c	WY2015		8.4						5.2		6.1		6.1
d	WY2016		10.2						4.7		4.4		7.8
e	WY2017		8.0						2.8		15.9		9.7
f	WY2018		5.4						4.6		7.1		5.7
n		0	6	0	0	0	0	0	6	0	6	0	6
t ₁		0	6	0	0	0	0	0	6	0	6	0	6
t ₂		0	0	0	0	0	0	0	0	0	0	0	0
t ₃		0	0	0	0	0	0	0	0	0	0	0	0
t ₄		0	0	0	0	0	0	0	0	0	0	0	0
t ₅		0	0	0	0	0	0	0	0	0	0	0	0
b-a			1						1		1		-1
c-a			1						1		1		-1
d-a			1						-1		-1		-1
e-a			1						-1		1		1
f-a			1						-1		1		-1
c-b			1						1		-1		-1
d-b			1						-1		-1		1
e-b			1						-1		1		1
f-b			1						-1		1		-1
d-c			1						-1		-1		1
e-c			-1						-1		1		1
f-c			-1						-1		1		-1
e-d			-1						-1		1		1
f-d			-1						-1		1		-1
f-e			-1						1		-1		-1
S _k		0	5	0	0	0	0	0	-7	0	5	0	-3
σ _S ² =			28.33						28.33		28.33		28.33
Z _k = S _k /σ _S			0.94						-1.32		0.94		-0.56
Z _k ²			0.88						1.73		0.88		0.32

ΣZ _k =	0.00	Tie Extent	t ₁	t ₂	t ₃	t ₄	t ₅	Σn	24
ΣZ _k ² =	3.81	Count	24	0	0	0	0	ΣS _k	0
Z-bar=ΣZ _k /K=	0.00								

χ _h ² =ΣZ _k ² -K(Z-bar) ² =	3.81	@α=5% χ _(K-1) ² =	7.81	Test for station homogeneity
p	0.283			χ _h ² < χ _(K-1) ² ACCEPT
ΣVAR(S _k)	Z _{calc} 0.00	@α/2=2.5% Z=	1.96	H ₀ (No trend) ACCEPT
113.33	p 0.500			H _A (± trend) REJECT



Seasonal-Kendall Slope Confidence Intervals			
α	Lower Limit	Sen's Slope	Upper Limit
0.010	-0.54	0.00	0.55
0.050	-0.33		0.24
0.100	-0.22		0.20
0.200	-0.14		0.07

INTERPRETIVE REPORT

SITE 609

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

The data collected during the current water year are listed in the following “Table of Results for Water Year 2018” 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 one-half of the for the purpose of median calculation.

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

Sample Date	Parameter	Value	Qualifier	Notes
No outliers, in the past six years, have been identified by HGCMC.				

The data for the current water year have been compared to the strictest fresh water quality criterion for each applicable analyte. One sample was slightly above the AWQS for total sulfate.

Table of Exceedance for Water Year 2018

Sample Date	Parameter	Value	Limits		
			Lower	Upper	Hardness
10-Sep-18	Sulfate, Total	251 mg/L		250	274 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. 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 2018

Site 609FMS - 'Further Creek Lower'

Sample Date/Parameter	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018	Median
Water Temp (°C)		2.8						5.2		10		10.2	7.6
Conductivity-Field(µmho)		388						354.4		512.5		532.9	450.3
Conductivity-Lab (µmho)		336						325		491		528	414
pH Lab (standard units)		6.63						6.94		6.76		6.58	6.70
pH Field (standard units)		7.09						6.77		7.15		6.9	7.00
Total Alkalinity (mg/L)		33.7						25.1		50.5		38.3	36.0
Total Sulfate (mg/L)		126						127		196		251	161.5
Hardness (mg/L)		186						168		255		274	220.5
Dissolved As (ug/L)		1.07						0.632		1.23		0.827	0.949
Dissolved Ba (ug/L)		33.4						40.2		60.7		65	50.5
Dissolved Cd (ug/L)		0.175						0.13		0.252		0.162	0.1685
Dissolved Cr (ug/L)		1.07						0.711		0.783		0.896	0.840
Dissolved Cu (ug/L)		0.715						0.673		0.958		0.685	0.700
Dissolved Pb (ug/L)		0.334						0.172		0.339		0.184	0.2590
Dissolved Ni (ug/L)		3.18						2.33		3.67		3.29	3.235
Dissolved Ag (ug/L)		0.006						0.002		0.006		0.002	0.004
Dissolved Zn (ug/L)		53.5						47.6		63.7		52.8	53.15
Dissolved Se (ug/L)		1.04						1.53		2.04		0.517	1.285
Dissolved Hg (ug/L)		0.0035						0.00178		0.00296		0.00197	0.002465

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

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

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

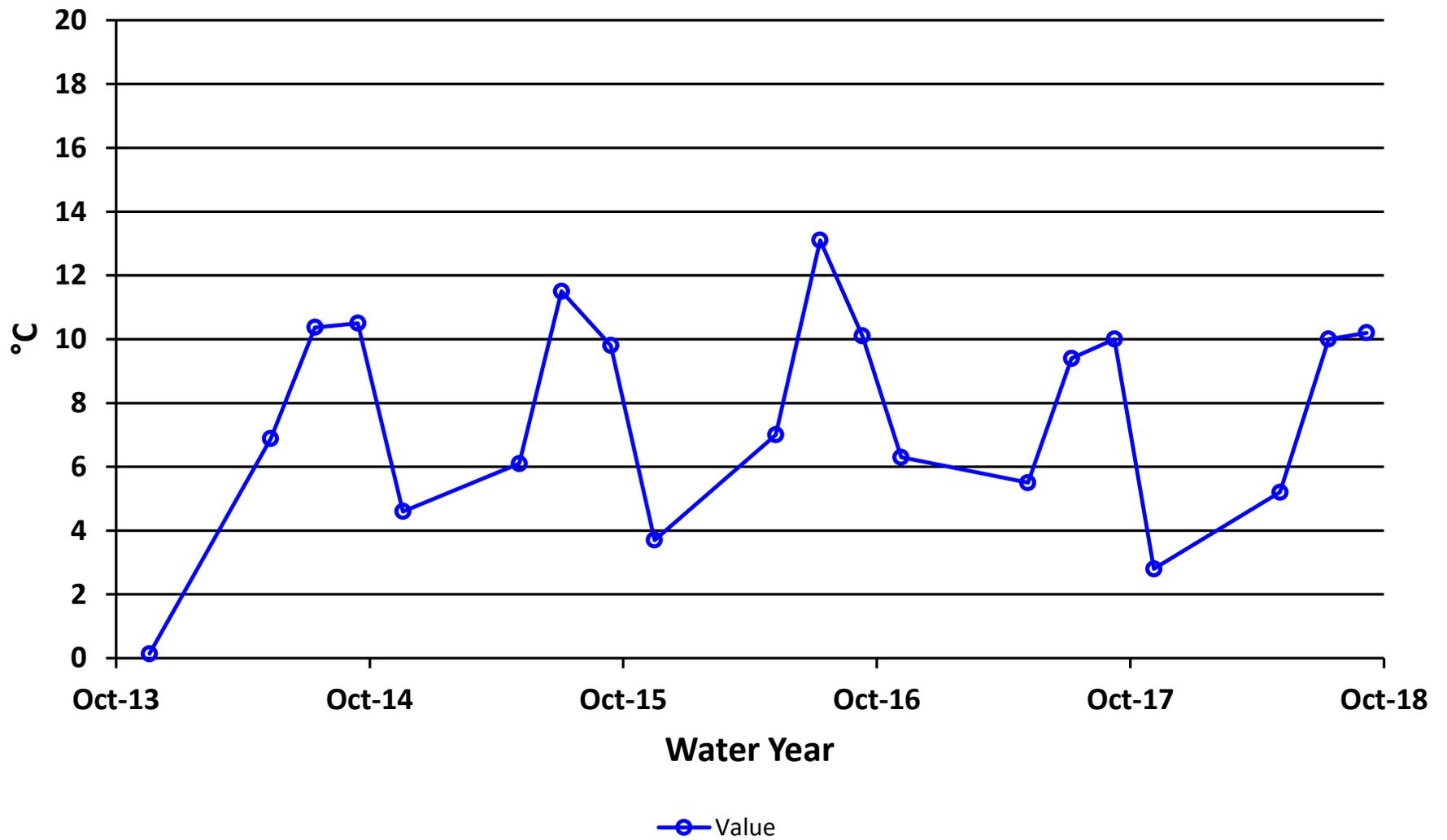
Qualified Data by QA Reviewer

Date Range: 10/01/2017 to 09/30/2018

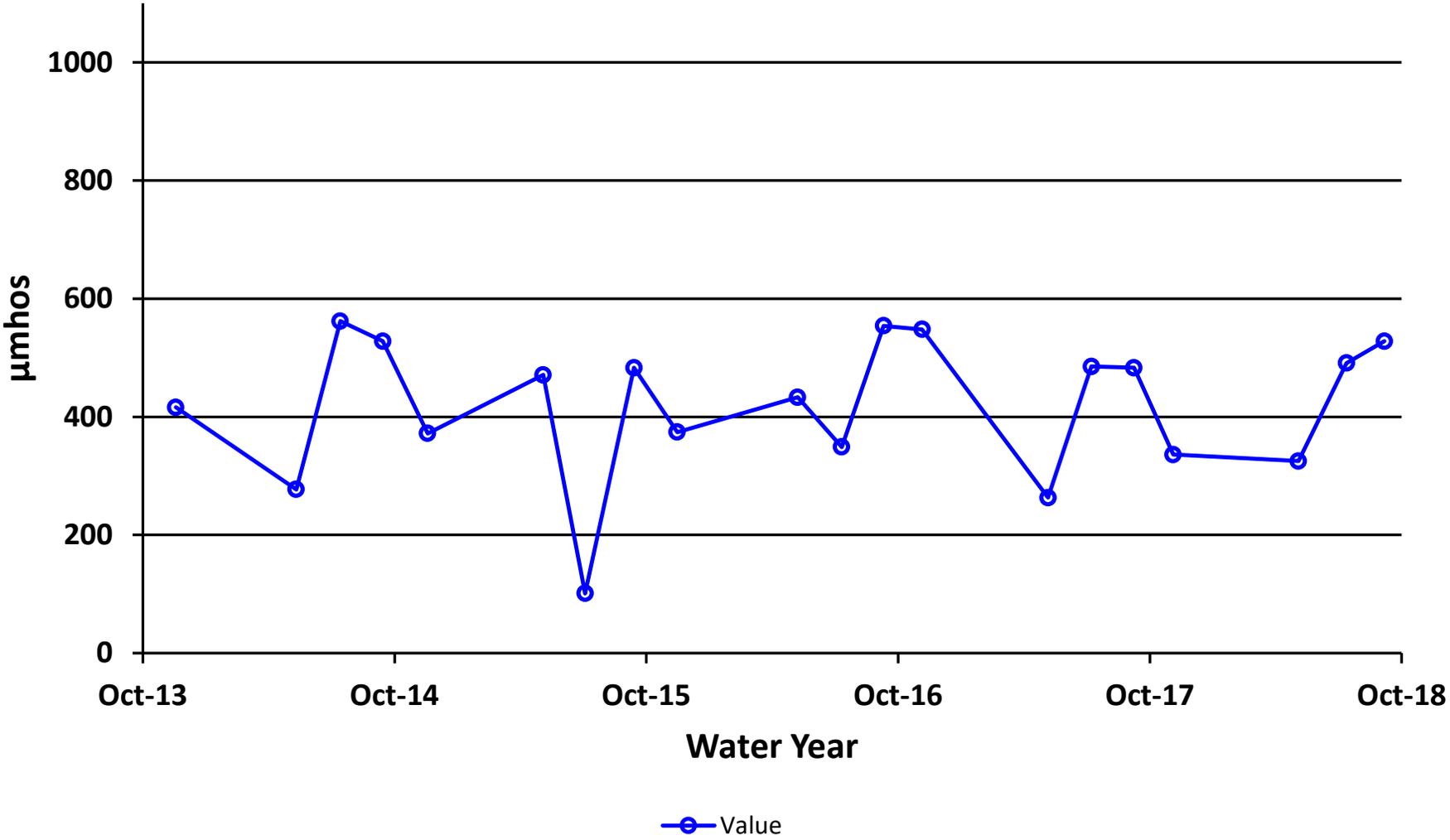
Site No.	Sample Date	Parameter	Value	Qualifier	Reason for Qualifier	
609FMS	11/7/2017	Diss. Ag-ICP/MS	0.0055	µg/L	J	Below Quantitative Range
	7/17/2018	Diss. Ag-ICP/MS	0.0061	µg/L	J	Below Quantitative Range
		pH	6.76	pH units	J	Hold time Violation
Total Sulfate		196	mg/L	J	Sample Receipt Temperature	
9/10/2018	pH	6.58	pH units	J	Hold Time Violation	
	Total Sulfate	251	mg/L	J	Sample Receipt Temperature	

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

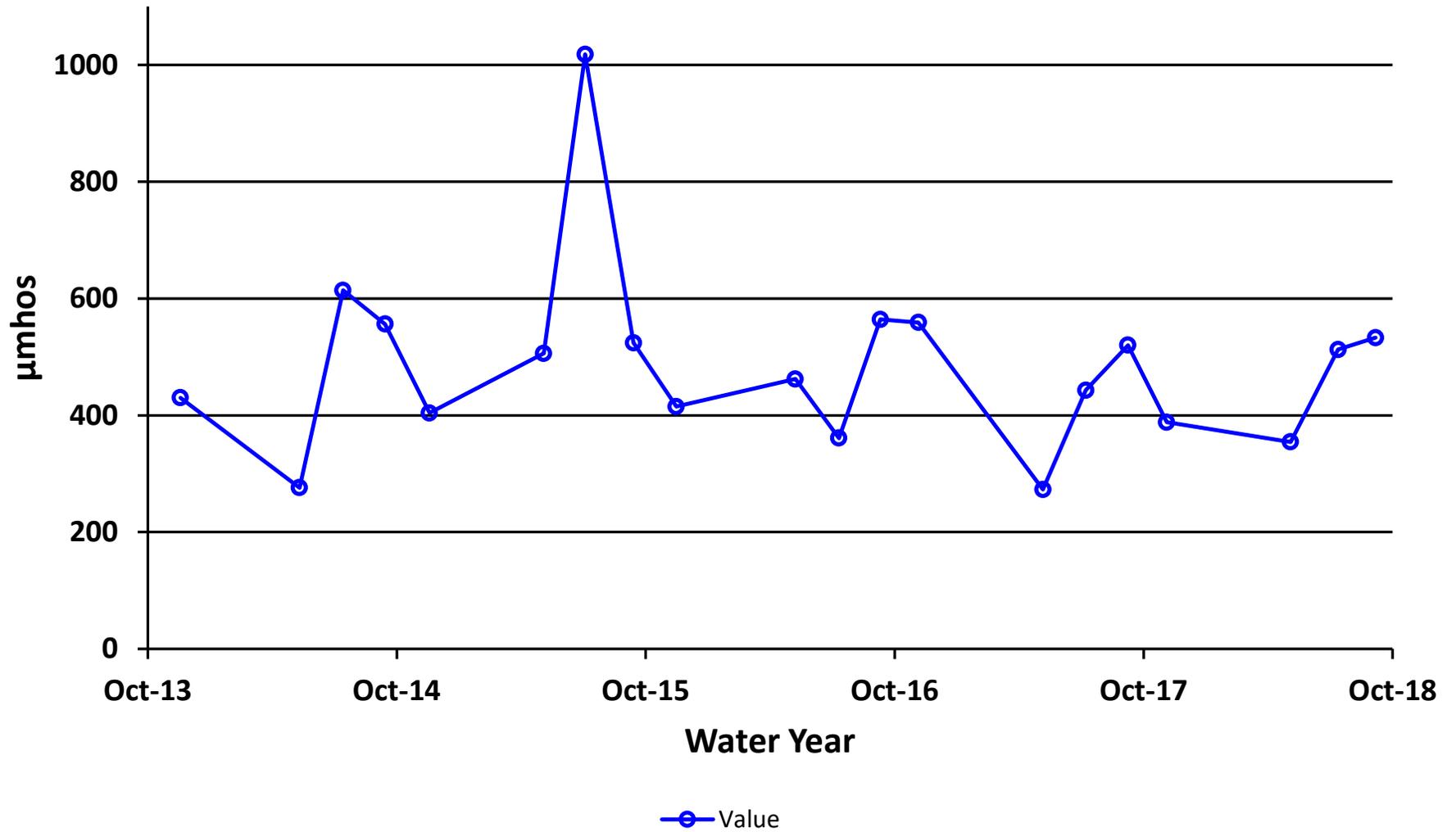
Site 609 - Water Temperature



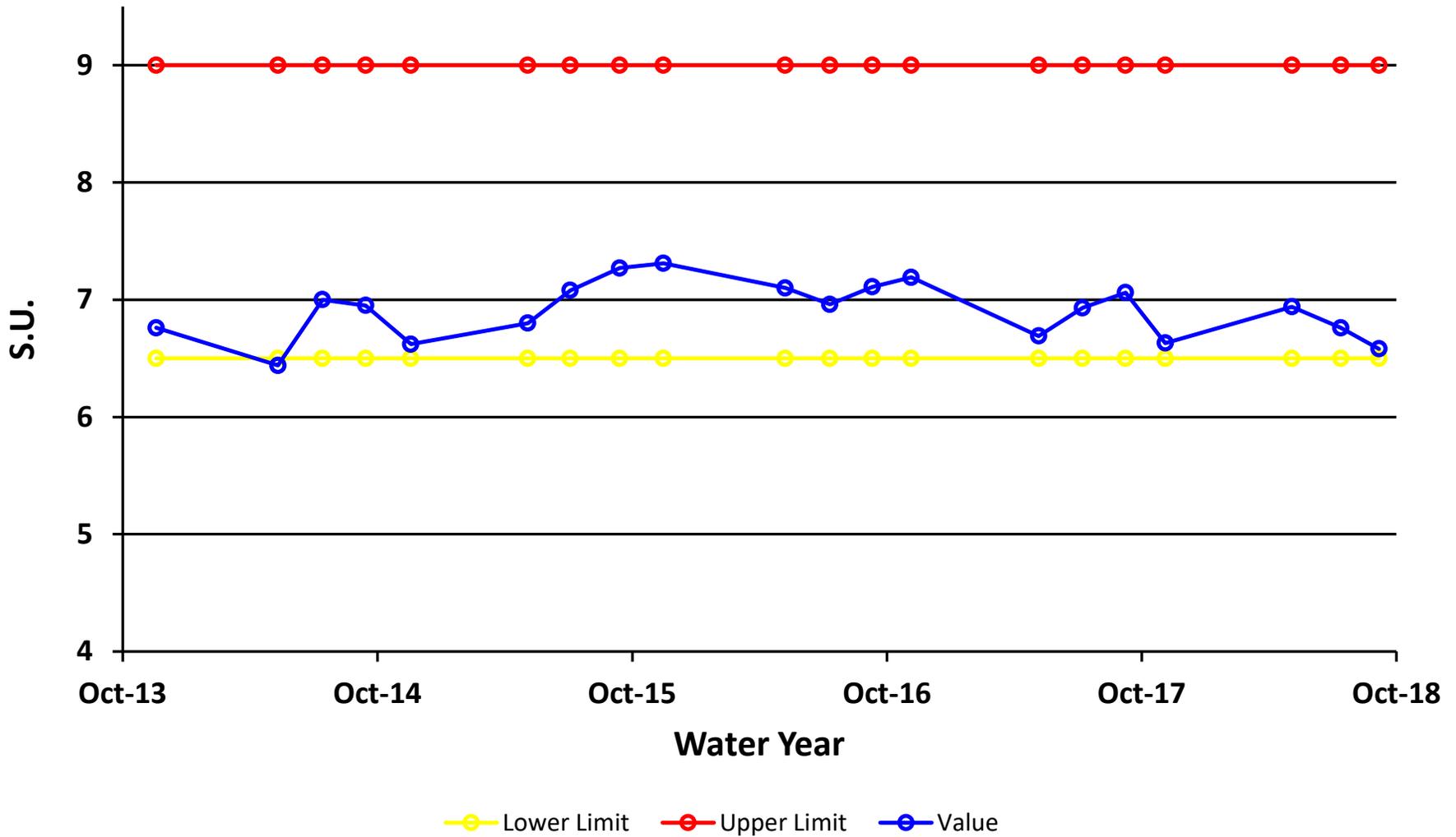
Site 609 - Conductivity Laboratory



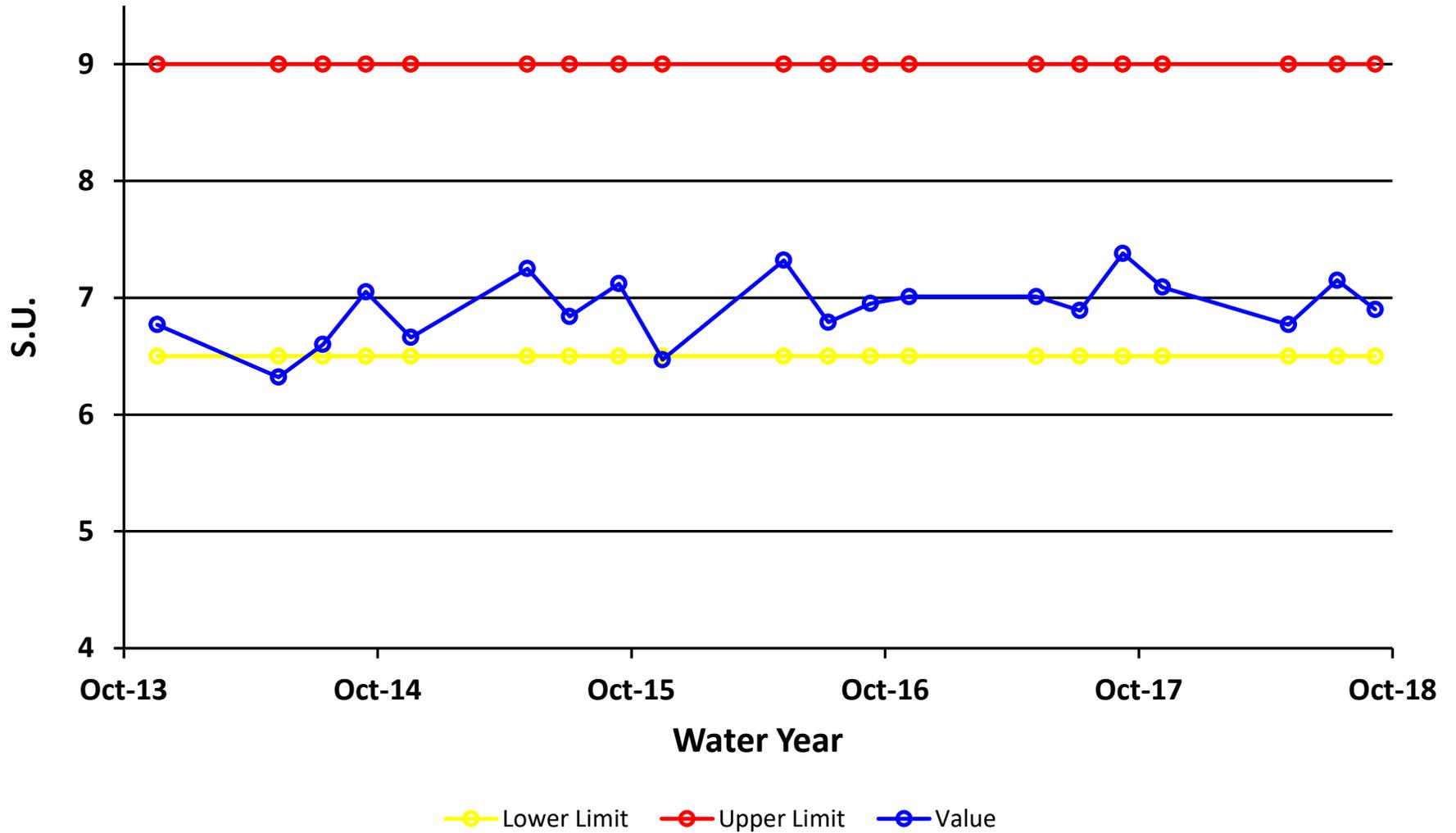
Site 609 - Conductivity Field



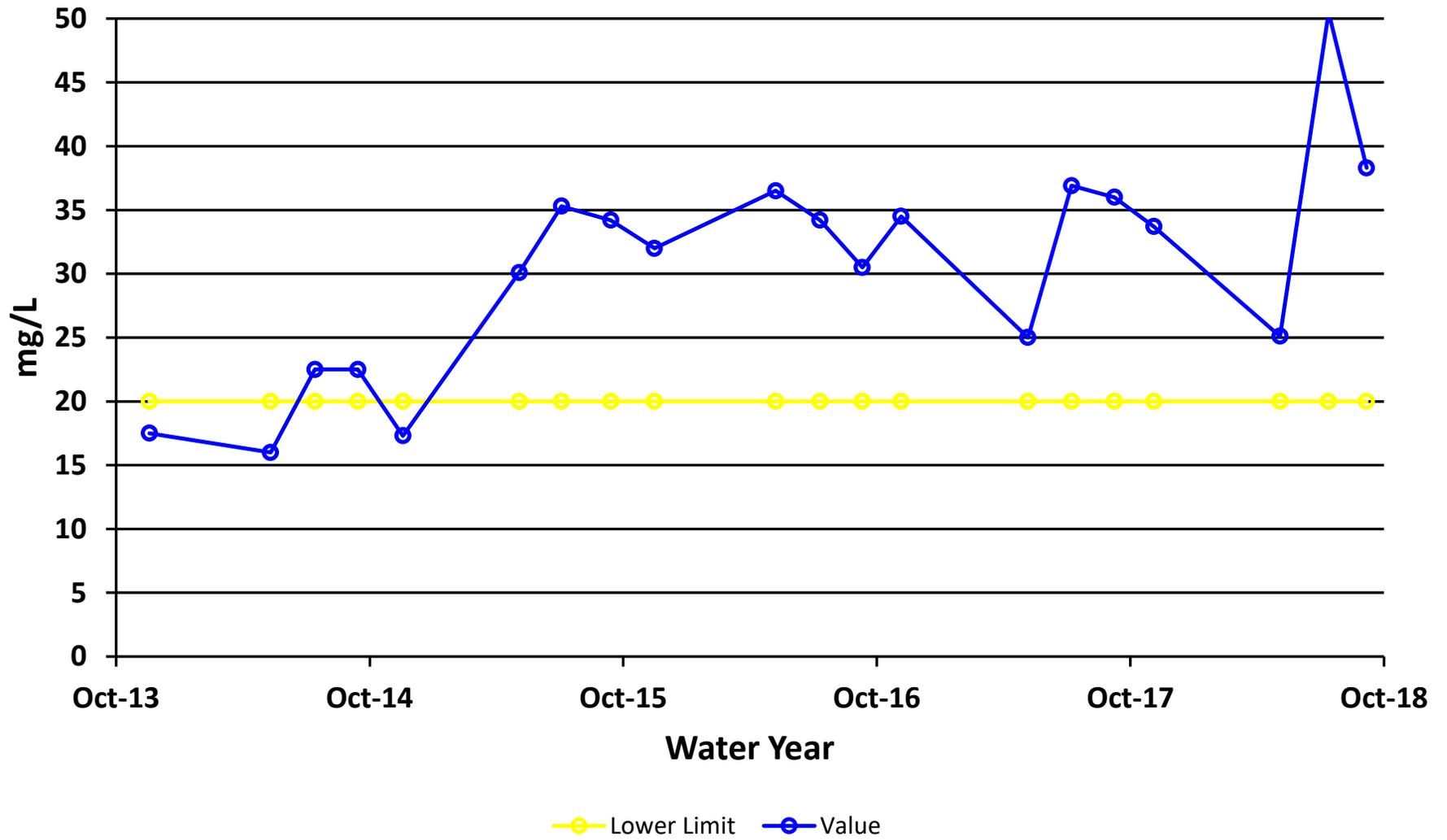
Site 609 - pH Laboratory



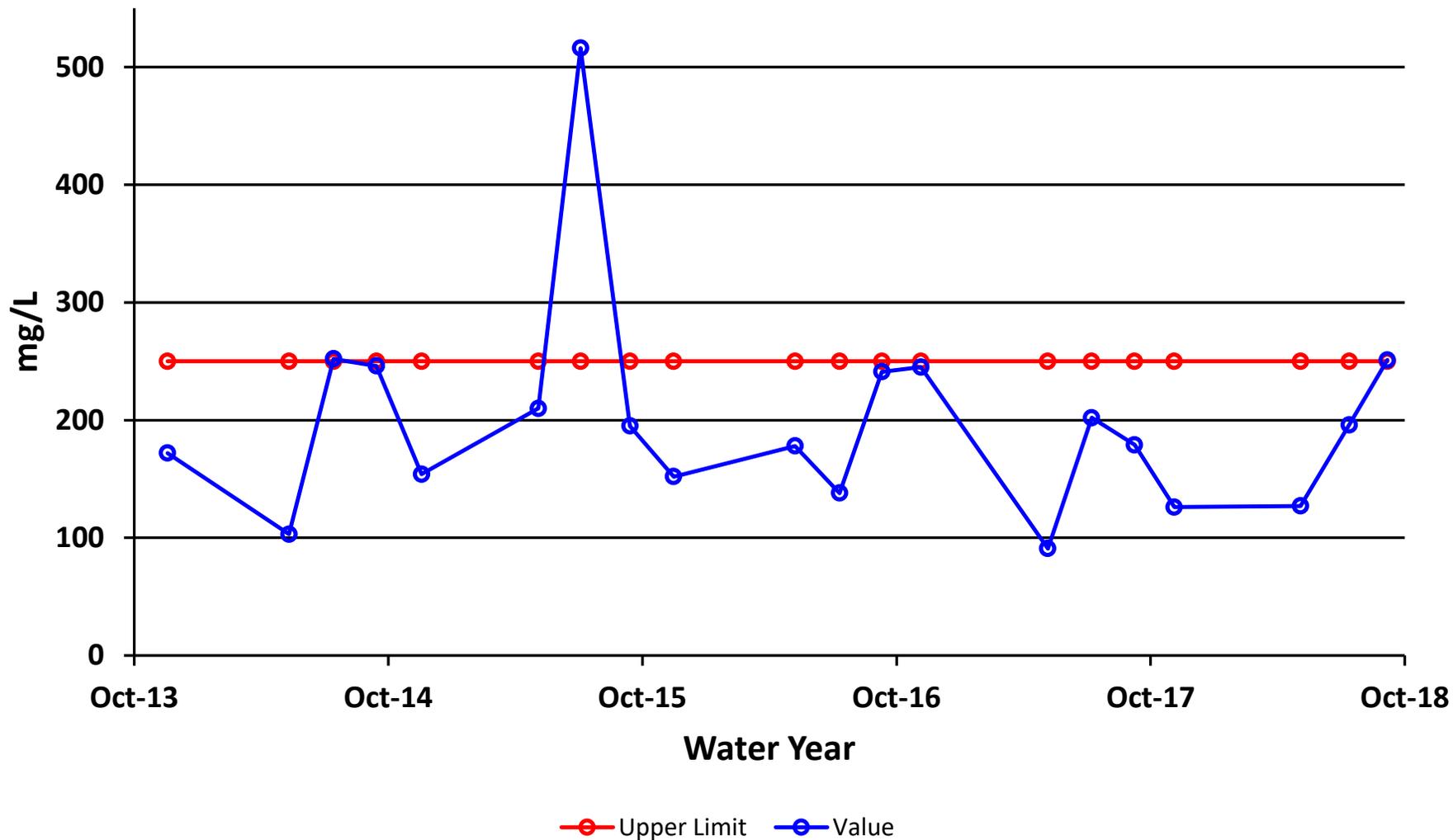
Site 609 - pH Field



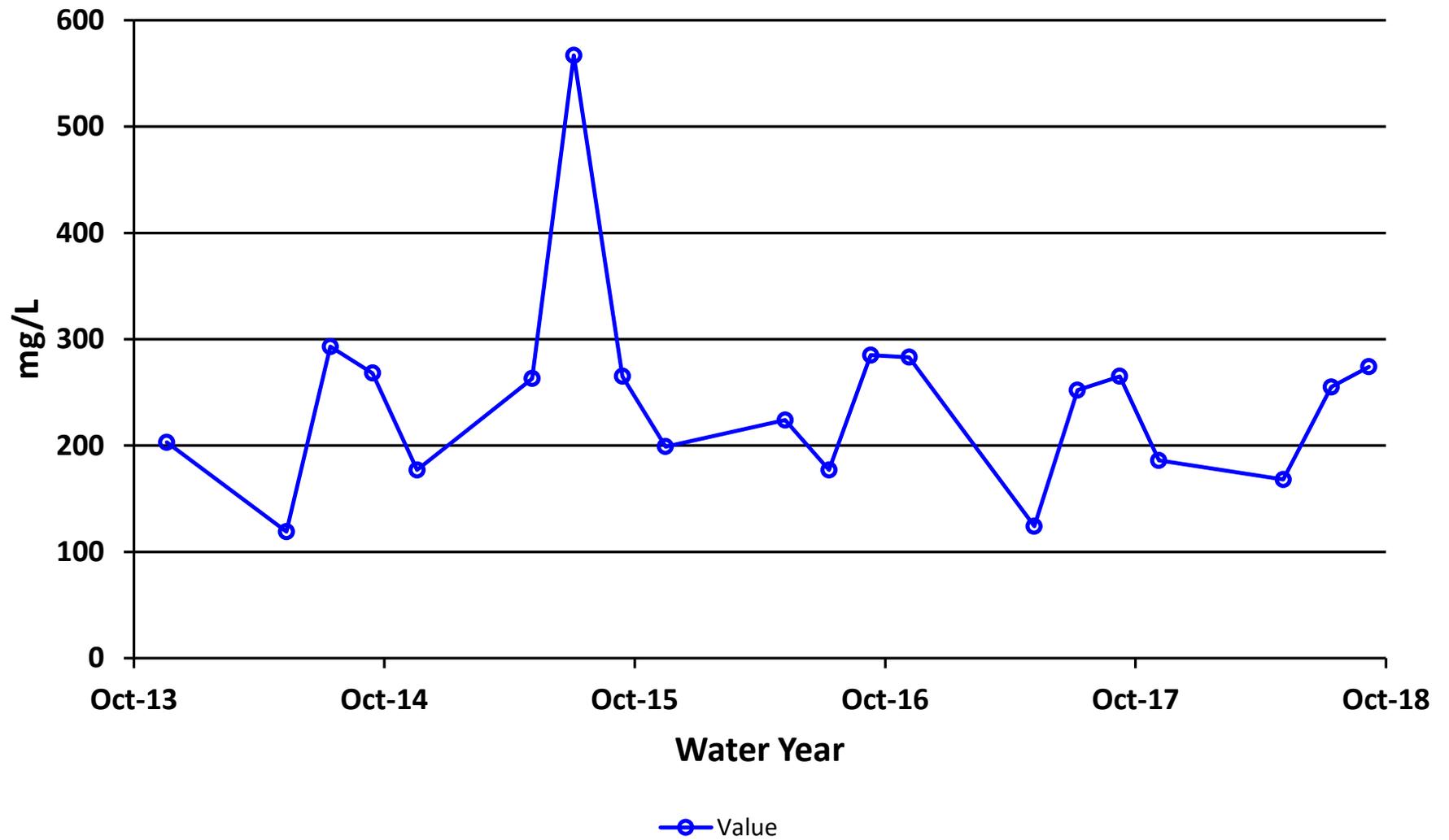
Site 609 - Alkalinity



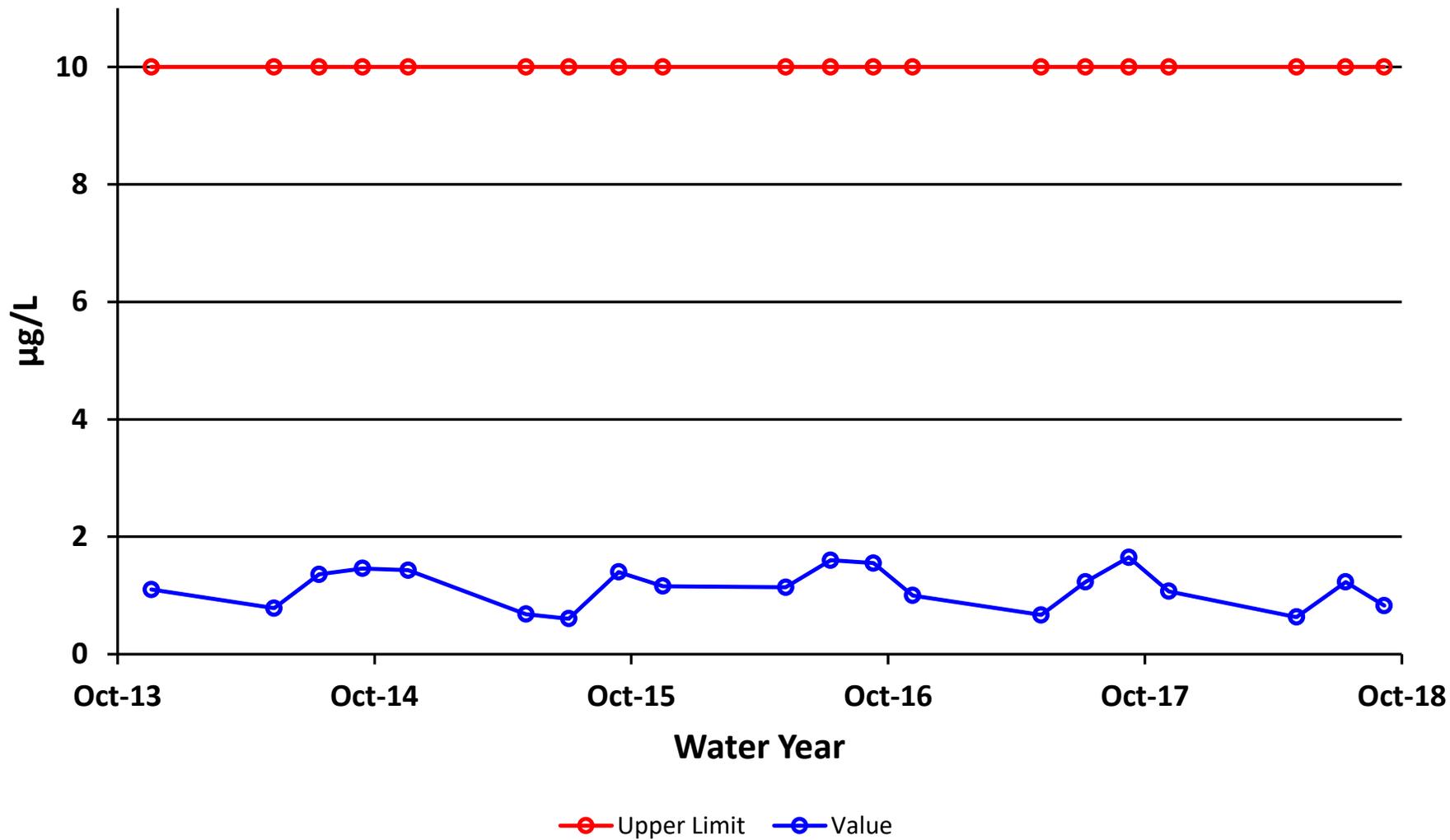
Site 609 - Sulfate



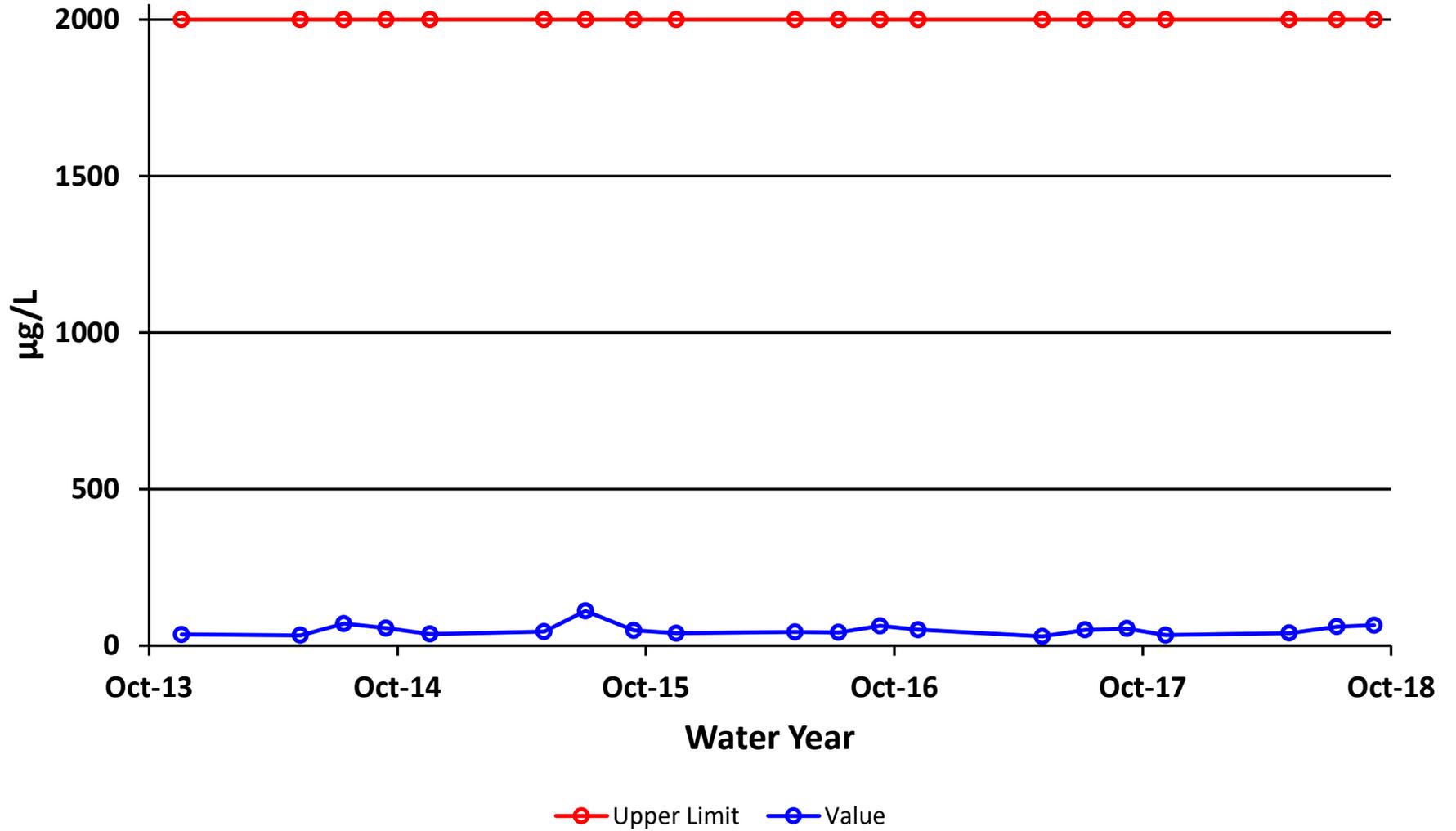
Site 609 - Hardness



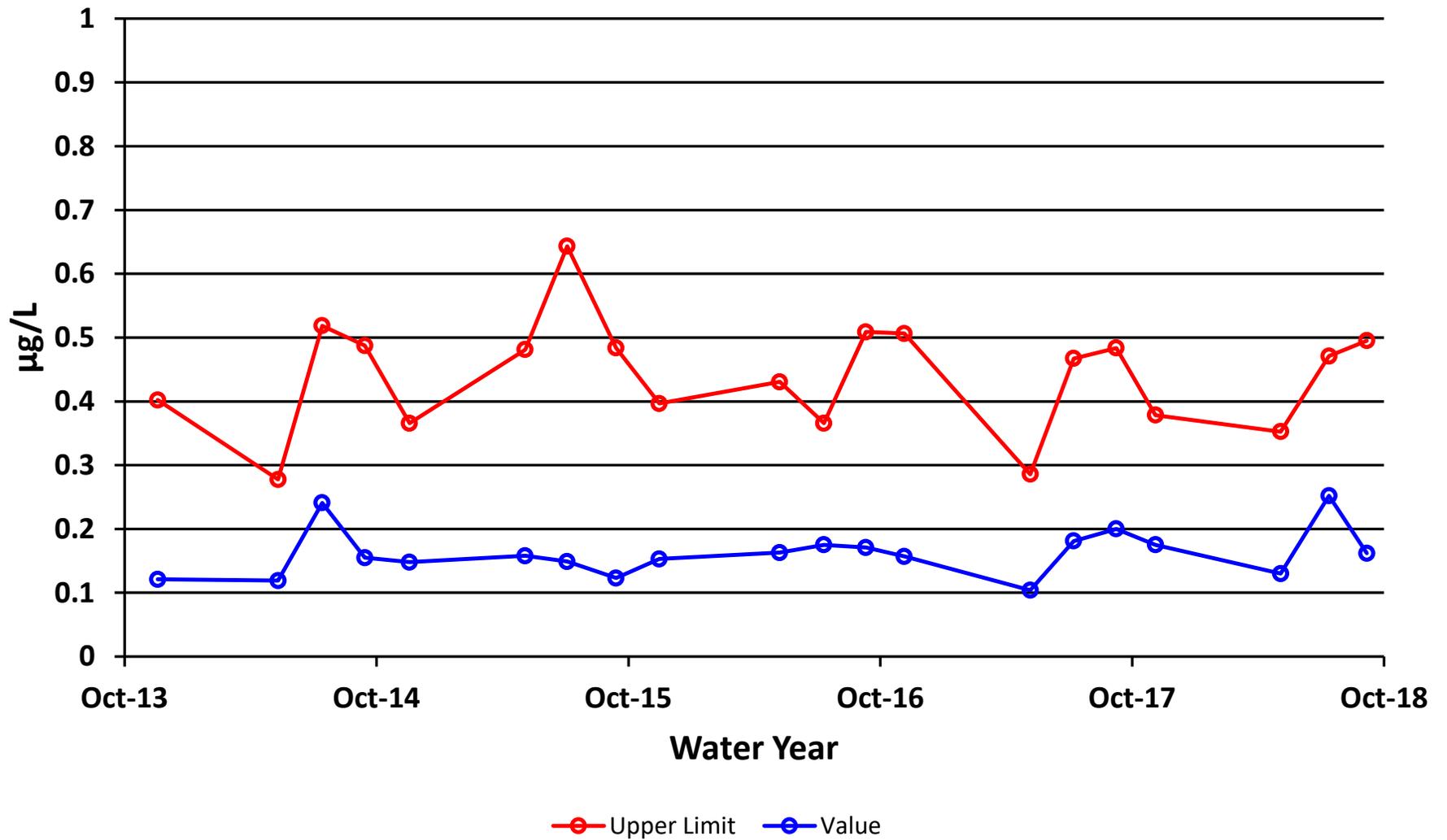
Site 609 - Arsenic Dissolved



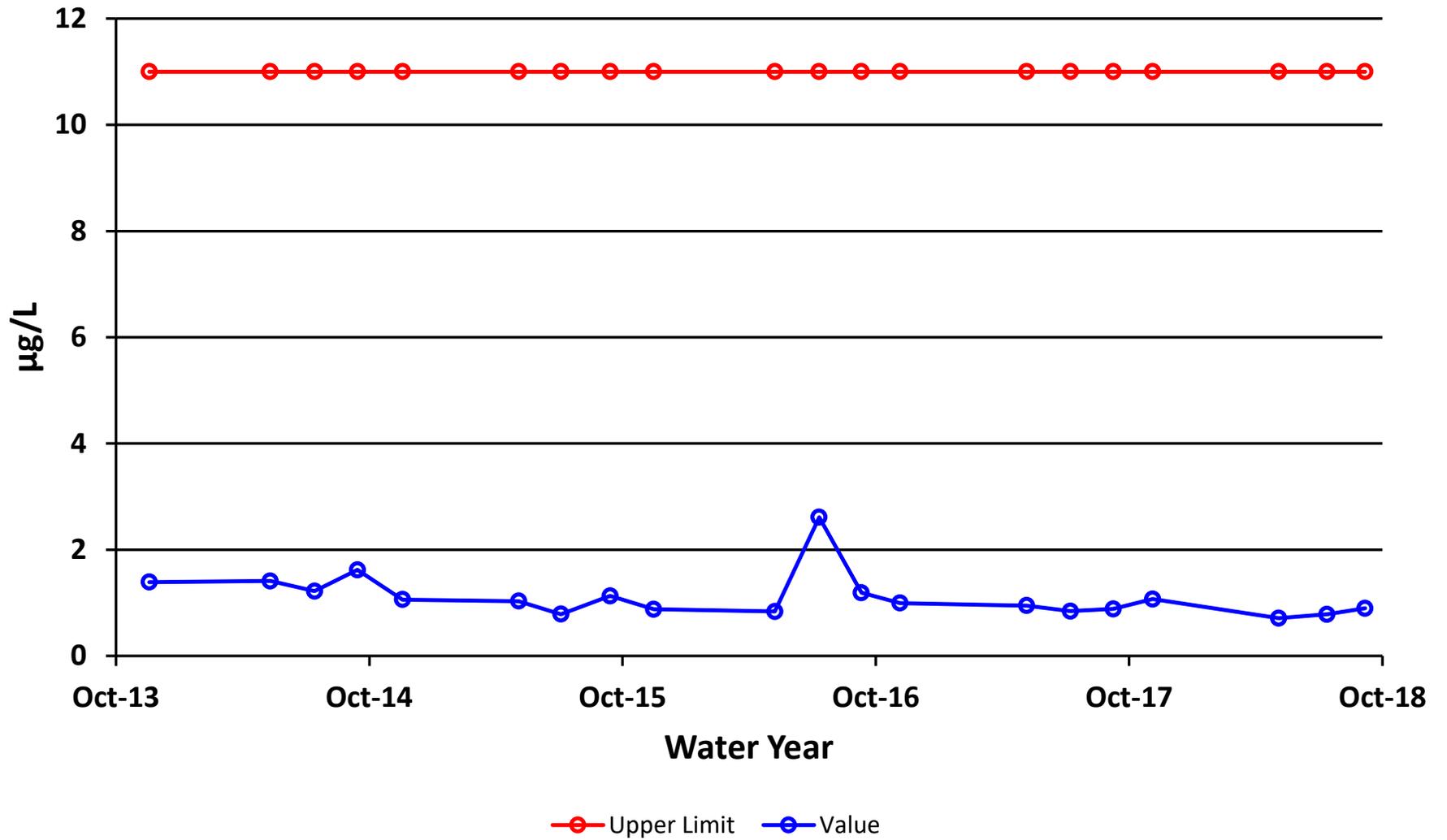
Site 609 - Barium Dissolved



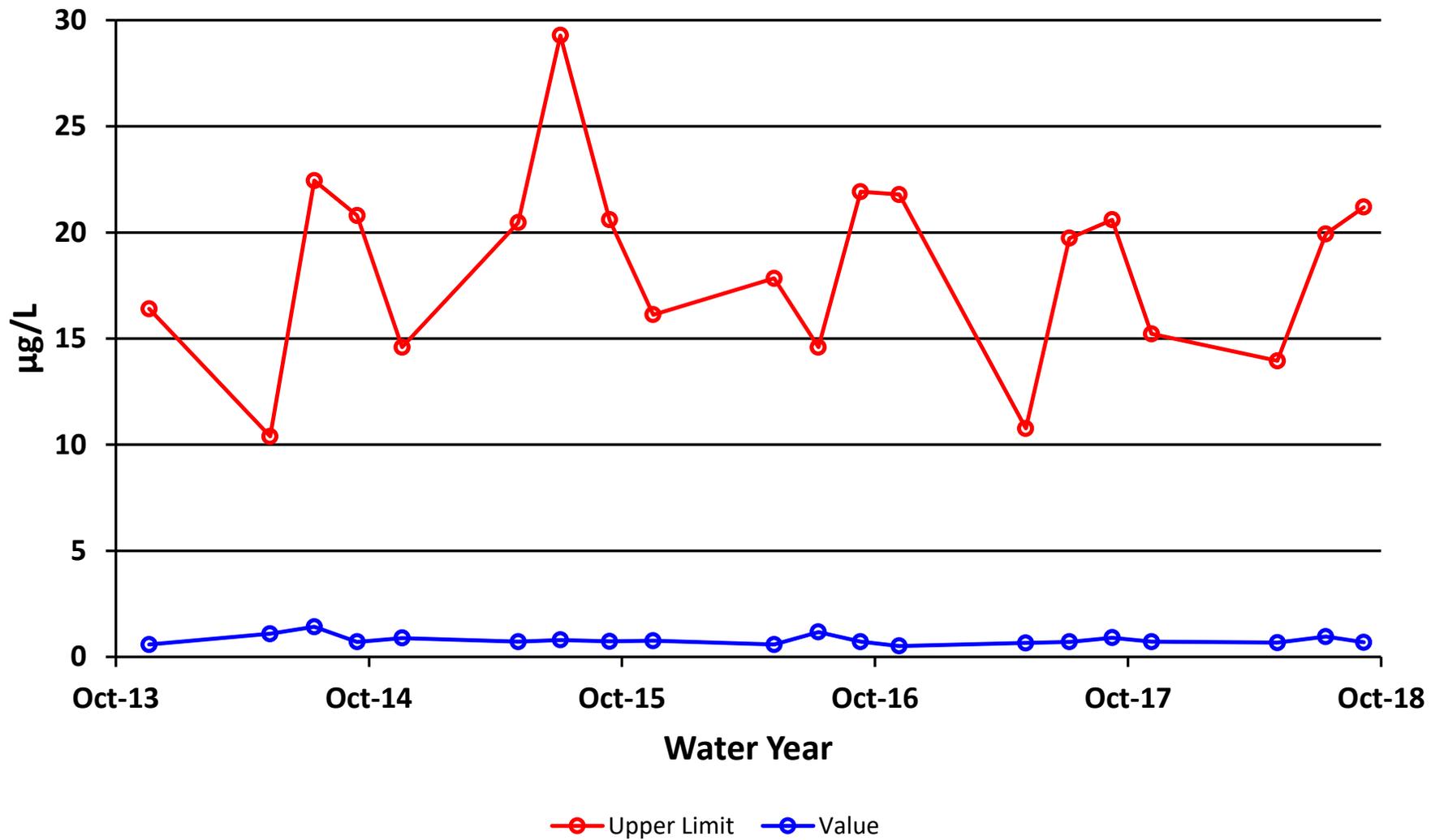
Site 609 - Cadmium Dissolved



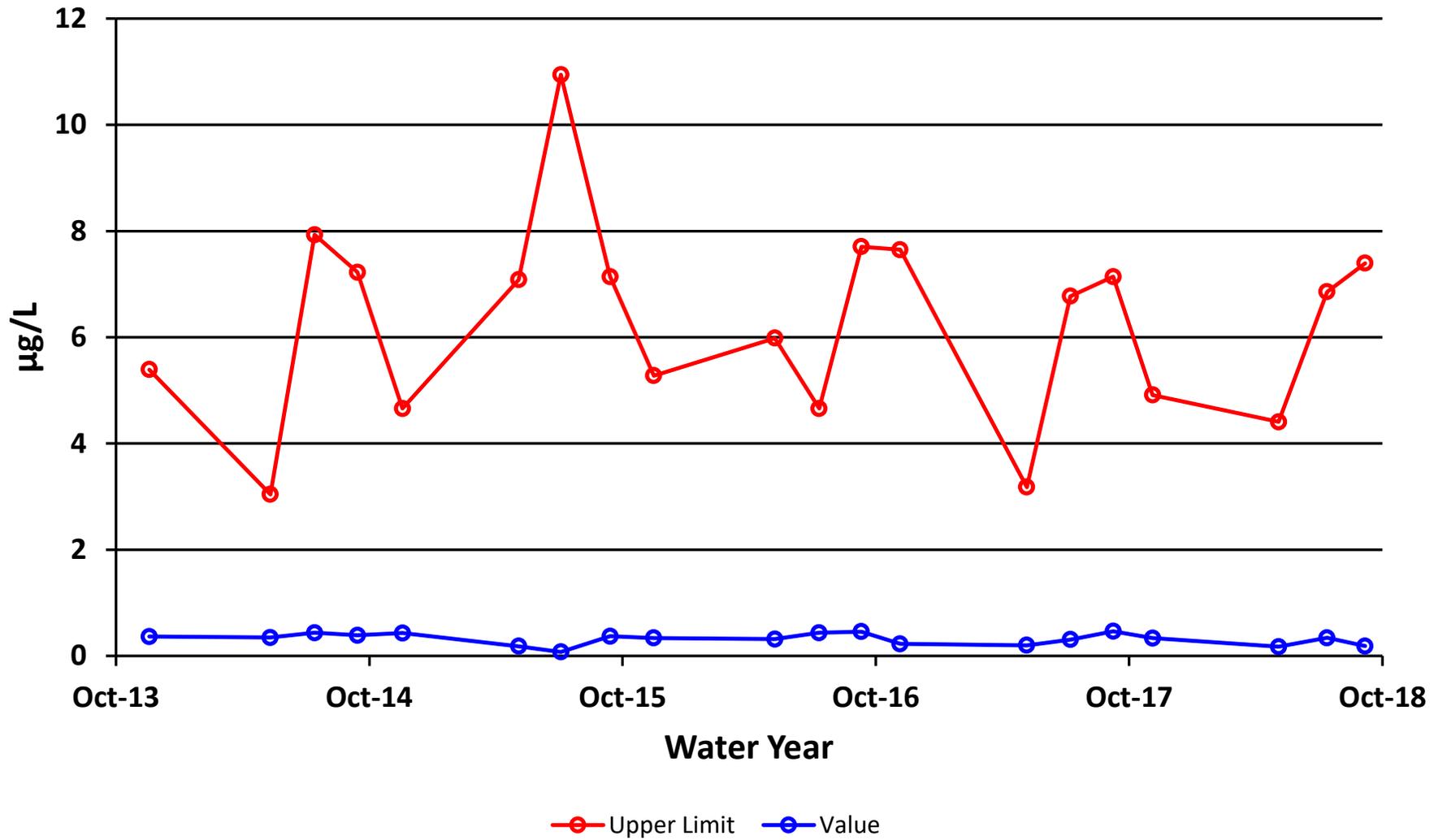
Site 609 - Chromium Dissolved



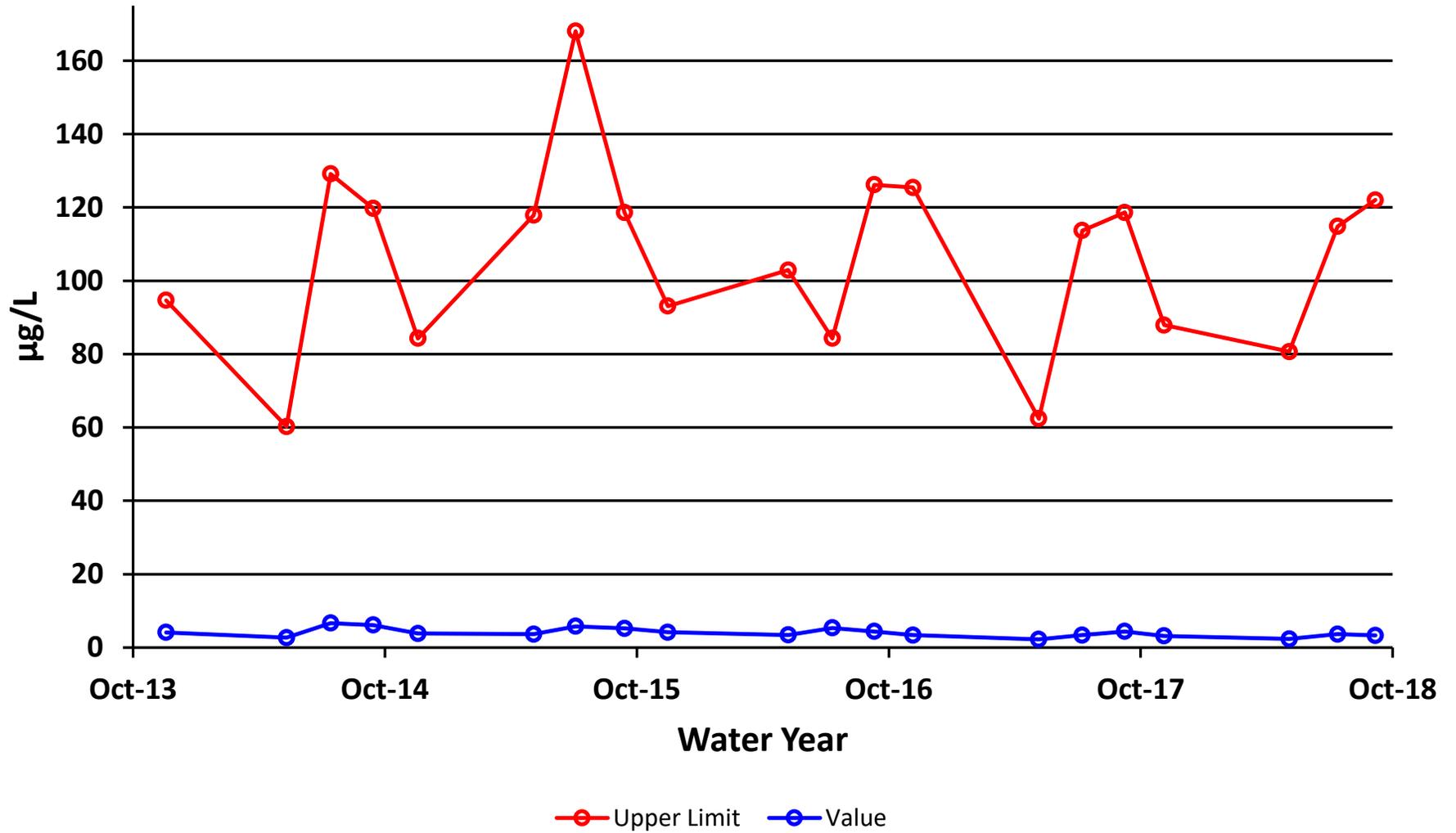
Site 609 - Copper Dissolved



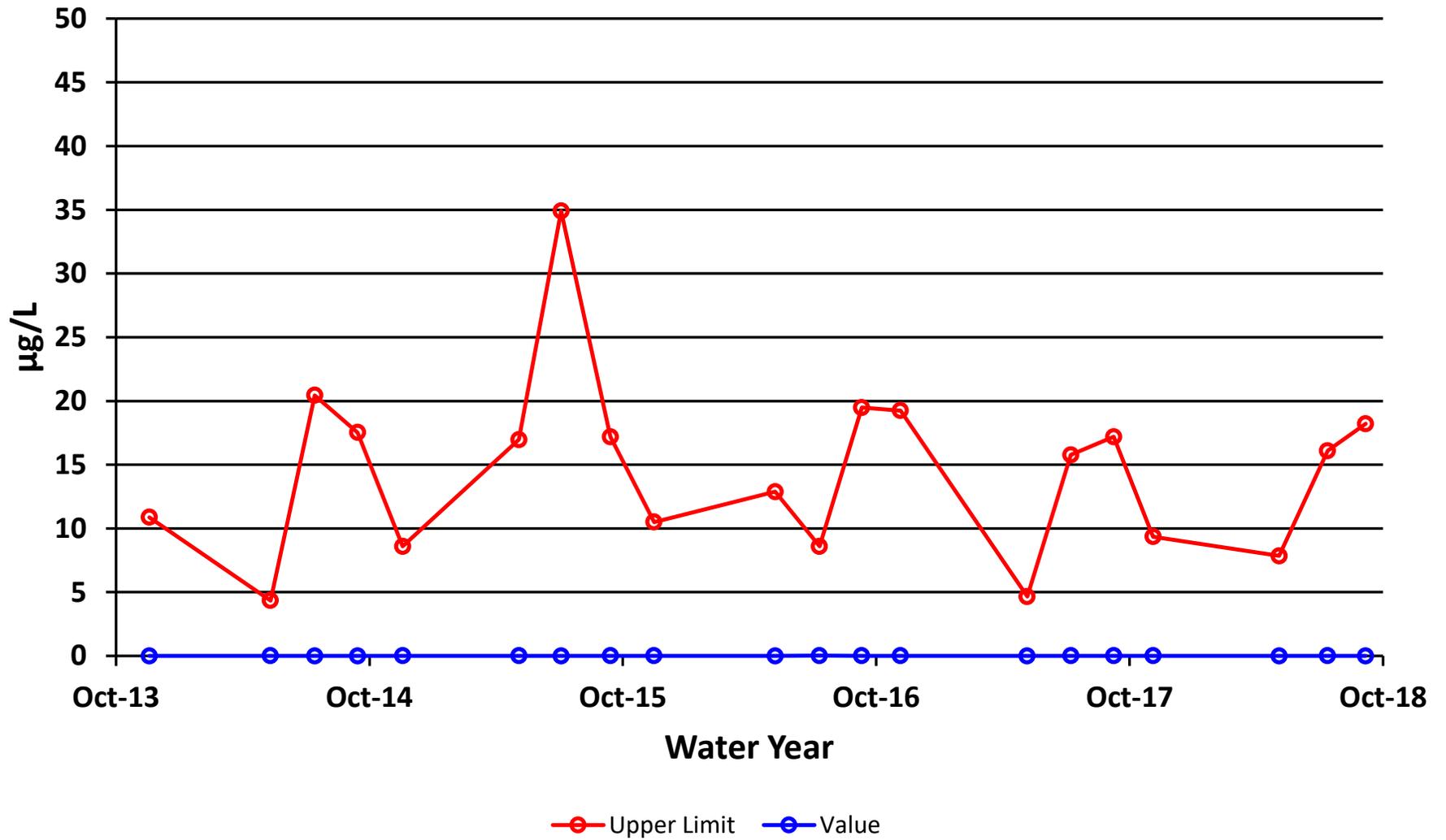
Site 609 - Lead Dissolved



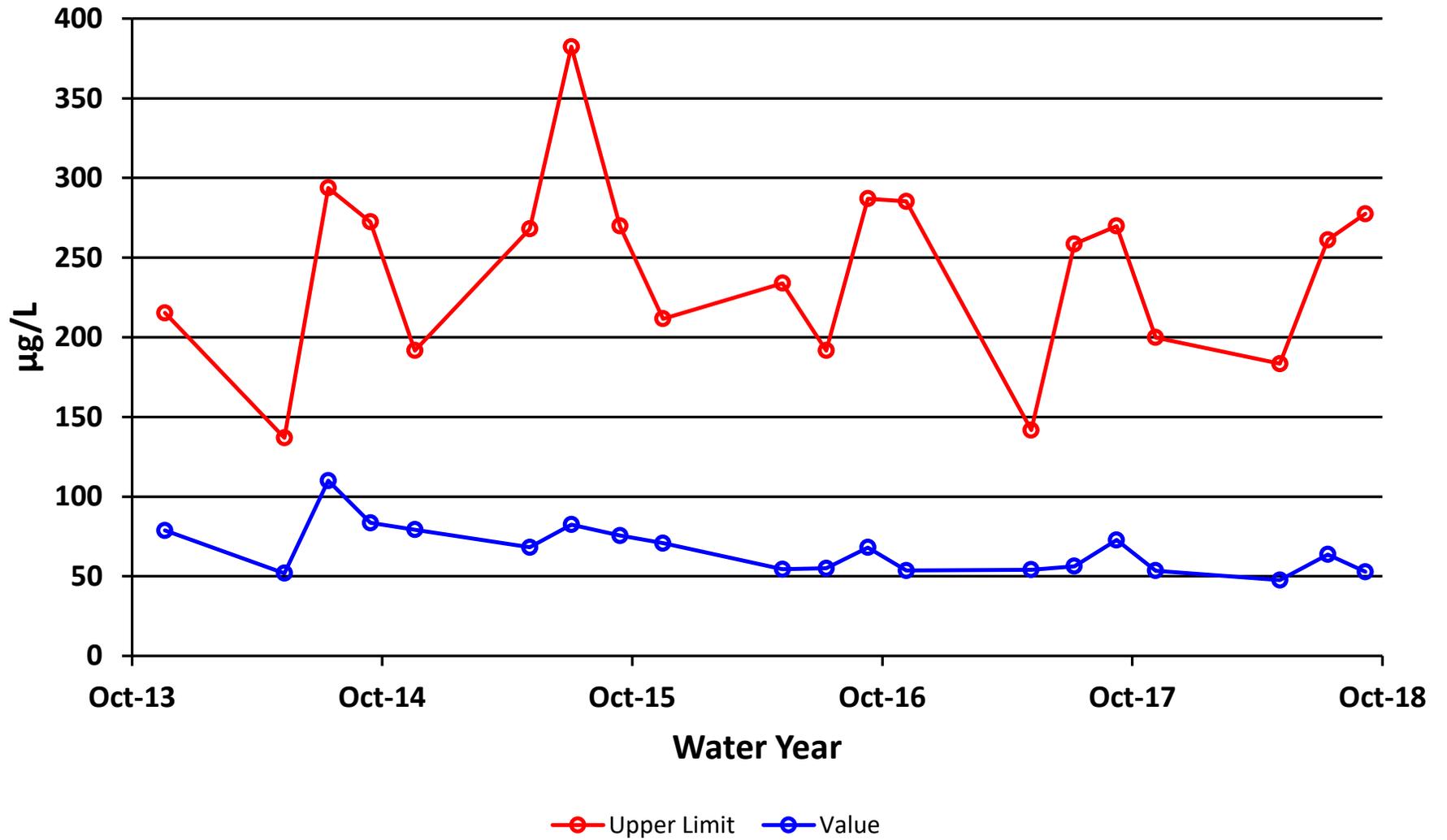
Site 609 - Nickel Dissolved



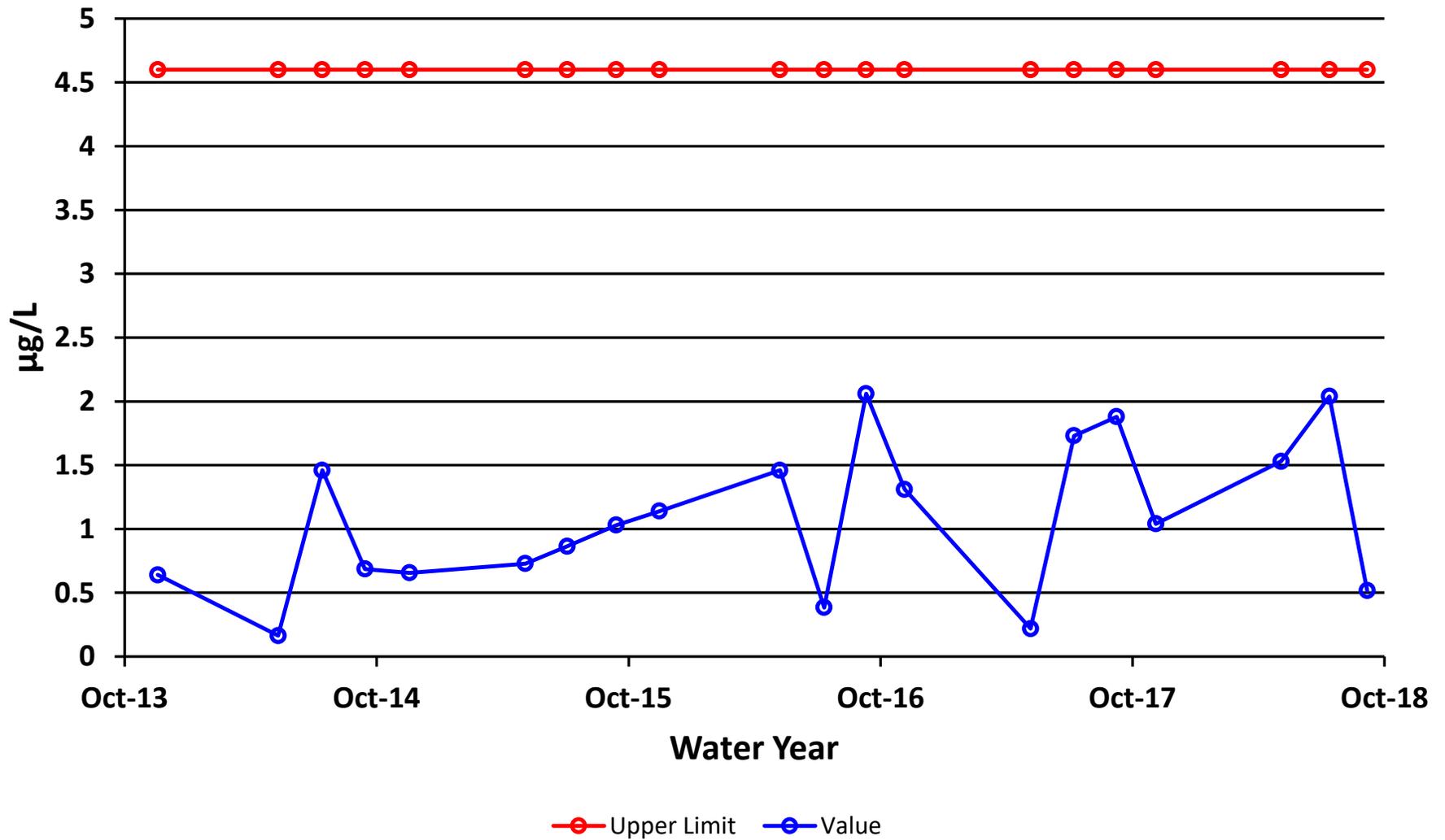
Site 609 - Silver Dissolved



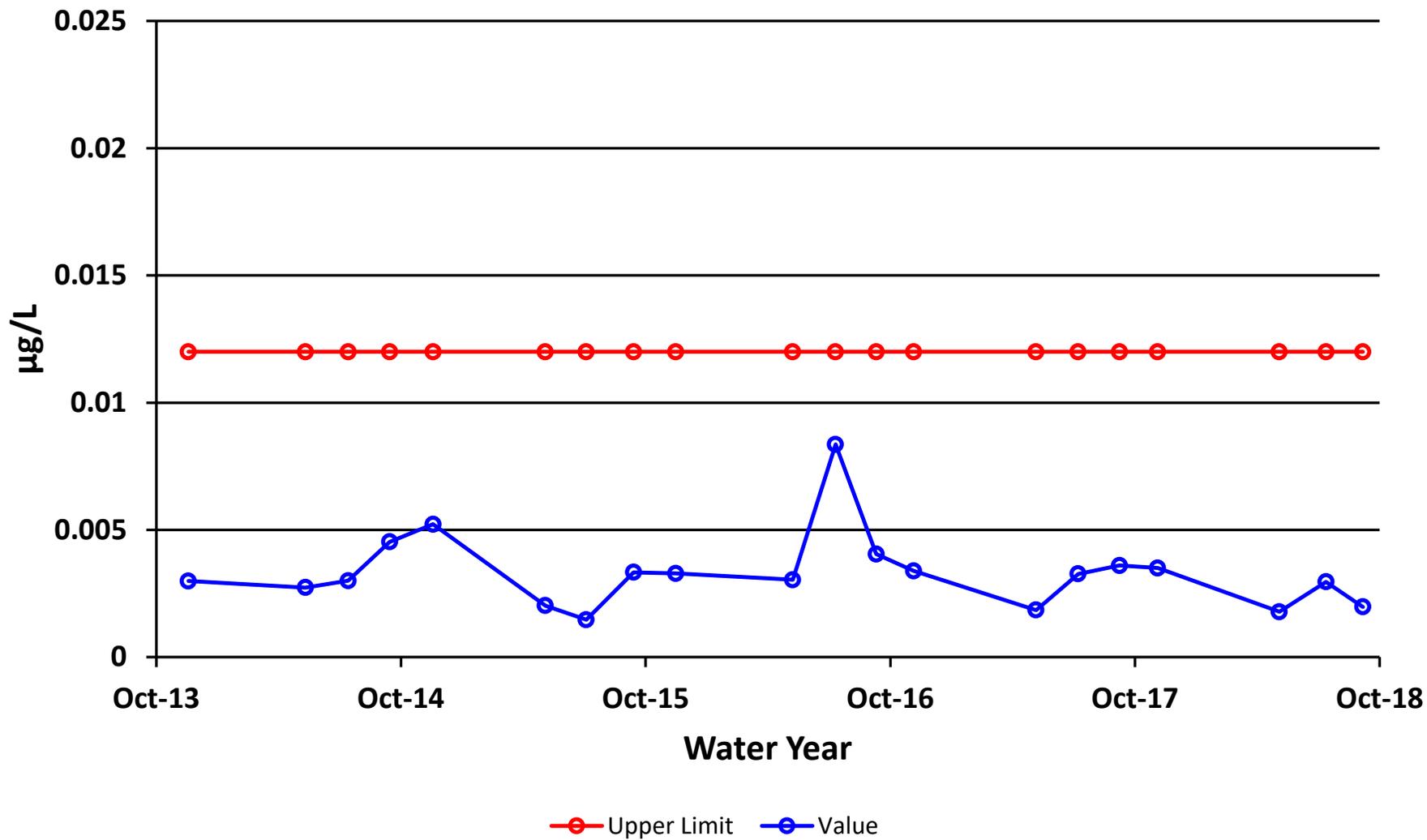
Site 609 - Zinc Dissolved



Site 609 - Selenium Dissolved



Site 609 - Mercury Dissolved



INTERPRETIVE REPORT

SITE 711

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

The data collected during the current water year are listed in the following “Table of Results for Water Year 2018” 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 one-half of the for the purpose of median calculation.

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

Sample Date	Parameter	Value	Qualifier	Notes
No outliers, in the past six years, have been identified by HGCMC.				

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

Table of Exceedance for Water Year 2018

Sample Date	Parameter	Value	Limits		Hardness
			Lower	Upper	
No exceedances have been identified by HGCMC for the period of October 2017 through September 2018.					

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 2018

Site 711FMS - 'Greens Creek Above Site E'

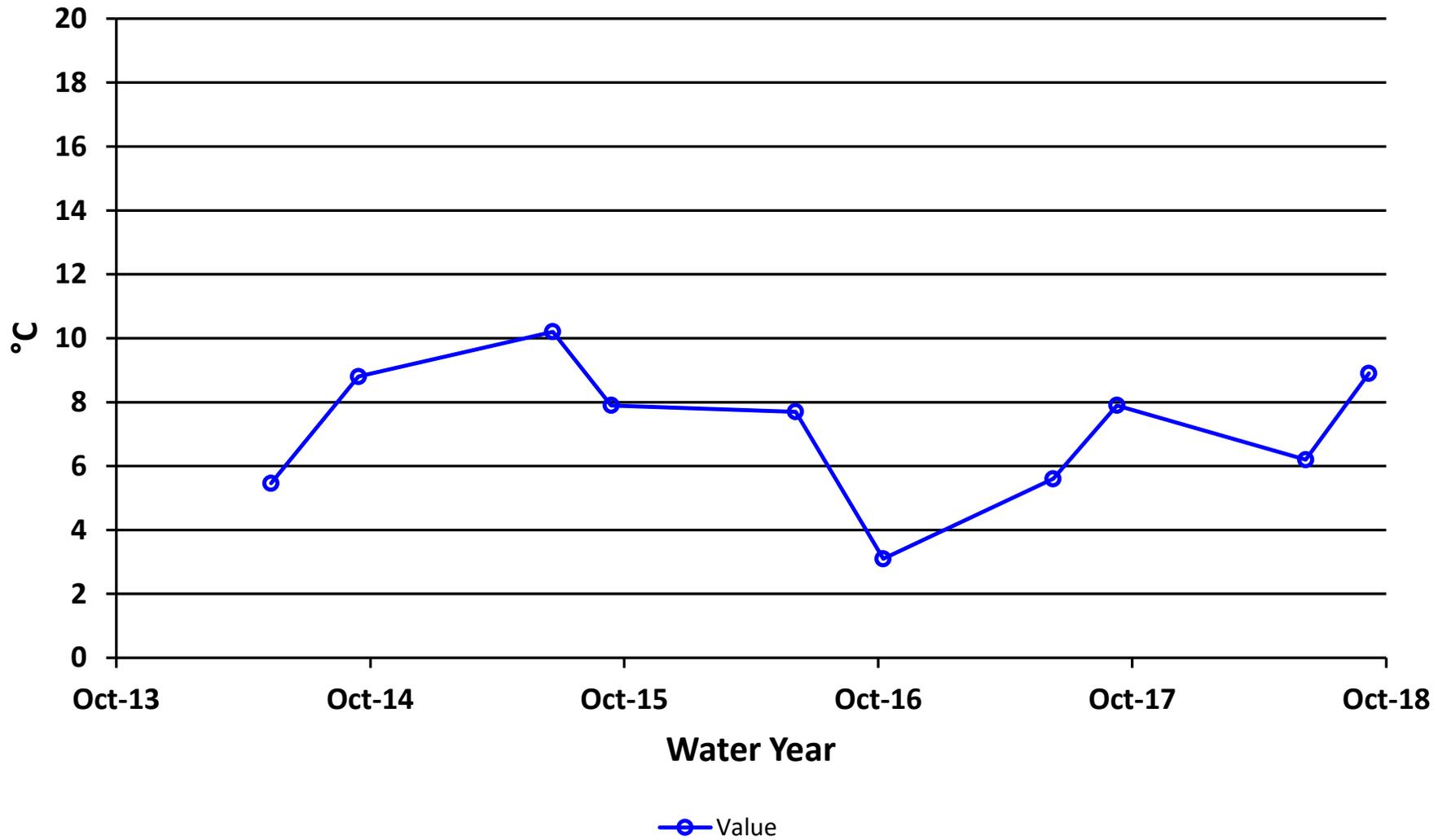
Sample Date/Parameter	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018	Median
Water Temp (°C)									6.2			8.9	7.6
Conductivity-Field(µmho)									106.4			185.3	145.9
Conductivity-Lab (µmho)									97			171	134
pH Lab (standard units)									6.7			7.45	7.08
pH Field (standard units)									7.74			8.22	7.98
Total Alkalinity (mg/L)									39.1			68.1	53.6
Total Sulfate (mg/L)									9.7			19.6	14.7
Hardness (mg/L)									52.3			83.1	67.7
Dissolved As (ug/L)									0.188			0.211	0.200
Dissolved Ba (ug/L)									29.8				29.8
Dissolved Cd (ug/L)									0.0293			0.0295	0.0294
Dissolved Cr (ug/L)									0.137				0.137
Dissolved Cu (ug/L)									0.649			0.425	0.537
Dissolved Pb (ug/L)									0.0185			0.0052	0.0119
Dissolved Ni (ug/L)									0.432				0.432
Dissolved Ag (ug/L)									0.002				0.002
Dissolved Zn (ug/L)									3.1			2.21	2.66
Dissolved Se (ug/L)									0.674				0.674
Dissolved Hg (ug/L)									0.00112			0.000501	0.000811

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

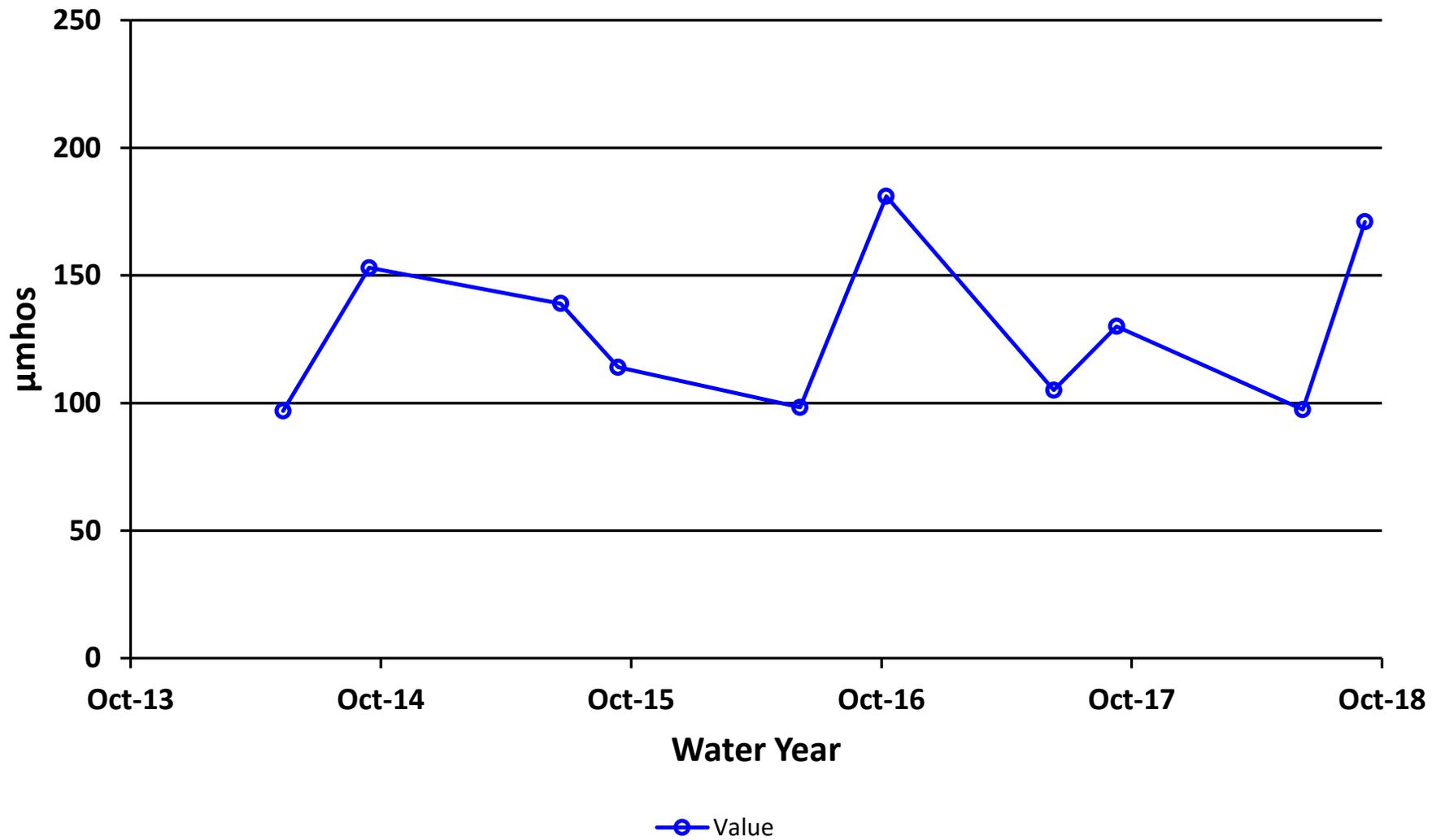
Values reported as less than MDL are replaced by 1/2 MDL for median calculation purposes.

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

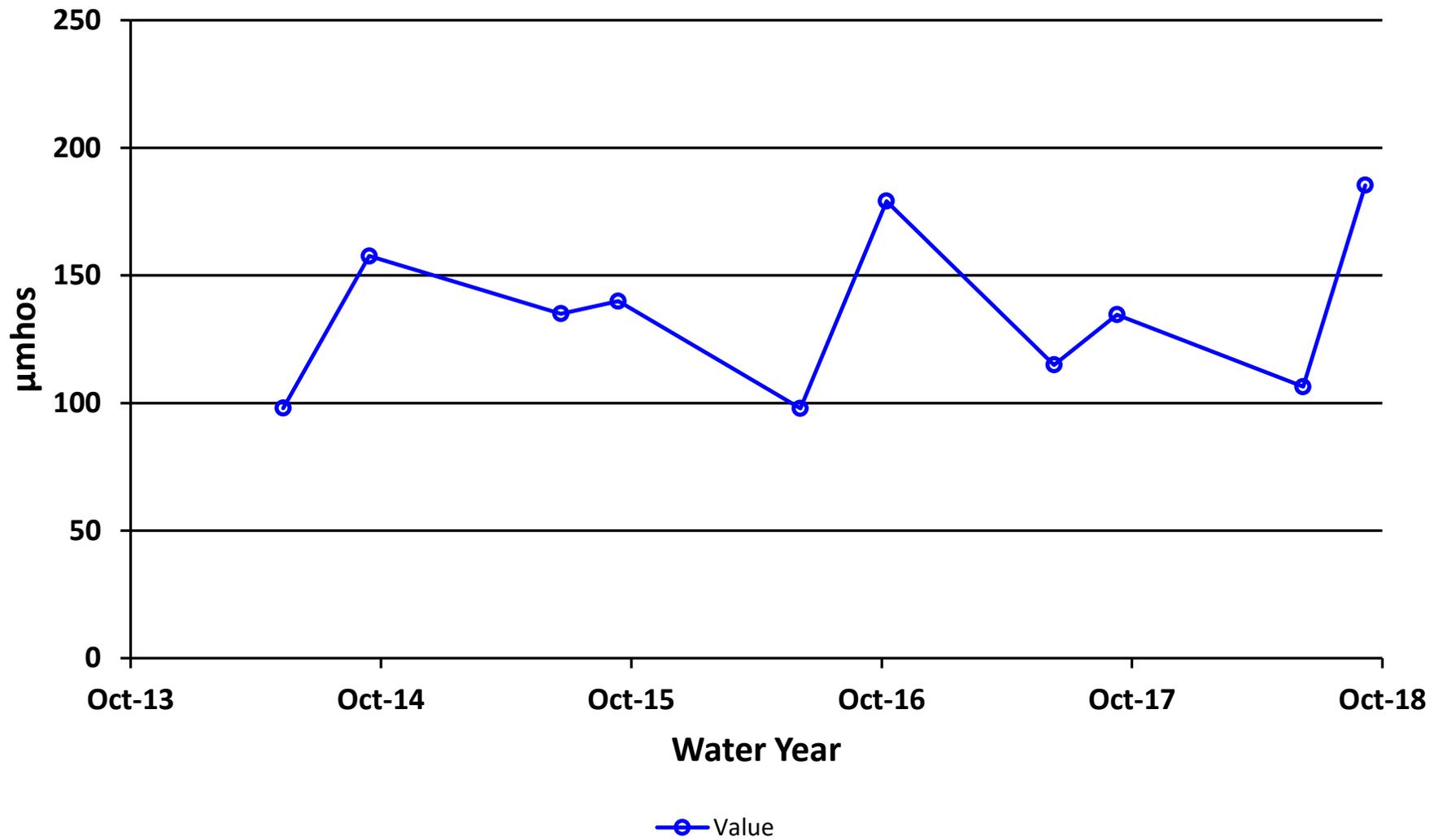
Site 711 - Water Temperature



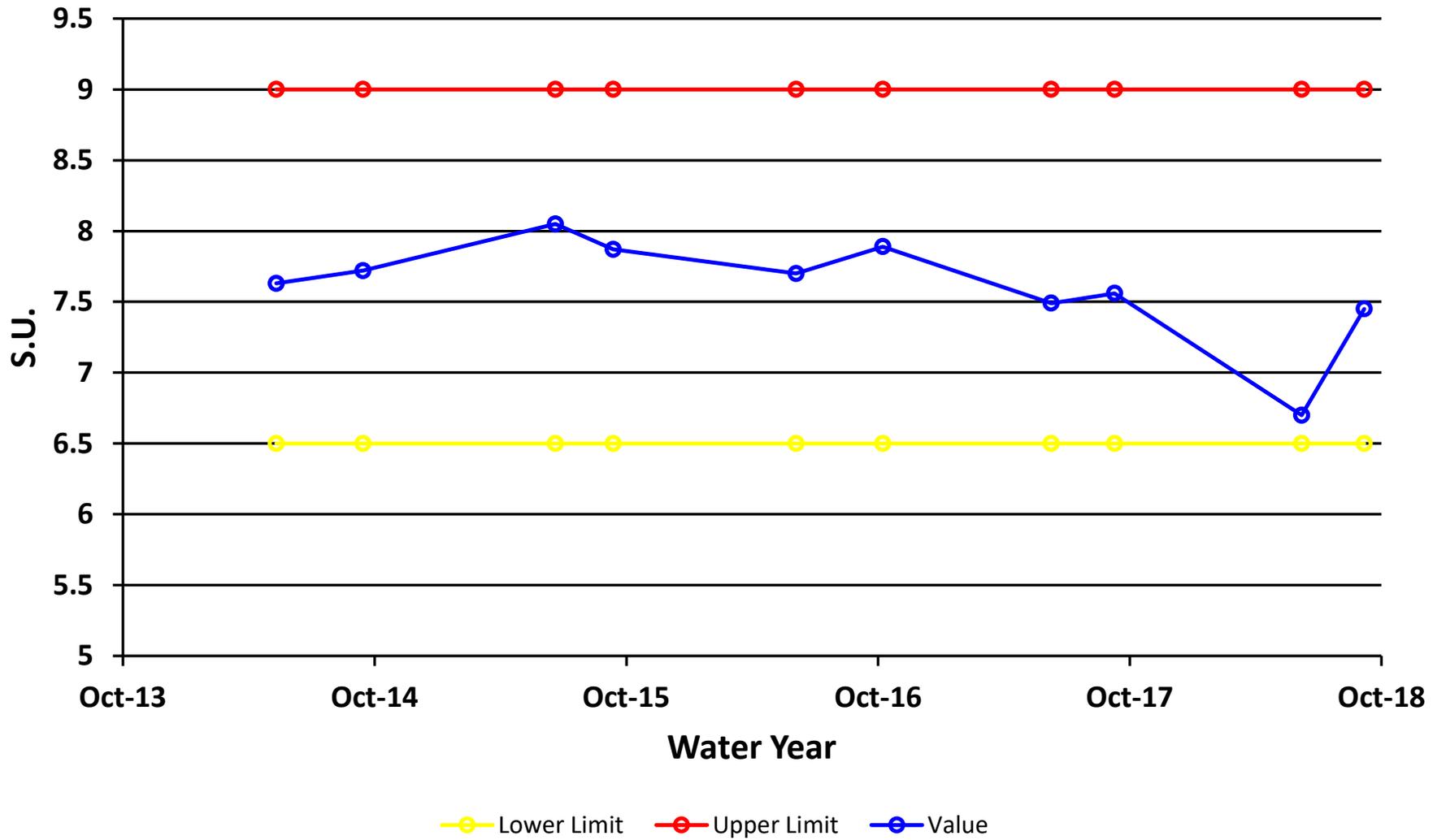
Site 711 - Conductivity Laboratory



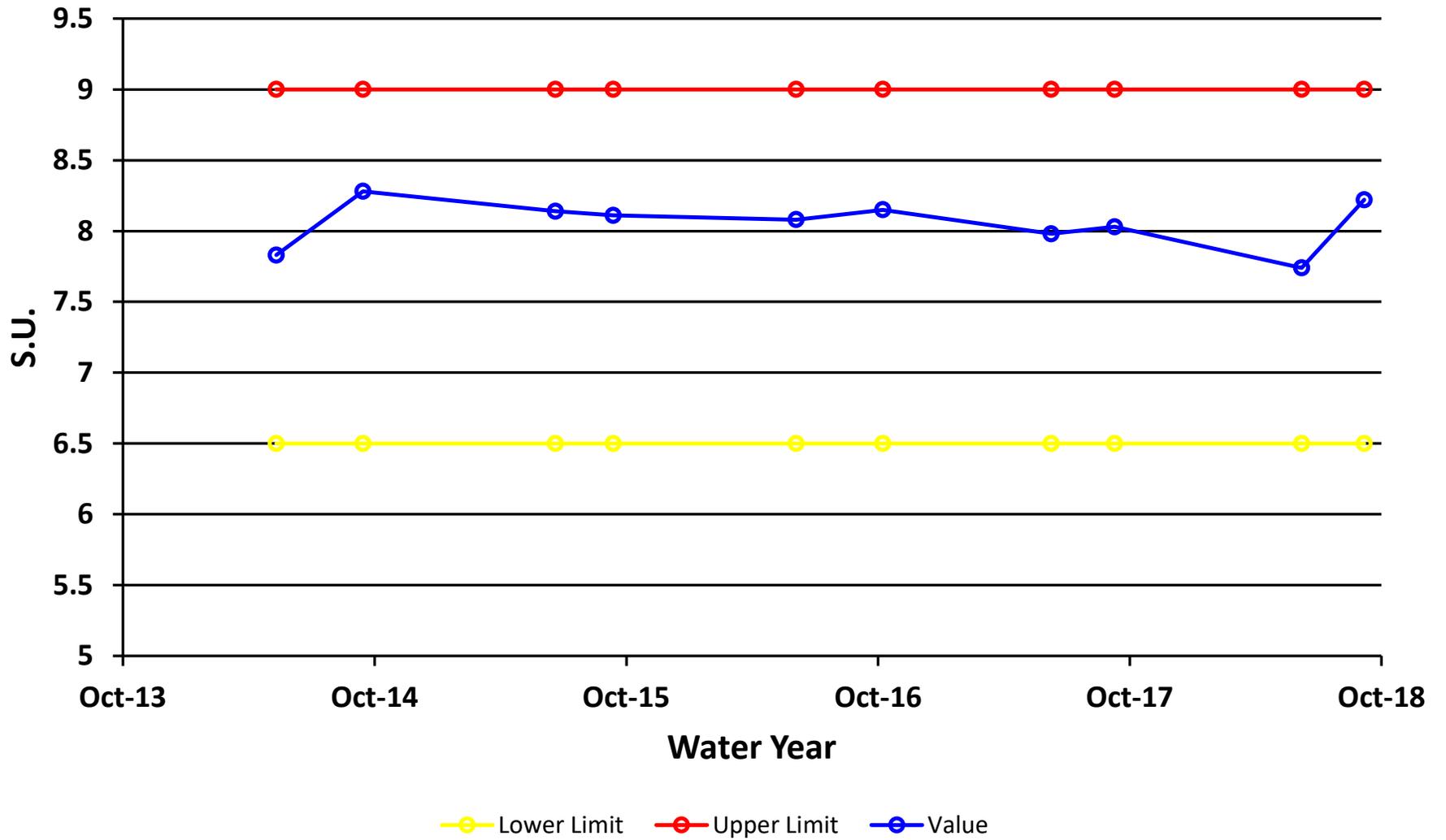
Site 711 - Conductivity Field



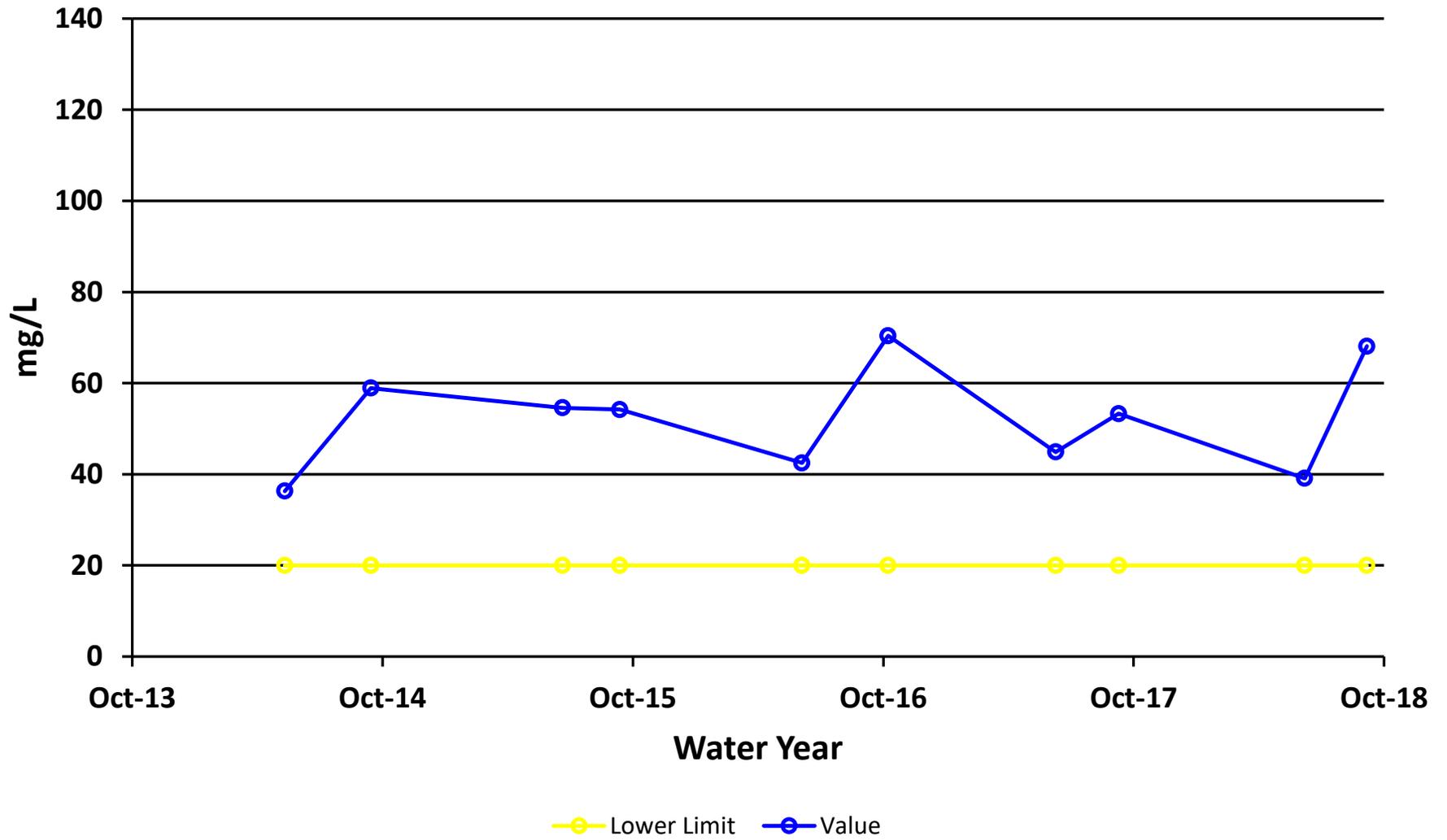
Site 711 - pH Laboratory



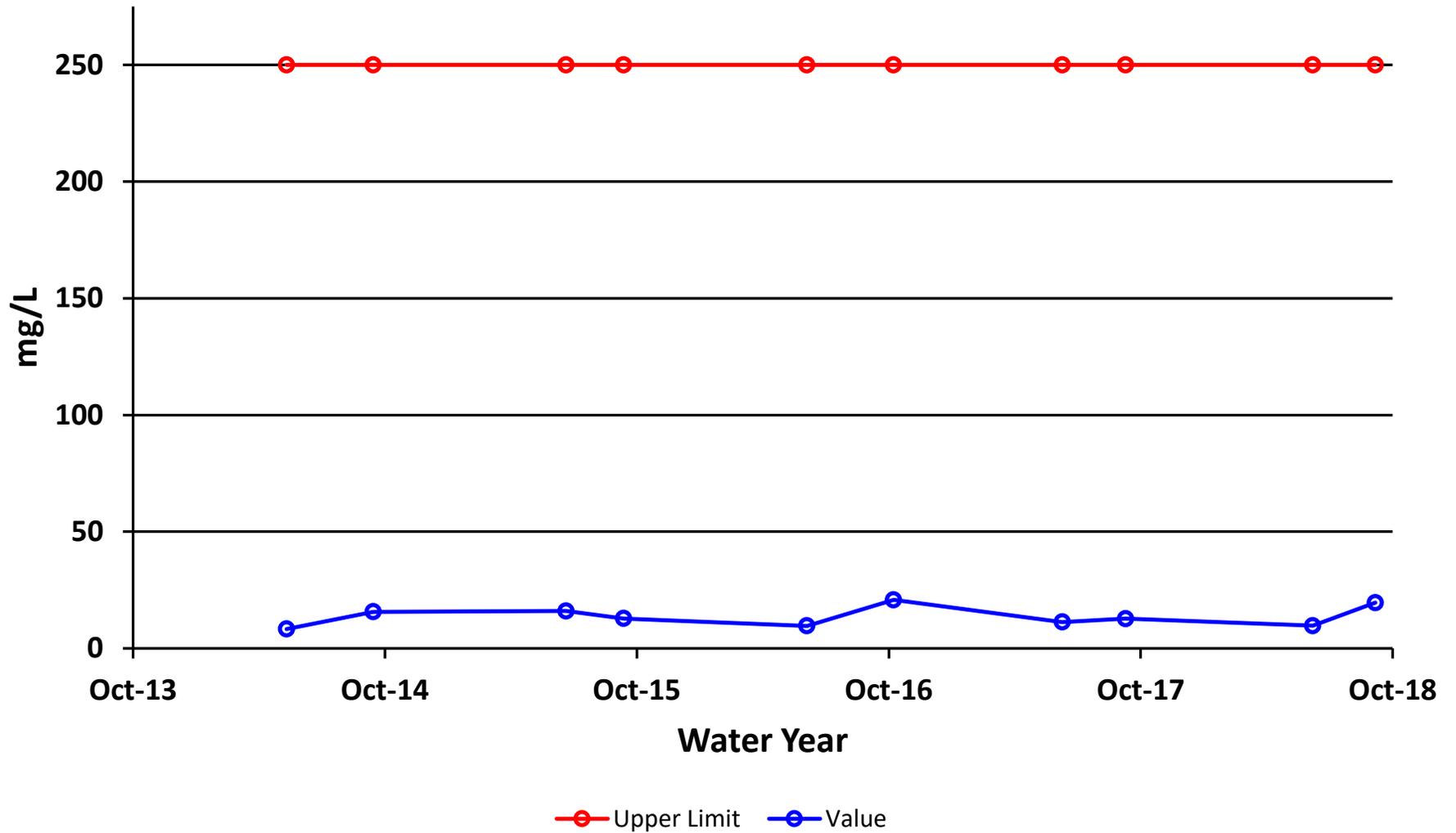
Site 711 - pH Field



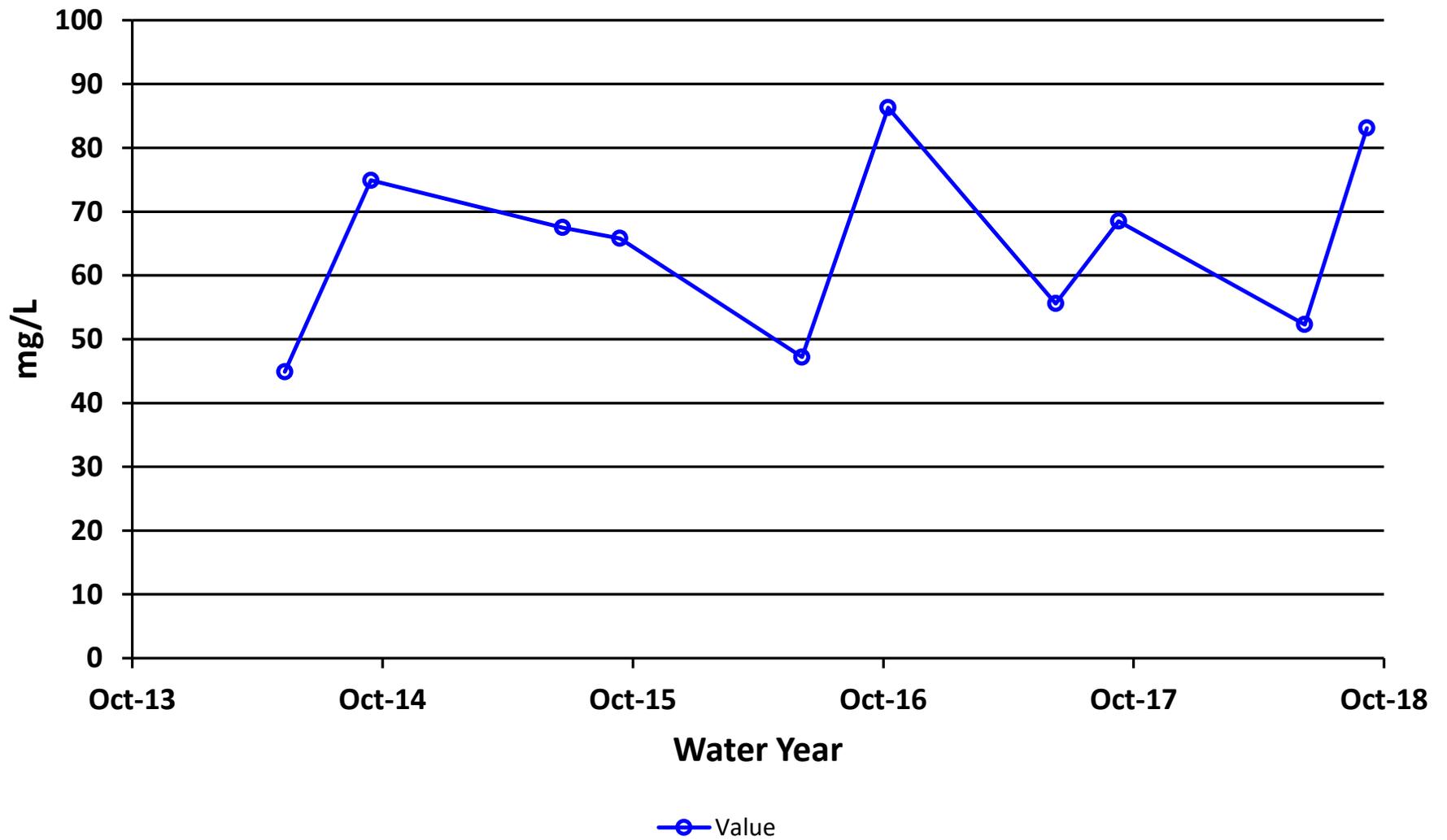
Site 711 - Alkalinity



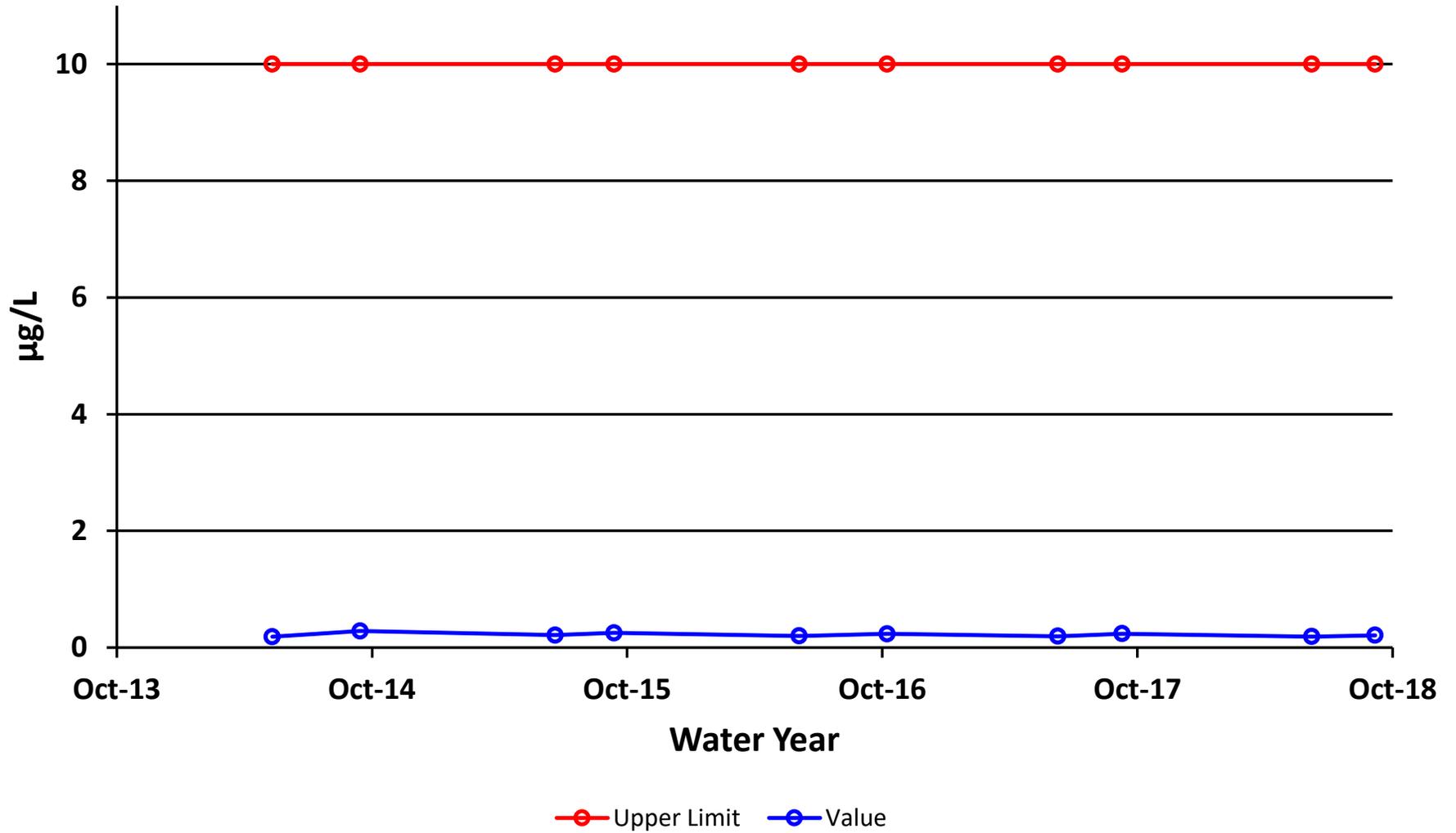
Site 711 - Sulfate



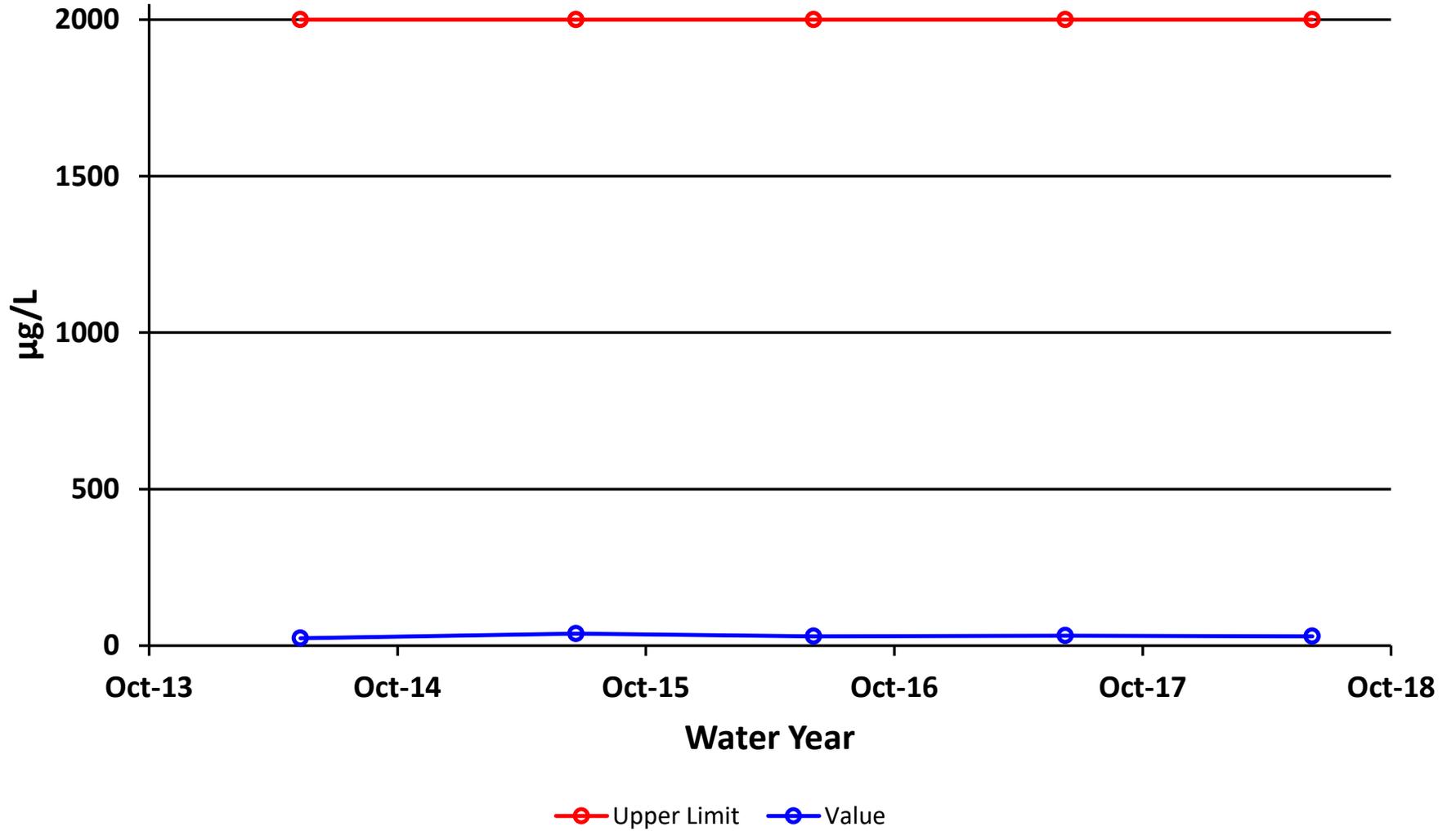
Site 711 - Hardness



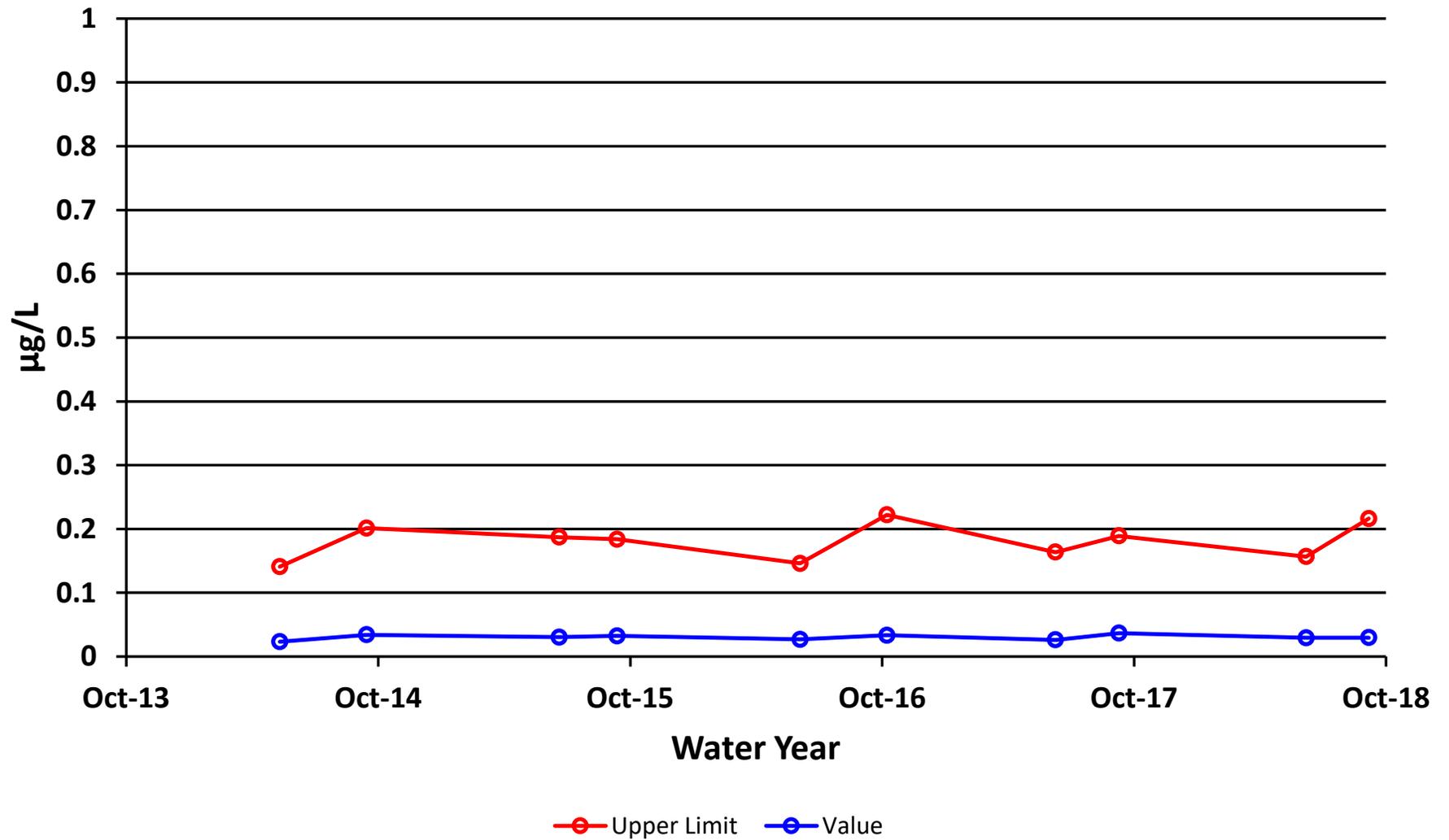
Site 711 - Arsenic Dissolved



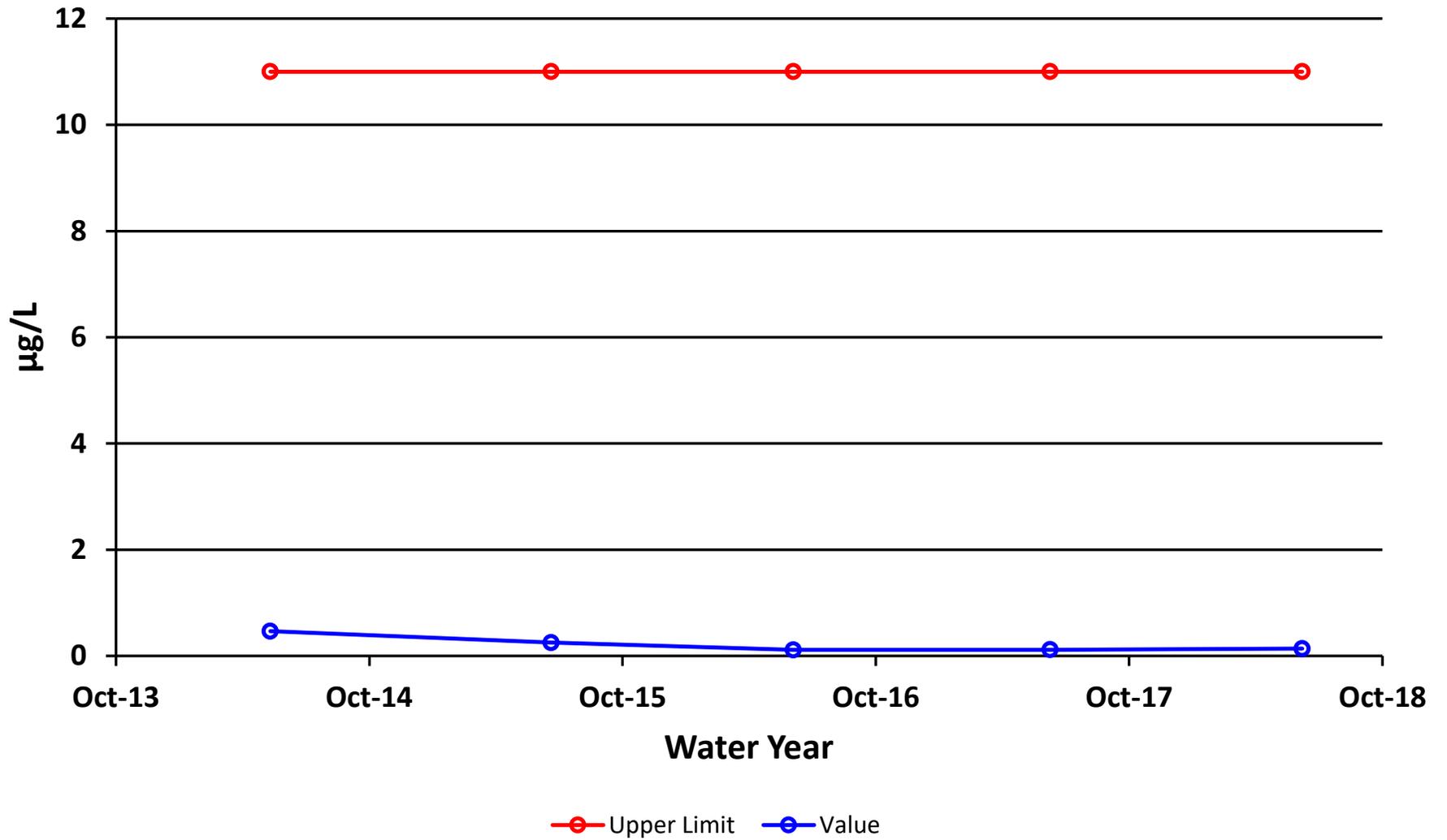
Site 711 - Barium Dissolved



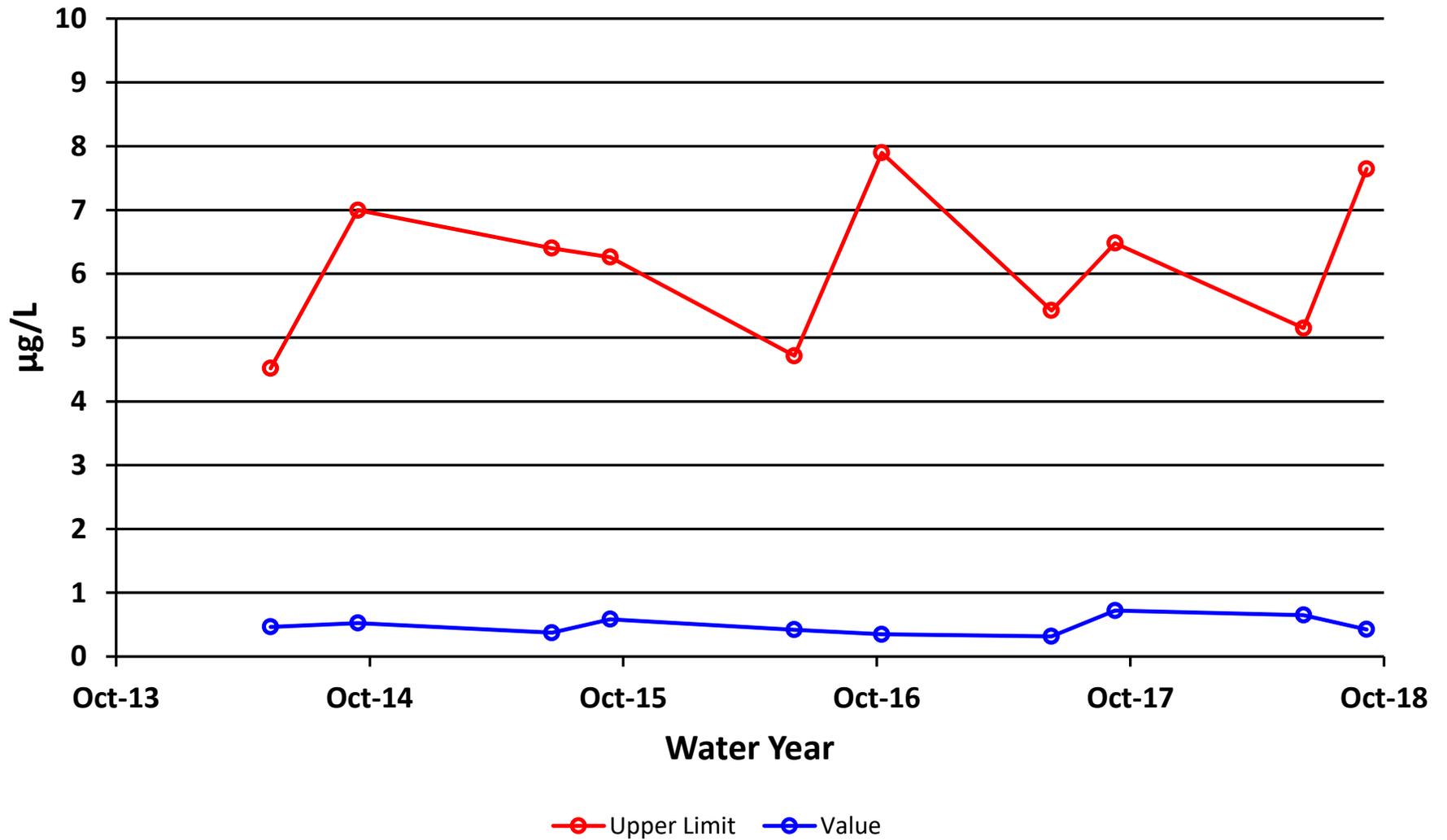
Site 711 - Cadmium Dissolved



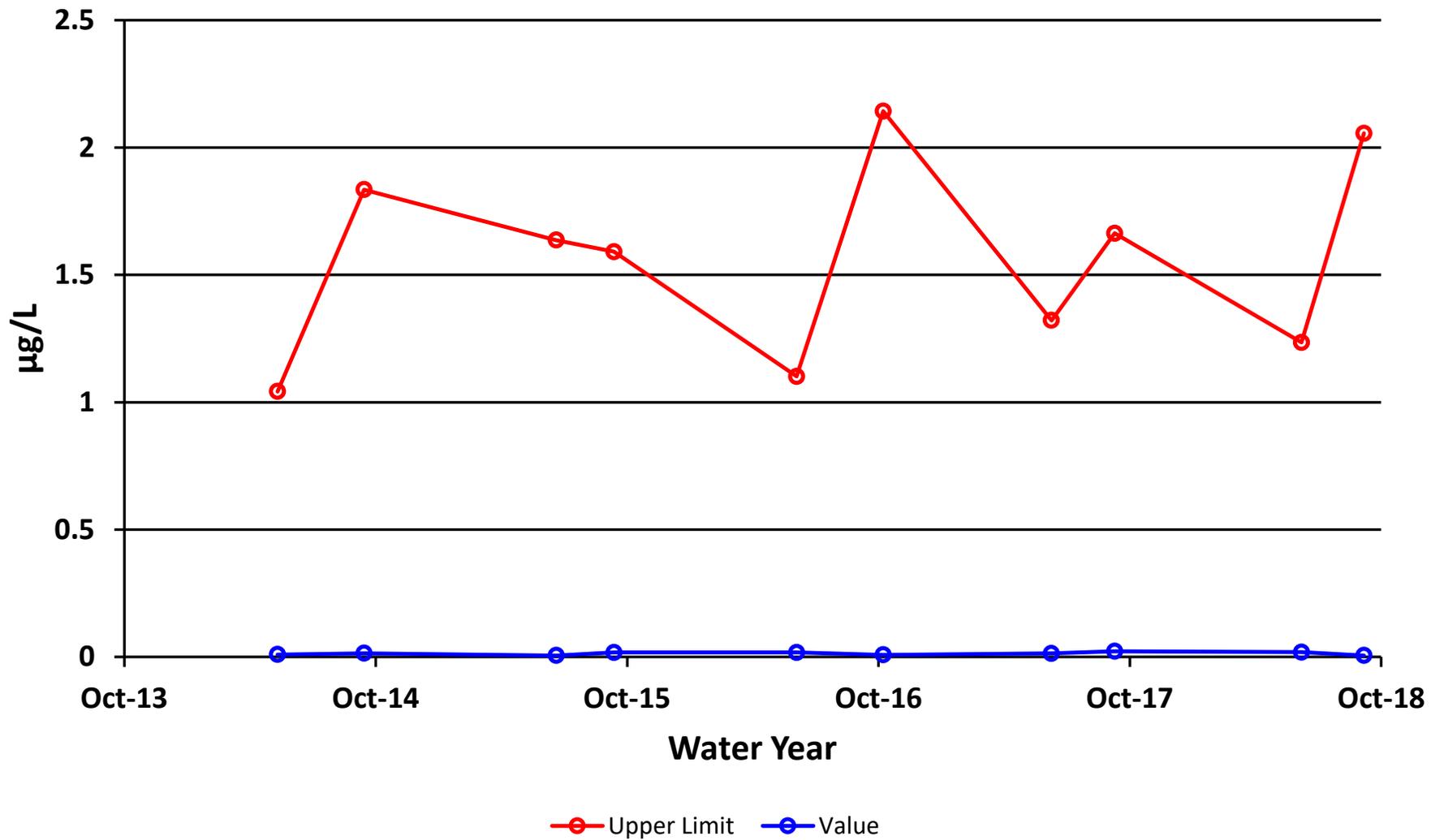
Site 711 - Chromium Dissolved



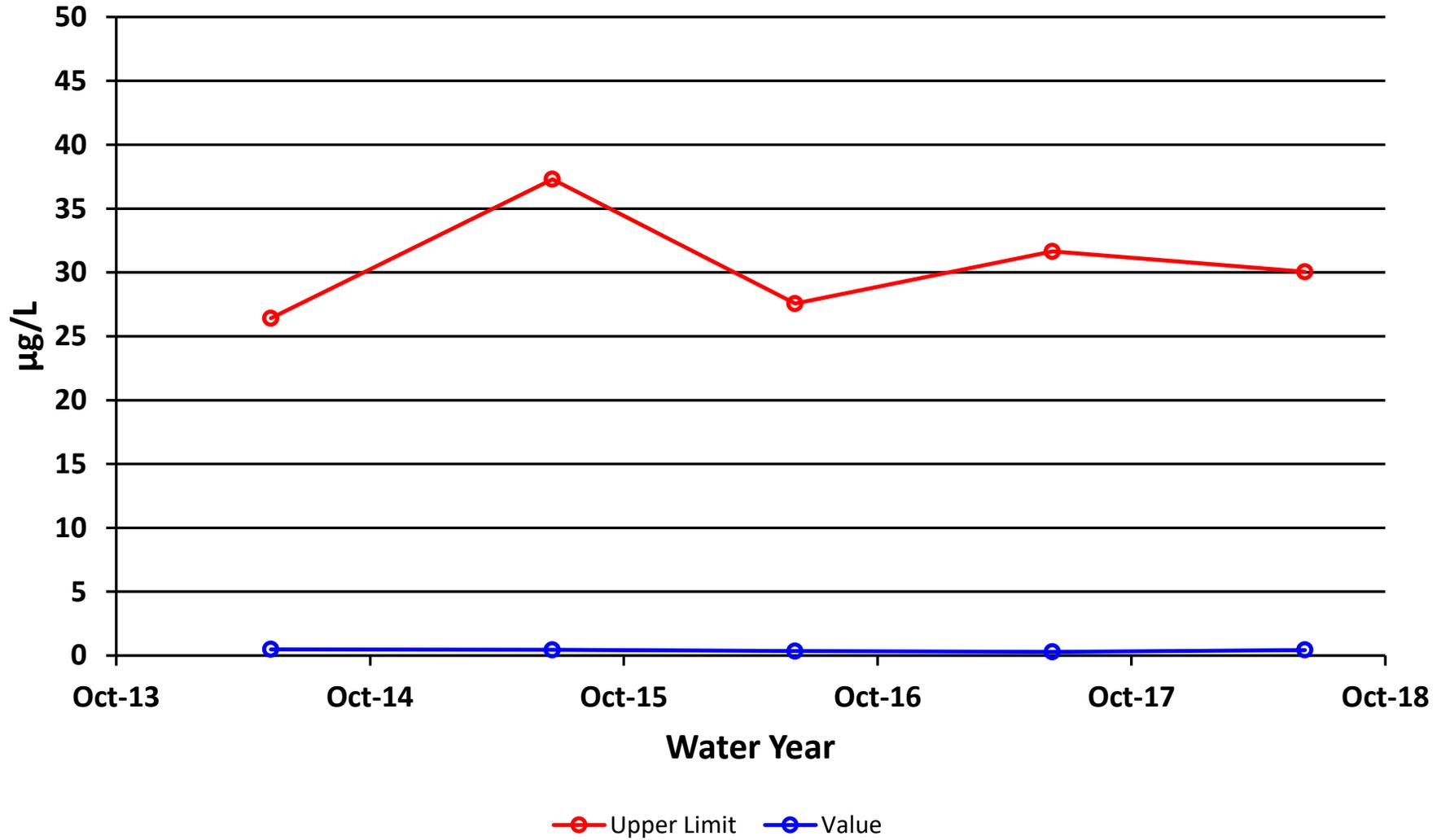
Site 711 - Copper Dissolved



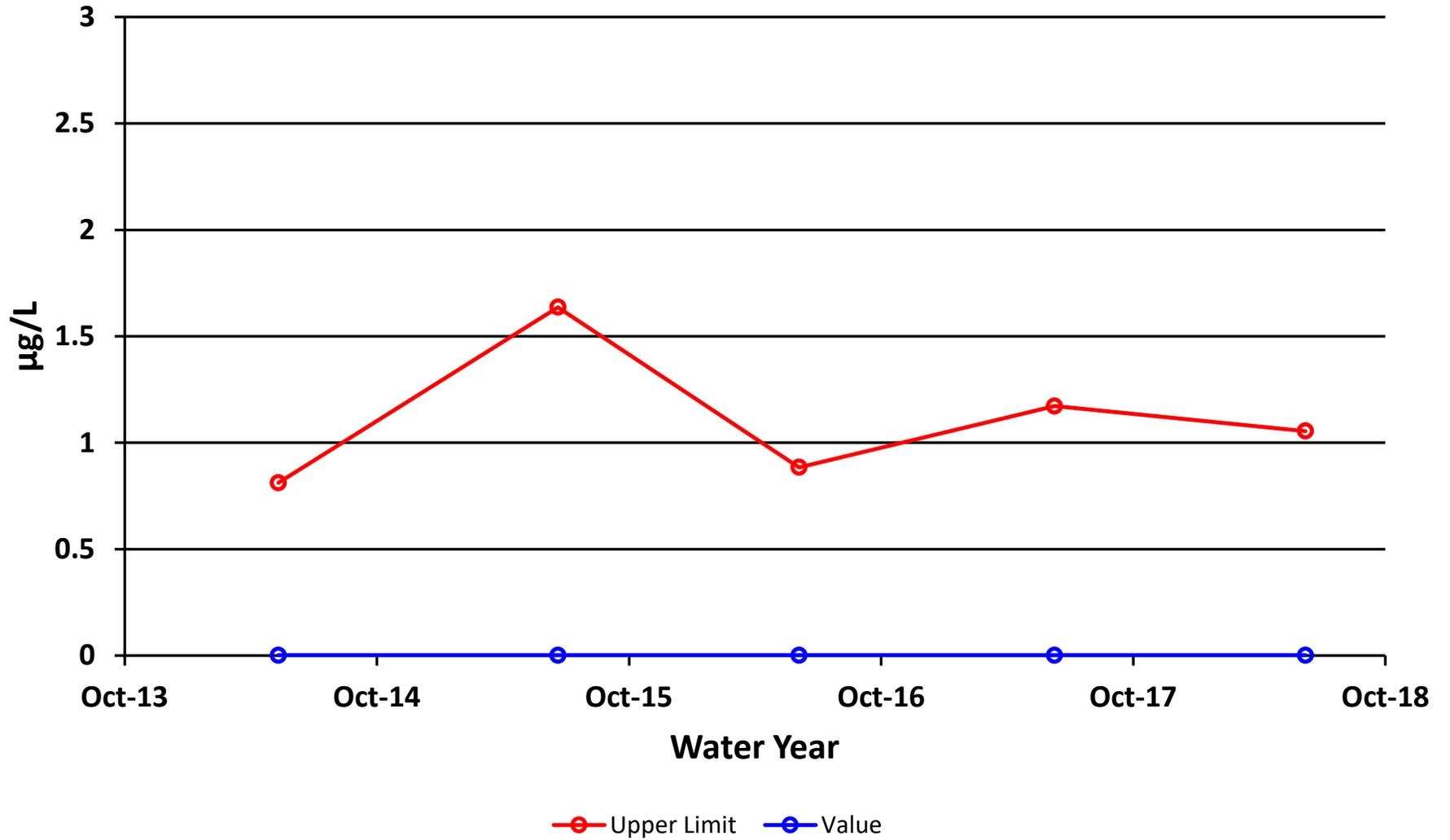
Site 711 - Lead Dissolved



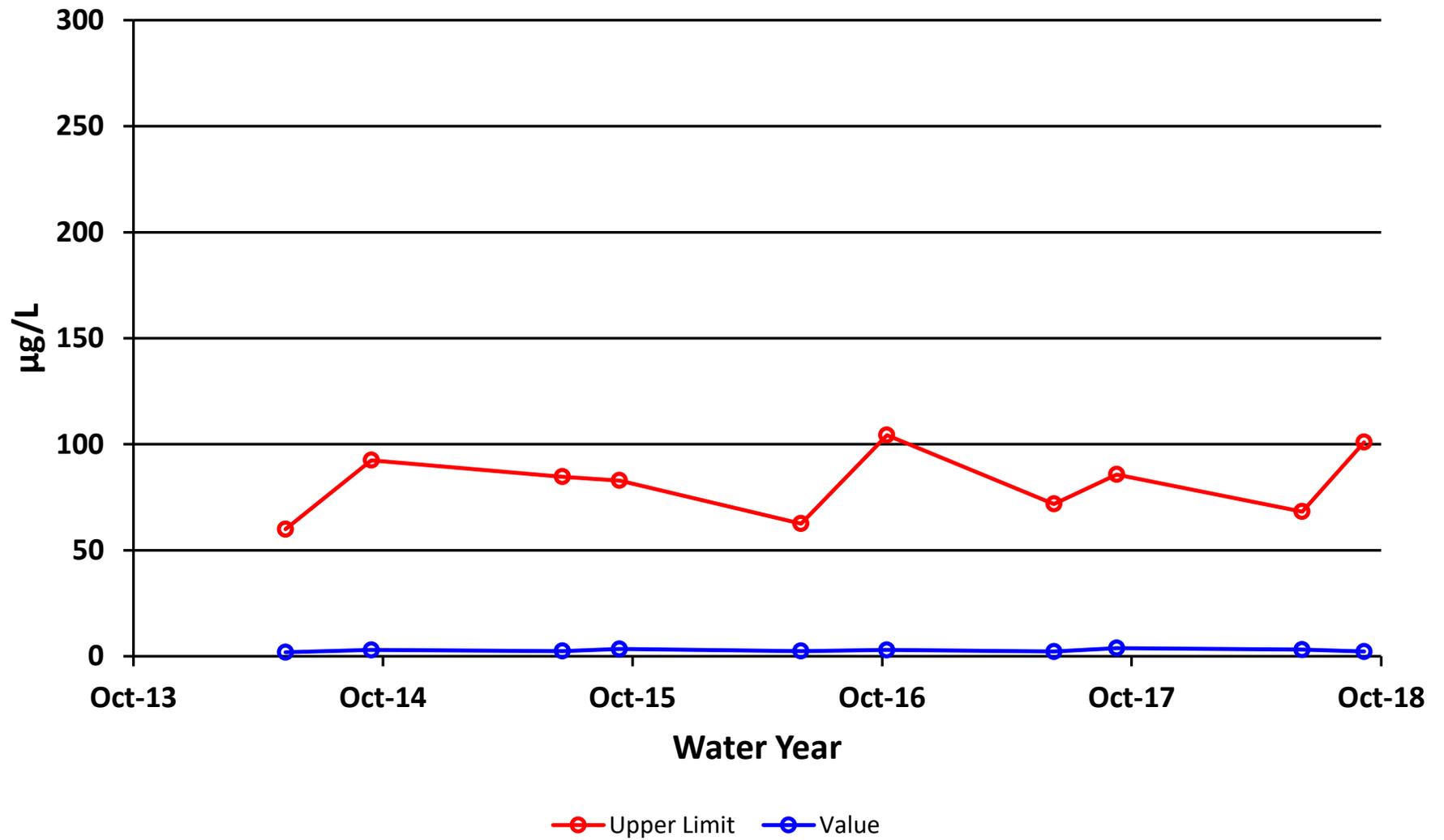
Site 711 - Nickel Dissolved



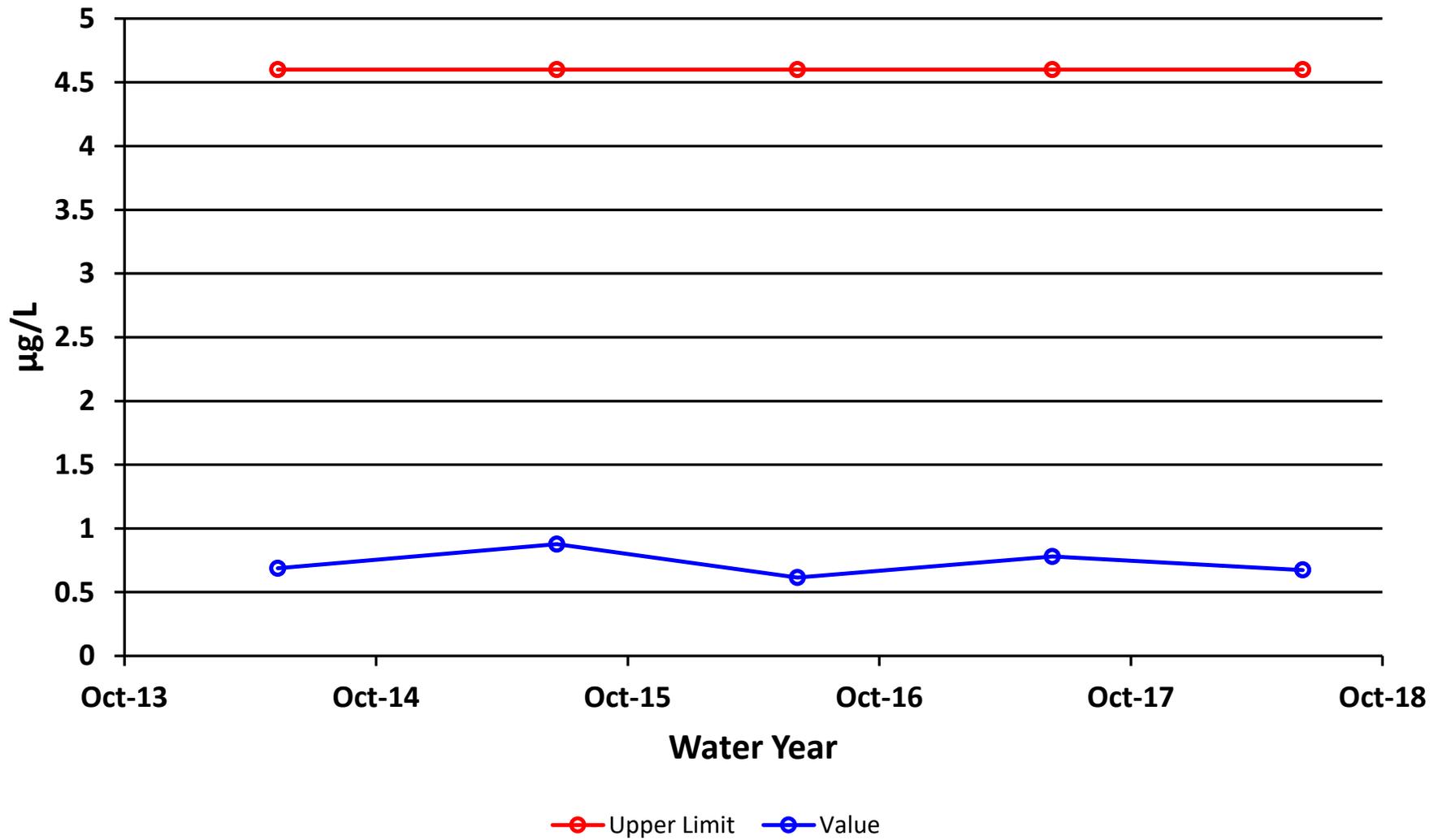
Site 711 - Silver Dissolved



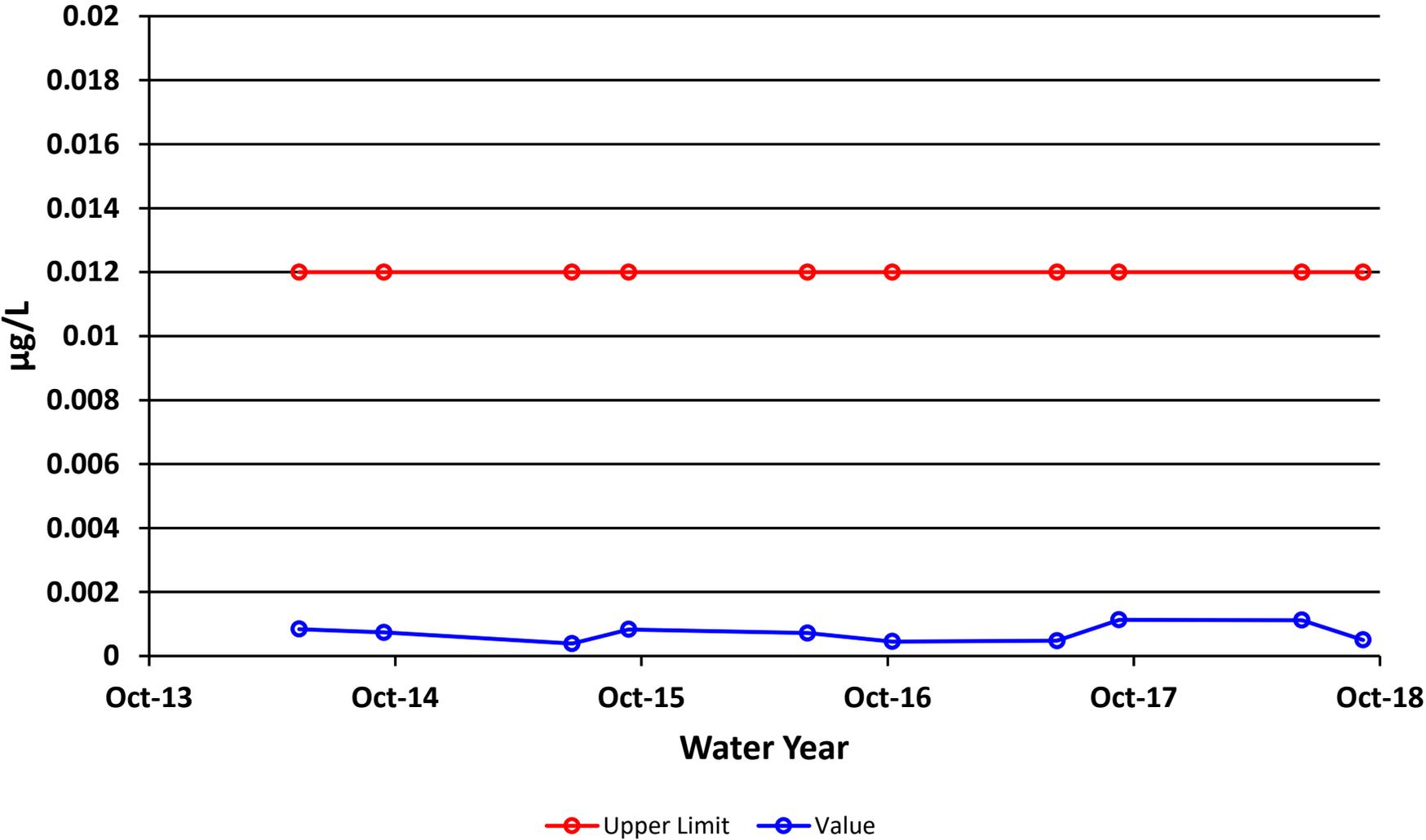
Site 711 - Zinc Dissolved



Site 711 - Selenium Dissolved



Site 711 - Mercury Dissolved



INTERPRETIVE REPORT

SITE 712

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

The data collected during the current water year are listed in the following “Table of Results for Water Year 2018” 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 one-half of the for the purpose of median calculation.

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

Sample Date	Parameter	Value	Qualifier	Notes
No outliers, in the past six years, have been identified by HGCMC.				

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

Table of Exceedance for Water Year 2018

Sample Date	Parameter	Value	Limits		Hardness
			Lower	Upper	
No exceedances have been identified by HGCMC for the period of October 2017 through September 2018.					

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 2018

Site 712FMS - 'Greens Creek Below Site E'

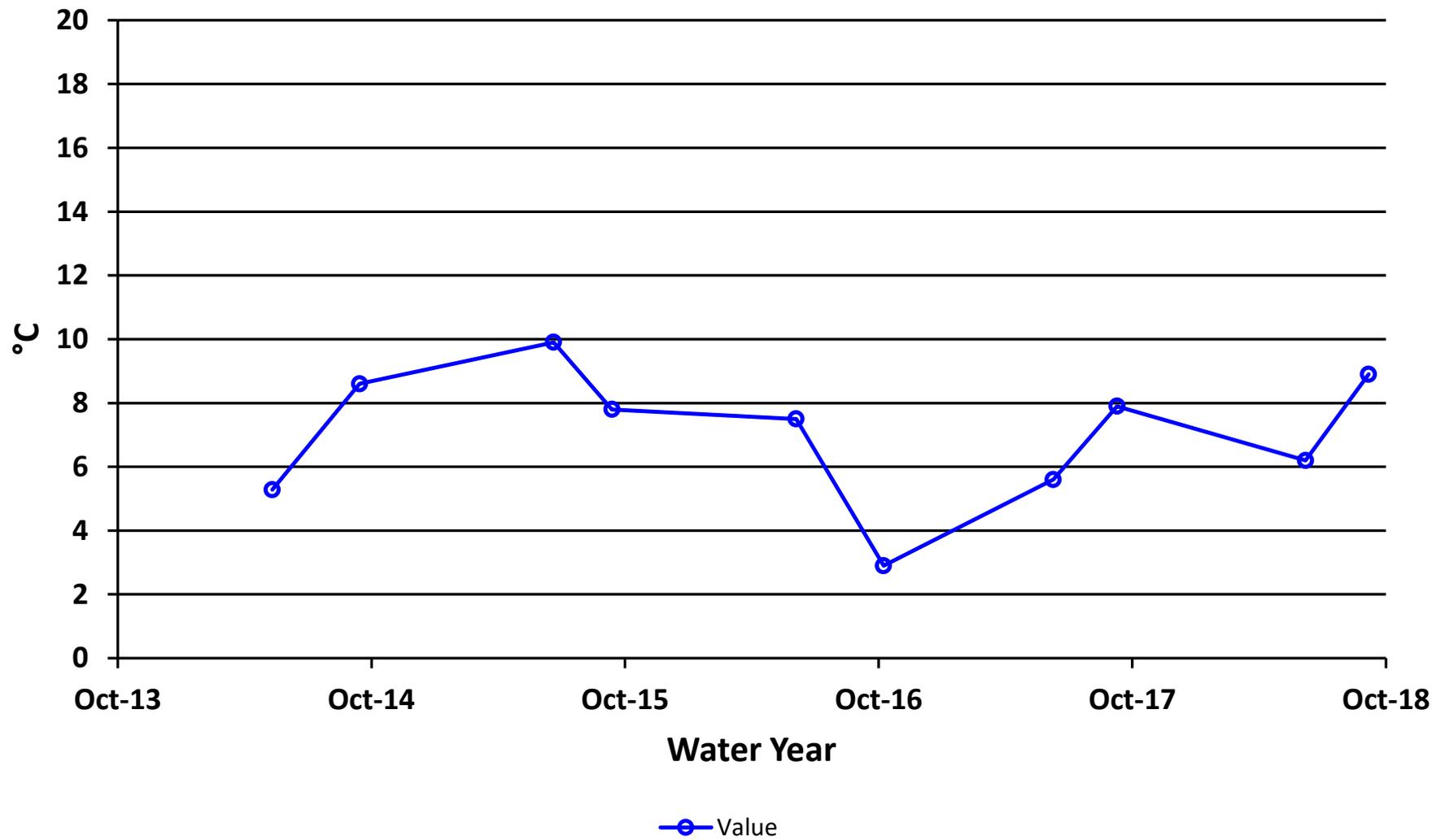
Sample Date/Parameter	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018	Median
Water Temp (°C)									6.2			8.9	7.6
Conductivity-Field(µmho)									108			186.2	147.1
Conductivity-Lab (µmho)									98			175	137
pH Lab (standard units)									6.37			7.53	6.95
pH Field (standard units)									7.19			8.22	7.71
Total Alkalinity (mg/L)									39.6			69.8	54.7
Total Sulfate (mg/L)									10.4			20.8	15.6
Hardness (mg/L)									53			87.4	70.2
Dissolved As (ug/L)									0.176			0.225	0.201
Dissolved Ba (ug/L)									30.3				30.3
Dissolved Cd (ug/L)									0.0331			0.0315	0.0323
Dissolved Cr (ug/L)									0.151				0.151
Dissolved Cu (ug/L)									0.686			0.447	0.567
Dissolved Pb (ug/L)									0.0166			0.0056	0.0111
Dissolved Ni (ug/L)									0.503				0.503
Dissolved Ag (ug/L)									0.002				0.002
Dissolved Zn (ug/L)									5.15			2.5	3.83
Dissolved Se (ug/L)									0.627				0.627
Dissolved Hg (ug/L)									0.00115			0.000598	0.000874

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

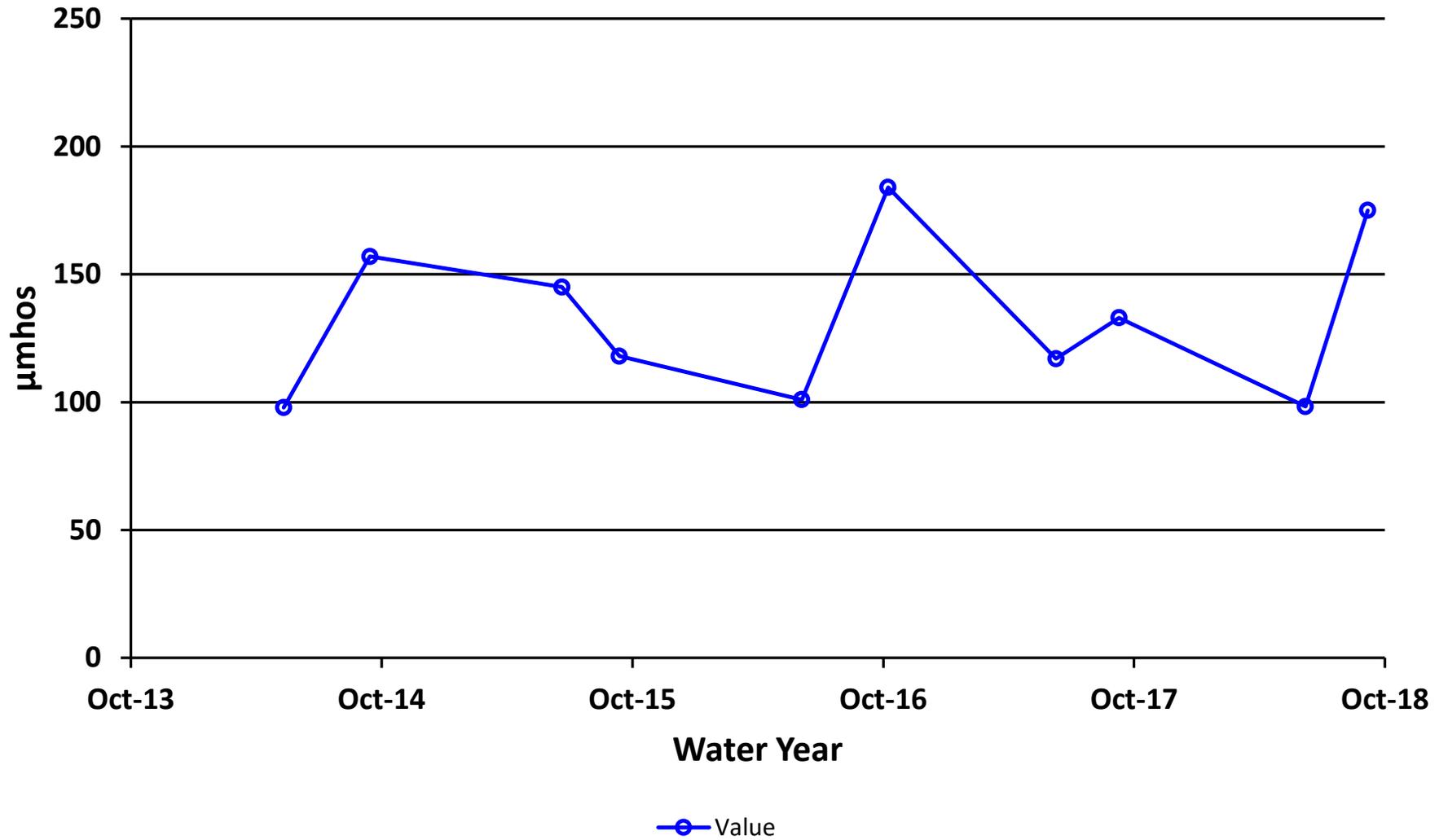
Values reported as less than MDL are replaced by 1/2 MDL for median calculation purposes.

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

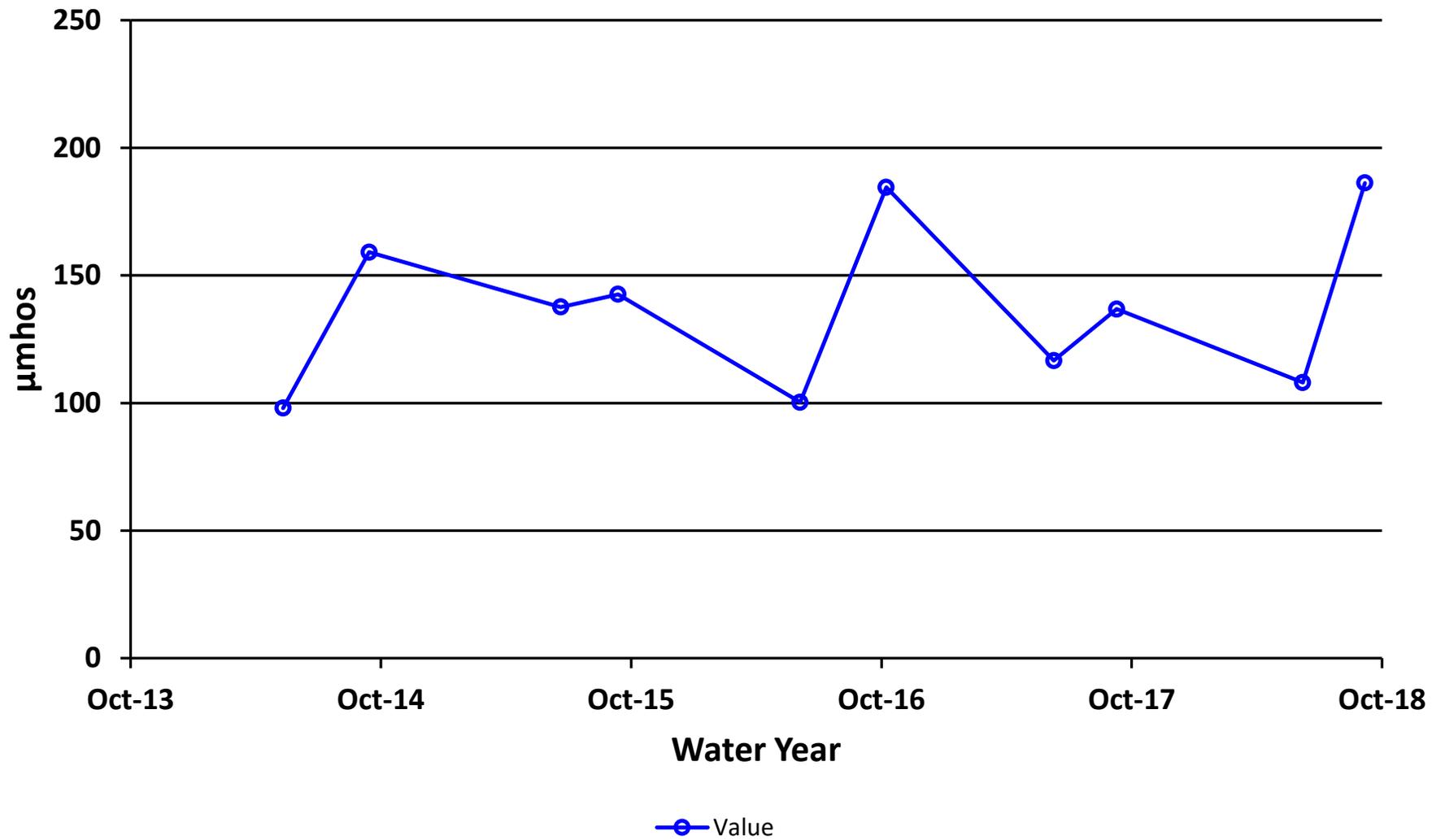
Site 712 - Water Temperature



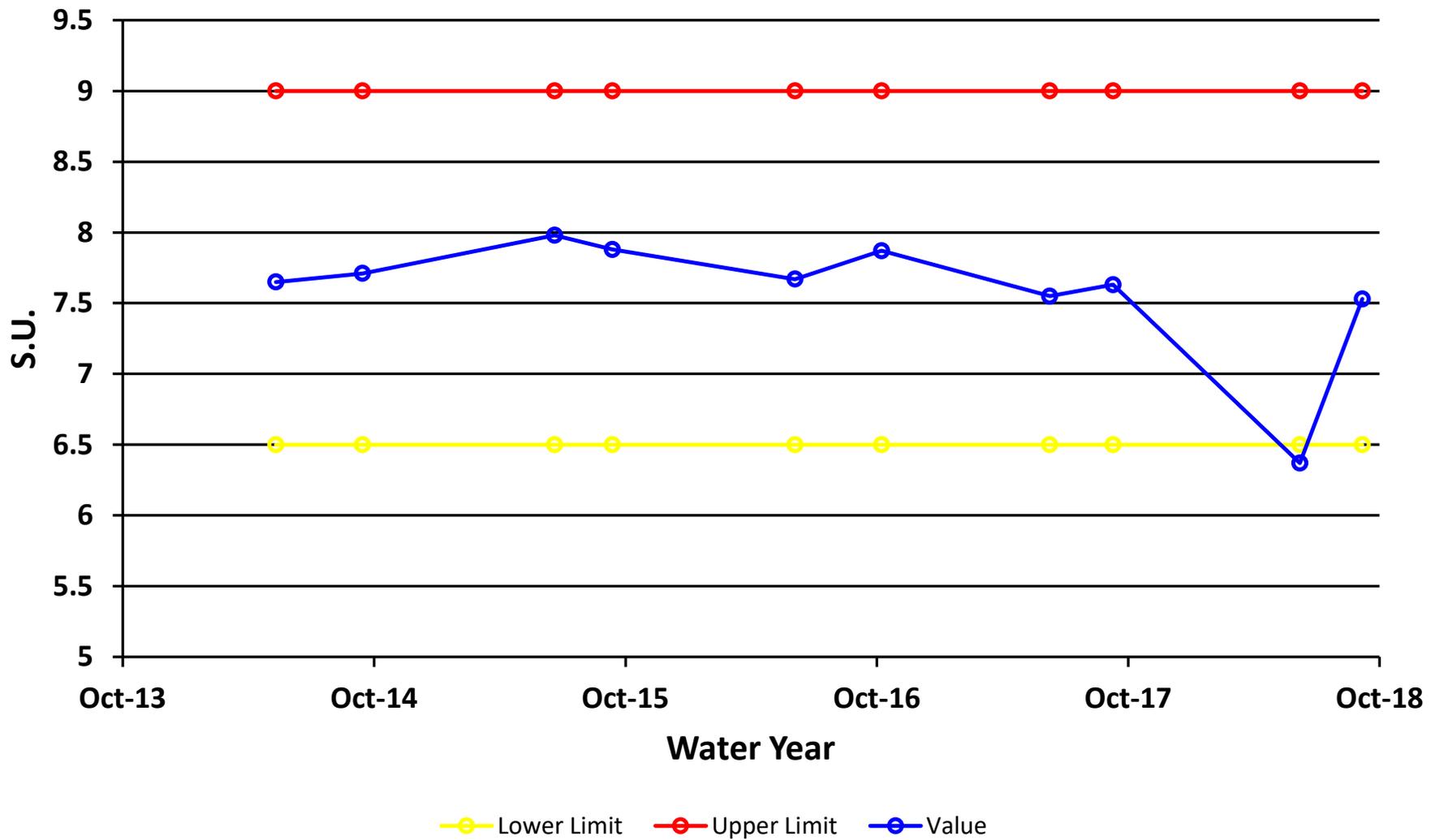
Site 712 - Conductivity Laboratory



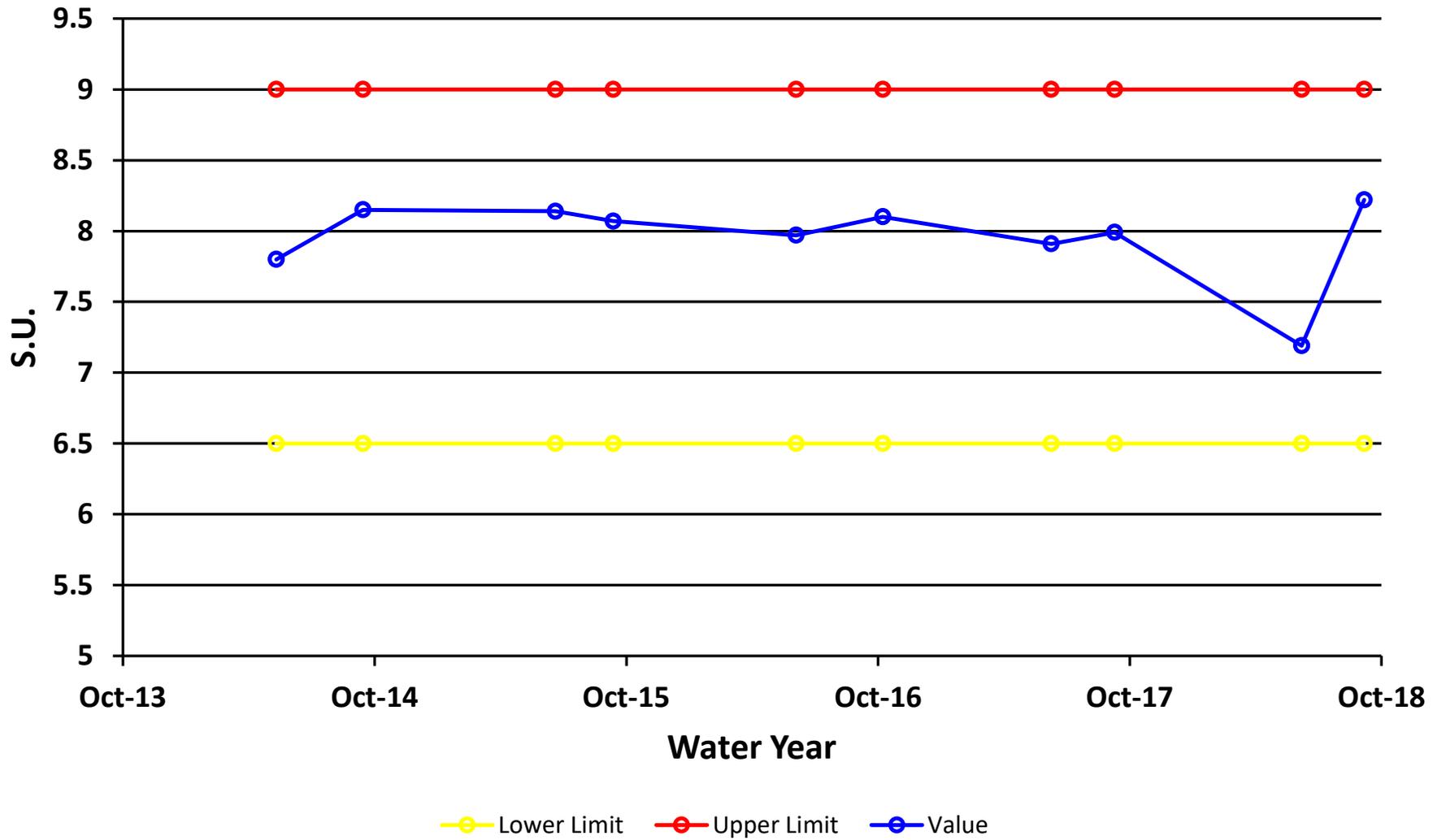
Site 712 - Conductivity Field



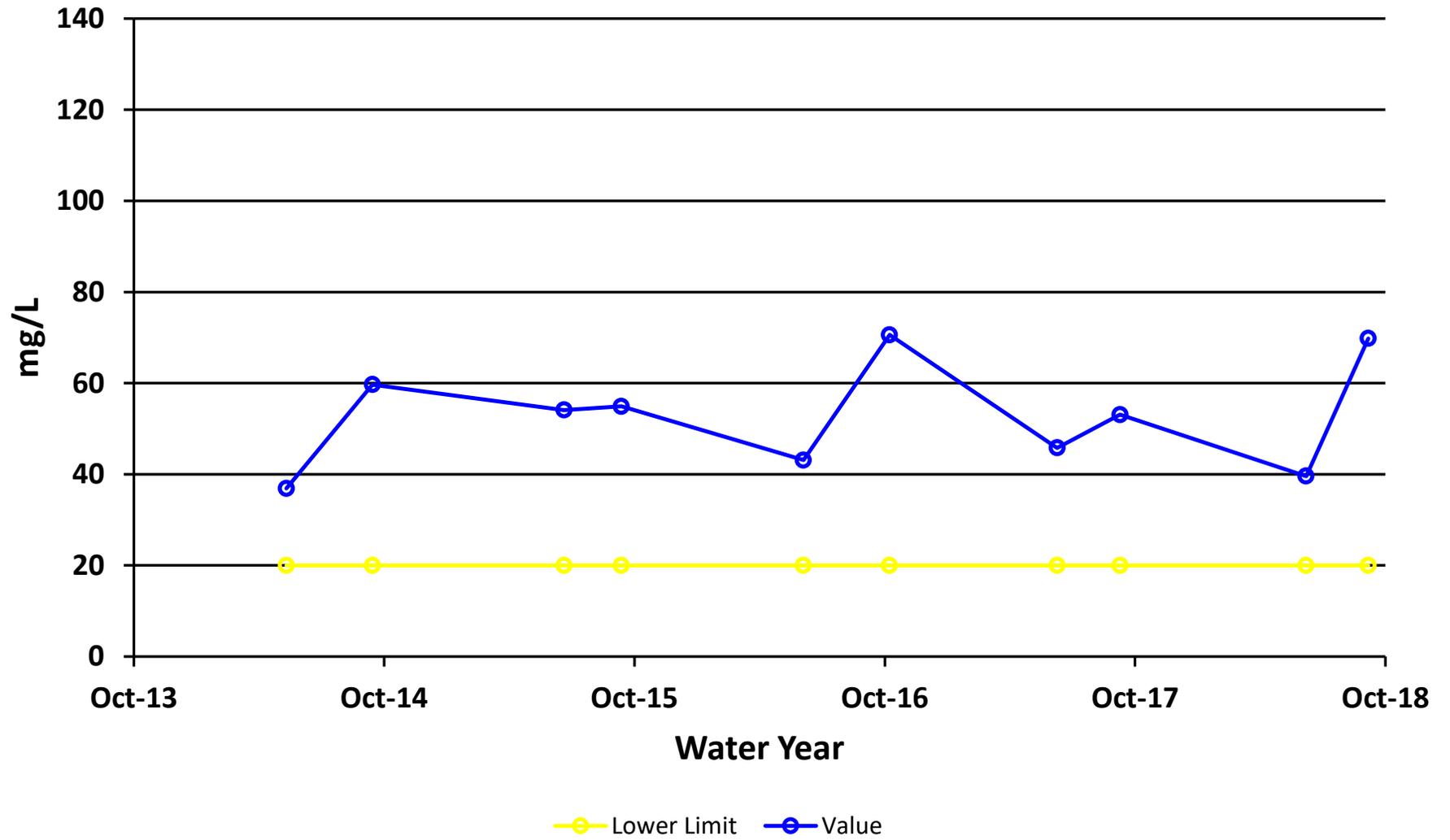
Site 712 - pH Laboratory



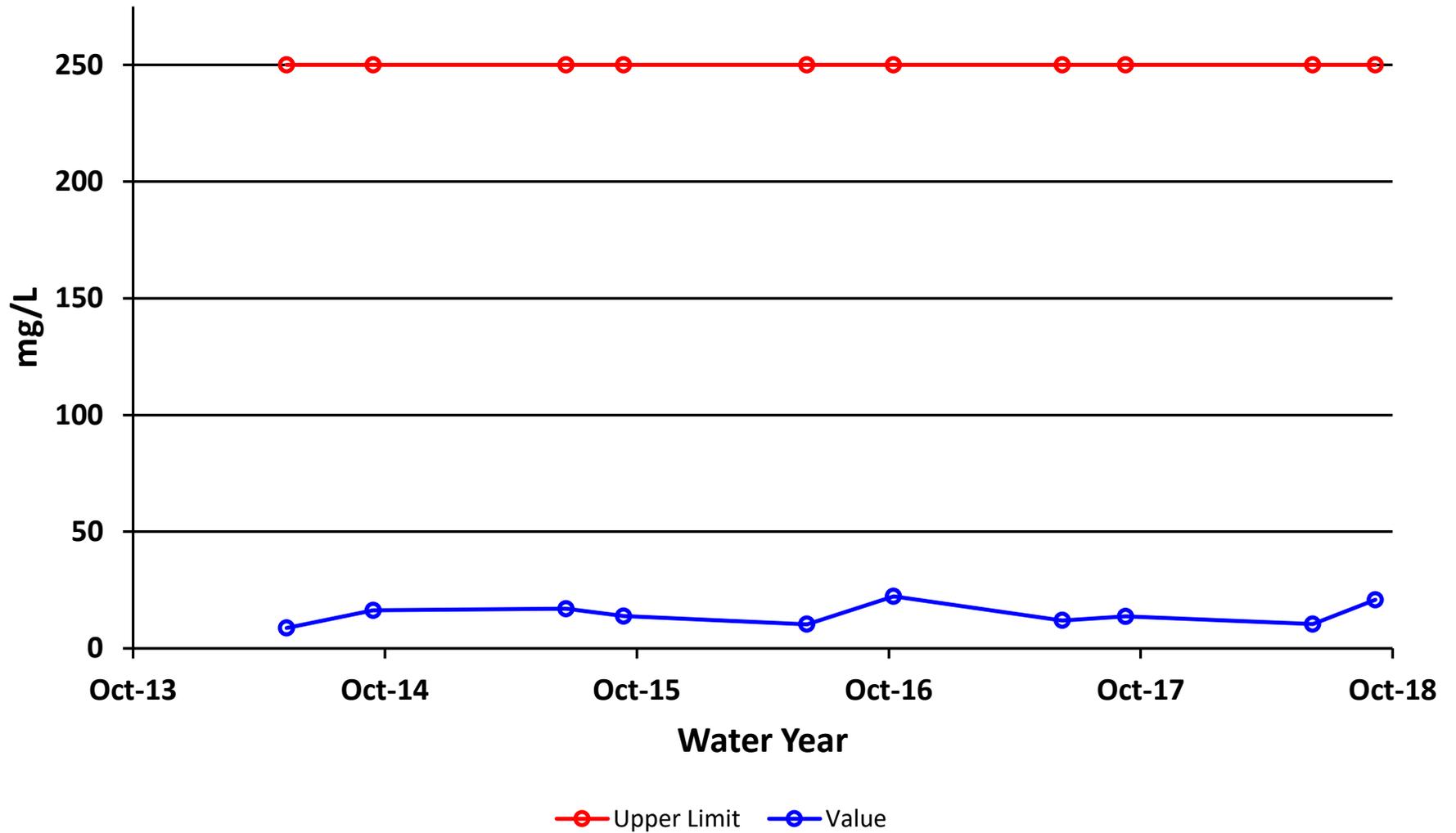
Site 712 - pH Field



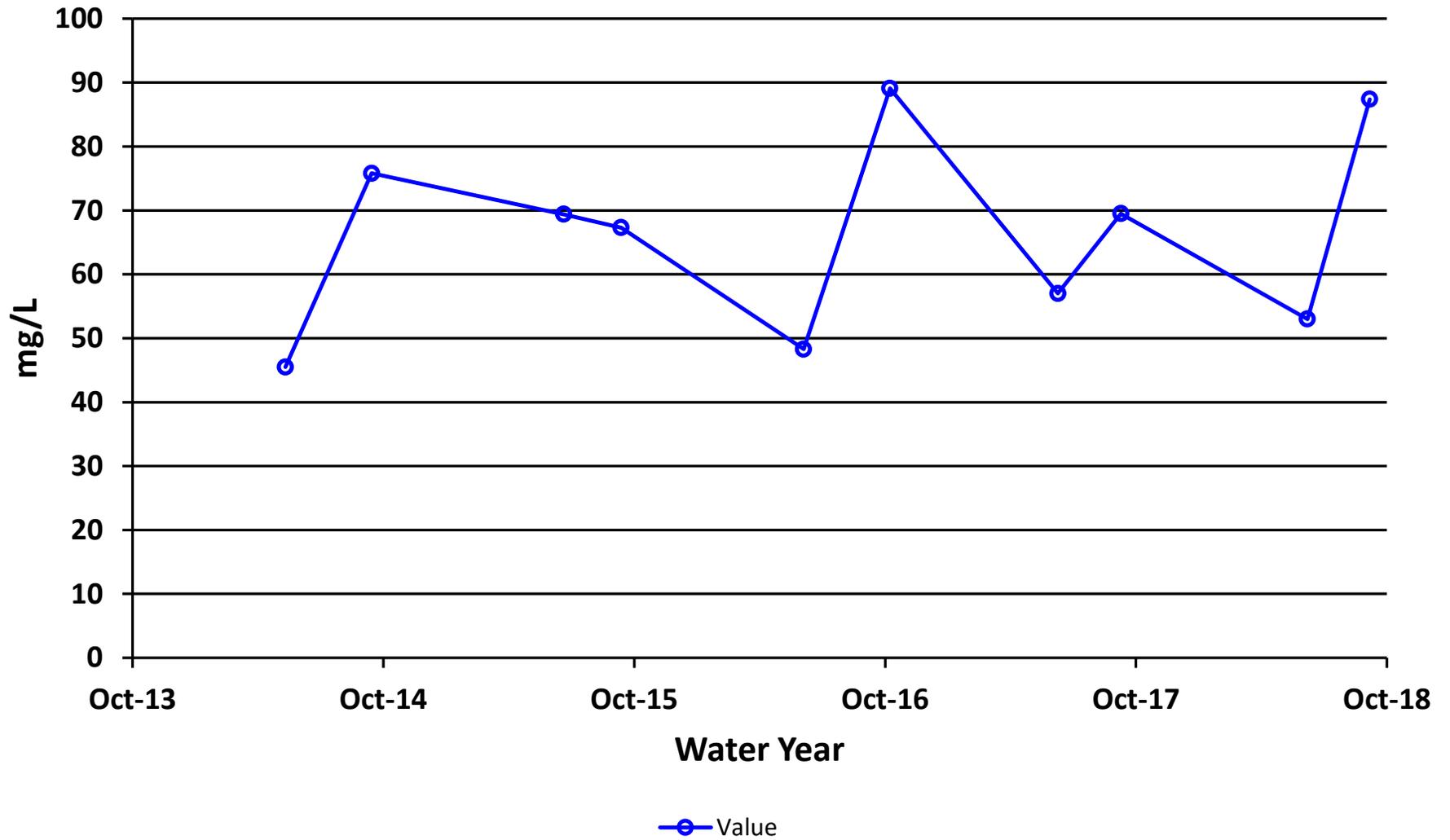
Site 712 - Alkalinity



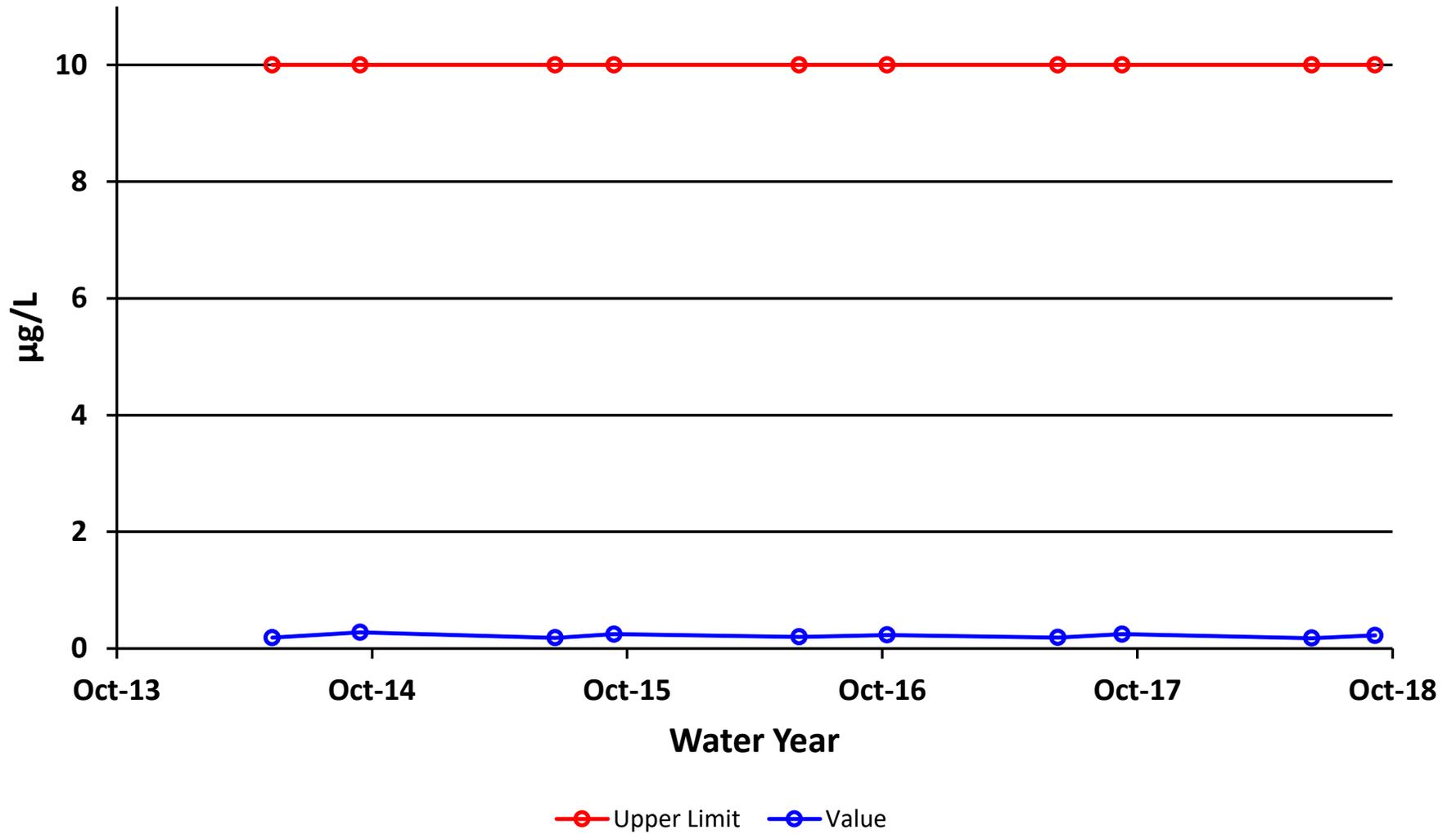
Site 712 - Sulfate



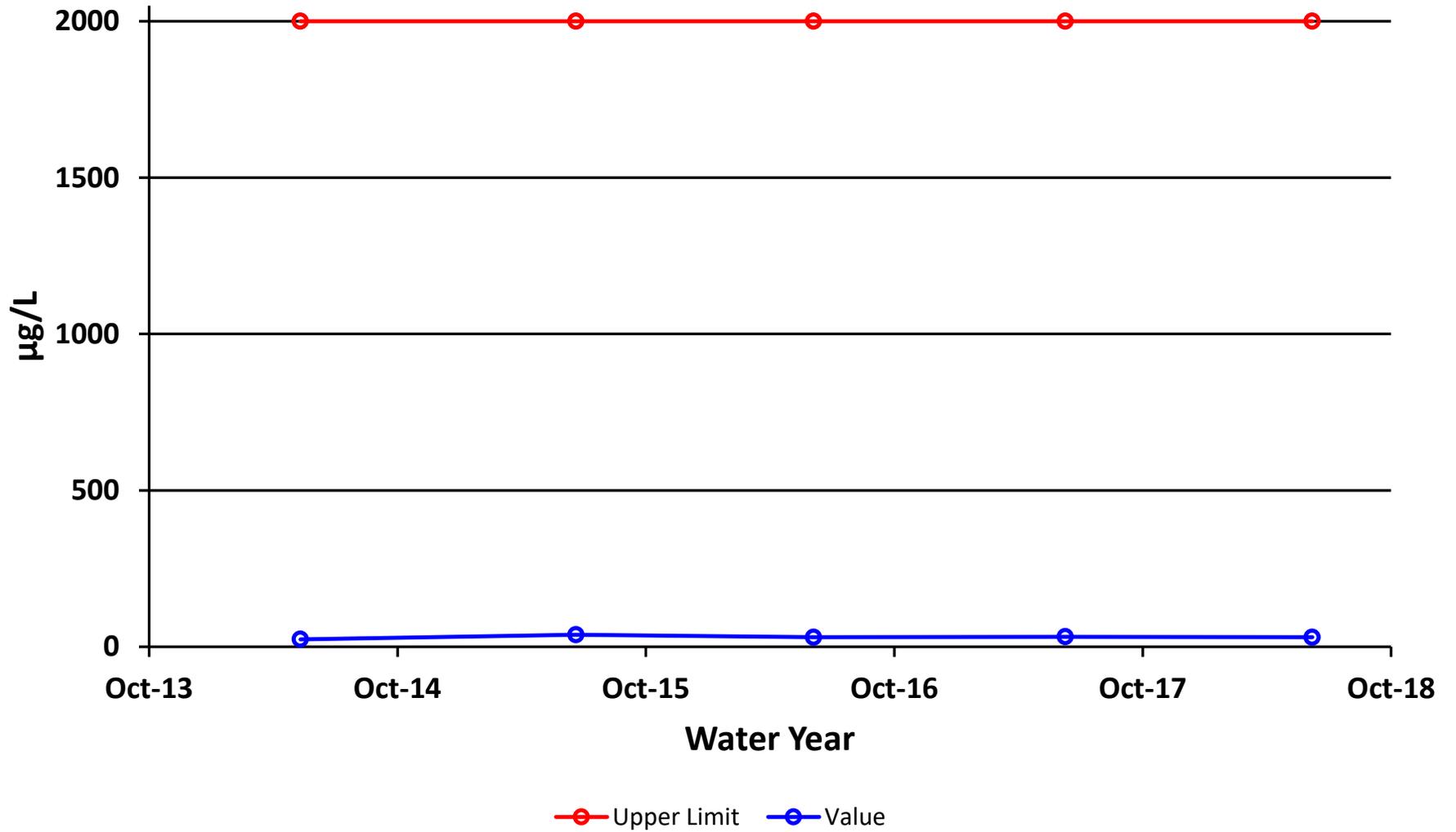
Site 712 - Hardness



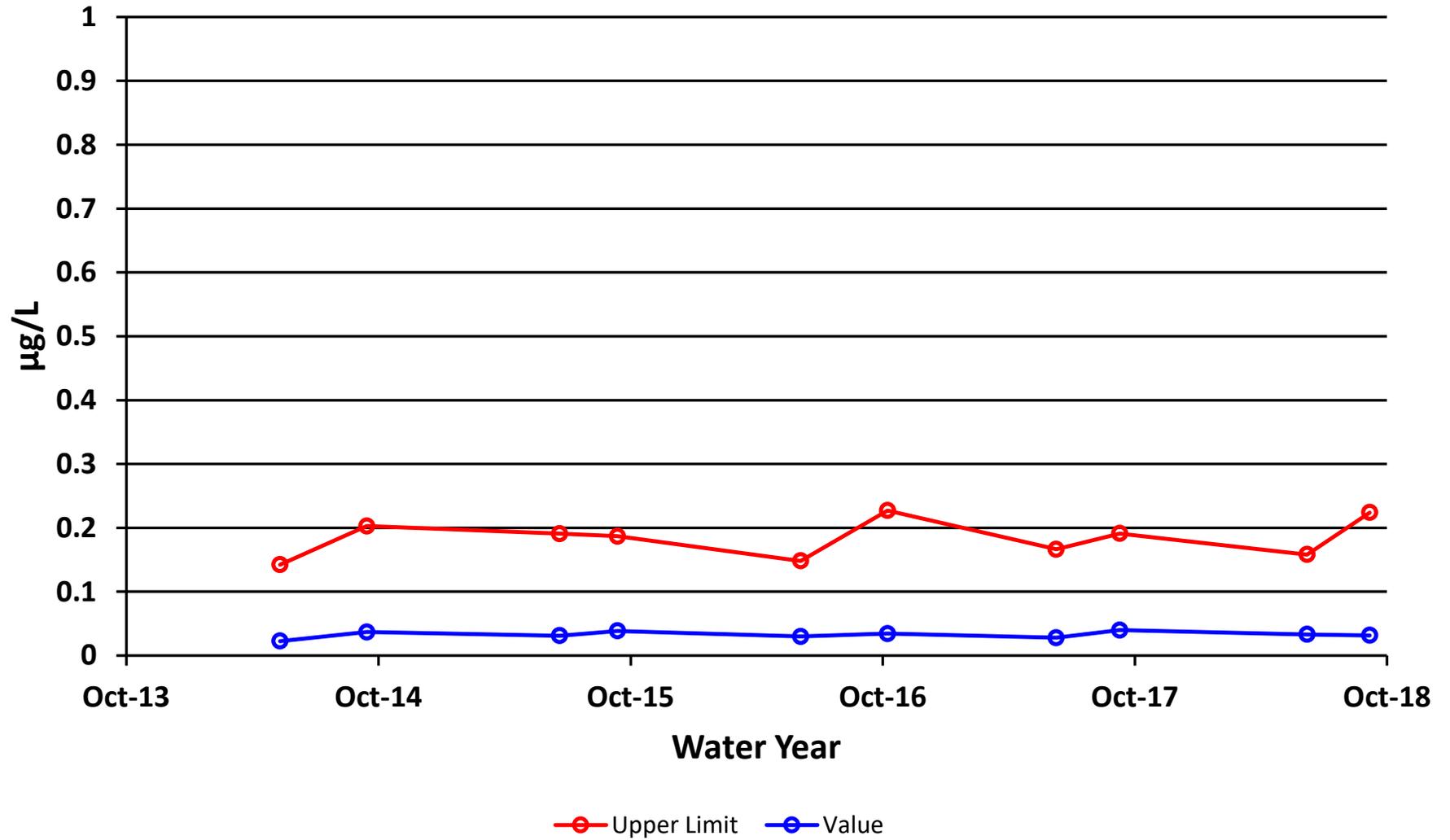
Site 712 - Arsenic Dissolved



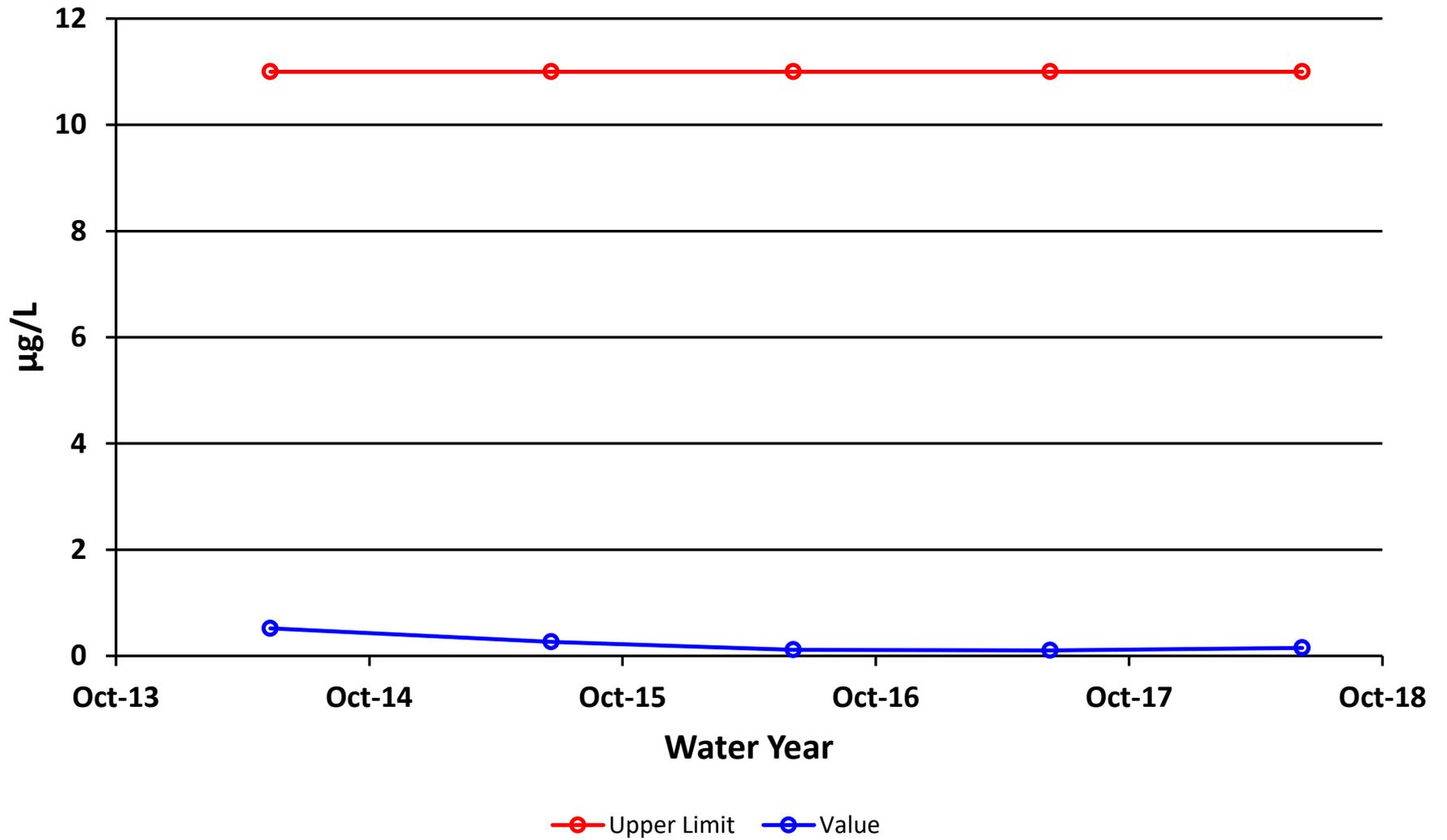
Site 712 - Barium Dissolved



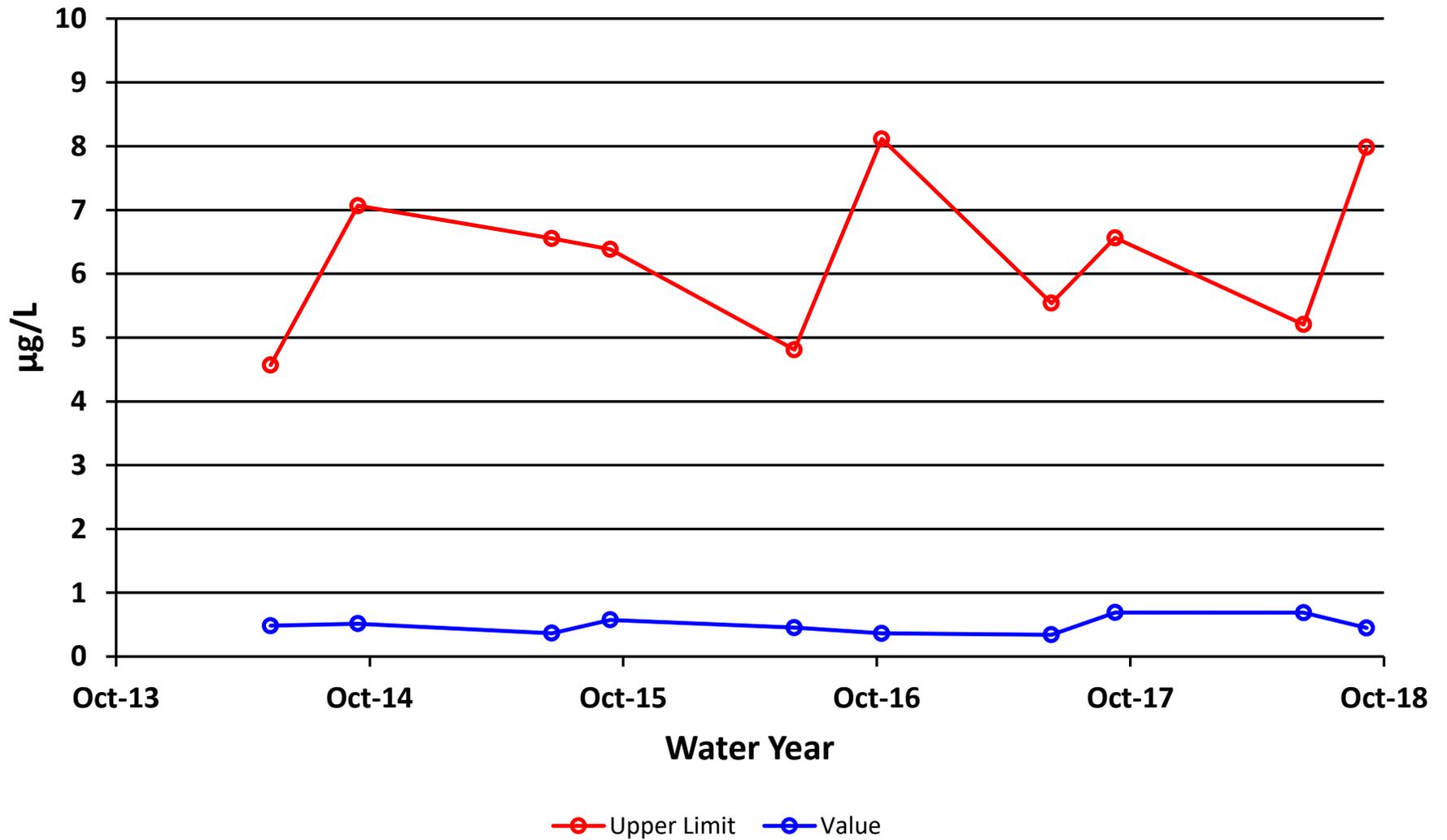
Site 712 - Cadmium Dissolved



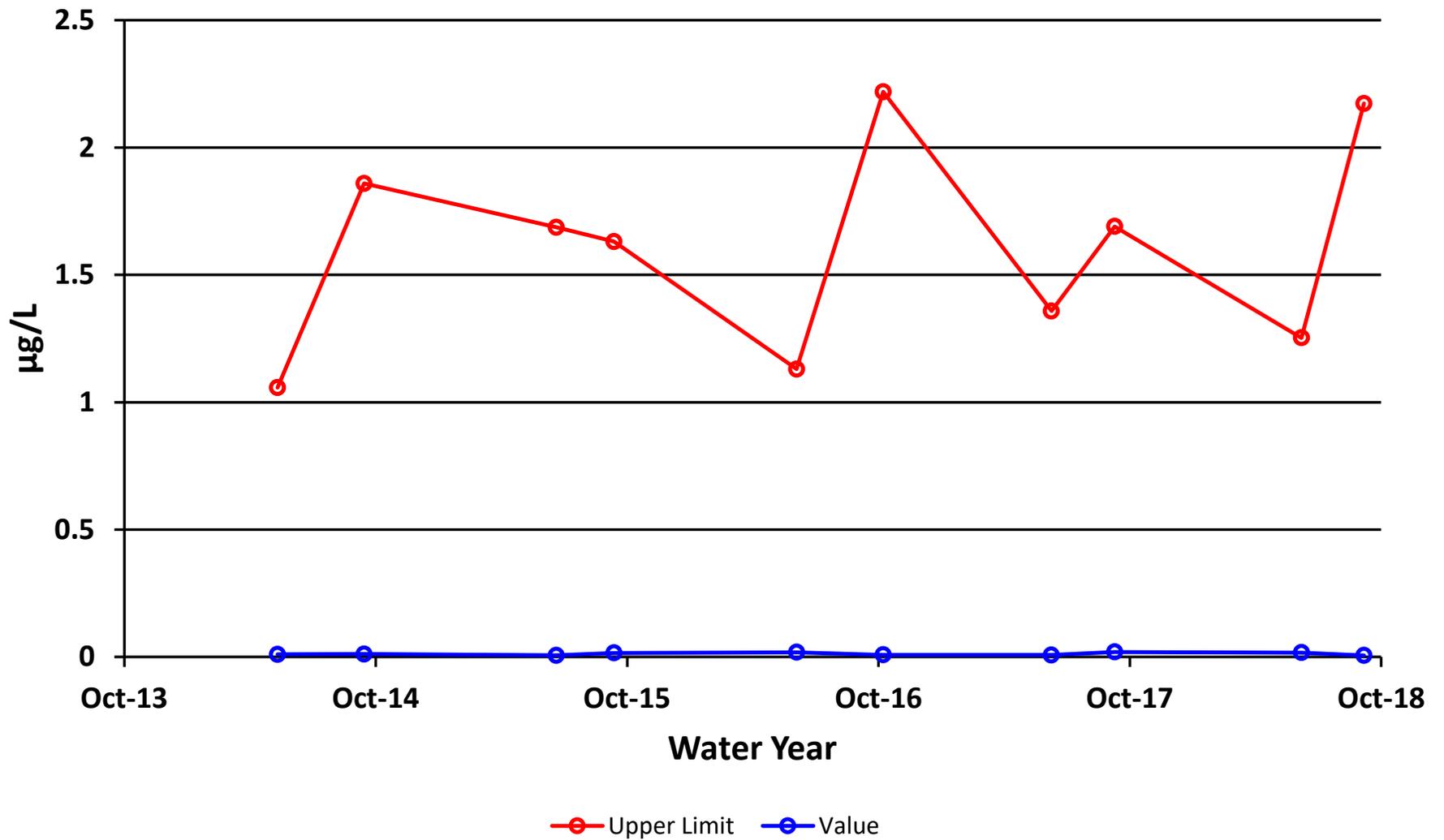
Site 712 - Chromium Dissolved



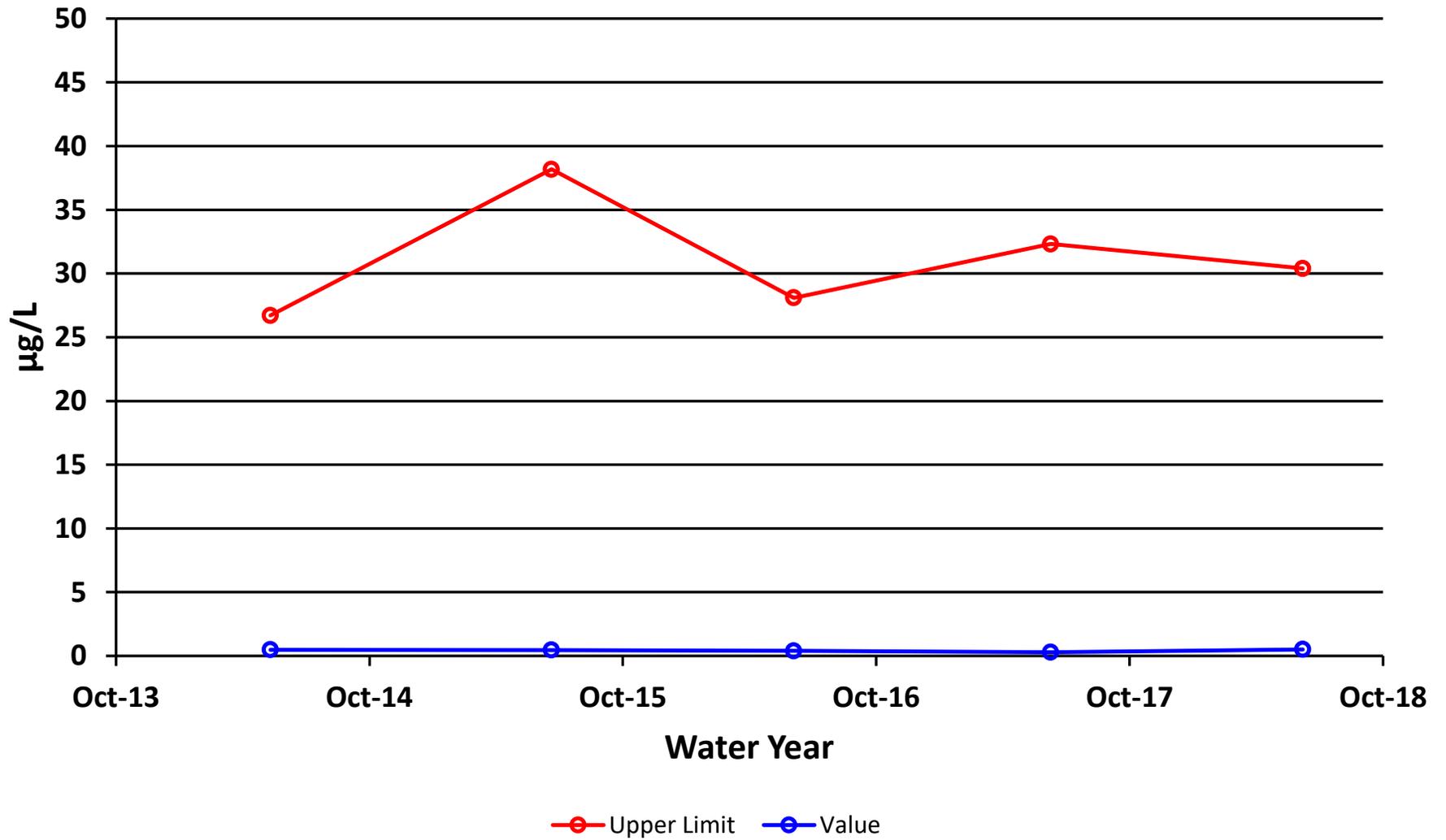
Site 712 - Copper Dissolved



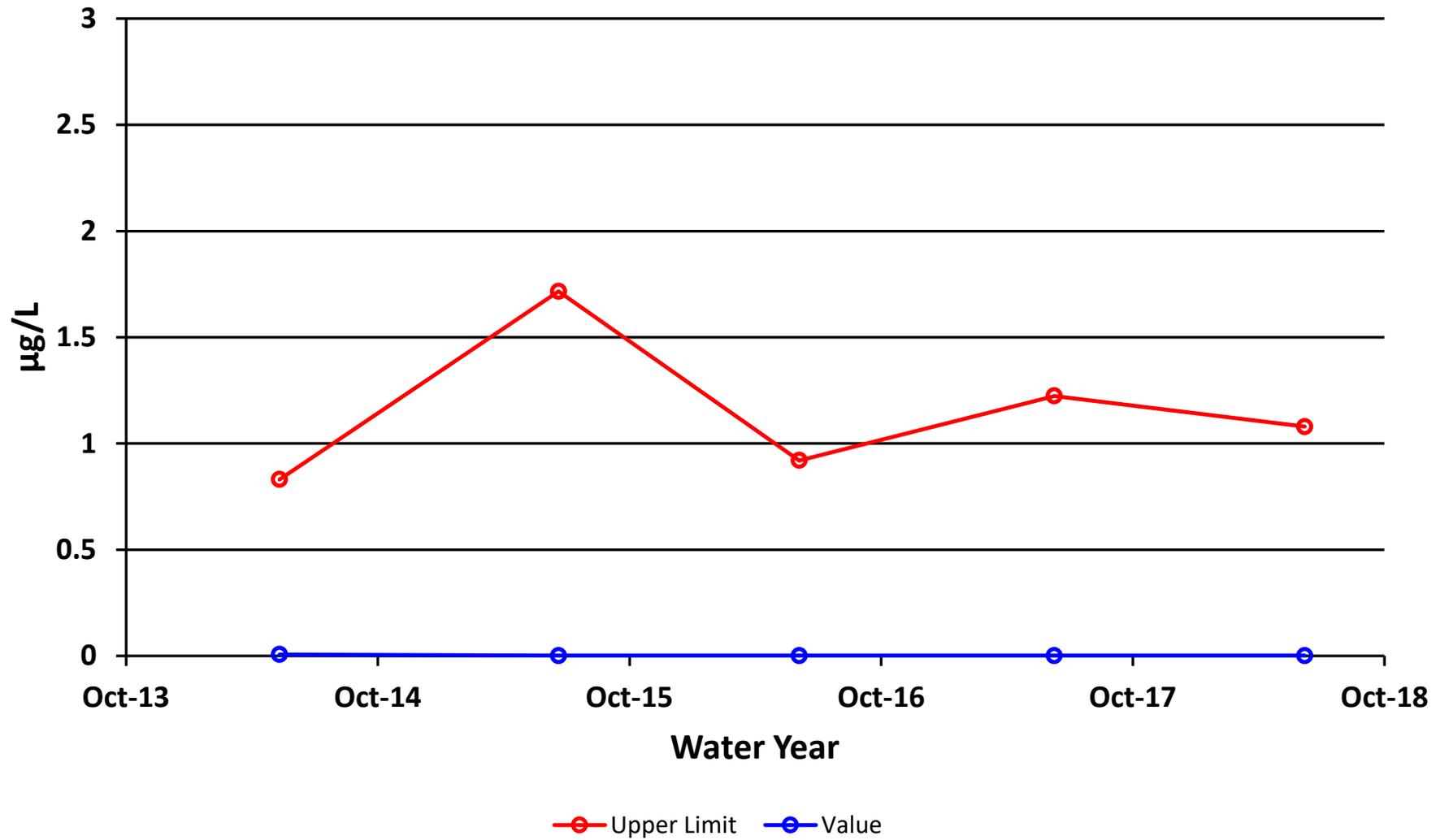
Site 712 - Lead Dissolved



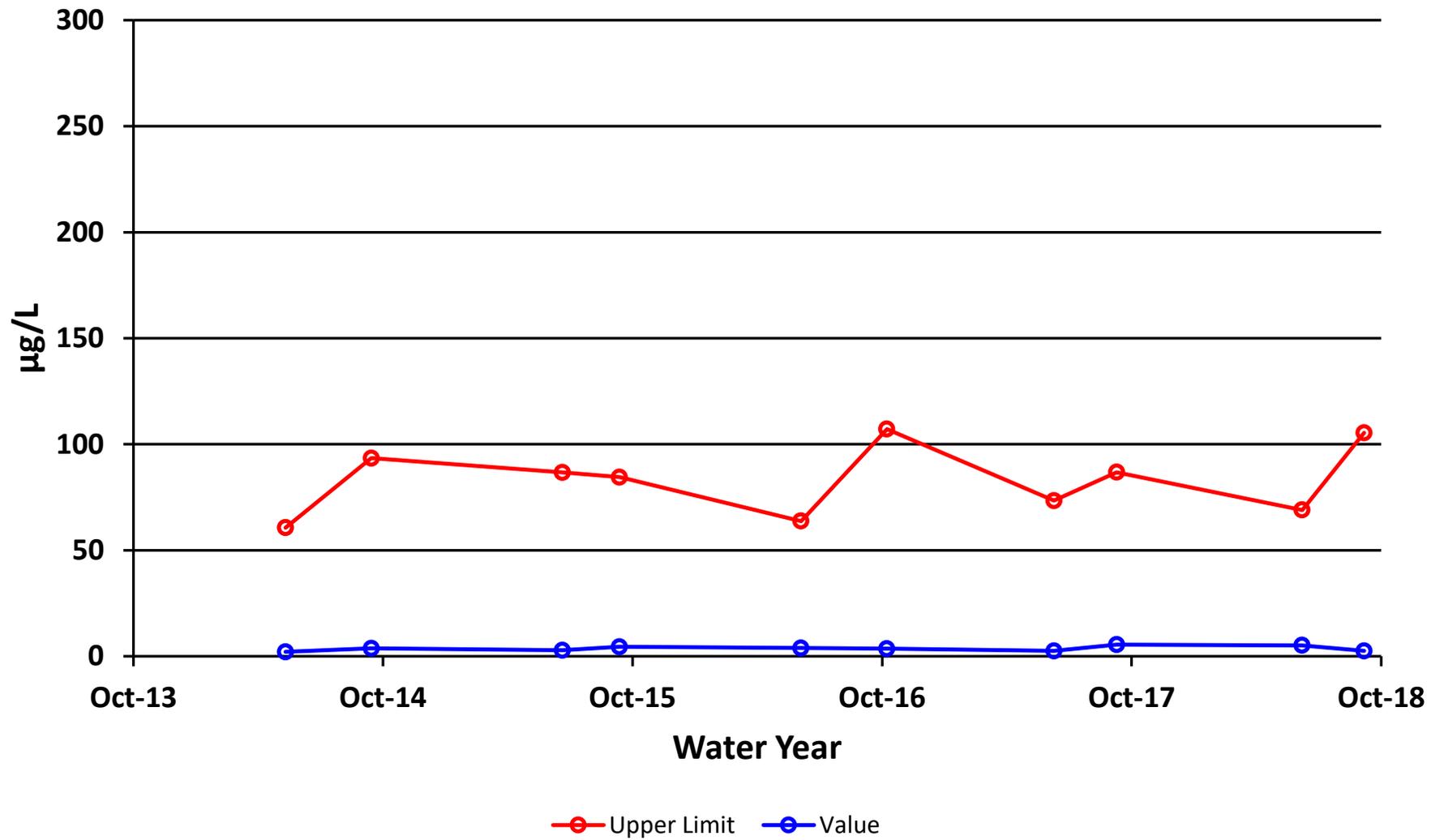
Site 712 - Nickel Dissolved



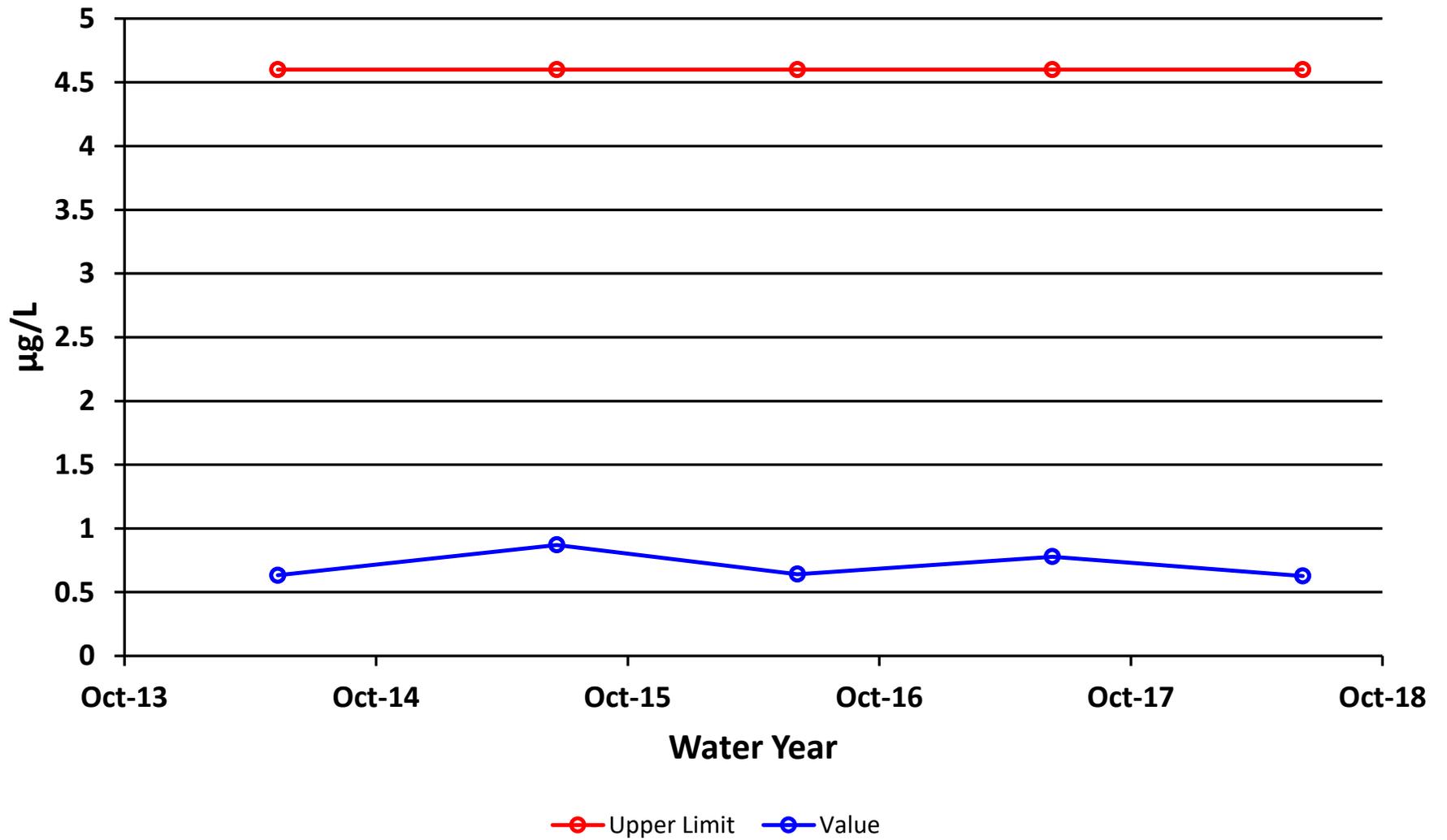
Site 712 - Silver Dissolved



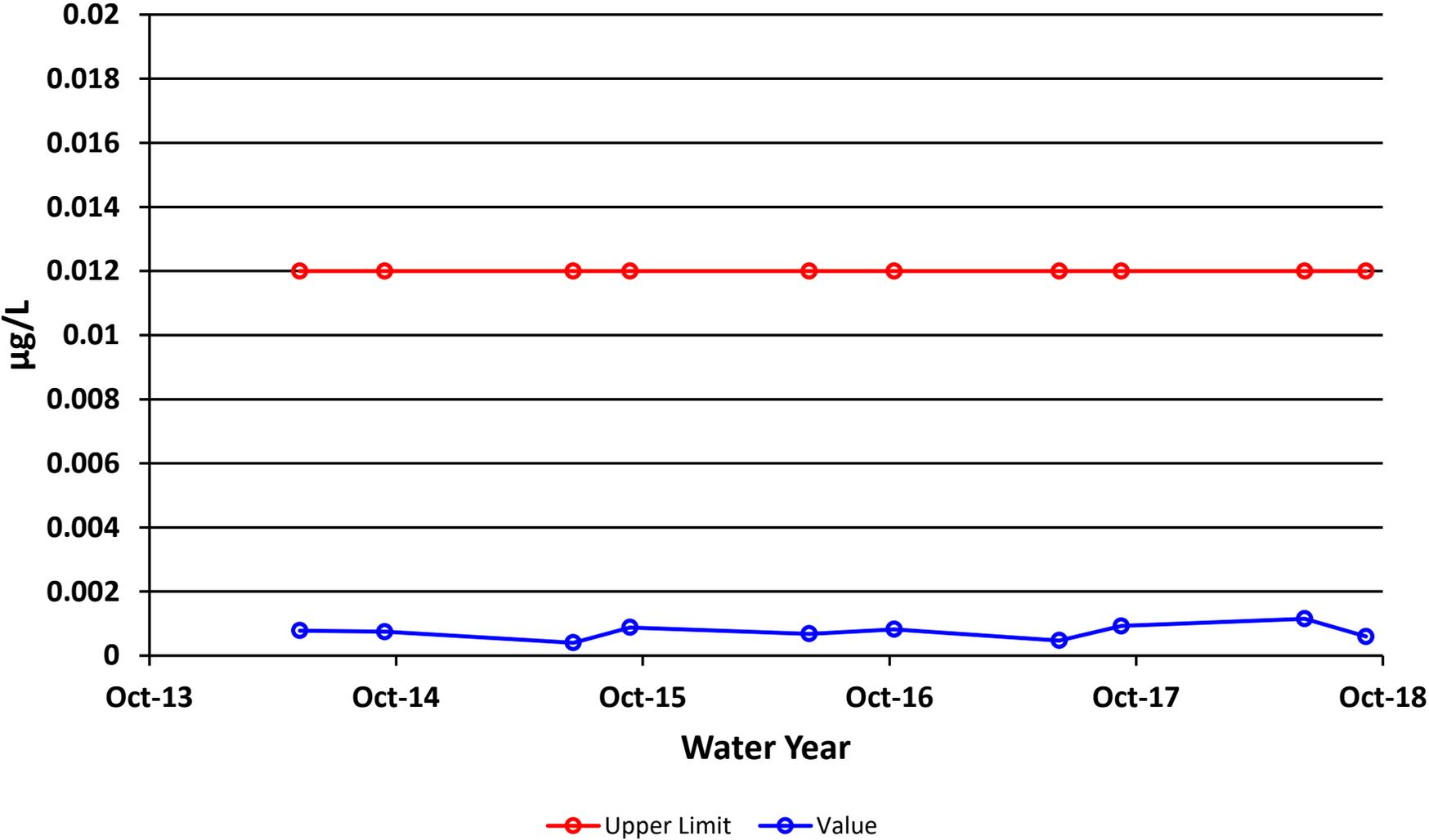
Site 712 - Zinc Dissolved



Site 712 - Selenium Dissolved



Site 712 - Mercury Dissolved



APPENDIX A

Parameter	Drinking Water	Stockwater	Irrigation Water	Aquatic Life-Fresh Water								Human Health Criteria for NonCarcinogens		
				Acute				Chronic				Water + Aquatic Organisms	Aquatic Organisms Only	
				criteria	as	multiply by conversion factor	to convert to	criteria	as	multiply by conversion factor	to convert to			
alkalinity										20,000 minimum				
As	10	50	100	340	TR	1	D	150	TR	1	D			
Ba	2,000													
Cd	5	10	10	$e^{1.0166(\ln \text{hardness})-3.924}$	TR	$1.136672-[(\ln \text{hardness})(0.041838)]$	D	$e^{0.7409(\ln \text{hardness})-4.719}$	TR	$1.101672-[(\ln \text{hardness})(0.041838)]$	D			
Cr	100													
Cr(total)			100											
Cr(III)				$e^{0.819(\ln \text{hardness})+3.7256}$	TR	0.316	D	$e^{0.819(\ln \text{hardness})+0.6848}$	TR	0.860	D			
Cr(VI)		50		16	D			11	D					
Cu			200	$e^{0.9422(\ln \text{hardness})-1.700}$	TR	0.960	D	$e^{0.8545(\ln \text{hardness})-1.702}$	TR	0.960	D	1,300		
Pb		50	5,000	$e^{1.273(\ln \text{hardness})-1.460}$	TR	$1.46203-[(\ln \text{hardness})(0.145712)]$	D	$e^{1.273(\ln \text{hardness})-4.705}$	TR	$1.46203-[(\ln \text{hardness})(0.145712)]$	D			
Hg	2			1.4	D			0.012	TR			0.05	0.051	
Ni	100		200	$e^{0.846(\ln \text{hardness})+2.255}$	TR	0.998	D	$e^{0.846(\ln \text{hardness})+0.0584}$	TR	0.997	D	610	4,600	
Se	50	10	20	$1/[(\text{selenite})/185.9+(\text{selenate})/12.83]$	TR	0.922	D	5	TR	0.922	D	170	11,000	
Ag				$e^{1.72(\ln \text{hardness})-6.52}$	TR	0.850	D							
Zn			2,000	$e^{0.8473(\ln \text{hardness})+0.884}$	TR	0.978	D	$e^{0.8473(\ln \text{hardness})+0.884}$	TR	0.986	D	9,100	69,000	

all units in micrograms per liter (ug/L)

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

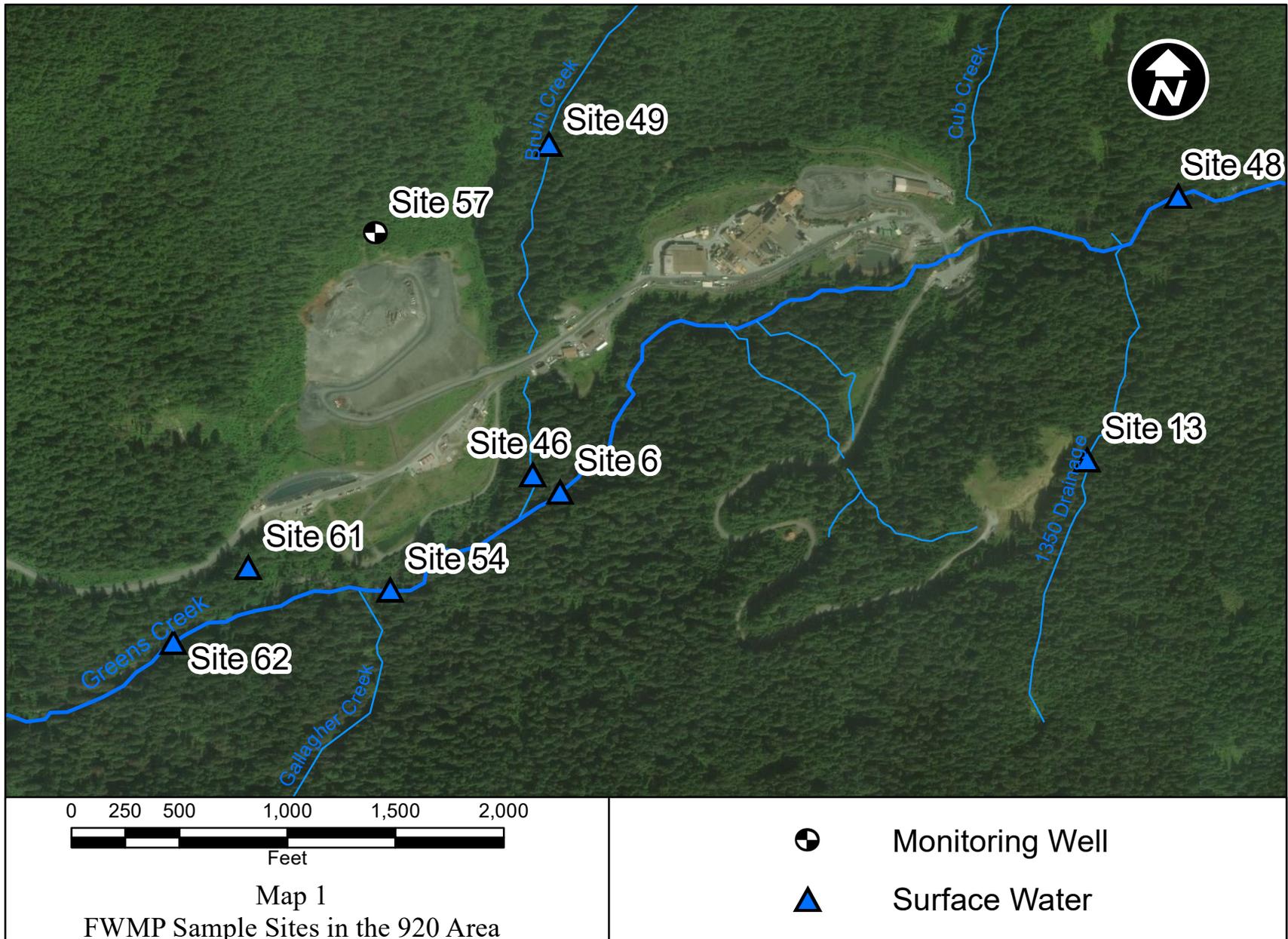
DENOTES STRICTEST CRITERIA

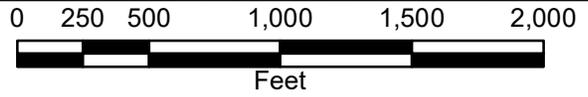
Source: <http://www.dec.state.ak.us/water/wqsar/wqs/toxicsbook.xls>
Table formatting was modified by HGCMC to include only parameters include in Suite P and Q and to highlight the strictest standard.

APPENDIX B

Map Sheets

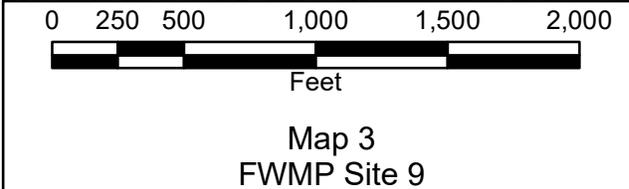
Map 1-920 Area FWMP Sites
Map 2-Tailings Area FWMP Sites
Map 3-Site 9, Tributary Creek





-  Monitoring Well
-  Surface Water

Map 2
FWMP Sample Sites in the Tailings Area



	Monitoring Well
	Surface Water