FRESH WATER MONITORING PROGRAM
ANNUAL REPORT

WATER YEAR 2017

(October 1, 2016 through September 30, 2017)

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

EXECUTIVE SUMMARY

This annual report has been prepared by Hecla Greens Creek Mining Company (HGCMC) in accordance with the 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, Site 6, Site 54, and Site 62) or the one floodplain monitoring site (Site 61) during Water Year 2017.

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 substantial reduction in zinc and cadmium concentrations in 2017 is attributed to installation of the collection system and natural attenuation of the stored metal load in the reclaimed area. HGCMC has no additional work planned for the 1350 reclamation, but will continue to monitor the area as it stabilizes and matures.

No exceedances of AWQS were recorded for Bruin Creek, during Water Year 2017; monitored at the up-gradient Site 49 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, low alkalinity, and elevated levels of lead. The shallow wells (Site 27, Site 29, and Site 32) continued to express the natural condition of low pH and low alkalinity that characterize these sites located in organic rich peat sediments. One exceedance for dissolved lead occurred at Site 32. The exceedance continues the recent history of low to moderate levels of lead that may in part be due to minor amounts of tailings escaping the facility due to fugitive dust or tracking. HGCMC has been and will continue to improve best management practices to minimize fugitive dust and tracking.

Site 60 had exceedances for low alkalinity, low pH, and elevated mercury. 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 (0.016 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 alkalinity values are expected given the naturally occurring acidic muskeg conditions in the headwaters near Site 27 and Site 29. Site 609 west of the facility had no exceedances in 2017.

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, increasing trend in pH, decreasing trend in dissolved zinc; Site 6, upward trend in pH; Site 54, upward trend in pH, downward trend in dissolved zinc; Site 46, upward trend in pH; Site 13, decreasing trend in conductivity and dissolved zinc. Site 60, upward trend in total sulfate; Site 27, upward trend in total alkalinity and conductivity; Site 9, decreasing trend in dissolved zinc.

Site 48 is considered an up-gradient control site, the trends are a result of natural variation potentially being driven by large scale meteorological conditions. The Greens Creek sites (Site 48, Site 6, and Site 54) had similar low magnitude increasing trends in pH. Though this is an increasing trend the similar magnitude of increase across the three sites, including an upgradient background site, indicates natural variation.

A non-parametric comparison of medians was performed for all the appropriately paired surface sites (48-6, 6-54, 54-62). Significant differences were noted for the paired datasets from Greens Creek (48-6) for conductivity, total sulfate, and dissolved zinc. These differences have all been noted in previous annual reports and do not appear to be increasing in magnitude. There were significant differences for the paired dataset (48-6) from Greens Creek for conductivity, dissolved zinc, total sulfate and total alkalinity. Paired sites 6-54 showed significant differences for 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 west of Pond 7. Both of these 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 current 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 2017 (October 1, 2016 through September 30, 2017 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 2017 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 2017.

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

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

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

Statistical Tests

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

The advantages of the Seasonal Kendall trend test is that it is a rank-based procedure especially suitable for non-normally distributed data, censored data, data containing outliers and non-linear trends. The null hypothesis (H_0) states that the data(x_1, ., x_n) are a sample of n independent and identically distributed random variables. The trend test statistic Z is used as a measure of trend magnitude, or of its significance. A positive Z value indicates an upward trend while a negative value indicates a downward trend. However, the Z statistic is not a direct quantification of trend magnitude. For trend of significant magnitude a separate statistic, Sen's slope estimator, is calculated by computing the seasonally adjusted (monthly) median value for the slope. For datasets which fail the homogeneity test, individual monthly S_k statistics are compared to a theoretical probability distribution of S derived by Mann and Kendall (Table A18 in Gilbert, 1987). Statistically significant trends ($\alpha/2 = 0.025$) are noted for p-values >0.974 or <0.026. Further guidance and background on these statistical methods can be found in Gilbert (1987) or Helsel and Hirsch (1992).

The Wilcoxon signed-rank test is used to determine if the median difference between paired data points is equal to zero. In general terms the signed-rank is used to determine if a set of paired data observations, x's and y's, come from the same population (i.e. have the same median) or as the alternative hypothesis differ only in the location of the central value (median). If the data are from the same population then the differences of the paired data should be equally distributed around 0, or about half the differences should be greater than 0 and half should be less than 0. Computationally the test is straight forward. First the differences $D_i=x_i-y_i$,i=1…N are computed for each pair. The absolute values of the differences $|D_i|$, i=1…N are ranked from smallest to largest and data pairs that are tied, thus having differences of zero, are ignored. The ranks of the absolute differences are assigned the sign of the actual differences. For example, negative differences have negative-signed ranks and positive differences have positive-signed ranks thus the term "signed-rank" in the method name. The test statistic W^+ is the sum of all positively signed ranks. The statistic W^+ is then compared to tabled values that vary based on N. The one-tailed version of the signed-rank test has been applied to the key indicator analytes of conductivity, pH, total alkalinity, sulfate, and dissolved zinc as listed in the table below. For a significant difference to be noted, the difference must be in the direction indicated in the table and at a significance level of α=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 buffing capacity due to H^+ produced by pyrite oxidation, associated with waste rock.	>0	X's > Y's	$W^+(calc)>W(table)_{\alpha,n}$
Total Alkalinity	Total alkalinity **increase** by the weathering of carbonate mineralogy, associated with tailings	<0	X's < Y's	$W^+(calc)<W(table)_{\alpha,n}$
Total Sulfate	Total sulfate **increases** due to oxidation of sulfides	<0	X's < Y's	$W^+(calc)<W(table)_{\alpha,n}$
Dissolved Zinc	Dissolved zinc **increases** due to sulfide oxidation and is more readily soluble at neutral pH than other metals.	<0	X's < Y's	$W^+(calc)<W(table)_{\alpha,n}$

X: Upgradient Site

Y: Downgradient Site

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

Qualified Data by QA Reviewer - QA reports provide a summary for each site section of data limitations found in the monthly QA reviews. They list all data for that site that was qualified by the QA Reviewer for Water Year 2017 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 2017. Results of any visual data analyses to detect effects of these interventions are also indicated.

Prior interventions (and negotiated mid-year program modifications such as changes to laboratories, methods, detection limits, and reporting limits), and anything else which may affect data comparability and quality which occurred during previous Water Years, are documented in the "General History" section of the FWMP and in previous annual reports.

MID-YEAR MODIFICATIONS

There were no mid-year modifications.

GENERAL HISTORY

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

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

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

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

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

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

FWMP SAMPLE LOG

2017 Water Year October 2016 Through September 2017
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		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	P								Q			P
712	712FMS	Greens Creek Below Site E	P								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**

(yellow)	Sample not taken
(blue)	Off schedule sample
(white)	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

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Edward Gazzetti
Richard Dudek

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Kate Kanouse
Jackie Timothy
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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
609	Further Creek – Lower	58°07’05.707” N	134°45’06.332” W
61	Greens Creek Floodplain	58°04’43.480” N	134°38’52.910” W
62	Greens Creek Lower Than 54	58°04’38.650” N	134°39’06.000” W
711	Greens Creek Above Site E	58°04’08.425” N	134°43’27.181” W
712	Greens Creek Below Site E	58°04’13.858” N	134°43’42.438” W

PROPOSED PROGRAM MODIFICATIONS

HGCMC is not proposing changes to the FWMP during the 2018 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 2017" report. The table includes all the required FWMP analyte data (field and laboratory) collected for the current water year and a series of flags keyed to the summary report "Qualified Data by QA Reviewer". The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of ½ MDL for the purpose of median calculation.

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

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

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

Table of Exceedance for Water Year 2017

			Limits		
Sample Date	**Parameter**	**Value**	**Lower**	**Upper**	**Hardness**
No exceedances have been identified by HGCMC for the period of October 2016 through September 2017.					

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-11 and Sep-17 (WY2012-WY2017).

Table of Summary Statistics for Trend Analysis

	Mann-Kendall test statistics			Sen's slope estimate	
Parameter	**n***	**p****	**Trend**	**Q**	**Q(%)**
Conductivity Field	6	0.93			
pH Field	6	0.98	+	0.03	0.4
Alkalinity, Total	6	Rejected			
Sulfate, Total	6	0.44			
Zinc, Dissolved	6	<0.01	-	-0.22	-6.9

* Number of Years ** Significance level

For datasets with a statistically significant trend ($\alpha/2=2.5\%$) a Seasonal-Sen's Slope estimate statistic has also been calculated. For the current water year field pH has a slope estimate of 0.03 su/year, which is slightly less than the Sen's Slope estimates reported over the past few years. Dissolved zinc had a slope estimate of -0.22 µg/l/year. Alkalinity failed the homogeneity test and was therefore rejected for annualized trend analysis.

Table of Results for Water Year 2017

Site 048FMS - 'Upper Greens Creek'

Sample Date/Parameter	Oct 2016	Nov 2016	Dec 2016	Jan 2017	Feb 2017	Mar 2017	Apr 2017	May 2017	Jun 2017	Jul 2017	Aug 2017	Sep 2017	**Median**
Water Temp (°C)	2.8	5.1	0.70	0.7	0.40	0.3	1	3.2	4.9	7.4	9.3	7.6	3.00
Conductivity-Field(μmho)	147.5	79.8	133	148.8	106	154.6	104.6	105.8	96.2	100.2	140.6	115.1	110.6
Conductivity-Lab (μmho)	146	77	138	149	100	152	106	101	94	101	129	117	112
pH Lab (standard units)	7.64	7.49	7.42	7.48	7.25	7.4	7.56	7.49	7.38	7.42	7.39	7.48	7.45
pH Field (standard units)	7.99	7.78	7.99	7.87	7.5	7.72	7.91	7.97	7.86	7.88	7.98	7.94	7.90
Total Alkalinity (mg/L)	57.2	31.3	53.3	55	38.2	56.8	41.2	42	41.3	40	50	44.4	43.2
Total Sulfate (mg/L)	17	6.2	15.6	17.7	10.8	18.6	11.1	9.7	9.2	10	15.3	11.1	11.1
Hardness (mg/L)	69	36.2	65.9	72.9	48.3	71.4	50.3	48.6	46	47.6	59.9	57.2	53.8
Dissolved As (ug/L)	0.212	0.225	0.193	0.194	0.189	0.201	0.192	0.177	0.218	0.227	0.237	0.249	0.207
Dissolved Ba (ug/L)			28.8		19.6								24.2
Dissolved Cd (ug/L)	0.0327	0.0228	0.0269	0.0303	0.0371	0.0317	0.027	0.0239	0.0263	0.0282	0.0313	0.0337	0.0293
Dissolved Cr (ug/L)			0.063		0.125								0.094
Dissolved Cu (ug/L)	0.249	0.552	0.293	0.289	0.837	0.271	0.667	0.443	0.192	0.29	0.267	0.411	0.292
Dissolved Pb (ug/L)	0.0029	0.0118	0.0015	0.0052	0.0281	0.0104	0.0082	0.006	0.0015	0.0015	0.0015	0.0044	0.0048
Dissolved Ni (ug/L)			0.234		0.43								0.332
Dissolved Ag (ug/L)			0.002		0.002								0.002
Dissolved Zn (ug/L)	2.42	1.64	2.02	2.29	3.74	2.63	2.21	1.92	1.76	2.01	1.81	3	2.12
Dissolved Se (ug/L)			0.953		0.69								0.822
Dissolved Hg (ug/L)	0.000398	0.00157	0.000505	0.000521	0.00276	0.000477	0.00148	0.000841	0.00038	0.000546	0.000417	0.000669	0.000534

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

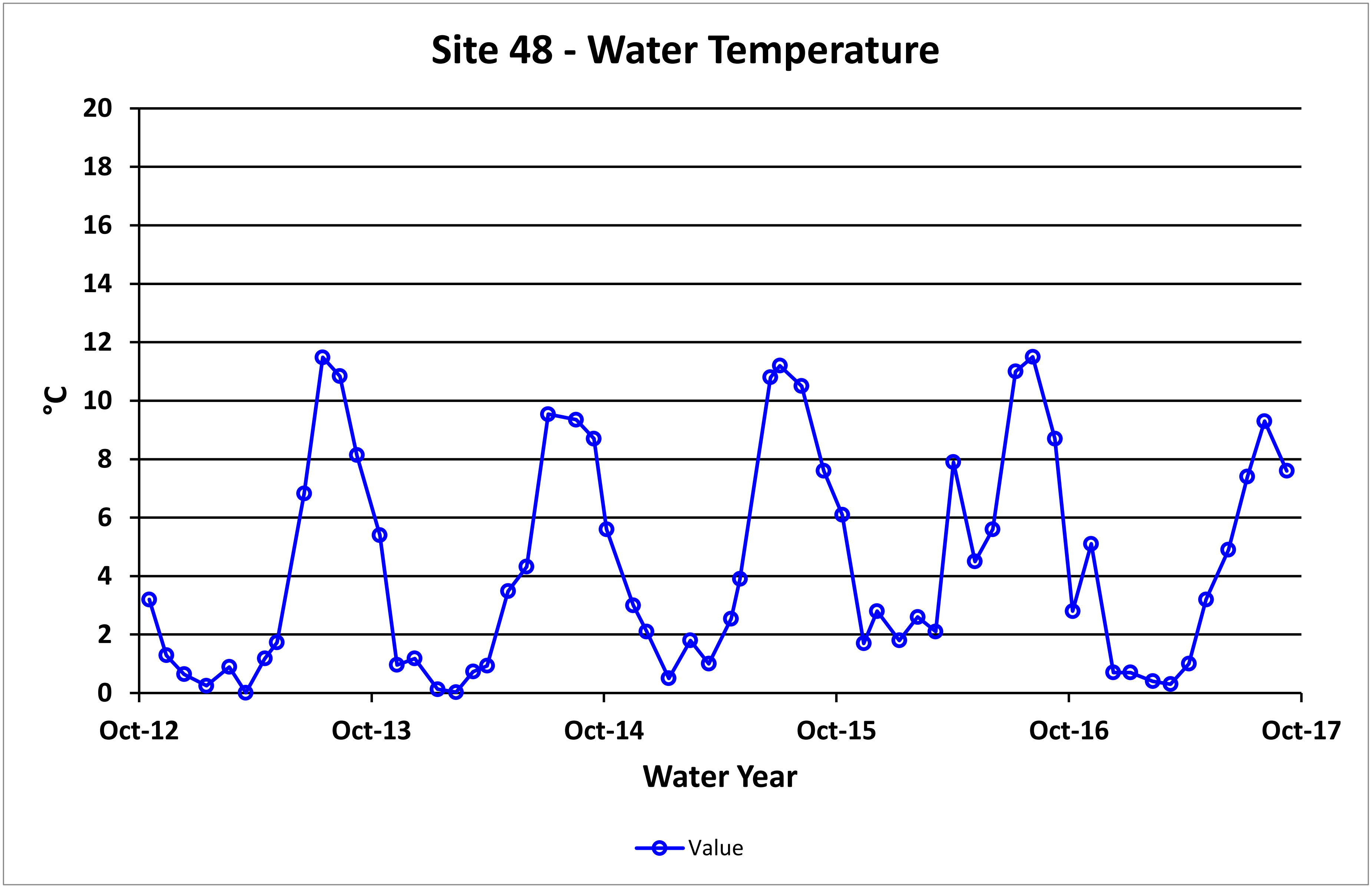
Values reported as less than MDL are replaced by 1/2 MDL for median calculation purposes.

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

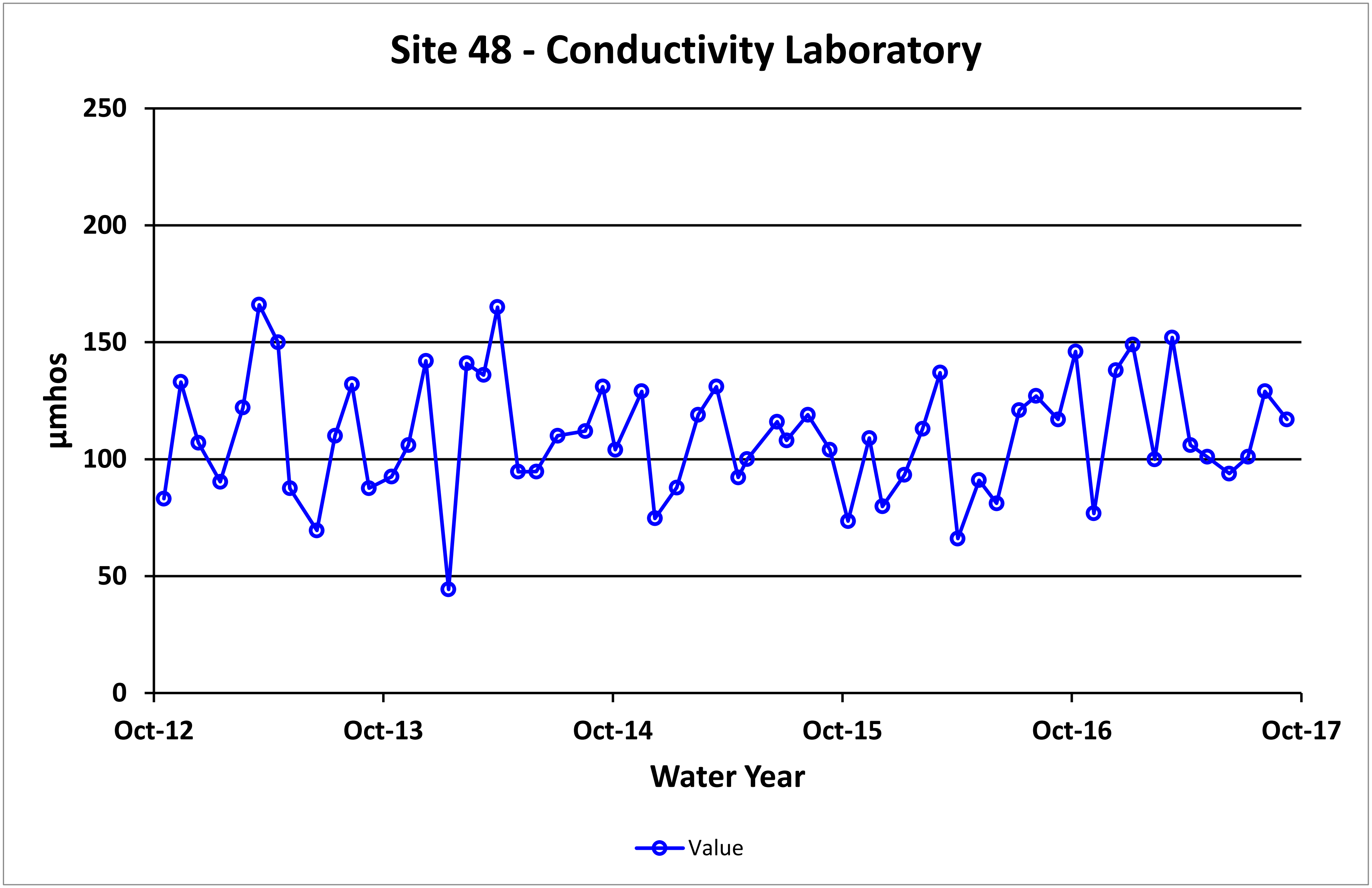
Qualified Data by QA Reviewer

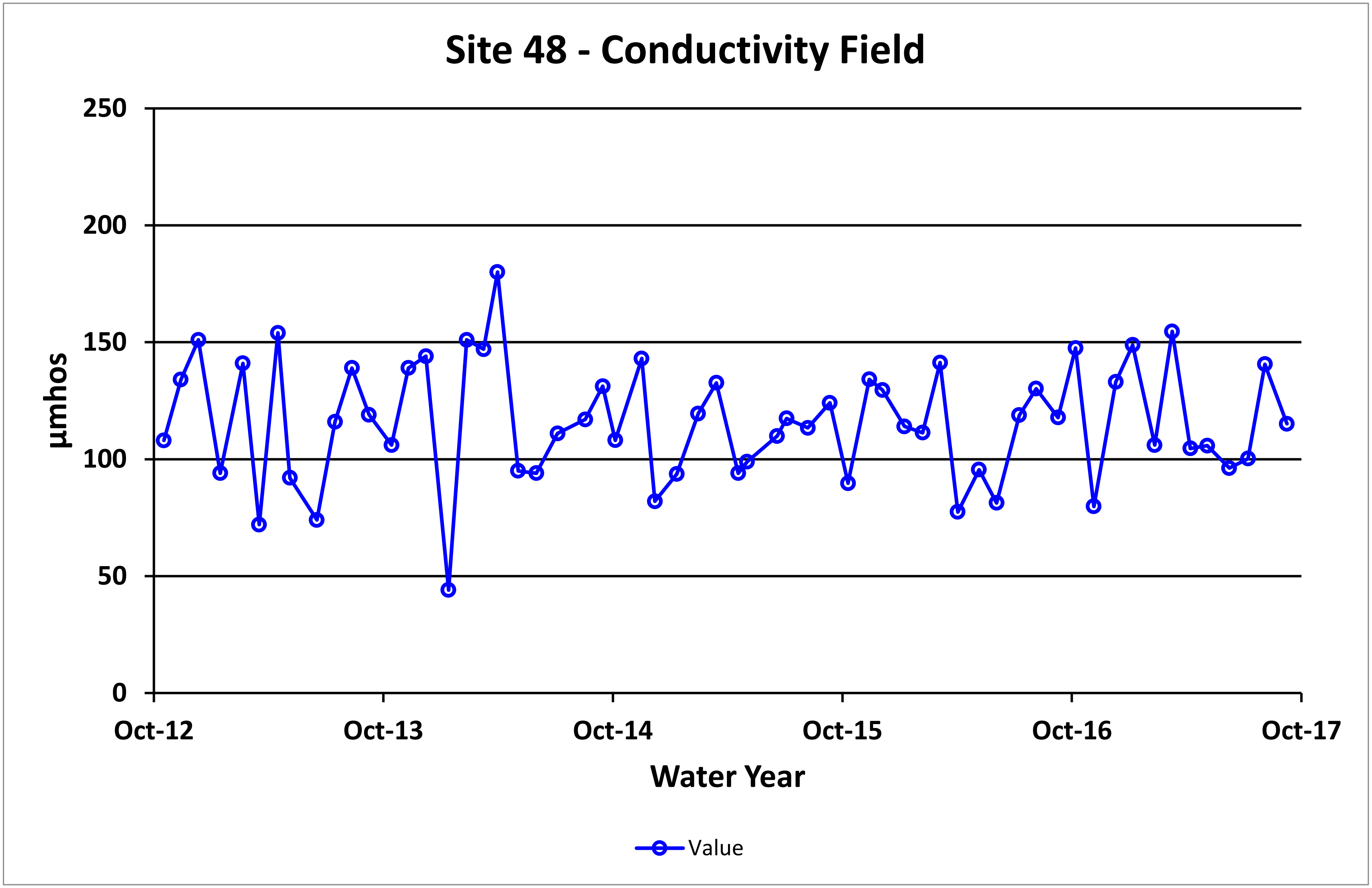
Date Range: 10/01/2016 to 09/30/2017

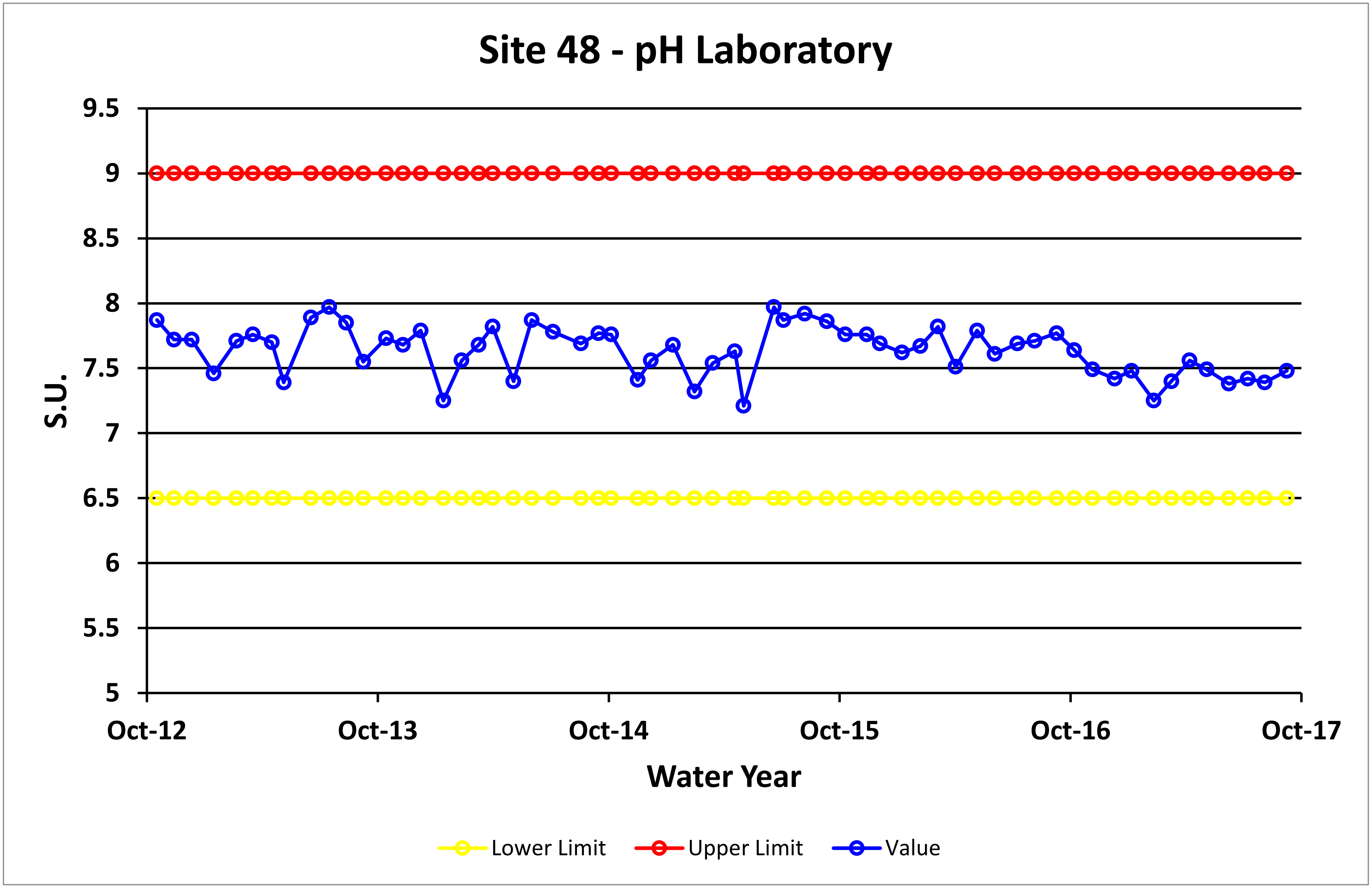
Site No.	Sample Date	Sample Time	Parameter	Value		Qualifier	Reason for Qualifier
048FMS	10/10/2016	12:00 PM	Diss. Pb-ICP/MS	0.00285	µg/L	J	Below Quantitative Range
	12/13/2016	12:00 PM	Diss. Cr-ICP/MS	0.06	µg/L	J	Below Quantitative Range
	1/9/2017	12:00 PM	Diss. Pb-ICP/MS	0.00523	µg/L	J	Below Quantitative Range
	2/13/2017	12:00 PM	Diss. Cr-ICP/MS	0.12	µg/L	J	Below Quantitative Range
	4/11/2017	12:00 PM	Diss. Pb-ICP/MS	0.0082	µg/L	J	Below Quantitative Range
	5/8/2017	12:00 PM	Diss. Hg-CVAF	0.000841	µg/L	U	Trip Blank Contamination
			Diss. Pb-ICP/MS	0.00595	µg/L	J	Below Quantitative Range
			Tot. Sulfate	9.7	mg/L	J	Sample Receipt Temperature
	6/12/2017	12:00 PM	Diss. Cu-ICP/MS	0.19	µg/L	U	Field Blank Contamination
			Diss. Zn-ICP/MS	1.76	µg/L	U	Field Blank Contamination
			Tot. Sulfate	9.15	mg/L	J	Hold Time Violatoin, Sample Receipt Temperature
	8/8/2017	12:00 PM	Tot. Sulfate	15.3	mg/L	J	Sample Receipt Temperature
	9/12/2017	12:00 PM	Diss. Pb-ICP/MS	0.00435	µg/L	J	Below Quantitative Range



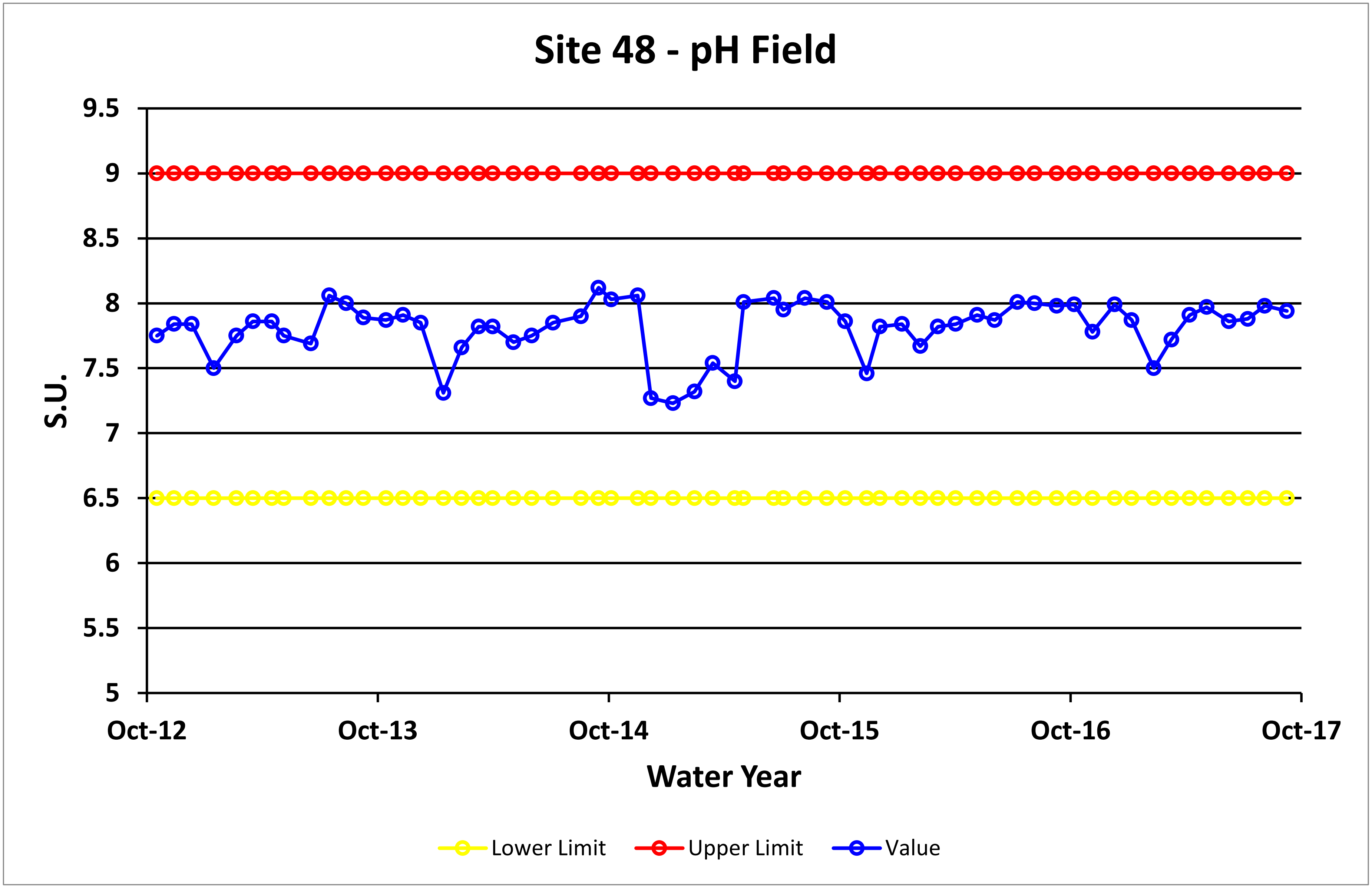
Site 48 - Water Temperature
20
18
16
14
12
10
8
6
4
2
0
°C
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value


Site 48 - Conductivity Laboratory
250
200
150
100
50
0
µmhos
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value

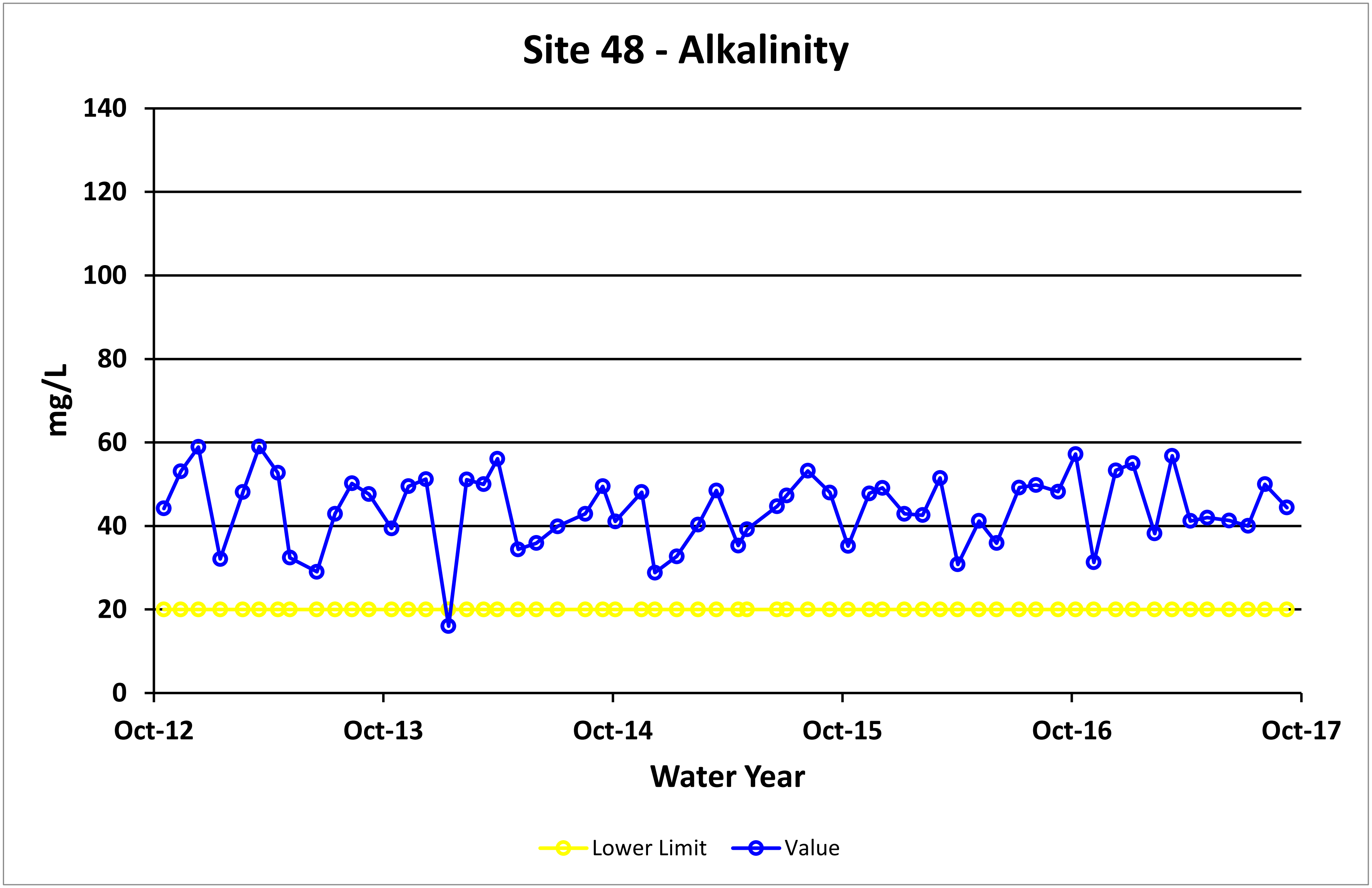

Site 48 - Conductivity Field
250
200
150
100
50
0
µmhos
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value

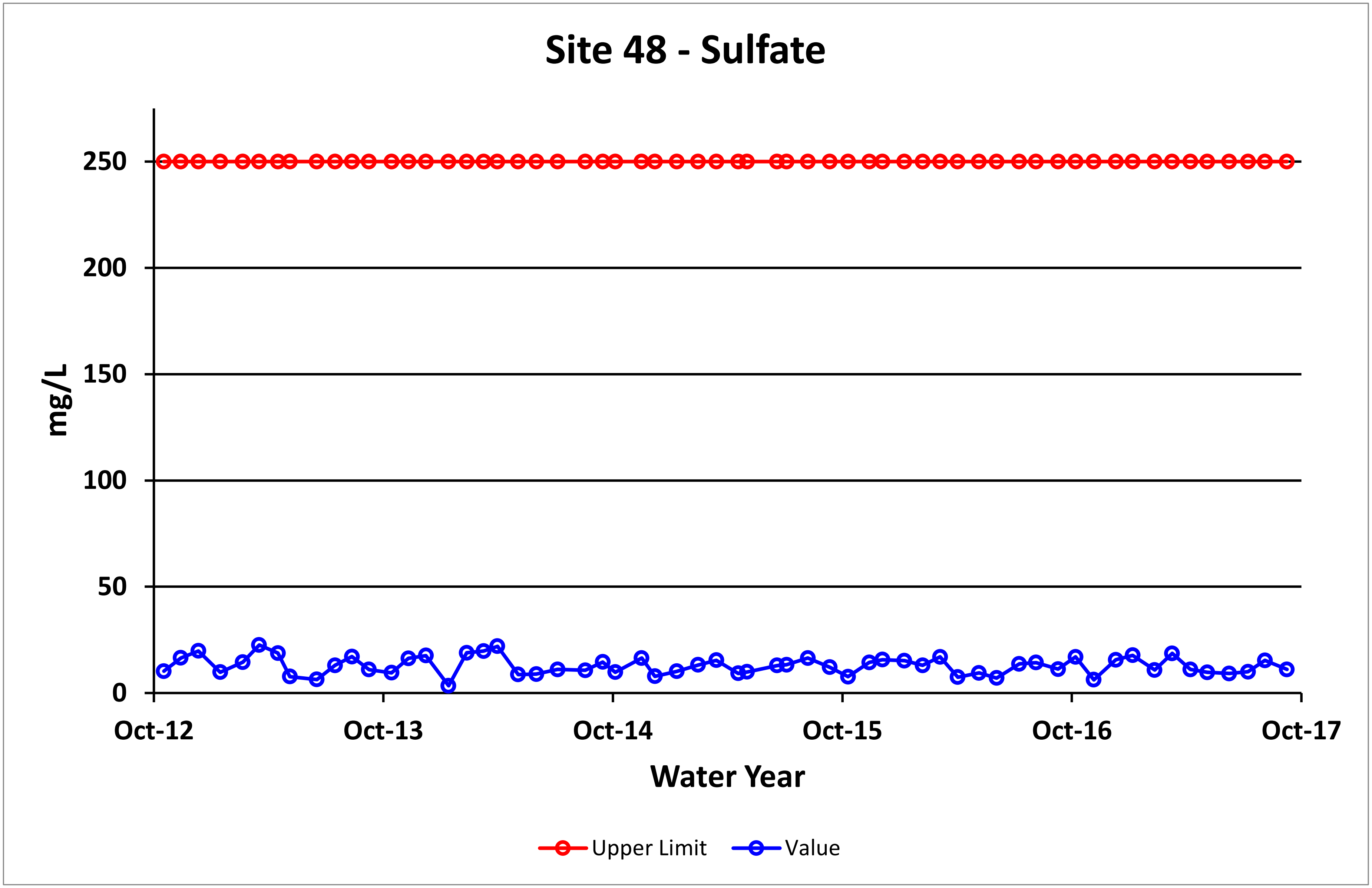


Site 48 - pH Laboratory
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
S.U.
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Lower Limit
Upper Limit
Value

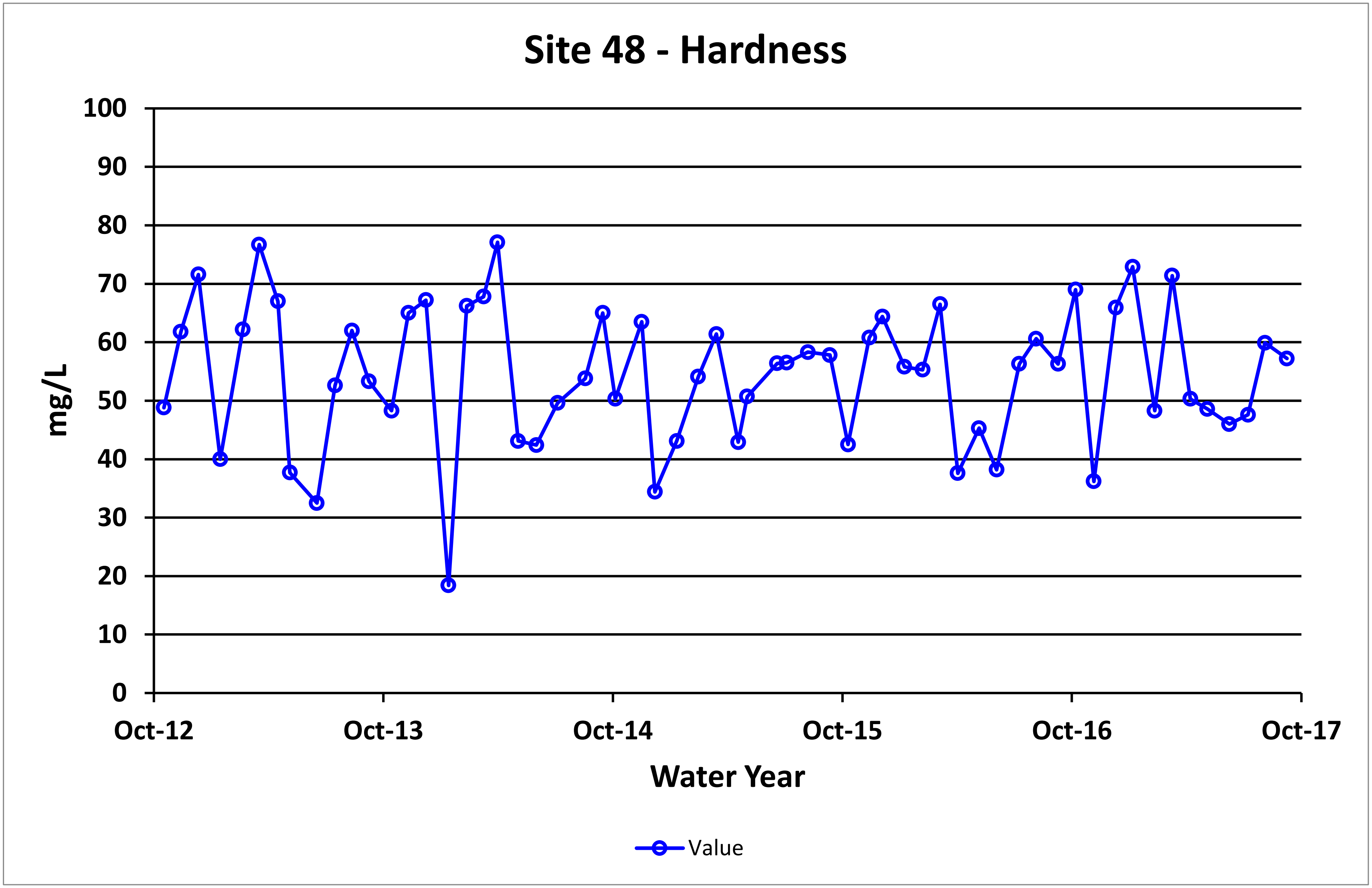


Site 48 - pH Field
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
S.U.
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Lower Limit
Upper Limit
Value

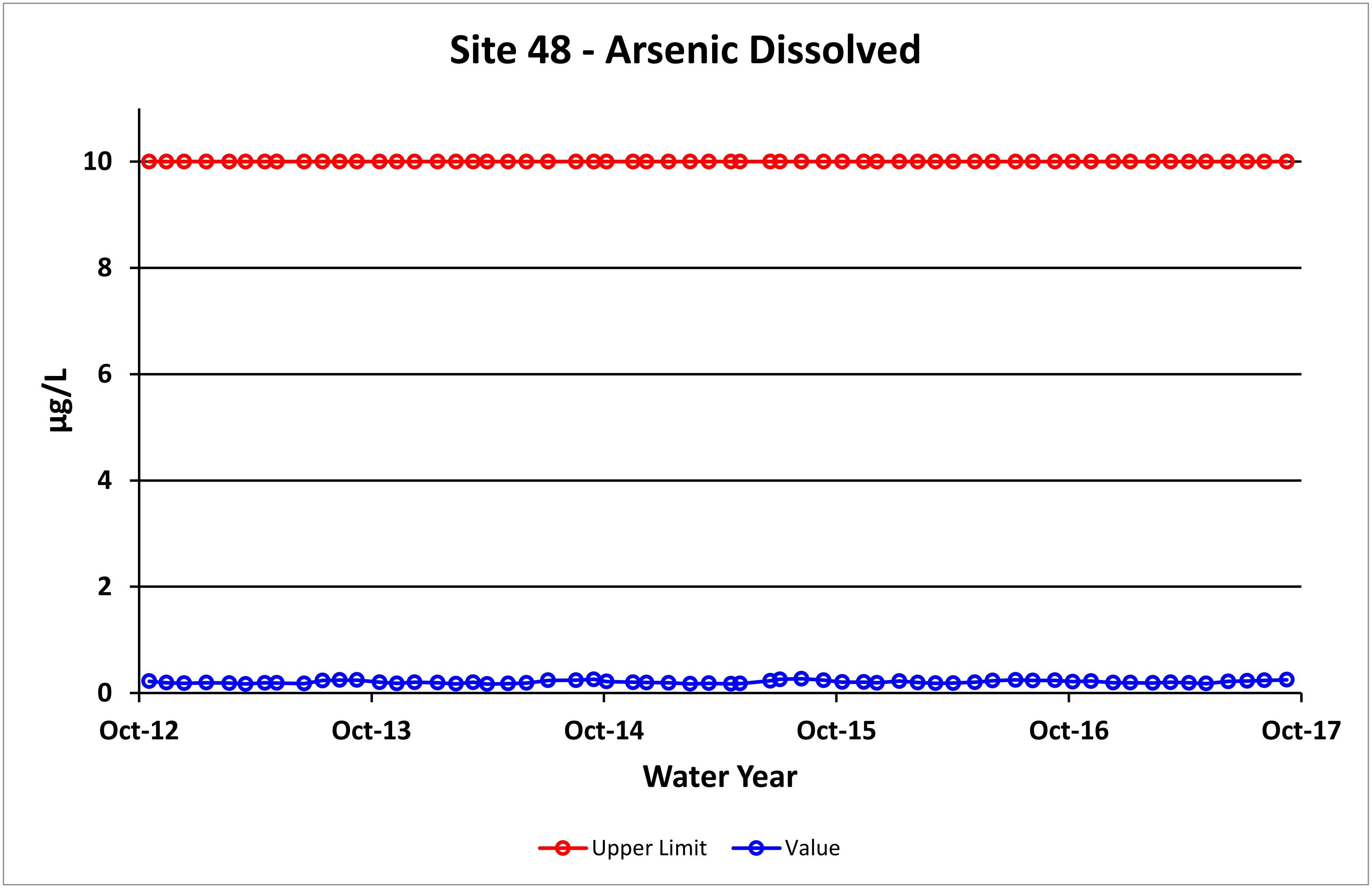

Site 48 - Alkalinity
mg/L
140
120
100
80
60
40
20
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Lower Limit
Value

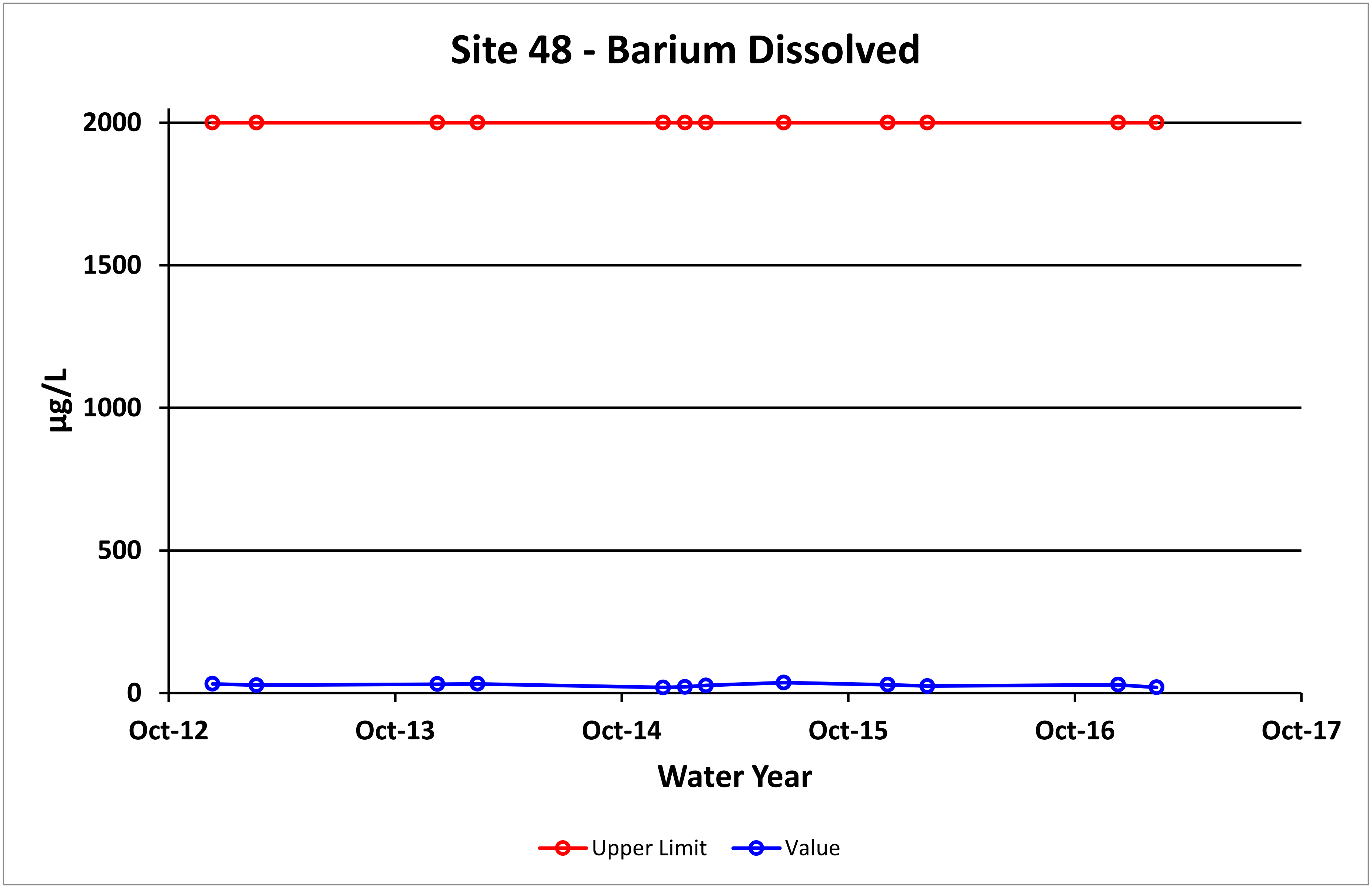


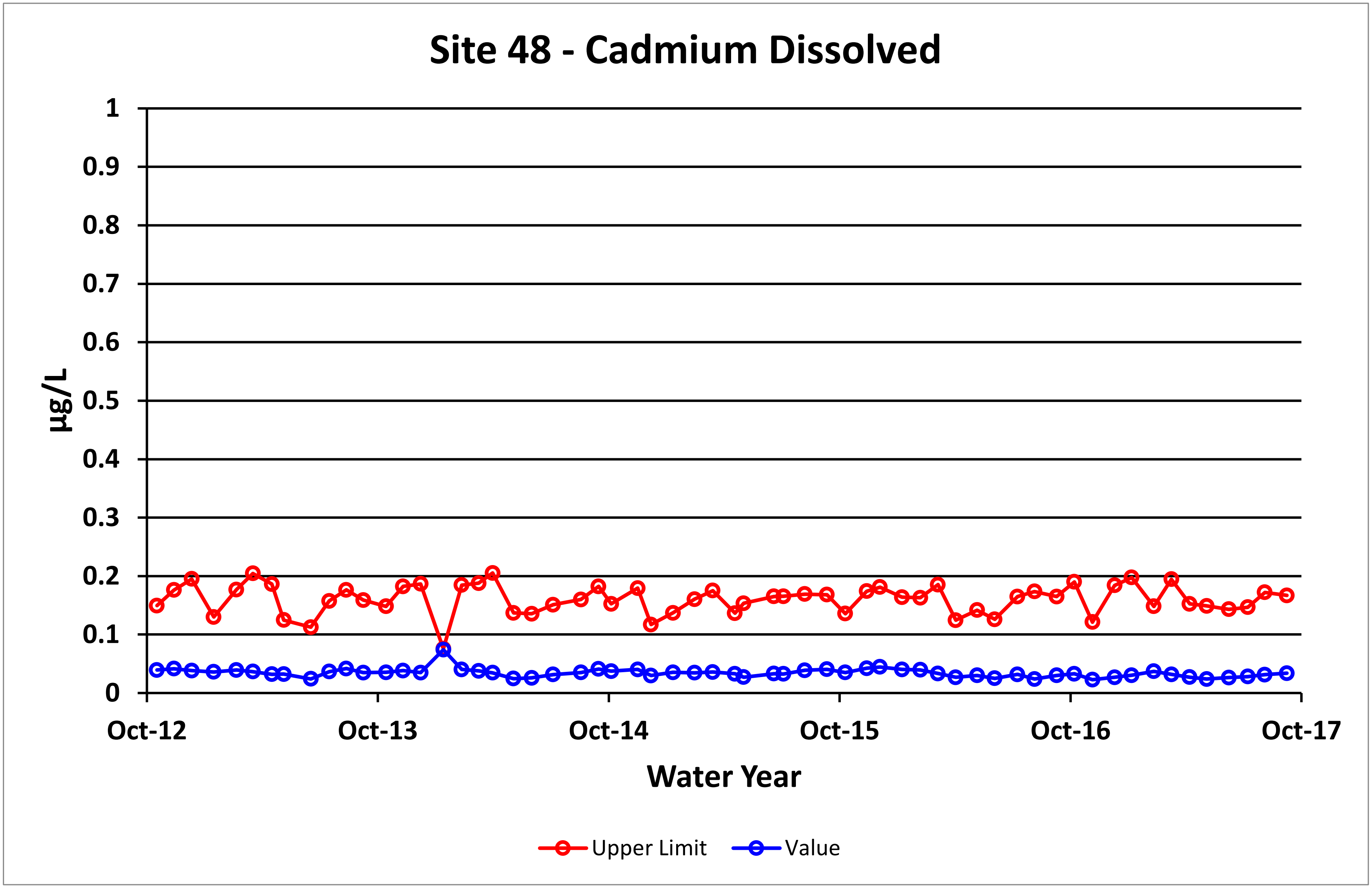
Site 48 - Sulfate
mg/L
250
200
150
100
50
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

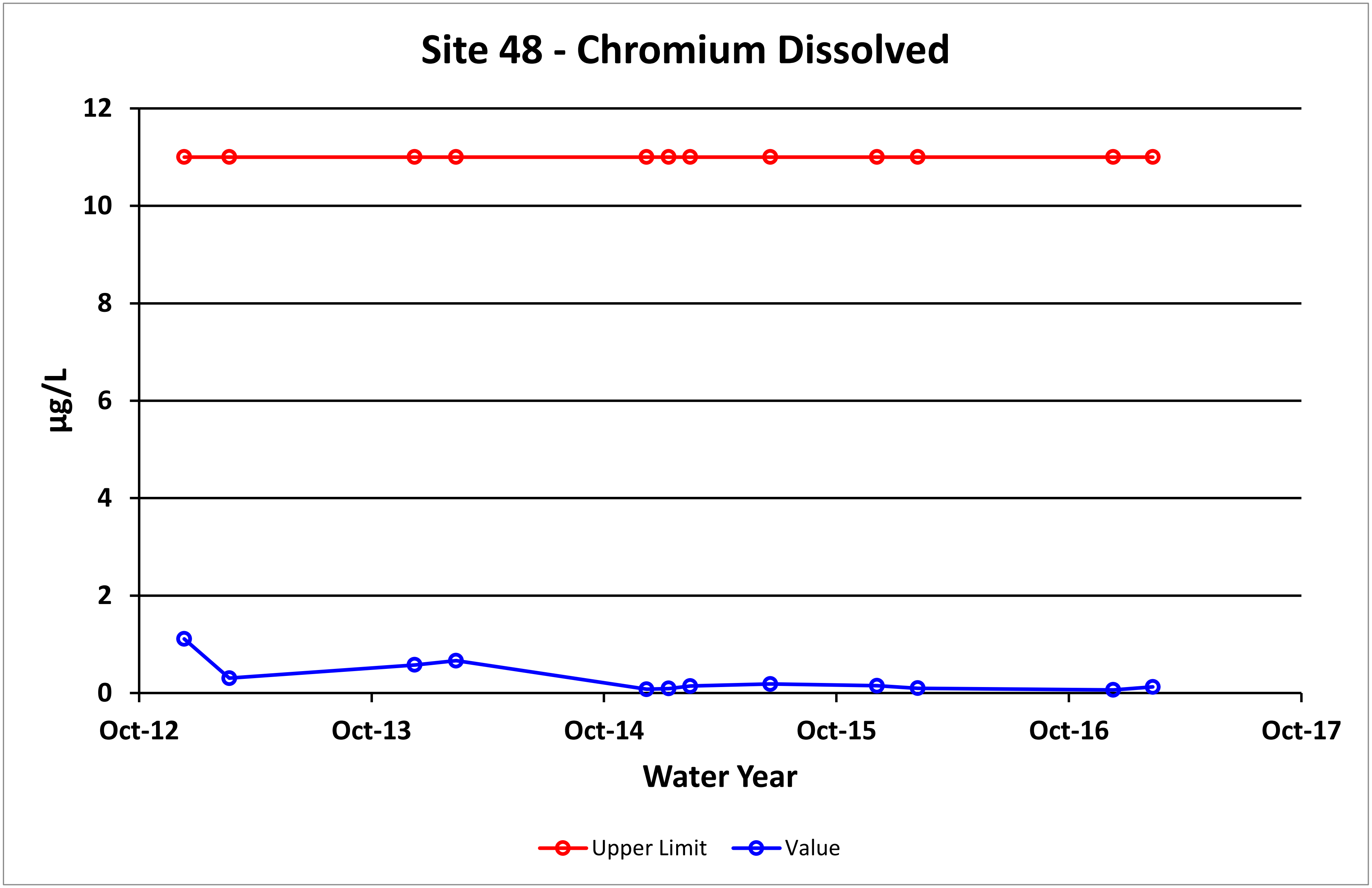


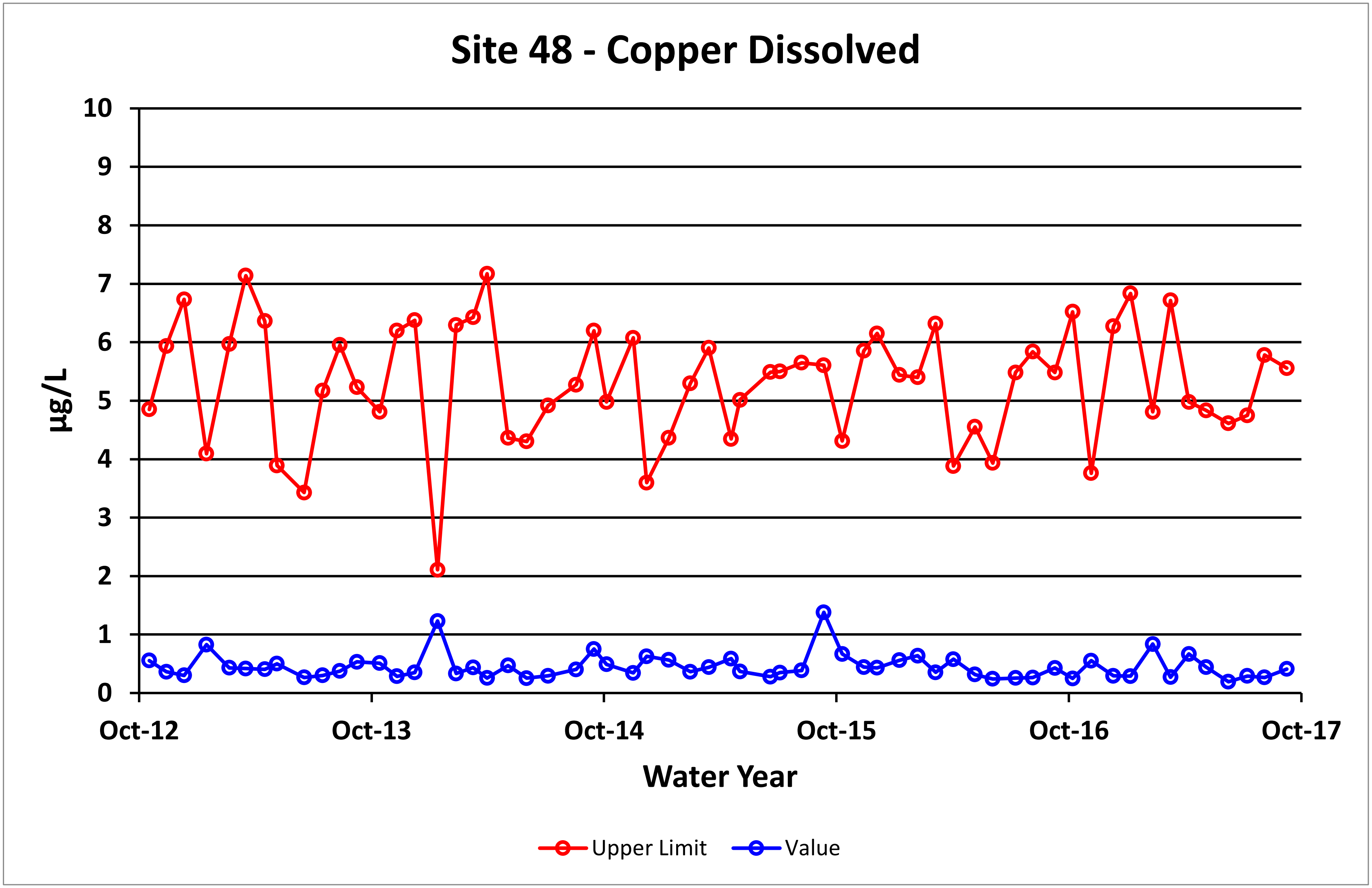
Site 48 - Hardness
mg/L
100
90
80
70
60
50
40
30
20
10
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value

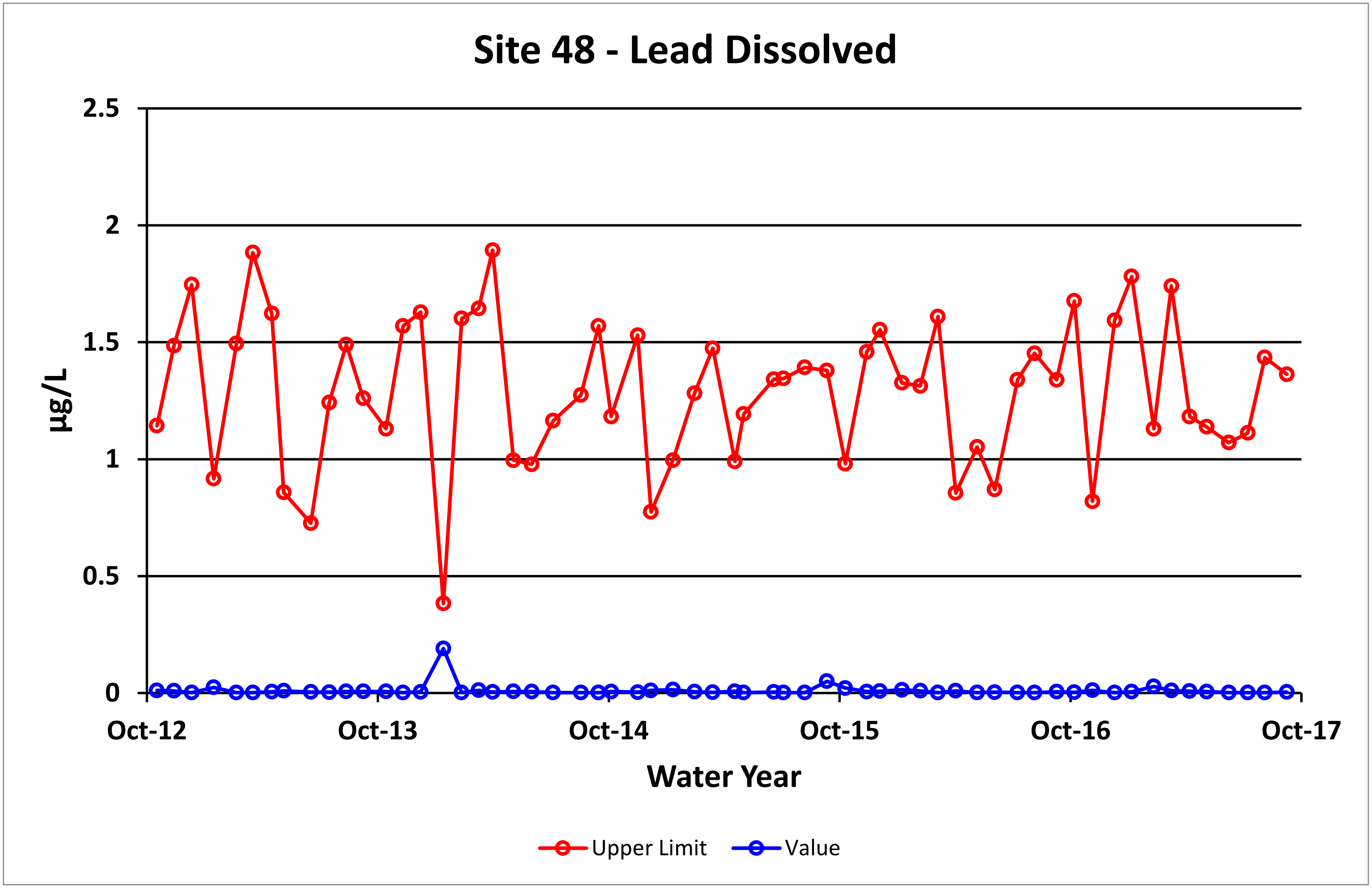

Site 48 - Arsenic Dissolved
µg/L
10
8
6
4
2
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

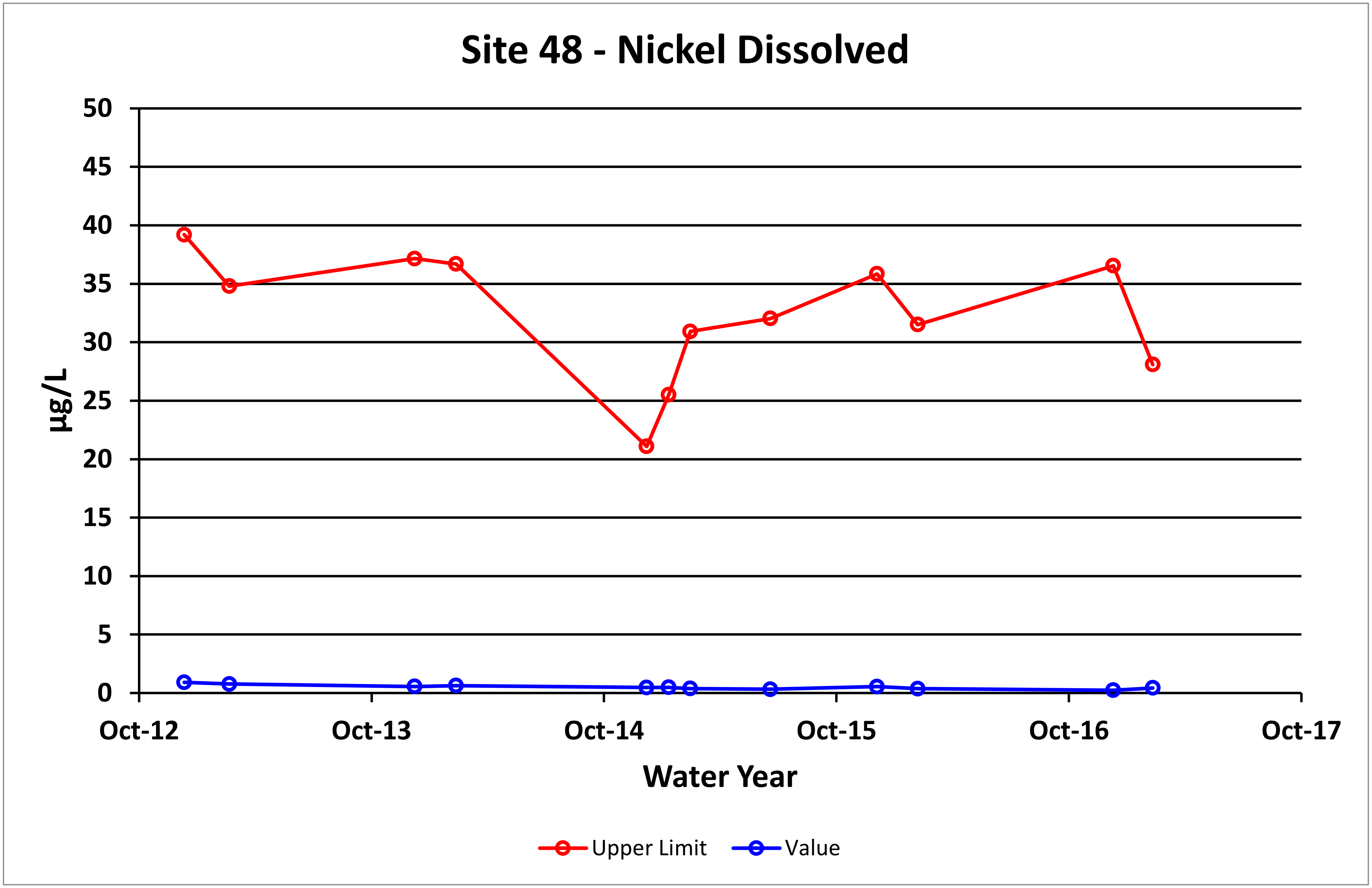

Site 48 - Barium Dissolved
2000
1500
1000
500
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value


Site 48 - Cadmium Dissolved
µg/L
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

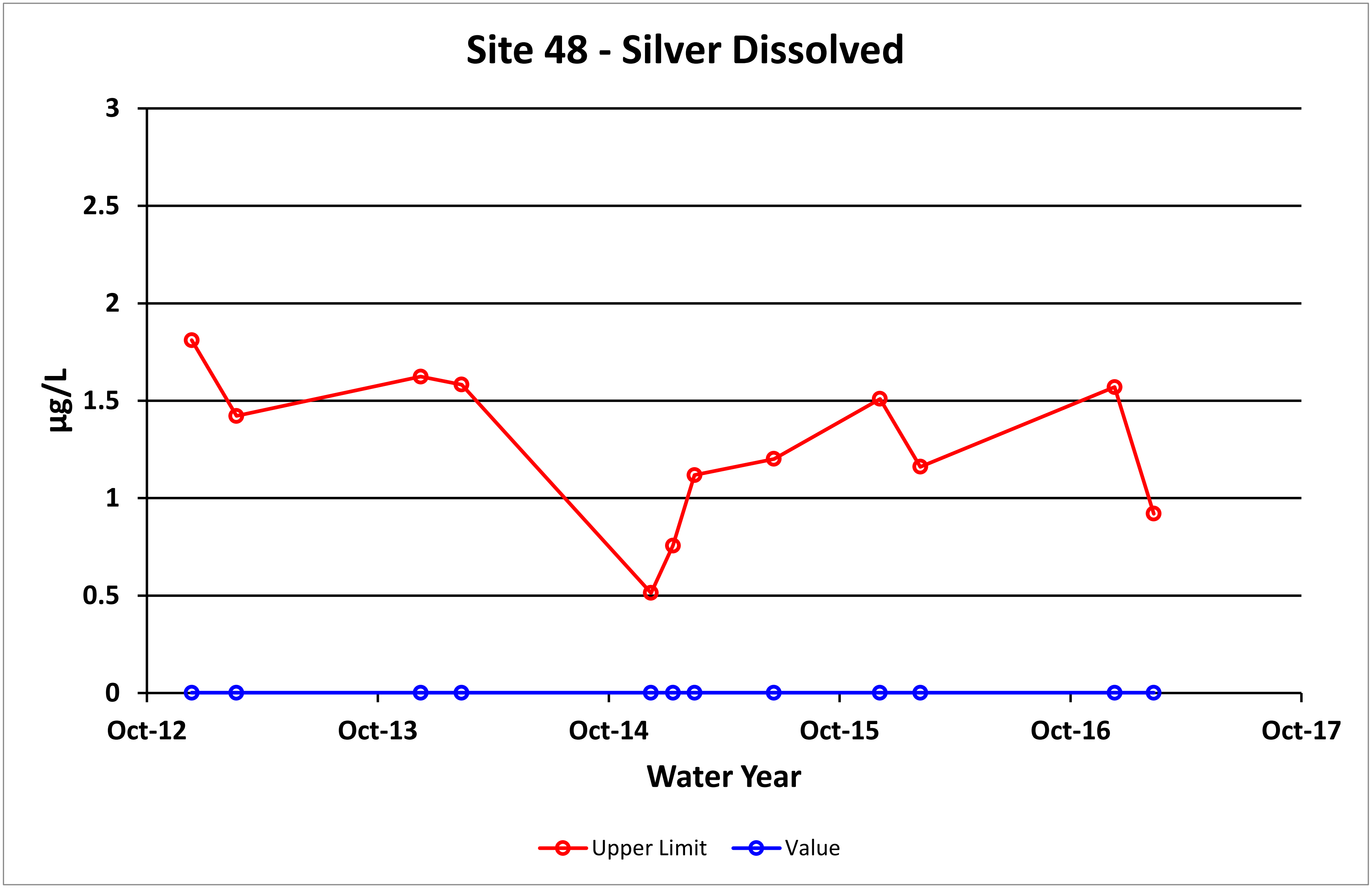

Site 48 - Chromium Dissolved
12
10
8
6
4
2
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value


Site 48 - Copper Dissolved
µg/L
10
9
8
7
6
5
4
3
2
1
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

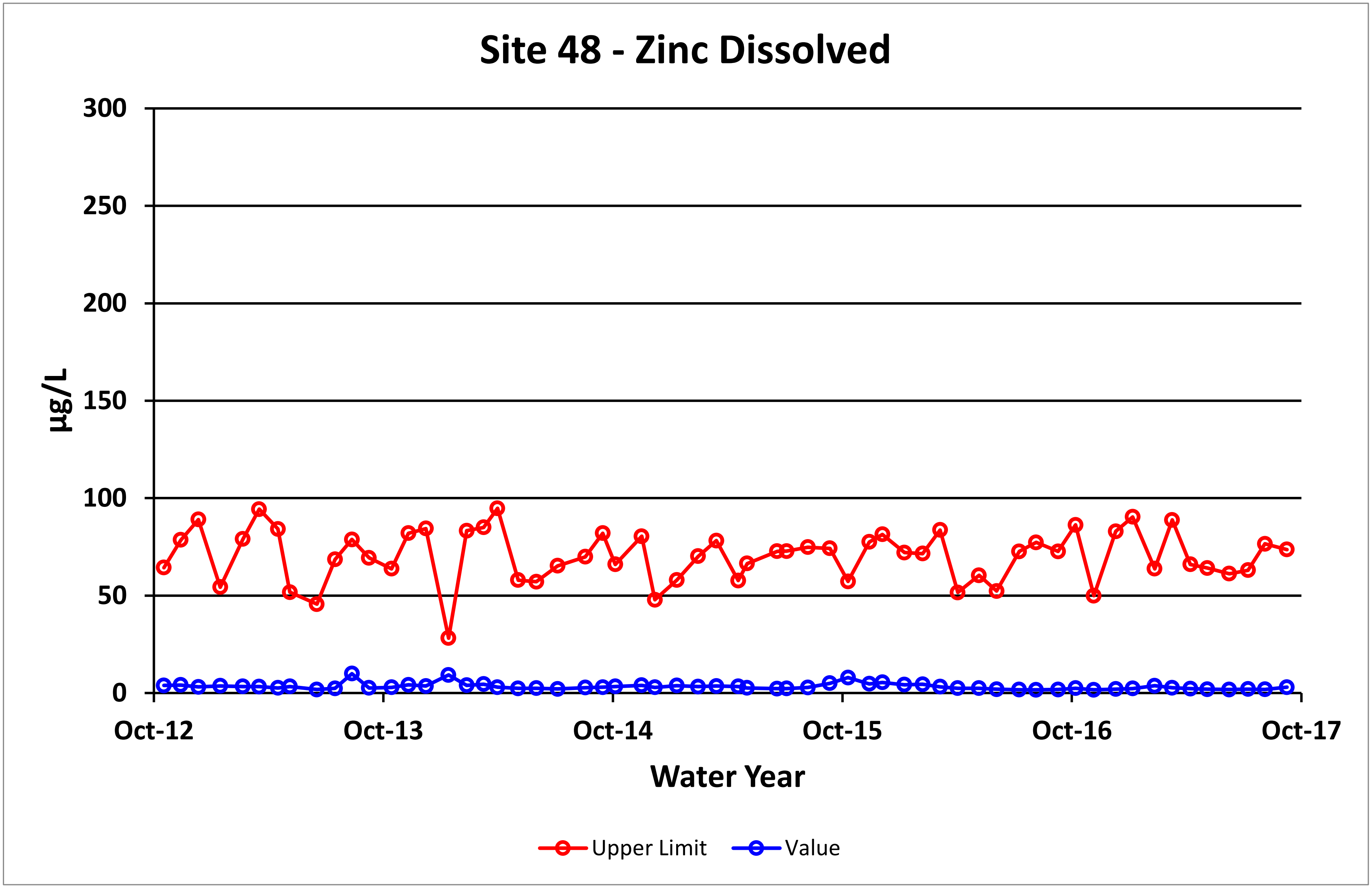

Site 48 - Lead Dissolved
2.5
2
1.5
1
0.5
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value



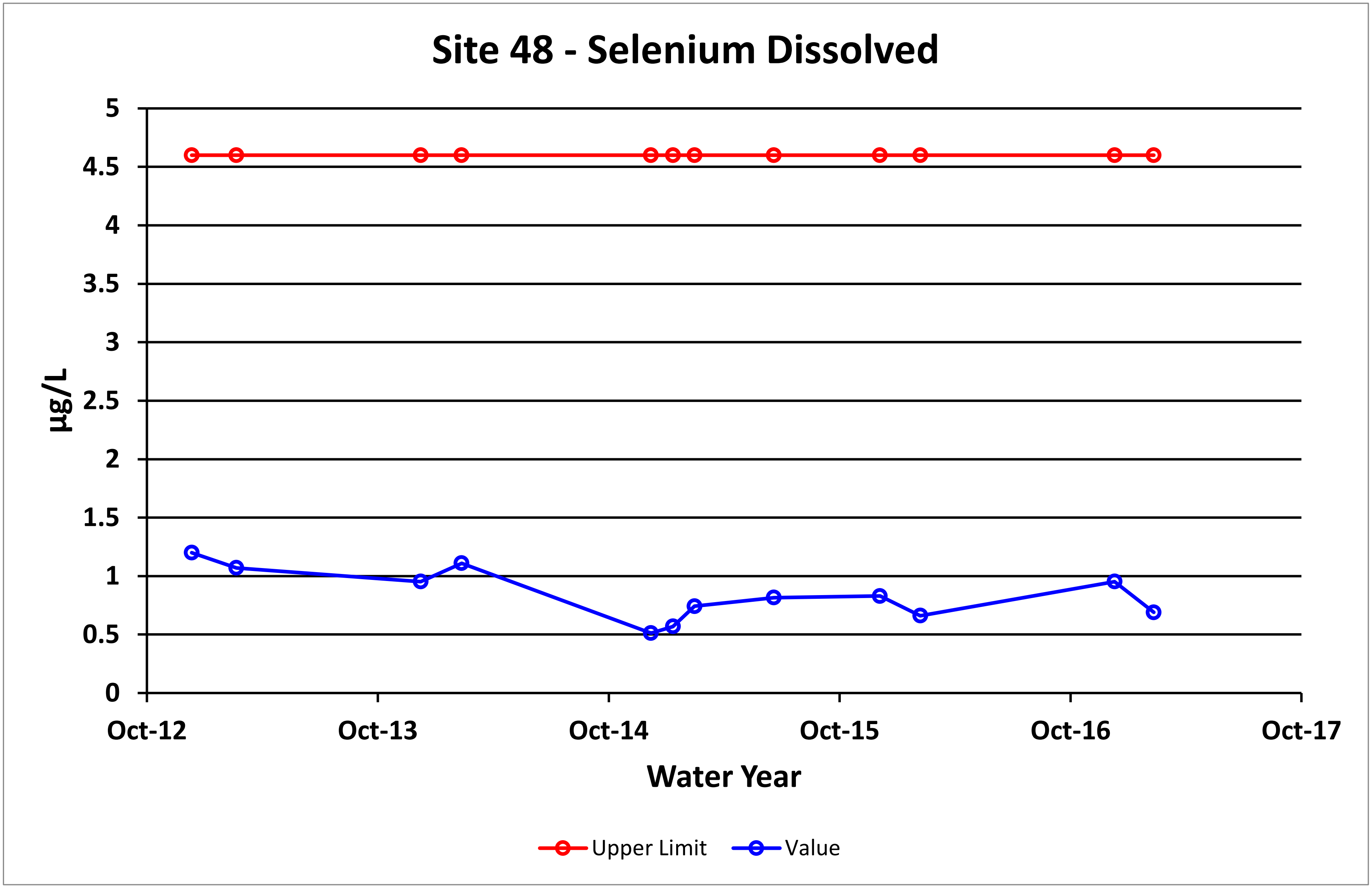
Site 48 - Nickel Dissolved
50
45
40
35
30
25
20
15
10
5
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value



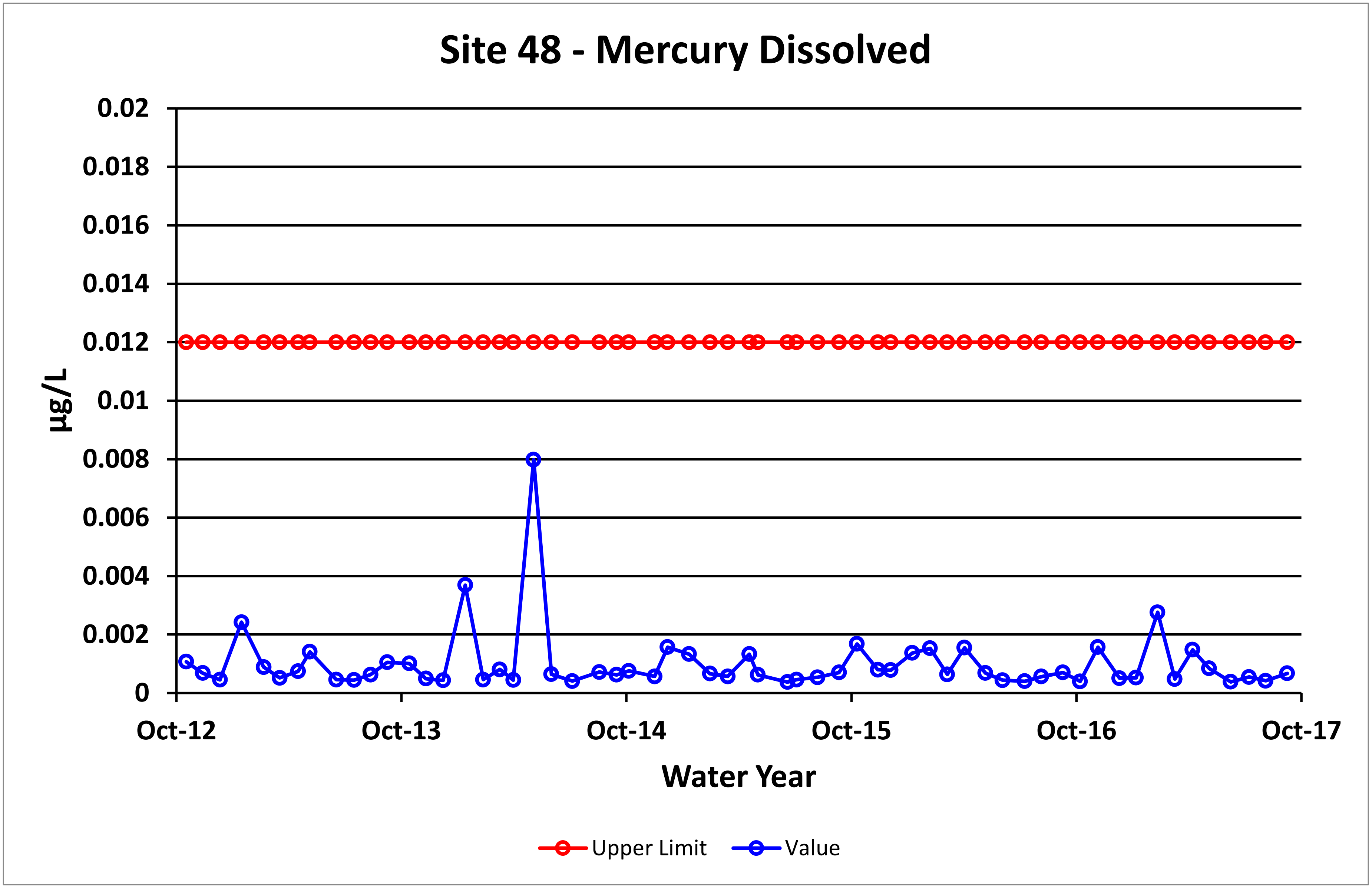
Site 48 - Silver Dissolved
µg/L
3
2.5
2
1.5
1
0.5
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value



Site 48 - Zinc Dissolved
300
250
200
150
100
50
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value



Site 48 - Selenium Dissolved
µg/L
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value


Site 48 - Mercury Dissolved
0.02
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

INTERPRETIVE REPORT
SITE 6

The data collected during the current water year are listed in the following "Table of Results for Water Year 2017" report. The table includes all the required FWMP analyte data (field and laboratory) collected for the current water year and a series of flags keyed to the summary report "Qualified Data by QA Reviewer". The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of ½ MDL for the purpose of median calculation.

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

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

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

Table of Exceedance for Water Year 2017

			Limits		
Sample Date	**Parameter**	**Value**	**Lower**	**Upper**	**Hardness**
No exceedances have been identified by HGCMC for the period of October 2016 through September 2017.					

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-11 and Sep-17 (WY2012-WY2017).

Table of Summary Statistics for Trend Analysis

	Mann-Kendall test statistics			Sen's slope estimate	
Parameter	**n***	**p****	**Trend**	**Q**	**Q(%)**
Conductivity Field	6	0.71			
pH Field	6	0.99	+	0.03	0.4
Alkalinity, Total	6	0.94			
Sulfate, Total	6	0.35			
Zinc, Dissolved	6	0.04			

* Number of Years ** Significance level

Out of the five parameters evaluated field pH had a statistically significant positive slope (0.03 su/year), slightly less than the past few years. The direction and magnitude of trend is similar to the pH trend measured at the background site (Site 48). Currently, HGCMC does not believe that this increasing trend is a significant indication of changes in water chemistry.

A comparison of median values for alkalinity, laboratory pH, lab conductivity, total sulfate, and dissolved zinc between Site 6 and Site 48 has been conducted as specified in the Statistical Information Goals for Site 6. Additionally, X-Y plots have been generated for total alkalinity, field pH, specific conductance, total sulfate, and dissolved zinc that co-plot data from Site 6 and Site 48, the upstream control site, to aid in the comparison between those sites. Calculation details of the non-parametric signed-rank tests are presented in detail on the pages following this interpretive section. The table below summarizes the results of the signed-rank test as performed on the Water Year 2017 dataset.

Table of Summary Statistics for Median Analysis

Site 6 vs Site 48

Parameter	**Signed Ranks p-value**	**Site 48 median**	**Site 6 median**	**Median Differences**
Conductivity Field	0.017	110.55	119.6	-4.95
pH Field	0.138	7.9	7.94	-0.01
Alkalinity, Total	<0.01	43.2	44.25	-1.45
Sulfate, Total	<0.01	11.1	13.1	-1.90
Zinc, Dissolved	<0.01	2.12	6.12	-3.41

Field pH does not have a statistically significant difference between measured median values at a significance level of α=0.05 for a one-tailed test. The median values for field pH for Site 48 and Site 6 are 7.90 su and 7.94 su respectively and the median of differences, Site 48 minus Site 6, is -0.01 su.

The median values for field conductivity for Site 48 and Site 6 are 110.55 µS/cm and 119.6 µS/cm respectively. Median values for total alkalinity for Site 48 and Site 6 are 43.2 mg/L and

44.25 mg/L respectively. The median values for total sulfate for Site 48 and Site 6 are 11.1 mg/L and 13.1 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 2.12 µg/L and 6.12 µg/L respectively, with a median difference of -3.411 µg/L. Signed-rank test results for prior datasets for Water Years 2000 – 2016 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 2017

Site 006FMS - 'Greens Creek Middle'

Sample Date/Parameter	Oct 2016	Nov 2016	Dec 2016	Jan 2017	Feb 2017	Mar 2017	Apr 2017	May 2017	Jun 2017	Jul 2017	Aug 2017	Sep 2017	**Median**
Water Temp (°C)	2.8	5	0.7	0.7	0.5	0.4	0.9	2.9	4.9	7.2	9	7.6	2.9
Conductivity-Field(μmho)	152.9	87.8	134.2	130.7	119.5	165.7	112.6	110	99.6	103.6	147	119.6	119.6
Conductivity-Lab (μmho)	151	84	150	163	113	164	115	106	99	102	128	121	118
pH Lab (standard units)	7.7	7.58	7.52	7.64	7.28	7.5	7.52	7.51	7.35	7.46	7.34	7.39	7.51
pH Field (standard units)	7.99	7.78	8.05	7.94	7.48	7.79	7.94	7.96	7.87	7.85	7.94	7.96	7.94
Total Alkalinity (mg/L)	56.2	33.5	57.2	59.8	40.9	57.4	42.4	41.7	40.3	42.6	51.4	45.9	44.3
Total Sulfate (mg/L)	19	7.7	18.9	20.8	12.8	22.4	13.4	10.7	10	10.9	17.1	12.4	13.1
Hardness (mg/L)	71.7	40.1	71.9	79.6	54.8	77.8	54.4	51	47.5	52.6	62.8	59.2	57.0
Dissolved As (ug/L)	0.194	0.214	0.177	0.172	0.186	0.157	0.171	0.165	0.192	0.212	0.205	0.227	0.189
Dissolved Ba (ug/L)			30.7		22.3								26.5
Dissolved Cd (ug/L)	0.0453	0.0374	0.0508	0.0529	0.0683	0.0483	0.0453	0.0366	0.0299	0.0413	0.0413	0.049	0.0453
Dissolved Cr (ug/L)			0.062		0.132								0.097
Dissolved Cu (ug/L)	0.291	0.652	0.333	0.302	0.905	0.275	0.753	0.469	0.197	0.342	0.297	0.513	0.338
Dissolved Pb (ug/L)	0.0102	0.024	0.009	0.0449	0.0837	0.0055	0.0178	0.0152	0.0015	0.0153	0.0054	0.0093	0.0127
Dissolved Ni (ug/L)			0.349		0.519								0.434
Dissolved Ag (ug/L)			0.002		0.002								0.002
Dissolved Zn (ug/L)	5.86	4.51	9.87	9.46	12.7	8.2	7.95	5.02	2.87	4.31	4.2	6.37	6.12
Dissolved Se (ug/L)			1.06		0.772								0.916
Dissolved Hg (ug/L)	0.000439	0.0016	0.000547	0.00054	0.00256	0.000628	0.00165	0.000934	0.00044	0.000688	0.000531	0.00081	0.000658

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

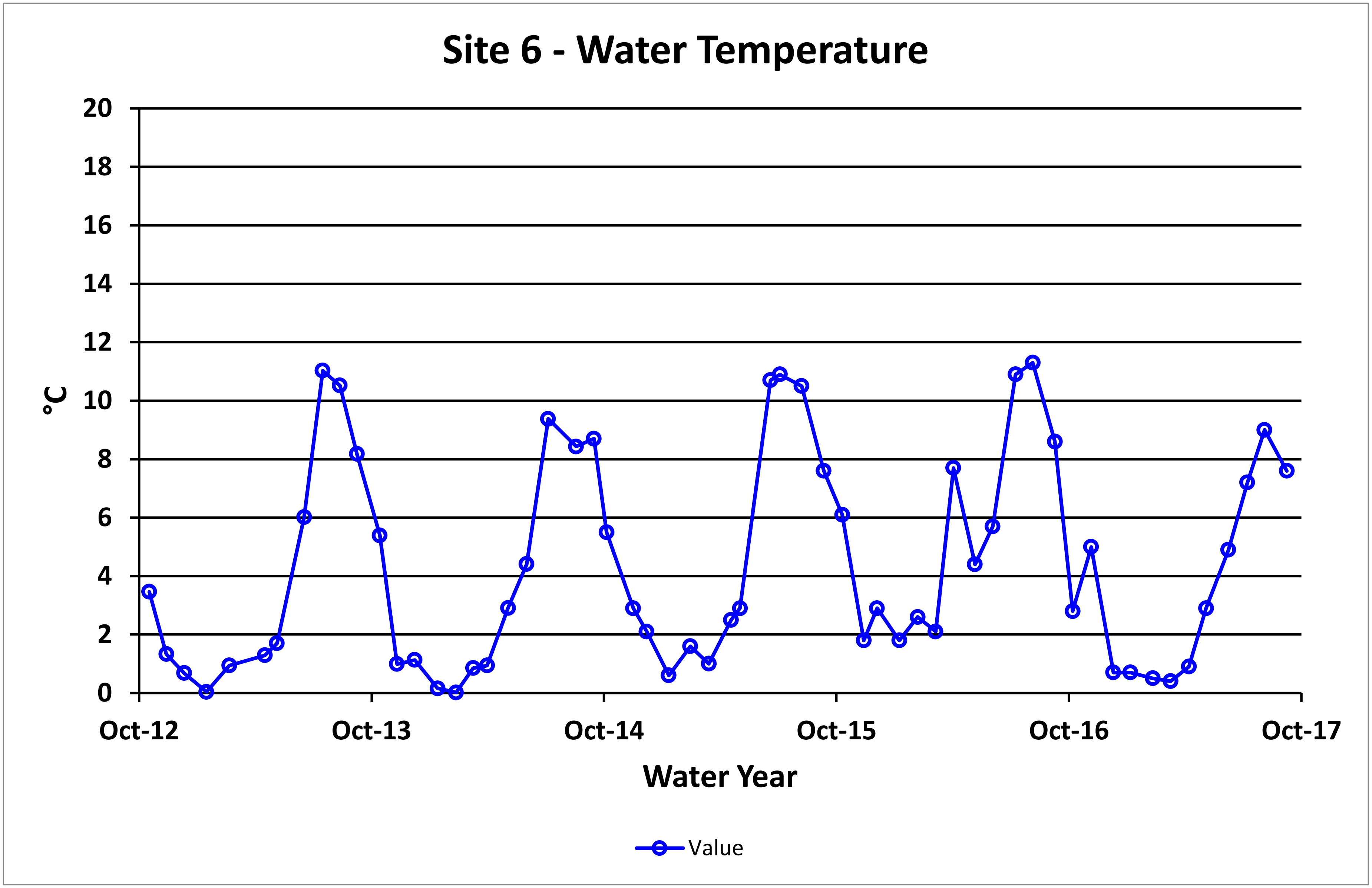
Values reported as less than MDL are replaced by 1/2 MDL for median calculation purposes.

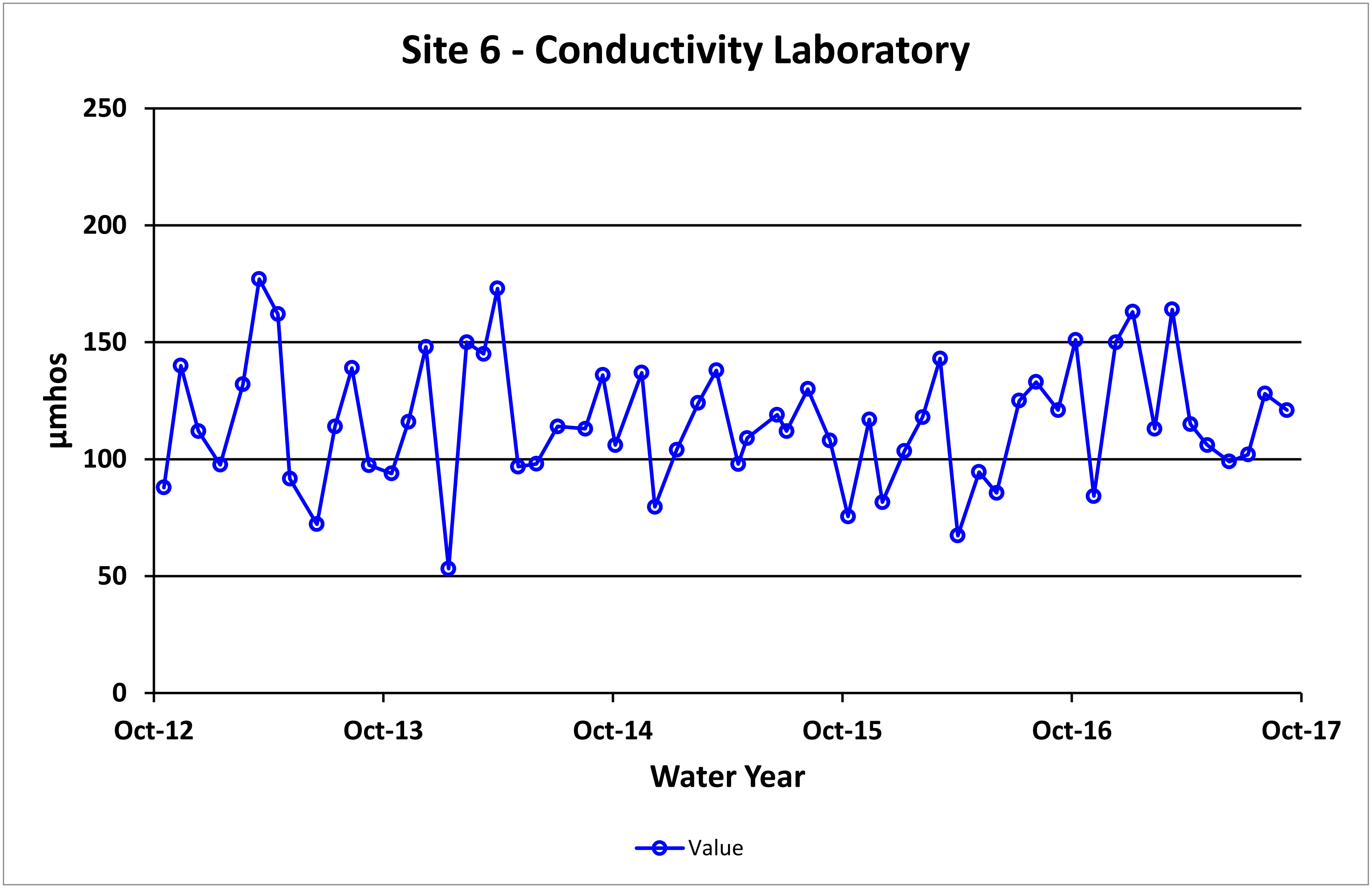
Shaded data has been qualified as an outlier by HGCMC and removed from any further analysis and is not included into the calculation of the median

Qualified Data by QA Reviewer

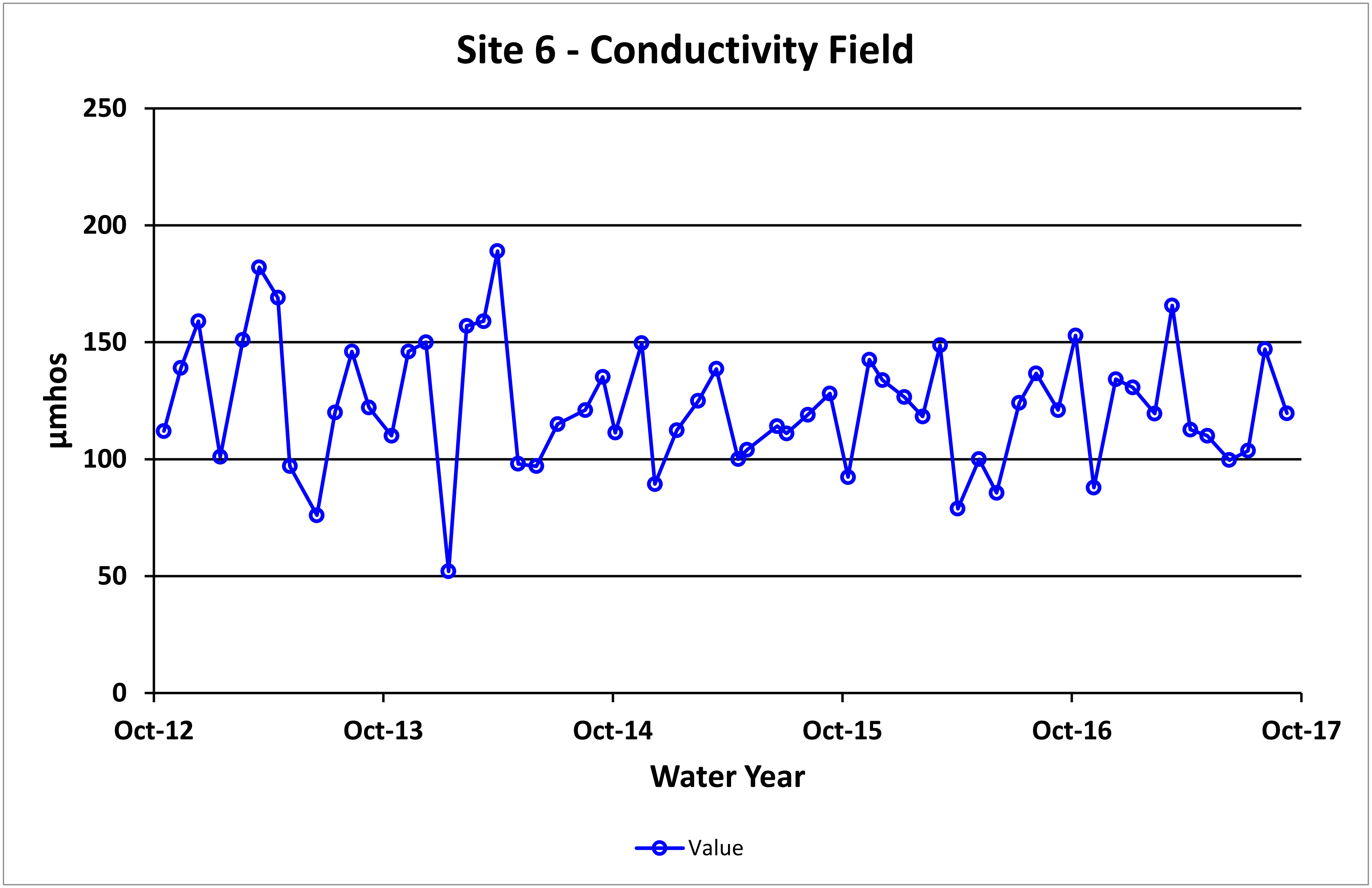
Date Range: 10/01/2016 to 09/30/2017

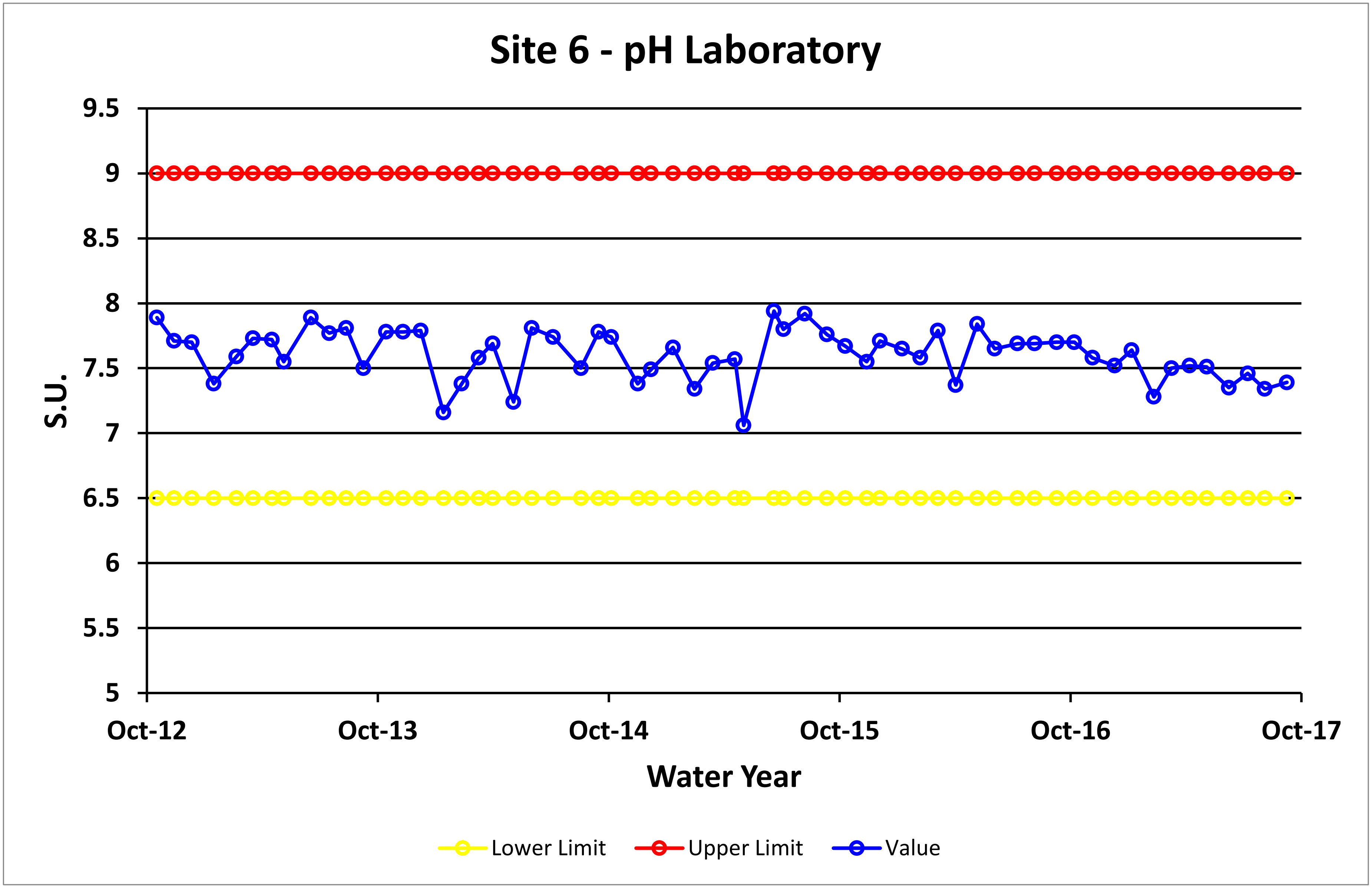
Site No.	Sample Date	Sample Time	Parameter	Value		Qualifier	Reason for Qualifier
006FMS	12/13/2016	12:00 PM	Diss. Cr-ICP/MS	0.06	µg/L	J	Below Quantitative Range
			Diss. Pb-ICP/MS	0.009	µg/L	J	Below Quantitative Range
	2/13/2017	12:00 PM	Diss. Cr-ICP/MS	0.13	µg/L	J	Below Quantitative Range
	3/13/2017	12:00 PM	Diss. Pb-ICP/MS	0.0055	µg/L	J	Below Quantitative Range
	5/8/2017	12:00 PM	Diss. Hg-CVAF	0.000934	µg/L	U	Trip Blank Contamination
			Tot. Sulfate	10.7	mg/L	J	Sample Receipt Temperature
	6/12/2017	12:00 PM	Diss. Cu-ICP/MS	0.19	µg/L	U	Field Blank Contamination
			Diss. Zn-ICP/MS	2.87	µg/L	U	Field Blank Contamination
			Tot. Sulfate	9.97	mg/L	J	Hold Time Violatoin, Sample Receipt Temperature
	8/8/2017	12:00 PM	Diss. Pb-ICP/MS	0.00541	µg/L	J	Below Quantitative Range
			Tot. Sulfate	17.1	mg/L	J	Sample Receipt Temperature


Site 6 - Water Temperature
°C
20
18
16
14
12
10
8
6
4
2
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value

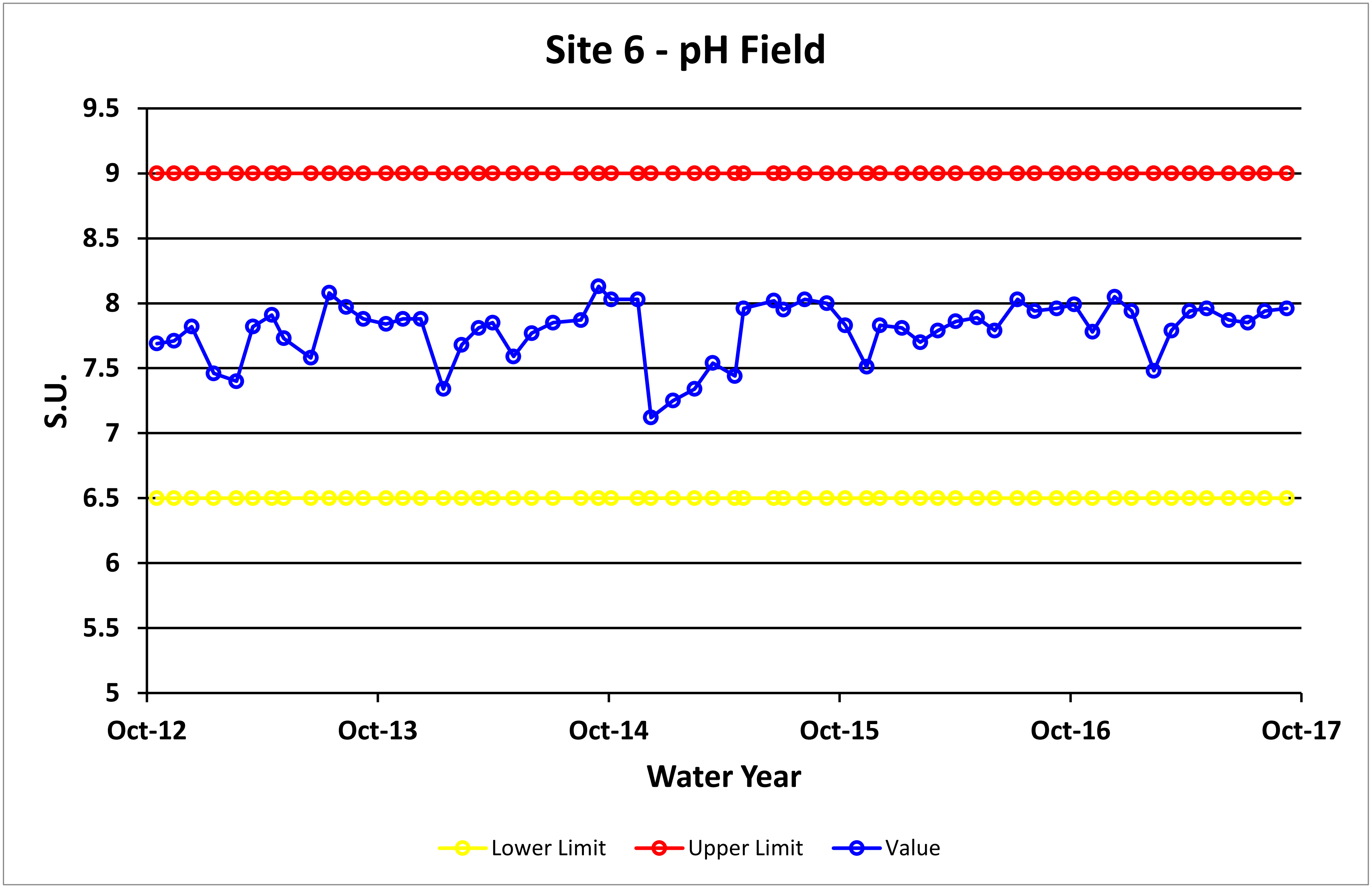


Site 6 - Conductivity Laboratory
250
200
150
100
50
0
µmhos
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value

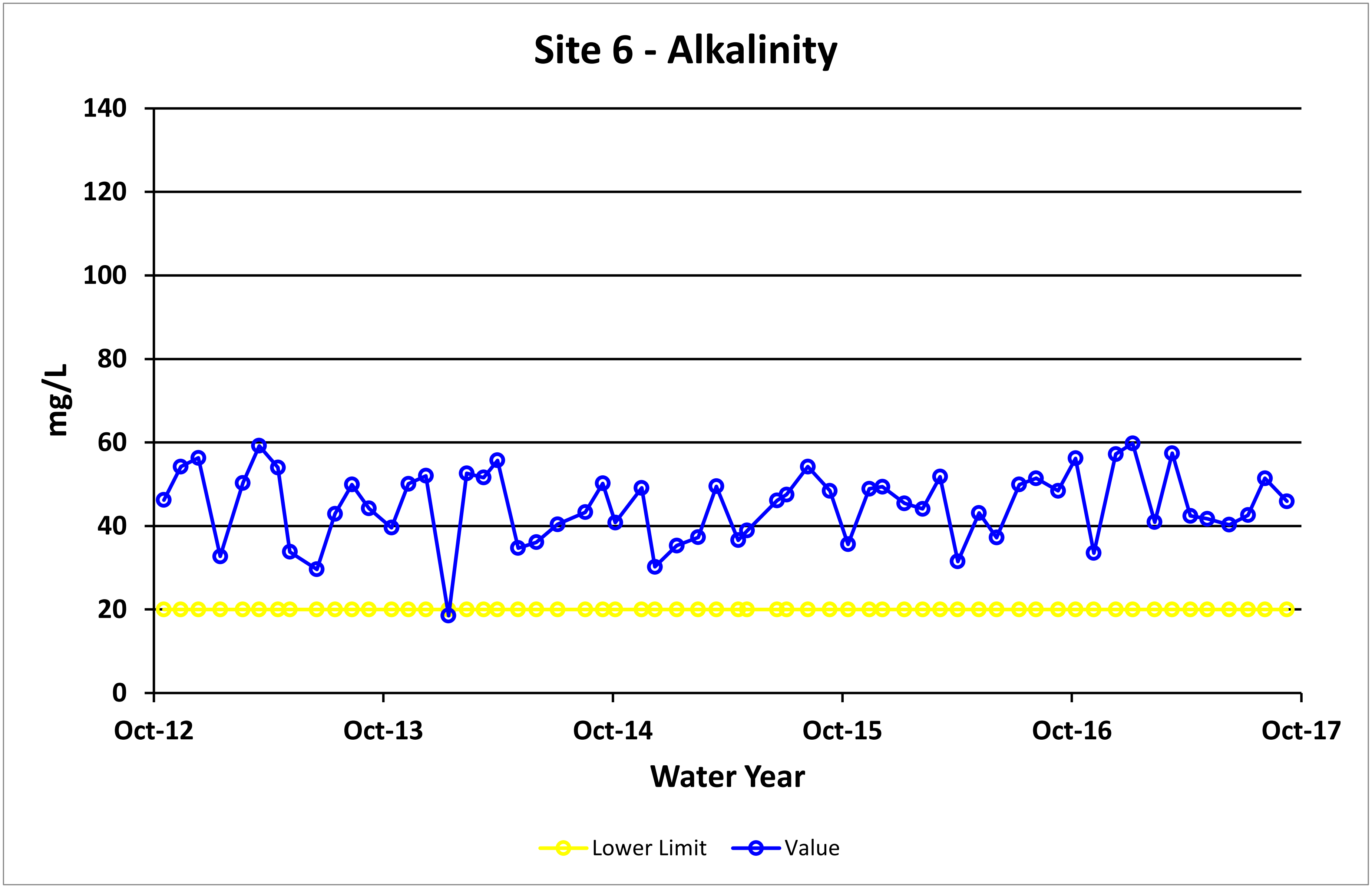

Site 6 - Conductivity Field
250
200
150
100
50
0
µmhos
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value



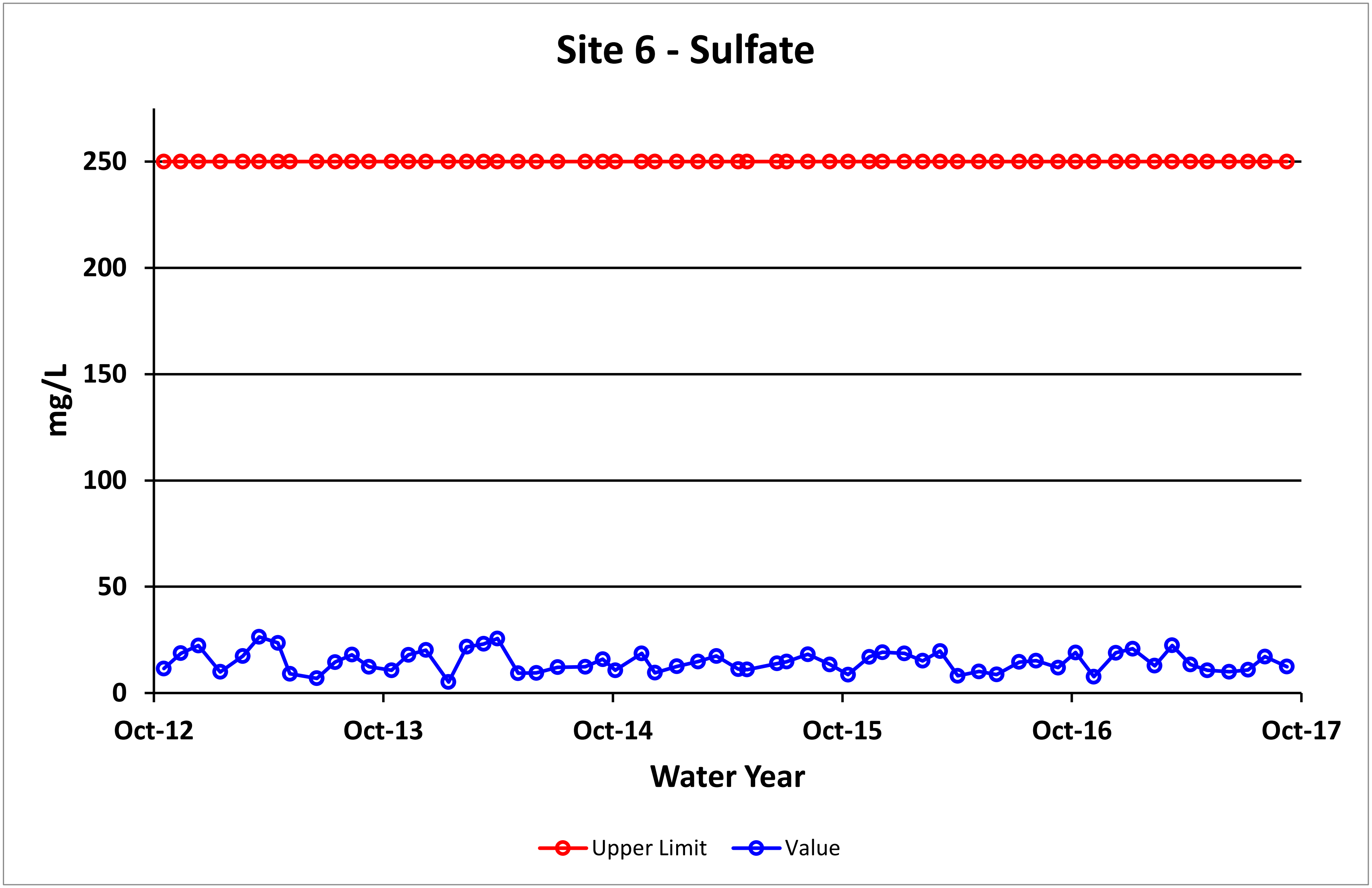
Site 6 - pH Laboratory
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
S.U.
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Lower Limit
Upper Limit
Value

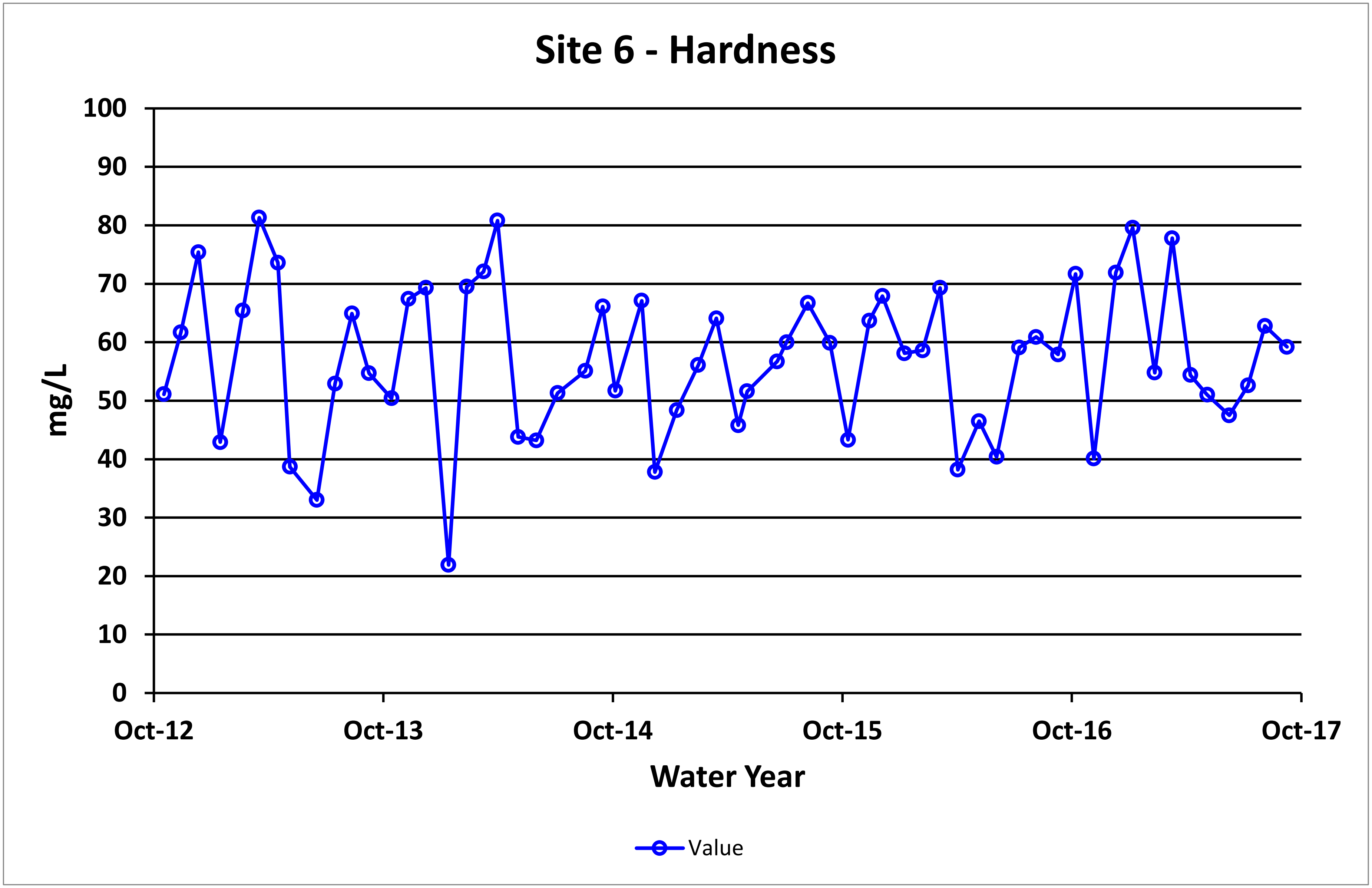


Site 6 - pH Field
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
S.U.
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Lower Limit
Upper Limit
Value

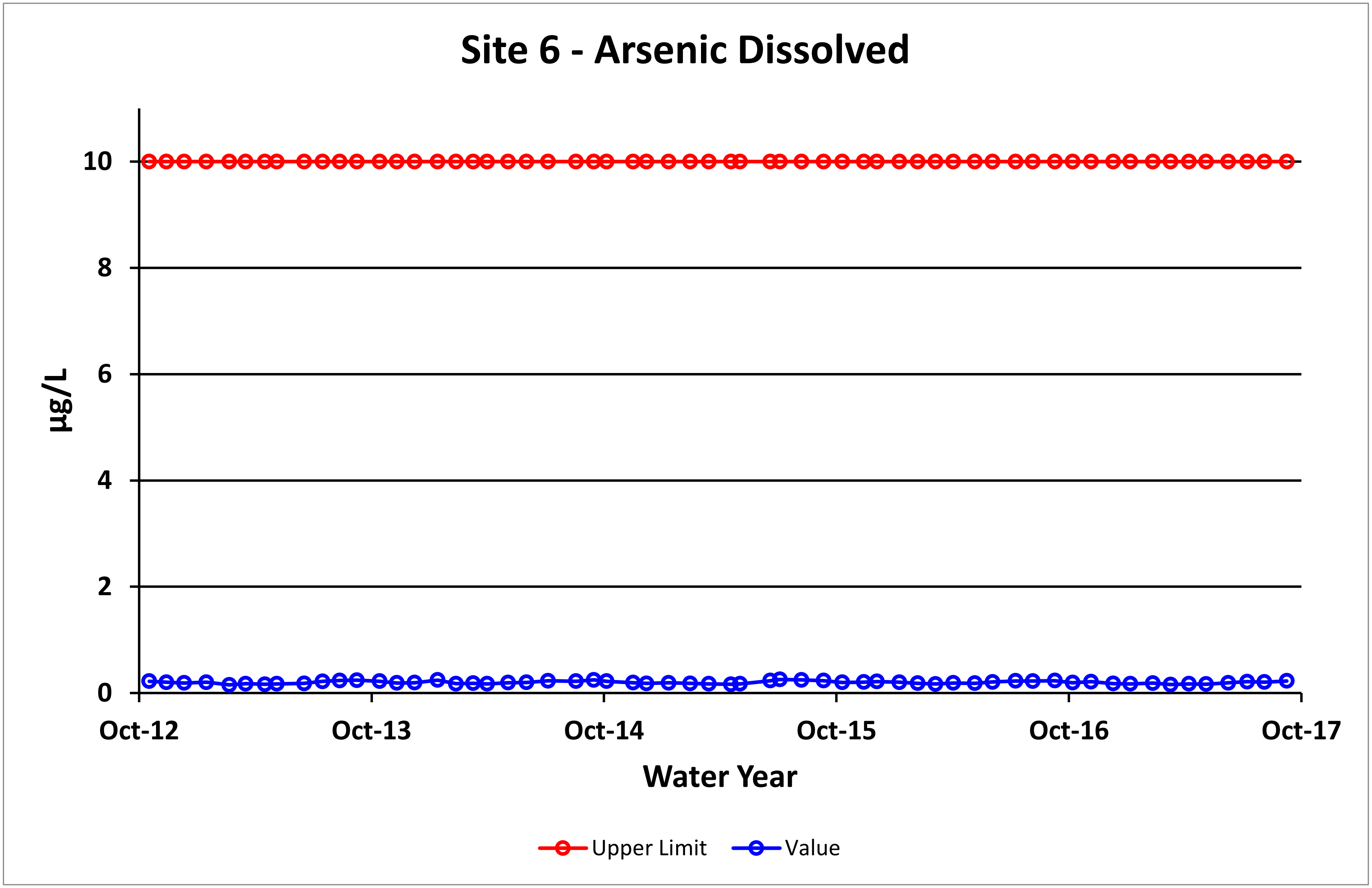


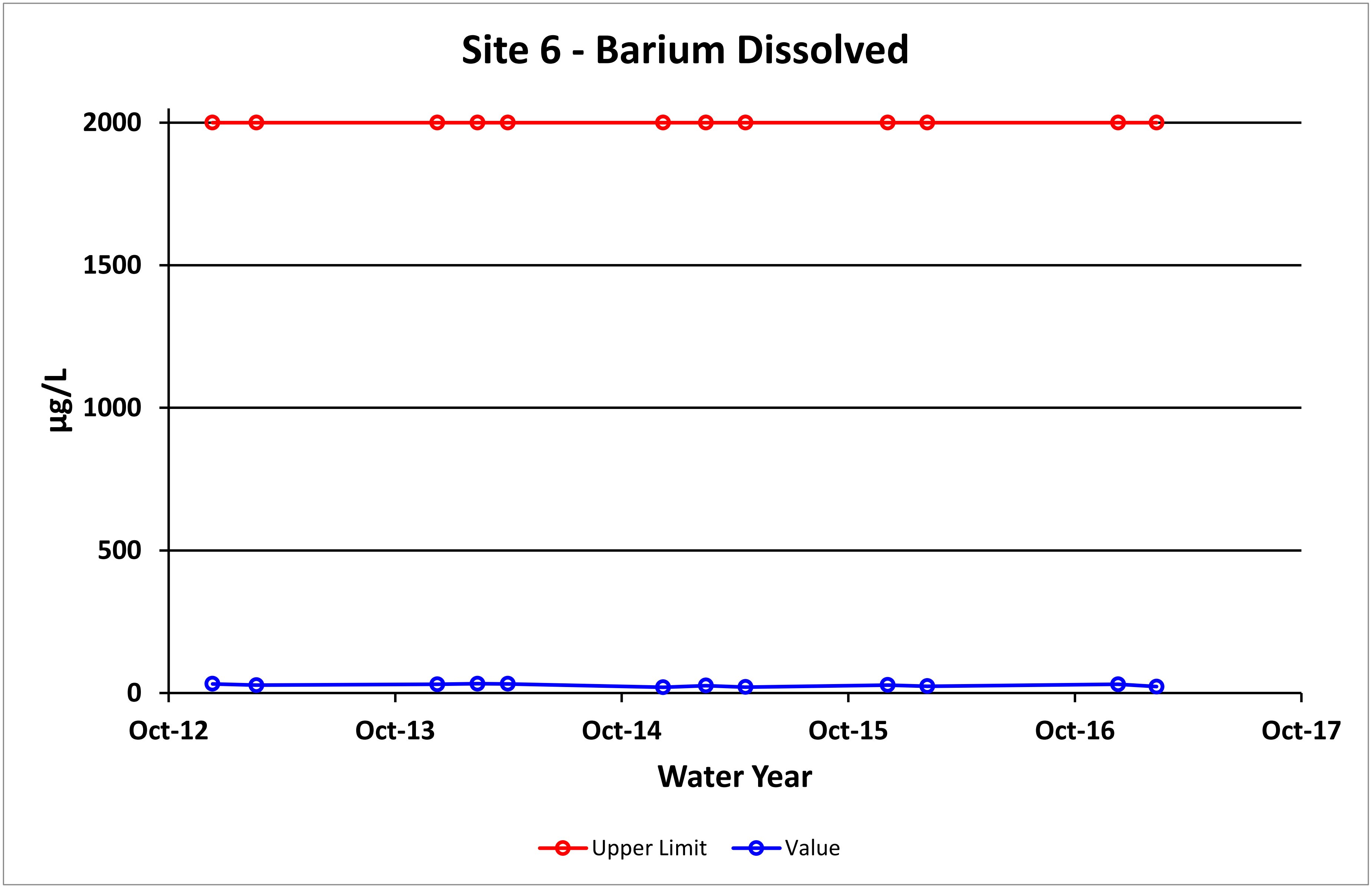
Site 6 - Alkalinity
mg/L
140
120
100
80
60
40
20
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Lower Limit
Value


Site 6 - Sulfate
mg/L
250
200
150
100
50
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

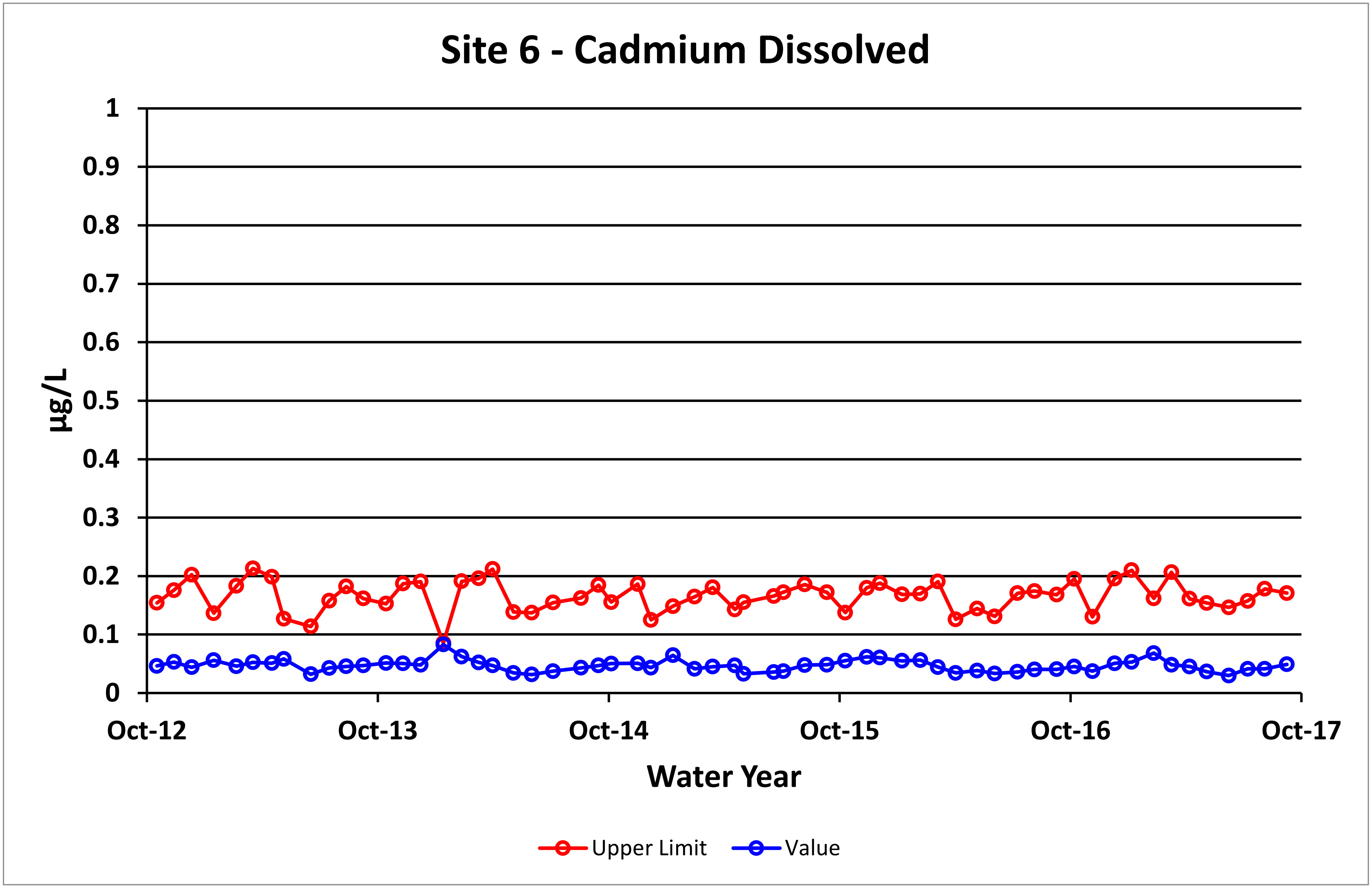


Site 6 - Hardness
100
90
80
70
60
50
40
30
20
10
0
mg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value

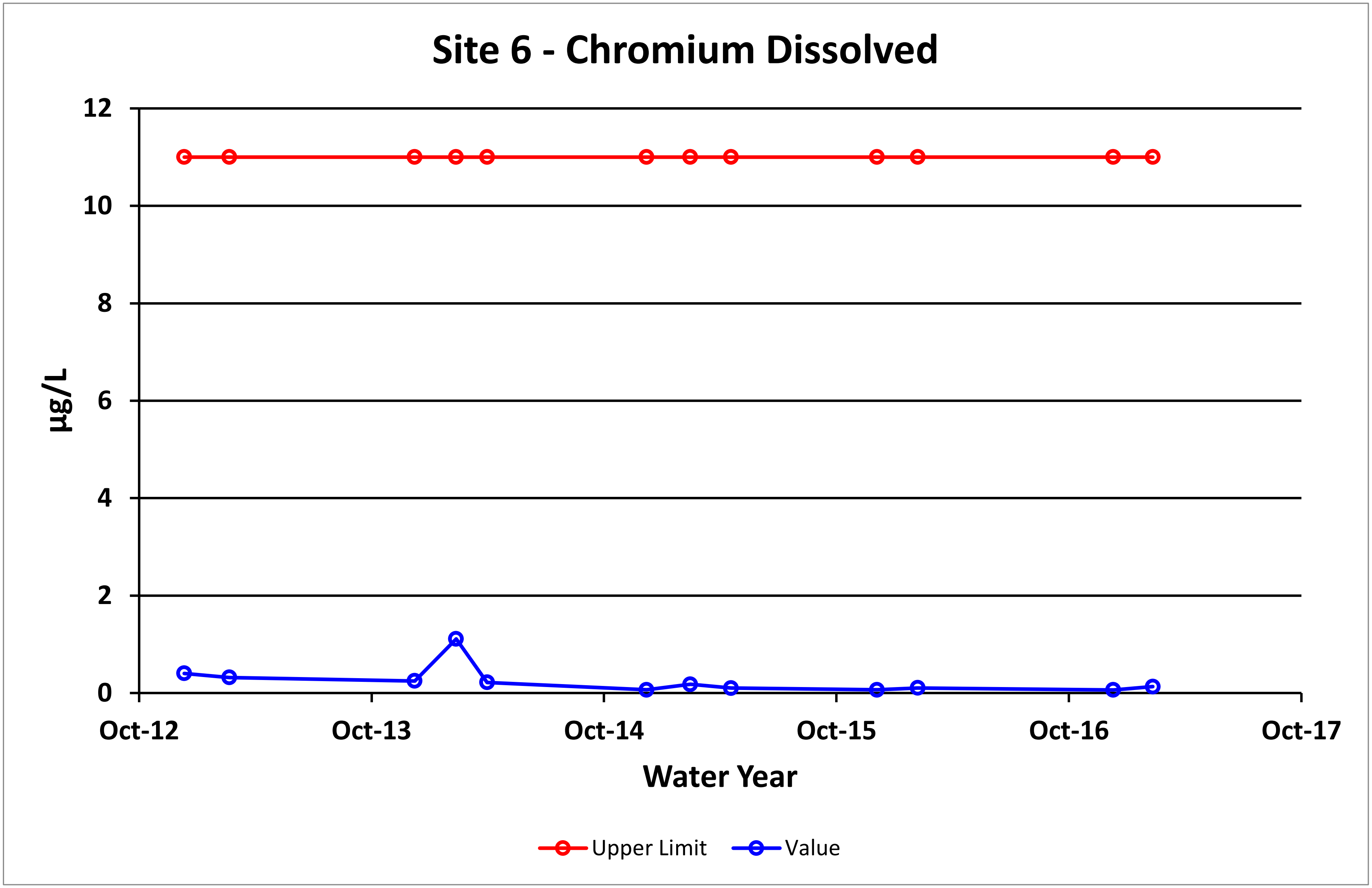

Site 6 - Arsenic Dissolved
10
8
6
4
2
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

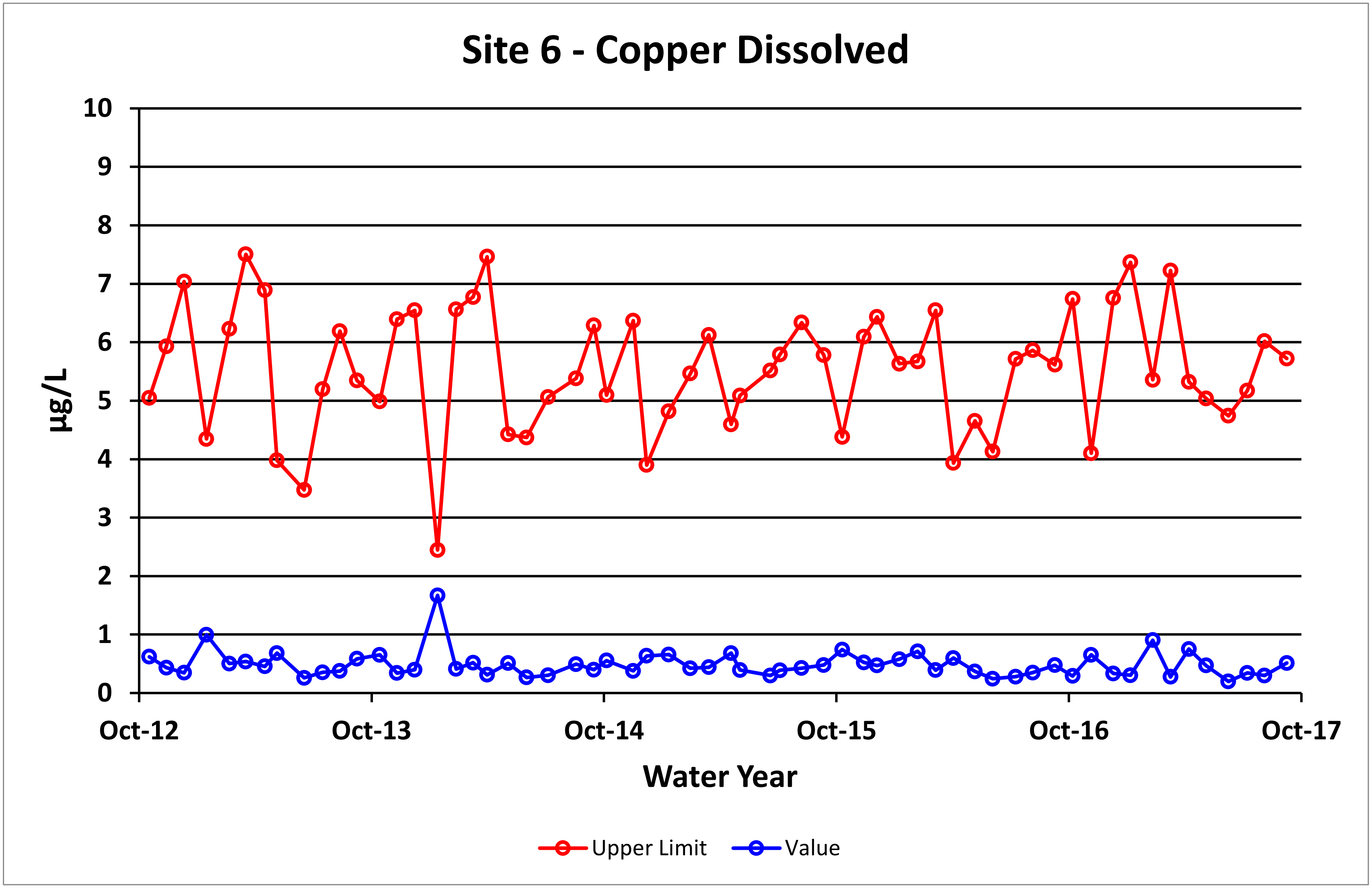


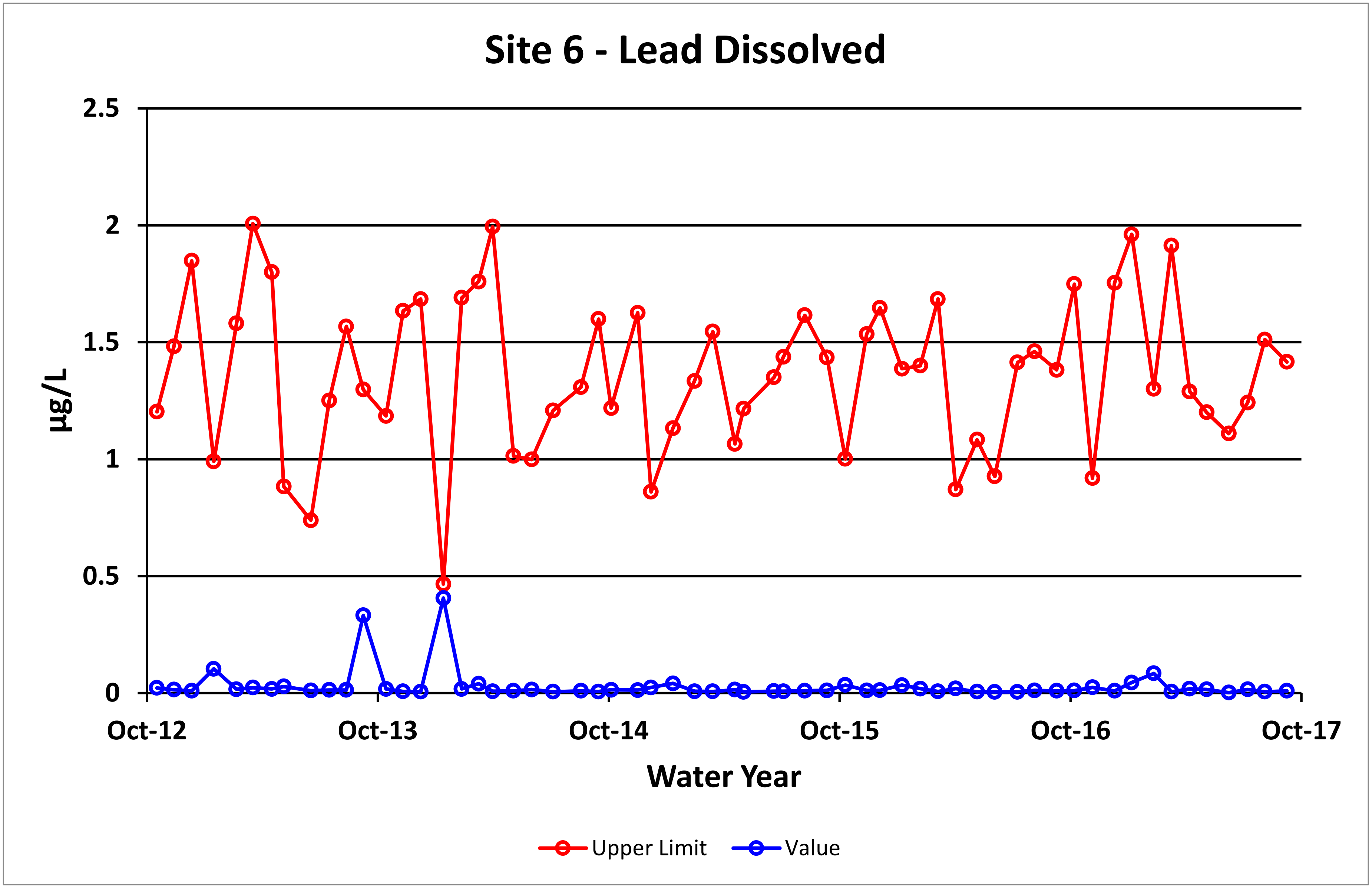
Site 6 - Barium Dissolved
µg/L
2000
1500
1000
500
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value



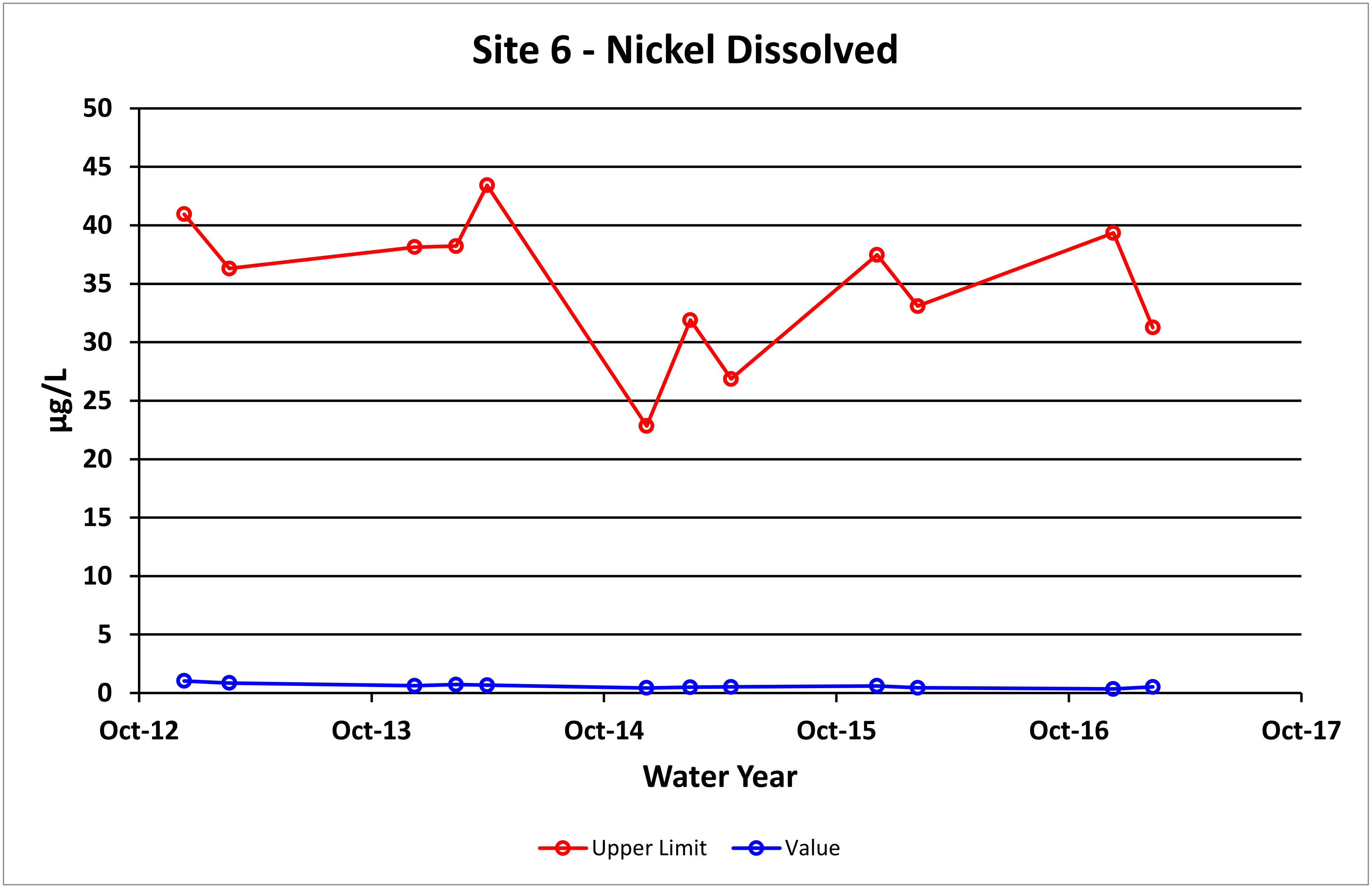
Site 6 - Cadmium Dissolved
µg/L
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

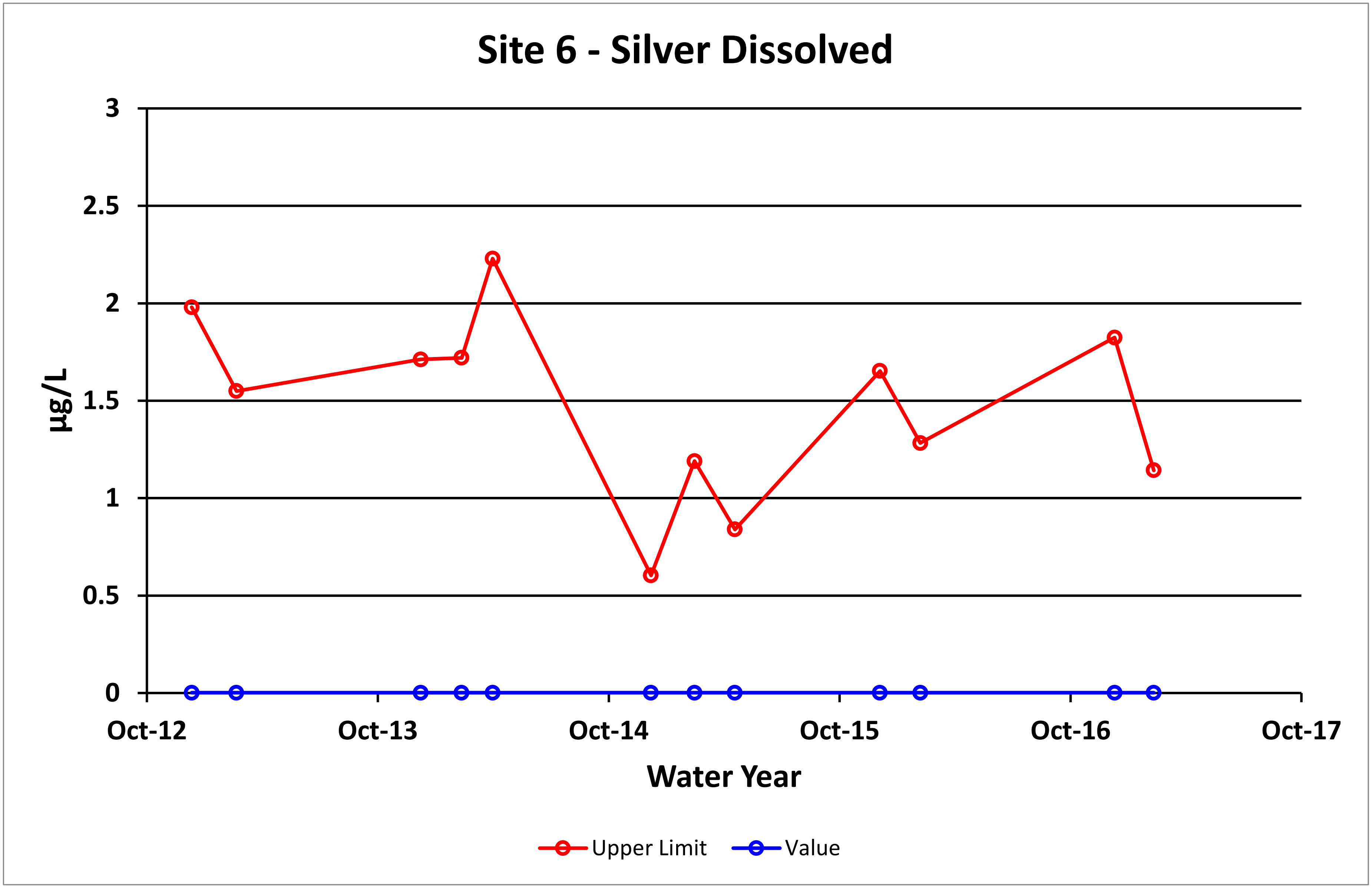

Site 6 - Chromium Dissolved
12
10
8
6
4
2
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

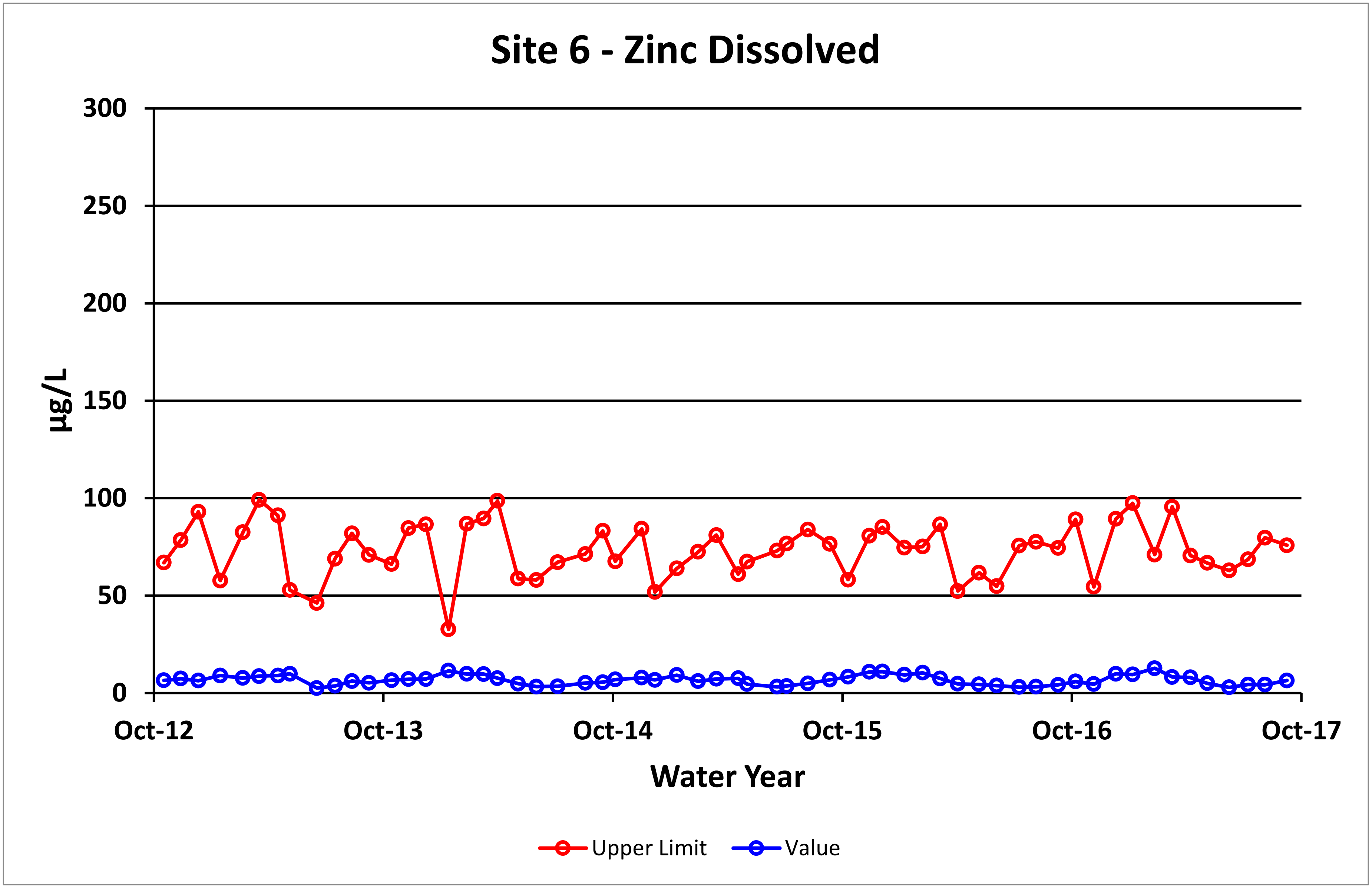

Site 6 - Copper Dissolved
10
9
8
7
6
5
4
3
2
1
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value



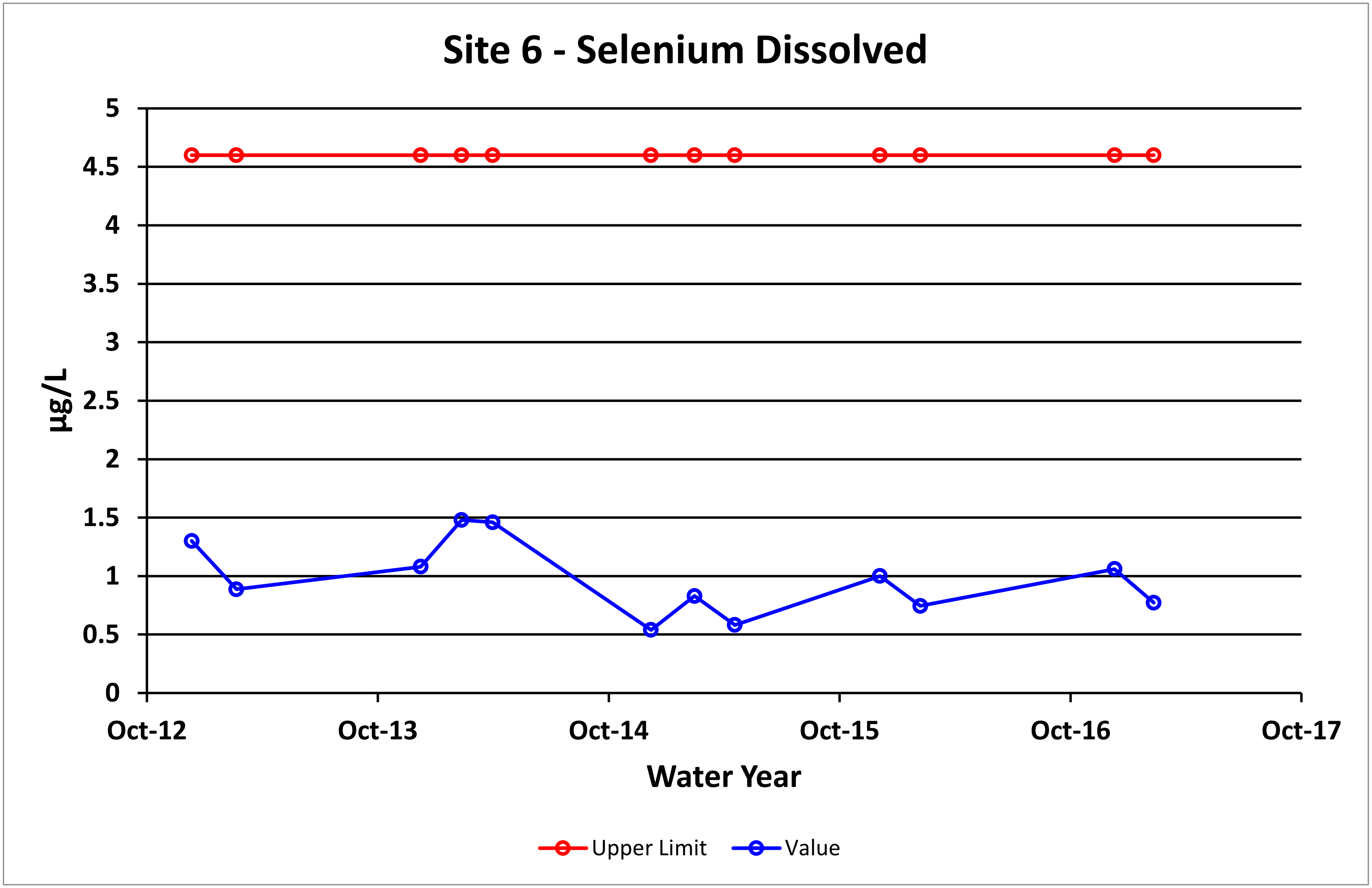
Site 6 - Lead Dissolved
2.5
2
1.5
1
0.5
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

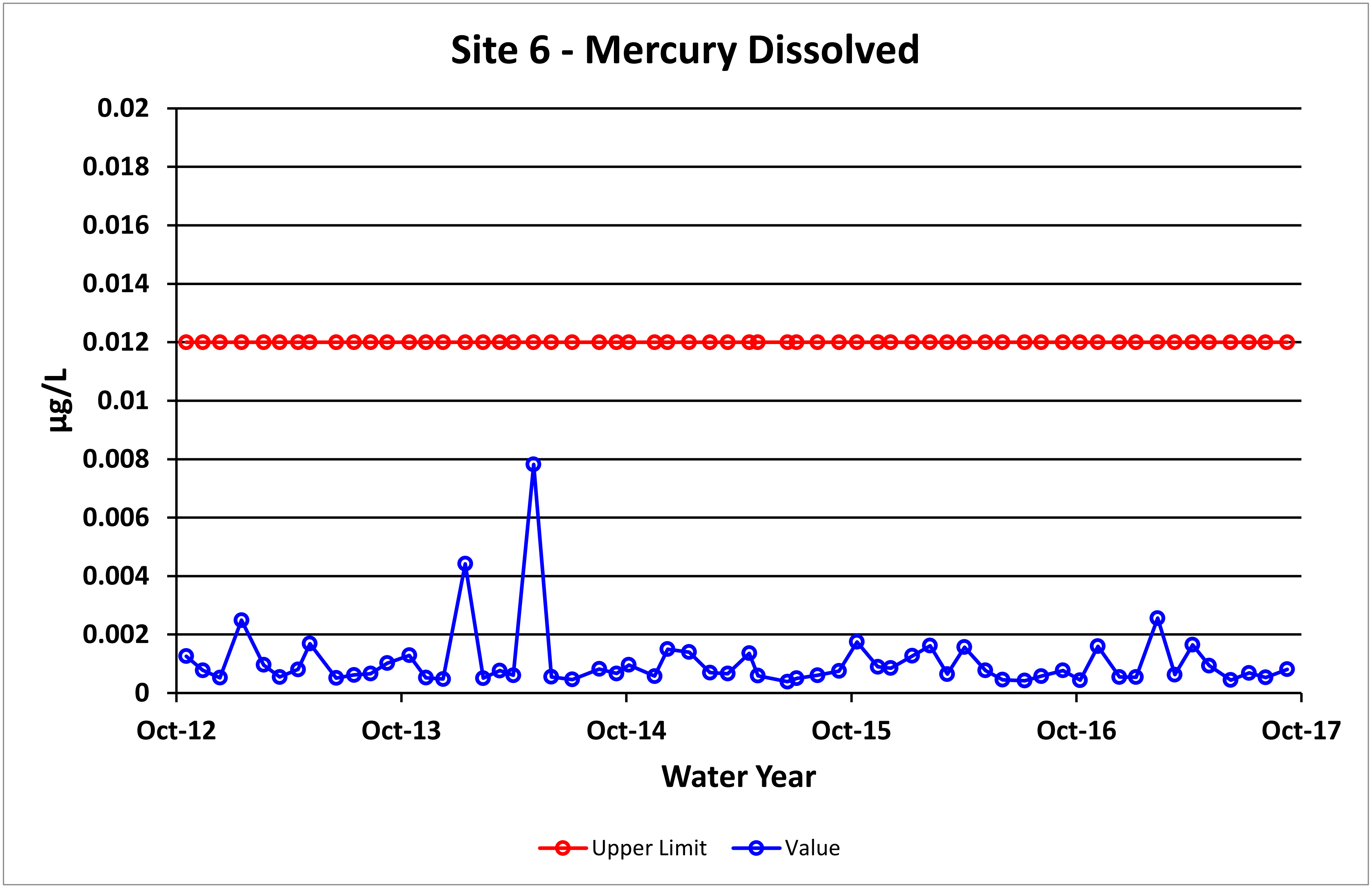

Site 6 - Nickel Dissolved
50
45
40
35
30
25
20
15
10
5
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value


Site 6 - Silver Dissolved
3
2.5
2
1.5
1
0.5
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value



Site 6 - Zinc Dissolved
µg/L
300
250
200
150
100
50
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value


Site 6 - Selenium Dissolved
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value



Site 6 - Mercury Dissolved
0.02
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

Wilcoxon-signed-ranks test

Exact Form

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

	X	Y	Differences		
Site	#48	#6			
Year	WY2017	WY2017	**D**	**|D|**	**Rank**
Oct	147.50	152.90	-5.40	5.40	-6
Nov	79.80	87.80	-8.00	8.00	-8.5
Dec	133.00	134.20	-1.20	1.20	-1
Jan	148.80	130.70	18.10	18.10	12
Feb	106.00	119.50	-13.50	13.50	-11
Mar	154.60	165.70	-11.10	11.10	-10
Apr	104.60	112.60	-8.00	8.00	-8.5
May	105.80	110.00	-4.20	4.20	-4
Jun	96.20	99.60	-3.40	3.40	-2.5
Jul	100.20	103.60	-3.40	3.40	-2.5
Aug	140.60	147.00	-6.40	6.40	-7
Sep	115.10	119.60	-4.50	4.50	-5
Median	110.55	119.55	-4.95	5.90	

n	**m**
12	12

N= 12

$\Sigma R=$ -54

α
0.05
W'α,n
17

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

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

Wilcoxon-signed-ranks test

Exact Form

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

	X	Y	Differences		
Site	#48	#6			
Year	WY2017	WY2017	**D**	**|D|**	**Rank**
Oct	7.99	7.99	0.00		
Nov	7.78	7.78	0.00		
Dec	7.99	8.05	-0.06	0.06	-8
Jan	7.87	7.94	-0.07	0.07	-9.5
Feb	7.50	7.48	0.02	0.02	3
Mar	7.72	7.79	-0.07	0.07	-9.5
Apr	7.91	7.94	-0.03	0.03	-6
May	7.97	7.96	0.01	0.01	1
Jun	7.86	7.87	-0.01	0.01	-2
Jul	7.88	7.85	0.03	0.03	5
Aug	7.98	7.94	0.04	0.04	7
Sep	7.94	7.96	-0.02	0.02	-4
Median	7.90	7.94	-0.01	0.03	

n	m
12	10

N= 10

$\Sigma R=$ -23

α
0.05
W'$_{\alpha,n}$
10

$W^{+}=$
16
p-test
0.138

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

Wilcoxon-signed-ranks test
Exact Form

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

	X	**Y**	Differences		
Site	#48	#6			
Year	WY2017	WY2017	**D**	**|D|**	**Rank**
Oct	57.20	56.20	1.00	1.00	3.5
Nov	31.30	33.50	-2.20	2.20	-8
Dec	53.30	57.20	-3.90	3.90	-11
Jan	55.00	59.80	-4.80	4.80	-12
Feb	38.20	40.90	-2.70	2.70	-10
Mar	56.80	57.40	-0.60	0.60	-2
Apr	41.20	42.40	-1.20	1.20	-5
May	42.00	41.70	0.30	0.30	1
Jun	41.30	40.30	1.00	1.00	3.5
Jul	40.00	42.60	-2.60	2.60	-9
Aug	50.00	51.40	-1.40	1.40	-6
Sep	44.40	45.90	-1.50	1.50	-7
Median	43.20	44.25	-1.45	1.45	

n	**m**
12	12

N= 12

$\Sigma R=$ -62

α
0.05
W'$_{\alpha,n}$
17

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

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

Wilcoxon-signed-ranks test
Exact Form

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

	X	**Y**			
Site	#48	#6	Differences		
Year	WY2017	WY2017	**D**	**|D|**	**Rank**
Oct	17.0	19.0	-2.0	2.0	-7.5
Nov	6.2	7.7	-1.5	1.5	-5
Dec	15.6	18.9	-3.3	3.3	-11
Jan	17.7	20.8	-3.1	3.1	-10
Feb	10.8	12.8	-2.0	2.0	-7.5
Mar	18.6	22.4	-3.8	3.8	-12
Apr	11.1	13.4	-2.3	2.3	-9
May	9.7	10.7	-1.0	1.0	-3
Jun	9.2	10.0	-0.8	0.8	-1
Jul	10.0	10.9	-0.9	0.9	-2
Aug	15.3	17.1	-1.8	1.8	-6
Sep	11.1	12.4	-1.3	1.3	-4
Median	11.1	13.1	-1.9	1.9	

n	**m**
12	12

N= 12

$\Sigma R =$ -78

α
0.05
W'α,n
17

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

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

Wilcoxon-signed-ranks test
Exact Form

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

	X	**Y**	Differences		
Site	#48	#6			
Year	WY2017	WY2017	**D**	**|D|**	**Rank**
Oct	2.42	5.86	-3.44	3.44	-7
Nov	1.64	4.51	-2.87	2.87	-4
Dec	2.02	9.87	-7.85	7.85	-11
Jan	2.29	9.46	-7.17	7.17	-10
Feb	3.74	12.70	-8.96	8.96	-12
Mar	2.63	8.20	-5.57	5.57	-8
Apr	2.21	7.95	-5.74	5.74	-9
May	1.92	5.02	-3.10	3.10	-5
Jun	1.76	2.87	-1.11	1.11	-1
Jul	2.01	4.31	-2.30	2.30	-2
Aug	1.81	4.20	-2.39	2.39	-3
Sep	3.00	6.37	-3.37	3.37	-6
Median	2.12	6.12	-3.41	3.41	

n	**m**
12	12

N= 12
ΣR= -78

α
0.05
W'α,n
17

W^+=
0
p-test
0.000

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

INTERPRETIVE REPORT
SITE 54

The data collected during the current water year are listed in the following "Table of Results for Water Year 2017" report. The table includes all the required FWMP analyte data (field and laboratory) collected for the current water year and a series of flags keyed to the summary report "Qualified Data by QA Reviewer". The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of ½ MDL for the purpose of median calculation.

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

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

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

Table of Exceedance for Water Year 2017

			Limits		
Sample Date	**Parameter**	**Value**	**Lower**	**Upper**	**Hardness**
No exceedances have been identified by HGCMC for the period of October 2016 through September 2017.					

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-11 and Sep-17 (WY2012-WY2017).

Table of Summary Statistics for Trend Analysis

	Mann-Kendall test statistics			Sen's slope estimate	
Parameter	**n***	**p****	**Trend**	**Q**	**Q(%)**
Conductivity Field	6	0.48			
pH Field	6	1.00	+	0.04	0.6
Alkalinity, Total	6	0.84			
Sulfate, Total	6	0.16			
Zinc, Dissolved	6	0.01	-	-0.16	-2.4

* Number of Years ** Significance level

Field pH had a statistically significant ($p = 1$) trend with a slope estimate of 0.04 su/yr. or 0.6% increase. However given the low magnitude and similar trend noted at Site 6 and Site 48, HGCMC does not believe that this is a significant indication of changes in water chemistry at Site 54. Zinc had a -0.16 µg/l/year slope estimate, similar to the previous year and that observed at Site 48.

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 2017 dataset.

Table of Summary Statistics for Median Analysis

Site 54 vs Site 6

Parameter	**Signed Ranks p-value**	**Site 6 median**	**Site 54 median**	**Median Differences**
Conductivity Field	0.088	119.6	123.2	-1.9
pH Field	0.076	7.94	7.88	0.03
Alkalinity, Total	0.032	44.25	45.7	-0.07
Sulfate, Total	0.014	13.1	14.9	-0.20
Zinc, Dissolved	<0.01	6.12	5.87	0.3

Unlike the previous year there was a significant difference in sulfate observed in the current year. It was not accompanied by a statistically significant increasing trend at Site 54 or decreasing trend at Site 6, which indicates there hasn't been a significant change in sulfate over the past several years. 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 2017

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

Sample Date/Parameter	Oct 2016	Nov 2016	Dec 2016	Jan 2017	Feb 2017	Mar 2017	Apr 2017	May 2017	Jun 2017	Jul 2017	Aug 2017	Sep 2017	**Median**
Water Temp (°C)	2.8	5	0.7	0.7	0.5	0.3	0.9	2.9	4.9	7.1	9.1	7.5	2.9
Conductivity-Field(µmho)	154.8	89.5	124.7	167.3	126	172	117.6	95.5	101.1	105.5	148.8	121.6	123.2
Conductivity-Lab (µmho)	155	85	152	168	120	169	117	108	100	105	134	123	122
pH Lab (standard units)	7.73	7.49	7.45	7.61	7.19	7.44	7.42	7.29	7.28	7.33	7.5	7.35	7.43
pH Field (standard units)	7.98	7.82	8.1	7.87	7.44	7.72	7.89	7.92	7.85	7.87	7.92	7.93	7.88
Total Alkalinity (mg/L)	57.6	34	56	59.2	43.5	58.3	44.6	42.2	40.5	42.3	52.7	46.8	45.7
Total Sulfate (mg/L)	19.3	7.7	19.1	21.4	15.1	22.5	14.6	10.8	10.3	10.9	16.8	12.4	14.9
Hardness (mg/L)	73.1	41	79.8	81.9	58.1	78.6	45.4	52.1	48.5	52.3	65.3	62	60.1
Dissolved As (ug/L)	0.182	0.215	0.181	0.169	0.182	0.143	0.169	0.17	0.195	0.208	0.209	0.232	0.182
Dissolved Ba (ug/L)			32		22.8								27.4
Dissolved Cd (ug/L)	0.0459	0.0343	0.0543	0.0502	0.0632	0.0438	0.0445	0.0363	0.0307	0.0382	0.0396	0.0486	0.0442
Dissolved Cr (ug/L)			0.103		0.138								0.121
Dissolved Cu (ug/L)	0.28	0.649	0.325	0.311	0.893	0.291	0.755	0.502	0.212	0.347	0.299	0.493	0.336
Dissolved Pb (ug/L)	0.005	0.0217	0.0095	0.0365	0.0965	0.0059	0.0191	0.0147	0.0015	0.0047	0.0072	0.0091	0.0093
Dissolved Ni (ug/L)			0.36		0.654								0.507
Dissolved Ag (ug/L)			0.002		0.003								0.003
Dissolved Zn (ug/L)	5.57	4.52	8.94	8.77	11.9	7.37	7.25	4.78	2.96	3.99	4.16	6.16	5.87
Dissolved Se (ug/L)			1.18		0.747								0.964
Dissolved Hg (ug/L)	0.000443	0.00162	0.000522	0.000473	0.00269	0.000453	0.00164	0.000944	0.000394	0.000706	0.0005	0.000892	0.000614

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

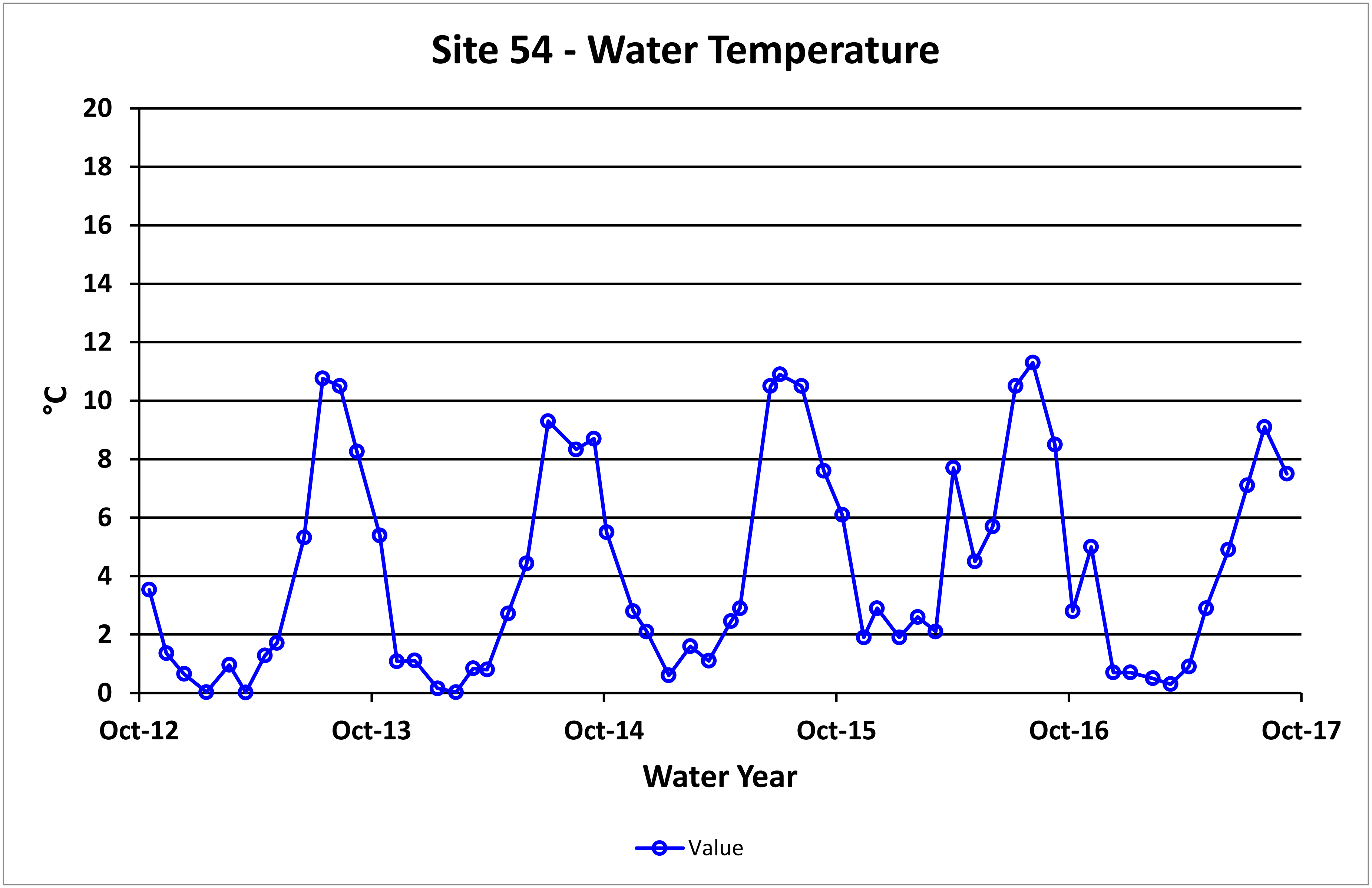
Values reported as less than MDL are replaced by 1/2 MDL for median calculation purposes.

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

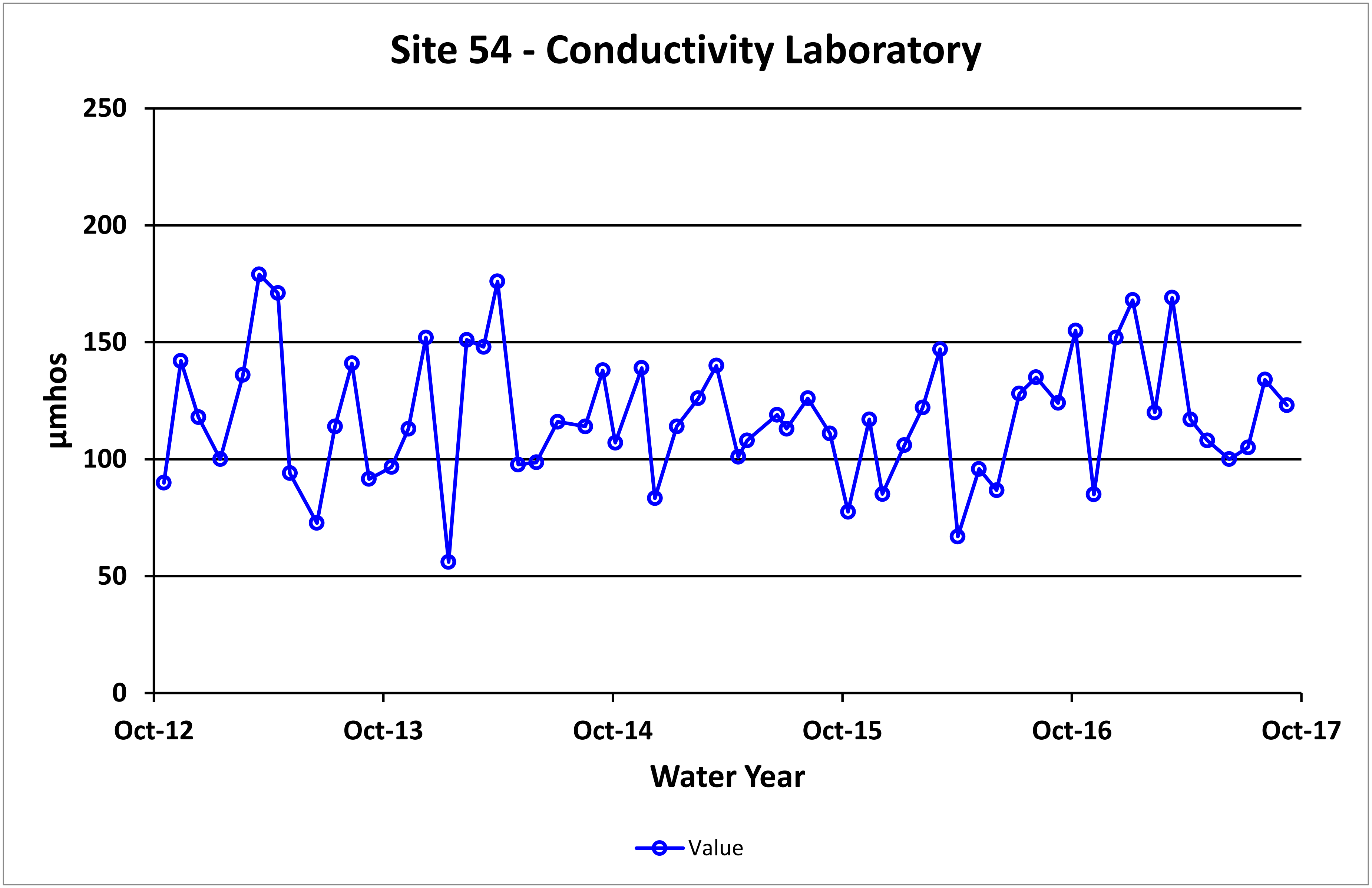
Qualified Data by QA Reviewer

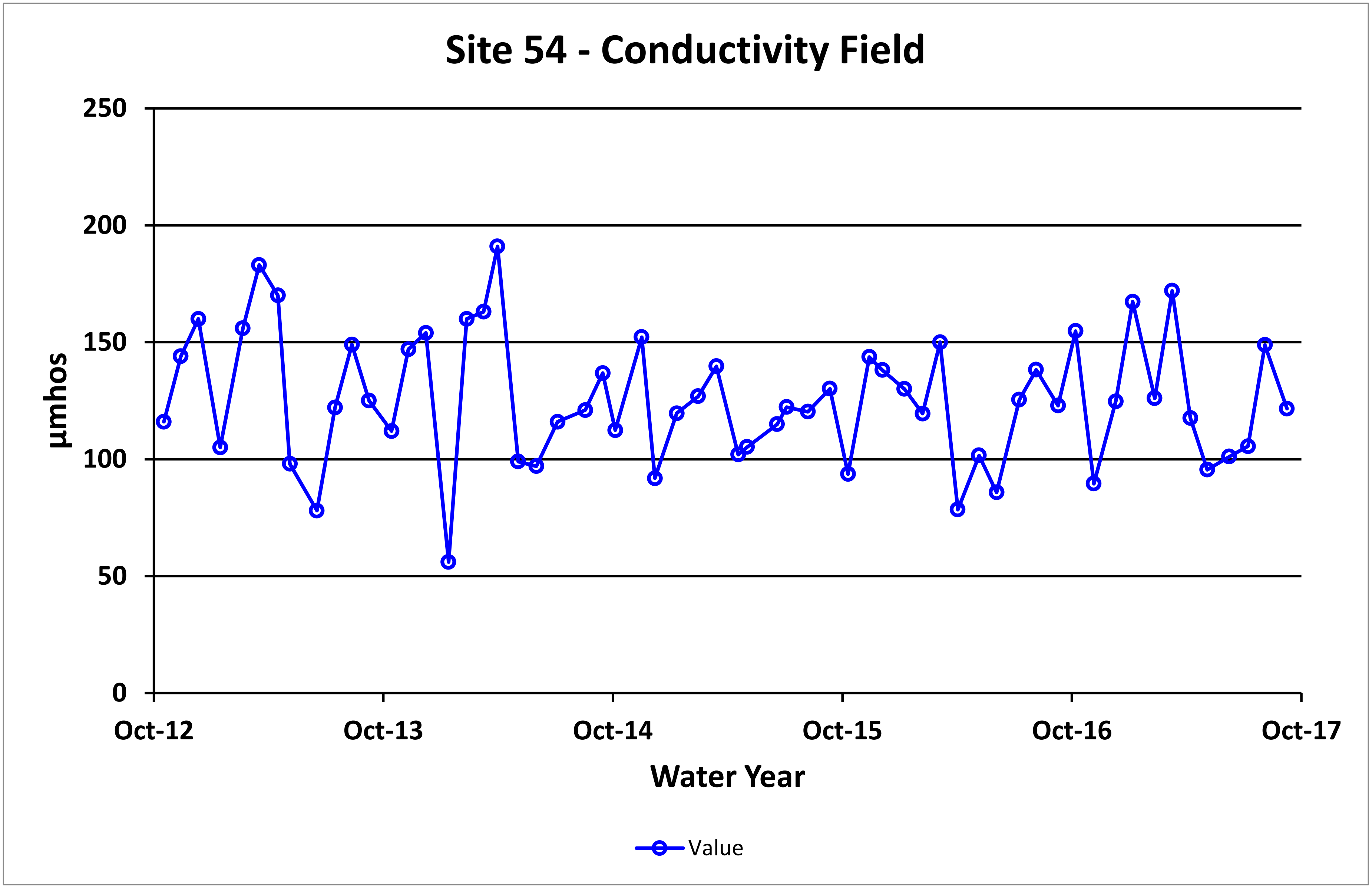
Date Range: 10/01/2016 to 09/30/2017

Site No.	Sample Date	Sample Time	Parameter	Value		Qualifier	Reason for Qualifier
054FMS	10/10/2016	12:00 PM	Diss. Pb-ICP/MS	0.00501	µg/L	J	Below Quantitative Range
	12/13/2016	12:00 PM	Diss. Cr-ICP/MS	0.1	µg/L	J	Below Quantitative Range
	2/13/2017	12:00 PM	Diss. Ag-ICP/MS	0.00331	µg/L	J	Below Quantitative Range
			Diss. Cr-ICP/MS	0.13	µg/L	J	Below Quantitative Range
	3/13/2017	12:00 PM	Diss. Pb-ICP/MS	0.00591	µg/L	J	Below Quantitative Range
	5/8/2017	12:00 PM	Diss. Hg-CVAF	0.000944	µg/L	U	Trip Blank Contamination
			Tot. Sulfate	10.8	mg/L	J	Sample Receipt Temperature
	6/12/2017	12:00 PM	Diss. Cu-ICP/MS	0.21	µg/L	U	Field Blank Contamination
			Diss. Zn-ICP/MS	2.96	µg/L	U	Field Blank Contamination
			Tot. Sulfate	10.3	mg/L	J	Hold Time Violatoin, Sample Receipt Temperature
	7/12/2017	12:00 PM	Diss. Pb-ICP/MS	0.00469	µg/L	J	Below Quantitative Range
	8/8/2017	12:00 PM	Diss. Pb-ICP/MS	0.00723	µg/L	J	Below Quantitative Range
			Tot. Sulfate	16.8	mg/L	J	Sample Receipt Temperature

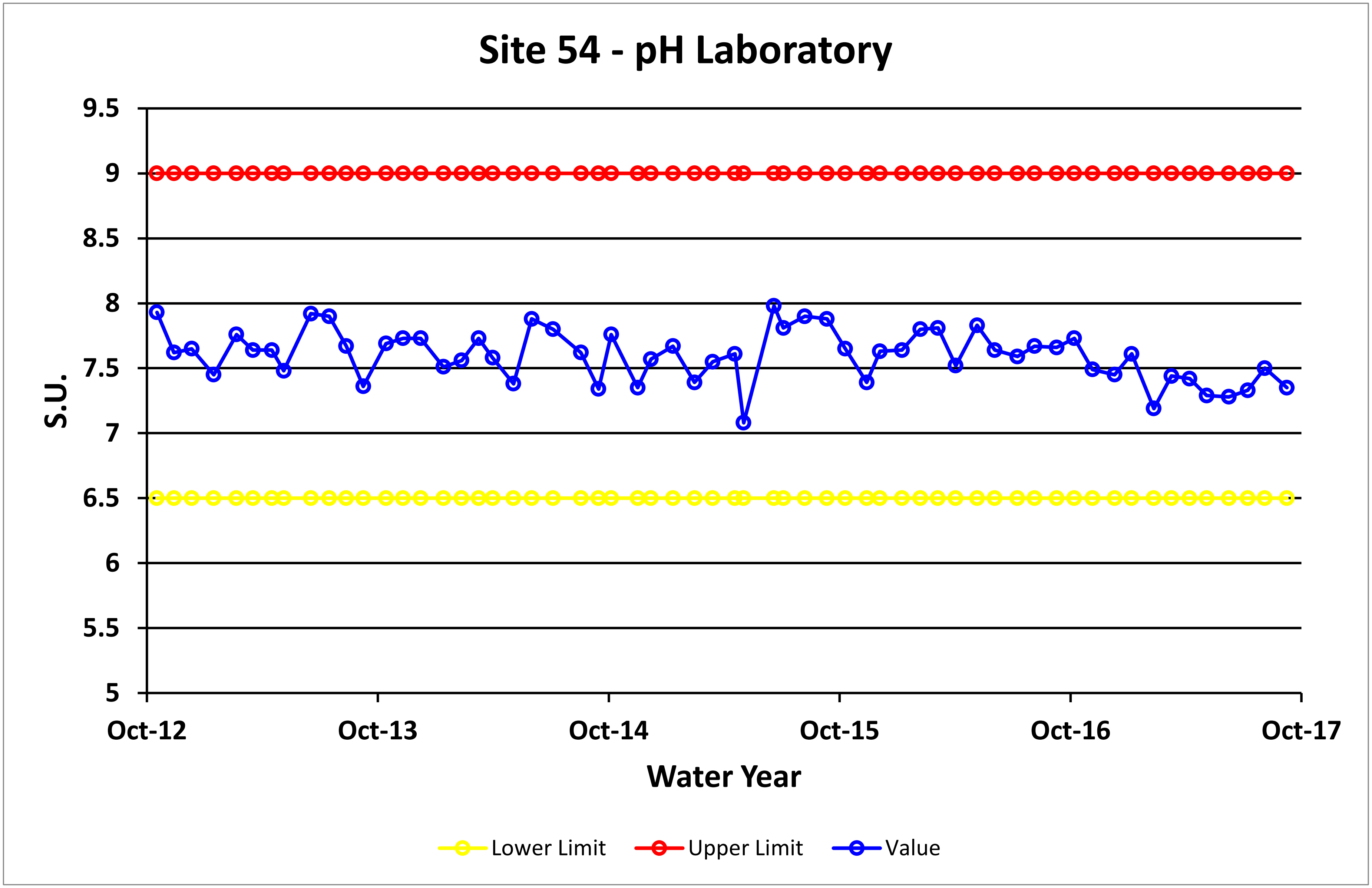


Site 54 - Water Temperature
20
18
16
14
12
10
8
6
4
2
0
°C
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value

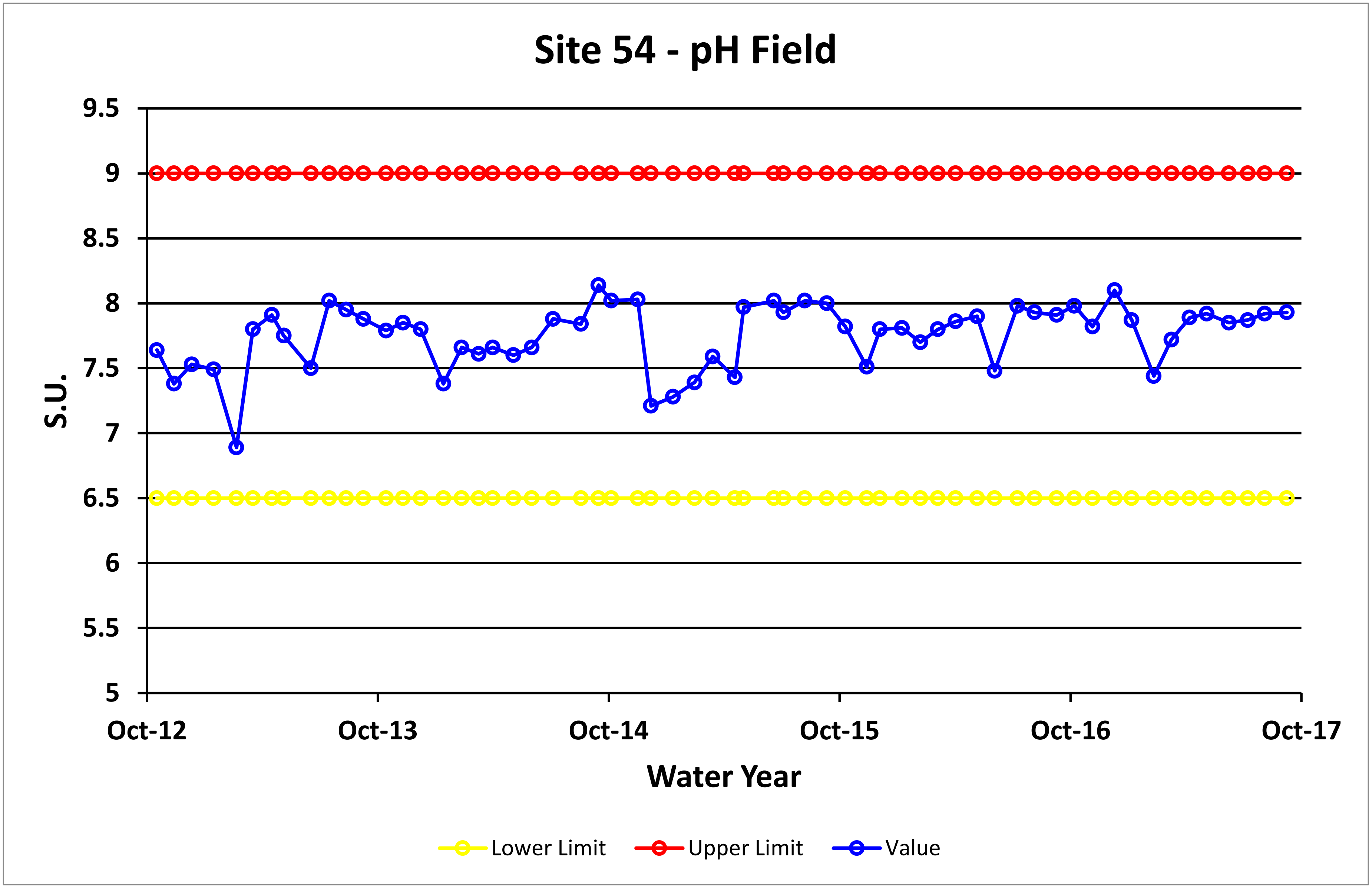

Site 54 - Conductivity Laboratory
250
200
150
100
50
0
µmhos
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value

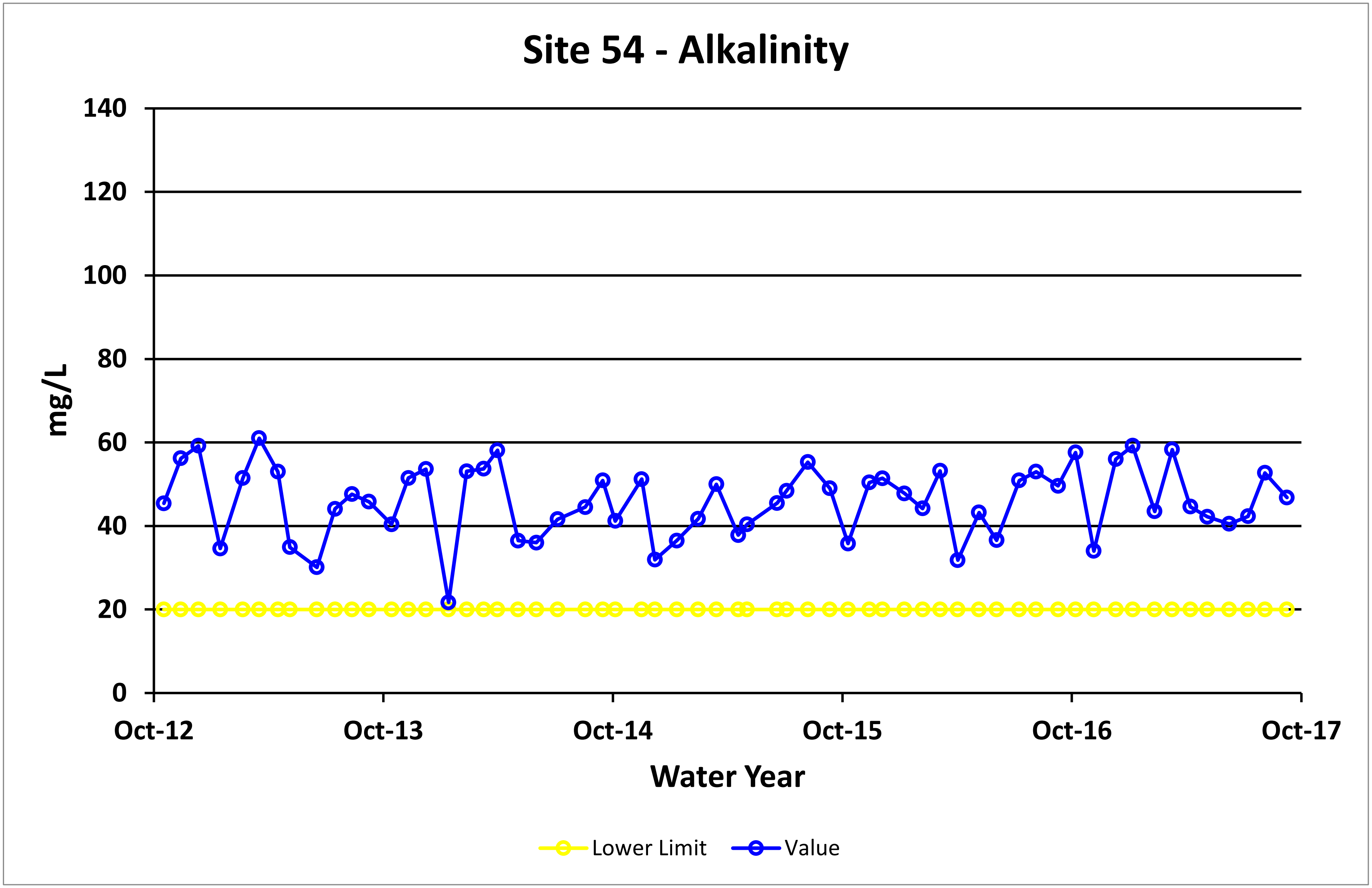


Site 54 - Conductivity Field
250
200
150
100
50
0
µmhos
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value

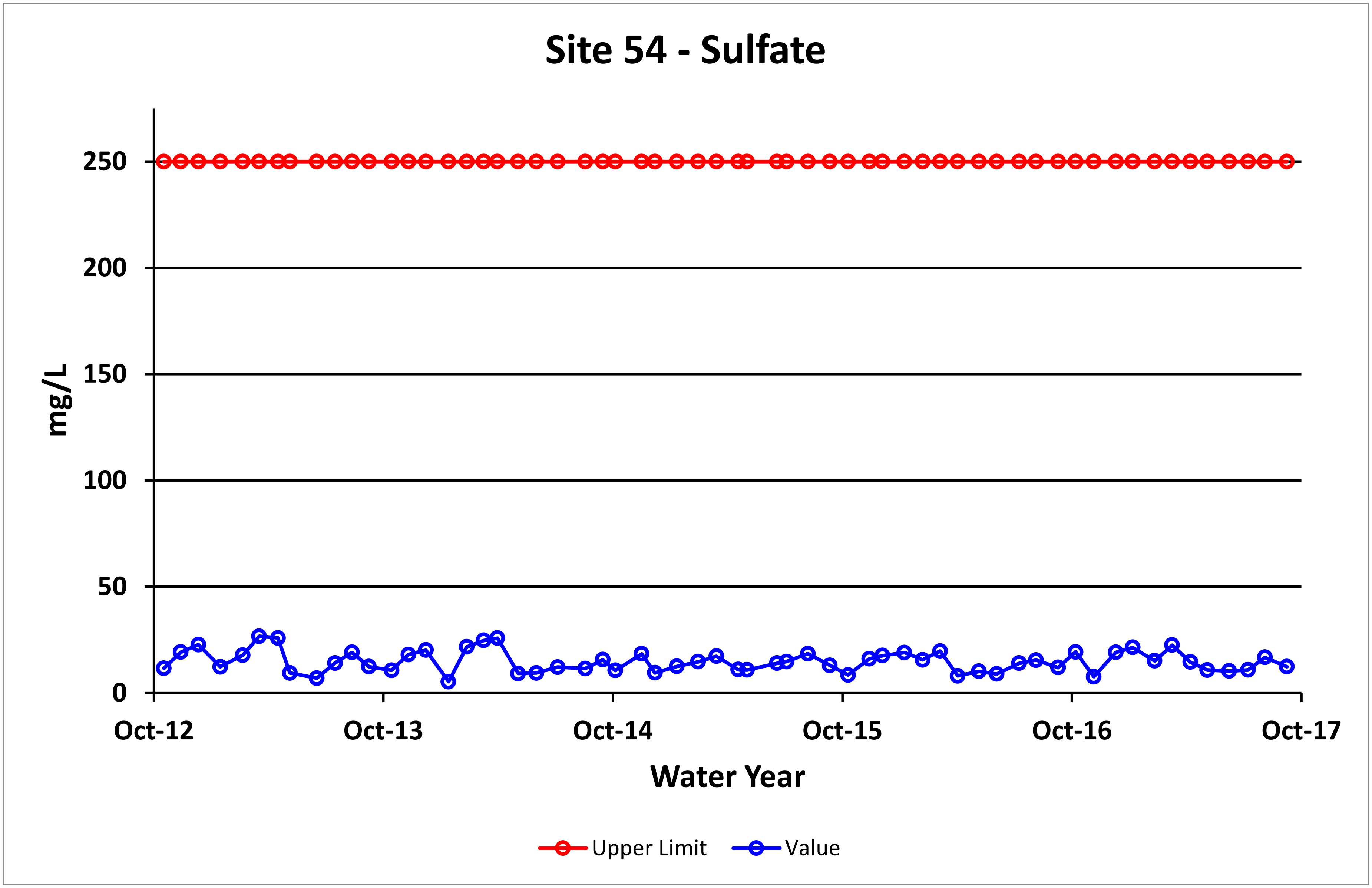


Site 54 - pH Laboratory
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
S.U.
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Lower Limit
Upper Limit
Value

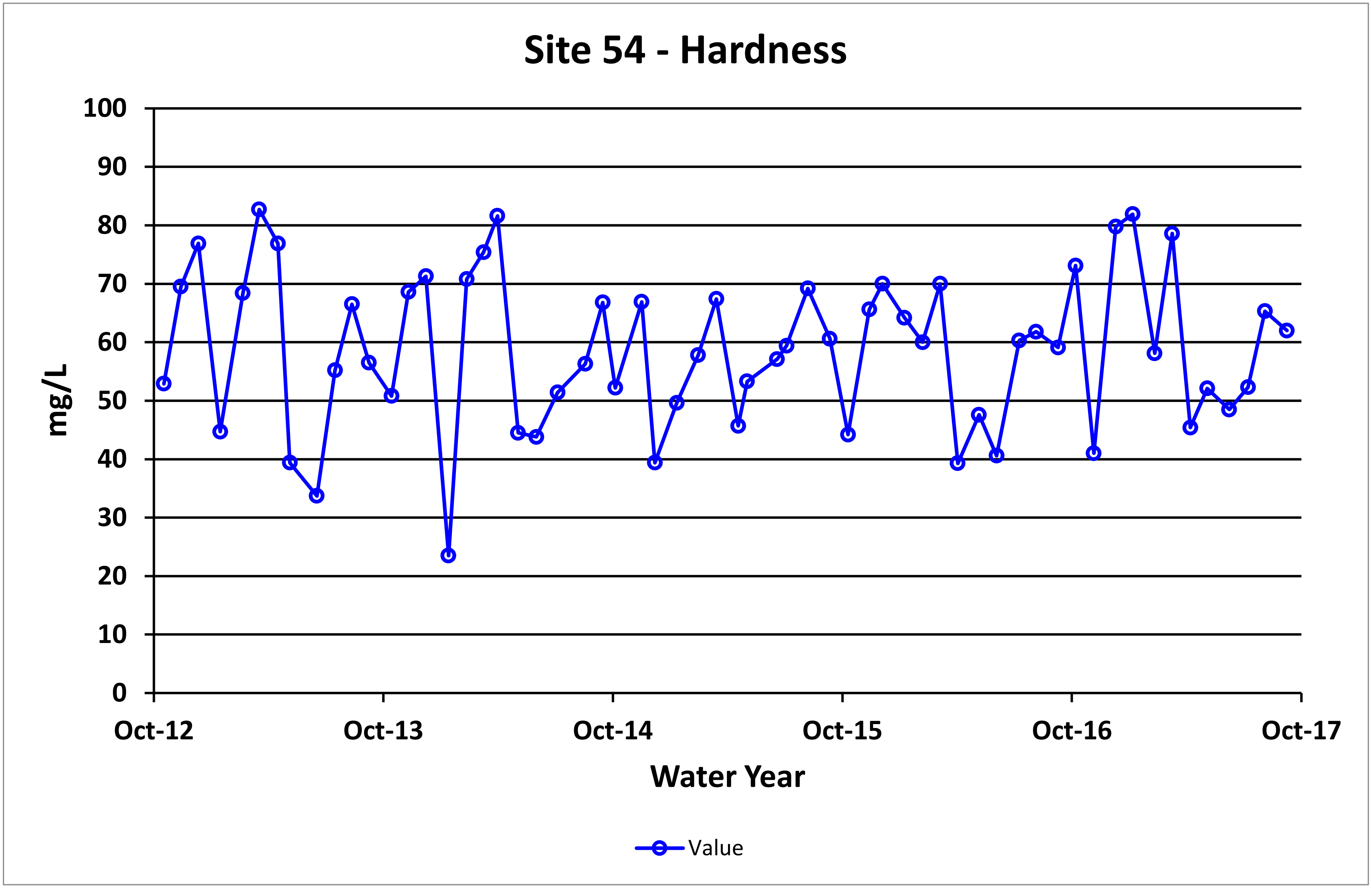

Site 54 - pH Field
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
S.U.
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Lower Limit
Upper Limit
Value

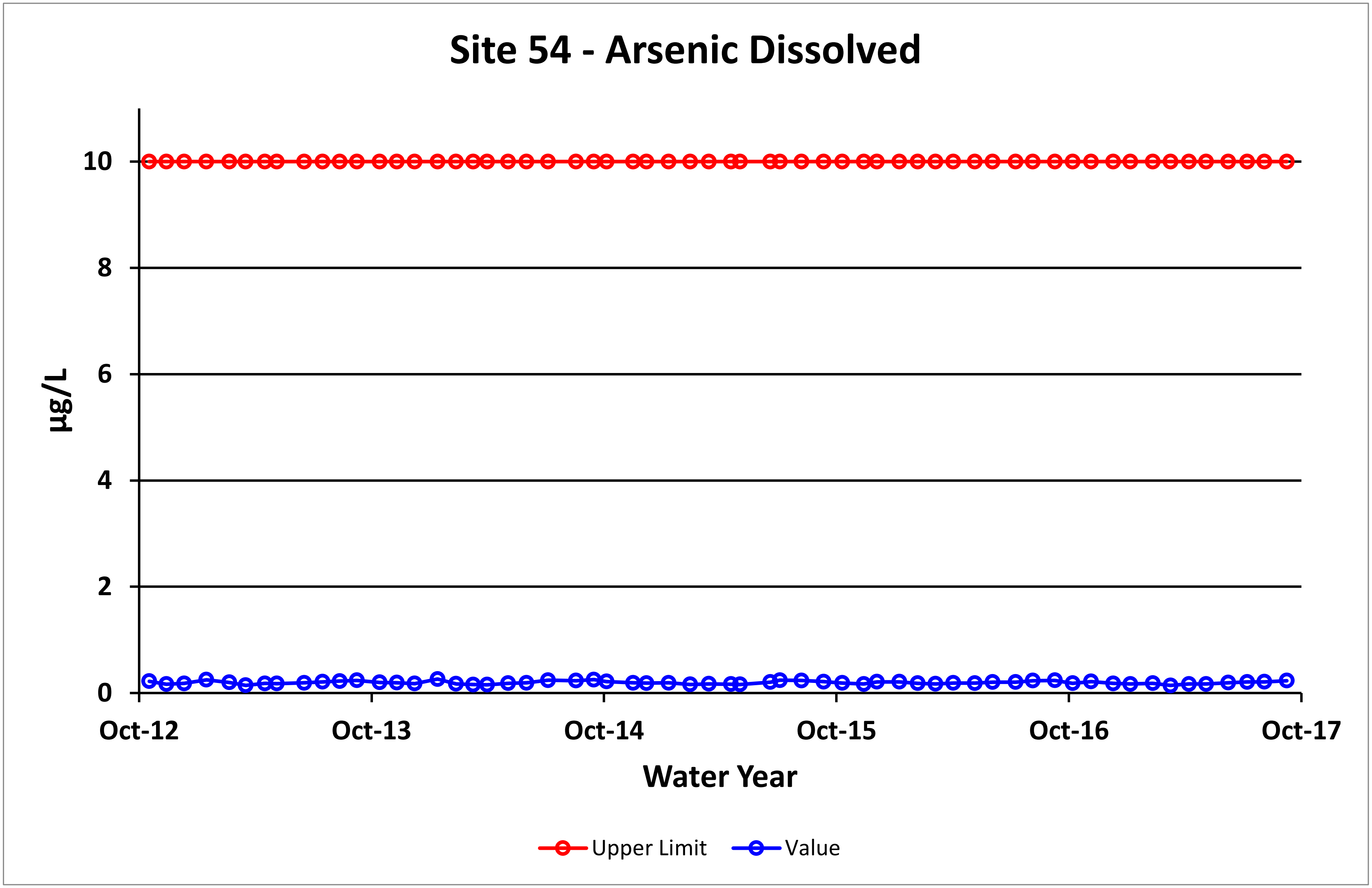


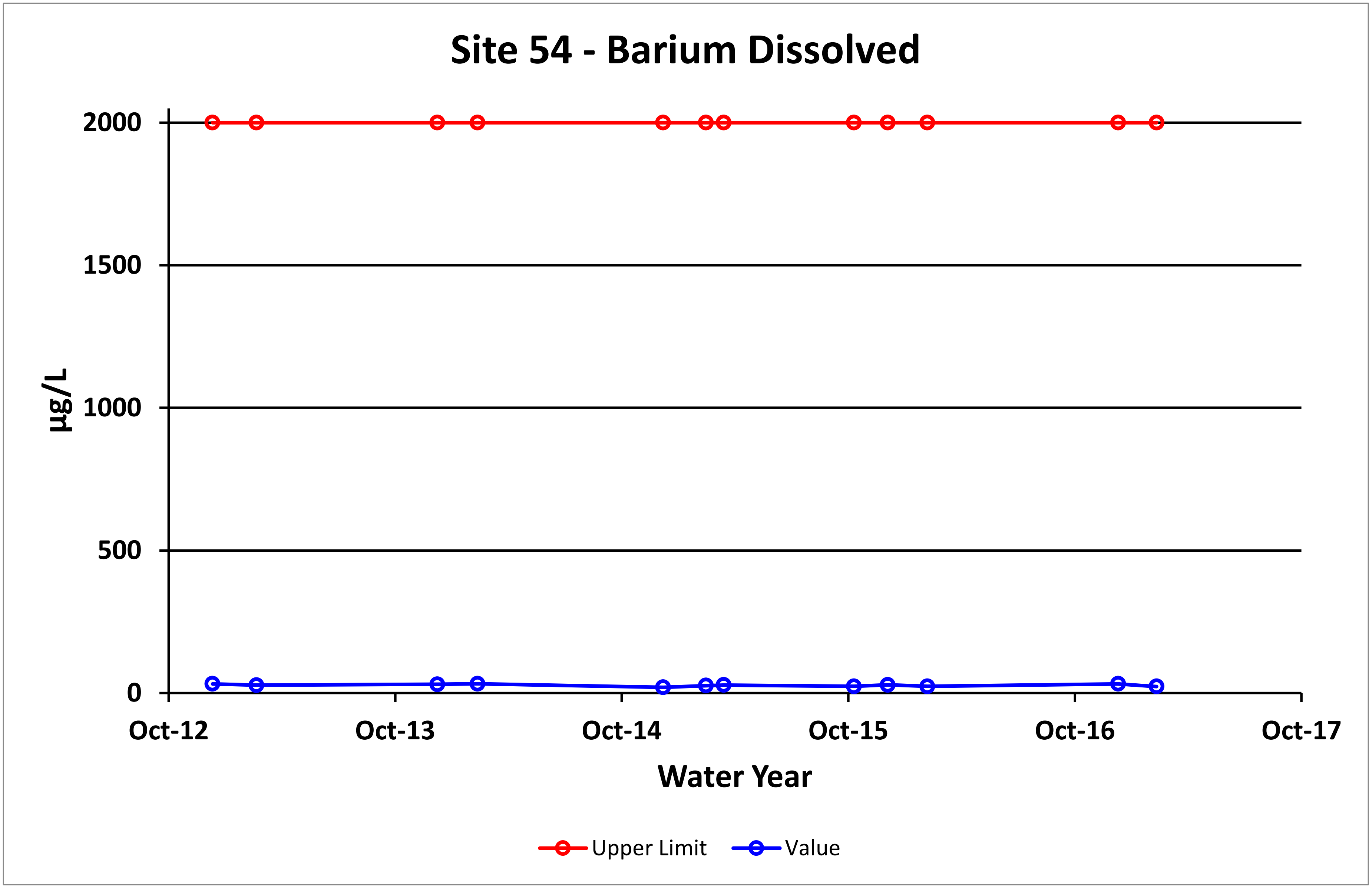
Site 54 - Alkalinity
140
120
100
80
60
40
20
0
mg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Lower Limit
Value

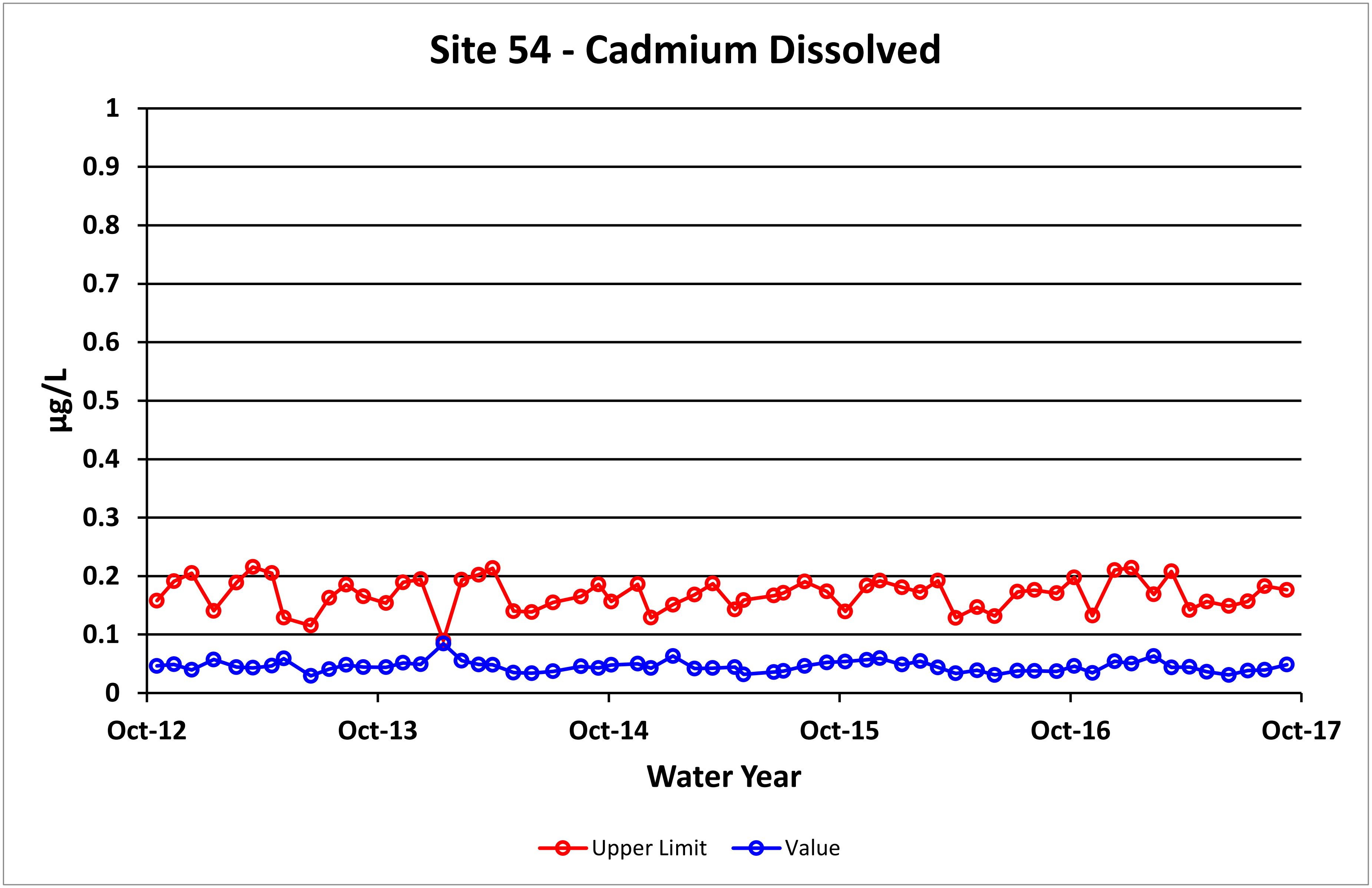


Site 54 - Sulfate
mg/L
250
200
150
100
50
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

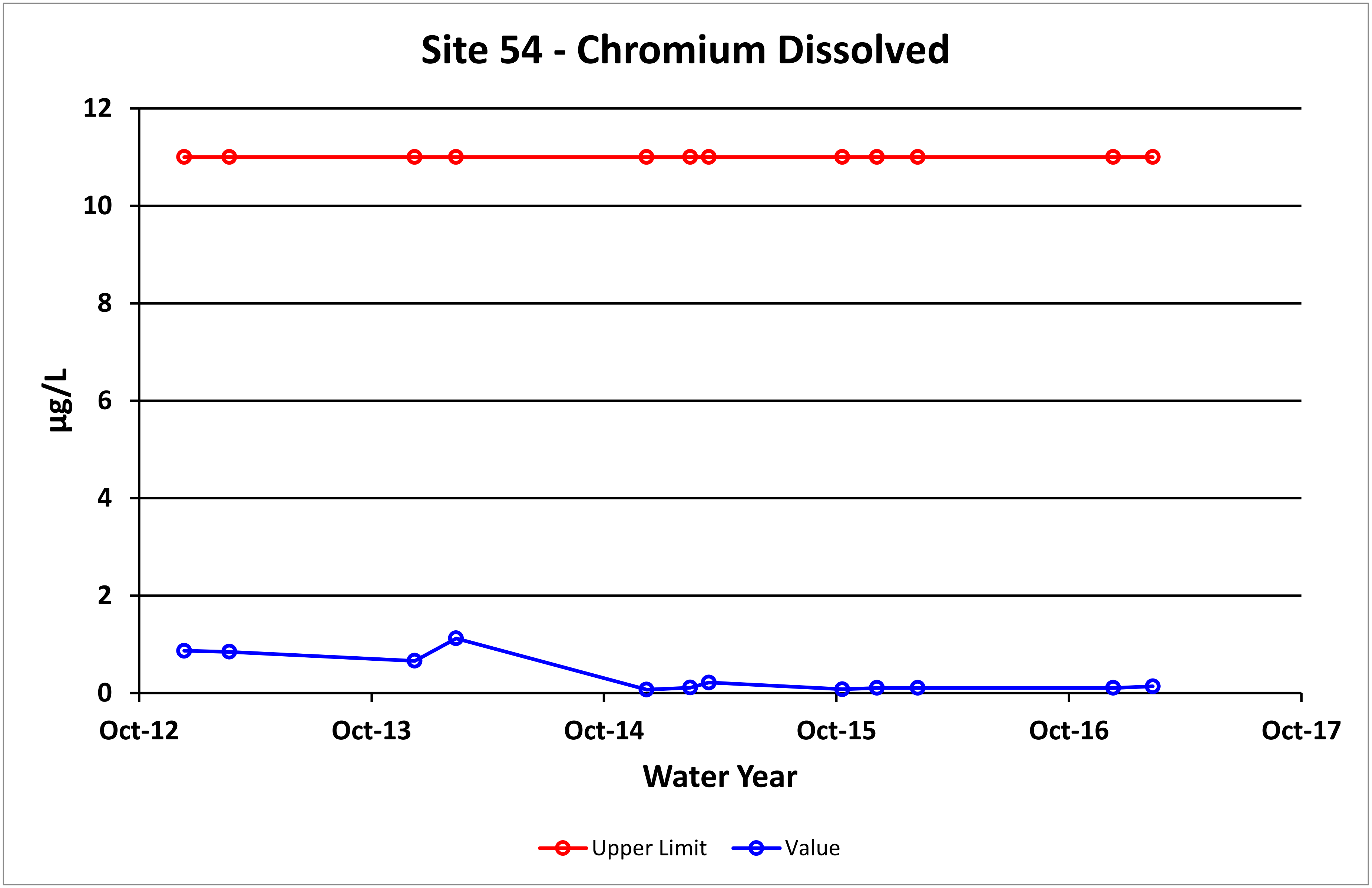

Site 54 - Hardness
100
90
80
70
60
50
40
30
20
10
0
mg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value


Site 54 - Arsenic Dissolved
µg/L
10
8
6
4
2
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

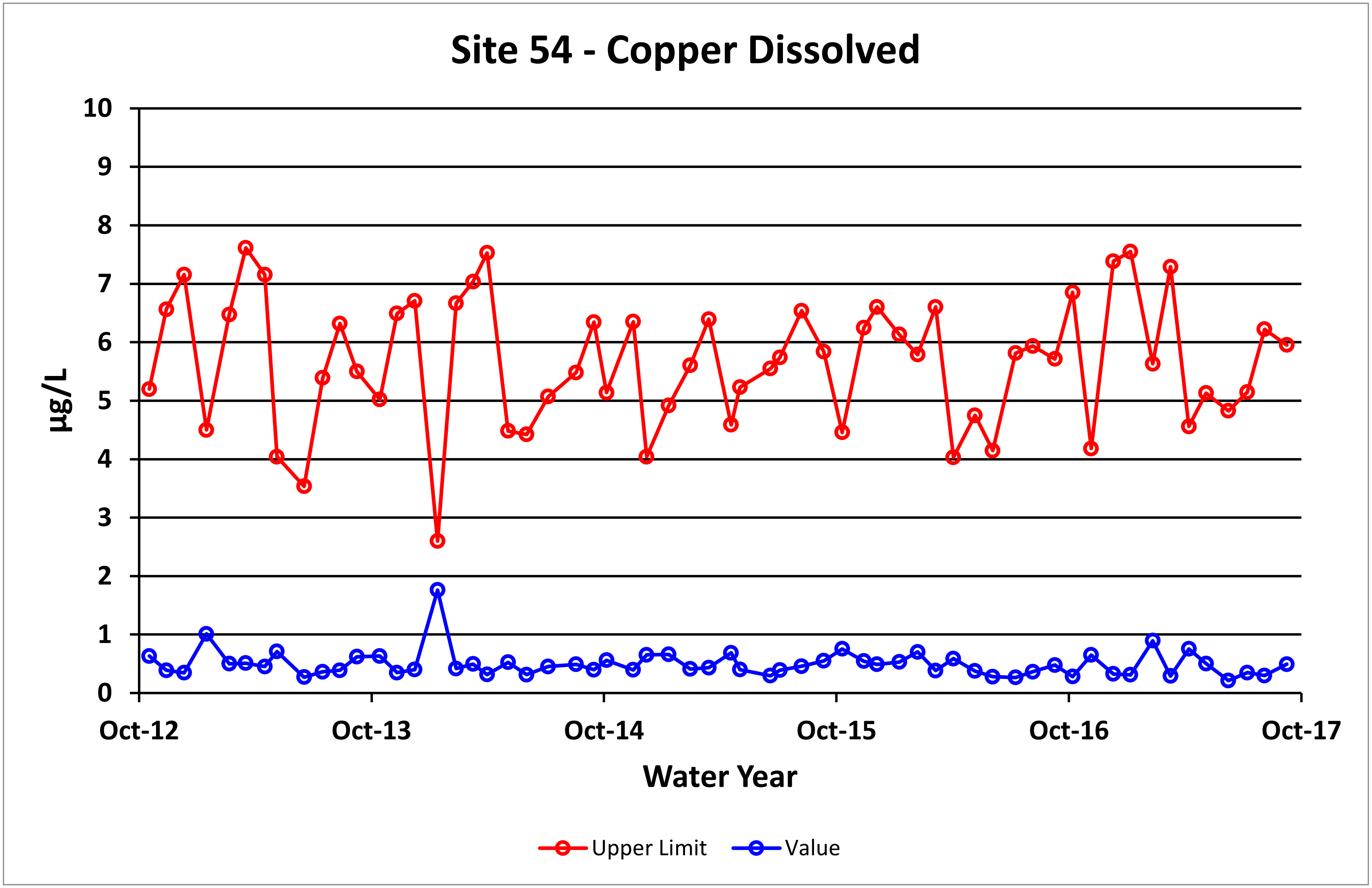

Site 54 - Barium Dissolved
µg/L
2000
1500
1000
500
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

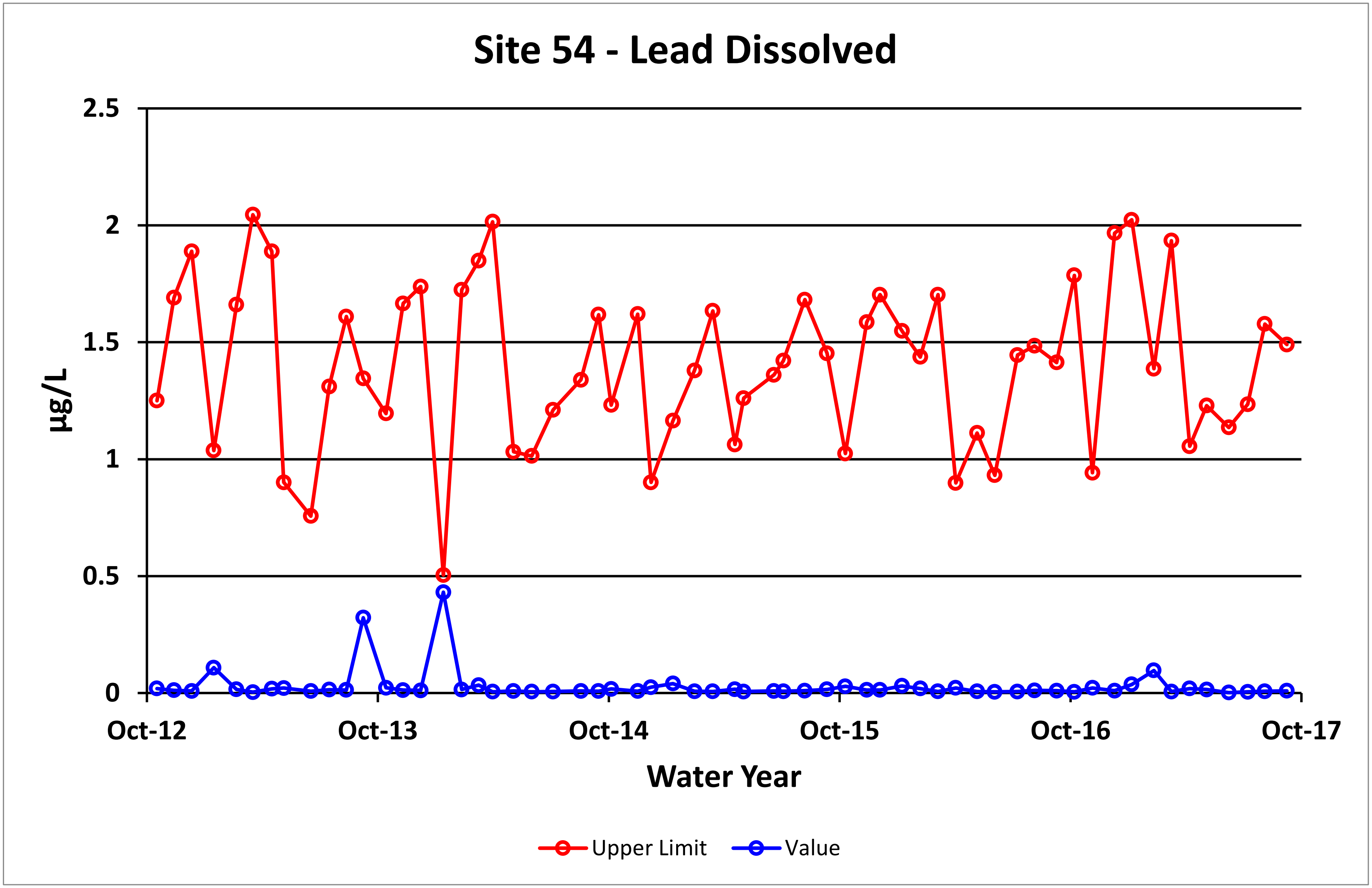


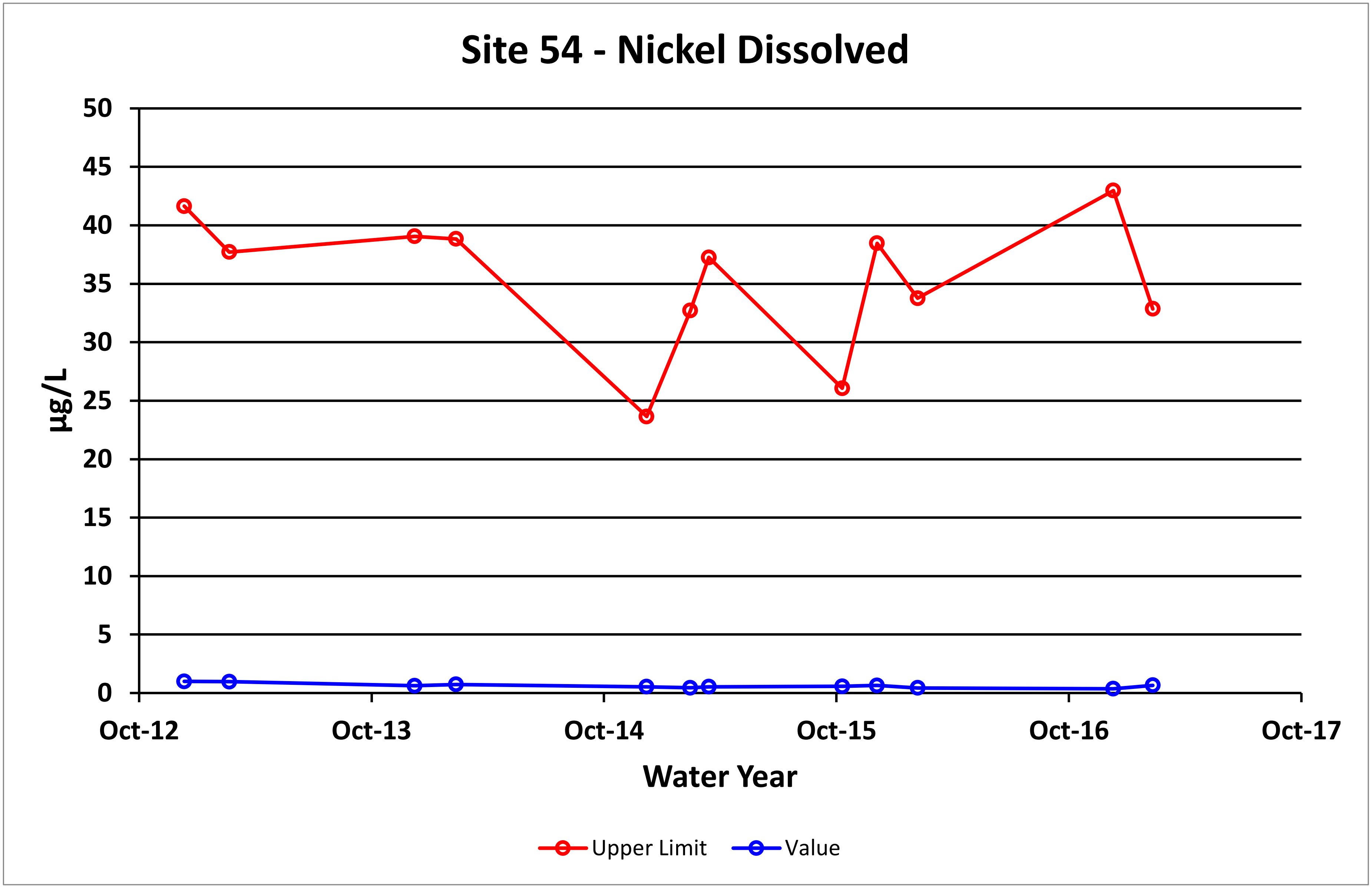
Site 54 - Cadmium Dissolved
µg/L
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

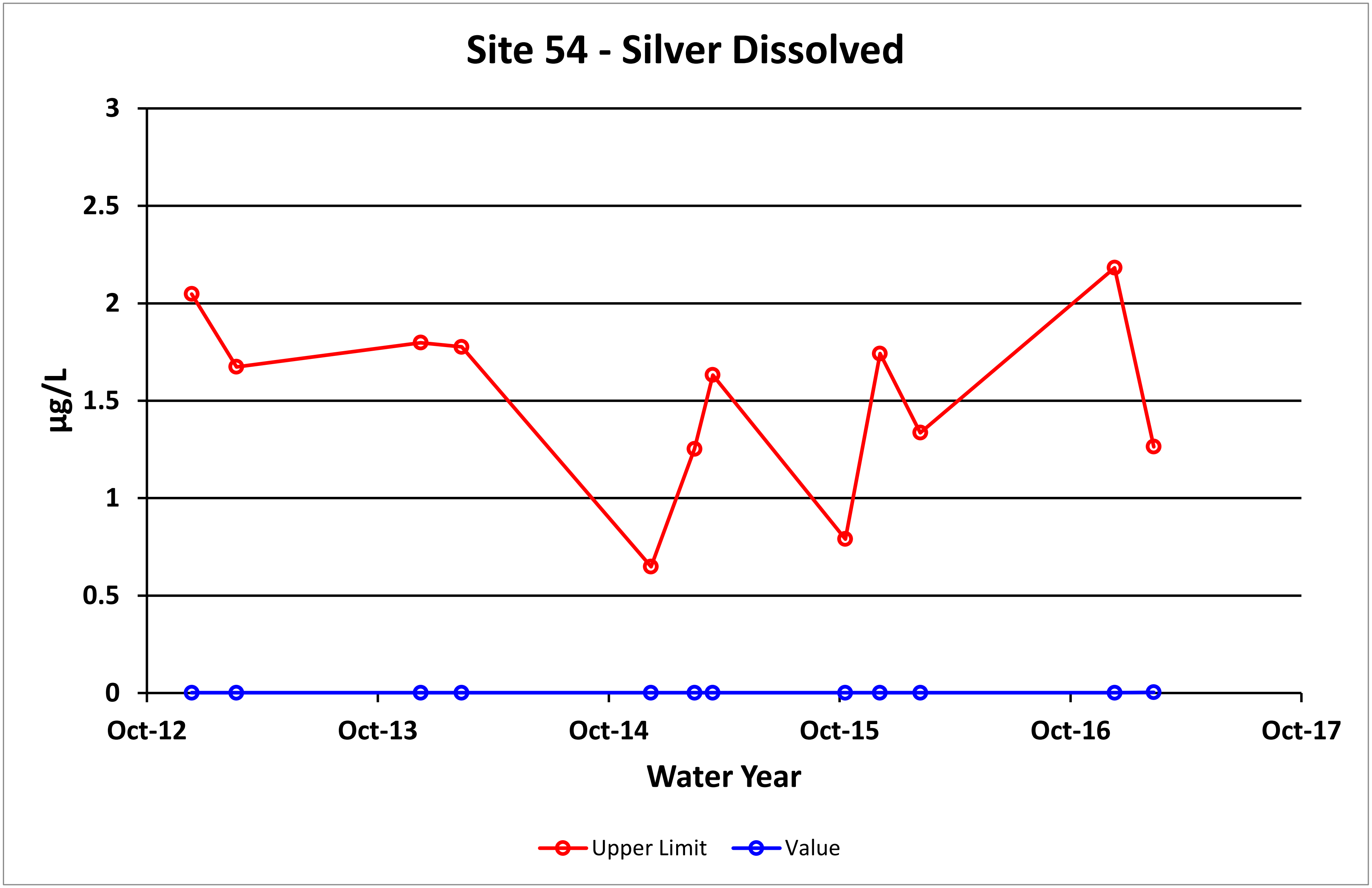


Site 54 - Chromium Dissolved
µg/L
12
10
8
6
4
2
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

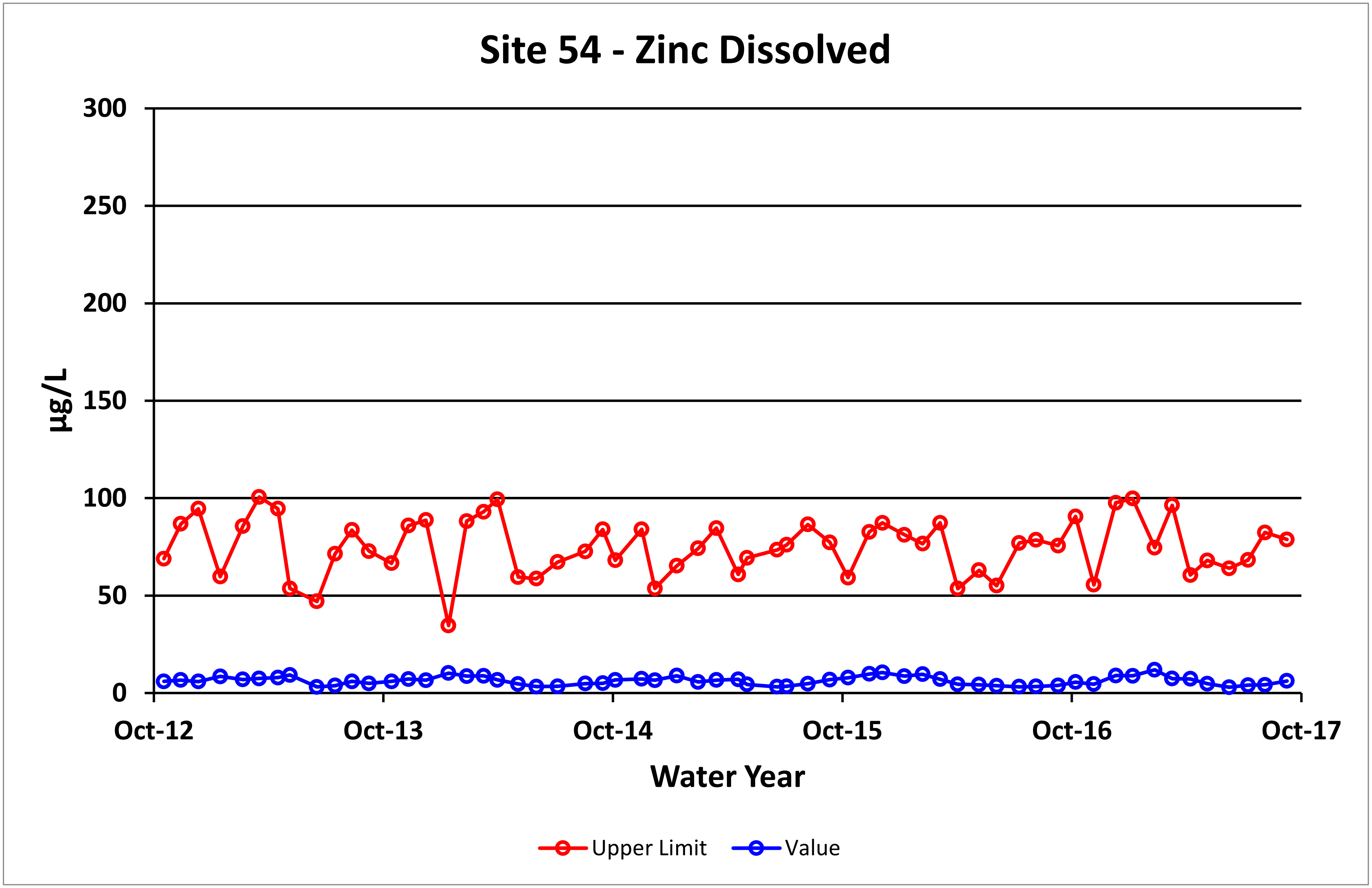

Site 54 - Copper Dissolved
µg/L
10
9
8
7
6
5
4
3
2
1
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value


Site 54 - Lead Dissolved
2.5
2
1.5
1
0.5
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

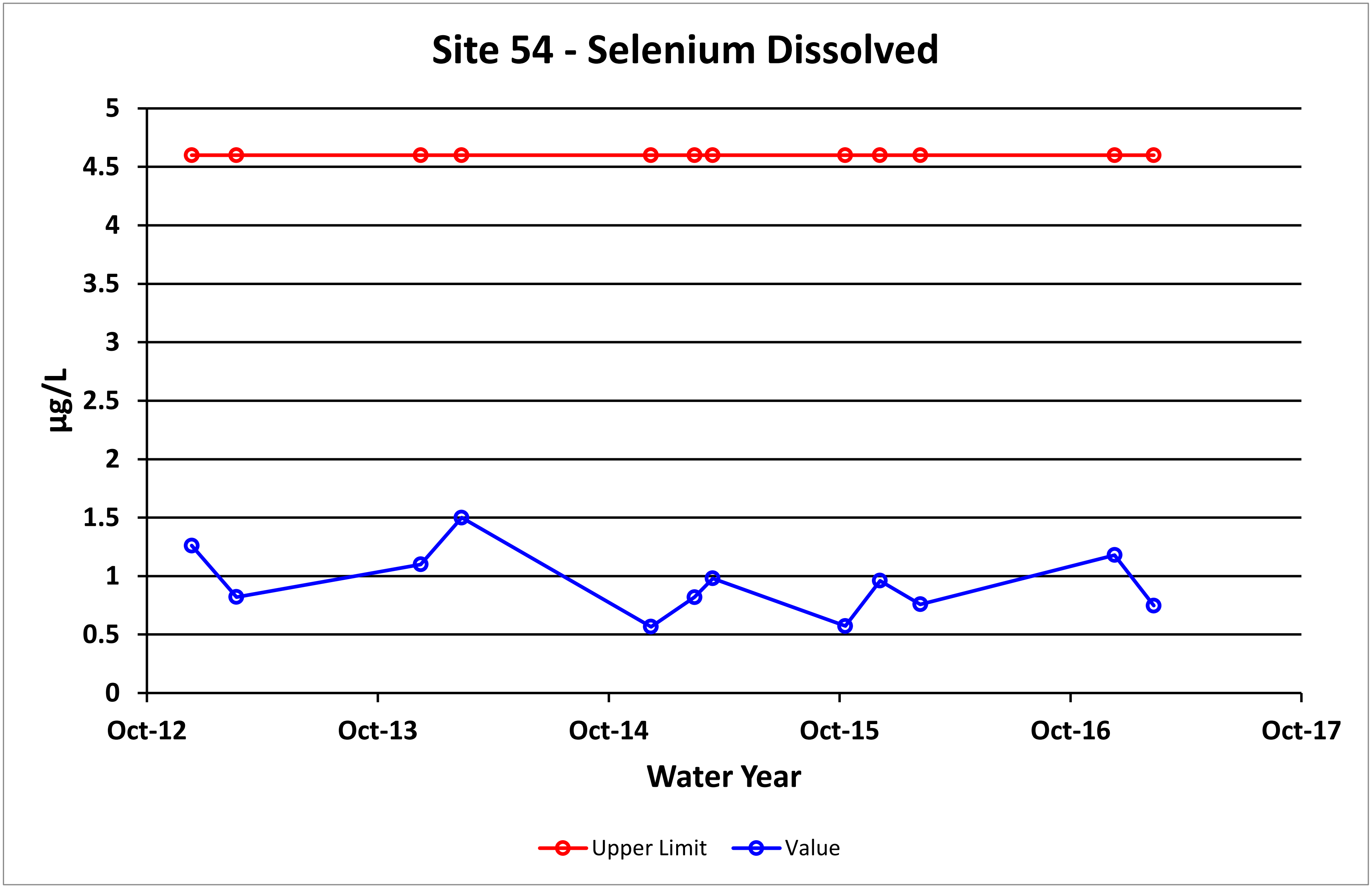

Site 54 - Nickel Dissolved
50
45
40
35
30
25
20
15
10
5
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value



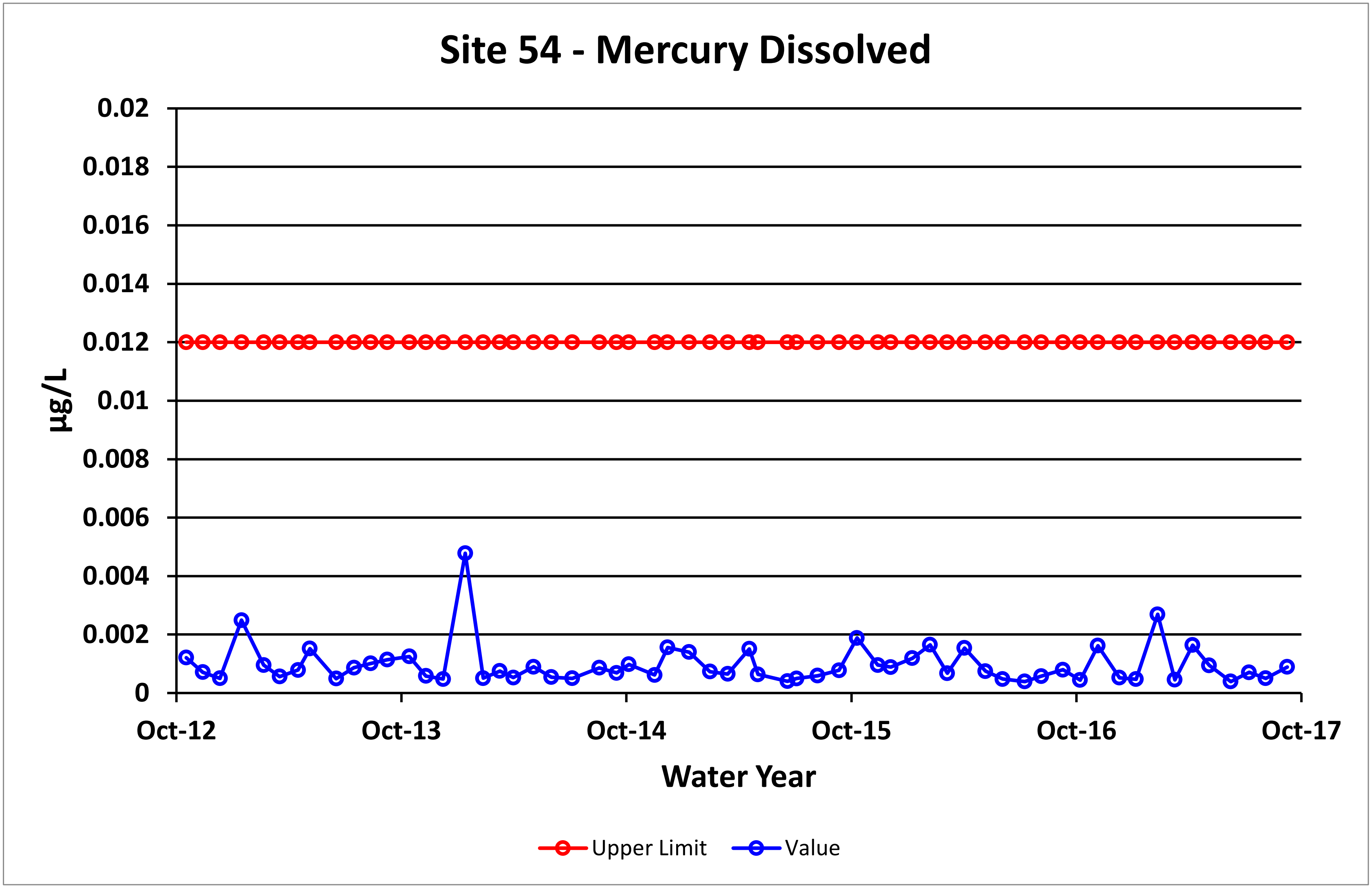
Site 54 - Silver Dissolved
3
2.5
2
1.5
1
0.5
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value



Site 54 - Zinc Dissolved
300
250
200
150
100
50
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value



Site 54 - Selenium Dissolved
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value



Site 54 - Mercury Dissolved
0.02
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

Wilcoxon-signed-ranks test

Exact Form

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

	X	**Y**	Differences		
Site	#6	#54			
Year	WY2017	WY2017	**D**	**|D|**	**Rank**
Oct	152.90	154.80	-1.90	1.90	-4.5
Nov	87.80	89.50	-1.70	1.70	-2
Dec	134.20	124.70	9.50	9.50	10
Jan	130.70	167.30	-36.60	36.60	-12
Feb	119.50	126.00	-6.50	6.50	-9
Mar	165.70	172.00	-6.30	6.30	-8
Apr	112.60	117.60	-5.00	5.00	-7
May	110.00	95.50	14.50	14.50	11
Jun	99.60	101.10	-1.50	1.50	-1
Jul	103.60	105.50	-1.90	1.90	-4.5
Aug	147.00	148.80	-1.80	1.80	-3
Sep	119.60	121.60	-2.00	2.00	-6
Median	119.55	123.15	-1.90	3.50	

n	**m**
12	12

N= 12

ΣR= -36

α
0.05
W'α,n
17

W^{+}=
21
p-test
0.088

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

Wilcoxon-signed-ranks test
Exact Form

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

	X	**Y**			
Site	#6	#54	Differences		
Year	WY2017	WY2017	**D**	**|D|**	**Rank**
Oct	7.99	7.98	0.01	0.01	1
Nov	7.78	7.82	-0.04	0.04	-7
Dec	8.05	8.10	-0.05	0.05	-9.5
Jan	7.94	7.87	0.07	0.07	11.5
Feb	7.48	7.44	0.04	0.04	7
Mar	7.79	7.72	0.07	0.07	11.5
Apr	7.94	7.89	0.05	0.05	9.5
May	7.96	7.92	0.04	0.04	7
Jun	7.87	7.85	0.02	0.02	2.5
Jul	7.85	7.87	-0.02	0.02	-4
Aug	7.94	7.92	0.02	0.02	2.5
Sep	7.96	7.93	0.03	0.03	5
Median	7.94	7.88	0.03	0.04	

n	**m**
12	12

N= 12
ΣR= 37

α
0.05
W'α,n
17

W^{+}=
20.5
p-test
0.076

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

Wilcoxon-signed-ranks test
Exact Form

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

	X	**Y**			
Site	#6	#54	Differences		
Year	WY2017	WY2017	**D**	**|D|**	**Rank**
Oct	56.20	57.60	-1.40	1.40	-10
Nov	33.50	34.00	-0.50	0.50	-3.5
Dec	57.20	56.00	1.20	1.20	8
Jan	59.80	59.20	0.60	0.60	5
Feb	40.90	43.50	-2.60	2.60	-12
Mar	57.40	58.30	-0.90	0.90	-6.5
Apr	42.40	44.60	-2.20	2.20	-11
May	41.70	42.20	-0.50	0.50	-3.5
Jun	40.30	40.50	-0.20	0.20	-1
Jul	42.60	42.30	0.30	0.30	2
Aug	51.40	52.70	-1.30	1.30	-9
Sep	45.90	46.80	-0.90	0.90	-6.5
Median	44.25	45.70	-0.70	0.90	

n	**m**
12	12

N= 12
$\Sigma R =$ -48

α
0.05
W'α,n
17

$W^{+}=$
15
p-test
0.032

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

Wilcoxon-signed-ranks test
Exact Form

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

	X	**Y**			
Site	#6	#54	Differences		
Year	WY2017	WY2017	**D**	**|D|**	**Rank**
Oct	19.0	19.3	-0.3	0.3	-6
Nov	7.7	7.7	0.0	0.0	1
Dec	18.9	19.1	-0.2	0.2	-4
Jan	20.8	21.4	-0.6	0.6	-8
Feb	12.8	15.1	-2.3	2.3	-10
Mar	22.4	22.5	-0.1	0.1	-2.5
Apr	13.4	14.6	-1.2	1.2	-9
May	10.7	10.8	-0.1	0.1	-2.5
Jun	10.0	10.3	-0.3	0.3	-7
Jul	10.9	10.9	0.0		
Aug	17.1	16.8	0.3	0.3	5
Sep	12.4	12.4	0.0		
Median	13.1	14.9	-0.2	0.3	

n	**m**
12	10

N= 10
ΣR= -43

α
0.05
W'α,n
10

W^{+}=
6
p-test
0.014

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	WY2017	WY2017	**D**	**|D|**	**Rank**
Oct	5.86	5.57	0.29	0.29	6
Nov	4.51	4.52	-0.01	0.01	-1
Dec	9.87	8.94	0.93	0.93	12
Jan	9.46	8.77	0.69	0.69	8
Feb	12.70	11.90	0.80	0.80	10
Mar	8.20	7.37	0.83	0.83	11
Apr	7.95	7.25	0.70	0.70	9
May	5.02	4.78	0.24	0.24	5
Jun	2.87	2.96	-0.09	0.09	-3
Jul	4.31	3.99	0.32	0.32	7
Aug	4.20	4.16	0.04	0.04	2
Sep	6.37	6.16	0.21	0.21	4
Median	6.12	5.87	0.30	0.30	

n	**m**
12	12

N= 12

ΣR= 70

α
0.05
W'α,n
17

W^+=
4
p-test
0.002

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 2017" report. The table includes all the required FWMP analyte data (field and laboratory) collected for the current water year and a series of flags keyed to the summary report "Qualified Data by QA Reviewer". The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of ½ MDL for the purpose of median calculation.

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

Sample Date	Parameter	Value	Qualifier	Notes
No outliers, 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 2017

			Limits		
Sample Date	**Parameter**	**Value**	**Lower**	**Upper**	**Hardness**
No exceedances have been identified by HGCMC for the period of October 2016 through September 2017.					

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 2017 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	123.2	134.6	-8.6
pH Field	0.088	7.88	7.88	0.03
Alkalinity, Total	<0.01	45.7	50.6	-4.5
Sulfate, Total	<0.01	14.9	16.0	-1.2
Zinc, Dissolved	0.395	5.87	6.22	-0.03

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 2017

Site 062FMS - 'Greens Creek Below Site 54'

Sample Date/Parameter	Oct 2016	Nov 2016	Dec 2016	Jan 2017	Feb 2017	Mar 2017	Apr 2017	May 2017	Jun 2017	Jul 2017	Aug 2017	Sep 2017	**Median**
Water Temp (°C)	2.8	4.9	0.8	0.7	0.6	0.4	0.9	2.8	4.8	7.1	9	7.5	2.8
Conductivity-Field(μmho)	167.9	156	152.9	174.7	135.7	153.3	123.7	120.8	105.8	111.8	158.7	133.4	144.3
Conductivity-Lab (μmho)	170	91	164	180	122	182	118	117	106	113	142	133	128
pH Lab (standard units)	7.73	7.51	7.43	7.57	7.06	7.3	7.4	7.45	7.46	7.54	7.38	7.3	7.44
pH Field (standard units)	8.01	7.69	7.98	7.96	7.32	7.53	7.66	7.93	7.89	7.86	7.87	7.94	7.88
Total Alkalinity (mg/L)	63.5	35.8	61.5	64.1	47.5	63	50.3	47.8	42	44.4	56.9	50.8	50.6
Total Sulfate (mg/L)	21.2	8.9	21	23.9	16.7	25	15.3	11.9	10.5	11.5	18	13.6	16.0
Hardness (mg/L)	80.9	43.7	72.6	87.8	62.3	85.8	58.7	56.7	51.7	43.7	71.3	67.8	65.1
Dissolved As (ug/L)	0.199	0.217	0.161	0.172	0.18	0.142	0.162	0.16	0.192	0.217	0.208	0.232	0.186
Dissolved Ba (ug/L)			30.8		24.3					28.5			28.5
Dissolved Cd (ug/L)	0.0493	0.0372	0.0486	0.0558	0.0631	0.0517	0.0464	0.0348	0.0324	0.0367	0.0455	0.052	0.0475
Dissolved Cr (ug/L)			0.066		0.138					0.093			0.093
Dissolved Cu (ug/L)	0.251	0.625	0.336	0.296	0.818	0.335	0.758	0.463	0.252	0.325	0.301	0.511	0.336
Dissolved Pb (ug/L)	0.0086	0.0314	0.0149	0.0352	0.0886	0.0074	0.0199	0.0115	0.0042	0.0046	0.0062	0.0117	0.0116
Dissolved Ni (ug/L)			0.35		0.533					0.264			0.350
Dissolved Ag (ug/L)			0.002		0.004					0.002			0.002
Dissolved Zn (ug/L)	6	4.77	8.61	8.69	11.2	7.51	7.31	4.58	2.91	3.98	4.38	6.44	6.22
Dissolved Se (ug/L)			1.08		0.883					0.864			0.883
Dissolved Hg (ug/L)	0.000415	0.0016	0.000544	0.000755	0.00224	0.000369	0.00156	0.000845	0.000473	0.000646	0.000573	0.000771	0.000701

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

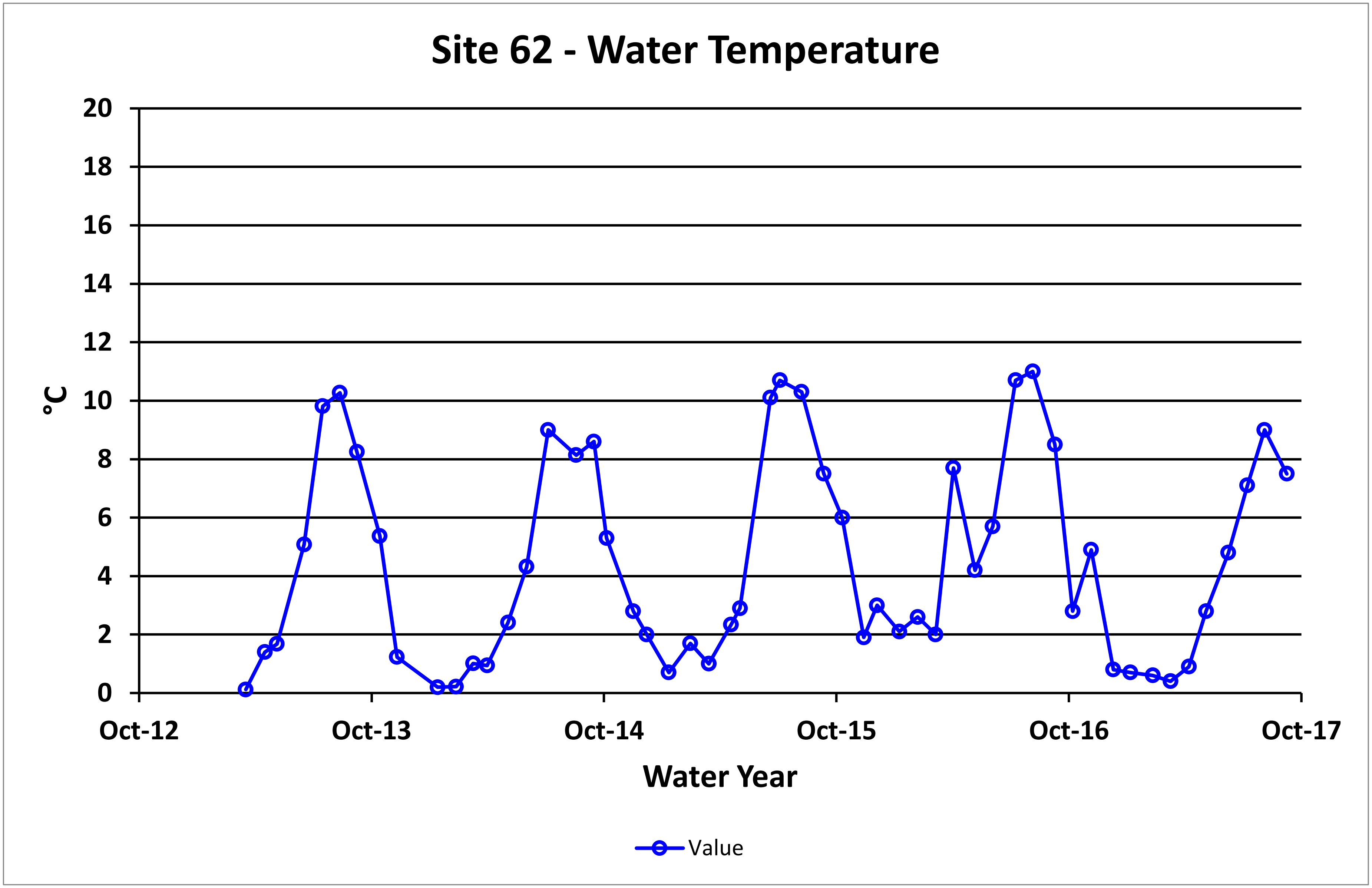
Values reported as less than MDL are replaced by 1/2 MDL for median calculation purposes.

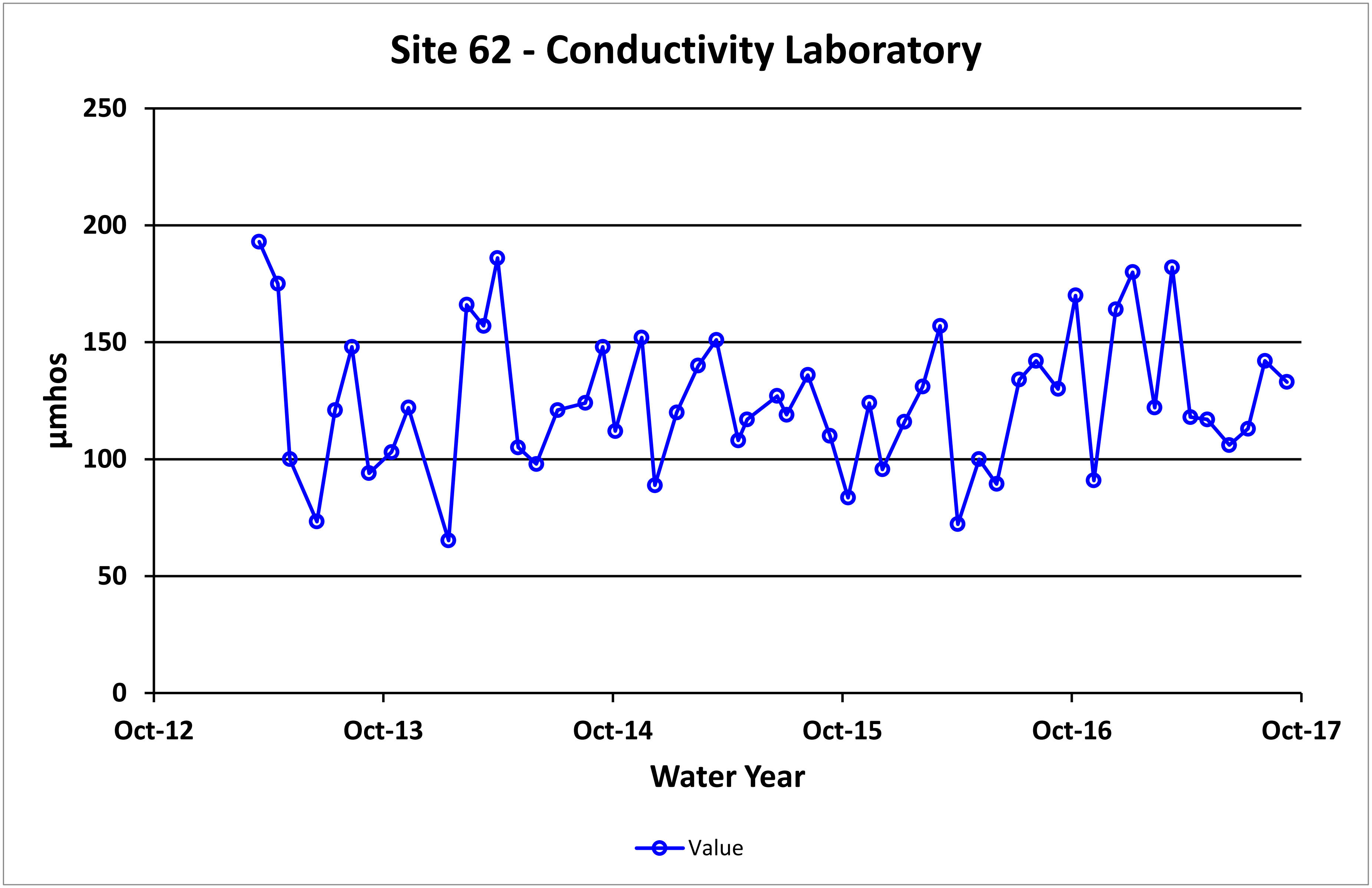
Shaded data has been qualified as an outlier by HGCMC and removed from any further analysis and is not included into the calculation of the median

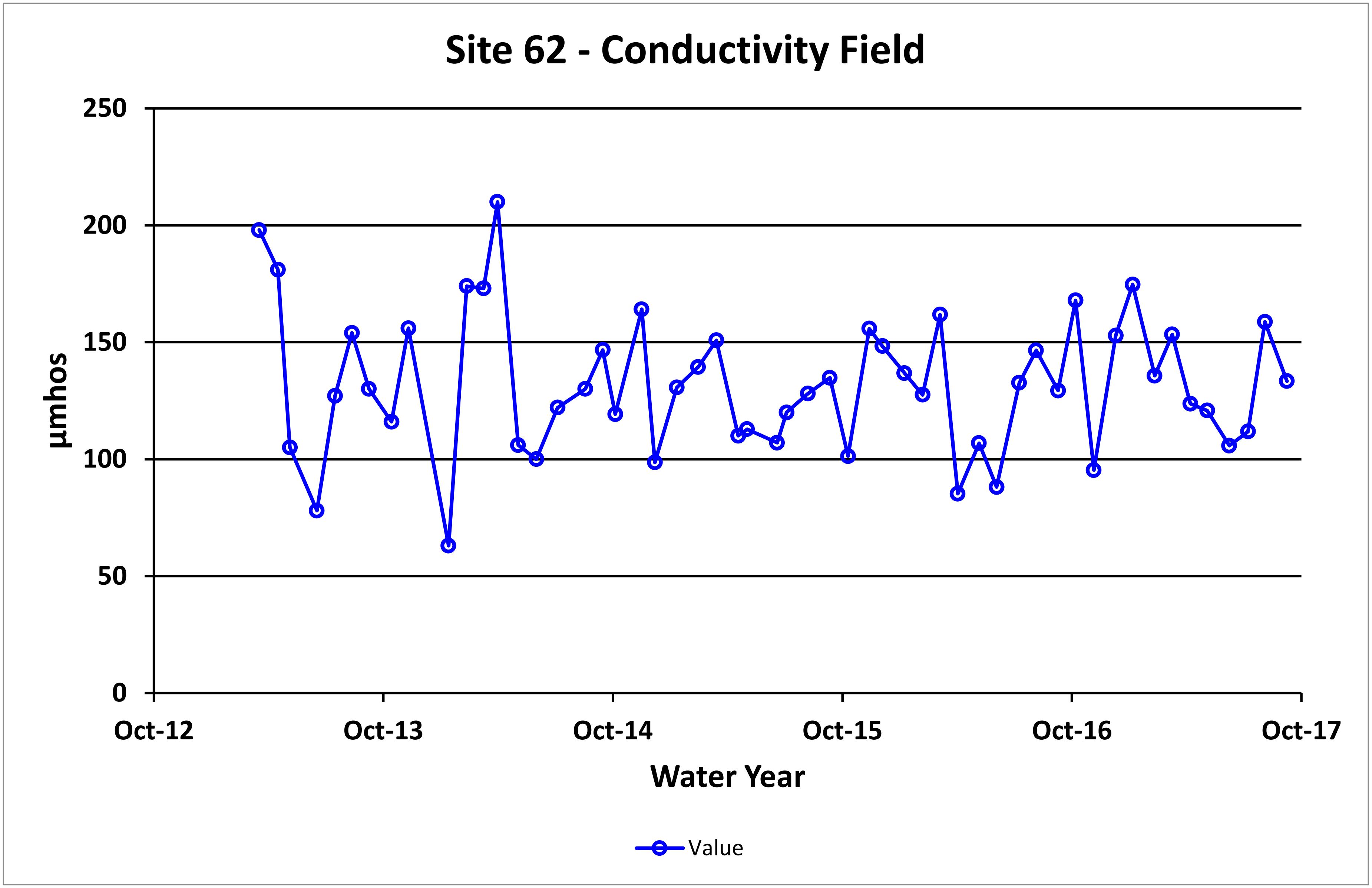
Qualified Data by QA Reviewer

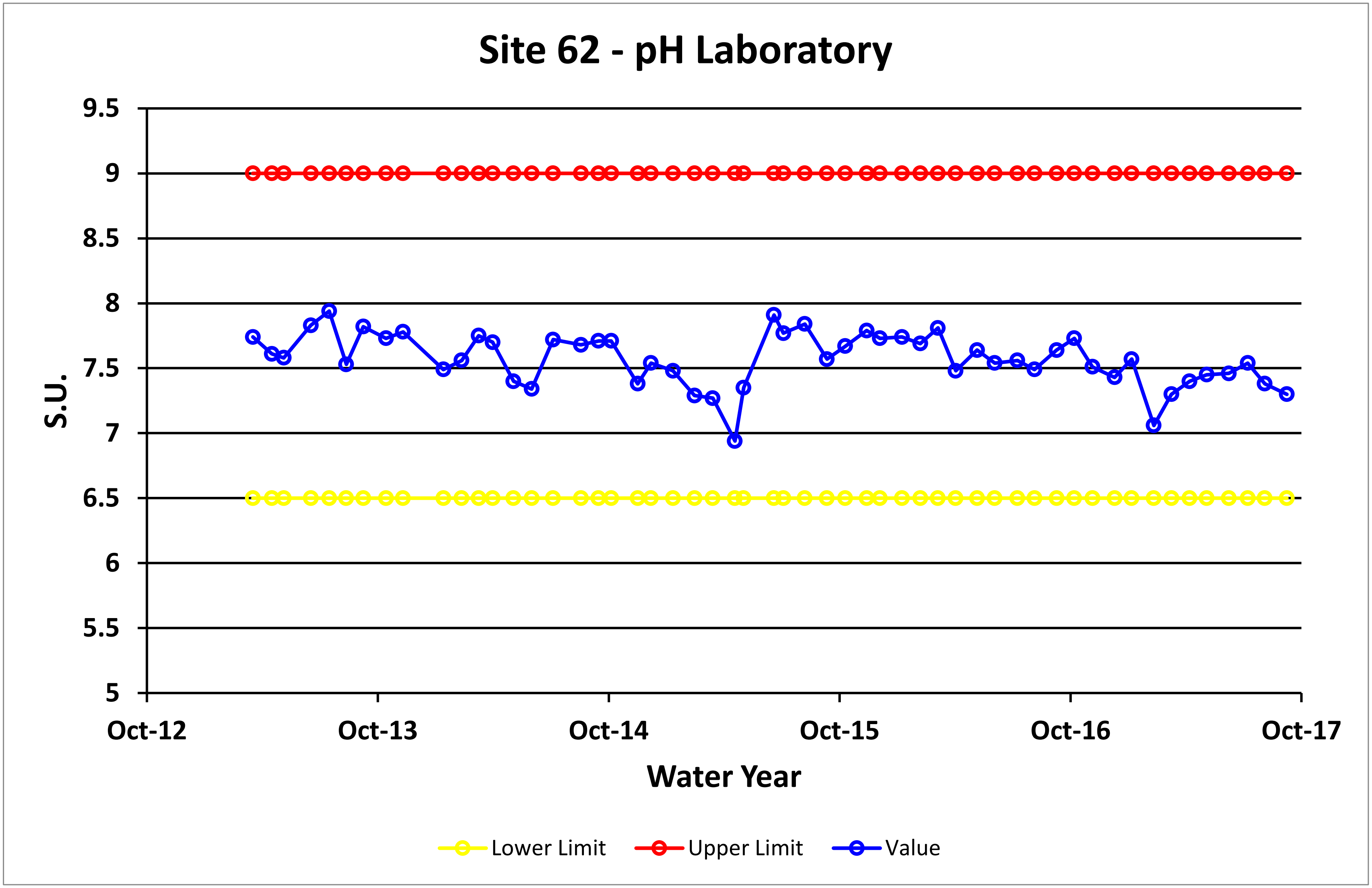
Date Range: 10/01/2016 to 09/30/2017

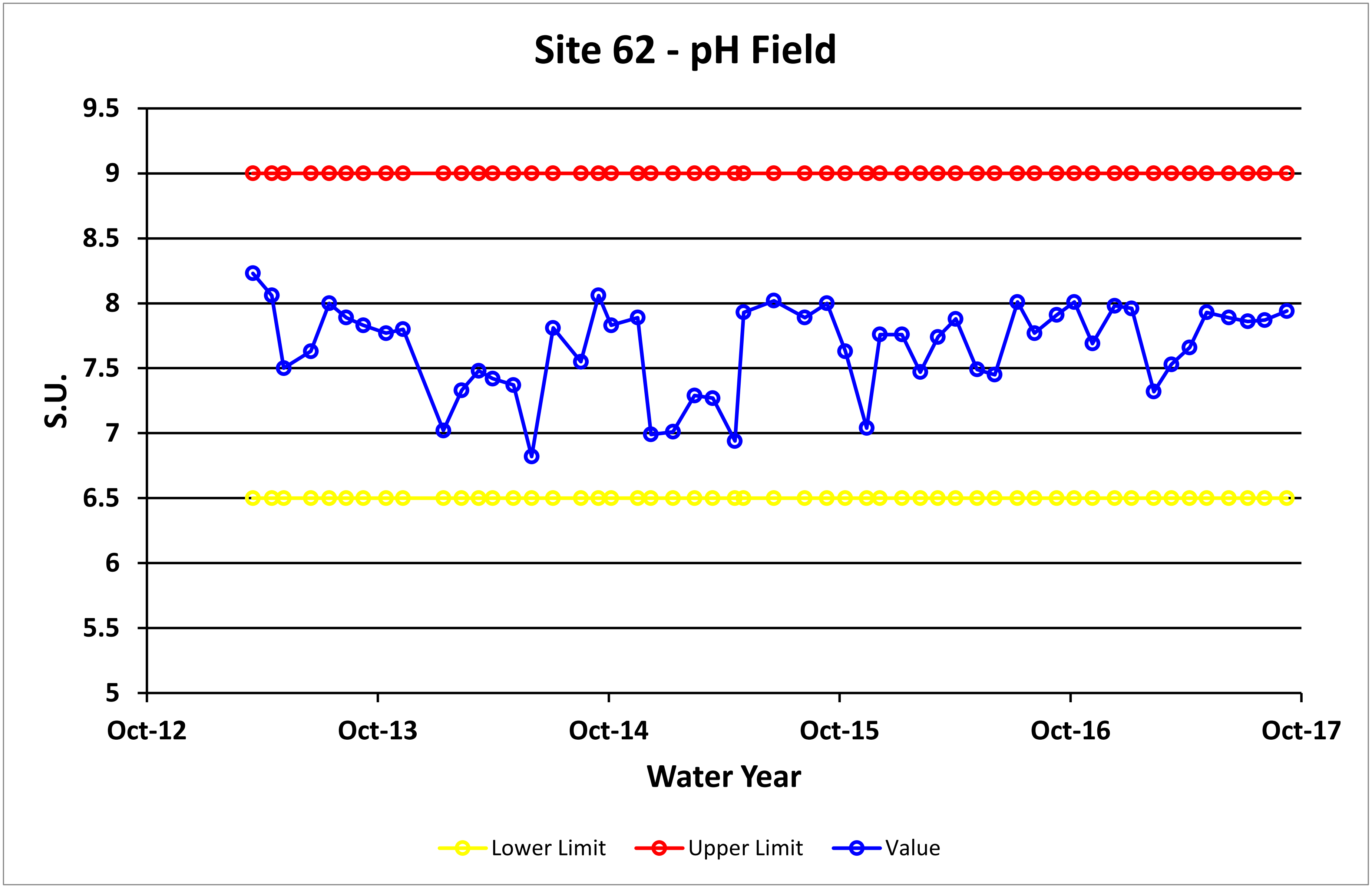
Site No.	Sample Date	Sample Time	Parameter	Value		Qualifier	Reason for Qualifier
062FMS	10/10/2016	12:00 PM	Diss. Pb-ICP/MS	0.0086	µg/L	J	Below Quantitative Range
	12/13/2016	12:00 PM	Diss. Cr-ICP/MS	0.06	µg/L	J	Below Quantitative Range
	2/13/2017	12:00 PM	Diss. Ag-ICP/MS	0.00395	µg/L	J	Below Quantitative Range
			Diss. Cr-ICP/MS	0.13	µg/L	J	Below Quantitative Range
	3/13/2017	12:00 PM	Diss. Pb-ICP/MS	0.00738	µg/L	J	Below Quantitative Range
	5/8/2017	12:00 PM	Diss. Hg-CVAF	0.000845	µg/L	U	Trip Blank Contamination
			Tot. Sulfate	11.9	mg/L	J	Sample Receipt Temperature
	6/12/2017	12:00 PM	Diss. Pb-ICP/MS	0.00417	µg/L	U	Field Blank Contamination
			Diss. Zn-ICP/MS	2.91	µg/L	U	Field Blank Contamination
			Tot. Sulfate	10.5	mg/L	J	Hold Time Violatoin, Sample Receipt Temperature
	7/12/2017	12:00 PM	Diss. Cr-ICP/MS	0.09	µg/L	J	Below Quantitative Range
			Diss. Pb-ICP/MS	0.0046	µg/L	J	Below Quantitative Range
	8/8/2017	12:00 PM	Diss. Pb-ICP/MS	0.00624	µg/L	J	Below Quantitative Range
			Tot. Sulfate	18	mg/L	J	Sample Receipt Temperature


Site 62 - Water Temperature
°C
20
18
16
14
12
10
8
6
4
2
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value

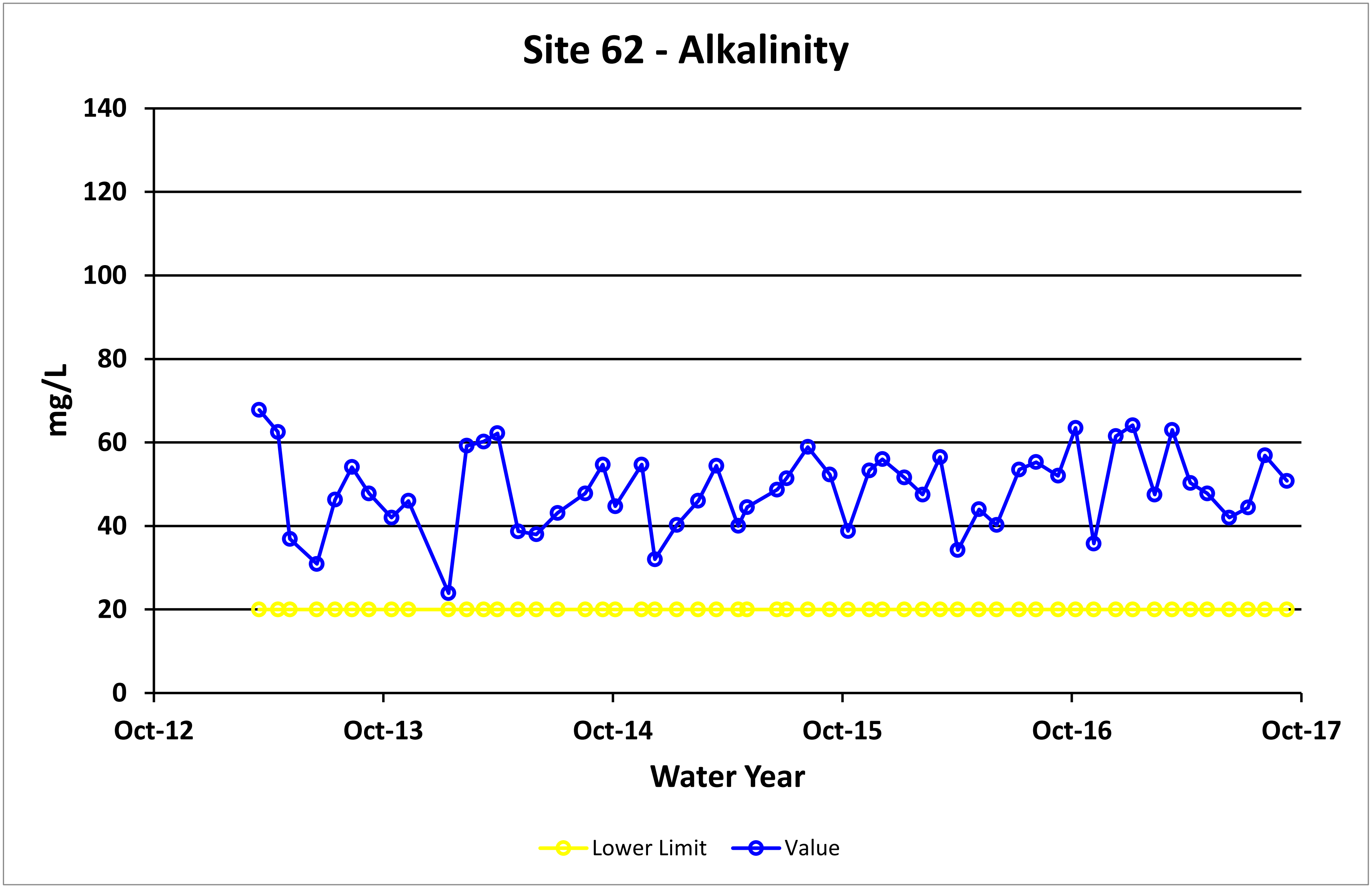

Site 62 - Conductivity Laboratory
250
200
150
100
50
0
µmhos
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value

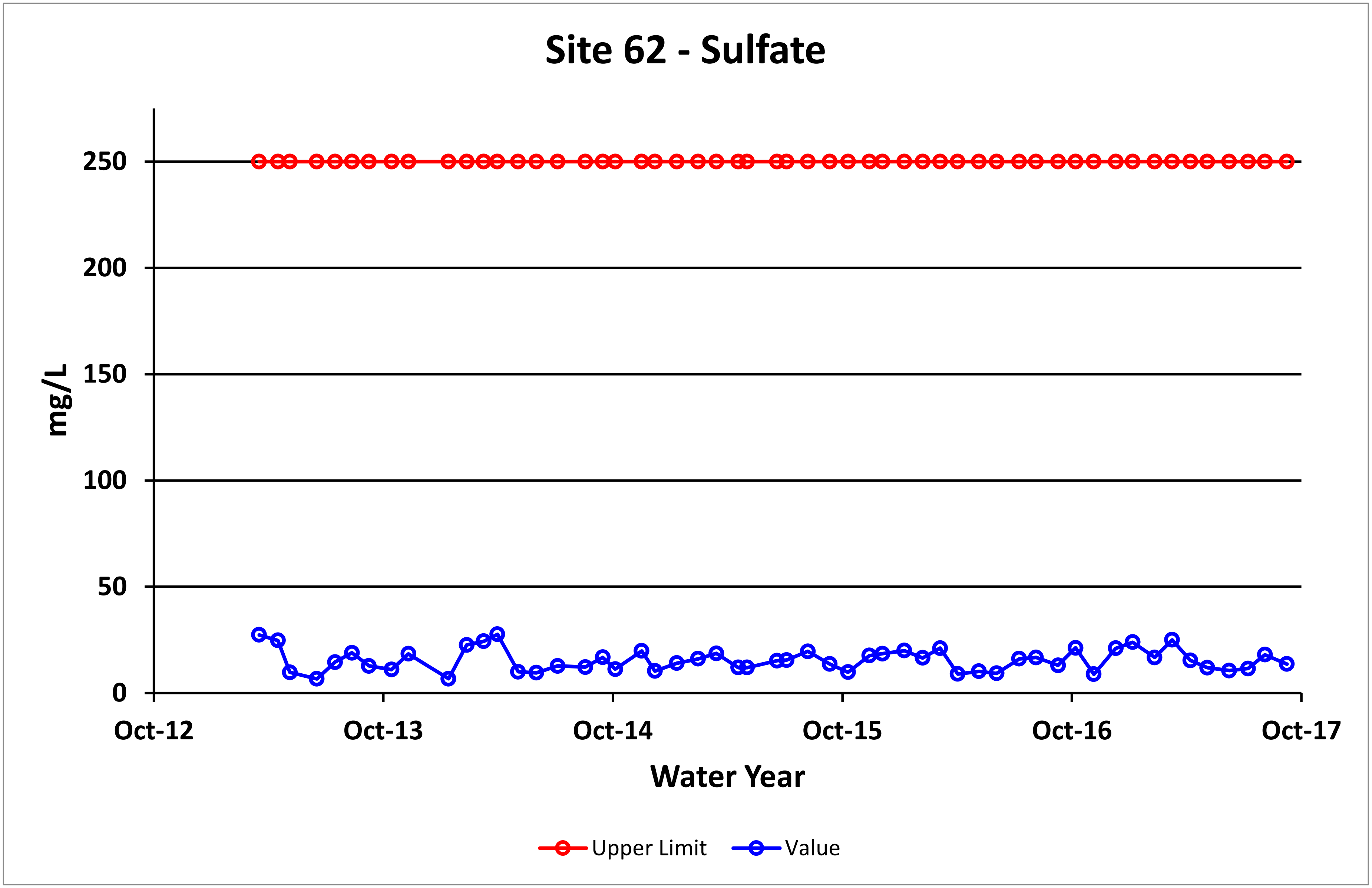

Site 62 - Conductivity Field
250
200
150
100
50
0
µmhos
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value


Site 62 - pH Laboratory
S.U.
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Lower Limit
Upper Limit
Value

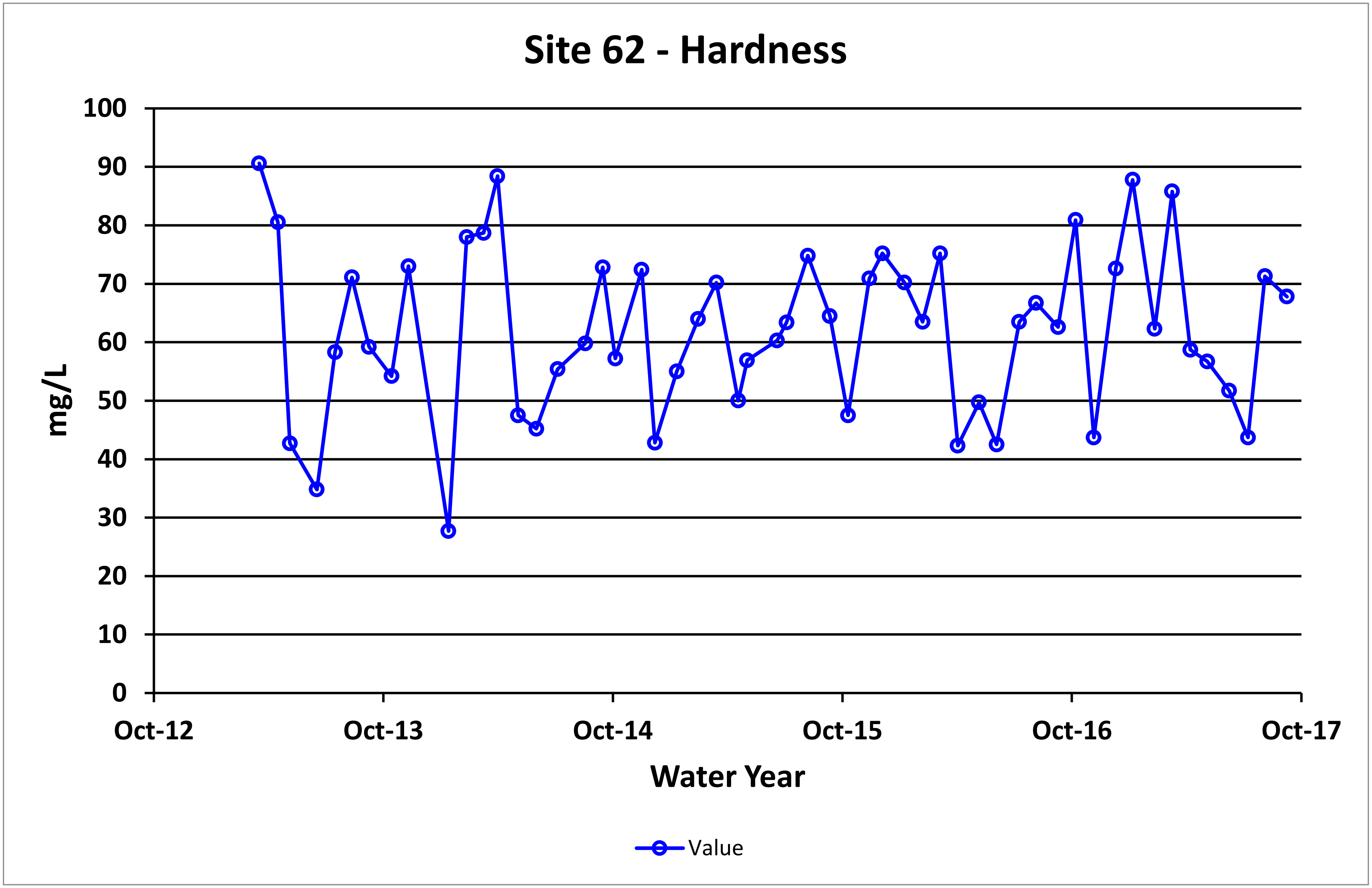


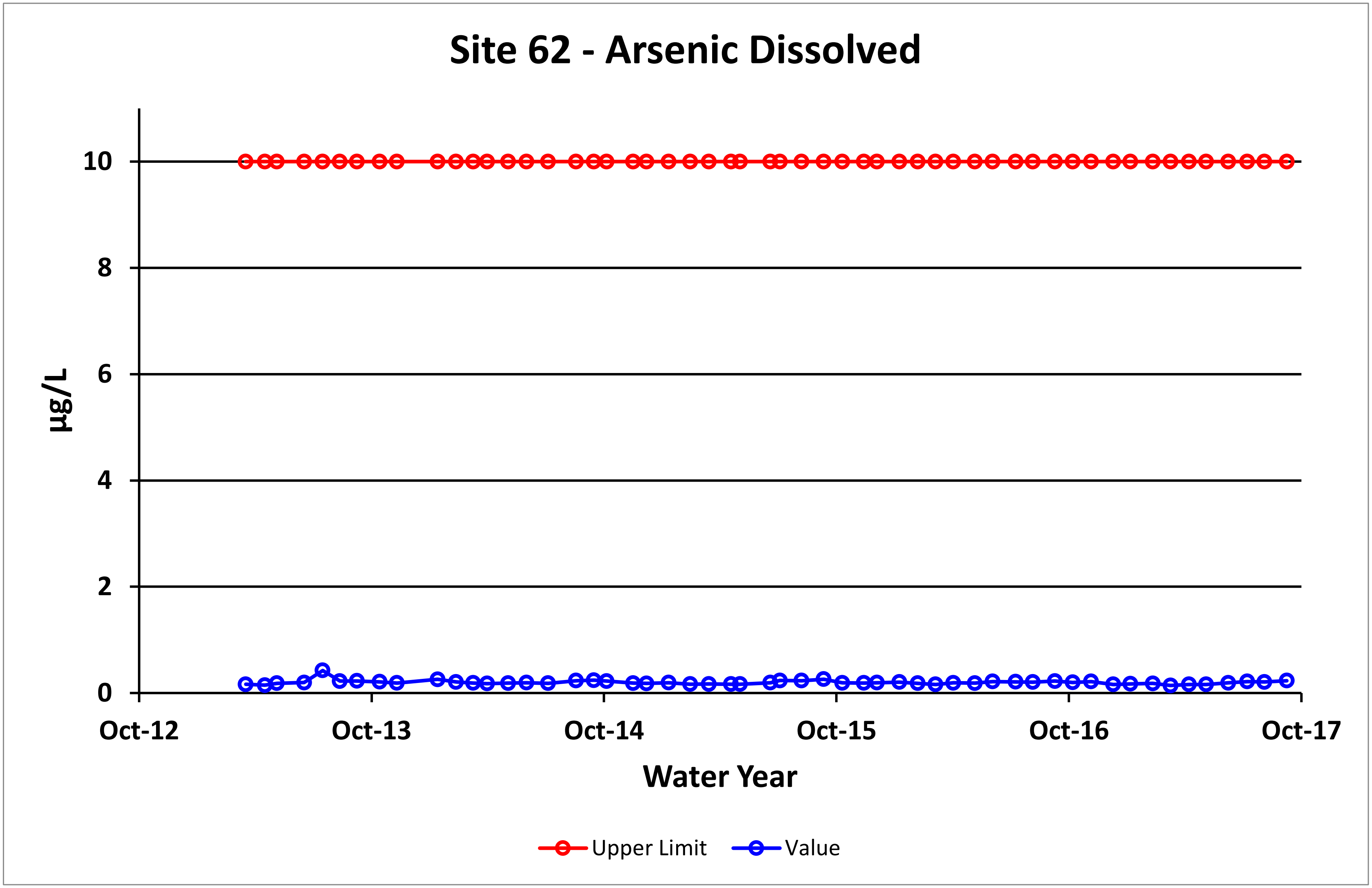
Site 62 - pH Field
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
S.U.
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Lower Limit
Upper Limit
Value

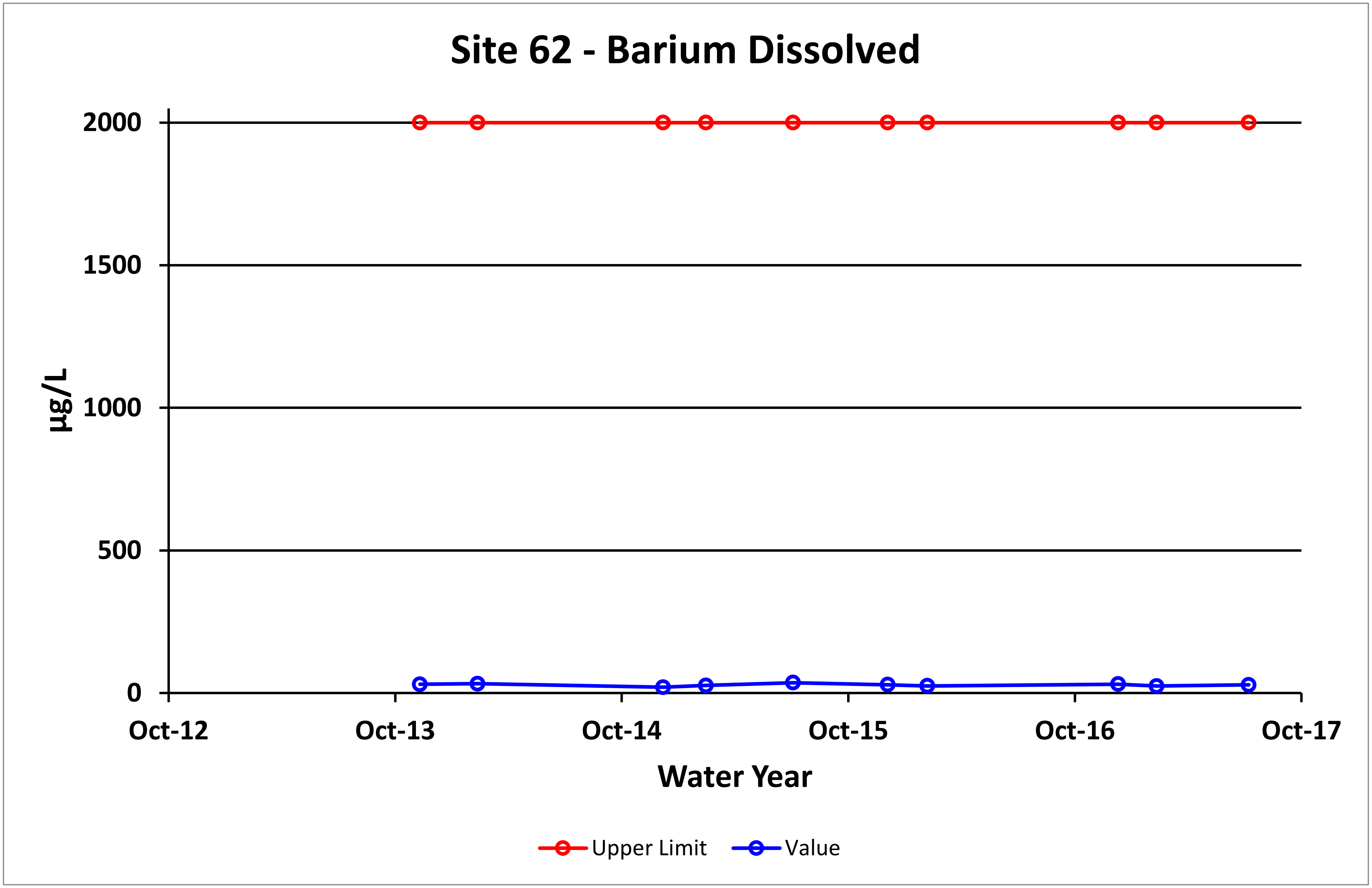

Site 62 - Alkalinity
mg/L
140
120
100
80
60
40
20
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Lower Limit
Value

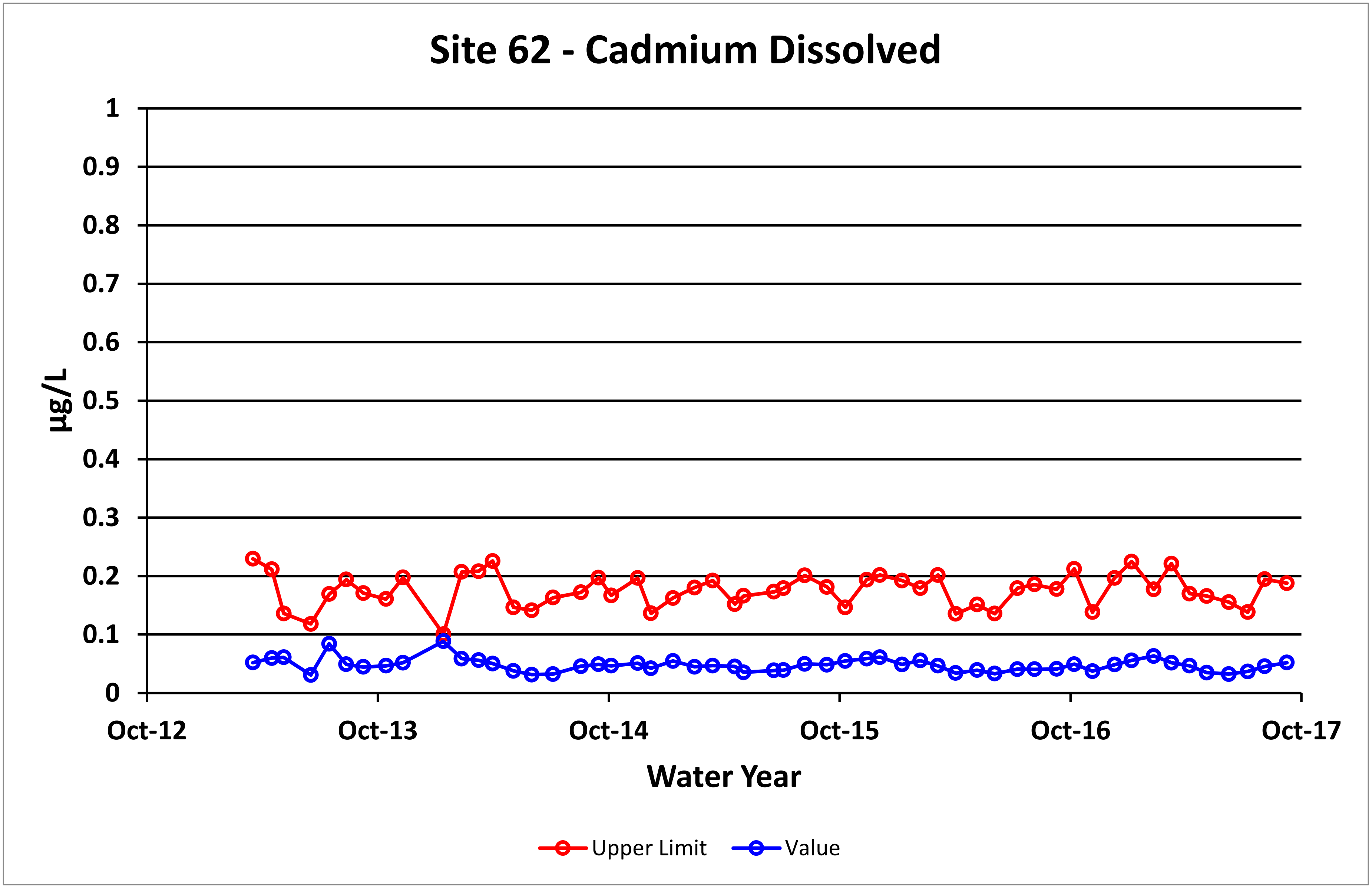


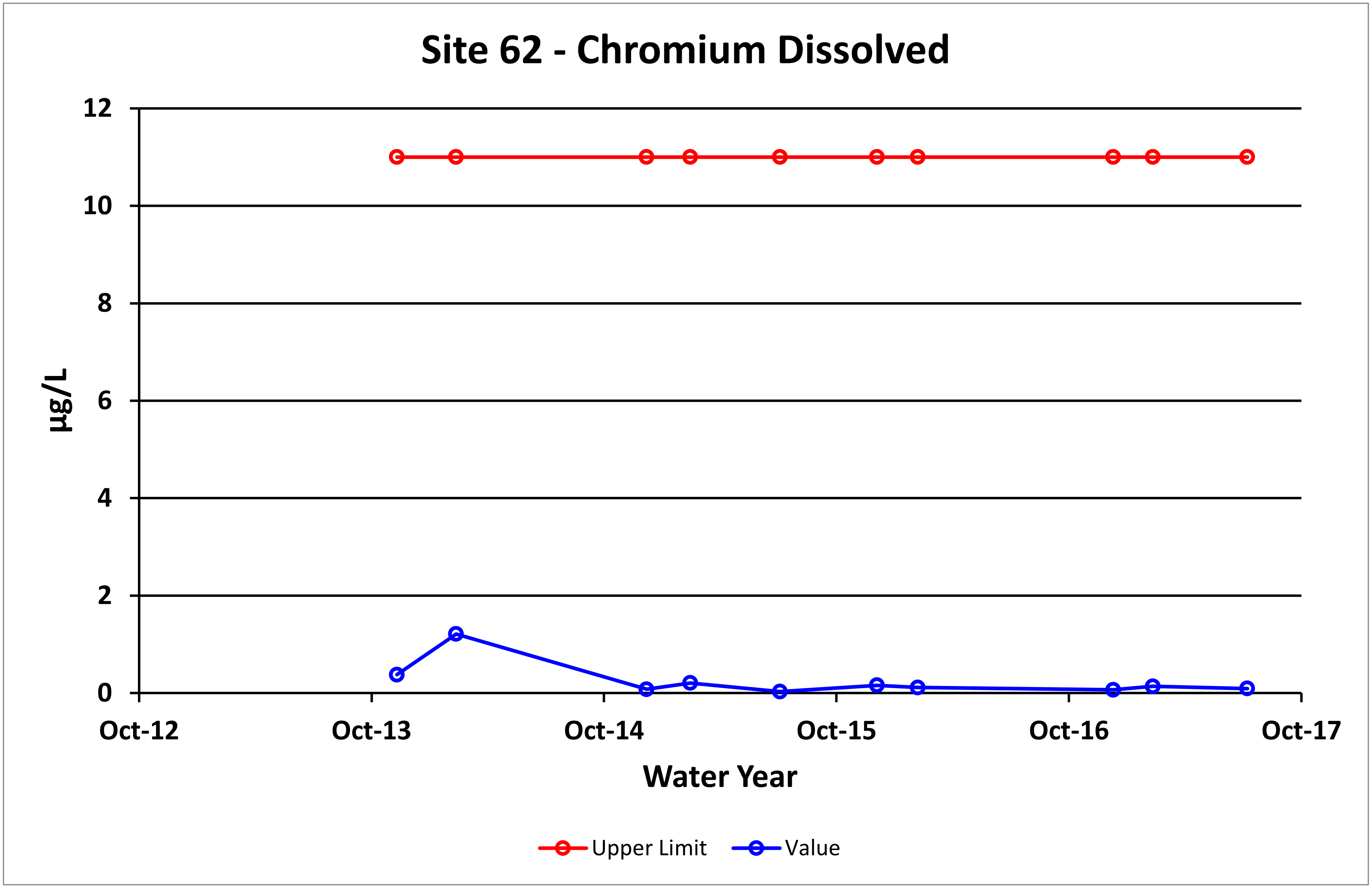
Site 62 - Sulfate
mg/L
250
200
150
100
50
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value


Site 62 - Hardness
100
90
80
70
60
50
40
30
20
10
0
mg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value

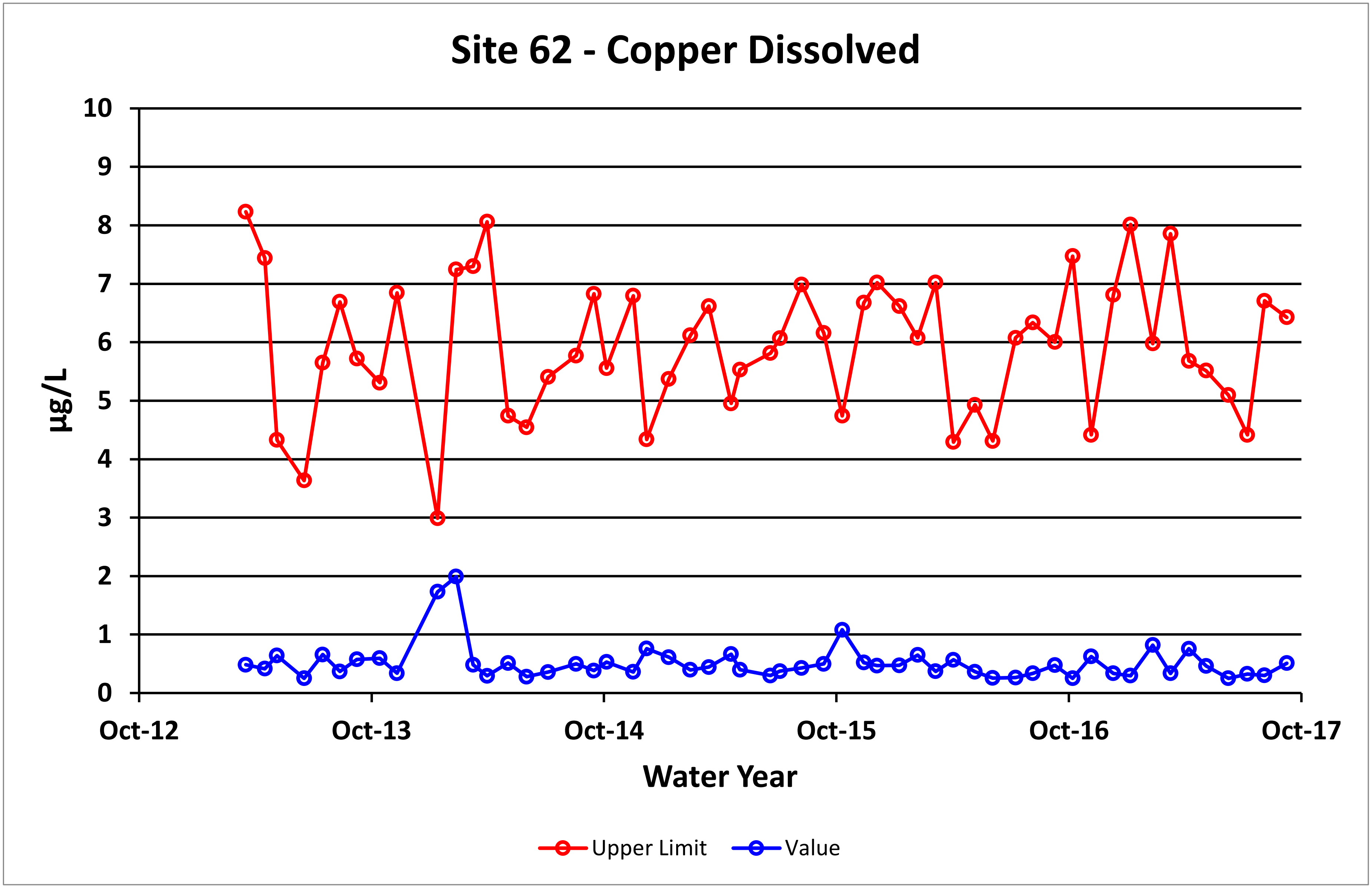

Site 62 - Arsenic Dissolved
µg/L
0
2
4
6
8
10
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

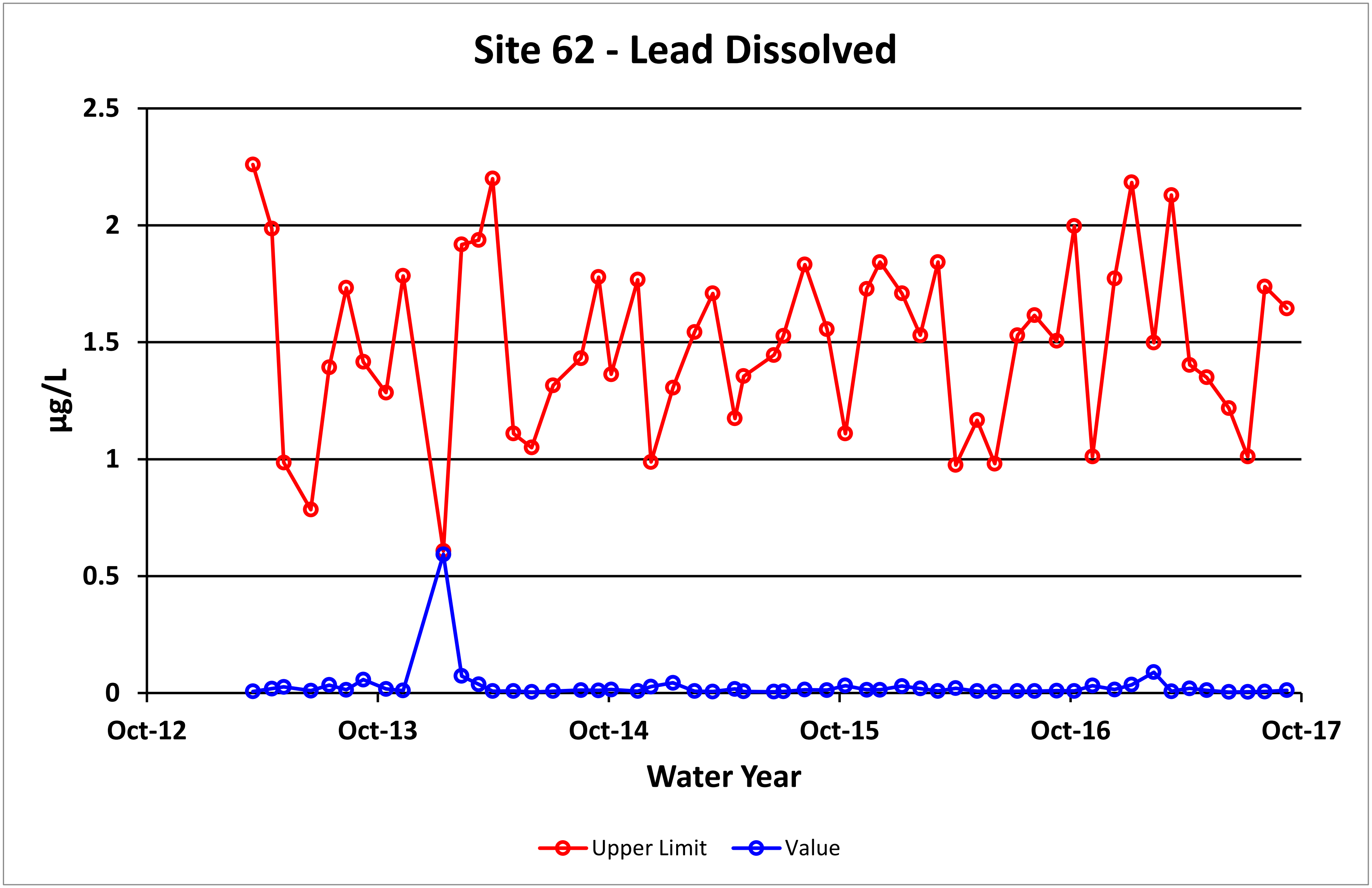

Site 62 - Barium Dissolved
µg/L
2000
1500
1000
500
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

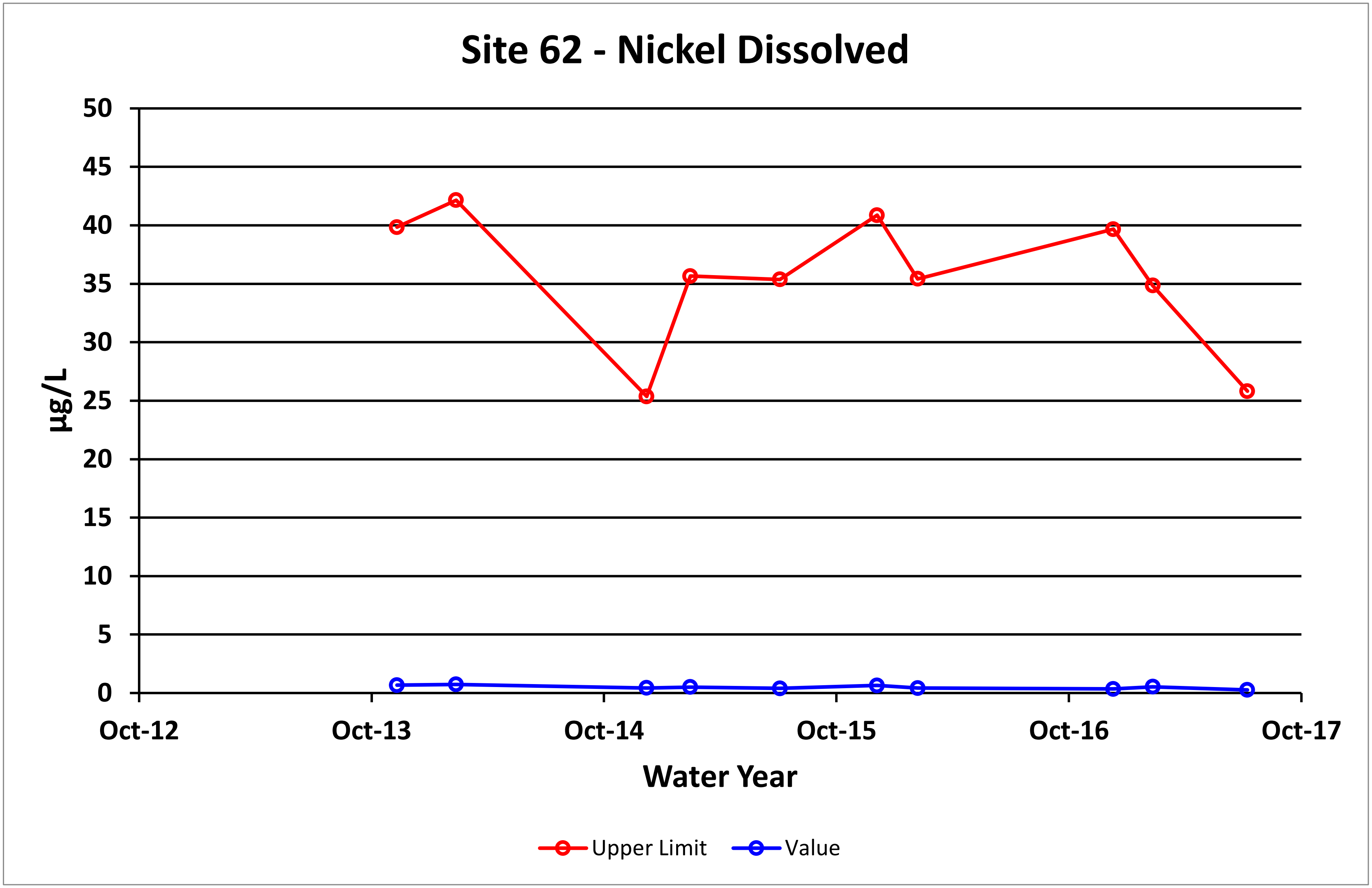

Site 62 - Cadmium Dissolved
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

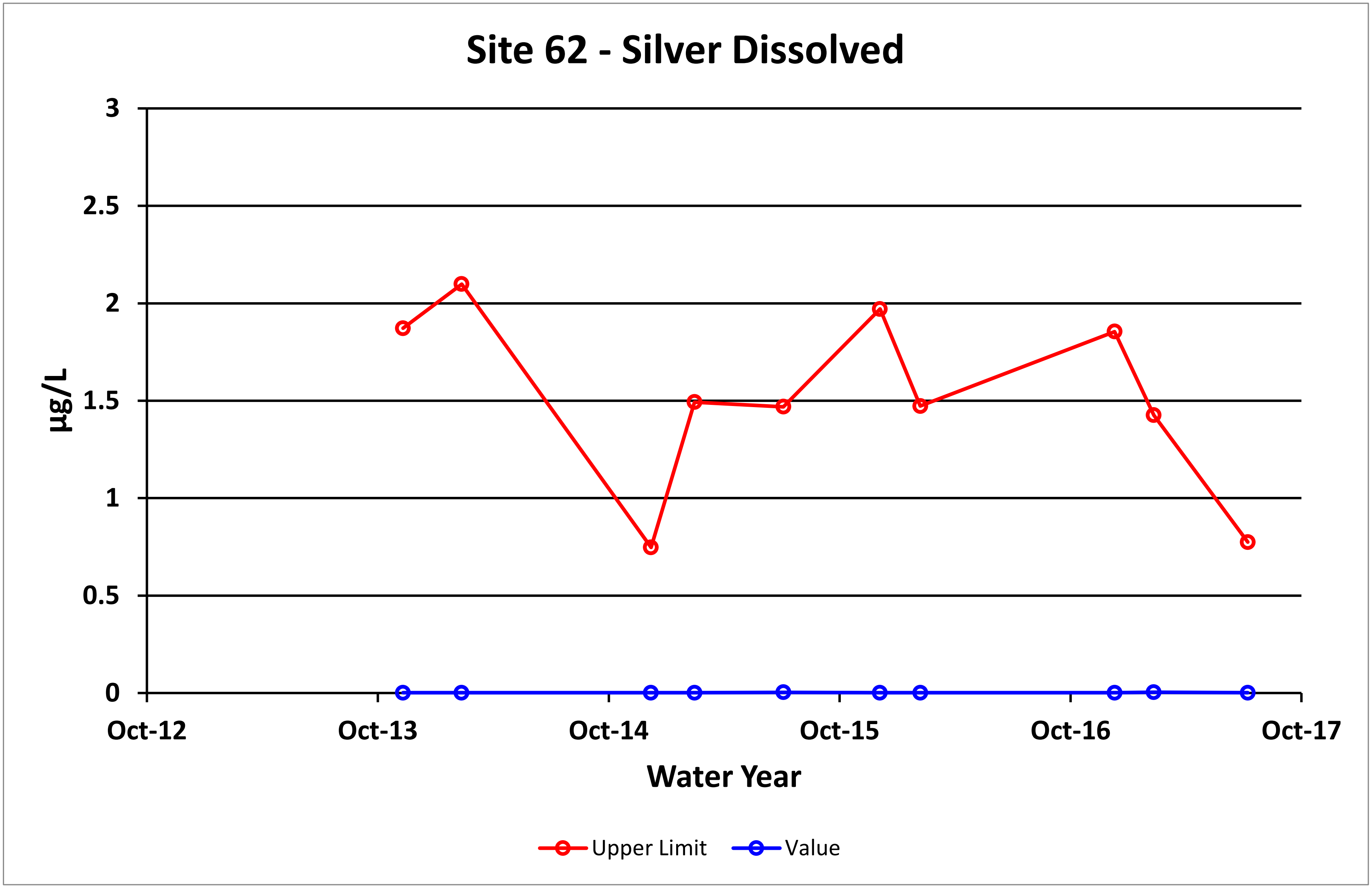


Site 62 - Chromium Dissolved
µg/L
12
10
8
6
4
2
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

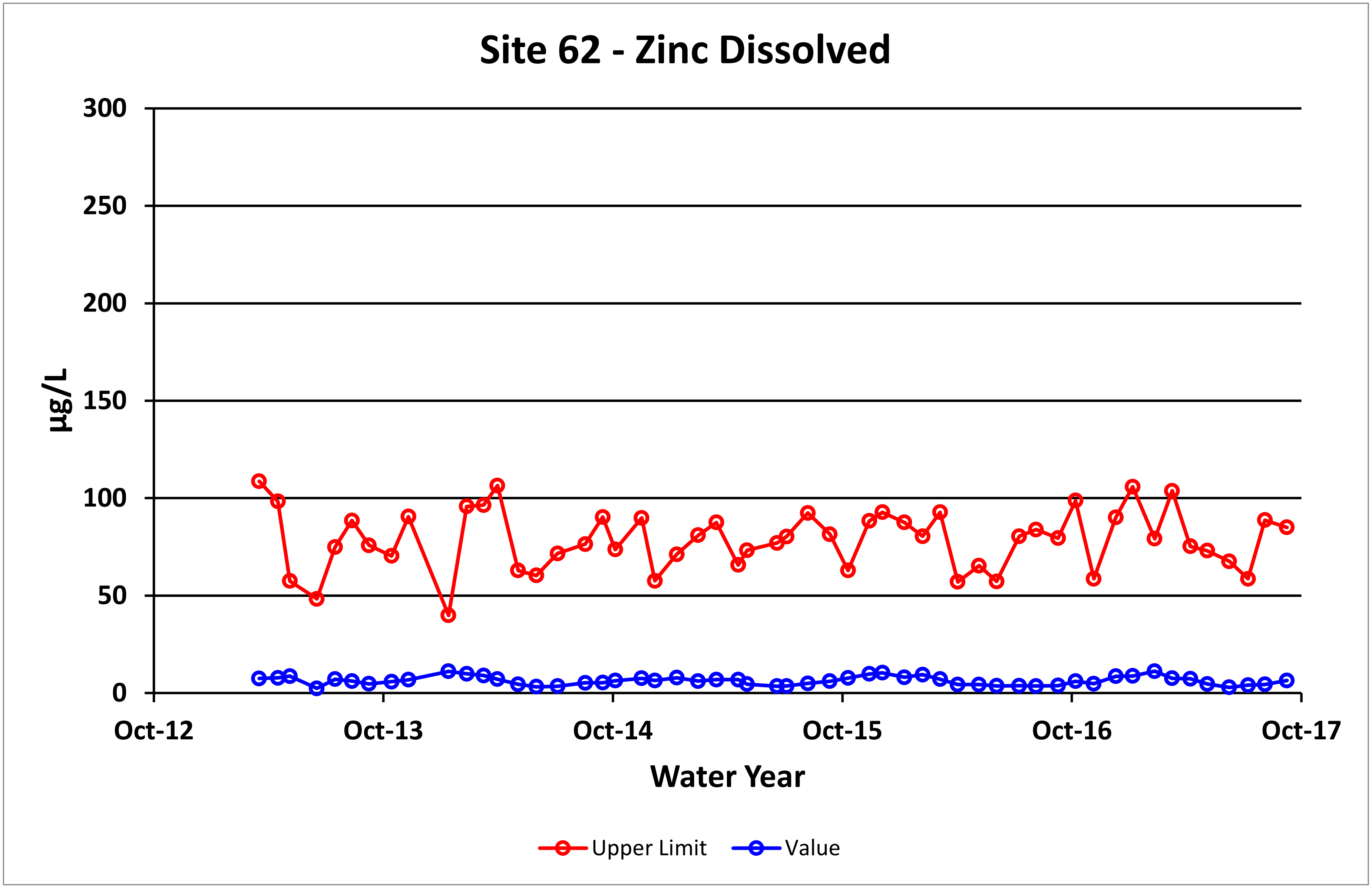

Site 62 - Copper Dissolved
µg/L
0
1
2
3
4
5
6
7
8
9
10
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

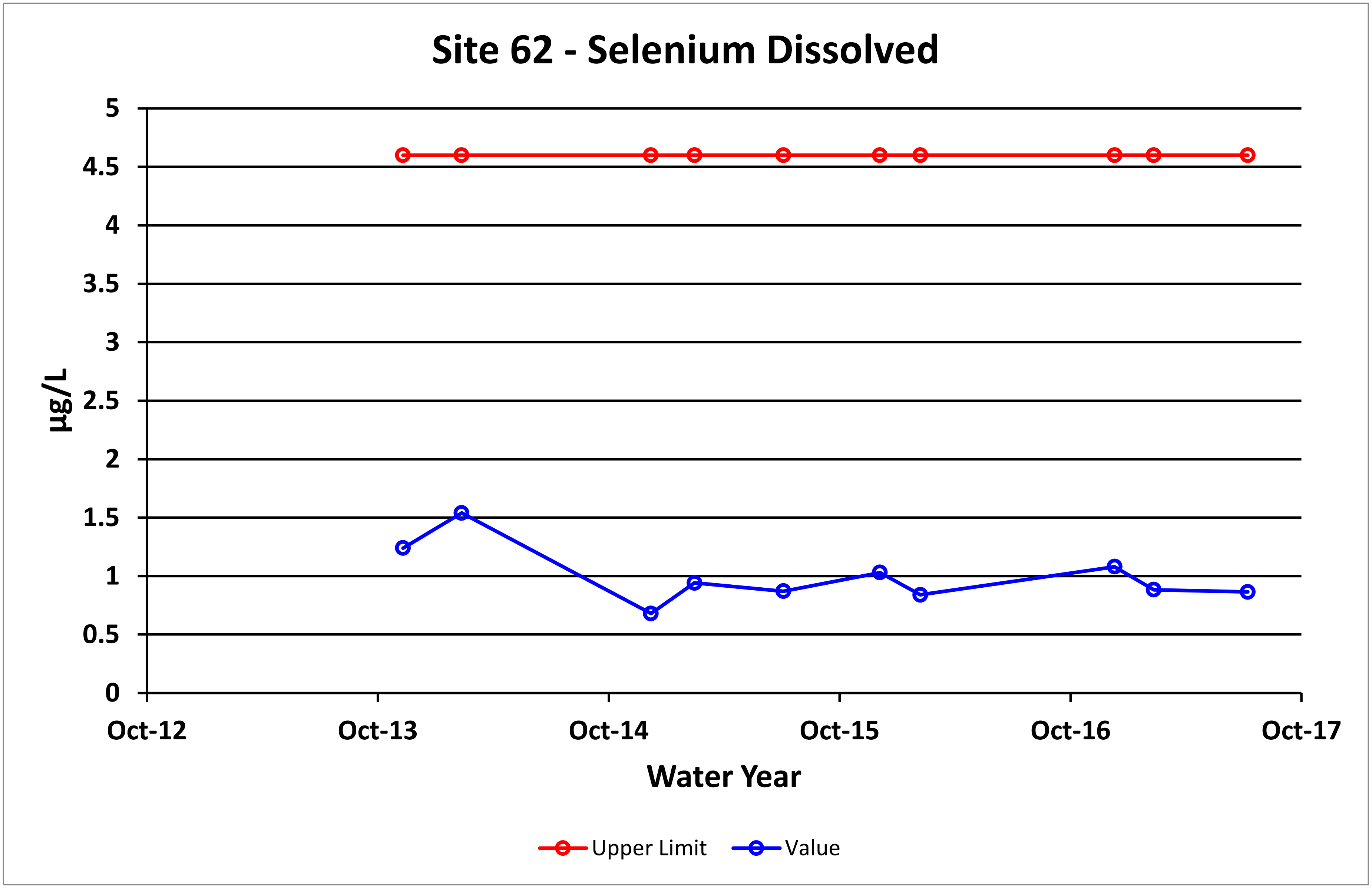

Site 62 - Lead Dissolved
2.5
2
1.5
1
0.5
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

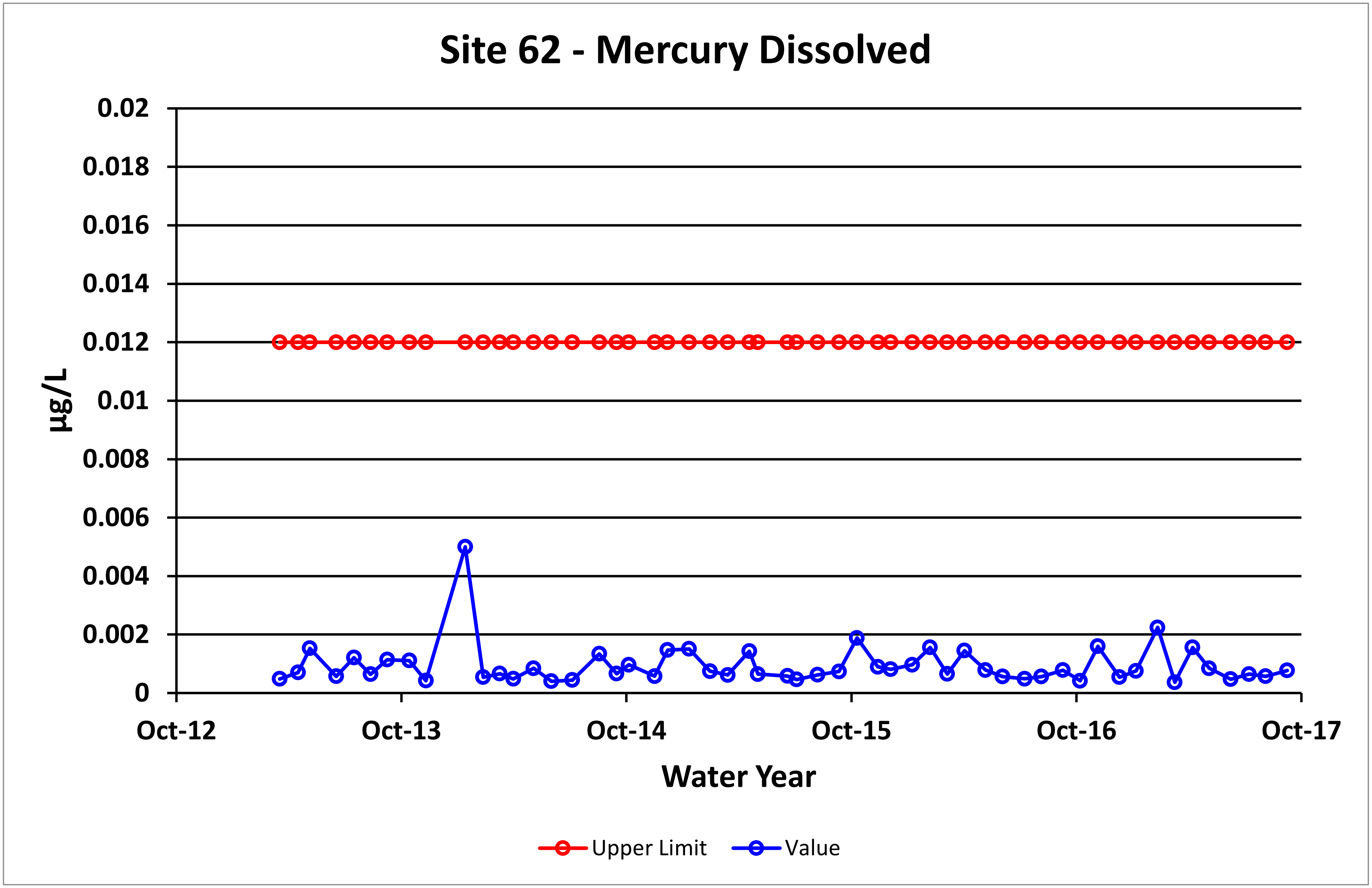

Site 62 - Nickel Dissolved
µg/L
50
45
40
35
30
25
20
15
10
5
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value



Site 62 - Silver Dissolved
3
2.5
2
1.5
1
0.5
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value


Site 62 - Zinc Dissolved
µg/L
300
250
200
150
100
50
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value


Site 62 - Selenium Dissolved
µg/L
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value



Site 62 - Mercury Dissolved
0.02
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

Wilcoxon-signed-ranks test

Exact Form

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

	X	**Y**			
Site	#54	#62	Differences		
Year	WY2017	WY2017	**D**	**|D|**	**Rank**
Oct	154.80	167.90	-13.10	13.10	-9
Nov	89.50	95.30	-5.80	5.80	-2
Dec	124.70	152.90	-28.20	28.20	-12
Jan	167.30	174.70	-7.40	7.40	-5
Feb	126.00	135.70	-9.70	9.70	-6
Mar	172.00	153.30	18.70	18.70	10
Apr	117.60	123.70	-6.10	6.10	-3
May	95.50	120.80	-25.30	25.30	-11
Jun	101.10	105.80	-4.70	4.70	-1
Jul	105.50	111.80	-6.30	6.30	-4
Aug	148.80	158.70	-9.90	9.90	-7
Sep	121.60	133.40	-11.80	11.80	-8
Median	123.15	134.55	-8.55	9.80	

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	#54	#62	Differences		
Year	WY2017	WY2017	**D**	**|D|**	**Rank**
Oct	7.98	8.01	-0.03	0.03	-4
Nov	7.82	7.69	0.13	0.13	10
Dec	8.10	7.98	0.12	0.12	8
Jan	7.87	7.96	-0.09	0.09	-7
Feb	7.44	7.32	0.12	0.12	9
Mar	7.72	7.53	0.19	0.19	11
Apr	7.89	7.66	0.23	0.23	12
May	7.92	7.93	-0.01	0.01	-2
Jun	7.85	7.89	-0.04	0.04	-5
Jul	7.87	7.86	0.01	0.01	1
Aug	7.92	7.87	0.05	0.05	6
Sep	7.93	7.94	-0.01	0.01	-3
Median	7.88	7.88	0.03	0.07	

n	**m**
12	12

N= 12

ΣR= 36

α
0.05
W'α,n
17

W^+=
21
p-test
0.088

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

Wilcoxon-signed-ranks test

Exact Form

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

	X	Y	Differences		
Site	#54	#62			
Year	WY2017	WY2017	**D**	**|D|**	**Rank**
Oct	57.60	63.50	-5.90	5.90	-12
Nov	34.00	35.80	-1.80	1.80	-2
Dec	56.00	61.50	-5.50	5.50	-9
Jan	59.20	64.10	-4.90	4.90	-8
Feb	43.50	47.50	-4.00	4.00	-4.5
Mar	58.30	63.00	-4.70	4.70	-7
Apr	44.60	50.30	-5.70	5.70	-11
May	42.20	47.80	-5.60	5.60	-10
Jun	40.50	42.00	-1.50	1.50	-1
Jul	42.30	44.40	-2.10	2.10	-3
Aug	52.70	56.90	-4.20	4.20	-6
Sep	46.80	50.80	-4.00	4.00	-4.5
Median	45.70	50.55	-4.45	4.45	

n	**m**
12	12

N= 12

$\Sigma R=$ -78

α
0.05
W'α,n
17

$W^+=$
0
p-test
0.000

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

Wilcoxon-signed-ranks test
Exact Form

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

	X	**Y**			
Site	#54	#62	Differences		
Year	WY2017	WY2017	**D**	**|D|**	**Rank**
Oct	19.3	21.2	-1.9	1.9	-9.5
Nov	7.7	8.9	-1.2	1.2	-6
Dec	19.1	21.0	-1.9	1.9	-9.5
Jan	21.4	23.9	-2.5	2.5	-11.5
Feb	15.1	16.7	-1.6	1.6	-8
Mar	22.5	25.0	-2.5	2.5	-11.5
Apr	14.6	15.3	-0.7	0.7	-3
May	10.8	11.9	-1.1	1.1	-4
Jun	10.3	10.5	-0.2	0.2	-1
Jul	10.9	11.5	-0.6	0.6	-2
Aug	16.8	18.0	-1.2	1.2	-6
Sep	12.4	13.6	-1.2	1.2	-6
Median	14.9	16.0	-1.2	1.2	

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

	X	Y	Differences		
Site	#54	#62			
Year	WY2017	WY2017	**D**	**|D|**	**Rank**
Oct	5.57	6.00	-0.43	0.43	-11
Nov	4.52	4.77	-0.25	0.25	-8
Dec	8.94	8.61	0.33	0.33	10
Jan	8.77	8.69	0.08	0.08	4
Feb	11.90	11.20	0.70	0.70	12
Mar	7.37	7.51	-0.14	0.14	-5
Apr	7.25	7.31	-0.06	0.06	-3
May	4.78	4.58	0.20	0.20	6
Jun	2.96	2.91	0.05	0.05	2
Jul	3.99	3.98	0.01	0.01	1
Aug	4.16	4.38	-0.22	0.22	-7
Sep	6.16	6.44	-0.28	0.28	-9
Median	5.87	6.22	-0.03	0.21	

n	**m**
12	12

N= 12
ΣR= -8

α
0.05
W'$_{\alpha,n}$
17

W^+=
35
p-test
0.395

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 2017” report. The table includes all the required FWMP analyte data (field and laboratory) collected for the current water year and a series of flags keyed to the summary report “Qualified Data by QA Reviewer”. The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of ½ MDL for the purpose of median calculation.

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

Sample Date	Parameter	Value	Qualifier	Notes
No outliers have been identified by HGCMC for the period of October 2013 through September 2017.				

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 2017

			Limits		
Sample Date	**Parameter**	**Value**	**Lower**	**Upper**	**Hardness**
No exceedances have been identified by HGCMC for the period of October 2016 through September 2017.					

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. Two samples showed slightly elevated lead concentrations in the current water year, but they were well 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 5 years) amount of data, visual trend analysis and statistical analysis of the data was not performed.

Table of Results for Water Year 2017

Site 061FMS - 'Greens Creek Floodplain'

Sample Date/Parameter	Oct 2016	Nov 2016	Dec 2016	Jan 2017	Feb 2017	Mar 2017	Apr 2017	May 2017	Jun 2017	Jul 2017	Aug 2017	Sep 2017	**Median**
Water Temp (°C)		5.7			1.3			5.5			6.5		5.6
Conductivity-Field(μmho)		560			409			432			345.5		420.5
Conductivity-Lab (μmho)		536			385			408			342		397
pH Lab (standard units)		7.39			6.98			7.46			7.27		7.33
pH Field (standard units)		7.45			7.21			7.69			7.62		7.54
Total Alkalinity (mg/L)		131			87.6			124			123		123.5
Total Sulfate (mg/L)		146			102			85.6			59.4		93.8
Hardness (mg/L)		271			191			208			172		199.5
Dissolved As (ug/L)		0.199			0.152			0.216			0.225		0.208
Dissolved Ba (ug/L)		52			41.1								46.6
Dissolved Cd (ug/L)		0.4			0.25			0.298			0.291		0.2945
Dissolved Cr (ug/L)		0.208			0.108								0.158
Dissolved Cu (ug/L)		0.353			0.463			0.233			0.163		0.293
Dissolved Pb (ug/L)		0.995			0.808			0.0878			0.0323		0.4479
Dissolved Ni (ug/L)		1.69			1.09								1.390
Dissolved Ag (ug/L)		0.002			0.002								0.002
Dissolved Zn (ug/L)		90.3			59.4			54.9			67.2		63.30
Dissolved Se (ug/L)		2.21			1.21								1.710
Dissolved Hg (ug/L)		0.000251			0.000417			0.000193			0.000157		0.000222

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

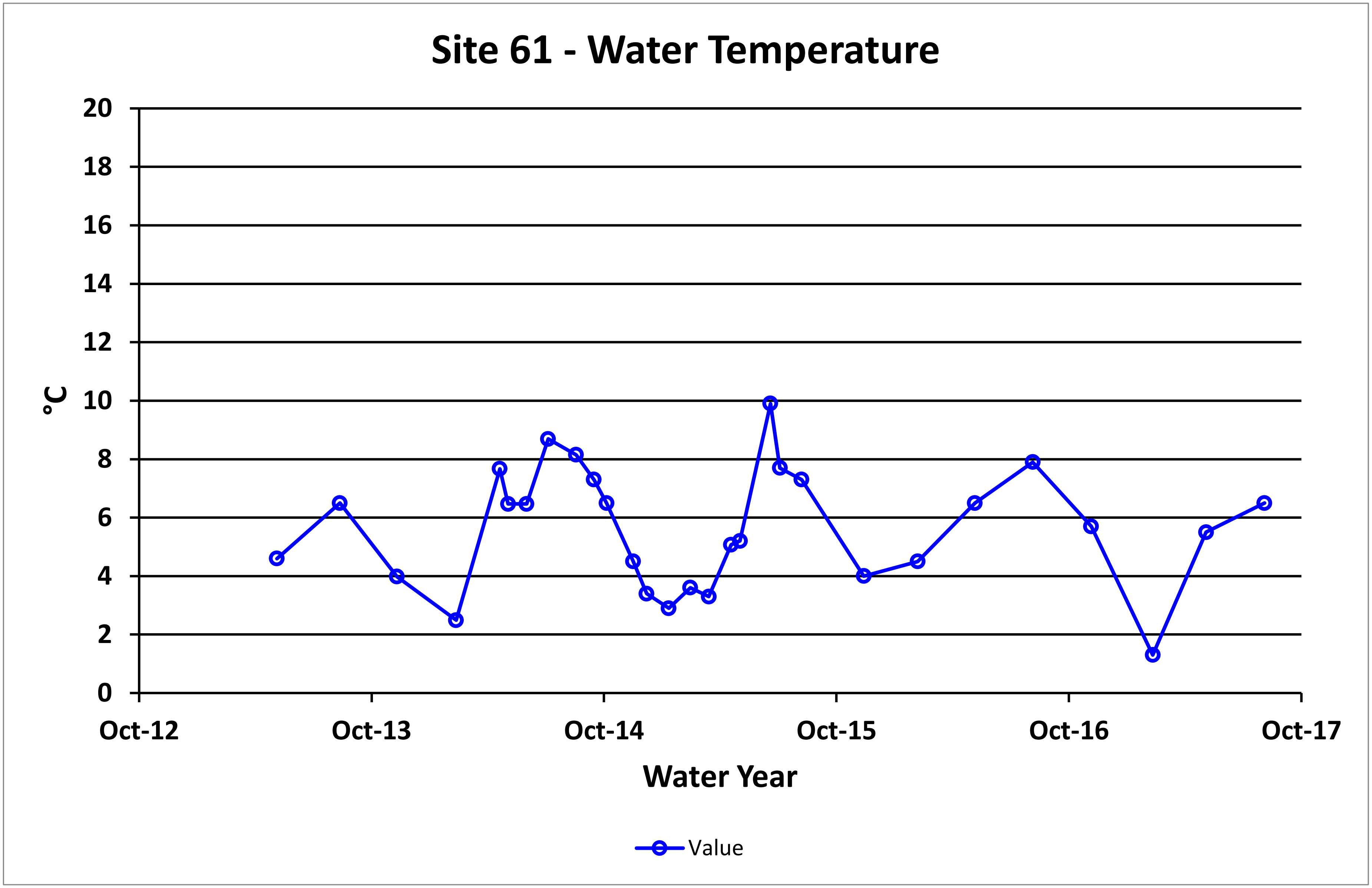
Values reported as less than MDL are replaced by 1/2 MDL for median calculation purposes.

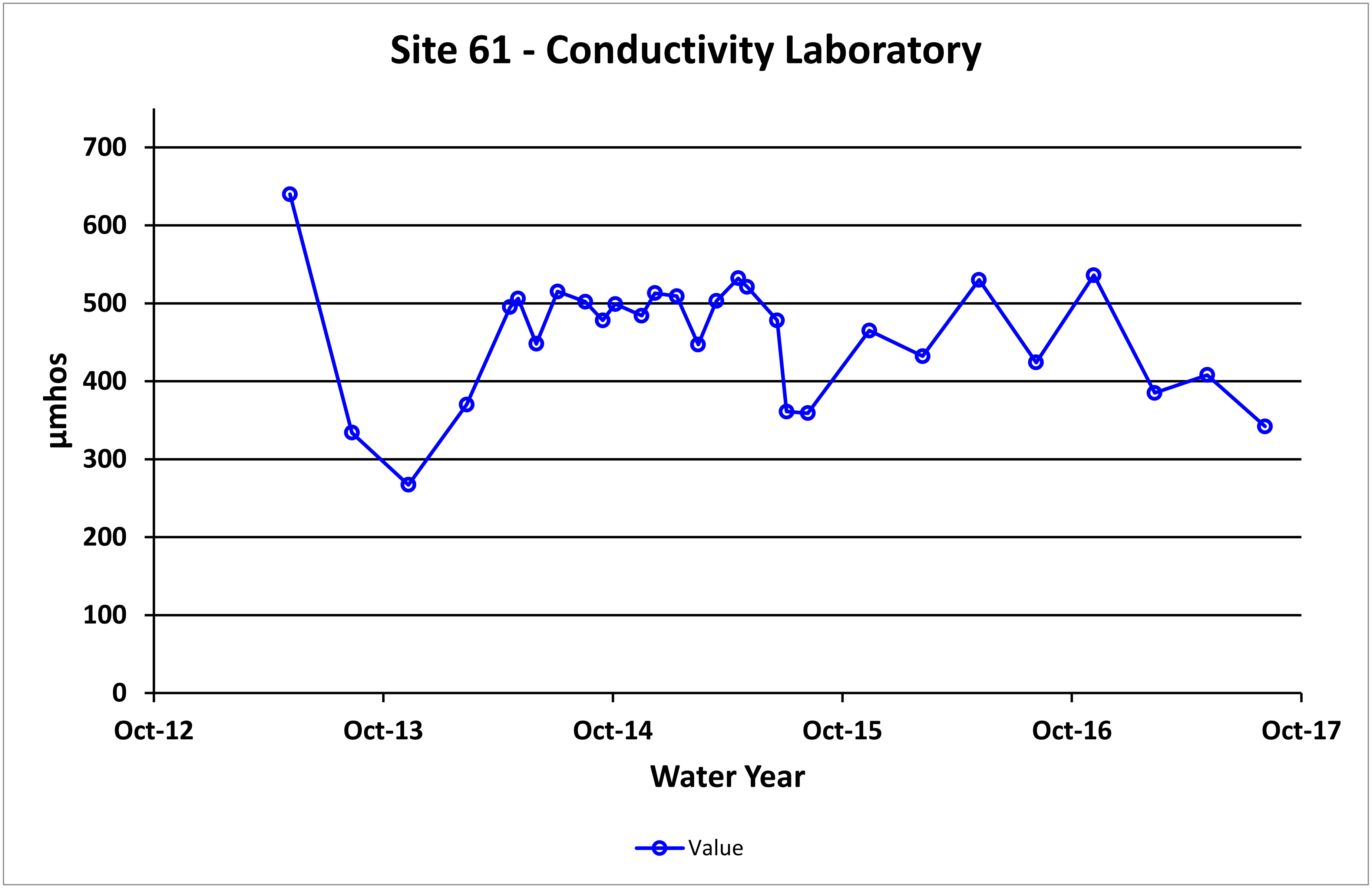
Shaded data has been qualified as an outlier by HGCMC and removed from any further analysis and is not included into the calculation of the median

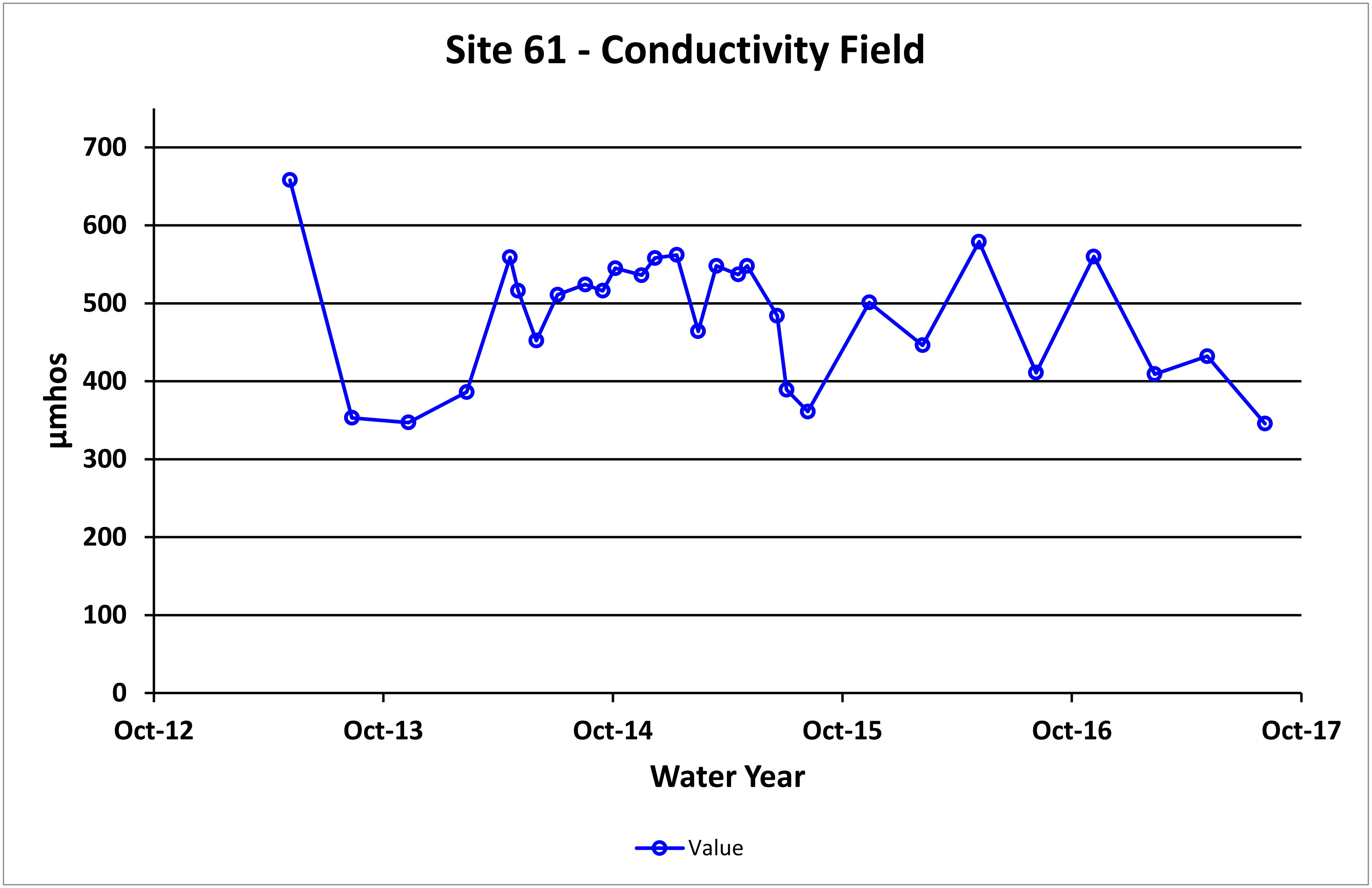
Qualified Data by QA Reviewer

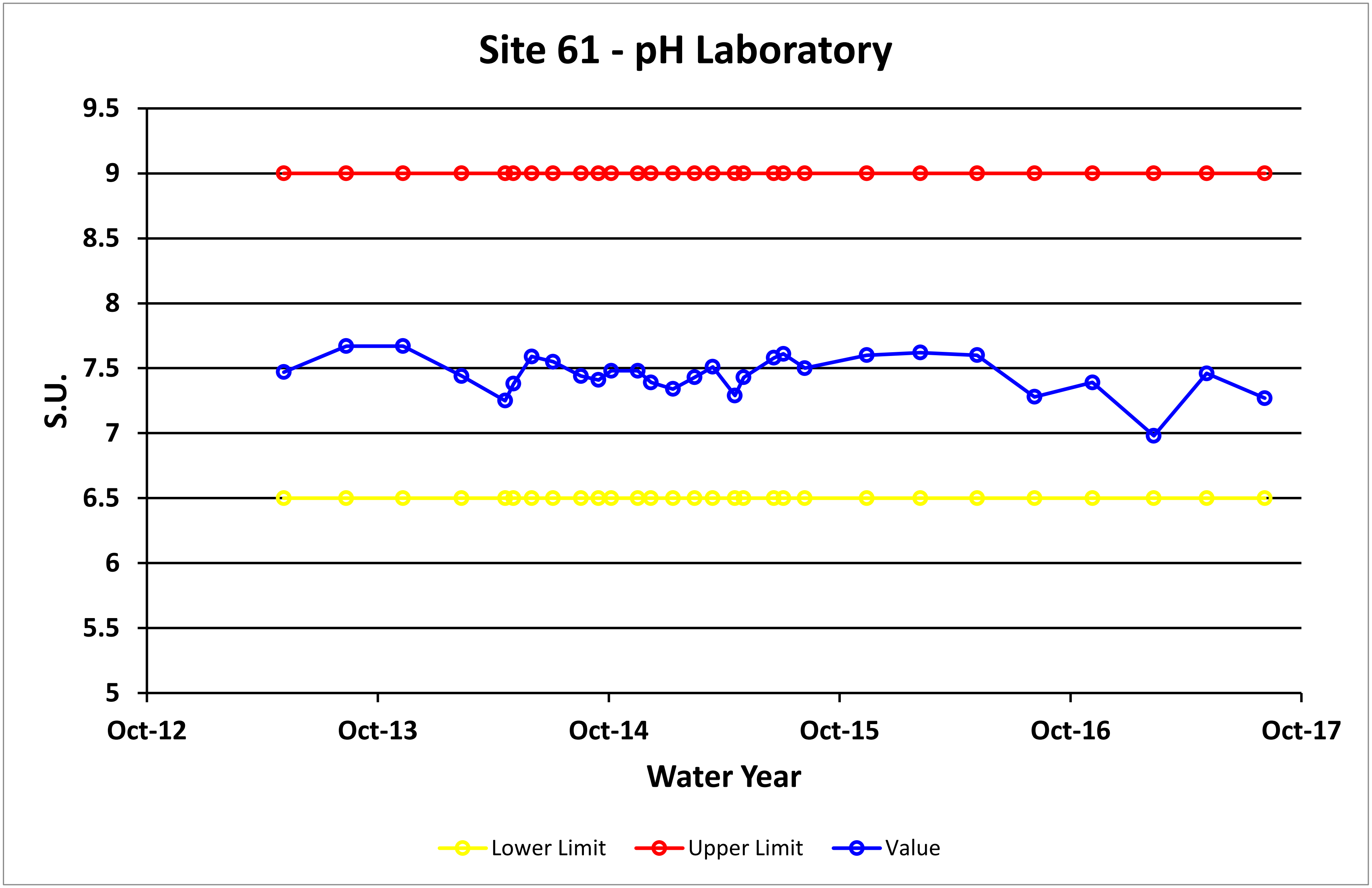
Date Range: 10/01/2016 to 09/30/2017

Site No.	Sample Date	Sample Time	Parameter	Value		Qualifier	Reason for Qualifier
061FMS	2/13/2017	12:00 PM	Diss. Cr-ICP/MS	0.1	µg/L	J	Below Quantitative Range
	5/8/2017	12:00 PM	Diss. Hg-CVAF	0.000193	µg/L	U	Trip Blank Contamination
			Tot. Sulfate	85.6	mg/L	J	Sample Receipt Temperature
	8/8/2017	12:00 PM	Diss. Hg-CVAF	0.000157	µg/L	J	Below Quantitative Range
			Tot. Sulfate	59.4	mg/L	J	Sample Receipt Temperature

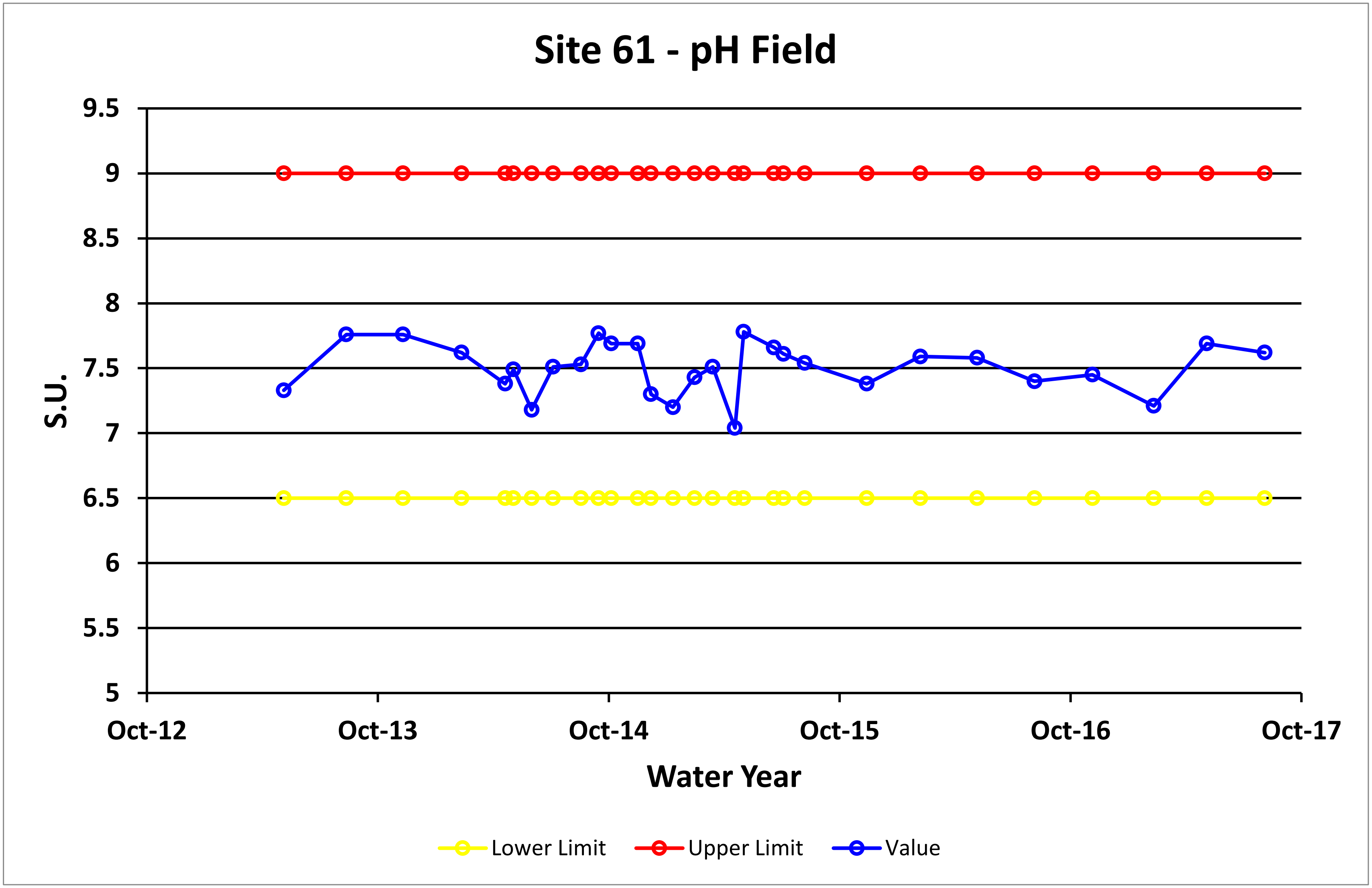

Site 61 - Water Temperature
°C
20
18
16
14
12
10
8
6
4
2
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value

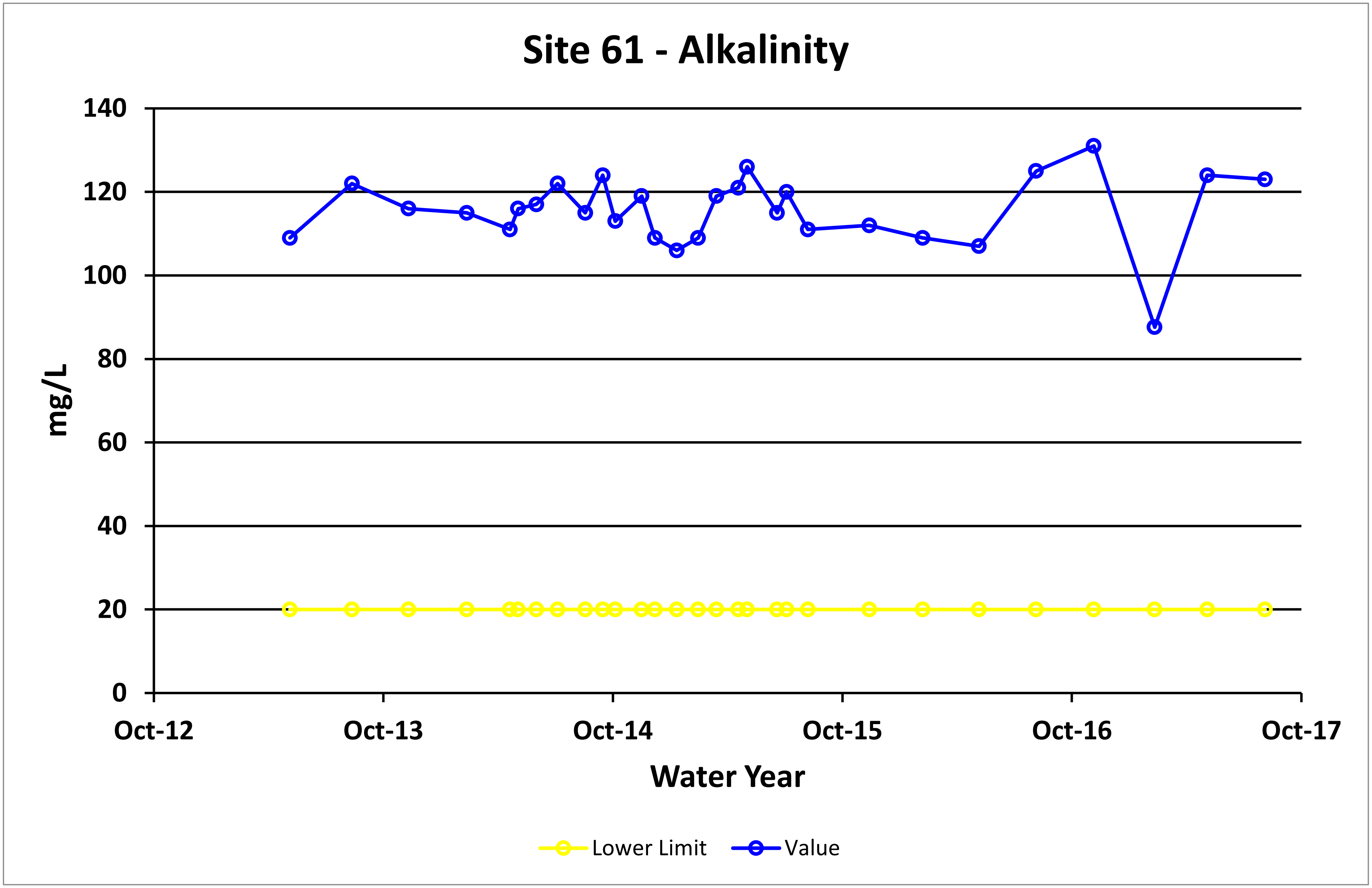

Site 61 - Conductivity Laboratory
700
600
500
400
300
200
100
0
µmhos
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value

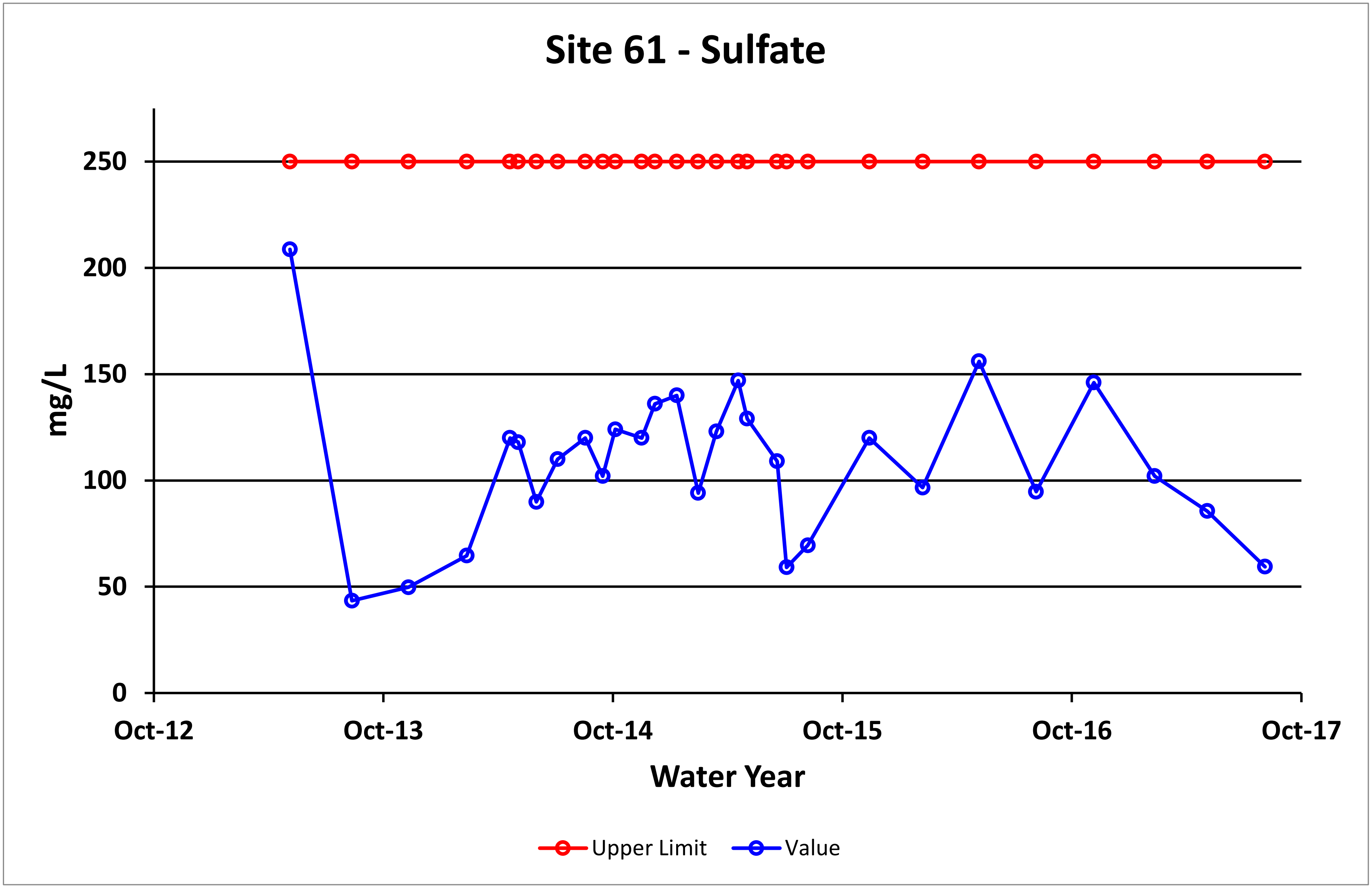

Site 61 - Conductivity Field
µmhos
700
600
500
400
300
200
100
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value

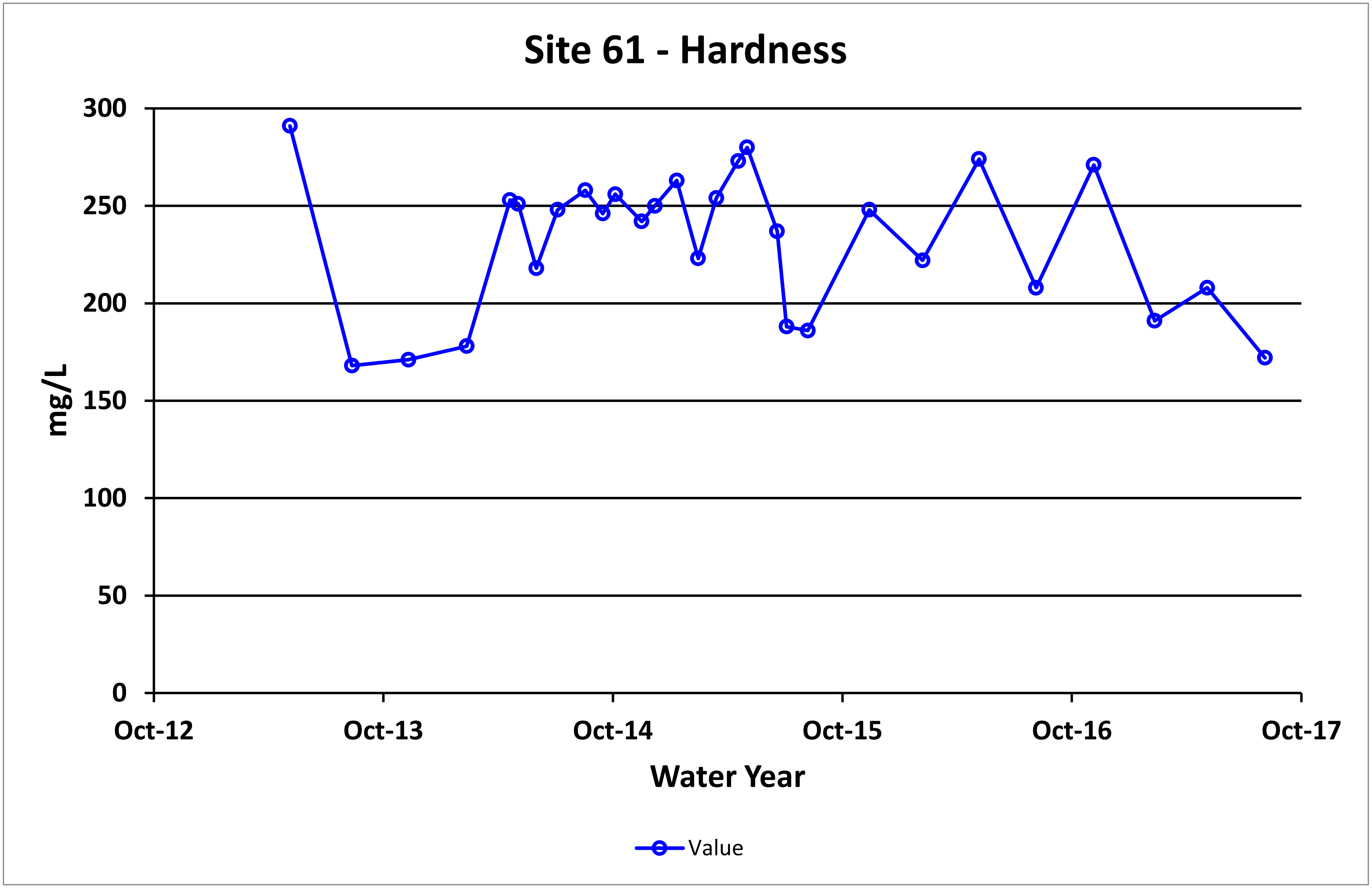


Site 61 - pH Laboratory
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
S.U.
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Lower Limit
Upper Limit
Value

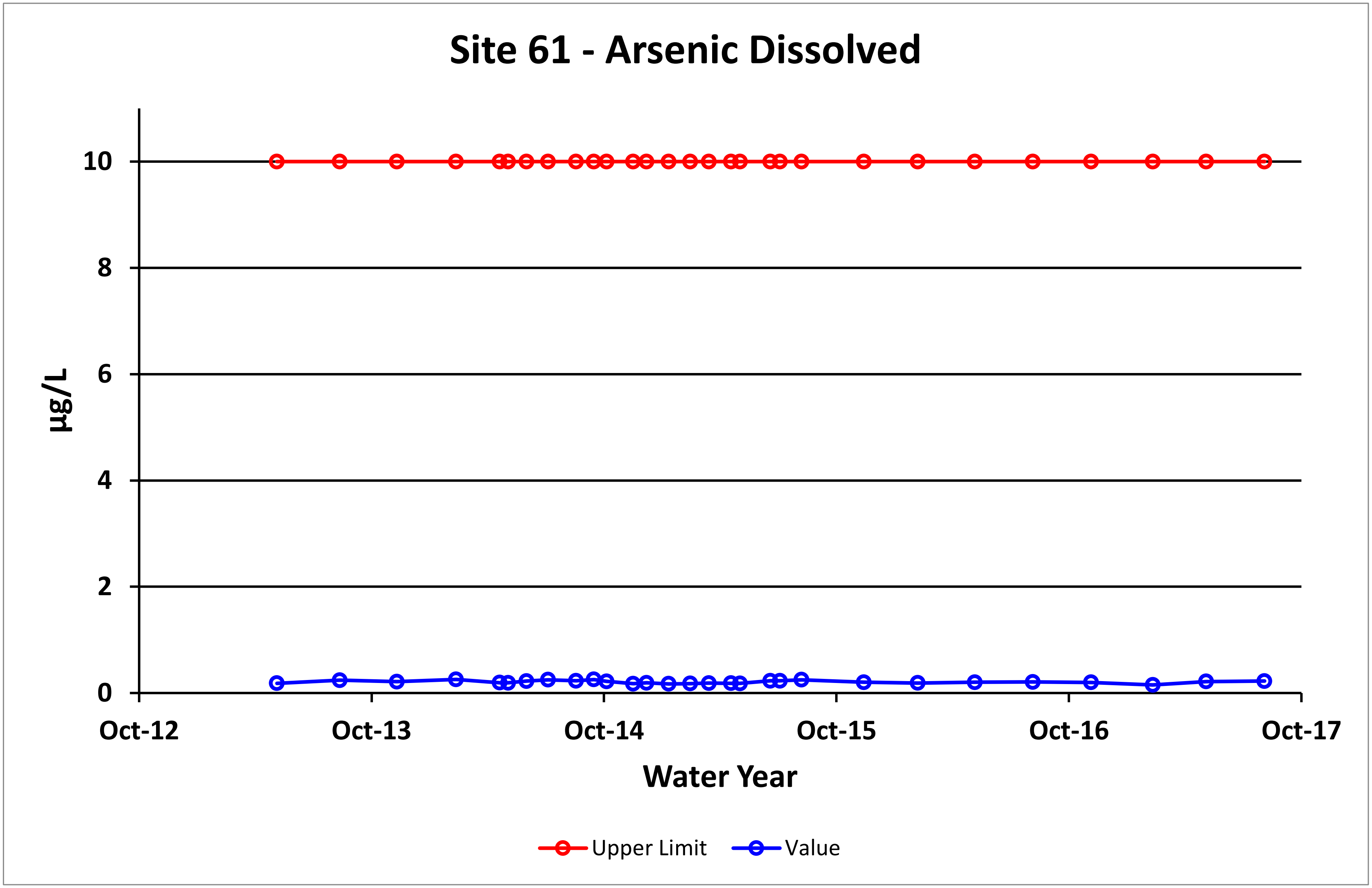

Site 61 - pH Field
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
S.U.
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Lower Limit
Upper Limit
Value


Site 61 - Alkalinity
140
120
100
80
60
40
20
0
mg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Lower Limit
Value

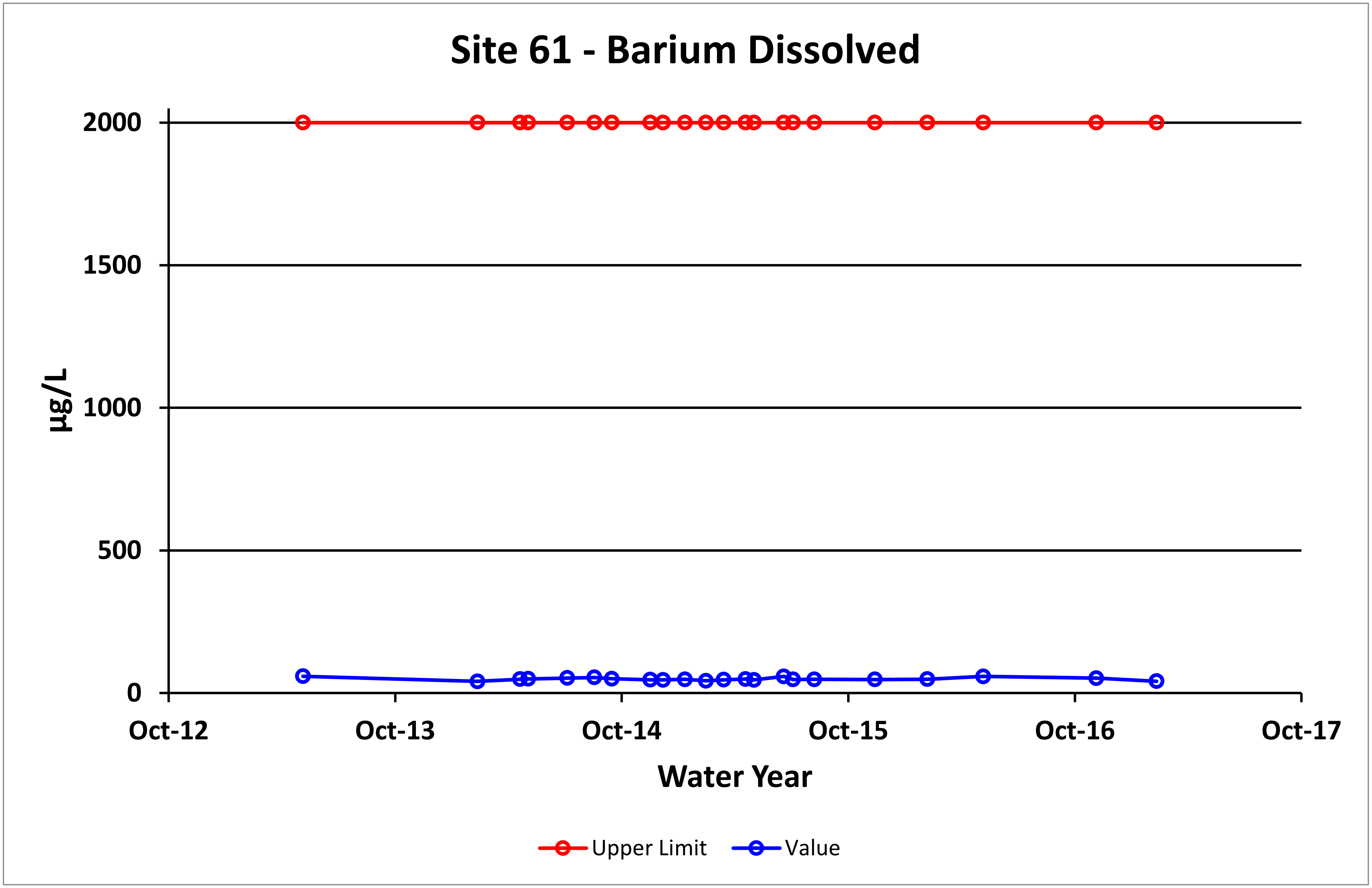

Site 61 - Sulfate
250
200
150
100
50
0
mg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

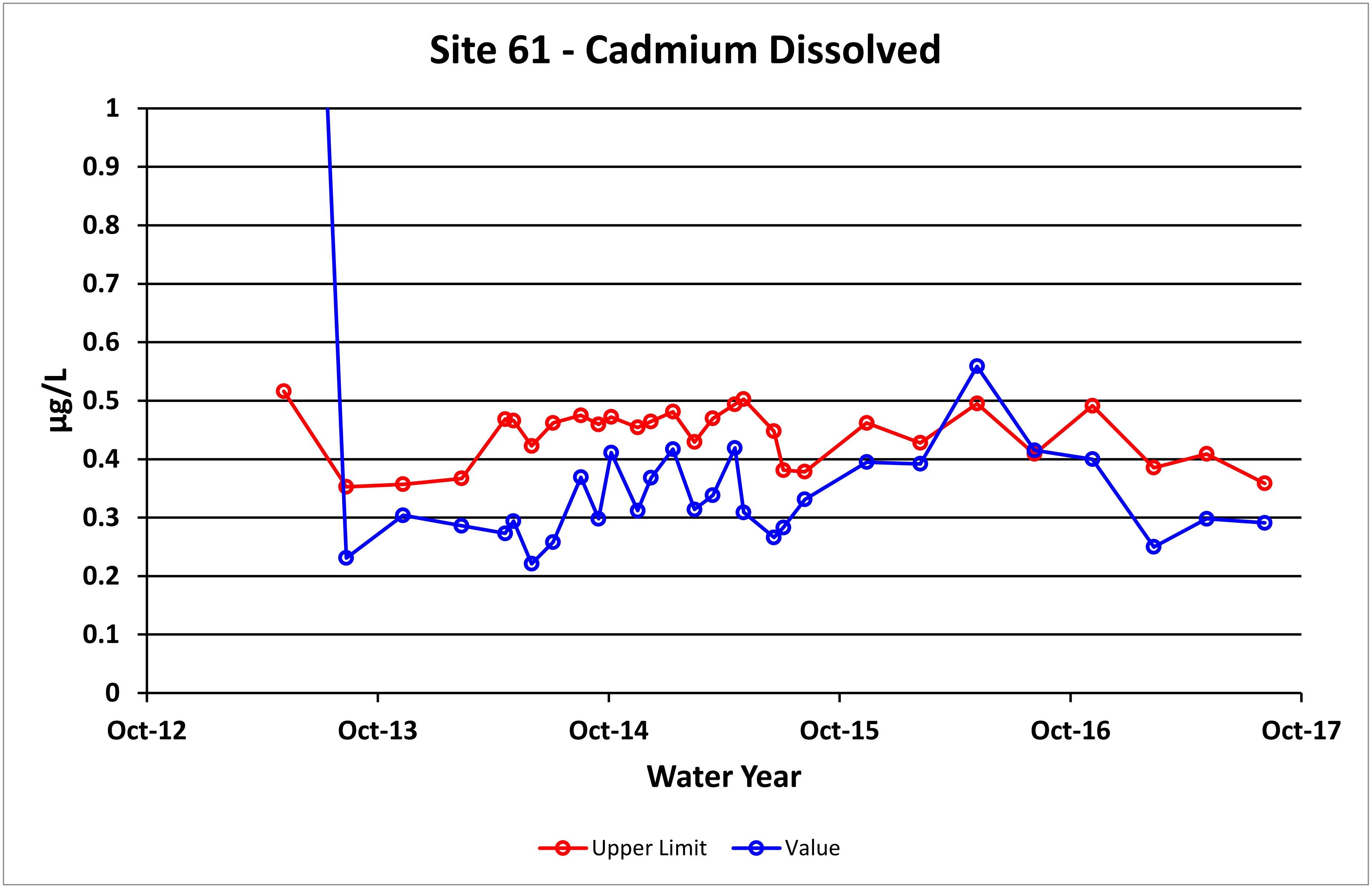


Site 61 - Hardness
300
250
200
150
100
50
0
mg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value

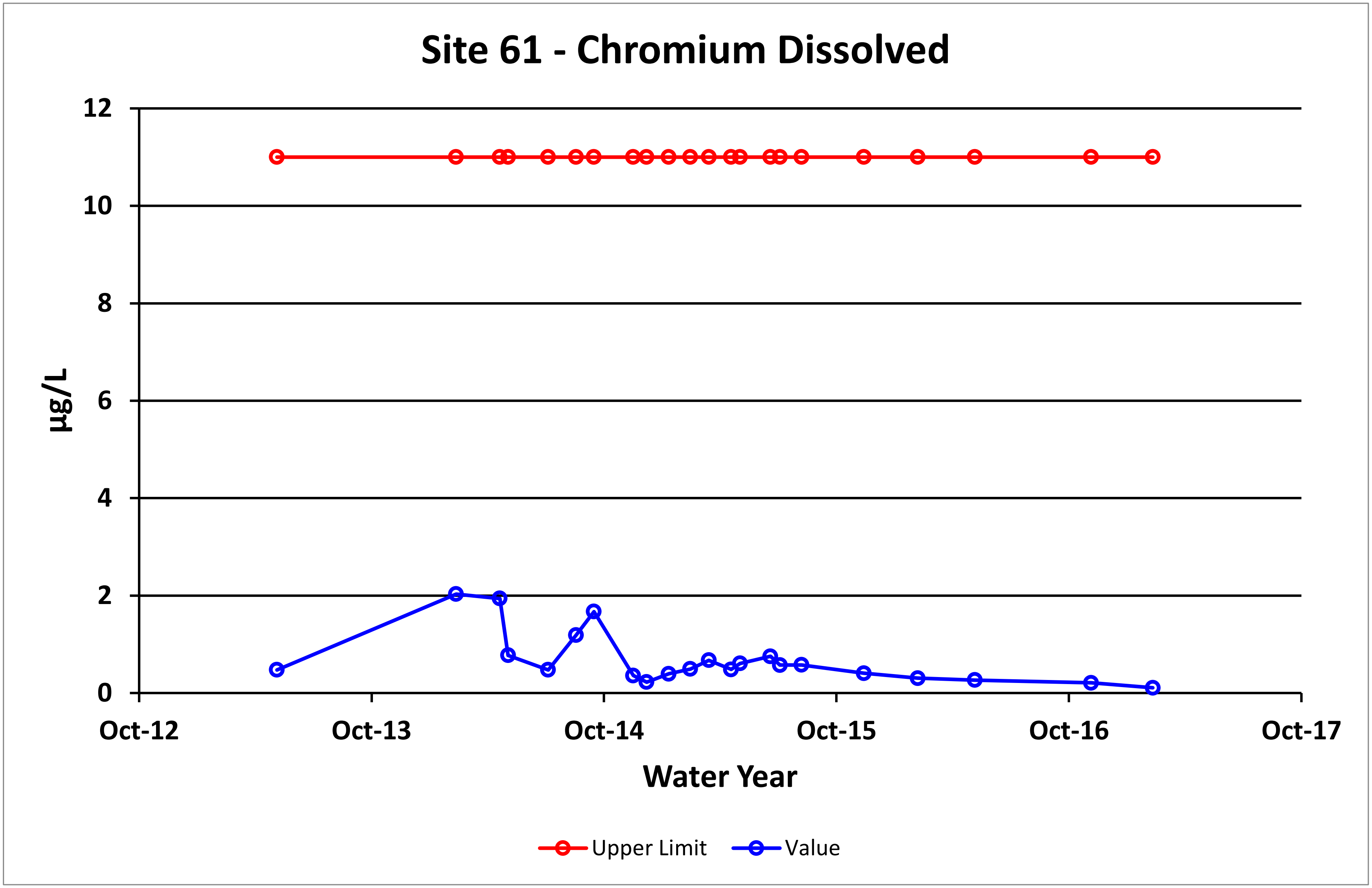


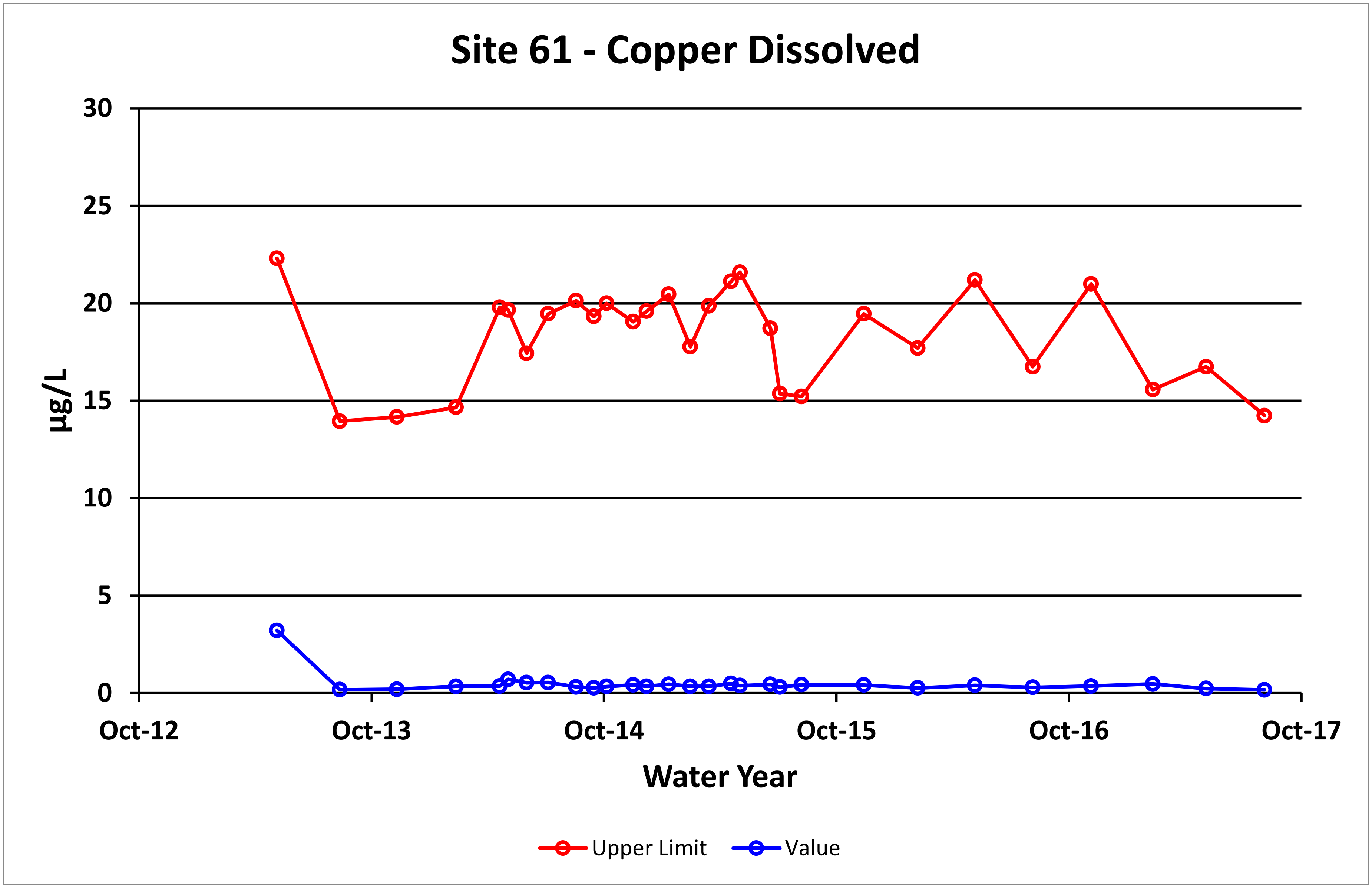
Site 61 - Arsenic Dissolved
µg/L
10
8
6
4
2
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

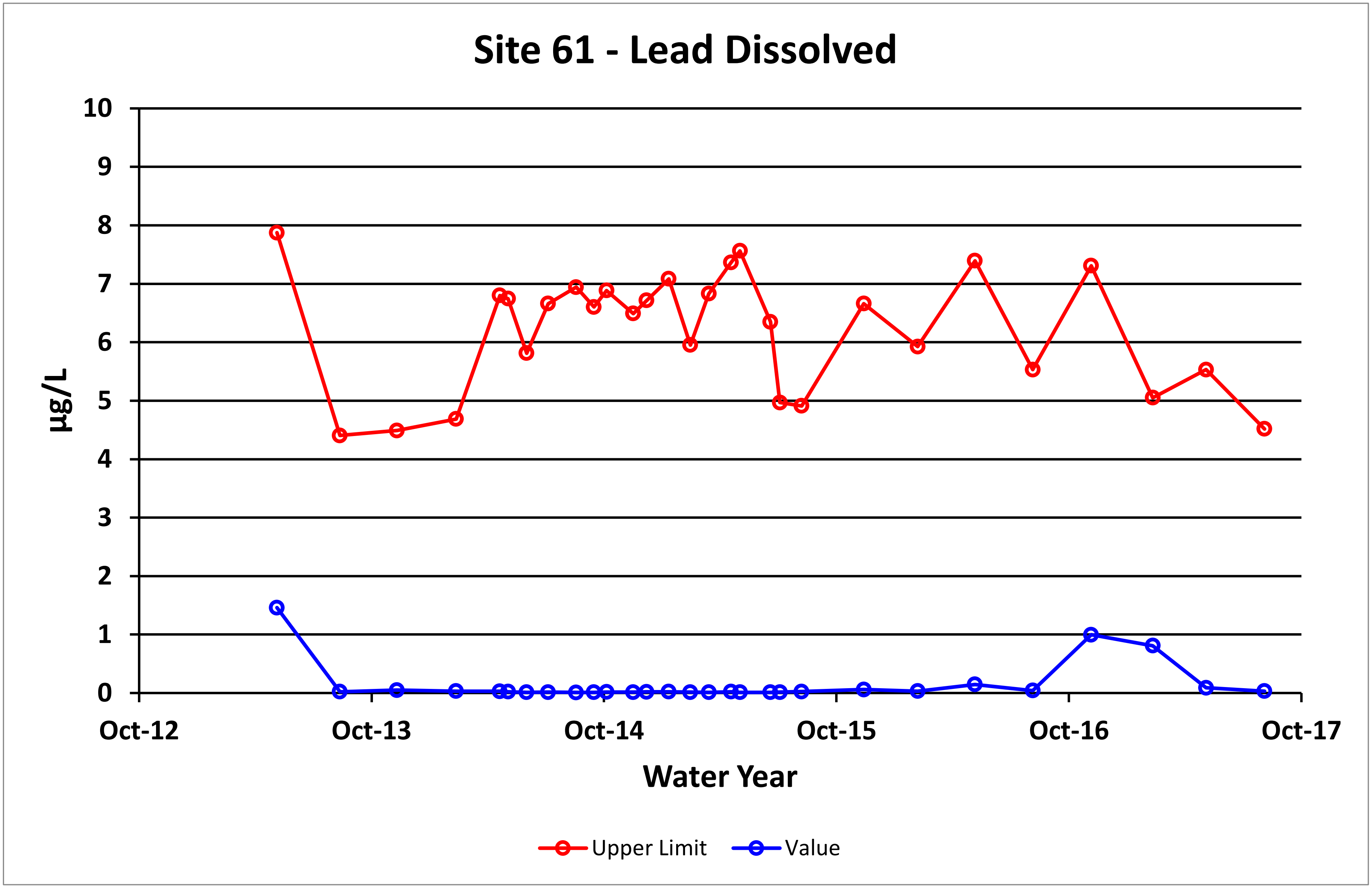

Site 61 - Barium Dissolved
µg/L
2000
1500
1000
500
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value



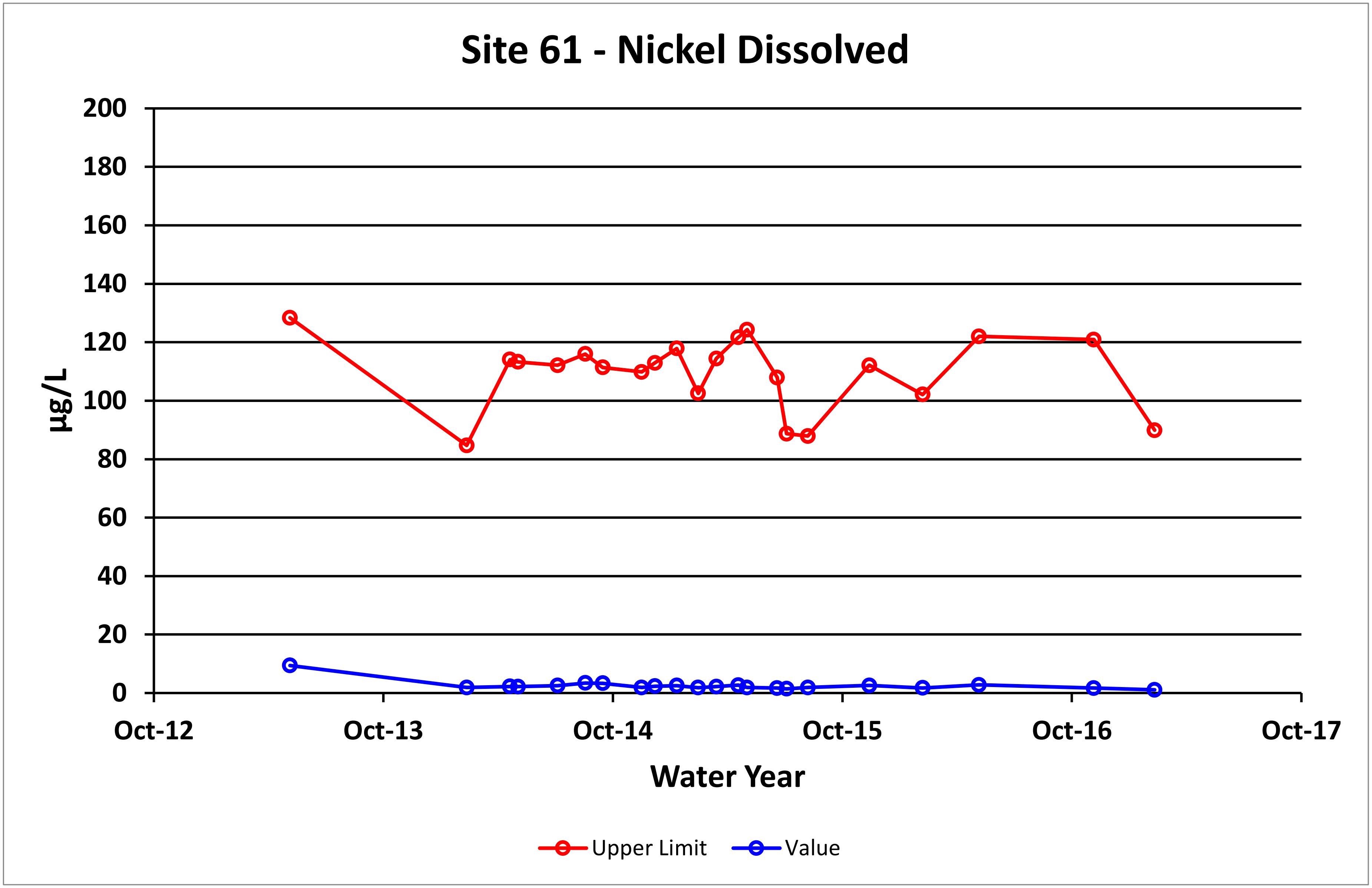
Site 61 - Cadmium Dissolved
µg/L
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

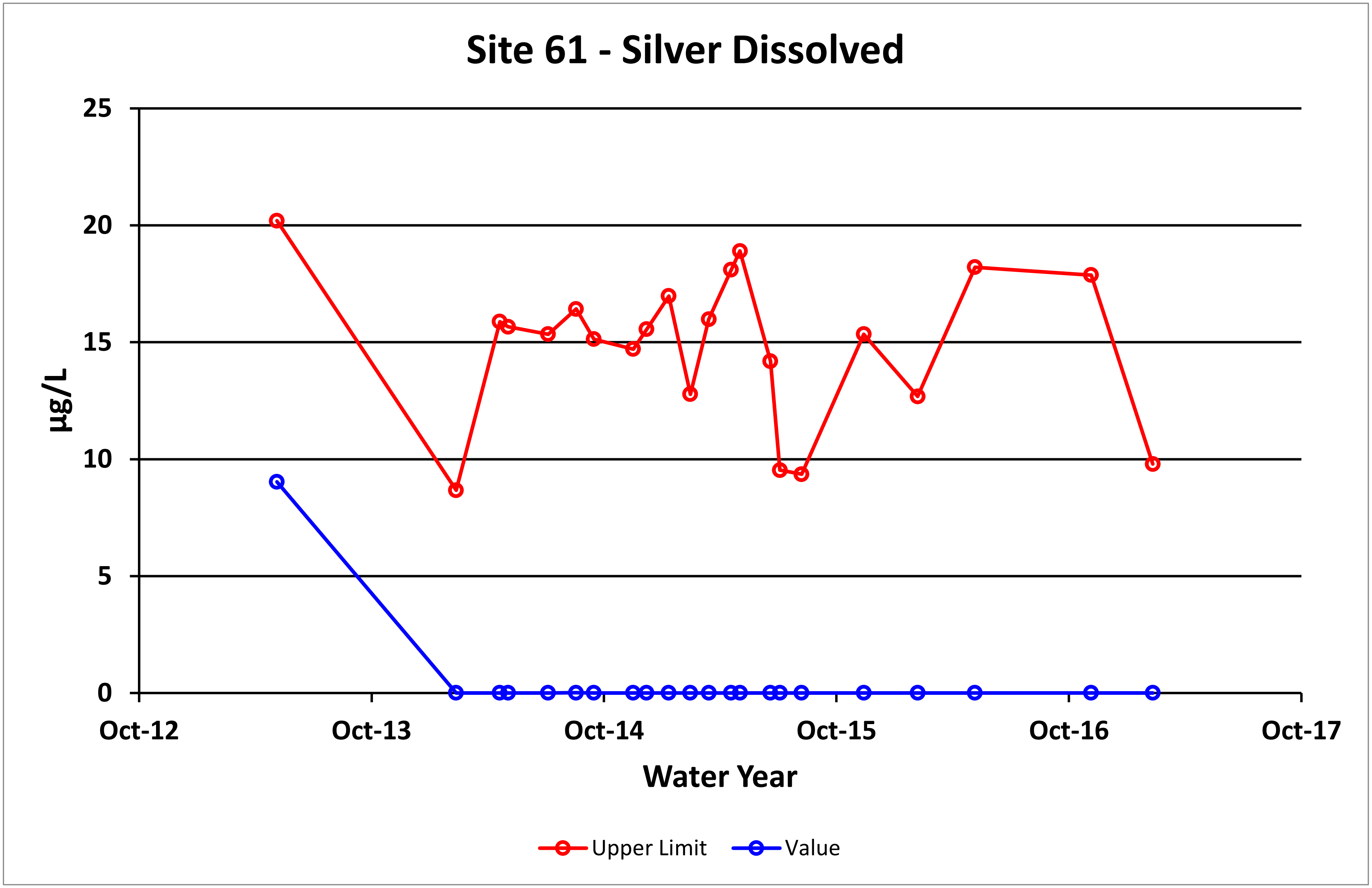

Site 61 - Chromium Dissolved
12
10
8
6
4
2
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

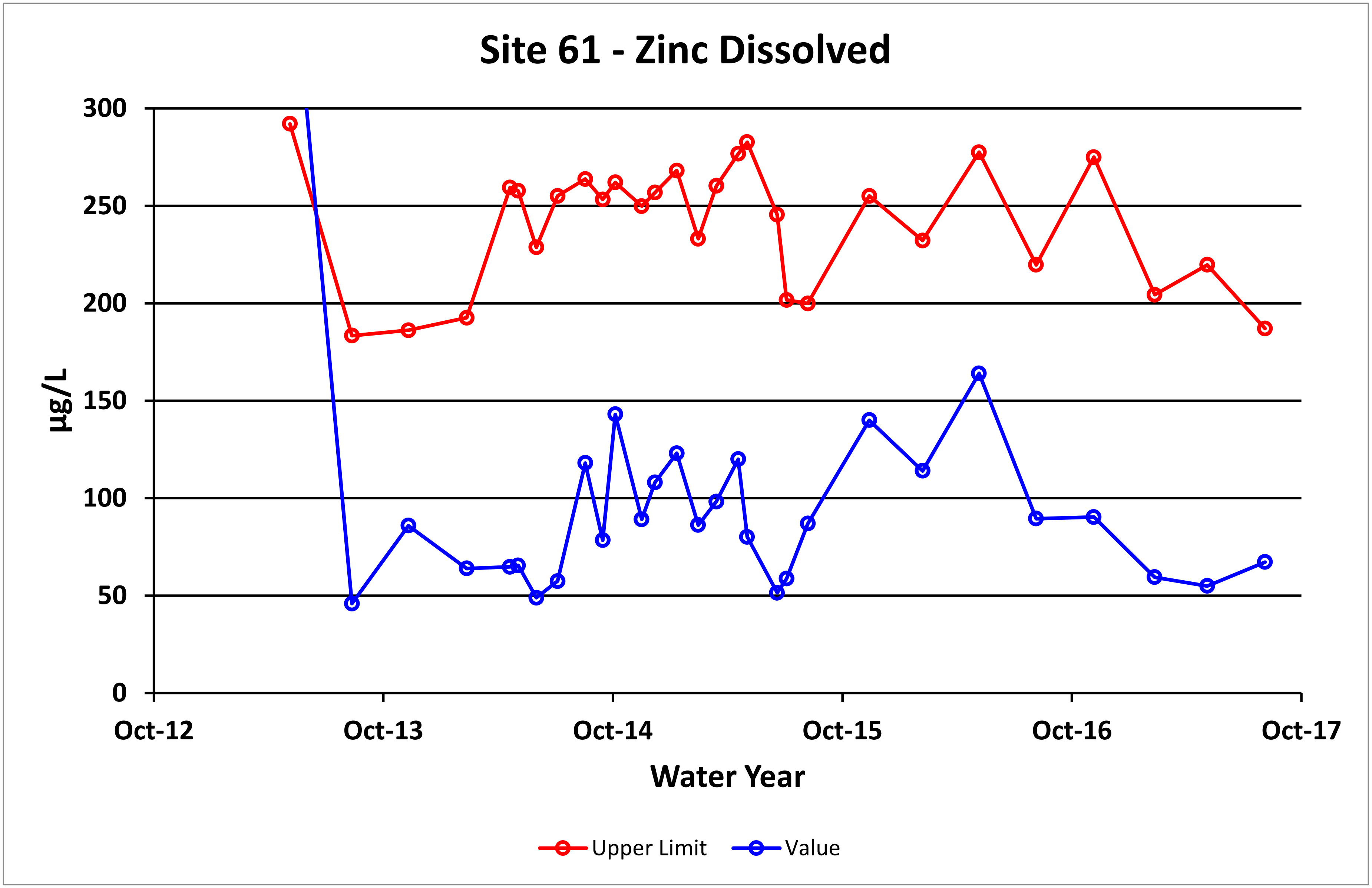

Site 61 - Copper Dissolved
30
25
20
15
10
5
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value



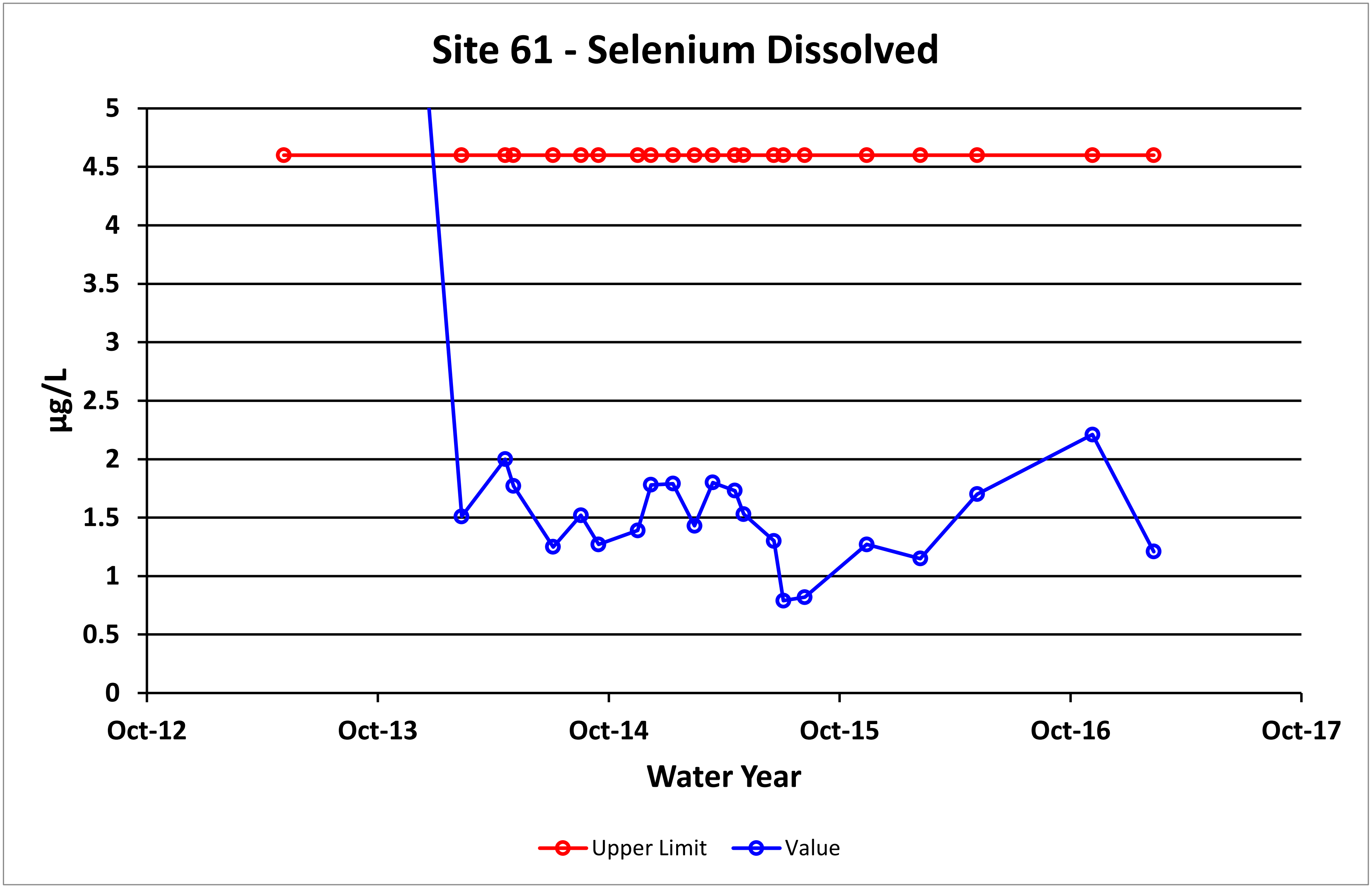
Site 61 - Lead Dissolved
10
9
8
7
6
5
4
3
2
1
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value


Site 61 - Nickel Dissolved
200
180
160
140
120
100
80
60
40
20
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

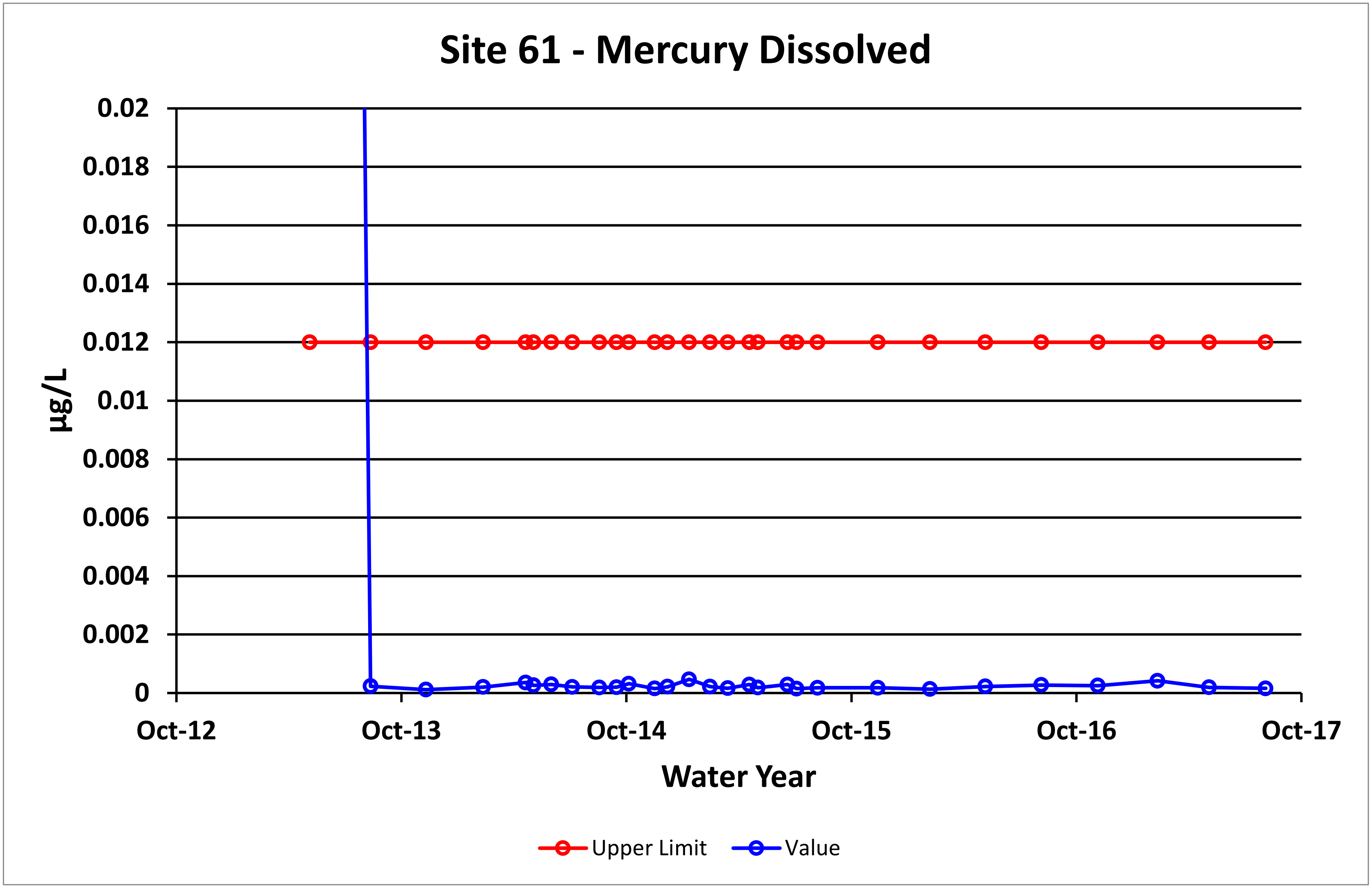

Site 61 - Silver Dissolved
µg/L
25
20
15
10
5
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value



Site 61 - Zinc Dissolved
300
250
200
150
100
50
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value



Site 61 - Selenium Dissolved
µg/L
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value


Site 61 - Mercury Dissolved
0.02
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

INTERPRETIVE REPORT
SITE 49

The data collected during the current water year are listed in the following "Table of Results for Water Year 2017" report. The table includes all the required FWMP analyte data (field and laboratory) collected for the current water year and a series of flags keyed to the summary report "Qualified Data by QA Reviewer". The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of ½ MDL for the purpose of median calculation.

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

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

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

Table of Exceedance for Water Year 2017

			Limits		
Sample Date	Parameter	Value	Lower	Upper	Hardness
No exceedances have been identified by HGCMC for the period of October 2016 through September 2017.					

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-11 and Sep-17 (WY2012-WY2017). 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 Summary Statistics for Trend Analysis

Parameter	Mann-Kendall test statistics n*	p**	Trend	Sen's slope estimate Q	Q(%)
Conductivity Field	6	0.26			
pH Field	6	0.96			
Alkalinity, Total	6	0.39			
Sulfate, Total	6	0.15			
Zinc, Dissolved	6	0.04			

* Number of Years ** Significance level

Table of Results for Water Year 2017

Site 049FMS - 'Upper Bruin Creek'

Sample Date/Parameter	Oct 2016	Nov 2016	Dec 2016	Jan 2017	Feb 2017	Mar 2017	Apr 2017	May 2017	Jun 2017	Jul 2017	Aug 2017	Sep 2017	**Median**
Water Temp (°C)		5.2			0.6			3.3			10.1		4.3
Conductivity-Field(μmho)		133.5			124.5			128			184.8		130.8
Conductivity-Lab (μmho)		130			119			122			164		126
pH Lab (standard units)		7.7			7.62			7.69			7.67		7.68
pH Field (standard units)		8.02			8.06			8.08			8.08		8.07
Total Alkalinity (mg/L)		55.9			48.2			54.9			75		55.4
Total Sulfate (mg/L)		9.4			9.9			8.2			14		9.7
Hardness (mg/L)		63			59.3			63			85.6		63.0
Dissolved As (ug/L)		0.167			0.169			0.156			0.207		0.168
Dissolved Ba (ug/L)		8.8			9.5								9.2
Dissolved Cd (ug/L)		0.0287			0.0302			0.0247			0.0299		0.0293
Dissolved Cr (ug/L)		0.15			0.288								0.219
Dissolved Cu (ug/L)		0.532			0.886			0.36			0.437		0.485
Dissolved Pb (ug/L)		0.0082			0.0263			0.0037			0.0015		0.0060
Dissolved Ni (ug/L)		0.686			1.04								0.863
Dissolved Ag (ug/L)		0.002			0.004								0.003
Dissolved Zn (ug/L)		2			2.64			1.73			1.55		1.87
Dissolved Se (ug/L)		0.491			0.673								0.582
Dissolved Hg (ug/L)		0.0018			0.00398			0.00115			0.00128		0.001540

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

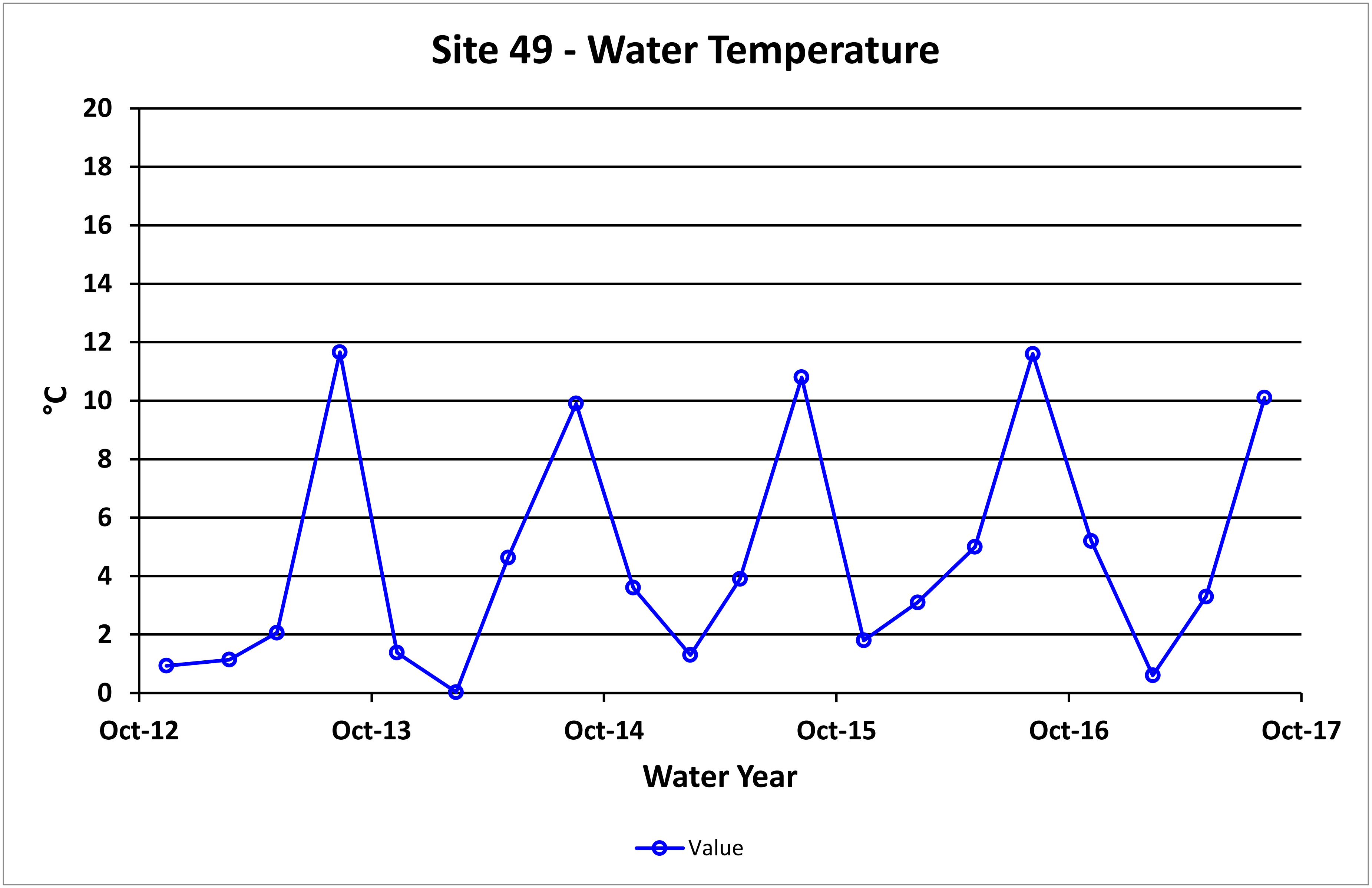
Values reported as less than MDL are replaced by 1/2 MDL for median calculation purposes.

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

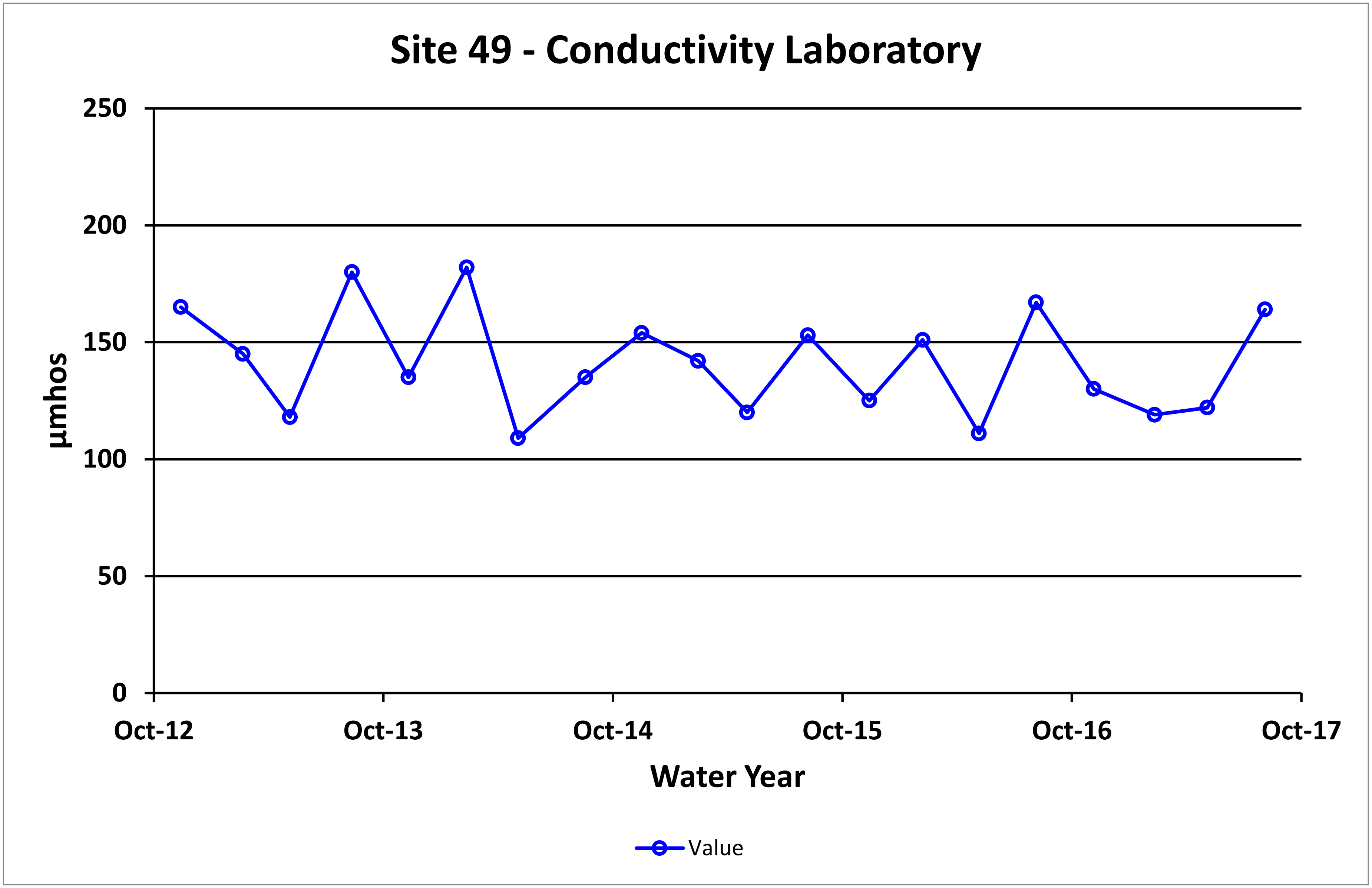
Qualified Data by QA Reviewer

Date Range: 10/01/2016 to 09/30/2017

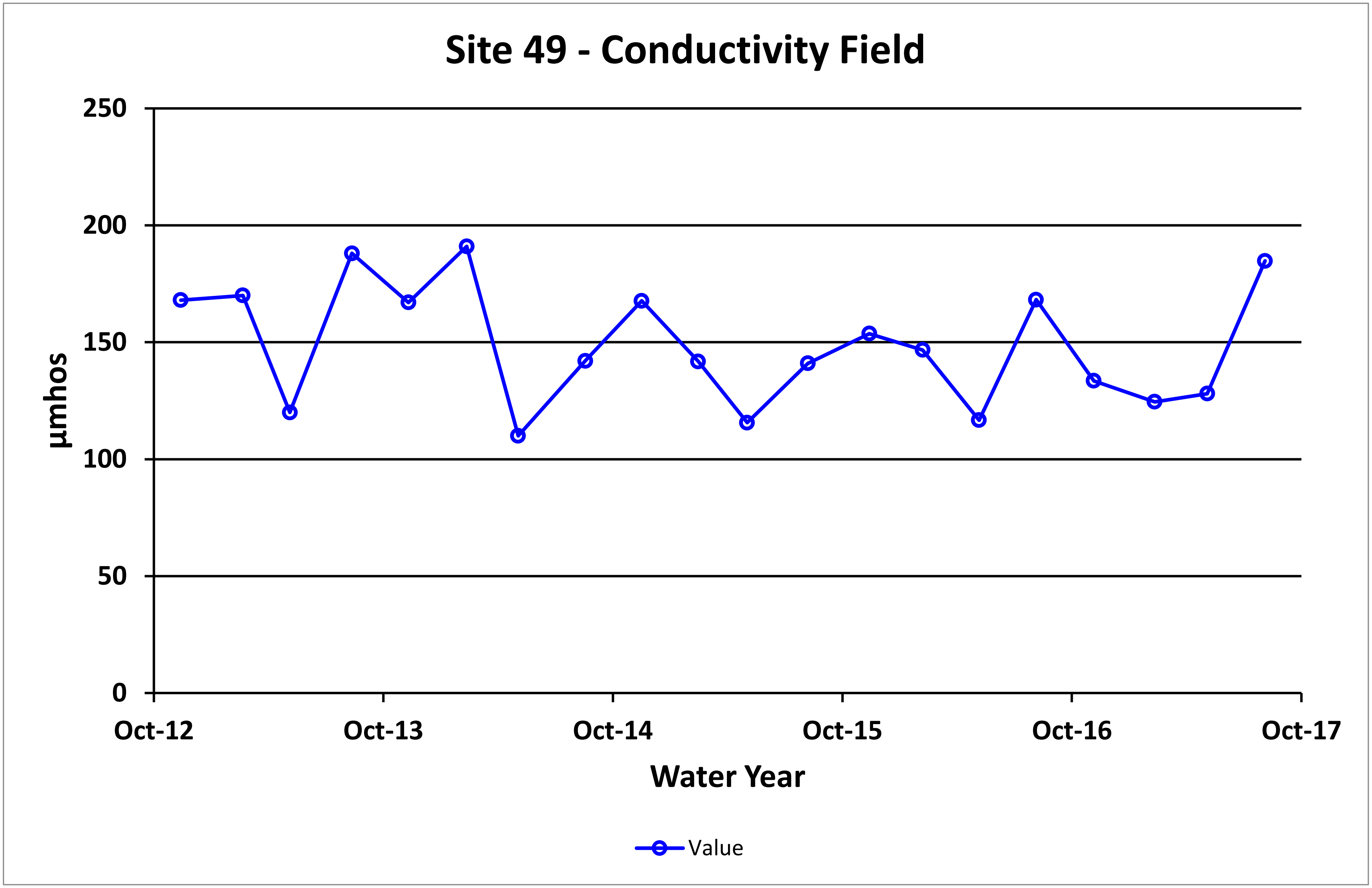
Site No.	Sample Date	Sample Time	Parameter	Value		Qualifier	Reason for Qualifier
049FMS	2/13/2017	12:00 PM	Diss. Ag-ICP/MS	0.00365	µg/L	J	Below Quantitative Range
	5/8/2017	12:00 PM	Diss. Hg-CVAF	0.00115	µg/L	U	Trip Blank Contamination
			Diss. Pb-ICP/MS	0.00371	µg/L	J	Below Quantitative Range
			Tot. Sulfate	8.15	mg/L	J	Sample Receipt Temperature
	8/8/2017	12:00 PM	Tot. Sulfate	14	mg/L	J	Sample Receipt Temperature



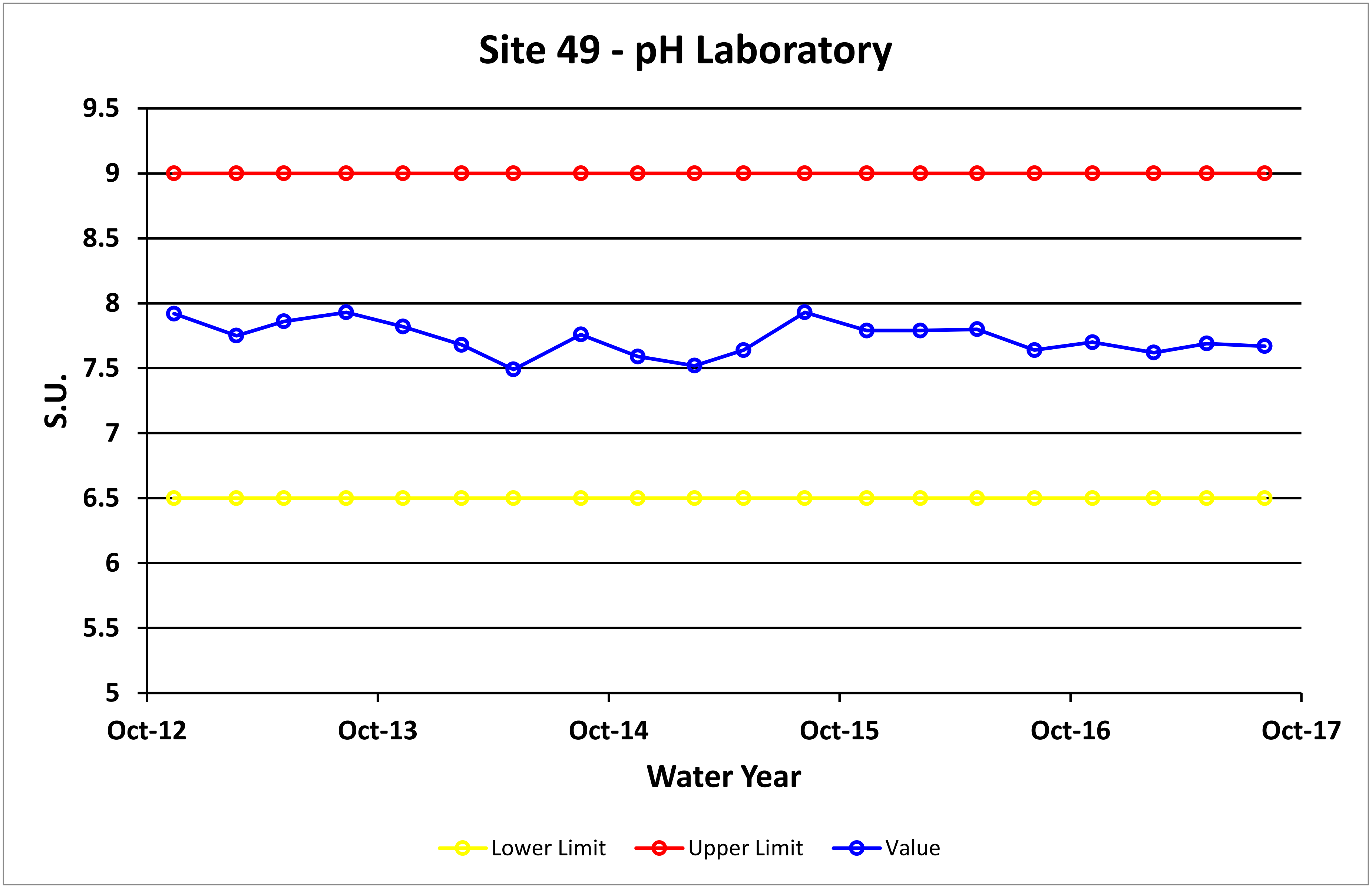
Site 49 - Water Temperature
20
18
16
14
12
10
8
6
4
2
0
°C
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value

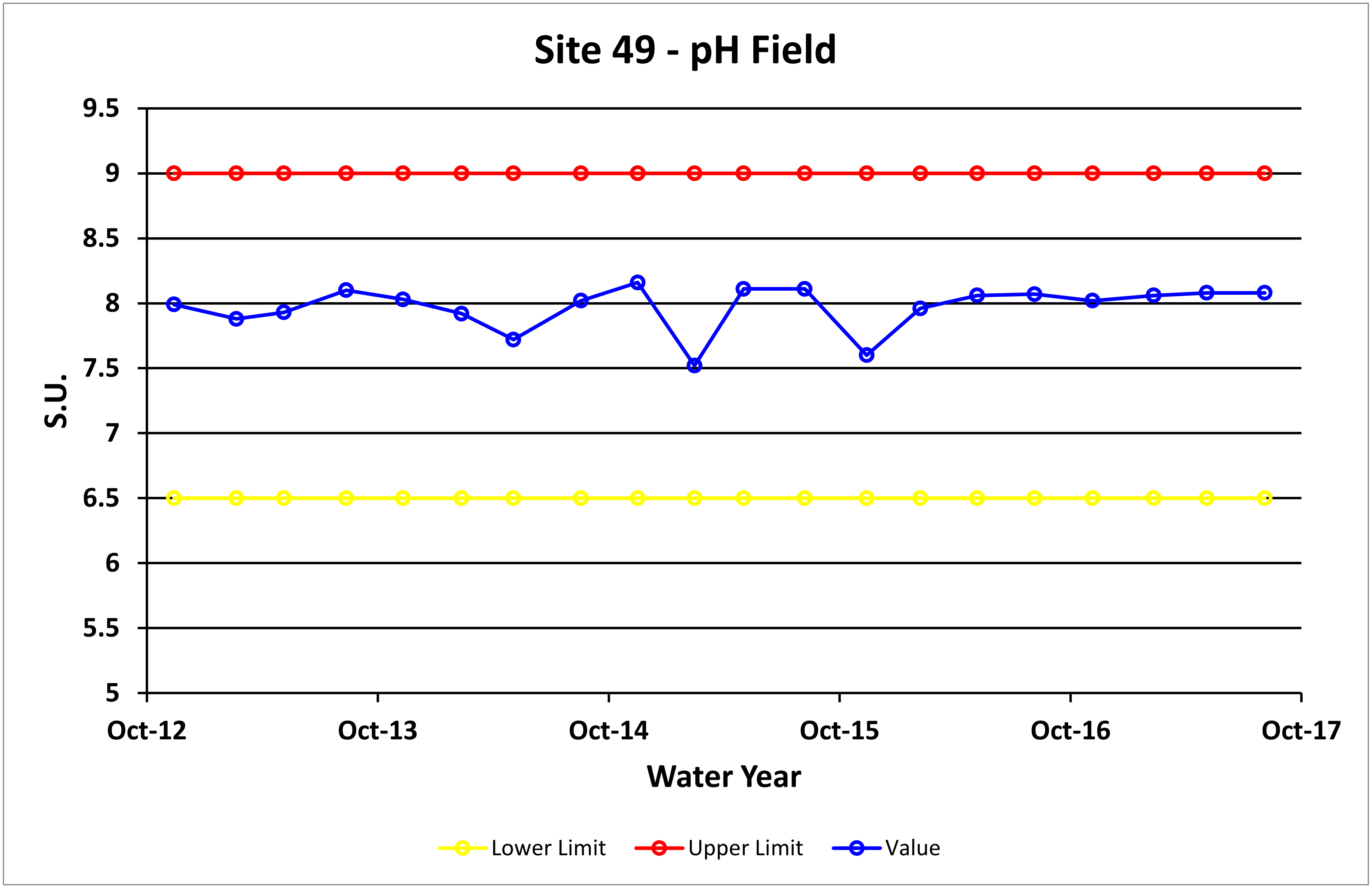


Site 49 - Conductivity Laboratory
250
200
150
100
50
0
µmhos
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value

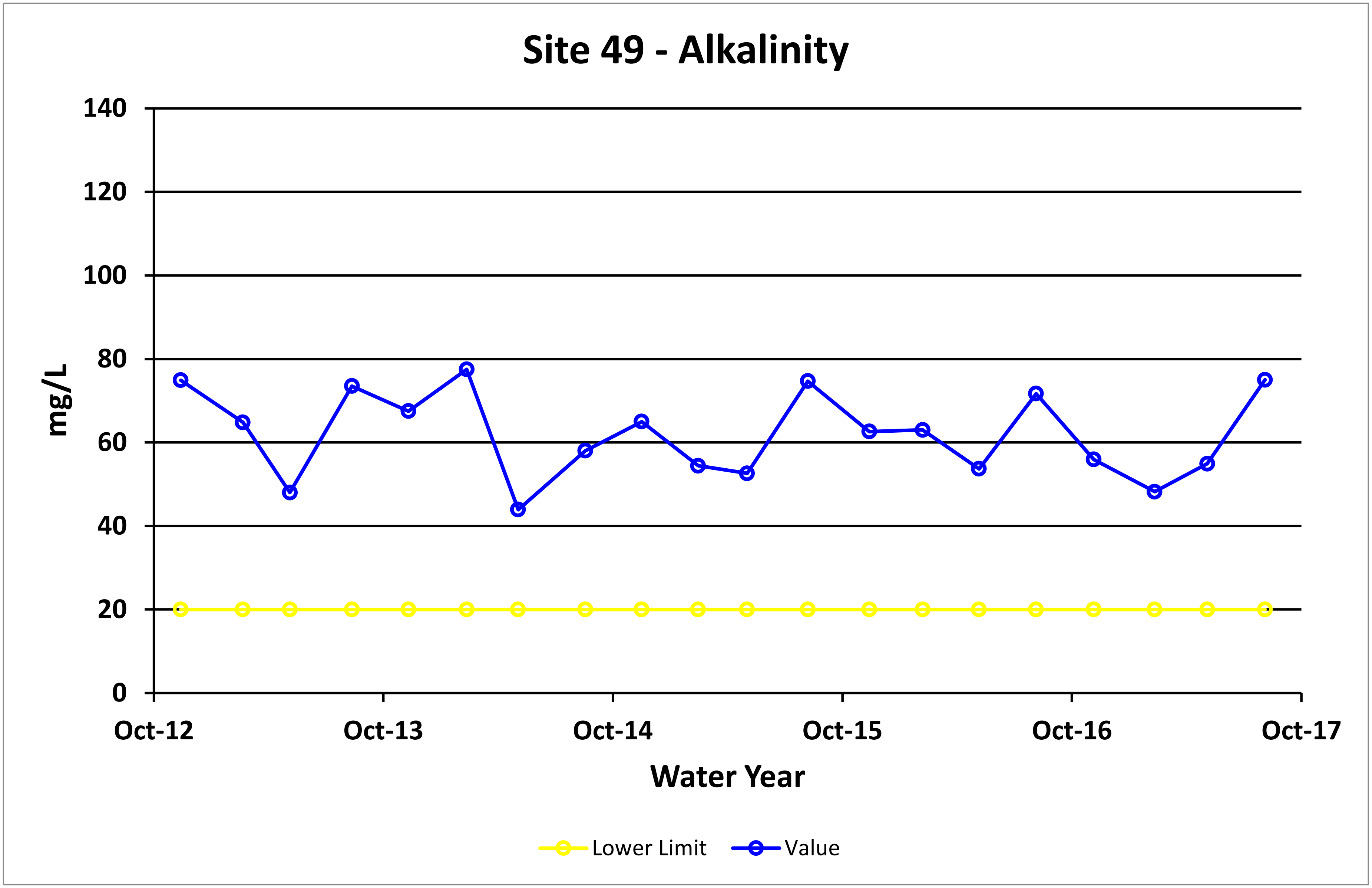


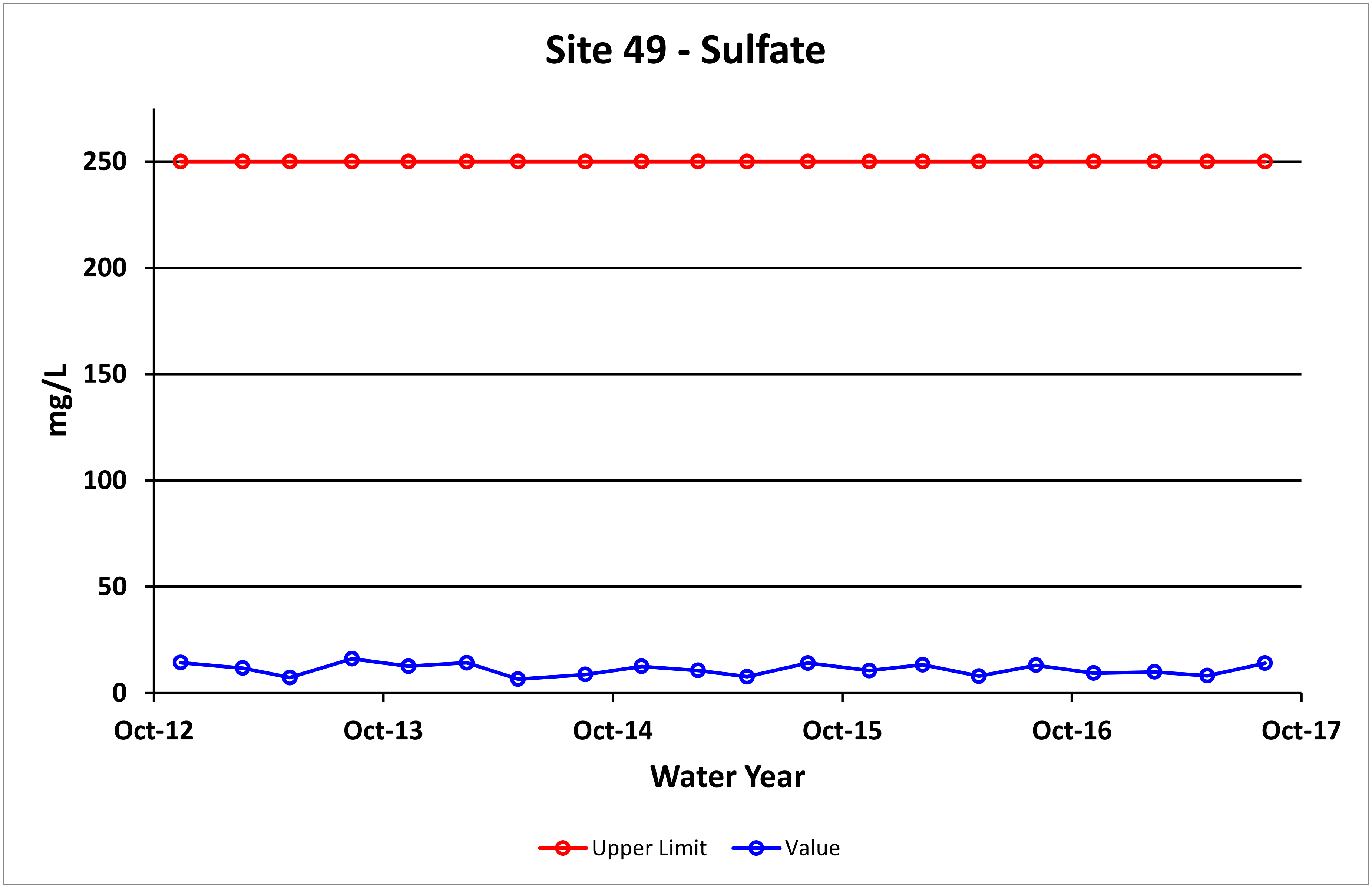
Site 49 - Conductivity Field
250
200
150
100
50
0
µmhos
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value


Site 49 - pH Laboratory
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
S.U.
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Lower Limit
Upper Limit
Value

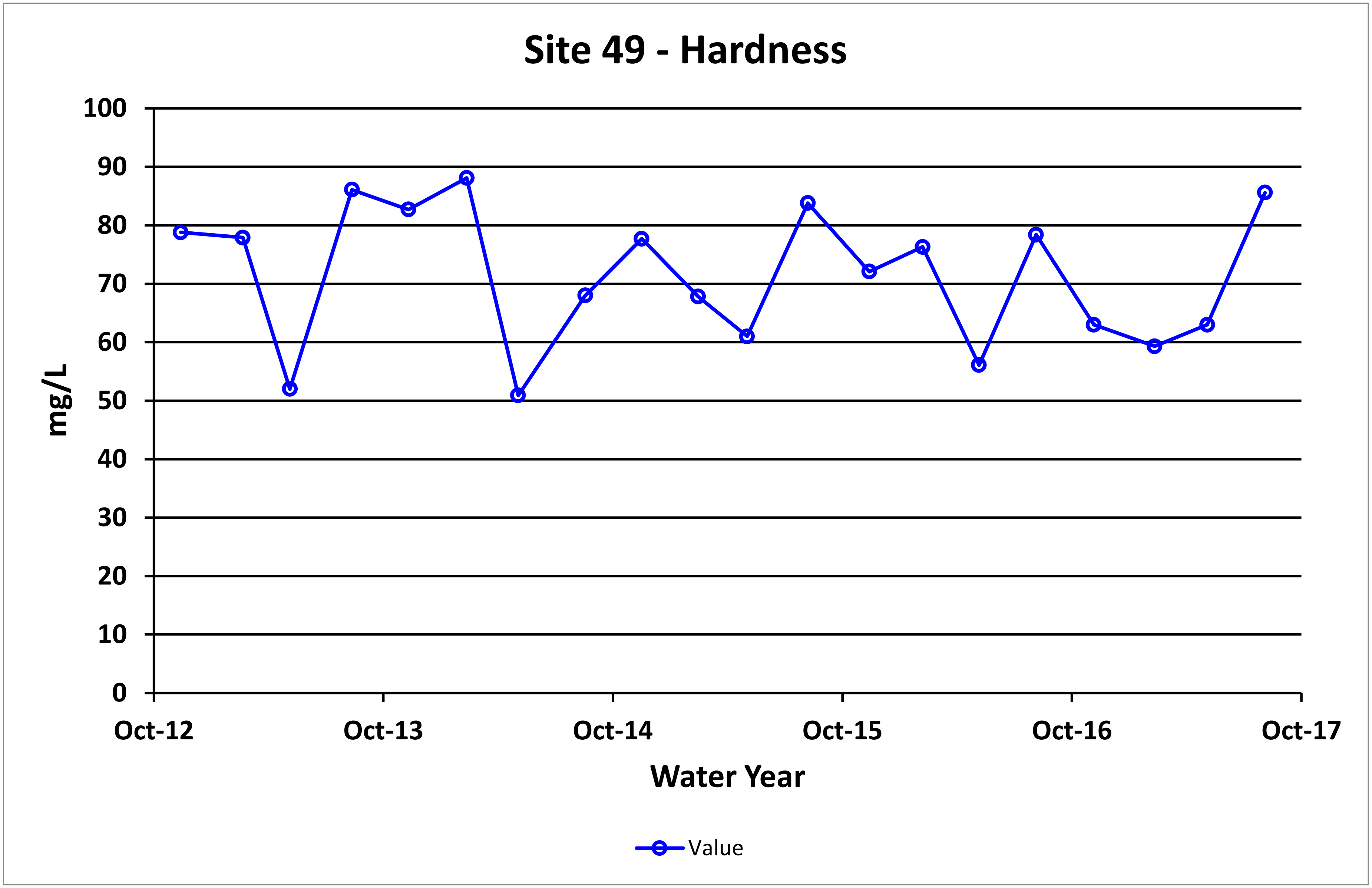


Site 49 - pH Field
S.U.
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Lower Limit
Upper Limit
Value

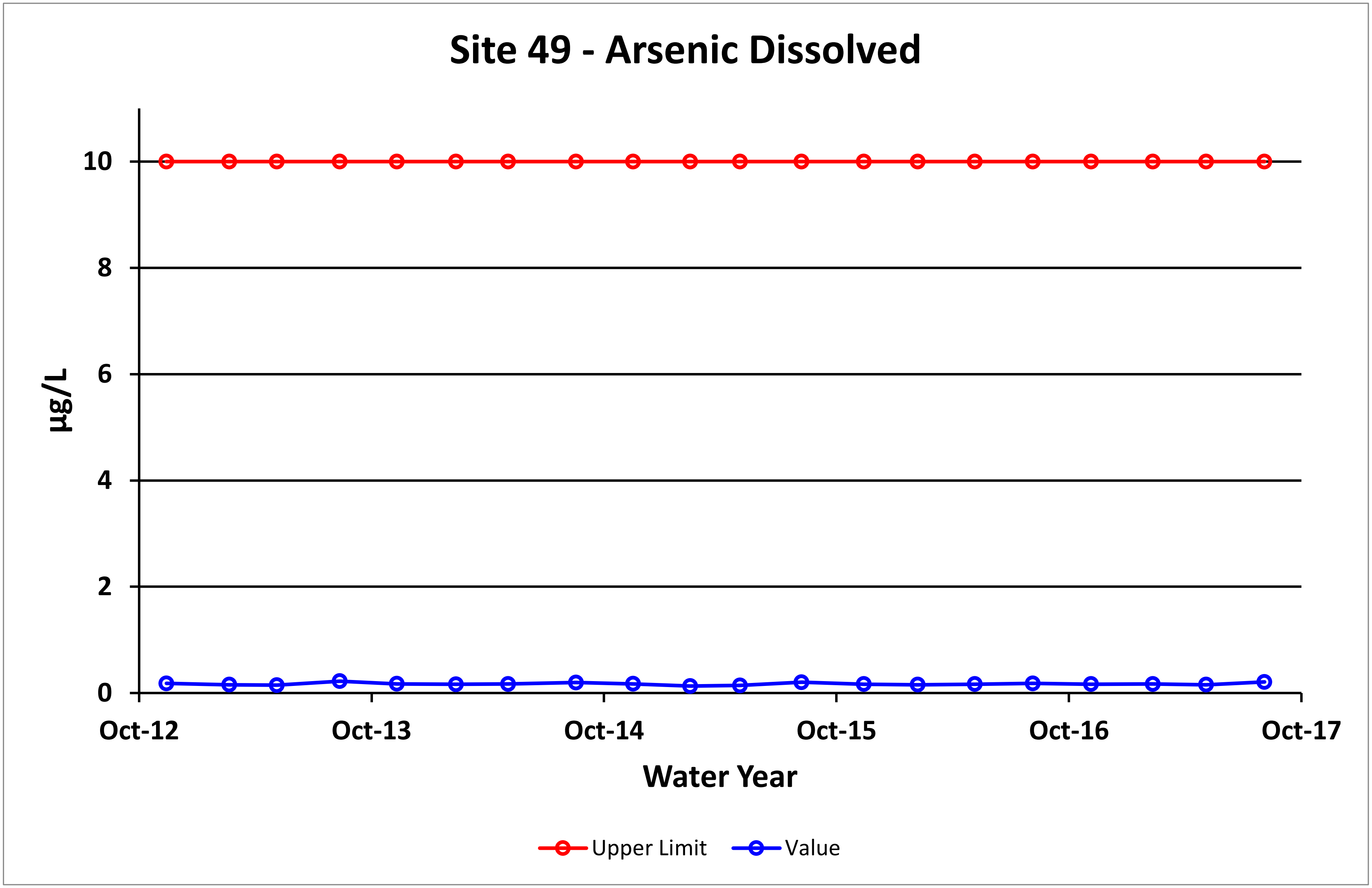

Site 49 - Alkalinity
140
120
100
80
60
40
20
0
mg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Lower Limit
Value



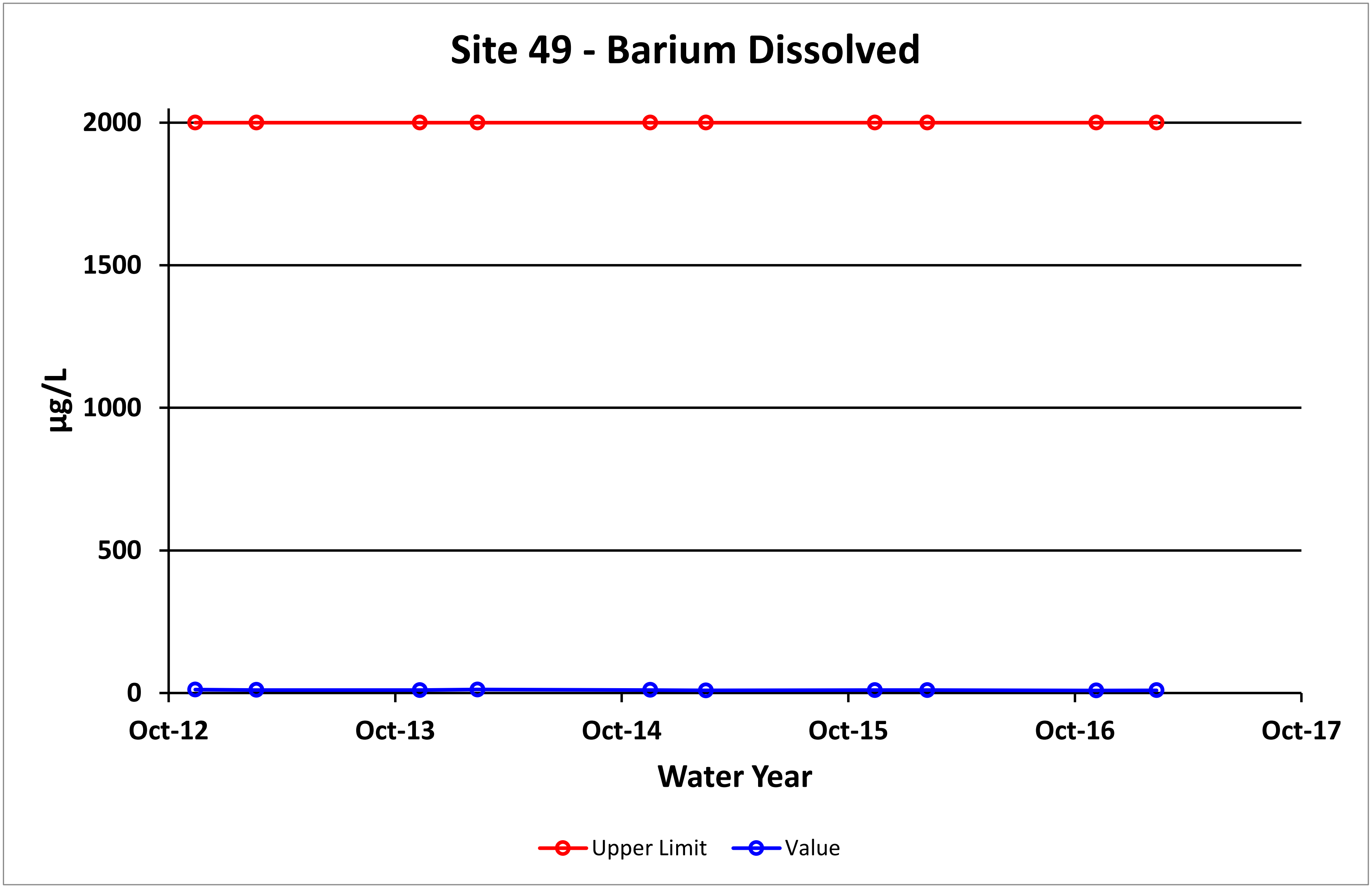
Site 49 - Sulfate
mg/L
250
200
150
100
50
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value



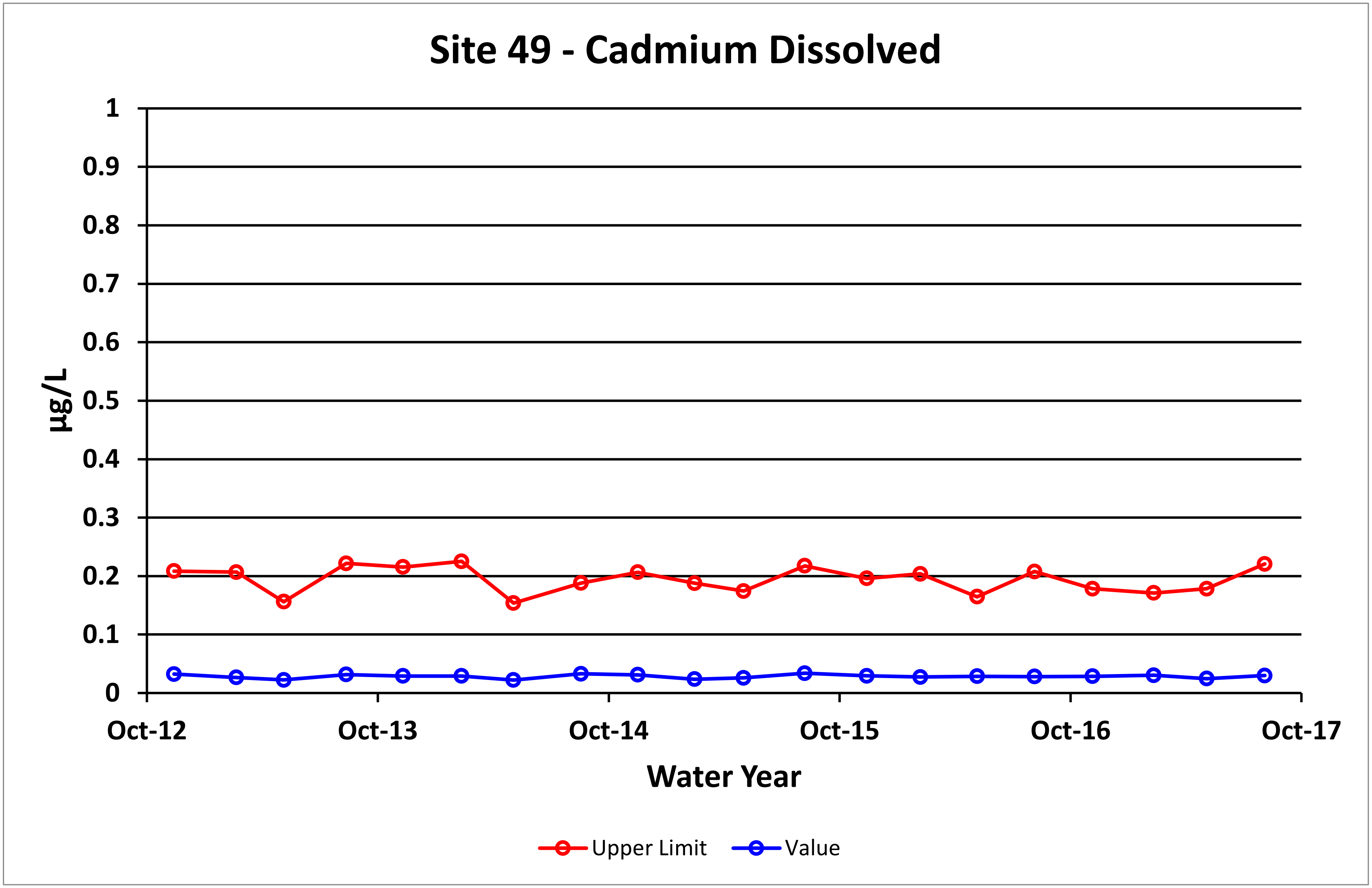
Site 49 - Hardness
100
90
80
70
60
50
40
30
20
10
0
mg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value



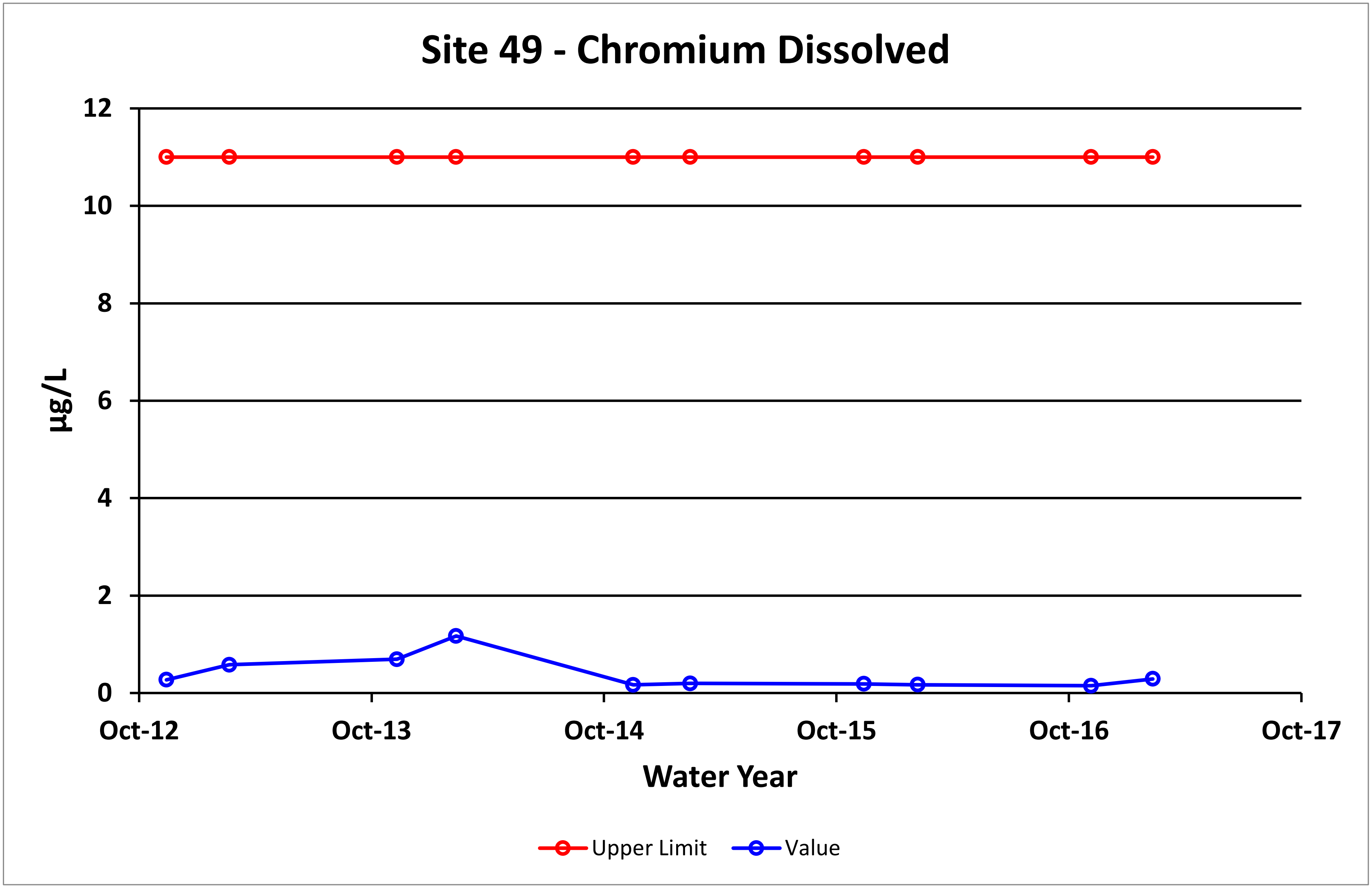
Site 49 - Arsenic Dissolved
µg/L
10
8
6
4
2
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value



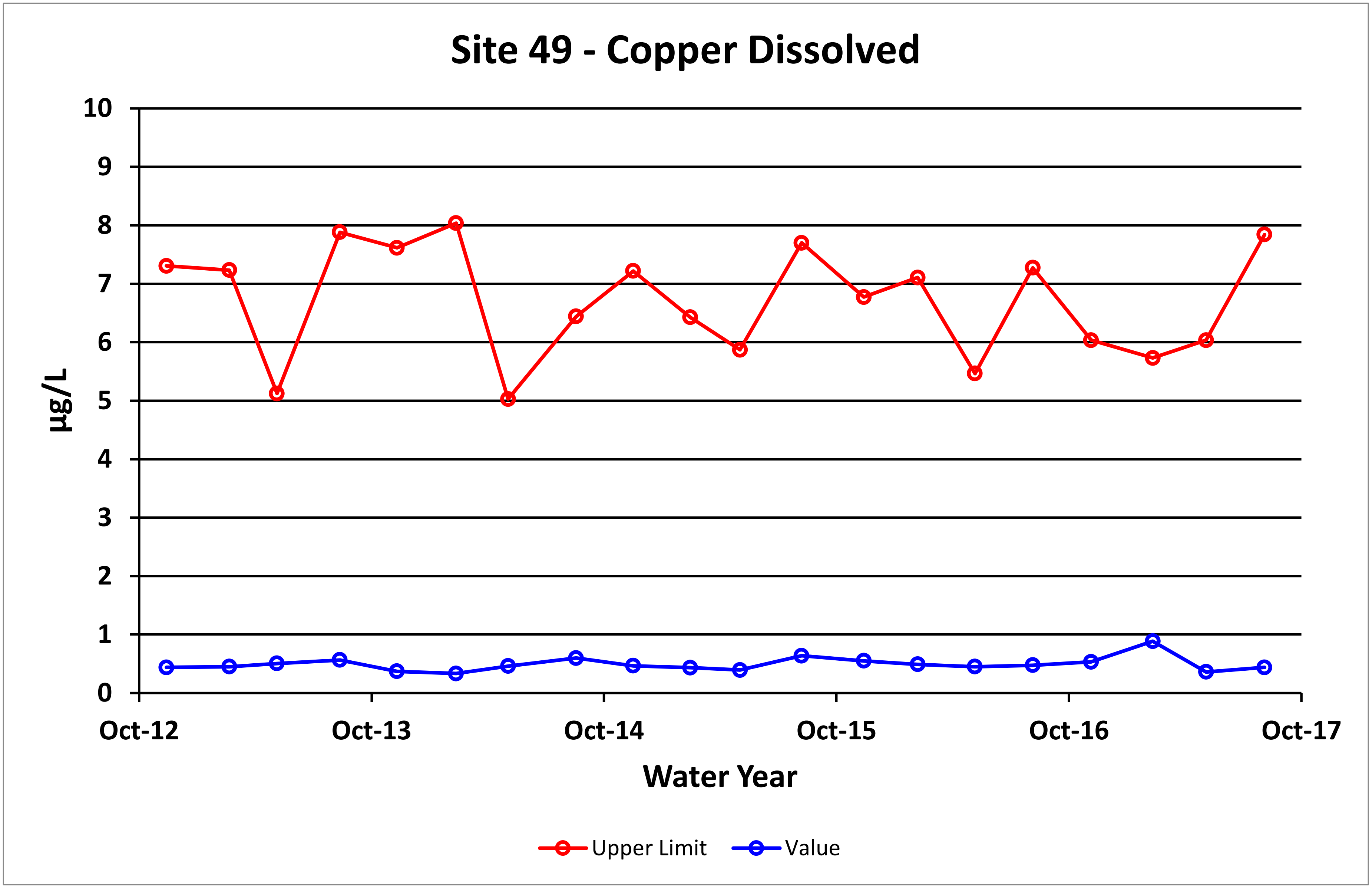
Site 49 - Barium Dissolved
µg/L
2000
1500
1000
500
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

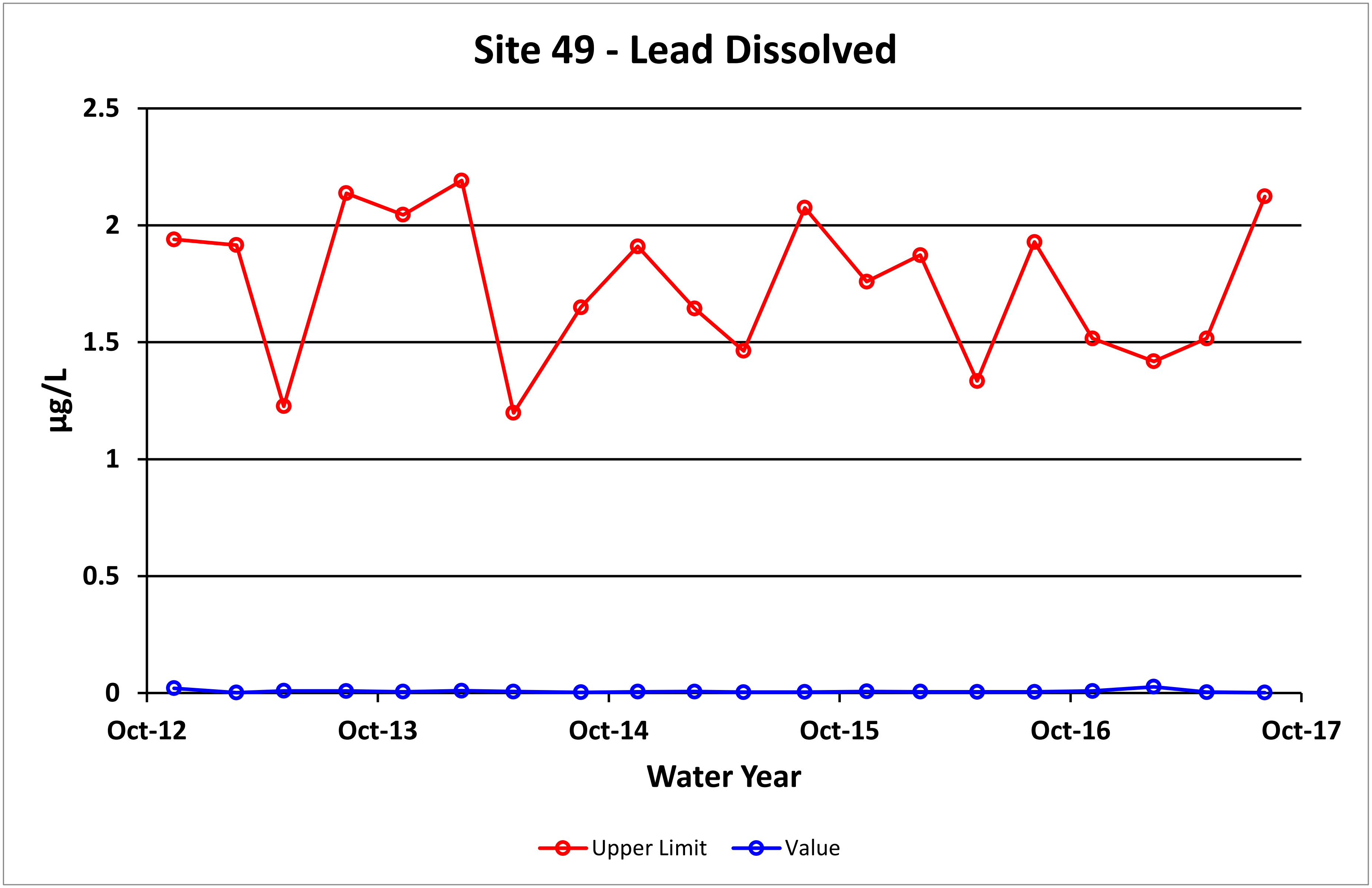


Site 49 - Cadmium Dissolved
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

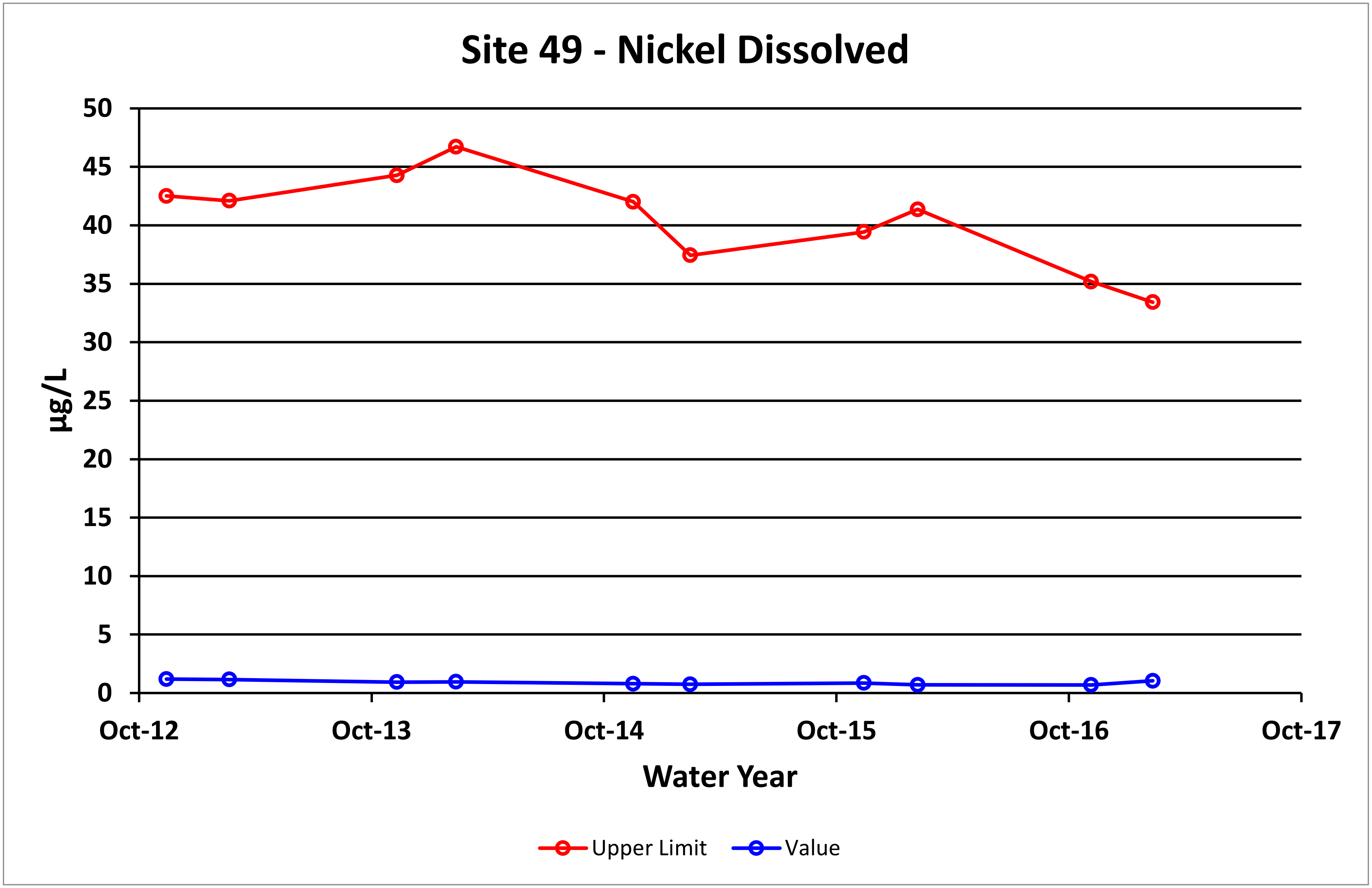


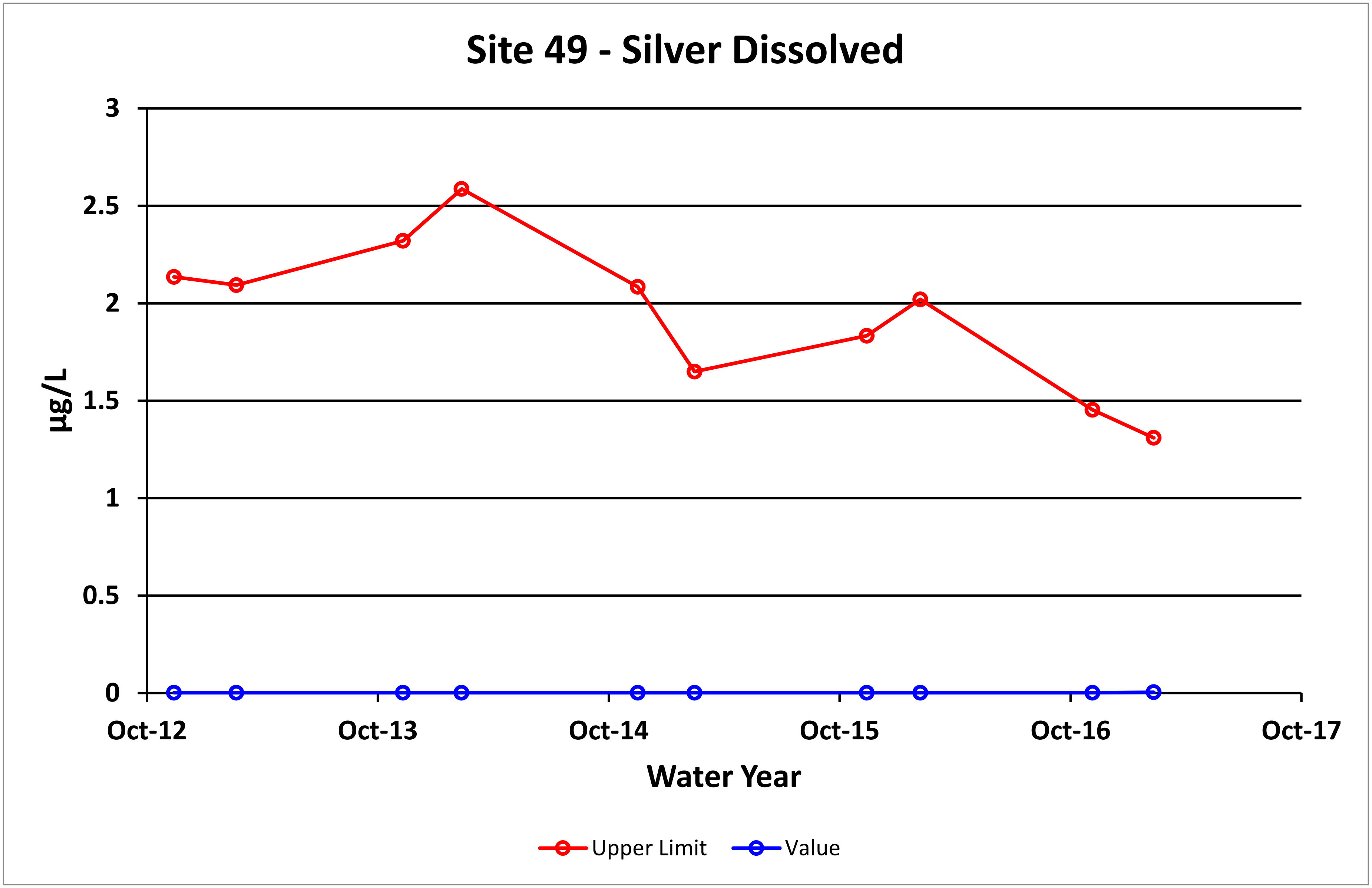
Site 49 - Chromium Dissolved
12
10
8
6
4
2
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value


Site 49 - Copper Dissolved
10
9
8
7
6
5
4
3
2
1
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

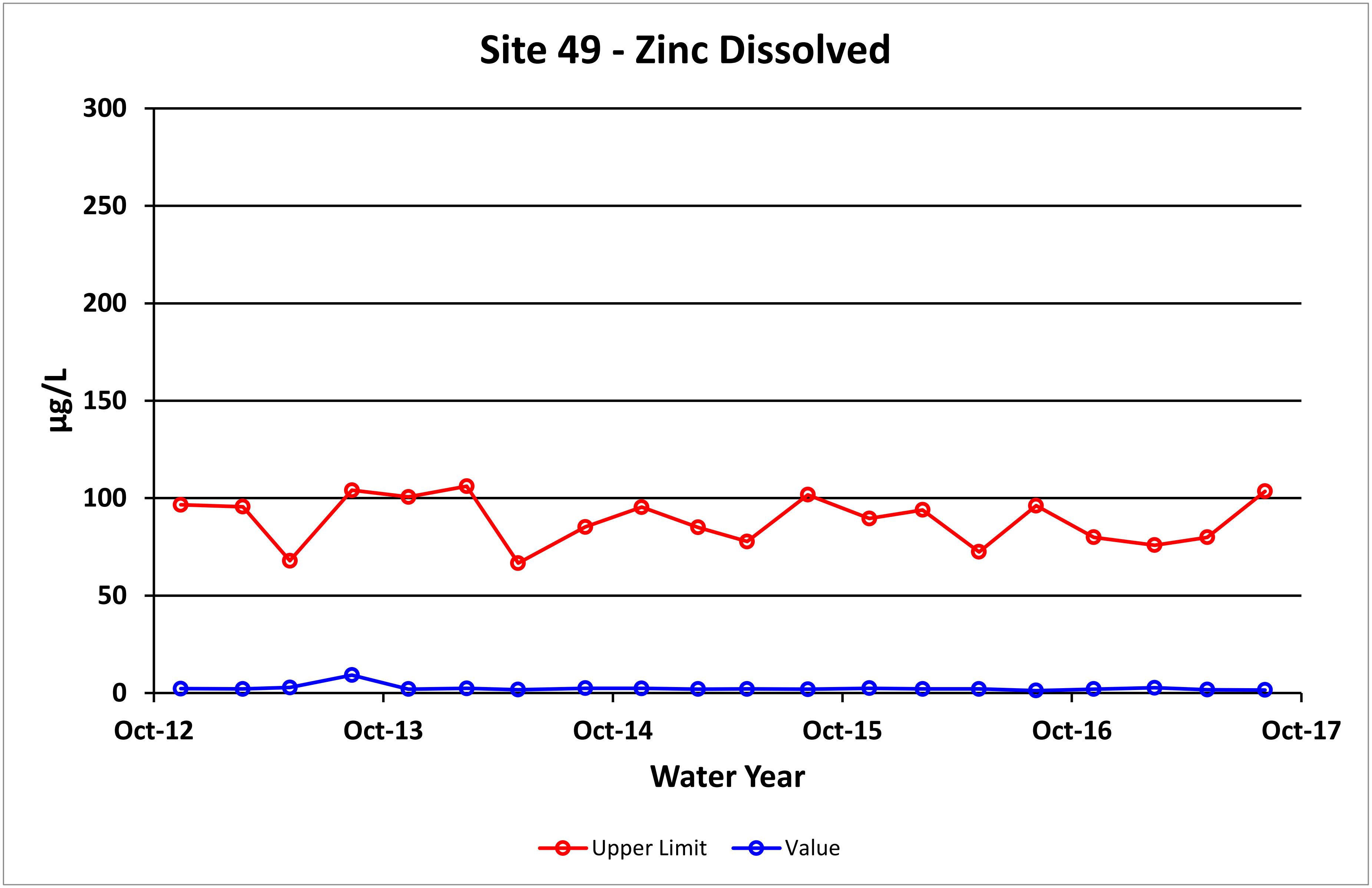


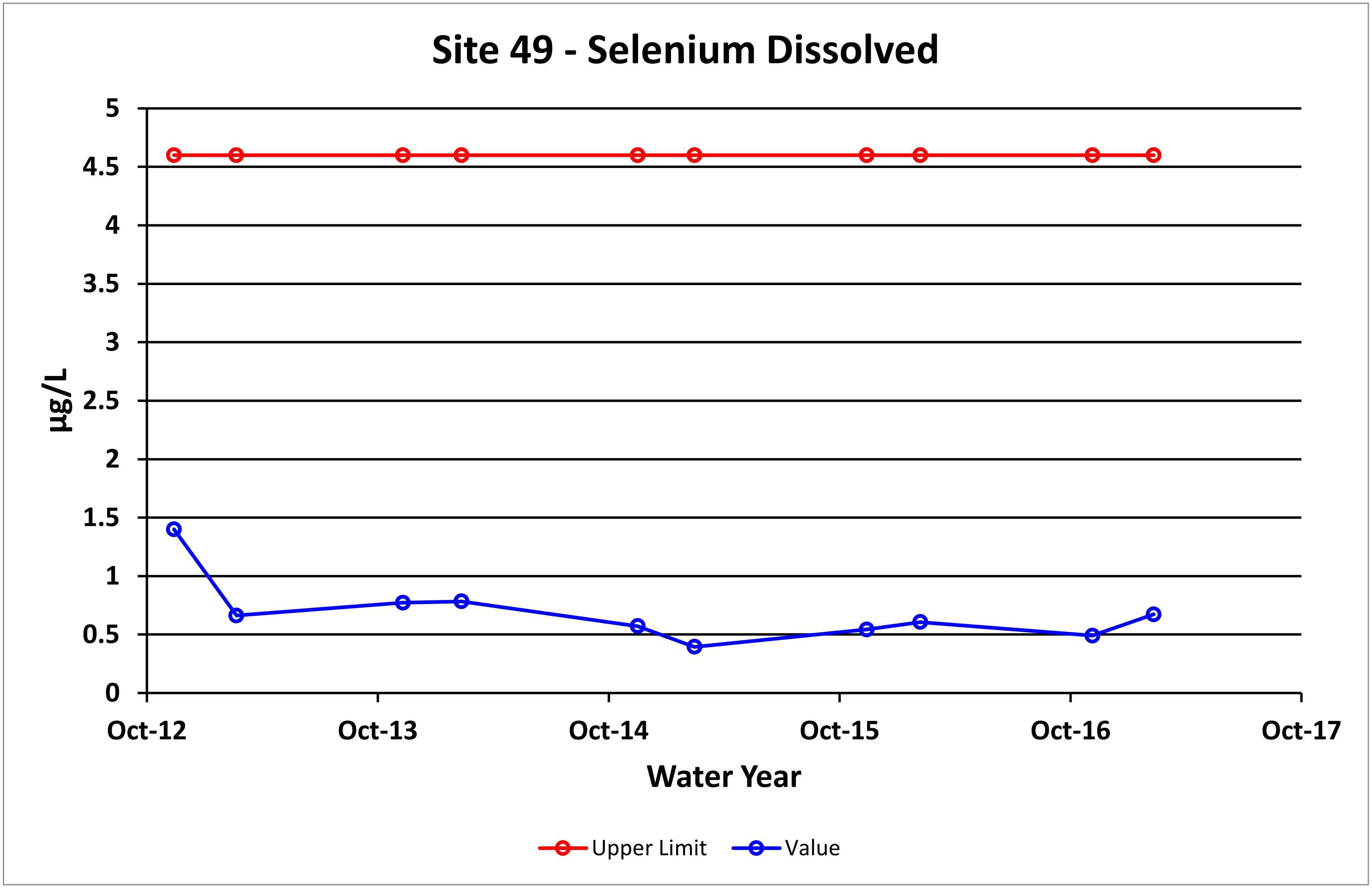
Site 49 - Lead Dissolved
2.5
2
1.5
1
0.5
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value


Site 49 - Nickel Dissolved
50
45
40
35
30
25
20
15
10
5
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

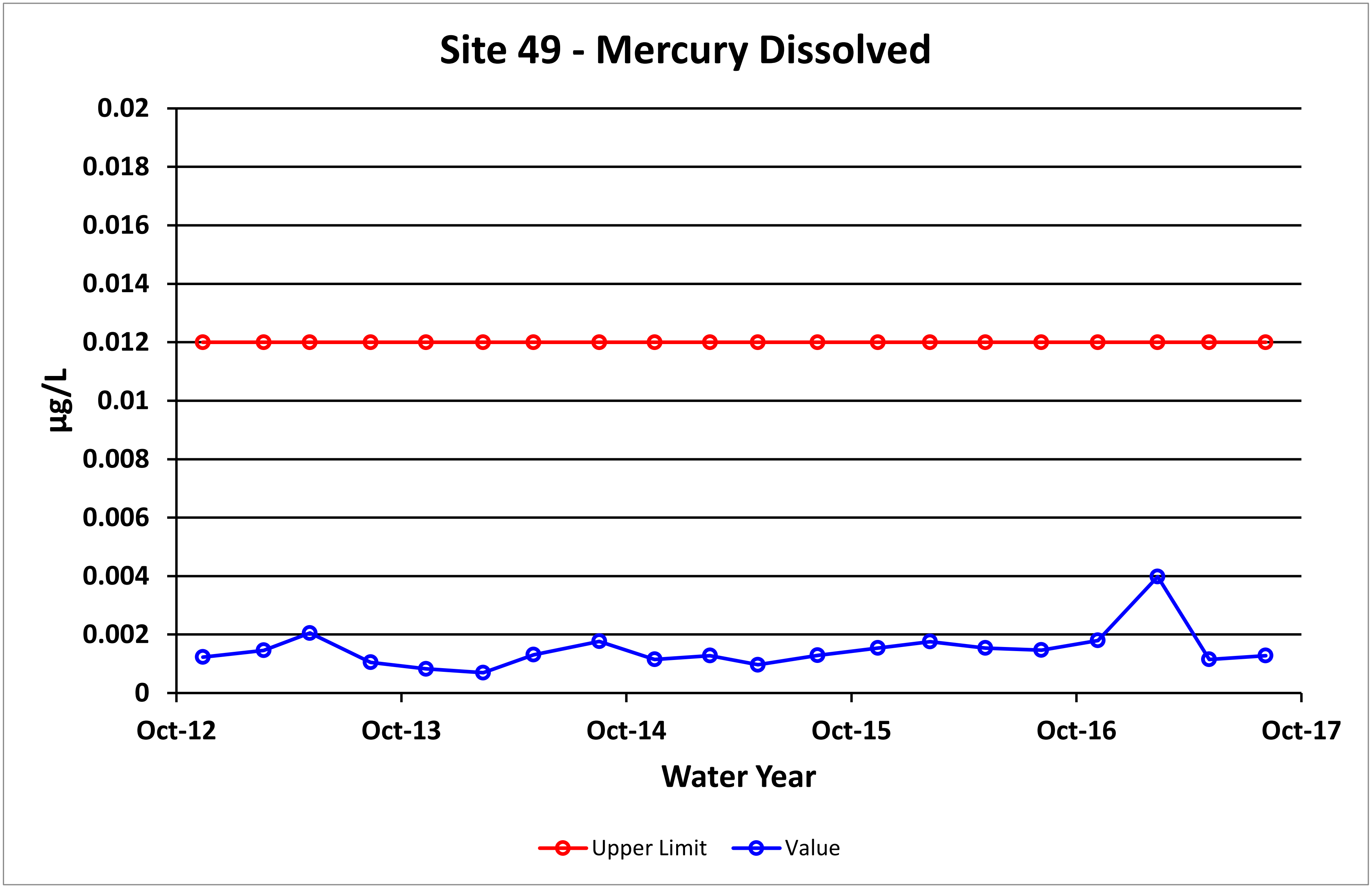


Site 49 - Silver Dissolved
3
2.5
2
1.5
1
0.5
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value


Site 49 - Zinc Dissolved
µg/L
300
250
200
150
100
50
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value



Site 49 - Selenium Dissolved
µg/L
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value


Site 49 - Mercury Dissolved
0.02
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

INTERPRETIVE REPORT
SITE 46

The data collected during the current water year are listed in the following “Table of Results for Water Year 2017” report. The table includes all the required FWMP analyte data (field and laboratory) collected for the current water year and a series of flags keyed to the summary report “Qualified Data by QA Reviewer”. The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of ½ MDL for the purpose of median calculation.

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

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

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

Table of Exceedance for Water Year 2017

			Limits		
Sample Date	**Parameter**	**Value**	**Lower**	**Upper**	**Hardness**
No exceedances have been identified by HGCMC for the period of October 2016 through September 2017.					

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-11 and Sep-17 (WY2012-WY2017). Datasets with a statistically significant trend ($\alpha/2=2.5\%$) a Seasonal-Sen’s Slope estimate statistic has also been calculated. Field pH showed a slight statistically significant increase for the reporting period.

Table of Summary Statistics for Trend Analysis

	Mann-Kendall test statistics			Sen's slope estimate	
Parameter	**n***	**p****	**Trend**	**Q**	**Q(%)**
Conductivity Field	6	0.50			
pH Field	6	0.98	+	0.04	0.5
Alkalinity, Total	6	Rejected			
Sulfate, Total	6	0.21			
Zinc, Dissolved	6	0.12			

* Number of Years ** Significance level

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 (µS/cm)	Site 46 Diss. Zinc (µg/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**

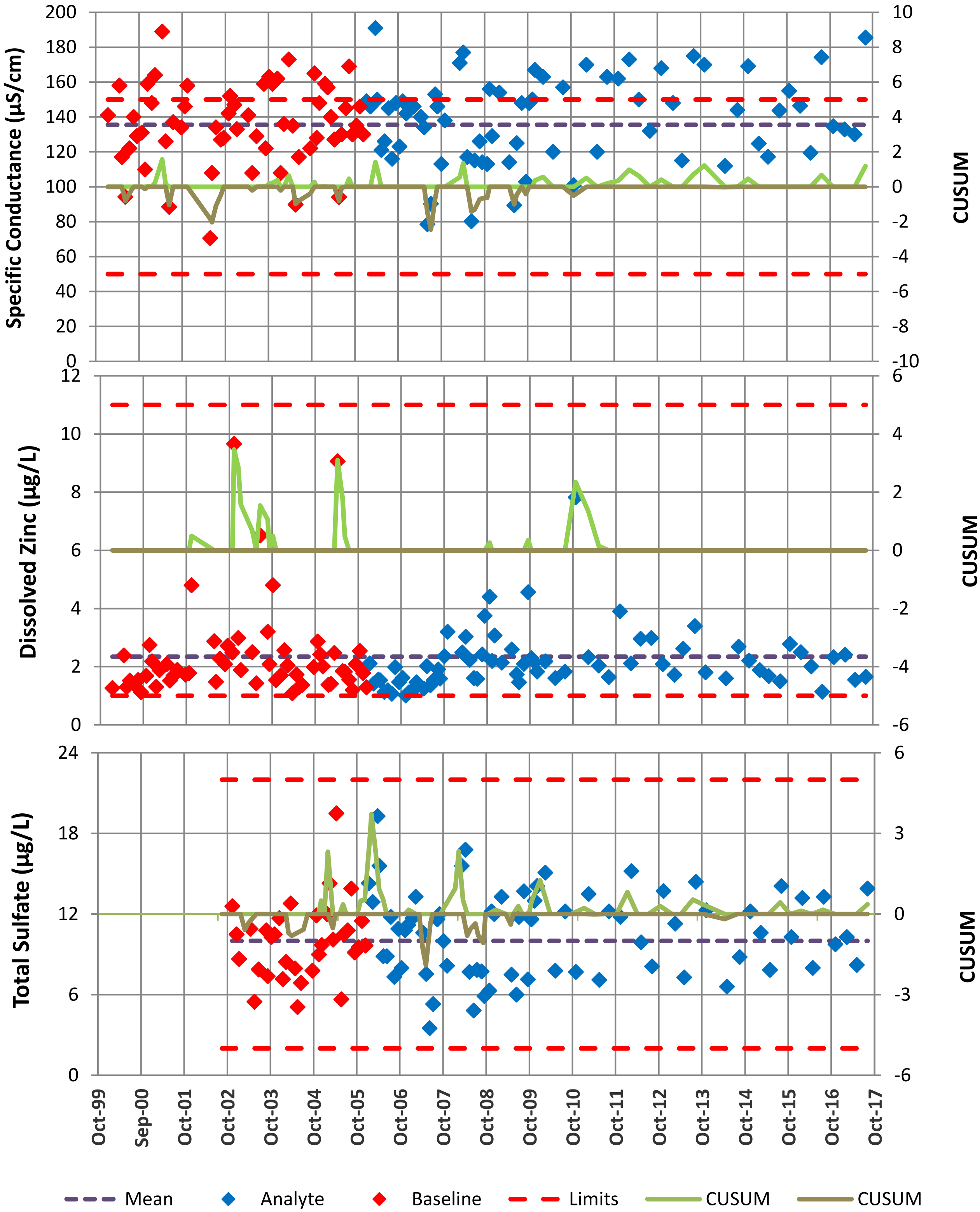


Table of Results for Water Year 2017

Site 046FMS - 'Lower Bruin Creek'

Sample Date/Parameter	Oct 2016	Nov 2016	Dec 2016	Jan 2017	Feb 2017	Mar 2017	Apr 2017	May 2017	Jun 2017	Jul 2017	Aug 2017	Sep 2017	**Median**
Water Temp (°C)		5.3			0.4			3.4			10.3		4.4
Conductivity-Field(μmho)		134.8			132.9			130			185.6		133.9
Conductivity-Lab (μmho)		131			126			123			176		129
pH Lab (standard units)		7.69			7.31			7.59			7.65		7.62
pH Field (standard units)		8.06			7.99			8.05			8.04		8.05
Total Alkalinity (mg/L)		56.6			52.1			55.4					55.4
Total Sulfate (mg/L)		9.8			10.3			8.2			13.9		10.1
Hardness (mg/L)		64.3			62.7			63.6			84.3		64.0
Dissolved As (ug/L)		0.226			0.251			0.183			0.292		0.239
Dissolved Ba (ug/L)		10.5			11								10.8
Dissolved Cd (ug/L)		0.0265			0.0263			0.0198			0.0264		0.0264
Dissolved Cr (ug/L)		0.152			0.248								0.200
Dissolved Cu (ug/L)		0.659			0.844			0.484			0.448		0.572
Dissolved Pb (ug/L)		0.0463			0.0817			0.0121			0.0097		0.0292
Dissolved Ni (ug/L)		0.657			0.876								0.767
Dissolved Ag (ug/L)		0.002			0.002								0.002
Dissolved Zn (ug/L)		2.33			2.41			1.55			1.65		1.99
Dissolved Se (ug/L)		0.483			0.657								0.570
Dissolved Hg (ug/L)		0.00194			0.00345			0.00121			0.00131		0.001625

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

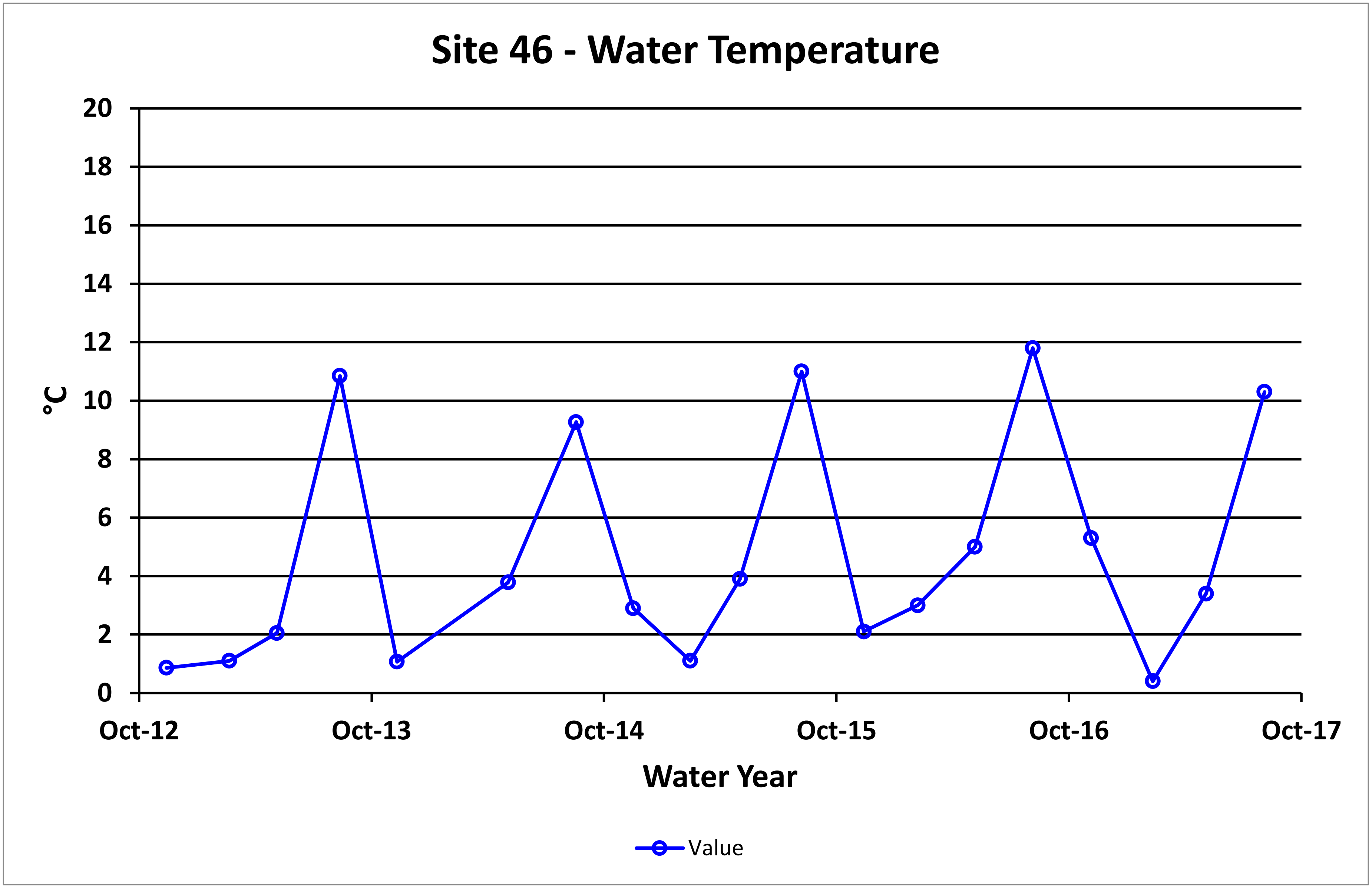
Values reported as less than MDL are replaced by 1/2 MDL for median calculation purposes.

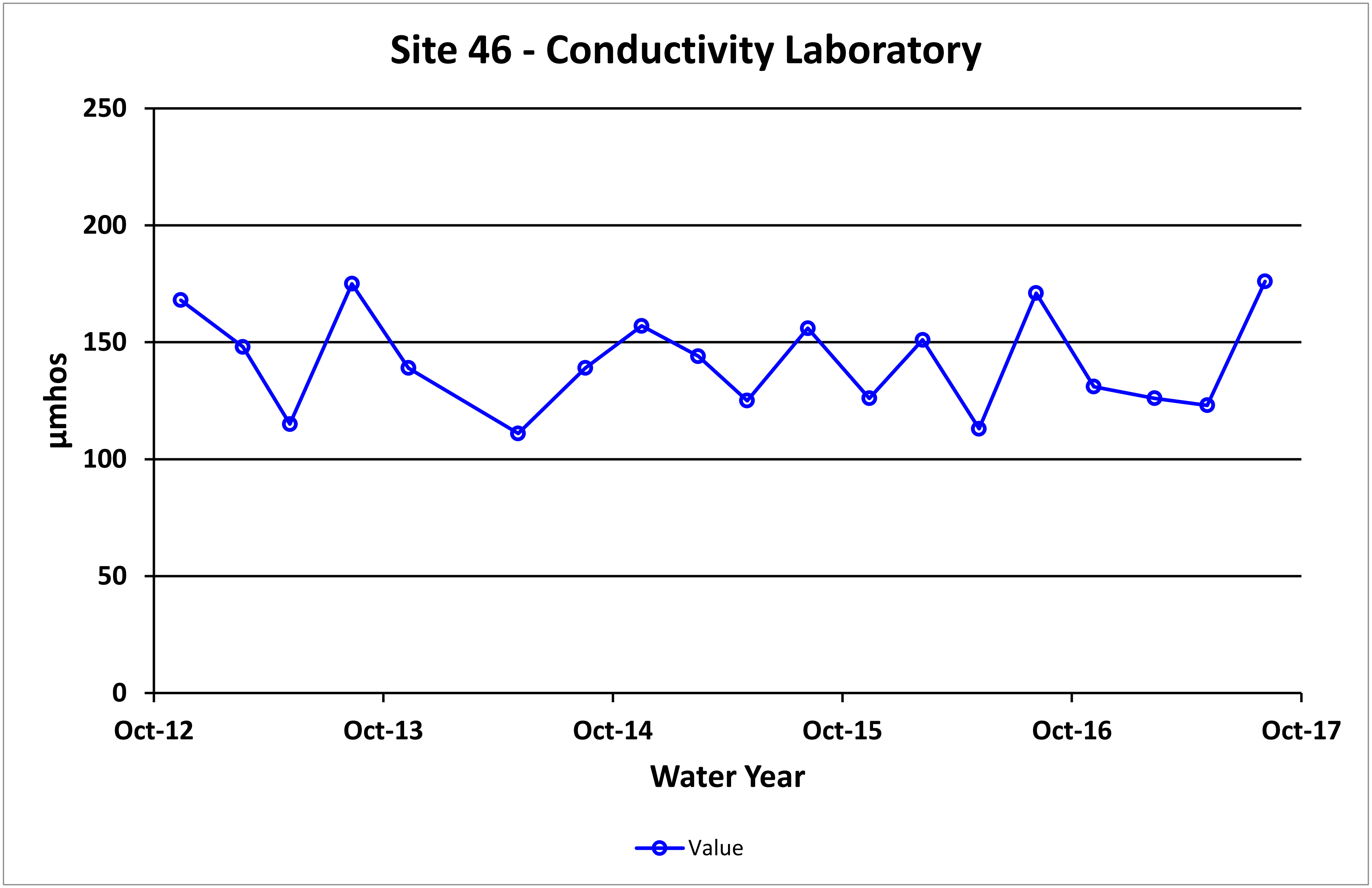
Shaded data has been qualified as an outlier by HGCMC and removed from any further analysis and is not included into the calculation of the median

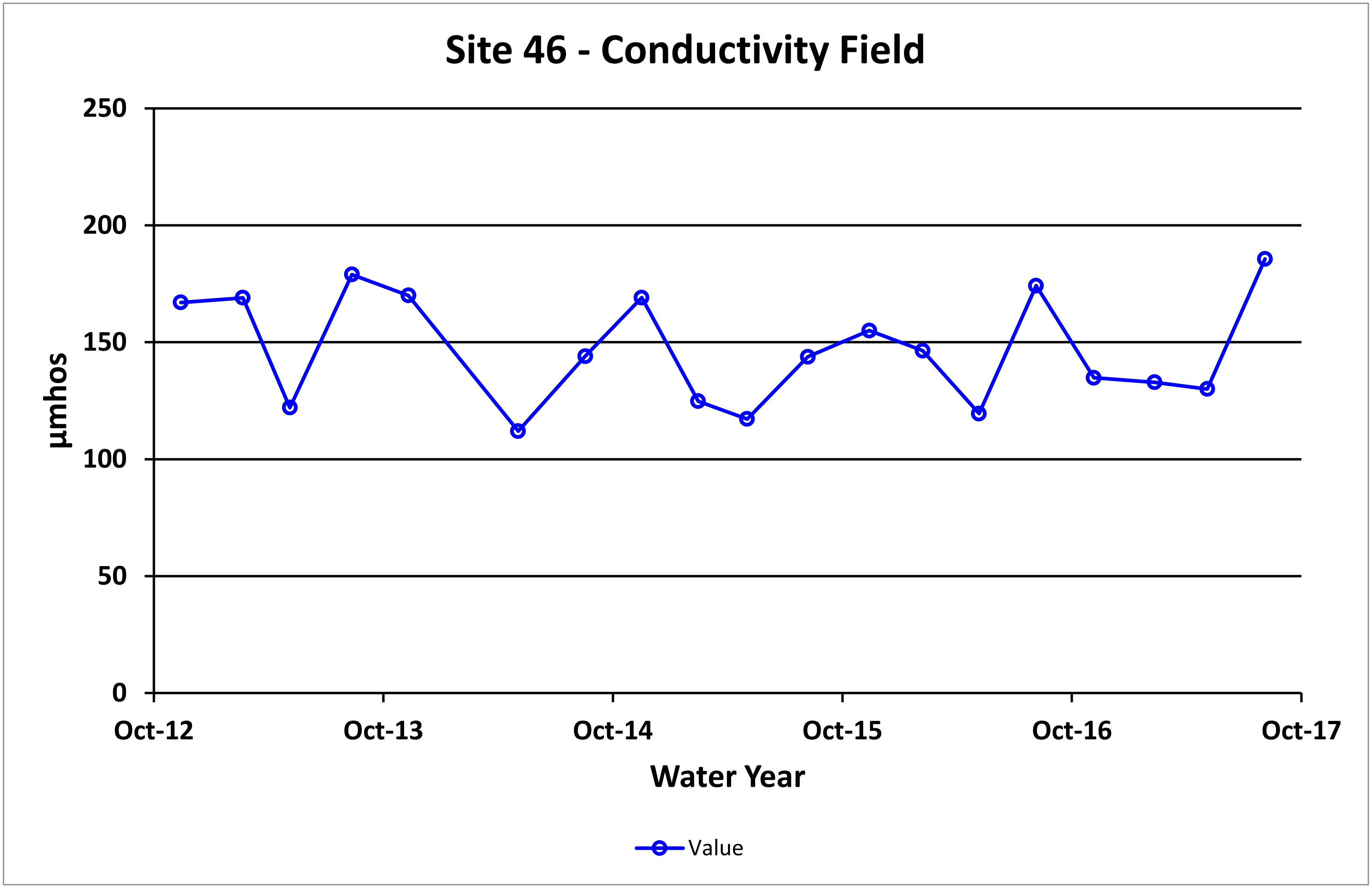
Qualified Data by QA Reviewer

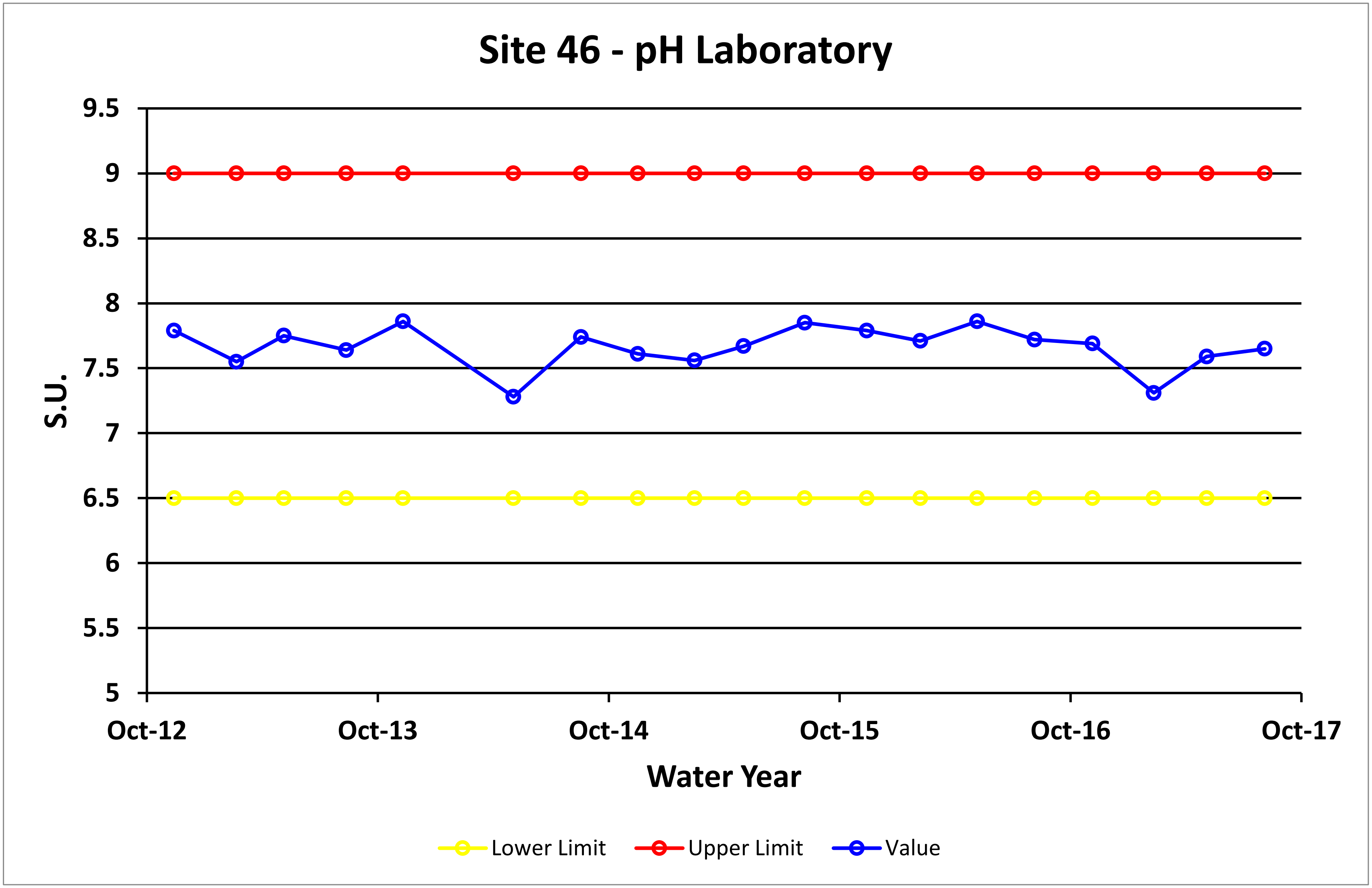
Date Range: 10/01/2016 to 09/30/2017

Site No.	Sample Date	Sample Time	Parameter	Value		Qualifier	Reason for Qualifier
046FMS	5/8/2017	12:00 PM	Diss. Hg-CVAF	0.00121	µg/L	U	Trip Blank Contamination
			Tot. Sulfate	8.21	mg/L	J	Sample Receipt Temperature
	8/8/2017	12:00 PM	Tot. Sulfate	13.9	mg/L	J	Sample Receipt Temperature

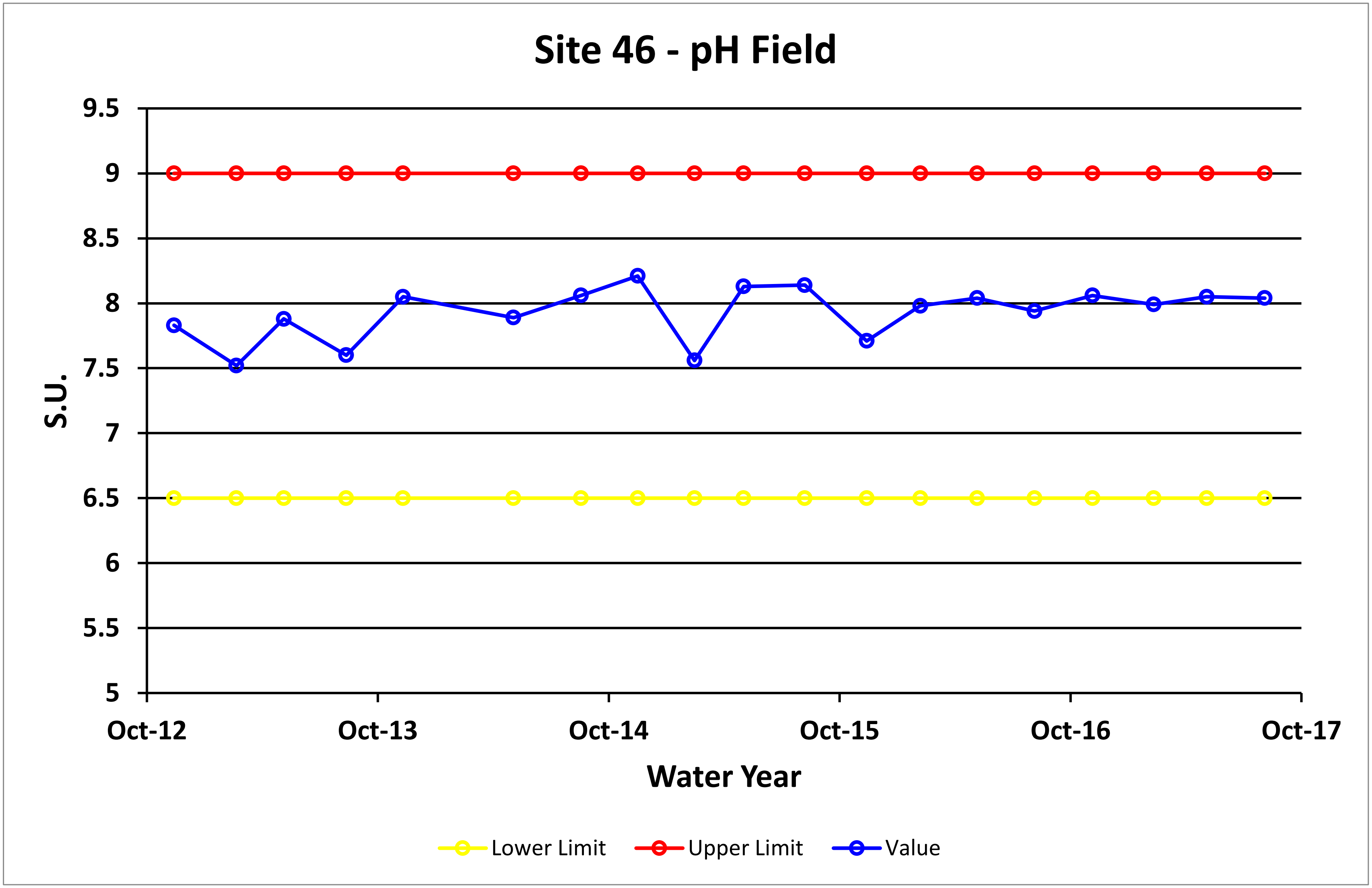

Site 46 - Water Temperature
°C
20
18
16
14
12
10
8
6
4
2
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value


Site 46 - Conductivity Laboratory
250
200
150
100
50
0
µmhos
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value

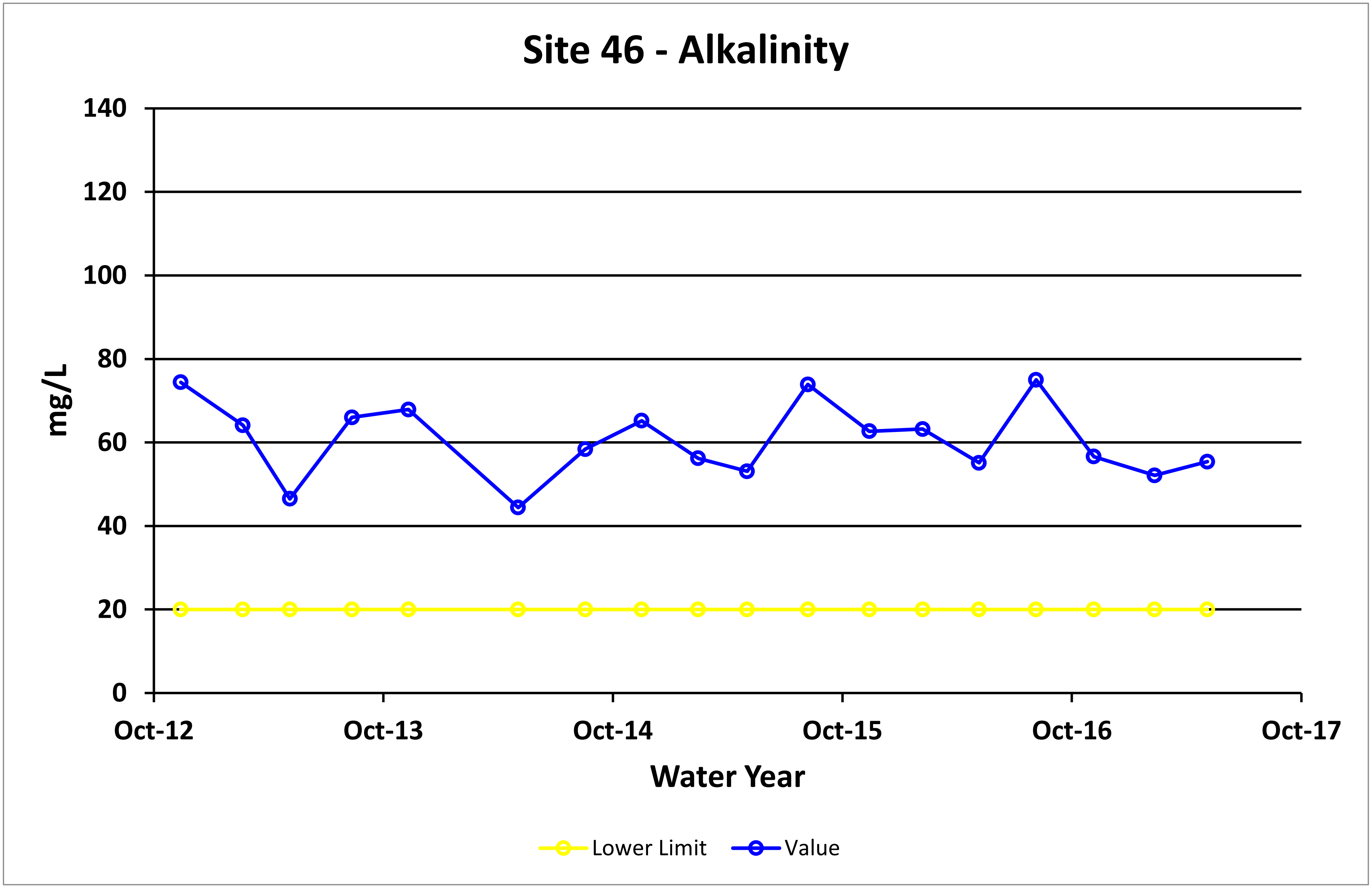

Site 46 - Conductivity Field
250
200
150
100
50
0
µmhos
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value

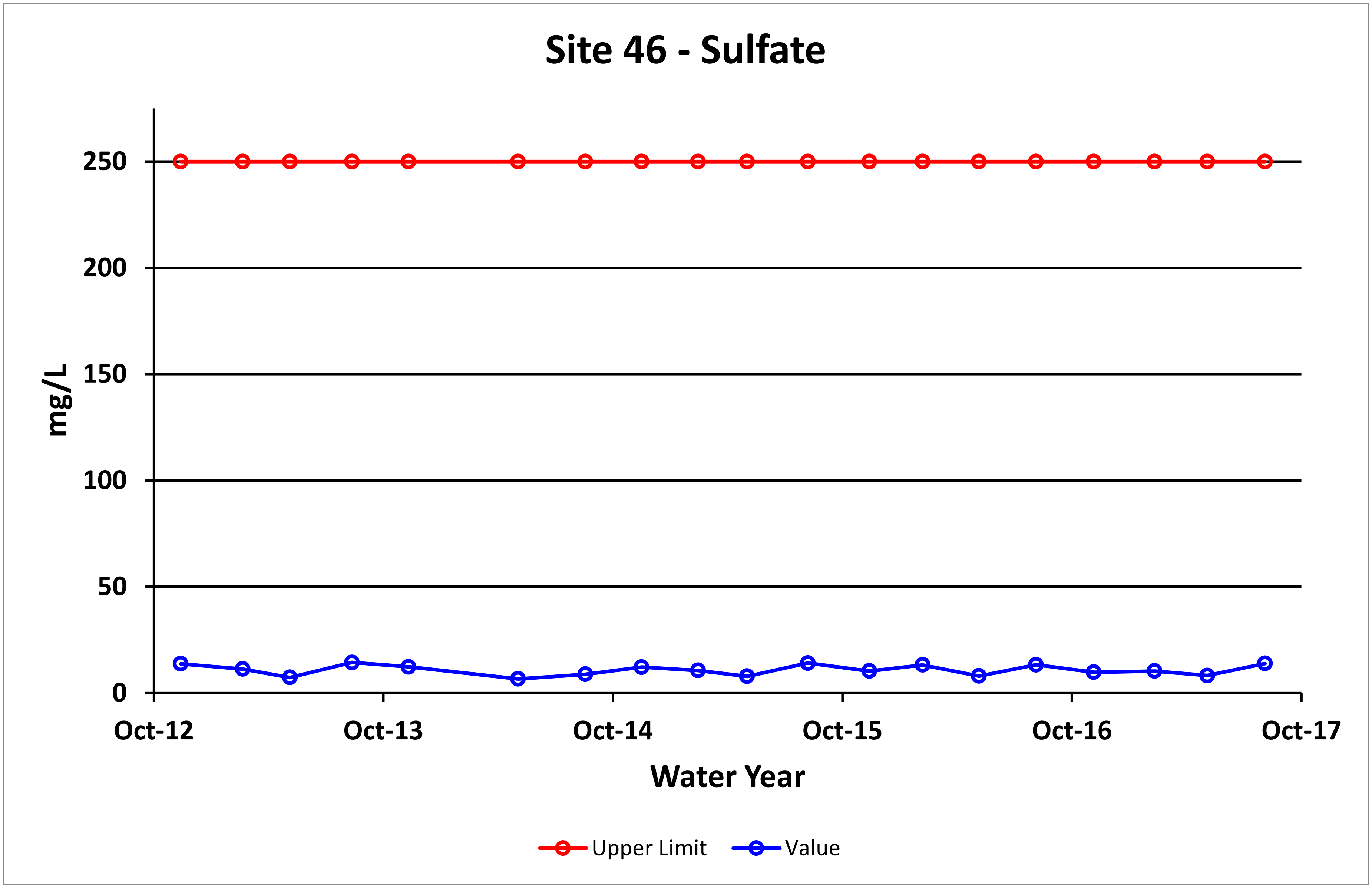


Site 46 - pH Laboratory
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
S.U.
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Lower Limit
Upper Limit
Value

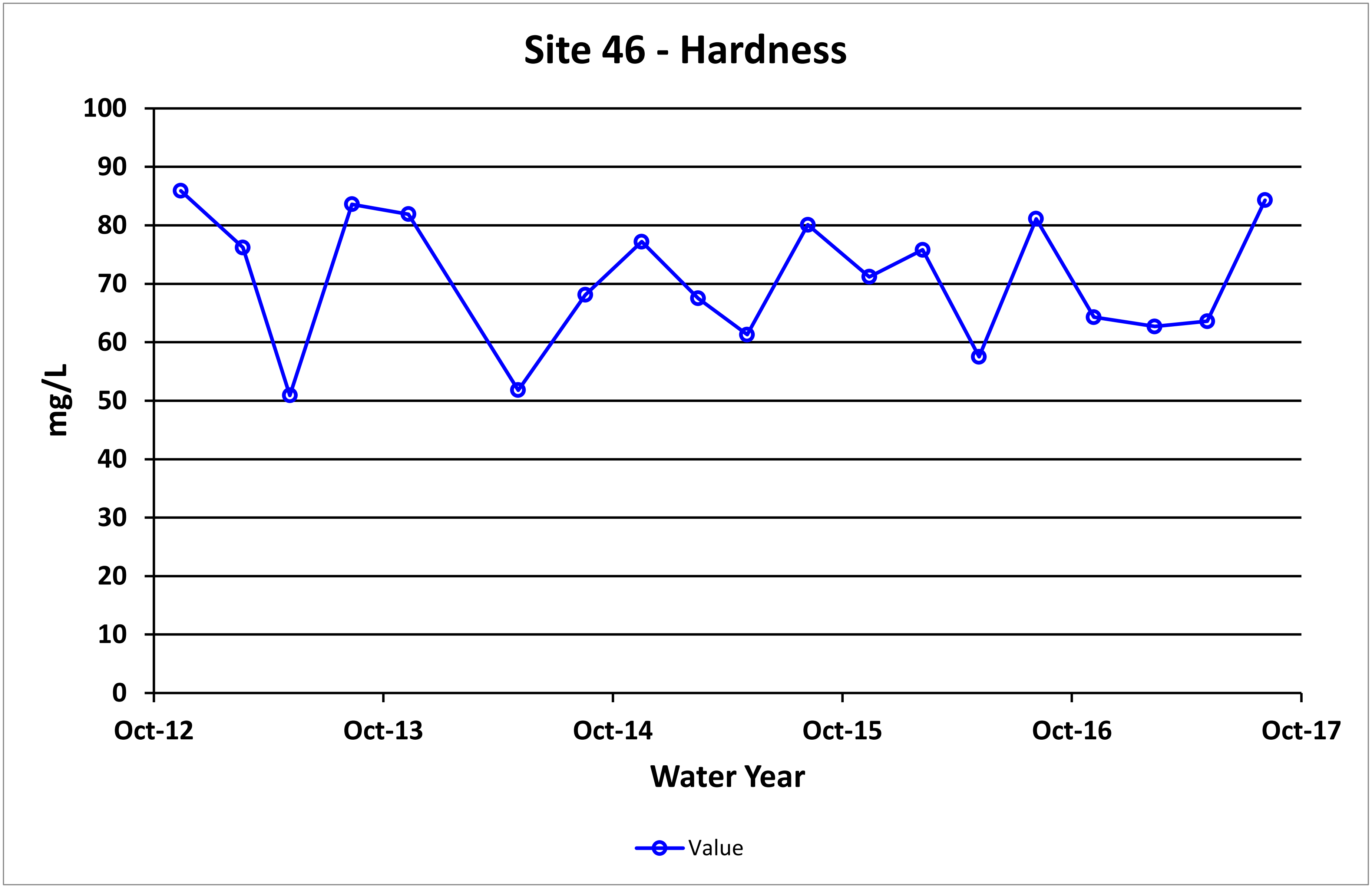


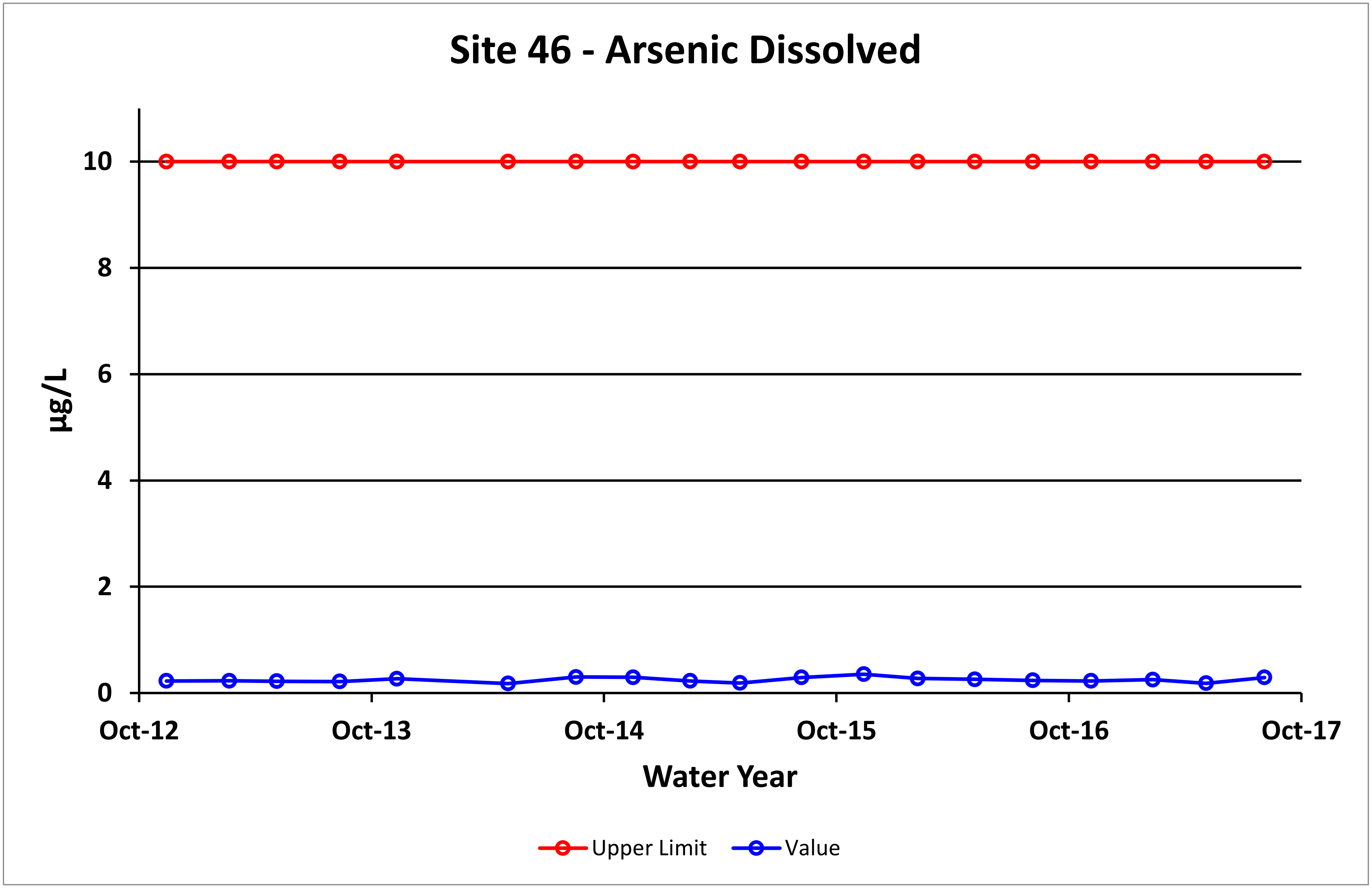
Site 46 - pH Field
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
S.U.
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Lower Limit
Upper Limit
Value


Site 46 - Alkalinity
140
120
100
80
60
40
20
0
mg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Lower Limit
Value

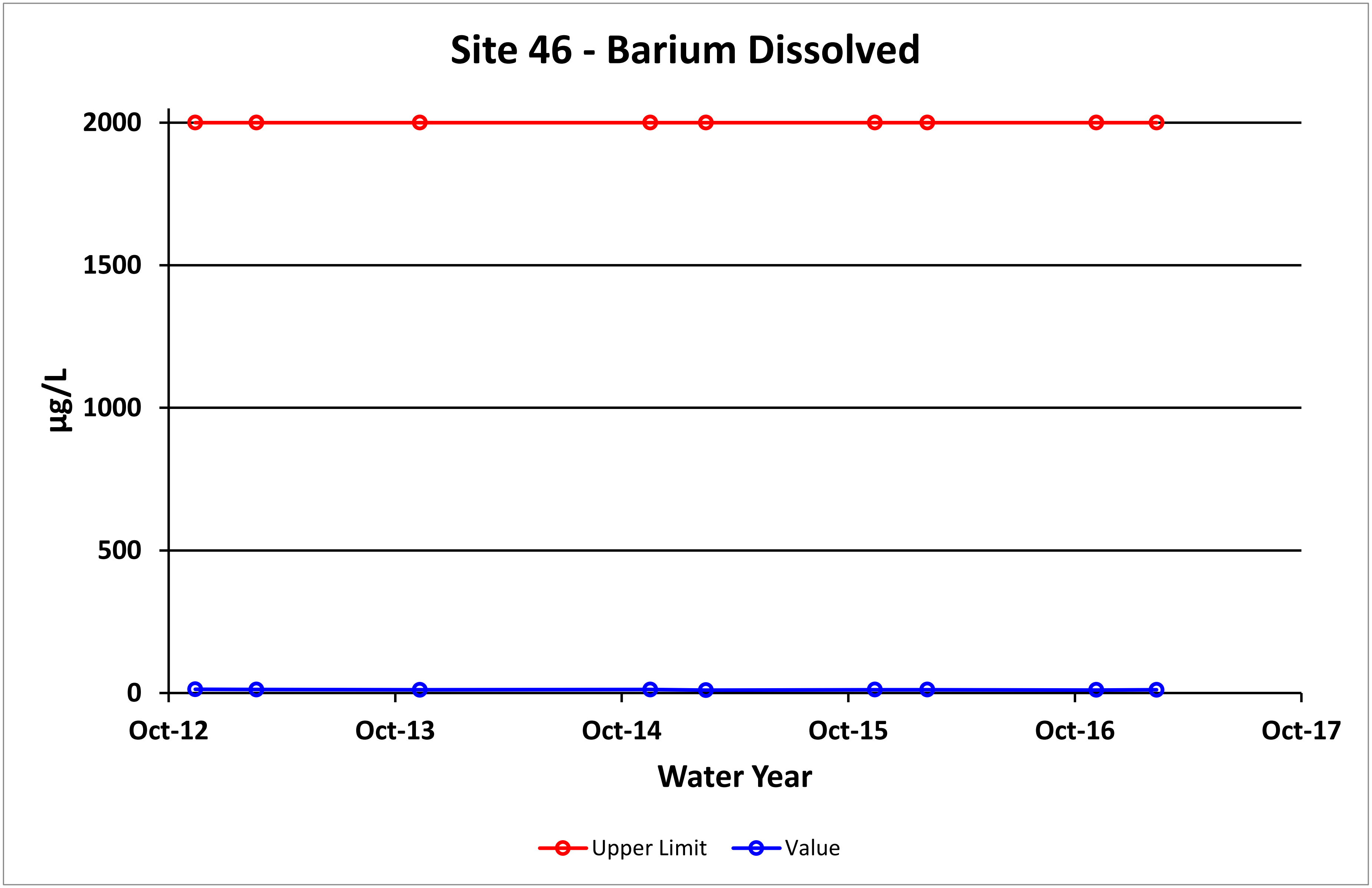


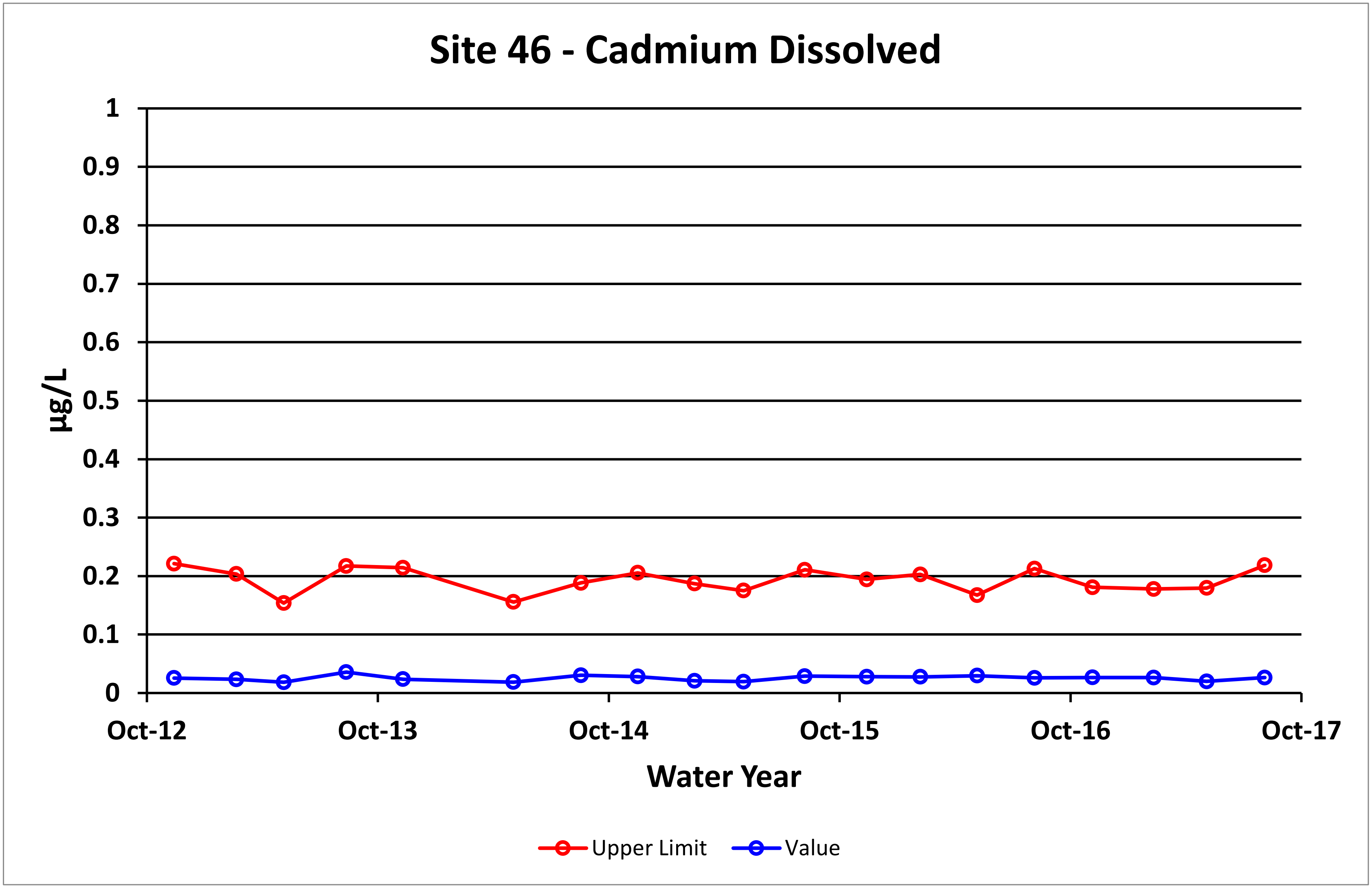
Site 46 - Sulfate
250
200
150
100
50
0
mg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

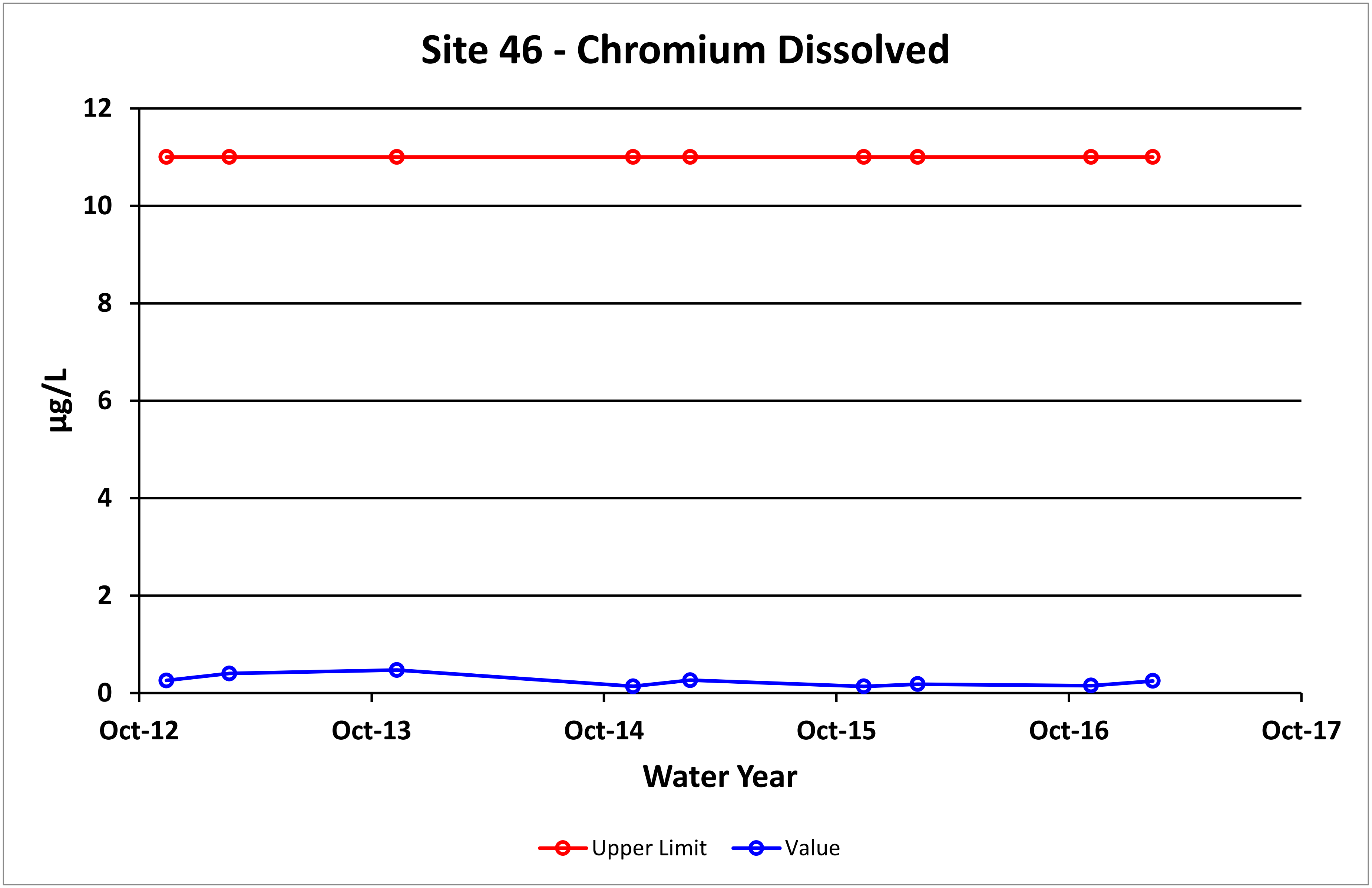

Site 46 - Hardness
100
90
80
70
60
50
40
30
20
10
0
mg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value

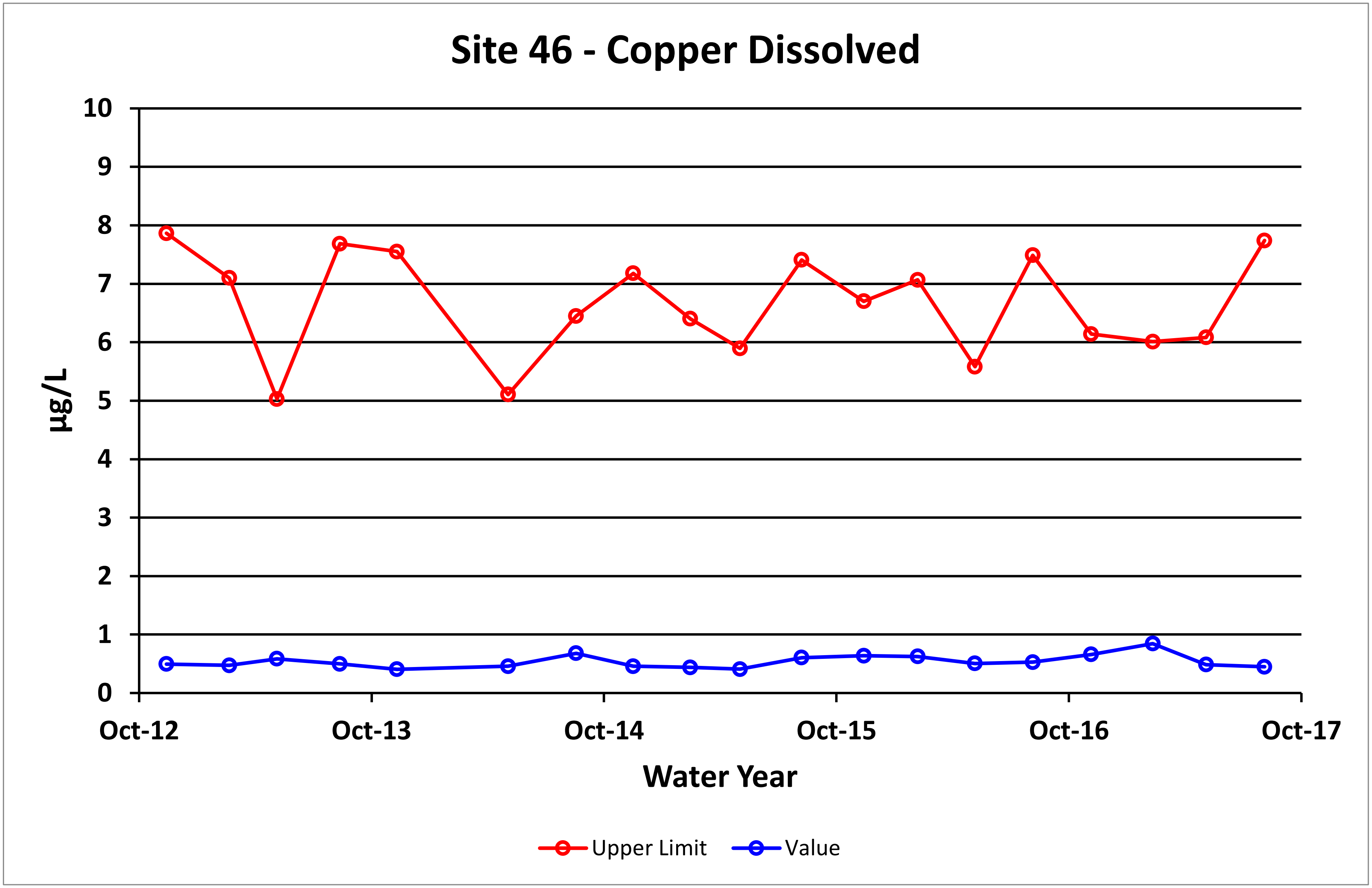


Site 46 - Arsenic Dissolved
µg/L
10
8
6
4
2
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

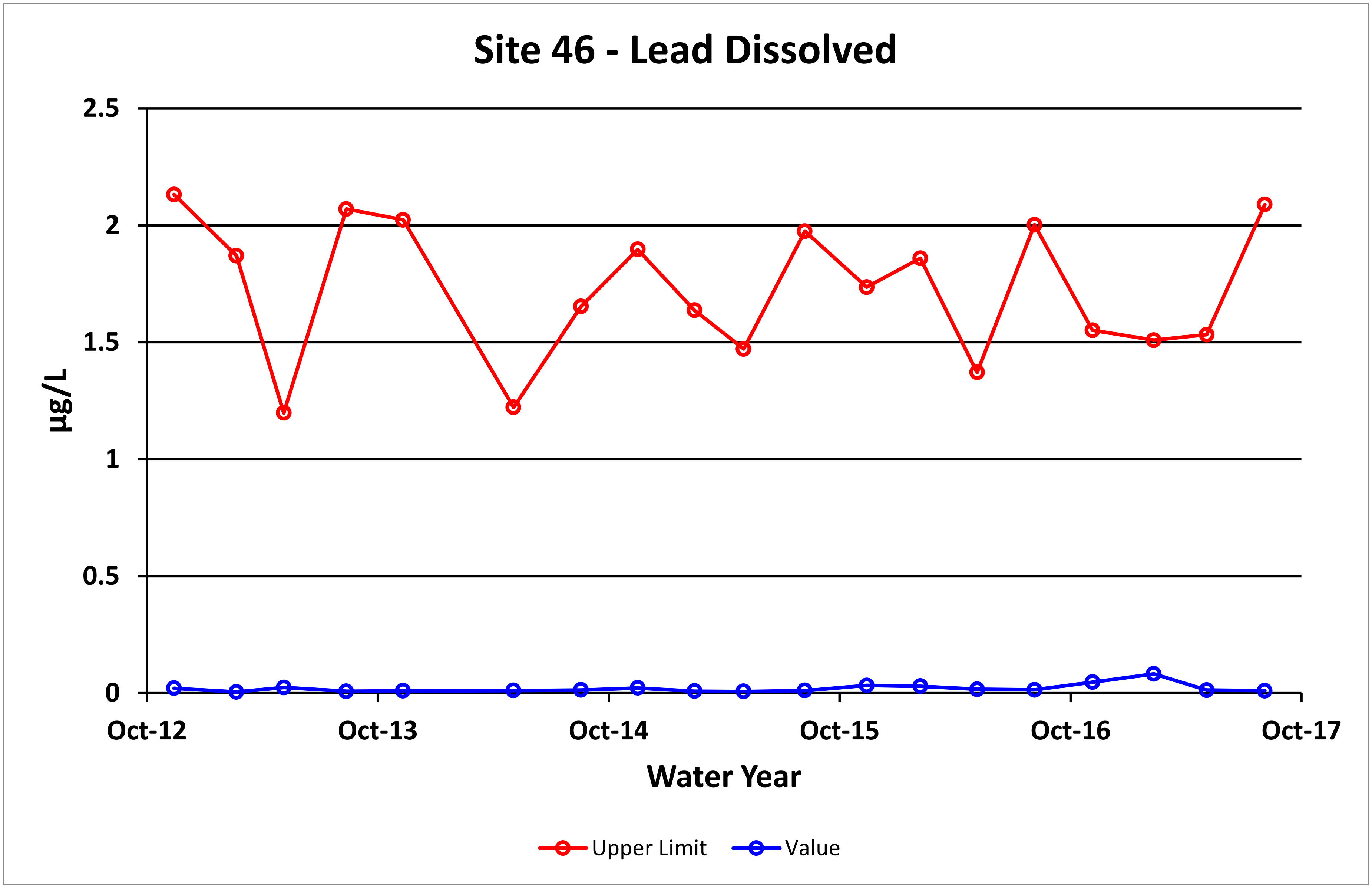

Site 46 - Barium Dissolved
2000
1500
1000
500
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value


Site 46 - Cadmium Dissolved
µg/L
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

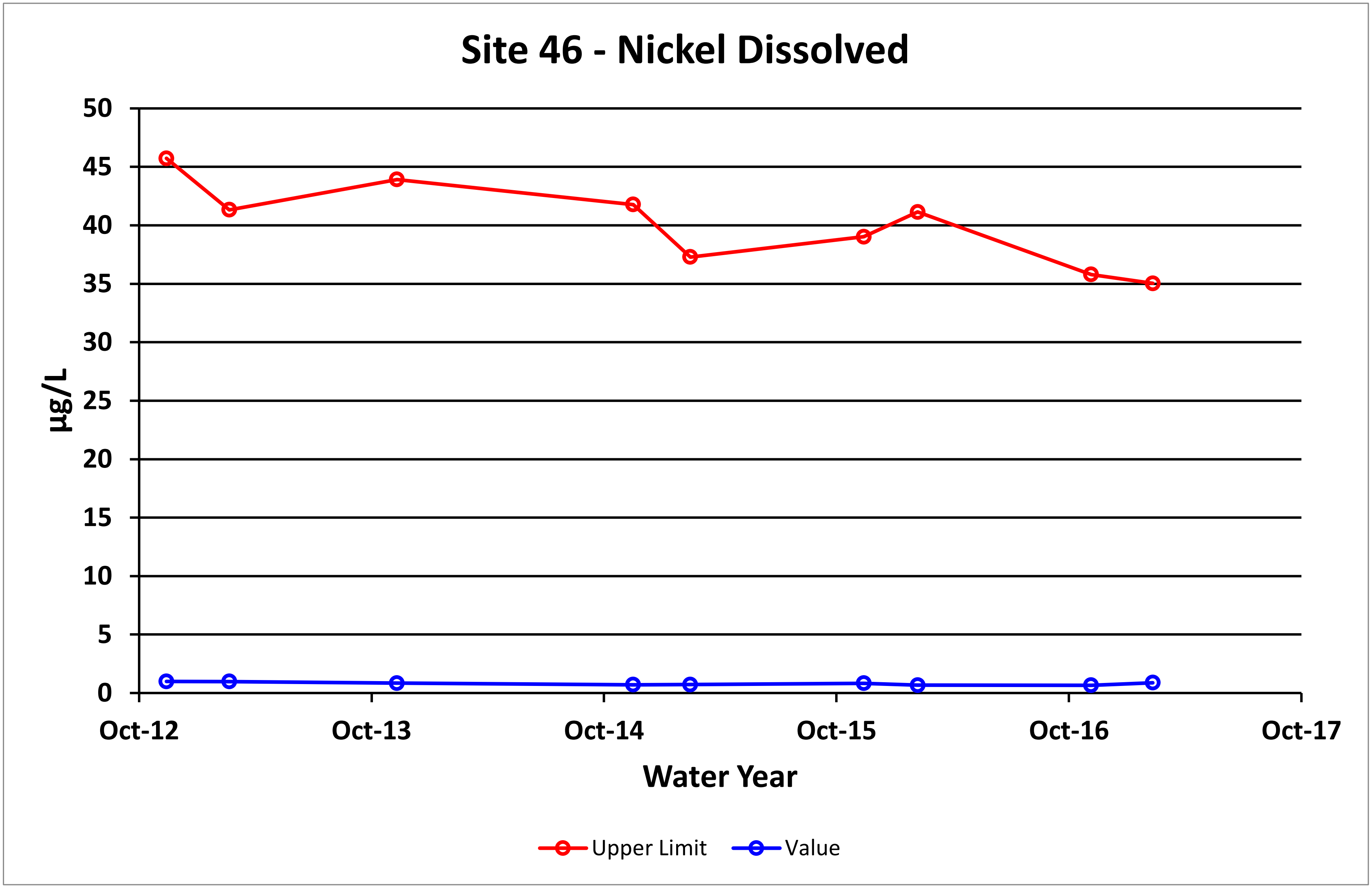

Site 46 - Chromium Dissolved
12
10
8
6
4
2
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

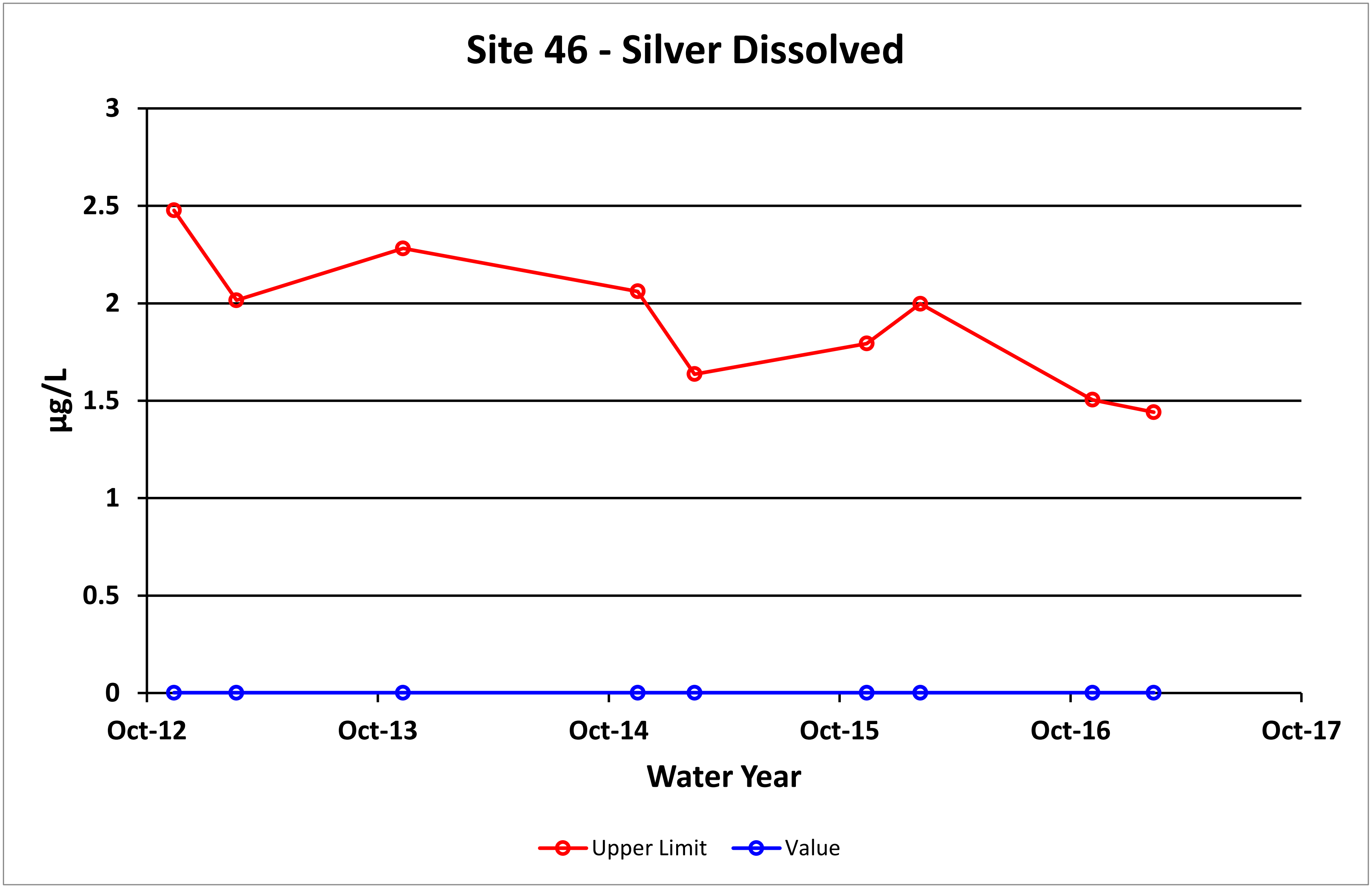


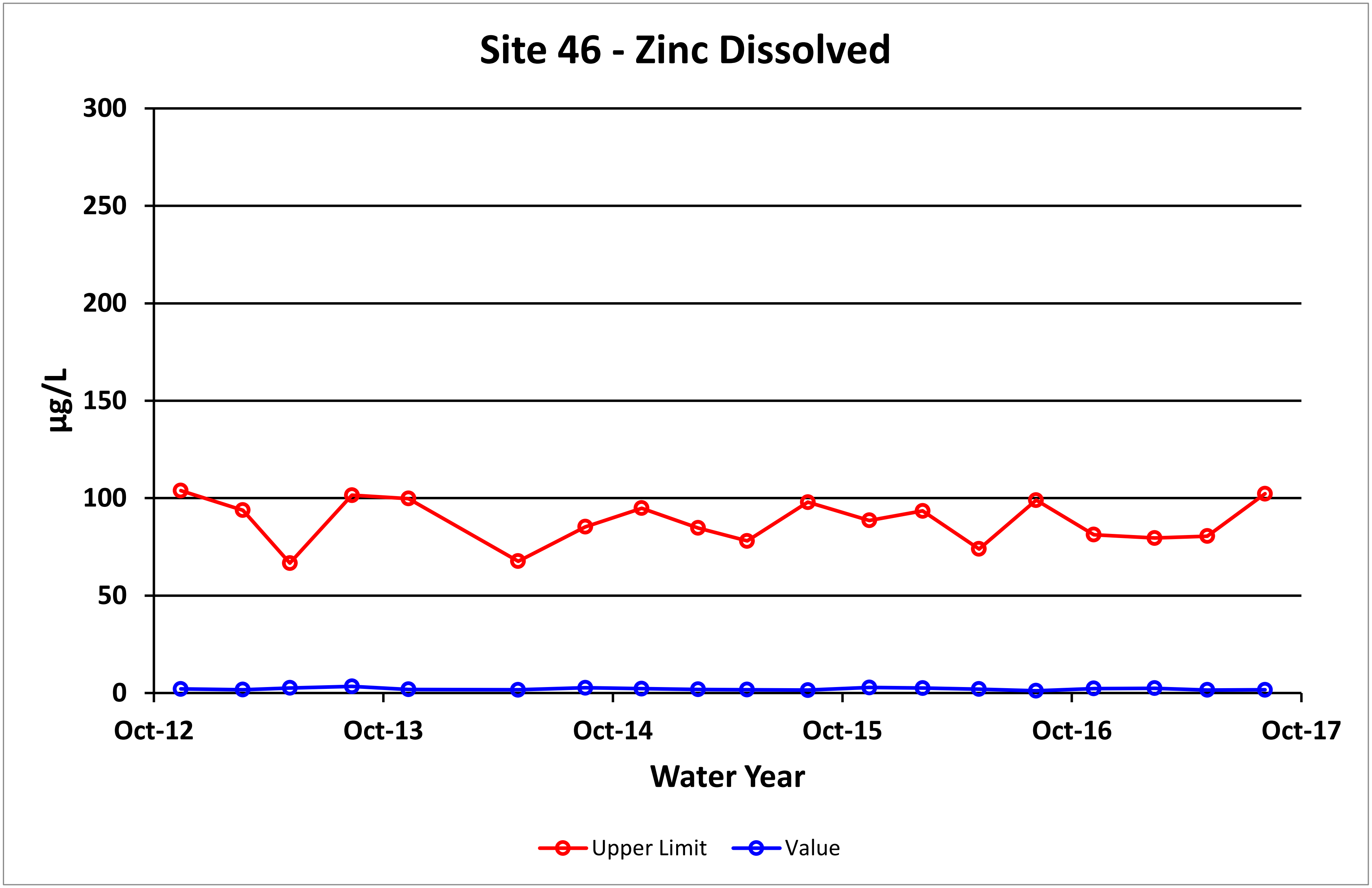
Site 46 - Copper Dissolved
10
9
8
7
6
5
4
3
2
1
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value



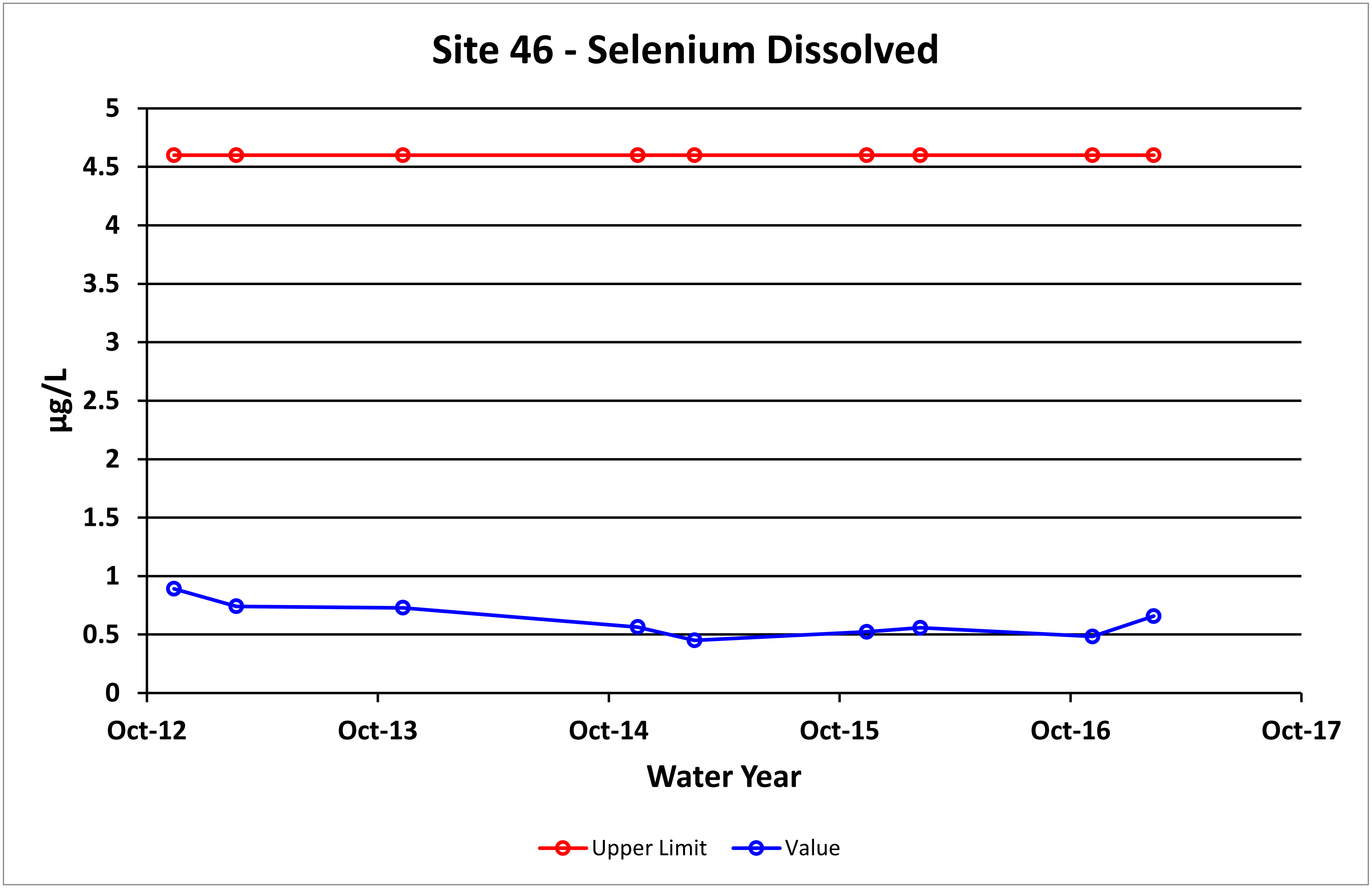
Site 46 - Lead Dissolved
2.5
2
1.5
1
0.5
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value


Site 46 - Nickel Dissolved
50
45
40
35
30
25
20
15
10
5
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

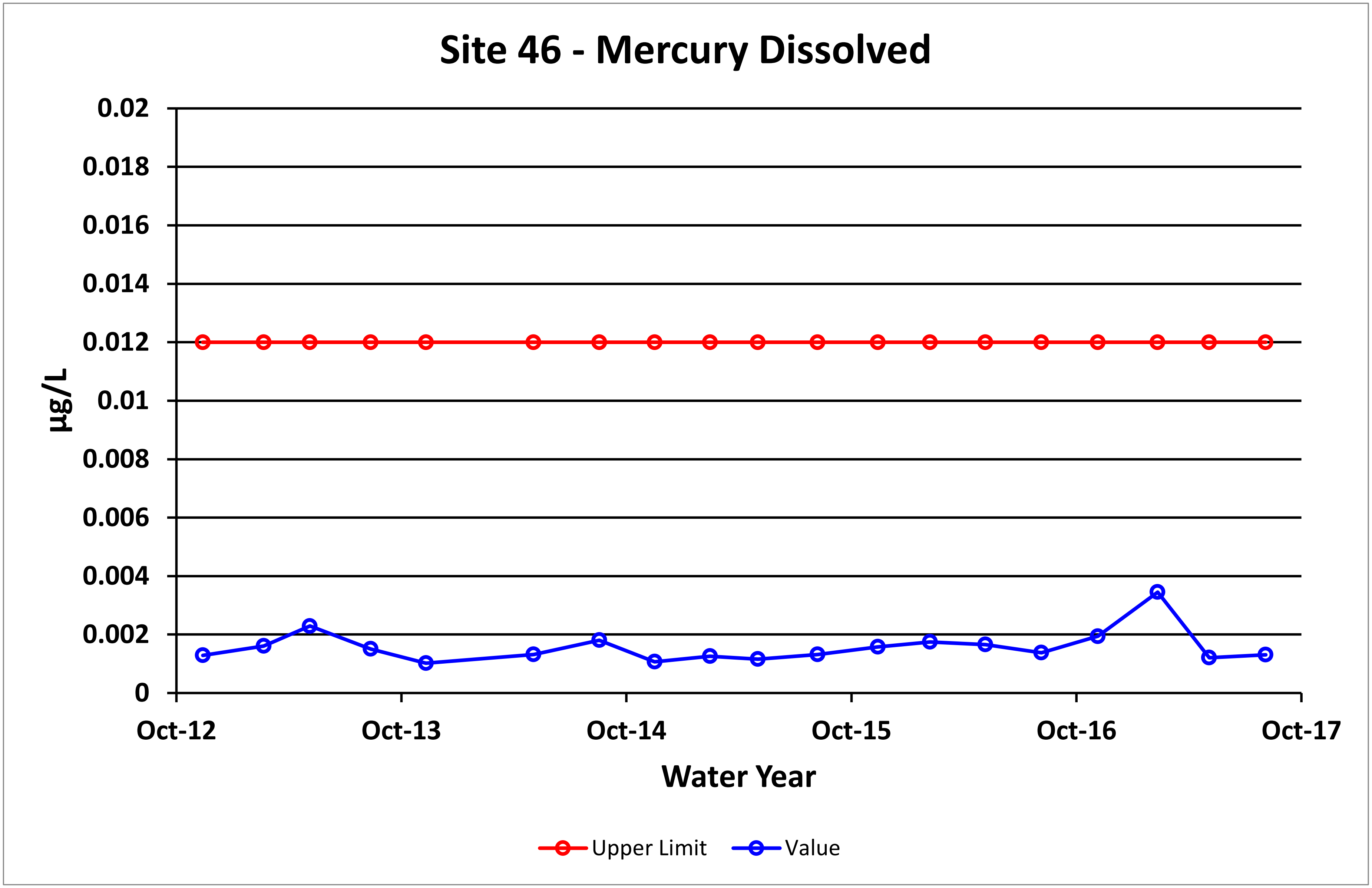

Site 46 - Silver Dissolved
3
2.5
2
1.5
1
0.5
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value



Site 46 - Zinc Dissolved
300
250
200
150
100
50
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value



Site 46 - Selenium Dissolved
µg/L
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value


Site 46 - Mercury Dissolved
0.02
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

INTERPRETIVE REPORT
SITE 57

The data collected during the current water year are listed in the following "Table of Results for Water Year 2017" report. The table includes all the required FWMP analyte data (field and laboratory) collected for the current water year and a series of flags keyed to the summary report "Qualified Data by QA Reviewer". The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of ½ MDL for the purpose of median calculation.

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

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

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

Table of Exceedance for Water Year 2017

			Limits		
Sample Date	Parameter	Value	Lower	Upper	Hardness
No exceedances have been identified by HGCMC for the period of October 2016 through September 2017.					

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 to historical levels and remained there during the 2016 Water Year. The 2017 water year had an initial decrease in hardness, conductivity and sulfate followed by a rebound to historic 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-11 and Sep-17 (WY2012-WY2017). Datasets with a statistically significant trend ($\alpha/2$=2.5%) a Seasonal-Sen's Slope estimate statistic has also been calculated. There were no statistically significant trends calculated for these parameters this water year.

Table of Summary Statistics for Trend Analysis

	Mann-Kendall test statistics			Sen's slope estimate	
Parameter	**n***	**p****	**Trend**	**Q**	**Q(%)**
Conductivity Field	6	0.38			
pH Field	6	0.59			
Alkalinity, Total	6	0.26			
Sulfate, Total	6	0.04			
Zinc, Dissolved	6	0.70			

* Number of Years ** Significance level

Table of Results for Water Year 2017

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

Sample Date/Parameter	Oct 2016	Nov 2016	Dec 2016	Jan 2017	Feb 2017	Mar 2017	Apr 2017	May 2017	Jun 2017	Jul 2017	Aug 2017	Sep 2017	**Median**
Water Temp (°C)		5.9			5.1			6.4			7.1		6.2
Conductivity-Field(μmho)		290			405			383			381.6		382.3
Conductivity-Lab (μmho)		258			389			358			337		348
pH Lab (standard units)		7.41			7.44			7.63			7.53		7.49
pH Field (standard units)		7.58			7.86			7.71			7.75		7.73
Total Alkalinity (mg/L)		100			155			147			143		145.0
Total Sulfate (mg/L)		8.1			52.1			42.2			41.5		41.9
Hardness (mg/L)		155			204			185			158		171.5
Dissolved As (ug/L)		3.45			0.602			0.582			0.735		0.669
Dissolved Ba (ug/L)		42.4			31			28.5			23.8		29.8
Dissolved Cd (ug/L)		0.19			0.161			0.148			0.127		0.1545
Dissolved Cr (ug/L)		0.93			0.592			0.392			0.424		0.508
Dissolved Cu (ug/L)		0.956			1.13			0.29			0.555		0.756
Dissolved Pb (ug/L)		0.271			0.0736			0.0988			0.143		0.1209
Dissolved Ni (ug/L)		1.97			0.301			0.186			0.299		0.300
Dissolved Ag (ug/L)		0.018			0.002			0.002			0.002		0.002
Dissolved Zn (ug/L)		70.6			12.5			21.4			12		16.95
Dissolved Se (ug/L)		0.865			0.711			0.627			0.752		0.732
Dissolved Hg (ug/L)		0.000207			0.000227			0.00016			0.000135		0.000184

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

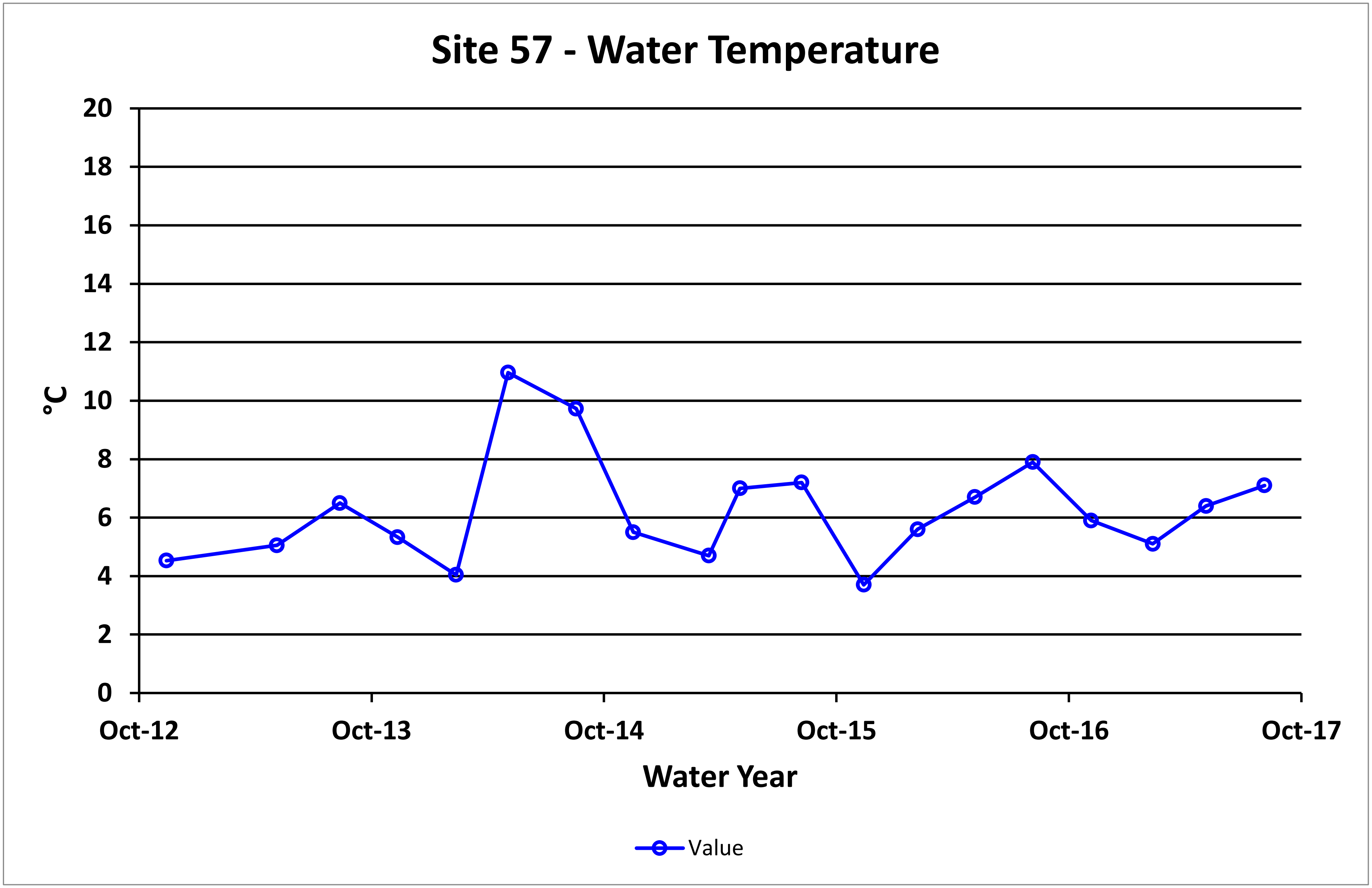
Values reported as less than MDL are replaced by 1/2 MDL for median calculation purposes.

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

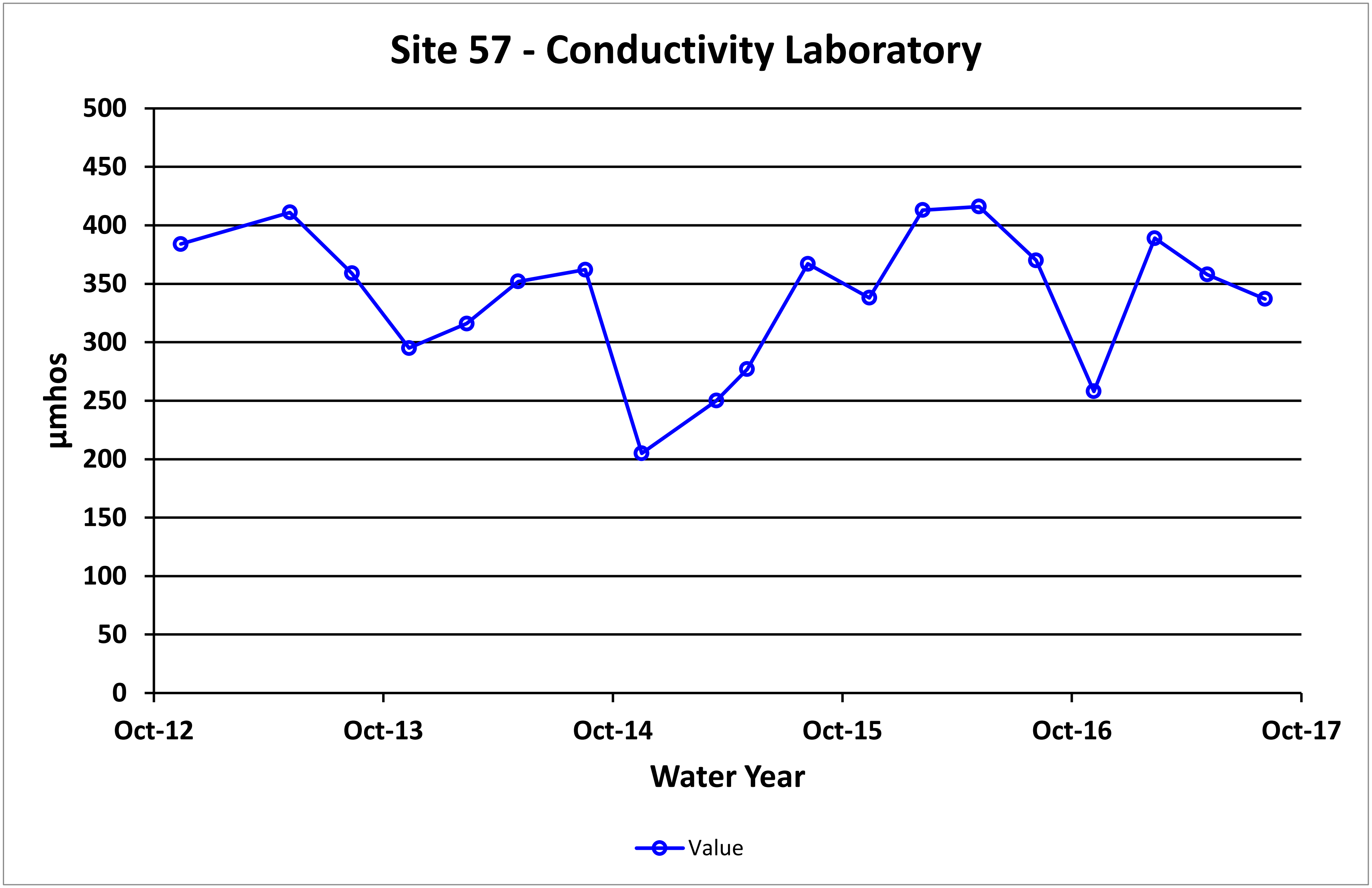
Qualified Data by QA Reviewer

Date Range: 10/01/2016 to 09/30/2017

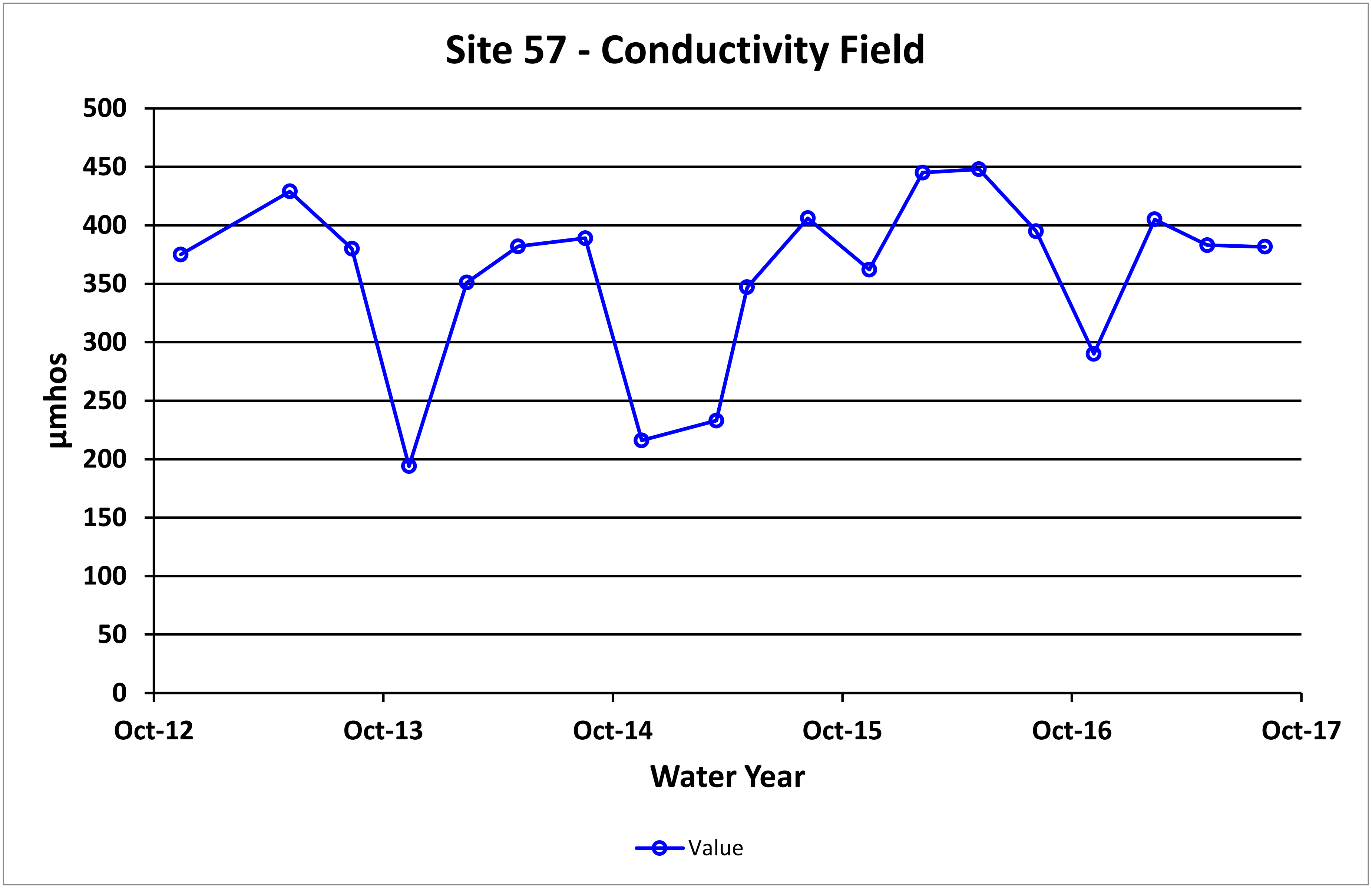
Site No.	Sample Date	Sample Time	Parameter	Value		Qualifier	Reason for Qualifier
057FMG	2/13/2017	12:00 PM	Diss. Hg-CVAF	0.000227	µg/L	J	Below Quantitative Range
	5/8/2017	12:00 PM	Diss. Hg-CVAF	0.00016	µg/L	U	Trip Blank Contamination
			Tot. Sulfate	42.2	mg/L	J	Sample Receipt Temperature
	8/8/2017	12:00 PM	Diss. Hg-CVAF	0.000135	µg/L	J	Below Quantitative Range
			Tot. Sulfate	41.5	mg/L	J	Sample Receipt Temperature

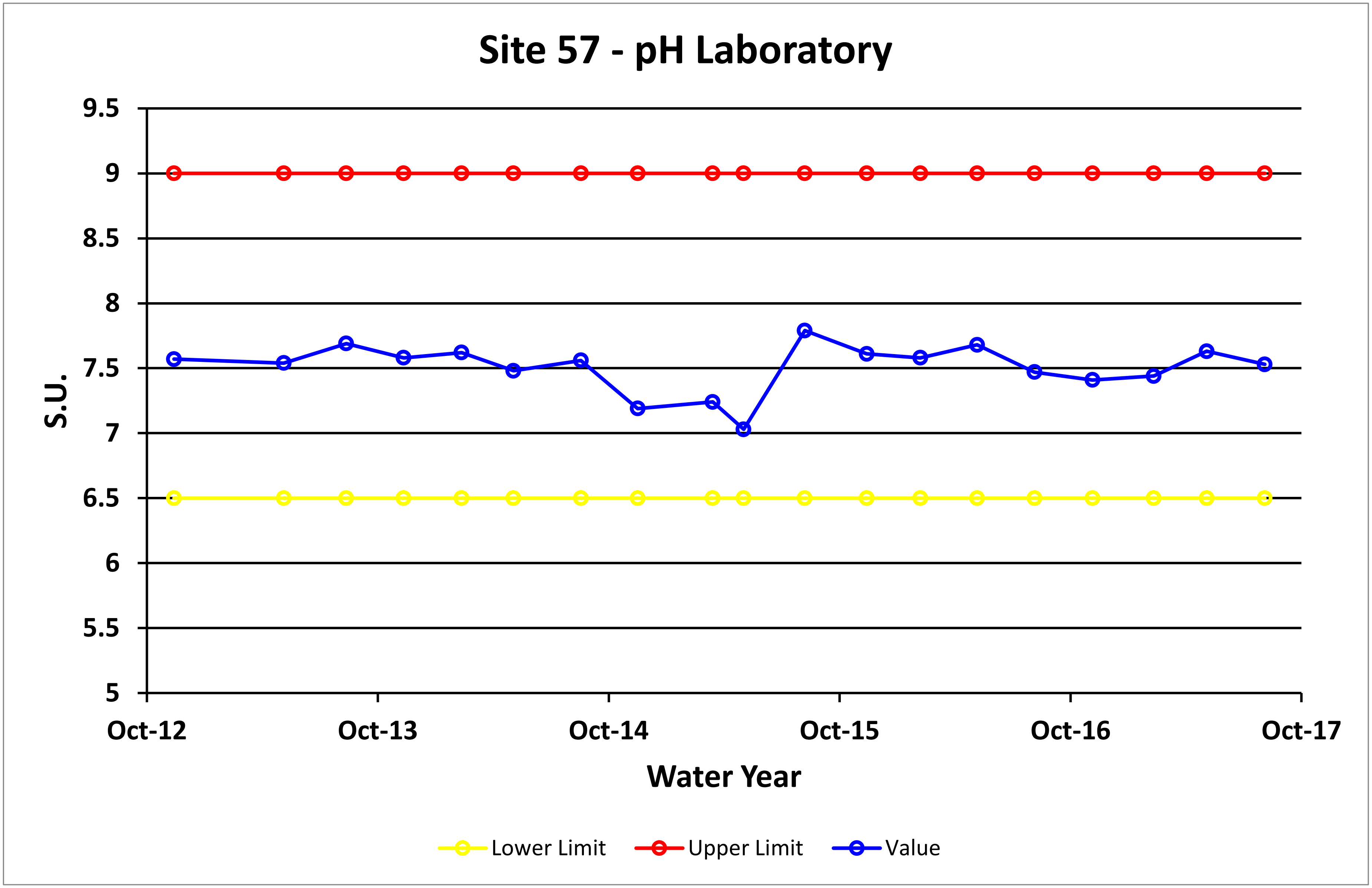


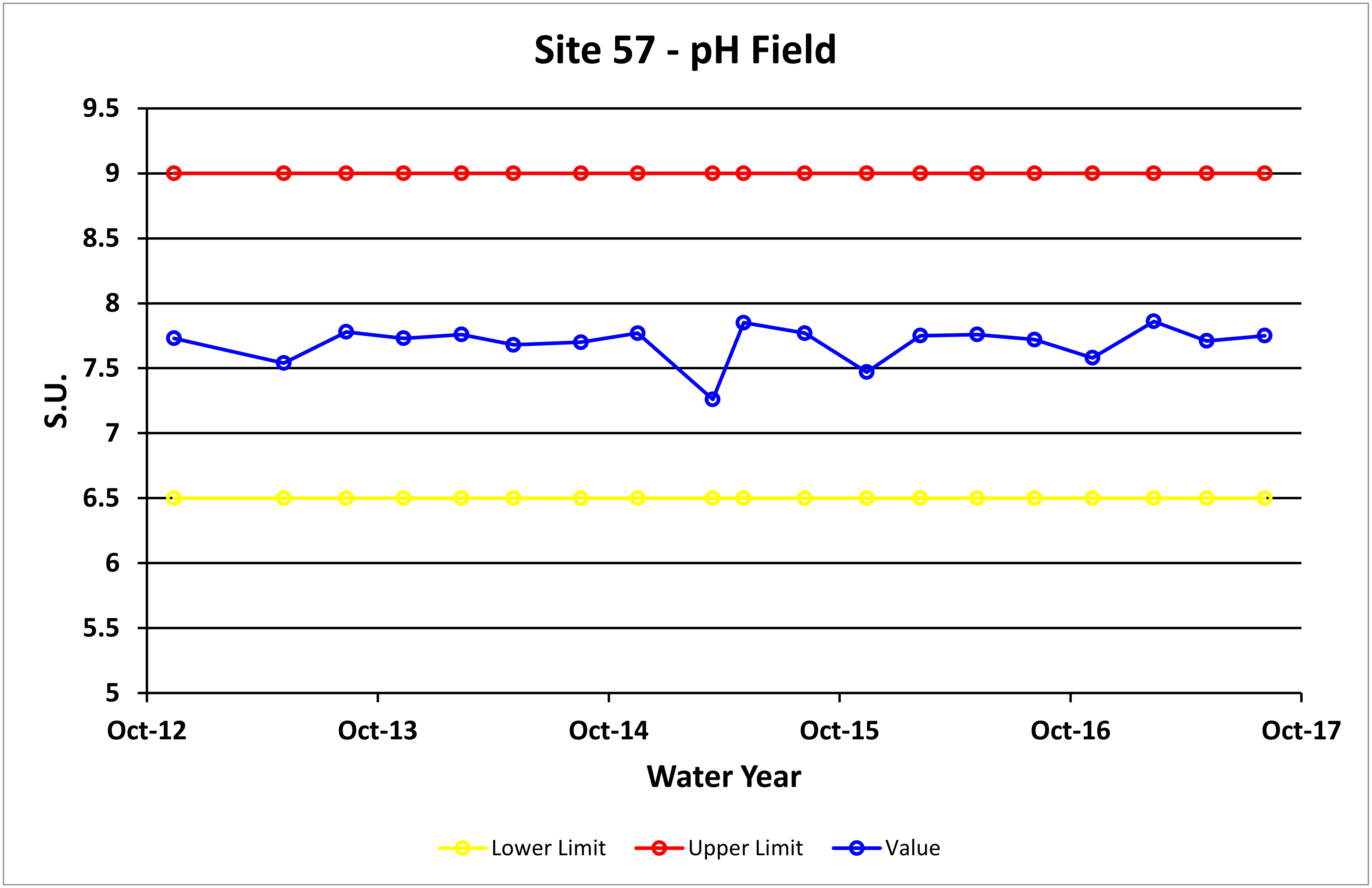
Site 57 - Water Temperature
20
18
16
14
12
10
8
6
4
2
0
°C
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value



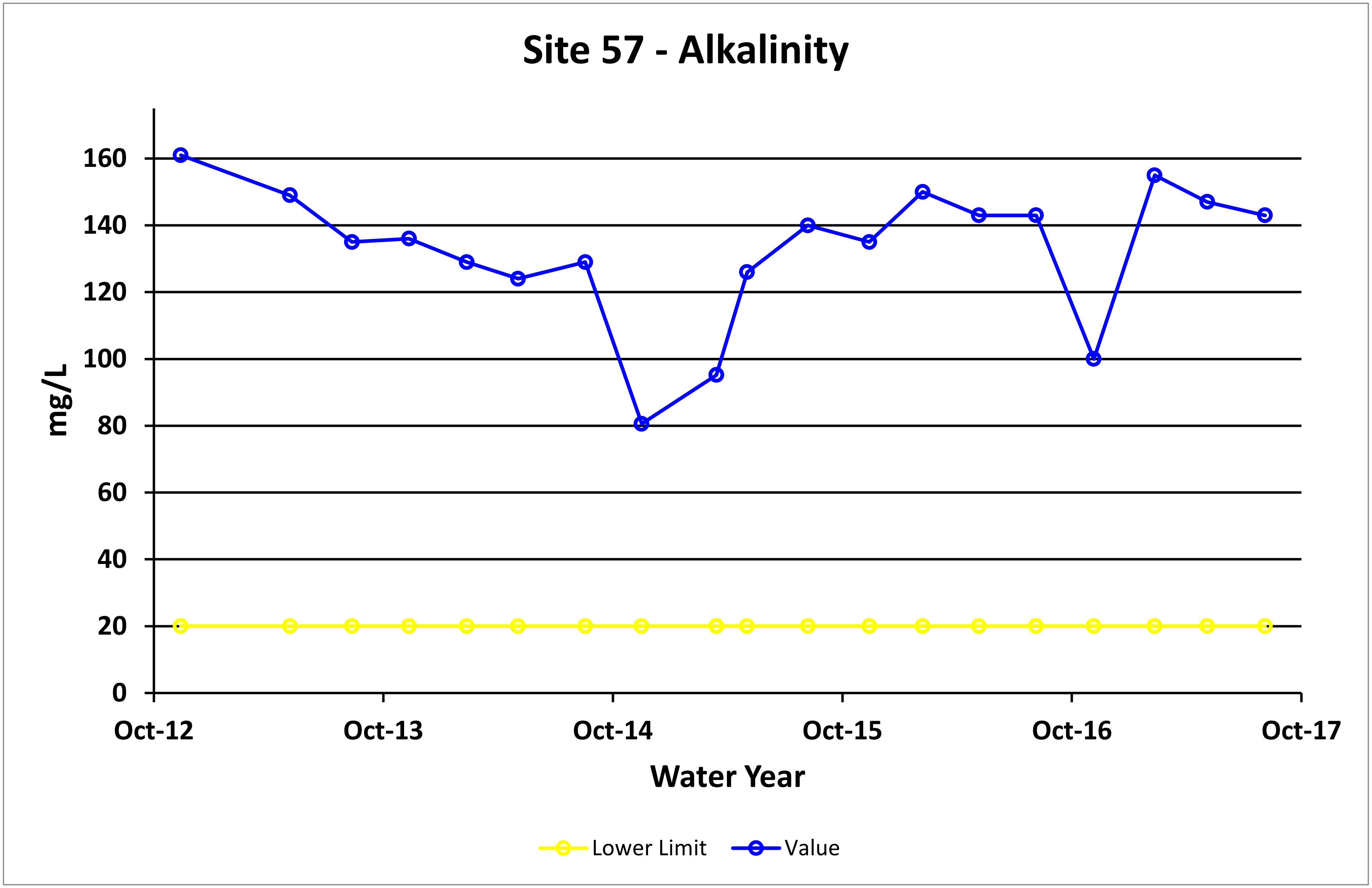
Site 57 - Conductivity Laboratory
500
450
400
350
300
250
200
150
100
50
0
µmhos
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value

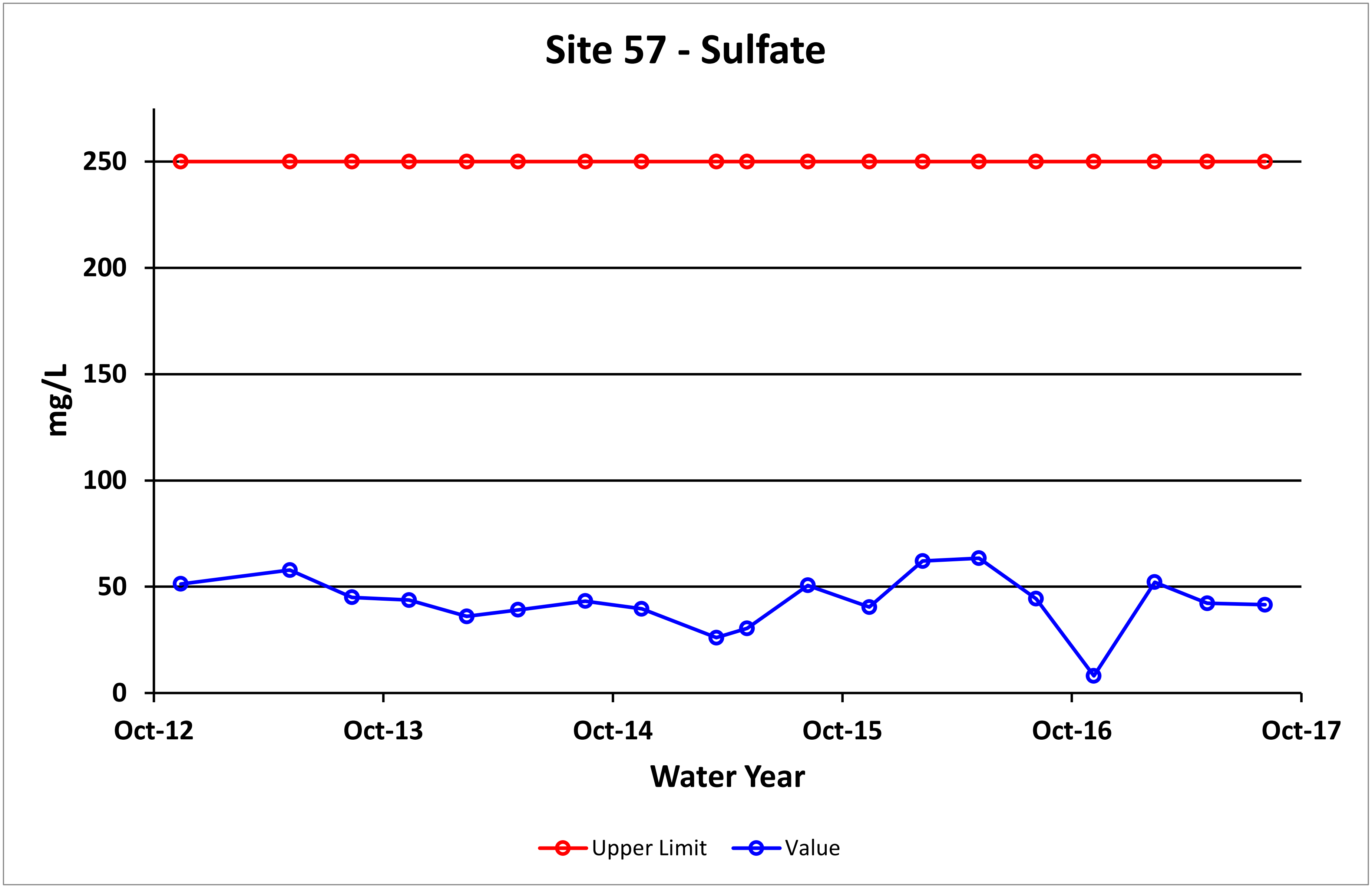

Site 57 - Conductivity Field
µmhos
500
450
400
350
300
250
200
150
100
50
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value


Site 57 - pH Laboratory
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
S.U.
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Lower Limit
Upper Limit
Value

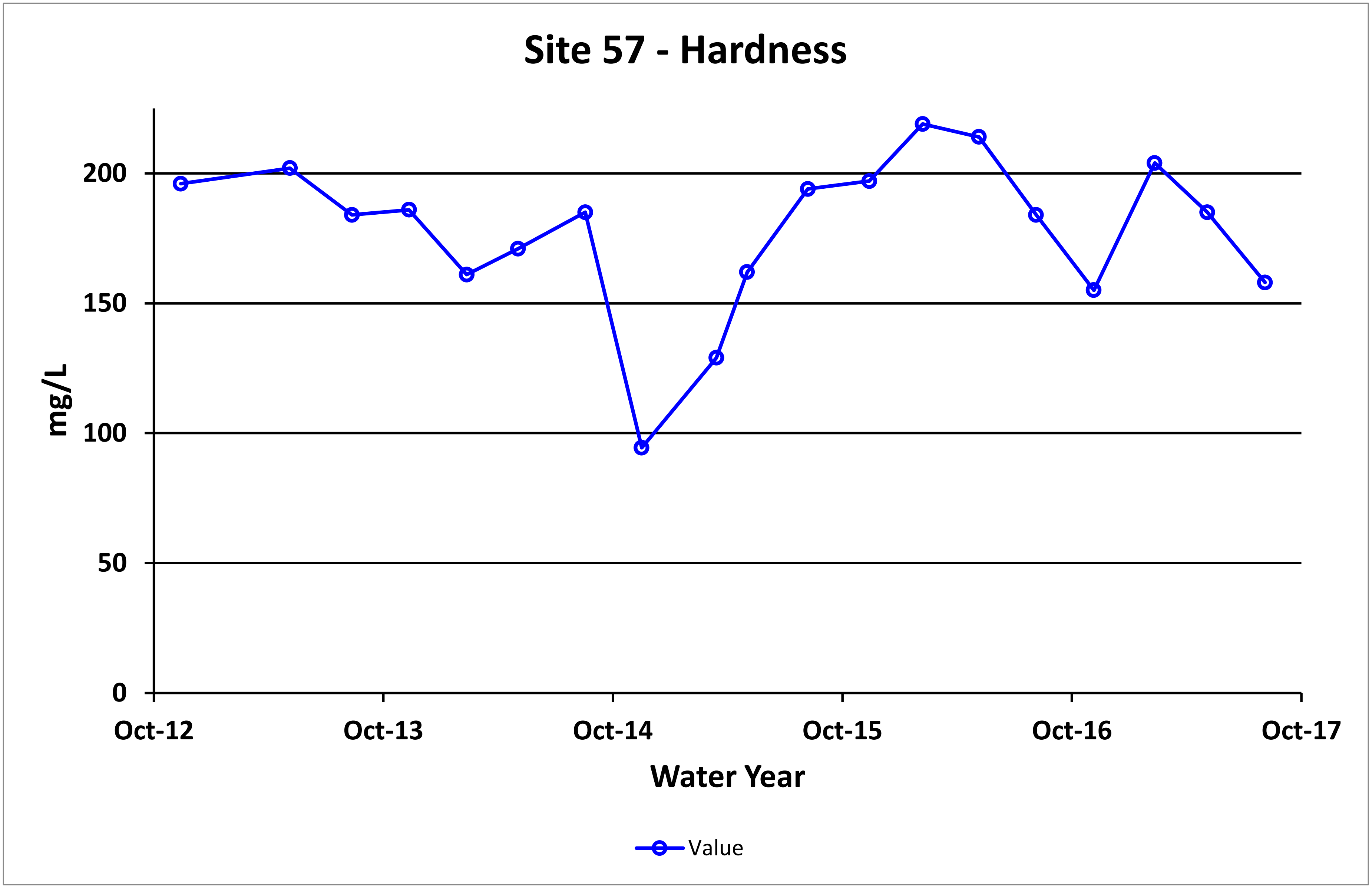


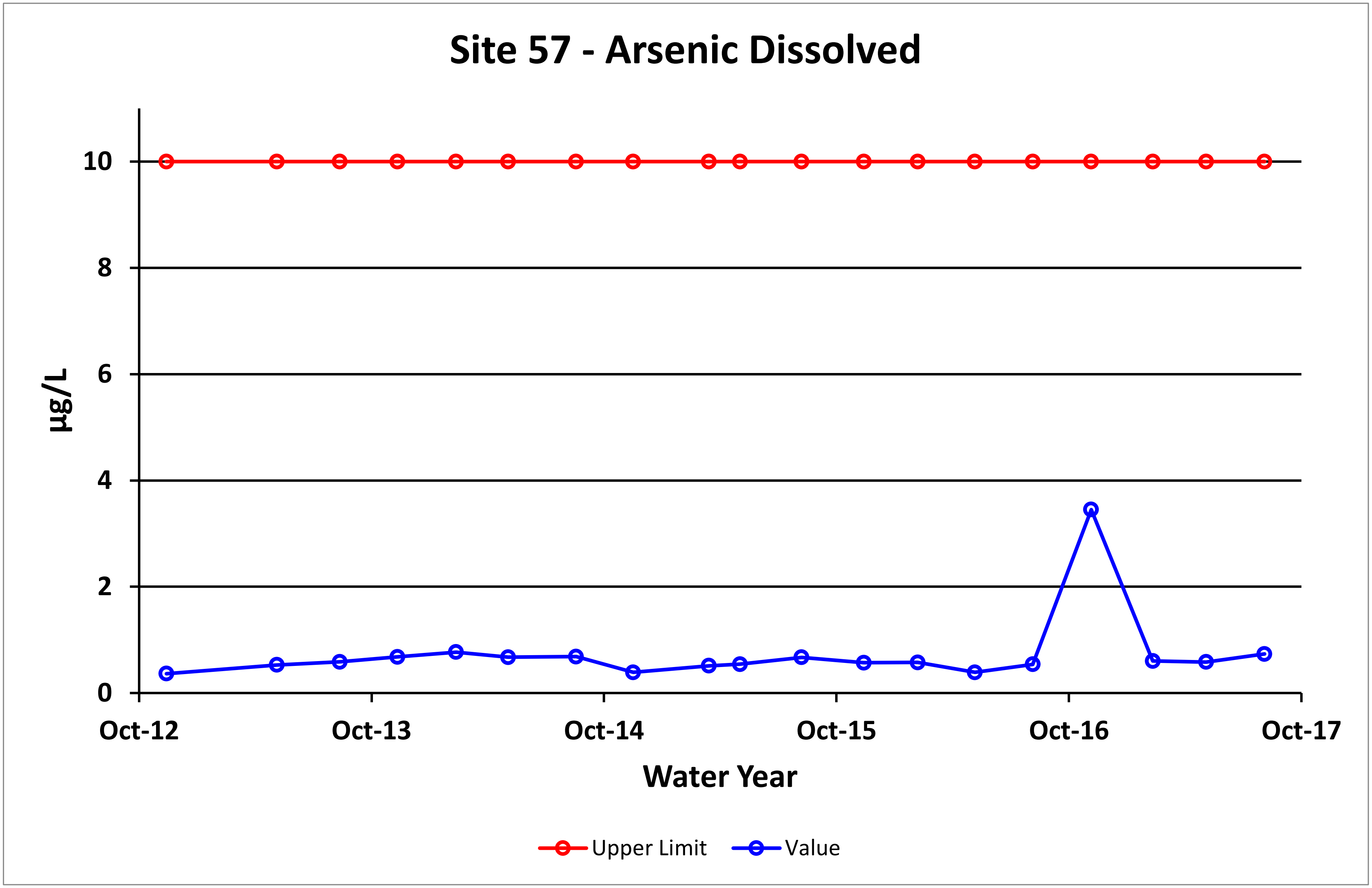
Site 57 - pH Field
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
S.U.
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Lower Limit
Upper Limit
Value

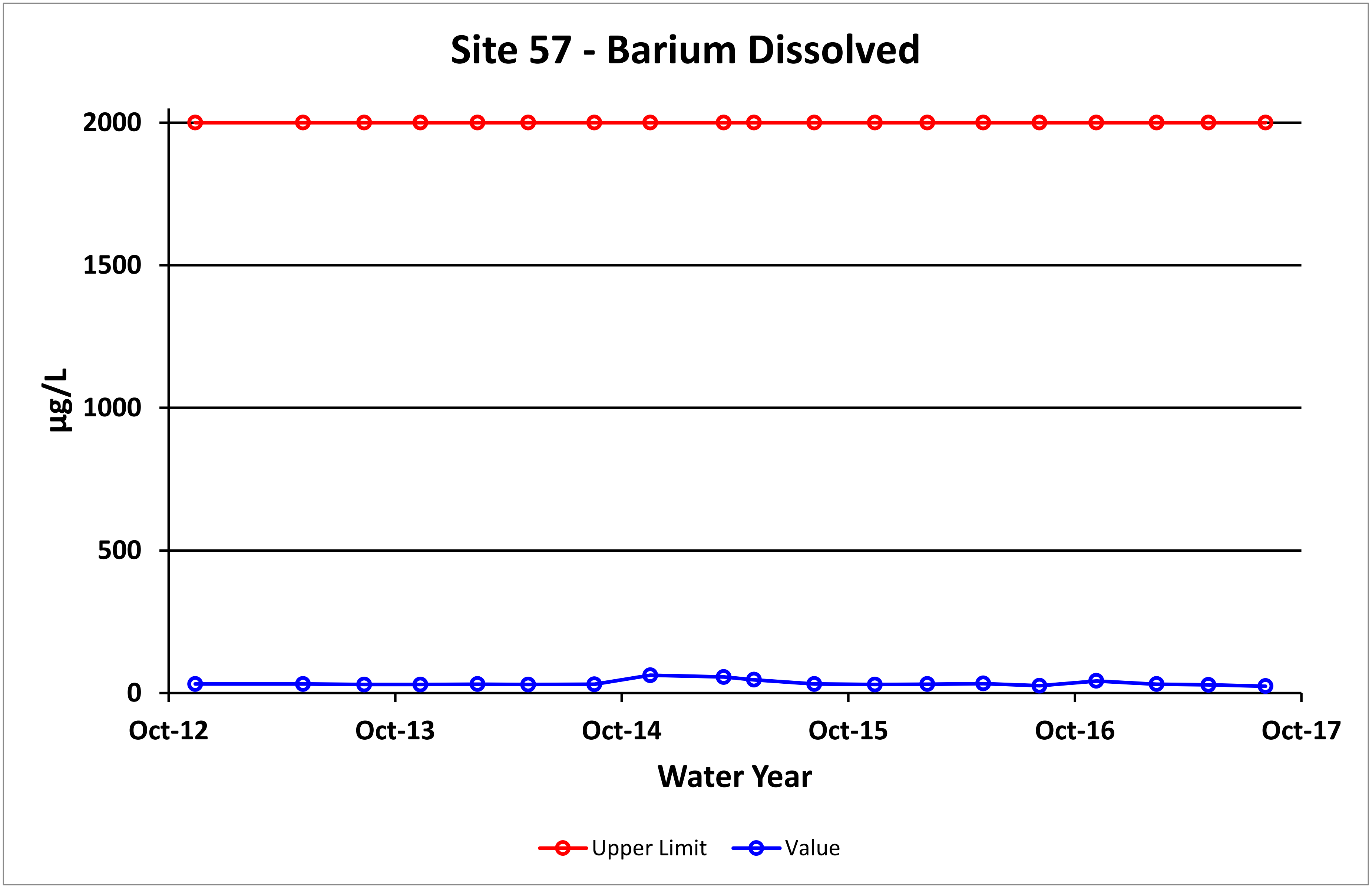

Site 57 - Alkalinity
mg/L
0
20
40
60
80
100
120
140
160
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Lower Limit
Value



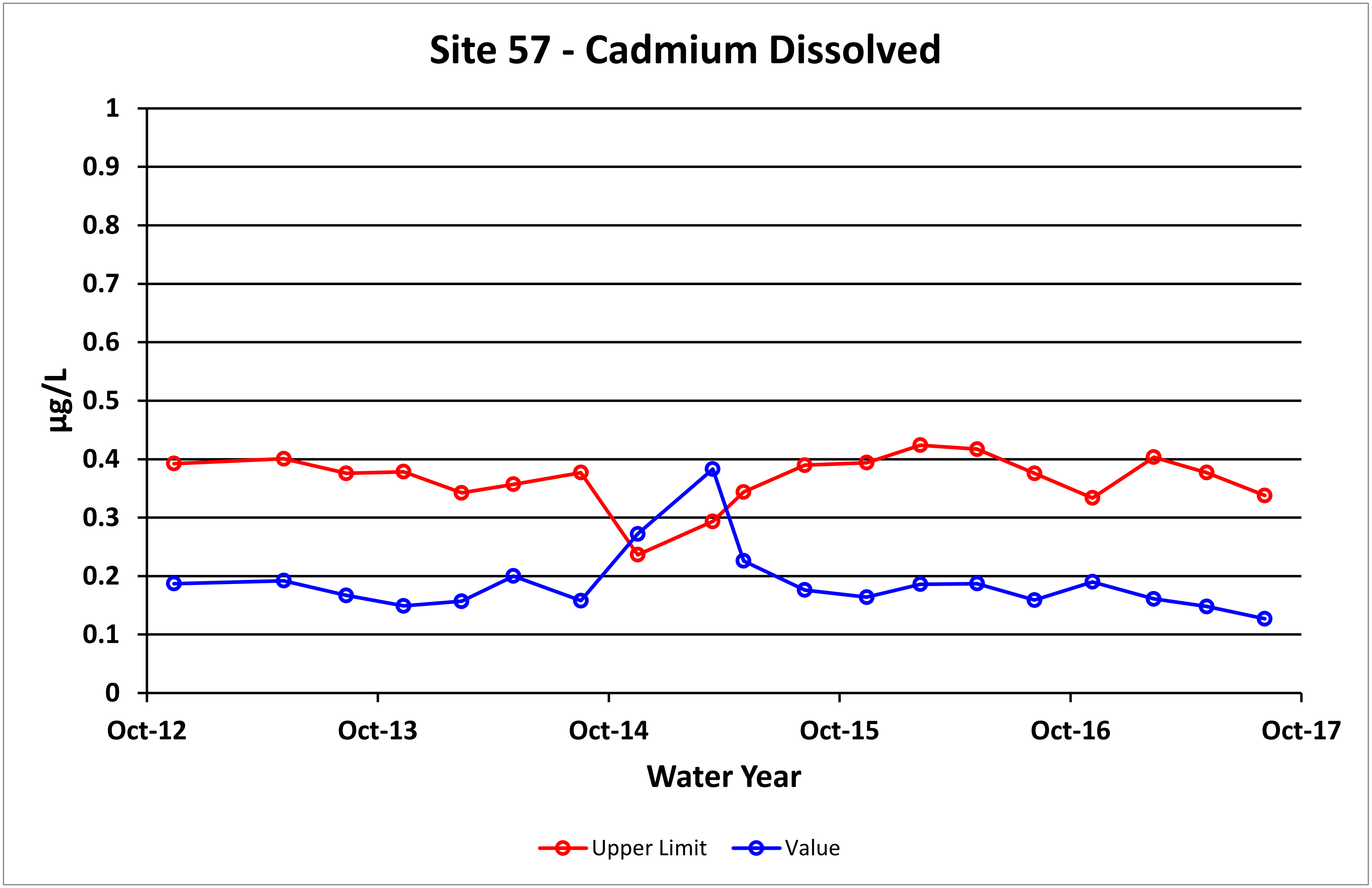
Site 57 - Sulfate
mg/L
250
200
150
100
50
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

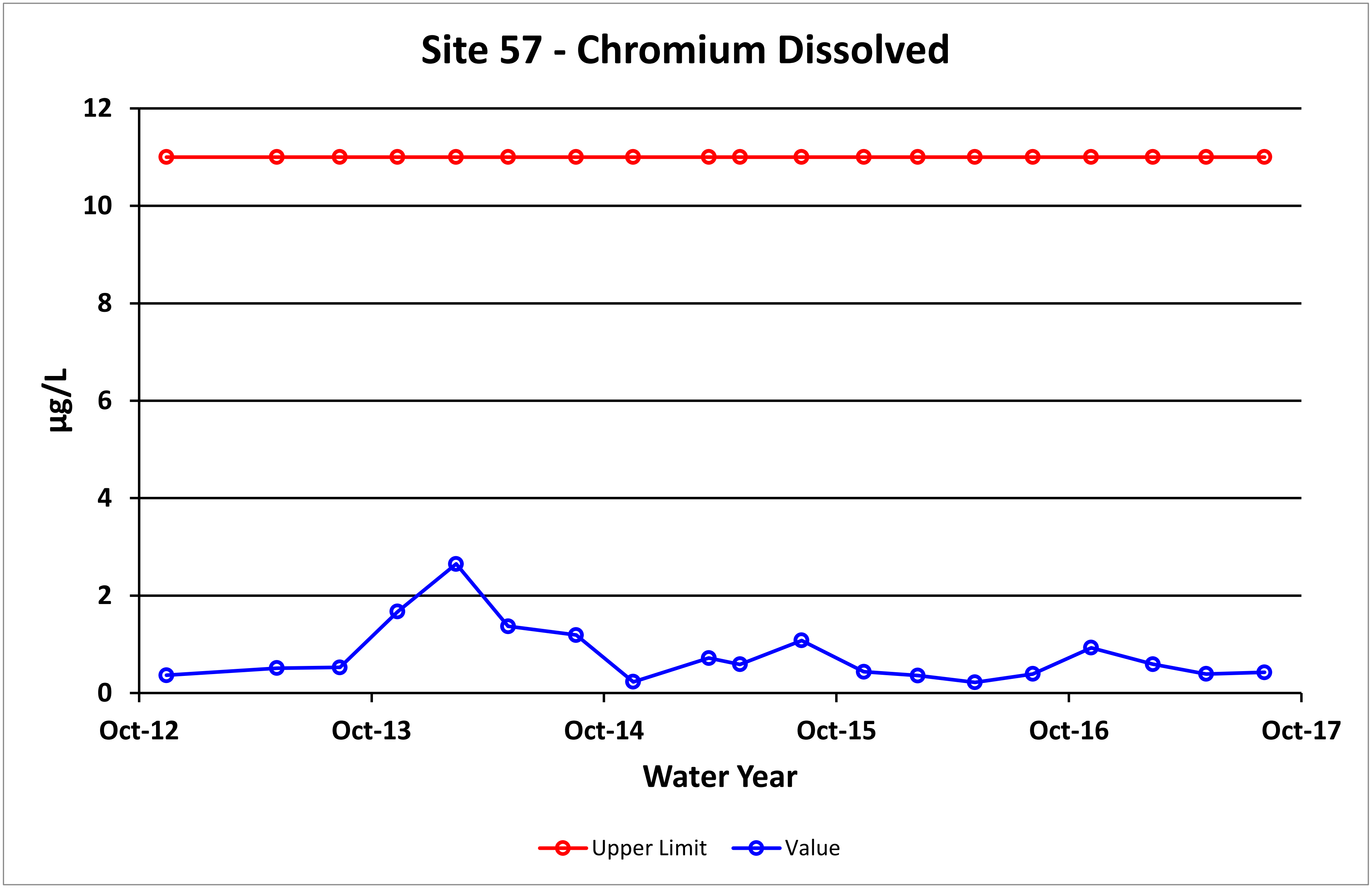

Site 57 - Hardness
mg/L
200
150
100
50
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value


Site 57 - Arsenic Dissolved
µg/L
10
8
6
4
2
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

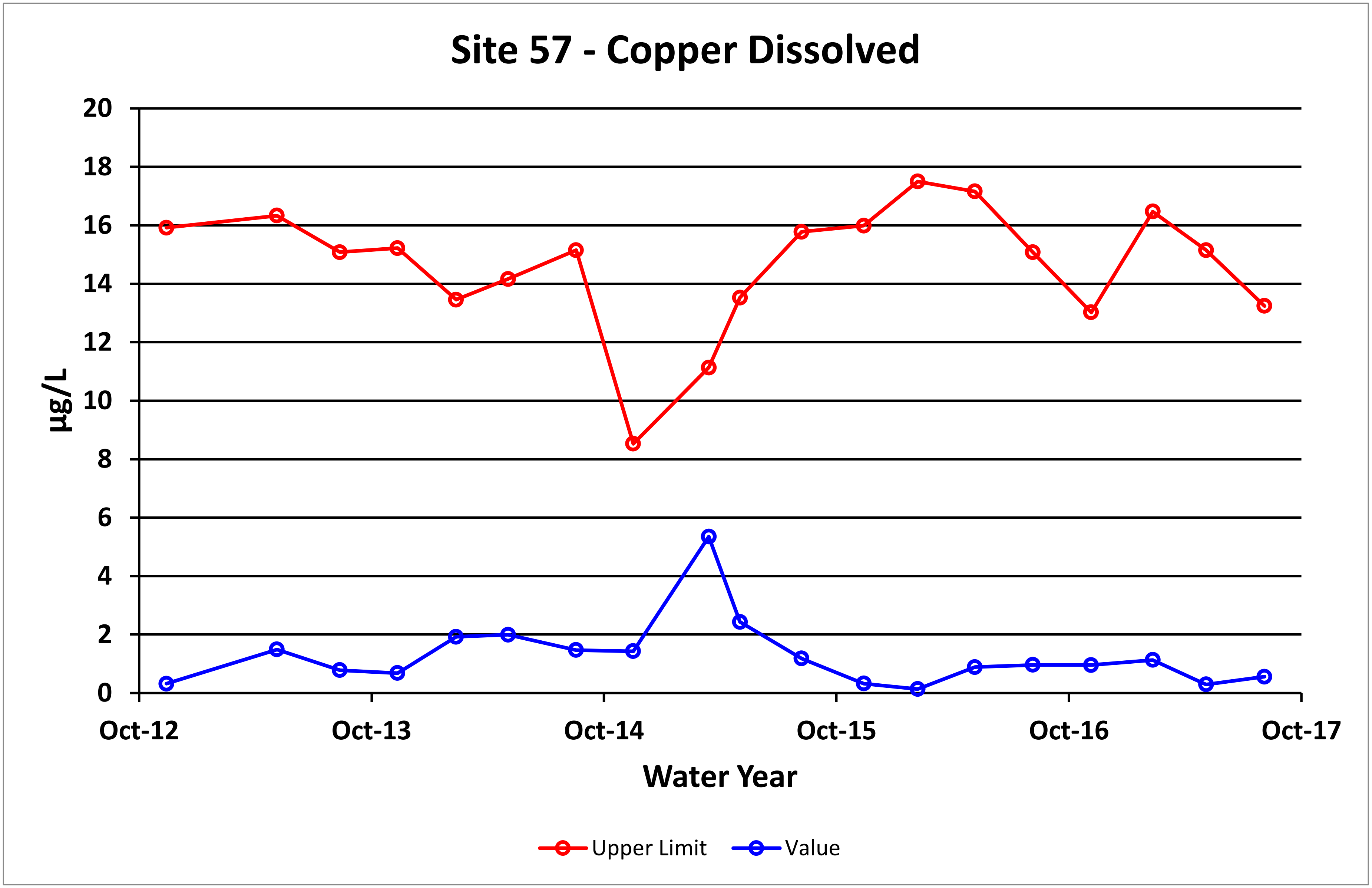


Site 57 - Barium Dissolved
2000
1500
1000
500
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

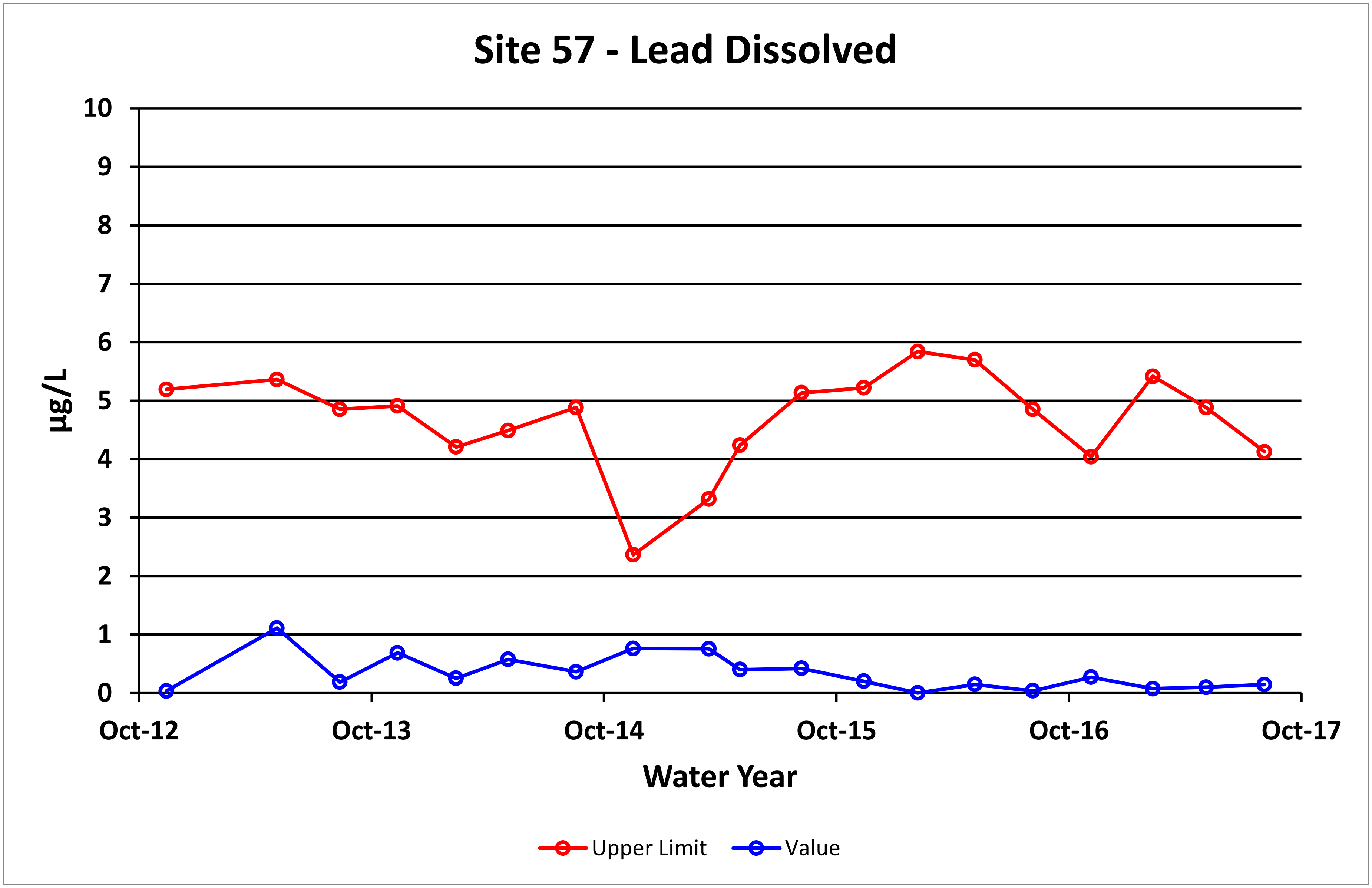

Site 57 - Cadmium Dissolved
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

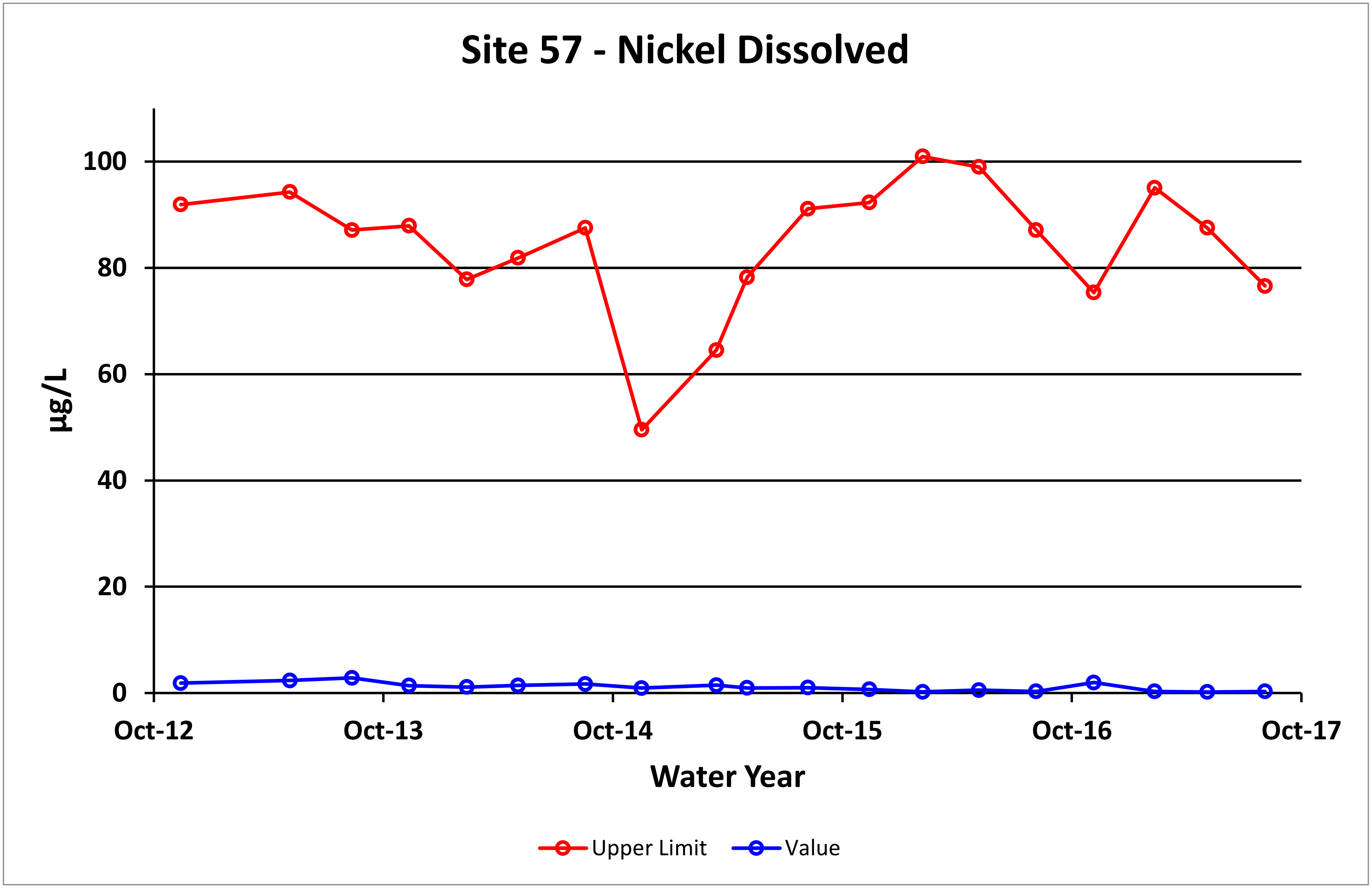


Site 57 - Chromium Dissolved
12
10
8
6
4
2
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

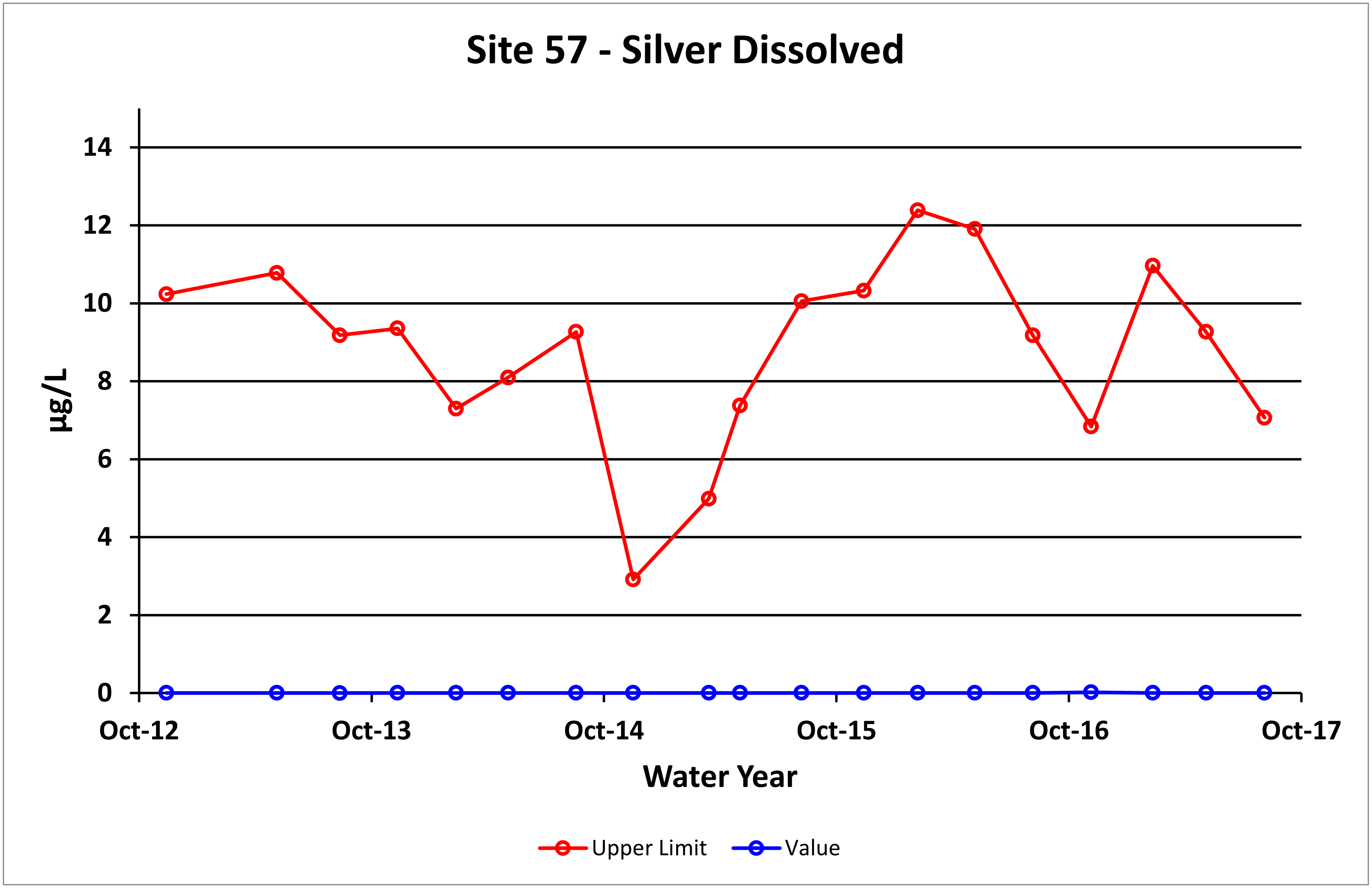


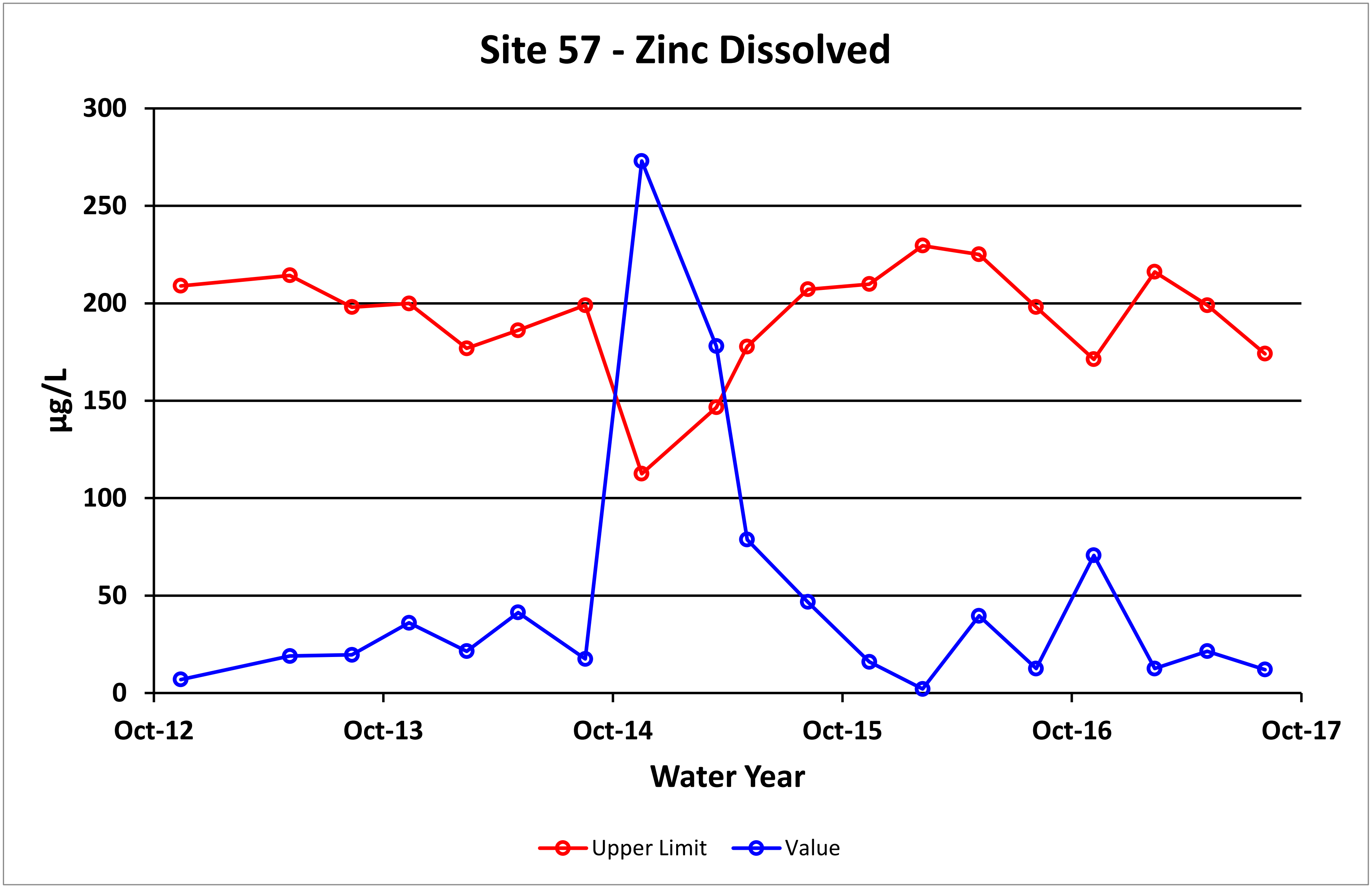
Site 57 - Copper Dissolved
20
18
16
14
12
10
8
6
4
2
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value


Site 57 - Lead Dissolved
10
9
8
7
6
5
4
3
2
1
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

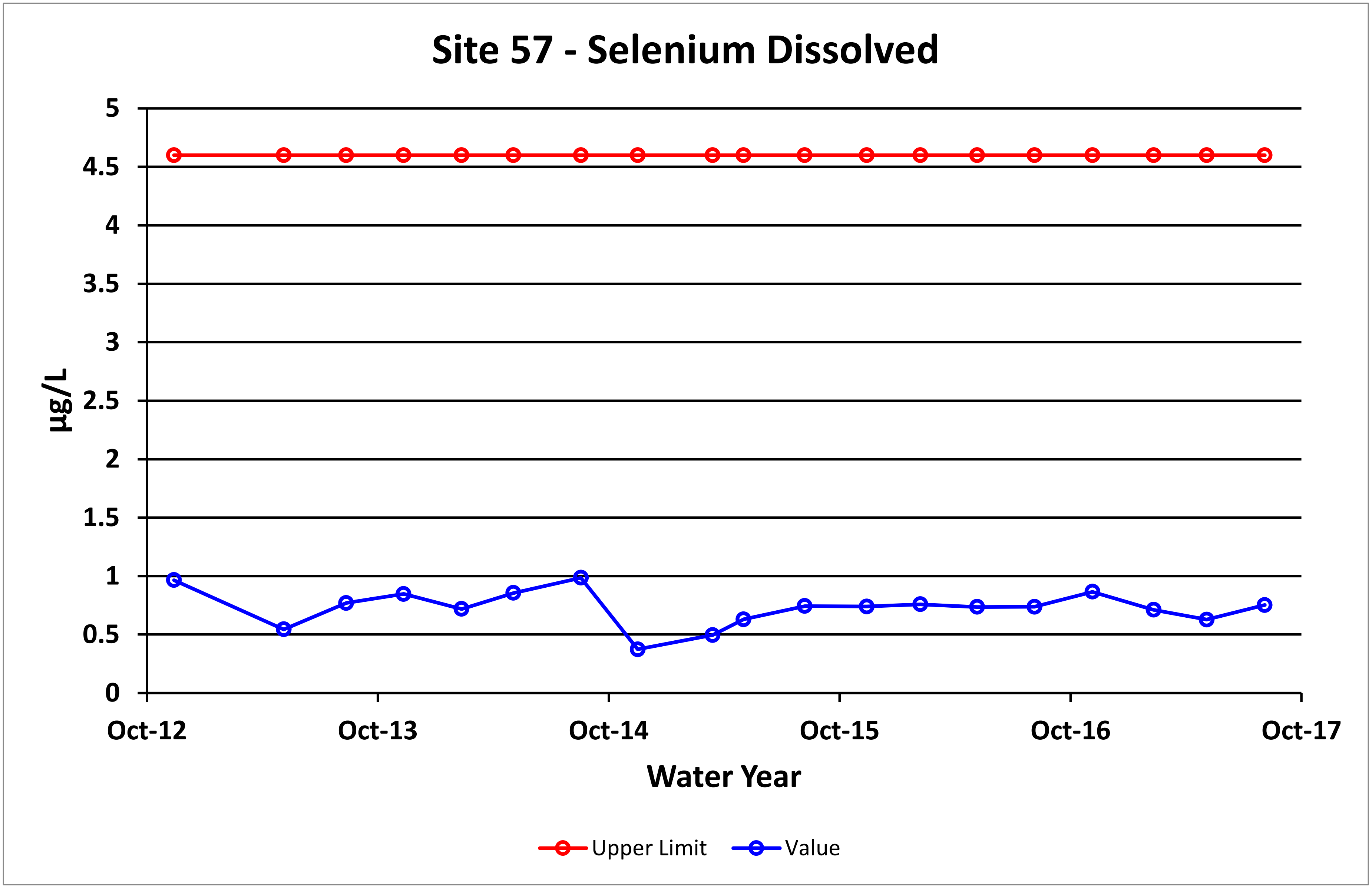


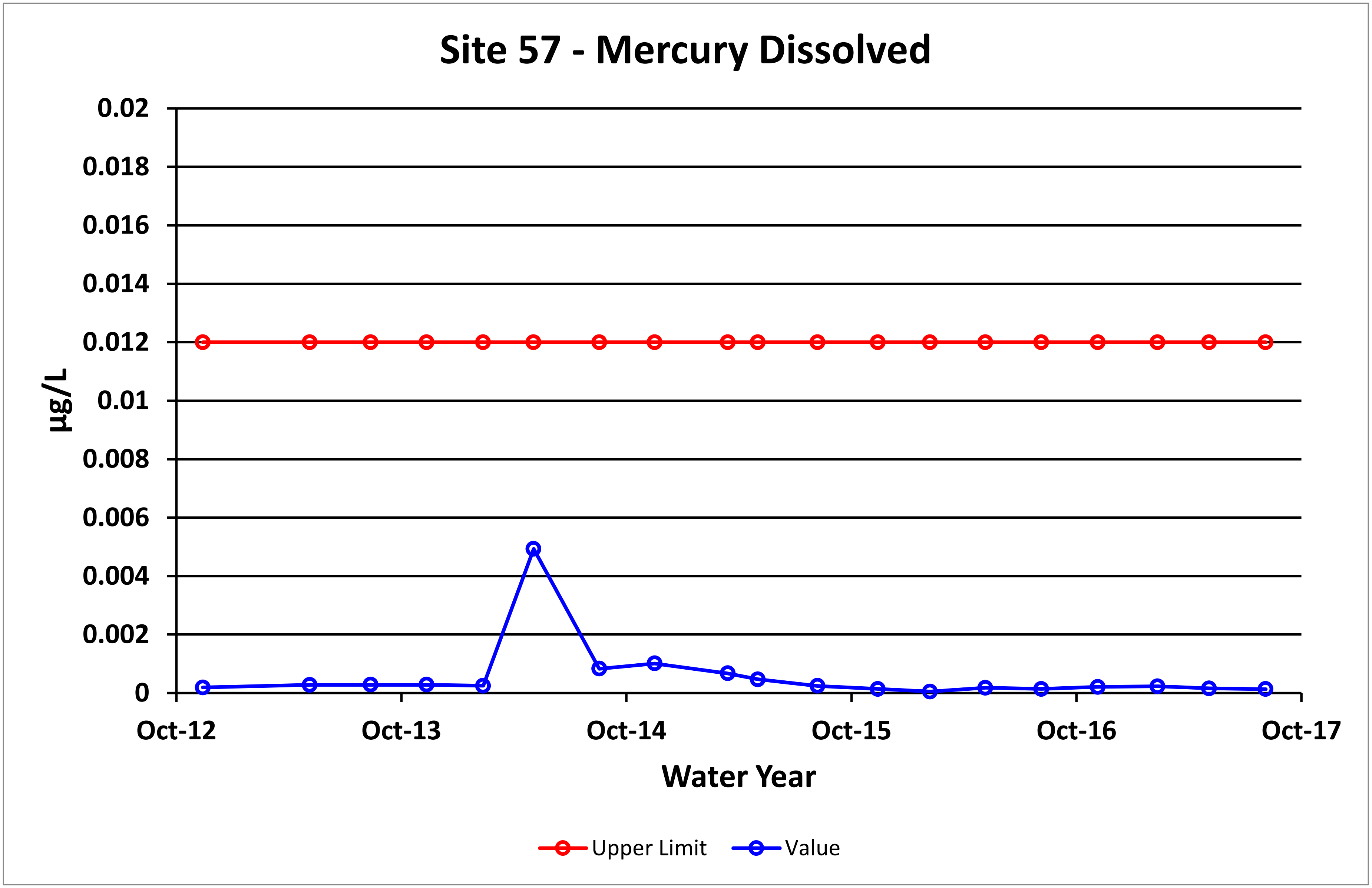
Site 57 - Nickel Dissolved
µg/L
100
80
60
40
20
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value


Site 57 - Silver Dissolved
µg/L
14
12
10
8
6
4
2
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value



Site 57 - Zinc Dissolved
µg/L
300
250
200
150
100
50
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value


Site 57 - Selenium Dissolved
µg/L
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value



Site 57 - Mercury Dissolved
0.02
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

INTERPRETIVE REPORT
SITE 13

The data collected during the current water year are listed in the following "Table of Results for Water Year 2017" report. The table includes all the required FWMP analyte data (field and laboratory) collected for the current water year and a series of flags keyed to the summary report "Qualified Data by QA Reviewer". The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of ½ MDL for the purpose of median calculation.

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

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

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

Table of Exceedance for Water Year 2017

			Limits		
Sample Date	**Parameter**	**Value**	**Lower**	**Upper**	**Hardness**
8-Nov-16	Cd	0.26 µg/L		0.20	71.6 mg/L
8-Nov-16	Zn	120 µg/L		89	71.6 mg/L
12-Jun-17	Cd	1.25 µg/L		0.28	118 mg/L
12-Jun-17	Zn	702 µg/L		136	118 mg/L
8-Aug-17	Cd	0.76 µg/L		0.24	94 mg/L
8-Aug-17	Zn	389 µg/L		112	94 mg/L

The spring sample was taken in June instead of May due to limited site access. 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. During 2012 no material was removed, a limited amount was removed in 2013, HGCMC removed most of the remaining material in 2014, a small amount of material was removed in 2015. Only the material in the road access was left and it will be removed during final reclamation.

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

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-11 and Sep-17 (WY2012-WY2017). 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 (-91.7 µS/cm/yr.) trend for field conductivity and a -41.1 mg/l decreasing trend for sulfate 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 Summary Statistics for Trend Analysis

	Mann-Kendall test statistics			Sen's slope estimate	
Parameter	**n***	**p****	**Trend**	**Q**	**Q(%)**
Conductivity Field	6	<0.01	-	-91.7	-23.9
pH Field	6	0.32			
Alkalinity, Total	6	0.05			
Sulfate, Total	6	<0.01	-	-41.1	-30.2
Zinc, Dissolved	6	0.95			

* Number of Years ** Significance level

Table of Results for Water Year 2017

Site 013FMS - '1350 East Drainage'

Sample Date/Parameter	Oct 2016	Nov 2016	Dec 2016	Jan 2017	Feb 2017	Mar 2017	Apr 2017	May 2017	Jun 2017	Jul 2017	Aug 2017	Sep 2017	**Median**
Water Temp (°C)		5.4							8.1		11.4		8.1
Conductivity-Field(μmho)		152.3							226.7		210.8		210.8
Conductivity-Lab (μmho)		149							232		203		203
pH Lab (standard units)		7.27							7.43		7.33		7.33
pH Field (standard units)		7.52							7.56		7.65		7.56
Total Alkalinity (mg/L)		24.8							58.7		69.3		58.7
Total Sulfate (mg/L)		41.3							58.5		34.3		41.3
Hardness (mg/L)		71.6							118		94		94.0
Dissolved As (ug/L)		0.112							0.192		0.197		0.192
Dissolved Ba (ug/L)		8.9							9.1		7.7		8.9
Dissolved Cd (ug/L)		0.3							1.3		0.8		0.8
Dissolved Cr (ug/L)		0.098							0.093		0.106		0.098
Dissolved Cu (ug/L)		0.86							0.96		0.89		0.89
Dissolved Pb (ug/L)		0.03							0.013		0.014		0.014
Dissolved Ni (ug/L)		0.9							2.2		1.5		1.5
Dissolved Ag (ug/L)		0.002							0.002		0.004		0.002
Dissolved Zn (ug/L)		120							702		389		389
Dissolved Se (ug/L)		0.057							0.142		0.135		0.135
Dissolved Hg (ug/L)		0.00158							0.000957		0.00109		0.001090

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

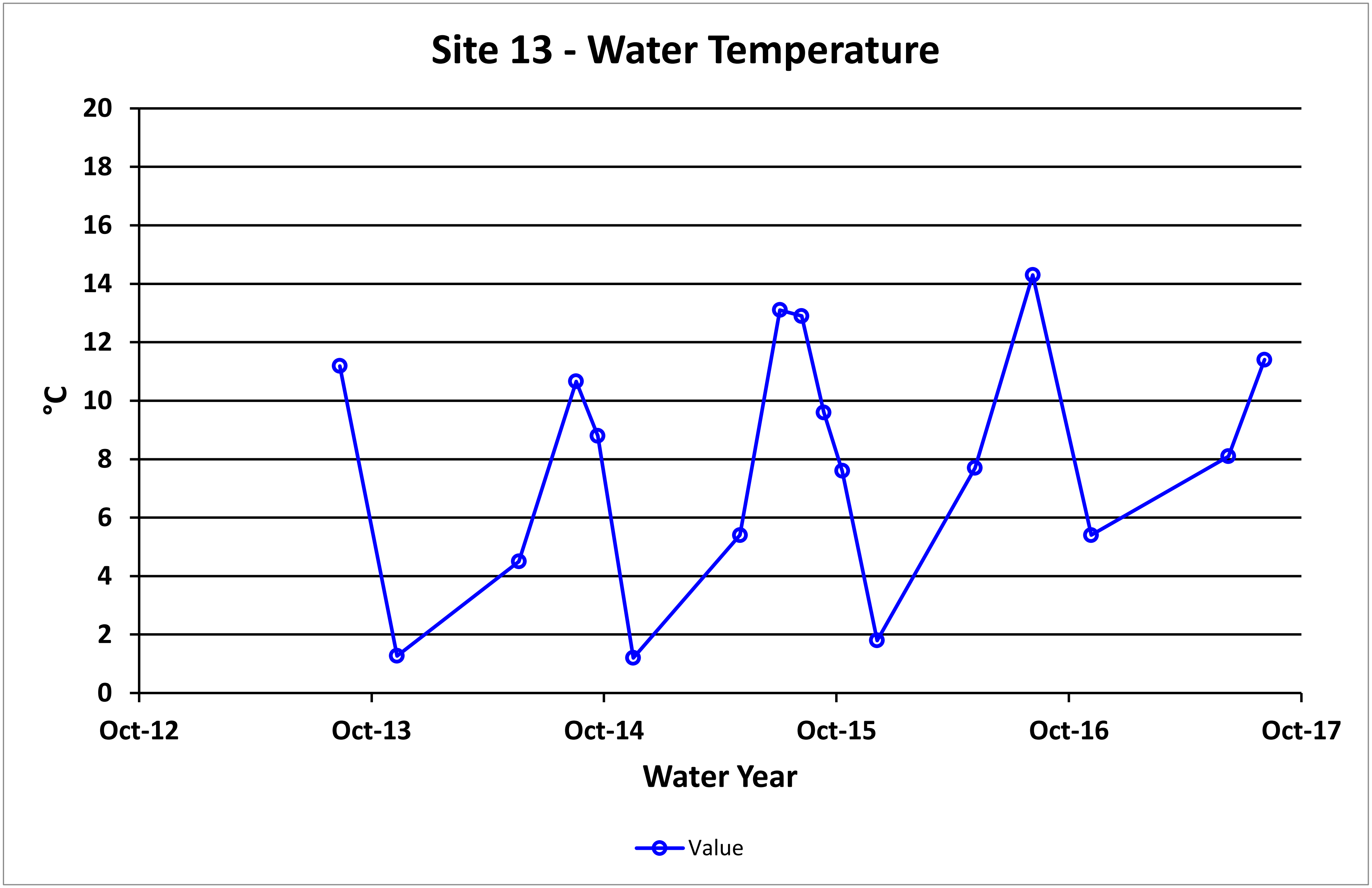
Values reported as less than MDL are replaced by 1/2 MDL for median calculation purposes.

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

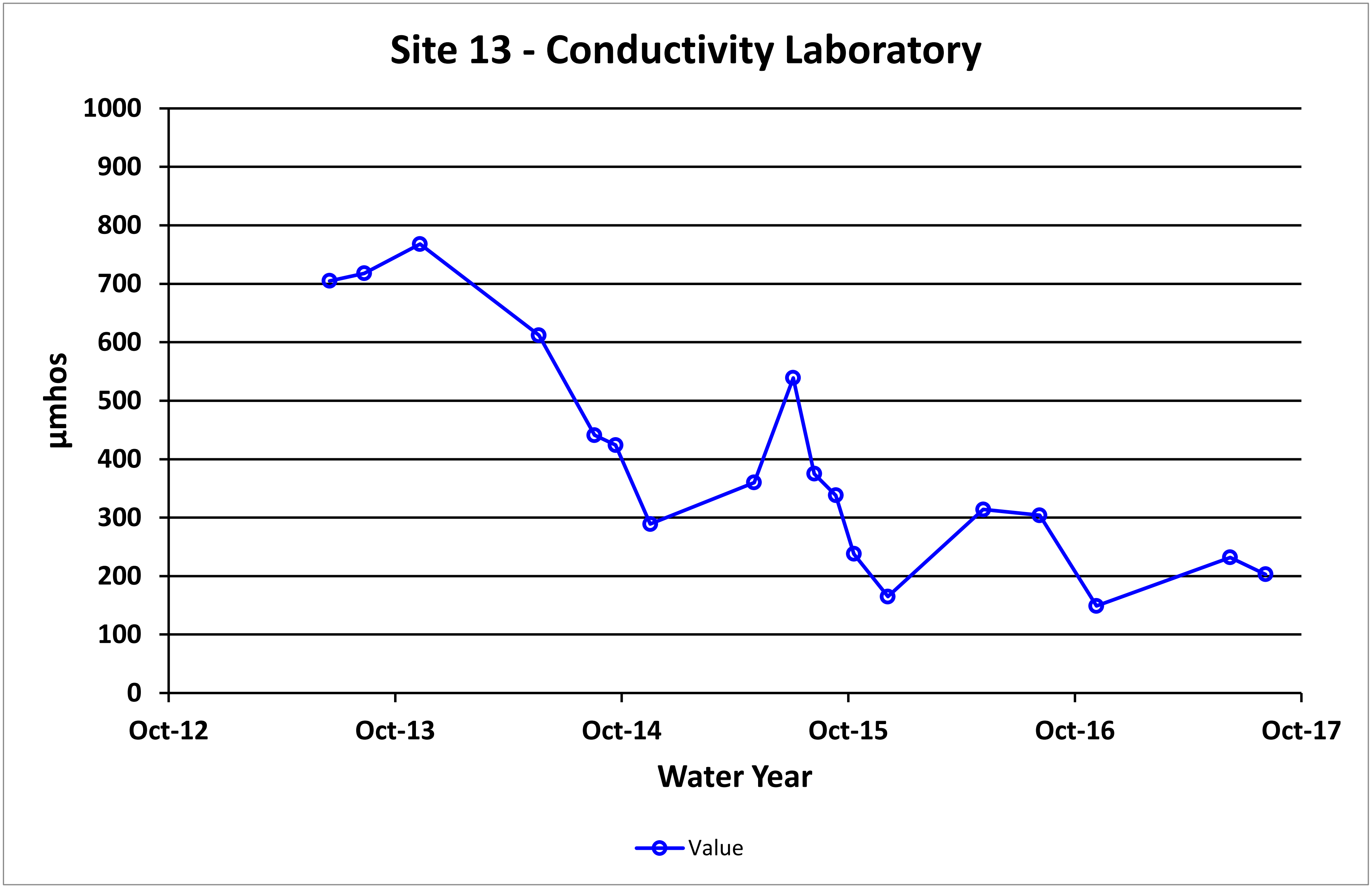
Qualified Data by QA Reviewer

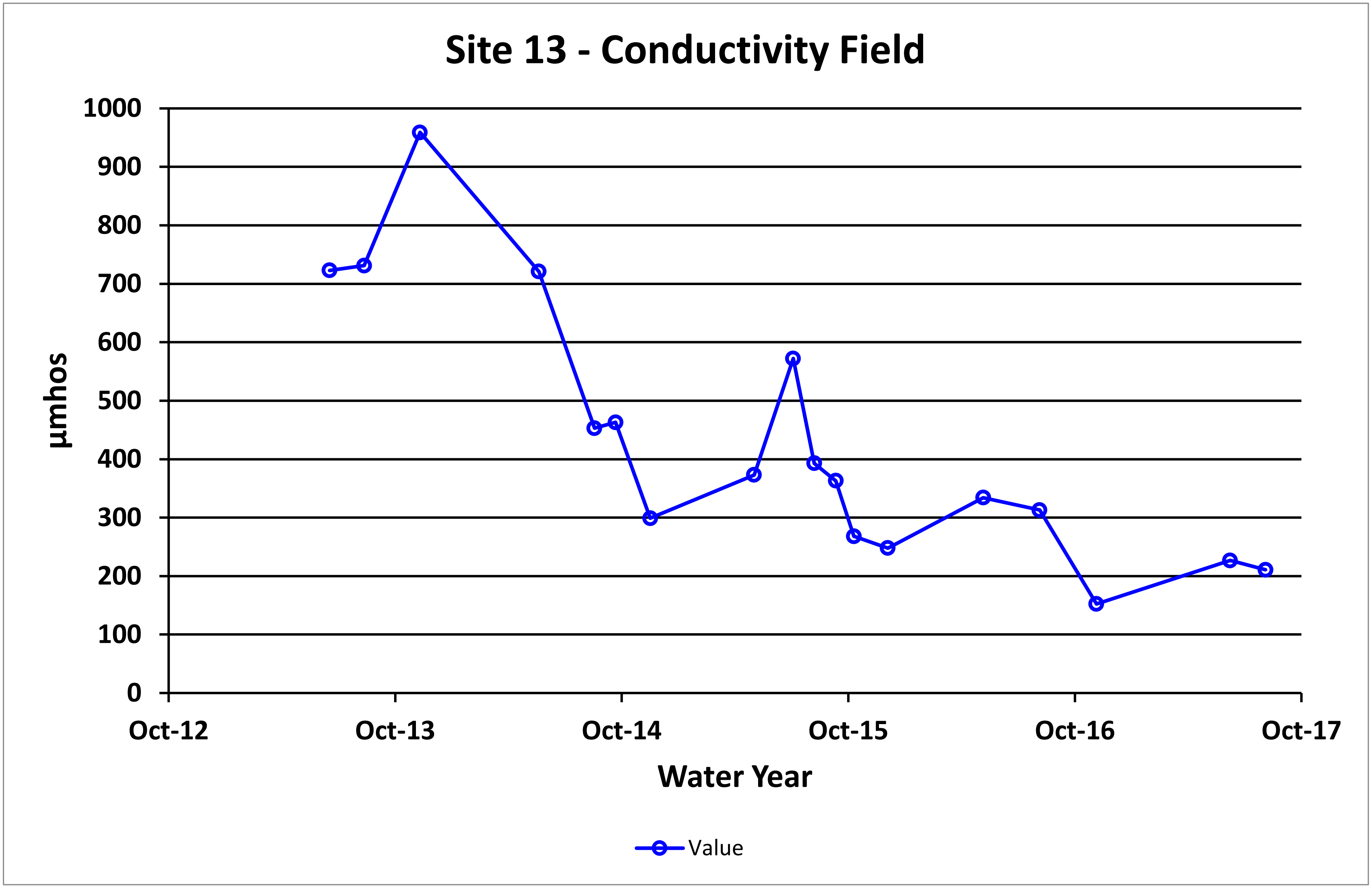
Date Range: 10/01/2016 to 09/30/2017

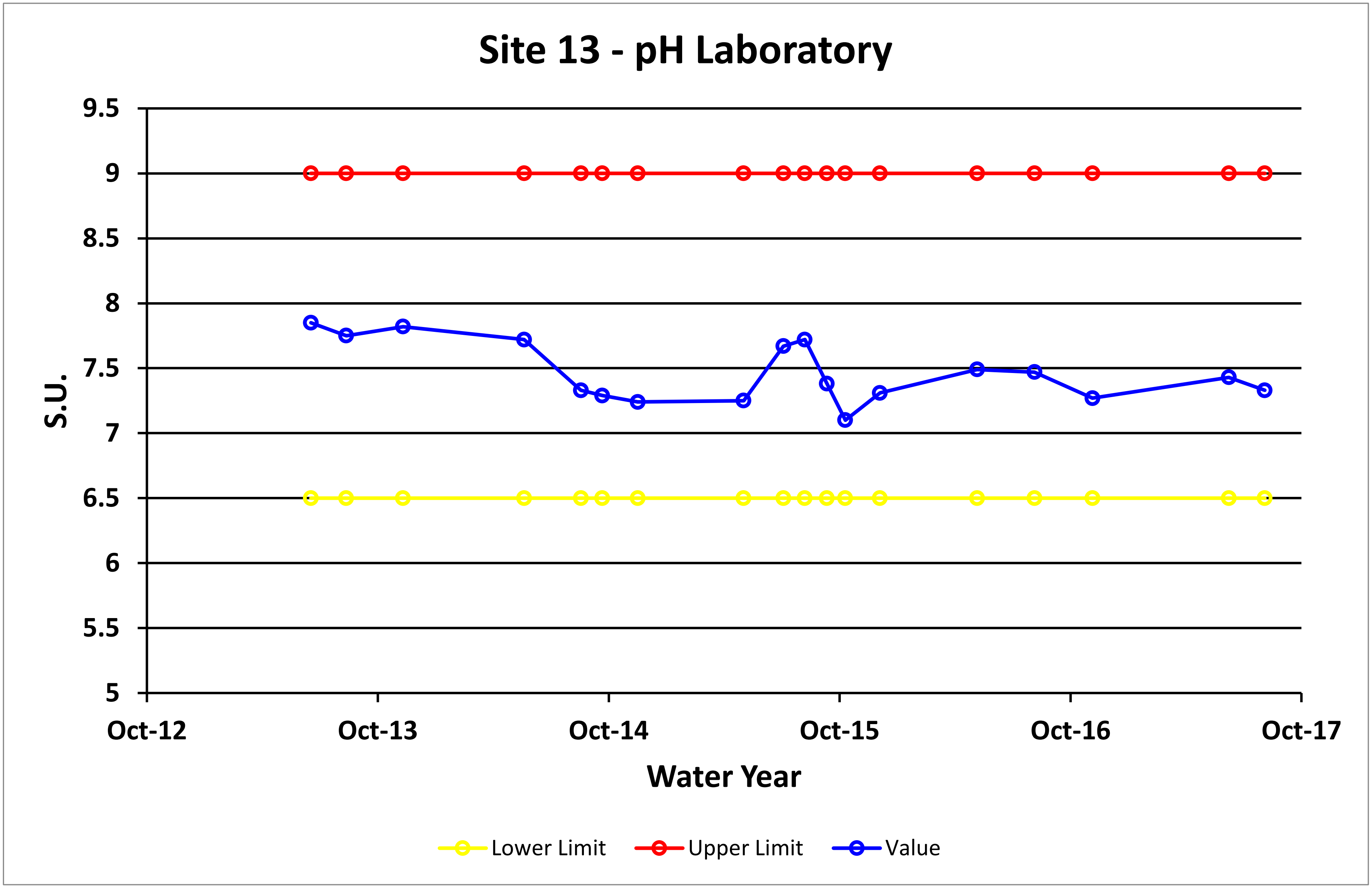
Site No.	Sample Date	Sample Time	Parameter	Value		Qualifier	Reason for Qualifier
013FMS	6/12/2017	12:00 PM	Diss. Cr-ICP/MS	0.09	µg/L	U	Field Blank Contamination
			Diss. Ni-ICP/MS	2.17	µg/L	U	Field Blank Contamination
			Diss. Pb-ICP/MS	0.01	µg/L	U	Field Blank Contamination
			Diss. Se-ICP/MS	0.14	µg/L	J	Below Quantitative Range
			Tot. Sulfate	58.5	mg/L	J	Hold Time Violatoin, Sample Receipt Temperature
	8/8/2017	12:00 PM	Diss. Ag-ICP/MS	0.0035	µg/L	J	Below Quantitative Range
			Diss. Cr-ICP/MS	0.1	µg/L	J	Below Quantitative Range
			Diss. Se-ICP/MS	0.13	µg/L	J	Below Quantitative Range
			Tot. Sulfate	34.3	mg/L	J	Sample Receipt Temperature



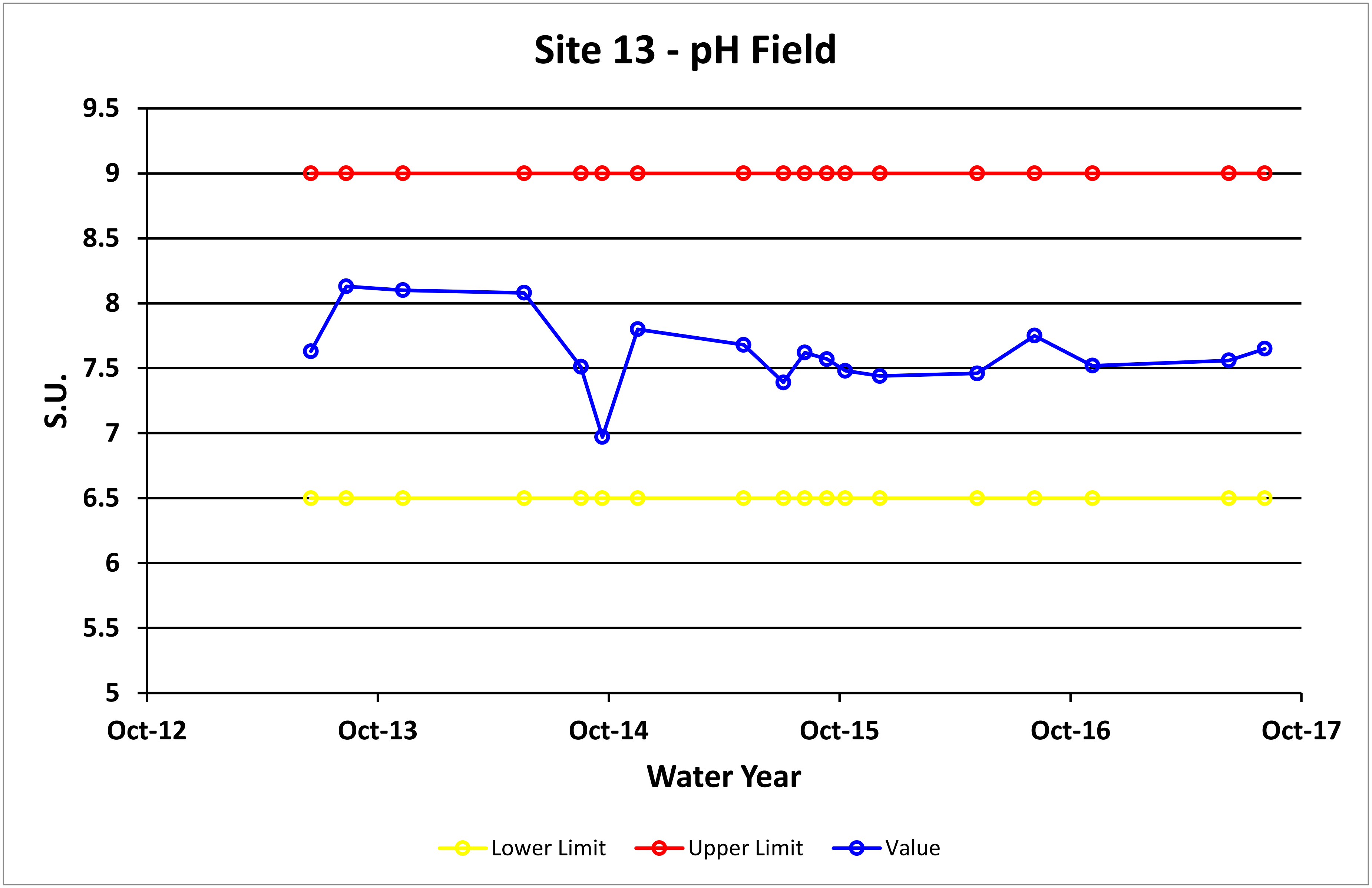
Site 13 - Water Temperature
°C
20
18
16
14
12
10
8
6
4
2
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value


Site 13 - Conductivity Laboratory
1000
900
800
700
600
500
400
300
200
100
0
µmhos
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value

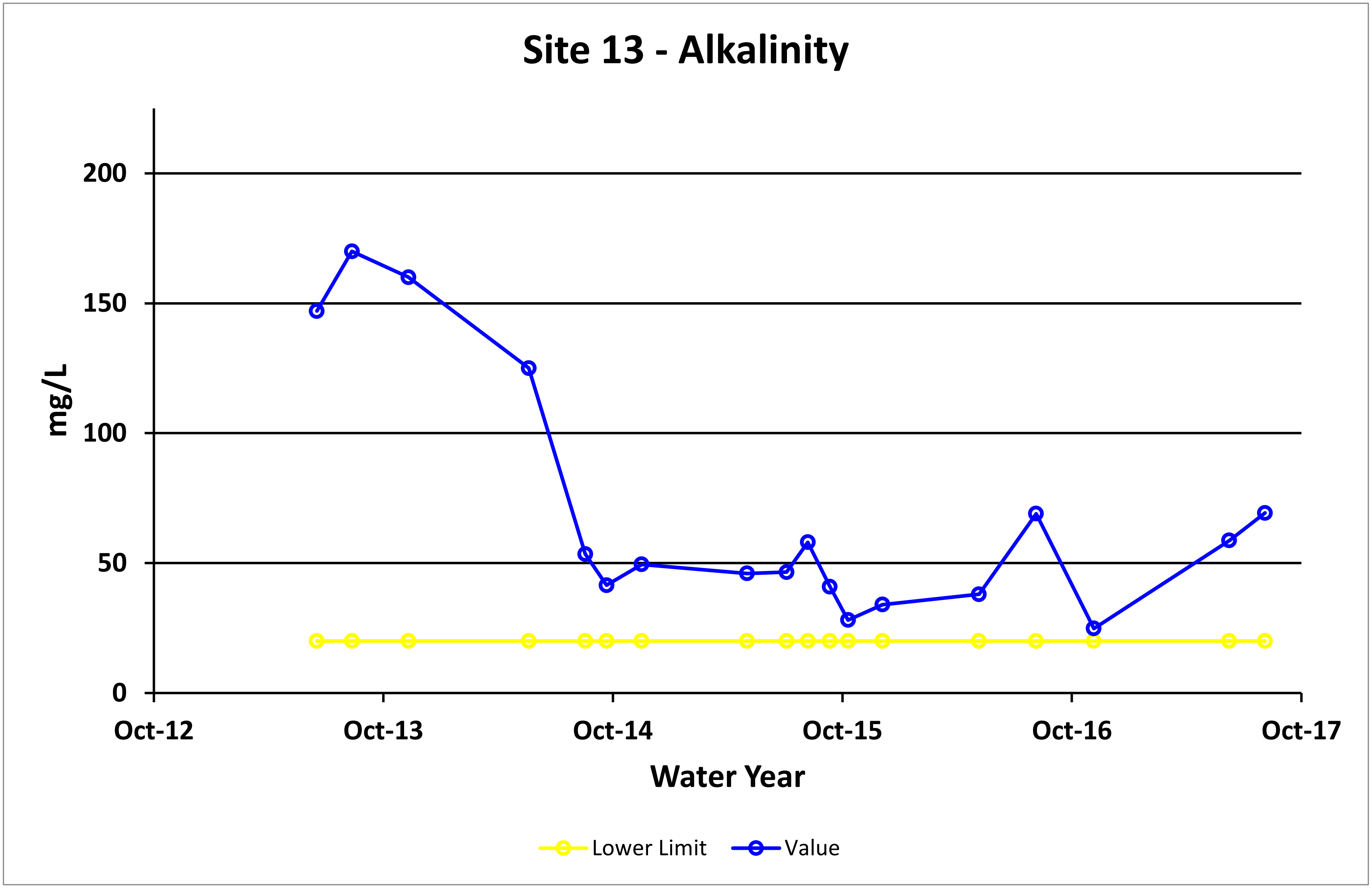

Site 13 - Conductivity Field
1000
900
800
700
600
500
400
300
200
100
0
µmhos
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value

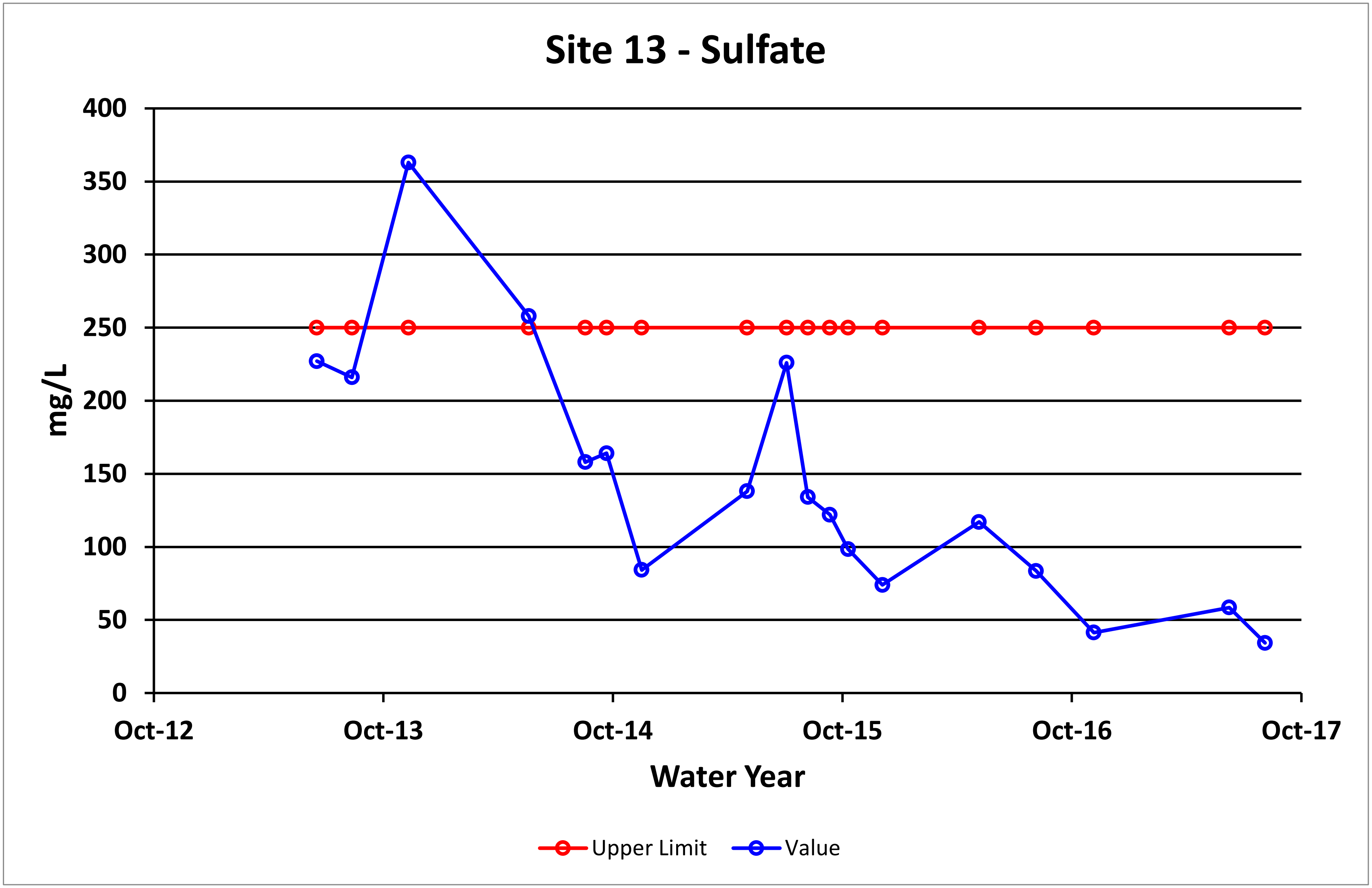


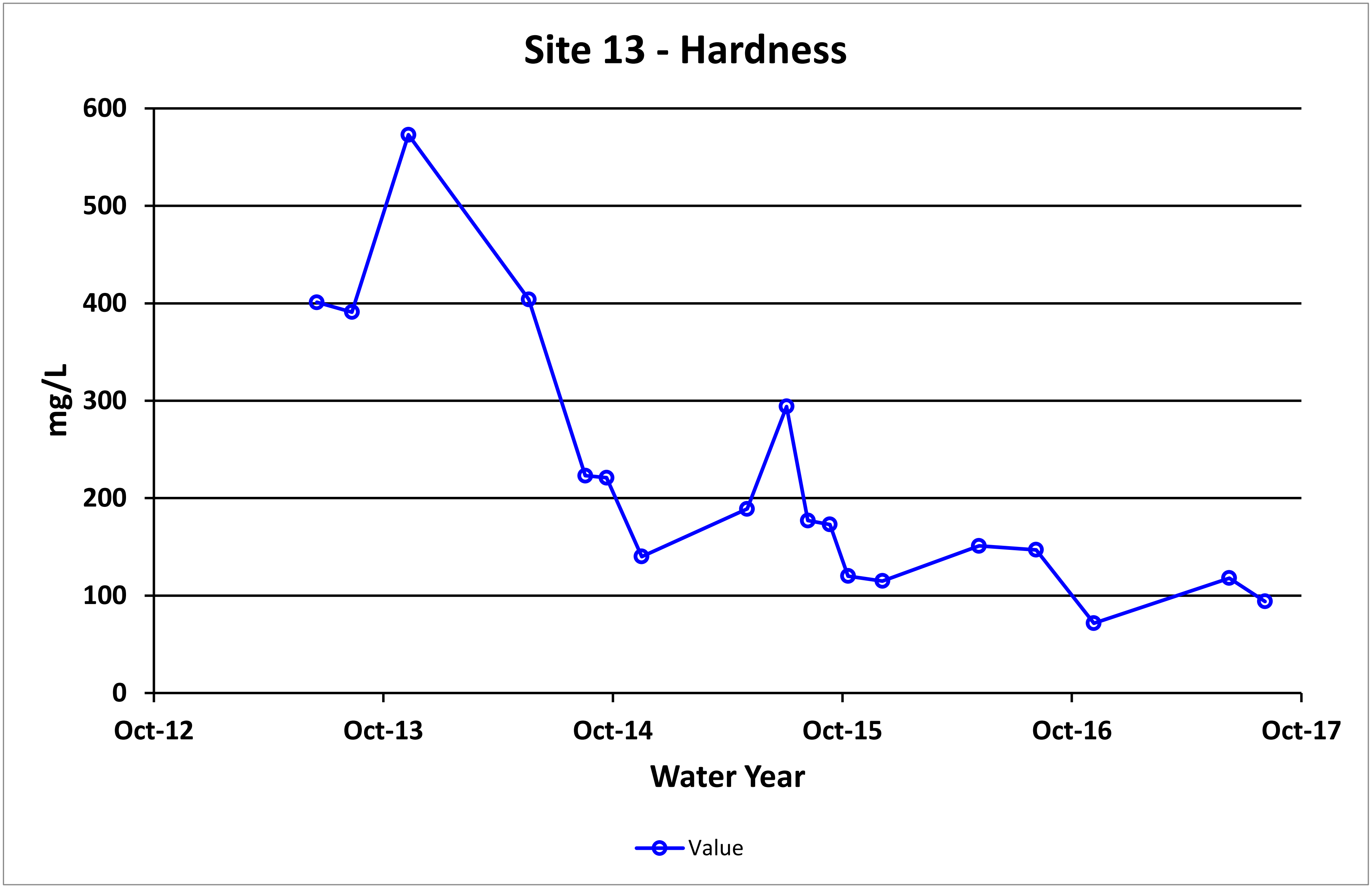
Site 13 - pH Laboratory
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
S.U.
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Lower Limit
Upper Limit
Value

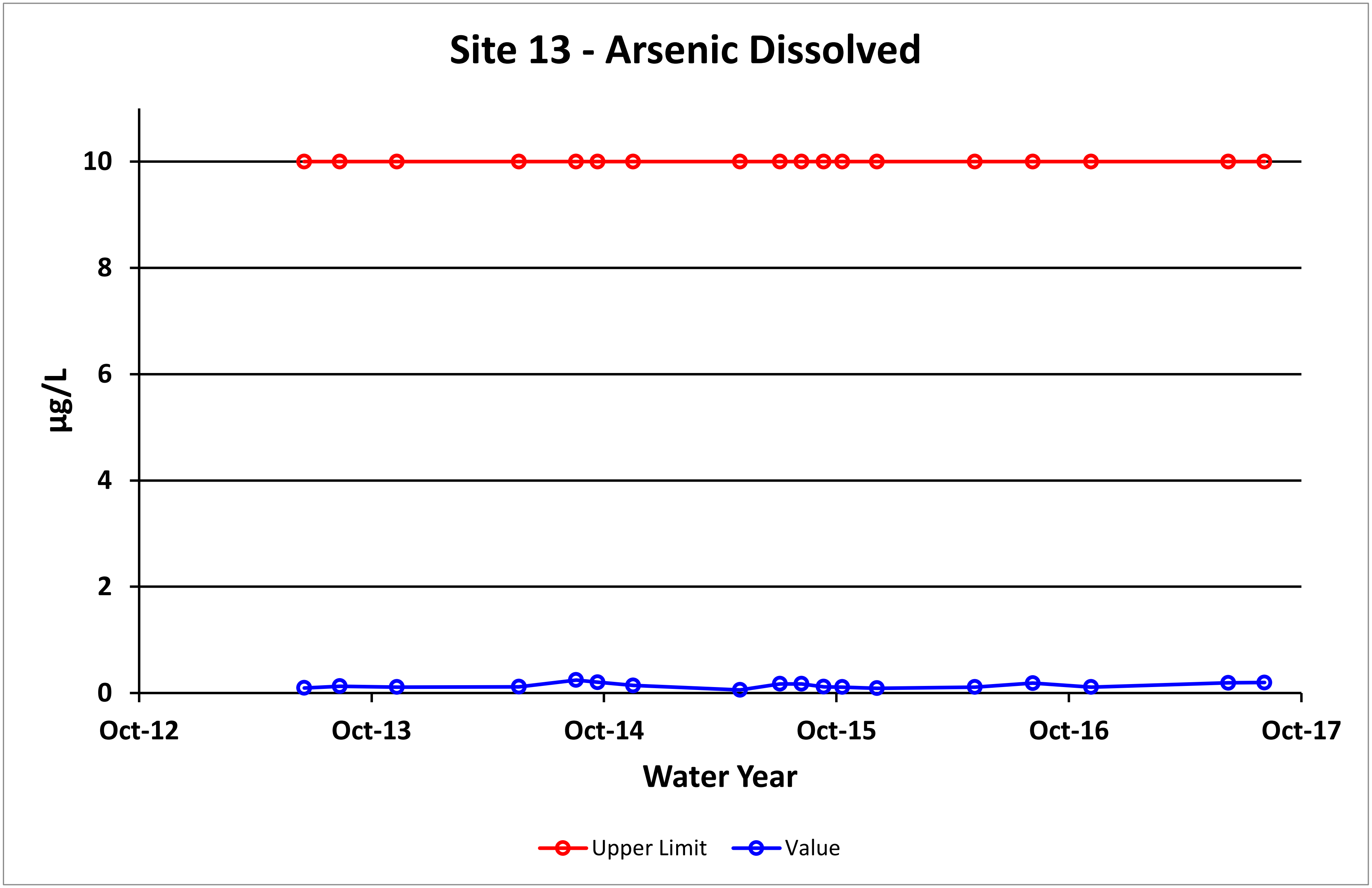


Site 13 - pH Field
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
S.U.
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Lower Limit
Upper Limit
Value

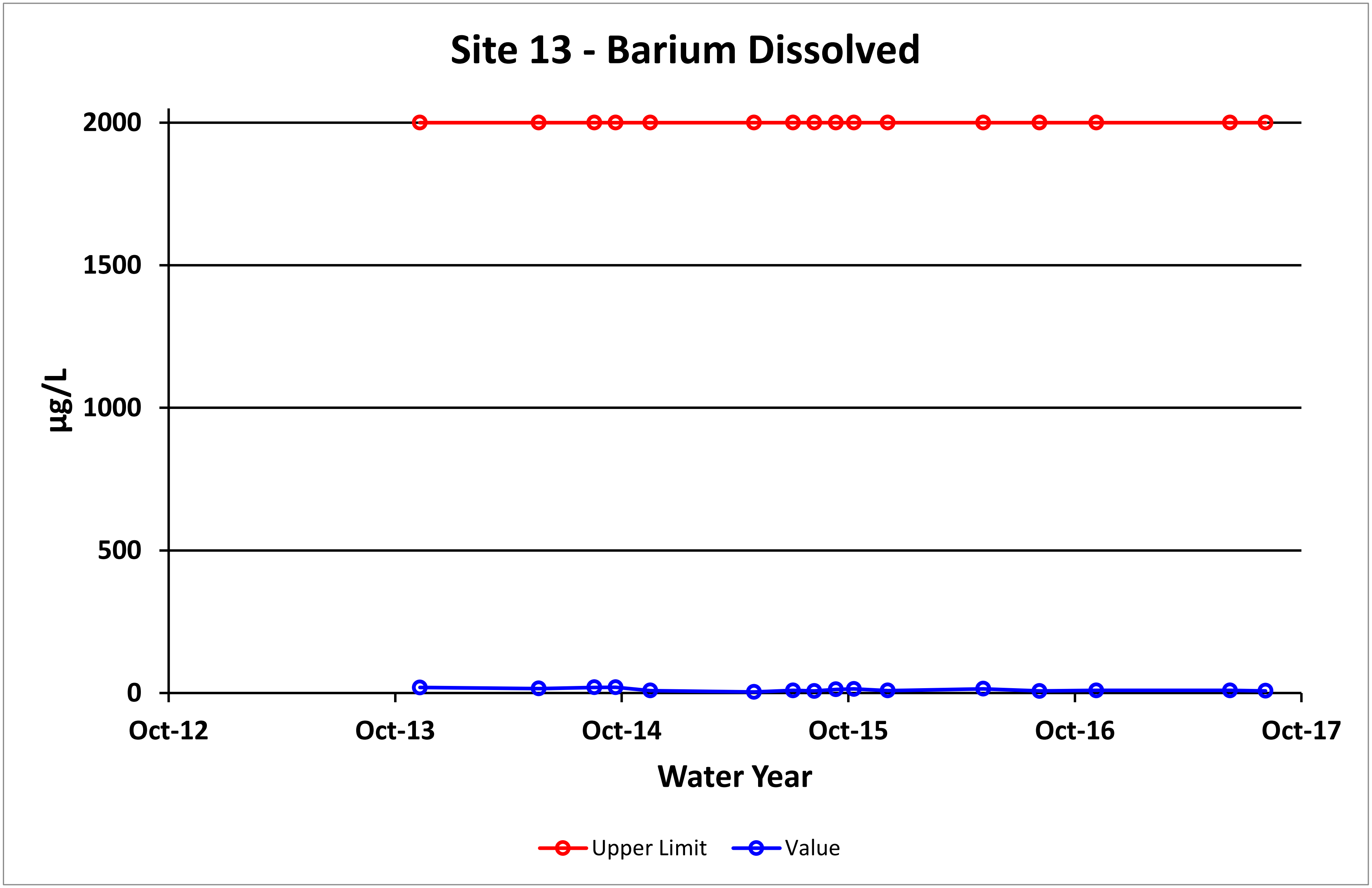

Site 13 - Alkalinity
mg/L
200
150
100
50
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Lower Limit
Value

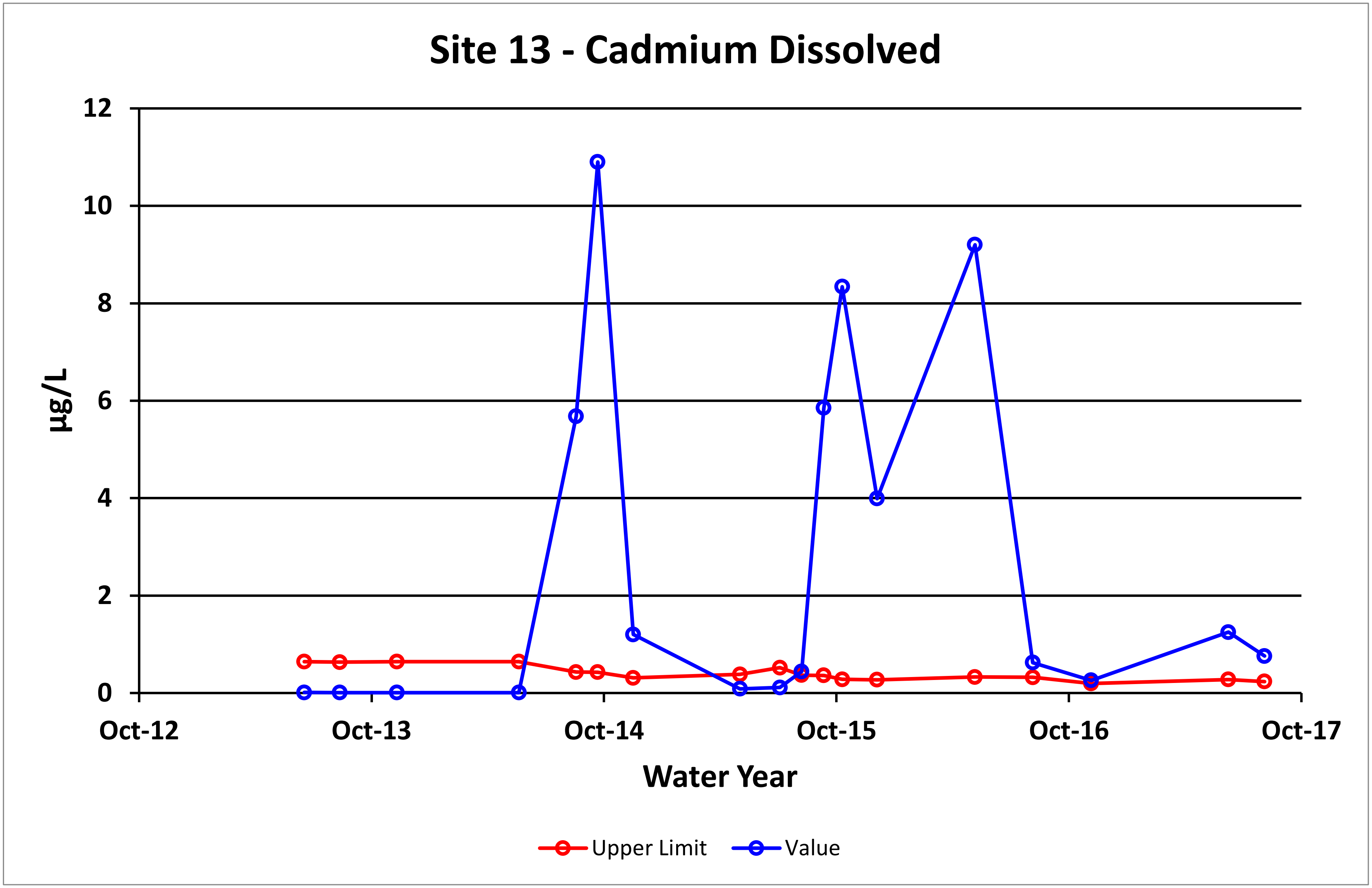

Site 13 - Sulfate
400
350
300
250
200
150
100
50
0
mg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

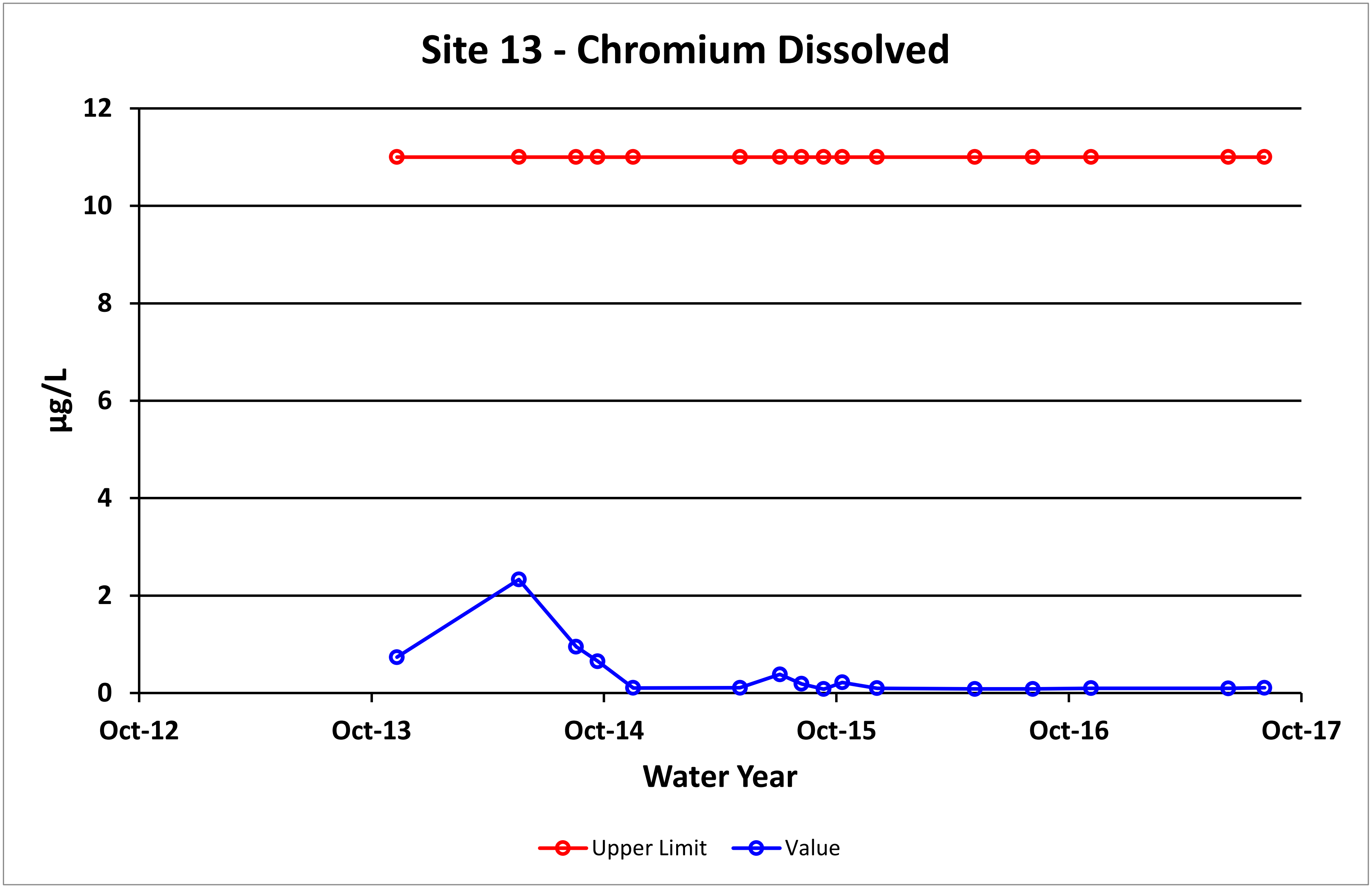

Site 13 - Hardness
mg/L
600
500
400
300
200
100
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value

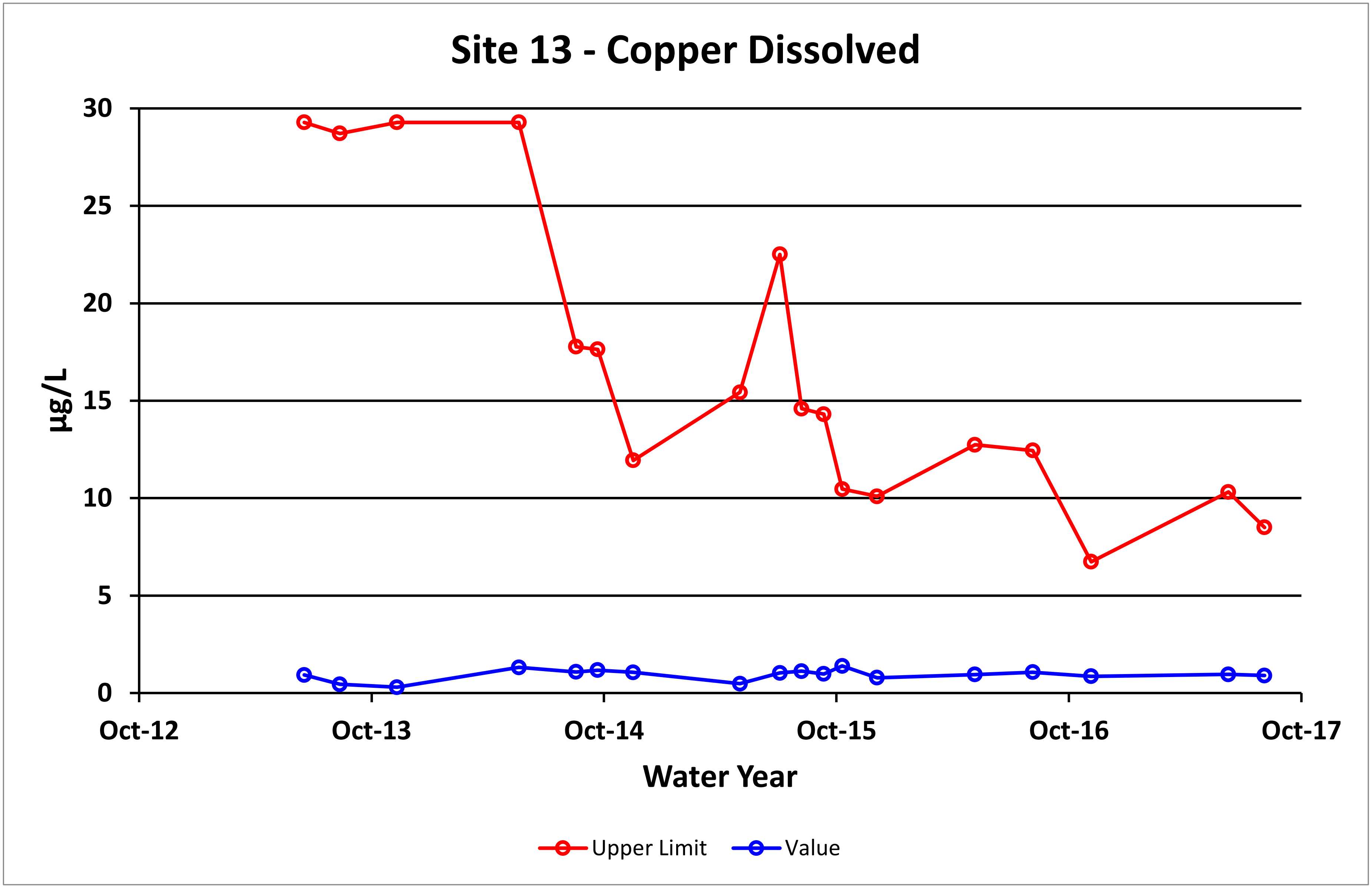


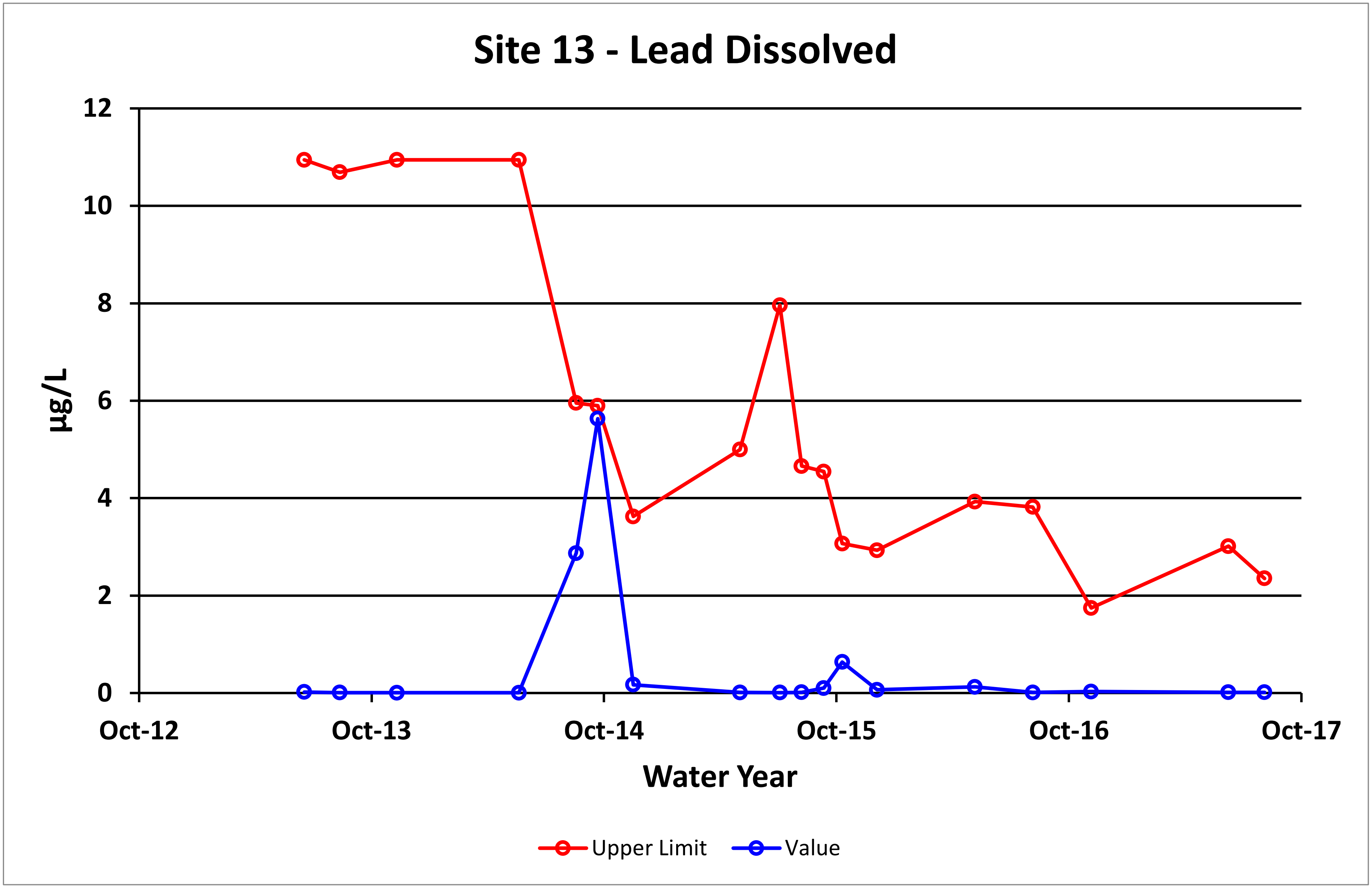
Site 13 - Arsenic Dissolved
µg/L
10
8
6
4
2
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value


Site 13 - Barium Dissolved
µg/L
2000
1500
1000
500
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

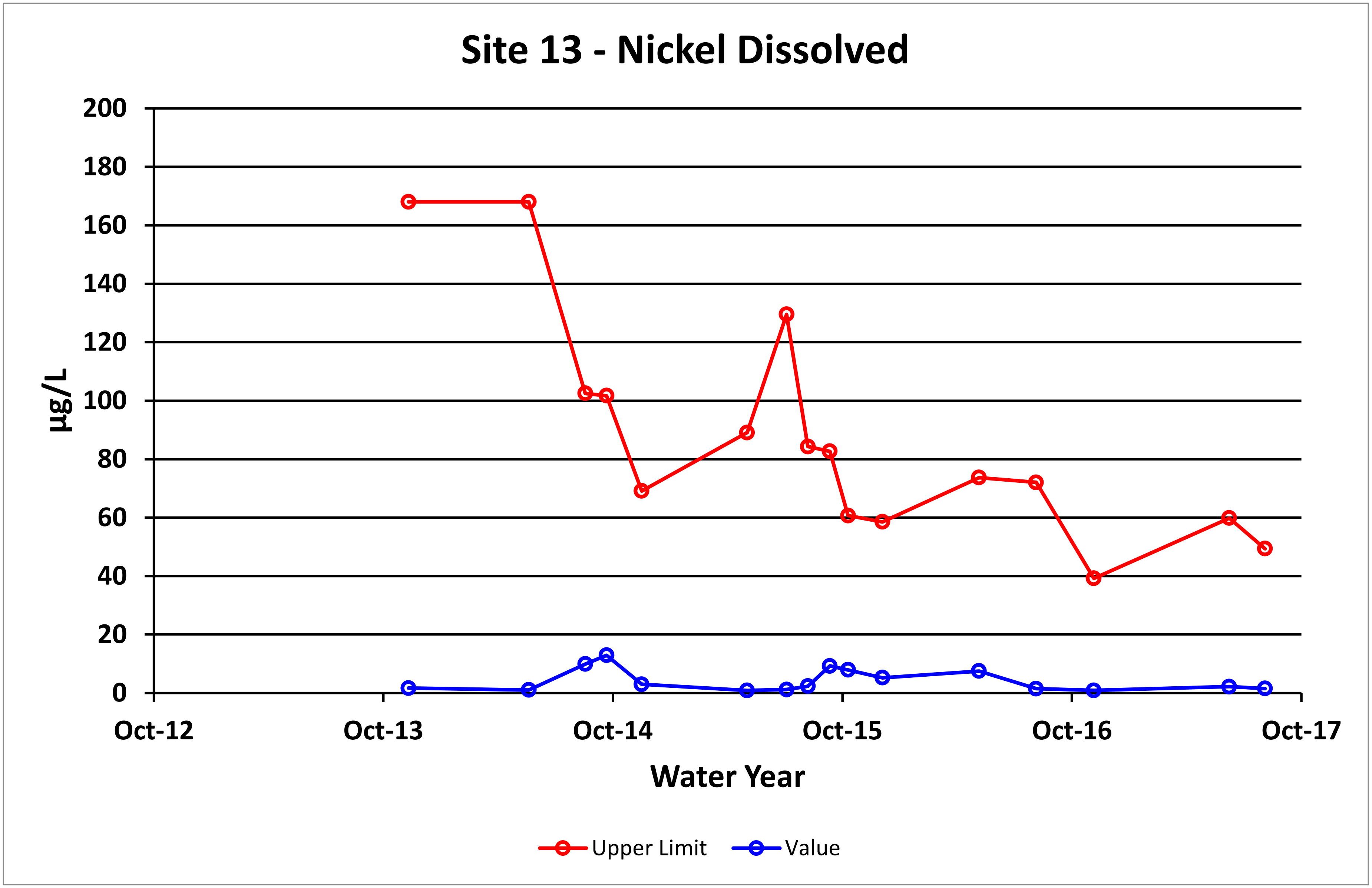

Site 13 - Cadmium Dissolved
12
10
8
6
4
2
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value


Site 13 - Chromium Dissolved
12
10
8
6
4
2
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

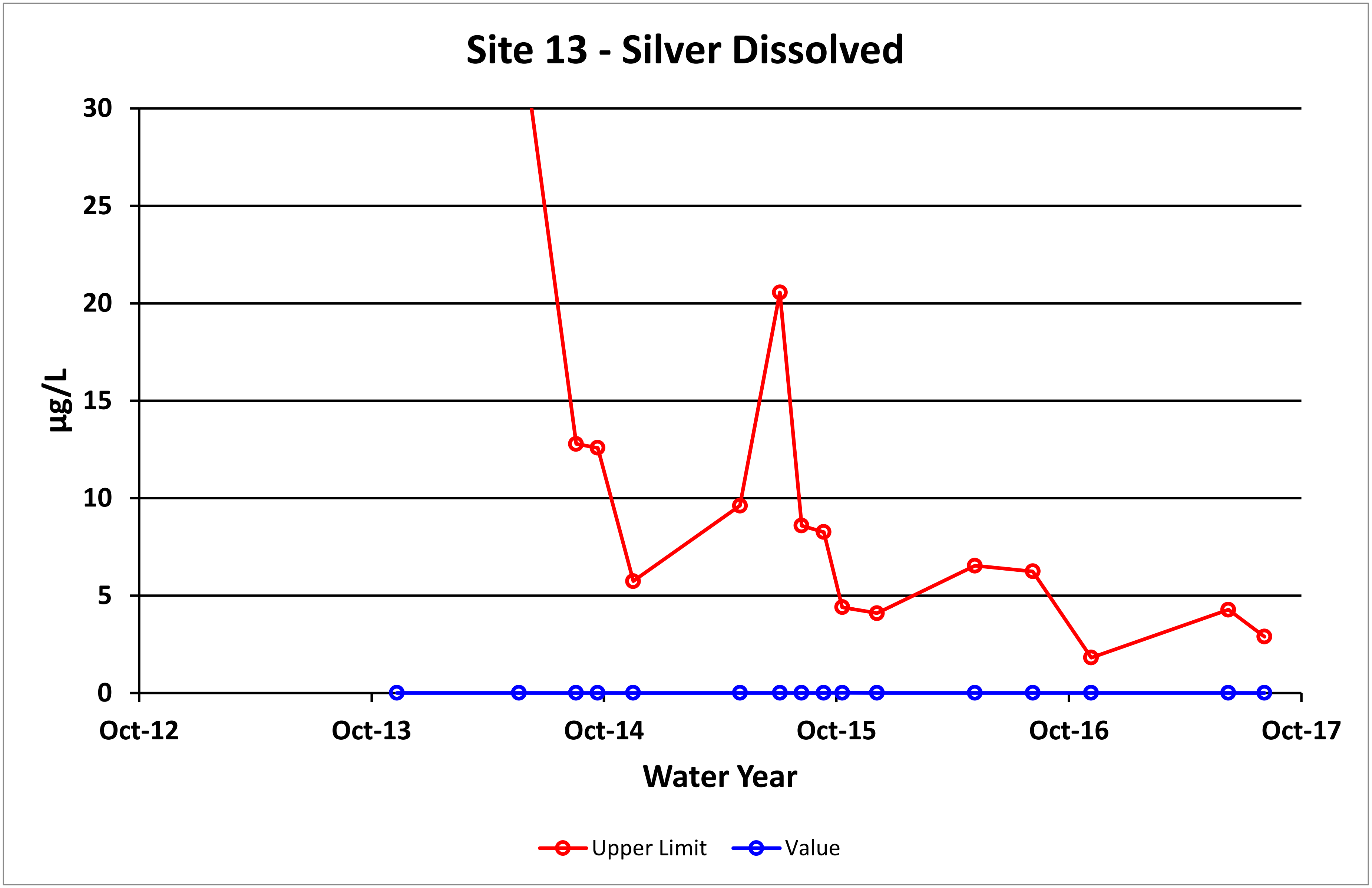

Site 13 - Copper Dissolved
µg/L
30
25
20
15
10
5
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

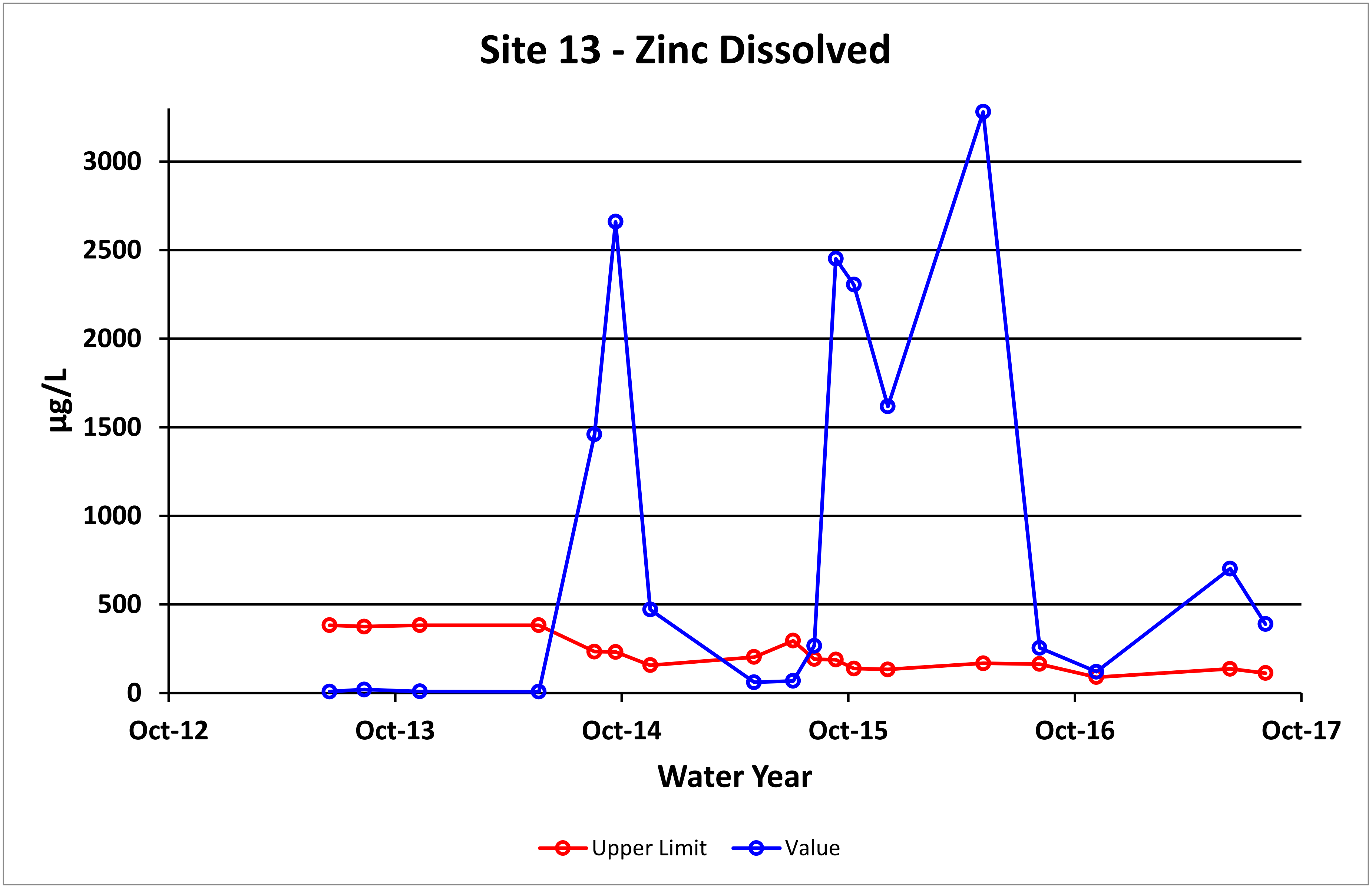


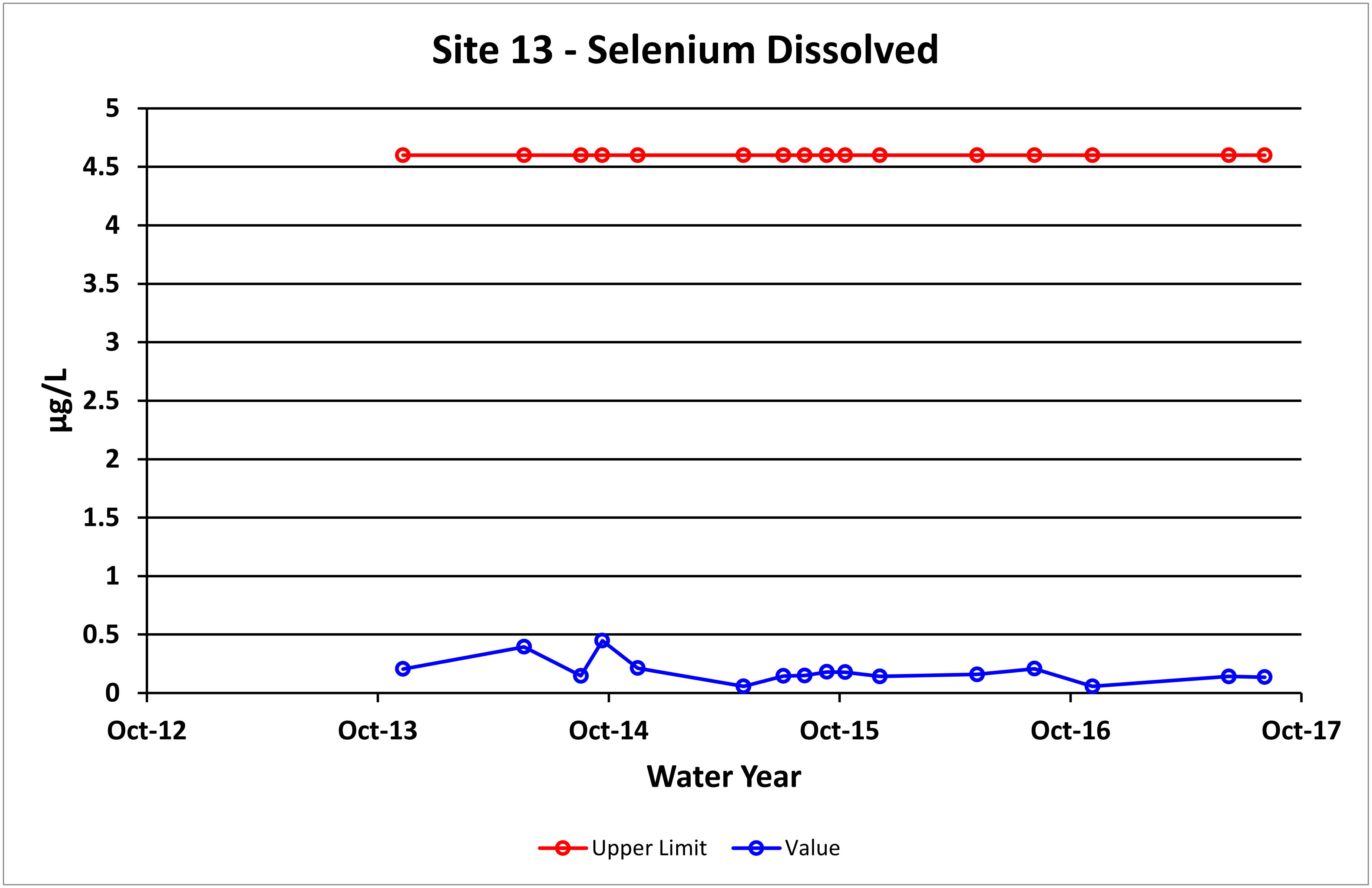
Site 13 - Lead Dissolved
µg/L
12
10
8
6
4
2
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value



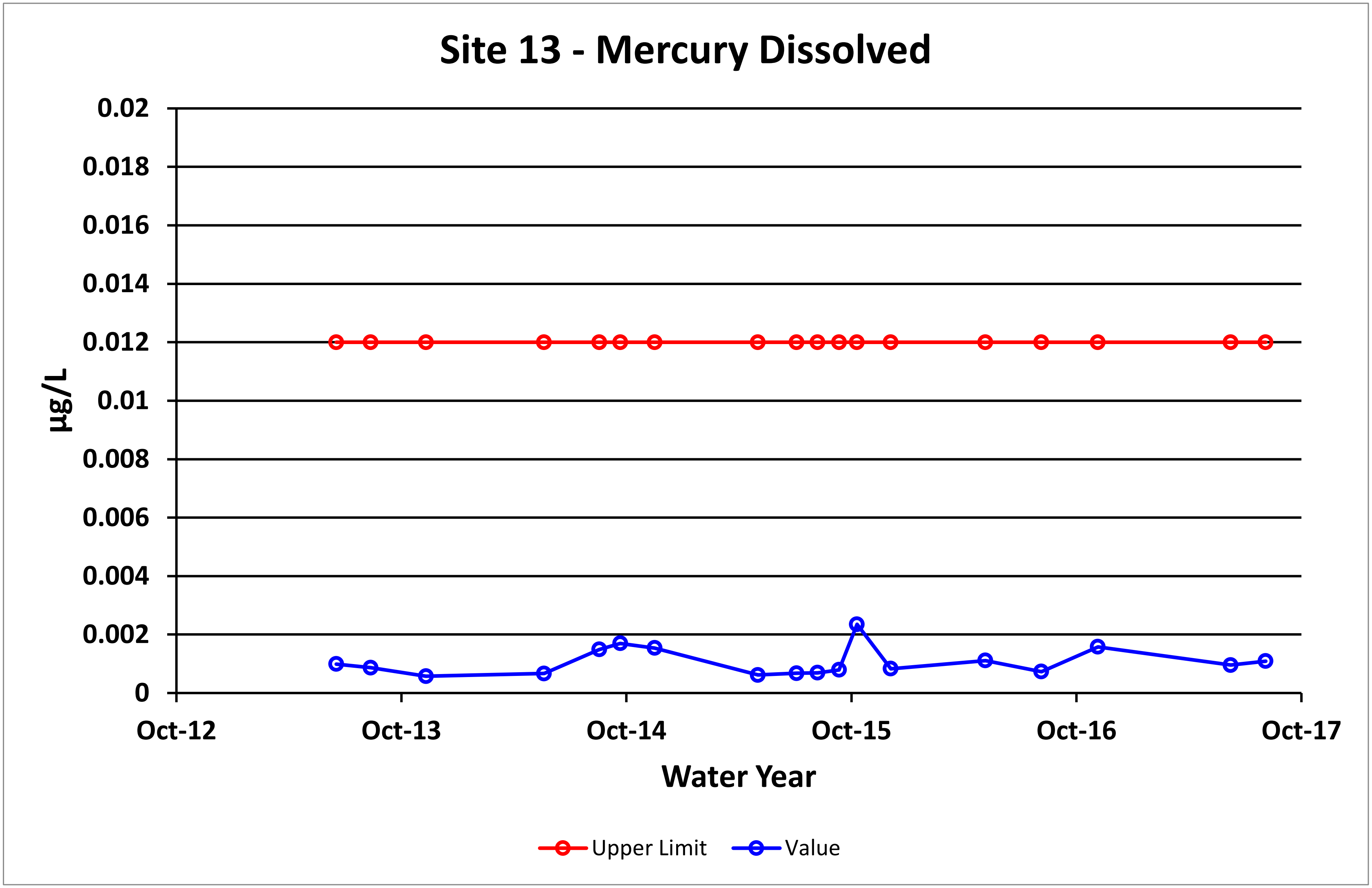
Site 13 - Nickel Dissolved
µg/L
200
180
160
140
120
100
80
60
40
20
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value


Site 13 - Silver Dissolved
µg/L
30
25
20
15
10
5
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value


Site 13 - Zinc Dissolved
µg/L
3000
2500
2000
1500
1000
500
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value



Site 13 - Selenium Dissolved
µg/L
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value



Site 13 - Mercury Dissolved
0.02
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

INTERPRETIVE REPORT
SITE 27

The data collected during the current water year are listed in the following “Table of Results for Water Year 2017” report. The table includes all the required FWMP analyte data (field and laboratory) collected for the current water year and a series of flags keyed to the summary report “Qualified Data by QA Reviewer”. The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of ½ MDL for the purpose of median calculation.

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

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

The data have been compared to the strictest fresh water quality criterion for each applicable analyte. 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 of the other analytes were within AWQS for the current water year.

Table of Exceedance for Water Year 2017

			Limits		
Sample Date	**Parameter**	**Value**	**Lower**	**Upper**	**Hardness**
7-Nov-16	pHfld	6.43 su	6.5	9	45.8 mg/L
9-May-17	pHfld	6.41 su	6.5	9	40.3 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 1.6 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-11 and Sep-17 (WY2012-WY2017).

Table of Summary Statistics for Trend Analysis

Parameter	Mann-Kendall test statistics n*	p**	Trend	Sen's slope estimate Q	Q(%)
Conductivity Field	6	0.99	+	13.37	10.5
pH Field	6	0.82			
Alkalinity, Total	6	1.00	+	5.1	10.7
Sulfate, Total	6	0.50			
Zinc, Dissolved	6	0.46			

* Number of Years ** Significance level

For datasets with a statistically significant trend ($\alpha/2=2.5\%$) a Seasonal-Sen's Slope estimate statistic has also been calculated. The dataset for total alkalinity has a statistically significant (p= 1.0) trend with a slope estimate of 5.1 mg/L/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 (µS/cm)	Site 27 Diss. Zinc (µg/L)	Site 27 Total Sulfate (mg/L)
Baseline Statistics			
Baseline Period	09/18/01-05/18/04	09/18/01-05/18/04	09/17/02-09/21/04
Number of Samples	6	6	5
Mean (x)	95.88	2.78	1.56
Standard Deviation	6.43	1.42	0.43
Shewhart-CUSUM Control Limits (SCL)			
Control Limit (mean x+ 2s)	108.6	5.6	2.4
Control Limit (mean x + 3s)	115.5	7.0	2.8
Control Limit (mean x + 4s)	122.3	8.4	3.3
Control Limit (mean x + 4.5s)	125.7	9.2	3.5
CUSUM Control Limits			
Cumulative increase (h)	5	5	5

Figure 1 shows the three analytes examined eventually went out of control. Total sulfate went out of control during the Water Year 2008. This has been discussed in previous reports and is related to the material that was placed to the east of Pond 7 to form a pad. The fill material originated from the 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 2017 Water Year, this correlates with the excavation and construction of the Stage 3 Phase 1 tailings expansion that began in May 2015. Once 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**

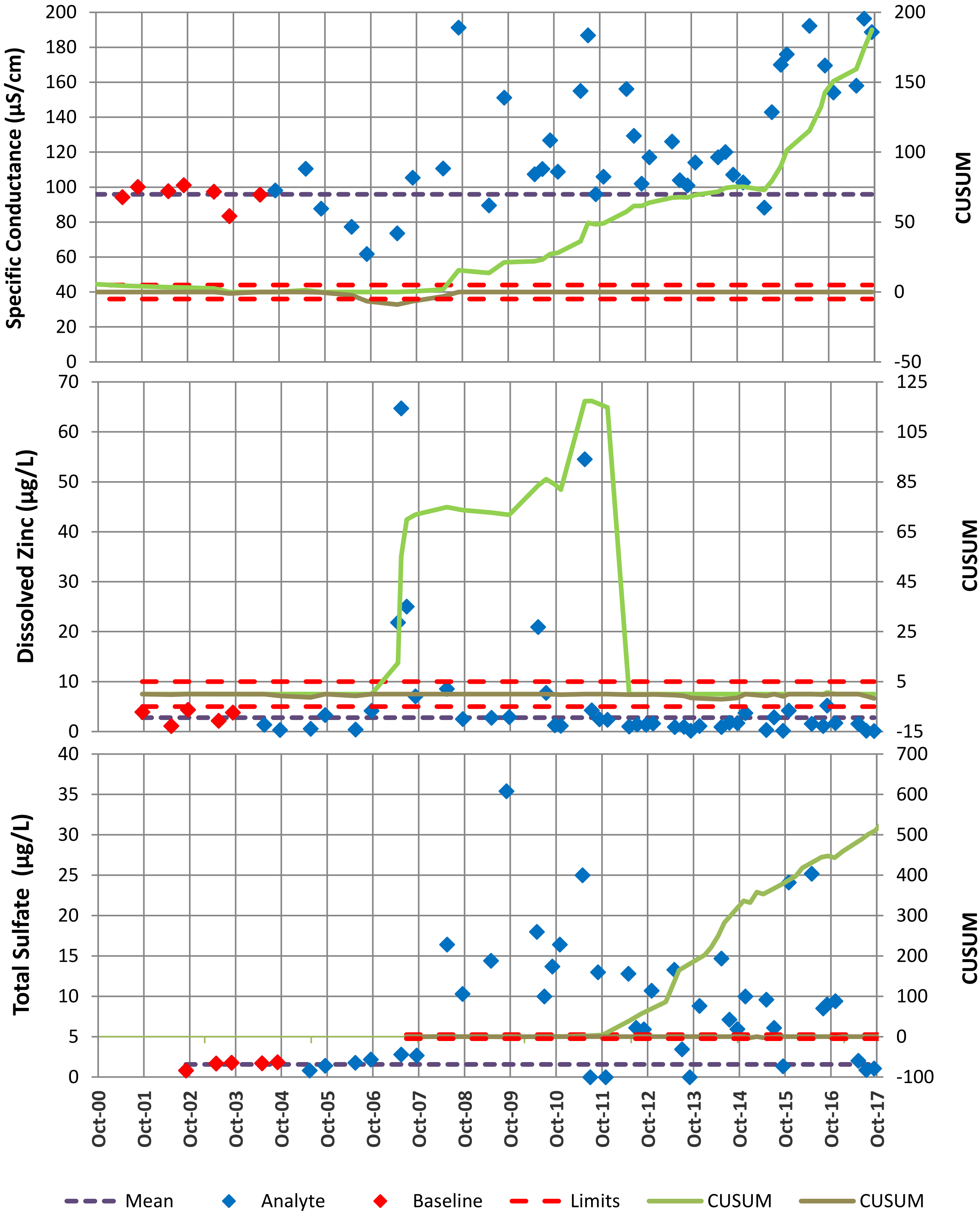


Table of Results for Water Year 2017

Site 027FMG - 'Monitoring Well - 2S'

Sample Date/Parameter	Oct 2016	Nov 2016	Dec 2016	Jan 2017	Feb 2017	Mar 2017	Apr 2017	May 2017	Jun 2017	Jul 2017	Aug 2017	Sep 2017	**Median**
Water Temp (°C)		7.2						5.5		7.7		8.8	7.5
Conductivity-Field(μmho)		154.1						158		196.4		188.6	173.3
Conductivity-Lab (μmho)		144						142		133		137	140
pH Lab (standard units)		6.29						6.3		6.1		6.23	6.26
pH Field (standard units)		6.43						6.41		6.51		6.5	6.47
Total Alkalinity (mg/L)		55.4						67.8		62.3			62.3
Total Sulfate (mg/L)		9.4						2		0.9		1.1	1.6
Hardness (mg/L)		45.8						40.3		42.2		44.3	43.3
Dissolved As (ug/L)		2.49						0.736		0.726		0.746	0.741
Dissolved Ba (ug/L)		60.9						47.8		49.9		54.1	52.0
Dissolved Cd (ug/L)		0.0018						0.0018		0.0018		0.0018	0.0018
Dissolved Cr (ug/L)		0.201						0.292		0.439		0.527	0.366
Dissolved Cu (ug/L)		0.05						0.08		0.031		0.057	0.054
Dissolved Pb (ug/L)		0.0719						0.0799		0.0074		0.0094	0.0407
Dissolved Ni (ug/L)		0.723						0.308		0.268		0.207	0.288
Dissolved Ag (ug/L)		0.002						0.002		0.002		0.002	0.002
Dissolved Zn (ug/L)		1.69						1.53		0.15		0.1	0.84
Dissolved Se (ug/L)		0.057						0.057		0.057		0.057	0.057
Dissolved Hg (ug/L)		0.000413						0.000256		0.00036		0.000388	0.000374

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

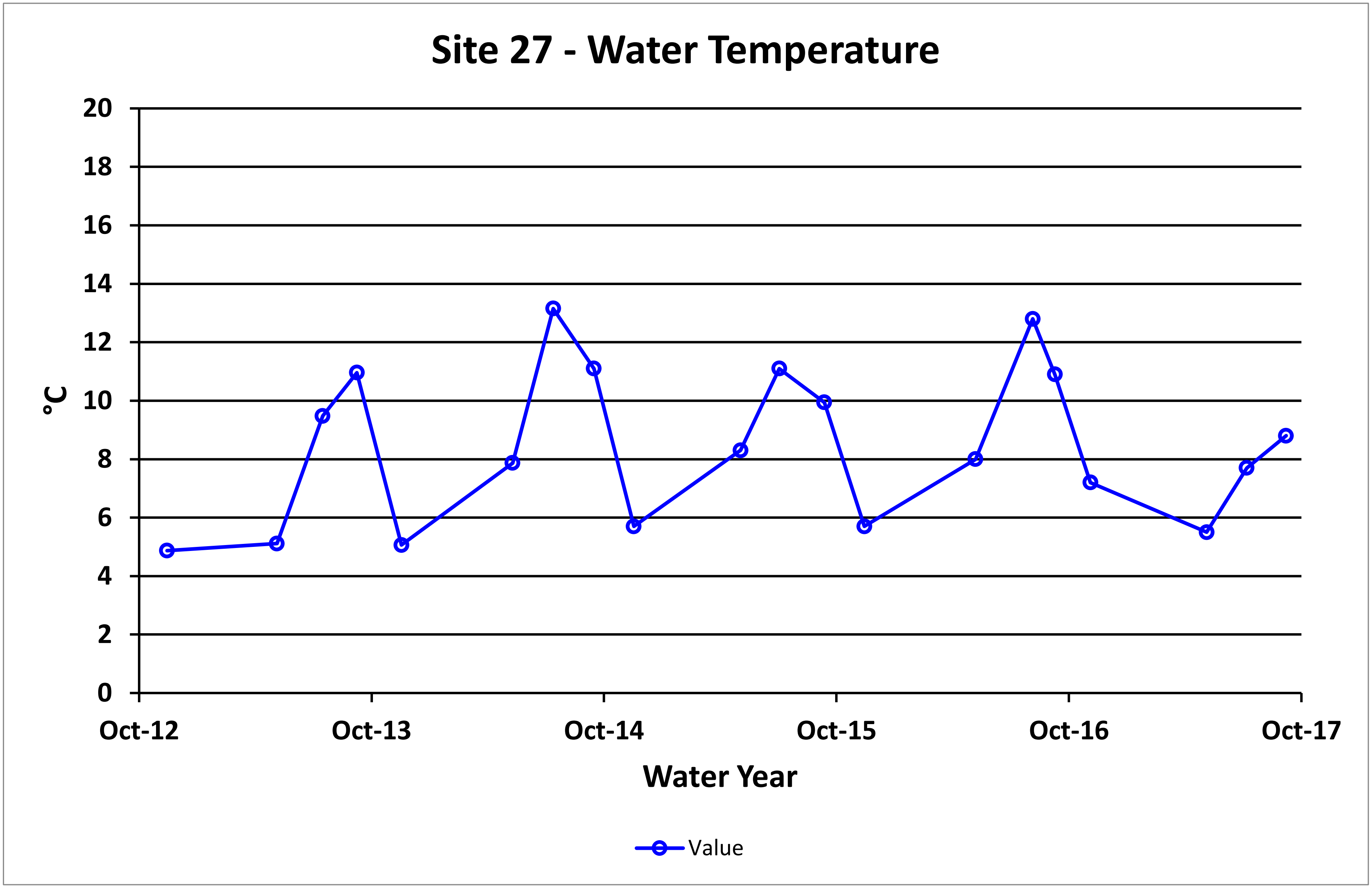
Values reported as less than MDL are replaced by 1/2 MDL for median calculation purposes.

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

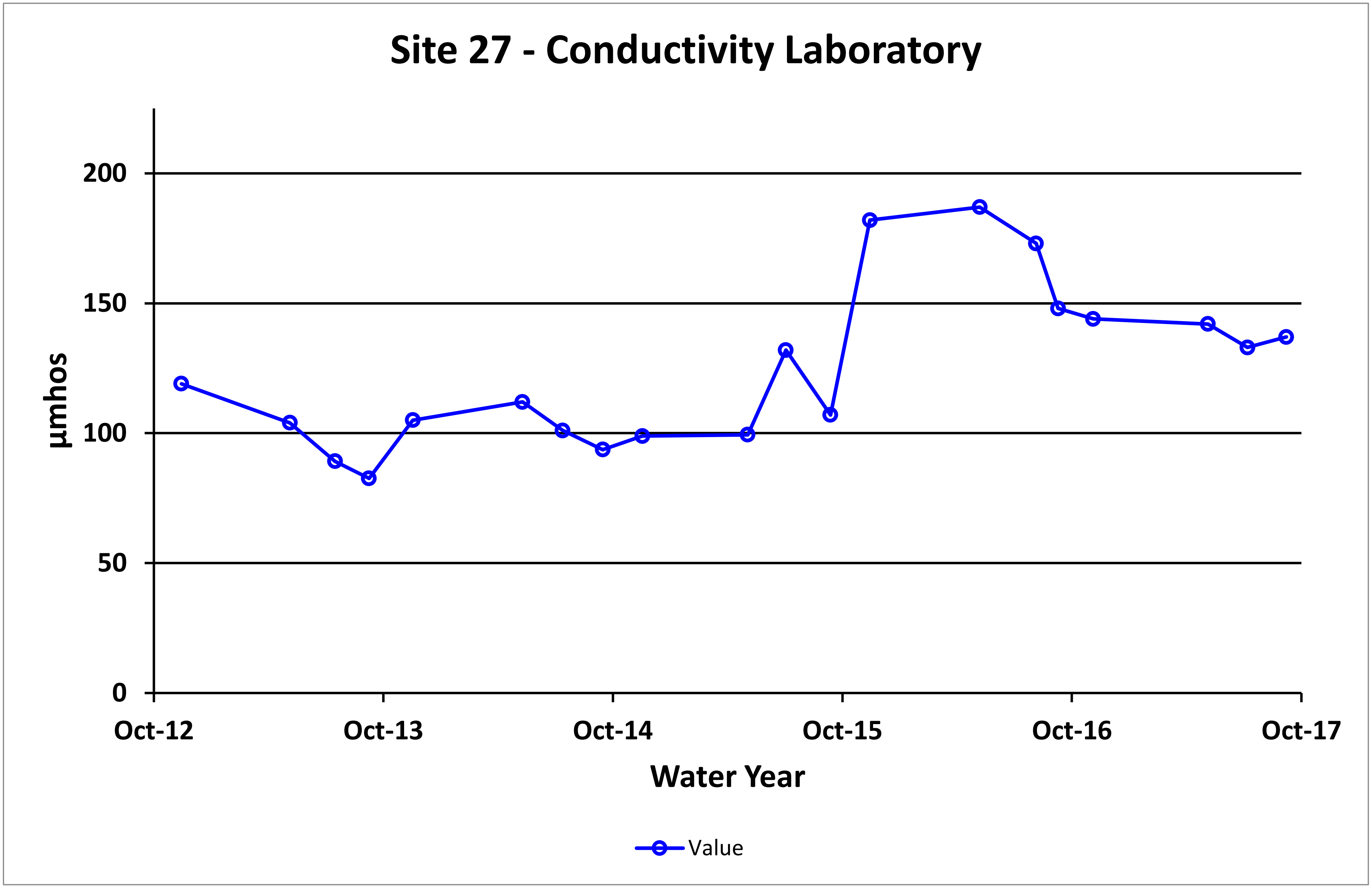
Qualified Data by QA Reviewer

Date Range: 10/01/2016 to 09/30/2017

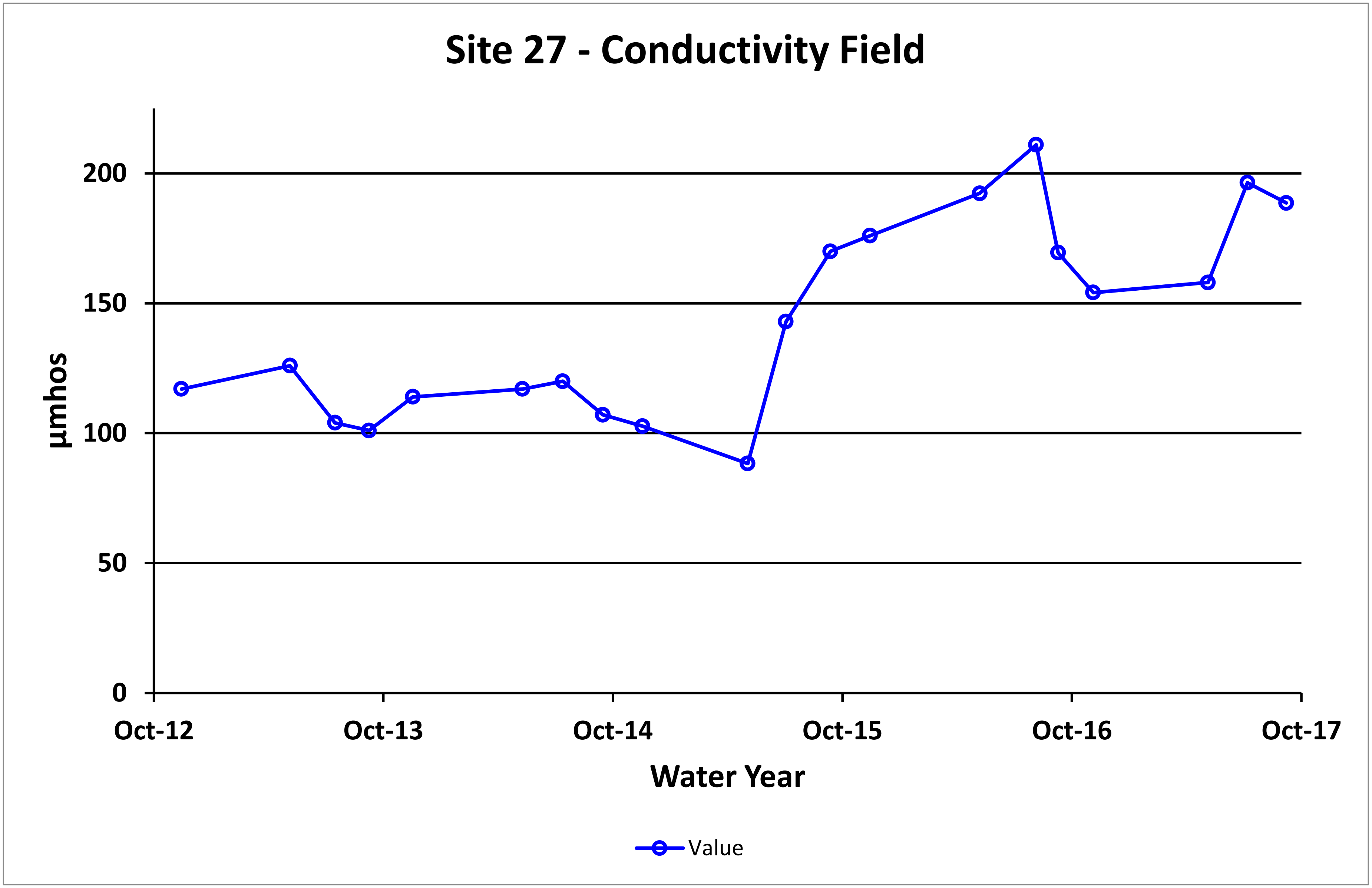
Site No.	Sample Date	Sample Time	Parameter	Value		Qualifier	Reason for Qualifier
027FMG	5/9/2017	12:00 PM	Diss. Hg-CVAF	0.000256	µg/L	U	Trip Blank Contamination
			Tot. Sulfate	2.02	mg/L	J	Sample Receipt Temperature
	7/11/2017	12:00 PM	Diss. Pb-ICP/MS	0.00736	µg/L	J	Below Quantitative Range
			Tot. Sulfate	0.88	mg/L	J	Below Quantitative Range, Sample Receipt Temperature
	9/11/2017	12:00 PM	Diss. Cu-ICP/MS	0.05	µg/L	U	Field Blank Contamination
			Diss. Zn-ICP/MS	0.09	µg/L	U	Field Blank Contamination
			Tot. Sulfate	1.07	mg/L	J	Below Quantitative Range



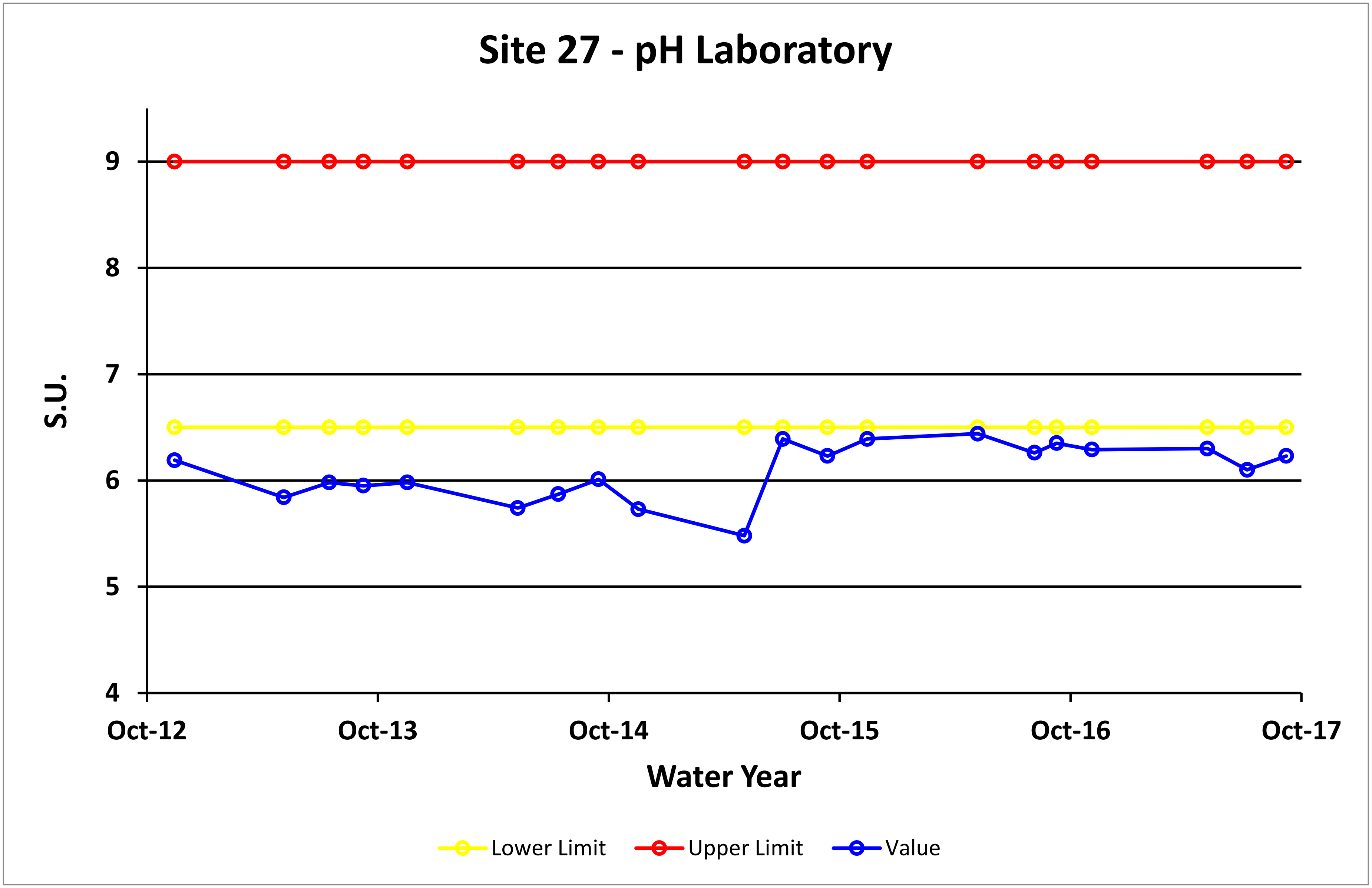
Site 27 - Water Temperature
°C
20
18
16
14
12
10
8
6
4
2
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value



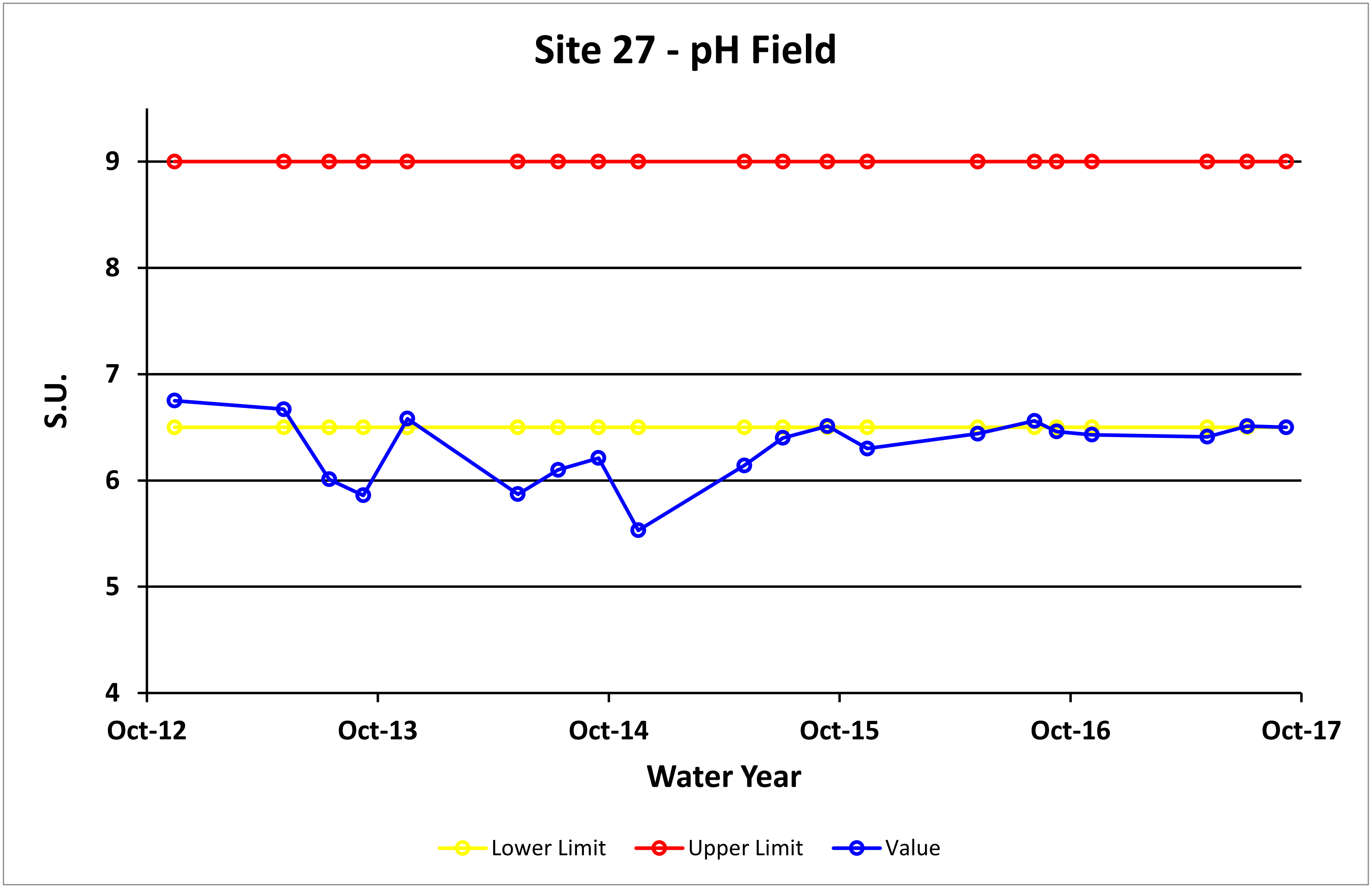
Site 27 - Conductivity Laboratory
µmhos
200
150
100
50
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value

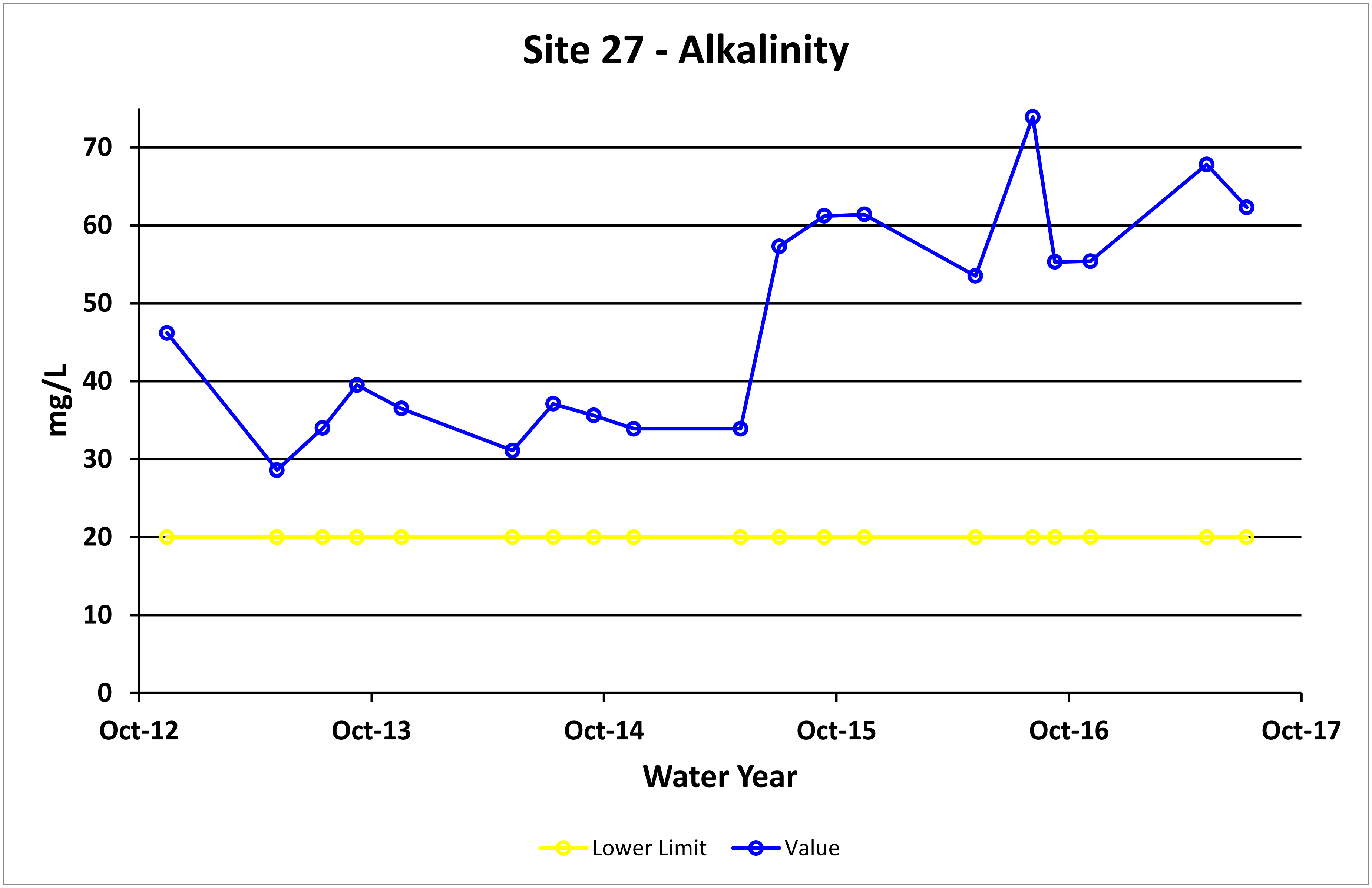


Site 27 - Conductivity Field
µmhos
200
150
100
50
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value

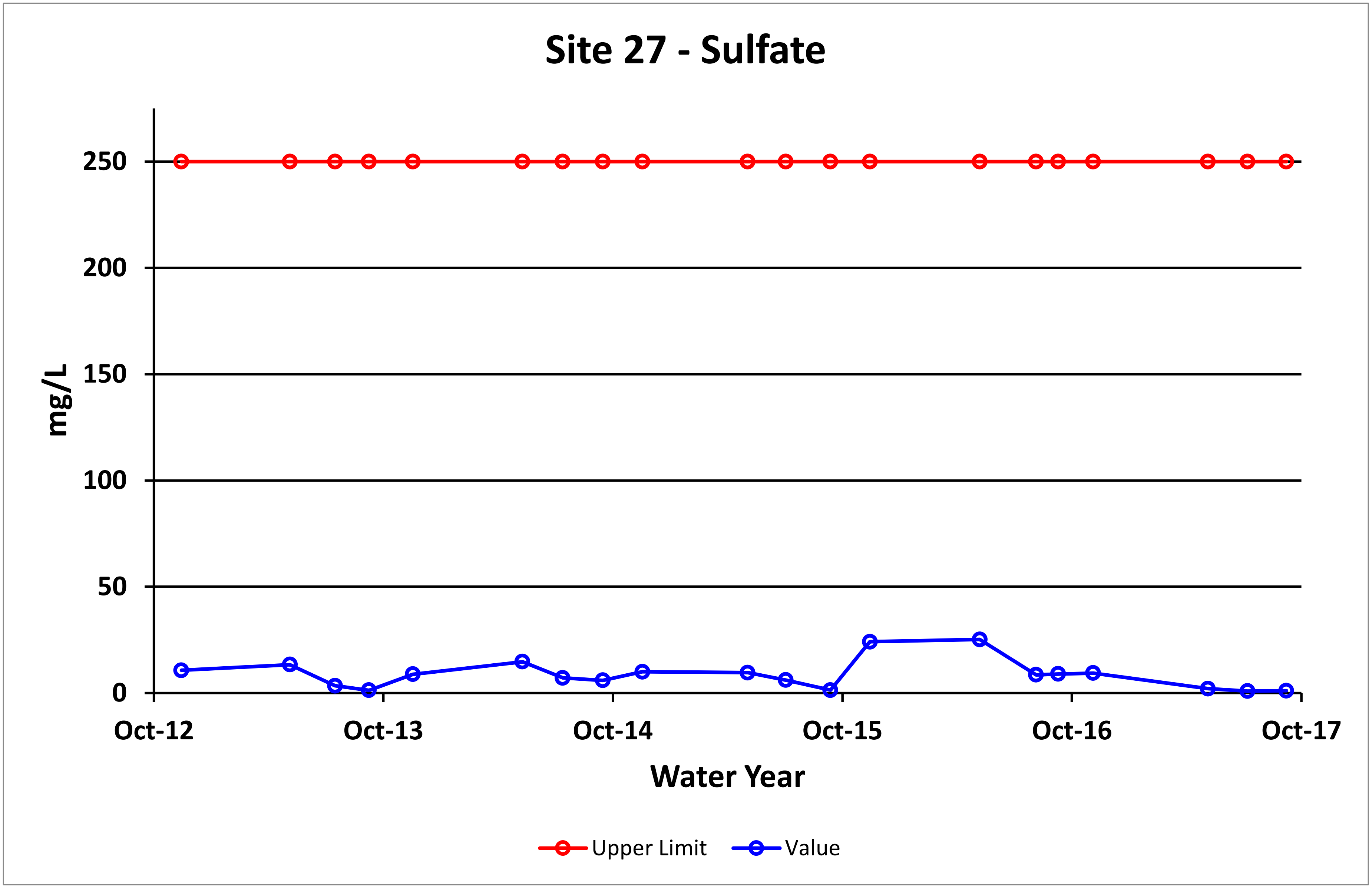


Site 27 - pH Laboratory
9
8
7
6
5
4
S.U.
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Lower Limit
Upper Limit
Value

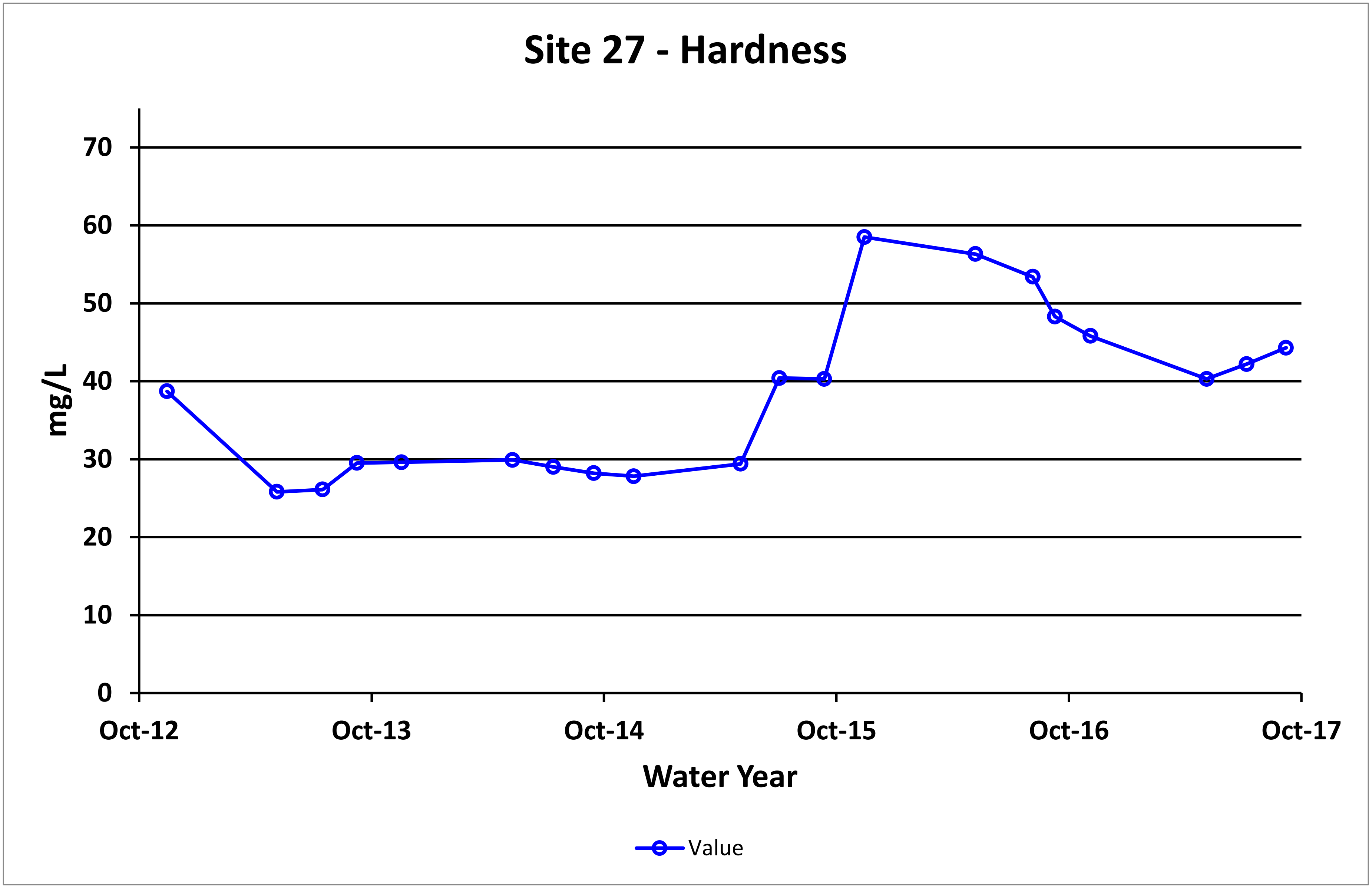

Site 27 - pH Field
S.U.
9
8
7
6
5
4
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Lower Limit
Upper Limit
Value

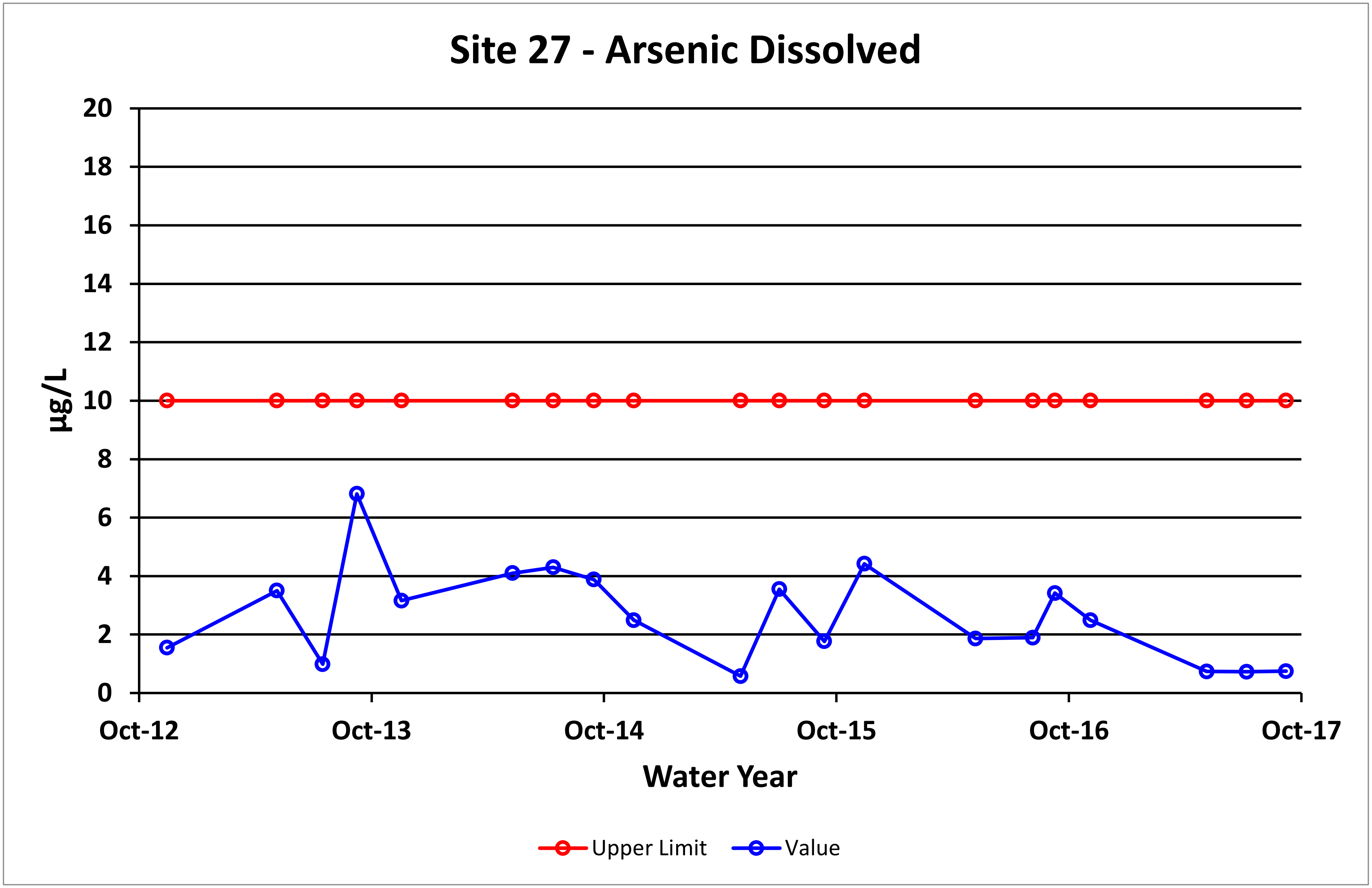


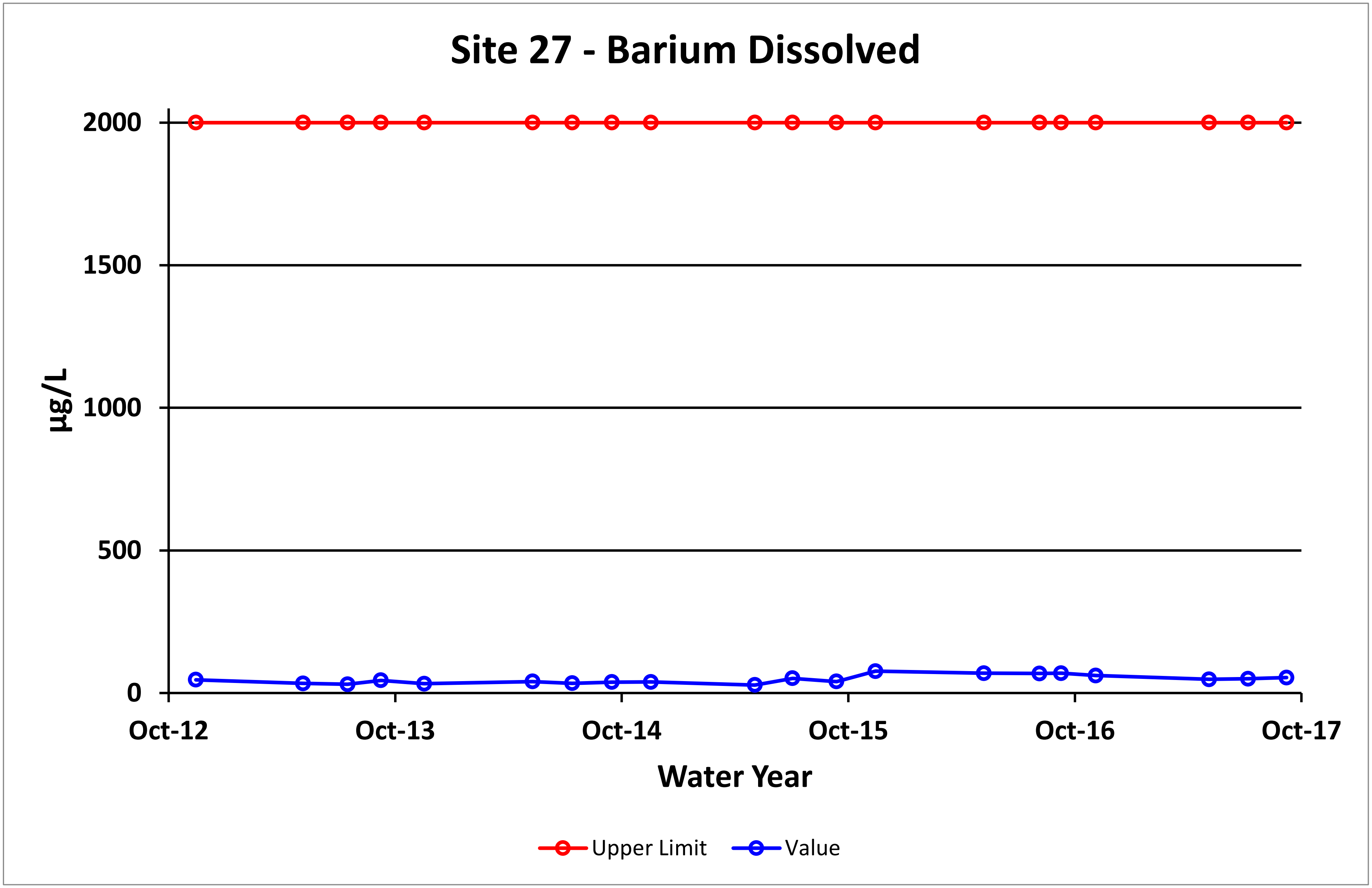
Site 27 - Alkalinity
70
60
50
40
30
20
10
0
mg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Lower Limit
Value



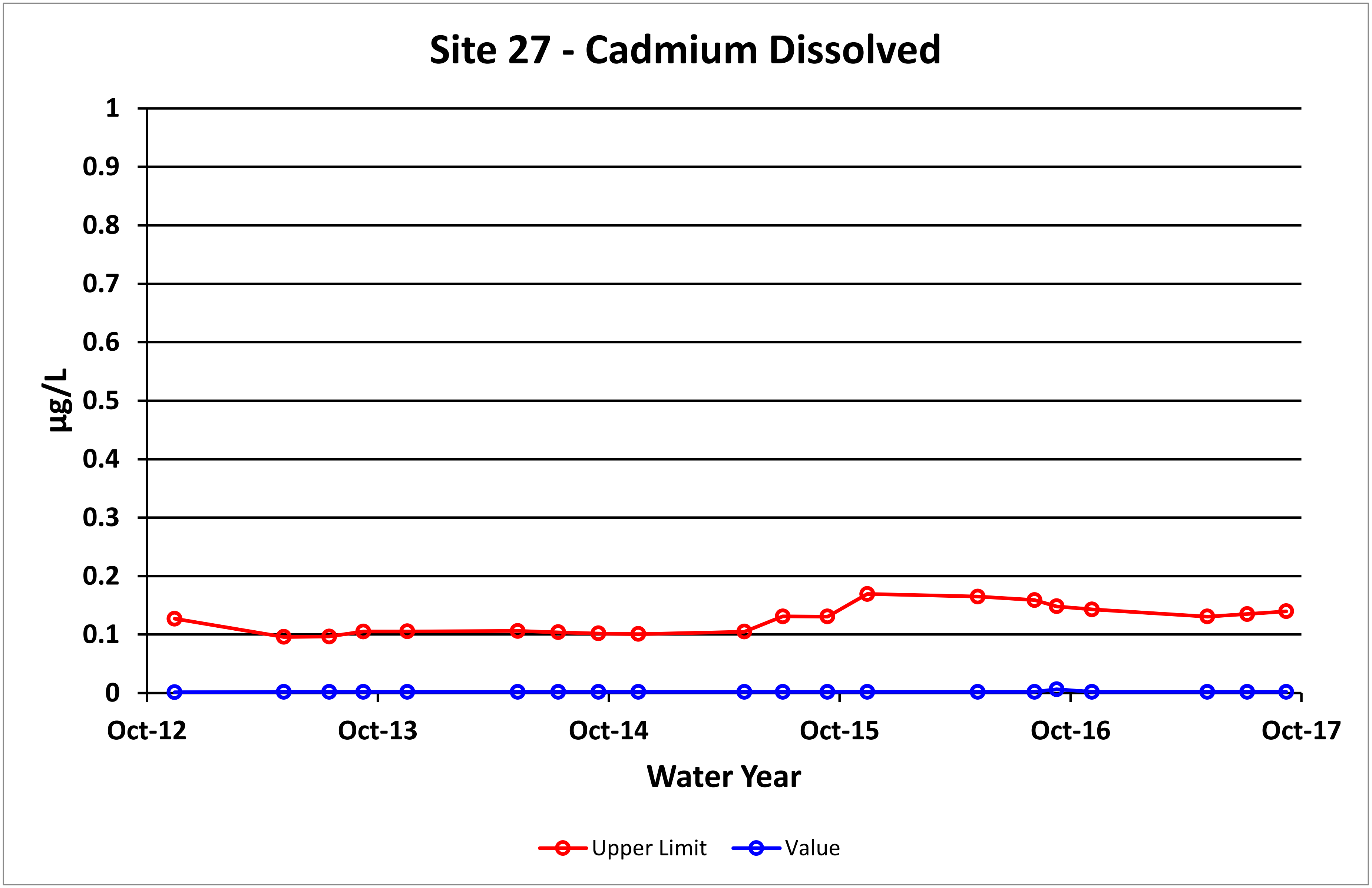
Site 27 - Sulfate
mg/L
250
200
150
100
50
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value


Site 27 - Hardness
mg/L
70
60
50
40
30
20
10
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value

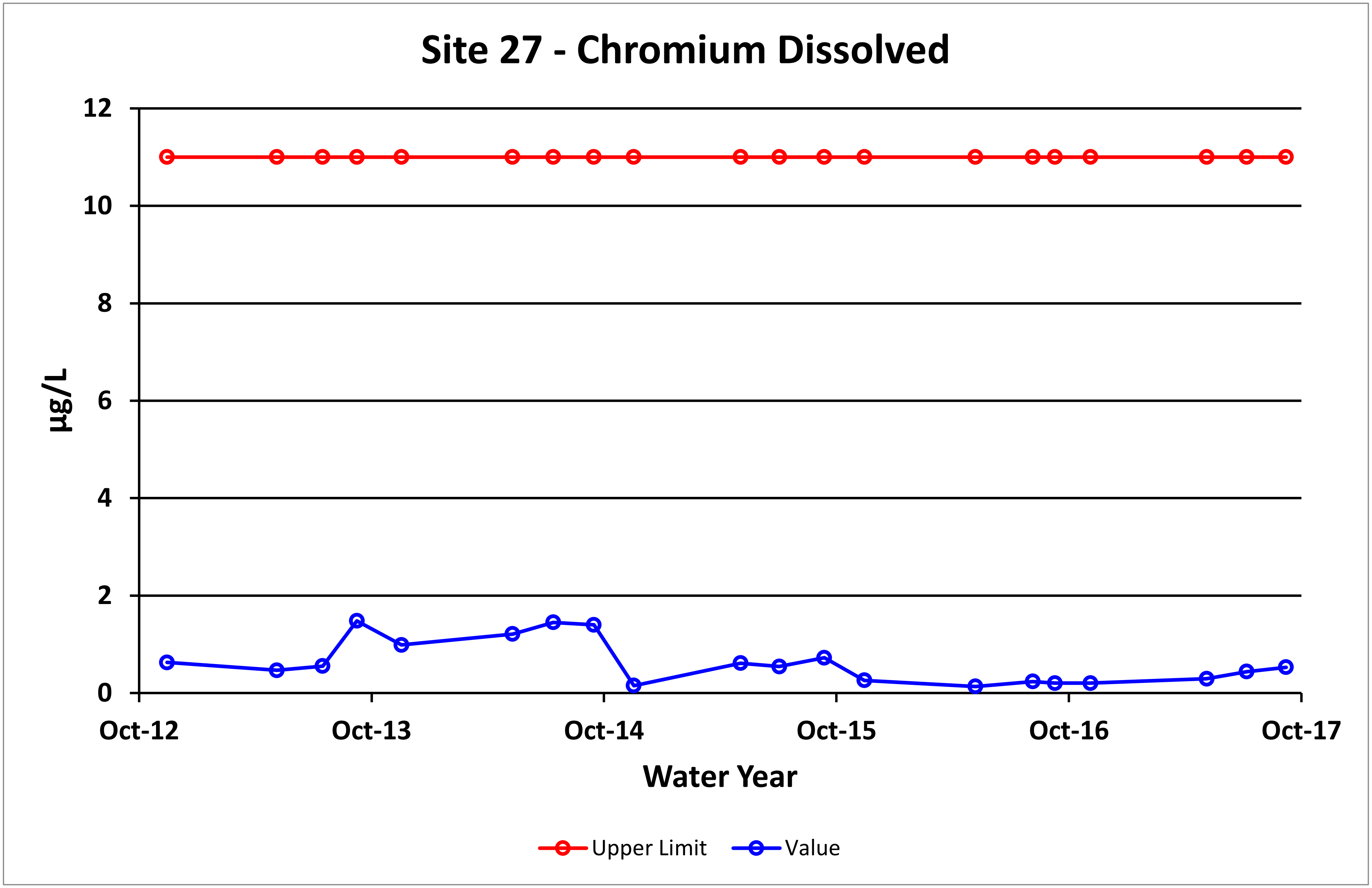

Site 27 - Arsenic Dissolved
µg/L
20
18
16
14
12
10
8
6
4
2
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

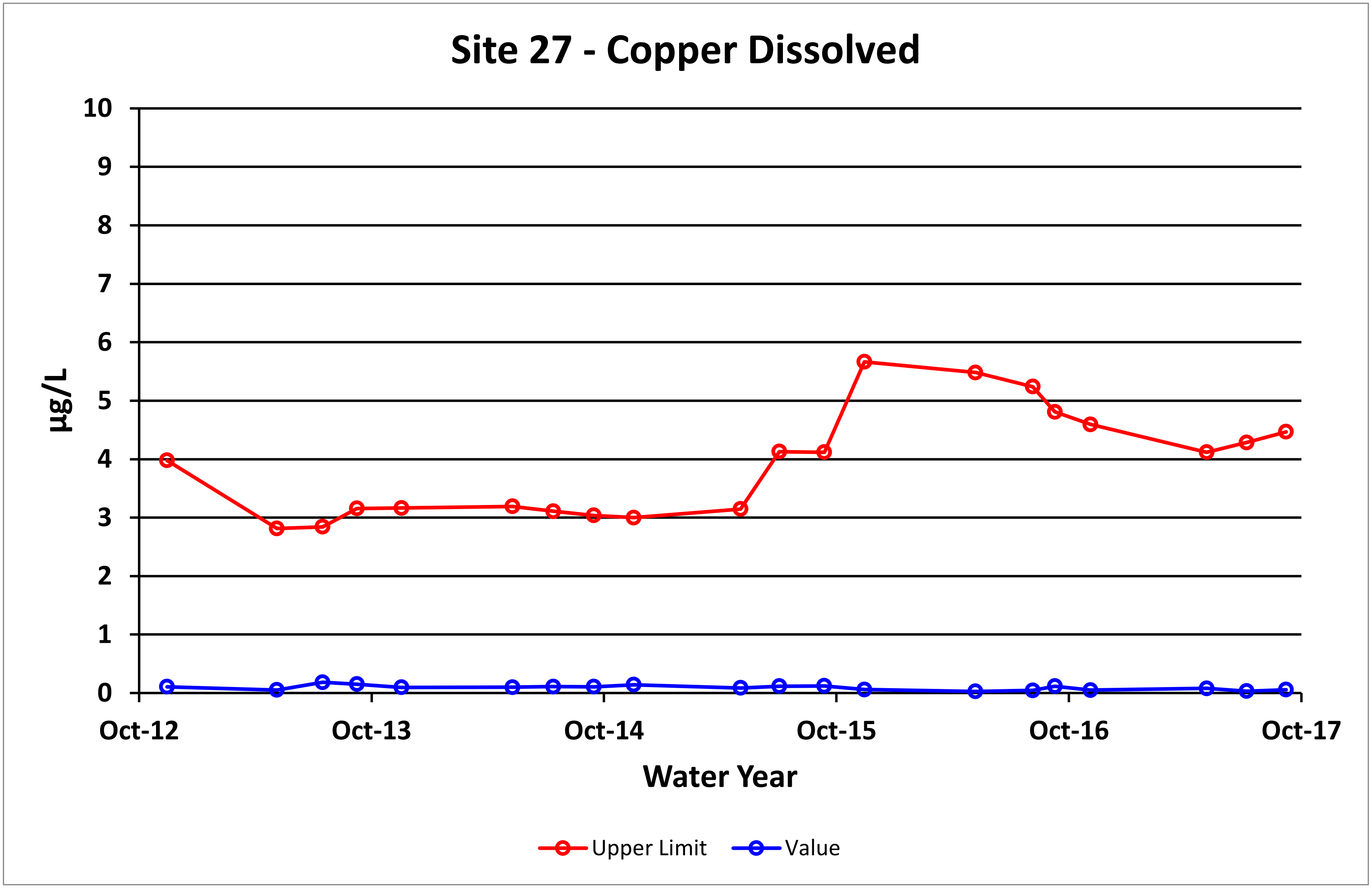


Site 27 - Barium Dissolved
µg/L
2000
1500
1000
500
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

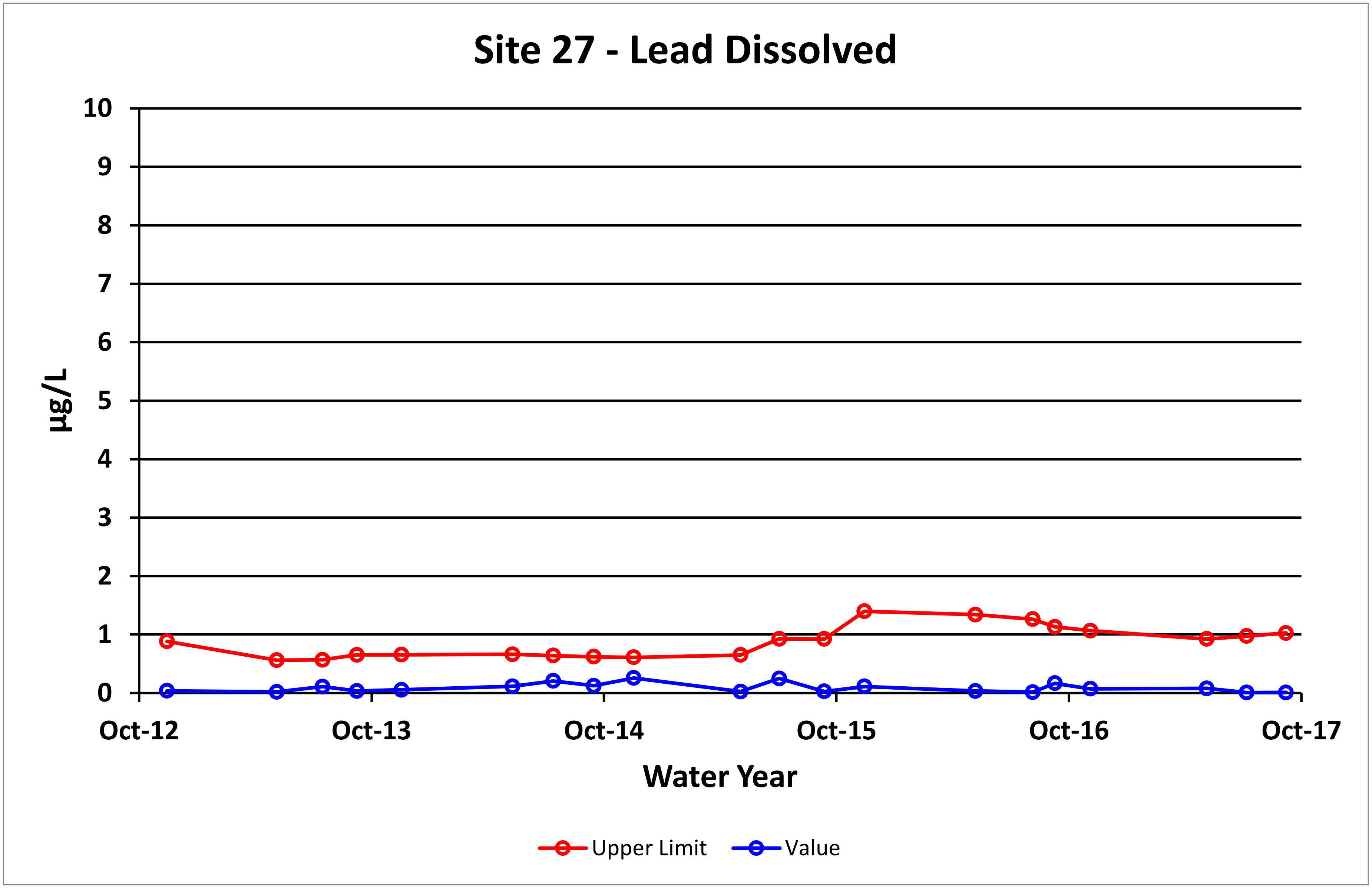


Site 27 - Cadmium Dissolved
µg/L
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

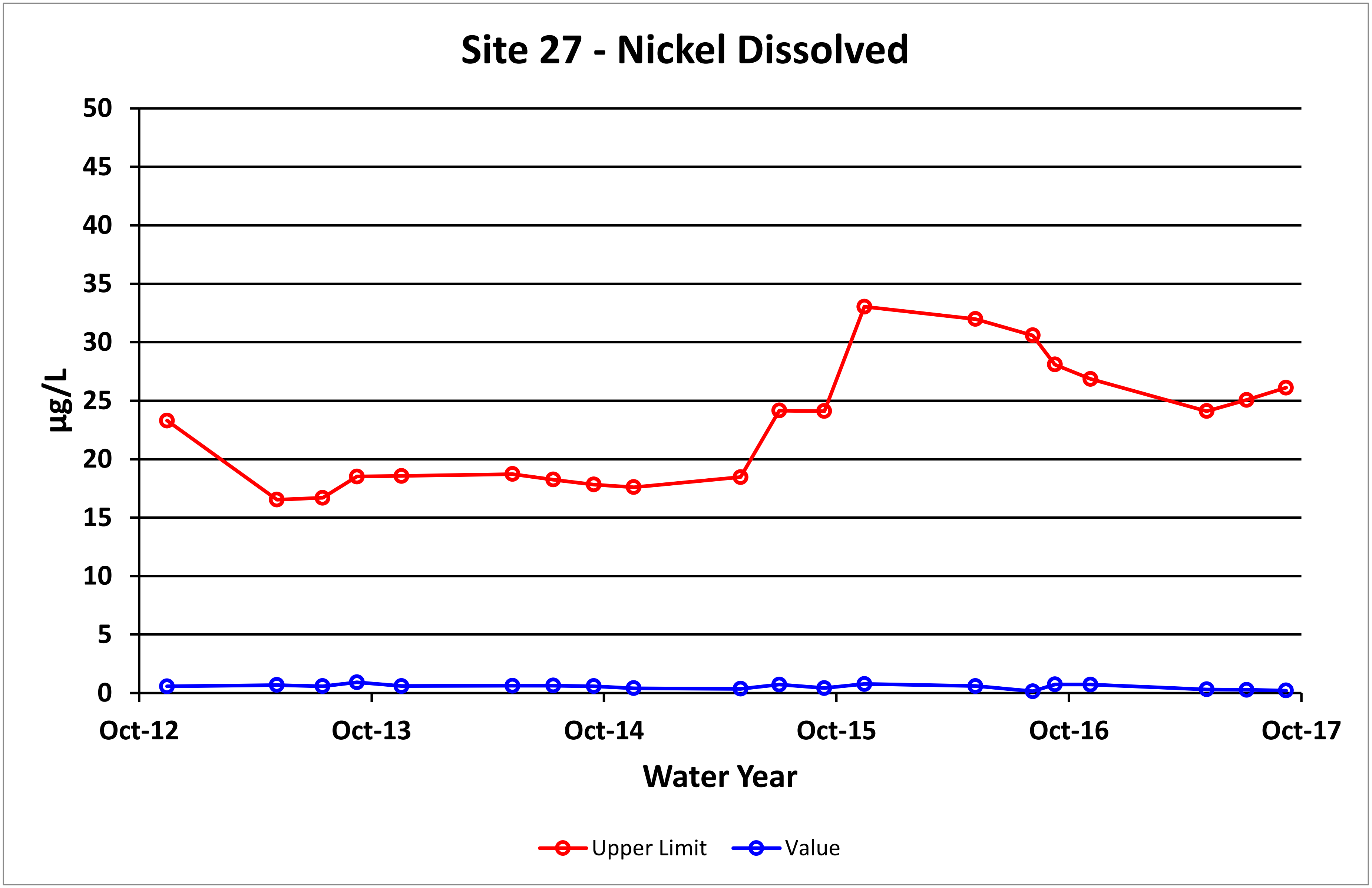

Site 27 - Chromium Dissolved
12
10
8
6
4
2
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value



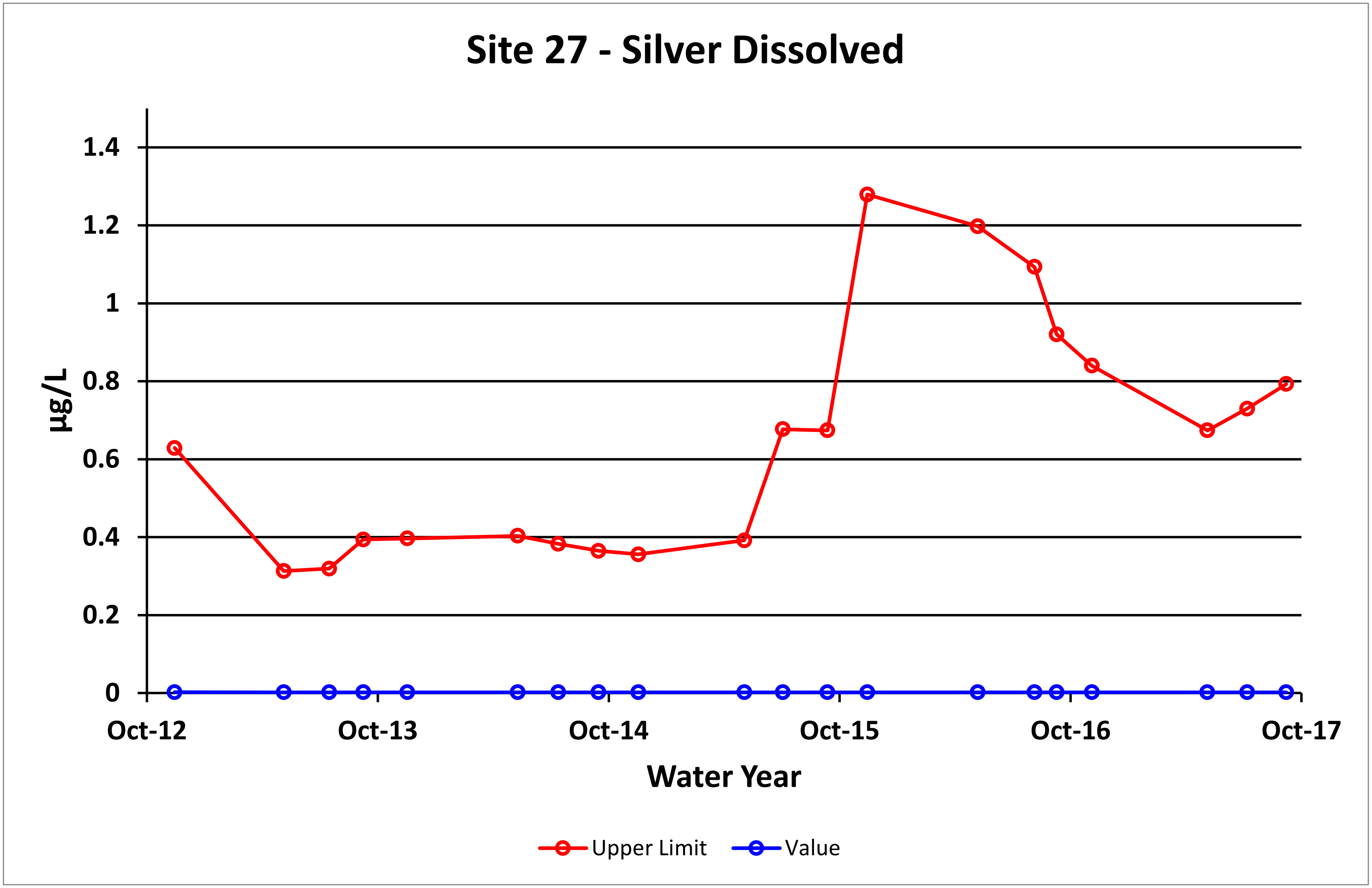
Site 27 - Copper Dissolved
10
9
8
7
6
5
4
3
2
1
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value



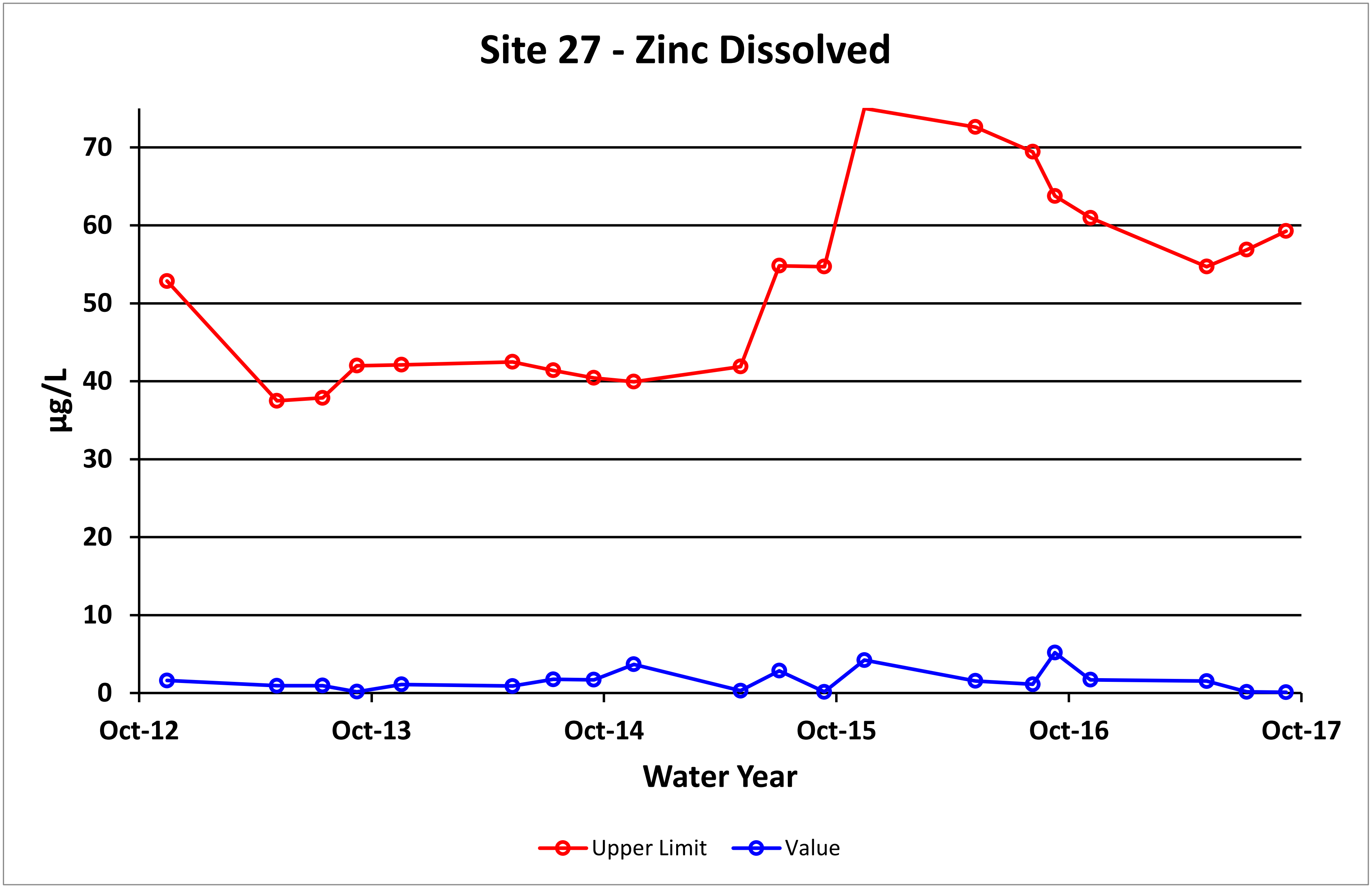
Site 27 - Lead Dissolved
10
9
8
7
6
5
4
3
2
1
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

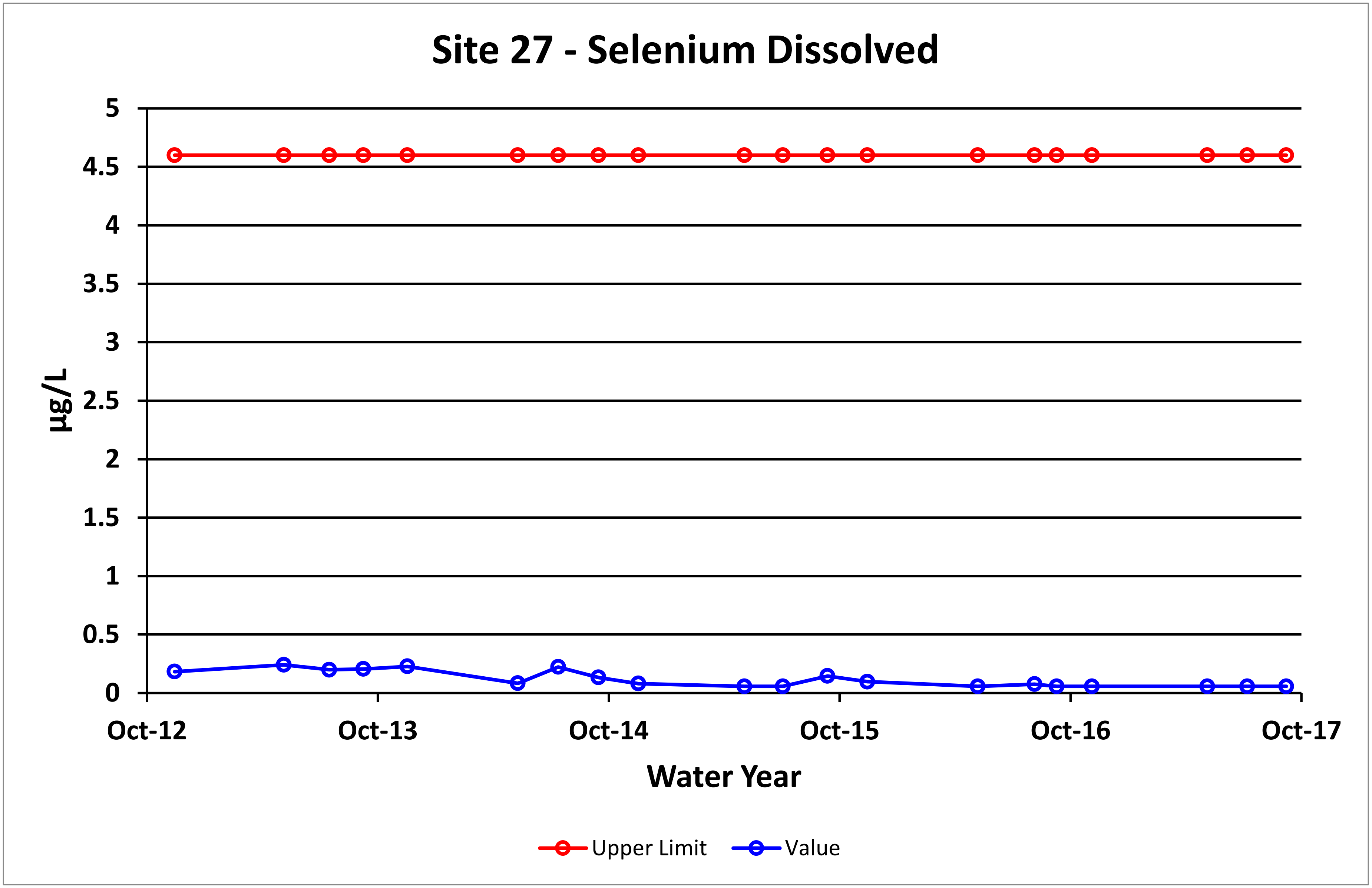


Site 27 - Nickel Dissolved
µg/L
50
45
40
35
30
25
20
15
10
5
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

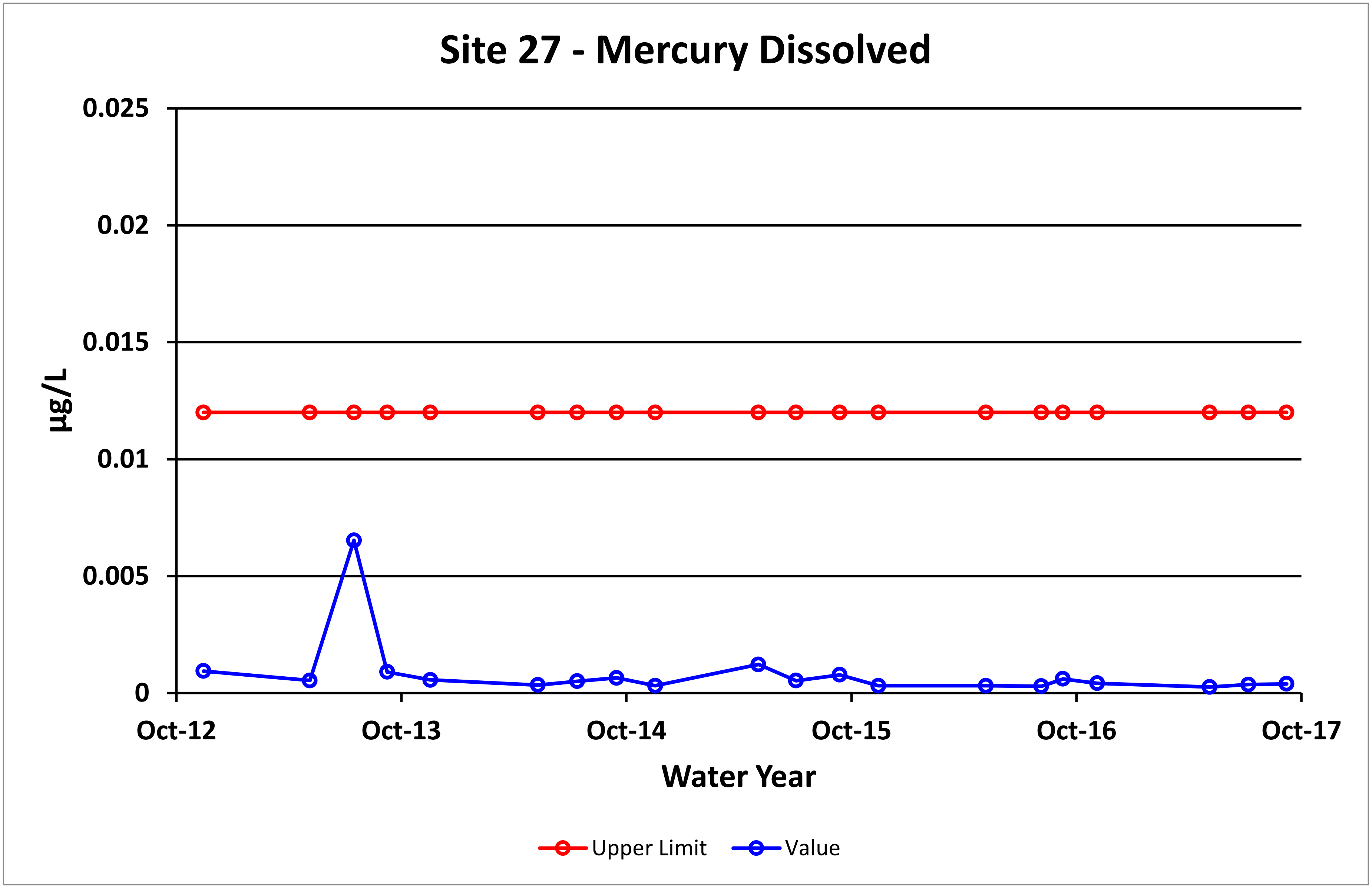


Site 27 - Silver Dissolved
µg/L
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value


Site 27 - Zinc Dissolved
µg/L
70
60
50
40
30
20
10
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value



Site 27 - Selenium Dissolved
µg/L
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value



Site 27 - Mercury Dissolved
0.025
0.02
0.015
0.01
0.005
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

INTERPRETIVE REPORT
SITE 29

The data collected during the current water year are listed in the following "Table of Results for Water Year 2017" report. The table includes all the required FWMP analyte data (field and laboratory) collected for the current water year and a series of flags keyed to the summary report "Qualified Data by QA Reviewer". The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of ½ MDL for the purpose of median calculation.

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

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

The data for 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 2017

			Limits		
Sample Date	**Parameter**	**Value**	**Lower**	**Upper**	**Hardness**
7-Nov-16	pHfld	5.4 su	6.5	9	23.3 mg/L
9-May-17	Alk	10.6 mg/L	20		23.5 mg/L
9-May-17	pHfld	5.3 su	6.5	9	23.5 mg/L
11-Jul-17	Alk	14.0 mg/L	20		16.7 mg/L
11-Jul-17	pHfld	5.29 su	6.5	9	16.7 mg/L
11-Sep-17	Alk	6.4 mg/L	20		19.5 mg/L

Three 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. During the last couple of years this area has been brought up in elevation. With the increase in elevation this area is not as protected from the winds that predominantly prevail from the northeast. Dispersal of fugitive dust from this region would be to the southwest towards Site 29 and Site 32, which likely explains the increase in lead observed during water year 2014. In Water Year 2015 tailings were not placed in the northwest, but primarily in the central and eastern portion of the facility. This would result in less fugitive dust in the area of Site 29 and may explain the lower lead values in the 2015 samples. There was heavy construction activity occurring in the tailings facility in Water Year 2016 which may have increased fugitive dust emissions away from the tailings pile.

In 2011 HGCMC implemented a biweekly dust monitoring program to support the snow monitoring program. This program has continued into 2017 and the results from this monitoring are summarized in the 2017 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-11 and Sep-17 (WY2012-WY2017). No statistically significant trends were found with the trend analysis.

Table of Summary Statistics for Trend Analysis

	Mann-Kendall test statistics			Sen's slope estimate	
Parameter	**n***	**p****	**Trend**	**Q**	**Q(%)**
Conductivity Field	6	0.15			
pH Field	6	0.61			
Alkalinity, Total	6	0.65			
Sulfate, Total	6	Inconsistent detection limits			
Zinc, Dissolved	6	0.85			

* Number of Years ** Significance level

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

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

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

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

Site 29 was installed in 1988 and has an extensive sampling history, however establishing a baseline has been difficult. Since the installation of the well a 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 in the FWMP directly related to construction activities in the tailings facility. As previously discussed in the report, with regards to Site 27, there was an increase in total sulfate and conductivity after the pad was built east of Pond 7. In the 5-6 years after this pad was built the values for these parameters are still elevated, though trending towards pre–disturbance conditions. A similar sort of change was also recorded at Site 60 after the construction of Pond 7. Until the groundwater collection system was brought online there were substantial increases for specific conductivity and alkalinity at Site 60. These are two examples of where the placement of construction rock has resulted in changes to the water chemistry. Therefore, the decreasing trends in alkalinity and specific conductance seen at Site 29 are potentially the result of weathering of the initial rock placed for construction of the tailings facility.

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

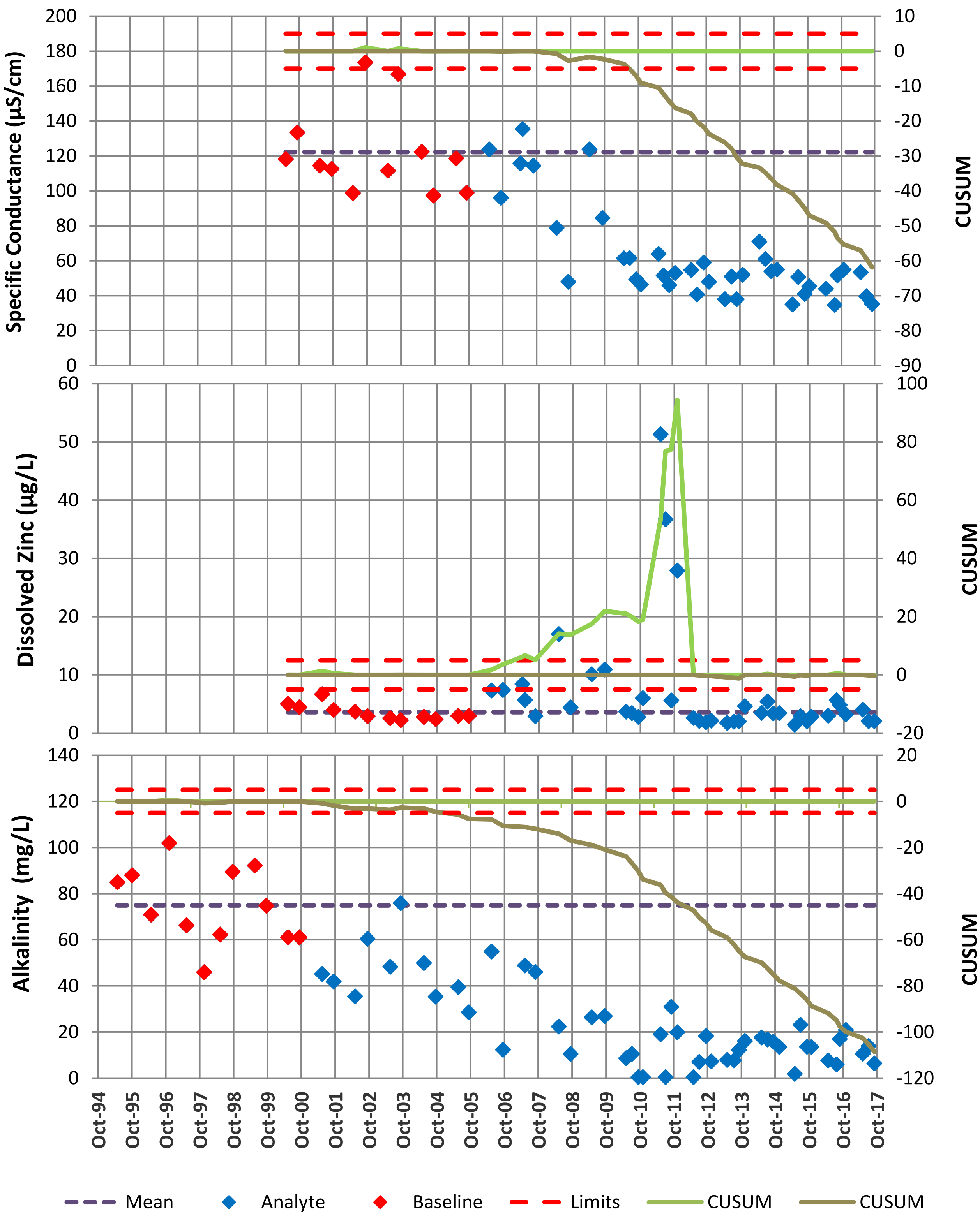


Table of Results for Water Year 2017

Site 029FMG - 'Monitoring Well - 3S'

Sample Date/Parameter	Oct 2016	Nov 2016	Dec 2016	Jan 2017	Feb 2017	Mar 2017	Apr 2017	May 2017	Jun 2017	Jul 2017	Aug 2017	Sep 2017	**Median**
Water Temp (°C)		7.9						7.3		6.6		6.9	7.1
Conductivity-Field(µmho)		54.9						53.5		39.7		35.4	46.6
Conductivity-Lab (µmho)		50						37		47		36	42
pH Lab (standard units)		5.26						5.02		4.96		4.76	4.99
pH Field (standard units)		5.38						5.26		5.29		4.98	5.28
Total Alkalinity (mg/L)		20.9						10.6		14		6.4	12.3
Total Sulfate (mg/L)		0.3						0.3		0.3		0.2	0.3
Hardness (mg/L)		23.3						23.5		16.7		19.5	21.4
Dissolved As (ug/L)		8.76						7.88		6.65		7.39	7.635
Dissolved Ba (ug/L)		7.3						6.5		5.4		5.7	6.1
Dissolved Cd (ug/L)		0.0018						0.0051		0.0018		0.0036	0.0027
Dissolved Cr (ug/L)		0.654						0.588		0.596		0.56	0.592
Dissolved Cu (ug/L)		0.21						0.189		0.099		0.137	0.163
Dissolved Pb (ug/L)		0.362						0.196		0.101		0.0902	0.1485
Dissolved Ni (ug/L)		1.14						1.02		1.12		0.981	1.070
Dissolved Ag (ug/L)		0.002						0.002		0.002		0.002	0.002
Dissolved Zn (ug/L)		3.2						4.04		2.04		2.05	2.63
Dissolved Se (ug/L)		0.057						0.057		0.057		0.057	0.057
Dissolved Hg (ug/L)		0.000753						0.000659		0.000624		0.000613	0.000642

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

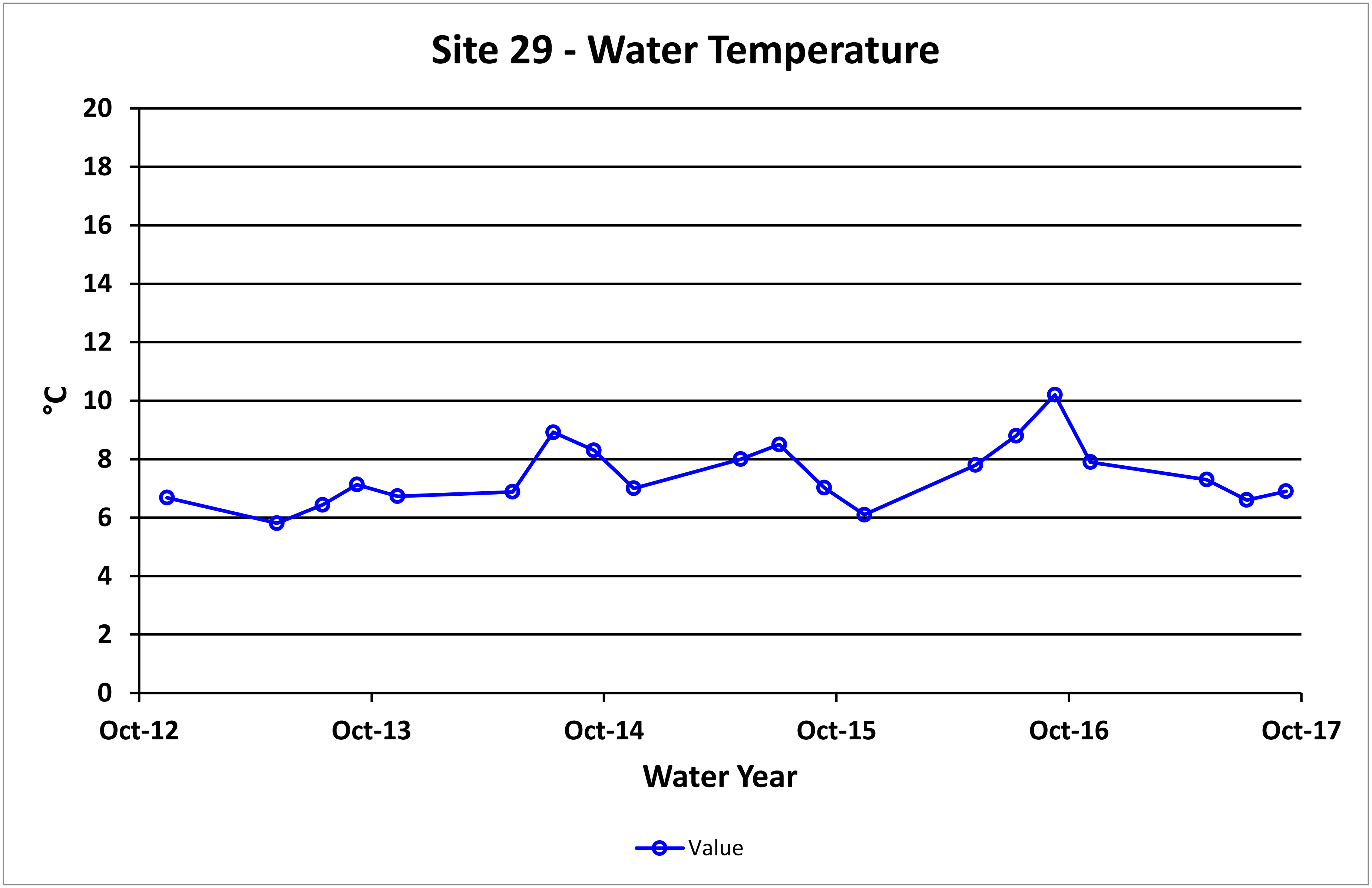
Values reported as less than MDL are replaced by 1/2 MDL for median calculation purposes.

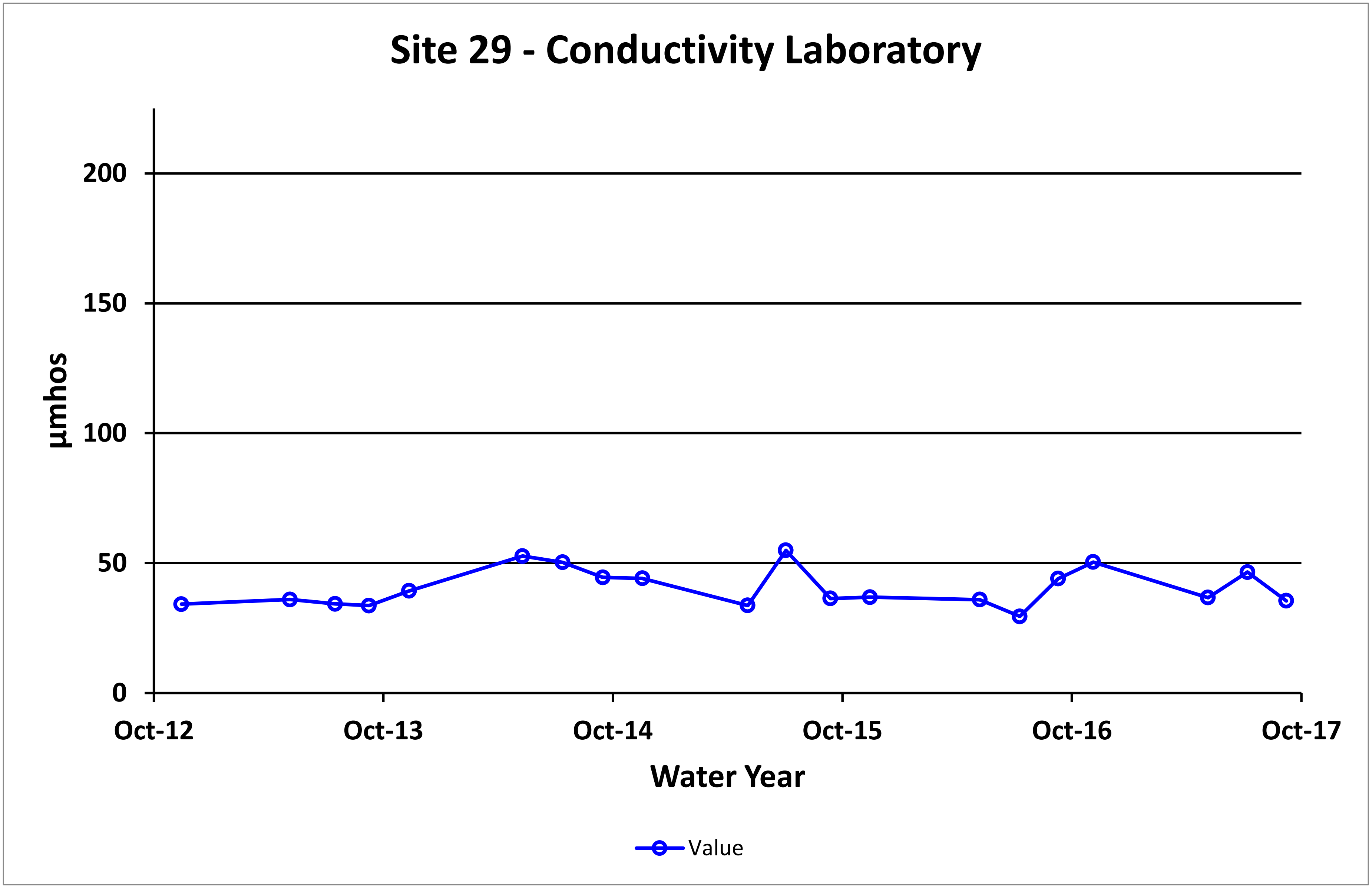
Shaded data has been qualified as an outlier by HGCMC and removed from any further analysis and is not included into the calculation of the median

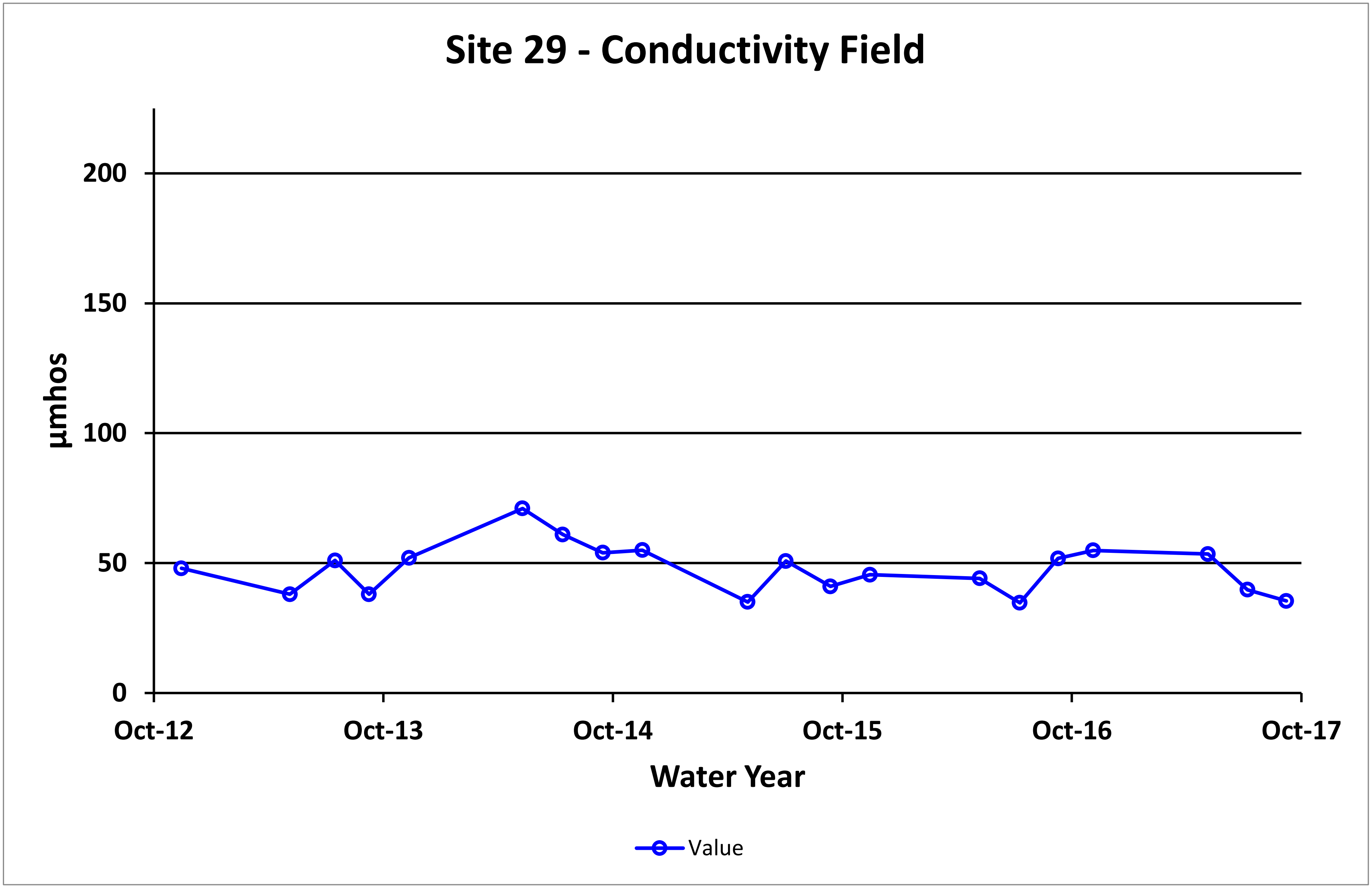
Qualified Data by QA Reviewer

Date Range: 10/01/2016 to 09/30/2017

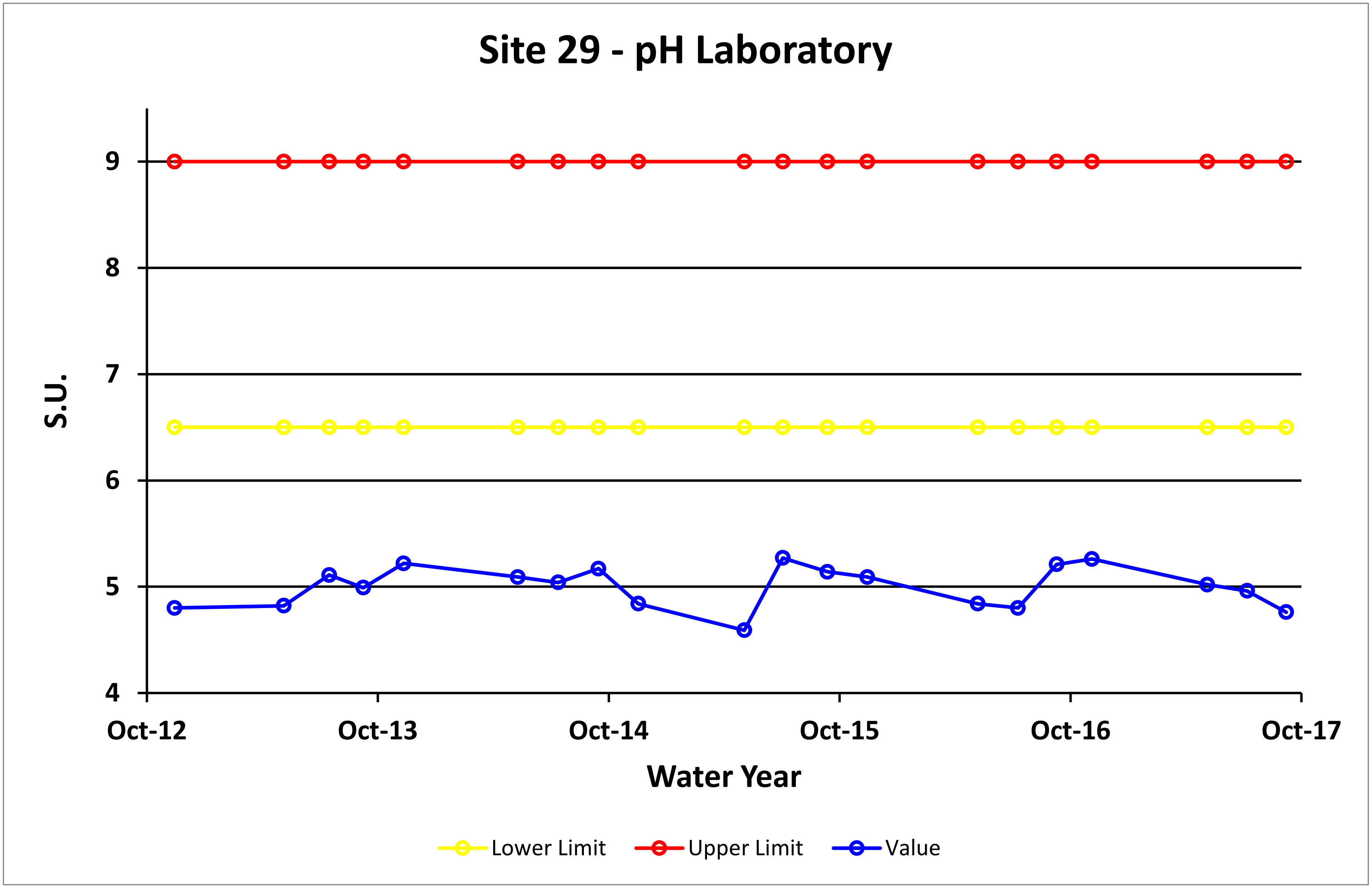
Site No.	Sample Date	Sample Time	Parameter	Value		Qualifier	Reason for Qualifier
029FMG	5/9/2017	12:00 PM	Diss. Cd-ICP/MS	0.00505	µg/L	J	Below Quantitative Range
			Diss. Hg-CVAF	0.000659	µg/L	U	Trip Blank Contamination
			Tot. Sulfate	-0.5	mg/L	UJ	Sample Receipt Temperature
	7/11/2017	12:00 PM	Tot. Sulfate	-0.5	mg/L	UJ	Sample Receipt Temperature
	9/11/2017	12:00 PM	Diss. Cd-ICP/MS	0.00362	µg/L	J	Below Quantitative Range
			Diss. Cu-ICP/MS	0.13	µg/L	U	Field Blank Contamination

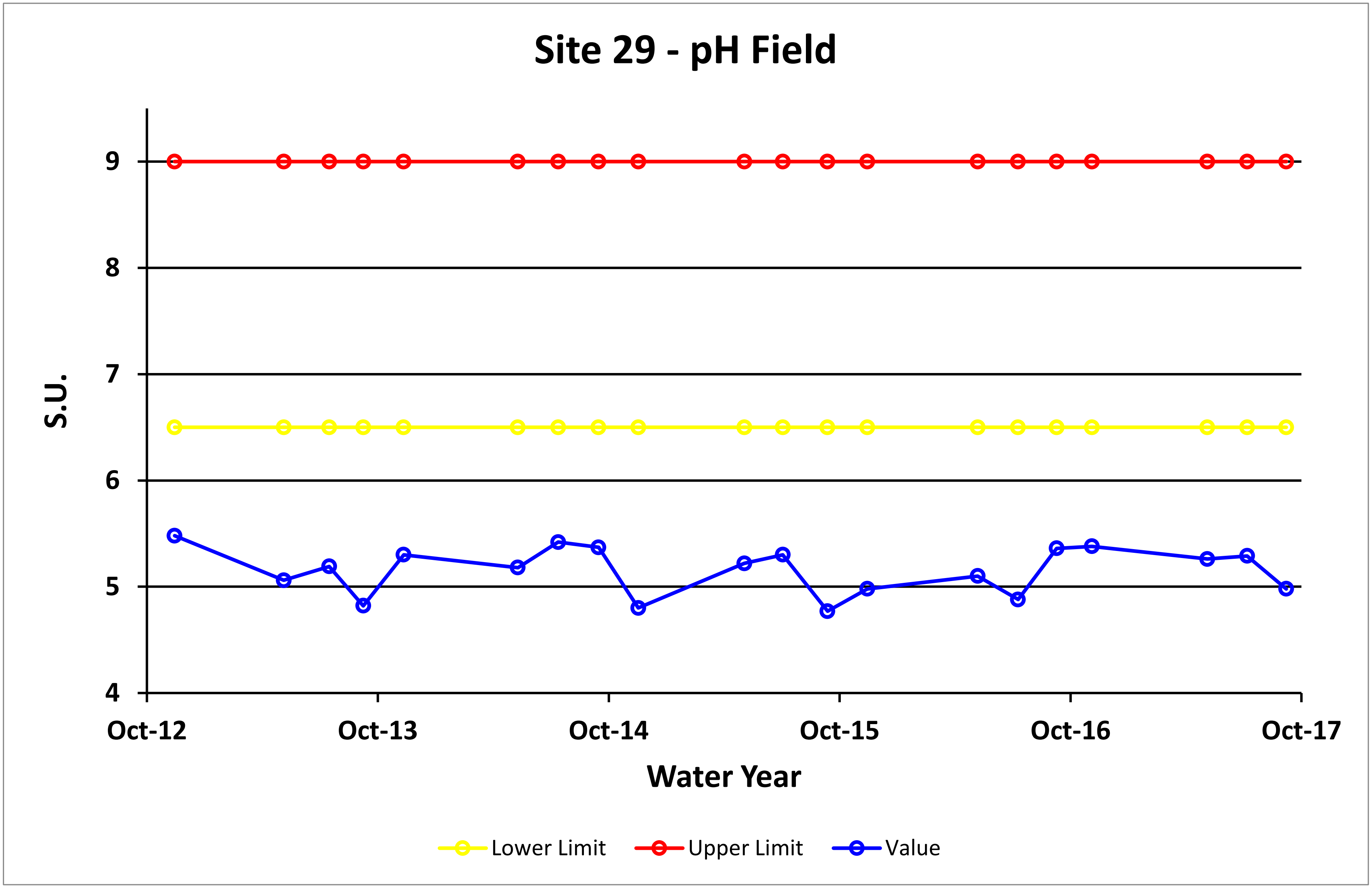

Site 29 - Water Temperature
°C
20
18
16
14
12
10
8
6
4
2
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value

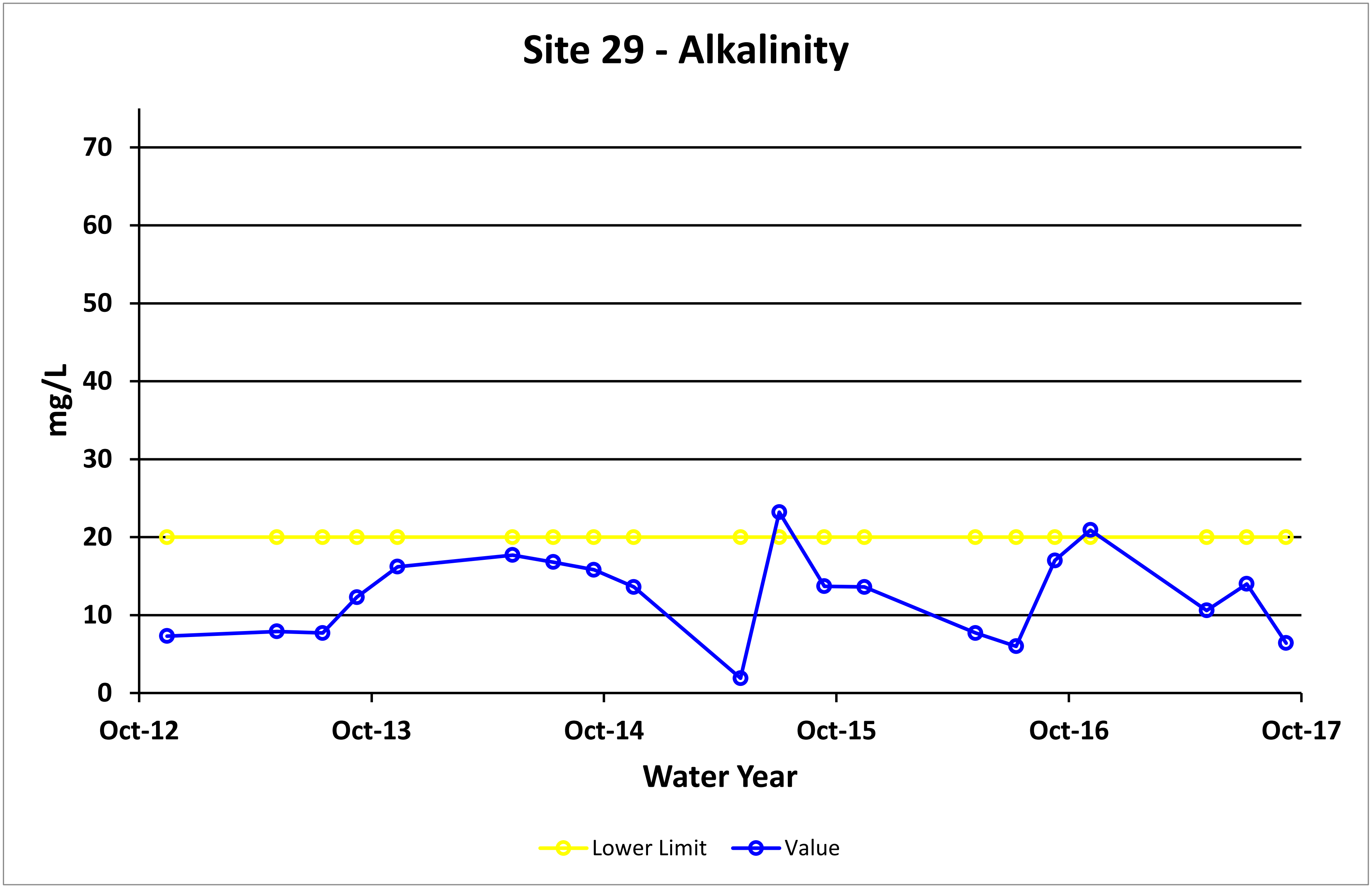

Site 29 - Conductivity Laboratory
µmhos
200
150
100
50
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value



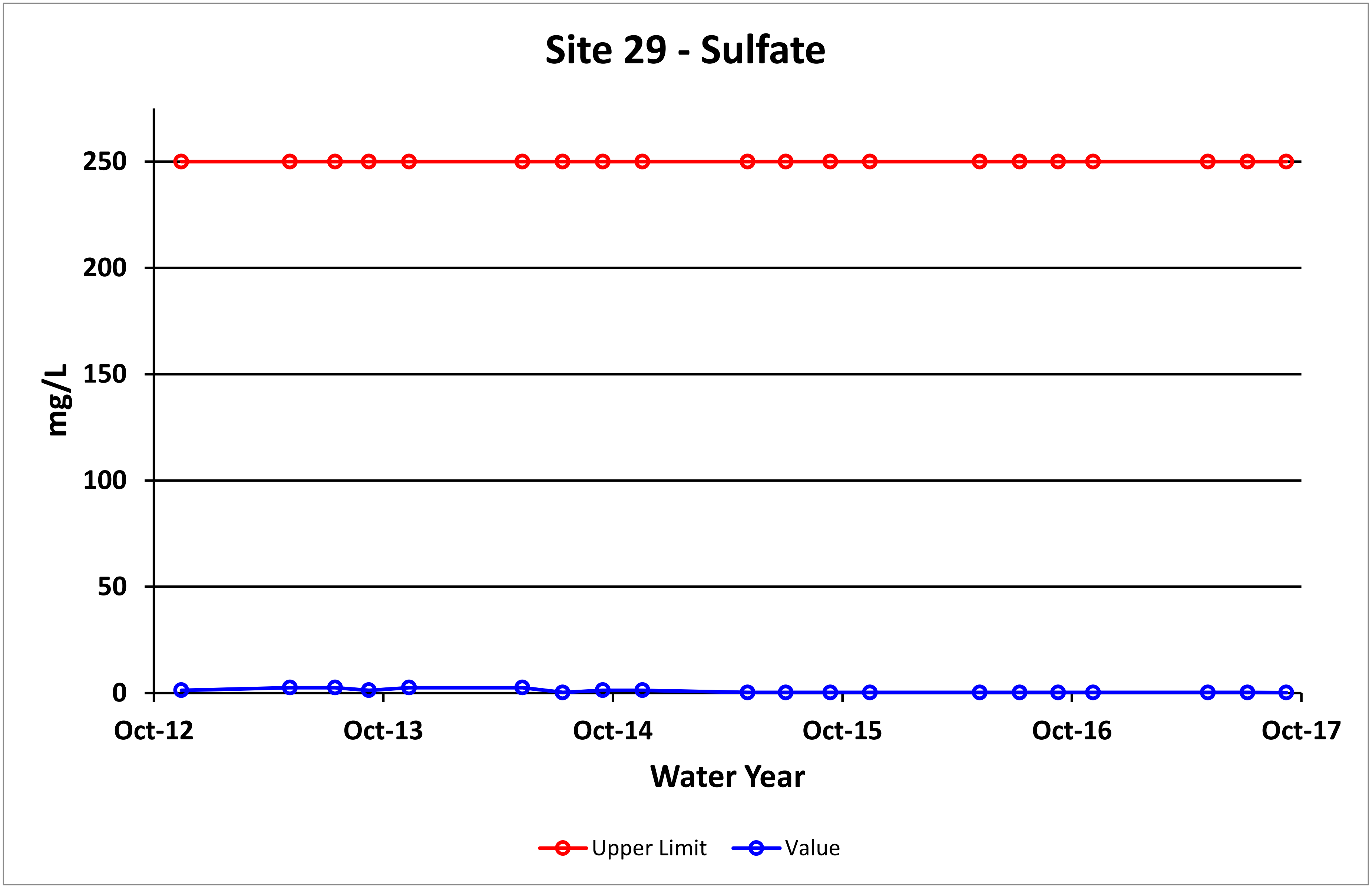
Site 29 - Conductivity Field
µmhos
200
150
100
50
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value


Site 29 - pH Laboratory
S.U.
9
8
7
6
5
4
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Lower Limit
Upper Limit
Value

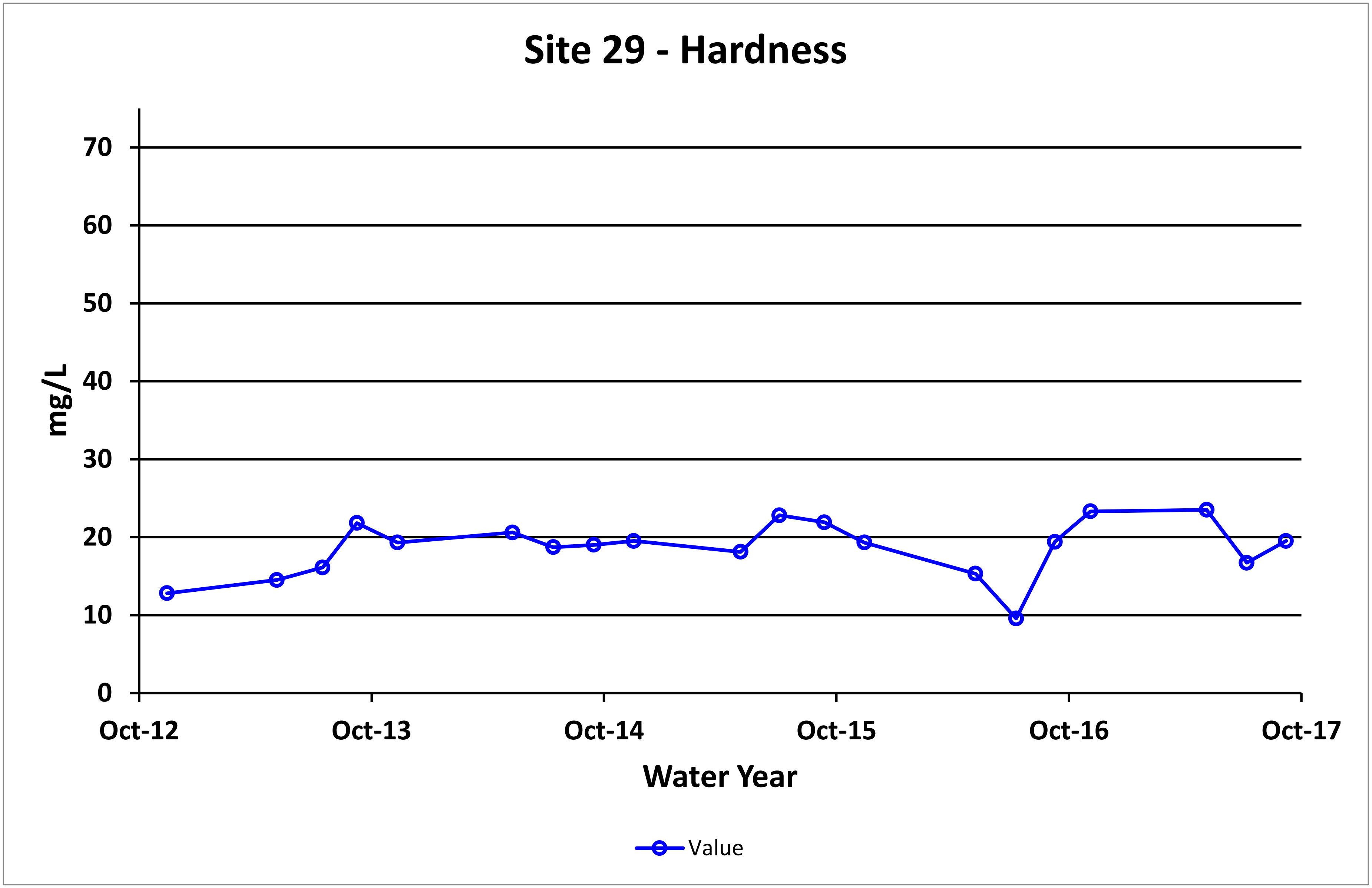

Site 29 - pH Field
S.U.
9
8
7
6
5
4
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Lower Limit
Upper Limit
Value

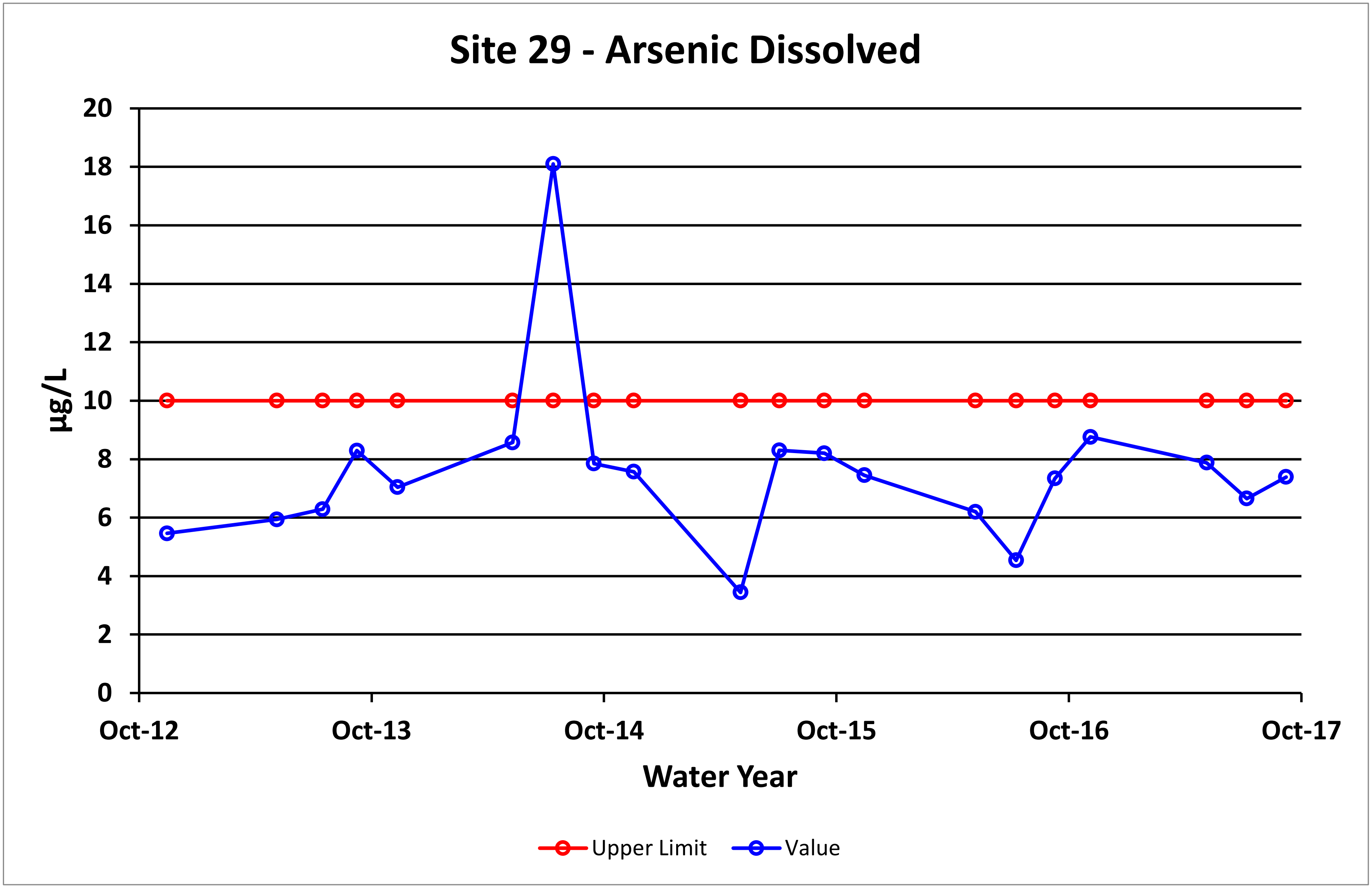


Site 29 - Alkalinity
mg/L
70
60
50
40
30
20
10
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Lower Limit
Value

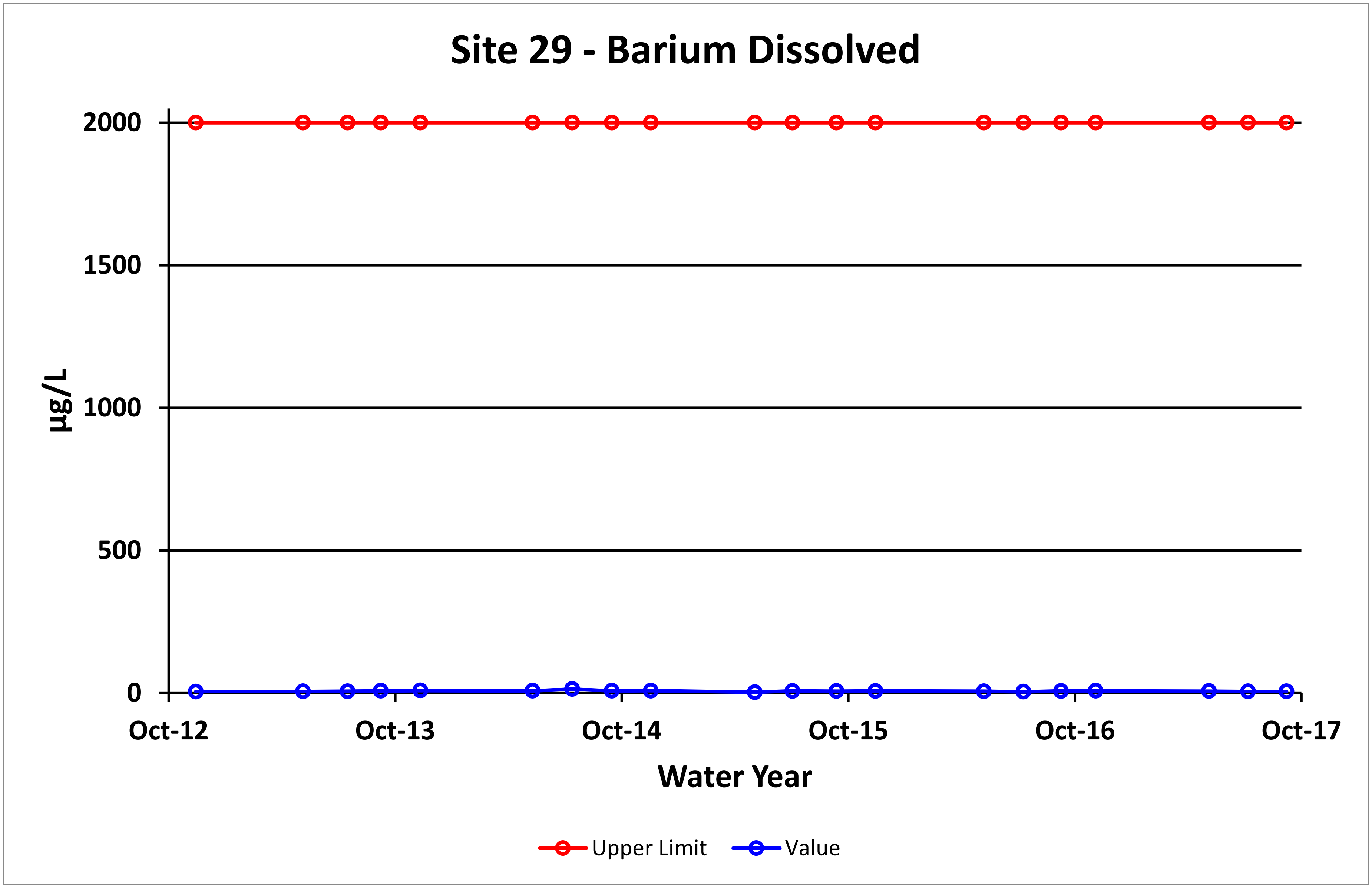


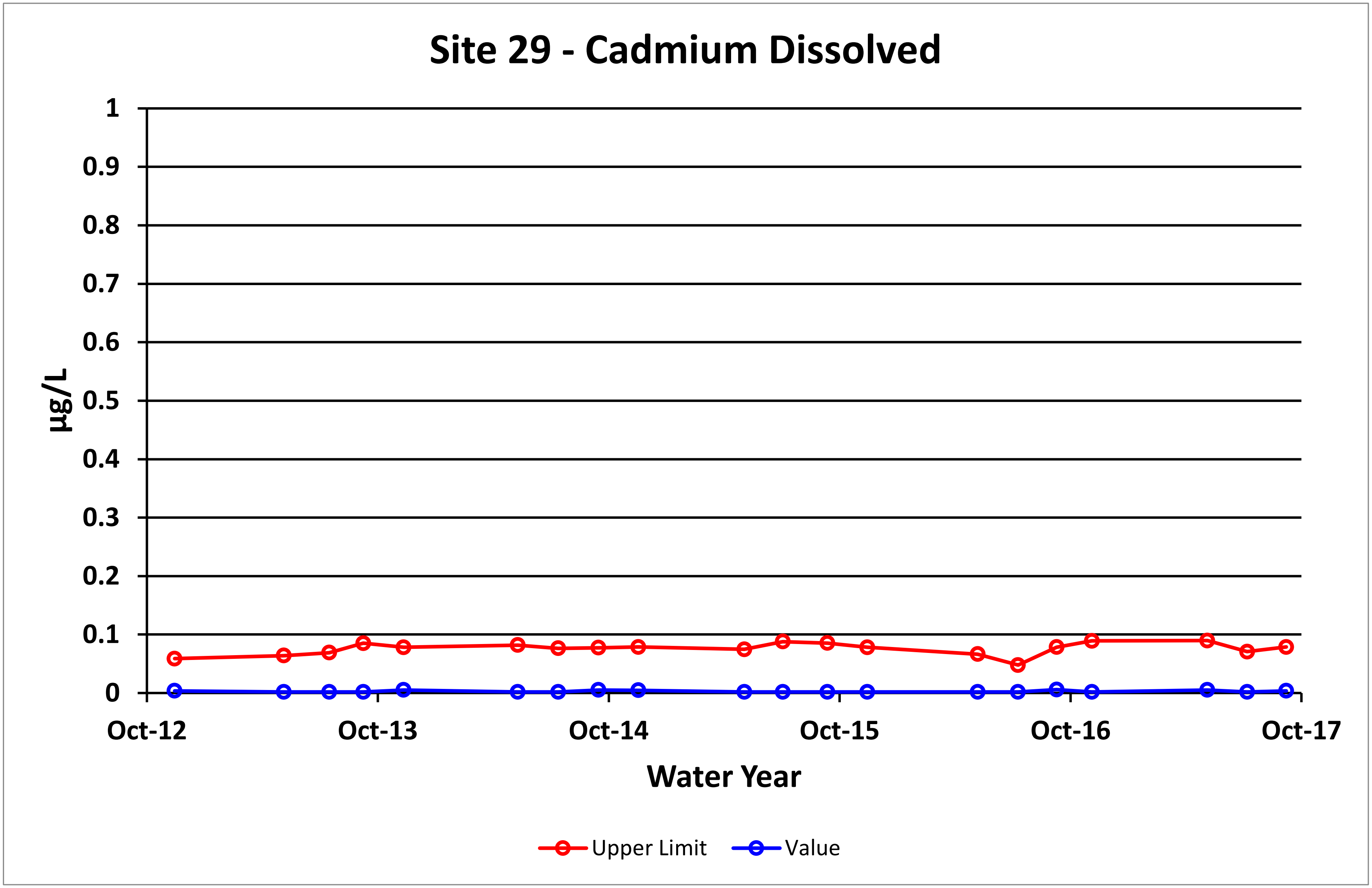
Site 29 - Sulfate
mg/L
250
200
150
100
50
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

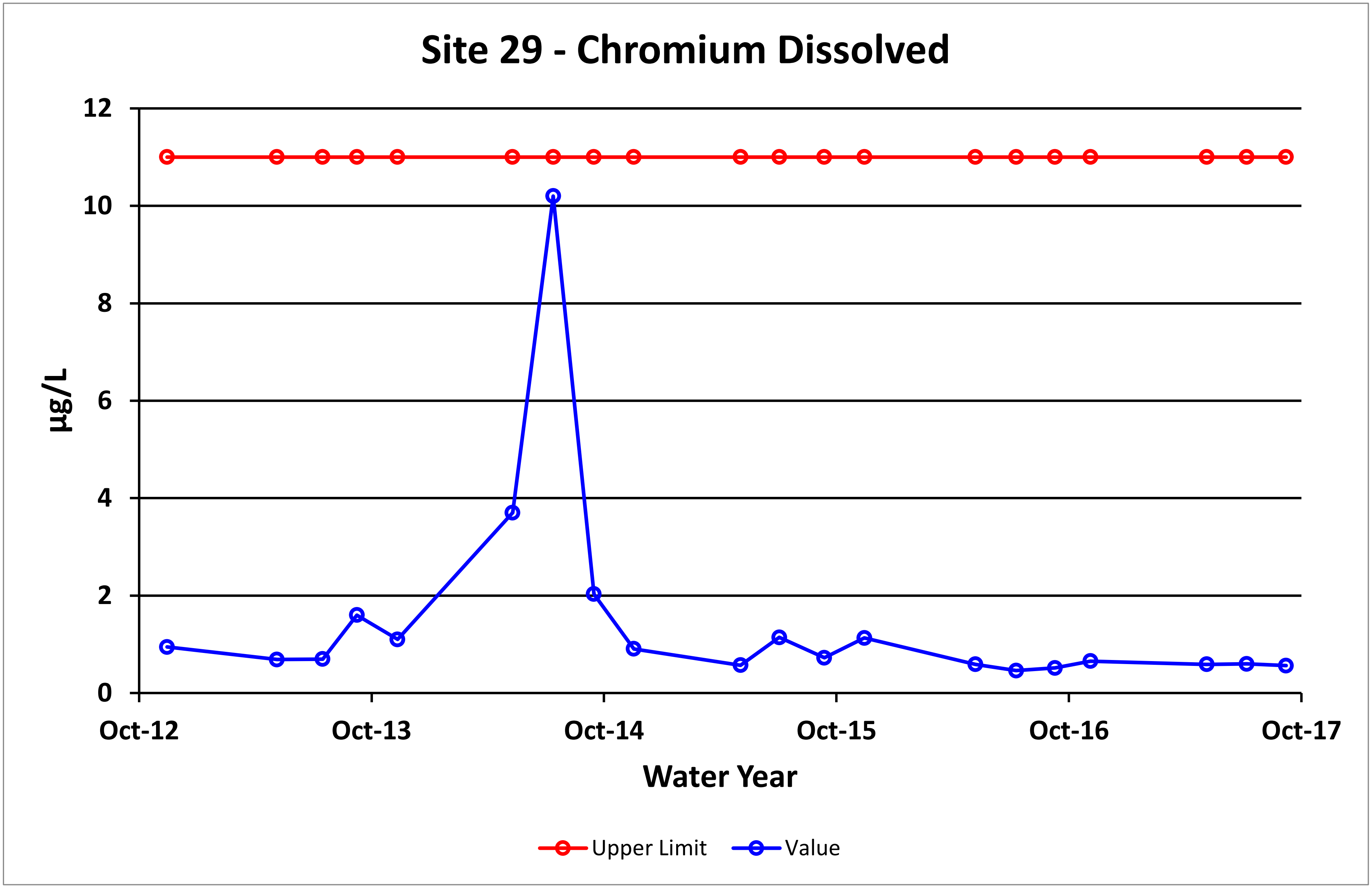

Site 29 - Hardness
mg/L
70
60
50
40
30
20
10
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value



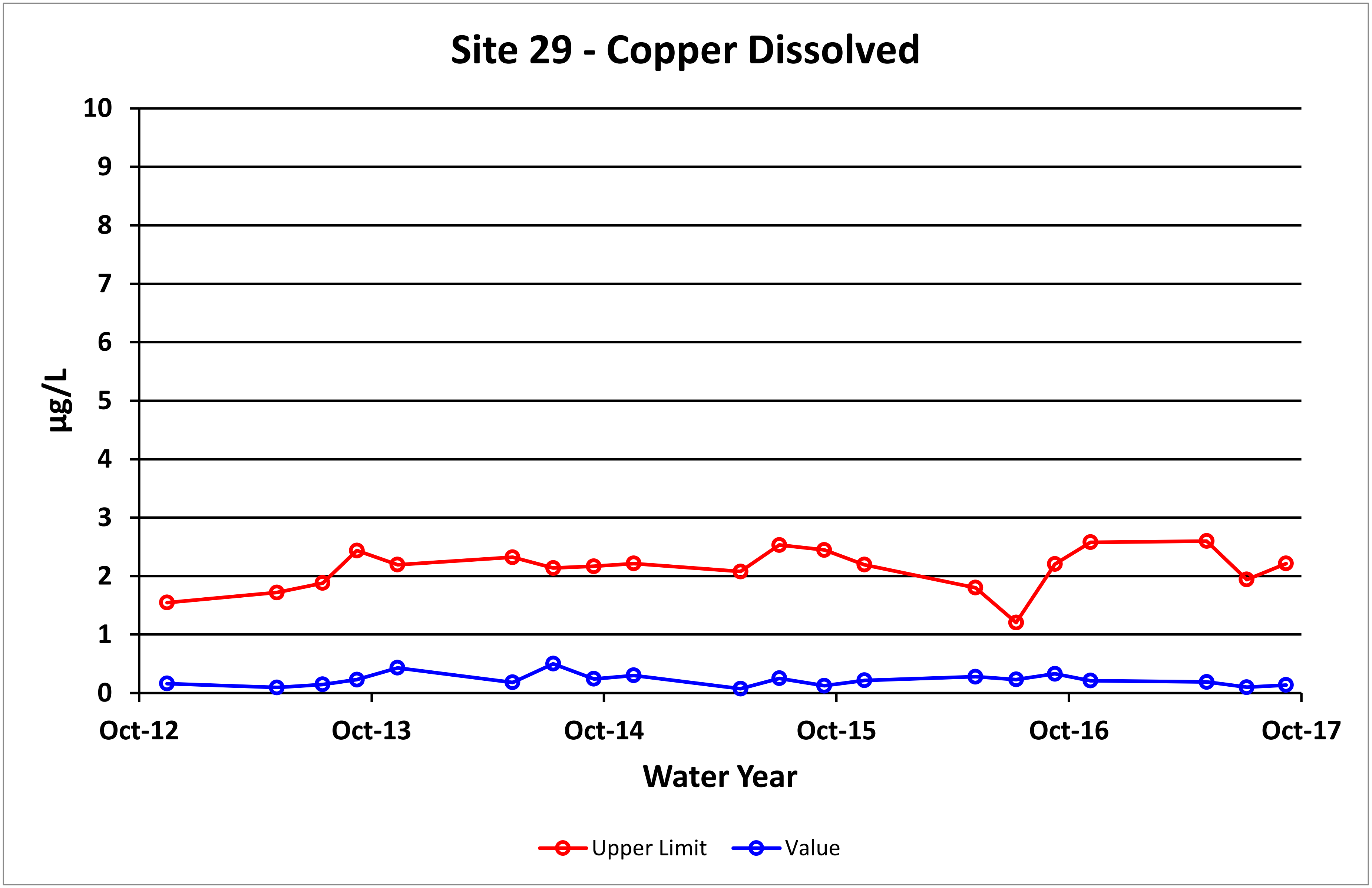
Site 29 - Arsenic Dissolved
µg/L
20
18
16
14
12
10
8
6
4
2
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

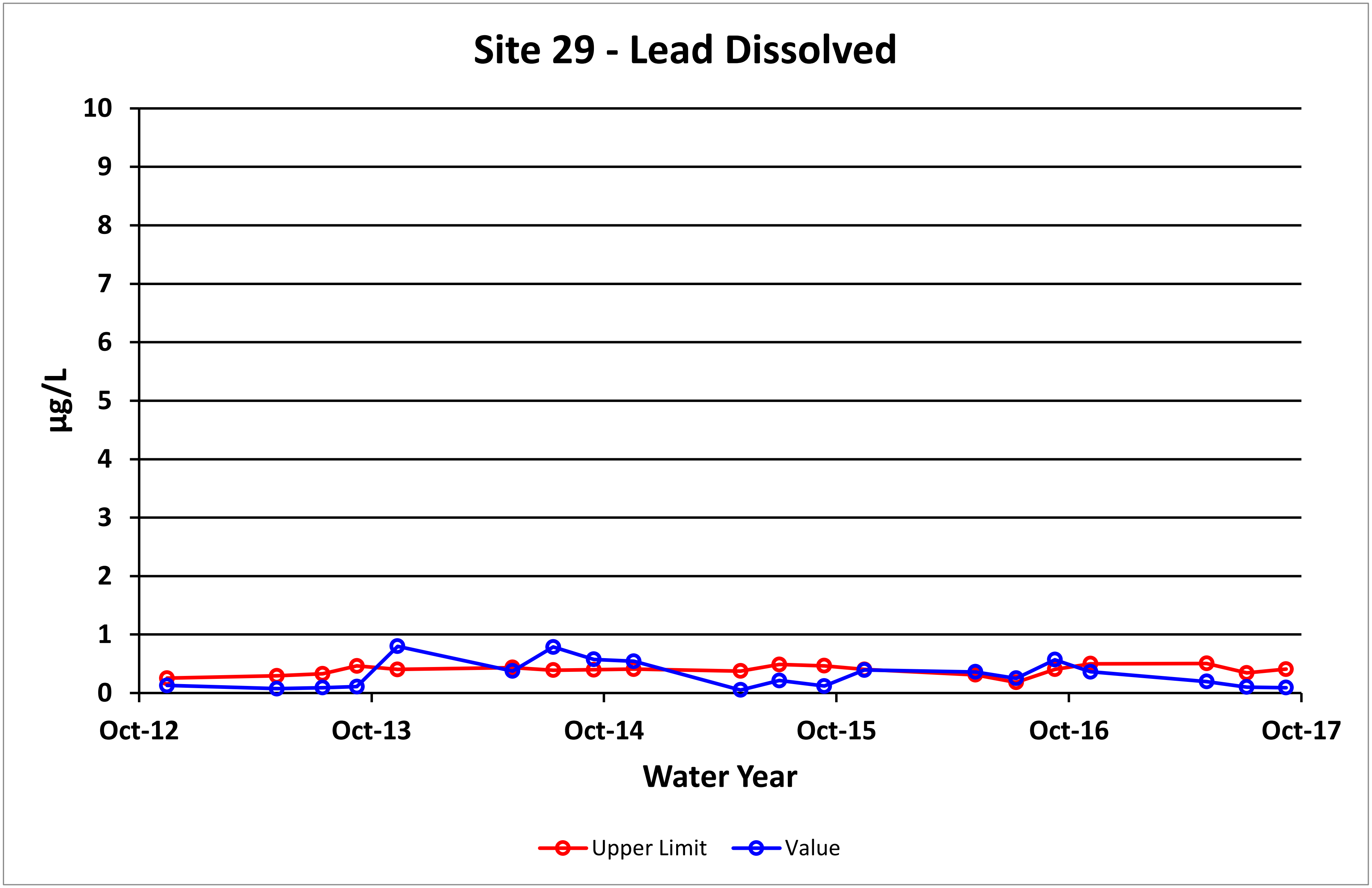

Site 29 - Barium Dissolved
2000
1500
1000
500
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

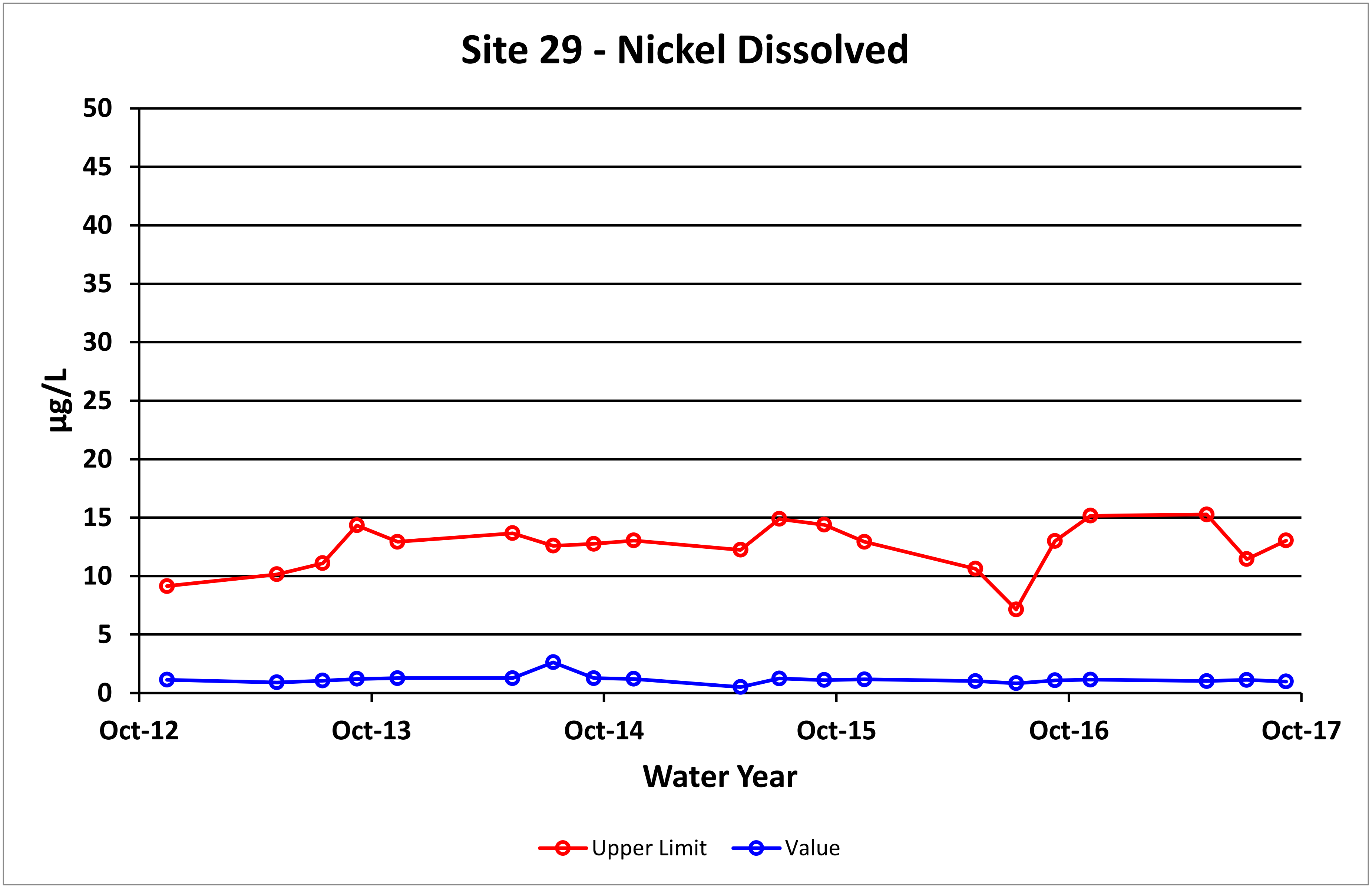

Site 29 - Cadmium Dissolved
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

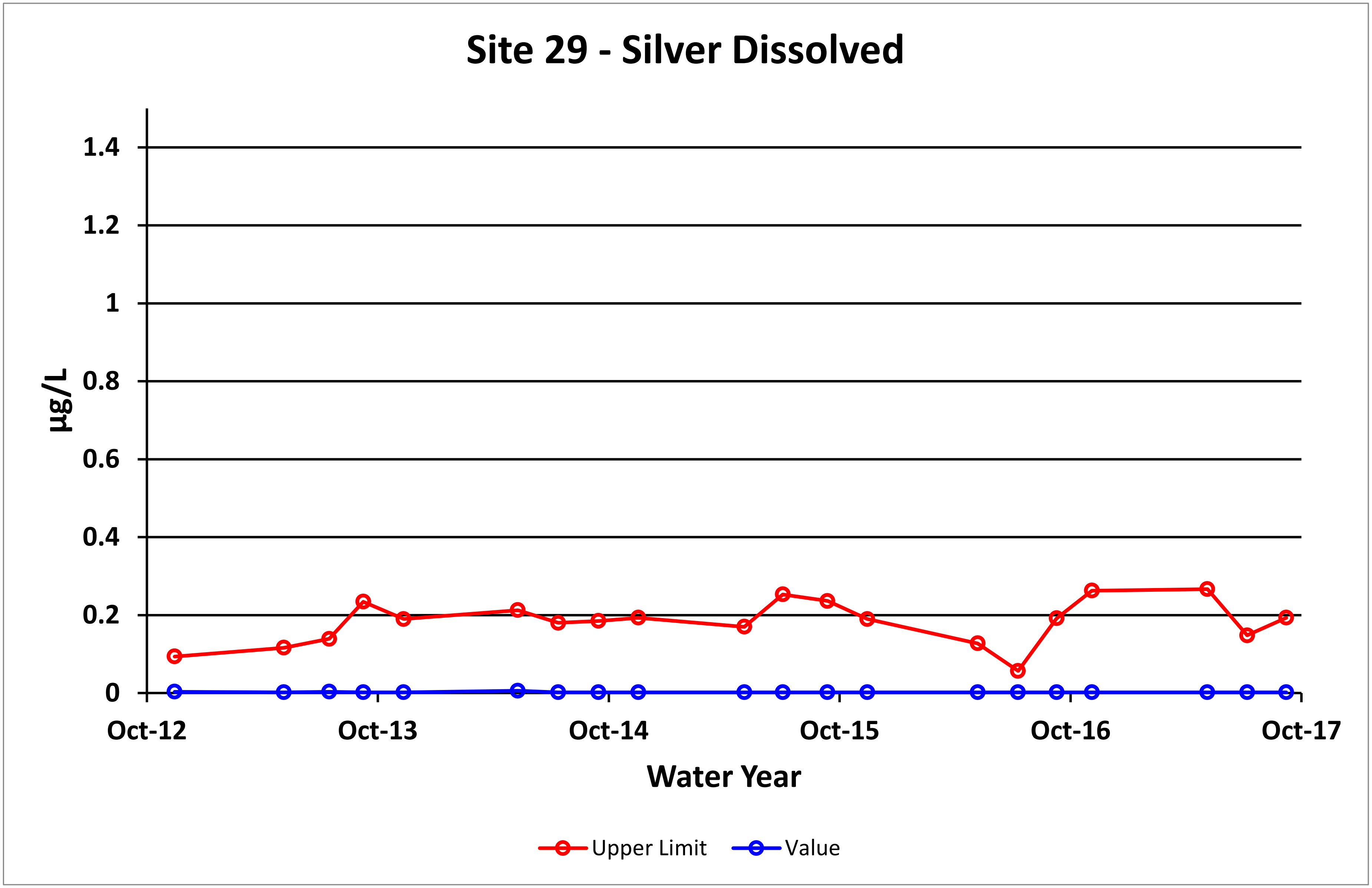


Site 29 - Chromium Dissolved
12
10
8
6
4
2
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

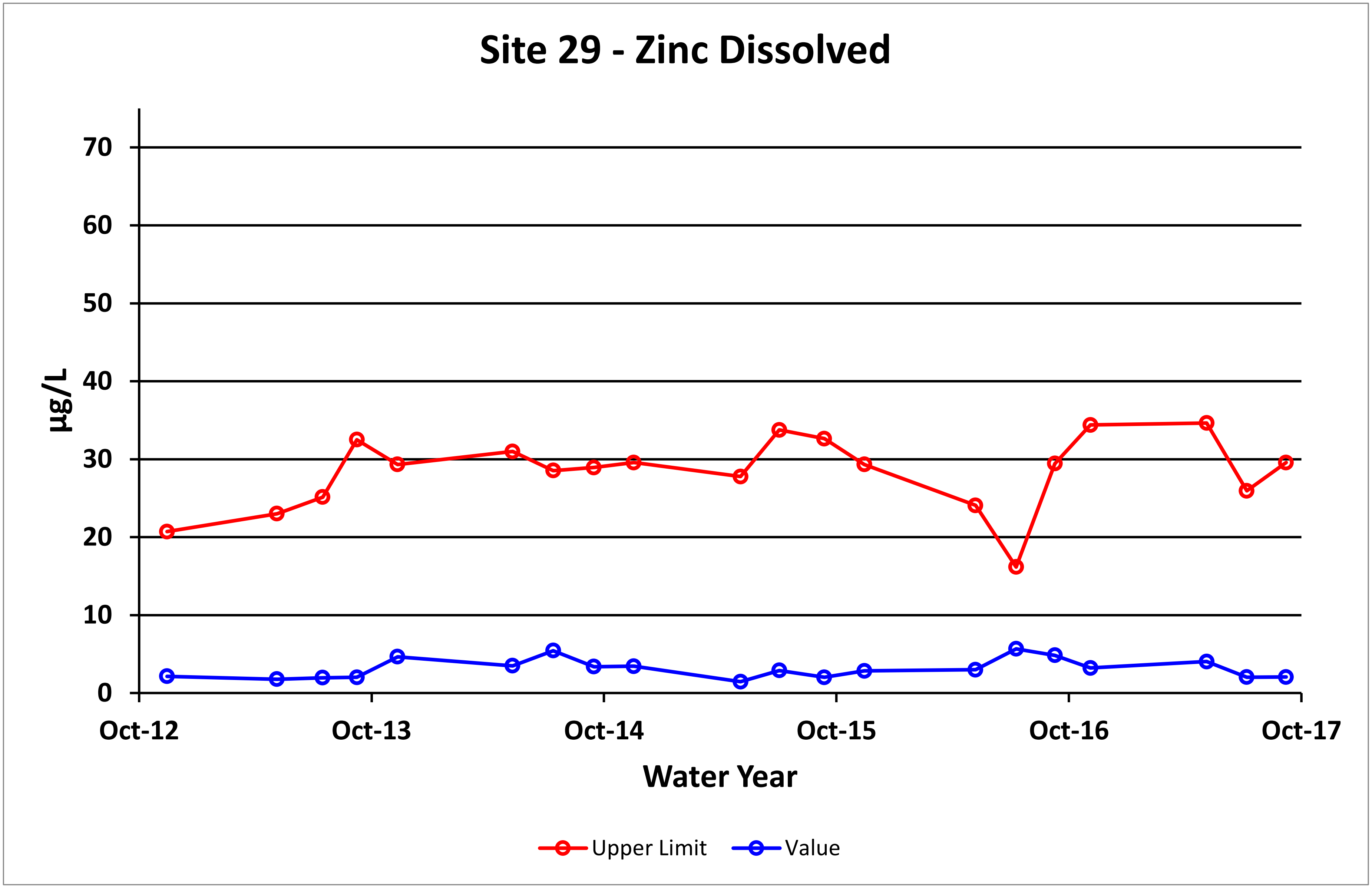

Site 29 - Copper Dissolved
10
9
8
7
6
5
4
3
2
1
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

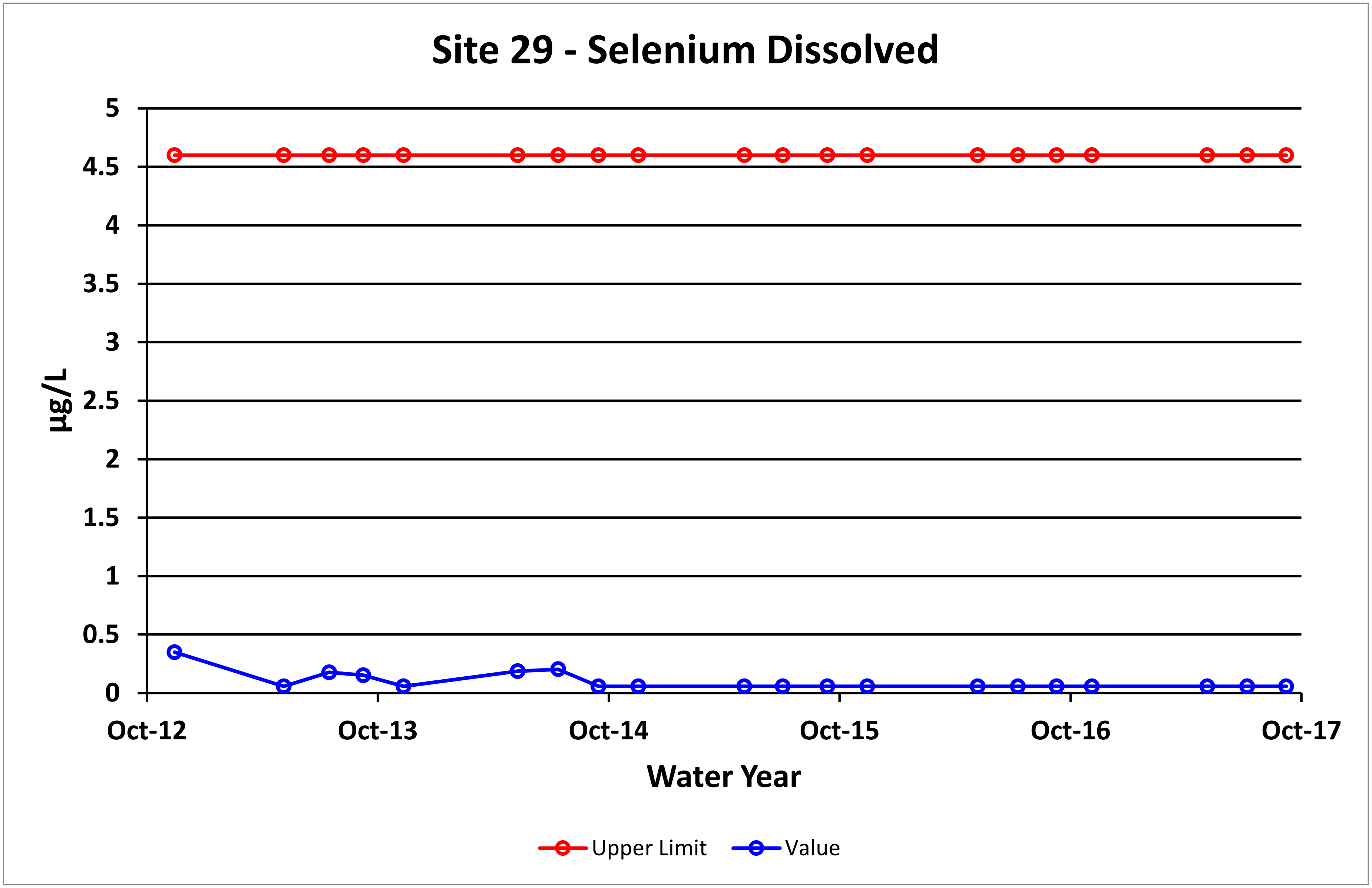

Site 29 - Lead Dissolved
10
9
8
7
6
5
4
3
2
1
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value


Site 29 - Nickel Dissolved
µg/L
50
45
40
35
30
25
20
15
10
5
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

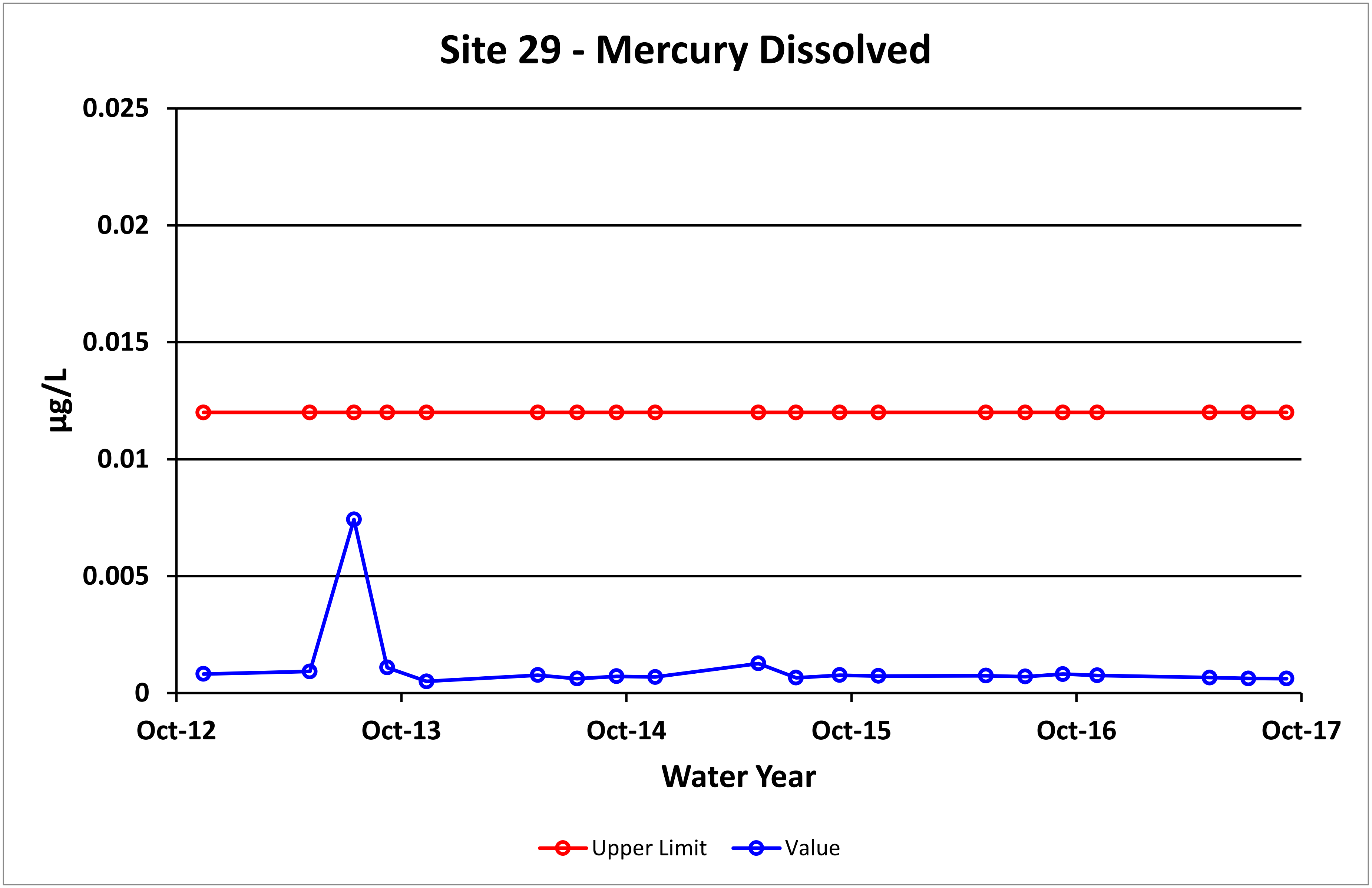


Site 29 - Silver Dissolved
µg/L
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value


Site 29 - Zinc Dissolved
70
60
50
40
30
20
10
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value



Site 29 - Selenium Dissolved
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value


Site 29 - Mercury Dissolved
0.025
0.02
0.015
0.01
0.005
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

INTERPRETIVE REPORT
SITE 32

The data collected during the current water year are listed in the following "Table of Results for Water Year 2017" report. The table includes all the required FWMP analyte data (field and laboratory) collected for the current water year and a series of flags keyed to the summary report "Qualified Data by QA Reviewer". The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of ½ MDL for the purpose of median calculation.

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

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

The data for 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 2017

			Limits		
Sample Date	**Parameter**	**Value**	**Lower**	**Upper**	**Hardness**
7-Nov-16	Alk	14.6 mg/L	20		8.31 mg/L
7-Nov-16	Pb	1.13 µg/L		0.15	8.31 mg/L
7-Nov-16	pHfld	5.28 su	6.5	9	8.31 mg/L
9-May-17	pHfld	6.23 su	6.5	9	61.3 mg/L
11-Jul-17	pHfld	6.07 su	6.5	9.00	63.1 mg/L
11-Sep-17	pHfld	5.90 su	6.5	9.00	50.7 mg/L

All four of the annual sampling events for field pH and one event for total alkalinity were in exceedance. Well completion in organic rich peat, as discussed for Sites 27 and 29, is a reasonable explanation for the low pH and alkalinity values. The fall lead value exceeded the AWQS. As noted in the interpretive section for Site 29 fugitive tailings dust may be contributing to the elevated lead levels monitored at Site 32.

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, field pH, total alkalinity, total sulfate, and dissolved zinc. Calculation details of the Seasonal Kendall analyses are presented in detail on the pages following this interpretive section. The adjacent table summarizes the results on the data collected between Oct-11 and Sep-17 (WY2012-WY2017). No statistically significant trends were identified for six-year period.

Table of Summary Statistics for Trend Analysis

	Mann-Kendall test statistics			Sen's slope estimate	
Parameter	**n***	**p****	**Trend**	**Q**	**Q(%)**
Conductivity Field	6	0.75			
pH Field	6	0.83			
Alkalinity, Total	6	0.87			
Sulfate, Total	6	Inconsistent detection limits			
Zinc, Dissolved	6	0.35			

* Number of Years ** Significance level

Trend analysis was not performed on the total sulfate dataset because of a change in the method detection limit used by 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.

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

The construction-related influences on near-surface hydrology discussed previously caused specific conductance and alkalinity to go out of control during the current 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**

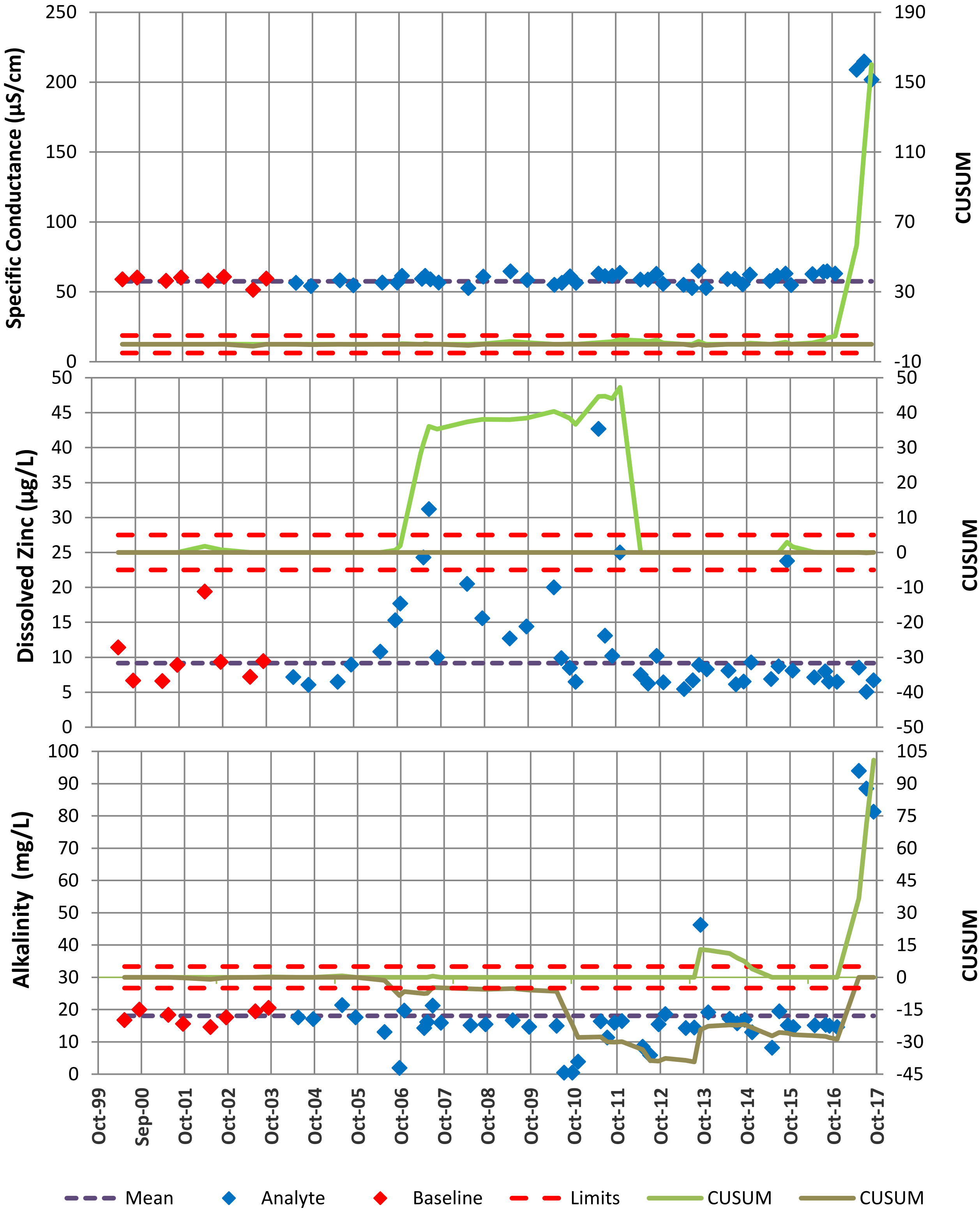


Table of Results for Water Year 2017

Site 032FMG - 'Monitoring Well - 5S'

Sample Date/Parameter	Oct 2016	Nov 2016	Dec 2016	Jan 2017	Feb 2017	Mar 2017	Apr 2017	May 2017	Jun 2017	Jul 2017	Aug 2017	Sep 2017	**Median**
Water Temp (°C)		8						7.6		6.9		7.7	7.7
Conductivity-Field(μmho)		63						209		214.8		201.8	205.4
Conductivity-Lab (μmho)		57						187		181		174	178
pH Lab (standard units)		4.9						6.16		5.83		5.63	5.73
pH Field (standard units)		5.28						6.23		6.07		5.9	5.99
Total Alkalinity (mg/L)		14.6						94		88.5		81.3	84.9
Total Sulfate (mg/L)		0.3						0.3		0.3		0.5	0.3
Hardness (mg/L)		8.3						61.3		63.1		50.7	56.0
Dissolved As (ug/L)		4.3						2.95		5.15		3.92	4.110
Dissolved Ba (ug/L)		13.6						38.2		51.1		45.8	42.0
Dissolved Cd (ug/L)		0.0075						0.0007		0.0018		0.0018	0.0018
Dissolved Cr (ug/L)		1.47						0.428		0.704		0.777	0.741
Dissolved Cu (ug/L)		0.706						0.176		0.227		0.321	0.274
Dissolved Pb (ug/L)		1.13						0.121		0.373		0.277	0.3250
Dissolved Ni (ug/L)		2.91						2.6		4.14		4.03	3.470
Dissolved Ag (ug/L)		0.002						0.005		0.002		0.002	0.002
Dissolved Zn (ug/L)		6.51						8.54		5.08		6.72	6.62
Dissolved Se (ug/L)		0.202						0.057		0.144		0.057	0.101
Dissolved Hg (ug/L)		0.0012						0.000427		0.000693		0.000656	0.000675

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

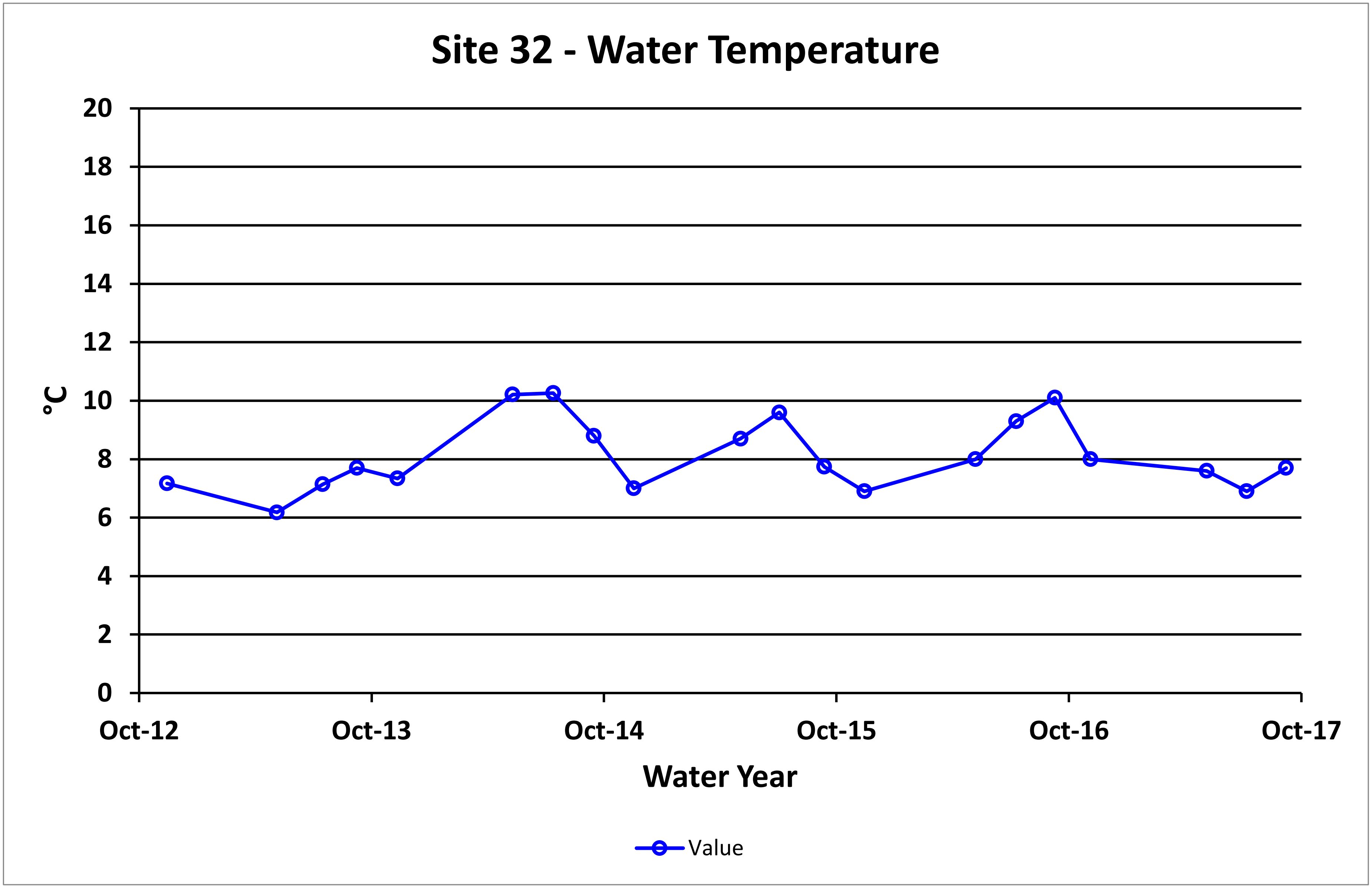
Values reported as less than MDL are replaced by 1/2 MDL for median calculation purposes.

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

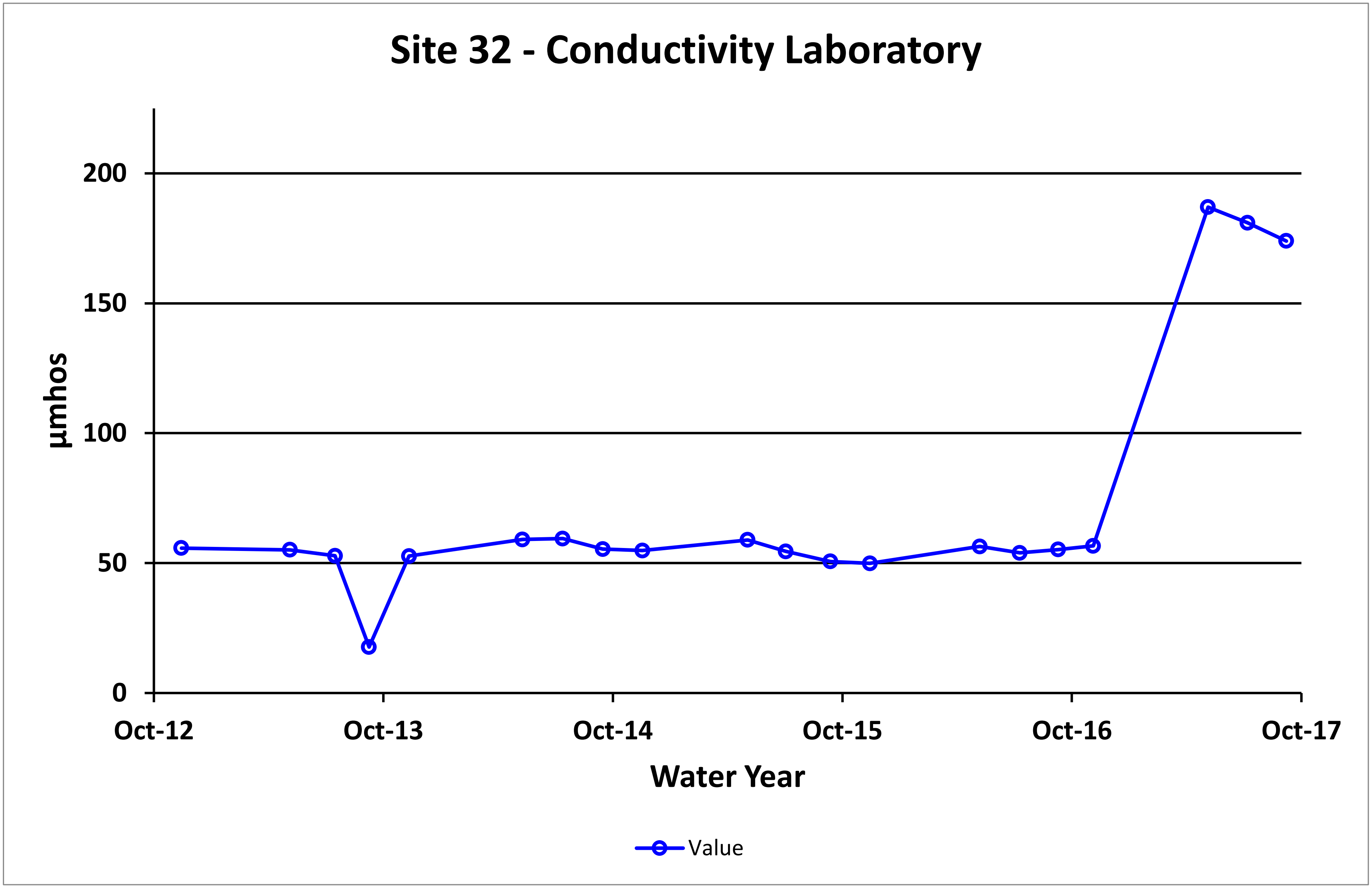
Qualified Data by QA Reviewer

Date Range: 10/01/2016 to 09/30/2017

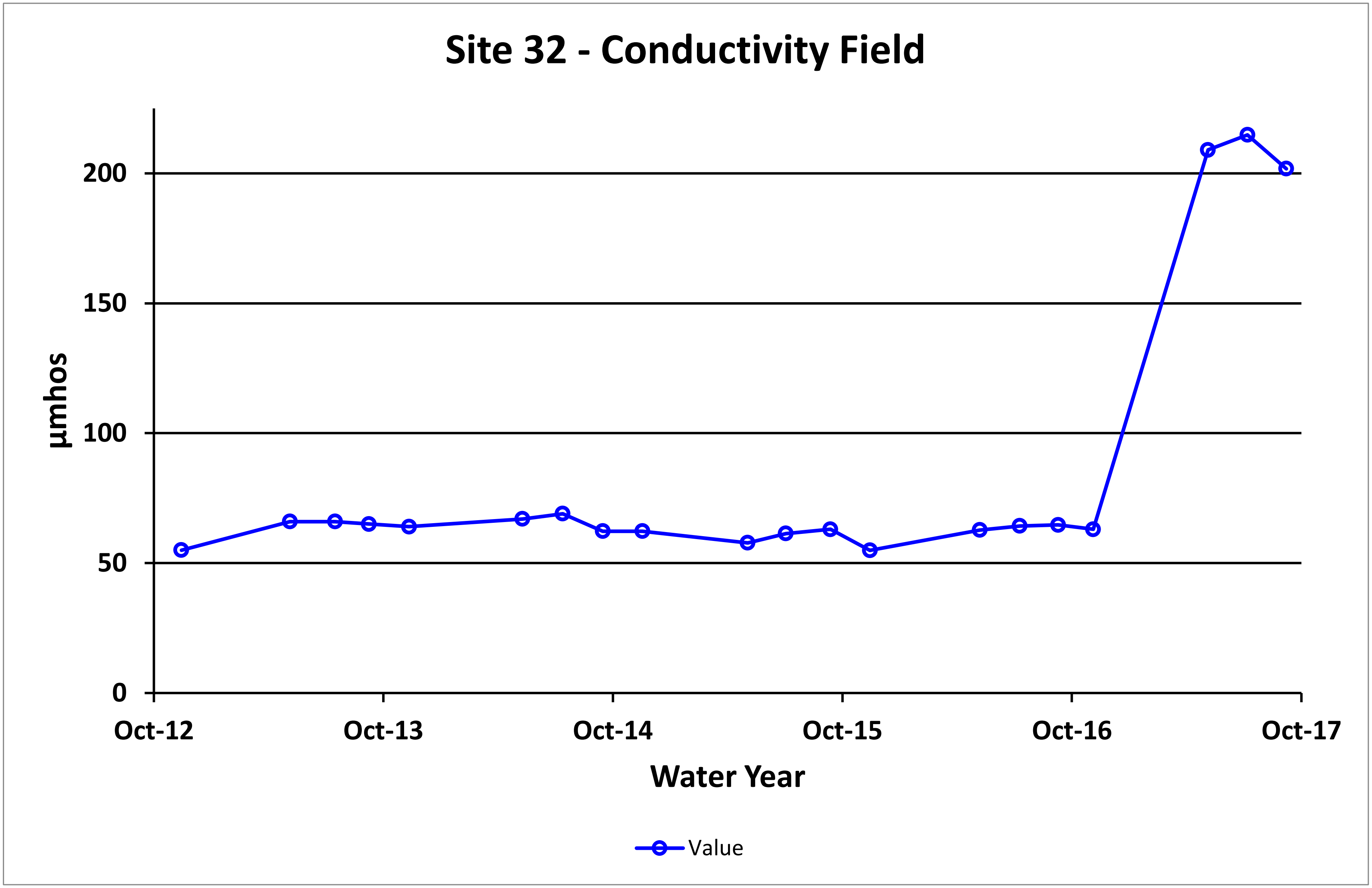
Site No.	Sample Date	Sample Time	Parameter	Value		Qualifier	Reason for Qualifier
032FMG	11/7/2016	12:00 PM	Diss. Cd-ICP/MS	0.00747	µg/L	J	Below Quantitative Range
			Diss. Se-ICP/MS	0.2	µg/L	J	Below Quantitative Range
	5/9/2017	12:00 PM	Diss. Ag-ICP/MS	0.00488	µg/L	J	Below Quantitative Range
			Diss. Cd-ICP/MS	0.0007	µg/L	J	Below Quantitative Range
			Diss. Hg-CVAF	0.000427	µg/L	U	Trip Blank Contamination
			Tot. Sulfate	-0.5	mg/L	UJ	Sample Receipt Temperature
	7/11/2017	12:00 PM	Diss. Se-ICP/MS	0.14	µg/L	J	Below Quantitative Range
			Tot. Sulfate	-0.5	mg/L	UJ	Sample Receipt Temperature
	9/11/2017	12:00 PM	Tot. Sulfate	0.48	mg/L	J	Below Quantitative Range

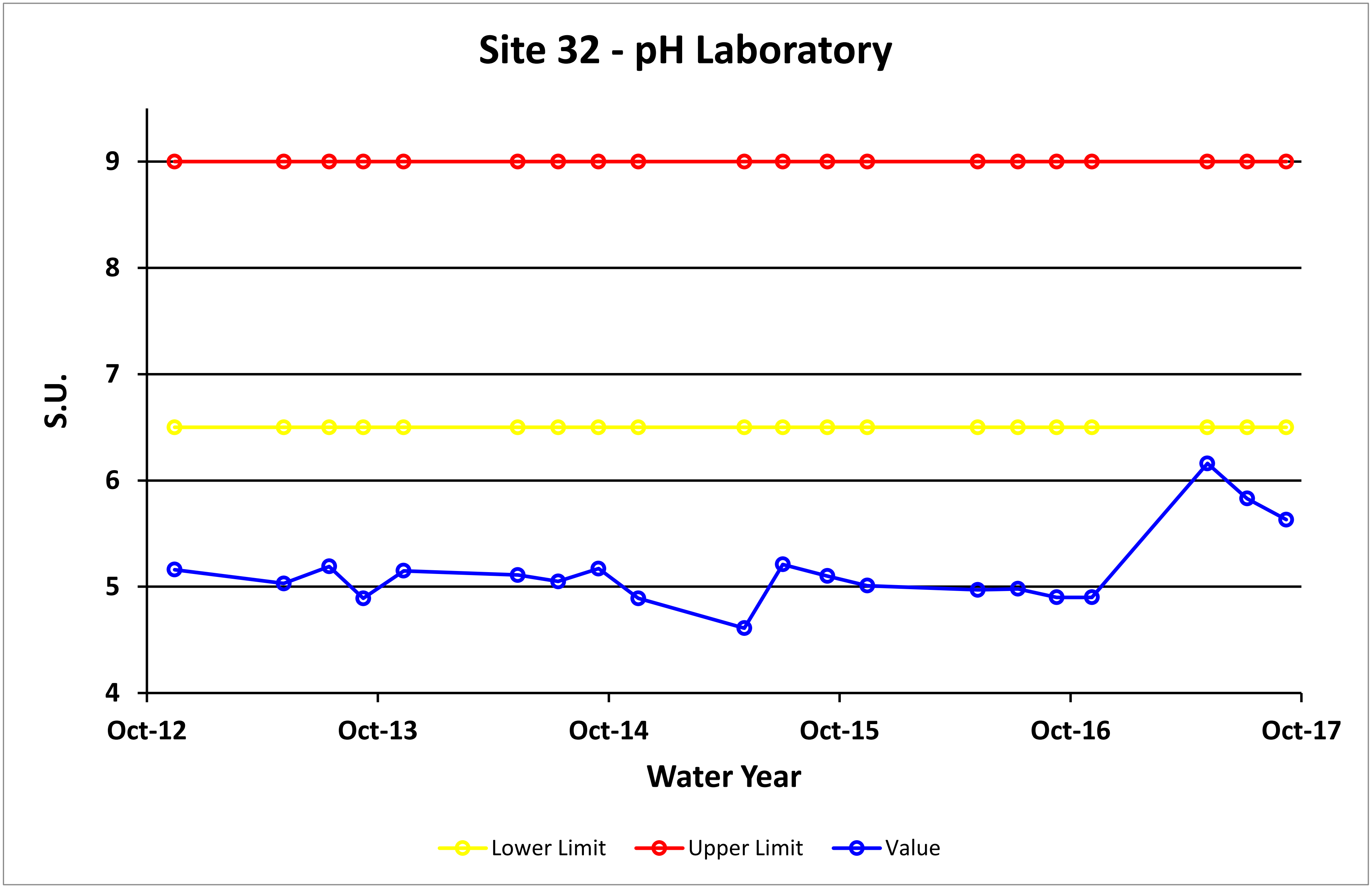


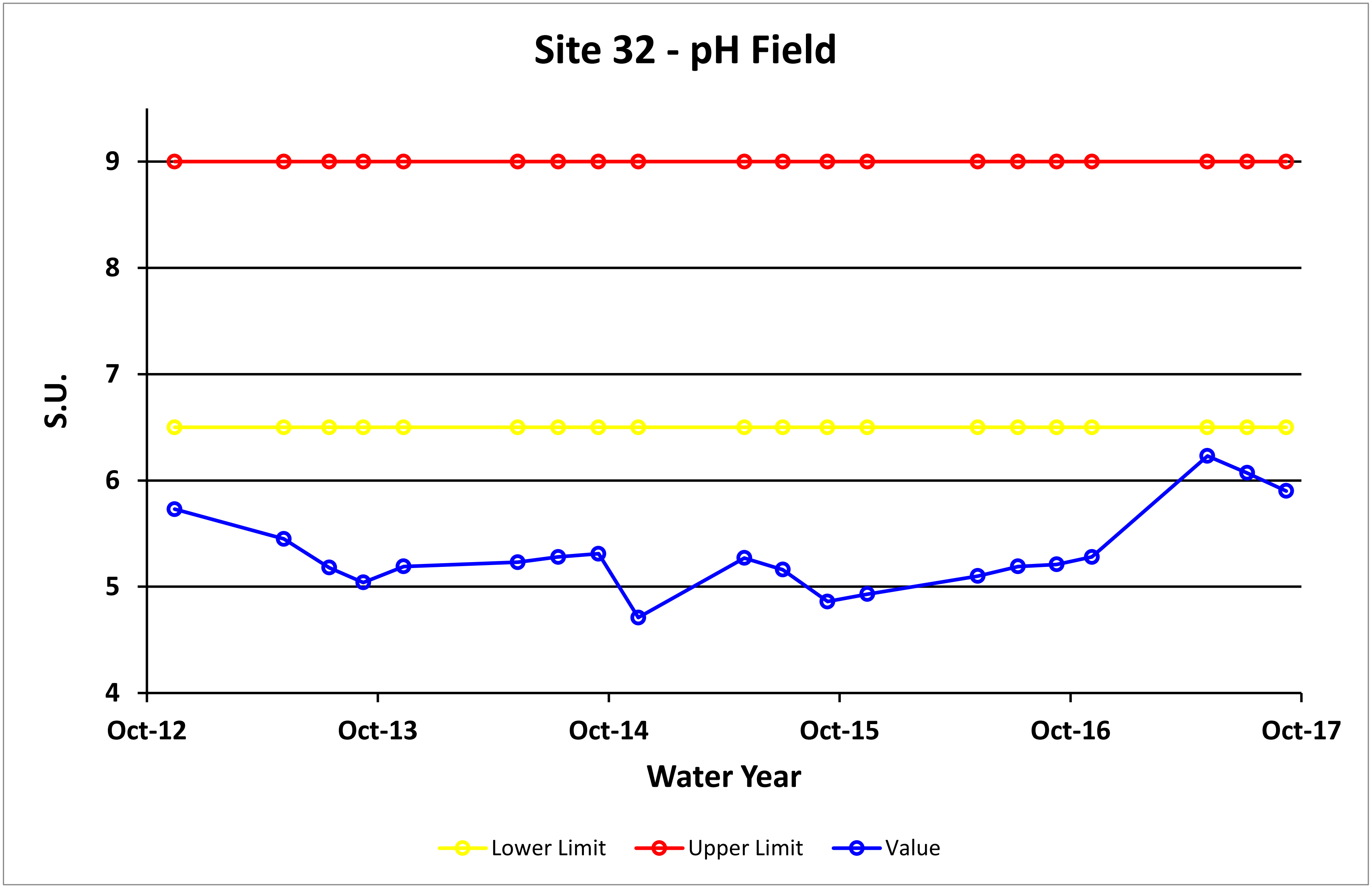
Site 32 - Water Temperature
20
18
16
14
12
10
8
6
4
2
0
°C
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value



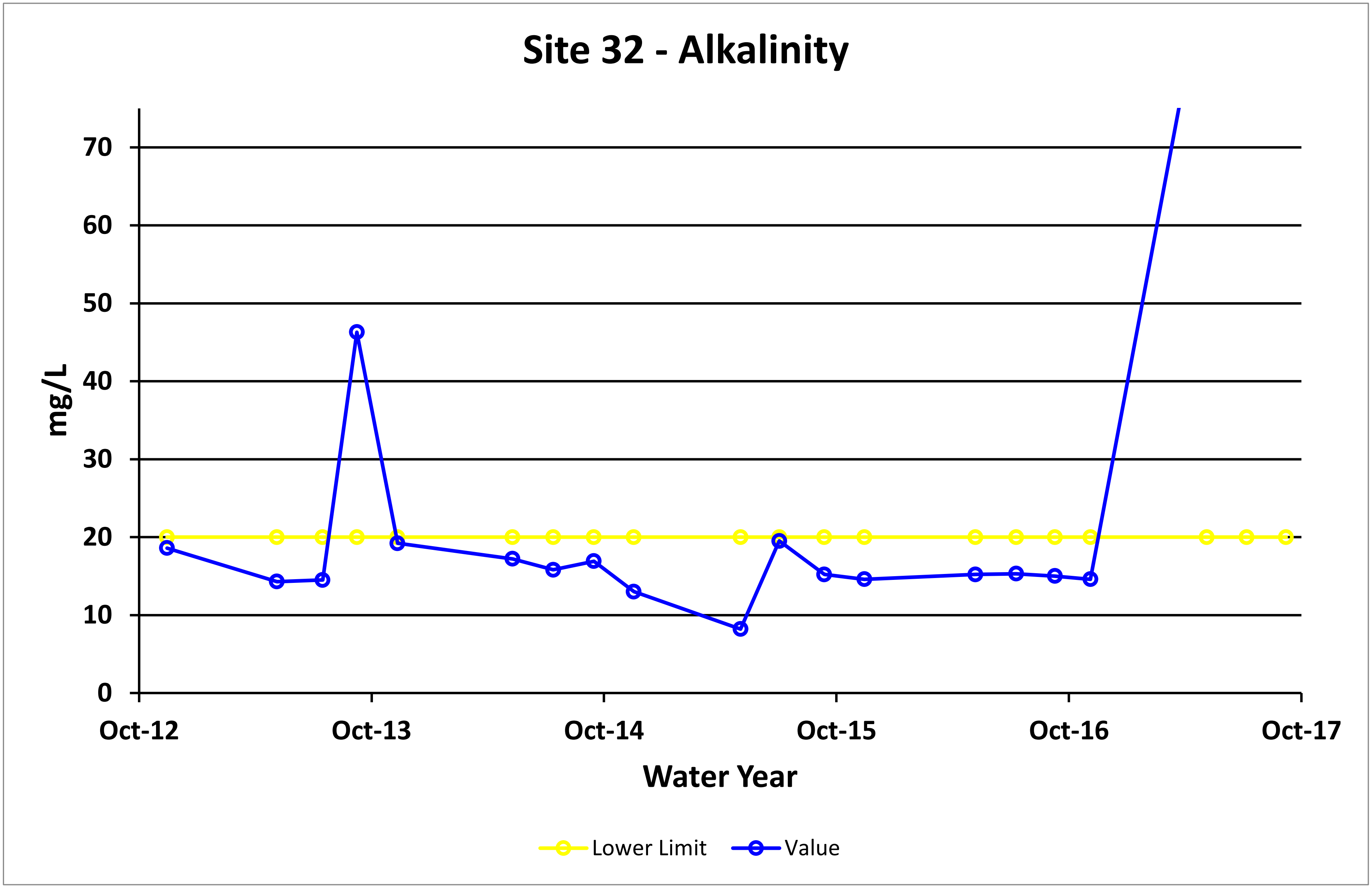
Site 32 - Conductivity Laboratory
µmhos
200
150
100
50
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value


Site 32 - Conductivity Field
µmhos
0
50
100
150
200
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value

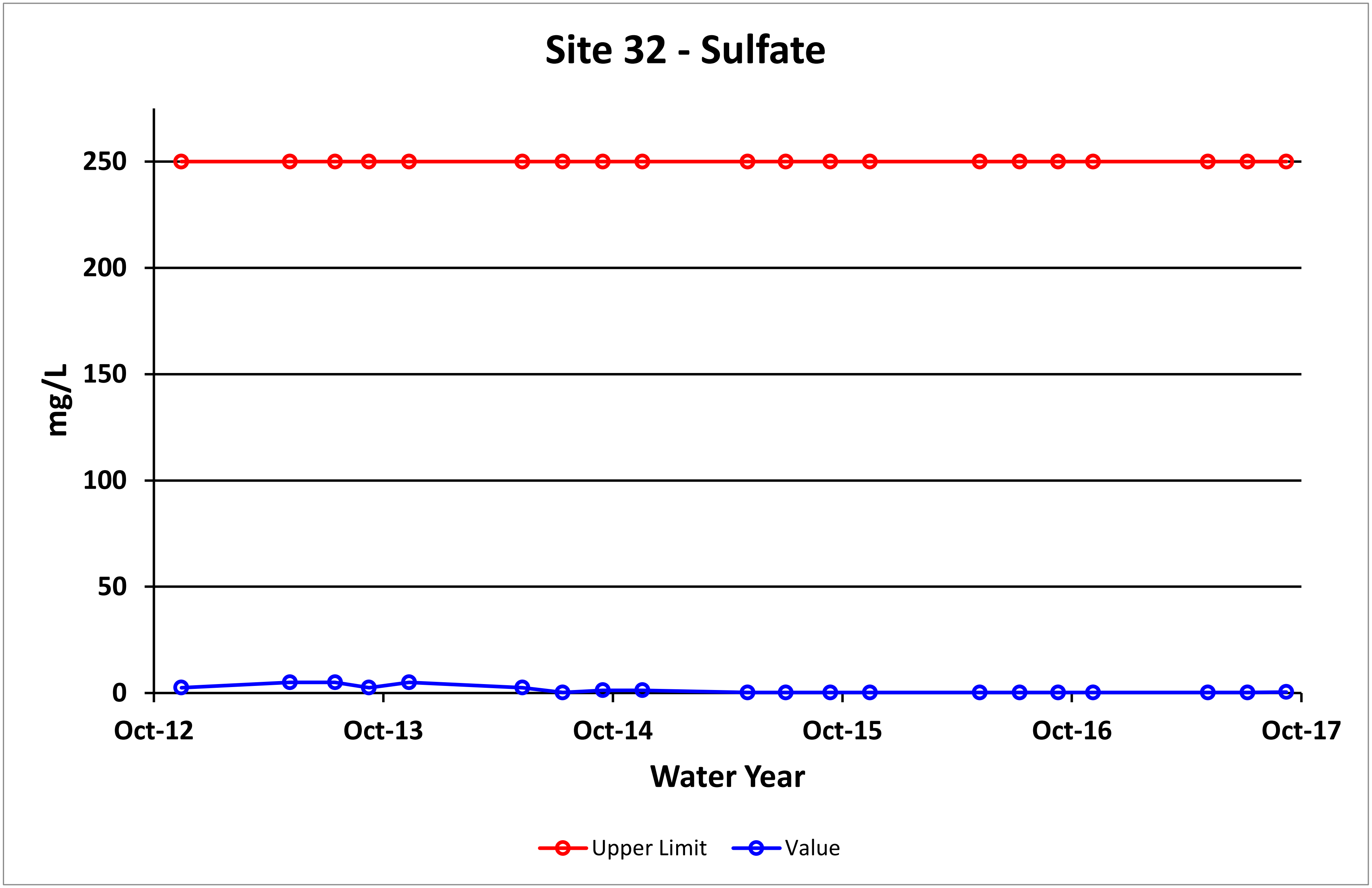

Site 32 - pH Laboratory
S.U.
9
8
7
6
5
4
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Lower Limit
Upper Limit
Value

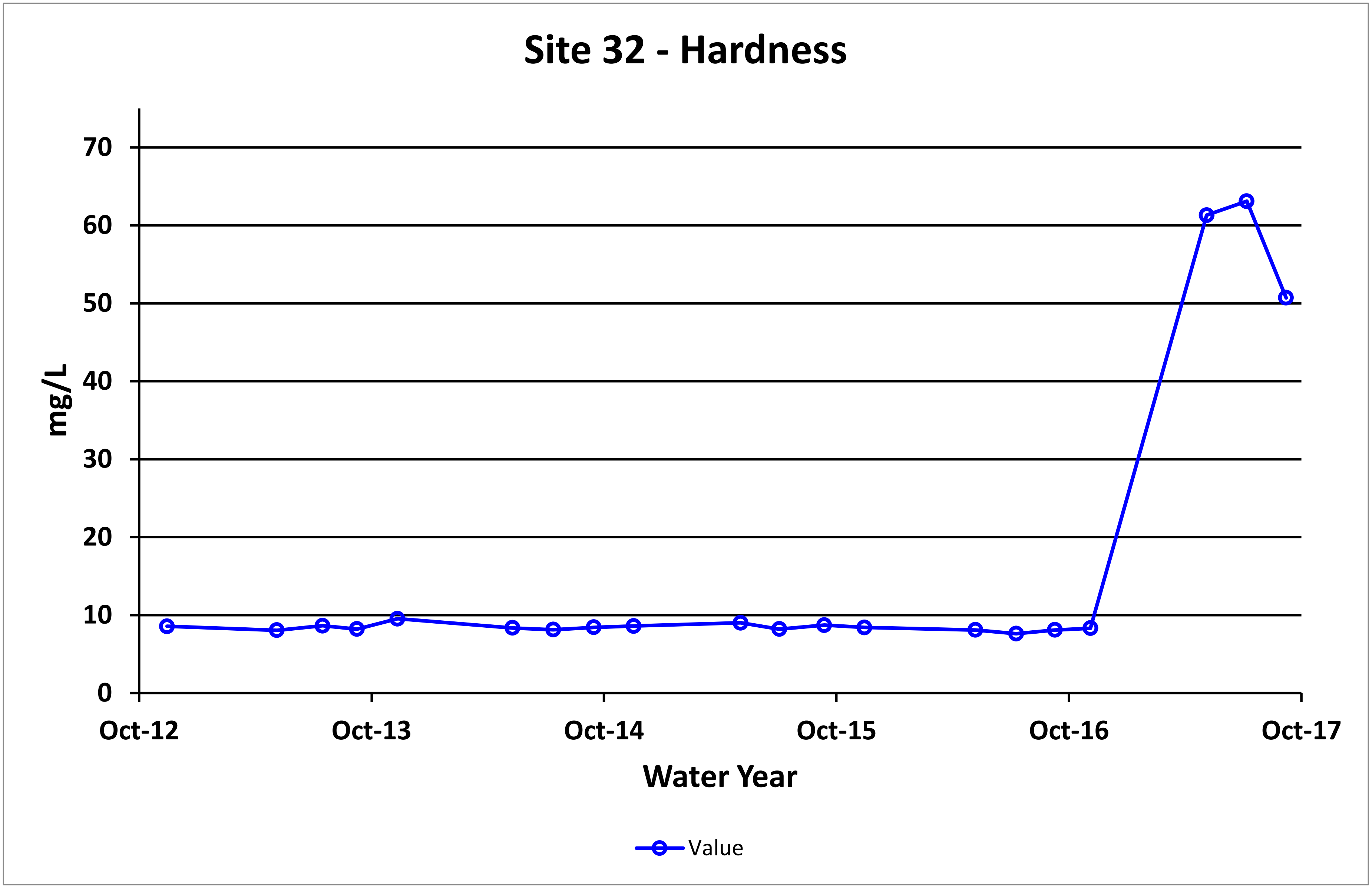


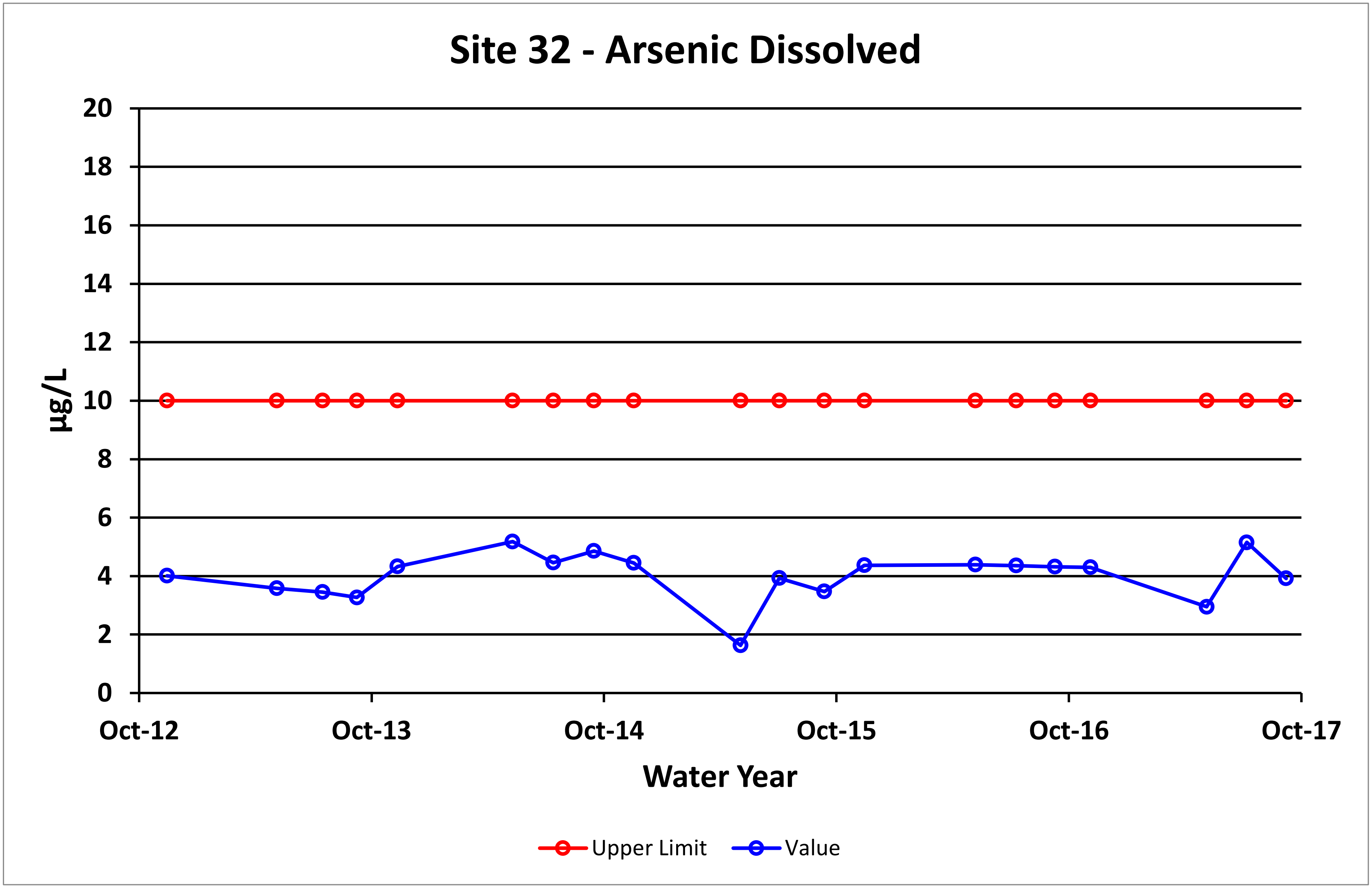
Site 32 - pH Field
S.U.
9
8
7
6
5
4
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Lower Limit
Upper Limit
Value



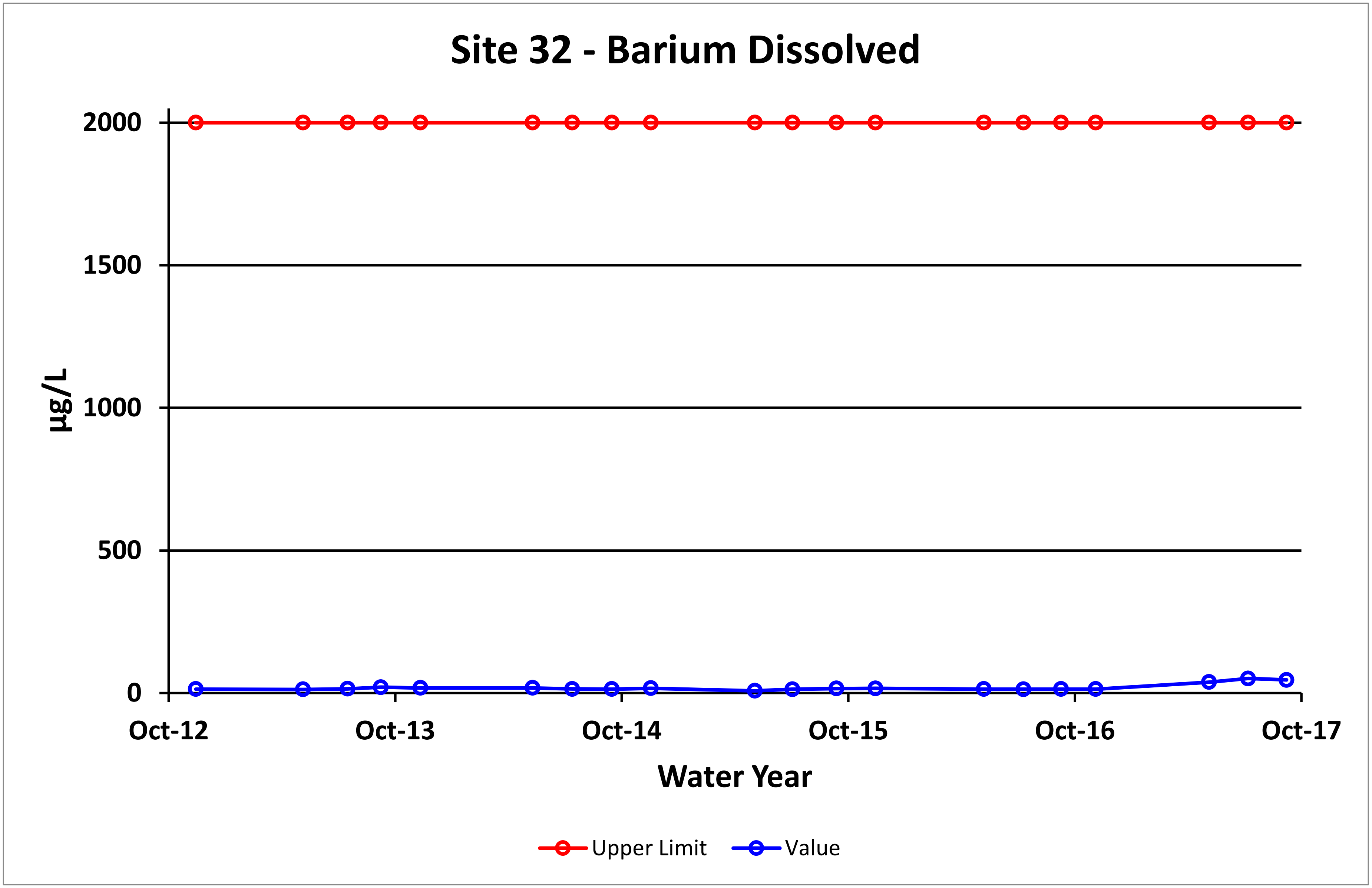
Site 32 - Alkalinity
70
60
50
40
30
20
10
0
mg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Lower Limit
Value


Site 32 - Sulfate
mg/L
250
200
150
100
50
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

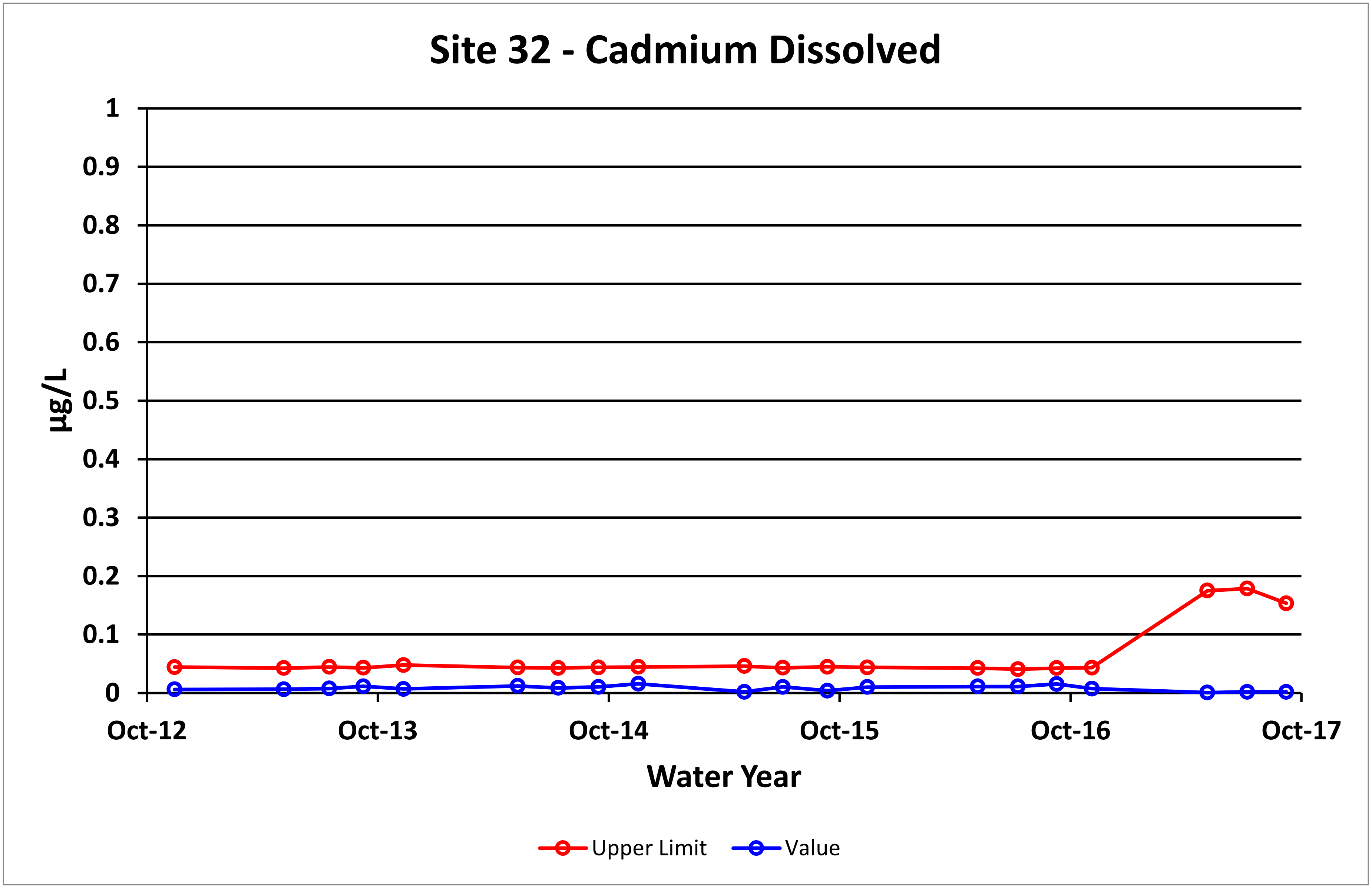

Site 32 - Hardness
mg/L
70
60
50
40
30
20
10
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value

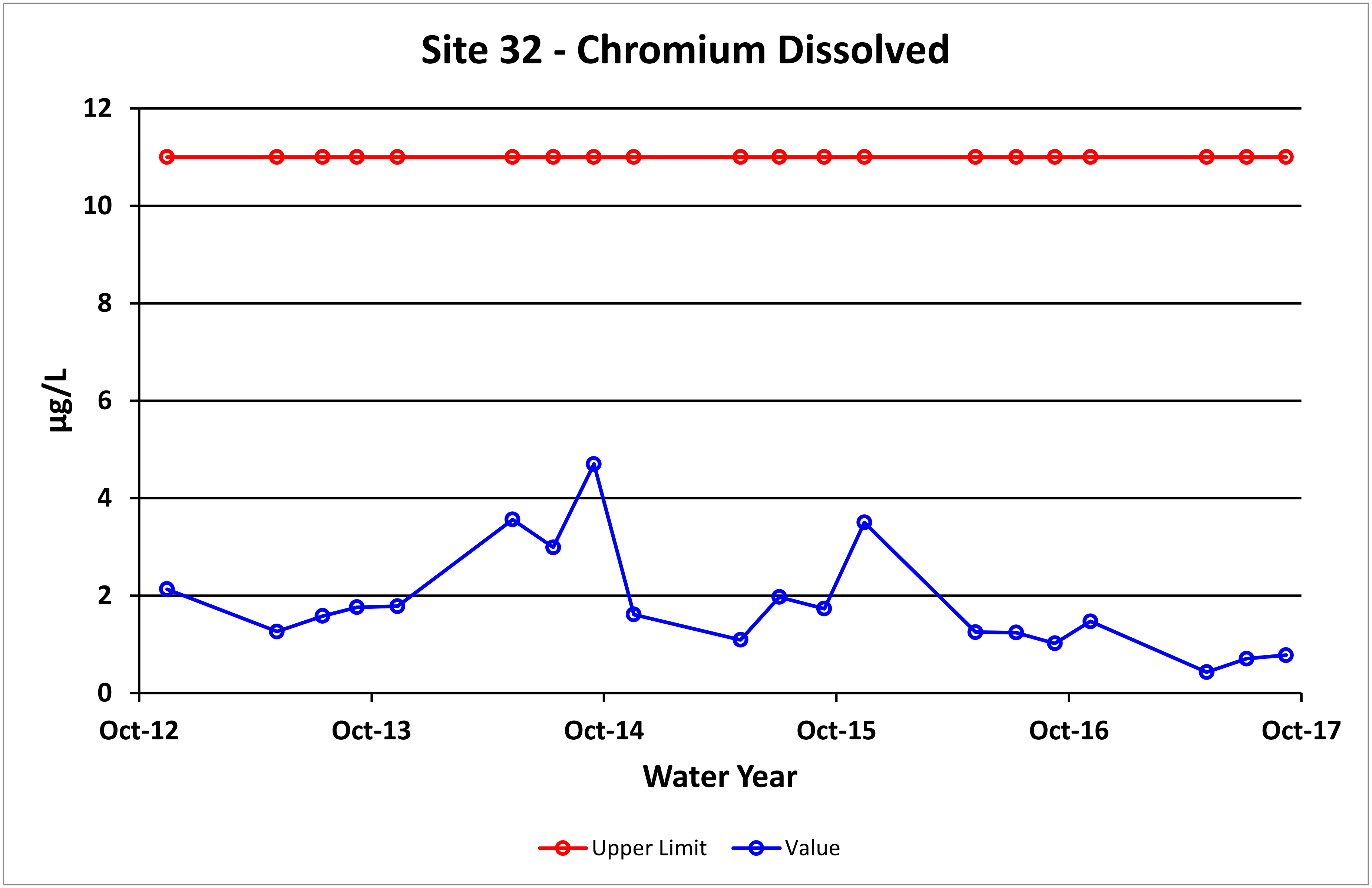


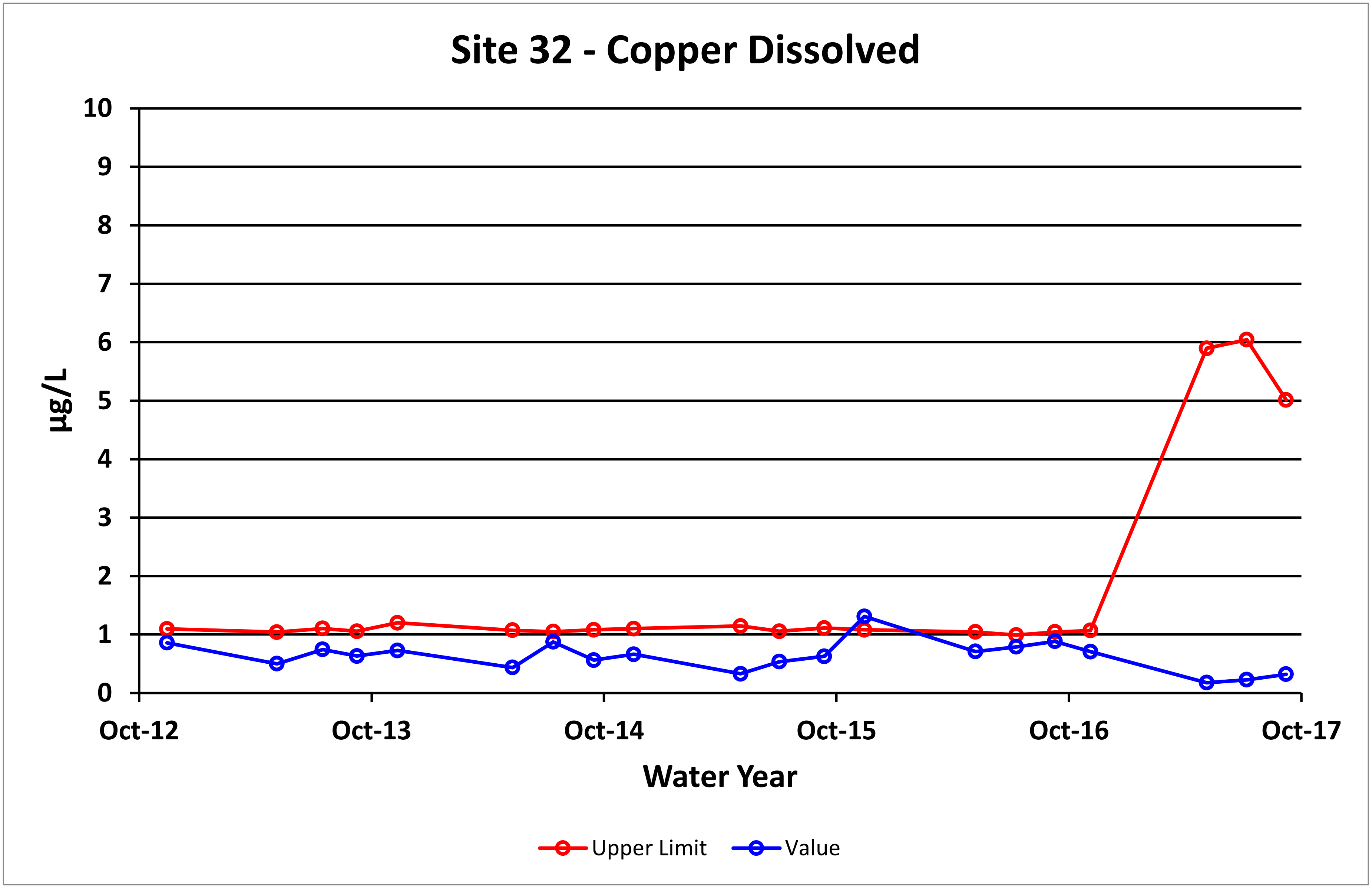
Site 32 - Arsenic Dissolved
µg/L
20
18
16
14
12
10
8
6
4
2
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value



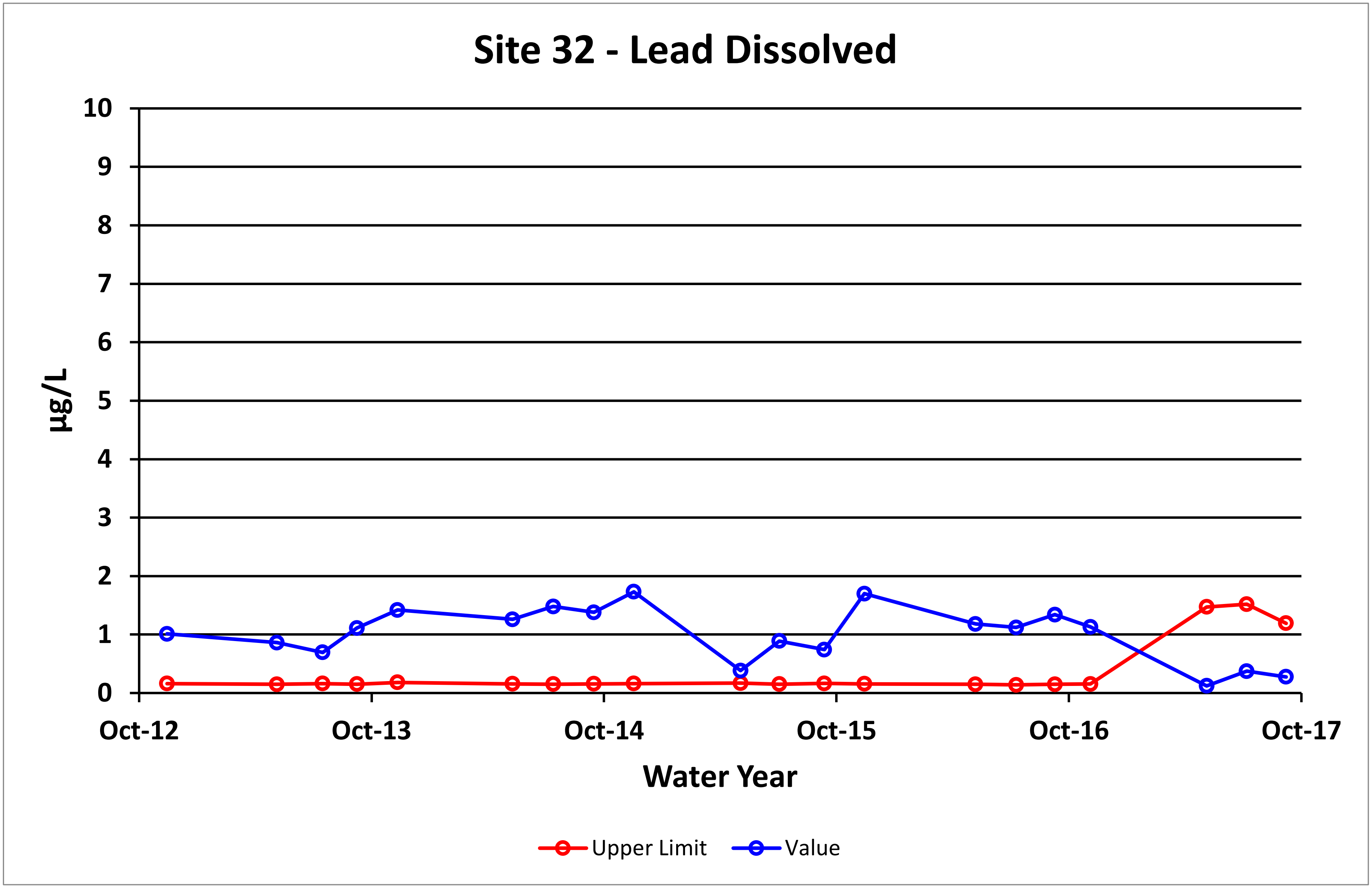
Site 32 - Barium Dissolved
2000
1500
1000
500
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

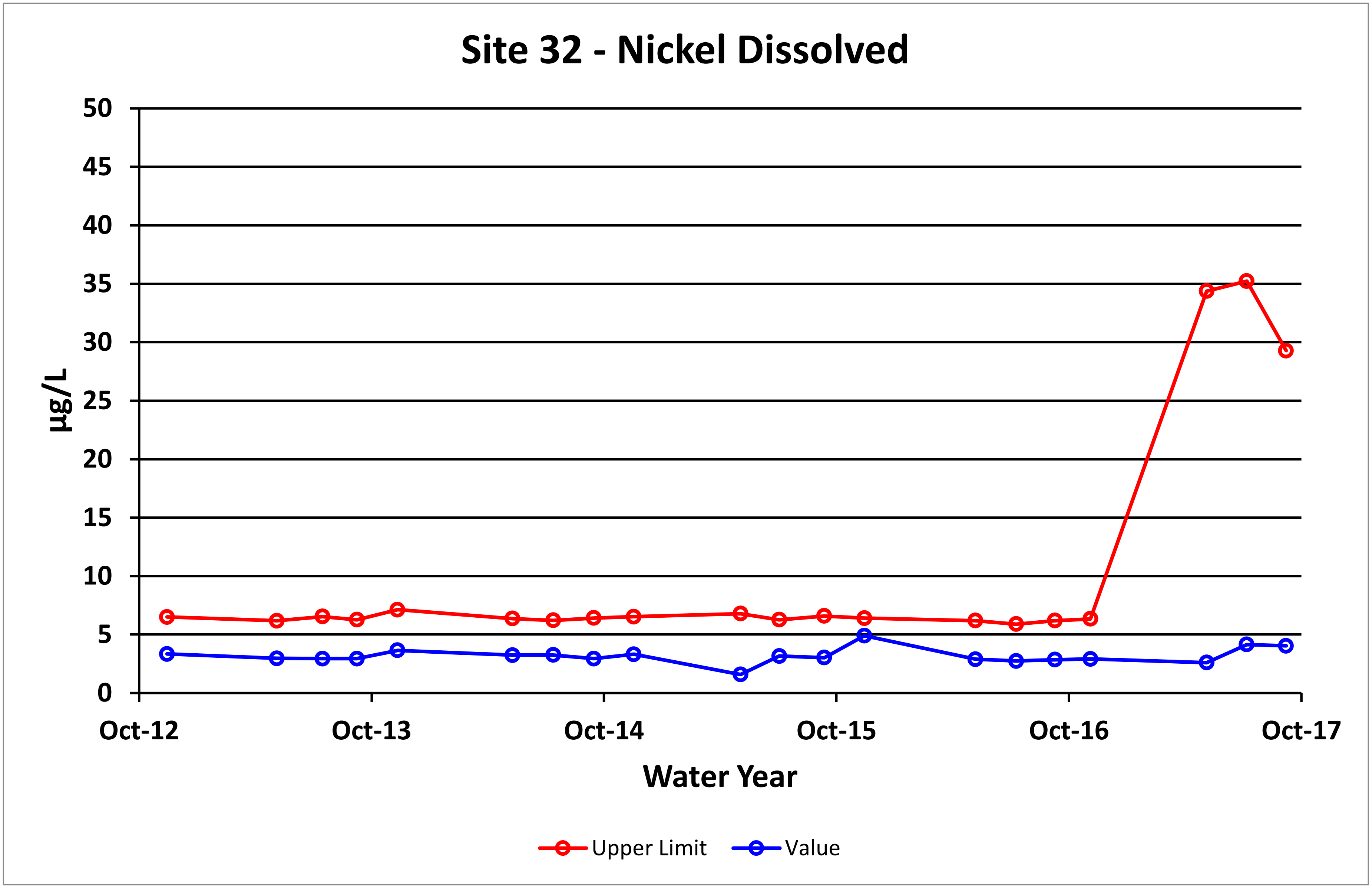

Site 32 - Cadmium Dissolved
µg/L
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

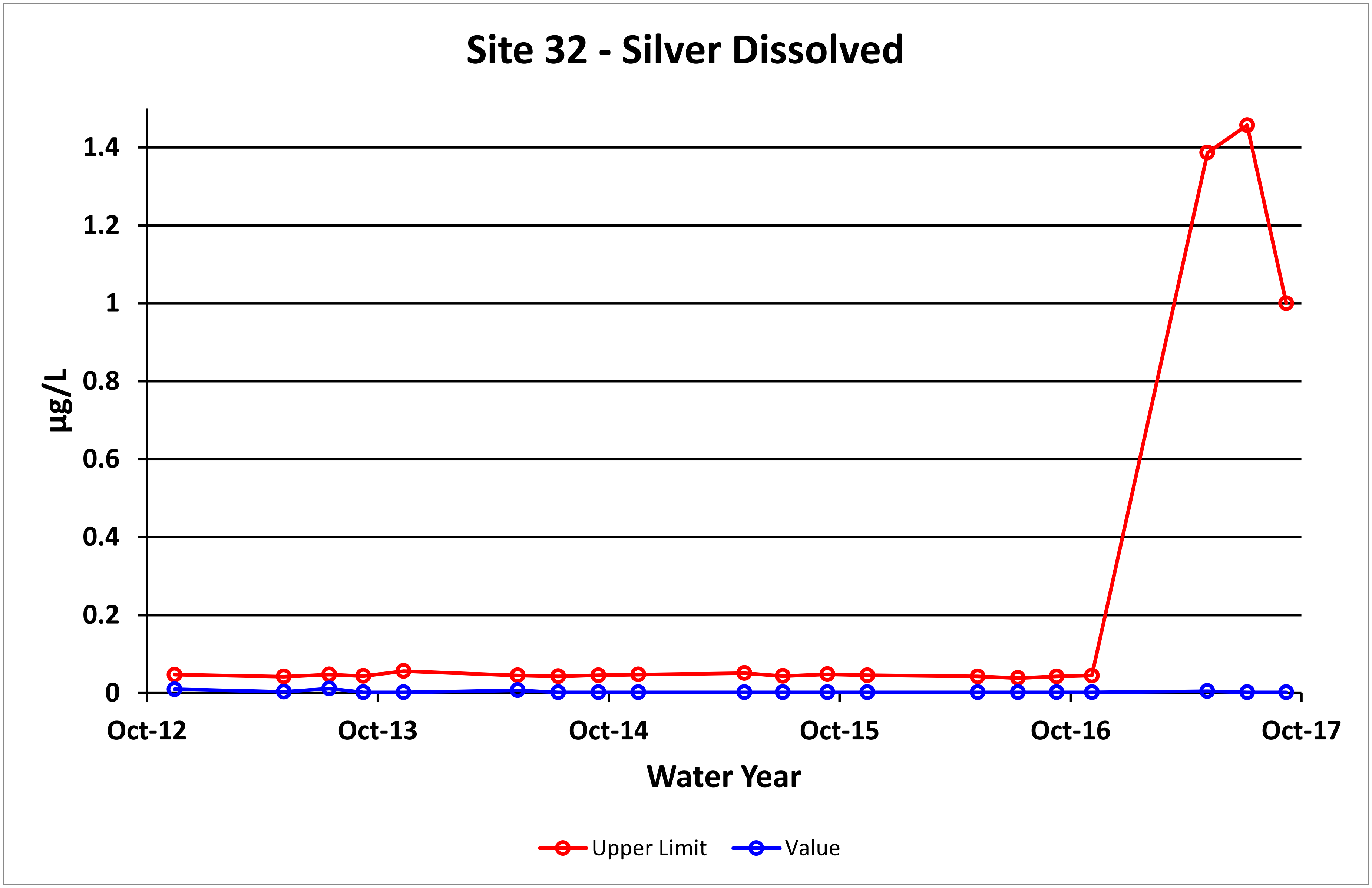

Site 32 - Chromium Dissolved
µg/L
12
10
8
6
4
2
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value



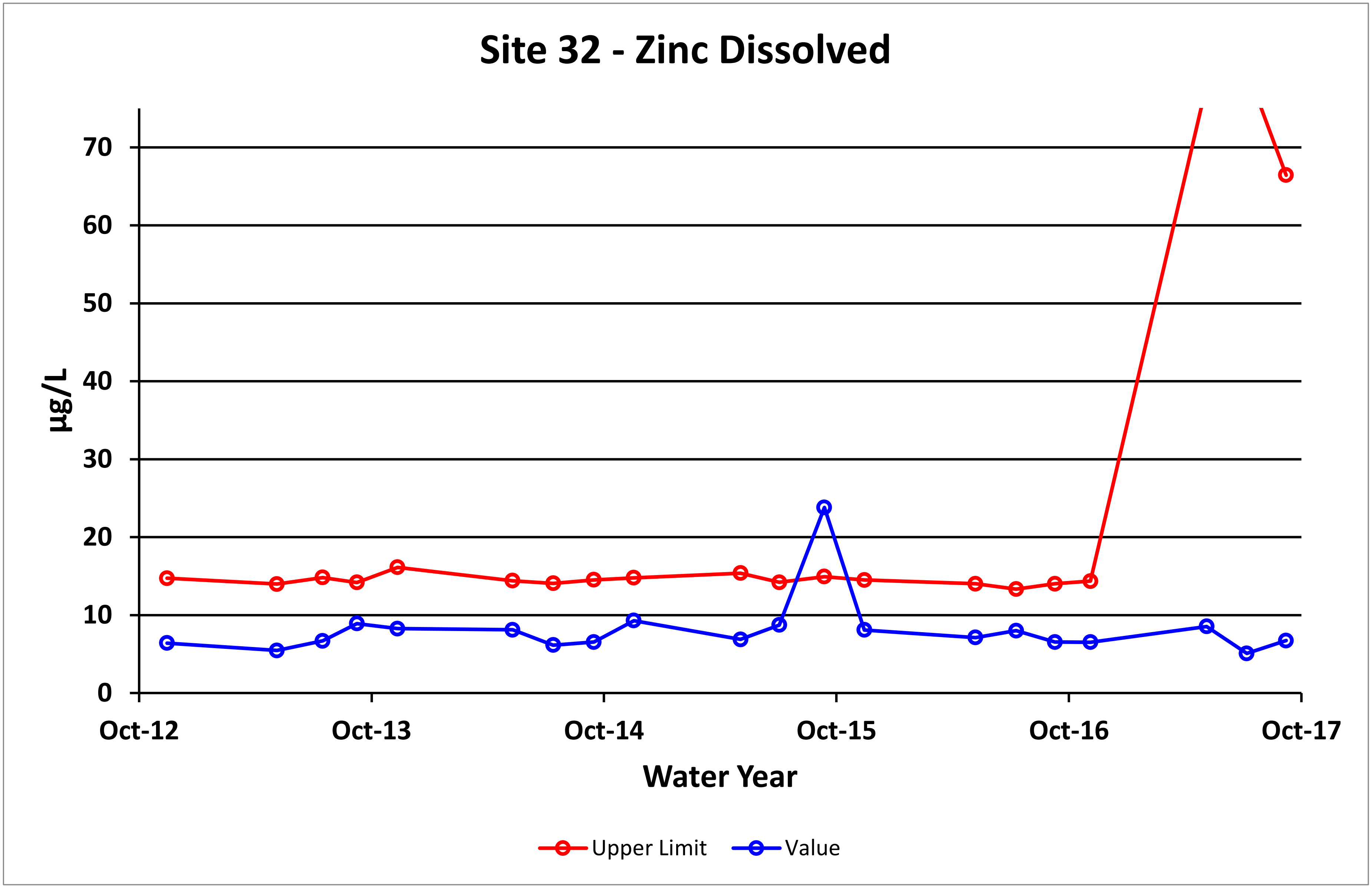
Site 32 - Copper Dissolved
µg/L
10
9
8
7
6
5
4
3
2
1
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

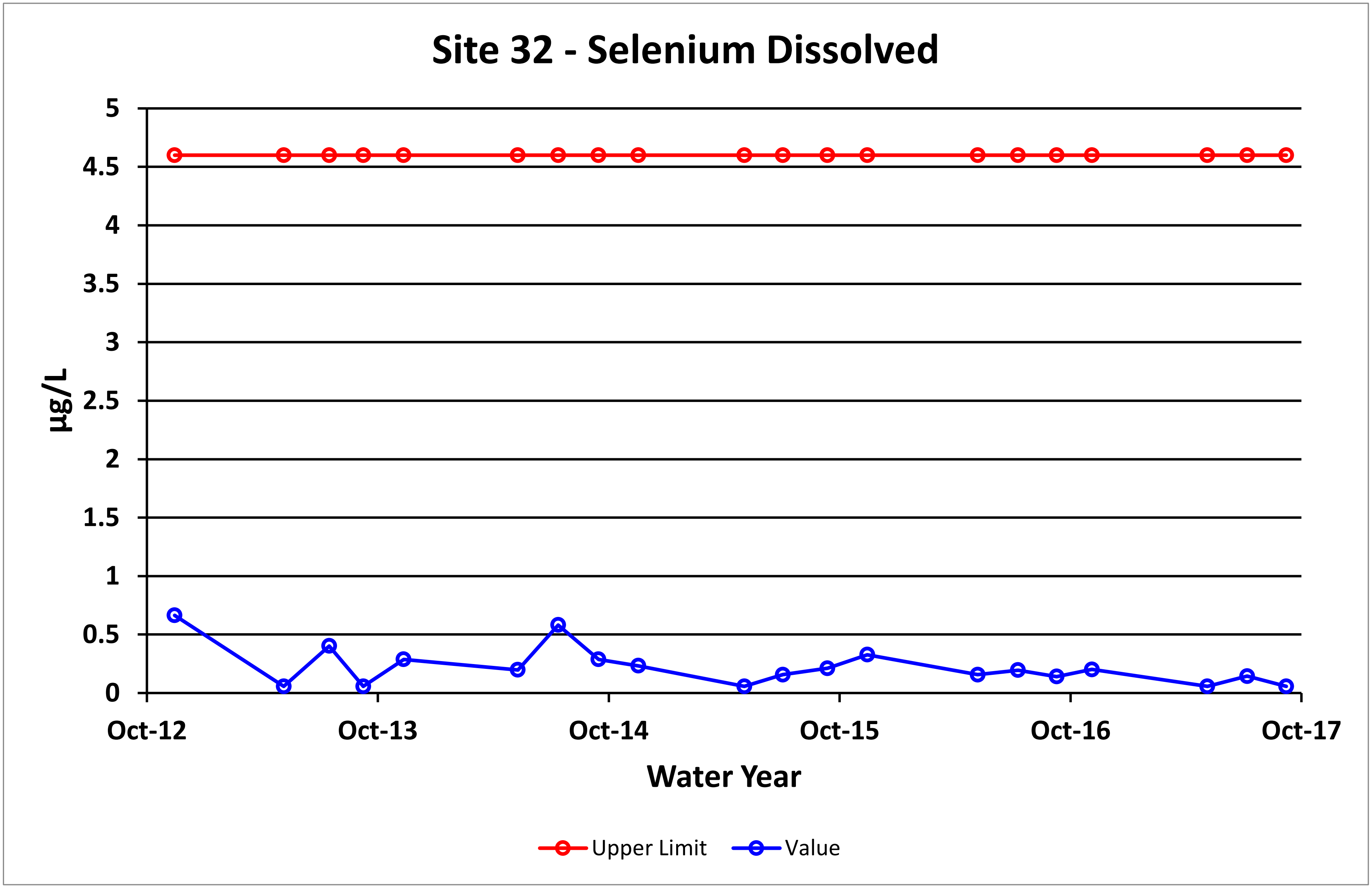

Site 32 - Lead Dissolved
10
9
8
7
6
5
4
3
2
1
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value


Site 32 - Nickel Dissolved
µg/L
50
45
40
35
30
25
20
15
10
5
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

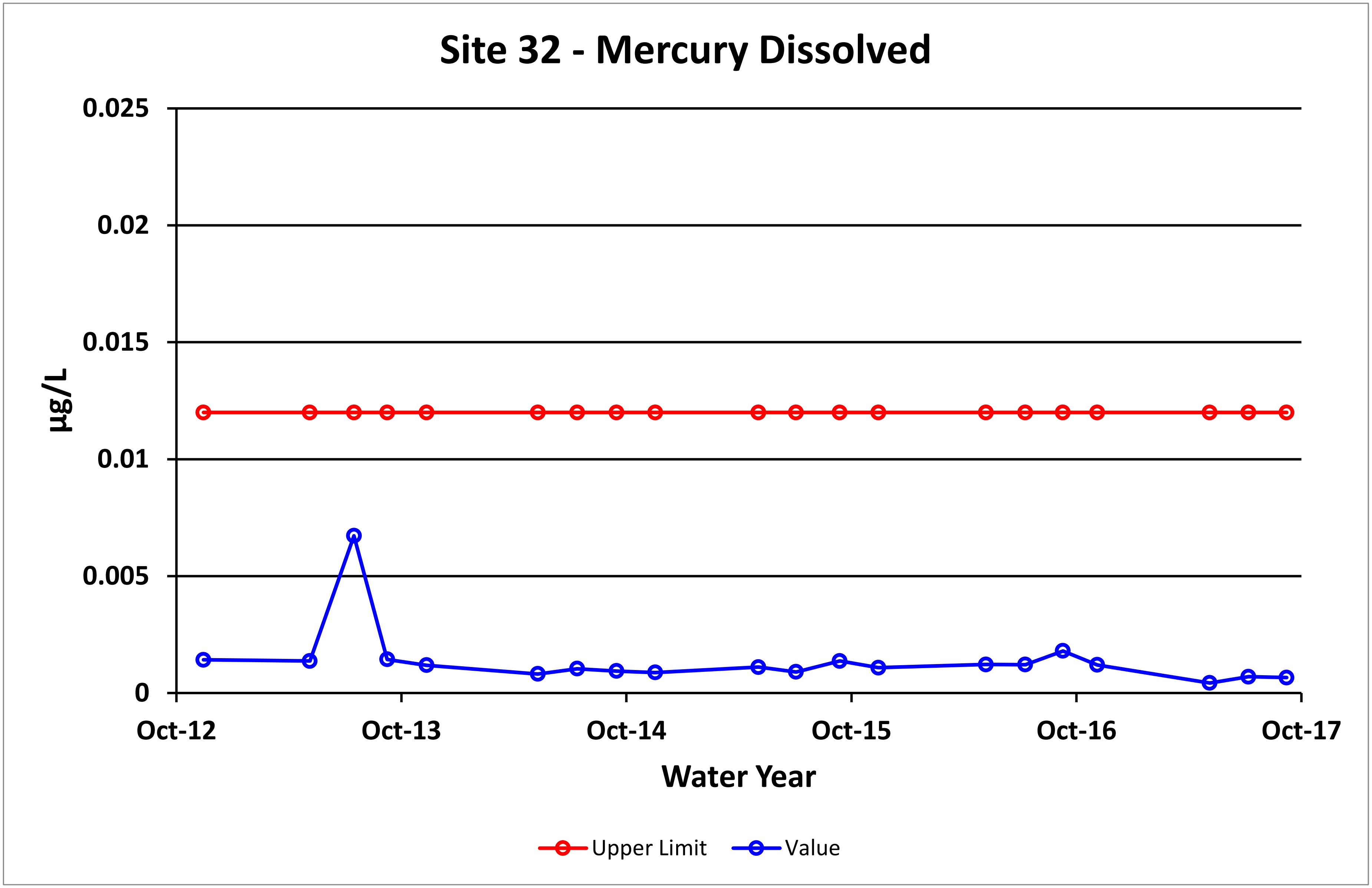


Site 32 - Silver Dissolved
µg/L
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value


Site 32 - Zinc Dissolved
µg/L
70
60
50
40
30
20
10
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value



Site 32 - Selenium Dissolved
µg/L
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value


Site 32 - Mercury Dissolved
0.025
0.02
0.015
0.01
0.005
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

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 2017" report. The table includes all the FWMP analyte data (field and laboratory) collected for the current water year and a series of flags keyed to the summary report "Qualified Data by QA Reviewer". The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of ½ MDL for the purpose of median calculation.

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

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

The data for 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 is listed in the table below.

Table of Exceedance for Water Year 2017

			Limits		
Sample Date	Parameter	Value	Lower	Upper	Hardness
7-Nov-16	Alk	18.7 mg/L	20		34.9 mg/L
9-May-17	Alk	17.3 mg/L	20		31.1 mg/L
11-Jul-17	Alk	19.40 mg/L	20		32.6 mg/L
11-Sep-17	Alk	18.10 mg/L	20		35.5 mg/L

All four samples were slightly below the lower limit for alkalinity. Low alkalinity 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.

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-11 and Sep-17 (WY2012-WY2017). A statistically significant ($\alpha/2=2.5\%$) decreasing trend for zinc continued during the current water year.

Table of Summary Statistics for Trend Analysis

	Mann-Kendall test statistics			Sen's slope estimate	
Parameter	**n***	**p****	**Trend**	**Q**	**Q(%)**
Conductivity Field	6	0.83			
pH Field	6	0.12			
Alkalinity, Total	6	0.96			
Sulfate, Total	6	0.95			
Zinc, Dissolved	6	<0.01	-	-0.66	-14.9

* Number of Years ** Significance level

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 2017

Site 009FMS - 'Lower Tributary Creek'

Sample Date/Parameter	Oct 2016	Nov 2016	Dec 2016	Jan 2017	Feb 2017	Mar 2017	Apr 2017	May 2017	Jun 2017	Jul 2017	Aug 2017	Sep 2017	**Median**
Water Temp (°C)		5.4						6		10.6		10.3	8.2
Conductivity-Field(µmho)		83.6						80.7		77.9		78.6	79.7
Conductivity-Lab (µmho)		82						74		71		76	75
pH Lab (standard units)		7						6.66		6.62		6.73	6.70
pH Field (standard units)		7.02						6.88		6.78		7.01	6.95
Total Alkalinity (mg/L)		18.7						17.3		19.4		18.1	18.4
Total Sulfate (mg/L)		13						13.5		10.5		12.3	12.7
Hardness (mg/L)		34.9						31.1		32.6		35.5	33.8
Dissolved As (ug/L)		0.962						0.629		1.07		1.06	1.011
Dissolved Ba (ug/L)		42.1						33.3		40.8		44	41.5
Dissolved Cd (ug/L)		0.0232						0.0166		0.0239		0.0336	0.0236
Dissolved Cr (ug/L)		0.572						0.436		0.627		0.623	0.598
Dissolved Cu (ug/L)		1.26						1.39		1.72		1.9	1.555
Dissolved Pb (ug/L)		0.548						0.247		0.555		0.505	0.527
Dissolved Ni (ug/L)		1.86						1.42		2.05		2.28	1.955
Dissolved Ag (ug/L)		0.01						0.007		0.011		0.009	0.010
Dissolved Zn (ug/L)		3.58						2.94		3.53		4.57	3.56
Dissolved Se (ug/L)		0.12						0.057		0.137		0.169	0.129
Dissolved Hg (ug/L)		0.0041						0.0031		0.0053		0.0056	0.0047

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

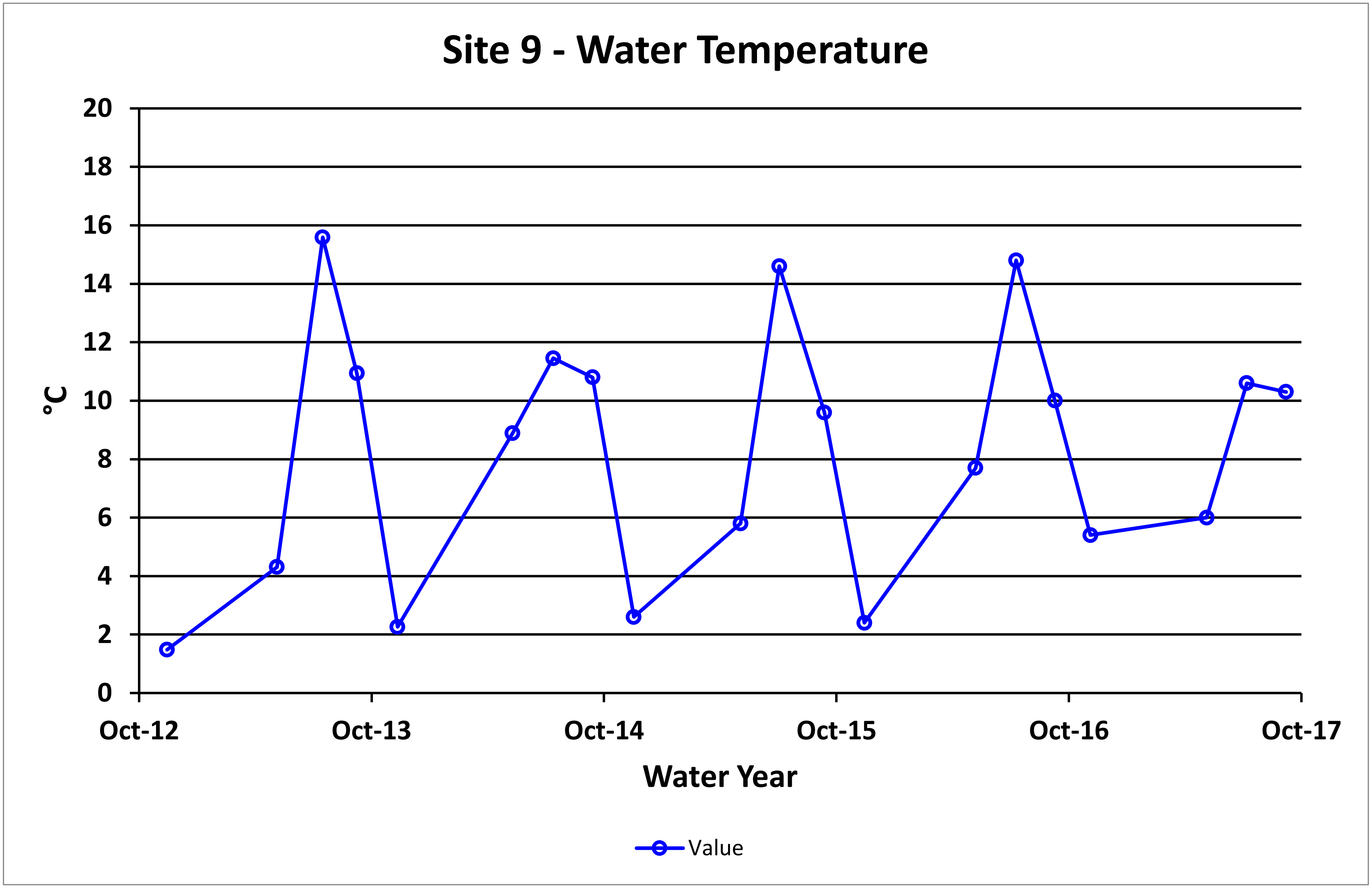
Values reported as less than MDL are replaced by 1/2 MDL for median calculation purposes.

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

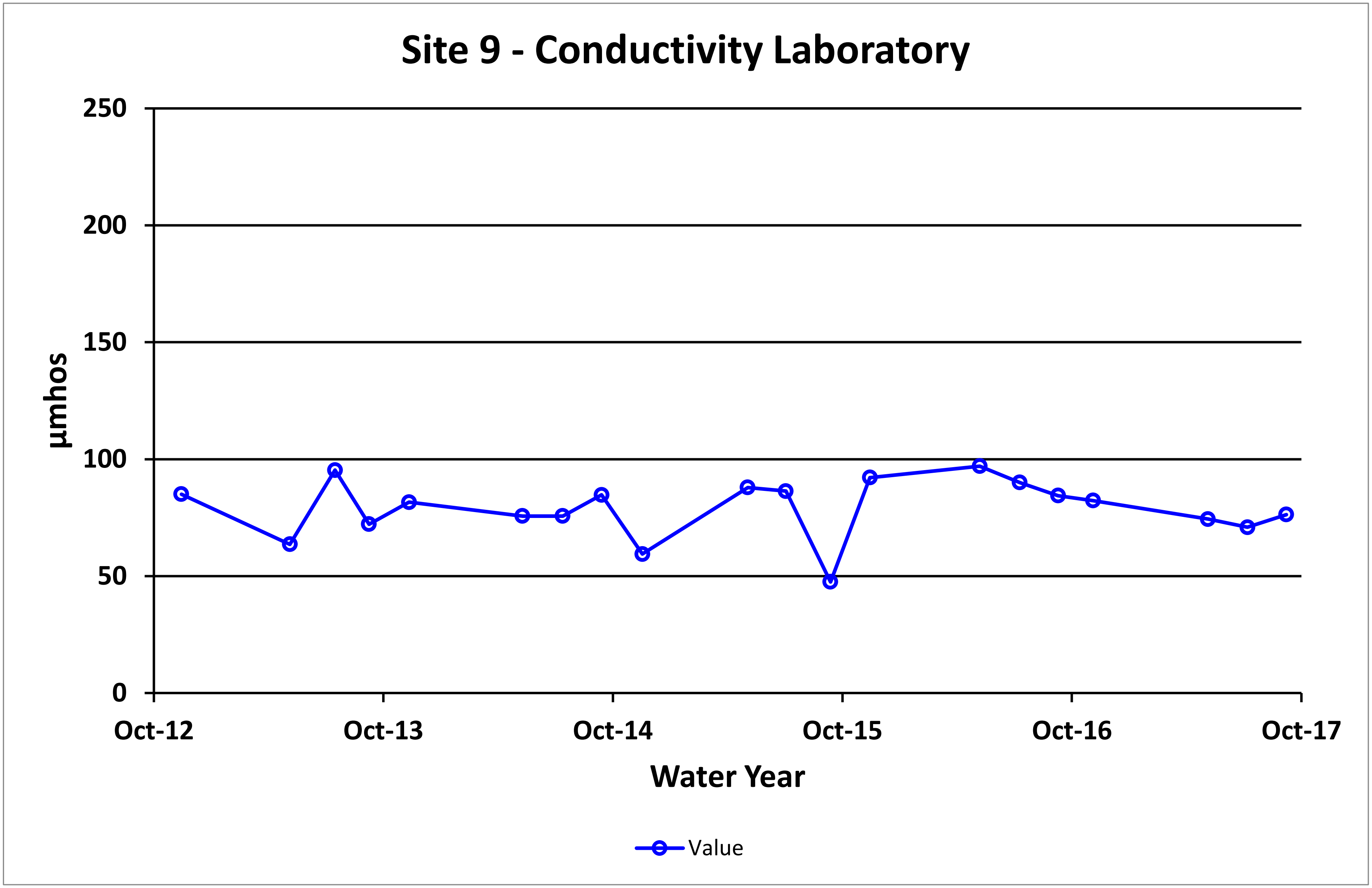
Qualified Data by QA Reviewer

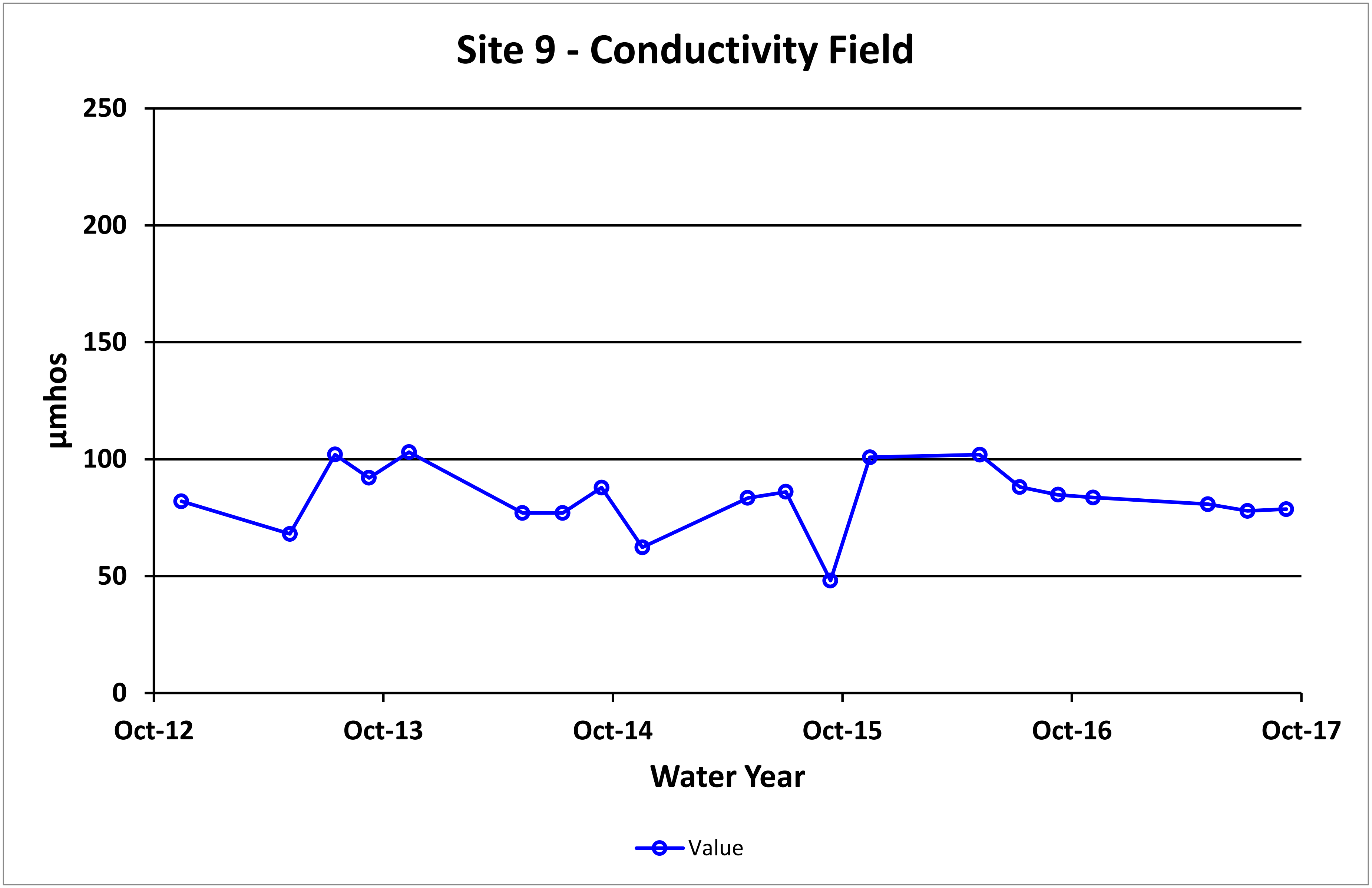
Date Range: 10/01/2016 to 09/30/2017

Site No.	Sample Date	Sample Time	Parameter	Value		Qualifier	Reason for Qualifier
009FMS	11/7/2016	12:00 PM	Diss. Se-ICP/MS	0.12	µg/L	J	Below Quantitative Range
	5/9/2017	12:00 PM	Diss. Ag-ICP/MS	0.00659	µg/L	J	Below Quantitative Range
			Tot. Sulfate	13.5	mg/L	J	Sample Receipt Temperature
	7/11/2017	12:00 PM	Diss. Se-ICP/MS	0.13	µg/L	J	Below Quantitative Range
			Tot. Sulfate	10.5	mg/L	J	Sample Receipt Temperature
	9/11/2017	12:00 PM	Diss. Ag-ICP/MS	0.00938	µg/L	J	Below Quantitative Range
			Diss. Se-ICP/MS	0.16	µg/L	J	Below Quantitative Range

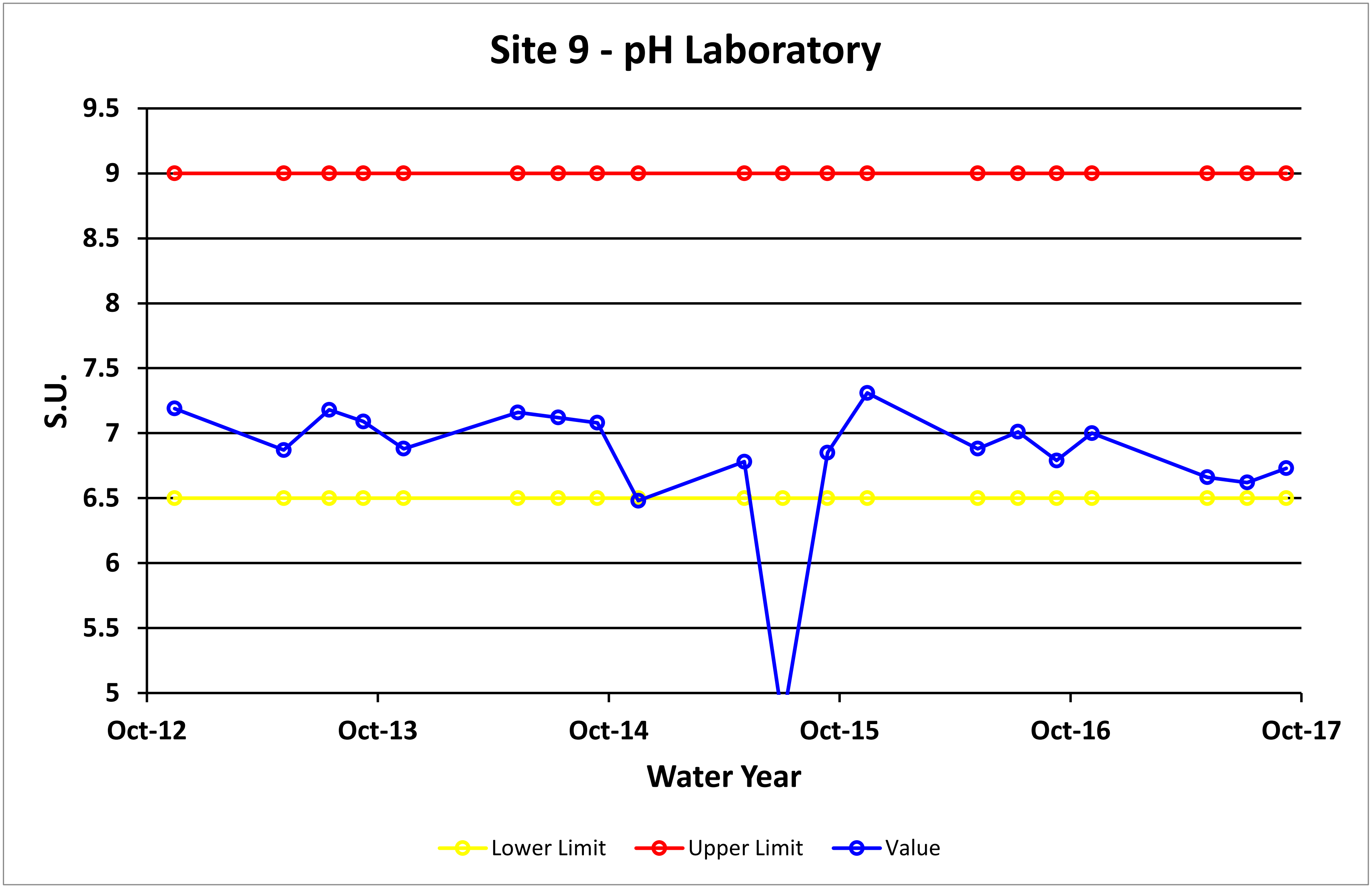


Site 9 - Water Temperature
°C
20
18
16
14
12
10
8
6
4
2
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value

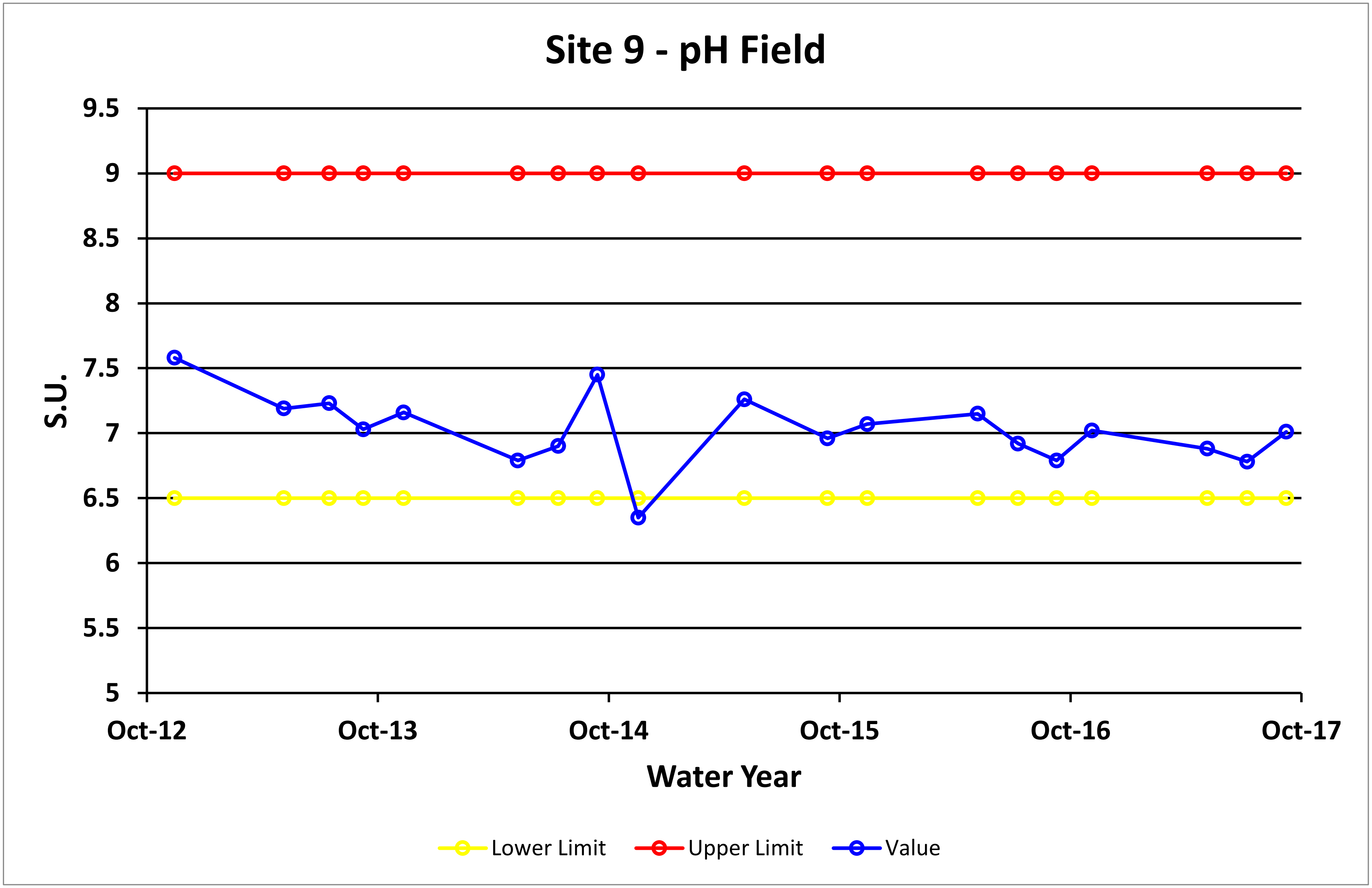

Site 9 - Conductivity Laboratory
250
200
150
100
50
0
µmhos
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value

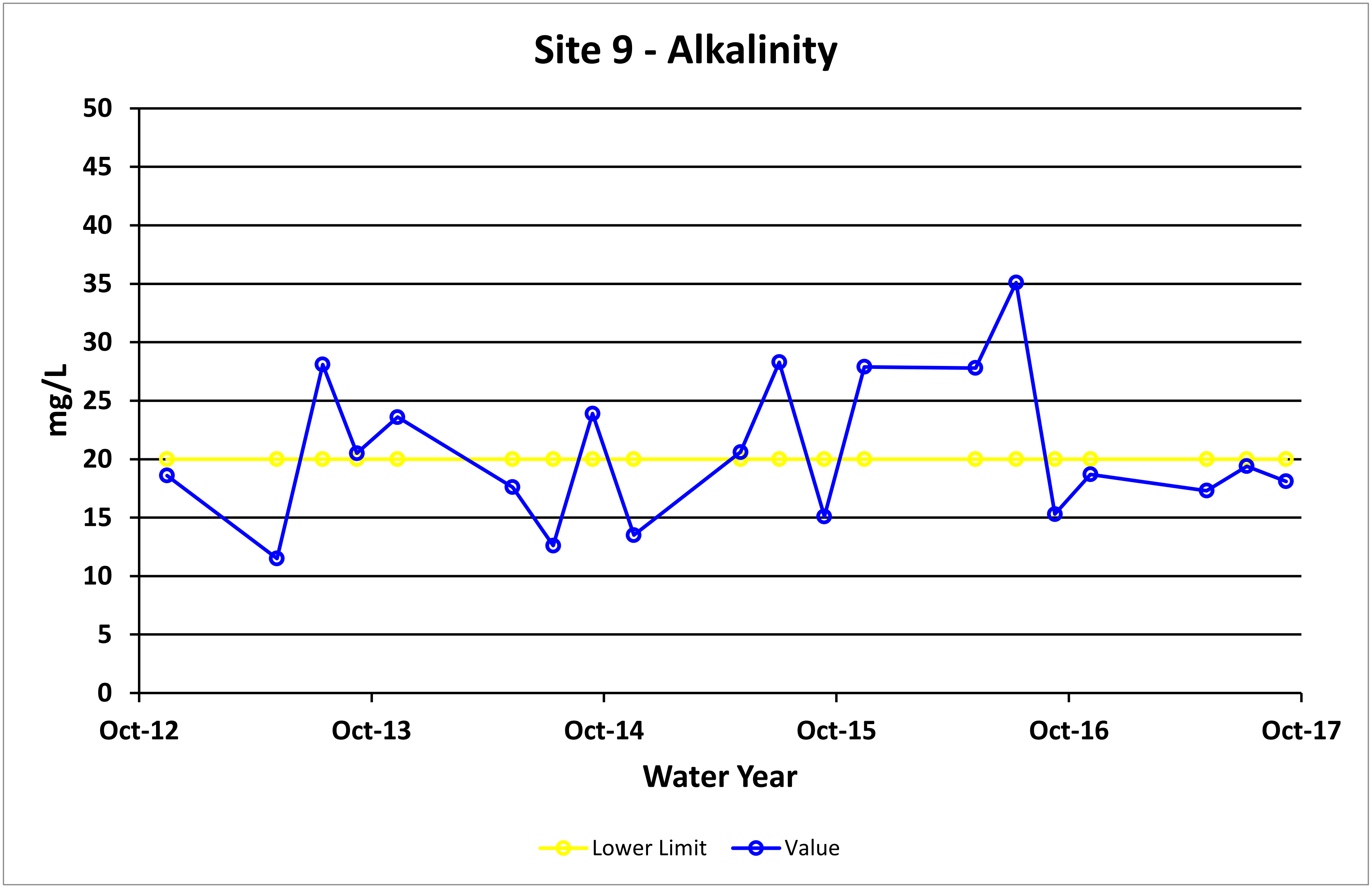


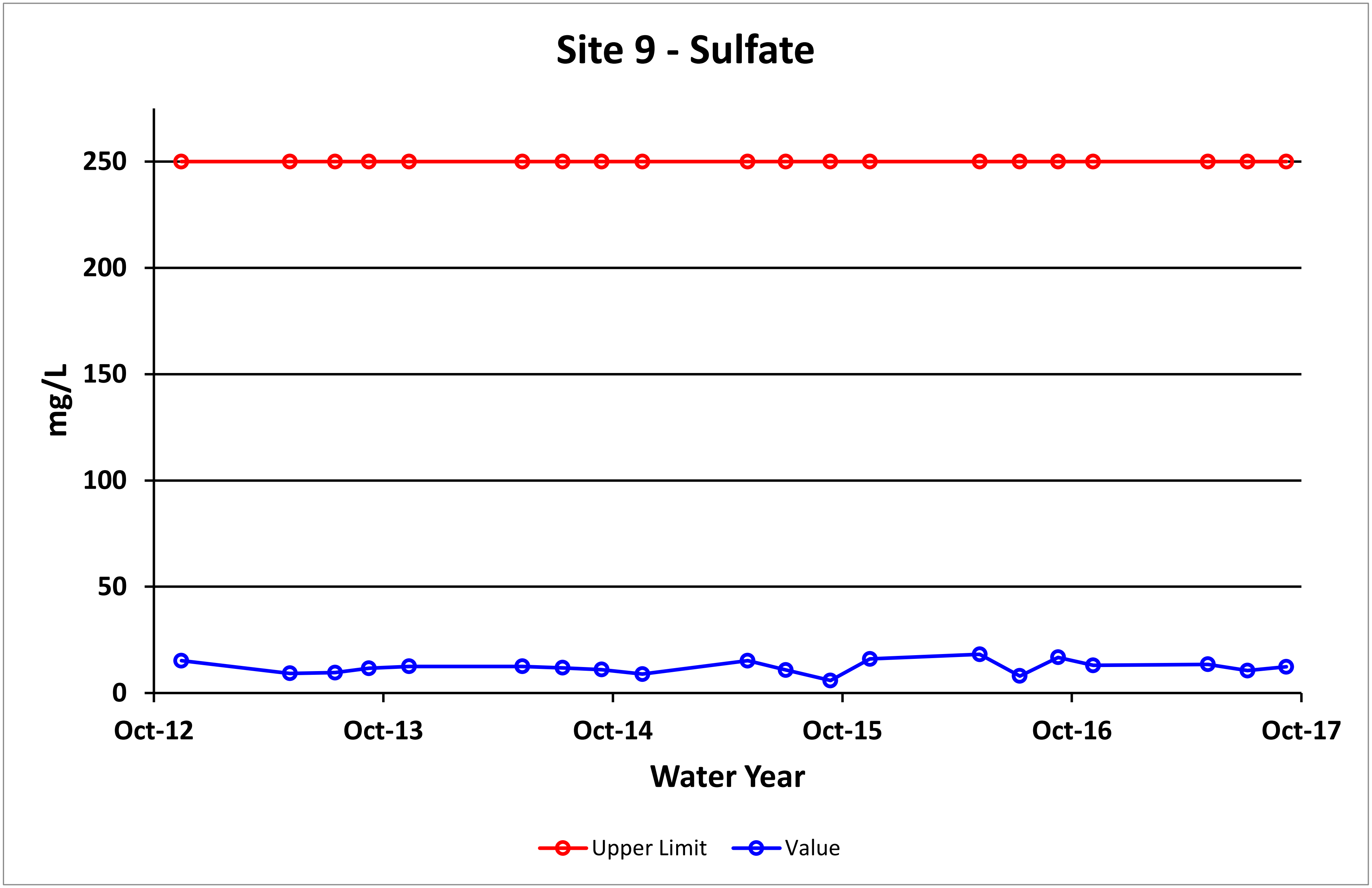
Site 9 - Conductivity Field
250
200
150
100
50
0
µmhos
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value



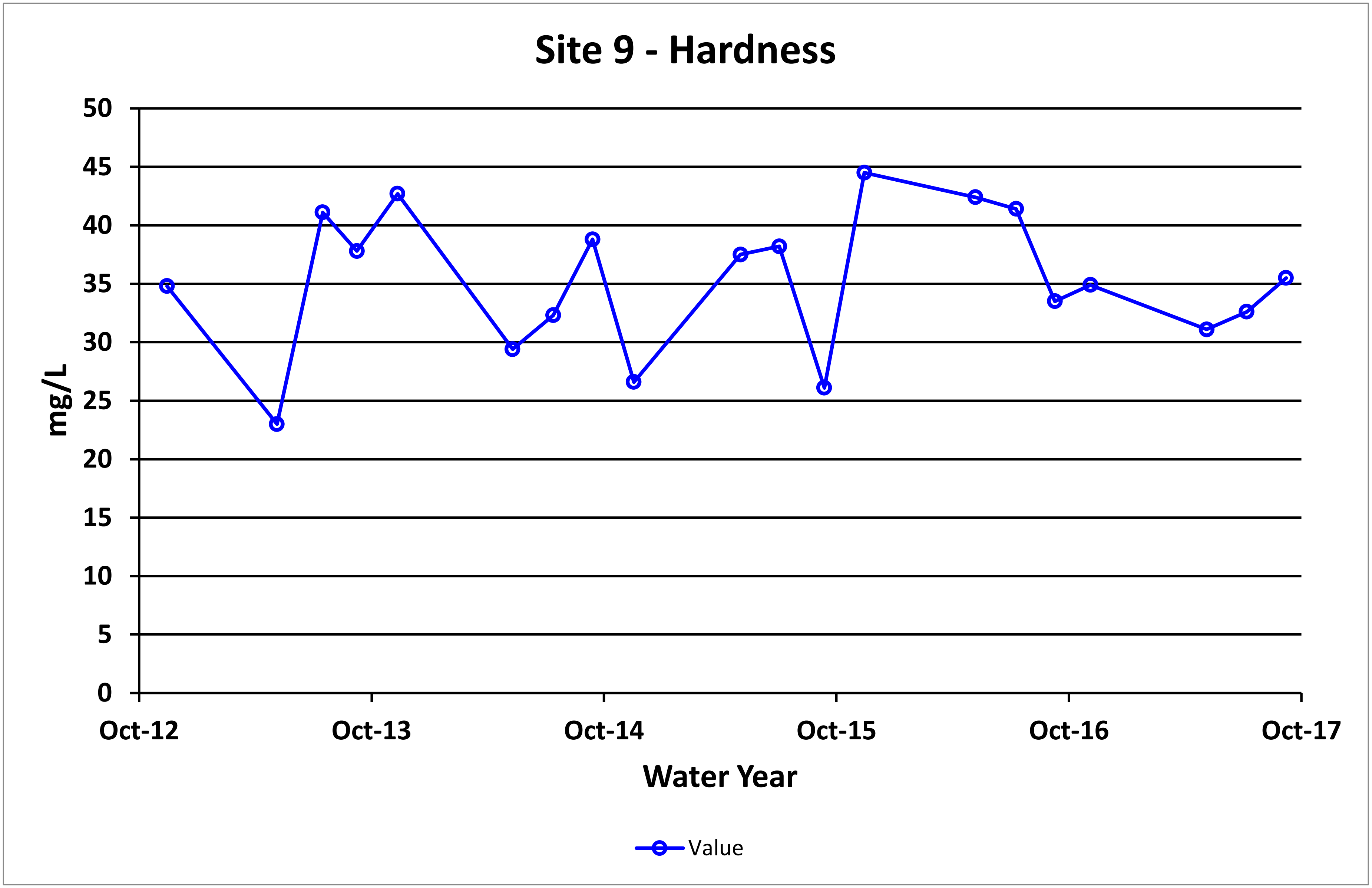
Site 9 - pH Laboratory
S.U.
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Lower Limit
Upper Limit
Value

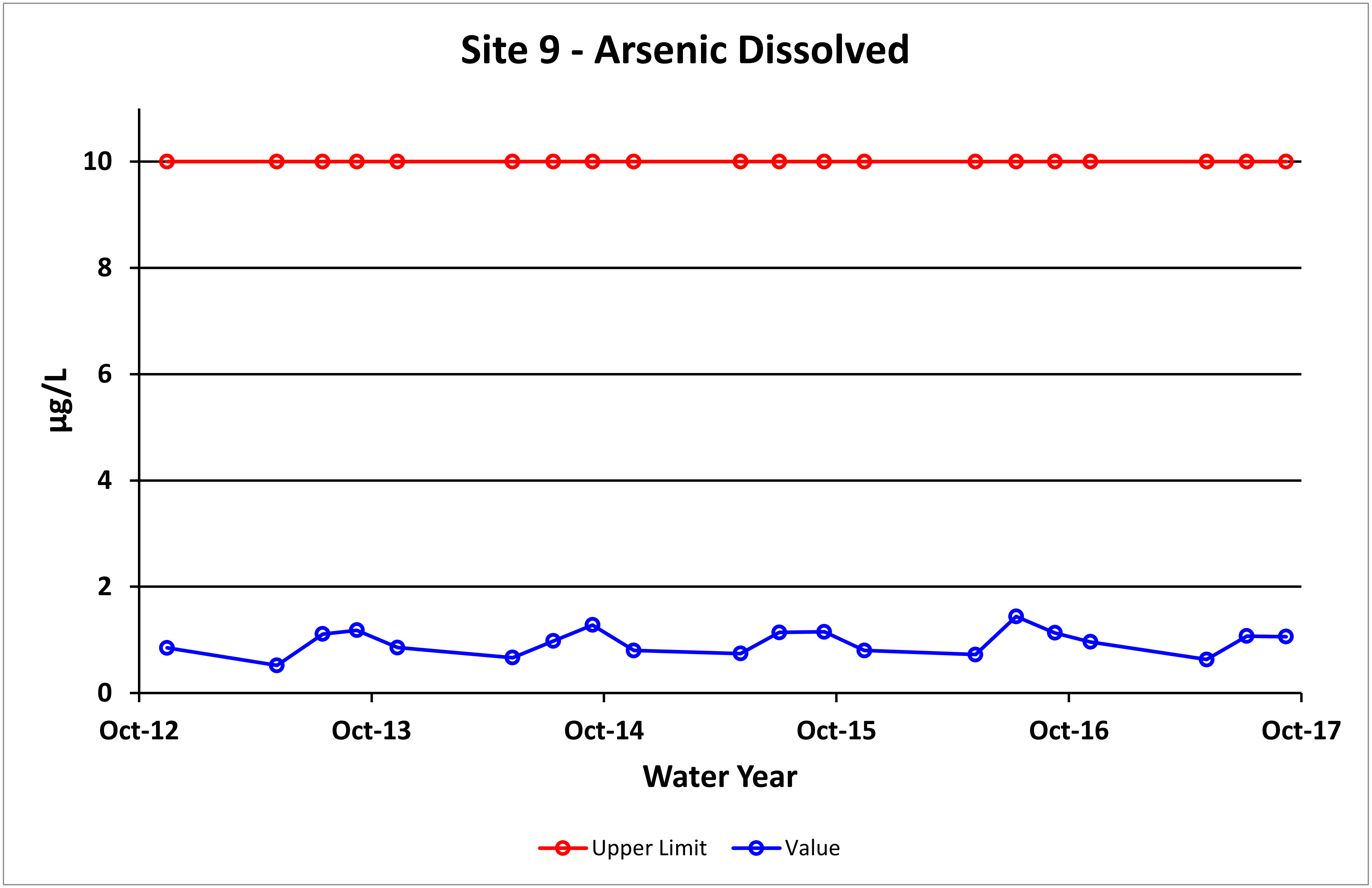

Site 9 - pH Field
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
S.U.
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Lower Limit
Upper Limit
Value


Site 9 - Alkalinity
50
45
40
35
30
25
20
15
10
5
0
mg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Lower Limit
Value

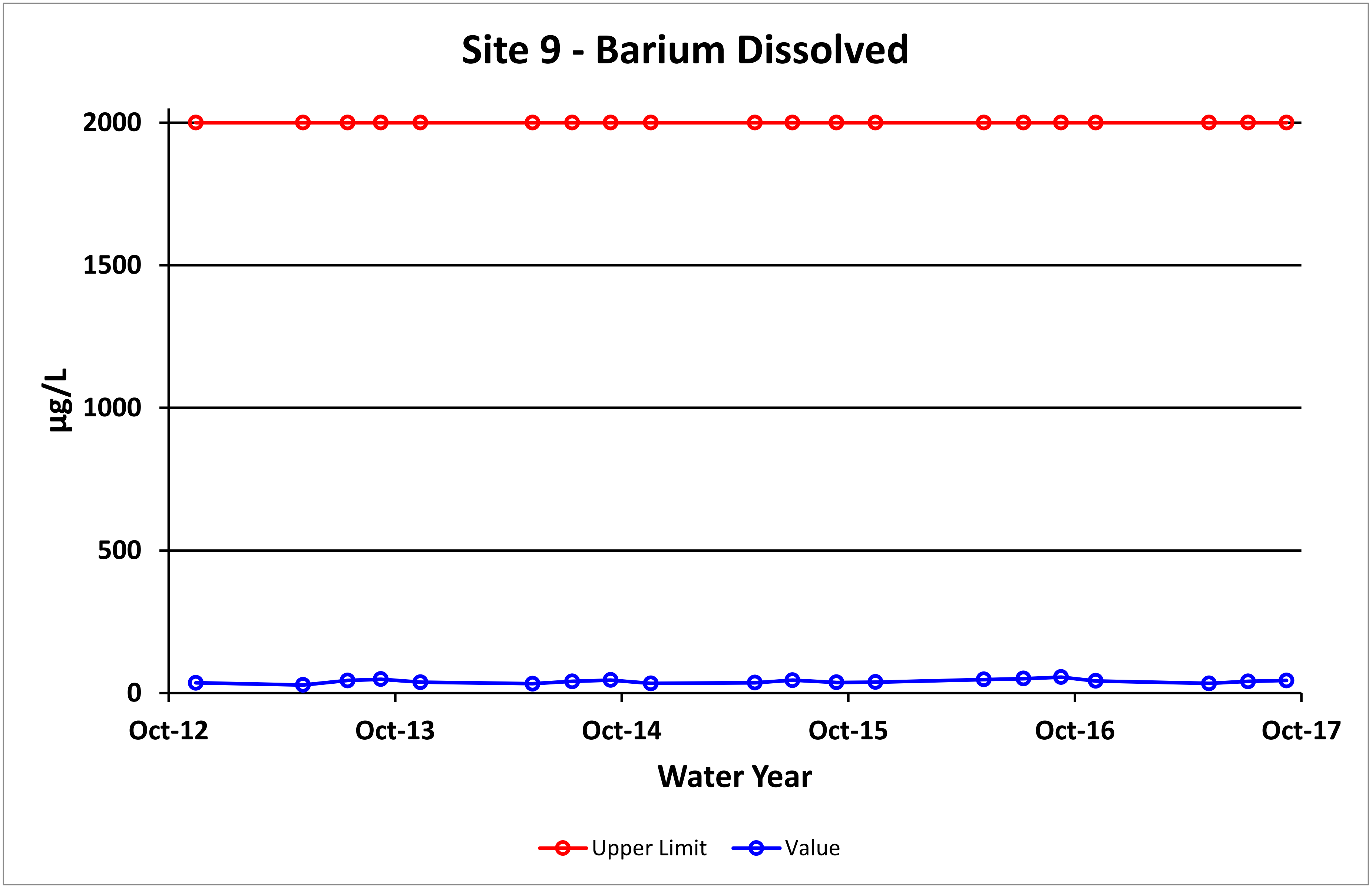


Site 9 - Sulfate
mg/L
250
200
150
100
50
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

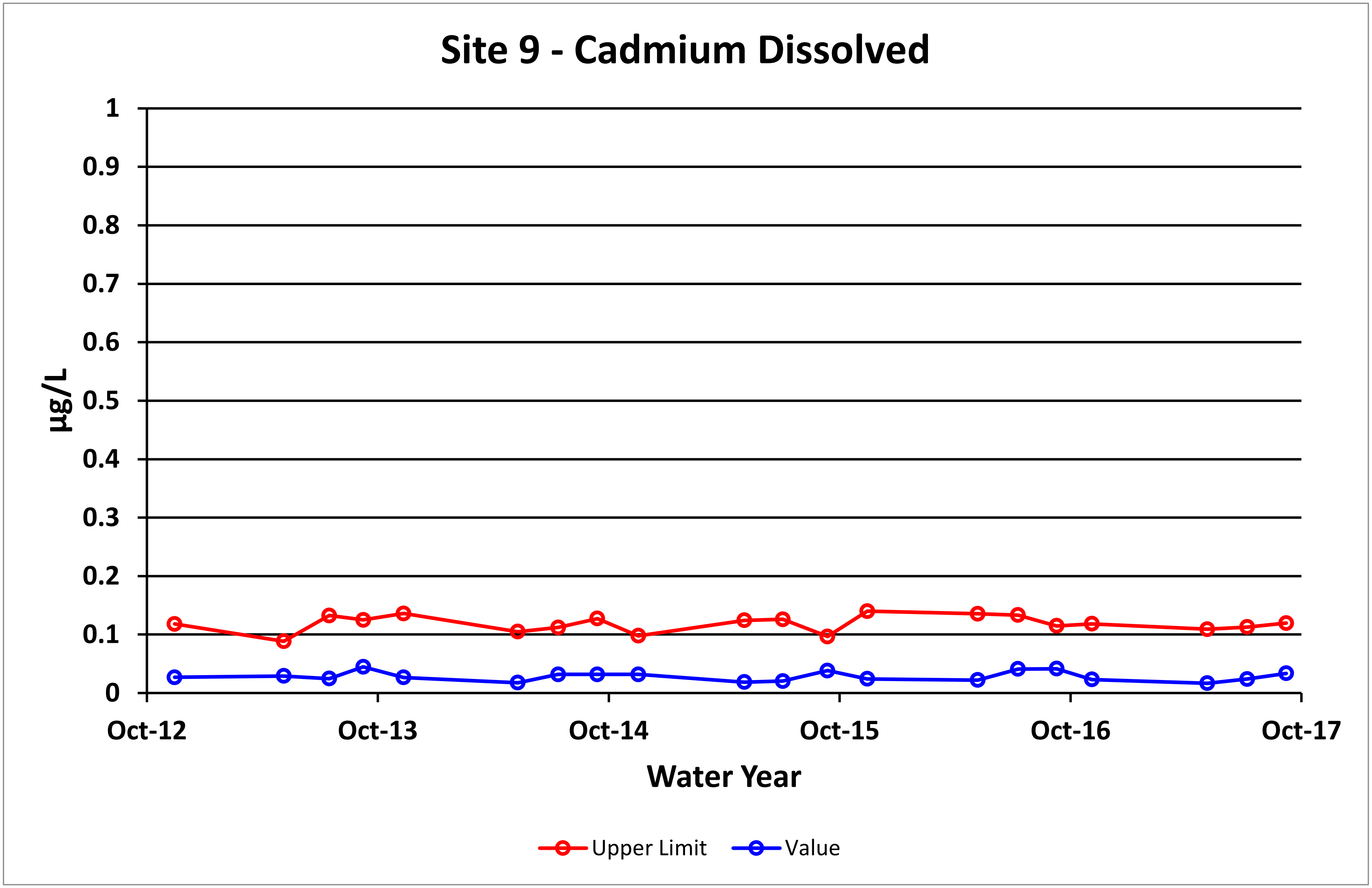

Site 9 - Hardness
mg/L
50
45
40
35
30
25
20
15
10
5
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value

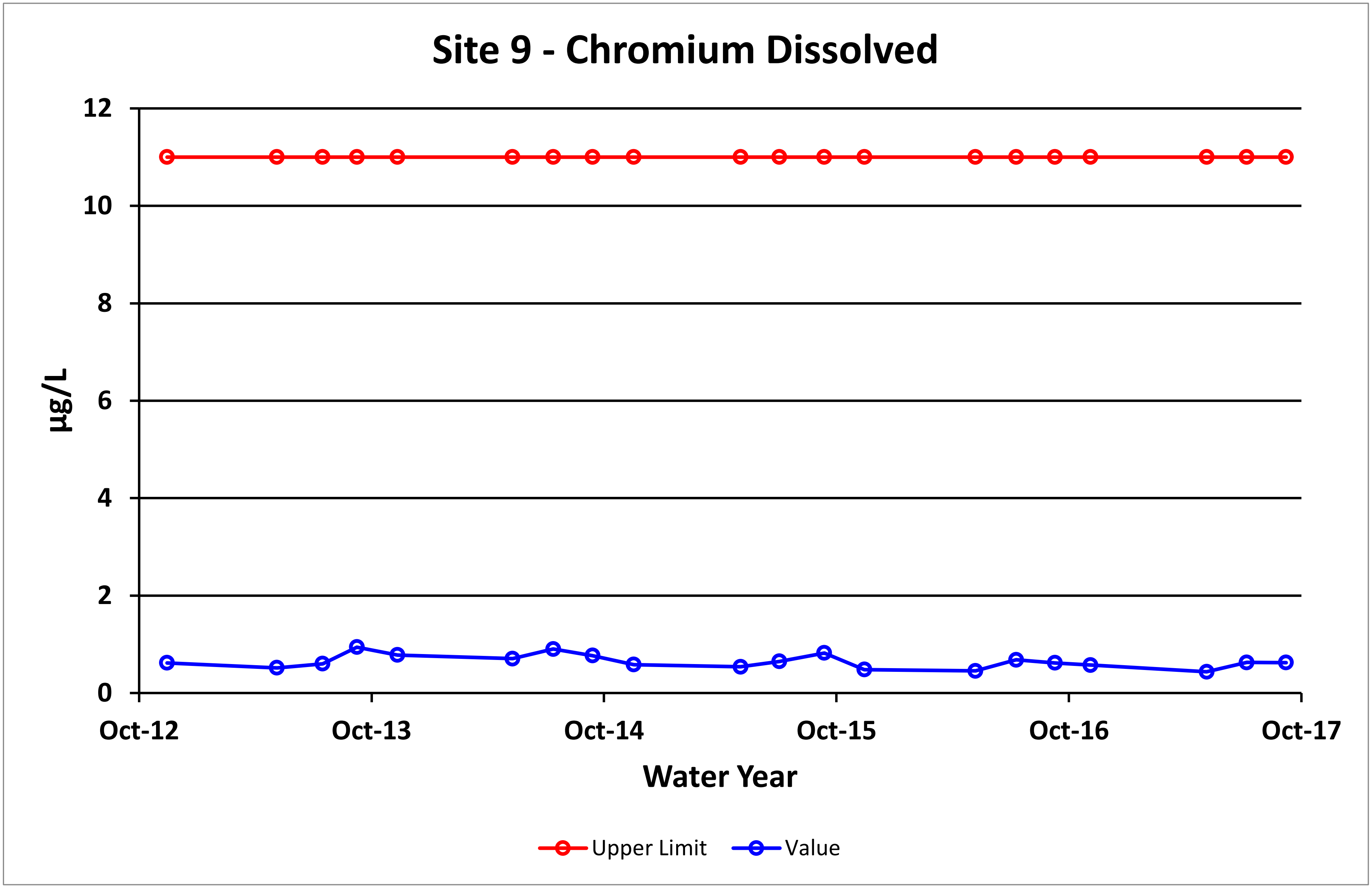


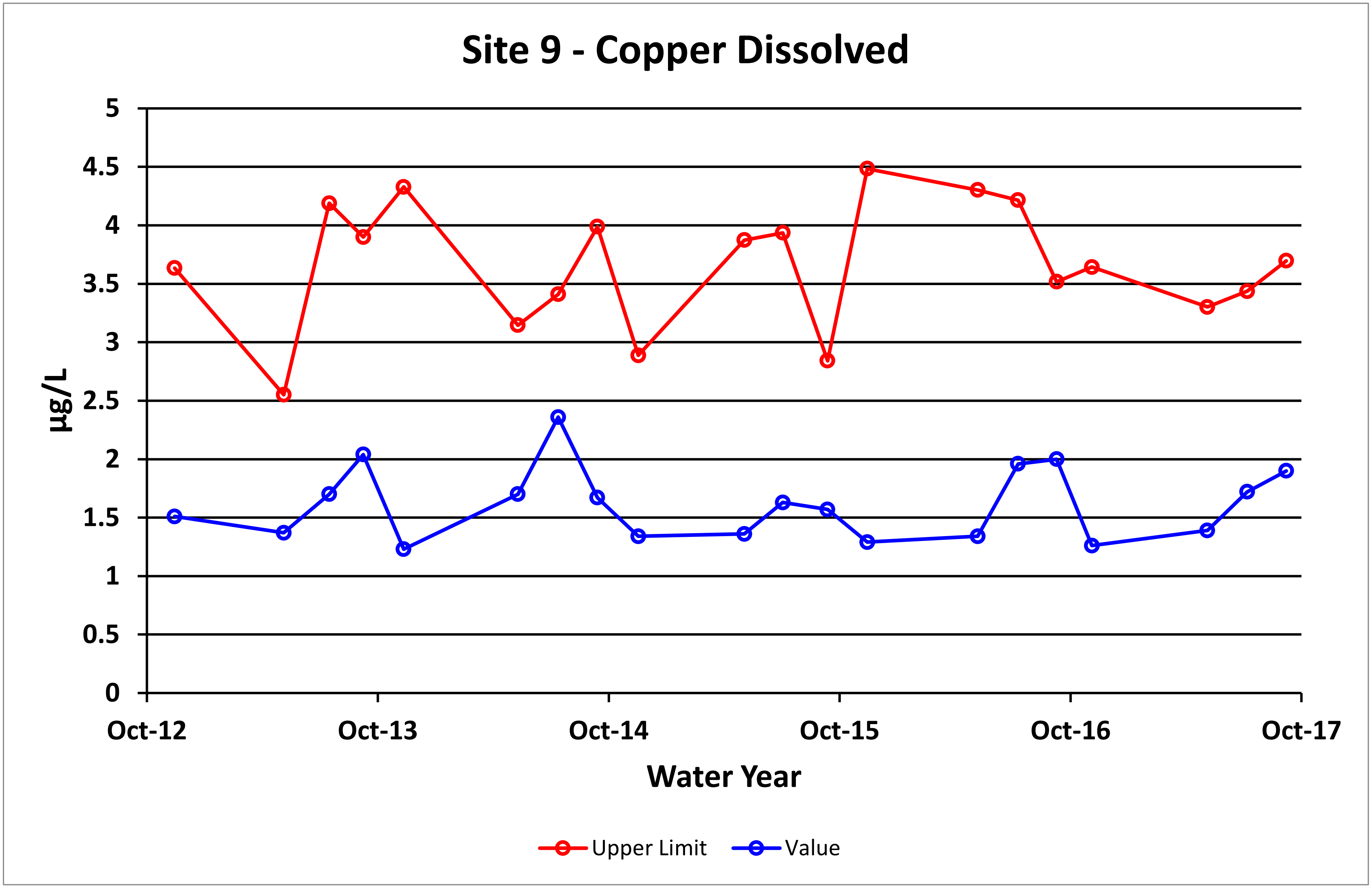
Site 9 - Arsenic Dissolved
10
8
6
4
2
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

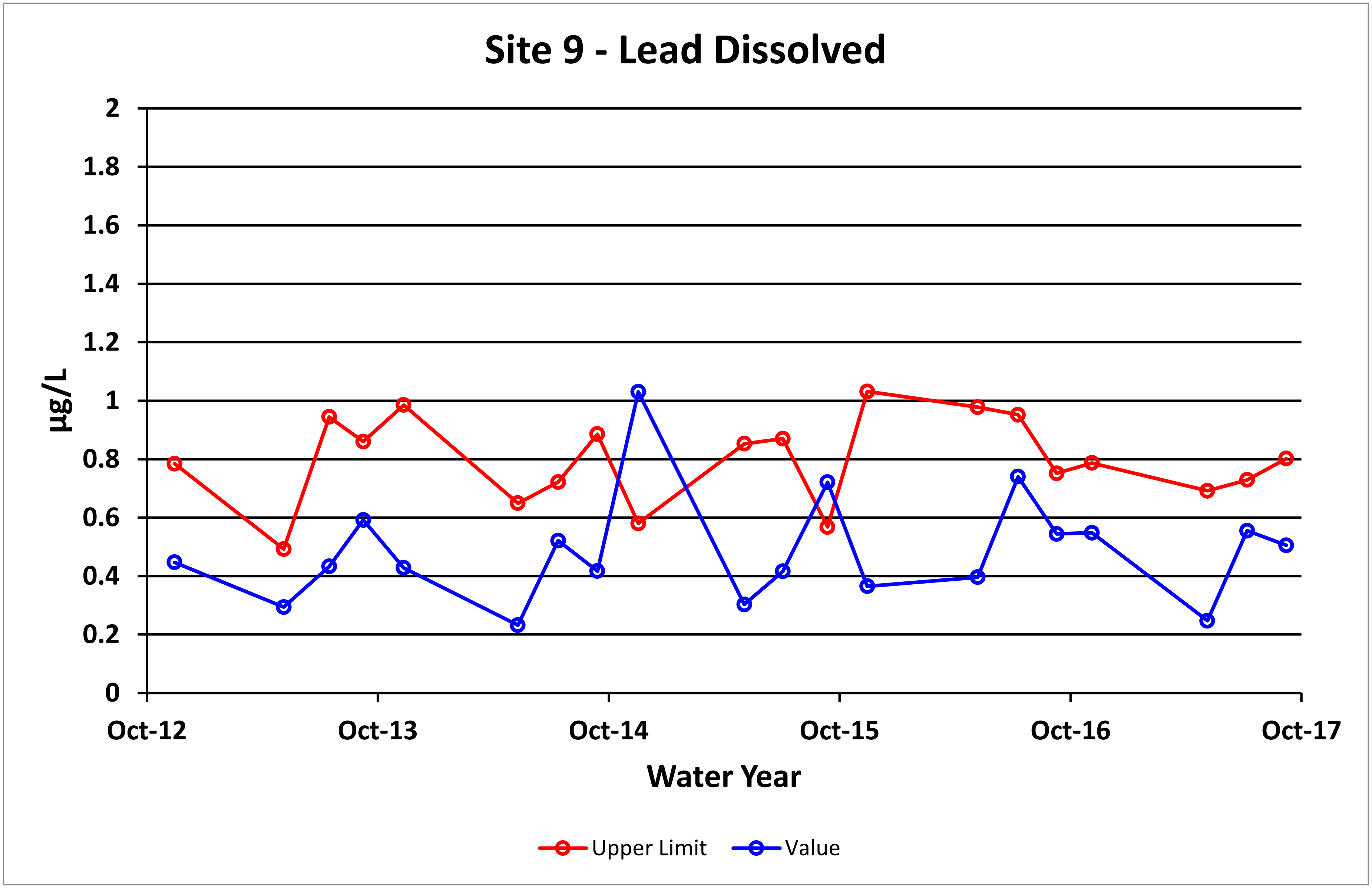


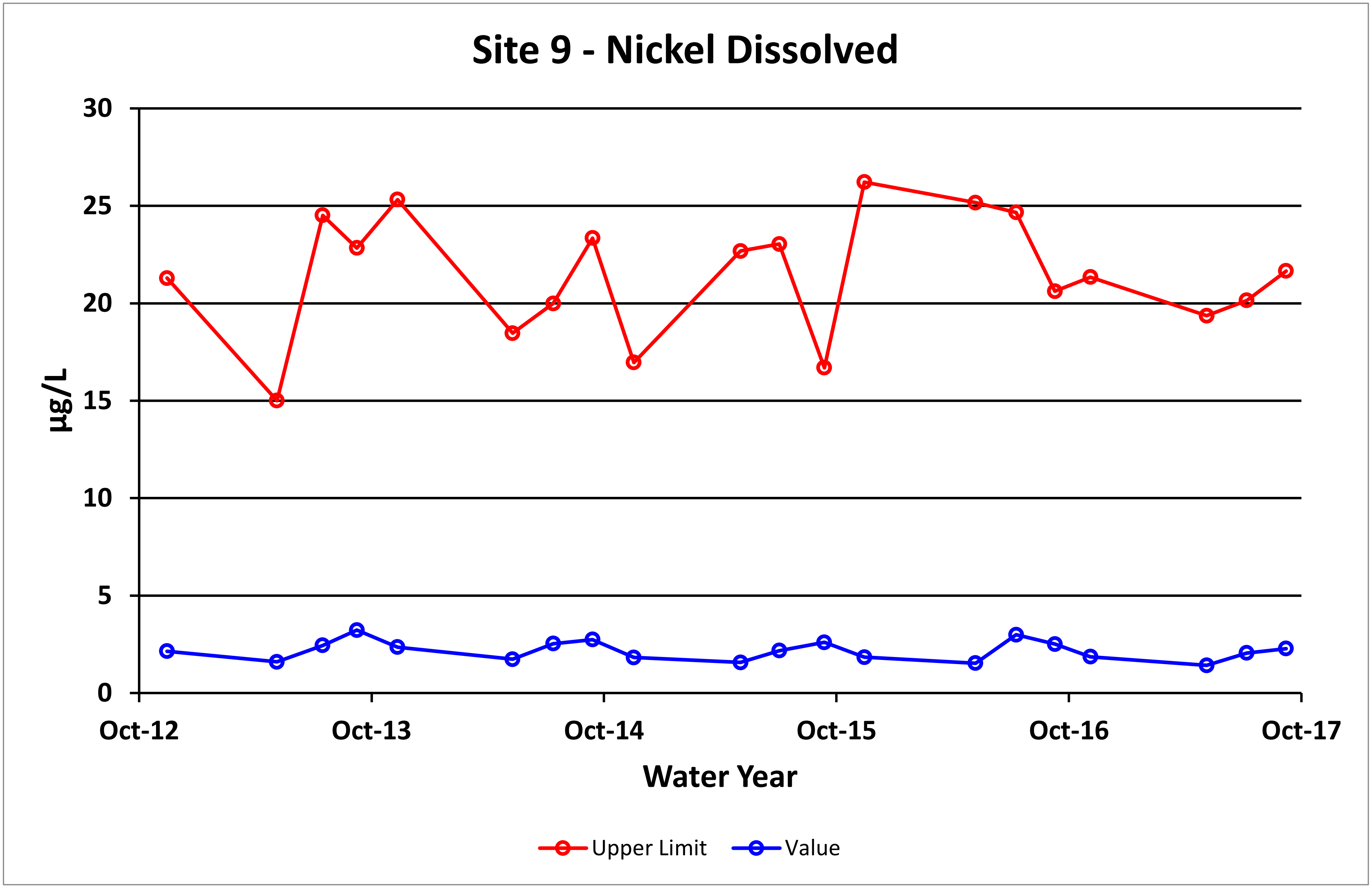
Site 9 - Barium Dissolved
µg/L
2000
1500
1000
500
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

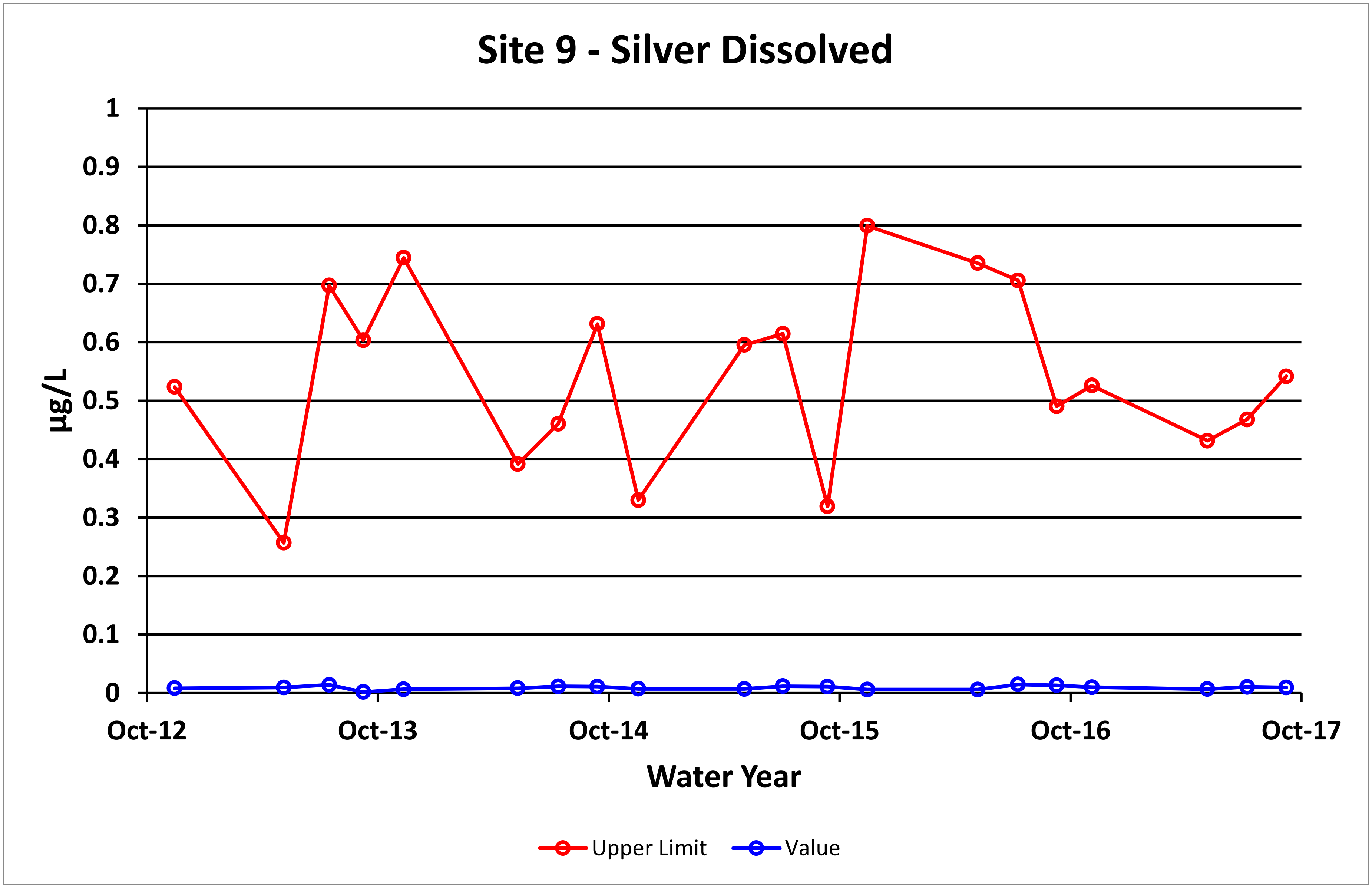

Site 9 - Cadmium Dissolved
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value


Site 9 - Chromium Dissolved
12
10
8
6
4
2
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

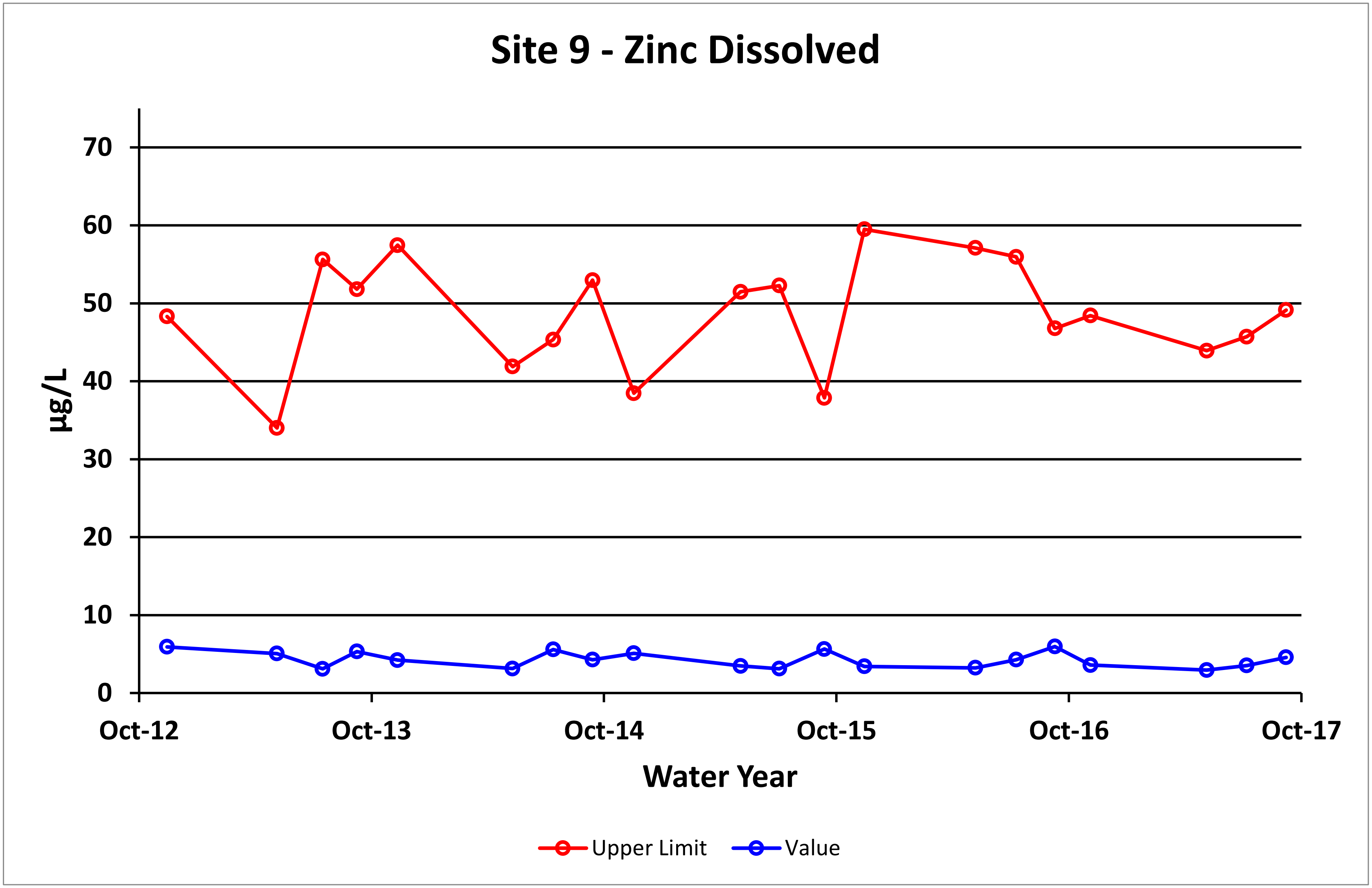

Site 9 - Copper Dissolved
µg/L
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

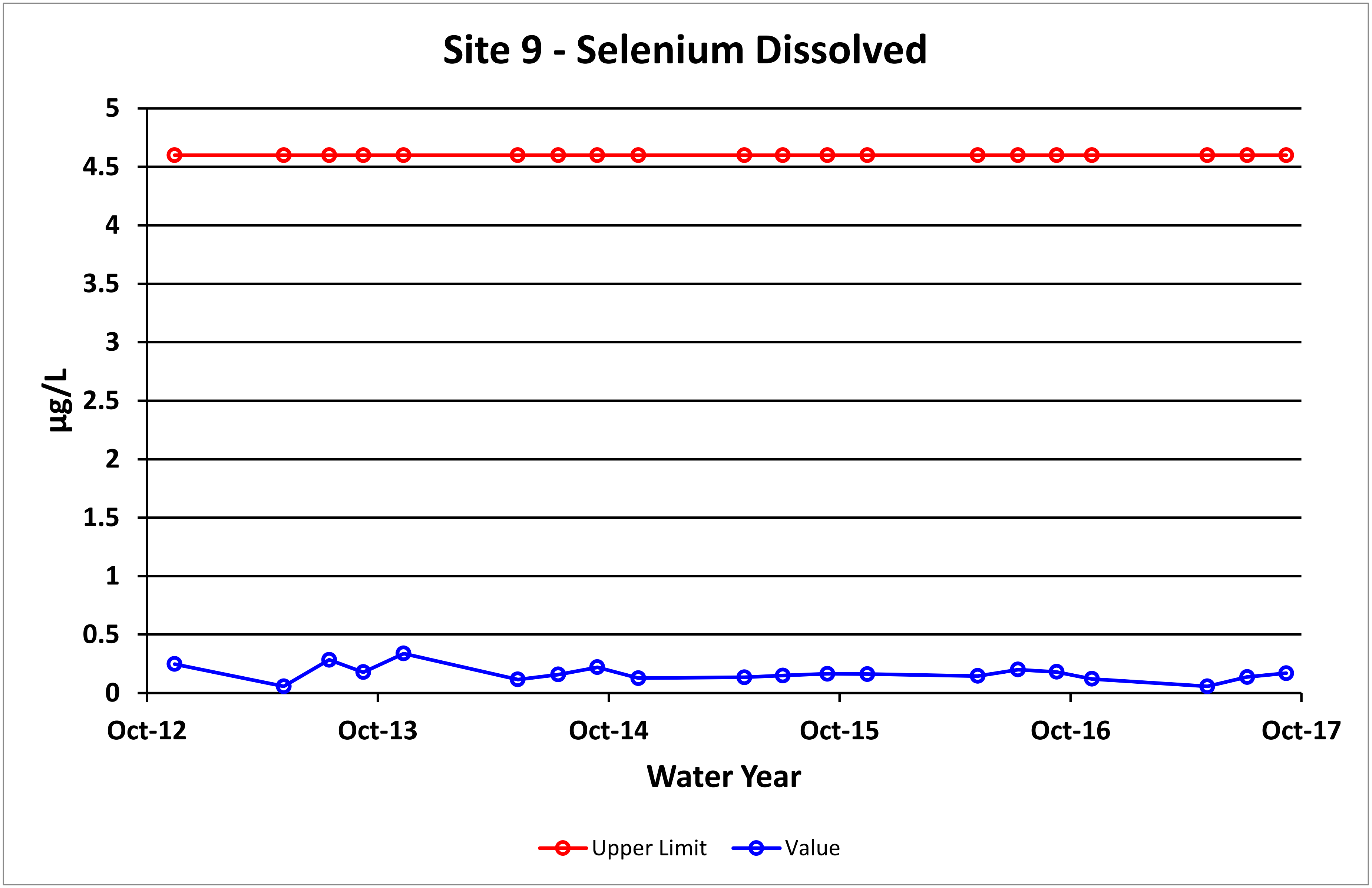

Site 9 - Lead Dissolved
µg/L
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value


Site 9 - Nickel Dissolved
30
25
20
15
10
5
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

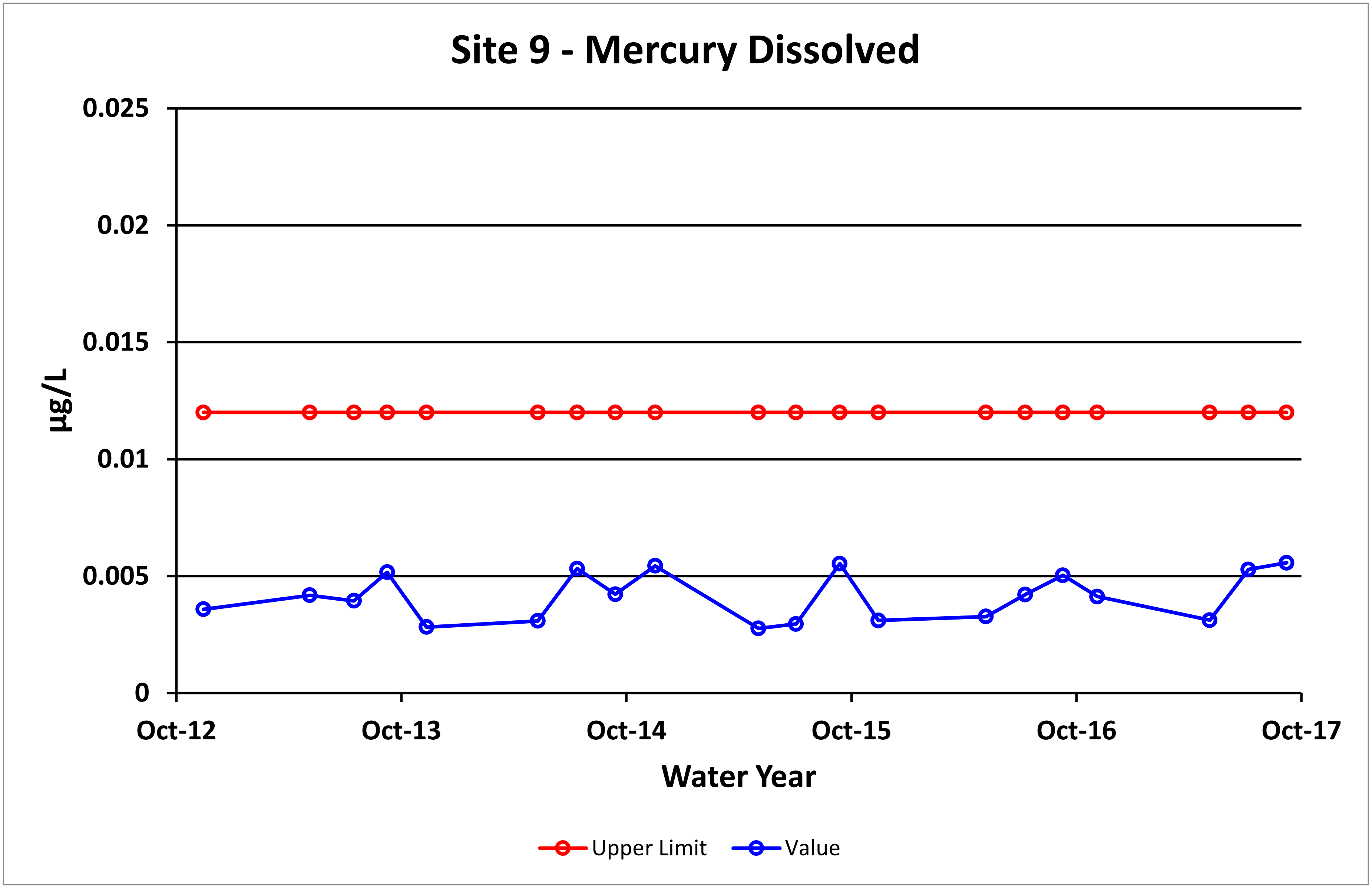


Site 9 - Silver Dissolved
µg/L
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value


Site 9 - Zinc Dissolved
70
60
50
40
30
20
10
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value



Site 9 - Selenium Dissolved
µg/L
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value



Site 9 - Mercury Dissolved
0.025
0.02
0.015
0.01
0.005
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

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 2017" report. The table includes all the required FWMP analyte data (field and laboratory) collected for the current water year and a series of flags keyed to the summary report "Qualified Data by QA Reviewer". The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of ½ MDL for the purpose of median calculation.

As shown in the table below, there were no data outliers.

Sample Date	Parameter	Value	Qualifier	Notes
No outliers, 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. Six results exceeding these criteria have been identified, as listed in the table below. One of the exceedances was for field pH and four were for low total alkalinity. 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 2017

			Limits		
Sample Date	**Parameter**	**Value**	**Lower**	**Upper**	**Hardness**
7-Nov-16	Alk	9.5 mg/L	20		22.5 mg/L
9-May-17	Alk	15.3 mg/L	20		45.7 mg/L
11-Jul-17	Alk	13.6 mg/L	20		34.3 mg/L
11-Sep-17	Alk	9.500 mg/L	20		27.1 mg/L
11-Sep-17	Hg	0.016 µg/L		0.012	27.1 mg/L
11-Sep-17	pHfld	6.4 su	6.5	9	27.1 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. 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-11 and Sep-17 (WY2012-WY2017).

Table of Summary Statistics for Trend Analysis

	Mann-Kendall test statistics			Sen's slope estimate	
Parameter	**n***	**p****	**Trend**	**Q**	**Q(%)**
Conductivity Field	6	0.95			
pH Field	6	0.78			
Alkalinity, Total	6	0.91			
Sulfate, Total	6	1.00	+	1.44	37.1
Zinc, Dissolved	6	0.68			

* 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 1.44 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 2017

Site 060FMS - 'Lower Althea creek'

Sample Date/Parameter	Oct 2016	Nov 2016	Dec 2016	Jan 2017	Feb 2017	Mar 2017	Apr 2017	May 2017	Jun 2017	Jul 2017	Aug 2017	Sep 2017	**Median**
Water Temp (°C)		6.2						5.2		9.6		10.2	7.9
Conductivity-Field(µmho)		48.2						116.5		79.7		53.8	66.8
Conductivity-Lab (µmho)		49						108		71		52	62
pH Lab (standard units)		6.81						6.59		6.23		6.02	6.41
pH Field (standard units)		6.6						6.87		6.63		6.39	6.62
Total Alkalinity (mg/L)		9.5						15.3		13.6		9.5	11.6
Total Sulfate (mg/L)		3.7						28.9		13.6		6.8	10.2
Hardness (mg/L)		22.5						45.7		34.3		27.1	30.7
Dissolved As (ug/L)		2.2						0.846		2.38		3.61	2.290
Dissolved Ba (ug/L)		23.6						31.8		31.2		32.9	31.5
Dissolved Cd (ug/L)		0.0144						0.0083		0.0153		0.0244	0.0149
Dissolved Cr (ug/L)		1.45						0.553		1.04		1.29	1.165
Dissolved Cu (ug/L)		1.11						0.566		1.2		1.65	1.155
Dissolved Pb (ug/L)		0.339						0.0589		0.2201		0.522	0.2796
Dissolved Ni (ug/L)		1.11						0.577		1.22		1.24	1.165
Dissolved Ag (ug/L)		0.011						0.002		0.008		0.016	0.010
Dissolved Zn (ug/L)		7.99						2.79		15.9		9.69	8.84
Dissolved Se (ug/L)		0.14						0.057		0.133		0.164	0.137
Dissolved Hg (ug/L)		0.0095						0.00379		0.00992		0.0161	0.009710

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

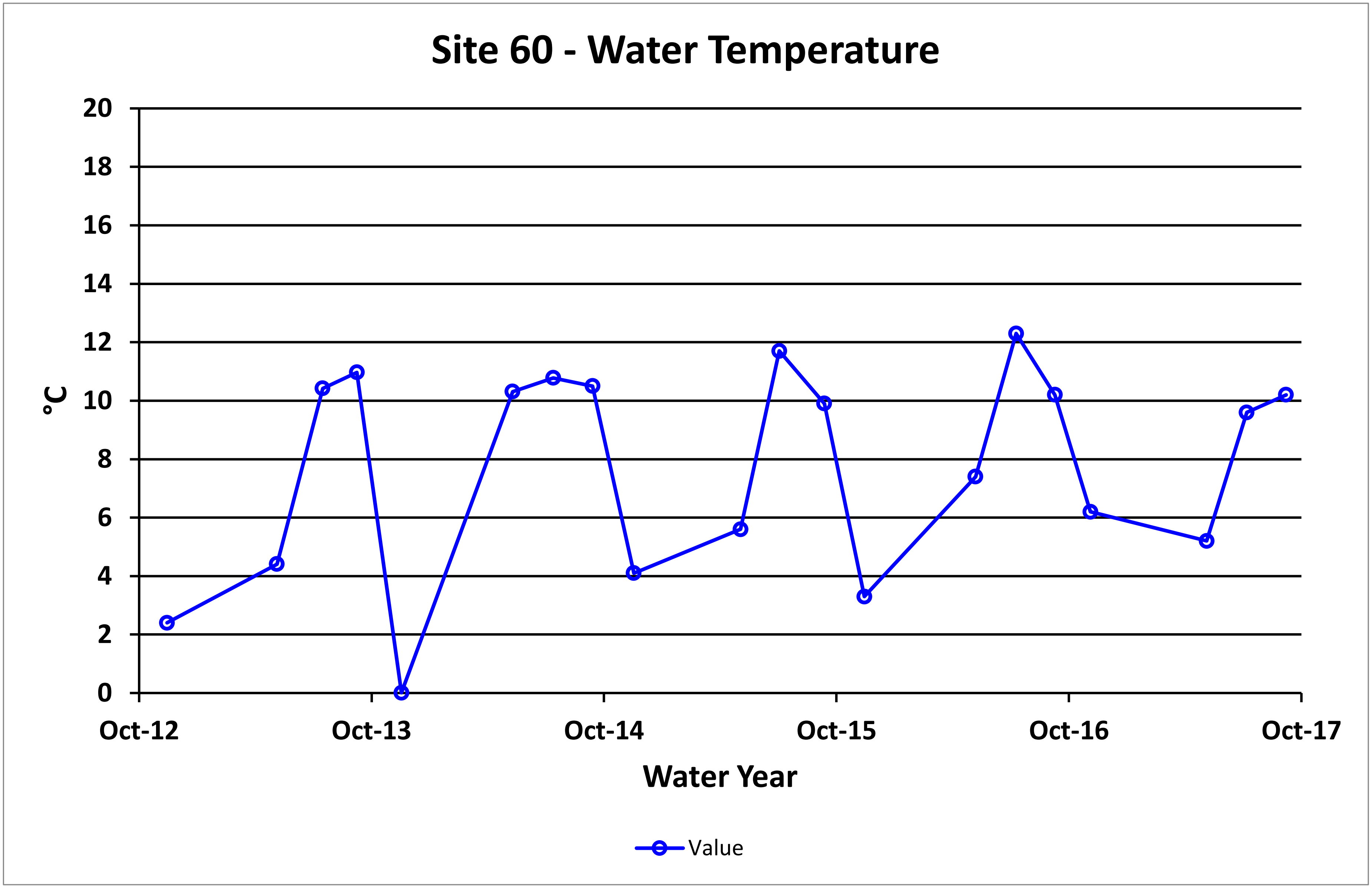
Values reported as less than MDL are replaced by 1/2 MDL for median calculation purposes.

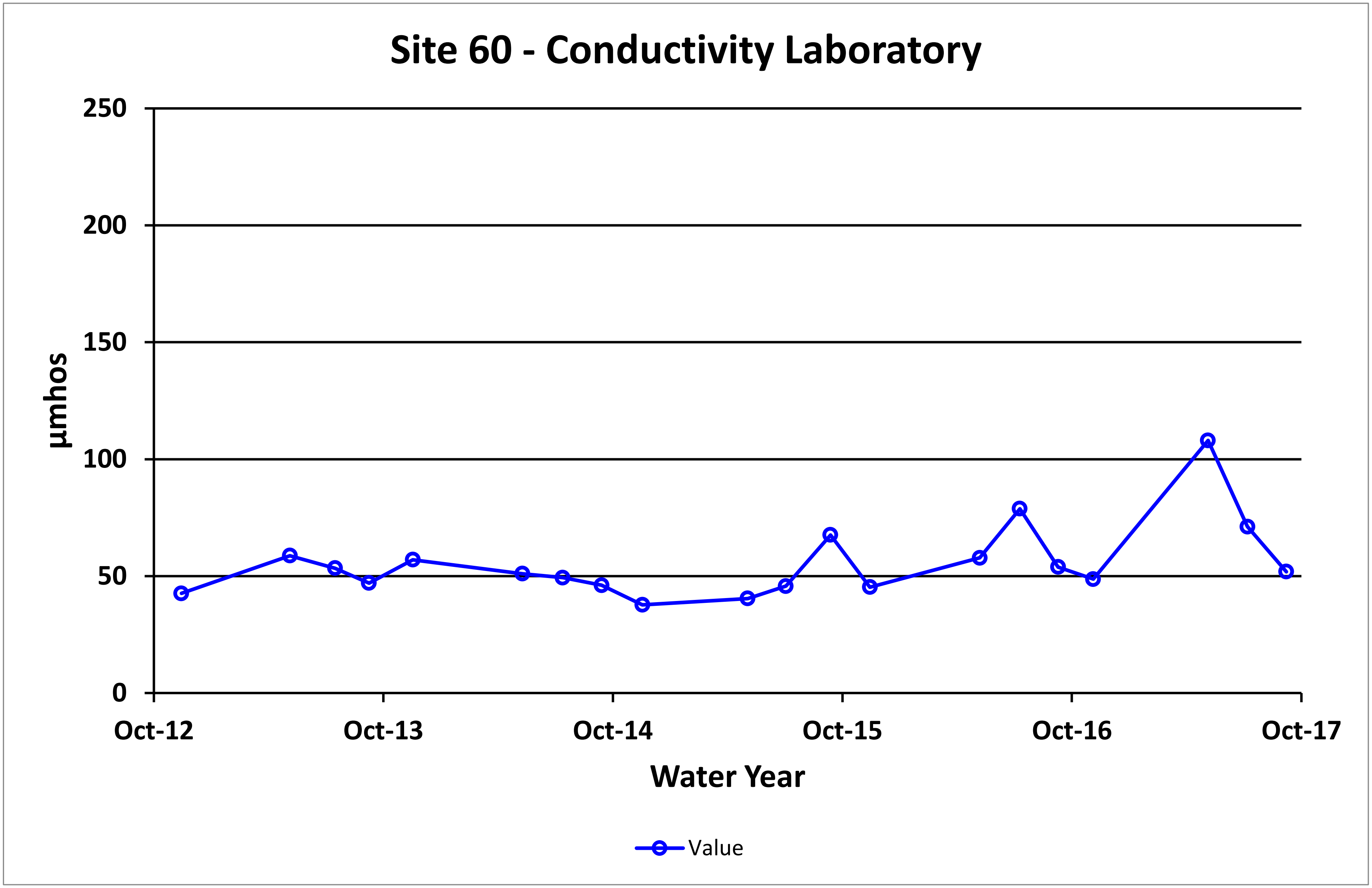
Shaded data has been qualified as an outlier by HGCMC and removed from any further analysis and is not included into the calculation of the median

Qualified Data by QA Reviewer

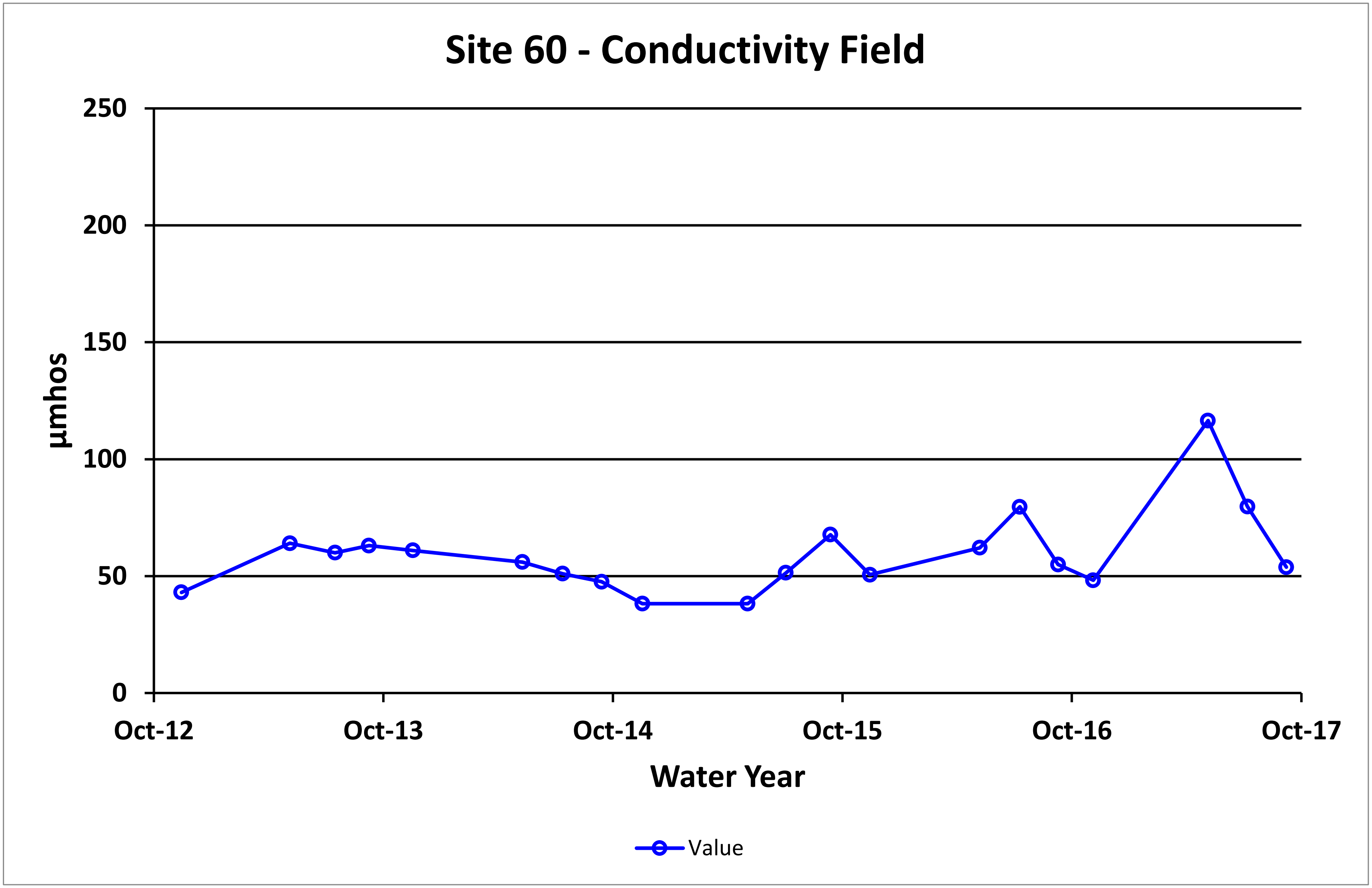
Date Range: 10/01/2016 to 09/30/2017

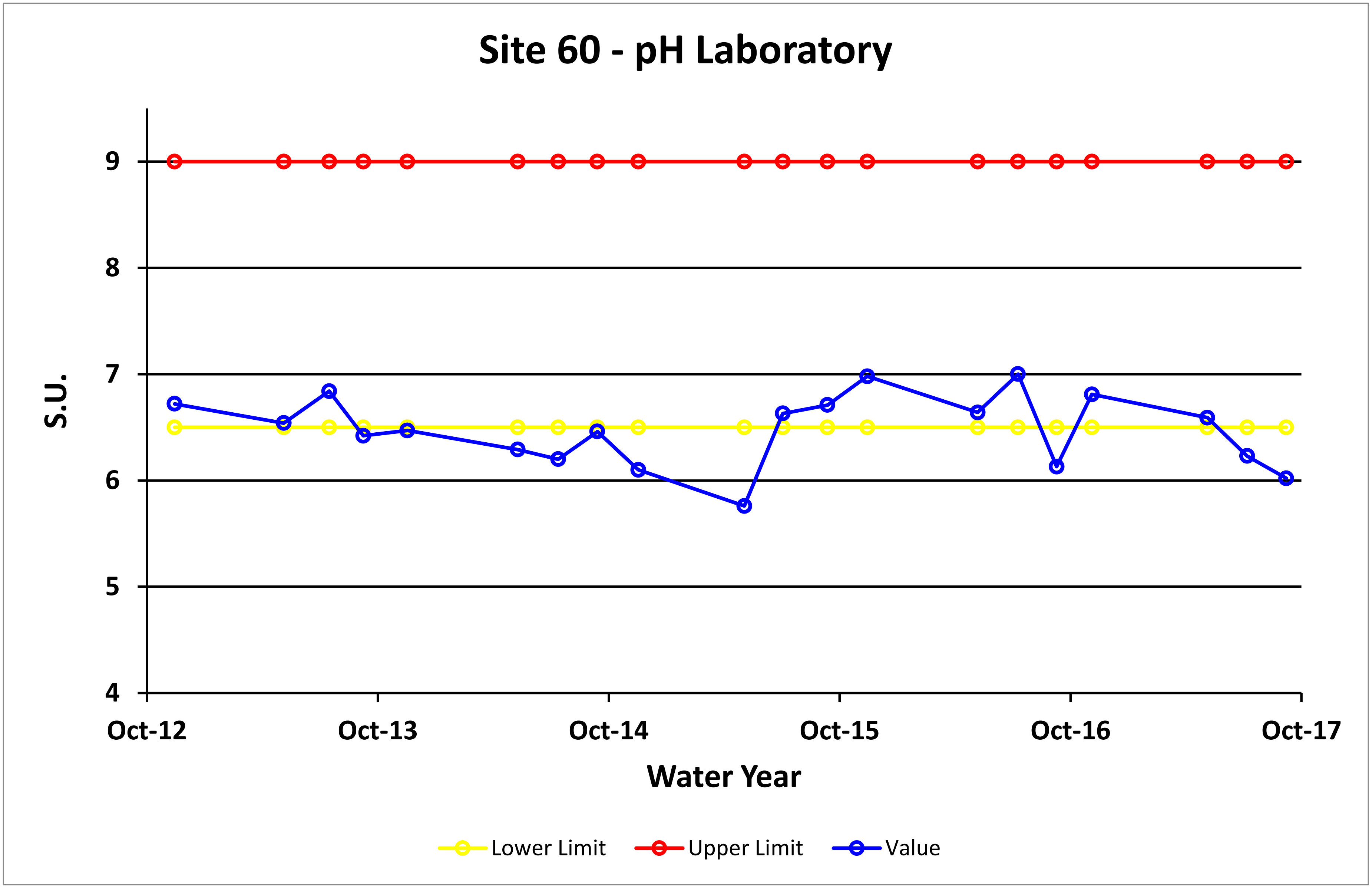
Site No.	Sample Date	Sample Time	Parameter	Value		Qualifier	Reason for Qualifier
060FMS	11/7/2016	12:00 PM	Diss. Se-ICP/MS	0.14	µg/L	J	Below Quantitative Range
	5/9/2017	12:00 PM	Diss. Cd-ICP/MS	0.00832	µg/L	J	Below Quantitative Range
			Tot. Sulfate	28.9	mg/L	J	Sample Receipt Temperature
	7/11/2017	12:00 PM	Diss. Ag-ICP/MS	0.00815	µg/L	J	Below Quantitative Range
			Diss. Se-ICP/MS	0.13	µg/L	J	Below Quantitative Range
			Tot. Sulfate	13.6	mg/L	J	Sample Receipt Temperature
	9/11/2017	12:00 PM	Diss. Se-ICP/MS	0.16	µg/L	J	Below Quantitative Range

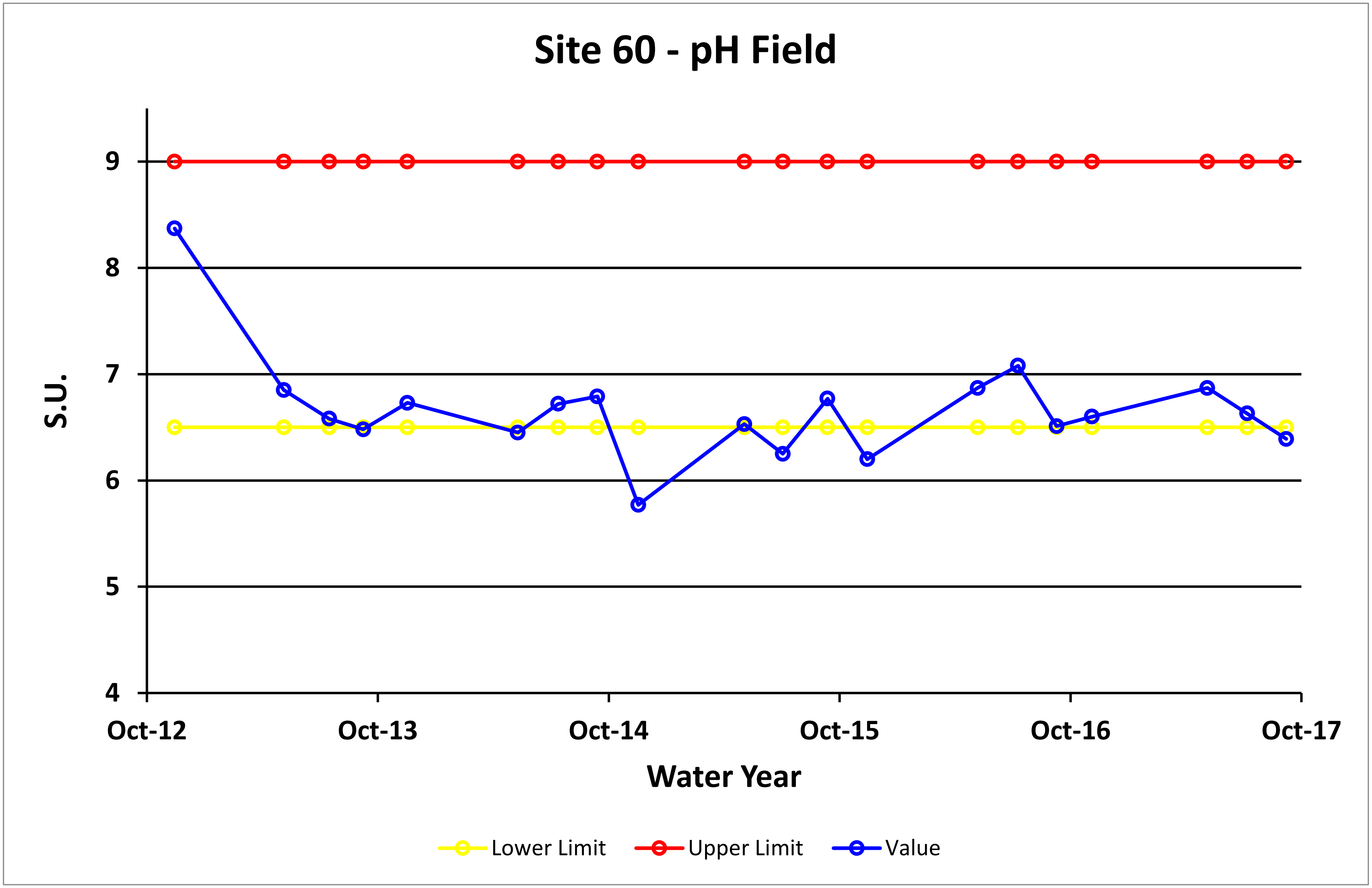

Site 60 - Water Temperature
°C
20
18
16
14
12
10
8
6
4
2
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value

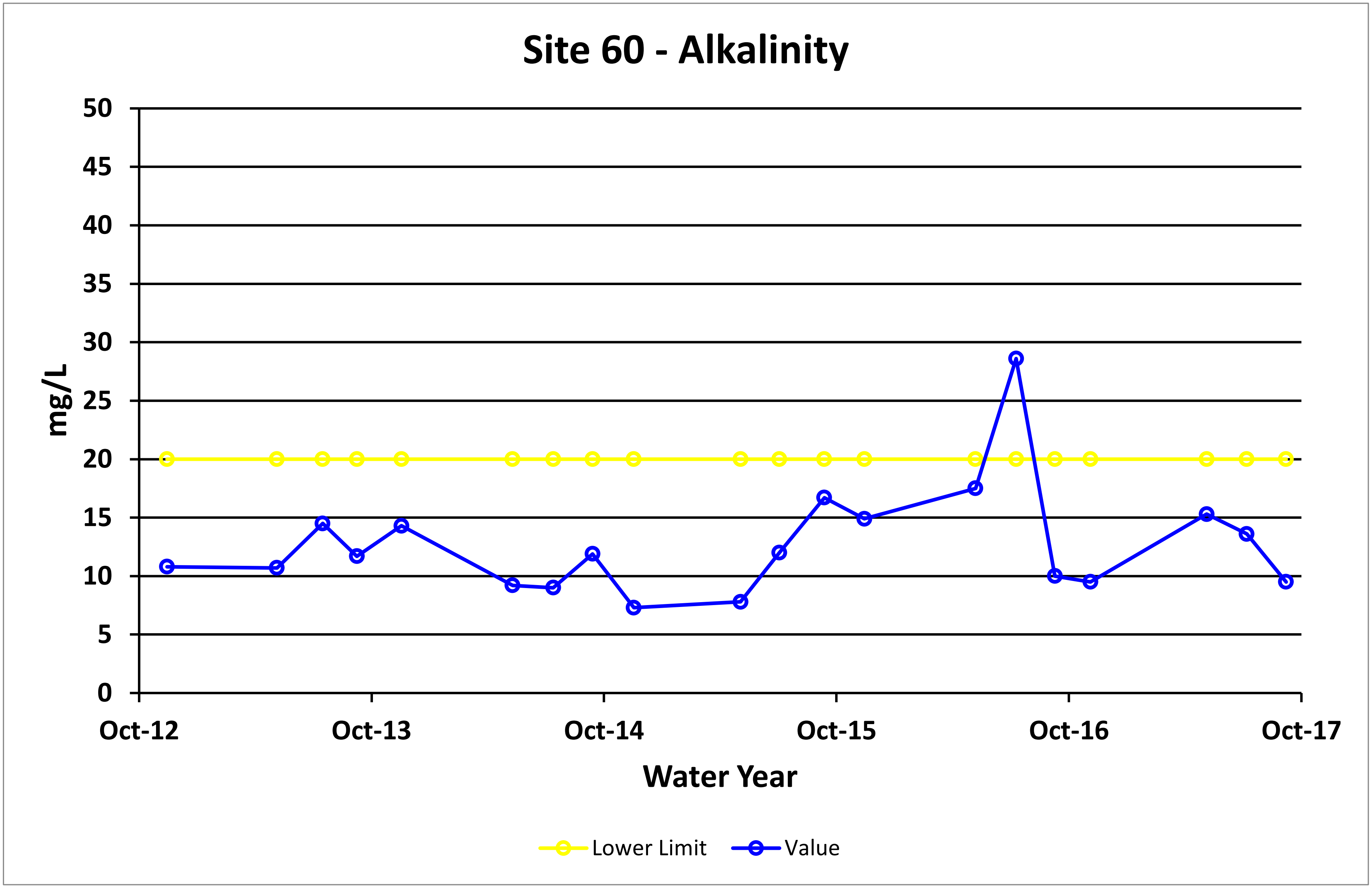


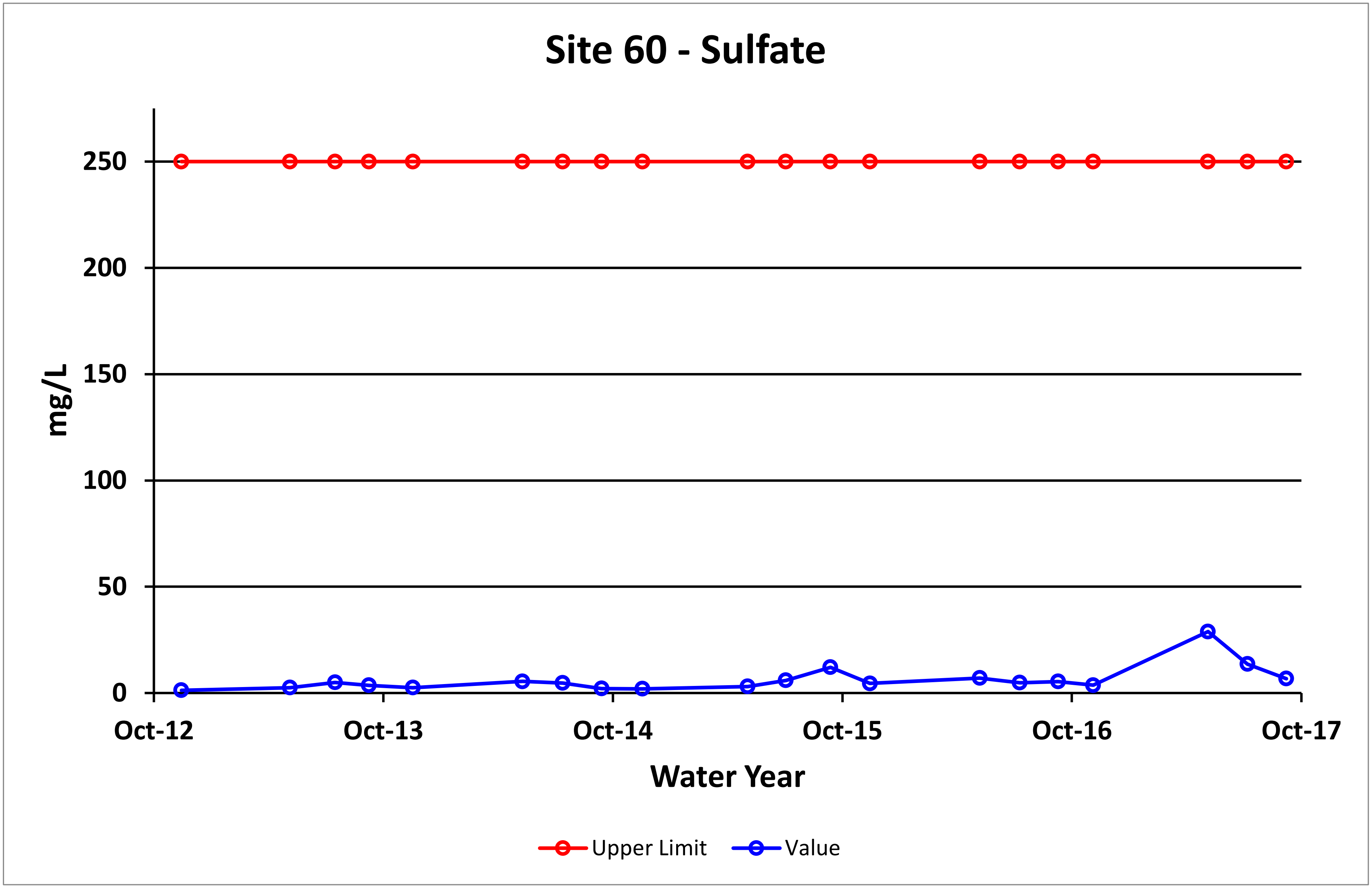
Site 60 - Conductivity Laboratory
250
200
150
100
50
0
µmhos
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value

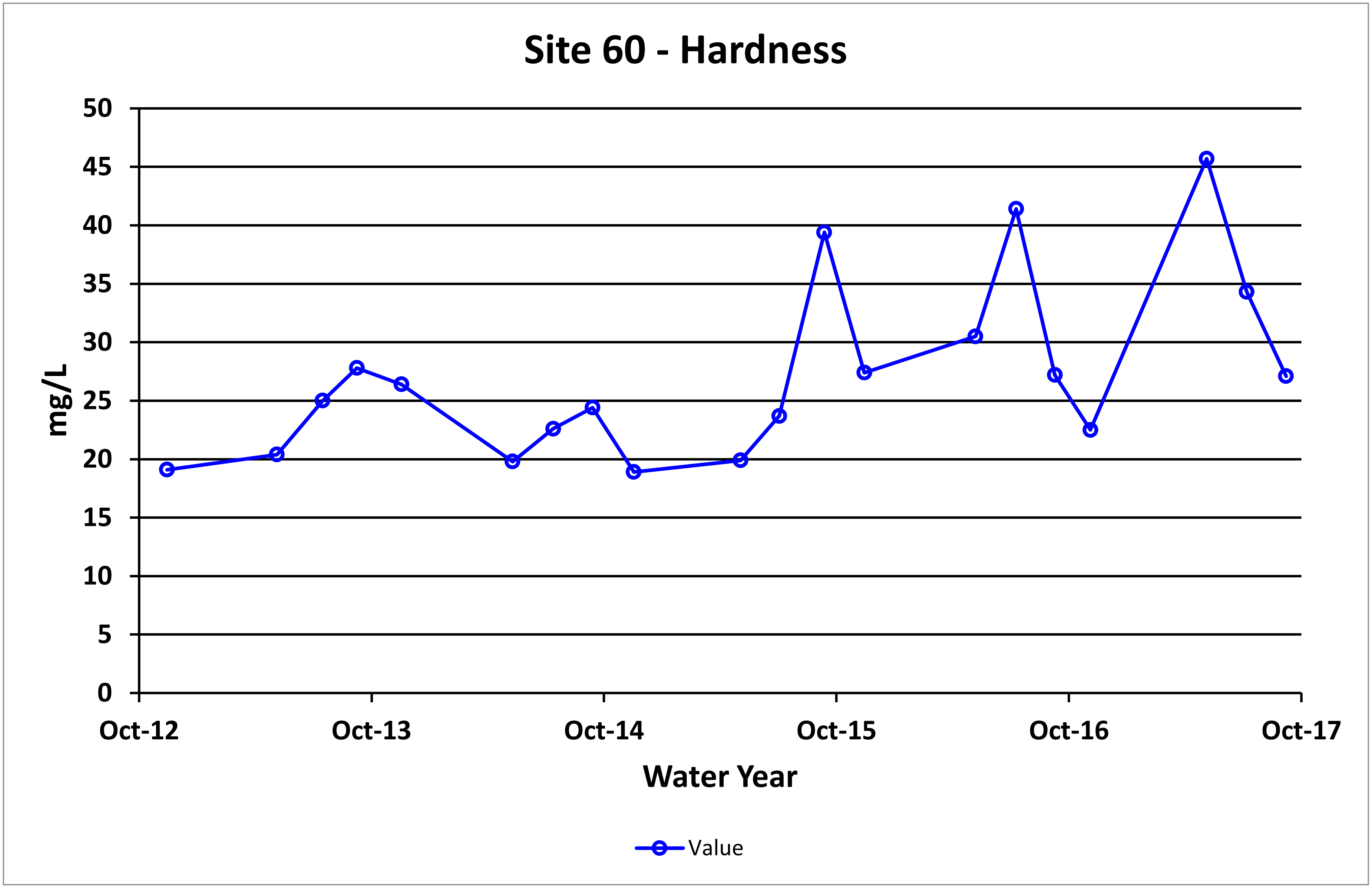

Site 60 - Conductivity Field
250
200
150
100
50
0
µmhos
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value

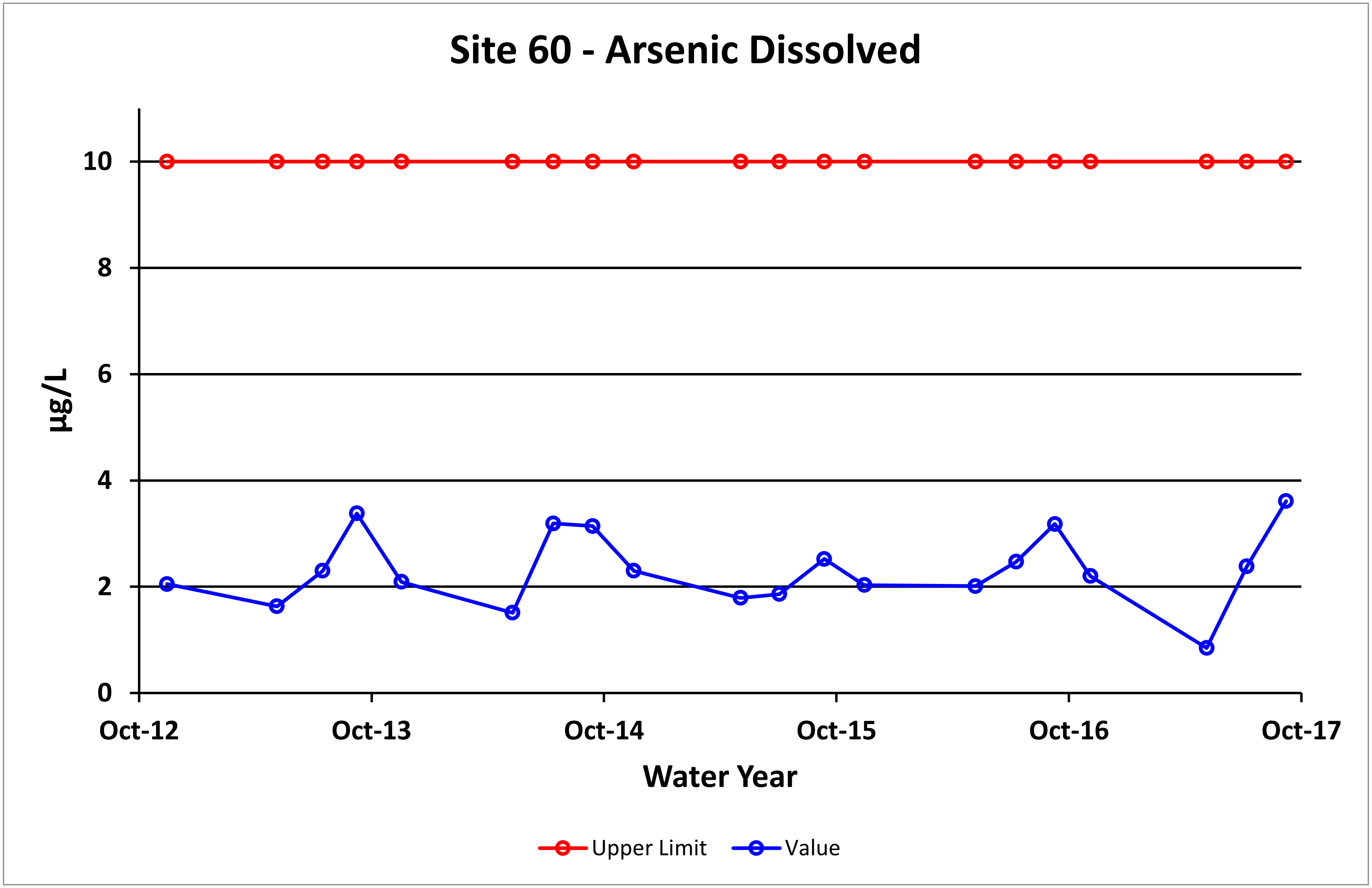

Site 60 - pH Laboratory
S.U.
9
8
7
6
5
4
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Lower Limit
Upper Limit
Value

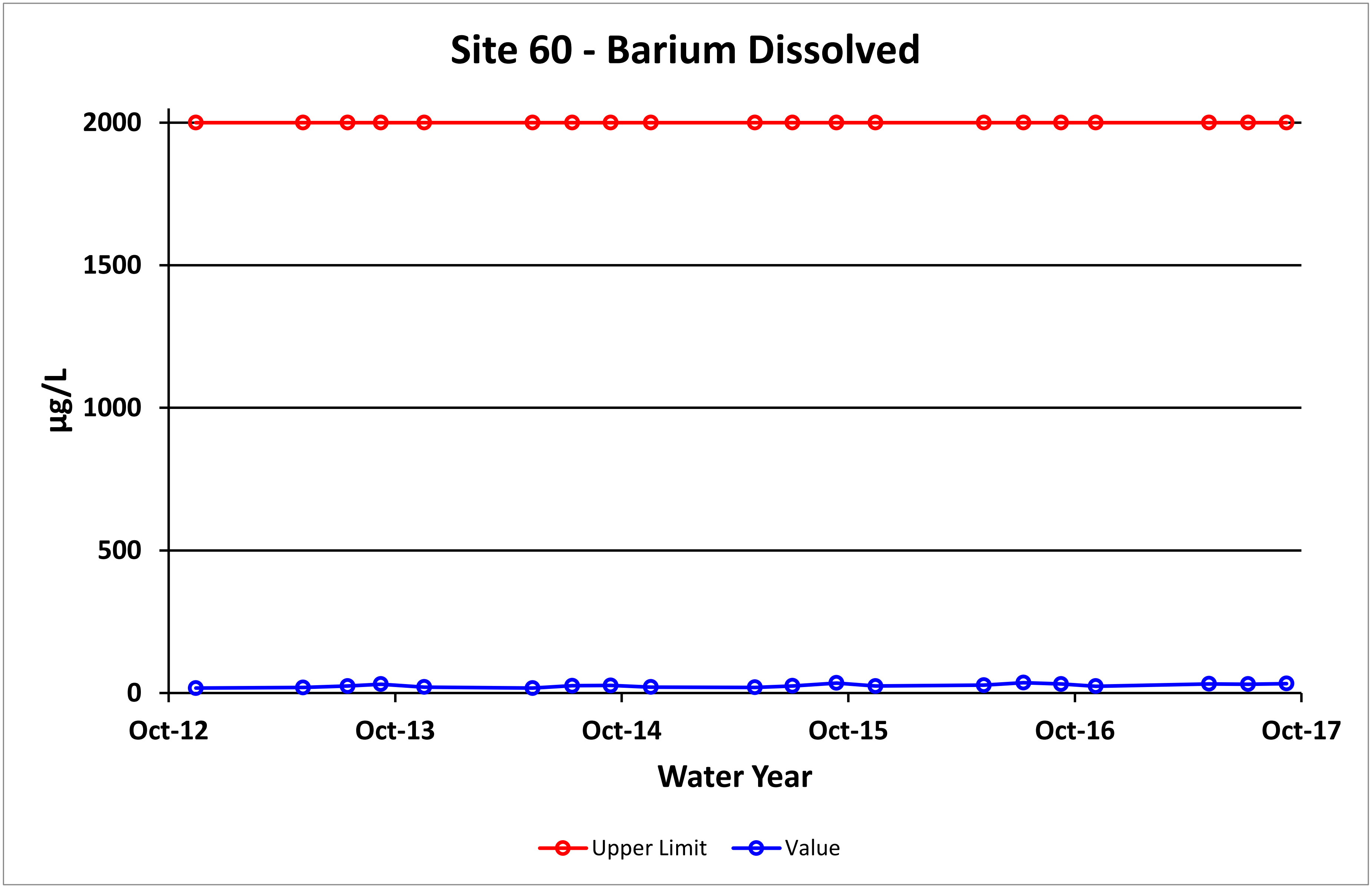

Site 60 - pH Field
S.U.
9
8
7
6
5
4
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Lower Limit
Upper Limit
Value

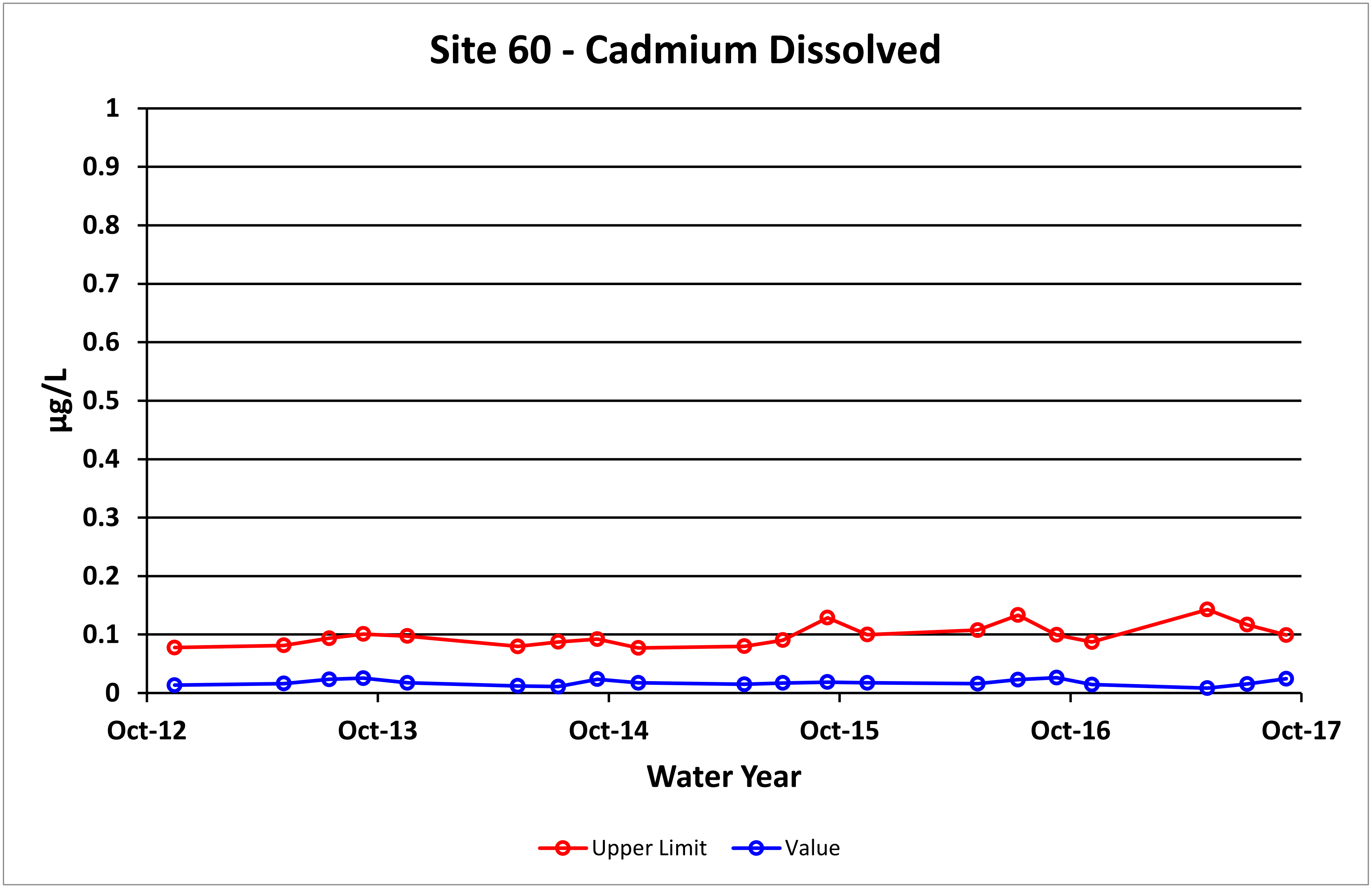

Site 60 - Alkalinity
mg/L
50
45
40
35
30
25
20
15
10
5
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Lower Limit
Value


Site 60 - Sulfate
mg/L
250
200
150
100
50
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

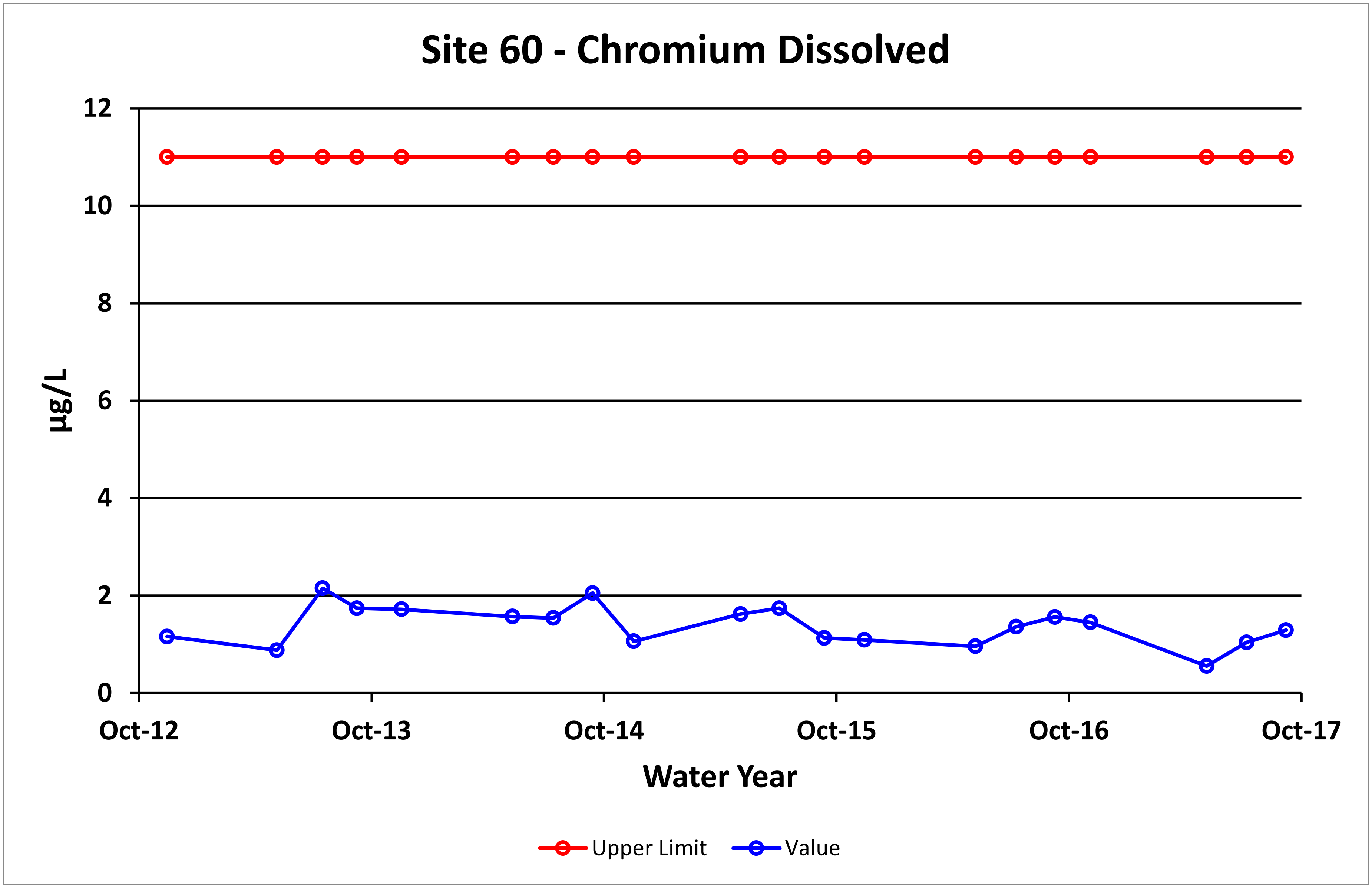

Site 60 - Hardness
mg/L
0
5
10
15
20
25
30
35
40
45
50
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value


Site 60 - Arsenic Dissolved
µg/L
0
2
4
6
8
10
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

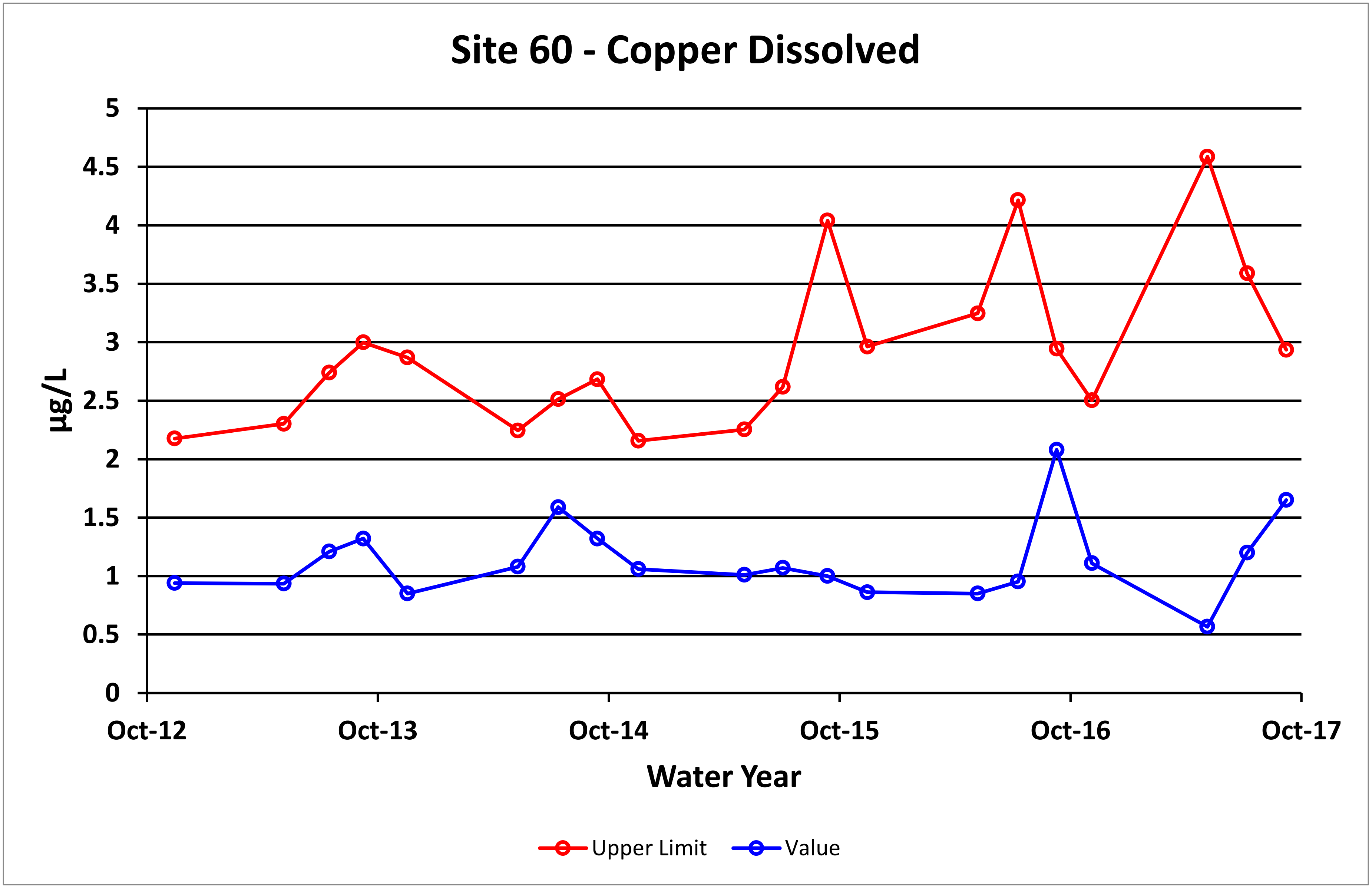

Site 60 - Barium Dissolved
2000
1500
1000
500
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value



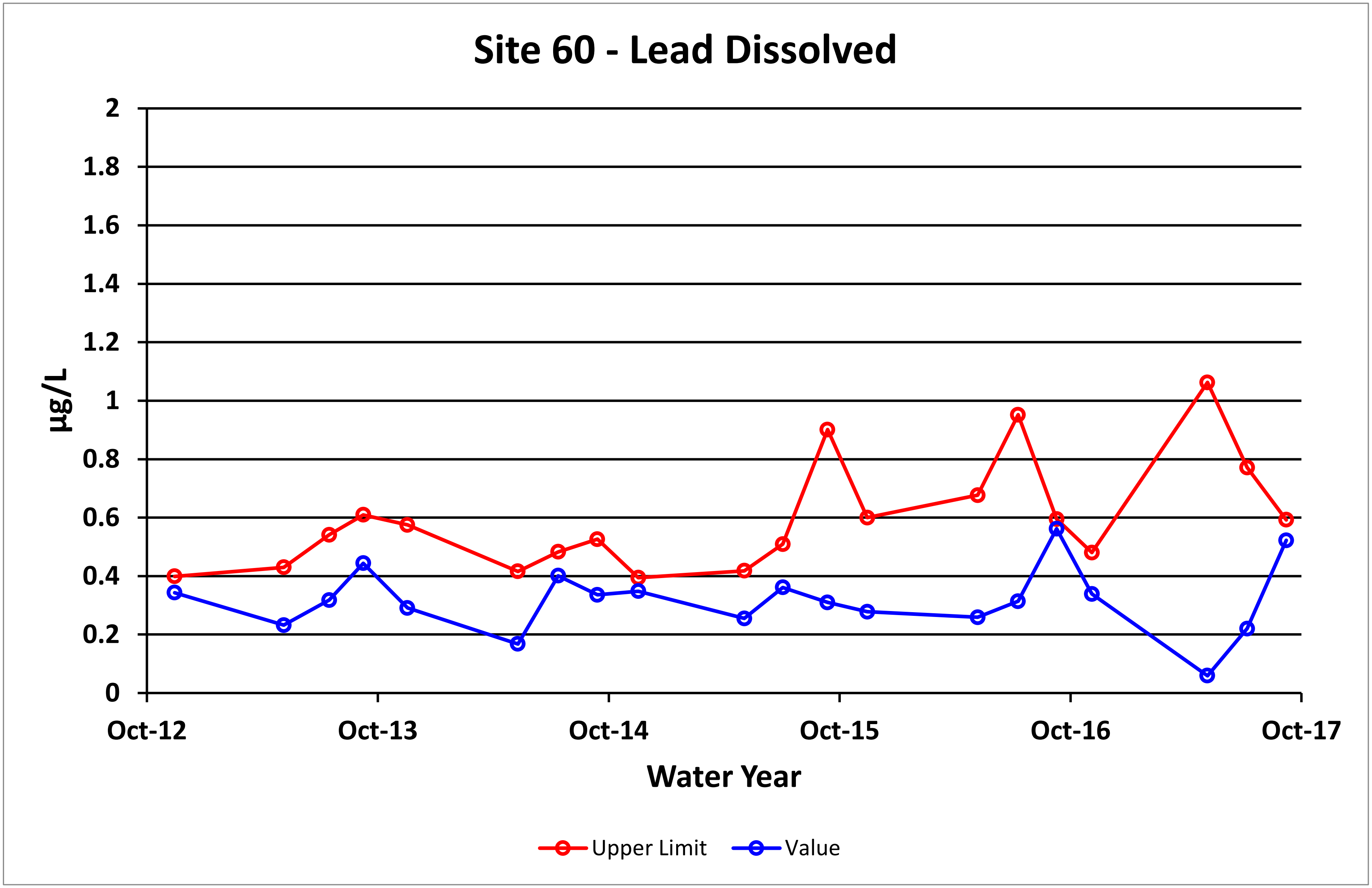
Site 60 - Cadmium Dissolved
µg/L
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

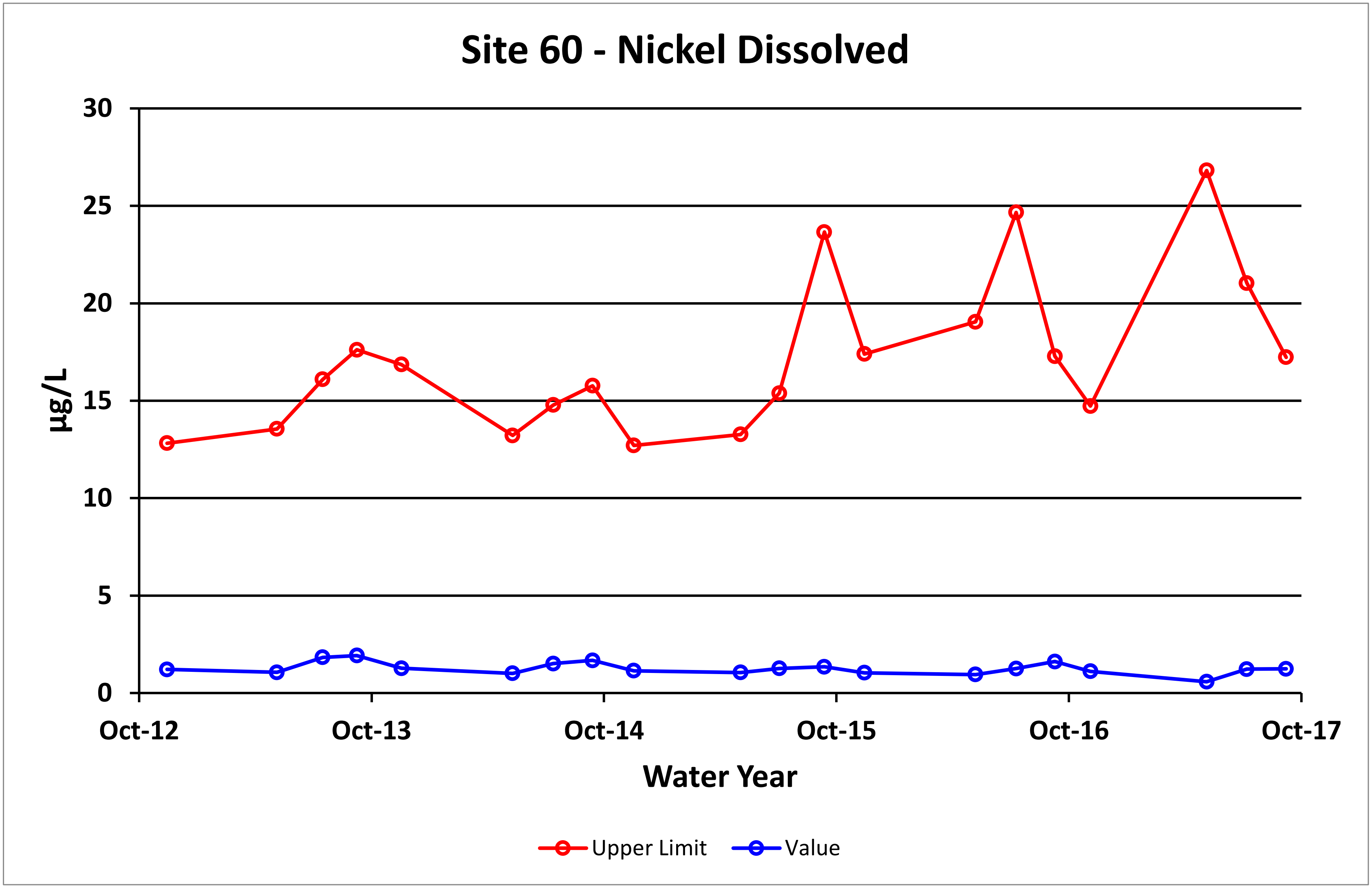


Site 60 - Chromium Dissolved
12
10
8
6
4
2
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

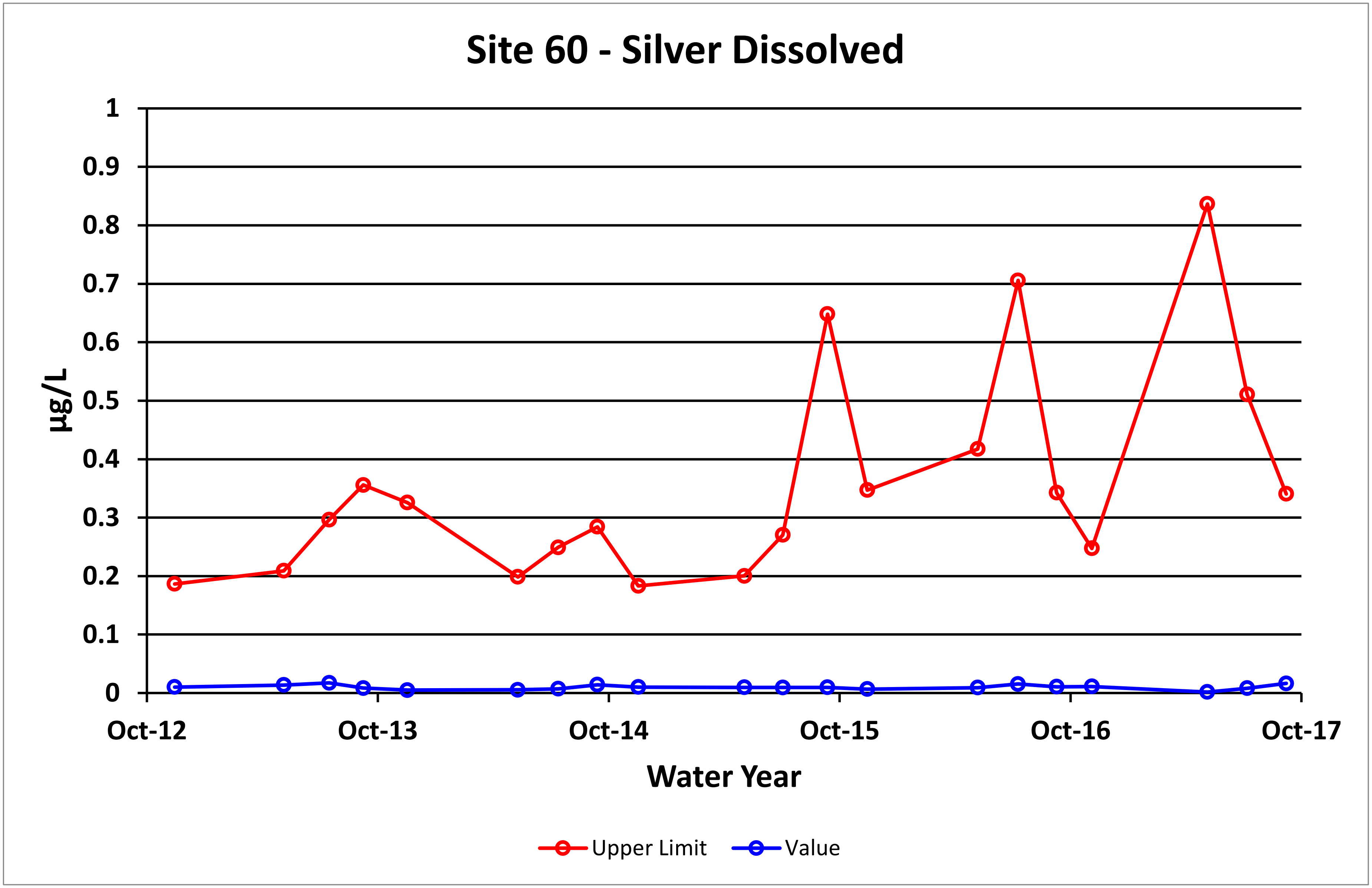


Site 60 - Copper Dissolved
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

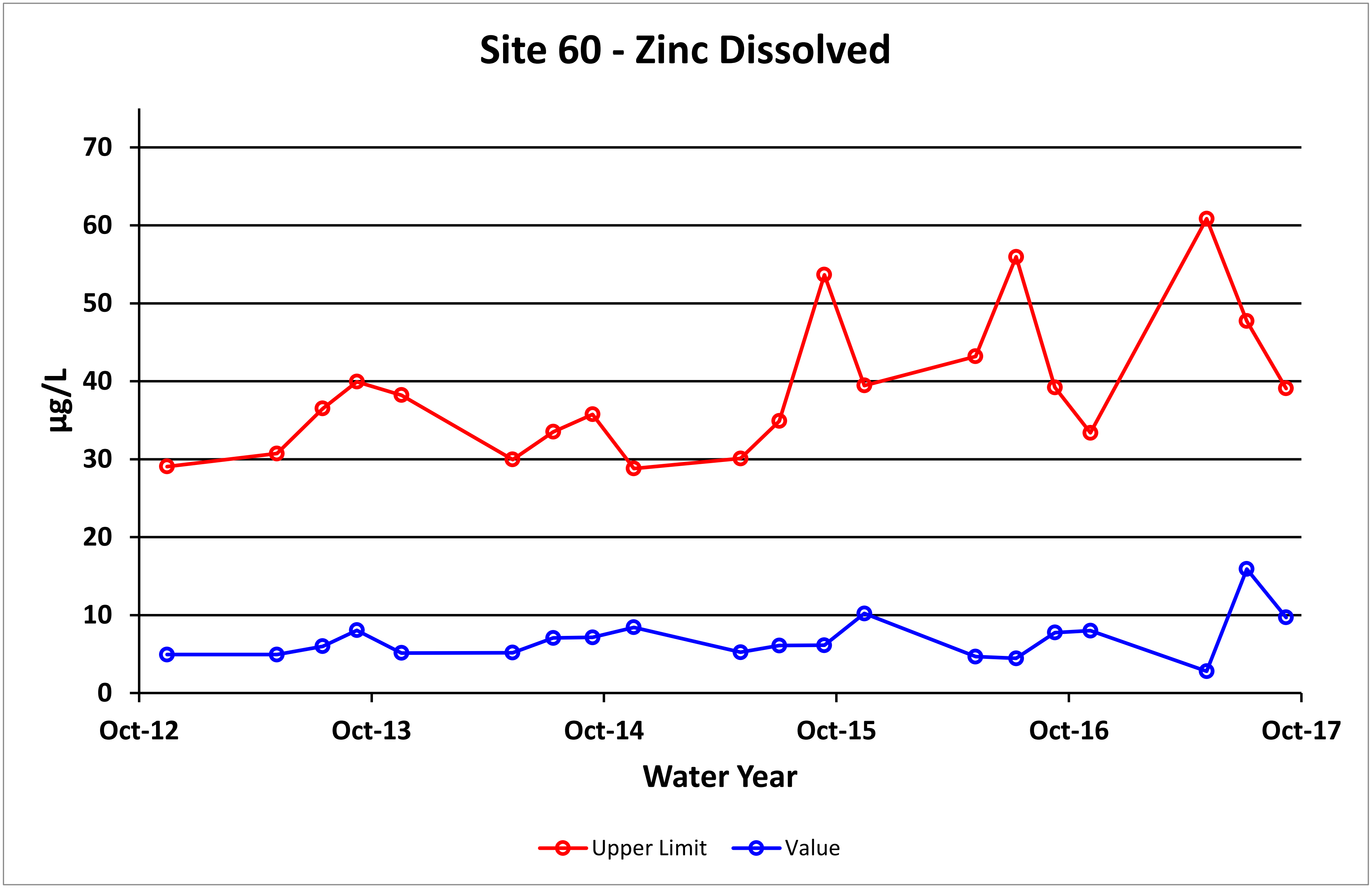

Site 60 - Lead Dissolved
µg/L
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value



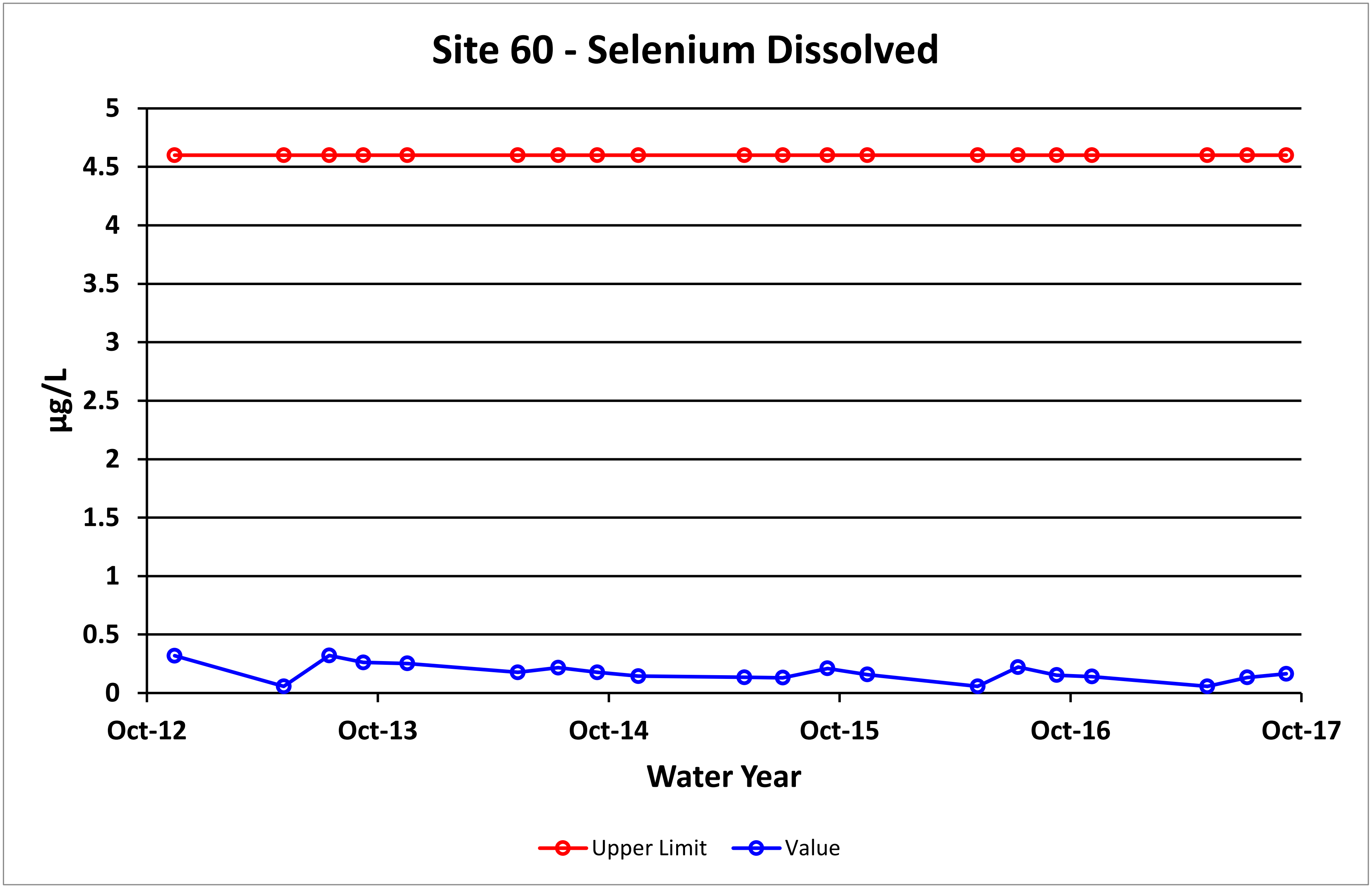
Site 60 - Nickel Dissolved
30
25
20
15
10
5
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value



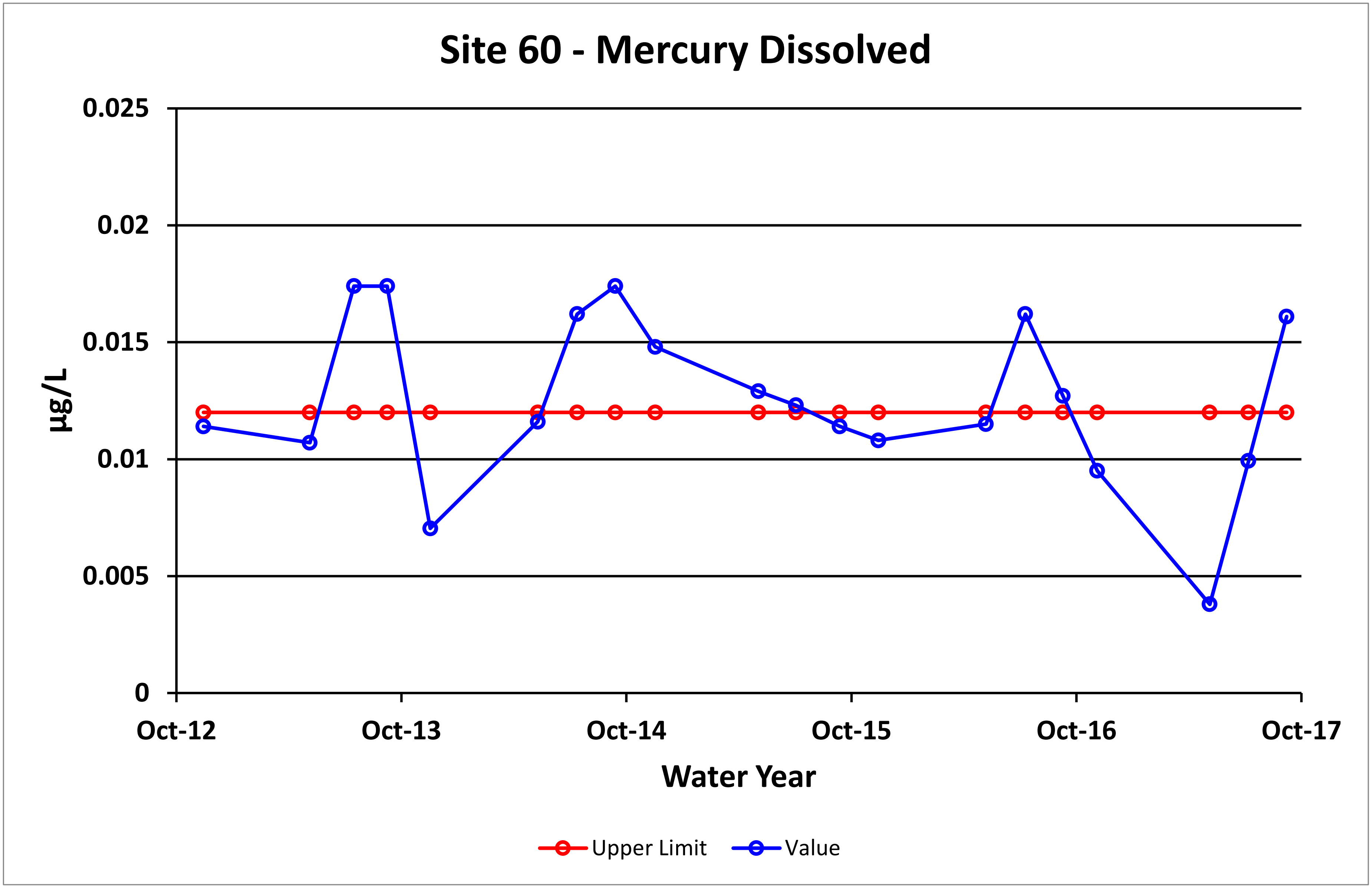
Site 60 - Silver Dissolved
µg/L
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value



Site 60 - Zinc Dissolved
µg/L
70
60
50
40
30
20
10
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value



Site 60 - Selenium Dissolved
µg/L
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value


Site 60 - Mercury Dissolved
0.025
0.02
0.015
0.01
0.005
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

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 2017” report. The table includes all the required FWMP analyte data (field and laboratory) collected for the current water year and a series of flags keyed to the summary report “Qualified Data by QA Reviewer”. The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of ½ MDL for the purpose of median calculation.

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

Sample Date	Parameter	Value	Qualifier	Notes
No outliers have been identified by HGCMC for the period of October 2013 through September 2017.				

The data for the current water year have been compared to the strictest fresh water quality criterion for each applicable analyte. No exceedances were identified.

Table of Exceedance for Water Year 2017

			Limits		
Sample Date	Parameter	Value	Lower	Upper	Hardness
No exceedances have been identified by HGCMC for the period of October 2016 through September 2017.					

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.

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Table of Results for Water Year 2017

Site 609FMS - 'Further Creek Lower'

Sample Date/Parameter	Oct 2016	Nov 2016	Dec 2016	Jan 2017	Feb 2017	Mar 2017	Apr 2017	May 2017	Jun 2017	Jul 2017	Aug 2017	Sep 2017	**Median**
Water Temp (°C)		6.3						5.5		9.4		10	7.9
Conductivity-Field(μmho)		559						273		443		520	481.5
Conductivity-Lab (μmho)		548						263		485		483	484
pH Lab (standard units)		7.19						6.69		6.93		7.06	7.00
pH Field (standard units)		7.01						7.01		6.89		7.38	7.01
Total Alkalinity (mg/L)		34.5						25		36.9		36	35.3
Total Sulfate (mg/L)		245						90.8		202		179	190.5
Hardness (mg/L)		283						124		252		265	258.5
Dissolved As (ug/L)		1						0.669		1.23		1.65	1.115
Dissolved Ba (ug/L)		51						29.6		50.6		54.6	50.8
Dissolved Cd (ug/L)		0.157						0.104		0.181		0.2	0.1690
Dissolved Cr (ug/L)		0.996						0.946		0.841		0.883	0.915
Dissolved Cu (ug/L)		0.51						0.657		0.708		0.899	0.683
Dissolved Pb (ug/L)		0.225						0.198		0.306		0.463	0.2655
Dissolved Ni (ug/L)		3.37						2.23		3.38		4.37	3.375
Dissolved Ag (ug/L)		0.005						0.002		0.004		0.004	0.004
Dissolved Zn (ug/L)		53.6						54.1		56.3		72.7	55.20
Dissolved Se (ug/L)		1.31						0.219		1.73		1.88	1.520
Dissolved Hg (ug/L)		0.00339						0.00185		0.00327		0.0036	0.003330

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

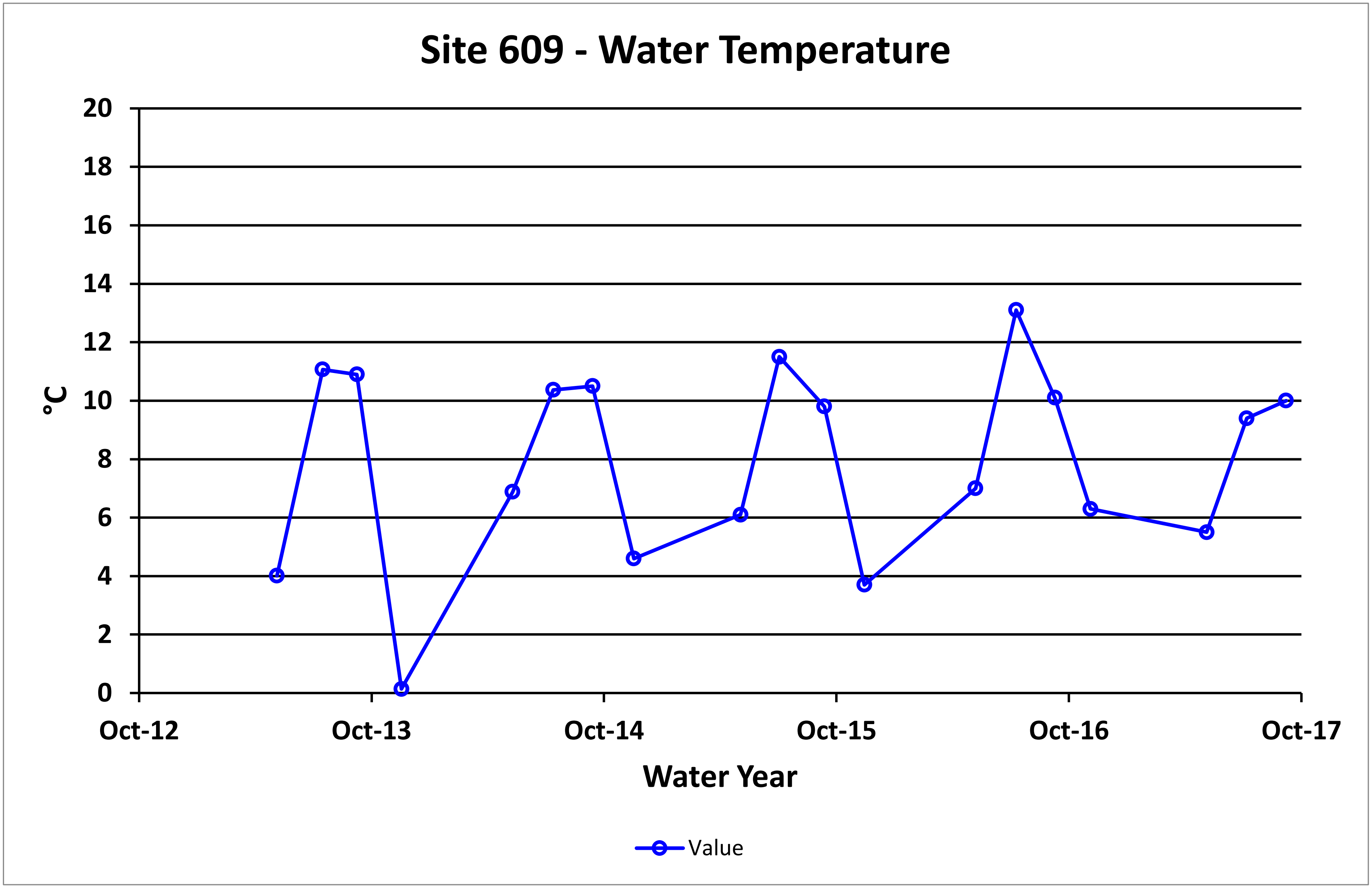
Values reported as less than MDL are replaced by 1/2 MDL for median calculation purposes.

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

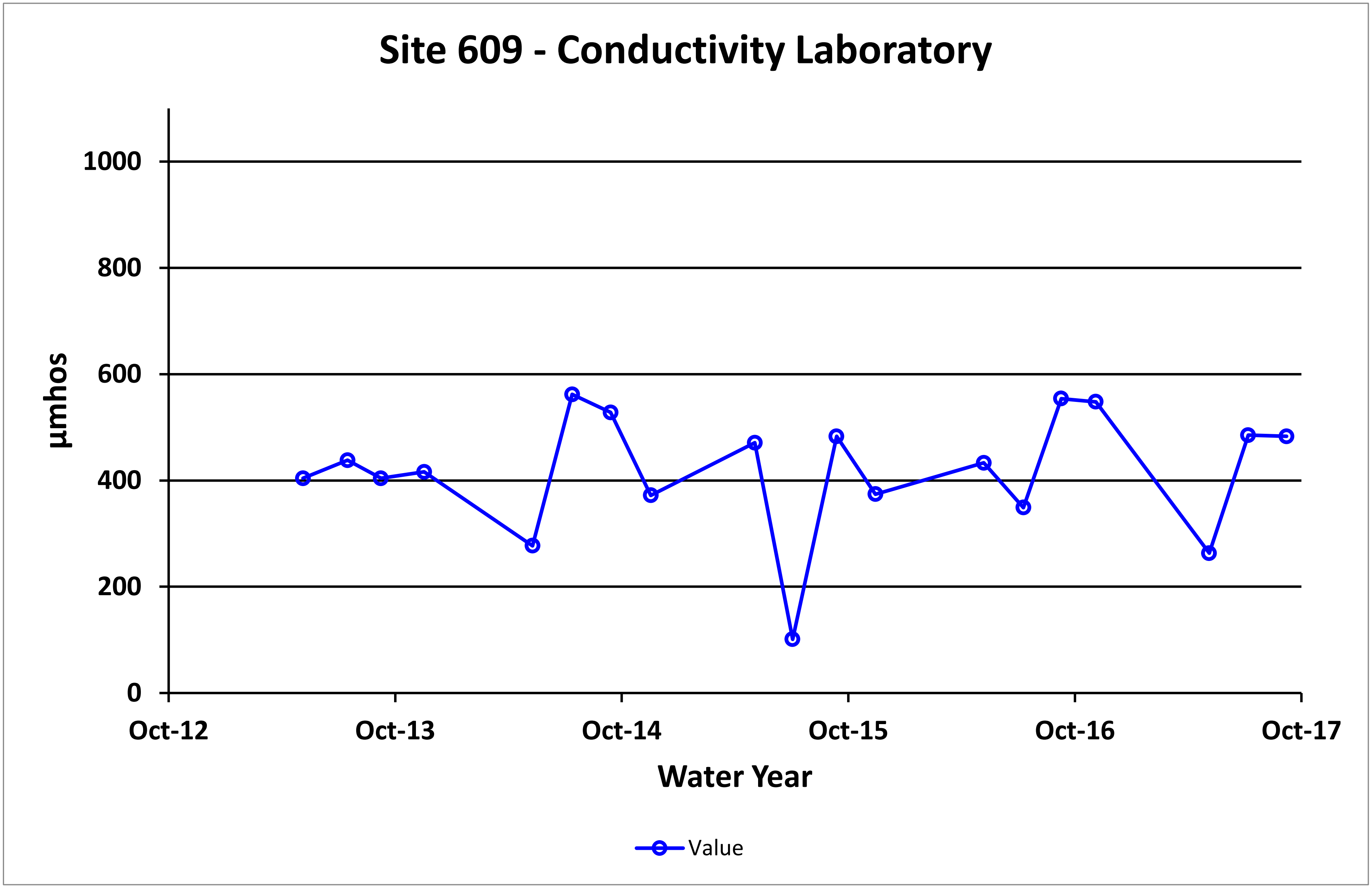
Qualified Data by QA Reviewer

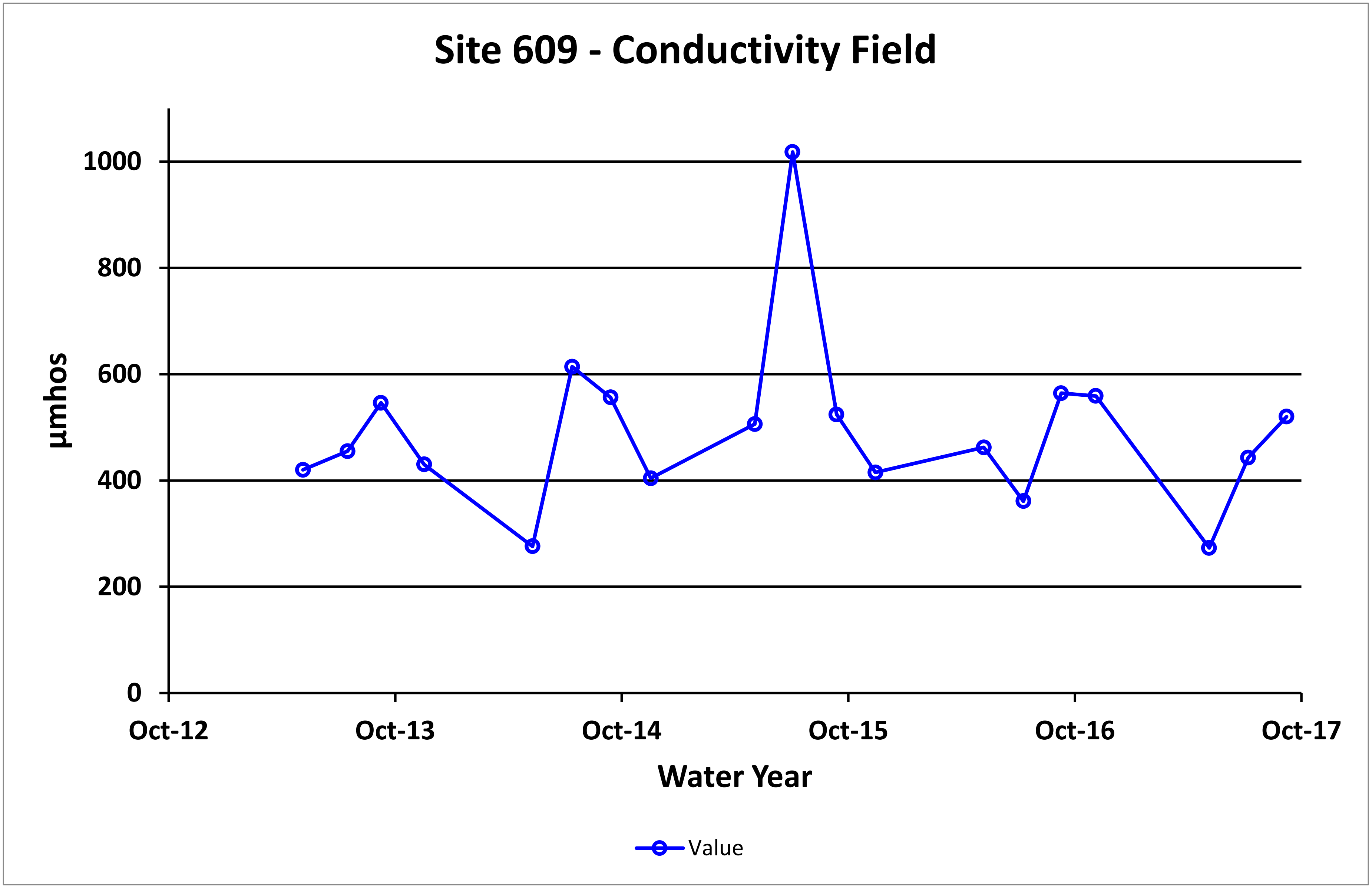
Date Range: 10/01/2016 to 09/30/2017

Site No.	Sample Date	Sample Time	Parameter	Value		Qualifier	Reason for Qualifier
609FMG	5/9/2017	12:00 PM	Tot. Sulfate	90.8	mg/L	J	Sample Receipt Temperature
	11/7/2016	12:00 PM	Diss. Ag-ICP/MS	0.00458	µg/L	J	Below Quantitative Range
	5/9/2017	12:00 PM	Diss. Se-ICP/MS	0.21	µg/L	J	Below Quantitative Range
	7/11/2017	12:00 PM	Diss. Ag-ICP/MS	0.00408	µg/L	J	Below Quantitative Range
			Tot. Sulfate	202	mg/L	J	Sample Receipt Temperature
	9/11/2017	12:00 PM	Diss. Ag-ICP/MS	0.00374	µg/L	J	Below Quantitative Range

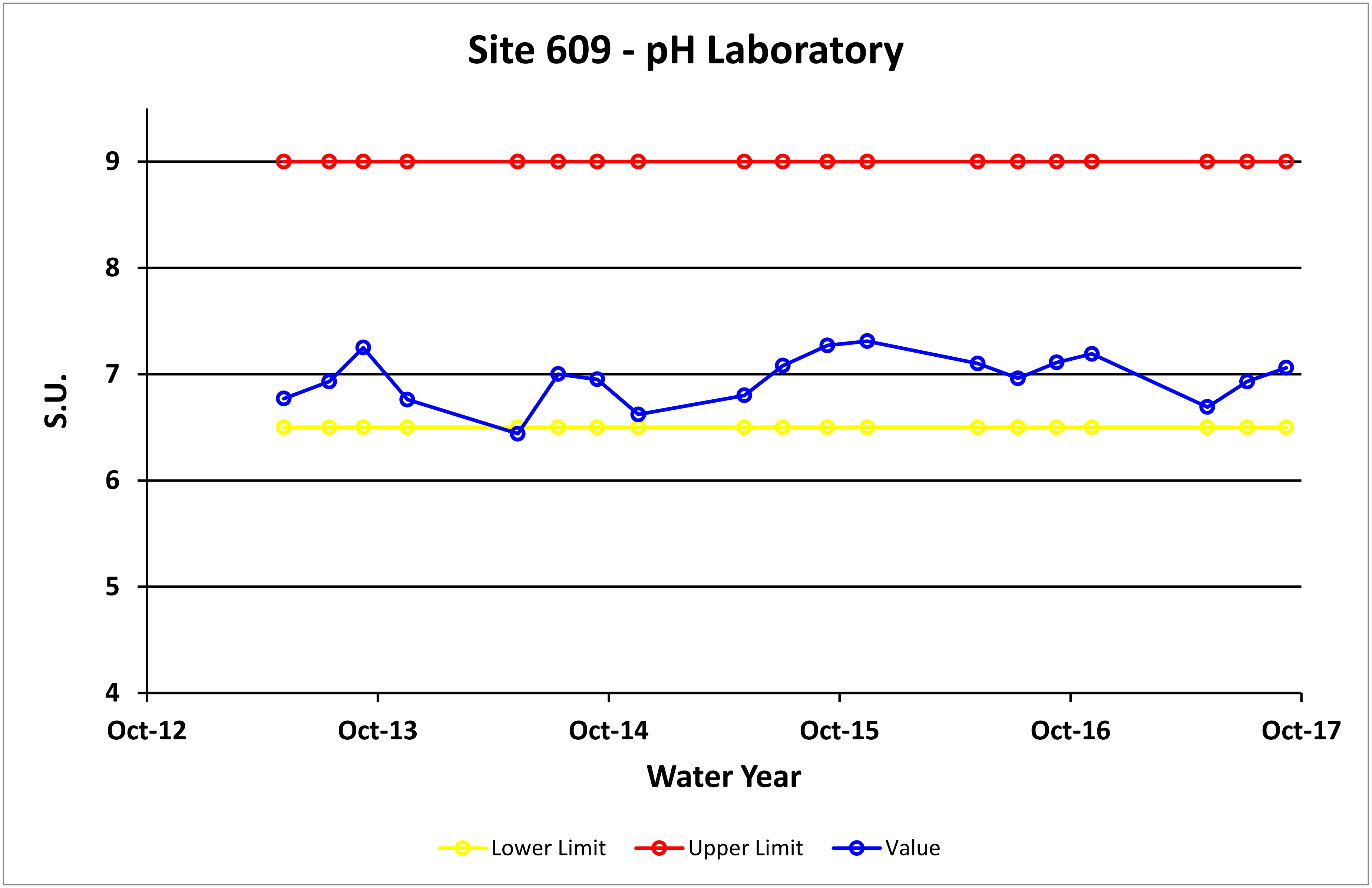


Site 609 - Water Temperature
20
18
16
14
12
10
8
6
4
2
0
°C
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value

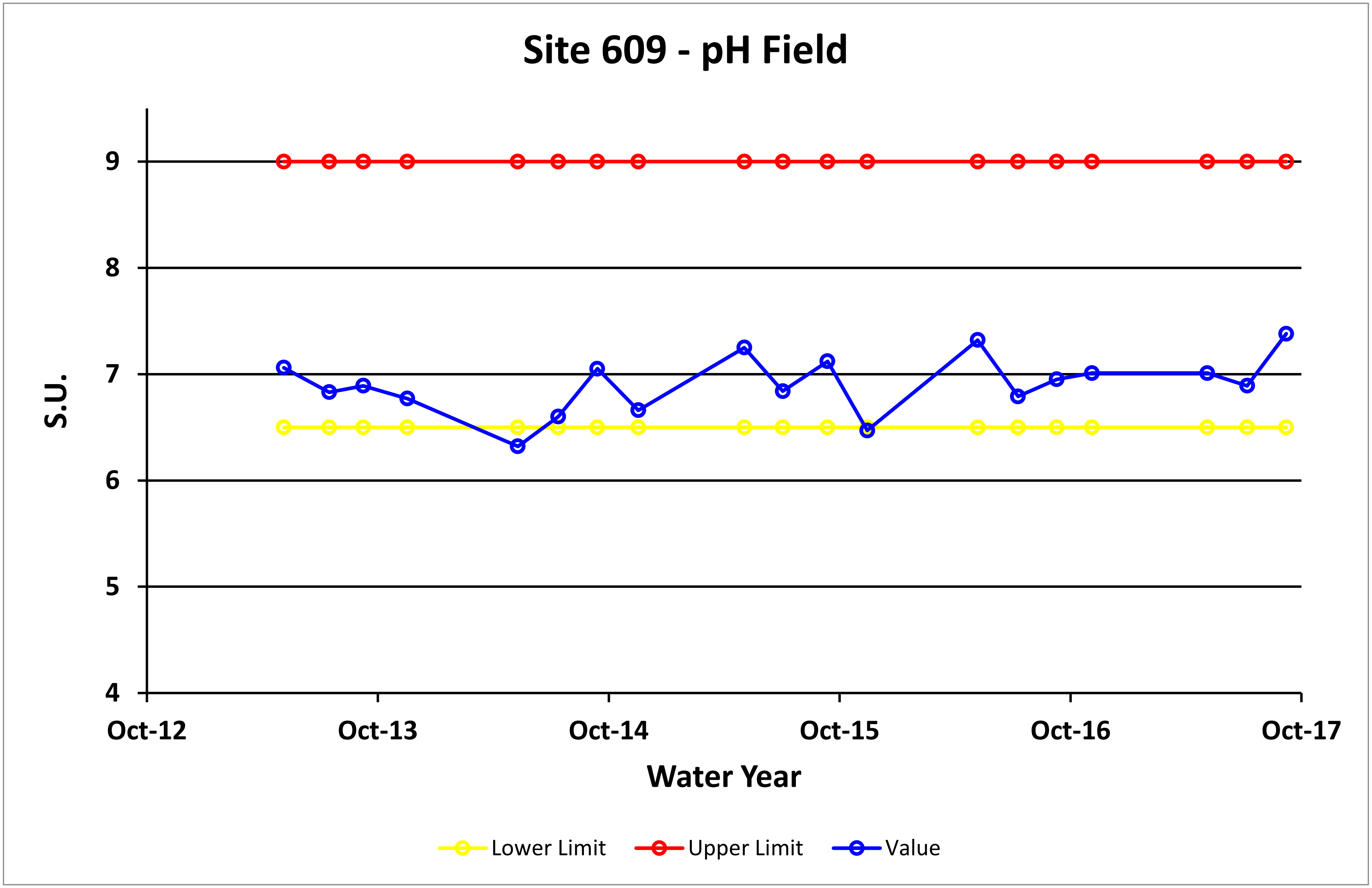

Site 609 - Conductivity Laboratory
µmhos
1000
800
600
400
200
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value

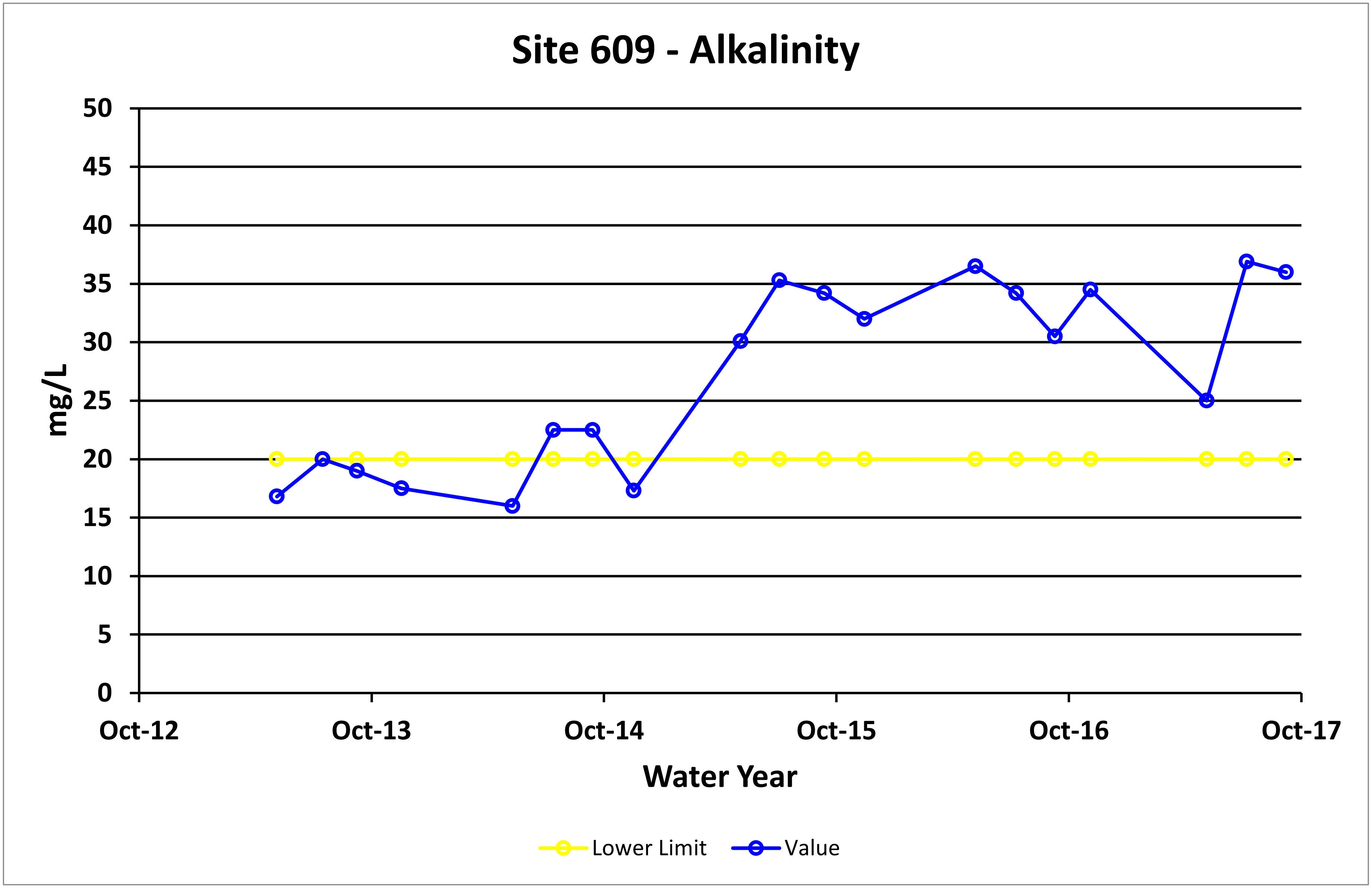


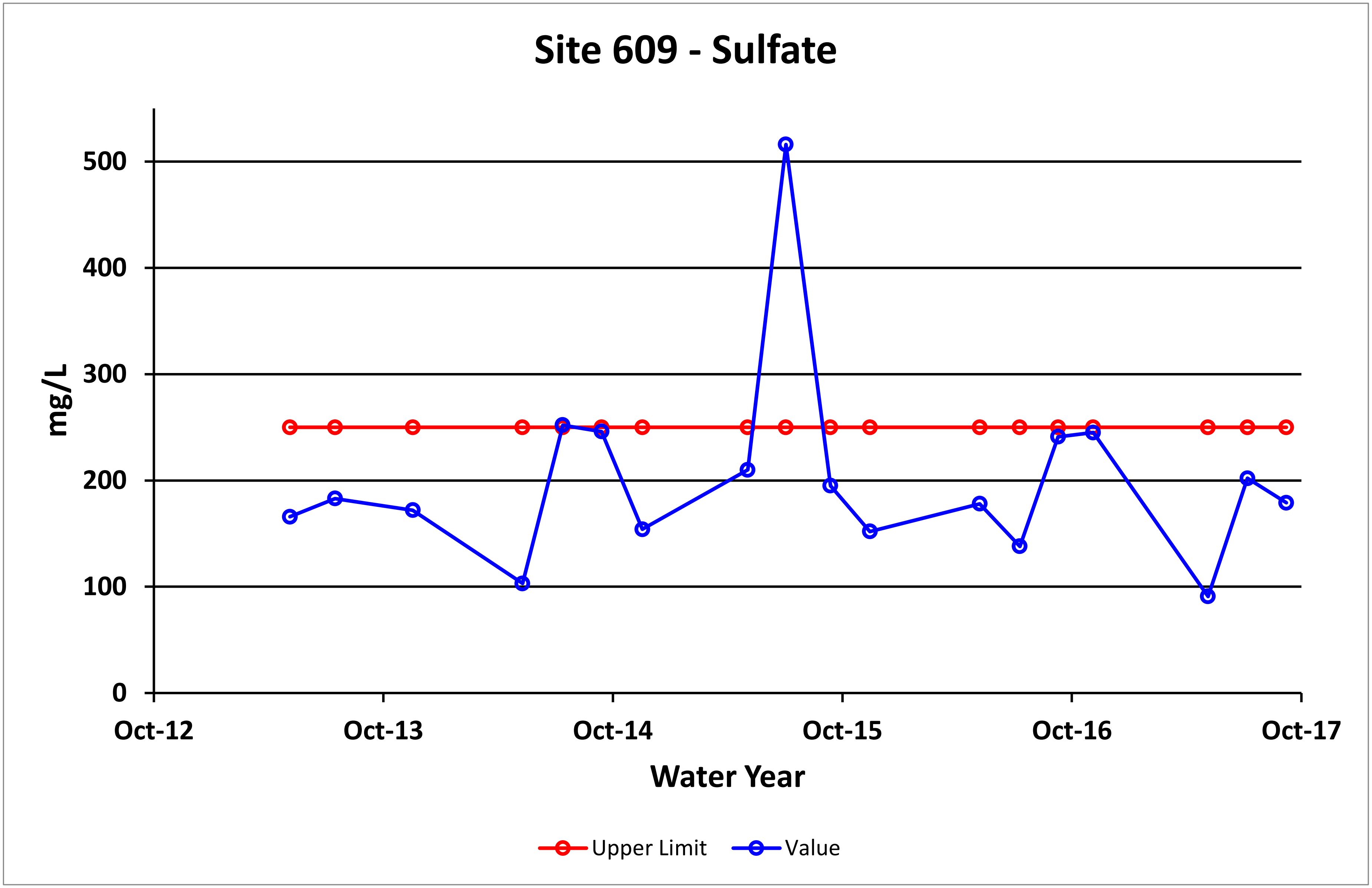
Site 609 - Conductivity Field
µmhos
0
200
400
600
800
1000
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value



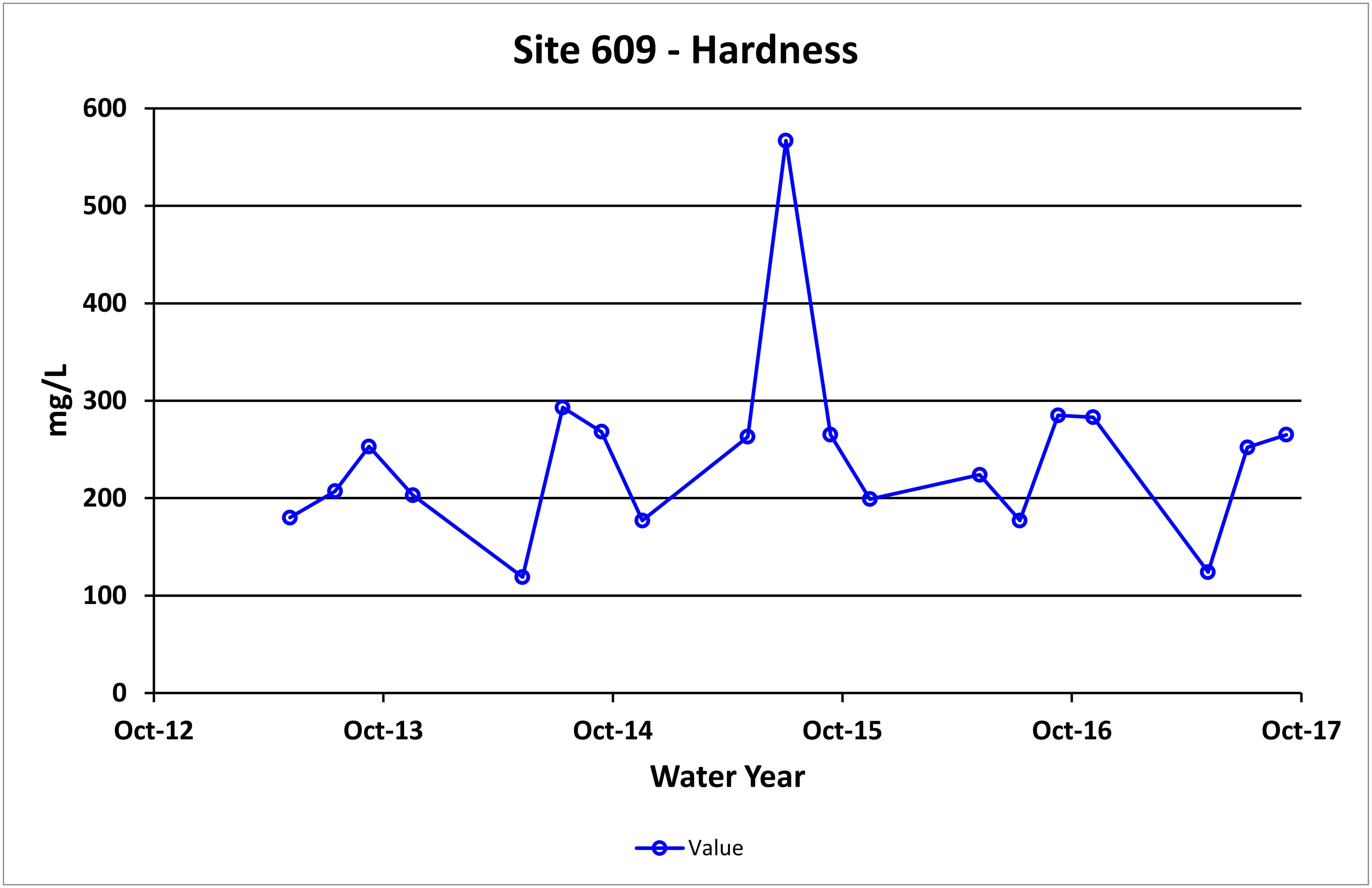
Site 609 - pH Laboratory
S.U.
9
8
7
6
5
4
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Lower Limit
Upper Limit
Value


Site 609 - pH Field
S.U.
9
8
7
6
5
4
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Lower Limit
Upper Limit
Value

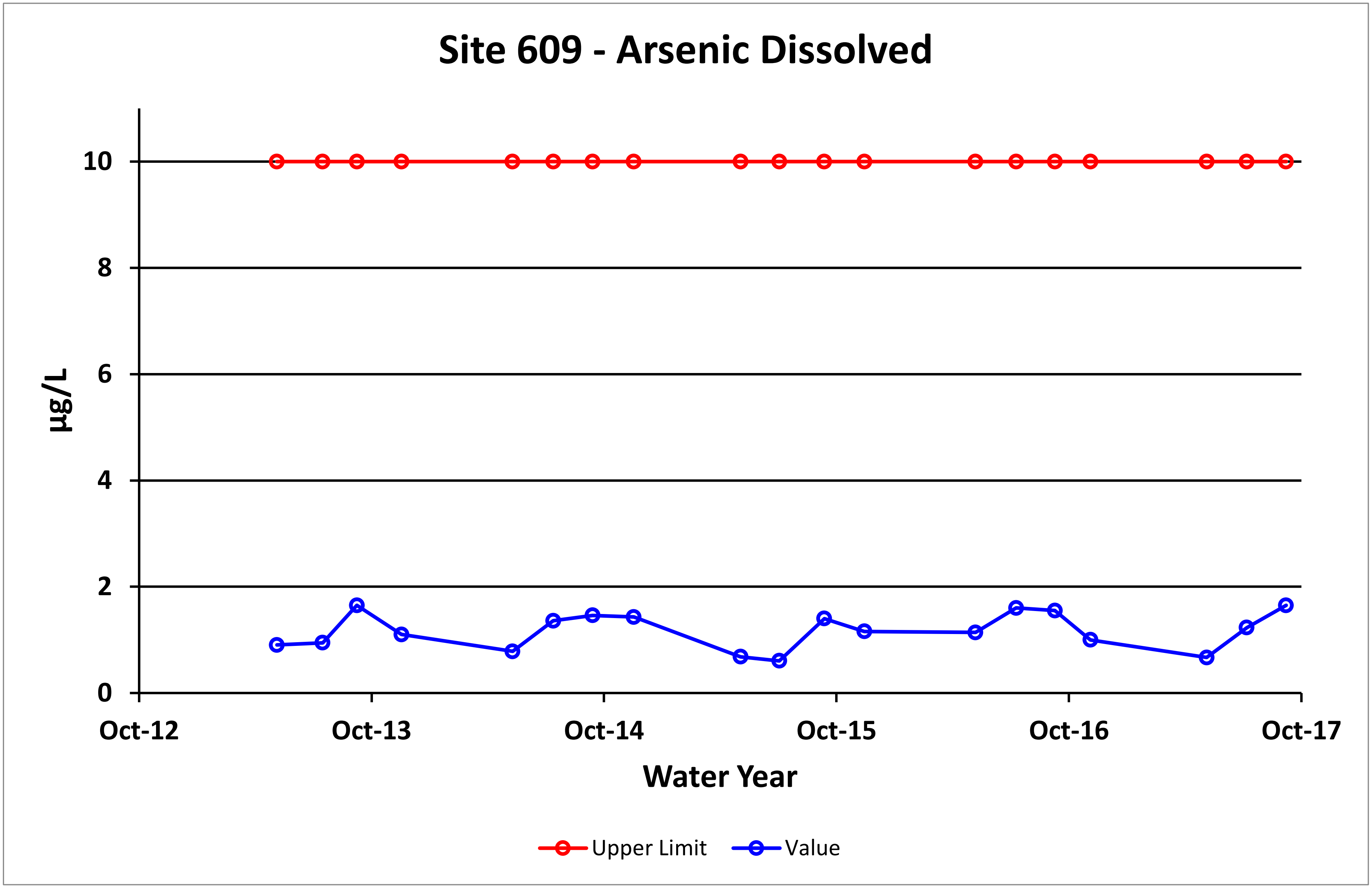

Site 609 - Alkalinity
mg/L
50
45
40
35
30
25
20
15
10
5
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Lower Limit
Value

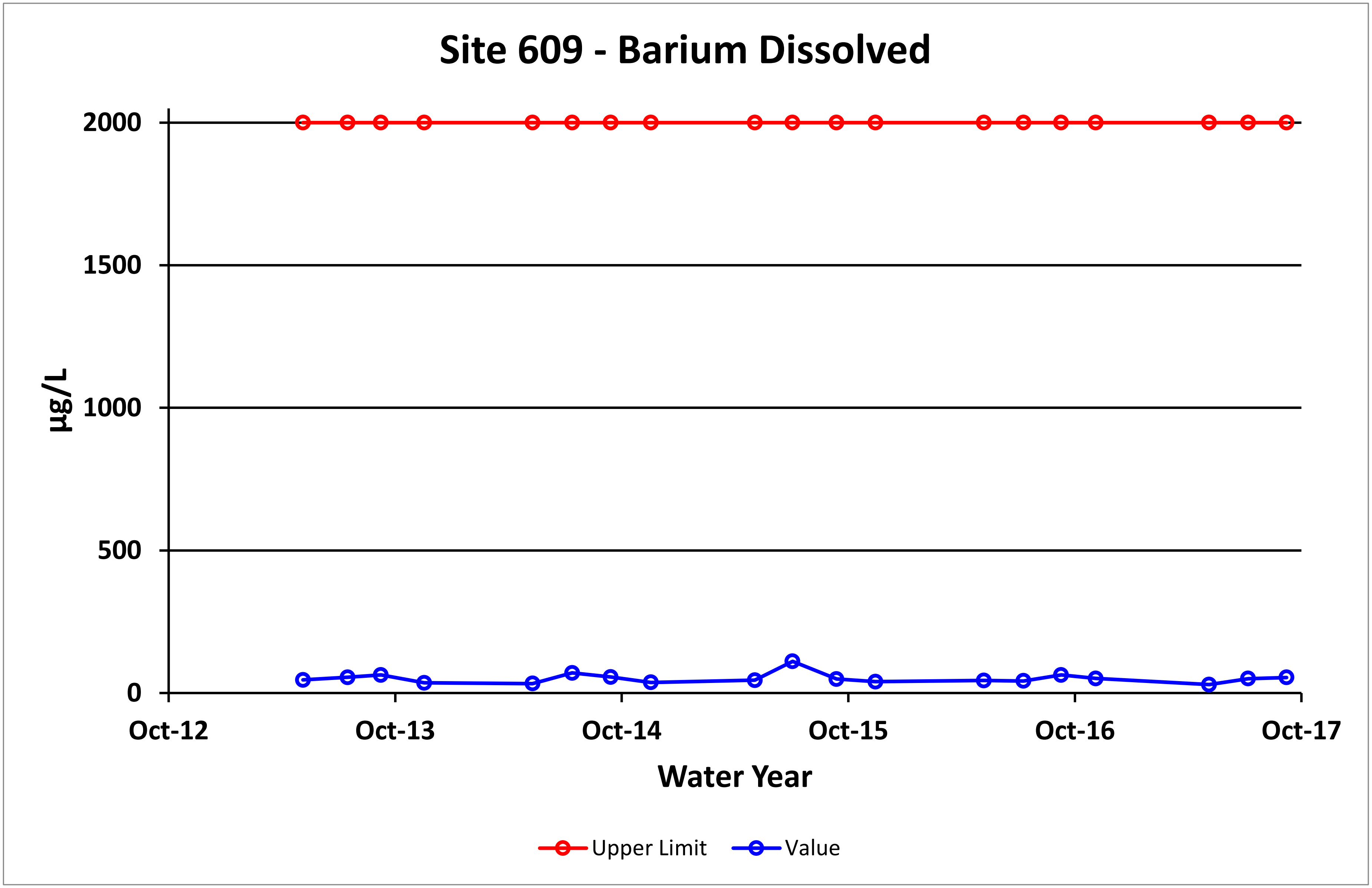


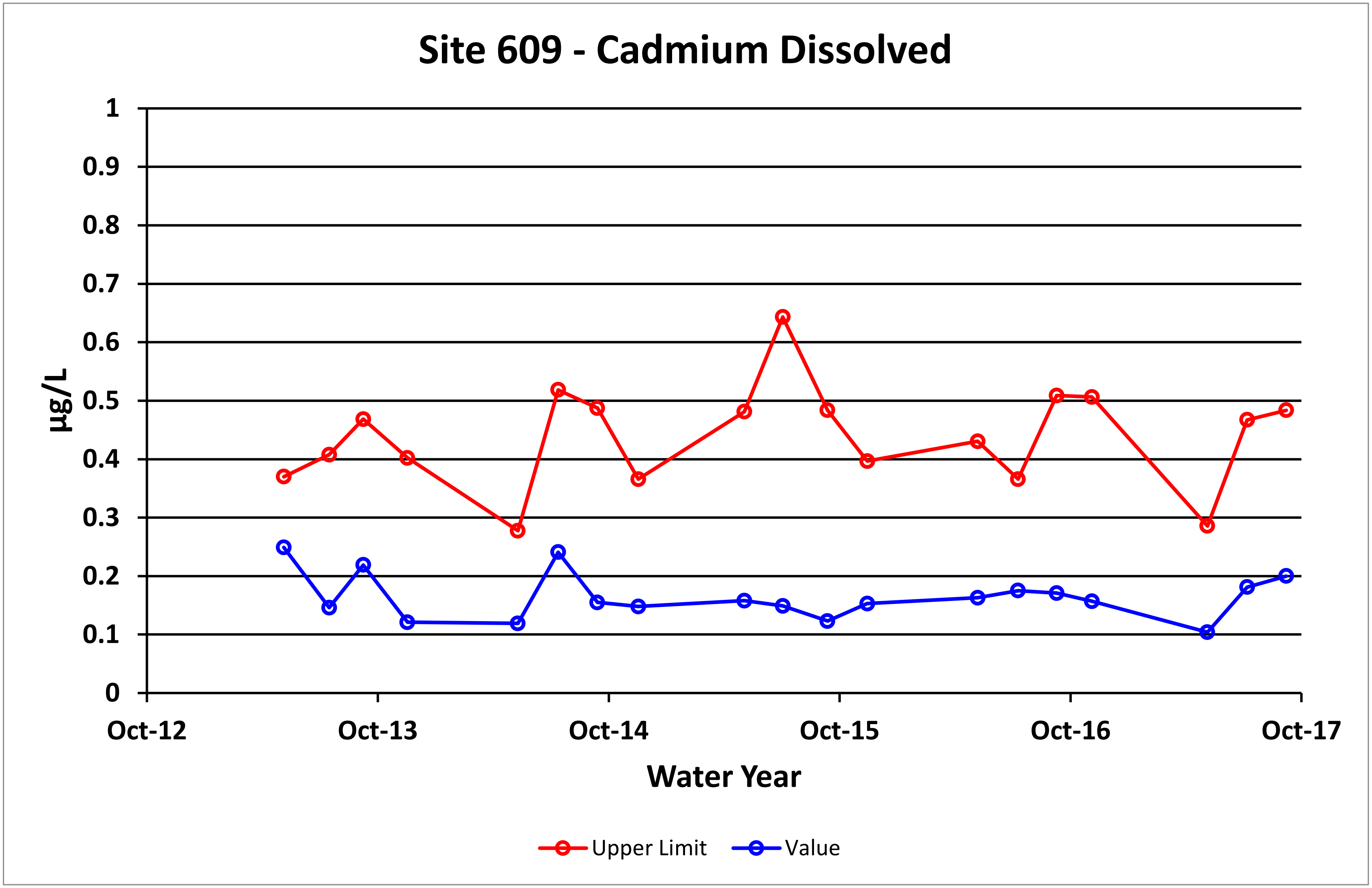
Site 609 - Sulfate
mg/L
0
100
200
300
400
500
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value



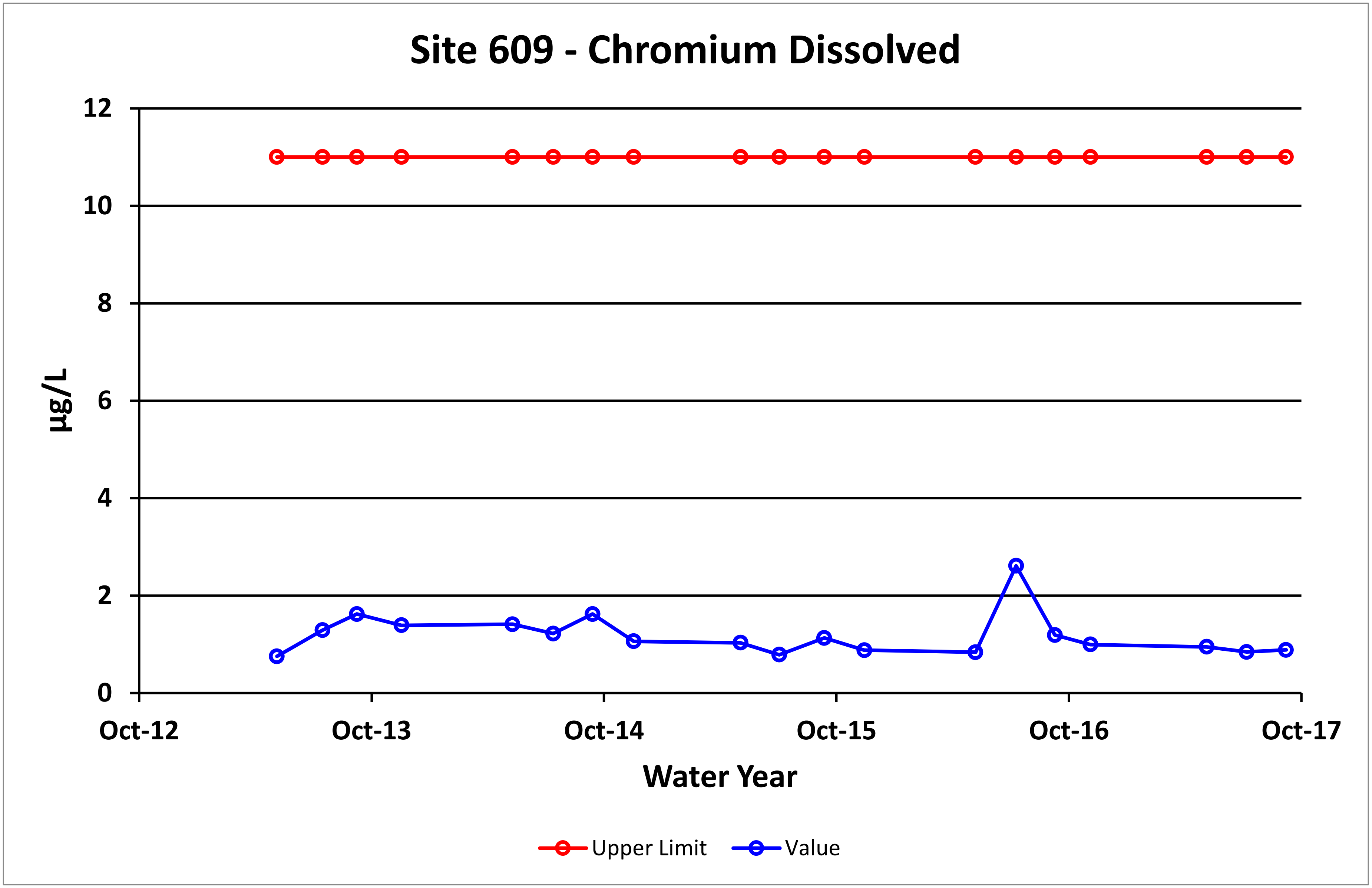
Site 609 - Hardness
600
500
400
300
200
100
0
mg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value


Site 609 - Arsenic Dissolved
µg/L
10
8
6
4
2
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

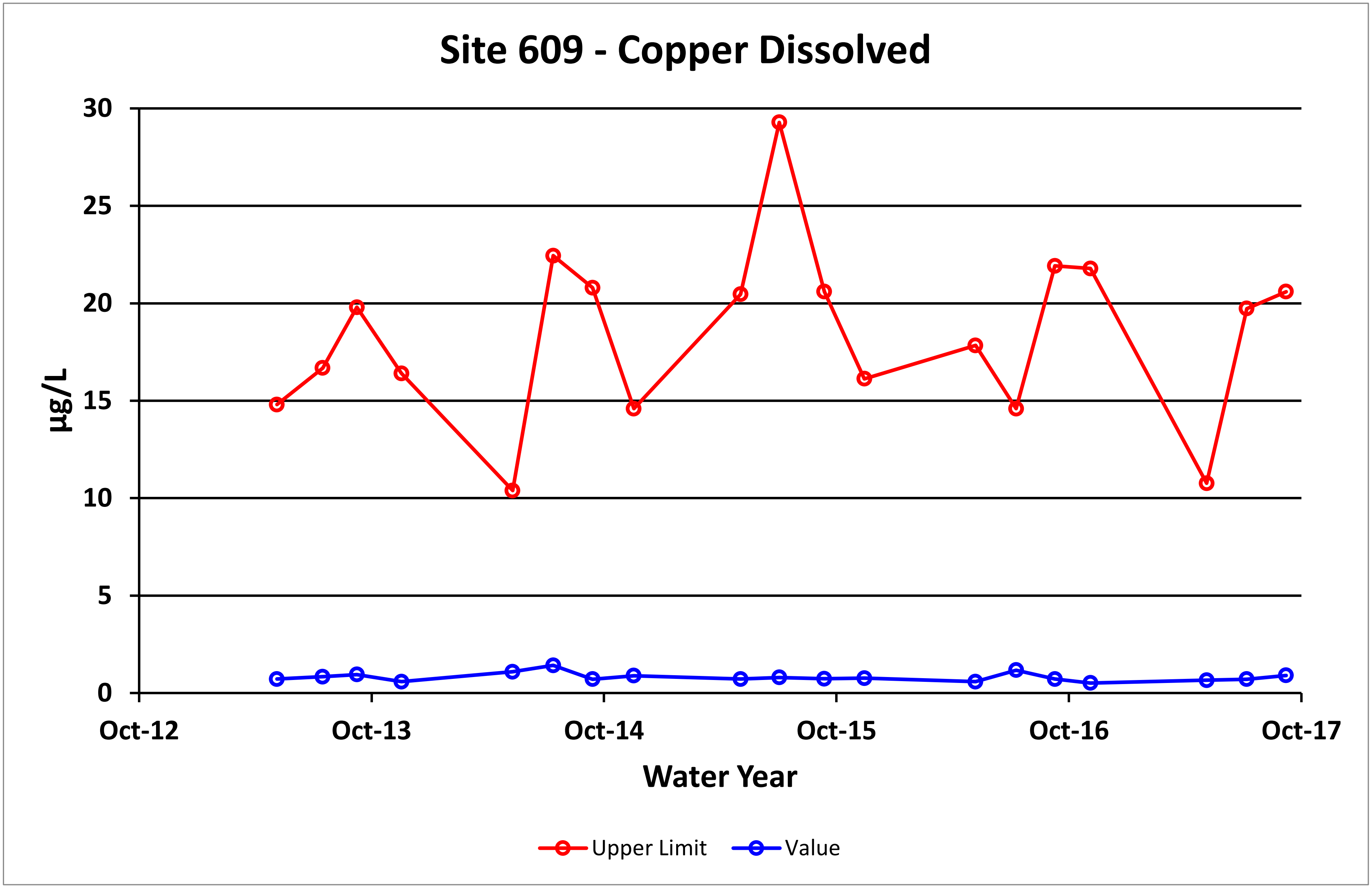

Site 609 - Barium Dissolved
2000
1500
1000
500
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

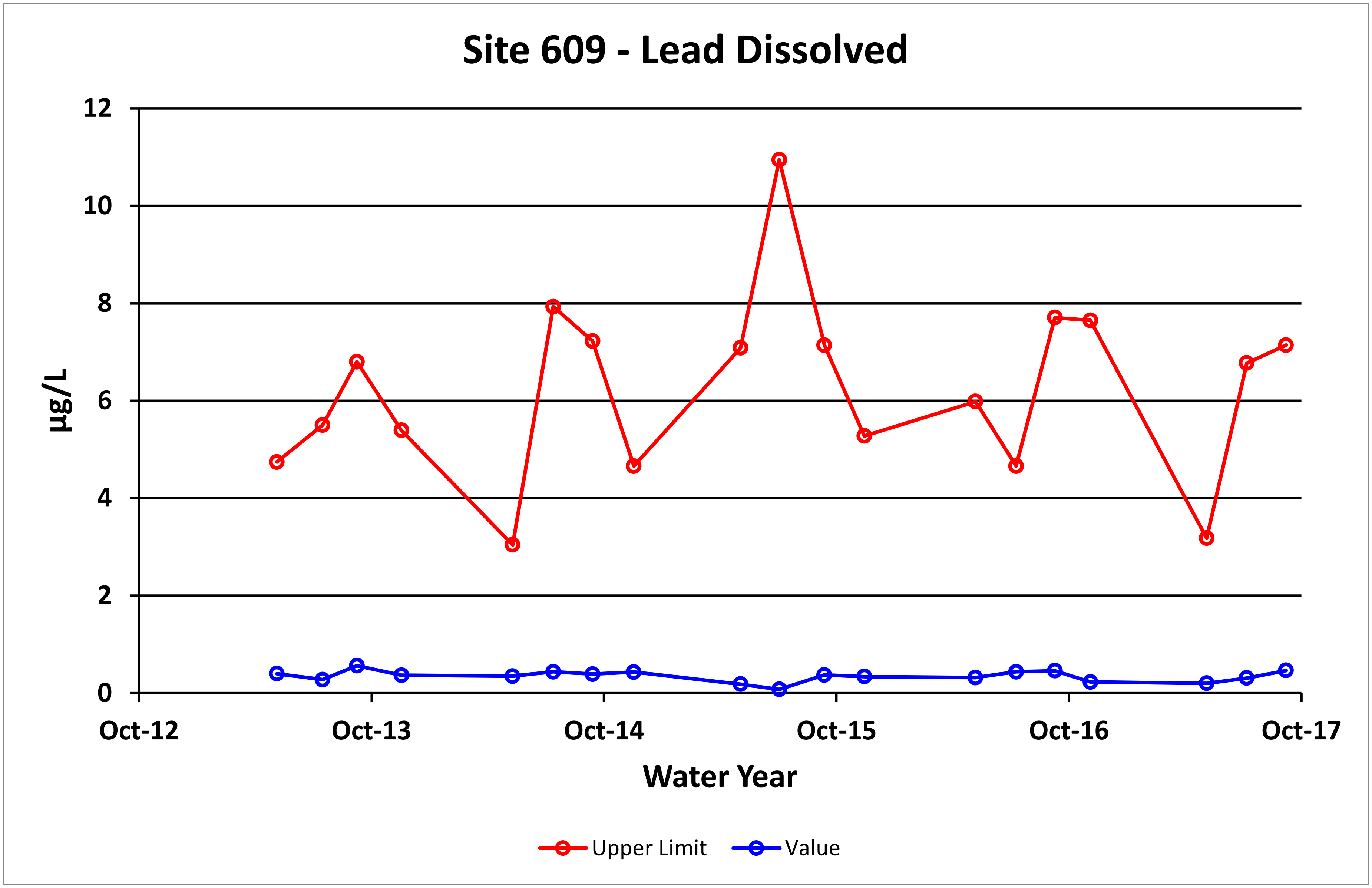


Site 609 - Cadmium Dissolved
µg/L
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

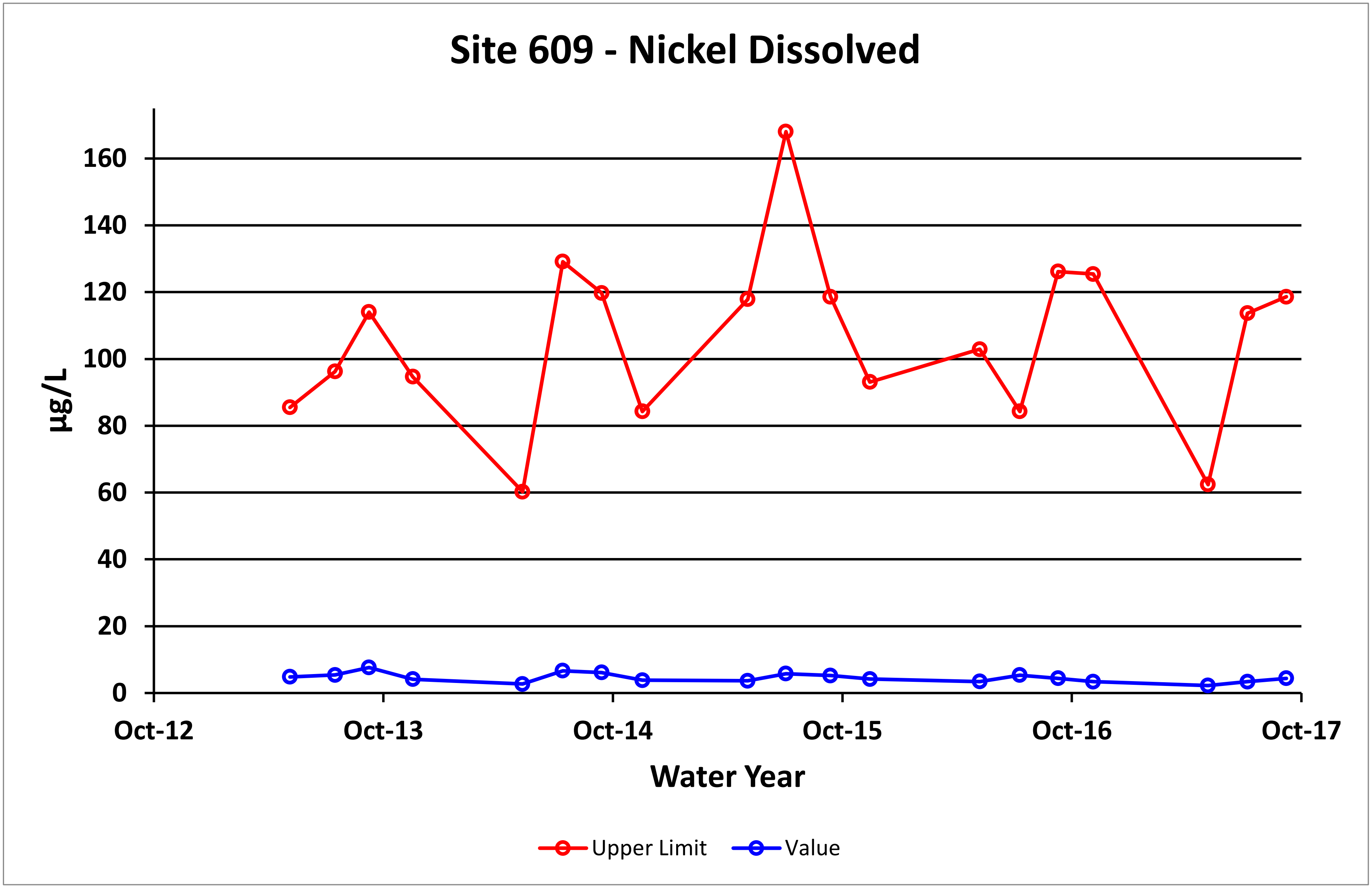


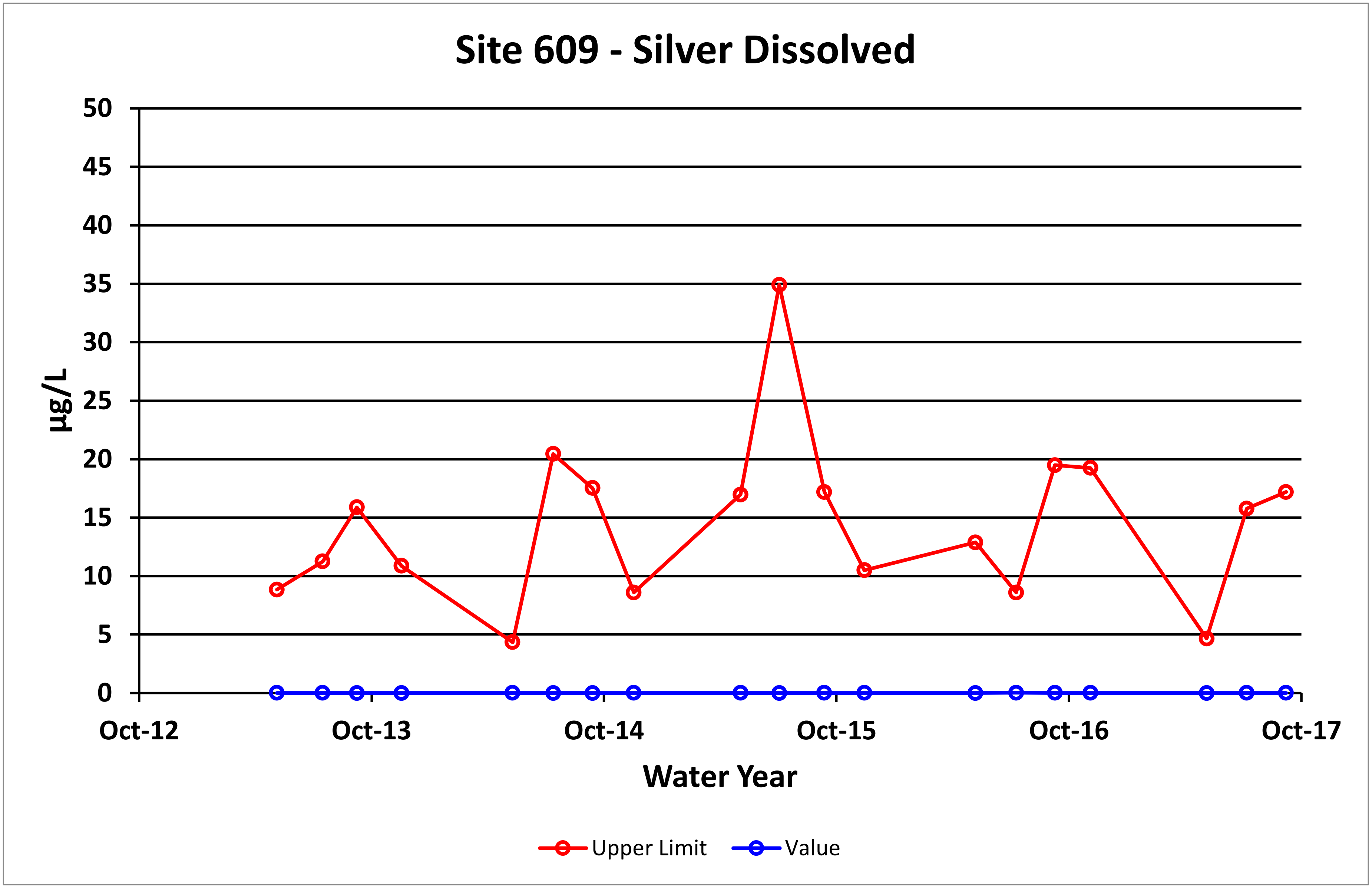
Site 609 - Chromium Dissolved
12
10
8
6
4
2
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

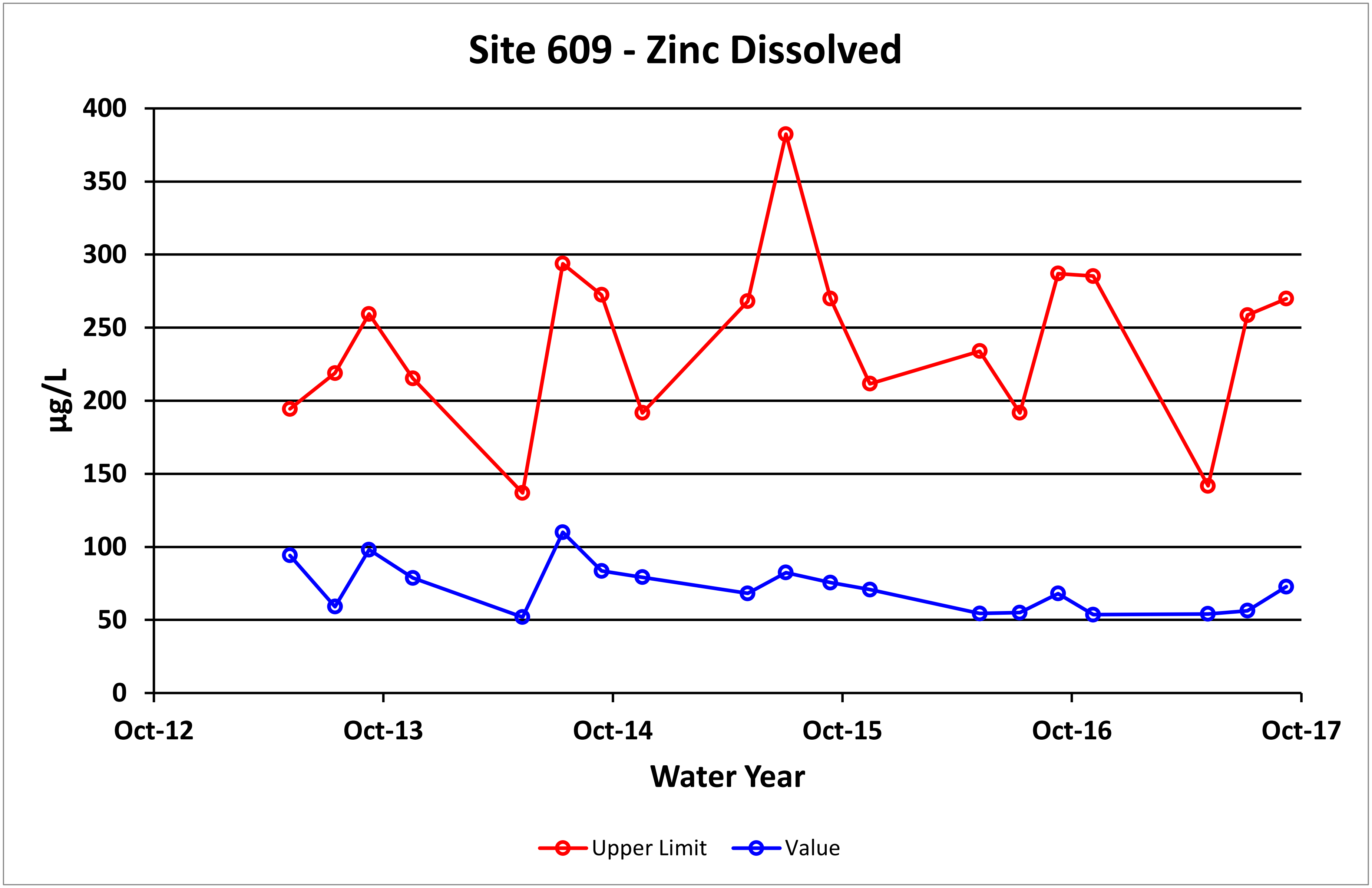

Site 609 - Copper Dissolved
µg/L
30
25
20
15
10
5
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

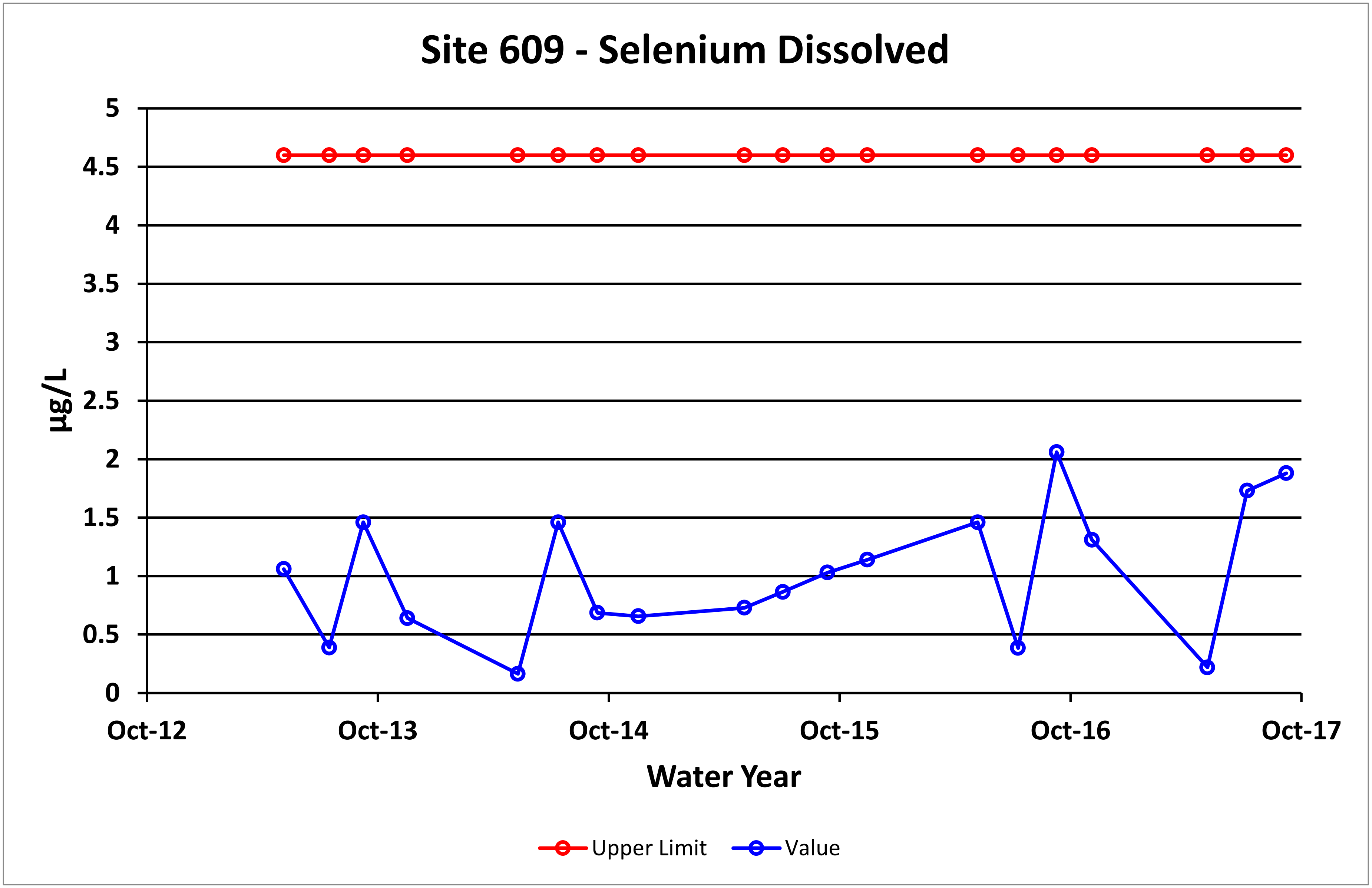


Site 609 - Lead Dissolved
µg/L
12
10
8
6
4
2
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

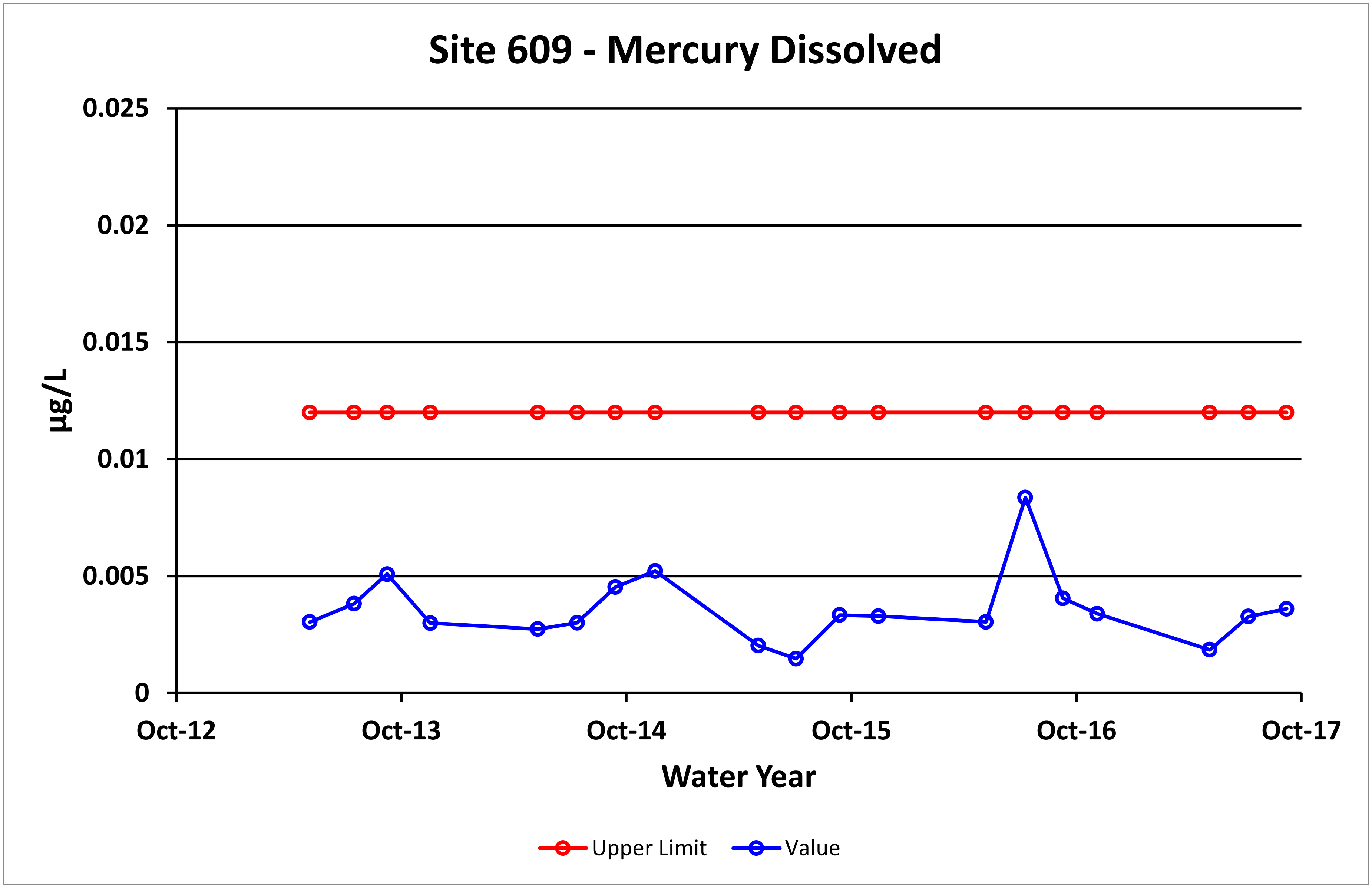

Site 609 - Nickel Dissolved
µg/L
160
140
120
100
80
60
40
20
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value


Site 609 - Silver Dissolved
50
45
40
35
30
25
20
15
10
5
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value


Site 609 - Zinc Dissolved
400
350
300
250
200
150
100
50
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value



Site 609 - Selenium Dissolved
µg/L
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value



Site 609 - Mercury Dissolved
0.025
0.02
0.015
0.01
0.005
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

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 2017" report. The table includes all the required FWMP analyte data (field and laboratory) collected for the current water year and a series of flags keyed to the summary report "Qualified Data by QA Reviewer". The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of ½ MDL for the purpose of median calculation.

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

Sample Date	Parameter	Value	Qualifier	Notes
No outliers have been identified by HGCMC for the period of October 2013 through September 2017.				

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 2017

			Limits		
Sample Date	**Parameter**	**Value**	**Lower**	**Upper**	**Hardness**
No exceedances have been identified by HGCMC for the period of October 2016 through September 2017.					

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 2017

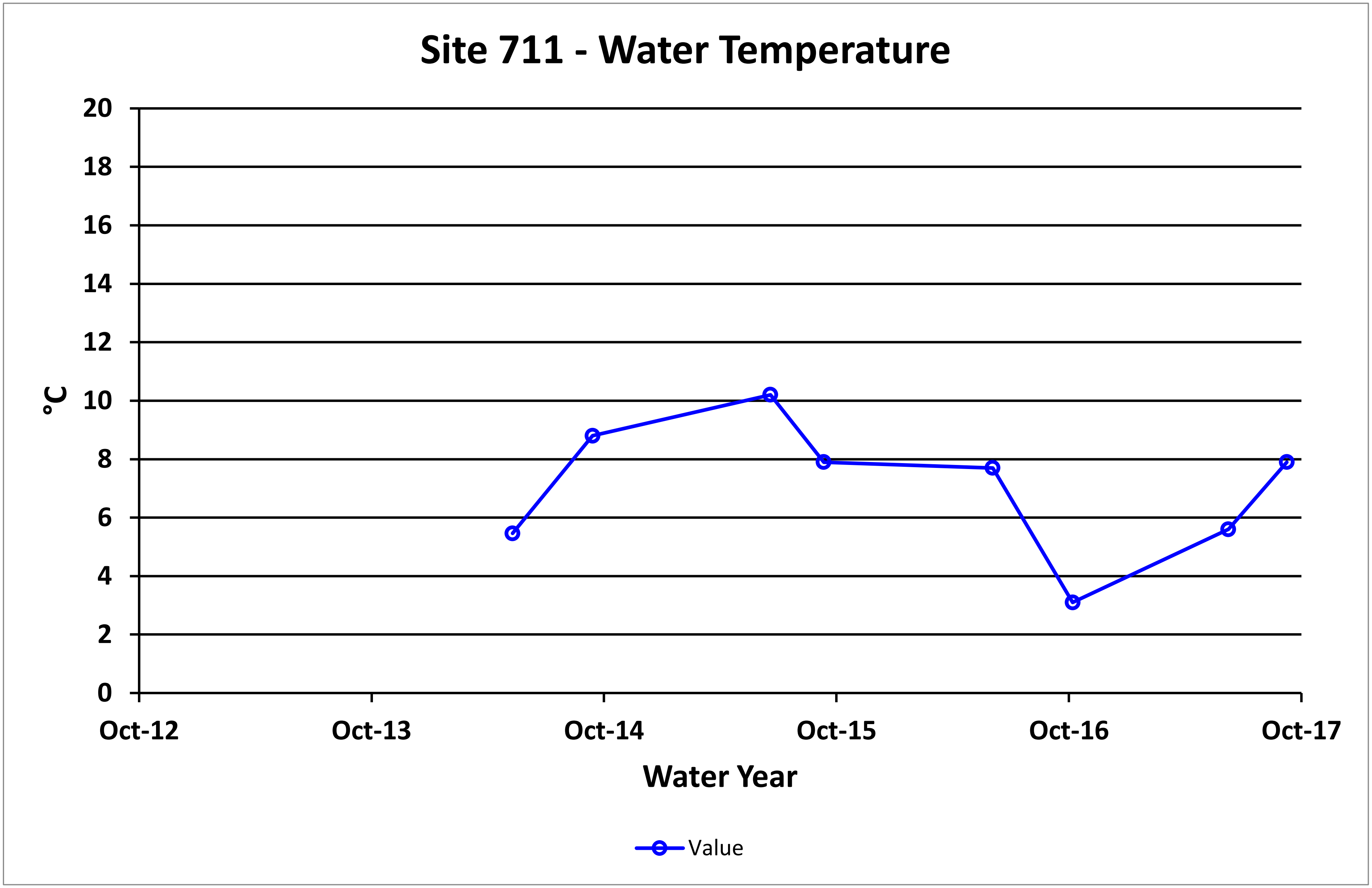
Site 711FMS - 'Greens Creek Above Site E'

Sample Date/Parameter	Oct 2016	Nov 2016	Dec 2016	Jan 2017	Feb 2017	Mar 2017	Apr 2017	May 2017	Jun 2017	Jul 2017	Aug 2017	Sep 2017	**Median**
Water Temp (°C)	3.1								5.6				4.4
Conductivity-Field(µmho)	179.1								114.9				147.0
Conductivity-Lab (µmho)	181								105				143
pH Lab (standard units)	7.89								7.49				7.69
pH Field (standard units)	8.15								7.98				8.07
Total Alkalinity (mg/L)	70.4								44.9				57.7
Total Sulfate (mg/L)	20.8								11.3				16.1
Hardness (mg/L)	86.3								55.6				71.0
Dissolved As (ug/L)	0.234								0.195				0.215
Dissolved Ba (ug/L)									31.9				31.9
Dissolved Cd (ug/L)	0.0333								0.026				0.0297
Dissolved Cr (ug/L)									0.115				0.115
Dissolved Cu (ug/L)	0.349								0.316				0.333
Dissolved Pb (ug/L)	0.0077								0.0134				0.0106
Dissolved Ni (ug/L)									0.282				0.282
Dissolved Ag (ug/L)									0.002				0.002
Dissolved Zn (ug/L)	2.98								2.21				2.60
Dissolved Se (ug/L)									0.78				0.780
Dissolved Hg (ug/L)	0.000451								0.000476				0.000464

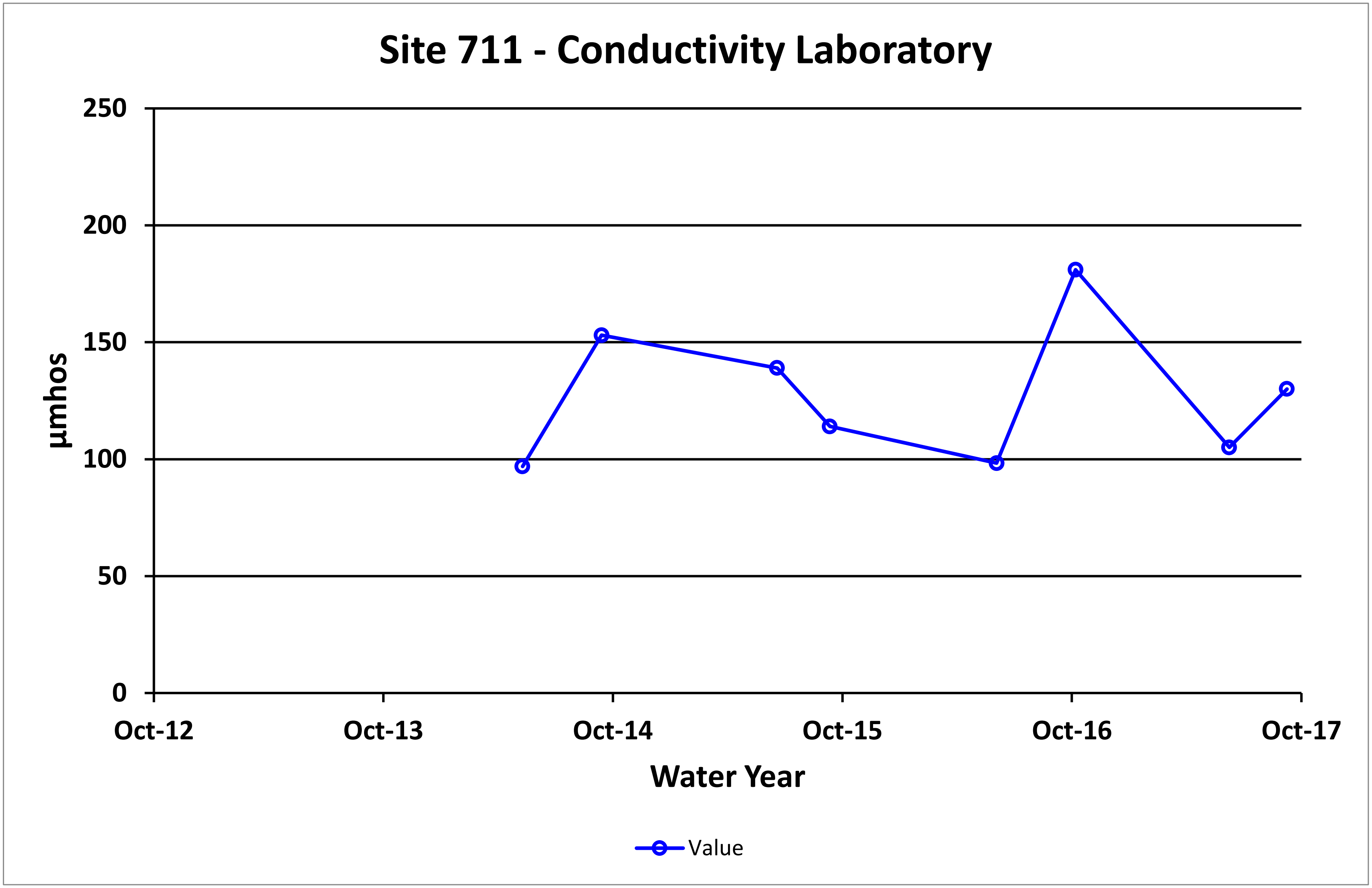
For individual sample/analyte qualifier descriptions see "Qualified Data by QA Reviewer" table.

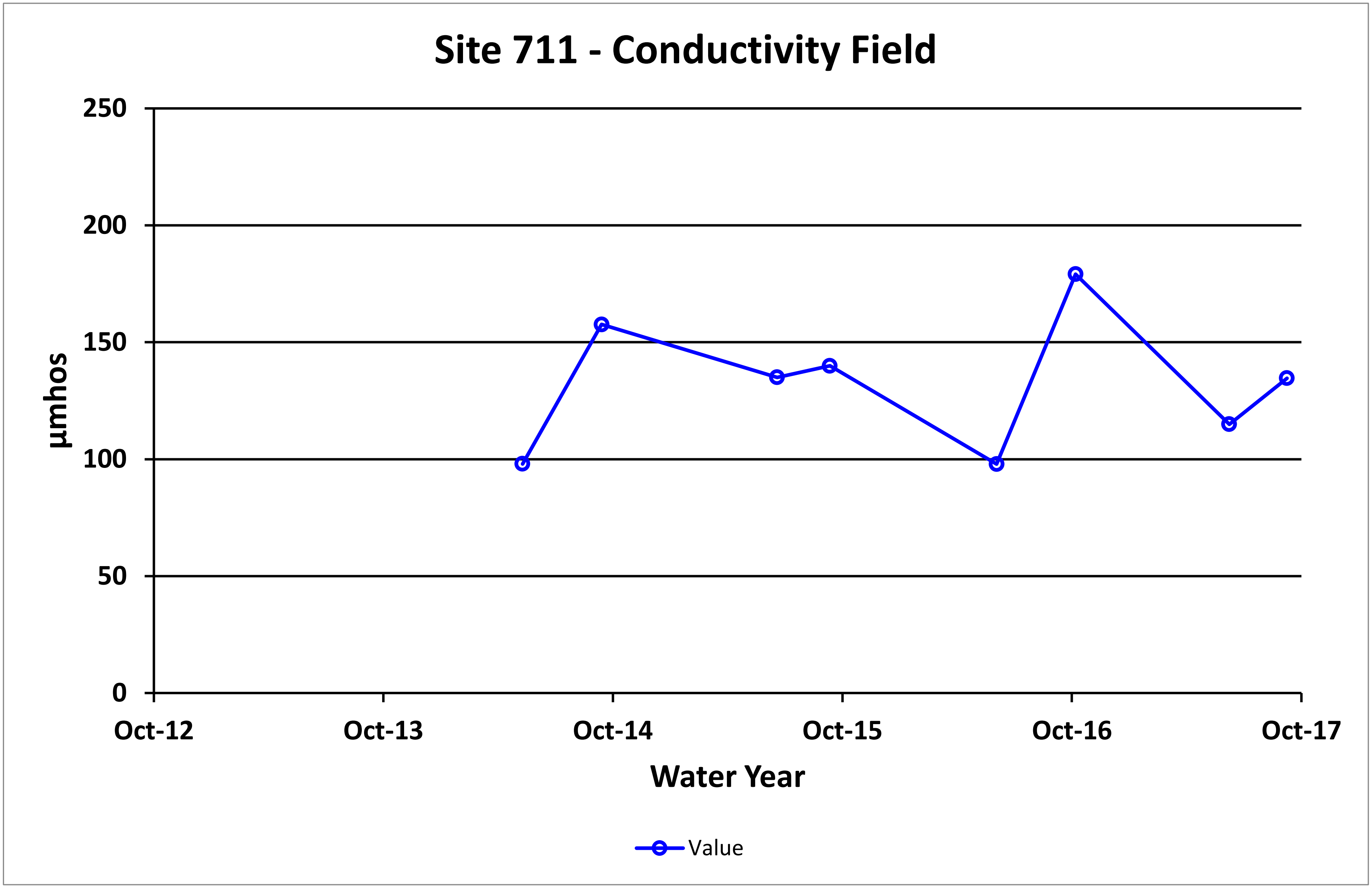
Values reported as less than MDL are replaced by 1/2 MDL for median calculation purposes.

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

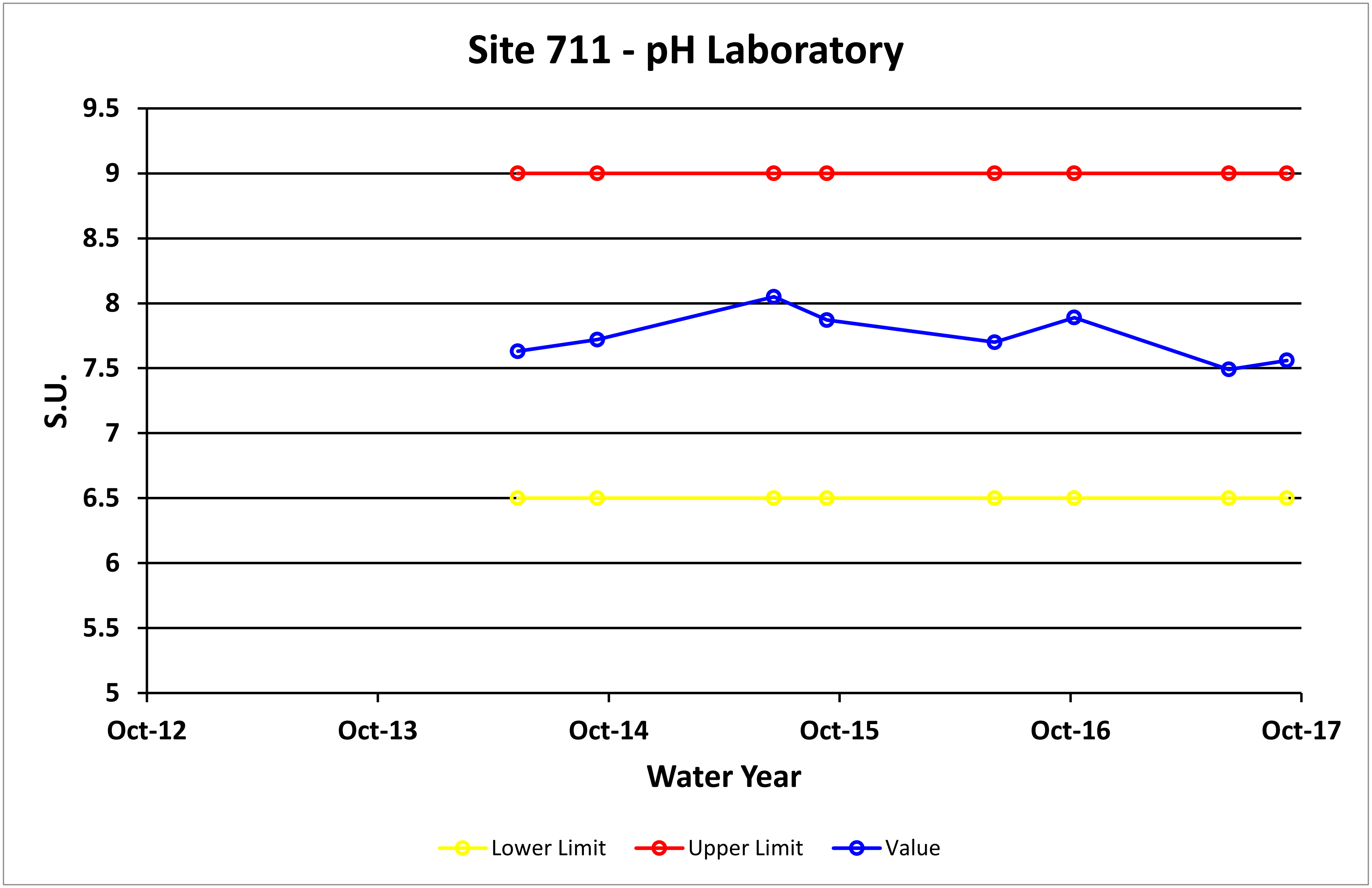


Site 711 - Water Temperature
°C
20
18
16
14
12
10
8
6
4
2
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value

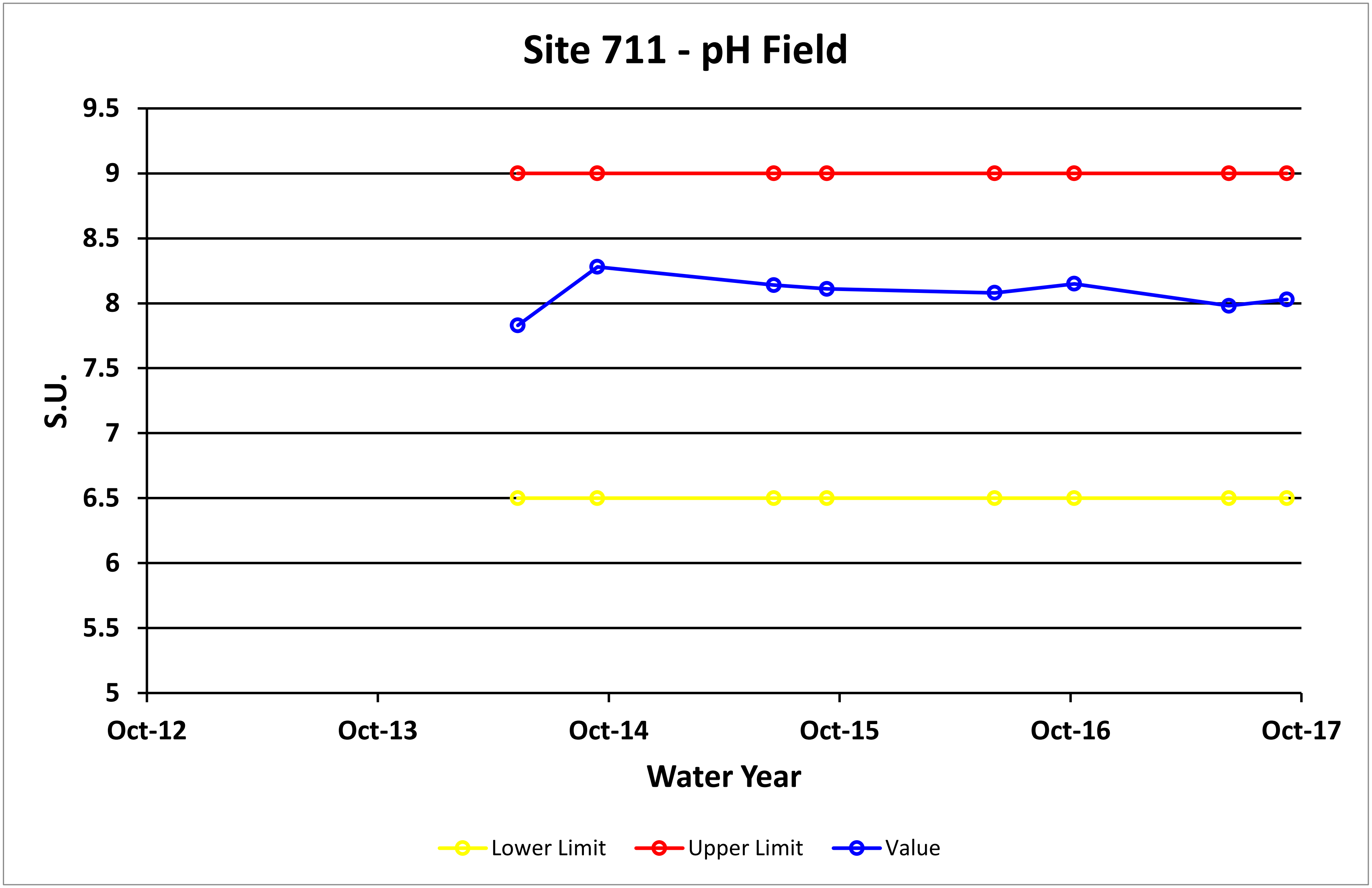

Site 711 - Conductivity Laboratory
250
200
150
100
50
0
µmhos
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value



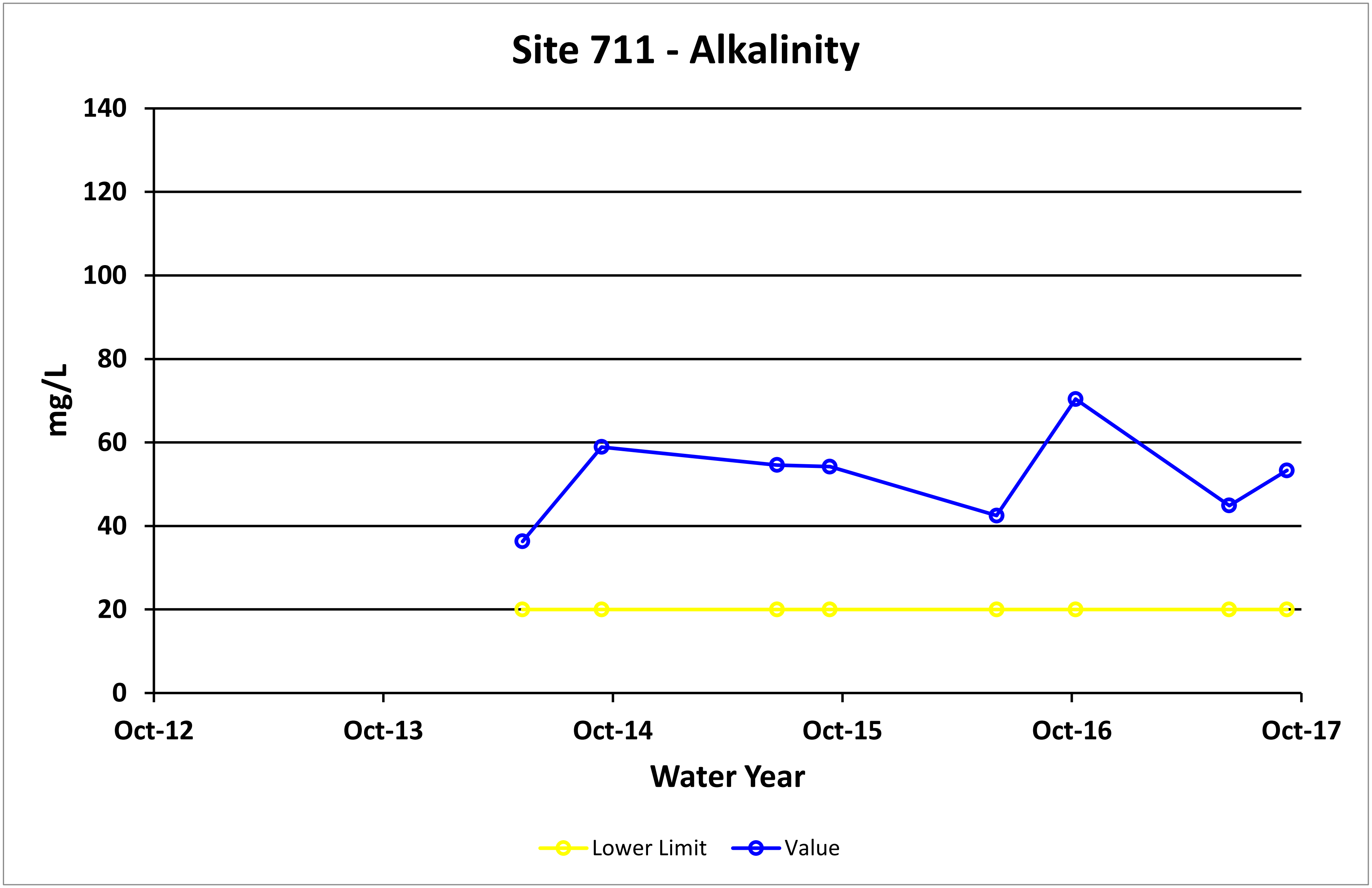
Site 711 - Conductivity Field
250
200
150
100
50
0
µmhos
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value



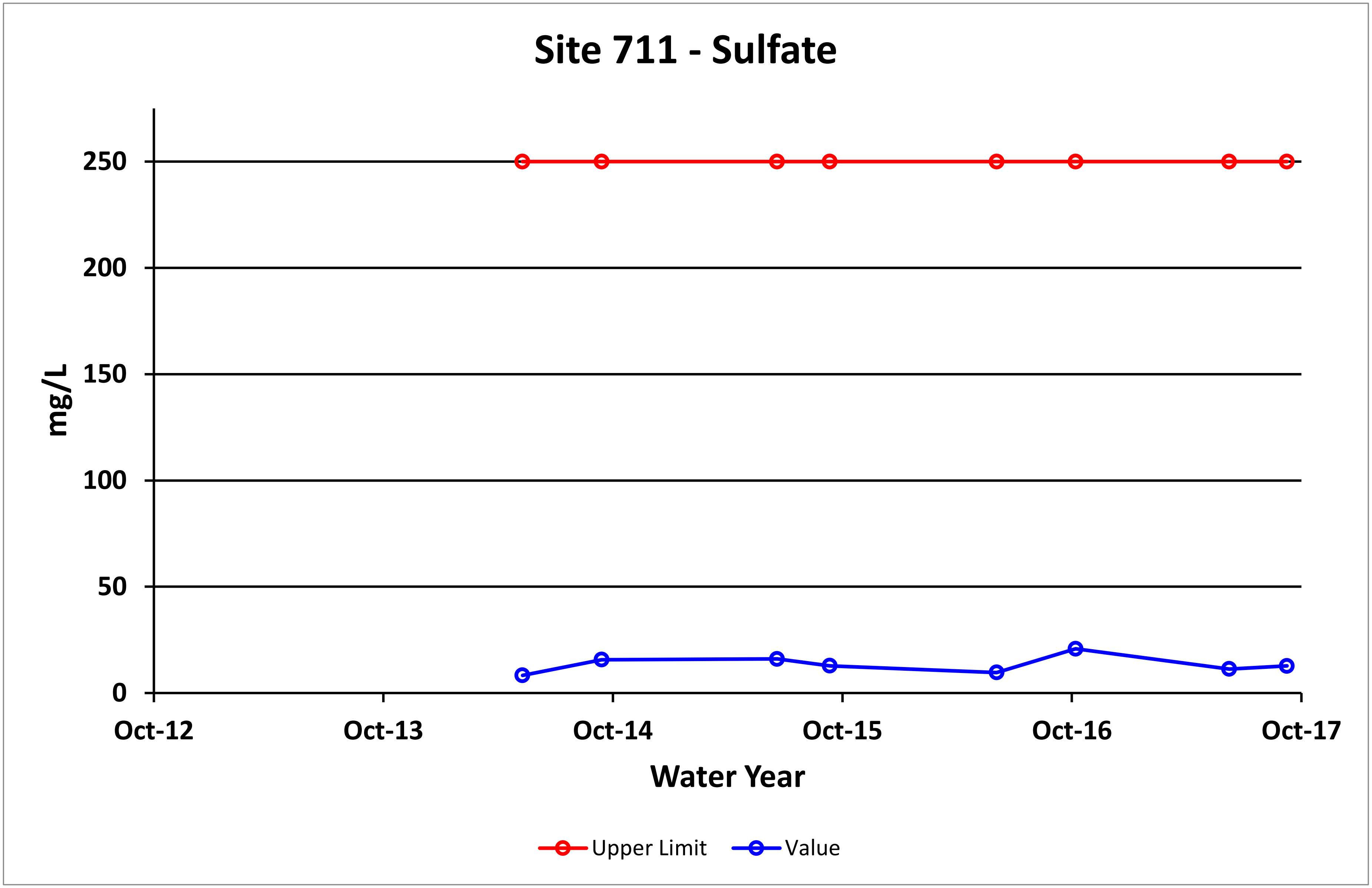
Site 711 - pH Laboratory
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
S.U.
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Lower Limit
Upper Limit
Value



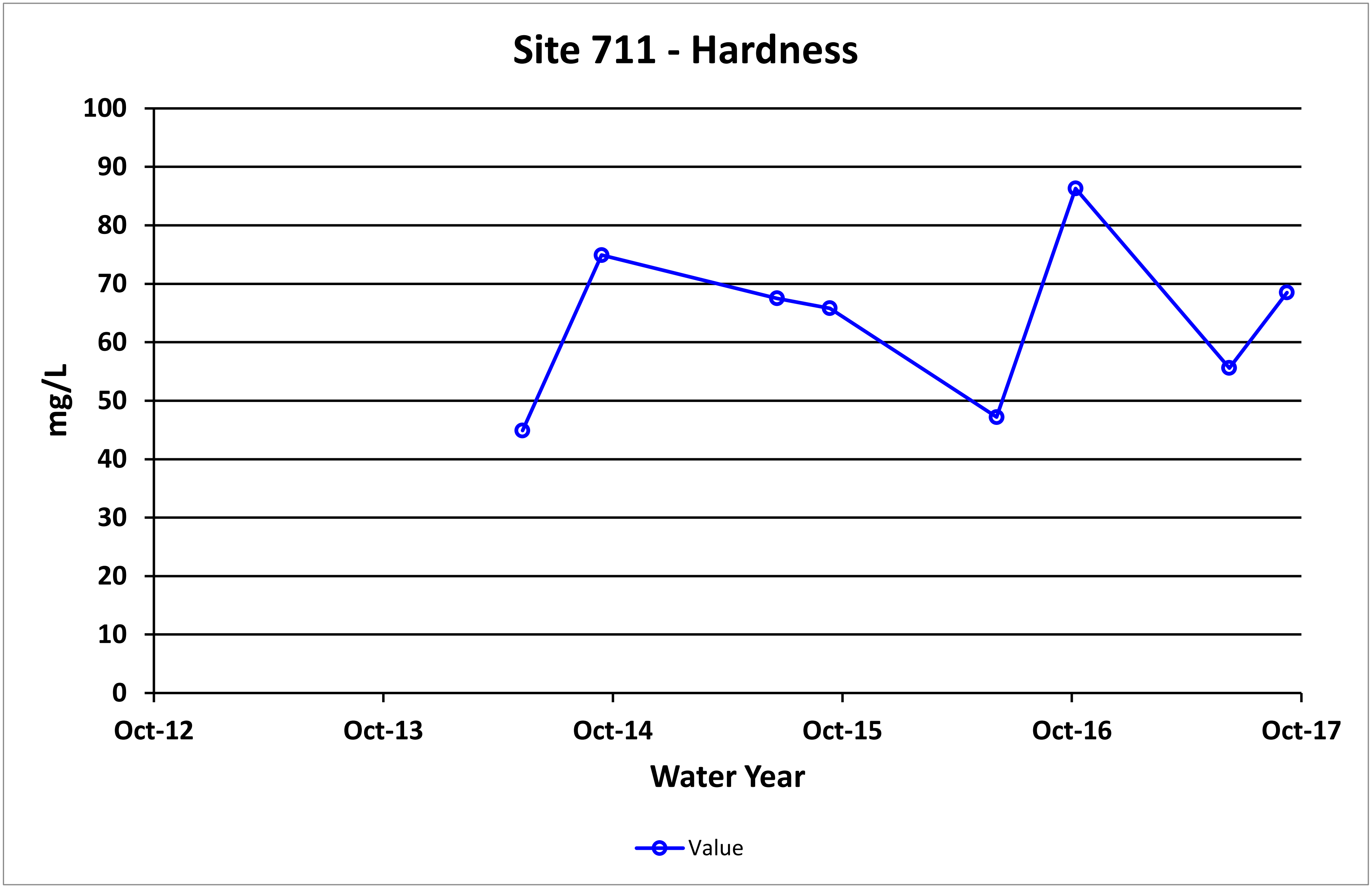
Site 711 - pH Field
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
S.U.
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Lower Limit
Upper Limit
Value



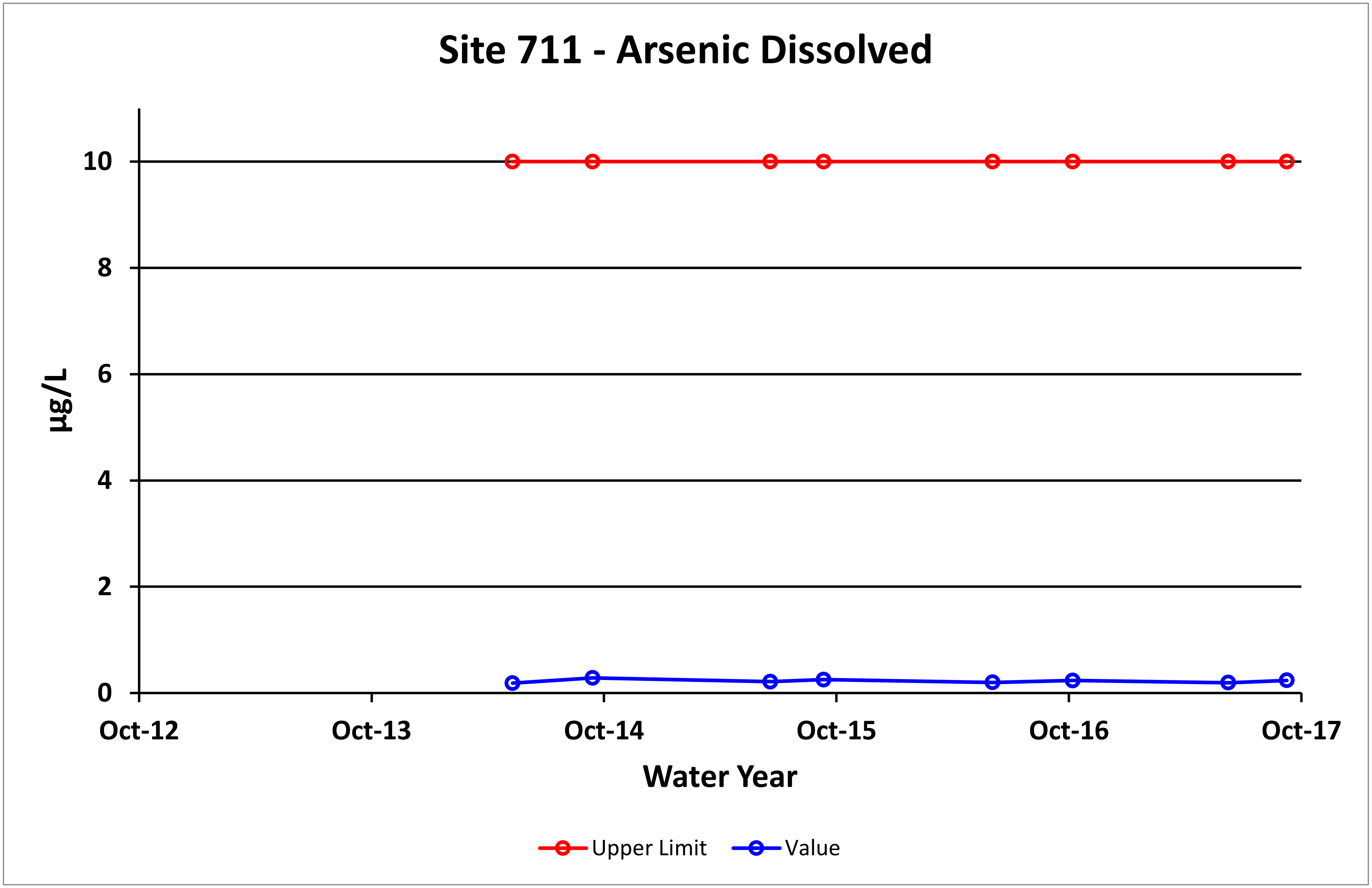
Site 711 - Alkalinity
140
120
100
80
60
40
20
0
mg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Lower Limit
Value



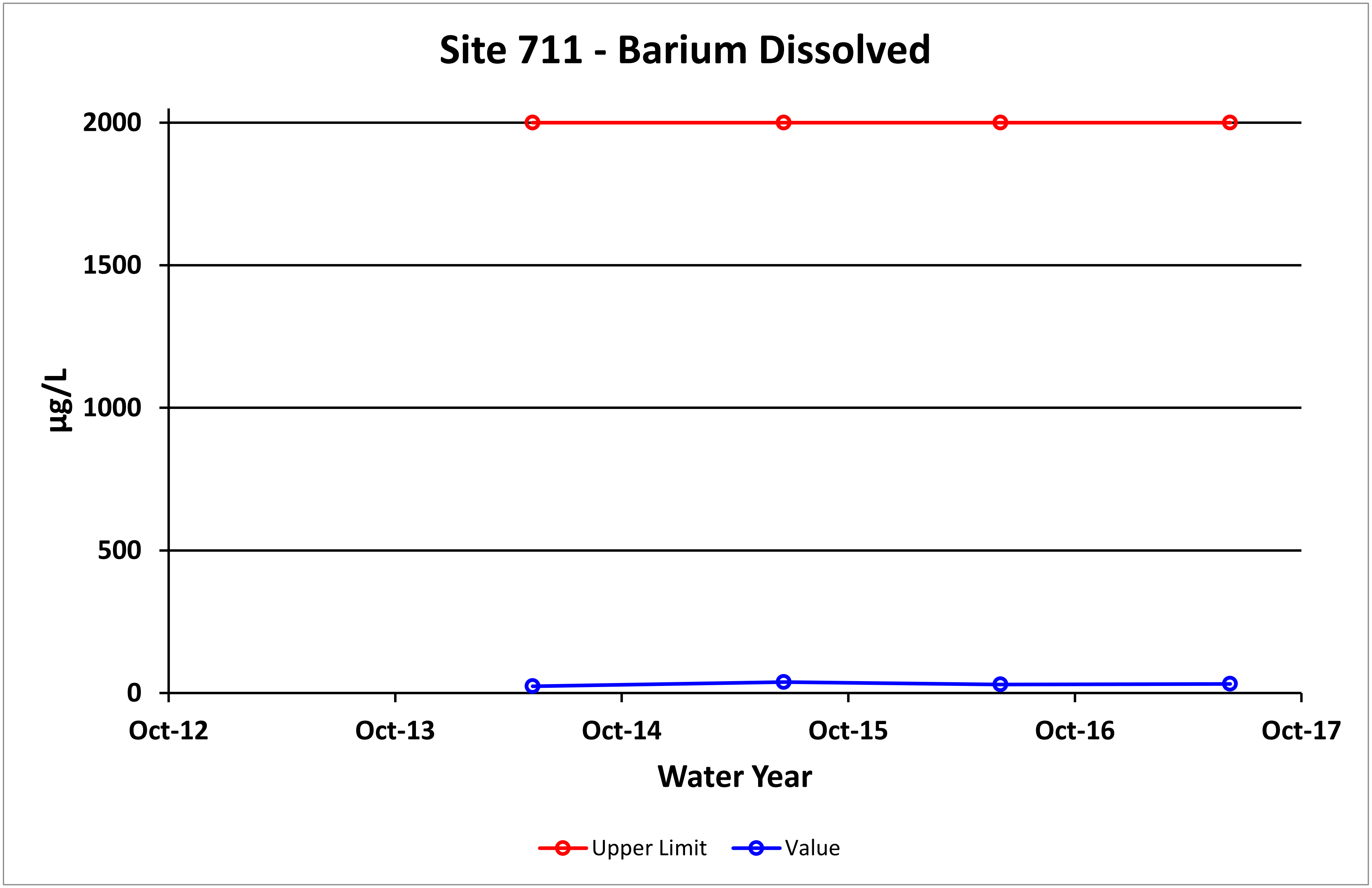
Site 711 - Sulfate
mg/L
250
200
150
100
50
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

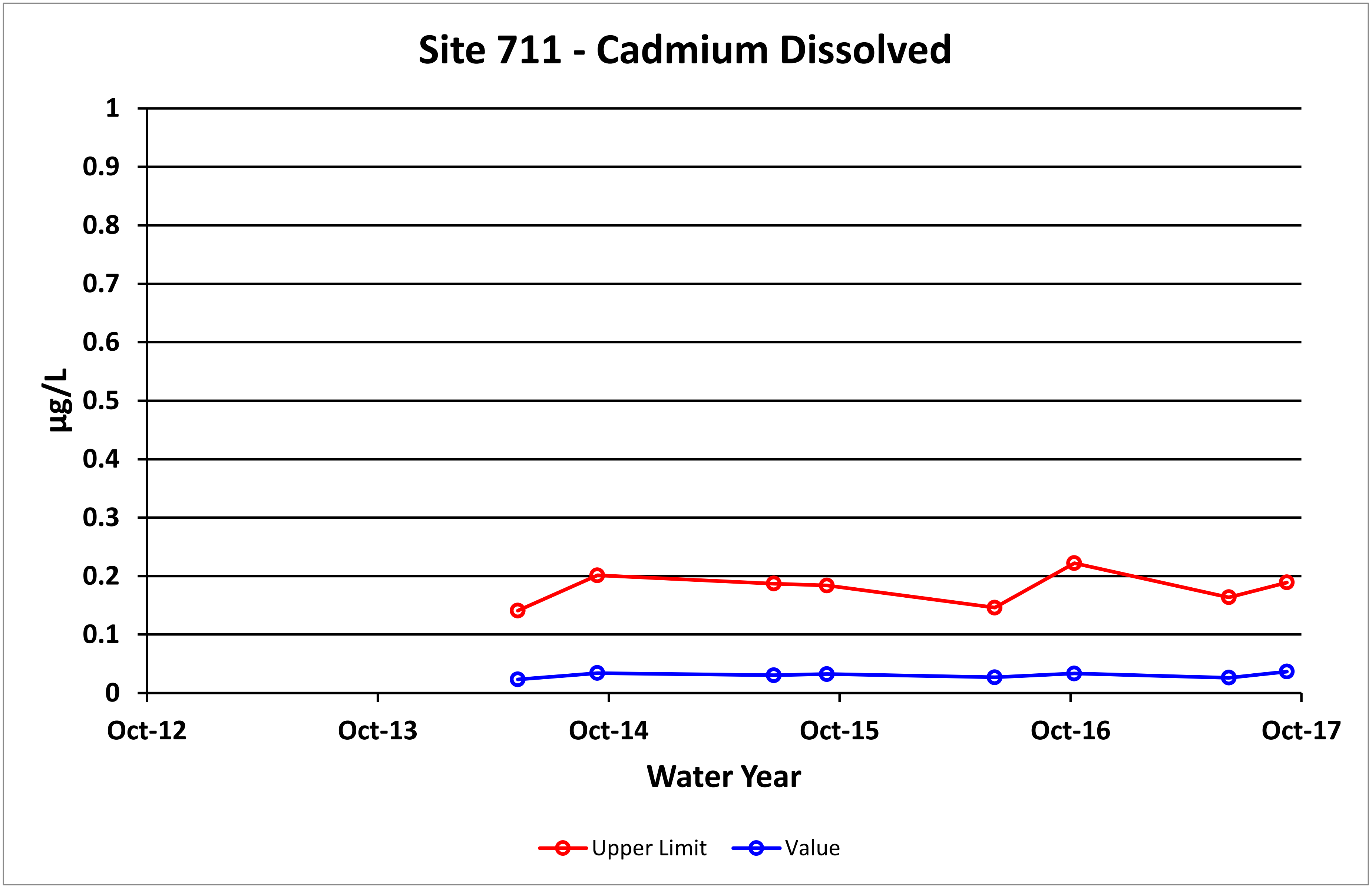


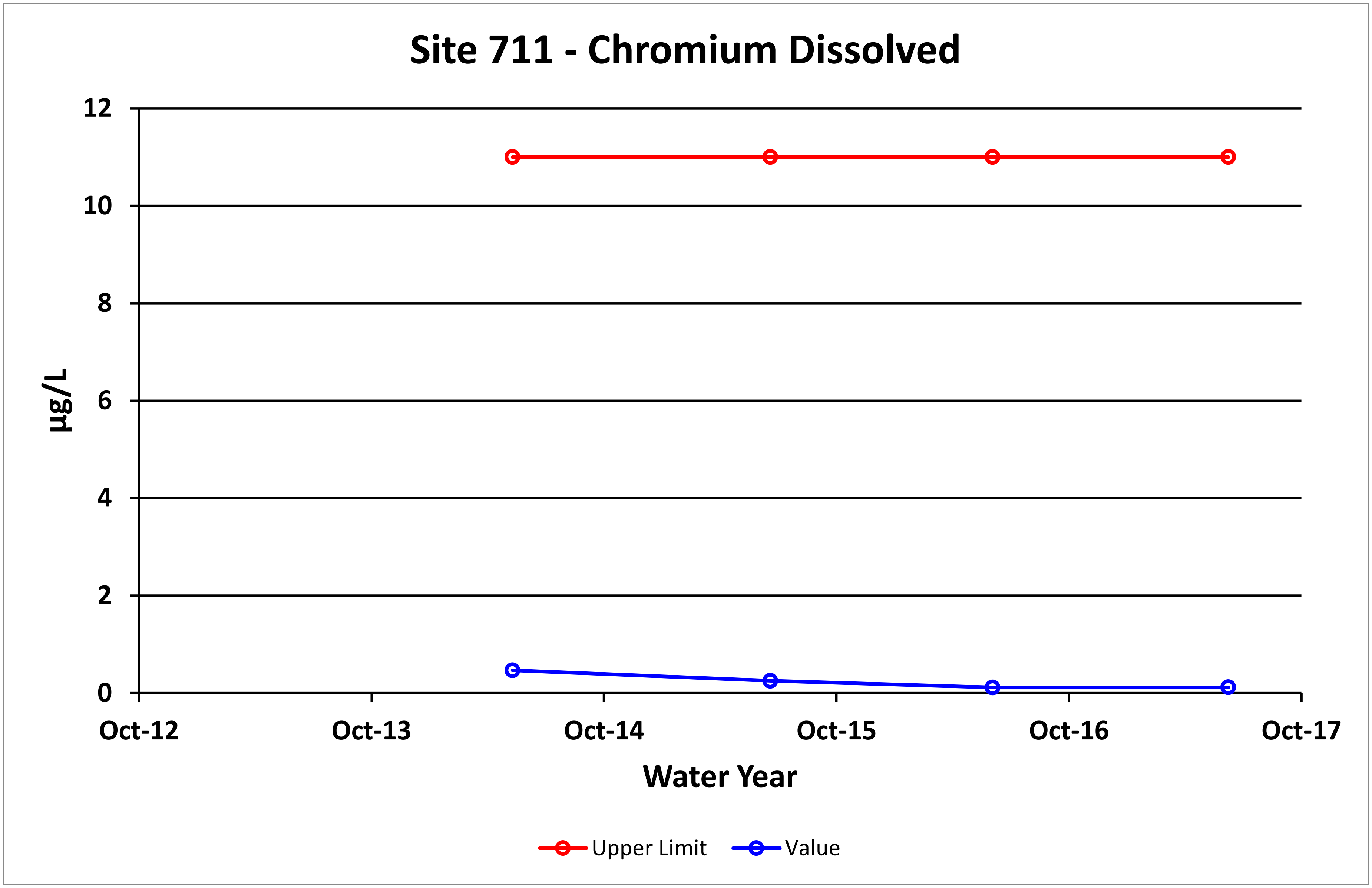
Site 711 - Hardness
100
90
80
70
60
50
40
30
20
10
0
mg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value

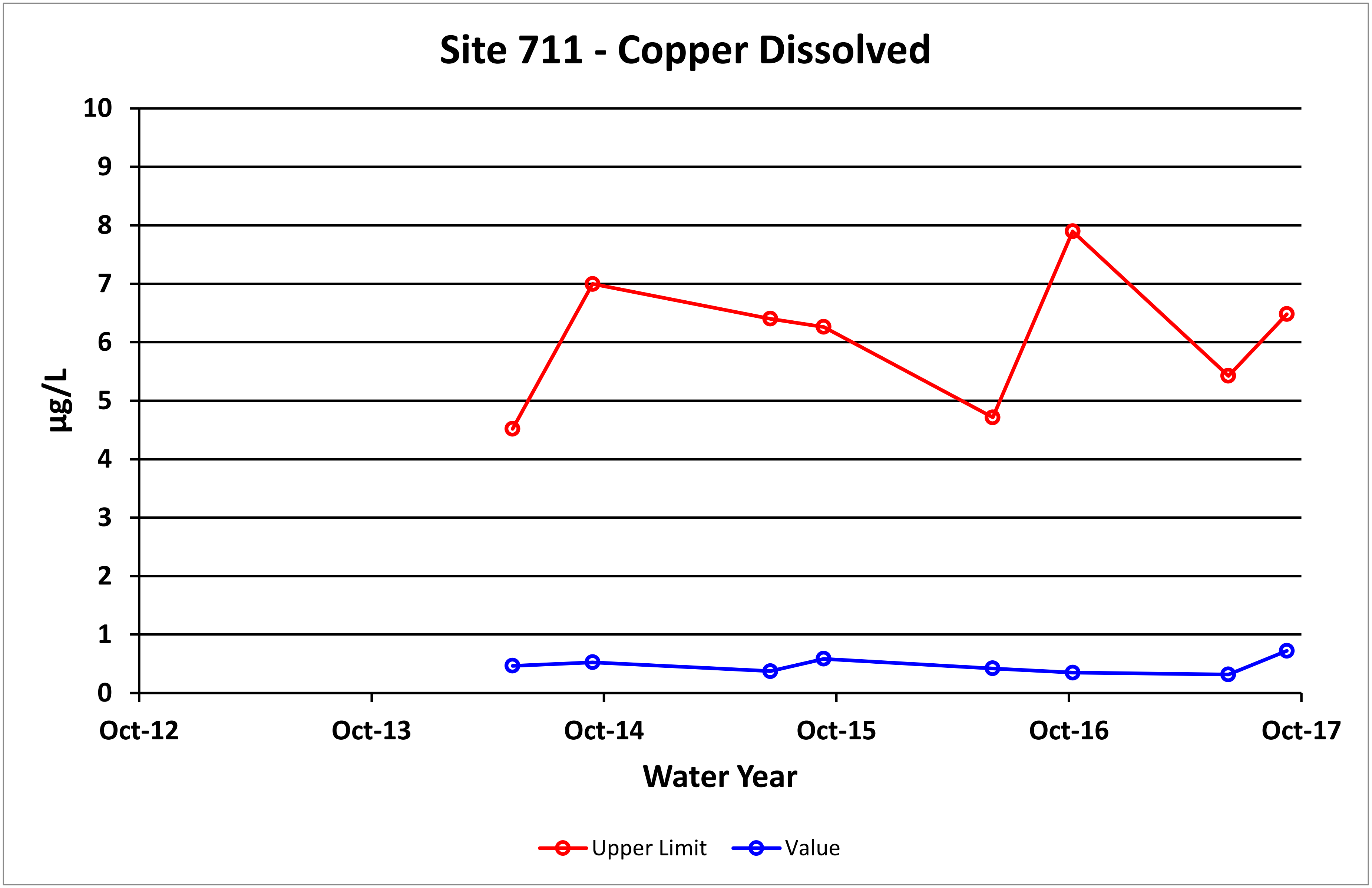


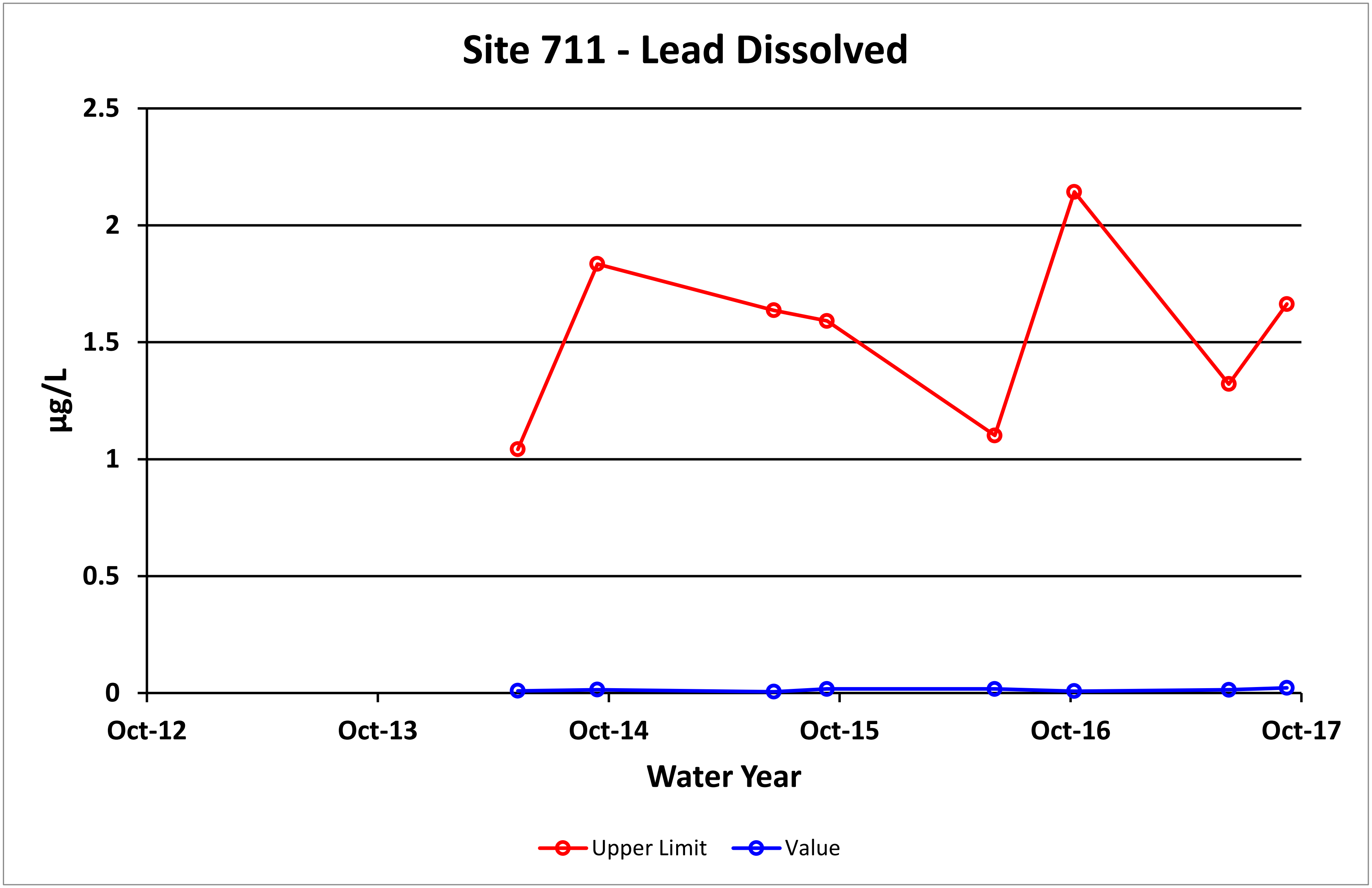
Site 711 - Arsenic Dissolved
µg/L
10
8
6
4
2
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

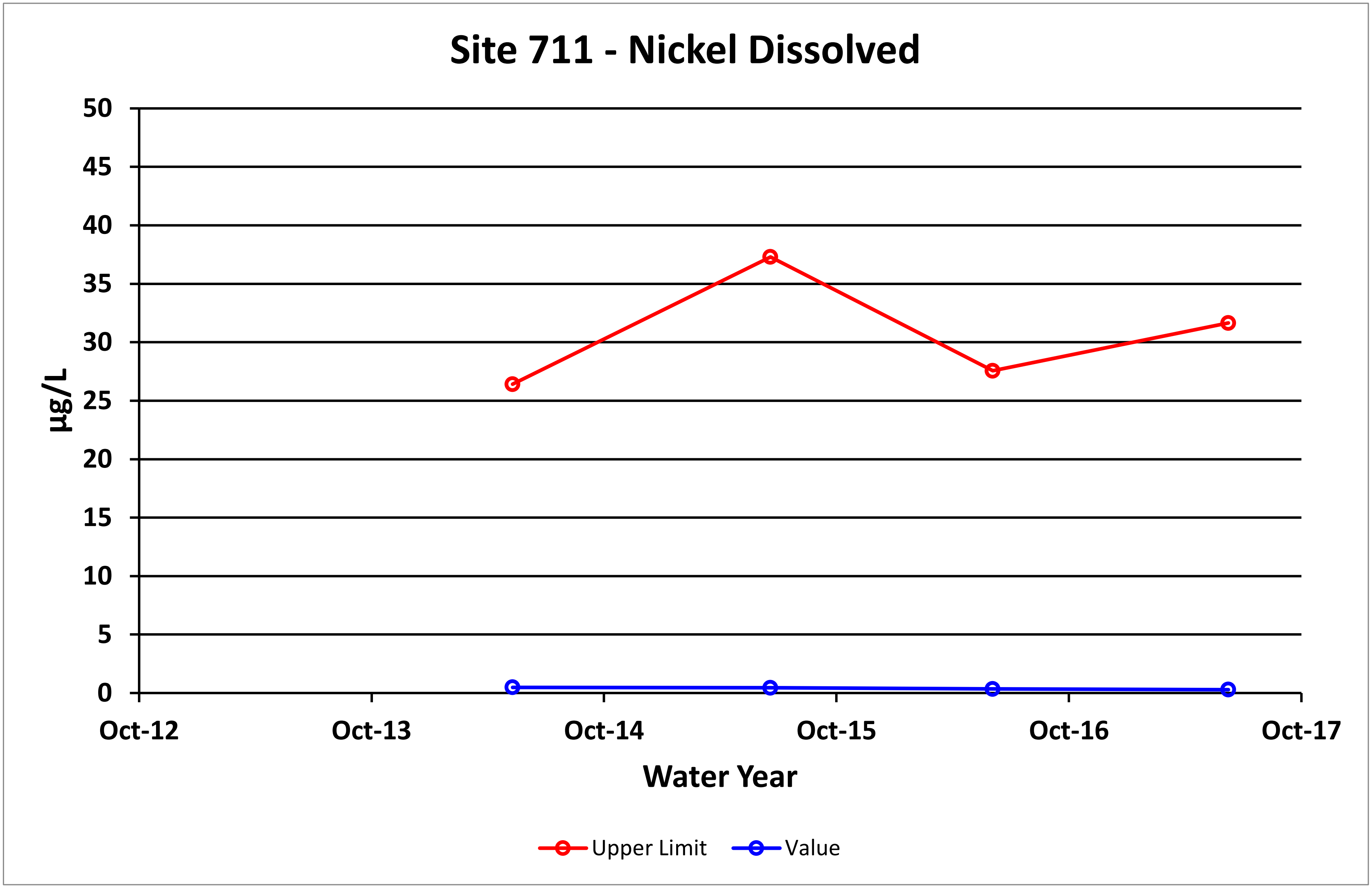

Site 711 - Barium Dissolved
2000
1500
1000
500
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value


Site 711 - Cadmium Dissolved
µg/L
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

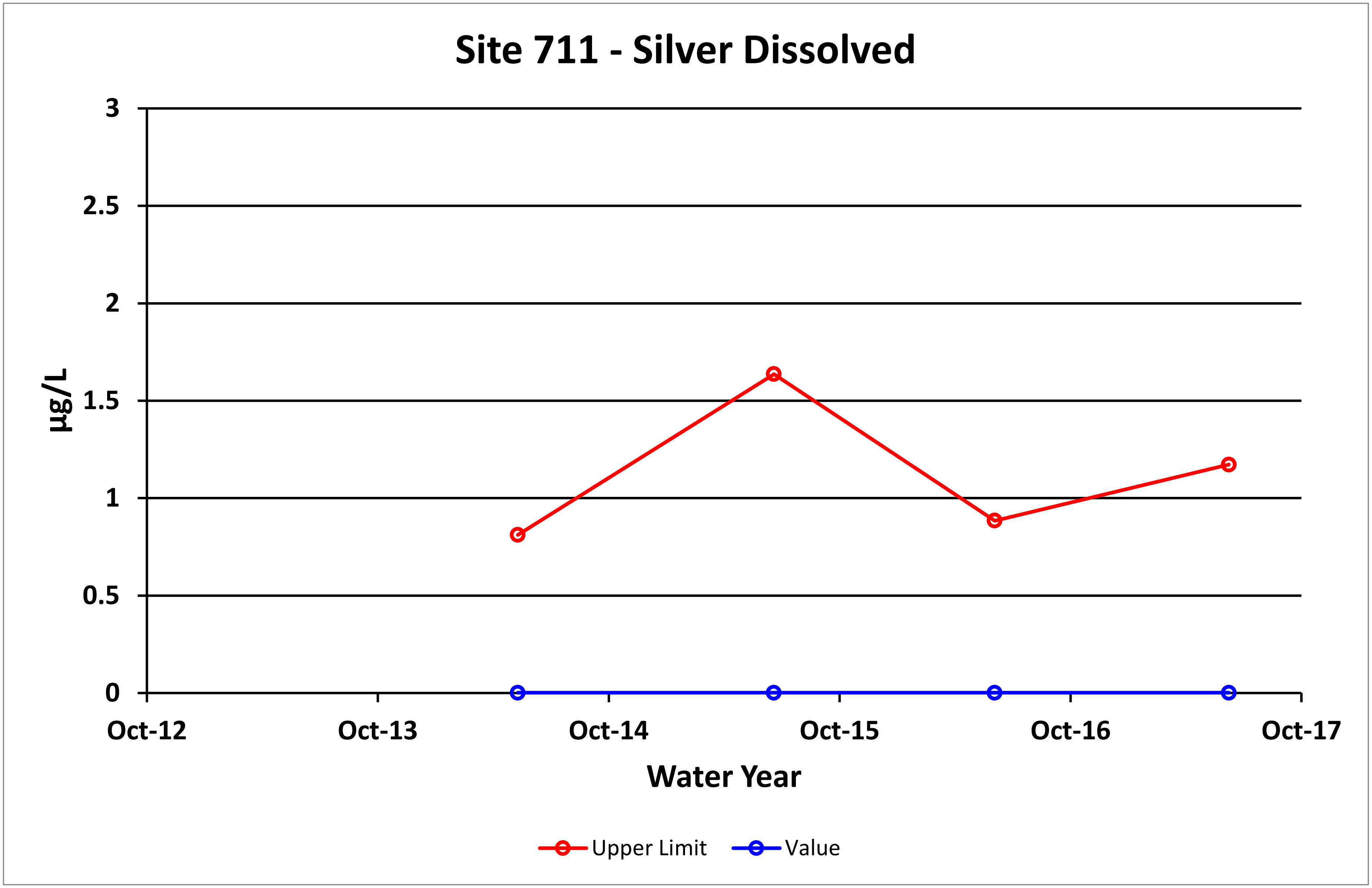

Site 711 - Chromium Dissolved
12
10
8
6
4
2
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

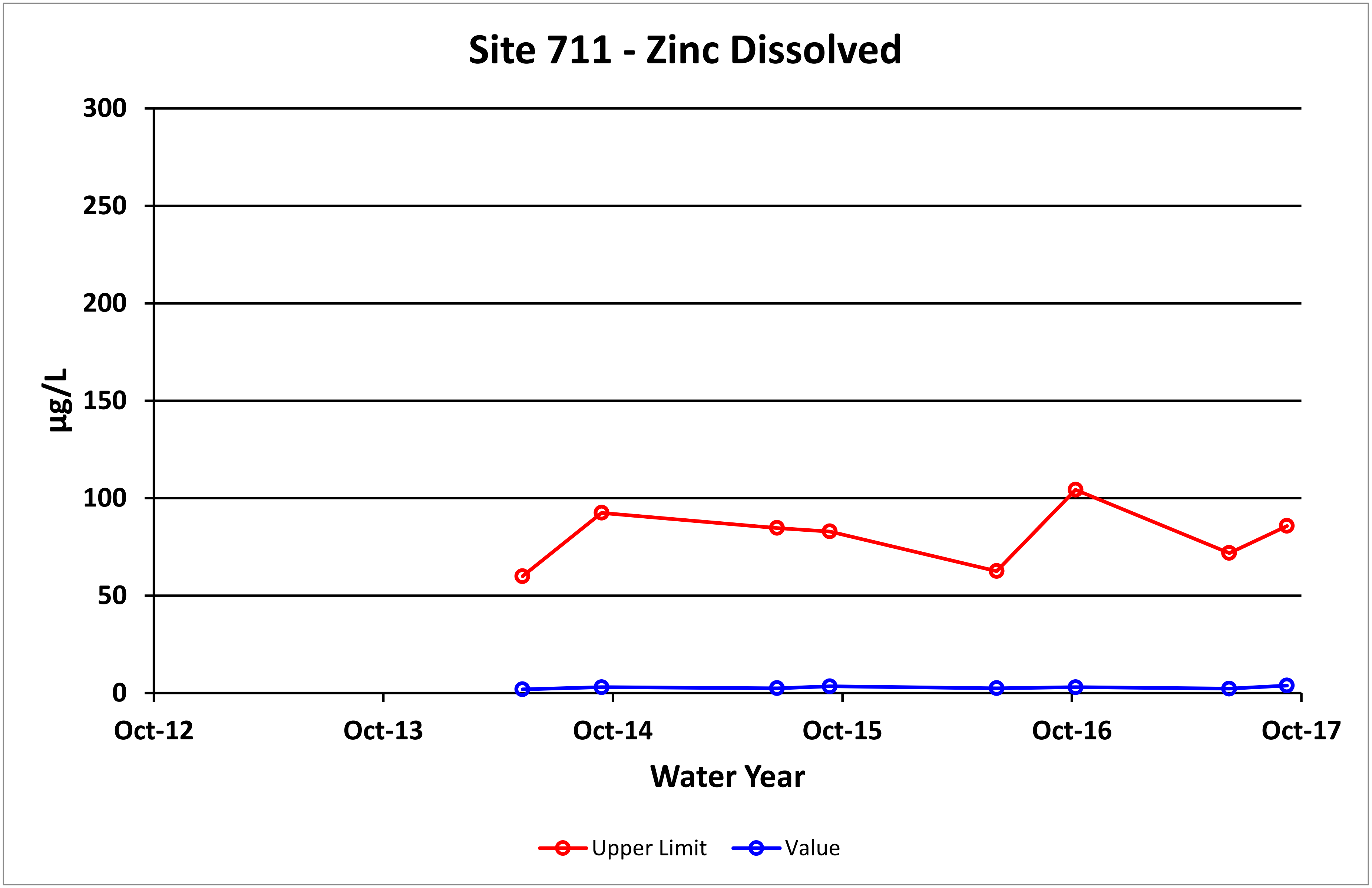

Site 711 - Copper Dissolved
10
9
8
7
6
5
4
3
2
1
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

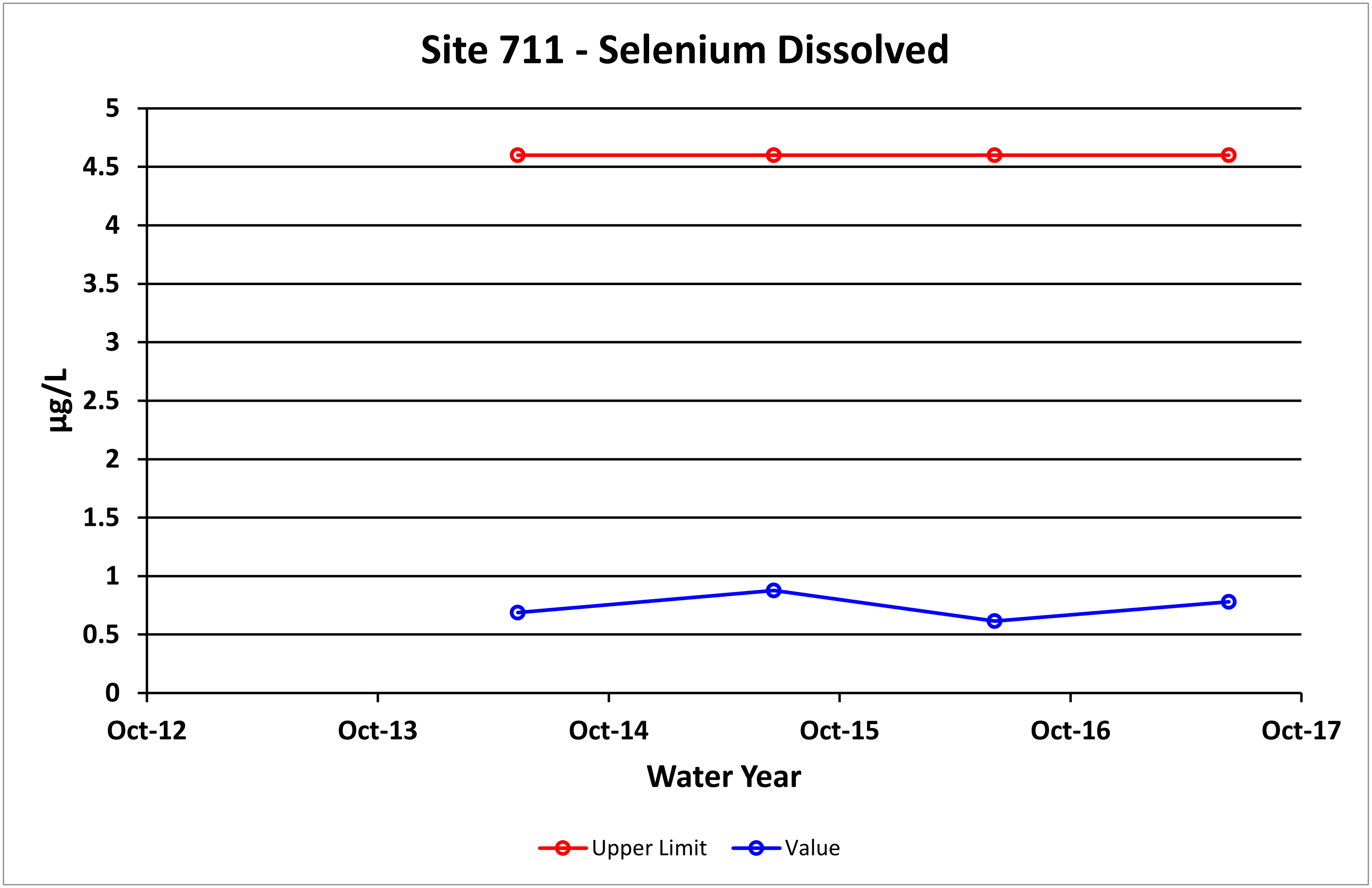

Site 711 - Lead Dissolved
2.5
2
1.5
1
0.5
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

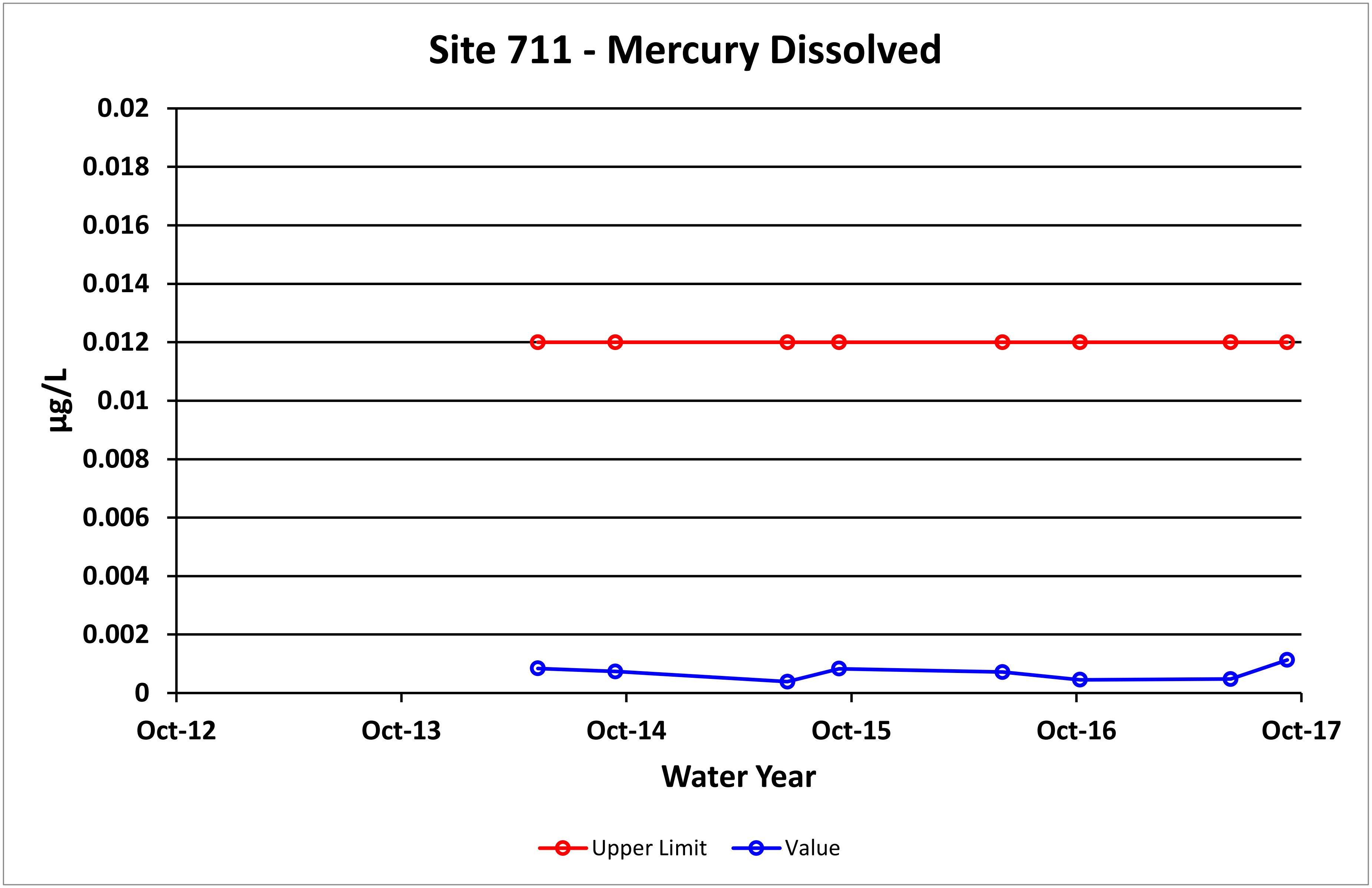


Site 711 - Nickel Dissolved
50
45
40
35
30
25
20
15
10
5
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value


Site 711 - Silver Dissolved
3
2.5
2
1.5
1
0.5
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value


Site 711 - Zinc Dissolved
300
250
200
150
100
50
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value


Site 711 - Selenium Dissolved
µg/L
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value


Site 711 - Mercury Dissolved
0.02
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

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 2017" report. The table includes all the required FWMP analyte data (field and laboratory) collected for the current water year and a series of flags keyed to the summary report "Qualified Data by QA Reviewer". The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of ½ MDL for the purpose of median calculation.

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

Sample Date	Parameter	Value	Qualifier	Notes
No outliers have been identified by HGCMC for the period of October 2013 through September 2017.				

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 2017

			Limits		
Sample Date	Parameter	Value	Lower	Upper	Hardness
No exceedances have been identified by HGCMC for the period of October 2016 through September 2017.					

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 2017

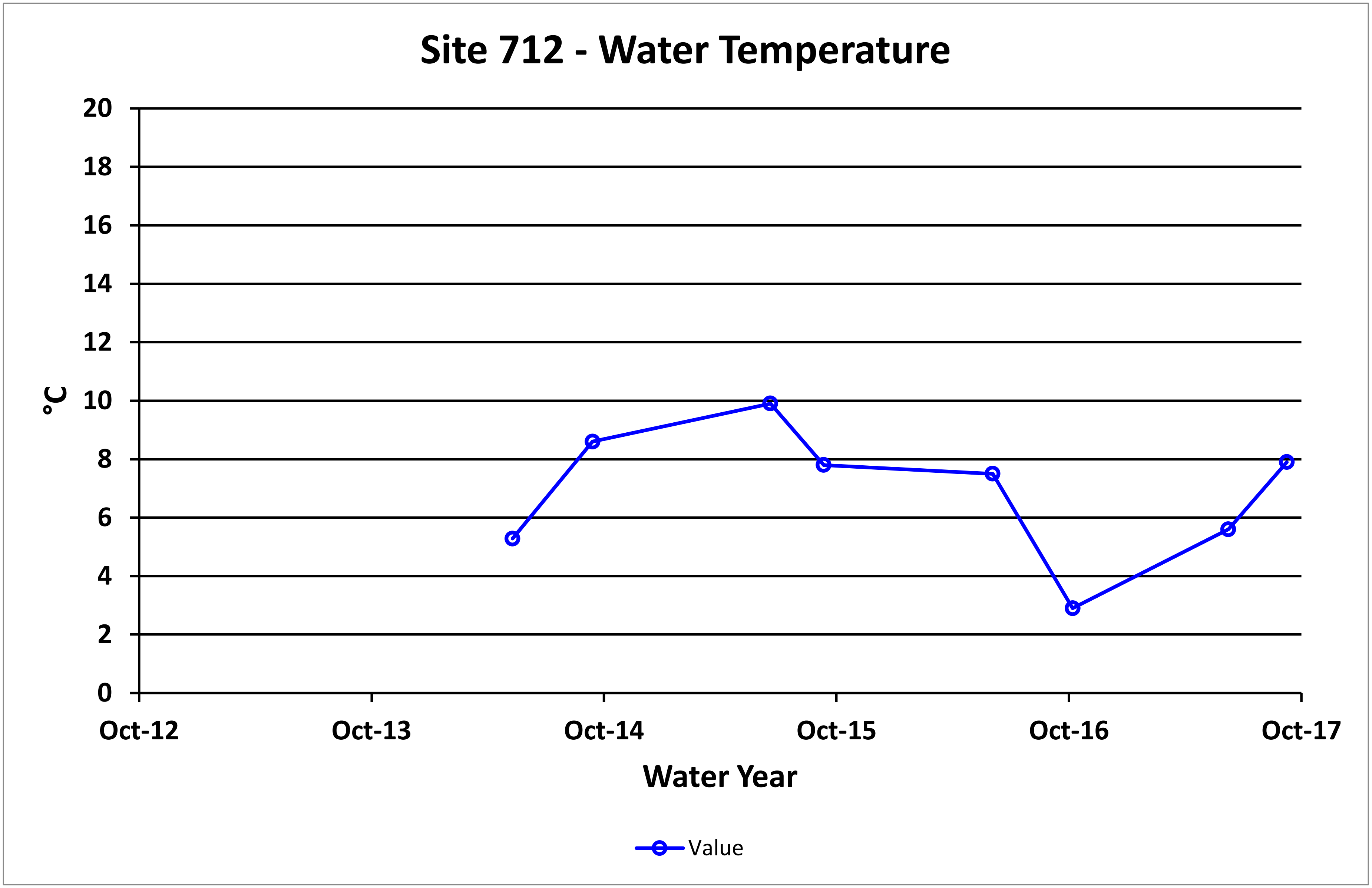
Site 712FMS - 'Greens Creek Below Site E'

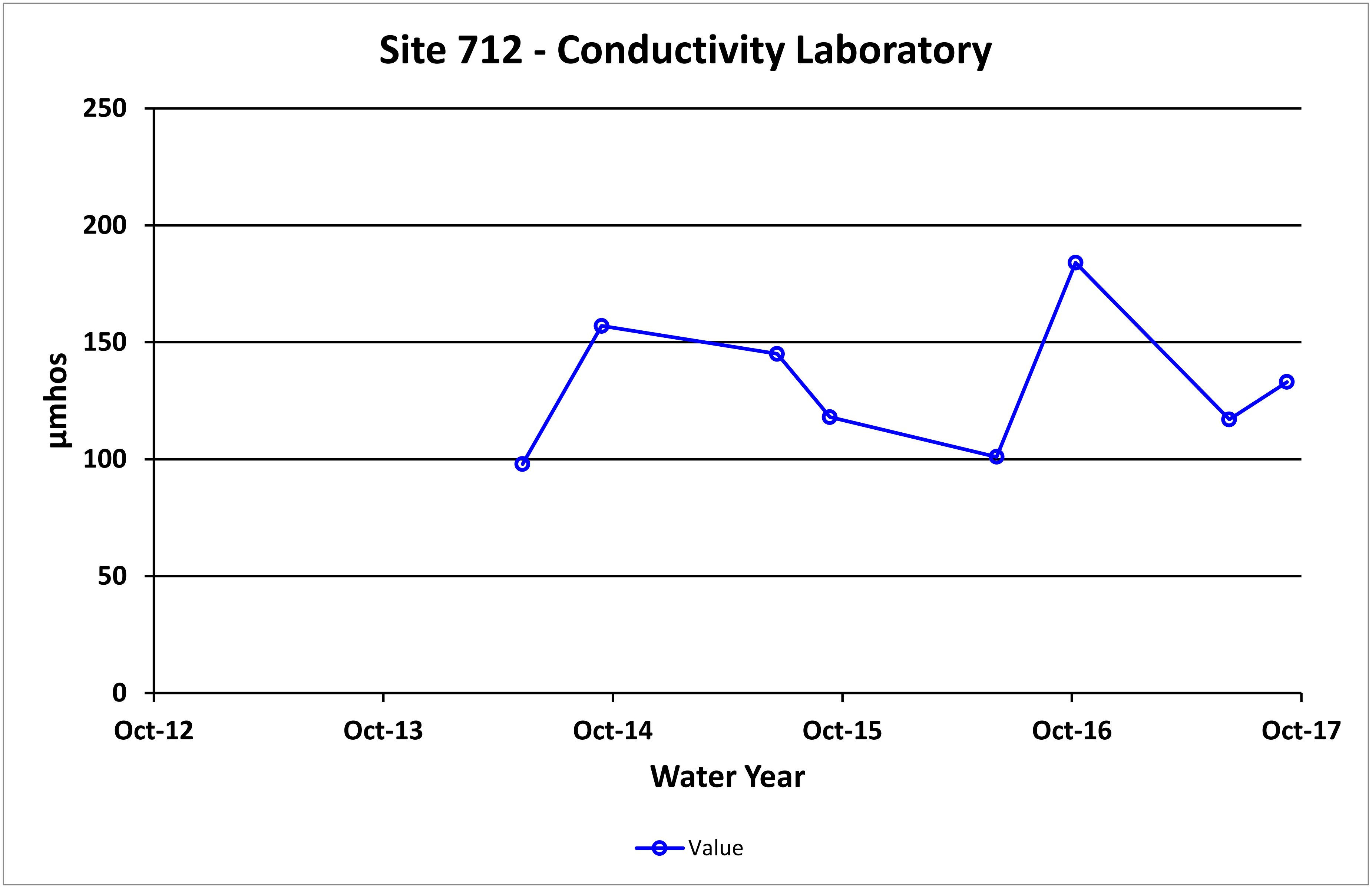
Sample Date/Parameter	Oct 2016	Nov 2016	Dec 2016	Jan 2017	Feb 2017	Mar 2017	Apr 2017	May 2017	Jun 2017	Jul 2017	Aug 2017	Sep 2017	**Median**
Water Temp (°C)	2.9								5.6				4.3
Conductivity-Field(μmho)	184.5								116.6				150.6
Conductivity-Lab (μmho)	184								117				151
pH Lab (standard units)	7.87								7.55				7.71
pH Field (standard units)	8.1								7.91				8.01
Total Alkalinity (mg/L)	70.6								45.8				58.2
Total Sulfate (mg/L)	22.3								12				17.2
Hardness (mg/L)	89.1								57				73.1
Dissolved As (ug/L)	0.233								0.188				0.211
Dissolved Ba (ug/L)									32.1				32.1
Dissolved Cd (ug/L)	0.0344								0.0279				0.0312
Dissolved Cr (ug/L)									0.103				0.103
Dissolved Cu (ug/L)	0.363								0.341				0.352
Dissolved Pb (ug/L)	0.008								0.0074				0.0077
Dissolved Ni (ug/L)									0.285				0.285
Dissolved Ag (ug/L)									0.002				0.002
Dissolved Zn (ug/L)	3.54								2.49				3.02
Dissolved Se (ug/L)									0.778				0.778
Dissolved Hg (ug/L)	0.00082								0.000474				0.000647

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

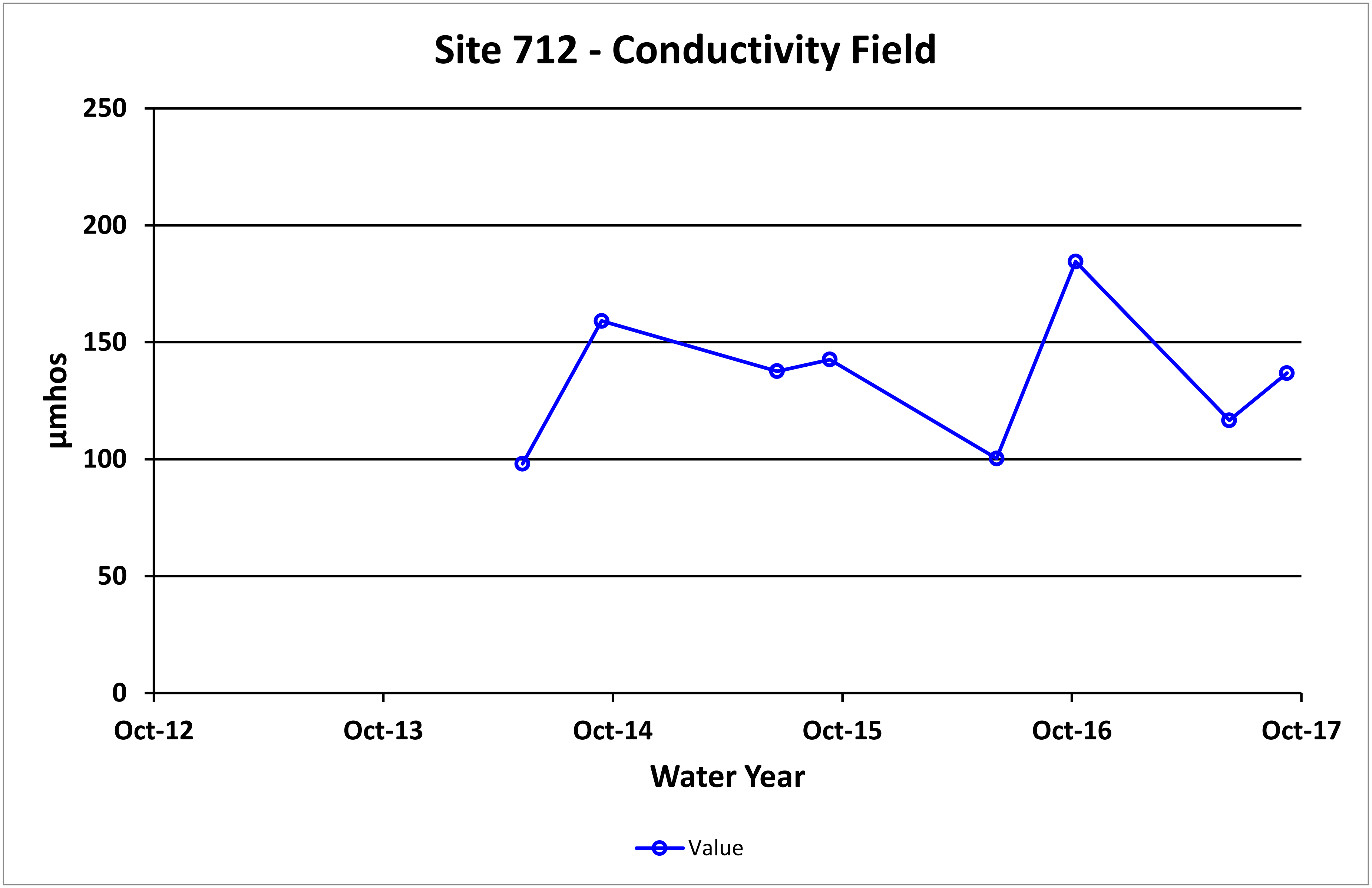
Values reported as less than MDL are replaced by 1/2 MDL for median calculation purposes.

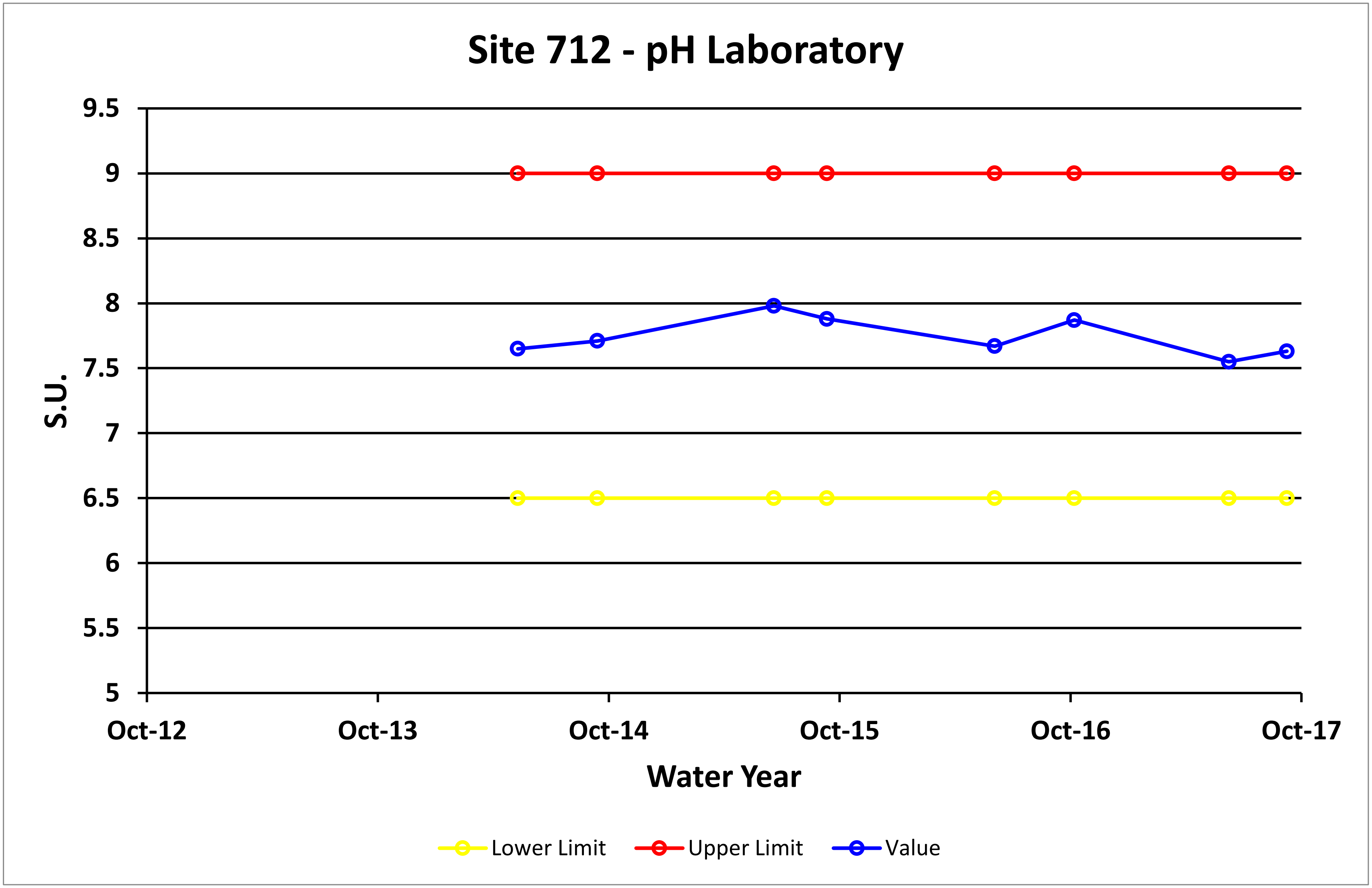
Shaded data has been qualified as an outlier by HGCMC and removed from any further analysis and is not included into the calculation of the median


Site 712 - Water Temperature
20
18
16
14
12
10
8
6
4
2
0
°C
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value

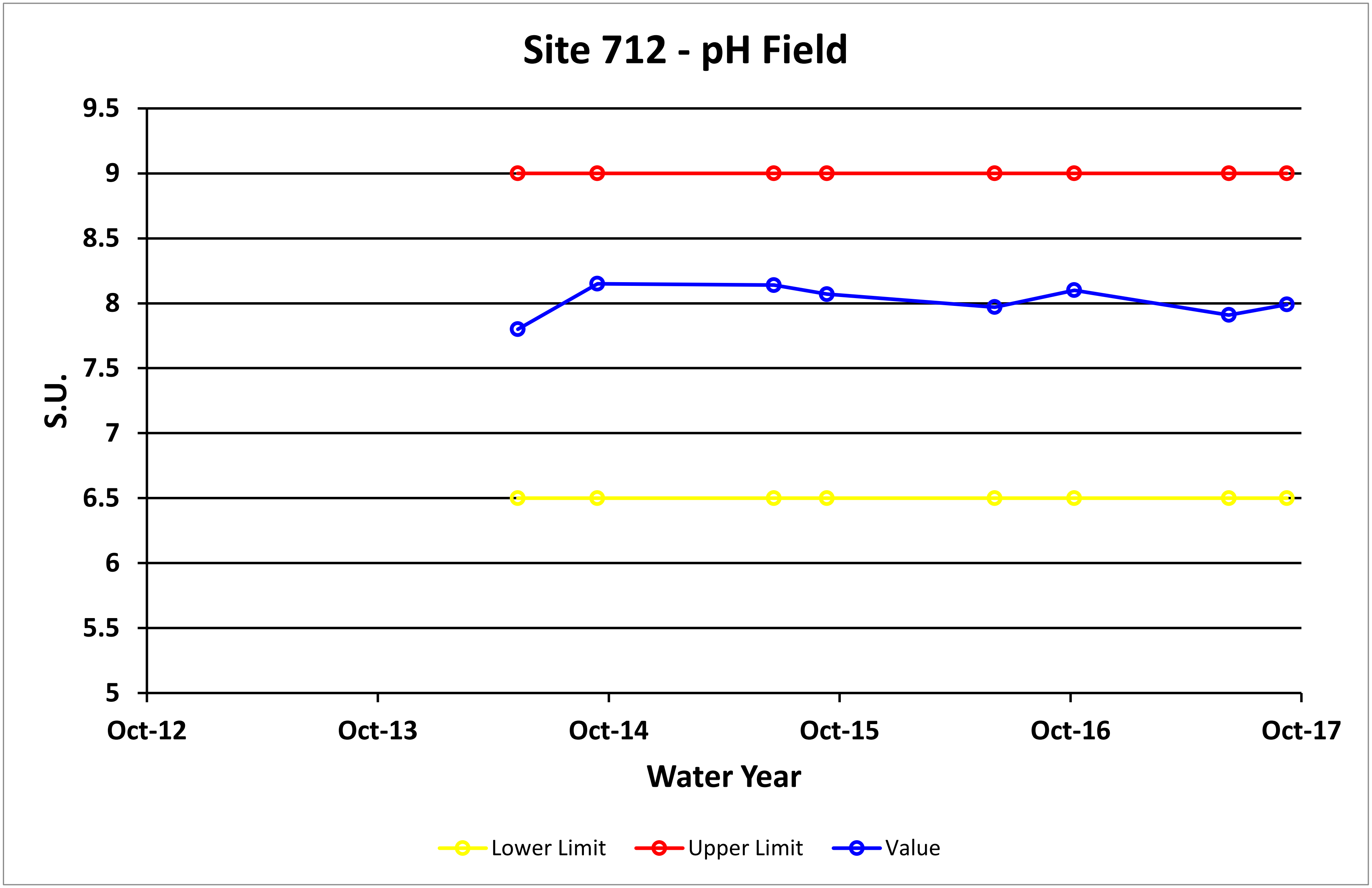


Site 712 - Conductivity Laboratory
250
200
150
100
50
0
µmhos
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value

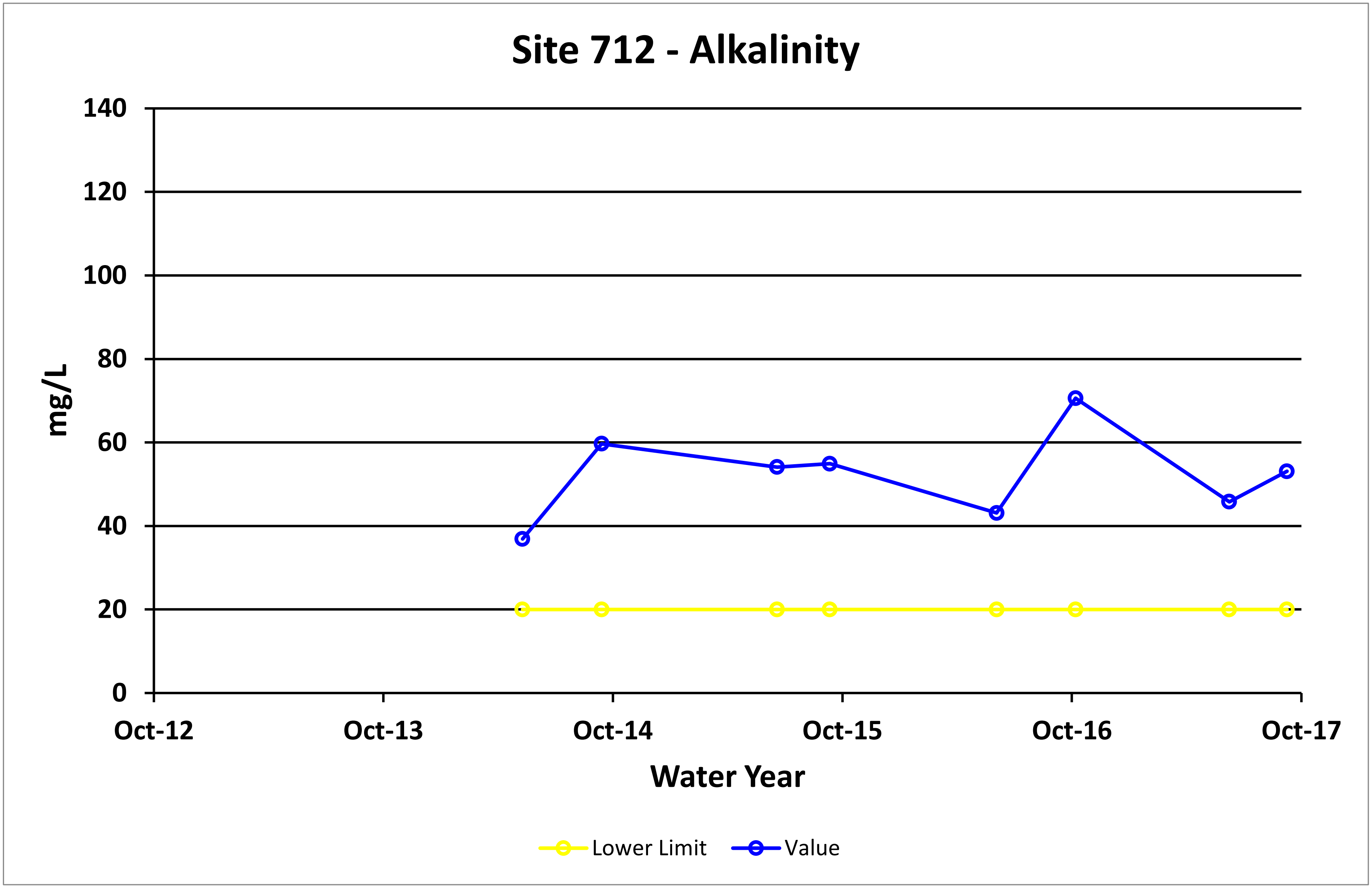

Site 712 - Conductivity Field
250
200
150
100
50
0
µmhos
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value

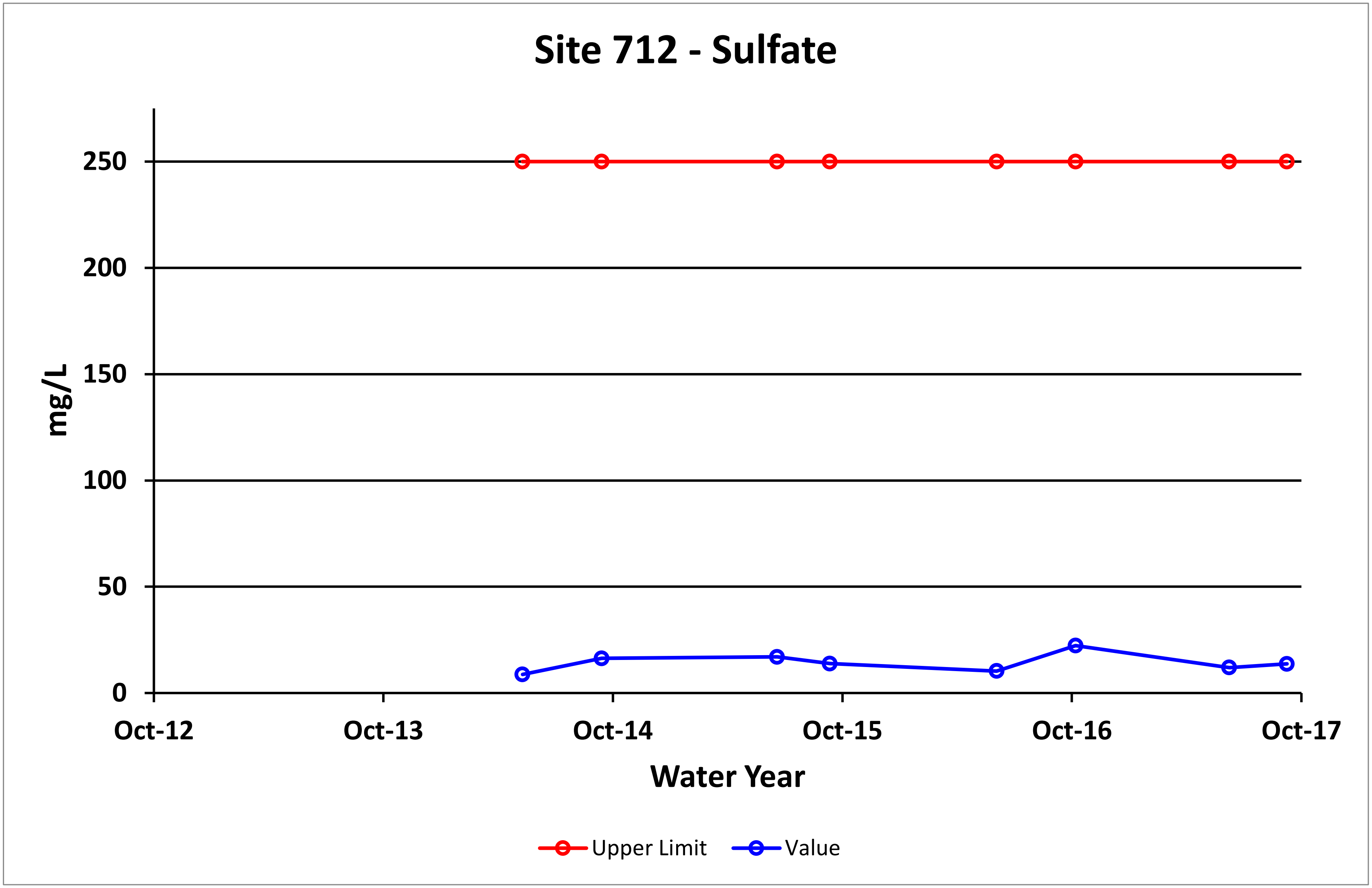


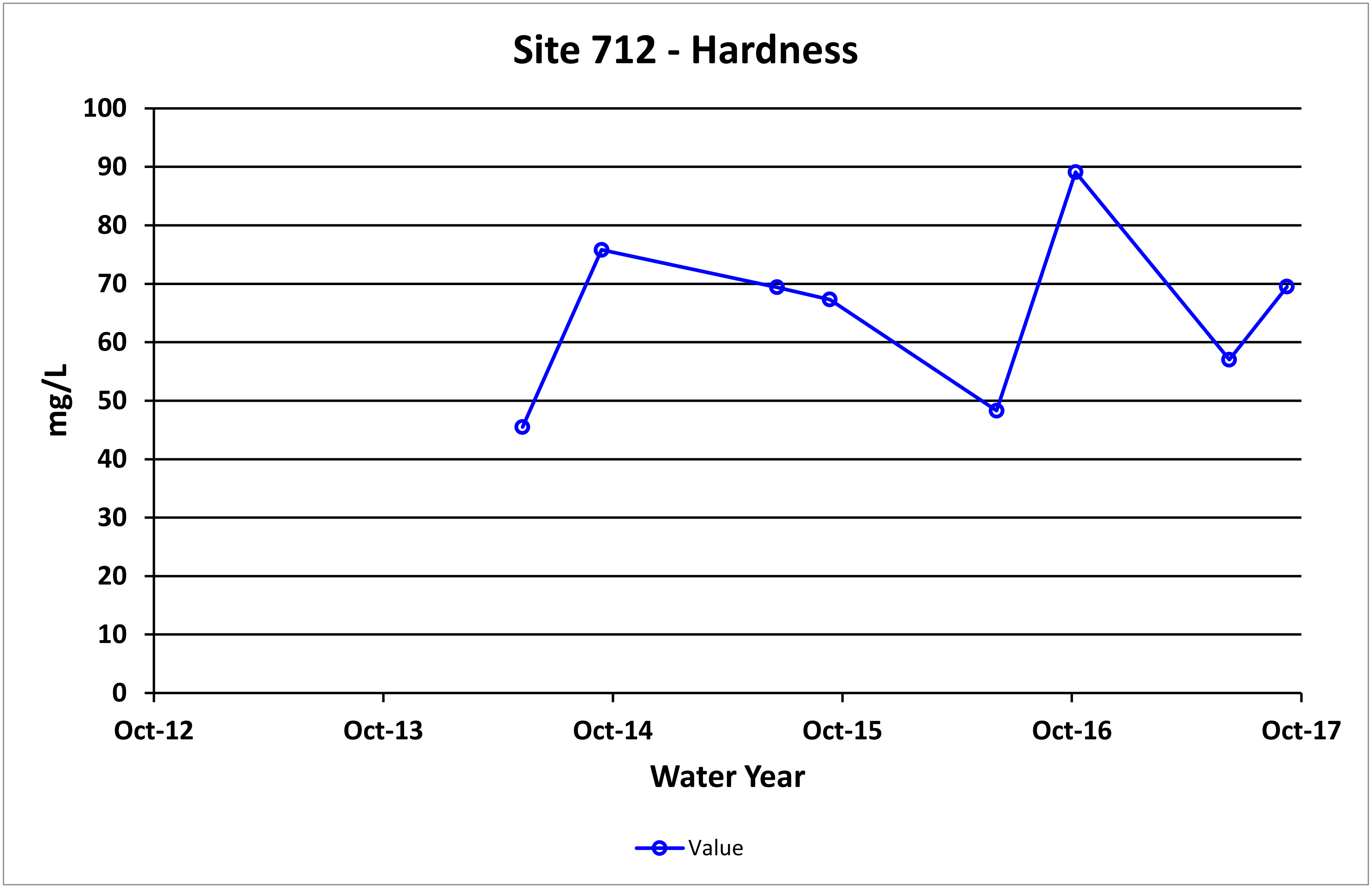
Site 712 - pH Laboratory
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
S.U.
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Lower Limit
Upper Limit
Value

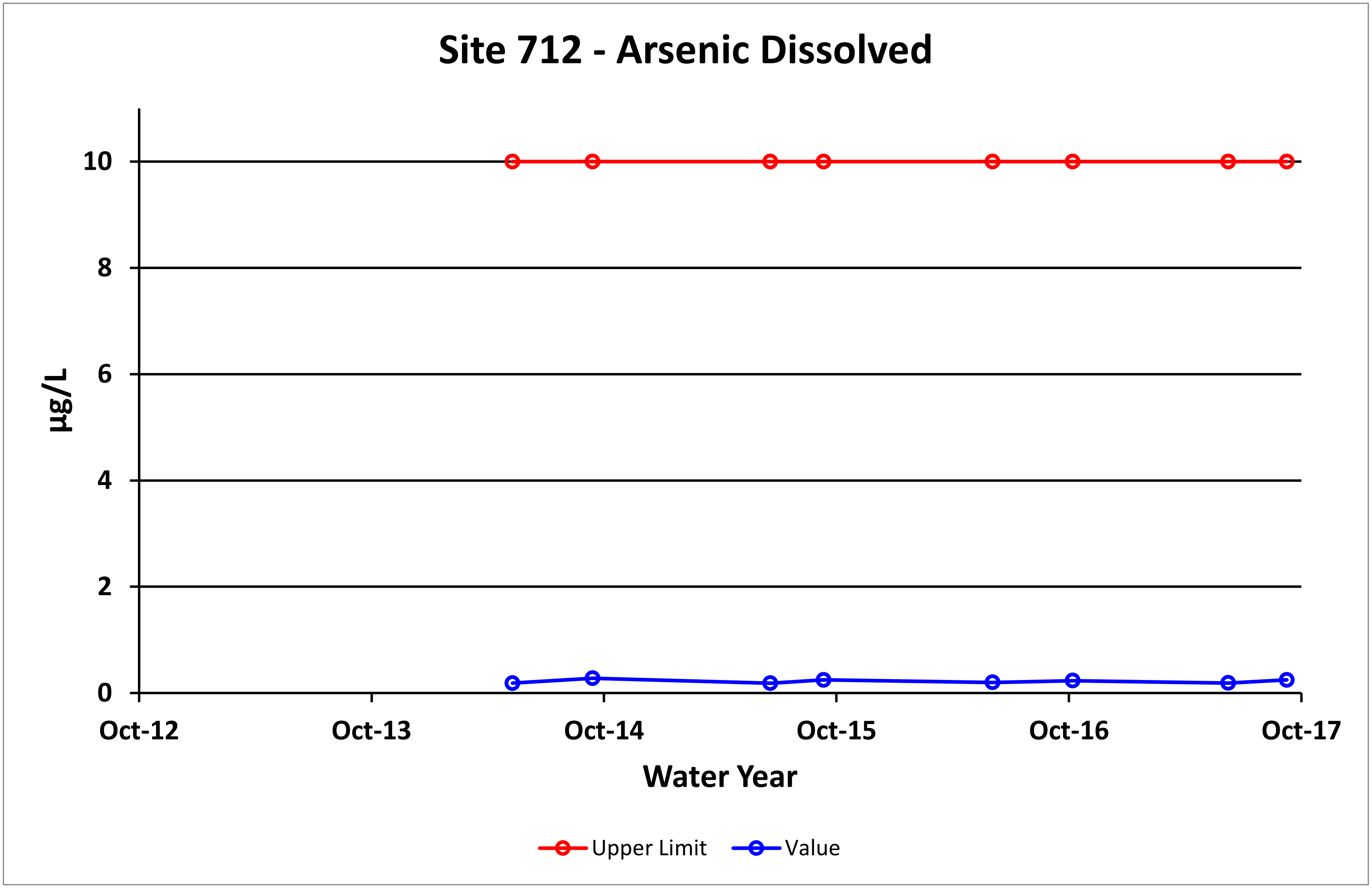


Site 712 - pH Field
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
S.U.
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Lower Limit
Upper Limit
Value

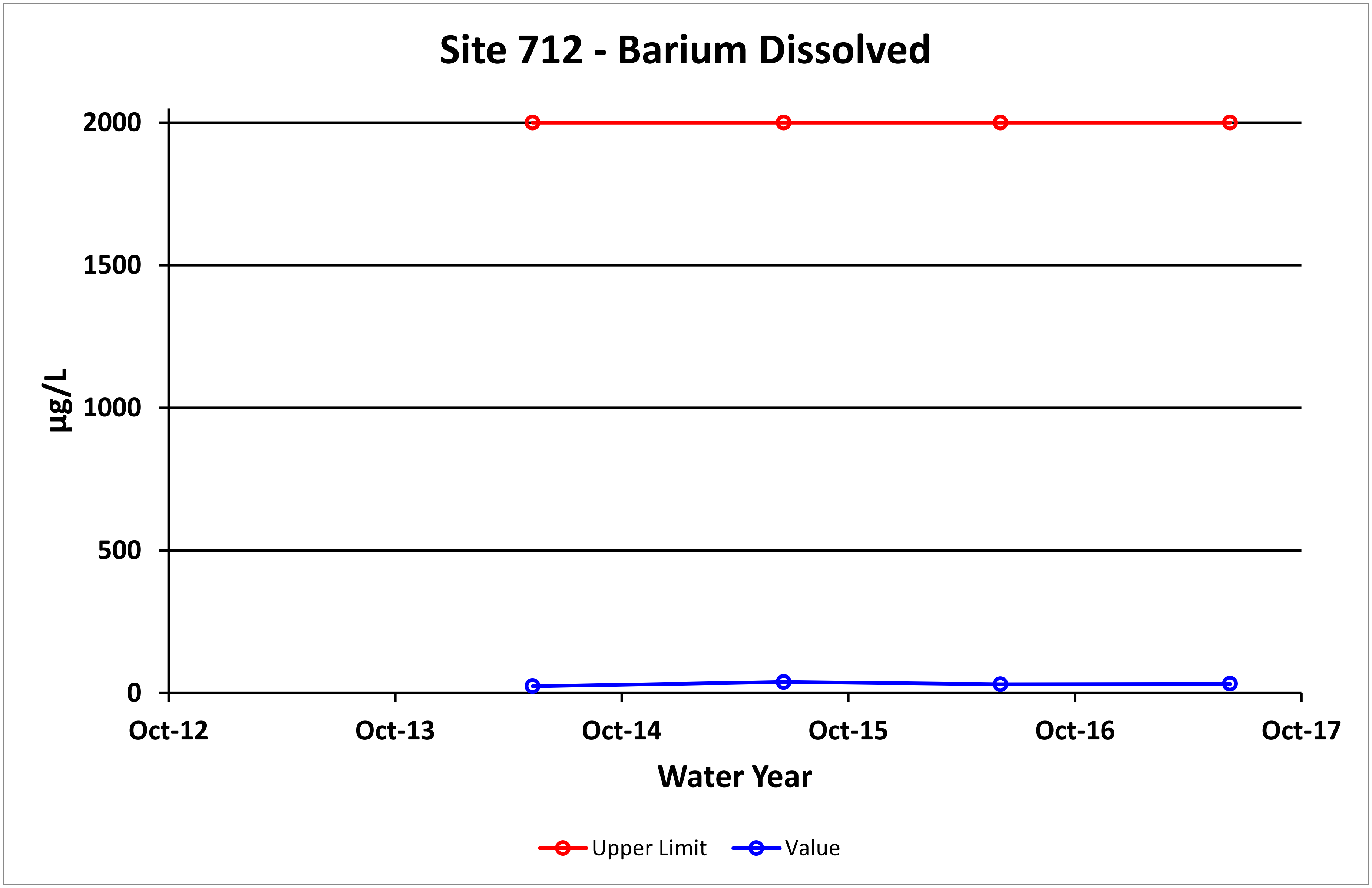

Site 712 - Alkalinity
mg/L
140
120
100
80
60
40
20
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Lower Limit
Value

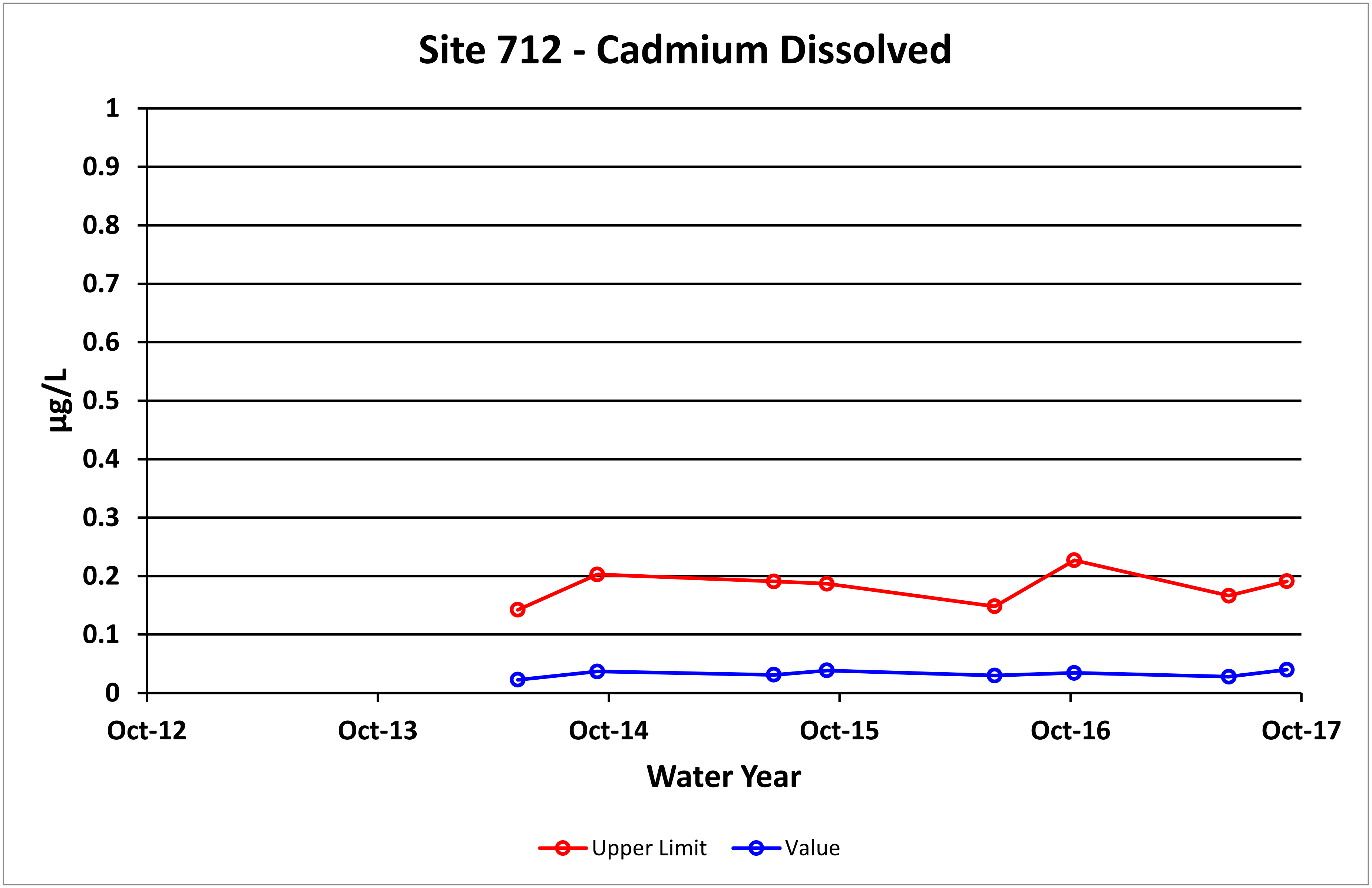

Site 712 - Sulfate
mg/L
250
200
150
100
50
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value


Site 712 - Hardness
mg/L
100
90
80
70
60
50
40
30
20
10
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Value

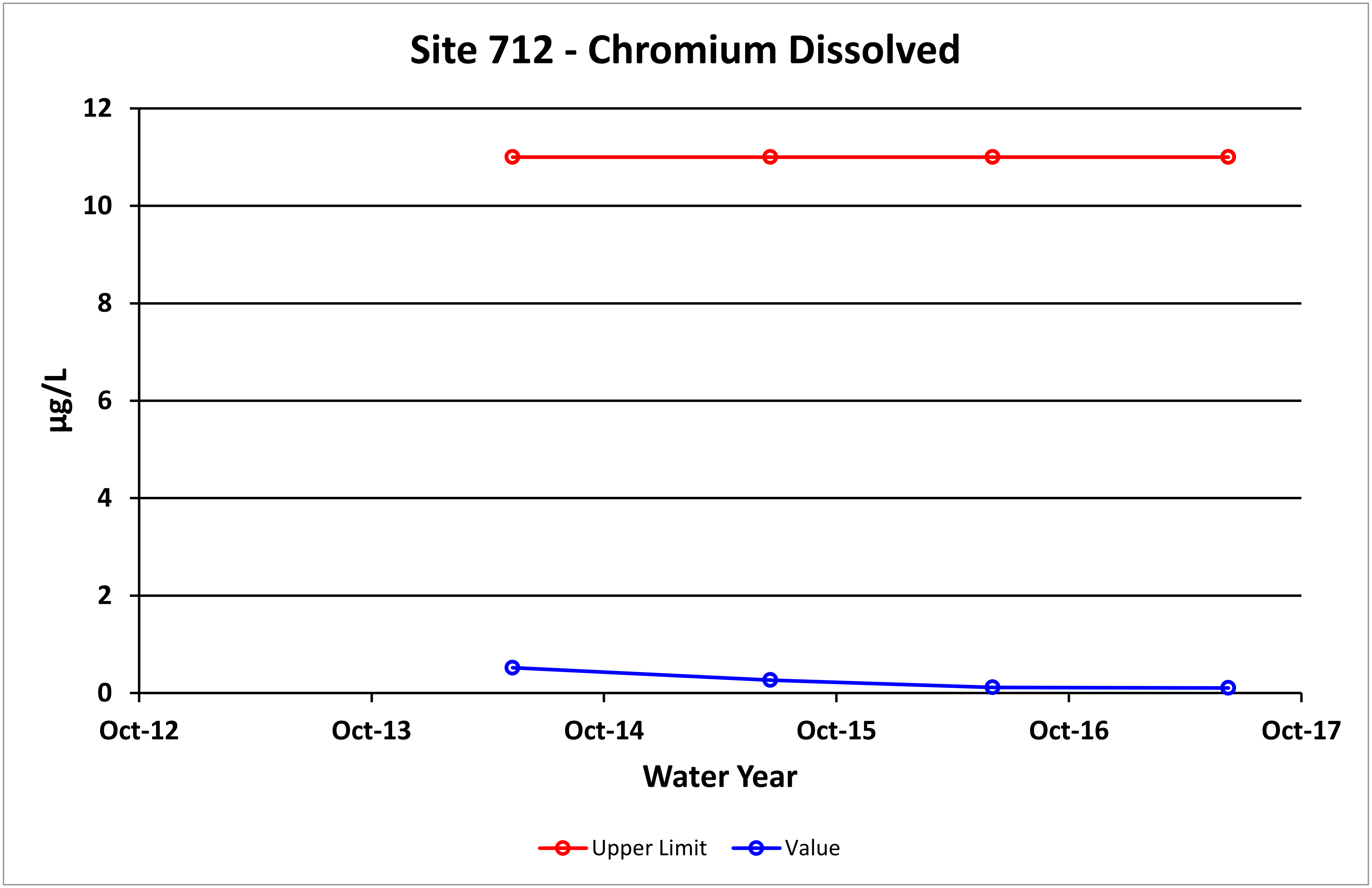


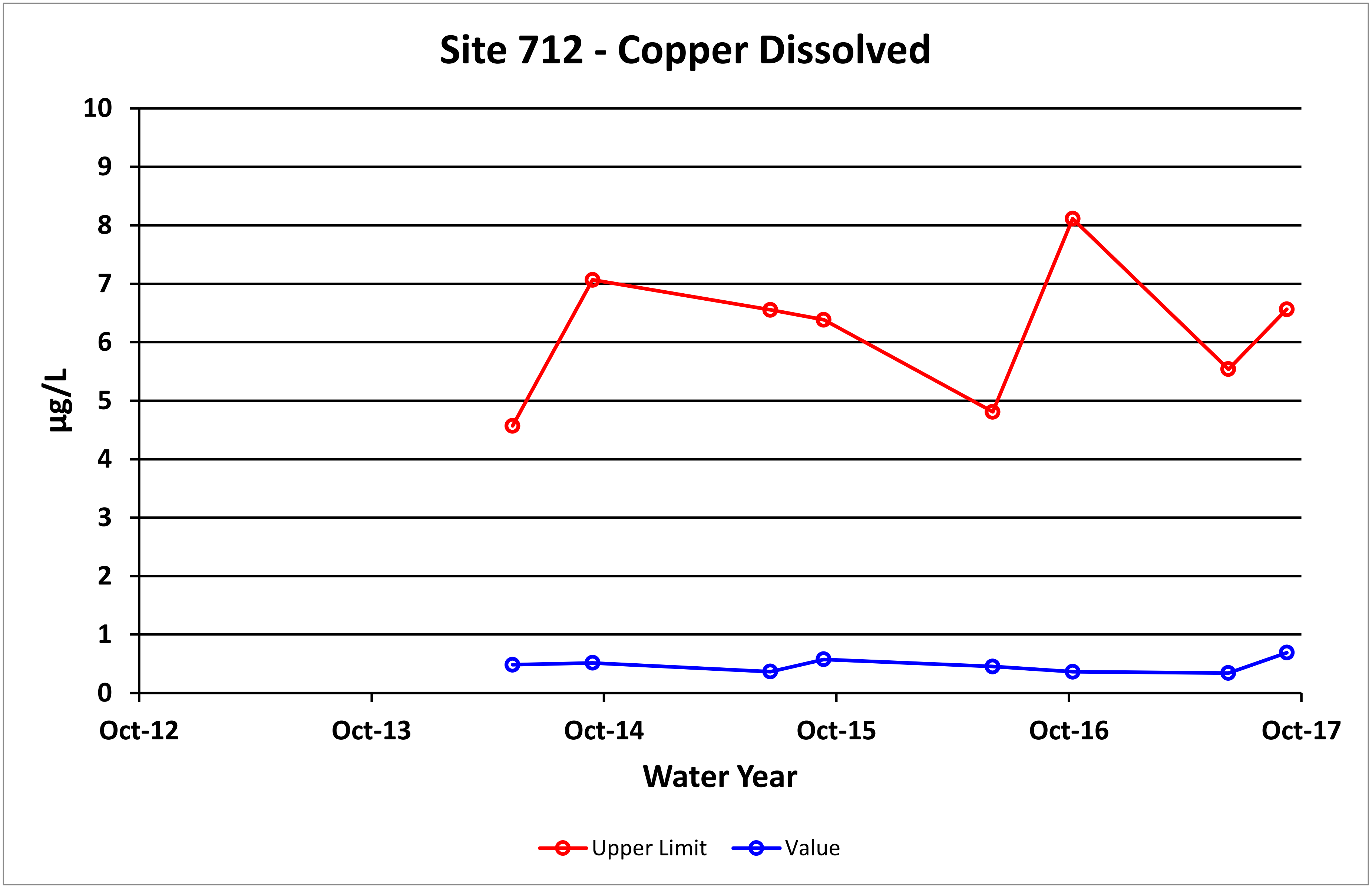
Site 712 - Arsenic Dissolved
µg/L
10
8
6
4
2
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

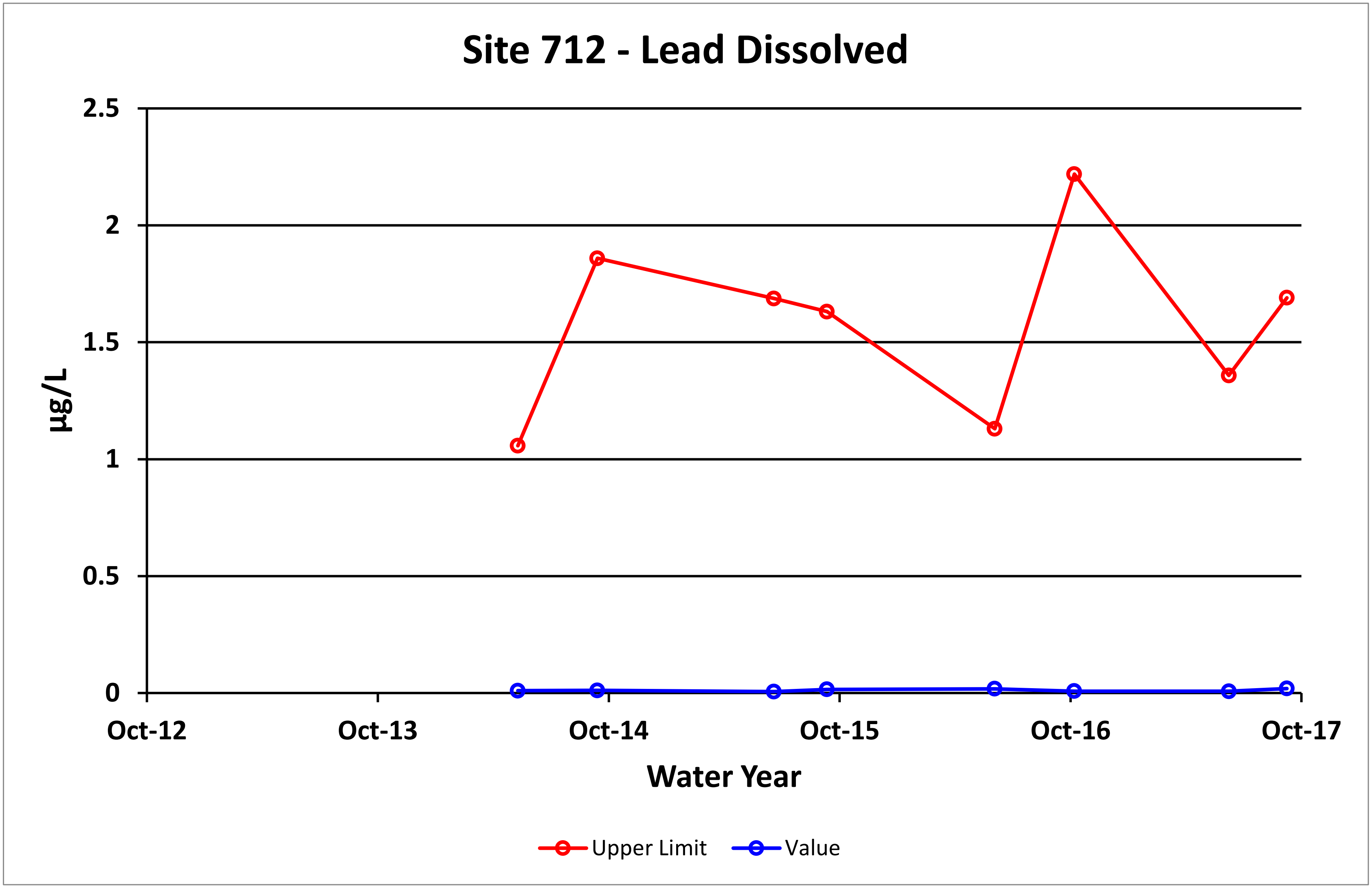

Site 712 - Barium Dissolved
2000
1500
1000
500
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

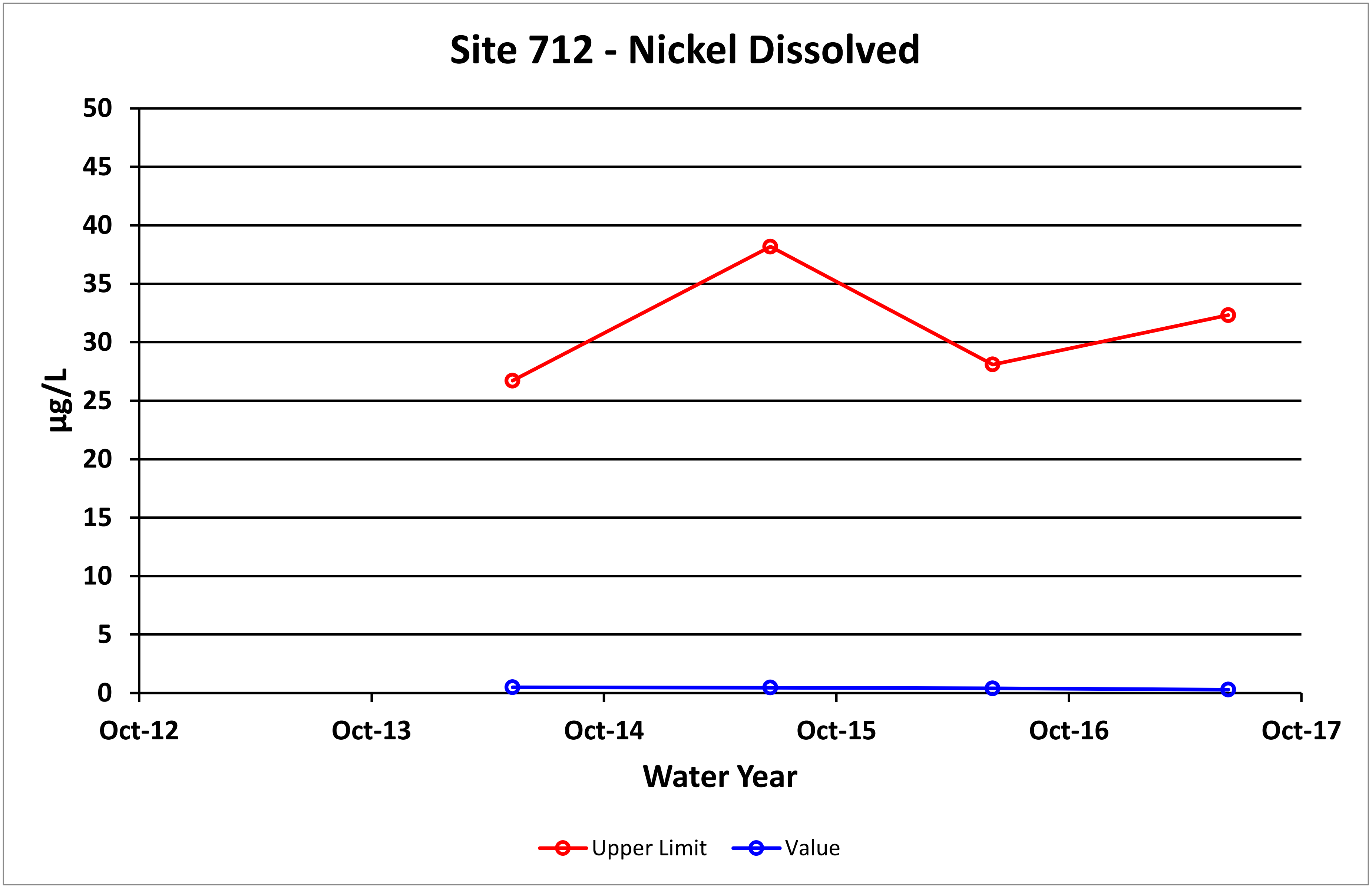


Site 712 - Cadmium Dissolved
µg/L
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

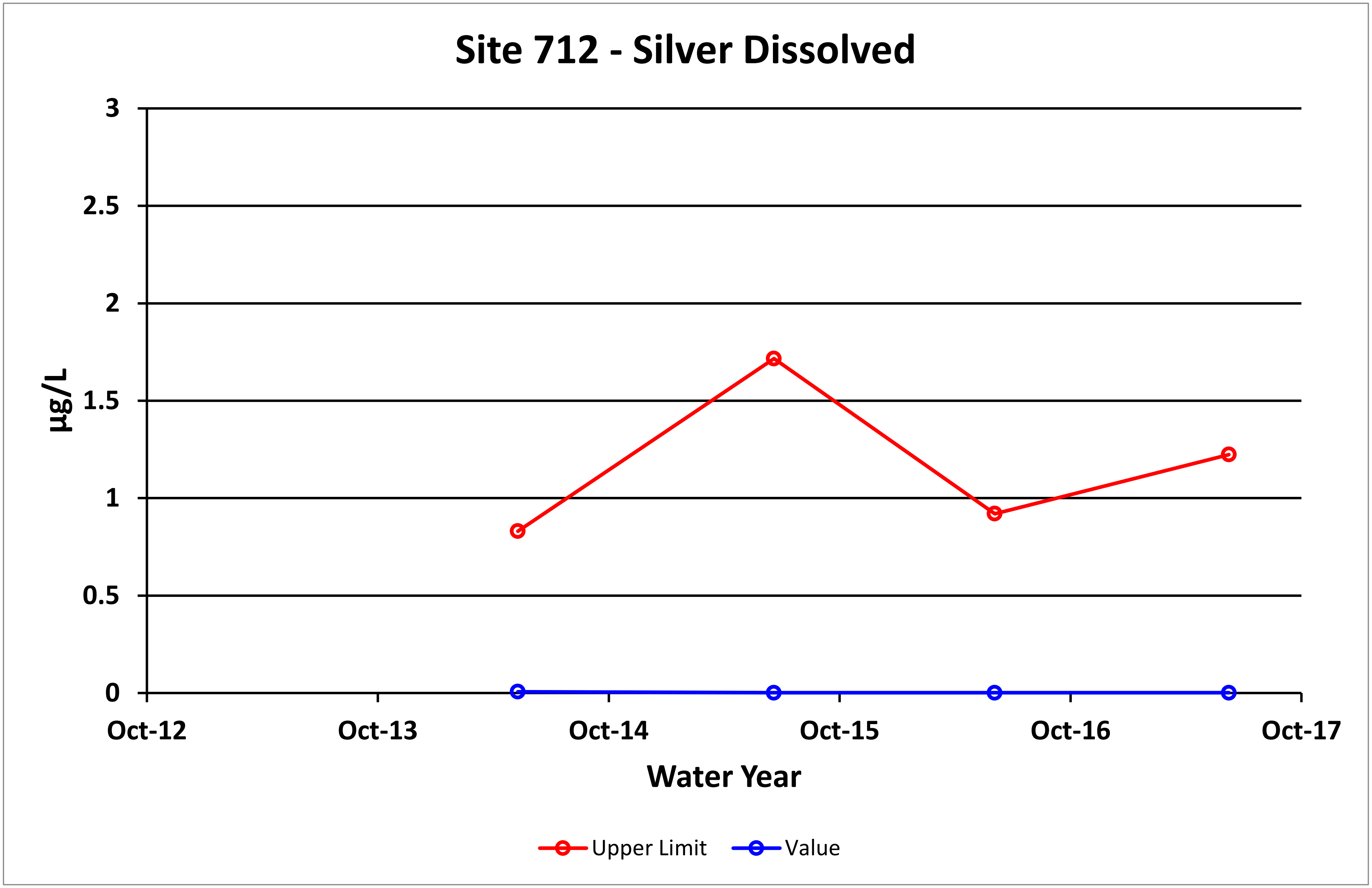

Site 712 - Chromium Dissolved
12
10
8
6
4
2
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value


Site 712 - Copper Dissolved
10
9
8
7
6
5
4
3
2
1
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

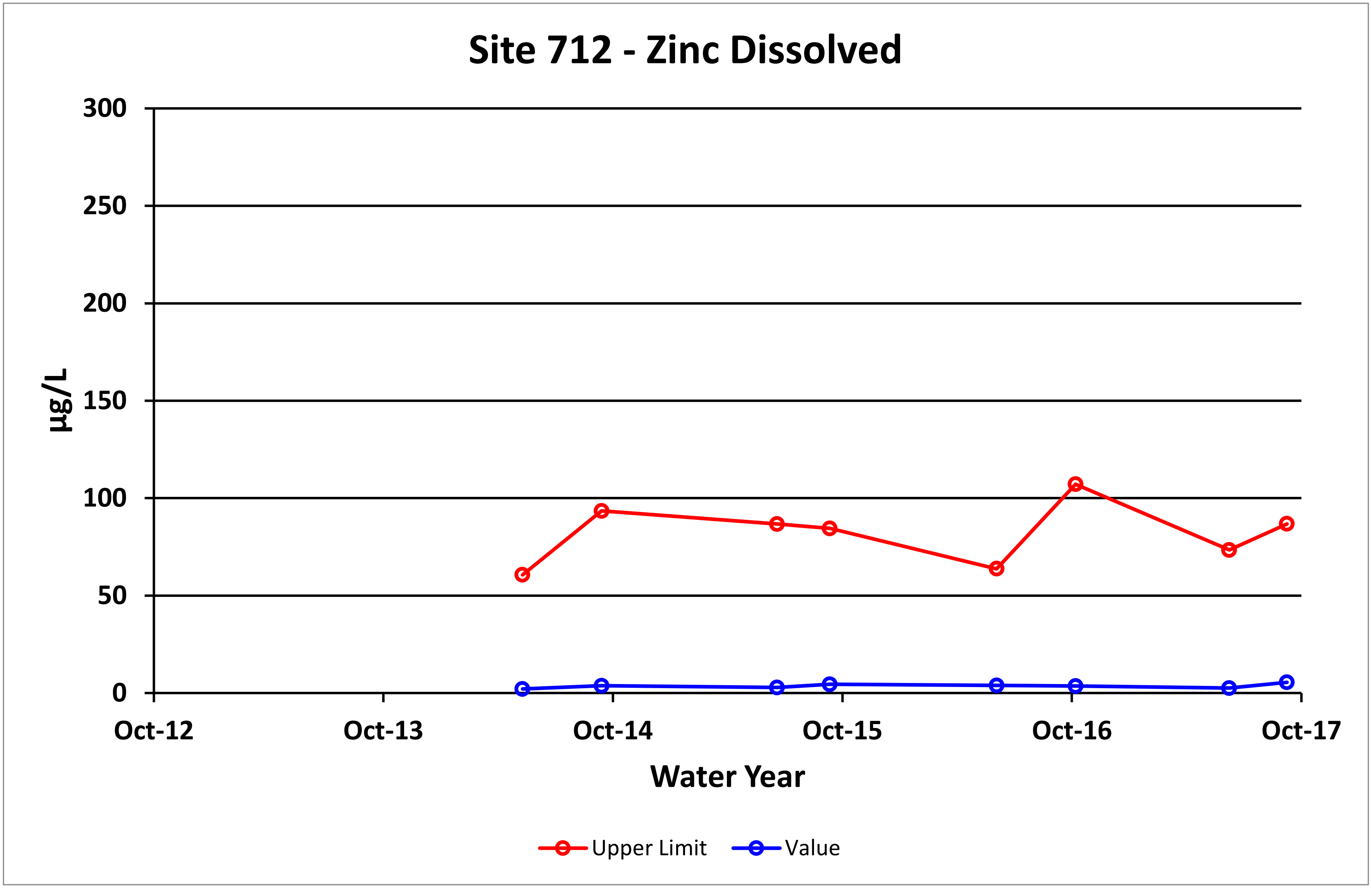

Site 712 - Lead Dissolved
2.5
2
1.5
1
0.5
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value



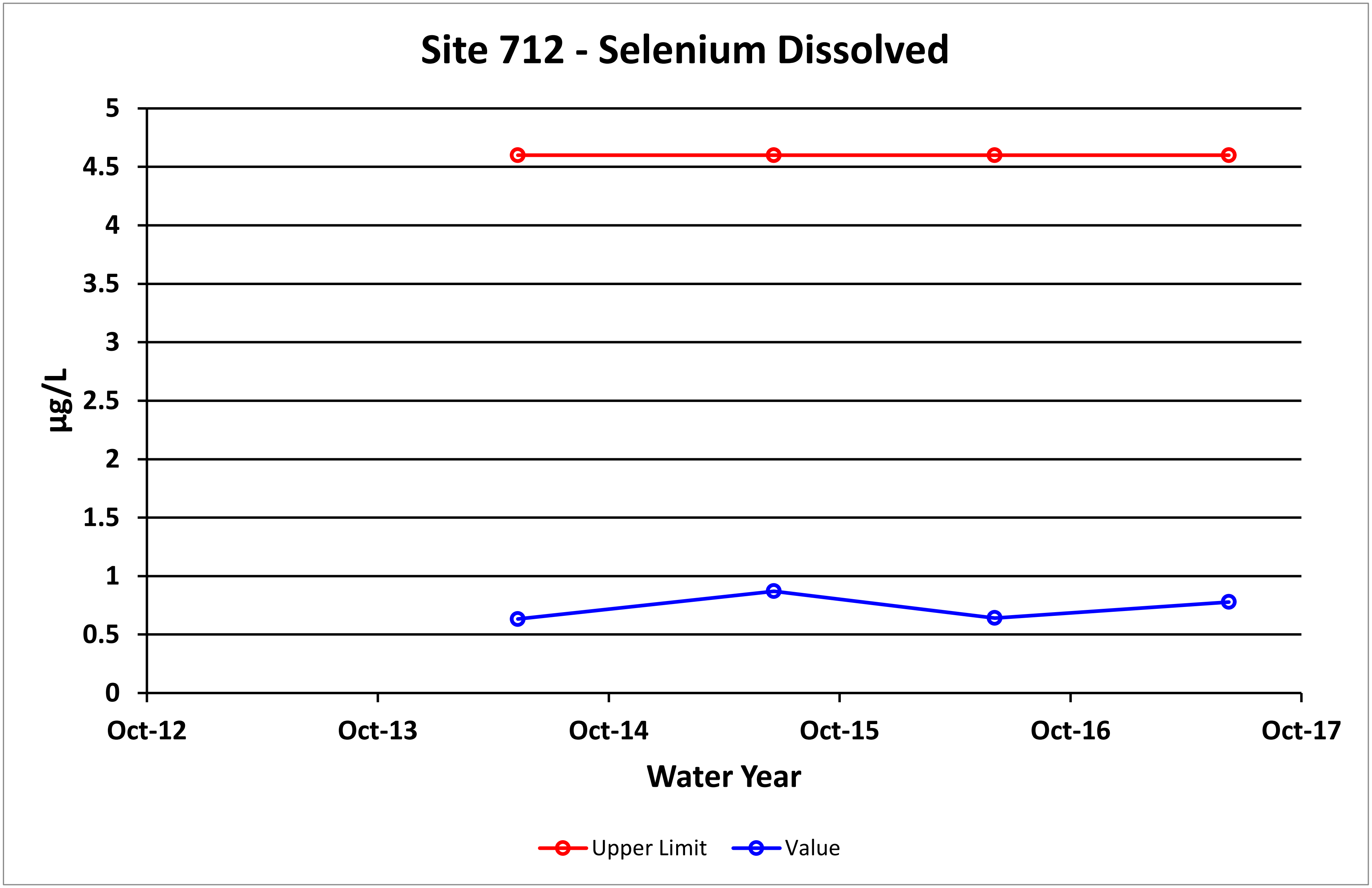
Site 712 - Nickel Dissolved
50
45
40
35
30
25
20
15
10
5
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

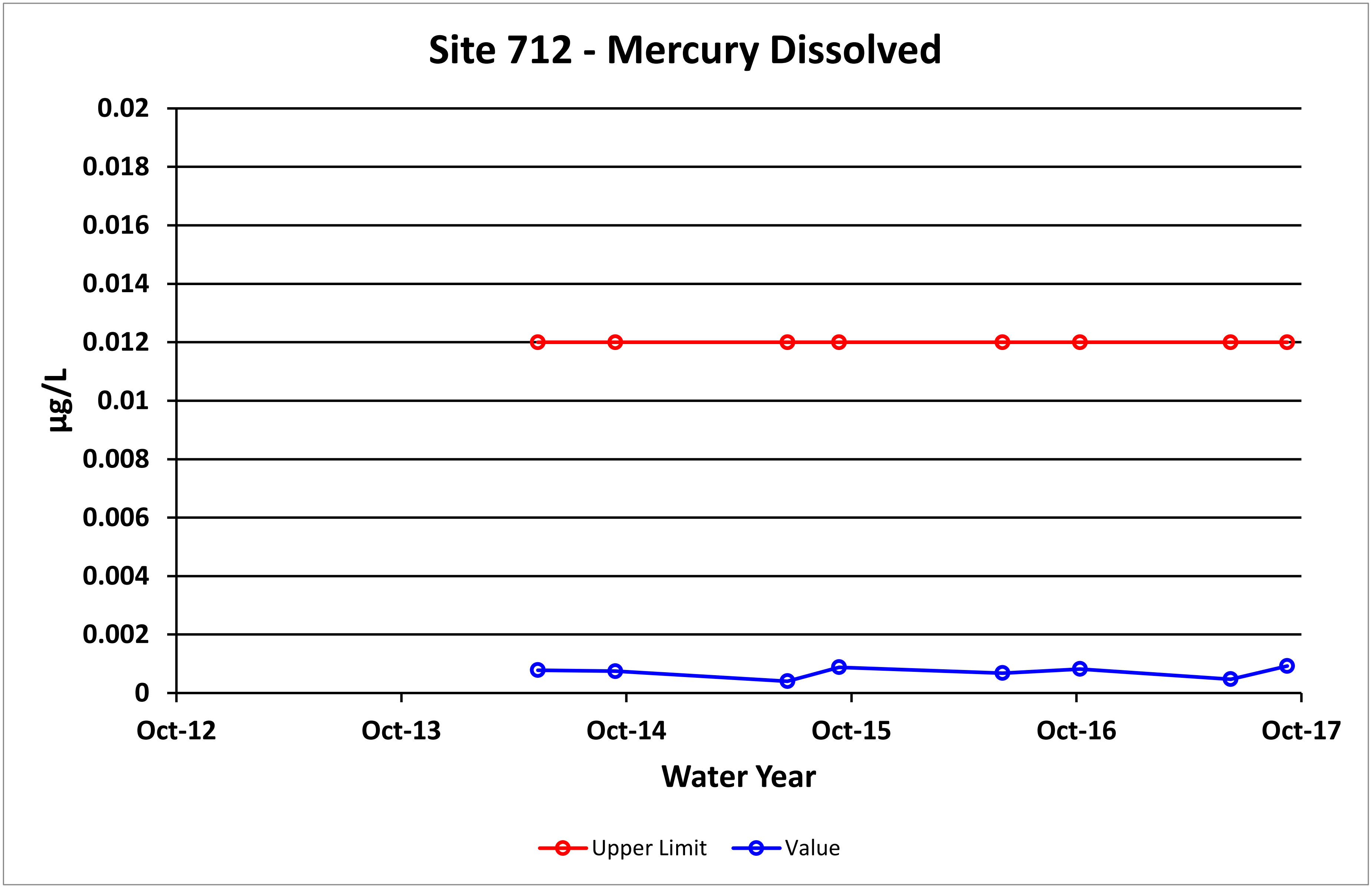


Site 712 - Silver Dissolved
µg/L
3
2.5
2
1.5
1
0.5
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value



Site 712 - Zinc Dissolved
300
250
200
150
100
50
0
µg/L
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value


Site 712 - Selenium Dissolved
µg/L
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value


Site 712 - Mercury Dissolved
µg/L
0.02
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
Oct-12
Oct-13
Oct-14
Oct-15
Oct-16
Oct-17
Water Year
Upper Limit
Value

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

all units in micrograms per liter (ug/L)

DENOTES STRICTEST CRITERIA

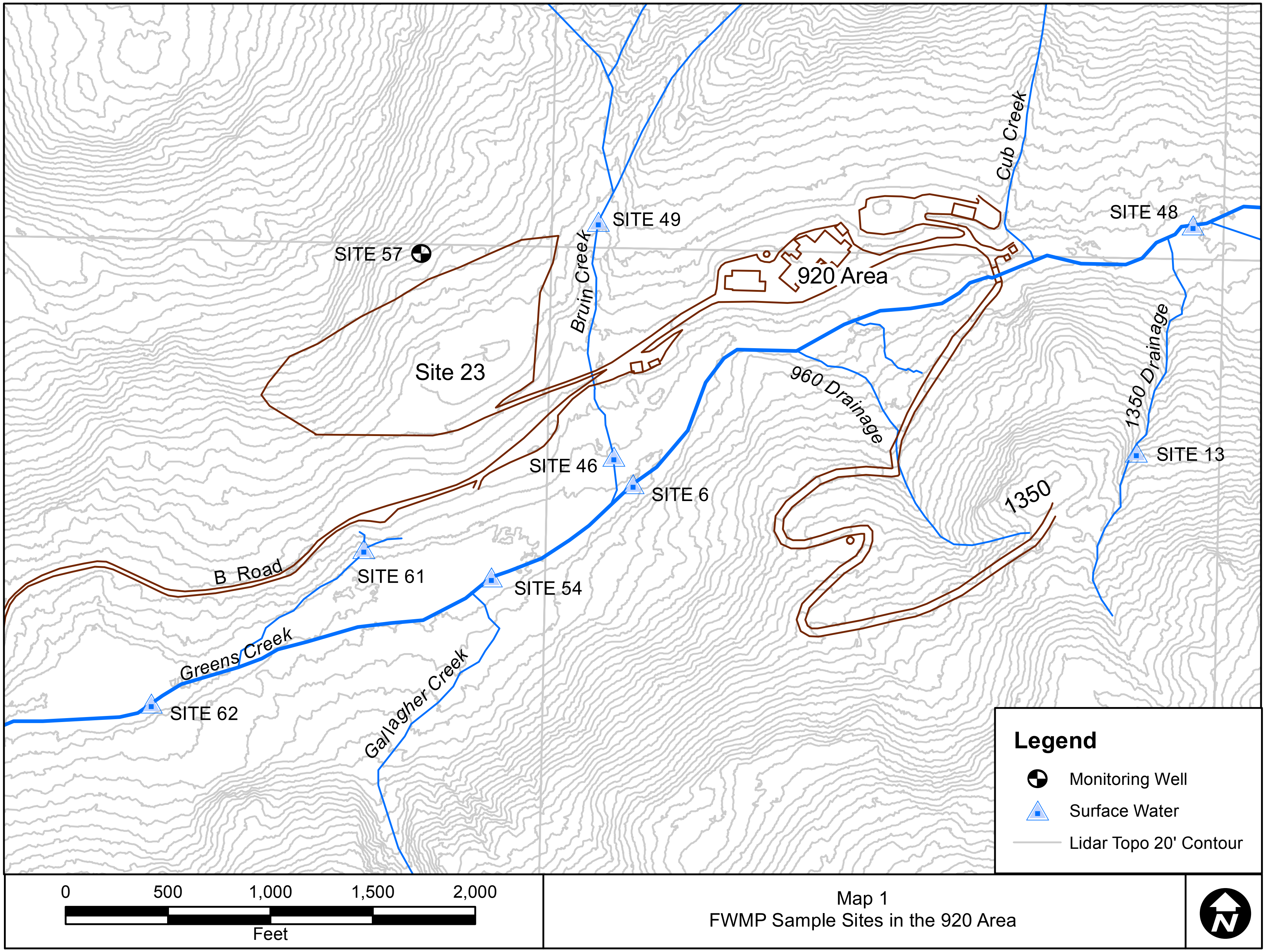
TR total recoverable
D dissolved
H some of the criteria for this parameter are hardness dependant
FWA Fresh Water Acute
FWC Fresh Water Chronic

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

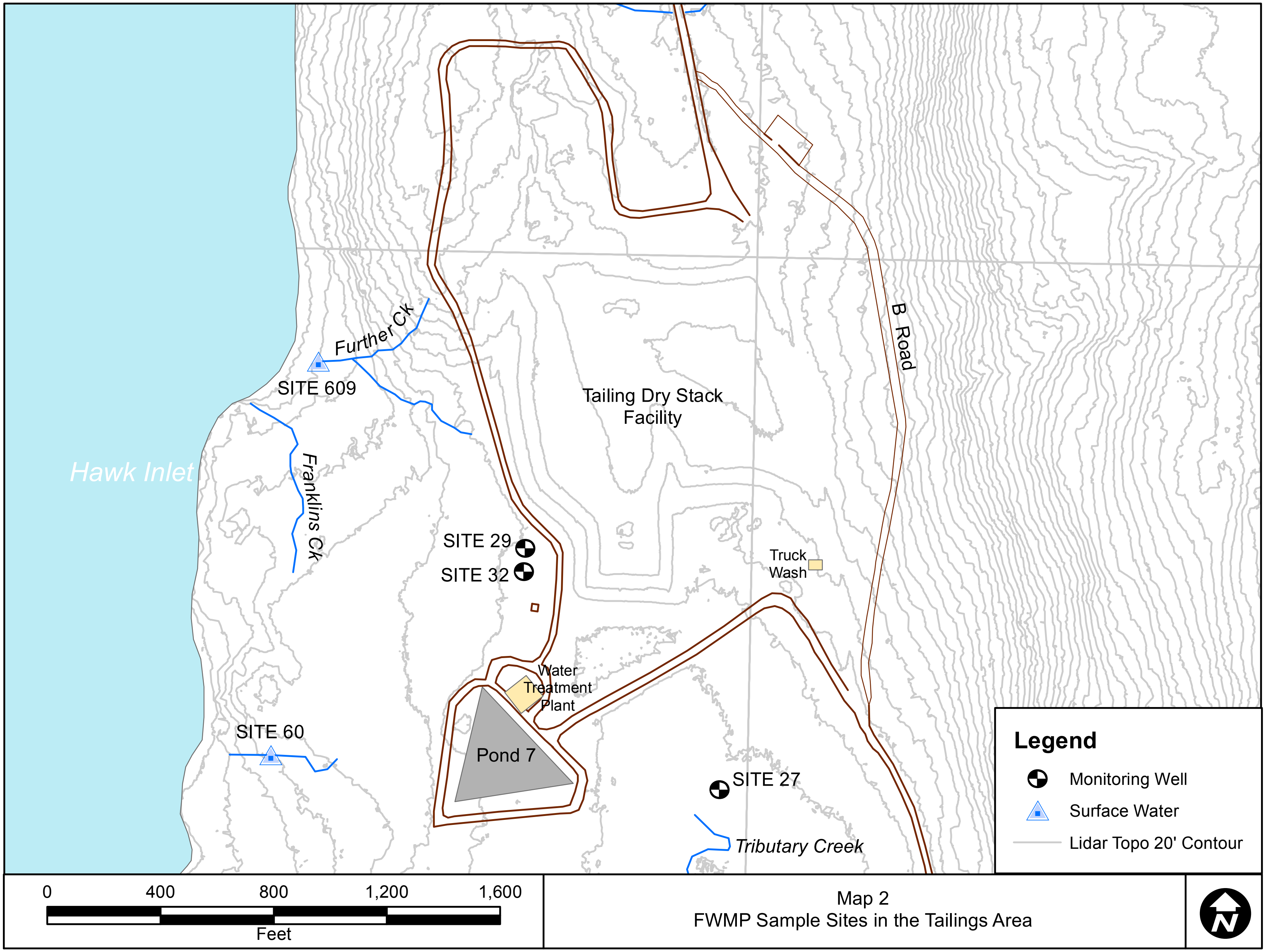
APPENDIX B

Map Sheets

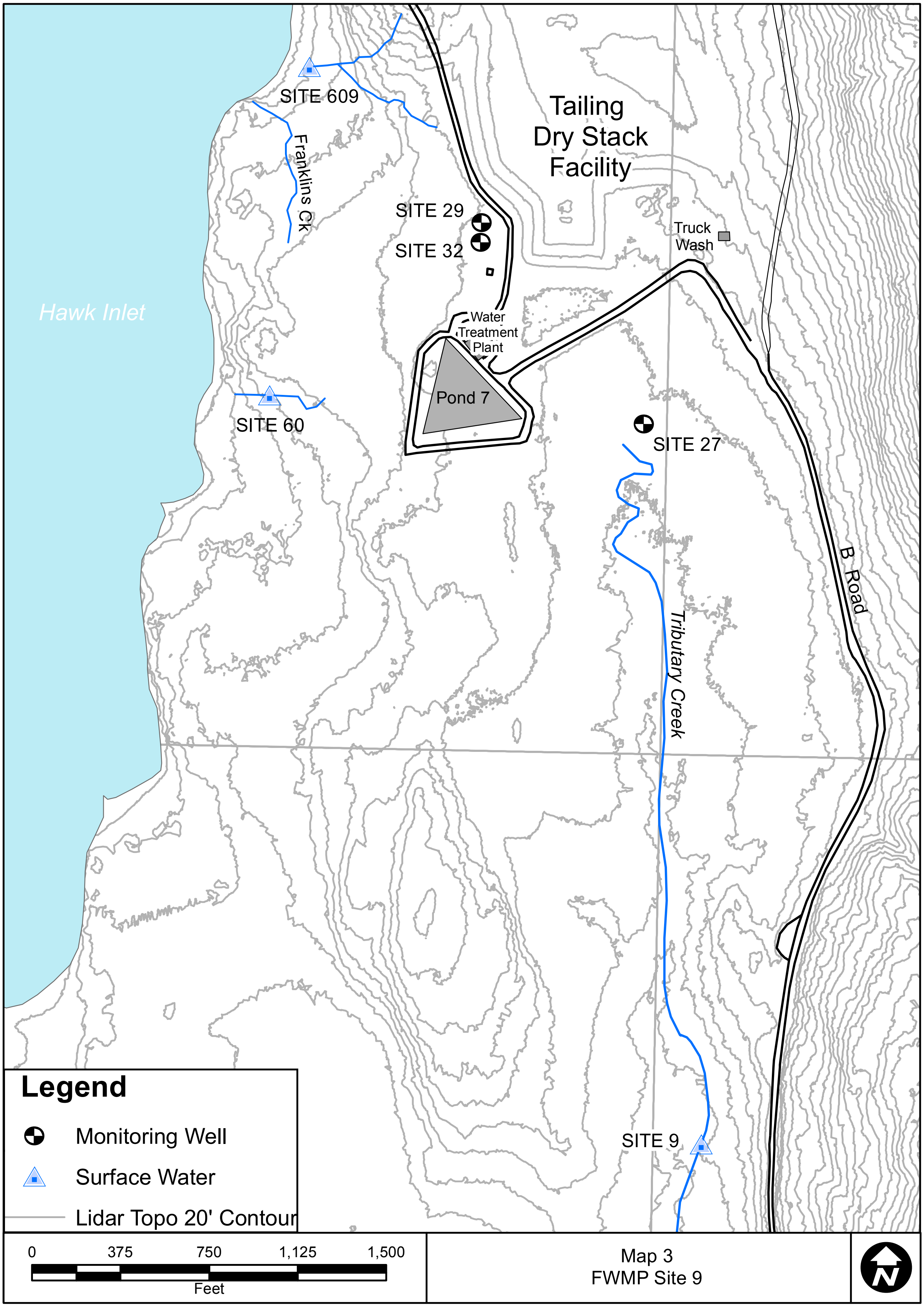
Map 1-920 Area FWMP Sites
Map 2-Tailings Area FWMP Sites
Map 3-Site 9, Tributary Creek



Map 1
FWMP Sample Sites in the 920 Area



Map 2
FWMP Sample Sites in the Tailings Area


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