KENNECOTT GREENS CREEK MINING COMPANY

FRESH WATER MONITORING PROGRAM
ANNUAL REPORT

WATER YEAR 2003

(October 1, 2002 through September 30, 2003)

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INTRODUCTION

This annual report for water year 2003 (October 1, 2002 through September 30, 2003) provides the information required by the Fresh Water Monitoring Program (FWMP) for Kennecott Greens Creek Mining Company (KGCMC). 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 may lead 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 sites 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 was modified under the most recent revision of GPO Appendix 1 that was implemented at the start of water year 2002. Different sites are monitored for different analytes on different months of the year. At times throughout the year sites scheduled for sampling may not be available due to weather or more rarely operational reasons. Copies of the water year 2003 sampling log are included on page 6 of this section and any variations from scheduled sampling events are noted on each site's table of results presented in the interpretive section.

The adjacent table outlines the requested Statistical Information Goals (SIGs) for each site sampled during the 2003 Water Year. 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. These water quality standards differ from previous year's standards since the State of Alaska implemented new limits on June 26, 2003. 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 (5) years of data collected. The second method is a non-parametric statistical method, Mann-Kendall seasonal trend

		AWQS	Trend		Calculate	Median
Site	Description	Comparison	Visual	Calc	Median	Comparison
48	Upper GC	X	X	+	X	
6	Middle GC	X	X	+	X	48 vs 6
54	Lower GC	X	X	+	X	6 vs 54
49	Upper Bruin Crk	X	X	+	X	
46	Lower Bruin Crk	X	X	+	X	49 vs 46
13	1350 Audit	X	X	+	X	
57	MW-23-00-03	X	X	+	X	
56	MW-D-00-01	X	X	+	X	57 vs 56
58	MW-T-00-01C	X	X		X	**
27	MW-2S	X	X		X	**
29	MW-3S	X	X		X	**
32	MW-5S	X	X		X	**
59	MW-T-00-1A	X	X		X	**
28	MW-2D	X	X		X	**

+: Addional statitical trend analysis done for conductivity, pH, alkalinity, dissolved z

**: Insufficiant Data for a robust statistical evaluation analysis, and is routinely done for conductivity, pH, alkalinity, and dissolved zinc. These are the key parameters along with sulfate that can be strongly affected by ARD. Sulfate was added back into the required list of analytes in the 2002 water year and thus currently there is insufficient data to conduct a robust statistical analysis. KGCMC anticipates adding a non-parametric analysis for trend in the sulfate data set in the 2006 water year report for appropriate sites. Median calculation is shown in the annual table of results for each site. Finally, for all down gradient sites that are paired with an upgradient reference site, which are monitored with a frequency greater than 4 times per year, a comparison of medians is presented for each specific site. These down gradient sites (upgradient site in parenthesis) include Site 6 (Site 48), Site 54 (Site 6), Site 46 (Site 49), and Site 58 (Site 57). For each of these sites, the statistical information goals requested a comparison of medians for total alkalinity, pH, conductivity, sulfate and dissolved-zinc. The statistical test utilized is a non-parametric Seasonal Mann-Whitney-Wilcox rank sum test. A brief summary of the two main statistical procedures, the Wilcoxon-Mann-Whitney rank sum test and the Mann-Kendall seasonal trend are given below.

Statistical Tests

The Wilcoxon-Mann-Whitney comparison of medians is a non-parametric, rank-sum test. Wilcoxon originally developed the test method in 1945. Mann and Whitney developed an equivalent test at approximately the same time and thus the name Wilcoxon-Mann-Whitney rank-sum test is used. In general terms the rank-sum test is a test for whether one group of data tends to produce larger observations than a second group. The rank-sum test makes no assumptions about the nature of the data distribution and thus is considered more robust when applied to non-normally distributed data sets. The robust nature of the test is critical when applied to the varied distributions typically found in water quality data that commonly include positive skewness, non-normal distributions, censored data due to finite instrument detection limits, seasonality, autocorrelation, and dependence on other uncontrolled variables such as flow rate. All of the aforementioned attributes have been observed in various water-quality data collected under the FWMP.

The rank-sum tests as applied in this report determine if two groups of data come from the same population as measured by the median value. If both groups of data are from the same population, about half of the time an observation from either group could be expected to be greater than a data point from the second data set. Further guidance and background can be found in one of the following references: Section 3.3.3.1 of the EPA document "Guidance for Data Quality Assessment" EPA/600/R-96/084, Gilbert (1987), or Helsel and Hirsch (1992).

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 and its variance VAR(S) for data from each season (month). The S 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 Mann-Kendall S statistic and VAR(S) are then used to compute the test statistic Z that follows the normal distribution.

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. Further guidance and background on these statistical methods can be found in Gilbert (1987) or Helsel and Hirsch (1992).

Additional Summary Data Tables

KGCMC utilizes a custom-built Microsoft Access database (WDMS) for the storage, retrieval, and utilization of all data collected under the FWMP, as well as many other environmental monitoring programs being conducted at KGCMC. This database incorporates many different report-generating functions, and several of them have been utilized for the preparation of this report. These individual summary reports have a variety of uses, and the terms used within them are generic. The following explanations clarify the terms used and the information contained in the summary reports utilized for the site-specific data analysis.

Qualified Data by QA Reviewer reports are generated to 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 2003 along with the reason for qualification. These data are all included in the data analyses, unless also identified as an outlier in the WDMS Qualified Data Summary.

INTERVENTIONS

This section identifies below any procedural changes, natural phenomena, mine operational changes, or other interventions that could possibly have affected data during water year 2003. Results of any visual data analyses to detect evident effects of these interventions are so 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.

Freezing conditions prohibited sample collected during this water year in the following months at these scheduled sites; March 2003, Site 46 and Site 49; January 2002, Sites 49 and 54.

No flow conditions prohibited sample collection during this water year in the following months at these scheduled sites: Site 46, July 2003, Site 46.

No samples were taken at Site 13 during April 2003 because of limited site access due to snow cover on the 1350 Road. The total sulfate sample taken at Site 13 for August 2003 was lost at the laboratory.

The 2000 FWMP revision changed the suite of analytes to be monitored and added sulfate into the list of analytes. Through an oversight by KGCMC the addition of sulfate into the suite list was not identified until February 2003 when immediate remedial action was taken. The samples taken during November 2002 through February 2003 were still available at Battelle Marine Sciences Laboratory that has been the laboratory utilized for sample analyses since October 1996. The samples were sent to Analytica Alaska for sulfate analyses since Battelle does not have the necessary instrumentation for this analyte. The sulfate concentrations for the prior month's samples were determined on March 12, 2003 and reported to KGCMC. Sulfate has a twenty-eight day holding time and thus all the data collected prior to that holding time is qualified for expired periods. For the remainder of the water year sulfate samples were routinely collected and analyzed as per the methods and procedures outlined in the FWMP program.

MID-YEAR MODIFICATIONS

The immediate area surrounding Site 32, the Seepage Control Structure site, was modified in June 2002. The access road below the Main Embankment was removed according to the action plan prepared and submitted to the USFS by KGCMC in January 2002. The road material contained pyritic rock, which was likely contributing to the elevated sulfate readings observed in the Seepage Control Pond. The majority of the pyritic material was removed into the Tailings containment area. With the removal of the road material the majority of the water previously retained in the pond now flows as a diffuse surface flow through the natural muskeg that surrounds, or is downgradient from the previous site location. The sampling scheduled for May and September 2003 was taken at the approximately the same location as the old sample site. It is anticipated that the site will recover and again become like the surrounding muskeg with broad diffuse flow occurring in the sub-surface and through numerous shallow, localized channels. KGCMC has suggested in the 2002 FWMP Annual Report to discontinue sampling at Site 34 due to these changes. Subsequent to the period covered by this report KGCMC has received approval by the USFS and ADEC to discontinue sampling at this site under the FWMP program.

No other mid-year modifications occurred during water year 2003.

FWMP SAMPLE LOG

Water Year October 2002 Through September 2003

Annual Water Quality Monitoring Schedule-Laboratory Samples

Site	Site Name	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
6	Middle Greens Creek	10-30 P	11-12 P	12-19 Q	1-8 P	2-25 Q	3-17 P	4-16 P	5-20 P	6-24 P	7-17 7-21 P,R	8-27 P	9-9 P
9	Tributary Creek-Lower										7-22 R		
13	Mine Adit Discharge East	10-30 Q	11-12 Q					4-16 Q	5-20 Q	6-24 Q	7-17 Q	8-27 Q	9-9 Q
27	Monitoring Well 2S								5-21 Q				9-10 Q
28	Monitoring Well 2D								5-21 Q				9-10 Q
29	Monitoring Well 3S								5-21 Q				9-10 Q
32	Monitoring Well 5S								5-21 Q				9-10 Q
34	Seepage Control								5-21 Q				9-10 Q
46	Lower Bruin Creek	10-30 P	11-12 P	12-19 Q	1-8 P	2-25 Q	3-17 P	4-16 P	5-20 P	6-24 P	7-17 P	8-27 P	9-9 P
48	Upper Bruin Creek	10-30 P	11-12 P	12-19 Q	1-8 P	2-25 Q	3-17 P	4-16 P	5-20 P	6-24 P	7-17 7-21 P,R	8-27 P	9-9 P
49	Control Site Upper Bruin Creek	10-30 P	11-12 P	12-19 Q	1-8 P	2-25 Q	3-17 P	4-16 P	5-20 P	6-24 P	7-17 P	8-27 P	9-9 P
54	Greens Creek below D-Pond	10-30 P	11-12 P	12-19 Q	1-8 P	2-25 Q	3-17 P	4-16 P	5-20 P	6-24 P	7-17 P	8-27 P	9-9 P
56	Monitoring Well -D-00-01	10-30 Q	11-12 Q					4-16 Q	5-20 Q	6-24 Q	7-17 Q	8-27 Q	9-9 Q
57	Monitoring Well -23-00-03	10-30 Q	11-12 Q					4-16 Q	5-20 Q	6-24 Q	7-17 Q	8-27 Q	9-9 Q
58	Monitoring Well -T-00-01C								5-21 Q				9-10 Q
59	Monitoring Well -T-00-01A								5-21 Q				9-10 Q

Sample Date / Suite	
Sample Date / Suite	Monthly Field Blank taken at this site
Sample Date / Suite	No Sample taken due to ice
Sample Date / Suite	No Sample taken due to lack of access (snow).
Sample Date / Suite	No Sample taken due to lack of flow

SAMPLE SUITES

Suite P
(Surface water only)

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

Suite Q
(Groundwater and surface water twice a year)

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

PERSONNEL INVOLVED

USFS

Pete Griffen, Monument Manager
USFS
Jeff Defreest
USFS
Steve Hohensee
USFS
David Cox
USFS
Pete Schneider
USFS

Biomonitoring

James D. Durst
ADNR
Alan Townsend
ADNR
Laura Jacobs
ADF&G
Steve Peck
Private Contractor
William Morris
ADF&G
Robert McLean
ADNR
Jack Winters
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Bill Oelklaus, Environmental Manager
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Kerry Lear, Geologist
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Steve Hutson, Environmental Technician
KGCMC
Ted Morales, Environmental Technician
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Laboratory and Data Review

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Environmental Synectics, Inc.
Evin McKinney , Senior Scientist
Environmental Synectics, Inc.
Leticia Sangalang, Senior Scientist
Environmental Synectics, Inc.
Linda Bingler, Project Coordinator
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John Woodward, Consultant
EnviroData Solutions, Inc.
David Wetzel, Project Manager
Analytica Alaska

USF&WS

Deborah Rudis
USFWS

PROPOSED PROGRAM MODIFICATIONS

No modifications are proposed at this time.

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

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

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

INTERPRETIVE REPORT
SITE 48 "UPPER GREENS CREEK"

The data collected during the current water year are listed in the following "Table of Results for Water Year 2003" report. The table includes all the data, field and lab, 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 zero for the purpose of median calculation.

All data collected at this site for the past five years are included in the data analyses with the exception of one outlier shown on the table below. During the current year no data points were flagged as outliers.

Sample Date	Parameter	Value	Qualifier	Notes
12/5/2001	Cond Field, umho	37.0	RR	Suspected field instrument malfunction

The data for water year 2003 have been compared to the strictest fresh water quality criterion for each applicable analyte. One result exceeding these criteria has been identified as listed in the table below. The result is for laboratory pH for which the corresponding field pH was 7.57 which is within AWQS. This data point was also flagged by the outside data reviewer for exceeding the holding time for pH analysis. This may have affected pH value as determined in the lab.

Sample Date	Parameter	Value	Standard	Standard Type
08/27/03	pH Lab, su	8.78	6.5 - 8.5	Aquatic Life

X-Y plots have been generated to graphically present the data for each of the analytes requested in the Statistical Information Goals for this site. These plots have been visually analyzed for the appearance of any trend in concentration. No obvious trends are apparent. A non-parametric statistical analysis for trend was preformed for conductivity, pH, Alkalinity, and dissolved zinc. Calculation details of the Seasonal Mann-Kendall analyses are presented in detail on the pages following this interpretive section. The table below summarizes the results on the data collected between Oct-97 and Sep-03 (WY1998-WY2003). For data sets with a statistically significant trend ($\alpha<5\%$) a Seasonal-Sen's Slope estimate statistic has also been calculated. Dissolved zinc is the only analyte that has a statistically significant trend (p=0.03) and the Sen's slope estimate is 0.12 $\mu g \cdot L^{-1} \cdot yr^{-1}$ or an 8% upward trend over the last 6 years. Given the low absolute magnitude of the change and the fact that site is used as a background reference, the change is considered due to natural variation.

		Mann-Kendall test statistics			Sen's slope estimate	
Parameter	n*	Z	Trend	a**	Q	Q(%)
Conductivity, Lab	6	0.84	-	0.36		
pH, Lab	6	0.01	-	0.93		
Alkalinity, Total	6	0.91	+	0.34		
Zinc, Dissolved	6	4.66	+	**0.03**	0.12	8.0

*: Number of years **:Significance level

Table of Results for Water Year 2003

Site48 "Upper Greens Creek"

Sample Date/Parameter	10/30/2002	11/12/2002	12/19/2002	1/8/2003	2/25/2003	3/17/2003	4/16/2003	5/20/2003	6/24/2003	7/17/2003	8/27/2003	9/9/2003	**Median**
Water Temp (°C)	3.4	4.6	0.6	0.8	0.2	1.0	1.1	4.8	6.5	9.2	8.5	8.4	4.0
Conductivity-Field(μmho)	122	151	129	97	164	157	125	100	99	126	126	102	125
Conductivity-Lab (μmho)	117	123	119	103 U	139 J	147	117	97	95	131	129	96	118
pH Lab (standard units)	7.36	7.93	7.68	7.68	7.73 J	7.72	7.46	7.77	7.81	7.88	8.78 J	7.85	7.73
pH Field (standard units)	7.71	7.23	7.56	6.91	6.97	7.54	7.50	7.32	7.28	8.04	7.57	7.71	7.52
Total Alkalinity (mg/L)	40.4	41.2	45.7	39.5	52.1 J	53.6	45.5	40.2	39.6	51.0	50.8	41.1	43.4
Total Sulfate (mg/L)	**Note 1**	16.1 J	13.7 J	10.0 J	17.6	18.6	12.7	7.3	8.2	12.2	12.7 J	7.8 J	12.7
Hardness (mg/L)	41.5	60.3	49.2	41.0	63.1	65.7	53.5	45.9	78.2	49.4	64.6	45.9	51.5
Dissolved As (ug/L)	0.299 J	0.271 J	0.264 J	0.316 U	<0.386	0.214	0.299 U	0.217	<0.204	<0.331	0.589 U	0.227 J	0.246
Dissolved Ba (ug/L)			28.5		28.2								28.4
Dissolved Cd (ug/L)	0.049	0.042 J	0.045 J	0.038 U	0.036 J	0.094 J	0.035	0.028	0.035 J	0.035 J	0.066	0.028 J	0.037
Dissolved Cr (ug/L)			<1.010		0.463								0.484
Dissolved Cu (ug/L)	0.323 U	0.415 U	0.480 U	0.526 U	0.305	0.558 U	0.595	0.485	0.272	0.336 J	0.340	0.538	0.448
Dissolved Pb (ug/L)	0.0260 J	<0.0290	0.0238 U	<0.0280	<0.0210	0.1990 J	0.0153 U	0.0951	0.1200	0.0288 J	0.0313 J	0.0721 J	0.0274
Dissolved Ni (ug/L)			0.942		0.349								0.646
Dissolved Ag (ug/L)			<0.011		<0.057	0.017 J							0.017
Dissolved Zn (ug/L)	5.52	3.73 J	4.68	2.24	3.09	4.11	2.74	2.84	6.07	2.62 U	2.22	2.16	2.97
Dissolved Se (ug/L)			1.470 U		1.110								1.290
Dissolved Hg (ug/L)	0.000777	0.000760 U	0.000822	0.001240 U	0.000687 U	0.000692	0.001350	0.000618	0.000819 U	0.001170 U	0.001060	0.001480 J	0.000821

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

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

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

NOTE (1) Analysis was not performed on sample.

Qualified Data by QA Reviewer

Date Range: 10/01/2002 to 09/30/2003

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
48	01/08/2003	12:40:00 PM				
			Cond Lab, umho	103	U	Field Blank Contamination
			SO4 Tot, mg/l	10	J	Hold Time
			As Diss, ug/l	0.316	U	Below Quantitative Range, Fi
			Cd Diss, ug/l	0.0383	U	Below Quantitative Range, Fi
			Cu Diss, ug/l	0.526	U	Field Blank Contamination
			Hg Diss, ug/l	0.00124	U	Field Blank Contamination
48	10/30/2002	1:31:00 PM				
			As Diss, ug/l	0.299	J	Below Quantitative Range
			Cu Diss, ug/l	0.323	U	Field Blank Contamination
			Pb Diss, ug/l	0.026	J	Below Quantitative Range
48	11/12/2002	2:40:00 PM				
			SO4 Tot, mg/l	16.1	J	Hold Time
			As Diss, ug/l	0.271	J	Below Quantitative Range, L
			Cd Diss, ug/l	0.0418	J	Below Quantitative Range
			Cu Diss, ug/l	0.415	U	Field Blank Contamination
			Zn Diss, ug/l	3.73	J	LCS Recovery
			Hg Diss, ug/l	0.00076	U	Field Blank Contamination
48	12/19/2002	11:52:00 AM				
			SO4 Tot, mg/l	13.7	J	Hold Time
			As Diss, ug/l	0.264	J	Below Quantitative Range
			Cd Diss, ug/l	0.0445	J	Below Quantitative Range, L
			Cu Diss, ug/l	0.48	U	Field Blank Contamination
			Pb Diss, ug/l	0.0238	U	Below Quantitative Range, Fi
			Se Diss, ug/l	1.47	U	Method Blank Contamination
48	02/25/2003	1:00:00 PM				
			Cond Lab, umho	139	J	Sample Temperature
			pH Lab, su	7.73	J	Hold Time
			Alk Tot, mg/l	52.1	J	Sample Temperature
			Cd Diss, ug/l	0.0355	J	Below Quantitative Range
			Hg Diss, ug/l	0.000687	U	Field Blank Contamination

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

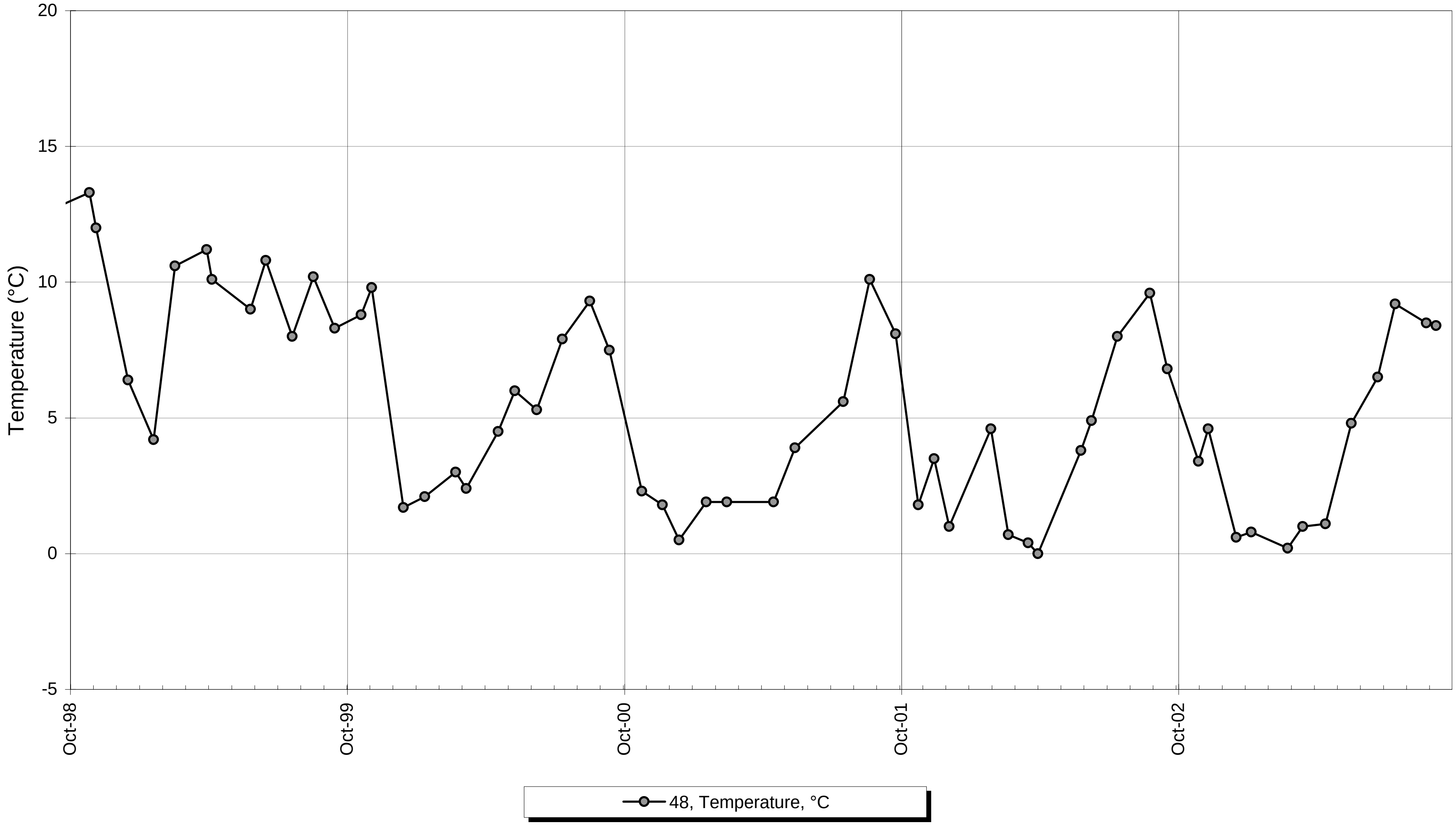
Qualified Data by QA Reviewer

Date Range: 10/01/2002 to 09/30/2003

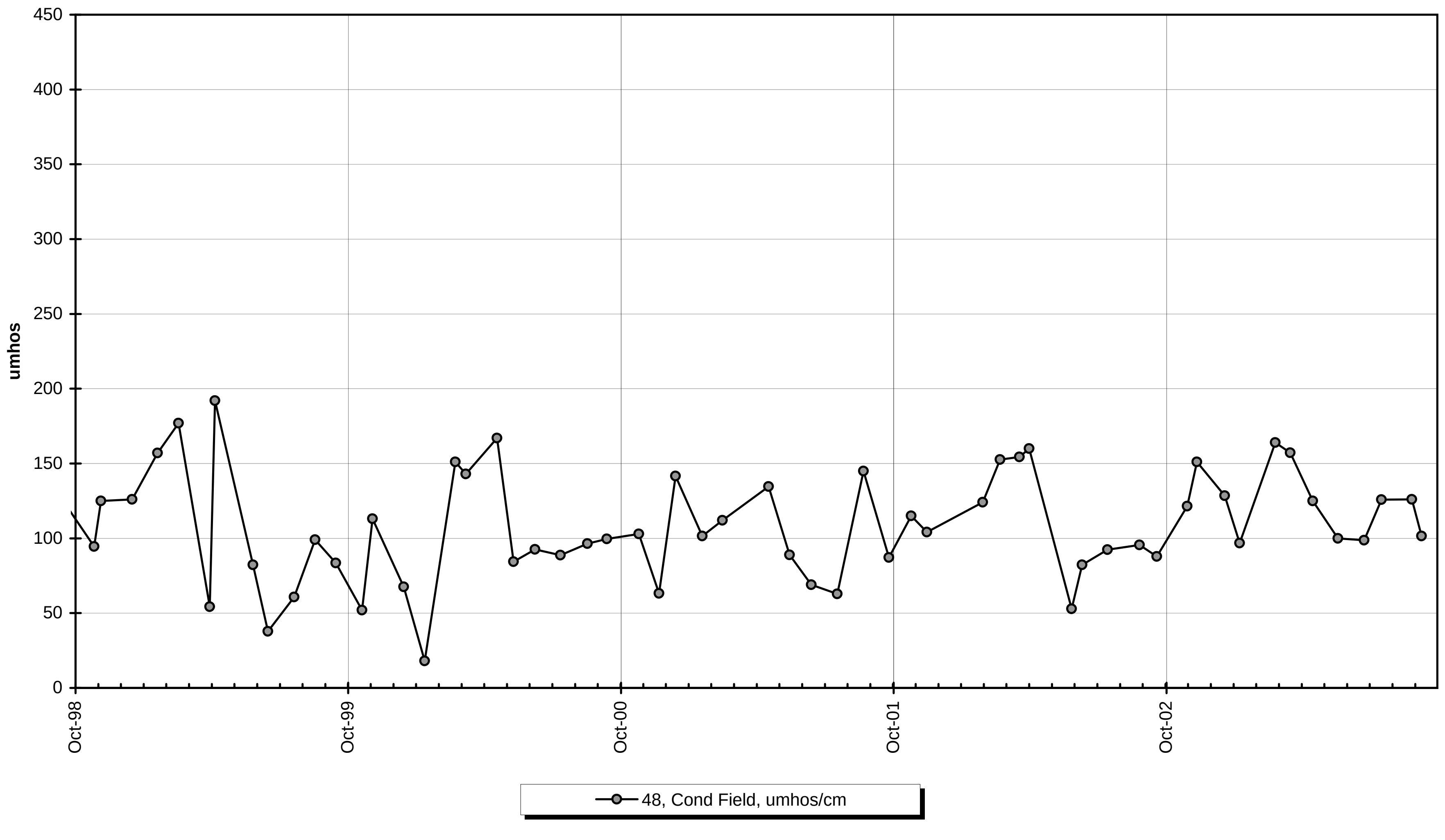
Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
48	03/17/2003	10:58:00 AM				
			Cd Diss, ug/l	0.094	J	LCS Recovery
			Cu Diss, ug/l	0.558	U	Field Blank Contamination
			Pb Diss, ug/l	0.199	J	LCS Recovery
				0.017	J	Below Quantitative Range, L
48	04/16/2003	12:40:00 PM				
			As Diss, ug/l	0.299	U	Field Blank Contamination
			Pb Diss, ug/l	0.0153	U	Below Quantitative Range, Fi
48	06/24/2003	1:59:00 PM				
			Cd Diss, ug/l	0.0353	J	Below Quantitative Range
			Hg Diss, ug/l	0.000819	U	Field Blank Contamination
48	07/17/2003	1:28:00 PM				
			Cd Diss, ug/l	0.0352	J	Below Quantitative Range
			Cu Diss, ug/l	0.336	J	Continuing Calibration Verific
			Pb Diss, ug/l	0.0288	J	Below Quantitative Range
			Zn Diss, ug/l	2.62	U	Field Blank Contamination
			Hg Diss, ug/l	0.00117	U	Field Blank Contamination
48	08/27/2003	2:20:00 PM				
			pH Lab, su	8.78	J	Hold Time
			SO4 Tot, mg/l	12.7	J	Sample Temperature
			As Diss, ug/l	0.589	U	Below Quantitative Range, M
			Pb Diss, ug/l	0.0313	J	Field Blank Contamination
48	09/09/2003	1:58:00 PM				
			SO4 Tot, mg/l	7.82	J	Sample Temperature
			As Diss, ug/l	0.227	J	Below Quantitative Range
			Cd Diss, ug/l	0.0277	J	Below Quantitative Range
			Pb Diss, ug/l	0.0721	J	Below Quantitative Range
			Hg Diss, ug/l	0.00148	J	Duplicate RPD

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

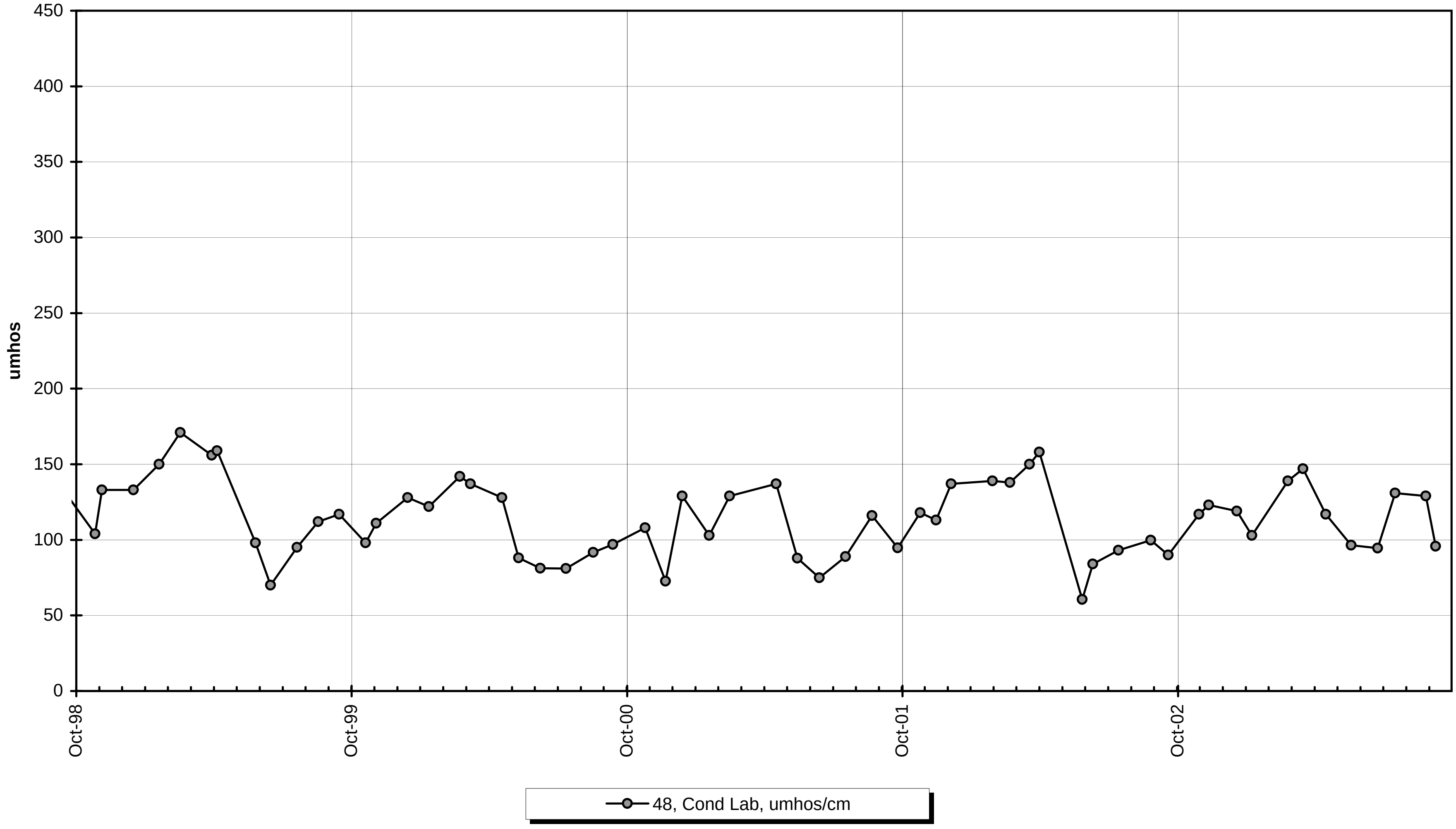
Site 48 -Water Temperature



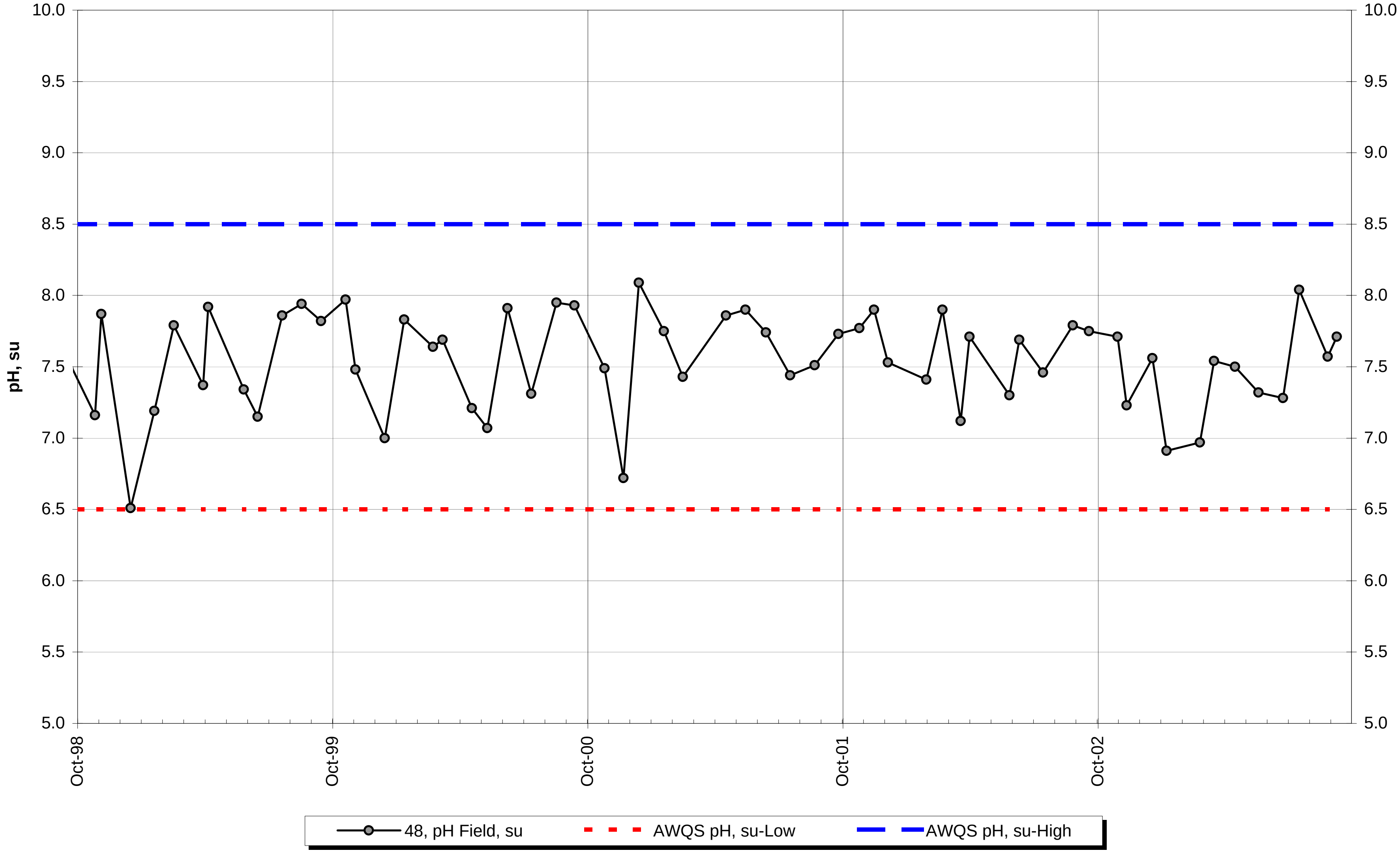
Site 48 -Conductivity-Field

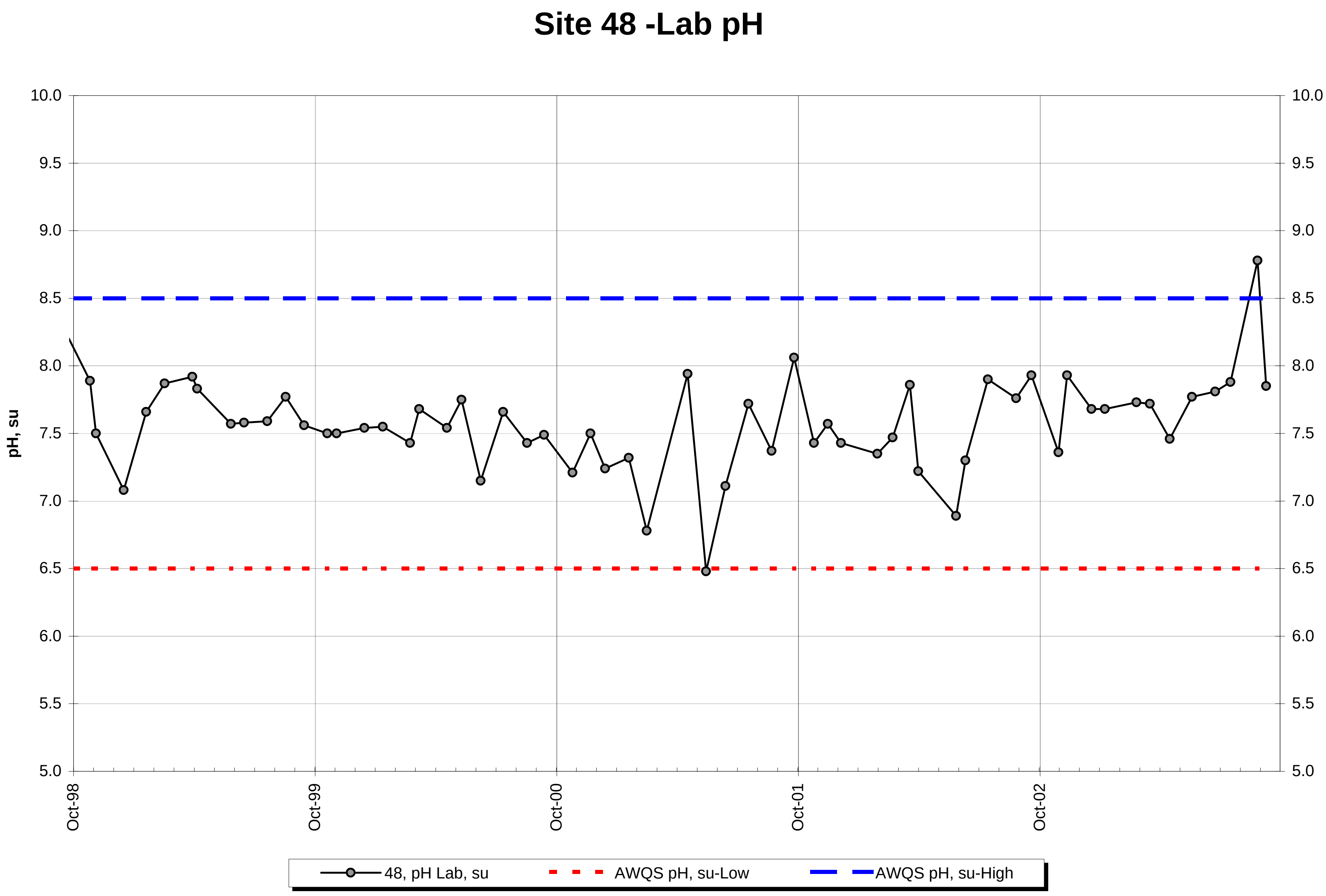


Site 48 -Conductivity-Lab



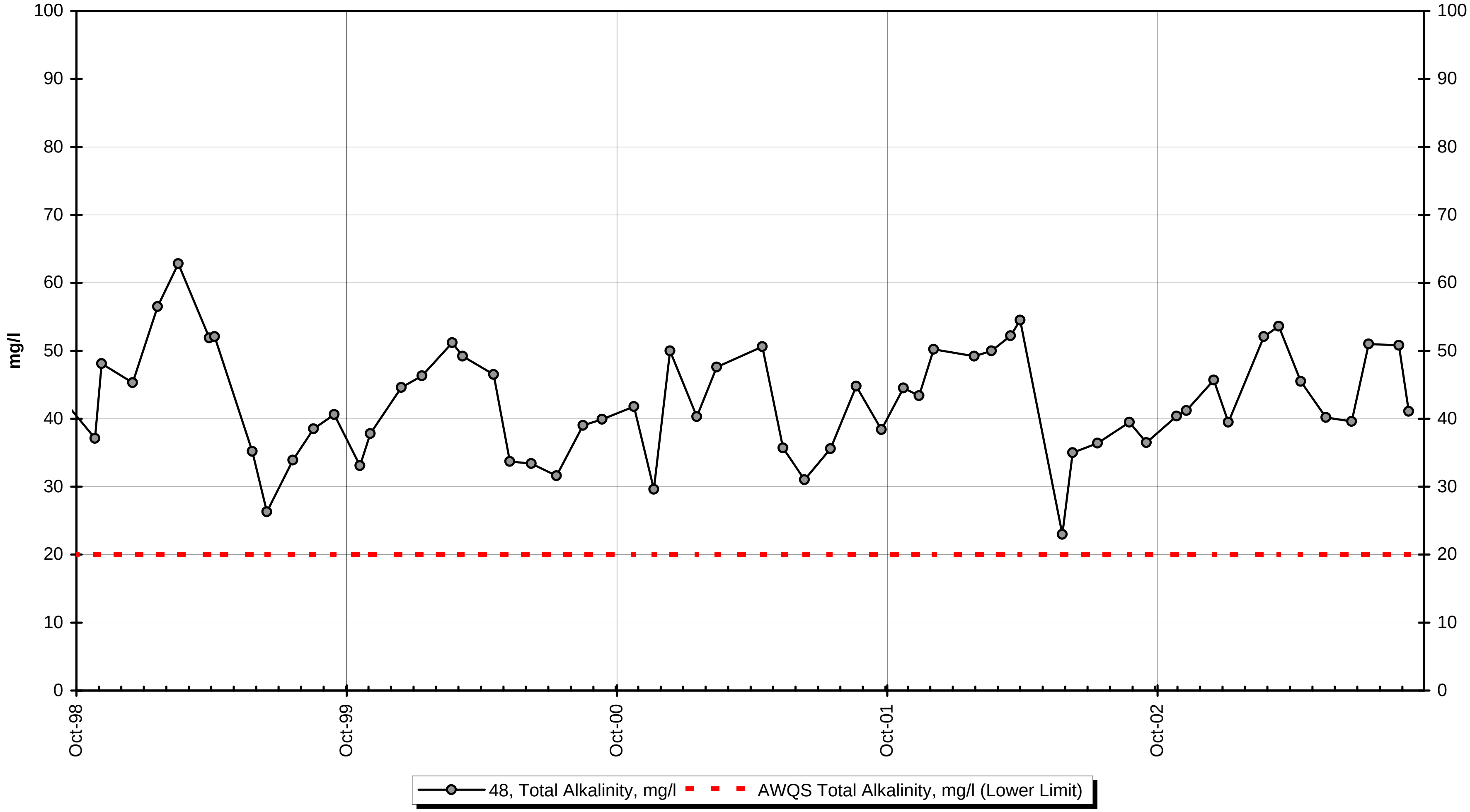
Site 48 -Field pH



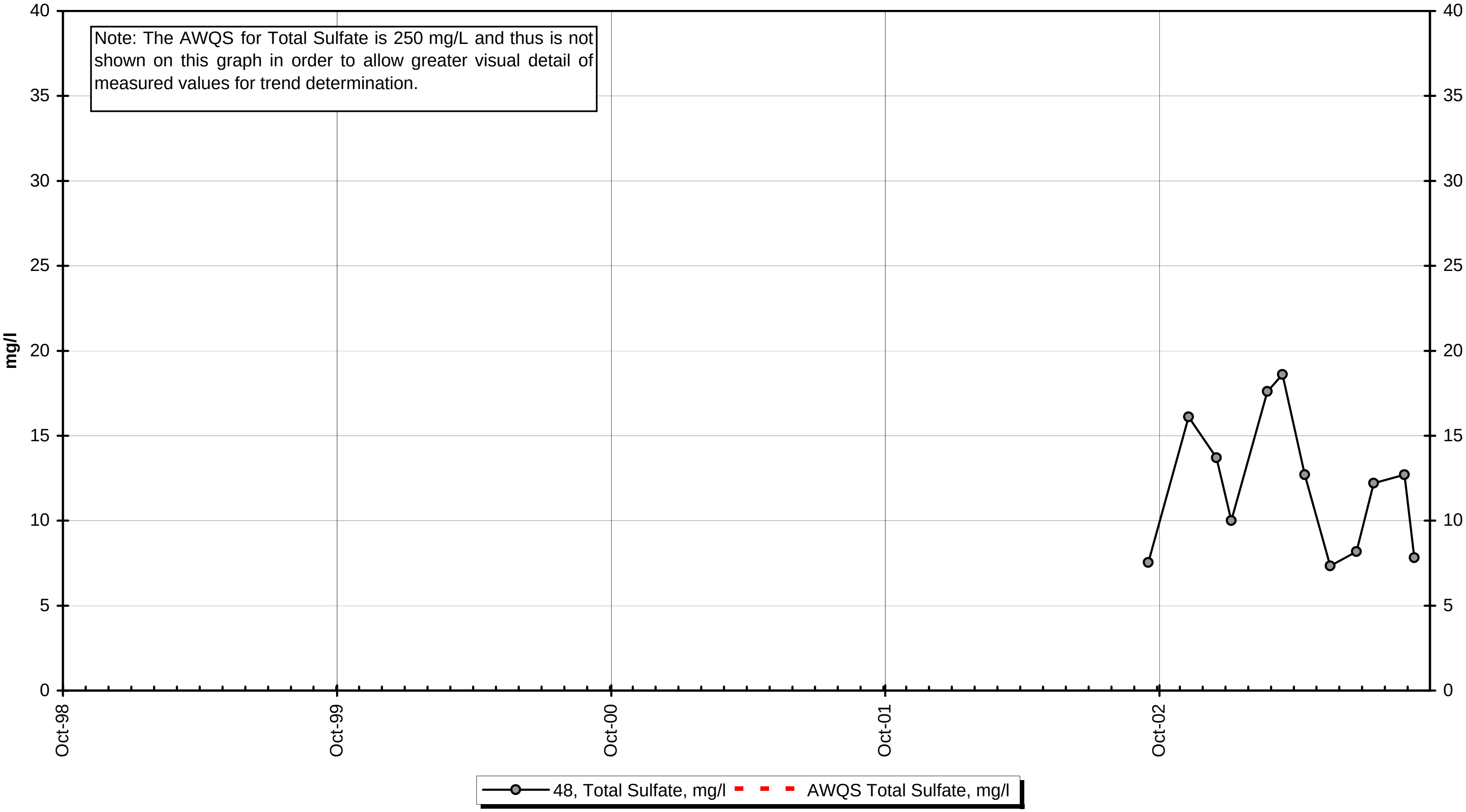


Site 48 -Lab pH
pH, su
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
48, pH Lab, su
AWQS pH, su-Low
AWQS pH, su-High

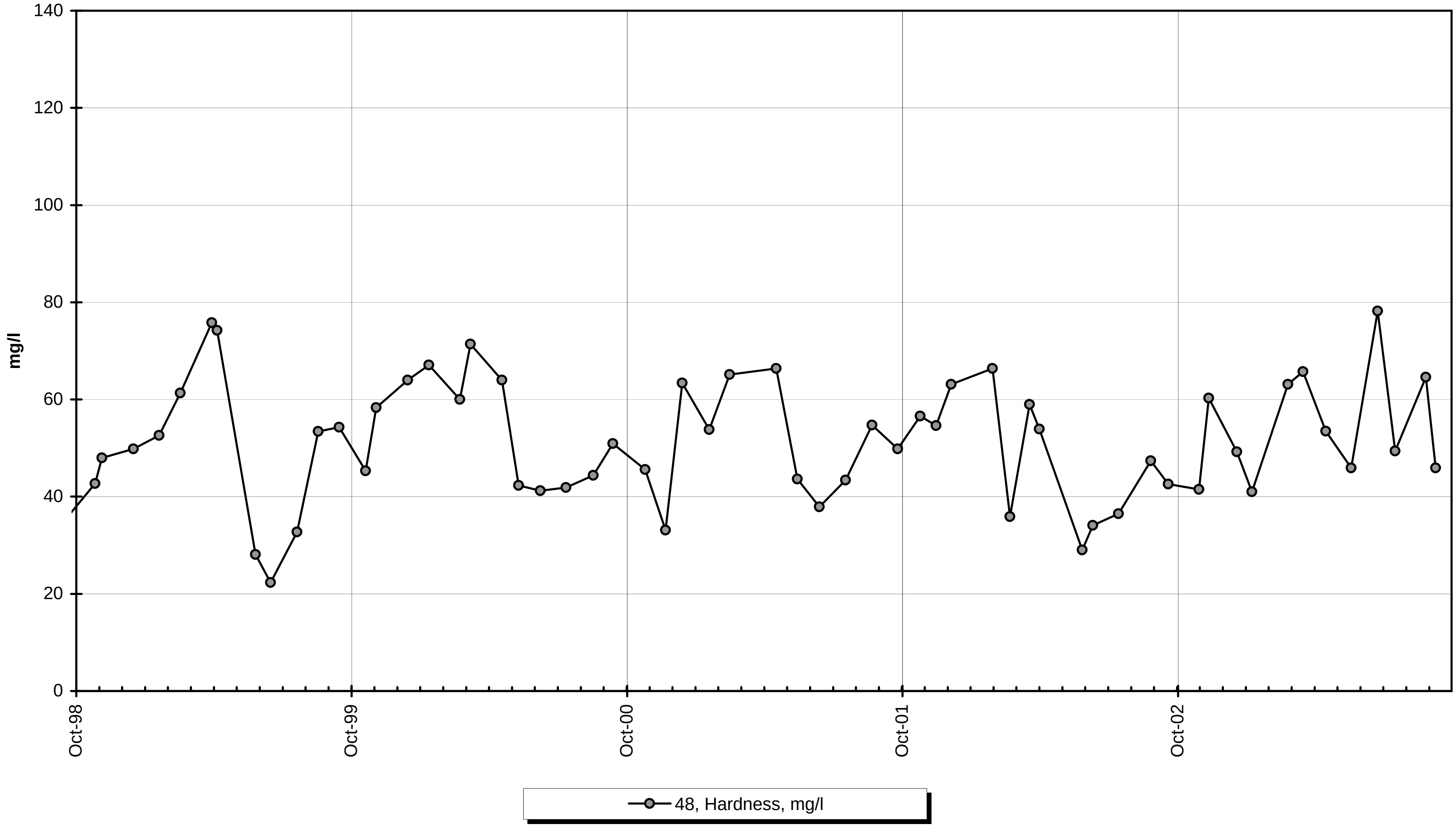
Site 48 -Total Alkalinity

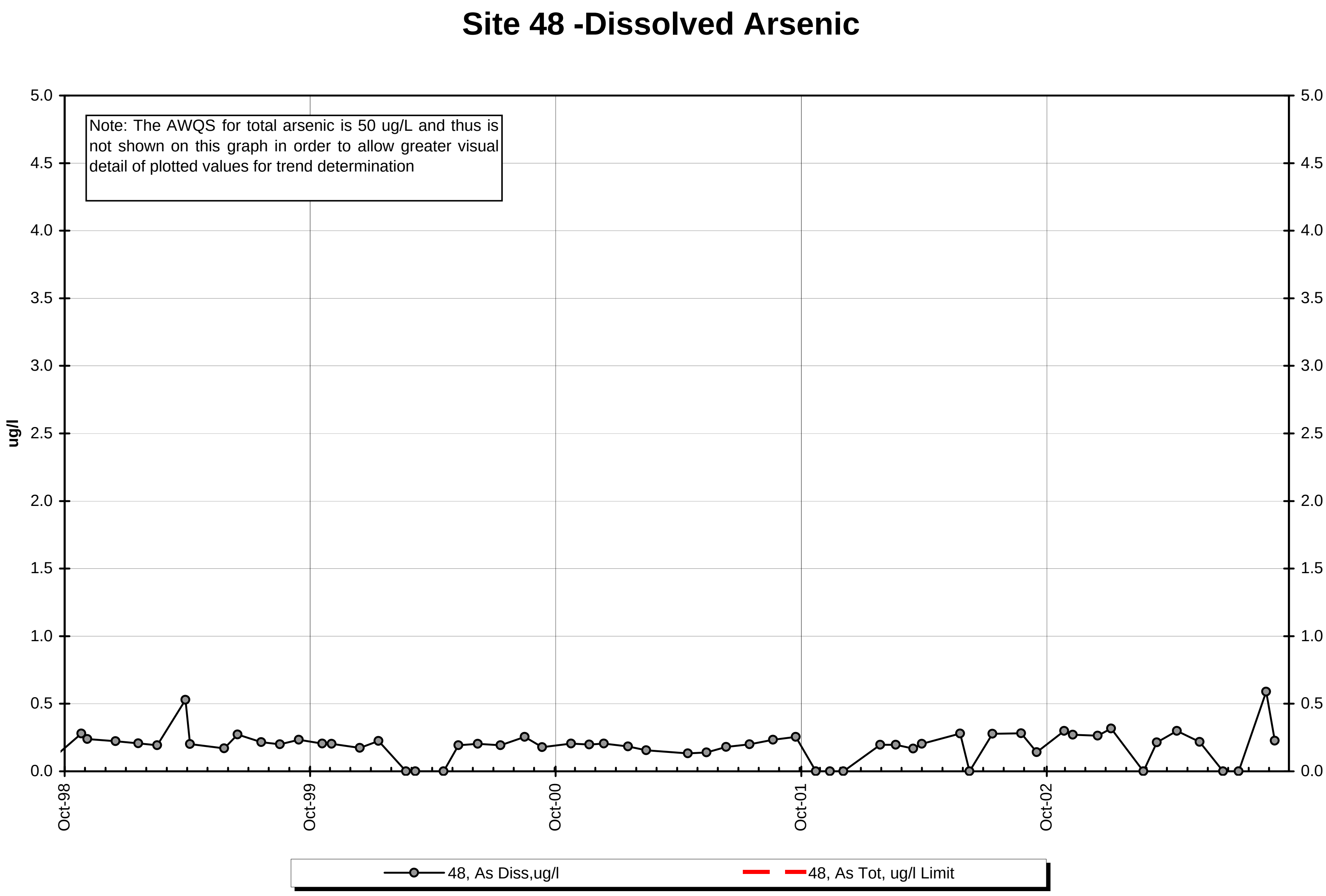


Site 48 -Total Sulfate

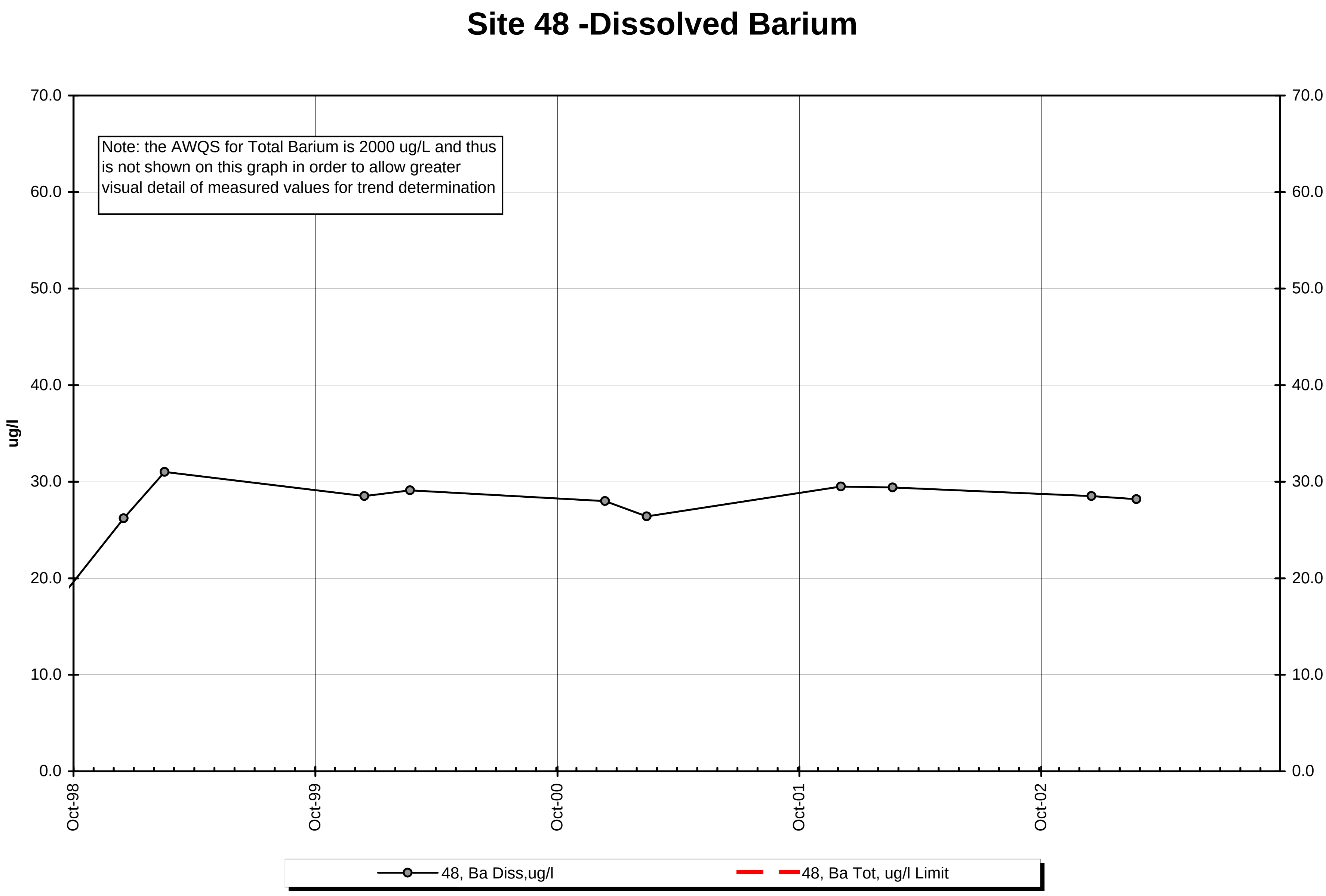


Site 48 -Hardness



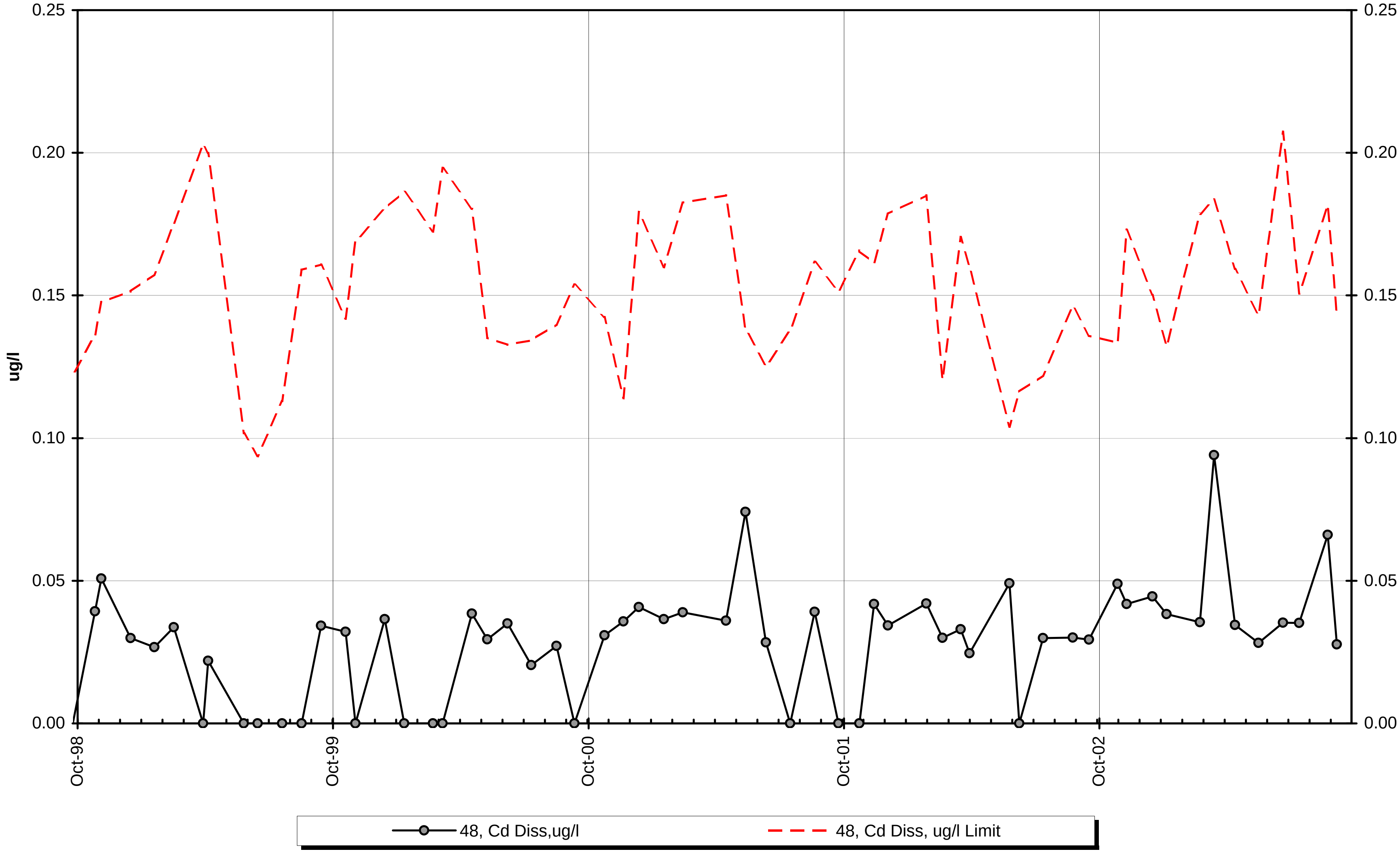


Site 48 -Dissolved Arsenic
Note: The AWQS for total arsenic is 50 ug/L and thus is not shown on this graph in order to allow greater visual detail of plotted values for trend determination
ug/l
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
48, As Diss,ug/l
48, As Tot, ug/l Limit

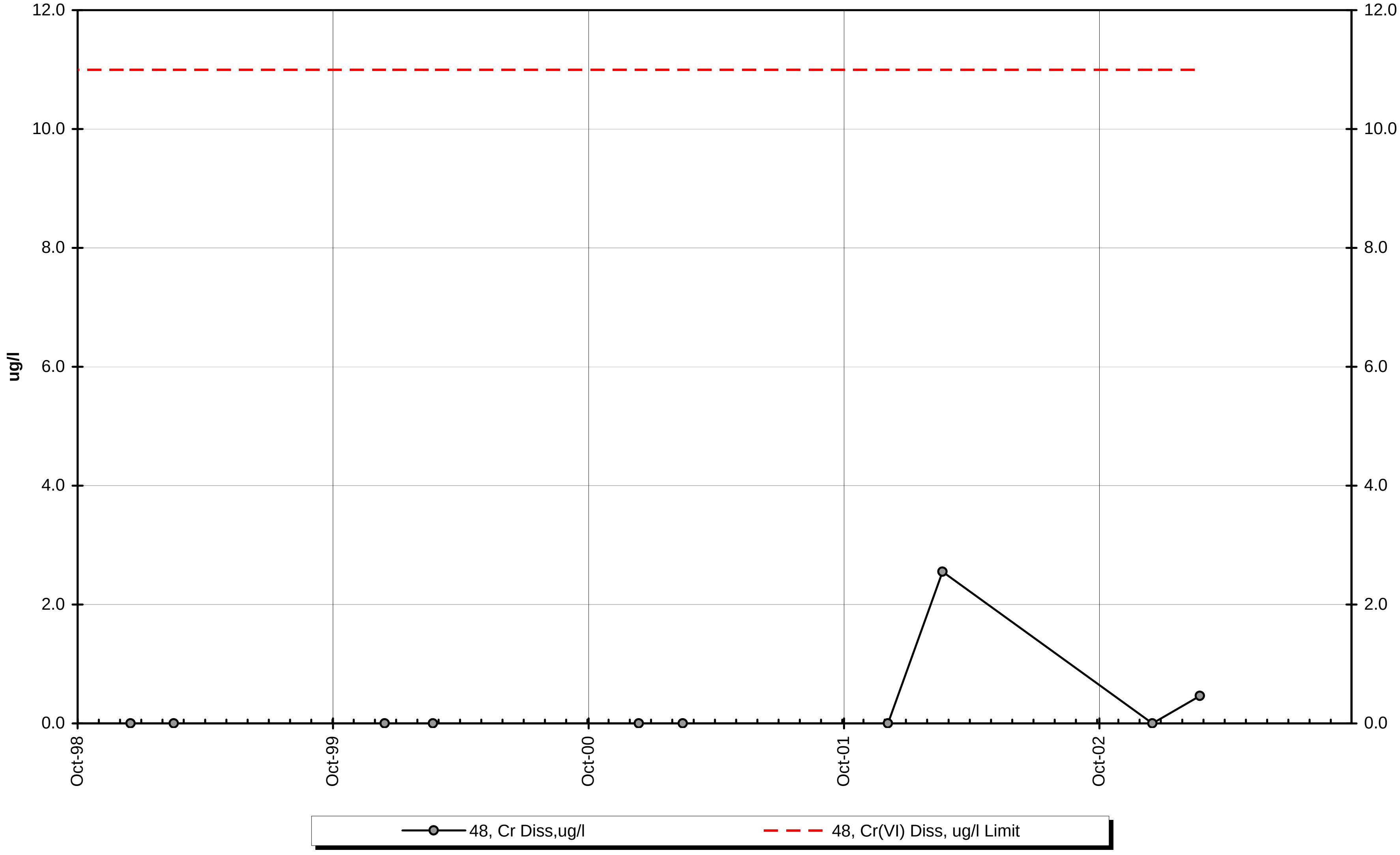


Site 48 -Dissolved Barium
Note: the AWQS for Total Barium is 2000 ug/L and thus is not shown on this graph in order to allow greater visual detail of measured values for trend determination
ug/l
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
48, Ba Diss,ug/l
48, Ba Tot, ug/l Limit

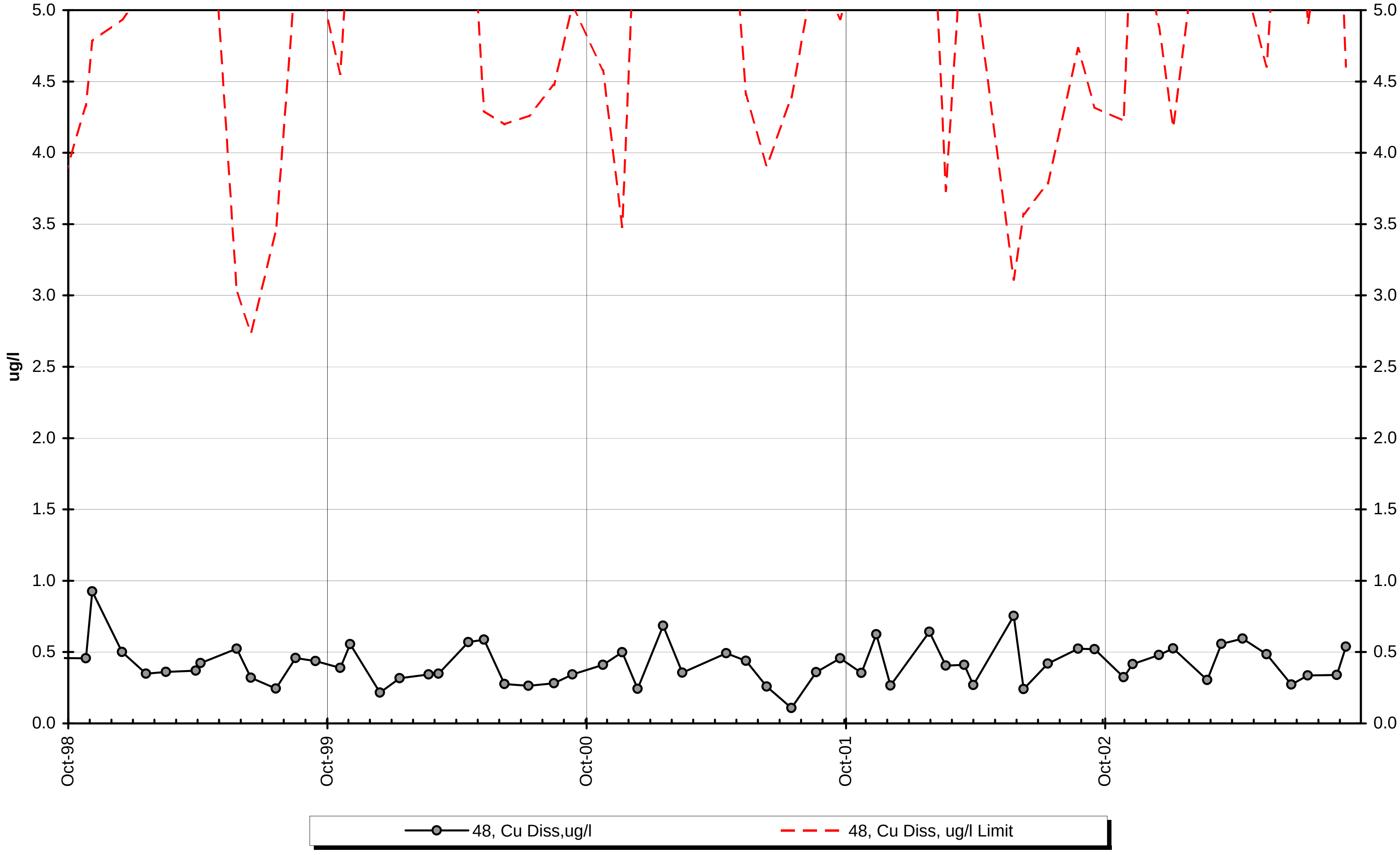
Site 48 -Dissolved Cadmium



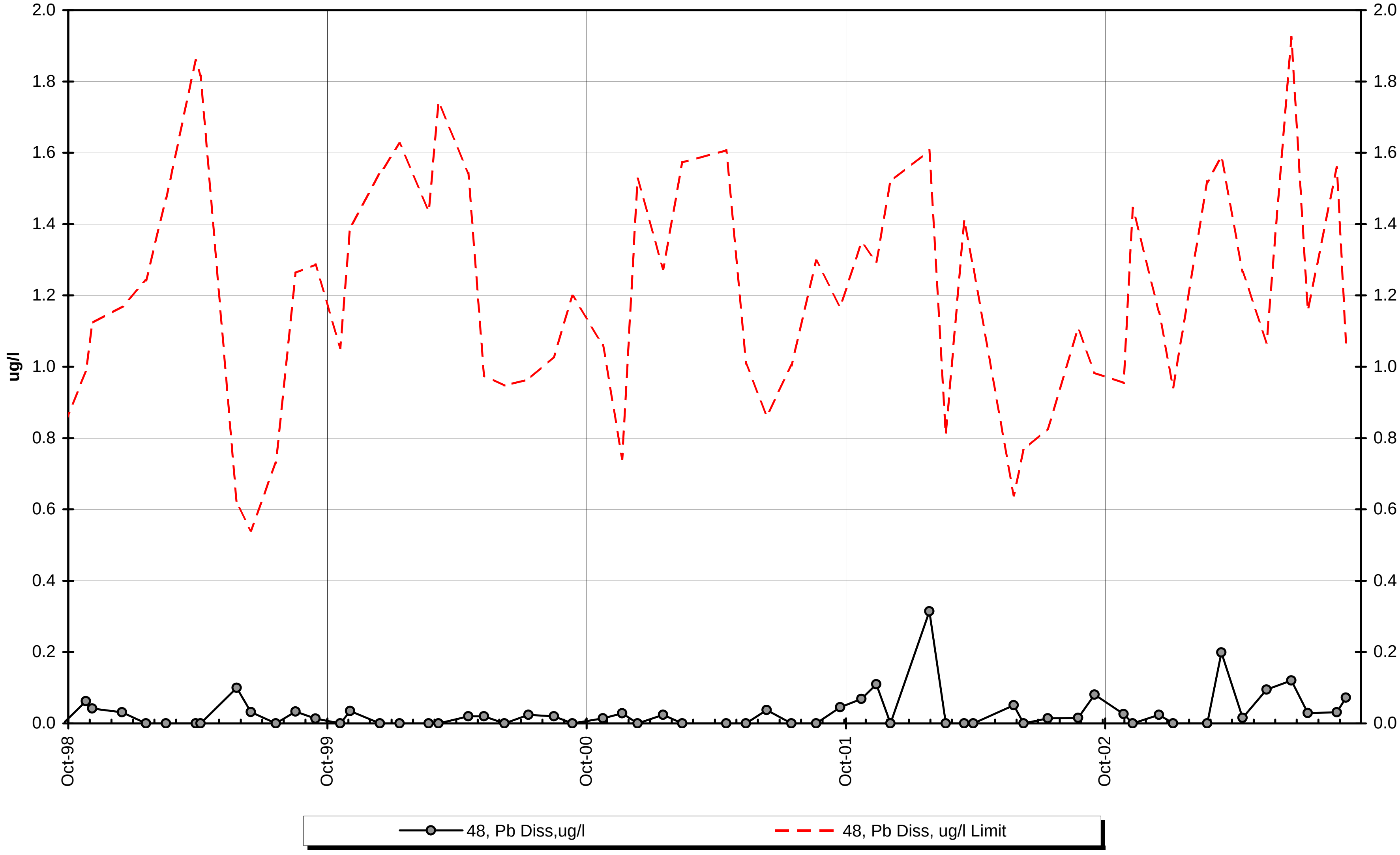
Site 48 -Dissolved Chromium



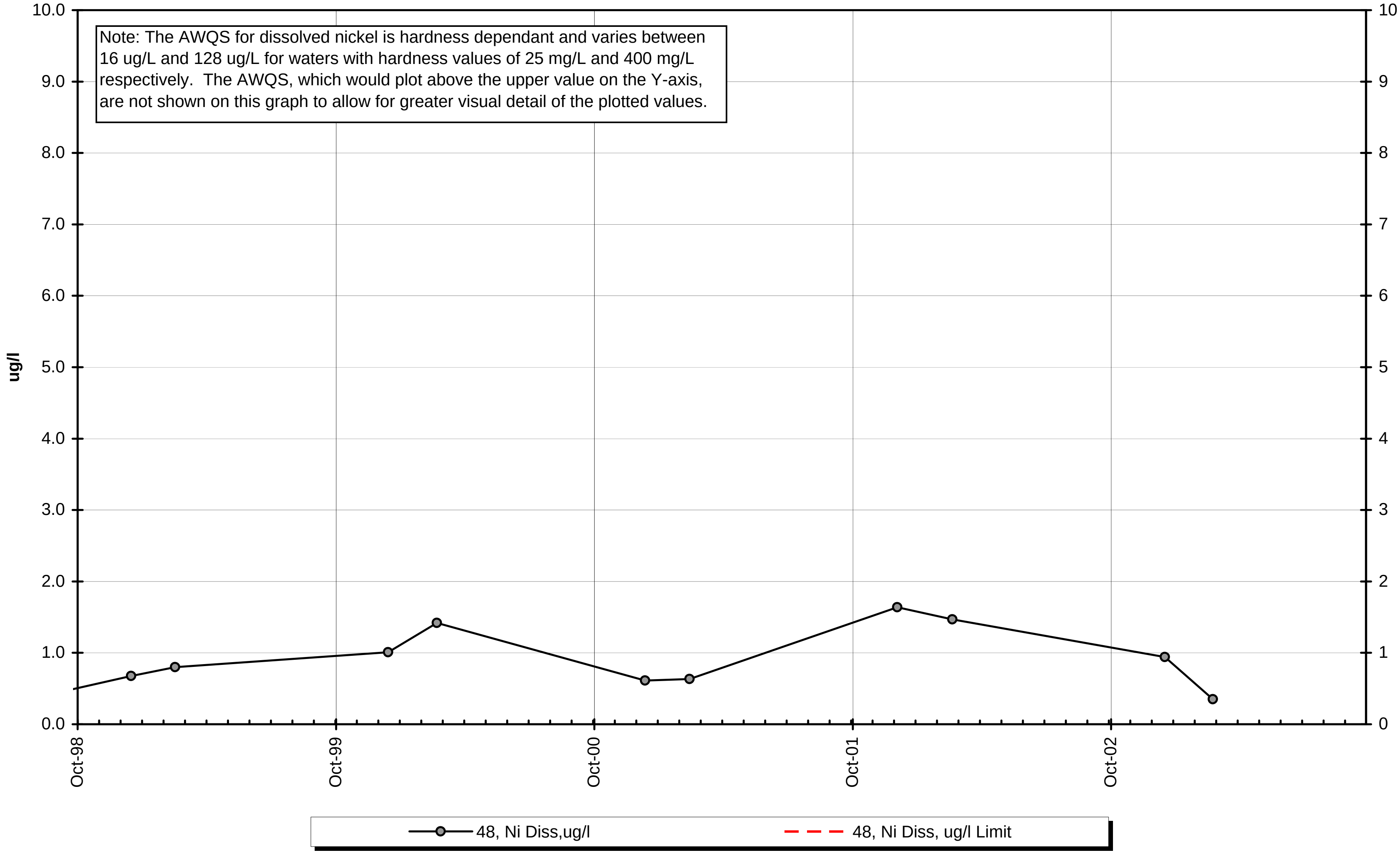
Site 48 -Dissolved Copper

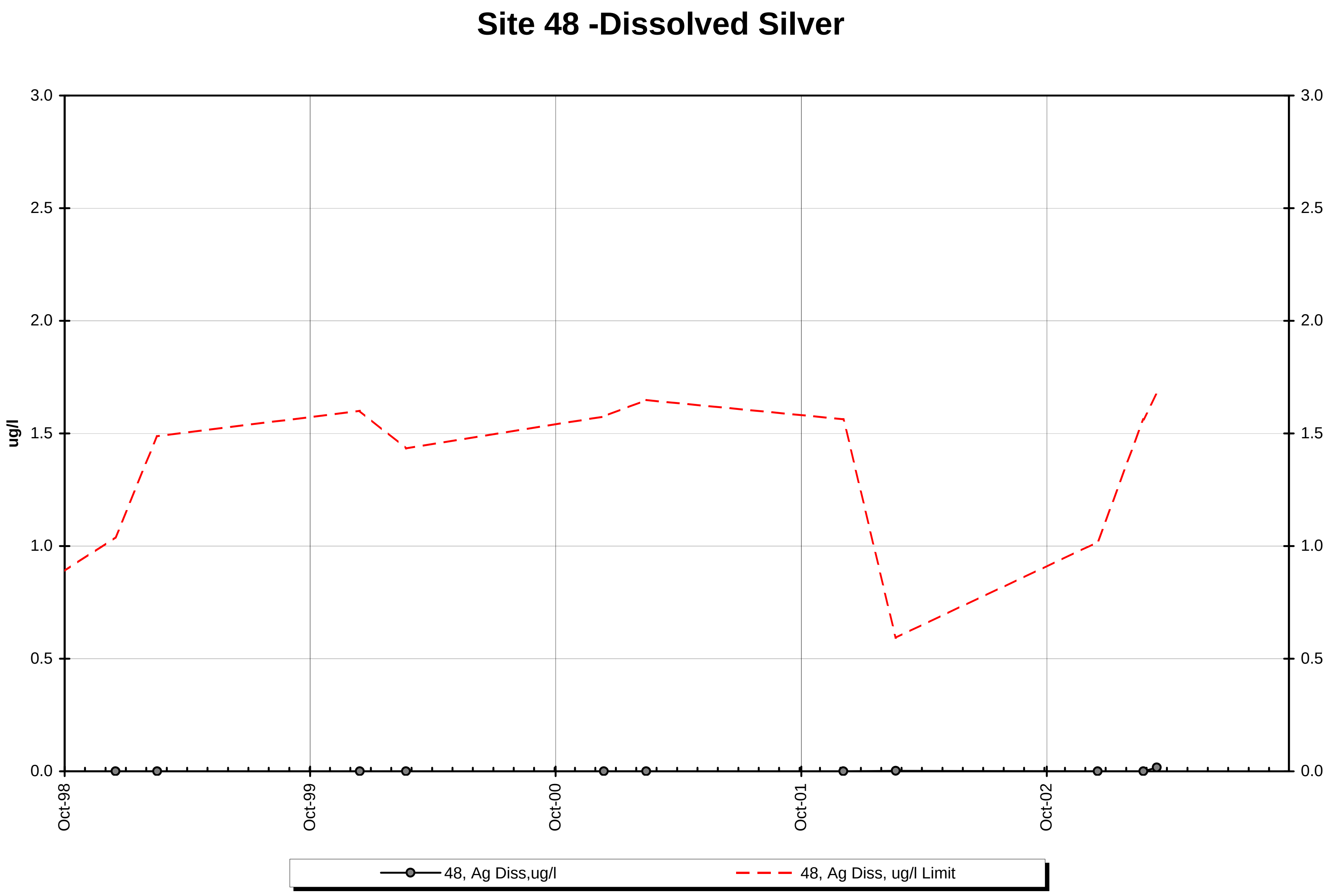


Site 48 -Dissolved Lead

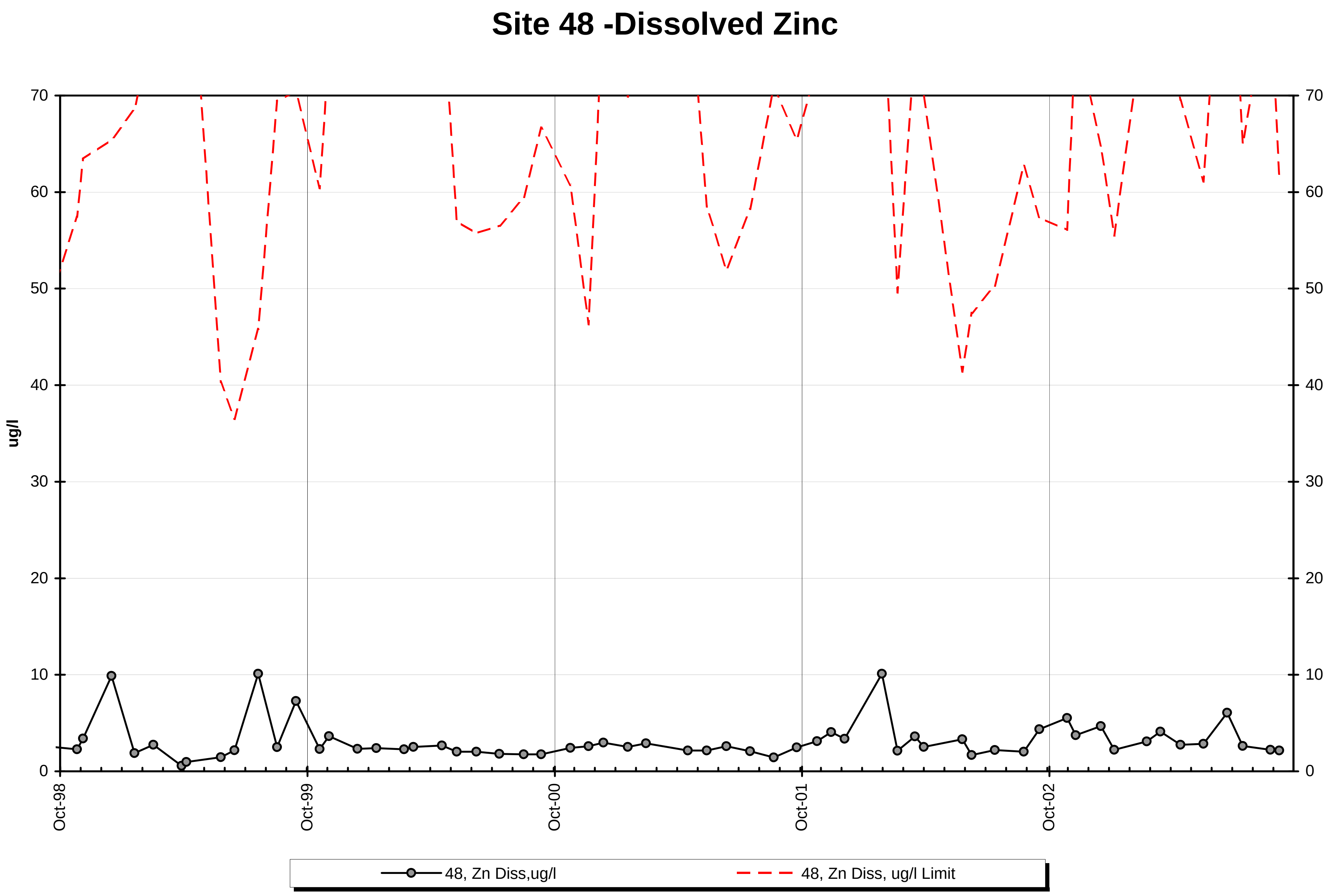


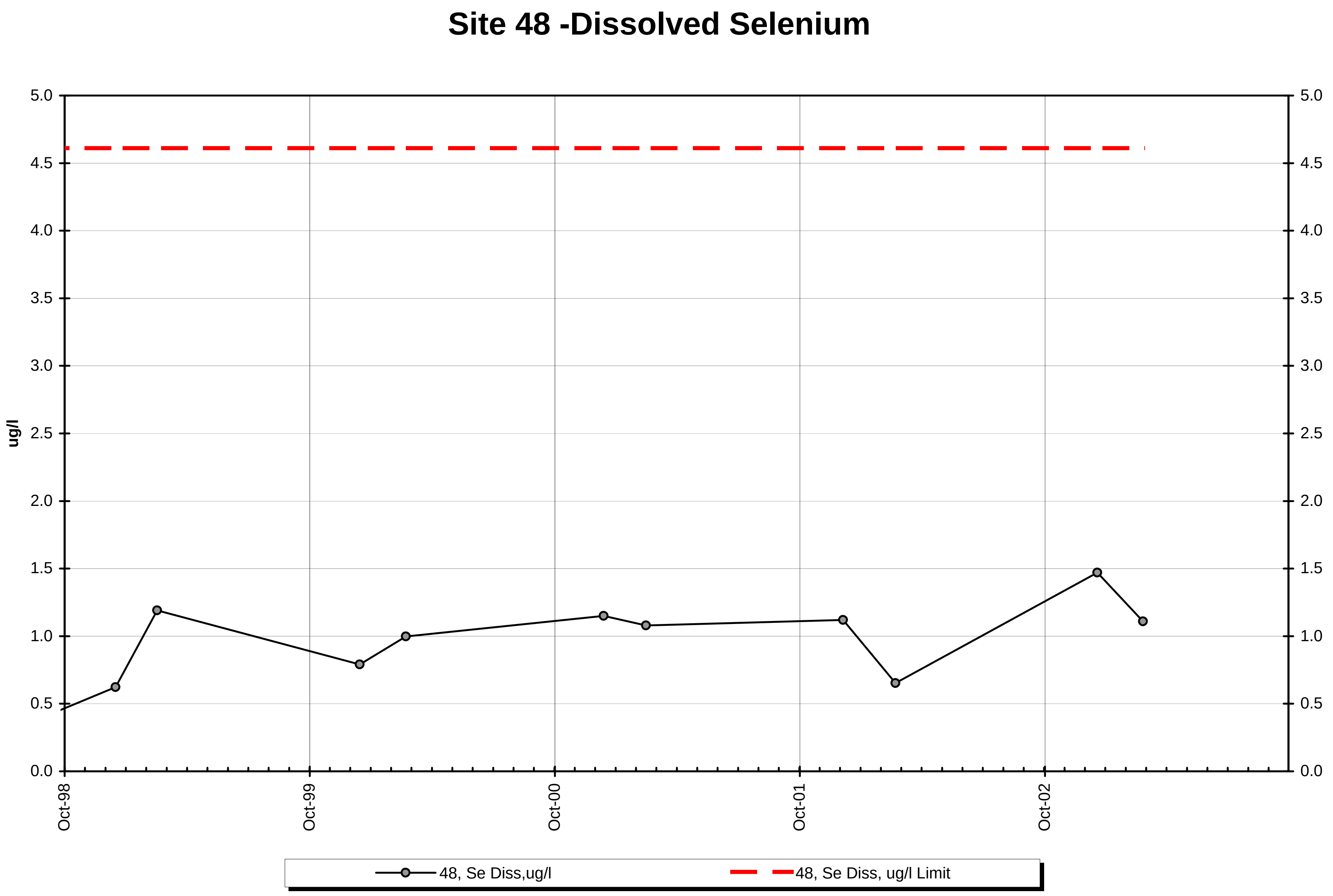
Site 48 -Dissolved Nickel



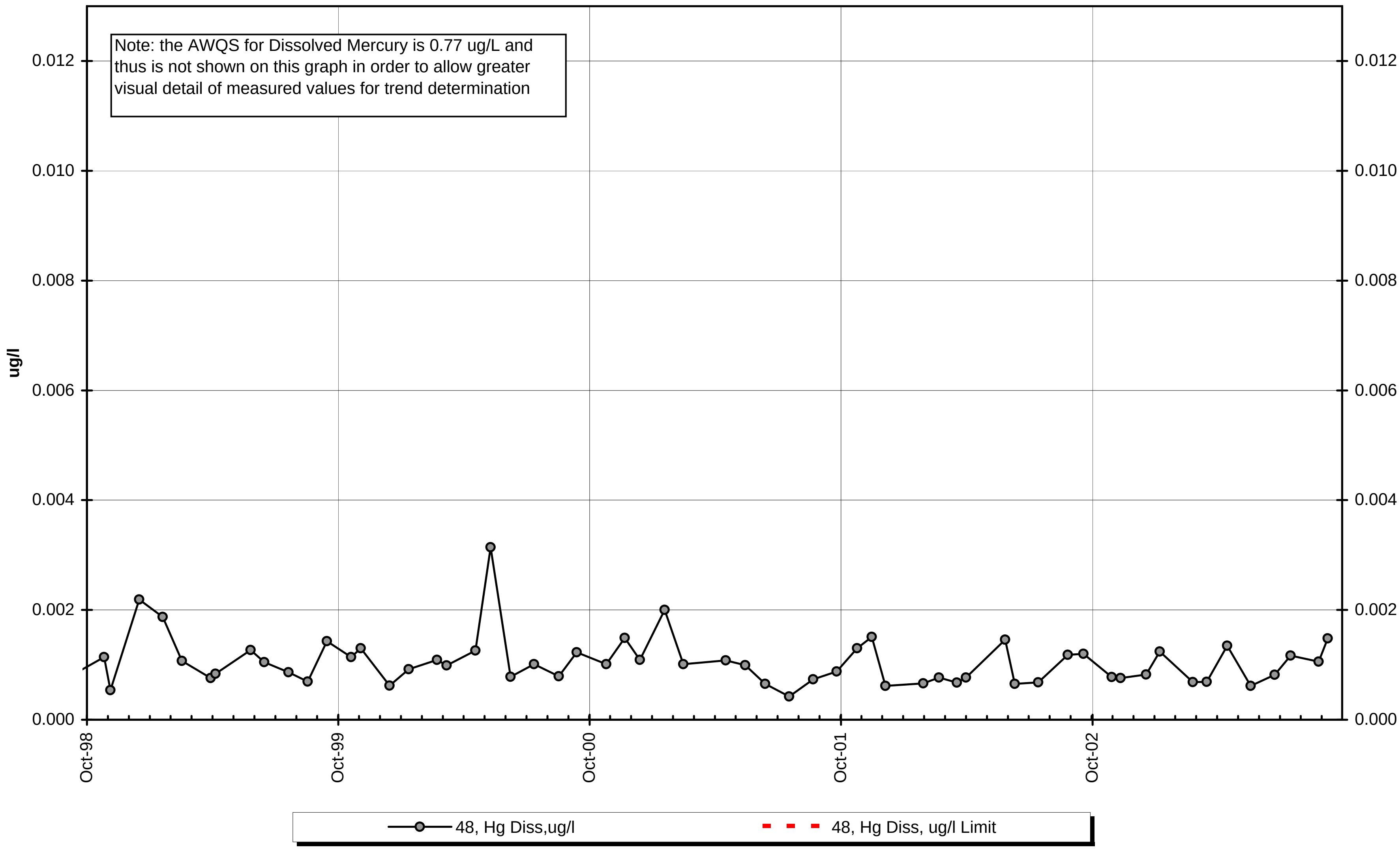


Site 48 -Dissolved Silver
ug/l
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
48, Ag Diss,ug/l
48, Ag Diss, ug/l Limit


Site 48 -Dissolved Zinc
ug/l
0
10
20
30
40
50
60
70
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
48, Zn Diss,ug/l
48, Zn Diss, ug/l Limit


Site 48 -Dissolved Selenium
ug/l
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
48, Se Diss,ug/l
48, Se Diss, ug/l Limit

Site 48 -Dissolved Mercury



Site **#48** Seasonal Mann-Kendall analysis for Specific Conductance, Lab (umhos/cm @ 25°C)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY1998**	116	137	110		119	136	141	102	94	107	116	126
b	**WY1999**	104	133	133	150	171	156	159	98	70	95	112	117
c	**WY2000**	98	111	128	122	142	137	128	88	81	81	92	97
d	**WY2001**	108	73	129	103	129		137	88	75	89	116	95
e	**WY2002**	118	113	137	139	138	150	158	61	84	93	100	90
f	**WY2003**	117	123	119	103	139	147	117	97	95	131	129	96
	n	6	6	6	5	6	5	6	6	6	6	6	6

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

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

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
$\sigma^2{}_S$=	28.33	28.33	28.33	16.67	28.33	16.67	28.33	28.33	28.33	28.33	28.33	28.33
$Z_k = S_k/\sigma_S$	0.94	-0.94	0.56	-1.22	0.19	0.49	-0.94	-1.69	0.94	0.19	0.38	-2.07
$Z^2{}_k$	0.88	0.88	0.32	1.50	0.04	0.24	0.88	2.86	0.88	0.04	0.14	4.27

ΣZ_k= -3.18

$\Sigma Z^2{}_k$= 12.93

Z-bar=ΣZ_k/K= -0.26

p(Z-bar)= 0.396

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

Σn	70
ΣS_k	-16
V(S)	38908
Z	-0.086
K	12

$\chi^2{}_h = \Sigma Z^2{}_k - K(\text{Z-bar})^2$= 12.09

p 0.36

@α=5% $\chi^2{}_{(K-1)}$= 19.68

Test for station homogeneity

$\chi^2{}_h < \chi^2{}_{(K-1)}$ ACCEPT

K*(Z-bar)^2= 0.84

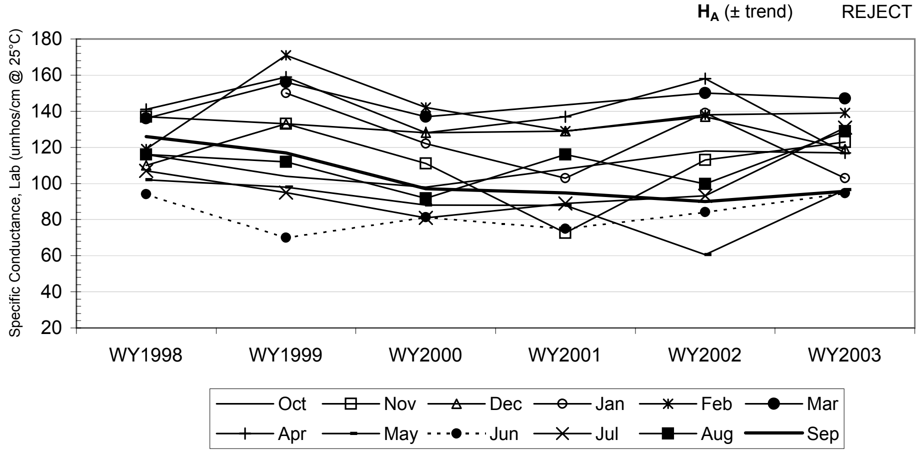
p 0.36

@α=5% $\chi^2{}_{(1)}$= 3.84

K*(Z-bar)² < $\chi^2{}_{(1)}$

H_0 (No trend) ACCEPT

H_A (± trend) REJECT



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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY1998**	7.75	8.50	7.27		7.66	7.84	8.10	8.15	7.49	7.55	7.67	8.20
b	**WY1999**	7.89	7.50	7.08	7.66	7.87	7.92	7.83	7.57	7.58	7.59	7.77	7.56
c	**WY2000**	7.50	7.50	7.54	7.55	7.43	7.68	7.54	7.75	7.15	7.66	7.43	7.49
d	**WY2001**	7.21	7.50	7.24	7.32	6.78		7.94	6.48	7.11	7.72	7.37	8.06
e	**WY2002**	7.43	7.57	7.43	7.35	7.47	7.86	7.22	6.89	7.30	7.90	7.76	7.93
f	**WY2003**	7.36	7.93	7.68	7.68	7.73	7.72	7.46	7.77	7.81	7.88	8.78	7.85
	n	6	6	6	5	6	5	6	6	6	6	6	6
	t_1	0	0	0	0	0	0	0	0	0	0	0	0
	t_2	0	1	0	0	0	0	0	0	0	0	0	0
	t_3	0	0	0	0	0	0	0	0	0	0	0	0
	t_4	0	0	0	0	0	0	0	0	0	0	0	0
	t_5	0	0	0	0	0	0	0	0	0	0	0	0
	b-a	1	-1	-1		1	1	-1	-1	1	1	1	-1
	c-a	-1	-1	1		-1	-1	-1	-1	-1	1	-1	-1
	d-a	-1	-1	-1		-1		-1	-1	-1	1	-1	-1
	e-a	-1	-1	1		-1	1	-1	-1	-1	1	1	-1
	f-a	-1	-1	1		1	-1	-1	-1	1	1	1	-1
	c-b	-1	0	1	-1	-1	-1	-1	1	-1	1	-1	-1
	d-b	-1	0	1	-1	-1		1	-1	-1	1	-1	1
	e-b	-1	1	1	-1	-1	-1	-1	-1	-1	1	-1	1
	f-b	-1	1	1	1	-1	-1	-1	1	1	1	1	1
	d-c	-1	0	-1	-1	-1		1	-1	-1	1	-1	1
	e-c	-1	1	-1	-1	1	1	-1	-1	1	1	1	1
	f-c	-1	1	1	1	1	1	-1	1	1	1	1	1
	e-d	1	1	1	1	1		-1	1	1	1	1	-1
	f-d	1	1	1	1	1		-1	1	1	1	1	-1
	f-e	-1	1	1	1	1	-1	1	1	1	-1	1	-1
	S_k	-9	2	7	0	-1	-2	-9	-3	1	13	3	-3
	σ^2_S=	28.33	27.33	28.33	16.67	28.33	16.67	28.33	28.33	28.33	28.33	28.33	28.33
	$Z_k = S_k/\sigma_S$	-1.69	0.38	1.32	0.00	-0.19	-0.49	-1.69	-0.56	0.19	2.44	0.56	-0.56
	Z^2_k	2.86	0.15	1.73	0.00	0.04	0.24	2.86	0.32	0.04	5.96	0.32	0.32

ΣZ_k= -0.30

ΣZ^2_k= 14.82

Z-bar=ΣZ_k/K= -0.02

p(Z-bar)= 0.490

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

Σn	70
ΣS_k	-1
V(S)	38908
Z	-0.010
K	12

$\chi^2_h = \Sigma Z^2_k - K(\text{Z-bar})^2$= 14.81

p 0.19

@α=5% $\chi^2_{(K-1)}$= 19.68

Test for station homogeneity

$\chi^2_h < \chi^2_{(K-1)}$ ACCEPT

K*(Z-bar)^2= 0.01

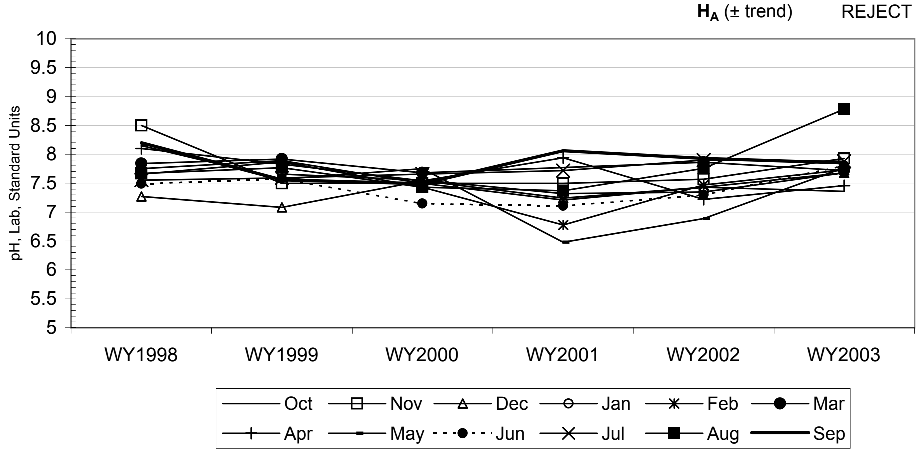
p 0.93

@α=5% $\chi^2_{(1)}$= 3.84

K*(Z-bar)² < $\chi^2_{(1)}$

H_0 (No trend) ACCEPT

H_A (± trend) REJECT



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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY1998**	45	51	39		43	46	48	39	35	37	43	41
b	**WY1999**	37	48	45	57	63	52	52	35	26	34	39	41
c	**WY2000**	33	38	45	46	51	49	47	34	33	32	39	40
d	**WY2001**	42	30	50	40	48		51	36	31	36	45	38
e	**WY2002**	45	43	50	49	50	52	55	23	35	36	40	37
f	**WY2003**	40	41	46	40	52	54	46	40	40	51	51	41
	n	6	6	6	5	6	5	6	6	6	6	6	6

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

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a	-1	-1	1		1	1	1	-1	-1	-1	-1	-1
c-a	-1	-1	1		1	1	-1	-1	-1	-1	-1	-1
d-a	-1	-1	1		1		1	-1	-1	-1	1	-1
e-a	0	-1	1		1	1	1	-1	1	-1	-1	-1
f-a	-1	-1	1		1	1	-1	1	1	1	1	-1
c-b	-1	-1	-1	-1	-1	-1	-1	-1	1	-1	1	-1
d-b	1	-1	1	-1	-1		-1	1	1	1	1	-1
e-b	1	-1	1	-1	-1	1	1	-1	1	1	1	-1
f-b	1	-1	1	-1	-1	1	-1	1	1	1	1	1
d-c	1	-1	1	-1	-1		1	1	-1	1	1	-1
e-c	1	1	1	1	-1	1	1	-1	1	1	1	-1
f-c	1	1	1	-1	1	1	-1	1	1	1	1	1
e-d	1	1	1	1	1		1	-1	1	1	-1	-1
f-d	-1	1	-1	-1	1		-1	1	1	1	1	1
f-e	-1	-1	-1	-1	1	1	-1	1	1	1	1	1
S_k	0	-7	9	-6	3	8	-1	-1	7	5	7	-7

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	28.33	28.33	28.33	16.67	28.33	16.67	28.33	28.33	28.33	28.33	28.33	28.33
$Z_k = S_k/\sigma_S$	0.00	-1.32	1.69	-1.47	0.56	1.96	-0.19	-0.19	1.32	0.94	1.32	-1.32
Z^2_k	0.00	1.73	2.86	2.16	0.32	3.84	0.04	0.04	1.73	0.88	1.73	1.73

ΣZ_k= 3.31
ΣZ^2_k= 17.05
Z-bar=ΣZ_k/K= 0.28
p(Z-bar)= 0.609

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

Σn 70
ΣS_k 17
V(S) 38908
Z 0.081
K 12

$\chi^2_h = \Sigma Z^2_k - K(\text{Z-bar})^2$= 16.14
p 0.14

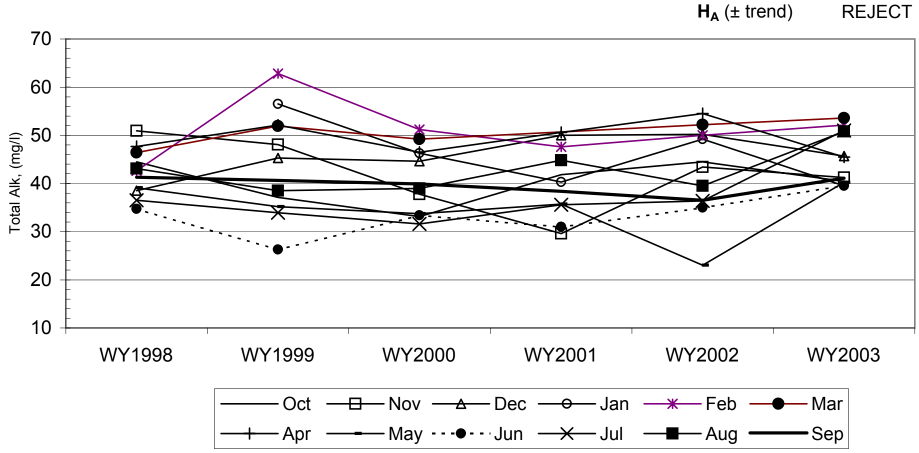
@α=5% $\chi^2_{(K-1)}$= 19.68

Test for station homogeneity
$\chi^2_h < \chi^2_{(K-1)}$ ACCEPT

K*(Z-bar)^2= 0.91
p 0.34

@α=5% $\chi^2_{(1)}$= 3.84

K*(Z-bar)² < $\chi^2_{(1)}$
H_0 (No trend) ACCEPT
H_A (± trend) REJECT



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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY1998**	2.35	4.98	2.35		4.67	81.00	2.35	2.35	1.50	2.28	1.78	2.50
b	**WY1999**	2.28	3.39	9.89	1.88	2.76	0.58	0.97	1.45	2.19	10.10	2.50	7.27
c	**WY2000**	2.30	3.65	2.33	2.41	2.29	2.53	2.68	2.03	2.04	1.82	1.77	1.75
d	**WY2001**	2.43	2.59	2.98	2.53	2.89		2.15	2.15	2.61	2.09	1.44	2.47
e	**WY2002**	3.11	4.05	3.38	10.10	2.14	3.61	2.53	3.32	1.69	2.21	2.03	4.37
f	**WY2003**	5.52	3.73	4.68	2.24	3.09	4.11	2.74	2.84	6.07	2.62	2.22	2.16
	n	6	6	6	5	6	5	6	6	6	6	6	6

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

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

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	28.33	28.33	28.33	16.67	28.33	16.67	28.33	28.33	28.33	28.33	28.33	28.33
$Z_k = S_k/\sigma_S$	2.07	-0.19	0.94	0.98	-0.56	0.49	1.32	1.32	1.32	0.19	0.19	-0.56
Z^2_k	4.27	0.04	0.88	0.96	0.32	0.24	1.73	1.73	1.73	0.04	0.04	0.32

ΣZ_k= 7.48

ΣZ^2_k= 12.28

Z-bar=ΣZ_k/K= 0.62

p(Z-bar)= 0.734

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

Σn	70
ΣS_k	38
V(S)	38908
Z	0.188
K	12

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$= 7.62

p 0.75

@α=5% $\chi^2_{(K-1)}$= 19.68

Test for station homogeneity

$\chi^2_h<\chi^2_{(K-1)}$ ACCEPT

K*(Z-bar)^2= 4.66

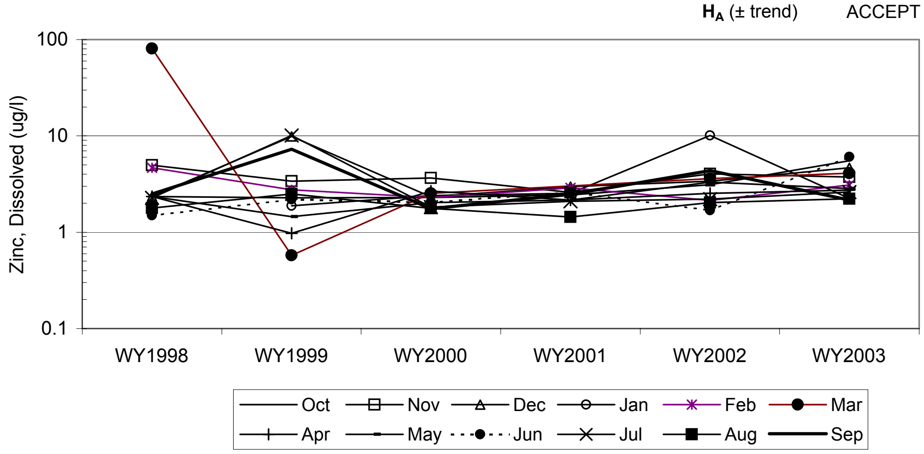
p 0.03

@α=5% $\chi^2_{(1)}$= 3.84

K*(Z-bar)² < $\chi^2_{(1)}$

H_0 (No trend) REJECT

H_A (± trend) ACCEPT



INTERPRETIVE REPORT
SITE 6 “MIDDLE GREENS CREEK”

The data collected during the current water year are listed in the following “Table of Results for Water Year 2003” report. The table includes all the data, field and lab, 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 zero for the purpose of median calculation.

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

Sample Date	Parameter	Value	Qualifier	Notes
2/16/1999	Cond Lab, umho	408.0	RR	Statistical outlier, not collaborated by field measurements.
12/5/2001	Cond Field, umho	37.0	RR	Suspected field instrument malfunction

The data for water year 2003 have been compared to the strictest fresh water quality criterion for each applicable analyte. No results exceeding these criteria have been identified.

X-Y plots have been generated to graphically present the data for each of the analytes requested in the Statistical Information Goals for this site. These plots have been visually analyzed for the appearance of any trend in concentration. No visually obvious trends are apparent. A non-parametric statistical analysis for trend was preformed for conductivity, pH, Alkalinity, and dissolved zinc. Calculation details of the Seasonal Mann-Kendall analyses are presented in detail on the pages following this interpretive section. The table below summarizes the results on the data collected between Oct-97 and Sep-03 (WY1998-WY2003). No statistically significant (α=5%) trends are present in the data. Additional X-Y plots have been generated for alkalinity, pH, conductance, sulfate, and dissolved zinc that plot Site 6 and Site 48, the upstream control site, to aid in the comparison between those two sites.

		Mann-Kendall test statistic			Sen's slope estimate	
Parameter	n*	Z	Trend	÷□□	Q	Q(%)
Conductivity, Lab	6	0.41	-	0.52		
pH, Lab	6	0.07	-	0.79		
Alkalinity, Total	6	0.95	+	0.33		
Zinc, Dissolved	6	0.42	+	0.52		

*: Number of years **:Significance level

A statistical comparison between Site 6 and Site 48 of median values for alkalinity, lab pH, specific conductance, sulfate, and dissolved zinc have been conducted as specified in the Statistical Information Goals for Site 6. Calculation details of the non-parametric

Parameter	Rank Sum Test p-value	Site #48 median	Site #06 median
Conductivity, Lab	0.83	118	125
pH, Lab	0.39	7.75	7.76
Alkalinity, Total	0.48	43.4	42.3
Sulfate, Total	0.87	12.7	14.4
Zinc, Dissolved	**1.00**	2.97	5.20

rank sum tests are presented in detail on the pages following this interpretive section. The adjacent table summarizes the results of the large sample approximation to the Wilcoxon-Mann-Whitney rank sum test as performed on the water year 2003 data set. For alkalinity, pH, and conductivity there is no statistical difference between the measured median values at a significance level of $\alpha/2=0.025$ for a two-tailed test. The dissolved zinc concentrations are statistically different, which has been previously noted in prior water years. A visual inspection of the dissolved zinc X-Y plot with Site 48 and Site 6 data continue to show the different concentrations appears to display a distinct seasonal trend where summer flow conditions typically show the smallest difference of approximately 1 μg/l, while winter flow conditions show the largest difference of approximately 3-4 μg/l. This trend is less apparent for the current water than the prior two preceding water years.

KGCMC believes that no additional monitoring is warranted at this time due to the consistent differences in dissolved zinc concentrations between the two sites, which remain approximately an order-of-magnitude below the AWQS for these sites. The current FWMP program is sufficient to monitor any changes at Site 6. The sampled concentrations for dissolved zinc are typically more than one order of magnitude below the strictest AWQS, currently the level does not approach or endanger water quality values. Second, as documented by the above analysis, differences of as little as 2 μg/l are effectively monitored and documented with the current program. Thus, if an as yet undetected upward trend in dissolved zinc at Site 6 should occur, the current program is able to identify the change before any water quality values are impaired.

Table of Results for Water Year 2003

Site 6 "Middle Greens Creek"

Sample Date/Parameter	10/30/2002	11/12/2002	12/19/2002	1/8/2003	2/25/2003	3/17/2003	4/16/2003	5/20/2003	6/24/2003	7/17/2003	8/27/2003	9/9/2003	**Median**
Water Temp (°C)	3.3	4.7	1.0	1.0	0.2	1.0	1.4	4.5	7.0	8.9	8.4	7.5	3.9
Conductivity-Field(µmho)	123	164	134	104	174	160	134	106	102	130	132	104	131
Conductivity-Lab (µmho)	120	136	125	106 U	144 J	163	124	100	97	137	133	101	125
pH Lab (standard units)	7.74	7.79	7.81	7.39	7.72 J	7.77	6.95	7.57	7.64	7.87	8.35 J	7.89	7.76
pH Field (standard units)	7.46	7.41	7.40	6.97	7.00	7.16	7.67	7.41	7.47	7.89	7.82	7.73	7.44
Total Alkalinity (mg/L)	37.9	42.1	46.3	33.7	52.3 J	59.4	42.4	40.7	39.1	49.1	51.0	41.6	42.3
Total Sulfate (mg/L)	**Note 1**	18.7 J	16.3 J	12.6 J	20.8	20.4	15.7	7.9	9.0	13.6	14.4 J	9.3 J	14.4
Hardness (mg/L)	49.5	64.6	54.9	43.8	65.4	75.5	56.0	45.9	79.2	50.0	67.7	50.1	55.5
Dissolved As (ug/L)	0.403 J	0.305 J	0.244 J	0.347 U	<0.386	0.175	0.294 U	0.215	0.212 J	<0.331	0.653 U	0.301 J	0.269
Dissolved Ba (ug/L)			28.3		27.4								27.9
Dissolved Cd (ug/L)	0.053	0.049 J	0.051 J	0.060 U	0.042 J	0.107 J	0.046	0.032	0.106	0.041 J	0.054 J	0.033 J	0.050
Dissolved Cr (ug/L)			<1.010		1.180								0.843
Dissolved Cu (ug/L)	0.296 U	0.425 U	0.522 U	0.687 U	0.300	0.658 U	0.748	0.485	1.440	0.432 J	0.383	0.641	0.504
Dissolved Pb (ug/L)	<0.0180	0.0388 J	0.0716 U	0.0659 U	<0.0210	0.0914 U	0.0521 U	0.1100	0.6050	0.1790	0.0787	0.1420 J	0.0752
Dissolved Ni (ug/L)			0.976		0.350								0.663
Dissolved Ag (ug/L)			<0.011		<0.057	0.020 J							0.020
Dissolved Zn (ug/L)	4.73	4.97 J	6.82	5.42	4.30	6.20	6.08	3.76	9.33	3.29 U	2.91	5.71	5.20
Dissolved Se (ug/L)			0.957 U		1.190								1.074
Dissolved Hg (ug/L)	0.000681	0.000720 U	0.000894	0.001350 U	0.000639 U	0.000858	0.001220	0.000665	0.000822 U	0.000868 U	0.000861	<0.000000	0.000840

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

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

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

NOTE (1) Analysis was not performed on sample.

Qualified Data by QA Reviewer

Date Range: 10/01/2002 to 09/30/2003

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
6	01/08/2003	11:55:00 AM				
			Cond Lab, umho	106	U	Field Blank Contamination
			SO4 Tot, mg/l	12.6	J	Hold Time
			As Diss, ug/l	0.347	U	Below Quantitative Range, Fi
			Cd Diss, ug/l	0.0595	U	Below Quantitative Range, Fi
			Cu Diss, ug/l	0.687	U	Field Blank Contamination
			Pb Diss, ug/l	0.0659	U	Below Quantitative Range, Fi
			Hg Diss, ug/l	0.00135	U	Field Blank Contamination
6	10/30/2002	12:42:00 PM				
			As Diss, ug/l	0.403	J	Below Quantitative Range
			Cu Diss, ug/l	0.296	U	Field Blank Contamination
6	11/12/2002	1:20:00 PM				
			SO4 Tot, mg/l	18.7	J	Hold Time
			As Diss, ug/l	0.305	J	Below Quantitative Range, L
			Cd Diss, ug/l	0.0487	J	Below Quantitative Range
			Cu Diss, ug/l	0.425	U	Field Blank Contamination
			Pb Diss, ug/l	0.0388	J	Below Quantitative Range
			Zn Diss, ug/l	4.97	J	LCS Recovery
			Hg Diss, ug/l	0.00072	U	Field Blank Contamination
6	12/19/2002	11:25:00 AM				
			SO4 Tot, mg/l	16.3	J	Hold Time
			As Diss, ug/l	0.244	J	Below Quantitative Range
			Cd Diss, ug/l	0.0512	J	Below Quantitative Range, L
			Cu Diss, ug/l	0.522	U	Field Blank Contamination
			Pb Diss, ug/l	0.0716	U	Field Blank Contamination
			Se Diss, ug/l	0.957	U	Below Quantitative Range, M
6	02/25/2003	11:46:00 AM				
			Cond Lab, umho	144	J	Sample Temperature
			pH Lab, su	7.72	J	Hold Time
			Alk Tot, mg/l	52.3	J	Sample Temperature
			Cd Diss, ug/l	0.0416	J	Below Quantitative Range
			Hg Diss, ug/l	0.000639	U	Field Blank Contamination

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

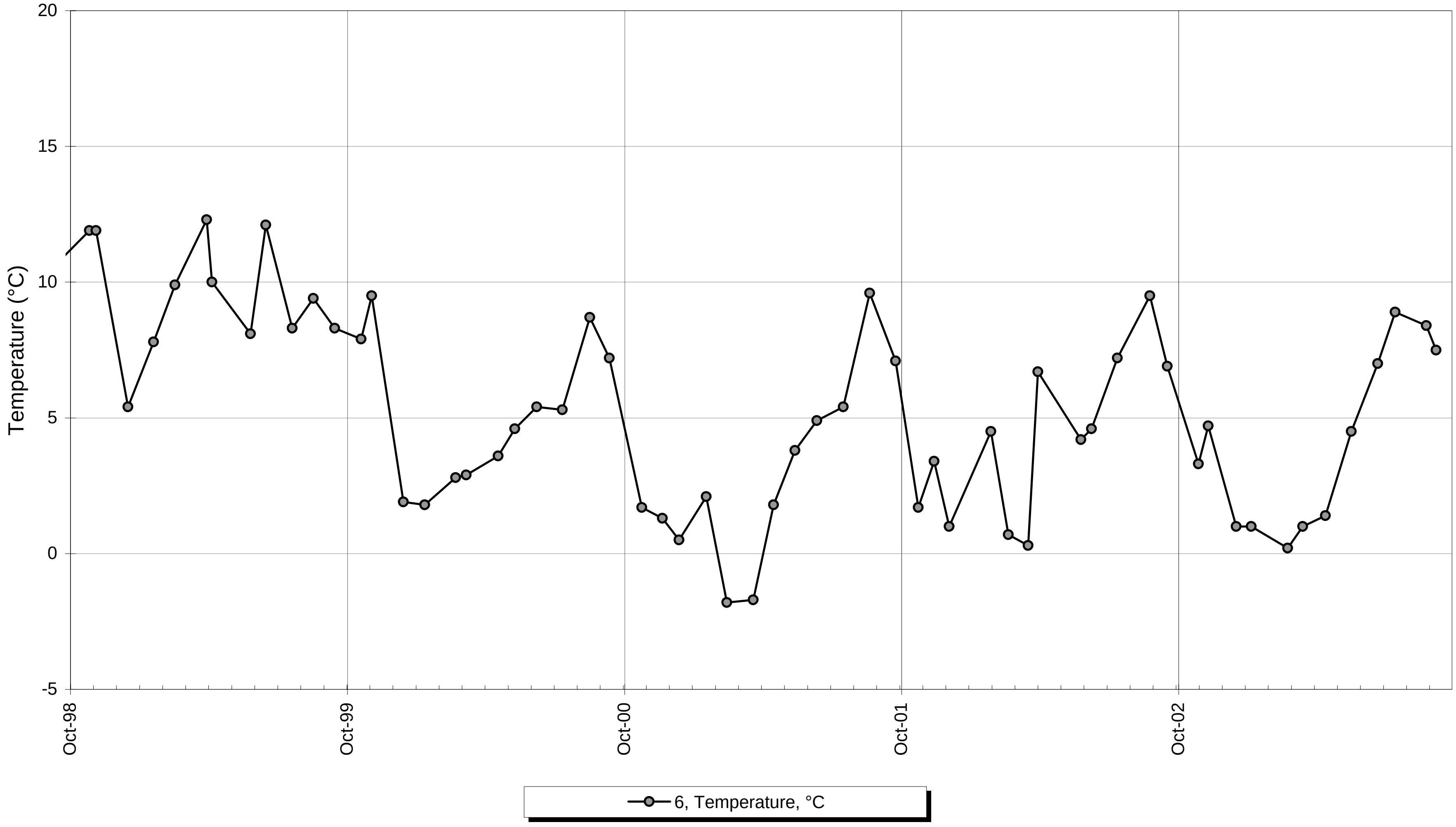
Qualified Data by QA Reviewer

Date Range: 10/01/2002 to 09/30/2003

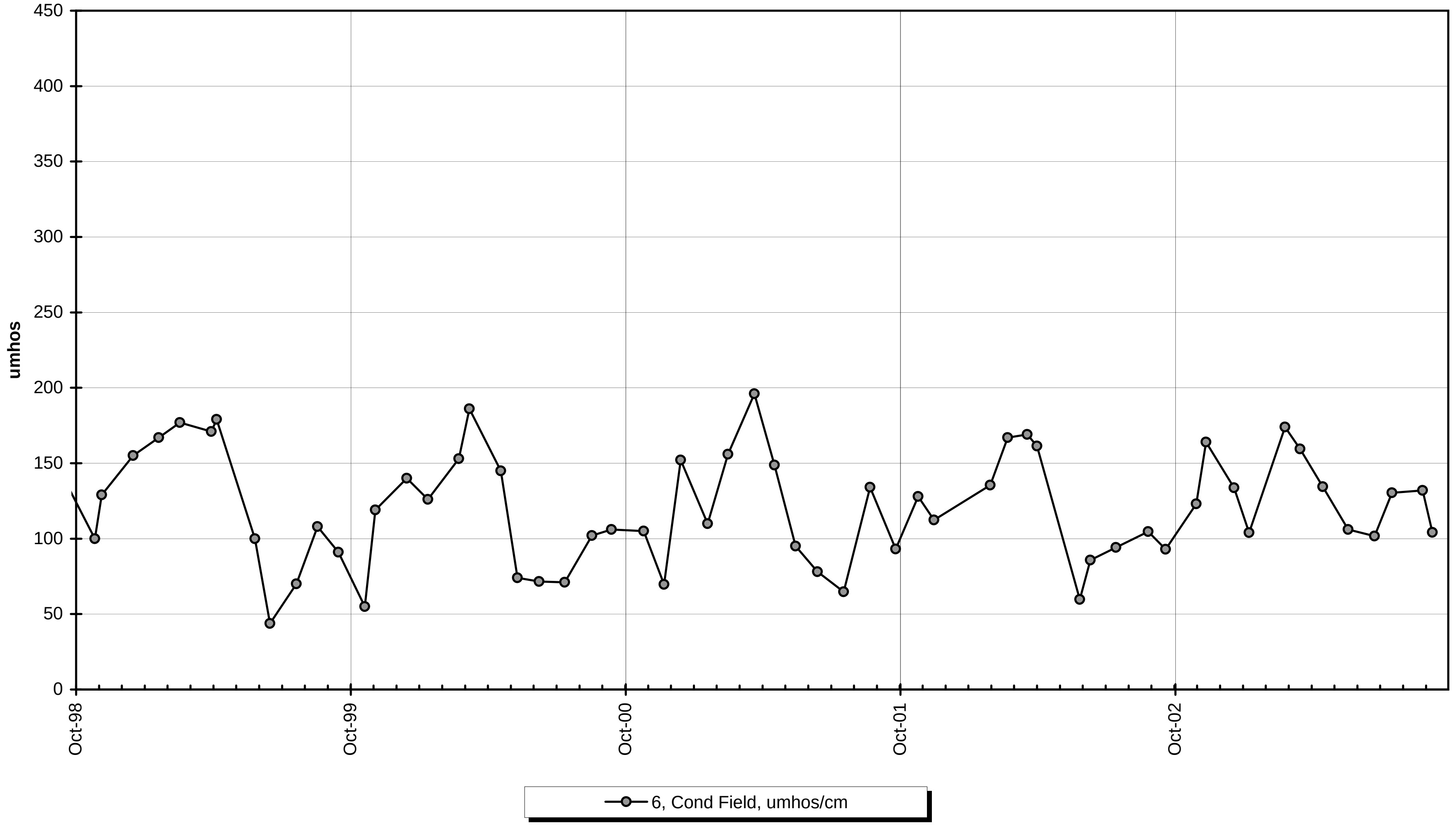
Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
6	03/17/2003	10:20:00 AM				
			Cd Diss, ug/l	0.107	J	LCS Recovery
			Cu Diss, ug/l	0.658	U	Field Blank Contamination
			Pb Diss, ug/l	0.0914	U	Field Blank Contamination
				0.0196	J	Below Quantitative Range, L
6	04/16/2003	11:44:00 AM				
			As Diss, ug/l	0.294	U	Field Blank Contamination
			Pb Diss, ug/l	0.0521	U	Field Blank Contamination
6	06/24/2003	12:35:00 PM				
			As Diss, ug/l	0.212	J	Below Quantitative Range
			Hg Diss, ug/l	0.000822	U	Field Blank Contamination
6	07/17/2003	12:12:00 PM				
			Cd Diss, ug/l	0.0412	J	Below Quantitative Range
			Cu Diss, ug/l	0.432	J	Continuing Calibration Verific
			Zn Diss, ug/l	3.29	U	Field Blank Contamination
			Hg Diss, ug/l	0.000868	U	Field Blank Contamination
6	08/27/2003	1:20:00 PM				
			pH Lab, su	8.35	J	Hold Time
			SO4 Tot, mg/l	14.4	J	Sample Temperature
			As Diss, ug/l	0.653	U	Below Quantitative Range, M
			Cd Diss, ug/l	0.0544	J	Below Quantitative Range
6	09/09/2003	12:40:00 PM				
			SO4 Tot, mg/l	9.28	J	Sample Temperature
			As Diss, ug/l	0.301	J	Below Quantitative Range
			Cd Diss, ug/l	0.0333	J	Below Quantitative Range
			Pb Diss, ug/l	0.142	J	Below Quantitative Range
			Hg Diss, ug/l	0.00138	J	Duplicate RPD

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

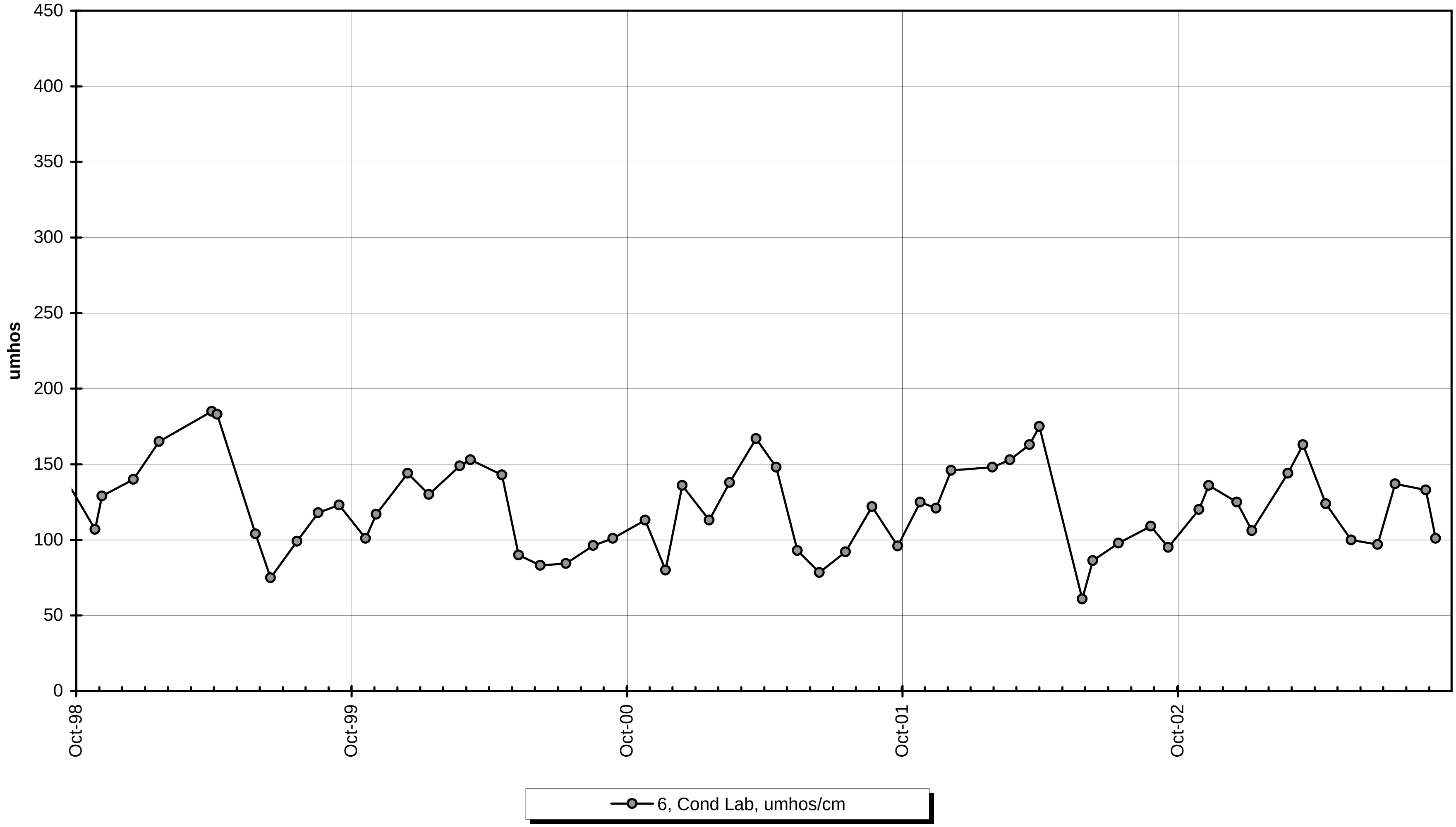
Site 6 -Water Temperature

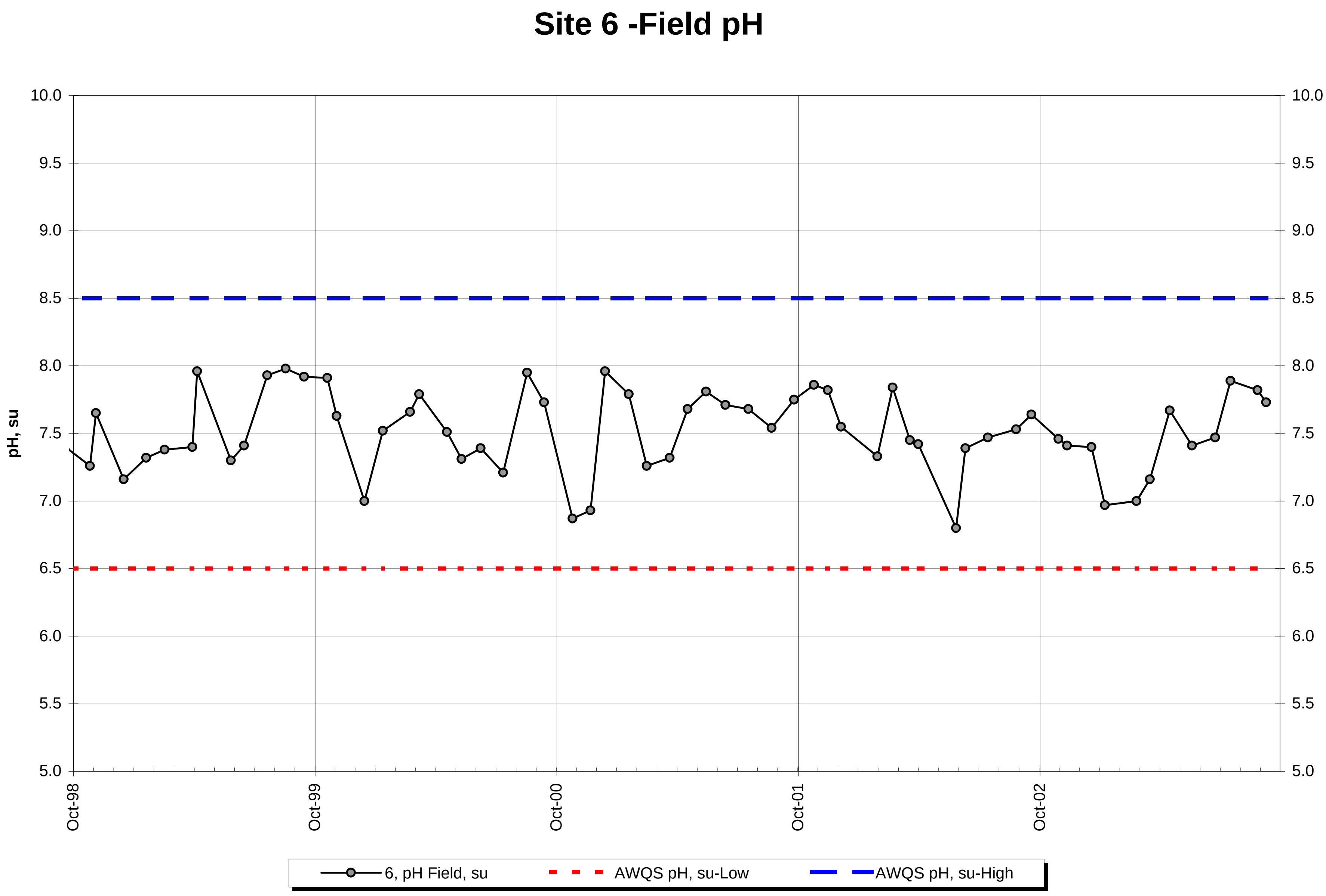


Site 6 -Conductivity-Field



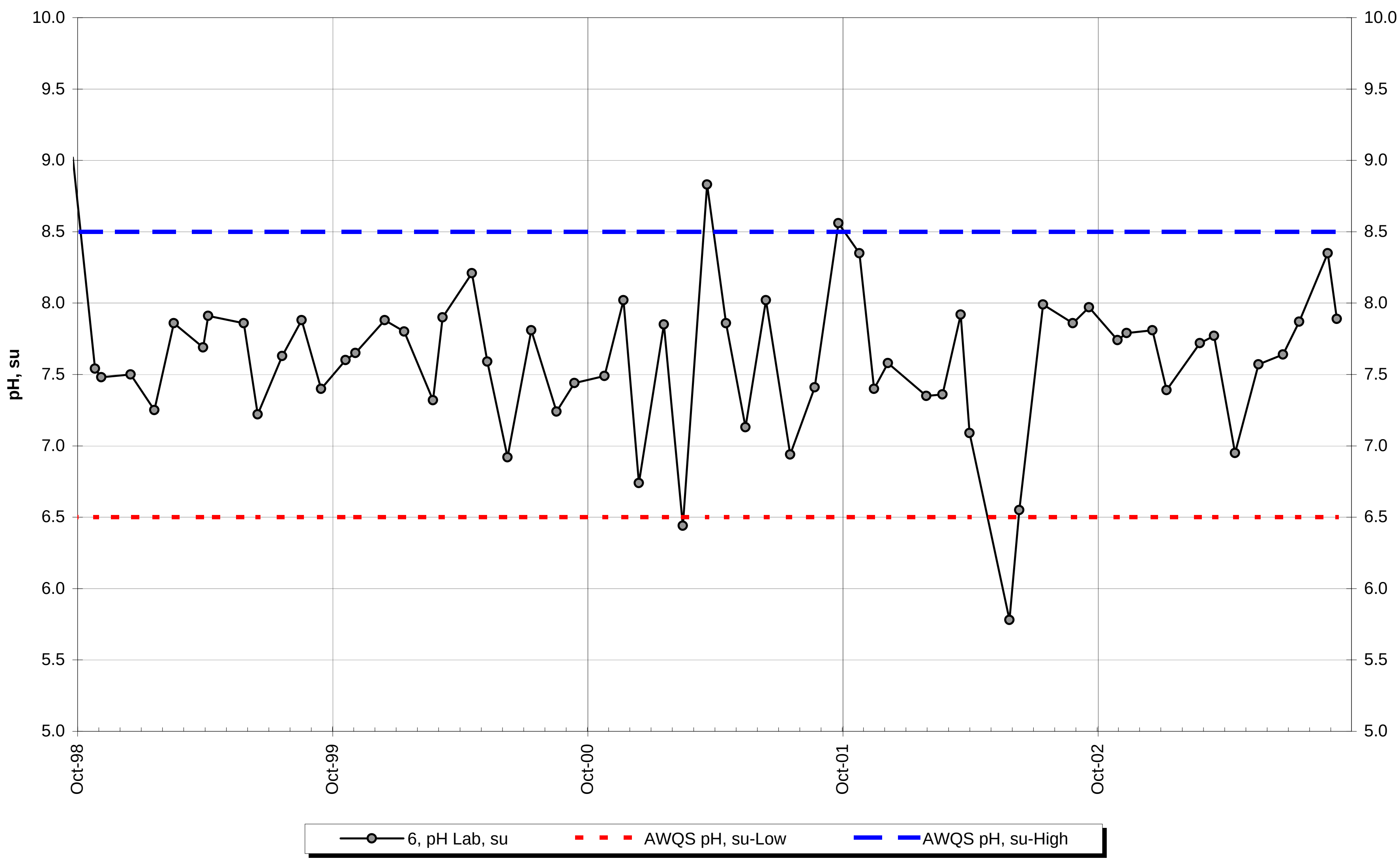
Site 6 -Conductivity-Lab





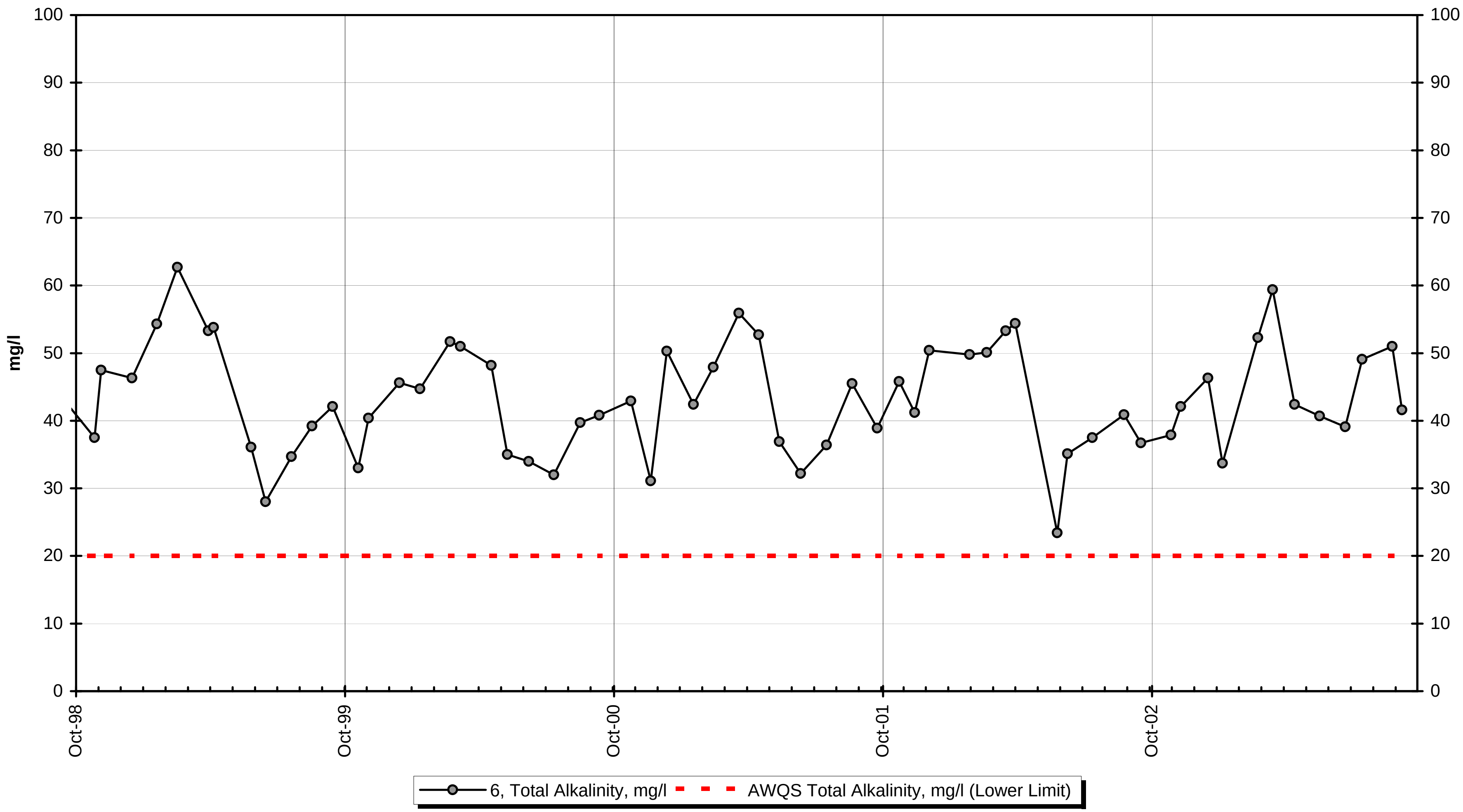
Site 6 -Field pH
pH, su
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
6, pH Field, su
AWQS pH, su-Low
AWQS pH, su-High

Site 6 -Lab pH

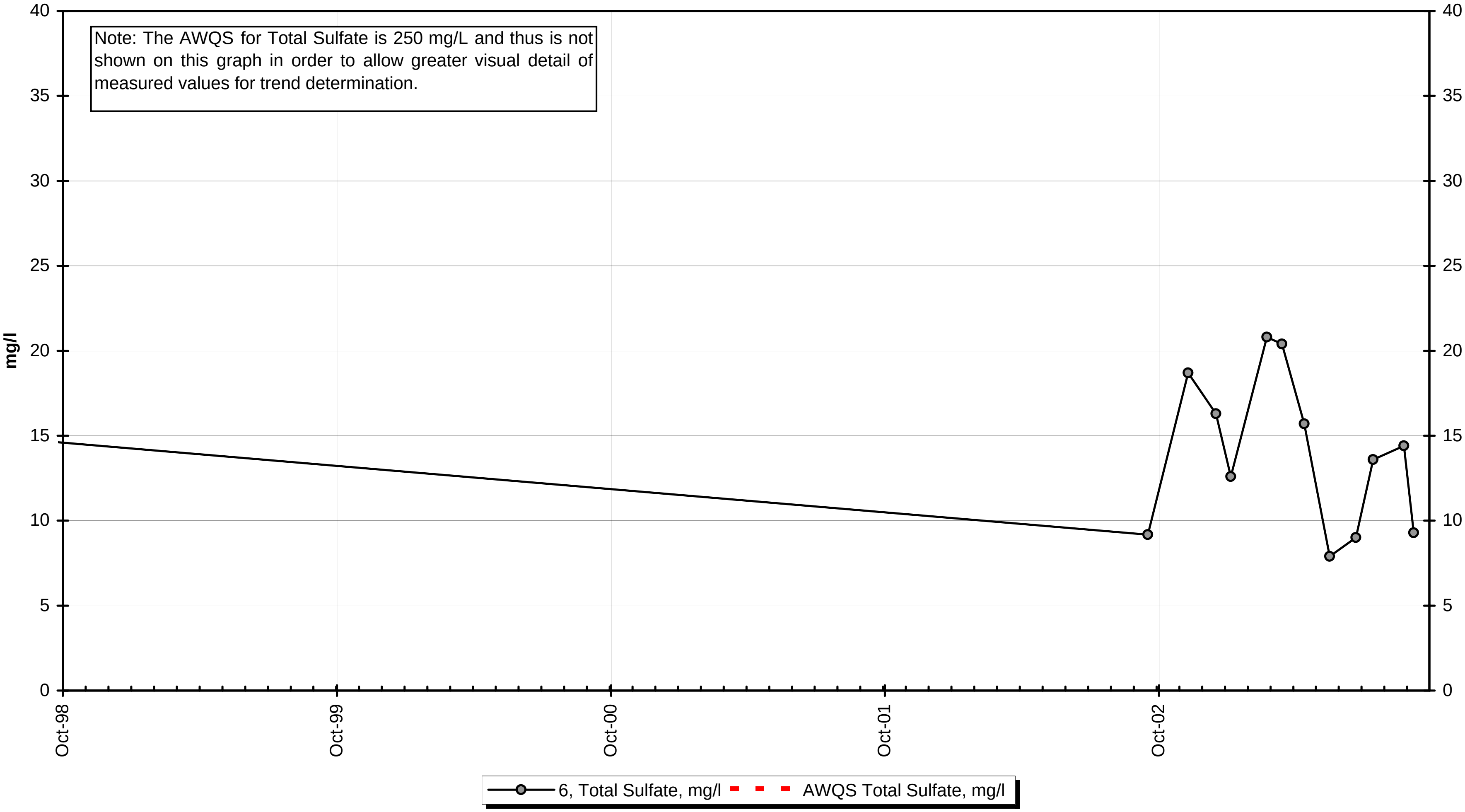


pH, su
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
6, pH Lab, su
AWQS pH, su-Low
AWQS pH, su-High

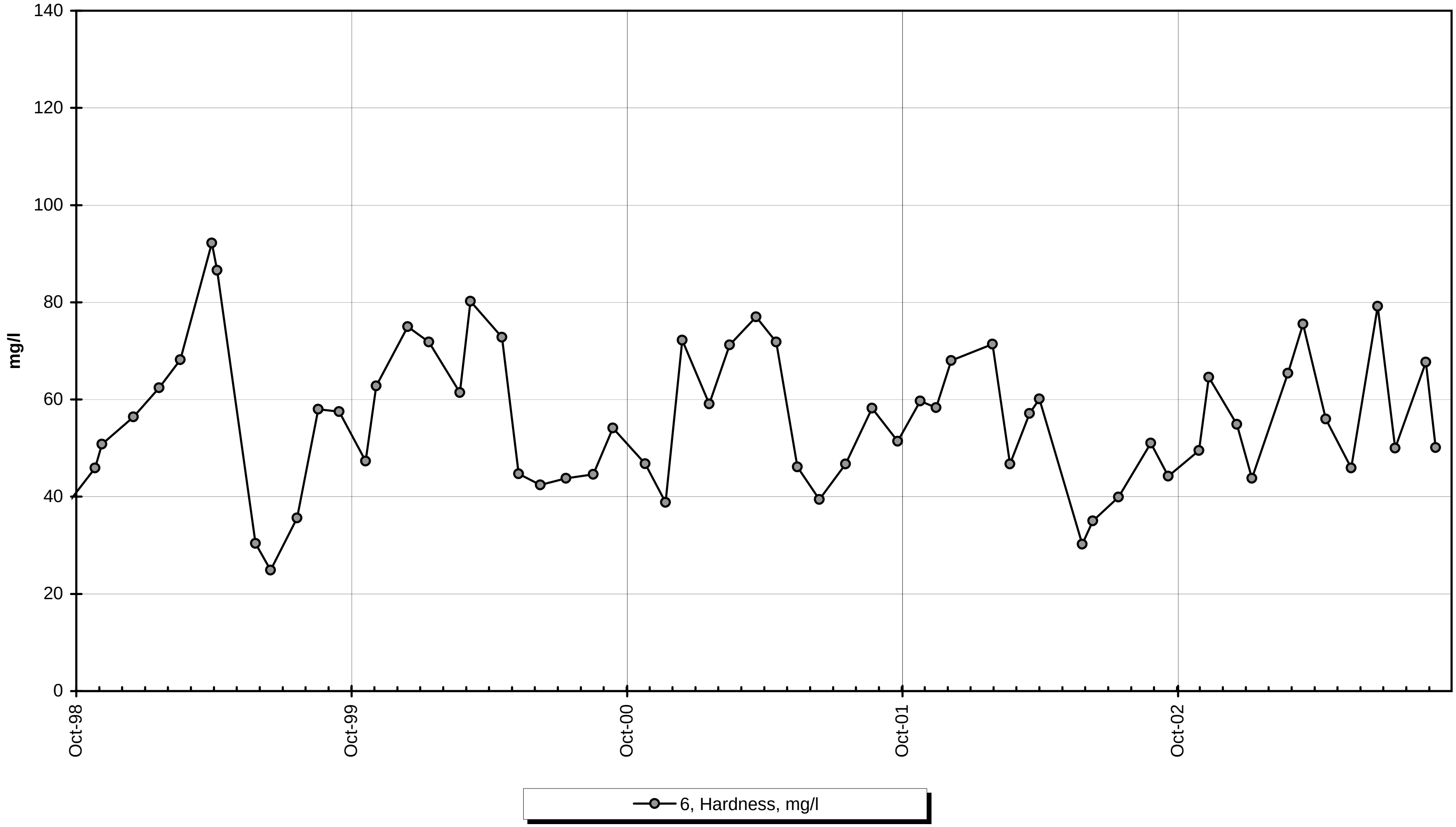
Site 6 -Total Alkalinity

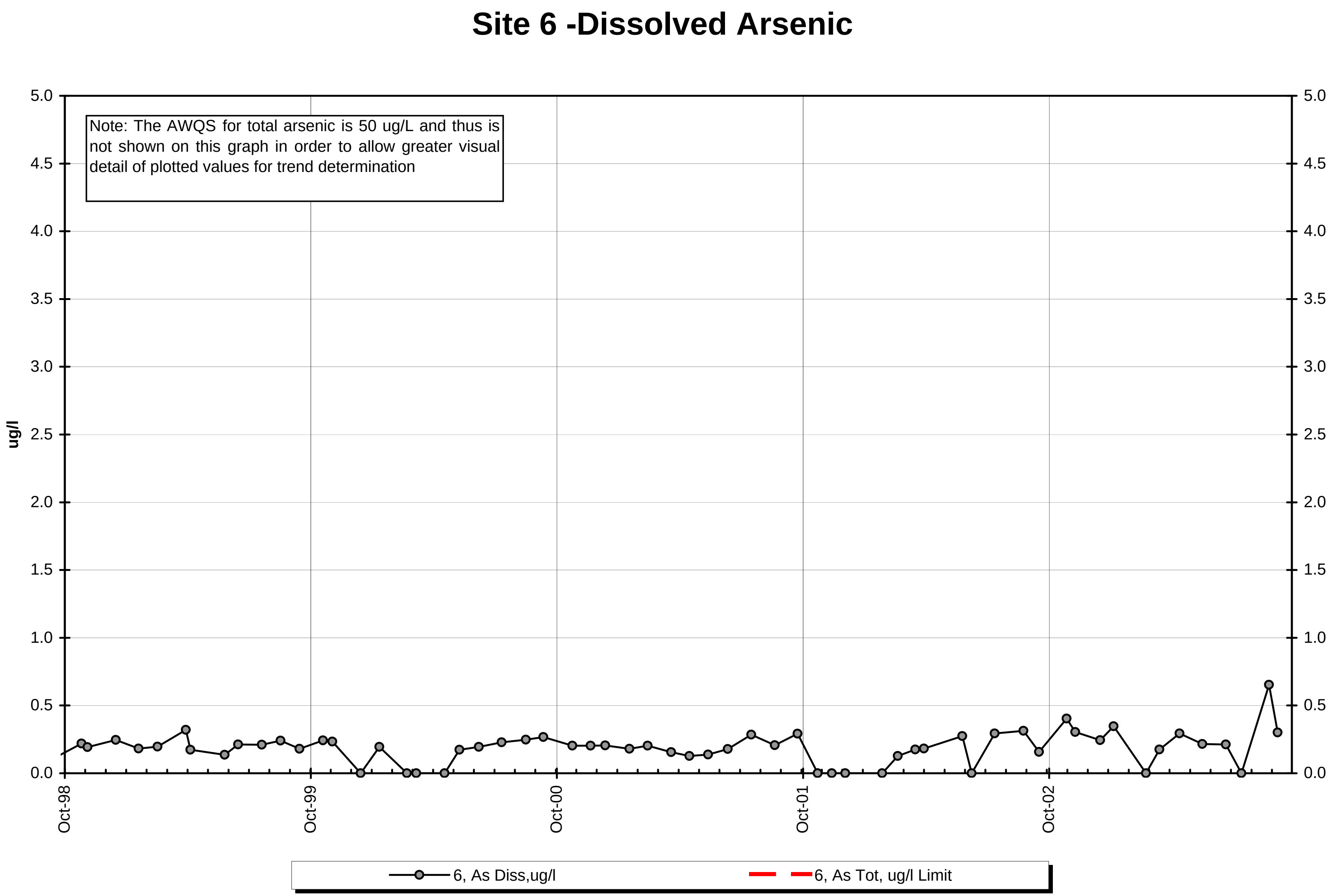


Site 6 -Total Sulfate

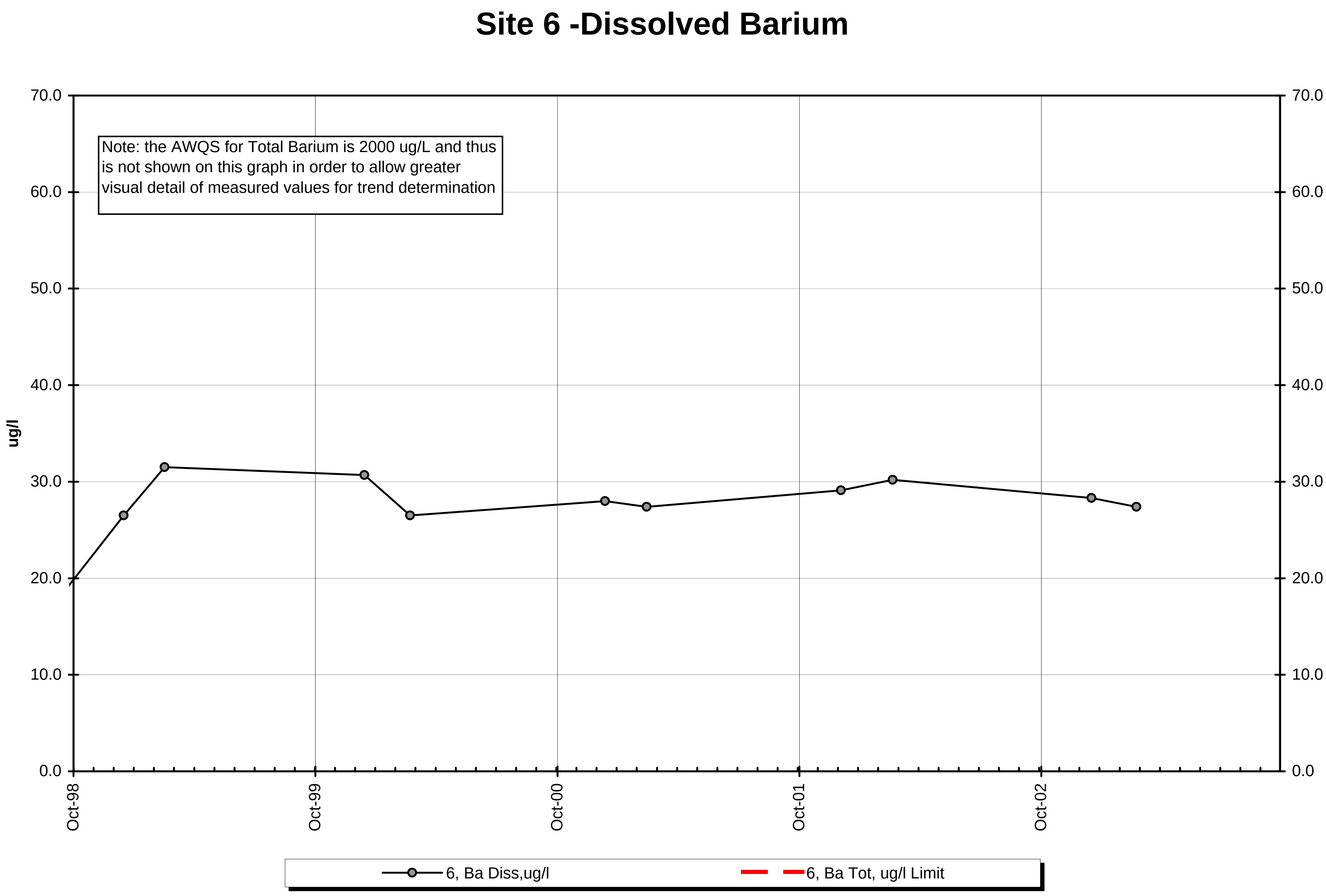


Site 6 -Hardness

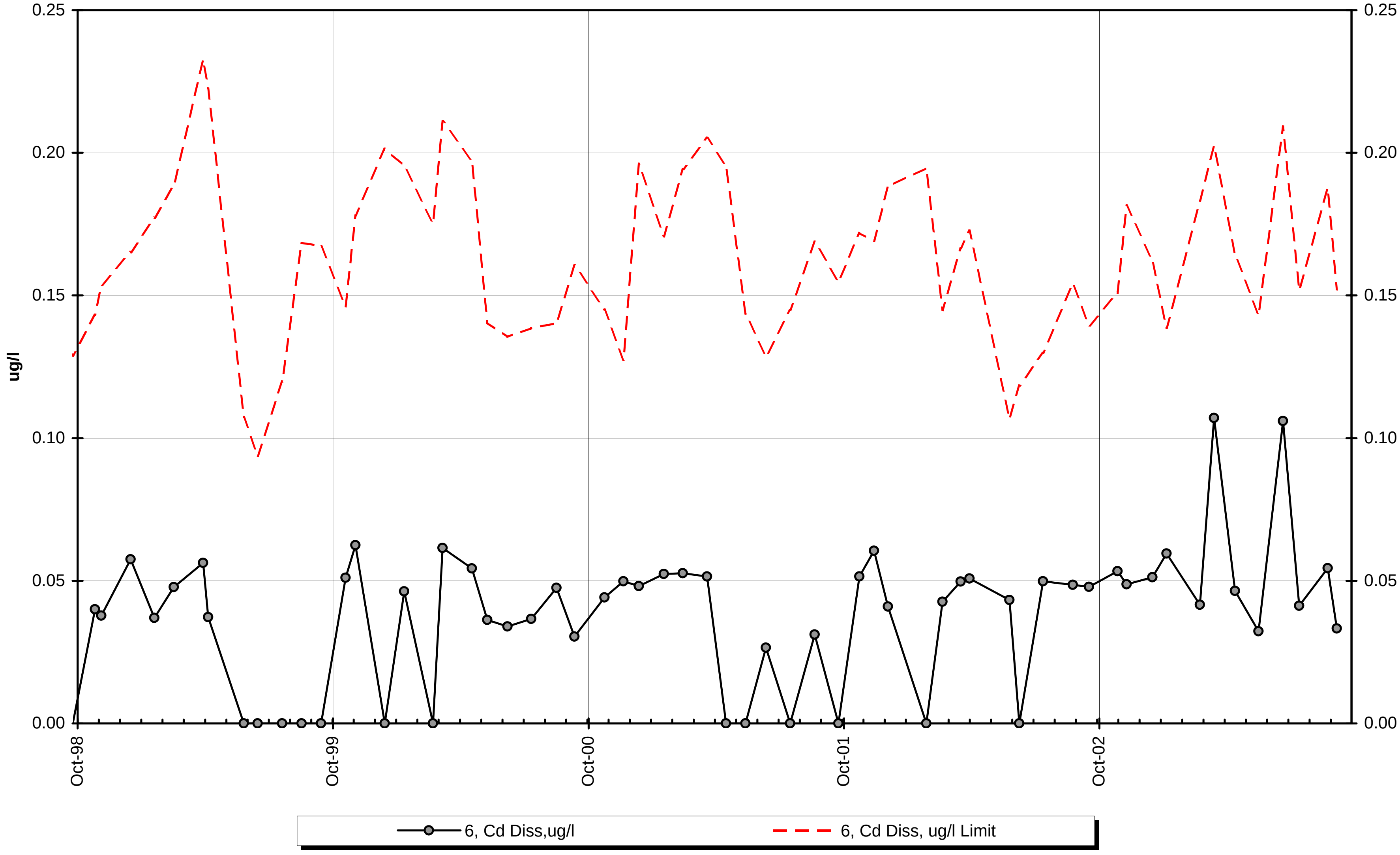


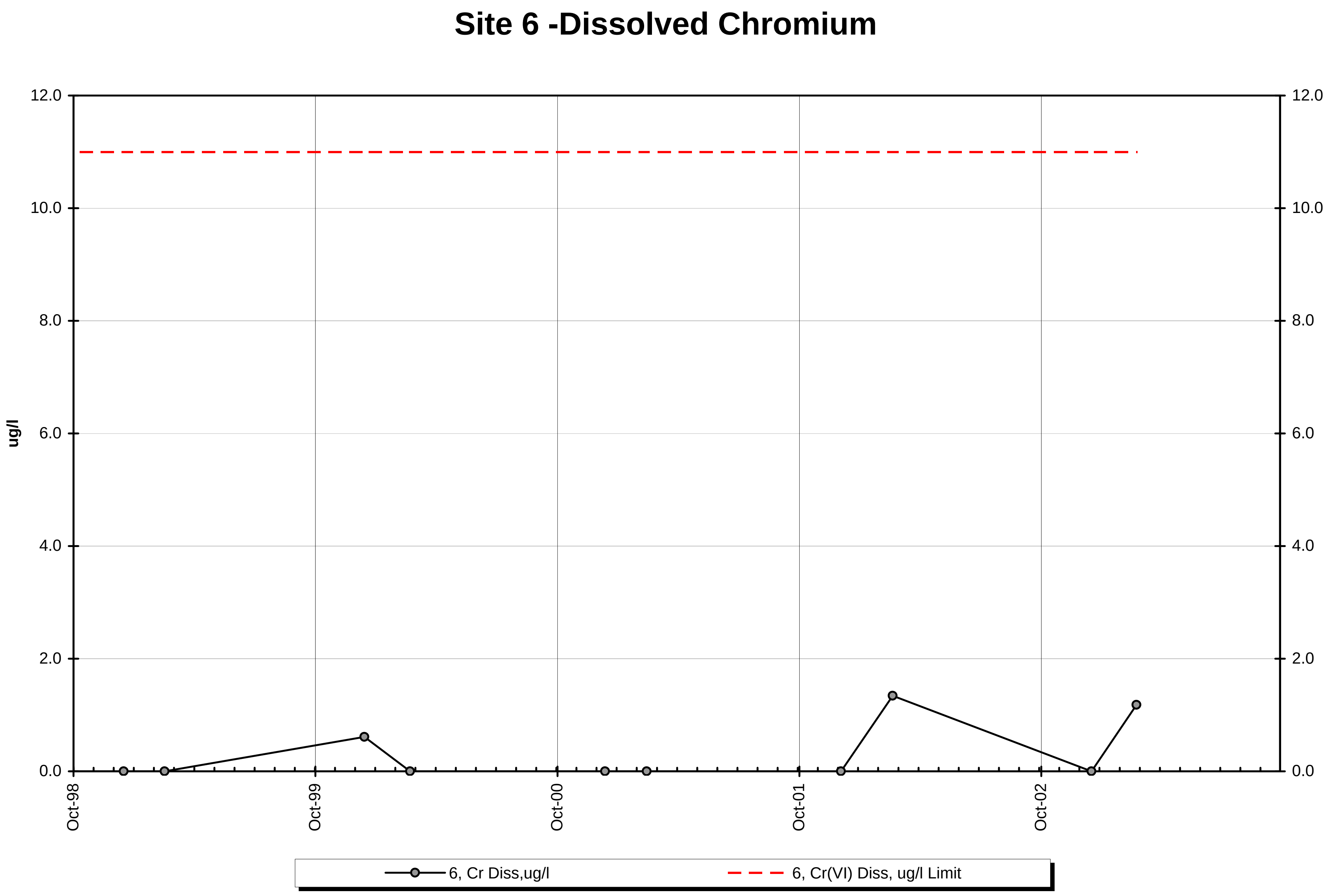


Site 6 -Dissolved Arsenic
Note: The AWQS for total arsenic is 50 ug/L and thus is not shown on this graph in order to allow greater visual detail of plotted values for trend determination
ug/l
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
6, As Diss,ug/l
6, As Tot, ug/l Limit

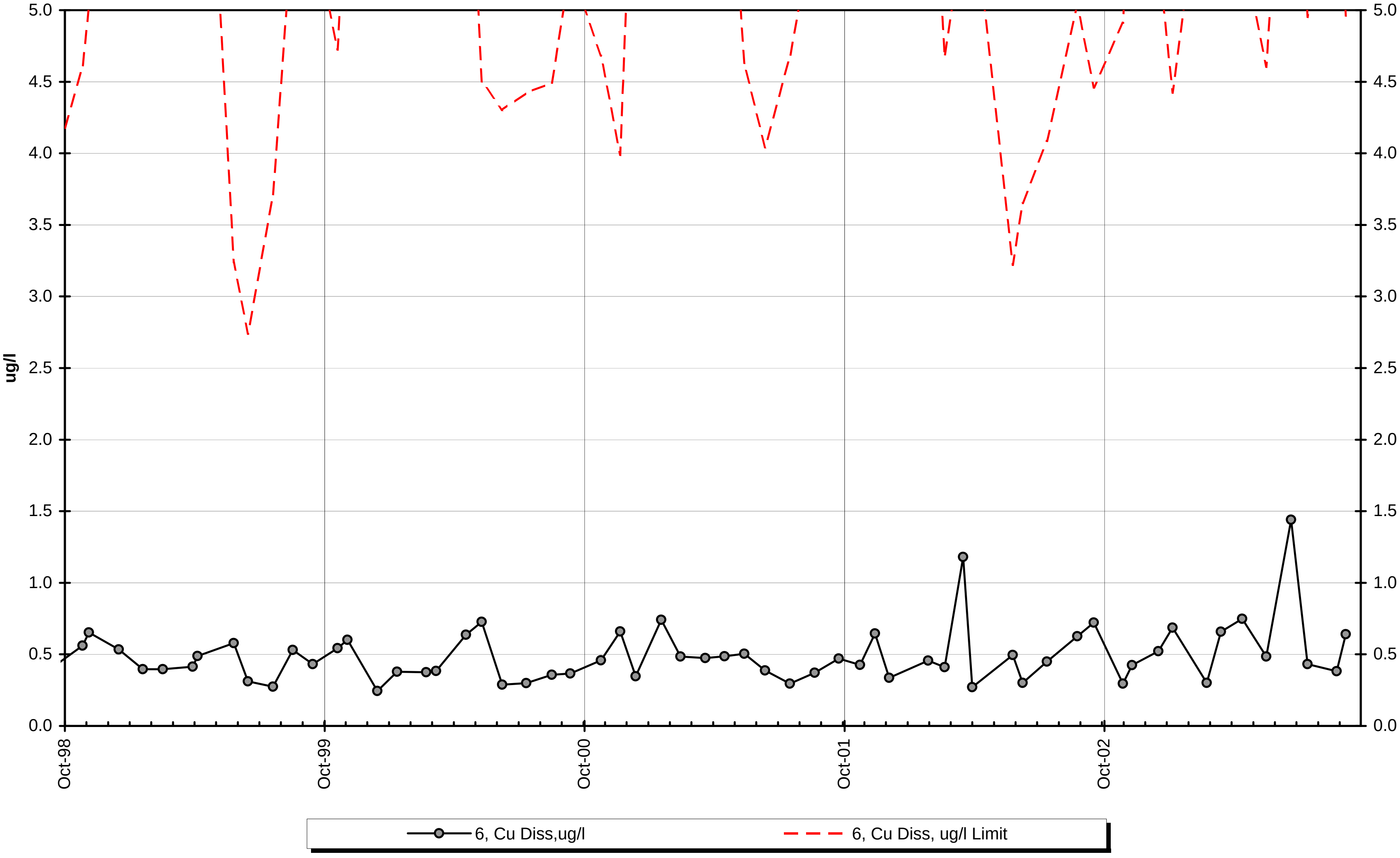

Site 6 -Dissolved Barium
Note: the AWQS for Total Barium is 2000 ug/L and thus is not shown on this graph in order to allow greater visual detail of measured values for trend determination
ug/l
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
6, Ba Diss,ug/l
6, Ba Tot, ug/l Limit

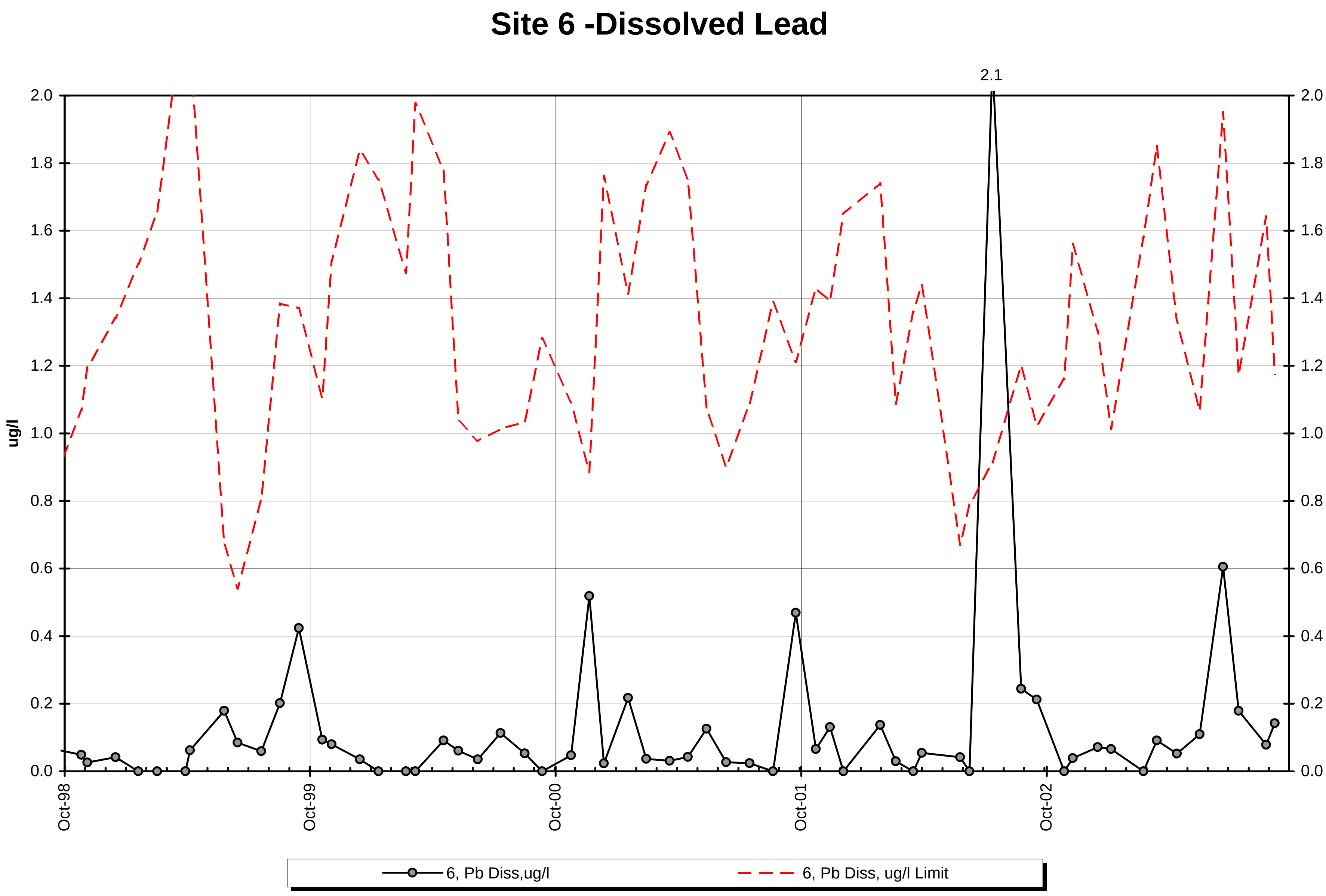
Site 6 -Dissolved Cadmium



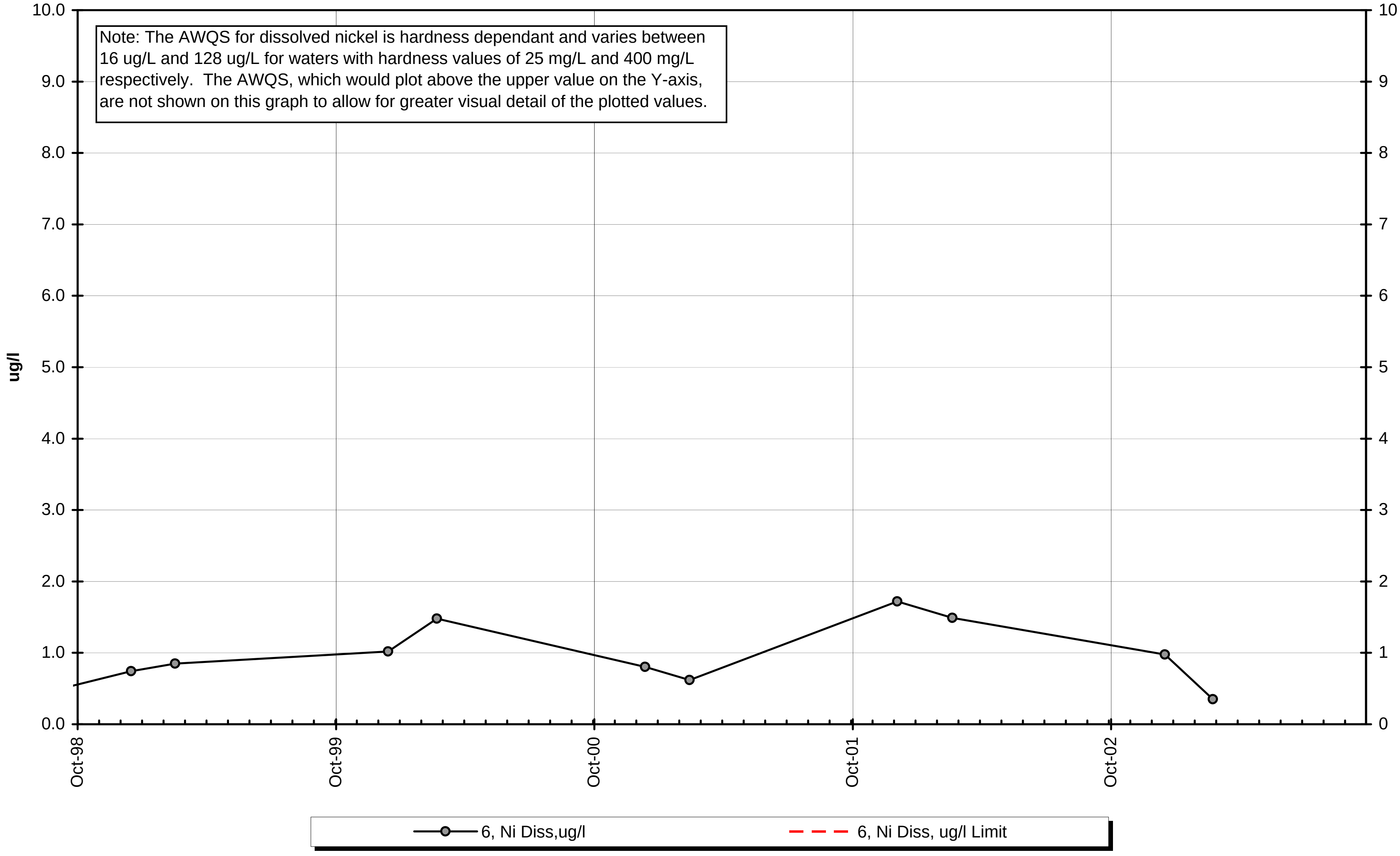

Site 6 -Dissolved Chromium
ug/l
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
6, Cr Diss,ug/l
6, Cr(VI) Diss, ug/l Limit

Site 6 -Dissolved Copper

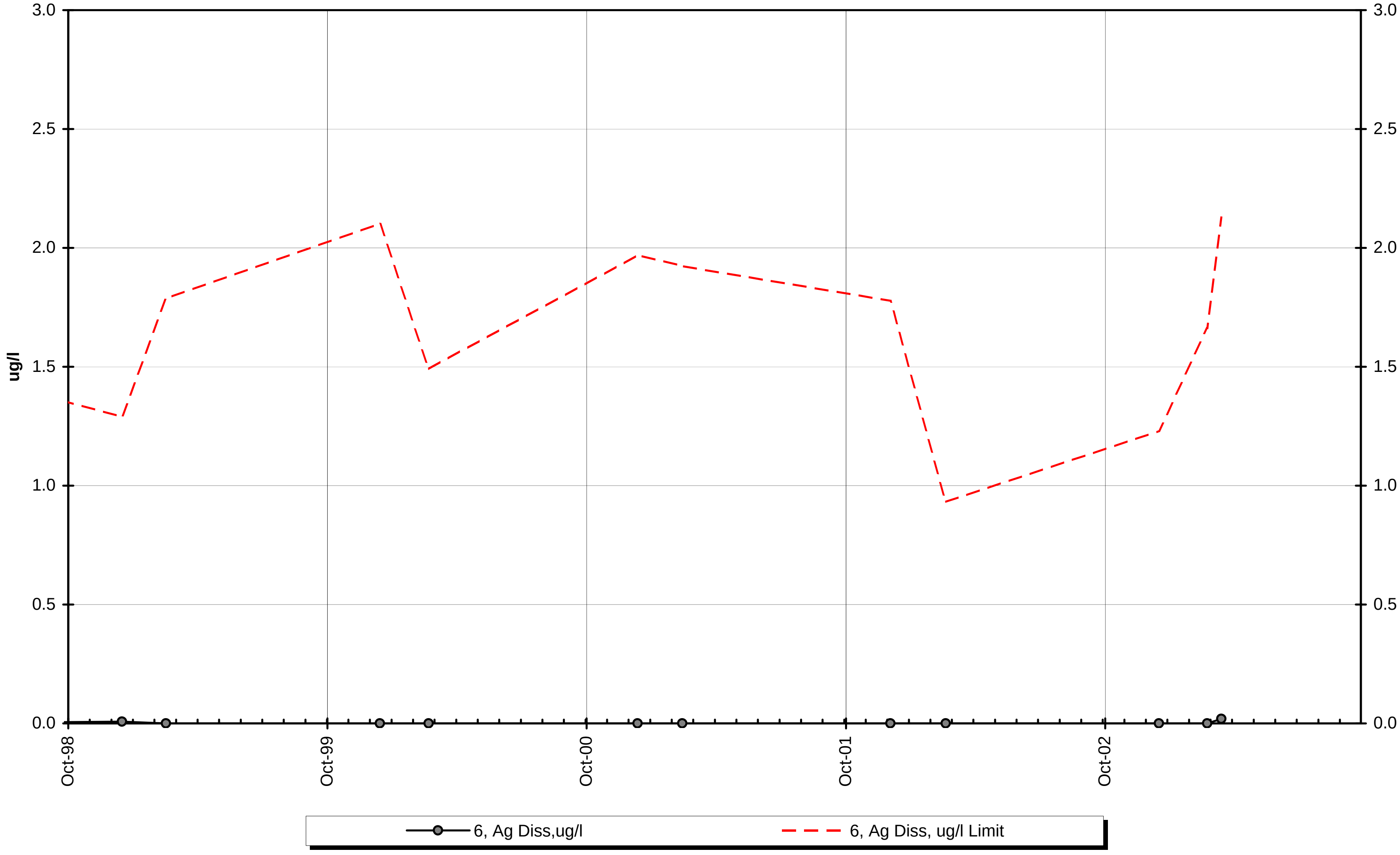


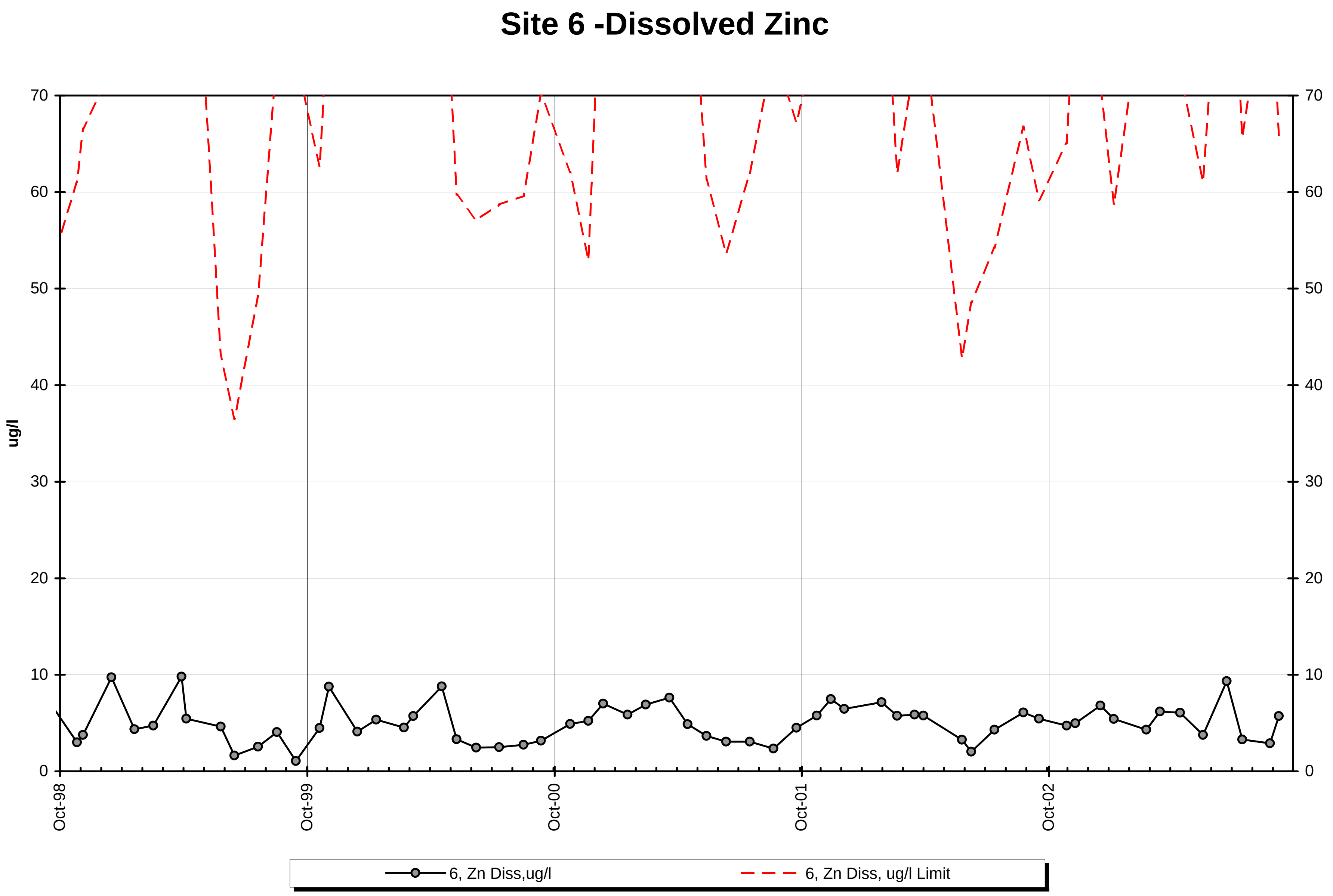

Site 6 -Dissolved Lead
2.1
ug/l
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
6, Pb Diss,ug/l
6, Pb Diss, ug/l Limit

Site 6 -Dissolved Nickel



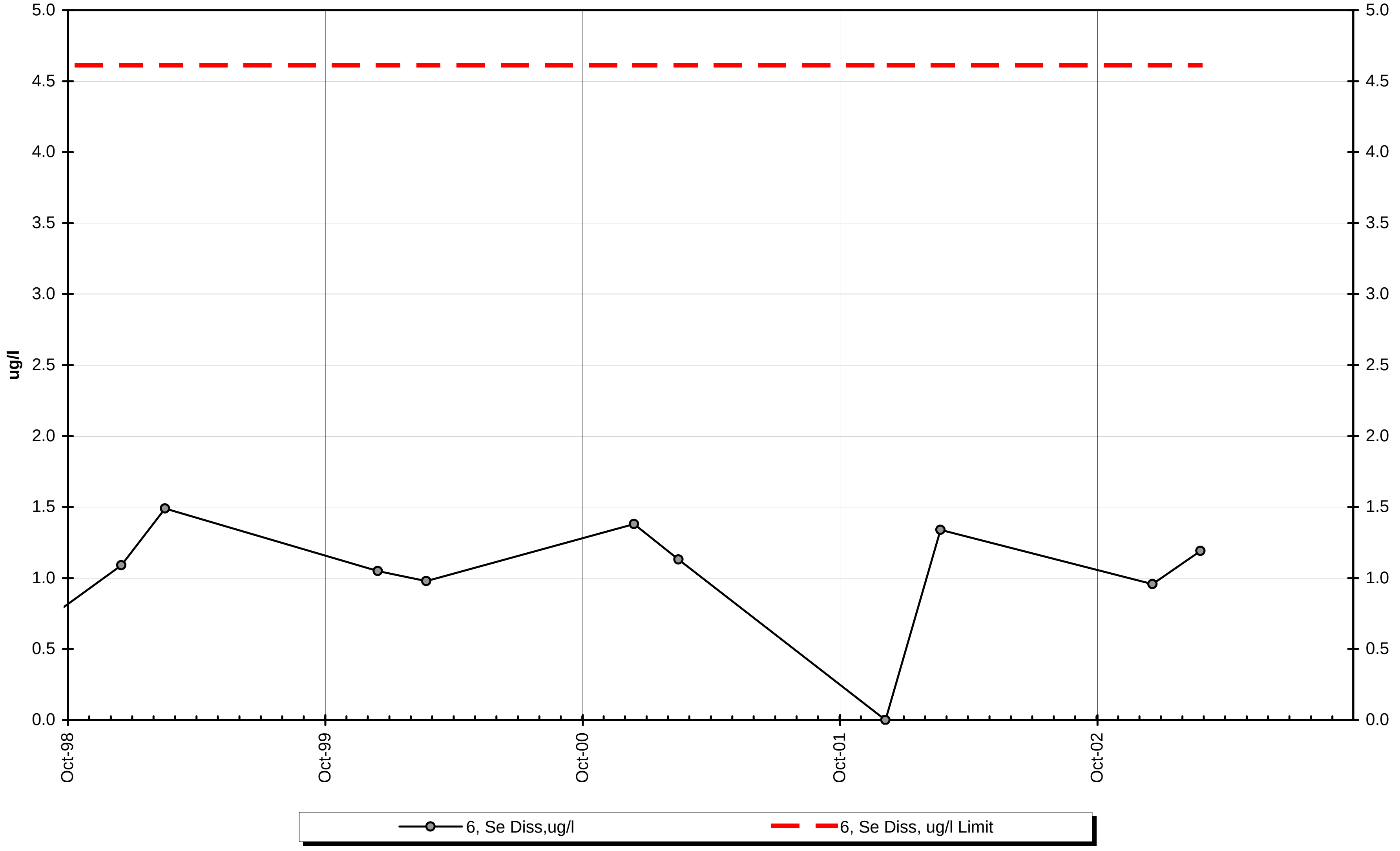
Site 6 -Dissolved Silver



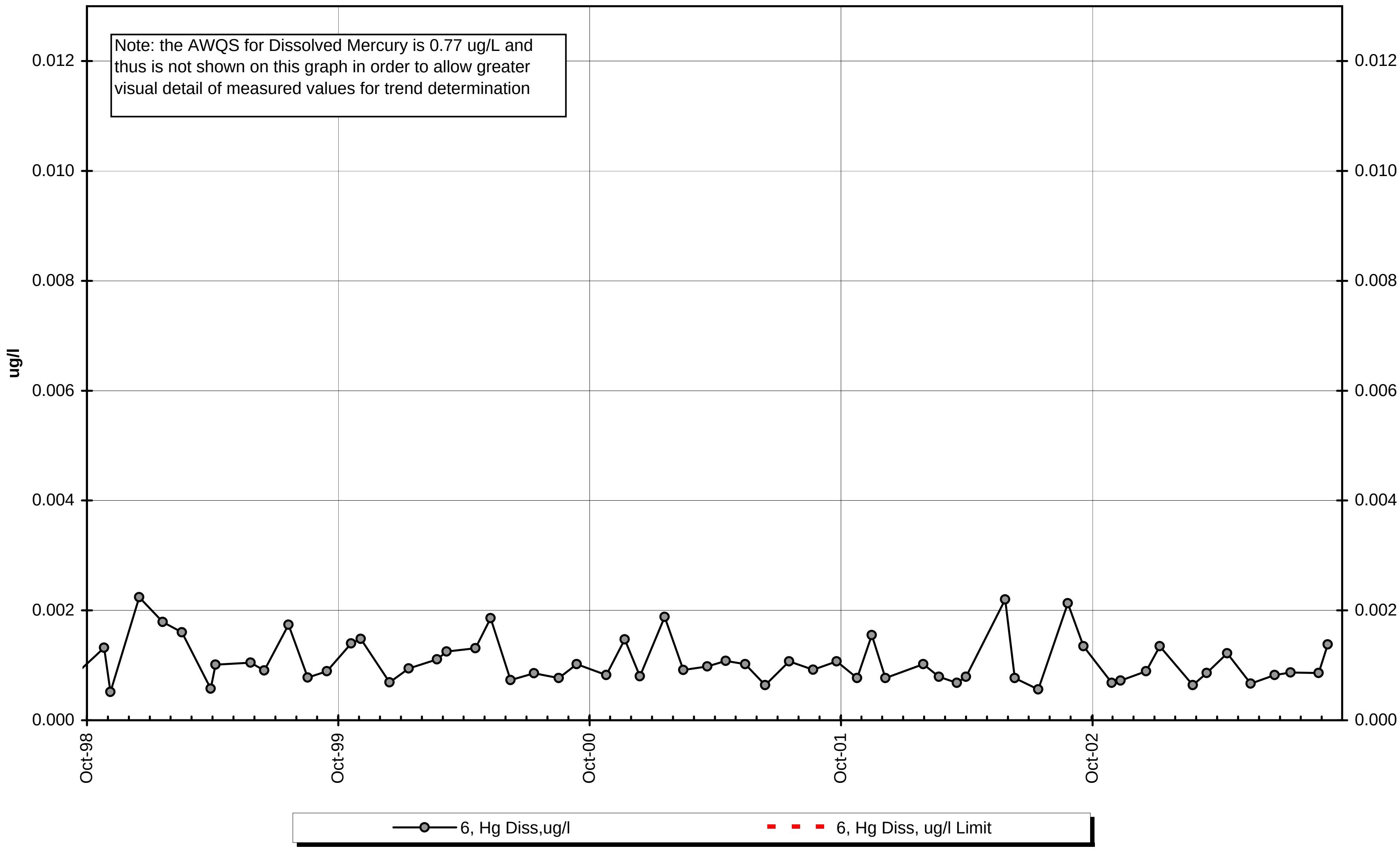


Site 6 -Dissolved Zinc
ug/l
0
10
20
30
40
50
60
70
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
6, Zn Diss,ug/l
6, Zn Diss, ug/l Limit

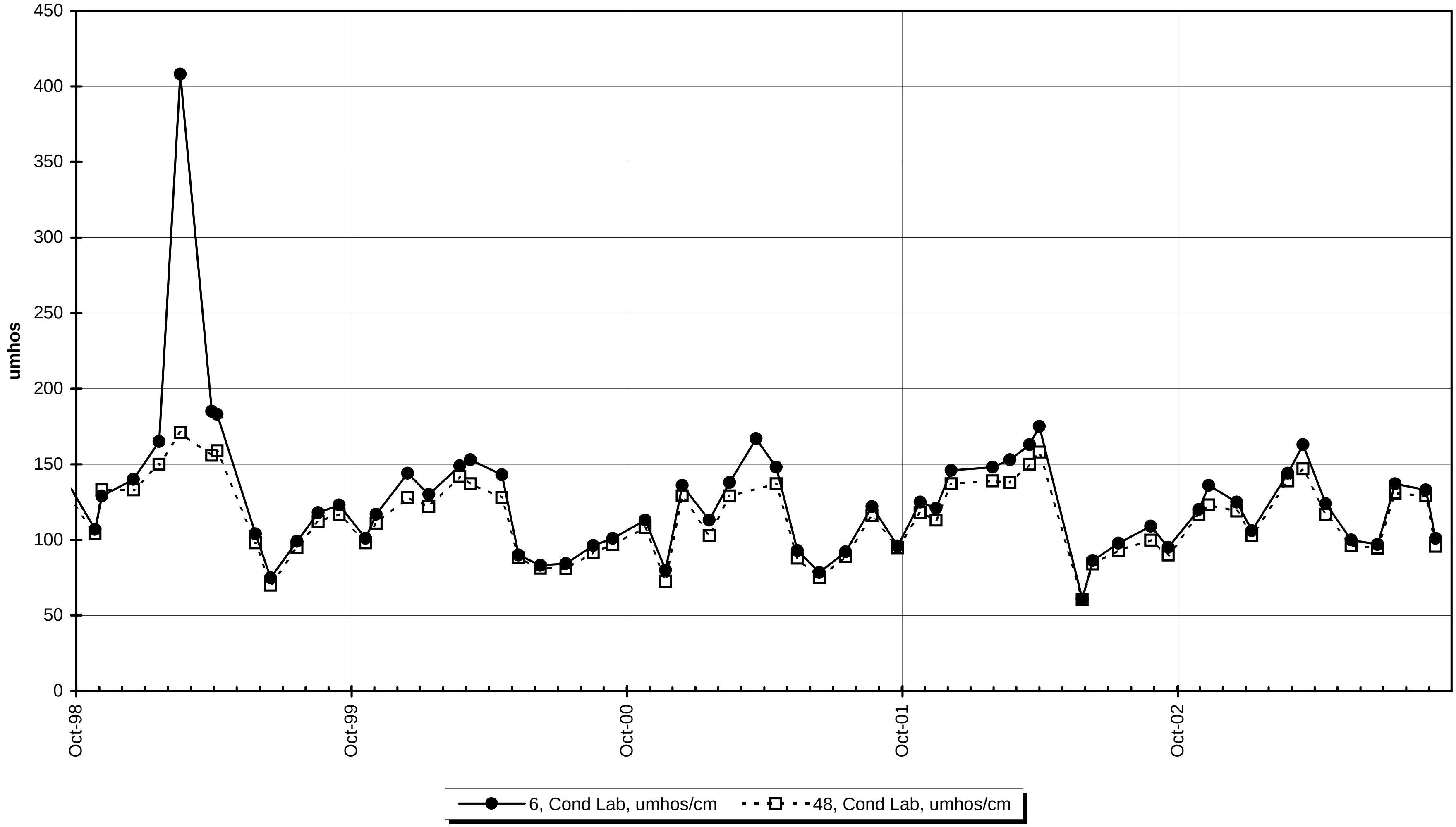
Site 6 -Dissolved Selenium

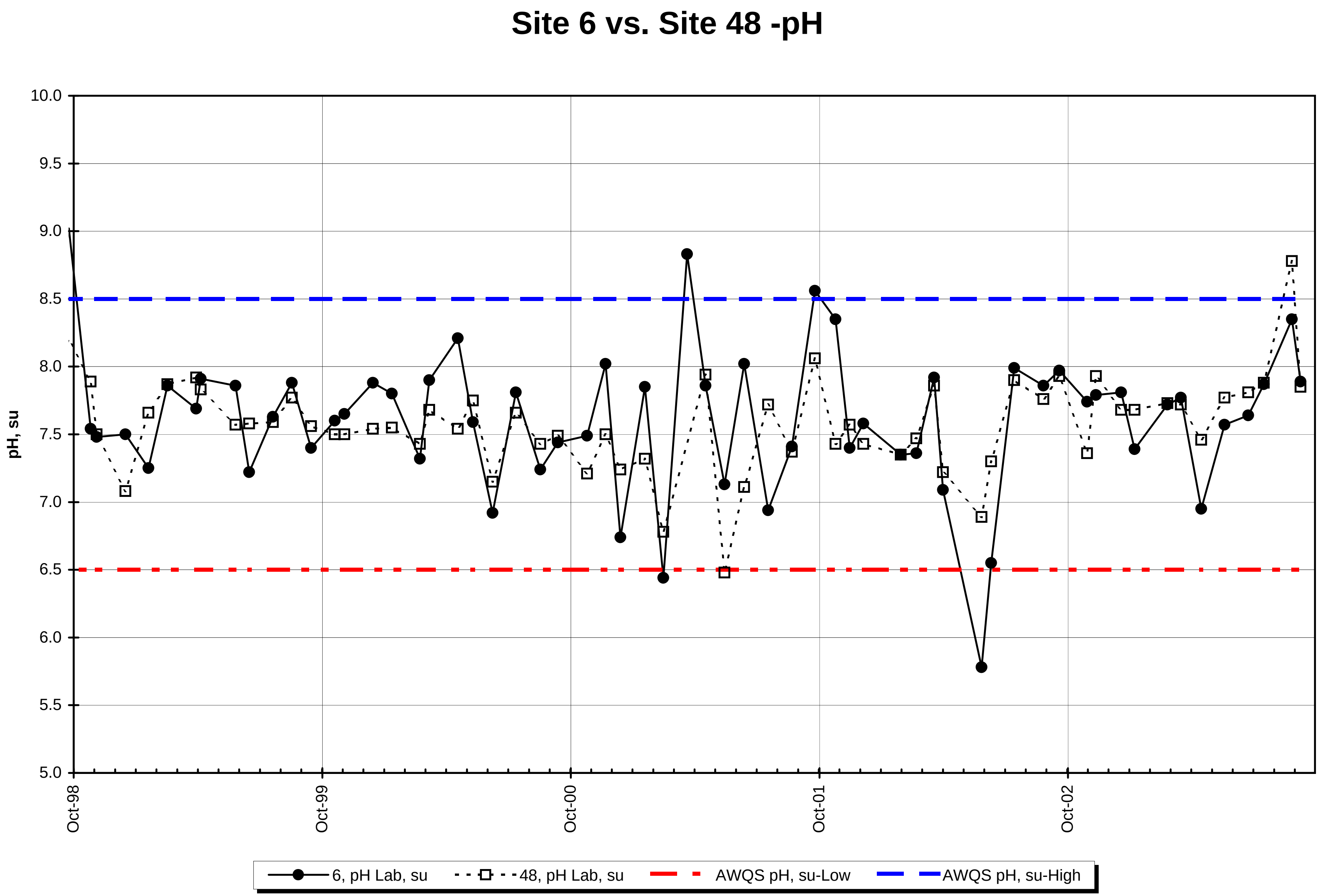


Site 6 -Dissolved Mercury



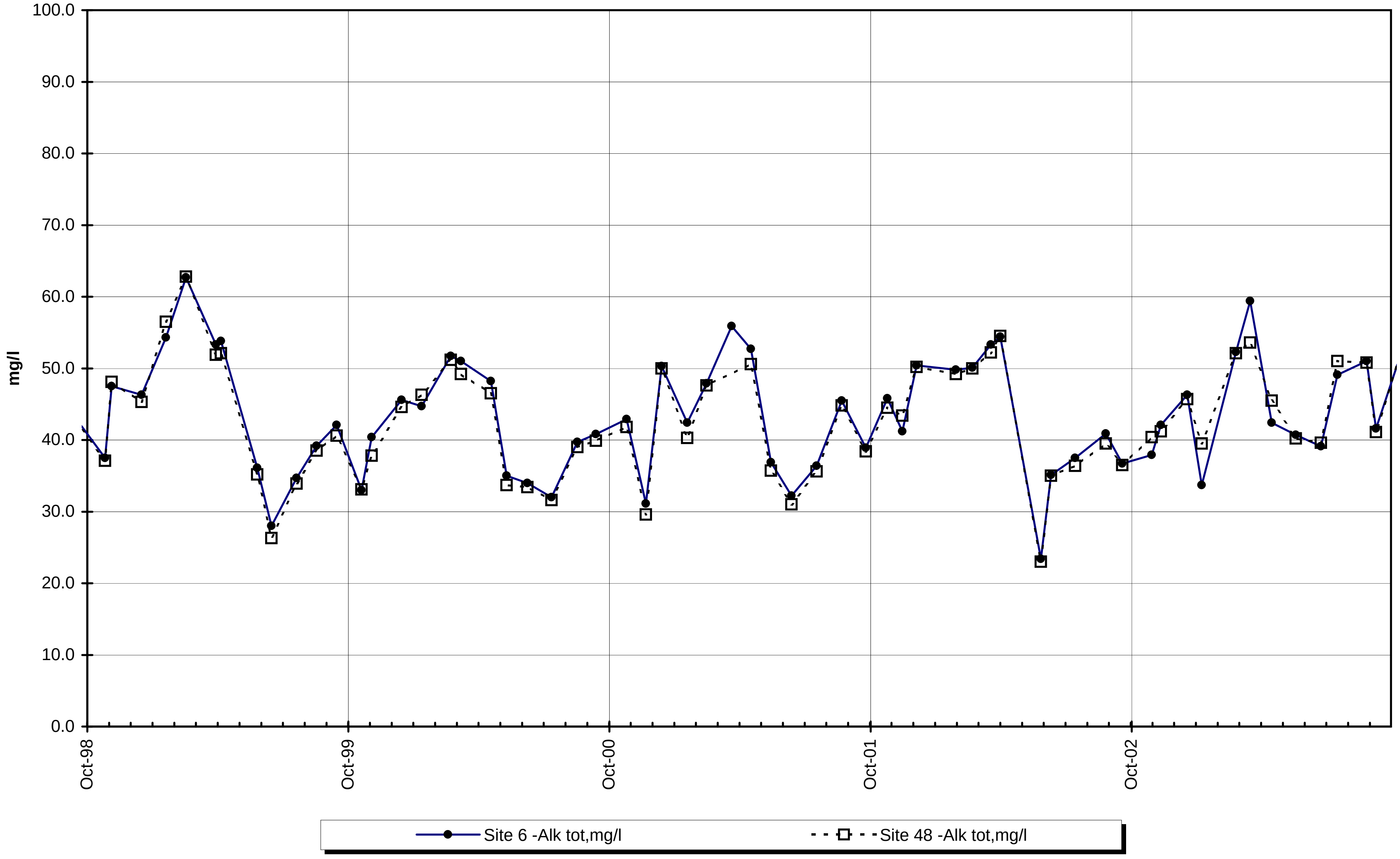
Site 6 vs Site 48 -Conductivity



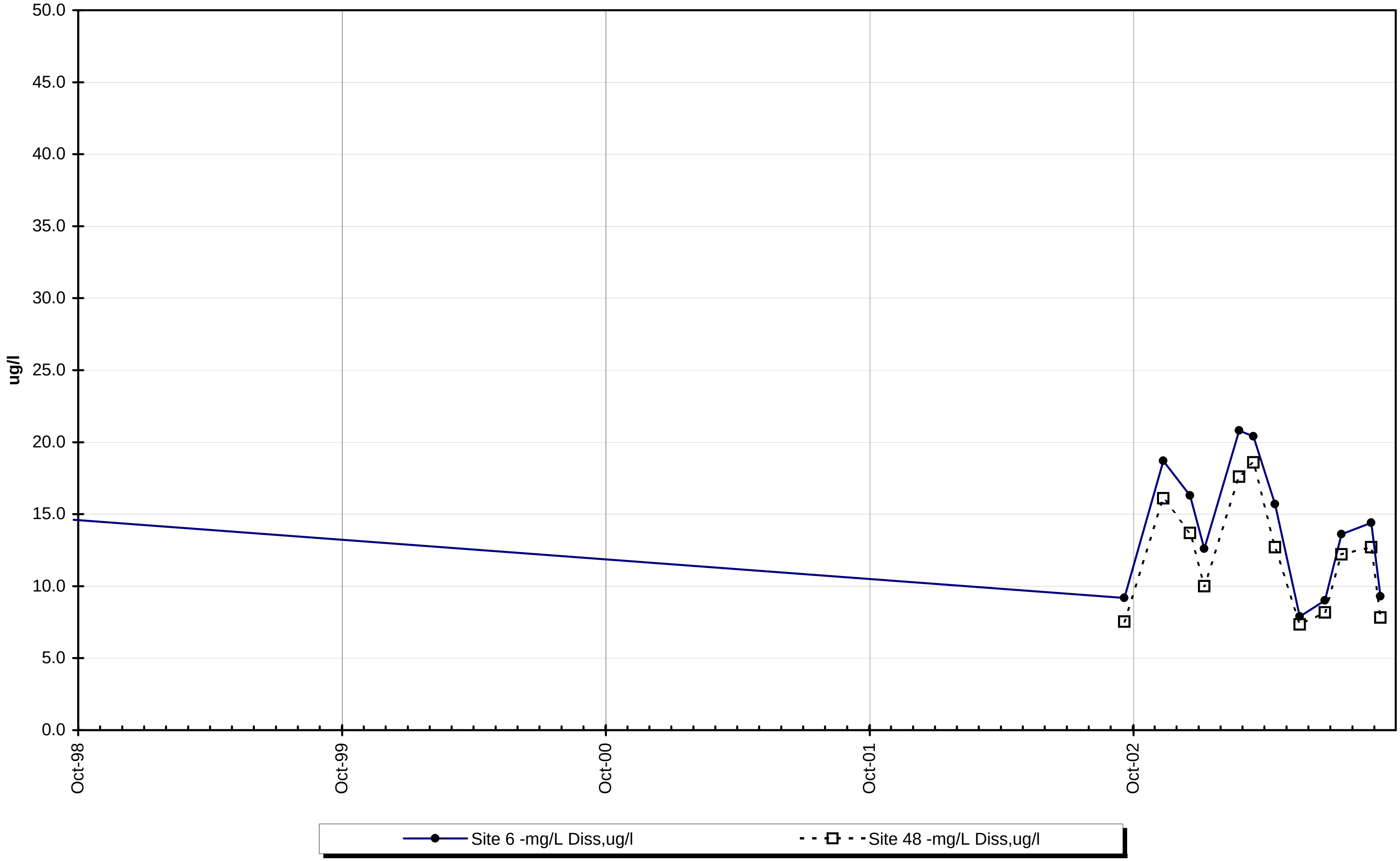


Site 6 vs. Site 48 -pH
pH, su
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
6, pH Lab, su
48, pH Lab, su
AWQS pH, su-Low
AWQS pH, su-High

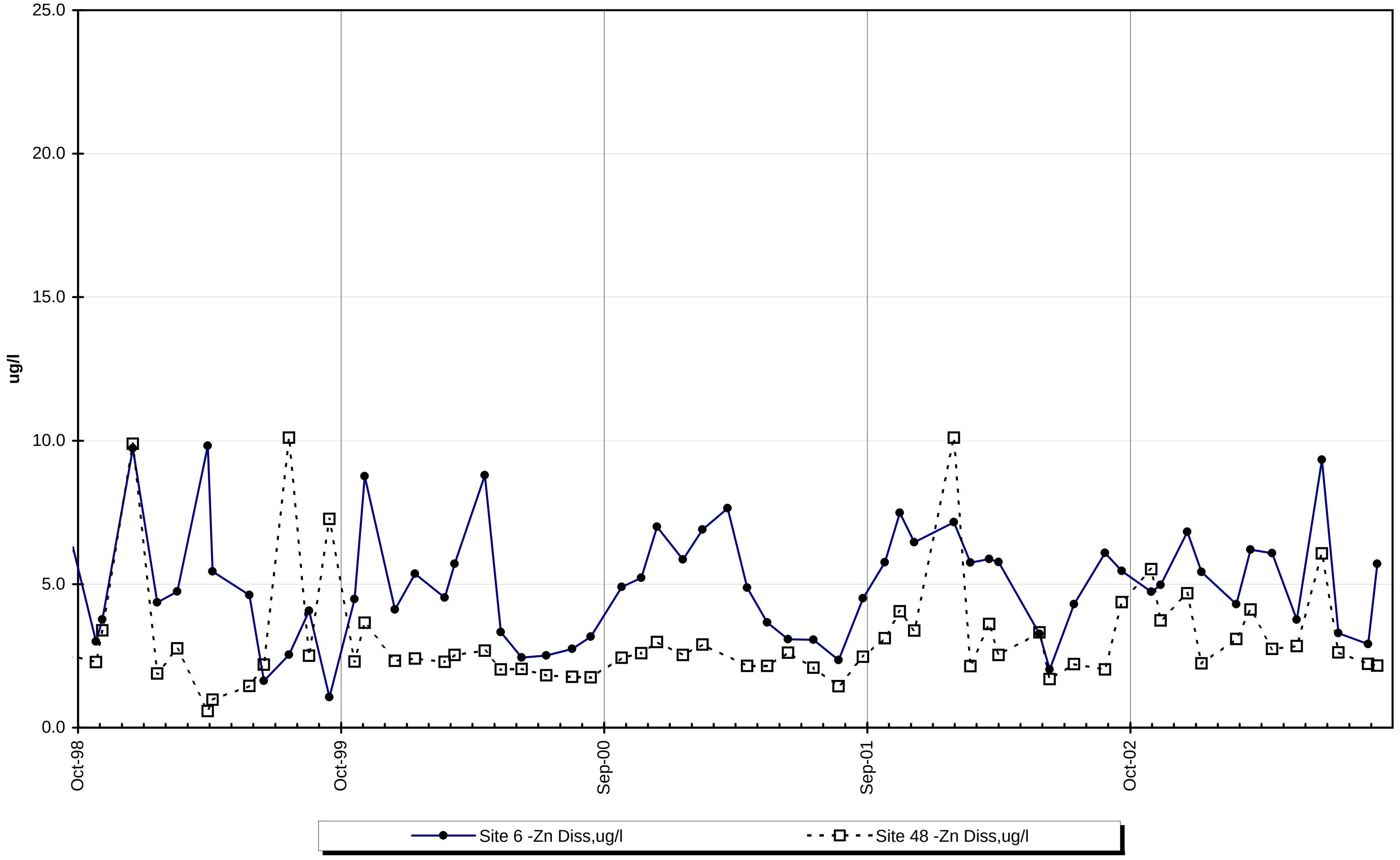
Site 6 vs. Site 48 -Total Alkalinity



Site 6 vs. Site 48 -Total Sulfate



Site 6 vs. Site 48 -Dissolved Zinc



Large Sample Approximation
Wilcoxon-Mann-Whitney Rank Sum Test

Variable: Specific Conductance, Lab (umhos/cm @ 25°C)

Site	#48	#6	Ranks	
Year	WY2003	WY2003	**A**	**B**
Oct	117.0	120.0	9.5	12
Nov	123.0	136.0	13	19
Dec	119.0	125.0	11	15
Jan	103.0	106.0	7	8
Feb	139.0	144.0	21	22
Mar	147.0	163.0	23	24
Apr	117.0	124.0	9.5	14
May	96.5	100.0	3	5
Jun	94.6	96.9	1	4
Jul	131.0	137.0	17	20
Aug	129.0	133.0	16	18
Sep	95.7	101.0	2	6
Median	118.00	124.50		

N= 24

ΣR 133 167

n	**m**
12	12

W= 89

w_α 18

Upper 126

Lower 18

μ_W= 150

σ_W= 17.32

Z_{rs}= 0.95

p-test

0.8297

$\alpha/2$

0.025

H_0

(μ_A=μ_B)

ACCEPT

Large Sample Approximation
Wilcoxon-Mann-Whitney Rank Sum Test
Variable: **pH, Lab, Standard Units**

Site	#48	#6	Ranks	
Year	WY2003	WY2003	**A**	**B**
Oct	7.36	7.74	2	12
Nov	7.93	7.79	22	15
Dec	7.68	7.81	7.5	16.5
Jan	7.68	7.39	7.5	3
Feb	7.73	7.72	11	9.5
Mar	7.72	7.77	9.5	13.5
Apr	7.46	6.95	4	1
May	7.77	7.57	13.5	5
Jun	7.81	7.64	16.5	6
Jul	7.88	7.87	20	19
Aug	8.78	8.35	24	23
Sep	7.85	7.89	18	21
Median	7.75	7.76		

N= 24

ΣR 155.5 144.5

n	**m**
12	12

W= 66.5

w_α 18

Upper 126

Lower 18

μ_W= 150

σ_W= 17.31

Z_{rs}= -0.29

p-test

$\boxed{0.3863}$

$\alpha/2$

$\boxed{0.025}$

H_0

$(\mu_A=\mu_B)$

ACCEPT

Large Sample Approximation
Wilcoxon-Mann-Whitney Rank Sum Test
Variable: **Total Alk, (mg/l)**

Site	#48	#6	Ranks	
Year	WY2003	WY2003	**A**	**B**
Oct	40.40	37.90	7	2
Nov	41.20	42.10	10	12
Dec	45.70	46.30	15	16
Jan	39.50	33.70	4	1
Feb	52.10	52.30	21	22
Mar	53.60	59.40	23	24
Apr	45.50	42.40	14	13
May	40.20	40.70	6	8
Jun	39.60	39.10	5	3
Jul	51.00	49.10	19.5	17
Aug	50.80	51.00	18	19.5
Sep	41.10	41.60	9	11
Median	43.35	42.25		

N= 24

ΣR 151.5 148.5

	n	**m**
	12	12

W= 70.5

w_{α} 18

Upper 126

Lower 18

μ_W= 150

σ_W= 17.32

Z_{rs}= -0.06

p-test

$\boxed{0.4770}$

$\alpha/2$

$\boxed{0.025}$

H_0

$(\mu_A=\mu_B)$

ACCEPT

Large Sample Approximation
Wilcoxon-Mann-Whitney Rank Sum Test
Variable: **Sulfate, Total (mg/l)**

Site	#48	#6	Ranks	
Year	WY2003	WY2003	**A**	**B**
Oct				
Nov	16.1	18.7	16	20
Dec	13.7	16.3	13	17
Jan	10.0	12.6	7	9
Feb	17.6	20.8	18	22
Mar	18.6	20.4	19	21
Apr	12.7	15.7	10.5	15
May	7.3	7.9	1	3
Jun	8.2	9.0	4	5
Jul	12.2	13.6	8	12
Aug	12.7	14.4	10.5	14
Sep	7.8	9.3	2	6
Median	12.7	14.4		

N= 22

ΣR	109	144
	n	**m**
	11	11

W= 78

w$_\alpha$ 18

Upper 103

Lower 18

μ_W= 126.5

σ_W= 15.22

Z_{rs}= 1.12

p-test

$\boxed{0.8679}$

$\alpha/2$

$\boxed{0.025}$

H_0

$(\mu_A=\mu_B)$

ACCEPT

Large Sample Approximation
Wilcoxon-Mann-Whitney Rank Sum Test
Variable: **Zinc, Dissolved (ug/l)**

Site	#48	#6	Ranks	
Year	WY2003	WY2003	**A**	**B**
Oct	5.5	4.7	18	15
Nov	3.7	5.0	10	16
Dec	4.7	6.8	14	23
Jan	2.2	5.4	3	17
Feb	3.1	4.3	8	13
Mar	4.1	6.2	12	22
Apr	2.7	6.1	5	21
May	2.8	3.8	6	11
Jun	6.1	9.3	20	24
Jul	2.6	3.3	4	9
Aug	2.2	2.9	2	7
Sep	2.2	5.7	1	19
Median	2.97	5.20		

N= 24 ΣR 103 197

	n	**m**
	12	12

W= 119

wα 18

Upper 126

Lower 18

μ_W= 150

σ_W= 17.32

Z_{rs}= 2.68

p-test

0.9964

$\alpha/2$

0.025

H_0

$(\mu_A=\mu_B)$

REJECT

Site **#6** Seasonal Mann-Kendall analysis for Specific Conductance, Lab (umhos/cm @ 25°C)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY1998**	123	138	123	147	135	155	159	106	86	115	131	134
b	**WY1999**	107	129	140	165		185	183	104	75	99	118	123
c	**WY2000**	101	117	144	130	149	153	143	90	83	84	96	101
d	**WY2001**	113	80	136	113	138	167	148	93	79	92	122	96
e	**WY2002**	125	121	146	148	153	163	175	61	86	98	109	95
f	**WY2003**	120	136	125	106	144	163	124	100	97	137	133	101
	n	6	6	6	6	5	6	6	6	6	6	6	6

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

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

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	28.33	28.33	28.33	28.33	16.67	28.33	28.33	28.33	28.33	28.33	28.33	28.33
$Z_k = S_k/\sigma_S$	0.56	-0.56	0.56	-1.32	0.98	0.00	-0.94	-1.32	1.32	0.19	0.19	-1.88
Z^2_k	0.32	0.32	0.32	1.73	0.96	0.00	0.88	1.73	1.73	0.04	0.04	3.53

ΣZ_k= -2.21

ΣZ^2_k= 11.58

Z-bar=$\Sigma Z_k/K$= -0.18

p(Z-bar)= 0.427

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

Σn	71
ΣS_k	-13
V(S)	40588
Z	-0.069
K	12

$\chi^2_h = \Sigma Z^2_k - K(\text{Z-bar})^2$= 11.18

p 0.43

@α=5% $\chi^2_{(K-1)}$= 19.68

Test for station homogeneity

$\chi^2_h < \chi^2_{(K-1)}$ ACCEPT

K*(Z-bar)^2= 0.41

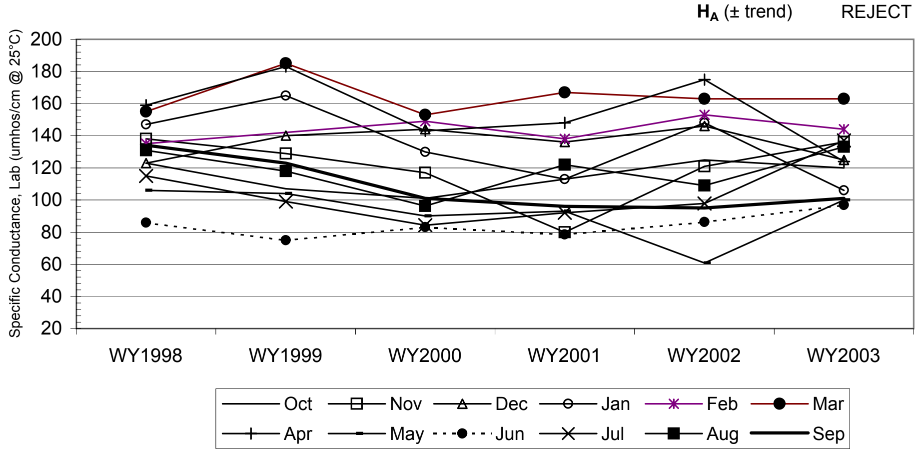
p 0.52

@α=5% $\chi^2_{(1)}$= 3.84

K*(Z-bar)² < $\chi^2_{(1)}$

H_0 (No trend) ACCEPT

H_A (± trend) REJECT



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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY1998**	7.74	7.20	8.16	7.63	8.10	7.88	8.17	8.06	6.96	7.27	7.67	9.02
b	**WY1999**	7.54	7.48	7.50	7.25	7.86	7.69	7.91	7.86	7.22	7.63	7.88	7.40
c	**WY2000**	7.60	7.65	7.88	7.80	7.32	7.90	8.21	7.59	6.92	7.81	7.24	7.44
d	**WY2001**	7.49	8.02	6.74	7.85	6.44	8.83	7.86	7.13	8.02	6.94	7.41	8.56
e	**WY2002**	8.35	7.40	7.58	7.35	7.36	7.92	7.09	5.78	6.55	7.99	7.86	7.97
f	**WY2003**	7.74	7.79	7.81	7.39	7.72	7.77	6.95	7.57	7.64	7.87	8.35	7.89
	n	6	6	6	6	6	6	6	6	6	6	6	6

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

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

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33
$Z_k = S_k/\sigma_S$	0.38	1.32	-0.56	0.19	-0.94	0.56	-2.07	-2.07	0.19	1.32	0.94	-0.19
Z^2_k	0.14	1.73	0.32	0.04	0.88	0.32	4.27	4.27	0.04	1.73	0.88	0.04

ΣZ_k= -0.94
ΣZ^2_k= 14.65
Z-bar=ΣZ_k/K= -0.08
p(Z-bar)= 0.469

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

Σn	72
ΣS_k	-5
V(S)	42316
Z	-0.029
K	12

$\chi^2_h=\Sigma Z^2_k - K(\text{Z-bar})^2$= 14.57
p 0.20

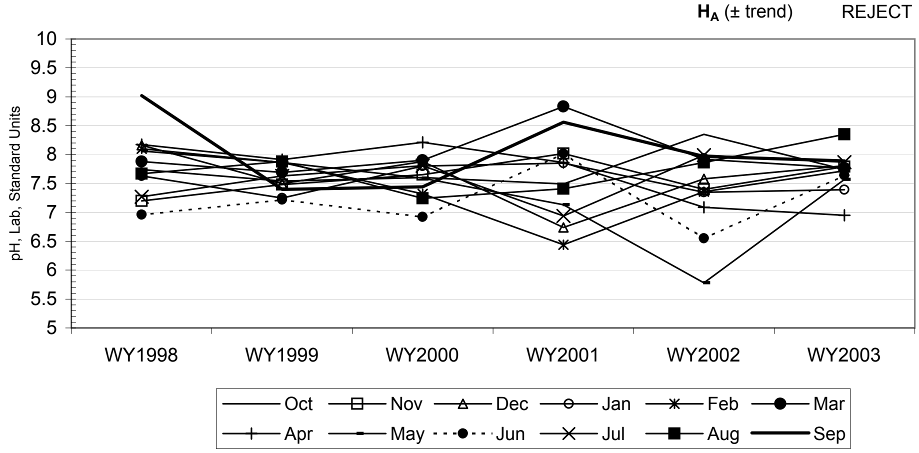
@α=5% $\chi^2_{(K-1)}$= 19.68

Test for station homogeneity
$\chi^2_h < \chi^2_{(K-1)}$ ACCEPT

K*(Z-bar)^2= 0.07
p 0.79

@α=5% $\chi^2_{(1)}$= 3.84

K*(Z-bar)² < $\chi^2_{(1)}$
H_0 (No trend) ACCEPT
H_A (± trend) REJECT



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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY1998**	46	48	38	48	44	48	50	40	34	39	46	42
b	**WY1999**	38	48	46	54	63	53	54	36	28	35	39	42
c	**WY2000**	33	40	46	45	52	51	48	35	34	32	40	41
d	**WY2001**	43	31	50	42	48	56	53	37	32	36	46	39
e	**WY2002**	46	41	50	50	50	53	54	23	35	38	41	37
f	**WY2003**	38	42	46	34	52	59	42	41	39	49	51	42
	n	6	6	6	6	6	6	6	6	6	6	6	6

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

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a	-1	-1	1	1	1	1	1	-1	-1	-1	-1	1
c-a	-1	-1	1	-1	1	1	-1	-1	-1	-1	-1	-1
d-a	-1	-1	1	-1	1	1	1	-1	-1	-1	-1	-1
e-a	1	-1	1	1	1	1	1	-1	1	-1	-1	-1
f-a	-1	-1	1	-1	1	1	-1	1	1	1	1	-1
c-b	-1	-1	-1	-1	-1	-1	-1	-1	1	-1	1	-1
d-b	1	-1	1	-1	-1	1	-1	1	1	1	1	-1
e-b	1	-1	1	-1	-1	0	1	-1	1	1	1	-1
f-b	1	-1	0	-1	-1	1	-1	1	1	1	1	-1
d-c	1	-1	1	-1	-1	1	1	1	-1	1	1	-1
e-c	1	1	1	1	-1	1	1	-1	1	1	1	-1
f-c	1	1	1	-1	1	1	-1	1	1	1	1	1
e-d	1	1	1	1	1	-1	1	-1	1	1	-1	-1
f-d	-1	1	-1	-1	1	1	-1	1	1	1	1	1
f-e	-1	1	-1	-1	1	1	-1	1	1	1	1	1
S_k	1	-5	8	-7	3	10	-1	-1	7	5	5	-7

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33
$Z_k = S_k/\sigma_S$	0.19	-0.94	1.50	-1.32	0.56	1.88	-0.19	-0.19	1.32	0.94	0.94	-1.32
Z^2_k	0.04	0.88	2.26	1.73	0.32	3.53	0.04	0.04	1.73	0.88	0.88	1.73

ΣZ_k= 3.38

ΣZ^2_k= 14.05

Z-bar=ΣZ_k/K= 0.28

p(Z-bar)= 0.611

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

Σn	72
ΣS_k	18
V(S)	42316
Z	0.083
K	12

$\chi^2_h = \Sigma Z^2_k - K(\text{Z-bar})^2$= 13.09

p 0.29

@α=5% $\chi^2_{(K-1)}$= 19.68

Test for station homogeneity

$\chi^2_h < \chi^2_{(K-1)}$ ACCEPT

K*(Z-bar)^2= 0.95

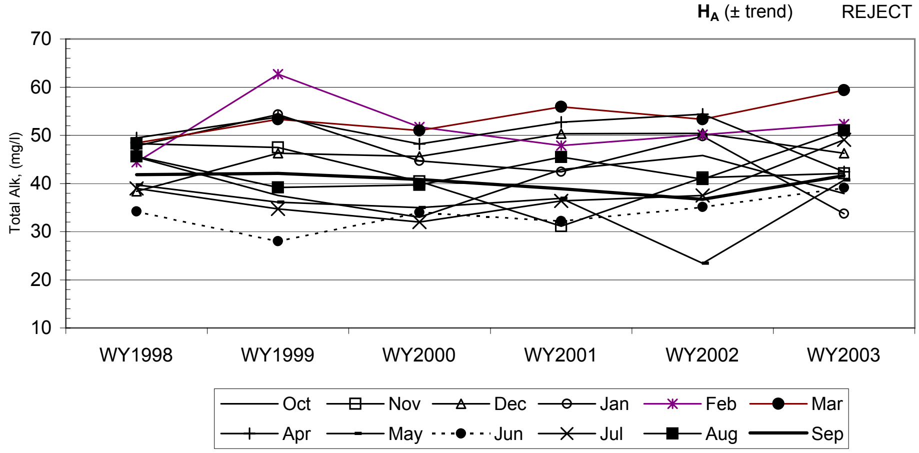
p 0.33

@α=5% $\chi^2_{(1)}$= 3.84

K*(Z-bar)² < $\chi^2_{(1)}$

H_0 (No trend) ACCEPT

H_A (± trend) REJECT



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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY1998**	4.89	22.50	6.66	5.76	11.70	10.00	44.90	2.35	1.99	4.05	2.31	6.29
b	**WY1999**	3.00	3.77	9.73	4.36	4.74	9.82	5.44	4.62	1.63	2.54	4.07	1.06
c	**WY2000**	4.48	8.76	4.11	5.36	4.53	5.71	8.79	3.33	2.44	2.51	2.74	3.17
d	**WY2001**	4.90	5.22	7.00	5.86	6.90	7.64	4.87	3.66	3.08	3.06	2.35	4.50
e	**WY2002**	5.76	7.48	6.46	7.16	5.75	5.87	5.77	3.26	2.03	4.30	6.09	5.46
f	**WY2003**	4.73	4.97	6.82	5.42	4.30	6.20	6.08	3.76	9.33	3.29	2.91	5.71
	n	6	6	6	6	6	6	6	6	6	6	6	6

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

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

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

ΣZ_k= 2.25
ΣZ^2_k= 11.72
Z-bar=ΣZ_k/K= 0.19
p(Z-bar)= 0.575

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

Σn 72
ΣS_k 12
V(S) 42316
Z 0.053
K 12

$\chi^2_h = \Sigma Z^2_k - K(\text{Z-bar})^2$= 11.29
p 0.42

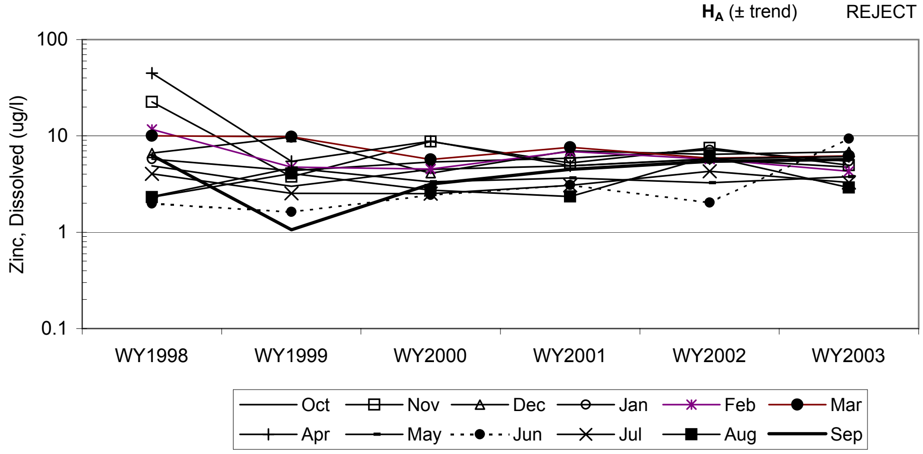
@α=5% $\chi^2_{(K-1)}$= 19.68

Test for station homogeneity
$\chi^2_h < \chi^2_{(K-1)}$ ACCEPT

K*(Z-bar)^2= 0.42
p 0.52

@α=5% $\chi^2_{(1)}$= 3.84

K*(Z-bar)² < $\chi^2_{(1)}$
H_0 (No trend) ACCEPT
H_A (± trend) REJECT



INTERPRETIVE REPORT
SITE 54 "LOWER GREENS CREEK"

The data collected during the current water year are listed in the following "Table of Results for Water Year 2003" report. The table includes all the data, field and lab, 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 zero for the purpose of median calculation.

All data collected at this site for the past five years are included in the data analyses with the exception of one outlier shown on the table below. During the current year no new data point were flagged as outliers after review by KGCMC.

Sample Date	Parameter	Value	Qualifier	Notes
12/5/2001	Cond Field, umho	46.0	R	Suspected field instrument malfunction

The data for water year 2003 have been compared to the strictest fresh water quality criterion for each applicable analyte. No results exceeding these criteria have been identified.

X-Y plots have been generated to graphically present the data for each of the analytes requested in the Statistical Information Goals for this site. These plots have been visually analyzed for the appearance of any trend in concentration. No visually obvious trends are apparent. A non-parametric statistical analysis for trend was preformed for conductivity, pH, Alkalinity, and dissolved zinc. Calculation details of the Seasonal Mann-Kendall analyses are presented in detail on the pages following this interpretive section. The table below summarizes the results on the data collected between Oct-97 and Sep-03 (WY1998-WY2003). No statistically significant (α=5%) trends are present in the data. Additional X-Y plots have been generated for alkalinity, pH, conductance, sulfate, and dissolved zinc that plot Site 54 and Site 6, the upstream control site, to aid in the comparison between those two sites.

		Mann-Kendall test statistic			Sen's slope estimate	
Parameter	n*	Z	Trend	a**	Q	Q(%)
Conductivity, Lab	6	2.45	-	0.12		
pH, Lab	6	1.56	-	0.21		
Alkalinity, Total	6	0.15	+	0.70		
Zinc, Dissolved	6	0.24	+	0.63		

*: Number of years **:Significance level

Median values for alkalinity, pH, specific conductance, sulfate, and dissolved zinc from site 54 have been compared to those of Site 6. The comparisons were done utilizing a two-tailed, large sample approximation to the Wilcoxon-Mann-Whitney rank sum test with a significance level of $\alpha/2=0.025$. Rank-sum test calculation details can be found in subsequent pages of this section and a summary of the test results is shown in the table below. For all analytes there are no statistically significant differences between the medians at the $\alpha/2=0.025$ significance level.

Parameter	Rank Sum Test p-value	Site #6 median	Site #54 median
Conductivity, Lab	0.66	125	128
pH, Lab	0.51	7.76	7.75
Alkalinity, Total	0.81	42.3	45.6
Sulfate, Total	0.55	14.4	14.5
Zinc, Dissolved	0.19	5.20	4.99

Table of Results for Water Year 2003

Site 54 "Lower Greens Creek"

Sample Date/Parameter	10/30/2002	11/12/2002	12/19/2002	1/8/2003	2/25/2003	3/17/2003	4/16/2003	5/20/2003	6/24/2003	7/17/2003	8/27/2003	9/9/2003	**Median**
Water Temp (°C)	3.8	5.5	2.5	1.2	0.2	1.7	1.4	4.4	7.2	9.0	8.0	7.5	4.1
Conductivity-Field(μmho)	123	171	130	107	175	162	139	110	103	134	134	107	132
Conductivity-Lab (μmho)	122	140	128	109 U	148 J	158	128	99	100	138	137	104	128
pH Lab (standard units)	7.49	7.98	7.79	7.72	7.71 J	7.72	7.55	7.72	7.81	7.90	7.78 J	7.77	7.75
pH Field (standard units)	7.39	7.20	7.02	7.01	6.93	7.28	7.34	7.39	7.42	7.85	7.62	7.58	7.37
Total Alkalinity (mg/L)	40.4	43.7	47.4	41.6	53.8 J	55.7	47.6	41.0	41.1	49.9	53.2	43.1	45.6
Total Sulfate (mg/L)	NOTE 1	18.9 J	16.2 J	12.5 J	20.9	22.8	15.8	7.8	9.0	13.8	14.5 J	9.4 J	14.5
Hardness (mg/L)	39.9	67.0	55.1	47.7	68.6	70.3	57.8	48.5	41.8	51.8	68.9	49.9	53.5
Dissolved As (ug/L)	0.271 J	0.265 J	0.235 J	0.302 U	<0.386	0.180	0.341 U	0.212	<0.204	<0.331	0.565 U	0.231 J	0.233
Dissolved Ba (ug/L)			28.1		28.6								28.4
Dissolved Cd (ug/L)	0.048	0.048 J	0.075 J	0.047 U	0.042 J	0.096 J	0.042	0.035	<0.034	0.040 J	0.047 J	0.041 J	0.044
Dissolved Cr (ug/L)			<1.010		1.700								1.103
Dissolved Cu (ug/L)	0.410 U	0.446 U	0.554 U	0.625 U	0.305	0.578 U	0.694	0.475	0.319	0.352 J	0.358	0.645	0.461
Dissolved Pb (ug/L)	0.0276 J	<0.0290	0.0638 U	0.0494 U	<0.0210	0.0757 U	0.0694 U	0.1690	0.1040	0.0219 J	0.2190	0.1370 J	0.0666
Dissolved Ni (ug/L)			0.967		0.320								0.644
Dissolved Ag (ug/L)			<0.011		<0.057	0.015 J							0.015
Dissolved Zn (ug/L)	5.05	4.92 J	6.36	5.28	4.20	6.55	5.49	3.13	2.79	3.15 U	3.11	5.32	4.99
Dissolved Se (ug/L)			0.768 U		1.200								0.984
Dissolved Hg (ug/L)	0.000794	0.000765 U	0.000854	0.001470 U	0.000586 U	0.000680	0.001100	0.000794	0.002520 U	0.000805 U	0.001040	0.001790 J	0.000830

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

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

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

NOTE (1) Analysis was not performed on sample.

Qualified Data by QA Reviewer

Date Range: 10/01/2002 to 09/30/2003

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
54	01/08/2003	11:20:00 AM				
			Cond Lab, umho	109	U	Field Blank Contamination
			SO4 Tot, mg/l	12.5	J	Hold Time
			As Diss, ug/l	0.302	U	Below Quantitative Range, Fi
			Cd Diss, ug/l	0.0472	U	Below Quantitative Range, Fi
			Cu Diss, ug/l	0.625	U	Field Blank Contamination
			Pb Diss, ug/l	0.0494	U	Below Quantitative Range, Fi
			Hg Diss, ug/l	0.00147	U	Field Blank Contamination
54	10/30/2002	12:10:00 PM				
			As Diss, ug/l	0.271	J	Below Quantitative Range
			Cu Diss, ug/l	0.41	U	Field Blank Contamination
			Pb Diss, ug/l	0.0276	J	Below Quantitative Range
54	11/12/2002	1:00:00 PM				
			SO4 Tot, mg/l	18.9	J	Hold Time
			As Diss, ug/l	0.265	J	Below Quantitative Range, L
			Cd Diss, ug/l	0.0478	J	Below Quantitative Range
			Cu Diss, ug/l	0.446	U	Field Blank Contamination
			Zn Diss, ug/l	4.92	J	LCS Recovery
			Hg Diss, ug/l	0.000765	U	Field Blank Contamination
54	12/19/2002	11:00:00 AM				
			SO4 Tot, mg/l	16.2	J	Hold Time
			As Diss, ug/l	0.235	J	Below Quantitative Range
			Cd Diss, ug/l	0.075	J	Below Quantitative Range, L
			Cu Diss, ug/l	0.554	U	Field Blank Contamination
			Pb Diss, ug/l	0.0638	U	Field Blank Contamination
			Se Diss, ug/l	0.768	U	Below Quantitative Range, M
54	02/25/2003	11:02:00 AM				
			Cond Lab, umho	148	J	Sample Temperature
			pH Lab, su	7.71	J	Hold Time
			Alk Tot, mg/l	53.8	J	Sample Temperature
			Cd Diss, ug/l	0.0419	J	Below Quantitative Range
			Hg Diss, ug/l	0.000586	U	Field Blank Contamination

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

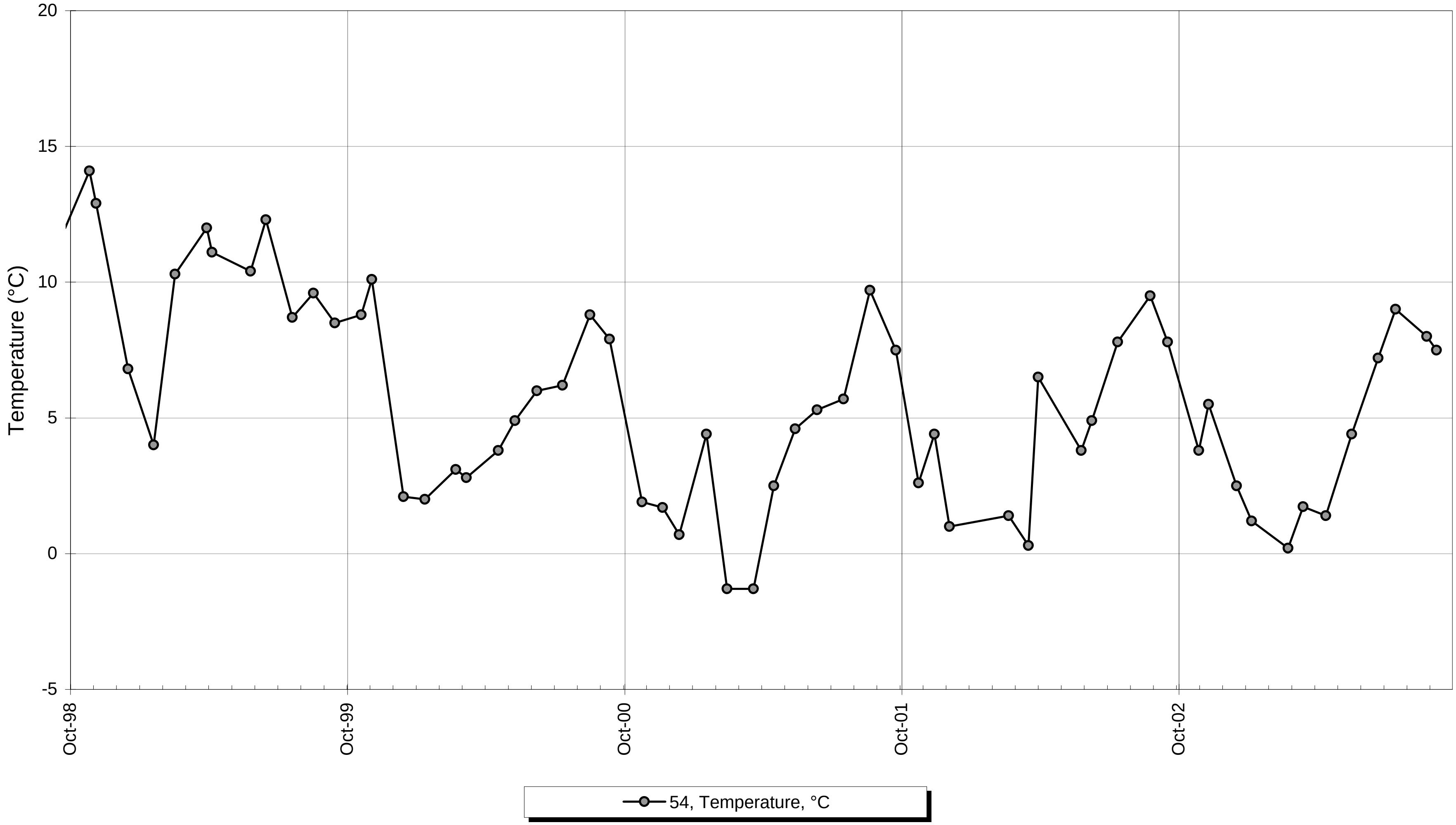
Qualified Data by QA Reviewer

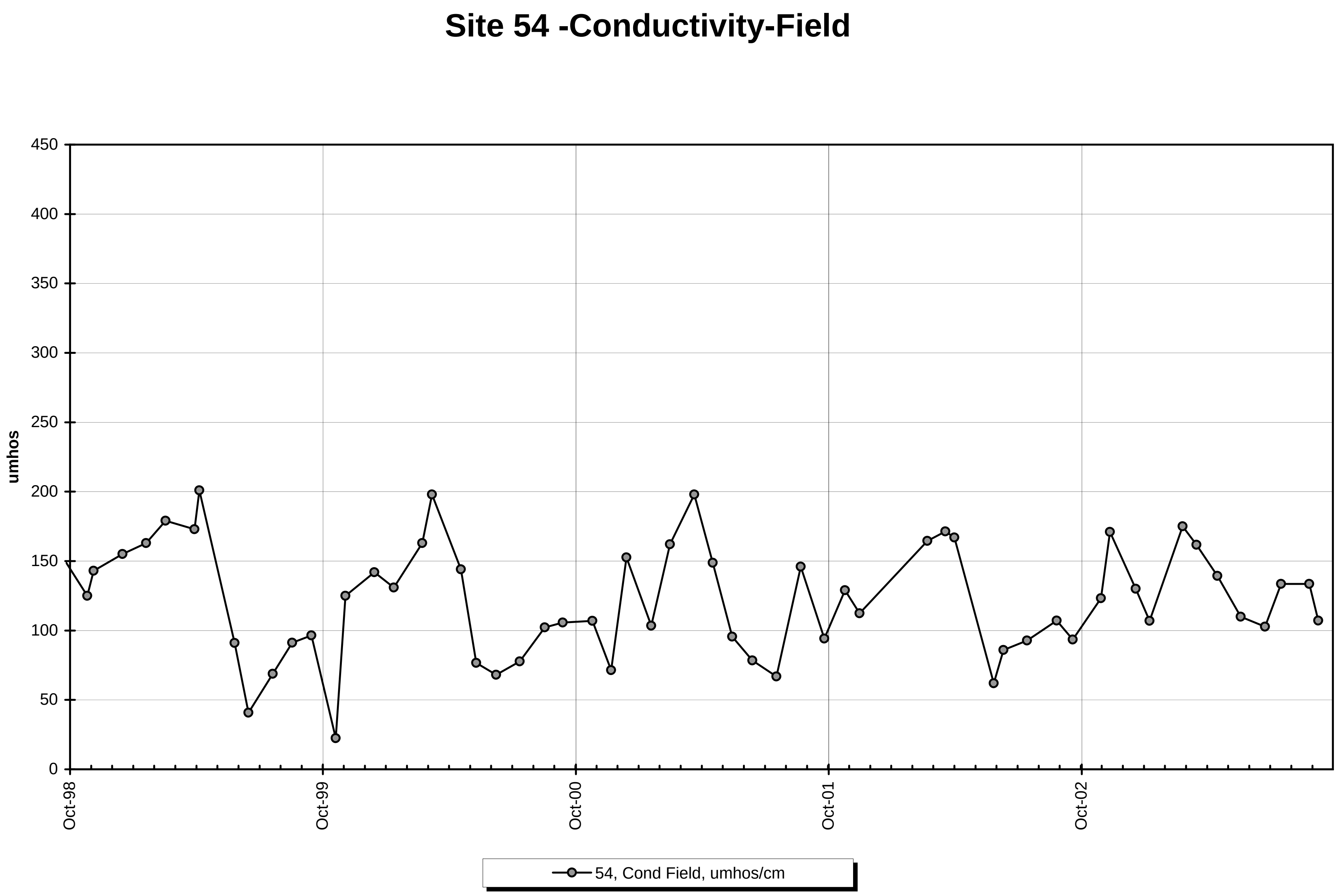
Date Range: 10/01/2002 to 09/30/2003

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
54	03/17/2003	10:05:00 AM				
			Cd Diss, ug/l	0.096	J	LCS Recovery
			Cu Diss, ug/l	0.578	U	Field Blank Contamination
			Pb Diss, ug/l	0.0757	U	Field Blank Contamination
				0.0151	J	Below Quantitative Range, L
54	04/16/2003	11:26:00 AM				
			As Diss, ug/l	0.341	U	Field Blank Contamination
			Pb Diss, ug/l	0.0694	U	Field Blank Contamination
54	06/24/2003	12:20:00 PM				
			Hg Diss, ug/l	0.00252	U	Field Blank Contamination
54	07/17/2003	12:00:00 PM				
			Cd Diss, ug/l	0.0404	J	Below Quantitative Range
			Cu Diss, ug/l	0.352	J	Continuing Calibration Verific
			Pb Diss, ug/l	0.0219	J	Below Quantitative Range
			Zn Diss, ug/l	3.15	U	Field Blank Contamination
			Hg Diss, ug/l	0.000805	U	Field Blank Contamination
54	08/27/2003	1:05:00 PM				
			pH Lab, su	7.78	J	Hold Time
			SO4 Tot, mg/l	14.5	J	Sample Temperature
			As Diss, ug/l	0.565	U	Below Quantitative Range, M
			Cd Diss, ug/l	0.0465	J	Below Quantitative Range
54	09/09/2003	12:10:00 PM				
			SO4 Tot, mg/l	9.44	J	Sample Temperature
			As Diss, ug/l	0.231	J	Below Quantitative Range
			Cd Diss, ug/l	0.0411	J	Below Quantitative Range
			Pb Diss, ug/l	0.137	J	Below Quantitative Range
			Hg Diss, ug/l	0.00179	J	Duplicate RPD

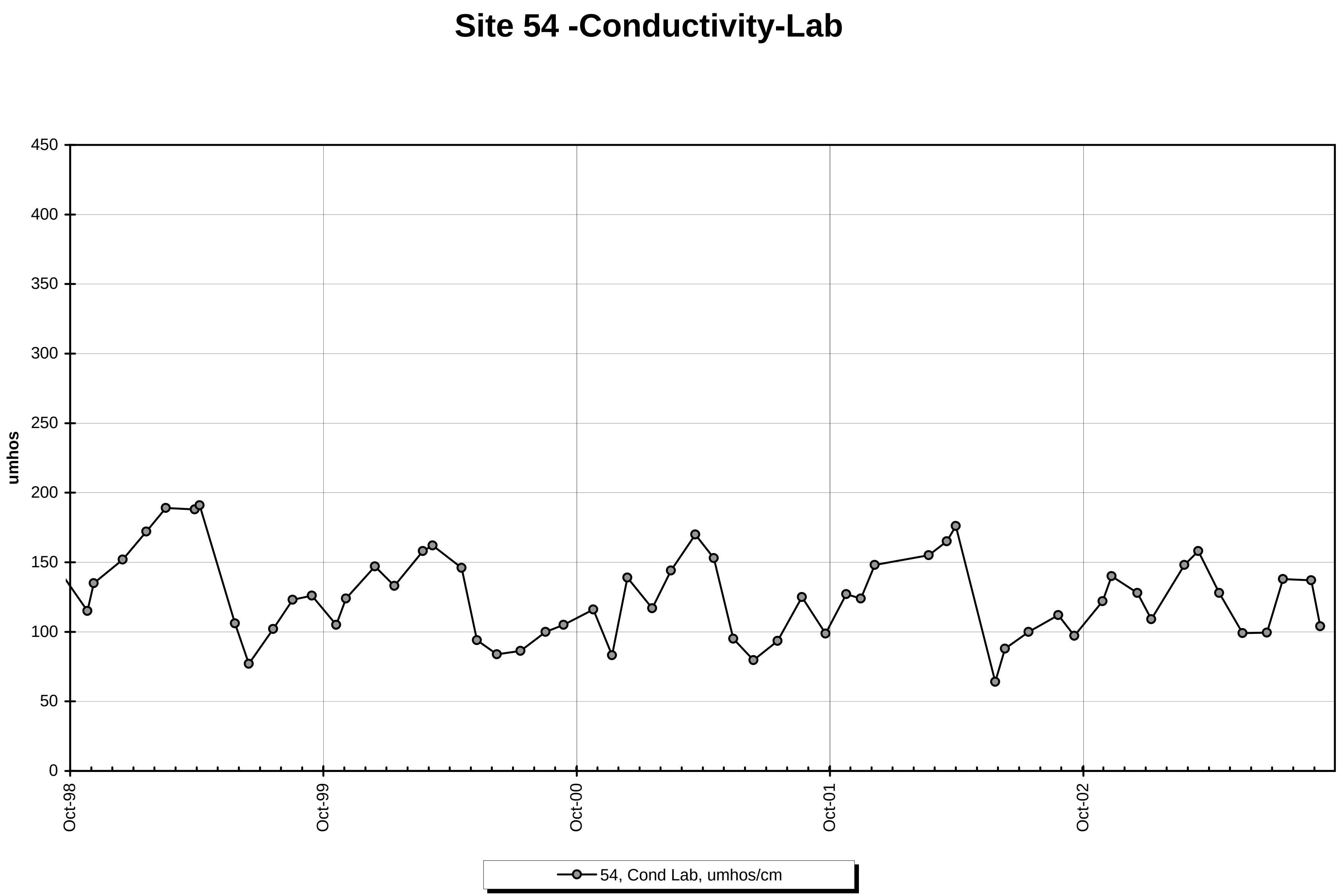
Qualifier	Description
J	Positively Identified - Approximate Concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot Be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit

Site 54 -Water Temperature



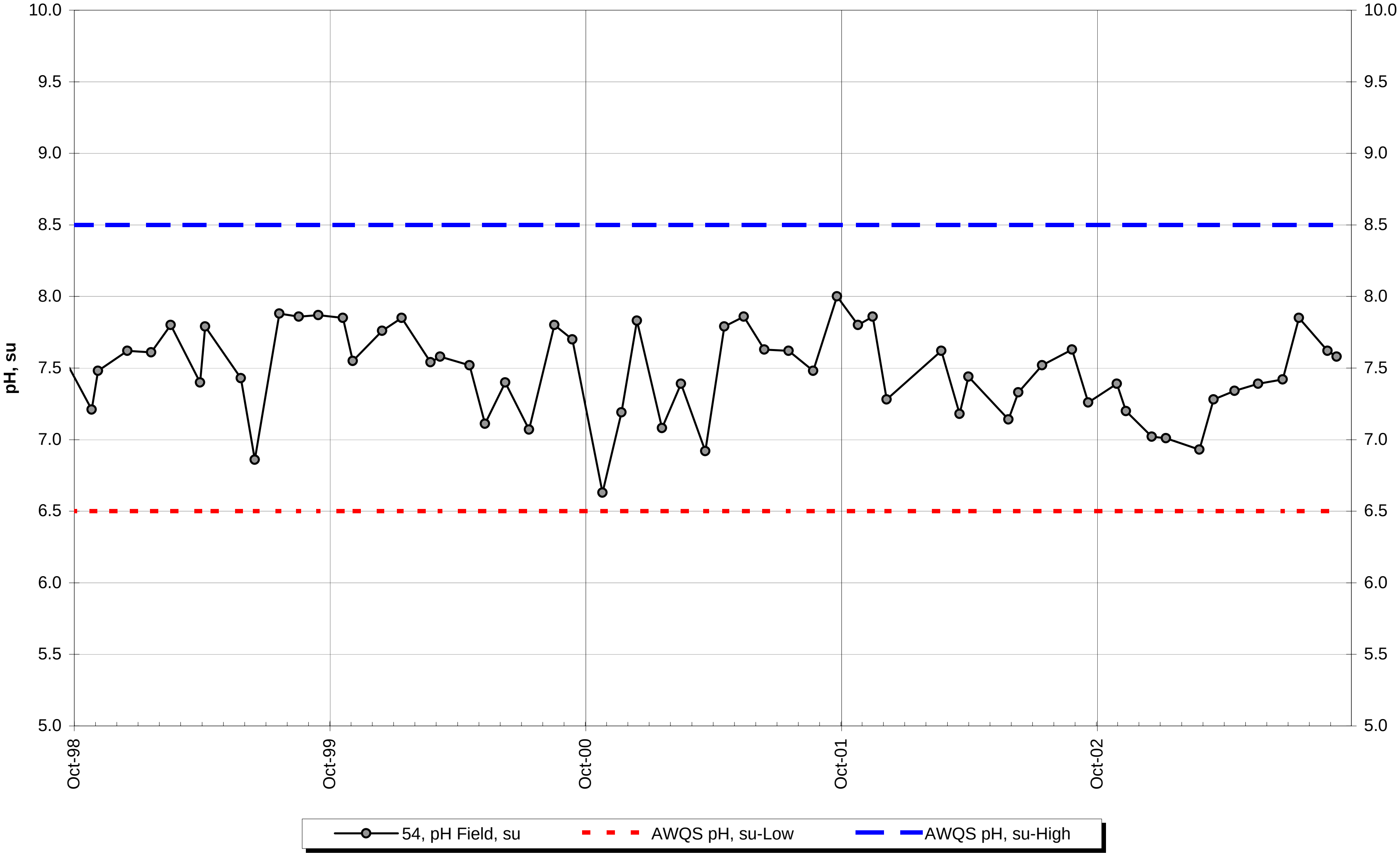


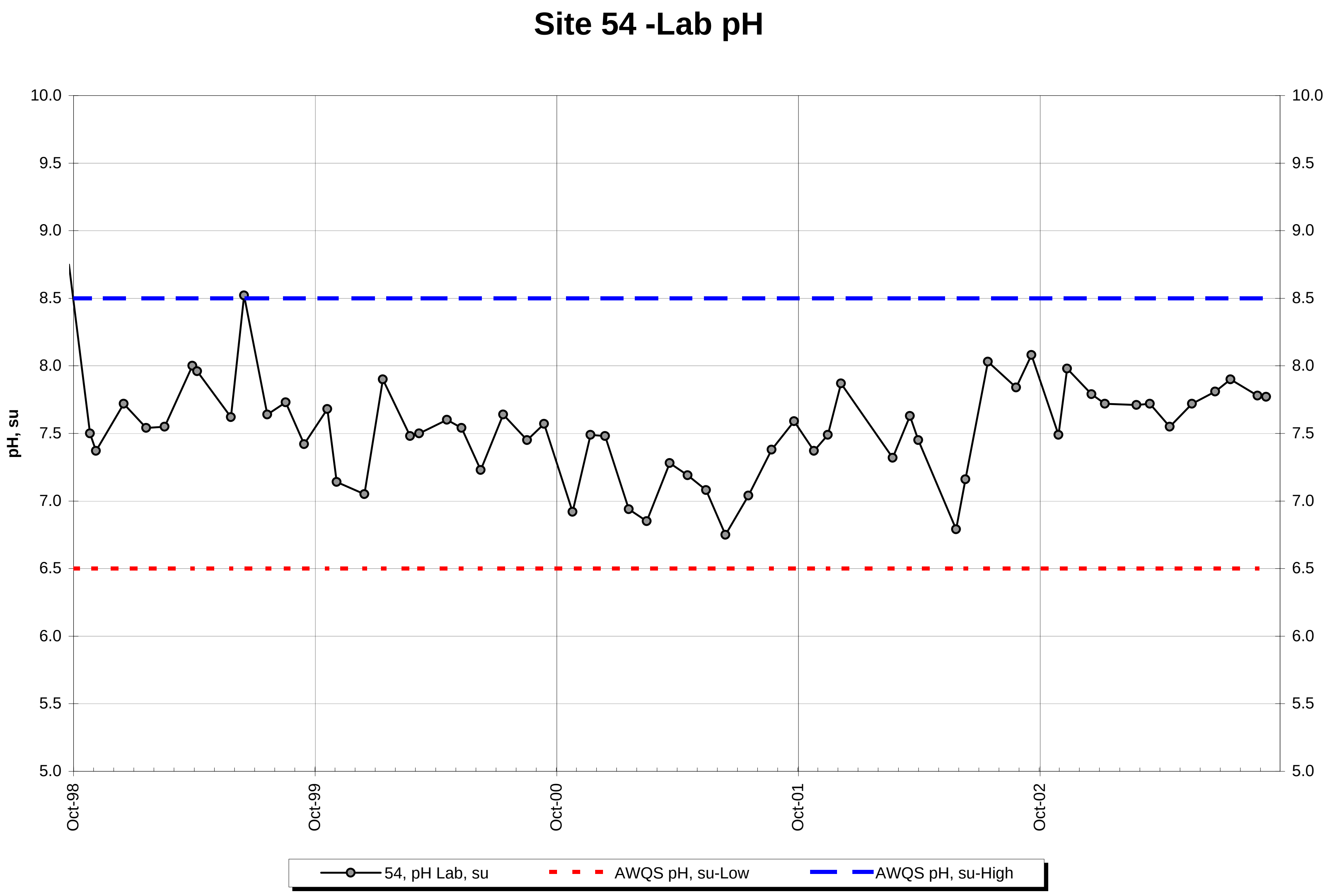
Site 54 -Conductivity-Field
umhos
450
400
350
300
250
200
150
100
50
0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
54, Cond Field, umhos/cm



Site 54 -Conductivity-Lab
umhos
450
400
350
300
250
200
150
100
50
0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
54, Cond Lab, umhos/cm

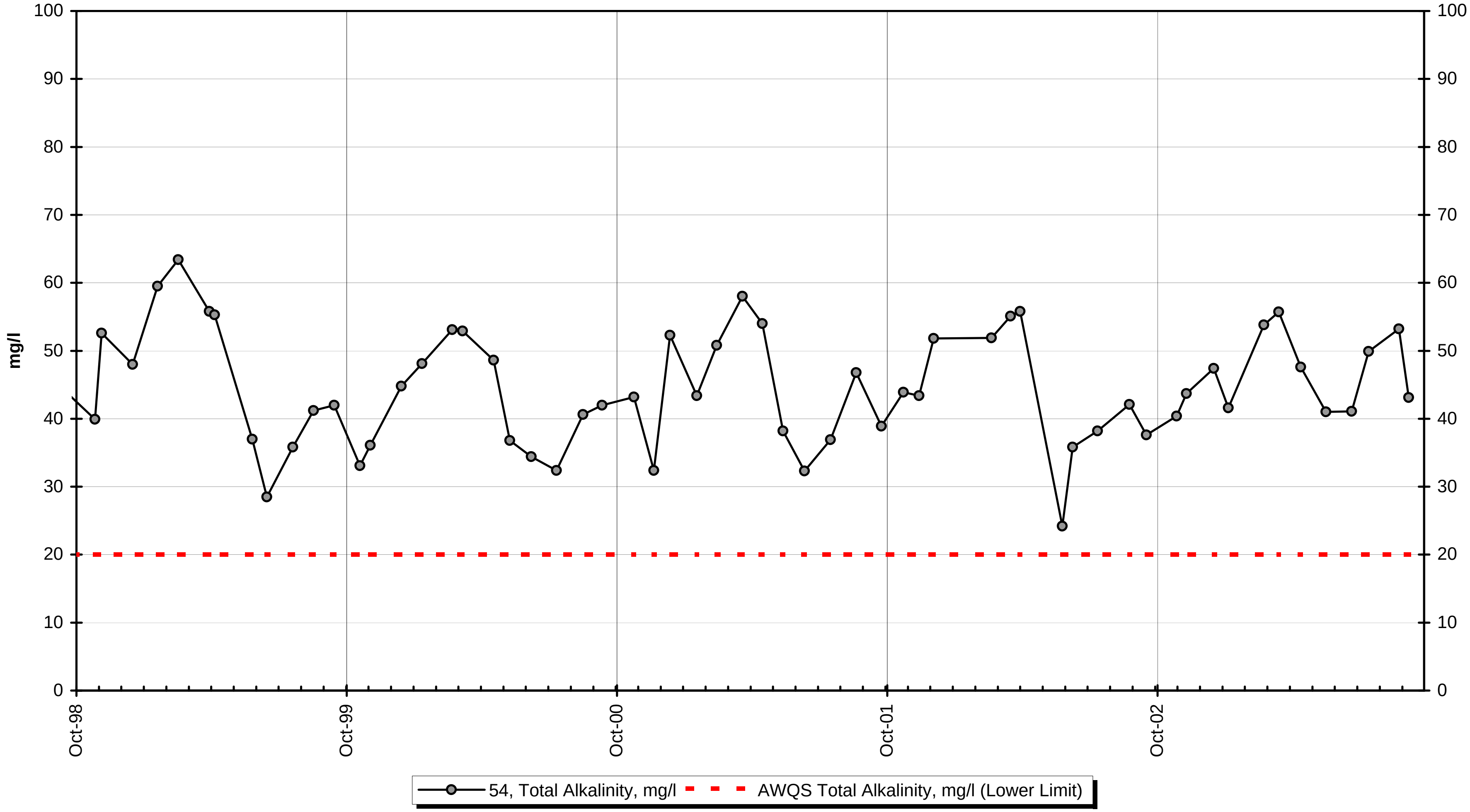
Site 54 -Field pH



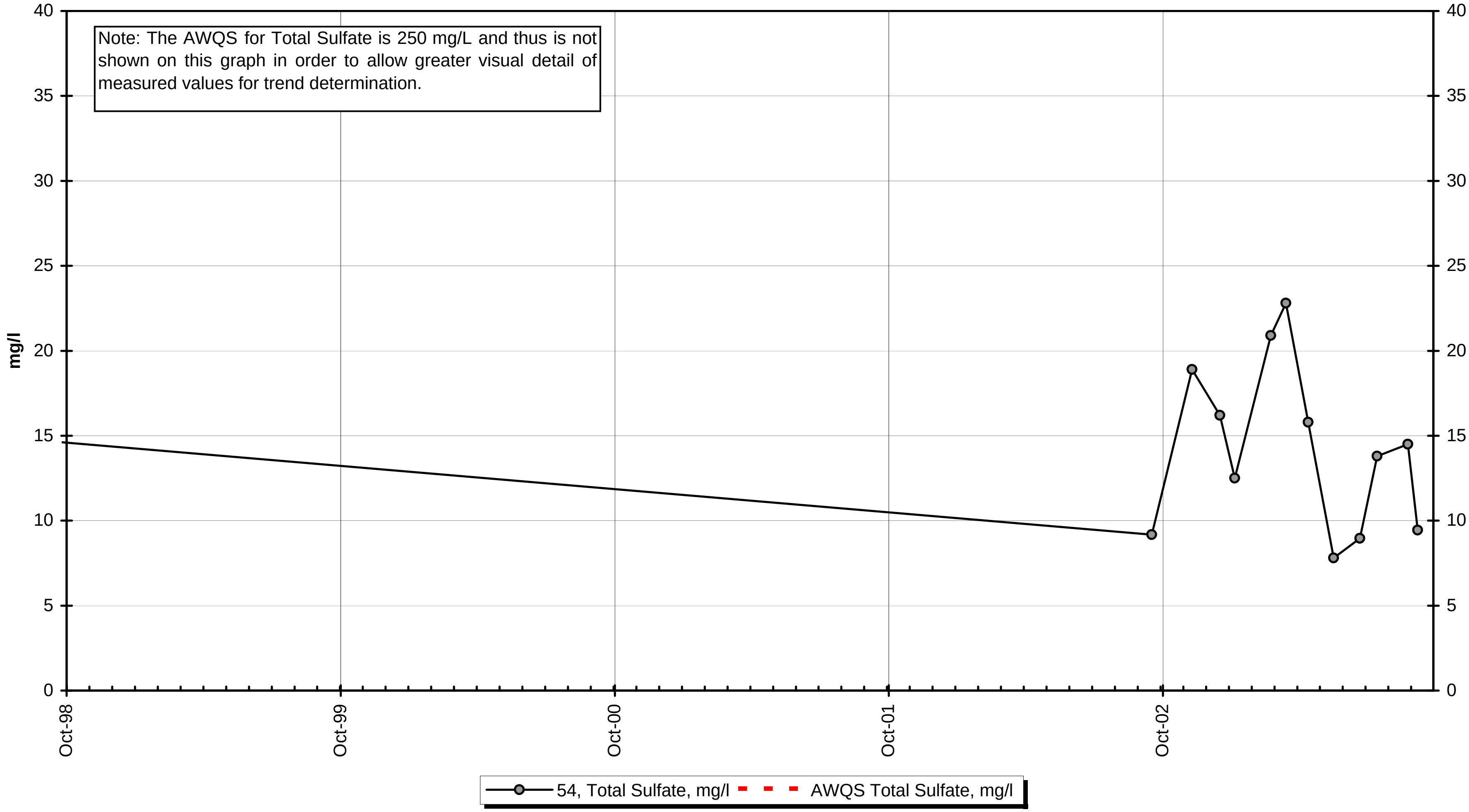


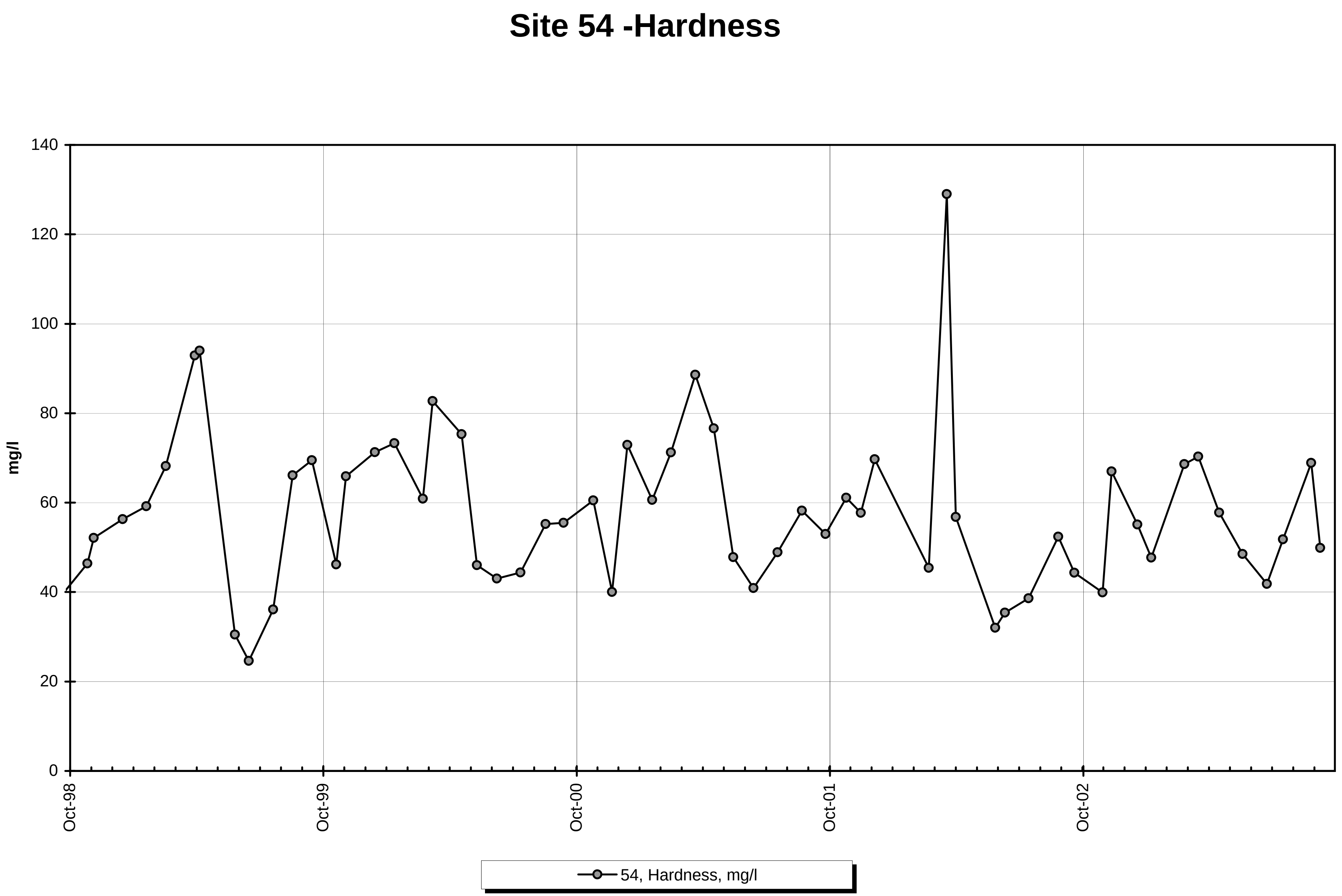
Site 54 -Lab pH
pH, su
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
54, pH Lab, su
AWQS pH, su-Low
AWQS pH, su-High

Site 54 -Total Alkalinity



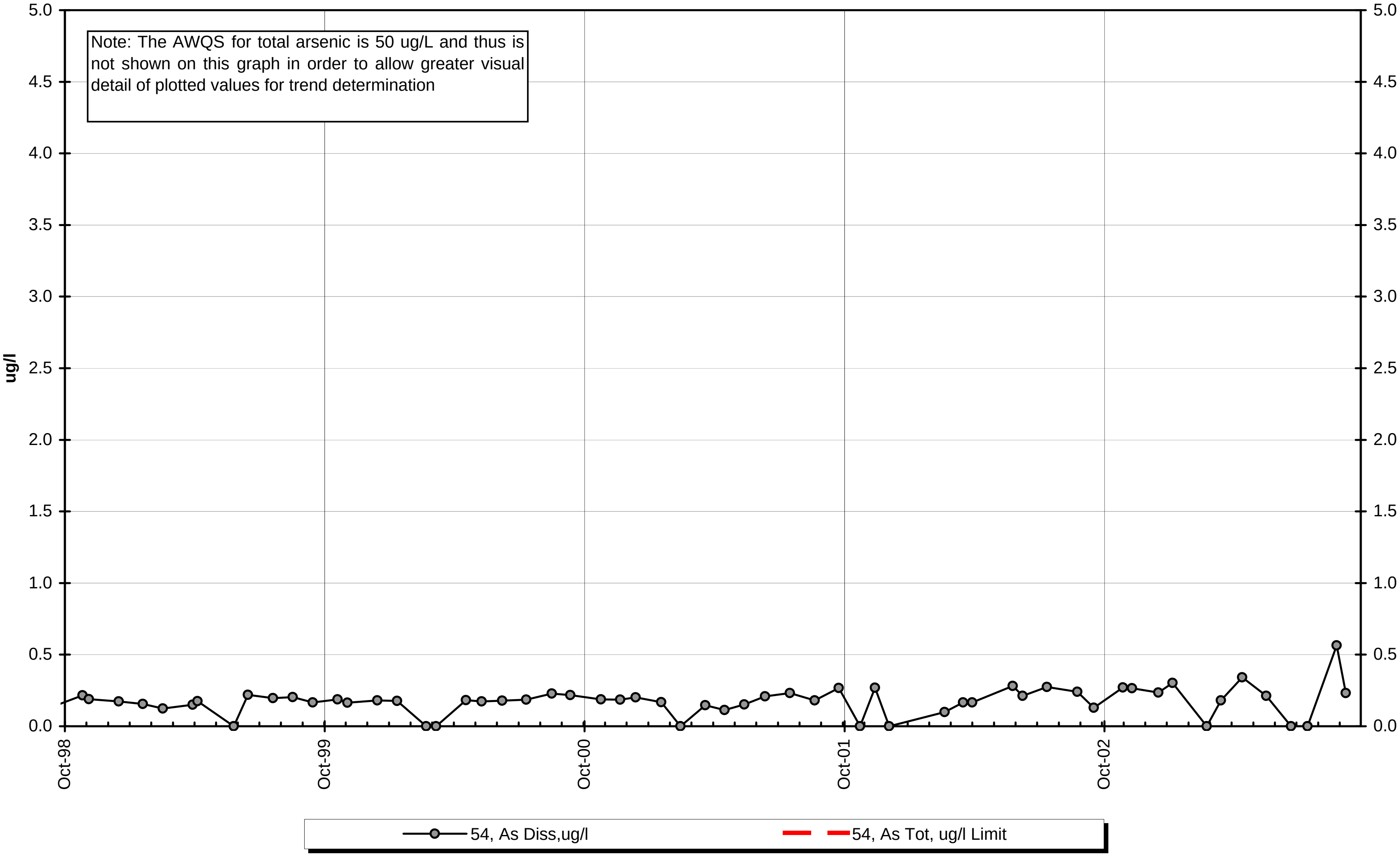
Site 54 -Total Sulfate



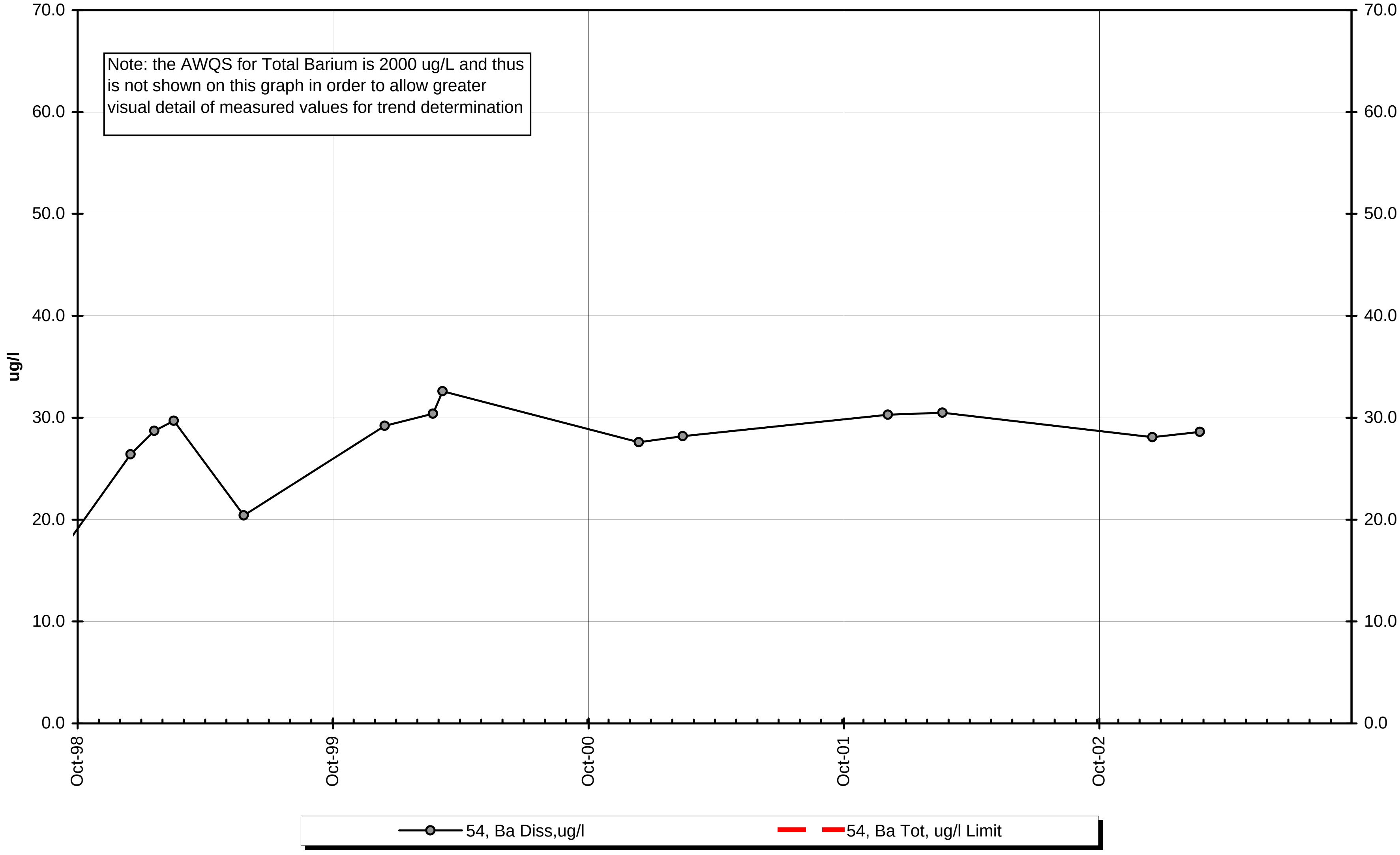


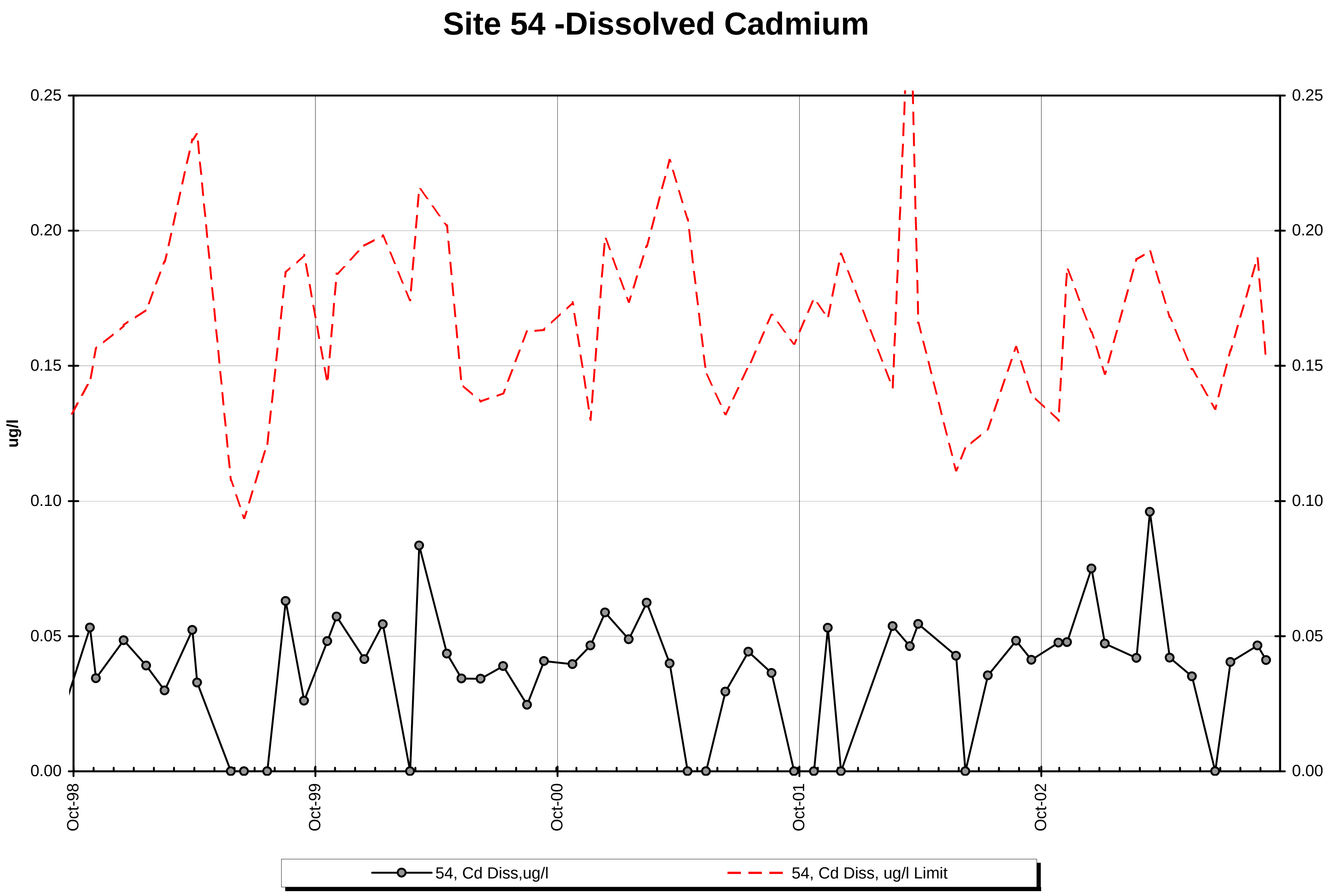
Site 54 -Hardness
mg/l
140
120
100
80
60
40
20
0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
54, Hardness, mg/l

Site 54 -Dissolved Arsenic

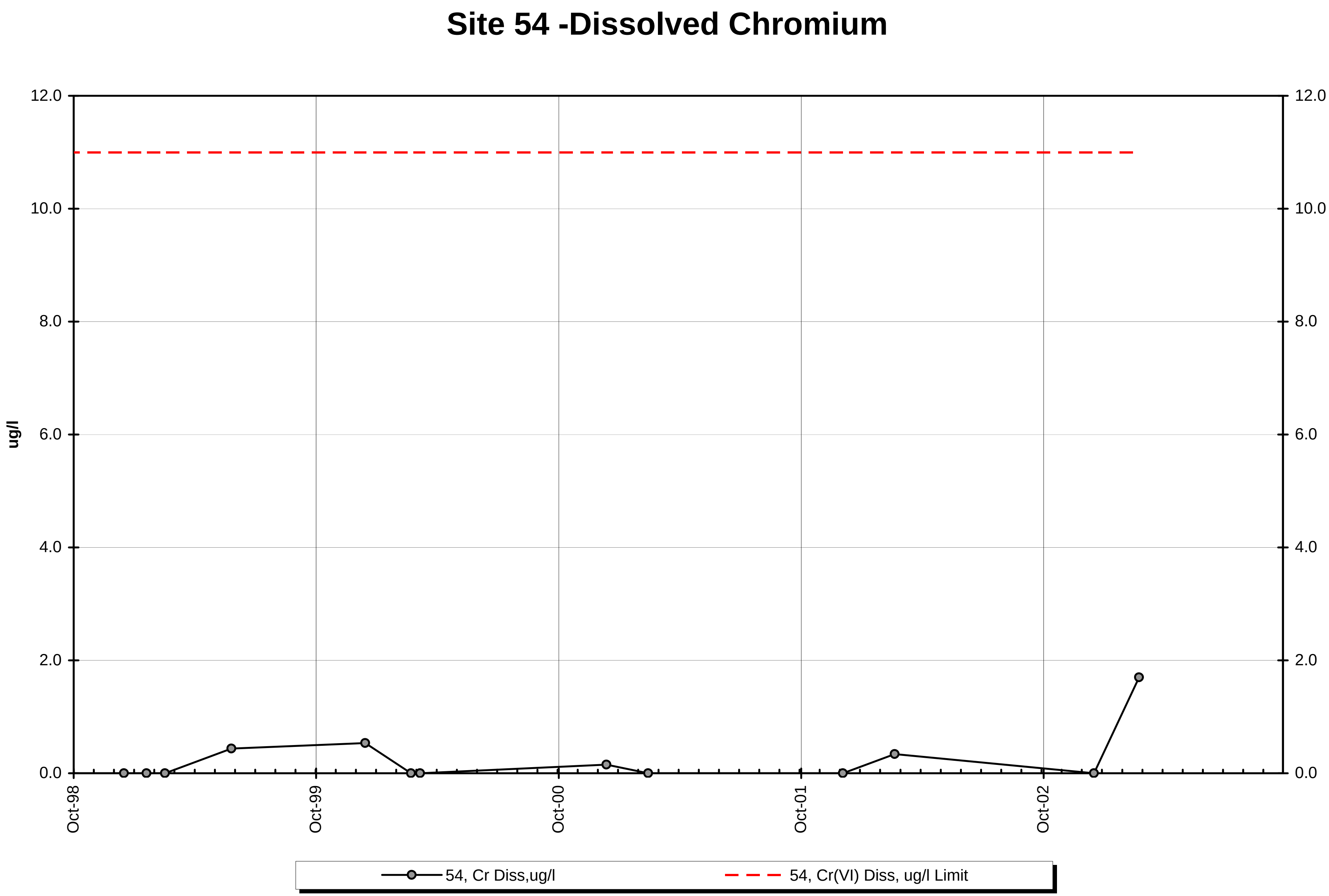


Site 54 -Dissolved Barium



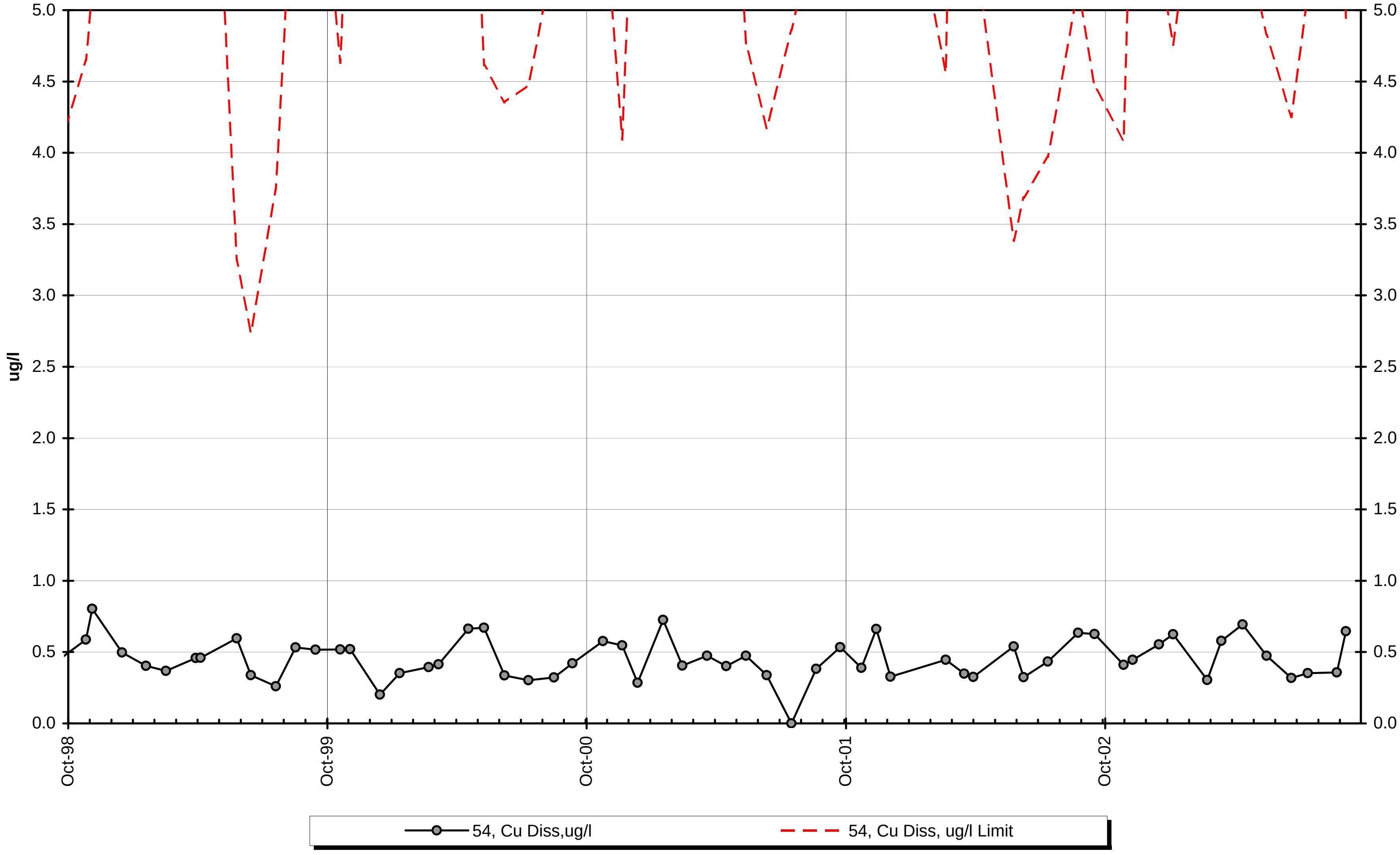


Site 54 -Dissolved Cadmium
ug/l
0.25
0.20
0.15
0.10
0.05
0.00
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
54, Cd Diss,ug/l
54, Cd Diss, ug/l Limit

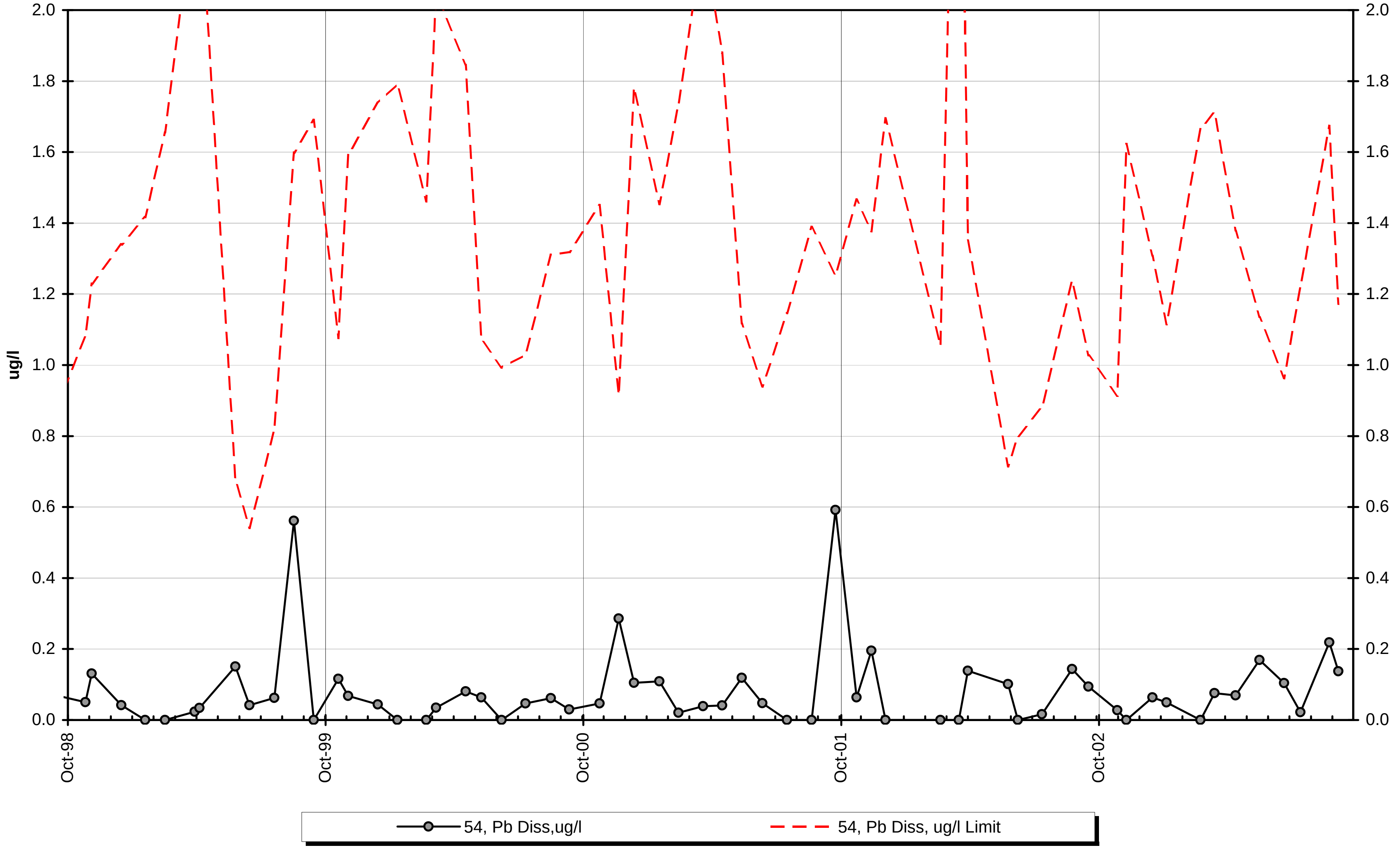


Site 54 -Dissolved Chromium
ug/l
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
54, Cr Diss,ug/l
54, Cr(VI) Diss, ug/l Limit

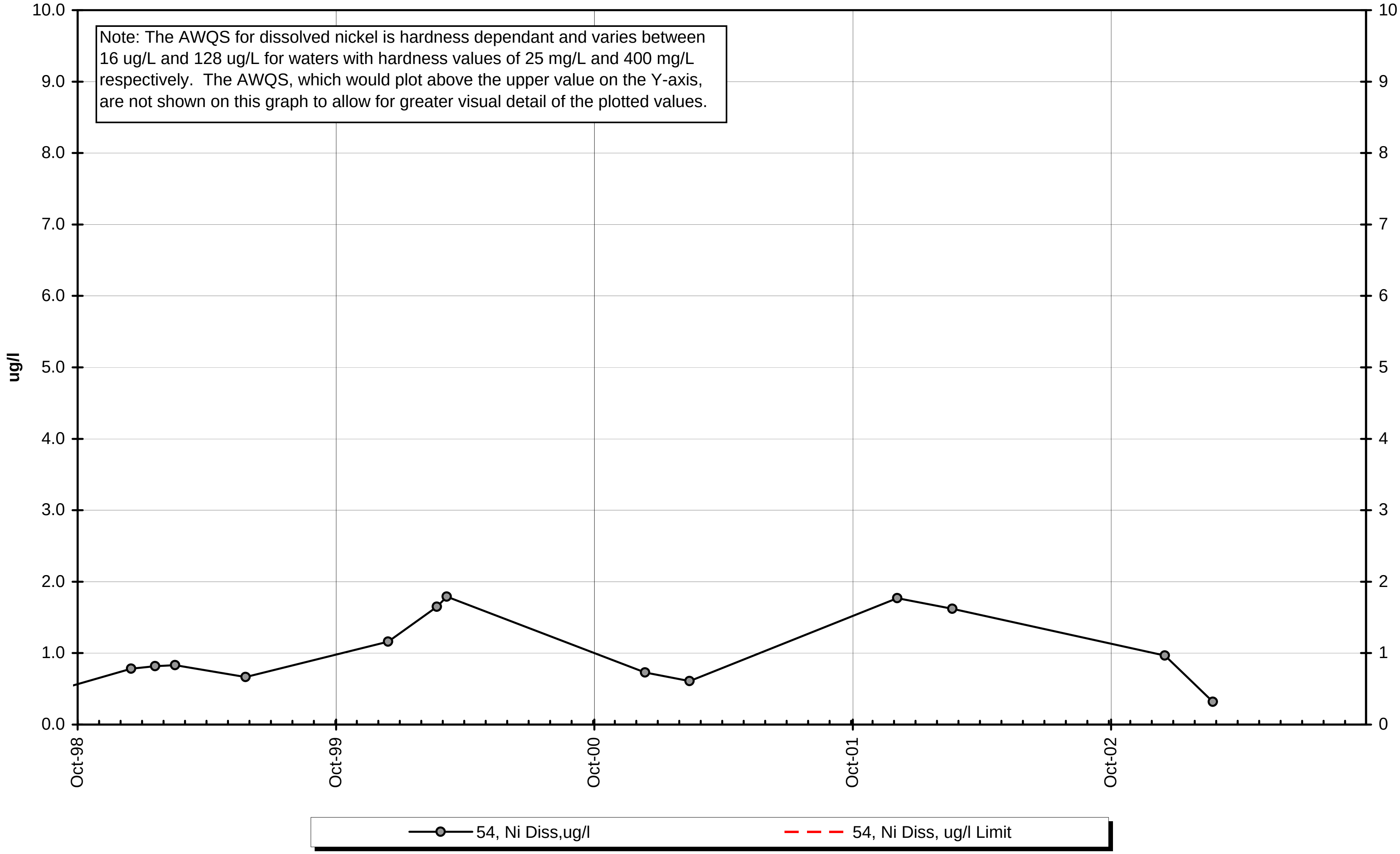
Site 54 -Dissolved Copper

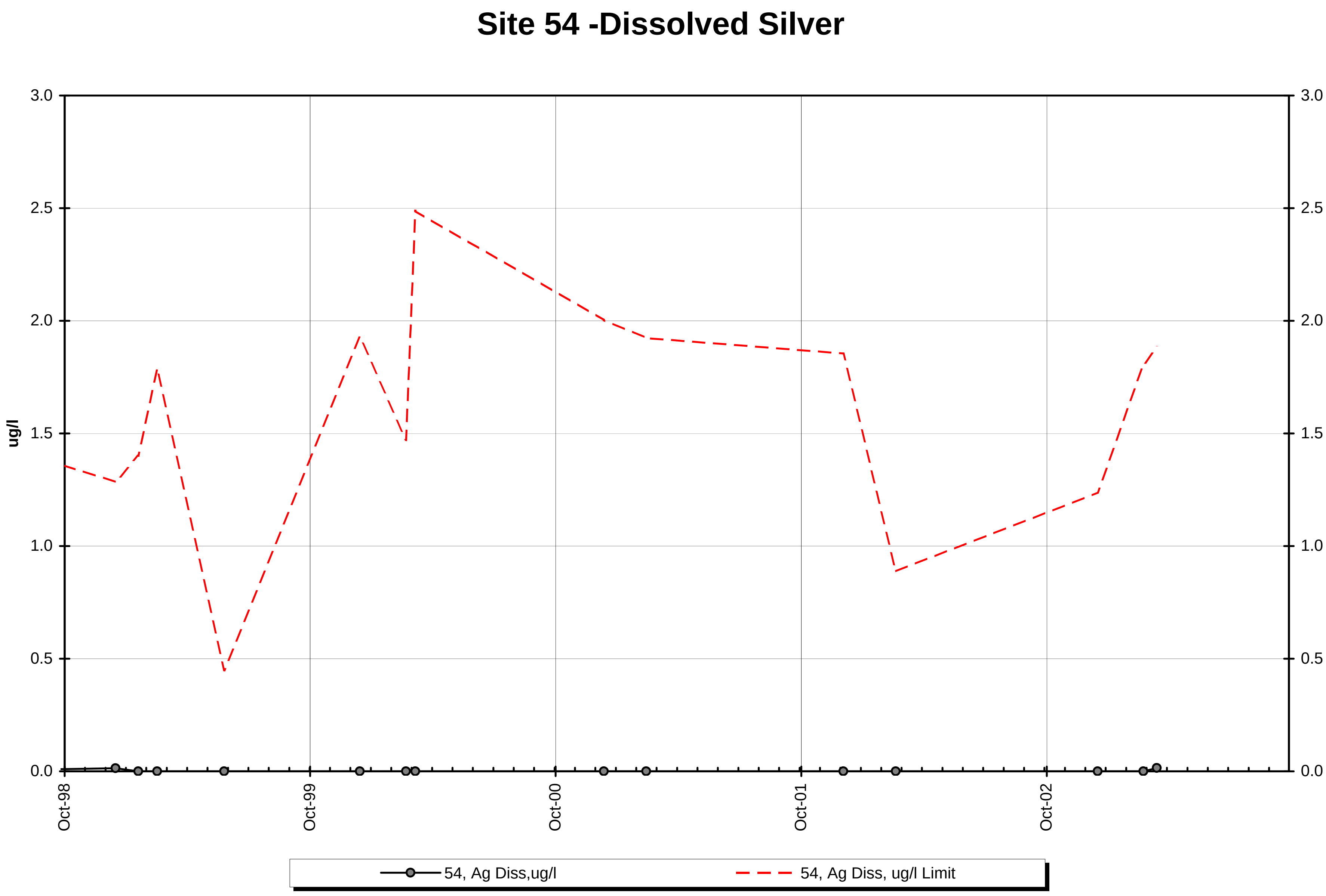


Site 54 -Dissolved Lead

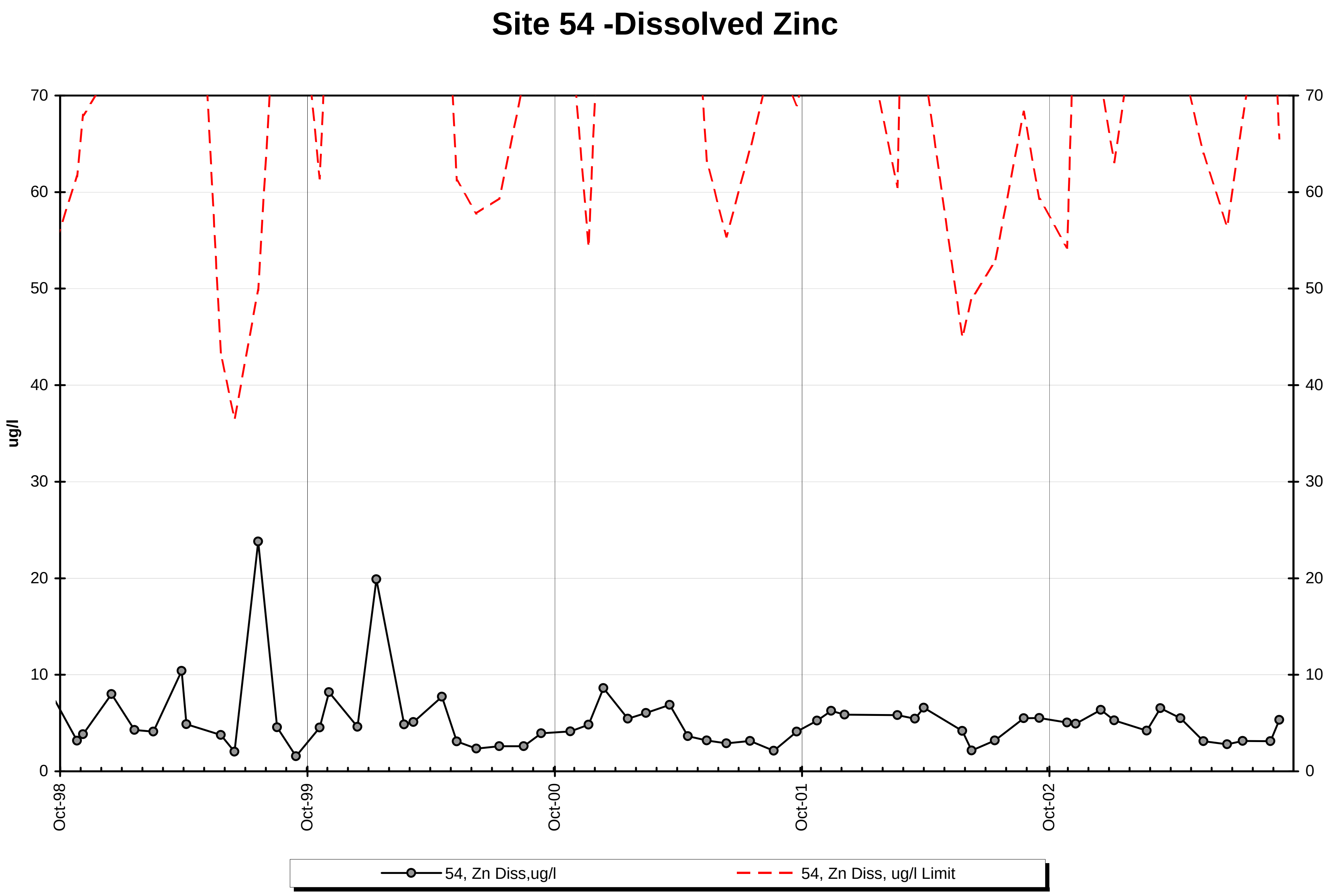


Site 54 -Dissolved Nickel



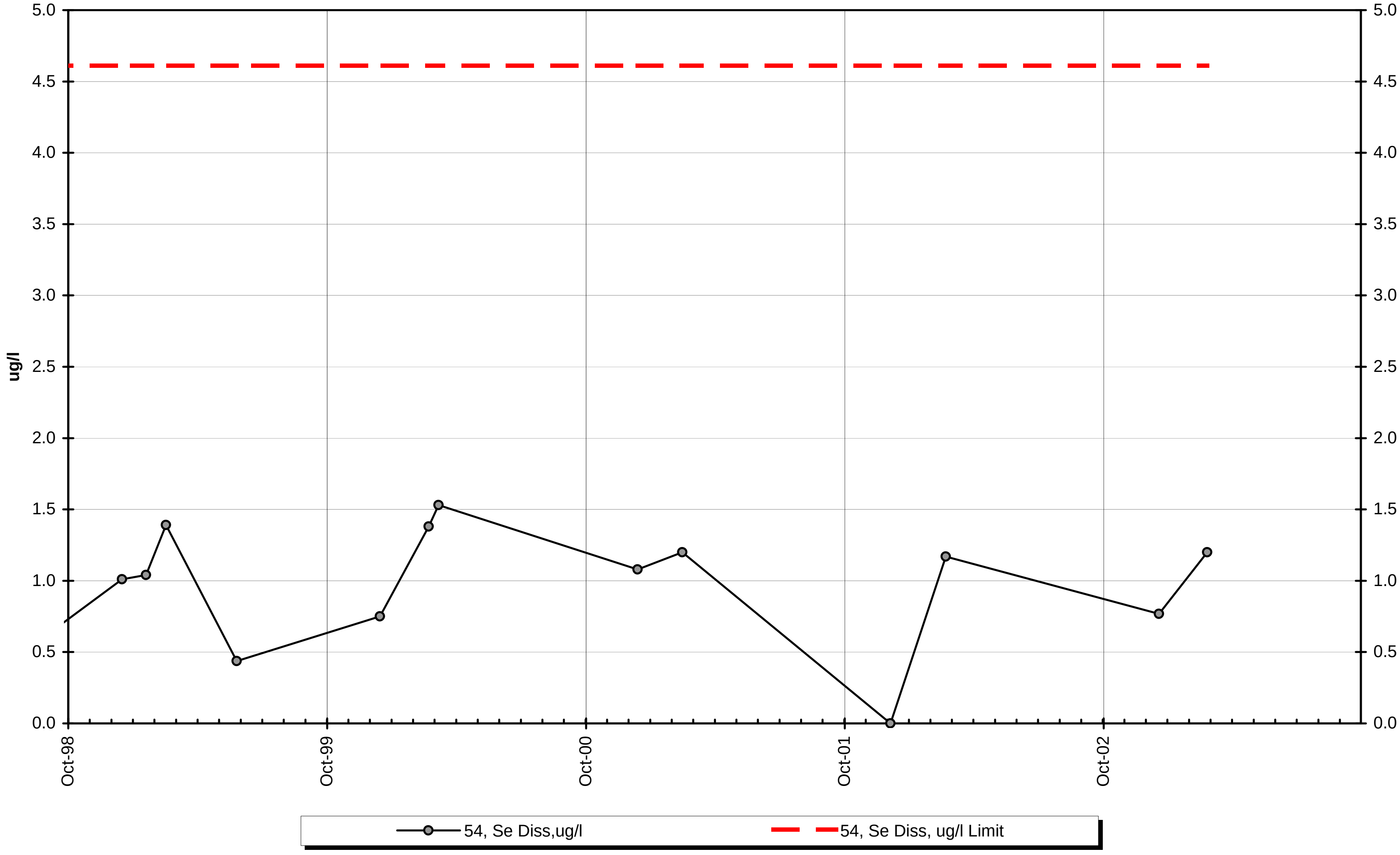


Site 54 -Dissolved Silver
ug/l
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
54, Ag Diss,ug/l
54, Ag Diss, ug/l Limit

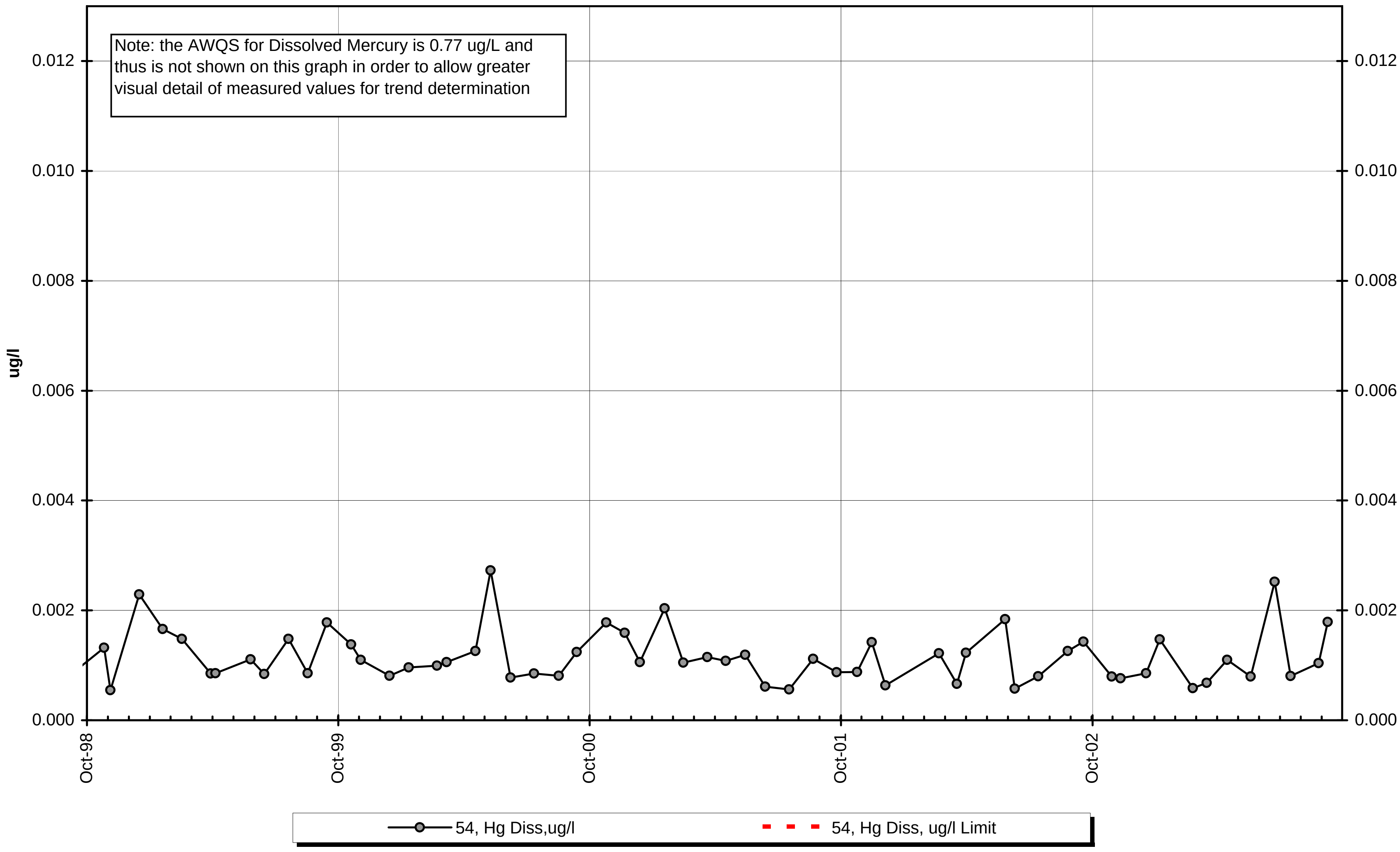


Site 54 -Dissolved Zinc
ug/l
70
60
50
40
30
20
10
0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
54, Zn Diss,ug/l
54, Zn Diss, ug/l Limit

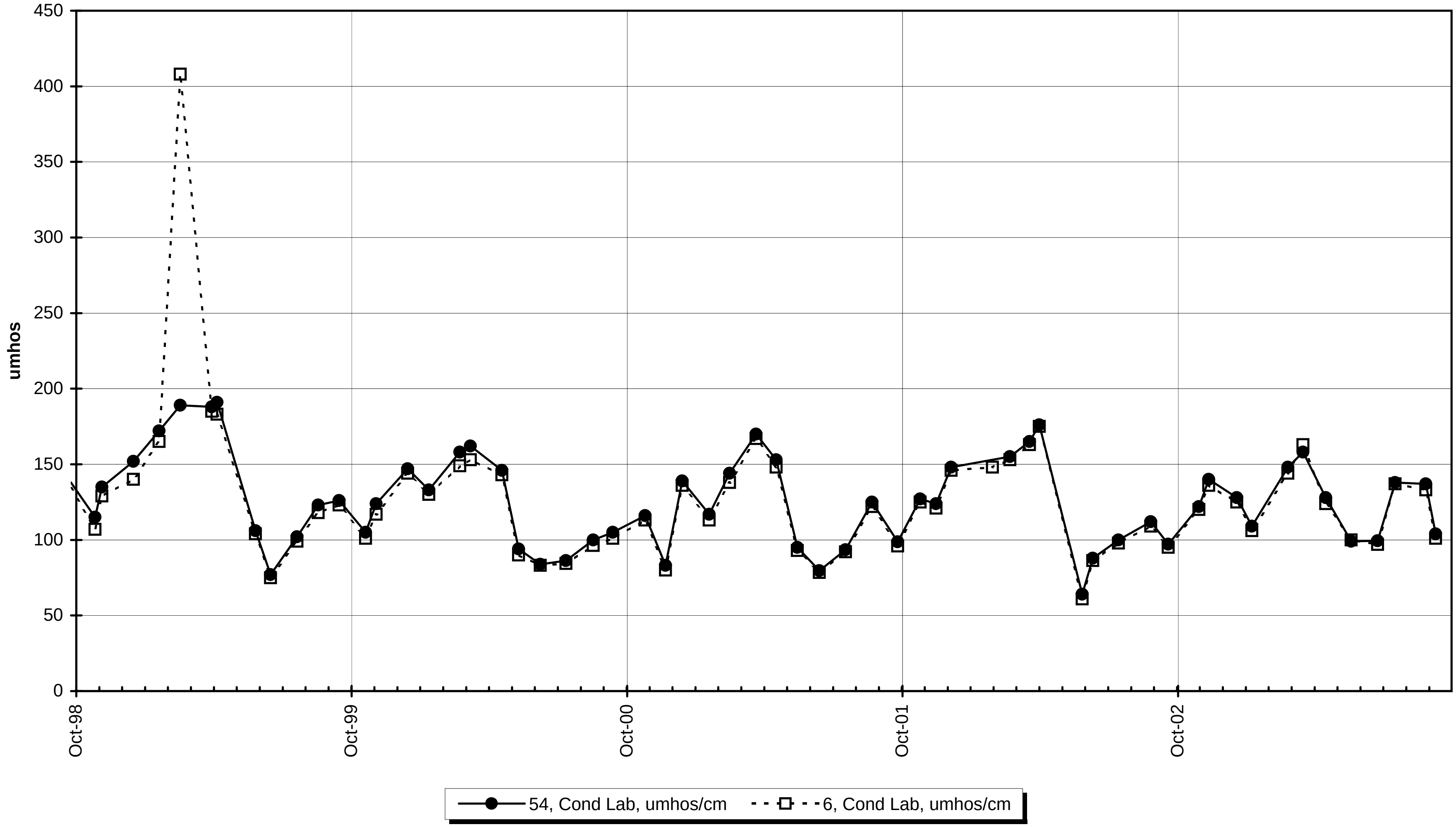
Site 54 -Dissolved Selenium



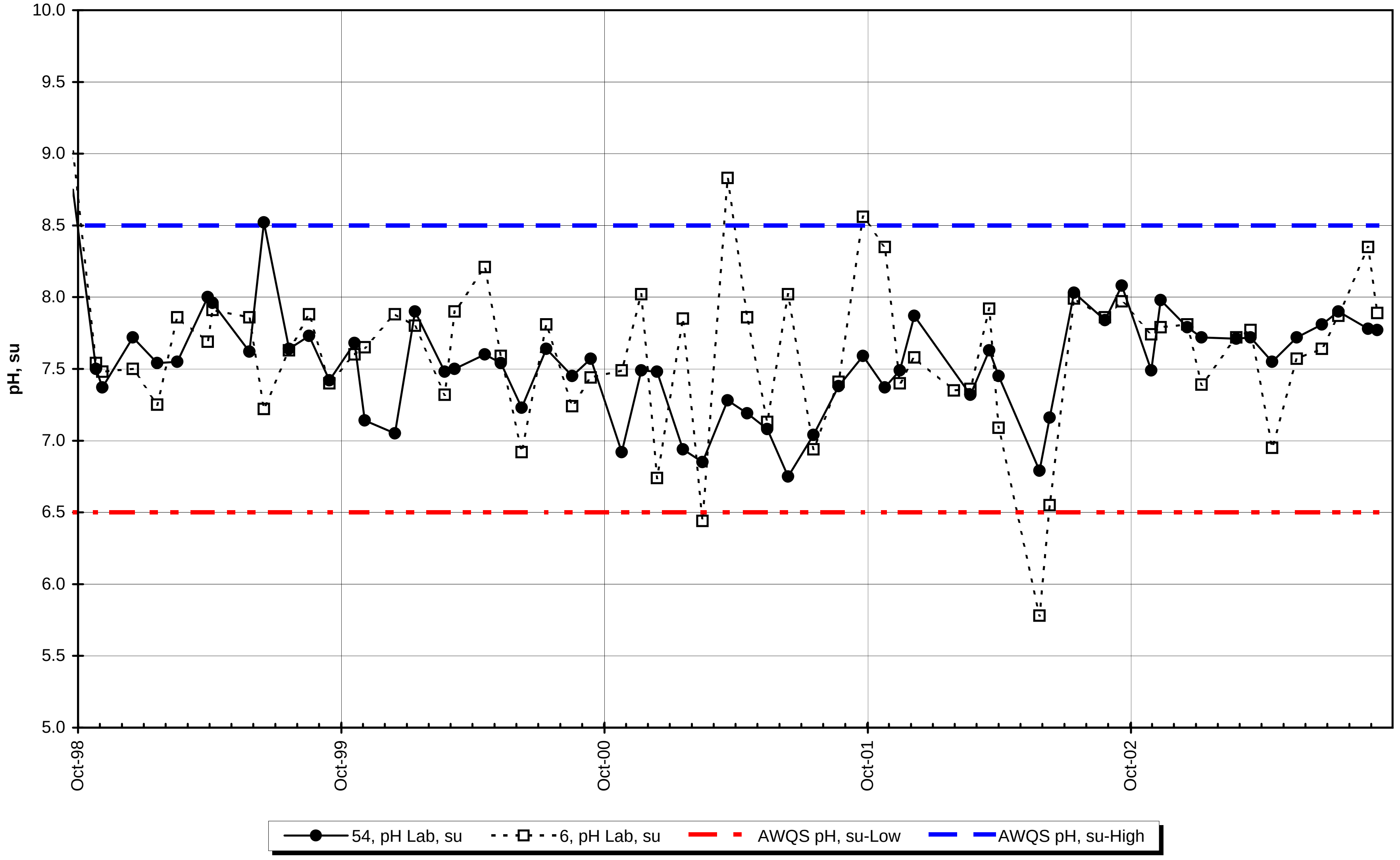
Site 54 -Dissolved Mercury



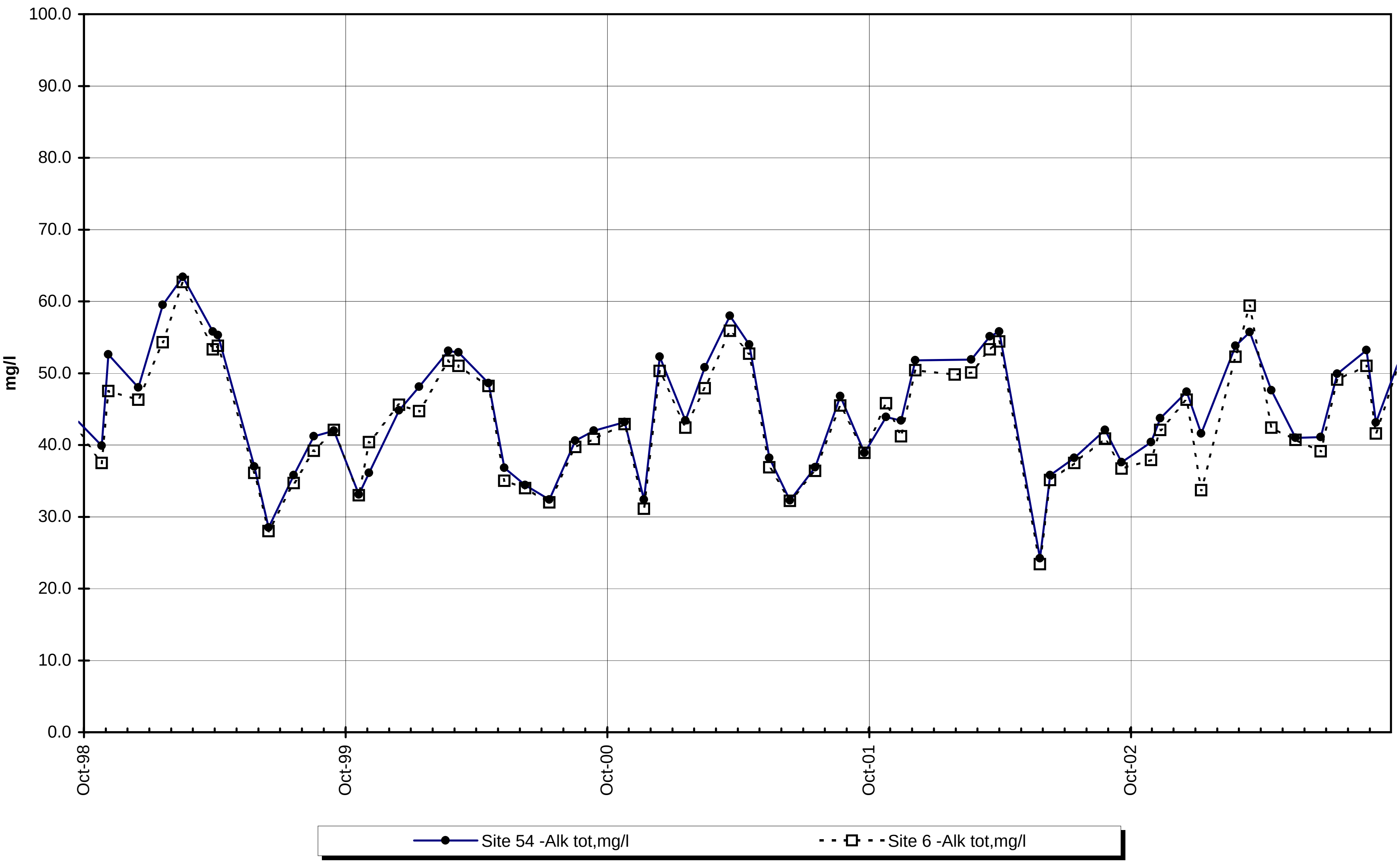
Site 54 vs Site 6 -Conductivity



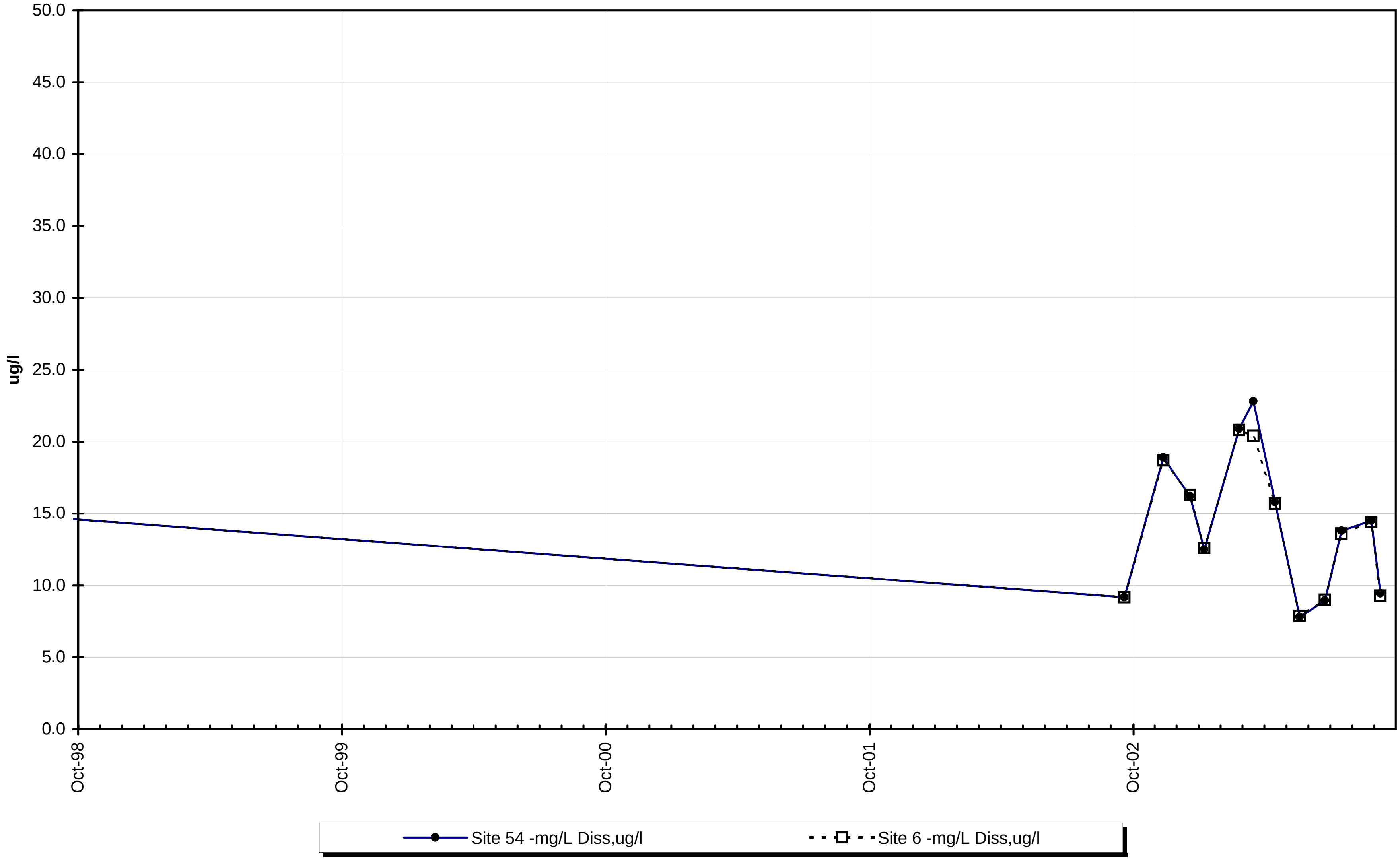
Site 54 vs. Site 6 -pH



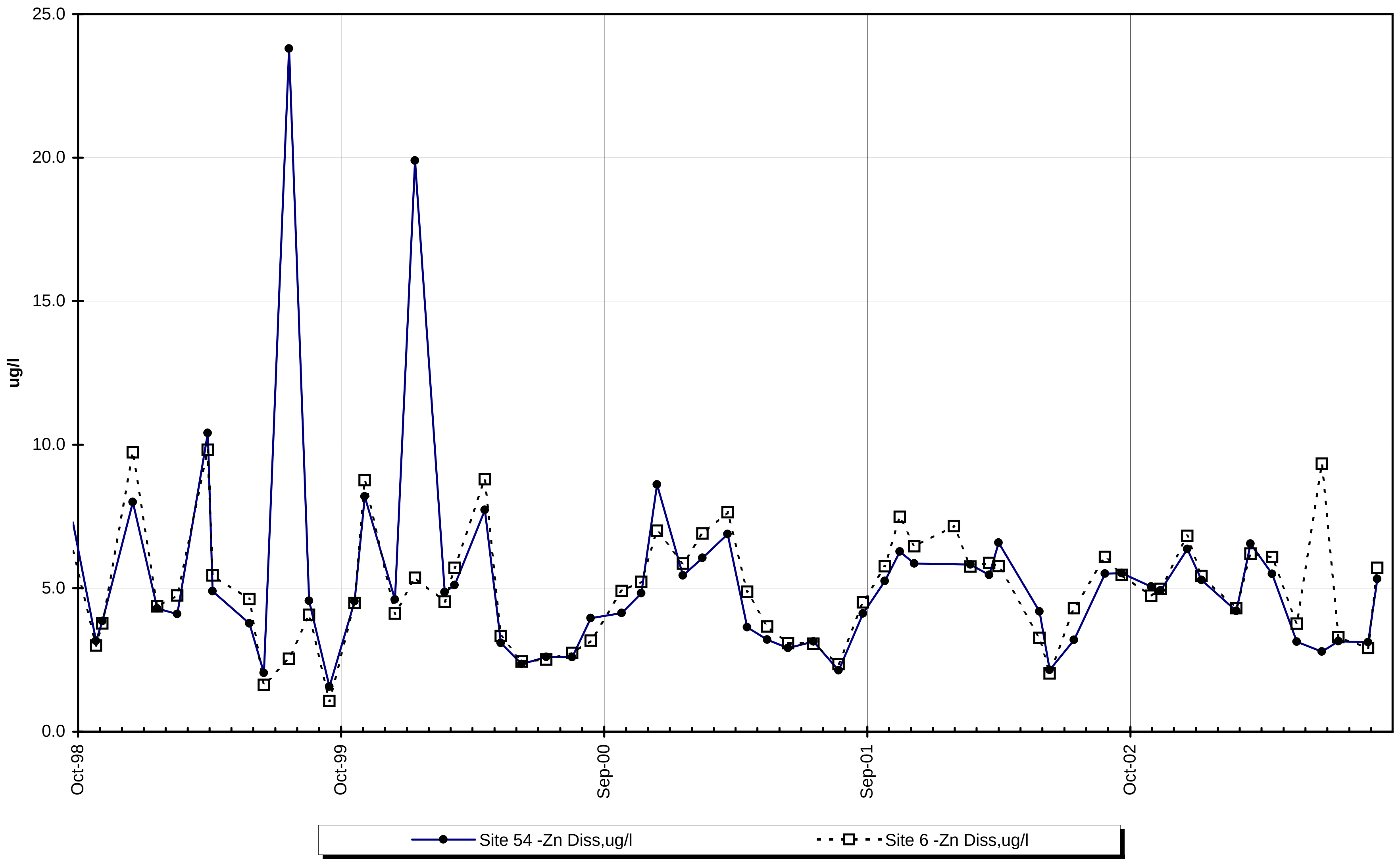
Site 54 vs. Site 6 -Total Alkalinity



Site 54 vs. Site 6 -Total Sulfate



Site 54 vs. Site 6 -Dissolved Zinc



Large Sample Approximation
Wilcoxon-Mann-Whitney Rank Sum Test

Variable: Specific Conductance, Lab (umhos/cm @ 25°C)

Site	#6	#54	Ranks	
Year	WY2003	WY2003	**A**	**B**
Oct	120.0	122.0	9	10
Nov	136.0	140.0	16	20
Dec	125.0	128.0	12	13.5
Jan	106.0	109.0	7	8
Feb	144.0	148.0	21	22
Mar	163.0	158.0	24	23
Apr	124.0	128.0	11	13.5
May	100.0	99.1	4	2
Jun	96.9	99.5	1	3
Jul	137.0	138.0	17.5	19
Aug	133.0	137.0	15	17.5
Sep	101.0	104.0	5	6
Median	124.50	128.00		

N= 24

ΣR 142.5 157.5

	n	**m**
	12	12

W= 79.5

w_α 18

Upper 126

Lower 18

μ_W= 150

σ_W= 17.31

Z_{rs}= 0.40

p-test

0.6570

$\alpha/2$

0.025

H_0

$(\mu_A=\mu_B)$

ACCEPT

Large Sample Approximation
Wilcoxon-Mann-Whitney Rank Sum Test
Variable: **pH, Lab, Standard Units**

Site	#6	#54	Ranks	
Year	WY2003	WY2003	**A**	**B**
Oct	7.74	7.49	12	3
Nov	7.79	7.98	16.5	23
Dec	7.81	7.79	18.5	16.5
Jan	7.39	7.72	2	9.5
Feb	7.72	7.71	9.5	7
Mar	7.77	7.72	13.5	9.5
Apr	6.95	7.55	1	4
May	7.57	7.72	5	9.5
Jun	7.64	7.81	6	18.5
Jul	7.87	7.90	20	22
Aug	8.35	7.78	24	15
Sep	7.89	7.77	21	13.5
Median	7.76	7.75		

N= 24

ΣR 149 151

n	**m**
12	12

W= 73

w_α 18

Upper 126

Lower 18

μ_W= 150

σ_W= 17.27

Z_{rs}= 0.03

p-test

0.5115

$\alpha/2$

0.025

H_0

$(\mu_A=\mu_B)$

ACCEPT

Large Sample Approximation
Wilcoxon-Mann-Whitney Rank Sum Test

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

Site	#6	#54	Ranks	
Year	WY2003	WY2003	**A**	**B**
Oct	37.90	40.40	2	4
Nov	42.10	43.70	10	13
Dec	46.30	47.40	14	15
Jan	33.70	41.60	1	8.5
Feb	52.30	53.80	20	22
Mar	59.40	55.70	24	23
Apr	42.40	47.60	11	16
May	40.70	41.00	5	6
Jun	39.10	41.10	3	7
Jul	49.10	49.90	17	18
Aug	51.00	53.20	19	21
Sep	41.60	43.10	8.5	12
Median	42.25	45.55		

N= 24 ΣR 134.5 165.5

	n	**m**
	12	12

W= 87.5

w_{α} 18

Upper 126

Lower 18

μ_W= 150

σ_W= 17.32

Z_{rs}= 0.87

p-test

0.8068

$\alpha/2$

0.025

H_0

$(\mu_A=\mu_B)$

ACCEPT

Large Sample Approximation
Wilcoxon-Mann-Whitney Rank Sum Test
Variable: **Sulfate, Total (mg/l)**

Site	#6	#54	Ranks	
Year	WY2003	WY2003	**A**	**B**
Oct				
Nov	18.7	18.9	17	18
Dec	16.3	16.2	16	15
Jan	12.6	12.5	8	7
Feb	20.8	20.9	20	21
Mar	20.4	22.8	19	22
Apr	15.7	15.8	13	14
May	7.9	7.8	2	1
Jun	9.0	9.0	4	3
Jul	13.6	13.8	9	10
Aug	14.4	14.5	11	12
Sep	9.3	9.4	5	6
Median	14.4	14.5		

N= 22

ΣR: 124 (A), 129 (B)

n	**m**
11	11

W= 63

wα 18

Upper 103

Lower 18

μ_W= 126.5

σ_W= 15.23

Z_{rs}= 0.13

p-test

0.5522

$\alpha/2$

0.025

H_0

$(\mu_A=\mu_B)$

ACCEPT

Large Sample Approximation
Wilcoxon-Mann-Whitney Rank Sum Test
Variable: **Zinc, Dissolved (ug/l)**

Site	#6	#54	Ranks	
Year	WY2003	WY2003	**A**	**B**
Oct	4.7	5.1	10	13
Nov	5.0	4.9	12	11
Dec	6.8	6.4	23	21
Jan	5.4	5.3	16	14
Feb	4.3	4.2	9	8
Mar	6.2	6.6	20	22
Apr	6.1	5.5	19	17
May	3.8	3.1	7	4
Jun	9.3	2.8	24	1
Jul	3.3	3.2	6	5
Aug	2.9	3.1	2	3
Sep	5.7	5.3	18	15
Median	5.20	4.99		

N= 24 ΣR 166 134

n	**m**
12	12

W= 56

w$_\alpha$ 18

Upper 126

Lower 18

μ_W= 150

σ_W= 17.32

Z_{rs}= -0.89

p-test

0.1854

$\alpha/2$

0.025

H_0

$(\mu_A=\mu_B)$

ACCEPT

Site **#54** Seasonal Mann-Kendall analysis for Specific Conductance, Lab (umhos/cm @ 25°C)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY1998**	119	147	126		131	158	162	106	97	120	126	138
b	**WY1999**	115	135	152	172	189	188	191	106	77	102	123	126
c	**WY2000**	105	124	147	133	158	162	146	94	84	86	100	105
d	**WY2001**	116	83	139	117	144	170	153	95	80	94	125	99
e	**WY2002**	127	124	148		155	165	176	64	88	100	112	97
f	**WY2003**	122	140	128	109	148	158	128	99	100	138	137	104
	n	6	6	6	4	6	6	6	6	6	6	6	6

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

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

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
$\sigma^2{}_S$=	28.33	28.33	28.33	8.67	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33
$Z_k = S_k/\sigma_S$	0.94	-0.75	-0.19	-2.04	-0.19	-0.38	-0.94	-1.13	0.94	0.19	0.19	-2.07
$Z^2{}_k$	0.88	0.56	0.04	4.15	0.04	0.14	0.88	1.27	0.88	0.04	0.04	4.27

ΣZ_k= -5.42
$\Sigma Z^2{}_k$= 13.19
Z-bar=$\Sigma Z_k/K$= -0.45
p(Z-bar)= 0.326

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

Σn	70
ΣS_k	-24
V(S)	38908
Z	-0.127
K	12

$\chi^2{}_h = \Sigma Z^2{}_k - K(\text{Z-bar})^2$= 10.74
p 0.47

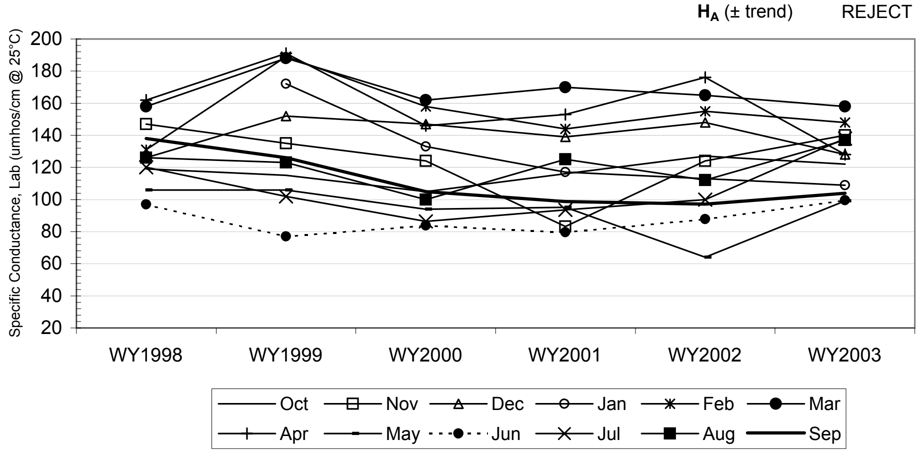
@α=5% $\chi^2{}_{(K-1)}$= 19.68

Test for station homogeneity
$\chi^2{}_h < \chi^2{}_{(K-1)}$ ACCEPT

K*(Z-bar)^2= 2.45
p 0.12

@α=5% $\chi^2{}_{(1)}$= 3.84

K*(Z-bar)² < $\chi^2{}_{(1)}$
H_0 (No trend) ACCEPT
H_A (± trend) REJECT



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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY1998**	7.75	8.46	8.96		7.61	7.62	8.20	7.91	8.00	7.97	7.67	8.75
b	**WY1999**	7.50	7.37	7.72	7.54	7.55	8.00	7.96	7.62	8.52	7.64	7.73	7.42
c	**WY2000**	7.68	7.14	7.05	7.90	7.48	7.50	7.60	7.54	7.23	7.64	7.45	7.57
d	**WY2001**	6.92	7.49	7.48	6.94	6.85	7.28	7.19	7.08	6.75	7.04	7.38	7.59
e	**WY2002**	7.37	7.49	7.87		7.32	7.63	7.45	6.79	7.16	8.03	7.84	8.08
f	**WY2003**	7.49	7.98	7.79	7.72	7.71	7.72	7.55	7.72	7.81	7.90	7.78	7.77
	n	6	6	6	4	6	6	6	6	6	6	6	6
	t_1	0	1	0	0	0	0	0	0	0	1	0	0
	t_2	0	0	0	0	0	0	0	0	0	0	0	0
	t_3	0	0	0	0	0	0	0	0	0	0	0	0
	t_4	0	0	0	0	0	0	0	0	0	0	0	0
	t_5	0	0	0	0	0	0	0	0	0	0	0	0
	b-a	-1	-1	-1		-1	1	-1	-1	1	-1	1	-1
	c-a	-1	-1	-1		-1	-1	-1	-1	-1	-1	-1	-1
	d-a	-1	-1	-1		-1	-1	-1	-1	-1	-1	-1	-1
	e-a	-1	-1	-1		-1	1	-1	-1	-1	1	1	-1
	f-a	-1	-1	-1		1	1	-1	-1	-1	-1	1	-1
	c-b	1	-1	-1	1	-1	-1	-1	-1	-1	0	-1	1
	d-b	-1	1	-1	-1	-1	-1	-1	-1	-1	-1	-1	1
	e-b	-1	1	1		-1	-1	-1	-1	-1	1	1	1
	f-b	-1	1	1	1	1	-1	-1	1	-1	1	1	1
	d-c	-1	1	1	-1	-1	-1	-1	-1	-1	-1	-1	1
	e-c	-1	1	1		-1	1	-1	-1	-1	1	1	1
	f-c	-1	1	1	-1	1	1	-1	1	1	1	1	1
	e-d	1	0	1		1	1	1	-1	1	1	1	1
	f-d	1	1	1	1	1	1	1	1	1	1	1	1
	f-e	1	1	-1		1	1	1	1	1	-1	-1	-1
	S_k	-7	2	-1	0	-3	1	-9	-7	-5	0	3	3
	σ^2_S=	28.33	28.33	28.33	8.67	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33
	$Z_k = S_k/\sigma_S$	-1.32	0.38	-0.19	0.00	-0.56	0.19	-1.69	-1.32	-0.94	0.00	0.56	0.56
	Z^2_k	1.73	0.14	0.04	0.00	0.32	0.04	2.86	1.73	0.88	0.00	0.32	0.32

ΣZ_k= -4.32

ΣZ^2_k= 8.36

Z-bar=ΣZ_k/K= -0.36

p(Z-bar)= 0.359

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

Σn	70
ΣS_k	-23
V(S)	38908
Z	-0.122
K	12

$\chi^2_h = \Sigma Z^2_k - K(\text{Z-bar})^2$= 6.81

p 0.81

@α=5% $\chi^2_{(K-1)}$= 19.68

Test for station homogeneity

$\chi^2_h < \chi^2_{(K-1)}$ ACCEPT

K*(Z-bar)^2= 1.56

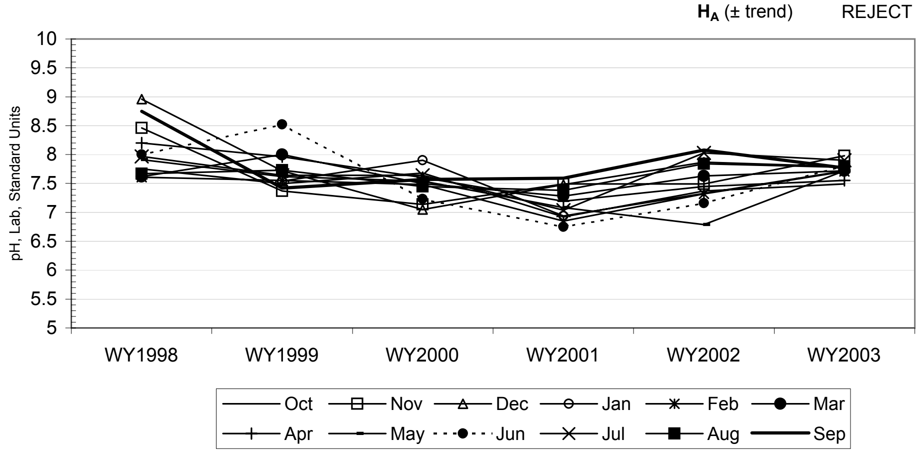
p 0.21

@α=5% $\chi^2_{(1)}$= 3.84

K*(Z-bar)² < $\chi^2_{(1)}$

H_0 (No trend) ACCEPT

H_A (± trend) REJECT



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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY1998**	48	52	41		45	49	51	41	35	40	46	43
b	**WY1999**	40	53	48	60	63	56	55	37	29	36	41	42
c	**WY2000**	33	36	45	48	53	53	49	37	34	32	41	42
d	**WY2001**	43	32	52	43	51	58	54	38	32	37	47	39
e	**WY2002**	44	43	52		52	55	56	24	36	38	42	38
f	**WY2003**	40	44	47	42	54	56	48	41	41	50	53	43
	n	6	6	6	4	6	6	6	6	6	6	6	6

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

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

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	28.33	28.33	28.33	8.67	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33
$Z_k = S_k/\sigma_S$	-0.19	-0.56	0.94	-2.04	0.56	0.94	-0.19	-0.19	1.32	0.94	0.94	-1.13
Z^2_k	0.04	0.32	0.88	4.15	0.32	0.88	0.04	0.04	1.73	0.88	0.88	1.27

ΣZ_k= 1.34
ΣZ^2_k= 11.42
Z-bar=$\Sigma Z_k/K$= 0.11
p(Z-bar)= 0.545

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

Σn	70
ΣS_k	12
V(S)	38908
Z	0.056
K	12

$\chi^2_h = \Sigma Z^2_k - K(\text{Z-bar})^2$= 11.27
p 0.42

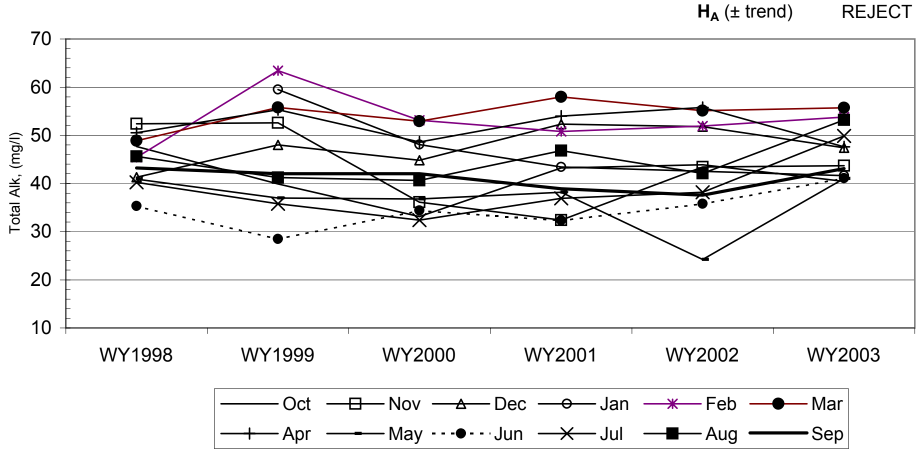
@α=5% $\chi^2_{(K-1)}$= 19.68

Test for station homogeneity
$\chi^2_h < \chi^2_{(K-1)}$ ACCEPT

$K^*(\text{Z-bar})^2$= 0.15
p 0.70

@α=5% $\chi^2_{(1)}$= 3.84

$K^*(\text{Z-bar})^2 < \chi^2_{(1)}$
H_0 (No trend) ACCEPT
H_A (± trend) REJECT



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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY1998**	5.87	2.35	6.01		9.38	8.87	26.50	2.35	1.78	4.79	3.75	7.29
b	**WY1999**	3.16	3.85	8.00	4.29	4.10	10.40	4.89	3.77	2.04	23.80	4.56	1.57
c	**WY2000**	4.54	8.19	4.60	19.90	4.86	5.10	7.72	3.09	2.35	2.60	2.59	3.95
d	**WY2001**	4.13	4.82	8.61	5.44	6.05	6.88	3.64	3.20	2.91	3.14	2.13	4.11
e	**WY2002**	5.25	6.27	5.86		5.82	5.46	6.58	4.18	2.15	3.19	5.50	5.52
f	**WY2003**	5.05	4.92	6.36	5.28	4.20	6.55	5.49	3.13	2.79	3.15	3.11	5.32
	n	6	6	6	4	6	6	6	6	6	6	6	6

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

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

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	28.33	28.33	28.33	8.67	28.33	28.33	28.33	28.33	28.33	28.33	28.33	28.33
$Z_k = S_k/\sigma_S$	0.19	1.32	0.19	0.00	-0.56	-0.94	-0.94	0.94	1.69	-0.56	-0.19	0.56
Z^2_k	0.04	1.73	0.04	0.00	0.32	0.88	0.88	0.88	2.86	0.32	0.04	0.32

ΣZ_k= 1.69
ΣZ^2_k= 8.29
Z-bar=ΣZ_k/K= 0.14
p(Z-bar)= 0.556

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

Σn	70
ΣS_k	9
V(S)	38908
Z	0.041
K	12

$\chi^2_h=\Sigma Z^2_k-K(\text{Z-bar})^2$= 8.06
p 0.71

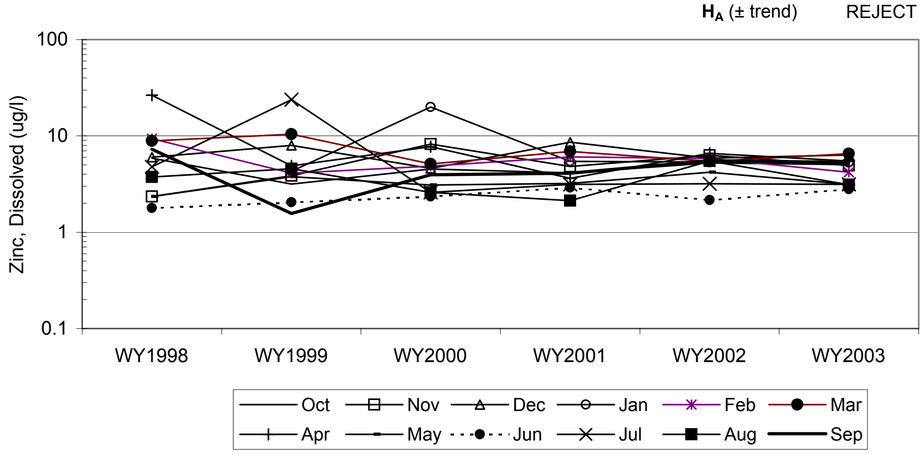
@α=5% $\chi^2_{(K-1)}$= 19.68

Test for station homogeneity
$\chi^2_h<\chi^2_{(K-1)}$ ACCEPT

K*(Z-bar)^2= 0.24
p 0.63

@α=5% $\chi^2_{(1)}$= 3.84

K*(Z-bar)^2 < $\chi^2_{(1)}$
H_0 (No trend) ACCEPT
H_A (± trend) REJECT



INTERPRETIVE REPORT
SITE 49 “UPPER BRUIN CREEK”

The data collected during the current water year are listed in the following “Table of Results for Water Year 2003” report. The table includes all the data, field and lab, 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 zero for the purpose of median calculation.

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

Sample Date	Parameter	Value	Qualifier	Notes
No outliers have been identified by KGCMC for the period of Oct-98 though Sept-03.				

The data for water year 2003 have been compared to the strictest fresh water quality criterion for each applicable analyte. No results exceeding these criteria have been identified.

X-Y plots have been generated to graphically present the data for each of the analytes requested in the Statistical Information Goals for this site. These plots have been visually analyzed for the appearance of any trend in concentration. No obvious visual trends are apparent except for the lab-pH. The lab-pH does appear to have a step increase of approximately 0.3 su from a pH of 7.5 to 7.8 that occurs after June-2002. The visual trend analysis was followed-up with an additional non-parametric statistical analysis for trend. In addition to pH; conductivity, alkalinity, and dissolved zinc were also subject to a Seasonal Mann-Kendall analyses, of which the calculation details are presented on the pages following this interpretive section. The table below summarizes the results on the data collected between Oct-97 and Sep-03 (WY1998-WY2003). For data sets with a statistically significant trend (α=5%) a Seasonal-Sen’s Slope estimate statistic has also been calculated. Dissolved zinc is the only analyte that has a statistically significant trend (p=0.03) and the Sen’s slope estimate is 0.11 ug$\cdot$L$^{-1}\cdot$yr^{-11} or an 8.2% upward trend over the last 6 years. Given the low absolute magnitude of the change and the fact that site is used as a background reference, the change is considered due to natural variation. The visual trend noted above for pH is not statistically significant when analyzed over a 5+ year dataset. Thus the apparent recent increase appears to fall within the overall variation for this site.

		Mann-Kendall test statistics			Sen's slope estimate	
Parameter	n*	Z	Trend	a**	Q	Q(%)
Conductivity, Lab	6	3.5	-	0.06		
pH, Lab	6	0.97	-	0.33		
Alkalinity, Total	6	0.56	+	0.46		
Zinc, Dissolved	6	8.51	+	**<0.01**	0.17	8.2

*: Number of years **:Significance level

Table of Results for Water Year 2003

Site 49 "Upper Bruin Creek"													
Sample Date/Parameter	10/30/2002	11/12/2002	12/19/2002	1/8/2003	2/25/2003	3/17/2003	4/16/2003	5/20/2003	6/24/2003	7/17/2003	8/27/2003	9/9/2003	**Median**
Water Temp (°C)	4.2	5.2	3.0	1.2	0.3		1.0	6.0	7.3	9.6	8.7	8.3	5.2
Conductivity-Field(µmho)	144	201	144	132	212		145	109	126	169	156	126	144
Conductivity-Lab (µmho)	140	159	145	126 U	167 J		135	104	122	180	158	122	140
pH Lab (standard units)	7.62	8.05	7.80	7.86	7.83 J		7.57	7.84	7.94	8.04	7.81 J	8.03	7.84
pH Field (standard units)	7.69	7.61	7.69	7.15	7.80		7.50	7.39	7.58	8.15	7.94	7.98	7.69
Total Alkalinity (mg/L)	73.9	63.1	63.8	57.4	74.3 J		60.3	47.4	58.4	74.5	71.2	56.7	63.1
Total Sulfate (mg/L)	NOTE 1	12.7 J	10.5 J	8.7 J	14.3		10.7	5.3	7.6	12.6	11.0 J	7.2 J	10.6
Hardness (mg/L)	44.5	80.4	70.5	60.3	86.0		69.1	51.5	78.3	76.8	85.0	59.7	70.5
Dissolved As (ug/L)	<0.186	0.235 J	0.176 J	0.296 U	<0.386		0.250 U	0.157	<0.204	<0.331	0.538 U	0.153 J	0.176
Dissolved Ba (ug/L)			9.5		11.0	FROZEN							10.2
Dissolved Cd (ug/L)	0.046	0.030 J	0.041 J	0.034 U	<0.028		0.025	0.025	<0.034	0.030 J	0.041 J	<0.023	0.030
Dissolved Cr (ug/L)			<1.010		2.120								1.313
Dissolved Cu (ug/L)	0.380 U	0.579 U	0.587 U	0.537 U	0.311		0.588	0.621	0.625	0.462 J	0.575	0.648	0.579
Dissolved Pb (ug/L)	0.0209 J	0.0333 J	0.0976 J	<0.0280	<0.0210		0.0414 U	0.0248 U	0.3570	0.0323 J	0.1960	0.2740	0.0333
Dissolved Ni (ug/L)			1.260		0.688								0.974
Dissolved Ag (ug/L)			<0.011		<0.057								0.017
Dissolved Zn (ug/L)	2.48	2.56 J	3.36	2.59	1.86 U		2.08	2.59	6.05	2.09 U	3.78	3.74	2.59
Dissolved Se (ug/L)			0.377 U		0.989								0.683
Dissolved Hg (ug/L)	0.001300	0.001160 U	0.001190	0.002050 U	0.000970 U		0.001580	0.001150	0.000581 U	0.001290 U	0.001580	0.002460 J	0.001290

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

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

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

NOTE (1) Analysis was not performed on sample.

Qualified Data by QA Reviewer

Date Range: 10/01/2002 to 09/30/2003

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
49	01/08/2003	1:26:00 PM				
			Cond Lab, umho	126	U	Field Blank Contamination
			SO4 Tot, mg/l	8.65	J	Hold Time
			As Diss, ug/l	0.296	U	Below Quantitative Range, Fi
			Cd Diss, ug/l	0.0343	U	Below Quantitative Range, Fi
			Cu Diss, ug/l	0.537	U	Field Blank Contamination
			Hg Diss, ug/l	0.00205	U	Field Blank Contamination
49	10/30/2002	2:10:00 PM				
			Cu Diss, ug/l	0.38	U	Field Blank Contamination
			Pb Diss, ug/l	0.0209	J	Below Quantitative Range
49	11/12/2002	3:20:00 PM				
			SO4 Tot, mg/l	12.7	J	Hold Time
			As Diss, ug/l	0.235	J	Below Quantitative Range, L
			Cd Diss, ug/l	0.0303	J	Below Quantitative Range
			Cu Diss, ug/l	0.579	U	Field Blank Contamination
			Pb Diss, ug/l	0.0333	J	Below Quantitative Range
			Zn Diss, ug/l	2.56	J	LCS Recovery
			Hg Diss, ug/l	0.00116	U	Field Blank Contamination
49	12/19/2002	12:30:00 PM				
			SO4 Tot, mg/l	10.5	J	Hold Time
			As Diss, ug/l	0.176	J	Below Quantitative Range
			Cd Diss, ug/l	0.0414	J	Below Quantitative Range, L
			Cu Diss, ug/l	0.587	U	Field Blank Contamination
			Pb Diss, ug/l	0.0976	J	LCS Recovery
			Se Diss, ug/l	0.377	U	Below Quantitative Range, M
49	02/25/2003	1:30:00 PM				
			Cond Lab, umho	167	J	Sample Temperature
			pH Lab, su	7.83	J	Hold Time
			Alk Tot, mg/l	74.3	J	Sample Temperature
			Zn Diss, ug/l	1.86	U	Field Blank Contamination
			Hg Diss, ug/l	0.00097	U	Field Blank Contamination

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

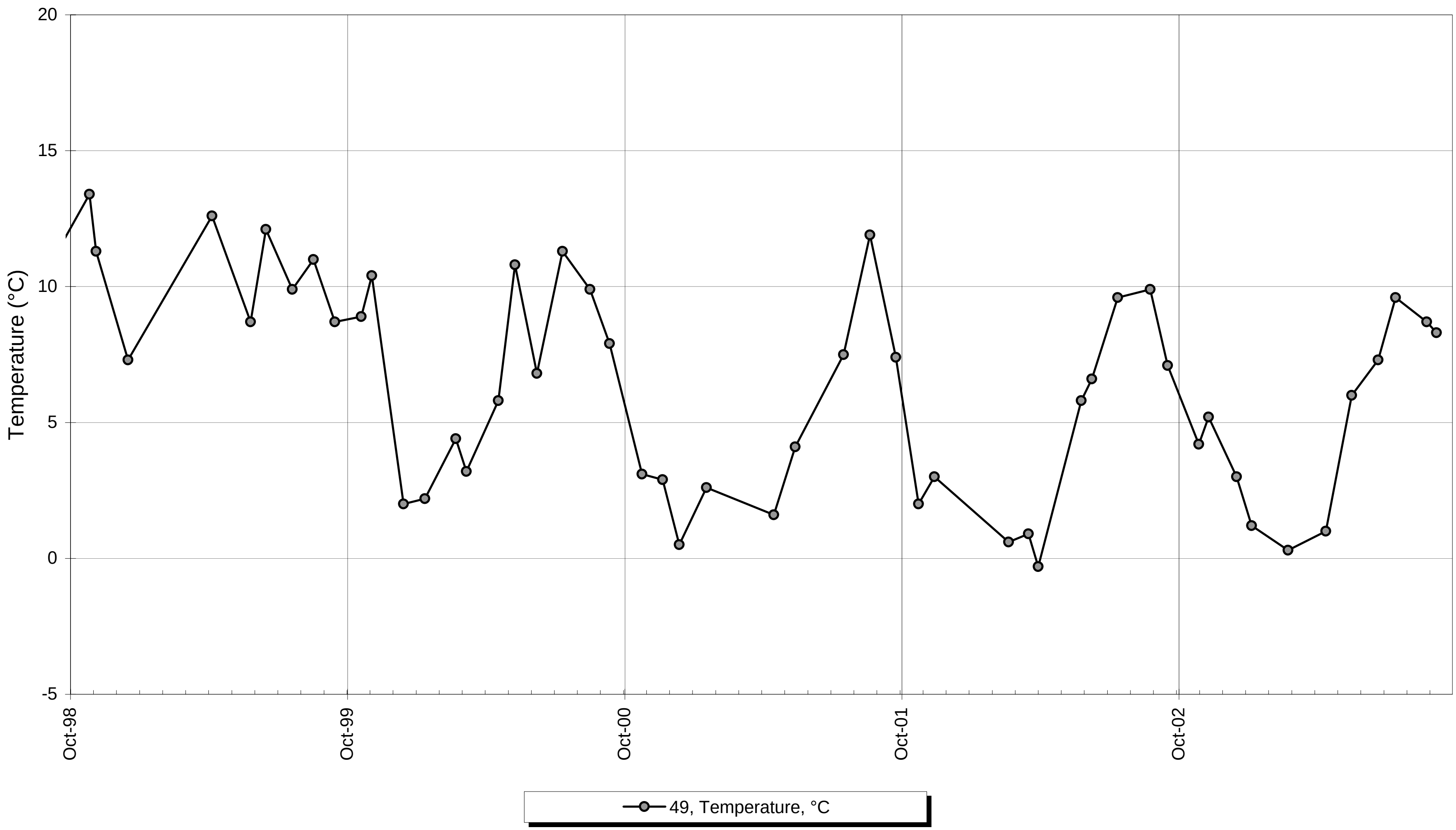
Qualified Data by QA Reviewer

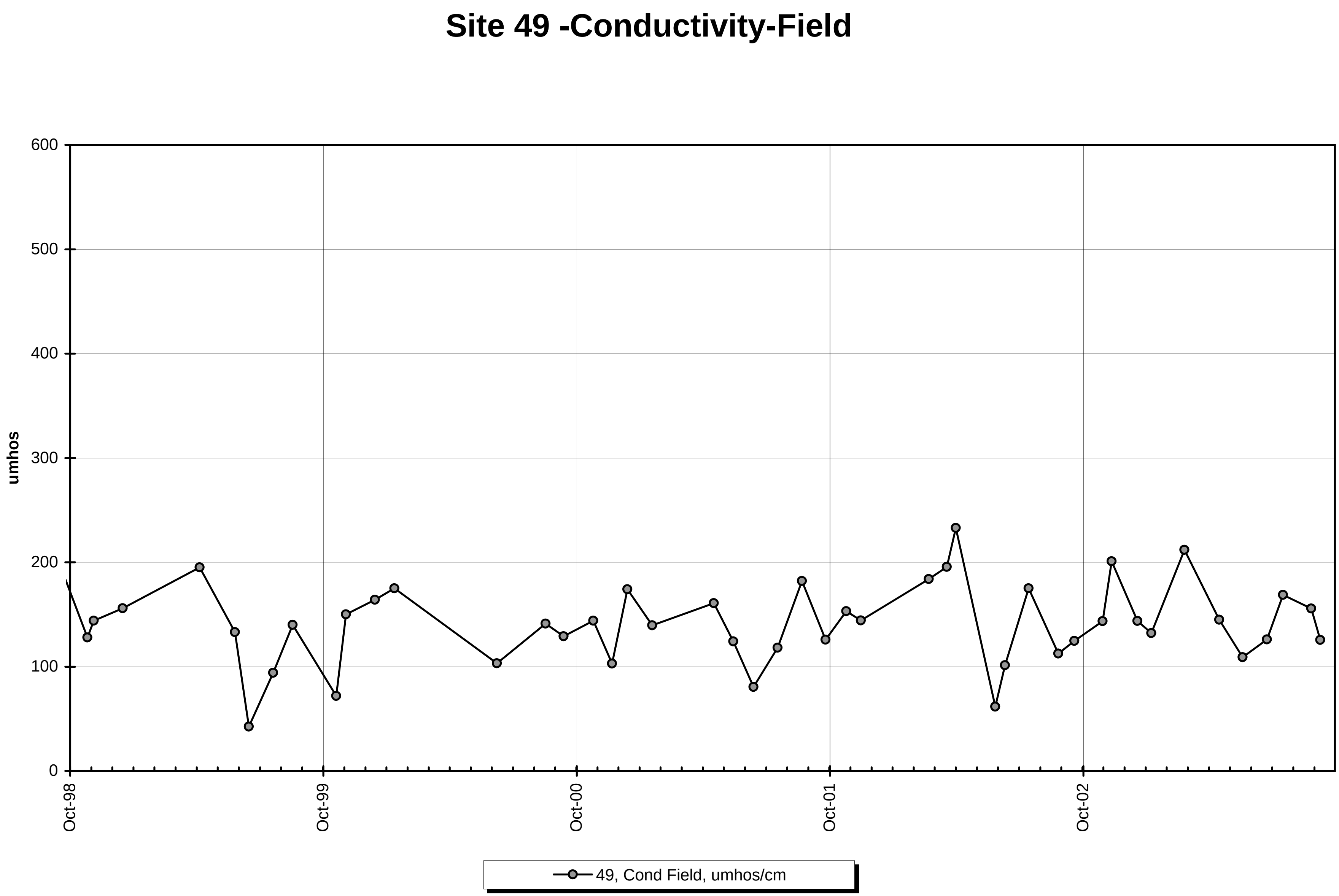
Date Range: 10/01/2002 to 09/30/2003

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
49	04/16/2003	1:45:00 PM				
			As Diss, ug/l	0.25	U	Field Blank Contamination
			Pb Diss, ug/l	0.0414	U	Field Blank Contamination
49	05/20/2003	1:50:00 PM				
			Pb Diss, ug/l	0.0248	U	Field Blank Contamination
49	06/24/2003	2:30:00 PM				
			Hg Diss, ug/l	0.000581	U	Field Blank Contamination
49	07/17/2003	2:30:00 PM				
			Cd Diss, ug/l	0.0298	J	Below Quantitative Range
			Cu Diss, ug/l	0.462	J	Continuing Calibration Verific
			Pb Diss, ug/l	0.0323	J	Below Quantitative Range
			Zn Diss, ug/l	2.09	U	Field Blank Contamination
			Hg Diss, ug/l	0.00129	U	Field Blank Contamination
49	08/27/2003	3:10:00 PM				
			pH Lab, su	7.81	J	Hold Time
			SO4 Tot, mg/l	11	J	Sample Temperature
			As Diss, ug/l	0.538	U	Below Quantitative Range, M
			Cd Diss, ug/l	0.041	J	Below Quantitative Range
49	09/09/2003	3:10:00 PM				
			SO4 Tot, mg/l	7.16	J	Sample Temperature
			As Diss, ug/l	0.153	J	Below Quantitative Range
			Hg Diss, ug/l	0.00246	J	Duplicate RPD

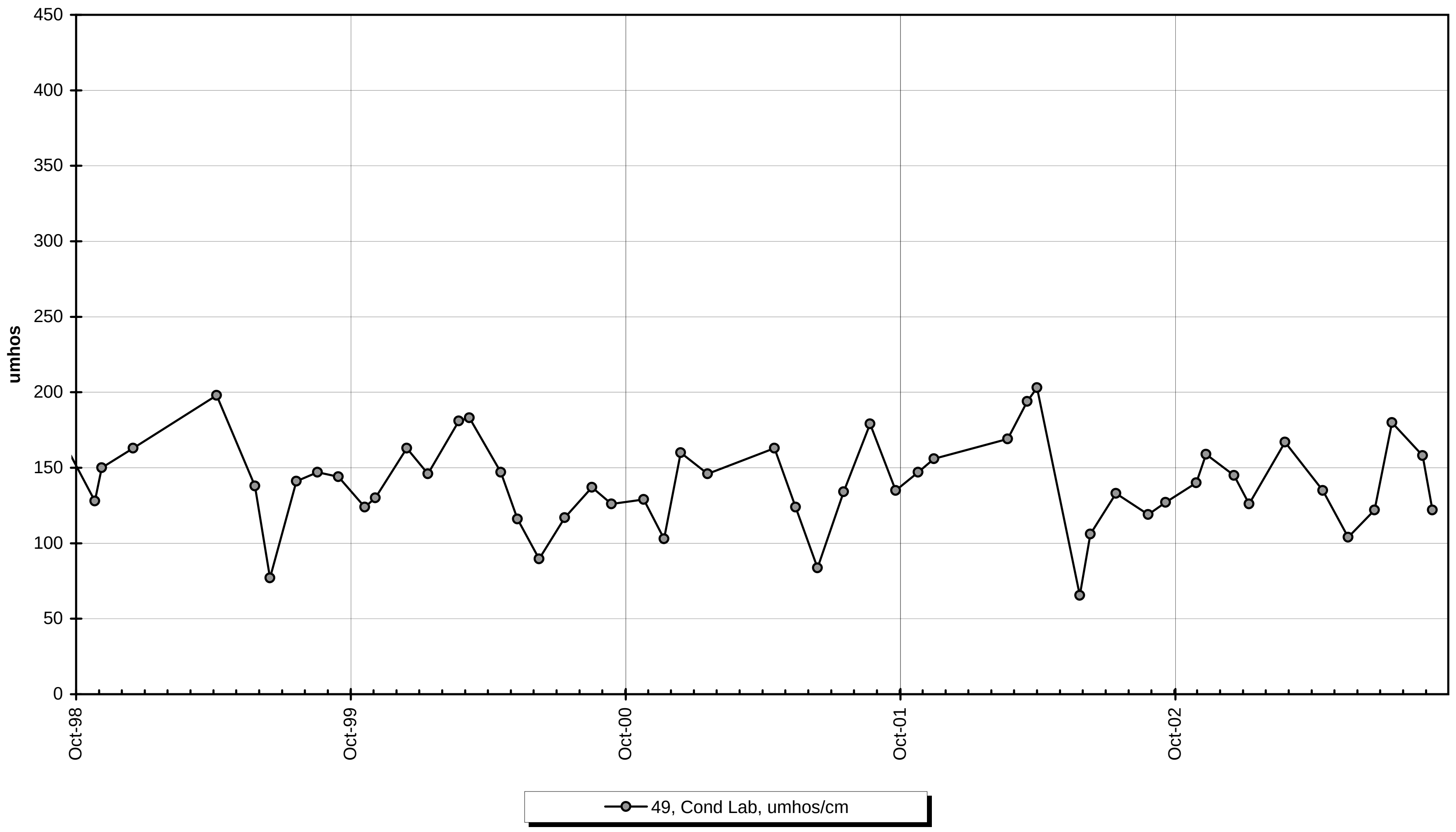
Qualifier	Description
J	Positively Identified - Approximate Concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot Be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit

Site 49 -Water Temperature

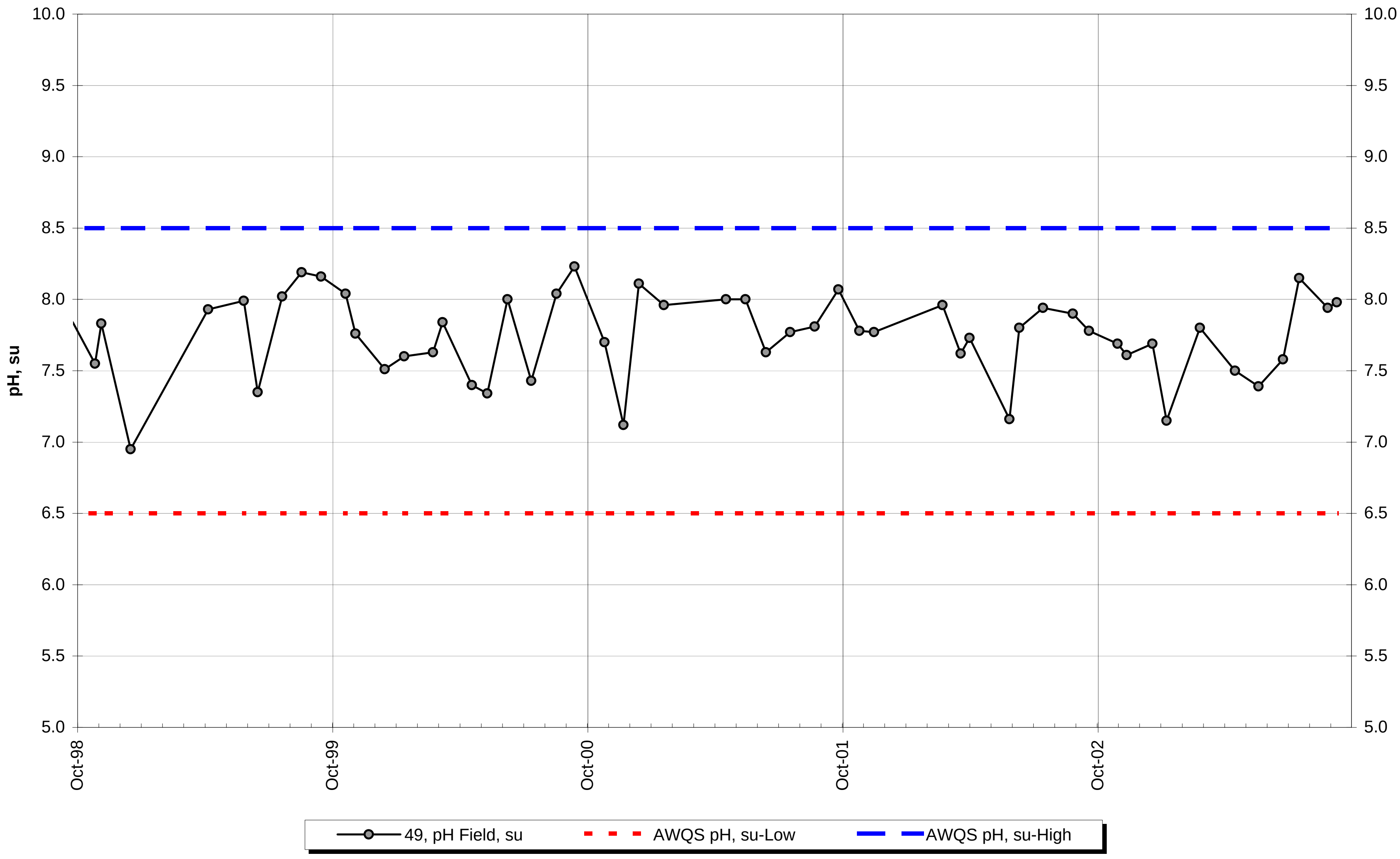


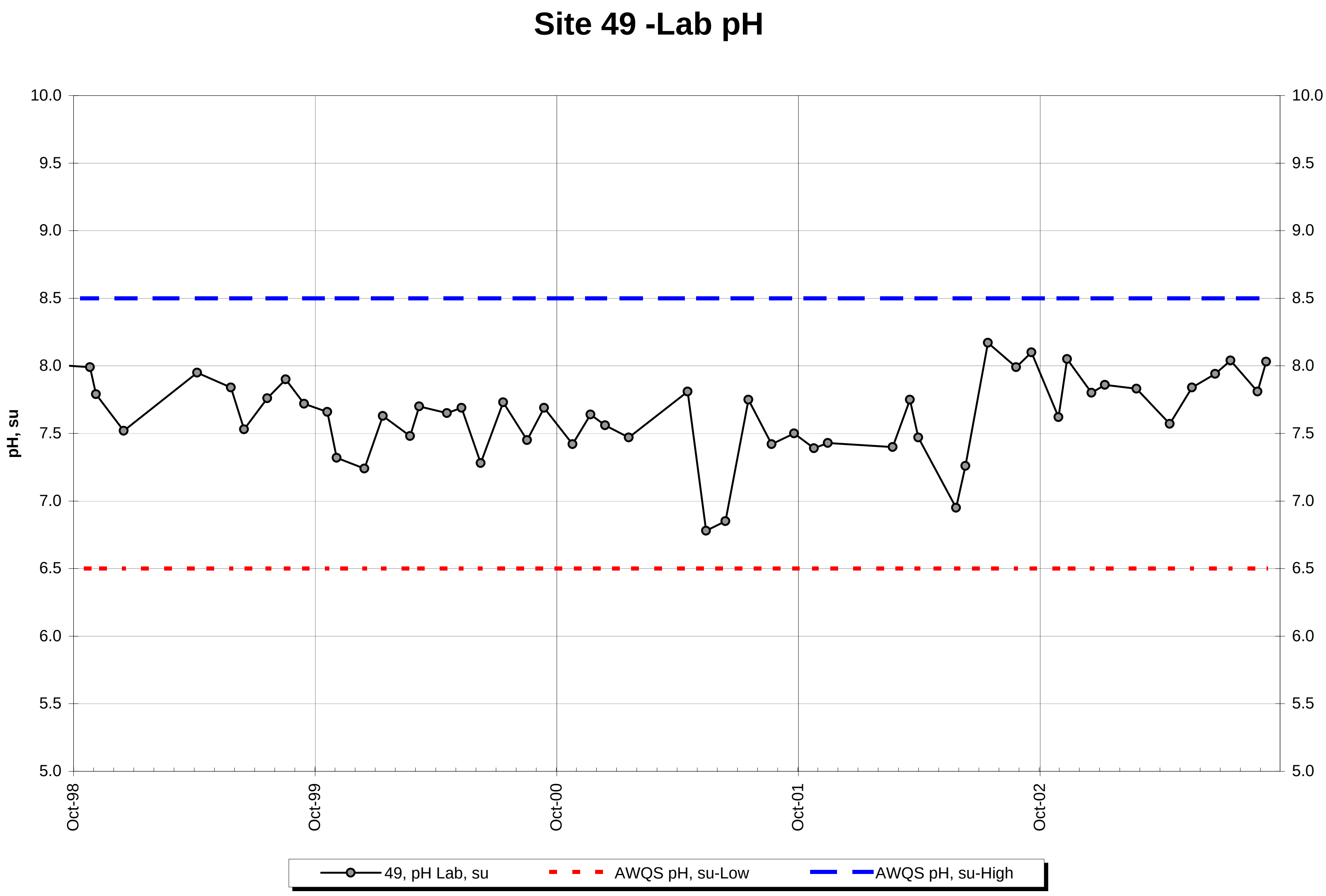

Site 49 -Conductivity-Field
umhos
0
100
200
300
400
500
600
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
49, Cond Field, umhos/cm

Site 49 -Conductivity-Lab

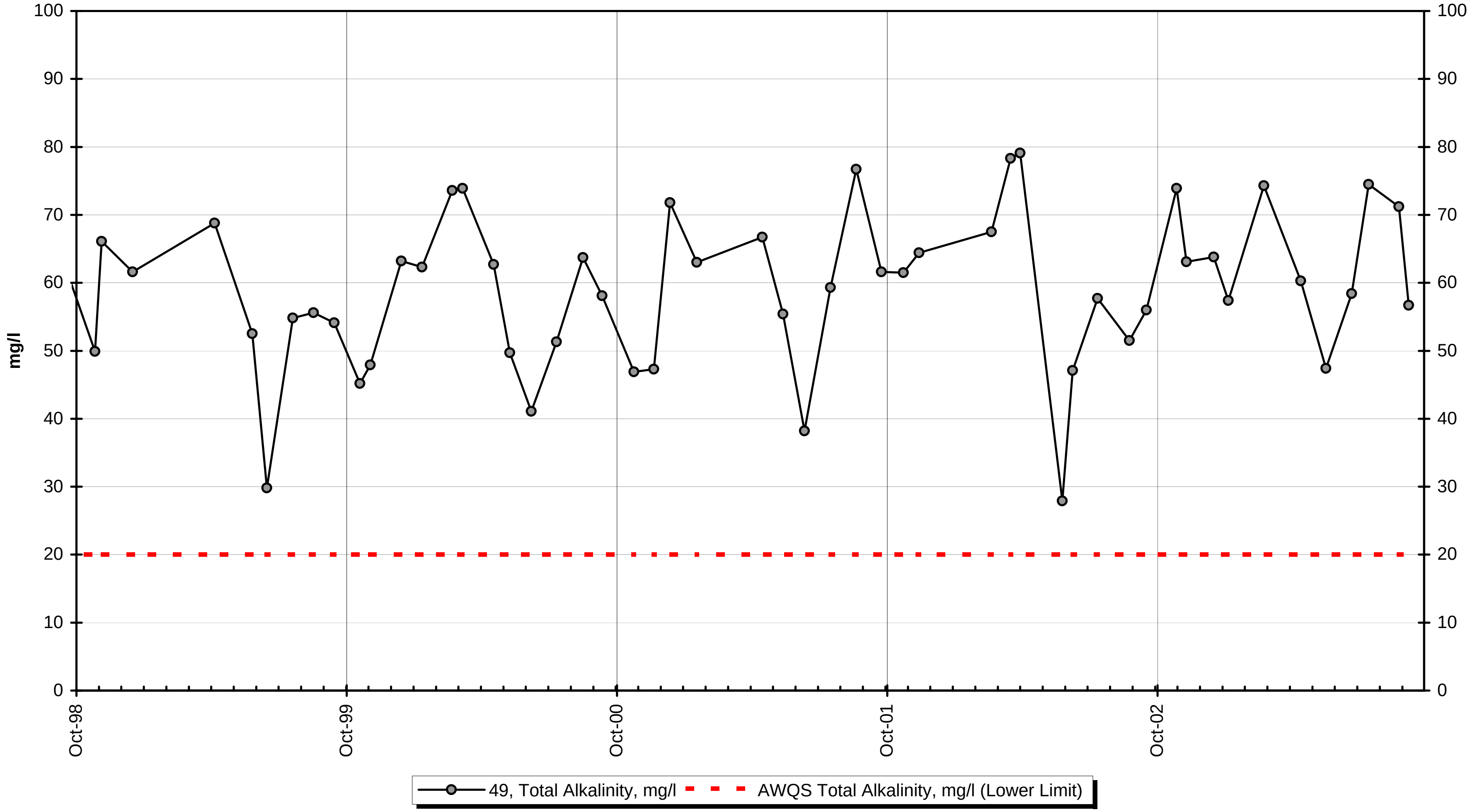


Site 49 -Field pH

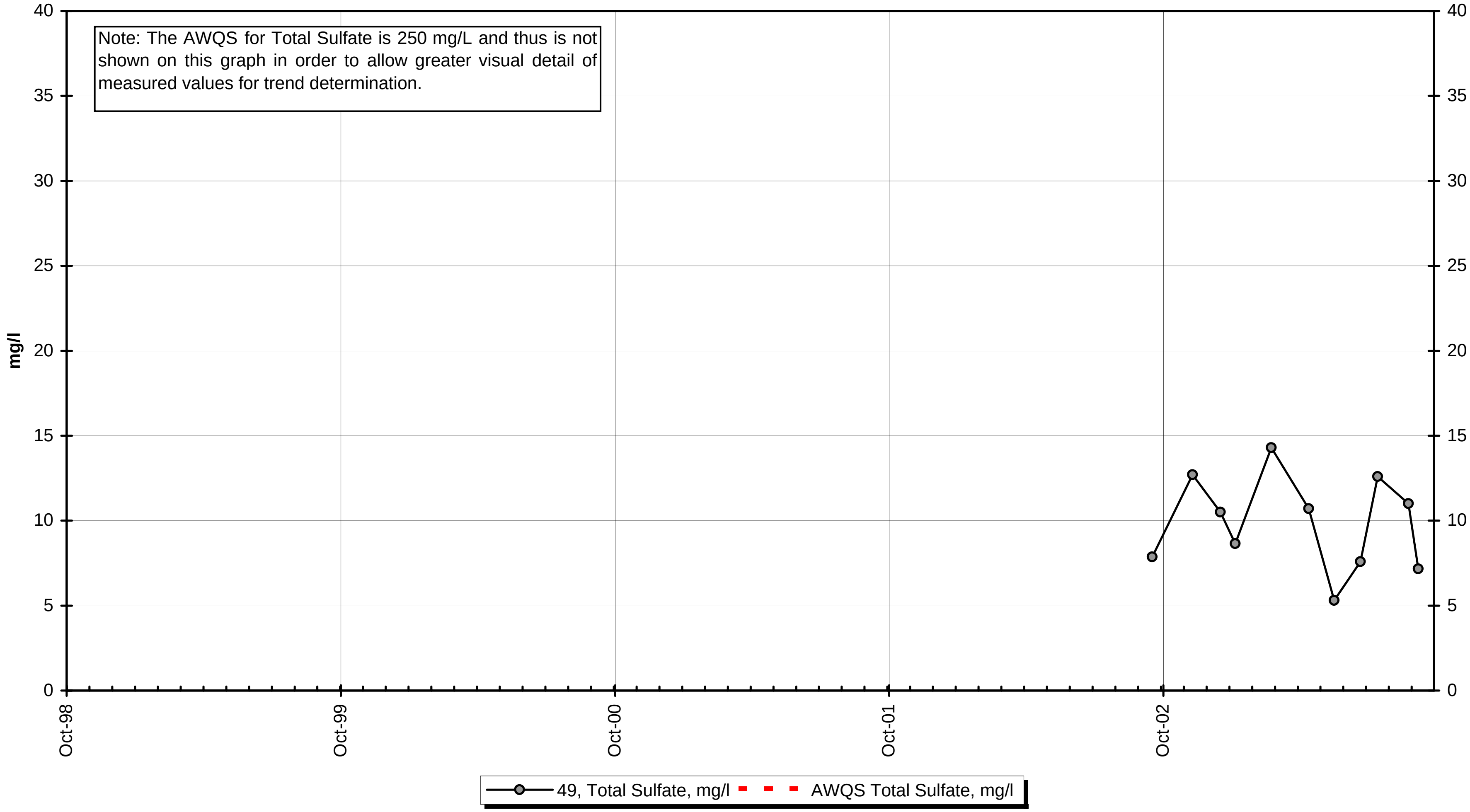



Site 49 -Lab pH
pH, su
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
49, pH Lab, su
AWQS pH, su-Low
AWQS pH, su-High

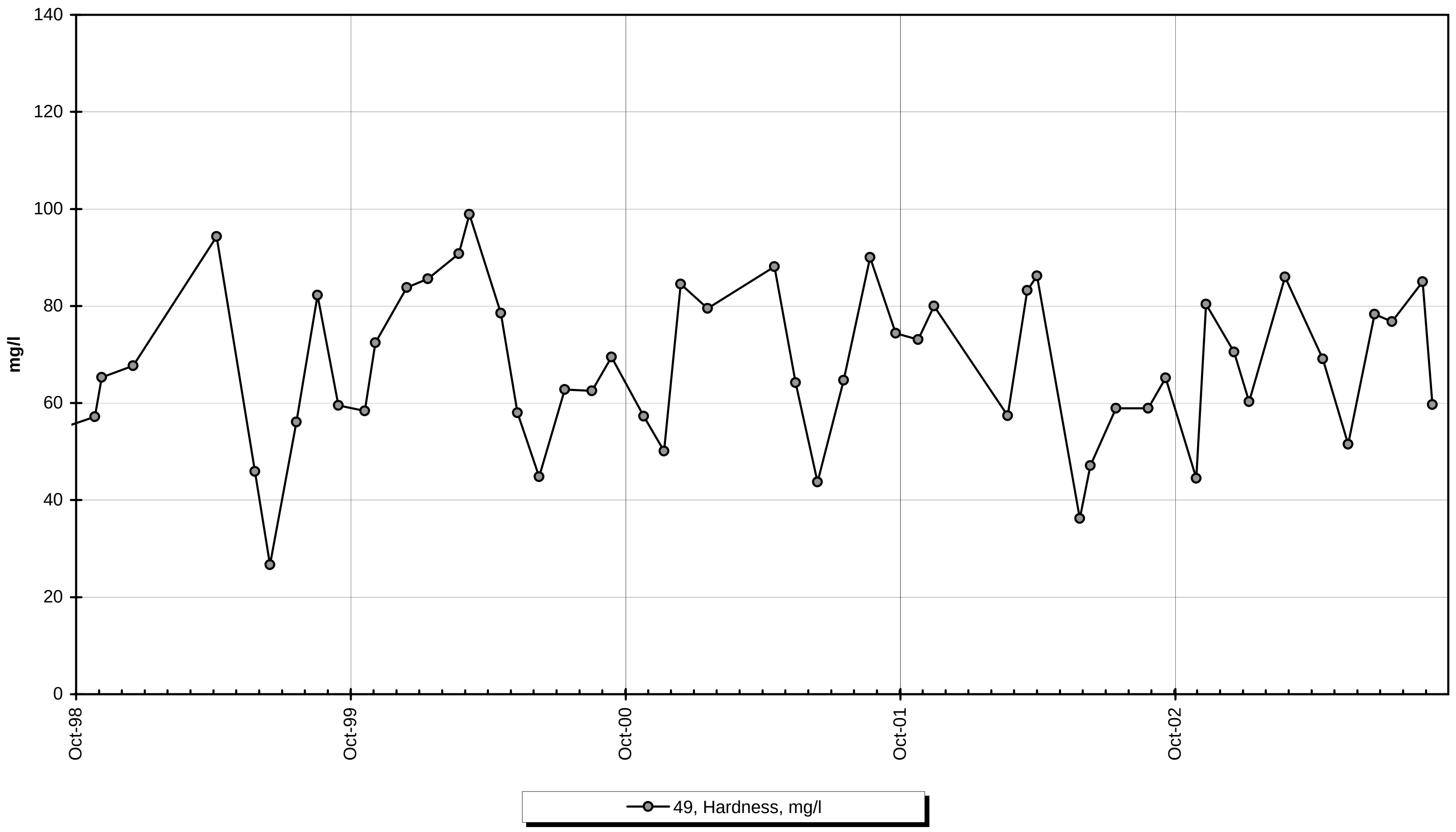
Site 49 -Total Alkalinity



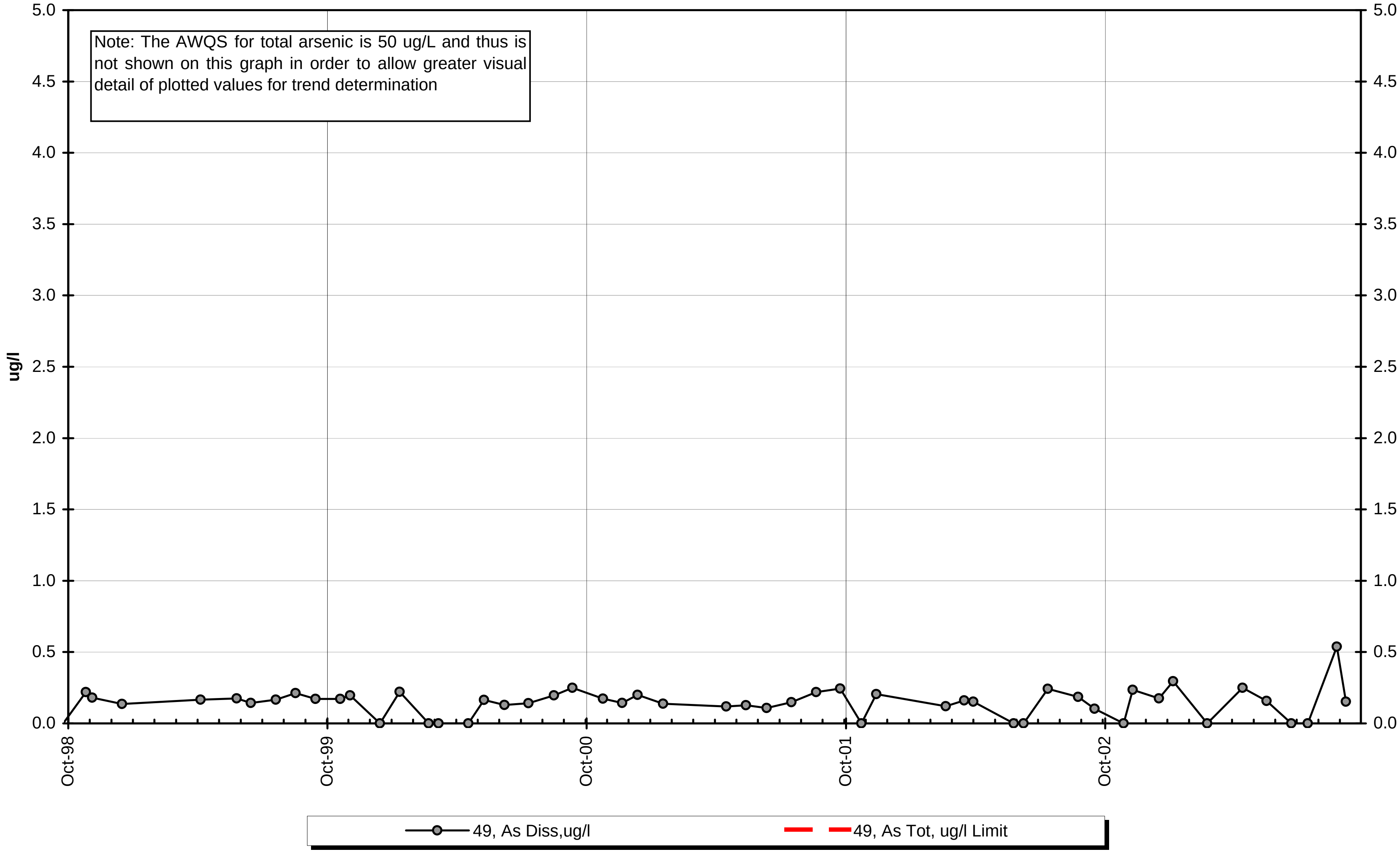
Site 49 -Total Sulfate

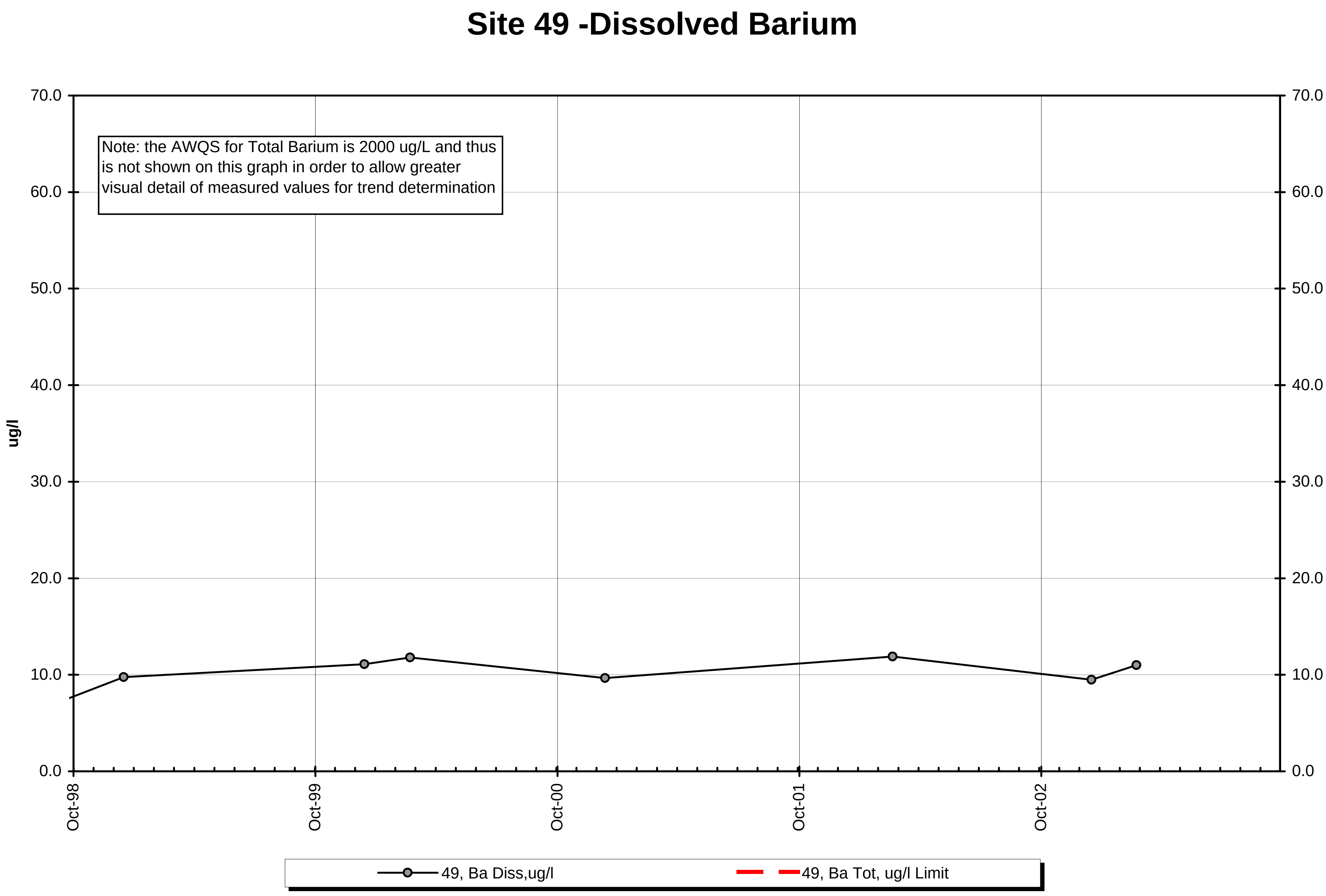


Site 49 -Hardness



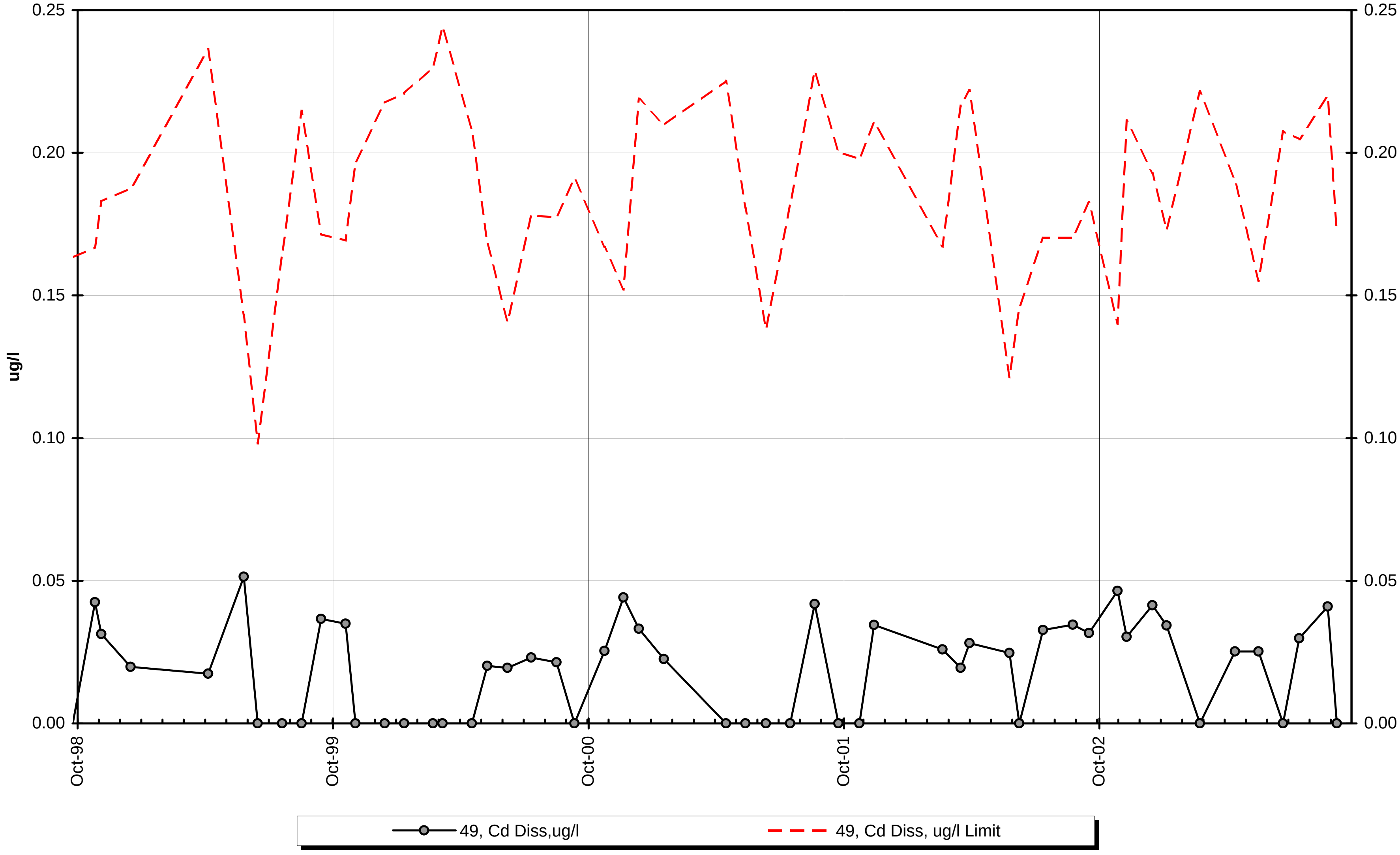
Site 49 -Dissolved Arsenic



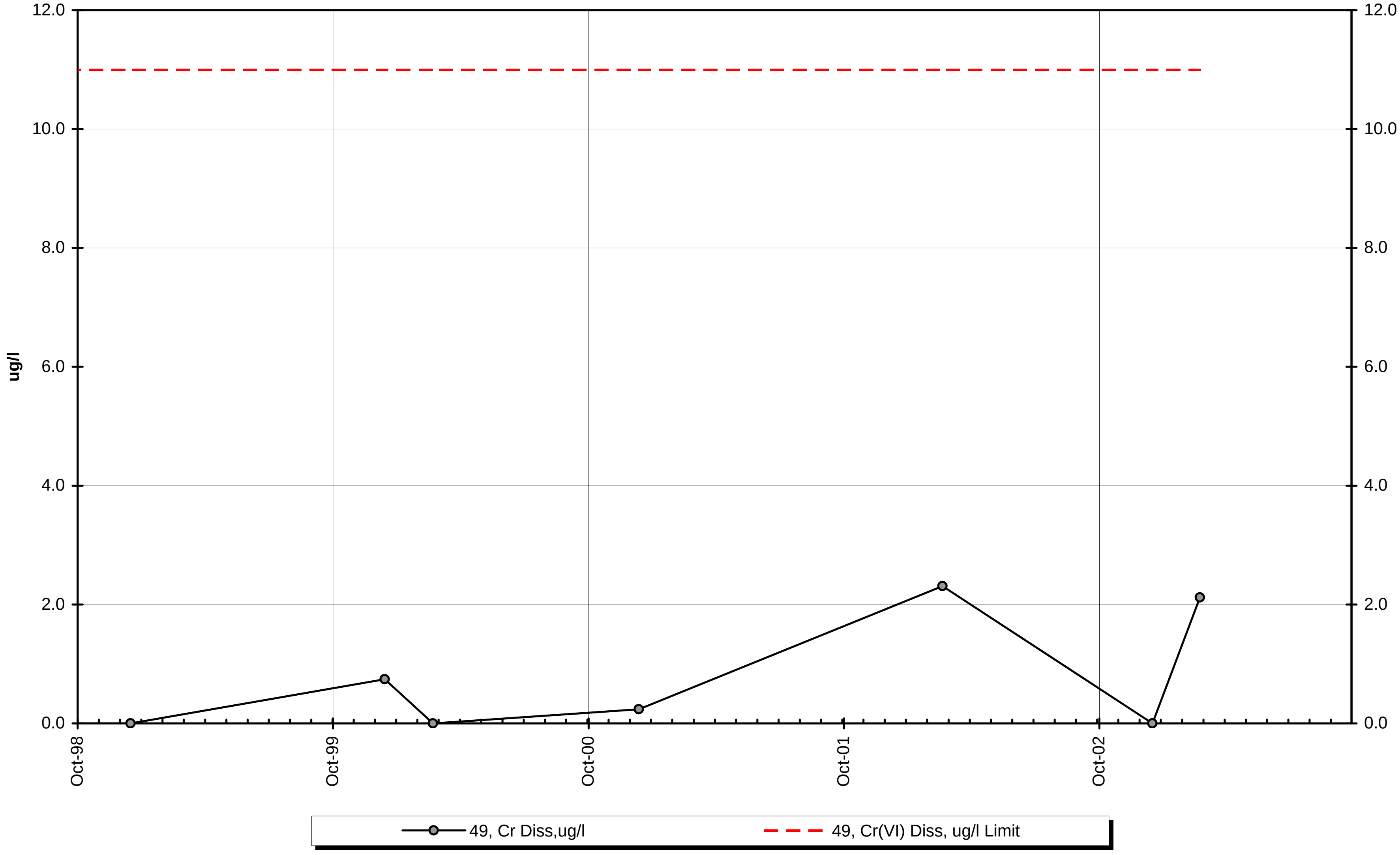


Site 49 -Dissolved Barium
Note: the AWQS for Total Barium is 2000 ug/L and thus is not shown on this graph in order to allow greater visual detail of measured values for trend determination
ug/l
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
49, Ba Diss,ug/l
49, Ba Tot, ug/l Limit

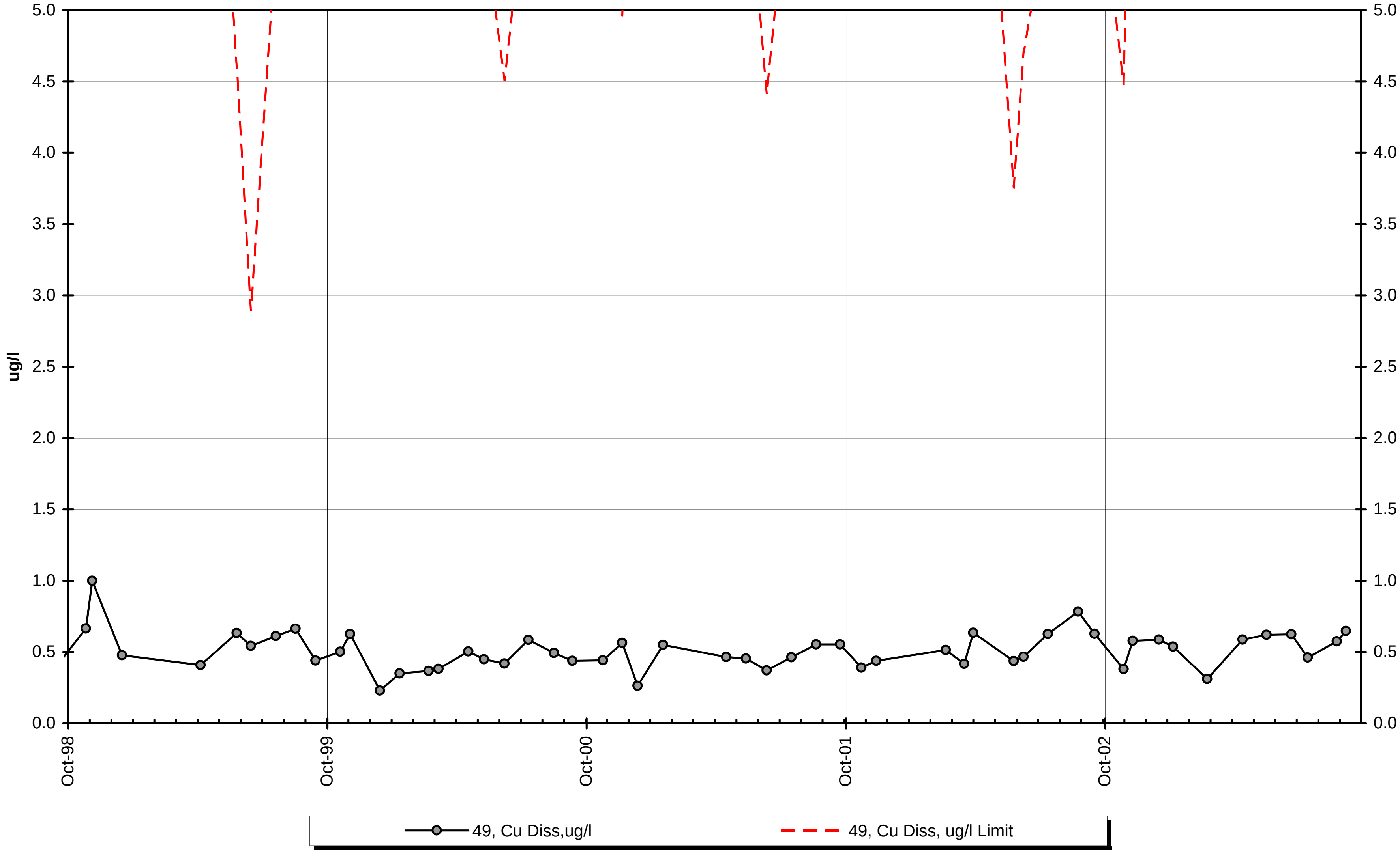
Site 49 -Dissolved Cadmium



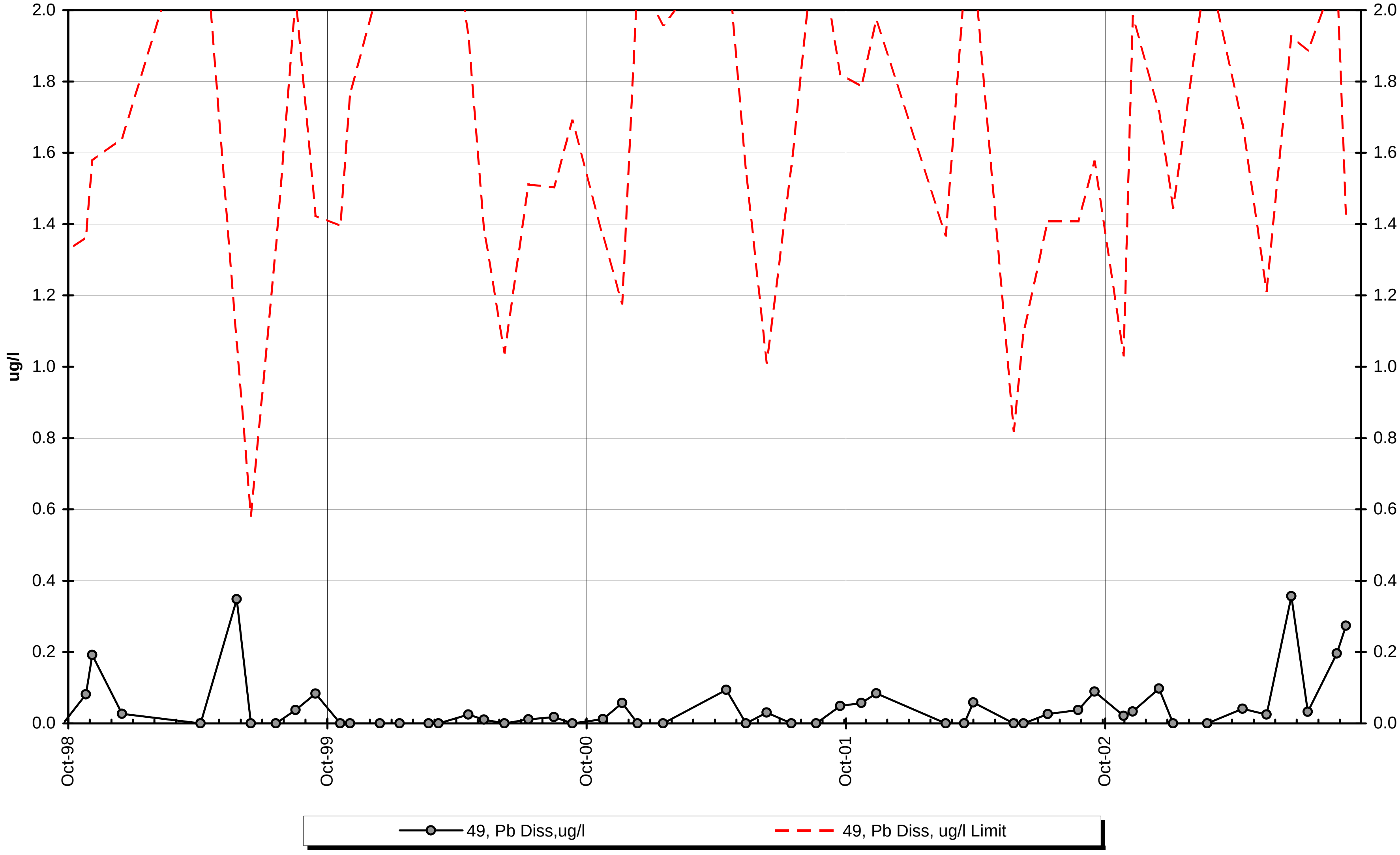
Site 49 -Dissolved Chromium

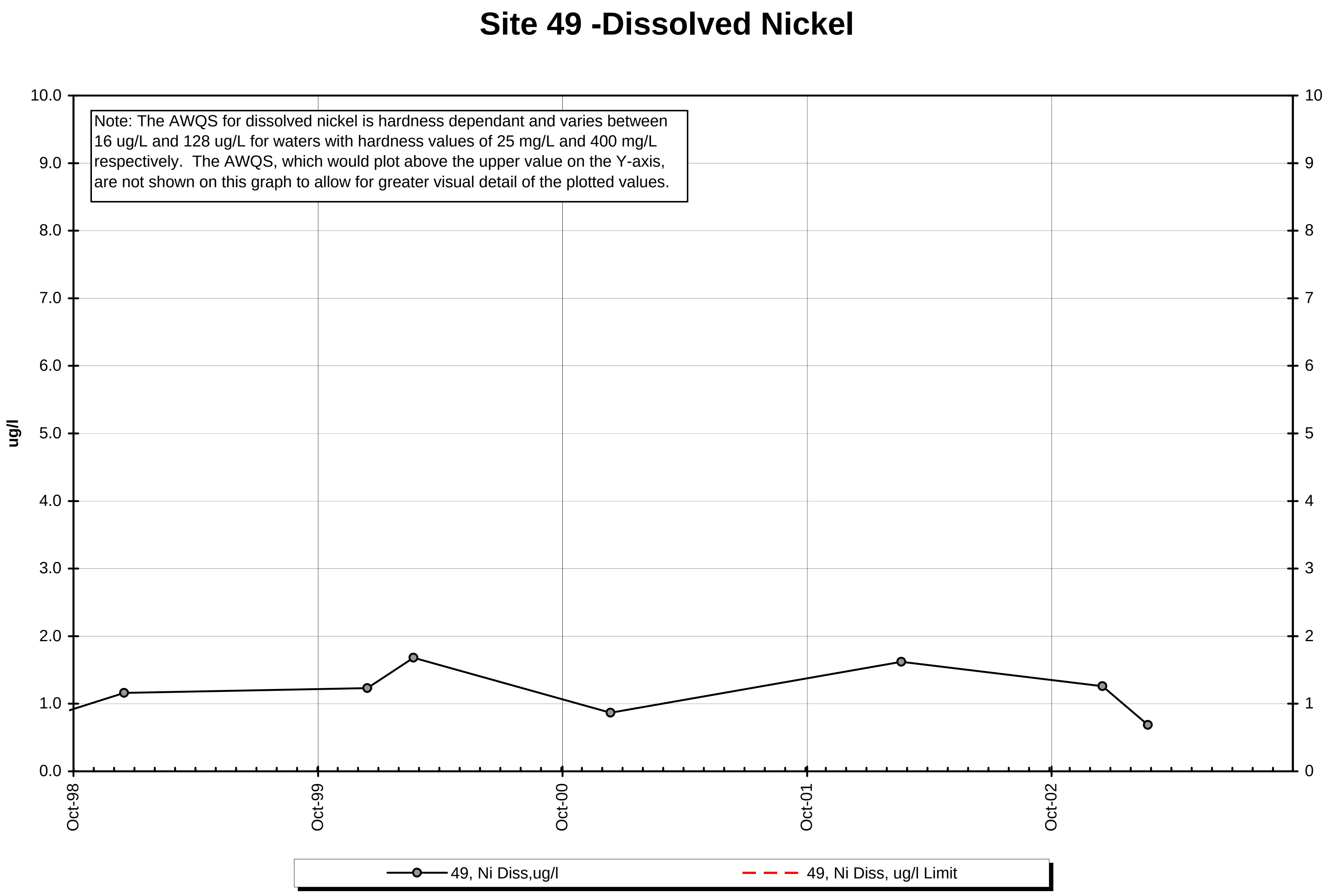


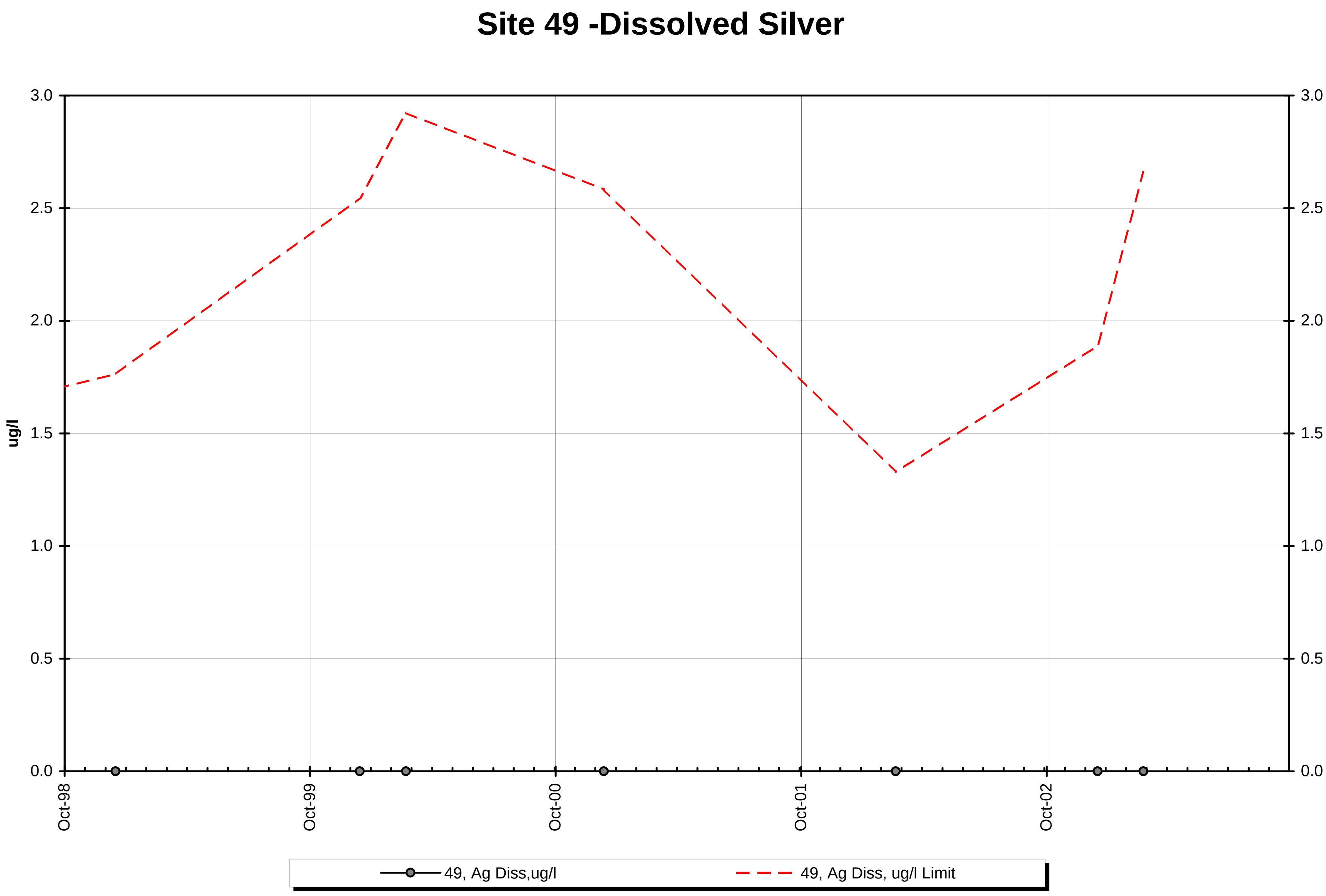
Site 49 -Dissolved Copper

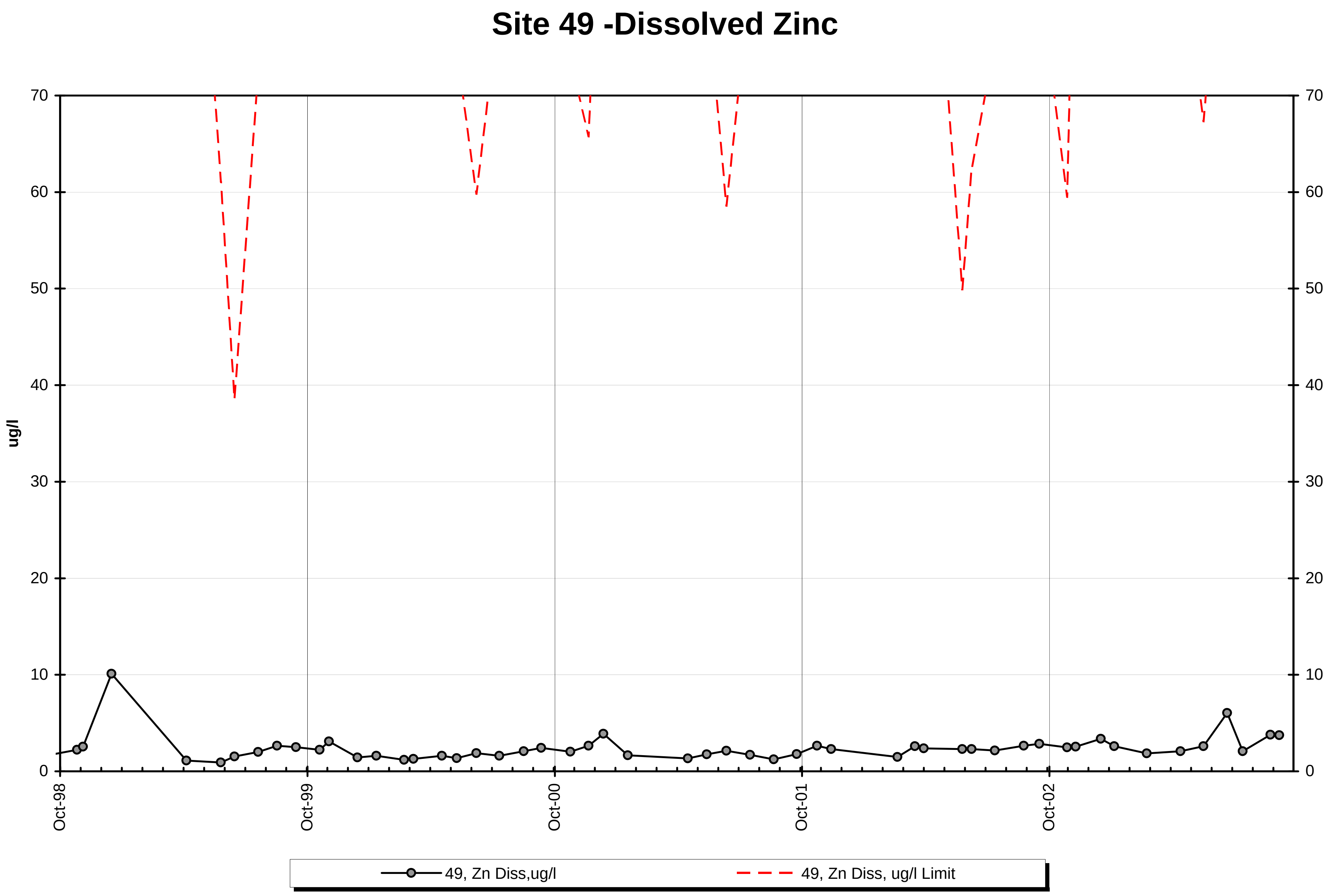


Site 49 -Dissolved Lead



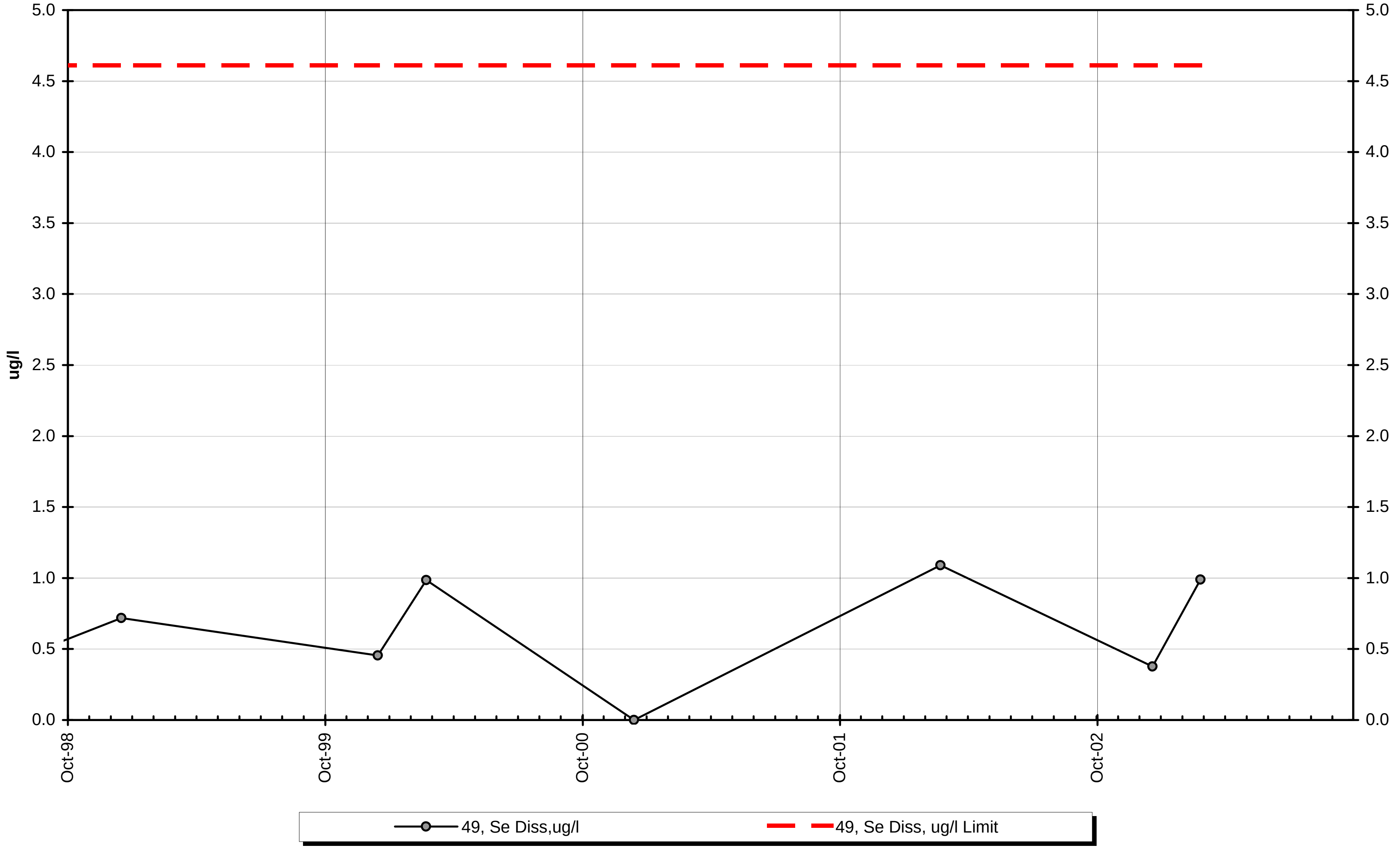

Site 49 -Dissolved Nickel
Note: The AWQS for dissolved nickel is hardness dependant and varies between 16 ug/L and 128 ug/L for waters with hardness values of 25 mg/L and 400 mg/L respectively. The AWQS, which would plot above the upper value on the Y-axis, are not shown on this graph to allow for greater visual detail of the plotted values.
ug/l
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
10
9
8
7
6
5
4
3
2
1
0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
49, Ni Diss,ug/l
49, Ni Diss, ug/l Limit


Site 49 -Dissolved Silver
ug/l
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
49, Ag Diss,ug/l
49, Ag Diss, ug/l Limit

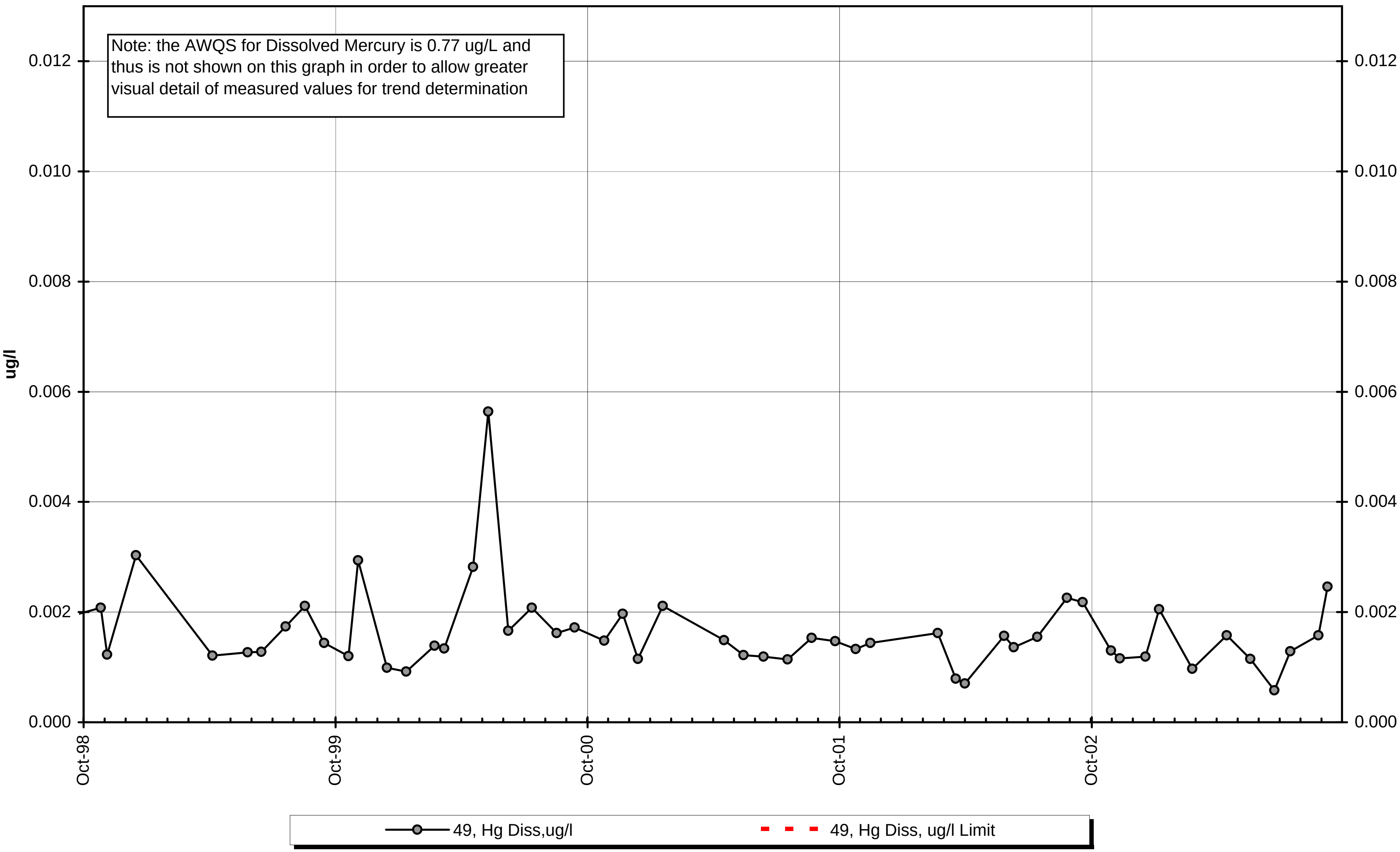


Site 49 -Dissolved Zinc
ug/l
0
10
20
30
40
50
60
70
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
49, Zn Diss,ug/l
49, Zn Diss, ug/l Limit

Site 49 -Dissolved Selenium



Site 49 -Dissolved Mercury



Site **#49** Seasonal Mann-Kendall analysis for Specific Conductance, Lab (umhos/cm @ 25°C)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY1998**	252	170	154				178	121	136	146	160	158
b	**WY1999**	128	150	163				198	138	77	141	147	144
c	**WY2000**	124	130	163	146	181	183	147	116	90	117	137	126
d	**WY2001**	129	103	160	146			163	124	84	134	179	135
e	**WY2002**	147	156			169	194	203	66	106	133	119	127
f	**WY2003**	140	159	145	126	167		135	104	122	180	158	122
	n	6	6	5	3	3	2	6	6	6	6	6	6

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

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

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	28.33	28.33	16.67	3.67	3.67	1.00	28.33	28.33	28.33	28.33	28.33	28.33
$Z_k = S_k/\sigma_S$	0.19	-0.19	-0.73	-1.04	-1.57	1.00	-0.56	-1.32	0.56	-0.19	-0.56	-2.07
Z^2_k	0.04	0.04	0.54	1.09	2.45	1.00	0.32	1.73	0.32	0.04	0.32	4.27

ΣZ_k= -6.48

ΣZ^2_k= 12.14

Z-bar=$\Sigma Z_k/K$= -0.54

p(Z-bar)= 0.295

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

Σn 61

ΣS_k -29

V(S) 25823

Z -0.187

K 12

$\chi^2_h=\Sigma Z^2_k - K(\text{Z-bar})^2$= 8.65

p 0.65

@α=5% $\chi^2_{(K-1)}$= 19.68

Test for station homogeneity

$\chi^2_h<\chi^2_{(K-1)}$ ACCEPT

K*(Z-bar)^2= 3.50

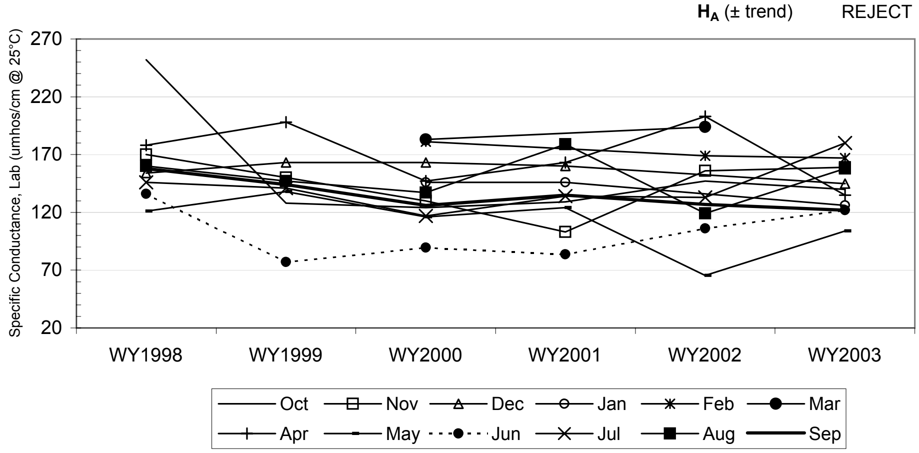
p 0.06

@α=5% $\chi^2_{(1)}$= 3.84

K*(Z-bar)² < $\chi^2_{(1)}$

H_0 (No trend) ACCEPT

H_A (± trend) REJECT



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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY1998**	7.94	8.90	8.10				8.33	8.21	8.29	7.67	8.09	8.00
b	**WY1999**	7.99	7.79	7.52				7.95	7.84	7.53	7.76	7.90	7.72
c	**WY2000**	7.66	7.32	7.24	7.63	7.48	7.70	7.65	7.69	7.28	7.73	7.45	7.69
d	**WY2001**	7.42	7.64	7.56	7.47			7.81	6.78	6.85	7.75	7.42	7.50
e	**WY2002**	7.39	7.43			7.40	7.75	7.47	6.95	7.26	8.17	7.99	8.10
f	**WY2003**	7.62	8.05	7.80	7.86	7.83		7.57	7.84	7.94	8.04	7.81	8.03
	n	6	6	5	3	3	2	6	6	6	6	6	6

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

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a	1	-1	-1				-1	-1	-1	1	-1	-1
c-a	-1	-1	-1				-1	-1	-1	1	-1	-1
d-a	-1	-1	-1				-1	-1	-1	1	-1	-1
e-a	-1	-1					-1	-1	-1	1	-1	1
f-a	-1	-1	-1				-1	-1	-1	1	-1	1
c-b	-1	-1	-1				-1	-1	-1	-1	-1	-1
d-b	-1	-1	1				-1	-1	-1	-1	-1	-1
e-b	-1	-1					-1	-1	-1	1	1	1
f-b	-1	1	1				-1	0	1	1	-1	1
d-c	-1	1	1	-1			1	-1	-1	1	-1	-1
e-c	-1	1			-1	1	-1	-1	-1	1	1	1
f-c	-1	1	1	1	1		-1	1	1	1	1	1
e-d	-1	-1					-1	1	1	1	1	1
f-d	1	1	1	1			-1	1	1	1	1	1
f-e	1	1			1		1	1	1	-1	-1	-1
S_k	-9	-3	0	1	1	1	-11	-6	-5	9	-5	1

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	28.33	28.33	16.67	3.67	3.67	1.00	28.33	28.33	28.33	28.33	28.33	28.33
$Z_k = S_k/\sigma_S$	-1.69	-0.56	0.00	0.52	0.52	1.00	-2.07	-1.13	-0.94	1.69	-0.94	0.19
Z^2_k	2.86	0.32	0.00	0.27	0.27	1.00	4.27	1.27	0.88	2.86	0.88	0.04

ΣZ_k= -3.40
ΣZ^2_k= 14.92
Z-bar=ΣZ_k/K= -0.28
p(Z-bar)= 0.388

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

Σn	61
ΣS_k	-26
V(S)	25823
Z	-0.168
K	12

$\chi^2_h = \Sigma Z^2_k - K(\text{Z-bar})^2$= 13.96
p 0.24

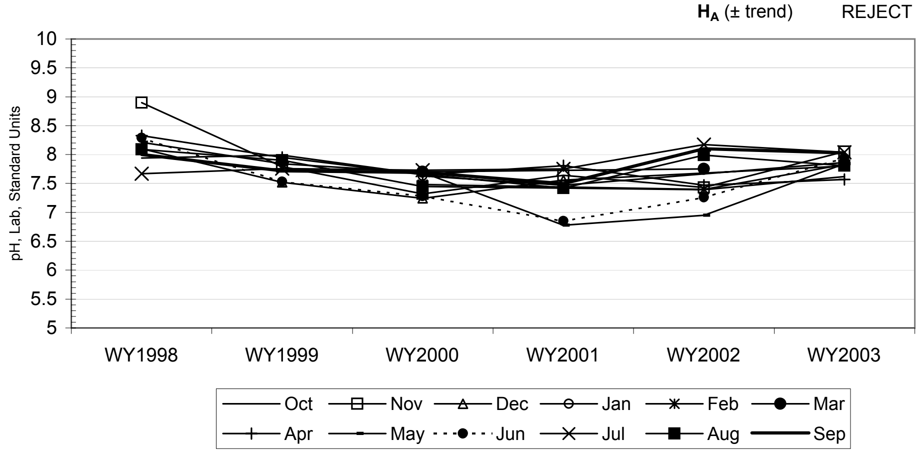
@α=5% $\chi^2_{(K-1)}$= 19.68

Test for station homogeneity
$\chi^2_h < \chi^2_{(K-1)}$ ACCEPT

K*(Z-bar)^2= 0.97
p 0.33

@α=5% $\chi^2_{(1)}$= 3.84

K*(Z-bar)² < $\chi^2_{(1)}$
H_0 (No trend) ACCEPT
H_A (± trend) REJECT



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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY1998**	111	72	60				69	52	55	57	66	60
b	**WY1999**	50	66	62				69	53	30	55	56	54
c	**WY2000**	45	48	63	62	74	74	63	50	41	51	64	58
d	**WY2001**	47	47	72	63			67	55	38	59	77	62
e	**WY2002**	62	64			68	78	79	28	47	58	52	56
f	**WY2003**	74	63	64	57	74		60	47	58	75	71	57
	n	6	6	5	3	3	2	6	6	6	6	6	6

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

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

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	28.33	28.33	16.67	3.67	3.67	1.00	28.33	28.33	28.33	28.33	28.33	28.33
$Z_k = S_k/\sigma_S$	0.19	-1.32	1.96	-0.52	0.52	1.00	-0.56	-0.94	0.94	1.32	0.19	-0.19
Z^2_k	0.04	1.73	3.84	0.27	0.27	1.00	0.32	0.88	0.88	1.73	0.04	0.04

ΣZ_k= 2.58

ΣZ^2_k= 11.03

Z-bar=$\Sigma Z_k/K$= 0.22

p(Z-bar)= 0.585

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

Σn	61
ΣS_k	7
V(S)	25823
Z	0.037
K	12

$\chi^2_h = \Sigma Z^2_k - K(\text{Z-bar})^2$= 10.48

p 0.49

@α=5% $\chi^2_{(K-1)}$= 19.68

Test for station homogeneity

$\chi^2_h < \chi^2_{(K-1)}$ ACCEPT

K*(Z-bar)^2= 0.56

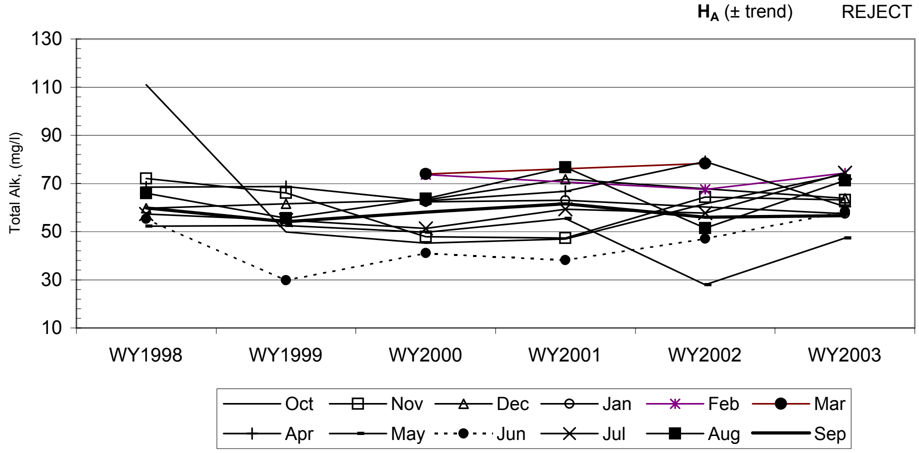
p 0.46

@α=5% $\chi^2_{(1)}$= 3.84

K*(Z-bar)² < $\chi^2_{(1)}$

H_0 (No trend) ACCEPT

H_A (± trend) REJECT



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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY1998**	2.35	7.25	6.07				14.30	2.35	1.79	1.57	2.55	1.81
b	**WY1999**	2.24	2.54	10.10				1.12	0.91	1.54	2.01	2.64	2.49
c	**WY2000**	2.24	3.09	1.44	1.61	1.19	1.30	1.62	1.35	1.89	1.61	2.07	2.43
d	**WY2001**	2.03	2.65	3.90	1.65			1.34	1.77	2.13	1.71	1.23	1.79
e	**WY2002**	2.65	2.30			1.49	2.59	2.39	2.31	2.31	2.16	2.66	2.86
f	**WY2003**	2.48	2.56	3.36	2.59	1.86		2.08	2.59	6.05	2.09	3.78	3.74
	n	6	6	5	3	3	2	6	6	6	6	6	6
	t_1	1	0	0	0	0	0	0	0	0	0	0	0
	t_2	0	0	0	0	0	0	0	0	0	0	0	0
	t_3	0	0	0	0	0	0	0	0	0	0	0	0
	t_4	0	0	0	0	0	0	0	0	0	0	0	0
	t_5	0	0	0	0	0	0	0	0	0	0	0	0
	b-a	-1	-1	1				-1	-1	-1	1	1	1
	c-a	-1	-1	-1				-1	-1	1	1	-1	1
	d-a	-1	-1	-1				-1	-1	1	1	-1	-1
	e-a	1	-1					-1	-1	1	1	1	1
	f-a	1	-1	-1				-1	1	1	1	1	1
	c-b	0	1	-1				1	1	1	-1	-1	-1
	d-b	-1	1	-1				1	1	1	-1	-1	-1
	e-b	1	-1					1	1	1	1	1	1
	f-b	1	1	-1				1	1	1	1	1	1
	d-c	-1	-1	1	1			-1	1	1	1	-1	-1
	e-c	1	-1			1	1	1	1	1	1	1	1
	f-c	1	-1	1	1	1		1	1	1	1	1	1
	e-d	1	-1					1	1	1	1	1	1
	f-d	1	-1	-1	1			1	1	1	1	1	1
	f-e	-1	1			1		-1	1	1	-1	1	1
	S_k	2	-7	-4	3	3	1	1	7	13	9	5	7
	σ^2_S=	28.33	28.33	16.67	3.67	3.67	1.00	28.33	28.33	28.33	28.33	28.33	28.33
	$Z_k = S_k/\sigma_S$	0.38	-1.32	-0.98	1.57	1.57	1.00	0.19	1.32	2.44	1.69	0.94	1.32
	Z^2_k	0.14	1.73	0.96	2.45	2.45	1.00	0.04	1.73	5.96	2.86	0.88	1.73

ΣZ_k= 10.10
ΣZ^2_k= 21.94
Z-bar=$\Sigma Z_k/K$= 0.84
p(Z-bar)= 0.800

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

Σn	61
ΣS_k	40
V(S)	25823
Z	0.243
K	12

$\chi^2_h = \Sigma Z^2_k - K(\text{Z-bar})^2$= 13.43
p 0.27

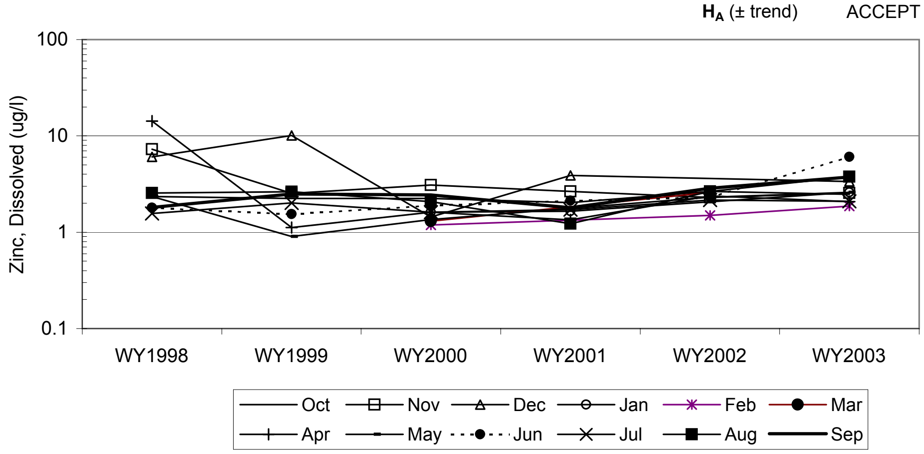
@α=5% $\chi^2_{(K-1)}$= 19.68

Test for station homogeneity
$\chi^2_h < \chi^2_{(K-1)}$ ACCEPT

K*(Z-bar)^2= 8.51
p 0.00

@α=5% $\chi^2_{(1)}$= 3.84

K*(Z-bar)^2 < $\chi^2_{(1)}$
H_0 (No trend) REJECT
H_A (± trend) ACCEPT



INTERPRETIVE REPORT
SITE 46 "LOWER BRUIN CREEK"

The data collected during the current water year are listed in the following "Table of Results for Water Year 2003" report. The table includes all the data, field and lab, 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 zero for the purpose of median calculation.

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

Sample Date	Parameter	Value	Qualifier	Notes
No outliers have been identified by KGCMC for the period of Oct-98 though Sept-03.				

The data for water year 2003 have been compared to the strictest fresh water quality criterion for each applicable analyte. No results exceeding these criteria have been identified

X-Y plots have been generated to graphically present the data for each of the analytes requested in the Statistical Information Goals for this site. These plots have been visually analyzed for the appearance of any trend in concentration. No visually obvious trends are apparent except for an intermittent-variable increase in dissolved lead. Dissolved-lead appears to increase starting in Oct-01 and continues throughout the current water-year with several individual spikes. The detection limit for lead has not changed significantly over the period covered by the graph (average MDL of 0.021 ug/L for datasets from 2000-2003WY). The change may also be associated with hydrological changes in lower Bruin Creek where perennial flow has become seasonal, apparently due to natural changes in the stream bed below the 'B'-road. A robust statistical analysis of trend for dissolved lead is hindered by the large percentage of values below the method MDL (43% for the period covering 1998-2003WY). The large number of dissolved-lead values below the MDL (screened) if treated as zero in a statistical analysis result in a large number of ties in the dataset. For the typical non-parametric statistical analysis of trend applied in this report, the Seasonal Mann-Kendall test, if a large number of ties are present the overall power of the test is reduced and false positive errors may occur (i.e. falsely accepting the H_0 hypothesis of no trend). Greens Creek will continue to monitor the values of dissolved-lead at Site 49 as outline in Appendix-1 of the General Plan of Operations. Current methods and frequency of monitoring appear to be adequate to characterize the dissolved-lead levels at his site. If after additional data analysis an increasing trend is apparent, additional measures may be warranted. Similar to analysis done for other sites with monthly sampling schedules a non-parametric statistical analysis for trend was preformed for conductivity, pH, alkalinity, and dissolved zinc. Calculation details of the Seasonal Mann-Kendall analyses are presented in detail on the pages following this interpretive section. The table below summarizes the results on the data collected between Oct-97 and Sep-03 (WY1998-WY2003). Two analytes, specific conductance (p=0.01) and dissolved zinc (p=0.04) show statistically significant (α=5%) trends. Specific conductance shows a decreasing trend of -3.0 $\mu S \cdot cm^{-1} \cdot yr^{-1}$ or a -2.1% annual decrease. This is the opposite trend that would be expected if contact water from the adjacent Site 23/D waste rock area were influencing readings at Site 46. Dissolved zinc has an increasing trend with a slope estimate of 0.12 $\mu g \cdot L^{-1} \cdot yr^{-1}$ or a 5.8% annual increase. This value is similar in magnitude to that noted at Site 49 and Site 48. Given the lack of any other associated upward trends in analytes associated with waste rock the slight upward trend is interpreted to be associated with the same, probably natural, mechanism that is affecting site 49 and 48. Additional X-Y plots have been generated for alkalinity, pH, conductance, sulfate, and dissolved zinc that plot Site 49 and Site 46, the upstream control site, to aid in the comparison between those two sites.

		Mann-Kendall test statistic			Sen's slope estimate	
Parameter	n*	Z	Trend	a**	Q	Q(%)
Conductivity, Lab	6	6.56	-	**0.01**	-3	-2.1
pH, Lab	6	0.42	-	0.51		
Alkalinity, Total	6	0.00	-	0.97		
Zinc, Dissolved	6	4.37	+	**0.04**	0.12	5.8

*: Number of years **:Significance level

Median values for alkalinity, pH, specific conductance, and dissolved zinc from site 46 have been compared to those of site 49. The comparisons were done utilizing a two-tailed, Wilcoxon-Mann-Whitney rank sum test with a significance level of $\alpha/2=0.025$. Rank-sum test calculation details can be found in subsequent pages of this section and a summary of the test results is shown in the table below. For all analytes there are no statistically significant differences between the medians at the $\alpha/2=0.025$ significance level.

Parameter	**Rank Sum Test p-value**	**Site #6 median**	**Site #54 median**
Conductivity, Lab	0.40	140	141
pH, Lab	0.30	7.84	7.88
Alkalinity, Total	0.09	63.1	57.9
Sulfate, Total	0.31	10.6	9.58
Zinc, Dissolved	0.45	2.59	2.50

Table of Results for Water Year 2003

Site 46 "Lower Bruin Creek"

Sample Date/Parameter	10/30/2002	11/12/2002	12/19/2002	1/8/2003	2/25/2003	3/17/2003	4/16/2003	5/20/2003	6/24/2003	7/17/2003	8/27/2003	9/9/2003	**Median**
Water Temp (°C)	4.2	5.2	2.0	1.3			1.0	4.6	7.8		8.4	7.7	4.6
Conductivity-Field(μmho)	144	202	152	137			151	112	131		154	126	144
Conductivity-Lab (μmho)	142	152	147	133 U			141	108	129		159	122	141
pH Lab (standard units)	7.70	8.01	7.99	7.77			7.31	7.88	7.89		7.39 J	7.97	7.88
pH Field (standard units)	7.56	7.54	7.37	7.14			7.81	7.66	7.68		7.72	7.97	7.66
Total Alkalinity (mg/L)	54.7	57.9	65.0	50.5			61.4	49.8	59.5		70.3	57.3	57.9
Total Sulfate (mg/L)	NOTE 1	12.6 J	10.5 J	8.7 J			10.9	5.5	7.9		10.8 J	7.4 J	9.6
Hardness (mg/L)	61.8	80.1	73.2	60.0			70.6	54.6	101.0		84.5	62.9	70.6
Dissolved As (ug/L)	0.237 J	0.305 J	0.095 J	0.389 U	NO FLOW	NO FLOW	0.294 U	0.161	<0.204	NO FLOW	0.500 U	0.167 J	0.237
Dissolved Ba (ug/L)			10.7										10.7
Dissolved Cd (ug/L)	0.031 J	0.027 J	0.049 J	<0.031			0.024	0.020	0.051 J		0.048 J	<0.023	0.027
Dissolved Cr (ug/L)			<1.010										0.505
Dissolved Cu (ug/L)	0.423 U	0.609	0.510 U	0.561 U			0.614	0.537	1.310		0.659	0.732	0.609
Dissolved Pb (ug/L)	0.1120	0.2230	0.0196 U	<0.0280			0.0350 U	0.0360 U	0.4790		0.5310	<0.0650	0.0360
Dissolved Ni (ug/L)			1.120										1.120
Dissolved Ag (ug/L)			0.016 J										0.016
Dissolved Zn (ug/L)	2.49	9.66 J	2.99	1.88			2.50	1.43	6.51		3.20	2.09	2.50
Dissolved Se (ug/L)			0.363 U										0.363
Dissolved Hg (ug/L)	0.001530	0.001460 U	0.000871	0.001980 U			0.001800	0.001170	0.001820 U		0.001320	0.002830 J	0.001530

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

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

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

NOTE (1) Analysis was not performed on sample.

Qualified Data by QA Reviewer

Date Range: 10/01/2002 to 09/30/2003

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
46	01/08/2003	11:43:00 AM				
			Cond Lab, umho	133	U	Field Blank Contamination
			SO4 Tot, mg/l	8.66	J	Hold Time
			As Diss, ug/l	0.389	U	Below Quantitative Range, Fi
			Cu Diss, ug/l	0.561	U	Field Blank Contamination
			Hg Diss, ug/l	0.00198	U	Field Blank Contamination
46	10/30/2002	12:25:00 PM				
			As Diss, ug/l	0.237	J	Below Quantitative Range
			Cd Diss, ug/l	0.0313	J	Below Quantitative Range
			Cu Diss, ug/l	0.423	U	Field Blank Contamination
46	11/12/2002	1:10:00 PM				
			SO4 Tot, mg/l	12.6	J	Hold Time
			As Diss, ug/l	0.305	J	Below Quantitative Range, L
			Cd Diss, ug/l	0.0273	J	Below Quantitative Range
			Zn Diss, ug/l	9.66	J	LCS Recovery
			Hg Diss, ug/l	0.00146	U	Field Blank Contamination
46	12/19/2002	11:15:00 AM				
			SO4 Tot, mg/l	10.5	J	Hold Time
			As Diss, ug/l	0.0945	J	Below Quantitative Range
			Cd Diss, ug/l	0.0485	J	Below Quantitative Range, L
			Cu Diss, ug/l	0.51	U	Field Blank Contamination
			Pb Diss, ug/l	0.0196	U	Below Quantitative Range, Fi
				0.0164	J	Below Quantitative Range
			Se Diss, ug/l	0.363	U	Below Quantitative Range, M
46	04/16/2003	11:57:00 AM				
			As Diss, ug/l	0.294	U	Field Blank Contamination
			Pb Diss, ug/l	0.035	U	Field Blank Contamination
46	05/20/2003	12:14:00 PM				
			Pb Diss, ug/l	0.036	U	Field Blank Contamination
46	06/24/2003	12:40:00 PM				
			Cd Diss, ug/l	0.0507	J	Below Quantitative Range
			Hg Diss, ug/l	0.00182	U	Field Blank Contamination

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

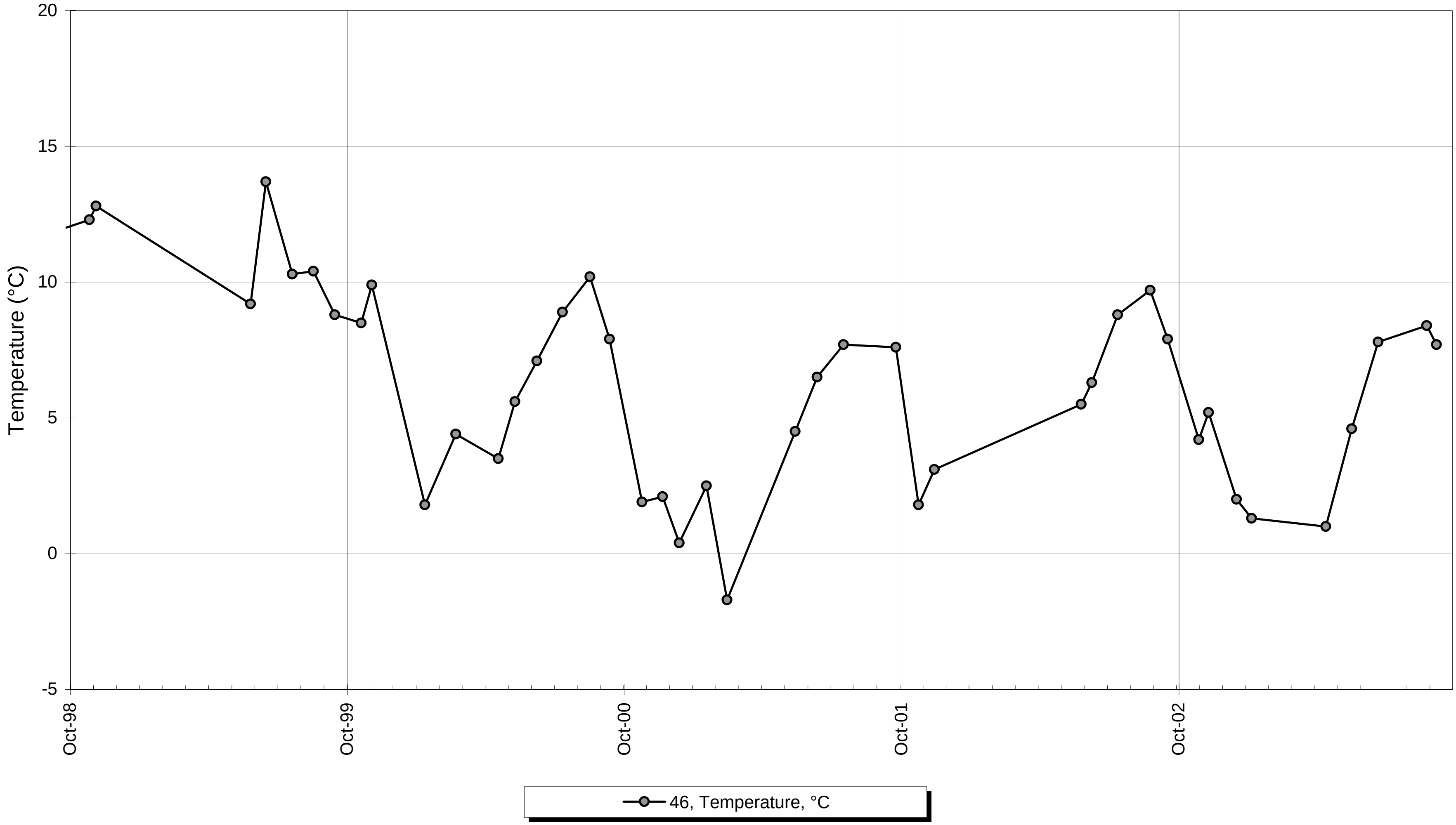
Qualified Data by QA Reviewer

Date Range: 10/01/2002 to 09/30/2003

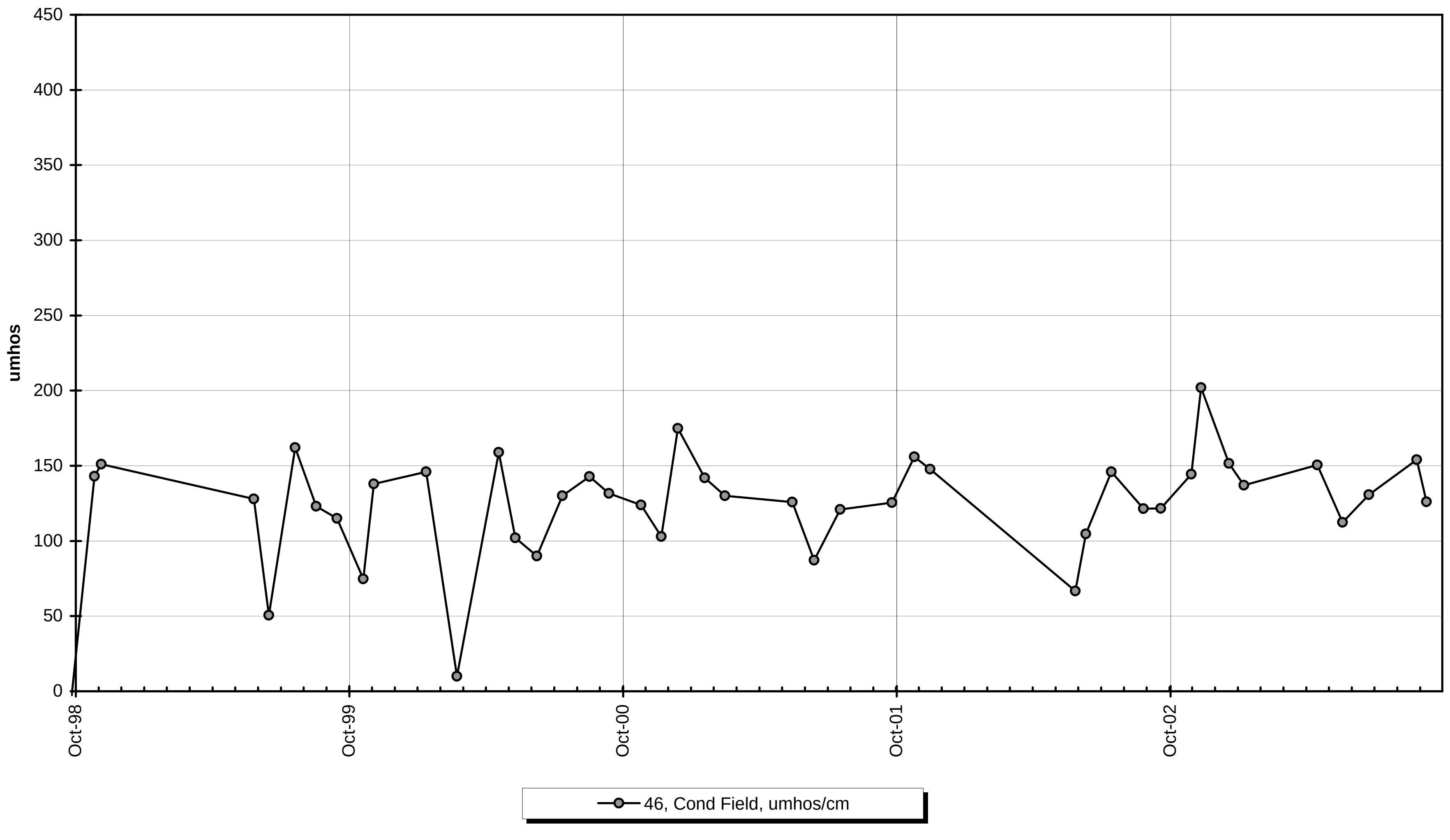
Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
46	08/27/2003	1:27:00 PM				
			pH Lab, su	7.39	J	Hold Time
			SO4 Tot, mg/l	10.8	J	Sample Temperature
			As Diss, ug/l	0.5	U	Below Quantitative Range, M
			Cd Diss, ug/l	0.0483	J	Below Quantitative Range
46	09/09/2003	12:25:00 PM				
			SO4 Tot, mg/l	7.38	J	Sample Temperature
			As Diss, ug/l	0.167	J	Below Quantitative Range
			Hg Diss, ug/l	0.00283	J	Duplicate RPD

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

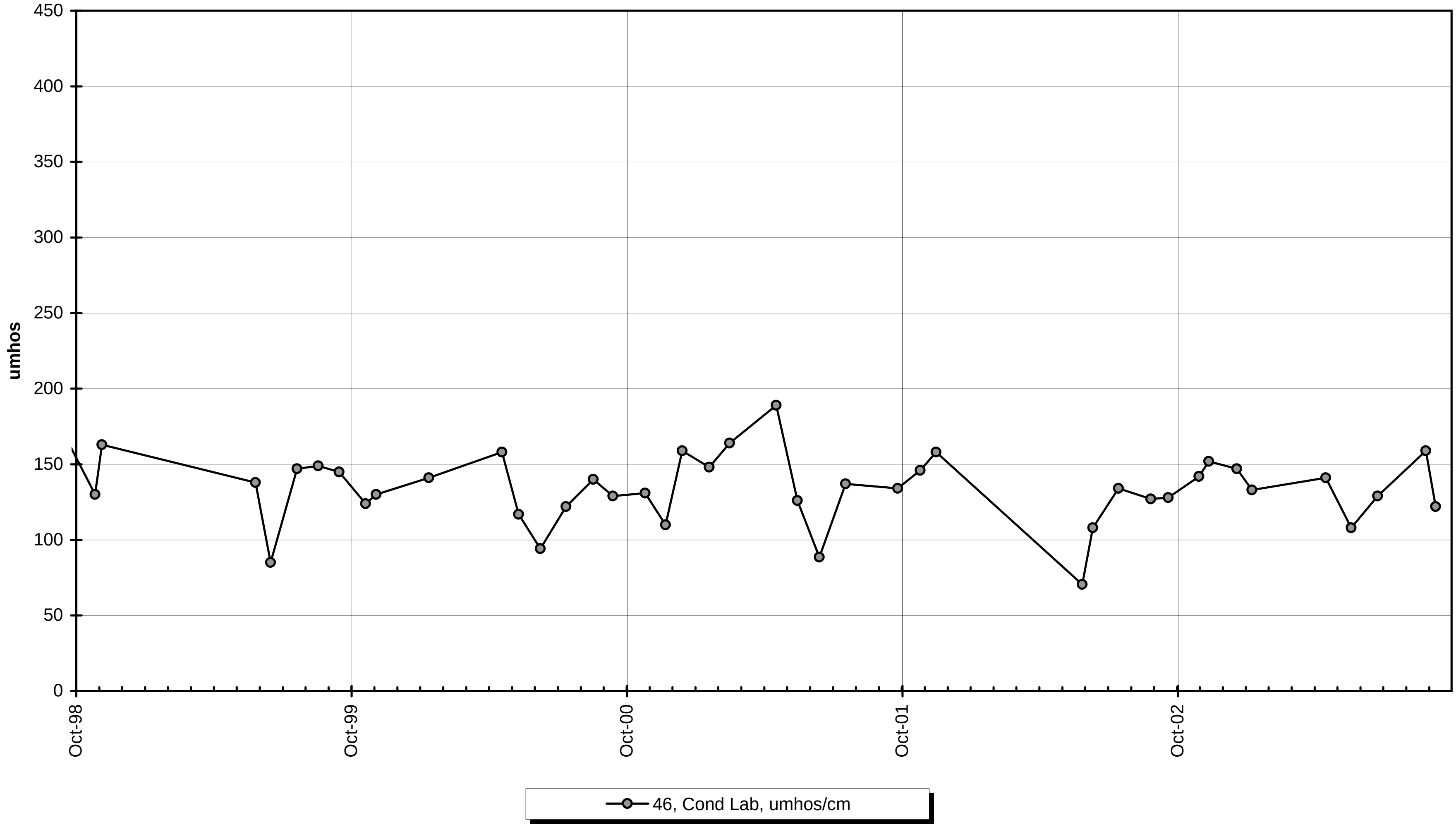
Site 46 -Water Temperature



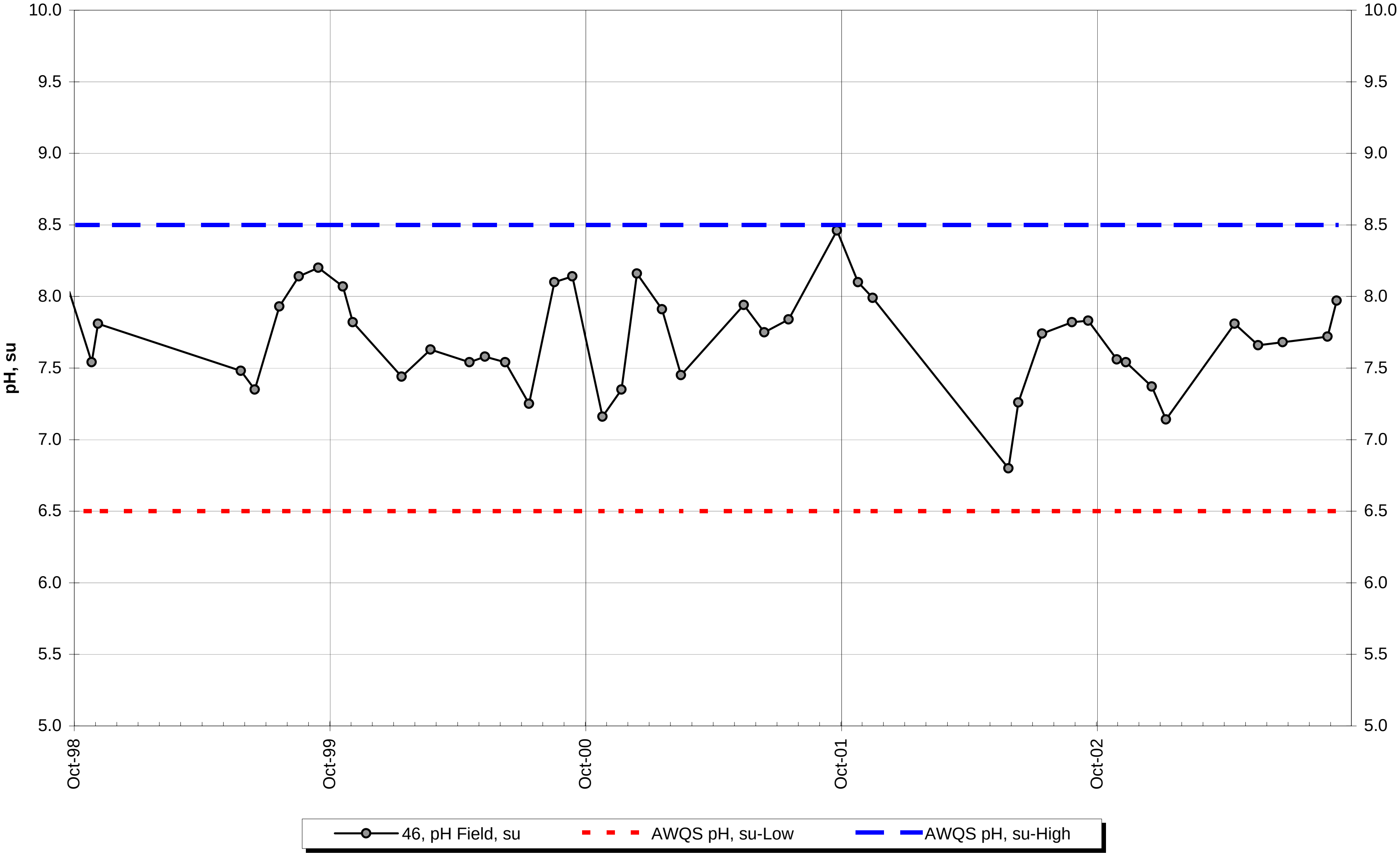
Site 46 -Conductivity-Field



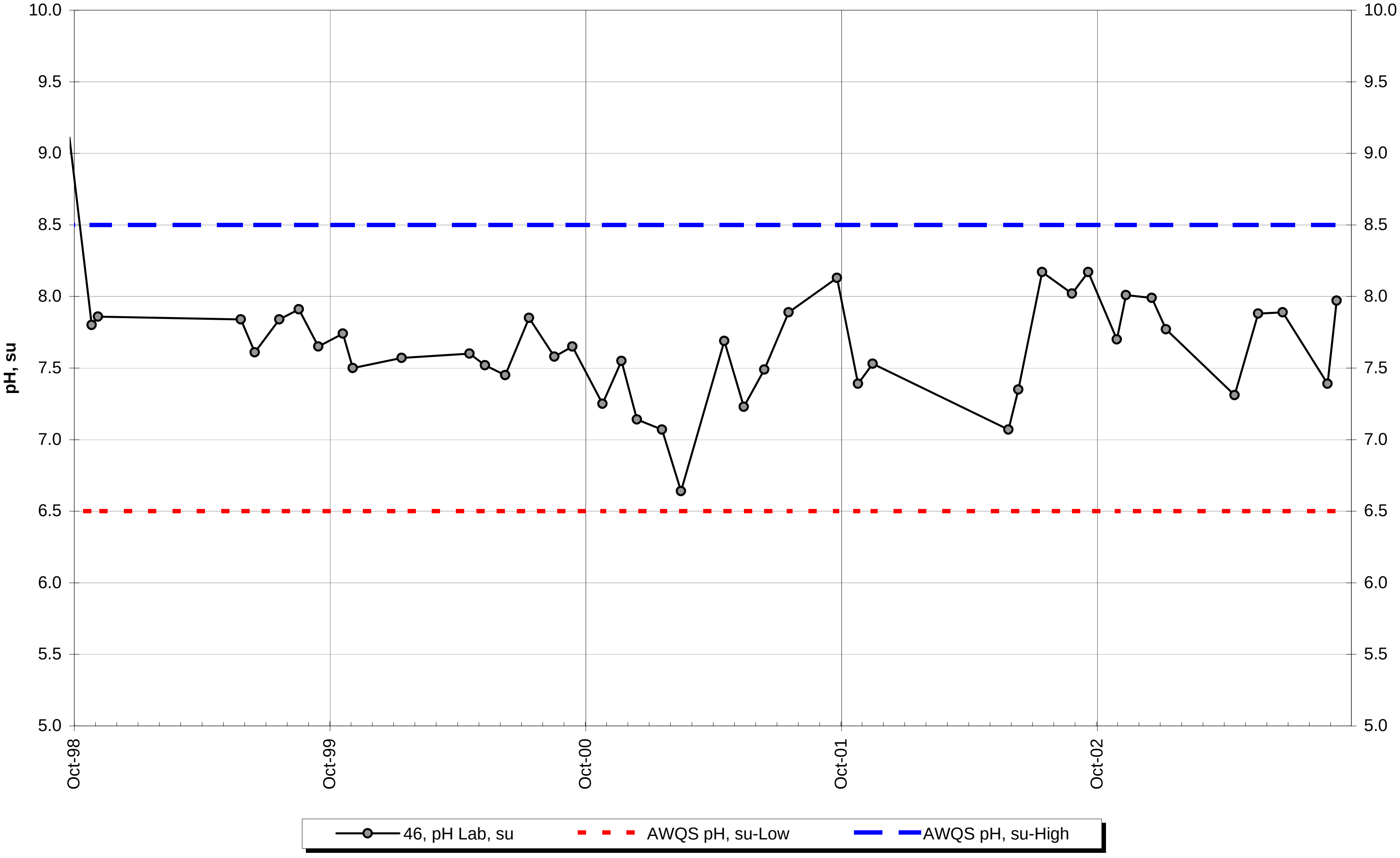
Site 46 -Conductivity-Lab



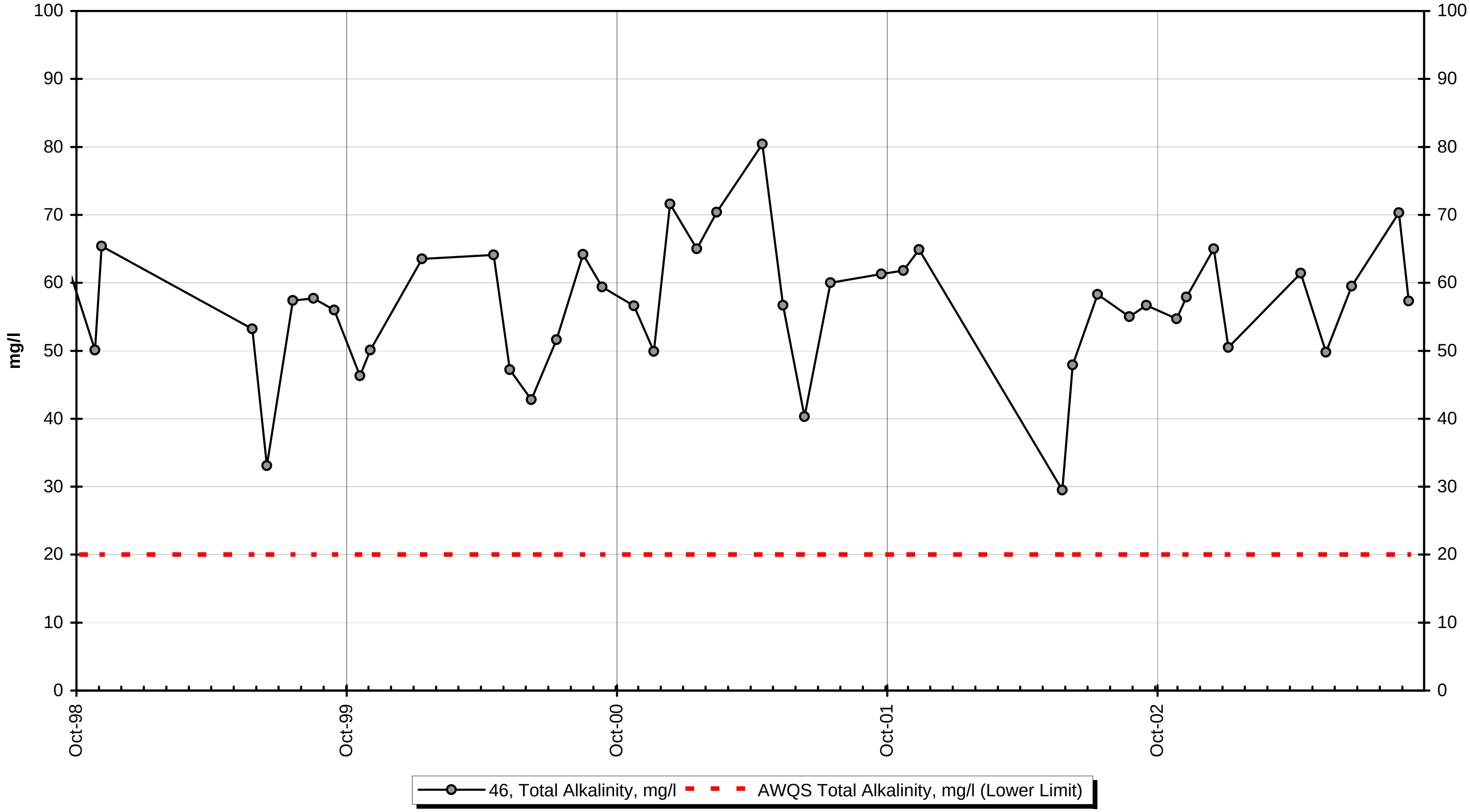
Site 46 -Field pH



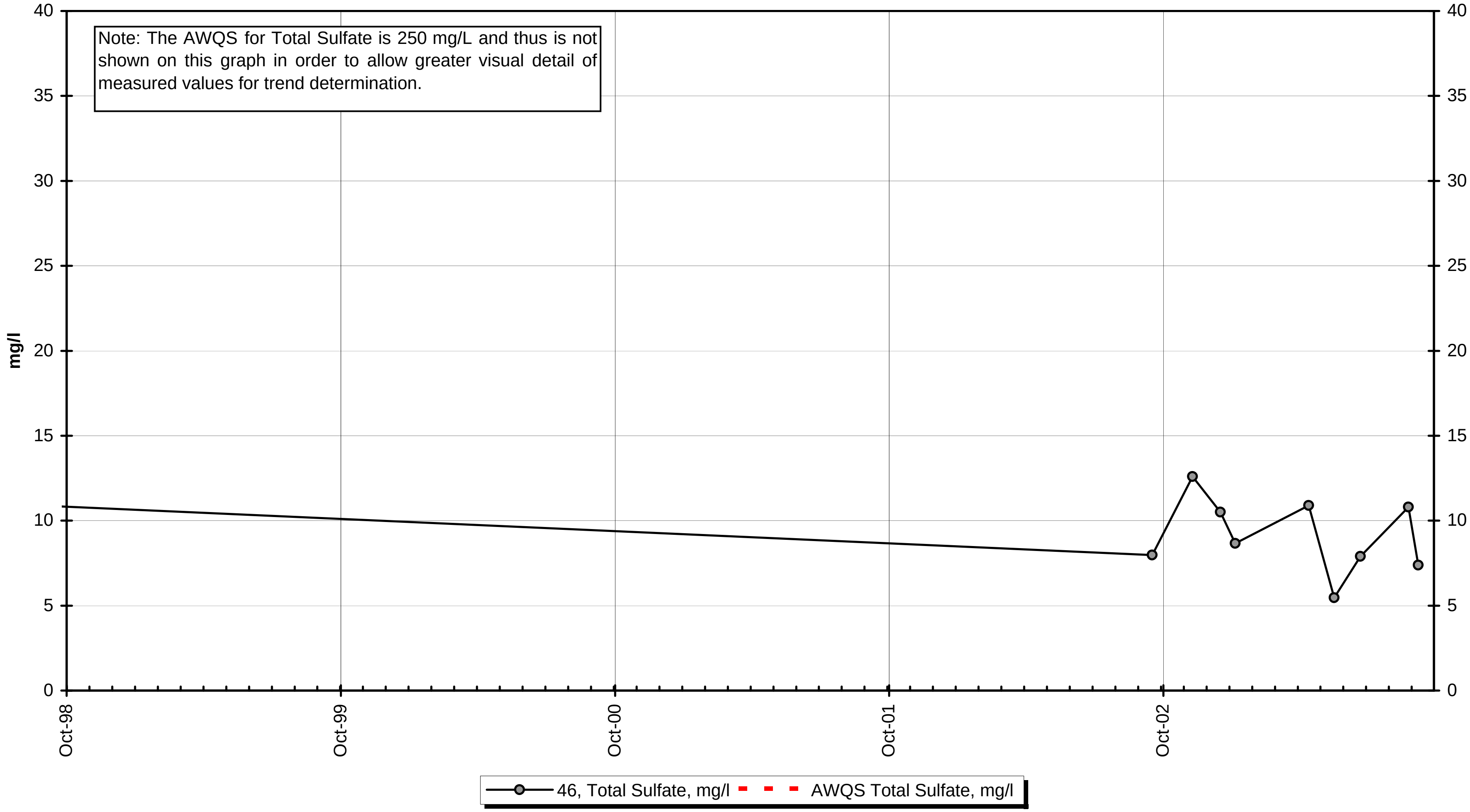
Site 46 -Lab pH

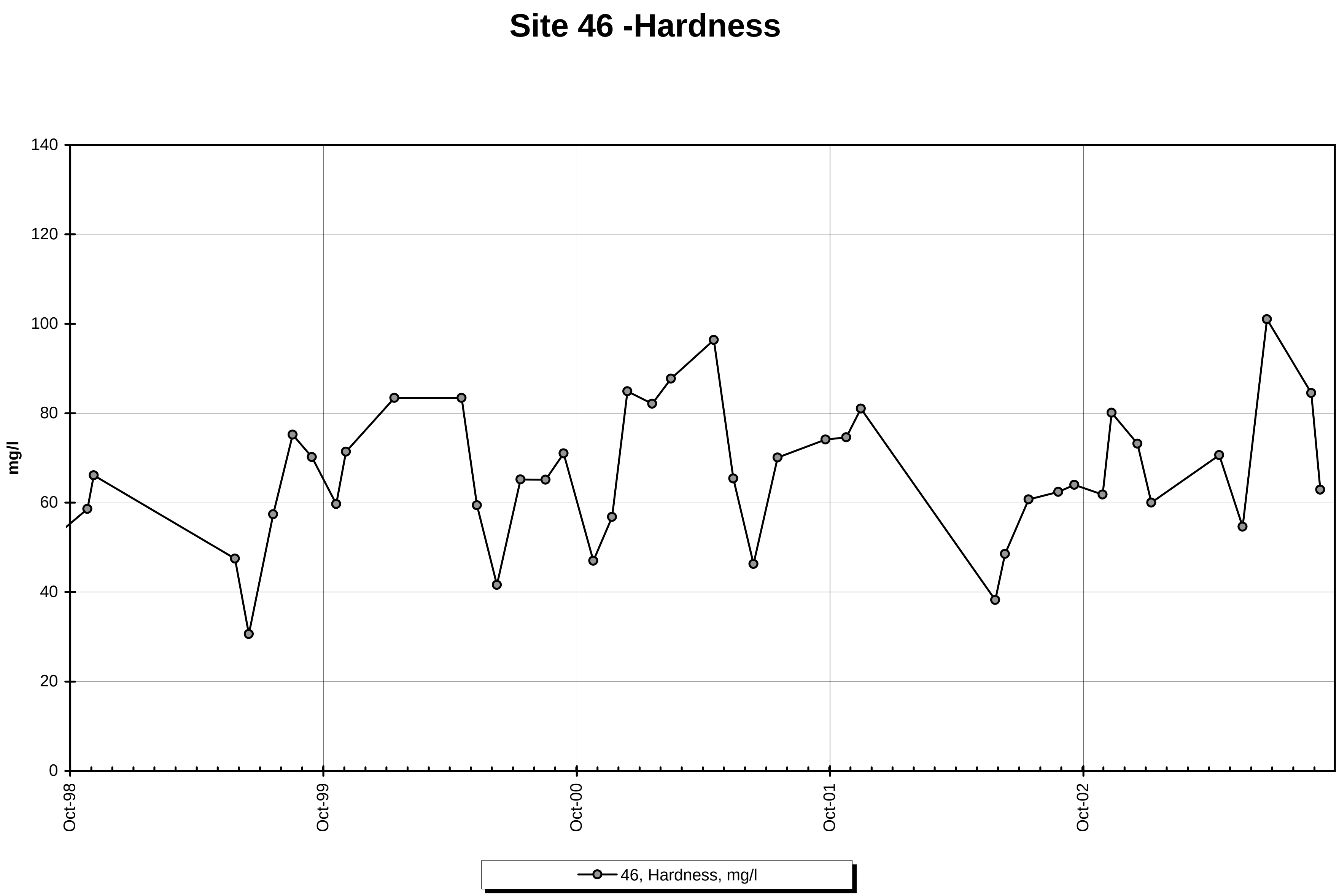


Site 46 -Total Alkalinity



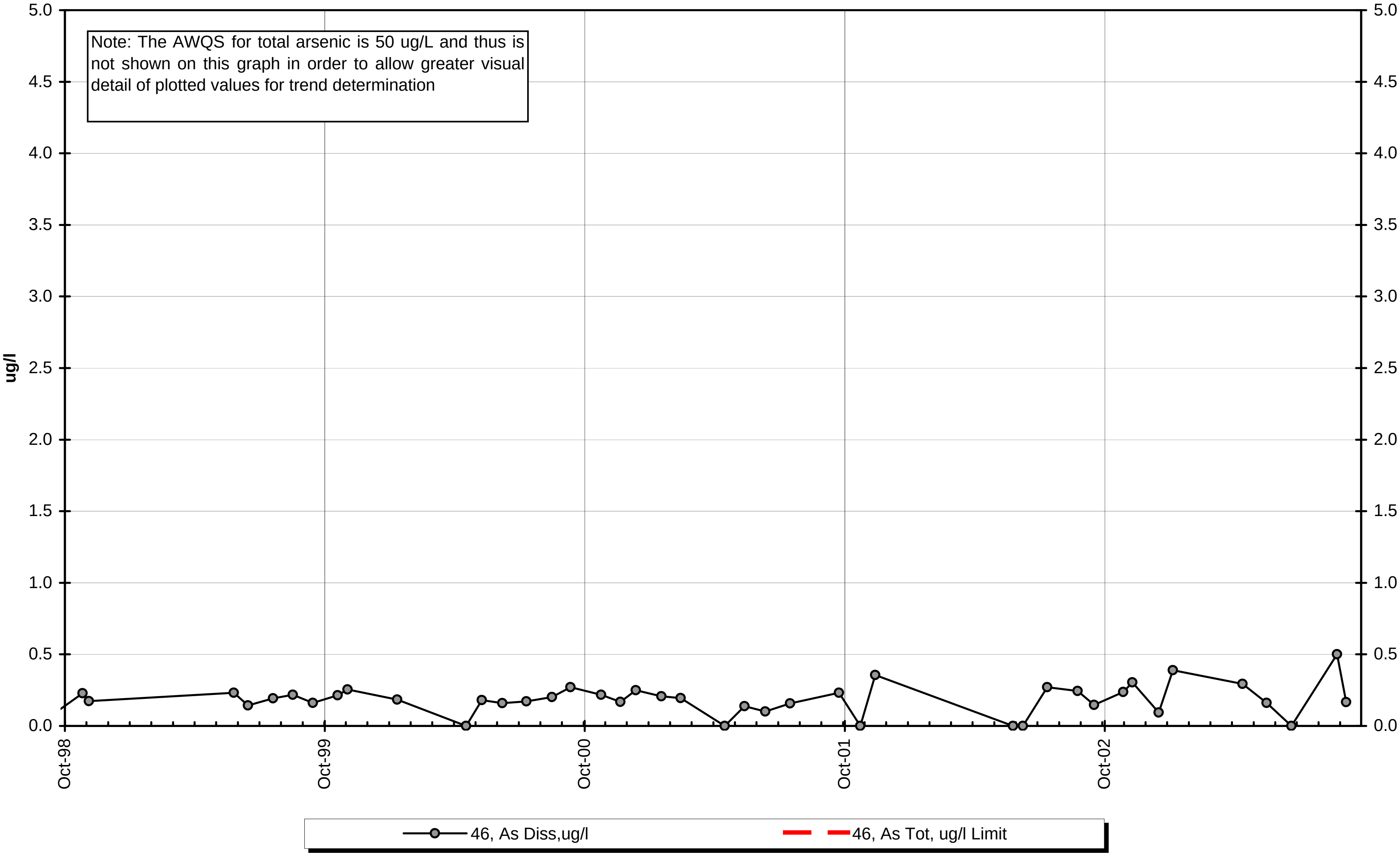
Site 46 -Total Sulfate



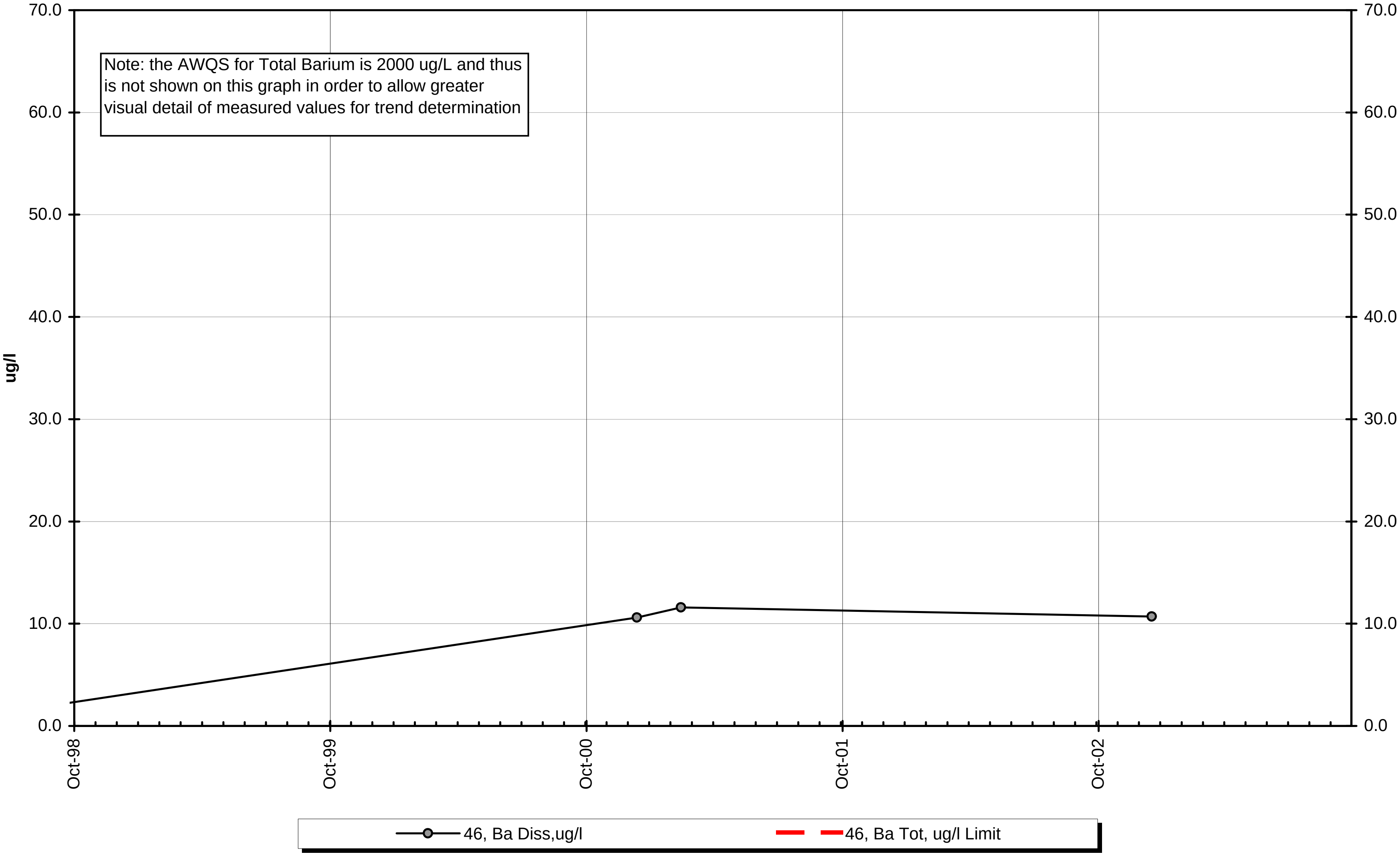


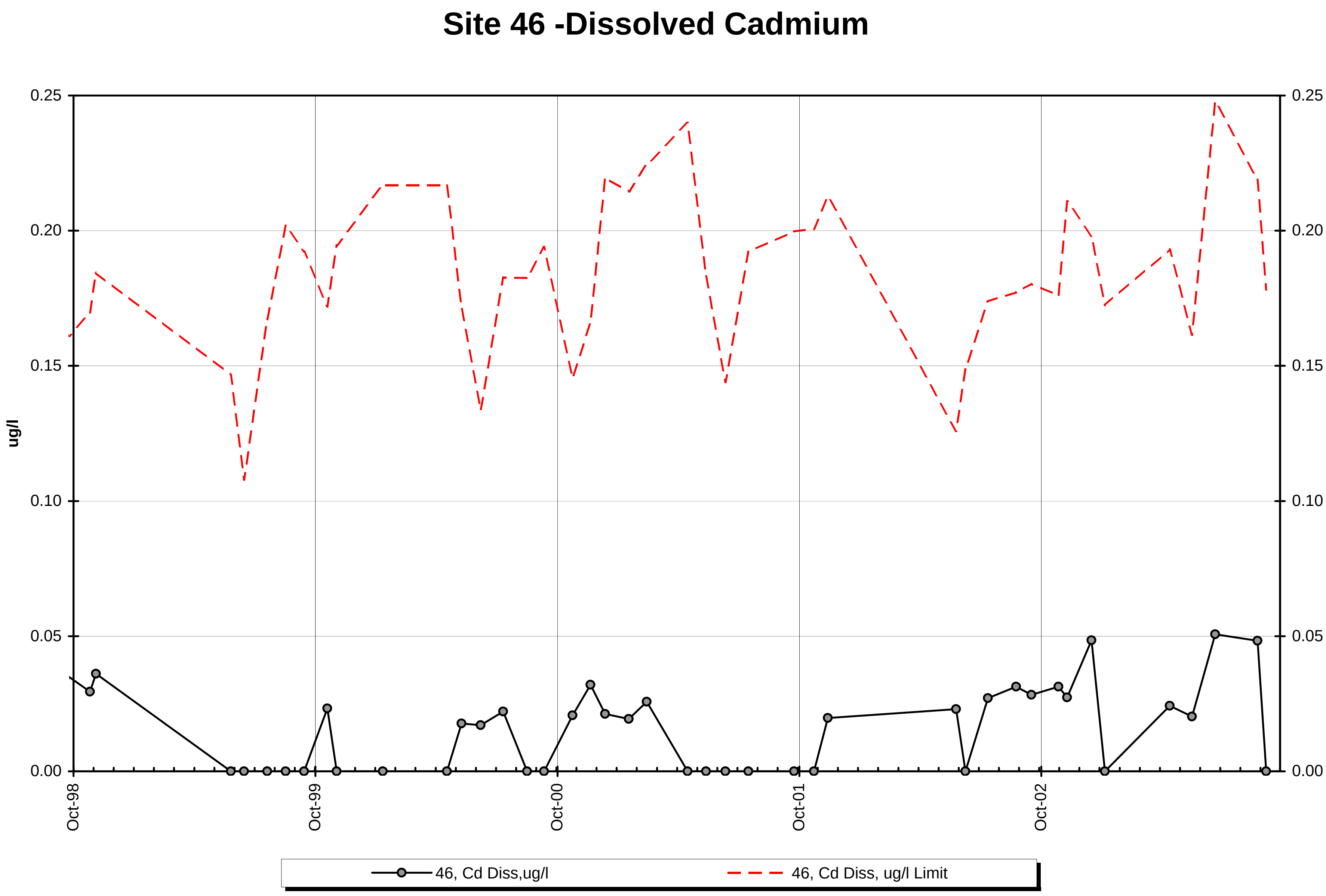
Site 46 -Hardness
mg/l
0
20
40
60
80
100
120
140
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
46, Hardness, mg/l

Site 46 -Dissolved Arsenic



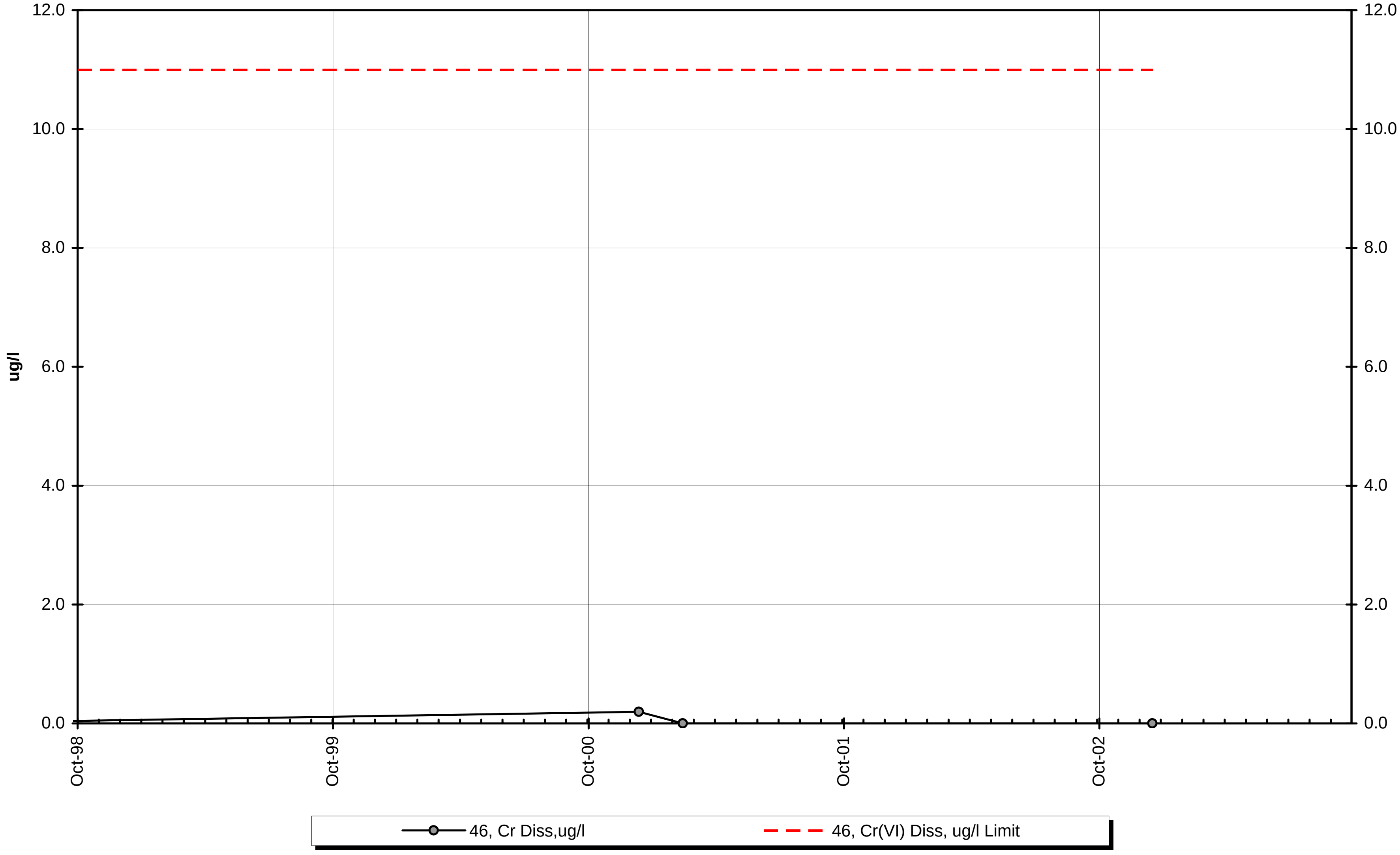
Site 46 -Dissolved Barium

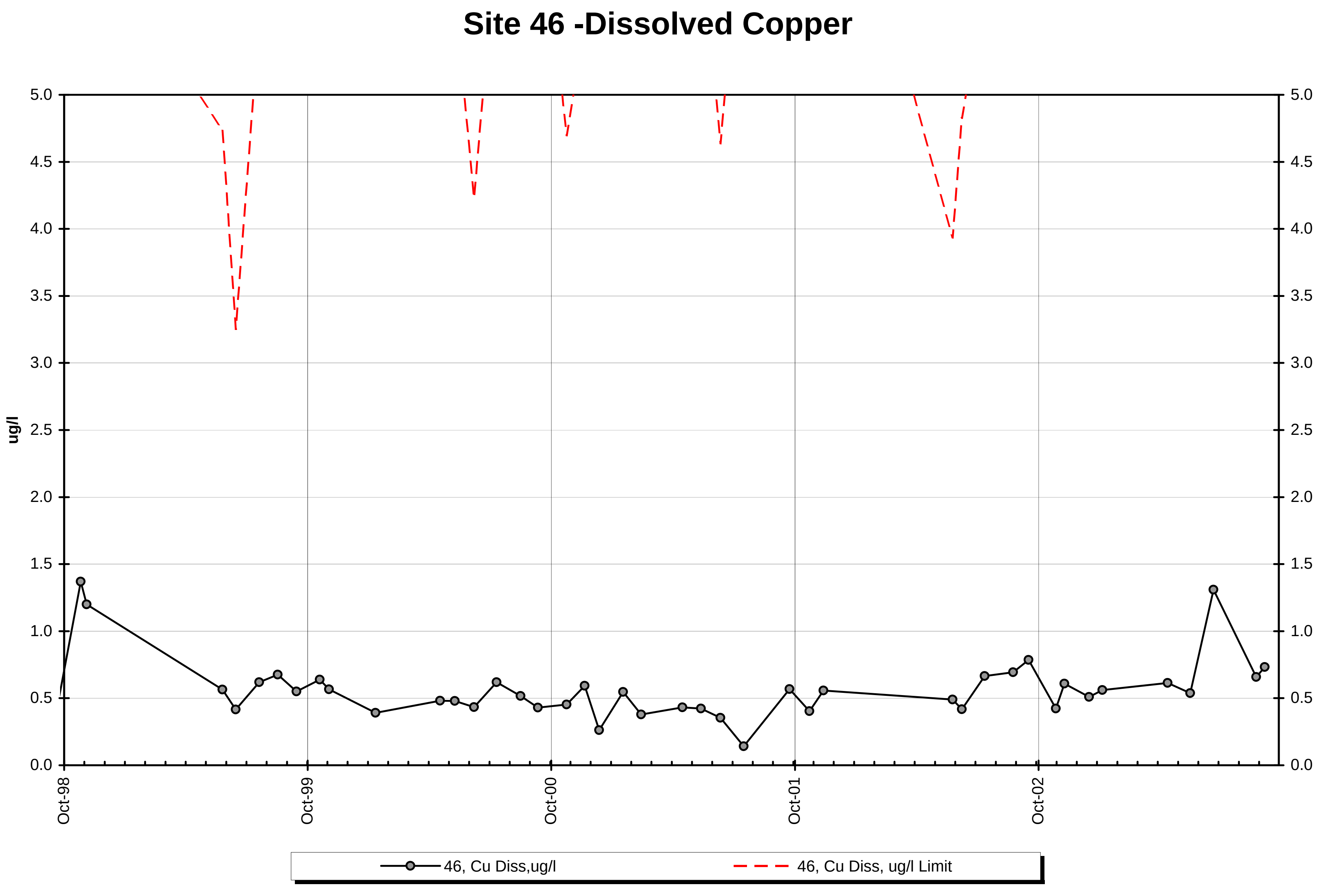




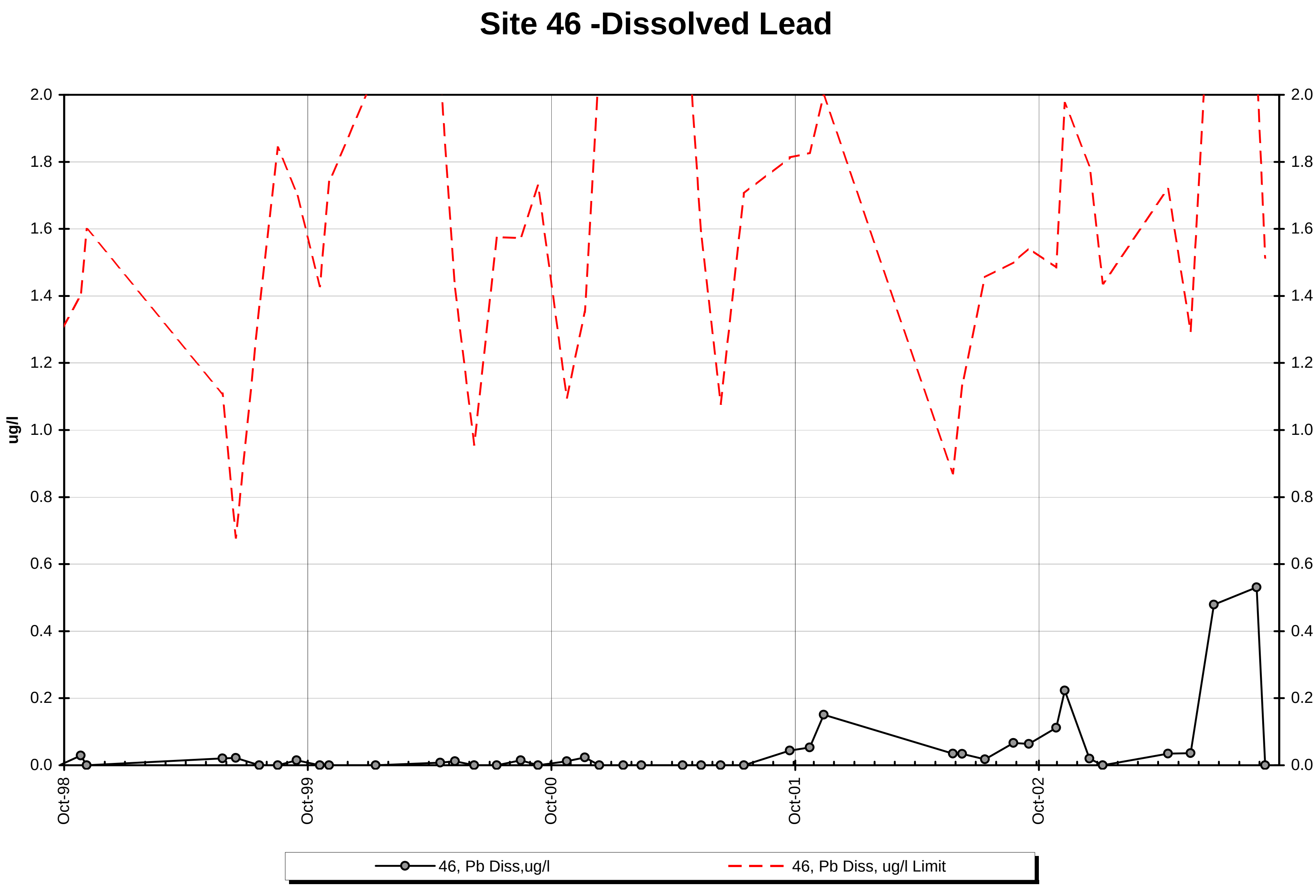
Site 46 -Dissolved Cadmium
ug/l
0.25
0.20
0.15
0.10
0.05
0.00
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
46, Cd Diss,ug/l
46, Cd Diss, ug/l Limit

Site 46 -Dissolved Chromium

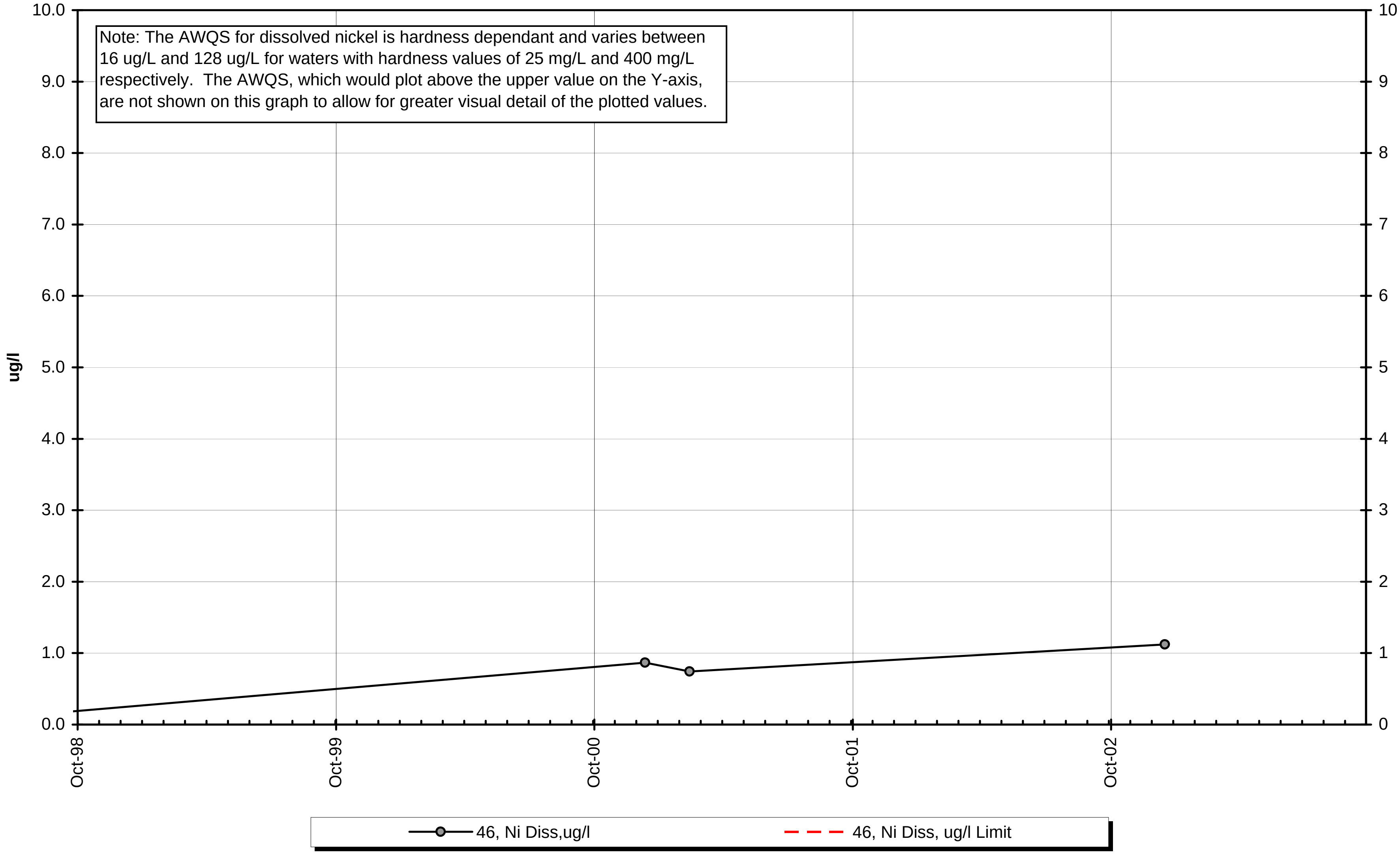




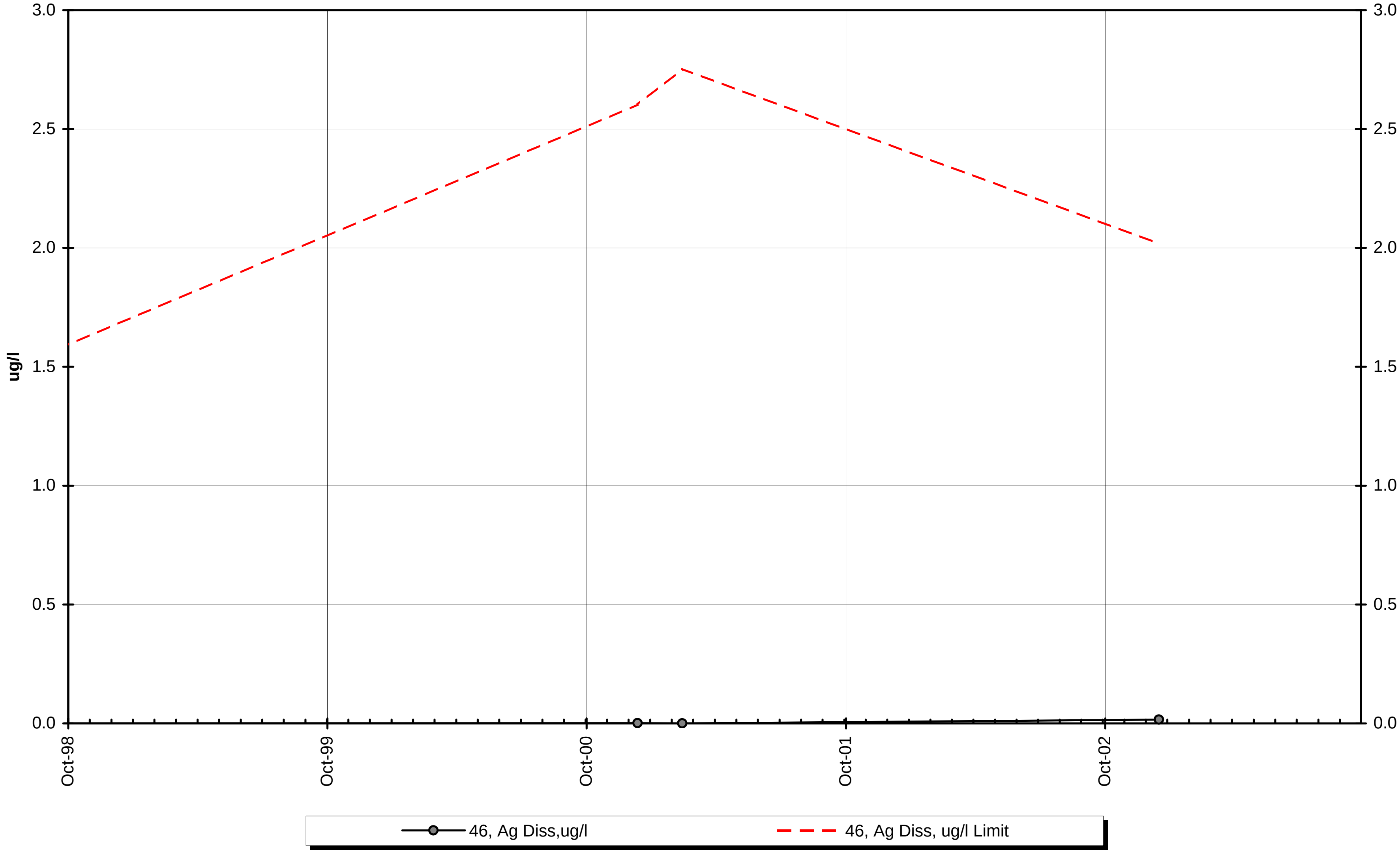
Site 46 -Dissolved Copper
ug/l
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
46, Cu Diss,ug/l
46, Cu Diss, ug/l Limit


Site 46 -Dissolved Lead
ug/l
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
46, Pb Diss,ug/l
46, Pb Diss, ug/l Limit

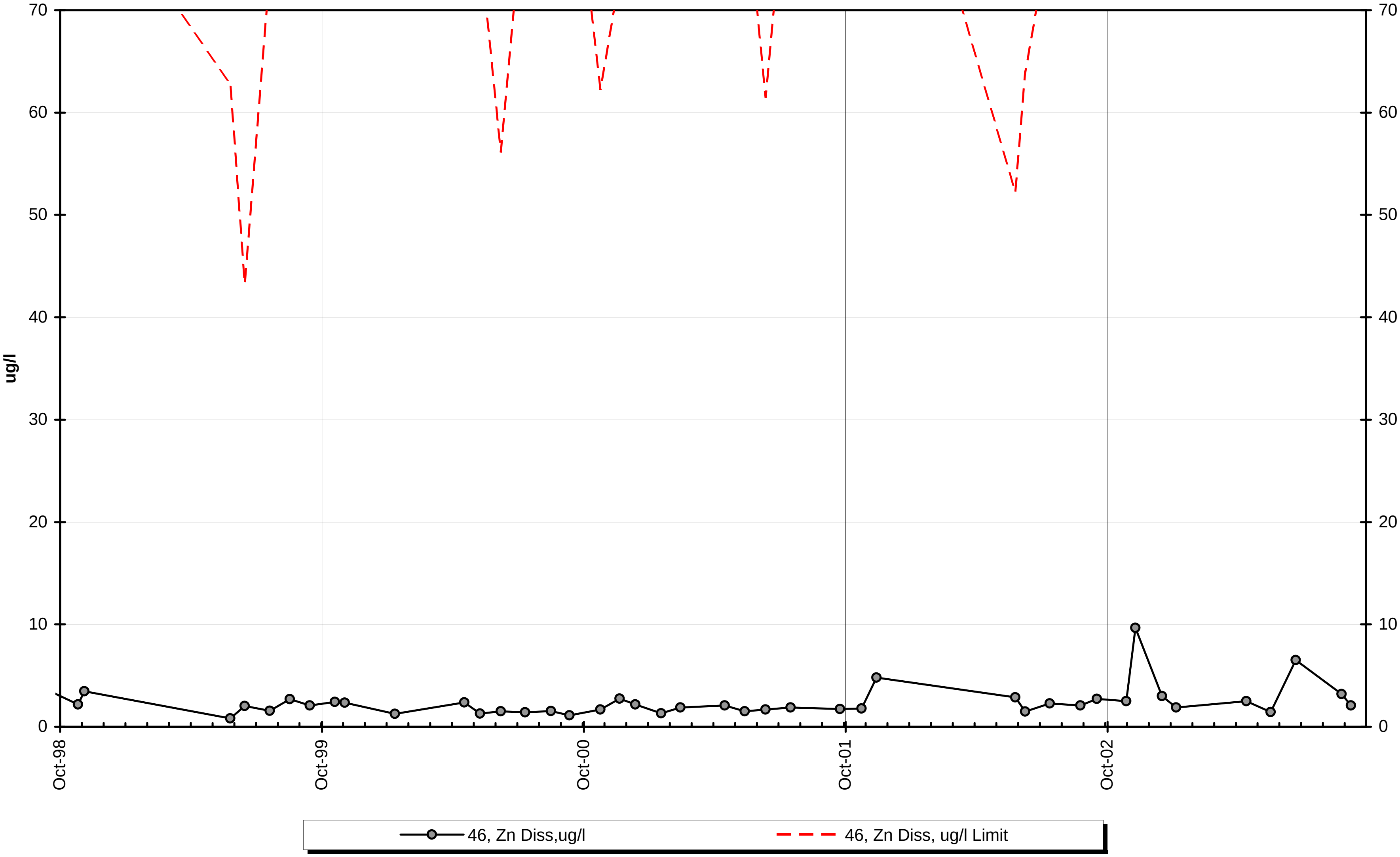
Site 46 -Dissolved Nickel

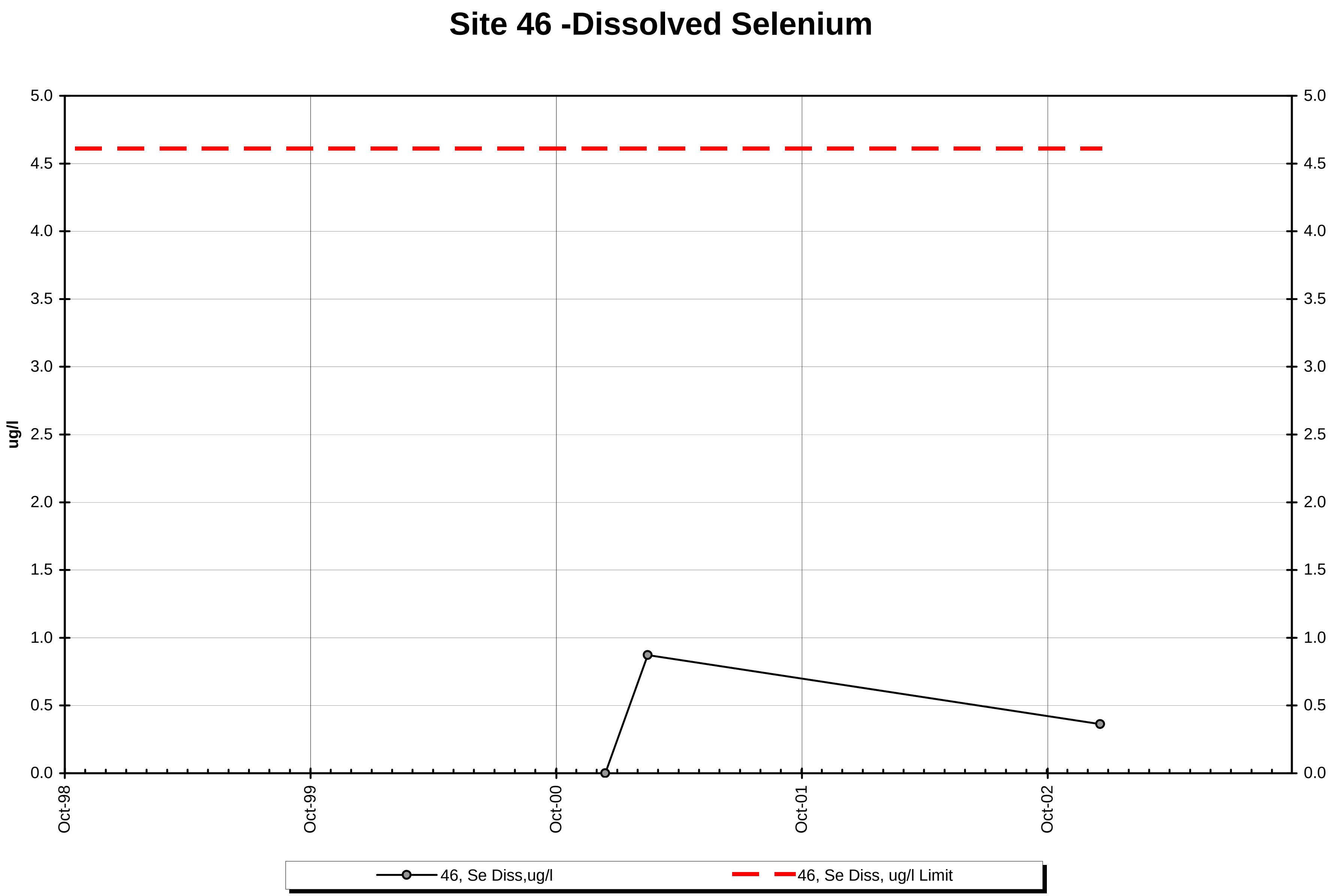


Site 46 -Dissolved Silver

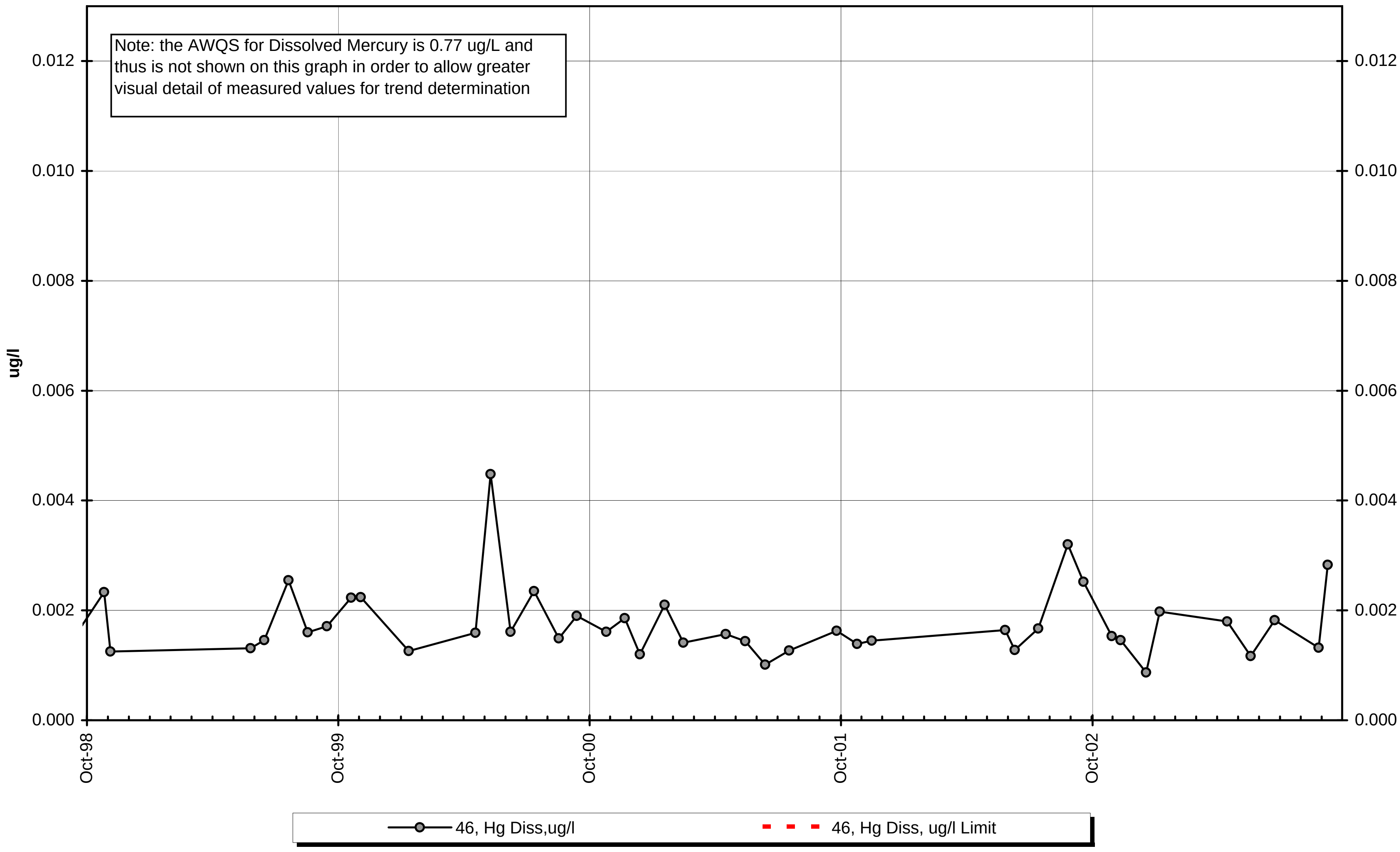


Site 46 -Dissolved Zinc

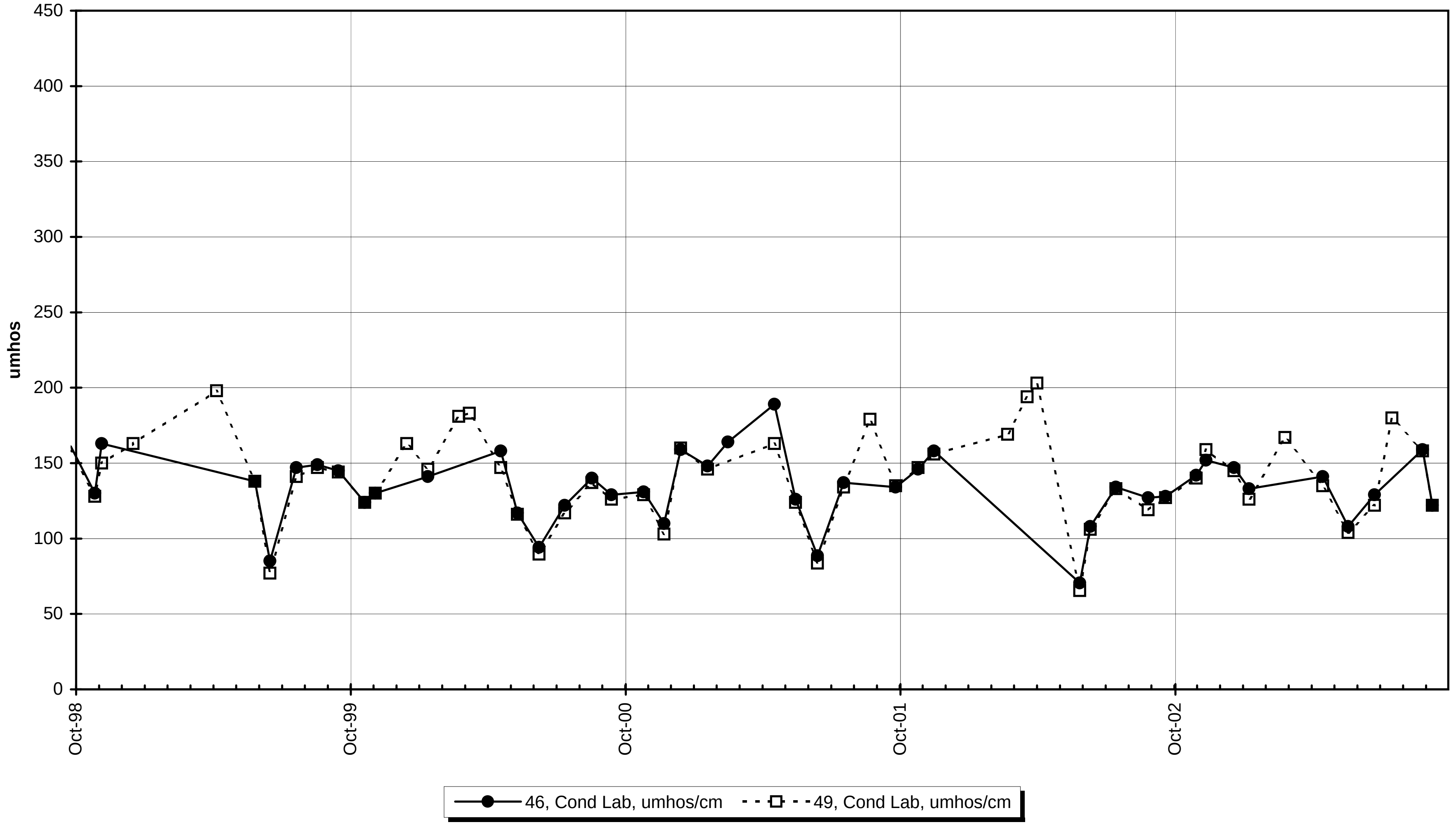



Site 46 -Dissolved Selenium
ug/l
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
46, Se Diss,ug/l
46, Se Diss, ug/l Limit

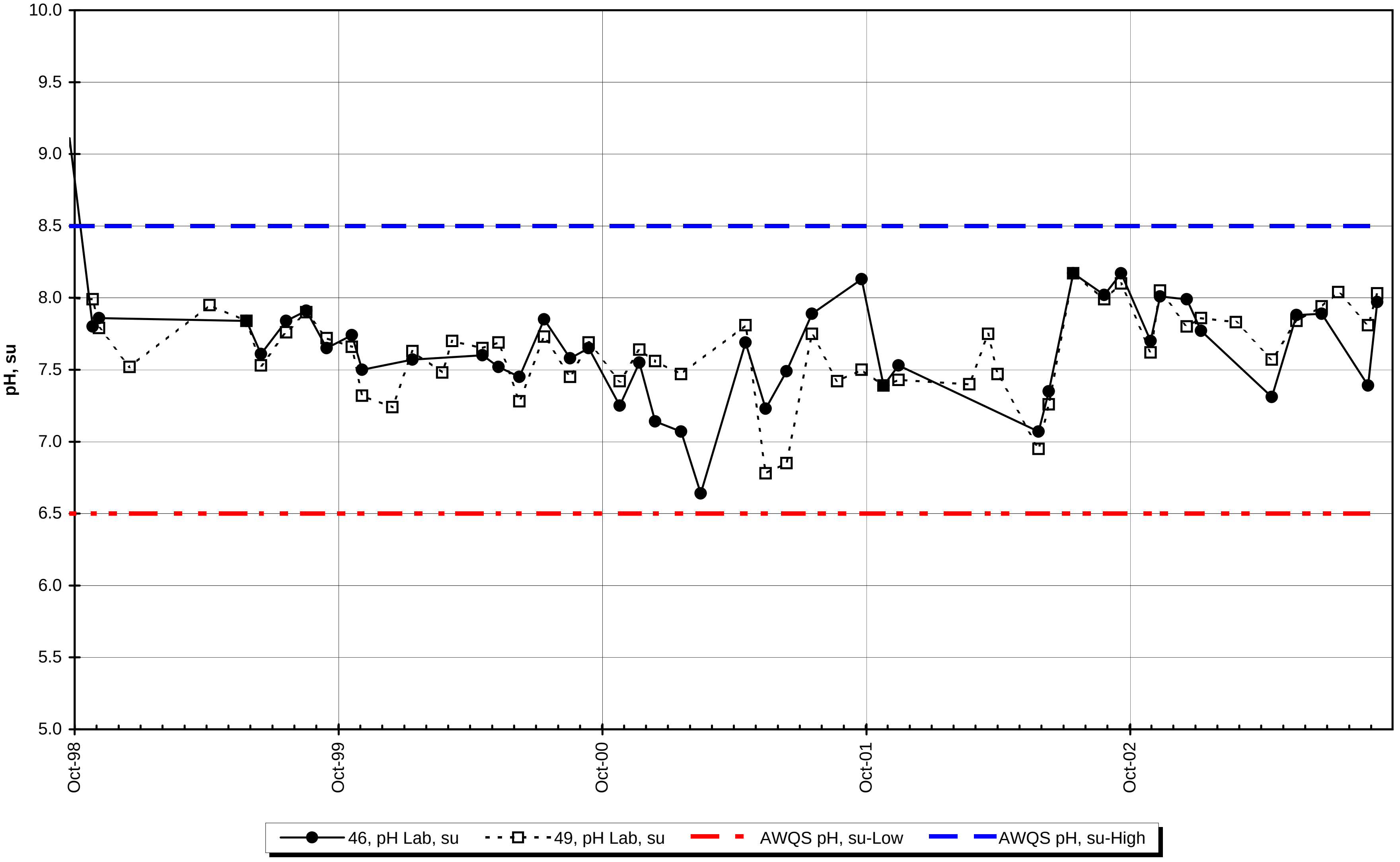
Site 46 -Dissolved Mercury

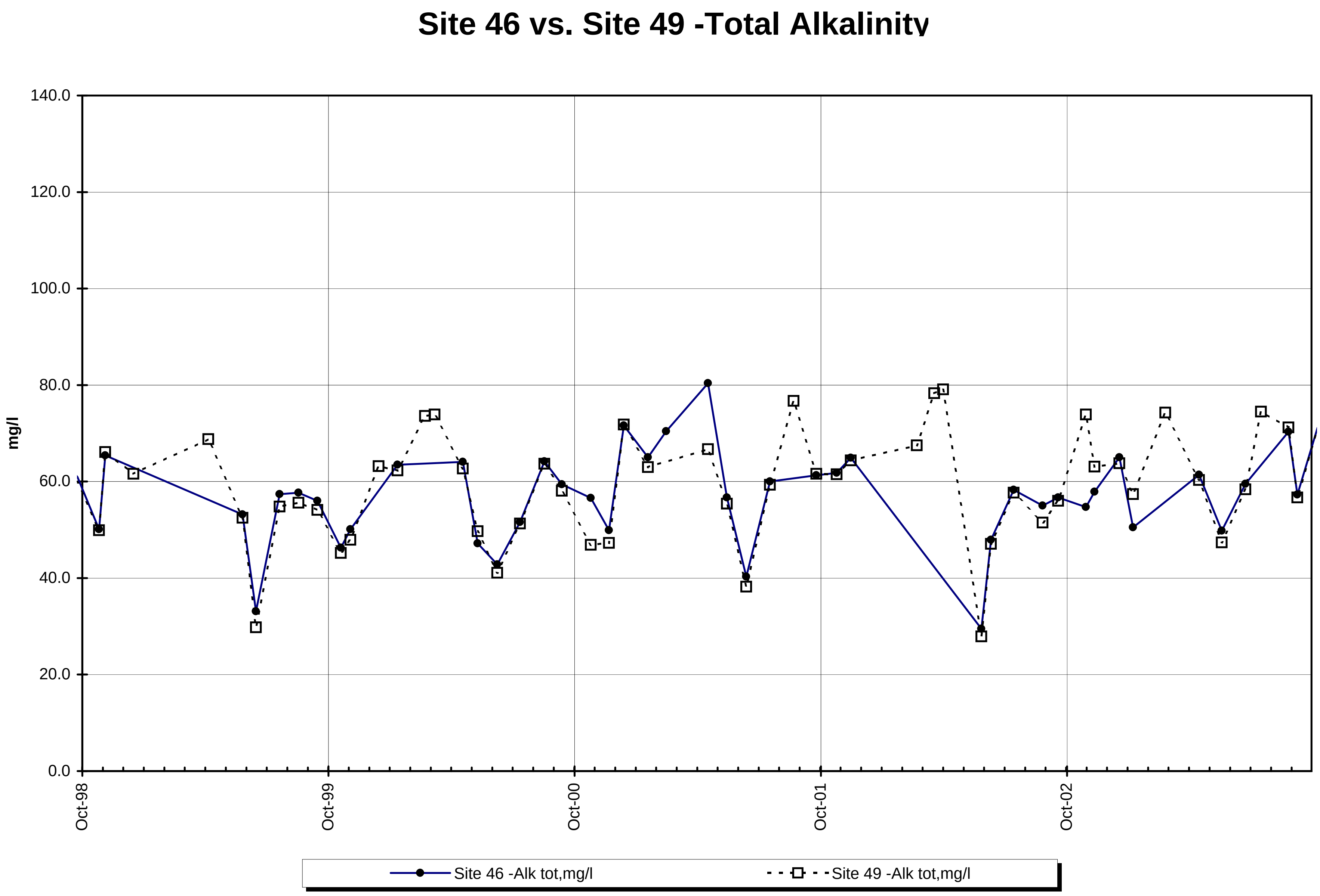


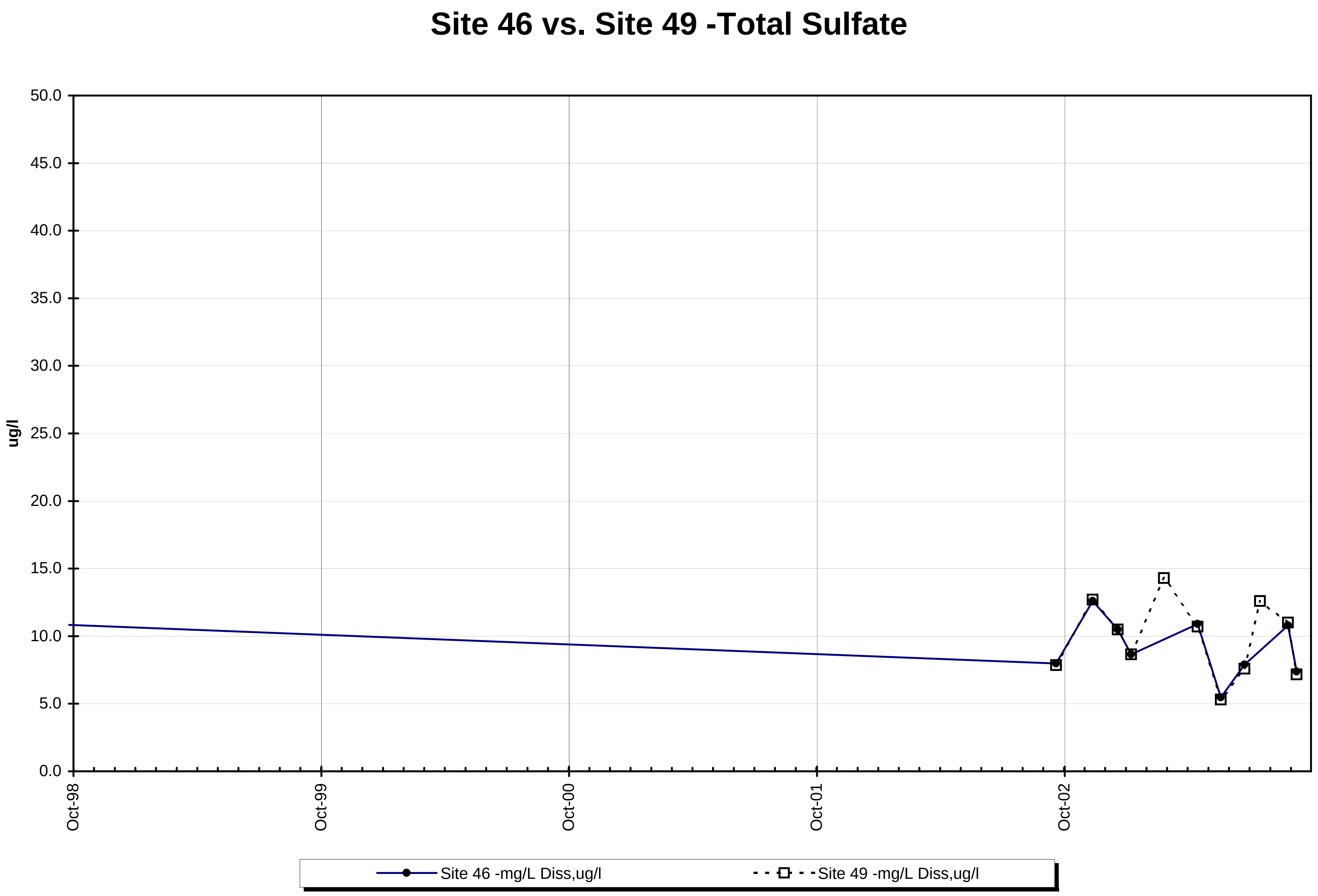
Site 46 vs Site 49 -Conductivity



Site 46 vs. Site 49 -pH

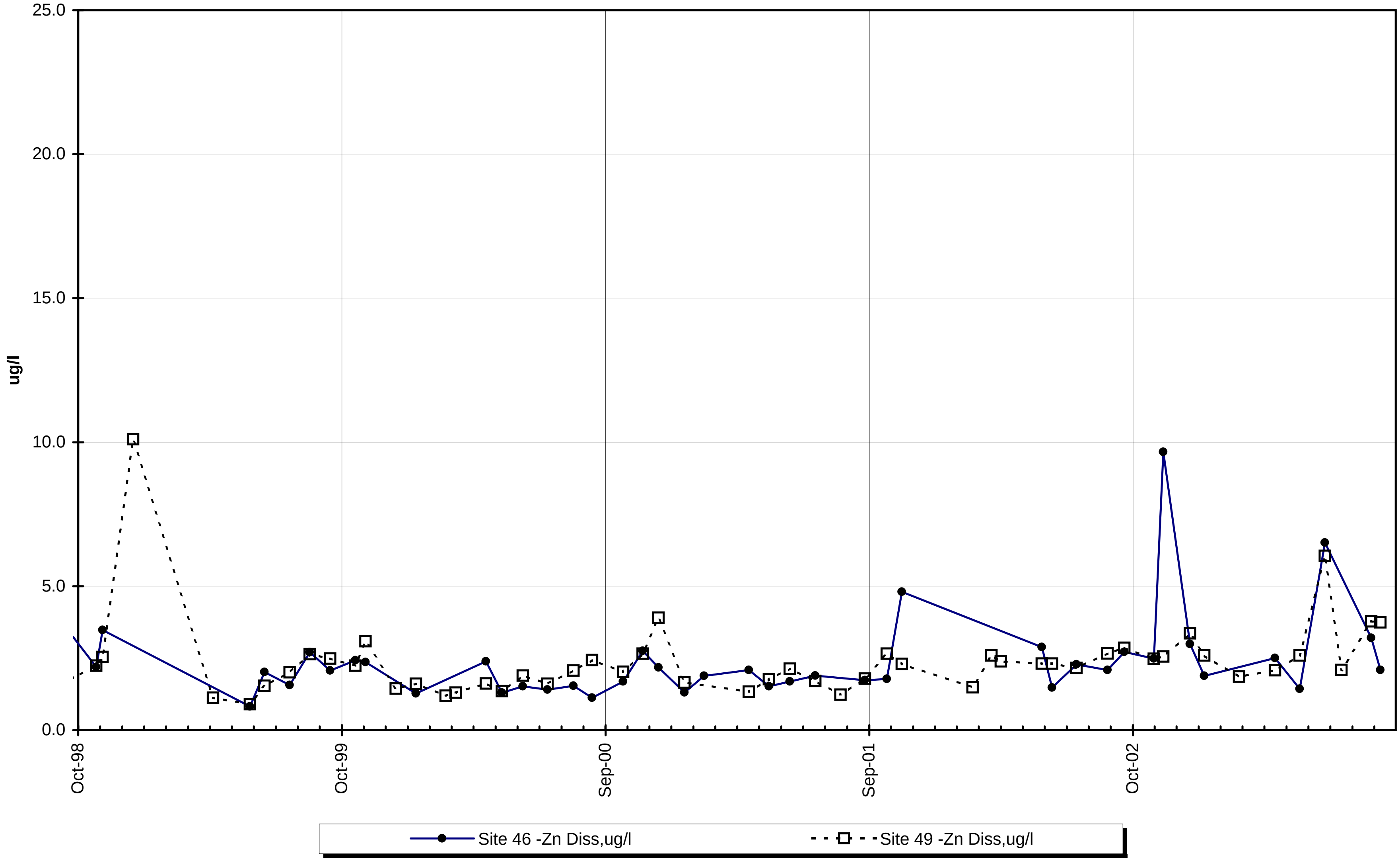



Site 46 vs. Site 49 -Total Alkalinity
mg/l
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
Site 46 -Alk tot,mg/l
Site 49 -Alk tot,mg/l



Site 46 vs. Site 49 -Total Sulfate
ug/l
50.0
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
Site 46 -mg/L Diss,ug/l
Site 49 -mg/L Diss,ug/l

Site 46 vs. Site 49 -Dissolved Zinc



Large Sample Approximation
Wilcoxon-Mann-Whitney Rank Sum Test

Variable: Specific Conductance, Lab (umhos/cm @ 25°C)

Site	#49	#46	Ranks	
Year	WY2003	WY2003	**A**	**B**
Oct	140.0	142.0	10	12
Nov	159.0	152.0	17.5	15
Dec	145.0	147.0	13	14
Jan	126.0	133.0	6	8
Feb	167.0		19	
Mar				
Apr	135.0	141.0	9	11
May	104.0	108.0	1	2
Jun	122.0	129.0	4	7
Jul	180.0		20	
Aug	158.0	159.0	16	17.5
Sep	122.0	122.0	4	4
Median	140.00	141.00		

N= 20

	n	m
ΣR	119.5	90.5
	11	9

W= 45.5

w_α 18

Upper 81

Lower 18

μ_W= 94.5

σ_W= 13.14

Z_{rs}= -0.27

p-test

0.3950

$\alpha/2$

0.025

H_0

($\mu_A=\mu_B$)

ACCEPT

Large Sample Approximation
Wilcoxon-Mann-Whitney Rank Sum Test
Variable: **pH, Lab, Standard Units**

Site	#49	#46	Ranks	
Year	WY2003	WY2003	**A**	**B**
Oct	7.62	7.70	4	5
Nov	8.05	8.01	20	17
Dec	7.80	7.99	7	16
Jan	7.86	7.77	11	6
Feb	7.83		9	
Mar				
Apr	7.57	7.31	3	1
May	7.84	7.88	10	12
Jun	7.94	7.89	14	13
Jul	8.04		19	
Aug	7.81	7.39	8	2
Sep	8.03	7.97	18	15
Median	7.84	7.88		

N= 20

	A	B
ΣR	123	87
	n	**m**
	11	9

W= 42

w_α 18

Upper 81

Lower 18

μ_W= 94.5

σ_W= 13.16

Z_{rs}= -0.53

p-test

0.2974

$\alpha/2$

0.025

H_0

(μ_A=μ_B)

ACCEPT

Large Sample Approximation

Wilcoxon-Mann-Whitney Rank Sum Test

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

Site	#49	#46	Ranks	
Year	WY2003	WY2003	**A**	**B**
Oct	73.90	54.70	18	4
Nov	63.10	57.90	13	8
Dec	63.80	65.00	14	15
Jan	57.40	50.50	7	3
Feb	74.30		19	
Mar				
Apr	60.30	61.40	11	12
May	47.40	49.80	1	2
Jun	58.40	59.50	9	10
Jul	74.50		20	
Aug	71.20	70.30	17	16
Sep	56.70	57.30	5	6
Median	63.10	57.90		

N= 20 ΣR 134 76

	n	**m**
	11	9

W= 31

w_α 18

Upper 81

Lower 18

μ_W= 94.5

σ_W= 13.16

Z_{rs}= -1.37

p-test

0.0857

$\alpha/2$

0.025

H_0

$(\mu_A=\mu_B)$

ACCEPT

Large Sample Approximation
Wilcoxon-Mann-Whitney Rank Sum Test
Variable: **Sulfate, Total (mg/l)**

Site	#49	#46	Ranks	
Year	WY2003	WY2003	**A**	**B**
Oct				
Nov	12.7	12.6	17	15.5
Dec	10.5	10.5	9.5	9.5
Jan	8.7	8.7	7	8
Feb	14.3		18	
Mar				
Apr	10.7	10.9	11	13
May	5.3	5.5	1	2
Jun	7.6	7.9	5	6
Jul	12.6		15.5	
Aug	11.0	10.8	14	12
Sep	7.2	7.4	3	4
Median	10.6	9.6		

N= 18

ΣR 101 70

	n	**m**
	10	8

W= 34

w_α 18

Upper 62

Lower 18

μ_W= 76

σ_W= 11.24

Z_{rs}= -0.49

p-test

$\boxed{0.3124}$

$\alpha/2$

$\boxed{0.025}$

H_0

$(\mu_A=\mu_B)$

ACCEPT

Large Sample Approximation
Wilcoxon-Mann-Whitney Rank Sum Test
Variable: **Zinc, Dissolved (ug/l)**

Site	#49	#46	Ranks	
Year	WY2003	WY2003	**A**	**B**
Oct	2.5	2.5	7	8
Nov	2.6	9.7	10	20
Dec	3.4	3.0	15	13
Jan	2.6	1.9	11.5	3
Feb	1.9		2	
Mar				
Apr	2.1	2.5	4	9
May	2.6	1.4	11.5	1
Jun	6.1	6.5	18	19
Jul	2.1		5.5	
Aug	3.8	3.2	17	14
Sep	3.7	2.1	16	5.5
Median	2.59	2.50		

N= 20

ΣR 117.5 92.5

	n	m
	11	9

W= 47.5

wα 18

Upper 81

Lower 18

μ_W= 94.5

σ_W= 13.15

Z_{rs}= -0.11

p-test

0.4546

$\alpha/2$

0.025

H_0

$(\mu_A=\mu_B)$

ACCEPT

Site **#46** Seasonal Mann-Kendall analysis for Specific Conductance, Lab (umhos/cm @ 25°C)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY1998**	153	172	157		173		131	123	132	159	163	161
b	**WY1999**	130	163						138	85	147	149	145
c	**WY2000**	124	130		141			158	117	94	122	140	129
d	**WY2001**	131	110	159	148	164		189	126	89	137		134
e	**WY2002**	146	158						71	108	134	127	128
f	**WY2003**	142	152	147	133			141	108	129		159	122
	n	6	6	3	3	2	0	4	6	6	5	5	6

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
t_1	0	0	0	0	0	0	0	0	0	0	0	0
t_2	0	0	0	0	0	0	0	0	0	0	0	0
t_3	0	0	0	0	0	0	0	0	0	0	0	0
t_4	0	0	0	0	0	0	0	0	0	0	0	0
t_5	0	0	0	0	0	0	0	0	0	0	0	0
b-a	-1	-1						1	-1	-1	-1	-1
c-a	-1	-1					1	-1	-1	-1	-1	-1
d-a	-1	-1	1		-1		1	1	-1	-1		-1
e-a	-1	-1						-1	-1	-1	-1	-1
f-a	-1	-1	-1				1	-1	-1		-1	-1
c-b	-1	-1						-1	1	-1	-1	-1
d-b	1	-1						-1	1	-1		-1
e-b	1	-1						-1	1	-1	-1	-1
f-b	1	-1						-1	1		1	-1
d-c	1	-1		1			1	1	-1	1		1
e-c	1	1						-1	1	1	-1	-1
f-c	1	1		-1			-1	-1	1		1	-1
e-d	1	1						-1	1	-1		-1
f-d	1	1	-1	-1			-1	-1	1			-1
f-e	-1	-1						1	1		1	-1
S_k	1	-7	-1	-1	-1	0	2	-7	3	-6	-4	-13

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	28.33	28.33	3.67	3.67	1.00		8.67	28.33	28.33	16.67	16.67	28.33
$Z_k = S_k/\sigma_S$	0.19	-1.32	-0.52	-0.52	-1.00		0.68	-1.32	0.56	-1.47	-0.98	-2.44
Z^2_k	0.04	1.73	0.27	0.27	1.00		0.46	1.73	0.32	2.16	0.96	5.96

ΣZ_k=	-8.14
ΣZ^2_k=	14.90
Z-bar=$\Sigma Z_k/K$=	-0.74
p(Z-bar)=	0.230

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

Σn	52
ΣS_k	-34
V(S)	16059
Z	-0.276
K	11

$\chi^2_h = \Sigma Z^2_k - K(\text{Z-bar})^2$= 8.34
p 0.60

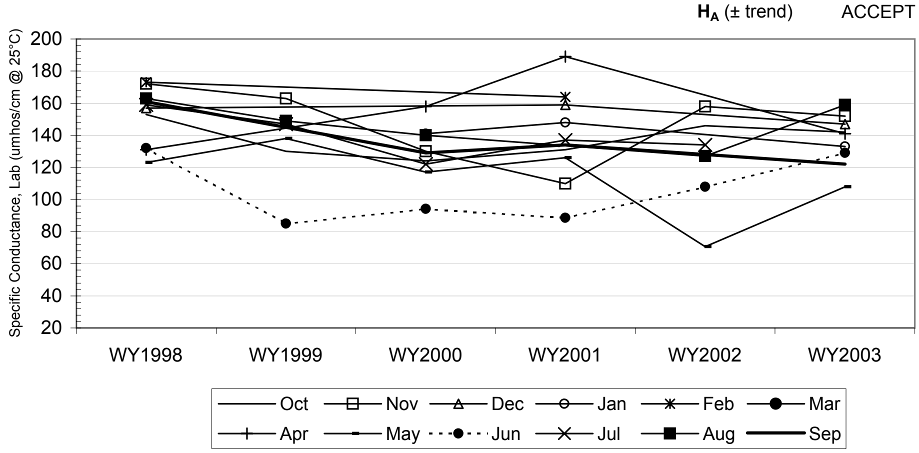
@α=5% $\chi^2_{(K-1)}$= 18.31

Test for station homogeneity
$\chi^2_h < \chi^2_{(K-1)}$ ACCEPT

K*(Z-bar)^2= 6.56
p 0.01

@α=5% $\chi^2_{(1)}$= 3.84

K*(Z-bar)² < $\chi^2_{(1)}$
H_0 (No trend) REJECT
H_A (± trend) ACCEPT



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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY1998**	7.88	8.41	7.09		7.32		8.21	8.20	7.53	7.64	7.66	9.11
b	**WY1999**	7.80	7.86						7.84	7.61	7.84	7.91	7.65
c	**WY2000**	7.74	7.50		7.57			7.60	7.52	7.45	7.85	7.58	7.65
d	**WY2001**	7.25	7.55	7.14	7.07	6.64		7.69	7.23	7.49	7.89		8.13
e	**WY2002**	7.39	7.53						7.07	7.35	8.17	8.02	8.17
f	**WY2003**	7.70	8.01	7.99	7.77			7.31	7.88	7.89		7.39	7.97
	n	6	6	3	3	2	0	4	6	6	5	5	6

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

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a	-1	-1						-1	1	1	1	-1
c-a	-1	-1					-1	-1	-1	1	-1	-1
d-a	-1	-1	1		-1		-1	-1	-1	1		-1
e-a	-1	-1						-1	-1	1	1	-1
f-a	-1	-1	1				-1	-1	1		-1	-1
c-b	-1	-1						-1	-1	1	-1	0
d-b	-1	-1						-1	-1	1		1
e-b	-1	-1						-1	-1	1	1	1
f-b	-1	1						1	1		-1	1
d-c	-1	1		-1			1	-1	1	1		1
e-c	-1	1						-1	-1	1	1	1
f-c	-1	1		1			-1	1	1		-1	1
e-d	1	-1						-1	-1	1		1
f-d	1	1	1	1			-1	1	1			-1
f-e	1	1						1	1		-1	-1
S_k	-9	-3	3	1	-1	0	-4	-7	-1	10	-2	0

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	28.33	28.33	3.67	3.67	1.00		8.67	28.33	28.33	16.67	16.67	28.33
$Z_k = S_k/\sigma_S$	-1.69	-0.56	1.57	0.52	-1.00		-1.36	-1.32	-0.19	2.45	-0.49	0.00
Z^2_k	2.86	0.32	2.45	0.27	1.00		1.85	1.73	0.04	6.00	0.24	0.00

ΣZ_k= -2.07
ΣZ^2_k= 16.75
Z-bar=$\Sigma Z_k/K$= -0.19
p(Z-bar)= 0.425

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

Σn 52
ΣS_k -13
V(S) 16059
Z -0.110
K 11

$\chi^2_h = \Sigma Z^2_k - K(\text{Z-bar})^2$= 16.33
p 0.09

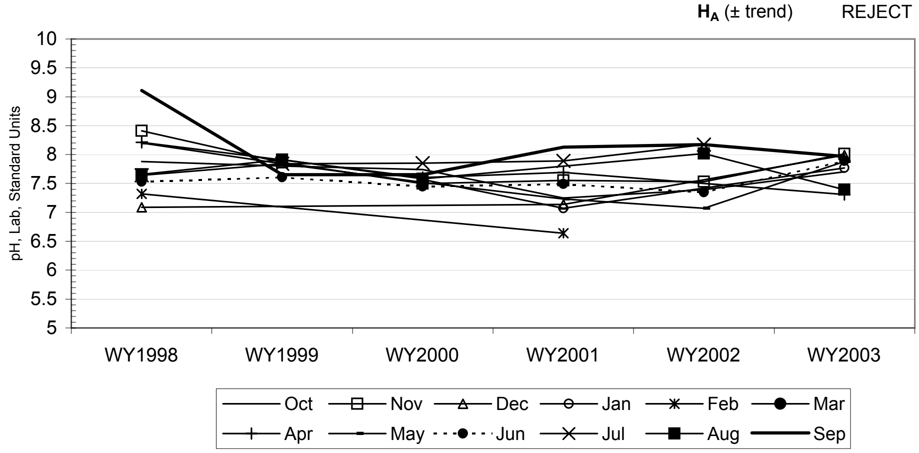
@α=5% $\chi^2_{(K-1)}$= 18.31

Test for station homogeneity
$\chi^2_h < \chi^2_{(K-1)}$ ACCEPT

K*(Z-bar)^2= 0.42
p 0.51

@α=5% $\chi^2_{(1)}$= 3.84

K*(Z-bar)² < $\chi^2_{(1)}$
H_0 (No trend) ACCEPT
H_A (± trend) REJECT



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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY1998**	64	73	62		70		54	52	57	63	67	61
b	**WY1999**	50	65						53	33	57	58	56
c	**WY2000**	46	50		64			64	47	43	52	64	59
d	**WY2001**	57	50	72	65	70		80	57	40	60		61
e	**WY2002**	62	65						30	48	58	55	57
f	**WY2003**	55	58	65	51			61	50	60		70	57
	n	6	6	3	3	2	0	4	6	6	5	5	6

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

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

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	28.33	28.33	3.67	3.67	1.00		8.67	28.33	28.33	16.67	16.67	28.33
$Z_k = S_k/\sigma_S$	-0.19	-1.32	0.52	-0.52	1.00		0.68	-0.56	0.94	-0.49	0.00	-0.19
Z^2_k	0.04	1.73	0.27	0.27	1.00		0.46	0.32	0.88	0.24	0.00	0.04

ΣZ_k=	-0.13
ΣZ^2_k=	5.25
Z-bar=ΣZ_k/K=	-0.01
p(Z-bar)=	0.495

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

Σn	52
ΣS_k	-6
V(S)	16059
Z	-0.055
K	11

$\chi^2_h=\Sigma Z^2_k$-K(Z-bar)^2= 5.25
p 0.87

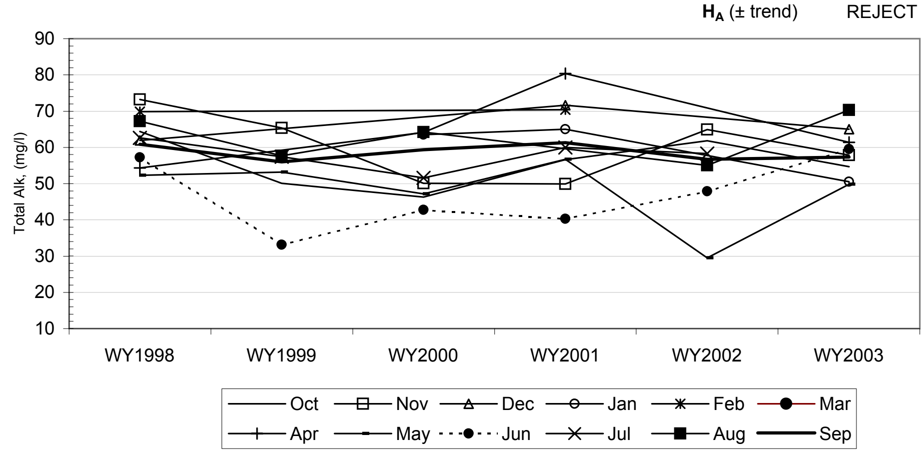
@α=5% $\chi^2_{(K-1)}$= 18.31

Test for station homogeneity
$\chi^2_h<\chi^2_{(K-1)}$ ACCEPT

K*(Z-bar)^2= 0.00
p 0.97

@α=5% $\chi^2_{(1)}$= 3.84

K*(Z-bar)² < $\chi^2_{(1)}$
H_0 (No trend) ACCEPT
H_A (± trend) REJECT



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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY1998**	2.35	2.35	5.85		-4.70		2.35	2.35	1.71	1.96	1.59	3.24
b	**WY1999**	2.19	3.48						0.83	2.02	1.57	2.71	2.07
c	**WY2000**	2.42	2.36		1.27			2.39	1.30	1.52	1.41	1.54	1.12
d	**WY2001**	1.69	2.75	2.18	1.31	1.88		2.09	1.52	1.69	1.89		1.73
e	**WY2002**	1.78	4.80						2.88	1.48	2.28	2.09	2.72
f	**WY2003**	2.49	9.66	2.99	1.88			2.50	1.43	6.51		3.20	2.09
	n	6	6	3	3	2	0	4	6	6	5	5	6

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

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

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	28.33	28.33	3.67	3.67	1.00		8.67	28.33	28.33	16.67	16.67	28.33
$Z_k = S_k/\sigma_S$	0.19	2.07	-0.52	1.57	1.00		0.68	0.56	-0.19	0.49	0.98	-0.19
Z^2_k	0.04	4.27	0.27	2.45	1.00		0.46	0.32	0.04	0.24	0.96	0.04

ΣZ_k= 6.64

ΣZ^2_k= 10.08

Z-bar=$\Sigma Z_k/K$= 0.60

p(Z-bar)= 0.727

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

Σn	52
ΣS_k	24
V(S)	16059
Z	0.181
K	11

$\chi^2_h = \Sigma Z^2_k - K(\text{Z-bar})^2$= 5.72

p 0.84

@α=5% $\chi^2_{(K-1)}$= 18.31

Test for station homogeneity

$\chi^2_h < \chi^2_{(K-1)}$ ACCEPT

K*(Z-bar)^2= 4.37

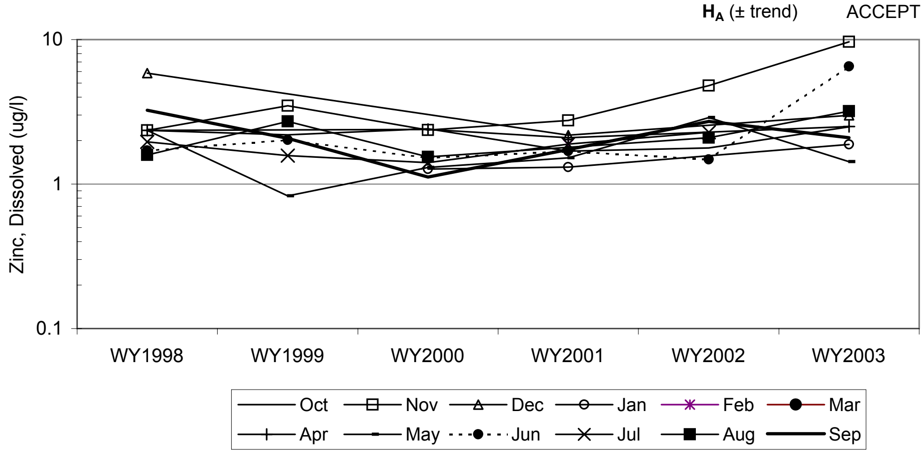
p 0.04

@α=5% $\chi^2_{(1)}$= 3.84

K*(Z-bar)² < $\chi^2_{(1)}$

H_0 (No trend) REJECT

H_A (± trend) ACCEPT



INTERPRETIVE REPORT
SITE 57 "MONITORING WELL 23-00-03"

The data collected during the current water year are listed in the following "Table of Results for Water Year 2003" report. The table includes all the data, field and lab, 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 zero for the purpose of median calculation.

Sampling at this site was added to the FWMP in October-2001. All data collected at this site since it's inception into the FWMP are included in the data analyses with the exception of one outlier shown on the table below. The qualified data point is for the total alkalinity determination from the July-03 sample. The reported value of 35.3 mg/L is nearly five-times lower than all other alkalinity determinations for this well. While no identifiable errors were noted in lab QAQC the large variation in magnitude away from the norm in additional to similar noted lab errors that did occur at Site 56 during the following month's (Aug-03) sampling event lead to KGCMC classifying this data point as suspect. Thus the July-03 total alkalinity data point will not be used for graphic or statistical analysis as required by the SIGs for this site.

Sample Date	Parameter	Value	Qualifier	Notes
7/17/2003	Alkalinity, Total mg/L	35.3	RR	Suspected sample contamination

The data for water year 2003 have been compared to the strictest fresh water quality criterion for each applicable analyte. No results exceeding these criteria have been identified

X-Y plots have been generated to graphically present the data for each of the analytes requested in the Statistical Information Goals for this site. These plots have been visually analyzed for the appearance of any trend in concentration. No obvious long term trends were apparent. Dissolved arsenic, barium, and lead show moderate but distinct increasing trends from approximately July-03 through the end of the current water year (Sept-03). Dissolved cadmium shows a marked decrease for the same period. Given the number of different analytes and the different trend direction this may indicate a change in the character of the ground water at this site. As noted in the "Site 23/D Hydrogeology and Geochemistry Analysis" report (EDE, 2004) Site 57 may sample one of multiple perched water lenses. Thus, if Site 57 samples a relatively small aquifer it may be more susceptible to short term variations in recharge rate. The changes noted at Site 57 are thus interpreted to mostly likely be the result of the limited aquifer sampled at this site. No statistical analysis for trend was performed on the Site 57 data. For a robust analysis of trend at least 5 years of data is required. KGCMC anticipates adding this component into the Water Year 2006 annual report for this site.

Table of Results for Water Year 2003

Site 57 "MW-23-00-03"

Sample Date/Parameter	10/30/2002	11/12/2002	Dec-02	Jan-03	Feb-03	Mar-03	4/16/2003	5/20/2003	6/24/2003	7/17/2003	8/27/2003	9/9/2003	**Median**
Water Temp (°C)	4.6	4.9	NOT SCHEDULED FOR SAMPLING				4.3	4.5	5.2	4.9	4.4	4.6	4.6
Conductivity-Field(μmho)	407	388					447	449	438	453	469	465	448
Conductivity-Lab (μmho)	382	370					404	407	407	449	417	426	407
pH Lab (standard units)	7.42	7.77					7.57	7.59	7.78	7.71	7.42 J	7.63	7.61
pH Field (standard units)	7.43	7.31					7.66	7.56	7.54	7.75	7.49	7.58	7.55
Total Alkalinity (mg/L)	174.0	128.0					190.0	152.0	207.0	*35.3*	143.0	153.0	152.5
Total Sulfate (mg/L)	**NOTE 1**	50.6 J					58.7	62.1	60.3	47.1	54.4 J	51.2 J	54.4
Hardness (mg/L)	135.0	184.0					205.0	218.0	192.0	162.0	194.0	180.0	188.0
Dissolved As (ug/L)	1.040	0.651 J					0.643	0.614	0.487	0.755 J	1.650 U	1.050	0.703
Dissolved Ba (ug/L)	33.9	28.5					31.7	30.6	31.5	39.1	42.1	41.0	32.8
Dissolved Cd (ug/L)	0.144	0.160					0.163	0.174	0.175	0.030 J	0.023 J	<0.023	0.152
Dissolved Cr (ug/L)	0.412	1.790					0.424 J	0.736	0.565	0.432	0.528	1.180	0.547
Dissolved Cu (ug/L)	0.027 U	0.295 U					0.403	0.158 U	0.193 U	0.155 J	0.162	0.163	0.163
Dissolved Pb (ug/L)	<0.0180	0.0434 J					0.0323 U	0.0870	0.4900	0.3740	0.9960	1.2300	0.2305
Dissolved Ni (ug/L)	1.900	1.750					2.070	2.210	1.130	2.330 J	2.630	1.770	1.985
Dissolved Ag (ug/L)	<0.004	<0.088					<0.018	<0.028	<0.013	<0.066	<0.079	<0.004	0.012
Dissolved Zn (ug/L)	2.86	3.64 J					2.33	2.73	3.20	3.51 U	4.44	3.47	3.34
Dissolved Se (ug/L)	<0.401	0.916 J					<0.496 UJ	1.180 J	0.704	0.753 J	0.851	0.699 J	0.729
Dissolved Hg (ug/L)	0.000551	0.000498 U					0.000335 U	0.000450 U	0.000527 U	0.000632 U	0.000510 U	0.000481 J	0.000504

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

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

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

NOTE (1) Analysis was not performed on sample.

Qualified Data by QA Reviewer

Date Range: 10/01/2002 to 09/30/2003

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
57	10/30/2002	1:54:00 PM				
			Cu Diss, ug/l	0.0273	U	Below Quantitative Range, Fi
57	11/12/2002	3:45:00 PM				
			SO4 Tot, mg/l	50.6	J	Hold Time
			As Diss, ug/l	0.651	J	LCS Recovery
			Cu Diss, ug/l	0.295	U	Field Blank Contamination
			Pb Diss, ug/l	0.0434	J	Below Quantitative Range
			Zn Diss, ug/l	3.64	J	LCS Recovery
			Se Diss, ug/l	0.916	J	Below Quantitative Range
			Hg Diss, ug/l	0.000498	U	Field Blank Contamination
57	04/16/2003	2:01:00 PM				
			Cr Diss, ug/l	0.424	J	Below Quantitative Range
			Pb Diss, ug/l	0.0323	U	Field Blank Contamination
			Se Diss, ug/l	-0.496	UJ	LCS Recovery
			Hg Diss, ug/l	0.000335	U	Method Blank Contamination
57	05/20/2003	2:15:00 PM				
			Cu Diss, ug/l	0.158	U	Field Blank Contamination
			Se Diss, ug/l	1.18	J	LCS Recovery
			Hg Diss, ug/l	0.00045	U	Method Blank Contamination
57	06/24/2003	2:45:00 PM				
			Cu Diss, ug/l	0.193	U	Field Blank Contamination
			Hg Diss, ug/l	0.000527	U	Method Blank Contamination
57	07/17/2003	2:04:00 PM				
			As Diss, ug/l	0.755	J	Below Quantitative Range
			Cd Diss, ug/l	0.0297	J	Below Quantitative Range
			Cu Diss, ug/l	0.155	J	Continuing Calibration Verific
			Ni Diss, ug/l	2.33	J	Continuing Calibration Verific
			Zn Diss, ug/l	3.51	U	Field Blank Contamination
			Se Diss, ug/l	0.753	J	Below Quantitative Range
			Hg Diss, ug/l	0.000632	U	Field Blank Contamination

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

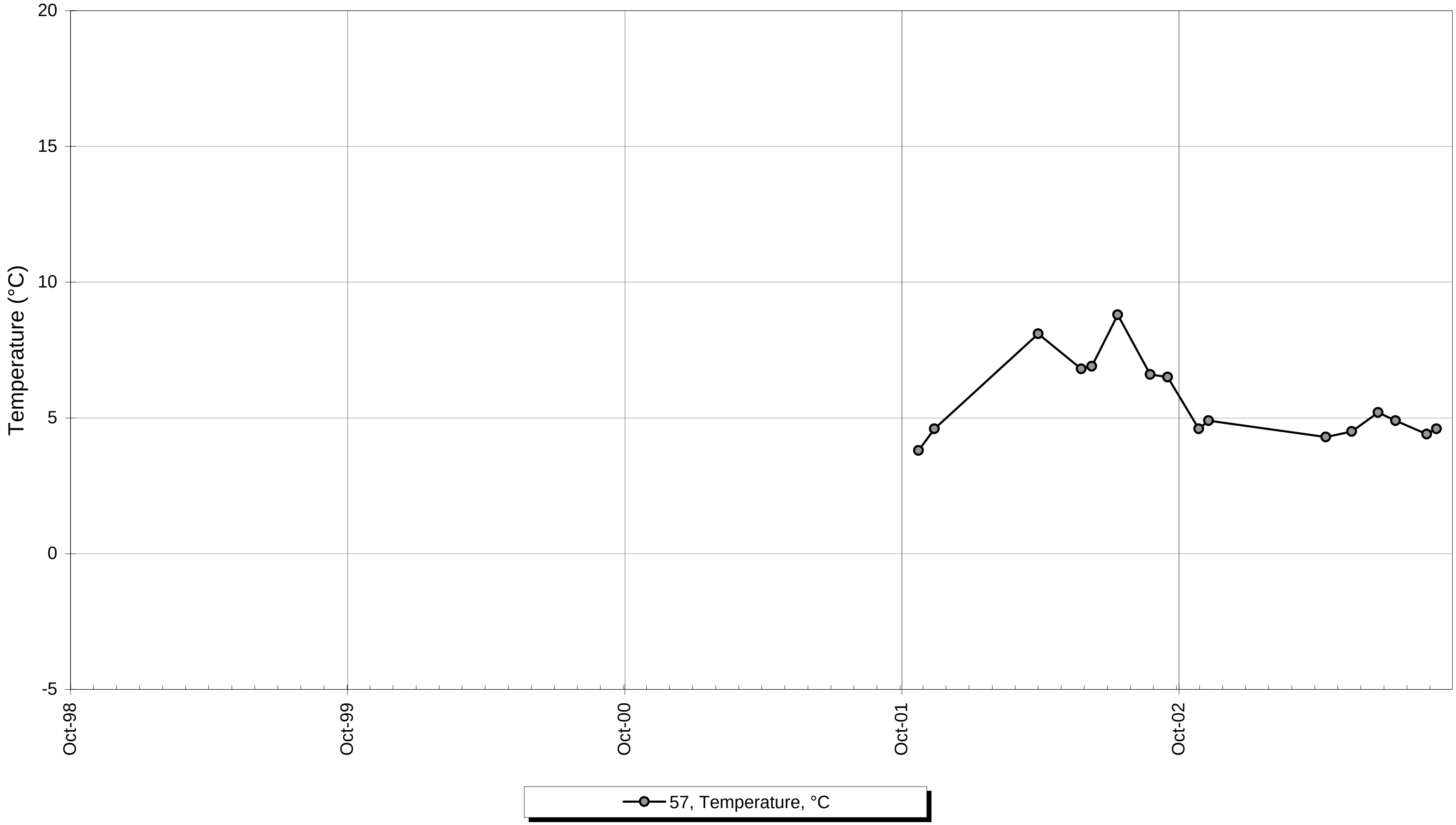
Qualified Data by QA Reviewer

Date Range: 10/01/2002 to 09/30/2003

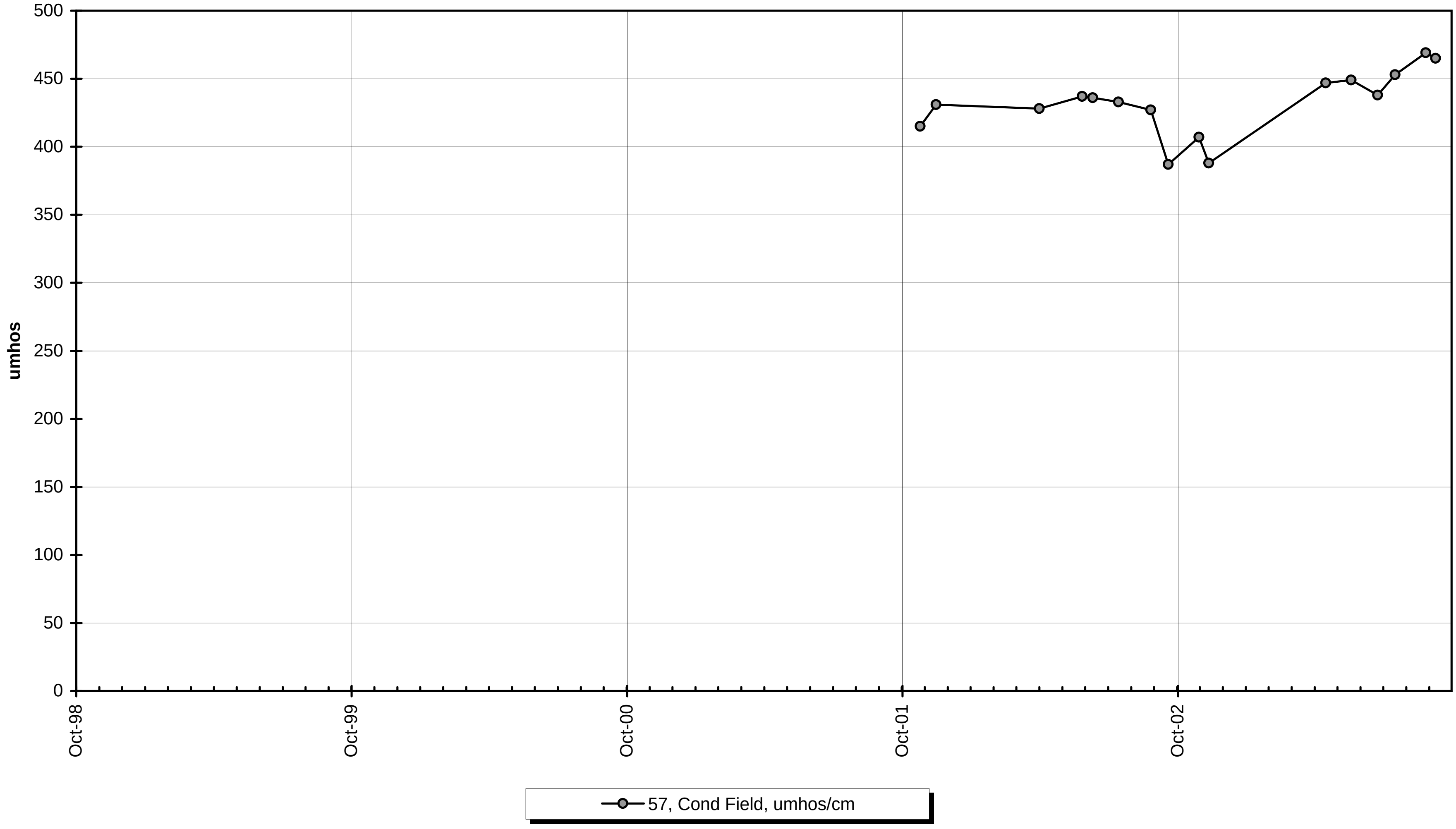
Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
57	08/27/2003	2:45:00 PM				
			pH Lab, su	7.42	J	Hold Time
			SO4 Tot, mg/l	54.4	J	Sample Temperature
			As Diss, ug/l	1.65	U	Method Blank Contamination
			Cd Diss, ug/l	0.0229	J	Below Quantitative Range
			Hg Diss, ug/l	0.00051	U	Method Blank Contamination
57	09/09/2003	2:40:00 PM				
			SO4 Tot, mg/l	51.2	J	Sample Temperature
			Se Diss, ug/l	0.699	J	Below Quantitative Range
			Hg Diss, ug/l	0.000481	J	Method Blank Contamination

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

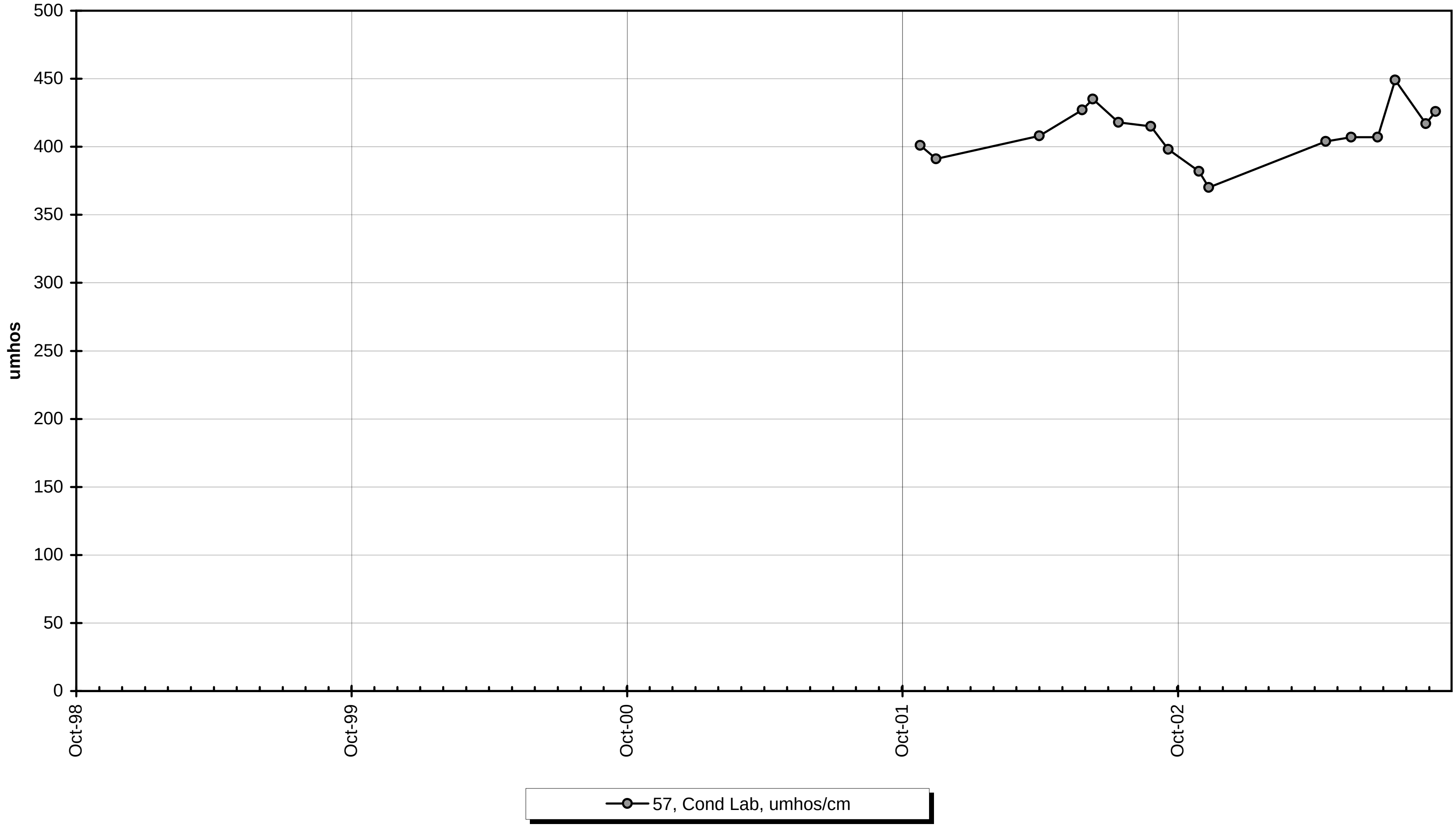
Site 57 -Water Temperature



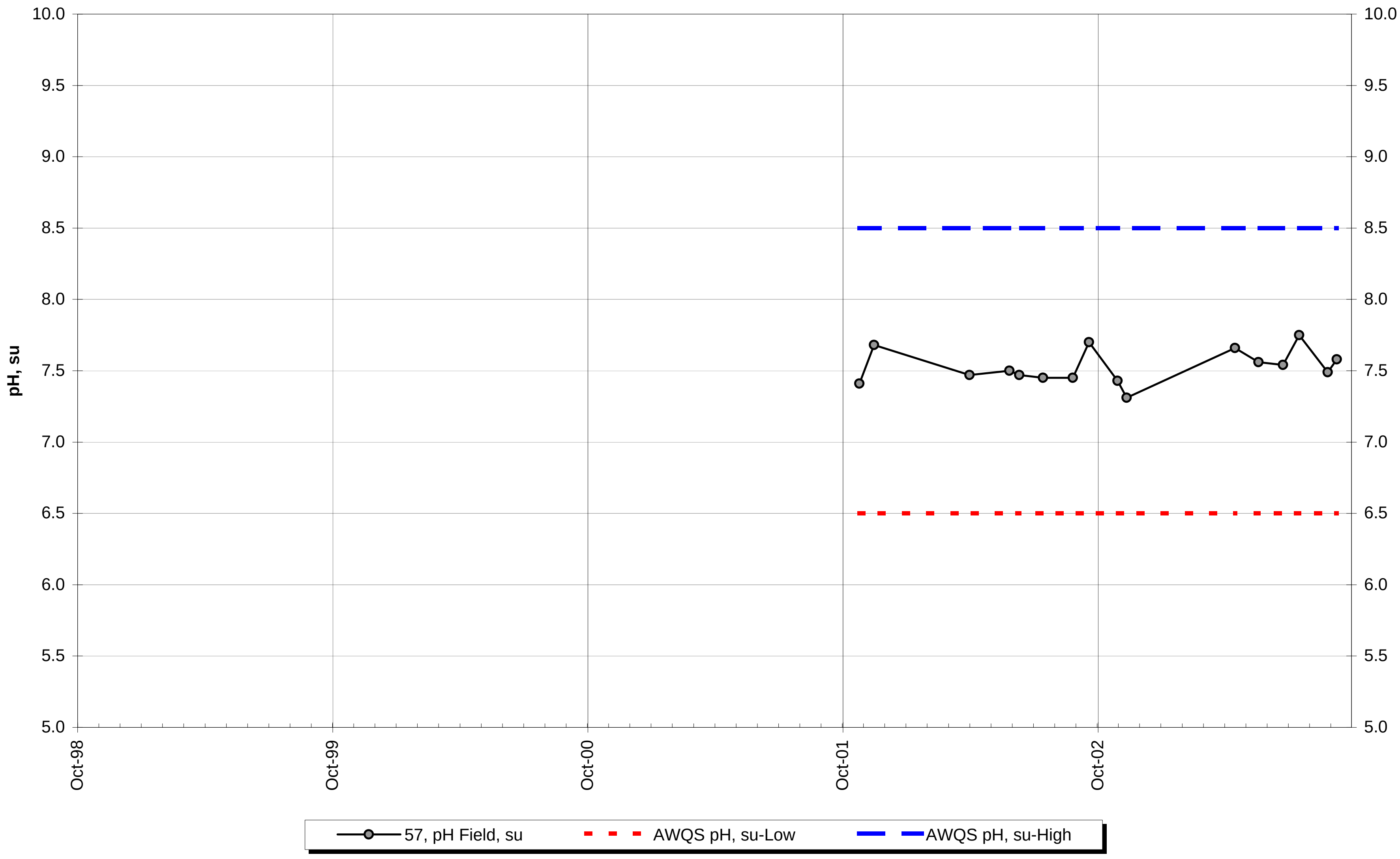
Site 57 -Conductivity-Field



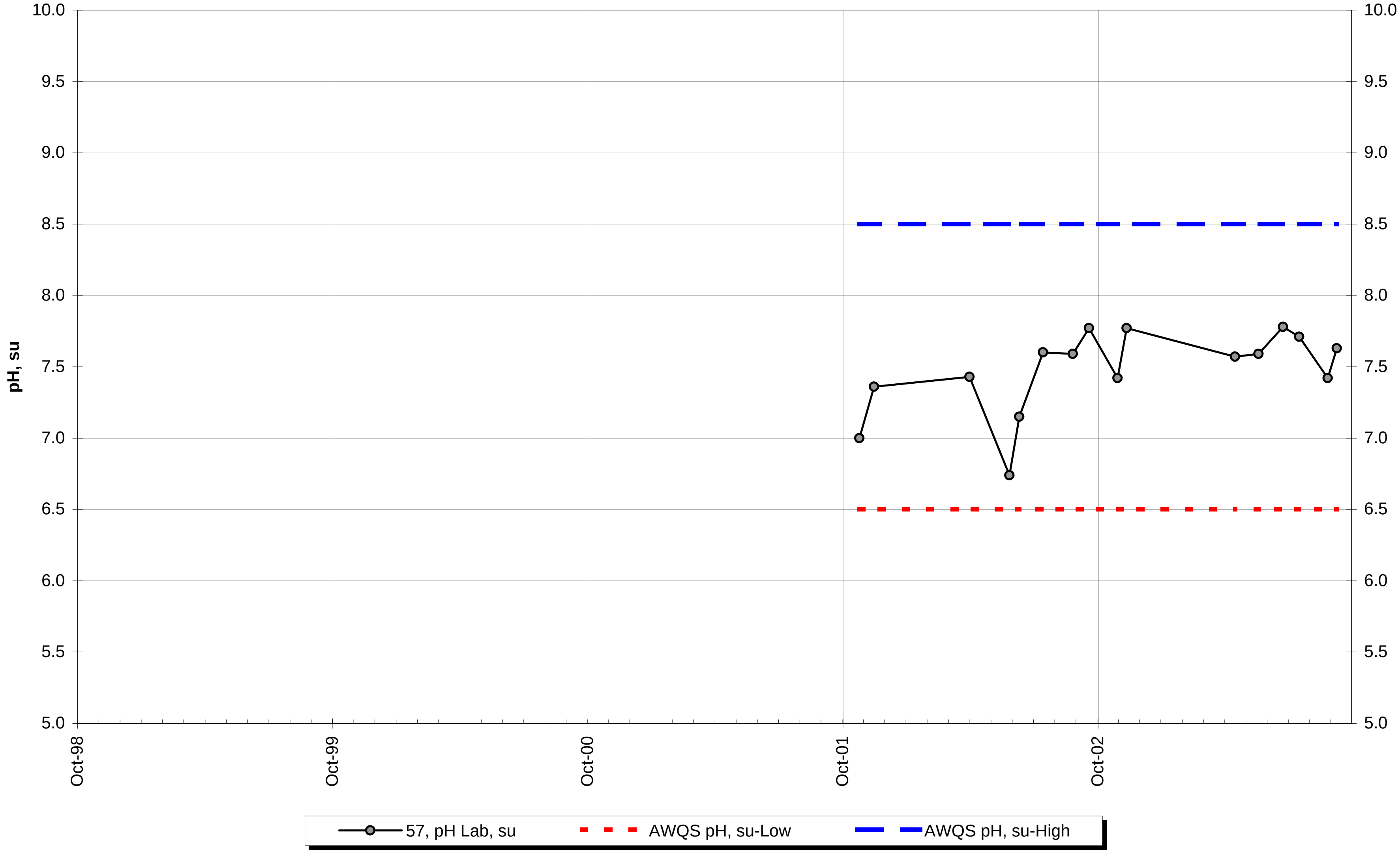
Site 57 -Conductivity-Lab



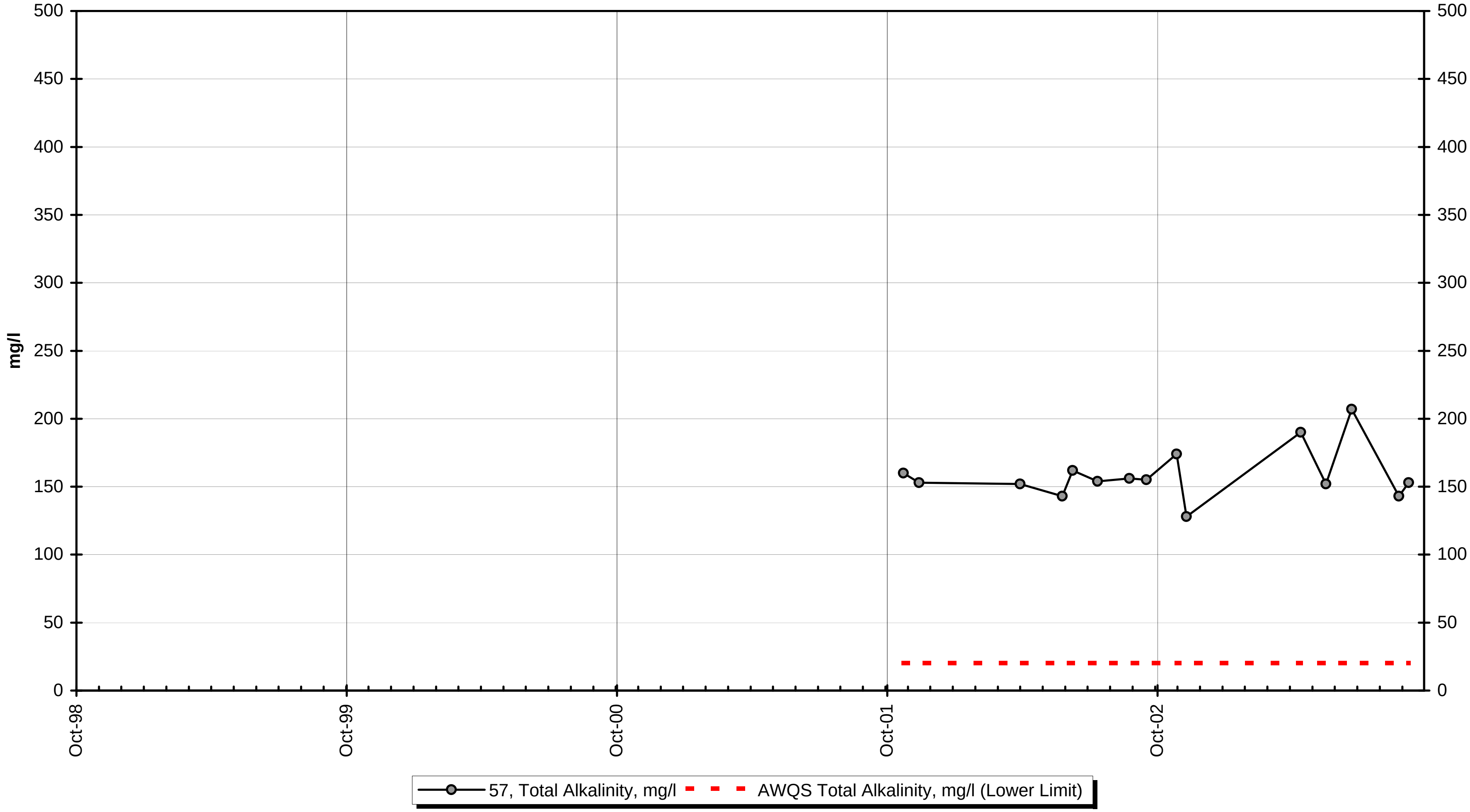
Site 57 -Field pH



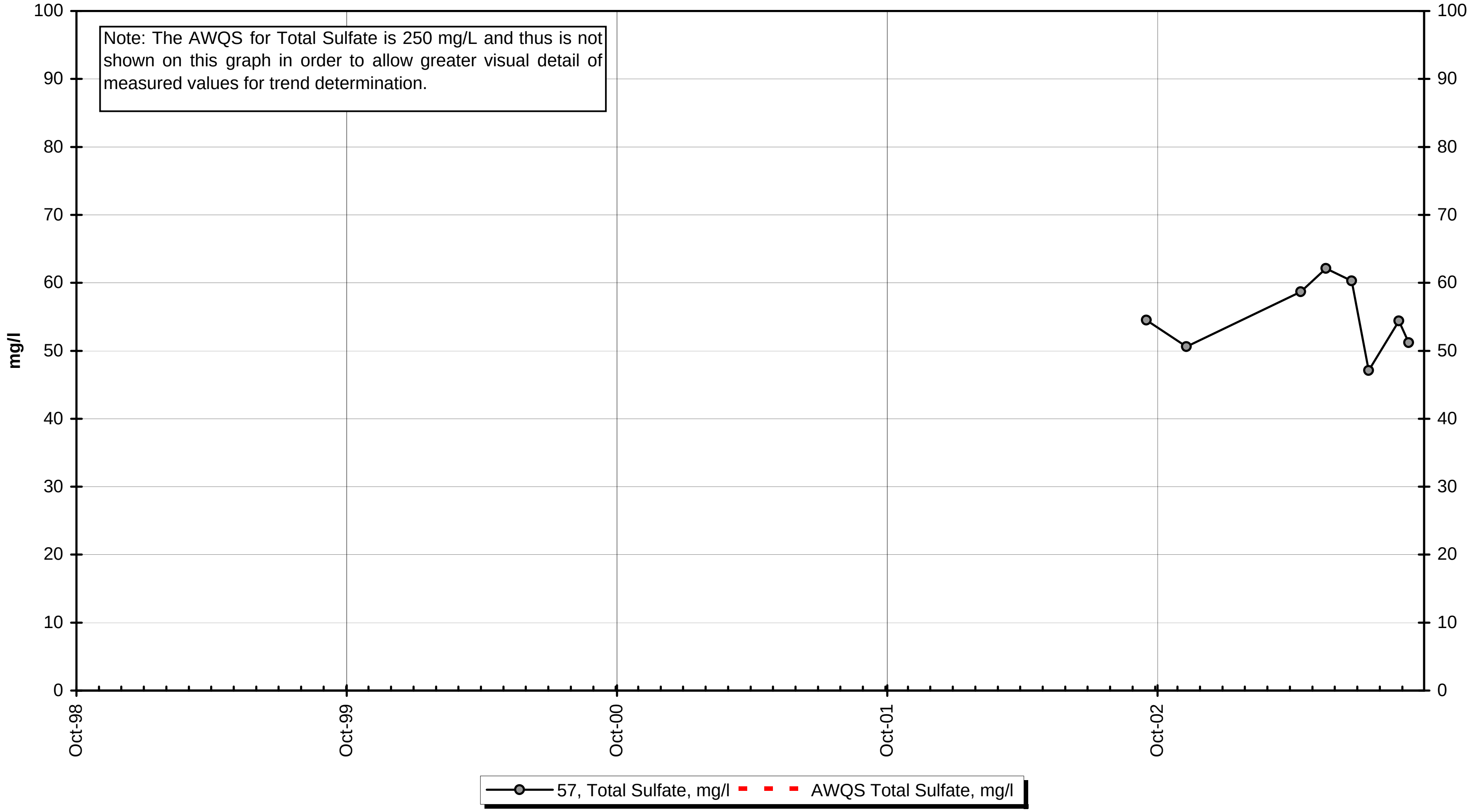
Site 57 -Lab pH



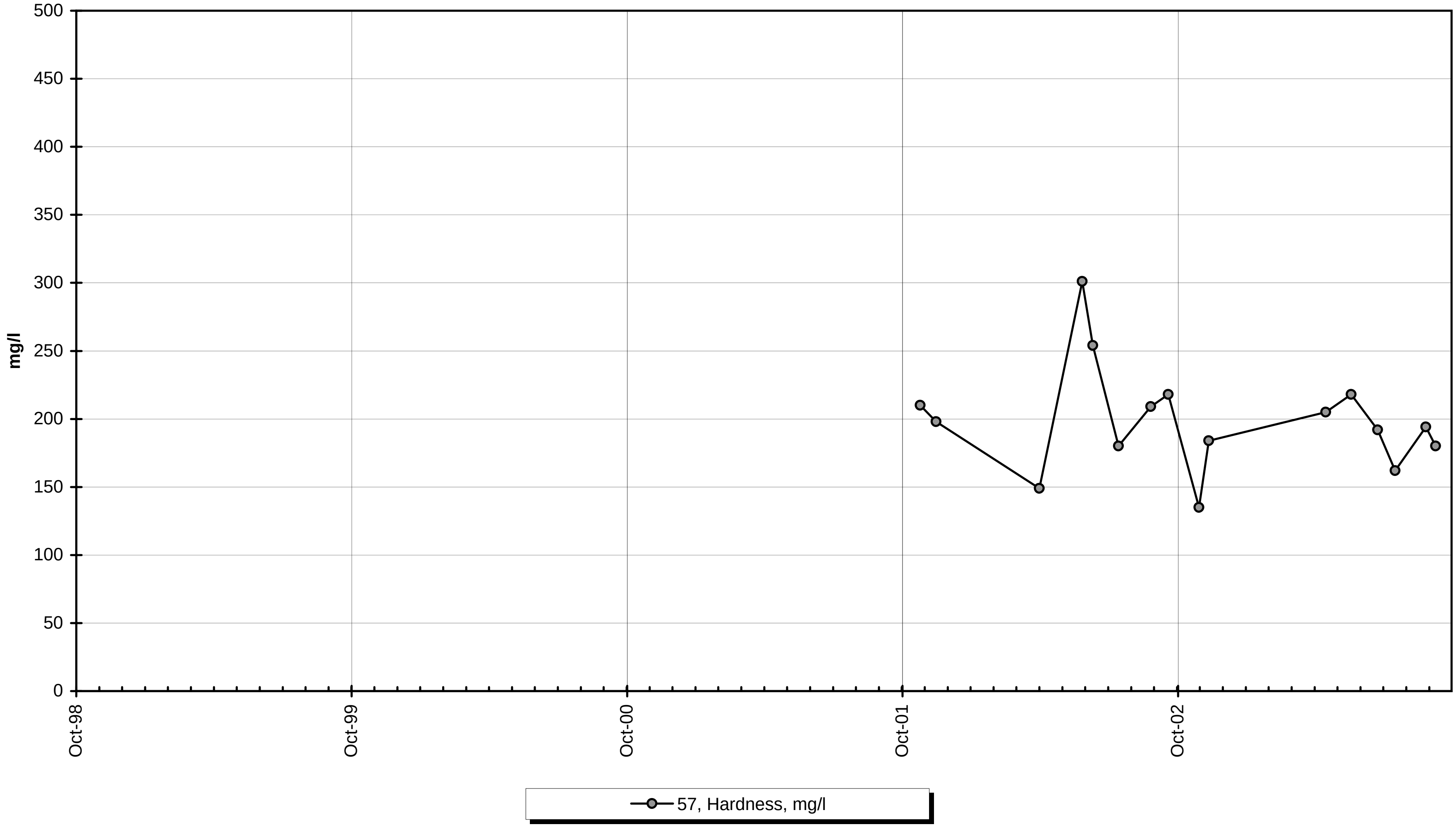
Site 57 -Total Alkalinity



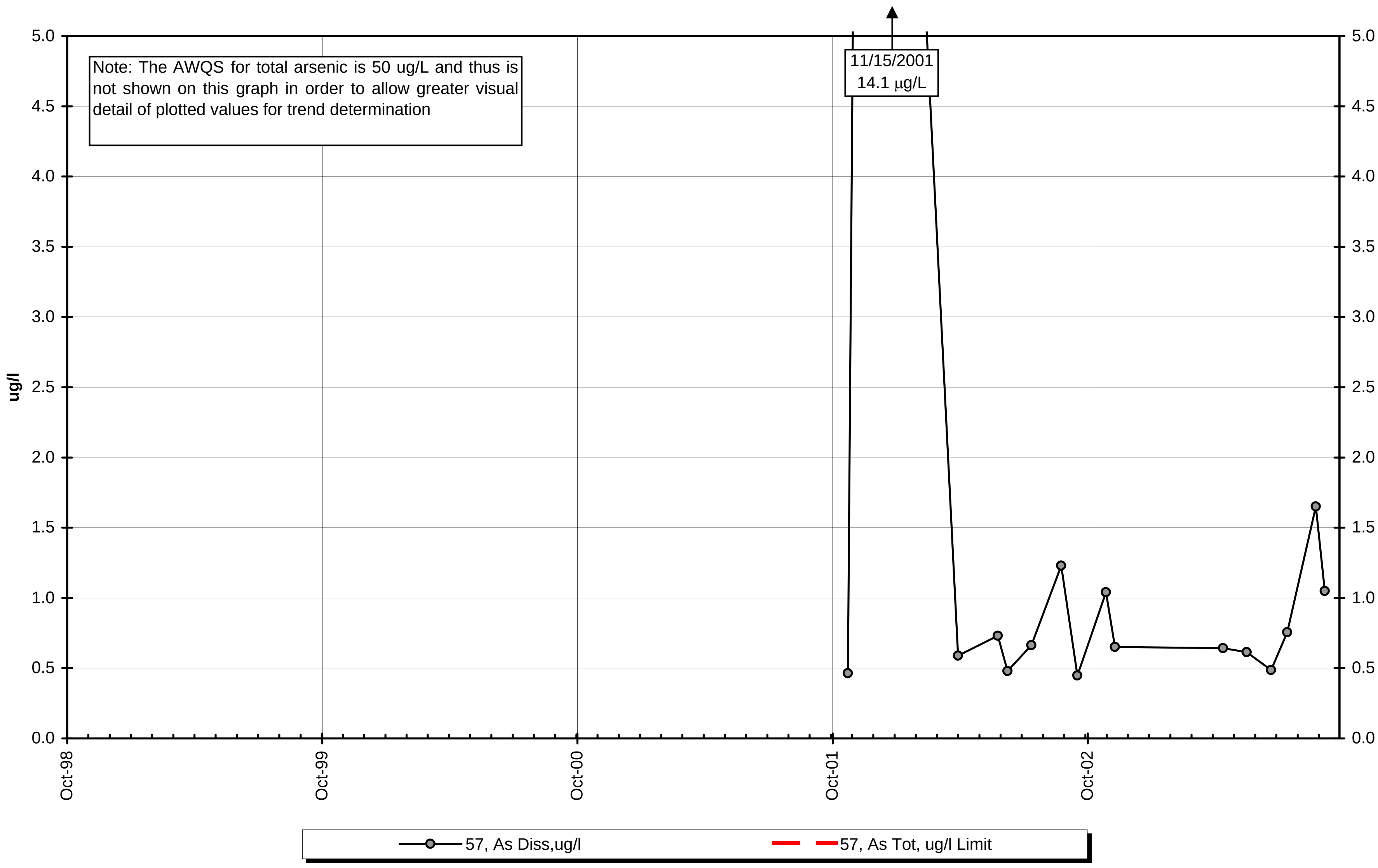
Site 57 -Total Sulfate



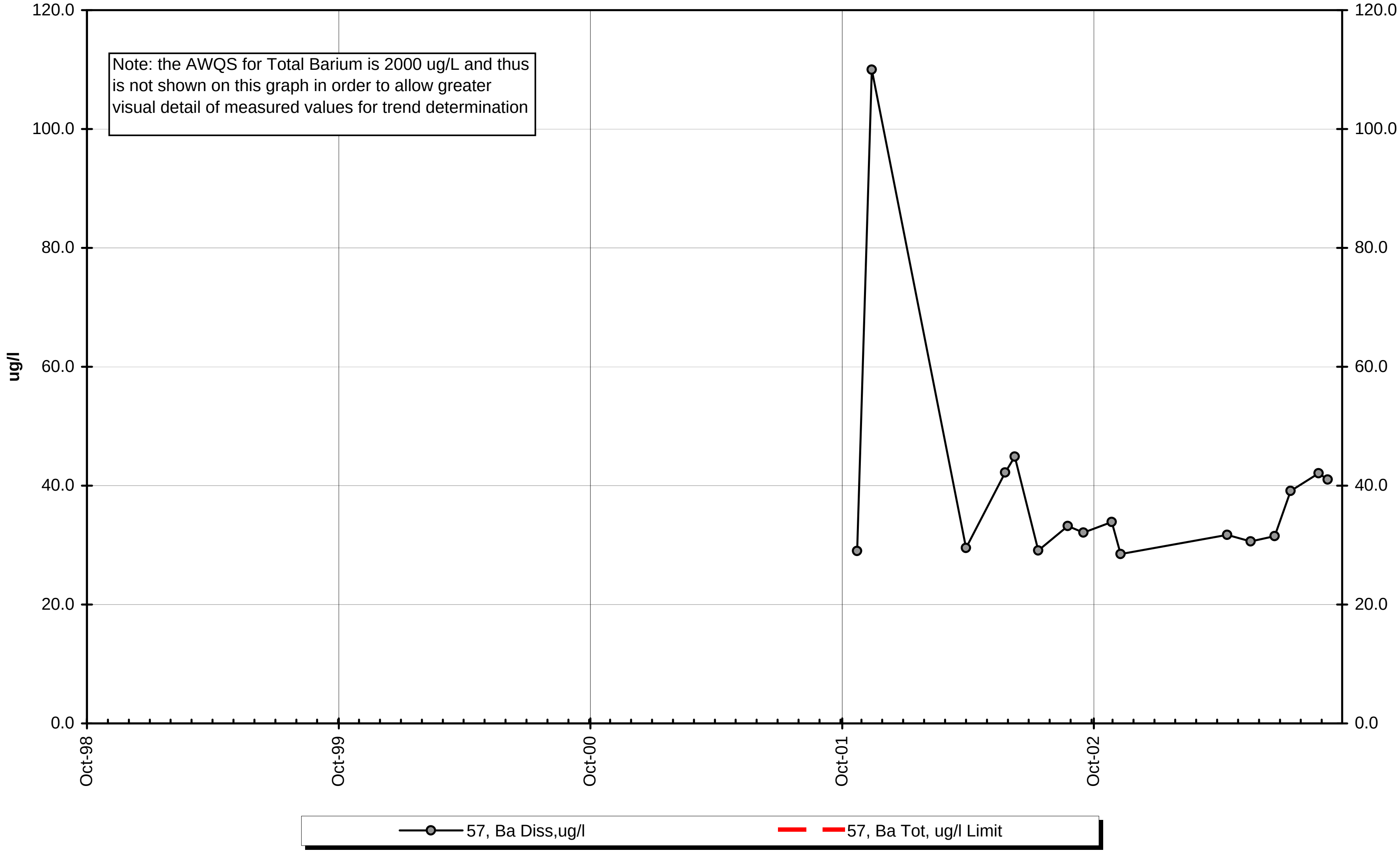
Site 57 -Hardness



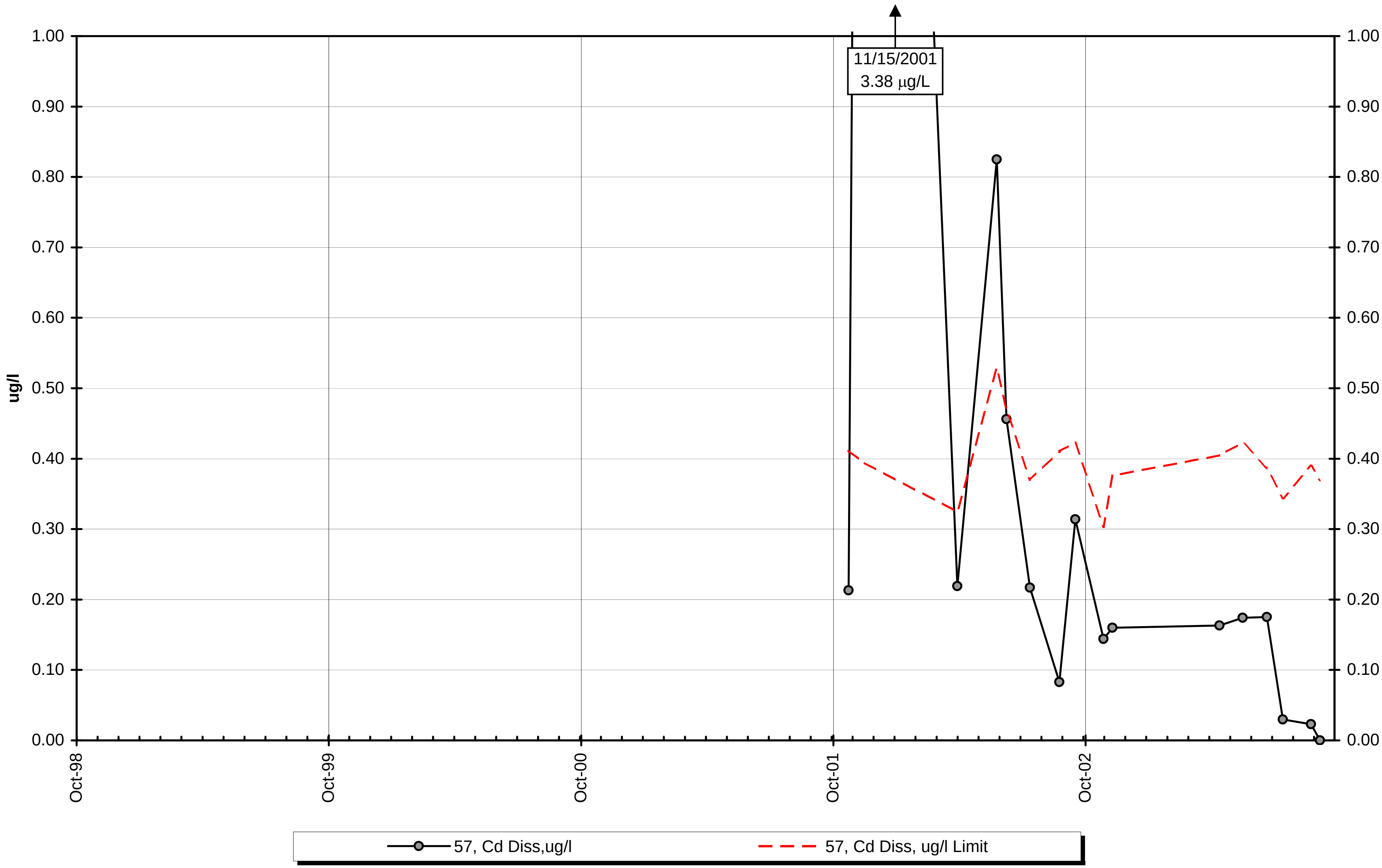
Site 57 -Dissolved Arsenic

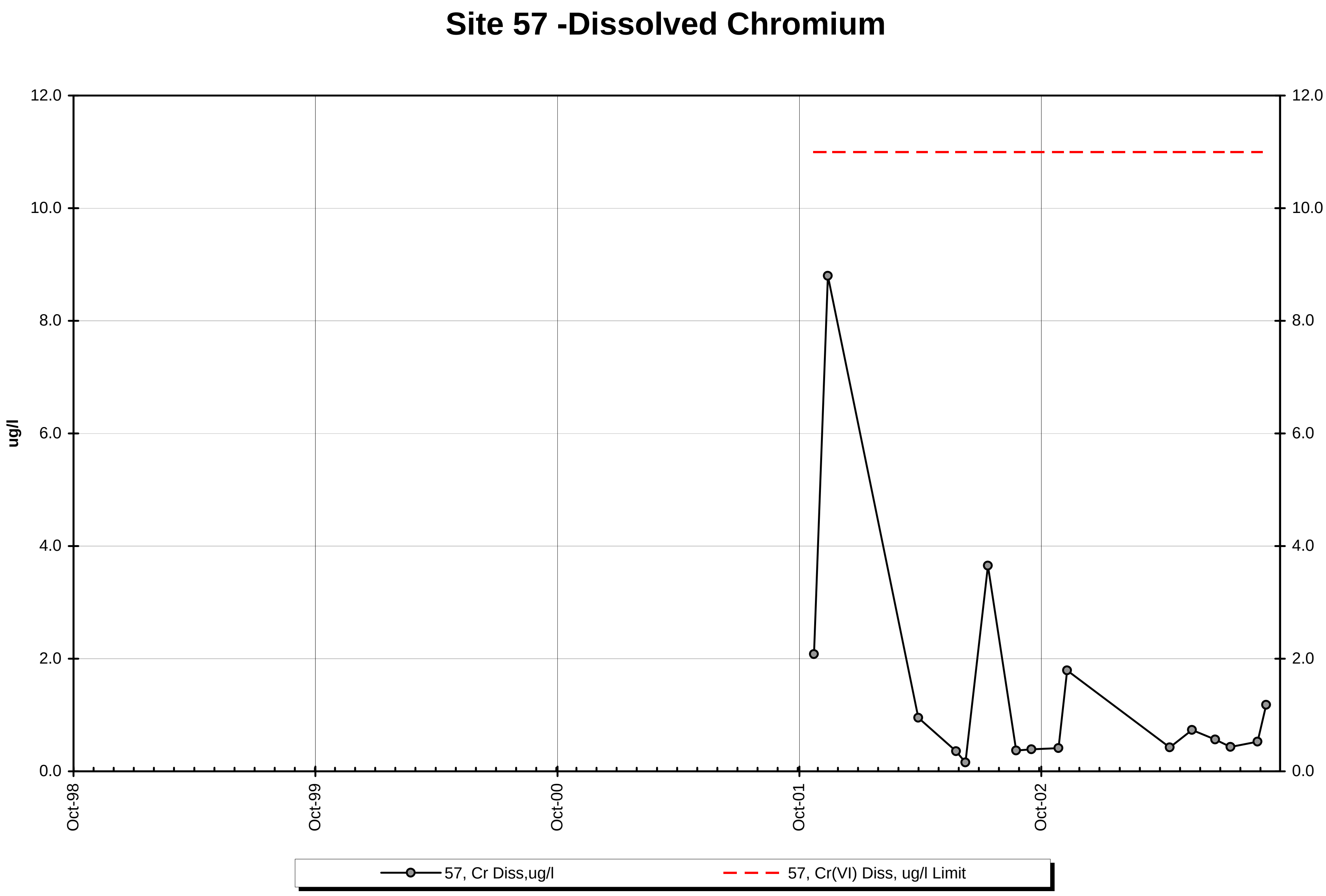


Site 57 -Dissolved Barium

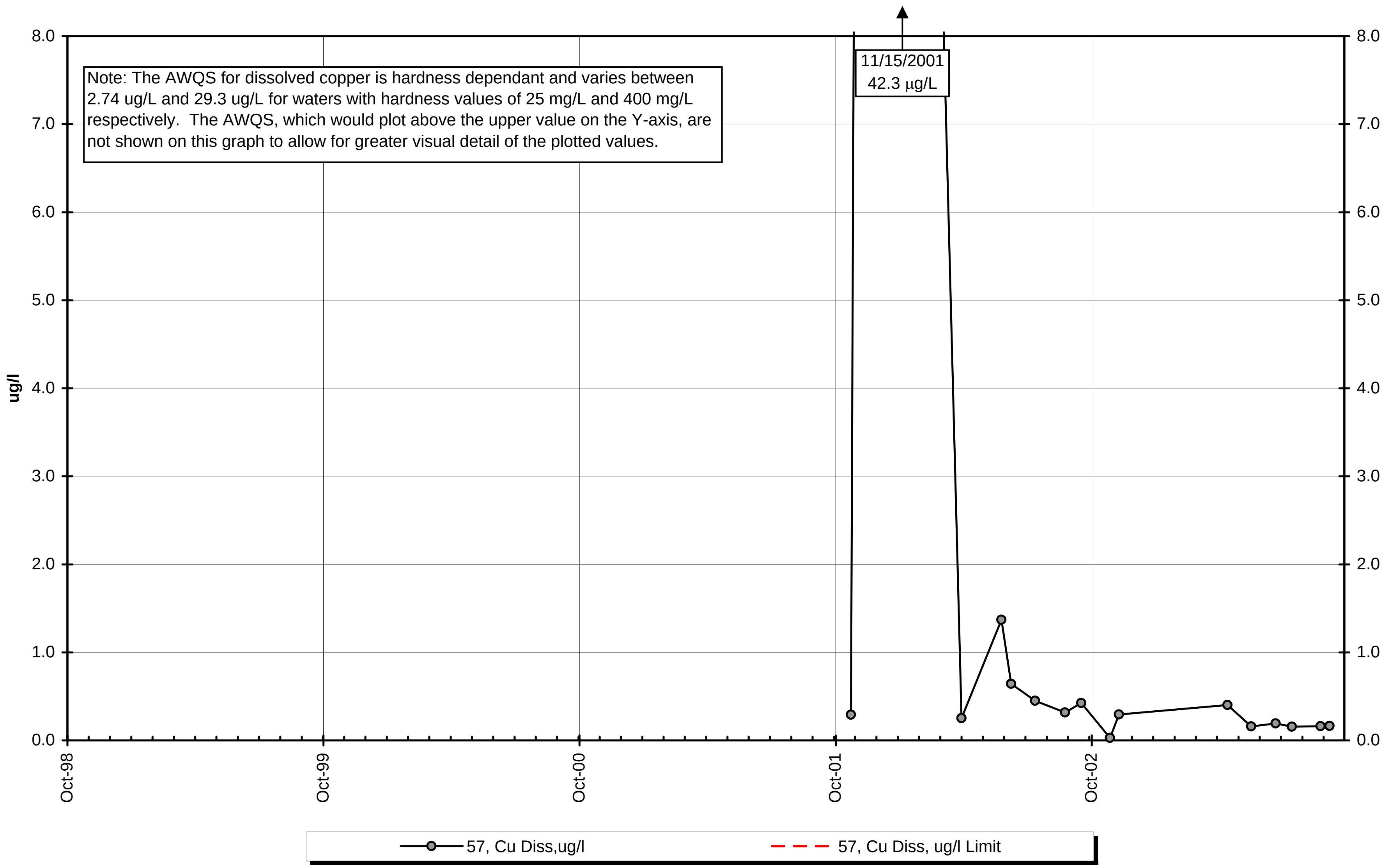


Site 57 -Dissolved Cadmium

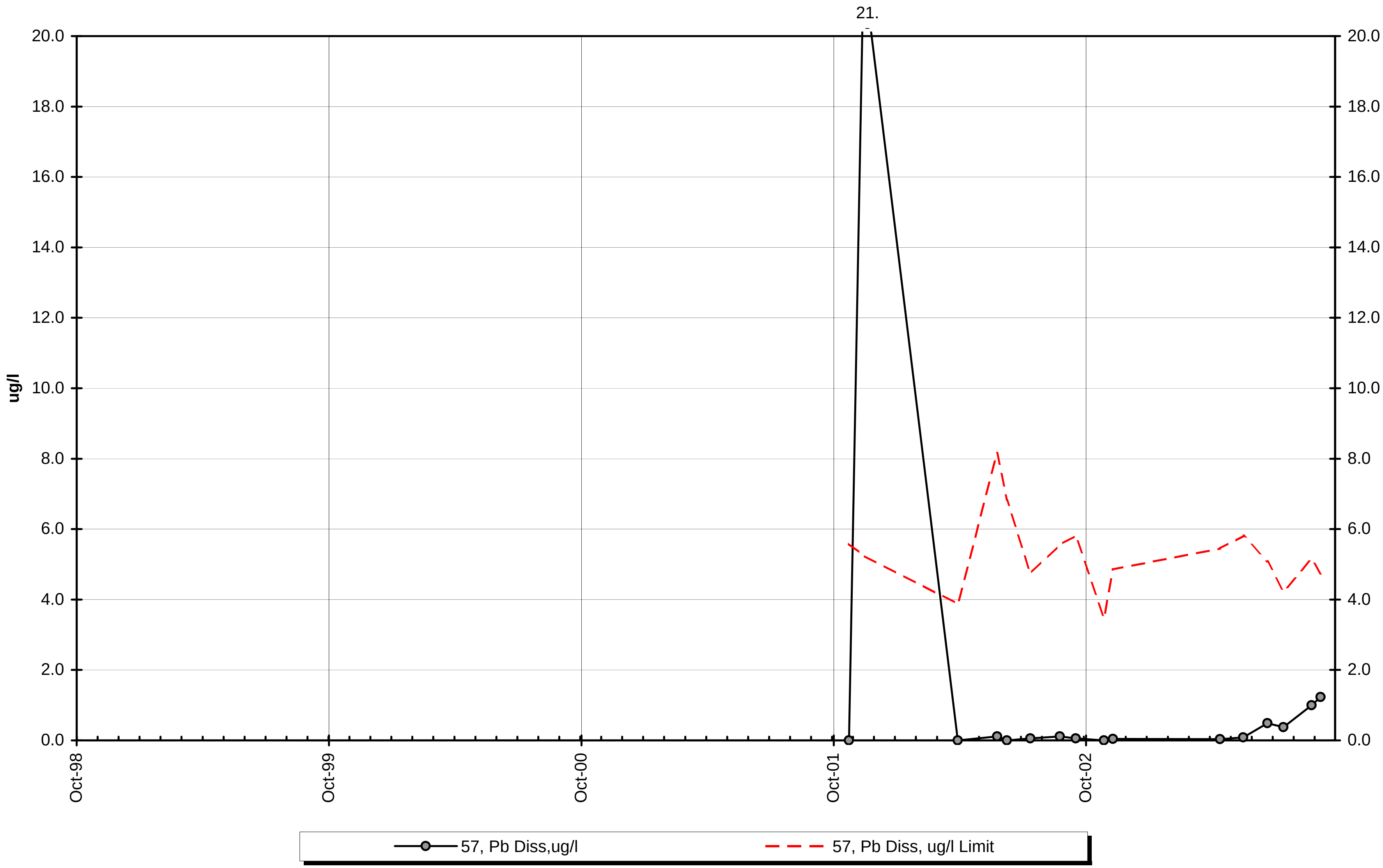



Site 57 -Dissolved Chromium
ug/l
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
57, Cr Diss,ug/l
57, Cr(VI) Diss, ug/l Limit

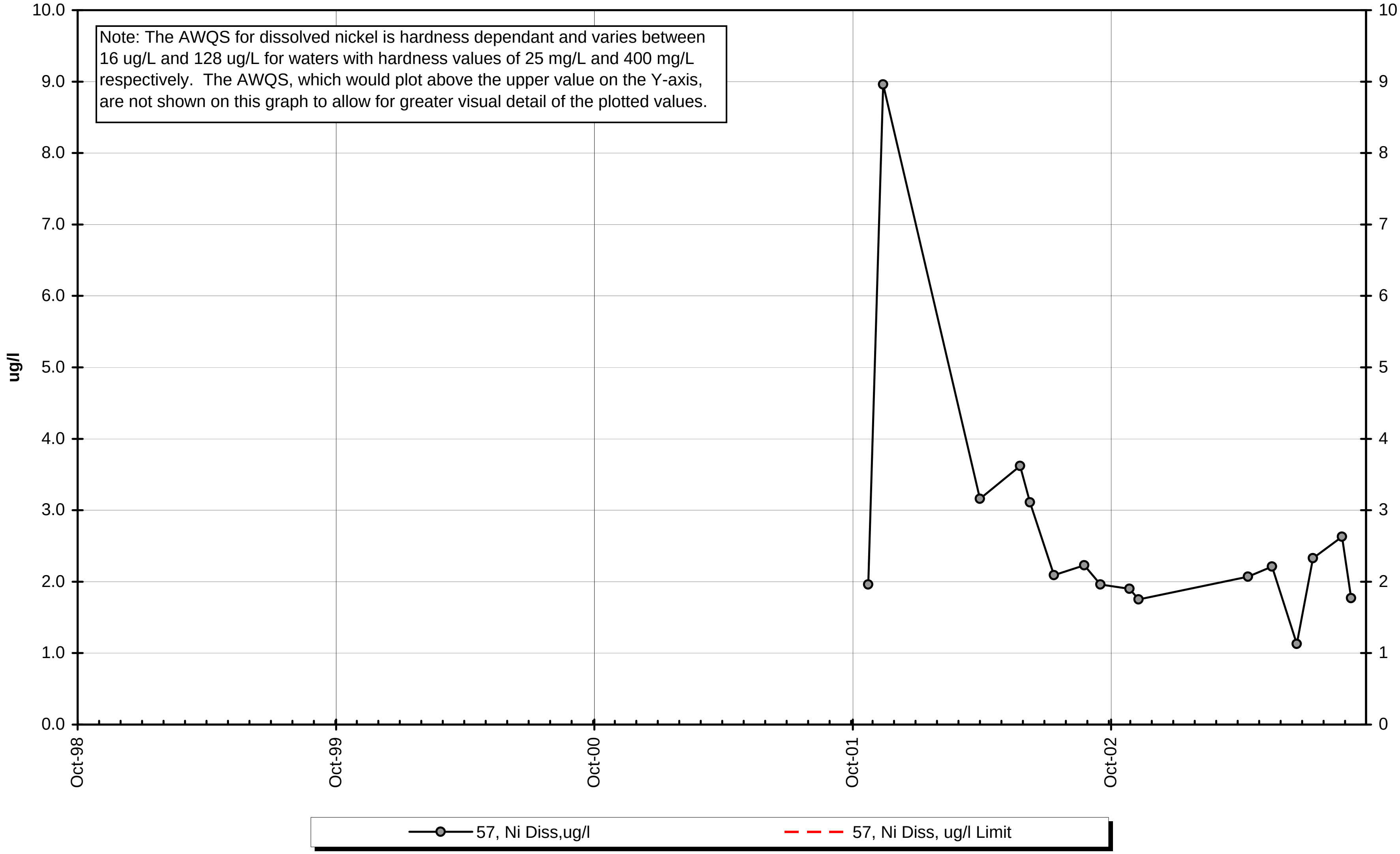
Site 57 -Dissolved Copper



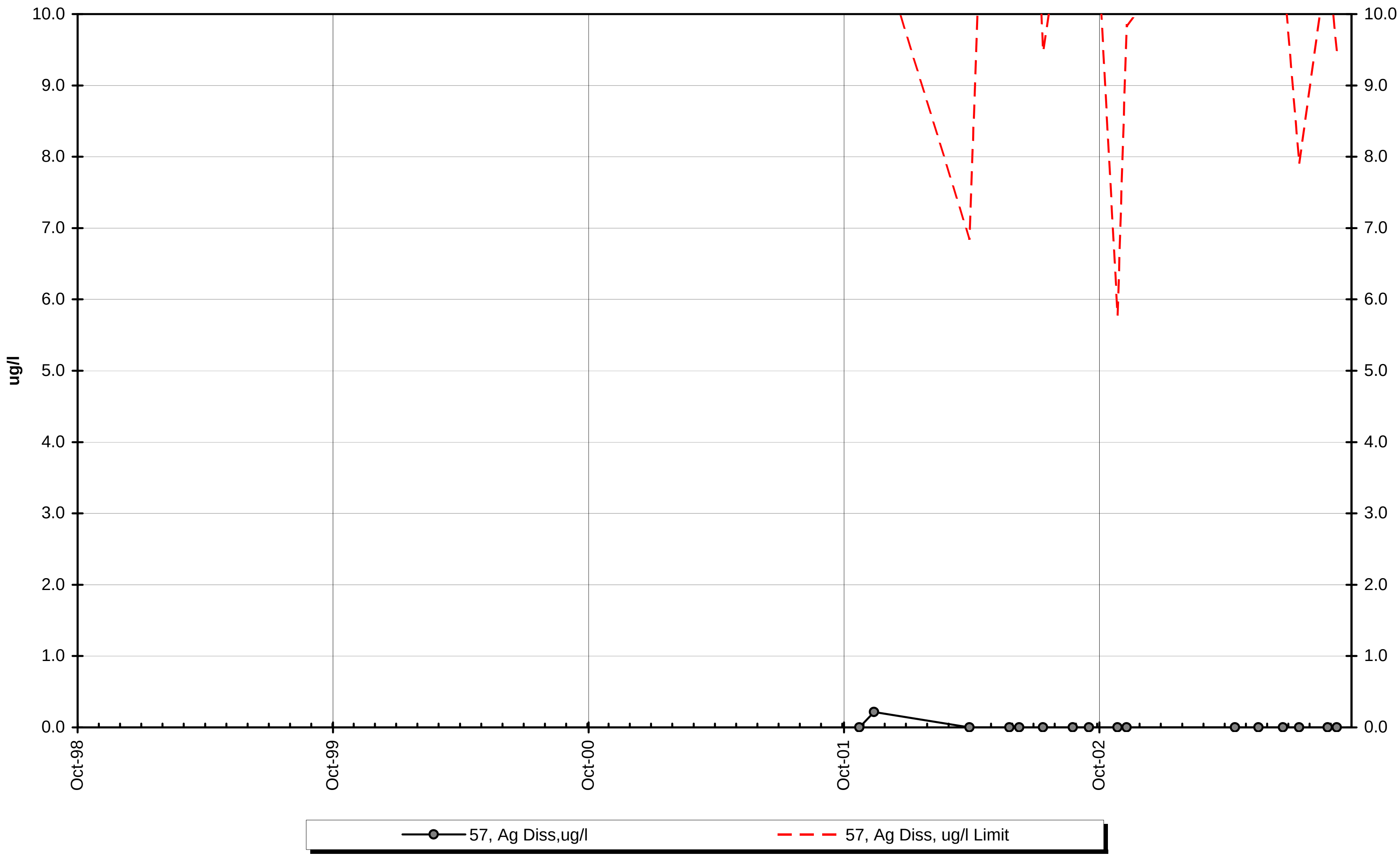
Site 57 -Dissolved Lead



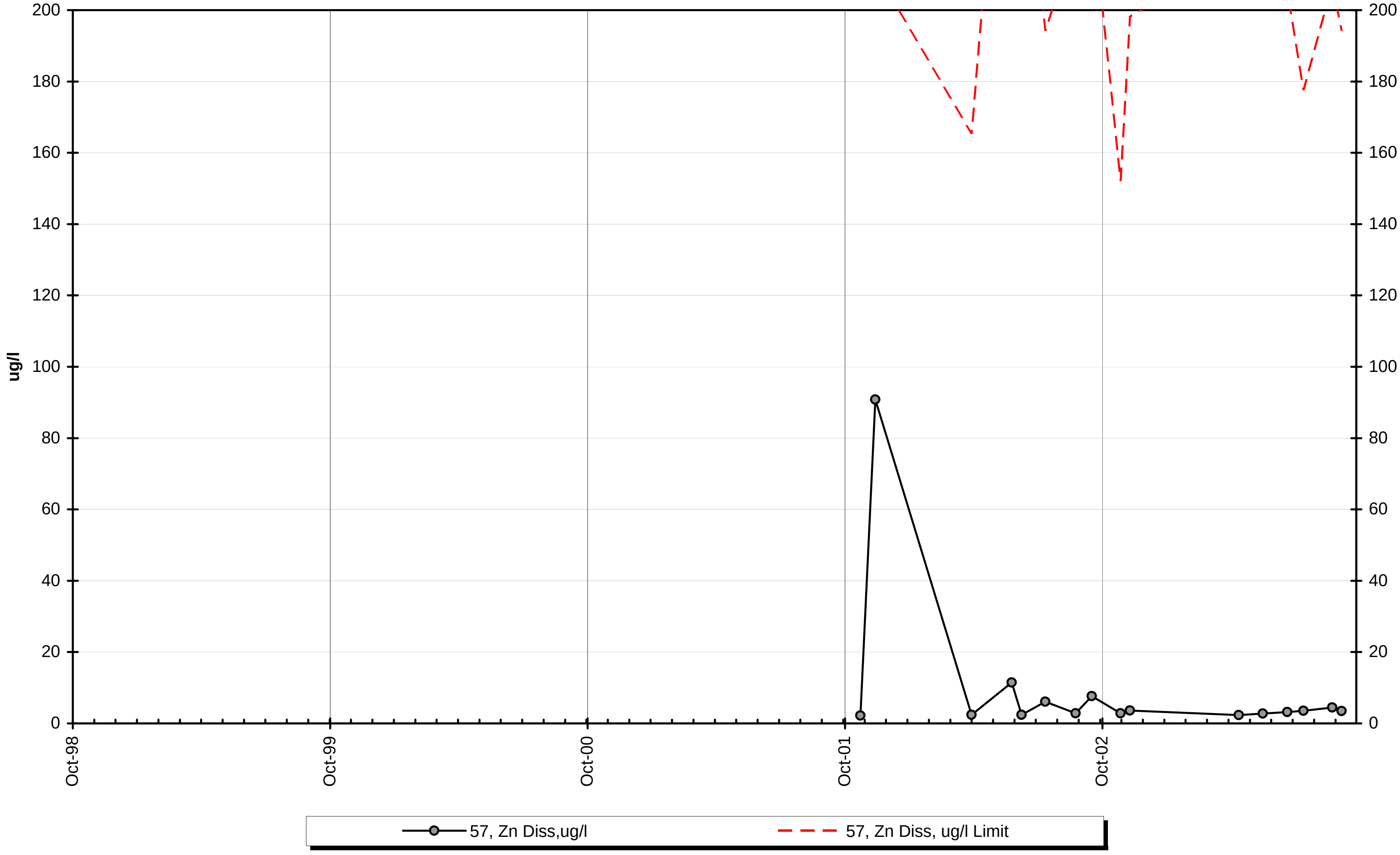
Site 57 -Dissolved Nickel



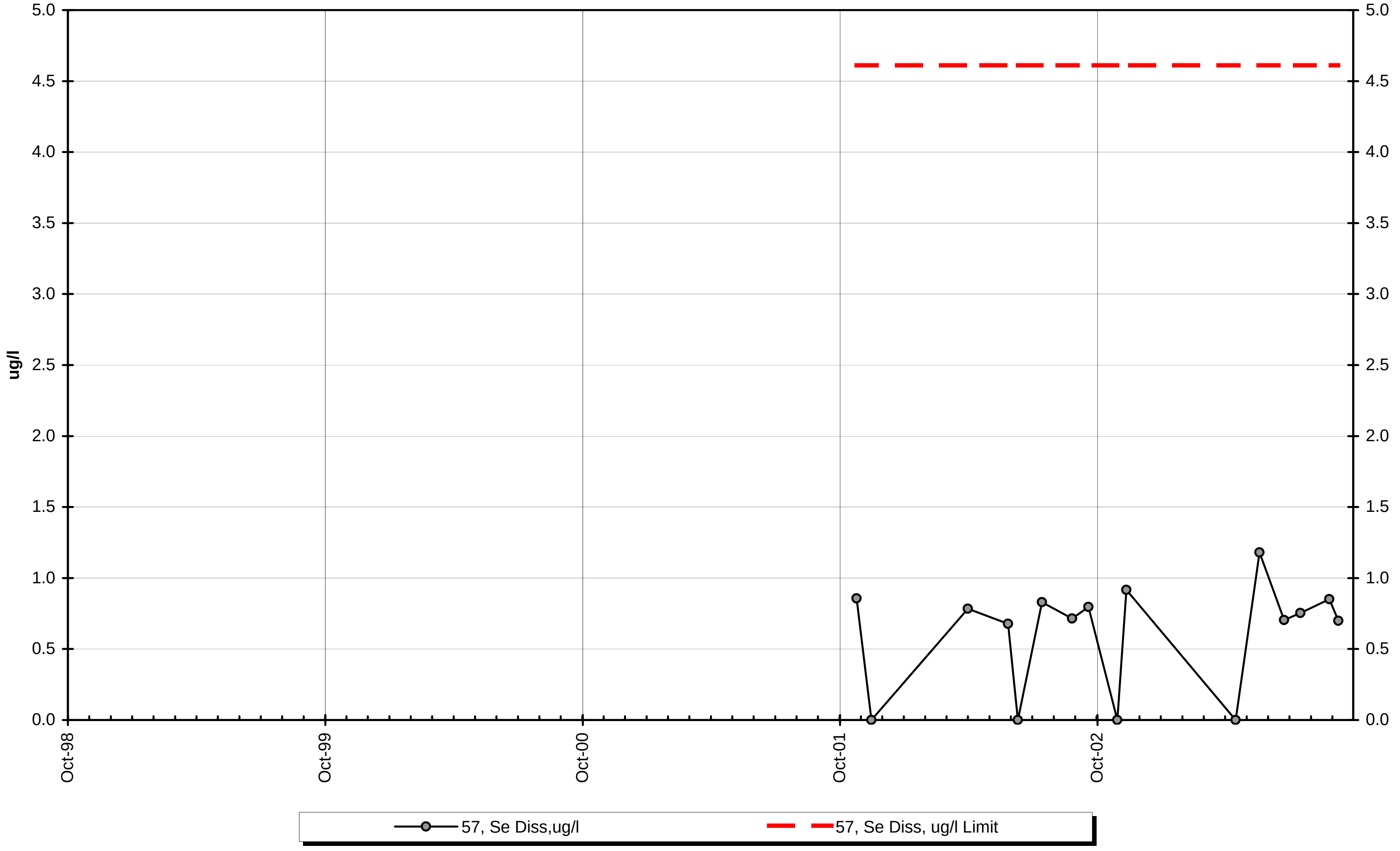
Site 57 -Dissolved Silver

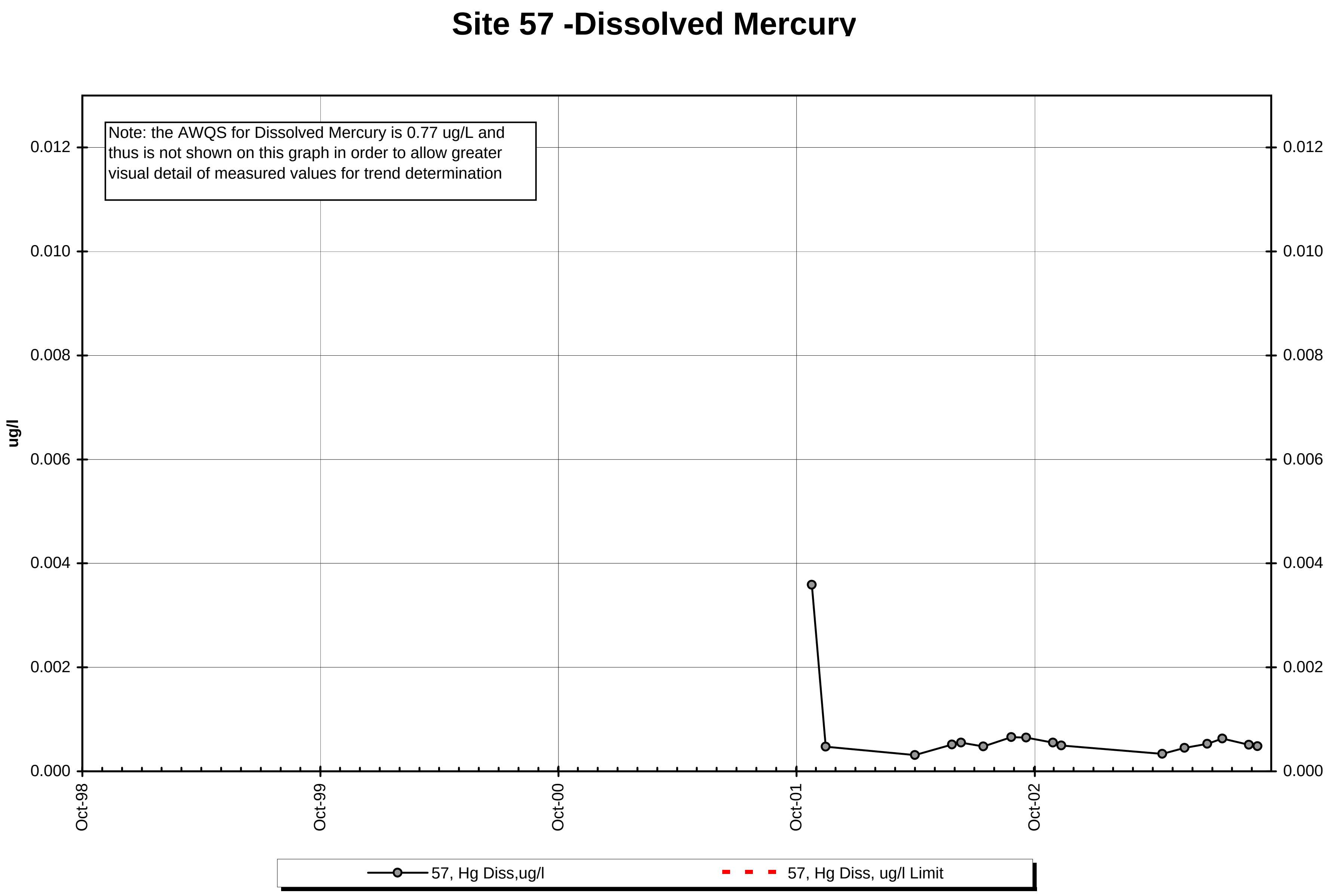


Site 57 -Dissolved Zinc



Site 57 -Dissolved Selenium




Site 57 -Dissolved Mercury
Note: the AWQS for Dissolved Mercury is 0.77 ug/L and
thus is not shown on this graph in order to allow greater
visual detail of measured values for trend determination
ug/l
0.012
0.010
0.008
0.006
0.004
0.002
0.000
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
57, Hg Diss,ug/l
57, Hg Diss, ug/l Limit

INTERPRETIVE REPORT
SITE 56 "MONITORING WELL D-00-01"

The data collected during the current water year are listed in the following "Table of Results for Water Year 2003" report. The table includes all the data, field and lab, 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 zero for the purpose of median calculation.

Sampling at this site was added to the FWMP in October-2001. All data collected at this site since it's inception into the FWMP are included in the data analyses with the exception of the (3) outliers shown on the table below. As noted in the Aug-03 data report letter from the analytical lab that performed the metals and physical parameter analysis it is suspected that the physical parameters bottle may have been inadvertently contaminated with acid. Thus the lab-pH, conductivity, and alkalinity values are not considered valid.

Sample Date	Parameter	Value	Qualifier	Notes
8/27/2003	Cond Lab, umho	6.0	RR	Statistical outlier, not collaborated by field measurements.
8/27/2003	pH Lab, su	2.1	RR	Suspected sample contamination
8/27/2003	Alkalinity, Total mg/L	<0.0	RR	Suspected sample contamination

The data for water year 2003 have been compared to the strictest fresh water quality criterion for each applicable analyte. One result exceeding these criteria has been identified as listed in the table below. The result is for laboratory pH for which the corresponding field pH was 7.57 which is within AWQS.

Sample Date	Parameter	Value	Standard	Standard Type
08/27/03	pH Lab, su	8.78	6.5 - 8.5	Aquatic Life

X-Y plots have been generated to graphically present the data for each of the analytes requested in the Statistical Information Goals for this site. These plots have been visually analyzed for the appearance of any trend in concentration. No obvious trends were apparent. While not forming a trend, there was a distinctive spike in dissolved mercury , 0.0096 ug/L, in the Aug-03 sample. This appears to have been a unique event since values have return to normal levels in subsequent months sampling. Additional X-Y plots have been generated for alkalinity, pH, conductance, sulfate, and dissolved zinc that plot Site 56 and Site 57, the up-gradient control site, to aid in the comparison between those two sites.

Median values for alkalinity, pH, specific conductance, sulfate, and dissolved zinc from Site 56 have been compared to those of Site 57. The comparisons were done utilizing a

	N		Median Values		□ Ranks		Exact Test Bounds		$H_0:u_{57}=u_{56}$
Parameter	#57	#56	#57	#56	#57	#56	Lower	Upper	
Conductivity, Lab	8	7	407	130	92	28	38.7	73.3	**REJECT**
pH, Lab	8	7	7.61	7.52	79	41	38.7	73.3	ACCEPT
Alkalinity, Total	7	7	57.9	97.0	77	28	36.8	68.3	**REJECT**
Sulfate, Total	7	7	54.4	10.9	77	28	36.8	68.3	**REJECT**
Zinc, Dissolved	8	8	3.34	0.43	100	36	49.0	87.0	**REJECT**

two-tailed, exact Wilcoxon-Mann-Whitney rank sum test with a significance level of $\alpha/2=0.025$. Rank-sum test calculation details can be found in subsequent pages of this section and a summary of the test results is shown in the table below. For all analytes except pH there were statistically significant differences between the medians at the $\alpha/2=0.025$ significance level. The statistically significant difference of most of the constituents analyzed in these two wells is likely the result of several inherent differences between the two sites.

The two major differences between the sites are the unit of completion and the hydrological setting. The up-gradient control site, Site 57, is in an area away from the influence of any major surface flow. The screened interval is in the colluvial unit that underlies most of Site-23 production rock area and samples 63 to 68 feet below the surface. The aquifer sampled by the screened interval may be one of multiple perched aquifers located below Site 23 as noted in the "Site 23/D Hydrogeology and Geochemistry Analysis" report (EDE, 2004). The down-gradient well, Site 56, is to the southeast of the Site-23/D production rock areas and is located approximately 40 ft. west of the lower reaches of Bruin Creek. The screened interval was originally interpreted as the same colluvial unit as Site 57, but recent drilling information suggests the completion is in the alluvial sands which underlie most of Site-D. The sampled interval is at a depth of 14 to 19 feet. The difference in the unit of completion may have an effect on the resulting water quality. The colluvium is characterized as a fine to coarse sand with angular to sub-rounded, partially weathered chloritic rock with localized residual pyrite. The alluvial sand is characterized as a fine to coarse sand with subangular to rounded gravel and is composed of well-weathered clasts with a more stable mineral assemblage. Thus the colluvial material, being less deeply weathered, would typically generate a higher leachable load of dissolved salts that would be reflected in the chemistry of the associated ground water. Additionally, the proximity of Site 56 to Bruin Creek and Greens Creek and its shallow completion depth suggest there would be a much greater influence of a surface water component relative to Site 57. The water temperature data for Site 56 reflects this by showing a very strong seasonal variation that is very similar to the data collected at the nearby surface sites 46 and 6. In contrast the Site 57 water temperature data shows a much lower variation that is indicative of groundwater with a minor seasonal surface component. The surface water recharge to the local aquifer would tend to act as a diluent with respect to the more concentrated dissolved fraction of groundwater. Finally, if Site 57 does sample a localized, perched aquifer it would probably be more strongly influenced by seasonal and/or annual variations in recharge rate since the area of capture would be more limited than for Site 56. In summary, the combined effects of the difference in completion units and the different hydrological regimes likely explain the disparity in analyte concentrations found at the two sites.

Table of Results for Water Year 2003

Site 56 "MW-D-00-01"

Sample Date/Parameter	10/30/2002	11/12/2002	Dec-02	Jan-03	Feb-03	Mar-03	4/16/2003	5/20/2003	6/24/2003	7/17/2003	8/27/2003	9/9/2003	**Median**
Water Temp (°C)	5.4	5.4					1.1	3.8	7.2	10.2	8.1	8.8	6.3
Conductivity-Field(μmho)	141	201					150	116	126	166	154	132	145
Conductivity-Lab (μmho)	133	153					139	108	127	177	**6 R**	126	130
pH Lab (standard units)	7.24	7.42					7.51	7.55	7.62	7.53	**2.13 R**	7.52	7.52
pH Field (standard units)	7.12	6.98					7.91	7.10	7.44	7.51	7.40	7.62	7.42
Total Alkalinity (mg/L)	50.7	59.9					61.3	50.5	57.2	72.7	**<0.0 R**	58.5	57.9
Total Sulfate (mg/L)	**NOTE 1**	11.6 J					11.0	5.1	7.7	12.2	10.9 J	7.4 J	10.9
Hardness (mg/L)	77.1	73.7					68.8	55.2	79.9	74.4	84.7	62.1	74.1
Dissolved As (ug/L)	<0.186	0.175 J	NOT SCHEDULED FOR SAMPLING				0.234 U	0.130	0.082 J	<0.331	0.701 U	0.131 J	0.148
Dissolved Ba (ug/L)	10.4	10.8					9.3	7.4	9.7	13.4	18.9	10.0	10.2
Dissolved Cd (ug/L)	0.019 J	<0.019					0.009 J	0.013	<0.013	<0.025	0.046 J	<0.023	0.012
Dissolved Cr (ug/L)	0.327	0.835					0.194 J	0.285 J	0.463	0.163 J	0.269 J	0.895	0.306
Dissolved Cu (ug/L)	0.577 U	0.585 U					0.606	0.541	0.609	0.556 J	0.842	0.828	0.596
Dissolved Pb (ug/L)	<0.0180	<0.0290					<0.0080	<0.0050	0.0160 U	<0.0150	0.9550	<0.0650	0.0118
Dissolved Ni (ug/L)	0.554	0.634					0.697	1.140	0.222	1.180 J	1.340	0.573	0.666
Dissolved Ag (ug/L)	<0.004	<0.088					<0.018	<0.028	<0.013	<0.066	<0.079	<0.004	0.012
Dissolved Zn (ug/L)	0.41 U	1.05 UJ					0.27 U	0.23 J	0.35	0.84 U	1.46 U	0.44	0.43
Dissolved Se (ug/L)	<0.401	0.778 J					<0.496 UJ	0.566 J	0.349 J	0.553 J	0.738	<0.496	0.451
Dissolved Hg (ug/L)	0.001910	0.000911 U					0.001960	0.001690	0.002770 U	0.001380 U	0.009570	0.002340 J	0.001935

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

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

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

NOTE (1) Analysis was not performed on sample.

Qualified Data by QA Reviewer

Date Range: 10/01/2002 to 09/30/2003

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
56	10/30/2002	12:58:00 PM				
			Cd Diss, ug/l	0.0189	J	Below Quantitative Range
			Cu Diss, ug/l	0.577	U	Field Blank Contamination
			Zn Diss, ug/l	0.409	U	Field Blank Contamination
56	11/12/2002	3:35:00 PM				
			SO4 Tot, mg/l	11.6	J	Hold Time
			As Diss, ug/l	0.175	J	Below Quantitative Range, L
			Cu Diss, ug/l	0.585	U	Field Blank Contamination
			Zn Diss, ug/l	1.05	UJ	Field Blank Contamination, L
			Se Diss, ug/l	0.778	J	Below Quantitative Range
			Hg Diss, ug/l	0.000911	U	Field Blank Contamination
56	04/16/2003	12:10:00 PM				
			As Diss, ug/l	0.234	U	Field Blank Contamination
			Cd Diss, ug/l	0.00914	J	Below Quantitative Range
			Cr Diss, ug/l	0.194	J	Below Quantitative Range
			Zn Diss, ug/l	0.266	U	Field Blank Contamination
			Se Diss, ug/l	-0.496	UJ	LCS Recovery
56	05/20/2003	12:30:00 PM				
			Cr Diss, ug/l	0.285	J	Below Quantitative Range
			Zn Diss, ug/l	0.228	J	Below Quantitative Range
			Se Diss, ug/l	0.566	J	Below Quantitative Range, L
56	06/24/2003	1:05:00 PM				
			As Diss, ug/l	0.082	J	Below Quantitative Range
			Pb Diss, ug/l	0.016	U	Field Blank Contamination
			Se Diss, ug/l	0.349	J	Below Quantitative Range
			Hg Diss, ug/l	0.00277	U	Field Blank Contamination

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

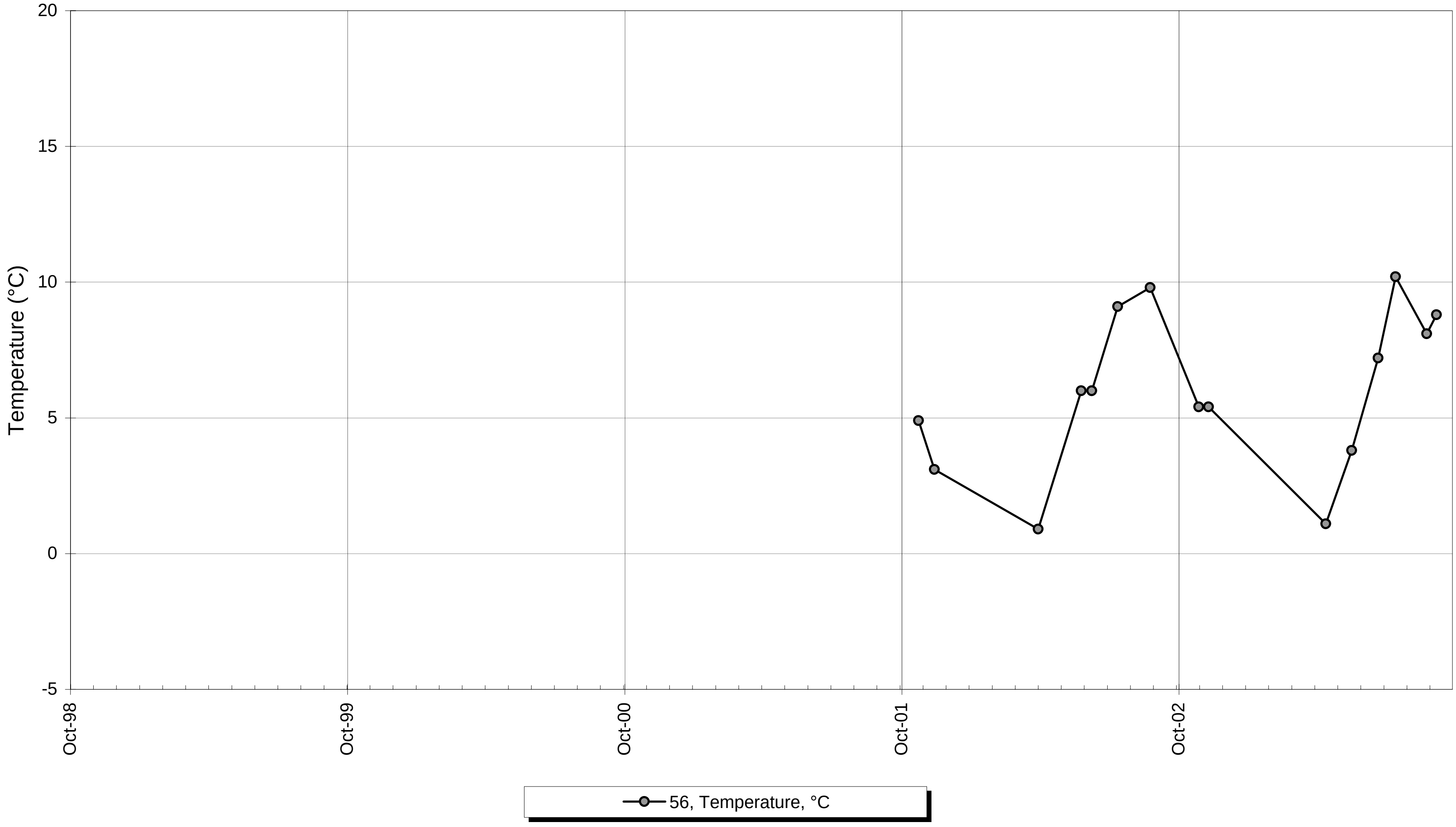
Qualified Data by QA Reviewer

Date Range: 10/01/2002 to 09/30/2003

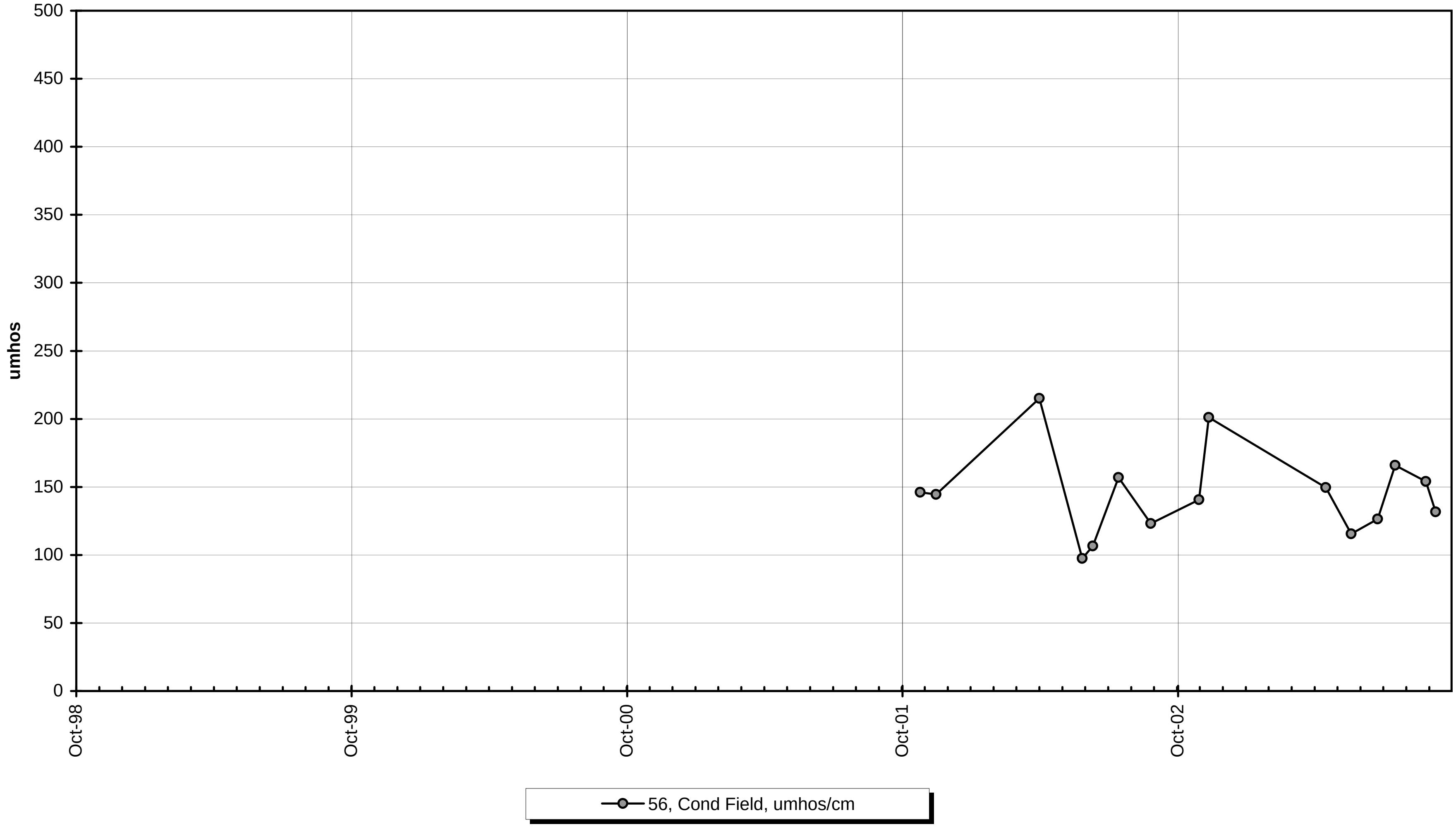
Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
56	07/17/2003	12:30:00 PM				
			Cr Diss, ug/l	0.163	J	Below Quantitative Range
			Cu Diss, ug/l	0.556	J	Continuing Calibration Verific
			Ni Diss, ug/l	1.18	J	Continuing Calibration Verific
			Zn Diss, ug/l	0.838	U	Field Blank Contamination
			Se Diss, ug/l	0.553	J	Below Quantitative Range
			Hg Diss, ug/l	0.00138	U	Field Blank Contamination
56	08/27/2003	1:45:00 PM				
			Cond Lab, umho	5.81	R	Below Quantitative Range, S
			pH Lab, su	2.13	R	Sample Preservation, Hold Ti
			Alk Tot, mg/l	0	R	Sample Preservation
			SO4 Tot, mg/l	10.9	J	Sample Temperature
			As Diss, ug/l	0.701	U	Below Quantitative Range, M
			Cd Diss, ug/l	0.0456	J	Below Quantitative Range
			Cr Diss, ug/l	0.269	J	Below Quantitative Range
			Zn Diss, ug/l	1.46	U	Field Blank Contamination
56	09/09/2003	12:45:00 PM				
			SO4 Tot, mg/l	7.35	J	Sample Temperature
			As Diss, ug/l	0.131	J	Below Quantitative Range
			Hg Diss, ug/l	0.00234	J	Duplicate RPD

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

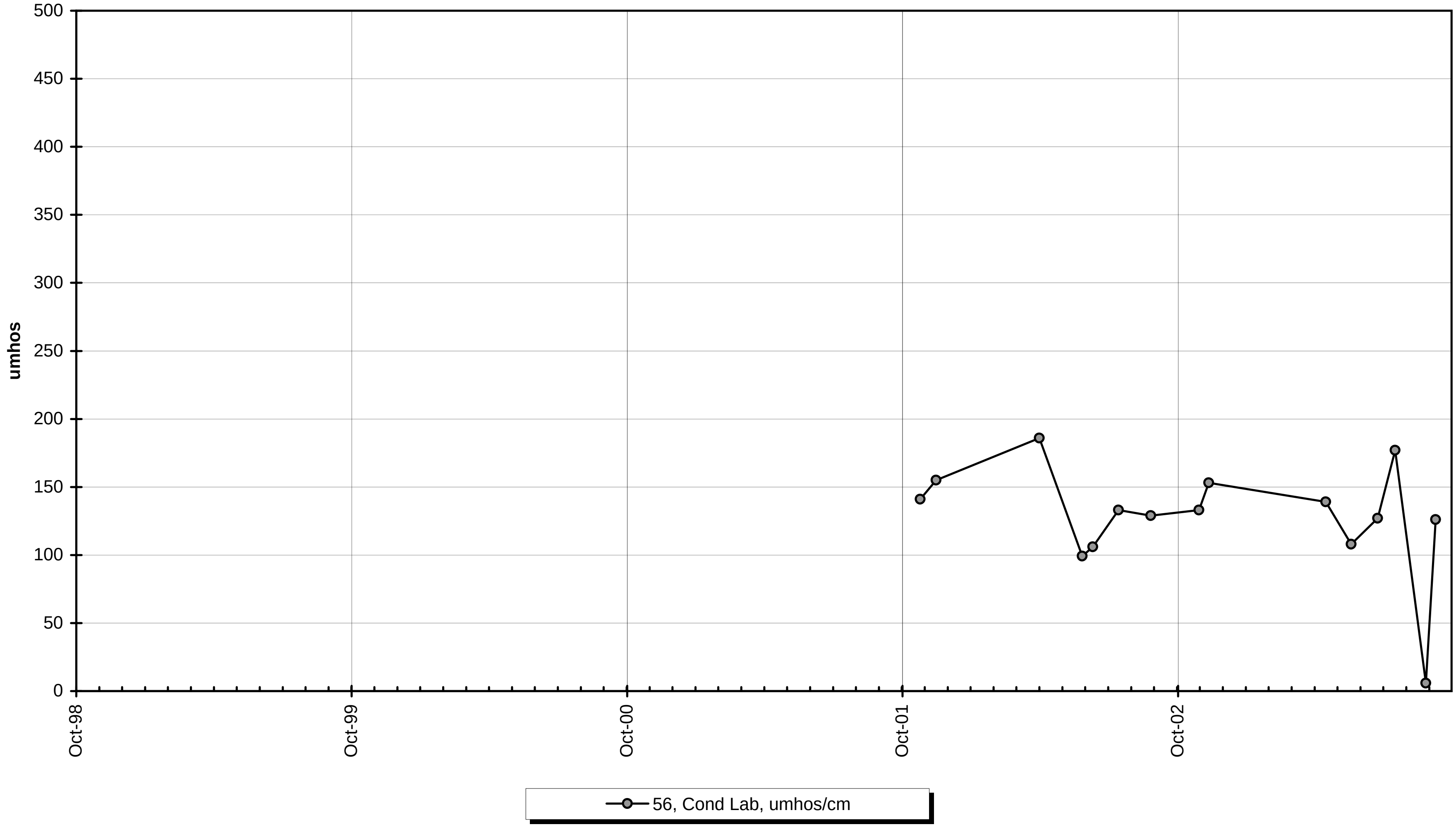
Site 56 -Water Temperature

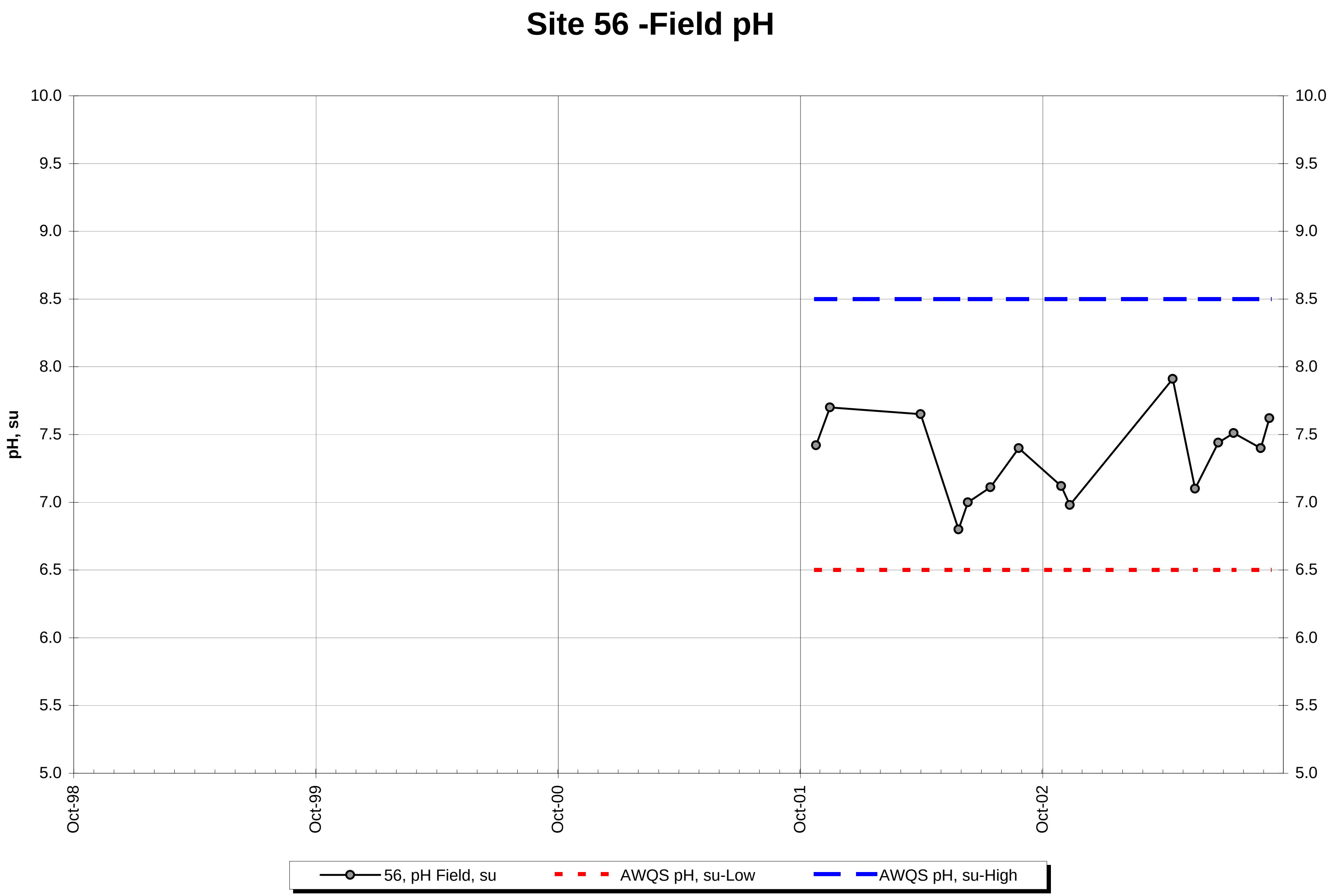


Site 56 -Conductivity-Field



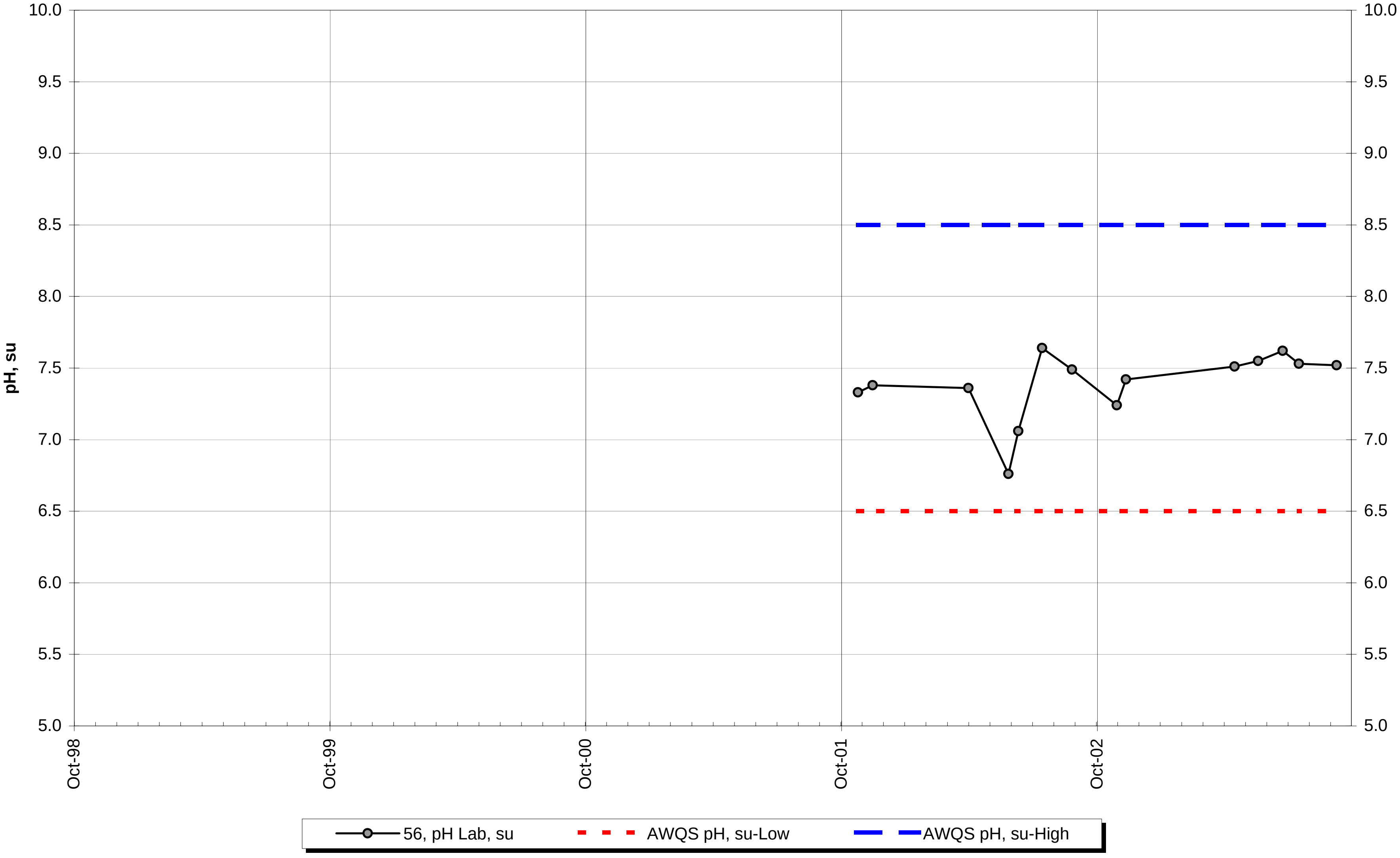
Site 56 -Conductivity-Lab



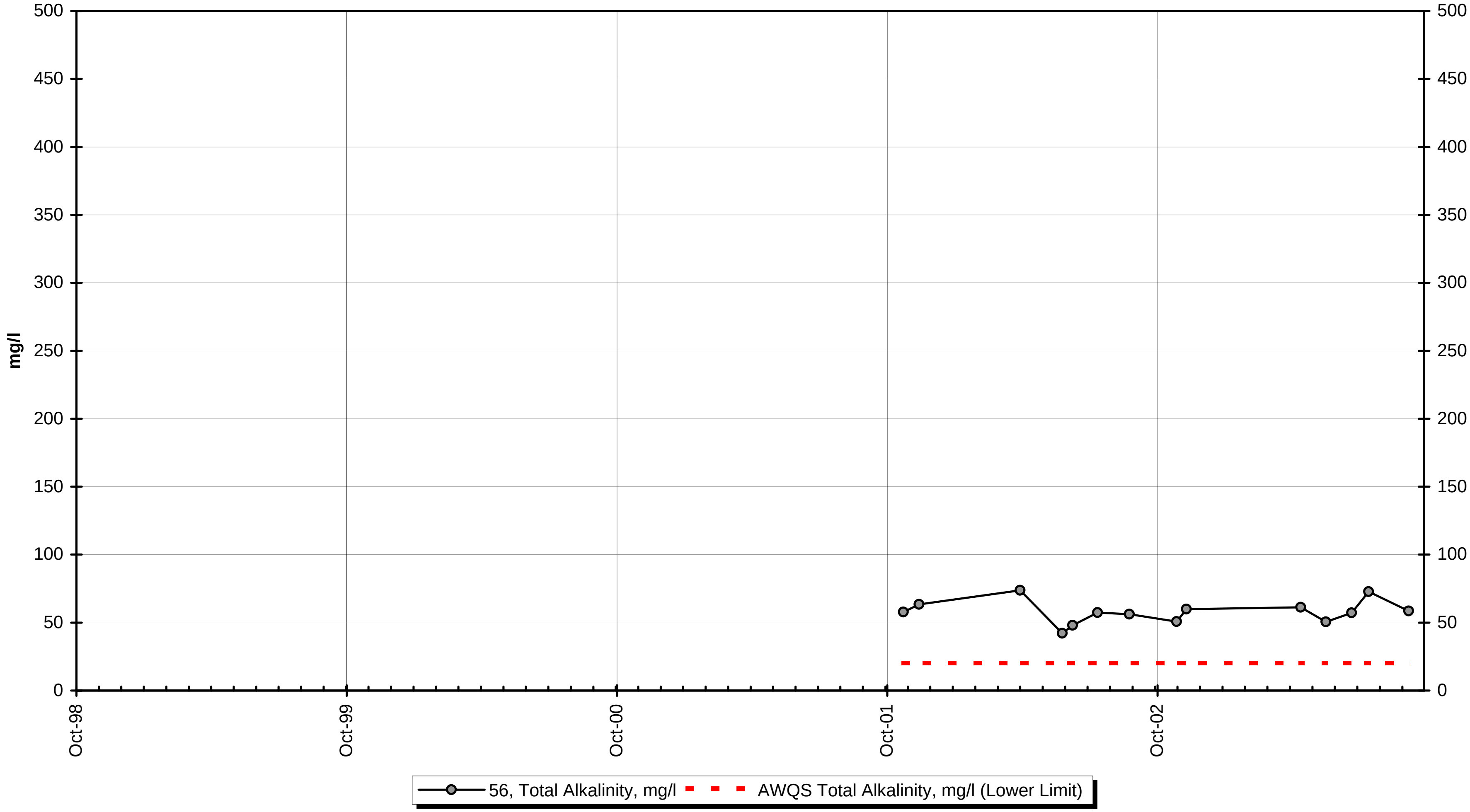


Site 56 -Field pH
pH, su
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
56, pH Field, su
AWQS pH, su-Low
AWQS pH, su-High

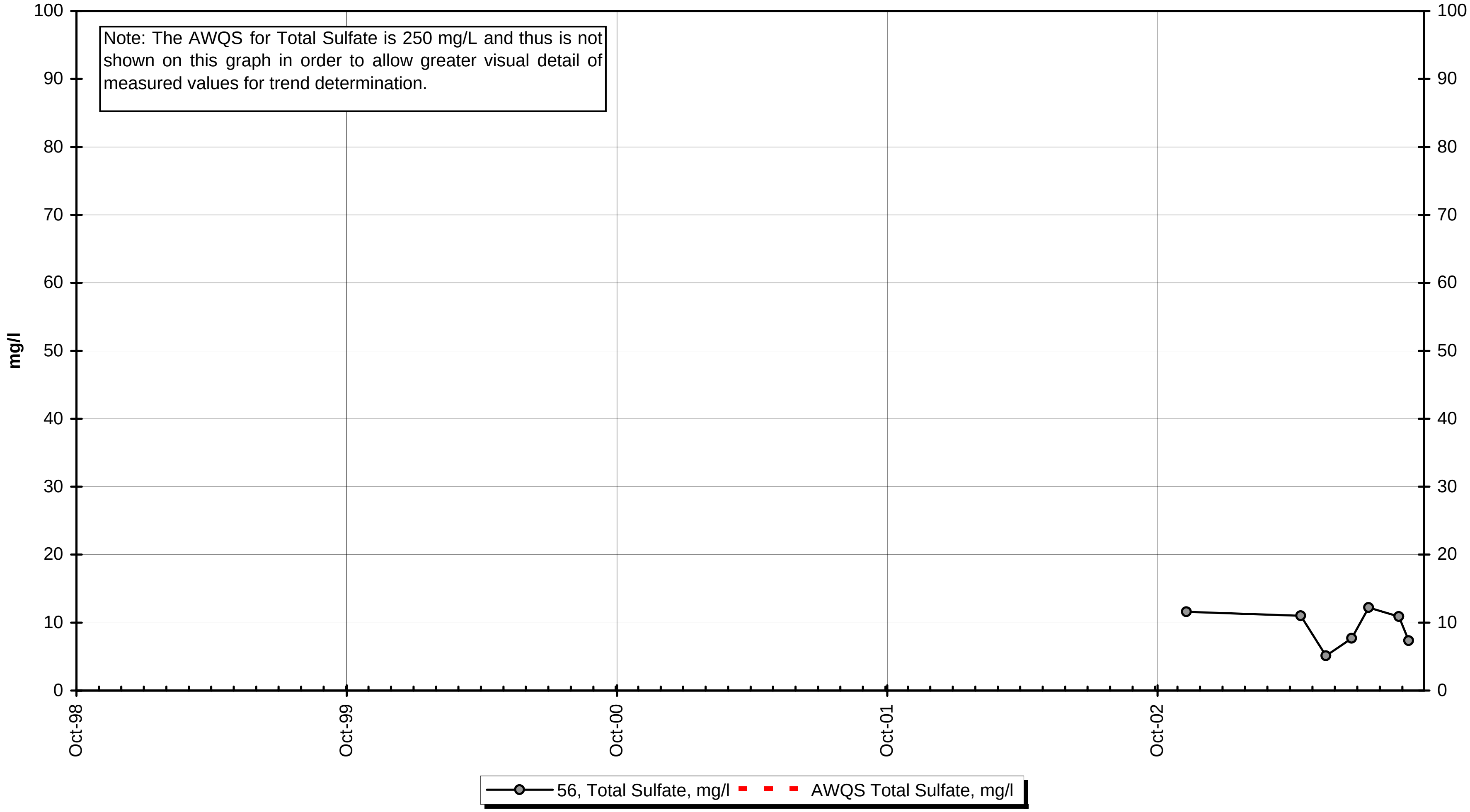
Site 56 -Lab pH



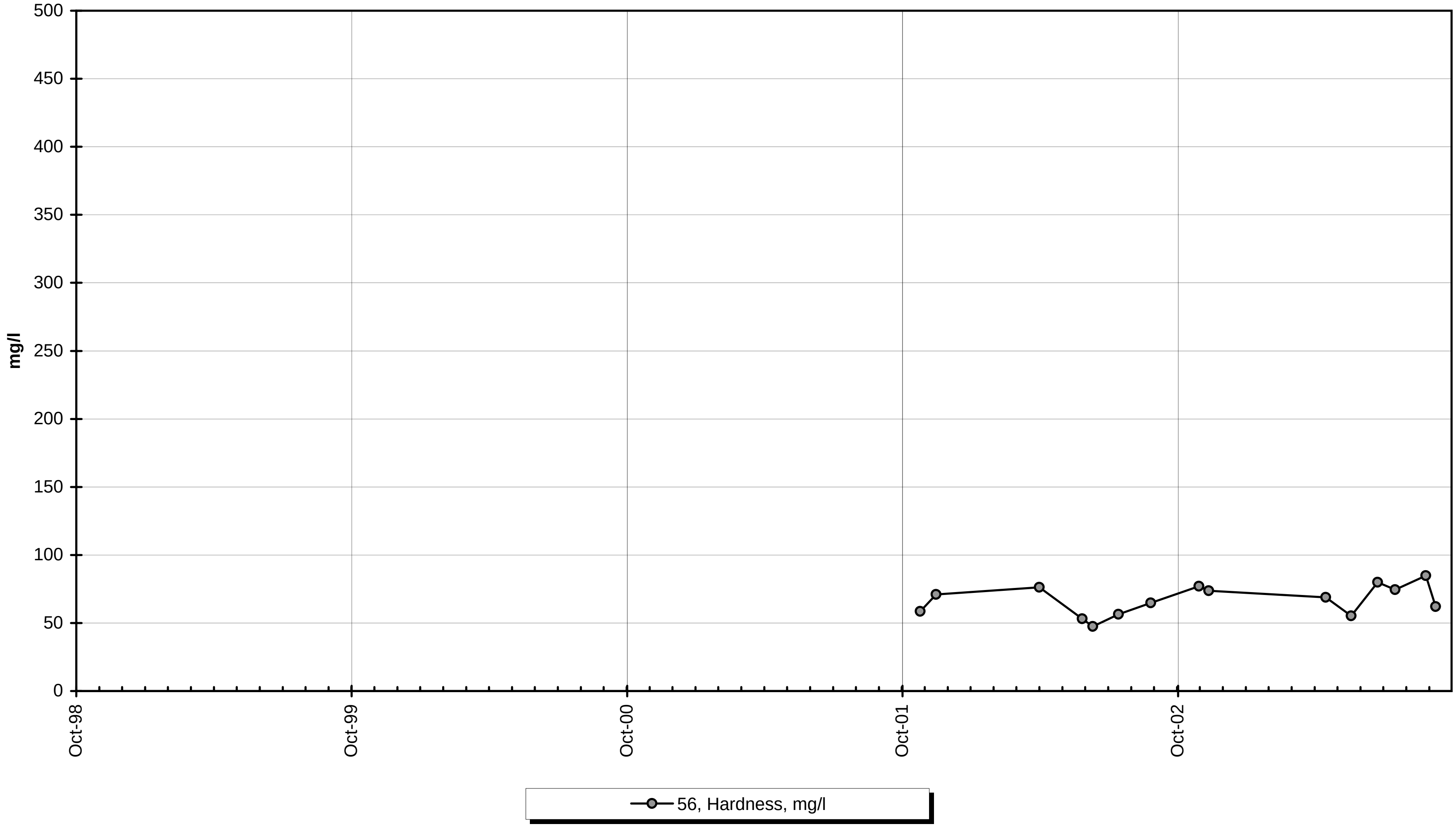
Site 56 -Total Alkalinity



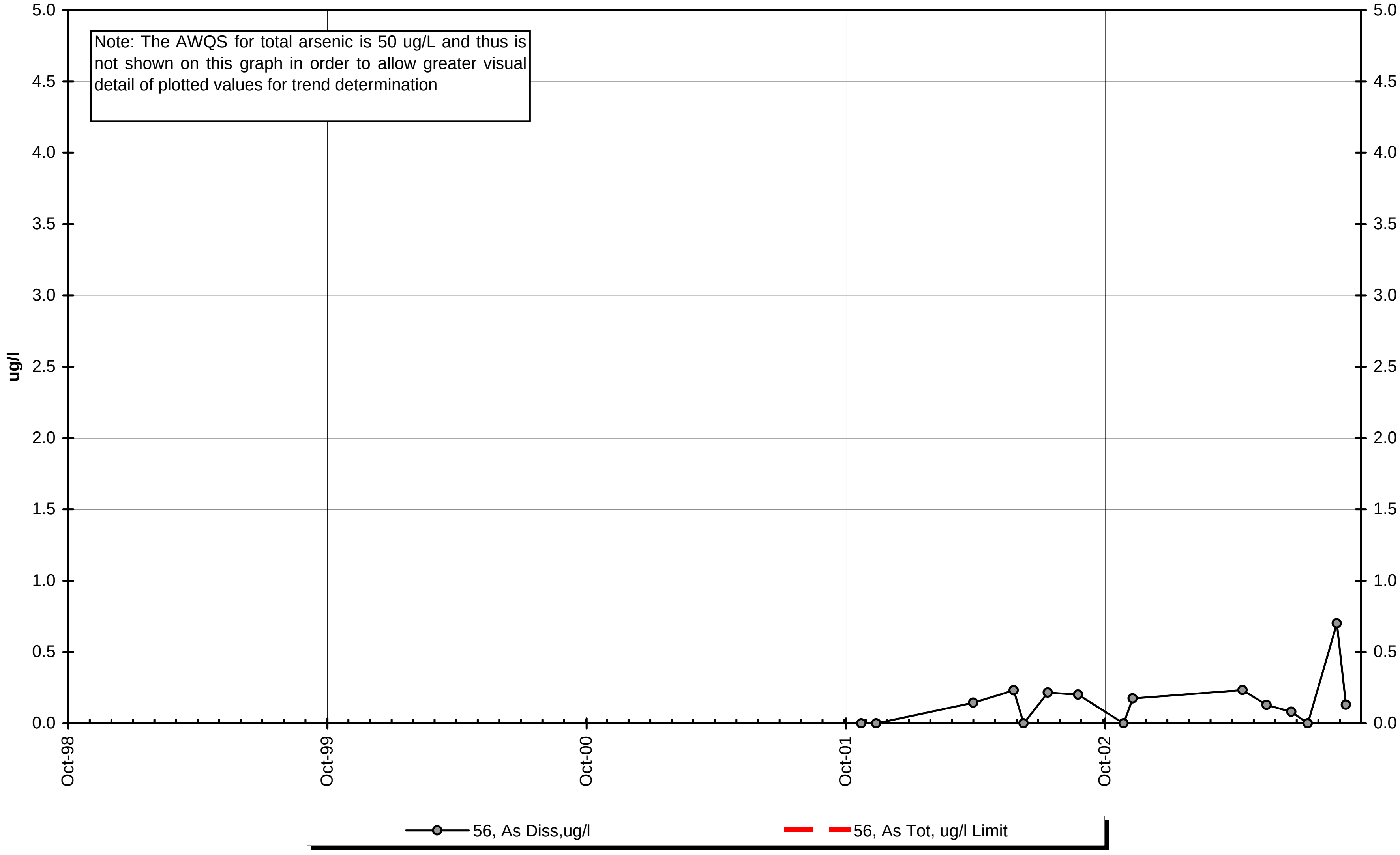
Site 56 -Total Sulfate

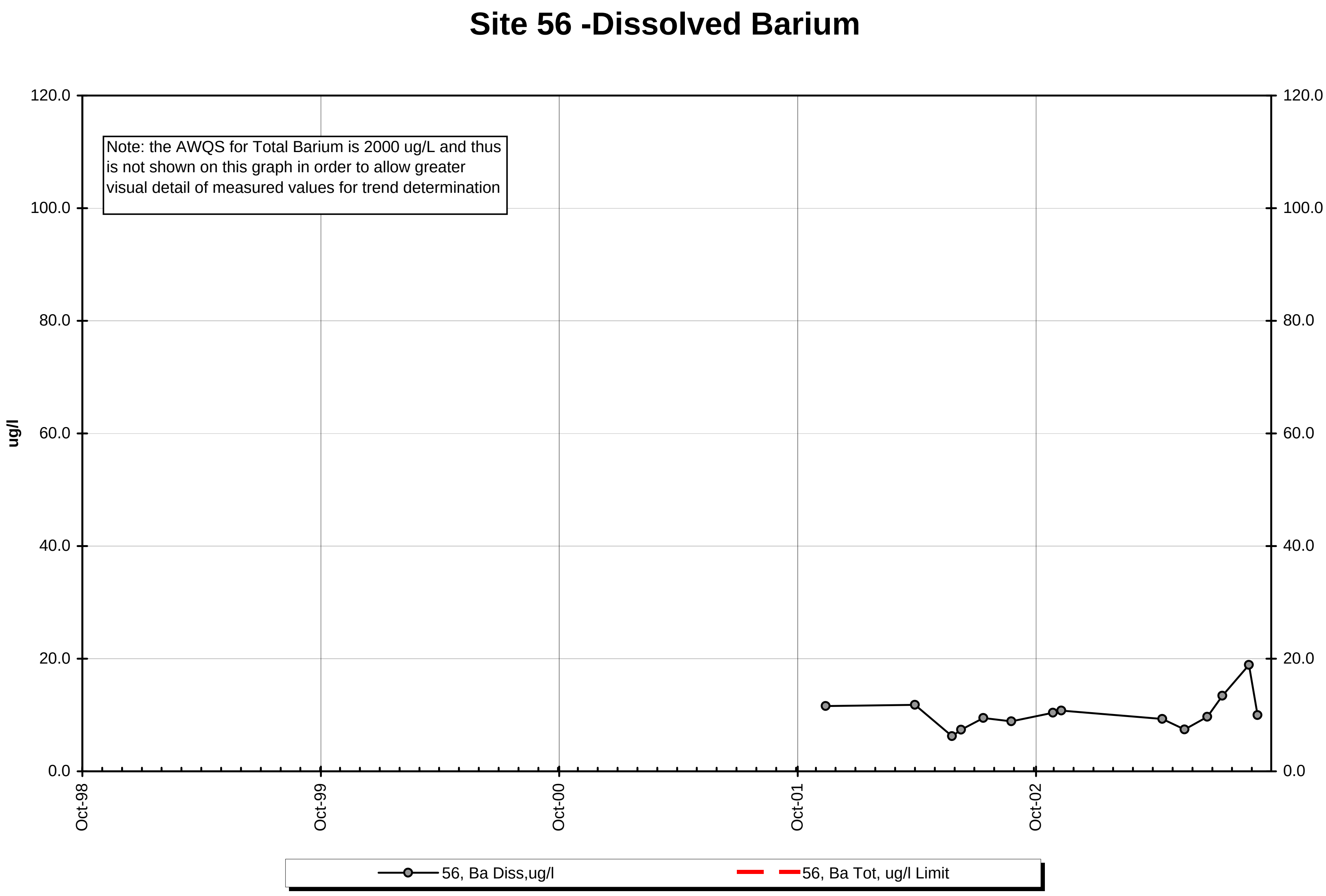


Site 56 -Hardness

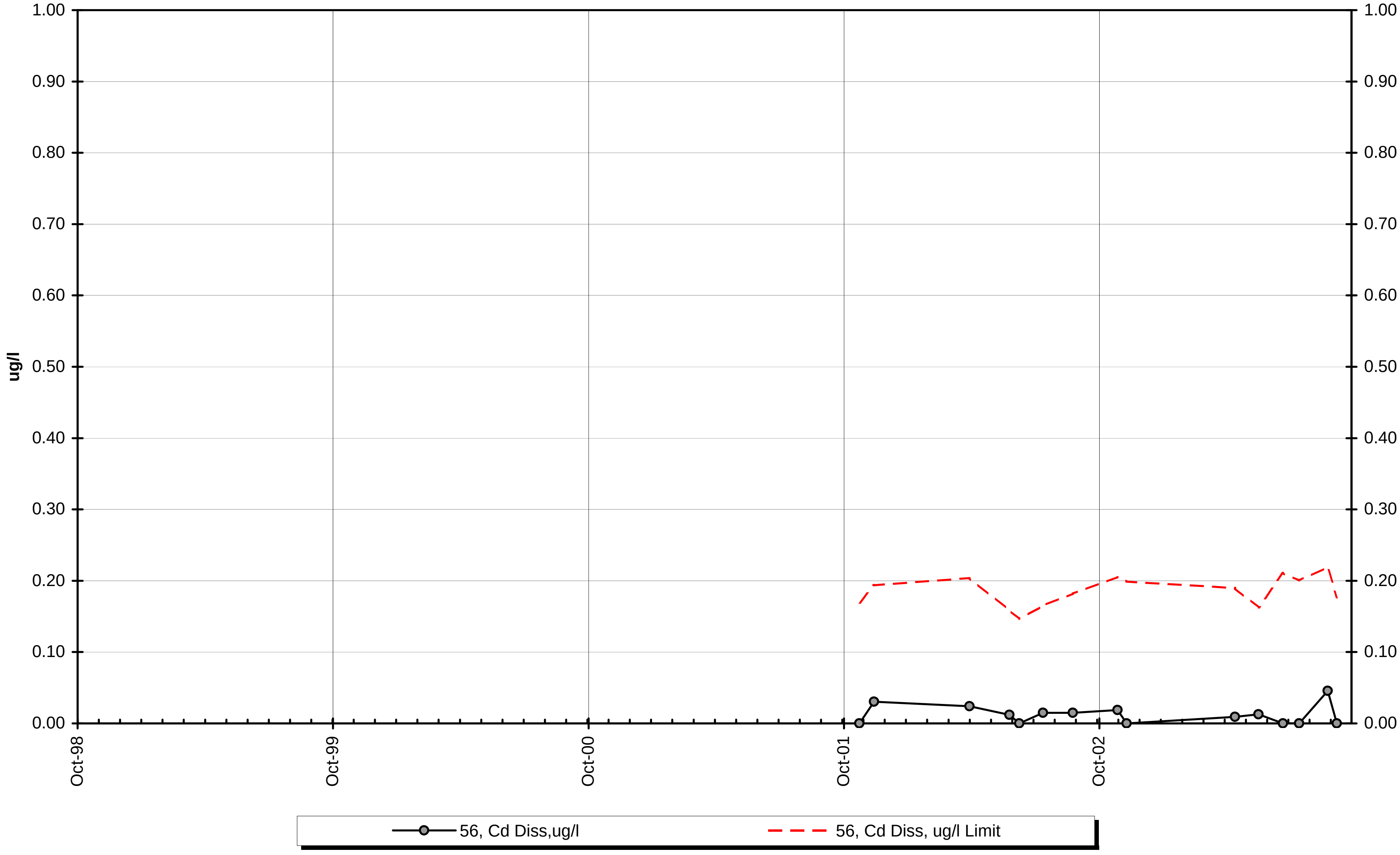


Site 56 -Dissolved Arsenic

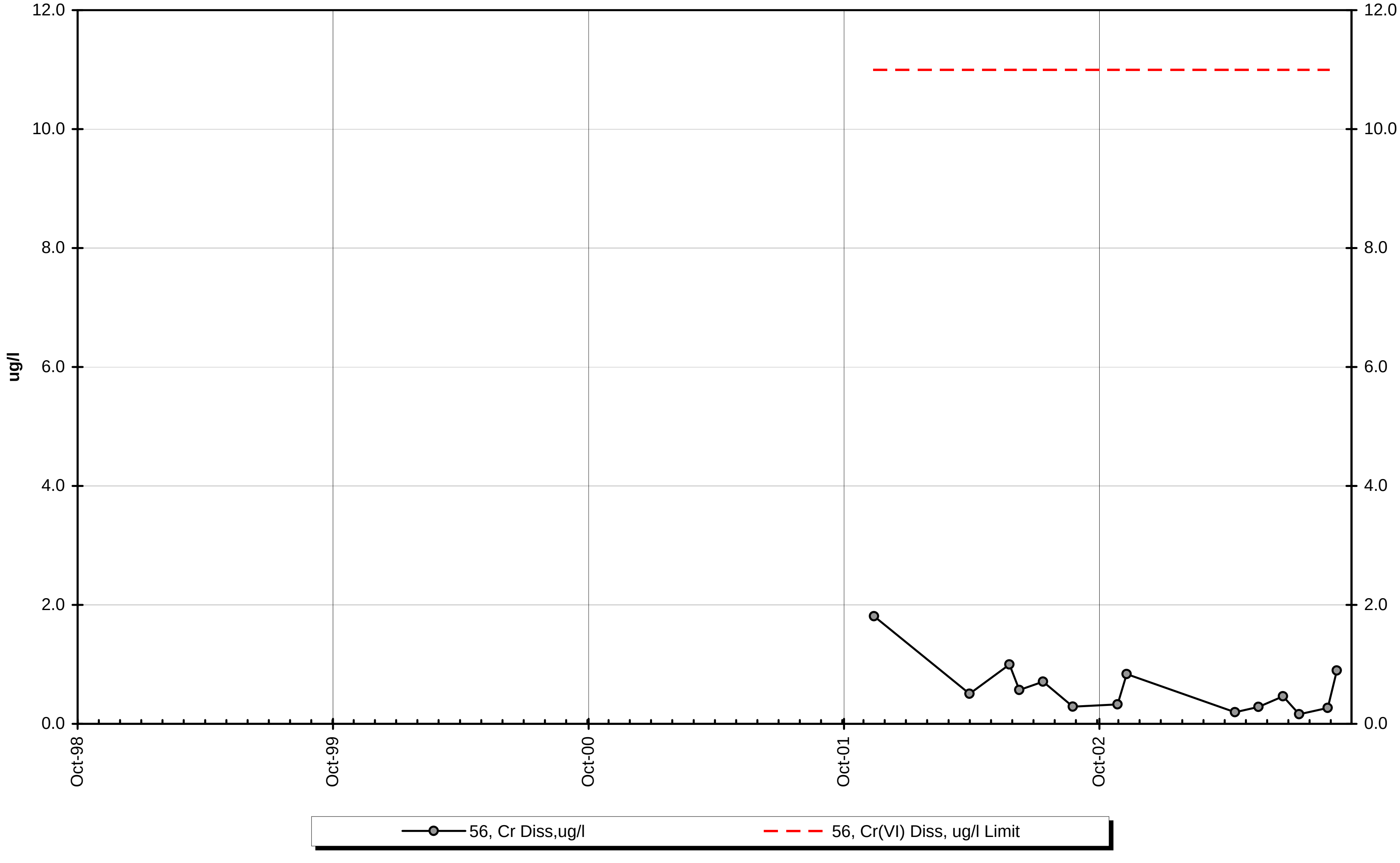



Site 56 -Dissolved Barium
Note: the AWQS for Total Barium is 2000 ug/L and thus is not shown on this graph in order to allow greater visual detail of measured values for trend determination
ug/l
120.0
100.0
80.0
60.0
40.0
20.0
0.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
56, Ba Diss,ug/l
56, Ba Tot, ug/l Limit

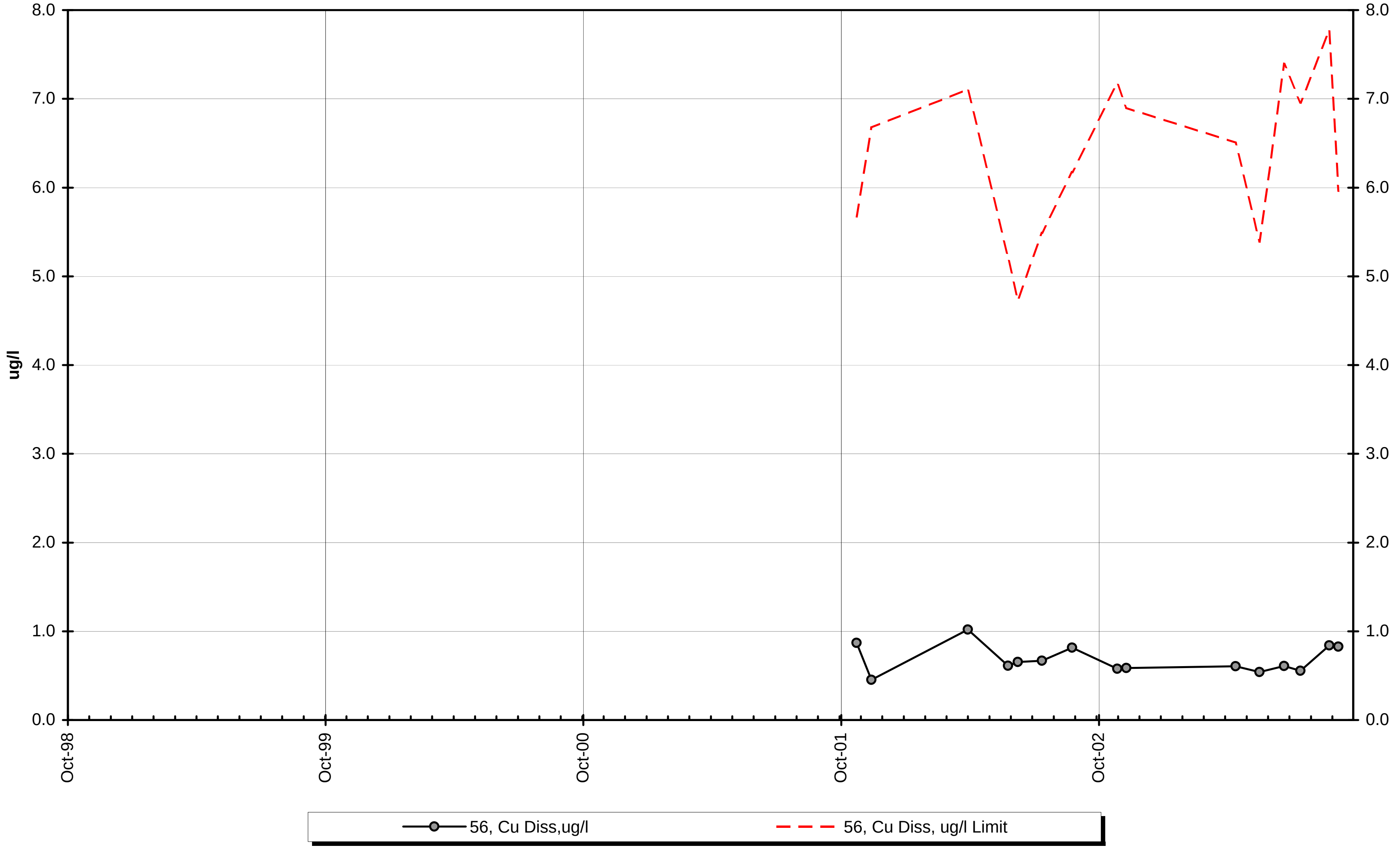
Site 56 -Dissolved Cadmium



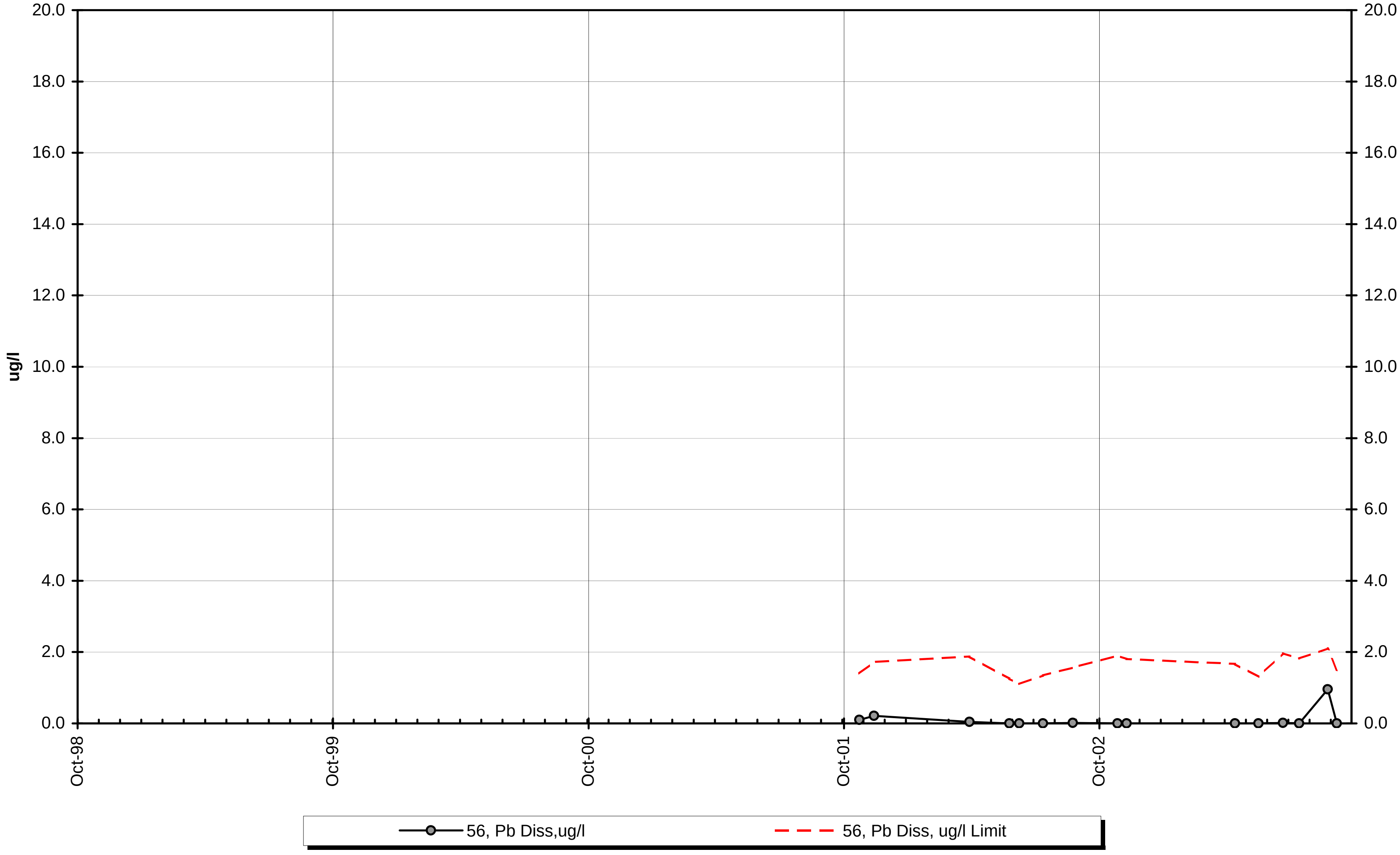
Site 56 -Dissolved Chromium



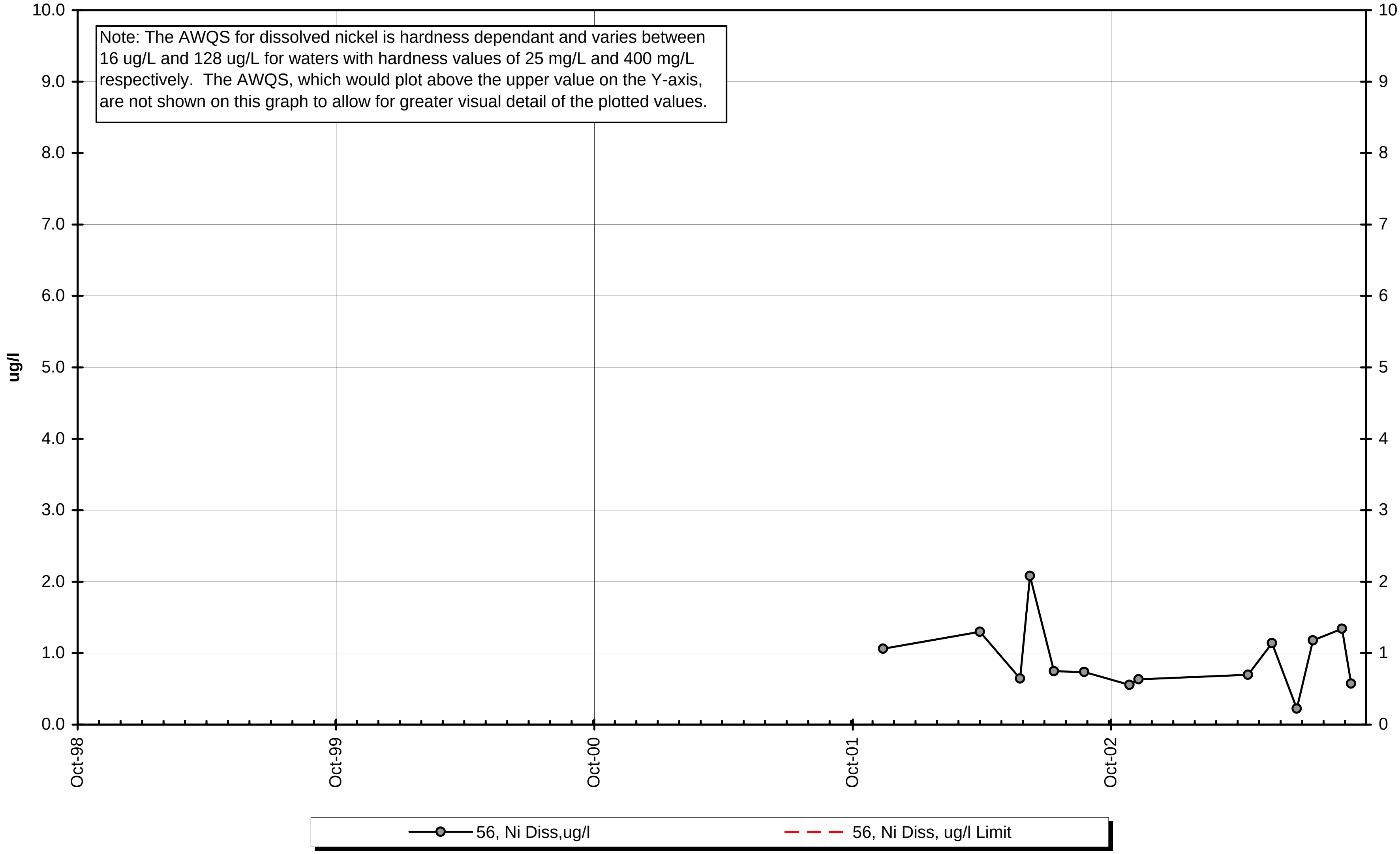
Site 56 -Dissolved Copper



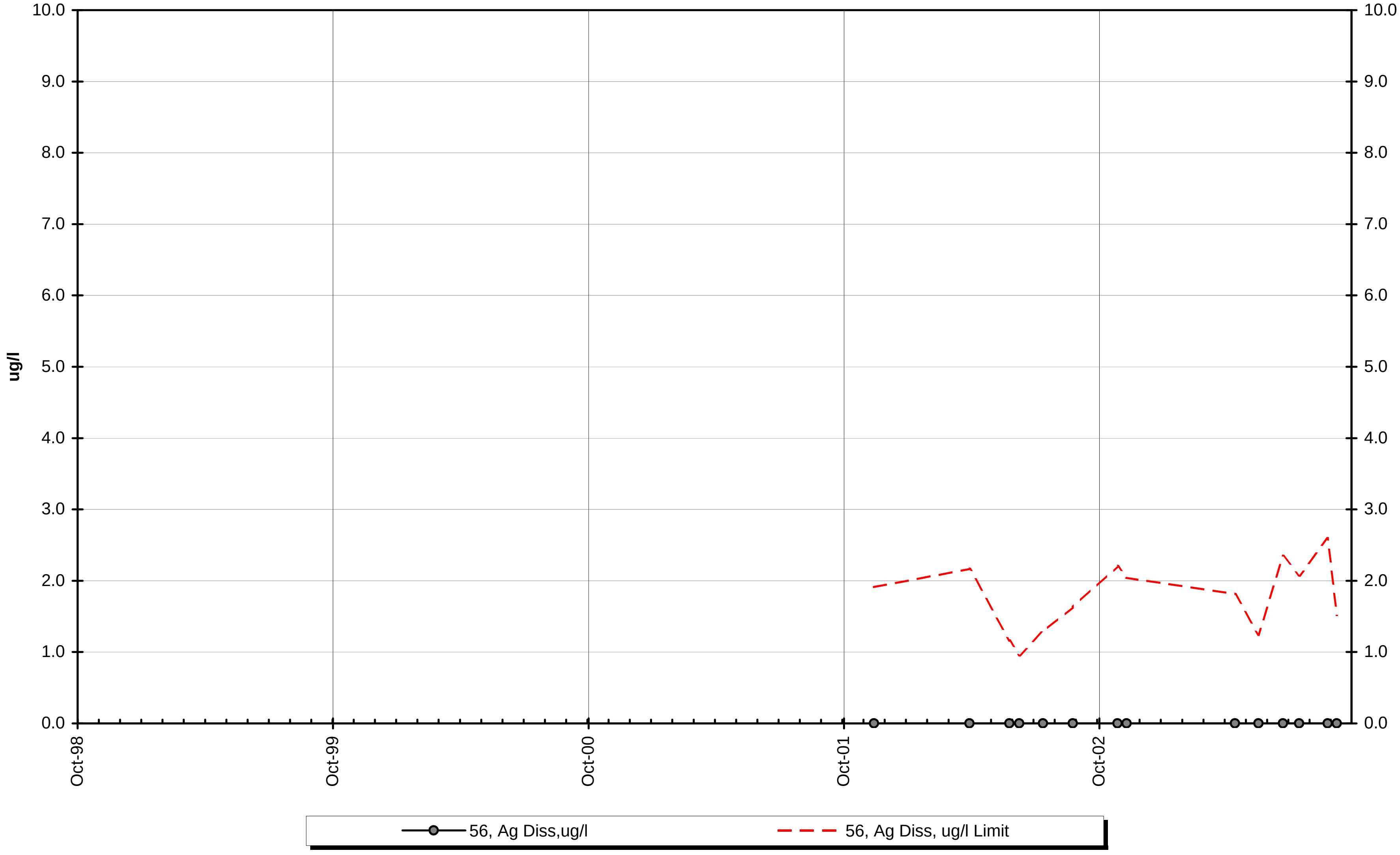
Site 56 -Dissolved Lead



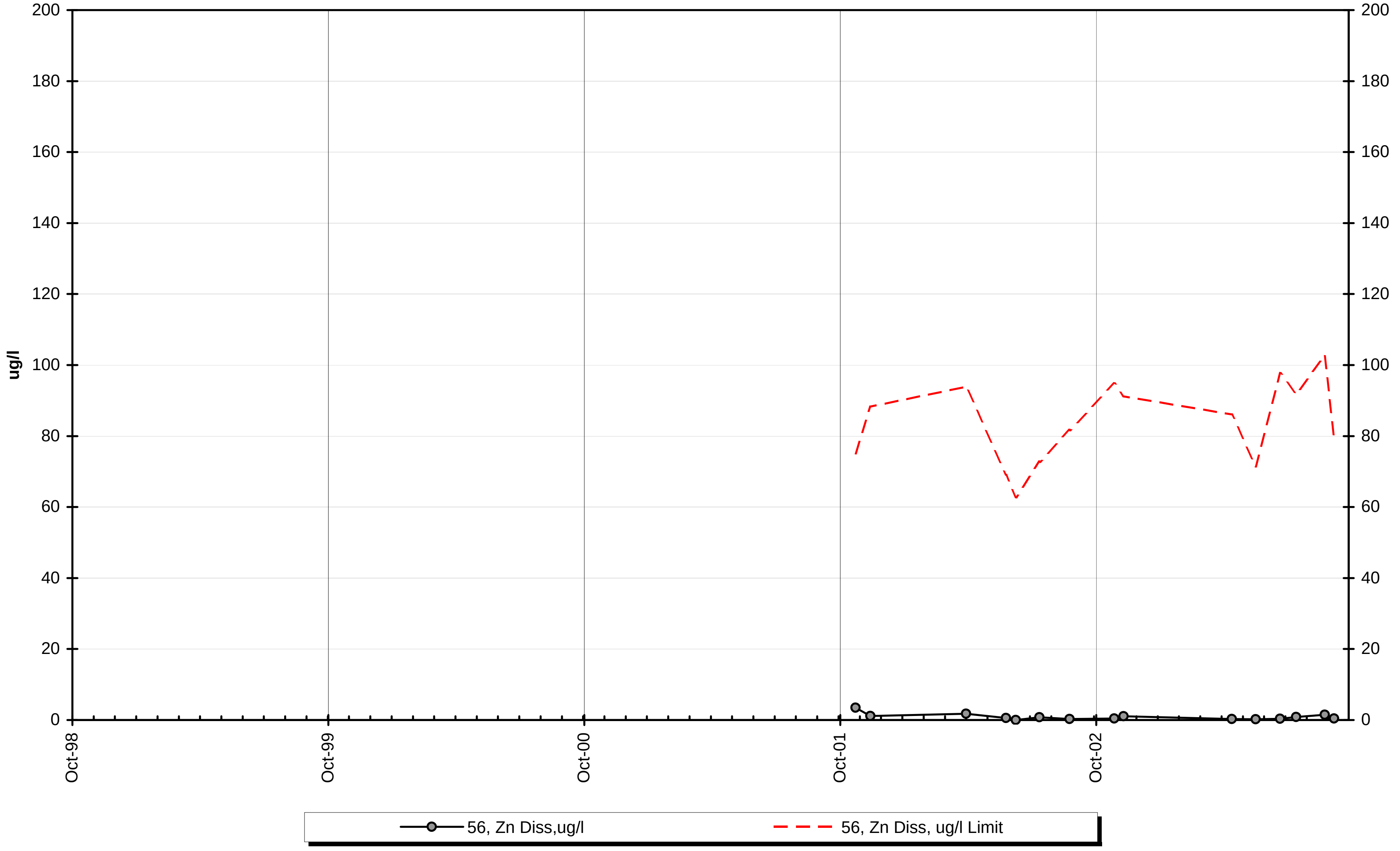
Site 56 -Dissolved Nickel



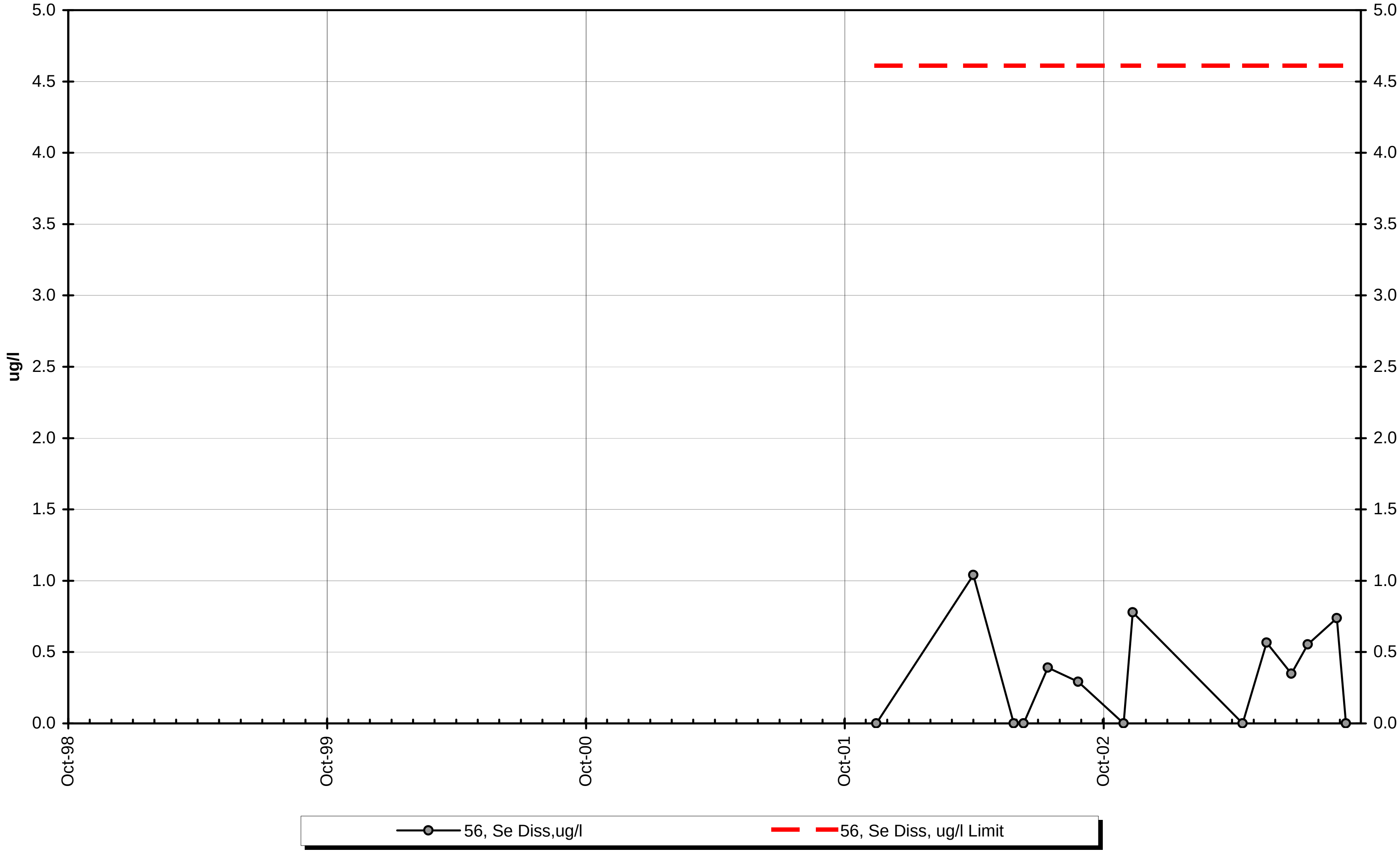
Site 56 -Dissolved Silver



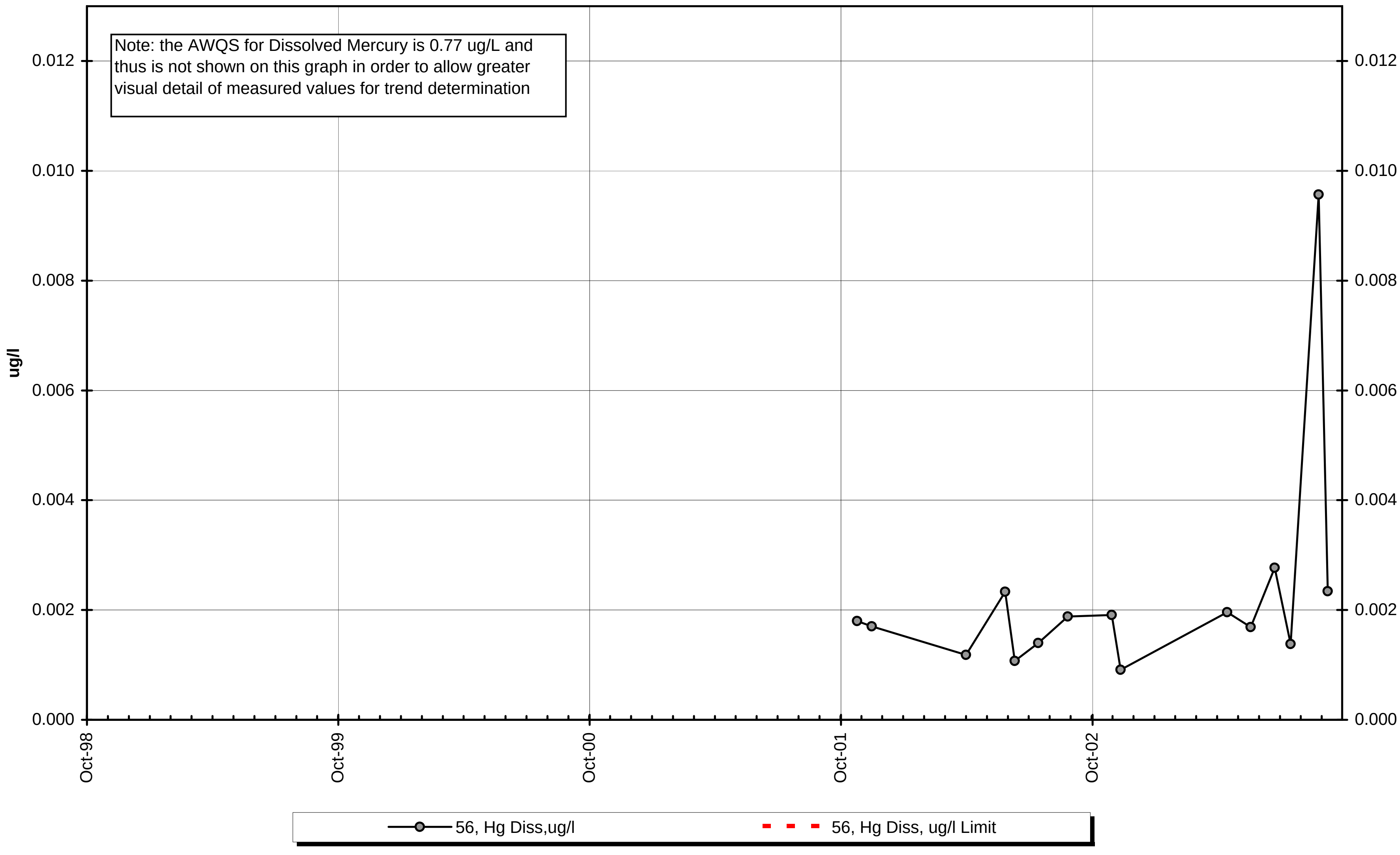
Site 56 -Dissolved Zinc



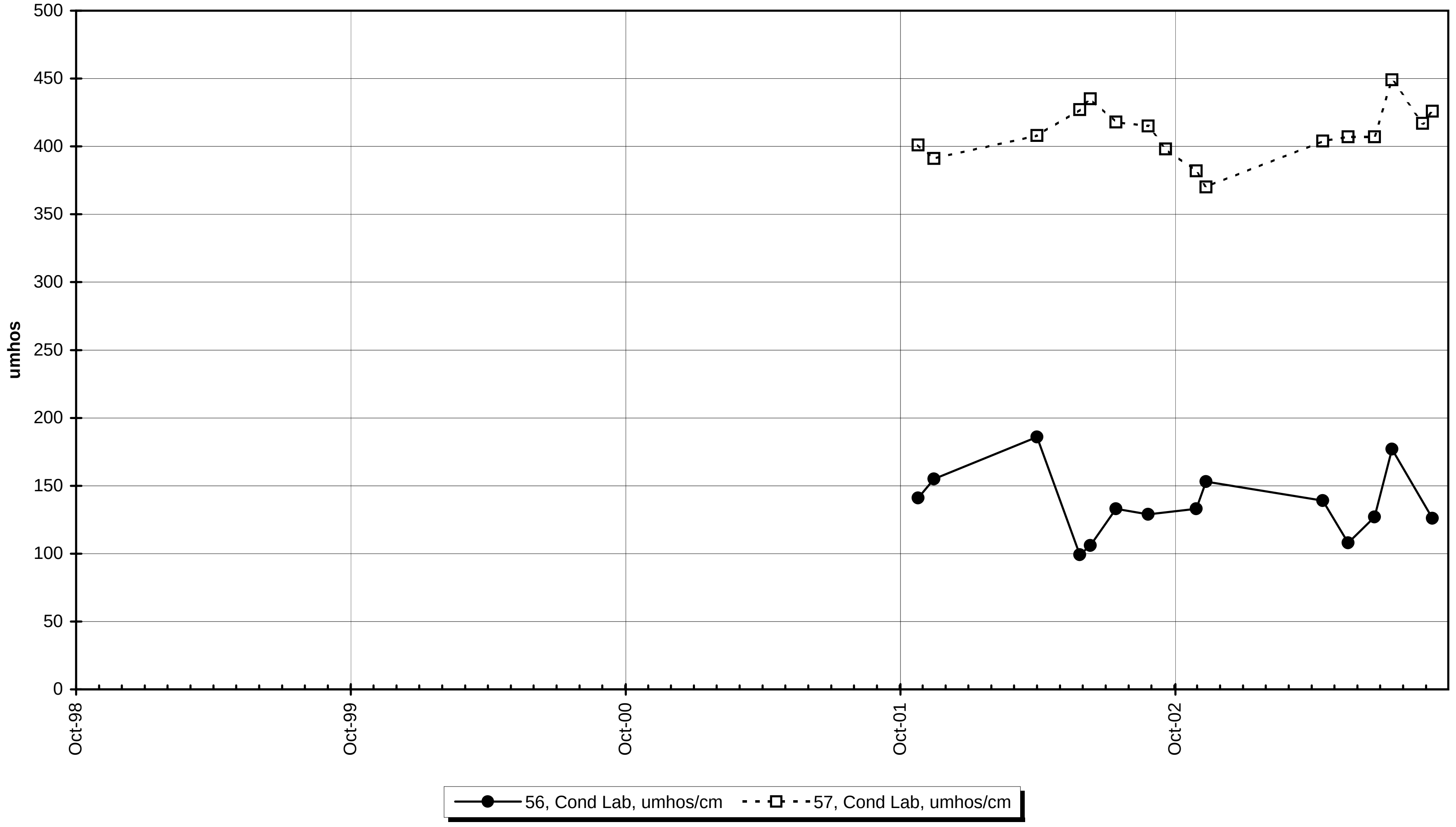
Site 56 -Dissolved Selenium



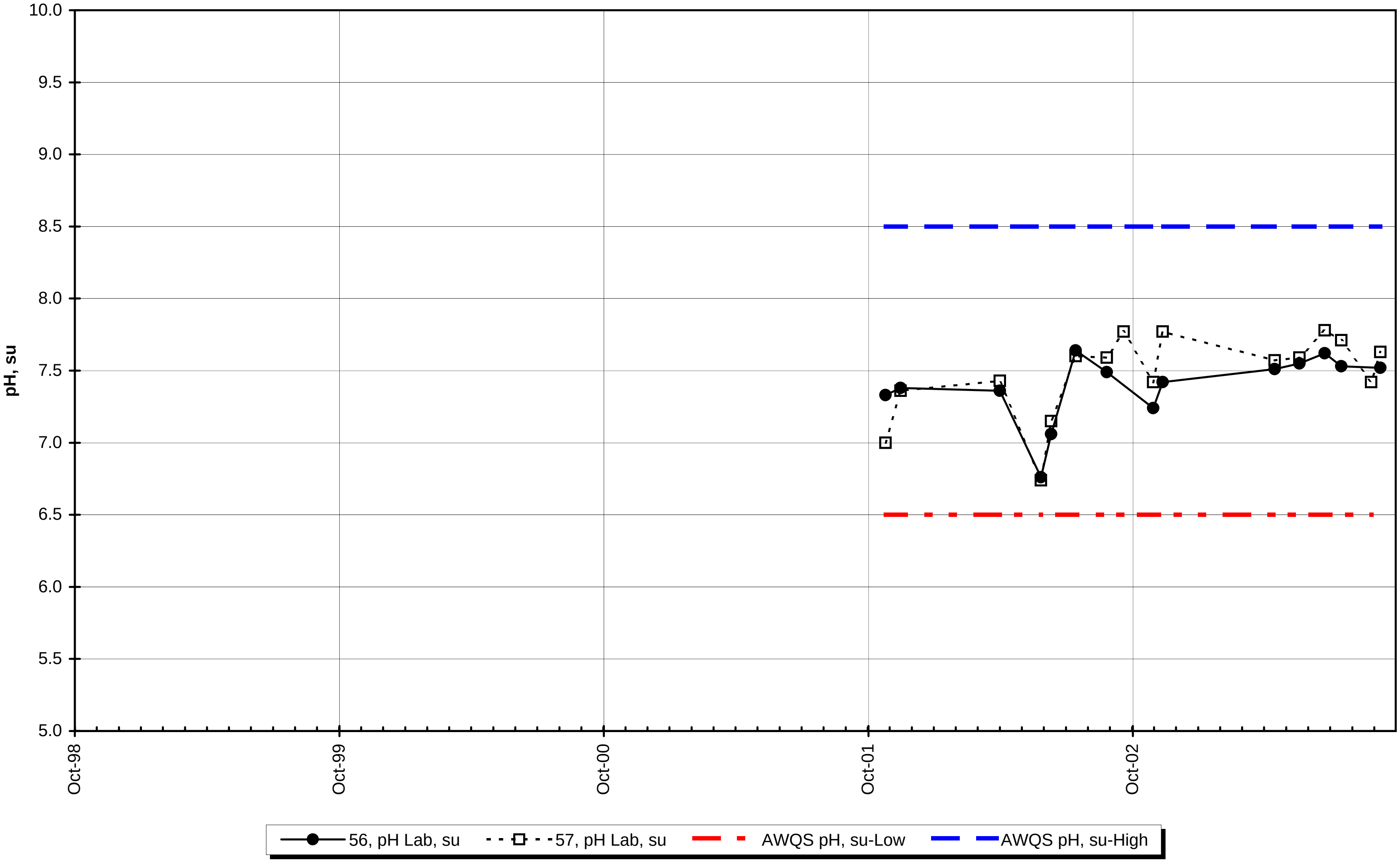
Site 56 -Dissolved Mercury



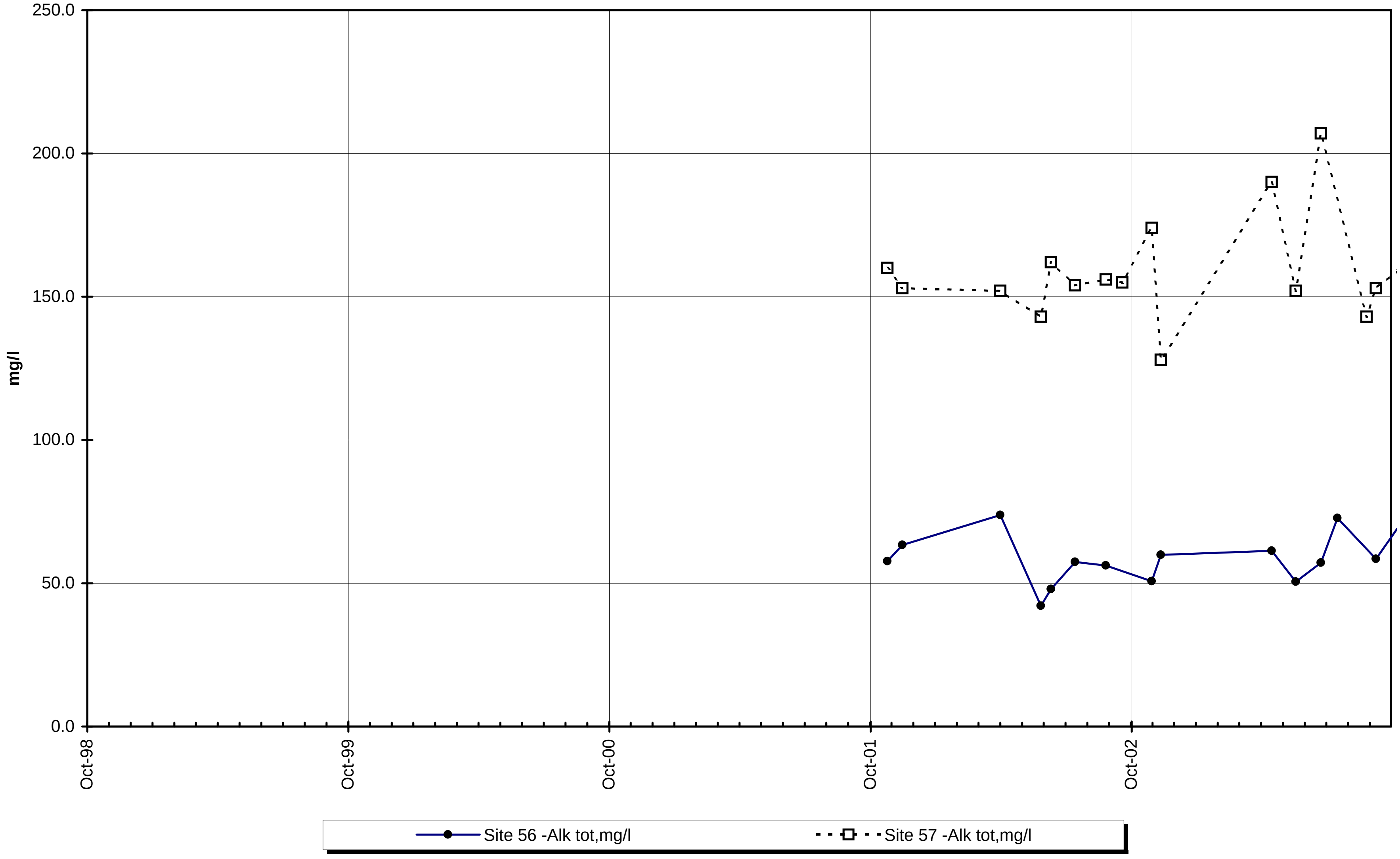
Site 56 vs Site 57 -Conductivity

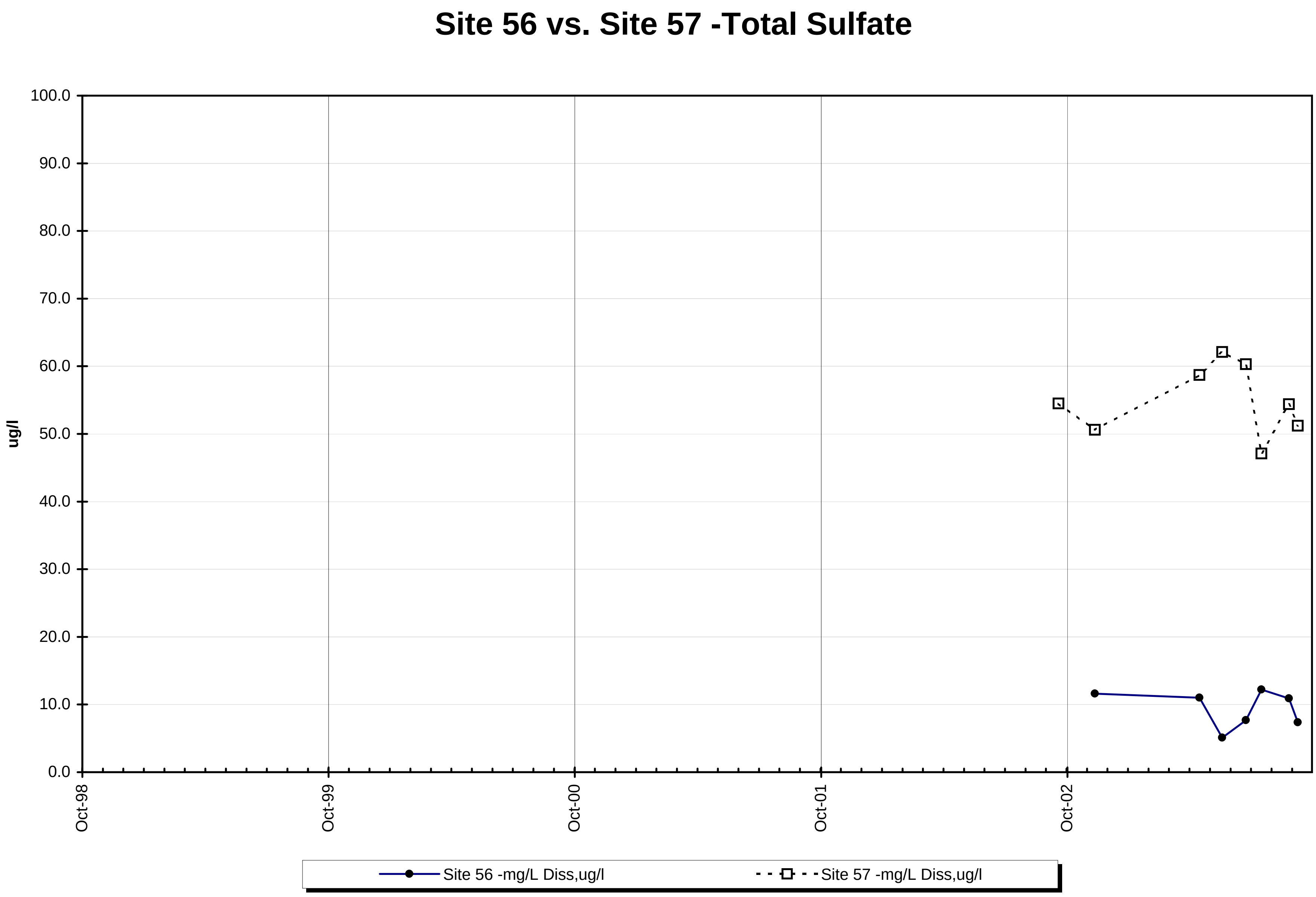


Site 56 vs. Site 57 -pH

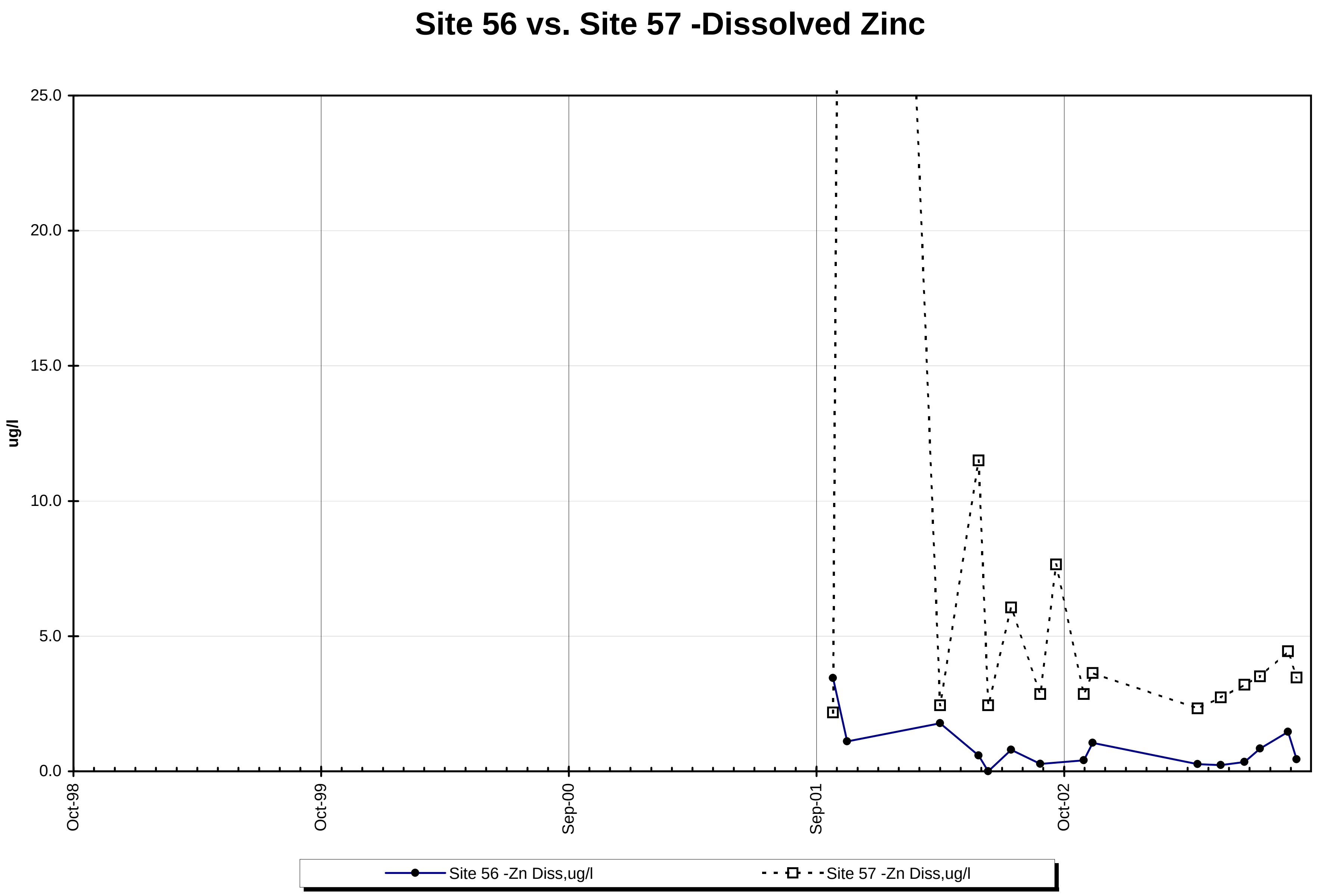


Site 56 vs. Site 57 -Total Alkalinity





Site 56 vs. Site 57 -Total Sulfate
ug/l
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
Site 56 -mg/L Diss,ug/l
Site 57 -mg/L Diss,ug/l



Site 56 vs. Site 57 -Dissolved Zinc
ug/l
25.0
20.0
15.0
10.0
5.0
0.0
Oct-98
Oct-99
Sep-00
Sep-01
Oct-02
Site 56 -Zn Diss,ug/l
Site 57 -Zn Diss,ug/l

EXACT Wilcoxon-Mann-Whitney Rank Sum Test

Variable: Specific Conductance, Lab (umhos/cm @ 25°C)

Site	#57	#56	Ranks	
Year	WY2003	WY2003	**A**	**B**
Oct	382.0	133.0	9	4
Nov	370.0	153.0	8	6
Dec				
Jan				
Feb				
Mar				
Apr	404.0	139.0	10	5
May	407.0	108.0	11.5	1
Jun	407.0	127.0	11.5	3
Jul	449.0	177.0	15	7
Aug	417.0		13	
Sep	426.0	126.0	14	2
Median	407.00	130.00		

N= 15		ΣR	92	28
			n	**m**
			8	7

X(.025,8,7)= 73.3

W_{rs}= **28**

X*(.025,8,7)= 38.7

$\alpha/2$	H_0 $(\mu_A=\mu_B)$
0.025	**REJECT**

EXACT Wilcoxon-Mann-Whitney Rank Sum Test

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

Site	#57	#56	Ranks	
Year	WY2003	WY2003	**A**	**B**
Oct	7.42	7.24	3	1
Nov	7.77	7.42	14	3
Dec				
Jan				
Feb				
Mar				
Apr	7.57	7.51	9	5
May	7.59	7.55	10	8
Jun	7.78	7.62	15	11
Jul	7.71	7.53	13	7
Aug	7.42		3	
Sep	7.63	7.52	12	6
Median	7.61	7.52		

N= 15 ΣR 79 41

n	**m**
8	7

X(.025,8,7)= 73.3

W_{rs}= **41**

X*(.025,8,7)= 38.7

H_0

$\alpha/2$ ($\mu_A = \mu_B$)

0.025 **ACCEPT**

EXACT Wilcoxon-Mann-Whitney Rank Sum Test

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

Site	#57	#56	Ranks	
Year	WY2003	WY2003	**A**	**B**
Oct	174.00	50.70	12	2
Nov	128.00	59.90	8	5
Dec				
Jan				
Feb				
Mar				
Apr	190.00	61.30	13	6
May	152.00	50.50	10	1
Jun	207.00	57.20	14	3
Jul		72.70		7
Aug	143.00		9	
Sep	153.00	58.50	11	4
Median	57.9	97.0		

N= 14		ΣR	77	28
			n	**m**
			7	7

$X(.025,7,7)=$ 68.3

$W_{rs}=$ **77**

$X^*(.025,7,7)=$ 36.8

$\alpha/2$	H_0 ($\mu_A=\mu_B$)
0.025	**REJECT**

EXACT Wilcoxon-Mann-Whitney Rank Sum Test

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

Site	#57	#56	Ranks	
Year	WY2003	WY2003	**A**	**B**
Oct				
Nov	50.6	11.6	9	6
Dec				
Jan				
Feb				
Mar				
Apr	58.7	11.0	12	5
May	62.1	5.1	14	1
Jun	60.3	7.7	13	3
Jul	47.1	12.2	8	7
Aug	54.4	10.9	11	4
Sep	51.2	7.4	10	2
Median	54.40	10.90		

N= 14 ΣR 77 28

n	**m**
7	7

X(.025,7,7)= 68.3

W_{rs}= **77**

X*(.025,7,7)= 36.8

$\alpha/2$	H_0 ($\mu_A=\mu_B$)
0.025	**REJECT**

EXACT Wilcoxon-Mann-Whitney Rank Sum Test

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

Site	#57	#56	Ranks	
Year	WY2003	WY2003	**A**	**B**
Oct	2.9	0.4	11	4
Nov	3.6	1.1	15	7
Dec				
Jan				
Feb				
Mar				
Apr	2.3	0.3	9	2
May	2.7	0.2	10	1
Jun	3.2	0.3	12	3
Jul	3.5	0.8	14	6
Aug	4.4	1.5	16	8
Sep	3.5	0.4	13	5
Median	3.34	0.43		

N= 16 ΣR 100 36

	n	**m**
	8	8

X(.025,8,8)= 87.0

W_{rs}= **100**

X*(.025,8,8)= 49.0

$\alpha/2$

0.025

H_0

$(\mu_A=\mu_B)$

REJECT

INTERPRETIVE REPORT
SITE 13 "MINE ADIT DISCHARGE EAST"

The data collected during the current water year are listed in the following "Table of Results for Water Year 2003" report. The table includes all the data, field and lab, 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 zero for the purpose of median calculation.

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

Sample Date	Parameter	Value	Qualifier	Notes
No outliers have been identified by KGCMC for the period of Oct-98 though Sept-03.				

The data for water year 2003 have been compared to the strictest fresh water quality criterion for each applicable analyte. Five (5) results exceeding these criteria have been identified, as listed in the table below. The data are for Total Sulfate and range from

Sample Date	Parameter	Value	Standard	Standard Type
11/12/02	Sulfate, Total mg/L	266	250	Water Supply, Drinking
05/20/03	Sulfate, Total mg/L	269	250	Water Supply, Drinking
06/24/03	Sulfate, Total mg/L	356	250	Water Supply, Drinking
07/17/03	Sulfate, Total mg/L	317	250	Water Supply, Drinking
09/09/03	Sulfate, Total mg/L	544	250	Water Supply, Drinking

266 - 544 mg/l. The elevated sulfate is likely the result of oxidation of pyrite contained in the production rock storage area located immediately upstream from Site 13. The persistence and increased values, relative to prior year's samples, may in part be due to the relatively dry, warm summer seasons conditions that existed from April-July 2003. KGCMC plans for the removal of this material are listed in the General Plan of Operation, Appendix 14 –Attachment A, November 2001. It is anticipated that the removal of the waste rock will lower the sulfate concentrations to below AWQS.

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. For conductivity and hardness slight upward trends may be present, while for pH a slight downward trend may be present. No other trend were visual apparent. A non-parametric statistical analysis for trend was preformed for conductivity, pH, Alkalinity, dissolved zinc and hardness. Calculation details of the Seasonal Mann-Kendall analyses are presented in detail on the pages following this interpretive section. The table below summarizes the results on the data collected between Oct-97 and Sep-03 (WY1998-WY2003). For data sets with a statistically significant trend (α<5%) a Seasonal-Sen's Slope estimate statistic has also been calculated. Laborotory pH and Hardness have statistically significant trends (p<0.01 for both) while conductivity which was noted as having an apparent visual trend does not show a statistically significant trend even at the α=10% level. The Sen's slope estimate is for pH is -0.09 su•yr^{-1} or an -1% downward trend while the slope estimate for total hardness is 20.5 mg•L^{-1}•yr^{-1} or an 5% increase annually. The slight downward trend in pH may due to a slow return to normal conditions following a lime addition to the area in the early 90's. The increasing trend in hardness, which is probably reflective of carbonate mineral dissolution, along with the adequate and steady alkalinity indicate that there is still ample buffering capacity contained in the waste rock at this site. The overall constituent loading for this site is within the range expected from exposed waste rock.

		Mann-Kendall test statistics			Sen's slope estimate	
Parameter	n*	Z	Trend	a**	Q	Q(%)
Conductivity, Lab	6	2.16	-	0.14		
pH, Lab	6	2.71	-	**<.01**	-0.09	-1%
Alkalinity, Total	6	0.02	+	0.87		
Zinc, Dissolved	6	0.43	+	0.43		
Hardness, Total	6	8.97	+	**<.01**	20.5	5%

*: Number of years **:Significance level

It is anticipated that upon completion of the planned reclamation of this site constituent loaded will return to background levels. Currently, steep slopes preclude constructing an oxygen-limiting soil cover on the site.. Consequently, KGCMC intends to remove the production rock from the site. Hauling the rock back into the mine via the 1350 portal is a feasible alternative, however ventilation and access infrastructure prevent doing so prior to closure of the underground workings. Other more logistically complex alternatives include hauling the material down to the 920 portal or one of the active surface disposal facilities. KGCMC plans to continue to monitor the site and will select an appropriate removal alternative that best suits the site's weathering performance and underground accessibility.

Table of Results for Water Year 2003

Site 13 "Mine Adit Discharge Creek"

Sample Date/Parameter	10/30/2002	11/12/2002	Dec-02	Jan-03	Feb-03	Mar-03	4/16/03	5/20/2003	6/24/2003	7/17/2003	8/27/2003	9/9/2003	**Median**
Water Temp (°C)	4.9	5.4	NOT SCHEDULED FOR SAMPLING				INACCESSIBLE DUE TO SNOW	4.1	7.6	9.7	9.3	9.3	7.6
Conductivity-Field(μmho)	888	813						827	957	947	1,250	1,183	947
Conductivity-Lab (μmho)	842	777						757	896	941	1,180	1,052	896
pH Lab (standard units)	7.25	7.49						7.42	7.43	7.57	7.69 J	7.31	7.43
pH Field (standard units)	7.14	7.22						7.37	7.37	7.51	7.33	7.28	7.33
Total Alkalinity (mg/L)	140.0	186.0						206.0	244.0	197.0	199.0	128.0	197.0
Total Sulfate (mg/L)	Note 1	266.0 J						269.0	356.0	317.0	Note 2	544.0 J	317.0
Hardness (mg/L)	450.0	479.0						442.0	556.0	505.0	750.0	686.0	505.0
Dissolved As (ug/L)	0.210 J	0.367 J						0.123	0.081 J	<0.331	0.657 U	0.188 J	0.188
Dissolved Ba (ug/L)	26.6	25.5						28.5	35.6	29.5	43.9	49.4	29.5
Dissolved Cd (ug/L)	0.033 J	0.045 J						0.027	<0.013	<0.025	0.034 J	0.098	0.033
Dissolved Cr (ug/L)	0.484	9.140						0.365	0.583	0.421	0.287 J	2.810	0.484
Dissolved Cu (ug/L)	0.297 U	1.230						0.370	0.284	0.320 J	0.237	0.518	0.320
Dissolved Pb (ug/L)	0.2260	0.5930						0.0553 U	0.0580 U	0.0299 J	0.0585 J	0.3160	0.0585
Dissolved Ni (ug/L)	2.020	2.270						2.680	1.770	3.110 J	4.490	2.840	2.680
Dissolved Ag (ug/L)	<0.004	<0.088						<0.028	<0.013	<0.066	<0.079	<0.004	0.014
Dissolved Zn (ug/L)	13.10	22.00 J						10.20	11.10	13.10	8.11	42.40	13.10
Dissolved Se (ug/L)	<0.401	<0.413						0.659 J	<0.144	<0.377	0.649	<0.496	0.207
Dissolved Hg (ug/L)	0.000629	0.001370 U						0.000514 U	0.000723 U	0.000817 U	0.000628 U	0.000618 J	0.000629

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

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

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

NOTE (1) Analysis was not performed on sample.

(2) Sample was lost at laboratory.

Qualified Data by QA Reviewer

Date Range: 10/01/2002 to 09/30/2003

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
13	10/30/2002	1:15:00 PM				
			As Diss, ug/l	0.21	J	Below Quantitative Range
			Cd Diss, ug/l	0.033	J	Below Quantitative Range
			Cu Diss, ug/l	0.297	U	Field Blank Contamination
13	11/12/2002	2:33:00 PM				
			SO4 Tot, mg/l	266	J	Hold Time
			As Diss, ug/l	0.367	J	Below Quantitative Range, L
			Cd Diss, ug/l	0.0454	J	Below Quantitative Range
			Zn Diss, ug/l	22	J	LCS Recovery
			Hg Diss, ug/l	0.00137	U	Field Blank Contamination
13	05/20/2003	12:51:00 PM				
			Pb Diss, ug/l	0.0553	U	Field Blank Contamination
			Se Diss, ug/l	0.659	J	Below Quantitative Range, L
			Hg Diss, ug/l	0.000514	U	Method Blank Contamination
13	06/24/2003	1:43:00 PM				
			As Diss, ug/l	0.0811	J	Below Quantitative Range
			Pb Diss, ug/l	0.058	U	Field Blank Contamination
			Hg Diss, ug/l	0.000723	U	Field Blank Contamination
13	07/17/2003	1:00:00 PM				
			Cu Diss, ug/l	0.32	J	Continuing Calibration Verific
			Pb Diss, ug/l	0.0299	J	Below Quantitative Range
			Ni Diss, ug/l	3.11	J	Continuing Calibration Verific
			Hg Diss, ug/l	0.000817	U	Field Blank Contamination
13	08/27/2003	2:05:00 PM				
			pH Lab, su	7.69	J	Hold Time
			As Diss, ug/l	0.657	U	Below Quantitative Range, M
			Cd Diss, ug/l	0.0336	J	Below Quantitative Range
			Cr Diss, ug/l	0.287	J	Below Quantitative Range
			Pb Diss, ug/l	0.0585	J	Field Blank Contamination
			Hg Diss, ug/l	0.000628	U	Method Blank Contamination

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

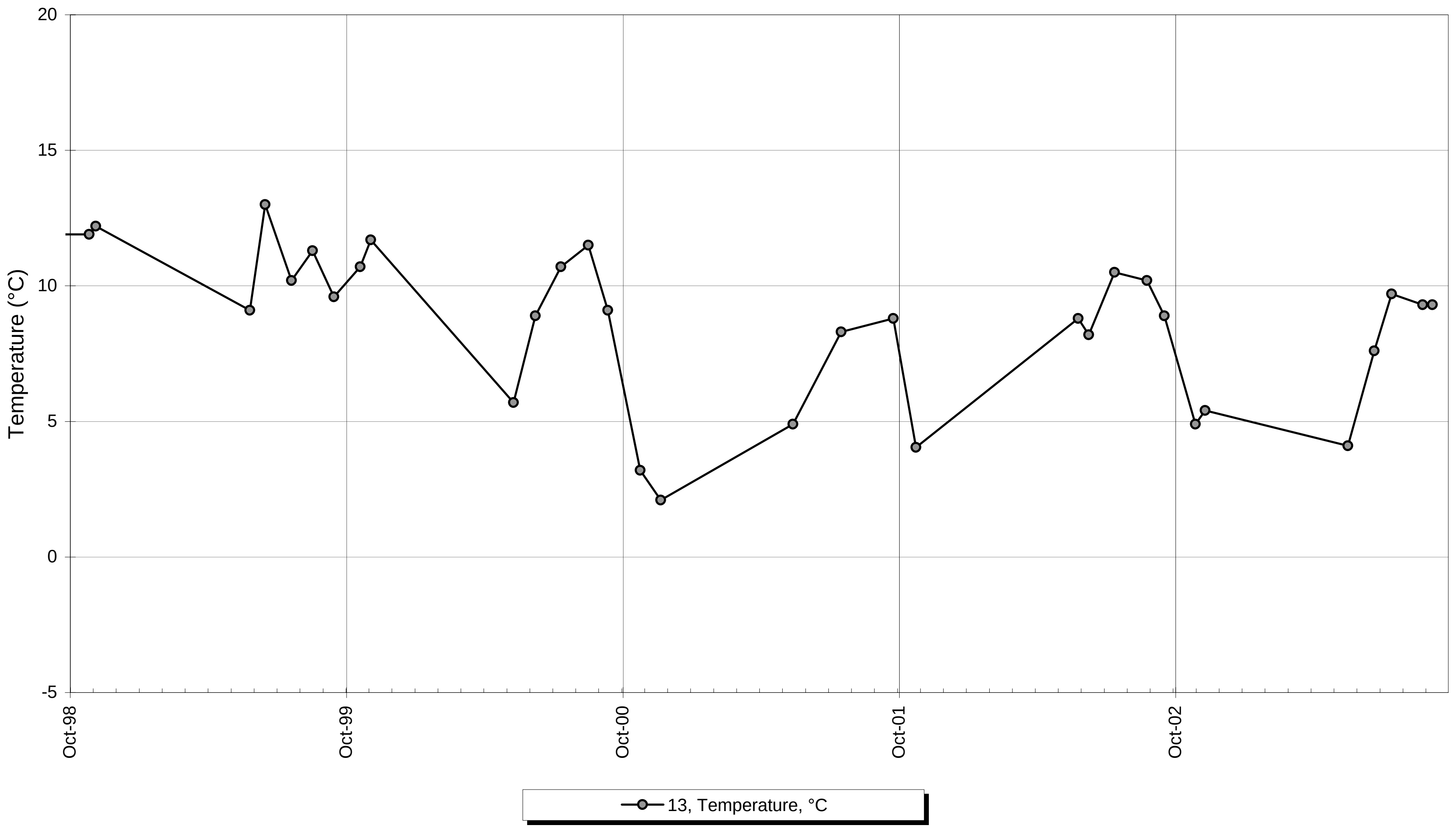
Qualified Data by QA Reviewer

Date Range: 10/01/2002 to 09/30/2003

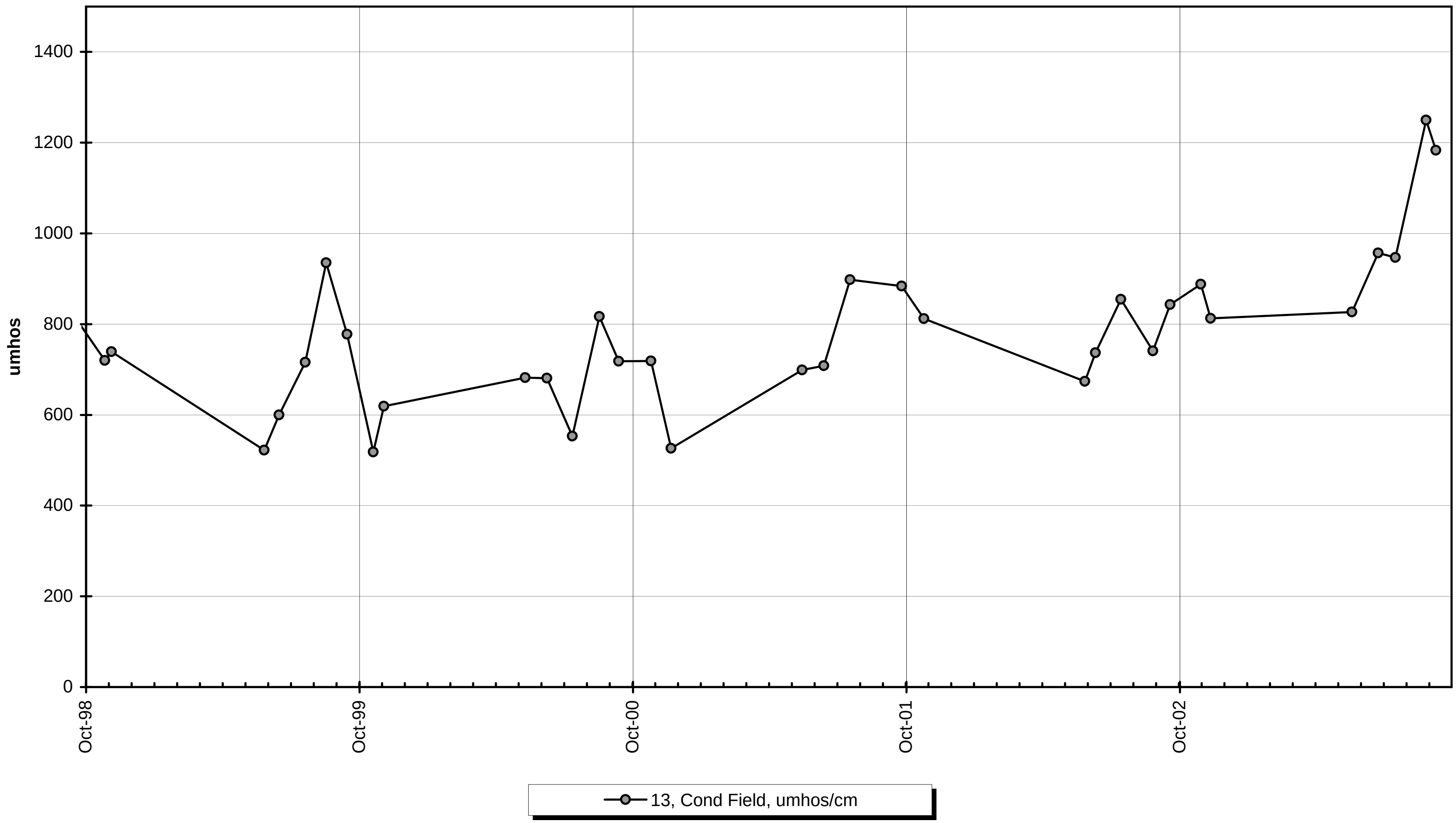
Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
13	09/09/2003	1:20:00 PM				
			SO4 Tot, mg/l	544	J	Sample Temperature
			As Diss, ug/l	0.188	J	Below Quantitative Range
			Hg Diss, ug/l	0.000618	J	Method Blank Contamination

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

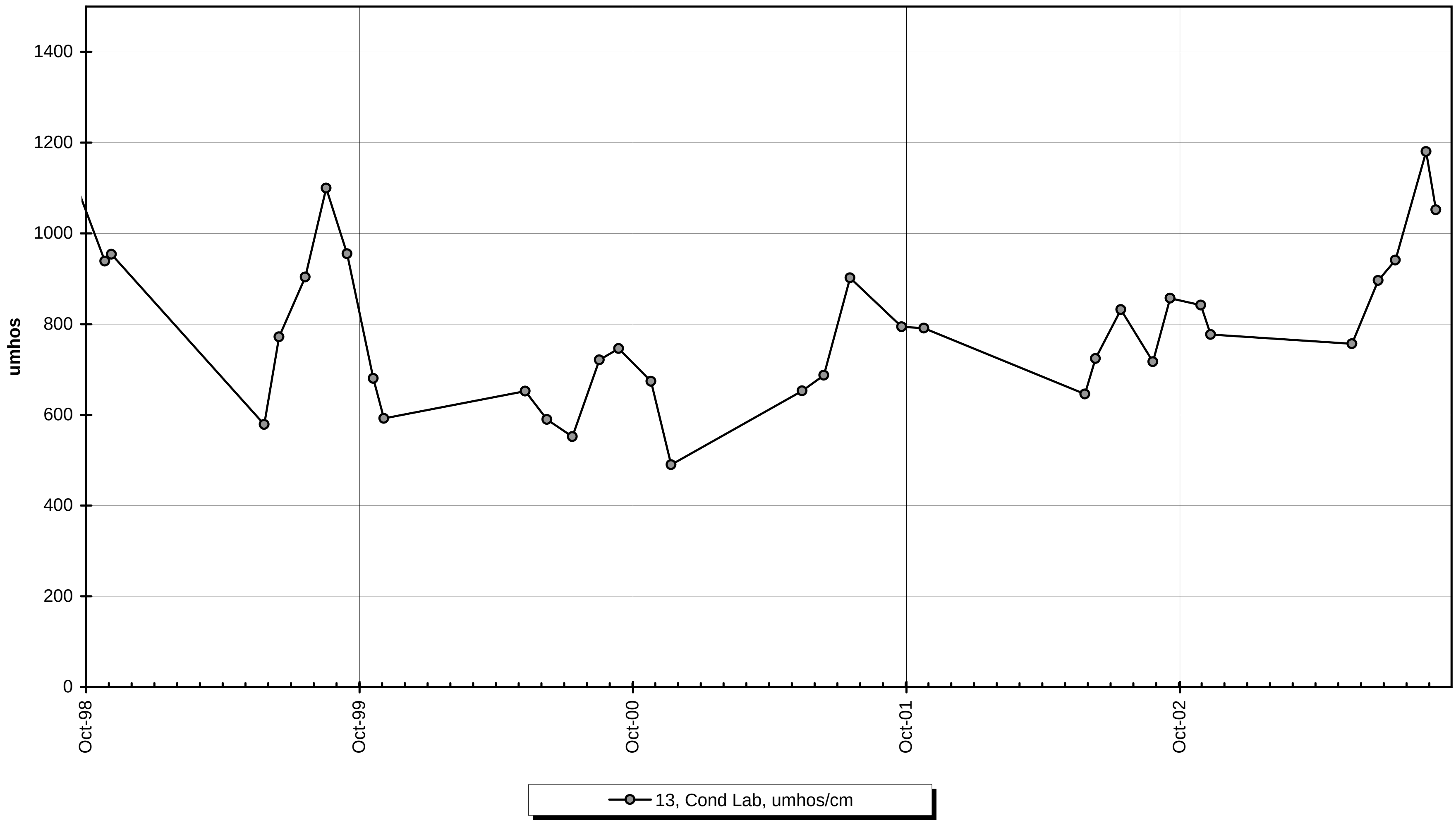
Site 13 -Water Temperature

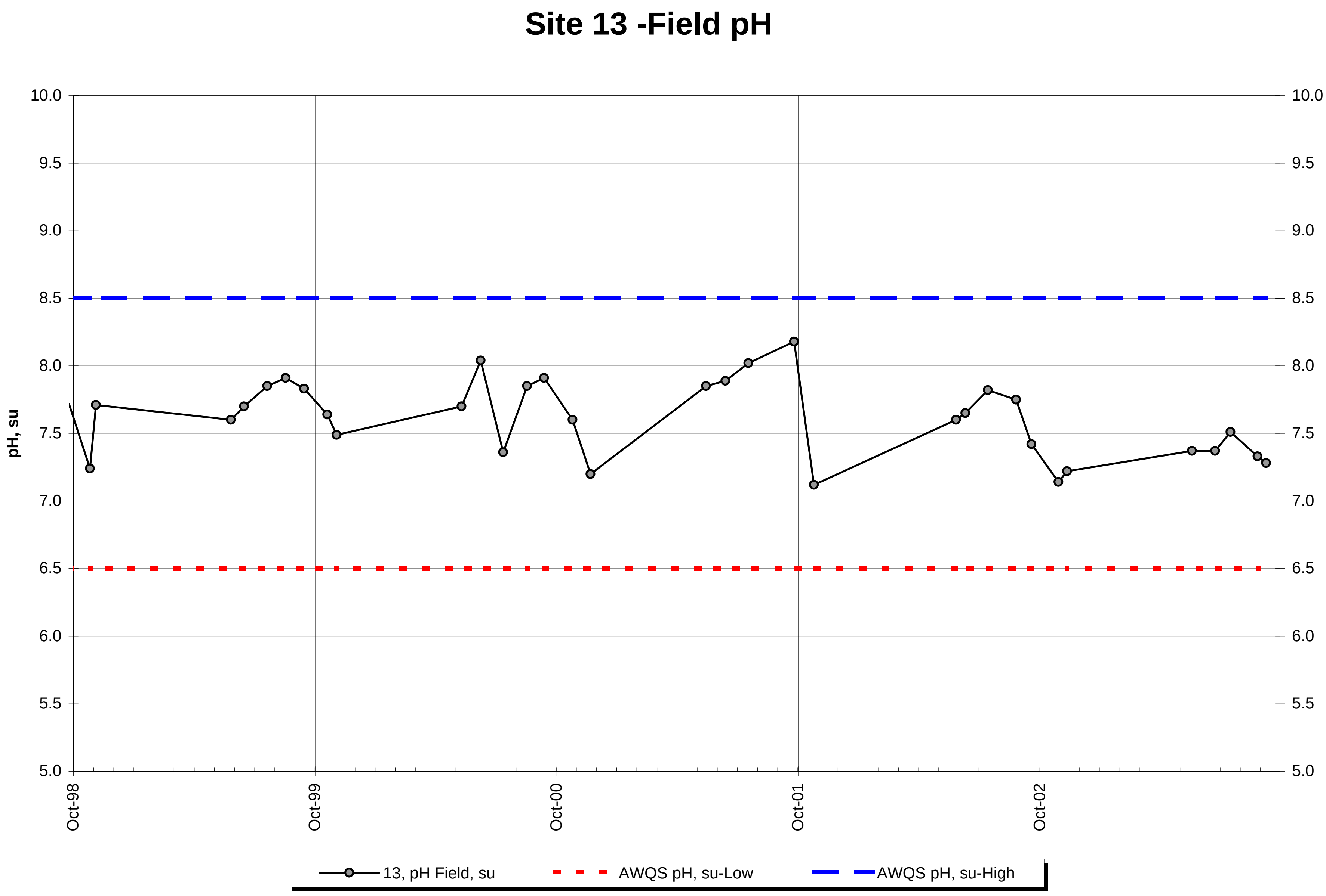


Site 13 -Conductivity-Field



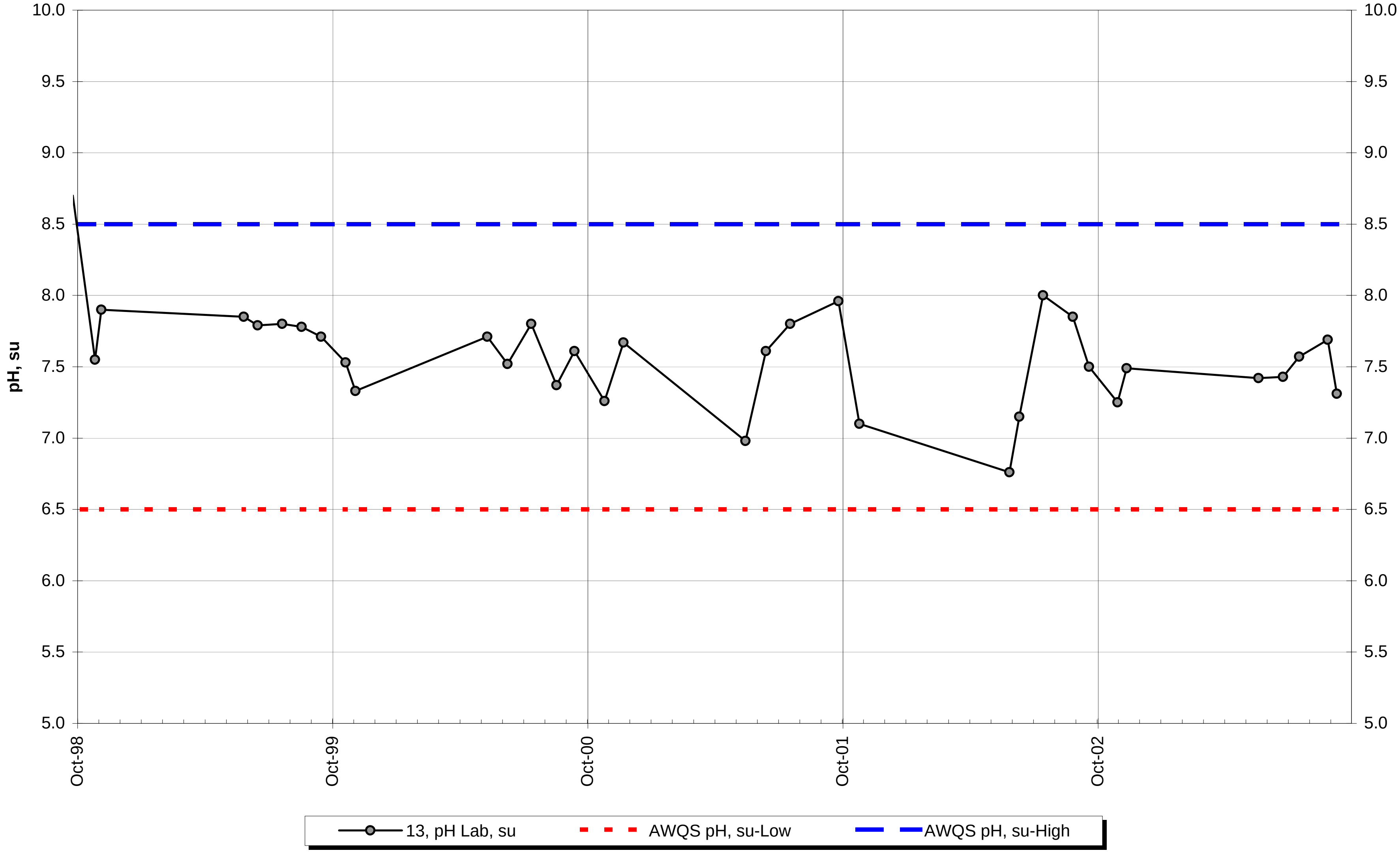
Site 13 -Conductivity-Lab



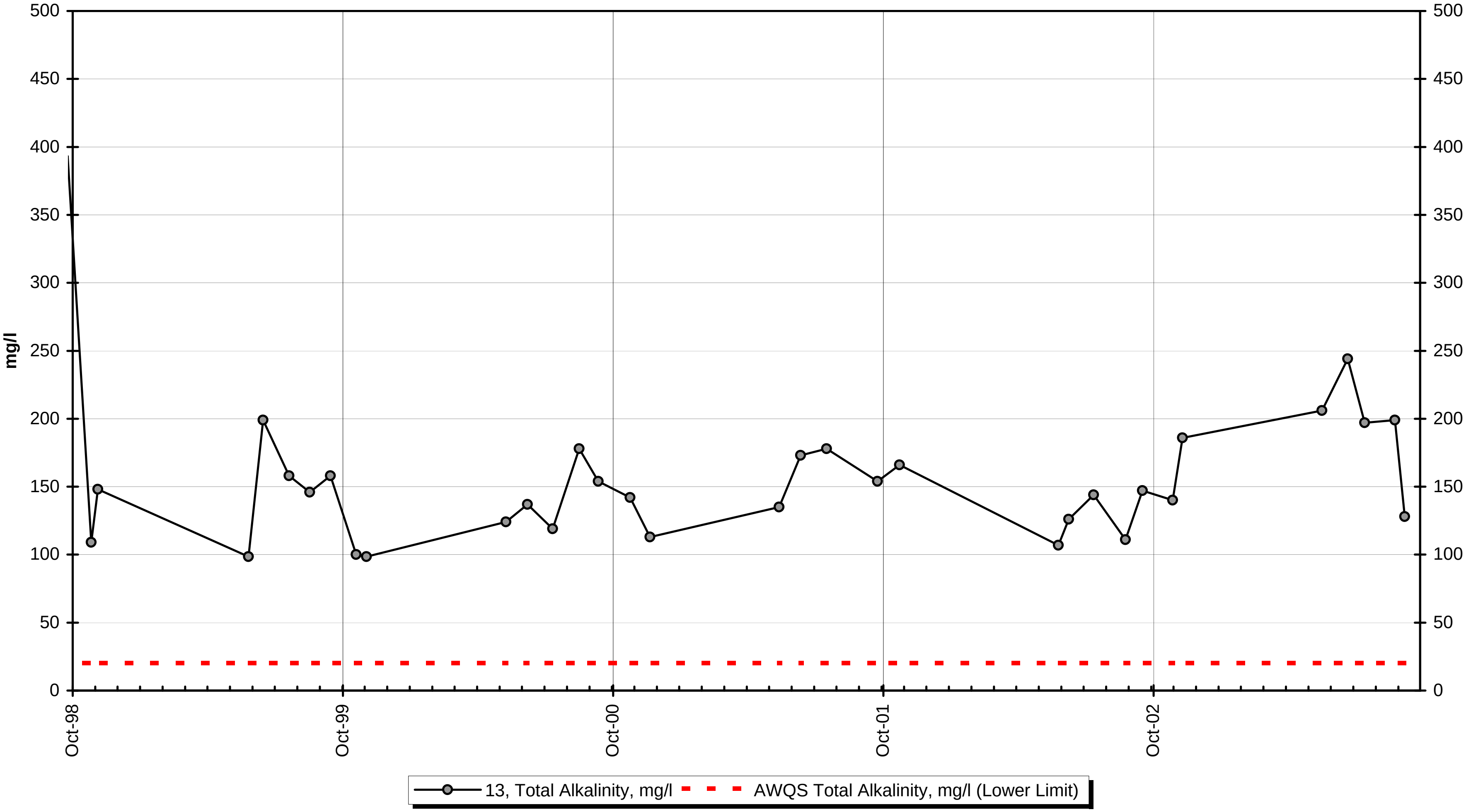


Site 13 -Field pH
pH, su
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
13, pH Field, su
AWQS pH, su-Low
AWQS pH, su-High

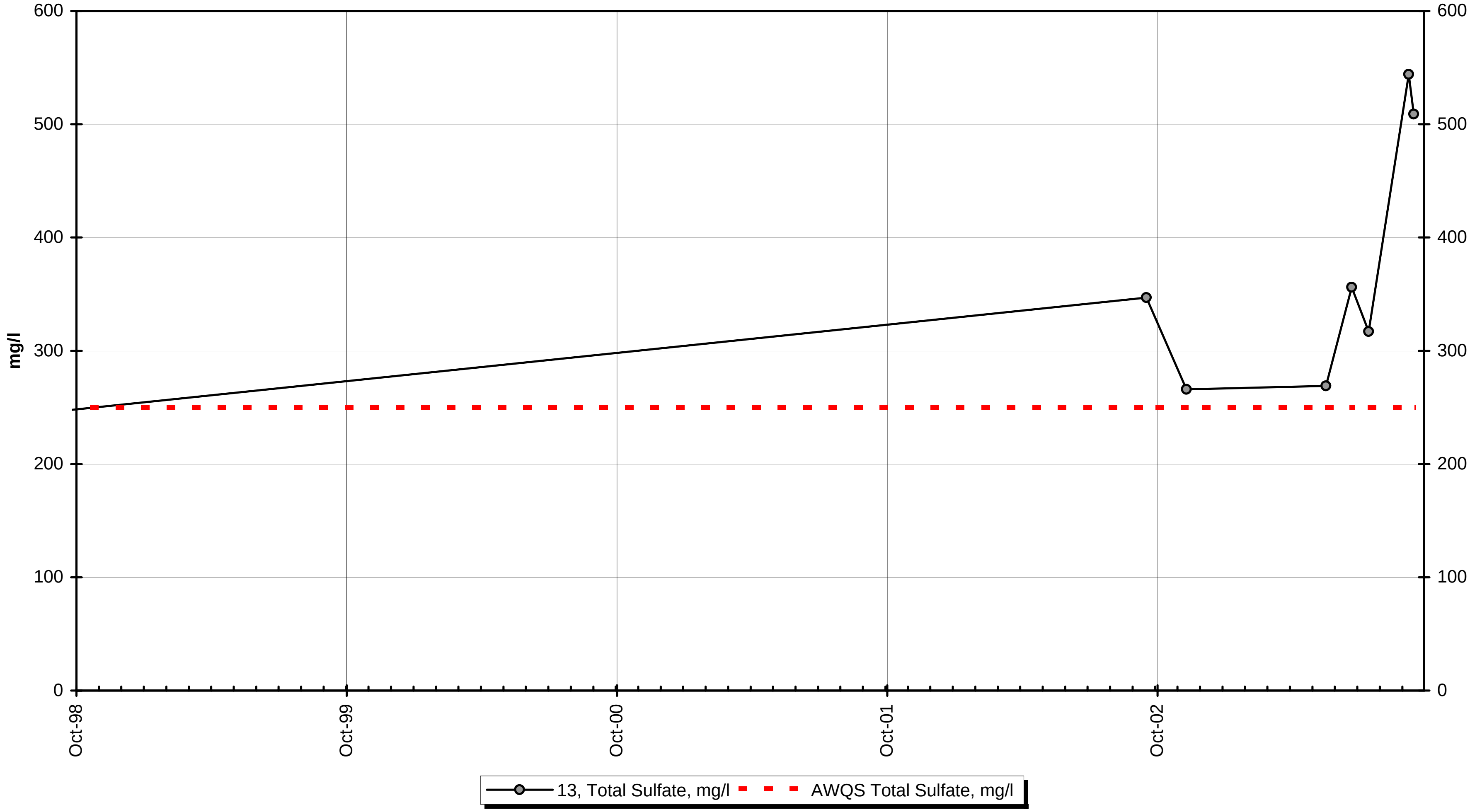
Site 13 -Lab pH



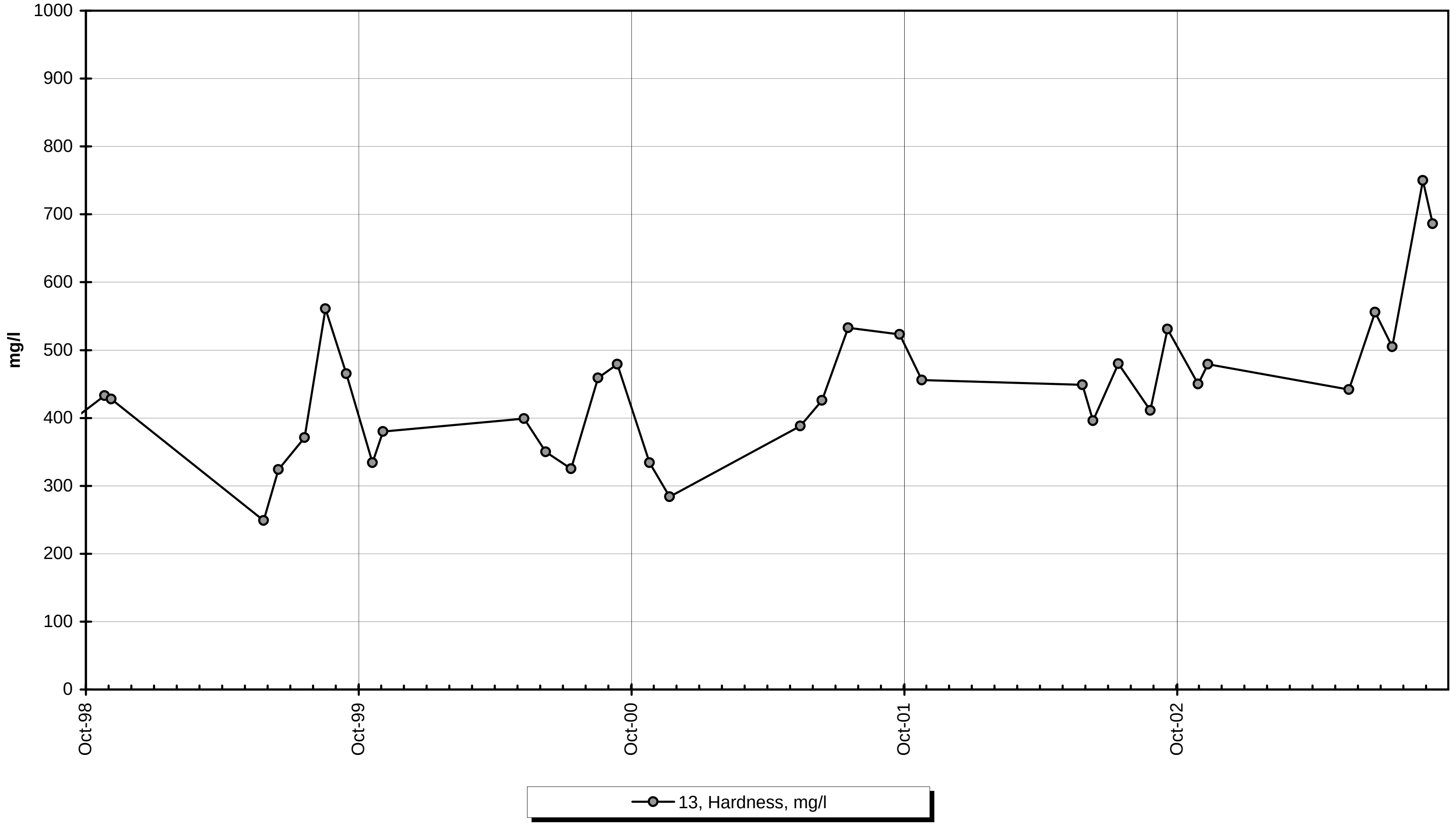
Site 13 -Total Alkalinity



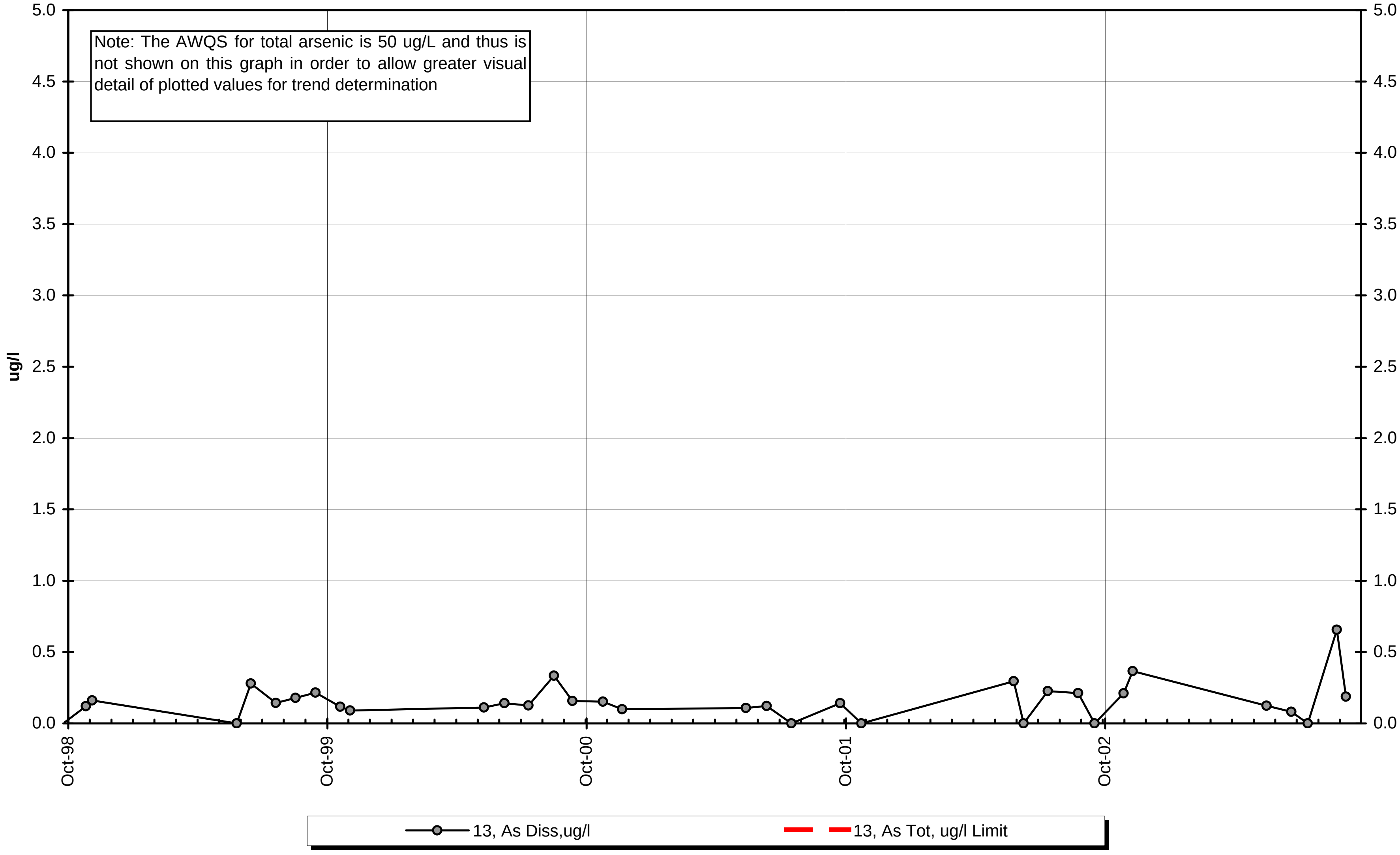
Site 13 -Total Sulfate



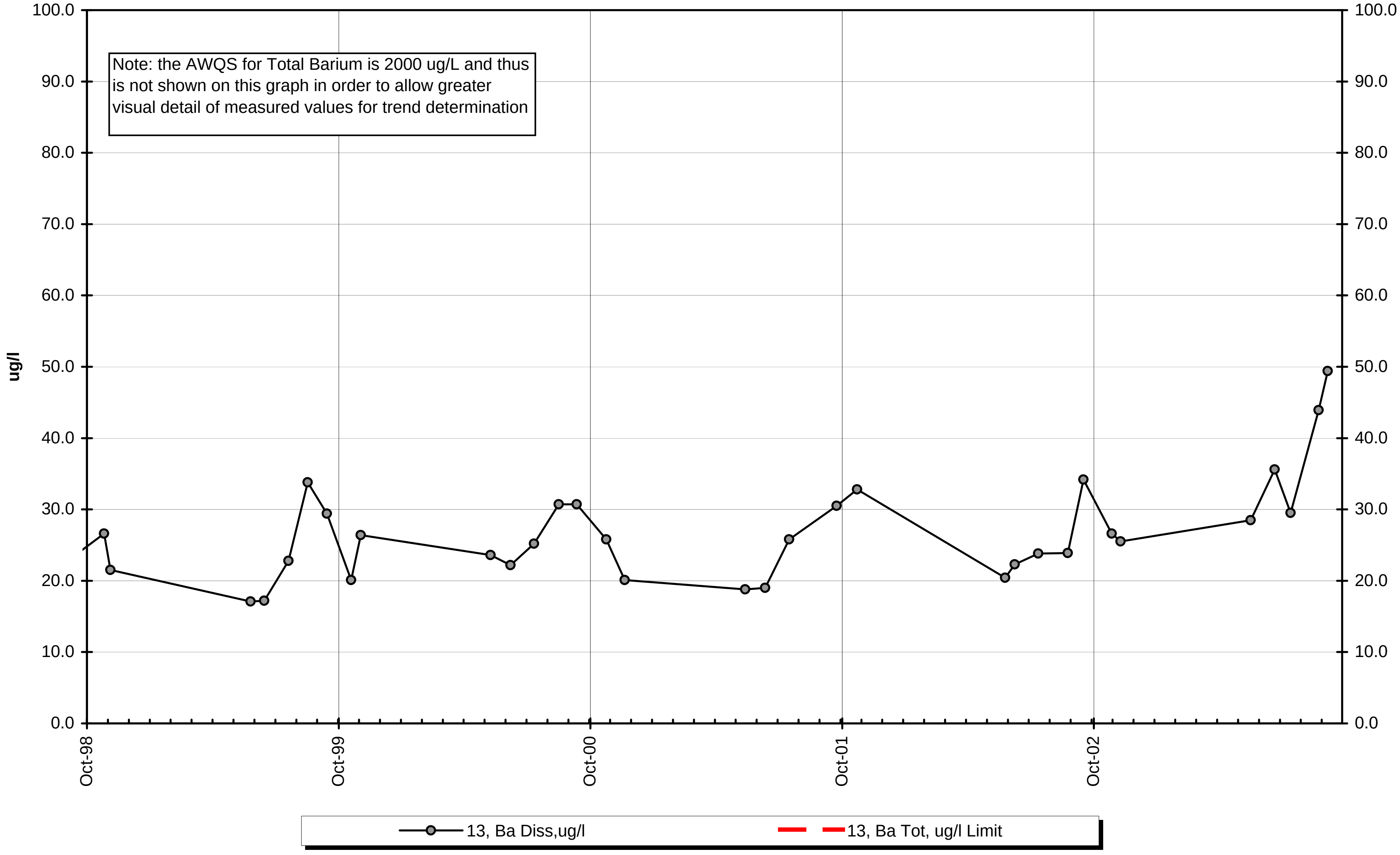
Site 13 -Hardness



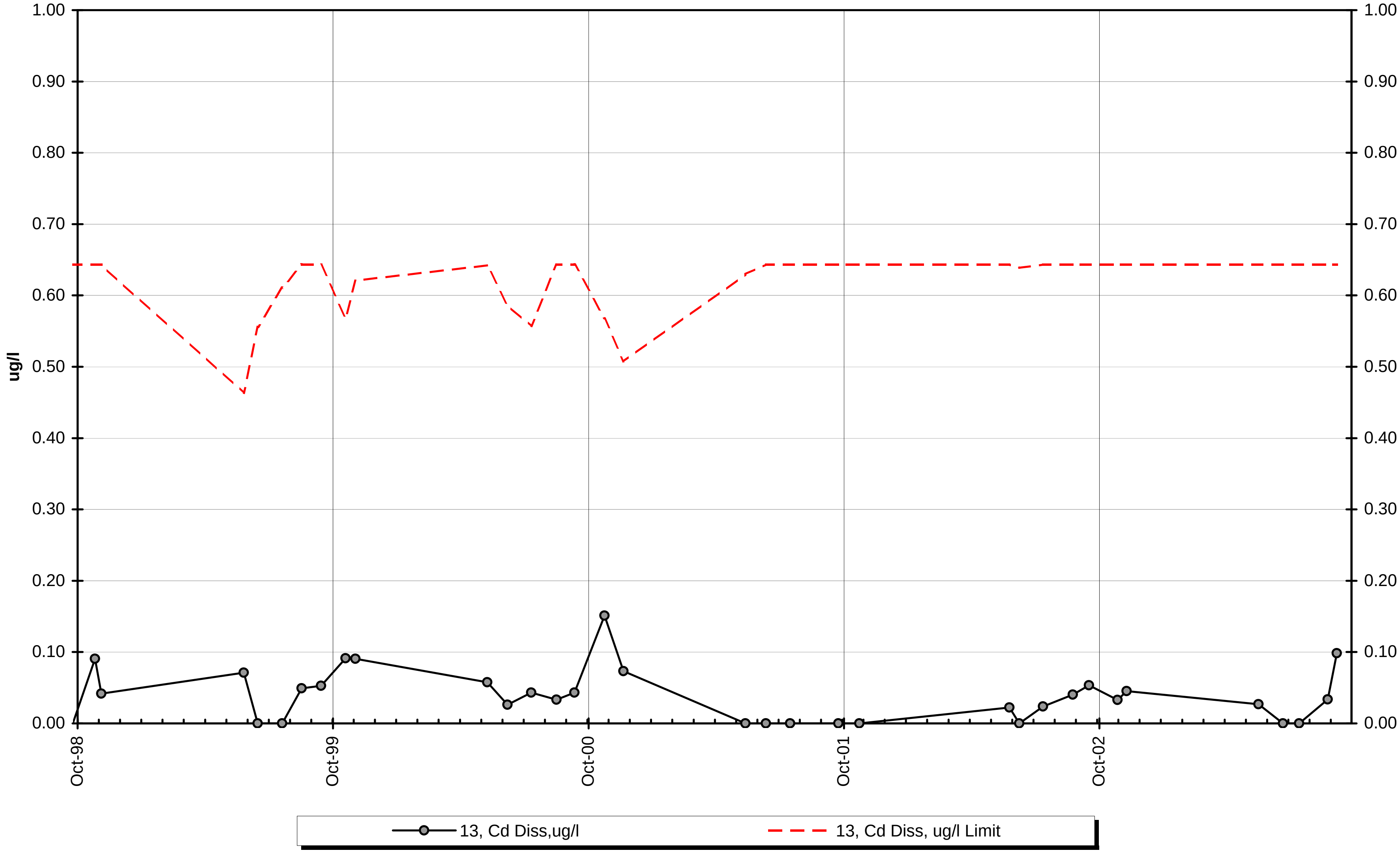
Site 13 -Dissolved Arsenic



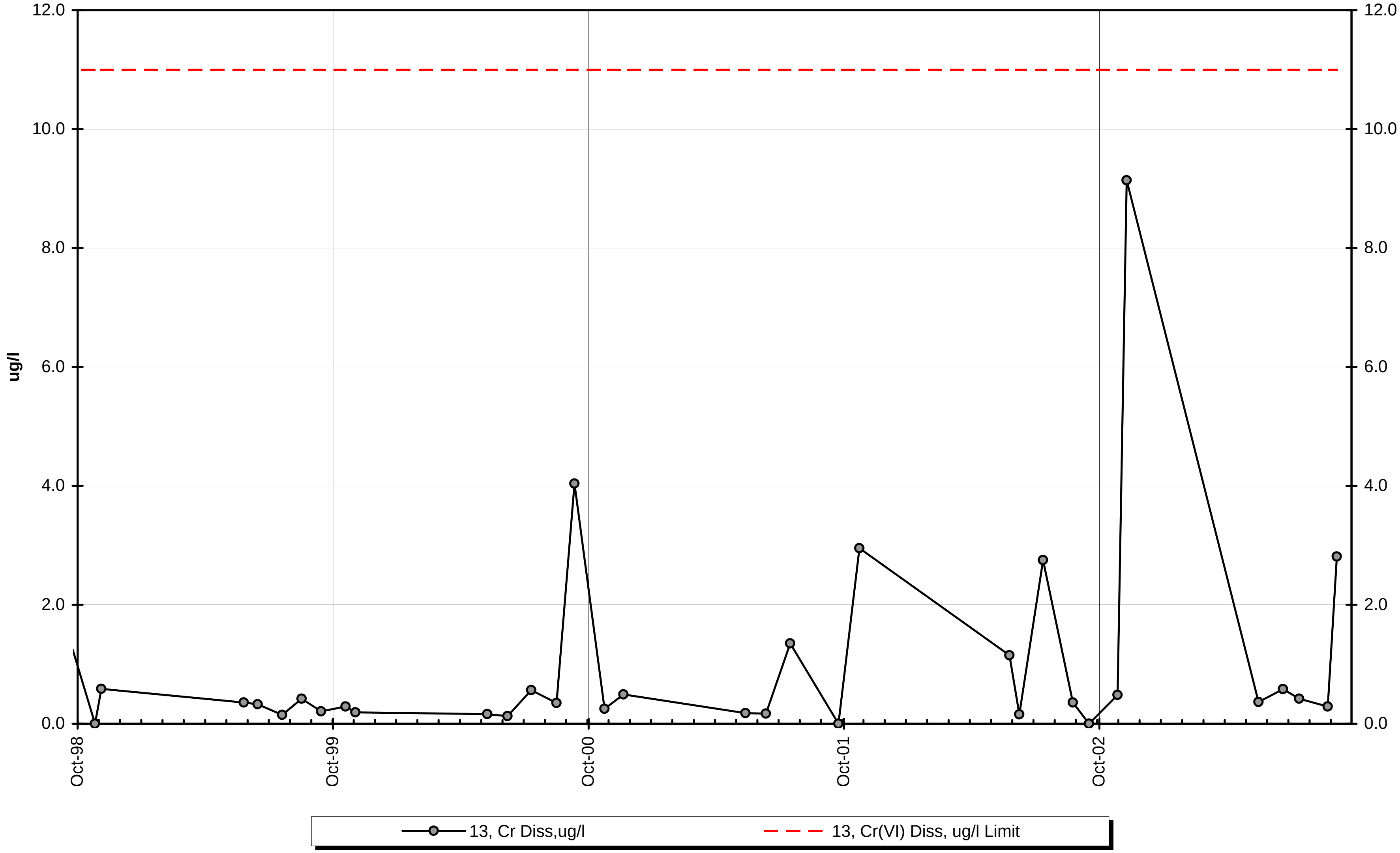
Site 13 -Dissolved Barium

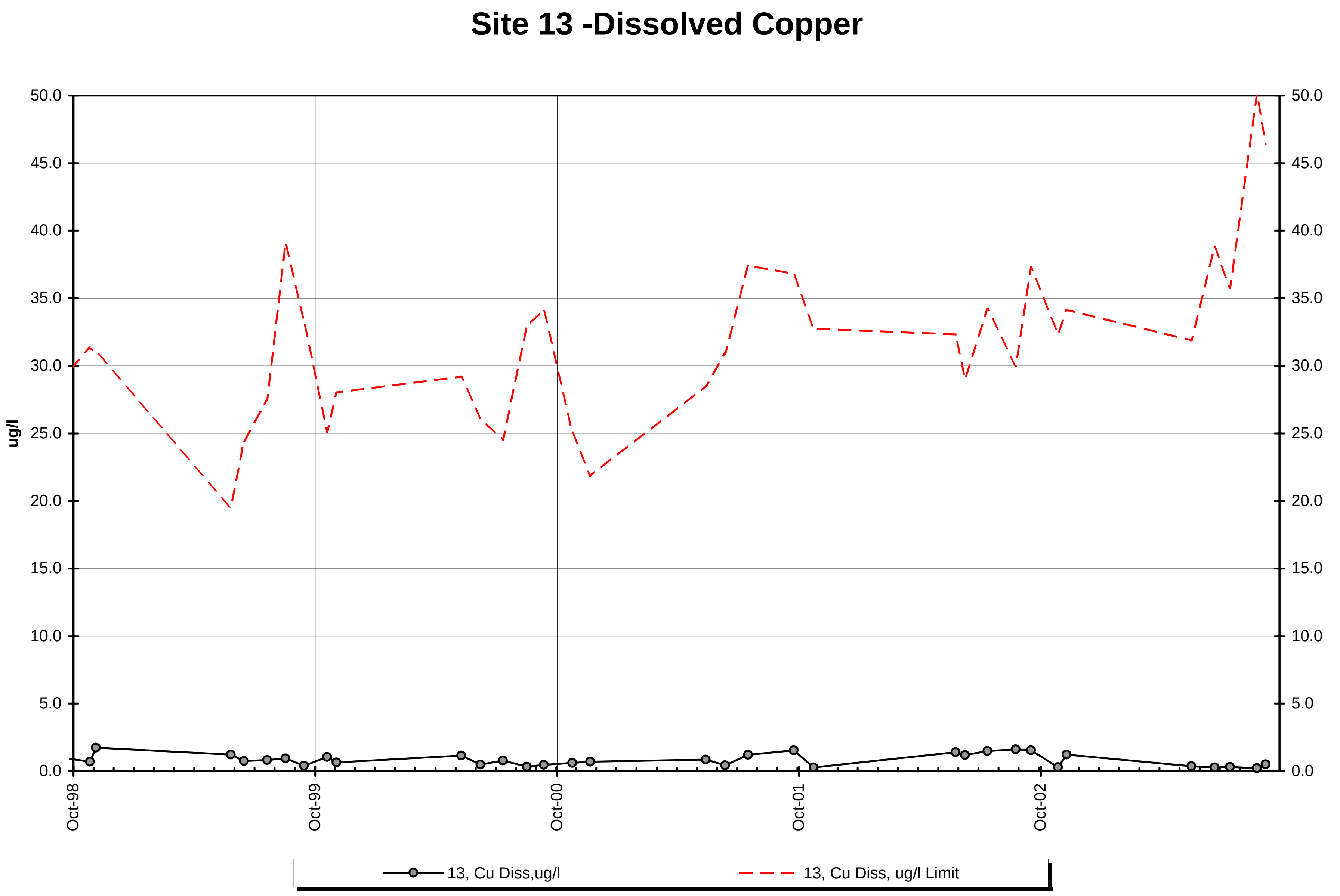


Site 13 -Dissolved Cadmium



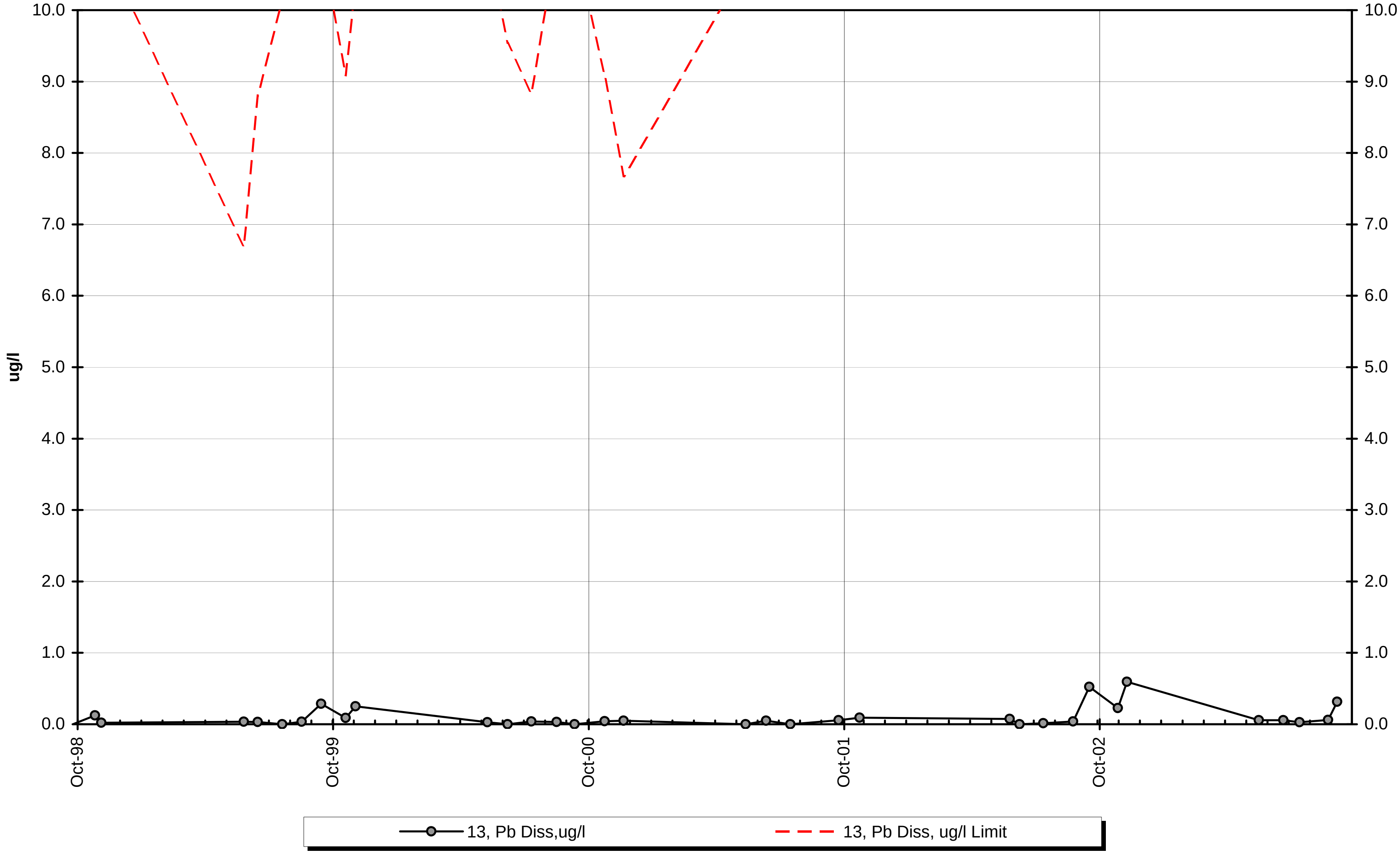
Site 13 -Dissolved Chromium



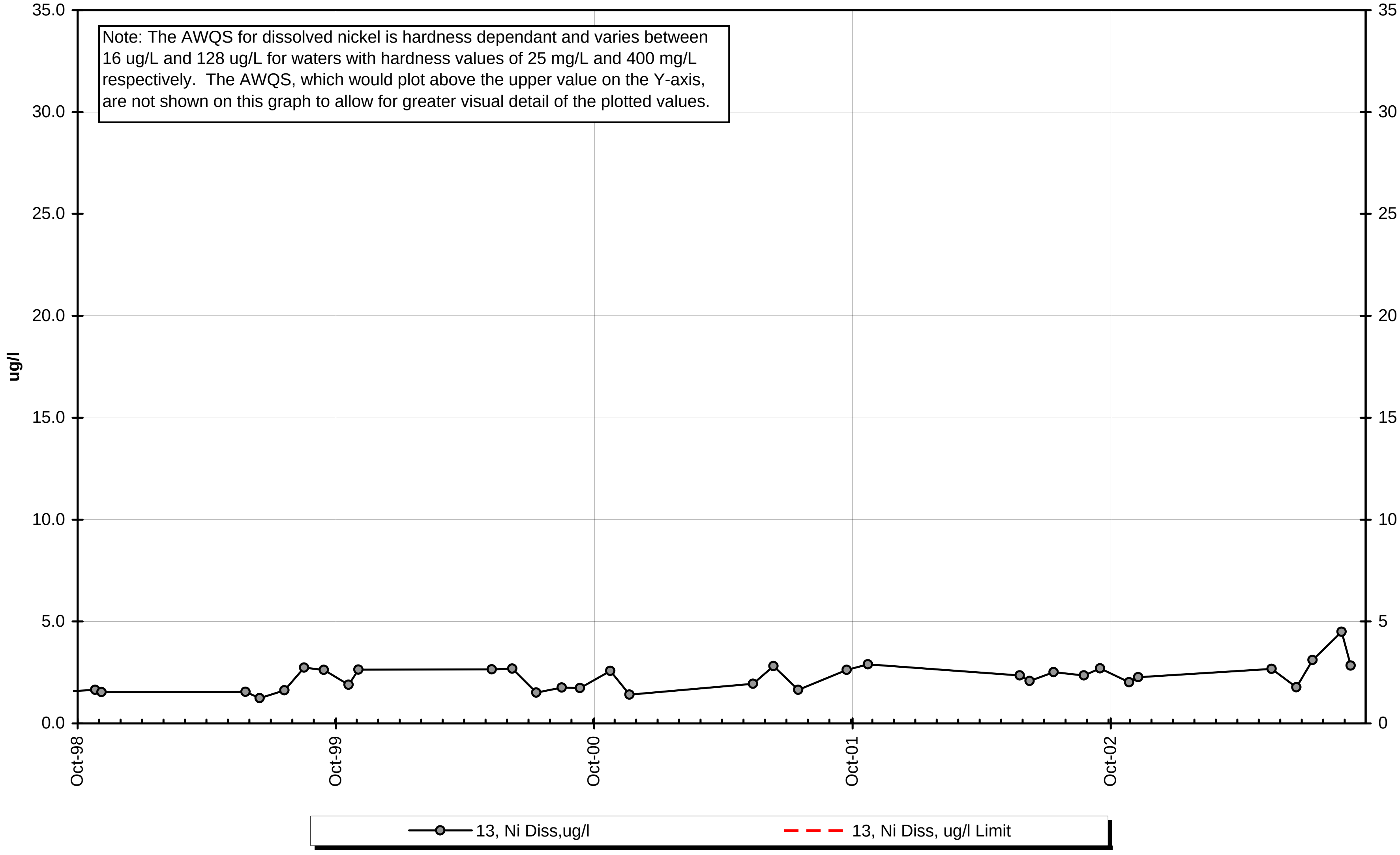


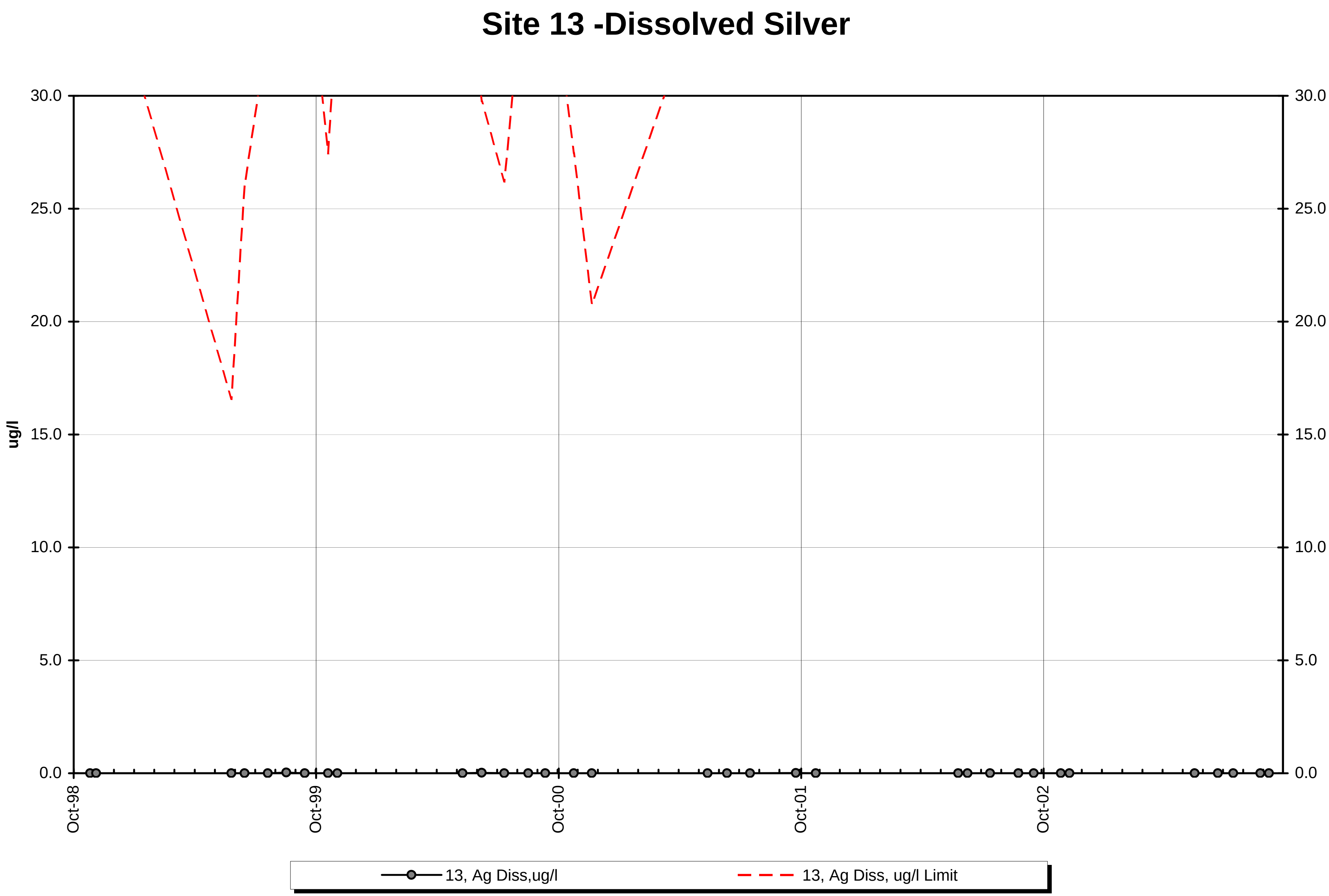
Site 13 -Dissolved Copper
ug/l
50.0
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
13, Cu Diss,ug/l
13, Cu Diss, ug/l Limit

Site 13 -Dissolved Lead

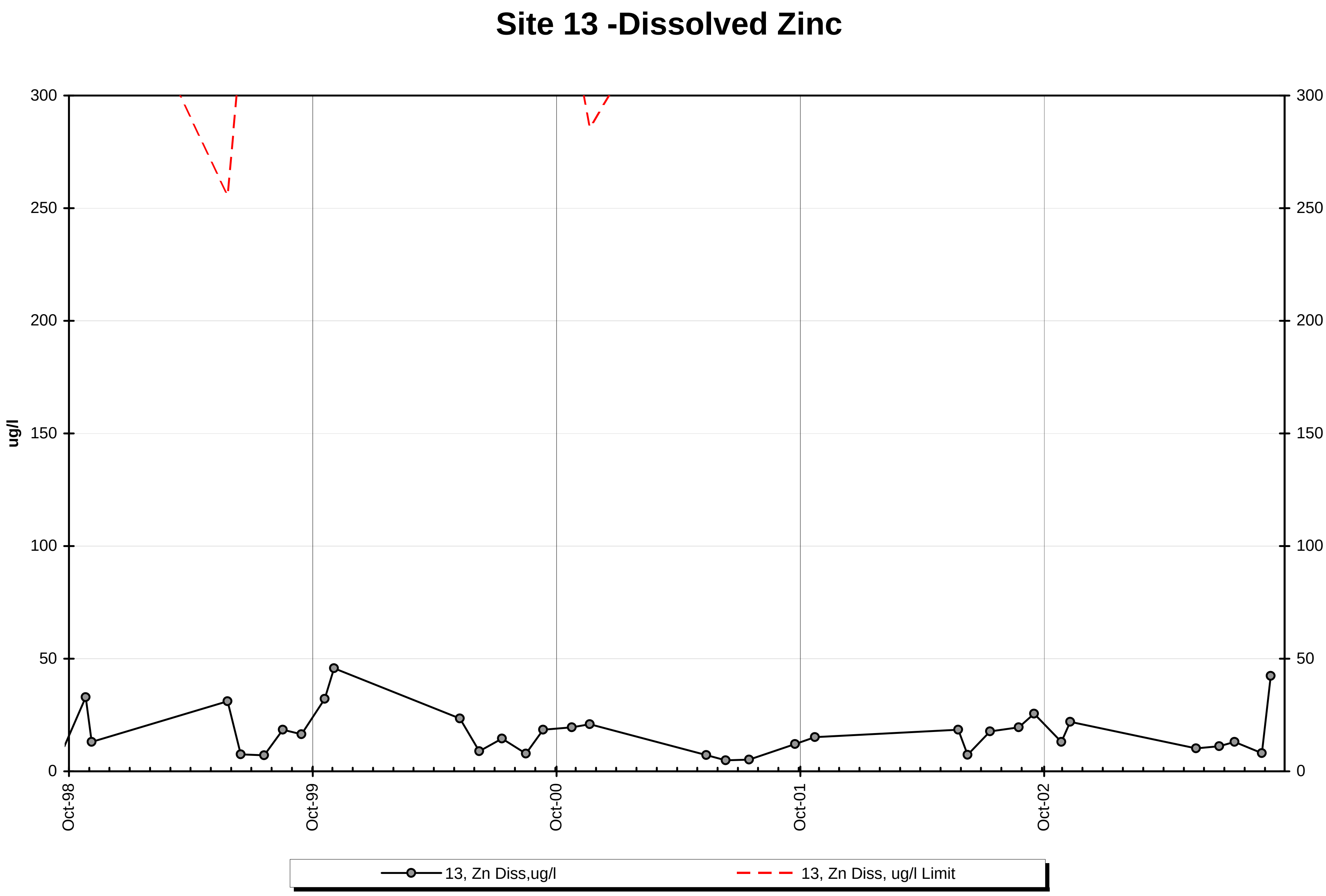


Site 13 -Dissolved Nickel

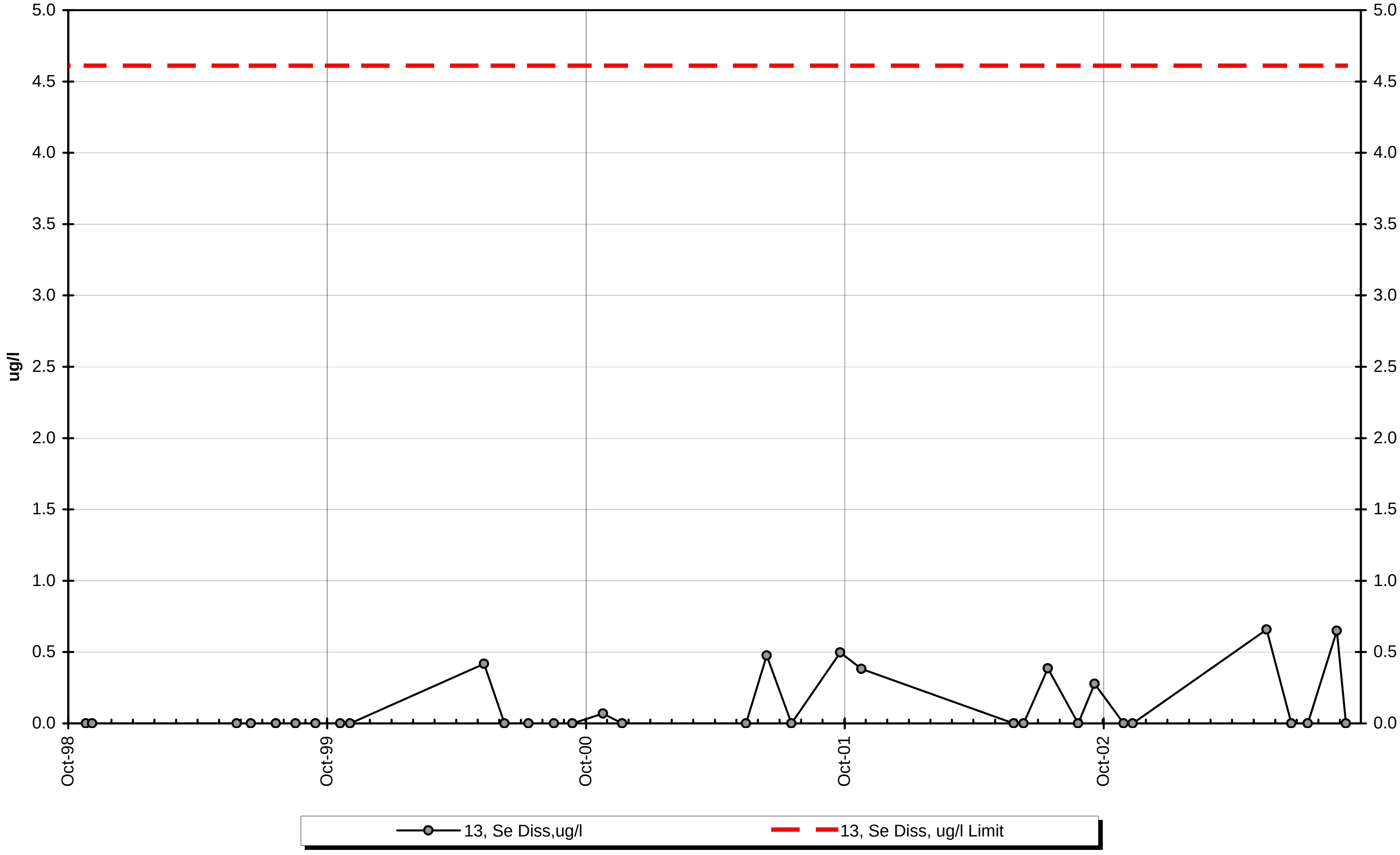


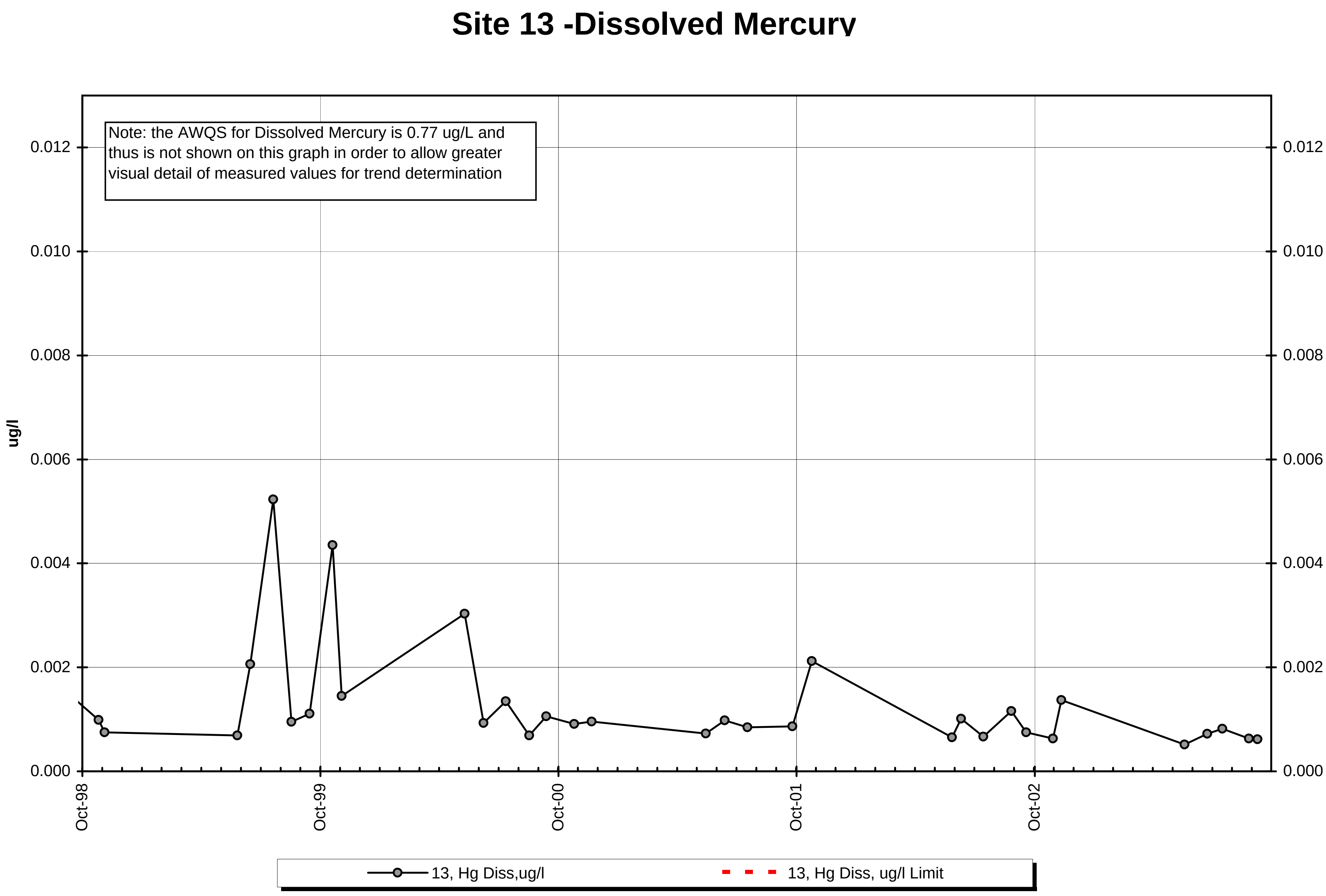


Site 13 -Dissolved Silver
ug/l
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
13, Ag Diss,ug/l
13, Ag Diss, ug/l Limit


Site 13 -Dissolved Zinc
ug/l
300
250
200
150
100
50
0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
13, Zn Diss,ug/l
13, Zn Diss, ug/l Limit

Site 13 -Dissolved Selenium





Site 13 -Dissolved Mercury
Note: the AWQS for Dissolved Mercury is 0.77 ug/L and thus is not shown on this graph in order to allow greater visual detail of measured values for trend determination
ug/l
0.012
0.010
0.008
0.006
0.004
0.002
0.000
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
13, Hg Diss,ug/l
13, Hg Diss, ug/l Limit

Site **#13** Seasonal Mann-Kendall analysis for Specific Conductance, Lab (umhos/cm @ 25°C)

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY1998**	1070	1040					1140	800		1180	1360	1080
b	**WY1999**	939	954						579	772	904	1100	955
c	**WY2000**	680	592						652	590	552	721	746
d	**WY2001**	674	490						653	687	902		794
e	**WY2002**	791							646	724	832	717	857
f	**WY2003**	842	777						757	896	941	1180	1052
	n	6	5	0	0	0	0	1	6	5	6	5	6
	t_1	0	0	0	0	0	0	0	0	0	0	0	0
	t_2	0	0	0	0	0	0	0	0	0	0	0	0
	t_3	0	0	0	0	0	0	0	0	0	0	0	0
	t_4	0	0	0	0	0	0	0	0	0	0	0	0
	t_5	0	0	0	0	0	0	0	0	0	0	0	0
	b-a	-1	-1						-1		-1	-1	-1
	c-a	-1	-1						-1		-1	-1	-1
	d-a	-1	-1						-1		-1		-1
	e-a	-1							-1		-1	-1	-1
	f-a	-1	-1						-1		-1	-1	-1
	c-b	-1	-1						1	-1	-1	-1	-1
	d-b	-1	-1						1	-1	-1		-1
	e-b	-1							1	-1	-1	-1	-1
	f-b	-1	-1						1	1	1	1	1
	d-c	-1	-1						1	1	1		1
	e-c	1							-1	1	1	-1	1
	f-c	1	1						1	1	1	1	1
	e-d	1							-1	1	-1		1
	f-d	1	1						1	1	1		1
	f-e	1							1	1	1	1	1
	S_k	-5	-6	0	0	0	0	0	1	4	-3	-4	-1
	σ^2_S=	28.33	16.67						28.33	16.67	28.33	16.67	28.33
	Z_k = S_k/σ_S	-0.94	-1.47						0.19	0.98	-0.56	-0.98	-0.19
	Z^2_k	0.88	2.16						0.04	0.96	0.32	0.96	0.04

ΣZ_k= -2.97

ΣZ^2_k= 5.35

Z-bar=ΣZ_k/K= -0.42

p(Z-bar)= 0.336

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

Σn	40
ΣS_k	-14
V(S)	7367
Z	-0.175
K	7

χ^2_h=ΣZ^2_k-K(Z-bar)^2= 3.19

p 0.79

@α=5% $\chi^2_{(K-1)}$= 12.59

Test for station homogeneity

$\chi^2_h<\chi^2_{(K-1)}$ ACCEPT

K*(Z-bar)^2= 2.16

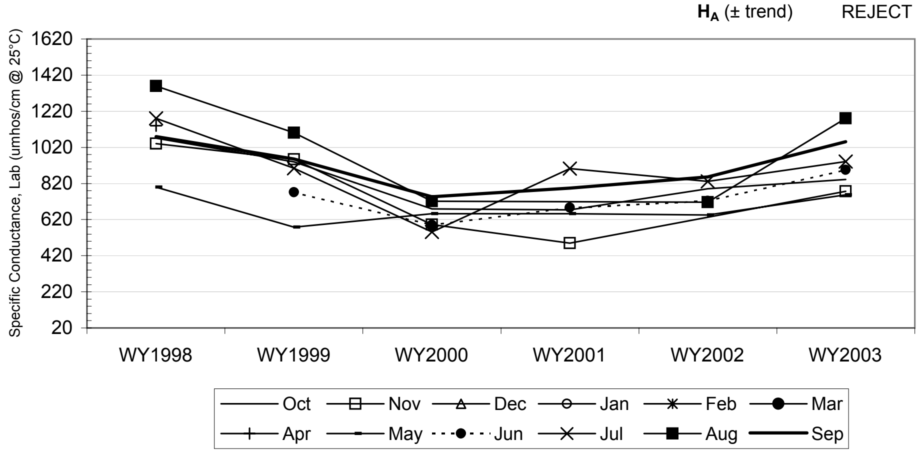
p 0.14

@α=5% $\chi^2_{(1)}$= 3.84

K*(Z-bar)² < $\chi^2_{(1)}$

H_0 (No trend) ACCEPT

H_A (± trend) REJECT



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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY1998**	7.77	7.60					8.01	8.25		7.53	7.76	8.70
b	**WY1999**	7.55	7.90						7.85	7.79	7.80	7.78	7.71
c	**WY2000**	7.53	7.33						7.71	7.52	7.80	7.37	7.61
d	**WY2001**	7.26	7.67						6.98	7.61	7.80		7.96
e	**WY2002**	7.10							6.76	7.15	8.00	7.85	7.50
f	**WY2003**	7.25	7.49						7.42	7.43	7.57	7.69	7.31
	n	6	5	0	0	0	0	1	6	5	6	5	6

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

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a	-1	1						-1		1	1	-1
c-a	-1	-1						-1		1	-1	-1
d-a	-1	1						-1		1		-1
e-a	-1							-1		1	1	-1
f-a	-1	-1						-1		1	-1	-1
c-b	-1	-1						-1	-1	0	-1	-1
d-b	-1	-1						-1	-1	0		1
e-b	-1							-1	-1	1	1	-1
f-b	-1	-1						-1	-1	-1	-1	-1
d-c	-1	1						-1	1	0		1
e-c	-1							-1	-1	1	1	-1
f-c	-1	1						-1	-1	-1	1	-1
e-d	-1							-1	-1	1		-1
f-d	-1	-1						1	-1	-1		-1
f-e	1							1	1	-1	-1	-1
S_k	-13	-2	0	0	0	0	0	-11	-6	4	0	-11

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	28.33	16.67						28.33	16.67	27.33	16.67	28.33
$Z_k = S_k/\sigma_S$	-2.44	-0.49						-2.07	-1.47	0.77	0.00	-2.07
Z^2_k	5.96	0.24						4.27	2.16	0.59	0.00	4.27

ΣZ_k=	-7.77
ΣZ^2_k=	17.49
Z-bar=ΣZ_k/K=	-1.11
p(Z-bar)=	0.134

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

Σn	40
ΣS_k	-39
V(S)	7367
Z	-0.466
K	7

$\chi^2_h = \Sigma Z^2_k - K(\text{Z-bar})^2$= 2.71 p 0.84

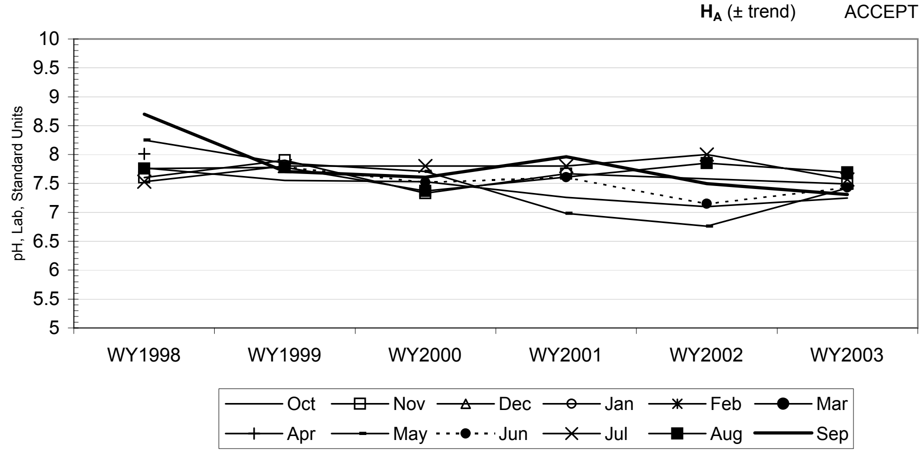
@α=5% $\chi^2_{(K-1)}$= 12.59

Test for station homogeneity
$\chi^2_h < \chi^2_{(K-1)}$ ACCEPT

K*(Z-bar)^2= 14.78 p 0.00

@α=5% $\chi^2_{(1)}$= 3.84

K*(Z-bar)² < $\chi^2_{(1)}$
H_0 (No trend) REJECT
H_A (± trend) ACCEPT



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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY1998**	129	164					158	129		143	199	393
b	**WY1999**	109	148						99	199	158	146	158
c	**WY2000**	100	99						124	137	119	178	154
d	**WY2001**	142	113						135	173	178		154
e	**WY2002**	166							107	126	144	111	147
f	**WY2003**	140	186						206	244	197	199	128
	n	6	5	0	0	0	0	1	6	5	6	5	6

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

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
b-a	-1	-1						-1		1	-1	-1
c-a	-1	-1						-1		-1	-1	-1
d-a	1	-1						1		1		-1
e-a	1							-1		1	-1	-1
f-a	1	1						1		1	0	-1
c-b	-1	-1						1	-1	-1	1	-1
d-b	1	-1						1	-1	1		-1
e-b	1							1	-1	-1	-1	-1
f-b	1	1						1	1	1	1	-1
d-c	1	1						1	1	1		0
e-c	1							-1	-1	1	-1	-1
f-c	1	1						1	1	1	1	-1
e-d	1							-1	-1	-1		-1
f-d	-1	1						1	1	1		-1
f-e	-1							1	1	1	1	-1
S_k	5	0	0	0	0	0	0	5	0	7	-1	-14

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
σ^2_S=	28.33	16.67						28.33	16.67	28.33	16.67	28.33
$Z_k = S_k/\sigma_S$	0.94	0.00						0.94	0.00	1.32	-0.24	-2.63
Z^2_k	0.88	0.00						0.88	0.00	1.73	0.06	6.92

ΣZ_k= 0.32
ΣZ^2_k= 10.47
Z-bar=ΣZ_k/K= 0.05
p(Z-bar)= 0.518

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

Σn	40
ΣS_k	2
V(S)	7367
Z	0.012
K	7

$\chi^2_h = \Sigma Z^2_k - K(\text{Z-bar})^2$= 10.45
p 0.11

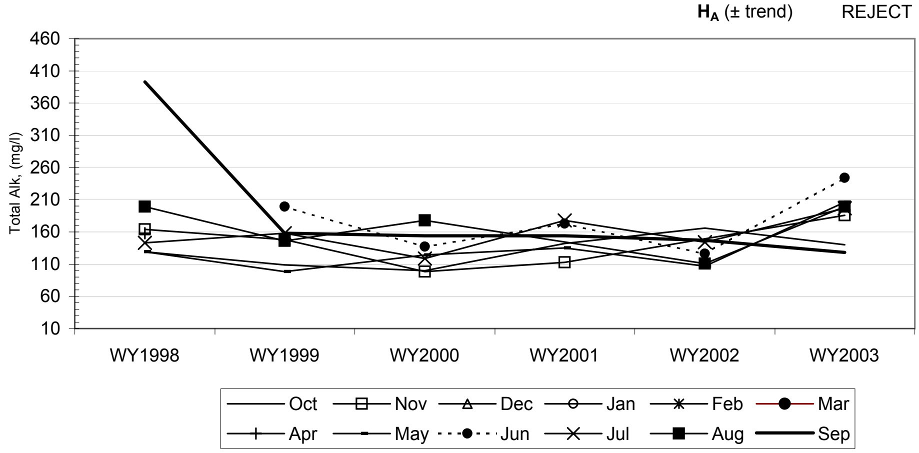
@α=5% $\chi^2_{(K-1)}$= 12.59

Test for station homogeneity
$\chi^2_h < \chi^2_{(K-1)}$ ACCEPT

K*(Z-bar)^2= 0.02
p 0.87

@α=5% $\chi^2_{(1)}$= 3.84

K*(Z-bar)² < $\chi^2_{(1)}$
H_0 (No trend) ACCEPT
H_A (± trend) REJECT



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

Row label	Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
a	**WY1998**	29.70	14.40					121.00	7.71		24.40	6.94	11.10
b	**WY1999**	32.90	13.10						31.10	7.49	7.07	18.50	16.50
c	**WY2000**	32.20	45.80						23.50	8.87	14.50	7.90	18.50
d	**WY2001**	19.50	20.90						7.25	4.93	5.21		12.10
e	**WY2002**	15.20							18.50	7.30	17.70	19.50	25.60
f	**WY2003**	13.10	22.00						10.20	11.10	13.10	8.11	42.40
	n	6	5	0	0	0	0	1	6	5	6	5	6
	t_1	0	0	0	0	0	0	0	0	0	0	0	0
	t_2	0	0	0	0	0	0	0	0	0	0	0	0
	t_3	0	0	0	0	0	0	0	0	0	0	0	0
	t_4	0	0	0	0	0	0	0	0	0	0	0	0
	t_5	0	0	0	0	0	0	0	0	0	0	0	0
	b-a	1	-1						1		-1	1	1
	c-a	1	1						1		-1	1	1
	d-a	-1	1						-1		-1		1
	e-a	-1							1		-1	1	1
	f-a	-1	1						1		-1	1	1
	c-b	-1	1						-1	1	1	-1	1
	d-b	-1	1						-1	-1	-1		-1
	e-b	-1							-1	-1	1	1	1
	f-b	-1	1						-1	1	1	-1	1
	d-c	-1	-1						-1	-1	-1		-1
	e-c	-1							-1	-1	1	1	1
	f-c	-1	-1						-1	1	-1	1	1
	e-d	-1							1	1	1		1
	f-d	-1	1						1	1	1		1
	f-e	-1							-1	1	-1	-1	1
	S_k	-11	4	0	0	0	0	0	-3	2	-3	4	11
	σ^2_S=	28.33	16.67						28.33	16.67	28.33	16.67	28.33
	$Z_k = S_k/\sigma_S$	-2.07	0.98						-0.56	0.49	-0.56	0.98	2.07
	Z^2_k	4.27	0.96						0.32	0.24	0.32	0.96	4.27

ΣZ_k= 1.32
ΣZ^2_k= 11.34
Z-bar=$\Sigma Z_k/K$= 0.19
p(Z-bar)= 0.575

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

Σn	40
ΣS_k	4
V(S)	7367
Z	0.035
K	7

$\chi^2_h = \Sigma Z^2_k - K(\text{Z-bar})^2$= 10.91
p 0.09

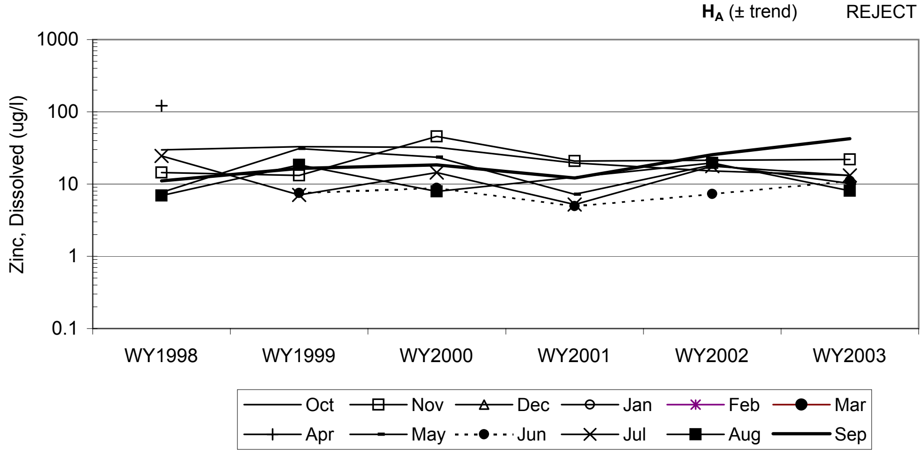
@α=5% $\chi^2_{(K-1)}$= 12.59

Test for station homogeneity
$\chi^2_h < \chi^2_{(K-1)}$ ACCEPT

K*(Z-bar)^2= 0.43
p 0.51

@α=5% $\chi^2_{(1)}$= 3.84

K*(Z-bar)² < $\chi^2_{(1)}$
H_0 (No trend) ACCEPT
H_A (± trend) REJECT



INTERPRETIVE REPORT
SITE 58 "MONITORING WELL T-00-01C"

The data collected during the current water year are listed in the following "Table of Results for Water Year 2003" report. The table includes all the data, field and lab, 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 zero for the purpose of median calculation.

Sampling at this site was added to the FWMP in May-2002. All data collected at this site since it's inception into the FWMP are included in the data analyses. As shown in the table below, there were no data outliers.

Sample Date	Parameter	Value	Qualifier	Notes
No outliers have been identified by KGCMC for the period of Oct-98 though Sept-03.				

The data for water year 2003 have been compared to the strictest fresh water quality criterion for each applicable analyte. Two (2) results exceeding these criteria have been identified, as listed in the table below. These data are both for lab pH. Values for lab pH from other wells completed into organic rich peat sediments similar to Site 58 have historically resulted in pH values ranging from 5 to 6 (e.g. Sites 27, 29, and 32).

Sample Date	Parameter	Value	Standard	Standard Type
05/21/03	pH Lab, su	6.27	6.5 - 8.5	Aquatic Life
09/10/03	pH Lab, su	6.11	6.5 - 8.5	Aquatic Life

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. The inception of sampling at this site commenced in the 2002 water year and thus only four data points are shown on each graph. There are no apparent trends present in the limited data collected to date.

Table of Results for Water Year 2003

Site 58 "MW-T-00-01C"

Sample Date/Parameter	Oct-02	Nov-02	Dec-02	Jan-03	Feb-03	Mar-03	Apr-03	5/21/2003	Jun-03	Jul-03	Aug-03	9/10/2003	**Median**
Water Temp (°C)	NOT SCHEDULED FOR SAMPLING							5.8	NOT SCHEDULED FOR SAMPLING			8.1	7.0
Conductivity-Field(μmho)								64				83	74
Conductivity-Lab (μmho)								70				81	76
pH Lab (standard units)								6.27				6.11	6.19
pH Field (standard units)								6.37				6.24	6.31
Total Alkalinity (mg/L)								28.7				37.0	32.9
Total Sulfate (mg/L)								0.6				2.1 J	1.3
Hardness (mg/L)								28.0				28.7	28.4
Dissolved As (ug/L)								0.095				<0.108	0.075
Dissolved Ba (ug/L)								6.8				7.7	7.2
Dissolved Cd (ug/L)								0.004 J				<0.023	0.008
Dissolved Cr (ug/L)								1.160				1.290	1.225
Dissolved Cu (ug/L)								0.105 U				0.067 J	0.086
Dissolved Pb (ug/L)								0.0850				<0.0650	0.0588
Dissolved Ni (ug/L)								<0.006				0.159	0.081
Dissolved Ag (ug/L)								<0.028				<0.004	0.008
Dissolved Zn (ug/L)								0.26 J				<0.14	0.17
Dissolved Se (ug/L)								<0.224 UJ				<0.496	0.180
Dissolved Hg (ug/L)								0.000516 U				0.001570 J	0.001043

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

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

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

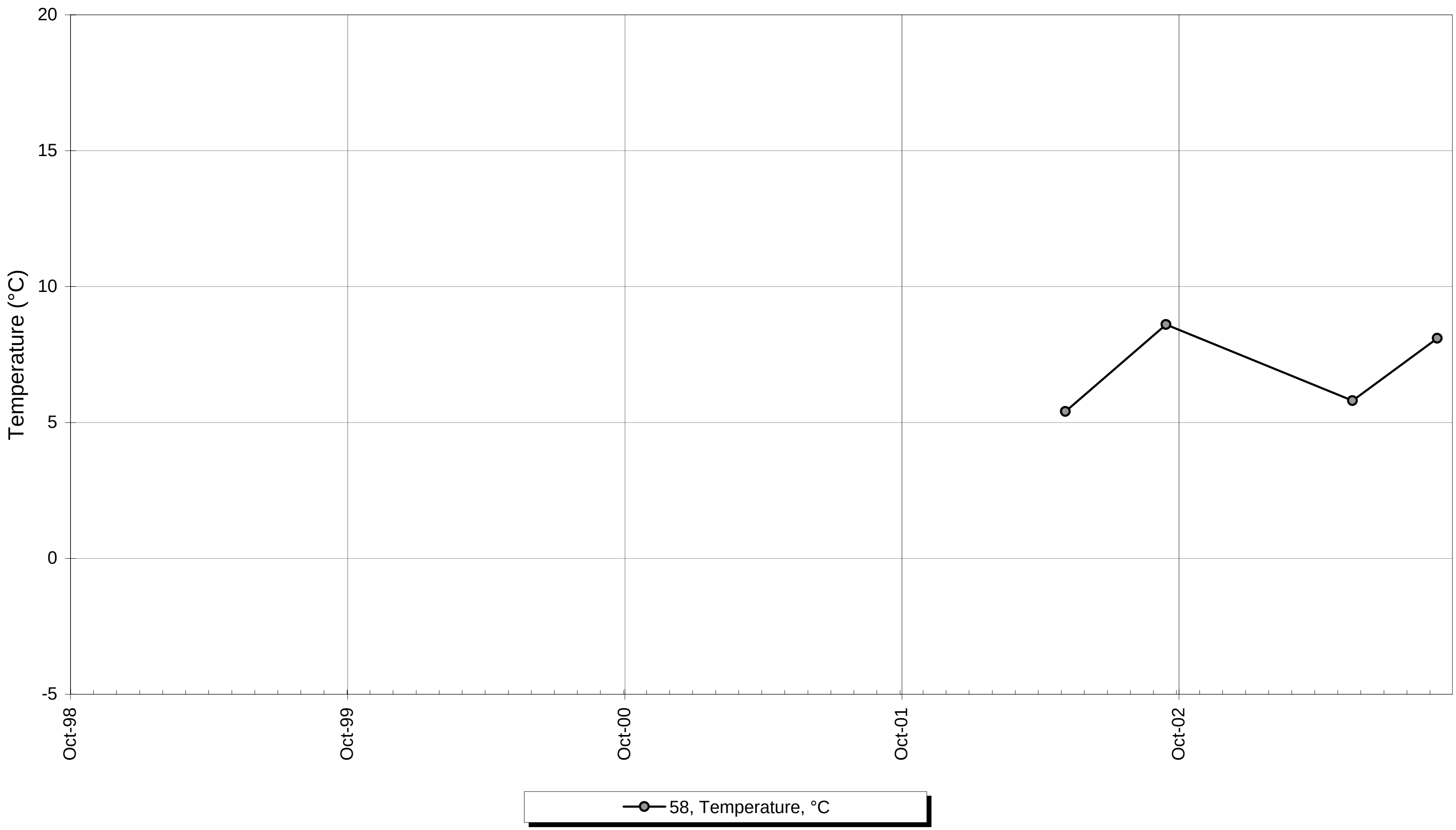
Qualified Data by QA Reviewer

Date Range: 10/01/2002 to 09/30/2003

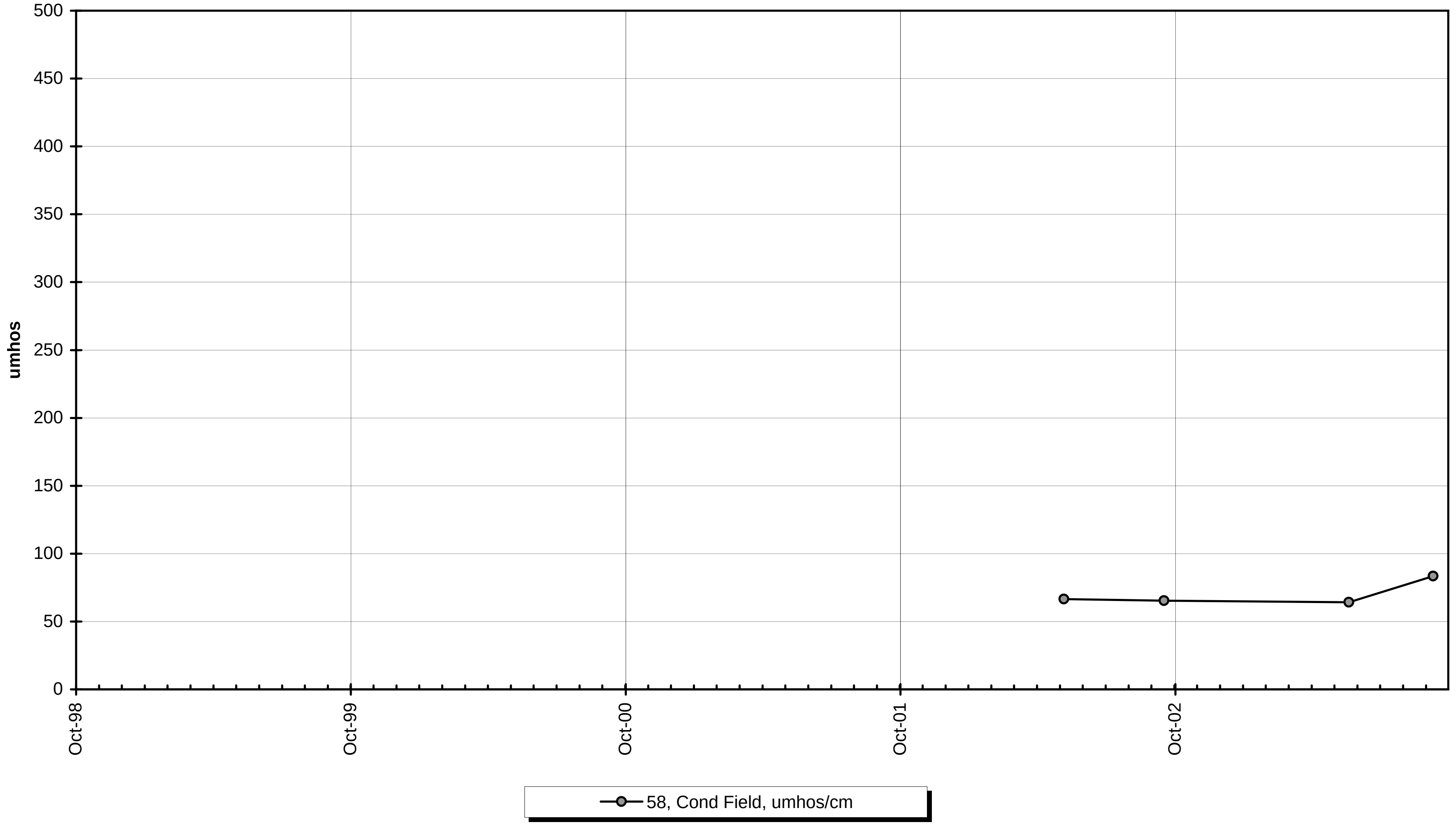
Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
58	05/21/2003	1:27:00 PM				
			Cd Diss, ug/l	0.00423	J	Below Quantitative Range
			Cu Diss, ug/l	0.105	U	Field Blank Contamination
			Zn Diss, ug/l	0.262	J	Below Quantitative Range
			Se Diss, ug/l	-0.224	UJ	LCS Recovery
			Hg Diss, ug/l	0.000516	U	Method Blank Contamination
58	09/10/2003	3:15:00 PM				
			SO4 Tot, mg/l	2.09	J	Sample Temperature
			Cu Diss, ug/l	0.0665	J	Below Quantitative Range
			Hg Diss, ug/l	0.00157	J	Duplicate RPD

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

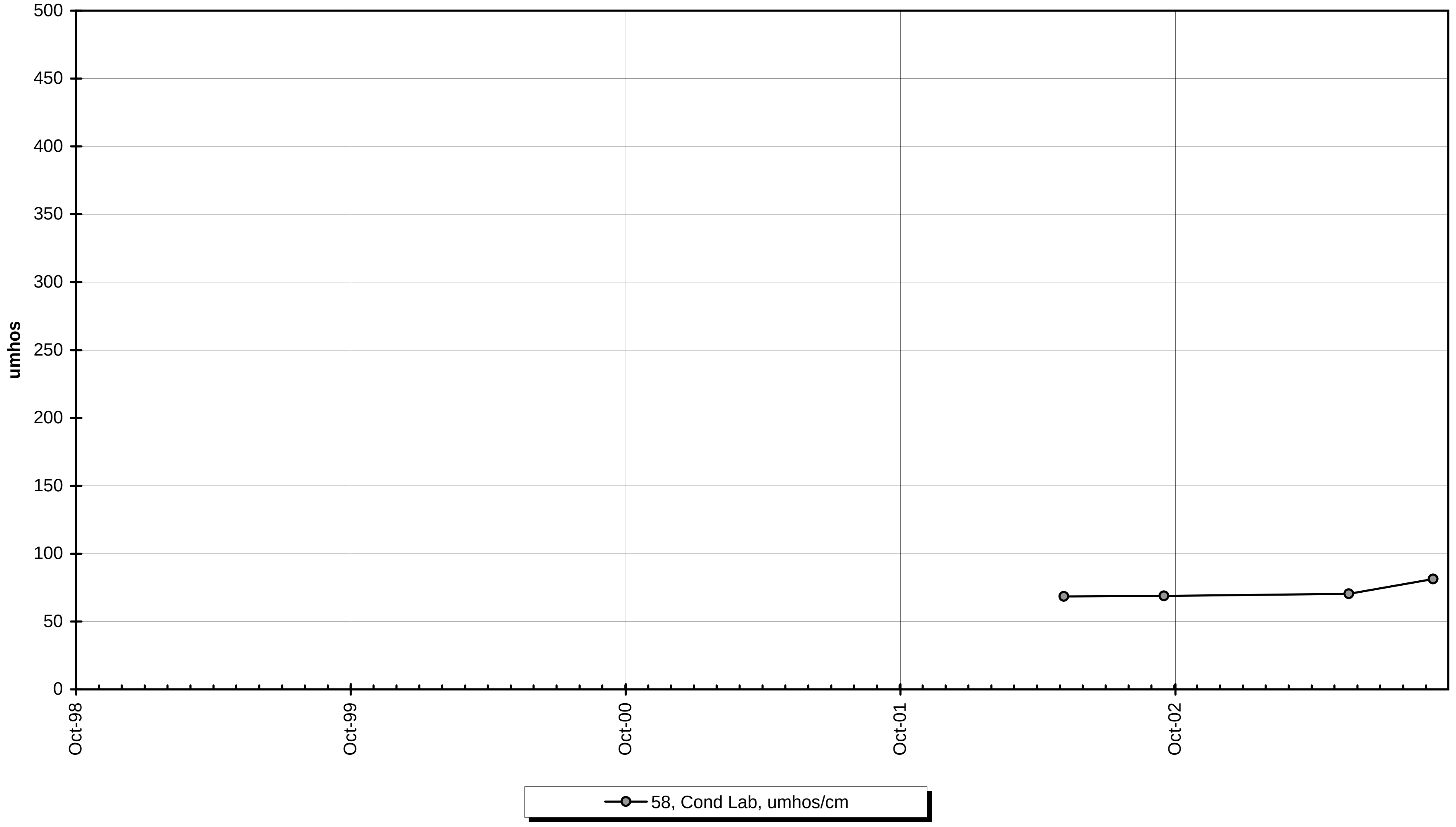
Site 58 -Water Temperature



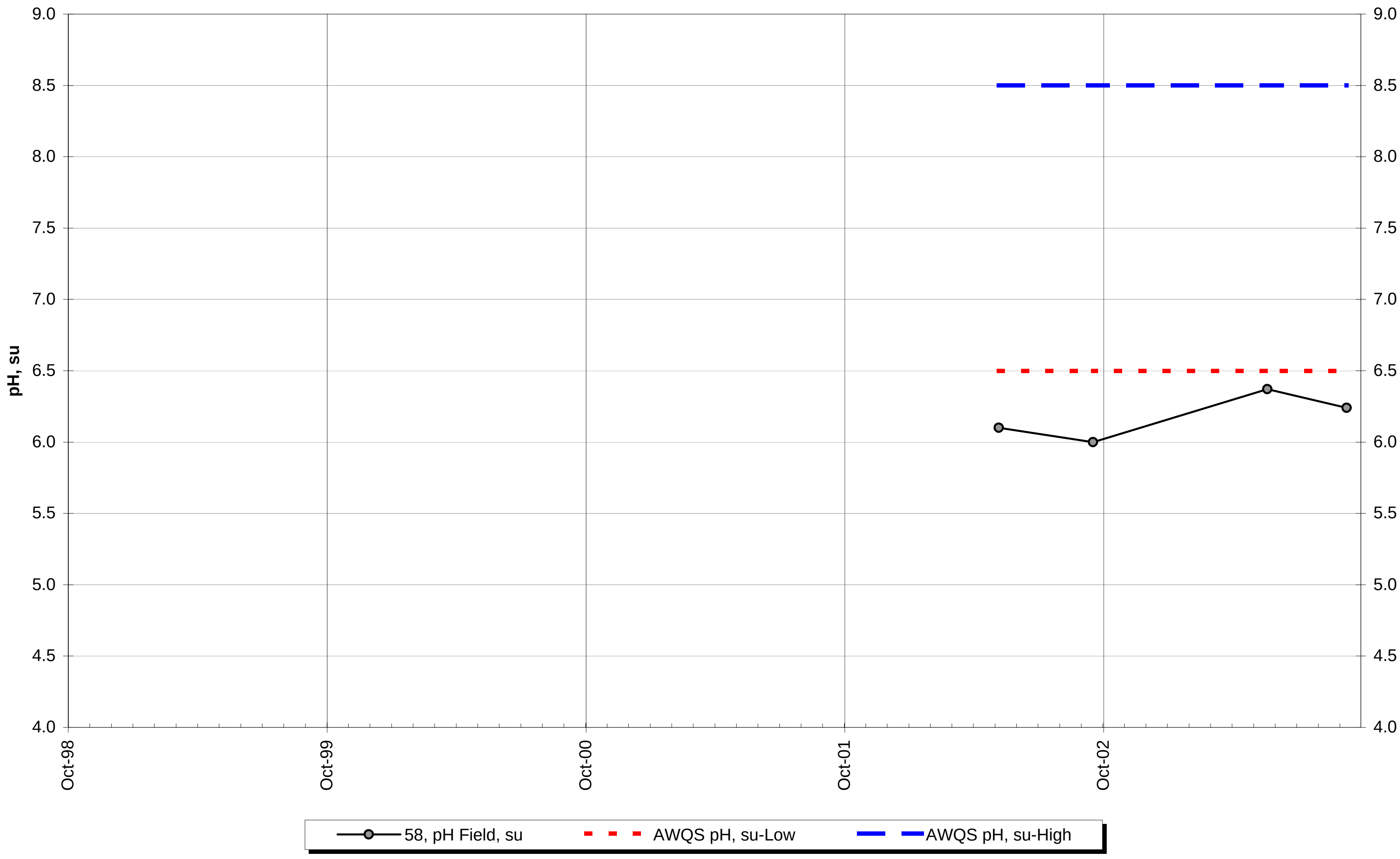
Site 58 -Conductivity-Field



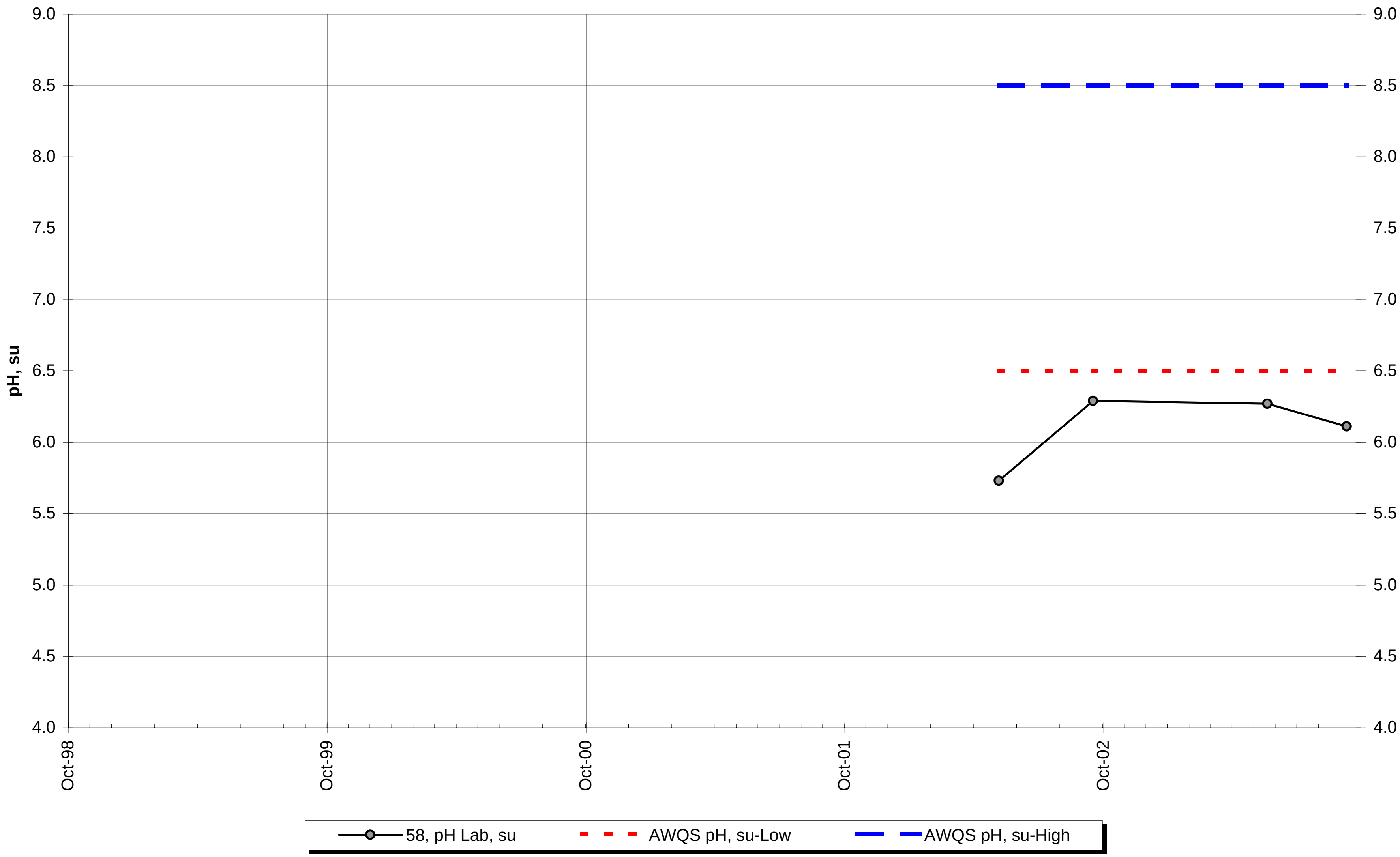
Site 58 -Conductivity-Lab



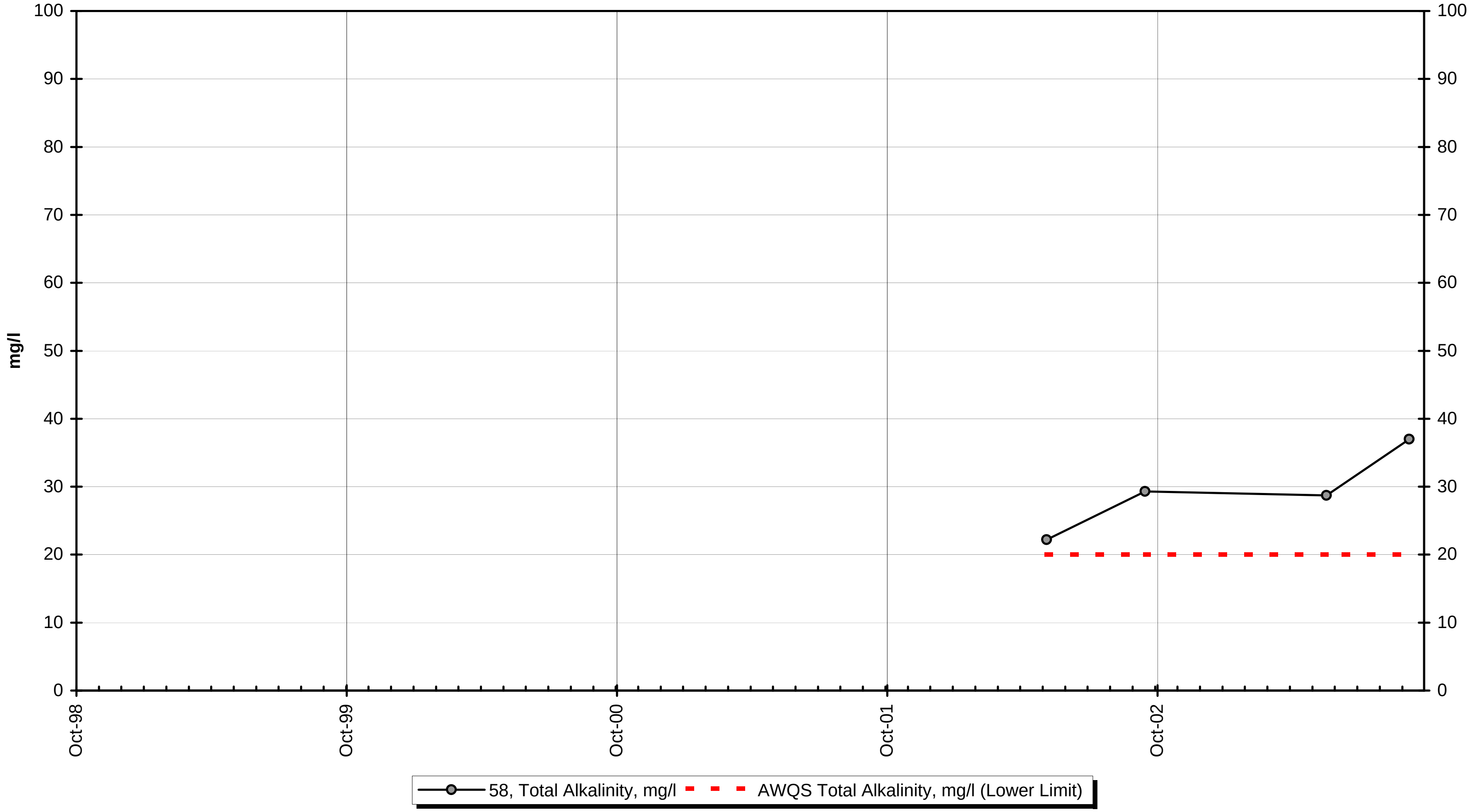
Site 58 -Field pH



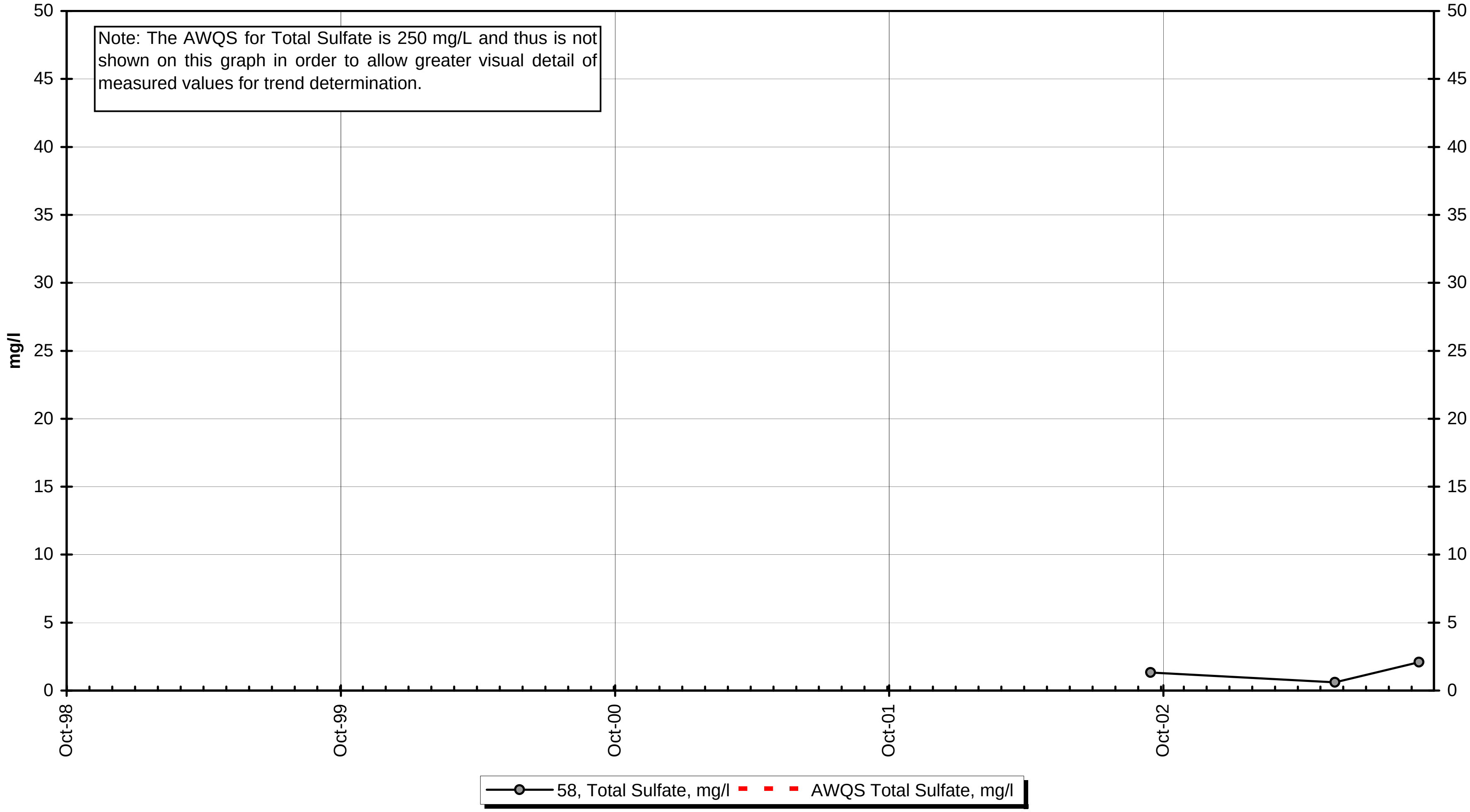
Site 58 -Lab pH



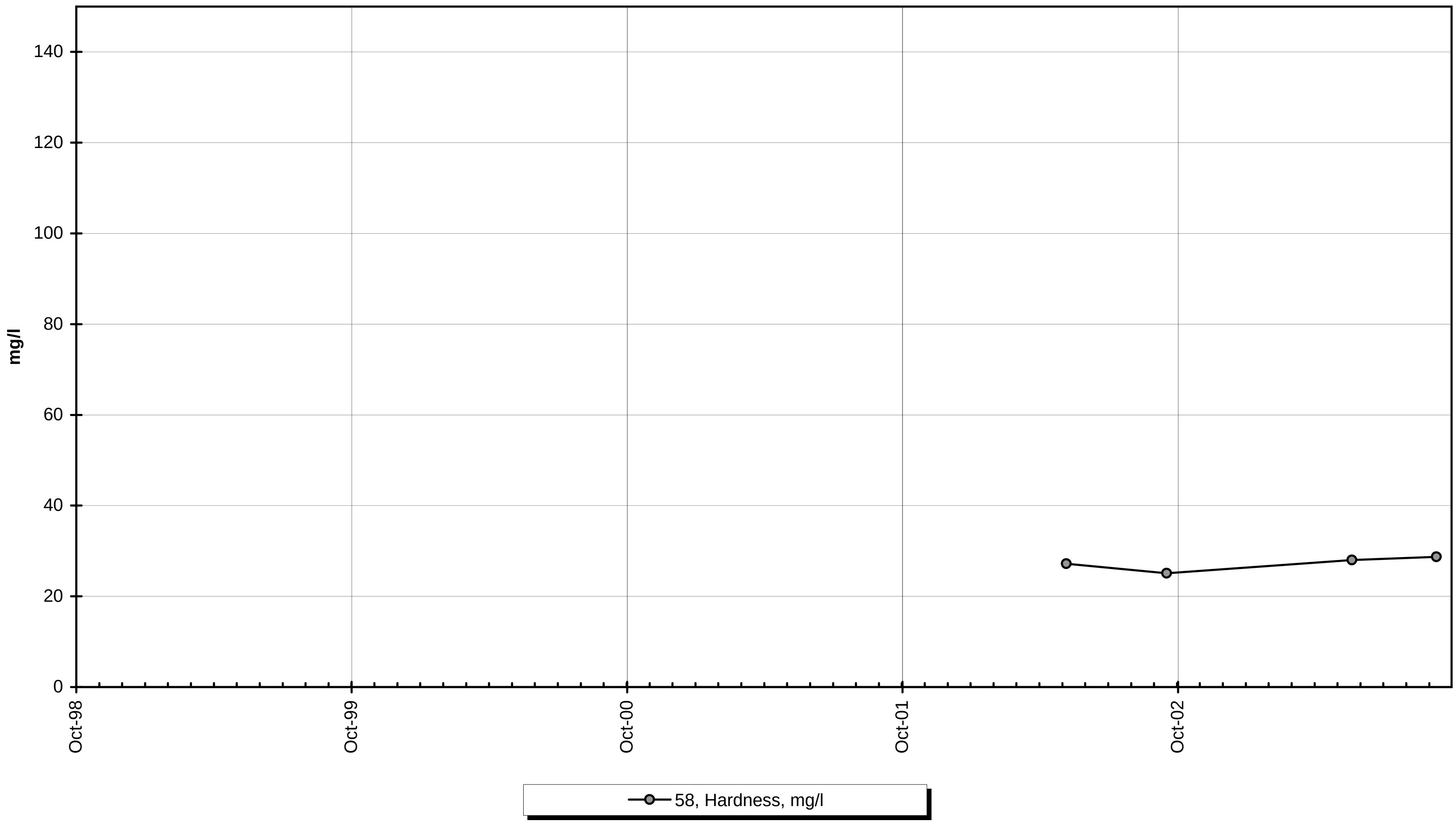
Site 58 -Total Alkalinity



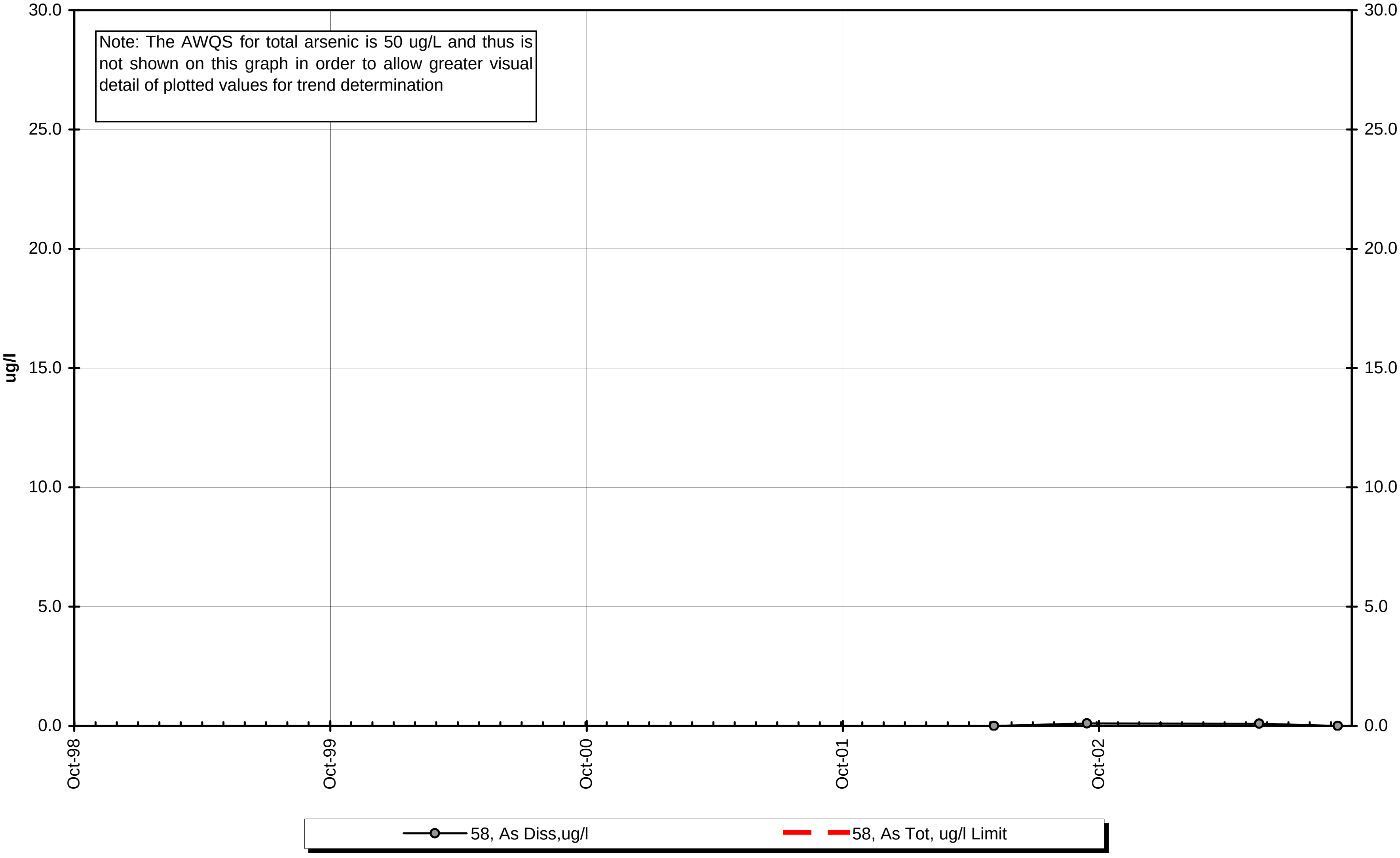
Site 58 -Total Sulfate

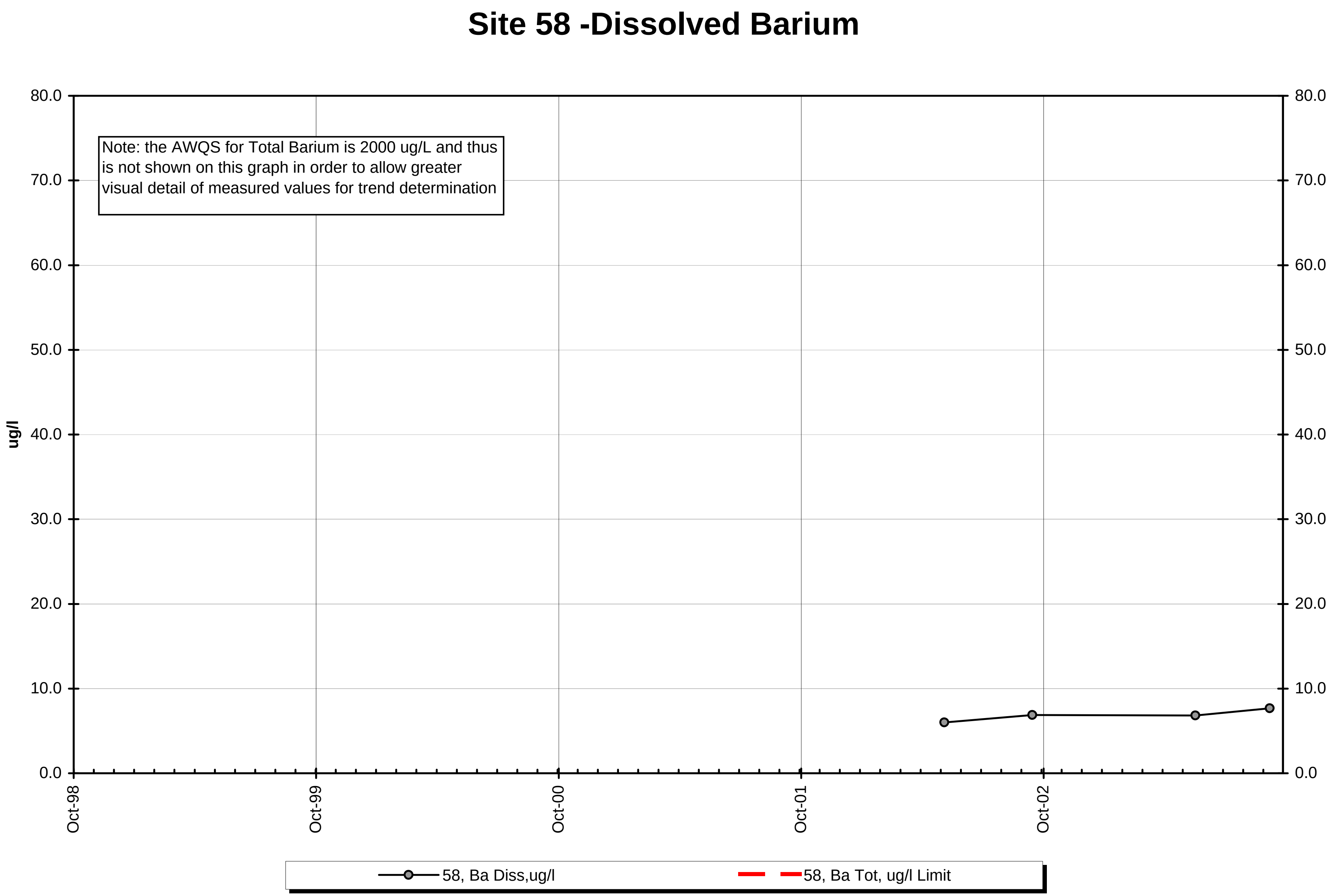


Site 58 -Hardness



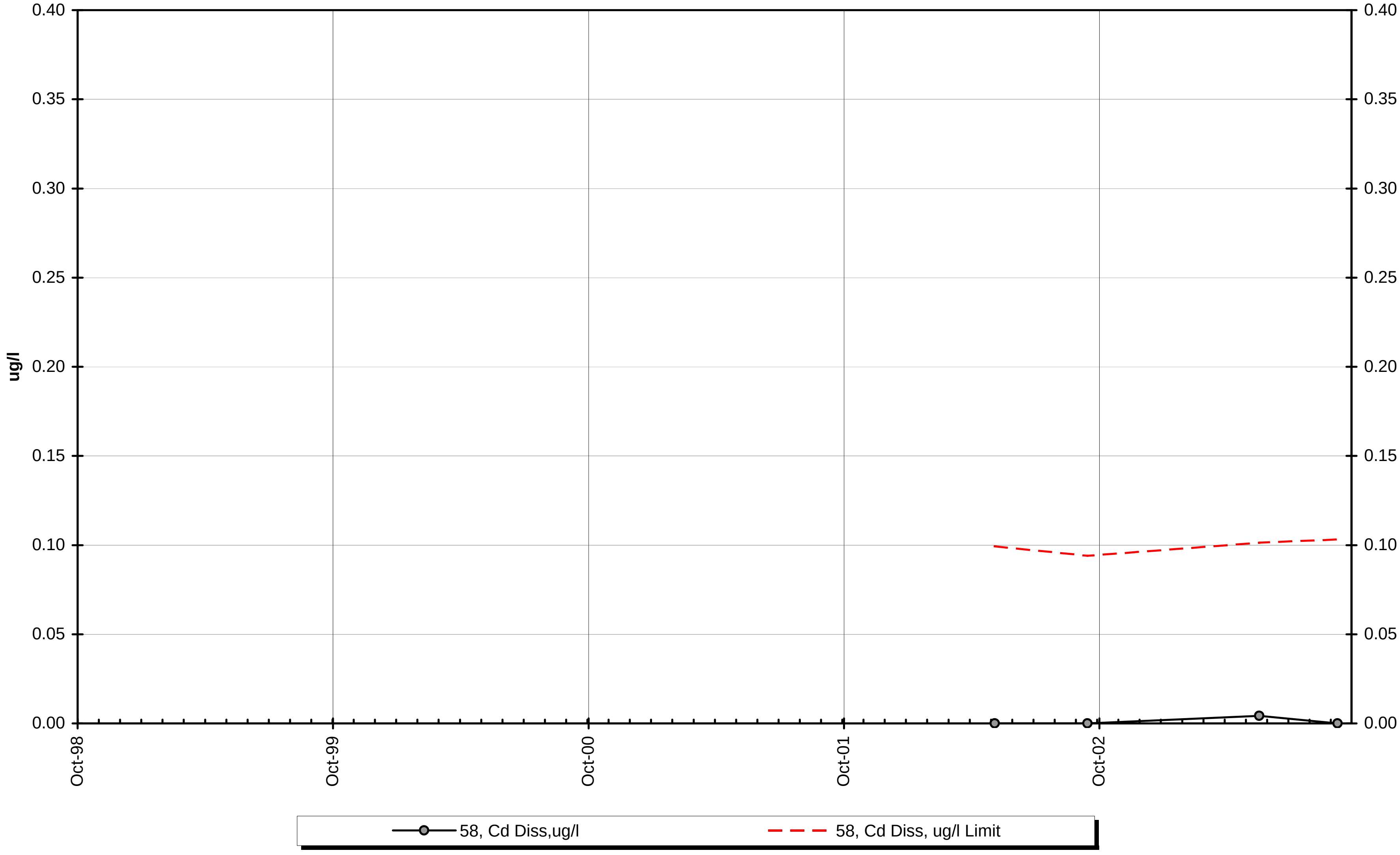
Site 58 -Dissolved Arsenic



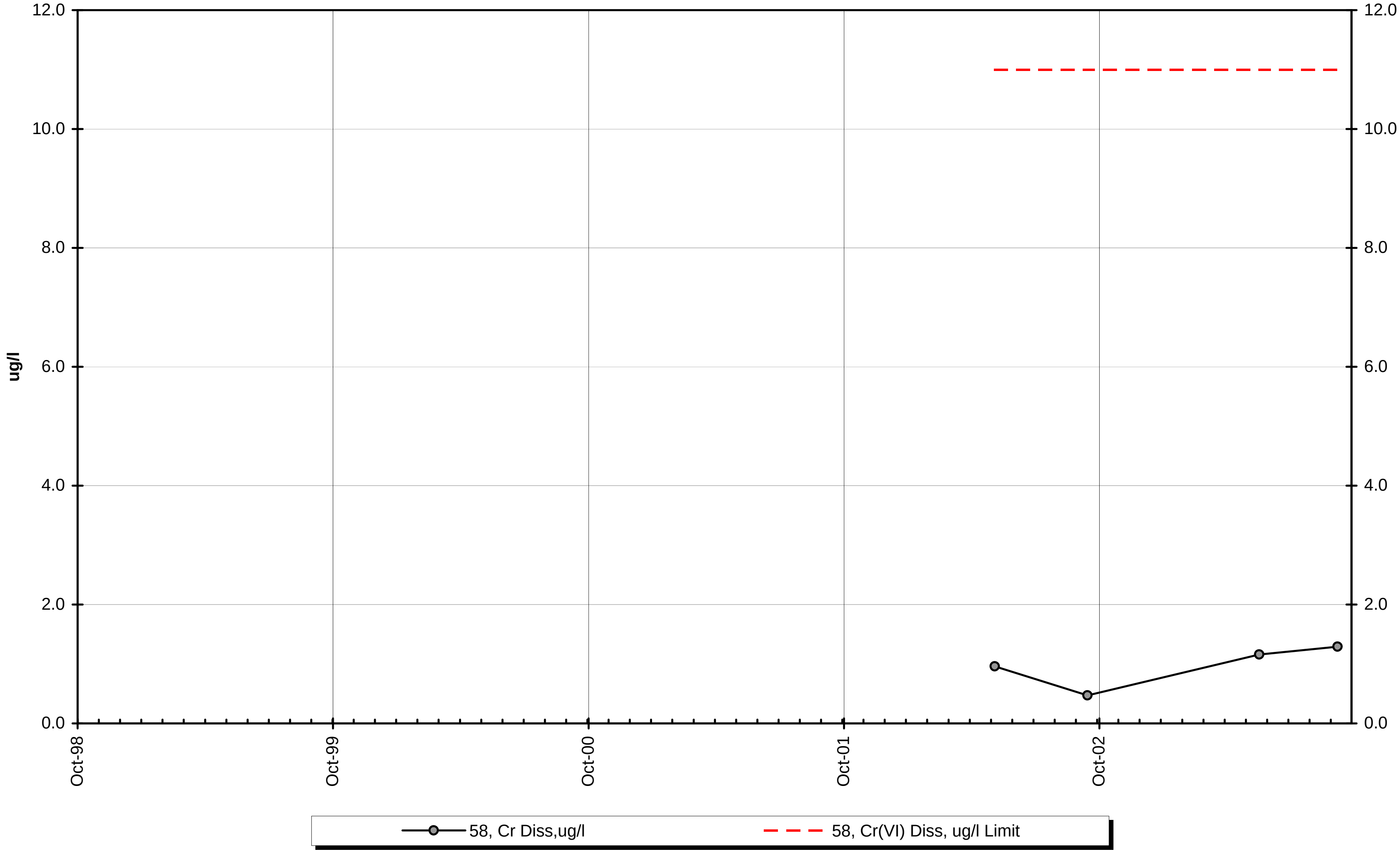


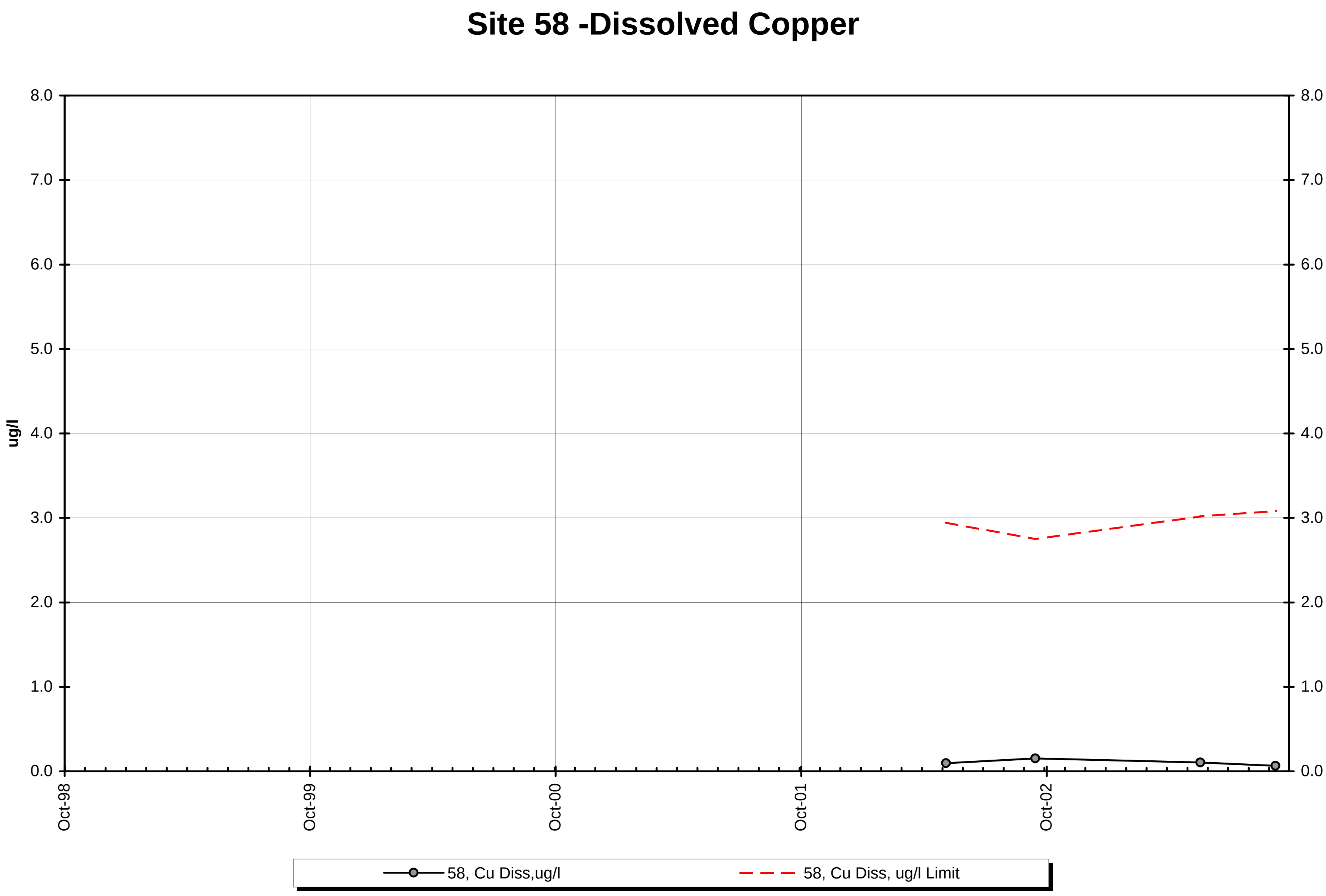
Site 58 -Dissolved Barium
Note: the AWQS for Total Barium is 2000 ug/L and thus is not shown on this graph in order to allow greater visual detail of measured values for trend determination
ug/l
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
58, Ba Diss,ug/l
58, Ba Tot, ug/l Limit

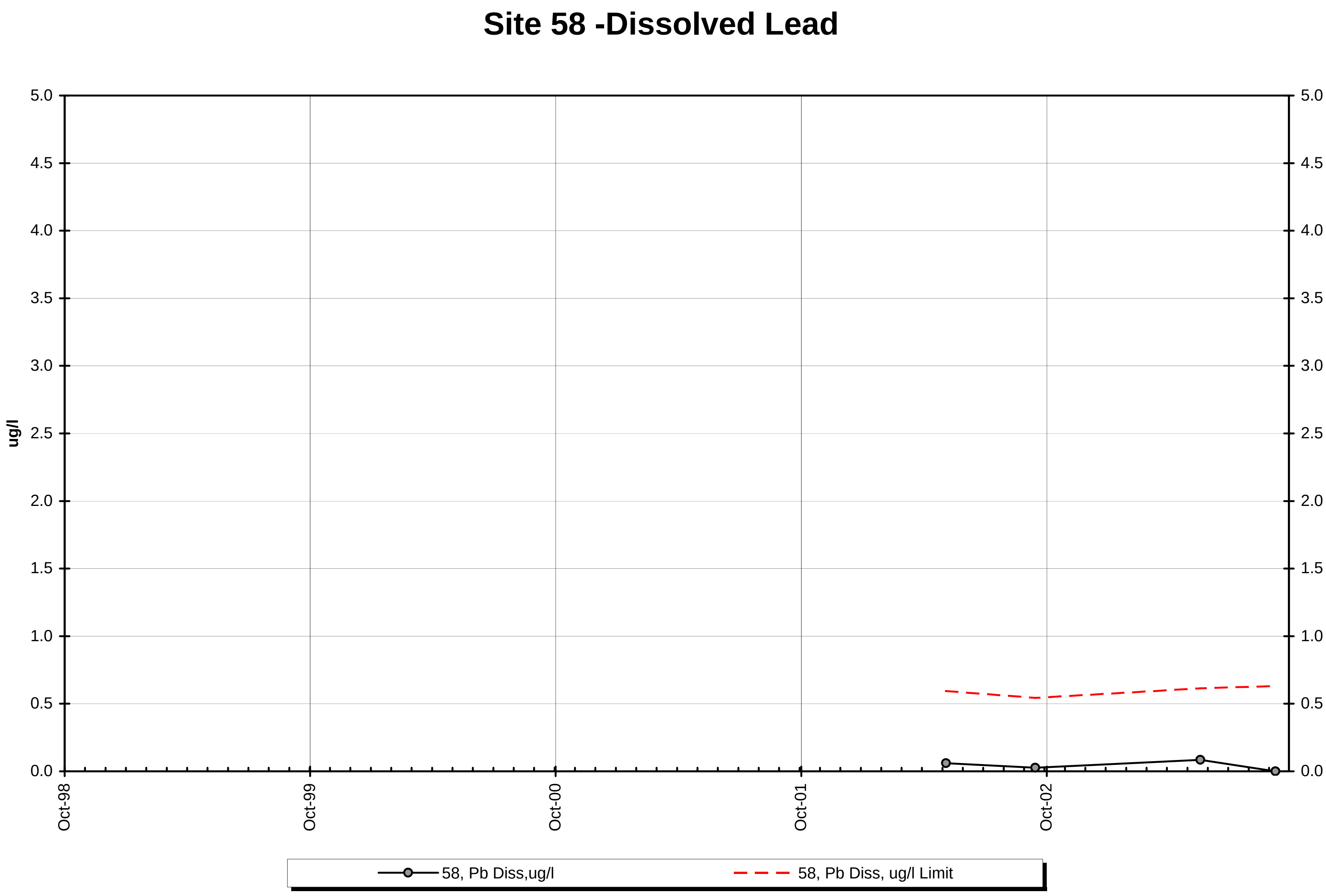
Site 58 -Dissolved Cadmium



Site 58 -Dissolved Chromium

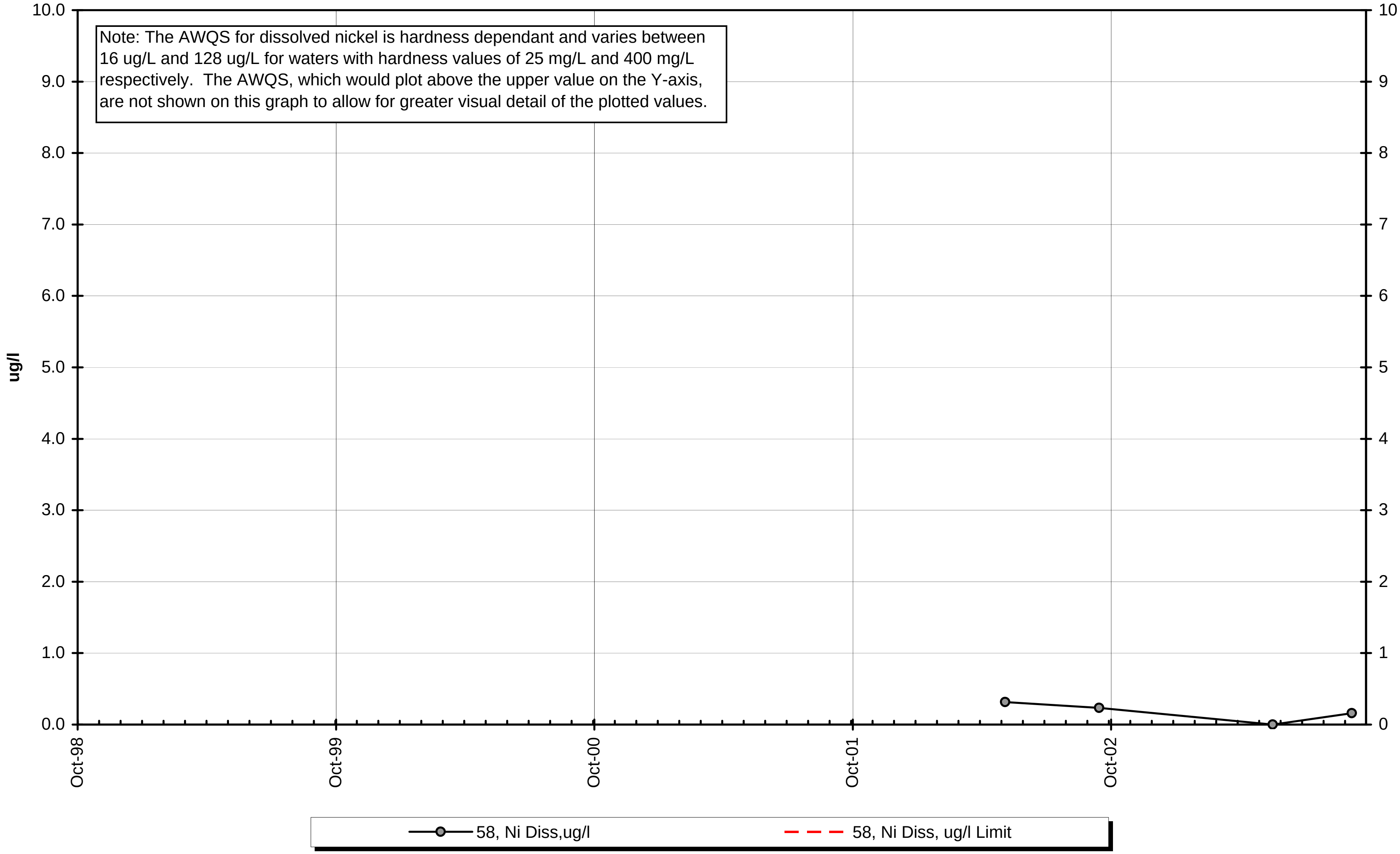


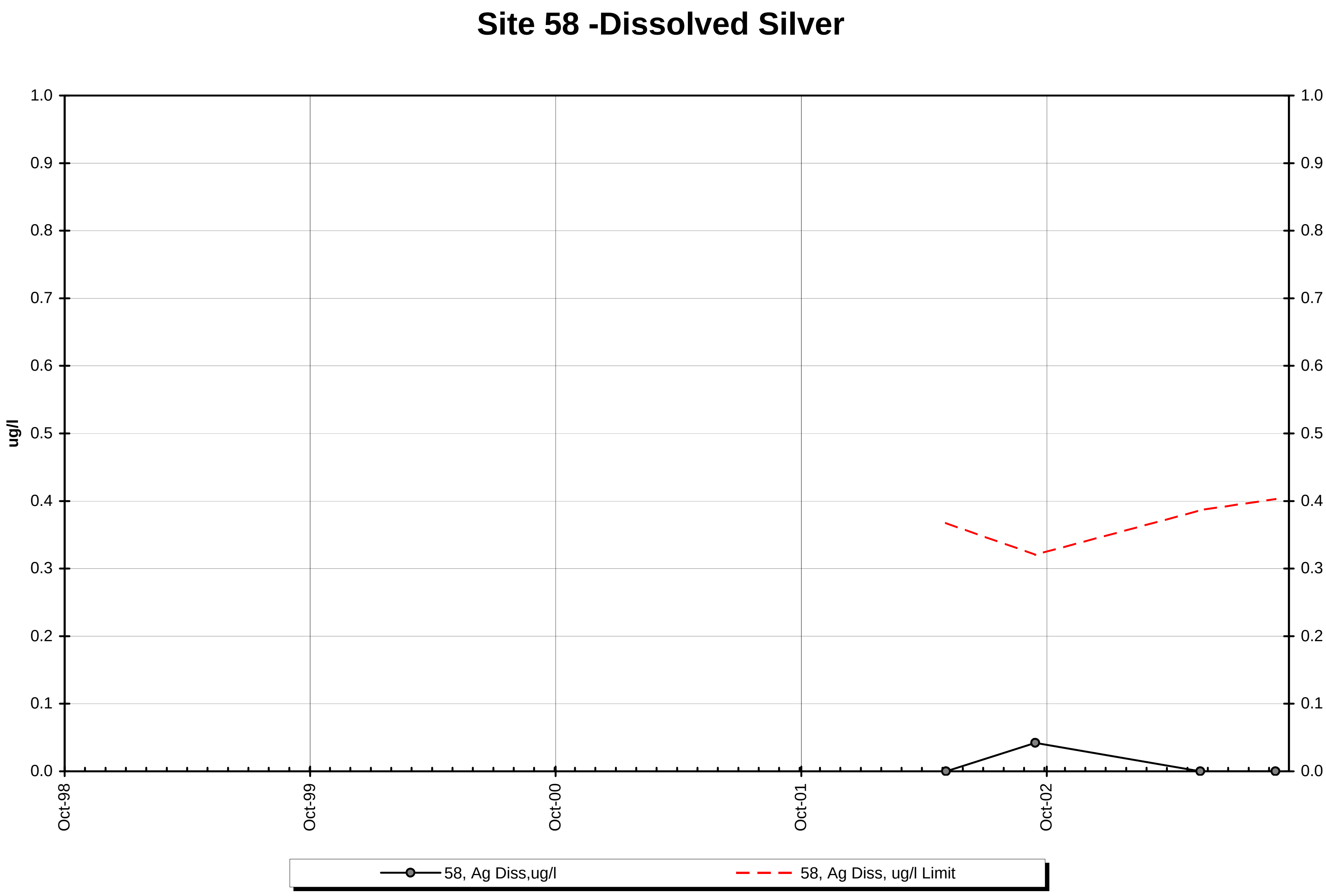

Site 58 -Dissolved Copper
ug/l
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
58, Cu Diss,ug/l
58, Cu Diss, ug/l Limit



Site 58 -Dissolved Lead
ug/l
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
58, Pb Diss,ug/l
58, Pb Diss, ug/l Limit

Site 58 -Dissolved Nickel

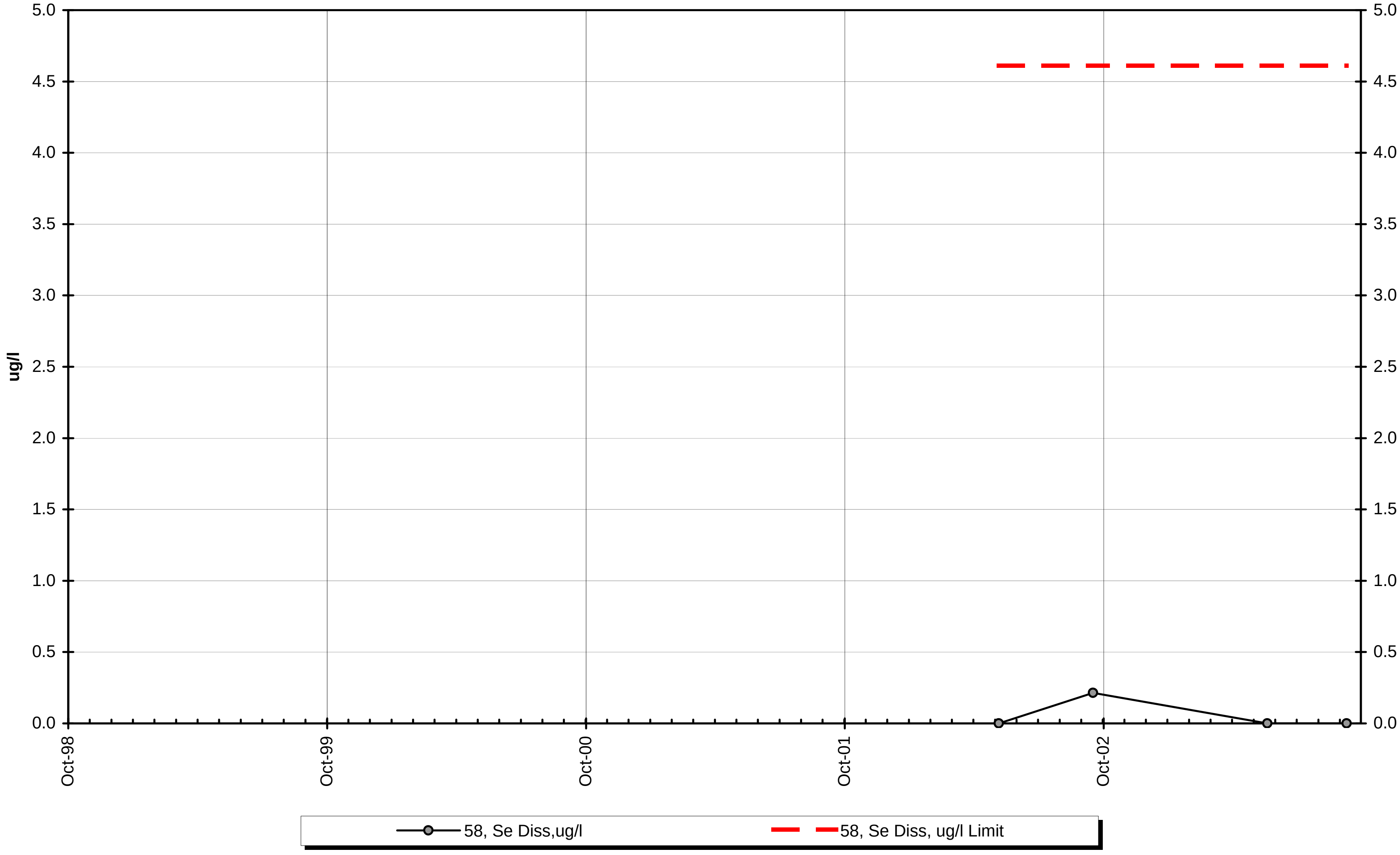




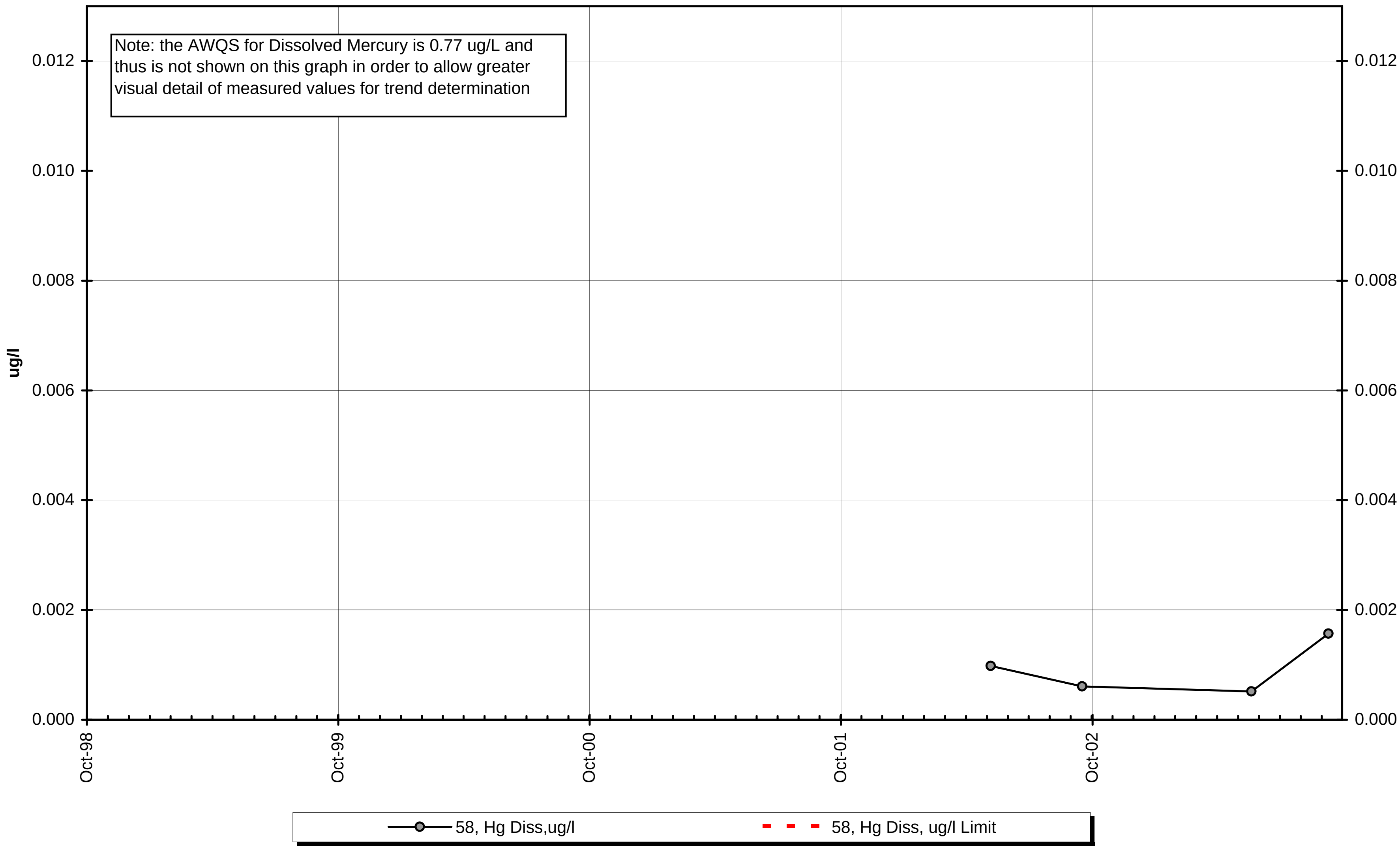
Site 58 -Dissolved Silver
ug/l
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
58, Ag Diss,ug/l
58, Ag Diss, ug/l Limit


Site 58 -Dissolved Zinc
ug/l
100
90
80
70
60
50
40
30
20
10
0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
58, Zn Diss,ug/l
58, Zn Diss, ug/l Limit

Site 58 -Dissolved Selenium



Site 58 -Dissolved Mercury



INTERPRETIVE REPORT
SITE 27 "MONITORING WELL 2S"

The data collected during the current water year are listed in the following "Table of Results for Water Year 2003" report. The table includes all the data, field and lab, 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 zero for the purpose of median calculation.

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

Sample Date	Parameter	Value	Qualifier	Notes
No outliers have been identified by KGCMC for the period of Oct-98 though Sept-03.				

The data for water year 2003 have been compared to the strictest fresh water quality criterion for each applicable analyte. Three (3) results exceeding these criteria have been identified, as listed in the table below. Two (2) datum are for lab pH values below the lower limit of 6.5 su listed in AWQS. Lab pH for Site 27 has historically resulted in values ranging from a pH of 5.5 to 7.0 which are characteristic for wells completed in organic rich peat sediments. Field-pH data also historically documents values that are consistently 0.2 to 0.5 su below the 6.5 su AWQS lower limit. The third exceedance is for a dissolved lead sample from May-2003 with a value of 0.695 µg/l that exceeds the hardness dependent AWQS standard of 0.541 µg/l. Lead concentrations for Site 27 have historically fluctuated above and below the hardness dependent AWQS due to the low hardness of the samples.

Sample Date	Parameter	Value	Hardness (mg/L)	Standard	Standard Type
05/21/03	pH Lab, su	5.76		6.5 - 8.5	Aquatic Life
09/10/03	pH Lab, su	5.82		6.5 - 8.5	Aquatic Life
09/10/03	Lead, Dissolved ug/L	0.695	19.6	0.541	Aquatic Life, chronic

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

Additional X-Y plots have been generated for alkalinity, pH, conductance, sulfate, and dissolved zinc that plot Site 27 and Site 58, the upgradient control site, to aid in the comparison between those two sites. Total alkalinity, lab conductivity, sulfate and dissolved zinc are all approximately twice the concentration at Site 27 than at Site 58. Lab pH is slightly lower at Site 27 than Site 58. The variation in the two site's water chemistries is a direct result of the inherent differences between the site's hydrogeologies and the affect this has upon the hydrologic conditions at the two sites. Site 58 is located in close proximity to the large bedrock ridge, which defines the eastern geologic and hydrologic boundary of the tails area. The upslope portion of the ridge acts as the major recharge zone to the area aquifer. Along this ridge it is likely that groundwater flow is dominated by shallow or near surface flows due to the steep gradient and thin mineral soil. Thus, the groundwater at Site 58 is typically a mixture of surficial recharge from the immediate area with a component of relatively juvenile groundwater originating from the ridge to the east. In contrast, Site 27 is located in an area of gently sloping muskeg that forms part of the upper Tributary Creek drainage area. The area's groundwater is characterized by diffuse flow through the peat/sand strata that make up the upper portion of the unconsolidated sediment fill in the Tributary Creek valley. Additionally, Site 27 is located in an area identified as a groundwater discharge site into Tributary Creek. Thus, Site 27 samples groundwater that is relatively mature in comparison to Site 58 and may have a higher component of groundwater that has been in contact with a larger variety of strata for a longer period of time. Therefore the groundwater would be expected to have a higher dissolved load. The lower pH would be a due to the greater interaction with organic matter in the muskeg and would promote greater solubility for naturally occurring dissolved metals sampled at this site.

Table of Results for Water Year 2003

Site 27 "MW-2S"

Sample Date/Parameter	Oct-02	Nov-02	Dec-02	Jan-03	Feb-03	Mar-03	Apr-03	5/21/2003	Jun-03	Jul-03	Aug-03	9/10/2003	**Median**
Water Temp (°C)								4.9				8.4	6.7
Conductivity-Field(μmho)								97				83	90
Conductivity-Lab (μmho)								65				72	68
pH Lab (standard units)								5.76				5.82	5.79
pH Field (standard units)								6.07				5.84	5.96
Total Alkalinity (mg/L)								33.4				31.4	32.4
Total Sulfate (mg/L)								1.7				1.8 J	1.7
Hardness (mg/L)								18.0				19.6	18.8
Dissolved As (ug/L)								2.320	NOT SCHEDULED FOR SAMPLING			3.020	2.670
Dissolved Ba (ug/L)	NOT SCHEDULED FOR SAMPLING							15.2				22.6	18.9
Dissolved Cd (ug/L)								0.005 J				<0.023	0.008
Dissolved Cr (ug/L)								0.866				2.540	1.703
Dissolved Cu (ug/L)								0.242				0.465	0.354
Dissolved Pb (ug/L)								0.3850				0.6950	0.5400
Dissolved Ni (ug/L)								1.860				2.420	2.140
Dissolved Ag (ug/L)								<0.028				<0.004	0.008
Dissolved Zn (ug/L)								2.13				3.82	2.98
Dissolved Se (ug/L)								0.254 J				<0.496	0.251
Dissolved Hg (ug/L)								0.001100				0.001730 J	0.001415

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

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

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

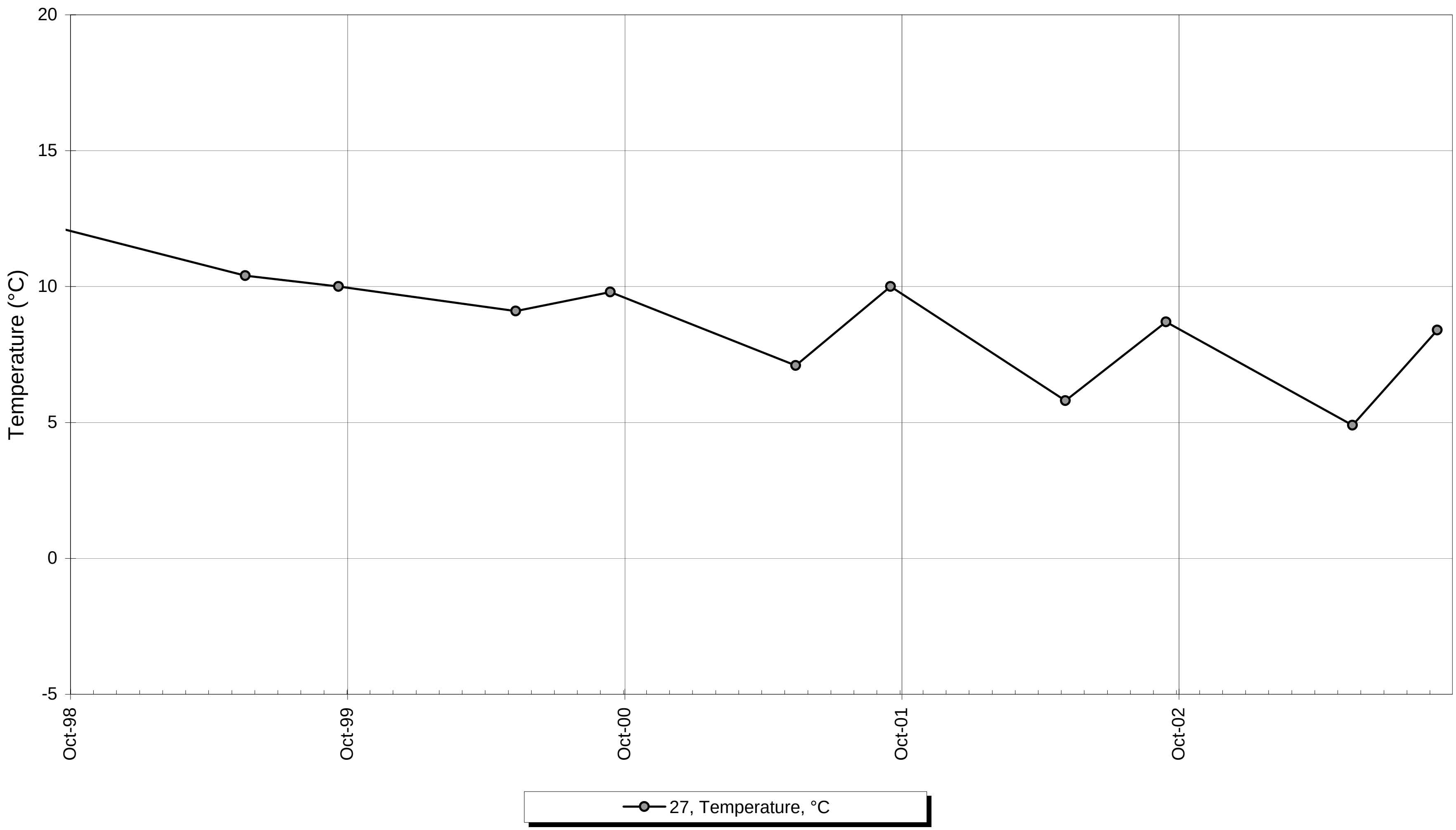
Qualified Data by QA Reviewer

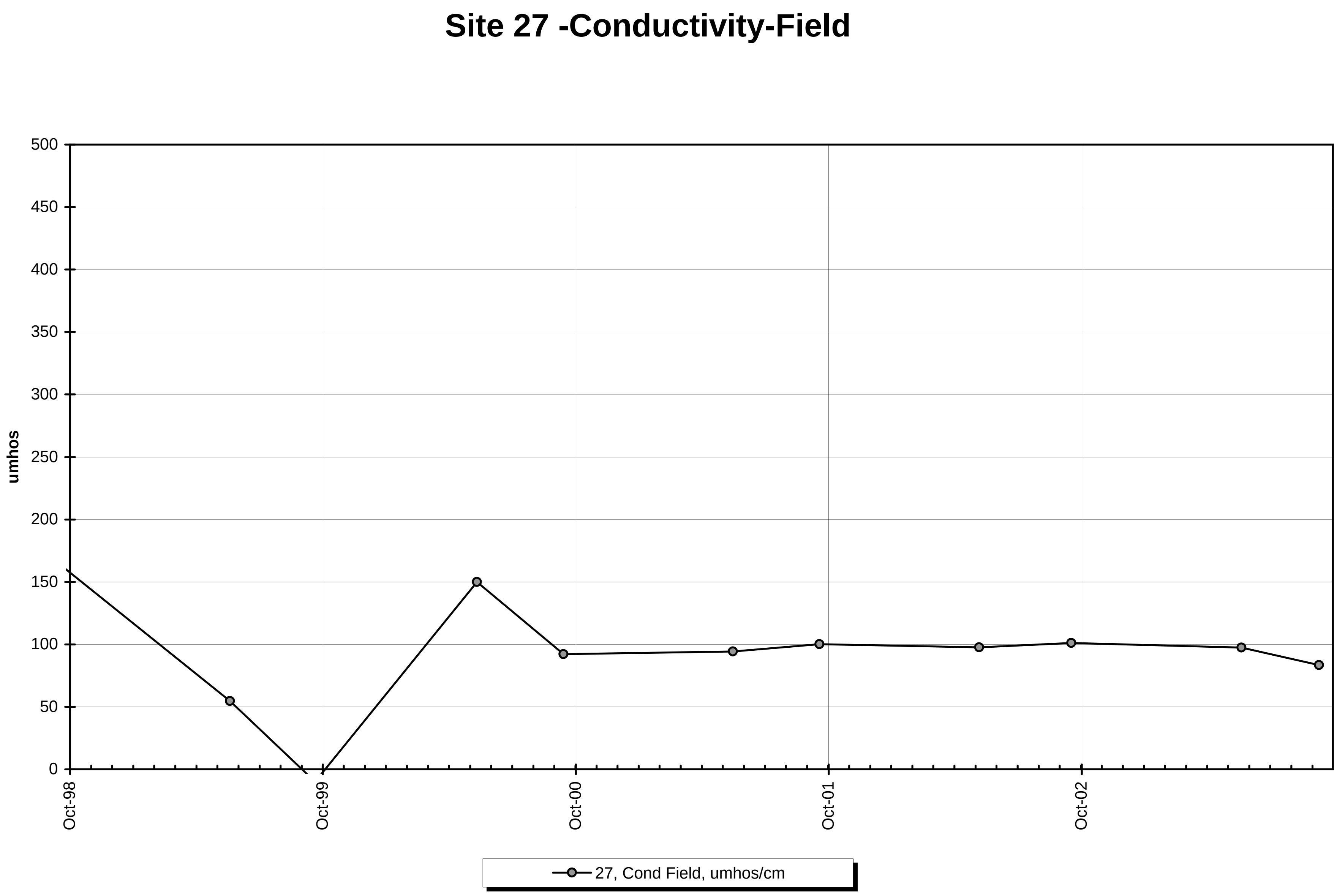
Date Range: 10/01/2002 to 09/30/2003

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
27	05/21/2003	11:05:00 AM				
			Cd Diss, ug/l	0.00533	J	Below Quantitative Range
			Se Diss, ug/l	0.254	J	Below Quantitative Range, L
27	09/10/2003	12:15:00 PM				
			SO4 Tot, mg/l	1.77	J	Sample Temperature
			Hg Diss, ug/l	0.00173	J	Duplicate RPD

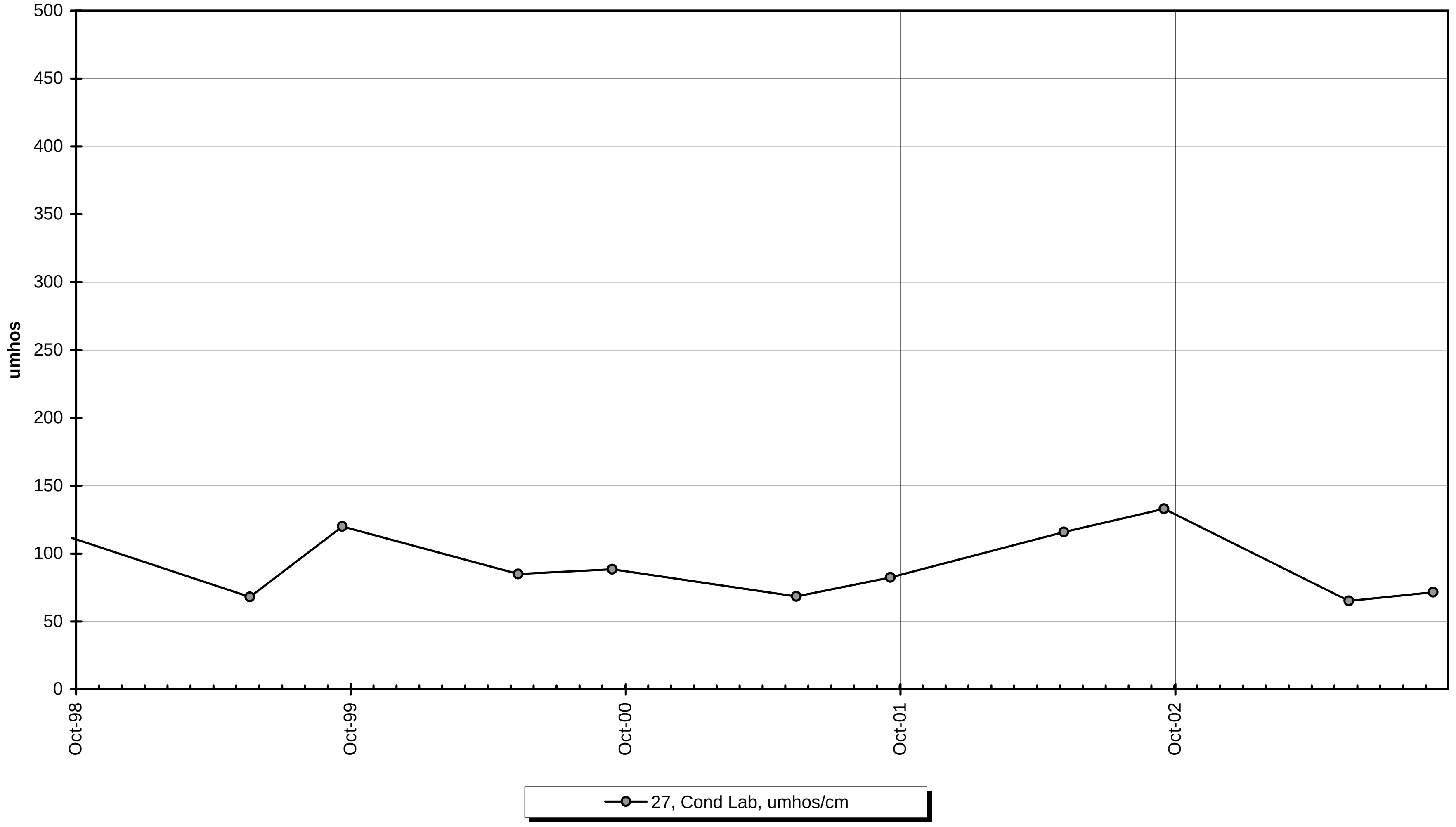
Qualifier	Description
J	Positively Identified - Approximate Concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot Be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit

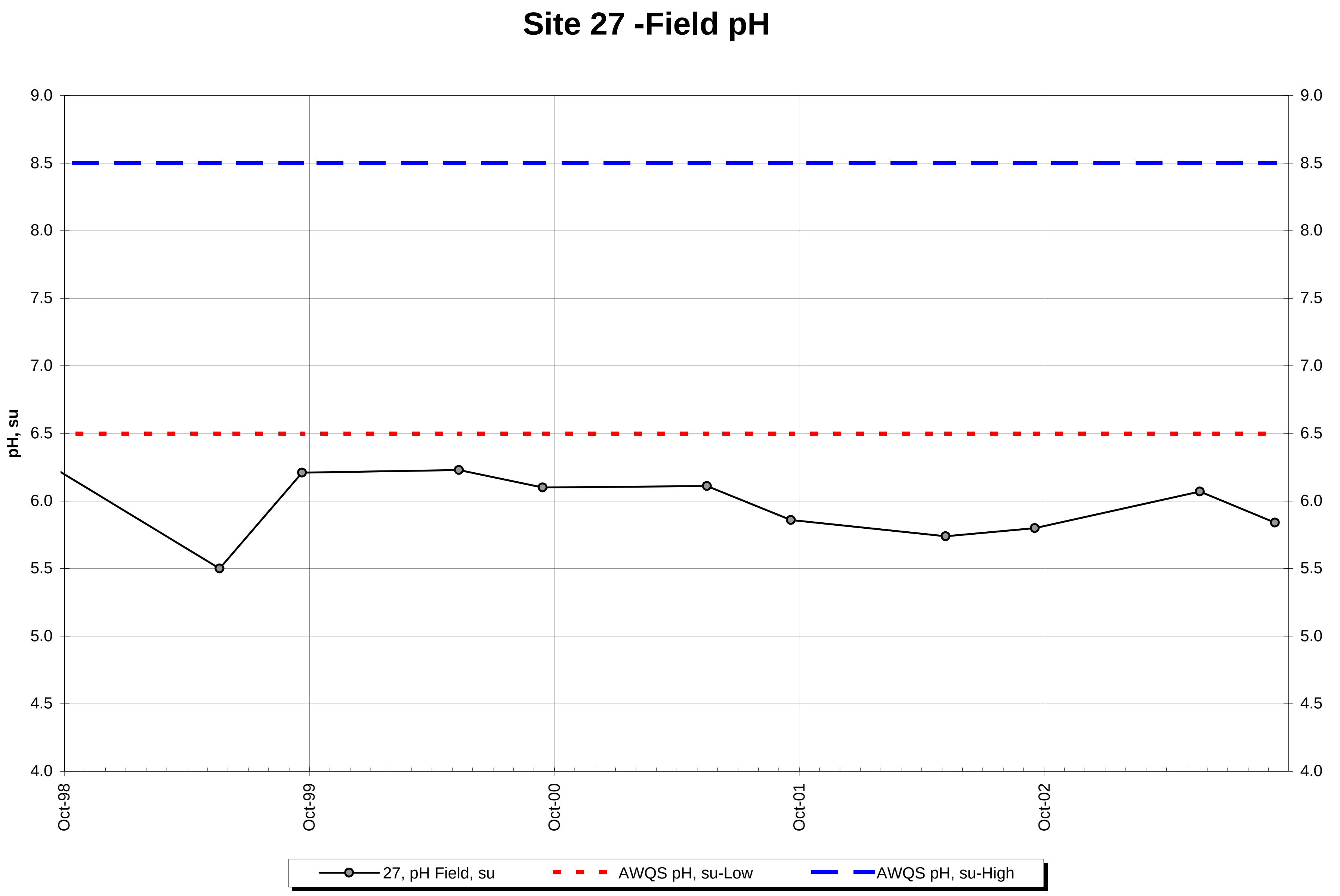
Site 27 -Water Temperature



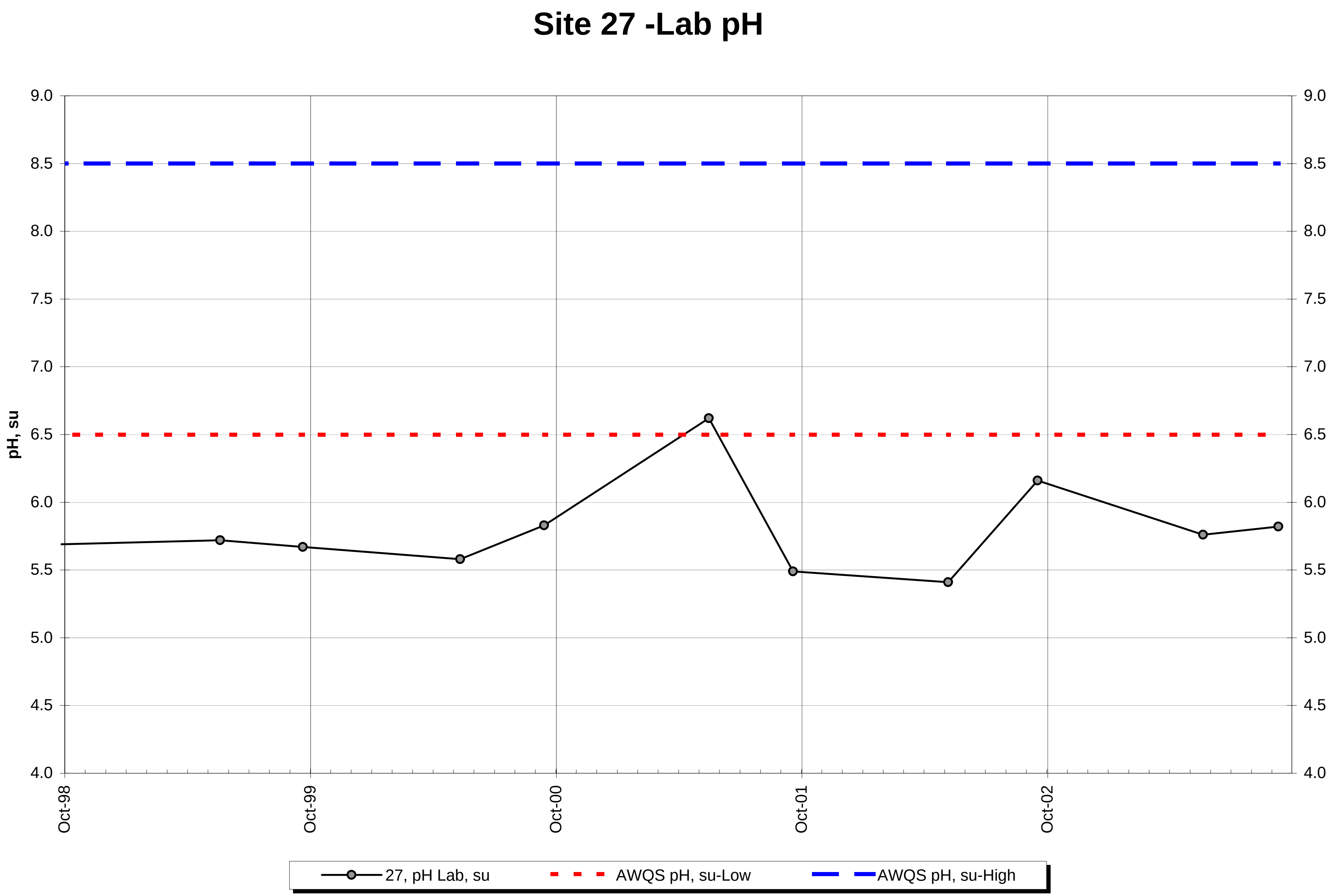

Site 27 -Conductivity-Field
umhos
500
450
400
350
300
250
200
150
100
50
0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
27, Cond Field, umhos/cm

Site 27 -Conductivity-Lab

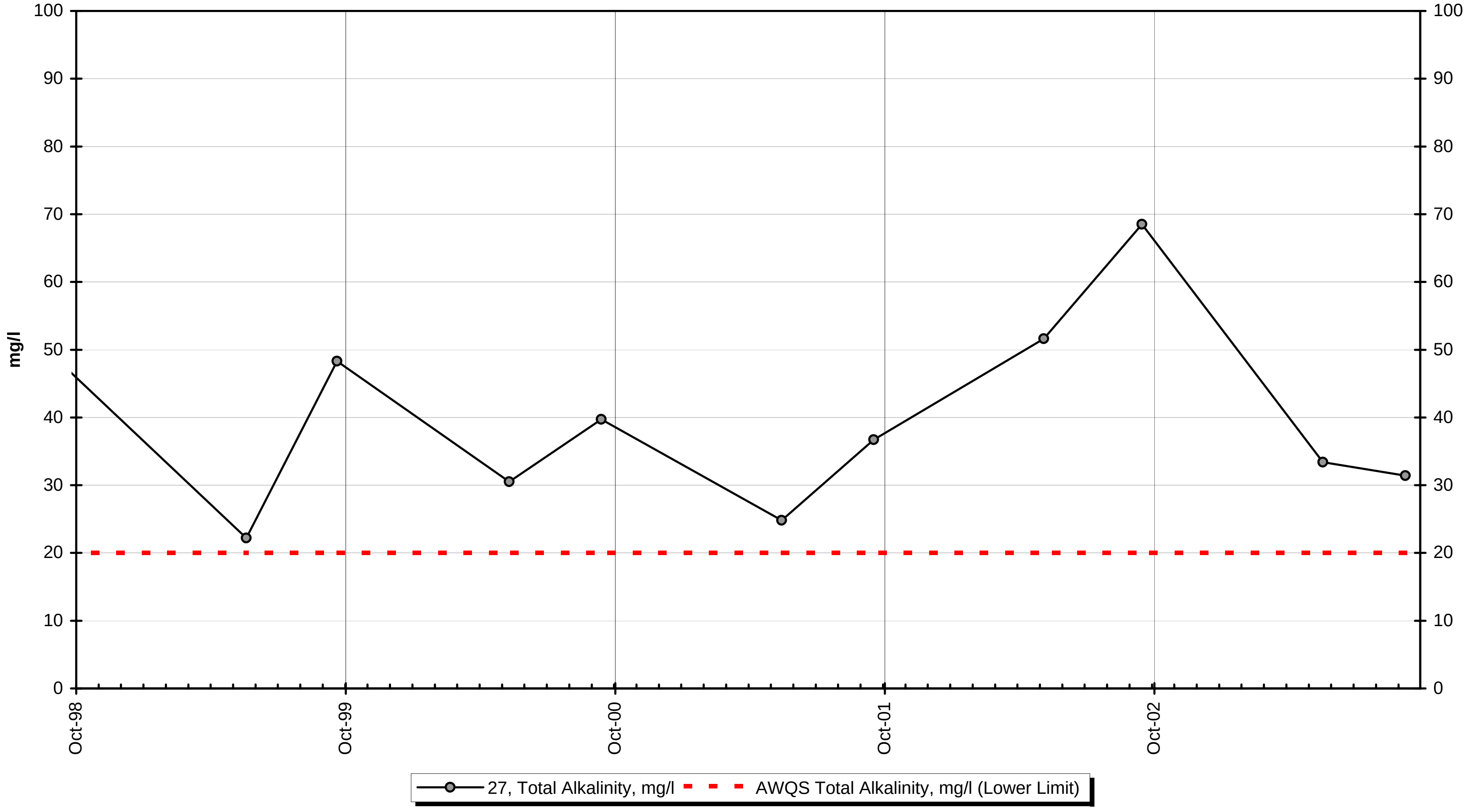




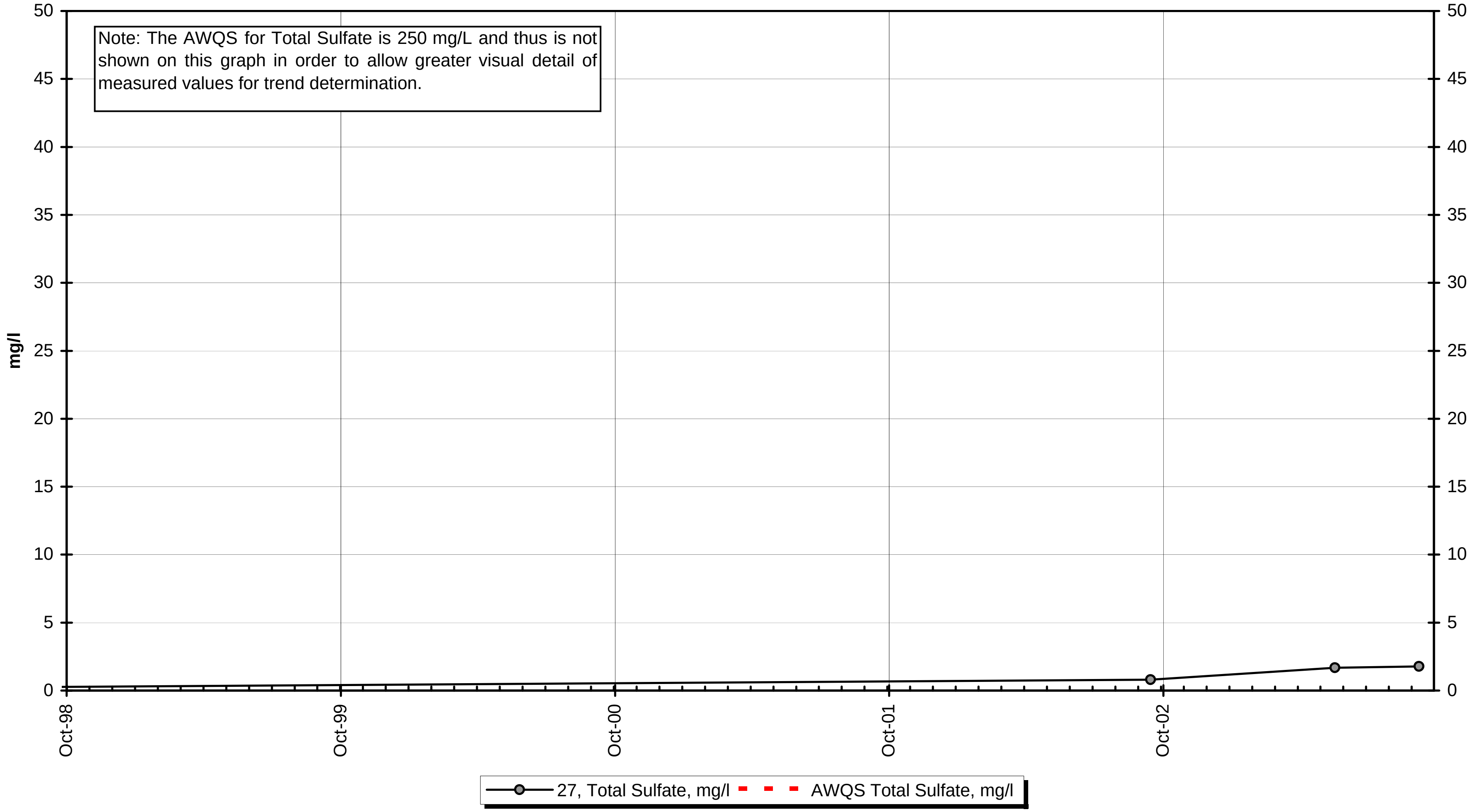
Site 27 -Field pH
pH, su
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
27, pH Field, su
AWQS pH, su-Low
AWQS pH, su-High

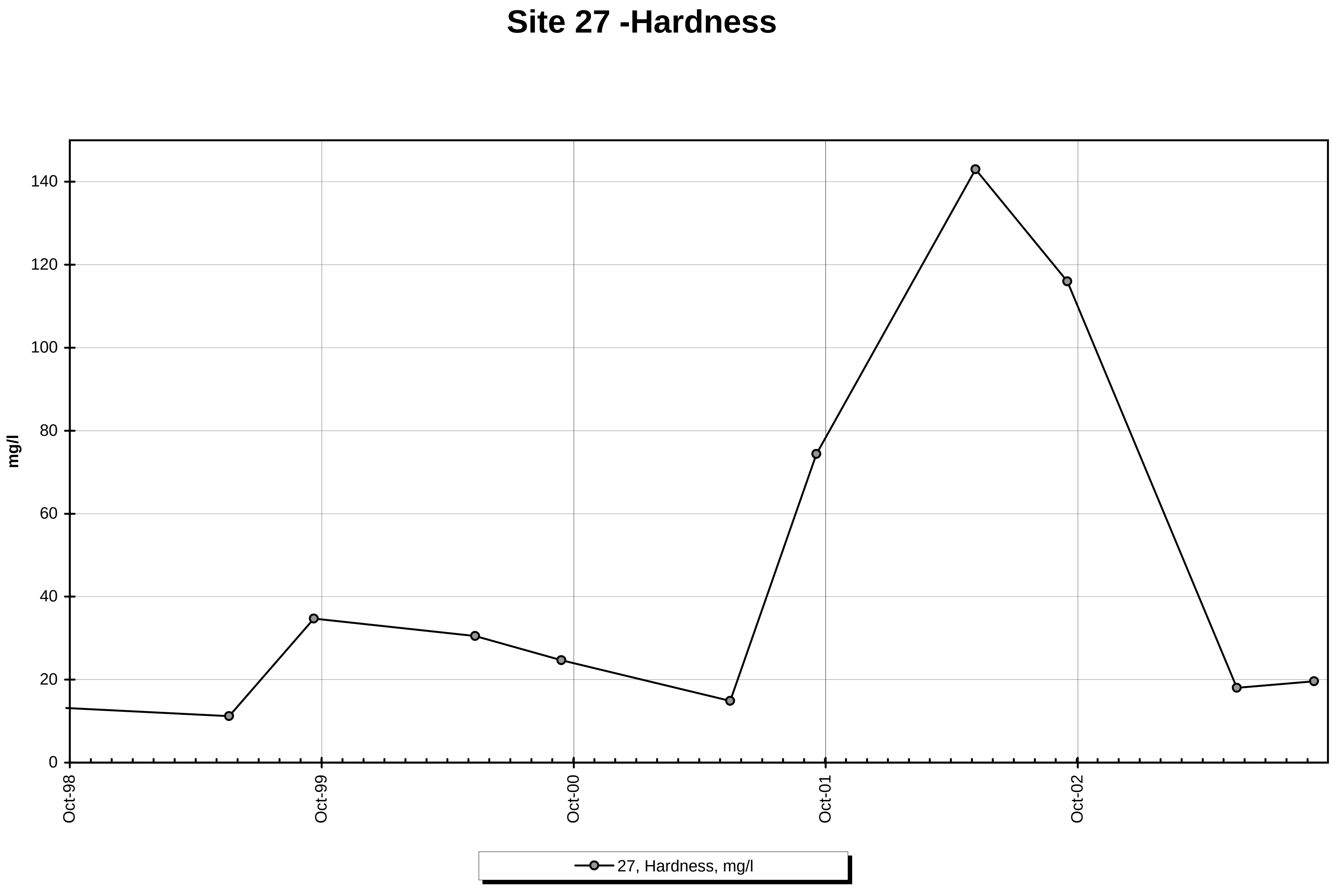

Site 27 -Lab pH
pH, su
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
27, pH Lab, su
AWQS pH, su-Low
AWQS pH, su-High

Site 27 -Total Alkalinity

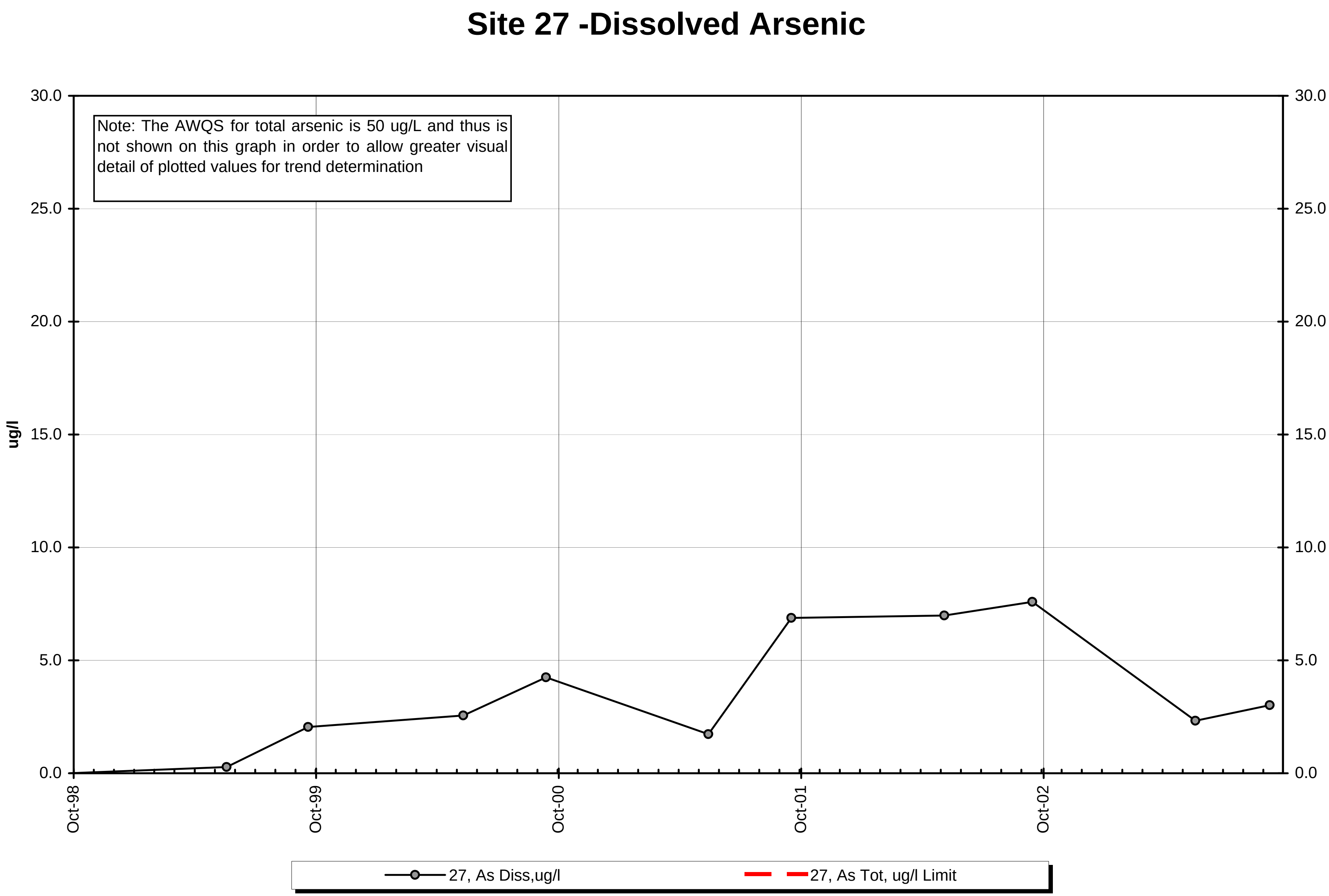


Site 27 -Total Sulfate



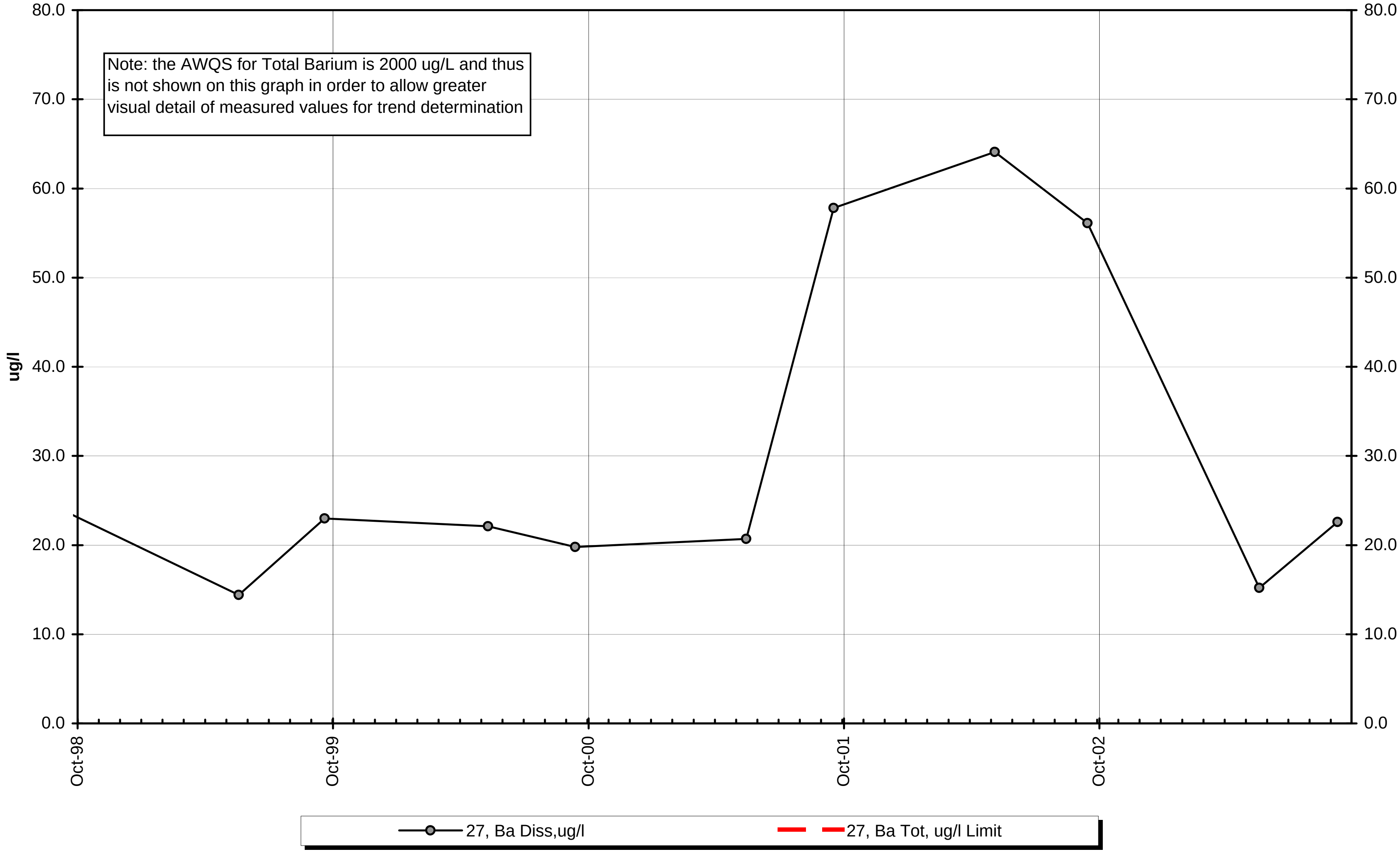


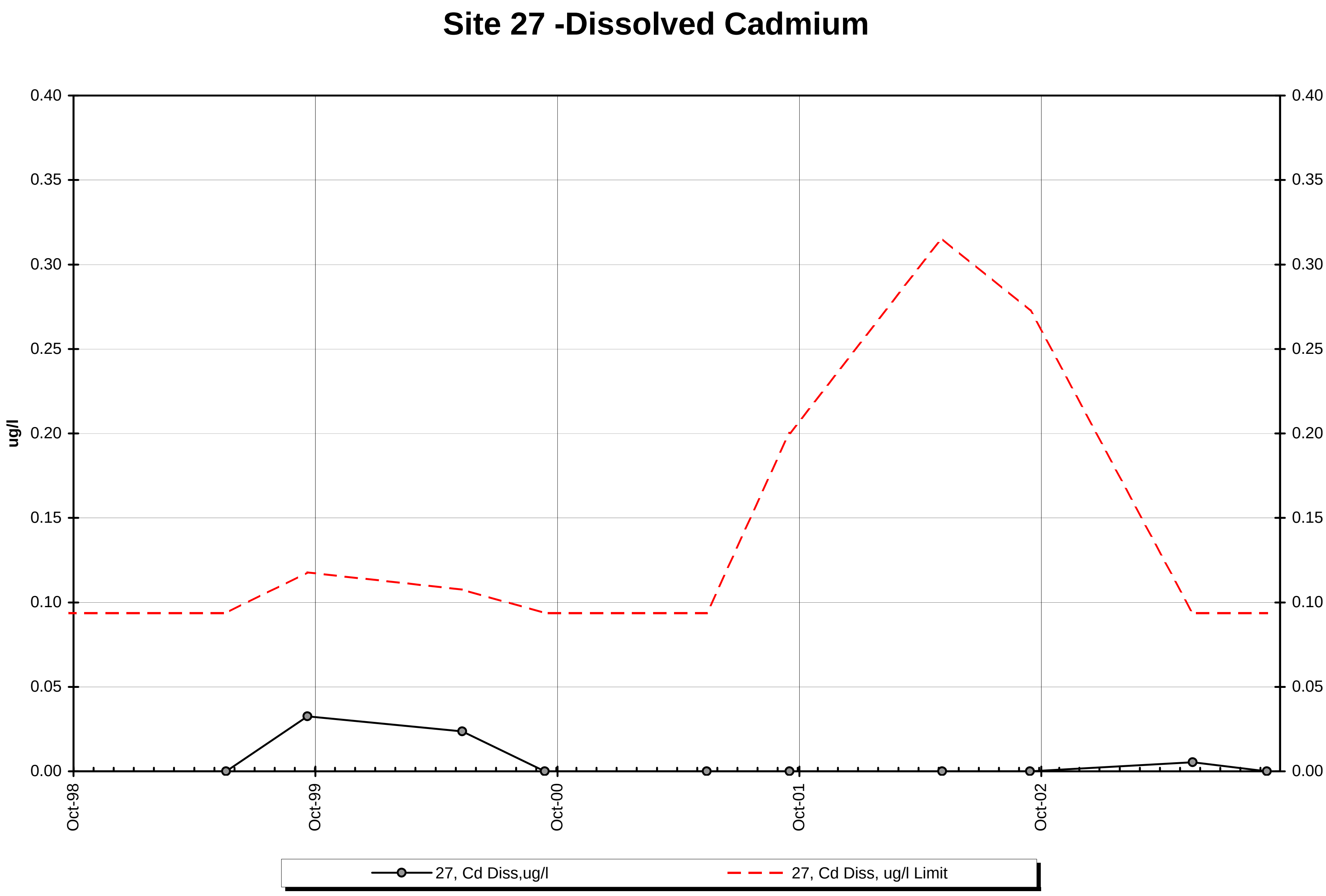
Site 27 -Hardness
mg/l
0
20
40
60
80
100
120
140
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
27, Hardness, mg/l



Site 27 -Dissolved Arsenic
Note: The AWQS for total arsenic is 50 ug/L and thus is not shown on this graph in order to allow greater visual detail of plotted values for trend determination
ug/l
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
27, As Diss,ug/l
27, As Tot, ug/l Limit

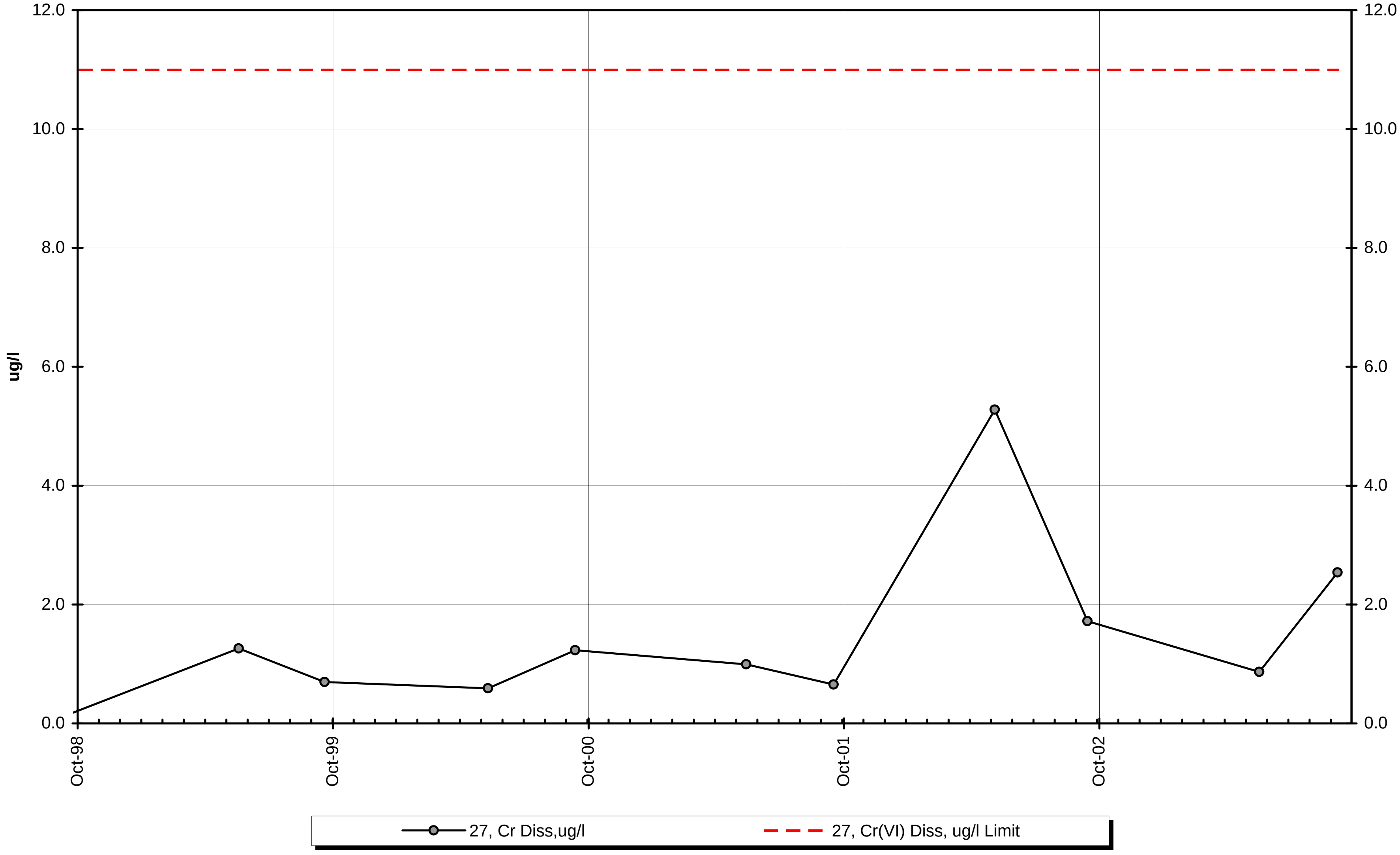
Site 27 -Dissolved Barium

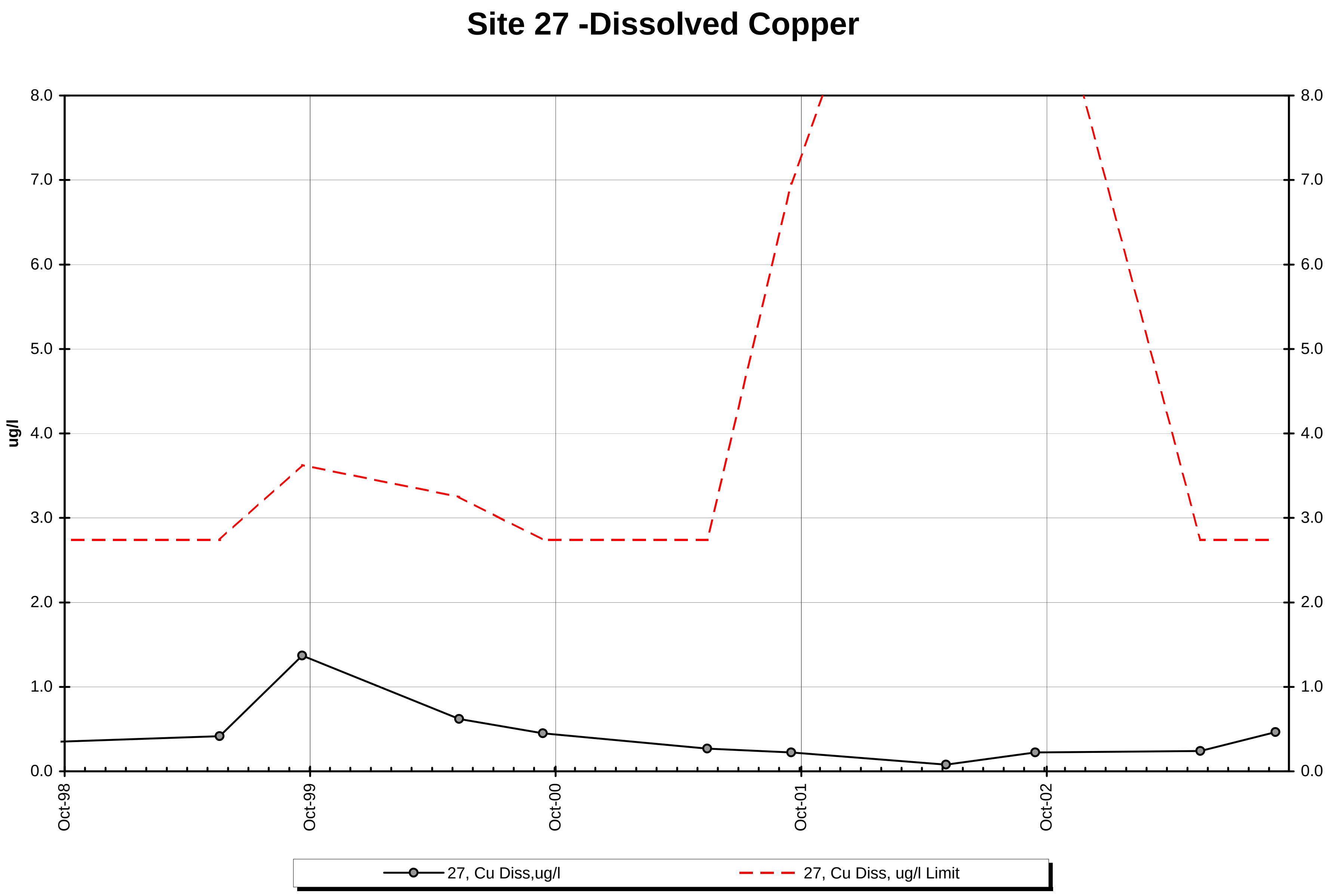




Site 27 -Dissolved Cadmium
ug/l
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
27, Cd Diss,ug/l
27, Cd Diss, ug/l Limit

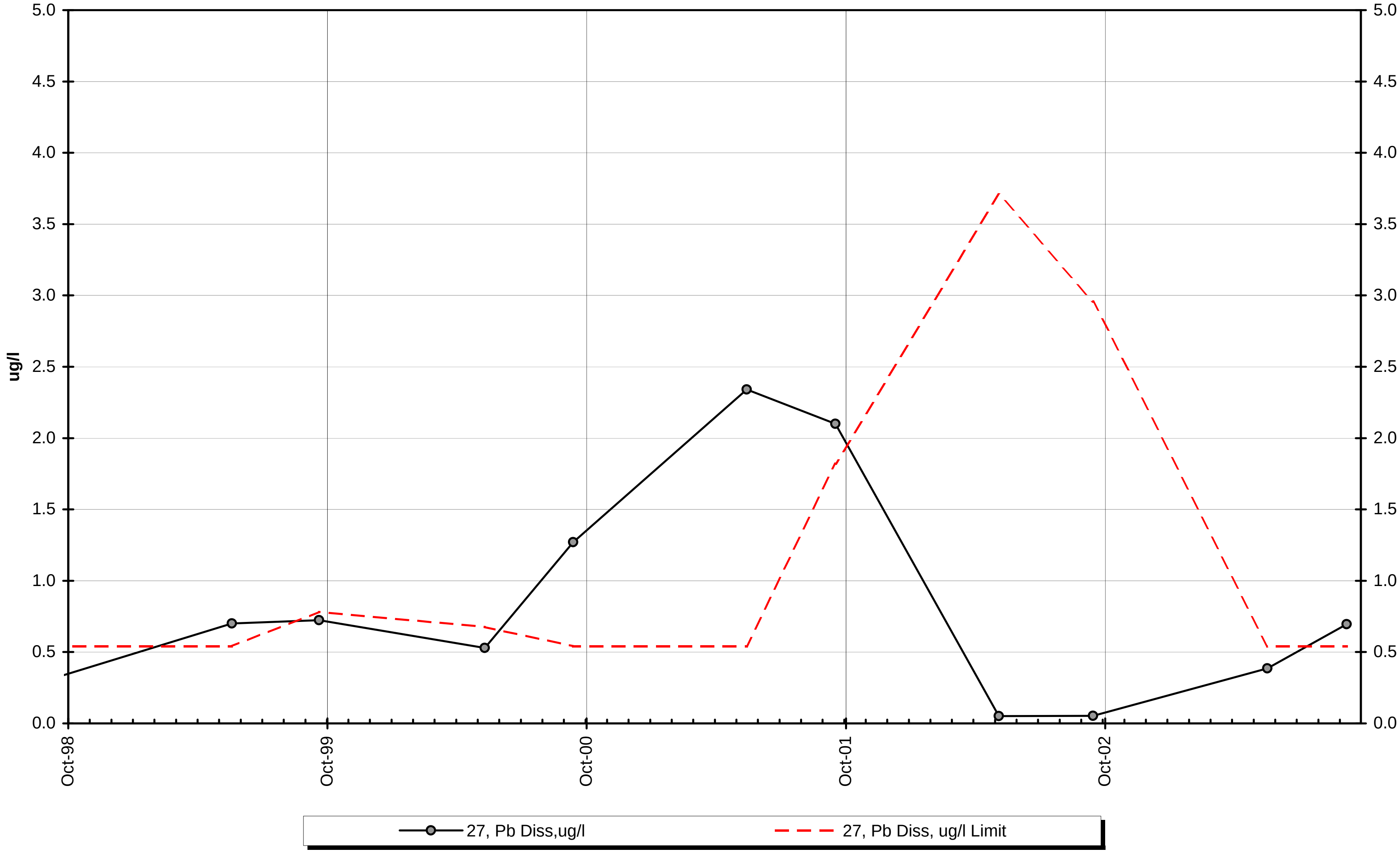
Site 27 -Dissolved Chromium



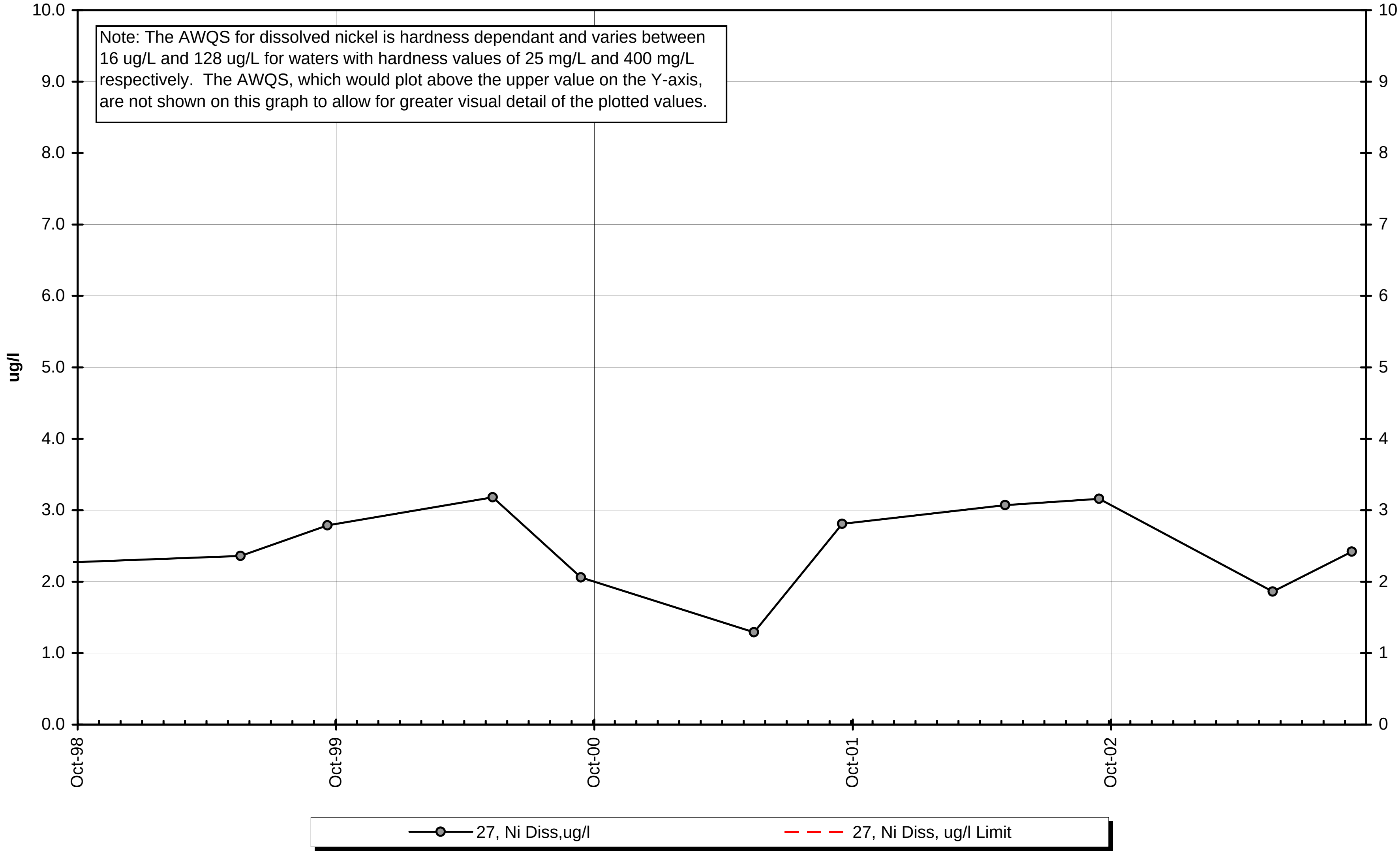


Site 27 -Dissolved Copper
ug/l
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
27, Cu Diss,ug/l
27, Cu Diss, ug/l Limit

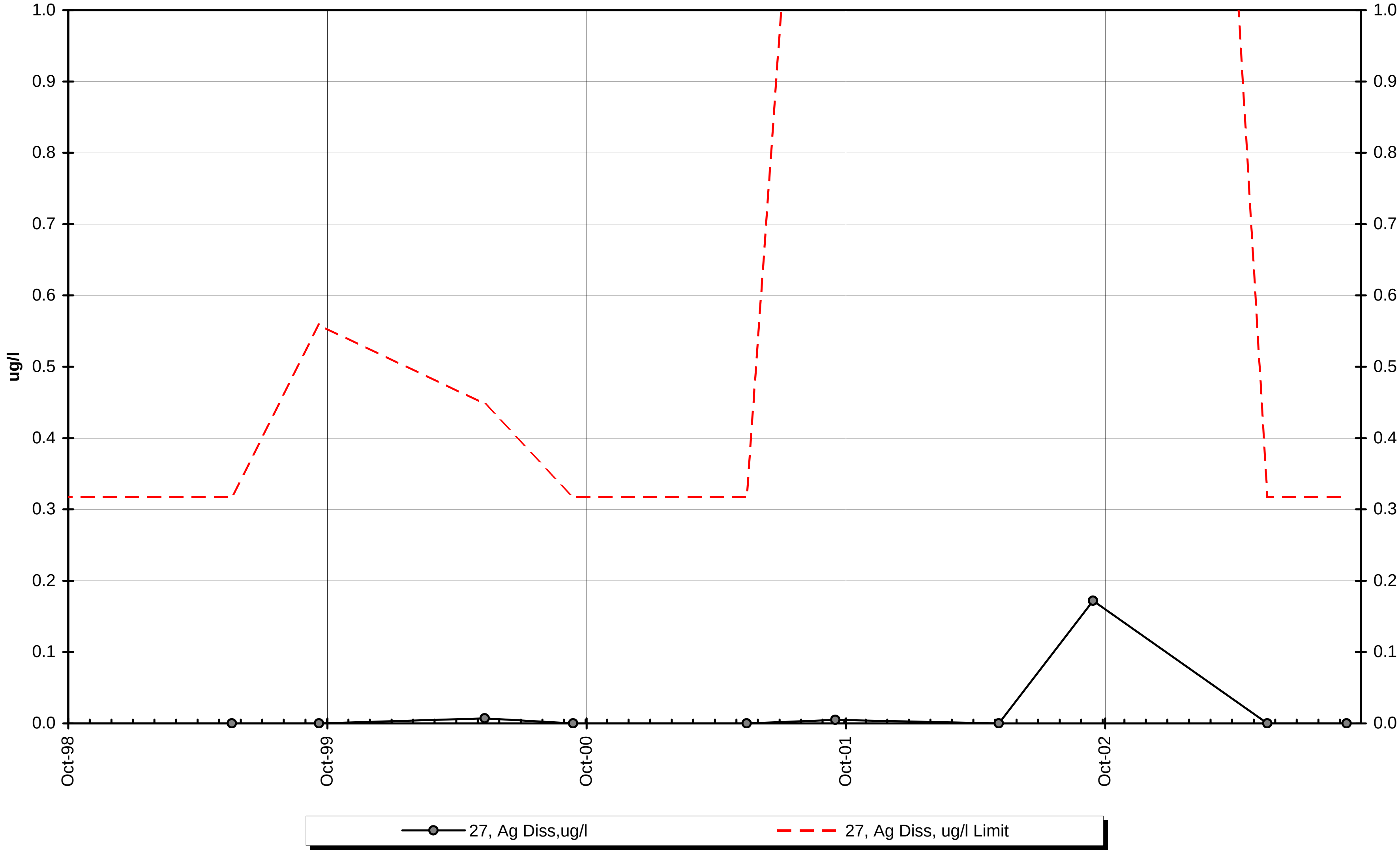
Site 27 -Dissolved Lead



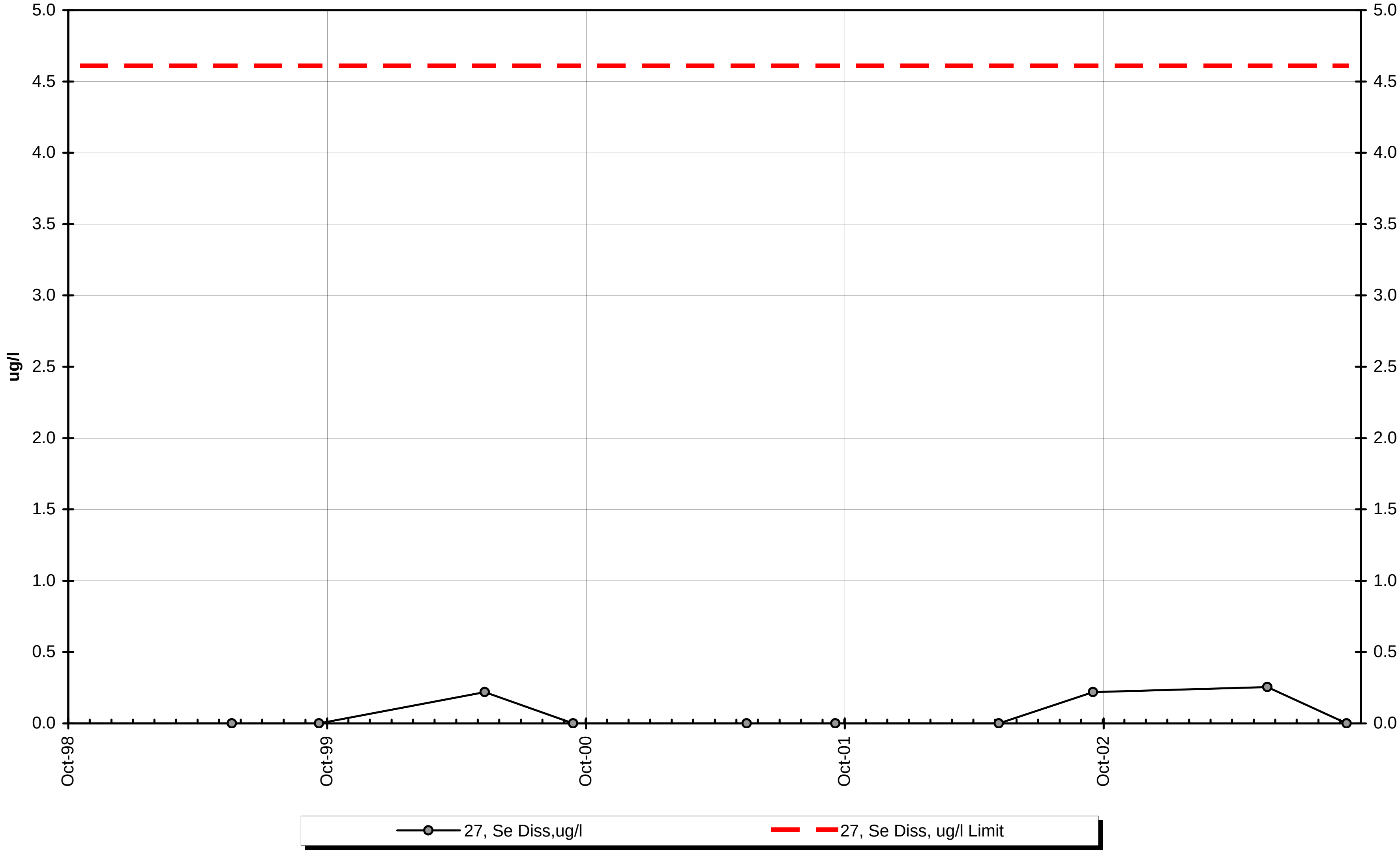
Site 27 -Dissolved Nickel



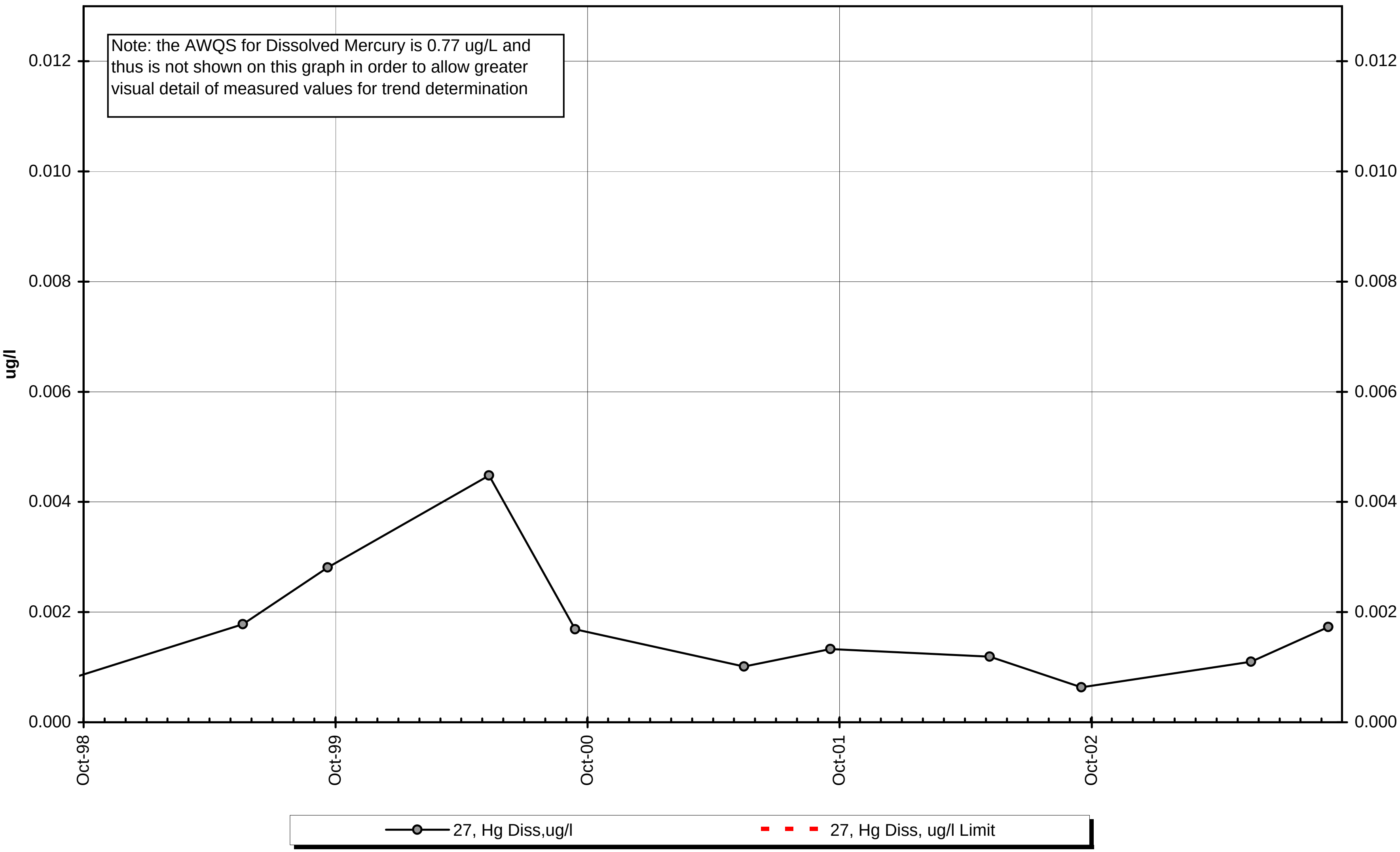
Site 27 -Dissolved Silver



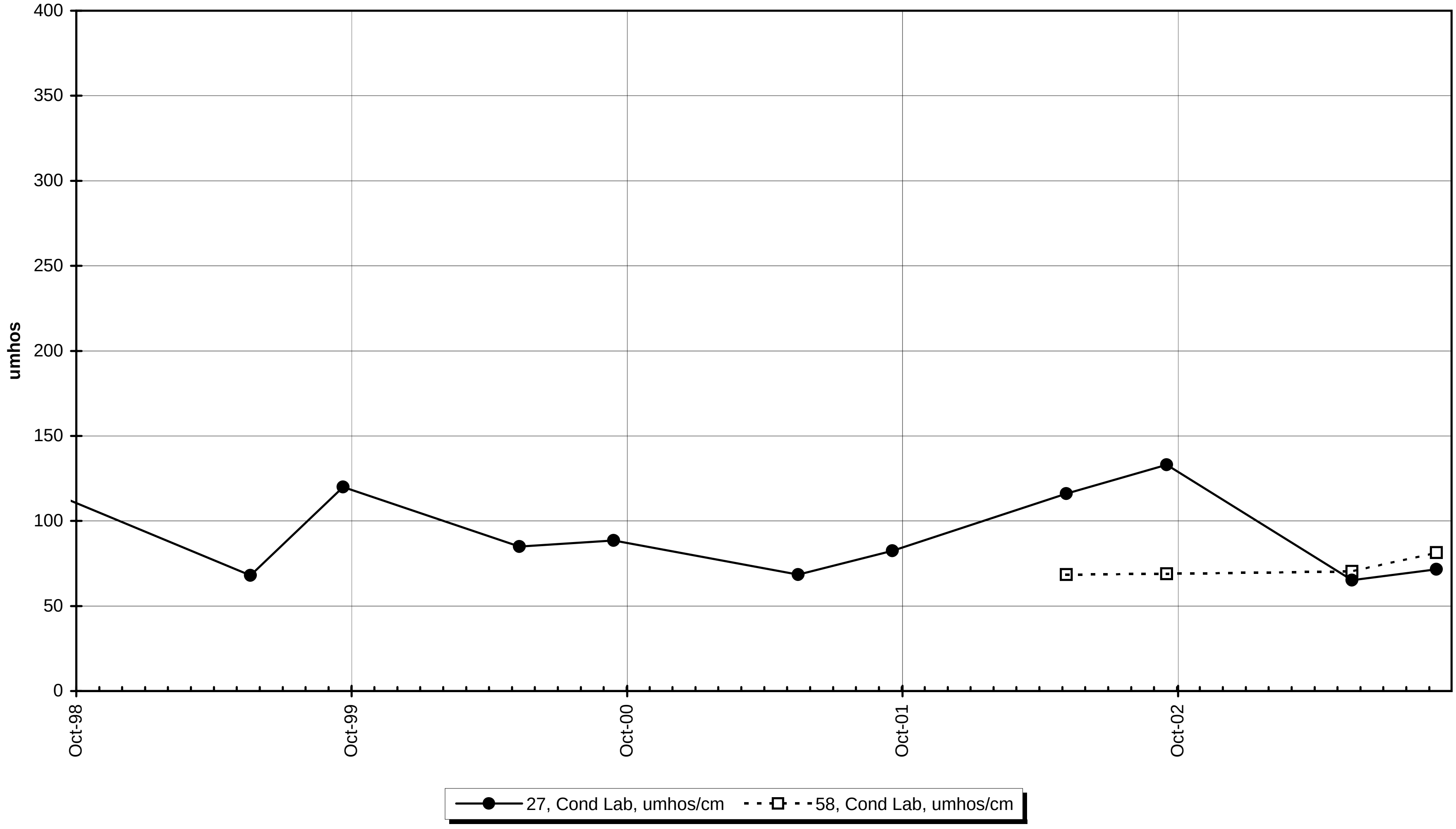
Site 27 -Dissolved Selenium



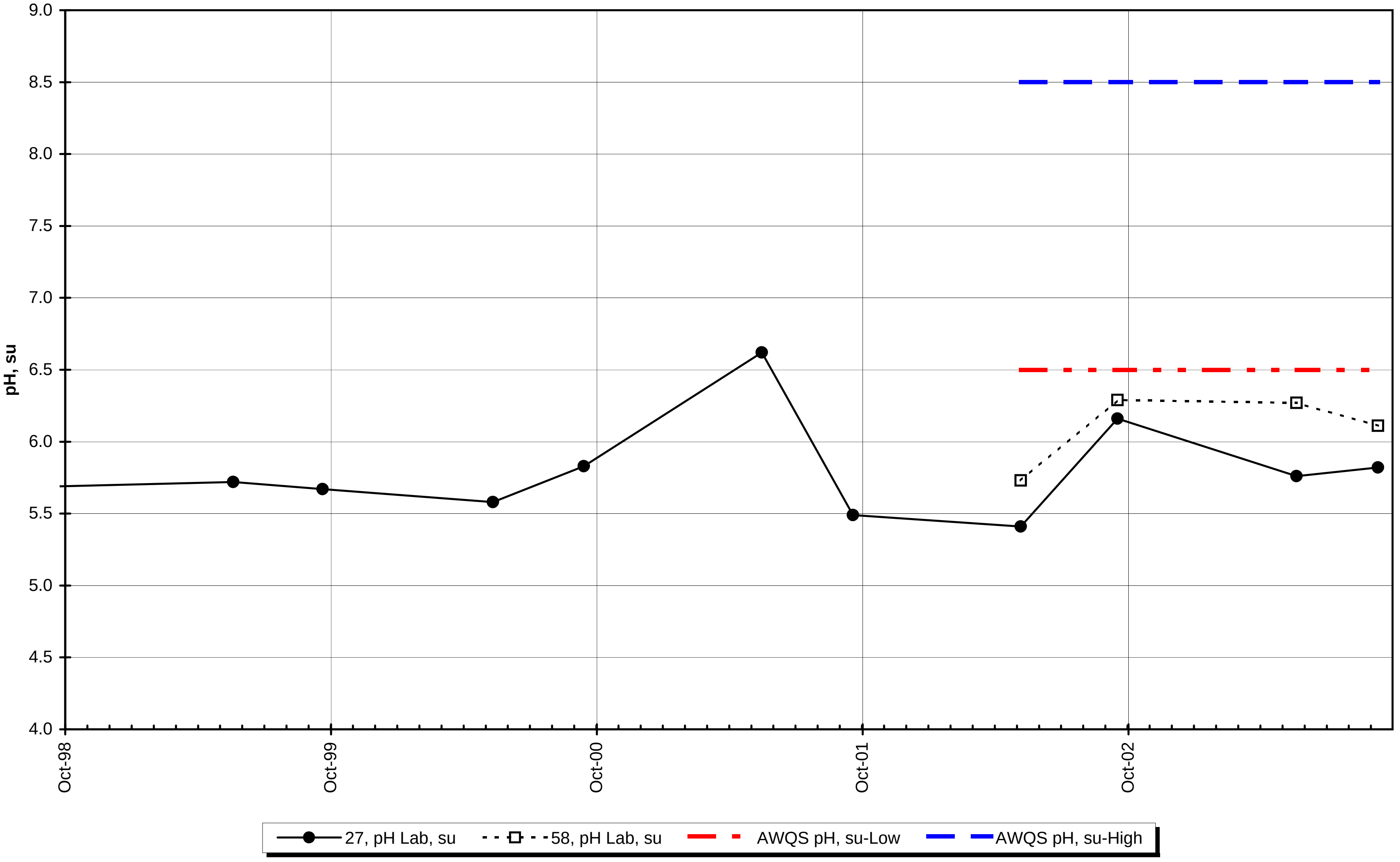
Site 27 -Dissolved Mercury



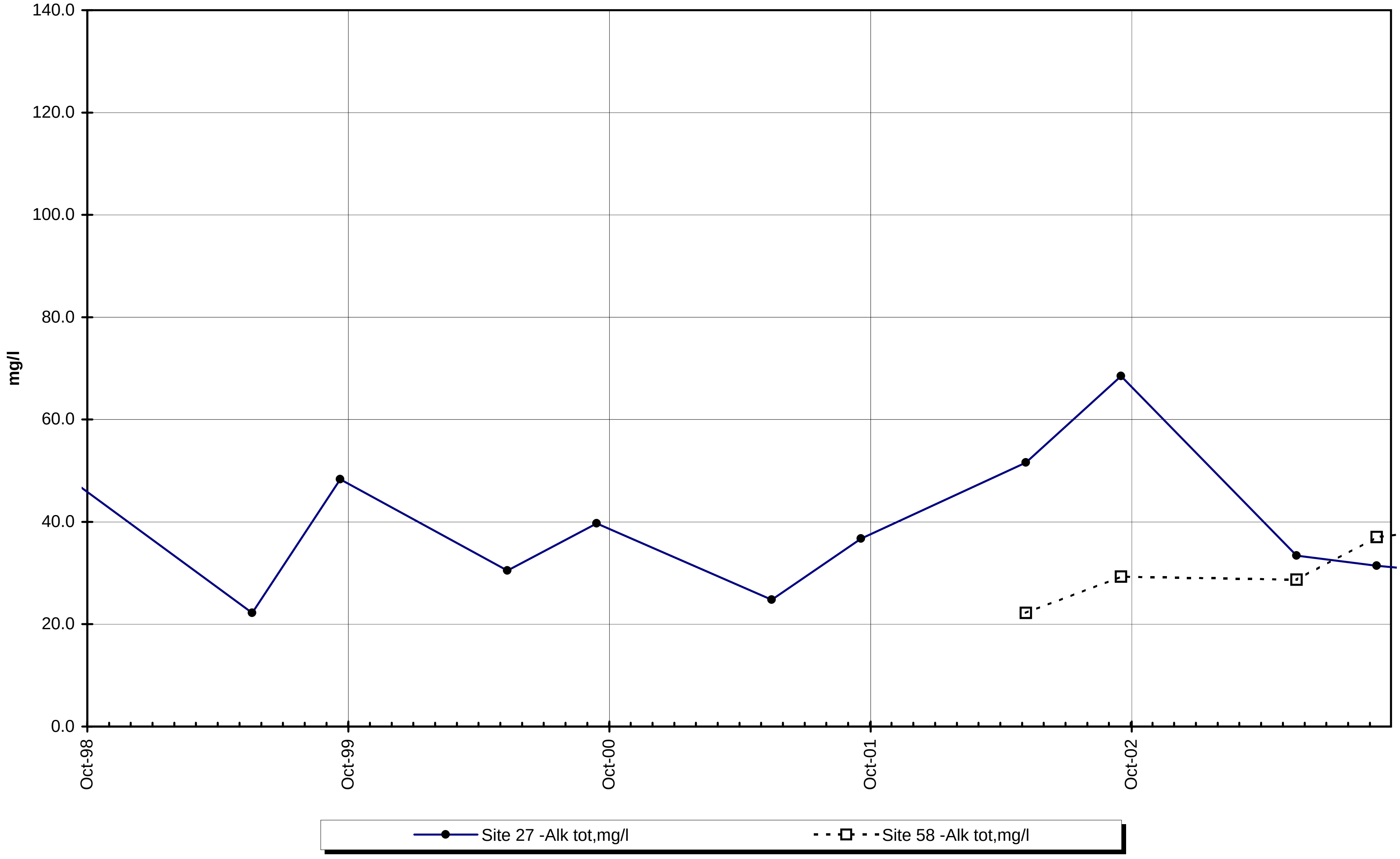
Site 27 vs Site 58 -Conductivity

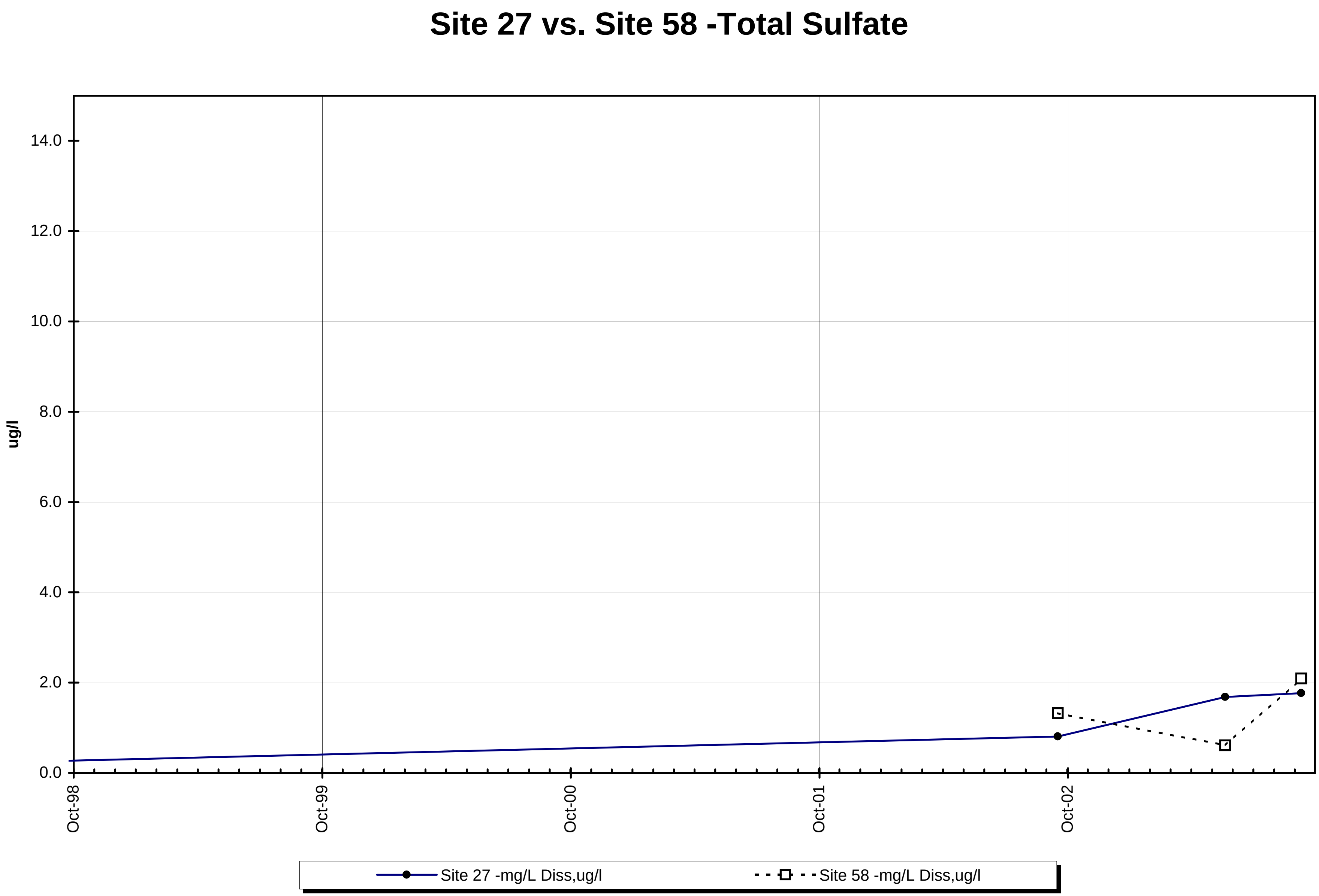


Site 27 vs. Site 58 -pH

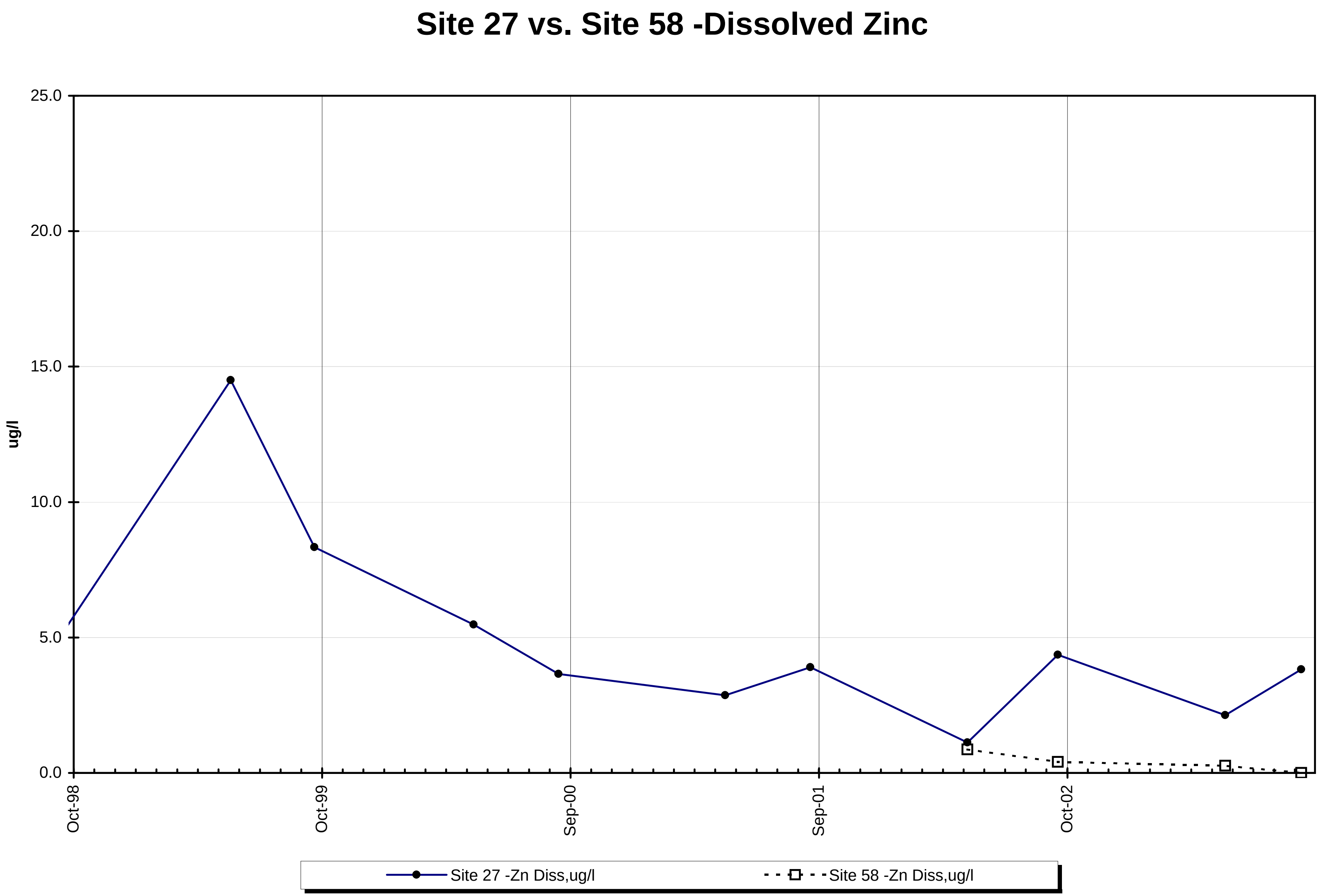


Site 27 vs. Site 58 -Total Alkalinity





Site 27 vs. Site 58 -Total Sulfate
ug/l
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
Site 27 -mg/L Diss,ug/l
Site 58 -mg/L Diss,ug/l



Site 27 vs. Site 58 -Dissolved Zinc
ug/l
25.0
20.0
15.0
10.0
5.0
0.0
Oct-98
Oct-99
Sep-00
Sep-01
Oct-02
Site 27 -Zn Diss,ug/l
Site 58 -Zn Diss,ug/l

INTERPRETIVE REPORT
SITE 29 "MONITORING WELL 3S"

The data collected during the current water year are listed in the following "Table of Results for Water Year 2003" report. The table includes all the data, field and lab, 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 zero for the purpose of median calculation.

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

Sample Date	Parameter	Value	Qualifier	Notes
No outliers have been identified by KGCMC for the period of Oct-98 though Sept-03.				

The data for water year 2003 have been compared to the strictest fresh water quality criterion for each applicable analyte. Two (2) results exceeding these criteria have been identified, as listed in the table below. The two datum are for lab pH values below the lower limit of 6.5 listed in AWQS. Lab pH for Site 29 has historically resulted in values ranging from a pH of 4.9 to 6.5 which are characteristic for wells completed in organic rich peat sediments.

Sample Date	Parameter	Value	Standard	Standard Type
05/21/03	pH Lab, su	5.59	6.5 - 8.5	Aquatic Life
09/10/03	pH Lab, su	5.75	6.5 - 8.5	Aquatic Life

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

Additional X-Y plots have been generated for alkalinity, pH, conductance, sulfate, and dissolved zinc that plot Site 29 and Site 58, the up-gradient control site, to aid in the comparison between those two sites. Total alkalinity, lab conductivity and dissolved zinc are all higher at Site 29 than at Site 58. Lab pH is slightly lower at Site 29 than Site 58. These differences are similar to what was noted previously for Site 27 with respect to the comparison with Site 58. The hydrogeologic conditions that exist at Site 29 are similar to Site 27 with the exception that Site 29 is in the headwater region of Further Creek, which drains westward into Hawk Inlet, and is not typically in an active surface discharge zone. Nevertheless, the same reasons for the differences that occur between Site 58 and Site 27 should apply to Site 29 with respect to Site 58.

Table of Results for Water Year 2003

Site 29 "MW-3S"

Sample Date/Parameter	Oct-02	Nov-02	Dec-02	Jan-03	Feb-03	Mar-03	Apr-03	5/21/2003	Jun-03	Jul-03	Aug-03	9/10/2003	**Median**
Water Temp (°C)								6.9				6.5	6.7
Conductivity-Field(μmho)								112				167	139
Conductivity-Lab (μmho)								90				143	117
pH Lab (standard units)								5.59				5.75	5.67
pH Field (standard units)								5.80				5.87	5.84
Total Alkalinity (mg/L)								48.4				75.9	62.2
Total Sulfate (mg/L)								<0.1 J				<0.1 J	0.1
Hardness (mg/L)								34.0				57.8	45.9
Dissolved As (ug/L)								14.400		NOT SCHEDULED FOR SAMPLING		22.900	18.650
Dissolved Ba (ug/L)				NOT SCHEDULED FOR SAMPLING				15.1				19.7	17.4
Dissolved Cd (ug/L)								0.011				<0.023	0.011
Dissolved Cr (ug/L)								2.960				5.200	4.080
Dissolved Cu (ug/L)								0.328				0.165	0.247
Dissolved Pb (ug/L)								0.3820				0.1810 J	0.2815
Dissolved Ni (ug/L)								8.250				1.400	4.825
Dissolved Ag (ug/L)								<0.028				<0.004	0.008
Dissolved Zn (ug/L)								2.56				2.24	2.40
Dissolved Se (ug/L)								<0.224 UJ				<0.496	0.180
Dissolved Hg (ug/L)								0.001030				0.000713 J	0.000872

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

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

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

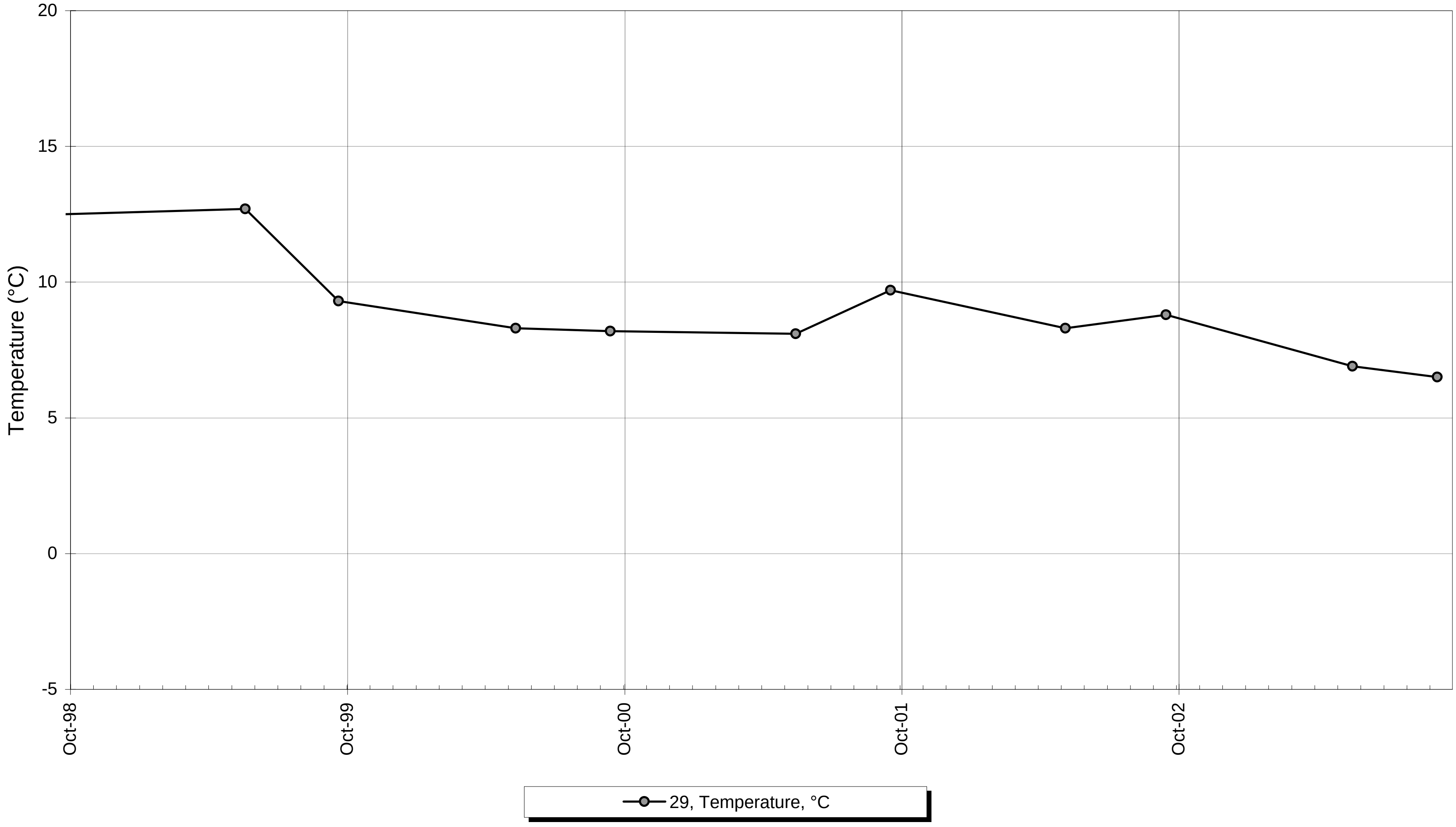
Qualified Data by QA Reviewer

Date Range: 10/01/2002 to 09/30/2003

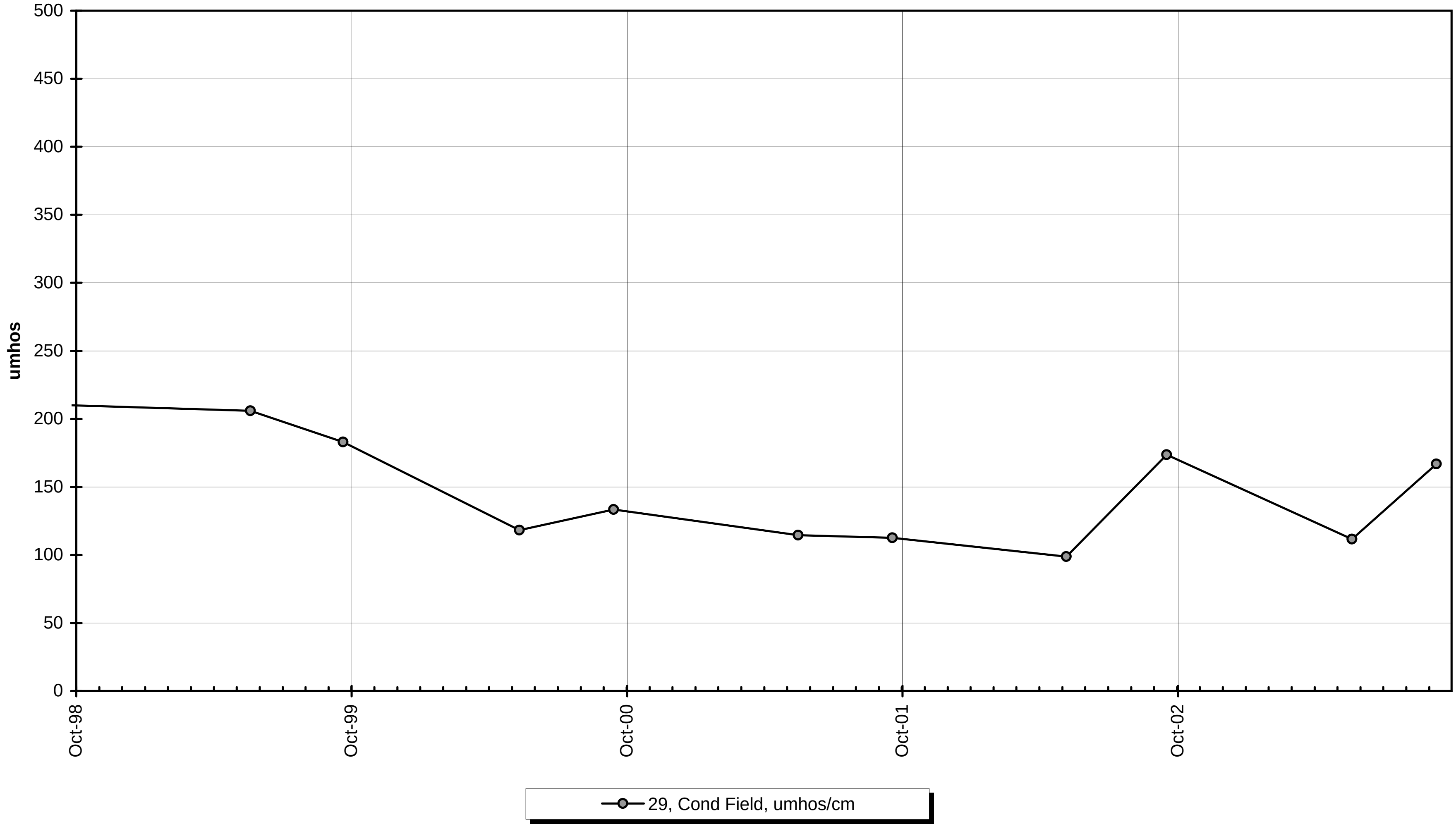
Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
29	05/21/2003	12:57:00 PM				
			SO4 Tot, mg/l	-0.1	J	Below Quantitative Range
			Se Diss, ug/l	-0.224	UJ	LCS Recovery
29	09/10/2003	2:10:00 PM				
			SO4 Tot, mg/l	-0.1	J	Below Quantitative Range, S
			Pb Diss, ug/l	0.181	J	Below Quantitative Range
			Hg Diss, ug/l	0.000713	J	Method Blank Contamination

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

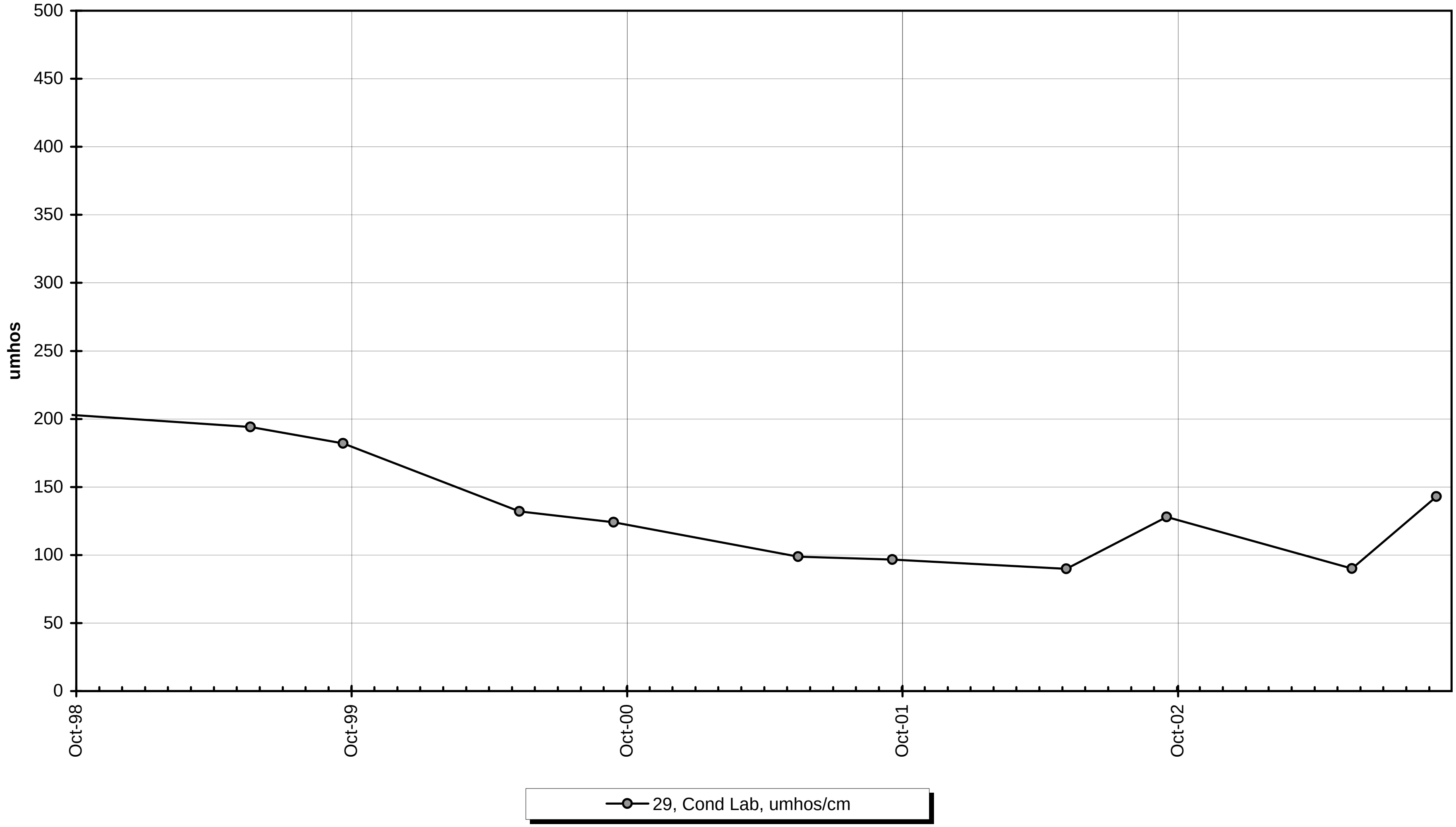
Site 29 -Water Temperature

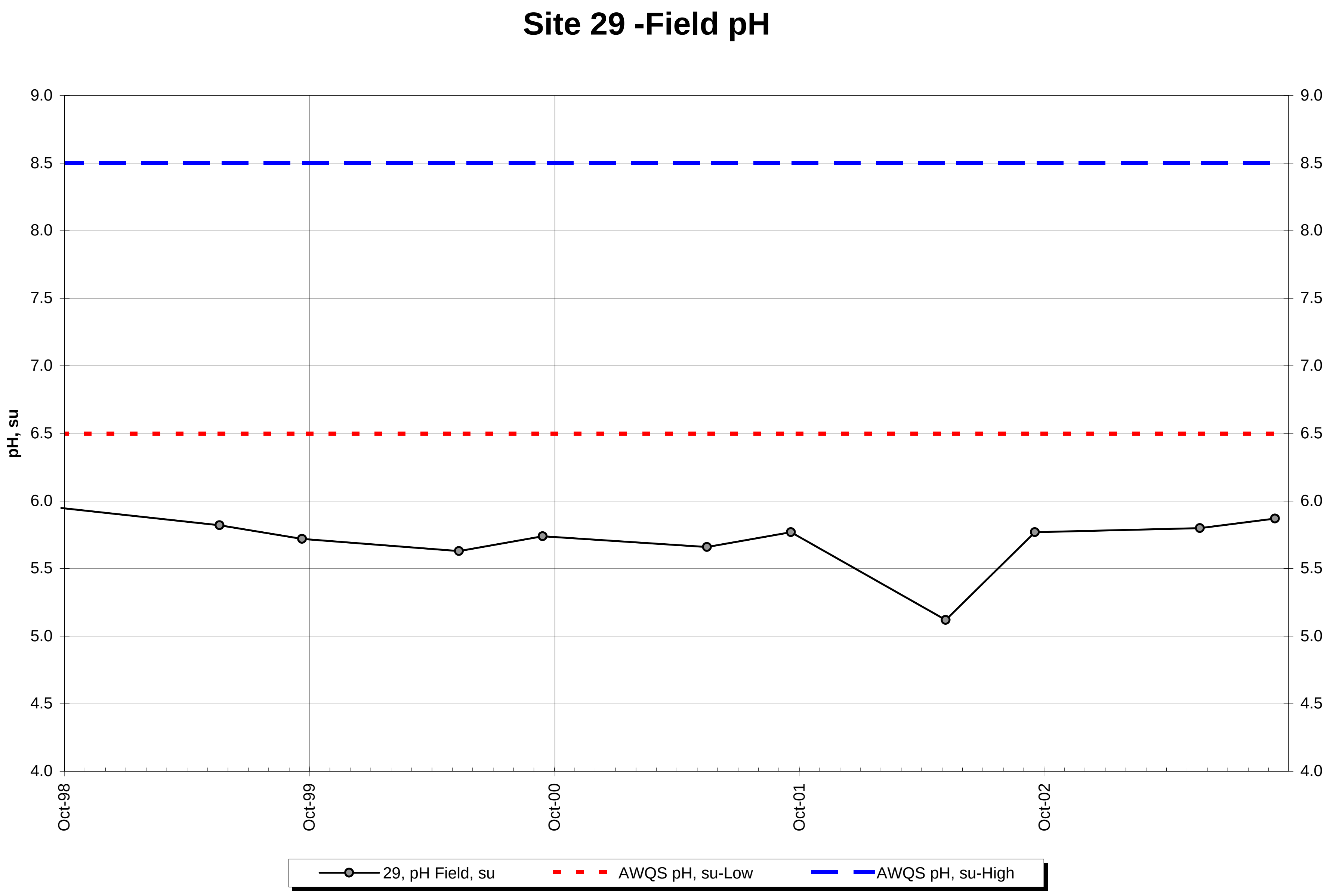


Site 29 -Conductivity-Field

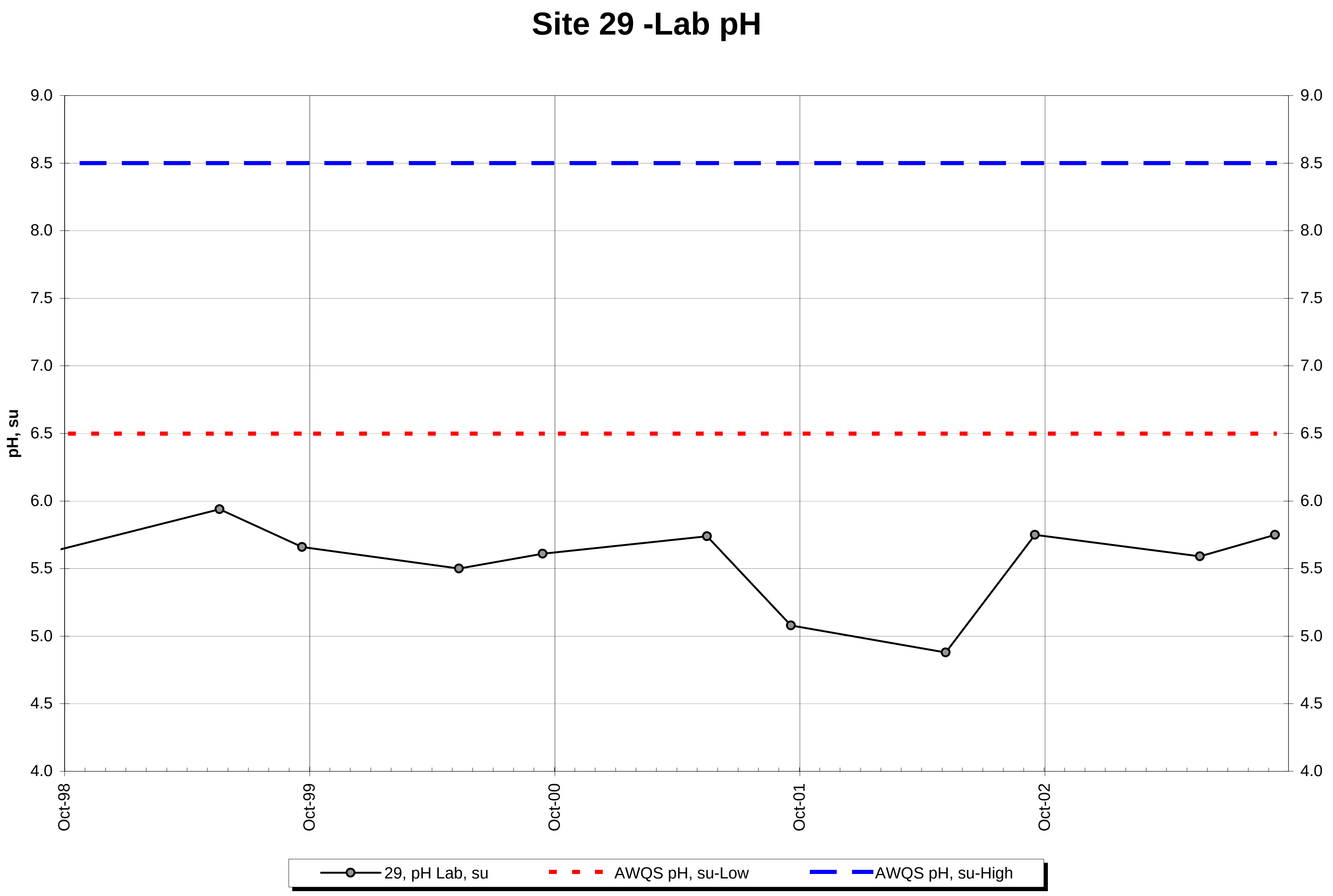


Site 29 -Conductivity-Lab

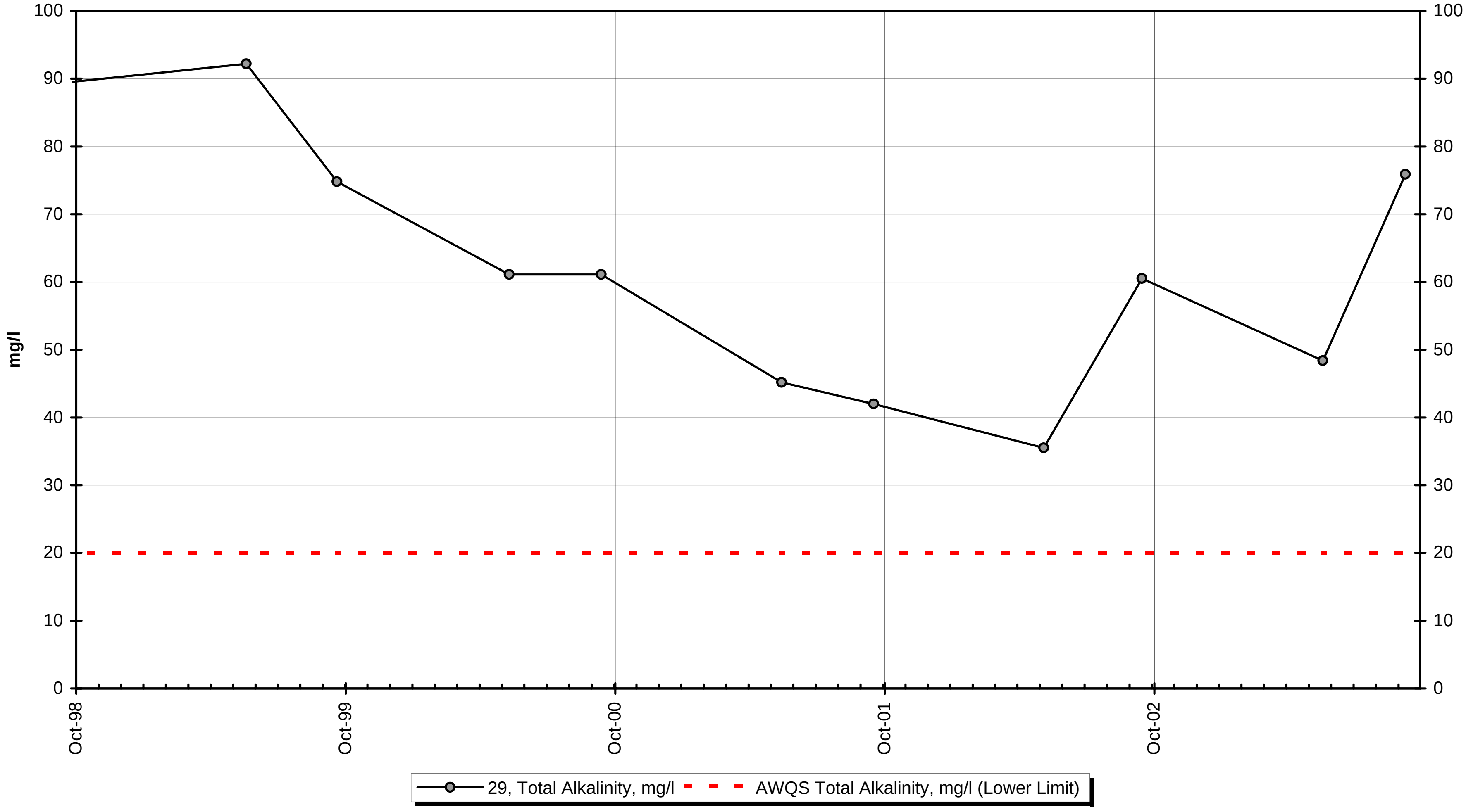


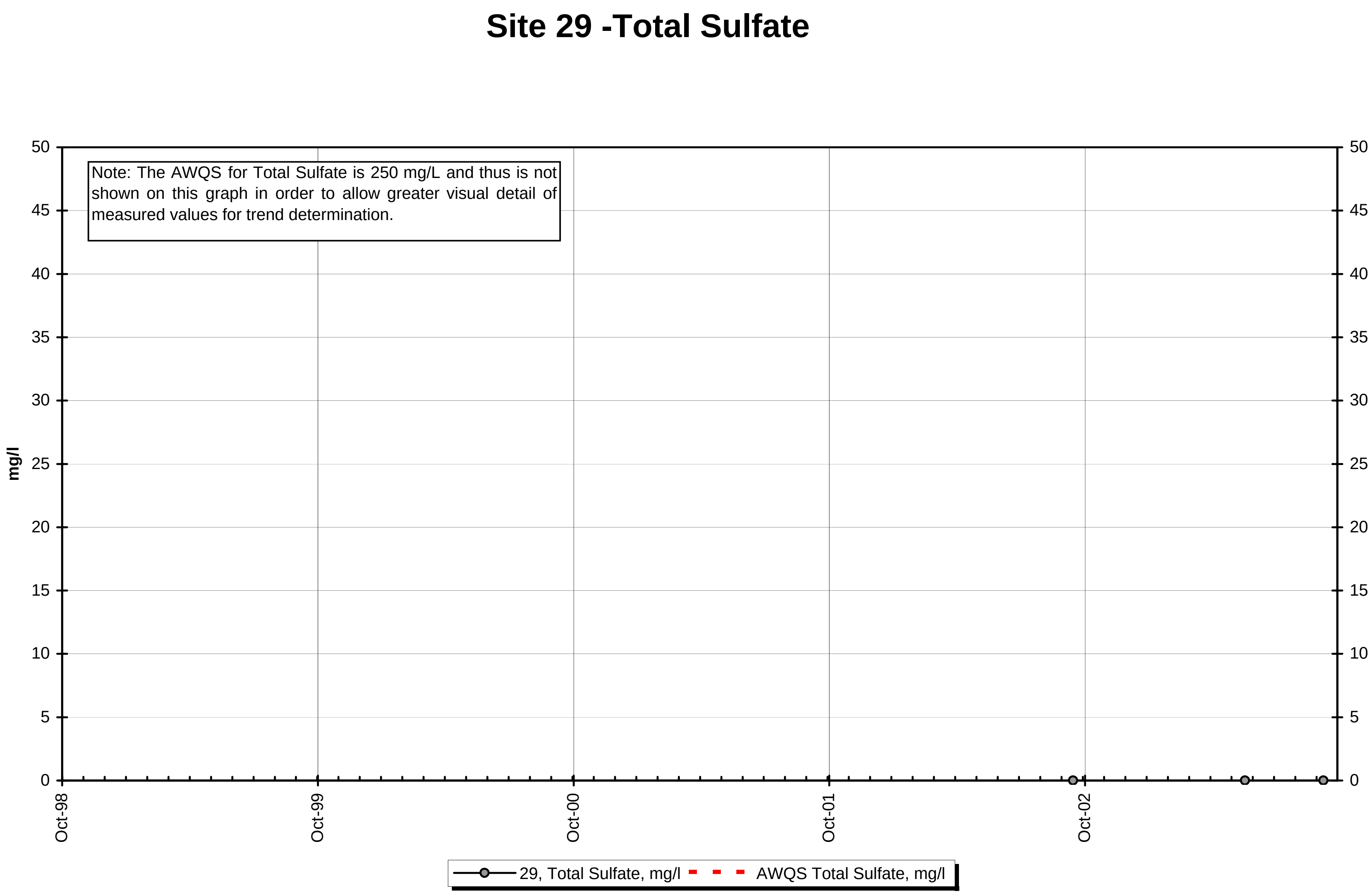


Site 29 -Field pH
pH, su
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
29, pH Field, su
AWQS pH, su-Low
AWQS pH, su-High


Site 29 -Lab pH
pH, su
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
29, pH Lab, su
AWQS pH, su-Low
AWQS pH, su-High

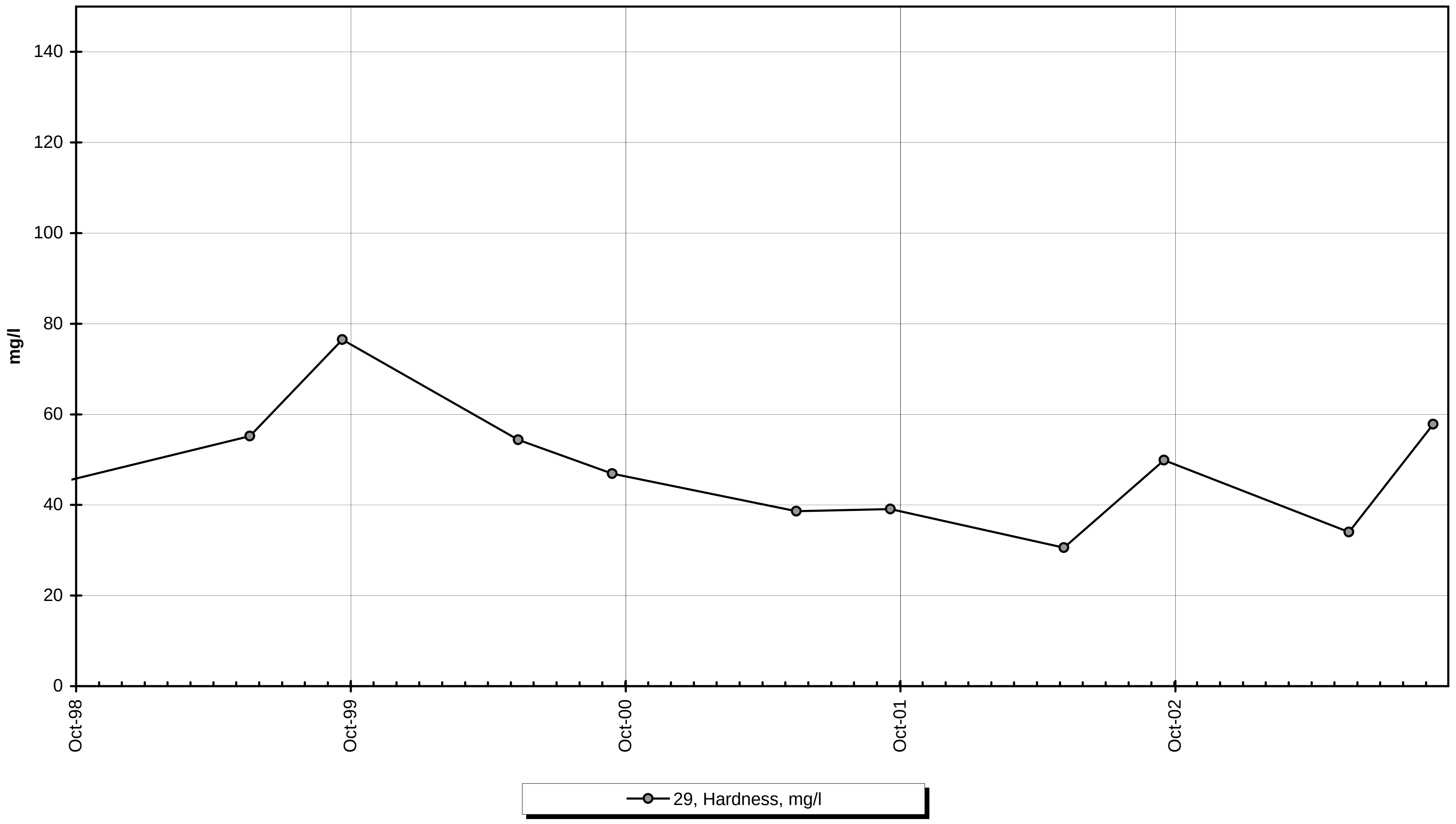
Site 29 -Total Alkalinity

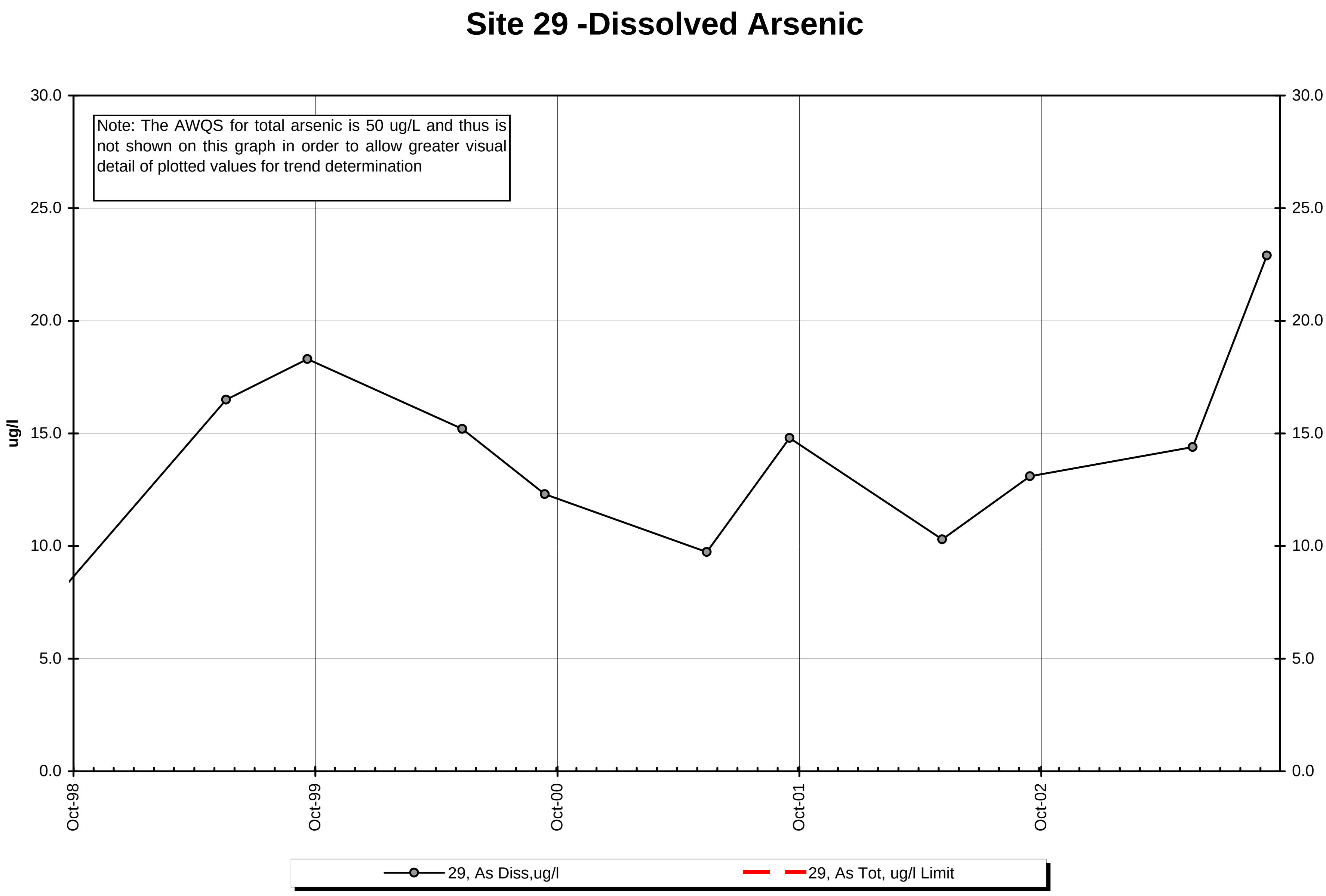




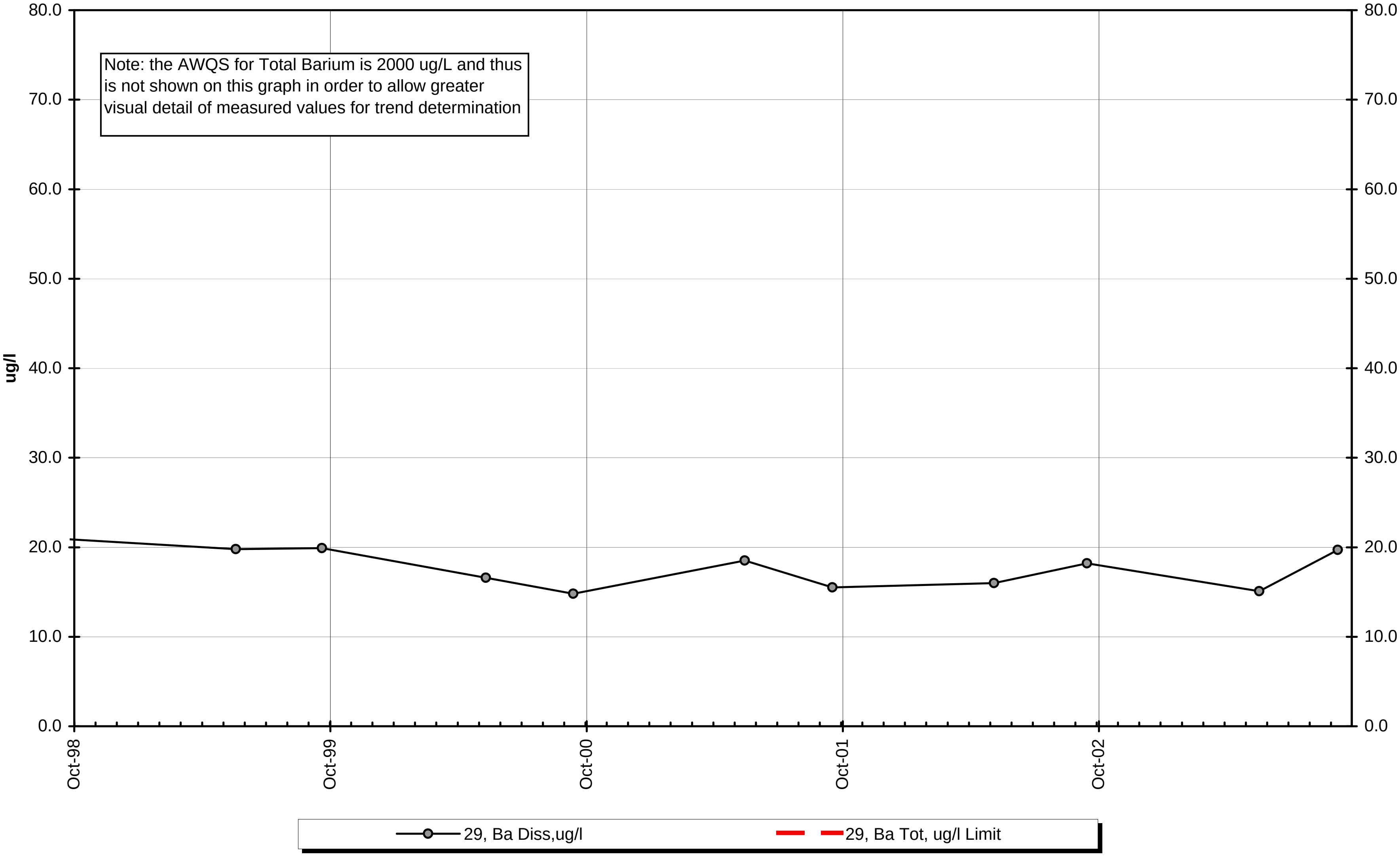
Site 29 -Total Sulfate
Note: The AWQS for Total Sulfate is 250 mg/L and thus is not shown on this graph in order to allow greater visual detail of measured values for trend determination.
mg/l
50
45
40
35
30
25
20
15
10
5
0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
29, Total Sulfate, mg/l
AWQS Total Sulfate, mg/l

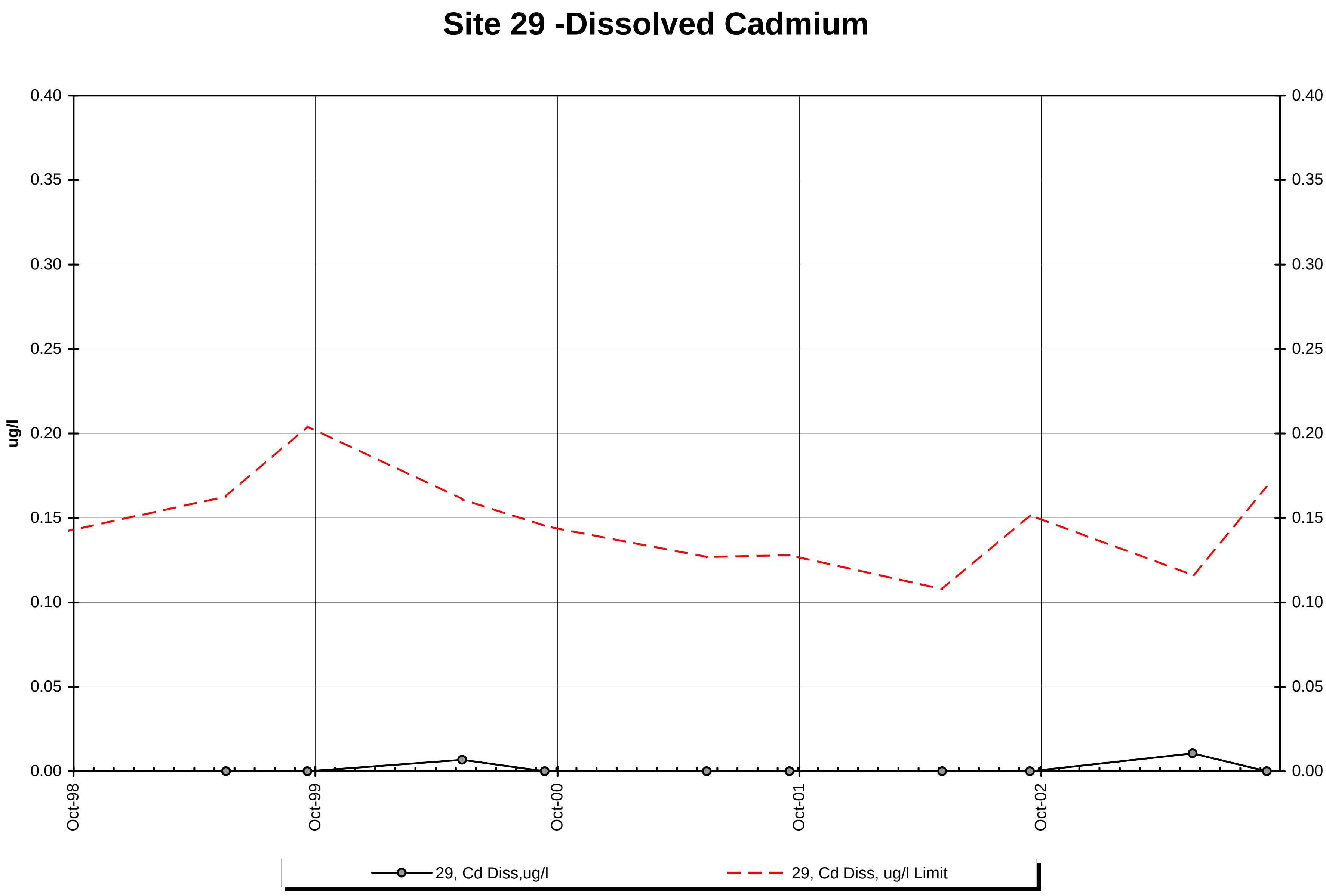
Site 29 -Hardness



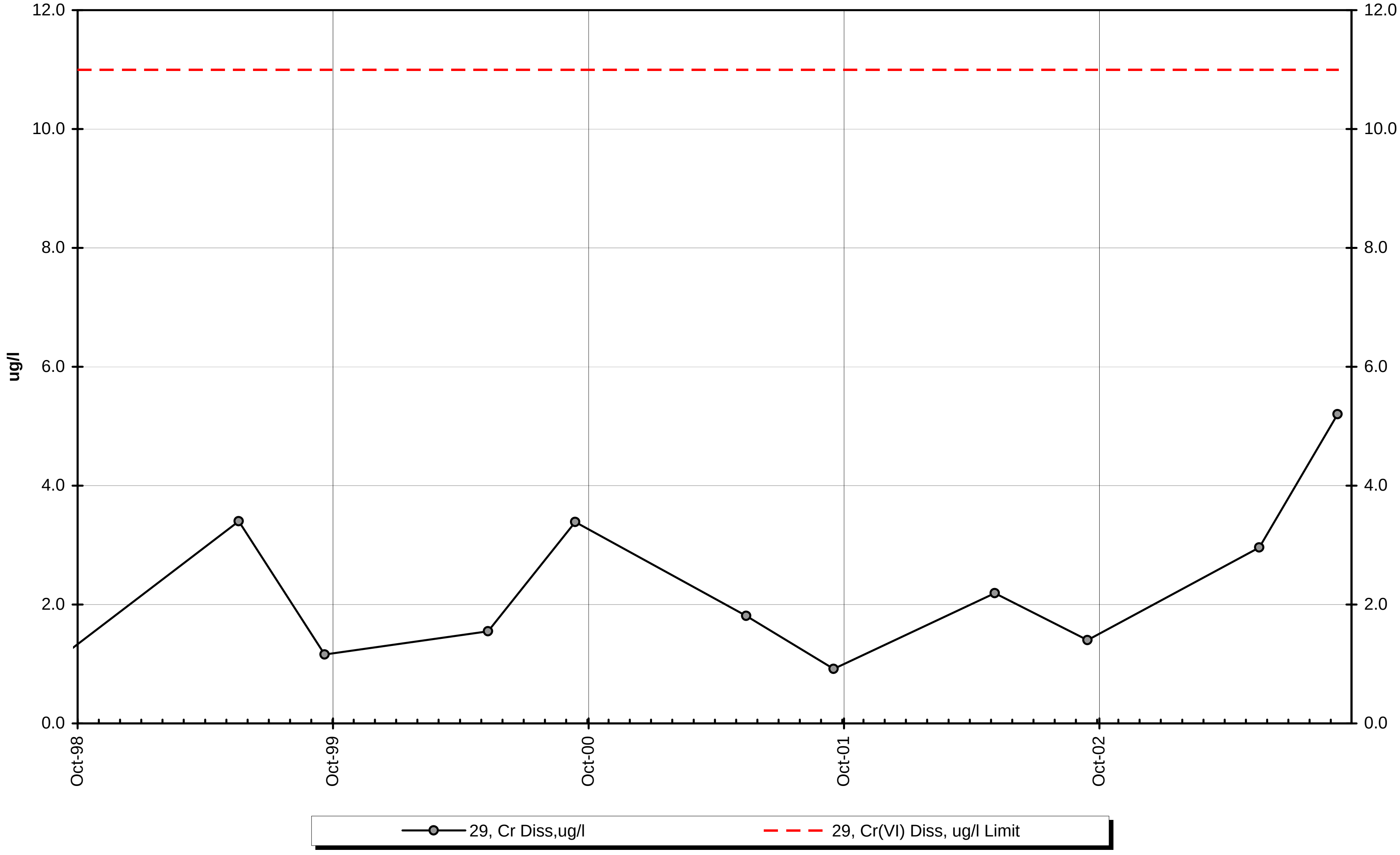

Site 29 -Dissolved Arsenic
Note: The AWQS for total arsenic is 50 ug/L and thus is not shown on this graph in order to allow greater visual detail of plotted values for trend determination
ug/l
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
29, As Diss,ug/l
29, As Tot, ug/l Limit

Site 29 -Dissolved Barium

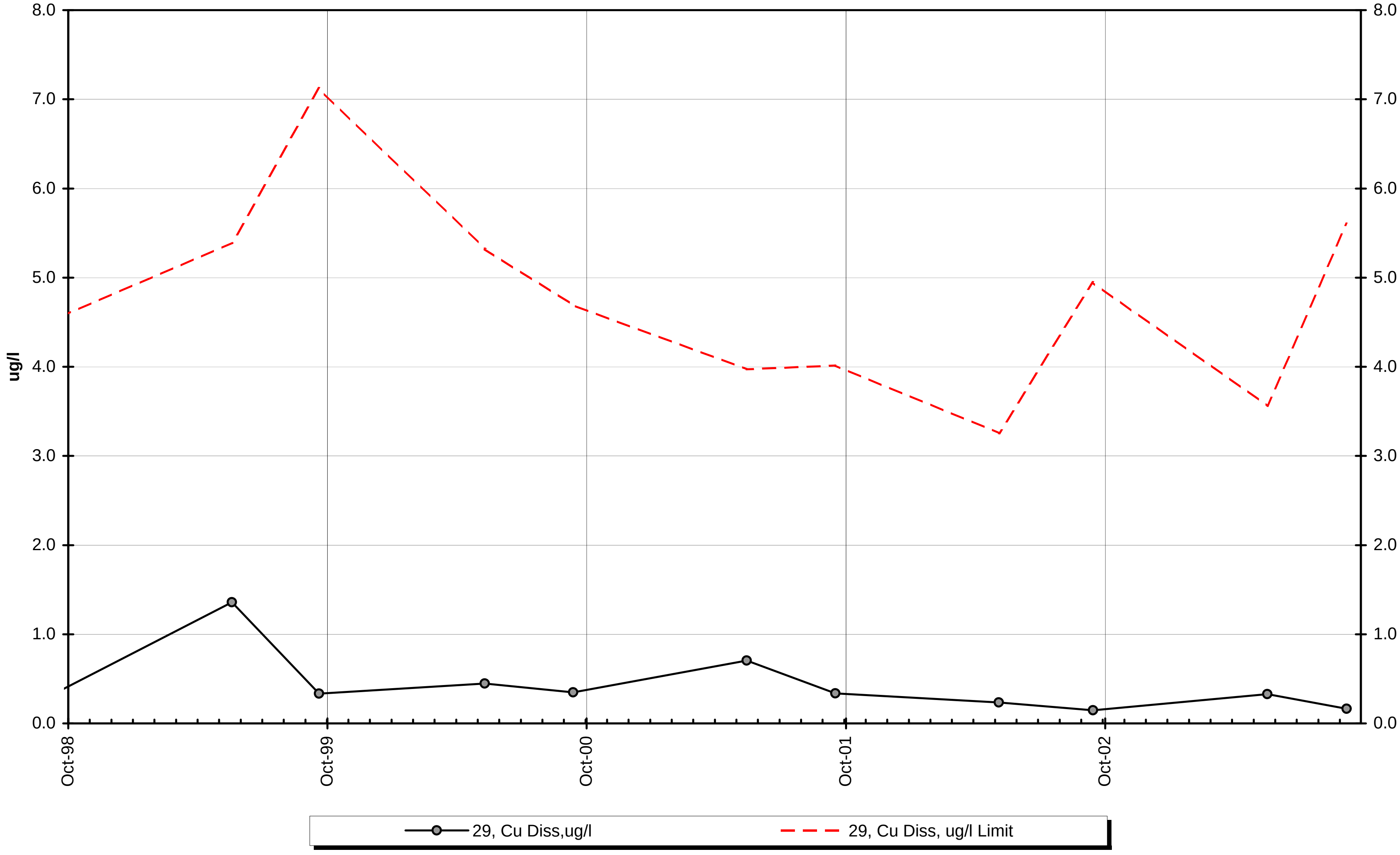



Site 29 -Dissolved Cadmium
ug/l
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
29, Cd Diss,ug/l
29, Cd Diss, ug/l Limit

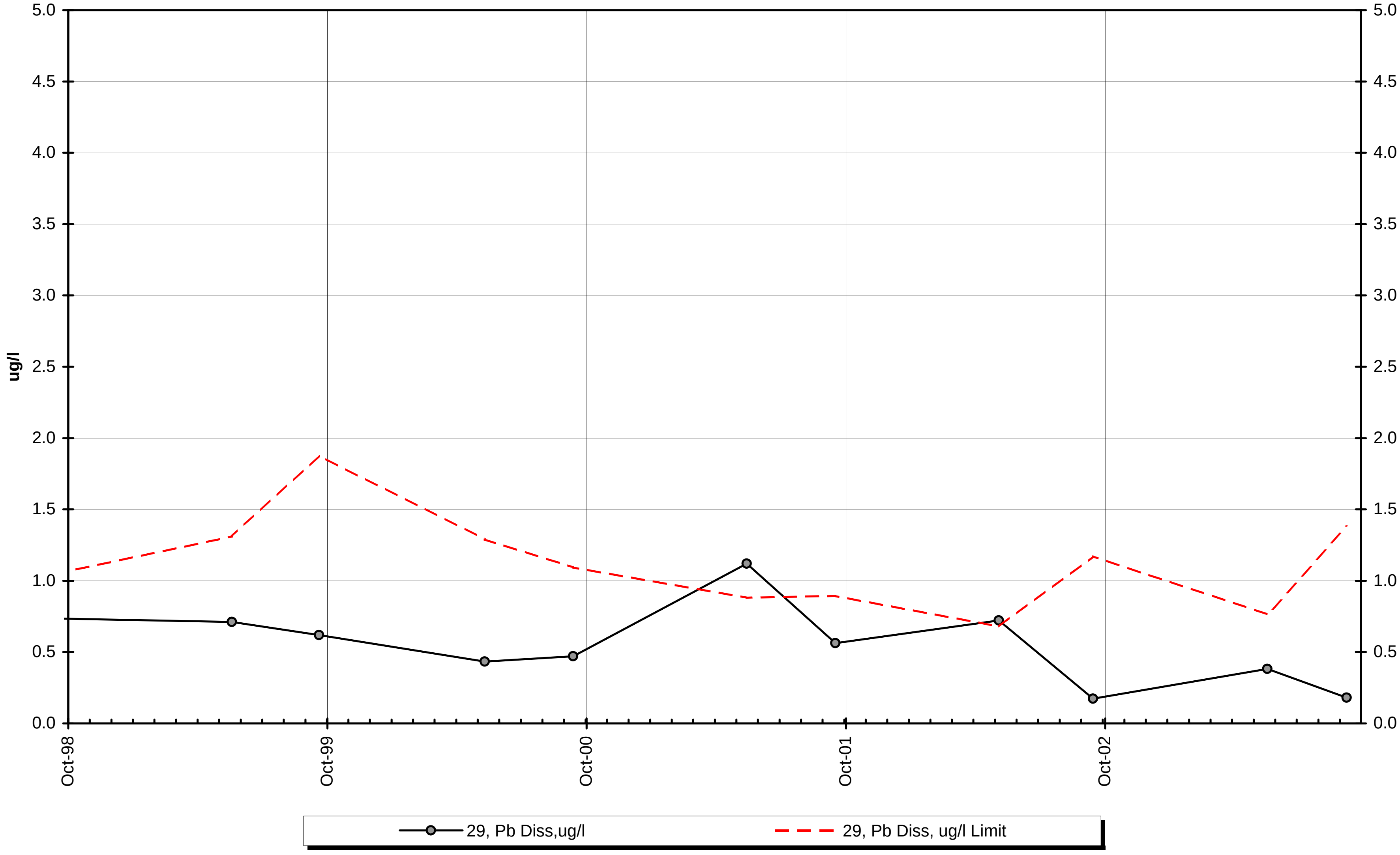
Site 29 -Dissolved Chromium

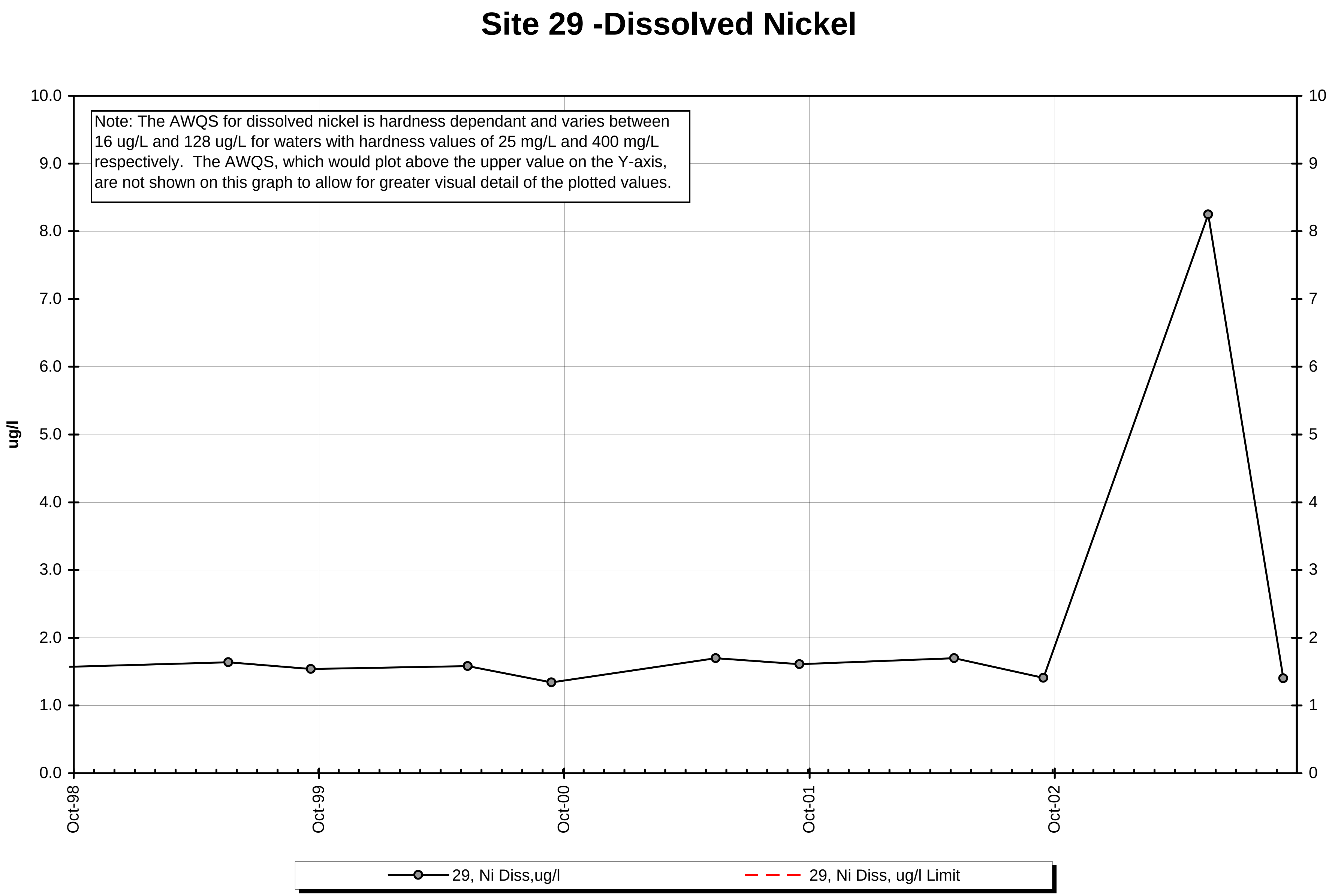


Site 29 -Dissolved Copper

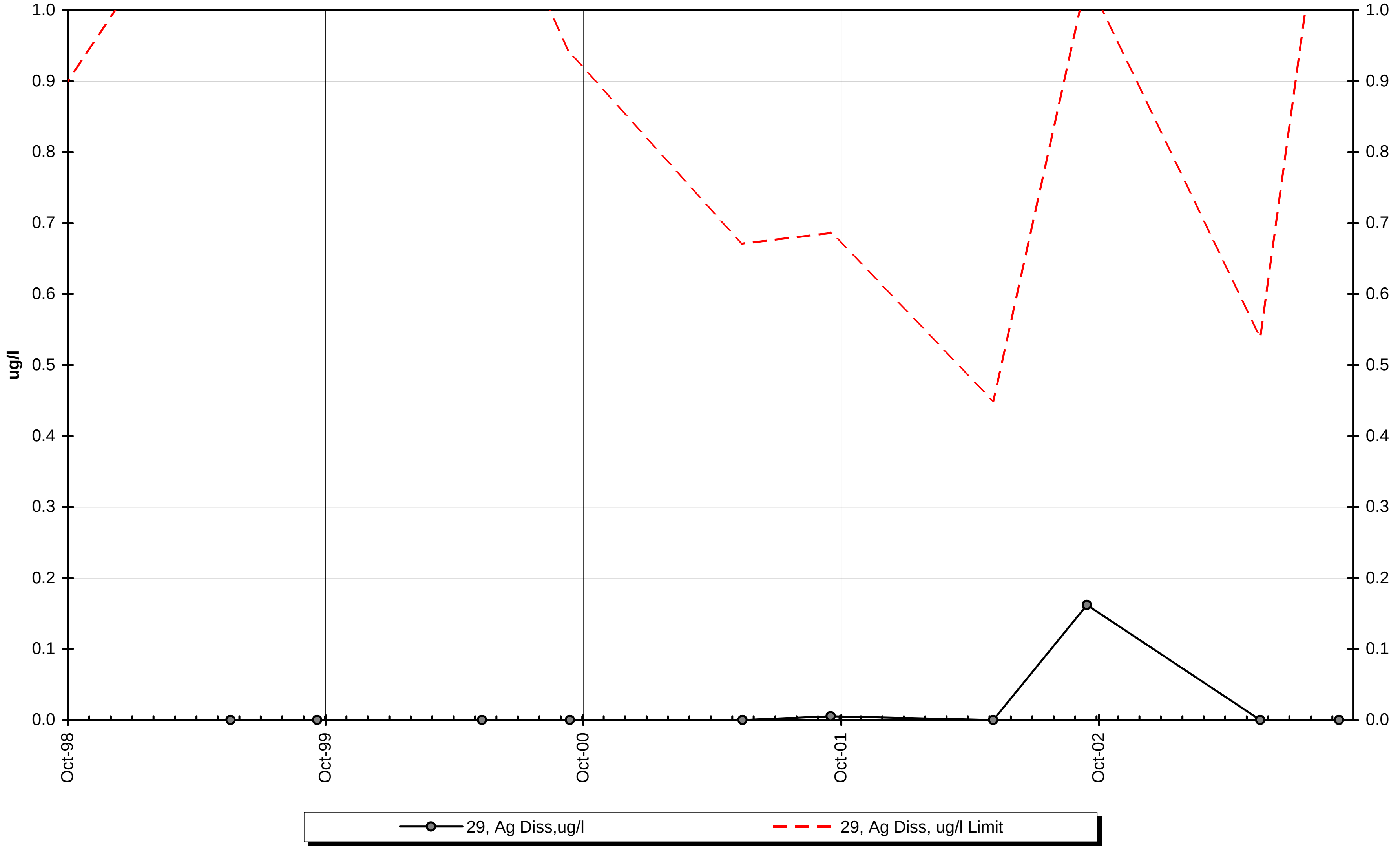


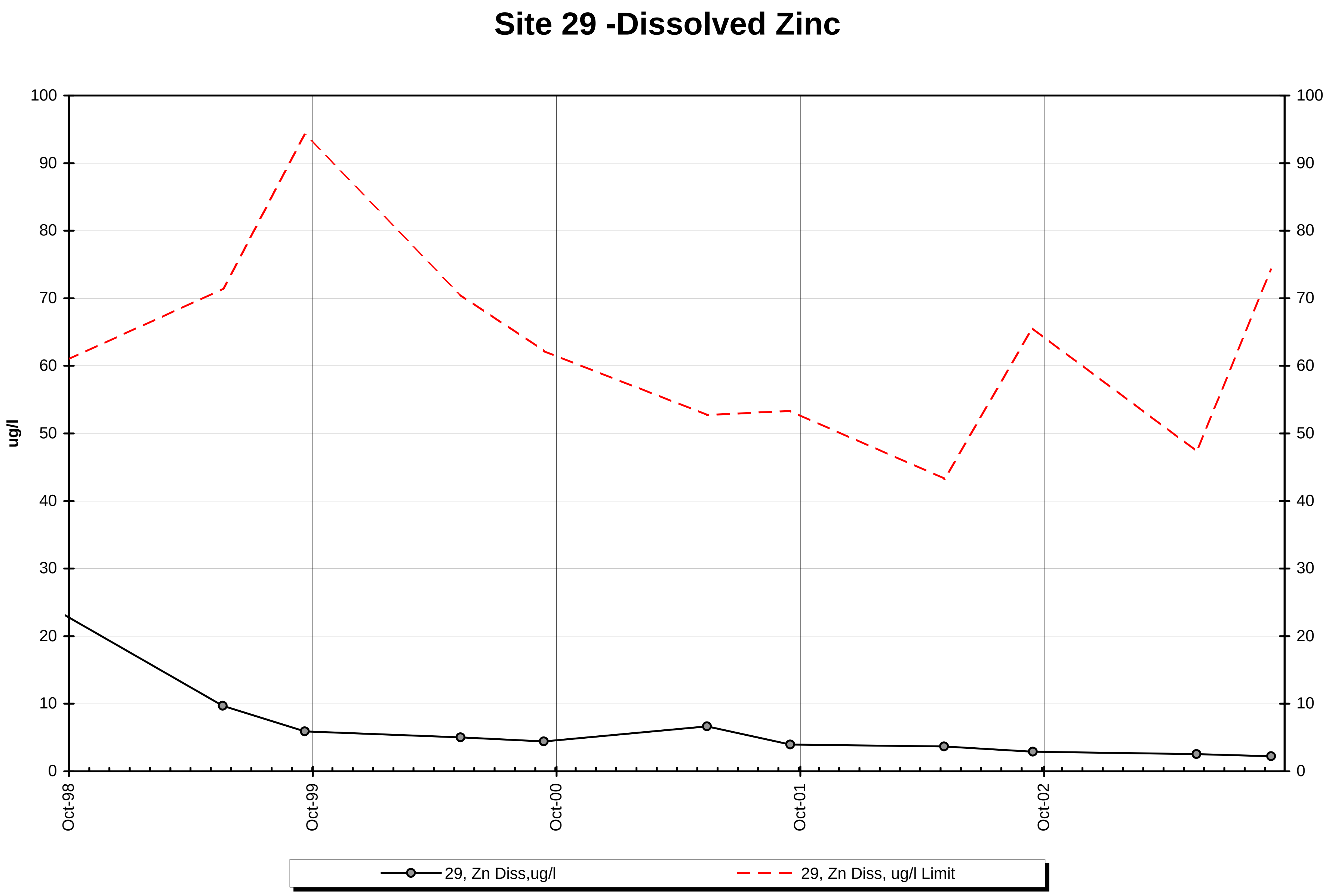
Site 29 -Dissolved Lead



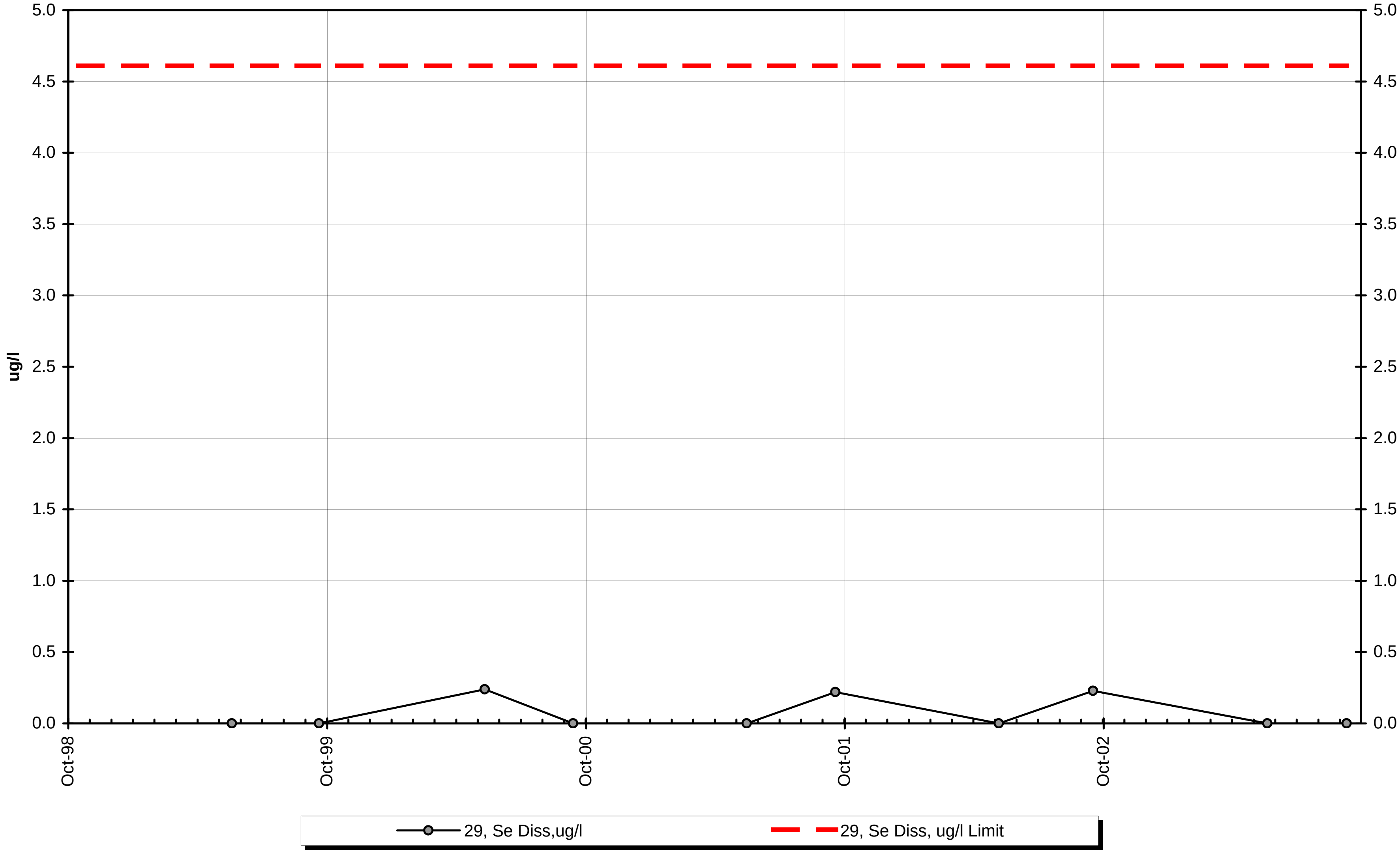

Site 29 -Dissolved Nickel
Note: The AWQS for dissolved nickel is hardness dependant and varies between 16 ug/L and 128 ug/L for waters with hardness values of 25 mg/L and 400 mg/L respectively. The AWQS, which would plot above the upper value on the Y-axis, are not shown on this graph to allow for greater visual detail of the plotted values.
ug/l
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
10
9
8
7
6
5
4
3
2
1
0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
29, Ni Diss,ug/l
29, Ni Diss, ug/l Limit

Site 29 -Dissolved Silver

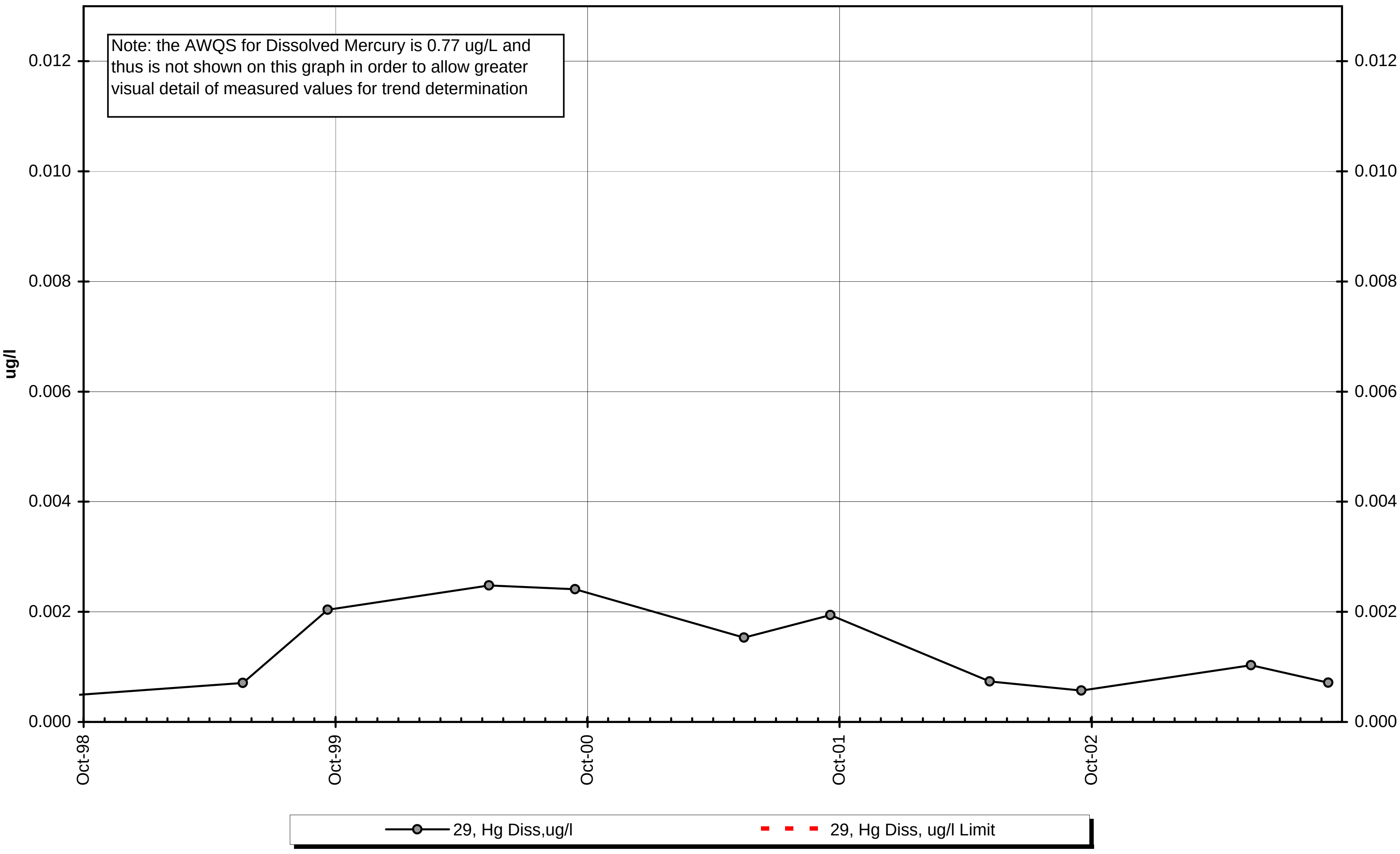



Site 29 -Dissolved Zinc
ug/l
100
90
80
70
60
50
40
30
20
10
0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
29, Zn Diss,ug/l
29, Zn Diss, ug/l Limit

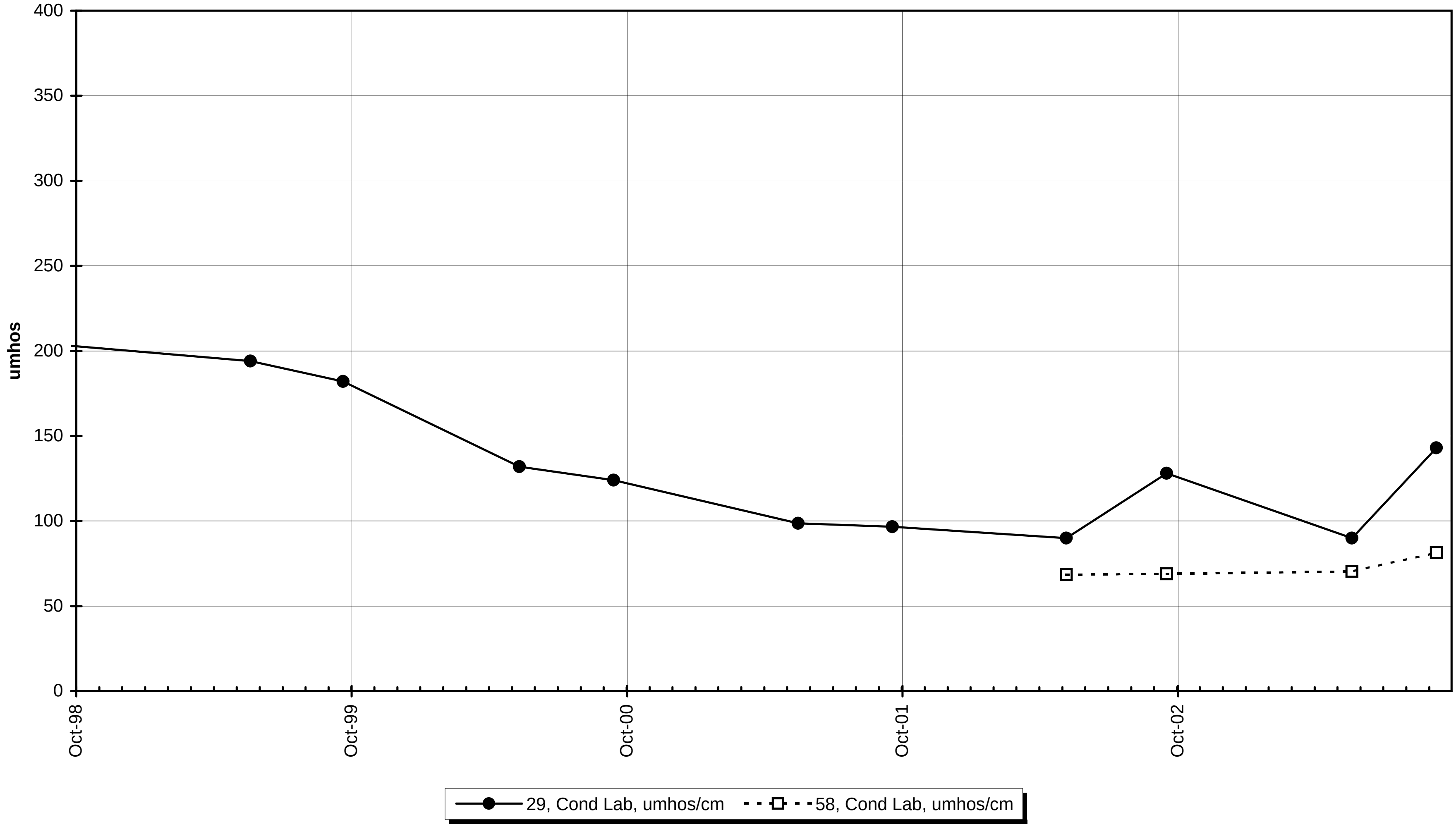
Site 29 -Dissolved Selenium

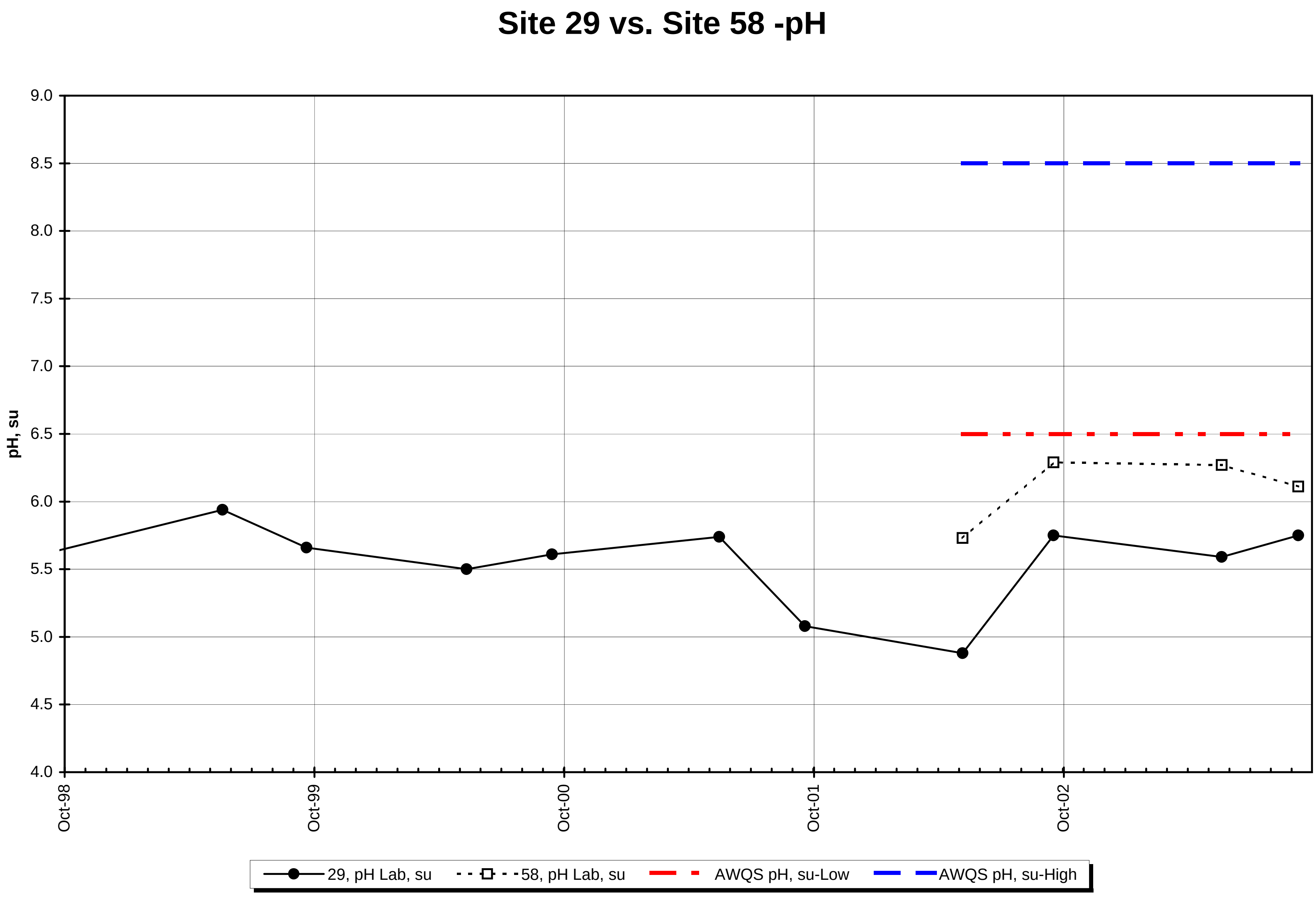


Site 29 -Dissolved Mercury



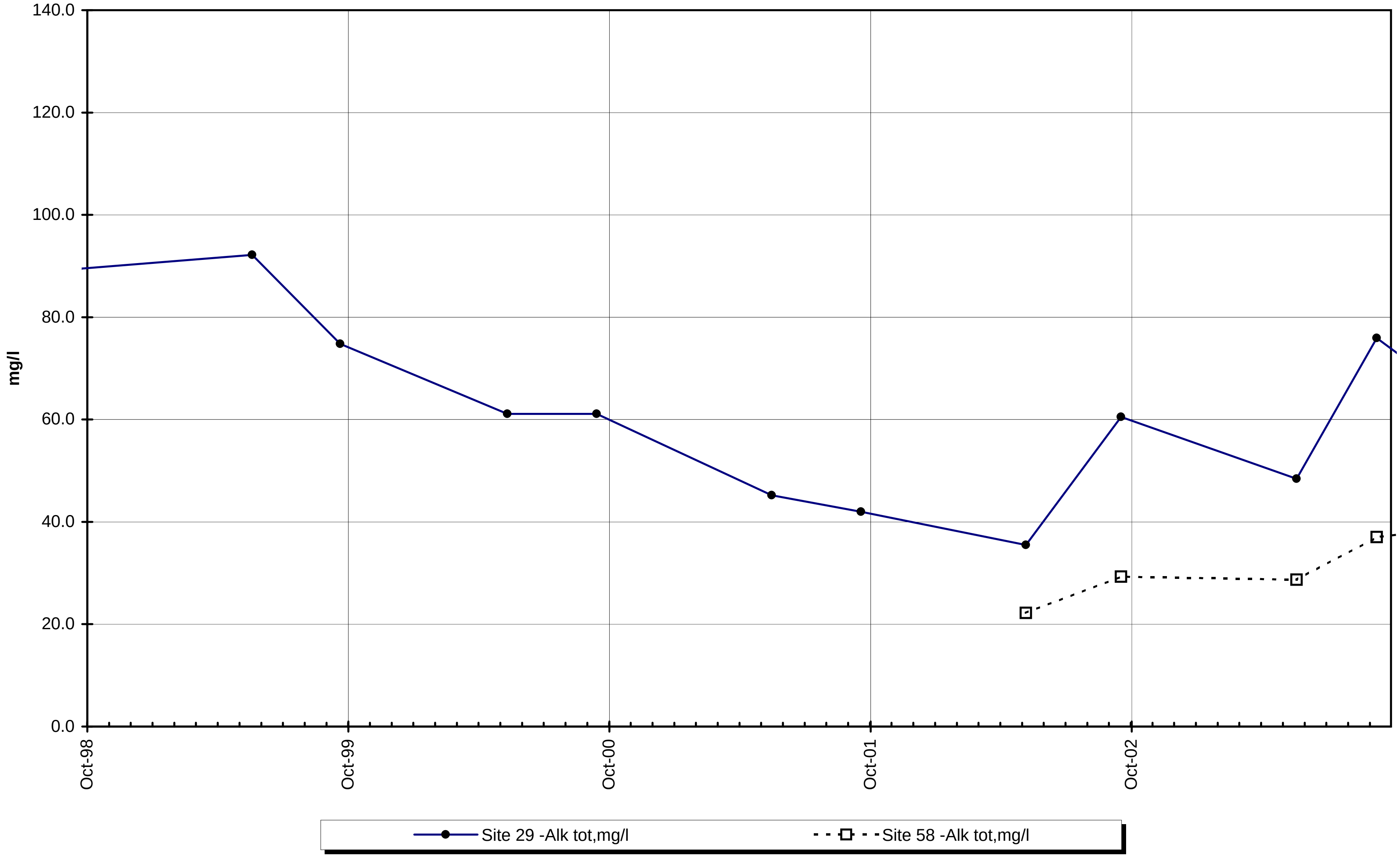
Site 29 vs Site 58 -Conductivity



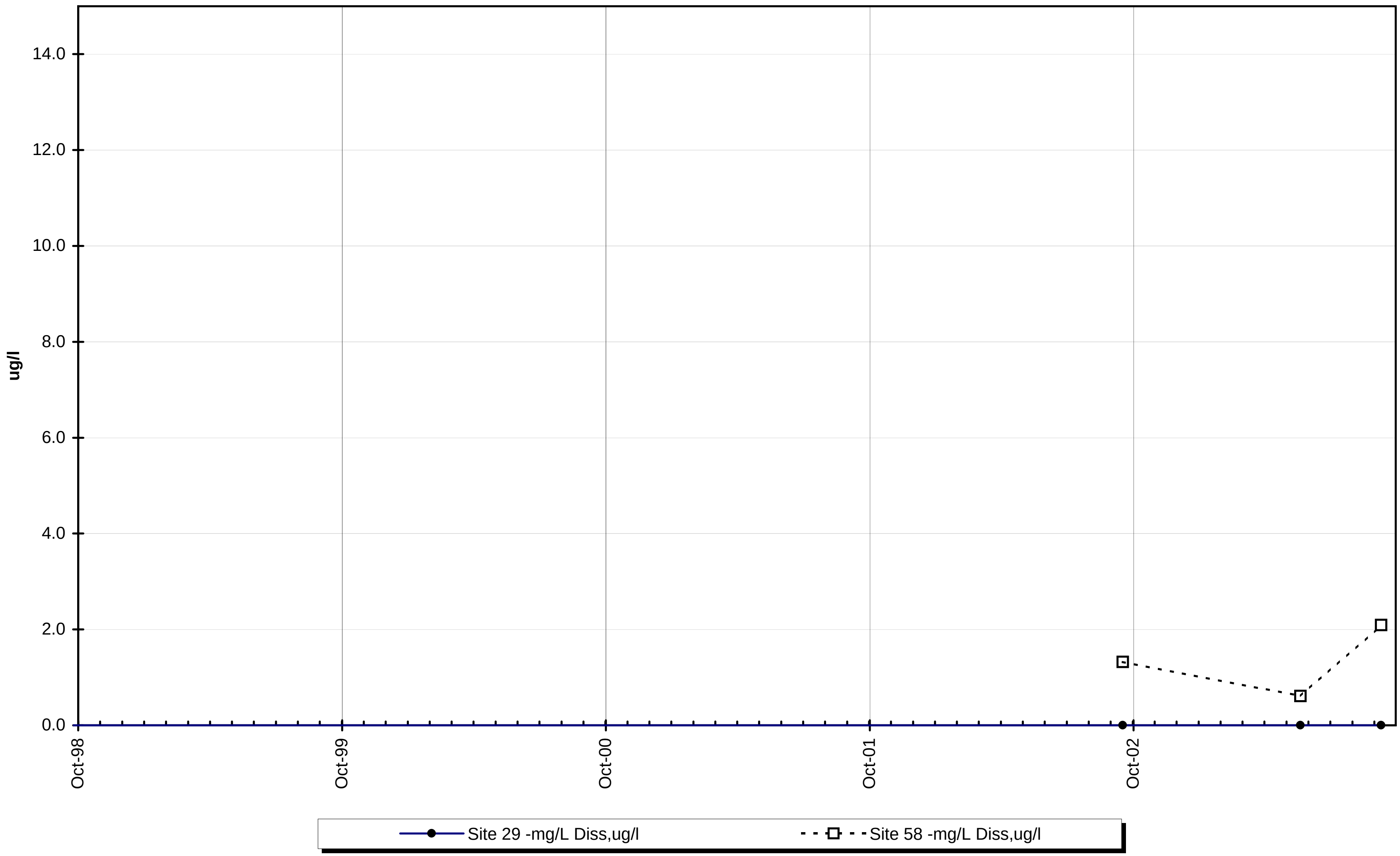


Site 29 vs. Site 58 -pH
pH, su
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
29, pH Lab, su
58, pH Lab, su
AWQS pH, su-Low
AWQS pH, su-High

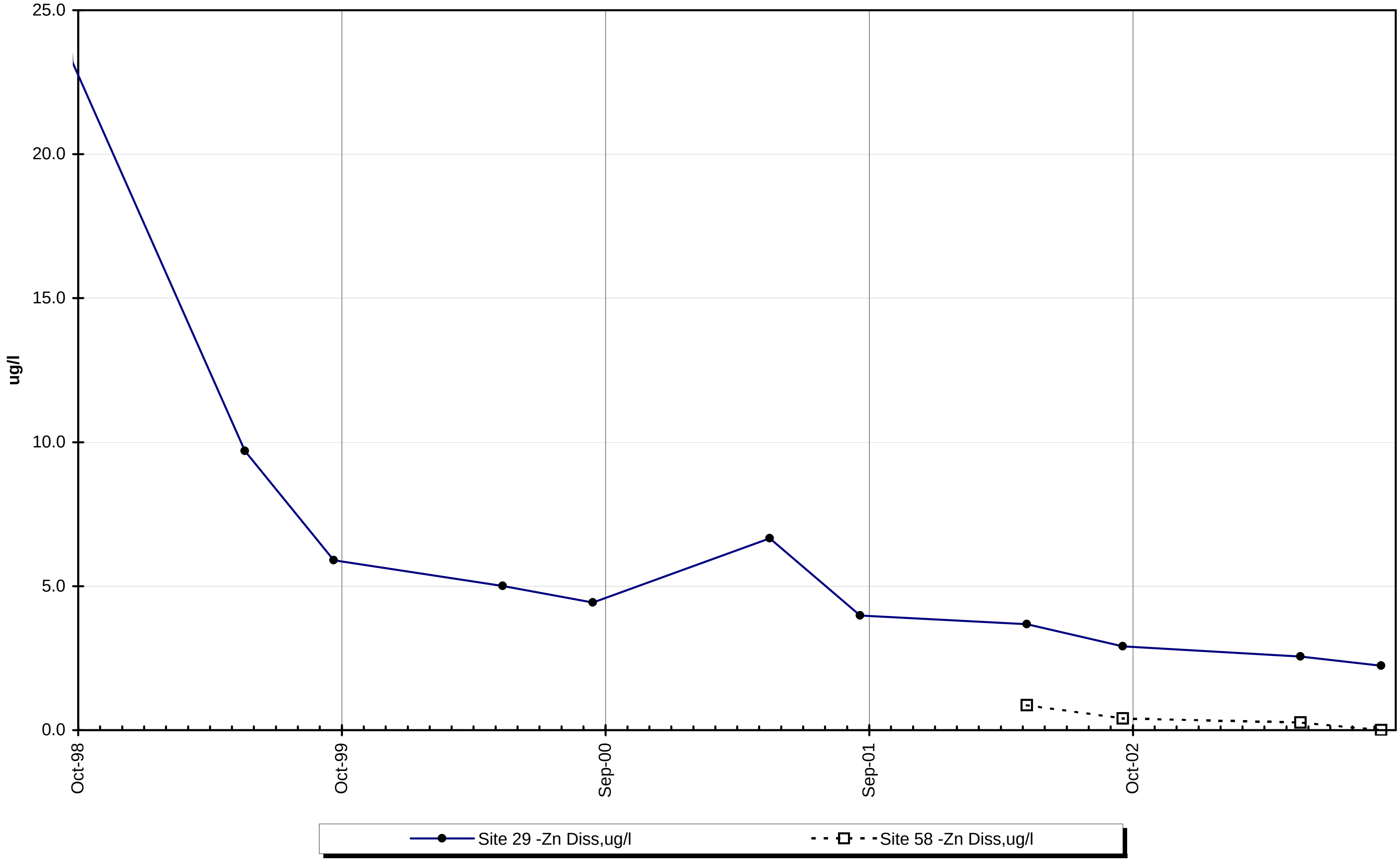
Site 29 vs. Site 58 -Total Alkalinity



Site 29 vs. Site 58 -Total Sulfate



Site 29 vs. Site 58 -Dissolved Zinc



INTERPRETIVE REPORT
SITE 32 "MONITORING WELL 5S"

The data collected during the current water year are listed in the following "Table of Results for Water Year 2003" report. The table includes all the data, field and lab, 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 zero for the purpose of median calculation.

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

Sample Date	Parameter	Value	Qualifier	Notes
No outliers have been identified by KGCMC for the period of Oct-98 though Sept-03.				

The data for water year 2003 have been compared to the strictest fresh water quality criterion for each applicable analyte. Five (5) results exceeding these criteria have been identified, as listed in the table below. Two (2) of these datum are for lab pH values below the lower limit of 6.5 listed in AWQS. Lab pH for Site 32 has historically resulted in values ranging from a pH of 4.5 to 5.5 which are characteristic for wells completed in organic rich peat sediments. One (1) exceedance for total alkalinity in May-2002 for which Site 32 has a five-year average value of 17.4 mg/l, which is below AWQS of 20 mg/l. The final two exceedances are for dissolved lead concentrations. The May-2002 sample had a dissolved lead concentration of 1.05 μg/l that exceeds the minimum hardness dependent AWQS standard of 0.541 μg/l. The September-2003 sample had a dissolved lead concentration of 0.832 μg/l that exceeds the hardness dependent AWQS standard of 0.541 μg/l. Due to the low hardness for this site 14 of the past 16 samples have returned lead values higher than AWQS but within the same general range of 1.0-3.5μg/l of dissolved lead. The sixteen samples represent all the samples taken since the inception of a lower MDL for lead determinations in June-1998.

Sample Date	Parameter	Value	Hardness (mg/L)	Standard	Standard Type
05/21/03	pH Lab, su	5.15		6.5 - 8.5	Aquatic Life
09/10/03	pH Lab, su	5.18		6.5 - 8.5	Aquatic Life
05/21/03	Total Alkalinity, mg/L	19.5		>20	Aquatic Life, chronic
05/21/03	Lead, Dissolved ug/L	1.05	8.0	0.541	Aquatic Life, chronic
09/10/03	Lead, Dissolved ug/L	0.832	10.3	0.541	Aquatic Life, chronic

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

Additional X-Y plots have been generated for alkalinity, pH, conductance, sulfate, and dissolved zinc that plot Site 32 and Site 58, the upgradient control site, to aid in comparison between those two sites. Lab conductivity, total sulfate, and total alkalinity are slightly higher at Site 58 while lab pH is more basic at Site 58, median pH of 6.24, than at Site 32 with a median pH of 5.2. Dissolved zinc levels are higher at Site 32 than at Site 58. The long-term median value for dissolved zinc since June 1998 is 8.9 μg/l, which is still elevated with respect to Site 58 and the other shallow wells completed into peat (e.g. Site 27 and Site 29). The lower pH at Site 32 with respect to the other shallow wells may account for the elevated zinc concentration found there due to the higher zinc solubility at a lower pH.

Table of Results for Water Year 2003

Site 32 "MW-5S"

Sample Date/Parameter	Oct-02	Nov-02	Dec-02	Jan-03	Feb-03	Mar-03	Apr-03	5/21/2003	Jun-03	Jul-03	Aug-03	9/10/2003	**Median**
Water Temp (°C)	NOT SCHEDULED FOR SAMPLING							6.6	NOT SCHEDULED FOR SAMPLING			7.1	6.9
Conductivity-Field(μmho)								68				73	71
Conductivity-Lab (μmho)								52				60	56
pH Lab (standard units)								5.15				5.18	5.17
pH Field (standard units)								5.23				5.27	5.25
Total Alkalinity (mg/L)								19.5				20.6	20.1
Total Sulfate (mg/L)								<0.1 J				<0.1 J	0.1
Hardness (mg/L)								8.0				10.3	9.2
Dissolved As (ug/L)								4.920				4.570	4.745
Dissolved Ba (ug/L)								19.3				20.8	20.1
Dissolved Cd (ug/L)								0.012				<0.023	0.012
Dissolved Cr (ug/L)								2.570				2.290	2.430
Dissolved Cu (ug/L)								1.160				0.868	1.014
Dissolved Pb (ug/L)								1.0500				0.8320	0.9410
Dissolved Ni (ug/L)								4.030				4.260	4.145
Dissolved Ag (ug/L)								<0.028				0.005 J	0.010
Dissolved Zn (ug/L)								7.20				9.45	8.33
Dissolved Se (ug/L)								0.503 J				<0.496	0.376
Dissolved Hg (ug/L)								0.001970				0.001300 J	0.001635

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

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

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

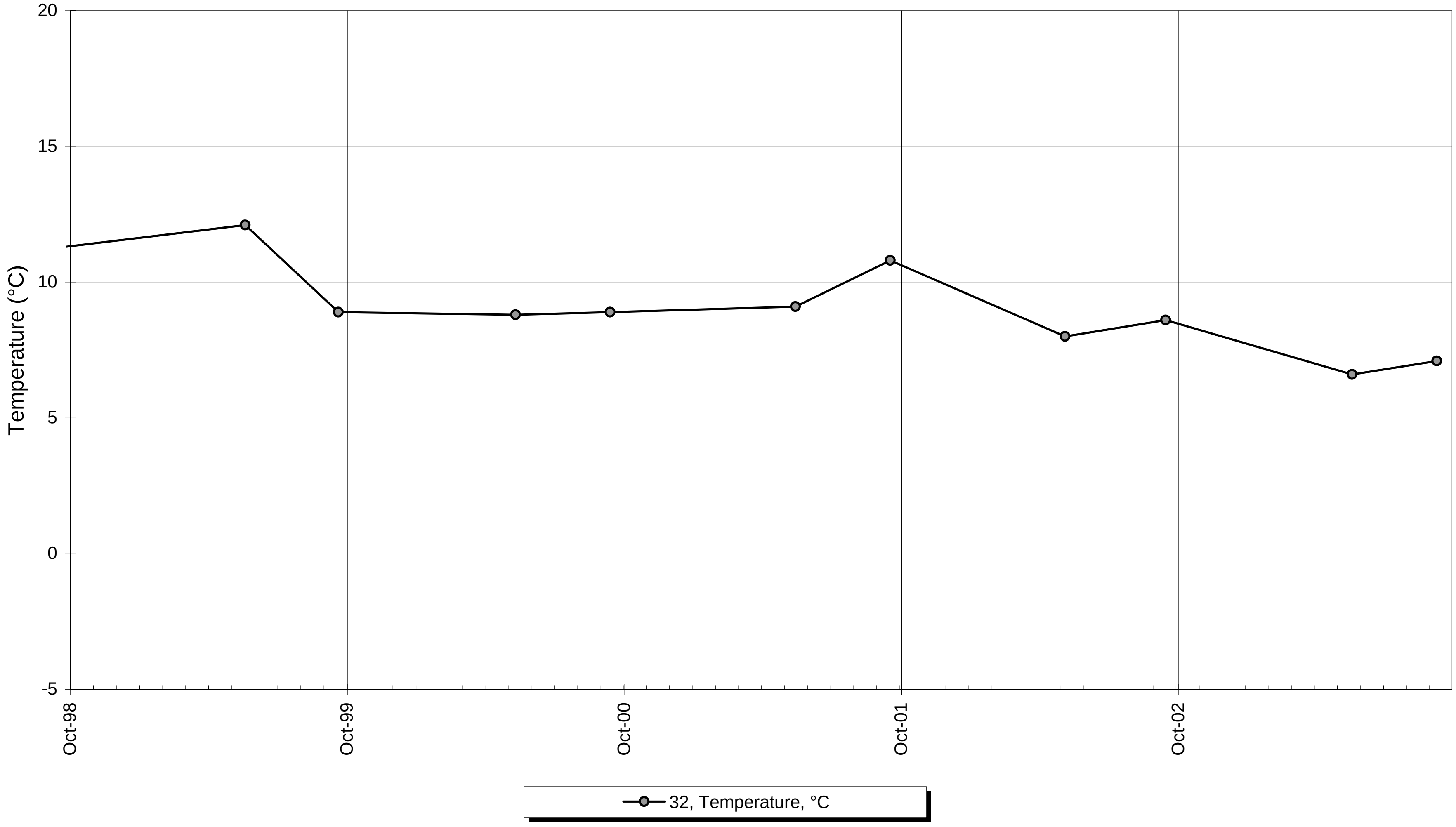
Qualified Data by QA Reviewer

Date Range: 10/01/2002 to 09/30/2003

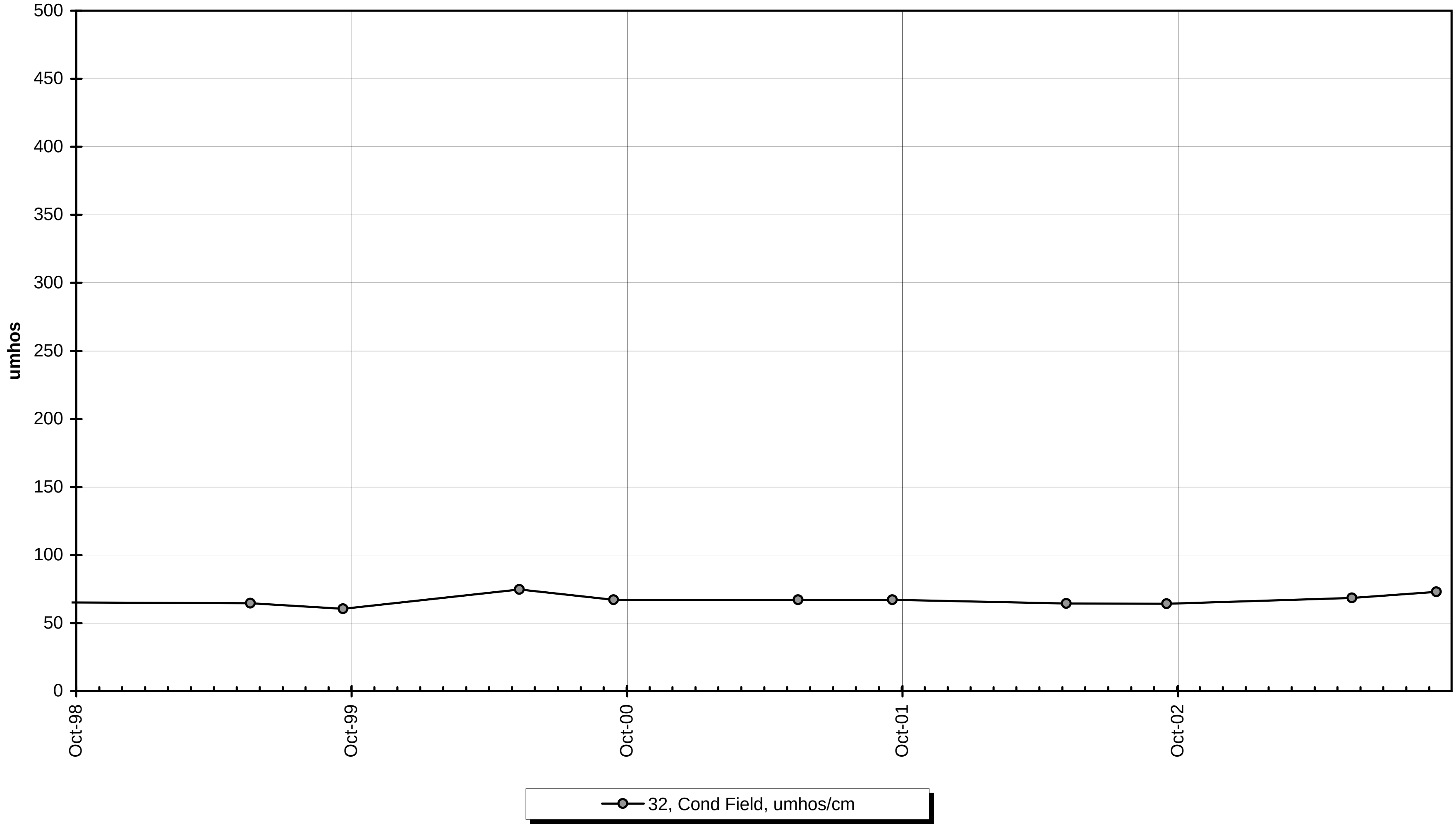
Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
32	05/21/2003	12:44:00 PM				
			SO4 Tot, mg/l	-0.1	J	Below Quantitative Range
			Se Diss, ug/l	0.503	J	Below Quantitative Range, L
32	09/10/2003	2:50:00 PM				
			SO4 Tot, mg/l	-0.1	J	Below Quantitative Range, S
				0.00519	J	Below Quantitative Range
			Hg Diss, ug/l	0.0013	J	Duplicate RPD

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

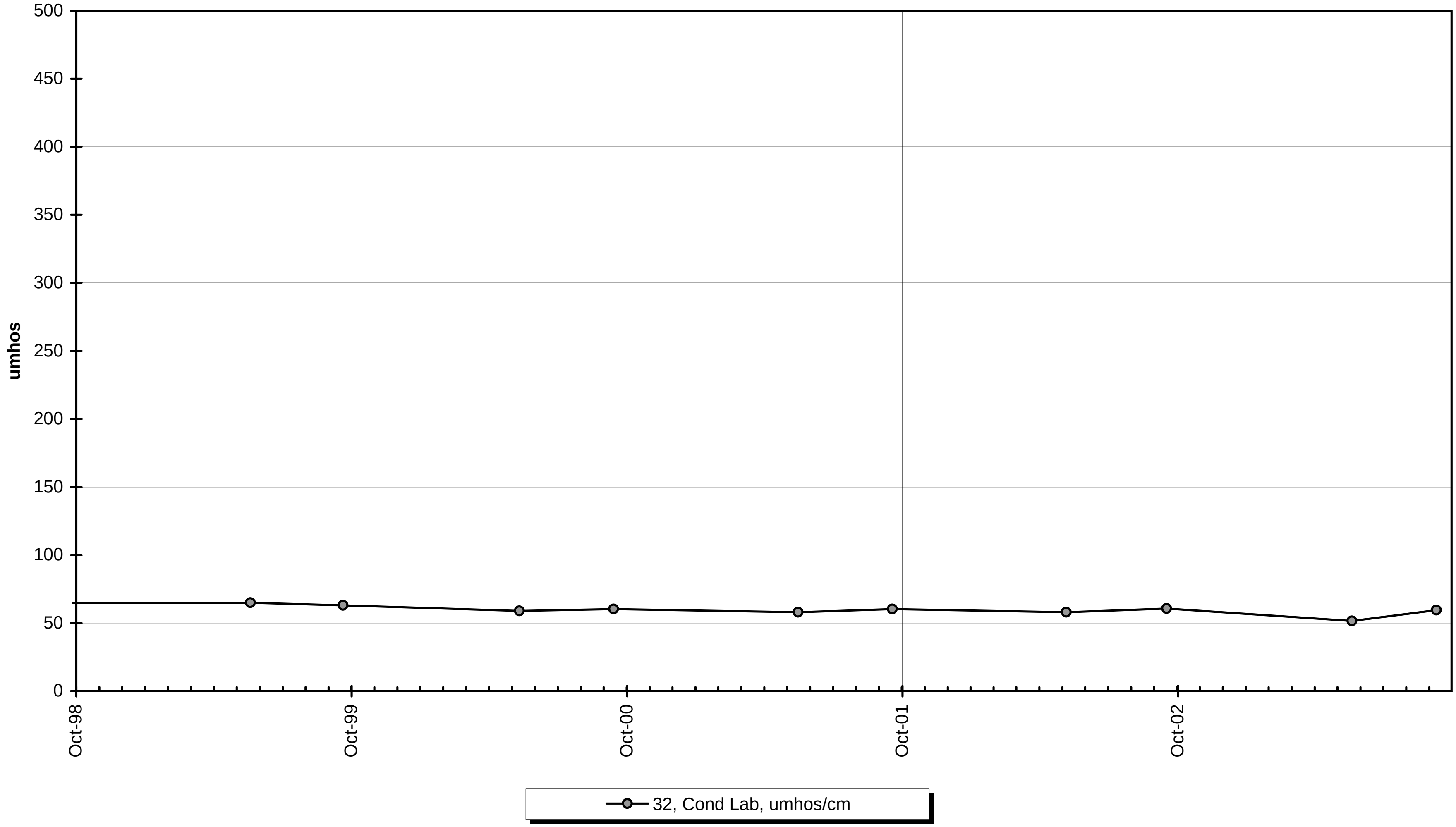
Site 32 -Water Temperature



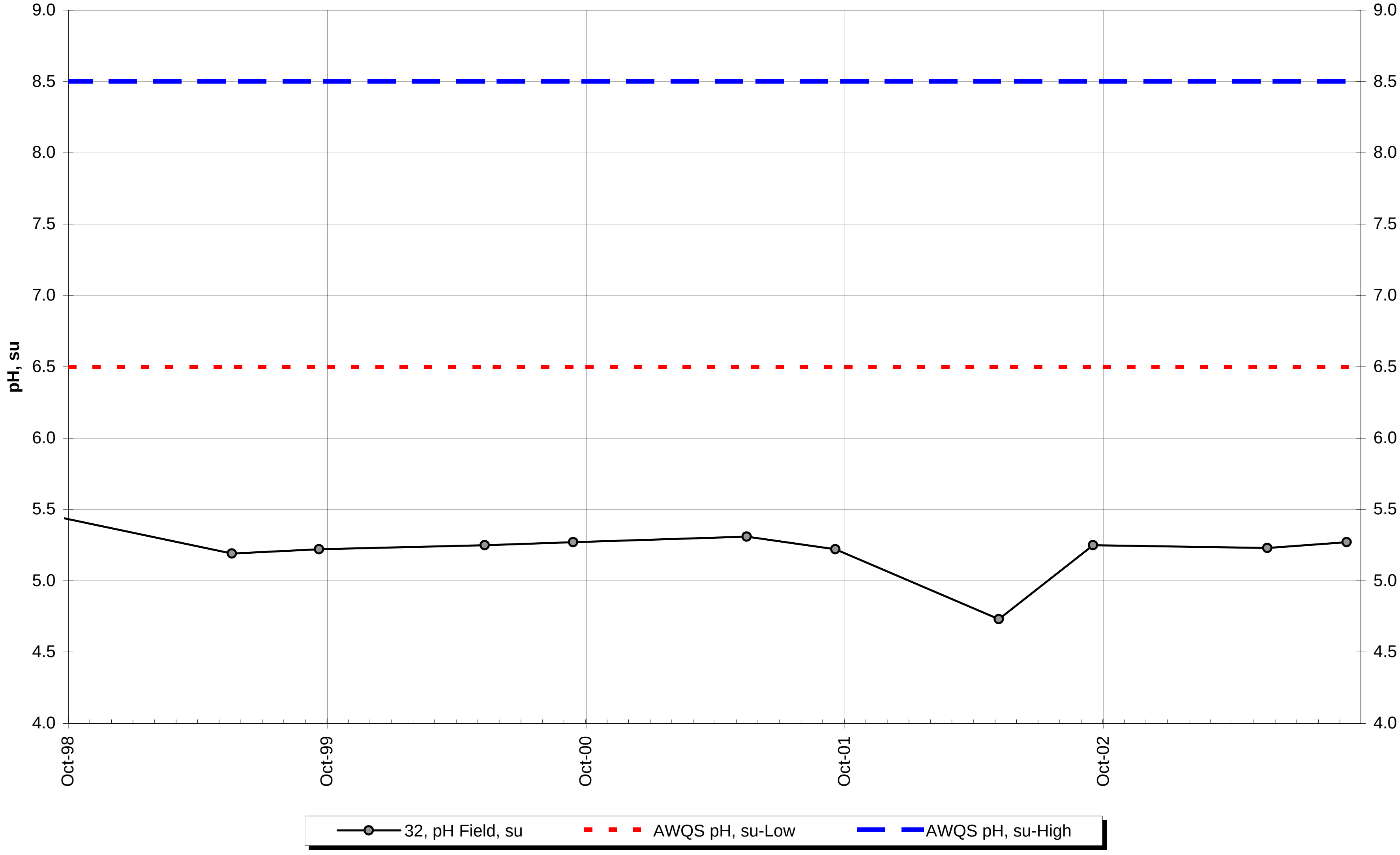
Site 32 -Conductivity-Field



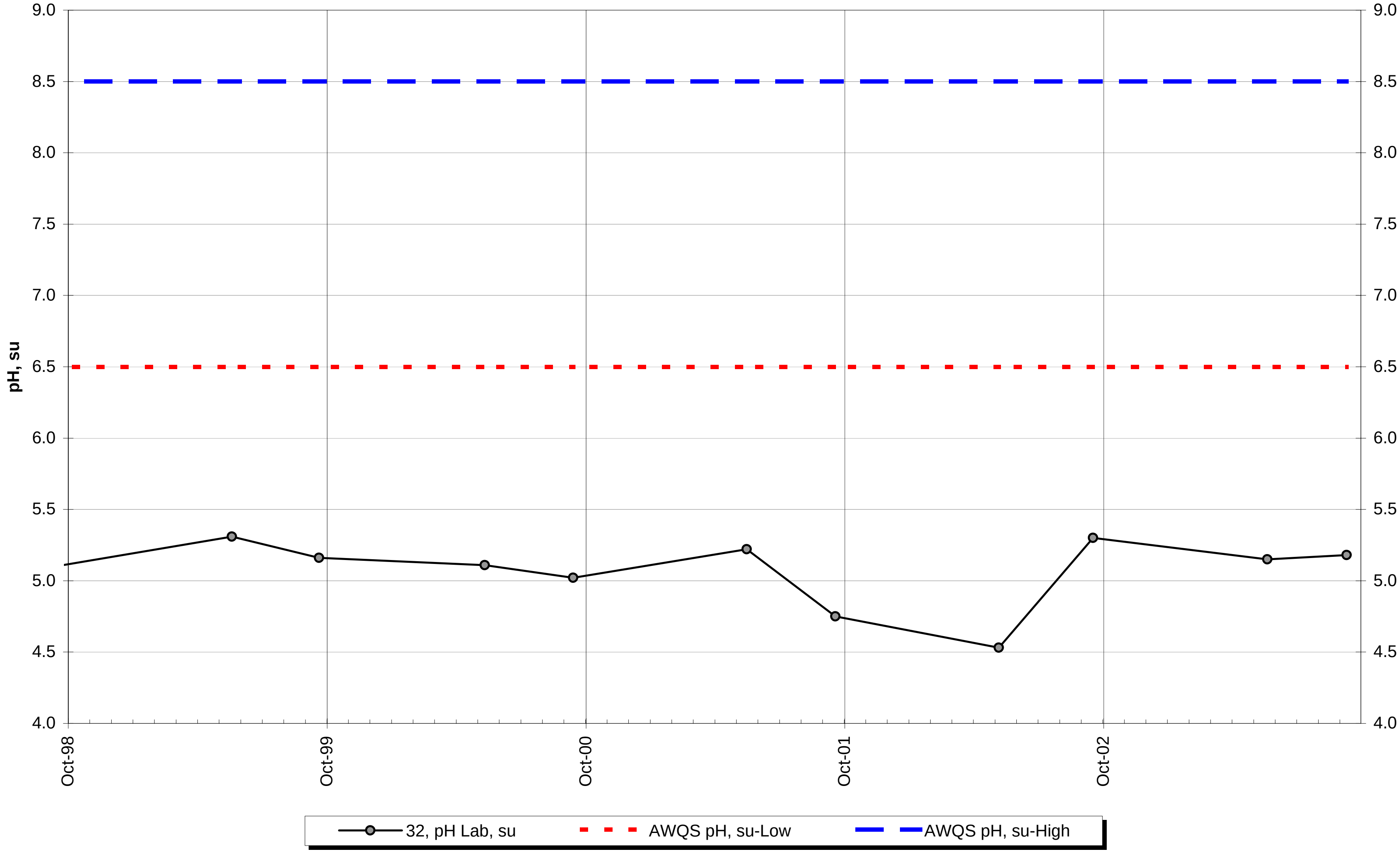
Site 32 -Conductivity-Lab



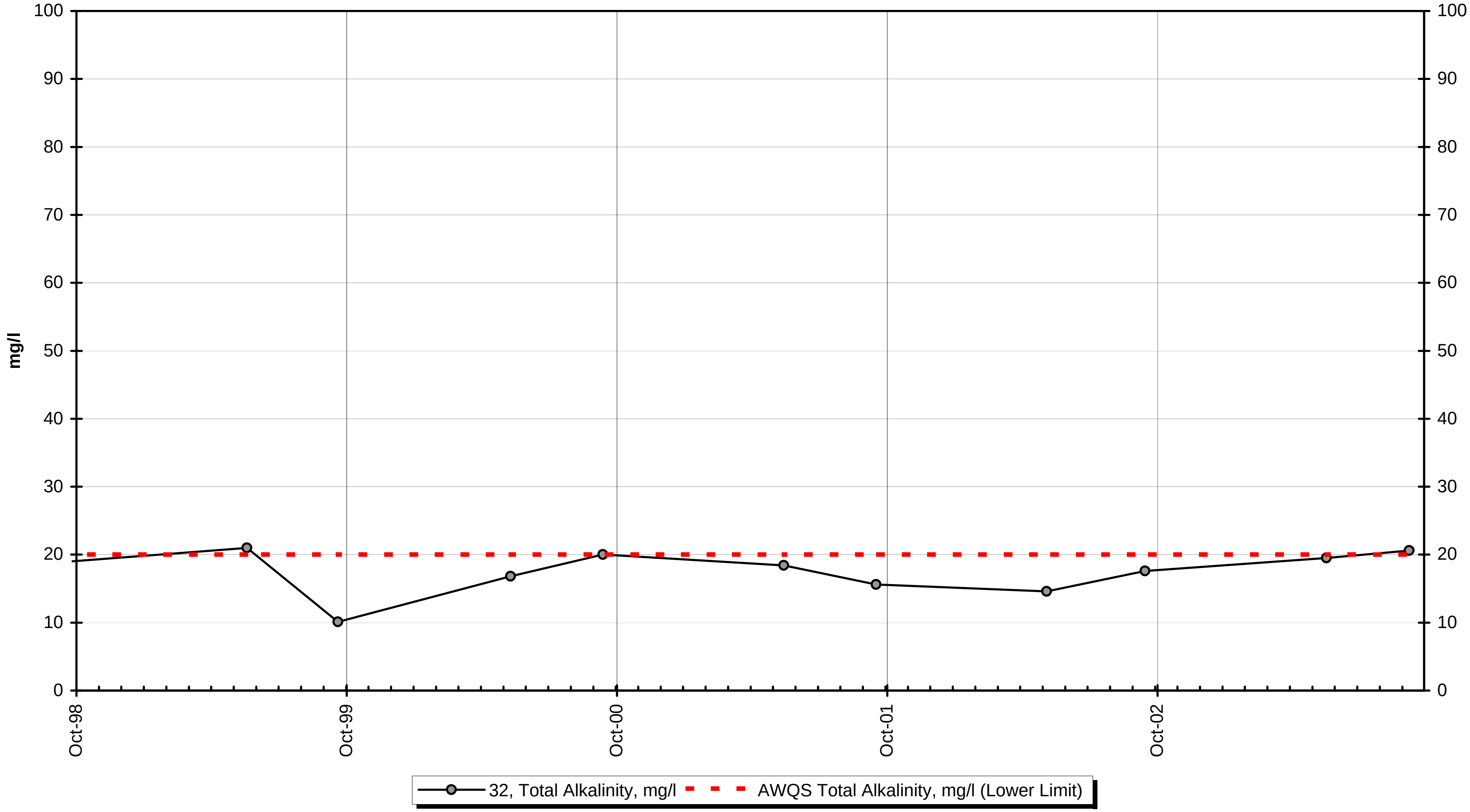
Site 32 -Field pH



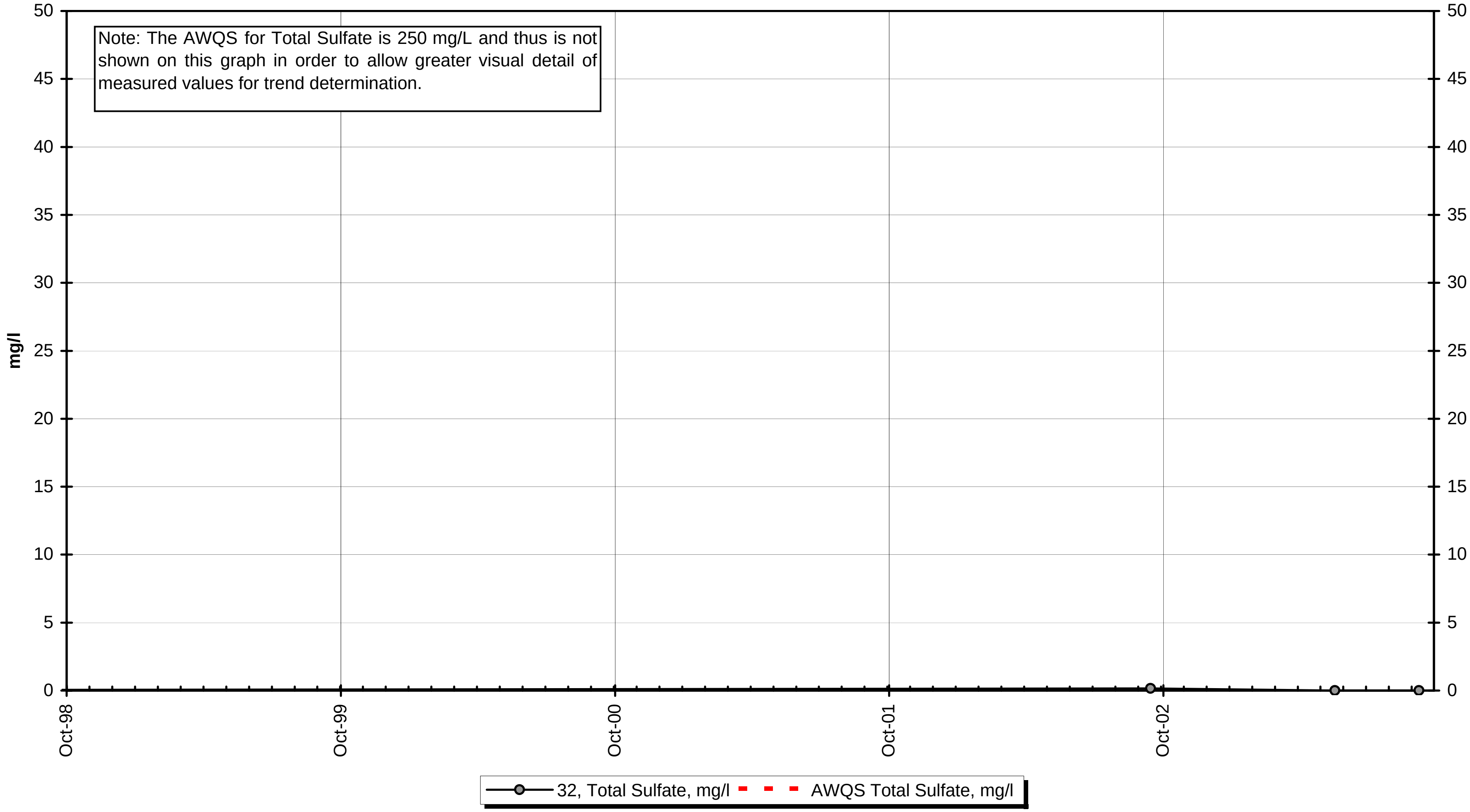
Site 32 -Lab pH



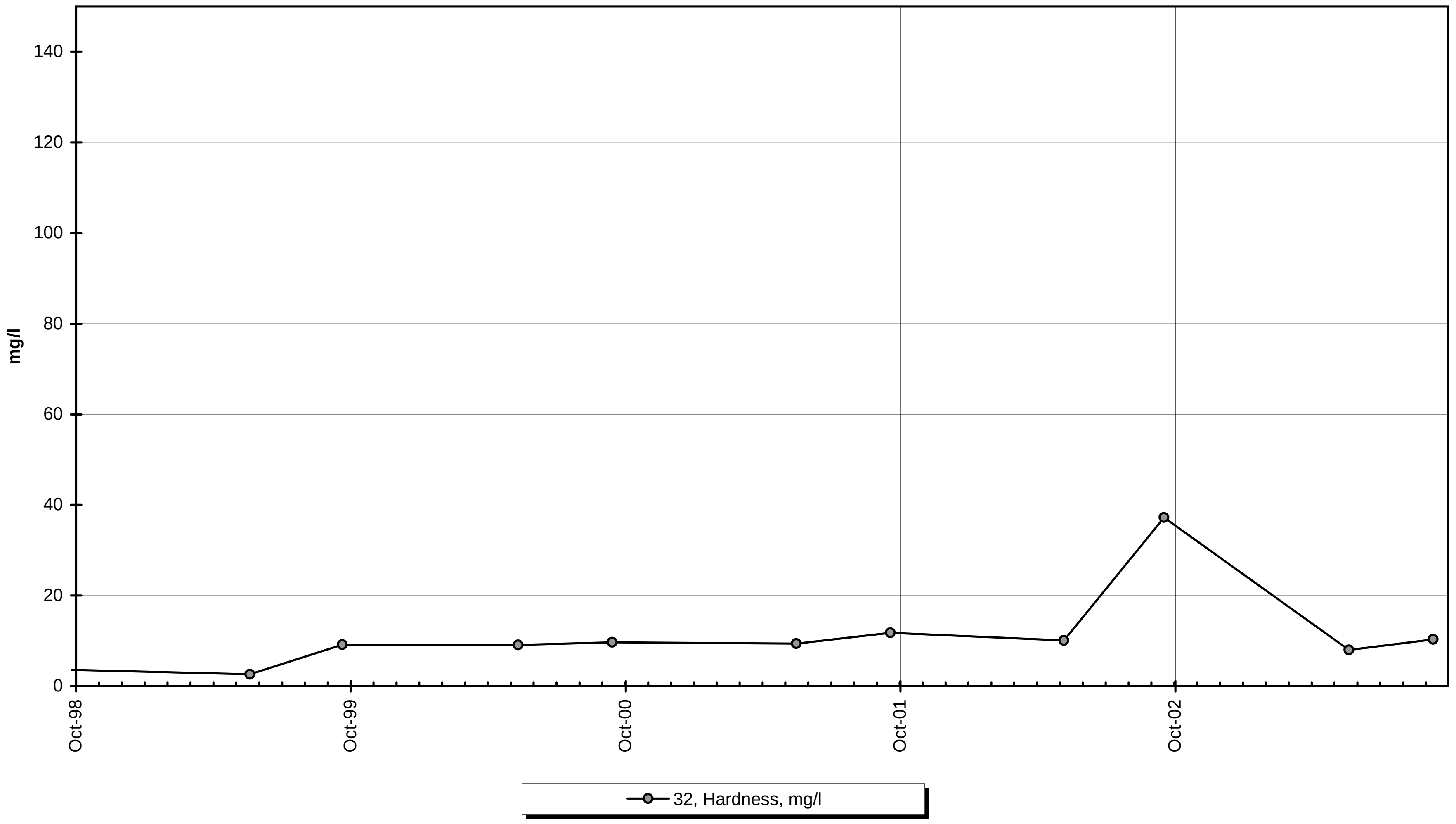
Site 32 -Total Alkalinity



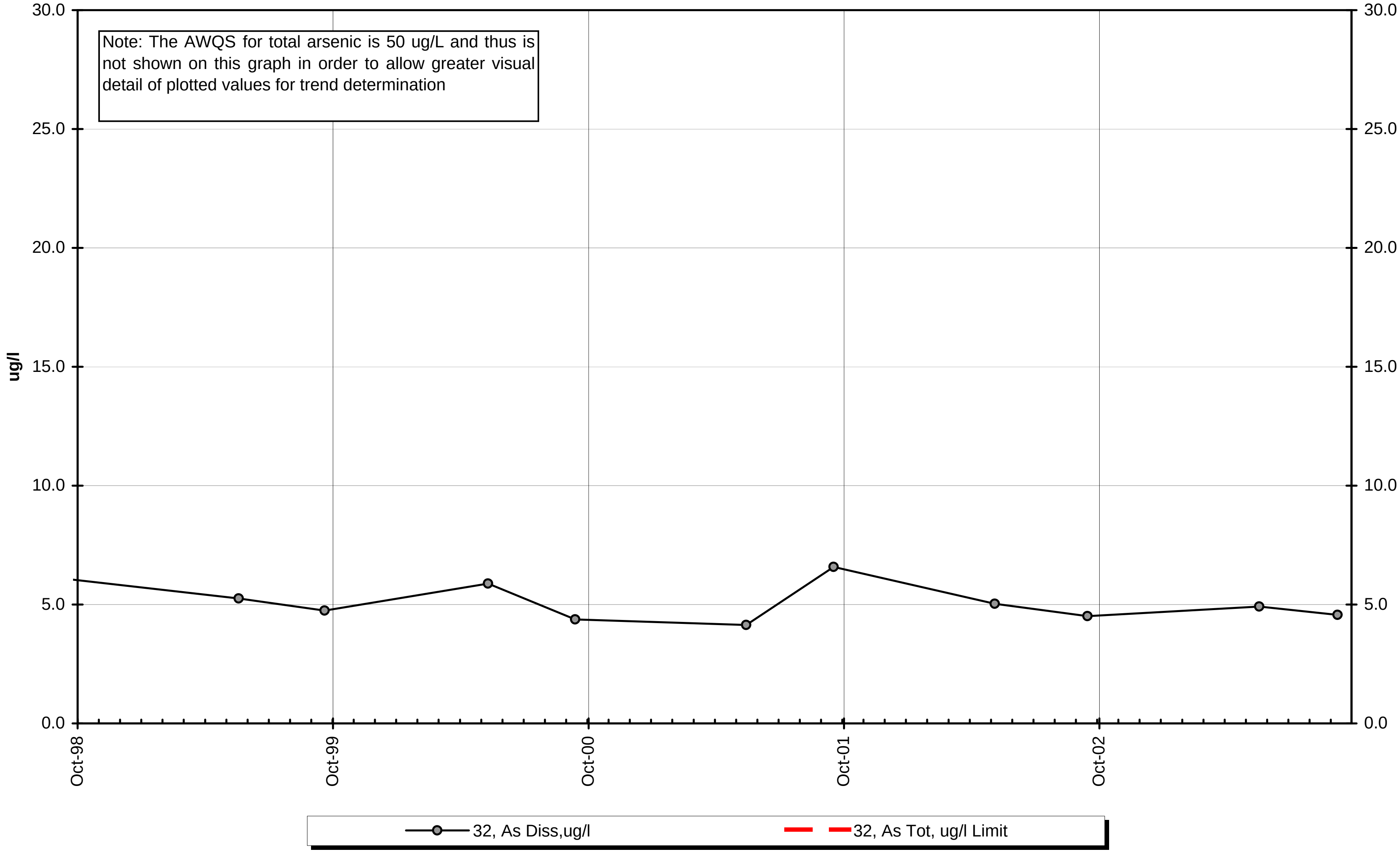
Site 32 -Total Sulfate



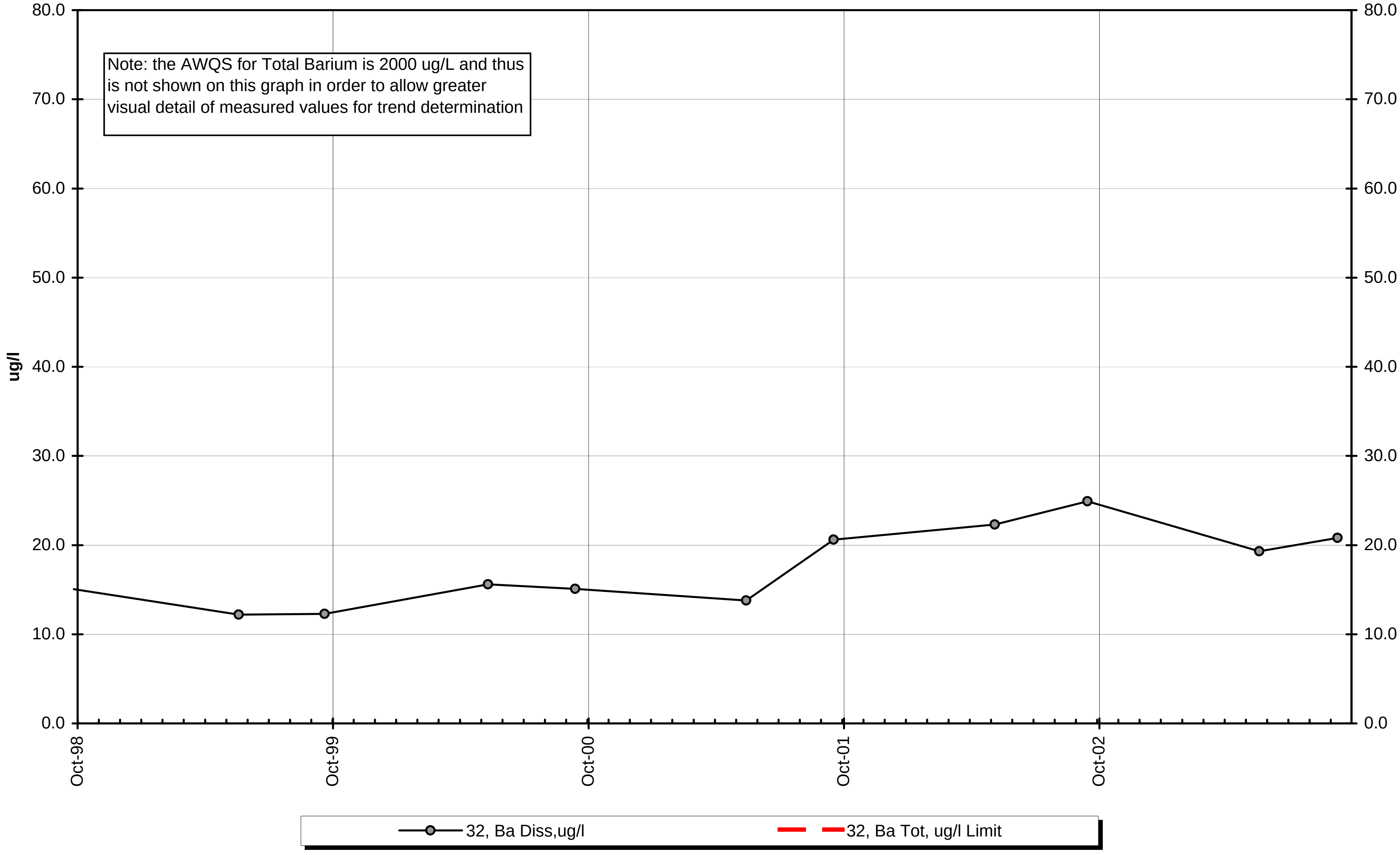
Site 32 -Hardness

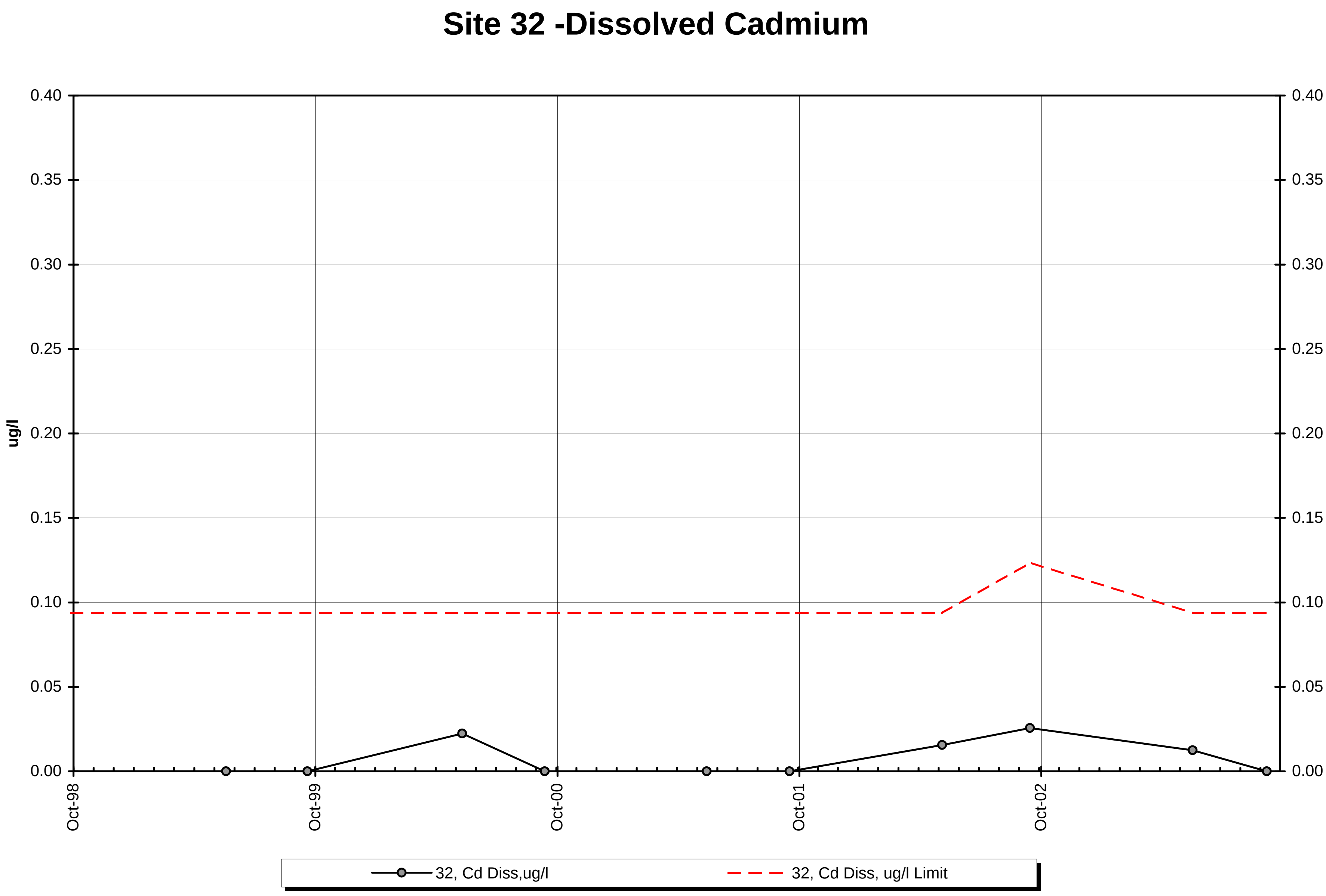


Site 32 -Dissolved Arsenic

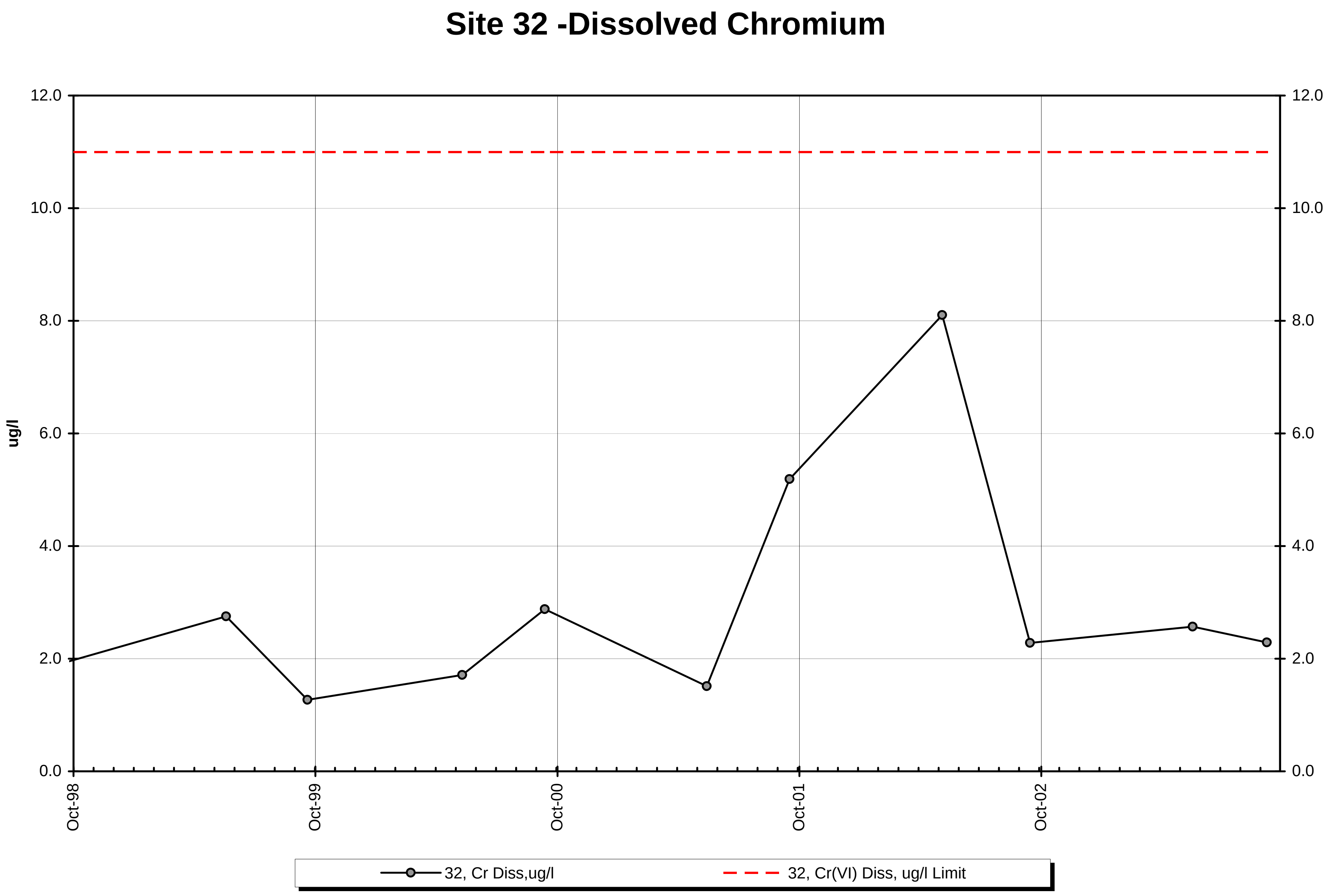


Site 32 -Dissolved Barium



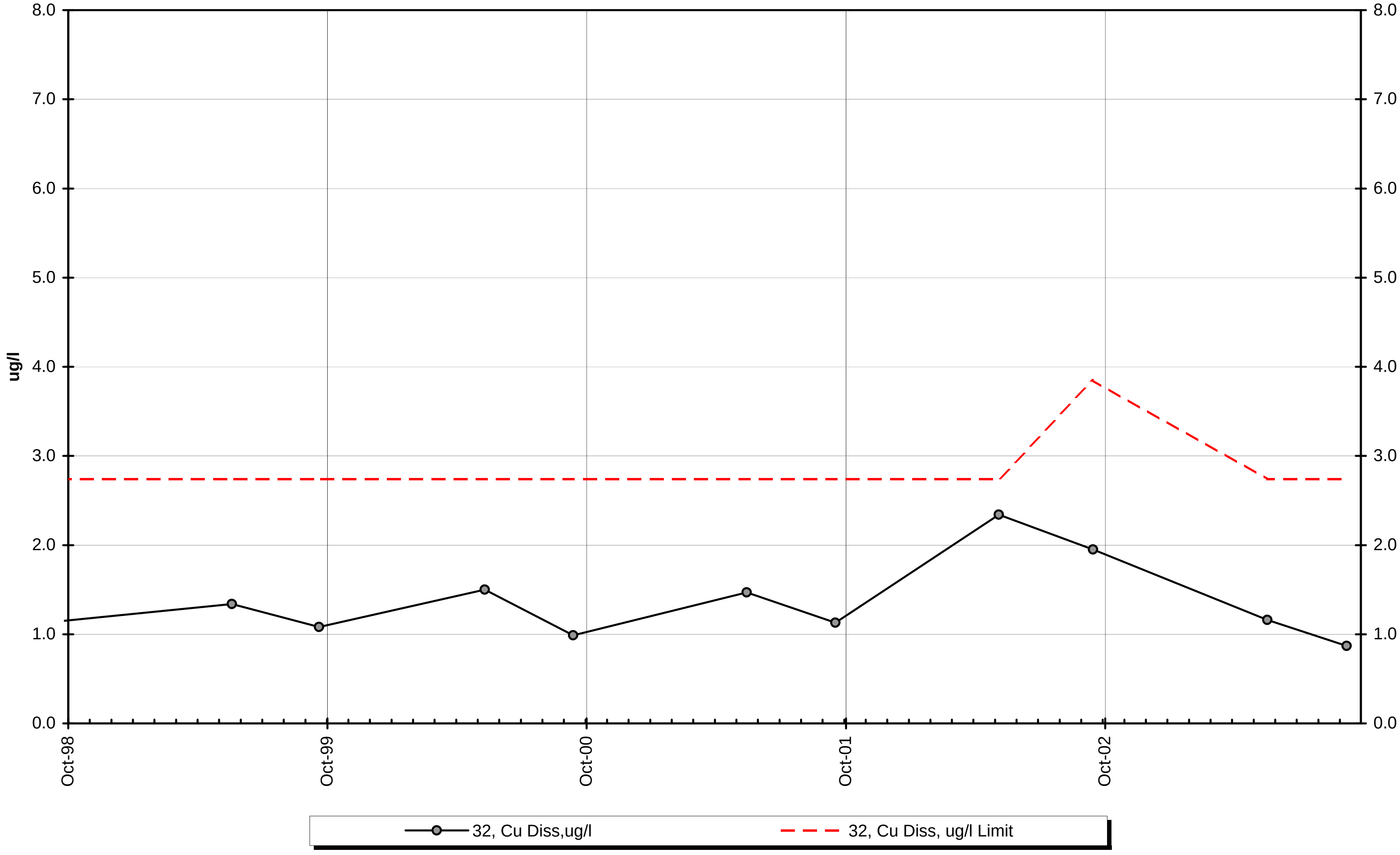


Site 32 -Dissolved Cadmium
ug/l
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
32, Cd Diss,ug/l
32, Cd Diss, ug/l Limit

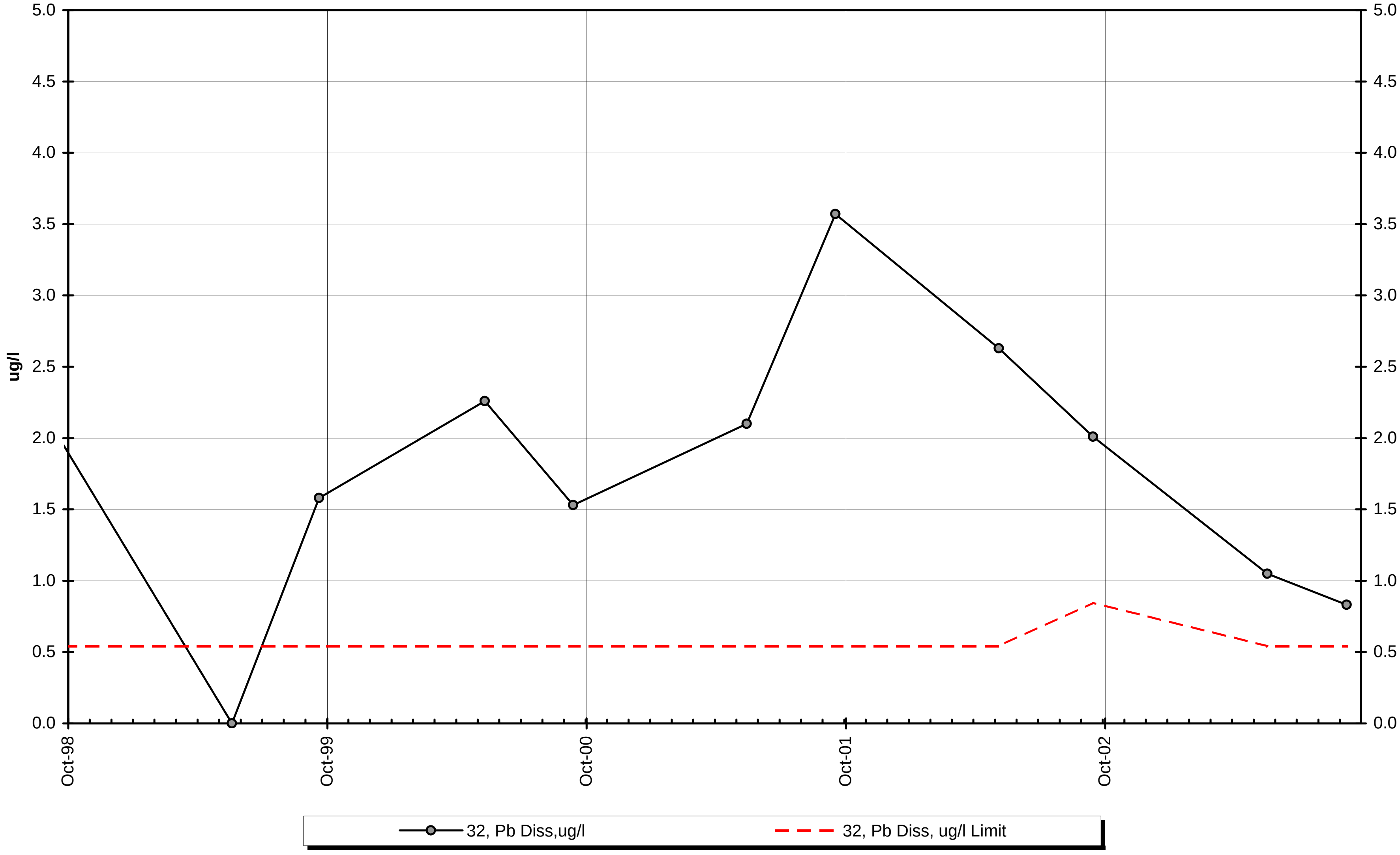


Site 32 -Dissolved Chromium
ug/l
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
32, Cr Diss,ug/l
32, Cr(VI) Diss, ug/l Limit

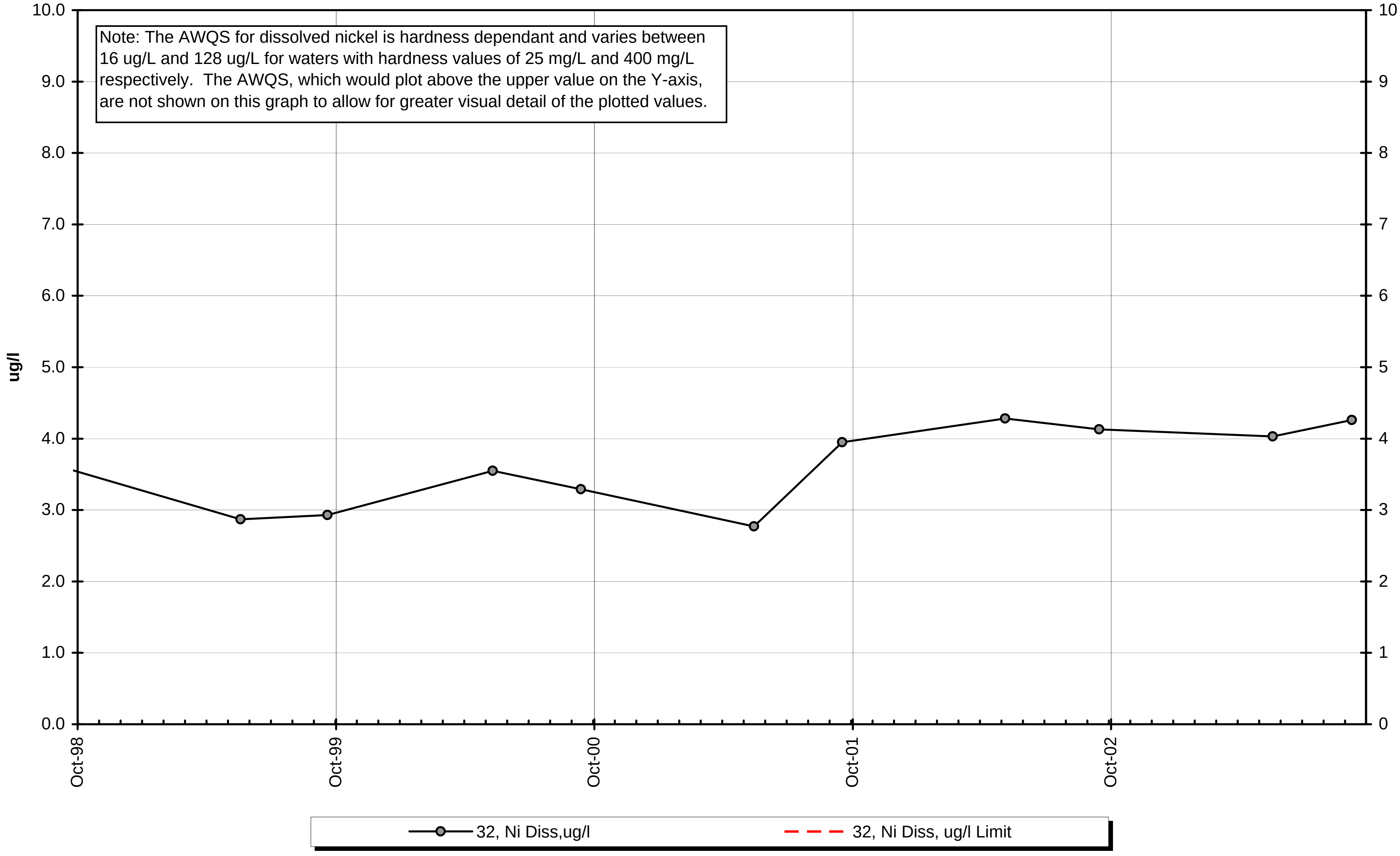
Site 32 -Dissolved Copper



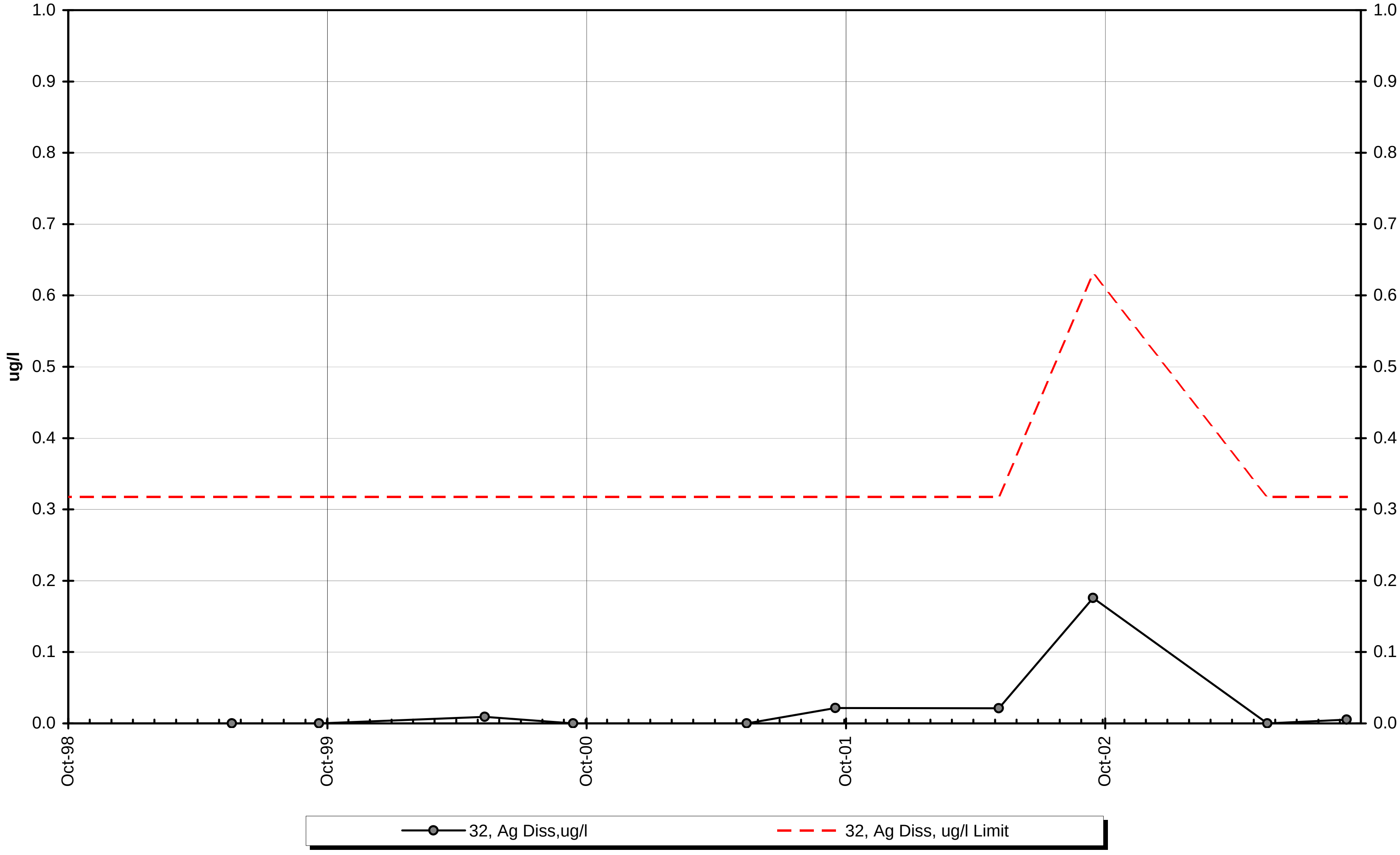
Site 32 -Dissolved Lead

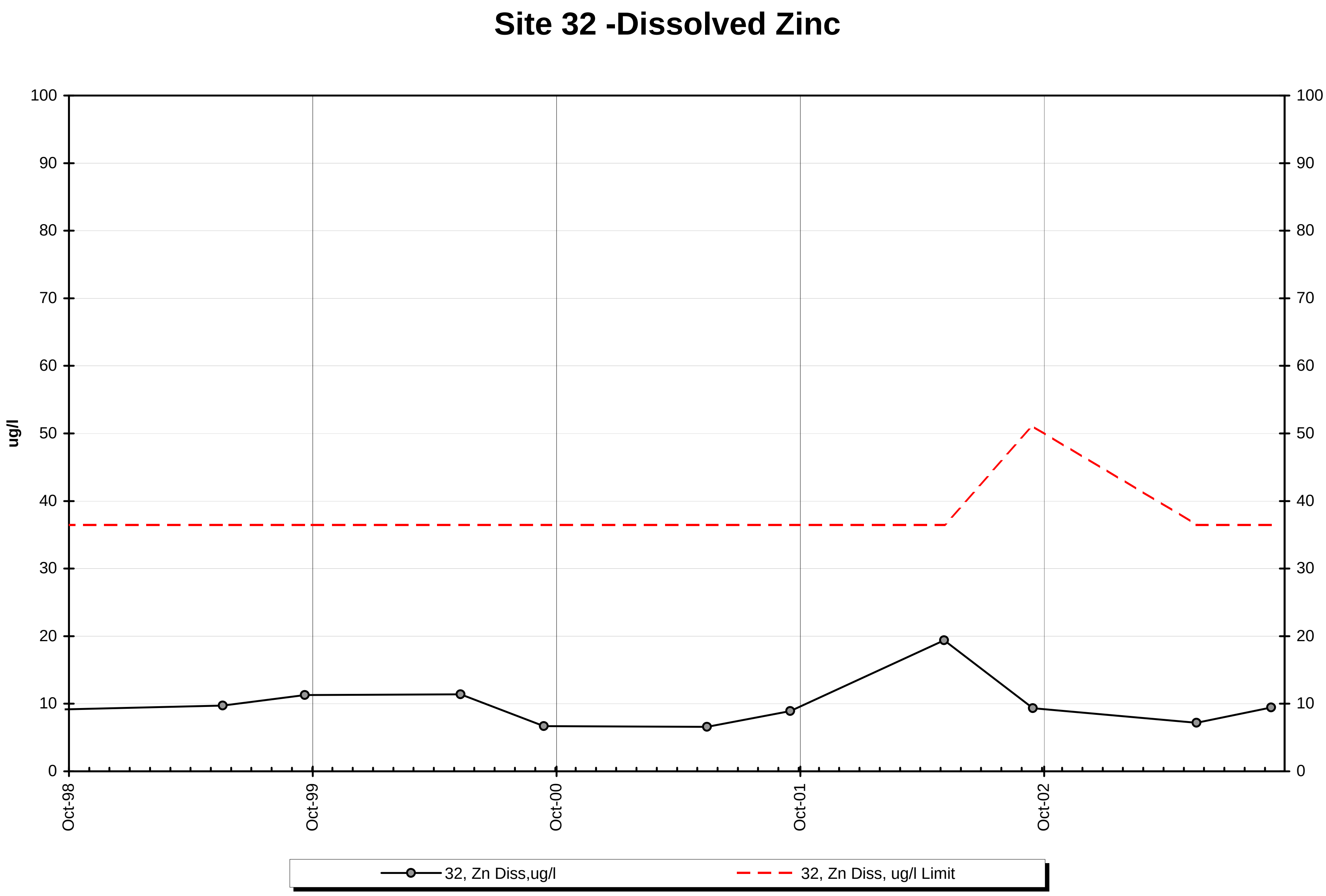


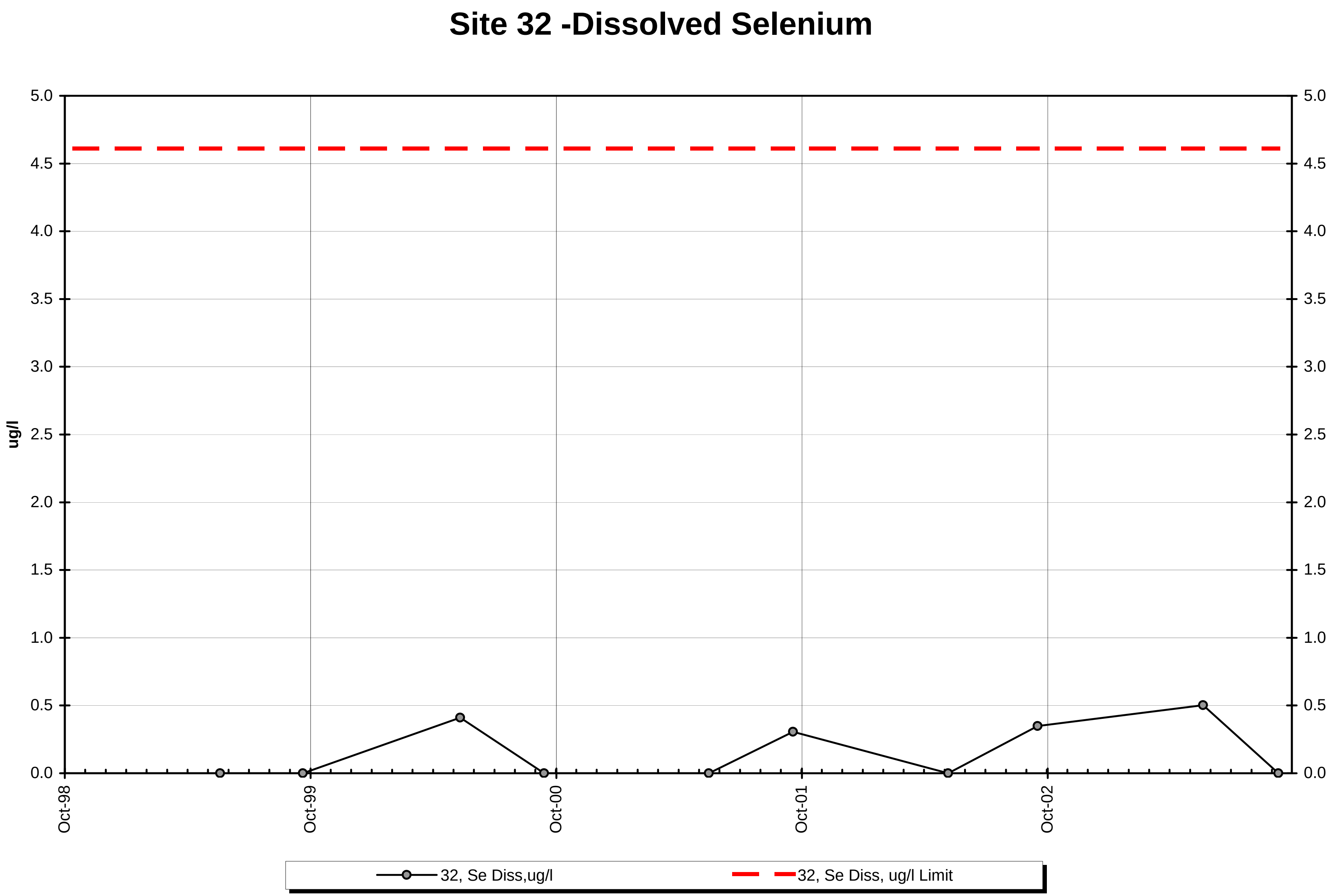
Site 32 -Dissolved Nickel



Site 32 -Dissolved Silver

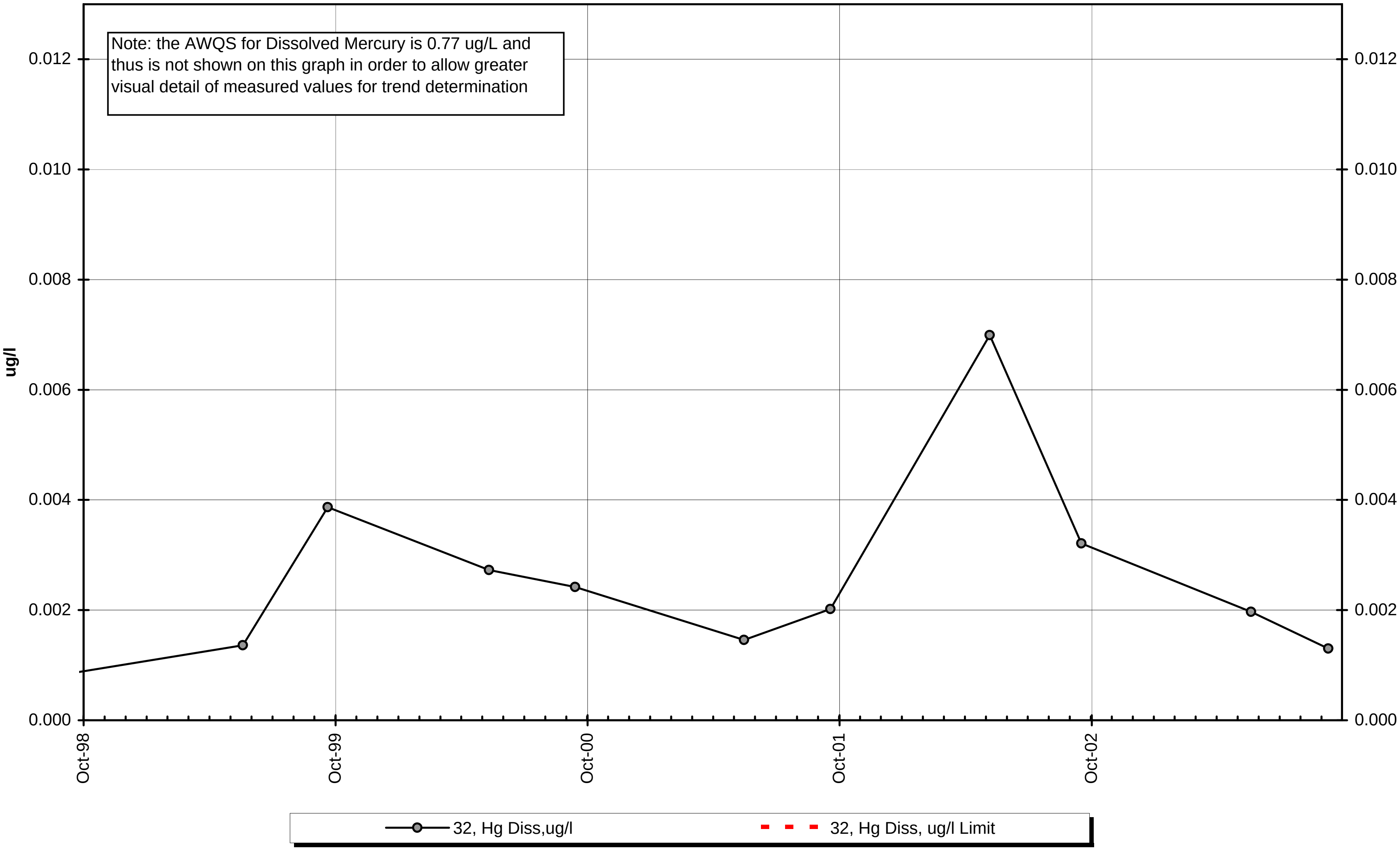



Site 32 -Dissolved Zinc
ug/l
100
90
80
70
60
50
40
30
20
10
0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
32, Zn Diss,ug/l
32, Zn Diss, ug/l Limit

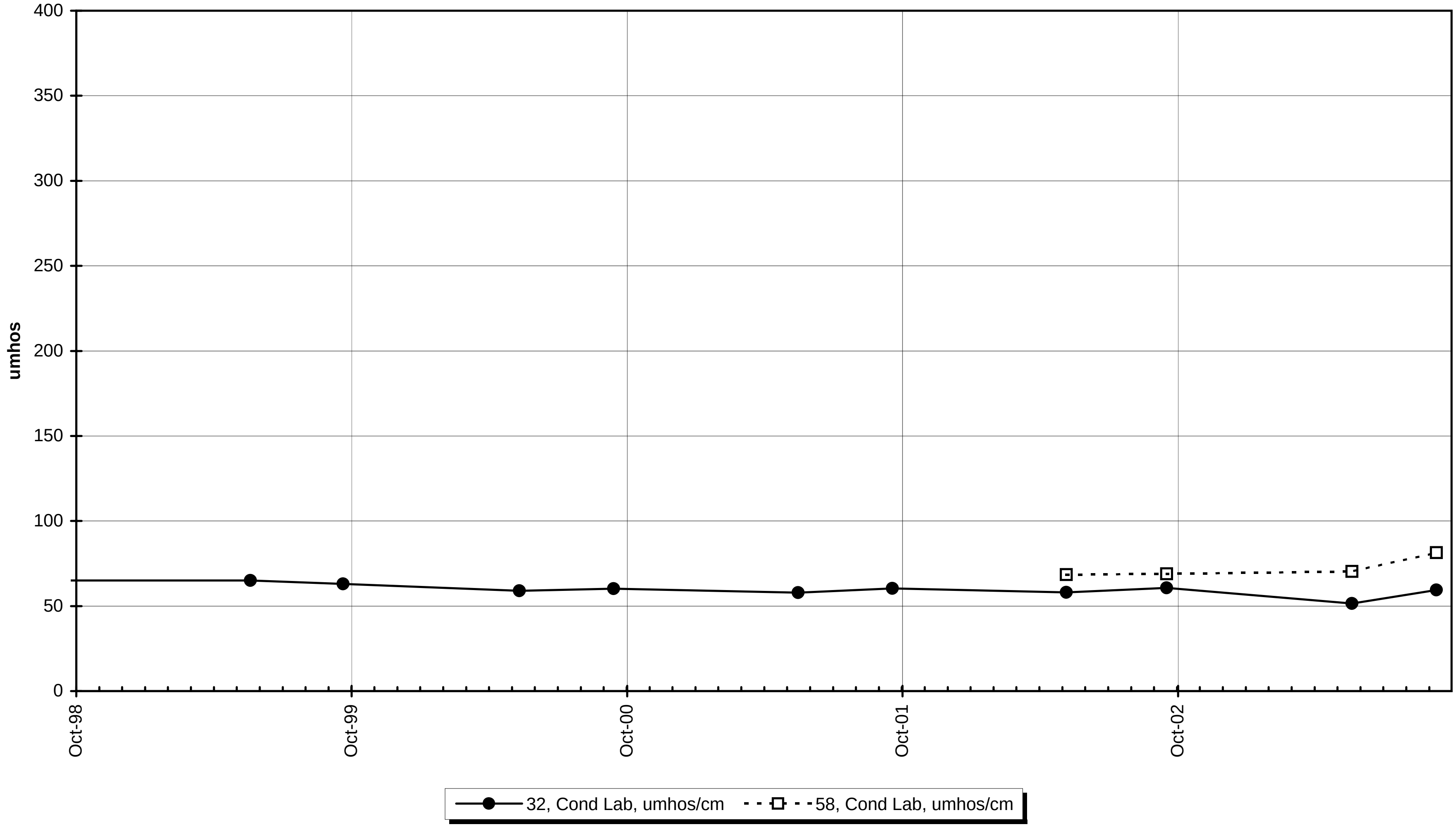


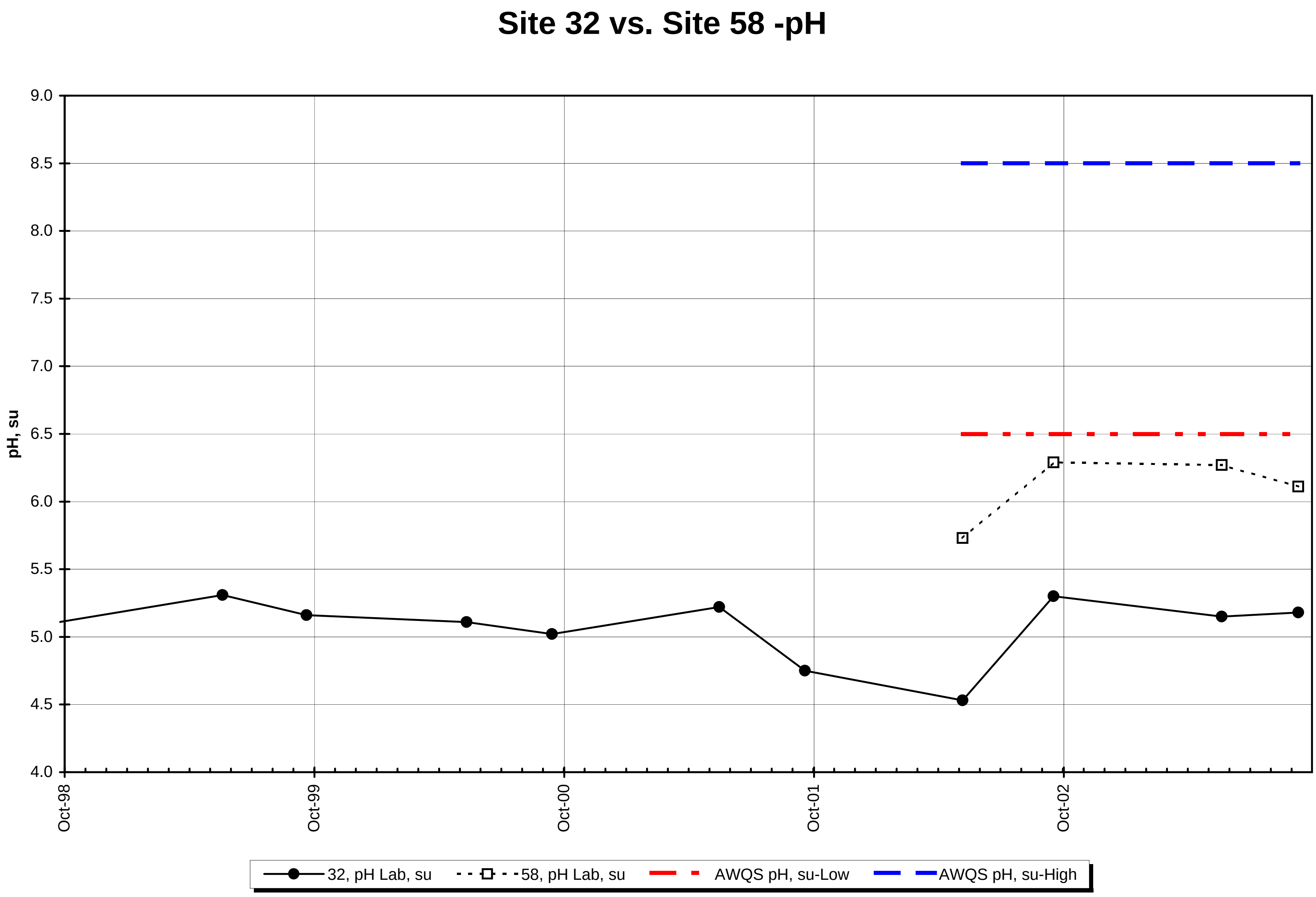
Site 32 -Dissolved Selenium
ug/l
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
32, Se Diss,ug/l
32, Se Diss, ug/l Limit

Site 32 -Dissolved Mercury

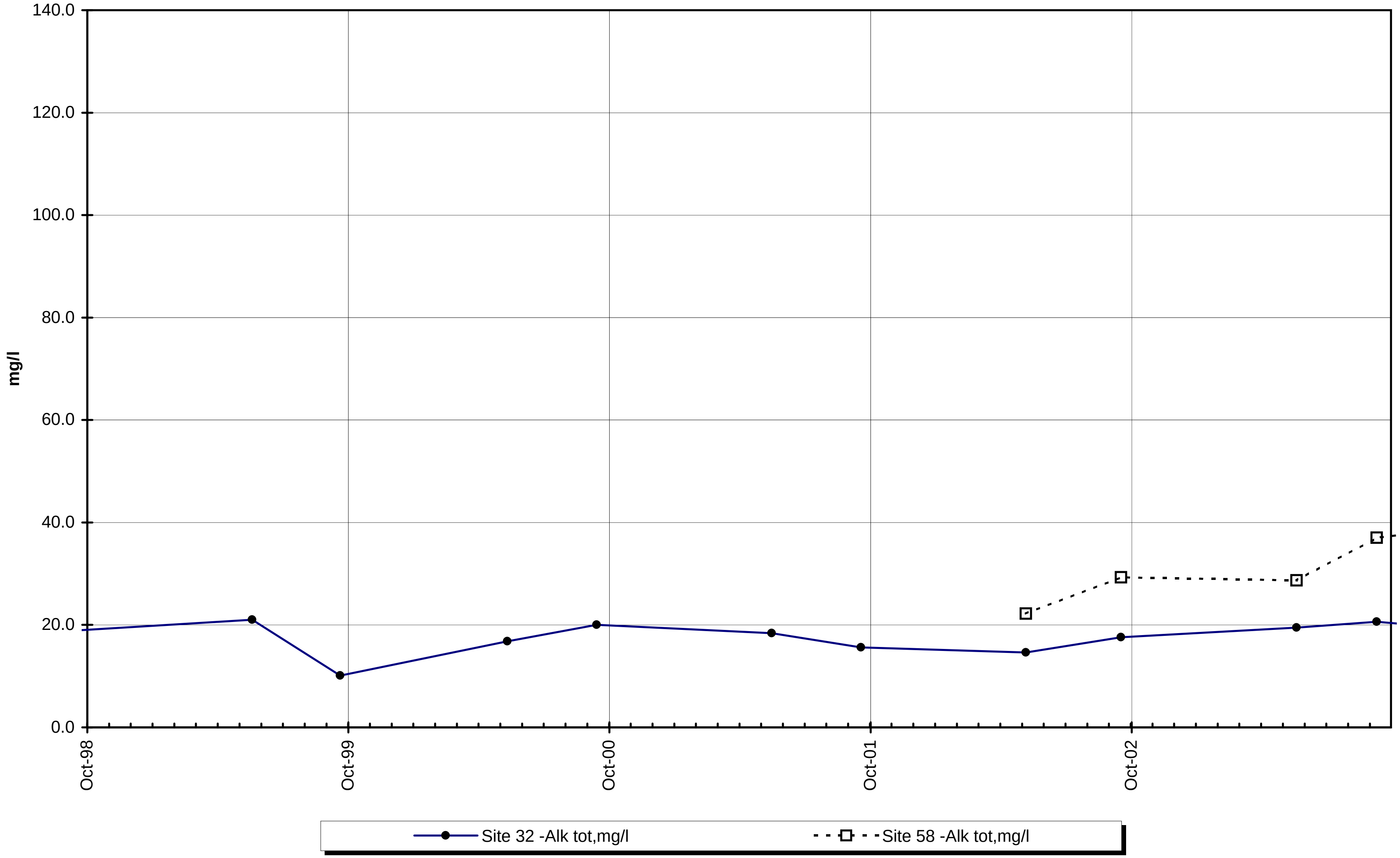


Site 32 vs Site 58 -Conductivity

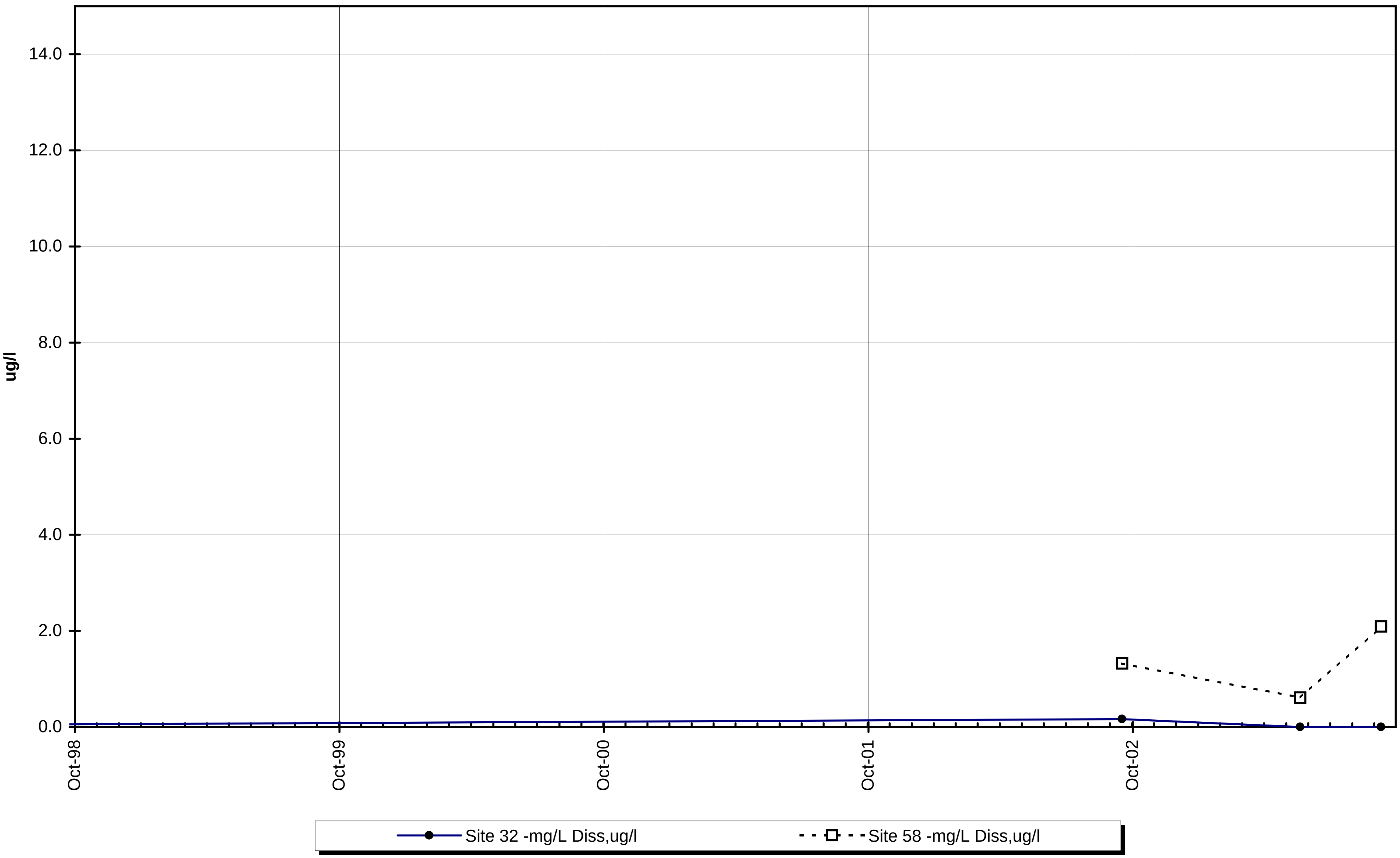



Site 32 vs. Site 58 -pH
pH, su
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
32, pH Lab, su
58, pH Lab, su
AWQS pH, su-Low
AWQS pH, su-High

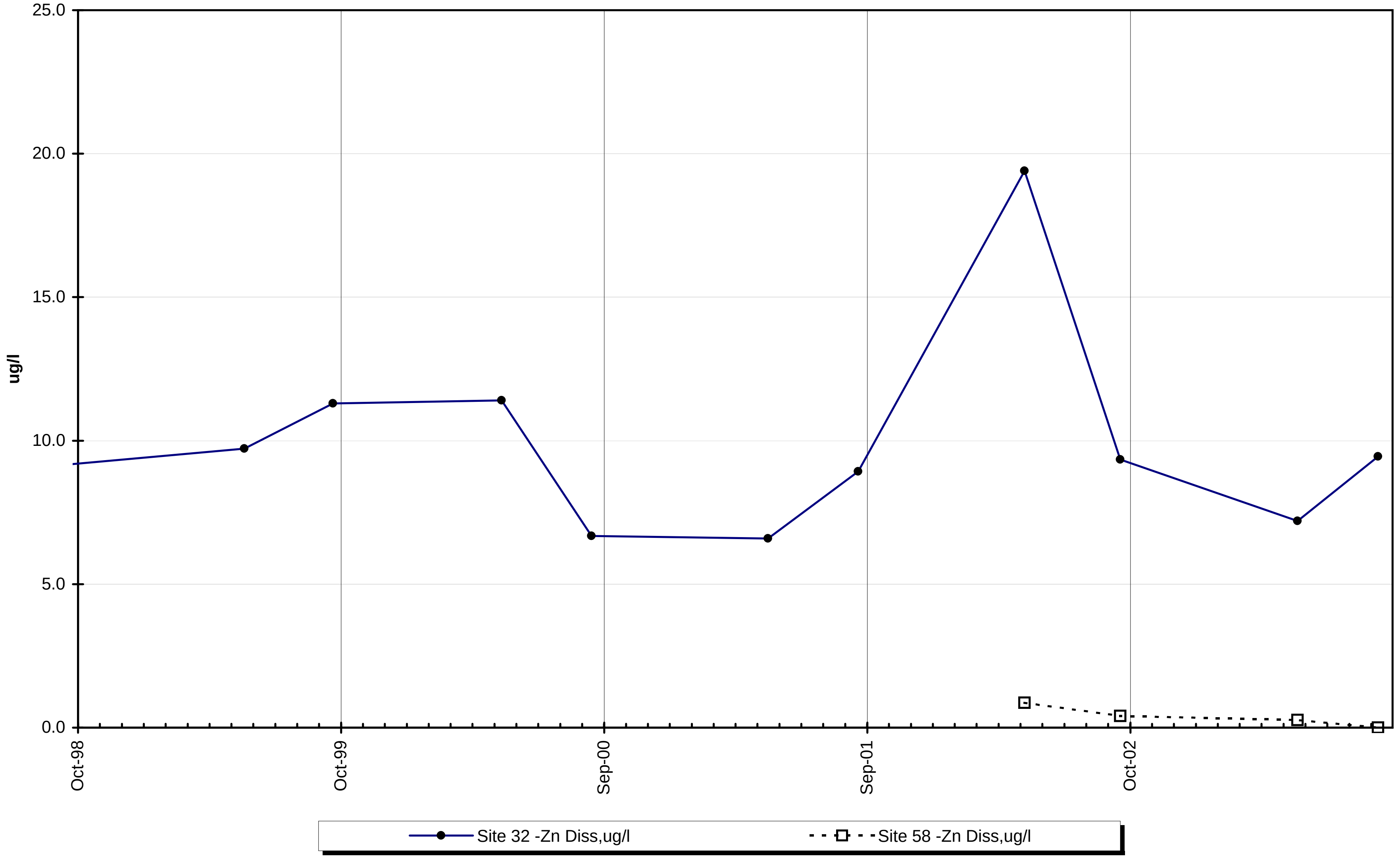
Site 32 vs. Site 58 -Total Alkalinity



Site 32 vs. Site 58 -Total Sulfate



Site 32 vs. Site 58 -Dissolved Zinc



INTERPRETIVE REPORT
SITE 59 “MONITORING WELL T-00-01A”

The data collected during the current water year are listed in the following “Table of Results for Water Year 2002” report. The table includes all the data, field and lab, 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 zero for the purpose of median calculation.

Sampling at this site was added to the FWMP in May-2003. All data collected at this site since it’s inception into the FWMP are included in the data analyses. As shown in the table below, there were no data outliers.

Sample Date	Parameter	Value	Qualifier	Notes
No outliers have been identified by KGCMC for the period of Oct-98 though Sept-03.				

The data for water year 2003 have been compared to the strictest fresh water quality criterion for each applicable analyte. No results exceeding these criteria have been identified.

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. The inception of sampling at this site commenced in the 2002 water year and thus only four data points are shown on each graph. There are no apparent trends present in the limited data collected to data.

Table of Results for Water Year 2003

Site 59 "MW-T-00-01A"													
Sample Date/Parameter	Oct-02	Nov-02	Dec-02	Jan-03	Feb-03	Mar-03	Apr-03	5/21/2003	Jun-03	Jul-03	Aug-03	9/10/2003	**Median**
Water Temp (°C)	NOT SCHEDULED FOR SAMPLING							6.3	NOT SCHEDULED FOR SAMPLING			9.5	7.9
Conductivity-Field(μmho)								112				105	109
Conductivity-Lab (μmho)								94				102	98
pH Lab (standard units)								6.75				6.69	6.72
pH Field (standard units)								6.68				6.74	6.71
Total Alkalinity (mg/L)								48.6				46.3	47.5
Total Sulfate (mg/L)								3.5				3.3 J	3.4
Hardness (mg/L)								49.0				40.6	44.8
Dissolved As (ug/L)								0.156				0.138 J	0.147
Dissolved Ba (ug/L)								7.2				7.2	7.2
Dissolved Cd (ug/L)								0.012				<0.023	0.012
Dissolved Cr (ug/L)								4.320				3.590	3.955
Dissolved Cu (ug/L)								0.136 U				0.111	0.124
Dissolved Pb (ug/L)								0.1470				0.1040 J	0.1255
Dissolved Ni (ug/L)								0.184				0.711	0.448
Dissolved Ag (ug/L)								<0.028				<0.004	0.008
Dissolved Zn (ug/L)								0.37 J				0.84	0.61
Dissolved Se (ug/L)								<0.224 UJ				<0.496	0.180
Dissolved Hg (ug/L)								0.000340 U				0.001340 J	0.000840

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

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

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

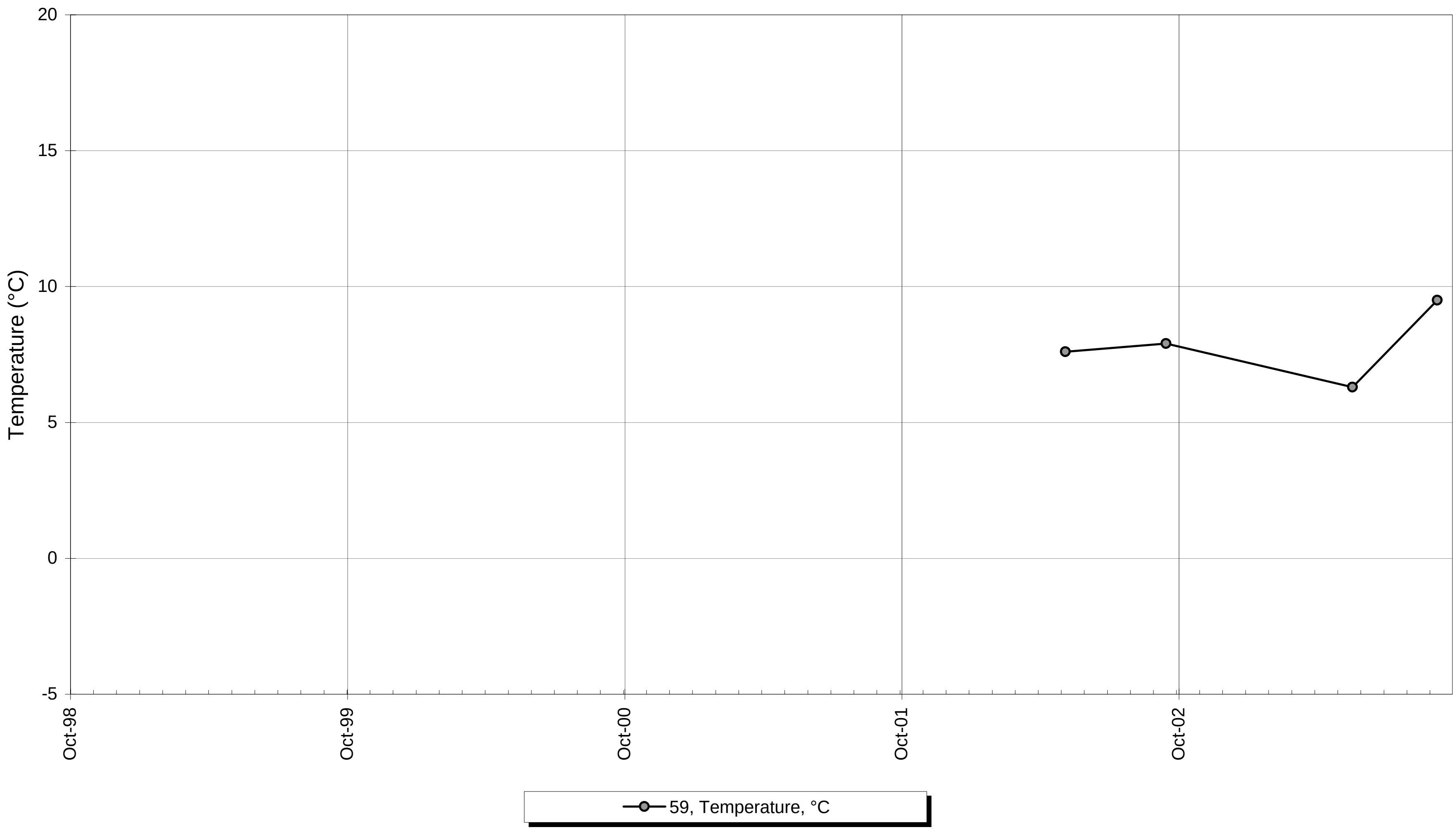
Qualified Data by QA Reviewer

Date Range: 10/01/2002 to 09/30/2003

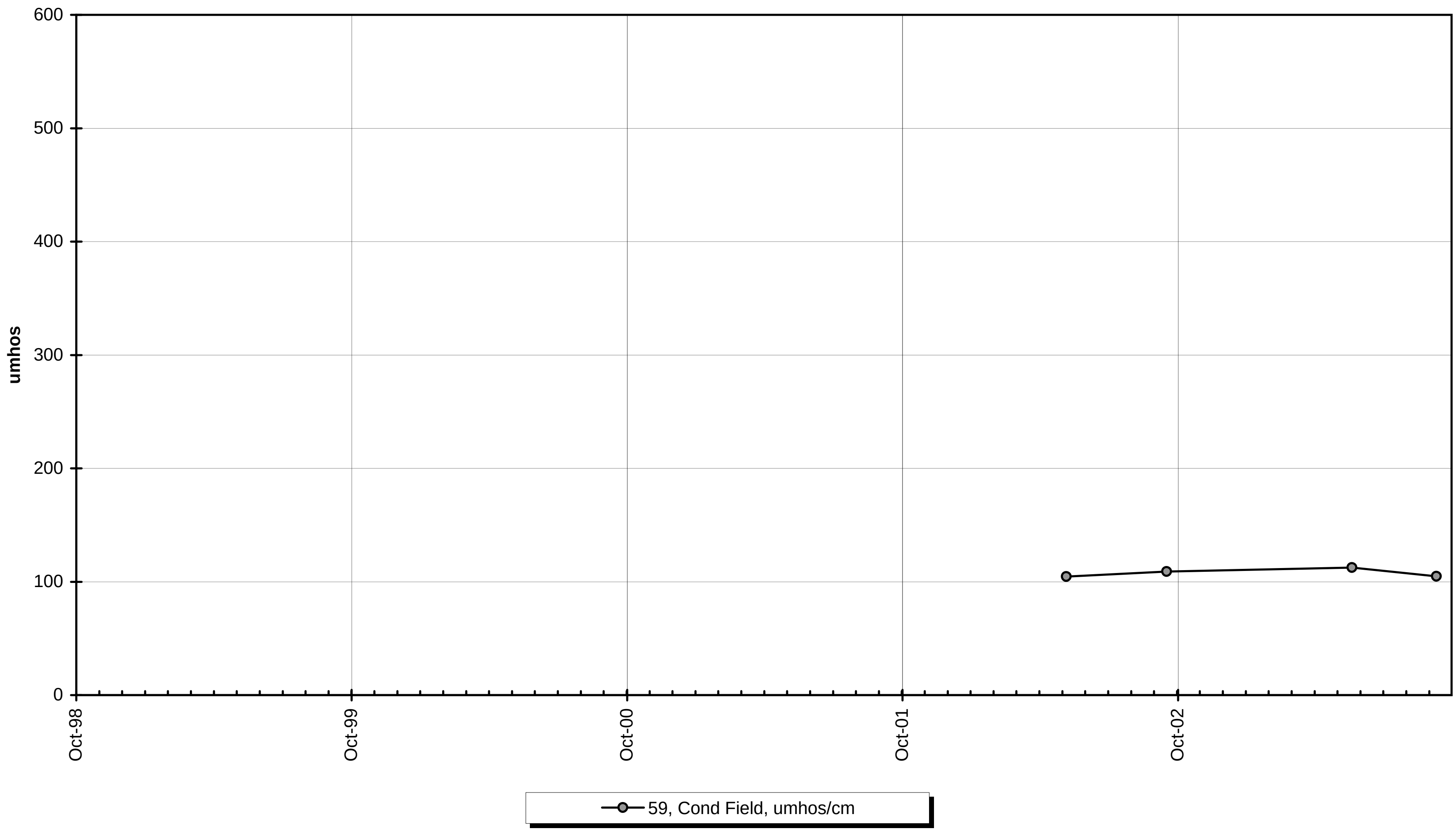
Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
59	05/21/2003	1:50:00 PM				
			Cu Diss, ug/l	0.136	U	Field Blank Contamination
			Zn Diss, ug/l	0.368	J	Below Quantitative Range
			Se Diss, ug/l	-0.224	UJ	LCS Recovery
			Hg Diss, ug/l	0.00034	U	Method Blank Contamination
59	09/10/2003	3:05:00 PM				
			SO4 Tot, mg/l	3.33	J	Sample Temperature
			As Diss, ug/l	0.138	J	Below Quantitative Range
			Pb Diss, ug/l	0.104	J	Below Quantitative Range
			Hg Diss, ug/l	0.00134	J	Duplicate RPD

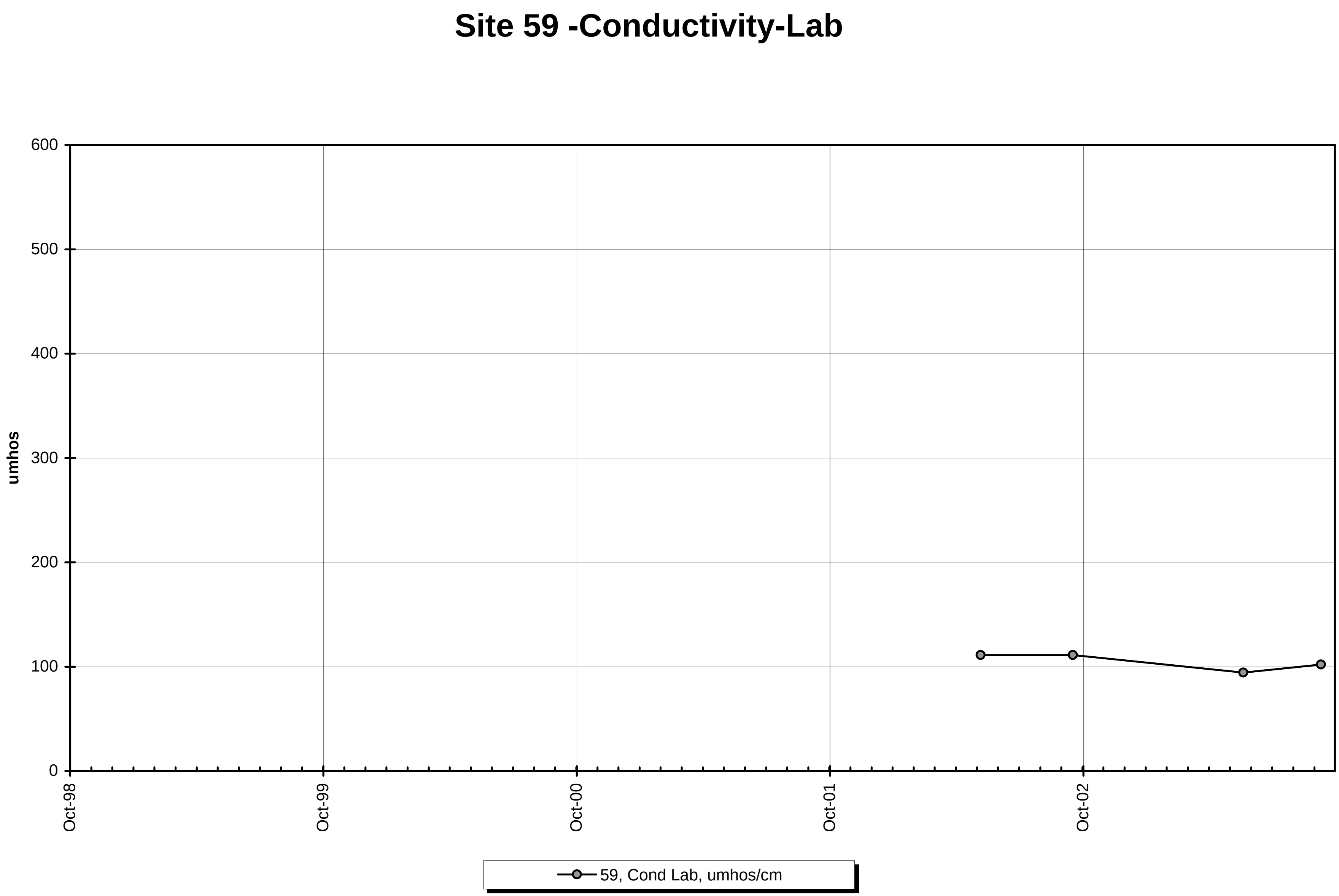
Qualifier	Description
J	Positively Identified - Approximate Concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot Be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit

Site 59 -Water Temperature

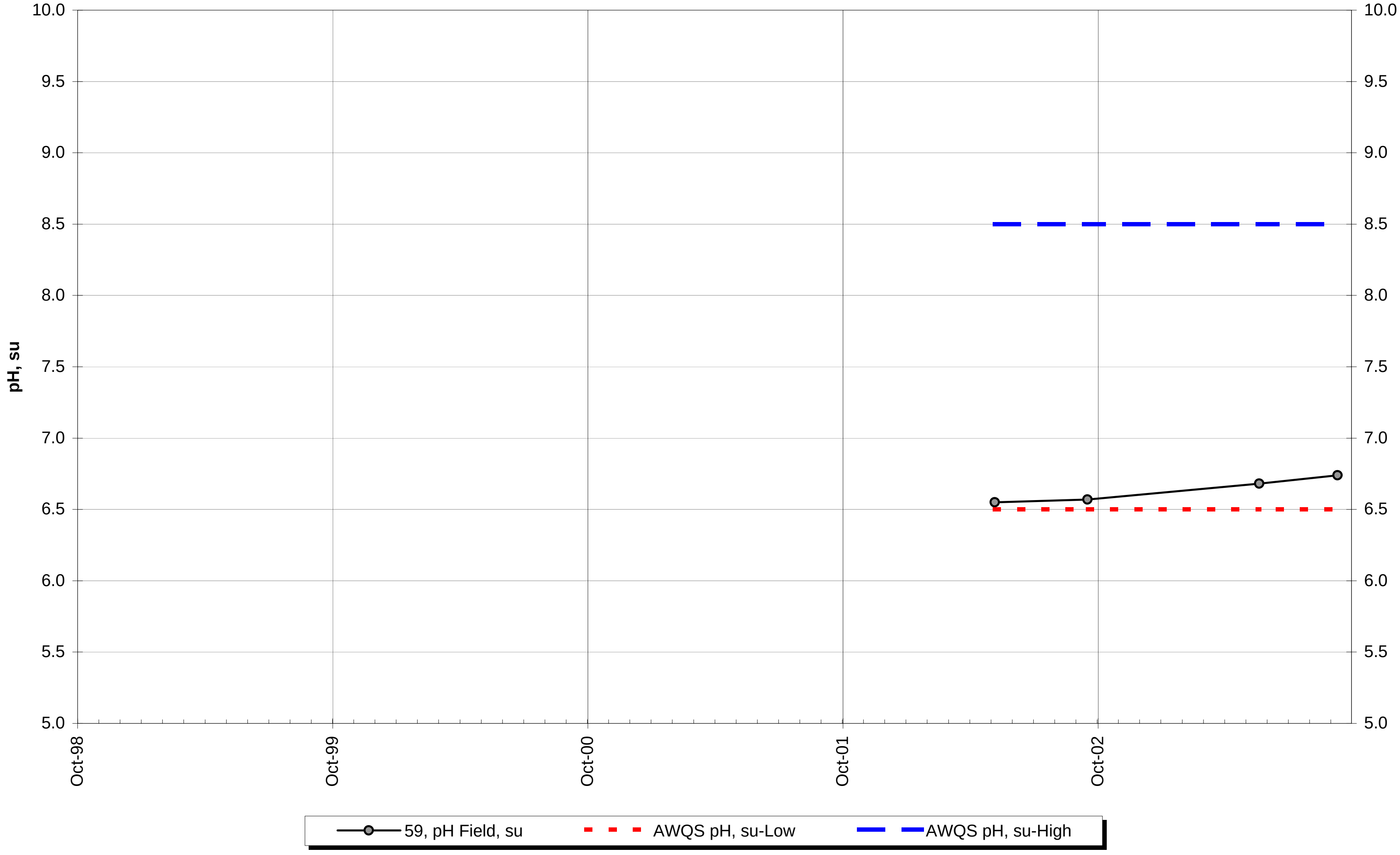


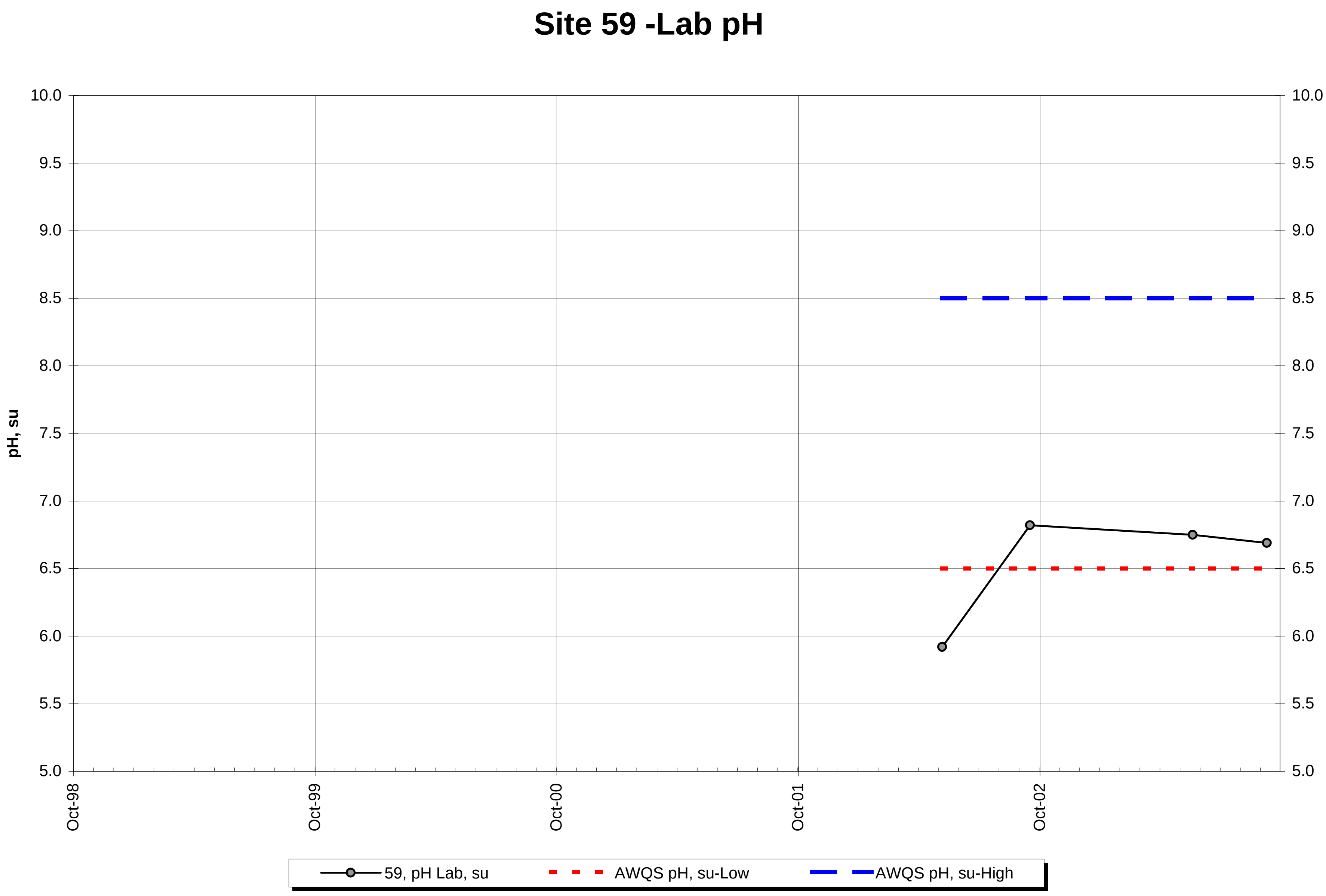
Site 59 -Conductivity-Field



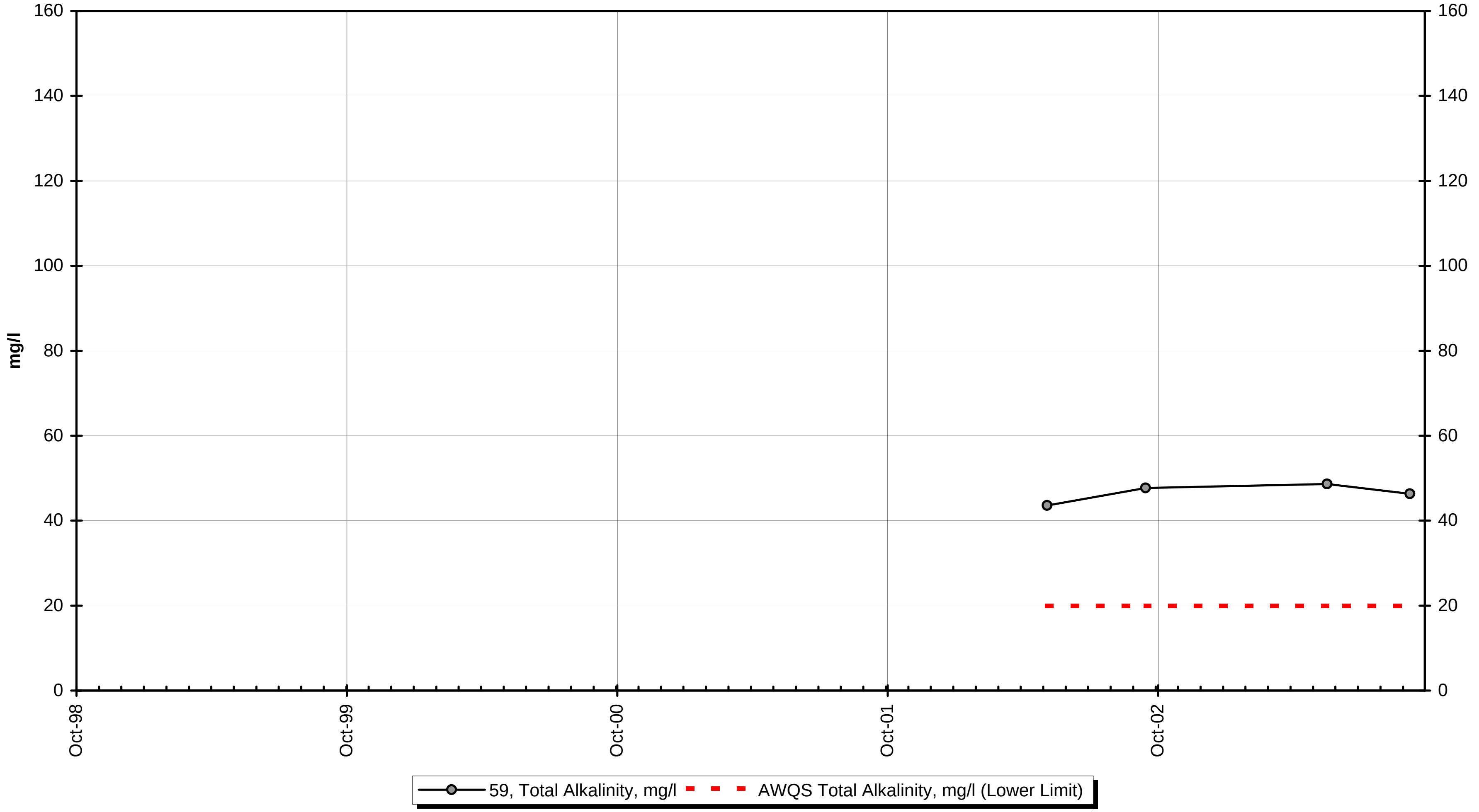

Site 59 -Conductivity-Lab
umhos
600
500
400
300
200
100
0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
59, Cond Lab, umhos/cm

Site 59 -Field pH

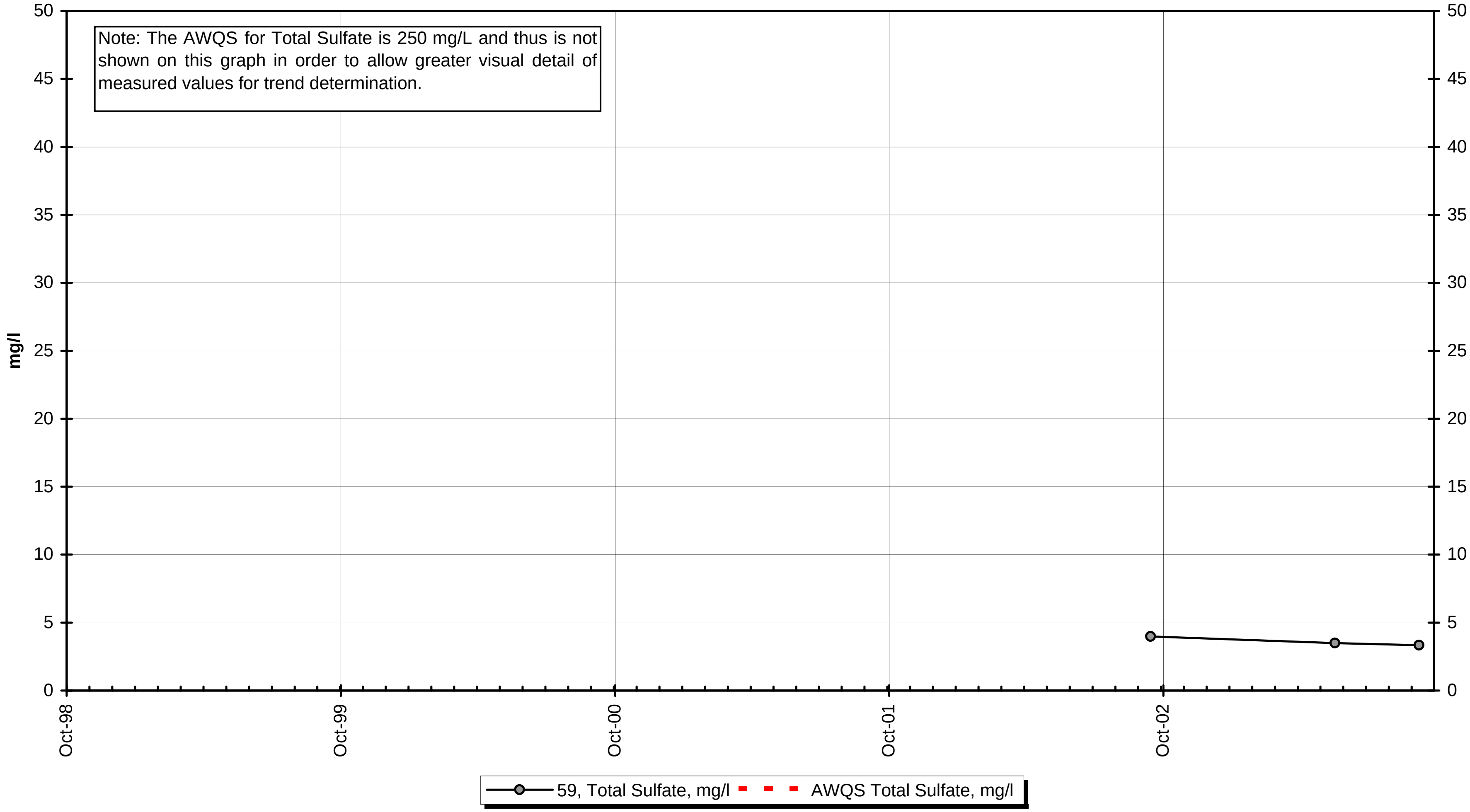



Site 59 -Lab pH
pH, su
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
59, pH Lab, su
AWQS pH, su-Low
AWQS pH, su-High

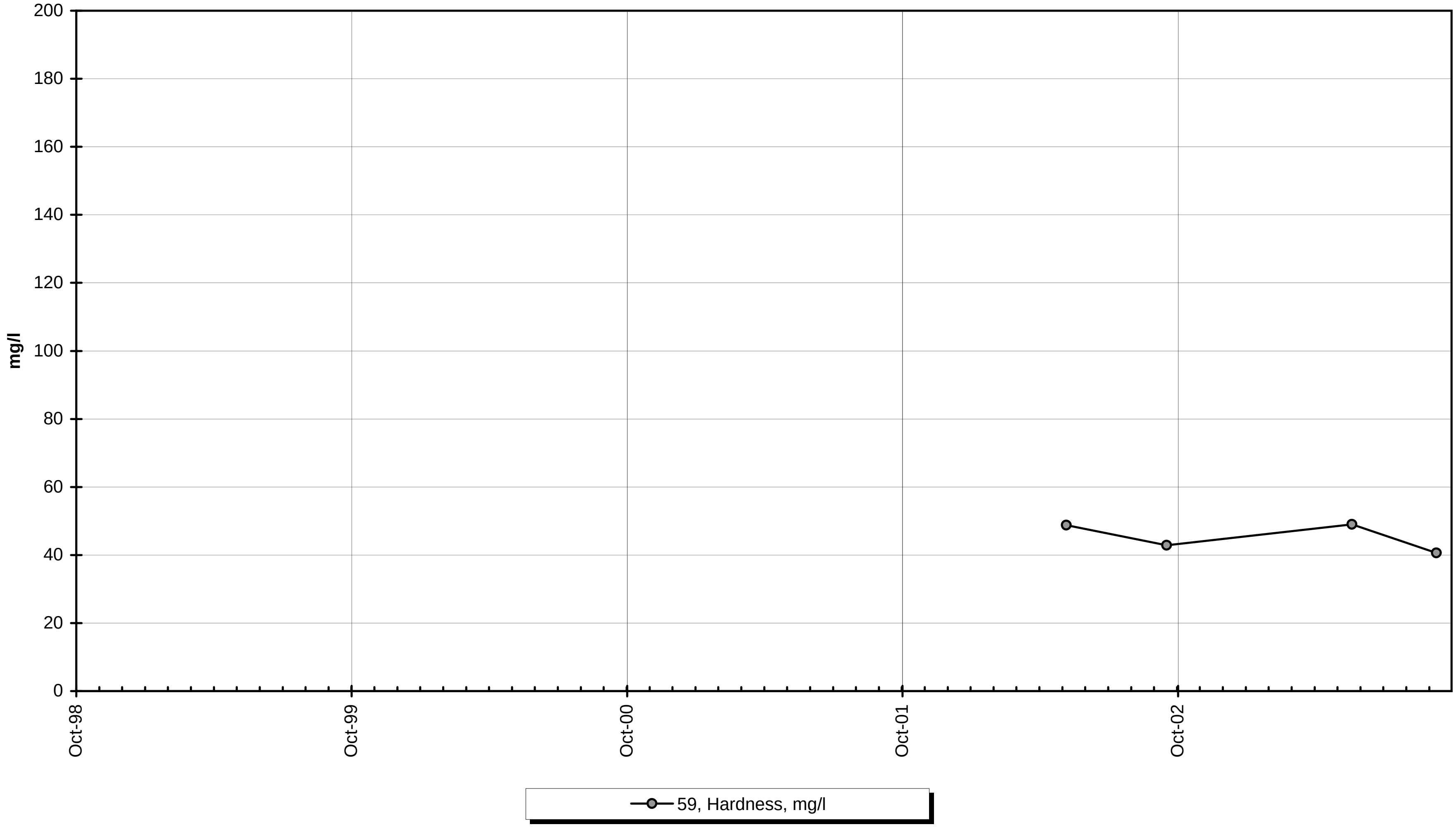
Site 59 -Total Alkalinity



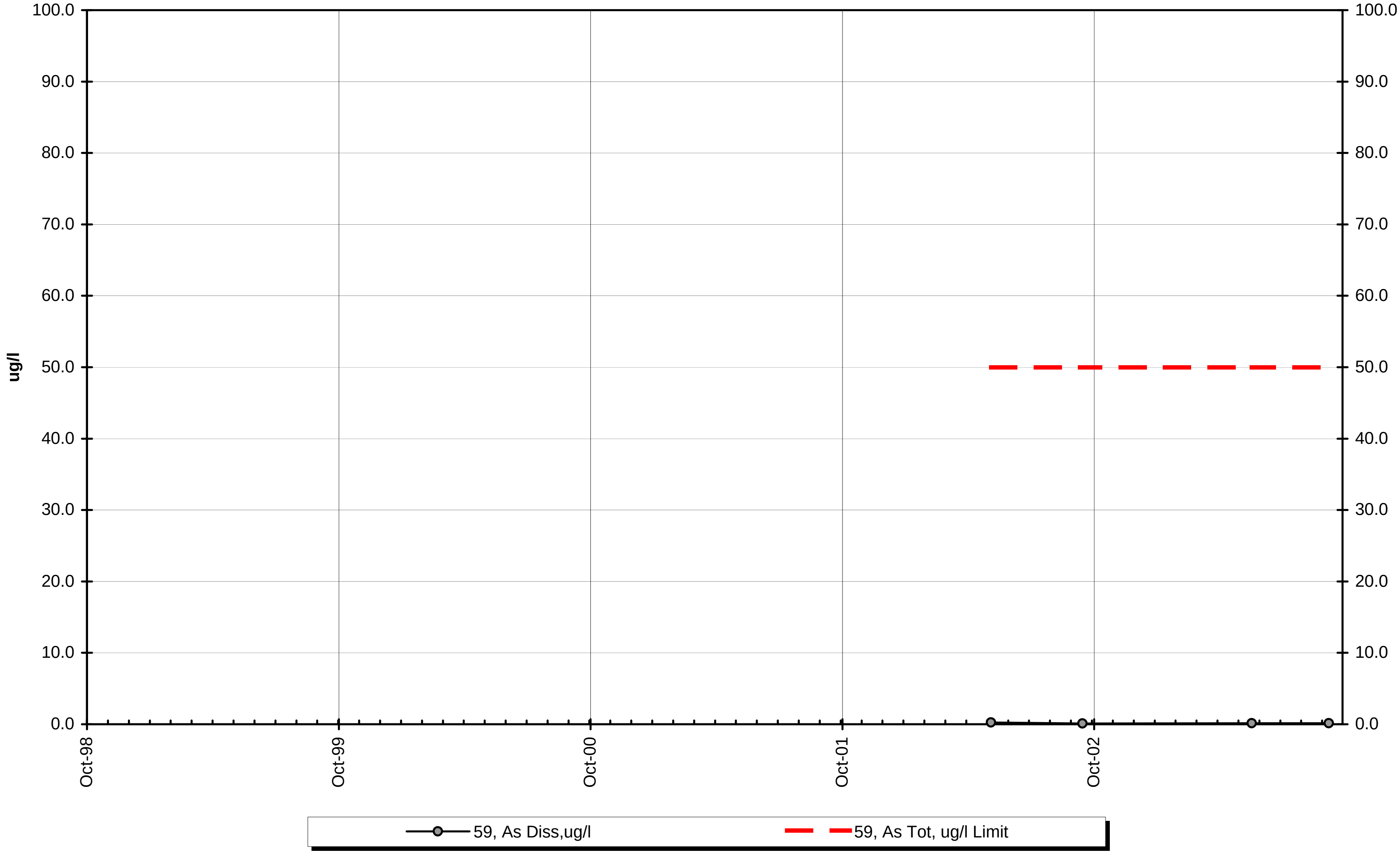
Site 59 -Total Sulfate



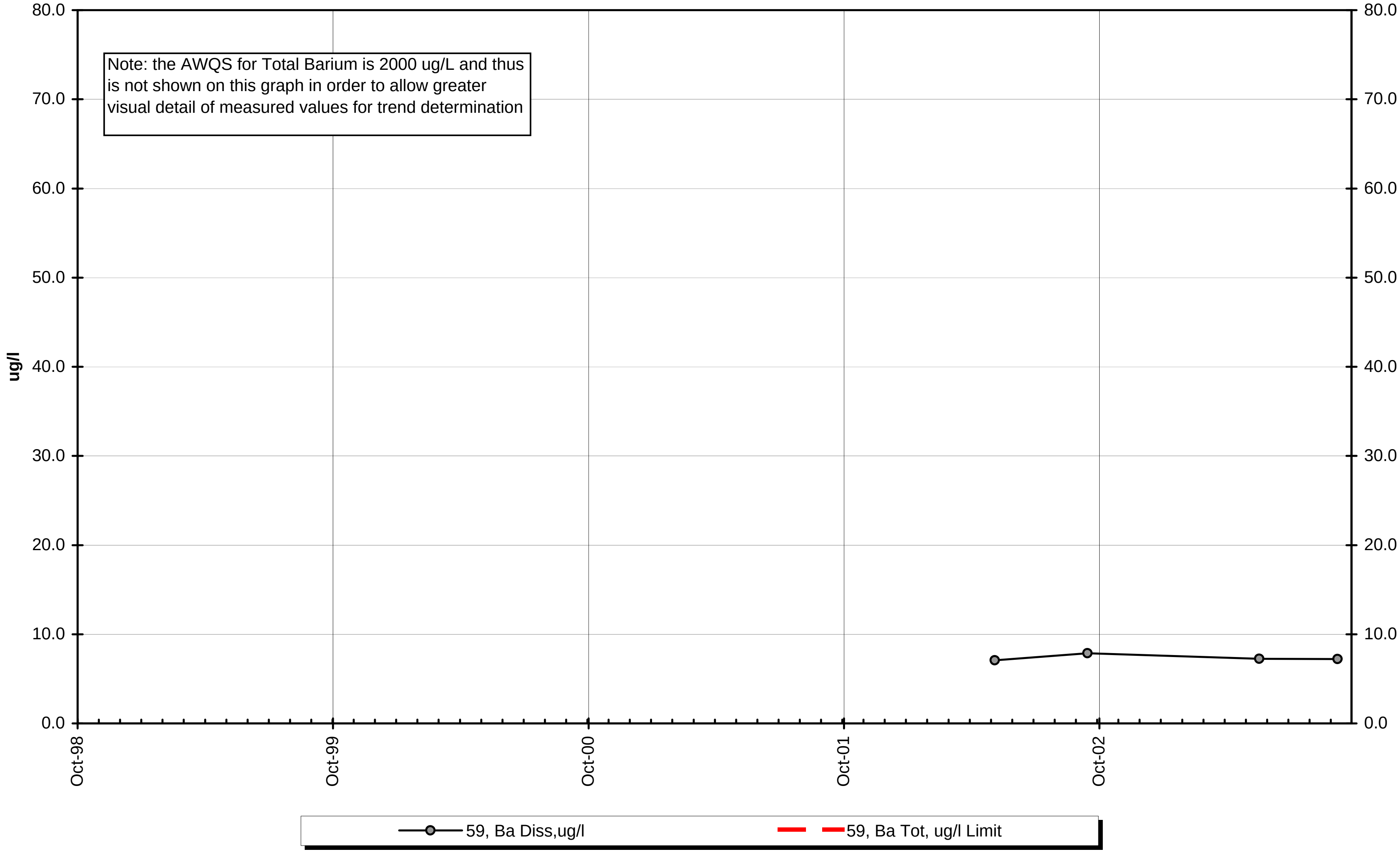
Site 59 -Hardness



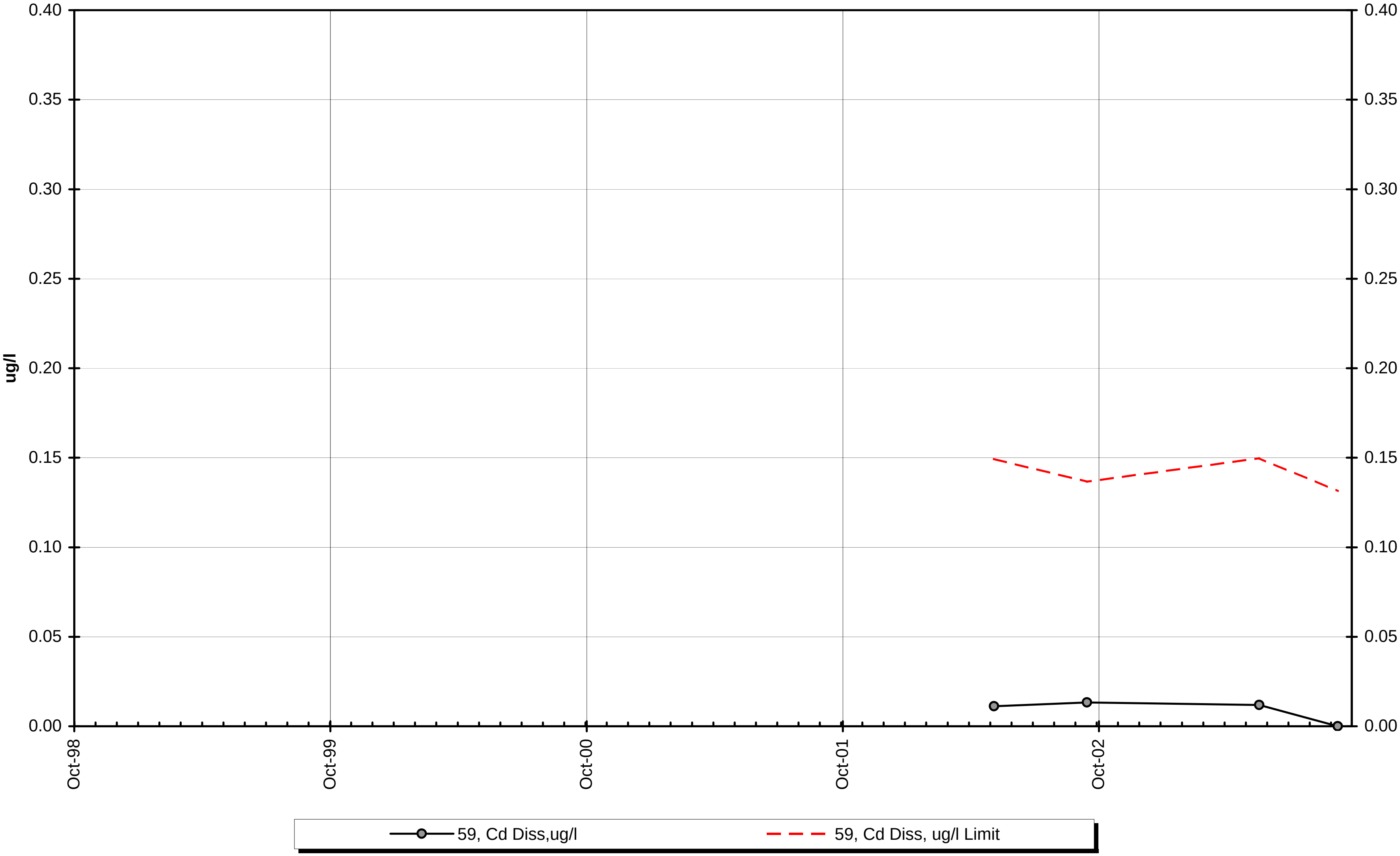
Site 59 -Dissolved Arsenic



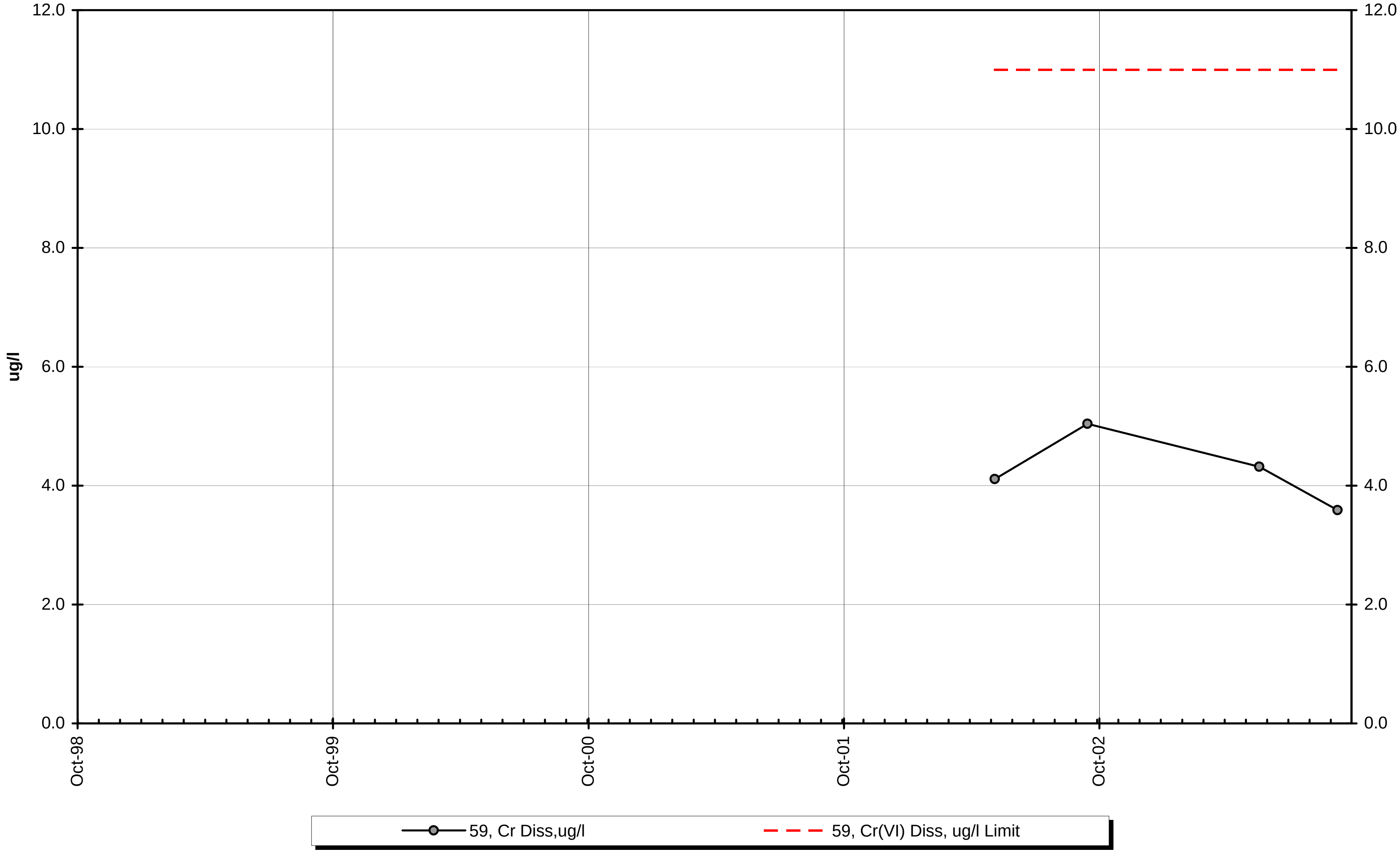
Site 59 -Dissolved Barium



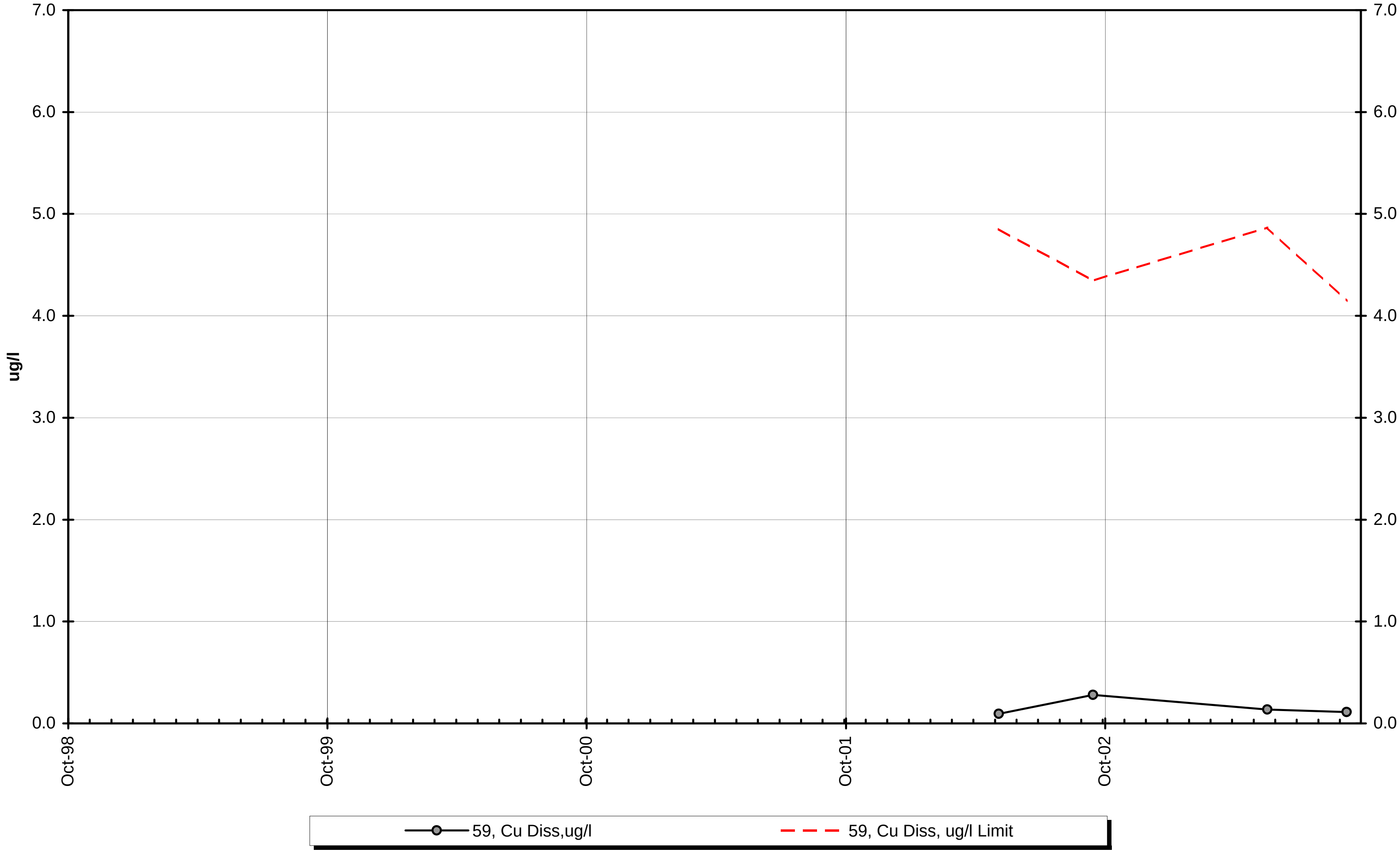
Site 59 -Dissolved Cadmium



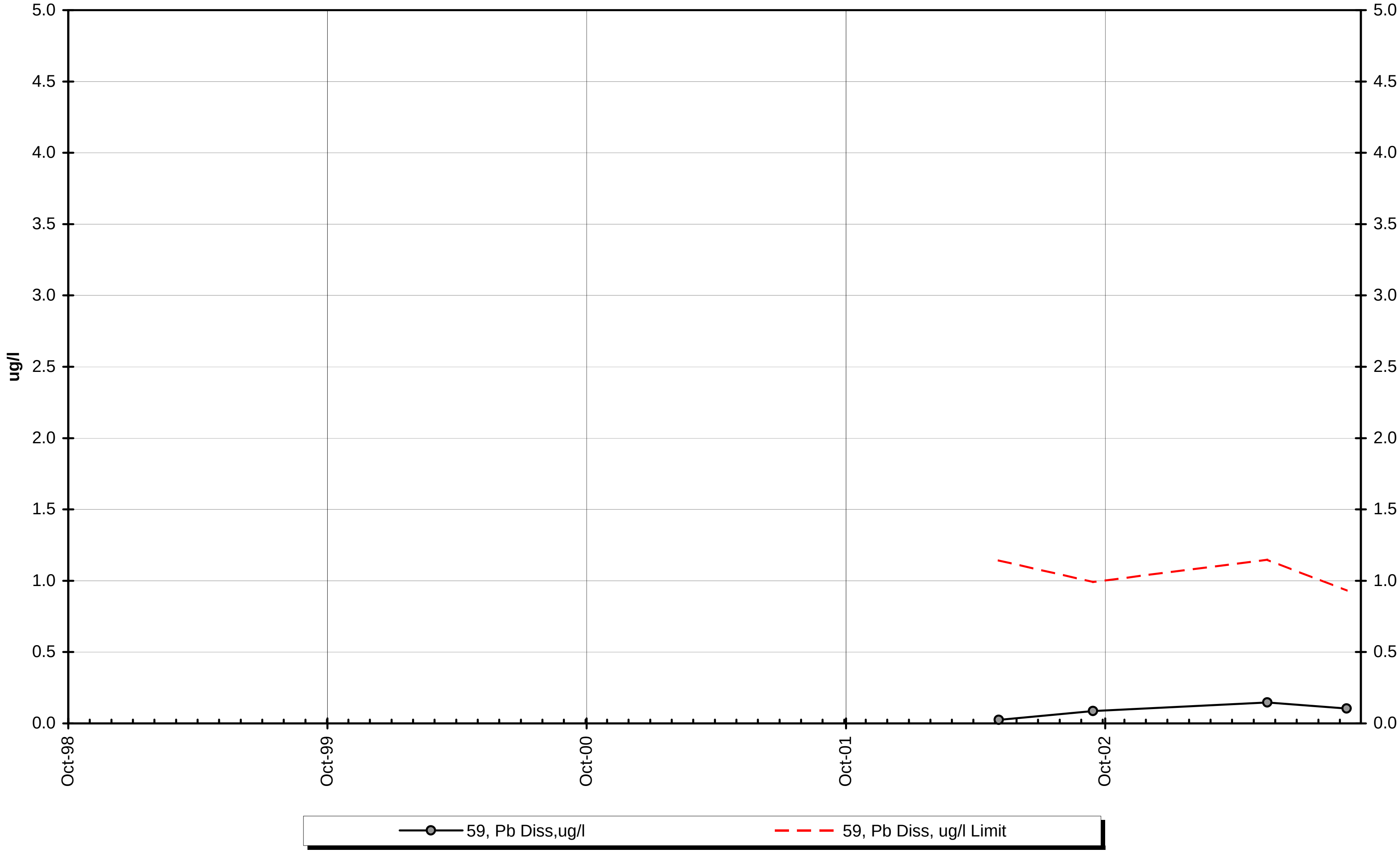
Site 59 -Dissolved Chromium

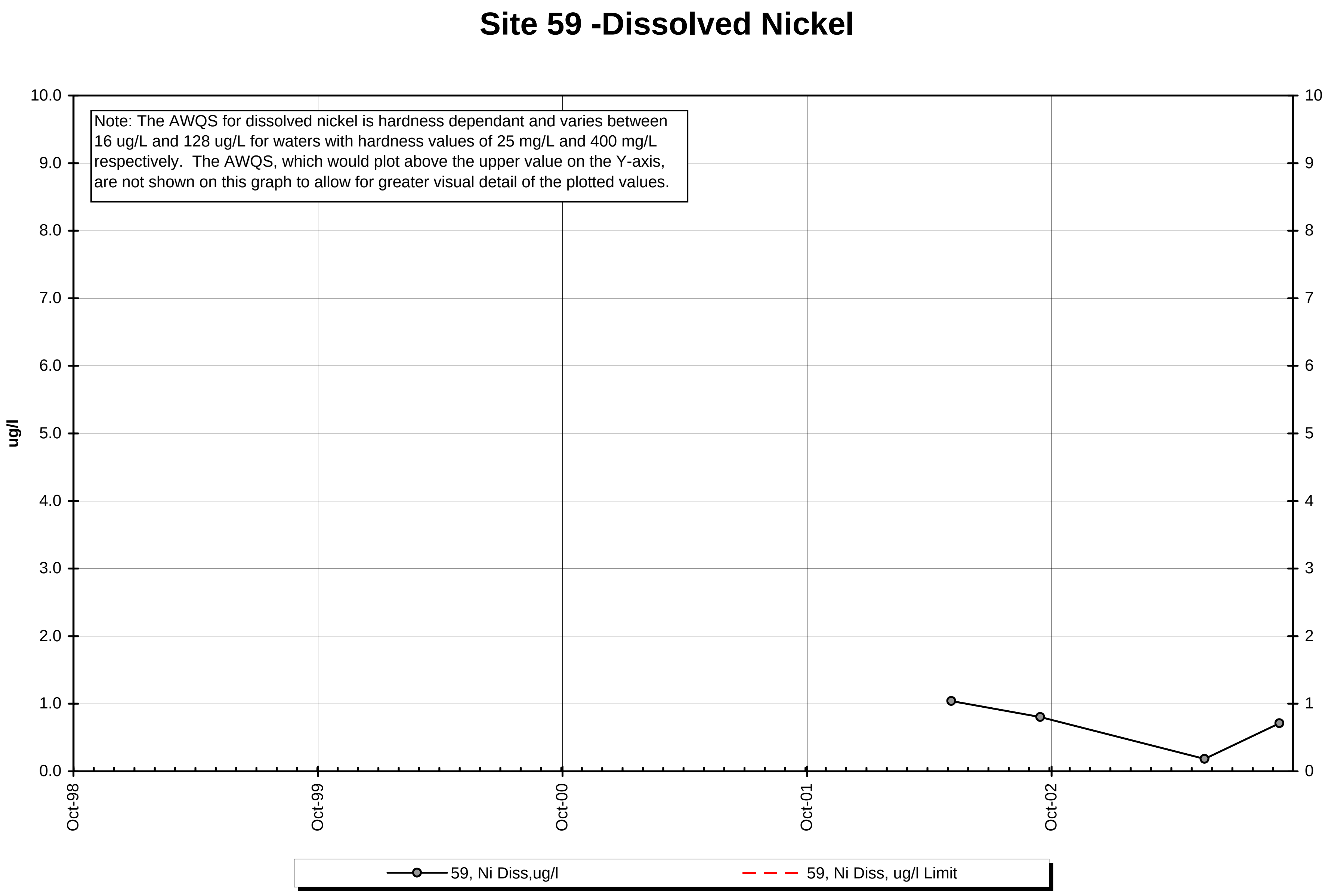


Site 59 -Dissolved Copper



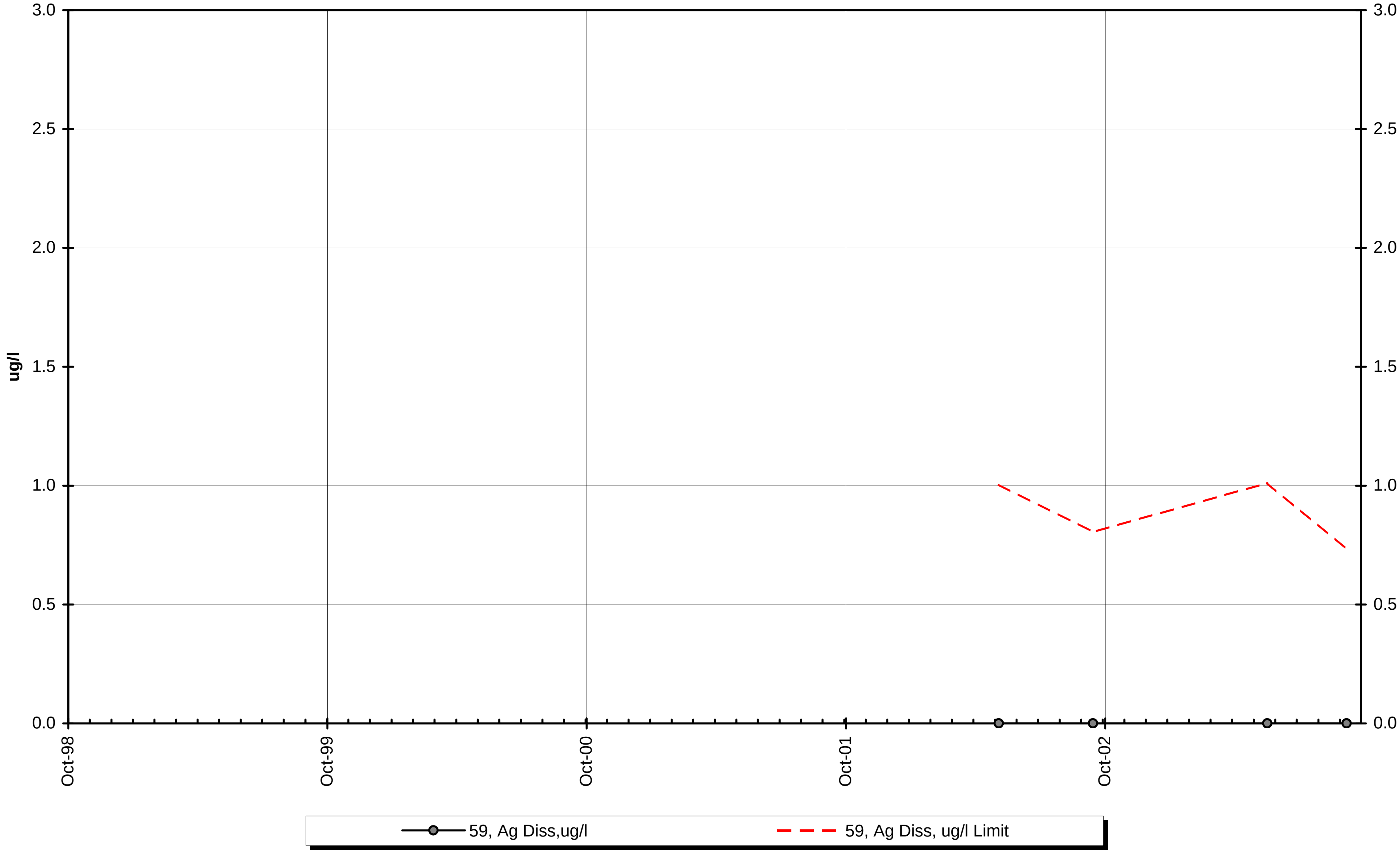
Site 59 -Dissolved Lead



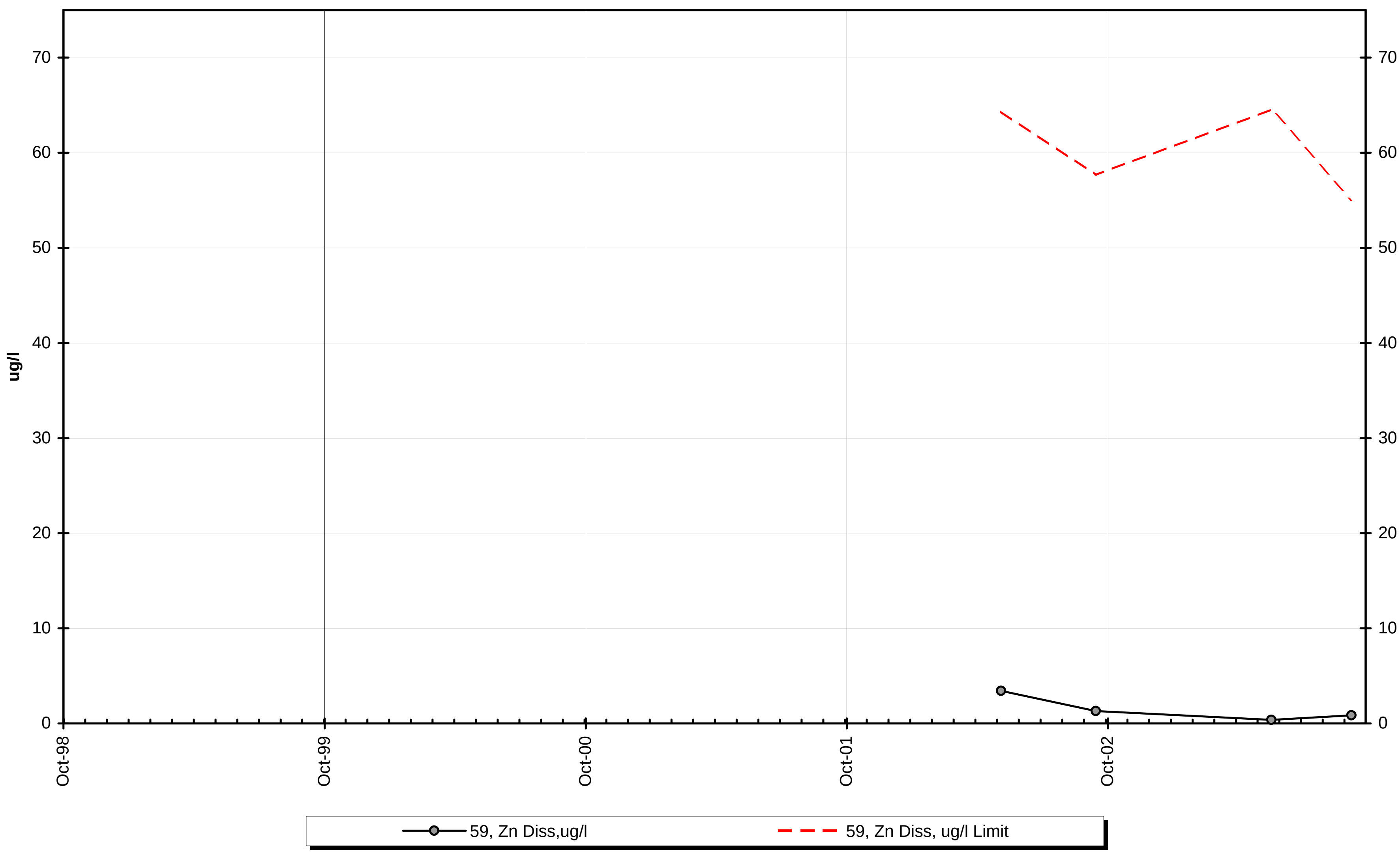


Site 59 -Dissolved Nickel
Note: The AWQS for dissolved nickel is hardness dependant and varies between 16 ug/L and 128 ug/L for waters with hardness values of 25 mg/L and 400 mg/L respectively. The AWQS, which would plot above the upper value on the Y-axis, are not shown on this graph to allow for greater visual detail of the plotted values.
ug/l
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
10
9
8
7
6
5
4
3
2
1
0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
59, Ni Diss,ug/l
59, Ni Diss, ug/l Limit

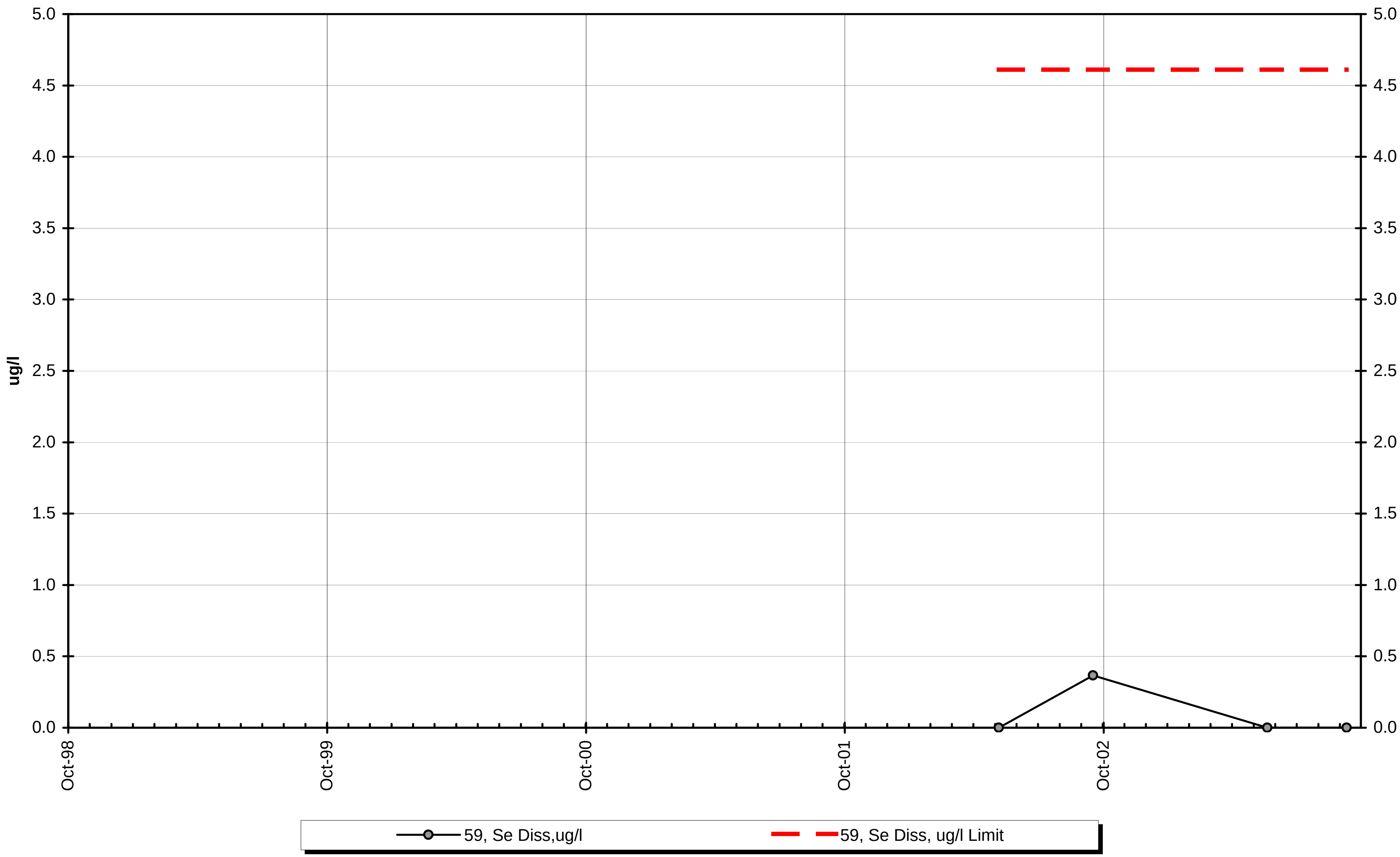
Site 59 -Dissolved Silver



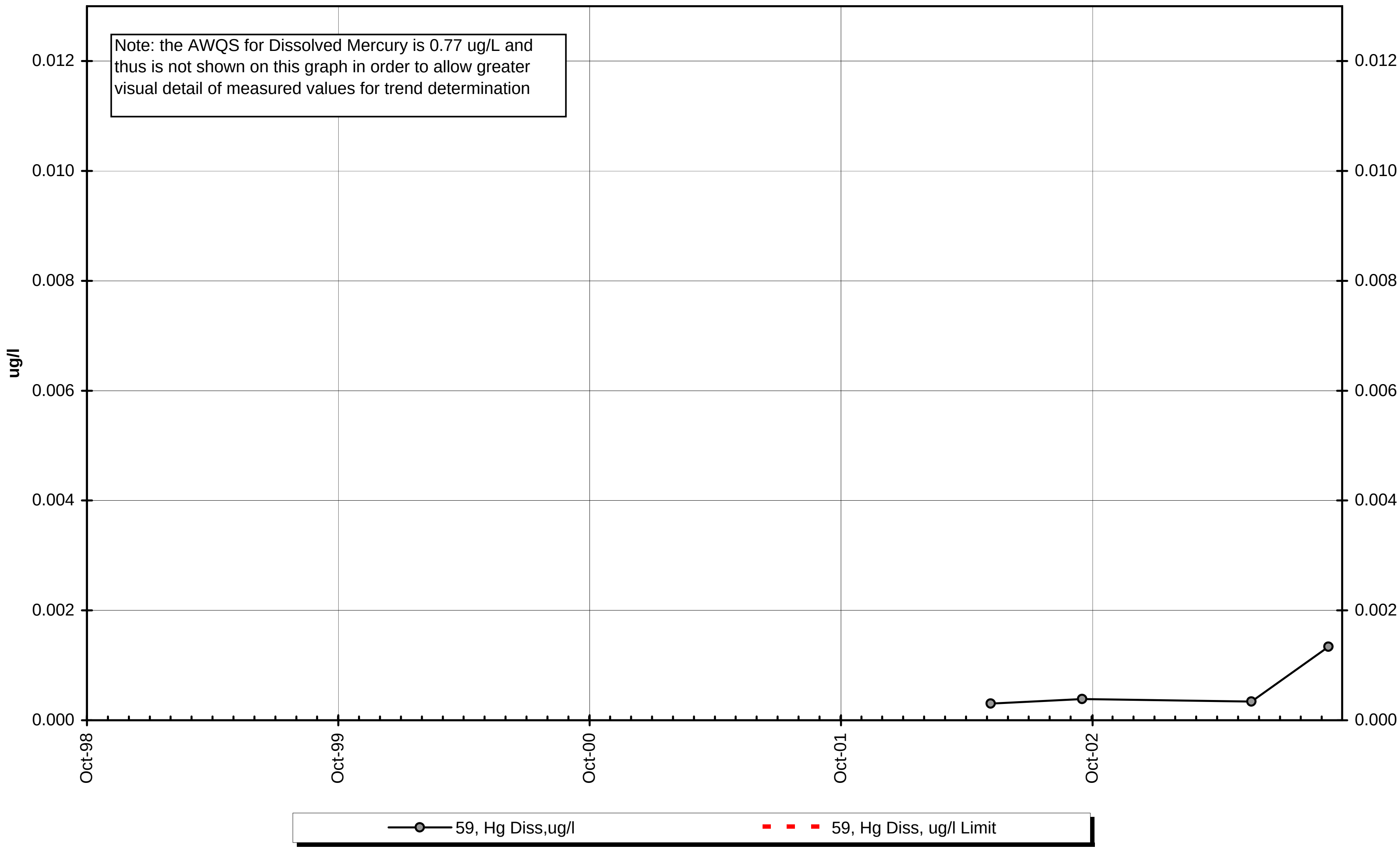
Site 59 -Dissolved Zinc



Site 59 -Dissolved Selenium



Site 59 -Dissolved Mercury



INTERPRETIVE REPORT
SITE 28 "MONITORING WELL 2D"

The data collected during the current water year are listed in the following "Table of Results for Water Year 2003" report. The table includes all the data, field and lab, 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 zero for the purpose of median calculation.

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

Sample Date	Parameter	Value	Qualifier	Notes
No outliers have been identified by KGCMC for the period of Oct-98 though Sept-03.				

The data for water year 2003 have been compared to the strictest fresh water quality criterion for each applicable analyte. Two (2) results exceeding these criteria have been identified, as listed in the table below. The two datum are for dissolved arsenic values of 72.5 µg/l and 70.6 µg/l for May-2003 and September-2003 respectively which exceed the AWQS of 50 µg/l. This site has routinely returned arsenic values above the AWQS and has a median value of 74.0 µg/l based on sampling since October-1988.

Sample Date	Parameter	Value	Standard *	Standard Type
05/21/03	Arsenic, Dissolved ug/L	72.5	50.0	Drinking Water
09/10/03	Arsenic, Dissolved ug/L	70.6	50.0	Drinking Water
* Standard is for Total Arsenic				

X-Y plots have been generated to graphically present the data for each of the analytes requested in the Statistical Information Goals for this site. These plots have been visually analyzed for the appearance of any trend in concentration. No obvious trends were apparent. Additional X-Y plots have been generated for alkalinity, pH, sulfate, conductance, and dissolved zinc that plot Site 28 and Site 59, the up-gradient control site, to aid in comparison between those two sites. Lab conductivity, lab pH, sulfate, and total alkalinity are all higher at Site 28 than at Site 59 while the dissolved zinc concentrations are similar. Site 59 and Site 28 are deep completion wells that are each respectively colocated with Site 58 and Site 27. A similar line of reasoning discussed in the section for Site 28 can be applied to explaining the differences in water chemistry between Site 59 and Site 28. Thus, the generally higher concentrations at Site 28 reflect the more mature nature of the groundwater sampled at this site, while the similar values for dissolved zinc are a strong indication of the lack of any influence from tailings contact water.

Table of Results for Water Year 2003

Site 28 "MW-2D"

Sample Date/Parameter	Oct-02	Nov-02	Dec-02	Jan-03	Feb-03	Mar-03	Apr-03	5/21/2003	Jun-03	Jul-03	Aug-03	9/10/2003	**Median**
Water Temp (°C)	NOT SCHEDULED FOR SAMPLING							6.5	NOT SCHEDULED FOR SAMPLING			6.2	6.4
Conductivity-Field(µmho)								259				243	251
Conductivity-Lab (µmho)								218				222	220
pH Lab (standard units)								8.49				8.41	8.45
pH Field (standard units)								8.51				8.62	8.57
Total Alkalinity (mg/L)								100.0				103.0	101.5
Total Sulfate (mg/L)								8.6				9.1 J	8.8
Hardness (mg/L)								69.0				70.5	69.8
Dissolved As (ug/L)								72.500				70.600	71.550
Dissolved Ba (ug/L)								7.0				9.8	8.4
Dissolved Cd (ug/L)								0.011				<0.023	0.011
Dissolved Cr (ug/L)								0.619				0.375	0.497
Dissolved Cu (ug/L)								0.130 U				0.099	0.114
Dissolved Pb (ug/L)								0.0533 U				0.0730 J	0.0632
Dissolved Ni (ug/L)								0.530				0.412	0.471
Dissolved Ag (ug/L)								<0.028				<0.004	0.008
Dissolved Zn (ug/L)								0.98				<0.14	0.52
Dissolved Se (ug/L)								0.317 J				<0.496	0.283
Dissolved Hg (ug/L)								0.000585				0.000504 J	0.000545

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

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

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

NOTE (1) Analysis was not performed on sample.

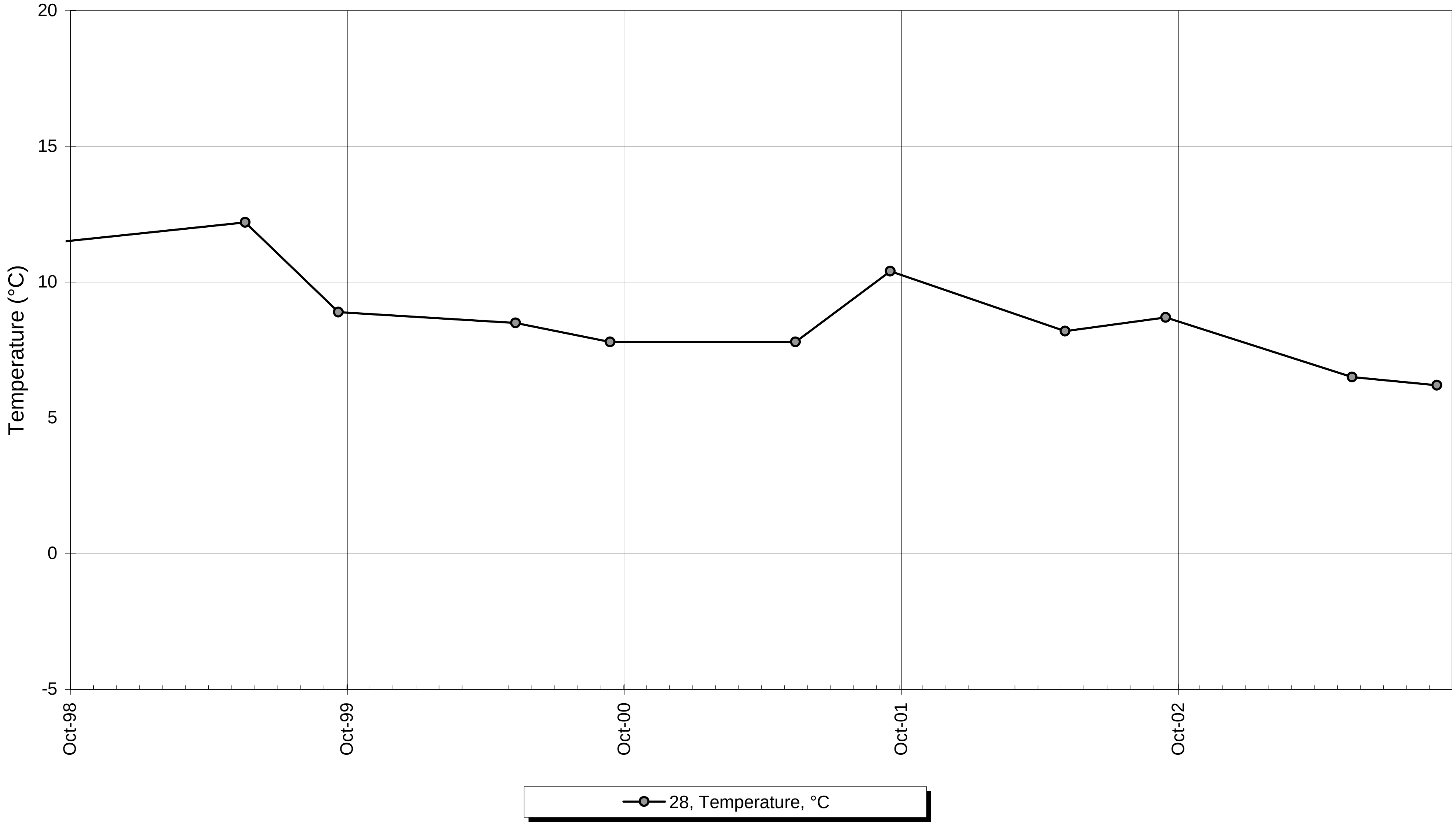
Qualified Data by QA Reviewer

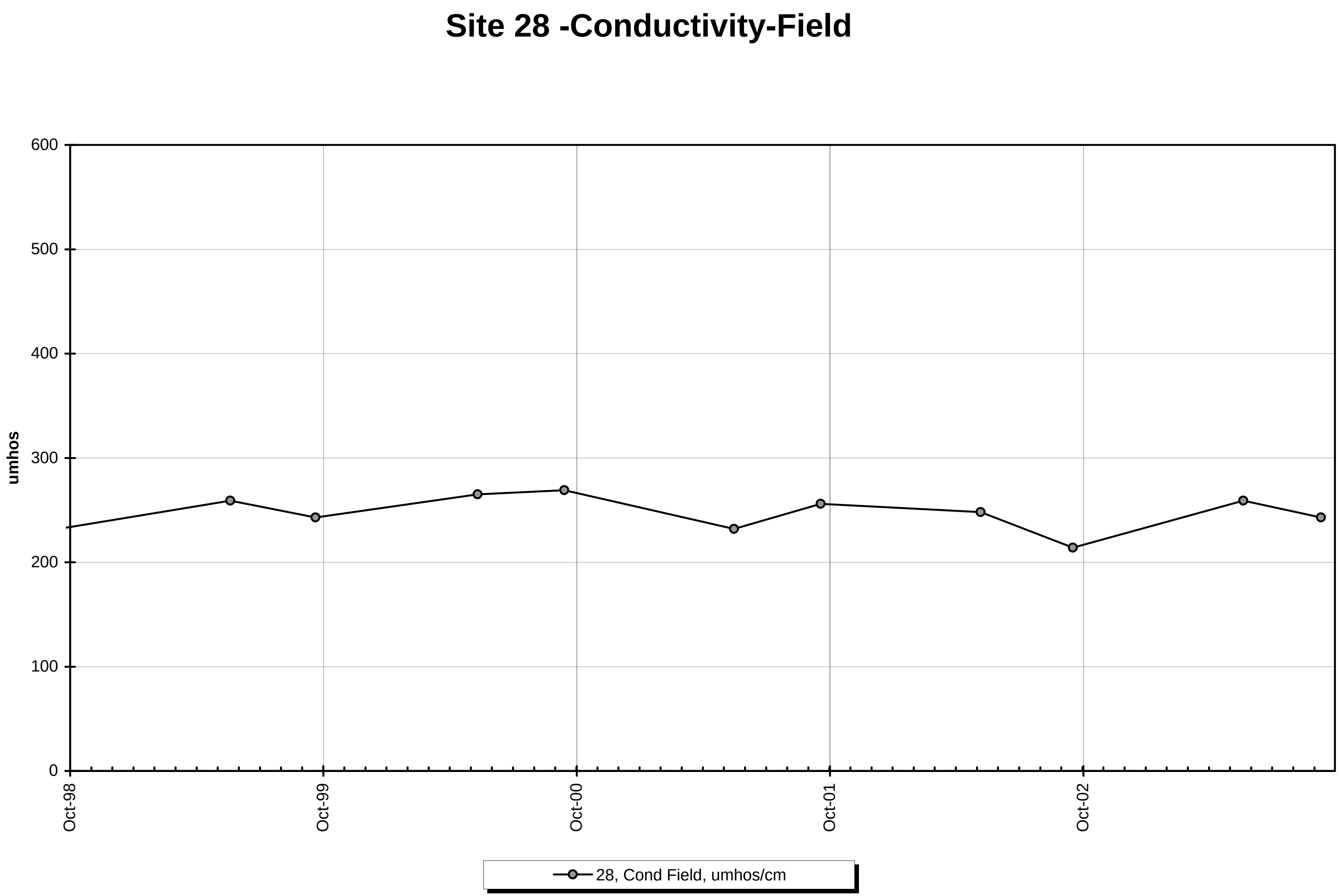
Date Range: 10/01/2002 to 09/30/2003

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
28	05/21/2003	11:23:00 AM				
			Cu Diss, ug/l	0.13	U	Field Blank Contamination
			Pb Diss, ug/l	0.0533	U	Field Blank Contamination
			Se Diss, ug/l	0.317	J	Below Quantitative Range, L
28	09/10/2003	12:30:00 PM				
			SO4 Tot, mg/l	9.05	J	Sample Temperature
			Pb Diss, ug/l	0.073	J	Below Quantitative Range
			Hg Diss, ug/l	0.000504	J	Method Blank Contamination

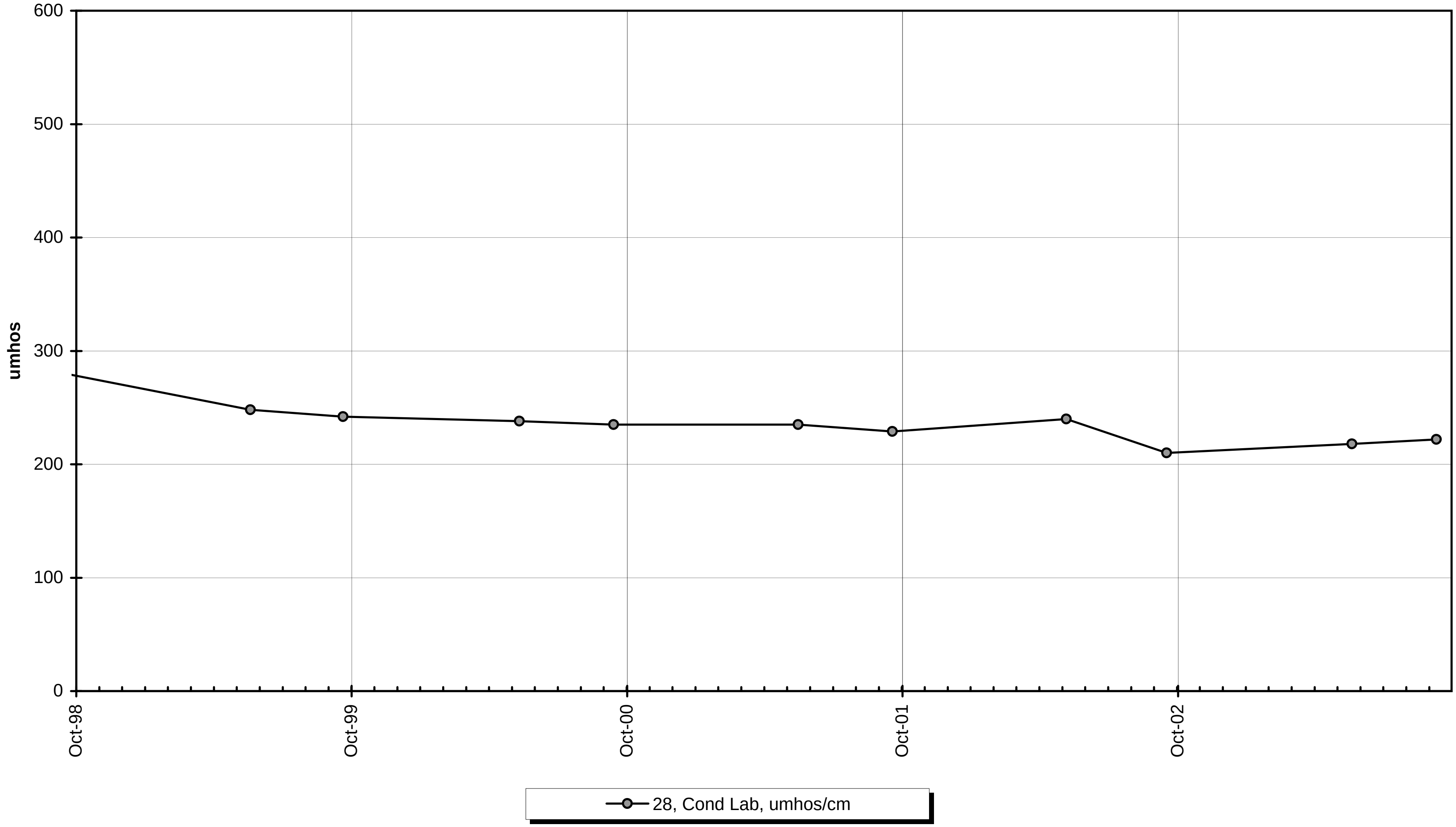
Qualifier	Description
J	Positively Identified - Approximate Concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot Be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit

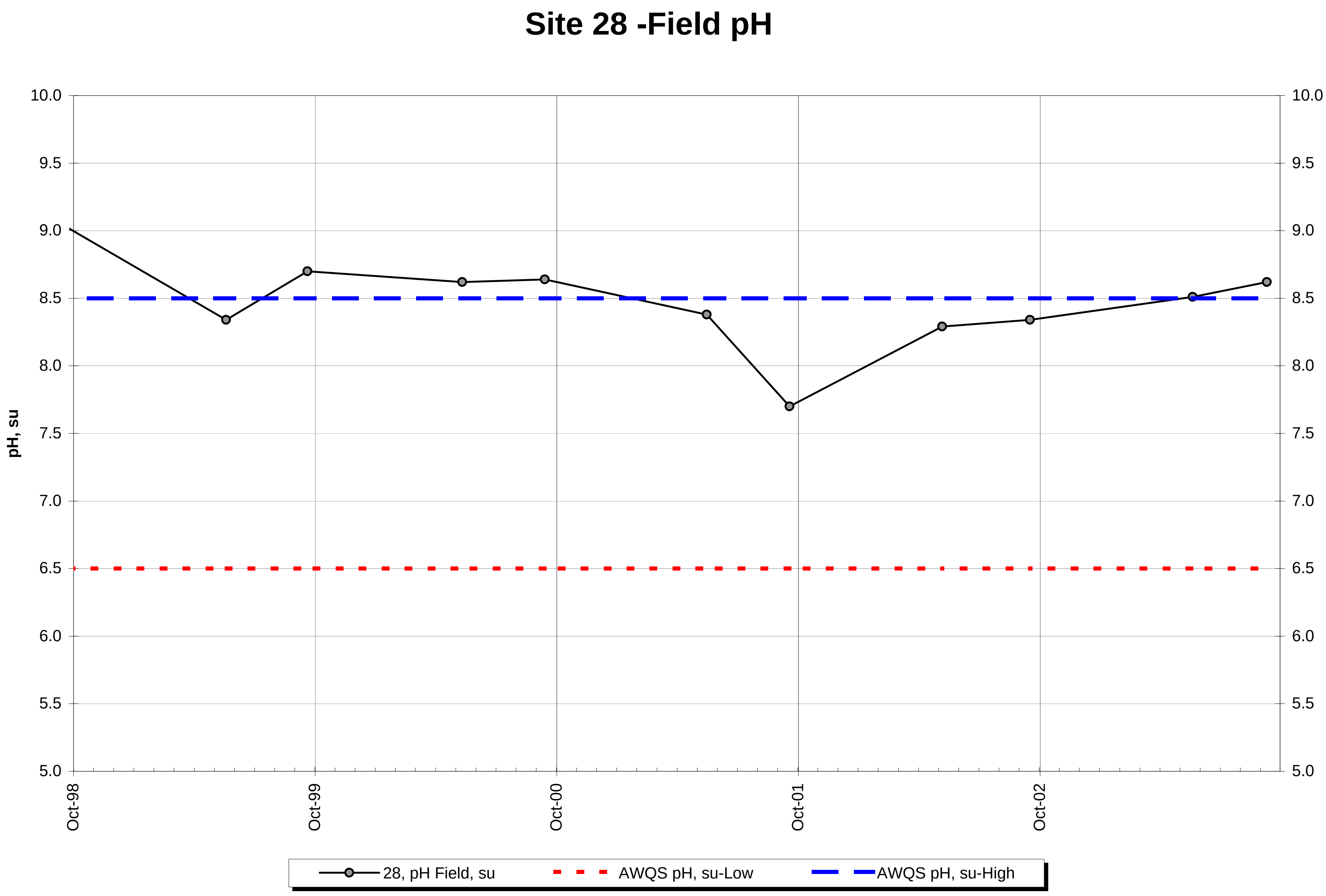
Site 28 -Water Temperature




Site 28 -Conductivity-Field
umhos
600
500
400
300
200
100
0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
28, Cond Field, umhos/cm

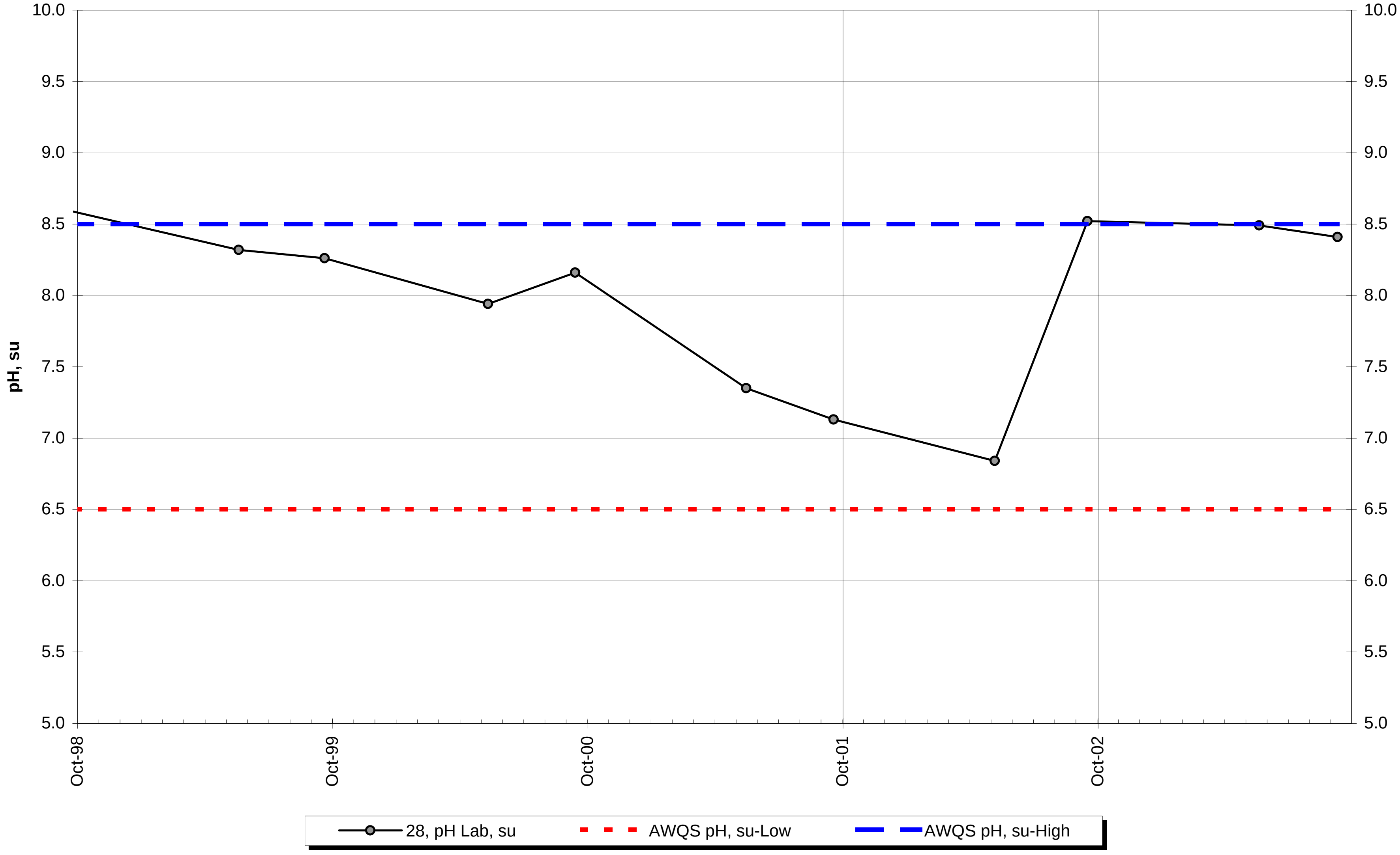
Site 28 -Conductivity-Lab



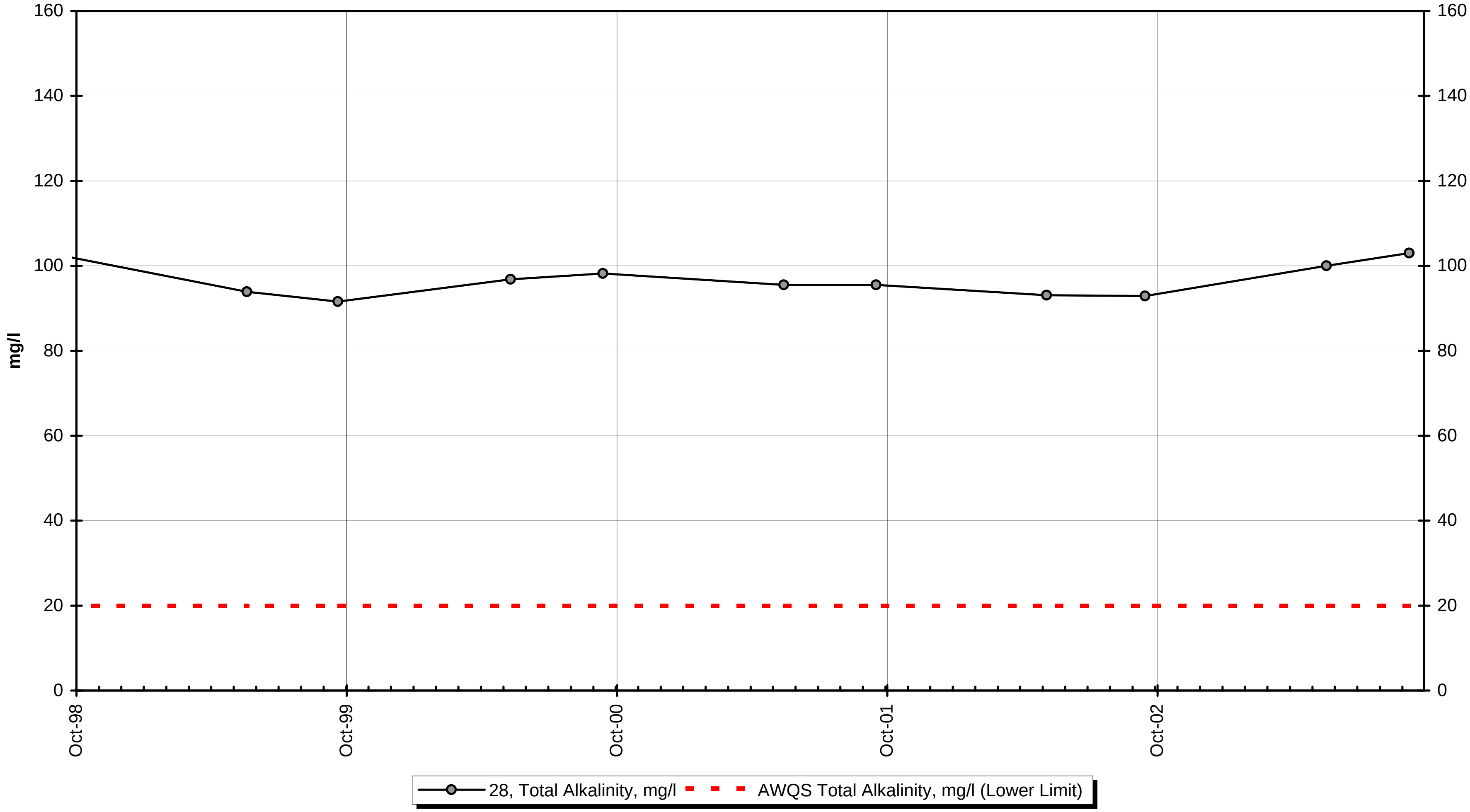


Site 28 -Field pH
pH, su
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
28, pH Field, su
AWQS pH, su-Low
AWQS pH, su-High

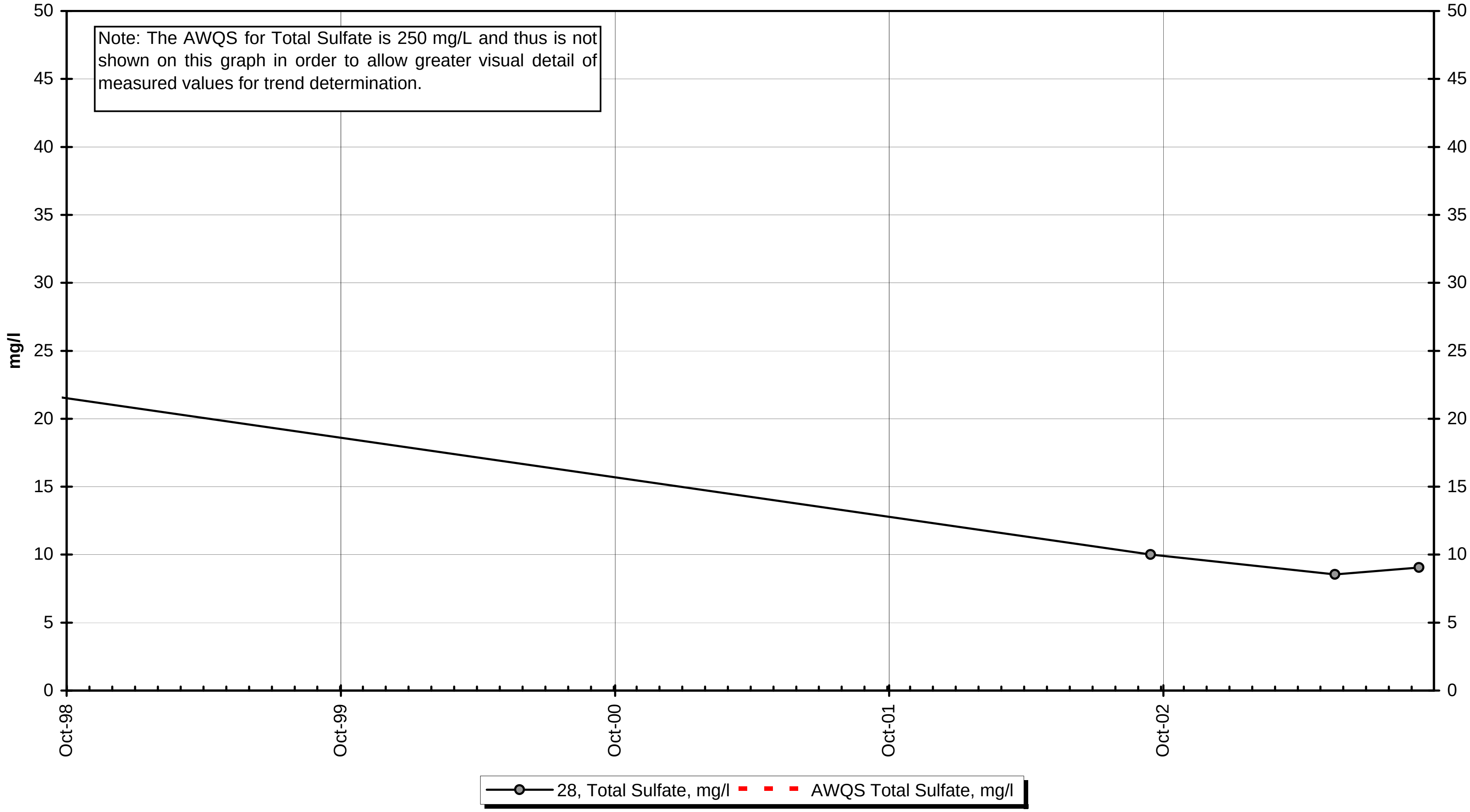
Site 28 -Lab pH

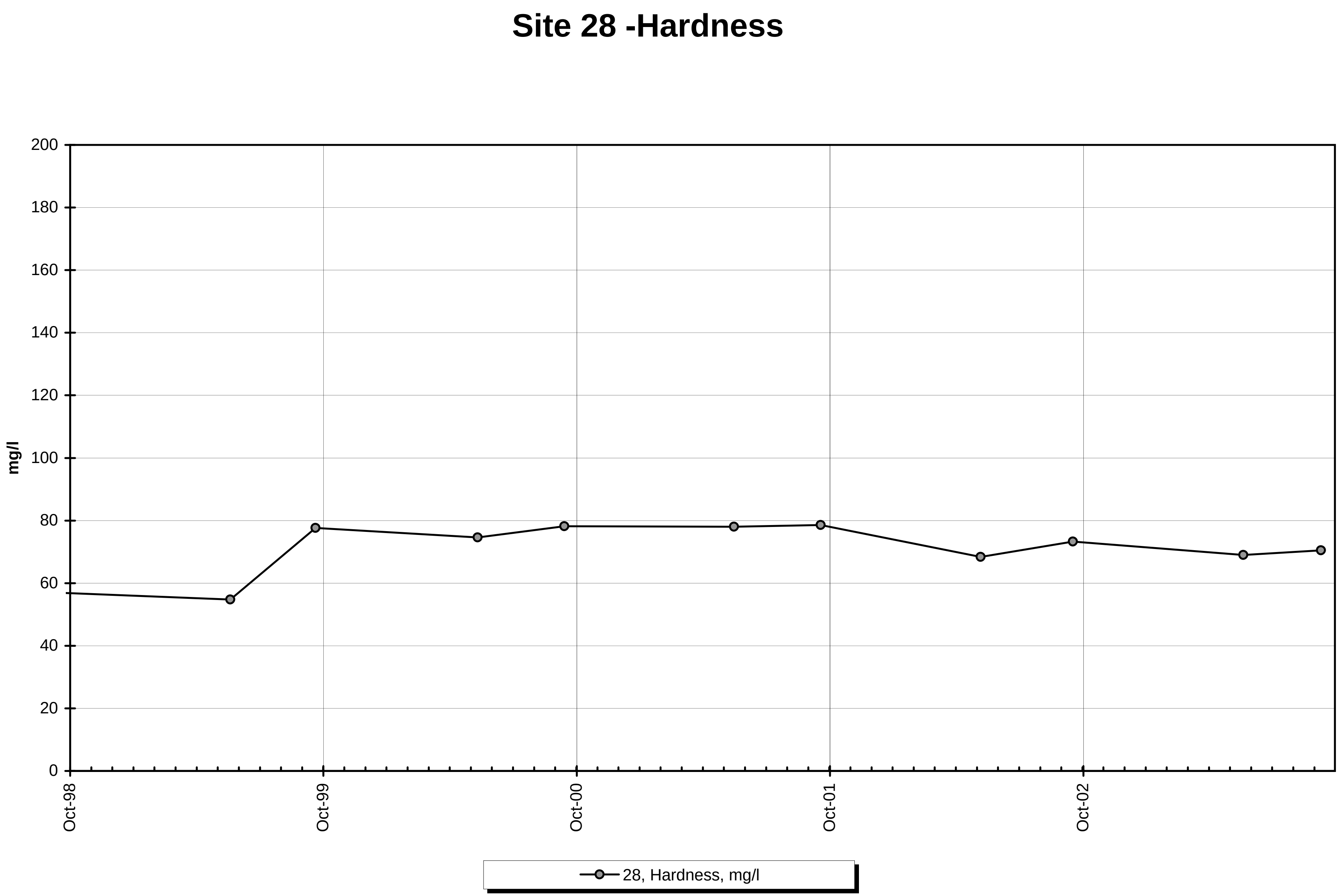


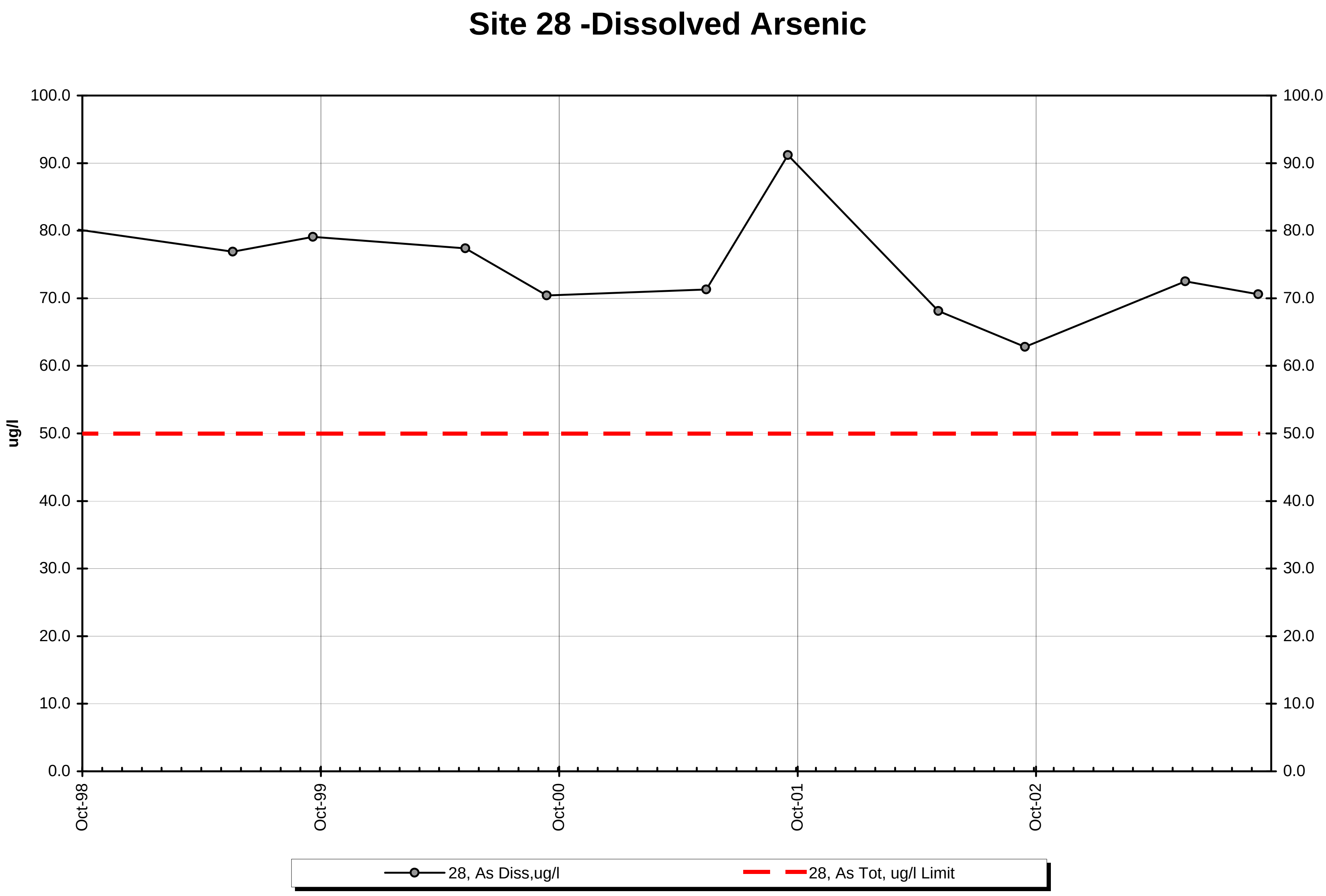
Site 28 -Total Alkalinity



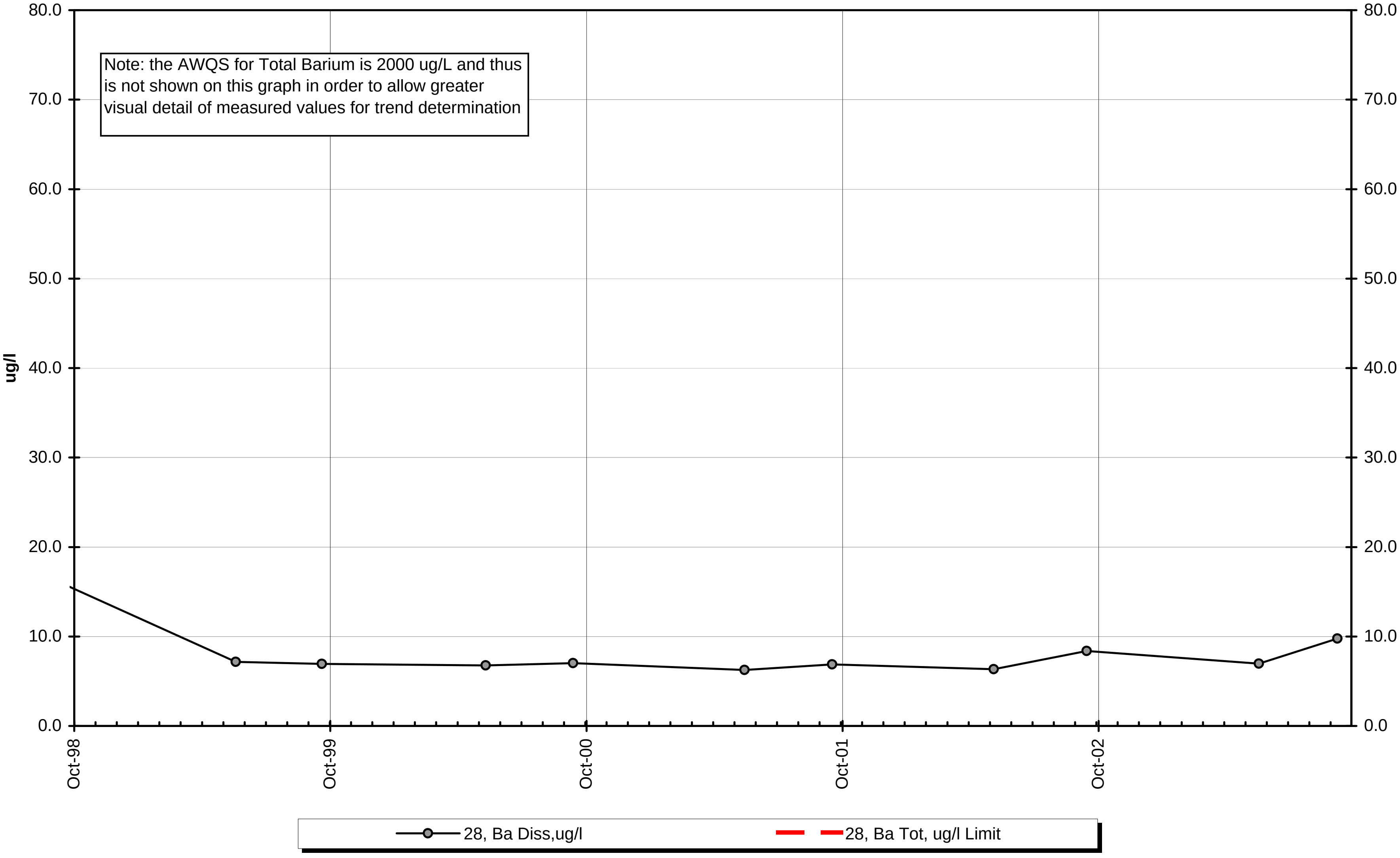
Site 28 -Total Sulfate



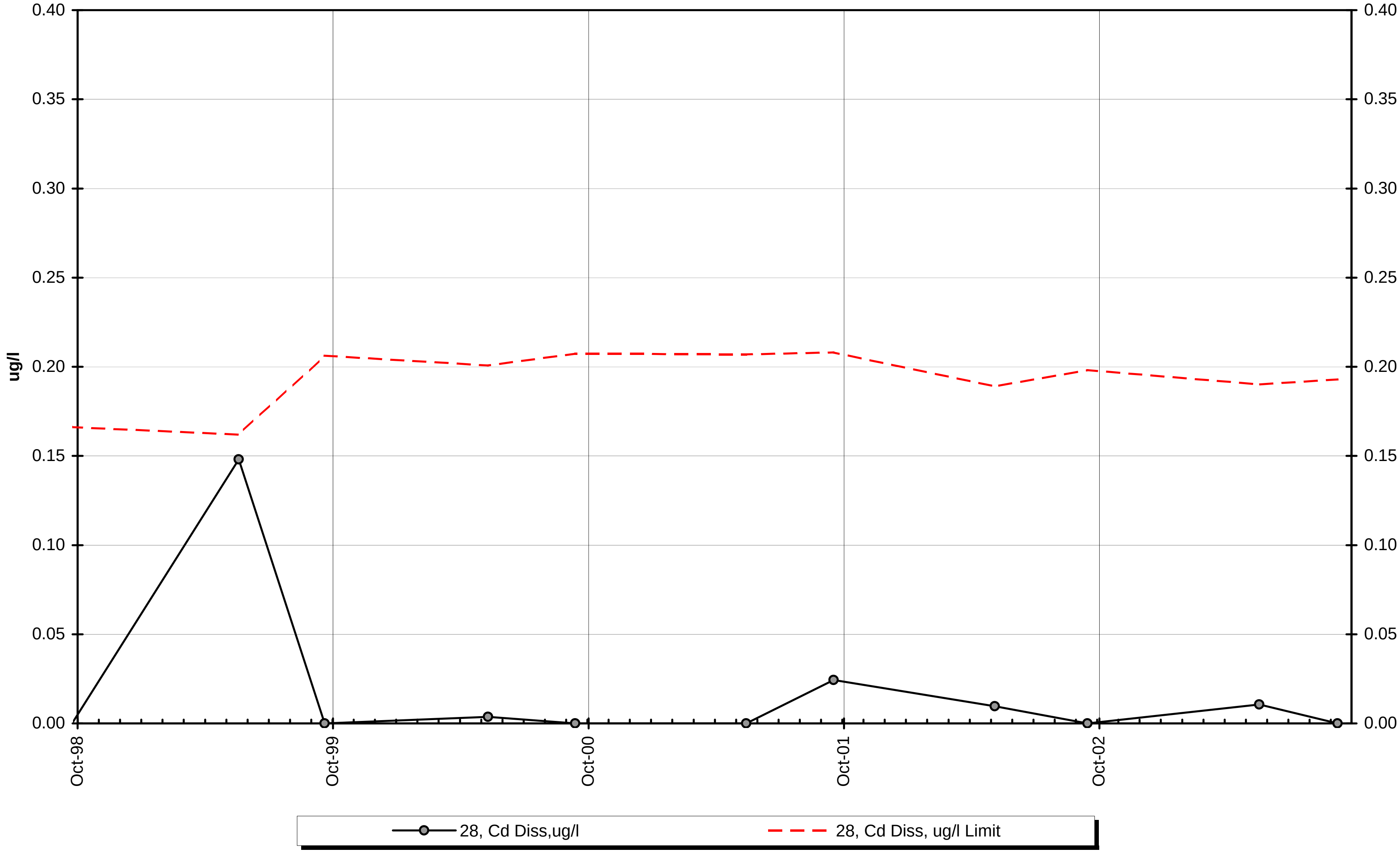

Site 28 -Hardness
mg/l
200
180
160
140
120
100
80
60
40
20
0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
28, Hardness, mg/l

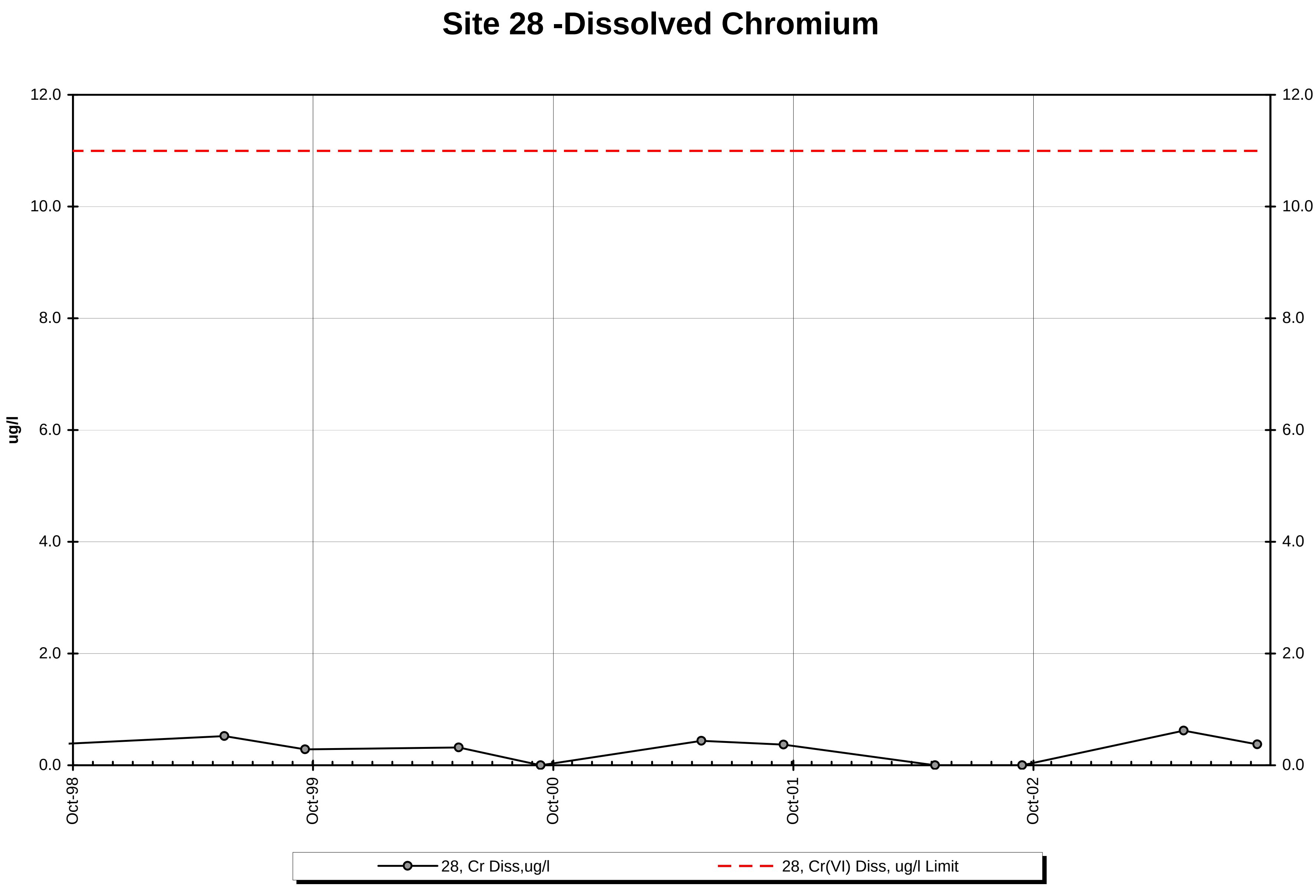

Site 28 -Dissolved Arsenic
ug/l
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
28, As Diss,ug/l
28, As Tot, ug/l Limit

Site 28 -Dissolved Barium

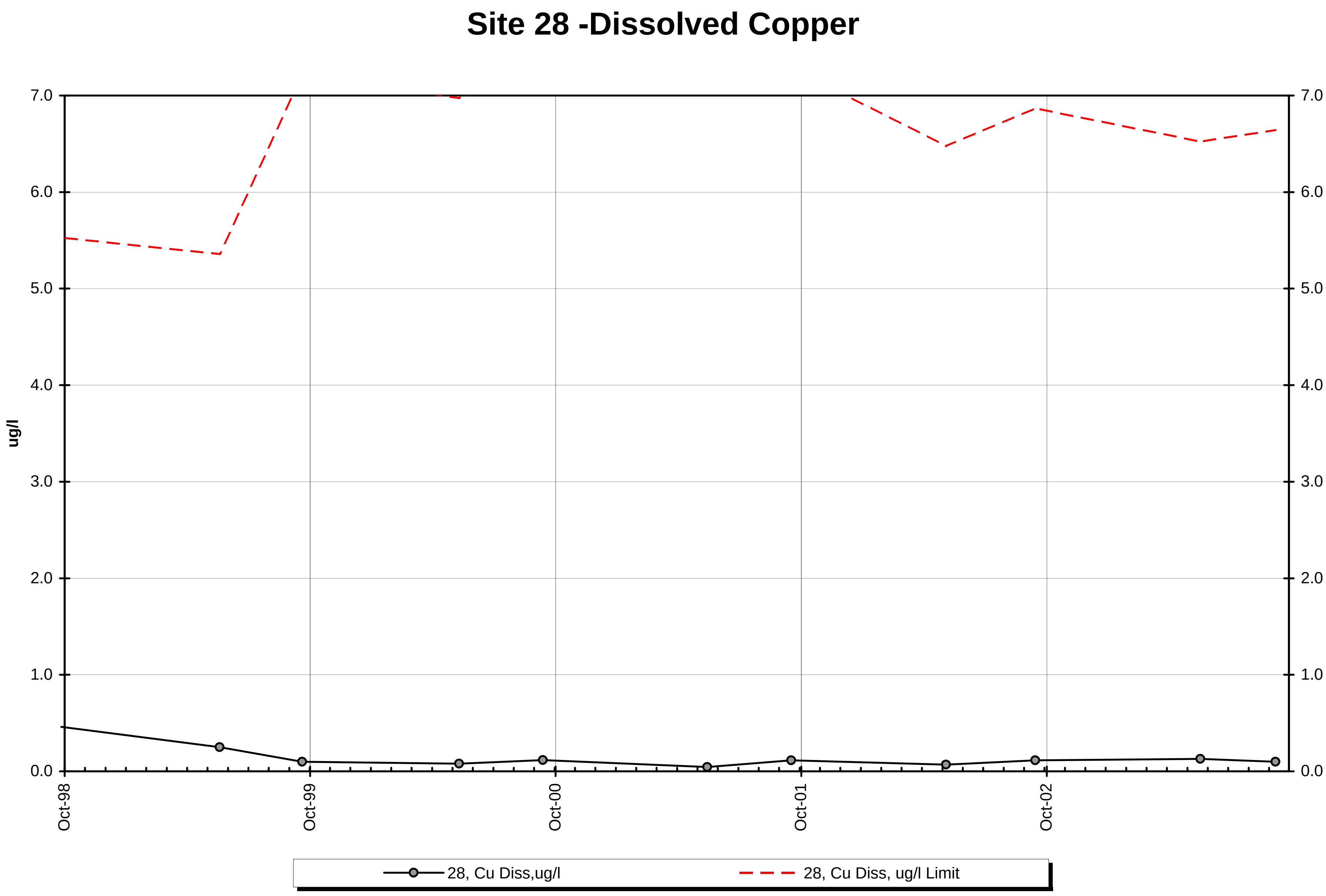


Site 28 -Dissolved Cadmium



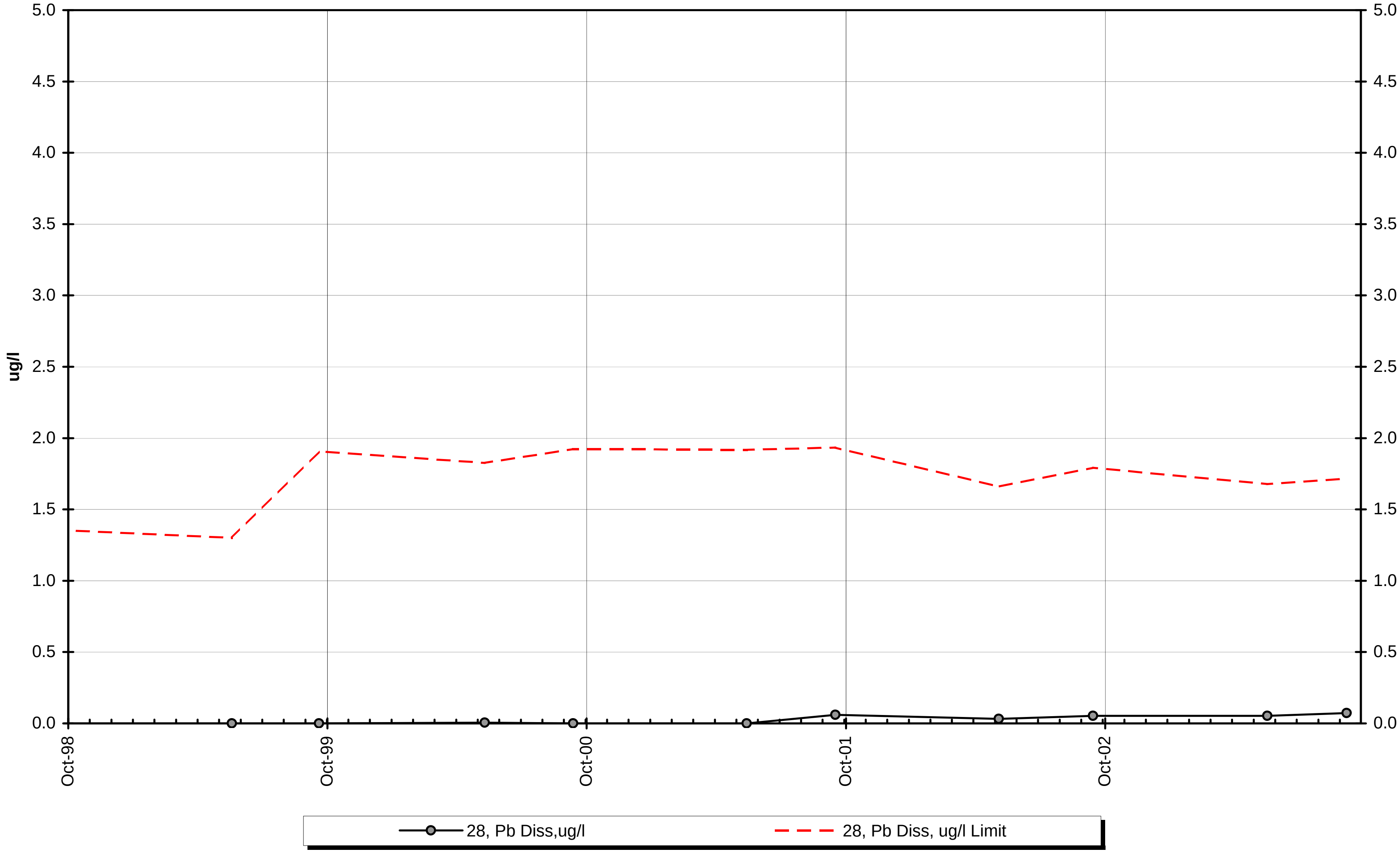


Site 28 -Dissolved Chromium
ug/l
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
28, Cr Diss,ug/l
28, Cr(VI) Diss, ug/l Limit

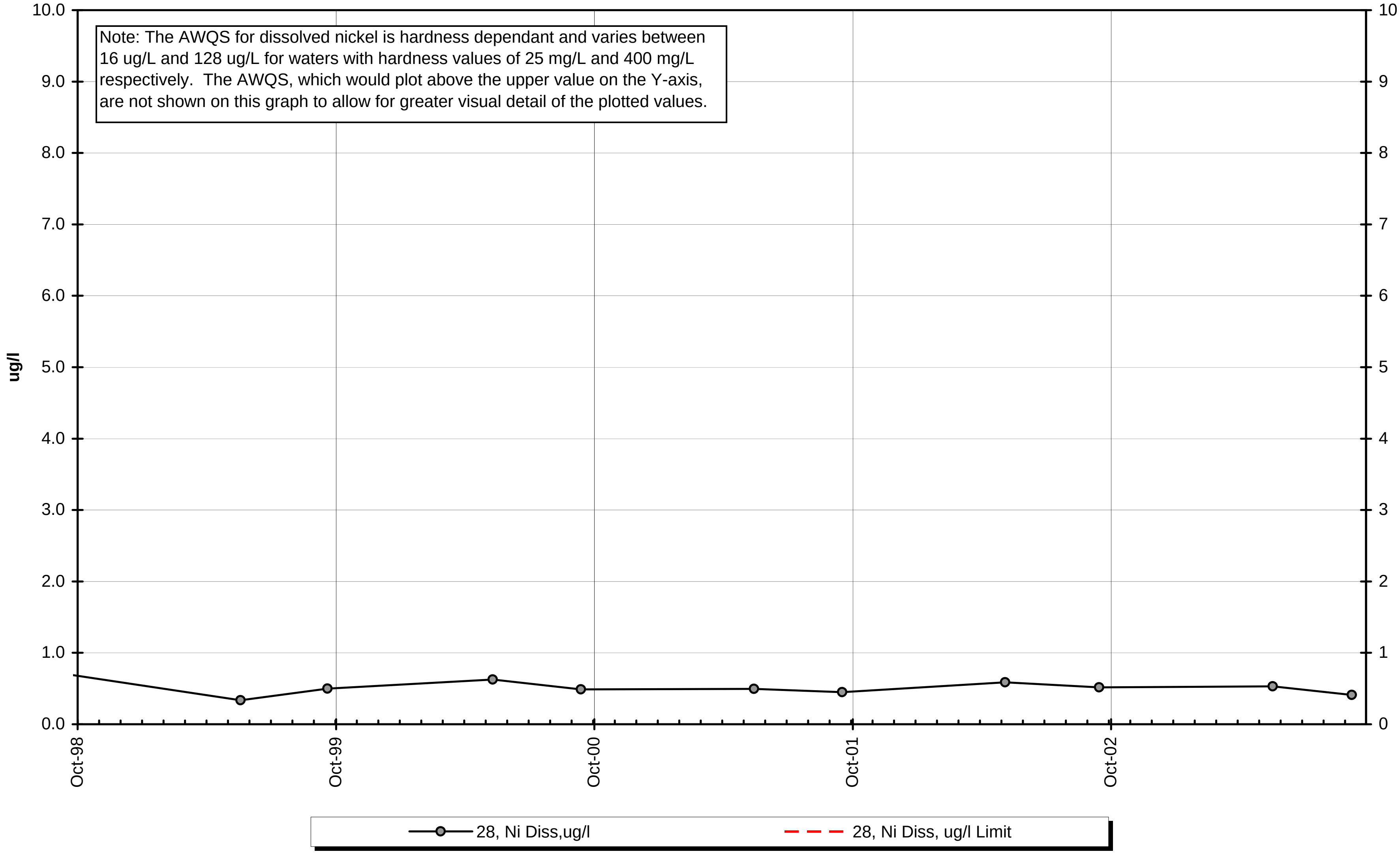


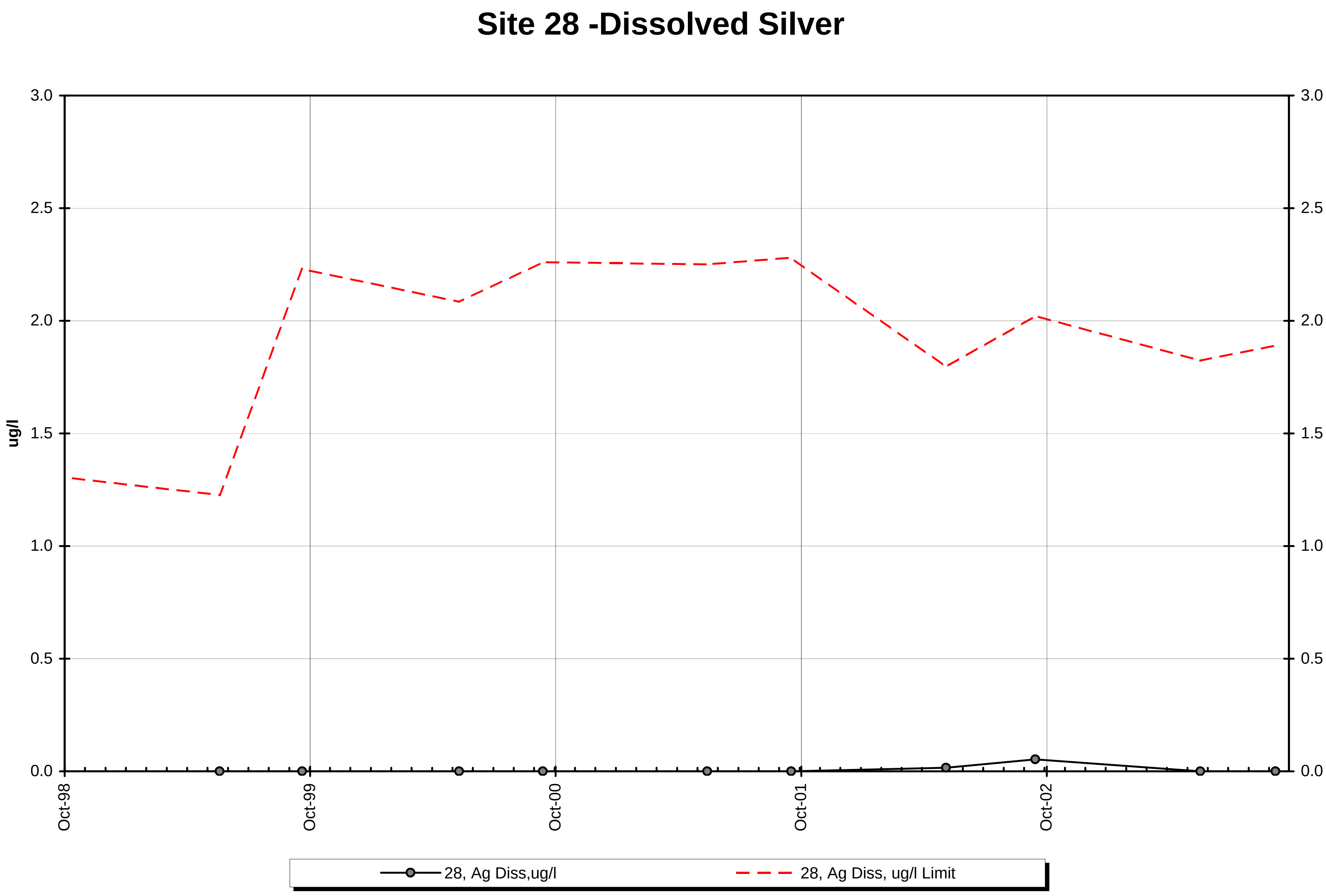
Site 28 -Dissolved Copper
ug/l
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
28, Cu Diss,ug/l
28, Cu Diss, ug/l Limit

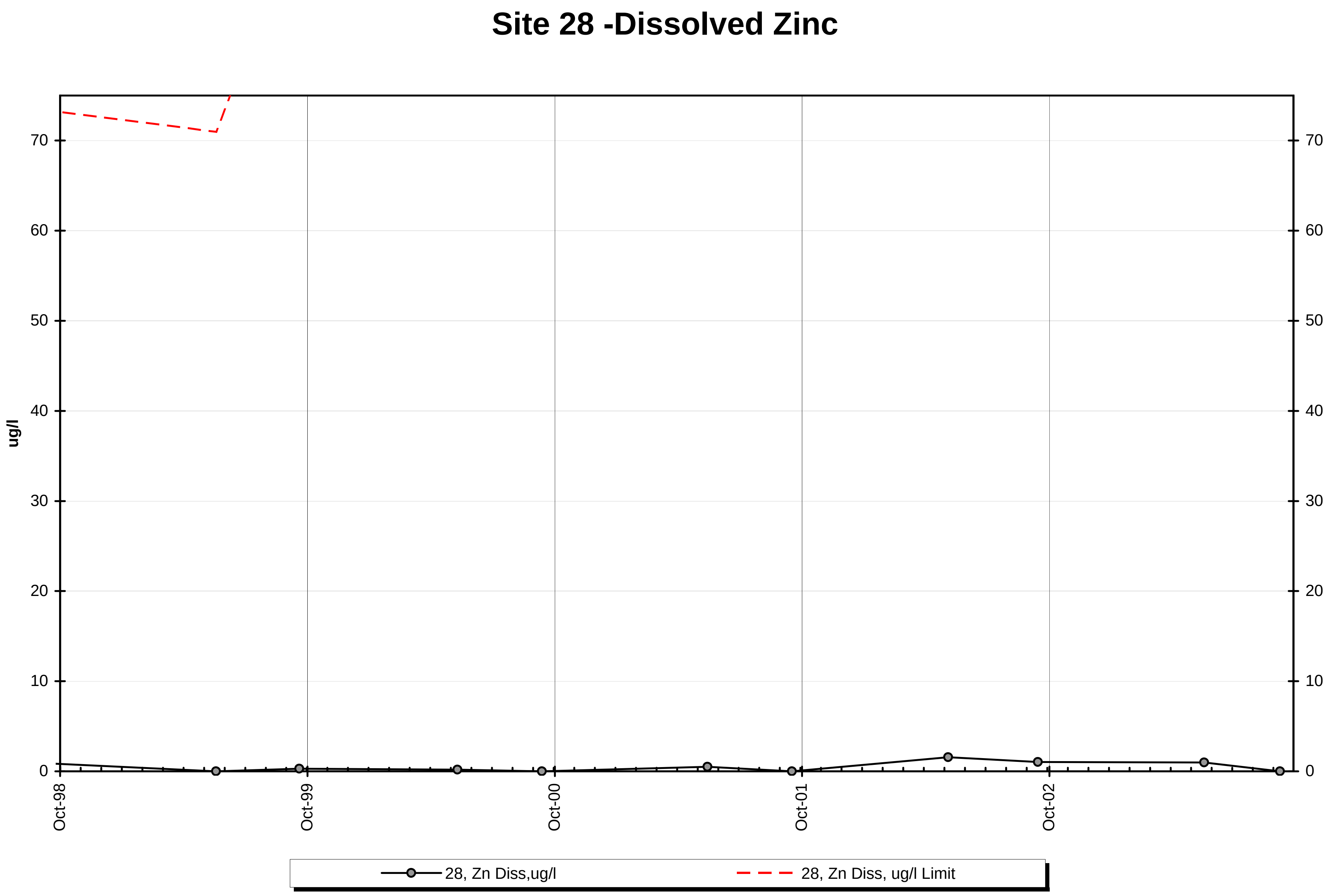
Site 28 -Dissolved Lead



Site 28 -Dissolved Nickel

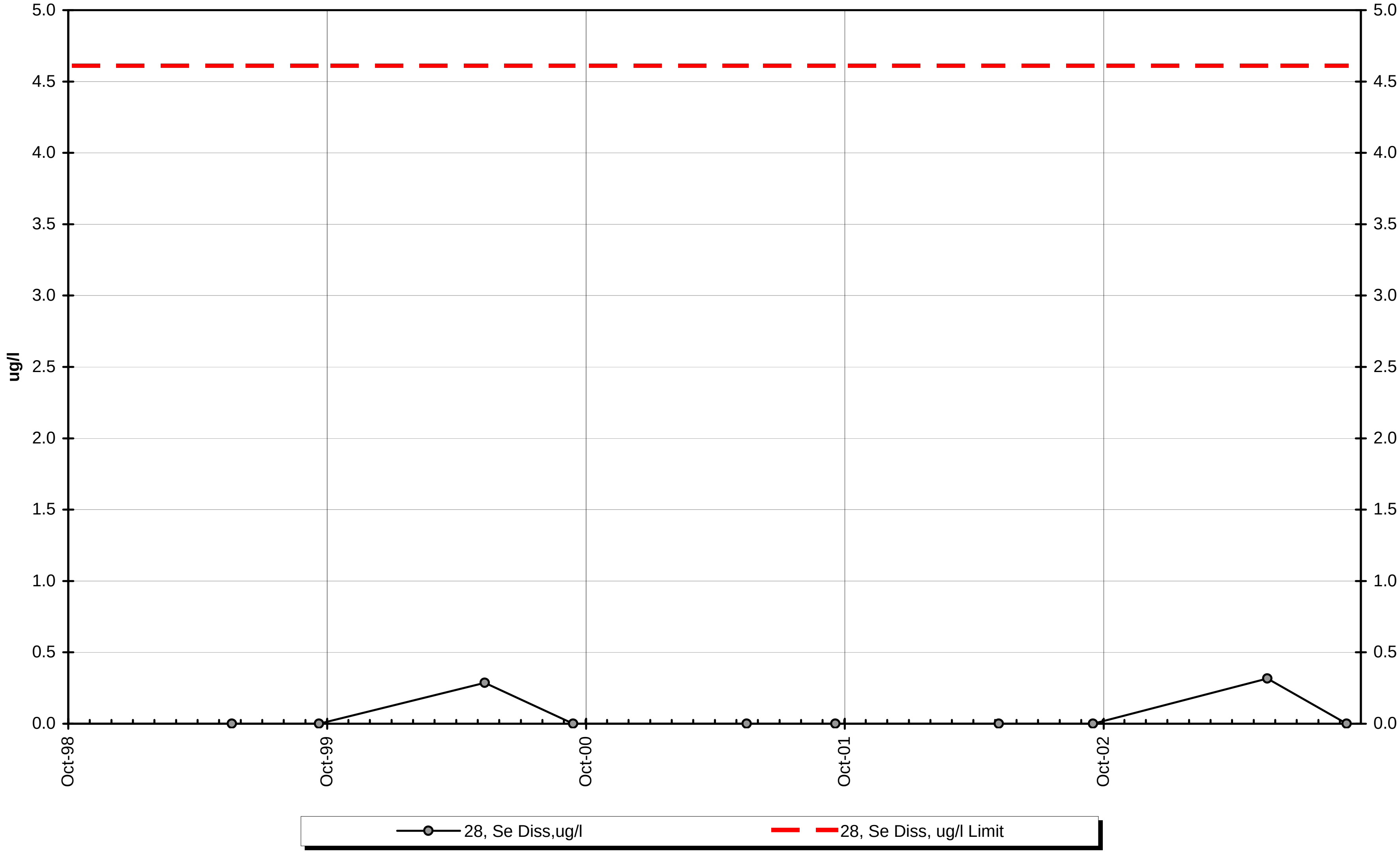



Site 28 -Dissolved Silver
ug/l
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
28, Ag Diss,ug/l
28, Ag Diss, ug/l Limit

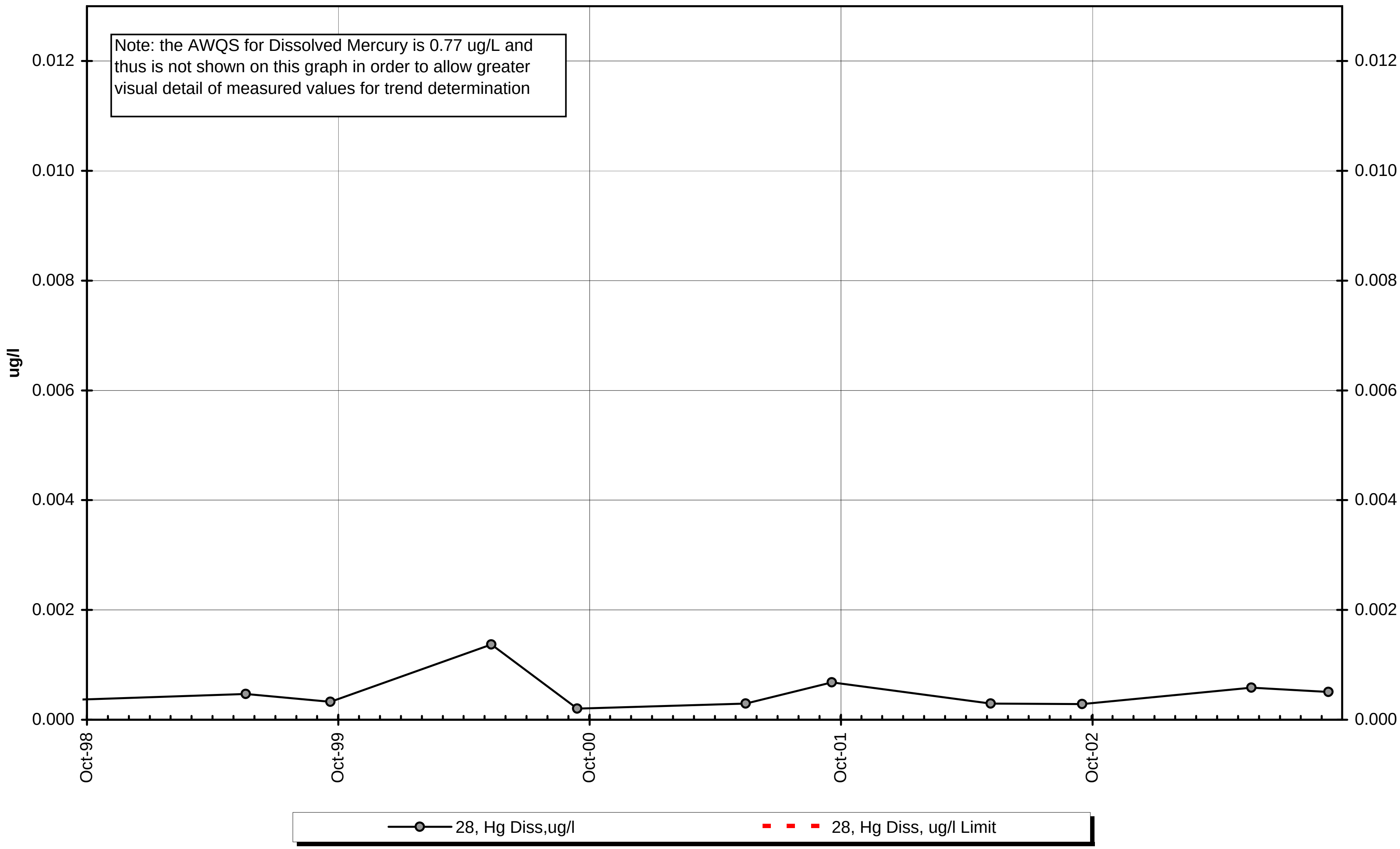


Site 28 -Dissolved Zinc
ug/l
0
10
20
30
40
50
60
70
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
28, Zn Diss,ug/l
28, Zn Diss, ug/l Limit

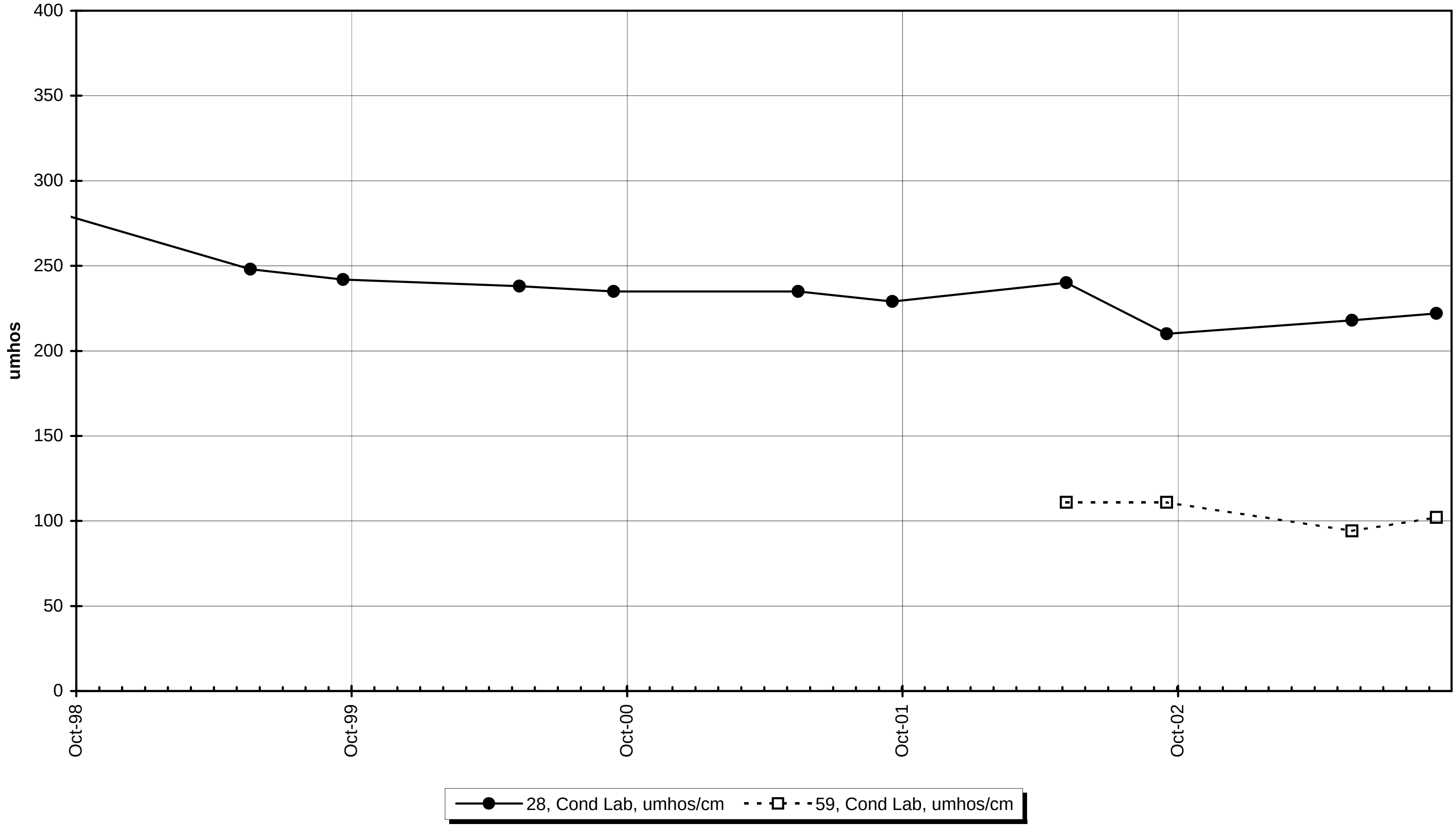
Site 28 -Dissolved Selenium

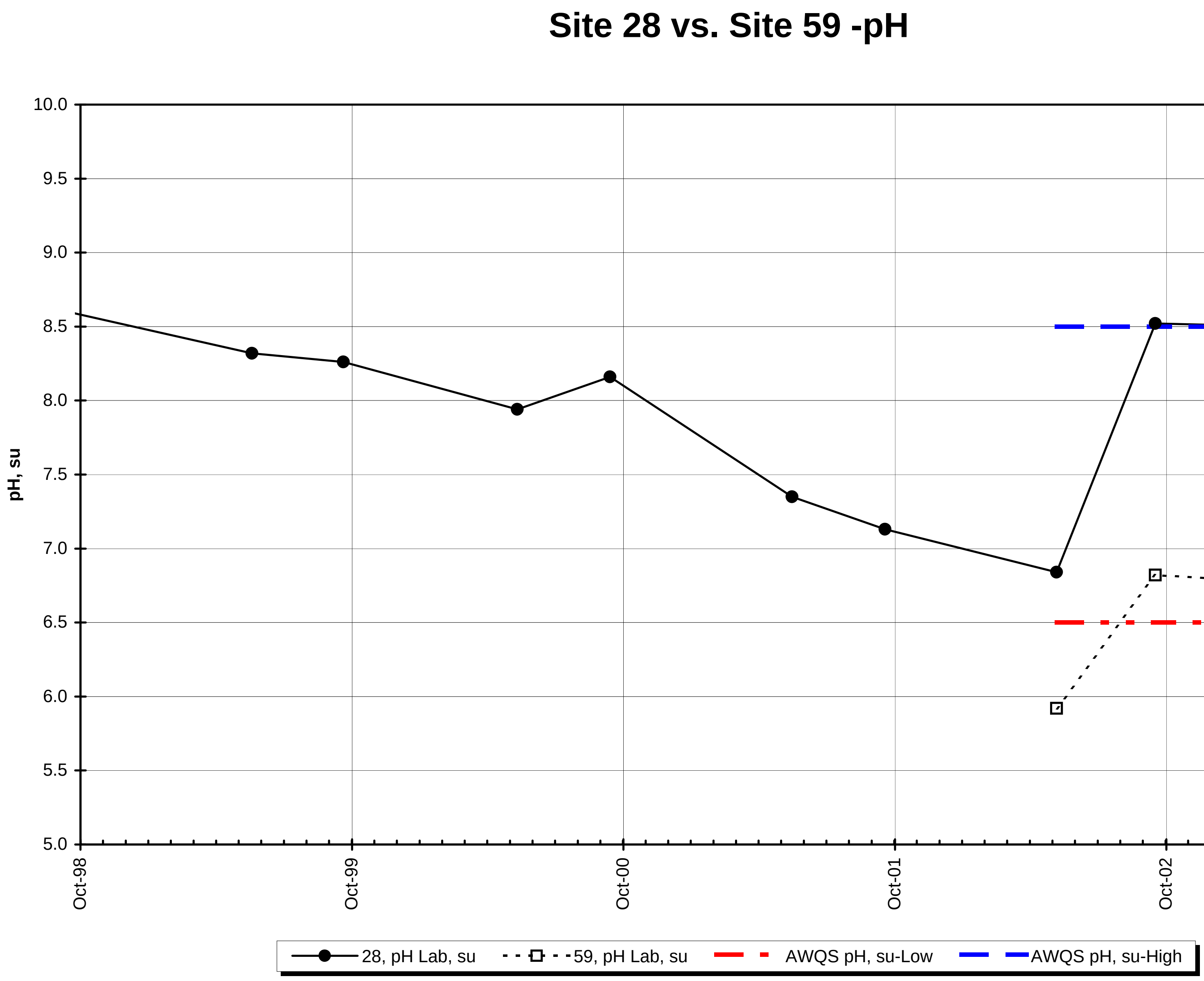


Site 28 -Dissolved Mercury



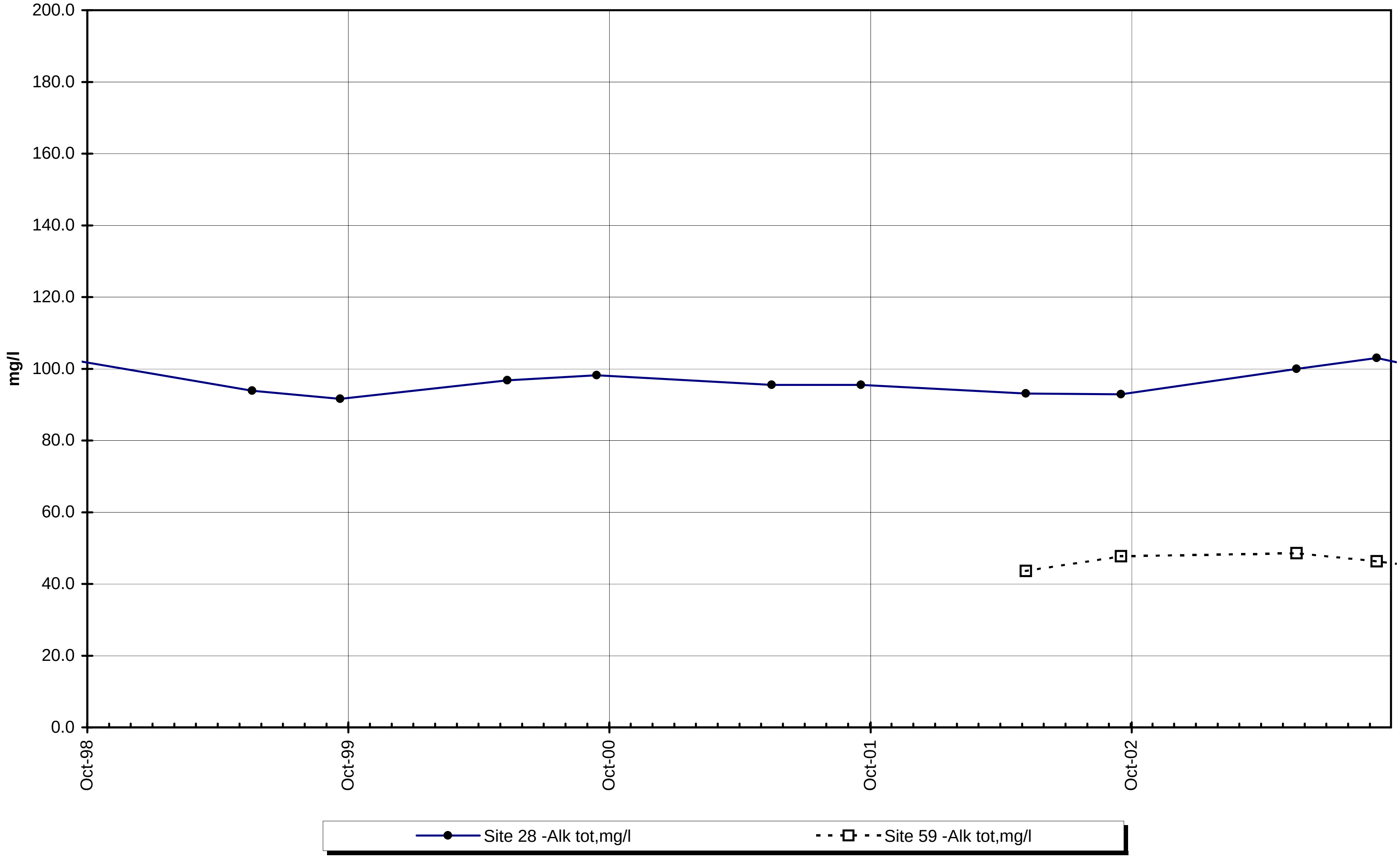
Site 28 vs Site 59 -Conductivity

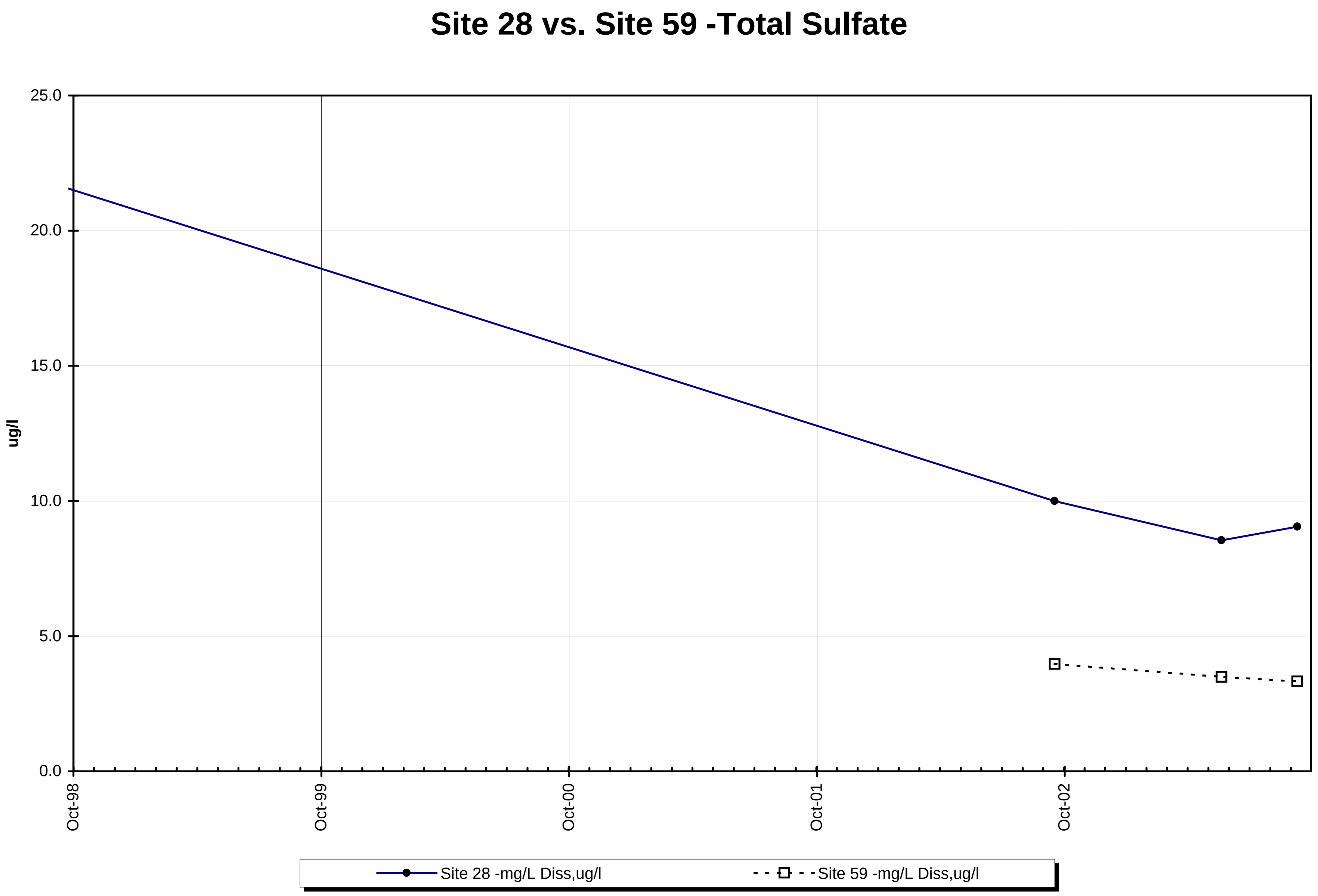




Site 28 vs. Site 59 -pH
pH, su
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
28, pH Lab, su
59, pH Lab, su
AWQS pH, su-Low
AWQS pH, su-High

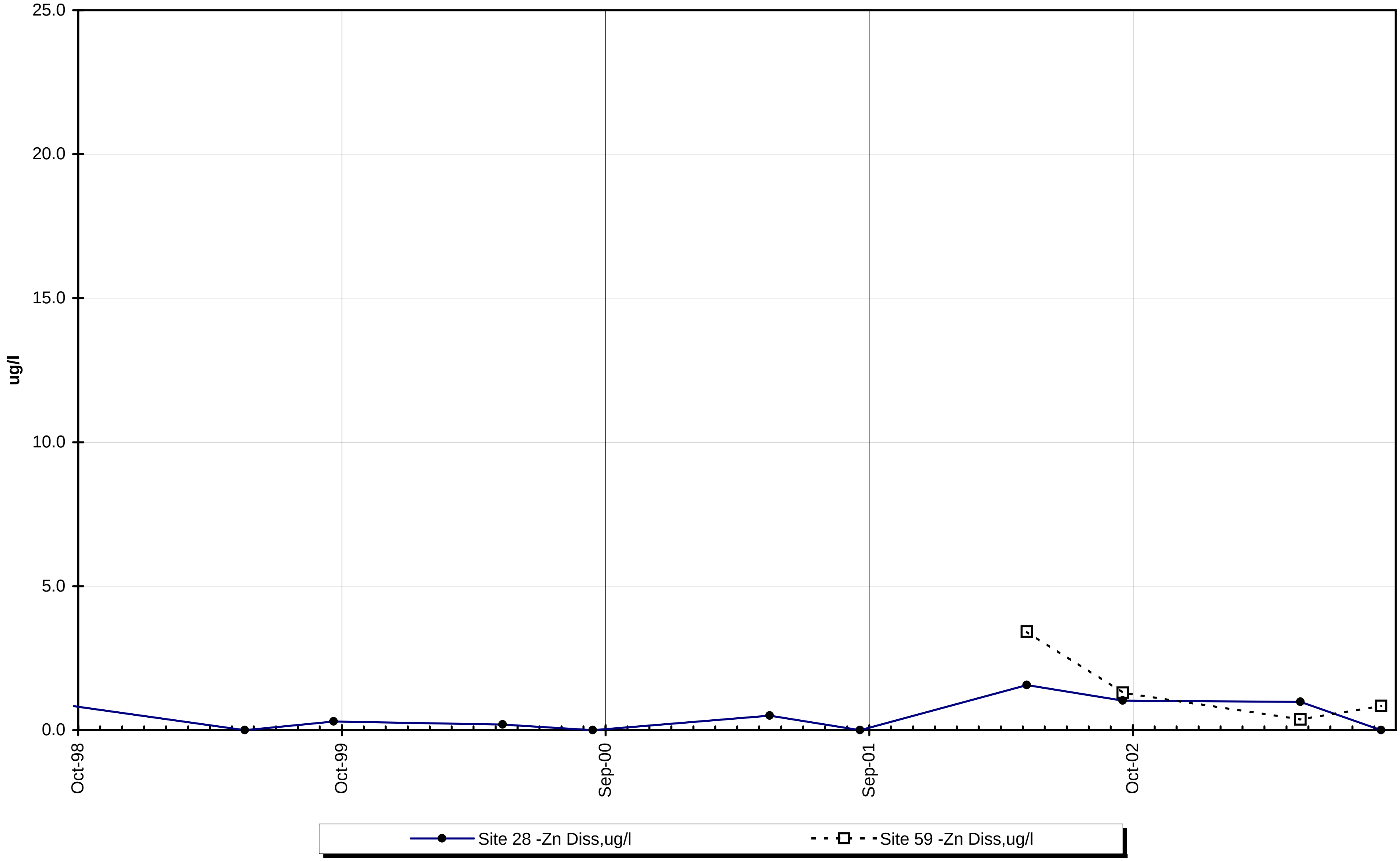
Site 28 vs. Site 59 -Total Alkalinity





Site 28 vs. Site 59 -Total Sulfate
ug/l
25.0
20.0
15.0
10.0
5.0
0.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
Site 28 -mg/L Diss,ug/l
Site 59 -mg/L Diss,ug/l

Site 28 vs. Site 59 -Dissolved Zinc



INTERPRETIVE REPORT
SITE 34 “SEEPAGE CONTROL”

The data collected during the current water year are listed in the following “Table of Results for Water Year 2003” report. The table includes all the data, field and lab, 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 zero for the purpose of median calculation.

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

Sample Date	Parameter	Value	Qualifier	Notes
No outliers have been identified by KGCMC for the period of Oct-98 though Sept-03.				

The data for water year 2003 have been compared to the strictest fresh water quality criterion for each applicable analyte. No results exceeding these criteria have been identified.

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. Except for dissolved nickel no obvious trends were apparent. Dissolved nickel appears to be on a slight increasing trend but is within the normal range of historical variation for this site and is well below the AWQS for dissolved nickel given this site’s hardness. It is expected with the removal of the road/dam structure in June 2002 and the anticipated return to natural muskeg conditions in subsequent years that nickel values will remain within the natural range for water of that type.

As noted in the Mid-Year Modification’s discussion at the front of this report, KGCMC has received approval (subsequent to the period covered by this report) to discontinue sampling at the Seepage Control Pond that was effectively eliminated by the removal of the road/dam structure in June 2002. Future water quality data collected at this site will be reported on in the KGCMC’s Annual Tailings and Production Rock reports.

Table of Results for Water Year 2003

Site 34 "Seepage Control"													
Sample Date/Parameter	Oct-02	Nov-02	Dec-02	Jan-03	Feb-03	Mar-03	Apr-03	5/21/2003	Jun-03	Jul-03	Aug-03	9/10/2003	**Median**
Water Temp (°C)	NOT SCHEDULED FOR SAMPLING							14.5	NOT SCHEDULED FOR SAMPLING			11.0	12.8
Conductivity-Field(μmho)								665				1,102	884
Conductivity-Lab (μmho)								579				431	505
pH Lab (standard units)								7.46				6.67	7.07
pH Field (standard units)								7.48				6.77	7.13
Total Alkalinity (mg/L)								157.0				36.9	97.0
Total Sulfate (mg/L)								198.0				210.0 J	204.0
Hardness (mg/L)								327.0				238.0	282.5
Dissolved As (ug/L)								1.290				0.925	1.108
Dissolved Ba (ug/L)								57.3				55.2	56.3
Dissolved Cd (ug/L)								0.026				0.111	0.069
Dissolved Cr (ug/L)								0.450				1.080	0.765
Dissolved Cu (ug/L)								1.030				1.130	1.080
Dissolved Pb (ug/L)								0.1270				0.1550 J	0.1410
Dissolved Ni (ug/L)								8.650				16.500	12.575
Dissolved Ag (ug/L)								<0.028				<0.004	0.008
Dissolved Zn (ug/L)								6.47				38.30	22.39
Dissolved Se (ug/L)								0.877 J				<0.496	0.563
Dissolved Hg (ug/L)								0.001480				0.000737 J	0.001109

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

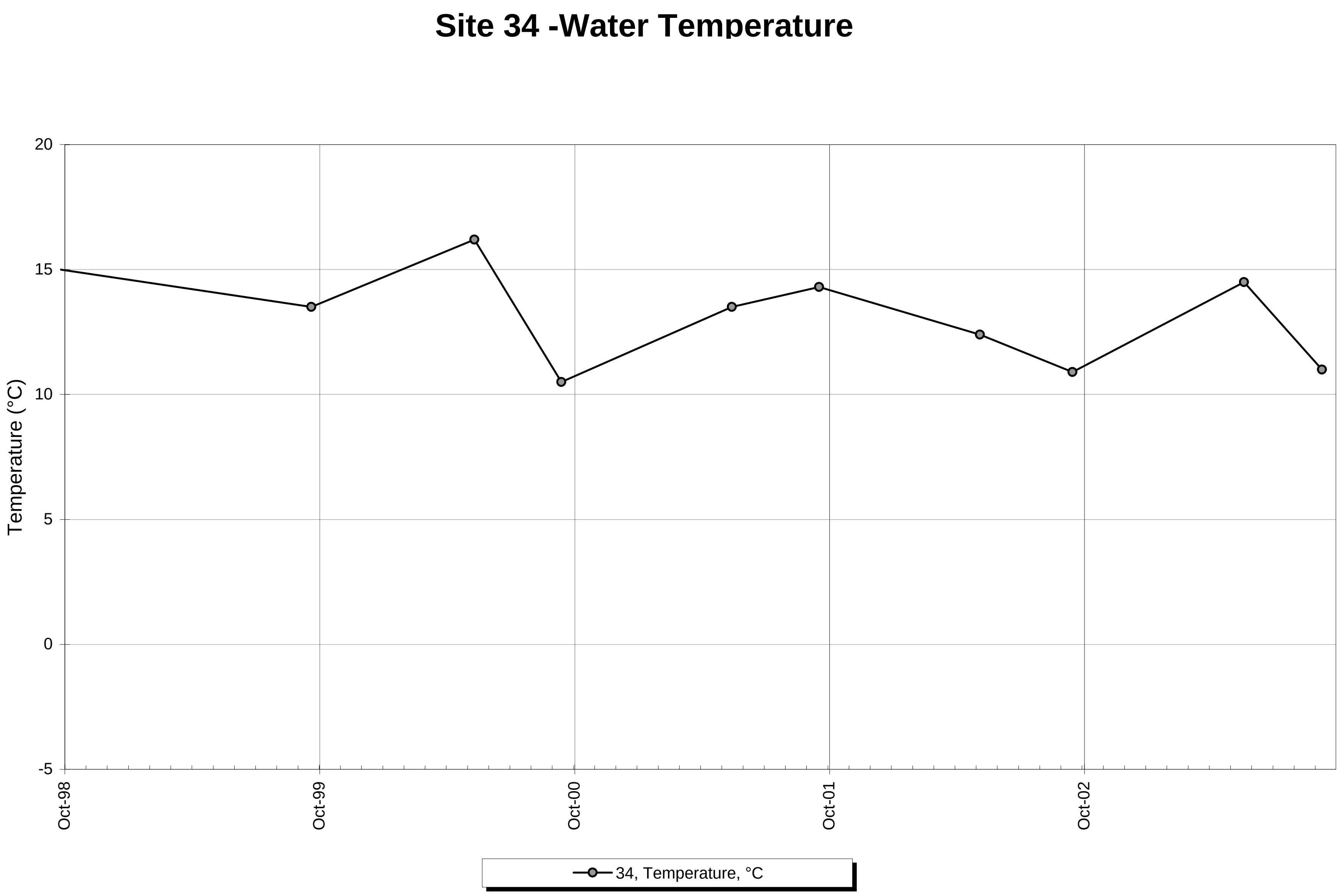
Values reported as less than MDL are replaced by 1/2 MDL for median calculation purposes.

Qualified Data by QA Reviewer

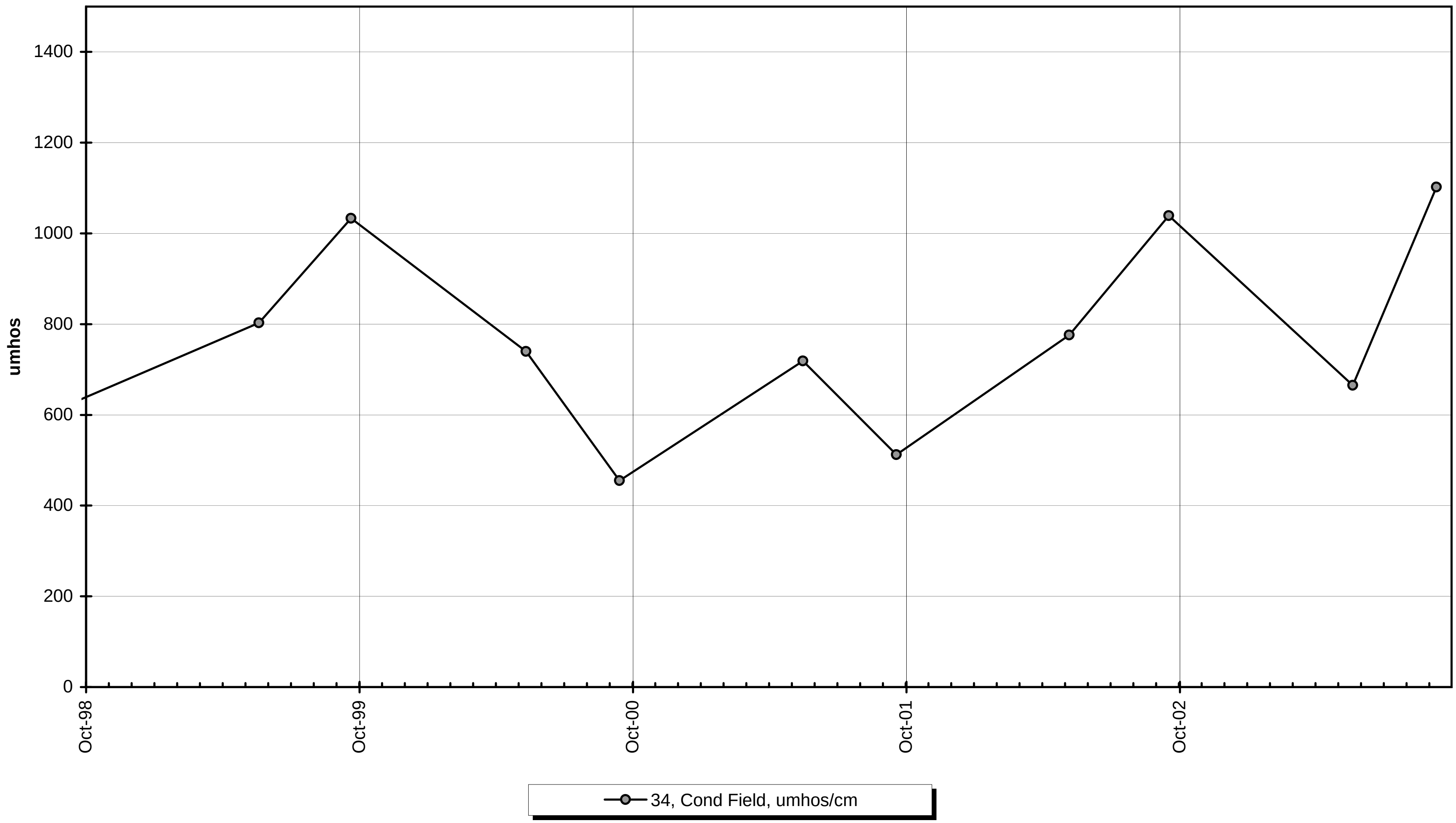
Date Range: 10/01/2002 to 09/30/2003

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
34	05/21/2003	11:57:00 AM				
			Se Diss, ug/l	0.877	J	LCS Recovery
34	09/10/2003	1:42:00 PM				
			SO4 Tot, mg/l	210	J	Sample Temperature
			Pb Diss, ug/l	0.155	J	Below Quantitative Range
			Hg Diss, ug/l	0.000737	J	Method Blank Contamination

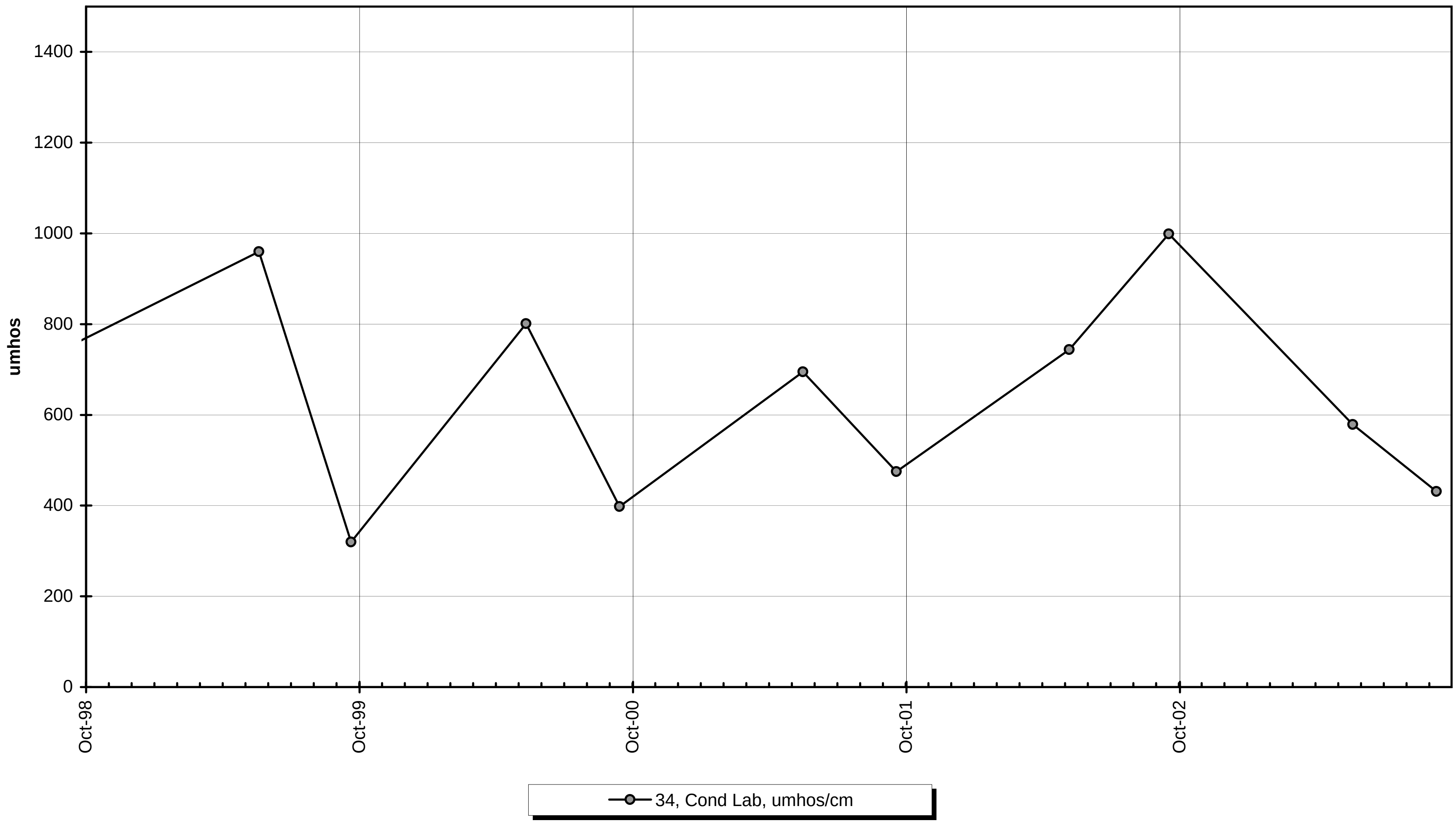
Qualifier	Description
J	Positively Identified - Approximate Concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot Be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit

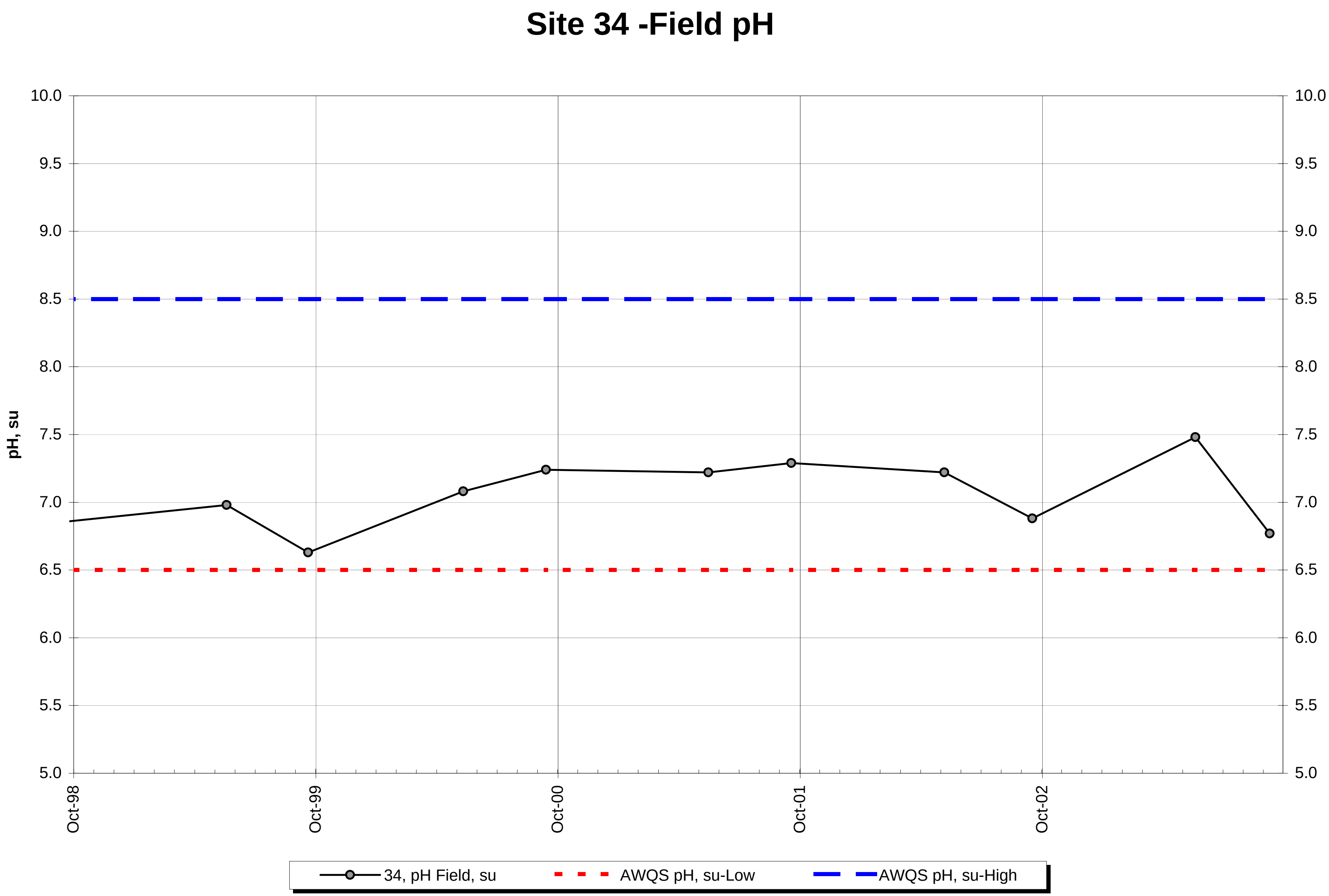

Site 34 -Water Temperature
Temperature (°C)
20
15
10
5
0
-5
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
34, Temperature, °C

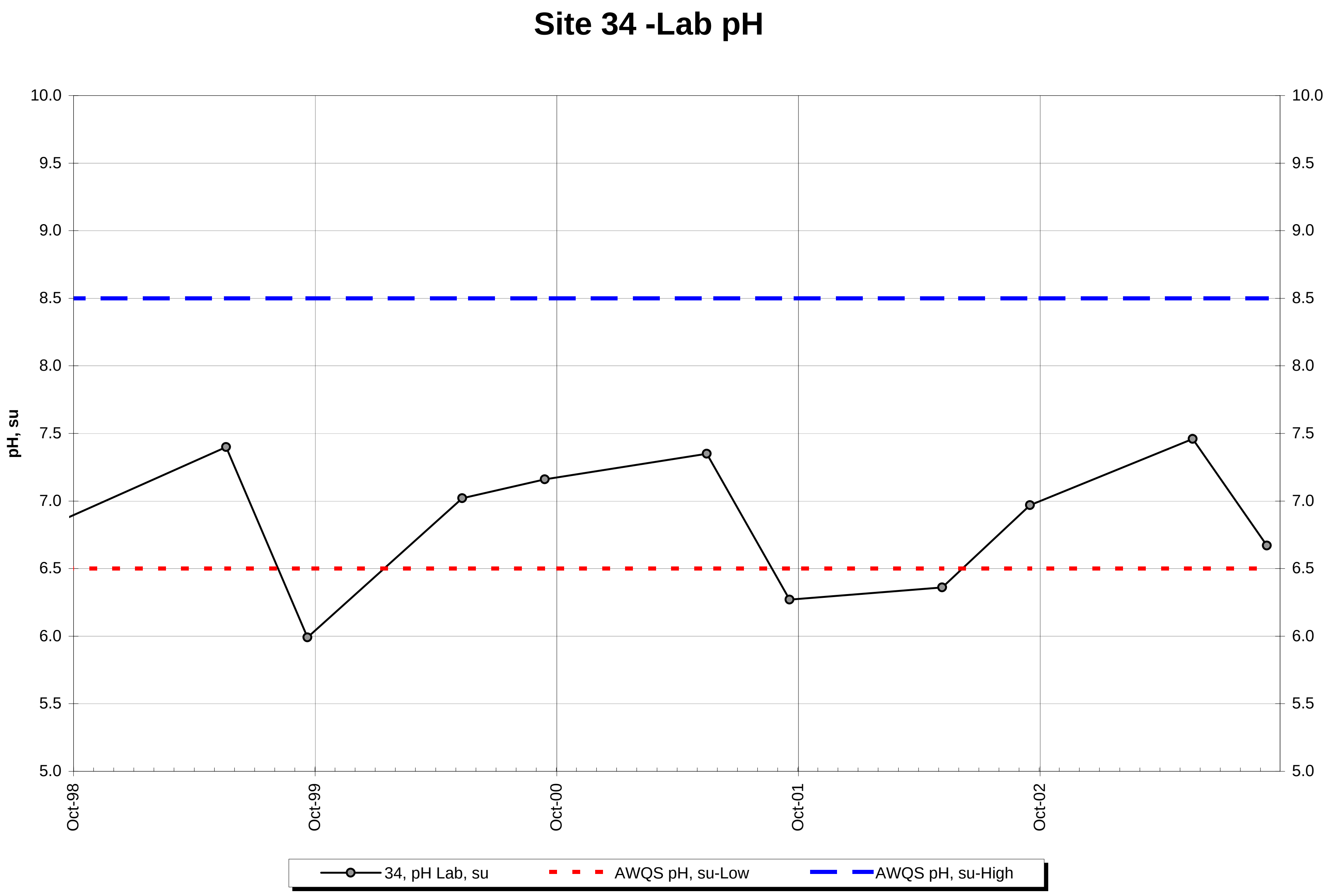
Site 34 -Conductivity-Field



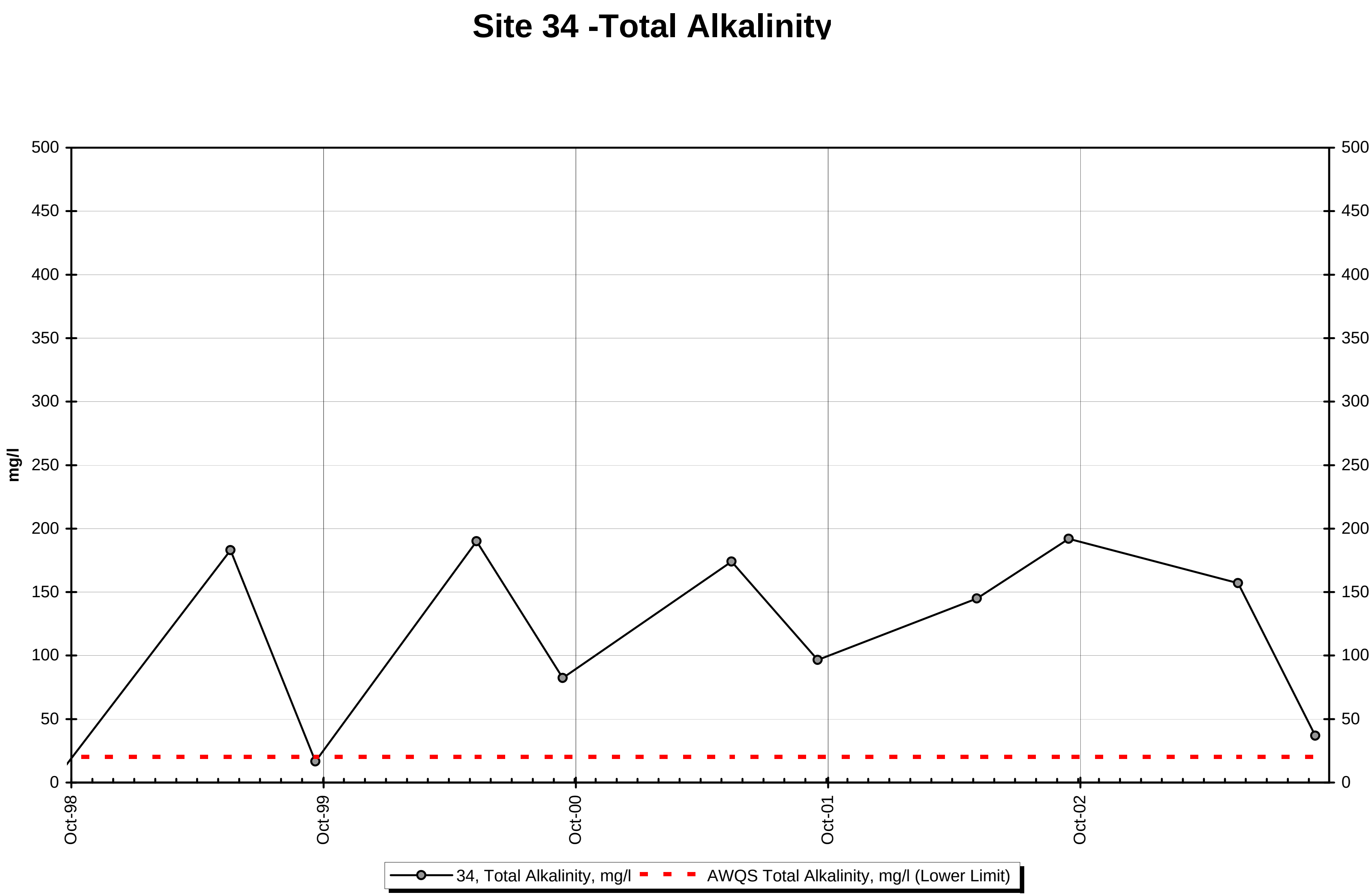
Site 34 -Conductivity-Lab



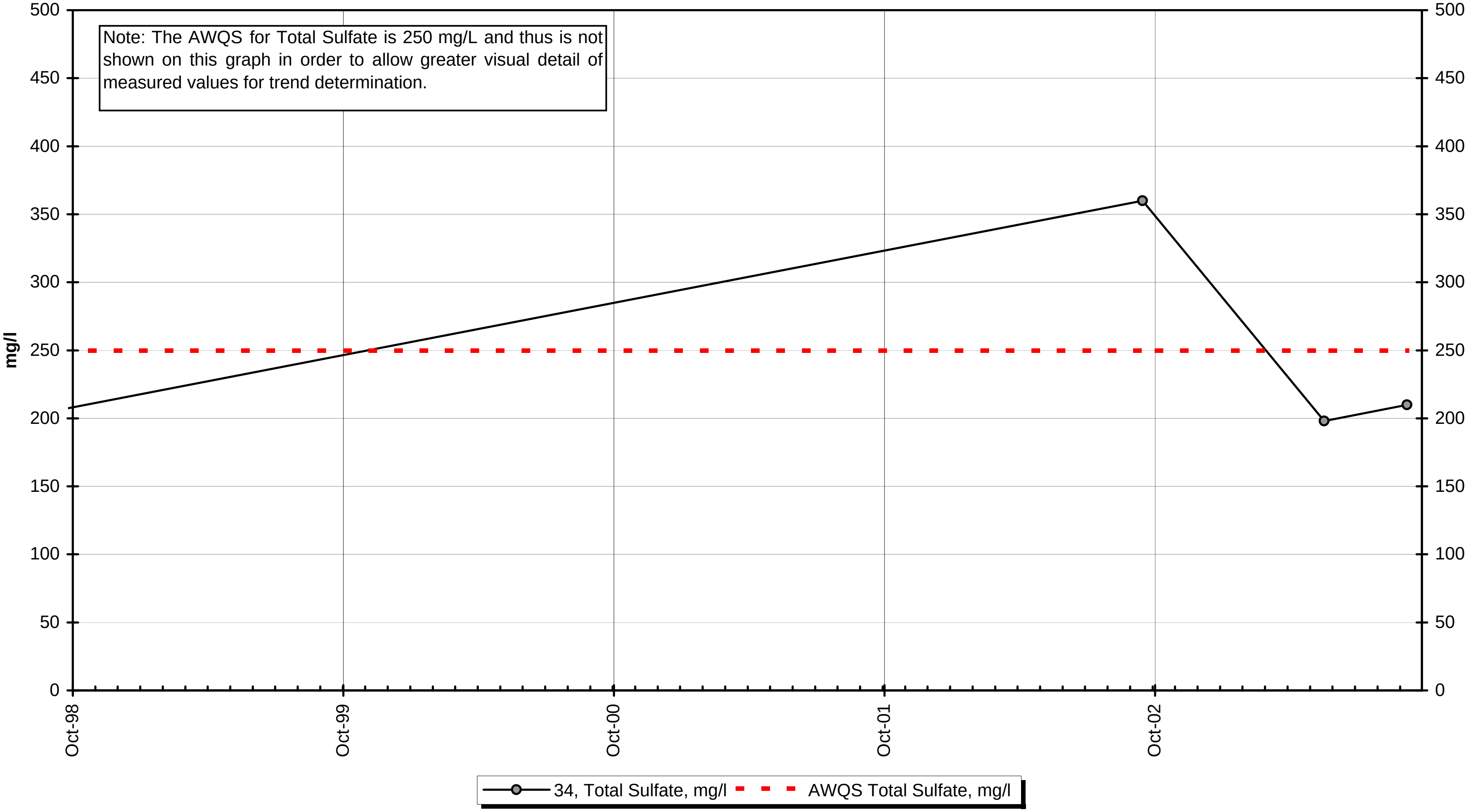

Site 34 -Field pH
pH, su
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
34, pH Field, su
AWQS pH, su-Low
AWQS pH, su-High



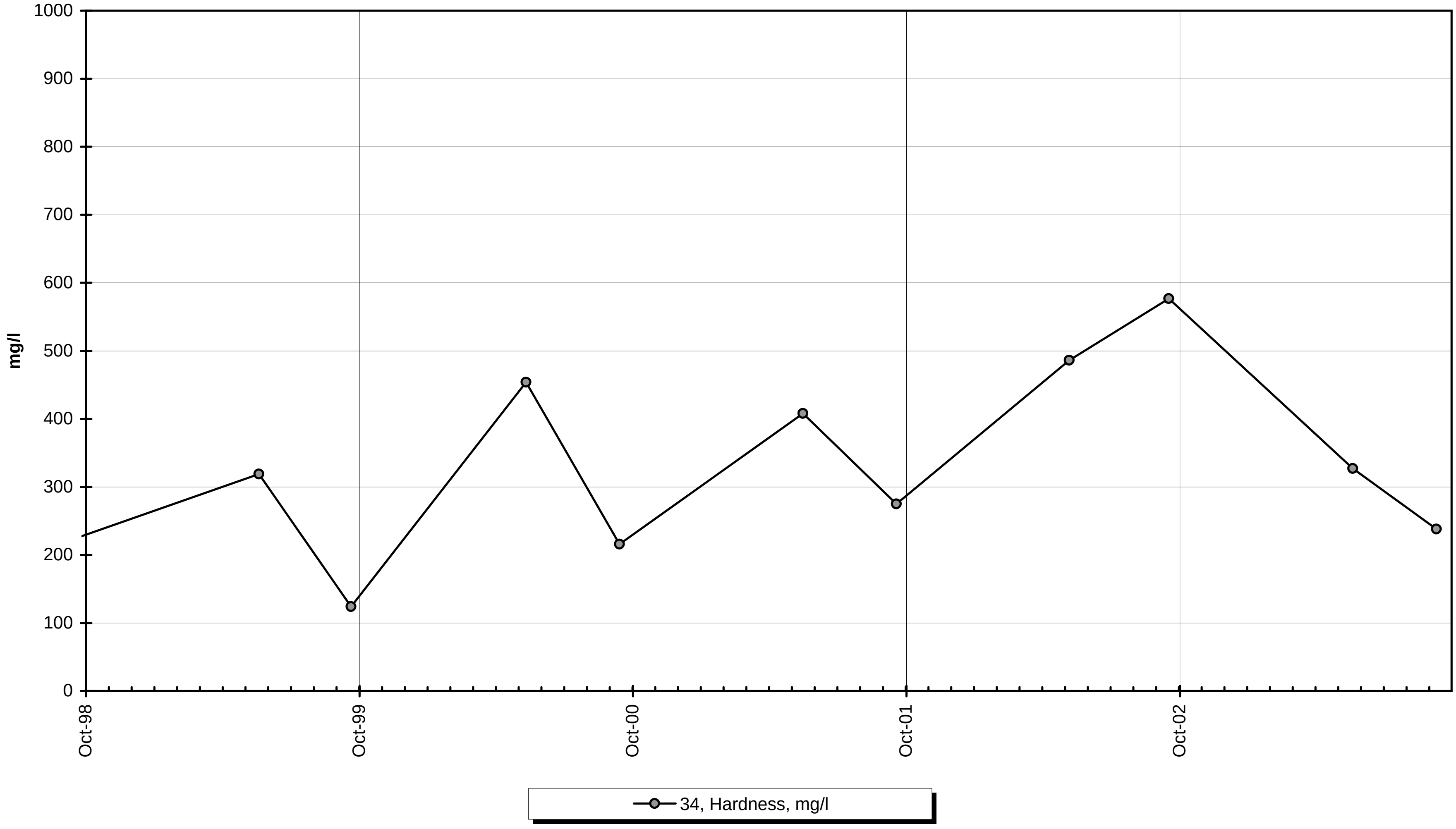
Site 34 -Lab pH
pH, su
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
34, pH Lab, su
AWQS pH, su-Low
AWQS pH, su-High


Site 34 -Total Alkalinity
mg/l
0
50
100
150
200
250
300
350
400
450
500
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
34, Total Alkalinity, mg/l
AWQS Total Alkalinity, mg/l (Lower Limit)

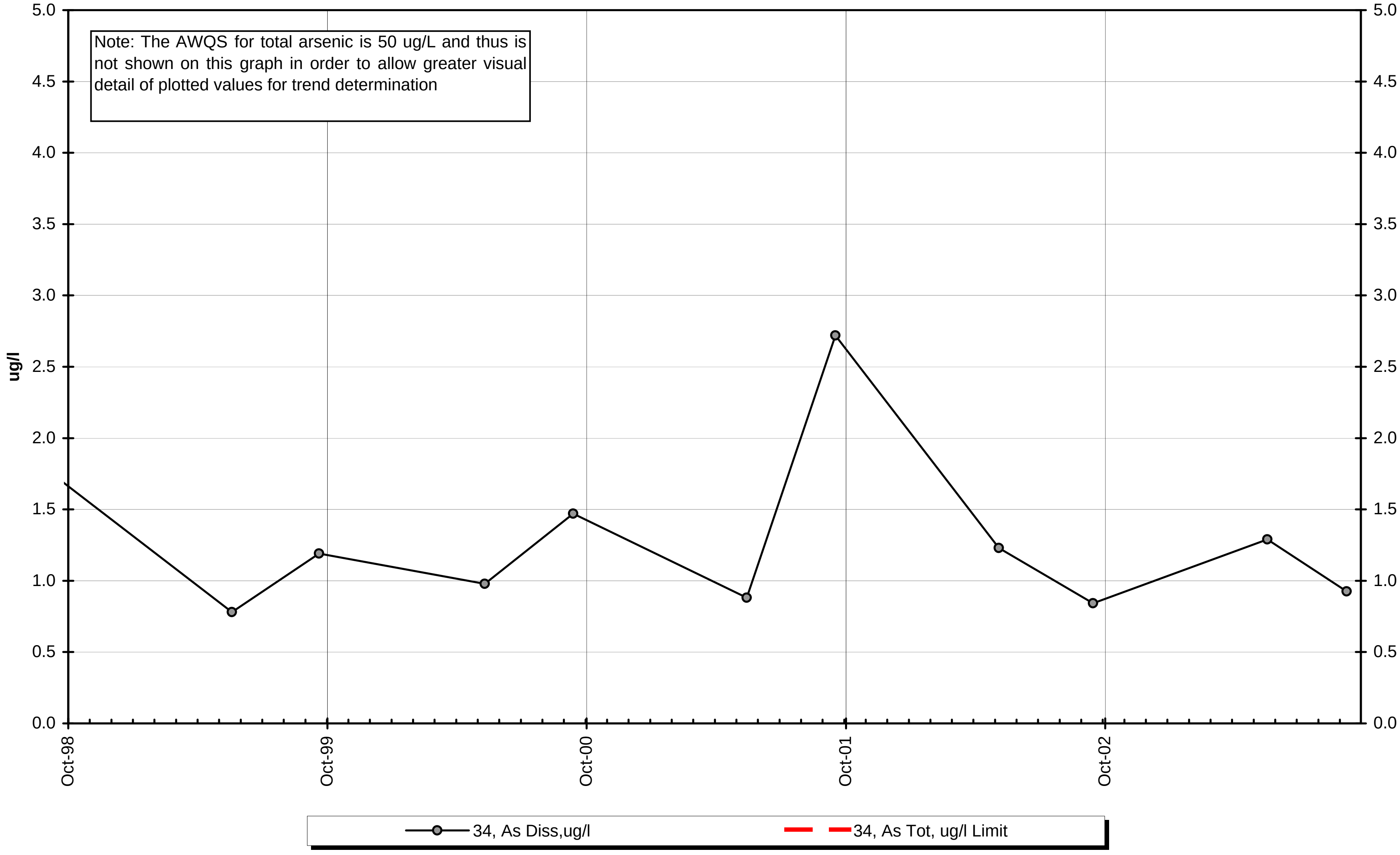
Site 34 -Total Sulfate

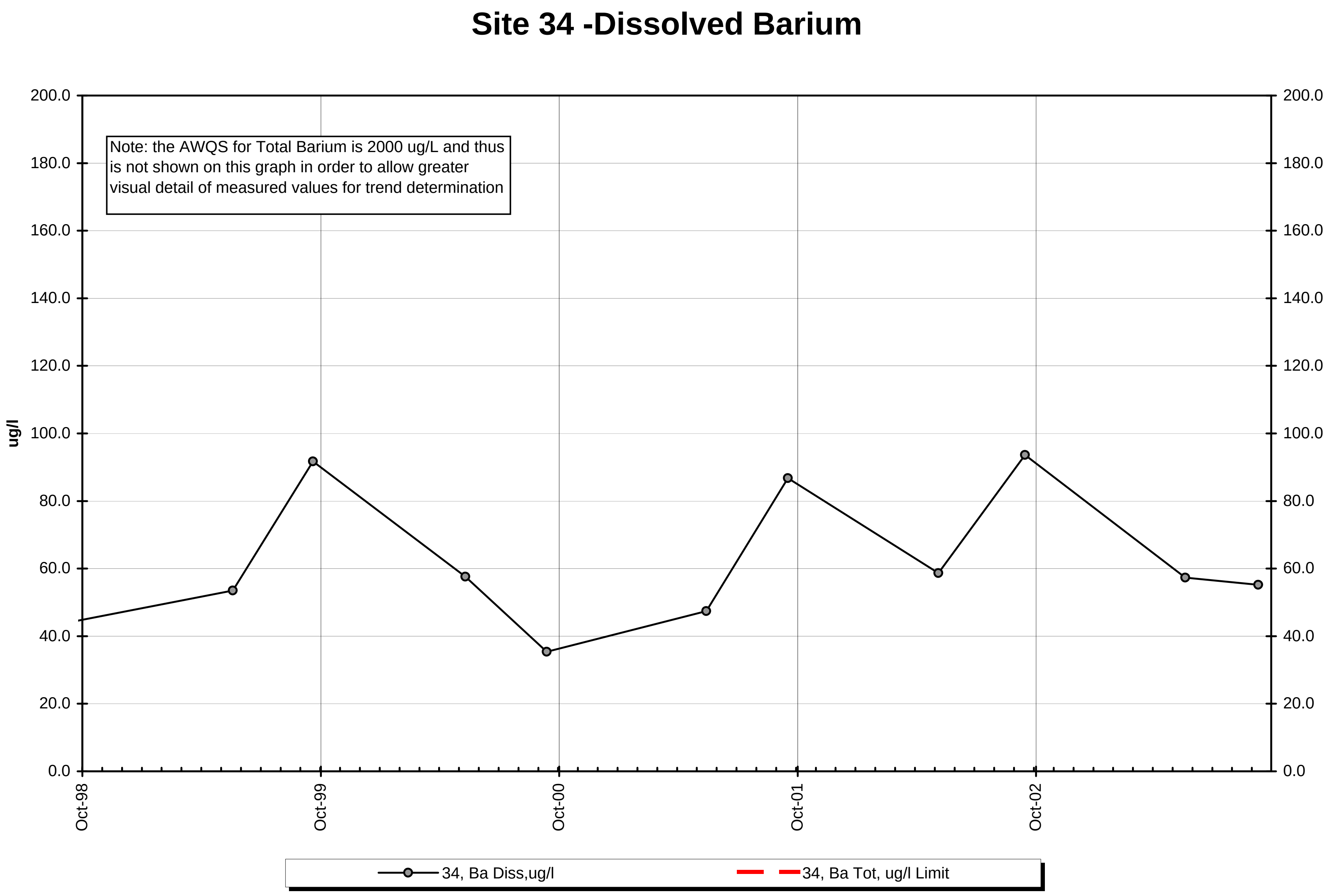


Site 34 -Hardness



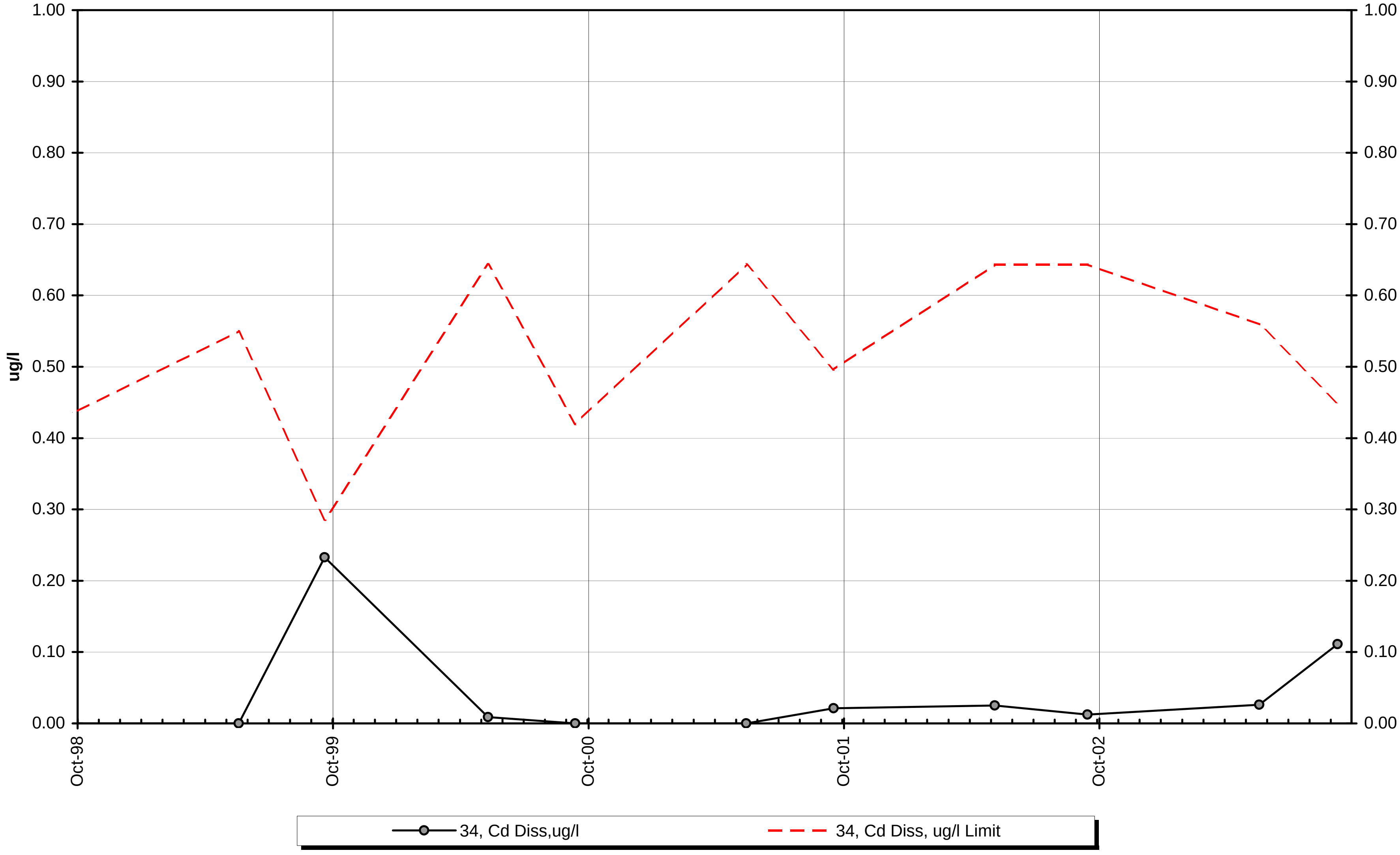
Site 34 -Dissolved Arsenic



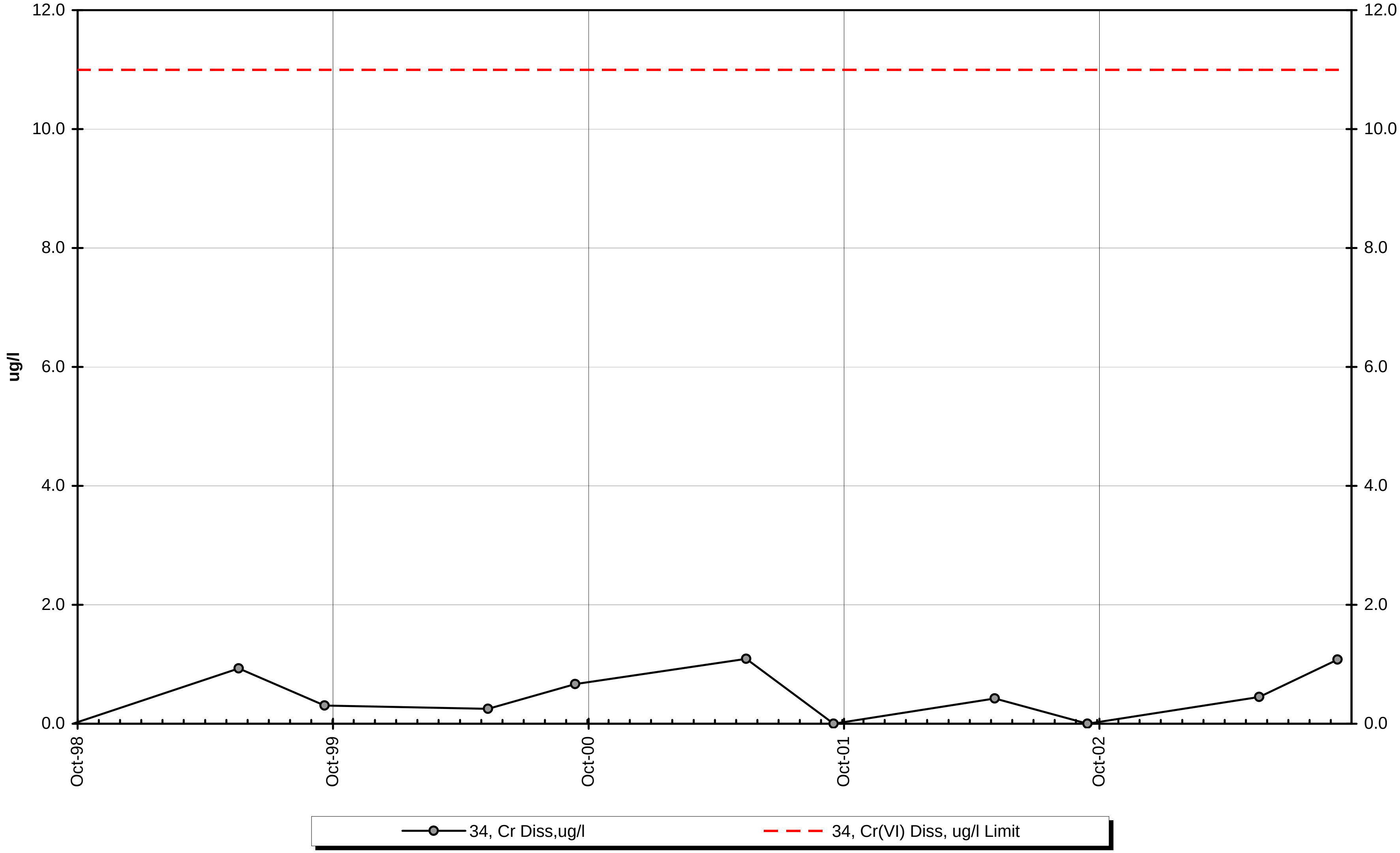


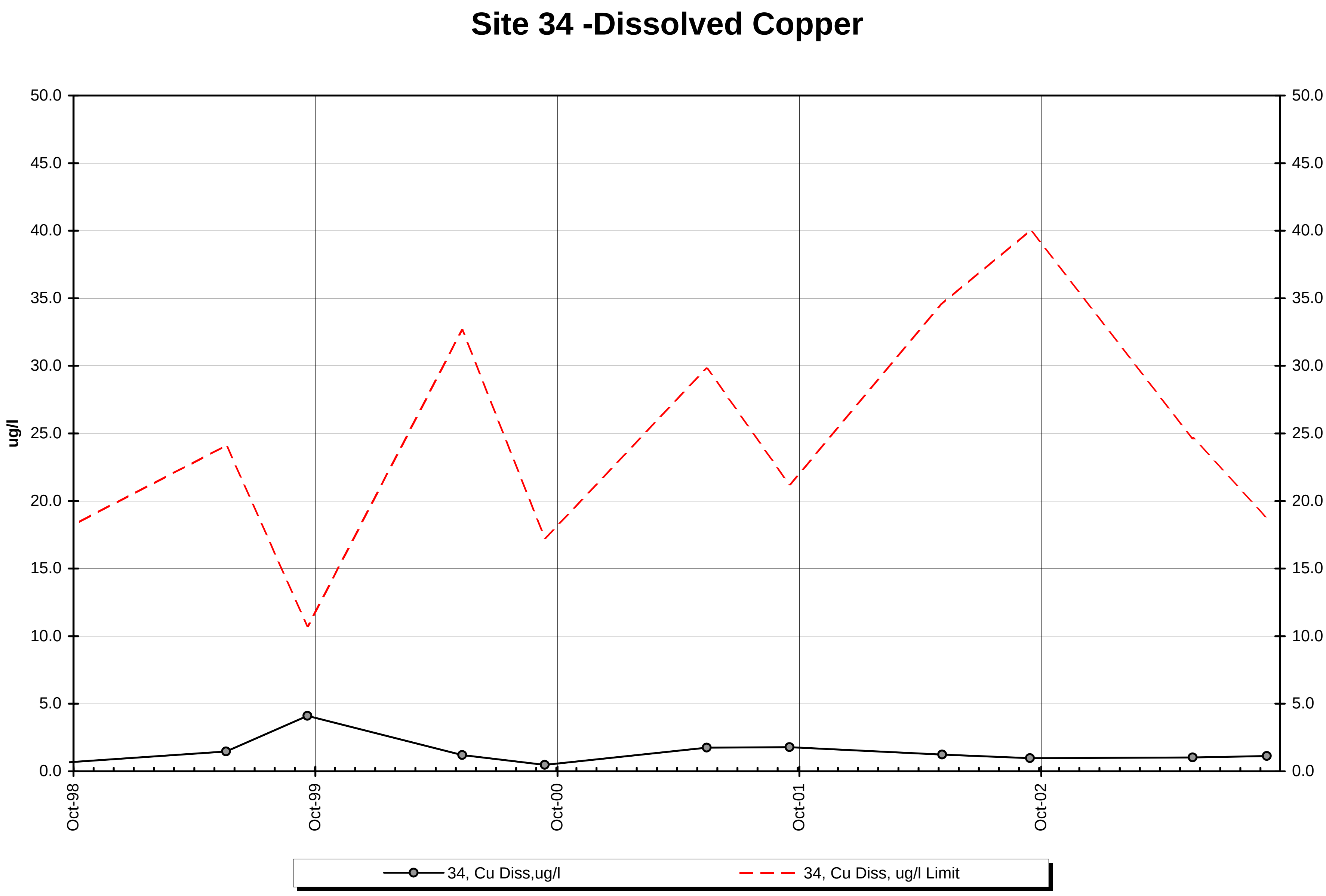
Site 34 -Dissolved Barium
Note: the AWQS for Total Barium is 2000 ug/L and thus is not shown on this graph in order to allow greater visual detail of measured values for trend determination
ug/l
200.0
180.0
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
34, Ba Diss,ug/l
34, Ba Tot, ug/l Limit

Site 34 -Dissolved Cadmium



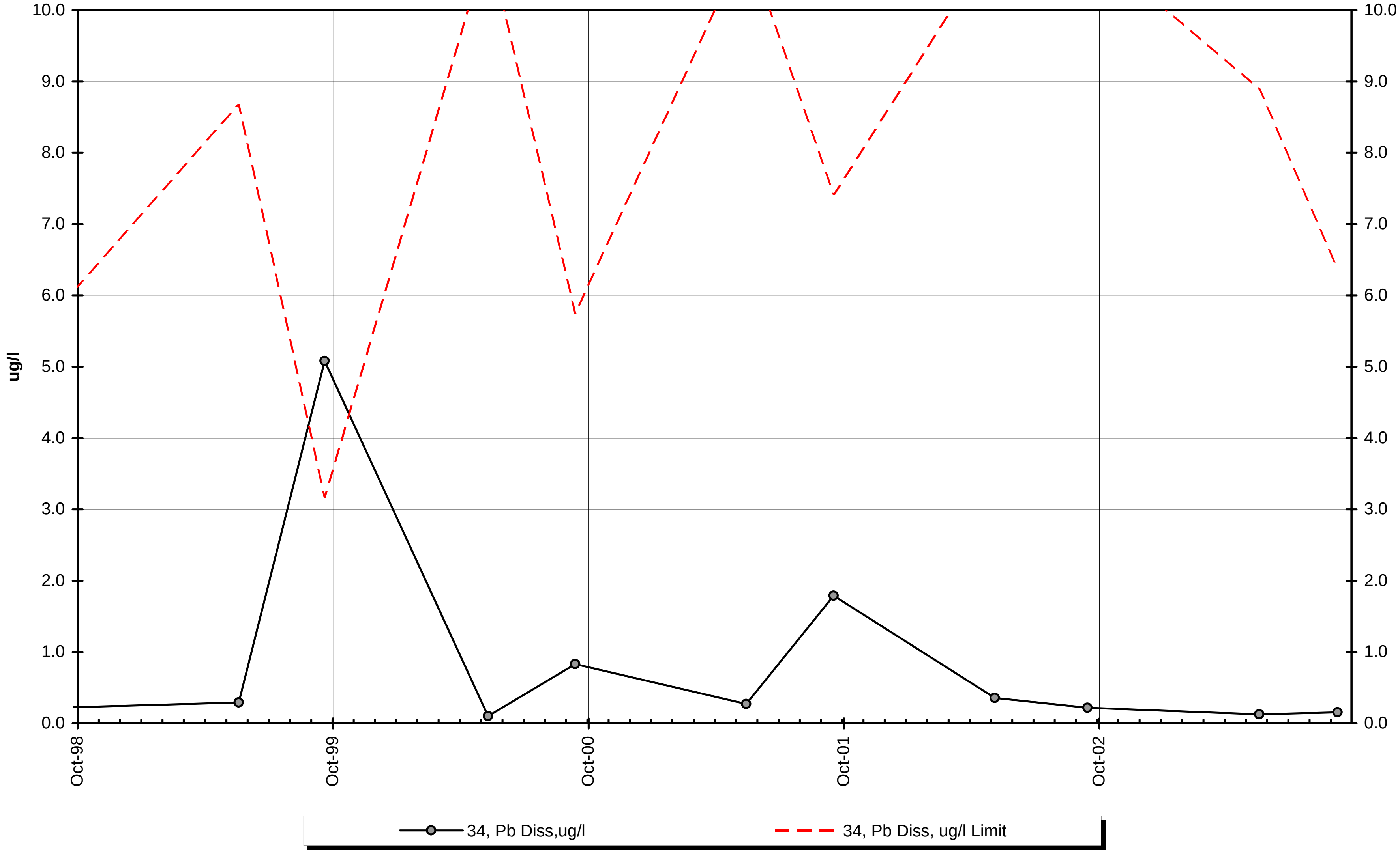
Site 34 -Dissolved Chromium



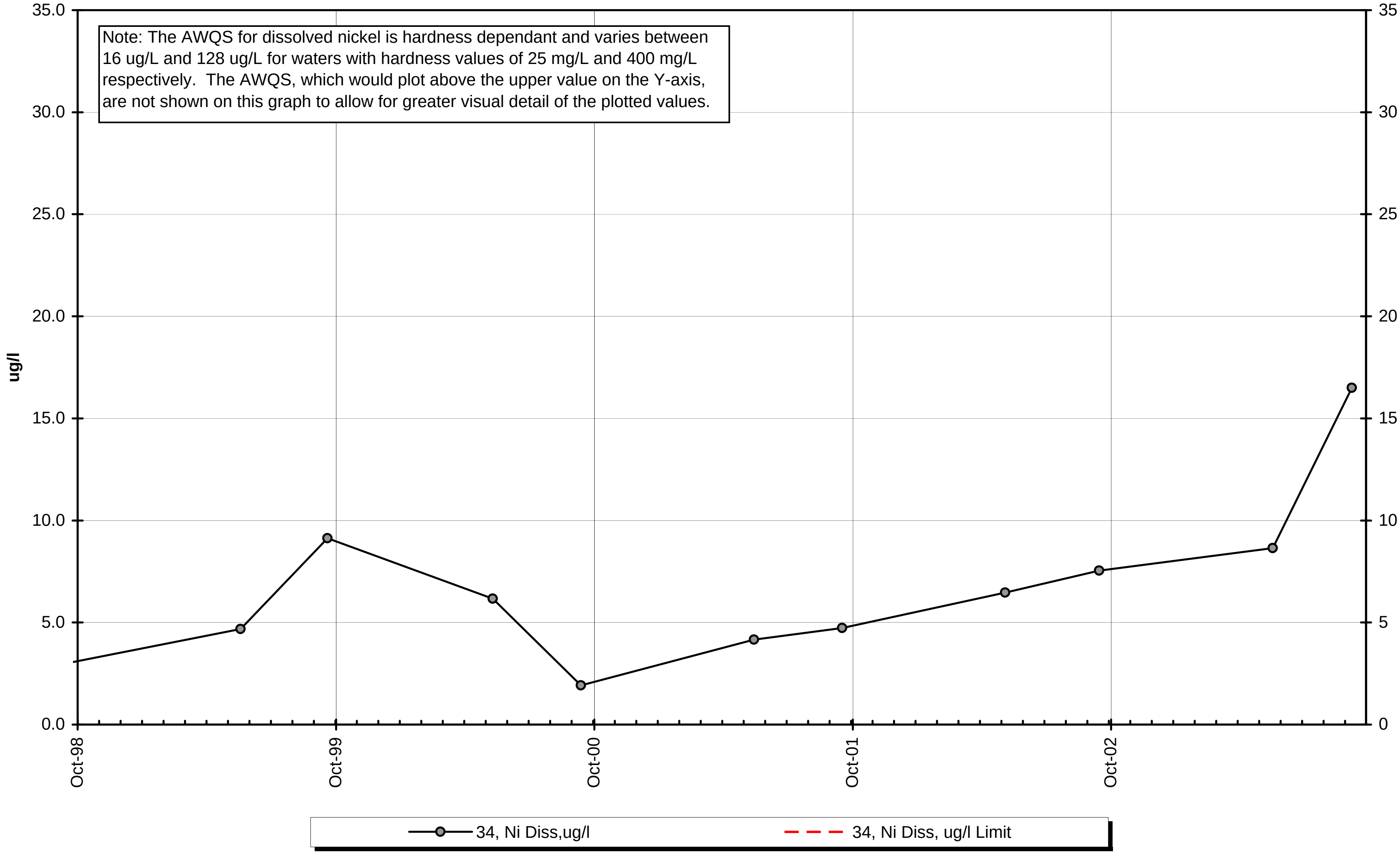


Site 34 -Dissolved Copper
ug/l
50.0
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
34, Cu Diss,ug/l
34, Cu Diss, ug/l Limit

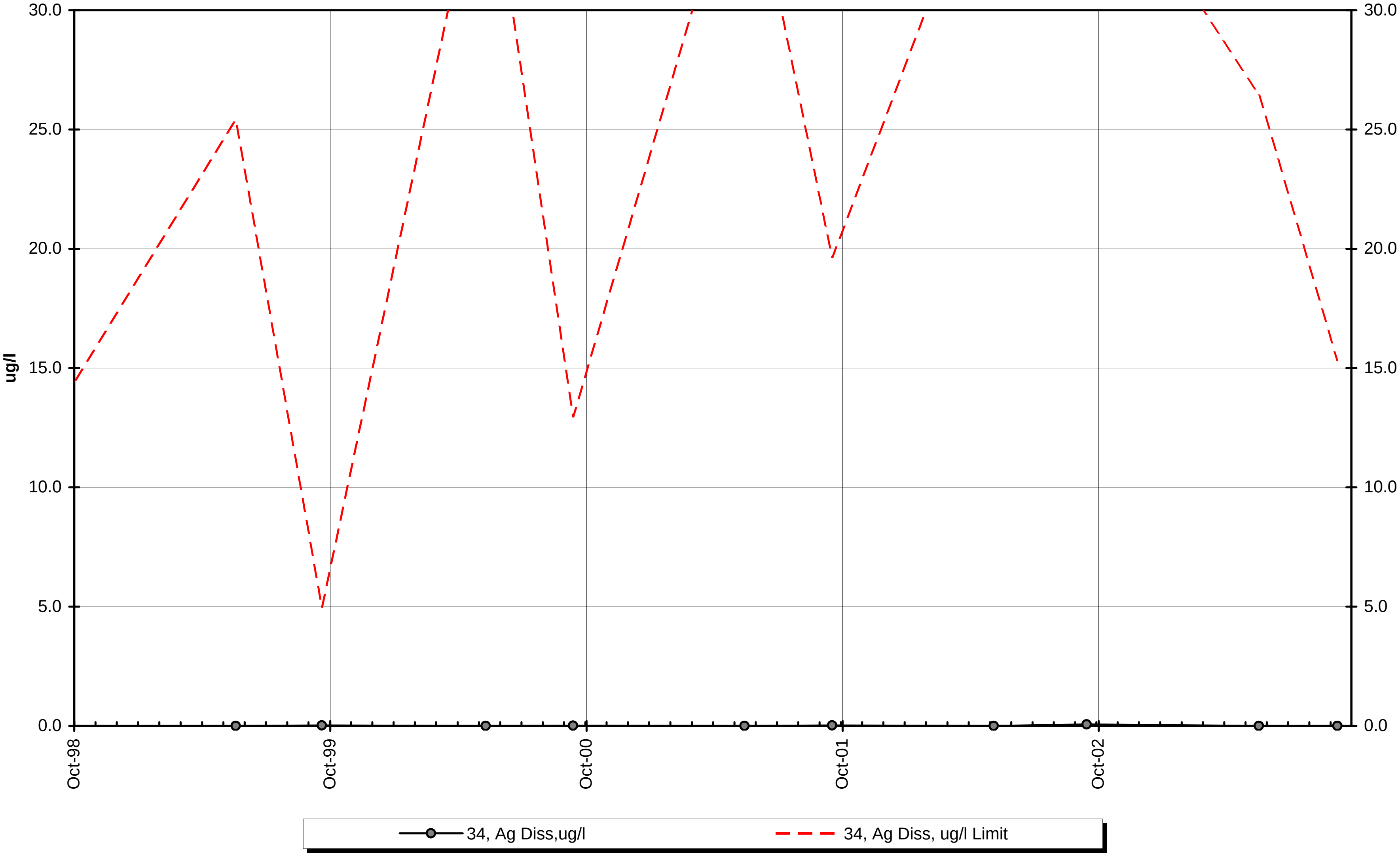
Site 34 -Dissolved Lead

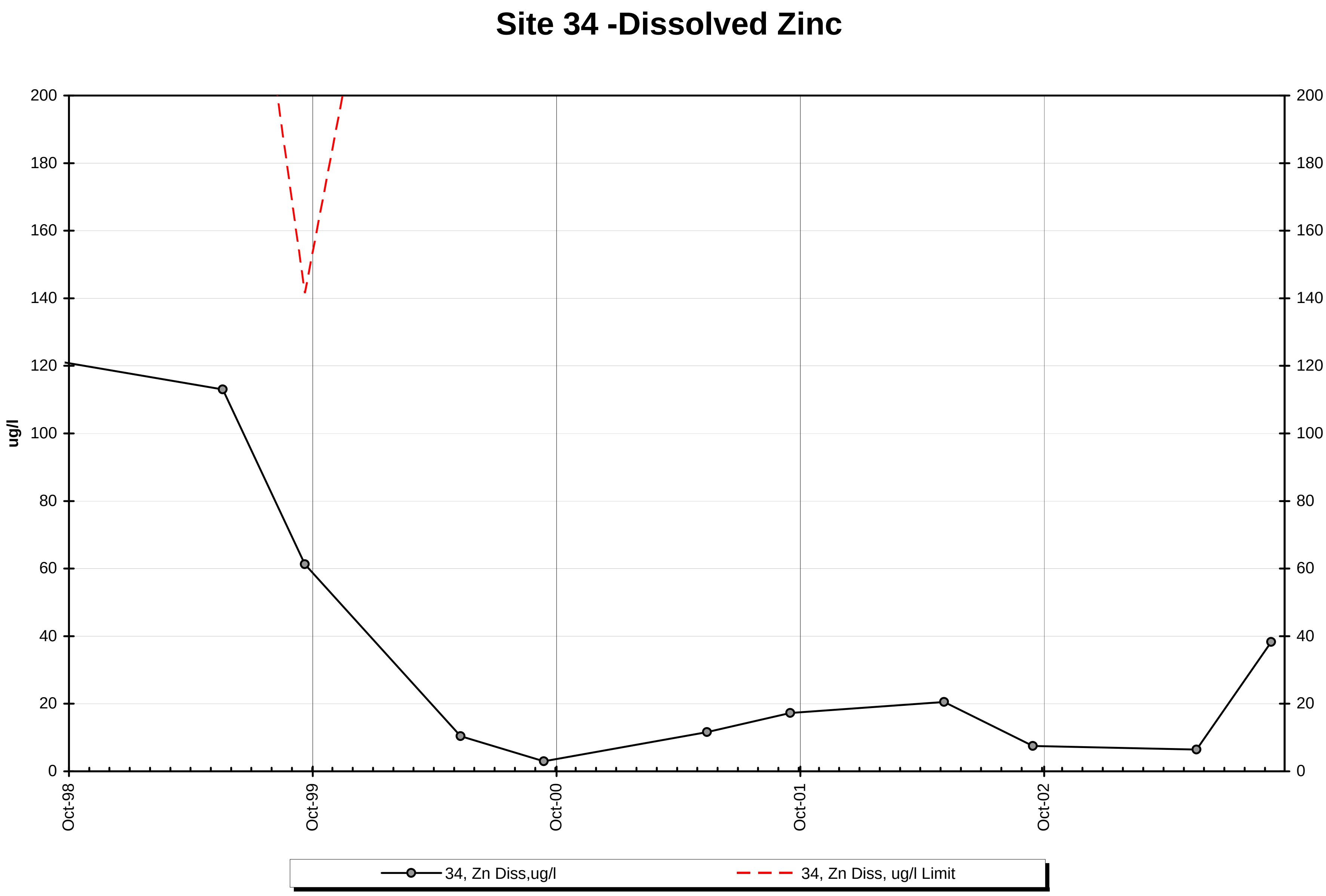


Site 34 -Dissolved Nickel



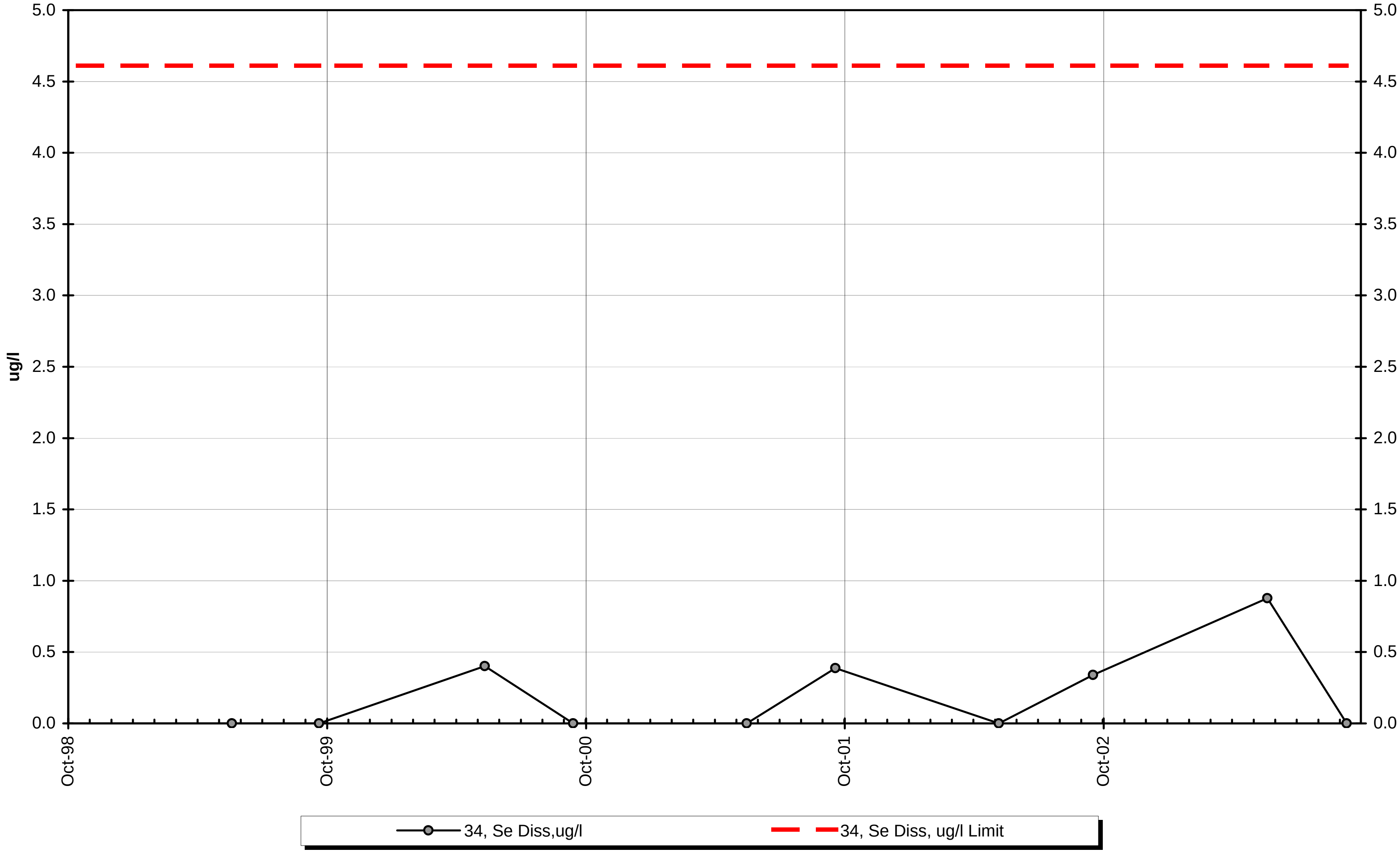
Site 34 -Dissolved Silver

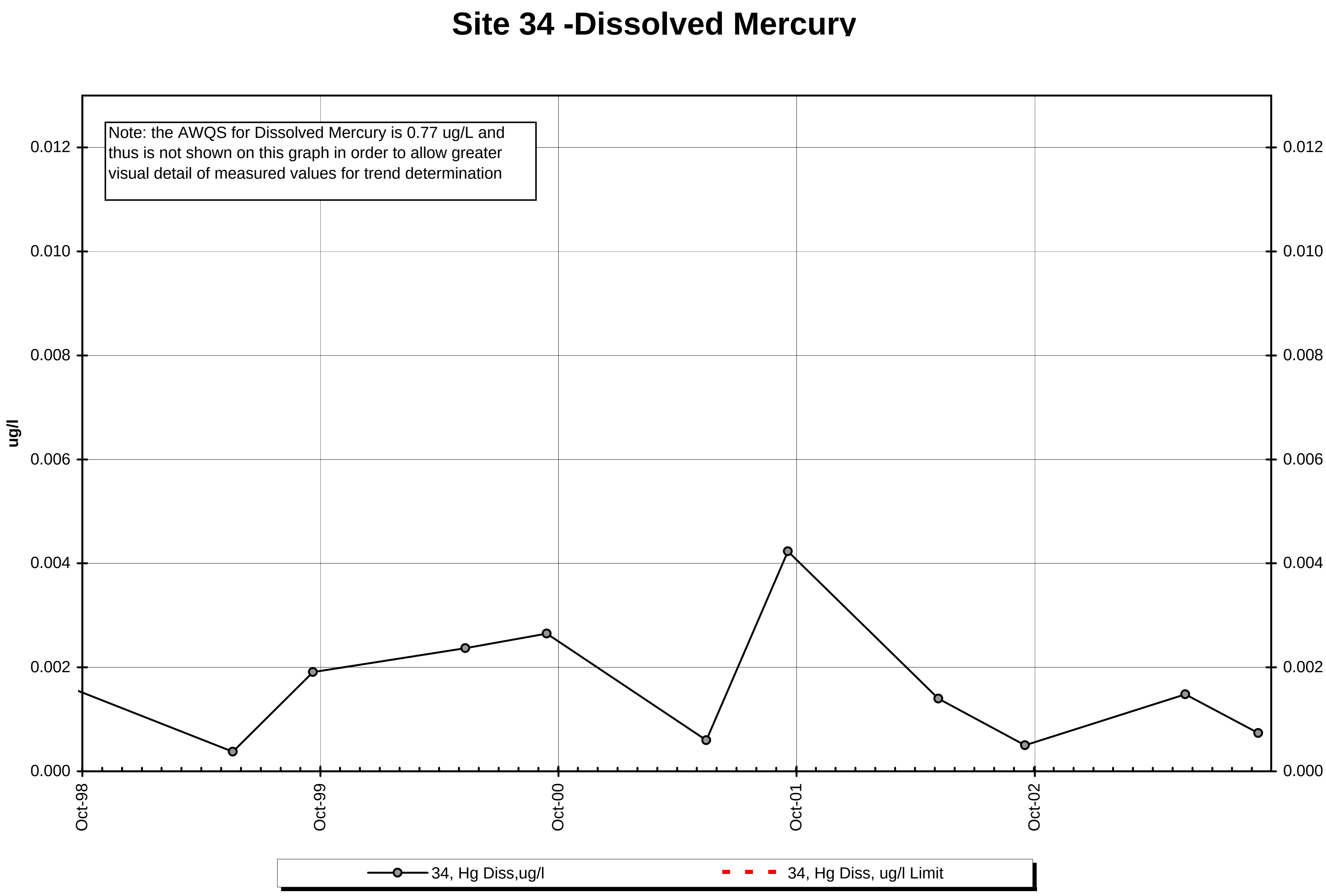




Site 34 -Dissolved Zinc
ug/l
0
20
40
60
80
100
120
140
160
180
200
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
34, Zn Diss,ug/l
34, Zn Diss, ug/l Limit

Site 34 -Dissolved Selenium




Site 34 -Dissolved Mercury
Note: the AWQS for Dissolved Mercury is 0.77 ug/L and thus is not shown on this graph in order to allow greater visual detail of measured values for trend determination
ug/l
0.012
0.010
0.008
0.006
0.004
0.002
0.000
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
34, Hg Diss,ug/l
34, Hg Diss, ug/l Limit

APPENDIX A

Parameter	Drinking Water	Stockwater	Irrigation Water	Aquatic Life-Fresh Water								Human Health Criteria for NonCarcinogens	
				Acute				Chronic				Water + Aquatic Organisms	Aquatic Organisms Only
				criteria	as	multilply by conversion factor	to convert to	criteria	as	multiply by conversion factor	to convert to		
alkalinity								**20,000 minimum**					
As	**50**	**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			0.77	D			**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)

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

DENOTES STRICTEST CRITERIA

Source: http://www.dec.state.ak.us/water/wqsar/wqs/toxicsbook.xls

Table formatting was modified by KGCMC to include only parameters include in Suite P and Q and to highlight the strictest standard.

APPENDIX B

Biomonitoring Report

Technical Report No. 04-04

Aquatic Biomonitoring At Greens Creek Mine, 2003

by James D. Durst
Alan H. Townsend

June 2004

Alaska Department of Natural Resources   Office of Habitat Management and Permitting

Aquatic Biomonitoring
at Greens Creek Mine
2003

Technical Report No. 04-04

by

James D. Durst
Alan H. Townsend

Kerry Howard
Executive Director
Office of Habitat Management and Permitting
Alaska Department of Natural Resources
Juneau, AK

Suggested Citation:

Durst, James D., and Alan H. Townsend. 2004. Aquatic biomonitoring at Greens Creek Mine, 2003. Technical Report No. 04-04. Alaska Department of Natural Resources, Office of Habitat Management and Permitting, Juneau, Alaska. 62 pp.

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ACKNOWLEDGEMENTS

We thank Kennecott Greens Creek Mining Company for their continued financial, logistical, and field sampling support of this biomonitoring project, particularly the assistance given by Bill Oelklaus, Steve Hutson, and Kerry Lear. David Cox, Steve Hohensee, and Pete Schneider of the U.S. Forest Service assisted with project continuity and field sampling. A number of staff from the Alaska Department of Natural Resources, Office of Habitat Management and Permitting played significant roles in this effort: Laura Jacobs and Al Townsend conducted the invertebrate analyses with the assistance of Steve Peck, a private contractor; Laura Jacobs and William Morris performed the chlorophyll analyses; and Robert McLean and Jack Winters provided technical review and editing. We appreciate the support of Dr. Joe Margraf and Ms. Kathy Pearse of the University of Alaska Cooperative Fish and Wildlife Research Unit for use of their laboratory equipment for chlorophyll analyses. This sampling effort and report were made possible by the previous Greens Creek Mine biomonitoring work done by KGCMC, USFS, ADF&G, OHMP, and UAF staffs, and their foundational work is gratefully acknowledged.

EXECUTIVE SUMMARY

The Alaska Department of Fish and Game (ADF&G) Habitat and Restoration Division and the U.S. Forest Service, in cooperation with the U.S. Fish and Wildlife Service, began an aquatic biomonitoring program in Greens Creek and Tributary Creek in 2001 and again performed the sampling in 2002. The Alaska Department of Natural Resources Office of Habitat Management and Permitting, as successor to ADF&G Habitat and Restoration, conducted the sampling in 2003.

The purpose of the biomonitoring program has been to document the health of aquatic communities in Greens Creek and Tributary Creek and to document the abundance and taxonomic richness of existing aquatic habitats so comparisons can be made with future conditions at the monitored sites. Elements of the program have included surveys of periphyton abundance, aquatic invertebrate density and community structure, juvenile fish abundance and distribution, concentrations of select elements in fish tissues, and toxicity testing.

The biomonitoring sites in Greens Creek Below Pond D Site 54 and Tributary Creek Site 9 continued to sustain complex, diverse aquatic communities at population levels similar to the reference site, Upper Greens Creek Site 48. The summer of 2003 was very dry at Greens Creek Mine, and the low water levels allowed for higher productivity in the streams but a decreased wetted area available for fish habitat, particularly in Tributary Creek.

Periphyton biomass and community composition continue to appear robust and were significantly higher in 2003 than in 2001 and 2002, particularly in Tributary Creek where stream flows are low, scouring flood events are rare, and annual variations in flow appear to be buffered by numerous wetlands in the watershed. Estimates of periphyton biomass in Greens Creek Below Pond D Site 54 were not significantly different from the reference site, Upper Greens Creek Site 48.

The benthic macroinvertebrate communities are taxonomically rich and abundant, and the populations of many pollution-sensitive taxa are well represented. Mean densities were similar between sites and significantly higher in 2003 than in 2001 and 2002. A slightly higher percentage of total aquatic invertebrates at the Greens Creek sites were Chironomidae compared to previous years. Aquatic communities at Greens Creek sites 48 and 54 were dominated by mayflies (Ephemeroptera), while at Tributary Creek Site 9 the community composition was only

slightly dominated by mayflies, with non-insect invertebrates forming a large component of the community. These differences are likely influenced by differences in physical features, including gradient, water velocity, and scour patterns in the different sites.

Juvenile fish populations continue to be relatively abundant at each site, with multiple size classes present. Total fish captures were higher in 2003 than in previous years at both Greens Creek sites and lower at Tributary Creek Site 9. The latter is likely related to low water levels.

Whole body concentrations of metals in fish tissues were similar to or less than those found in previous years' samples. Concentrations of silver and lead were somewhat lower at the Greens Creek sites than at Tributary Creek, whereas the opposite was the case for zinc. The Greens Creek sites had slightly higher concentrations of selenium than in previous years. Although some differences were noted between sites and stream systems, no clear pattern of differential water quality emerged between sites downstream of mine facilities and the control site Upper Greens Creek Site 48.

No testing of acute toxicity in water from the three biomonitoring sites was done in 2003. The results from the 2003 periphyton, benthic invertebrate, and juvenile fish biomonitoring program elements provide no evidence to suggest toxicity of the waters at the three biomonitoring sites.

Overall, the aquatic communities in Greens Creek Sites 48 and 54 and Tributary Creek Site 9 have remained abundant and diverse. Differences between the stream systems (Greens Creek and Tributary Creek) were typically of larger amplitude than were differences between the control and below-mining sites. We noted no indications of reduced productivity, community changes, or metals accumulation attributable to operations of the Greens Creek Mine.

INTRODUCTION

In 2000, an interagency regulatory team made up of representatives from the Alaska Department of Environmental Conservation (ADEC), the Alaska Department of Fish and Game (ADF&G), the Alaska Department of Natural Resources (ADNR), the Alaska Department of Law, the United States Environmental Protection Agency (USEPA), the United States Forest Service (USFS), and the United States Fish and Wildlife Service were invited by the Kennecott Greens Creek Mining Company (KGCMC) to conduct an environmental audit of the Greens Creek Mine operations within the Admiralty Island National Monument.

From findings of that review, the KGCMC Fresh Water Monitoring Plan (FWMP) was updated, including specifications for biomonitoring in areas adjacent to the KGCMC surface facilities associated with the mine and mill. This document presents results of the third year (2003) of biological monitoring of the Greens Creek Mine operation, conducted by the ADNR Office of Habitat Management and Permitting as successor to ADF&G Habitat and Restoration Division. Results from previous years' biomonitoring can be found in Weber Scannell and Paustian (2002) and Jacobs et al. (2003).

The intent of biological monitoring is to document the continued use of Greens Creek and Tributary Creek by fish and other aquatic species, and to document the continued health of the aquatic communities. Biomonitoring is designed to detect early changes to the aquatic community that may result from changes in water chemistry through either surface or groundwater inputs to the system.

Results from biomonitoring usually are compared to baseline conditions, or to a reference site that is unaffected if baseline data are unavailable. Few baseline biomonitoring studies as intensive as this current program were conducted before development of the Greens Creek Mine. The existing biomonitoring program is designed to compare present to future conditions at the mine, with consideration given to any previous monitoring. All biological monitoring follows standard protocols acceptable to USEPA, ADEC, USFS, ADF&G, and American Public Health Association (1992).

PURPOSE

The objective of the biomonitoring program is to establish existing conditions of the biological communities in selected reaches of Greens Creek and Tributary Creek near the KGCMC surface facilities. Future sampling during the mine life or during reclamation and closure can be compared to the conditions defined under the current biomonitoring program to detect any changes that may have occurred in aquatic communities.

The biological monitoring program for the Greens Creek mining and milling operations addresses the following factors:

1. Periphyton biomass, estimated by chlorophyll concentrations;
2. Abundance and community structure of benthic macroinvertebrate populations;
3. Distribution and abundance of juvenile fish;
4. Whole body concentrations of Ag, Cd, Cu, Pb, Se, and Zn in juvenile fish; and
5. Standardized laboratory toxicity testing.

LOCATION AND SCHEDULE OF MONITORING

Three of the sites routinely monitored under the FWMP were selected for routine biomonitoring. Upper Greens Creek Site 48 monitors Greens Creek upstream of all mine and mill activities. Biomonitoring occurs here annually and serves as a control site. Greens Creek Below Pond D Site 54 monitors Greens Creek downstream of all mine and mill facilities. Biomonitoring occurs at this site annually and serves as a treatment site. Tributary Creek Site 9 monitors Tributary Creek downstream of the tailings impoundment. Biomonitoring occurs annually to detect any changes over time. A fourth site, Middle Greens Creek Site 6 (upstream of Site 54 but below the mine portal and several facilities), was sampled in 2001 to provide information on baseline conditions (in this instance, baseline is meant to describe the conditions at the beginning of the biomonitoring program) and is monitored on a 5-year schedule. KGCMC monitors the ambient water quality at these and other FWMP sites on a monthly basis. Water quality samples were collected at each of the biomonitoring sites within the month of the biomonitoring effort. Figure 1 shows the location of the Greens Creek Mine and the biomonitoring sampling locations.

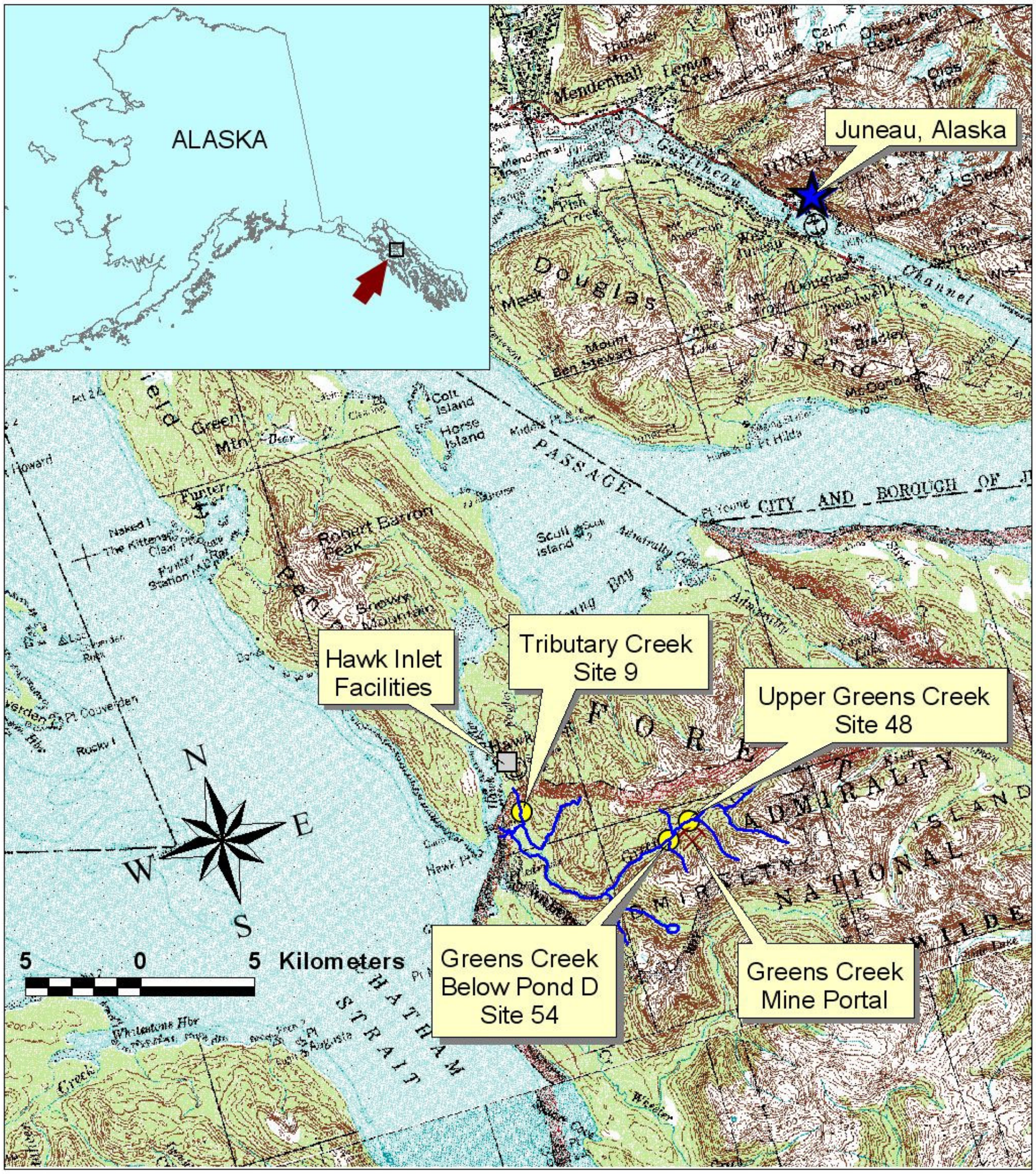


Figure 1. Location of the Greens Creek Mine operation and biomonitoring sampling sites on Admiralty Island in southeast Alaska, about 30 km southwest of Juneau.

METHODS

Sample design and methods followed procedures in the KGCMC Fresh Water Monitoring Program (KGCMC 2000), and as reported for the previous years of this biomonitoring study (Weber Scannell and Paustian 2002, Jacobs et al. 2003). Photographs were taken to document site conditions and sampling areas in each survey reach.

Data analyses were performed using hand calculators, Microsoft® Excel 2002, and Statistix® 8 (Analytical Software 2003). Kruskal-Wallis One-Way AOV, a nonparametric alternative to a one-way analysis of variance (ANOVA), was used to test for differences between years and sites. All-pairwise comparisons were conducted on the mean ranks for each group at various values of rejection level α to test for homogeneity between years and sites. Significant differences required an $\alpha = 0.05$ unless noted otherwise in the text.

PERIPHYTON BIOMASS

Rationale

Periphyton, or attached algae, is sensitive to changes in water quality. Their abundance confirms that productivity is occurring at specific locations within a water body.

Sample Collection and Analysis

The protocol for collecting stream periphyton follows the protocol from the ADF&G (1998) and Barbour et al. (1997). Periphyton was sampled during a period of stable flow. Ten rocks were collected from the stream benthos in each study reach. A 5-cm x 5-cm square of high-density foam was placed on the rock. Using a small toothbrush, all material around the foam square was removed and rinsed away with clean water. The foam was removed from the rock, the rock was brushed with a clean toothbrush, and the loosened periphyton was rinsed onto a 0.45 µm glass fiber filter attached to a vacuum pump. After extracting as much water as possible, approximately 1 ml saturated $MgCO_3$ was added to the filter to prevent acidification and conversion of chlorophyll to phaeophytin. The filter was wrapped in a large filter (to absorb any additional water), labeled, placed in a sealed plastic bag, and packed over desiccant. Filters were frozen on site in a lightproof container with desiccant, and then transported to Fairbanks where they were kept frozen until laboratory analysis.

Methods for extraction and measurement of chlorophyll followed USEPA protocol (USEPA 1997). Filters were removed from the freezer, cut into small pieces, and placed in a centrifuge tube with 10 ml of 90% buffered acetone. Centrifuge tubes were placed in a metal rack, covered with aluminum foil, and held in a dark refrigerator for 24 hr. After extraction, samples were centrifuged for 20 minutes at 1,600 rpm and then read on a Shimadzu Spectrophotometer UV-601 at optical densities (OD) 664 nm, OD 647 nm, and OD 630 nm. In addition, a reading was taken at OD 750 nm to correct for turbidity. An acetone blank was used to correct for the solvent. Samples were then treated with 0.1 ml of 0.1 N hydrochloric acid to convert chlorophyll to phaeophytin, and read at OD 665 nm and OD 750 nm. Based upon these readings, amounts of chlorophylls *a*, *b*, *c* and phaeophytin were determined according to Standard Methods (APHA 1992).

BENTHIC MACROINVERTEBRATES

Rationale

Benthic macroinvertebrate abundance and taxonomic richness are useful measures of stream health. Characterizing community structure and abundance of benthic macroinvertebrates at sample sites can show trends in stream health and water quality.

Sample Collection and Analysis

Five benthic samples were collected from each sample site with a modified Hess sampler. We used a stratified random sample design, modified from Barbour et al. (1997). Samples were collected exclusively from riffle areas where the greatest taxonomic richness and densities are typically found. This sample design eliminated variability from sampling pools or other marginal habitats where pollution-sensitive macroinvertebrates are less likely to occur. For each sample, the substrate was first manually disturbed, and then rocks were brushed and removed.

After the larger substrate was removed, the fine gravels were disturbed to a depth of approximately 10-15 cm. Macroinvertebrates disturbed from the stream bottom were collected in a 1-m, 300 μm mesh net and cup attached to the sampler. The sample was removed, placed in pre-labeled 500 ml Nalgene® bottles, and then preserved in 70% denatured ethanol. Macroinvertebrate samples were later sorted from all debris and identified to the lowest practical taxonomic level.

Analyses included comparisons of abundance, community composition, and percent dominant taxa. The latter is a metric that usually identifies the absence of environmentally sensitive species or dominance of less sensitive taxa.

JUVENILE FISH POPULATIONS

Rationale

Monitoring juvenile fish populations to determine potential trends in the numbers of Dolly Varden (*Salvelinus malma*) and coho salmon (*Oncorhynchus kisutch*) in stream reaches near the surface mine facilities helps evaluate the health of vertebrate populations in the Greens Creek and Tributary Creek drainages.

Sample Collection and Analysis

Fish population estimates were made using a modification of Aho (2000) with a three-pass removal method developed by the USFS (Bryant 2000), using 7.9 x 15.9 mm (5/16 x 5/8 in) diamond mesh plastic-coated minnow traps baited with salmon eggs that had been treated with a povidone-iodine (Betadine®) solution. Minnow traps used in previous years were 6.4 mm (1/4 in) square mesh zinc-coated traps. Approximately 25 minnow traps were deployed for each sampling event along each sample reach, identified by the aluminum tree tags set by the USFS during previous years' sampling. Sample reaches varied in length among sites because of the limited availability of suitable habitat to set traps. At Upper Greens Creek Site 48, the sampled reach was 75 m long in 2001 and 50 m long in 2002 and 2003; at Greens Creek Below Pond D Site 54, the same 28 m long reach was sampled in 2001, 2002, and 2003; and in Tributary Creek Site 9, the sampled reach was 44 m long in 2001 and 50 m long in 2002 and 2003.

Traps were placed throughout the sample section focusing on pools, undercut banks, bank alcoves, under root-wads or logjams, and other habitats where fish were likely to be captured. In higher velocity sites, rounded stream rocks were placed in the traps to keep them in place. Where possible, natural obstructions, like shallow riffles or small waterfalls over log steps, defined upper and lower section boundaries to minimize fish movement into the sample section during sampling.

Minnow traps were set for about 1.5 hr, at which time all captured fish were transferred to plastic buckets with holes drilled in the sides. Buckets were placed in the stream to keep water aerated and the captured fish in less stressful conditions. The traps were re-baited and reset for another 1.5 hr period. While the second set was fishing, fish captured during the first set were identified to species, counted, measured to fork length, and placed in a mesh holding bag in the stream. The procedure was repeated for the third 1.5 hr trapping period.

Fish population estimates for 2003 were developed using the multiple-pass depletion method of Lockwood and Schneider (2000), an iterative method that produces a maximum likelihood estimate (MLE) of fish numbers with a 95% confidence interval.

Six Dolly Varden from the first trapping period at each site were retained for whole body analysis of metals. Fish not retained for the metals analyses were returned to the stream immediately after sampling was completed.

METALS CONCENTRATIONS IN JUVENILE FISH

Rationale

The response time for juvenile fish to accumulate metals is rapid; for example, ADF&G has documented metals accumulation in juvenile Dolly Varden within five to six weeks after dispersing from their overwintering grounds to mineralized and unmineralized tributaries (Weber Scannell and Ott 2001). Should changes occur at the Greens Creek Mine that result in higher concentrations of metals in the creek, tissue sampling of juvenile fish should reflect these changes.

Sample Collection and Analysis

Six moderate-sized juvenile Dolly Varden captured in baited minnow traps at each sample site were collected for whole body metals analysis. Concern for potential contamination of fish collected for metals testing by zinc from galvanized traps used in 2001 and 2002 lead us to use plastic-coated minnow traps in 2003. Collected fish were measured to fork length, individually packed in clean, pre-labeled bags, placed in an acid-washed cooler, and frozen on-site until transport to Fairbanks. We followed the techniques of Crawford and Luoma (1993) for minimizing contamination of the samples. In Fairbanks, the fish were weighed without removal from the bags (we corrected for the weight of the sample bag). The fish were submitted to a private analytical laboratory, where they were digested, dried, and analyzed for Ag, Cd, Cu, Pb, Se, and Zn on a dry-weight basis, with percent moisture reported. In 2000, samples from Greens Creek Below Pond D Site 54 and Tributary Creek Site 9 both contained a mixture of coho salmon and Dolly Varden. In 2001, 2002, and 2003 all fish retained for metals analysis were Dolly Varden, although samples from Sites 48 and 9 may have contained a mixture of resident and anadromous forms.

Samples were numbered following the convention established by ADF&G:

Date/Stream Code/Species Code/Age Code/Sample Number

An example fish label would read: 071201GC54DVJ01, where 070201 represents July 2, 2001; GC54 represents Greens Creek Below Pond D Site 54; DV represents Dolly Varden; J represents juvenile; and 01 represents sample replicate 1.

Quality Control / Quality Assurance of Laboratory Analysis

The analytical laboratory provided Level III quality assurance/quality control information for each analyte, including matrix spikes, standard reference materials, laboratory calibration data, sample blanks, and sample duplicates.

TOXICITY TESTING

Rationale

Toxicity tests measure the combined toxic effects of all constituents in a particular sample, because some substances can be toxic in amounts that are below detection limits. This is especially true when multiple toxic components synergistically cause toxicity, although each component may be below a detection limit. One commonly available test is the Microtox® test, which uses the luminescent bacteria *Vibrio fischeri*. When grown under optimum conditions, the bacteria produce light as a by-product of their cellular respiration. Bacterial bioluminescence is directly related to cell respiration, and any inhibition of cellular activity results in a decreased rate of respiration and a corresponding decrease in the rate of luminescence (Azur 1999).

Sample Collection and Analysis

Water samples were collected at the same time other biomonitoring sampling was done. Samples were kept refrigerated in anticipation of analysis for acute (1 hr) Microtox toxicity. In previous years, ADF&G staff worked with University of Alaska Fairbanks (UAF) staff to make use of the Microtox bioassay to evaluate water toxicity. Because of the difficulty in getting reagents delivered in a timely and useable condition, and staff changes at ADF&G, OHMP, and UAF, we were not able to perform the Microtox toxicity testing in 2003 and the samples were discarded.

RESULTS AND DISCUSSION

Water levels appeared quite low at all sites during sampling. This was confirmed by gage data obtained by KGCMC from U.S. Geological Survey (USGS) Station 15101490, located at the road bridge between Greens Creek sites 48 and 54 (Table 1). Record low monthly mean flows were reported by the USGS for May, June, and July 2003 since the station was established in 1989.

Table 1. Mean daily discharge in Greens Creek during biomonitoring sampling periods.

Year	Sampling Dates	Discharge, cubic feet/sec	Discharge, cubic meters/sec
2001	July 25	72	2.04
	July 26	73	2.07
2002	July 25	91	2.58
	July 26	123	3.48
2003	July 22	16	0.45
	July 23	15	0.43

UPPER GREENS CREEK SITE 48

Upper Greens Creek Site 48 (Figure 2) was selected as an upstream reference site for comparison to "treatment" sites adjacent to and downstream from the KGCMC facilities. Site 48 lies approximately 1 km upstream of the weir that blocks access to upper Greens Creek by anadromous fish. Therefore, the only salmonid species at this site are resident Dolly Varden.

The Upper Greens Creek Site 48 sample reach has a Moderate Width Mixed Control (MM2) channel type (Appendix 1), with an average stream width of 9 m and a gradient of 2-4 percent. This is a typical stream for the middle to lower portions of moderately sized basins in southeast Alaska (Paustian et al. 1992, Weber Scannell and Paustian 2002). Cobble was the dominant substrate and large woody material was a key factor in pool formation and fish habitat cover. A stream reach of 50 m was sampled for fish populations.

Upper Greens Creek Site 48 was sampled in the afternoon of 22 July 2003. The weather was overcast, air temperature was 15.0°C, and water temperature was 9.5°C.

Figure 2. Upper Greens Creek Site 48, 22 July 2003.

Periphyton Biomass

Concentrations of chlorophyll *a*, an estimate of periphyton biomass, were significantly higher in 2003 than in 2001 or 2002 ($\alpha = 0.01$). Concentrations in 2001 and 2002 were not significantly different from each other ($\alpha = 0.10$; Figure 3). The box in the Box and Whisker graph shows the middle half of the data, the intersecting line is the median, the vertical lines at the top and the bottom of the box indicate the range of "typical" data values, and open circles indicate outlier values.

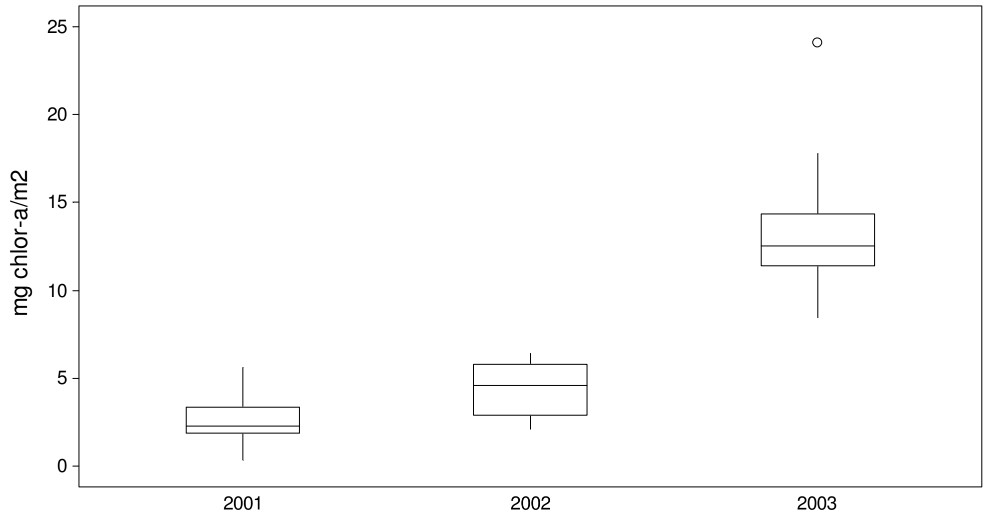


Figure 3. Estimated periphyton biomass densities at Upper Greens Creek Site 48 in 2001, 2002, and 2003. Box encompasses middle half of data; horizontal line is median value.

Algal communities contained higher proportions of chlorophyll *c* than chlorophyll *b* (Figure 4) in all three years sampled, indicating an algal community dominated by diatoms. Low to undetectable concentrations of chlorophyll *b* indicate minimal amounts of filamentous green algae or blue-green bacteria.

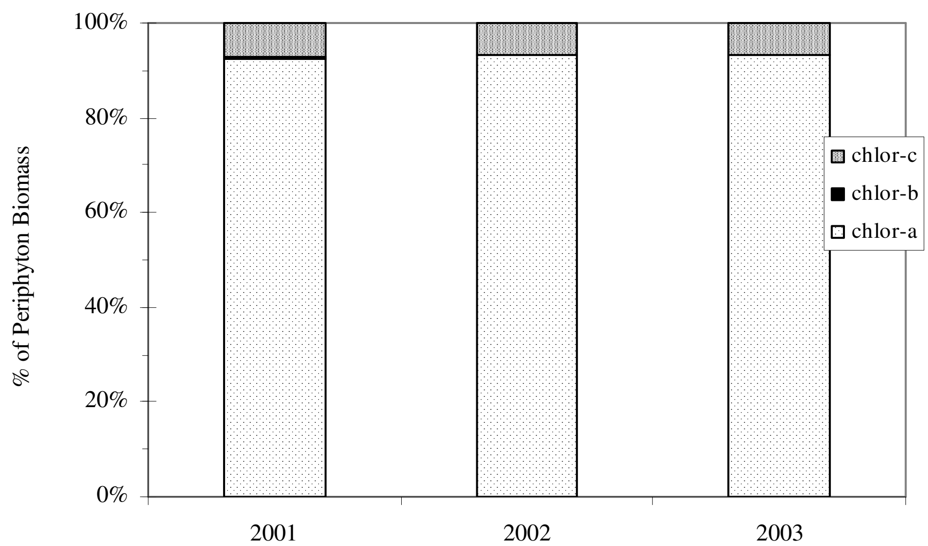


Figure 4. Proportions of chlorophylls *a*, *b*, and *c* in Upper Greens Creek Site 48 in 2001, 2002, and 2003.

Benthic Macroinvertebrates

The mean density of aquatic invertebrates in upper Greens Creek Site 48 was significantly higher in 2003 (4734/m², $\alpha = 0.01$) than in 2002 (1408/m^2), and also higher than in 2001 (2368/m^2) although differences were not significant (Figure 5).

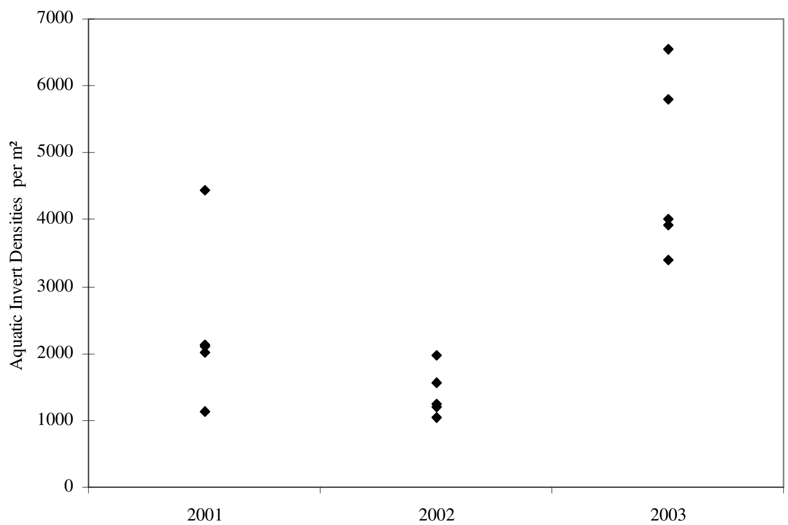


Figure 5. Density of aquatic invertebrates (n = 5 samples each year) at Upper Greens Creek Site 48 in 2001, 2002, and 2003.

Taxonomic richness was similar during the three years sampled. In 2001 we collected and identified 25 distinct taxa with an average of 11.8 taxa per sample; in 2002 we had 24 distinct taxa and an average of 13.0 taxa per sample; and in 2003 we had 27 distinct taxa with an average of 17.6 taxa per sample (Appendix 2).

Invertebrate communities were somewhat different among the three years sampled, with slightly higher proportions of Chironomidae occurring each year (Figure 6). However, the EPT taxa (Ephemeroptera, Plecoptera, and Trichoptera) continued to be most prevalent. Given that most of the EPT taxa are sensitive to water quality, especially metals, the high proportion found at this site signifies excellent water quality conditions for aquatic life.

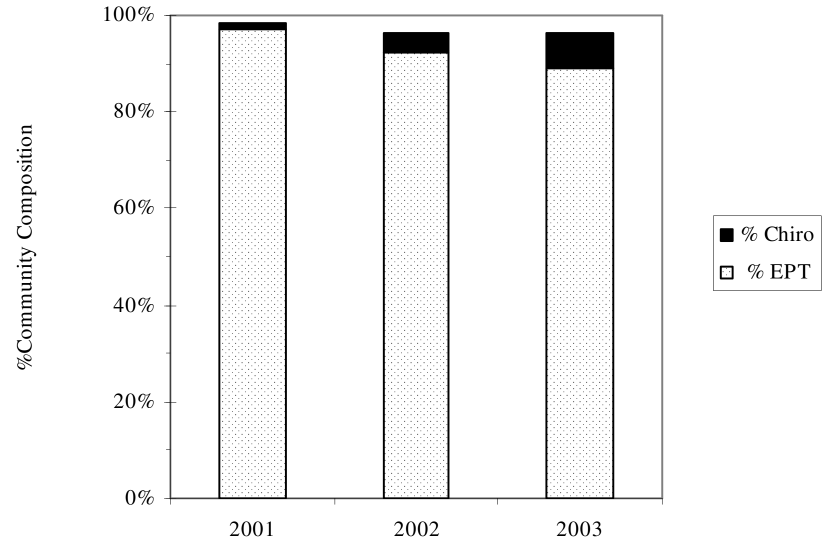


Figure 6. Proportions of EPT taxa and Chironomidae at Upper Greens Creek Site 48 in 2001, 2002, and 2003.

The aquatic invertebrate community was dominated by mayflies (Ephemeroptera, primarily Baetidae: *Baetis;* Ephemerellidae: *Drunella;* and Heptageniidae: *Cinygmula, Epeorus* and *Rhithrogena)* in all three years sampled (Figure 7). Appendix 2 lists the macroinvertebrate taxa found at Upper Greens Creek Site 48 in 2001, 2002, and 2003.

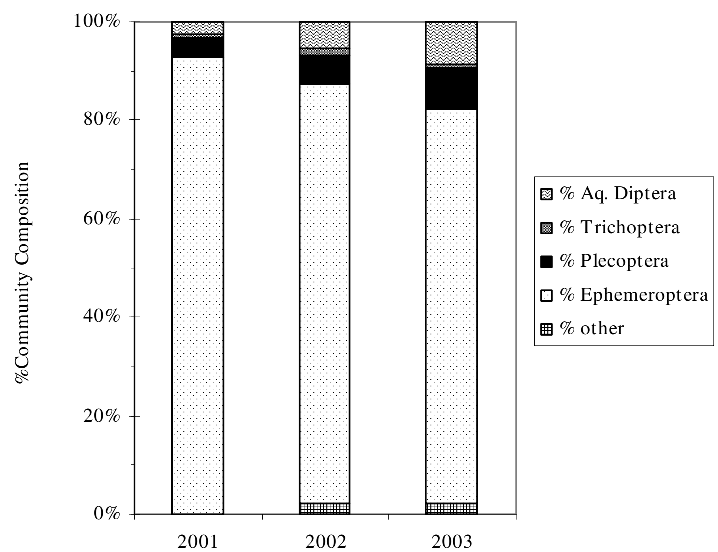


Figure 7. Community composition of aquatic invertebrates at Upper Greens Creek Site 48 in 2001, 2002, and 2003.

Table 2. Common taxa (>5% of invertebrates found in samples) at Upper Greens Creek Site 48 in 2001, 2002, and 2003.

Order	Family	Genus	2001	2002	2003
Ephemeroptera	Baetidae	*Baetis*	26%	22%	19%
	Ephemerellidae	*Drunella*		7%	27%
	Heptageniidae	*Cinygmula*	8%		
		Epeorus	38%	27%	16%
		Rhithrogena	16%	27%	12%
Diptera	Chironomidae				7%

At Upper Greens Creek Site 48, mayflies (Ephemeroptera) dominated the aquatic invertebrate samples (Table 2). Common taxa in all three years included the mayflies Baetidae: *Baetis*, Ephemerellidae: *Drunella*, and Heptgeniidae: *Epeorus* and *Rhithrogena*. *Baetis* are rated as "moderately sensitive," *Epeorus* are "sensitive," and *Rhithrogena* are "very sensitive" (Barbour et al. 1997). In all three years, pollution sensitive taxa dominated the invertebrate community at Upper Greens Creek Site 48 and the mixture of numerous taxa represents a complex community.

Juvenile Fish Populations

The 2003 juvenile fish survey captured 285 Dolly Varden in 28 minnow traps within the same 50-m reach at Upper Greens Creek Site 48 as sampled in 2002. No "block" traps were used at this site in 2003 to free up traps to better saturate available habitat in the sample reach. Because of low stream flow conditions, the riffles above and below the sample reach were quite shallow. Based on the numbers of captures in traps near the sample reach ends, movement into the sample reach during the 4.5-hour sample period was negligible. The estimated population size for the reach, based on a 3-pass removal, was 333 Dolly Varden with an approximate density of 0.9 fish/m². Population and density estimates in 2001 and 2002 were similar to each other and considerably less than those for 2003 (Table 3, Appendix 3).

Table 3. Juvenile fish population estimates for Upper Greens Creek Site 48.

Year Sampled	Fish Species	No. Fish Caught	FLength, mm	Popn Estimate, fish (95% CI)	Sample Reach, m	Density, fish/m^2
2001	DV	68	50-140*	144 (84, 448)	72	0.20
2002	DV	126	45-160*	145 (134, 178)	50	0.23
2003	DV	285	54-180	333 (305, 361)	50	0.9**

* Lengths represent upper end of 5-mm summary intervals reported by USFS.
** Based on estimated wetted area value.

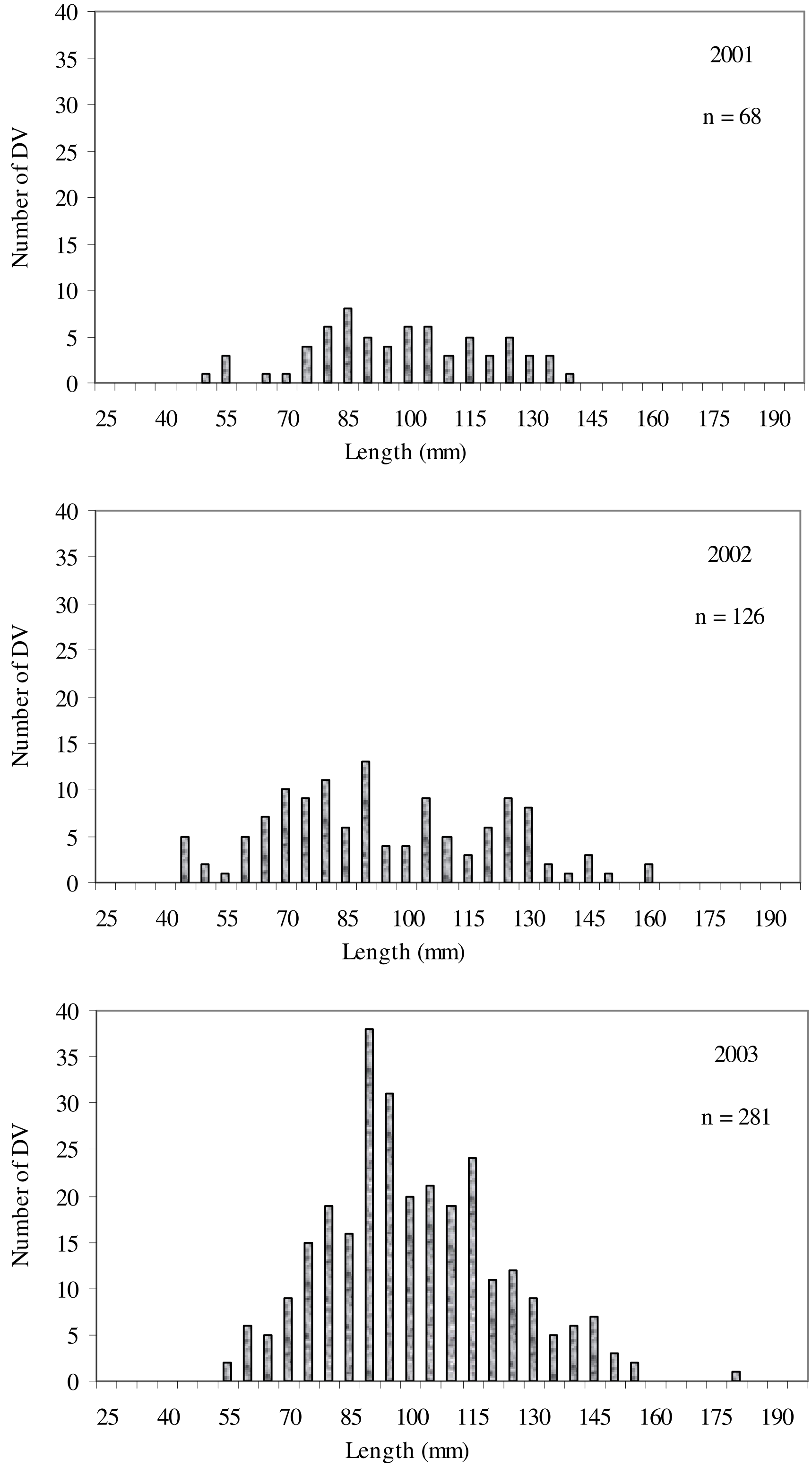


Figure 8. Dolly Varden captured at Upper Greens Creek Site 48 in 2001, 2002, and 2003.

Fork lengths of captured Dolly Varden represented a wide range of fish sizes. We have no validation data to correlate fish lengths with age as determined through scale or otolith analyses, but the length frequency plots (Figure 8) suggest that multiple age classes of Dolly Varden were captured in all three years of biomonitoring.

Metals Concentrations in Juvenile Fish

Concentrations of metals in juvenile Dolly Varden tissues were similar to or less than those found in 2001 and 2002 (Figure 9, Appendix 4). For comparison testing, silver concentrations were assumed to be the detection level (0.02 mg Ag/kg). Concentrations of silver and lead in 2003 were significantly less ($\alpha = 0.05$) than in 2002. Concentrations of cadmium and copper in 2003 were significantly less than in 2001. The mean rank scores for selenium and zinc concentrations in 2003 were not significantly different from previous years, although the selenium concentrations were slightly higher.

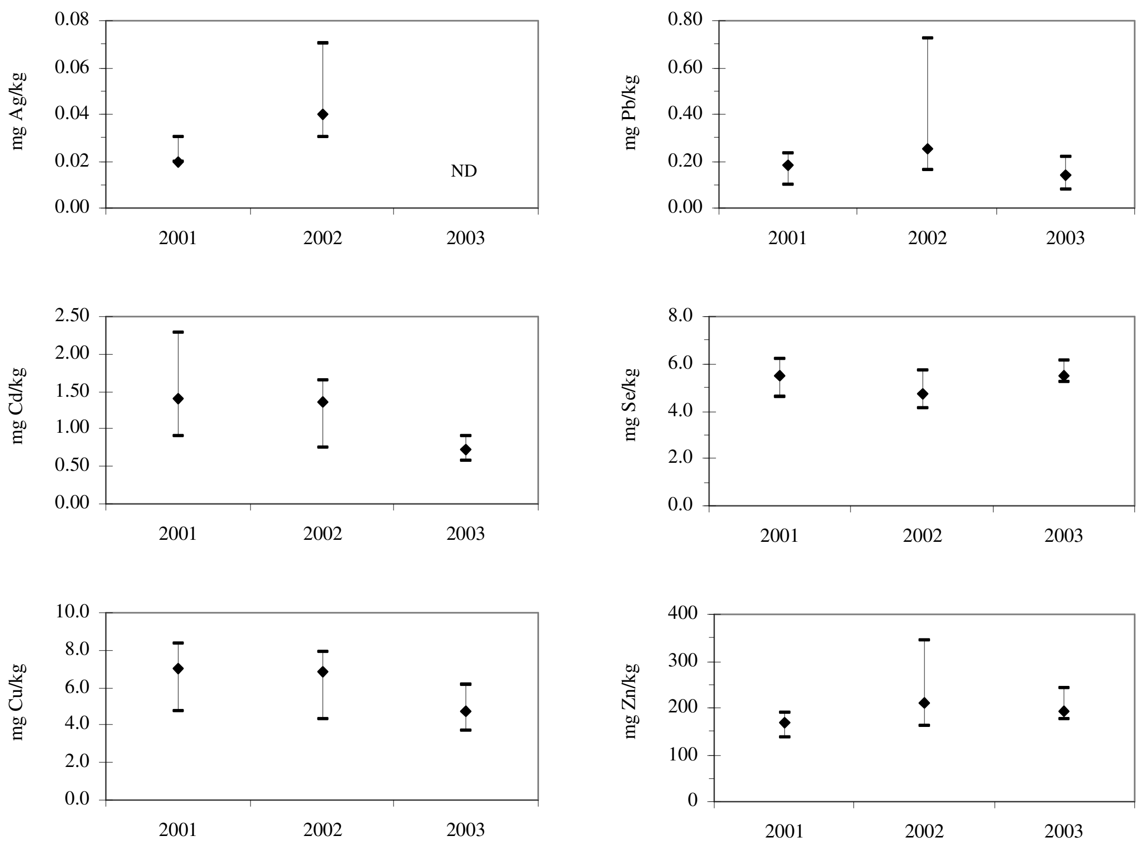


Figure 9. Whole body metals concentrations (medians and ranges) in Dolly Varden captured at Upper Greens Creek Site 48 in 2001, 2002 and 2003. ND = Not Detected at detection level of 0.02 mg Ag/kg.

Toxicity Testing

Water samples taken at Upper Greens Creek Site 48 for acute toxicity tests were not analyzed in 2003. In 2001 we did not detect any toxicity in any of the dilutions of Upper Greens Creek Site 48 water with either the chronic or the acute Microtox toxicity tests. In 2002 we did not find toxic effects from any of the dilutions of Greens Creek Site 48 water in the acute Microtox toxicity tests. Because dilutions ranged from 5% to 45% of Greens Creek Site 48 waters, our calculated IC-20 values for 2001 and 2002 were >100%. The results from the 2003 periphyton, benthic invertebrate, and juvenile fish biomonitoring program elements provide no evidence to suggest toxicity of the waters at the Upper Greens Creek Site 48.

Summary

The abundant periphyton and benthic macroinvertebrate communities, prevalence of pollution-sensitive invertebrate species, and stable metals concentrations over time in Dolly Varden in Upper Greens Creek Site 48 signify a functioning and healthy aquatic community. The Dolly Varden population density and size distribution is within expectations for this type of stream channel reach with a downstream barrier to anadromous fish.

MIDDLE GREENS CREEK SITE 6

Middle Greens Creek Site 6 (below the confluence of Bruin Creek) has been monitored continuously under the FWMP since 1978. The site was located to detect potential effects on Greens Creek from activities in the KGCMC mine, mill, and shop areas. Access of anadromous fish to this stream reach was created by KGCMC in 1989 by installing a fish pass in a waterfall about 5 km downstream. This site is near the upper limit of anadromous fish, defined by a weir located about 1 km upstream. Both Dolly Varden and coho salmon have been found in this reach. Biomonitoring information from this site will be used to detect possible changes in aquatic communities that occur from natural causes or as a result of mine activities. Biomonitoring data were collected in 2001 for baseline information (Weber Scannell and Paustian 2002); the site will be sampled again as part of the biomonitoring program in 2006.

GREENS CREEK BELOW POND D SITE 54

Greens Creek Below Pond D Site 54 (Figure 10) is located about 0.5 km downstream of Middle Greens Creek Site 6 and about 1 km downstream of the weir that limits the upstream migration of anadromous fish in Greens Creek. Anadromous fish access to Site 54 was created by KGCMC in 1989 when a fish pass was installed in a waterfall area about 5 km downstream. Both Dolly Varden and coho salmon have been documented in this reach.

The Greens Creek Below Pond D Site 54 sample reach has a Moderate Width Mixed Control (MM2) channel type (Appendix 1), with an average stream width of 10 m and a gradient of 2-4 percent. This is a typical stream for the middle to lower portions of moderately sized basins in southeast Alaska (Paustian et al. 1992, Weber Scannell and Paustian 2002). Cobble was the dominant streambed material and large woody debris has been integral to pool formation and fish habitat cover.

Greens Creek Below Pond D Site 54 was sampled in the morning of 22 July 2003. The weather was overcast, air temperature was 13.5°C, and water temperature was 9.5°C.

Figure 10. Greens Creek Below Pond D Site 54, 22 July 2003.

Periphyton Biomass

Concentrations of chlorophyll *a*, an estimate of periphyton biomass, in Greens Creek Below Pond D Site 54 were somewhat different ($\alpha = 0.10$) in 2001, 2002, and 2003, and were significantly higher ($\alpha = 0.01$) in 2003 than in 2001(Figure 11). Differences among the three years were similar to but more pronounced than those found at Upper Greens Creek Site 48, and are likely a result of climatic conditions, including water temperature and flow rates during the month before sampling.

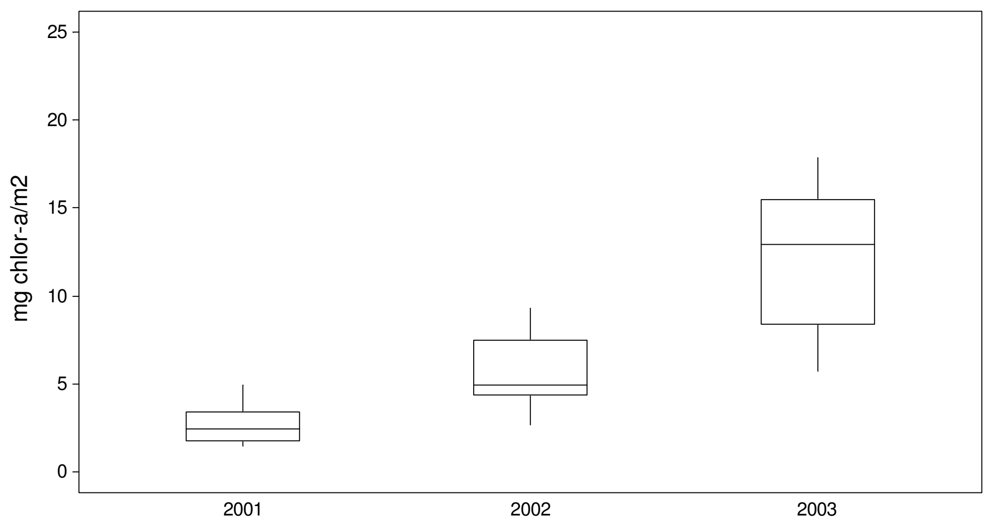


Figure 11. Estimated periphyton biomass densities at Greens Creek Below Pond D Site 54 in 2001, 2002, and 2003. Box encompasses middle half of data; horizontal line is median value.

The periphyton community was similar to that found in Upper Greens Creek Site 48, with chlorophyll *a* the dominant pigment and a higher proportion of chlorophyll *c* than chlorophyll *b* (Figure 12). As in Upper Greens Creek Site 48, the higher proportions of chlorophyll *c* at Greens Creek Below Pond D Site 54 indicate an algal community dominated by diatoms while low concentrations of chlorophyll *b* correspond to low populations of filamentous green algae and blue-green bacteria.

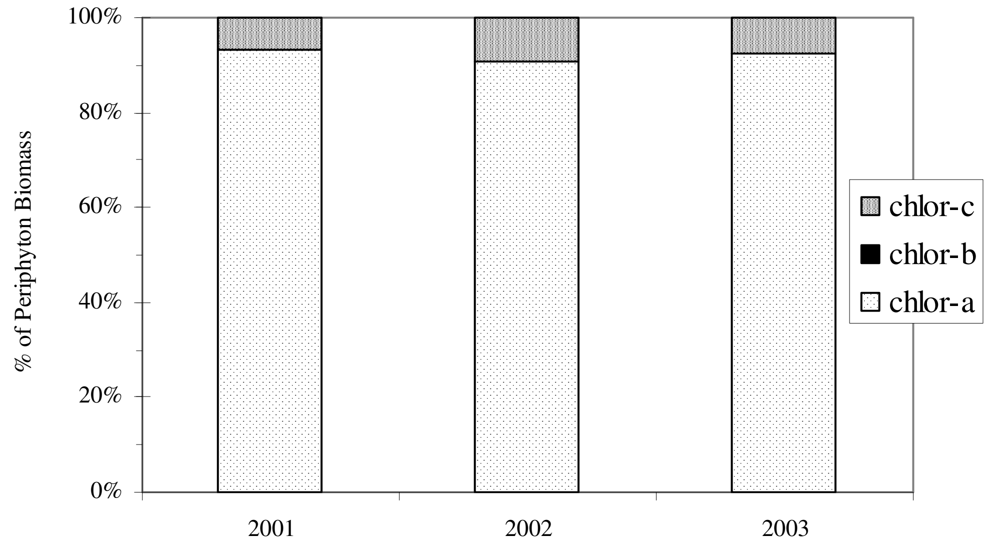


Figure 12. Proportions of chlorophylls *a*, *b*, and *c* in Greens Creek Below Pond D Site 54 in 2001, 2002, and 2003.

Benthic Macroinvertebrates

The average density of aquatic invertebrates in Greens Creek Below Pond D Site 54 was higher in 2003 (4670/m²) than in 2002 (2932/m²) although not significantly so ($\alpha = 0.11$). Average density in 2001 (3564/m²) was not significantly different from that in either 2002 or 2003 (Figure 13). Taxonomic richness was similar during the three years sampled. In 2001, we collected and identified 28 distinct aquatic taxa with an average of 15.2 taxa per sample; in 2002 we had 30 distinct taxa with an average of 13.8 taxa per sample; and in 2003 we had 26 distinct taxa with an average of 16.2 taxa per sample (Appendix 2).

Invertebrate communities in Greens Creek Site 54 were dominated by EPT taxa (Figure 14). In 2001, 2002, and 2003, Ephemeroptera were the most commonly collected order (Figure 15). In 2003, the Ephemeroptera were dominated by Baetidae: *Baetis,* Ephemerella: *Drunella*, and Heptageniidae: *Cinygumula, Epeorus*, and *Rhithrogena*. The dominance of the aquatic invertebrate community by these pollution-sensitive taxa (Table 4), combined with the mixture of many species of mayflies, stoneflies, caddisflies, and true flies (Appendix 2) suggests a complex and healthy aquatic ecosystem at this site.

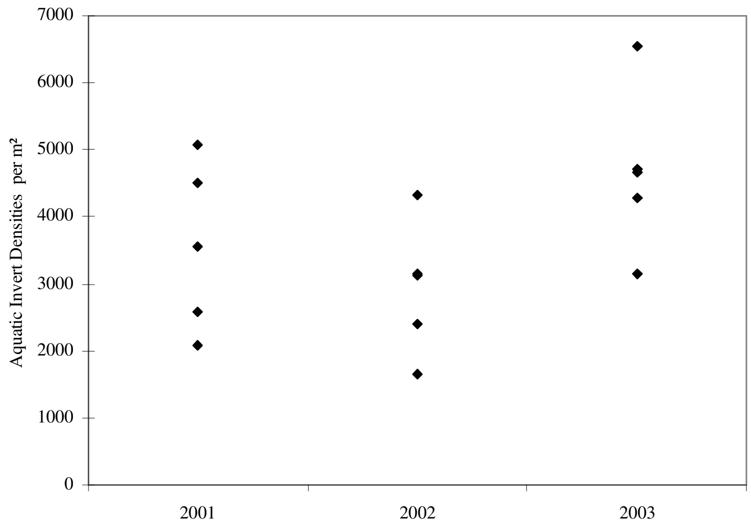


Figure 13. Density of aquatic invertebrates (n = 5 samples each year) at Greens Creek Below Pond D Site 54 in 2001, 2002, and 2003.

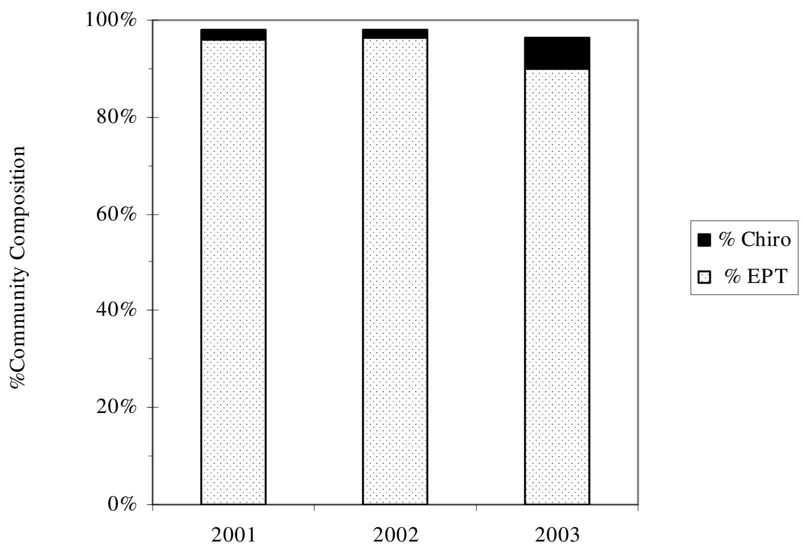


Figure 14. Proportions of EPT taxa and Chironomidae at Greens Creek Below Pond D Site 54 in 2001, 2002, and 2003.

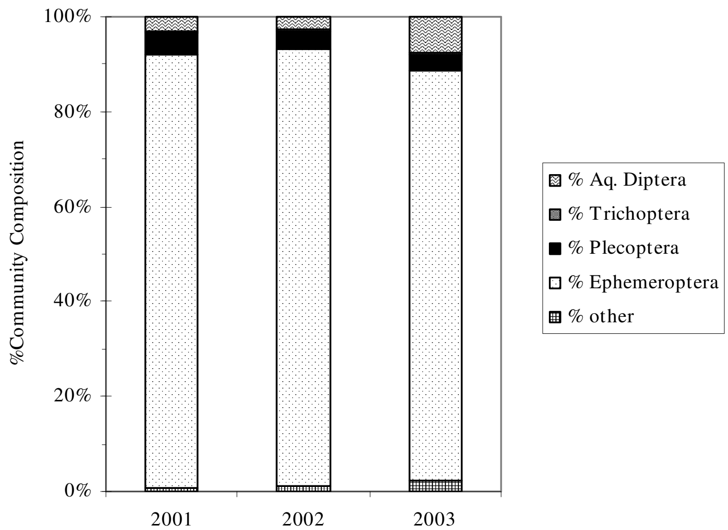


Figure 15. Community composition of aquatic invertebrates at Greens Creek Below Pond D Site 54 in 2001, 2002, and 2003.

Table 4. Common taxa (>5% of invertebrates found in samples) at Greens Creek Below Pond D Site 54 in 2001, 2002, and 2003.

Order	Family	Genus	2001	2002	2003
Ephemeroptera	Baetidae	*Baetis*	14	15	9
	Ephemerellidae	*Drunella*	7	19	38
	Heptageniidae	*Cinygmula*	18	5	8
		Epeorus	53	43	17
		Rhithrogena		10	13
Diptera	Chironomidae				6

Juvenile Fish Populations

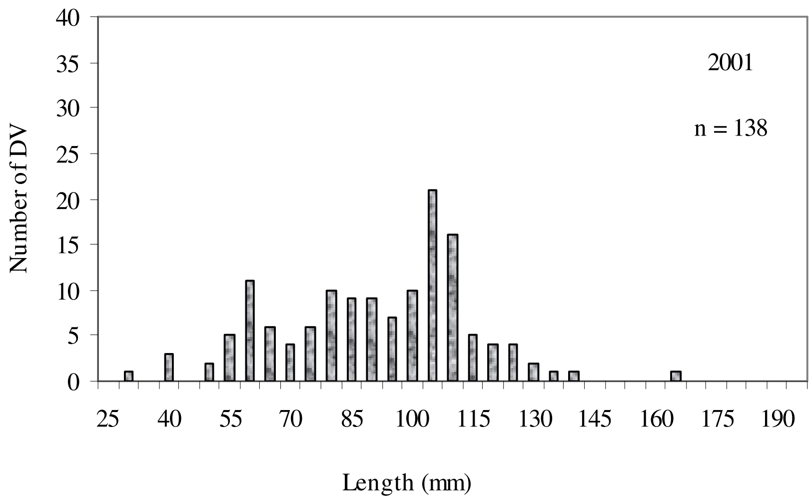
The 2003 juvenile fish survey at Greens Creek Below Pond D Site 54 captured 8 coho salmon and 232 Dolly Varden in 16 minnow traps in the same 28-m reach as sampled in 2001, 2002, and 2003. Two "block" traps were used immediately below the sample reach, one on each side of the stream. These traps captured an additional 15 Dolly Varden that are not included in the reported results. In 2001, the USFS reported catching too few juvenile coho salmon at Greens Creek Below Pond D Site 54 to estimate the population; in 2002 and 2003 juvenile coho salmon captures were high enough to estimate populations but too low for the 95% confidence interval to be meaningful (Table 5, Appendix 3). Dolly Varden were captured in greater abundance, with a wide range of size classes.

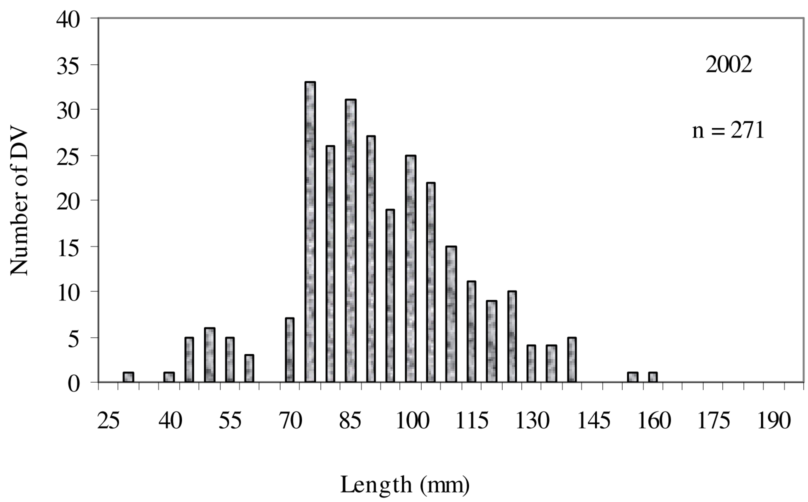
Table 5. Juvenile fish population estimates for Greens Creek Below Pond D Site 54.

Year Sampled	Fish Species	No. Fish Caught	FLength mm	Popn Estimate, Fish (95% CI)	Sample Reach, m	Density, fish/m^2
2001	DV	138	30-165*	164 (150, 200)	28	0.6
2002	DV	271	33-160	293 (282, 315)	28	1.0
2003	DV	232	51-184	331 (275, 387)	28	1.8**
2001	CO	---	---	Too few fish	28	---
2002	CO	21	55-85	21	28	0.07
2003	CO	8	44-52	8	28	0.04**

* Lengths represent upper end of 5-mm summary intervals reported by USFS.
** Based on estimated wetted area value.

We have no validation data to correlate fish lengths with age as determined through scale or otolith analyses, but the length frequency plots (Figure 16) suggest that multiple age classes of Dolly Varden were captured in all three years of biomonitoring.





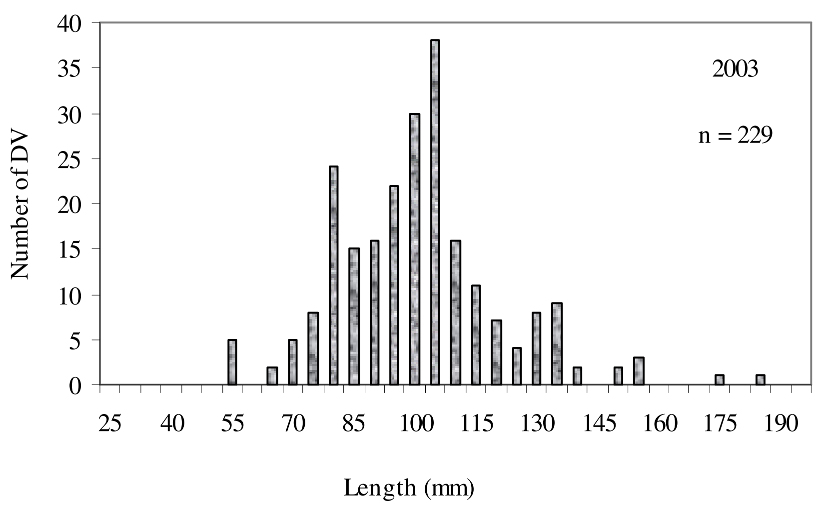


Figure 16. Dolly Varden captured at Greens Creek Below Pond D Site 54 in 2001, 2002 and 2003.

Juvenile coho salmon caught at the Greens Creek Below Pond D Site 54 in 2002 and 2003 appear to come from a single age class (Figure 17).

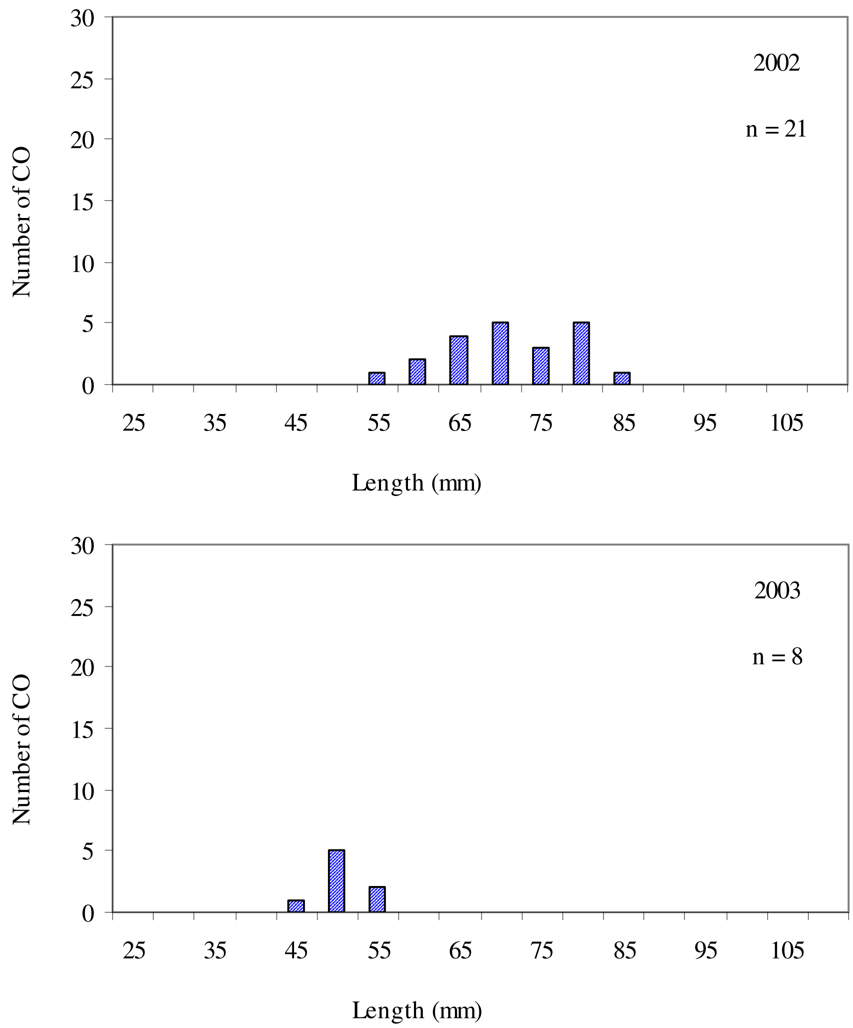


Figure 17. Juvenile coho salmon captured at Greens Creek Below Pond D Site 54 in 2001, 2002, and 2003.

Metals Concentrations in Juvenile Fish

Concentrations of metals in juvenile Dolly Varden tissues were generally similar to or less than those found in 2000, 2001, and 2002 (Figure 18, Appendix 4). Concentrations of silver, copper, and lead were similar in 2001 through 2003, and significantly less ($\alpha = 0.05$) than in 2000. Selenium concentrations in 2000 through 2002 were not significantly different from each other; 2003 concentrations were significantly higher than that group but not from the values for 2001 alone. Zinc concentrations were quite variable, with no significant differences between those in

2003 and those in previous years. There were no significant differences between years in cadmium concentrations.

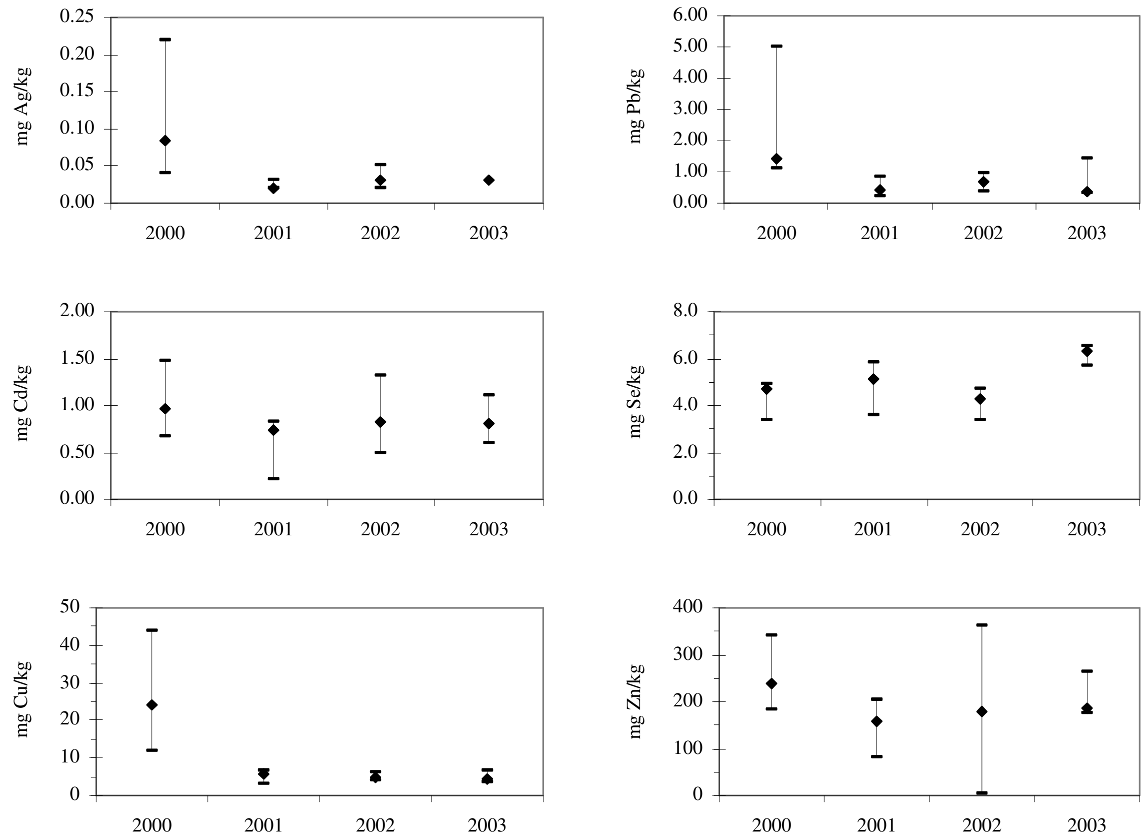


Figure 18. Whole body metals concentrations (medians and ranges) in fish captured at Greens Creek Below Pond D Site 54 in 2000, 2001, 2002 and 2003. Fish were coho salmon in 2000, Dolly Varden in other years.

Toxicity Testing

Water samples taken at Greens Creek Below Pond D Site 54 for acute toxicity tests were not analyzed in 2003. In 2001 we did not detect any toxicity in any of the dilutions of Upper Greens Creek Site 54 water with either the chronic or acute Microtox toxicity tests. In 2002 we did not find toxic effects from any of the dilutions of Greens Creek Site 54 water in the acute Microtox toxicity tests. Because dilutions ranged from 5% to 45% of Greens Creek Below Pond D Site 54 waters, our calculated IC-20 values for 2001 and 2002 were >100%. The results from the 2003 periphyton, benthic invertebrate, and juvenile fish biomonitoring program elements provide no evidence to suggest toxicity of the waters at the Greens Creek Below Pond D Site 54.

Summary

The abundant periphyton and benthic macroinvertebrate communities, prevalence of pollution-sensitive invertebrate species, and stable metals concentrations over time in Dolly Varden in Greens Creek Below Pond D Site 54 signify a functioning and healthy aquatic community. The Dolly Varden and coho salmon population densities and size distributions are within expectations for this type of stream channel reach with access to anadromous fish.

TRIBUTARY CREEK SITE 9

Tributary Creek is a small stream with a dense canopy (Figure 19). This site was previously monitored under the FWMP from 1981 through 1993 and is included in the current biomonitoring program because it is located downstream from the KGCMC dry tailings placement facilities. This creek has populations of pink (*Oncorhynchus gorbuscha*), chum (*O. keta*), and coho salmon, cutthroat trout (*O. clarki*), Dolly Varden, and sculpin (species not determined).

The sample reach in Tributary Creek Site 9 has a Narrow Low Gradient Flood Plain (FP3) Channel Type (Appendix 1), typical of a valley bottom or flat lowlands. The creek averages 2½ m wide with a 1% stream gradient, and has fine gravel as the dominant substrate (Paustian et al. 1992, Weber Scannell and Paustian 2002). The sampling reach was 44 m long in 2001, and 50 m long in 2002 and 2003.

Tributary Creek Site 9 was sampled in the morning of 23 July 2003. The weather was mostly sunny, air temperature was 14.5°C, and water temperature was 12.5°C.

Figure 19. Tributary Creek Site 9, 23 July 2003.

Periphyton Biomass

Concentrations of chlorophyll *a*, an estimate of periphyton biomass, at Tributary Creek Site 9 were similar in 2001 and 2002 and slightly higher in 2003 (Figure 20). Biomass in 2003 was significantly higher than in 2001 ($\alpha = 0.05$), whereas 2002 biomass values were not significantly different from those of either 2001 or 2003. As at the Greens Creek sites (48 and 54), the Tributary Creek Site 9 algal community contained higher proportions of chlorophyll *c* than chlorophyll *b* in 2001 and 2003 and nearly equal proportions in 2002 (Figure 21). Although dominated by diatoms, filamentous green algae and blue-green bacteria are important components of the algal community at Tributary Creek Site 9.

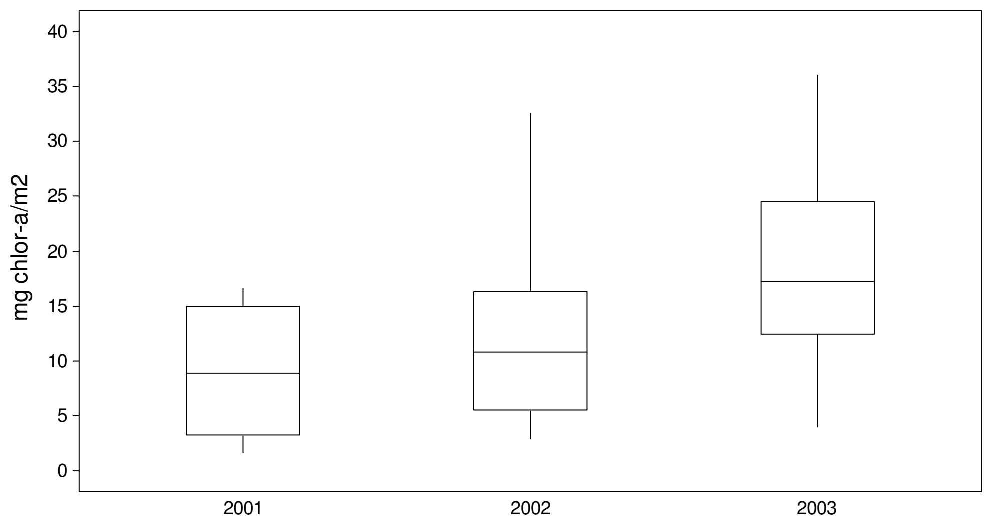


Figure 20. Estimated periphyton biomass densities at Tributary Creek Site 9 in 2001, 2002, and 2003. Box encompasses middle half of data; horizontal line is median value.

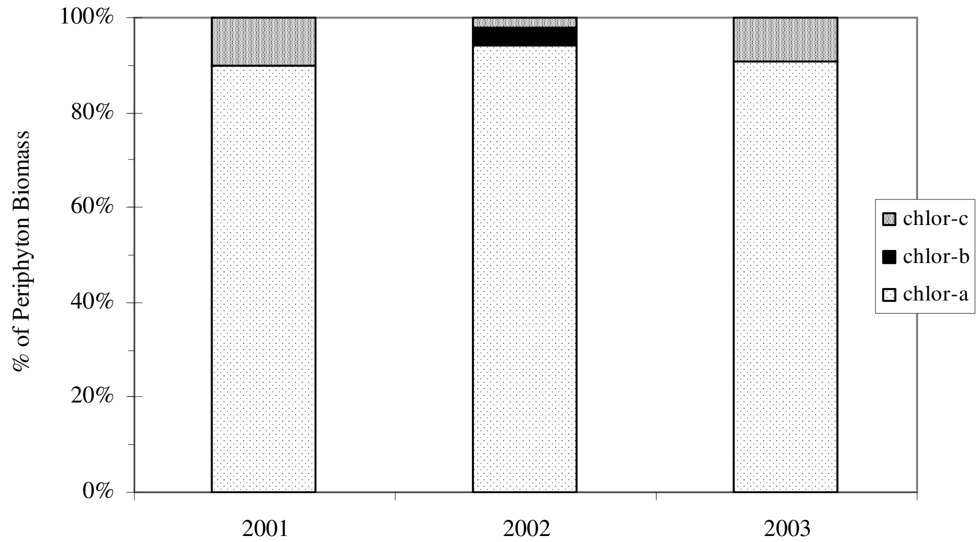


Figure 21. Proportions of chlorophylls *a*, *b*, and *c* at Tributary Creek Site 9 in 2001, 2002, and 2003.

Benthic Macroinvertebrates

As in Greens Creek Sites 48 and 54, the average density of aquatic invertebrates in Tributary Creek Site 9 was higher in 2003 (5032/m²) than in 2001 (1018/m²) or 2002 (1496/m²; Figure 22). Those in 2001 and 2003 differed significantly ($\alpha = 0.01$). Taxonomic richness, as expressed by number of taxa in samples, also increased some in 2002 and 2003. In 2001 we collected and identified 21 distinct aquatic taxa with an average of 13.6 taxa per sample; in 2002 we had 24 distinct taxa and an average of 15.2 taxa per sample; and in 2003 we had 36 distinct taxa with an average of 21.0 taxa per sample (Appendix 2).

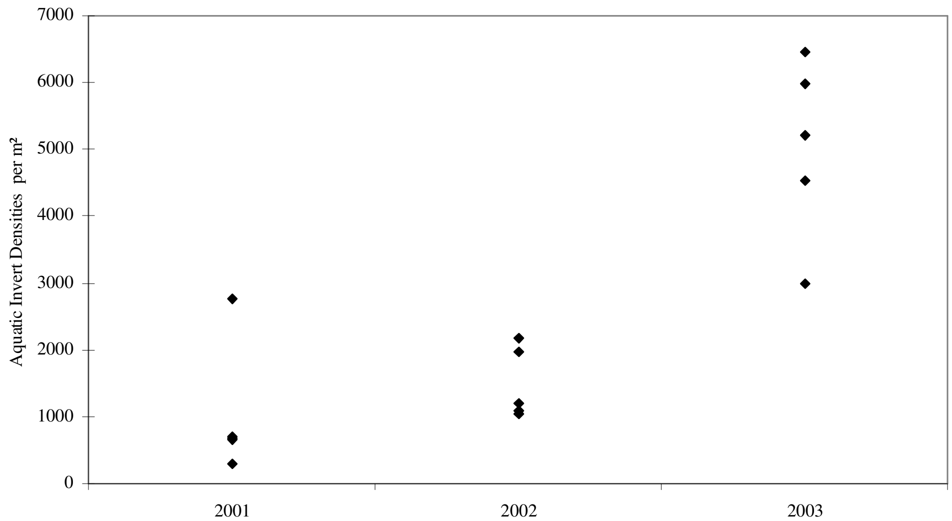


Figure 22. Density of aquatic invertebrates (n = 5 samples each year) at Tributary Creek Site 9 in 2001, 2002, and 2003.

As at the Greens Creek sites, the EPT taxa are the major component of Tributary Creek Site 9 aquatic invertebrates, while Chironomidae remain a relatively small, stable component (Figure 23).

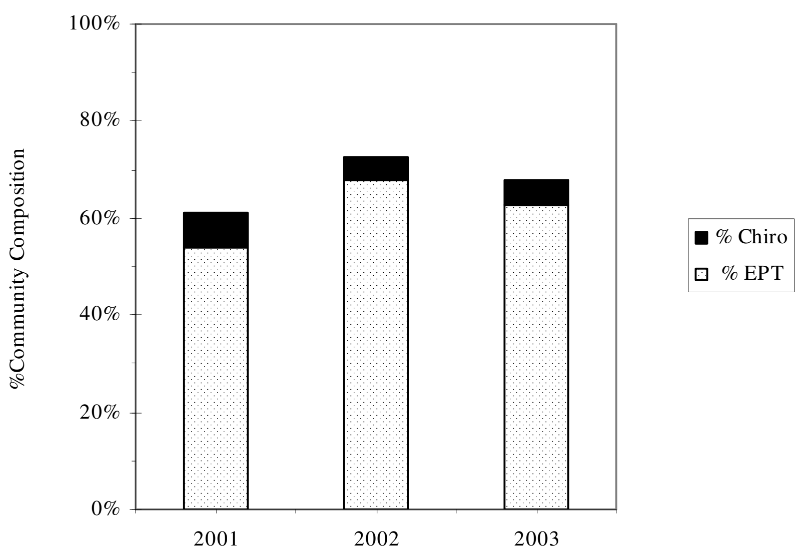


Figure 23. Proportions of EPT taxa and Chironomidae at Tributary Creek Site 9 in 2001, 2002, and 2003.

Unlike Greens Creek Sites 54 and 48 where one or two invertebrate taxa compose more than half of the community, the Tributary Creek Site 9 has a complex invertebrate community of mayflies, stoneflies, caddisflies, true flies, and non-insect groups containing lower proportions of many taxa (Table 6). Pollution-sensitive taxa, such as the mayflies *Baetis*, *Cinygmula*, and *Paraleptophlebia* were well represented (Figure 24). The presence of these orders reflects the stream channel characteristics of a small, valley-bottom stream with attached wetland areas. The non-insect group included springtails (Collembola), worms (Oligochaeta), mites (Acarina), and seed shrimp (Ostracoda).

Table 6. Common taxa (>5% of invertebrates found in samples) at Tributary Creek Site 9 in 2001, 2002, and 2003.

Order	Family	Genus	2001	2002	2003
Ephemeroptera	Baetidae	*Baetis*	8%	16%	6%
	Heptageniidae	*Cinygmula*	17%	24%	20%
	Leptophlebiidae	*Paraleptophlebia*	13%	13%	10%
Plecoptera	Chloroperlidae	*Suwallia*	7%		
		Sweltsa		6%	
		Neaviperla			7%
	Nemouridae	*Zapada*			15%
Diptera	Chironomidae		7%		
	Simuliidae	*Simulium*	8%		
Acarina				6%	
Oligochaeta			8%		14%
Ostracoda			18%		8%
Isopoda	Gammaride	*Gammarus*		14%	

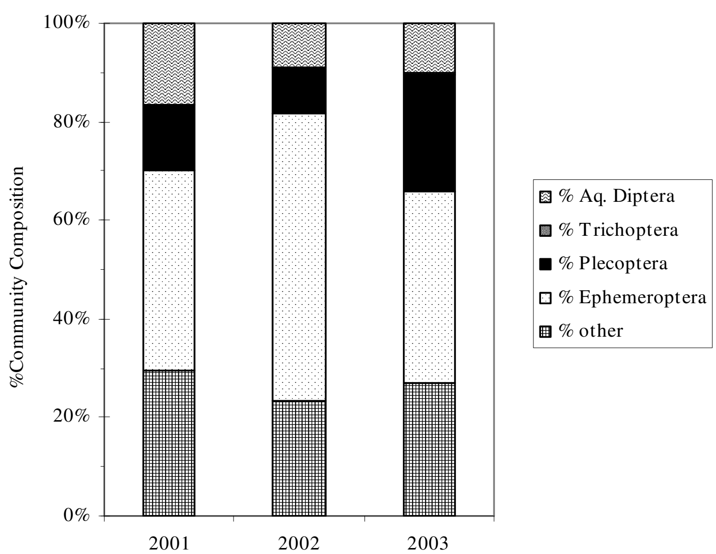


Figure 24. Community composition of aquatic invertebrates at Tributary Creek Site 9 in 2001, 2002, and 2003.

Juvenile Fish Populations

A variety of fishes rear in Tributary Creek, including coho salmon, Dolly Varden, cutthroat trout, and sculpin. Coho, pink, and chum salmon spawn in the creek but not necessarily at the sampling site. Cutthroat trout and sculpin are minor components of the fish community in this portion of Tributary Creek.

The 2003 juvenile fish survey in Tributary Creek Site 9 captured 52 coho salmon, 19 Dolly Varden, one cutthroat trout, and one sculpin in 19 minnow traps in the same 50-m sample reach as sampled in 2002. The low flow conditions in 2003 limited the ability to place minnow traps, and no "block" traps were placed because the nearly dry riffles above and below the sample reach appeared to provide adequate barriers to fish movement. Captures of Dolly Varden were lower in 2003 than in 2001 and 2002, while coho salmon captures were higher than in 2002 and lower than in 2001 (Table 7, Appendix 3). The effect of limitations on available habitat due to low water levels is unknown for either species composition or density, but the total density of fish in available habitat areas (1.1 fish/m²) was intermediate between densities found in 2001 (1.6 fish/m²) and in 2002 (0.8 fish/m²).

The range of fork lengths measured in both Dolly Varden and coho salmon captured at Tributary Creek Site 9 in 2003 suggest use by multiple age classes of both species (Figures 25 and 26).

Table 7. Juvenile fish population estimates for Tributary Creek Site 9.

Year Sampled	Fish Species	No. Fish Caught	FLength, mm	Popn Estimate, fish (95% CI)	Sample Reach, m	Density, fish/m^2
2001	DV	81	60-110*	81 (81, 81)	44	0.65
2002	DV	51	38-147	57 (53, 76)	50	0.46
2003	DV	19	54-114	20 (17, 23)	50	0.3**
2001	CO	118	40-105*	120 (119, 128)	44	0.94
2002	CO	44	27-85	46 (45, 47)	50	0.35
2003	CO	52	46-88	53 (51, 55)	50	0.8**

* Lengths represent upper end of 5-mm summary intervals reported by USFS.
** Based on estimated wetted area value.

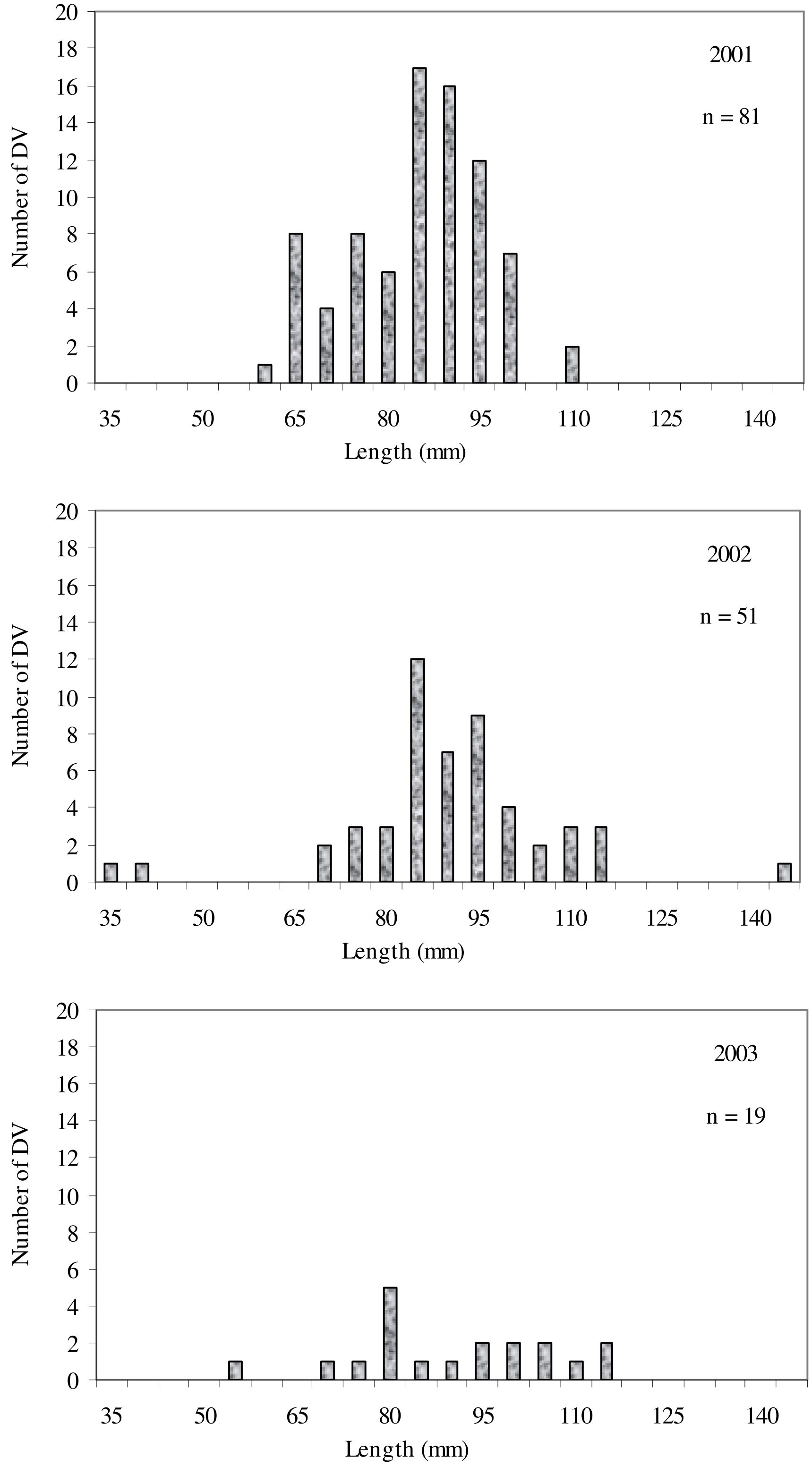


Figure 25. Dolly Varden captured at Tributary Creek Site 9 in 2001, 2002, and 2003.

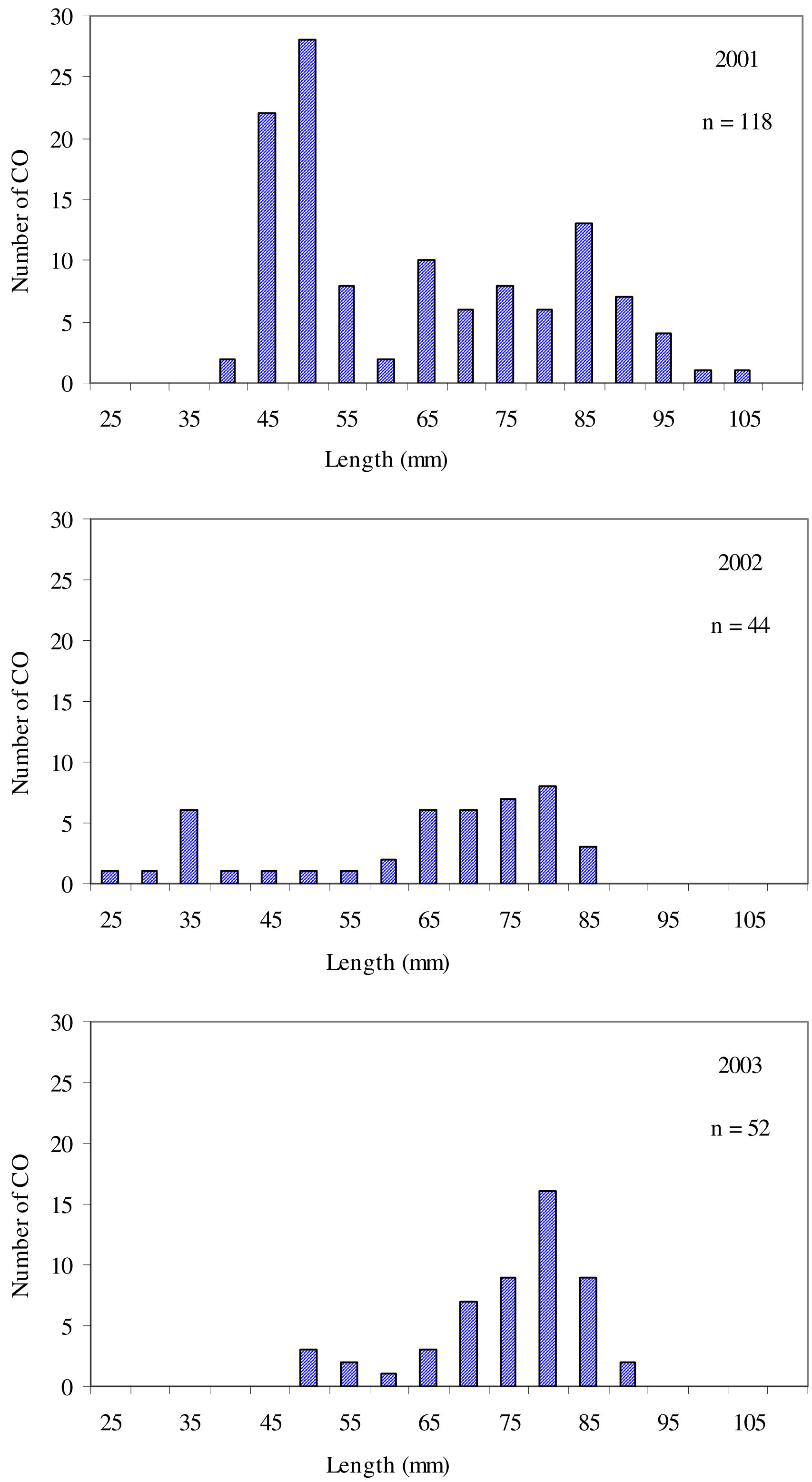


Figure 26. Coho salmon captured at Tributary Creek Site 9 in 2001, 2002, and 2003.

Metals Concentrations in Juvenile Fish

Concentration of metals in juvenile Dolly Varden tissues from Tributary Creek Site 9 were similar or less than those found in 2000, 2001, and 2002 (Figure 27, Appendix 4). Concentrations of silver, cadmium, and lead were not significantly different ($\alpha > 0.1$) between years. Concentrations of copper were significantly higher ($\alpha = 0.05$) in 2000 than in other years, and concentrations of selenium and zinc were significantly different between 2000 and 2001 only.

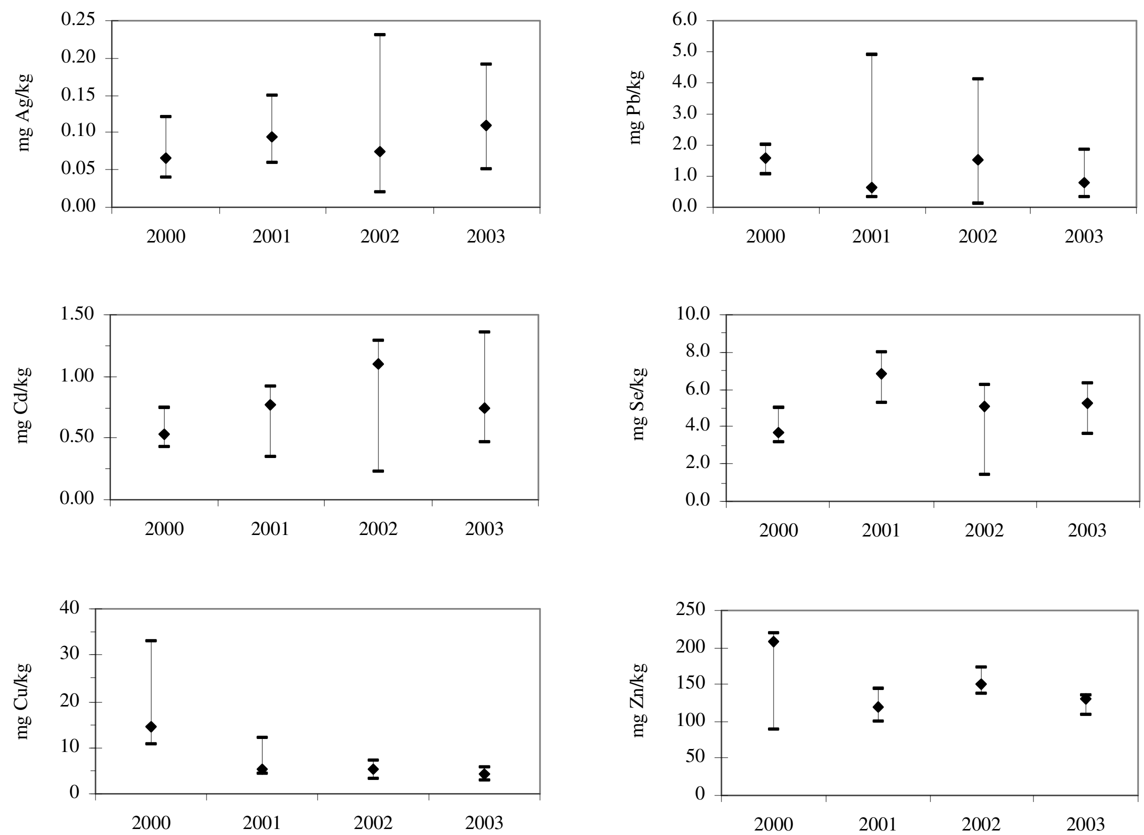


Figure 27. Whole body metals concentrations (medians and ranges) in fish captured at Tributary Creek Site 9 in 2000, 2001, 2002, and 2003. All fish Dolly Varden except two coho salmon in 2000.

Toxicity Testing

Water samples taken at Tributary Creek Site 9 for acute toxicity tests were not analyzed in 2003. In 2001 we did not detect any toxicity in any of the dilutions of Tributary Creek Site 9 water with either the chronic or acute Microtox toxicity tests. In 2002 we did not find toxic effects from any of the dilutions of Tributary Creek Site 9 water in the acute Microtox toxicity tests. Because dilutions ranged from 5% to 45% of Tributary Creek Site 9 waters, our calculated IC-20 values for 2001 and 2002 were >100%. The results from the 2003 periphyton, benthic invertebrate, and juvenile fish biomonitoring program elements provide no evidence to suggest toxicity of the waters at the Tributary Creek Site 9.

Summary

The abundant periphyton and diverse benthic macroinvertebrate communities, abundance of pollution-sensitive invertebrate species, and stable metals concentrations over time in Dolly Varden in Tributary Creek Site 9 all indicate a functioning and healthy aquatic community. The Dolly Varden and coho salmon population densities and size distributions are within expectations for this type of stream channel reach with access to anadromous fish.

Comparisons Among Sites

Periphyton Biomass

Periphyton biomass was higher in 2003 than in previous years. Chlorophyll *a* concentrations were not significantly different among sites in 2003, although Tributary Creek continued to have the higher median value. Taking the three sites together, the 2003 values were significantly (α= 0.05) higher than those for 2001 or 2002 (Figure 28). This was not surprising given the lower water levels in 2003 since water velocities were lower and stream temperatures were likely warmer than in previous years.

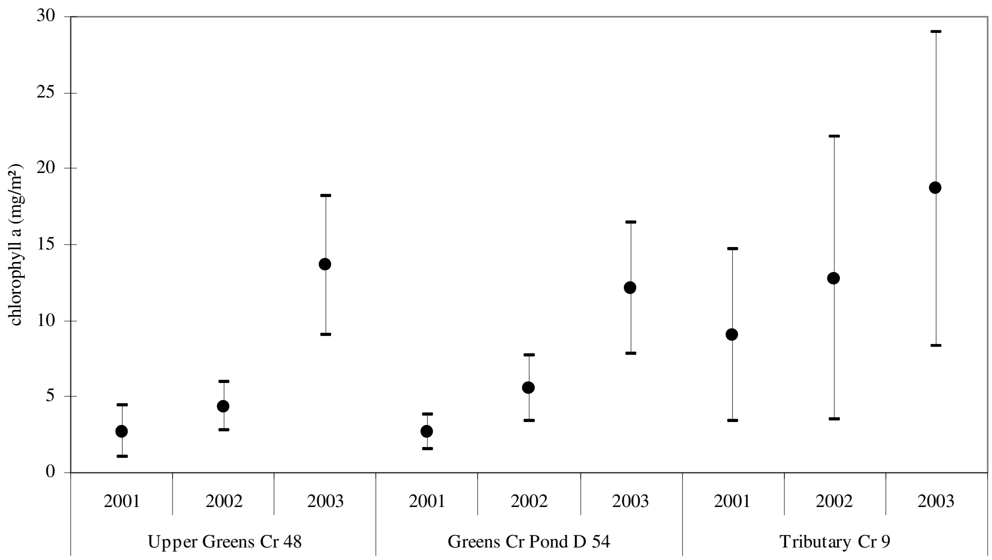


Figure 28. Comparison of estimated periphyton biomass (medians and ranges) among biomonitoring sites sampled in 2001, 2002, and 2003.

There were no significant differences in community composition of the periphyton sampled at the Greens Creek and Tributary Creek sites in 2003 (Figure 29). Chlorophyll *a* is the primary photosynthetic pigment, is present in all algae, and is a useful indicator of a healthy algal community (Wetzel 1983). The low concentrations of chlorophyll *b,* sometimes below detection limits, are not unusual. Chlorophyll *b* is an accessory pigment and is usually found in combination with other photosynthetic pigments. When measured above detection limits, Chlorophyll *b* is an indication of the presence of green algae and euglenophytes. Chlorophyll *c* is also an accessory pigment, and is only found in the photosynthetic Chromista and dinoflagellates (Waggoner and Speer 1999), of which diatoms form a major group in the periphyton community. Measurable quantities of chlorophyll *c* indicate the importance of diatoms in the community.

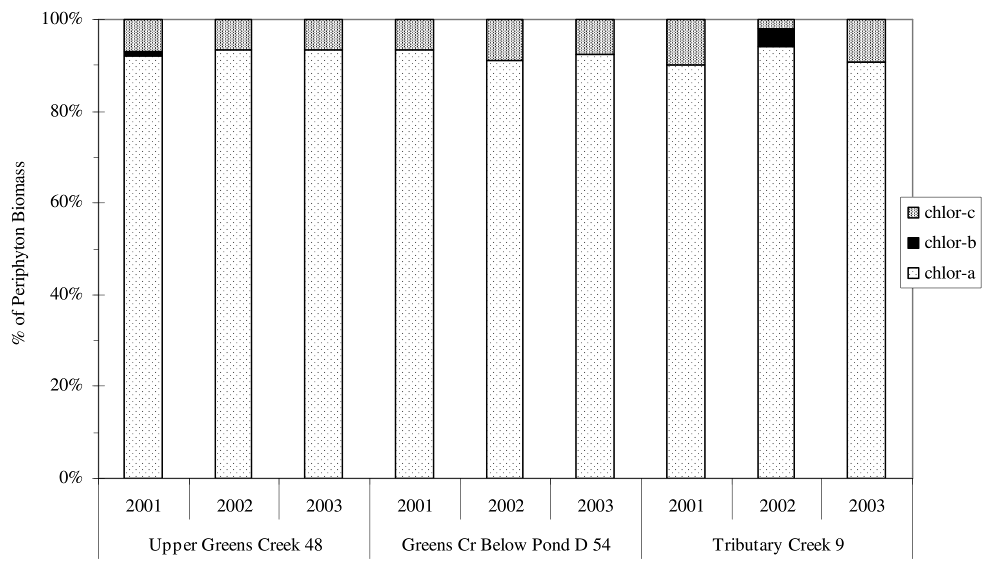


Figure 29. Comparison of proportions of chlorophylls *a*, *b*, *c* among sites in 2001, 2002, and 2003.

In the 2001 Upper Greens Creek Site 48 and 2002 Tributary Creek Site 9 samples, chlorophyll *b* was higher than in other samples, suggesting that at the time of sampling there was a larger percentage of green and blue-green algae in the periphyton community (Wetzel 1983). Given the differences in channel morphology, flow regimes and streamside vegetation between streams and years, the differences in algal communities are not unexpected. The periphyton communities in all biomonitoring sites are well within ranges of healthy aquatic systems (Wetzel 1983).

Benthic Macroinvertebrates

Average aquatic invertebrate densities were quite similar at all sites in 2003 and significantly higher ($\alpha = 0.01$) than at any site in 2001 or 2002 (Figure 30). We believe that this is a primarily related to the lower water levels and higher periphyton production in 2003.

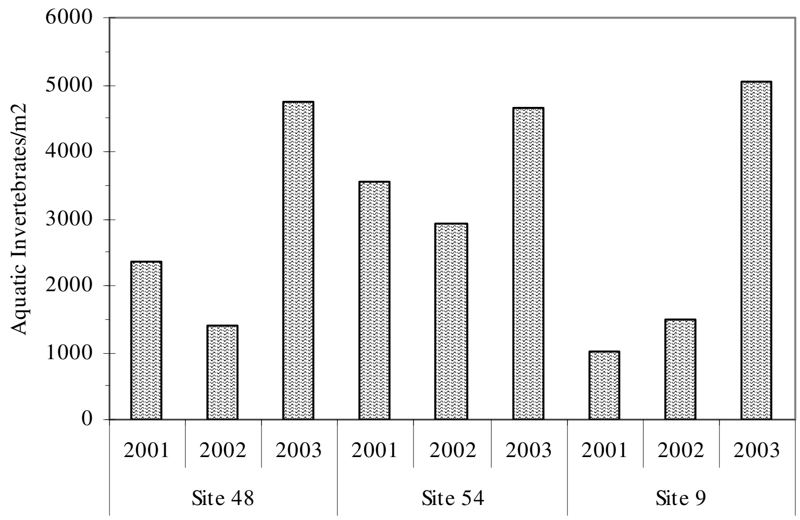


Figure 30. Comparison of aquatic invertebrate density among sites in 2001, 2002, and 2003.

All three of the biomonitoring sites had complex invertebrate communities with fairly large numbers of distinct taxa per sample (Figure 31). More than 50% of the invertebrates in Greens Creek sites 54 and 48 were one or two taxa; however, communities in Tributary Creek Site 9 contained lower proportions of many taxonomic groups (Figure 32). Differences in the structure of these communities reflect differences in channel morphology, frequency of flood events, streamside vegetation, and flow rates. Aquatic habitats with fairly even stream flows, such as Tributary Creek Site 9, usually do not have communities dominated by as few taxa as do more variable habitats (Hynes 1970). The predominance of one or two taxa in the Greens Creek sites is likely a result of perturbations due to higher stream flows and rapid re-colonization during lower water levels.

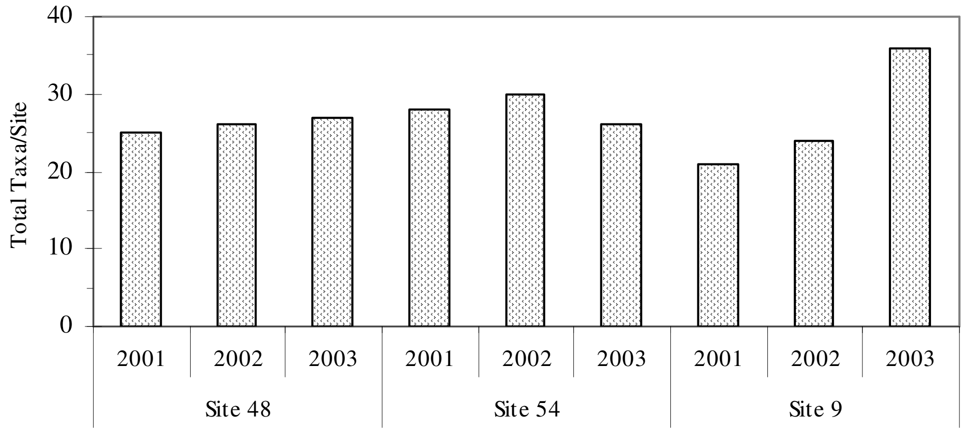


Figure 31. Comparison of benthic macroinvertebrate taxonomic richness among sites in 2001, 2002, and 2003.

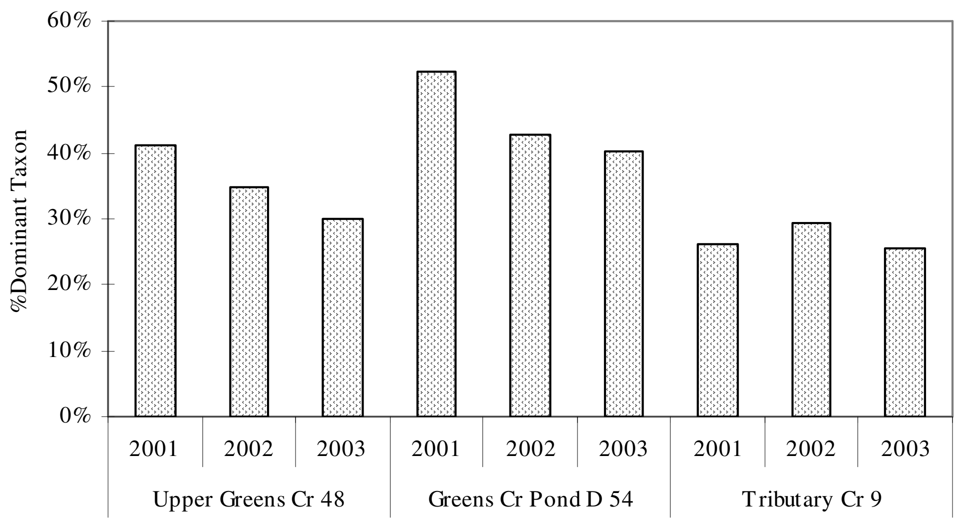


Figure 32. Comparison of benthic macroinvertebrate percent dominant taxa among sites in 2001, 2002, and 2003.

The percent EPT metric, based on the concept that most Ephemeroptera , Plecoptera, and Trichoptera taxa are sensitive to pollutants (Merritt and Cummins 1996), was high in all of the biomonitoring sites (Figure 33), and much higher than the percent of Chironomidae.

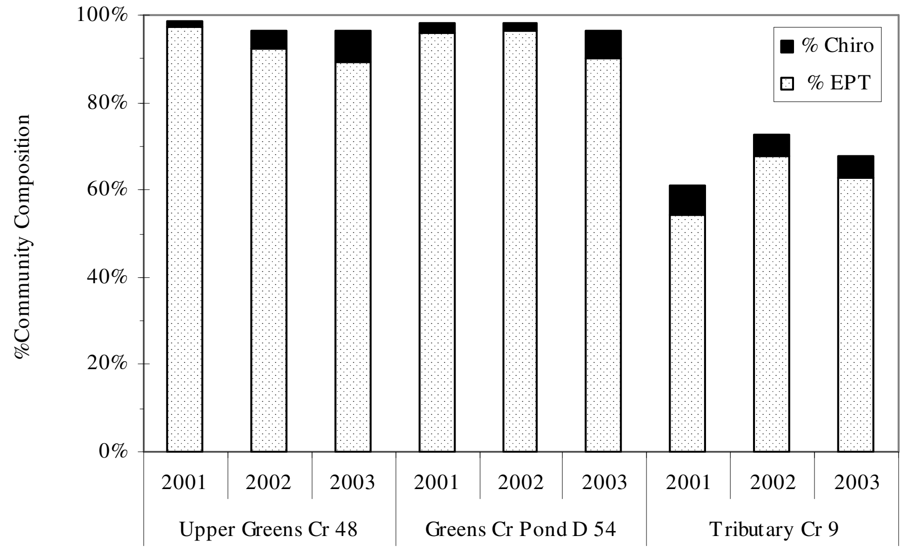


Figure 33. Comparisons of proportions of EPT taxa and Chironomidae among sites in 2001, 2002, and 2003.

Aquatic invertebrate communities in Greens Creek sites 48 and 54 were more similar to one another than to those in Tributary Creek Site 9 (Figure 34). Aquatic communities at both Greens Creek sites were dominated by mayflies (Ephemeroptera), with small contributions by stoneflies (Plecoptera) and true flies (aquatic Diptera). At Tributary Creek Site 9, the community was only slightly dominated by mayflies and contained numerous non-insect invertebrates. Aquatic Diptera and Plecoptera also were more important components of the aquatic community in Tributary Creek Site 9 than in Greens Creek sites 48 and 54. This difference is likely due to differences in physical characteristics of the stream systems.

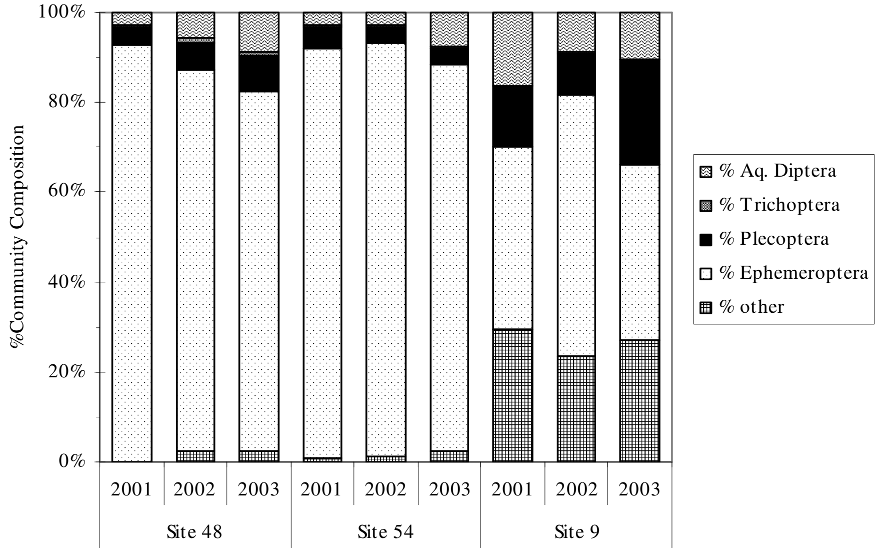


Figure 34. Comparison of community composition of aquatic invertebrates among sites in 2001, 2002, and 2002.

Density and taxonomic richness showed all three communities to be well-developed, complex communities with high invertebrate abundance. The percent dominant taxa showed the communities to have high proportions of pollution-sensitive invertebrates, and where a community was dominated by one or two groups, those groups were sensitive to pollution. Because all three communities show a prevalence of pollution-sensitive species, we believe that any perturbations by pollution or natural stressors in the future would likely cause a substantial change in the abundance or diversity of aquatic invertebrates.

Juvenile Fish Populations

All three biomonitoring sites supported relatively abundant fish populations in 2003 for the stream types and locations (Paustian et al. 1990). In terms of population estimates per sample reach, 2003 captures in both Greens Creek sites were higher than in either 2001 or 2002, while Tributary Creek Site 9 had lower numbers (Figure 35, Appendix 3). Comparisons among all sites must be tempered by the differences in size and channel type between Greens Creek and Tributary Creek, as reflected in the fish density values (population estimate per m² of wetted area in each sample reach) shown in Table 8. Using this metric, the 2003 production in Tributary Creek was higher than all three sites in 2002 and both Greens Creek sites in 2001. Densities were lowest in Greens Creek Site 48, which has resident fish only because anadromous fish access is limited by a weir downstream of the sample reach (Weber Scannell and Paustian 2002).

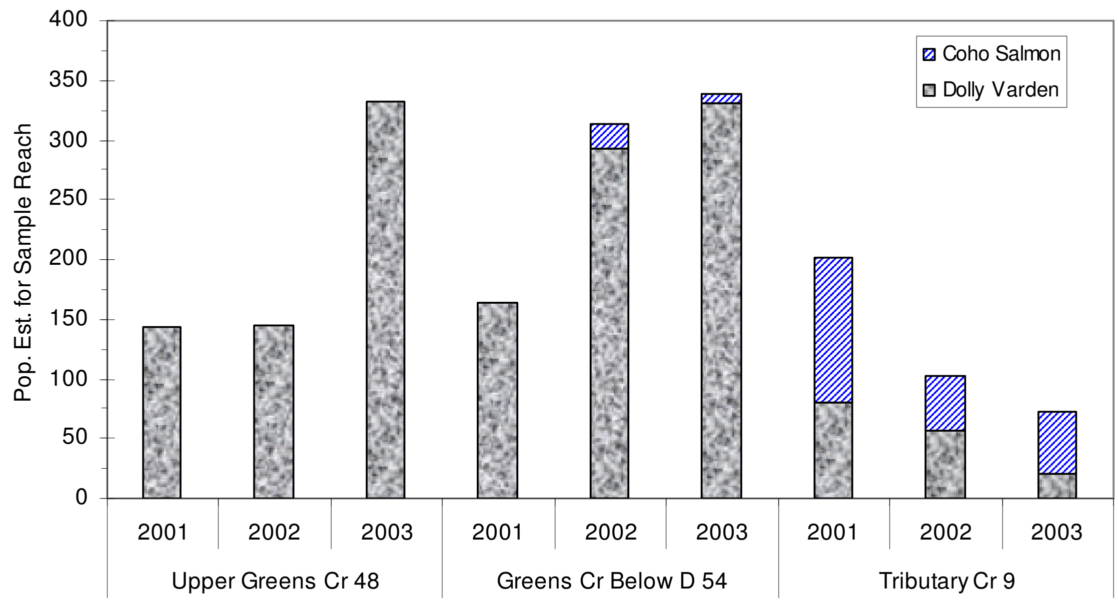


Figure 35. Population estimates for juvenile fish captured at Greens Creek Mine biomonitoring sites in 2001, 2002, and 2003.

Table 8. Estimated fish densities in the Greens Creek Mine biomonitoring site reaches.

	Upper Greens Creek Site 48		**Greens Creek Below Pond D Site 54**		**Tributary Creek Site 9**	
	Coho Salmon	Dolly Varden	Coho Salmon	Dolly Varden	Coho salmon	Dolly Varden
2001						
Number Fish Caught	*	68	***	138	118	81
Sample Reach, m	72	72	28	28	44	44
Population Estimate, fish	*	144	***	164	120	81
Density Est., fish/m^2	*	0.2	***	0.6	0.94	0.65
2002						
Number Fish Caught	*	126	21	271	44	51
Sample Reach, m	50	50	28	28	50	50
Population Estimate, fish	*	145	21	293	46	57
Density Est., fish/m^2	*	0.23	0.07	1.0	0.35	0.46
2003						
Number Fish Caught	*	285	8	232	52	19
Sample Reach, m	50	50	28	28	50	50
Population Estimate, fish	*	333	8	331	53	20
Density Est., fish/m^2	*	0.9**	0.04**	1.8**	0.8**	0.3**

* Coho salmon not present since above barrier to anadromous fish.
** Based on estimated wetted area value.
*** FS reported too few fish captured to provide estimates.

Metals Concentrations in Juvenile Fish

Dolly Varden from Greens Creek sites 48 and 54 had significantly ($\alpha = 0.05$) lower silver concentrations that did Dolly Varden from Tributary Creek, and significantly higher zinc concentrations (Figure 36). Lead concentrations were significantly lower in Upper Greens Creek Site 48 fish than in Tributary Creek Site 9 fish, while those in Greens Creek Below Pond D Site 54 fish were not significantly different from those in the other site. This was largely because of a higher reported lead concentration for one fish from Site 54. Selenium concentrations in Greens Creek Below Pond D Site 54 fish were slightly significantly higher ($\alpha = 0.1$) than in fish from the other two sites, and concentrations of cadmium and copper were not significantly different ($\alpha >$ 0.1) among sites in 2003.

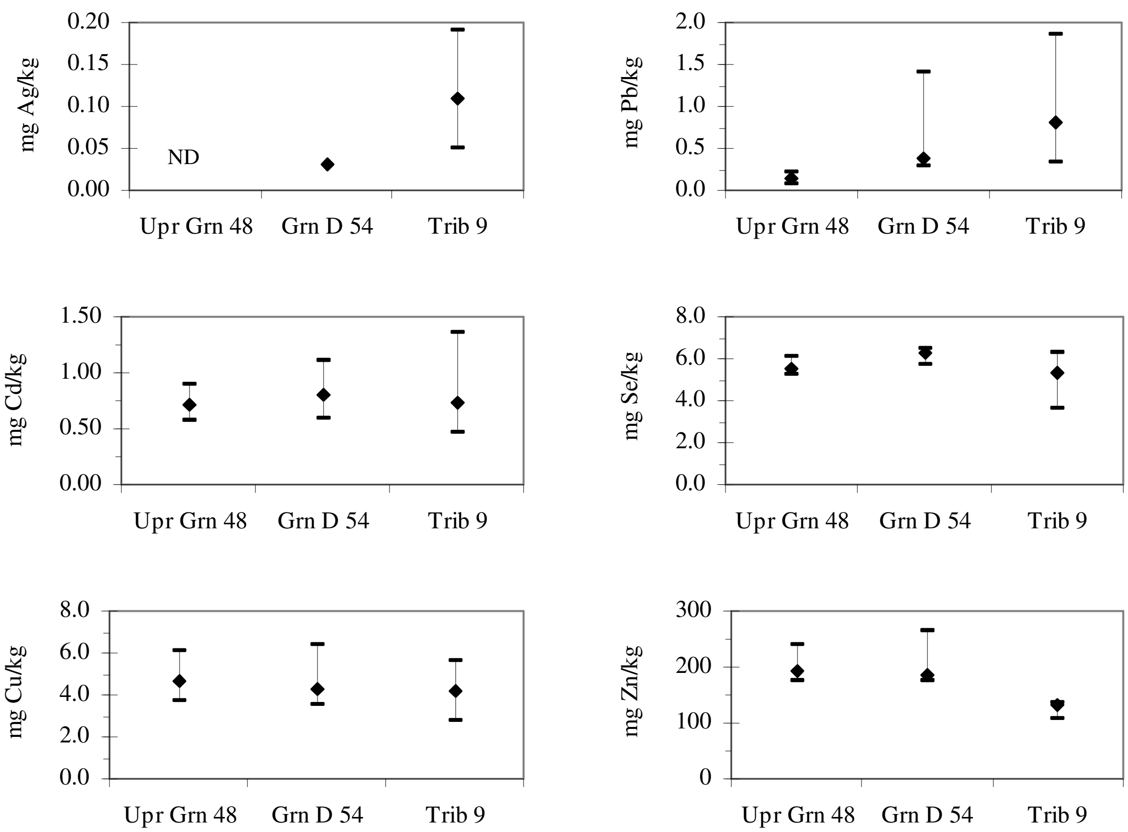


Figure 36. Comparison among sites of whole body metals concentrations (median, maximum, and minimum) in Dolly Varden captured in 2003. ND = Not Detected at detection level of 0.02 mg Ag/kg

Toxicity Testing

Acute toxicity testing was conducted on water samples from each of the three sites sampled in 2001 and 2002. No toxicity was detected during any of the tests and the IC-20 value for each site was >100%. Tests for chronic toxicity were completed in 2001, but the method failed repeatedly in 2002. In 2001, there was no toxic response and the IC-20 value for each site was >100%.

No Microtox toxicity testing was done in 2003. The results from the 2003 periphyton, benthic invertebrate, and juvenile fish biomonitoring program elements provide no evidence to suggest toxicity of the waters at the three biomonitoring sites.

CONCLUSIONS

The two biomonitoring sites on Greens Creek (Upper Greens Creek Sites 48 above all facilities and Greens Creek Below Pond D Site 54) and one on Tributary Creek (Tributary Creek Site 9 below the tailings facility) continued to sustain complex, diverse aquatic communities. Low water levels in summer 2003 allowed for higher productivity in the streams but decreased the wetted area available for fish habitat, particularly in Tributary Creek.

Periphyton biomass and community composition continue to appear robust, with a pronounced diatom component and minimal amounts of filamentous green algae or blue-green bacteria. Chlorophyll *a* concentrations were similar between sites and significantly higher in 2003 than in previous years.

The benthic macroinvertebrate communities are taxonomically rich with high densities, and the populations of many pollution-sensitive taxa are well represented. Mean densities were similar between sites and significantly higher than in previous years. A slightly higher percentage of total aquatic invertebrates were Chironomidae compared to previous years at the Greens Creek sites.

Juvenile fish populations continue to be relatively abundant at each site, with multiple size classes present. Total fish captures were higher in 2003 than in previous years at the Greens Creek sites and lower in Tributary Creek. The latter is likely related to low water levels.

Whole body concentrations of metals in fish tissues were similar to or less than those found in previous years' samples. Some differences were noted between sites and stream systems, but no clear pattern emerged.

No testing of acute toxicity in water from the three biomonitoring sites was done in 2003.

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APPENDIX 1. USFS CHANNEL TYPE DESCRIPTIONS

The following descriptions and definitions of channel types are from Paustian et al. (1992).

MM2 – Moderate Width Mixed Control Channel Type

An MM2 channel is defined as "normally found in the middle to lower portion of moderate size drainage basins. MM2 streams are often confined by mountainslope, footslope, and hillslope landforms, but they can develop a narrow flood plain. Bedrock knickpoints with cascades or falls may be present.

MM2 channels are generally accessible to anadromous species, with several species of spawners using the moderate amounts of available spawning area (ASA). These channels have moderate amounts of rearing area which are used by coho, Dolly Varden char, and steelhead juveniles. Pools are relatively deep and are highly dependent on large woody debris. Overwintering habitat is primarily associated with these pools. When located next to accessible lakes, these channels provide good quality spawning for sockeye salmon and steelhead trout.

Large woody debris significantly influences channel morphology and fish habitat quality. Large wood volume is generally high. Large wood accumulations form pool and stream bank rearing habitat, as well as stabilize spawning substrate behind log steps. Maintenance of large woody debris sources is an important management concern.

Banks are composed primarily of unconsolidated cobble and gravel size materials, therefore, stream bank sensitivity is rated high. The volume and energy of flood discharge in MM2 channels are the major factors affecting bank erosion. Disturbance of streamside vegetation root mats may contribute to accelerated channel scour and lateral channel migration.

Flood plains associated with MM2 channel types are generally narrow, however, side channels and flood overflow channels are commonly found along MM2 reaches. Flood plain stability can be a concern in these uncontained channel segments.

FP3 – Narrow Low Gradient Flood Plain Channel Type

FP3 streams are located in the valley bottoms and may also occur within flat lowlands or low elevation drainage divides. Frequently, FP3 streams lie adjacent to the toe of footslopes or hillslopes, adjacent to the main trunk, valley bottom channels. The flood plain of large, low gradient alluvial channels may be dissected by FP3 streams. Where FP3 streams occur parallel to the foot slopes or in the valley bottom locations, they are typically fed by high gradient streams. Less frequently, FP3 streams are situated on mountain slope benches.

The riparian plant associations for FP3 streams are dominated by the Sitka spruce series and the western hemlock series. Salmonberry and alder shrub communities are the principal non-forest riparian plant communities. Willow, shrub and sedge/sphagnum bog communities are the primary non-forest riparian communities in the FP3 phase. Sitka alder and willow shrub communities are the predominant riparian vegetation associated with the FP3 phase.

FP3 channels are frequently accessible to anadromous species. Coarse and fine gravels compose 49% of the substrate, therefore, available spawning area is high. These channels receive moderate to high spawning use by all anadromous species.

APPENDIX 2. BENTHIC MACROINVERTEBRATE DATA

Numbers of aquatic invertebrates identified in Upper Greens Creek Site 48 samples.

Taxa			**2001**	**2002**	**2003**
Order	**Family**	**Genus**			
Ephemeroptera	Baetidae	*Baetis*	309	152	445
	Ephemerellidae	*Caudatella*	2		
		Ephemerella			10
		Drunella	47	49	650
	Heptageniidae	*Cinygmula*	99	20	117
		Epeorus	444	190	384
		Rhithrogena	193	187	287
	Leptophlebiidae	*Paraleptophlebia*		1	
	Ameletidae	*Ameletus*			4
Plecoptera	Capniidae	*Capnia*			82
	Chloroperlidae	*Alloperla*	1	1	
		Kathroperla			2
		Neaviperla			70
		Plumiperla	5		
		Suwallia	8	1	
		Sweltsa	1	4	
	Leuctridae	*Despaxia*		2	
		Paraleuctra	4	3	6
		Perlomyia		12	
	Nemouridae	*Podmosta*	7	5	
		Zapada	23	4	30
	Perlodidae	*Megarcys*			1
		Skwala		9	
Trichoptera	Apataniidae	*Apatania*		1	
	Glossosomatidae	*Glossosoma*			2
	Hydropsychidae	*Arctopsyche*	2		
		Hydropsyche			1
	Limnephilidae	*Onocosmoecus*			1
	Rhyacophilidae	*Rhyacophila*	5	8	16
Coleoptera	Staphylinidae		1		6
Diptera	Ceratopogonidae	*Dasyhelea*		1	
	Chironomidae		14	30	172
	Deuterophlebiidae	*Deuterophlebia*	2		
	Empididae	*Chelifera*	1	2	5
		Oreogeton	3	2	22
	Psychodidae	*Psychoda*	1		
	Simuliidae	*Parasimulium*	2		
		Prosimulium	2		
		Simulium	6	4	

Numbers of aquatic invertebrates identified in Upper Greens Creek Site 48 samples (continued).

Order	**Family**	**Genus**	**2001**	**2002**	**2003**
	Tipulidae	*Antocha*			2
		Dicranota			3
		Tipula			2
Collembola	Onychiuridae	*Onychiurus*		1	
	Sminthuridae	*Dicyrtoma*	2		
Acarina				2	20
Oligochaeta				5	20
Ostracoda				8	7

Numbers of aquatic invertebrates identified in Greens Creek Below Pond D Site 54 samples.

Taxa			**2001**	**2002**	**2003**
Order	**Family**	**Genus**			
Ephemeroptera	Baetidae	*Baetis*	248	225	220
	Ephemerellidae	*Ephemerella*	2	6	6
		Drunella	118	280	894
	Heptageniidae	*Cinygmula*	319	75	176
		Epeorus	935	626	408
		Rhithrogena		140	306
	Leptophlebiidae	*Paraleptophlebia*	1		1
	Ameletidae	*Ameletus*	4		
Plecoptera	Capniidae	*Capnia*			5
	Chloroperlidae	*Alloperla*	3		
		Kathroperla			2
		Neaviperla		14	22
		Paraperla			5
		Plumiperla	2		
		Sweltsa	6		
	Leuctridae	*Paraleuctra*		4	
		Perlomyia	13	3	19
	Nemouridae	*Podmosta*		7	
		Zapada	52	22	14
	Perlodidae	*Diura*	1		
		Isoperla	3		
		Skwala		3	15
		Rickera		1	
Trichoptera	Hydropsychidae	*Arctopsyche*		1	
	Limnephilidae	*Psychoglypha*	1		
	Rhyacophilidae	*Rhyacophila*	6	5	12
Coleoptera	Staphylinidae		1	1	
Diptera	Chironomidae		33	27	149
	Deuterophlebiidae	*Deuterophlebia*		1	1
	Dolichopodidae		2		
	Empididae	*Chelifera*	2		
		Oreogeton	10	4	15
	Simuliidae	*Prosimulium*		1	
		Simulium	3	3	
	Tipulidae	*Antocha*	1		3
		Dicranota	2	1	
		Hesperoconopa		1	1
		Pilaria			1
		Rhabdomastix			3
		Tipula		1	
Collembola	Onychiuridae	*Onychiurus*		1	
	Sminthuridae	*Dicyrtoma*		1	

Numbers of aquatic invertebrates identified in Greens Creek Below Pond D Site 54 samples (continued).

Order	**Family**	**Genus**	**2001**	**2002**	**2003**
Copepoda	Cyclopoida				1
Acarina			9	3	6
Oligochaeta			3	7	49
Gastropoda	Valvatidae		1	1	
Ostracoda			1	1	1

Numbers of aquatic invertebrates identified in Tributary Creek Site 9 samples.

Taxa			**2001**	**2002**	**2003**
Order	**Family**	**Genus**			
Ephemeroptera	Baetidae	*Baetis*	41	123	160
		Procloeon	5		
	Ephemerellidae	*Caudatella*	3		
		Drunella		3	10
		Ephemerella		14	7
		Epeorus		8	
	Heptageniidae	*Cinygma*	1		
		Cinygmula	89	177	507
		Epeorus			1
		Rhithrogena			1
	Leptophlebiidae	*Paraleptophlebia*	66	96	249
	Ameletidae	*Ameletus*		15	46
Plecoptera	Chloroperlidae	*Neaviperla*			174
		Paraperla		11	
		Suwallia	34		24
		Sweltsa		42	
	Leuctridae	*Despaxia*	3		6
		Paraleuctra	7		1
		Perlomyia		3	
	Nemouridae	*Podmosta*		1	
		Zapada	23	12	388
	Perlodidae	*Isoperla*	1		
Trichoptera	Apataniidae	*Apatania*		1	
	Brachycentridae	*Brachycentrus*			1
	Limnephilidae	*Ecclisomyia*			1
	Rhycophilidae	*Rhycophila*		1	5
Coleoptera	Elmidae	*Narpus*	2	6	32
	Dytiscidae	*Megadytes*			2
Diptera	Ceratopogonidae	*Bezzia*			1
		Dasyhelea	3		
		Probezzia			9
	Chironomidae		35	36	125
	Empididae	*Chelifera*		1	
		Hemerodromia			1
		Oreogeton	4	2	24
	Psychodidae	*Psychoda*			
	Simuliidae	*Simulium*	40	22	81
	Tipulidae	*Antocha*			10
		Dicranota			2
		Pilaria			2
		Rhabdomastix			1
		Tipula	4	5	
Branchiopoda	Chydoridae				2

Numbers of aquatic invertebrates identified in Tributary Creek Site 9 samples (continued).

Order	**Family**	**Genus**	**2001**	**2002**	**2003**
Collembola	Sminthuridae	*Dicyrtoma*		2	
		Sminthurus			3
Copepoda	Cyclopoida				6
	Harpacticoida				5
Acarina			15	20	72
Oligochaeta			40	45	349
Gastropoda			1		1
Ostracoda			92	102	207

APPENDIX 3. JUVENILE FISH CAPTURE DATA

Location	Fish Species	Number Fish Captured				MLE Pop. Est.	Standard Error	95% Conf. Interval
		Set 1	Set 2	Set 3	Total			
2001								
Uppr Greens Cr 48								
	DV	---	---	---	---	144	74.76	84 - 448
Grns Cr Below D 54								
	DV	---	---	---	---	164	12.32	150 - 200
	CO	---	---	---	*	---	---	---
Tributary Cr 9								
	DV	---	---	---	---	81	0.78	81 - 81
	CO	---	---	---	---	120	2.14	119 - 128
	CT	---	---	---	*	---	---	---
	Sc	---	---	---	---	4	0.21	4 - 4
2002								
Uppr Greens Cr 48								
	DV	---	---	---	---	145	9.43	134 - 173
Grns Cr Below D 54								
	DV	---	---	---	---	57	5.17	53 - 76
	CO	---	---	---	---	46	2.51	45 - 57
Tributary Cr 9								
	DV	---	---	---	---	57	5.17	53 - 76
	CO	---	---	---	---	46	2.51	45 - 57
	CT	---	---	---	*	---	---	---
	Sc	---	---	---	*	---	---	---
2003								
Uppr Greens Cr 48								
	DV	157	75	56	285	333	14.04	305 - 361
Grns Cr Below D 54								
	DV	92	81	59	232	331	27.76	275 - 387
	CO	5	3	0	8	8	0.00	8 - 8
Tributary Cr 9								
	DV	13	4	2	19	20	1.52	17 - 23
	CO	37	11	4	52	53	1.20	51 - 55
	CT	1	0	0	1	1	---	---
	Sc	0	0	1	1	1	---	---
Species: DV = Dolly Varden, CO = coho salmon, CT = cutthroat trout, Sc = sculpin								
Data for 2001 and 2002 from U.S. Forest Service. * = actual number captured not reported.								

APPENDIX 4. METALS IN JUVENILE FISH DATA

Information on fish collected for analysis of metals in tissues. Sample Number contains codes for date collected, creek, site, fish species, age, and replicate number.

Sample Number	Date Collected	Creek	Site	Fish Species	Weight (gm)	ForkLength (mm)
072301GC48DVJ01	23-Jul-01	Upper Greens	48	Dolly Varden	26.02	131
072301GC48DVJ02	23-Jul-01	Upper Greens	48	Dolly Varden	28.81	137
072301GC48DVJ03	23-Jul-01	Upper Greens	48	Dolly Varden	18.84	119
072301GC48DVJ04	23-Jul-01	Upper Greens	48	Dolly Varden	21.13	121
072301GC48DVJ05	23-Jul-01	Upper Greens	48	Dolly Varden	13.71	111
072301GC48DVJ06	23-Jul-01	Upper Greens	48	Dolly Varden	21.08	121
072402GC48DVJ01	24-Jul-02	Upper Greens	48	Dolly Varden	23.23	133
072402GC48DVJ02	24-Jul-02	Upper Greens	48	Dolly Varden	15.04	120
072402GC48DVJ03	24-Jul-02	Upper Greens	48	Dolly Varden	17.52	122
072402GC48DVJ04	24-Jul-02	Upper Greens	48	Dolly Varden	20.75	127
072402GC48DVJ05	24-Jul-02	Upper Greens	48	Dolly Varden	24.77	134
072402GC48DVJ06	24-Jul-02	Upper Greens	48	Dolly Varden	21.66	128
072203GC48DVJ01	22-Jul-03	Upper Greens	48	Dolly Varden	8.9	90
072203GC48DVJ02	22-Jul-03	Upper Greens	48	Dolly Varden	9.9	98
072203GC48DVJ03	22-Jul-03	Upper Greens	48	Dolly Varden	12.1	103
072203GC48DVJ04	22-Jul-03	Upper Greens	48	Dolly Varden	12.5	112
072203GC48DVJ05	22-Jul-03	Upper Greens	48	Dolly Varden	11.9	108
072203GC48DVJ06	22-Jul-03	Upper Greens	48	Dolly Varden	10.5	100
072301GC06DVJ01	23-Jul-01	Middle Greens	6	Dolly Varden	28.4	139
072301GC06DVJ02	23-Jul-01	Middle Greens	6	Dolly Varden	30.49	140
072301GC06DVJ03	23-Jul-01	Middle Greens	6	Dolly Varden	43.9	167
072301GC06DVJ04	23-Jul-01	Middle Greens	6	Dolly Varden	34.8	155
072301GC06DVJ05	23-Jul-01	Middle Greens	6	Dolly Varden	15.69	109
072301GC06DVJ06	23-Jul-01	Middle Greens	6	Dolly Varden	49.1	168
062100GCCOJ01	21-Jun-00	Greens Below D	54	Coho Salmon	4.4	72
062100GCCOJ02	21-Jun-00	Greens Below D	54	Coho Salmon	6.1	82
062100GCCOJ03	21-Jun-00	Greens Below D	54	Coho Salmon	4.9	73
062100GCCOJ04	21-Jun-00	Greens Below D	54	Coho Salmon	3.4	68
062100GCCOJ05	21-Jun-00	Greens Below D	54	Coho Salmon	5.9	73
062100GCCOJ06	21-Jun-00	Greens Below D	54	Coho Salmon	6	75
072301GC54DVJ01	23-Jun-01	Greens Below D	54	Dolly Varden	21.5	121
072301GC54DVJ02	23-Jun-01	Greens Below D	54	Dolly Varden	19.32	119
072301GC54DVJ03	23-Jun-01	Greens Below D	54	Dolly Varden	15.73	107
072301GC54DVJ04	23-Jun-01	Greens Below D	54	Dolly Varden	13.64	109
072301GC54DVJ05	23-Jun-01	Greens Below D	54	Dolly Varden	13.52	105
072301GC54DVJ06	23-Jun-01	Greens Below D	54	Dolly Varden	27.54	138
072402GC54DVJ01	24-Jul-02	Greens Below D	54	Dolly Varden	17.96	118
072402GC54DVJ02	24-Jul-02	Greens Below D	54	Dolly Varden	22.26	128
072402GC54DVJ03	24-Jul-02	Greens Below D	54	Dolly Varden	17.7	115
072402GC54DVJ04	24-Jul-02	Greens Below D	54	Dolly Varden	18.94	115
072402GC54DVJ05	24-Jul-02	Greens Below D	54	Dolly Varden	21.09	124
072402GC54DVJ06	24-Jul-02	Greens Below D	54	Dolly Varden	20.88	123

Sample Number	Date Collected	Creek	Site	Fish Species	Weight (gm)	ForkLength (mm)
072203GC54DVJ01	22-Jul-03	Greens Below D	54	Dolly Varden	21.1	123
072203GC54DVJ02	22-Jul-03	Greens Below D	54	Dolly Varden	10.6	101
072203GC54DVJ03	22-Jul-03	Greens Below D	54	Dolly Varden	9.2	88
072203GC54DVJ04	22-Jul-03	Greens Below D	54	Dolly Varden	14.8	109
072203GC54DVJ05	22-Jul-03	Greens Below D	54	Dolly Varden	10.6	95
072203GC54DVJ06	22-Jul-03	Greens Below D	54	Dolly Varden	9.7	92
062100TRCOJ01	21-Jun-00	Tributary	9	Coho Salmon	9.7	102
062100TRCOJ02	21-Jun-00	Tributary	9	Coho Salmon	5.3	75
062100TRDVJ03	21-Jun-00	Tributary	9	Dolly Varden	12.8	112
062100TRDVJ04	21-Jun-00	Tributary	9	Dolly Varden	13.8	105
062100TRDVJ05	21-Jun-00	Tributary	9	Dolly Varden	13.4	105
062100TRDVJ06	21-Jun-00	Tributary	9	Dolly Varden	11.3	100
072301TR09DVJ01	23-Jul-01	Tributary	9	Dolly Varden	9.05	97
072301TR09DVJ02	23-Jul-01	Tributary	9	Dolly Varden	9.66	97
072301TR09DVJ03	23-Jul-01	Tributary	9	Dolly Varden	9.5	97
072301TR09DVJ04	23-Jul-01	Tributary	9	Dolly Varden	10.37	98
072301TR09DVJ05	23-Jul-01	Tributary	9	Dolly Varden	6.42	86
072301TR09DVJ06	23-Jul-01	Tributary	9	Dolly Varden	7.83	93
072402TR09DVJ01	24-Jul-02	Tributary	9	Dolly Varden	10.8	103
072402TR09DVJ02	24-Jul-02	Tributary	9	Dolly Varden	10.43	97
072402TR09DVJ03	24-Jul-02	Tributary	9	Dolly Varden	11.16	100
072402TR09DVJ04	24-Jul-02	Tributary	9	Dolly Varden	7.93	90
072402TR09DVJ05	24-Jul-02	Tributary	9	Dolly Varden	9.19	90
072402TR09DVJ06	24-Jul-02	Tributary	9	Dolly Varden	9.33	100
072303TR09DVJ01	23-Jul-03	Tributary	9	Dolly Varden	10.7	106
072303TR09DVJ02	23-Jul-03	Tributary	9	Dolly Varden	6.8	89
072303TR09DVJ03	23-Jul-03	Tributary	9	Dolly Varden	17.4	112
072303TR09DVJ04	23-Jul-03	Tributary	9	Dolly Varden	11.6	95
072303TR09DVJ05	23-Jul-03	Tributary	9	Dolly Varden	9.5	91
072303TR09DVJ06	23-Jul-03	Tributary	9	Dolly Varden	8.4	84

Concentration of select metals in juvenile fish collected in 2000, 2001, 2002, and 2003.

Sample Number	Ag (mg/kg)	Cd (mg/kg)	Cu (mg/kg)	Pb (mg/kg)	Se (mg/kg)	Zn (mg/kg)	Solids %
MRL	**0.02**	**0.02**	**0.1**	**0.02**	**1**	**0.5**	
072301GC48DVJ01	0.02	1.76	8.3	0.2	6.1	180	21.6
072301GC48DVJ02	0.03	0.89	7.2	0.17	4.6	146	23.7
072301GC48DVJ03	0.02	2.27	5.7	0.2	6.2	189	20.7
072301GC48DVJ04	0.02	1.56	6.9	0.17	5.2	182	22.8
072301GC48DVJ05	0.03	0.89	4.7	0.23	5.4	138	21.8
072301GC48DVJ06	0.02	1.26	7.4	0.1	5.6	157	20.3
072402GC48DVJ01	0.03	1.64	6.8	0.72	4.8	239	24.3
072402GC48DVJ02	0.07	0.85	7	0.28	4.1	210	19.2
072402GC48DVJ03	0.03	0.74	4.3	0.17	4.9	162	22.1
072402GC48DVJ04	0.04	1.4	6.1	0.16	4.7	185	21.2
072402GC48DVJ05	0.05	1.3	7.9	0.46	4.3	208	21.5
072402GC48DVJ06	0.04	1.56	6.8	0.22	5.7	343	20.9
072203GC48DVJ01	< 0.02	0.65	4.2	0.14	5.6	191	23.8
072203GC48DVJ01	< 0.02	0.90	5.1	0.22	5.5	180	23.6
072203GC48DVJ01	< 0.02	0.82	5.6	0.16	5.4	241	23.7
072203GC48DVJ01	< 0.02	0.78	6.1	0.11	6.1	192	23.5
072203GC48DVJ01	< 0.02	0.63	3.9	0.14	5.2	174	23.8
072203GC48DVJ01	< 0.02	0.58	3.7	0.08	5.5	218	24.2
072301GC06DVJ01	0.04	1.94	16.7	1.24	5	173	20.8
072301GC06DVJ02	0.03	0.84	4.6	1	4.5	167	22.8
072301GC06DVJ03	0.03	0.82	5.3	1.94	4.3	171	21.7
072301GC06DVJ04	0.03	1.52	5.4	1.78	4.5	215	21.6
072301GC06DVJ05	0.02	0.89	11.1	0.33	5.3	126	22.2
072301GC06DVJ06	0.04	0.73	8	1.96	4.6	169	21.9
062100GCCOJ01	0.04	0.95	15.3	1.4	4.9	251	20.5
062100GCCOJ02	0.09	0.66	11.7	1.21	4.7	224	20.2
062100GCCOJ03	0.22	1.07	24.2	1.4	3.4	206	20.4
062100GCCOJ04	0.1	0.97	24	1.12	3.5	181	21.4
062100GCCOJ05	0.05	0.96	44	1.53	4.9	304	20.7
062100GCCOJ06	0.08	1.47	36.1	5.02	4.7	340	20.2
072301GC54DVJ01	0.03	0.46	4.3	0.33	5.7	126	22.6
072301GC54DVJ02	0.02	0.21	3.2	0.22	3.6	82	26.1
072301GC54DVJ03	0.03	0.73	6.3	0.59	4.7	144	23.5
072301GC54DVJ04	0.02	0.82	5.4	0.86	4.9	172	21.1
072301GC54DVJ05	0.02	0.79	6.5	0.45	5.8	203	22.8
072301GC54DVJ06	0.02	0.74	5.8	0.4	5.4	171	22.1
072402GC54DVJ01	0.03	0.5	4.4	0.94	3.4	363	21.2
072402GC54DVJ02	0.03	0.52	4.5	0.35	4.7	150	23.2
072402GC54DVJ03	0.05	0.95	6	0.66	4.4	161	21.9
072402GC54DVJ04	0.03	1.03	5.2	0.66	4.2	216	21.3
072402GC54DVJ05	0.05	1.32	5.2	0.74	3.9	194	21.4
072402GC54DVJ06	0.02	0.7	3.9	0.78	4.4	195	20.9

Sample Number	Ag (mg/kg)	Cd (mg/kg)	Cu (mg/kg)	Pb (mg/kg)	Se (mg/kg)	Zn (mg/kg)	Solids %
MRL	**0.02**	**0.02**	**0.1**	**0.02**	**1**	**0.5**	
072203GC54DVJ01	0.03	0.85	6.4	1.40	6.1	188	25.1
072203GC54DVJ02	<0.02	0.67	4.2	0.32	6.4	174	22.9
072203GC54DVJ03	<0.02	0.75	4.3	0.35	6.5	186	22.8
072203GC54DVJ04	<0.02	1.11	5.8	0.38	5.7	188	24.0
072203GC54DVJ05	<0.02	0.59	3.5	0.29	5.7	174	23.9
072203GC54DVJ06	<0.02	0.91	4.1	0.43	6.5	263	23.8
062100TRCOJ01	0.04	0.42	16.2	1.03	3.2	213	22.9
062100TRCOJ02	0.07	0.5	16.5	2.01	3.7	220	22.5
062100TRDVJ03	0.12	0.75	11.2	1.63	3.8	194	23.1
062100TRDVJ04	0.07	0.56	10.6	1.53	3.6	87.9	22.2
062100TRDVJ05	0.06	0.58	12.8	1.59	3.5	204	22.1
062100TRDVJ06	0.05	0.45	32.8	1.57	5.	213	23.
072301TR09DVJ01	0.09	0.35	4.3	0.56	6.8	127	22.1
072301TR09DVJ02	0.1	0.77	5.2	0.67	8	118	21.3
072301TR09DVJ03	0.15	0.92	5.4	4.88	5.3	144	22.2
072301TR09DVJ04	0.15	0.86	6.7	2.19		99.1	22.6
072301TR09DVJ05	0.08	0.76	4.9	0.33	6.2	106	22.2
072301TR09DVJ06	0.06	0.37	12	0.38	6.8	122	20.6
072402TR09DVJ01	0.02	0.22	3.7	0.12	1.4	144	20.9
072402TR09DVJ02	0.07	1.2	5.5	1.66	3.3	172	22.8
072402TR09DVJ03	0.13	1.06	6.1	3.4	5	138	23.2
072402TR09DVJ04	0.23	1.29	7.1	4.08	5.2	168	23.1
072402TR09DVJ05	0.08	1.15	5.2	1.39	6.2	150	23
072402TR09DVJ06	0.04	0.84	3.2	0.33	5.4	152	17.8
072303TR09DVJ01	0.06	0.46	2.8	0.34	6.3	134	21.9
072303TR09DVJ02	0.10	1.01	4.0	0.82	6.0	131	22.8
072303TR09DVJ03	0.16	1.35	4.4	1.85	5.7	108	24.3
072303TR09DVJ04	0.19	0.69	5.6	1.30	3.6	136	22.5
072303TR09DVJ05	0.05	0.72	4.4	0.56	4.9	131	22.2
072303TR09DVJ06	0.12	0.76	3.9	0.78	4.7	125	23.2