



pennsylvania

DEPARTMENT OF ENVIRONMENTAL PROTECTION

BUREAU OF POINT & NON-POINT SOURCE MANAGEMENT

Continuous Instream Monitoring Report (CIMR)

Most recent revision: 11/20/2015

Revised by: Bendick

STATION DESCRIPTION:

STREAM CODE: 11830

STREAM NAME: Tuscarora Creek

SITE CODE: 66206949-001

SITE NAME: Groninger Valley Rd. Bridge

COUNTY: Juniata

2013 SITE DESCRIPTION

LATITUDE: 40.515499 **LONGITUDE:** -77.419200

LOCATION DESCRIPTION: Just upstream of Groninger Valley Rd. Bridge at the USGS gage station.

2014 SITE DESCRIPTION

LATITUDE: 40.516666 **LONGITUDE:** -77.420171

LOCATION DESCRIPTION: Approximately 50 meters downstream of Groninger Valley Rd. Bridge, off-center toward the right ascending bank.

HUC: 02050304

DRAINAGE AREA: 197.94 miles

BACKGROUND AND HISTORY: Tuscarora Creek is a limestone influenced tributary to the Juniata River within Juniata County (Figure 1). The basin is characterized by shallow valley topography with land use consisting of forested land (74%), urban land use (0%), and agricultural uses (26%). The purpose of this survey was to collect baseline data on a Cold Water Fishes, Migratory Fishes (CWF, MF) stream to determine water quality and biological conditions.

The primary objectives of the assessment were to:

1. Characterize baseline water temperature, specific conductance, pH, and dissolved oxygen using 24-hour monitoring.
2. Characterize water chemistry.
3. Characterize biological communities.

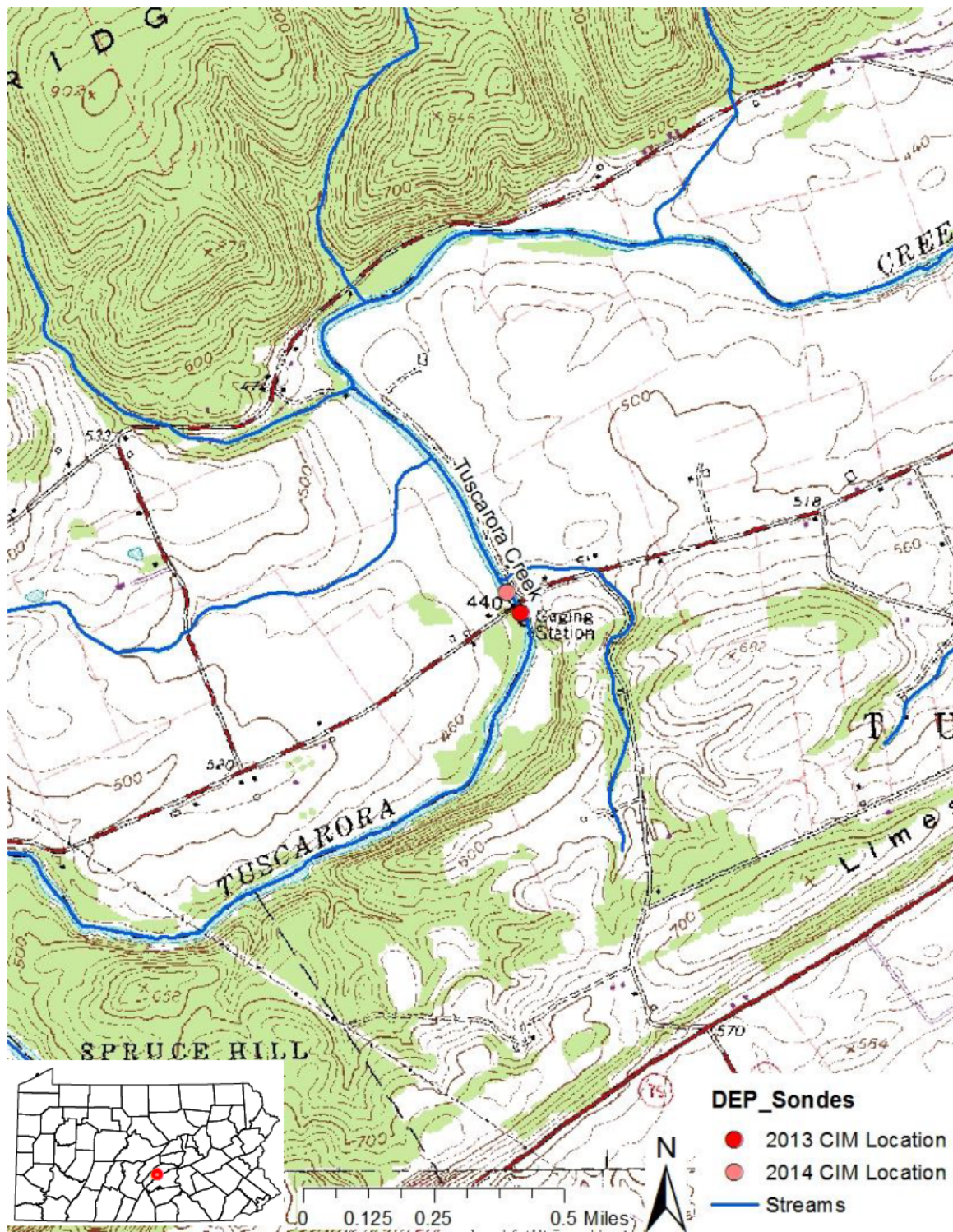


Figure 1. Map of the Tuscarora Creek continuous instream monitoring (CIM) site.

WATER QUALITY PARAMETERS:

Parameter	Units
Dissolved Oxygen	Mg/L
Water Temperature	°C
Specific Conductance (@25°C)	µS/cm ^c
pH	standard units

EQUIPMENT:

A single Measurement Specialties Eureka2 water-quality sonde (Serial #MM12100603) was used from April 10, 2013 to August 4, 2013. A Yellow Springs Instruments (YSI) 600XLM (Serial #1500B) was used April 14, 2014 to June 16, 2014 at which time the sonde was pulled and replaced. A Measurement Specialties Eureka2 water-quality sonde (Serial #MT04131241) was used from June 16, 2014 to November 10, 2014. A Yellow Springs Instruments (YSI) 6920 V2 was used as a field meter during revisits.

The sondes were housed in a 24-inch length of 4-inch diameter schedule 80 PVC pipe with holes drilled in it to allow for flow through. One end of the pipe was capped, and a notch was cut to accommodate the metal attachment bar on the top of the sonde. The attachment bar was clipped to an eye-bolt attached to rebar driven into the stream bed. The attachment bar was also clipped to a cable attached to a second piece of rebar located just upstream of the first. The sondes recorded water quality parameters every 30 minutes.

PERIOD OF RECORD: April 10, 2013 to August 4, 2013 AND April 14, 2014 to November 10, 2014.

In 2013, the station was revisited four times over four months for the purpose of downloading data, checking calibration, and cleaning. In 2014, the site was revisited nine times over seven months for the purpose of downloading data, checking calibration, and cleaning.

DATA:

Water chemistry grabs were collected four times during the 2013 sampling period and eight times during the 2014 sampling period. Benthic macroinvertebrates were collected on November 19, 2013 and November 10, 2014, and fishes were collected on July 12, 2013 using the Department's ICE protocol (PA DEP, 2013). No fishes were collected in 2014. Continuous data are graded based on a combination of fouling and calibration error according to the Department's Continuous Instream Monitoring Protocol (PA DEP, 2013). No data were graded unusable.

Discrete Water Quality Transect Characterization: A transect across the width of the stream was established to characterize water quality. The purpose of the transect was to determine if data collected by the sonde was representative of the surface water as a whole. Discrete water quality measurements were taken at equidistant points across the transect starting at the right ascending bank. Transects were conducted one time in 2013 and four times throughout the 2014 sampling period. Temperature, specific conductance, pH, and dissolved oxygen measurements indicated a homogenous system (Figures 2 and 3).

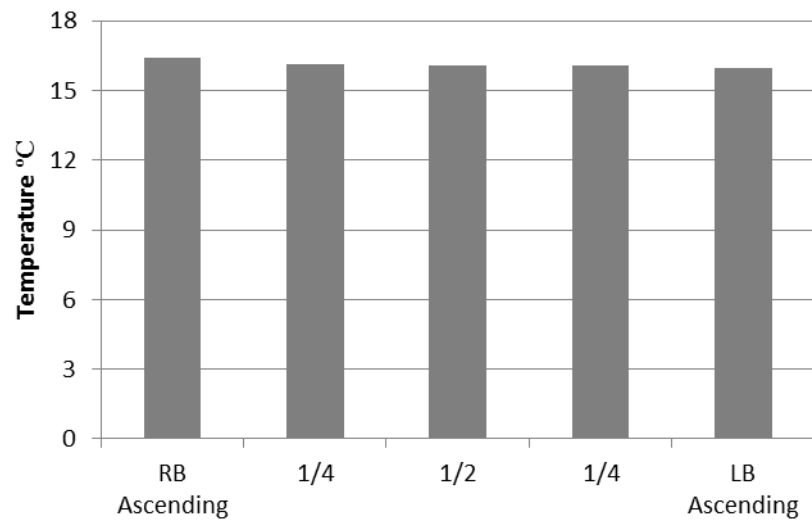
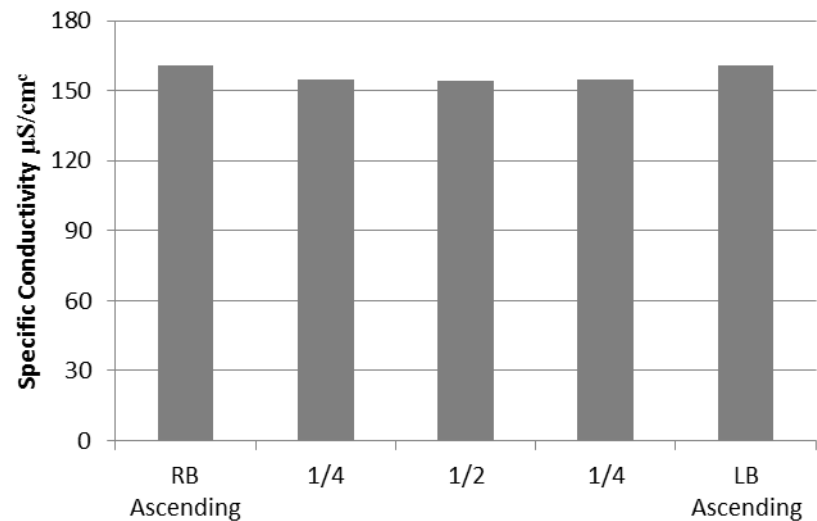
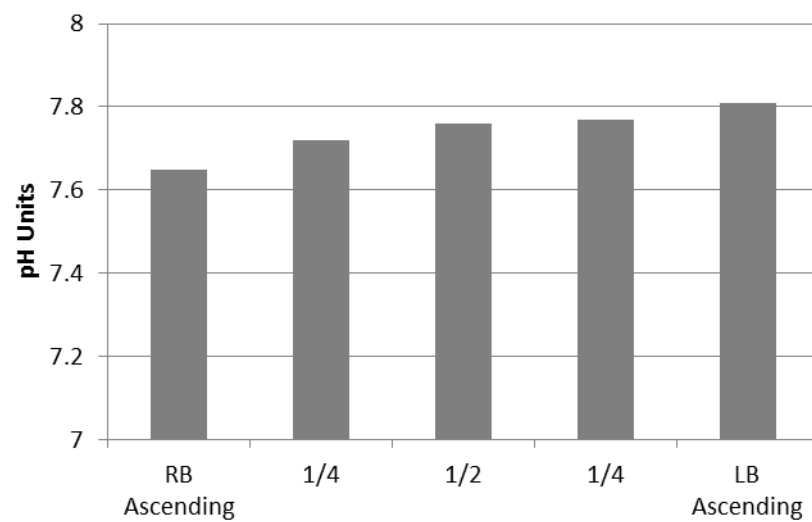
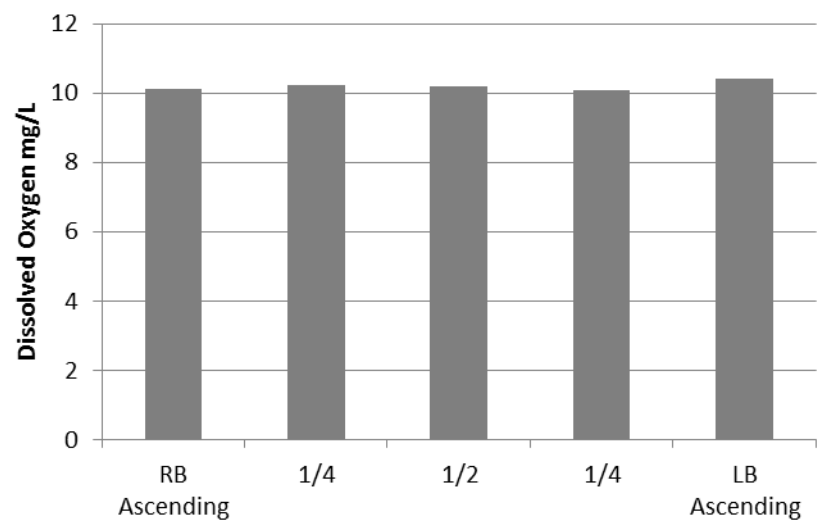


Figure 2. 2013 discrete water quality data collected on April 10 at equidistant points from the right ascending bank to the left ascending bank.

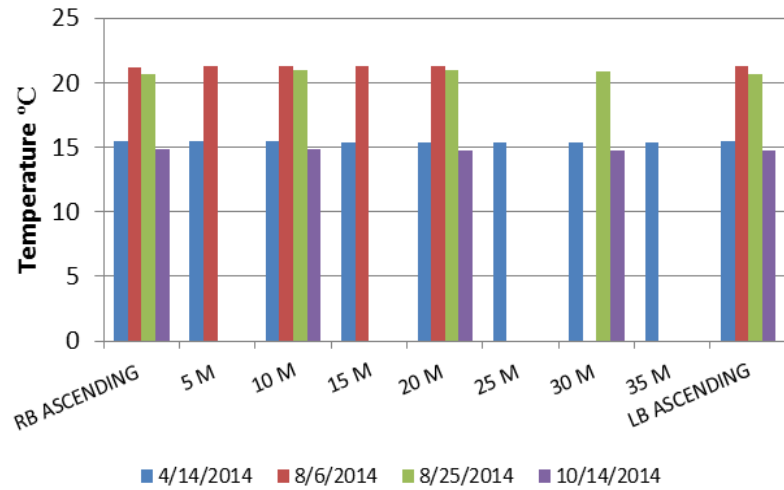
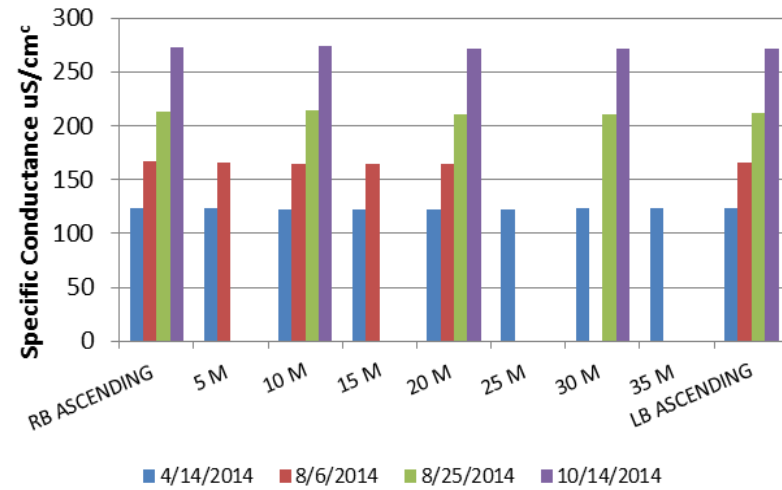
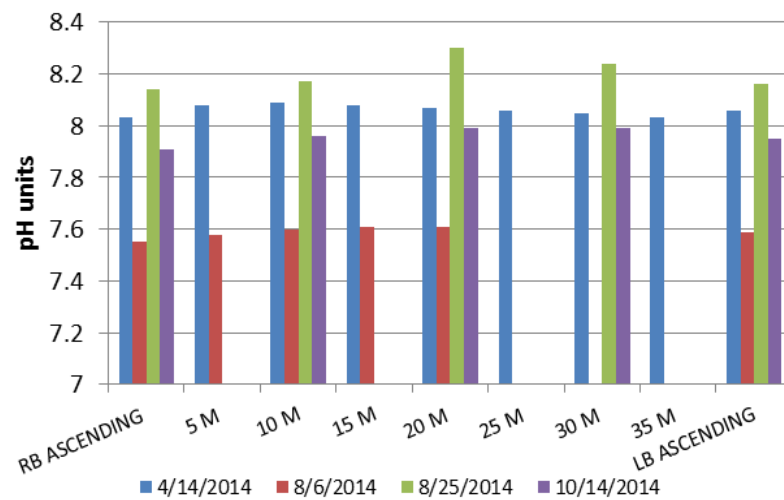
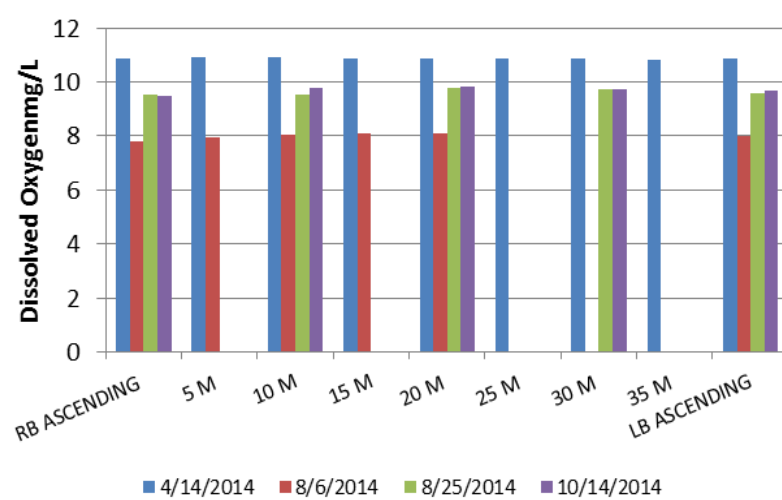


Figure 3. 2014 discrete water quality data collected 5 meters apart from the right ascending bank to the left ascending bank.

Depth: Depth data are used only as qualitative interpretation for changes in other parameters due to a lack of verification. The site locations allowed for the provisional use of discharge data from USGS. Data was downloaded from the U.S. Geological Survey's website using USGS station # 01566000, Tuscarora Creek near Port Royal, PA.

Water Temperature:

2013 Statistics - Average: 18.7 °C; Maximum: 30.0 °C; Minimum: 10.3 °C.

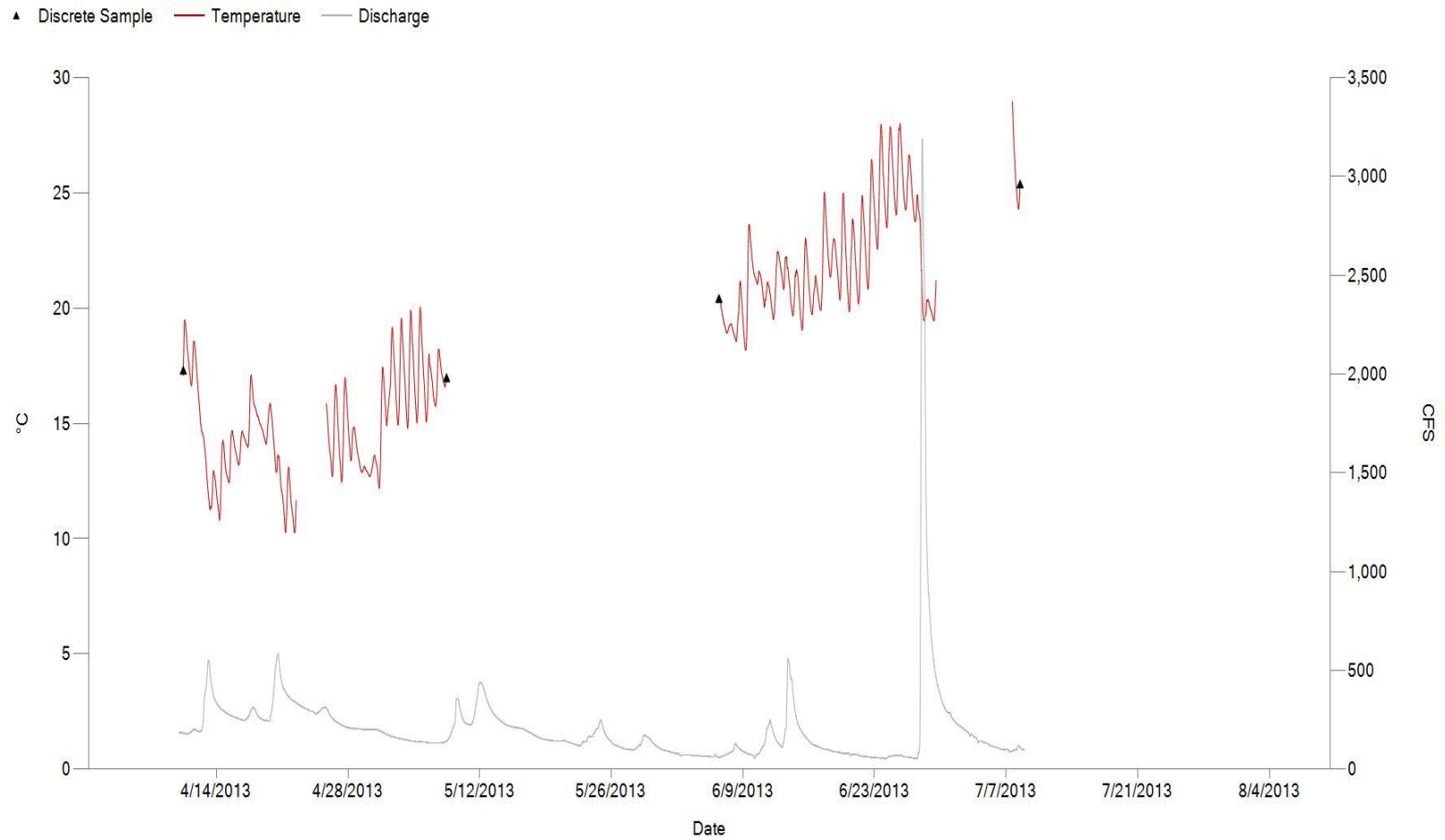


Figure 4. Continuous water temperature, continuous discharge, and discrete samples from April 10, 2013 to August 4, 2013. All data gaps are due to equipment failure.

2014 Statistics - Average: 18.4 °C; Maximum: 28.1 °C; Minimum: 6.4 °C.

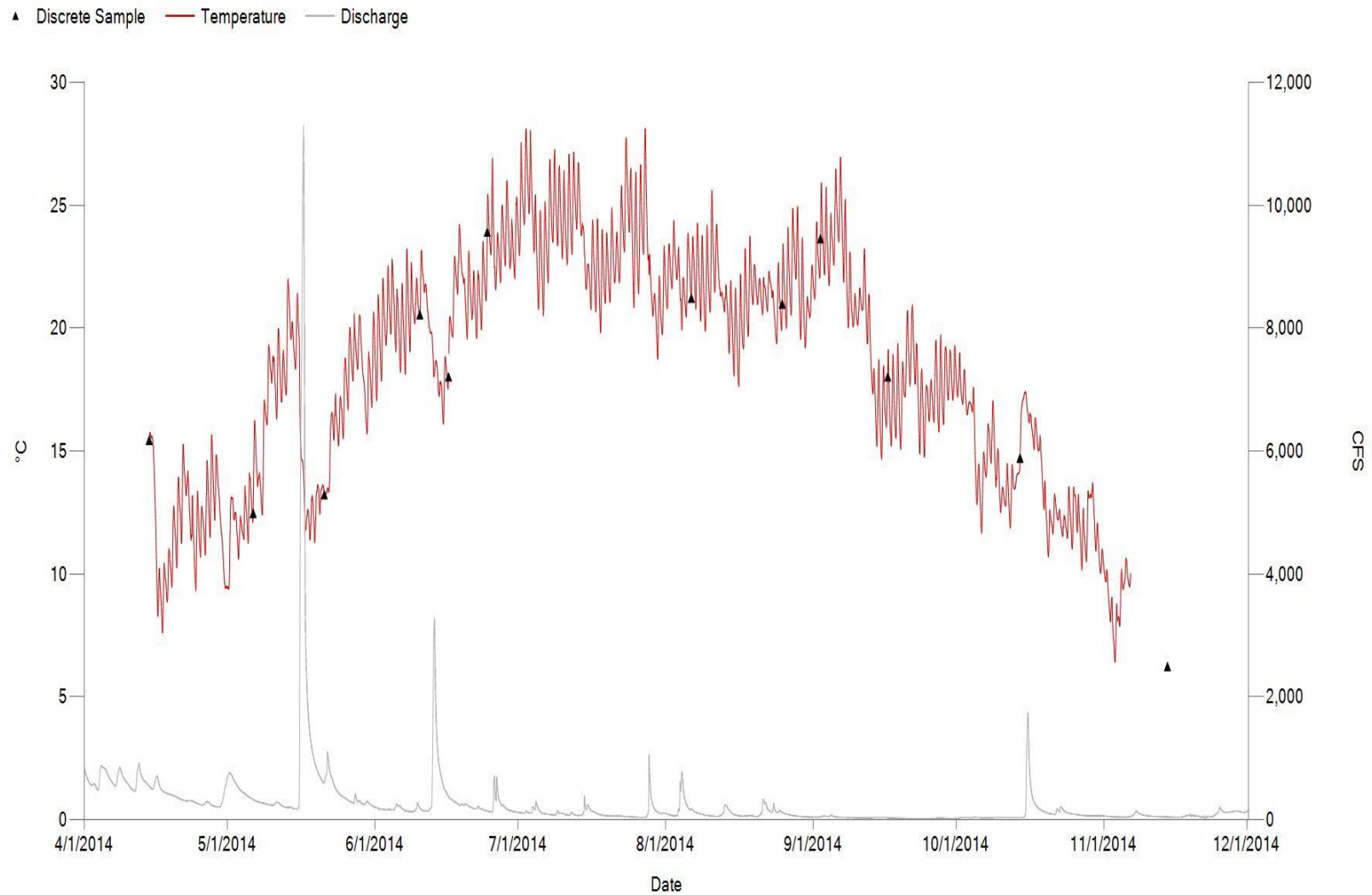


Figure 5. Continuous water temperature, continuous discharge, and discrete samples from April 14, 2014 to November 10, 2014.

Specific Conductance:

2013 Statistics - Average: 169 $\mu\text{S}/\text{cm}^c$; Maximum: 221 $\mu\text{S}/\text{cm}^c$; Minimum: 78 $\mu\text{S}/\text{cm}^c$.

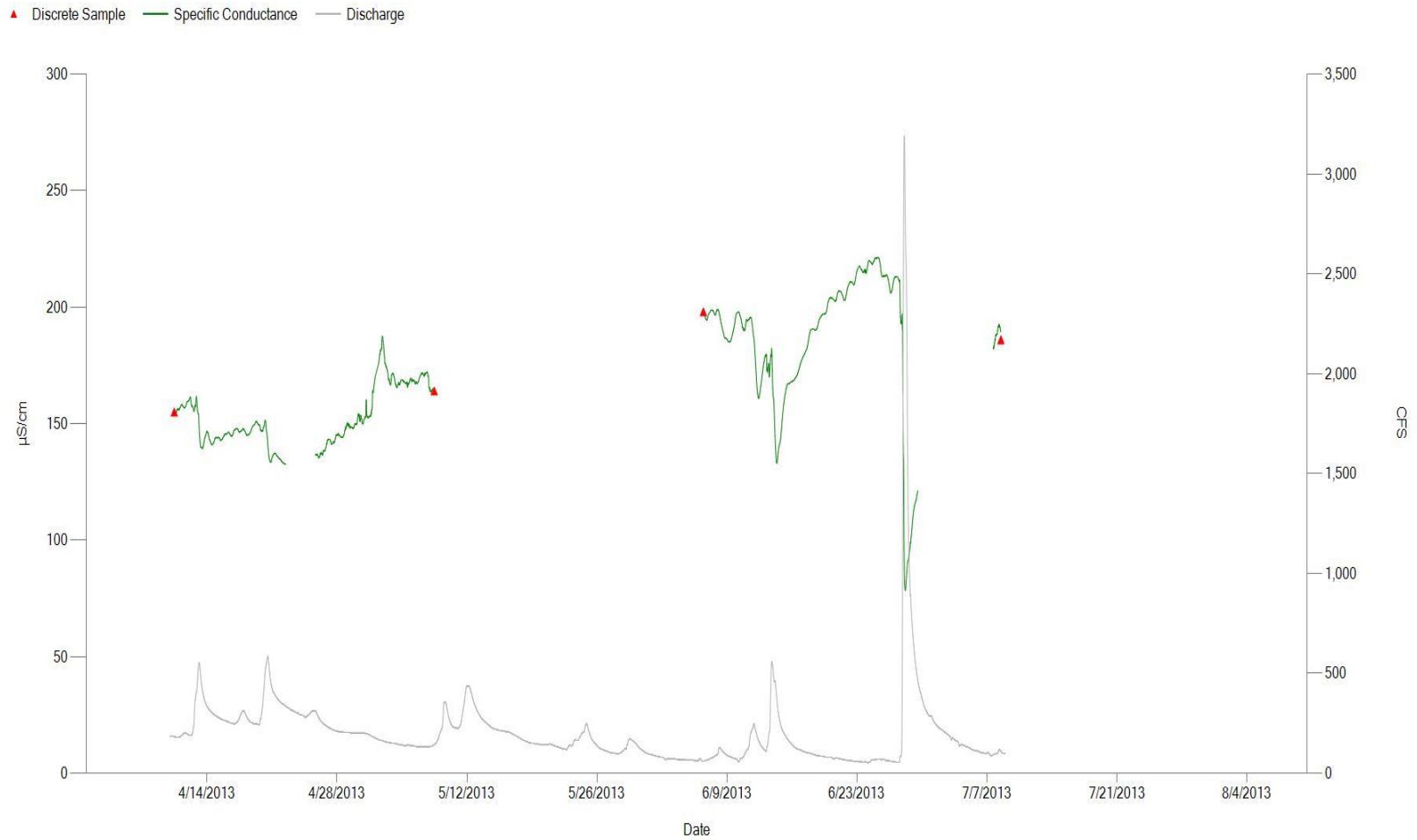


Figure 6. Continuous specific conductance, continuous discharge, and discrete samples from April 10, 2013 to August 4, 2013. All data gaps are due to equipment failure.

2014 Statistics - Average: 204 $\mu\text{S}/\text{cm}^c$; Maximum: 273 $\mu\text{S}/\text{cm}^c$; Minimum: 85 $\mu\text{S}/\text{cm}^c$.

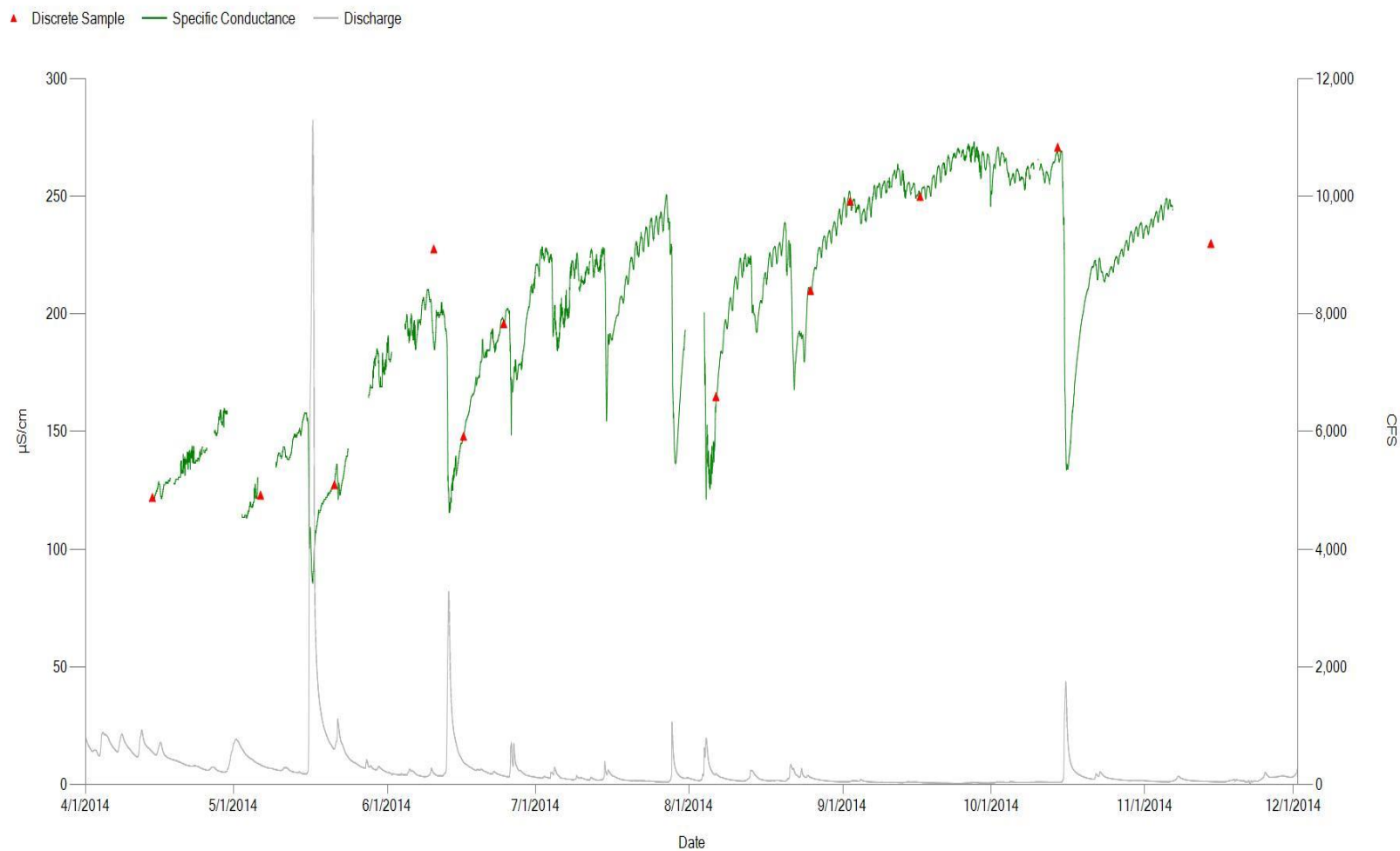


Figure 7. Continuous specific conductance, continuous discharge, and discrete samples from April 14, 2014 to November 10, 2014. All data gaps are due to erratic readings.

pH:

2013 Statistics - Average: 7.6 units; Maximum: 8.7 units; Minimum: 6.9 units.

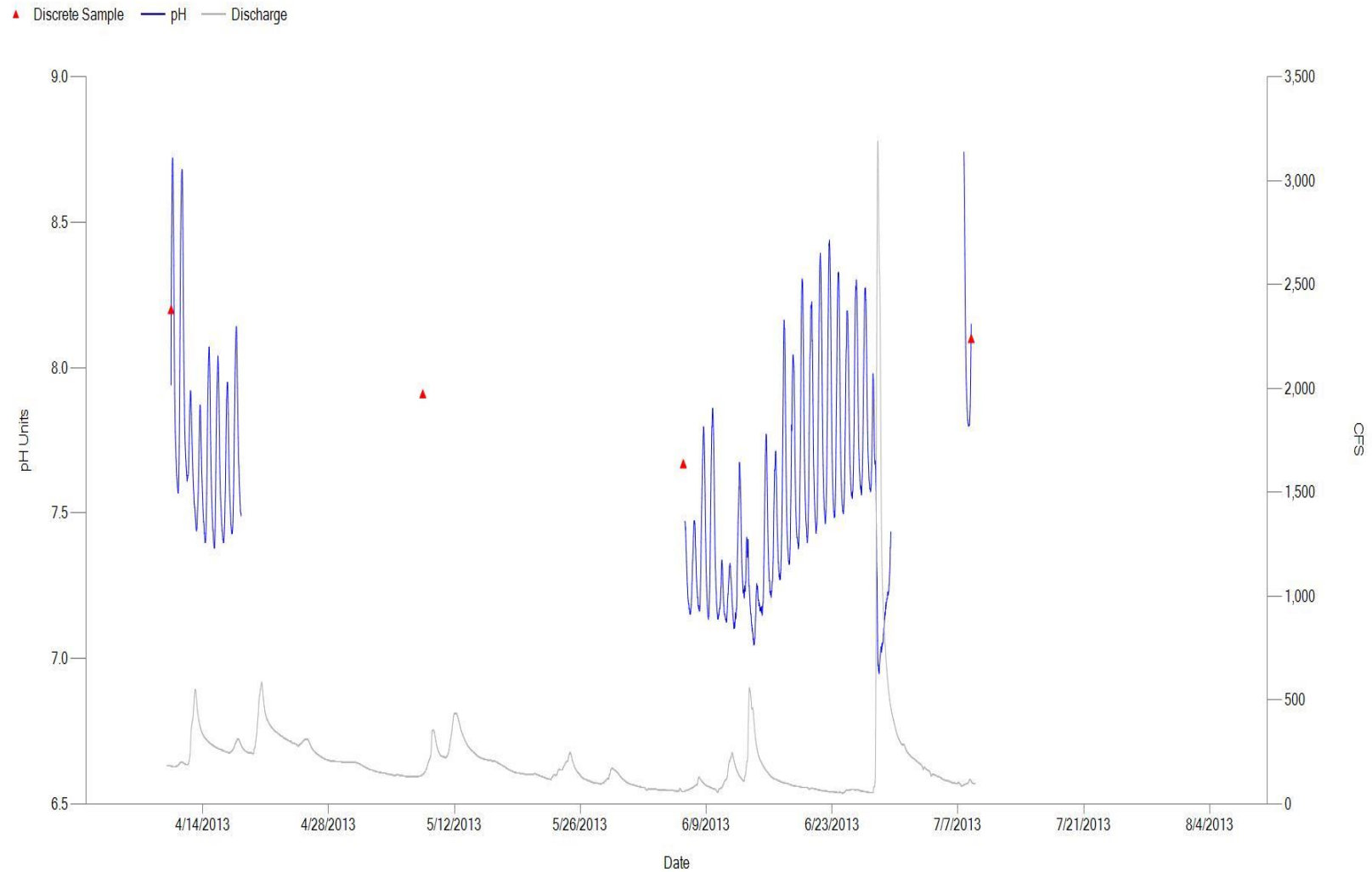


Figure 8. Continuous pH, continuous discharge, and discrete samples from April 10, 2013 to August 4, 2013. All data gaps are due to equipment failure.

2014 Statistics - Average: 7.9 units; Maximum: 9.3 units; Minimum: 6.7 units.

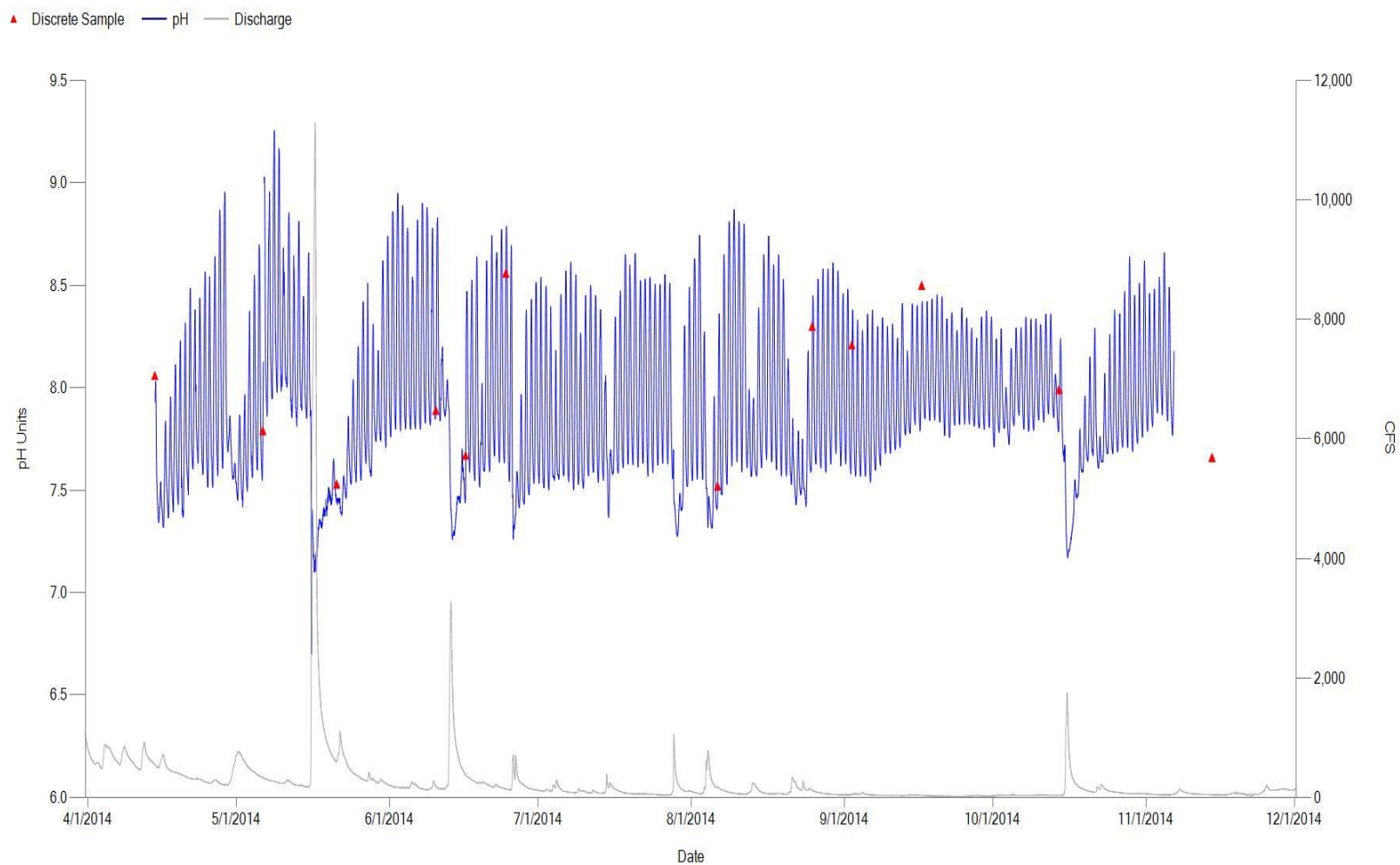


Figure 9. Continuous pH, continuous discharge, and discrete samples from April 14, 2014 to November 10, 2014.

Dissolved Oxygen:

2013 Statistics – Average: 8.73 mg/L; Maximum: 11.9 mg/L; Minimum: 5.6 mg/L.

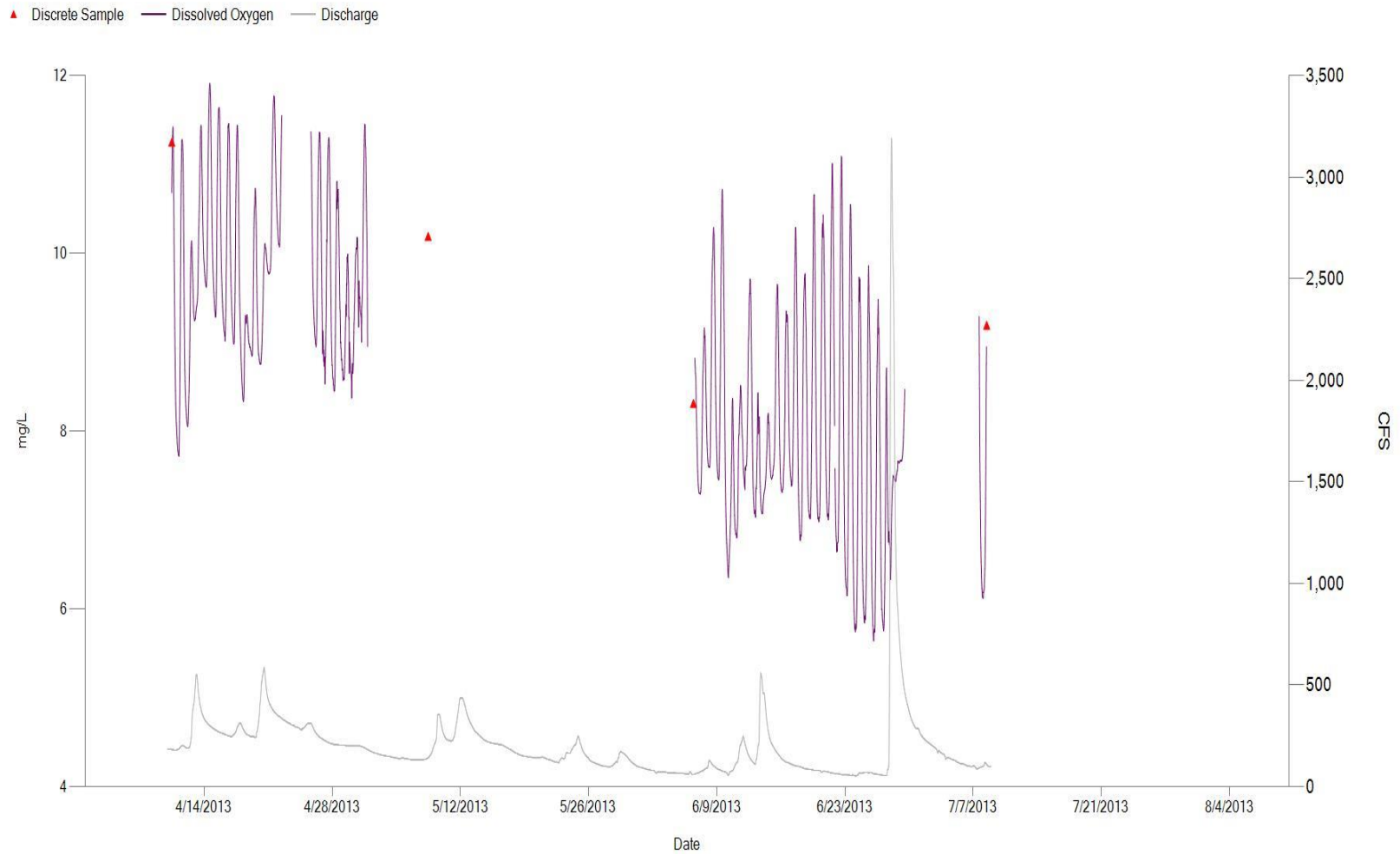


Figure 10. Continuous dissolved oxygen, continuous discharge, and discrete samples from April 10, 2013 to August 4, 2013. All data gaps are due to equipment failure.

2014 Statistics – Average: 9.3 mg/L; Maximum: 13.9 mg/L; Minimum: 6.2 mg/L.

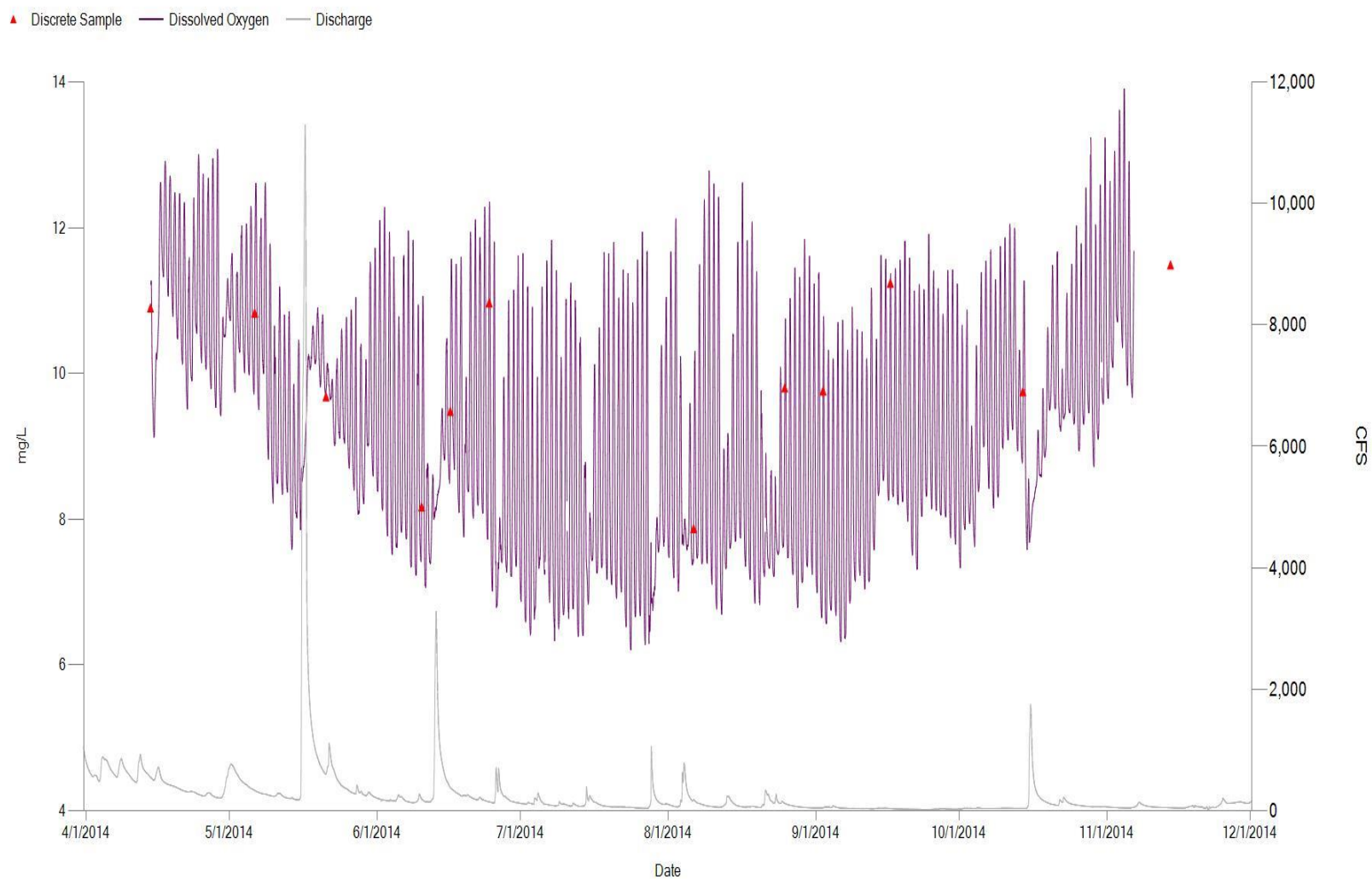


Figure 11. Continuous dissolved oxygen, continuous discharge, and discrete samples from April 14, 2014 to November 10, 2014.

In-situ Water Chemistry: Samples were collected four times in 2013 using standard analysis code 612. Samples were collected eight times in 2014 using standard analysis code 612 with additional dissolved metal concentration analyses. Measurements with "<" indicate concentrations below the reporting limit.

Table 1. 2013 Chemical grab sample results.

Parameter	Units	04/10/2013	05/06/2013	05/08/2013	07/08/2013
		11:30	11:45	11:25	12:38
DISCHARGE	CFS	163	128	--	--
ALUMINUM T	UG/L	51.000	61.000	84.000	143.000
BARIUM T	UG/L	32.000	31.000	33.000	40.000
BORON T	UG/L	20.00	20.00	20.00	<19.1058
BROMIDE	UG/L	<7.03284	<7.03284	<7.03284	9.9100
CALCIUM T	MG/L	17.600	19.000	20.870	21.900
CHLORIDE T	MG/L	4.0170	3.5420	3.4220	4.6480
COPPER T	UG/L	0.669	0.482	0.937	0.673
IRON T	UG/L	124.000	179.000	189.000	248.000
LEAD T	UG/L	0.138	0.133	0.171	0.185
MAGNESIUM T	MG/L	4.481	4.761	4.789	5.461
MANGANESE T	UG/L	11.000	19.000	19.000	19.000
NICKEL	UG/L	<13.7856	<13.7856	<13.7856	<13.7856
SELENIUM	UG/L	<0.32605	<0.32605	<0.32605	<0.32605
SODIUM	UG/L	2.877	2.547	2.505	2.745
STRONTIUM	UG/L	262.000	277.000	275.000	329.000
SULFATE T	MG/L	11.5280	11.3010	11.2960	11.7000
ZINC	UG/L	<5.1325	6.000	<5.1325	<5.1325
HARDNESS T	MG/L	62	67	72	77
OSMOTIC PRESSURE	MOSM	1	5	6	4
pH	pH units	8.2	8.2	8.2	8.3
SPECIFIC COND @ 25C	umhos/cm	150.70	161.00	160.70	181.70
TDS @ 180C	MG/L	82	106	88	116

Table 1 (continued): 2013 Chemical grab sample results.

Parameter	Units	04/10/2013	05/06/2013	05/08/2013	07/08/2013
		11:30	11:45	11:25	12:38
TSS	MG/L	<5	<5	<5	6
TOC	MG/L	1.9540	1.9580	1.9680	2.1470
ALKALINITY @ pH 4.5	MG/L	59.2	64.4	63.6	69.4
AMMONIA D	MG/L	0.012	0.028	<0.00672	0.016
AMMONIA T	MG/L	0.009	<0.00672	<0.00672	0.017
NITRATE & NITRITE D	MG/L	0.715	0.530	0.549	0.677
NITRATE & NITRITE T	MG/L	0.719	0.526	0.557	0.665
NITROGEN D	MG/L	0.885	0.682	0.719	0.882
NITROGEN T	MG/L	0.902	0.720	0.726	0.868
PHOSPHORUS D	MG/L	0.005	0.014	0.010	0.011
PHOSPHORUS T	MG/L	0.013	0.016	0.018	0.019
ORTHO PHOSPHOROUS D	MG/L	0.004	0.003	0.006	0.008
ORTHO PHOSPHOROUS T	MG/L	0.004	0.003	0.007	0.008

Table 2: 2014 Chemical grab sample results.

Parameters	Units	04/01/2014	05/06/2014	06/16/2014	06/24/2014	08/06/2014	09/02/2014	10/15/2014	11/10/2014
		09:40	08:53	09:19	12:25	09:07	12:06	09:55	10:04
ALUMINUM D	UG/L	--	--	<200.0	<200.0	<200.0	<200.0	--	11.000
ALUMINUM T	UG/L	252.000	112.000	156.000	73.000	340.000	51.000	56.000	21.000
BARIUM T	UG/L	26.000	28.000	31.000	36.000	35.000	47.000	51.000	41.000
BORON T	UG/L	20.00	<19.1058	20.00	<19.1058	30.00	<19.1058	<19.1058	<19.1058
BROMIDE	UG/L	8.5660	<6.677	9.5970	7.0740	<6.677	10.9460	<7.127	<7.127
CALCIUM T	MG/L	12.700	14.100	16.900	26.700	20.100	32.200	35.200	28.600
CHLORIDE T	MG/L	5.4790	3.8370	3.5970	5.2300	4.8700	4.6310	6.6260	6.6400
COPPER D	UG/L	--	--	<4	<4	<4	<4	--	0.707
COPPER T	UG/L	1.080	1.040	0.478	0.739	2.030	0.675	0.796	0.589
IRON D	UG/L	--	--	57.000	74.000	68.000	50.000	--	84.000
IRON T	UG/L	399.000	199.000	259.000	141.000	530.000	129.000	100.000	86.000
LEAD D	UG/L	--	--	<1.0	<1.0	<1.0	<1.0	--	<.101
LEAD T	UG/L	0.377	0.199	0.197	0.111	0.462	0.108	0.091	<0.101
MAGNESIUM T	MG/L	3.185	3.614	4.274	5.728	4.488	7.317	7.919	7.067
MANGANESE D	UG/L	--	--	<10	<10	<10	10.000	--	5.000
MANGANESE T	UG/L	20.000	17.000	14.000	11.000	23.000	16.000	16.000	5.000
NICKEL T	UG/L	<13.7856	<13.7856	<13.7856	<13.7856	<13.7856	<13.7856	<12	<12
SELENIUM T	UG/L	0.760	0.474	0.365	0.422	<0.32605	0.328	0.435	<.763
SODIUM T	MG/L	3.406	2.807	3.052	3.058	3.444	3.716	3.197	3.916
STRONTIUM T	UG/L	138.000	183.000	190.000	315.000	244.000	504.000	573.000	458.000
SULFATE T	MG/L	9.9140	9.7830	10.1040	11.8670	9.6850	14.8040	15.3690	14.0650
ZINC D	UG/L	--	--	<10.0	15.000	<10.0	<10.0	--	6.000
GLYPHOSPHATE	UG/L	--	--	nd*	nd*	nd*	--	--	--
HARDNESS T	MG/L	45	50	60	90	69	111	121	101

nd* = Not detected

Table 2 (continued): 2014 Chemical grab sample results.

Parameters	Units	04/01/2014	05/06/2014	06/16/2014	06/24/2014	08/06/2014	09/02/2014	10/15/2014	11/10/2014
		09:40	08:53	09:19	12:25	09:07	12:06	09:55	10:04
pH	pH units	7.1	7.7	7.9	8.6	8.0	8.3	8.1	8.0
SPECIFIC COND @ 25C	umhos/cm	112.30	123.70	144.50	193.10	161.40	245.00	254.00	224.00
TDS @ 180C	MG/L	90	90	110	128	114	156	140	134
TSS	MG/L	10	<5	<5	<5	16	<5	<5	<5
TOC	MG/L	2.5270	1.7710	2.1510	2.2620	4.7190	2.2040	3.2060	2.4230
ALKALINITY @ pH 4.5	MG/L	33.8	44.4	49.2	76.4	59.6	99.0	105.8	89.0
AMMONIA D	MG/L	0.01200	<0.00800	0.02000	0.01300	0.02300	0.02900	--	<0.007
AMMONIA T	MG/L	0.011	<0.008	0.015	0.015	0.019	0.019	0.015	<0.007
NITRATE & NITRITE D	MG/L	1.552	0.816	1.749	1.135	0.884	0.651	--	0.608
NITRATE & NITRITE T	MG/L	1.535	0.788	1.753	1.135	0.873	0.649	0.213	0.498
NITROGEN D	MG/L	1.666	0.941	1.860	1.256	1.173	0.831	--	0.778
NITROGEN T	MG/L	1.712	0.962	1.894	1.268	1.224	0.864	0.461	0.666
PHOSPHORUS D	MG/L	0.013	0.005	0.009	0.004	0.017	0.010	0.008	0.004
PHOSPHORUS T	MG/L	0.024	0.011	0.016	0.010	0.034	0.015	0.015	0.007
ORTHO PHOSPHORUS D	MG/L	0.006	0.004	0.008	<0.002	0.013	0.006	--	0.004
ORTHO PHOSPHORUS T	MG/L	0.006	0.005	0.008	<0.002	0.013	0.007	0.003	0.004

Ammonia Toxicity: The toxicity of ammonia in an aquatic environment varies with respect to the temperature and pH of the water. The ammonia concentrations measured from grab samples were compared to acute and chronic criteria derived from continuous temperature and pH data and formulas in Table 3 of §93.7(a) (Table 3 and Figures 14 and 15). Measured values were well below these calculated toxicity values.

Table 3. Grab sample ammonia concentrations and calculated toxicity values in mg/L.

Date	Time	Ammonia Concentration	Calculated Acute Toxicity	Calculated Chronic Toxicity
2013 Samples				
04/10/2013	11:30	0.009	2.18	0.51
05/06/2013	11:45	<0.00672	2.35	0.55
05/08/2013	11:25	<0.00672	2.23	0.52
07/08/2013	12:38	0.017	1.05	0.24
2014 Samples				
04/01/2014	09:40	0.011	*	*
05/06/2014	08:53	<0.008	7.63	2.24
06/16/2014	09:19	0.015	3.61	0.94
06/24/2014	12:25	0.015	0.66	0.14
08/06/2014	09:07	0.019	2.41	0.60
09/02/2014	12:06	0.019	1.17	0.27
10/15/2015	09:55	0.015	3.16	0.76
11/10/2015	10:04	<0.007	5.47	1.37

*Temperature value not available to calculate toxicity.

2013 Ammonia Toxicity Comparison

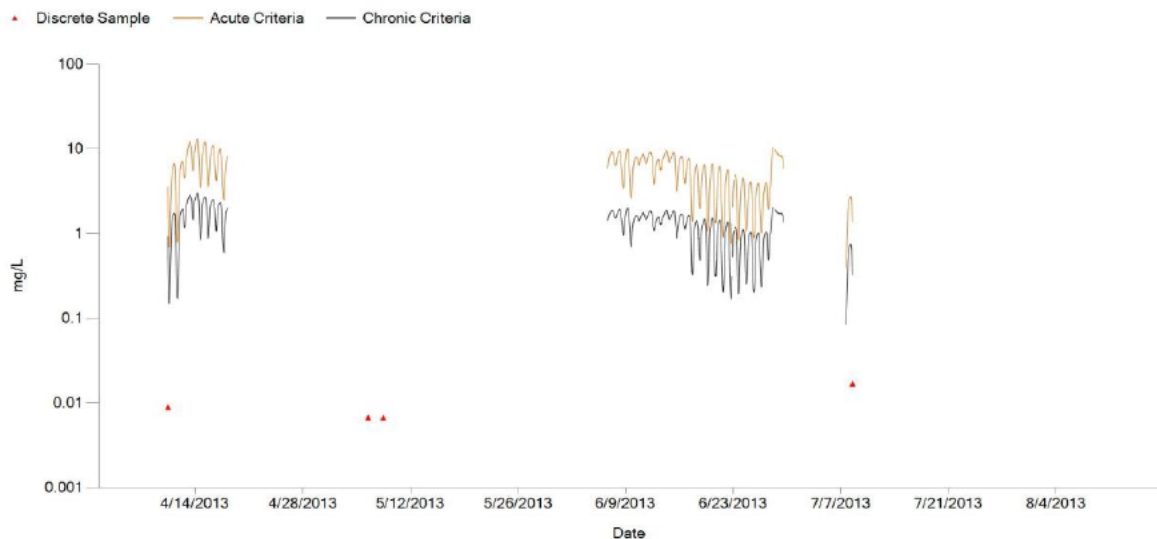


Figure 12. Calculated acute ammonia toxicity, calculated chronic ammonia toxicity, and measured ammonia concentrations from April 10, 2013 to August 4, 2013. All data gaps are due to equipment failure.

2014 Ammonia Toxicity Comparisons

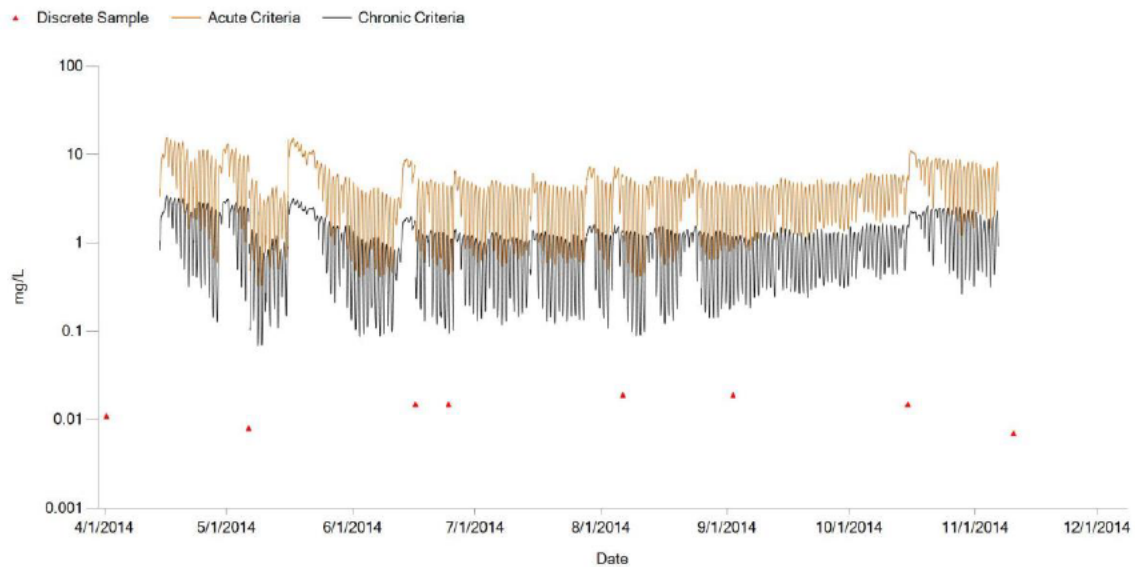


Figure 13. Calculated acute ammonia toxicity, calculated chronic ammonia toxicity, and measured ammonia concentrations from April 14, 2014 to November 11, 2014.

Biology: The indigenous aquatic community is an excellent indicator of long-term conditions and is used as a measure of water quality. Benthic macroinvertebrates (Table 2) were collected on November 19, 2013 and November 10, 2014. Fishes were collected on July 12, 2013 (Table 3).

Table 3. Taxa list for benthic macroinvertebrate survey.

Family	Genus	20131119-1349-jbutt	20141110-1030-mhoger
Baetidae	<i>Acerpenna</i>		1
Isonychiidae	<i>Isonychia</i>	15	15
Heptageniidae	<i>Leucrocuta</i>	3	1
Heptageniidae	<i>Maccaffertium</i>	34	21
Ephemerellidae	<i>Ephemera</i>	2	
Ephemerellidae	<i>Ephemerella</i>	1	
Taeniopterygidae	<i>Taeniopteryx</i>	26	16
Taeniopterygidae	<i>Taenionema</i>	6	
Taeniopterygidae	<i>Strophopteryx</i>		7
Capniidae	<i>Allocapnia</i>		4
Capniidae	<i>Paracapnia</i>	2	
Perlidae	<i>Agnatina</i>	2	3
Perlidae	<i>Acroneuria</i>	1	
Corydalidae	<i>Corydalus</i>	3	2
Hydropsychidae	<i>Ceratopsyche</i>		11
Hydropsychidae	<i>Cheumatopsyche</i>		64
Hydropsychidae	<i>Hydropsyche</i>		2

Table 3 (continued): Taxa list for benthic macroinvertebrate survey.

Family	Genus	20131119-1349-jbutt	20141110-1030-mhoger
Philopotamoidea	<i>Chimarra</i>	9	8
Uenoidae	<i>Neophylax</i>		2
Psephenidae	<i>Psephenus</i>	2	
Elmidae	<i>Dubiraphia</i>		1
Elmidae	<i>Optioservus</i>	29	65
Elmidae	<i>Stenelmis</i>	11	12
Chironomidae		9	3
Corbiculidae		1	
Oligochaeta		2	

Table 4. Taxa list for fish survey.

Family	Scientific Name	Common Name	20130712-841-twertz
Catostomidae	<i>Catostomus commersonii</i>	White Sucker	7
Catostomidae	<i>Erimyzon oblongus</i>	Creek Chubsucker	1
Catostomidae	<i>Hypentelium nigricans</i>	Northern Hogsucker	4
Centrarchidae	<i>Lepomis auritus</i>	Redbreast Sunfish	68
Centrarchidae	<i>Lepomis cyanellus</i>	Green Sunfish	7
Centrarchidae	<i>Micropterus dolomieu</i>	Smallmouth Bass	25
Centrarchidae	<i>Lepomis gibbosus</i>	Pumpkinseed	1
Centrarchidae	<i>Lepomis macrochirus</i>	Bluegill	1
Centrarchidae	<i>Ambloplites rupestris</i>	Rock Bass	219
Cyprinidae	<i>Campostoma anomalum</i>	Central Stoneroller	14
Cyprinidae	<i>Rhinichthys cataractae</i>	Longnose Dace	12
Cyprinidae	<i>Luxilus cornutus</i>	Common Shiner	32
Cyprinidae	<i>Semotilus corporalis</i>	Fallfish	30
Cyprinidae	<i>Exoglossum maxillingua</i>	Cutlip Minnow	36
Cyprinidae	<i>Nocomis micropogon</i>	River Chub	69
Cyprinidae	<i>Pimephales notatus</i>	Bluntnose Minnow	122
Cyprinidae	<i>Notropis rubellus</i>	Rosyface Shiner	97
Cyprinidae	<i>Cyprinella spiloptera</i>	Spotfin Shiner	8
Cyprinidae	<i>Notropis volucellus</i>	Mimic Shiner	784
Esocidae	<i>Esox niger</i>	Chain Pickerel	1
Ictaluridae	<i>Noturus insignis</i>	Margined Madtom	8
Ictaluridae	<i>Ameiurus natalis</i>	Yellow Bullhead	12
Ictaluridae	<i>Ictalurus punctatus</i>	Channel Catfish	1
Percidae	<i>Etheostoma blennioides</i>	Greenside Darter	42
Percidae	<i>Etheostoma olmstedii</i>	Tessellated Darter	30
Percidae	<i>Percina peltata</i>	Shield Darter	13
Percidae	<i>Etheostoma zonale</i>	Banded Darter	55

ASSESSMENT:

Continuous: The small amount of data collected in 2013, indicated good water quality. Specific conductance measurements were fairly consistent with the expected trends, with one small spike in the middle of May. Measurements of pH were slightly elevated in the beginning of the sampling period but remained consistent with expected diel and seasonal swings for the remainder of the sampling period. Dissolved oxygen concentrations were also consistent with the expected trends, and with all parameters dilution effects were observed.

Overall, parameters collected by the 2014 instream monitor indicated average water quality conditions. Specific conductance measurements show a relatively consistent pattern throughout the sampling period with no unexpected variation. Continuous measurements in pH were somewhat elevated for the entire sampling period, with a few occurrences at or exceeding 9.0 units on a few days, maximum value of 9.3 units. Dissolved oxygen measurements were fairly consistent with expected trends. All parameters exhibited a strong dilution effect with high flow events.

Biological: The 2013 benthic macroinvertebrate community indicated good water quality. Approximately 82% of the total taxa consisted of Ephemeroptera, Plecoptera & Trichoptera (EPT) taxa. The most dominant taxa were *Maccaffertium* and *Optioservus*, a mayfly and beetle, both are somewhat tolerant to pollution. The fish collected are typical of a warm water stream. The most abundant fishes were the rock bass and mimic shiner.

The 2014 benthic macroinvertebrate community indicated average water quality. Approximately 65% of the total taxa consisted of EPT taxa. The most dominant taxa were *Cheumatopsyche* and *Optioservus*, a caddisfly and beetle both somewhat tolerant to pollution.

Table 4. Metric calculations.

Date	IBI	Richness	Mod EPT	HBI	% Dom	% Mod May	Beck3	Shannon Div
November 19, 2013	70.8	17	10	3.41	21.7	34.4	10	2.30
November 10, 2014	61.4	20	11	4.28	27.1	15.8	7	2.19

SUMMARY: Continuous instream monitor, water chemistry, and biological data suggest overall good water quality. Measurements of pH were elevated at the beginning of both years suggesting possible anthropogenic influences in the early season; otherwise, continuous measurements of specific conductance and dissolved oxygen were fairly consistent, indicating minimal impacts to the watershed. Furthermore, water chemistry concentrations remained similar month to month and year to year, indicating a stable environment. The biological surveys yielded similar community compositions in both years, signifying aquatic life attainment for the watershed.

LITERATURE CITED

PA DEP. 2013. Instream Comprehensive Evaluations (ICE). <http://files.dep.state.pa.us/Water/Drinking%20Water%20and%20Facility%20Regulation/WaterQualityPortalFiles/Methodology/2013%20Methodology/ICE.pdf>

PA DEP. 2013. Continuous Instream Monitoring Protocol. http://files.dep.state.pa.us/Water/Drinking%20Water%20and%20Facility%20Regulation/WaterQualityPortalFiles/Methodology/2013%20Methodology/CIM_PROTOCOL.pdf