pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

BUREAU OF POINT & NON-POINT SOURCE MANAGEMENT

Continuous Instream Monitoring Report (CIMR)

Most recent revision: 2/4/19
Revised by: Hoger

STATION DESCRIPTION:
STREAM CODE: 01024
STREAM NAME: Skippack Creek
SITE NAME: Skippack Creek DWS Route 63

COUNTY: Montgomery

LATITUDE: 40.253802 **LONGITUDE:** -75.356011

LOCATION DESCRIPTION: Skippack Creek DWS Rt. 63 and just UPS of Mainland Road within thalweg.

HUC: 02040203

DRAINAGE AREA: 11.57 sq. miles

BACKGROUND AND HISTORY: Skippack Creek is a freestone tributary to Perkiomen Creek within Towamencin Township, Montgomery County (Figure 1). The portion of the basin above this site is characterized by relatively shallow topography with land use consisting of urban areas (42.2%), agricultural open use (34.2%) and forested land (23.6%). The purpose of this survey was to characterize water quality and biological conditions from early-spring to late fall as part of a greater nutrient impact assessment development. These data also allowed for comparison of the early-spring water quality throughout a basin as additional sites were located at Towamencin Creek, a tributary to Skippack Creek, and Skippack Creek at Ridge Pike in the lower portion of the watershed (Figure 1). Skippack Creek has a designated use of Trout Stocking, Migratory Fishes (TSF, MF). Three sewage discharges are active in this portion of the basin.

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 baseline biological communities.

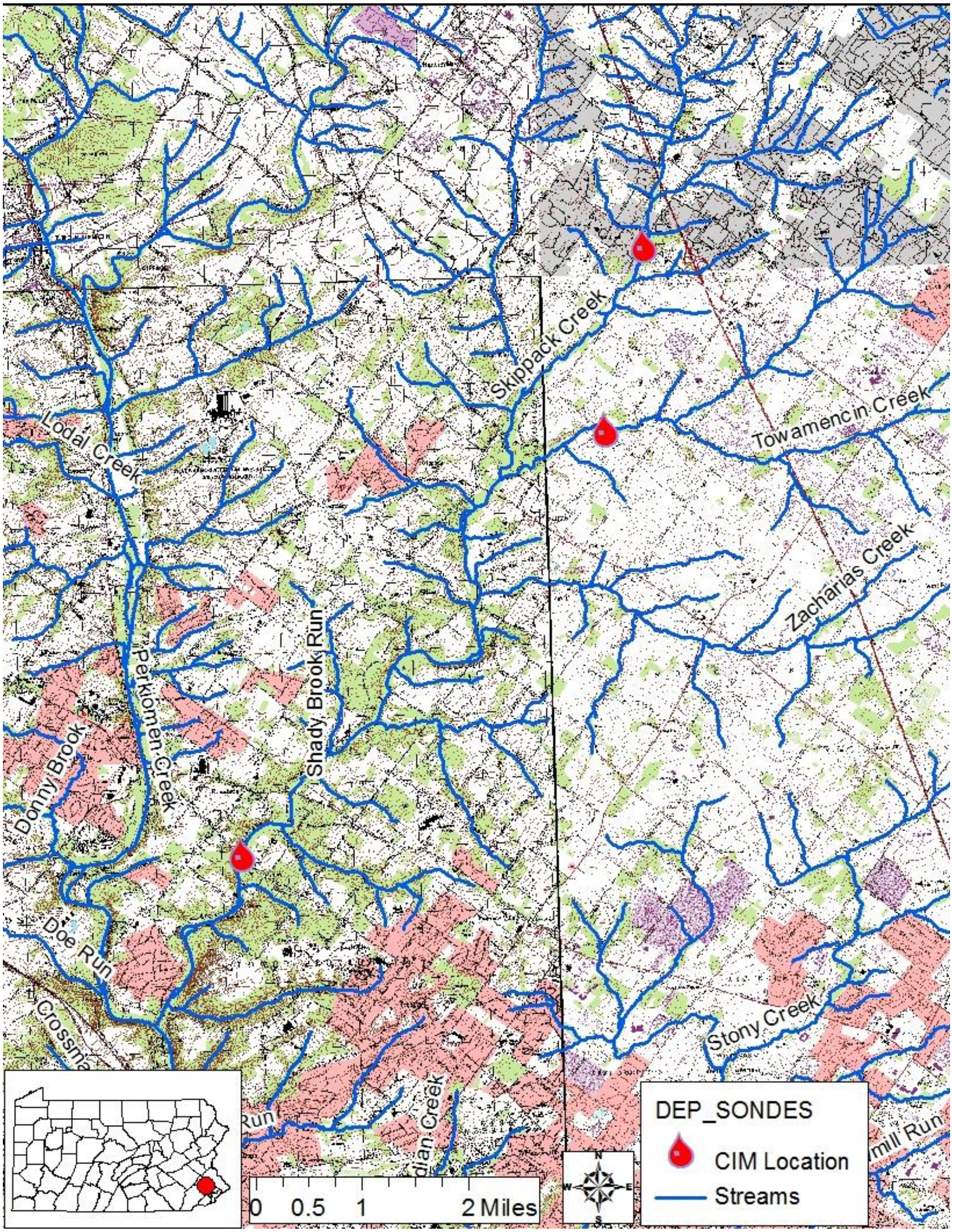

Figure 1. Map of the CIM locations within the Skippack Creek basin. Sites include a lower Skippack Creek location (at Ridge Pike), upper Skippack Creek location (Route 63) and one tributary (Towamencin Creek at Metz Rd).


Figure 2. Skippack Creek DWS Route 63 sampling location.

WATER QUALITY PARAMETERS:

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

EQUIPMENT:

A single Yellow Springs Instruments (YSI) 6600 water-quality sonde was used at this station. The sonde (Serial # 000146D3) was installed on March 4, 2013. A Yellow Springs Instruments (YSI) 6920 V2 was used as a field meter during revisits.

The sonde was 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, with a notch cut out 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 sonde recorded water quality parameters every 30 minutes.

PERIOD OF RECORD: March 4, 2013 to November 13, 2013

The station was revisited nine times over eight months for the purpose of downloading data, checking calibration, and cleaning.

DATA:

Water chemistry grabs were collected nine times during the sampling period. Benthic macroinvertebrates were collected on April 16, 2013, periphyton was collected on April 25, 2013 and fishes were collected on July 17, 2013 using the Department's ICE protocol (PA DEP, 2013). Continuous data are graded based on a combination of fouling and calibration error (PA DEP, 2013). Two periods for specific conductance and one period for dissolved oxygen were graded unusable due to excessive meter fouling and deleted from the final report.

Depth: Depth measured by this non-vented YSI 6600 is actually the measure of water column pressure plus atmospheric pressure. Changes in atmospheric pressure while the sonde was deployed appear as changes in depth. Data were corrected for barometric pressure using a Solinst Barologger located at this site. These data are used only as qualitative interpretation for changes in other parameters due to a lack of verification.

Discrete Water Quality Transect Characterization: A transect across the width of the stream was established to characterize water quality. The purpose 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 three points across the stream. Transects were conducted eight times throughout the sampling period. Temperature, specific conductance, pH and dissolved oxygen measurements indicated a fairly homogenous system with the greatest variation seen in dissolved oxygen (Figure 3).

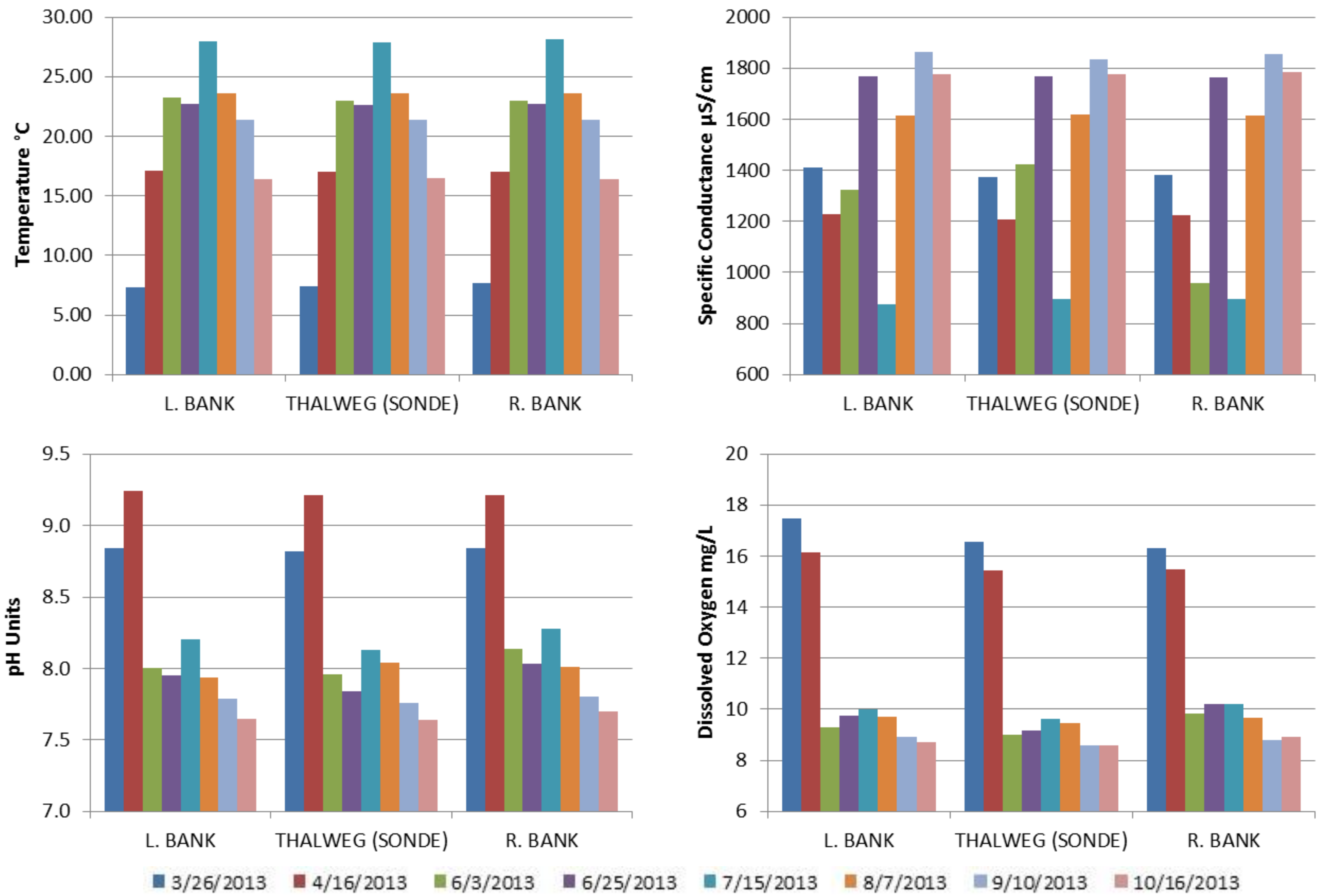

Figure 3. Discrete water quality transects.

Water Temperature: Average: 17.85°C; Maximum: 30.45°C; Minimum: 3.52°C.

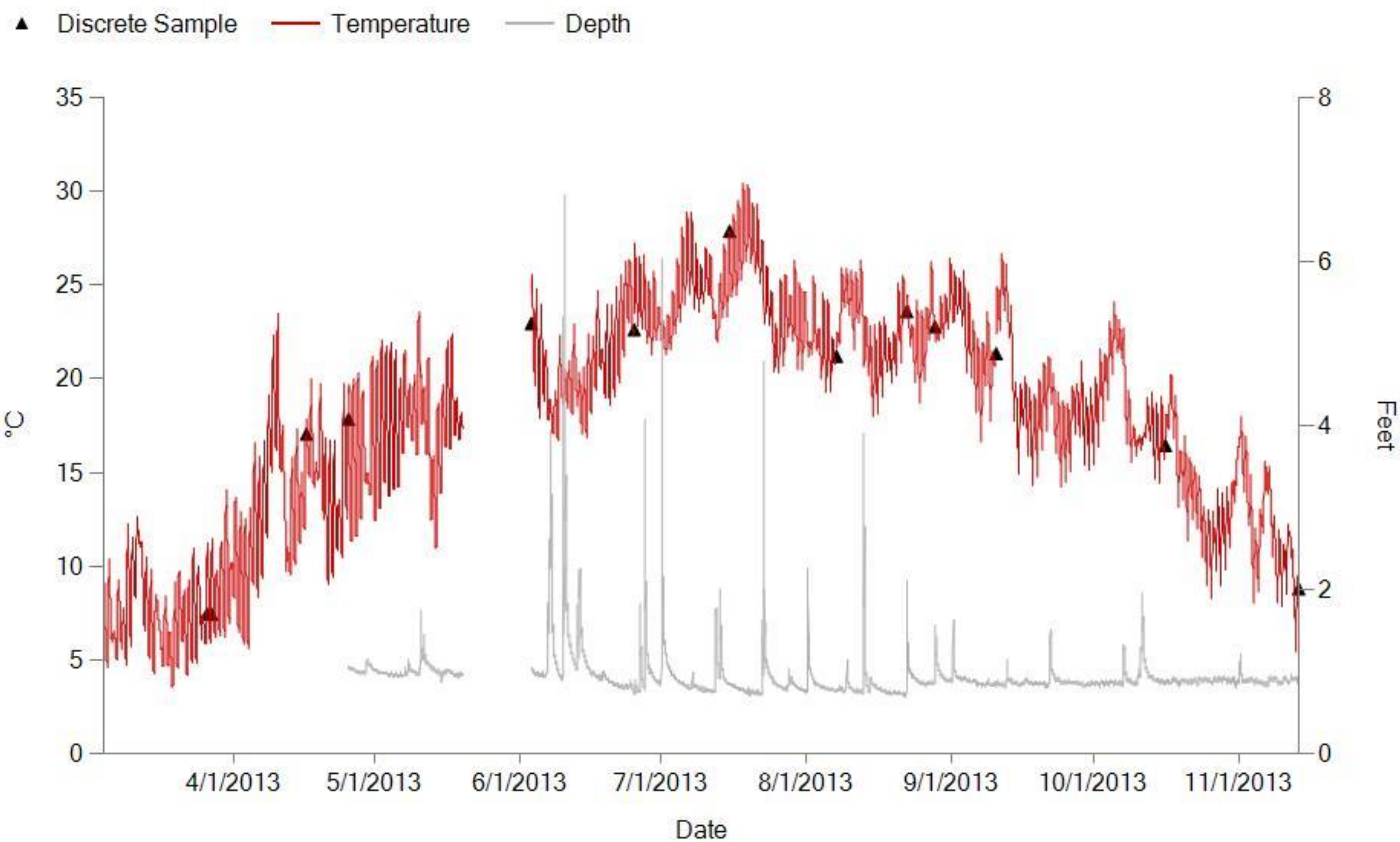

Figure 4. Continuous water temperature, continuous depth, and discrete water temperature from March 4, 2013 to November 13, 2013. The data gap at the end of May was due to battery failure.

Specific Conductance: Average: 1410.9 µS/cm; Maximum: 2591 µS/cm; Minimum: 111 µS/cm.

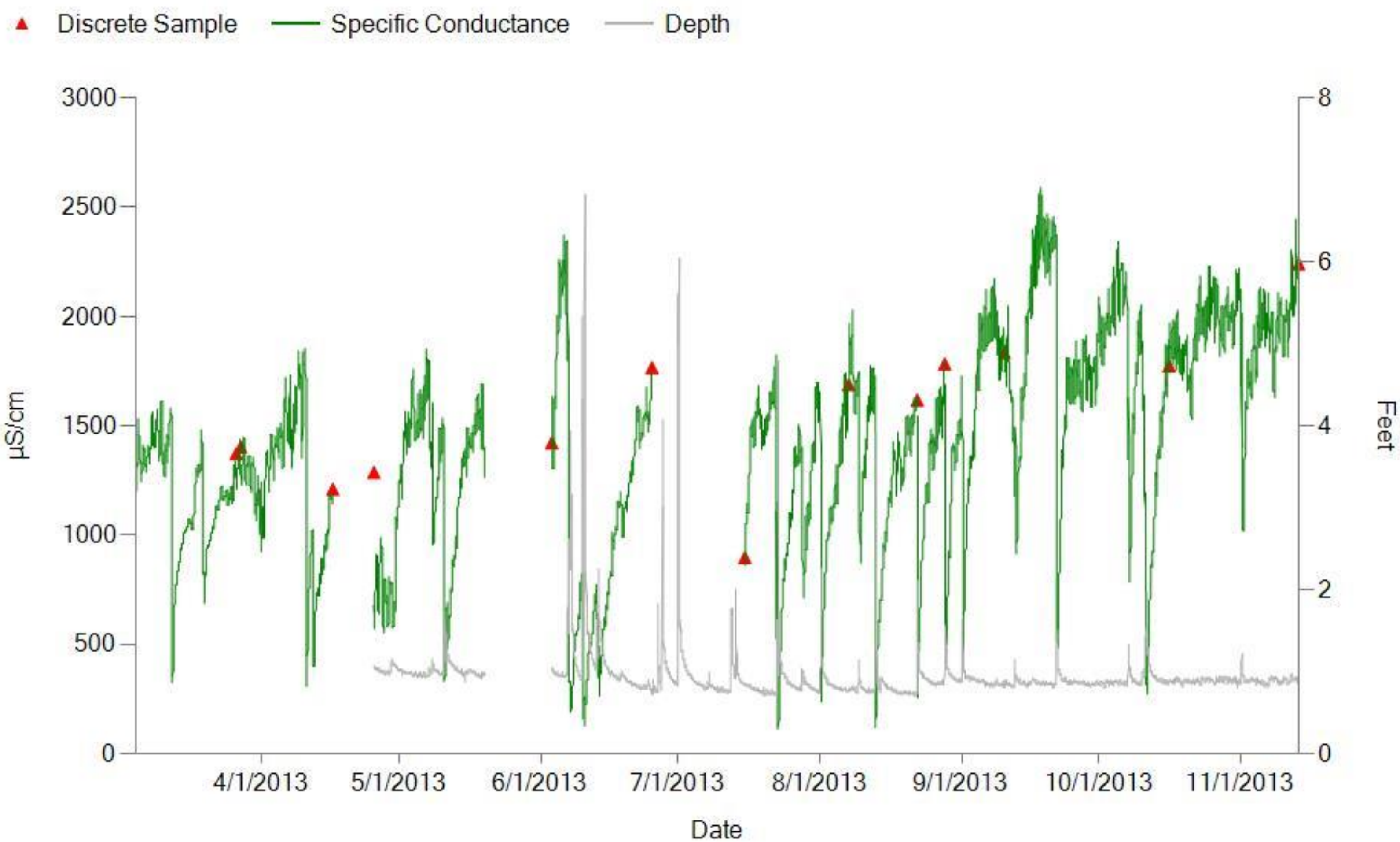

Figure 5. Continuous specific conductance, continuous depth, and discrete specific conductance from March 4, 2013 to November 13, 2013. The data gap at the end of May was due to battery failure. Gaps at the end of April and beginning of July were due to excessive meter fouling.

pH: Average: 7.92 units; Maximum: 9.57 units; Minimum: 7.00 units.

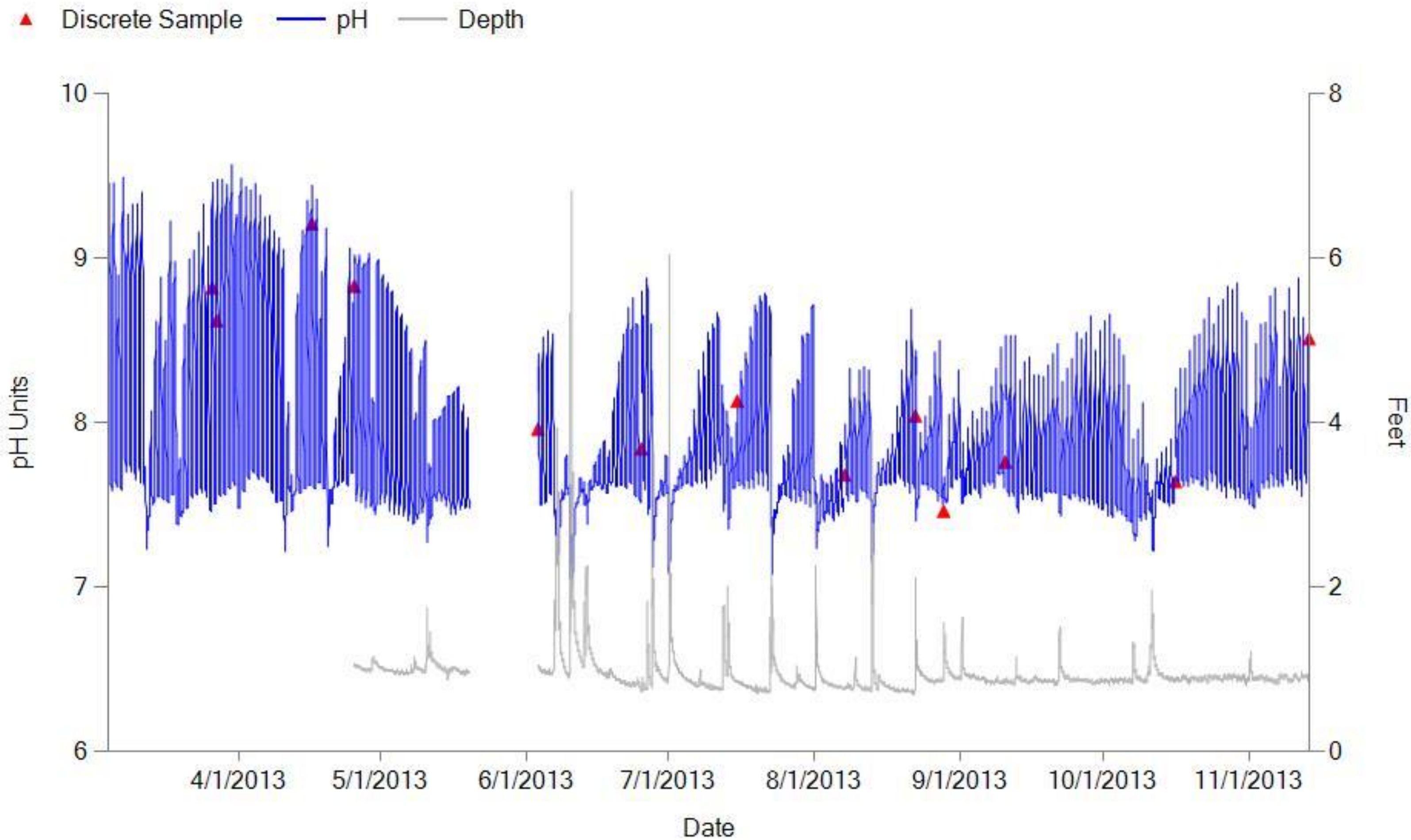

Figure 6. Continuous pH, continuous depth, and discrete pH from March 4, 2013 to November 13, 2013. The data gap at the end of May was due to battery failure.

Dissolved Oxygen: Average: 9.36 mg/l; Maximum: 23.33 mg/l; Minimum: 2.74 mg/l.

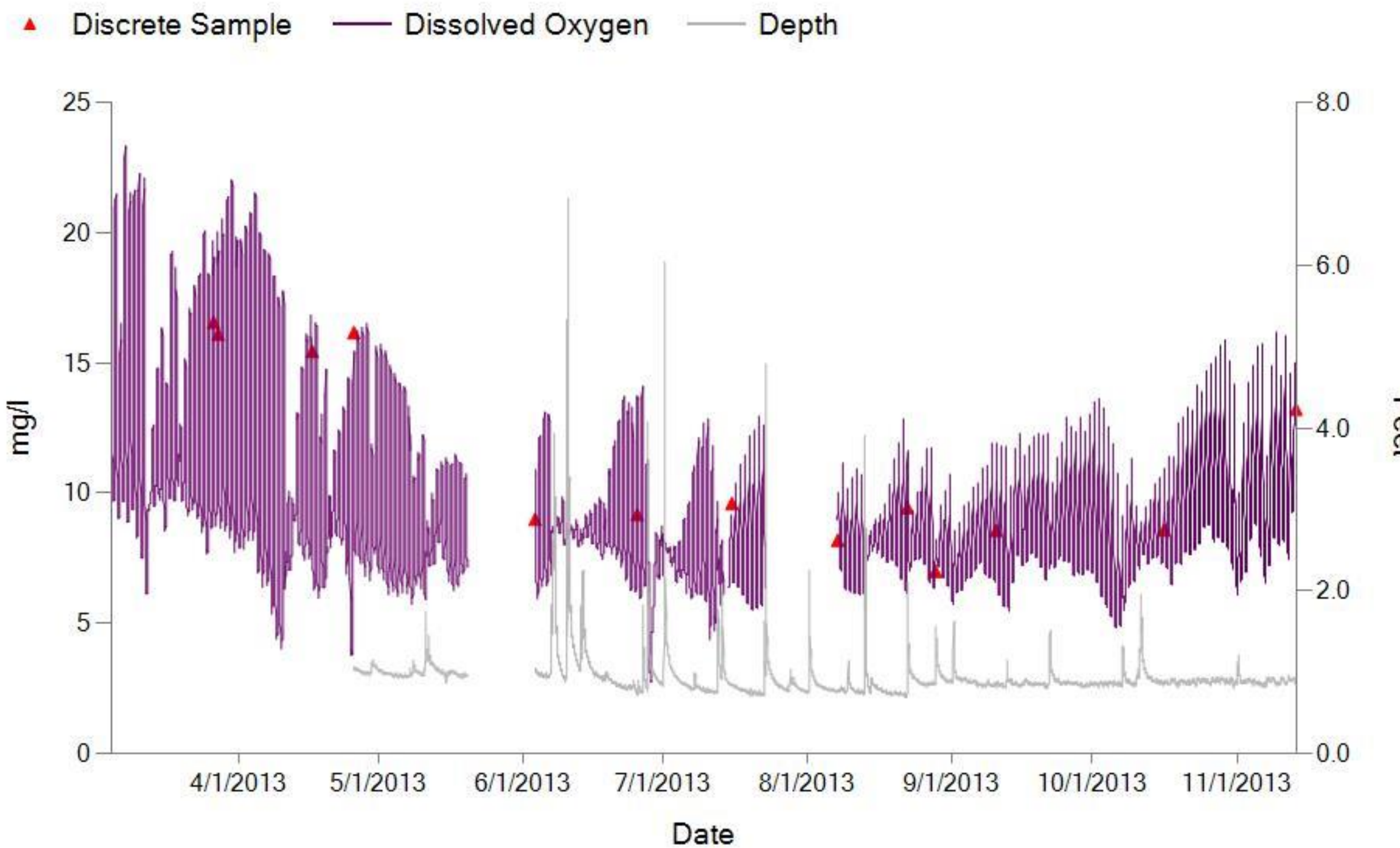

Figure 7. Continuous dissolved oxygen, continuous depth, and discrete dissolved oxygen from March 4, 2013 to November 13, 2013. The data gap at the end of May was due to battery failure. The data gap in July and August was due to excessive meter fouling.

In-situ Water Chemistry: Samples were collected nine times using standard analysis code 612. Measurements with "<" indicate concentrations below the reporting limit. Discharge values with "*" indicates that it was taken on the previous day.

Table 1. Chemical grab sample results.

PARAMETER	UNITS	03/27/2013 09:42	04/25/2013 12:43	06/04/2013 06:50	06/25/2013 09:01	07/17/2013 12:30	08/07/2013 10:15	9/10/2013 09:30	10/16/2013 10:26	11/13/2013 15:00
DISCHARGE	CFS	12.383	8.537	10.502*	5.056	10.242*	7.058	4.466	5.386	3.770
ALUMINUM T	UG/L	30.000	32.000	<13.7514	<13.7514	19.000	<13.7514	<13.7514	<13.7514	86.000
BARIUM T	UG/L	77.000	59.000	76.000	92.000	82.000	78.000	62.000	57.000	55.000
BORON T	UG/L	50.00	60.00	90.00	100.00	80.00	100.00	120.00	110.00	110.00
BROMIDE	UG/L	96.1340	83.4070	108.6570	630.0000	847.0000	1175.0000	1324.0000	1237.0000	1824.0000
CALCIUM T	MG/L	57.300	46.000	53.900	54.370	59.200	60.000	46.030	45.300	41.100
CHLORIDE T	MG/L	319.0000	267.0000	366.0000	383.0000	290.0000	358.0000	430.0000	377.7210	527.0000
COPPER T	UG/L	4.800	4.300	15.300	5.460	5.010	7.350	8.490	9.040	6.160
IRON T	UG/L	93.000	37.000	23.000	24.000	17.000	25.000	21.000	18.000	75.000
LEAD T	UG/L	0.166	0.189	0.662	0.110	0.121	0.127	0.193	0.169	0.225
MAGNESIUM T	MG/L	14.400	12.100	14.100	14.350	14.000	14.200	12.790	12.400	13.300
MANGANESE T	UG/L	17.000	15.000	12.000	4.000	12.000	4.000	3.000	5.000	9.000
NICKEL T	UG/L	<13.7856	<13.7856	<13.7856	<13.7856	<13.7856	<13.7856	<13.7856	<13.7856	<13.7856
SELENIUM T	UG/L	<0.32605	<0.32605	0.369	1.950	3.170	3.880	4.590	1.620	<0.32605
SODIUM T	MG/L	168.000	166.000	236.000	271.200	185.000	233.000	276.600	266.000	355.000
STRONTIUM T	UG/L	301.000	263.000	310.000	346.000	309.000	322.000	288.000	260.000	262.000
SULFATE T	MG/L	32.1800	31.5980	42.4470	36.7810	32.4590	41.5470	49.8210	41.2940	49.5090
ZINC T	UG/L	14.000	19.000	12.000	15.000	18.000	25.000	24.000	18.000	24.000
HARDNESS T	MG/L	203	165	193	195	206	209	168	164	158
OSMOTIC PRESSURE	MOSM	23	24	27	30	21	26	30	29	39
pH	pH units	8.3	8.2	7.9	8.1	8.2	7.9	7.9	7.6	8.4
SPECIFIC COND @ 25C	umhos/cm	1396.00	1257.00	1617.00	1776.00	1430.00	1631.00	1774.00	1772.00	2190.00
TDS @ 180C	MG/L	858	730	968	1112	894	1472	1008	752	1240
TSS	MG/L	<5	<5	<5	<5	<5	<5	<5	<5	16
TURBIDITY	NTU	1.27								
TOC	MG/L	4.4090	4.9740	4.8740	4.6810	4.4780	5.0160	5.0710	6.1150	6.9180
ALKALINITY	MG/L	102.4	100.8	97.6	87.8	102.4	99.6	97.0	102.0	102.2
AMMONIA D	MG/L	0.013	0.041	0.042	0.089	0.044	0.045	0.035	0.02900	0.03000
AMMONIA T	MG/L	0.014	0.033	0.048	0.091	0.034	0.037	0.029	0.024	0.032
NITRATE & NITRITE D	MG/L	13.737	13.618	19.950	30.896	28.464	29.533	12.422	21.882	17.056
NITRATE & NITRITE T	MG/L	13.807	13.705	19.390	30.871	30.122	29.625	12.260	22.407	16.344
NITROGEN D	MG/L	14.957	15.155	20.069	32.634	28.674	36.872	12.924	22.673	18.664
NITROGEN T	MG/L	14.957	14.730	19.008	33.701	29.303	31.374	12.817	22.235	18.653
ORTHO PHOSPHORUS D	MG/L	0.126	0.314	0.445	0.478	0.258	0.325	0.668	0.436	0.581
ORTHO PHOSPHORUS T	MG/L	0.128	0.317	0.444	0.477	0.260	0.322	0.668	0.453	0.577
PHOSPHORUS D	MG/L	0.153	0.329	0.482	0.508	0.274	0.350	0.701	0.476	0.623
PHOSPHORUS T	MG/L	0.179	0.348	0.486	0.512	0.281	0.359	0.715	0.510	0.639

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) (Figure 8 and Table 2). Measured values were well below these calculated toxicity values.

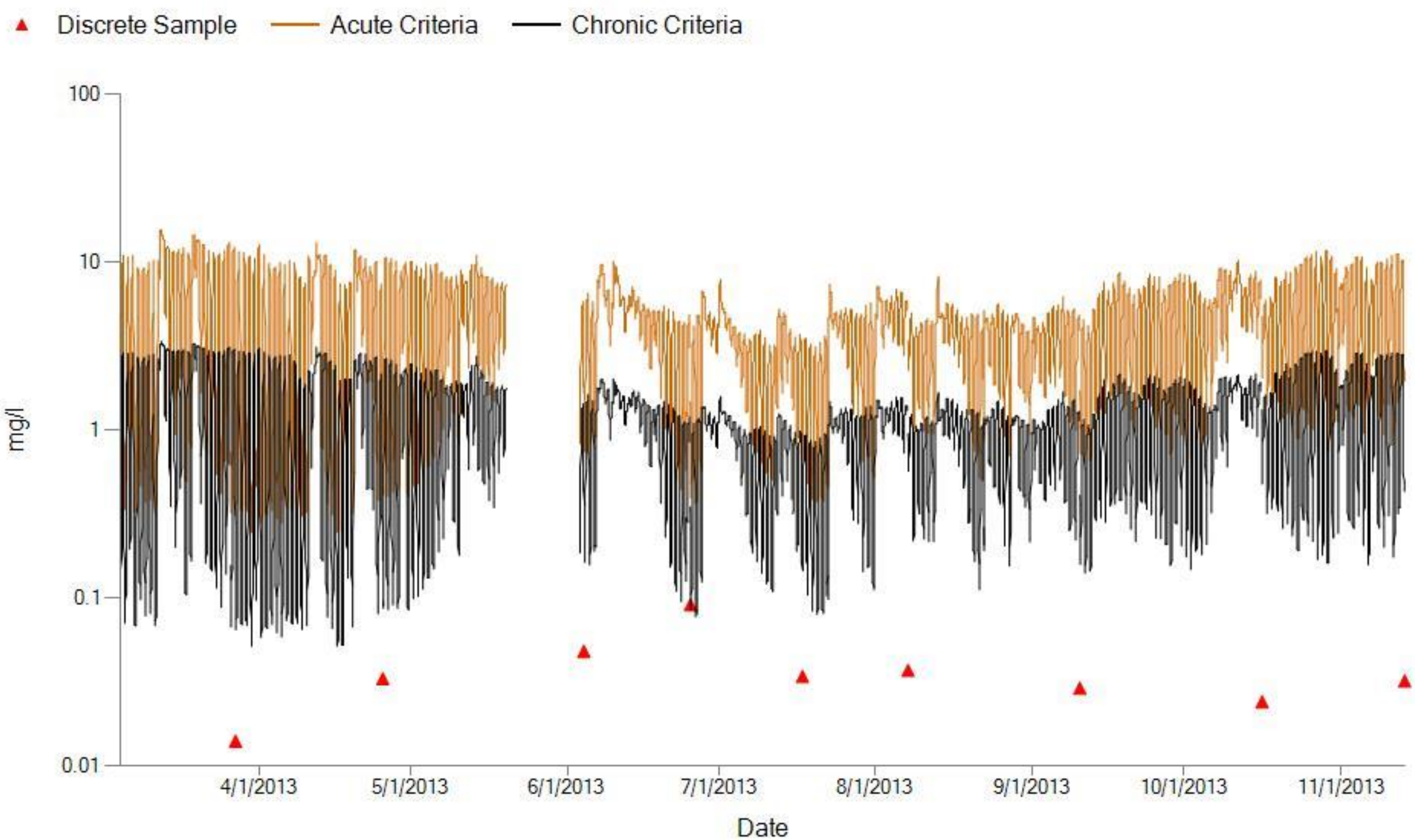

Figure 8. Calculated acute ammonia toxicity, calculated chronic ammonia toxicity, and measured ammonia concentrations. The gap in the calculated toxicity values at the end of May is due to the lack of pH and temperature data because of battery failure.

Table 2. Ammonia concentrations and calculated toxicity values

Date and Time	Ammonia Concentration	Calculated Acute Toxicity	Calculated Chronic Toxicity
3/27/2013 09:42	0.014	1.6	1.1
4/25/2013 12:43	0.033	0.7	0.1
6/4/2013 06:50	0.048	5.1	5.3
6/25/2013 09:01	0.091	1.5	0.3
7/17/2013 12:30	0.034	0.9	0.2
8/7/2013 10:15	0.037	3.3	1.3
9/10/2013 09:30	0.029	2.1	1.5
10/16/2013 10:26	0.024	4.4	2.9
11/13/2013 15:00	0.032	2.0	0.5

Biology: The indigenous aquatic community is an excellent indicator of long-term conditions and is used as a measure water quality. Benthic macroinvertebrates (Table 3) were collected on April 16, 2013. Fishes were collected on July 17, 2013 (Table 4). Periphyton was collected on April 25, 2013 and showed a chlorophyll-a concentration of 227 mg/m^2.

Table 3. Taxa list for benthic macroinvertebrate survey.

Family	Genus	20130416-1115-sunger
Philopotamidae	Chimarra	9
Hydropsychidae	Hydropsyche	2
Hydrophilidae	Berosus	2
Psephenidae	Psephenus	2
Elmidae	Stenelmis	36
Simuliidae	Simulium	18
Chironomidae	Chironomidae	124
Physidae	Physidae	1
	Oligochaeta (subclass)	3
Crangonyctidae	Crangonyx	1

Table 4. Taxa list for fish survey.

Family	Scientific Name	Common Name	20130717-1300-twertz
Catostomidae	*Catostomus commersonii*	White Sucker	16
Centrarchidae	*Lepomis auritus*	Redbreast Sunfish	68
	Lepomis macrochirus	Bluegill	23
	Micropterus dolomieu	Smallmouth Bass	9
	Amboplites rupestris	Rock Bass	8
	Lepomis cyanellus	Green Sunfish	5
	Lepomis gibbosus	Pumpkinseed	4
	Micropterus salmoides	Largemouth Bass	2
Cyprinidae	*Rhinichthys cataractae*	Longnose Dace	25

	Luxilus cornutus	Common Shiner	17
	Cyprinella spiloptera	Spotfin Shiner	13
	Notropis amoenus	Comely Shiner	2
Fundulidae	*Fundulus diaphanus*	Banded Killifish	7
Ictaluridae	*Ameiurus natalis*	Yellow Bullhead	8
Percidae	*Etheostoma olmstedi*	Tessellated Darter	2

ASSESSMENT:

The evaluation of CIM data incorporates water quality standards from 25 PA Code §93.7 and the 99% frequency rule from §96.3(c) (Hoger 2018). Because sondes at these sites recorded parameters every 30 minutes, 176 exceedances measured over a 365-day period constitutes a percentage greater than 1% (176 readings = 1.004% of a year). The evaluations in this report include 99% frequency rule calculations but do not include protected use assessment determinations.

Continuous: Data collected by the instream monitor indicated very poor water quality. Early spring pH was very high with a max of 9.57 units. The maximum pH criterion of 9.0 was exceeded 499 times during this sampling period, representing 2.85% of a year. Measurements below the minimum criterion for dissolved oxygen (5.0 mg/L) were also recorded during this period. One-hundred eleven measurements fell below this value, representing 0.63% of a year. Dissolved oxygen also exhibited extreme diel swings. Mean diel variation for the period was 6.0 mg/L and the max was 14.6 mg/L. Although there are no state criteria for daily changes in dissolved oxygen, changes of this degree indicate a highly productive environment, most likely due to excess nutrient loading. Specific conductance was extremely high reaching a max of 2591 µS/cm during the period.

Biological: The benthic macroinvertebrate community also indicated very poor water quality (Table 5). Only 10 taxa were present in the collection, including no stoneflies or mayflies. Sixty-three percent of the sample was Chironomidae. The fish community was poor with only 209 individuals collected, and had a noticeable lack of insectivores and benthic species. The fish community also had a high percentage of pollution tolerant species such as white sucker, bluegill, banded killifish, and yellow bullhead.

Table 5. Benthic macroinvertebrate metric calculations.

Date	IBI	Richness	Mod EPT	HBI	% Dom	% Mod May	Beck3	Shannon Div
April 16, 2013	21.8	10	1	5.75	62.6	0	0	1.22

Intra-basin Comparison: Data were collected at two different sites on Skippack Creek during early spring of 2013. An upstream site was located at the crossing of Route 63 and a downstream site at the crossing of Ridge Pike (Figure 1). There are three active sewage discharges in the upstream portion of the basin and an additional four sewage discharges before the lower site. Specific conductance was considerably higher at Route 63 (Figure 9). Additionally, nutrient concentrations were significantly greater at this upstream site (Table 6), which likely contributed to the greater diel swings observed (Figure 10). These differences in water quality were reflected in the biological communities of the two sites. The macroinvertebrate community indicated poorer water quality at the upper site than the lower site (IBI scores of 21.8 and 31.7, respectively), and the while the fish community at both locations was dominated by tolerant species, Skippack Creek at Ridge Pike had a more balanced fish community with a greater percentage of insectivores. The pH data, however, was notably higher at the lower site, with considerably more exceedances of maximum pH criterion (Figure 10).

A third site was located in this basin during early spring of 2013 on Towamencin Creek, a tributary to Skippack Creek between the upper and lower sites (Figure 1). Data collected at Towamencin Creek more closely resembled water quality of the upper Skippack Creek site and therefore do not account for the slight improvement in water quality at the lower site of Skippack Creek. While water quality does appear to improve at the lower portion of the basin, these data show a highly impacted watershed with extremely poor water quality throughout the basin.

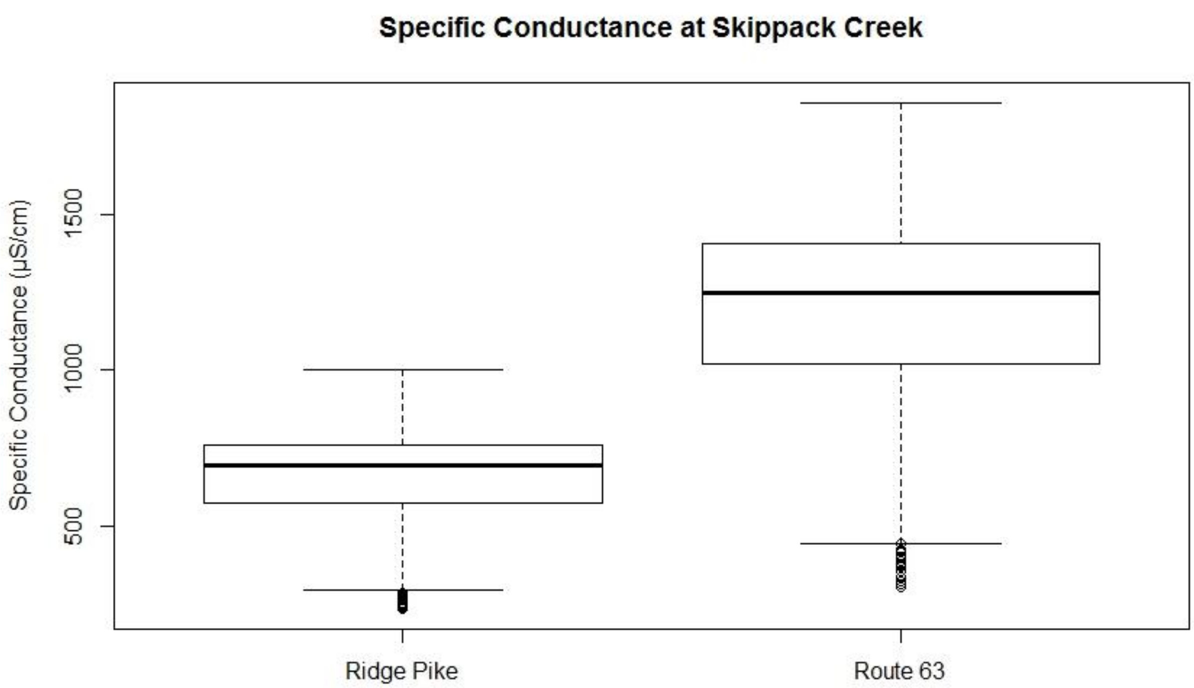

Figure 9. Comparison of specific conductance at two Skippack Creek sites.

Table 6. Comparison of nutrients from chemical grab samples.

Parameter	Units	3/27/2013		4/25/2013	
		Route 63	Ridge Pike	Route 63	Ridge Pike
NITRATE & NITRITE D	MG/L	13.737	3.522	13.618	4.275
NITRATE & NITRITE T	MG/L	13.807	3.515	13.705	4.248
NITROGEN D	MG/L	14.957	4.172	15.155	4.843
NITROGEN T	MG/L	14.957	4.074	14.730	4.905
ORTHO PHOSPHORUS D	MG/L	0.126	0.023	0.314	0.111
ORTHO PHOSPHORUS T	MG/L	0.128	0.026	0.317	0.114
PHOSPHORUS D	MG/L	0.153	0.034	0.329	0.121
PHOSPHORUS T	MG/L	0.179	0.052	0.348	0.135

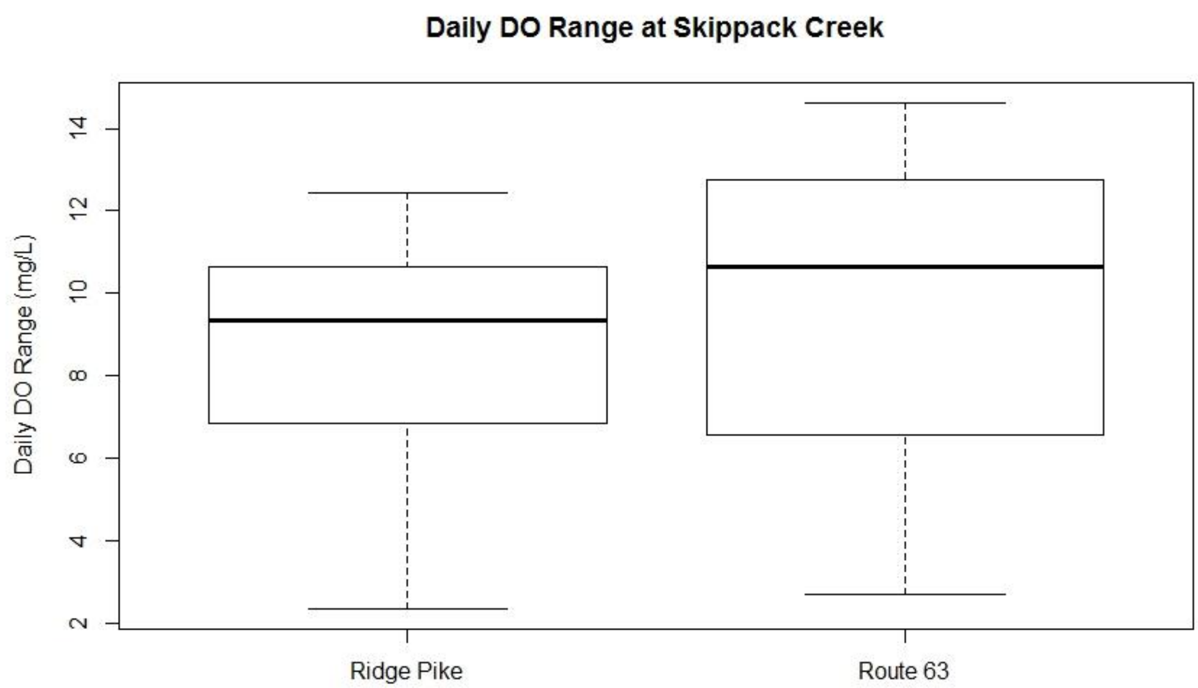

Figure 10. Comparison of daily dissolved oxygen range at two Skippack Creek sites.

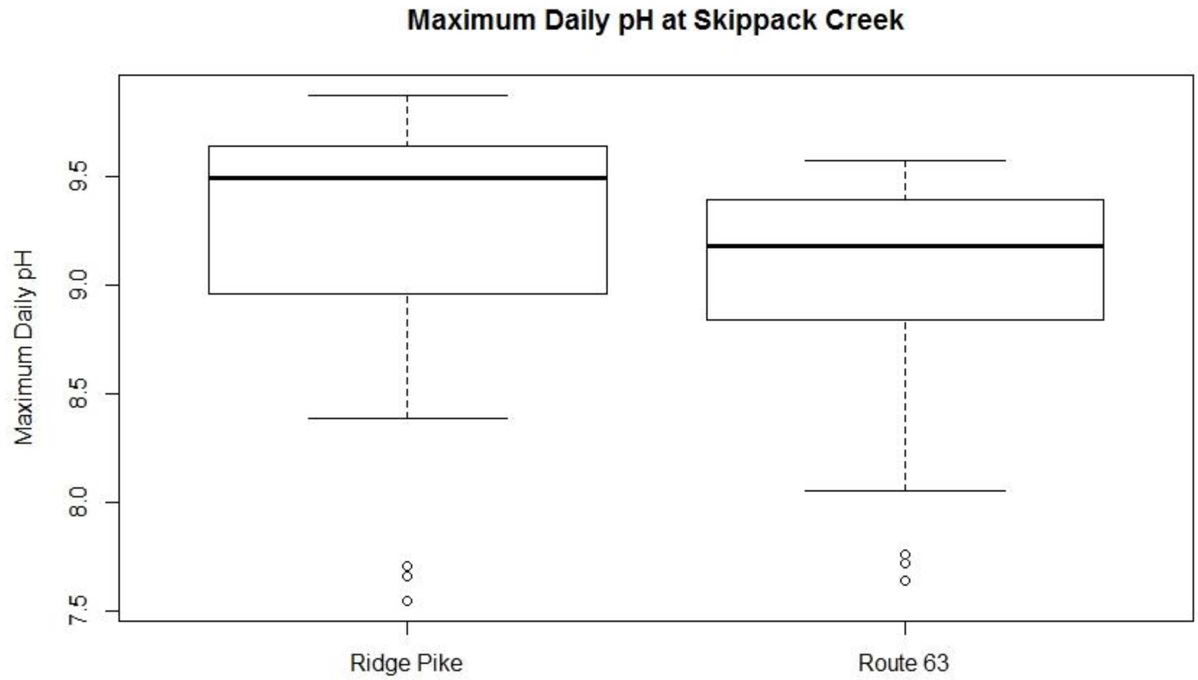

Figure 11. Comparison of daily maximum pH at two Skippack Creek sites.

SUMMARY:

This section of Skippack Creek is currently impaired for aquatic life, citing nutrients, siltation and excessive algal growth due to small residential runoff. Continuous monitoring, in-situ lab chemistries, and biological data from this report all support poor water quality conditions in Skippack Creek. Recorded pH data did not meet the criterion listed in Table 3 of §93.7(a), while extremely high specific conductance and increased dissolved oxygen swings further characterized a highly impacted watershed. These conditions are expressed through the extremely poor macroinvertebrate community and the small fish community dominated by tolerant species. A comparison of multiple sites within the basin revealed marginally worse water quality at this upper site within the Skippack Creek basin; however, water quality throughout the watershed has been shown to be highly influenced by human activity.

REVISION NOTES, FEBRUARY 2019:
Revisions were made to the 'Assessment' section of this report (original date 6/25/15), reflecting changes to the Department's assessment of CIM data. Previously, in evaluating CIM data, the Department had taken into consideration the analytical uncertainty of the method used to measure the data when an ambient measurement is compared to a numeric Water Quality Standard (WQS) criterion; this is inconsistent with the Department's established Assessment Methods. Therefore, this report was updated to provide exceedances of pH and DO criteria as listed in Table 3 of §93.7(a). A paragraph summarizing the approved assessment methodology, and a reference to it, were also added.

LITERATURE CITED

Hoger, M. S. 2018. Continuous Physicochemical Assessment Method. Chapter 3, pages 20-38. In Shull, D. R., and M. M. Pulket. (editors). Assessment methodology for streams and rivers. Pennsylvania Department of Environmental Protection. Harrisburg, Pennsylvania.

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