AQUETONG CREEK ECOLOGICALLY BASED WATER QUALITY MONITORING- 2025

SOLEBURY TOWNSHIP, BUCKS COUNTY, PA

FEBRUARY 2026

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INTRODUCTION

The Aquetong Creek restoration site is located in Solebury Township, Bucks County, PA, at the location of the former Aquetong Lake. Aquetong Lake was a 15-acre impoundment formed in 1870 by the construction of an earthen dam on Aquetong Creek. The main source of Aquetong Creek is Ingham Spring, an artesian spring formed at the contact of two geologic formations that flows at a rate of approximately 2,000 gallons per minute (GPM) (F.X. Browne, Inc., 2004). Aquetong Creek flows approximately 2.5 miles from Ingham Spring to its mouth at the Delaware River in New Hope, PA.

A 2004 study funded by Bucks County Trout Unlimited found that the impoundment was affecting downstream water quality, particularly water temperature (F.X. Browne, Inc., 2004). In 2015, the dam was breached with the goal of reducing thermal impacts on the creek and supporting a high-quality cold-water fishery in Aquetong Creek, while also avoiding the need for continued dam maintenance. With the dam breached and the lake drained, a meandering channel formed through the exposed former lakebed, connecting the upper and lower reaches of Aquetong Creek. Additionally, a small tributary flowing from the north under Route 202 now joins Aquetong Creek in the approximate center of the formerly impounded area.

In 2017 and 2018, Princeton Hydro conducted several monitoring events focusing on the downstream area closer to the dam breach, as well as upstream to the Ingham Spring and within the northern tributary passing under Route 202. This monitoring concluded that conditions within the former lakebed were partially conducive to maintaining a brook trout (*Salvelinus fontinalis*) population as it pertains to temperature, dissolved oxygen, and available forage. However, the physical habitat still needed additional restoration to further increase the stability of streambanks and create more refuge habitat for trout. Another survey was conducted in 2019 focusing on the areas downstream of the breach to assess impacts of the removal of several ash trees within the park, and further surveys focusing on the original study area were conducted in the fall of 2020 and the growing seasons of 2021-2024.

In 2025, Princeton Hydro again conducted a survey of the ecological condition of the six (6) main sites within the study area. In addition, at the request of the Aquetong Watershed Association, two (2) sites outside of the initial study area previously monitored by the PADEP were also sampled. The overall goal of the 2025 study was to continue to assess current water quality conditions, fish, and benthic invertebrate communities within the project site. Comparisons were also made between the 2025 data and data collected in previous years in order to assess any longitudinal changes occurring in the stream over time.

METHODS

As in previous years, six (6) points within the old lakebed and in areas downstream were sampled for water quality three (3) times over the course of 2025 (Figure 1). A survey of the stream's macroinvertebrate and fisheries communities at each site was conducted on September 29th and 30th. The downstream-most of these points is located near the eastern property line, while an additional site (ST1) is located approximately 450' downstream of the dam breach. ST2 is sited at the dam breach. ST2, ST3, and ST5 are all located along the mainstem of the Aquetong, while ST4 is located on a small tributary that enters the mainstem from the direction of Rt. 202. As in the past three seasons, two (2) additional sites outside of the Aquetong Park were also sampled in 2025. These are located near sites that have been previously sampled by the Pennsylvania Department of Environmental Protection (PADEP). One of these sites is located approximately 0.5 miles downstream of the dam breach and approximately 225 m downstream of Reeder Road (AW1). The other site is located along a northern branch of the Aquetong Creek at a reach that runs parallel to Creekside Drive (AW2). A map of locations is provided in Figure 1.

IN -SITU AND STREAMFLOW DATA COLLECTION

At each location, Princeton Hydro scientists collected *in-situ* water quality data using an *In-situ* Aquatroll 500 calibrated multimeter water quality probe. This probe measured the following analytes:

- Temperature (°C)
- Dissolved Oxygen (concentration as mg/L and percent saturation as %)
- Specific Conductivity (µS/cm)
- pH (standard units)

Additionally, water velocity data was collected at several points along a cross-section at each station using a Marsh-McBirney, Inc. Flo-Mate™ Model 2000 Portable digital flowmeter and a wading rod. Total streamflow was calculated using water velocity, depth, and distance along the cross section collected at each point.

DISCRETE WATER QUALITY DATA COLLECTION

On each water quality sampling date, whole water samples were collected at each station and analyzed for the following:

- Total Phosphorus
- Total Nitrogen
- Total Suspended Solids

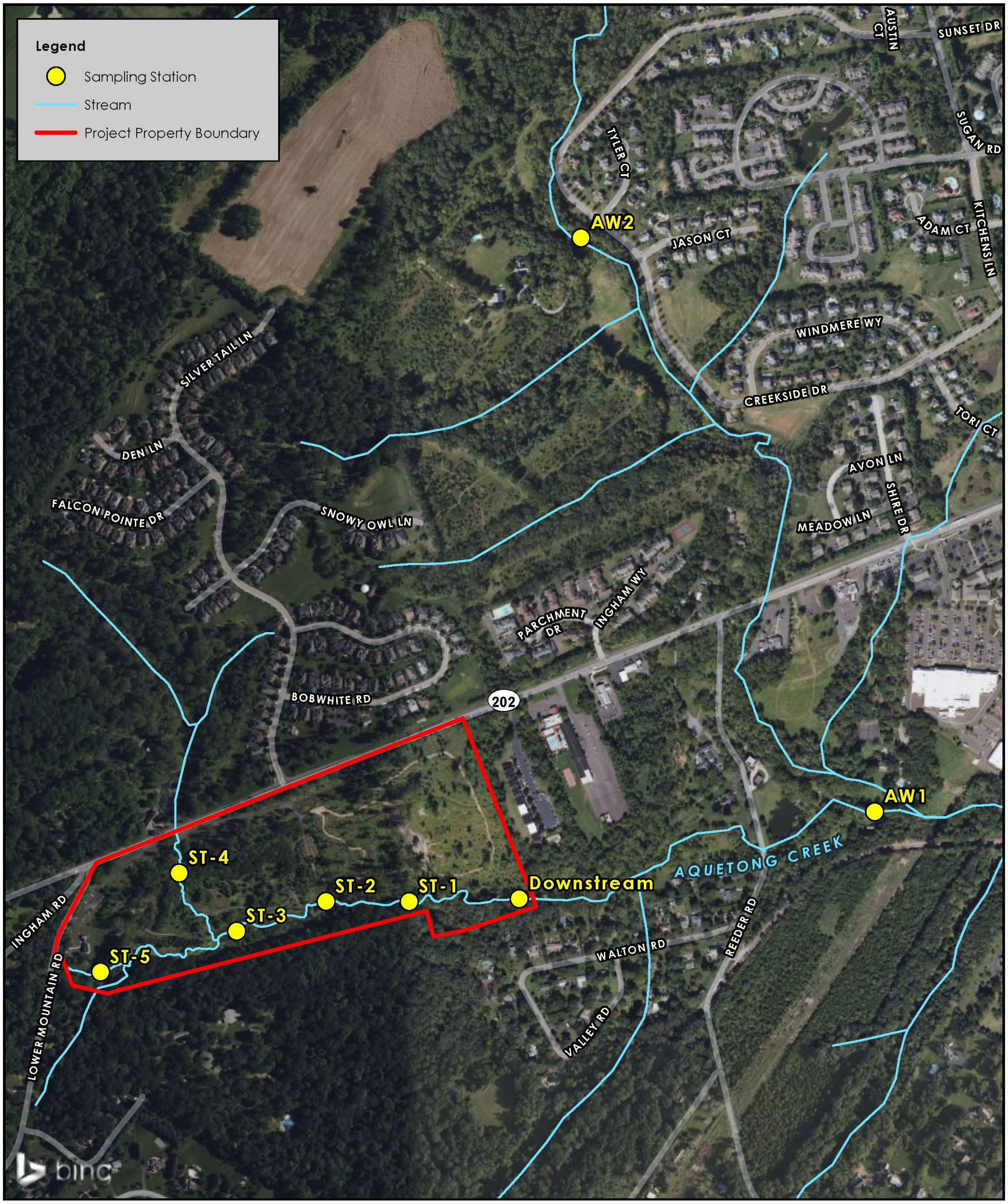
Following each sampling event, samples were delivered to Environmental Compliance Monitoring (ECM), a certified laboratory, for analysis.

FISHERIES SURVEY

A survey of the fish communities at each site was conducted in late September using the backpack electrofishing method. During each sampling event, seine nets were placed in the upstream and downstream ends of the reach to prevent fish from moving into and out of the area to be sampled. The length of each reach was sampled multiple times, beginning at the downstream end of the reach. Captured fish were kept in a temporary holding vessel. After each electrofishing pass the fish were either immediately processed and released outside the sampling area or pooled for the three runs and subsequently processed and released to avoid recapture in the surveyed segment. All captured fish were identified to species, measured for total length, and returned to the stream immediately following measurement. Additionally, all brook trout were weighed using a small digital scale to obtain their approximate mass. The resulting data was analyzed for composition, catch per unit effort, Shannon’s diversity, and evenness.

BENTHIC MACROINVERTEBRATE SAMPLING

During the September sampling events, the benthic macroinvertebrate community was also sampled at each station using a D-net. Ten kicks or jabs were collected per station in various microhabitat types (e.g. riffles, coarse woody debris, aquatic vegetation) and compiled into a single sample. This sample was preserved with alcohol and analyzed in Princeton Hydro’s in-house laboratory. A subsample of at least 50 organisms was picked from each sample, and each organism was identified to lowest practical taxon (typically family). The resulting data was used to calculate metrics such as %EPT, richness, diversity, and the family-level biotic index.



File: P:\0388\Projects\0388012\GIS\APRX\WQ_Sampling_Map\WQ_Sampling_Map.aprx, 1/18/2023, Drawn by bsmith, Copyright Princeton Hydro, LLC.

NOTES:
1. Stream sampling locations are approximate.
2. Property boundary is approximate.
3. Streams obtained from the Pennsylvania Spatial Data Access (PASDA) website: http://www.pasda.psu.edu/
4. Aerial imagery obtained through ArcGIS Online Bing Maps (C) 2021 Microsoft Corporation and its data suppliers.

0 350 700 Feet

Map Projection: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet

FIGURE 1: ECOLOGICAL SURVEY SAMPLING STATIONS

AQUETONG CREEK RESTORATION PROJECT
AQUETONG SPRING PARK
SOLEBURY TOWNSHIP
BUCKS COUNTY, PENNSYLVANIA

PRINCETON HYDRO
SCIENCE DESIGN ENGINEERING
www.PrincetonHydro.com

RESULTS

GENERAL OBSERVATIONS

Significant physical changes to the Aquetong Creek's morphology were generally not observed in 2025. Usually, such changes occur following an extreme weather event, such as a hurricane, that increases flows to such a high velocity that they erode banks, changing the morphology of the stream channel. This can also occur when large woody debris (larger trees) falls into the stream and create changes to the physical flow. Areas within the park boundaries remained relatively consistent in regard to channel morphology and observations made in previous years sampling events. As noted in past years, areas of fine sediment deposits are still present, such as in the inside of bends where water velocity slows.

As noted by Princeton Hydro staff in 2024 in an area of concern downstream of ST5, which has featured a considerable drop in grade (over 3') in the past several years. Due to the high flows that cascade from this height, the pool beneath this drop has become remarkably deep. As noted in past years, this drop likely serves as a barrier to upstream movement for Brook Trout and other fish.

Much of the main channel of the Aquetong Creek featured sufficient water flow throughout the season due to the consistent output from Ingham Spring. The tributary reach ST4, while still visibly featuring flow, featured velocities low enough that measurements using a flow meter could not be taken effectively and accurately during the July and September events. AW2 also featured low flows as in 2024, however, unlike in 2024, the summer monitoring event yielded the highest discharge of the season, with the spring and fall events yielding lower flows.

IN-SITU AND FLOW DATA

Aquetong Creek has continued to exhibit stable, cold temperatures over the 2025 monitoring events in the mainstem stations. Consistent with previous years, average temperatures typically varied by less than 1.0 °C in the mainstem stations. Temperatures in ST-4, a side tributary that is monitored upstream of its confluence with the mainstem, ranged from 19.44°C in September up to 27.08°C in July. The higher temperatures in this reach when compared to those of the mainstem are likely in part attributable to the upstream impoundment, north of RT. 202, which feeds the tributary. AW-1 and AW-2 also typically feature more variable temperatures than those measured in the mainstem. AW-1 had temperatures ranging from 14.79°C up to 18.66°C which was lower than what was observed in 2024. These are generally higher than temperatures found elsewhere in the mainstem, and may be influenced by warmer tributaries, such as that assessed in AW-2, entering the mainstem between AW-1 and the upstream locations. Temperatures in AW-2 ranged from 20.42°C in April up to 26.78°C in July. These increased temperatures in AW-2 are likely due to the Honey Hallow Pond impoundment upstream that releases largely stagnant water into the stream.

Dissolved oxygen concentrations in the mainstem stations were similarly consistent and well within a preferable range, fluctuating between 9.31-11.18 mg/L during the 2025 season. ST-4 had a similar range in DO, but concentrations were overall lower ranging from 8.46 mg/L in July and 9.84 mg/L in April. AW-1's dissolved oxygen concentrations were slightly higher than those measured in the mainstem upstream in the Aquetong Park, ranging from 8.48-10.17 mg/L. AW2 featured a slightly wider range of dissolved oxygen, ranging from 7.24 mg/L in July to 10.14 mg/L in April. The consistent temperatures and dissolved oxygen concentrations that stayed within the preferred range in the park's boundaries are largely due to the groundwater input from the spring in the park. This along with strong flows allow for good mixing in the stream throughout the park. These measurements are largely consistent with temperature and dissolved oxygen measurements collected in previous years surveys.

The mainstem's specific conductivity (SpC) within the Aquetong park was, on average, 430.03 µS/cm in April, increasing slightly to 439.23 µS/cm in July and increasing again to 441.14 µS/cm in September. These concentrations are consistent with levels seen in previous years. Conductivity values are reflective of the watershed and are heavily affected by its geology. Aquetong Park's watershed and the Aquetong Spring's geology are mostly limestone, resulting in a slightly elevated baseline conductivity. As in past years, ST-4 featured higher conductivity values, with a 2025 average of 593.67 µS/cm these concentrations are higher than what was seen in years past. These higher values likely reflect the denser development in that tributary's sub watershed. AW-2 had the lowest conductivity recorded in 2025 with a minimum value of 393.20 µS/cm in September with concentrations ranging up to 443.20 µS/cm in July.

Following the trend from previous years, pH values in the Aquetong Creek ran slightly basic during the 2025 monitoring season. pH values in the mainstem averaged 8.04 in April, 7.92 in July and 7.94 in September. These alkaline values are likely due to local limestone geology and the stream's origin at Ingham Spring. To a lesser extent, higher pH values may be due to abundant plant life along the stream, as photosynthesis increases pH values. As seen in previous years surveys ST-4 was increased when compared to the mainstem and had an average pH of 8.29. AW-1 and AW-2 featured pH values similar to the mainstem, averaging 7.93 and 8.03 respectively.

Figures displaying long-term In-situ data for Aquetong Creek are provided in the attached appendix.

Table 1: Aquetong Creek In-Situ Data 2025

Date	Station	Temperature °C	SpC µS/cm	DO mg/L	DO %	pH s.u.	Flow CFS
4/30/2025	Spring	-	-	-	-	-	-
	Downstream	13.82	432.63	10.6	103.17	8.05	5.25
	ST1	13.83	429.36	10.75	103.49	8.15	4.81
	ST2	13.75	430.65	11.18	108.03	8.07	4.93
	ST3	13.03	431.11	10.59	100.56	8.19	4.98
	ST4	22.8	534.01	9.84	114.54	8.80	0.08
	ST5	12.03	426.41	9.88	91.75	7.75	4.96
	AW1	16.13	429.70	9.49	96.96	7.79	6.10
	AW2	20.42	405.33	10.14	113.77	8.11	1.92
7/14/2025	Spring	15.01	424.00	7.48	74.24	7.80	-
	Downstream	14.02	442.70	9.67	93.99	8.06	6.52
	ST1	13.39	445.70	9.88	94.76	8.02	6.98
	ST2	13.22	446.00	10.12	96.5	7.90	9.10
	ST3	13.10	439.70	10.22	97.29	7.84	5.23
	ST4	27.08	614.50	8.46	106.7	8.14	0.54
	ST5	12.60	437.30	9.31	87.79	7.79	6.95
	AW1	18.66	440.20	8.48	90.73	7.86	14.88
	AW2	26.78	443.20	7.24	89.1	7.86	4.59
9/30/2025	Spring	-	-	-	-	-	-
	Downstream	12.94	442.80	10.61	100.50	8.03	3.91
	ST1	12.72	438.00	10.57	99.78	8.10	4.25
	ST2	12.63	437.60	10.49	98.84	7.98	3.05
	ST3	11.99	440.40	10.34	95.78	7.79	2.76
	ST4	19.44	632.50	9.34	101.50	7.92	0.01
	ST5	12.41	446.90	9.47	88.63	7.78	4.86
	AW1	14.79	437.80	10.17	100.50	8.19	3.14
	AW2	21.39	393.20	8.01	90.31	8.13	0.43

The mainstem of the Aquetong Creek is characterized by consistent and swift flows. As seen in previous monitoring surveys there was slight variation in flow in the mainstem of Aquetong Creek. The creeks discharge was highest during the July event, which is unexpected when considering typical seasonal precipitation patterns. Average discharge of the mainstem of Aquetong creek was 4.99 CFS in April, 6.95 CFS in July, and 3.77 CFS in September. The highest amount of discharge seen during the July event was at AW-1 and was recorded as 14.88 CFS. As in previous surveys ST-4 consistently featured the smallest discharge during all three monitoring events. As mentioned, only the 24 April event yielded measurable discharge in this reach. Subsequent events typically did not yield flow that could be accurately determined with the flow meter used. Many flow readings that were obtained this way yielded negative values. This would normally occur in an eddy, such that found behind a large rock or similar feature in a stream. In ST-4, this may be also due to a difference in flow at certain depths. The significantly lower flow out of that station is due to its origin of a dammed pond with a controlled discharge.

AW-2 had very consistent depth across its width, but had more variation in its flow rates, both in the channel, and from one monitoring event to another. The downstream station featured slight variation in water depth between events, but had consistent, swift water velocity. ST-1 had moderate depth and velocity across the channel. ST-2 was consistently the deepest station but did not have significantly fast water velocity. ST-4 is the most narrow and slowest flowing reach of those assessed.

COMPARISON TO WATER QUALITY CRITERIA

The collected data was also compared to the specific water quality criteria outlined in 25 Pa. Code § 93.7 where applicable. Of the various metrics described during this study, only three have directly comparable analogs in the technical regulations, including temperature, DO, and pH. The criteria and narratives provided below are applicable to Cold Water Fisheries (CWF).

Temperature: Maximum temperatures in the receiving water body resulting from heated waste sources regulated under Chapters 92a, 96 and other sources where temperature limits are necessary to protect designated and existing use.

Table 2. Maximum temperature standards for Pennsylvania streams during several critical use periods. From 25 Pa. Code § 93.7

Critical Use Period	°F
January 1-31	38
February 1-29	38
March 1-31	42
April 1-15	48
April 16-30	52
May 1-15	54
May 16-31	58
June 1-15	60
June 16-30	64
July 1-31	66
August 1-15	66
August 16-30	66
September 1-15	64
September 16-30	60
October 1-15	54
October 16-31	50
November 1-15	46
November 16-30	42
December 1-31	40

Dissolved Oxygen: For flowing waters, 7-day average 6.0 mg/L; minimum 5.0 mg/L. For naturally reproducing salmonid early life stages, 7-day average 9.0 mg/L; minimum 8.0 mg/L. Early life stage criteria applies from October 1 to May 31.

pH: From 6.0 to 9.0 inclusive.

In general, most of the sites stayed within PADEP compliance for applicable criteria. Starting with the temperature for CWF it is interesting to note that the standard has dual purposes, sustaining trout populations as well as protecting the temperature regime from heated discharges. The criteria are divided into discrete critical use periods throughout the year recognizing the expected seasonal changes in temperature.

During the April 2025 event, all stations exceeded the maximum temperature criteria for CWF, which is listed as 52°F (11.1°C) for the second two weeks of April. This may be a product of the unusually warm air temperatures and relatively low flow that occurred during this month. While most reaches did not exceed this by greater than 5°F, the temperatures at ST4 and AW2, however, did exhibit higher exceedances in temperature than the other reaches, likely due to their origins outside of the spring-fed mainstem. By 14 July, all mainstem stations featured temperatures well below the maximum temperature criteria for CWF of 66°F (18.88°C), with AW2 and ST4 exceeding this by over 14°F.

During the fall event, temperatures in the mainstem all remained below the maximum temperature criteria for CWF. Temperatures and ST4 and AW2 again exceeded these criteria as was seen throughout 2025. Although mainstem temperatures remained under the maximum temperature, increased temperatures in the beginning and end of the season may have an impact on trout populations. It should be noted, however, that, due to the origin of the mainstem stream in Ingham Spring, water temperatures in the mainstem station are often remarkably consistent and do not appear to be as strongly affected by air temperatures as some of the other stream segments appear to be.

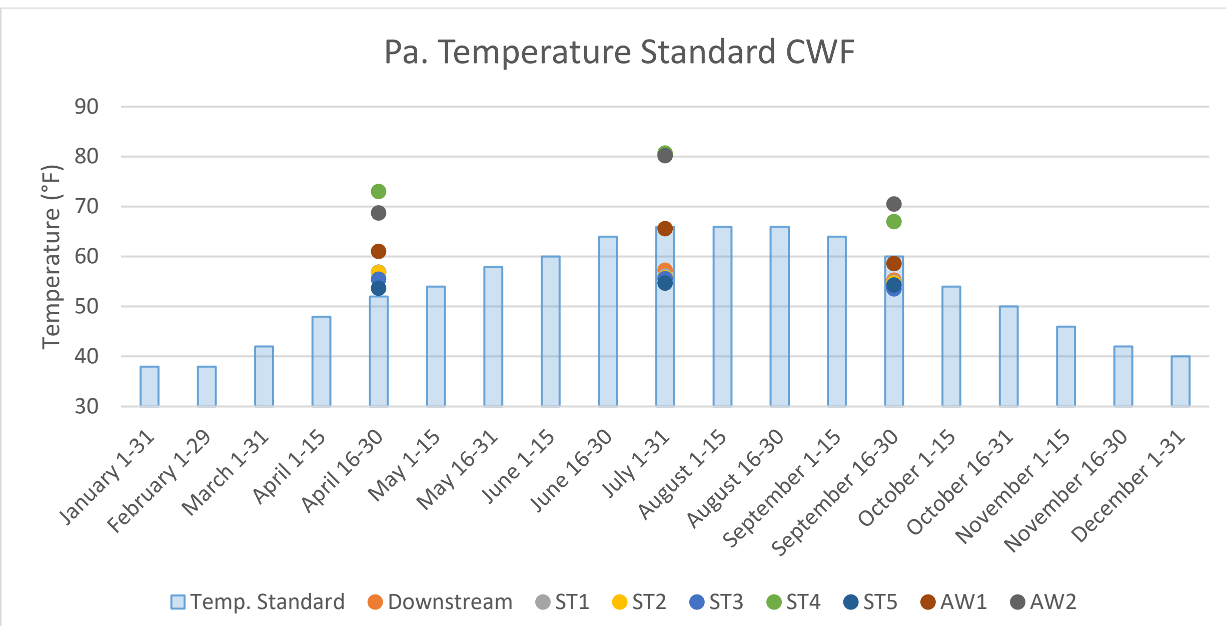


Figure 2: 2025 Water temperature data collected in Aquetong Creek compared to the Pennsylvania water temperature standard for CWF.

The DO criteria specify average and minimum values, with the objective of maintaining higher concentrations. Because young-of-year trout have been discovered onsite in past years, the criteria for early life stage (ELS) salmonids were explored in addition to the CWF criteria (Figure 3).

During the spring and fall sampling events, all sites satisfied DO criteria for ELS trout, which need more oxygen than larger fish. Consistently cool stream temperatures and energetic flow help maintain high DO concentrations throughout the year. These flow patterns allow riffles to add oxygen to the stream throughout the mainstem stretch. Throughout the season, all stations remained above both the 7-day and minimum criteria for adult cold-water fish. In July, however, AW1 and ST4 did not meet the 7-day criteria and AW2 did not meet the 7 day or the minimum DO criteria for ELS trout. In most cases, failures to meet criteria were likely due to the positioning of the locations and the stream topography in those areas.

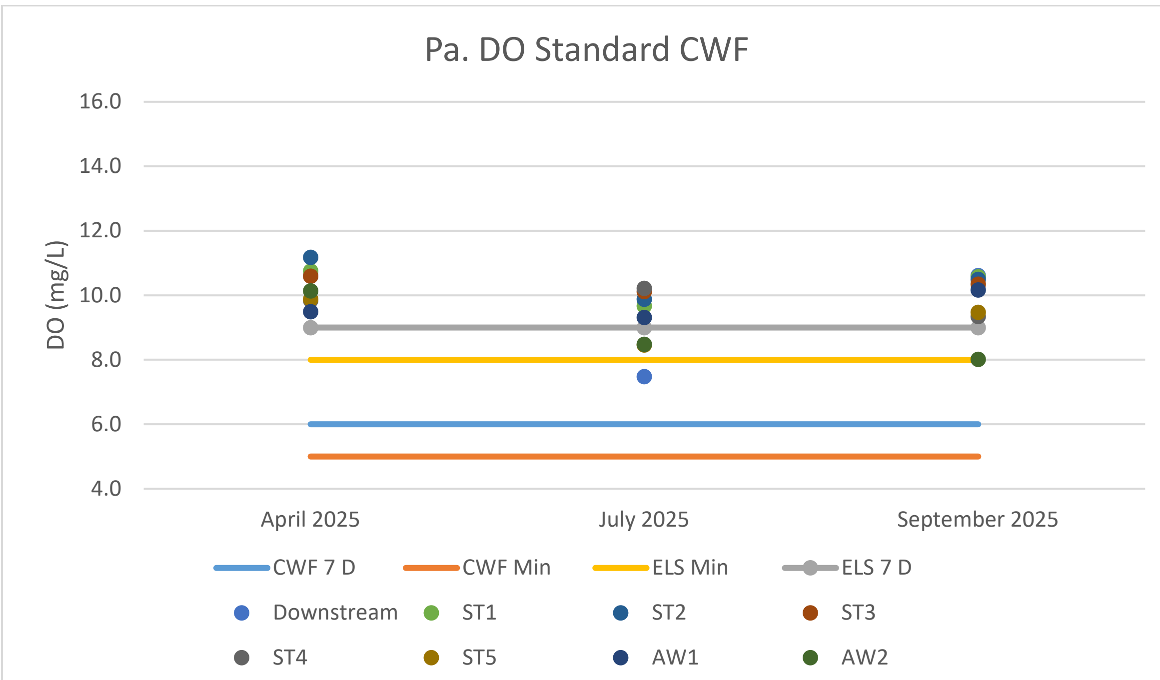


Figure 3: 2025 Dissolved oxygen data collected in Aquetong Creek compared to the Pennsylvania dissolved oxygen standards for CWF and ELS.

Lastly, pH was stable throughout 2025 and stayed with the limits of 6.0 to 9.0. This is consistent with previous years surveys.

DISCRETE WATER QUALITY DATA COLLECTION

Nutrients such as nitrogen and phosphorus influence growth of primary producers such as plants and algae, including periphyton and often indicate other organic pollutants. Total suspended solids are a measurement of sediment or other particulates. Phosphorus, an important nutrient for plant and algae life, was typically measured in relatively low amounts in the mainstem stations within the park, although some higher concentrations were measured occasionally (Table 3).

ST-4 had the highest average level of phosphorous throughout the 2025 season with concentrations ranging from 0.03 mg/L in July up to 0.26 mg/L in September. Phosphorus concentrations remained at or below 0.05 mg/L at all other stations throughout the 2025 season. Overall phosphorus remained relatively low and stable throughout the season, being recorded as 0.03 mg/L in April and July and 0.05 mg/L in September. This is similar to what has been observed during previous survey events in Aquetong Creek.

Similar to previous years, total nitrogen levels in 2025 were elevated in Aquetong Creek, ranging from 2.7 mg/L and 3.6 mg/L in the mainstem stations. ST4 had the lowest overall concentrations ranging from 0.7 mg/L to 1.5 mg/L. AW1 also had a wide range of concentrations ranging from 1.6 mg/L in July up to 2.5 mg/L in September. AW2 had more stable concentrations during the 2025 season ranging from 1.2 mg/L to 1.8 mg/L. Consistently high nitrogen concentrations can be expected in the mainstem stations where groundwater dominates flow, as groundwater typically contains higher concentrations of nitrogen than surface waters.

Total suspended solids (TSS) concentrations varied between monitoring events but never exceeded the 25 mg/L recommended threshold at the mainstem stations. Concentrations only exceeded the 25 mg/L threshold at ST-4 and AW-1. Concentrations at ST-4 and AW-1 were 72 mg/L and 46 mg/L respectively during the September sampling event. The elevated turbidity in ST-4 during this event may be in part due to influence from the upstream impoundment. Other than these two stations, TSS concentrations ranged from non-detectable (>2 mg/L) up to 6 mg/L throughout the 2025 season. Low concentrations are indicative of clear water, which is typically seen in the mainstem portion of Aquetong Creek. Concentrations above 25 mg/L can contribute to decrease water clarity and a 'muddy' appearance.

Table 3: Aquetong Creek Discrete Water Quality 2025

Date	Station	TN mg/L	TP mg/L	TSS mg/L
4/30/2025	Downstream	3.1	0.02	3
	1	3.2	0.02	2
	2	3.2	0.02	3
	3	3.1	0.02	2
	4	0.7	0.05	10
	5	3.5	0.03	ND<2
	AW-1	2.4	0.04	5
	AW-2	1.3	0.03	3
7/14/2025	Downstream	2.9	0.02	ND<2
	1	3.3	0.02	6
	2	3.2	0.02	3
	3	3.6	0.02	4
	4	0.8	0.03	4
	5	3.4	0.02	5
	AW-1	1.6	0.04	2
	AW-2	1.2	0.05	3
9/30/2025	Downstream	2.8	0.03	5
	1	2.7	0.01	4
	2	3.0	0.04	2
	3	3.1	0.01	ND<2
	4	1.5	0.26	72
	5	2.9	0.01	ND<2
	AW-1	2.5	0.02	46
	AW-2	1.8	0.02	ND<2

"ND" = Not detected at or above minimum detection limit

FISHERIES SURVEY

The fisheries community sampled in the fall of 2025 was marked by an increase in total fish when compared to the 2024 survey. In total, 327 fish were sampled between the eight (8) reaches of the stream, with 14 different species being recorded. Stations ST-4 and AW-1 had the highest number of fish, with 136 and 109 fish being recorded respectively.

Pumpkinseed (*Lepomis gibbosus)* were the most abundant fish collected during this survey, with all individuals being collected in the pool of ST-4. Blacknose dace (*Rhinichthys atratulus*) were also abundant with most fish being collected in AW-1. The stations with the lowest fish abundance were ST-1 and ST-5.

Shannon's diversity index, a measure of the general species diversity of a system, was calculated to be 1.28 for ST-1 through ST-5. This is an increase from 1.19, which was seen in 2024. ST 2 had the highest diversity index of 1.59. When all stations were evaluated, Shannons diversity index was 1.78, which is a sign of a relatively diverse fishery. ST-2 and ST-3 saw the highest number of brook trout, with four and five individuals being collected respectively.

As in past years, it should be noted that a majority of the fish sampled at ST4 were caught in the plunge pool immediately below Rt. 202. In 2025, most of the fish captured were pumpkin seeds, with small numbers of American Eels (*Anguilla rostrata*) and Largemouth bass (*Micropterus salmoides*) also caught. Most of the fish in the pool most likely have migrated from the pond on the other side of Rt. 202. This may also be a point of origin for some sunfish obtained at reaches further downstream, although this cannot be confirmed. It also suggests that this feature is a barrier to upstream migration for most if not all fish in this reach.

Lengths and masses of all captured brook trout are provided in Table 4. In 2025, 13 brook trout were sampled in the reaches of Aquetong Spring Park, which is an increase from 7 in 2024 but still significantly lower than the 43 individuals sampled in 2023. This year's sampling contained a disproportionate number of mature fish compared to young-of-the-year, of which there were only four (4). The average length of brook trout in 2025 was 190.5 mm with an average weight of 113.3 g. The average size of brook trout in 2025 was smaller in both length and weight. These parameters show an increase in younger fish within the sampled areas of the park.

The largest fish that was measured during this survey was 298 mm and 342 grams which suggests that food and habitat are available to support larger, older fish.

Brook trout were weighed using a small digital scale to obtain their mass in grams. A length to mass regression is provided in Figure 2. Note that this regressions accuracy is based on the number of trout sampled. In total, brook trout biomass was measured to be 1,473 g or 3.25 lbs. Additionally, young-of-the-year brook trout (assumed to be those less than 150 mm) comprised a biomass of 150 grams or 0.33 lbs.

Using the combined area of ST-1 through ST-5 and the downstream station, this correlates to approximately 28.99 lbs/acre of trout biomass. This is an increase from 2024, which yielded 21.09 lbs/acre. Additionally, the young-of-the-year brook trout caught in these areas correlates to 2.95 lbs/acre. This fulfills conditions listed by the PFBC for Class A wild brook trout streams (total wild trout biomass of over 26.7 lbs/acre and mass of young-of-the-year brook trout of over 0.089 lbs/acre). This marks a notable increase in brook trout biomass from the previous two years.

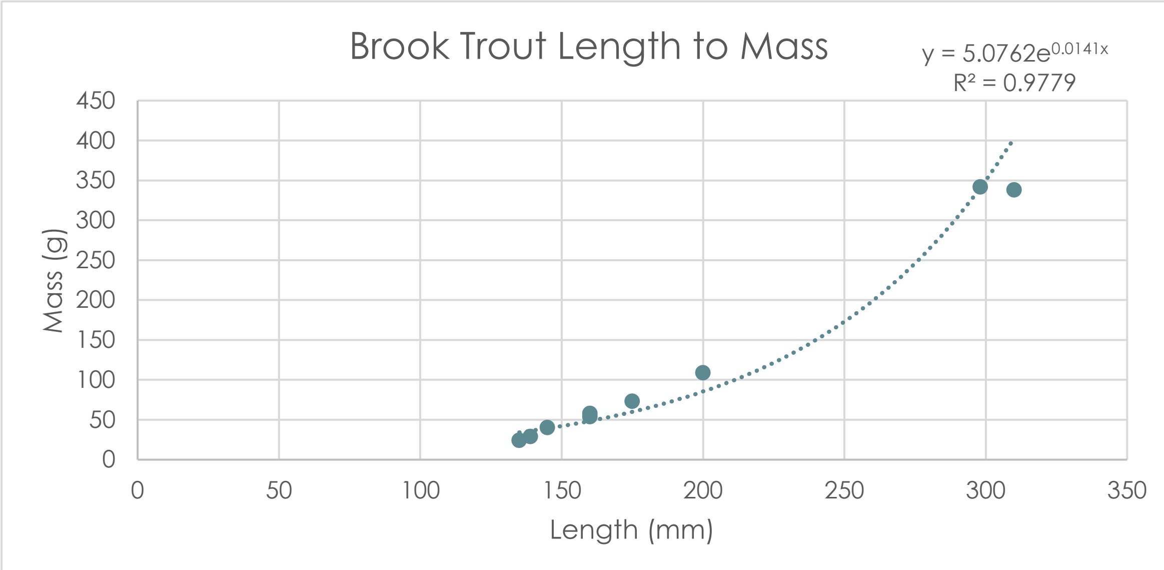


Figure 3: Length-to-mass regression for Brook Trout 2025

Table 4: Weights and Masses of brook trout sampled in 2025

Reach	Length (mm)	Mass (g)
ST1	298	342
ST2	310	338
ST2	160	58
ST2	135	24
ST2	139	29
ST3	175	73
ST3	160	54
ST3	145	40
ST3	200	109
ST3	170	54
ST5	190	83
ST5	140	57
ST5	255	212

Table 5: All Fish Sampled in Aquetong Creek 2025

Common Name	Downstream	ST-1	ST-2	ST-3	ST-4	ST-5	AW-1	AW-2	Total	Relative Abundance (fish/acre)
Black Nose Dace	7	3	7				42	5	64	302.85
Longnose Dace							28		28	132.50
White Sucker			1				13		14	66.25
Tessalated Darter							13	3	16	75.71
Banded Killifish								2	2	9.46
Largemouth Bass				1	3			5	9	42.59
Brook Trout		1	4	5		3			13	61.52
Green Sunfish			3		2				5	23.66
Pumpkinseed					126				126	596.24
Bluegill					1		1		2	9.46
Redbreast Sunfish								14	14	66.25
Creek Chub			1				1		2	9.46
Madtom								3	3	14.20
Fathead							6		6	28.39
American Eel			3		2	5	5	3	18	85.18
Total Abundance	7	4	19	6	134	8	109	35	322	1523.73
Richness (# Taxa)	1	1	5	5	4	1	5	5	12	
CPUE (fish/pass)	3.5	2	6.33	2.00	67	2.67	36.33	11.67	15.33	
Shannon's Diversity	-13.62	0.56	1.5887	0.451	0.305	0.37	1.17868	1.827	1.769	
Evenness		0.405639	0.540	0.251	0.062	0.177	0.251	0.502	0.306	

BENTHIC MACROINVERTEBRATE SURVEY

Consistent with previous years, the mainstem reaches of Aquetong Creek were dominated by amphipods ("scuds" or "side swimmers"; order Amphipoda, family Gammaridae). Scuds tend to be common and dominate in limestone stream systems. ST-4 was dominated by Ostrocoda, also known as seed shrimp for their very small size. Ostrocoda is a very diverse family that can be found in many types of aquatic habitats. Non-biting midges (order Diptera, family Chironomidae) dominated AW-1 and AW-2 during the 2025 survey. Chironomidae is a common and very diverse family that are able to withstand lesser water quality conditions, likely contributing to their large range.

Table 6: Benthic Macroinvertebrate Data 2025

Station	Density per ft^2	Taxa Richness	Dominant Taxa	Shannon's Diversity	Evenness	% EPT Taxa	Family Biotic Index
Downstream	322.8	12	Amphipoda, Gammaridae (Scuds)	1.46	0.61	4.83	4.25
ST-1	308.4	15	Amphipoda, Gammaridae (Scuds)	1.18	0.45	3.89	4.12
ST-2	153.6	9	Amphipoda, Gammaridae (Scuds)	1.26	0.57	0.78	4.94
ST-3	1016.4	16	Amphipoda, Gammaridae (Scuds)	0.95	0.36	2.95	4.16
ST-4	105.6	14	Ostrocoda, All (Seed Shrimp)	1.97	0.77	1.14	6.24
ST-5	213.6	11	Amphipoda, Gammaridae (Scuds)	1.71	0.74	20.22	3.80
AW-1	244.8	16	Diptera, Chironomidae (Non-biting Midges)	1.71	0.63	25.00	4.96
AW-2	223.2	19	Diptera, Chironomidae (Non-biting Midges)	1.56	0.58	10.22	5.33

Table 6, and Figures 4-6 display metrics pertaining to the benthic macroinvertebrates collected at each site. Note that these are calculated from the subsample collected for each sample. Using Hilsonhoff's family-level biotic index, most sites in the mainstem of the creek yielded values suggesting "Good" and "Very Good" water quality conditions. AW-1 yielded a value suggestive of "Good" conditions and AW-2 and ST-4 yielded values suggestive of "Fair" water quality conditions.

Percentages of EPT taxa (Ephemeroptera - mayflies, Plecoptera - stoneflies, and Tricoptera - caddisflies), a group of relatively sensitive taxa, were also calculated in order to assess ecological function of the stream and its ability to provide habitat to these sensitive taxa. An increase in % EPT taxa over time may suggest an overall increase in ecological function and habitat quality. AW-1 yielded the highest percentage of EPT taxa, with these orders comprising 25% of the total subsample. ST-2 yielded the lowest percentage of EPT taxa, with these only comprising 0.78% of the total subsample. This site also yielded the lowest taxa richness, with only 9 different taxa being found in the subsample. The site featured a family-level biotic index of 4.94, suggestive of "Good" conditions. While sensitive organisms were found in this site's sample, this suggests that the habitat can presently only support a relatively narrow range of taxa.

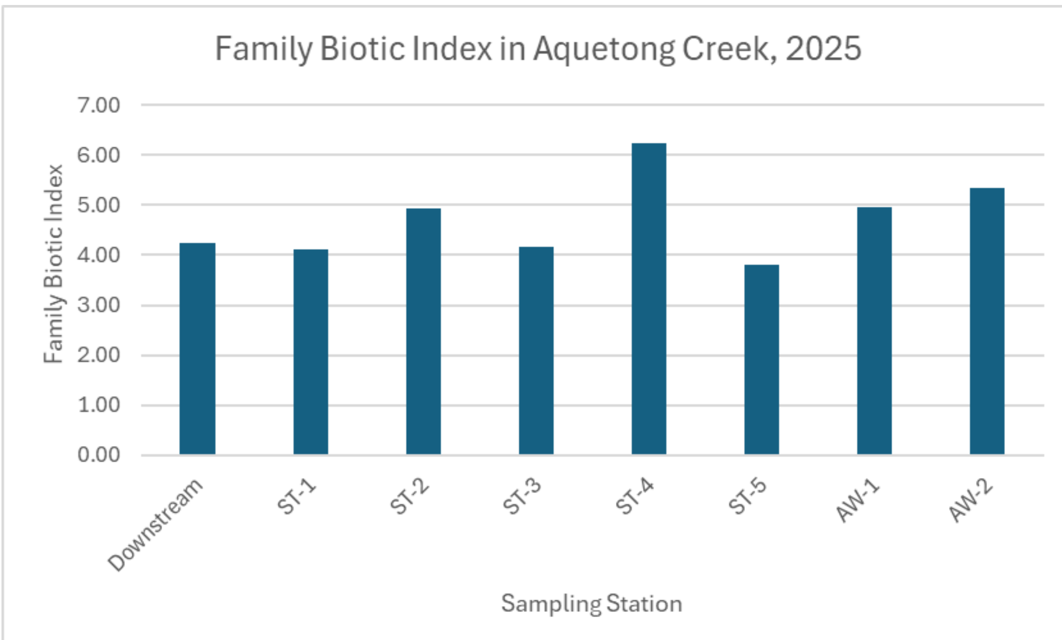


Figure 4: Hilsenhoff's Family Biotic Indices for Aquetong Creek

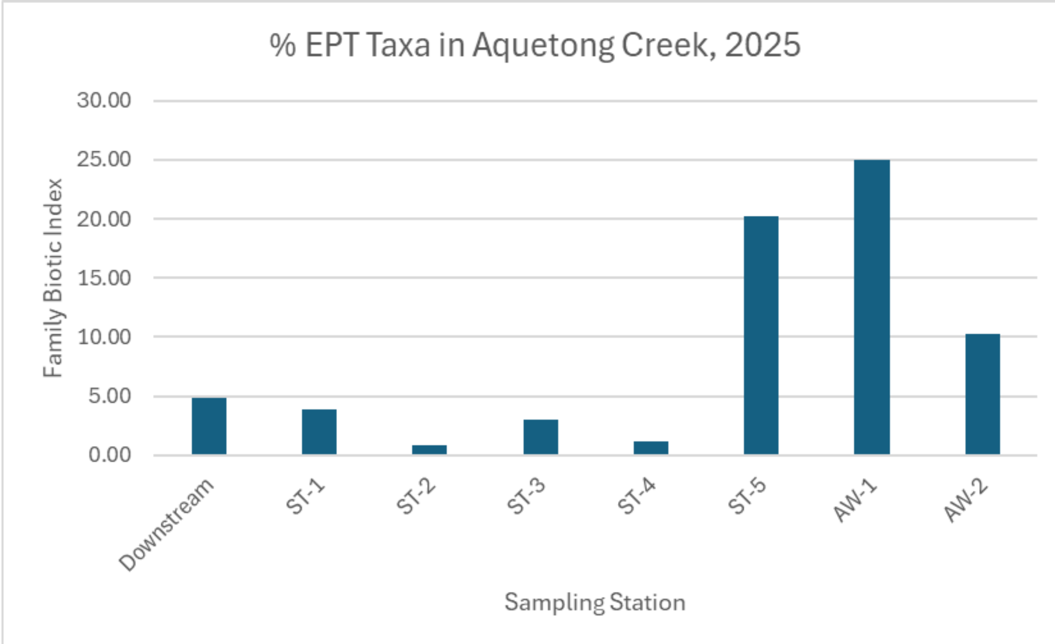


Figure 5: Percentage of samples comprising individuals from the orders Ephemeroptera, Plecoptera and Trichoptera

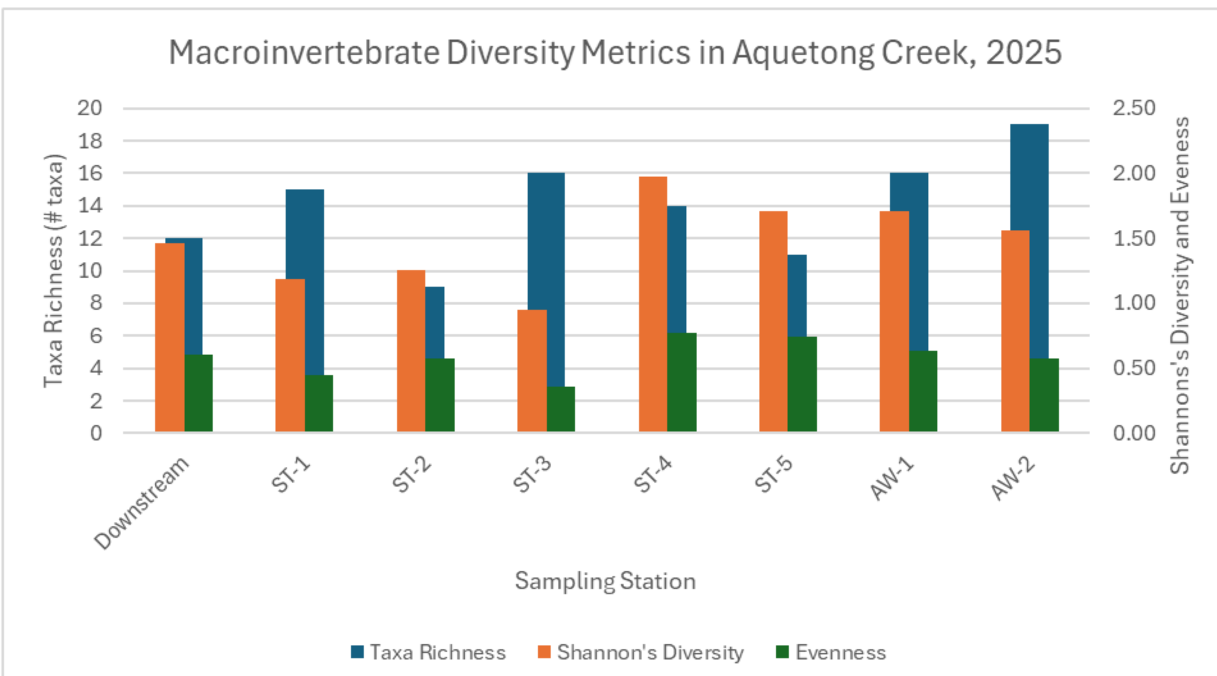


Figure 6: Aquatic Macroinvertebrate Density Metrics for Aquetong Creek

RECOMMENDATIONS

Based on the observations and measurements made during the 2025 monitoring of Aquetong Creek, Princeton Hydro proposes the following recommendations:

REDD SURVEY

Trout data from 2025 contained only a small number of young-of-the-year trout, suggesting a possible lack of spawning success from the 2024 spawning season. In order to assess brook trout spawning success in the Aquetong Creek, the township may be interesting in conducting a redd survey. Such a survey would entail counting the number of trout spawning nests, referred to as redds, and identifying which areas within the park are most utilized by spawning trout. These areas may subsequently be monitored prior to the annual fish survey for the presence of young of the year fish. Such a survey would be relatively easy to conduct, requiring only a GPS, polarized sunglasses, a notebook, and 2-3 volunteers. Yearly surveys may also be performed to assess long term patterns or changes in brook trout spawning behavior in Aquetong Creek. Trout Unlimited has published a handbook outlining how redd surveys may be conducted (Lemon and Rummel).

BROOK TROUT HABITAT SUITABILITY INDEX (OPTIONAL)

One of the goals for the Aquetong Creek Park is the establishment of a viable population of naturally reproducing brook trout. In order to facilitate this, Princeton Hydro recommends a full habitat assessment of the stream in accordance with the parameters used in the brook trout habitat suitability index (HSI, Raleigh, 1982). This index features a collection of several habitat metrics and their optimal ranges for different brook trout life stages (e.g. breeding habitat, habitat for larvae and fry, etc.). Many of these metrics within the Aquetong Creek may be obtained while conducting the usual annual stream monitoring, although some of them require taking measurements during certain times of year (e.g. assessing minimum winter temperatures, as this influences larvae survival). By collecting such data on the Aquetong Creek, the exact elements in which the stream needs improvement as they relate to brook trout habitat can be further ascertained. It should be noted, however, that a favorable HSI index for a stream does not necessarily guarantee a high brook trout biomass. This would need to be accompanied with fish surveys such as those that have been conducted in the present study to assess the continued impacts of restoration efforts on the standing stock of brook trout in the stream. Princeton Hydro recommends this assessment occur in 2026 to 2027.

REMOVAL OF BARRIERS TO FISH PASSAGE

As discussed above, an area immediately downstream of station ST5 was observed in the study area with a rapid change in grade that may be impassable to upstream movement by some fish. Princeton Hydro strongly recommends that this location be addressed, as barriers to fish movement may prevent fish from returning to areas upstream after downstream movement, reducing the populations upstream. This will be particularly important in maintaining brook trout populations. The same has been noted in the riverine surveys (provided under separate cover) with regard to PADEP stream restoration permit reporting requirements.

BROOK TROUT DIET STUDY(OPTIONAL)

A hypothesis for explaining the recent apparent reductions in YOY brook trout in the Aquetong Creek is predation on YOY individuals by larger individuals. Current data regarding overall brook trout diet in the Aquetong Creek is lacking; it is largely assumed that most individuals feed on the stream's aquatic invertebrate community, with the prolific amphipod population probably contributing largely to this. One method for assessing the diet of brook trout in the Aquetong Creek could be the examination of stomach contents of a subset of fish, with some focus placed on larger individuals. The biggest concern with such a study is that, in order to examine a fish's stomach contents, the fish usually needs to be euthanized. Methods do exist for obtaining stomach contents without euthanizing a fish, however these may not be effective on trout, as they stress easily and may die in the process regardless. The loss of larger individuals as a result of this process may have negative impacts on the overall population, as these bigger fish are likely contributing greatly to the spawning process. As of now, Princeton Hydro does not recommend conducting a diet study and recommends that a redd survey be prioritized over this in regards to assessing the apparent lack of YOY individuals.

AGE ASSESSMENT OF BROOK TROUT

There is a degree of uncertainty as to the age and growth rate of some of the smaller and mid-sized brook trout collected in the Aquetong Creek, although the variation in lengths and masses strongly suggests the presence of more than one age class. For purposes of determining brook trout stream class, as mentioned above, young-of-the-year (YOY) brook trout are considered to be those under 15 cm in length. While there isn't reason at this time to suspect that brook trout in the Aquetong Creek are not exhibiting healthy growth rates, this length-based aging may cause some inaccuracies if there exist smaller individuals that are over a year old. This can be assessed by collecting scales from each brook trout sampled and assessing them under magnification. While other methods of aging fish also exist, many of them (such as the assessment of otoliths) require that fish be euthanized. Collection of scales, however, is a relatively simple process that causes minimal stress to the fish being assessed and allows for assessed fish to be released. Age data can be paired with length data to produce age-length regressions similar to the length-weight regressions performed in 2021-2025. If desired, Princeton Hydro can perform scale assessments on brook trout during future fisheries assessments under a new task.

DIGITAL CAMERA-BASED UNDERWATER OBSERVATION

While not a part of the current SOW, in past years, Princeton Hydro staff have utilized GoPro© brand rugged digital cameras to collect underwater observations of parts of the Aquetong Creek. This yielded one of the only observations of a YOY brook trout individual in 2024. While the information gathered by this method has been sparse, this can be utilized for specific purposes, such as use during a redd survey, examining features of concern from an underwater view, or potentially for observing fish in a relatively non-invasive manner. The excellent water clarity in much of the Aquetong Creek allows for good camera visibility as long as appropriate light is available. Factors impacting the quality and usefulness of this data are the battery life and digital storage space of the camera, light availability, and ability to anchor the camera to the stream bottom at a useful angle. Princeton Hydro can discuss the use of this methodology further with Solebury Township if desired.

CONTINUED GENERAL MONITORING IN 2026

Princeton Hydro recommends the continued monitoring of the Aquetong Creek in order to assess the effectiveness of previous restoration efforts and the status of the stream's brook trout population. A monitoring event for 2026 should largely follow the same methodology used in 2020-2025. This involves the continued sampling of fish and macroinvertebrates at least once a year in either the Spring or Fall seasons, to assess how changes to the stream and habitat affect these populations and, in particular, if brook trout populations are reproducing.

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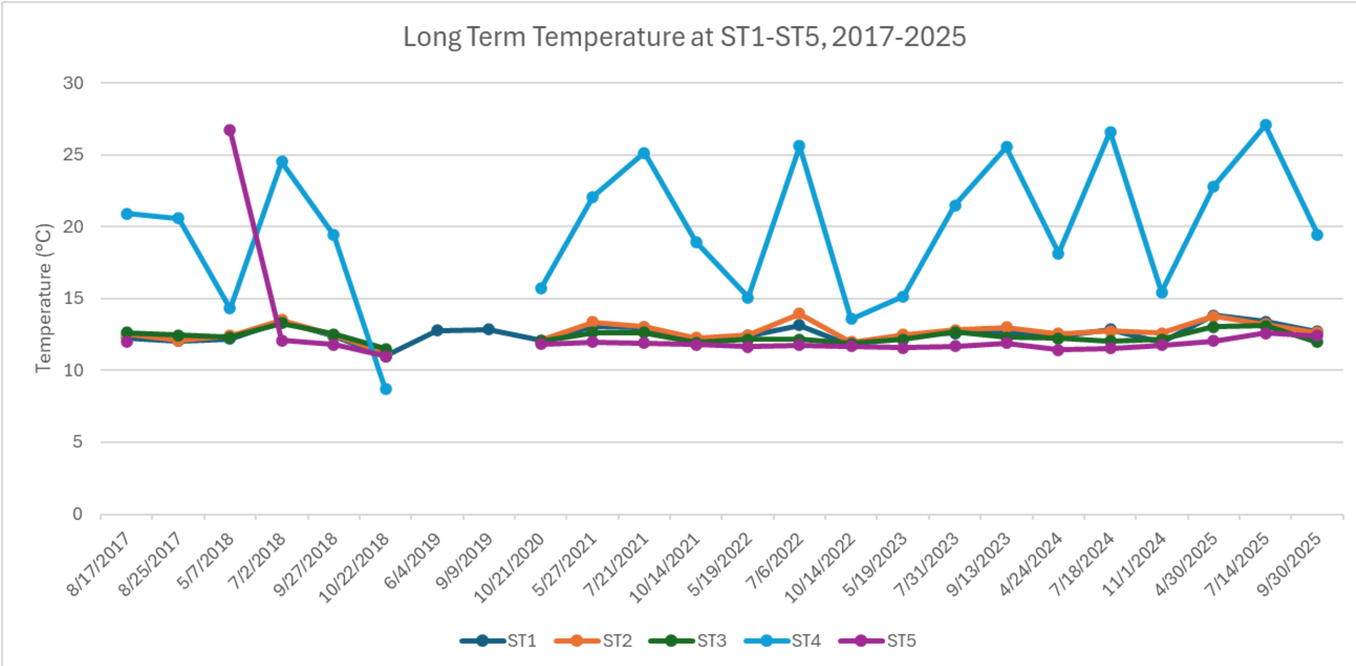
LONG TERM TREND FIGURES


Long Term Temperature at ST1-ST5, 2017-2025
Temperature (°C)
30
25
20
15
10
5
0
8/17/2017
8/25/2017
5/7/2018
7/2/2018
9/27/2018
10/22/2018
6/4/2019
9/9/2019
10/21/2020
5/27/2021
7/21/2021
10/14/2021
5/19/2022
7/6/2022
10/14/2022
5/19/2023
7/31/2023
9/13/2023
4/24/2024
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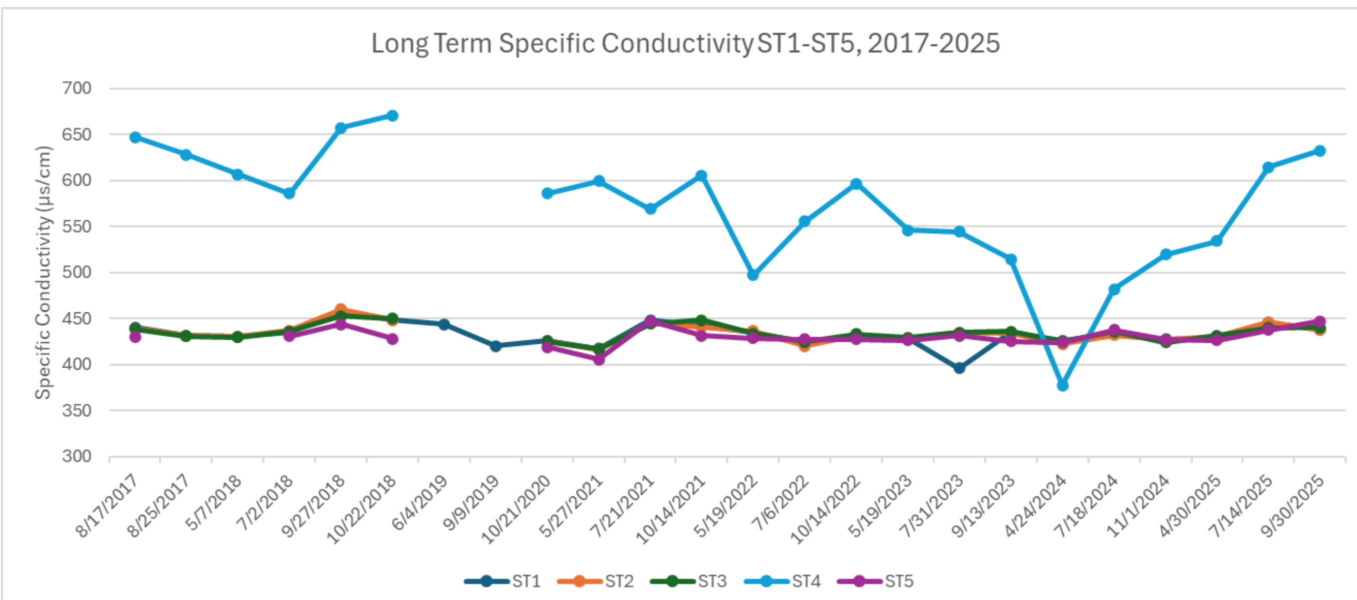
ST1
ST2
ST3
ST4
ST5


Long Term Specific Conductivity ST1-ST5, 2017-2025
Specific Conductivity (µs/cm)
700
650
600
550
500
450
400
350
300
8/17/2017
8/25/2017
5/7/2018
7/2/2018
9/27/2018
10/22/2018
6/4/2019
9/9/2019
10/21/2020
5/27/2021
7/21/2021
10/14/2021
5/19/2022
7/6/2022
10/14/2022
5/19/2023
7/31/2023
9/13/2023
4/24/2024
7/18/2024
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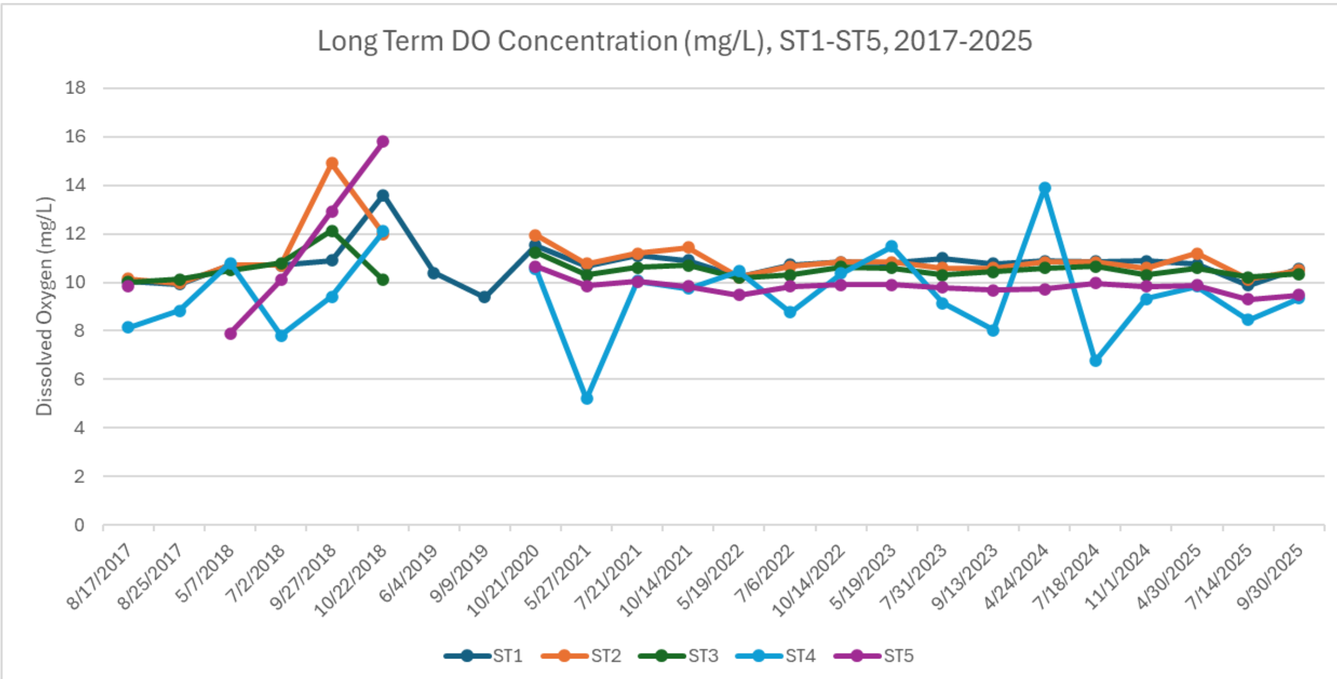
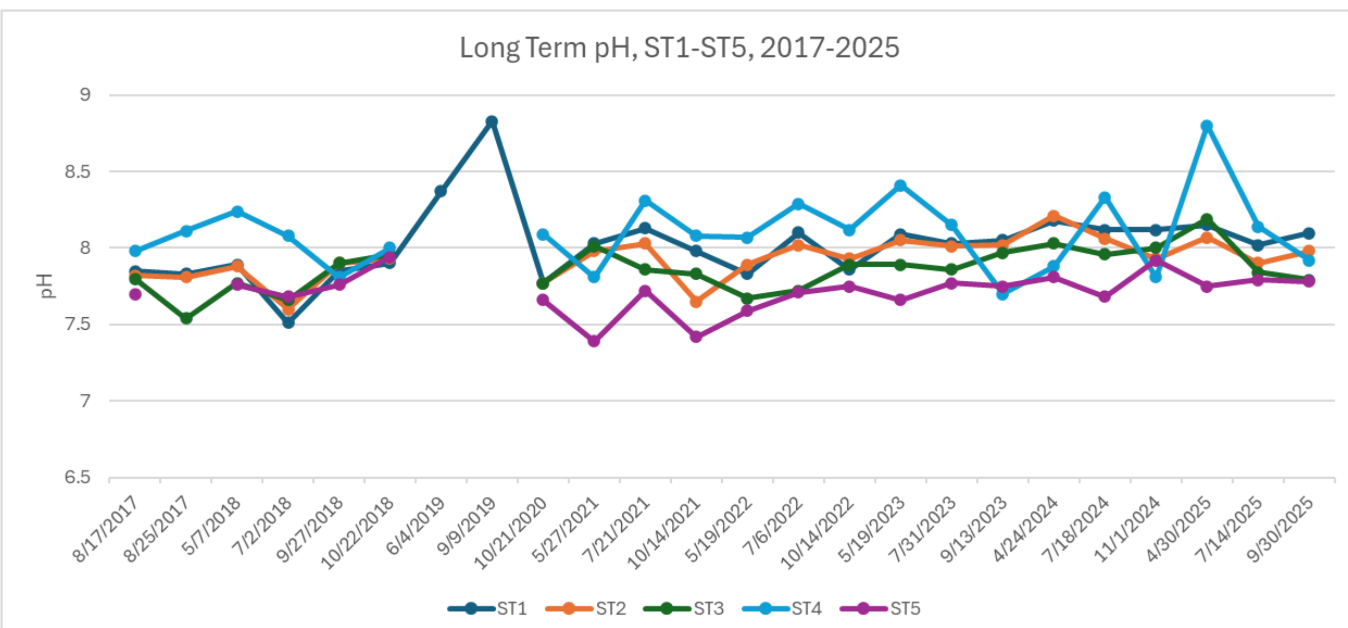
4/30/2025
7/14/2025
9/30/2025
ST1
ST2
ST3
ST4
ST5


Long Term DO Concentration (mg/L), ST1-ST5, 2017-2025
Dissolved Oxygen (mg/L)
18
16
14
12
10
8
6
4
2
0
8/17/2017
8/25/2017
5/7/2018
7/2/2018
9/27/2018
10/22/2018
6/4/2019
9/9/2019
10/21/2020
5/27/2021
7/21/2021
10/14/2021
5/19/2022
7/6/2022
10/14/2022
5/19/2023
7/31/2023
9/13/2023
4/24/2024
7/18/2024
11/1/2024
4/30/2025
7/14/2025
9/30/2025
ST1
ST2
ST3
ST4
ST5


Long Term pH, ST1-ST5, 2017-2025
pH
9
8.5
8
7.5
7
6.5
8/17/2017
8/25/2017
5/7/2018
7/2/2018
9/27/2018
10/22/2018
6/4/2019
9/9/2019
10/21/2020
5/27/2021
7/21/2021
10/14/2021
5/19/2022
7/6/2022
10/14/2022
5/19/2023
7/31/2023
9/13/2023
4/24/2024
7/18/2024
11/1/2024
4/30/2025
7/14/2025
9/30/2025
ST1
ST2
ST3
ST4
ST5