Aquetong Spring Park: Aquetong Creek Water Quality, Fish, and Benthos Sampling

Solebury Township, Bucks County, PA

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Introduction

The Aquetong Creek restoration site is 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 2000 gallons per minute(GPM) (F.X. Browne, Inc., 2004). Aquetong Creek flows approximately 2.5 miles from Ingham Spring to join with 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 (GPM) (F.X. Browne, Inc., 2004). In 2015, the dam was removed 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 middle of the formerly impounded area.

The overall goal of this project was to assess the existing water quality conditions, fish, and benthic invertebrate communities upstream of the project site, specifically with regard to its potential to support a brook trout fishery.

Methods

During August 2017, one (1) detailed stream survey was conducted to collect water quality, fish, and benthic invertebrate data. Sampling was conducted at five (5) stations located along Aquetong Creek (Figure 1). Four of the stations (Stations 2-5) were distributed down gradient of Ingham Spring but upgradient of the dam breach. The final station (Station 1) was located down-gradient of the breach, with this station serving as a "reference station" against which the upstream data was compared. The remaining four (4) stations were distributed somewhat uniformly along Aquetong Creek, but in a manner that enables evaluation of any impacts attributable to the Route 202 tributary.

Water Quality

Basic in-situ water quality and flow data were collected at each station. These data included temperature, dissolved oxygen, pH, and conductivity. The creek's cross-sectional dimensions (width and average depth) and velocity were measured to compute the creek's flow (discharge) at each station using standardized USGS procedures for measuring creek discharge.

During the collection of the water quality and flow data, a basic visual stream assessment was conducted and the physical attributes of the creek at each sampling station were documented. This included the conditions of the creek's bed and bank, any evidence of scour or sedimentation, estimates of the amount of canopy cover, amount of riparian vegetation and riparian cover, water clarity, and any other relevant observational data that could affect the fish or benthic invertebrate communities.

Biotic Assessment

Sampling of the fishery involved the use of a back pack electrofishing unit. Standardized passes of 100' reaches of the creek were conducted at each station. To maximize the return on the effort, a 50' bag seine was secured across the lower end of each sampled reach prior to electrofishing. The net helped capture any fish that may not have been collected by the dip netter working with the electrofisher. All collected fish were identified to species, measured (total length) and returned to the creek immediately following processing. The resulting fishery data was subjected to standard descriptive fishery statistical analyses (e.g. percent composition, dominance, catch per unit effort-CPUE, diversity, evenness, etc.).

Benthic invertebrate samples were collected at each station using a D-Net kick-sampler. All collected organisms were identified to lowest practical taxon and subjected to standard descriptive stream ecosystem statistical analyses (e.g. percent composition, dominance of EPT species, diversity, evenness, etc.).

Results and Recommendations

Current Creek Condition

Past geomorphic analysis has shown there to be erodible legacy sediment downstream of the Route 202 tributary and the potential for unstable downcutting of the creek channel. However, as of August 2017, the main stem of the creek has remained relatively stable. Presently some segments of the exposed creek channel also exhibit riffle habitat as well as some intermittent run habitat and some Large Woody Debris (LWD). Most of the creek's substrate is characterized as pebble or gravel with the exception of Station 3 which was well within the area of the historic impoundment. This is an area in which sediment accumulated historically in the old lake bed, where water coming from both the main stem and the Route 202 tributary converged, slowed down, and backed up behind a dam allowing sediment to settle. The creek has very clear water through most of its course. Areas of substantial cover exist at the distal ends of the formerly impounded area; in the proximity of Ingham Spring and downgradient of the dam breach. The majority of the creek corridor running through the former lake bed is well vegetated. Average creek width is 10.25ft and varies from 2.92-26.9ft.

Water Quality and Flow

A summary of water quality and flow data is presented in Table 1. Most notable is the difference between the Route 202 tributary and the main creek, particularly in terms of the tributary's higher temperature, specific conductance, pH, and lower dissolved oxygen and discharge rate. The entire Aquetong Creek at the time of our study had an average measured flow of approximately 2,135 gallons per minute, which is consistent with previous measurements of flow from Ingham Spring. At the time of measurement in August 2017, the tributary flow (20.79 gpm) was still very low relative to the main stem flow, and this flow measurement primarily consists of base flow (Table 1). However, the Route 202 tributary flow is more sensitive to precipitation and runoff; while the flow recorded in August is low, the flow will be greater when there is a combination of runoff and base flow.

The water quality of the main stem of the creek along with variations in discharge rate and substrate along its course indicate positive potential for trout habitat.

Biotic Assessment

Tables 2 summarizes the fish data. The highest abundance and diversity of fish occurred at the downgradient station closer to the area of the dam breach (Station 2); two brook trout, among other fish, were sampled at Station 2 on a second pass of collecting. Otherwise, American eels (*Anguilla rostrate*) dominated most of the areas where fish were found. No fish were collected within the section of Aquetong Creek located within the former impoundment or in the Route 202 tributary. Salamanders were observed at most sites.

The trout collected measured 210mm and 230mm with approximate extrapolated weights of 0.23 and 0.30 lbs, respectively (PA Fish an Boat Commission). Based on areas sampled, there is an average relative abundance of 17 fish per acre with a biomass of approximately 4.5 lbs per acre. Based on the data collected during our survey, the upper reach of Aquetong Creek cannot presently be classified as a Class A Brook Trout stream by PA DEP criteria (total wild brook trout biomass of at least 26.7 lbs/acre, PADEP 2014). However, our data suggest that conditions exist which are supportive of brook trout.

Table 3 summarizes the benthic invertebrate community data. Amphipods and mayflies were the dominant invertebrate species at most sites, with flies and true bugs in high abundance in the Route 202 tributary. Individuals from the orders Ephemeroptera (mayflies), Trichoptera (caddisflies), and Plecoptera (stoneflies) composed approximately 25-30% of the population collected at the two stations located at and below the dam breach (Stations 1 and 2, respectively) and decreased upstream. The presence of these three orders of aquatic insects (EPT spp.) is indicative of good water quality, as they are sensitive to declines in stream health.

Overall, the studied segment of Aquetong Creek exhibited excellent ecological health and was characterized by conditions supportive of a trout population. The cool, oxygen-rich, spring fed water exhibits natural riffles and glides as preferable trout habitat. There is plentiful detritus, decaying vegetative matter (leaves branches etc.), invertebrates, and vertebrates (salamanders) to support a healthy food web. Invertebrate species that are typically indicative of poor stream health were not found. Macroinvertebrates belonging to the sensitive orders Ephemeroptera (mayflies), Trichoptera (caddisflies), and Plecoptera (stoneflies) were present, indicating good water quality. Tipulidae (crane flies), amphipods, isopods, Mollusca (*Corbicula*), and Planaria (flatworms) were also observed.

The goal is to maintain and eventually optimize trout habitat and support a potential trout fishery in the future. Princeton Hydro recommends that Solebury Township implement future creek restoration and enhancement measures that support stable geomorphic processes and limit the establishment of invasive ripairan and floodplain vegetation. Stabilizing the banks and minimizing the amount of down-cutting will facilitate the immediate persistence and future expansion of desirable riffle and run habitat. As previously recommended by Princeton Hydro, the selective excavation of the lower creek channel to the bottom and expansion of its width will help to achieve greater stability. The previously proposed floodplain bench will allow flood flows to spread out across a wider area of the adjacent developing riparian area, further stabilizing the banks. Installation of large wood features within the restored creek channel will further provide stability to the restored channel. In-creek large wood creates varied hydraulic conditions, diversifies creek bed substrate types, and provides fish cover, resting, and feeding habitat.

Princeton Hydro, LLC also recommends restricting angling in this creek, as the trout population is limited and the removal of any individuals will substantially decrease the population available for spawning and recruitment, as well as decreasing genetic diversity.

References

F.X. Browne, Inc. 2004. Ingham Spring Dam Removal Study.

Pennsylvania Department of Environmental Protection. 2014. Class A Wild Trout Streams: Statewide Report.

Pennsylvania Fish and Boat Commission. Class A Wild Trout Fisheries Management Reports.

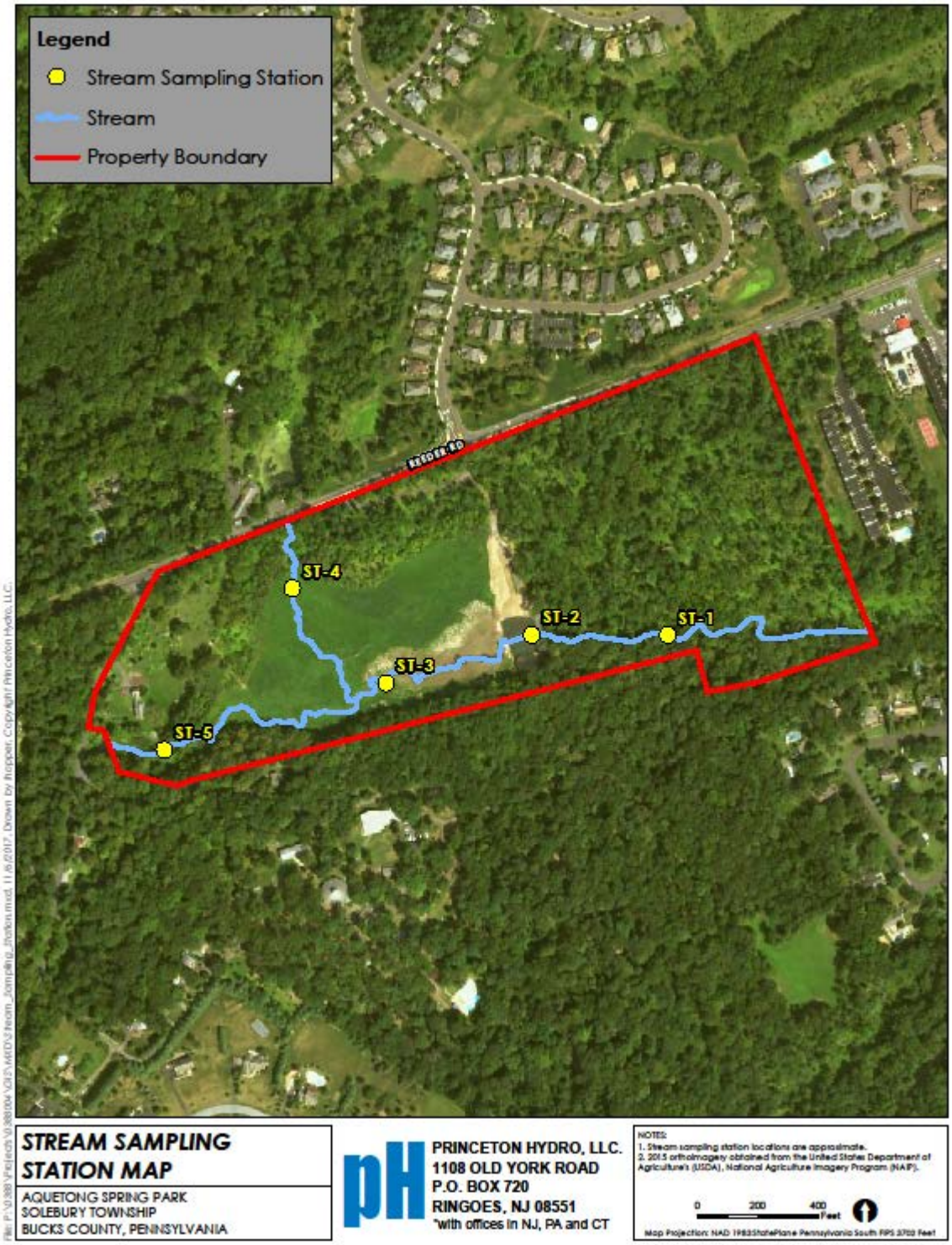

Figure 1. Map of Sampling locations along Aquetong Creek.

Table 1. In-Situ water quality monitoring and flow data for Aquatong Creek, August 2017.

In-Situ Monitoring and Flow Data for Aquetong Creek, August 2017									
Station	**Transect Width**	**Average Depth**	**Depth Sampled**	**Temperature**	**Specific Conductance**	**Dissolved Oxygen**		**pH**	**Discharge**
	Feet	**Feet**		**°C**	**mS/cm**	**mg/L**	**% Sat.**	**S.U.**	**gpm**
ST1	11.2	0.48	Surface	12.03	431.40	9.93	95.3	7.83	1880.16
ST2	26.9	0.54	Surface	12.09	431.30	9.97	95.8	7.81	2284.47
ST3	5.4	0.84	Surface	12.45	430.60	10.12	98.2	7.54	2541.01
ST4	2.92	0.18	Surface	20.56	628.30	8.84	97.6	8.11	20.79
ST5	4.8	0.51	Surface	11.99	429.50	9.86	94.6	7.70	1837.18

Table 2. Summary of Bioassessment with fish community data. Dominant species combine to make up 50% or more of the species composition and are noted in bold, italic text with an asterisk.

Fish Population for Aquetong Creek, August 2017								
Common Name	**Station 1**	**Station 2**	**Station 3**	**Station 4**	**Station 5**	**Total**	**Relative Abundance (# per acre)**	**Relative Abundance (# per hectare)**
American Eel	***5****	***13****	-	-	***1****	19	162	399
Black Nose Dace	-	1	-	-	-	1	9	21
Brook Trout	-	2	-	-	-	2	17	42
Green Sunfish	-	***9****	-	-	-	9	77	189
Largemouth Bass	-	1	-	-	-	1	9	21
Pumpkinseed Sunfish	-	5	-	-	-	5	43	105
Tesselated Darter	-	1	-	-	-	1	9	21
White Sucker	-	2	-	-	-	2	17	42
Abundance	**5**	**34**	**0**	**0**	**1**	40	340	841
Richness (# of taxa)	**1**	**8**	**0**	**0**	**1**	8	-	-
Evenness	1.00	0.79	0.00	0.00	1.00	0.77	-	-

Table 3. Summary of Bioassessment with benthic invertebrate community data. Dominant taxa combine to make up 50% or more of the species composition. EPT species are organisms that are indicative of stream quality and include individuals from the orders Ephemeroptera, Coleoptera, and Tricoptera.

Benthic Invertebrates for Aquetong Creek, August 2017					
Station	**Relative Abundance**	**Richness (# of taxa)**	**Evenness**	**Dominant taxa**	**% EPT species**
ST1	203	7	0.81	Amphipoda, Ephemeroptera	24.6%
ST2	200	8	0.68	Amphipoda, Ephemeroptera	30.0%
ST3	50	8	0.74	Amphipoda, Ephemeroptera	18.0%
ST4	32	10	0.79	Diptera, Hemiptera	6.25%
ST5	50	5	0.36	Amphipoda	6.0%