Solebury Township
Attn: Dennis Carney, Twp. Manager
3092 Sugan Road
Solebury, PA, 18963

RE: Fall 2020 Ecological Monitoring Event In Aquetong Creek
Solebury Township, PA
Project 0388.011

March 12, 2021

Dear Mr. Carney,

Princeton Hydro conducted the first post-construction field survey of the Aquetong Creek Monitoring Project on October 21st, 2020. This field survey consisted of identifying creek flow, measuring discharge, and collecting both in-situ (Table 1) and nutrient water quality data (Table 2). The in-situ data was collected with a YSI 650 MDS multiparameter water quality probe. Stream velocities were calculated by collecting flow measurement across a horizontal profile of the stream in multiple locations from bank to bank. In addition, visual observations of creek vegetation, creek substrate and characteristics were made. Finally, all discrete laboratory sample analysis was performed by Environmental Compliance Monitoring, Inc of Hillsborough, New Jersey using EPA-approved methods found in Standards Methods for the Examination of Water and Wastewater, 23rd Edition. The following paragraphs offer a brief description of the results of this field event.

Downstream – The downstream station had the largest discharge of all stations, which is supported by its larger width and deeper thalweg than other reaches of the stream. The substrate was primarily fine gravel and clay, with sparse vegetation. The primary species identified were watercress, curly leaf pondweed and water starwort. Freshwater bivalves, genus Corbicula, were found within this reach of stream. It is important to note that curly-leaf pondweed is an invasive species.

This reach featured the highest total phosphorus (TP) and total suspended solids (TSS) concentrations of any of the reaches sampled, with a TP concentration of 0.06 mg/L and a TSS concentration of 6 mg/L. This in part may be due to the location of this site farther downstream, thus giving it a larger watershed. Forestry management actions between this site and ST1 along the left side of the stream may also be resulting in increased runoff into the stream. Total nitrogen (TN) concentrations at this site were detected at 3.8 mg/L; while this is relatively high for aquatic ecosystems, it is similar to other concentrations detected during this event along the main-stem of the creek, likely due to its large consistency of spring water.

ST1 – Station 1 featured cold water temperatures as well as fully saturated concentrations of dissolved oxygen. ST1 had the highest DO% of any reach during this sampling event. Of particular note is the marked overall change in the stream segment's morphology with a very clear thalweg. ST1 also had

large amounts of woody debris. No woody debris was planned to be added to this reach during the stream restoration project, indicating this debris entered the stream by natural means.

TP and TSS concentrations at ST1 were relatively low, at 0.02 mg/L and 2 mg/L, respectively. This site is upstream of a majority of the more recent forestry operations and likely does not receive as large of an external load of nutrients as the Downstream site does. As with the downstream site, total nitrogen was similar to others detected along the main-stem of the creek, at 3.7 mg/L.

ST2 – Station 2 recorded cold water temperatures and high dissolved oxygen concentrations that were consistent with moderate discharge levels, similar to Stations 1 and 3. Since the removal of the dam from this location, a long riffle has formed as well as a clear thalweg. These morphologic features will help maintain habitat complexity as well as oxygenate the water. Evidence of the presence of caddisflies and mayflies was also found at this site.

As with ST1, TP and TSS concentrations in ST2 were relatively low, at 0.03 mg/L and 2 mg/L, respectively. In addition to improvements in the immediate watershed (the old lakebed) that have occurred upstream, the upper portion of the ST2 reach features excellent floodplain connectivity, with both banks of the stream manifesting as small areas of wetland. These wetland-like features, along with the slower pool-like water velocity in this area, likely allows for the increased settling of sediments and nutrients, as well as some uptake of nutrients by wetland vegetation. Nitrogen concentrations, however, were higher at this site than at all other sites sampled during this event at 4.0 mg/L.

ST3 – Station 3 had similar temperature, DO and pH values to those recorded at Stations 1 and 2. This is the first reach of stream where soft engineering techniques such as log vanes were implemented. These changes resulted in a much more diverse substrate than this reach had in past years. The width of the channel was also considerably wider than it previously was, also a result of the applied restoration techniques. Nutrient concentrations at this site were overall similar to those collected in ST2, with a TP concentration of 0.02, a TSS concentration of 3, and a TN concentration of 3.9 mg/L.

ST4 – Station 4 recorded a temperature of 15.68°C, which was several degrees warmer than any other station. This observation is consistent with data trends from past sampling events and is likely driven by this reach of stream not originating from the spring. Instead, water flows out of a small pond located directly across Rt. 202. This proximity to the road is also a probable explanation for the conductivity value at ST4 also being higher than any other station. It is also worth noting that the discharge at ST4 is noticeable lower than any other reach. This is the result of a narrow channel and slow flow velocity.

While the TP concentration measured from ST4 was similar to those measured in other areas of the Aquetong system, TN and TSS concentrations were relatively low, with a TN concentration of 0.4 mg/L and a TSS concentration lower than the minimal detectable concentration. As this tributary does not originate from the Aquetong Spring, it likely consists less of groundwater and has a nitrogen load that moreso consists of external inputs. Additionally, due to the typically low flows observed in this station,

streambank erosion during baseflows is likely lower, thus resulting in a very low TSS concentration, compared to that occurring in the main-stem of the Aquetong Creek, which has higher baseflows.

ST5 – Station 5 and the Aquetong Spring pool both held the lowest water temperatures (11.83 and 11.75°C, respectively) out of the five in-stream stations. While the water was well-saturated with dissolved oxygen in ST5, concentrations were lower in the spring pool (about 85% saturation). This can likely be attributed to the fairly stagnant conditions of the spring pool, as wel las the bedrock source of the spring. A lack of surface/air interface mixing at the spring pool would result in a lower amount of DO, while the outflow and turbulent flow between the pool and ST5 allows sufficient amounts of oxygen to become dissolved in the stream. Throughout this station watercress and moss appeared along both creek banks which can serve as a beneficial habitat for important benthic macroinvertebrates.

TP and TSS concentrations in ST5 were relatively low, at 0.02 mg/L and 2 mg/L, respectively. As the furthest upstream reach, ST5 has a relatively small drainage area compared to the other sites sampled, and external loads of nutrients are likely relatively low. The high flows that enter the system from the Aquetong Spring also likely result in a disproportionally high ability to dilute and flush incoming external nutrient loads from this portion of the watershed. The TN concentration obtained from this site of 3.9 mg/L is similar to those found in all sites downstream, likely due to a high contribution to flows from bedrock-sourced groundwater.

Table 1. *In-situ* and flow data collected in Aquetong Creek, 2020

Date	Station	Temperature	DO		SpC	pH	Flow
		°C	mg/L	%	mS/cm	S.U.	CFS
10/21/2020	Downstream	12.09	11.84	110.3	0.425	7.98	5.07
	ST1	12.09	11.53	115.3	0.426	7.77	4.01
	ST2	12.08	11.94	111.0	0.426	7.77	4.71
	ST3	12.04	11.23	104.4	0.425	7.77	4.45
	ST4	15.68	10.57	106.5	0.586	8.09	0.10
	ST5	11.83	10.65	98.6	0.419	7.66	4.21
	Spring	11.75	9.44	85.7	0.419	7.84	N/A

Table 2: Discrete water quality data collected in Aquetong Creek on 10.21.2020

Date	Station	Total Nitrogen	Total Phosphorus	Total Suspended Solids
		mg/L	mg/L	mg/L
10/21/2020	Downstream	3.8	0.06	6
	1	3.7	0.02	2
	2	4.0	0.03	2
	3	3.9	0.02	3
	4	0.4	0.03	ND <2
	5	3.9	0.02	2
"ND" = Not detected at or above minimum detection limit				

Princeton Hydro plans to return to Aquetong Creek for a Spring 2021 sampling event. If you have any questions or require additional information to facilitate your review of our proposed scope of services and costs, please contact myself (Chris Mikolajczyk, CLM) directly at cmiko@princetonhydro.com or 908-237-5660.

Sincerely,

Chris L. Mikolajczyk
Senior Project Manager – Aquatics
Princeton Hydro, LLC

cc: Fred Lubnow, Director of Aquatic Resources, Princeton Hydro
Jesse Smith, Staff Scientist, Princeton Hydro
William Kelleher, Staff Scientist, Princeton Hydro