The Great Swamp

Dutchess County, NY

2012 Biological Stream Assessment

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Prepared for

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Background

The Great Swamp, located in Dutchess County, is one of the largest freshwater wetlands in New York State. Only fifty miles north of New York City, the Great Swamp serves as a source of drinking water, flood control, recreation, and wildlife habitat. The Great Swamp encompasses two watersheds, the Swamp River and the East Branch of the Croton River, divided in a north-south orientation at the town of Pawling. The Swamp River watershed drains north into the Ten Mile River and then the Housatonic River, while the East Branch of the Croton River flows south into the East Branch Reservoir. Although these two watersheds encompassing the Great Swamp are approximately 70% forested (based on 2001 National Land Cover Data), pasture and cultivated crop land, as well as increased impervious area resulting from recent and proposed community growth, likely have deleterious effects on water quality and aquatic biota.

Biological assessment has been widely implemented as a useful, cost-effective approach for providing information on the extent and potential source of impacts to surface waters. Although biological assessments may utilize one or more biological communities, the use of aquatic macroinvertebrate communities has several advantages over other assemblages: Benthic macroinvertebrates are abundant in most streams, relatively easy and inexpensive to sample, and relatively sensitive to a wide range of environmental stressors, both physical and chemical. Their life span is short enough that sensitive life stages will be affected by stressors, but long enough that any impairment is measurable in the assemblage. Because they are relatively stationary, measured differences reliably convey localized conditions, allowing comparison of sites in close proximity to one another.

Changes in a macroinvertebrate community structure are indicative of these localized impacts and frequently provide insight into the type of impact. Benthic communities serve as indicators of overall, integrated water quality, including the effects of intermittent discharges and lapses in treatment, synergistic effects, and effects of substances in lower-than-detectable levels (Smith et al. 2009). Furthermore, macroinvertebrate collection and processing protocols have been standardized, proficiency in taxonomic identification has been established through a Society for Freshwater Science certification process, and state and federal agencies routinely use community metrics; all of these factors contribute to more accurate, reproducible data for making comparison between locations and for determining trends over time. Aquatic macroinvertebrate biological monitoring data may also be used to support documentation to establish a waterbody on the NYS 305(b) priority waterbodies list or 303(d) impaired waterbodies list, or be used in permit compliance.

The most recent Swamp River Watershed water quality assessments by the New York State Department of Environmental Conservation (NYS DEC) at Swamp River (GRSW01) in 2008 and Mill River (GRSW06) in 2007 indicated slightly impacted water quality conditions. As development pressure within the watershed continues, a need exists to develop a more comprehensive baseline of current water quality conditions in the Swamp River and tributaries. Recognizing this need, the Friends of the Great Swamp River (FRoGS) initiated biological stream assessments using aquatic macroinvertebrate communities in 2010. These 2010 assessments were conducted at seven locations within the Swamp River watershed, including the two sites previously assessed by DEC. Conditions in the tributary streams sampled in 2010 scored exclusively in the slight and non-impacted range.

In 2012, FRoGS supported further biological assessment of the Swamp River watershed and expanded sampling to include three tributary streams to the East Branch of the Croton River. In this study, 11 previously un-sampled locations were selected to further characterize and develop a water quality baseline of the Great Swamp and document if any rare, endangered, or special concern species were present. This report documents the approach, methods, and findings of the 2012 assessment.

Methods

Site Selection

2012 sample stations were selected to provide further characterization of current water quality conditions in the Swamp River watershed and to include several locations in the East Branch of the Croton River watershed (Figure 1, Table 1). Four previously un-assessed tributaries were sampled, including Brady Brook (BGBR01), Lost Lake Brook (LOLA01), Stevens Brook (STEV01), and West Mountain Brook (WMBK01). Two new stations on Burton Brook (BUBK05 & BUBK06) were sampled, both located downstream of the 2010 Burton Brook station (GRSW04). One new station was sampled in Hiller Brook (HIL01) in 2012 (Table 1).

Four previously un-assessed stations on the Swamp River also were sampled in 2012 (Figure 1, Table 1). Three of these stations served to bracket the proposed Harlem Valley Psychiatric Center redevelopment project in Wingdale. Station SWAR02 occurs approximately 2 km upriver of the proposed development to represent undeveloped control conditions, while stations SWAR03 and SWAR04 occur downriver of the proposed development center. One additional station (SWAR11) was sampled in the upper Swamp River. This station occurred in Pawling and was located approximately 1.2 km downriver of the 2010 Swamp River sample site GRSW2. All 2012 Swamp River sampling occurred in lower-gradient reaches dominated by fine sediments in order to allow comparisons among locations in the river.

See Figure 1 for maps of site locations.

Field Collection

Benthic surveys were conducted on July 21, 2012 in accordance with the NYS DEC SBU sampling season (July – September). The protocols established by NYS DEC SBU for the collection of benthic macroinvertebrates, physical habitat evaluation, and collection of basic water quality parameters for kick (riffle) and sandy stream samples (Smith et al.

2009) were followed. For kick riffles, an aquatic kick net was positioned in the water about 0.5 m downstream and the stream bottom was disturbed by foot so that the dislodged organisms were carried into the net. Sampling was continued for 5 minutes for a distance of 5 meters in a diagonal transect of the stream. The net contents were emptied into a pan of stream water and larger debris, once devoid of organisms, were removed. The contents of the pan were sieved with a US number 30 standard sieve and transferred to a jar for preservation with ethyl alcohol.

For the sandy stream samples, a jab technique was used, which consisted of jabbing (or thrusting) the net into the target aquatic habitat for a distance of approximately 1 meter at a depth of 1-2 inches and repeated five times. This was followed by 2-3 sweeps above the same area to collect dislodged organisms. (Unpublished NYS DEC 2003 screening sampling document, confirmed personal communication, A.J. Smith, NYS DEC SBU).

A single replicate sample was collected from each tributary station and from the Swamp River station SWAR11 in 2012. Samples were collected in triplicate from the three Swamp River stations bracketing the Wingdale proposed redevelopment project. Collection of triplicate samples at these sites is necessary to develop a dataset that will allow application of inferential statistics to test for significant effects of the development on the macroinvertebrate community at the downriver stations SWAR03 and SWAR04.

The following parameters were obtained from each station using a YSI 556™ following the manufacturer calibration guidelines: water temperature (accuracy ± 0.15°C); specific conductance (range 0 -200,000 µS/cm with an accuracy of ± 0.5% of reading); pH, with a range of 0 to 14 units (accuracy ± 0.2 units); dissolved oxygen, with a range of 0 to 50 mg/L (accuracy ± 0.2 mg/L); and percent oxygen saturation, with a range of 0-500% (accuracy ± 2%) .

The following physical habitat attributes were documented: estimated stream width, depth, velocity, substrate embeddedness, and substrate composition.

See Appendix II for description of rationale.

Sorting and Organism Identification

Sample sorting and identification adhered to the NYS DEC laboratory methods (Smith et al. 2009). The samples were rinsed with tap water in a U.S. number 40 standard sieve to remove fine particles and then examined under a dissecting microscope to separate 100 organisms from the sample matrix. All specimens were identified to genus/species, or lowest practical taxonomic level, and enumerated using a dissecting microscope. Oligochaetes and Chironomids were slide-mounted in CMCP-10 mounting medium and viewed using a compound microscope.

See Appendix II for description of rationale.

Habitat Assessment

Each site was evaluated for percent canopy cover, current speed, percent of rock, rubble, gravel, sand, and silt, and the embeddedness of the substrate. The depth and width of the stream were also measured.

Macroinvertebrate Community Metrics

Standard NYS DEC standard kick community metrics [species richness, EPT richness, biotic index (BI), and percent model affinity (PMA)] were calculated for each of the seven tributary subsamples. Sandy stream community metrics [species richness, EPT richness, biotic index (BI), and number of non Chironomidae and Oligochaeta (NCO)] were calculated for each of the ten subsamples collected and processed from the four Swamp River stations (Smith et al. 2009; Table 2).

The metric values are scaled to a common value between 0-10 and averaged to calculate the standard NYS biological assessment profile (BAP) score. The impact category scales for individual metrics change between sample and collection habitat types, but the final impact scale (BAP) is the same for each sample type and collection habitat.

The BAP indicates the water quality condition in response to low oxygen saturation, organic enrichment, and industrial pollutants based on four impact categories: non-impact 10 – 7.51, slight impact 7.5 – 5.01, moderate impact 5 – 2.51, and severe impact 2.5 – 0. The boundary between slight and moderate impact category is considered the decision threshold for designated use impairment based on biological data (NY DEC 2008).

Differences in mean metric values and BAP scores between the reference station (SWAR02) upriver of the proposed re-development project were statistically compared to those from the downriver stations (SWAR03 and SWAR04) using a Helmert contrast function. This contrast specifically tested for a difference between the values at station SWAR02 versus the mean of the values at stations SWAR03 and SWAR04 using Type III sums of squares and an F statistic. Results were deemed significant at $p < 0.05$.

See Appendix I, Table 6 for a descriptive summary of metrics used and Table 7 for a summary of water quality categories.

Impact Source Determination

Impact Source Determination (ISD) compares the sample community structure to a series of benthic model communities that are indicative of various sources of impact to help identify a likely source of impact affecting the sample community. The model that exhibits the highest similarity to the sample community denotes the likely impact source; alternatively, the sample community may be most similar to a “natural” or non-impacted community. If the sample community does not exhibit greater than 50% similarity to any model community, the determination is inconclusive (Novak and Bode, 1992).

ISD is applicable to benthic samples collected from wadeable stream systems only; the methods were developed for data derived from 100-organism subsamples of traveling kick samples from riffles of NYS streams.

Nutrient Biotic Index

Nutrient Biotic Index is a measure of nutrient enrichment based on responses of the macroinvertebrate community to effects of increasing nutrient levels for nitrate (NBI-N) and phosphorus (NBI-P). Taxa rate of occurrence at changing nutrient concentrations has enabled the identification of taxa-specific nutrient optima using a method of weighted averaging. Tolerance values have been assigned to taxa based on these nutrient optima, enabling the development of a linear scale of eutrophication (oligotrophic to eutrophic) using the macroinvertebrate community data.

Each taxon is assigned a tolerance value for phosphorus and a tolerance value for nitrate, enabling the calculation of two different biotic indices. Results are reported in a common 0-10 scale of eutrophication: oligotrophic 0-5, mesotrophic 5-6, and eutrophic 6-10 (Smith et al. 2009).

NBI is applied only to samples collected by kick method (not sandy bottom samples).

See Appendix I, Table 8 for a summary of NBI ranges.

Results

Macroinvertebrate Community Metrics and Community Structure

Among tributary streams, benthic macroinvertebrate community metrics indicated slightly impacted to moderately impacted water quality (Table 2). EPT richness ranged from 2 to 11; biotic index values ranged from 2.40 to 7.21; species richness ranged from 12 to 39; percent model affinity ranged from 16 to 79%. Biological assessment profile scores ranged from 2.75 to 7.05.

Community metrics also varied among the four Swamp River stations. Species richness ranged from 6 to 23, EPT richness ranged from 0 to 6, biotic index values ranged 7.07 to 7.76, and the number of non Chironomidae and Oligochaeta taxa ranged from 5 to 17 (Table 2). Three of four metrics exhibited strong upriver-to-downriver longitudinal trends across all four sample stations (Figure 2). BAPs for sandy-bottomed samples ranged from 2.11 to 7.54 across the four stations and also showed a strong correspondence with upstream-to-downstream location. These BAPS from the four stations corresponded to no impact at SWAR04, slight impact at SWAR03, moderate impact at SWAR02, and severe impact at SWAR11 (Figure 2).

Helmert contrasts indicated that total richness (p = 0.015), EPT richness (p = 0.004), and BAP scores (p = 0.011) were significantly different between SWAR02 and the two downstream stations (SWAR03 and SWAR04).

No rare, endangered, or species of special conservation concern were noted within the samples collected.

Station BGBR01. The Brady Brook station received a BAP score of 4.95, corresponding to a moderate impact classification (Table 2). Three of the four EPT taxa sampled from this site – *Baetis* sp., *Hydropsyche bronta*, and *Cheumatopsyche* sp. – are considered at least moderately tolerant to water quality impacts associated with agricultural and urbanized land uses. ISD results were inconclusive for this station (Table 3), yet NBI-I scores suggest a macroinvertebrate community potentially affected by nitrogen nutrient enrichment.

Station BUBK05. The lower Burton Brook station received a BAP score of 2.95, corresponding to moderate impact to the macroinvertebrate community (Table 2). Only two EPT taxa occurred at this site, including the caddisfly *Triaenodes* sp. and an undetermined Baetidae. The benthic community was heavily dominated by the crustaceans *Caecidotea* sp. and *Hyalella* sp. At 7.21, the biotic index score at this site was the highest among the seven tributary stations sampled, indicating a community dominated by taxa tolerant to organic enrichment pollution. NBI-N and NBI-P scores in the eutrophic range (see Table 8) corroborated this finding, yet ISD results were inconclusive (Table 3).

Station BUBK06. The upper Burton Brook station occurred approximately 2.5 km upstream of BUBK05 and 3.3 km downstream of the 2010 Burton Brook station, GRSW04. Contrary to 2010, both Burton Brook stations supported sufficient riffle habitat and coarse substrates to allow kick sampling from riffle habitat and application of the riffle kick BAP. Based on sampling from riffle habitat, the upper Burton Brook station received a BAP 6.70, corresponding to slight impact (Table 2). Six EPT taxa occurred at this site, and total taxa richness was the highest among all tributary stations sampled in 2012. Both NBI-P and NBI-N scores >6 indicated potential effects of nutrient enrichment on the benthic community at this station; however, ISD results were again inconclusive (Table 3).

Station HIL01. The Hiller Brook station received a BAP score of 7.05, corresponding to slight impact to the macroinvertebrate community (Table 2). Eleven EPT taxa occurred in the subsample from this station, representing half of the enumerated total taxa richness. Several EPT taxa typically associated with small, cold streams, including *Tallaperla* sp., and *Diplectrona* sp., occurred at this location. The biotic index value at HIL01 was lowest among all stations sampled in 2012, suggesting a benthic assemblage largely comprising taxa that are sensitive to organic enrichment pollution. Hiller Brook's ISD score was most similar to a community affected by non-point-source organic pollution (Table 3).

Station LOLA01. Lost Lake Brook station LOLA01 received the second lowest BAP scores of 2.96, corresponding to moderately impacted (Table 2). Only two EPT taxa, *Cheumatopsyche* sp. and *Oecetis* sp., occurred in the subsample. Twelve taxa occurred in the subsample, half of which were Chironomidae and Oligochaeta. Both NBI-P and NBI-N scores >7 indicate potential effects of nutrient enrichment pollution on the macroinvertebrate community at this station. ISD scores were highly inconclusive, as the community composition at this station was uniformly dissimilar from all ISD reference community signatures (Table 3).

Station STEV01. Stevens Brook received the highest BAP (7.06) among sites sampled in 2012, indicating slightly impacted biological conditions (Table 2). The subsample supported eight EPT taxa, six from the Baetidae and Hydropsychidae families, but also including *Perlesta* sp. and *Dolophilodes* sp. Twenty six taxa were sampled from the site. While both the NBI-P and NBI-N suggest potentially enriched conditions, Stevens Brook's ISD score was most similar to a community in a natural (unpolluted/undisturbed) condition (Table 3).

Station WMBK01. The West Mountain Brook station received a BAP 4.89, corresponding to moderate impact to the benthic community (Table 2). Five EPT taxa occurred in the sample, which was numerically dominated by the caddisflies *Hydropsyche betteni* and *Cheumatopsyche* sp. Both NBI-P and NBI-N indicate potential, yet likely marginal, effects of nutrient enrichment on biological conditions at this station. ISD results suggest several potential impact sources, including non-point-source nutrients, organic, municipal/industrial (Table 3).

Station SWAR11. Located in Pawling, the Swamp River station SWAR11 was the uppermost location sampled along the river in 2012. A BAP of 2.11 calculated from the single sample collected from this location corresponds to severe impact to the benthic community (Table 2). No EPT taxa were sampled from the site, and only 5 taxa were present in the sample. A biotic index score of 7.76 was the highest among the Swamp River mainstem sites.

Station SWAR02. Swamp River station SWAR02, located upriver of the proposed re-development project, received a mean BAP of 4.65, corresponding to moderately impacted conditions (Table 2). One EPT taxon occurred in each of the three replicate samples: *Callibaetis* sp. in two samples, and a Limnephilidae caddisfly in one sample. A biotic index score of 7.63 indicates a community that is tolerant to organic enrichment pollution.

Station SWAR03. Swamp River station SWAR03, located approximately 3.5 km downriver of the proposed re-development project, received a mean BAP of 5.73, indicating a slightly impacted macroinvertebrate community (Table 2). EPT richness averaged 2.7 taxa per replicate sample, and total richness averaged 21 taxa per sample. A biotic index score of 7.23 suggests a community comprised primarily of taxa that are tolerant to organic enrichment pollution.

Station SWAR04. Station SWAR04 was the farthest downriver location among those sampled on the mainstem in 2012, occurring approximately 1.8 km downriver of SWAR03. Among the four stations, this station received the most favorable mean BAP score of 7.54 and a corresponding non-impacted classification (Table 2). Taxa richness averaged 23.3 among the three replicate samples and included six EPT taxa. This station also received the lowest biotic index score (7.07) among the mainstem Swamp River stations (Table 2 & 6). In general higher biotic index values are suggestive of organically enriched conditions, while lower values indicate naturally occurring, ambient communities (Appendix I, Table 6).

Physical Habitat and Basic Water Quality

Most tributary stream reaches sampled in 2012 supported sufficient riffle habitat and coarse substrates for analysis using riffle-kick metrics; only the Lost Lake Brook station was dominated exclusively by sand and fine substrates. The Brady Brook station supported only marginal riffle habitat containing embedded gravel substrates. Burton, Hiller, Stevens, and West Mountains Brook stations all contained heterogeneous composition of coarse and fine substrates, including rock, rubble, gravel, sand, and silt (Table 4). Canopy cover ranged widely among the tributary streams, ranging from 25 to 90%.

Physical habitat conditions were similar among the four Swamp River stations. Substrate at each station comprised relatively even proportions of gravel, sand, and silt substrates (Table 4). Sample stations were dominated by depositional glide and pool habitats. Canopy cover was low among all stations, ranging from 10 to 25% (Table 5).

Water quality varied widely both among tributaries and across mainstem Swamp River stations. Dissolved oxygen concentrations ranged in tributaries from 0.48 to 10.2 mg/L (Table 4), and in the mainstem from 2.05 to 6.04 mg/L (Table 5). Water quality measurements were made at all sites (excepting WMBK01) after 1100, rather than during the peak stress early morning period. As such, these measurements are not indicative of diel minimum DO levels potentially occurring in these water bodies. Dissolved oxygen was not reported for stations LOLA01 and STEV01.

Conductivity in tributaries ranged from 268 to 583.5 µS/cm (Table 4) and in the mainstem from 409 to 654 µS/cm (Table 5). Conductivity was similar among Swamp River stations SWAR02, SWAR03, and SWAR04; but was considerably higher at SWAR11, suggesting input of inorganic dissolved solids upstream of SWAR11. pH was circumneutral to basic, ranging from 6.6 to 8.4 among tributaries (LOLA pH of 11 apparently a measurement/recording error) and from 6.8 to 7.5 among Swamp River mainstem sites.

Discussion

The 2012 Great Swamp assessment results indicate a range of biological conditions across the two watersheds. Conditions in eleven previously un-assessed river and stream reaches ranged from slightly to severely impacted. Among tributary reaches, NBI-P and NBI-N scores suggest that nutrient enrichment may be at least marginally affecting benthic community conditions. Hiller Brook (HIL01) represented an exception to this general pattern: Despite a low biotic index score and relatively low NBI-P and NBI-N scores at HIL01, non-point source nutrient enrichment was identified as potential impact source to the benthic community at this station with an ISD score of 53. The second highest ISD score for HIL01 indicted natural conditions with a score of 48 (Table 3).

Impact source determination (ISD) results were inconclusive at four of the seven tributary stations and suggested non-point source nutrient additions (runoff) as a probable source of impact only to West Mountain Brook (WMBK01) in addition to Hiller Brook. Nonpoint source additions are the result of stormwater runoff from a variety of sources, including fertilizer, livestock, and impervious surfaces (paved areas). These results indicate the need to consider both the NBI-P/NBI-N and ISD results, recognizing that concordance between the measures does not always occur. Examining both the direction and size of the result of each will assist with determining the likelihood that nutrient enrichment is contributing to measured biological impact.

As indicated by a number of measures, Stevens Brook exhibited the least impacted biological conditions among tributaries sampled in 2012. Stevens Brook received the highest BAP score and highest percent model affinity score, and was also the only 2012 station to score as most similar to a natural (un-impacted) condition using ISD.

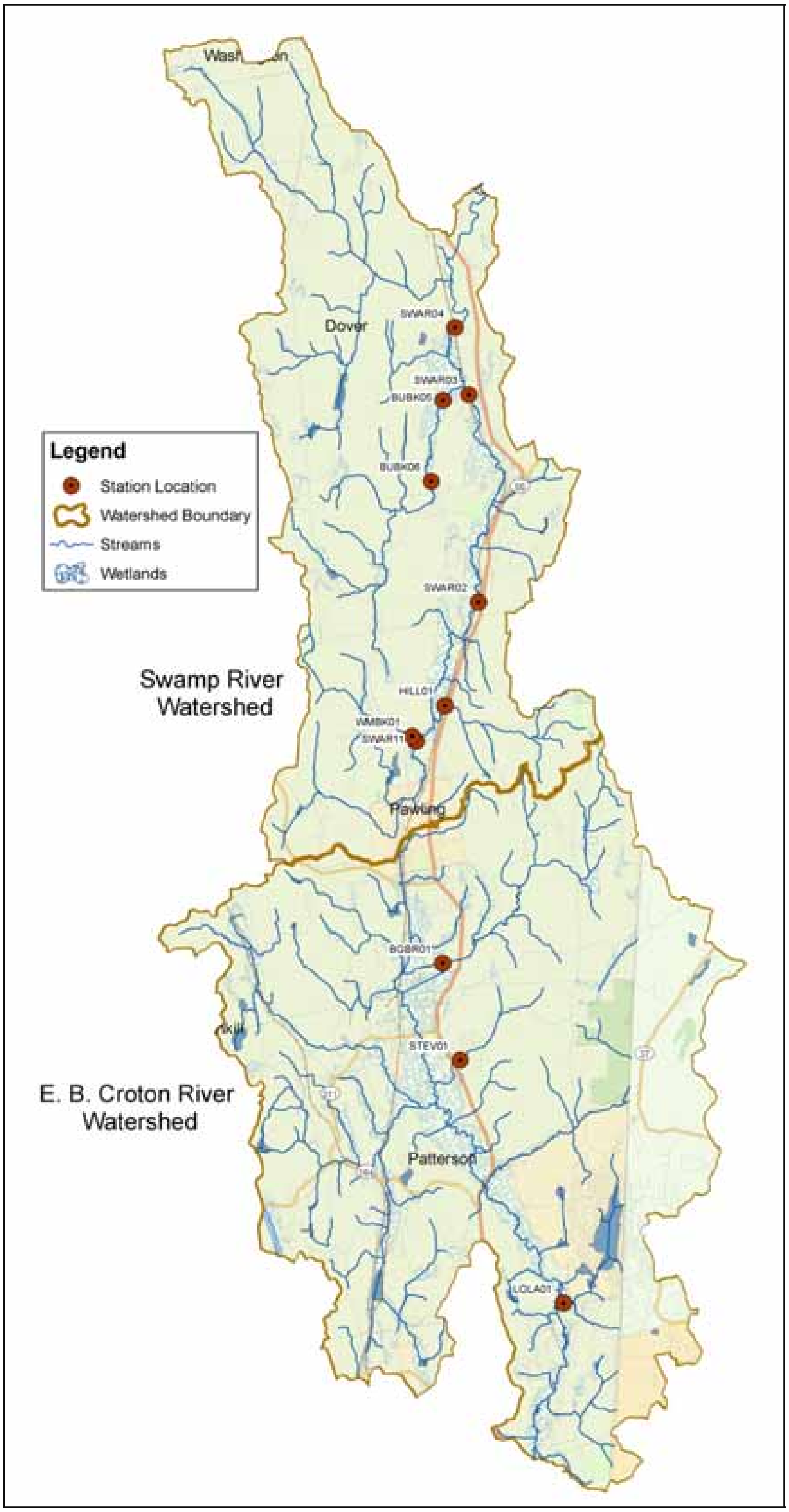
The Swamp River was more comprehensively assessed in 2012 and included sampling at four stations throughout the length of the river. Reaches selected for sampling were exclusively lower-gradient sections of river that were uniformly dominated by slow-water, depositional habitats and small (gravel, sand, and fines) inorganic substrates. Maintaining this consistency in habitat characteristics among sites allowed for more direct comparisons among the mainstem stations and reduced the extent to which natural variation in habitat confounded the effects of human activities.

Most sandy-kick metrics exhibited strong longitudinal trends within the Swamp River, including total richness, EPT richness, HBI, and BAP scores. Interestingly, trends consistently indicate improving water quality conditions in a downriver direction. This trend runs counter to that typically observed in flowing waters occurring in developed watersheds. These results suggest that factors limiting macroinvertebrate communities in the upper Swamp River are ameliorated as the river flows north; at least to station SWAR04 located just above Dover Furnace Rd. Agricultural and suburban land uses within the upper portion of the watershed likely contributes non-point-source organic and inorganic pollutants. Increased conductivity at SWAR11 relative to the three downriver stations suggests a potentially significant input of inorganic dissolved solids within the upper watershed. Among other important functions, wetlands serve to remove excess nutrients and inorganic pollutants from surface waters. The results of this study suggest that such “purification” may be occurring in the Swamp River, potentially resulting in improvements in water quality in a downriver direction. Further study of spatial trends in nutrient concentrations and other water quality attributes would be necessary to further elucidate the likely causes of observed trends in biological conditions in the Swamp River.

Stream substrate and embeddedness values were similar among Swamp River stations, suggesting comparable substrate for epifaunal and infaunal colonization. Dissolved oxygen was low across all sites, ranging from 2.05 to 6.04 mg/L, and was highest at the lowermost station, SWAR04. As water quality measurements were collected only during the midday period, diel minimum dissolved oxygen is likely lower at all of these sites and is therefore likely a limiting factor to benthic communities throughout the Swamp River.

Total richness, EPT richness, and BAP scores were significantly different between stations bracketing the proposed re-development site in Wingdale. These results have consequences for long-term monitoring of the effects of the development on the Swamp River. Importantly, post-development monitoring must not simply seek to determine whether a difference occurs between upriver and downriver locations, as such conditions already exist pre-development. Rather, monitoring for post-development effects would be best informed by implementing a before-after, control-impact (BACI) design that incorporates sampling repeatedly (ideally three or more years) from each of these locations both before and after re-development occurs. Such a sampling design would allow statistical analysis for a significant pre/post change in the *size* of the differences in metric values between upriver and downriver locations. This first year of data collection serves to begin to characterize the current size of that difference. Additional years of data collection before the re-development will allow for estimation of variation around the mean difference, a necessary element for statistical analysis of pre/post changes in downriver conditions.

Figure 1a – 1i. a.) Swamp River and E.B. Croton River watershed map of the 2012 benthic survey stations. 1b – 1i.) Individual map locations of 2012 benthic survey stations.



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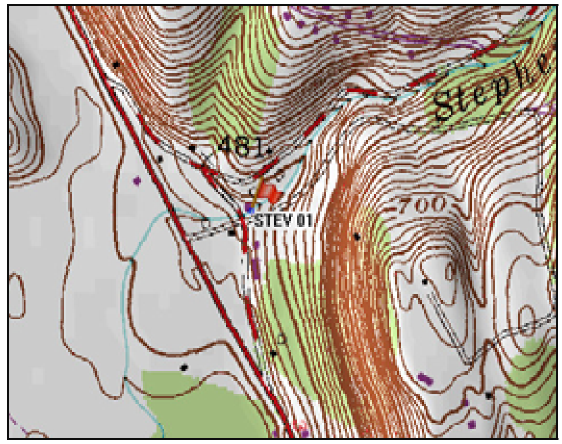
1c. 
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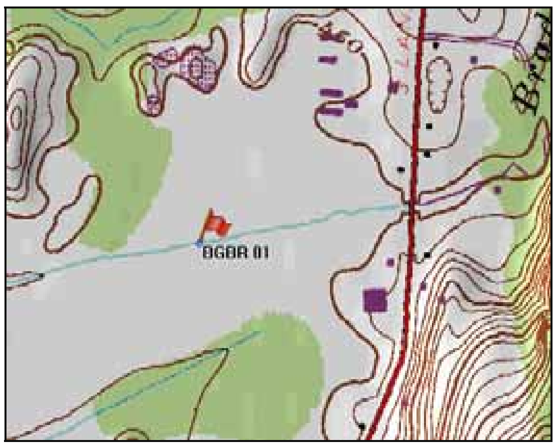
1d. 
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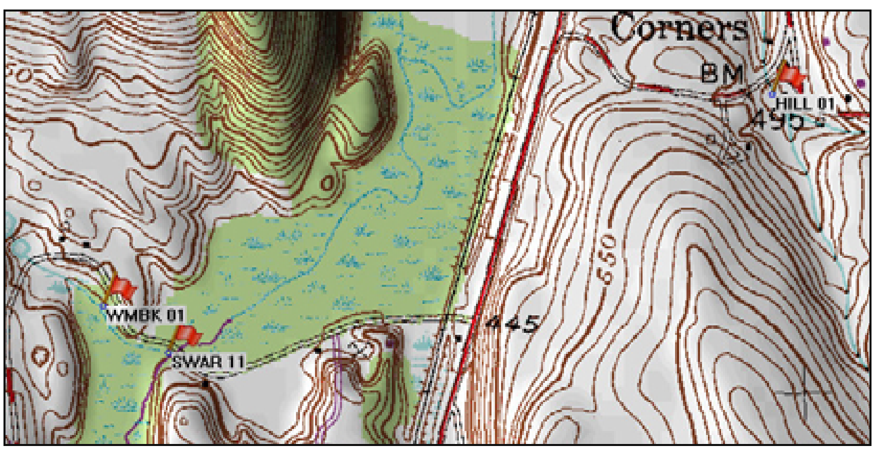
1e. 
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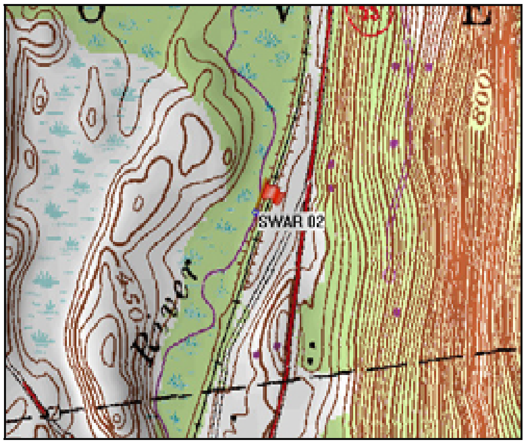
1f. 
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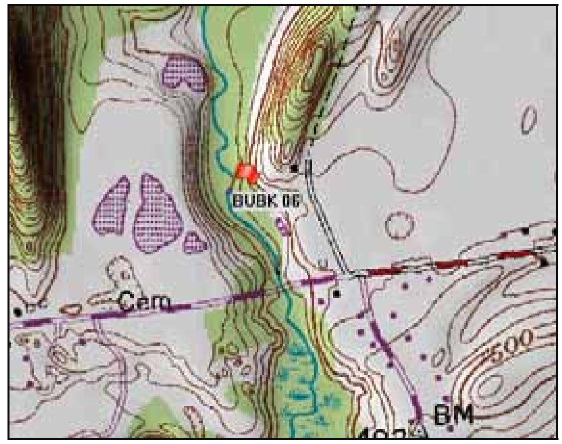
1g. 
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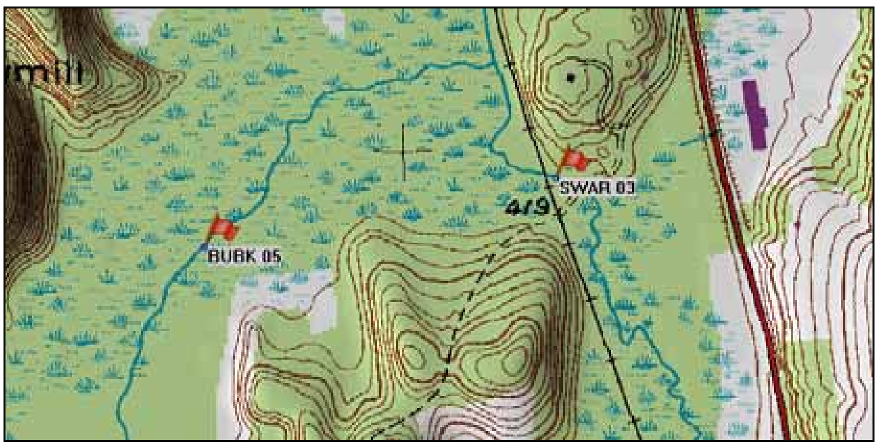
1h. 
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Figure 2. Macroinvertebrate community metrics calculated from samples collected from four Swamp River sampling stations in July 2012. Stations are arranged upriver to downriver from left to right. Error bars represent the standard deviation on the mean value calculated from three replicate samples collected at stations SWAR02, SWAR03, and SWAR04. One sample was collected from the upriver-most station, SWAR11.

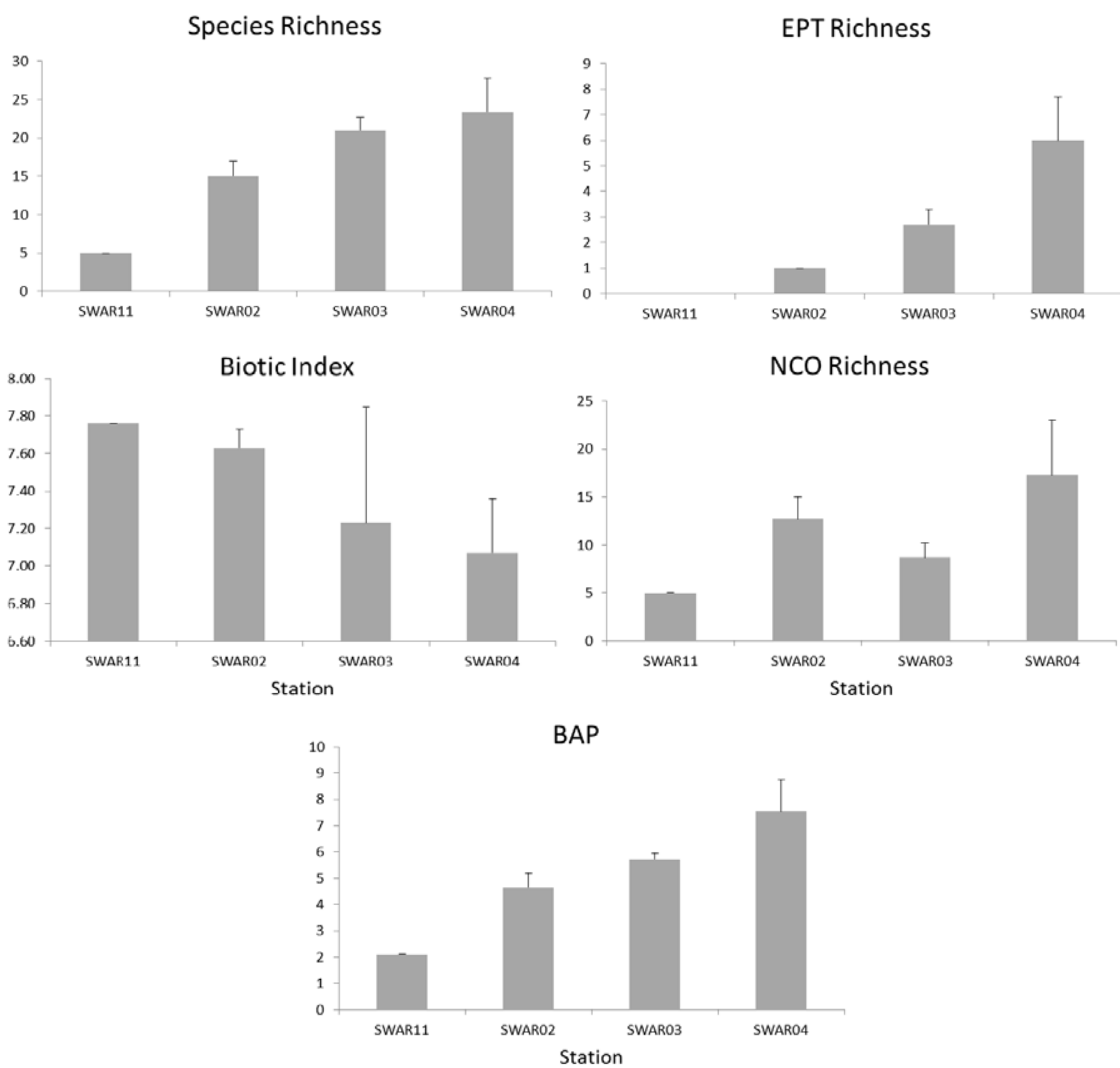

Table 1. List of 2012 Great Swamp benthic macroinvertebrate sample stations.

Stream name	Station ID	Station	Date Sampled	Watershed	Abv/Blw Proposed Re-Development	Habitat Sampled	Replicates Collected
Swamp River	SWAR02	02	21-Jul-12	Swamp River	Blw	Pool	3
Swamp River	SWAR03	03	21-Jul-12	Swamp River	Abv	Pool	3
Swamp River	SWAR04	04	21-Jul-12	Swamp River	Abv	Pool	3
Swamp River	SWAR11	11	21-Jul-12	Swamp River	Blw	Pool	1
Brady Brook	BGBR01	01	21-Jul-12	E Br Croton R	NA	Riffle*	1
Burton Brook	BUBK06	06	21-Jul-12	Swamp River	NA	Riffle	1
Burton Brook	BUBK05	05	21-Jul-12	Swamp River	NA	Riffle	1
Hiller Brook	HILL01	01	21-Jul-12	Swamp River	NA	Riffle	1
Lost Lake Brook	LOLA01	01	21-Jul-12	E Br Croton R	NA	Pool	1
Stevens Brook	STEV01	01	21-Jul-12	E Br Croton R	NA	Riffle	1
W Mountain Brook	WMBK01	01	21-Jul-12	Swamp R	NA	Riffle	1

*The riffle at BGBR01 was marginally developed supporting only gravel and sand substrate

Table 2. Benthic macroinvertebrate metric scores from 11 Great Swamp biological assessment stations sampled in 2012. Metrics include SR= species richness; BI= biotic index; EPT = Ephemeroptera-Plecoptera-Trichoptera taxa; PMA= percent model affinity; NCO = non-Chironomidae Oligochaeta; BAP = Biological Assessment Profile; WQA= water quality assessment category; NBI-N=nutrient biotic index for nitrogen; NBI-B=nutrient biotic index for phosphorus. SWAR02, SWAR03, and SWAR04 metric and BAP results are mean scores from 3 replicate samples taken at each station.

				Biotic Metrics									
Stream Name	**Station ID**	**Sample Type**	**Reps**	**SR**	**BI**	**EPT**	**PMA**	**DIV**	**NCO**	**BAP**	**WQA**	**NBI-P**	**NBI-N**
Swamp River	SWAR02	Sandy Kick	3	15.0	7.63	1.0	18.3	3.12	12.7	4.65	Non		
Swamp River	SWAR03	Sandy Kick	3	21	7.23	2.7	43.3	3.22	8.7	5.73	Slight		
Swamp River	SWAR04	Sandy Kick	3	23	7.07	6.0	48	3.52	17.3	7.54	Mod		
Swamp River	SWAR11	Sandy Kick	1	5	7.76	0	11	1.67	5	2.11	Severe		
Brady Brook	BGBR01	Kick	1	20	5.10	4	39	3.20	12	4.95	Mod	5.50	7.29
Burton Brook	BUBK05	Kick	1	14	7.21	2	21	2.55	11	2.75	Mod	7.21	9.15
Burton Brook	BUBK06	Kick	1	39	5.69	6	51	4.76	21	6.70	Slight	7.07	6.83
Hiller Brook	HIL01	Kick	1	22	2.40	11	46	3.48	18	7.05	Slight	5.03	5.48
Lost Lake Brook	LOLA01	Kick	1	12	5.94	2	16	3.45	6	2.96	Mod	7.44	7.89
Stevens Brook	STEV01	Kick	1	26	6.03	8	79	3.53	22	7.06	Slight	6.69	7.41
W Mountain Brk	WMBK01	Kick	1	13	4.88	5	46	3.02	12	4.89	Mod	6.80	7.52

Table 3. Benthic macroinvertebrate impact source determination percentages from 7 Great Swamp biological assessment stations sampled in 2012. Bold numbers indicate the most likely source of impact to the stream community. Impact source classes are as follows: NAT=natural; NPN = non-point nutrient; ORG = organic inputs; COMPLEX= municipal/industrial; SILT = siltation; IMP= impoundment.

				Impact Source Determination						
Stream Name	**Station ID**	**Sample Type**	**Reps**	**NAT**	**NPN**	**ORG**	**COMPLEX**	**TOXIC**	**SILT**	**IMP**
Brady Brook	BGBR01	Kick	1	17	16	11	10	10	12	11
Burton Brook	BUBK05	Kick	1	2	7	30	18	20	7	12
Burton Brook	BUBK06	Kick	1	29	22	28	29	27	28	30
Hiller Brook	HIL01	Kick	1	48	**53**	16	42	29	19	44
Lost Lake Brook	LOLA01	Kick	1	7	10	13	10	12	12	12
Stevens Brook	STEV01	Kick	1	**57**	42	22	32	41	28	35
W Mountain Brook	WMBK01	Kick	1	37	**64**	59	60	45	39	62

Table 4. Summary of physical habitat and in-field benthic community composition at 7 Great Swamp tributary stations sampled in 2012. NR = data not reported; ERR = outlier data omitted from summary and analyses.

Waterbody	Brady Brook	Burton Brook	Burton Brook	Hiller Brook	Lost Lake Brook	Stevens Brook	W Mtn Brk
Station	BGBR01	BUBK06	BUBK05	HILL01	LOLA01	STEV01	WMBK01
Station Physical Attributes							
Depth (meters)	0.06	NR	0.2	0.25	0.28	0.08	NR
Width (meters)	3.5	4	1.6	2.25	4.11	3.05	2
Current (cm/sec)	25	30.8	28.6	NR	NR	NR	45
Canopy (%)	25	25	25	90	30	50	85
Rock (%)	0	25	5	10	0	20	5
Rubble (%)	0	20	2	50	0	40	30
Gravel (%)	40	20	2	30	0	10	30
Sand (%)	50	30	20	10	80	30	20
Silt (%)	10	5	20	0	20	0	15
Embeddedness (%)	**NR**	5	5	50	20	12	25
Water Quality Parameters							
DO (mg/L)	10.17	0.74	0.48	10.12	NS	NS	9.77
DO sat. (%)	108.6	8.1	5.5	107.8	NS	NS	104.8
Temperature (C)	18.5	20.6	21.7	18.41	23.46	18.87	18.7
Spec. Conduct. (µS/cm)	300	583.5	492.8	268	273	290	339
pH	7.46	6.6	7.38	8.42	ERR	7.2	7.7
In-field biological community observations (presence/absence)							
Algae suspended					Y		
Algae filamentous	Y	Y		Y			
Diatoms		Y	Y	Y		Y	Y
Macrophytes					Y		
Ephemeroptera				Y			Y
Plecoptera				Y			
Trichoptera				Y			Y
Coleoptera	Y						
Megaloptera							
Odonata	Y						Y
Chironomidae				Y			
Simuliidae							
Decapoda							
Gammaridae							
Mollusca							
Oligochaeta							
Other macros							Diptera
In-field faunal condition							
Faunal Condition	Very poor	Very poor	Very poor	Very good	N/A	N/A	Good

Table 5. Summary of physical habitat and in-field benthic community composition at 4 Swamp River mainstem stations sampled in 2012. NR = data not reported.

Waterbody	Swamp River	Swamp River	Swamp River	Swamp River
Station	SWAR11	SWAR02	SWAR03	SWAR04
Station Physical Attributes				
Depth (meters)	NR	NR	NR	1
Width (meters)	8	20	6	12
Current (cm/sec)	10	10	50	10
Canopy (%)	25	10	20	20
Rock (%)	0	0	0	0
Rubble (%)	0	0	10	0
Gravel (%)	20	25	32	30
Sand (%)	50	45	30	35
Silt (%)	30	30	30	35
Embeddedness (%)	75	75	75	75
Water Quality Parameters				
DO (mg/L)	4.35	2.05	4.7	6.04
DO sat. (%)	47.4	22	54.3	72.2
Temperature (C)	19.65	21.08	22.43	22.58
Spec. Conduct. (µS/cm)	654	409	444	416
pH	7.31	6.83	7.32	7.53
In-field biological community observations (presence/absence)				
Algae suspended				
Algae filamentous		Y	Y	
Diatoms	Y	Y	Y	Y
Macrophytes	Y	Y	Y	Y
Ephemeroptera	Y			Y
Plecoptera				
Trichoptera				Y
Coleoptera				
Megaloptera				
Odonata		Y		
Chironomidae			Y	
Simuliidae				
Decapoda			Y	
Gammaridae				
Mollusca	Y		Y	
Oligochaeta	Y			
Other macros				
In-field faunal condition				
Faunal Condition	Good	Poor	Very poor	Good

Appendix I: Field Datasheets & Taxa Lists

Table 6. Descriptions of the common NYS metrics calculated (adapted from Smith et al. 2009).

Metric	**Description**	**Sample Type**	**Predicted response to impact**
Species Richness (SR)	Species richness is the total number of unique species or taxa found in the subsample. Higher species richness indicates higher water quality.	Kick/Sandy	Decrease
Ephemeroptera-Trichoptera-Plecoptera (EPT) Richness	EPT Richness is the total number of taxa of mayflies (Ephemeroptera), stoneflies (Plecoptera), and caddisflies (Trichoptera) found in a subsample. These are considered to be mostly clean-water organisms, and their presence may indicate good water quality.	Kick/Sandy	Decrease
Hilsenhoff's Biotic Index (BI)	Biotic index is calculated by multiplying the number of individuals of each species or taxa by its assigned tolerance value, summing these products, and dividing by the total number of individuals. Tolerance values range from intolerant (0) to tolerant (10). High biotic index values are suggestive of organically enriched condition, while low values indicate naturally occurring, ambient communities.	Kick/Sandy	Increase
Percent Model Affinity (PMA)	This is a measure of similarity to a model non-impacted community based on percent abundance in 7 major groups to measure similarity to a kick sample community of 40% Ephemeroptera, 5% Plecoptera, 10% Trichoptera, 10% Coleoptera, 20% Chironomidae, 5% Oligochaeta, and 10% Other. The lower the similarity value the greater the impact.	Kick	Decrease
Non-Chironomidae and Oligochaeta (NCO) Richness	NCO Richness is the total number of taxa excluding the groups Chironomidae and Oligochaeta. Generally, in impacted communities, Chironomidae and Oligochaeta are the most abundant groups. NCO taxa are considered to be less pollution tolerant, and their presence may indicate good water quality. This measure is the Sandy Stream counterpart of EPT richness (Smith et al. 2009).	Sandy	Decrease
Standard NYS Biological Assessment Profile (BAP)	BAP is the assessed impact for each station. The BAP score is the mean value of the above metrics after converting each metric score to a common scale of 0-10. The higher the BAP score, the better the assessed impact category. There are four impact categories in NYS: non-, slight, moderate, or severe impact.	Kick/Sandy	Decrease

Table 7. Abridged NYS DEC Water Quality Category Definitions

Abridged NYS DEC Water Quality Category Definitions	
Non-impacted	Indices reflect very good water quality. The macroinvertebrate community is diverse. Water quality should not be limiting to fish survival or propagation. This level of water quality includes both pristine habitats and those receiving discharges which minimally alter the biota.
Slightly impacted	Indices reflect good water quality. The macroinvertebrate community is slightly but significantly altered from the pristine state. Water quality is usually not limiting to fish survival, but may be limiting to fish propagation, especially sensitive coldwater fish taxa.
Moderately impacted	Indices reflect poor water quality. The macroinvertebrate community is altered to a large degree from the pristine state. Water quality often is limiting to fish propagation, but usually not to fish survival.
Severely impacted	Indices reflect very poor water quality. The macroinvertebrate community is limited to a few tolerant species. The dominant species are almost all tolerant, and are usually midges and worms. Often 1-2 species are very abundant. Water quality is often limiting to both fish propagation and fish survival.

Table 8. Nutrient Biotic Index (NBI) Ranges

Trophic state for NBI	NBI
Eutrophic	6-10
Mesotrophic	5-6
Oligotrophic	0-5

Stream Field Data Summary

Watershed Assessment Associates
Environmental Services / Biomonitoring / Invertebrate Taxonomy / Professional Training

Waterbody: **West Mountain Brook**		Latitude: **41.5852**
River Basin: **Swamp River**	Station: **WMBK 01**	Longitude: **-73.599**
County: **Dutchess**	Coll Date: **7/21/2012**	Field Crew: **jkn, cmf**
State: **NY**	Site description: **Just off River Road**	

Physical Characteristics

Depth (meters):	
Width (meters):	**2**
Current (cm/sec):	**45**
Canopy (%):	**85**
Substrate	
Rock (%):	**5**
Rubble (%):	**30**
Gravel (%):	**30**
Sand (%):	**20**
Silt (%):	**15**
Embeddedness (%):	**25**

Chemical Measurements

DO (mg/L):	**9.77**
DO sat. (%):	**104.8**
Temperature (C):	**18.7**
Spec. Conduct. (umhos):	**339**
Baro pressure:	**752**
pH:	**7.7**
Salinity (PSS):	**0.16**

Biological Attributes

Aquatic vegetation	
Macrophytes:	
Diatoms:	**Y**
Algae-suspended:	
Algae-filamentous:	
Occurance of macroinvertebrates	
Ephemeroptera:	**Y**
Plecoptera:	
Trichoptera:	**Y**
Coleoptera:	
Megaloptera:	
Odonata:	**Y**
Chironomidae:	
Simuliidae:	
Decapoda:	
Gammaridae:	
Mollusca:	
Oligochaeta:	
Other macro's:	**Diptera**
Field Faunal Condition:	**Good**

Flow

Flow

WAA Project: FROGS

Stream Field Data Summary

Watershed Assessment Associates
Environmental Services / Biomonitoring / Invertebrate Taxonomy / Professional Training

Waterbody: **Swamp Rver**
River Basin: **Swamp River**
County: **Dutchess**
State: **NY**

Station: **SWAR 02**
Coll Date: **7/21/2012**
Site description: **Just off Old Route 22**

Latitude: **41.6169**
Longitude: **-73.5774**
Field Crew: **jkn, cmf**

Physical Characteristics

Depth (meters):	
Width (meters):	**20**
Current (cm/sec):	**10**
Canopy (%):	**10**
Substrate	
Rock (%):	
Rubble (%):	
Gravel (%):	**25**
Sand (%):	**45**
Silt (%):	**30**
Embeddedness (%):	**75**

Chemical Measurements

DO (mg/L):	**2.05**
DO sat. (%):	**22**
Temperature (C):	**21.08**
Spec. Conduct. (umhos):	**409**
Baro pressure:	**753**
pH:	**6.83**
Salinity (PSS):	**0.20**

Biological Attributes

Aquatic vegetation	
Macrophytes:	**Y**
Diatoms:	**Y**
Algae-suspended:	
Algae-filamentous:	**Y**
Occurance of macroinvertebrates	
Ephemeroptera:	
Plecoptera:	
Trichoptera:	
Coleoptera:	
Megaloptera:	
Odonata:	**Y**
Chironomidae:	
Simuliidae:	
Decapoda:	
Gammaridae:	
Mollusca:	
Oligochaeta:	
Other macro's:	
Field Faunal Condition:	**Poor**

Flow

Flow

WAA Project: FROGS

Stream Field Data Summary

Watershed Assessment Associates
Environmental Services / Biomonitoring / Invertebrate Taxonomy / Professional Training

Waterbody: **Swamp River**
River Basin: **Swamp River**
County: **Dutchess**
State: **NY**

Station: **SWAR 03**
Coll Date: **7/21/2012**
Site description: **Aprox. 125 meters below N. Chippawalla Rd. bridge**

Latitude: **41.6664**
Longitude: **-73.5794**
Field Crew: **jkn, cmf**

Physical Characteristics

Depth (meters):	
Width (meters):	**6**
Current (cm/sec):	**50**
Canopy (%):	**20**
Substrate	
Rock (%):	
Rubble (%):	**10**
Gravel (%):	**32**
Sand (%):	**30**
Silt (%):	**30**
Embeddedness (%):	**75**

Chemical Measurements

DO (mg/L):	**4.7**
DO sat. (%):	**54.3**
Temperature (C):	**22.43**
Spec. Conduct. (umhos):	**444**
Baro pressure:	**754**
pH:	**7.32**
Salinity (PSS):	**0.21**

Biological Attributes

Aquatic vegetation	
Macrophytes:	**Y**
Diatoms:	**Y**
Algae-suspended:	
Algae-filamentous:	**Y**
Occurance of macroinvertebrates	
Ephemeroptera:	
Plecoptera:	
Trichoptera:	
Coleoptera:	
Megaloptera:	
Odonata:	
Chironomidae:	**Y**
Simuliidae:	
Decapoda:	**Y**
Gammaridae:	
Mollusca:	**Y**
Oligochaeta:	
Other macro's:	
Field Faunal Condition:	**Very poor**

Flow

Flow

WAA Project: FROGS

Stream Field Data Summary

Watershed Assessment Associates
Environmental Services / Biomonitoring / Invertebrate Taxonomy / Professional Training

Waterbody: **Swamp River**
River Basin: **Swamp River**
County: **Dutchess**
State: **NY**

Station: **SWAR 04**
Coll Date: **7/21/2012**
Site description: **Just above RR bridge above Dover Furnace Rd.**

Latitude: **41.6824**
Longitude: **-73.5834**
Field Crew: **jkn, cmf**

Physical Characteristics

Depth (meters):	**1**
Width (meters):	**12**
Current (cm/sec):	**10**
Canopy (%):	**20**
Substrate	
Rock (%):	
Rubble (%):	
Gravel (%):	**30**
Sand (%):	**35**
Silt (%):	**35**
Embeddedness (%):	**75**

Chemical Measurements

DO (mg/L):	**6.04**
DO sat. (%):	**72.2**
Temperature (C):	**22.58**
Spec. Conduct. (umhos):	**416**
Baro pressure:	**755.3**
pH:	**7.53**
Salinity (PSS):	**0.20**

Biological Attributes

Aquatic vegetation	
Macrophytes:	**Y**
Diatoms:	**Y**
Algae-suspended:	
Algae-filamentous:	
Occurance of macroinvertebrates	
Ephemeroptera:	**Y**
Plecoptera:	
Trichoptera:	**Y**
Coleoptera:	
Megaloptera:	
Odonata:	
Chironomidae:	
Simuliidae:	
Decapoda:	
Gammaridae:	
Mollusca:	
Oligochaeta:	
Other macro's:	
Field Faunal Condition:	**Good**

Flow

Flow

WAA Project: FROGS

Stream Field Data Summary

Watershed Assessment Associates
Environmental Services / Biomonitoring / Invertebrate Taxonomy / Professional Training

Waterbody: **Swamp River**		Latitude: **41.5840**
River Basin: **Swamp River**	Station: **SWAR 11**	Longitude: **-73.5979**
County: **Dutchess**	Coll Date: **7/21/2012**	Field Crew: **jkn, cmf**
State: **NY**	Site description: **Just above River Road bridge**	

Physical Characteristics

Depth (meters):	
Width (meters):	**8**
Current (cm/sec):	**10**
Canopy (%):	**25**
Substrate	
Rock (%):	
Rubble (%):	
Gravel (%):	**20**
Sand (%):	**50**
Silt (%):	**30**
Embeddedness (%):	**75**

Chemical Measurements

DO (mg/L):	**4.35**
DO sat. (%):	**47.4**
Temperature (C):	**19.65**
Spec. Conduct. (umhos):	**654**
Baro pressure:	**753**
pH:	**7.31**
Salinity (PSS):	**0.32**

Biological Attributes

Aquatic vegetation	
Macrophytes:	**Y**
Diatoms:	**Y**
Algae-suspended:	
Algae-filamentous:	
Occurance of macroinvertebrates	
Ephemeroptera:	**Y**
Plecoptera:	
Trichoptera:	
Coleoptera:	
Megaloptera:	
Odonata:	
Chironomidae:	
Simuliidae:	
Decapoda:	
Gammaridae:	
Mollusca:	**Y**
Oligochaeta:	**Y**
Other macro's:	
Field Faunal Condition:	**Good**

Flow

Flow

Stream Field Data Summary

Watershed Assessment Associates
Environmental Services / Biomonitoring / Invertebrate Taxonomy / Professional Training

Waterbody: **Brady Brook**
River Basin: **Swamp River**
County: **Dutchess**
State: **NY**

Station: **BGBR 01**
Coll Date: **7/21/2012**
Site description: **RT 22**

Latitude: **41.53117**
Longitude: **-73.5906**
Field Crew: **J, W, M, K**

Physical Characteristics

Depth (meters):	**0.06**
Width (meters):	**3.5**
Current (cm/sec):	**25**
Canopy (%):	**25**
Substrate	
Rock (%):	
Rubble (%):	
Gravel (%):	**40**
Sand (%):	**50**
Silt (%):	**10**
Embeddedness (%):	

Chemical Measurements

DO (mg/L):	**10.17**
DO sat. (%):	**108.6**
Temperature (C):	**18.5**
Spec. Conduct. (umhos):	**300**
Baro pressure:	
pH:	**7.46**
Salinity (PSS):	

Biological Attributes

Aquatic vegetation	
Macrophytes:	
Diatoms:	
Algae-suspended:	
Algae-filamentous:	**Y**
Occurance of macroinvertebrates	
Ephemeroptera:	
Plecoptera:	
Trichoptera:	
Coleoptera:	**Y**
Megaloptera:	
Odonata:	**Y**
Chironomidae:	
Simuliidae:	
Decapoda:	
Gammaridae:	
Mollusca:	
Oligochaeta:	
Other macro's:	
Field Faunal Condition:	**Very poor**

Flow

Flow

Stream Field Data Summary

Watershed Assessment Associates
Environmental Services / Biomonitoring / Invertebrate Taxonomy / Professional Training

Waterbody: **Stevens Brook**
River Basin: **Swamp River**
County: **Dutchess**
State: **NY**

Station: **STEV 01**
Coll Date: **7/21/2012**
Site description: **Behind old Alpine resturant SR 22**

Latitude: **41.50806**
Longitude: **-73.5856**
Field Crew: **RT, BC, JE**

Physical Characteristics

Depth (meters):	**0.08**
Width (meters):	**3.05**
Current (cm/sec):	
Canopy (%):	**50**
Substrate	
Rock (%):	**20**
Rubble (%):	**40**
Gravel (%):	**10**
Sand (%):	**30**
Silt (%):	
Embeddedness (%):	**12**

Chemical Measurements

DO (mg/L):	
DO sat. (%):	
Temperature (C):	**18.87**
Spec. Conduct. (umhos):	**290**
Baro pressure:	
pH:	**7.2**
Salinity (PSS):	**0.14**

Biological Attributes

Aquatic vegetation	
Macrophytes:	
Diatoms:	**Y**
Algae-suspended:	
Algae-filamentous:	
Occurance of macroinvertebrates	
Ephemeroptera:	
Plecoptera:	
Trichoptera:	
Coleoptera:	
Megaloptera:	
Odonata:	
Chironomidae:	
Simuliidae:	
Decapoda:	
Gammaridae:	
Mollusca:	
Oligochaeta:	
Other macro's:	
Field Faunal Condition:	**N/A**

Stream Field Data Summary

Watershed Assessment Associates
Environmental Services / Biomonitoring / Invertebrate Taxonomy / Professional Training

Waterbody: **Lost Lake Brook**
River Basin: **Swamp River**
County: **Dutchess**
State: **NY**

Station: **LOLA 01**
Coll Date: **7/21/2012**
Site description: **Just above culvert, south of county maintenance - Doansburg rd**

Latitude: **41.44975**
Longitude: **-73.5542**
Field Crew: **T, C, E**

Physical Characteristics

Depth (meters):	**0.28**
Width (meters):	**4.11**
Current (cm/sec):	
Canopy (%):	**30**
Substrate	
Rock (%):	
Rubble (%):	
Gravel (%):	
Sand (%):	**80**
Silt (%):	**20**
Embeddedness (%):	**20**

Chemical Measurements

DO (mg/L):	
DO sat. (%):	
Temperature (C):	**23.46**
Spec. Conduct. (umhos):	**273**
Baro pressure:	
pH:	**10.5**
Salinity (PSS):	**0.13**

Biological Attributes

Aquatic vegetation	
Macrophytes:	**Y**
Diatoms:	
Algae-suspended:	**Y**
Algae-filamentous:	
Occurance of macroinvertebrates	
Ephemeroptera:	
Plecoptera:	
Trichoptera:	
Coleoptera:	
Megaloptera:	
Odonata:	
Chironomidae:	
Simuliidae:	
Decapoda:	
Gammaridae:	
Mollusca:	
Oligochaeta:	
Other macro's:	
Field Faunal Condition:	**N/A**

Stream Field Data Summary

Watershed Assessment Associates
Environmental Services / Biomonitoring / Invertebrate Taxonomy / Professional Training

Waterbody: **Hiller Brook**
River Basin: **Swamp River**
County: **Dutchess**
State: **NY**

Station: **HILL 01**
Coll Date: **7/21/2012**
Site description:

Latitude: **41.58927**
Longitude: **-73.5972**
Field Crew: **J, K, M, W**

Physical Characteristics	
Depth (meters):	**0.25**
Width (meters):	**2.25**
Current (cm/sec):	
Canopy (%):	**90**
Substrate	
Rock (%):	**10**
Rubble (%):	**50**
Gravel (%):	**30**
Sand (%):	**10**
Silt (%):	
Embeddedness (%):	**50**

Chemical Measurements	
DO (mg/L):	**10.12**
DO sat. (%):	**107.8**
Temperature (C):	**18.41**
Spec. Conduct. (umhos):	**268**
Baro pressure:	
pH:	**8.42**
Salinity (PSS):	

Biological Attributes	
Aquatic vegetation	
Macrophytes:	
Diatoms:	**Y**
Algae-suspended:	
Algae-filamentous:	**Y**
Occurance of macroinvertebrates	
Ephemeroptera:	**Y**
Plecoptera:	**Y**
Trichoptera:	**Y**
Coleoptera:	
Megaloptera:	
Odonata:	
Chironomidae:	**Y**
Simuliidae:	
Decapoda:	
Gammaridae:	
Mollusca:	
Oligochaeta:	
Other macro's:	
Field Faunal Condition:	**Very good**

Stream Field Data Summary

Watershed Assessment Associates
Environmental Services / Biomonitoring / Invertebrate Taxonomy / Professional Training

Waterbody: **Burton Brook**		Latitude: **41.64583**
River Basin: **Swamp River**	Station: **BUBK 06**	Longitude: **-73.5917**
County: **Dutchess**	Coll Date: **7/21/2012**	Field Crew: **MP, BO, TR**
State: **NY**	Site description: **No side of pleasant ridge rd [Ken Hoag]**	

Physical Characteristics

Depth (meters):	
Width (meters):	**4**
Current (cm/sec):	**30.8**
Canopy (%):	**25**
Substrate	
Rock (%):	**25**
Rubble (%):	**20**
Gravel (%):	**20**
Sand (%):	**30**
Silt (%):	**5**
Embeddedness (%):	**5**

Chemical Measurements

DO (mg/L):	**0.74**
DO sat. (%):	**8.1**
Temperature (C):	**20.6**
Spec. Conduct. (umhos):	**583.5**
Baro pressure:	
pH:	**6.6**
Salinity (PSS):	**285.10**

Biological Attributes

Aquatic vegetation	
Macrophytes:	
Diatoms:	**Y**
Algae-suspended:	
Algae-filamentous:	**Y**
Occurance of macroinvertebrates	
Ephemeroptera:	
Plecoptera:	
Trichoptera:	
Coleoptera:	
Megaloptera:	
Odonata:	
Chironomidae:	
Simuliidae:	
Decapoda:	
Gammaridae:	
Mollusca:	
Oligochaeta:	
Other macro's:	
Field Faunal Condition:	**Very poor**

Stream Field Data Summary

Watershed Assessment Associates WAA
Environmental Services / Biomonitoring / Invertebrate Taxonomy / Professional Training

Waterbody: **Burton Brook**		Latitude: **41.66512**
River Basin: **Swamp River**	Station: **BUBK 05**	Longitude: **-73.5875**
County: **Dutchess**	Coll Date: **7/21/2012**	Field Crew: **MP, BO, TR**
State: **NY**	Site description: **Shooting range, N. of Chippawalla Road**	

Physical Characteristics

Depth (meters):	**0.2**
Width (meters):	**1.6**
Current (cm/sec):	**28.6**
Canopy (%):	**25**
Substrate	
Rock (%):	**5**
Rubble (%):	**2**
Gravel (%):	**2**
Sand (%):	**20**
Silt (%):	**20**
Embeddedness (%):	**5**

Chemical Measurements

DO (mg/L):	**0.48**
DO sat. (%):	**5.5**
Temperature (C):	**21.7**
Spec. Conduct. (umhos):	**492.8**
Baro pressure:	
pH:	**7.38**
Salinity (PSS):	**240.00**

Biological Attributes

Aquatic vegetation	
Macrophytes:	
Diatoms:	**Y**
Algae-suspended:	
Algae-filamentous:	
Occurance of macroinvertebrates	
Ephemeroptera:	
Plecoptera:	
Trichoptera:	
Coleoptera:	
Megaloptera:	
Odonata:	
Chironomidae:	
Simuliidae:	
Decapoda:	
Gammaridae:	
Mollusca:	
Oligochaeta:	
Other macro's:	
Field Faunal Condition:	**Very poor**

Station	BGBR 01	BUBK 05	BUBK 06	HILL 01	LOLA 01	STEV 01	WMBK 01
Date	07-21-2012	07-21-2012	07-21-2012	07-21-2012	07-21-2012	07-21-2012	07-21-2012
Taxon/Replicate	A	A	A	A	A	A	A
Ablabesmyia mallochi	---	---	---	---	---	---	---
Ablabesmyia sp.	---	---	---	---	---	---	---
Acroneuria sp.	---	---	---	2	---	---	---
Agabus sp.	---	---	---	---	---	5	---
Ancyronyx variegatus	---	---	---	---	---	---	---
Anopheles sp.	---	---	---	---	---	---	---
Atrichopogon sp.	---	1	---	---	---	---	---
Baetis flavistriga	---	---	2	---	---	---	---
Baetis sp.	1	---	---	---	---	---	---
Baetis tricaudatus	---	---	---	3	---	3	---
Bezzia/Palpomyia sp.	1	---	---	---	---	---	---
Boyeria vinosa	---	---	2	1	---	1	1
Caecidotea sp.	1	28	2	---	1	---	6
Caenis sp.	---	---	---	---	---	---	---
Callibaetis sp.	---	---	---	---	---	40	---
Calopteryx sp.	---	---	5	---	---	---	---
Campeloma decisum	---	---	---	---	1	---	---
Centroptilum sp.	---	---	1	---	---	---	---
Ceraclea sp.	---	---	---	---	---	---	---
Chaetocladius sp.	---	---	1	---	---	---	---
Cheumatopsyche sp.	2	---	7	3	2	1	33
Chimarra aterrima?	---	---	---	---	---	---	3
Chironomus sp.	---	---	2	---	---	---	---
Cladotanytarsus sp.	---	---	1	---	---	---	---
Clinotanypus sp.	---	---	---	---	---	---	---
Cordulegaster maculata	---	---	---	---	---	1	---
Crangonyx sp.	---	---	1	---	---	---	---
Cricotopus bicinctus	---	---	---	---	---	---	---
Cricotopus/Orthocladius Complex	2	---	---	---	---	---	---
Cryptochironomus sp.	3	2	6	---	---	---	---
Diamesa sp.	---	---	---	---	---	---	2
Dicranota sp.	24	---	---	1	---	---	---
Dicrotendipes sp.	---	---	1	---	---	---	---
Diplectrona sp.	---	---	---	3	---	---	---
Dolophilodes sp.	---	---	---	23	---	3	---
Dubiraphia sp.	---	4	---	---	---	---	---
Enallagma sp.	---	---	---	---	---	---	---
Ferrissia sp.	---	---	---	---	---	---	---
Glossosoma sp.	---	---	---	2	---	---	---
Gyraulus sp.	---	---	---	---	---	---	---
Haliplus sp.	---	---	---	---	---	---	---
Helichus sp.	---	---	---	1	---	---	---
Helobdella stagnalis	---	---	---	---	---	---	---
Hemerodromia sp.	33	---	2	---	---	---	---
Hexatoma sp.	---	---	---	---	---	1	---
Hyalella sp.	---	37	4	---	---	---	---
Hydropsyche betteni	---	---	---	4	---	12	20
Hydropsyche bronta	4	---	---	---	---	---	---
Hydropsyche slossonae	---	---	---	2	---	---	---
Hydropsyche sparna	---	---	---	4	---	6	---

Watershed Assessment Associates
Environmental Services / Biomonitoring / Invertebrate Taxonomy / Professional Training

Station	BGBR 01	BUBK 05	BUBK 06	HILL 01	LOLA 01	STEV 01	WMBK 01
Date	07-21-2012	07-21-2012	07-21-2012	07-21-2012	07-21-2012	07-21-2012	07-21-2012
Taxon/Replicate	A	A	A	A	A	A	A
Hydroptila sp.	---	---	---	---	---	---	---
Ischnura sp.	---	---	---	---	---	---	---
Isonychia sp.	---	---	---	---	---	---	9
Lanthus sp.	---	---	---	---	---	1	---
Larsia sp.	---	---	---	---	---	---	---
Lestes sp.	---	---	---	---	---	---	---
Leuctra sp.	1	---	1	20	---	---	---
Limonia sp.	---	---	---	---	---	---	---
Lype diversa	---	---	1	---	---	---	---
Macronychus glabratus	---	---	---	---	---	---	---
Microcylloepus pusillus	---	---	2	---	---	---	---
Micropsectra/Tanytarsus Complex	2	---	---	1	---	1	---
Microtendipes pedellus gr.	3	---	4	---	---	---	---
Musculium sp.	---	---	---	---	---	---	---
Natarsia sp.	---	---	---	---	1	---	---
Neoplasta sp.	3	---	1	---	---	---	---
Neoplea sp.	---	---	---	---	---	---	---
Nigronia serricornis	---	---	2	---	---	---	---
Oecetis sp.	---	---	---	---	1	---	---
Optioservus ovalis	3	---	---	---	---	---	---
Optioservus sp.	---	---	---	---	---	2	6
Orconectes sp.	---	---	1	---	---	---	---
Oulimnius latiusculus	3	---	---	2	---	---	1
Parametriocnemus sp.	---	---	---	3	---	---	---
Paraphaenocladius sp.	---	---	---	1	---	---	---
Paratanytarsus sp.	---	---	4	---	1	1	---
Paratendipes sp.	---	---	---	---	---	---	---
Pelocoris sp.	---	---	---	---	---	---	---
Pentaneura sp.	---	---	---	---	---	---	---
Perlesta sp.	---	---	---	---	---	2	---
Phaenopsectra punctipes gr.	---	1	1	---	---	---	---
Phylocentropus sp.	---	---	---	---	---	---	---
Physa sp.	---	1	---	---	---	2	---
Pisidium sp.	---	4	---	---	3	---	---
Polypedilum aviceps	---	---	---	19	---	---	---
Polypedilum fallax gr.	---	1	---	---	---	---	---
Polypedilum flavum	---	1	1	---	1	---	---
Polypedilum scalaenum gr.	1	---	---	---	1	---	---
Polypedilum tritum	---	---	---	---	---	---	---
Probezzia sp.	---	---	---	---	---	---	---
Procladius sp.	---	---	---	---	---	---	---
Procloeon sp.	---	---	---	---	---	2	---
Promenetus exacuous	---	---	---	---	---	---	---
Psectrocladius sp.	---	---	---	---	---	---	---
Psephenus herricki	---	---	---	1	---	2	4
Pseudochironomus sp.	---	---	---	---	---	---	---
Pseudosuccinea columella	---	---	---	---	---	---	---
Rheotanytarsus sp.	1	---	5	---	---	1	---
Saetheria tylus	2	---	---	---	---	---	---
Sialis sp.	---	---	---	---	---	1	---

Watershed Assessment Associates
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Station	BGBR 01	BUBK 05	BUBK 06	HILL 01	LOLA 01	STEV 01	WMBK 01
Date	07-21-2012	07-21-2012	07-21-2012	07-21-2012	07-21-2012	07-21-2012	07-21-2012
Taxon/Replicate	A	A	A	A	A	A	A
Simulium sp.	---	---	1	1	---	4	---
Sphaerium rhomboideum	---	---	---	---	---	---	---
Sphaerium simile	---	---	17	---	---	---	---
Sphaerium sp.	---	---	---	---	---	---	---
Stagnicola sp.	---	---	---	---	---	1	---
Stempellinella sp.	---	---	---	---	---	---	---
Stenacron interpunctatum	---	---	---	---	---	---	---
Stenacron sp.	---	---	---	---	---	---	---
Stenelmis sp.	---	---	2	---	2	---	4
Stenonema femoratum	---	---	---	---	---	---	---
Stenonema modestum	---	---	2	---	---	---	5
Stictochironomus sp.	---	---	1	---	---	1	---
Stylogomphus albystilus	---	---	2	---	---	1	---
Sublettea sp.	1	---	---	---	---	---	---
Tabanus sp.	---	---	1	---	---	---	---
Tallaperla sp.	---	---	---	2	---	---	---
Tanypus sp.	---	---	---	---	---	---	---
Tanytarsus sp.	---	---	2	---	1	---	---
Thienemanniella sp.	---	---	---	---	---	---	---
Thienemannimyia gr. spp.	---	---	4	---	---	4	---
Tipula sp.	---	1	---	---	---	---	---
Triaenodes sp.	---	1	---	---	---	---	---
Tribelos sp.	---	---	3	---	---	---	---
Tribelos/Phaenopsectra Co	---	---	---	---	---	---	---
Undetermined Baetidae	---	1	---	---	---	---	---
Undetermined Chironominae	---	---	---	---	---	---	---
Undetermined Coenagrionidae	---	---	---	---	---	---	---
Undetermined Corixidae	---	---	---	---	---	---	---
Undetermined Empididae	9	---	---	---	---	---	---
Undetermined Glossiphoniidae	---	---	---	---	---	---	---
Undetermined Gomphidae	---	---	---	1	---	---	6
Undetermined Hydrobiidae	---	---	---	---	---	---	---
Undetermined Lepidoptera	---	17	---	---	---	---	---
Undetermined Libellulidae	---	---	---	---	---	---	---
Undetermined Limnephilidae	---	---	---	---	---	---	---
Undetermined Lumbricina	---	---	2	---	1	---	---
Undetermined Lumbriculidae	---	---	1	---	---	---	---
Undetermined Notonectidae	---	---	---	---	---	---	---
Undetermined Scirtidae	---	---	---	---	---	---	---
Undetermined Tabanidae	---	---	---	---	---	1	---
Undetermined Tanypodinae	---	---	---	---	---	---	---
Xenochironomus sp.	---	---	1	---	---	---	---
Xylotopus par	---	---	1	---	---	---	---

Station	SWAR 11	SWAR 02	SWAR 02	SWAR 02	SWAR 03	SWAR 03	SWAR 03
Date	07-21-2012	07-21-2012	07-21-2012	07-21-2012	07-21-2012	07-21-2012	07-21-2012
Taxon/Replicate	A	A	B	C	A	B	C
Ablabesmyia mallochi	---	---	---	---	---	---	2
Ablabesmyia sp.	---	---	2	---	---	1	---
Acroneuria sp.	---	---	---	---	---	---	---
Agabus sp.	---	---	---	---	---	---	---
Ancyronyx variegatus	---	---	---	---	---	---	---
Anopheles sp.	---	---	---	---	---	---	---
Atrichopogon sp.	---	---	---	---	---	---	---
Baetis flavistriga	---	---	---	---	---	---	---
Baetis sp.	---	---	---	---	---	---	---
Baetis tricaudatus	---	---	---	---	---	---	---
Bezzia/Palpomyia sp.	---	---	1	---	---	---	---
Boyeria vinosa	---	---	---	---	1	---	---
Caecidotea sp.	10	6	17	14	1	---	1
Caenis sp.	---	---	---	---	4	2	6
Callibaetis sp.	---	1	---	1	---	---	---
Calopteryx sp.	---	---	---	---	---	1	---
Campeloma decisum	---	---	---	---	---	---	---
Centroptilum sp.	---	---	---	---	---	---	1
Ceraclea sp.	---	---	---	---	---	---	---
Chaetocladius sp.	---	---	---	---	---	---	---
Cheumatopsyche sp.	---	---	---	---	---	14	---
Chimarra aterrima?	---	---	---	---	---	---	---
Chironomus sp.	---	---	1	---	3	---	16
Cladotanytarsus sp.	---	---	---	---	6	---	1
Clinotanypus sp.	---	1	---	---	---	---	5
Cordulegaster maculata	---	---	---	---	---	---	---
Crangonyx sp.	---	---	---	---	2	---	---
Cricotopus bicinctus	---	---	---	---	---	4	---
Cricotopus/Orthocladius Complex	---	---	---	---	1	---	---
Cryptochironomus sp.	---	---	---	---	3	2	2
Diamesa sp.	---	---	---	---	---	---	---
Dicranota sp.	---	---	---	---	---	---	---
Dicrotendipes sp.	---	---	---	---	3	---	6
Diplectrona sp.	---	---	---	---	---	---	---
Dolophilodes sp.	---	---	---	---	---	---	---
Dubiraphia sp.	---	---	---	---	1	---	---
Enallagma sp.	---	---	---	---	---	---	---
Ferrissia sp.	---	---	---	---	---	---	---
Glossosoma sp.	---	---	---	---	---	---	---
Gyraulus sp.	---	---	3	---	---	---	---
Haliplus sp.	---	---	2	2	---	---	---
Helichus sp.	---	---	---	---	---	---	---
Helobdella stagnalis	---	8	5	6	---	---	---
Hemerodromia sp.	---	---	---	---	---	---	---
Hexatoma sp.	---	---	---	---	---	---	---
Hyalella sp.	8	40	19	20	40	40	39
Hydropsyche betteni	---	---	---	---	---	---	---
Hydropsyche bronta	---	---	---	---	---	---	---
Hydropsyche slossonae	---	---	---	---	---	---	---
Hydropsyche sparna	---	---	---	---	---	---	---

Station	SWAR 11	SWAR 02	SWAR 02	SWAR 02	SWAR 03	SWAR 03	SWAR 03
Date	07-21-2012	07-21-2012	07-21-2012	07-21-2012	07-21-2012	07-21-2012	07-21-2012
Taxon/Replicate	A	A	B	C	A	B	C
Hydroptila sp.	---	---	---	---	---	3	---
Ischnura sp.	---	---	4	1	---	---	---
Isonychia sp.	---	---	---	---	---	---	---
Lanthus sp.	---	---	---	---	---	---	---
Larsia sp.	---	9	3	---	---	---	---
Lestes sp.	---	---	---	---	---	---	---
Leuctra sp.	---	---	---	---	---	---	---
Limonia sp.	---	---	---	---	---	---	---
Lype diversa	---	---	---	---	---	---	---
Macronychus glabratus	1	---	---	---	---	---	---
Microcylloepus pusillus	---	---	---	---	---	---	---
Micropsectra/Tanytarsus Complex	---	---	---	---	---	2	---
Microtendipes pedellus gr.	---	---	---	---	---	---	---
Musculium sp.	---	---	1	---	---	---	---
Natarsia sp.	---	---	---	---	---	---	---
Neoplasta sp.	---	---	---	---	---	---	---
Neoplea sp.	---	---	---	1	---	---	---
Nigronia serricornis	---	---	---	---	---	---	---
Oecetis sp.	---	---	---	---	---	---	---
Optioservus ovalis	---	---	---	---	---	---	---
Optioservus sp.	---	---	---	---	---	---	---
Orconectes sp.	---	---	---	---	3	---	---
Oulimnius latiusculus	---	---	---	---	---	---	---
Parametriocnemus sp.	---	---	---	---	---	---	---
Paraphaenocladius sp.	---	---	---	---	---	---	---
Paratanytarsus sp.	---	---	---	---	1	---	1
Paratendipes sp.	---	---	---	---	2	---	---
Pelocoris sp.	---	---	3	12	---	---	---
Pentaneura sp.	---	---	---	---	---	1	---
Perlesta sp.	---	---	---	---	---	---	---
Phaenopsectra punctipes gr.	---	---	---	---	---	---	---
Phylocentropus sp.	---	---	---	---	---	---	---
Physa sp.	4	15	8	11	---	---	---
Pisidium sp.	1	7	---	---	---	---	1
Polypedilum aviceps	---	---	---	---	---	1	---
Polypedilum fallax gr.	---	---	---	---	---	---	---
Polypedilum flavum	---	---	---	---	---	1	---
Polypedilum scalaenum gr.	---	---	---	---	5	2	1
Polypedilum tritum	---	---	---	---	---	1	---
Probezzia sp.	---	1	---	1	---	---	---
Procladius sp.	---	---	---	---	---	---	2
Procloeon sp.	---	---	---	---	---	---	---
Promenetus exacuous	---	5	2	5	---	---	---
Psectrocladius sp.	---	---	---	---	---	---	---
Psephenus herricki	---	---	---	---	---	---	---
Pseudochironomus sp.	---	---	---	---	---	---	---
Pseudosuccinea columella	---	---	---	---	---	---	---
Rheotanytarsus sp.	---	---	---	---	1	18	1
Saetheria tylus	---	---	---	---	---	---	---
Sialis sp.	---	---	---	---	---	---	---

Watershed Assessment Associates
Environmental Services / Biomonitoring / Invertebrate Taxonomy / Professional Training

Station	SWAR 11	SWAR 02	SWAR 02	SWAR 02	SWAR 03	SWAR 03	SWAR 03
Date	07-21-2012	07-21-2012	07-21-2012	07-21-2012	07-21-2012	07-21-2012	07-21-2012
Taxon/Replicate	A	A	B	C	A	B	C
Simulium sp.	---	---	---	---	---	---	---
Sphaerium rhomboideum	---	---	5	---	---	---	---
Sphaerium simile	---	---	---	---	---	---	1
Sphaerium sp.	---	---	---	1	1	---	---
Stagnicola sp.	---	---	---	---	---	---	---
Stempellinella sp.	---	---	---	---	1	---	---
Stenacron interpunctatum	---	---	---	---	5	---	---
Stenacron sp.	---	---	---	---	---	---	4
Stenelmis sp.	---	---	---	---	5	1	1
Stenonema femoratum	---	---	---	---	---	---	---
Stenonema modestum	---	---	---	---	---	---	---
Stictochironomus sp.	---	---	---	---	---	---	---
Stylogomphus albystilus	---	---	---	---	---	---	---
Sublettea sp.	---	---	---	---	---	---	---
Tabanus sp.	---	---	---	---	---	---	---
Tallaperla sp.	---	---	---	---	---	---	---
Tanypus sp.	---	---	---	---	---	---	2
Tanytarsus sp.	---	1	---	---	7	---	3
Thienemanniella sp.	---	---	---	---	---	1	---
Thienemannimyia gr. spp.	---	---	---	---	4	2	---
Tipula sp.	---	---	---	---	---	---	---
Triaenodes sp.	---	---	---	---	---	---	---
Tribelos sp.	---	---	---	---	---	---	---
Tribelos/Phaenopsectra Co	---	---	---	---	---	---	2
Undetermined Baetidae	---	---	---	---	---	---	---
Undetermined Chironominae	---	---	---	---	---	---	---
Undetermined Coenagrionidae	1	---	---	6	---	3	2
Undetermined Corixidae	---	---	---	---	---	---	---
Undetermined Empididae	---	---	---	---	---	---	---
Undetermined Glossiphoniidae	---	4	---	2	---	---	---
Undetermined Gomphidae	---	---	---	---	---	---	---
Undetermined Hydrobiidae	---	2	23	16	---	---	---
Undetermined Lepidoptera	---	---	---	---	---	---	---
Undetermined Libellulidae	---	---	---	---	---	---	---
Undetermined Limnephilidae	---	---	1	---	---	---	---
Undetermined Lumbricina	---	---	---	---	---	---	---
Undetermined Lumbriculidae	---	---	---	---	---	---	---
Undetermined Notonectidae	---	---	---	---	---	---	---
Undetermined Scirtidae	---	---	---	---	---	---	---
Undetermined Tabanidae	---	---	---	---	---	---	---
Undetermined Tanypodinae	---	---	---	1	---	---	---
Xenochironomus sp.	---	---	---	---	---	---	---
Xylotopus par	---	---	---	---	---	---	---

Watershed Assessment Associates
Environmental Services / Biomonitoring / Invertebrate Taxonomy / Professional Training

Station	SWAR 04	SWAR 04	SWAR 04
Date	07-21-2012	07-21-2012	07-21-2012
Taxon/Replicate	A	B	C
Ablabesmyia mallochi	---	1	---
Ablabesmyia sp.	---	---	---
Acroneuria sp.	---	---	---
Agabus sp.	---	---	---
Ancyronyx variegatus	1	---	---
Anopheles sp.	---	4	1
Atrichopogon sp.	---	---	---
Baetis flavistriga	---	---	---
Baetis sp.	---	---	---
Baetis tricaudatus	---	---	---
Bezzia/Palpomyia sp.	1	---	---
Boyeria vinosa	---	---	---
Caecidotea sp.	---	---	---
Caenis sp.	5	3	12
Callibaetis sp.	5	5	1
Calopteryx sp.	---	---	---
Campeloma decisum	---	---	---
Centroptilum sp.	---	---	2
Ceraclea sp.	1	---	---
Chaetocladius sp.	---	---	---
Cheumatopsyche sp.	---	---	---
Chimarra aterrima?	---	---	---
Chironomus sp.	---	---	---
Cladotanytarsus sp.	---	---	---
Clinotanypus sp.	---	---	5
Cordulegaster maculata	---	---	---
Crangonyx sp.	---	---	---
Cricotopus bicinctus	---	---	---
Cricotopus/Orthocladius Complex	---	---	---
Cryptochironomus sp.	---	---	---
Diamesa sp.	---	---	---
Dicranota sp.	---	---	---
Dicrotendipes sp.	1	---	2
Diplectrona sp.	---	---	---
Dolophilodes sp.	---	---	---
Dubiraphia sp.	8	1	10
Enallagma sp.	---	---	1
Ferrissia sp.	---	1	1
Glossosoma sp.	---	---	---
Gyraulus sp.	---	---	---
Haliplus sp.	---	---	---
Helichus sp.	---	---	---
Helobdella stagnalis	---	---	---
Hemerodromia sp.	---	---	---
Hexatoma sp.	---	---	---
Hyalella sp.	34	40	14
Hydropsyche betteni	---	---	---
Hydropsyche bronta	---	---	---
Hydropsyche slossonae	---	---	---
Hydropsyche sparna	---	---	---

Station	SWAR 04	SWAR 04	SWAR 04
Date	07-21-2012	07-21-2012	07-21-2012
Taxon/Replicate	A	B	C
Hydroptila sp.	2	4	---
Ischnura sp.	4	7	3
Isonychia sp.	---	---	---
Lanthus sp.	---	---	---
Larsia sp.	---	1	---
Lestes sp.	---	---	2
Leuctra sp.	---	---	---
Limonia sp.	---	---	1
Lype diversa	1	---	---
Macronychus glabratus	---	---	1
Microcylloepus pusillus	---	---	---
Micropsectra/Tanytarsus Complex	---	---	1
Microtendipes pedellus gr.	---	---	1
Musculium sp.	---	---	---
Natarsia sp.	---	---	---
Neoplasta sp.	---	---	---
Neoplea sp.	5	2	---
Nigronia serricornis	---	---	---
Oecetis sp.	---	---	---
Optioservus ovalis	---	---	---
Optioservus sp.	---	---	---
Orconectes sp.	---	---	---
Oulimnius latiusculus	---	---	---
Parametriocnemus sp.	---	---	---
Paraphaenocladius sp.	---	---	---
Paratanytarsus sp.	6	13	---
Paratendipes sp.	---	---	---
Pelocoris sp.	---	2	---
Pentaneura sp.	---	---	---
Perlesta sp.	---	---	---
Phaenopsectra punctipes gr.	---	1	1
Phylocentropus sp.	---	---	1
Physa sp.	---	---	1
Pisidium sp.	---	---	---
Polypedilum aviceps	---	---	---
Polypedilum fallax gr.	---	---	---
Polypedilum flavum	---	---	1
Polypedilum scalaenum gr.	---	---	---
Polypedilum tritum	---	---	---
Probezzia sp.	---	---	---
Procladius sp.	---	---	---
Procloeon sp.	---	---	---
Promenetus exacuous	---	---	---
Psectrocladius sp.	---	1	---
Psephenus herricki	---	---	---
Pseudochironomus sp.	---	1	---
Pseudosuccinea columella	1	---	---
Rheotanytarsus sp.	---	1	---
Saetheria tylus	---	---	---
Sialis sp.	1	---	3

Station	SWAR 04	SWAR 04	SWAR 04
Date	07-21-2012	07-21-2012	07-21-2012
Taxon/Replicate	A	B	C
Simulium sp.	---	---	---
Sphaerium rhomboideum	---	---	---
Sphaerium simile	---	---	---
Sphaerium sp.	---	---	---
Stagnicola sp.	---	---	---
Stempellinella sp.	---	---	---
Stenacron interpunctatum	3	1	3
Stenacron sp.	---	---	---
Stenelmis sp.	---	---	---
Stenonema femoratum	---	---	3
Stenonema modestum	---	---	---
Stictochironomus sp.	---	---	---
Stylogomphus albystilus	---	---	---
Sublettea sp.	---	---	---
Tabanus sp.	---	---	---
Tallaperla sp.	---	---	---
Tanypus sp.	1	---	---
Tanytarsus sp.	---	2	---
Thienemanniella sp.	---	---	---
Thienemannimyia gr. spp.	---	---	---
Tipula sp.	---	---	---
Triaenodes sp.	1	---	1
Tribelos sp.	---	---	---
Tribelos/Phaenopsectra Co	---	---	---
Undetermined Baetidae	---	---	---
Undetermined Chironominae	---	---	1
Undetermined Coenagrionidae	15	9	21
Undetermined Corixidae	1	---	3
Undetermined Empididae	---	---	---
Undetermined Glossiphoniidae	---	---	---
Undetermined Gomphidae	---	---	---
Undetermined Hydrobiidae	---	---	---
Undetermined Lepidoptera	---	---	---
Undetermined Libellulidae	1	---	2
Undetermined Limnephilidae	---	---	---
Undetermined Lumbricina	---	---	---
Undetermined Lumbriculidae	---	---	---
Undetermined Notonectidae	1	---	---
Undetermined Scirtidae	---	---	1
Undetermined Tabanidae	---	---	---
Undetermined Tanypodinae	1	---	---
Xenochironomus sp.	---	---	---
Xylotopus par	---	---	---

Appendix II: Rationale

Physical

The physical survey is essential to a stream study because aquatic fauna often have specific habitat requirements independent of water composition, and alterations in these conditions affect the overall quality of a water body (Giller and Malmqvist, 1998). Additionally, the physical characteristics of a stream affect stream flow, volume of water within the channel, water temperature, and absorbed radiant energy from the sun.

Low gradient sites are evaluated for: epifaunal substrate/available cover, pool substrate characterization, pool variability sediment deposition, channel flow status, channel alteration, frequency of riffles, bank stability, vegetative protection, and riparian vegetative zone width.

High gradient sites are evaluated for: epifaunal substrate/available cover, embeddedness, velocity/depth regime, sediment deposition, channel flow status, channel alteration, channel sinuosity, bank stability, vegetative protection, and riparian vegetative one width.

Site photos were taken of the upstream and downstream area and are included with the physical and chemical data.

Water temperature directly affects both the nature of aquatic fauna and species diversity; temperature tolerance is organism specific, and the reproductive cycle (including timing of insect emergence and annual productivity) will vary within different temperature ranges. Temperature can also affect organisms indirectly as a consequence of oxygen saturation levels. As water temperature rises, the metabolism of aquatic organisms' increases with an attendant increases in their oxygen requirements. At higher water temperatures, however, the oxygen carrying capacity of water decreases because of a diminished affinity of the water for oxygen.

Optimal water temperature ranges and lethal limits of water temperature vary among different organisms. The ratio of Plecoptera to Ephemeroptera (individuals and numbers of species) has been found to drop as the annual range of temperature increases (Hynes, 1970). The optimal temperature range for Brook trout is 11-16 0 Celsius with an upper lethal limit of 240 Celsius (Hynes, 1970). The NYS Department of Environmental Conservation (NYS DEC) does not have a water quality standard for water temperature. Temperature is recorded using an YSI 556TM probe.

Velocity is calculated at the time of macroinvertebrate collection because an optimal macroinvertebrate collection site has a velocity between 0.45 and 0.75 meter/second. Velocity is determined by timing a floating object a given distance or using a Global Water® Flow Probe.

Chemical

Dissolved Oxygen (DO) level is a function of water turbulence, diffusion, and plant respiration. The EPA recommends that dissolved oxygen levels remain above 11 mg/l during embryonic and larval stages of salmonid production and above 8 mg/l during other life stages (EPA, 1987). The NYS DEC standard for dissolved oxygen for class C(T) and C(TS) stream is 6 mg/L and 7 mg/L respectively. A significant drop in DO concentration can occur over a 24-hour period, particularly if a waterbody contains a large amount of plant growth. Oxygen is released into the water as a result of plant photosynthesis during daylight; dense plant growth within a stream can therefore elevate the DO level significantly. At night photosynthesis ceases and DO may drop to levels maintained by diffusion and turbulence. A pre-dawn DO level will, in this case, reflect the lowest DO concentration in a 24 hour period and thus provide important data on the overall health of the system. DO is measured using an YSI 556™ probe.

Percent oxygen saturation is reported since dissolved oxygen levels vary inversely with water temperature. Percent saturation is the maximum level of dissolved oxygen that would be present in the water at a specific temperature in the absence of other influences, and is determined by calculating the ratio of measured dissolved oxygen to maximum dissolved oxygen for a given temperature. (The calculation is also standardized to altitude or barometric pressure.) Percent oxygen saturation falls when something other than temperature, such as dissolved solids or bacterial decomposition, affects oxygen levels. A healthy stream contains near 100 percent oxygen saturation at any given temperature (Hynes, 1970). Trout are particularly sensitive to even a slight drop in oxygen saturation and will migrate away from streams when oxygen saturation falls. Similarly, certain macroinvertebrates are sensitive to varying oxygen saturation levels and because the ability of these organisms to migrate away from changing conditions is limited, a drop in saturation can be lethal. NYS DEC has not adopted percent oxygen saturation as a water quality standard.

Specific Conductance or Conductivity is a measure of the ability of an electrical current to pass through a stream; it is dependent on both the concentration of dissolved electrolytes within the water and water temperature. Conductivity increases when inorganic ions are dissolved in water. Organic ions, such as phenols, oil, alcohol and sugar, can decrease conductivity (EPA, 1997). Warmer water is also more conductive and, therefore conductivity is reported for a standardized water temperature of 25 degrees Celsius. Measurements are reported in microsiemens per centimeter (µS/cm). In the United States, freshwater stream conductivity readings vary greatly from 50-1,500µS/cm. The conductivity of most streams remains relatively constant, however, unless an extraneous source of contamination is present. A failing septic system would raise conductivity because of its chloride, phosphate, and nitrate content, while an oil spill would lower conductivity. A YSI 556TM probe was used to measure conductivity.

The pH is a measure of a stream's acidity. A desirable pH for salmonid is 6.5-8.5. A YSI 556TM probe used to obtain pH. The NYS DEC standard for pH is 6.5-8.5.

Biological

Macroinvertebrates are collected by kick net and the specimens are preserved. Pollution-sensitive macroinvertebrates, a food source for trout, require similar chemical parameters as trout. The relative numbers of different macroinvertebrate groups indicate the overall health of an ecosystem. Perhaps more importantly, macroinvertebrate data demonstrate the effects of problems that may not be detected by chemical testing. The NYS DEC Stream Biomonitoring Unit has utilized stream biological monitoring for water quality analysis since 1972 but the biological profiles and water quality assessments are not a part of New York State's standards. They serve as a "decision threshold" to determine the need for further studies. The Environmental Protection Agency recommends that states and tribes with biomonitoring experience adopt biological criteria into water quality standards to provide a quantitative assessment of a waterway's designated and supportive use. Currently only several states have done so; NY is not one of these states.

Glossary

Assessment: a diagnosis or evaluation of water quality
Benthic: located on the bottom of a body of water or in the bottom sediments or pertaining to bottom-dwelling organisms
Benthos: organisms occurring on or in the bottom substrate of a waterbody
Biomonitoring: the use of biological indicators to measure water quality
Community: a group of populations of organisms interacting in a habitat
Eutrophic: very enriched with dissolved nutrients, resulting in increased growth of algae and other microscopic plants.
Fauna: the animal life of a particular habitat
Habitat: the type of environment in which an organism or group normally lives or occurs
Impact: a change in the physical, chemical, or biological condition of a waterbody
Impairment: a detrimental effect caused by an impact
Impoundment: a body of water formed by constructing a dam or embankment, or by excavating a pit or dugout
Index: a number, metric, or parameter derived from sample data used as a measure of water quality
Intolerant: unable to survive poor water quality
Macroinvertebrate: a larger-than-microscopic invertebrate animal that lives at least part of its life in aquatic habitats
Mesotrophic: moderately enriched with dissolved nutrients, resulting in increased growth of algae and other microscopic plants.
Non point source: diffuse pollution sources (i.e., without a single point of origin or not introduced into a receiving stream from a specific outlet)
Oligotrophic: few nutrients and relatively few plants and algae.
Point source: a stationary location or fixed facility from which pollutants are discharged or emitted. Also, any single identifiable source of pollution, e.g., a pipe, ditch, ship, ore pit, factory smokestack
Riffle: wadeable stretch of stream usually with a rubble bottom and sufficient current to have the water surface broken by the flow; rapids
Slack water: a stretch of water without current or movement
Station: a sampling site on a waterbody
Survey: a set of sampling conducted in succession along a stretch of stream
Tolerant: able to survive poor water quality

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