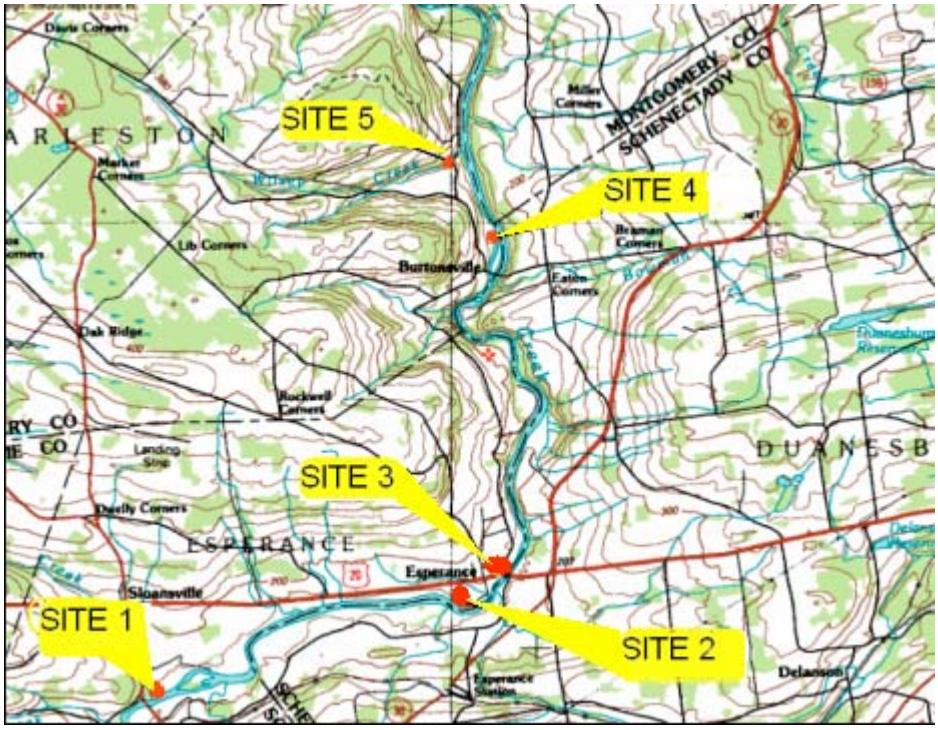
A RAPID BIO-REASSESSMENT OF THE SCHOHARIE CREEK BETWEEN SLOANSVILLE AND BURTONSVILLE, SCHOHARIE, SCHENECTADY, AND MONTGOMERY COUNTY, NY

Conducted: October 10 – November 24, 2006
By
The Schoharie River Center, Environmental Study Team

Report date: November 27, 2006



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Summary

A rapid bio-reassessment of the Schoharie Creek from Sloansville to just below Burtonsville indicates that there has been a change in water quality at every site since 2003. An increase in water quality is seen at every site except for Sloansville. The water quality ranges from almost moderately impacted to non-impacted.

Background

The Schoharie River Center's Environmental Study Team performed a rapid bioassessment of the Schoharie Creek at five different sites. The tests were performed at (1) Sloansville, (2) the sewage pipe of the Creek Side trailer park outside of Esperance, (3) the Esperance Bridge, (4) Burtonsville, and (5) Wilsey Creek (a tributary of the Schoharie) between October 10 and November 24, 2006. For each site, physical, chemical, biological, and bacteriological parameters were assessed. Since 2002, we have conducted rapid bioassessments on the Schoharie at four of these sites. Our four years of study at these sites has allowed us to document changes in water quality that have occurred over time. In 2002, site 3, the Esperance Bridge, was tested and was found to have the lowest water quality measured at "slightly impacted". In 2003 and 2004, two new sites were assessed; Sloansville, and the end of the sewage pipe at the Creek Side trailer park. When tested, the Sloansville site was found to have much better water quality then the site at the Esperance Bridge farther downstream. A point source was identified in 2003 at the trailer park outside of Esperance. This point was the sewage discharge pipe that ran from the trailer park into the creek. This year (2006), rapid bioassessments were conducted at these three sites to reassess the water quality. Throughout the past four years, the Environmental Study Team at the Schoharie River Center has been monitoring the Schoharie Creek at Burtonsville.

This year, a rapid bioassessment was also performed on the Wilsey Creek, a small tributary of the Schoharie Creek. This was an important task because the Wilsey Creek is located away from human impacts and has a habitat similar to that of the Schoharie, providing a model for what the Schoharie Creek could be like without the impact of humans. Together these five sites provide an overall idea of the changing health of the Schoharie Creek.

The Schoharie Creek is the major tributary of the Mohawk River. Its headwaters begin at the base of Indian Head Mountain, located in the Catskills in Greene County, NY. The Schoharie Creek flows north through Delaware, Schoharie, Schenectady, and Montgomery counties and enters the Mohawk River at Fort Hunter. Land use, draining more than 2,300 square kilometers, is approximately 20 percent agricultural, 77 percent forested, 2 percent urban, and 1 percent other use.

The NYS DEC stream classification of the testing sites is class C waters, designating that the water is suitable for both fish propagation and survival, and for primary and secondary contact recreation.

The Schoharie River was dammed in 1927 at Gilboa, NY, to create the Schoharie Reservoir, providing drinking water for New York City. The impoundment essentially severed the creek in half and changed its flow pattern and habitat. From below the dam to the confluence with the Mohawk River, the main stem of the creek was altered from a cold-water fishery (trout) to a warm water fishery (small mouth bass). No regular release of water occurs from the Schoharie Reservoir, and during summer months the creek bed from the reservoir dam is essentially dry to Middleburg, where minor tributaries begin to add enough water to recreate the creek.

At the study reaches, the Schoharie Creek is used heavily for recreation, primarily swimming and warm water sport fishing. There are no municipal sewage treatment plants along the study section, although at least one private sewage treatment facility has been identified through previous study, and residents rely on wells for drinking water. Septic systems, road runoff, and agricultural practices comprise potential pollutants and health hazards within the area.

Results

Physical site assessment, chemical analysis, and collection of macroinvertebrates were performed once at all four sites. Bacteriological analysis was performed four times over the testing period at all four test sites.

Site 1

N 42º 48.363’
W 074º 19.875’
Date October 22nd, 2006

Location: New York State public access site to the Schoharie Creek on NY Route 30A at Sloansville, NY, about 40 km from the confluence of the Schoharie and Mohawk River.

The creek at the site measures about 105ft wide with full velocity measured at 36m/min. and depths ranging from 0-4ft deep. Riparian vegetation was good on both banks of the creek, with the exception of a large cornfield adjacent to the creek on the east shore. The cornfield had several large piles of topsoil lining the edge of the field adjacent to and up hill from the shoreline. The Percent Cobble Embeddedness at the site was evaluated to be at 50%-75% embedded. On the opposite shoreline (west) a medium sized tributary enters the Schoharie with a large amount of gravel, sand, and silt forming an extended area of outwash into the Schoharie just down stream from the confluence. The Cobleskill Creek, a larger tributary enters the Schoharie on the western bank less than a ½ kilometer upstream from the test site. By comparing photographs of the test site taken in 2003 and in 2006 it appears that the natural riparian vegetation on the east shore has been reduced and the height and steepness of the bank has lowered significantly since 2003. (See appendix for comparison of site photos from 2003 and 2006.)

The pH measured within NY DEC standards of (6.5-8.5) at 7.1 compared to 2003, which had a pH of 8. Turbidity was 10 FAU compared to 2003 which had a turbidity of 8 FAU.

Conductivity was 173 us/cm, which is a little higher then the 2003 data, which had a Conductivity of 160 mg/L. Nitrate Nitrogen was detected at 0.4 mg/L which was lower then the 2003 tests which had a Nitrate Nitrogen level of 0.7. Phosphorous measured at 0.02 mg/L compared to the 2003 tests, which were 0.19 mg/L. Water temperature, was 12 º Celsius. Dissolved Oxygen was not collected this year but it was measured at 6.3 mg/L in 2003.

Bacteriological data collected on September 10th, October 10th and 22nd, and November 10th, and 24th. Included total Coliforms of > 3260 colonies/100 ml, 1820 colonies/100ml, 60 colonies/100ml, and 90 colonies/100 ml. The E-coli count was 1260 colonies/100 ml on September 10th, 1820 colonies/100ml on October 10th, 50 colonies/100ml on October 22nd, 60 colonies/100ml on November 10th, and 10 colonies/100ml on November 24th.

Bacteriological testing was completed on November 11th to confirm our lower results from sites 1 and 2. We measured total Coliforms to be 160 colonies/100ml and e-coli was measured at 160 colonies/100ml.

The Biological Assessment Profile (BAP) indices for site 1 indicated that water quality is “slightly – moderately impacted”. On measures of family Richness (8) “moderate” and EPT richness (7) “slightly –non impacted”. “Non-impacted” by the (1.26) family biotic index (severely impacted) by the Percent model Affinity (11%). Overall the mean water quality at site 1 was “Slight to moderately impacted,” suggesting that water quality is not limiting to fish survival but may affect fish propagation.

Site 1

N42°, 48.363’
W74°, 19.875’

North

South

East

West

Site 2

Location: Creekside Trailer Park near Esperance, NY, about 31 kilometers from the confluence of the Schoharie and Mohawk River. Water samples were taken at the end of the discharge pipe located about 25 feet from the water's edge on a steep bank. Stone riprap is installed under the area where the pipe discharges to the edge of the creek.

PH measured at 8.3 in 2006, above the NYS DEC standards for normal range (6.5 – 8.5). Turbidity measured 6 FAU in 2006 and 47 in 2003. Conductivity was measured at 1263 μS/cm in 2006 and in 2003 it was 1277 S/cm. Nitrate was measured at 20.1 mg/L in2006 and1.0 mg/L in 2003. Phosphorous was recorded at 3.9 mg/L. In 2006 and in 2003 it was 1.48mg/L. Water temperature was 12 C in 2006 and 25 C in 2003. Dissolved oxygen was not measured.

Bacteriological data was collected on September 10th, October 10th and 22nd, and November 10th and 24th. It included a total Coliform of >10,000 colonies/100 ml, >17,980 colonies/100ml, >10,000 colonies/100ml, 3080 colonies/100 ml, and 0 colonies/100 ml. The E-coli count was >10,000 colonies/100 ml on September 10th, >17,980 colonies/100ml on October 10th, >10,000 colonies/100ml on October 22nd, 80 colonies/100ml on November 10th, and 0 colonies/100ml on November 24th.

Bacteriological testing was completed on November 11th to confirm our lower results from sites 1 and 2. At Site 2 we measured a total Coliforms sample of 60 colonies/100ml and E-coli measured 0 colonies/100ml.

Bacterial data collected at the site in August 2003, indicated extremely high e-coli counts in excess of 10,000 colonies per 100ml. In our follow up assessment in 2006, a big change was seen in the number of e-coli and coliform colonies. On October 10th, 2006 there were 17,980 colonies of e-coli and 17,980 total colonies of coliform. On October 22nd, 2006 there were 10,000 e-coli colonies and 10,000 Coliforms colonies. Then on November 10th, 2006 there was an extreme decrease in the e-coli and coliform counts. There were only 80 e-coli colonies and 3080 Coliforms colonies. The numbers continued to drop. There were zero (0) e-coli colonies and 60 Coliforms colonies on November 11th, 2006. On November 24th, 2006 there were zero (0) e-coli and zero (0) Coliforms colonies.

Site #2
Creekside Trailer Park Sewage Treatment / Discharge

Discharge Pipe – West bank

Sand Tanks

West Bank

East Bank

Site 3 Location: N42° 45.670'
W70° 15.291'

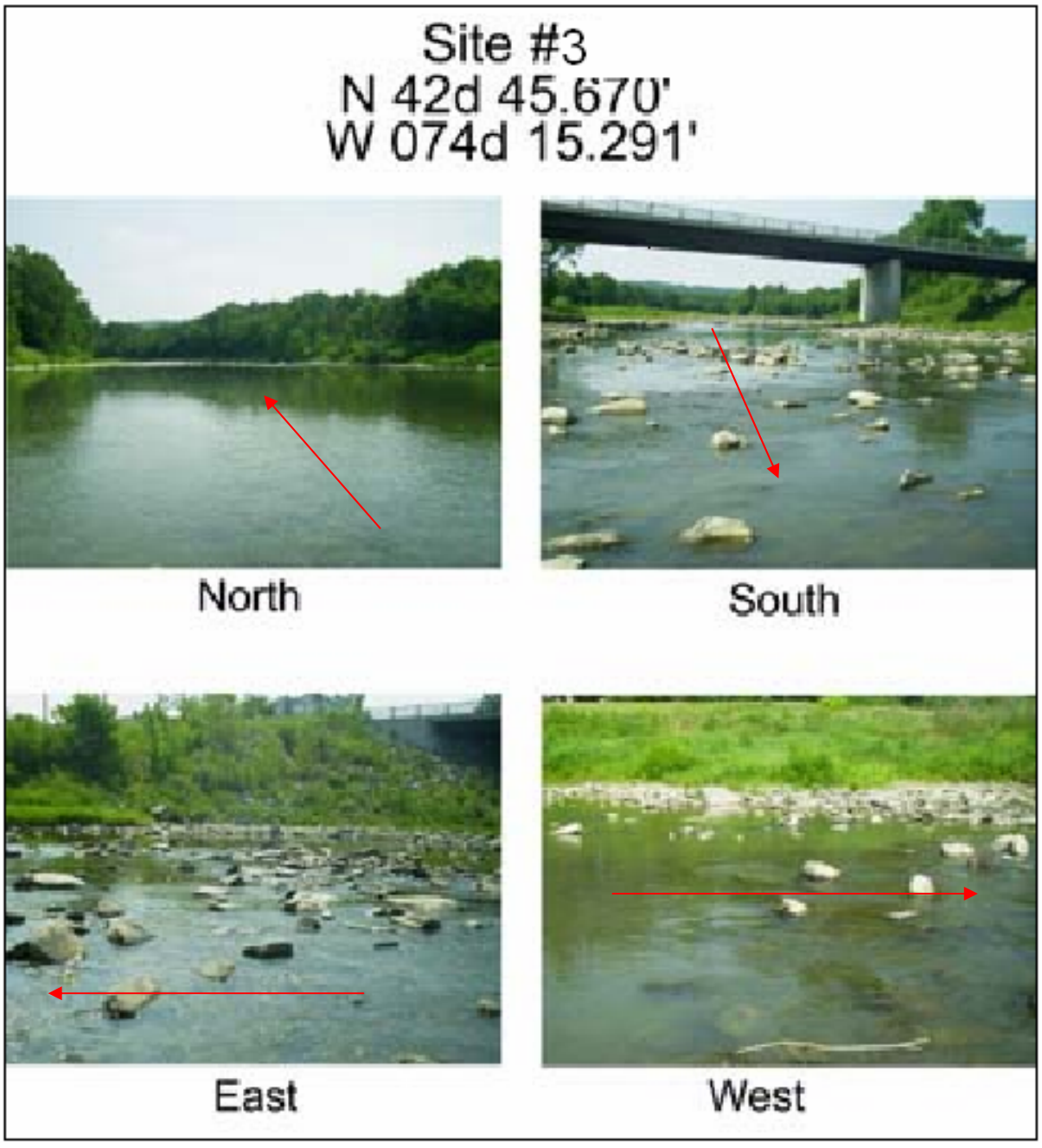
Location: 30 river kilometers from the confluence of the Mohawk River, just downstream from the bridge on Route 20 at Esperance.

Habitat assessment rating was good. Algae covered approximately 75% of the substrate, less than 10% of the area provided shelter for fish, and the width of the riparian vegetation zone was less than 6 yards. Percent Cobble Embeddedness was measured at 25-50%. Weather for the previous 24 hours included heavy rain.

pH measured at 8.4 in 2006 and 8.6 in 2003, at the high range of the NYS DEC standards for normal range (6.5 – 8.5). Turbidity measured 6 FAU's in 2006 and 9 in 2003. Conductivity was measured at 248 μS/cm and in 2003 it was 950 μS/cm. Nitrate was higher, it measured at 1 mg/L in 2006 and in 2003 it measured at 0.9 mg/L. Phosphorous was also increased, recorded at 0.4 mg/L in 2006 and 0.01 mg/L in 2003. Dissolved oxygen was not measured in 2006 but in 2003 it was measured at 10 mg/ L. Percent oxygen saturation was 113.4 % in 2003.

Bacteriological data was collected on September 10th, October 10th and 22nd, and November 10th, and 24th. It included total Coliforms of 2080 colonies/100 ml, 2670 colonies/100ml, 9370 colonies/100ml, 5350 colonies/100 ml, and 410 colonies/100 ml. The E-coli count was 80 colonies/100 ml on September 10th, 70 colonies/100ml on October 10th, 370 colonies/100ml on October 22nd, 350 colonies/100ml on November 10th, not taken November 11th, and 410 colonies/100ml on November 24th.

Biological indices for site 3 indicated that water quality was "non-impacted". Family Richness measured non-impacted at greater than 8 (14) on the water quality scale. EPT richness (11) was non-impacted, Family Biotic index (2.39) measured as non-impacted, however, PMA (Percent Model Affinity) was (46%) found to be was moderately impacted. Overall the mean water quality BAP at site 1 was measured at 8 non-impacted, suggesting that water quality is not limiting to fish survival but may affect fish propagation.


Site #3
N 42d 45.670'
W 074d 15.291'
North
South
East
West

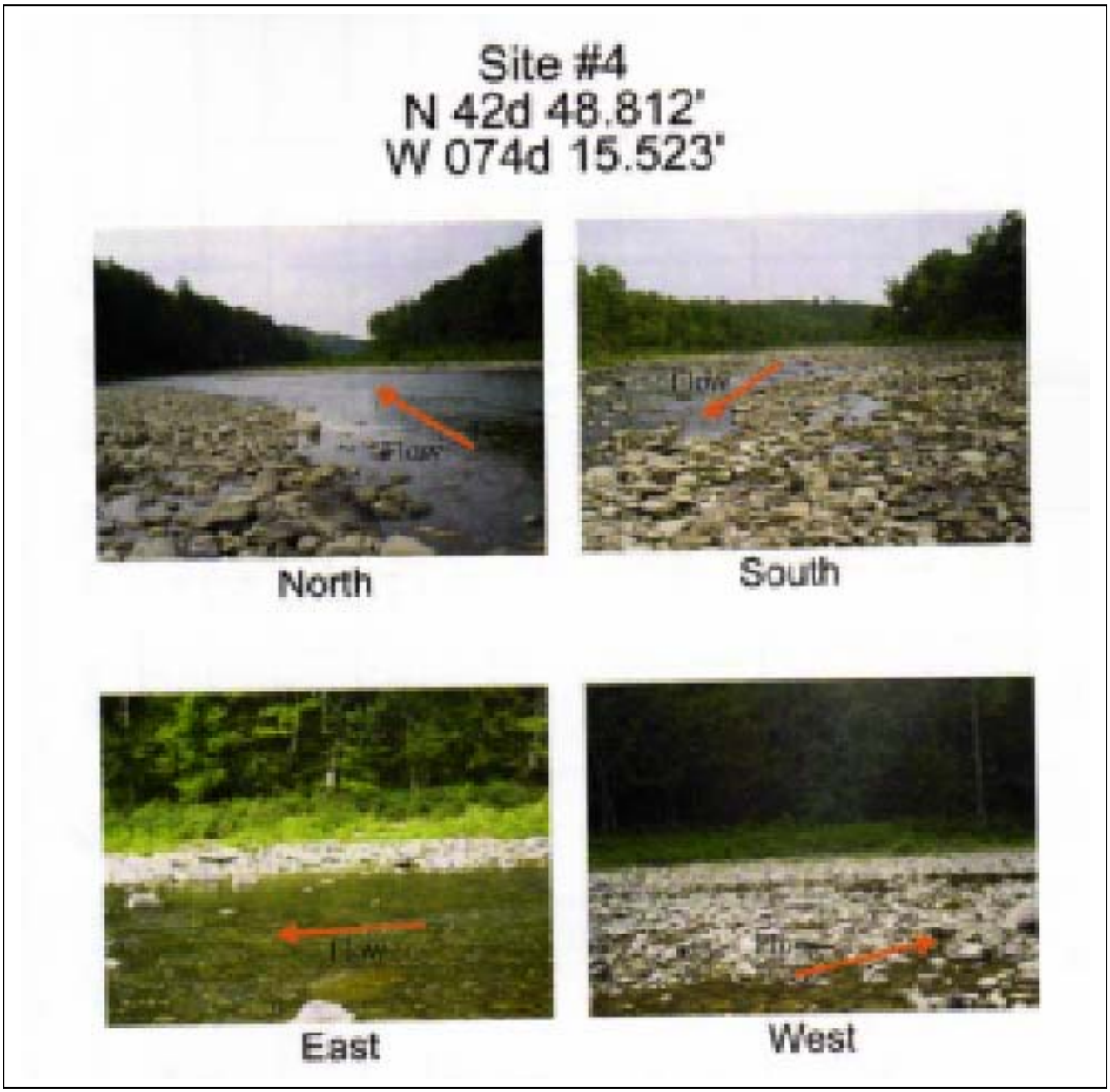
Site 4

N42° 48.812
W74° 15.523
Date: October 22 2006

Location: 24 River kilometers from the confluence of the Mohawk River, downstream from Burtonsville. Habitat assessment rating was excellent. Algae covered 75% of the substrate. The site has a large natural riparian zone with mature trees and vegetation growing down to the water's edge. The Percent Cobble Embeddedness was determined to be 25-50%.

The pH measured 8.4, within NYS DEC water standards. Turbidity was measured at 72 FAU, but we think there was a slight error in our testing. The conductivity measured at 273 µS. Nitrate measured 0.3mg/L and phosphorous was 0.09mg/L. The Water temperature was 9 degrees Celsius and the dissolved Oxygen was 8mg/L with a percent oxygen saturation of 68.45%.

Bacteriological data collected on September 10th, October 10th and 22nd, and November 10th, and 24th. Included total Coliforms of 1500 colonies/100 ml, 1480 colonies/100ml, 11,750 colonies/100ml, 4220 colonies/100 ml, and 0-colonies/100 ml. The E-coli count was 60 colonies/100 ml on September 10th, 80 colonies/100ml on October 10th, 750 colonies/100ml on October 22nd, 220 colonies/100ml on November 10th, and 10 colonies/100ml on November 24th.


Site #4
N 42d 48.812'
W 074d 15.523'
North
South
East
West

Site 5 N 42d 49.320
W 72d 15.905
Date: November 25, 2006

Location: approximately 23 ½ kilometers from the confluence of the Mohawk River, downstream from Burtonsville. The creek was about 20 feet wide at the test site, with water velocity at a moderate level. Riffle size was excellent and well developed. The riparian zone along the creek was excellent, with mature trees and natural vegetation growing down to the water's edge. The percent Cobble Embeddness was determined to be excellent, measuring at <25%.

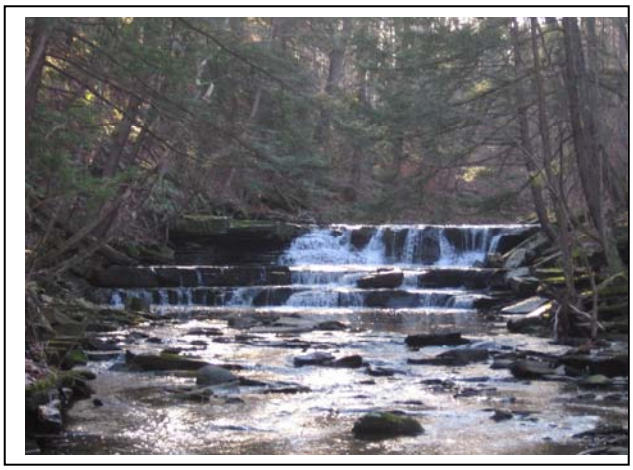
The temperature of Wilsey creek was 12°C. The pH was 10.7, which, according to the NYS DEC standards is very basic. The alkalinity was 36 mg/L, which is classified as Not Sensitive. The turbidity was 1 FAU and the conductivity was 83. The Nitrate nitrogen was 0.6 mg/L and the Ortho-Phosphate level was 0.04, so there is no likely impact. The Dissolved Oxygen level was11.4 mg/L.

Bacteriological data was collected on May 7, 2006. Our results showed that there were approximately 570 colonies of coliform per 100ml and about 235colonies of coliform per 100ml. There were only 10 colonies/100ml of E.Coli counted in both samples.

Biological indices for site five show the water quality was non-impacted for Family richness (17) and Family Biotic Index (9.1), EPT richness measured as non-impacted (15). Percent Model Affinity (PMA) was 60%, however our sample only contained 66 individual insects.

Site 5

N 42d 49.320
W 72d 15.905
Date: November 25, 2006



West

East

North

South

Discussion

Our assessment of the stream indicates that the water quality has changed over time at our test sites.

At Sloansville, (site 1-S in 2003 and site 1 in 2006), in 2003, based on the Macro-invertebrate Biological Assessment Profile (Figure 2) the site measured as only "slightly impacted". In 2006 our assessment indicated that the same site was on the borderline of being "moderately impacted"(Figure 1).

There are several possible factors that could be contributing to this decrease in water quality. Our physical assessment of the Sloansville site indicated that there were agricultural fields running down to the edge of the stream bank with evidence of run off and erosion. We saw that the stream bottom also had a great deal of loose soil, silt and sand. The percent of cobble embeddedness had increased to 50 – 75 %. Cobble embeddedness at this level is known to negatively impact macro-invertebrate habitat. This could affect the habitat and reduce the number and diversity of macros living at the site. A factor that could have a major effect on the amount of silt, sand, dirt, and other types of substrate entering the creek is water level and flooding. During 2006, rainfall and water flow in the Schoharie has been unusually high. In June and July the Mohawk River, the Schoharie and it tributaries experienced major flash floods due to unprecedented rain events. Flooding of communities and farmland along the creek continued off and on throughout September, October, and early November 2006.

Looking at the water chemistry data at the Sloansville site it is noted that both pH (from 8 to 7.1) and Alkalinity (104 to 88 mg/l) levels had decreased. Both nitrates and phosphates decreased as well. Turbidity however, had increased, another factor affected by increased sediment runoff.

At site 2 (the end of pipe) our results indicated a notable decrease in the amount of E. Coli bacteria that was discharging during our testing period. At the beginning of our evaluation on October 10th, total coliform counts were in the range of 1,700 per hundred mL. On October 22nd, total coliform counts were over 10,000 per hundred mL. On November 10th, total coliform counts decreased to 308. On November 11th, total coliform measured at 6. And on November 24th, total coliform measured 0.

Looking at the water chemistry levels found at site 2, there was a large increase of nitrate levels from 1 mg/L to 20.1 mg/L. Also, there was an increase of phosphate levels from 1.48 mg/L to 3.9 mg/L. Turbidity seemed to decrease at site 2 from 47 FAU to 6 FAU. A possible cause for these changes might be that the sewage treatment at the trailer park has been improved. A possible explanation for the rise of nitrates and phosphates would be an increase of the number of homes located on the sewage line, which increases the effluent discharge.

At site 3, we saw an overall increase in water quality when compared to our 2003 data. In 2003, the Esperance Bridge site was on the borderline of "moderately impacted" according to

the Biological Assessment Profile. Now in 2006 the Esperance bridge site has improved to a rating of "non-impacted" on the biological assessment profile. We feel that this increase in water quality could be due to several factors including the improved sewage treatment-taking place at the trailer park upstream from Esperance. Between Sloansville and Esperance, there are agricultural fields, which could be contributing to non-point source runoff.

At site 4, water quality improved, changing from boarder line "slightly impacted" in 2003 to "non-impacted" in 2006. Site 4's EPT richness and biotic index both increased substantially over the three-year period. This change in water quality could indicate that the Schoharie down stream from the sewage plant at site 2 continues to benefit from the improved "treated" effluent discharge.

At site 5, Wilsey Creek, assessment data indicates a stream that continues to be non-impacted" and in a pristine state. The assessment information provides a good baseline starting point from which to assess this stream in the future. The natural land areas along the Schoharie creek in Western Schenectady and Southern Montgomery County continues to under go increased residential development. Recently a large track of land (about 300 acres) bordering the Wilsey Creek was deeded to the Albany Land Conservancy, which has committed to allowing the area to remain wild.

Conclusions

1. From bacteriological tests, it appears that the Creekside Trailer park has started to treat the effluent discharge coming from their sewage system.
2. This treatment has lead to increased water quality at the other sites downstream, as indicated by test results from the Esperance and Burtonsville sites.
3. Overall water quality has increased in all sites except Sloansville.
4. One reason for elevated e-coli levels at Sloansville was non-point source runoff from adjacent agricultural fields.
5. Macroinvertebrate diversity has decreased at Sloansville due to increased sediment deposits from runoff and other small streams.
6. Further study should be done upstream from the Sloansville site to determine possible sources of sedimentary runoff and causes of the decrease in water quality at Site 1 (Sloansville).

RATIONALE OF DATA COLLECTED AND METHODS

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.

Testing sites are evaluated for: stream size and gradient; surrounding land use; presence/absence of upstream damns; algal or weed growth; presence/absence of oily film, grease globules, or unusual odor or color; riffle size; substrate size; presence/absence of shelter for fish; flow pattern; channel alteration; stream bank cover and stability; disruption of riparian bank cover; width of riparian vegetation zone; and the presence of litter. Habitat condition was scored as excellent, good, fair, or poor (see physical survey/habitat assessment data sheets for scoring parameters). Site photos were taken of the upstream area, downstream area, and banks of each testing site, and are included in the attached physical survey/habitat assessment sheets.

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 temperatures rise, the metabolism of aquatic organisms increases, with an attendant increase in their oxygen requirements. At higher water temperatures, however the oxygen carrying capacity of water decreases because of a diminished affinity of 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 increase (Hynes, 1970). The optimal temperature range for brook trout is 11-16º Celsius with an upper lethal limit of 24º Celsius (Hynes, 1970). NYS DEC does not have a water quality standard for water temperature.

Temperature was recorded by grab samples with a glass thermometer.

Turbidity, or the cloudiness of the water, is caused by multiple factors such as clay, silt, finely divided organic and inorganic matter, soluble colored organic compounds, plankton, and other microscopic organisms. Because of the ability of trout to sight feed is restricted at turbidity levels above 50 Nephelometric Turbidity Units (NTU), salmonid displacement will occur above this level. A turbidity of less than10 NTU is recommended for trout propagation (Watersheds, 1994).

The Hach DR 890 colorimeter was used in this study, which measures turbidity in Formazin Attenuation Units (FAU) (The equivalency ratio is 1FAU/1NTU).

NYS DEC does not have a numeric standard for turbidity.

Percent cobble embeddedness, is the degree to which gravel-sized and larger particles are surrounded by sand-sized and smaller particles, is an indicator of a stream's ability to support trout survival and propagation. If deposition of sediment occurs in a spawning area, it can be detrimental to trout reproduction. Trout eggs require a well-oxygenated environment; the eggs

are laid in permeable gravel beds with many open places to allow continuous bathing of the eggs with cool, oxygenated water. Sediment deposition destroys this environment by clogging these open spaces, leading to oxygen deprivation and buildup of metabolic waste. When cobble embeddedness reaches 50-60%, a stream loses its salmonid fry. Furthermore, although habitat quality is still considered fair for trout survival (though not propagation) at 50-75% embeddedness changes in the bethnic macroinvertebrate fauna population, on which trout feed, begin to occur (Harvey, 1989).

Velocity was calculated at the time of macroinvertebrate collection because an optimal macroinvertebrate collection site has a velocity between 0.l45 and 0.75 meter/second. Velocity was determined by averaging the time it takes a float to travel a marked distance midstream and near each bank, and dividing the distance of the course by the average time.

Chemical

Dissolved Oxygen (DO) level is a function of water turbulence, diffusion, and plant respiration. The NYS DEC standard for dissolved oxygen for this class C stream is 5 mg/L (see appendix V).

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 was measured using the modified Winkler titration with microburet method.

It is also important to consider *percent oxygen saturation*, 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. Trout are particularly sensitive to slight drops in oxygen saturation and will migrate away from streams when oxygen saturation falls. Similarly, certain macroinvertebrates are sensitive to varying saturation levels, and because the ability of these organisms to migrate away from the changing conditions is limited, a drop in saturation can be lethal. Saturation levels can significantly fluctuate during a 24-hour period depending on the amount of nutrients entering the water system, the densities of plankton, aquatic plants, and algae in the water, and the amount of light for photosynthesis.

During daylight, oxygen saturation levels can increase to supersaturation levels in streams with dense vegetation and high levels of photosynthesis. Supersaturation of water with oxygen produces the potential for gas bubble trauma (over-inflated swim bladder, exophthalmia, and bubbles in gill lamellae) in fish and other aquatic organisms. During the night, when

photosynthesis ceases and plants continue to utilize oxygen for respiration, dissolved oxygen concentration and saturation levels can drop critically low.

A healthy stream contains near 100 percent oxygen saturation at any given temperature (Hynes, 1970).

NYS DEC has not adopted percent oxygen saturation as a water quality standard. The US EPA recommends a maximum of 110% oxygen saturation for the protection of aquatic life. The assessment was included in this study because of our belief that it is vital to the complete evaluation of the health of a stream.

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. When inorganic ions are dissolved in water, conductivity increases. 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.

Conductivity between 150 and 500μS/cm is considered a good mixed-fisheries range (EPA, 1997). A Corning conductivity meter was used to measure conductivity. NYS DEC does not have a standard for conductivity.

The *pH* and *alkalinity* are measures of a stream's acidity and its buffering capacity, or ability to neutralize acidic influences and resist changes in pH. A desirable pH for salmonid is 6.5-8.5. An alkalinity of greater than 20 ppm helps to protect a stream from pH altering influences (such as acid rain). An Oakton pH tester meter and the LaMotte alkalinity test kit direct reading titrator method were used to obtain pH and alkalinity, respectively. The NYS DEC standard for pH is 6.5-8.5. No standard has been established for alkalinity.

In most fresh water streams, *nitrates* and *phosphates* are in short supply and are therefore the nutrients that limit plant growth. Because of this, even small excess amounts of these substances can significantly impact a stream. Typically, natural levels of nitrate nitrogen (NO_3-N) are <1.0 mg/l. Phosphorus (P) levels of >0.05 mg/l indicate that impact is likely; at levels >0.1 mg/l impact is certain. Increased levels of these nutrients often indicate that sewage, animal manure, fertilizer, and other types of contamination from commercials sites, residential homes, or farms are entering the system.

These nutrients affect aquatic organisms indirectly when elevated levels increase plant proliferation and, ultimately, decaying plant material in the stream. Bacteria that decompose this material require oxygen, depleting the dissolved oxygen. Excessive plant growth also physically changes the substrate on which macroinvertebrates live, altering the diversity of the macroinvertebrate community on which trout feed.

It has been documented that nitrate levels are highest just before dawn due to plant inactivity (Stevenson et al., 1996). Plant uptake of nitrates during daylight due to plant

metabolism can lower the levels in the water column; at night when plant activity ceases, nitrate levels increases. Pre-dawn nitrate levels will therefore indicate the maximum nitrates present in a 24-hour period.

Nitrates (NO_3-N) and Phosphates (P) were measured using the Hach DR 890 colorimeter by chromotropic acid method and ascorbic acid reduction method, respectively. NYS DEC does not have a numeric standard for nitrates or phosphates.

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 and water quality analysis since 1972 but the biological profiles and water quality assessments are not a part of the 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 five states have done so; NY is not one of these states. Biological assessment was included in this study because of our belief that it is vital to the complete evaluation of the health of a stream.

The four family indices, or metrics, that are recommended by the NYS DEC Biomonitoring Unit to provide a biological profile and overall stream water quality assessment are as follows:

1. Family richness: The total number of families found in the sample.
2. EPT richness: The number of families in the three most pollution sensitive orders – Ephemeroptera (mayflies), Plecoptera (stoneflies), Trichoptera (caddisflies) – that are present.
3. Biotic index: The product of the quantity of a particular macroinvertebrate found and its assigned biotic value (pollution tolerance value).
4. Percent model affinity (PMA): A comparison of the number of identified macroinvertebrates to a New York model "non-impacted" community, based on percent abundance in seven major groups.

A Biological Assessment Profile, as outlined by the DEC, is obtained from the four metrics by converting each metrics score to a 0-10 water quality scale and calculating their mean. The mean score identifies the water quality impact as: non-, slightly, moderately, or severely impacted. [For definitions of each category, see appendix VI]. The DEC surmises the ability of each of the above water qualities to support fish and their propagation, but a particular family or species of fish is not identified. This is significant because trout are sensitive to small amounts of pollutants and slight ecological changes, whereas bass or carp, having a higher tolerance to pollutants and ecological changes, are not.

It is prudent to remember that an index is a means to convey information about the status of a waterbody, but should not be used exclusive of its component metrics and data (EPA, 1999).

The HBRW Rapid Biological Assessment includes the above indices and:

1. Organism Density Per Sample: An estimate of the total number of individuals in the sample.
2. EPT/EPT + Chironomidae: A measure of the ratio of the intolerant EPT orders to the generally tolerant Diptera family Chironomidae.
3. Percent Contribution of Dominant Family: The percentage of the sample made up of the most abundant family.
4. Percent Composition of Major Groups: The percent of the sample comprised of selected major groups. [For complete definitions of indices see appendix VII]

Bacteriological

Coliforms are a group of bacteria that include fecal coliforms and other non-fecal bacteria that are widespread in the environment. They are found in the feces of both warm- and cold-blooded animals. They commonly live alongside numerous other pathogenic organisms present in fecal material, and serve as an indicator that these organisms might also be present in the water. Fecal material can pose a health risk, cause cloudy water with an unpleasant odor, and decrease dissolved oxygen as bacteria decompose the material.

Fecal coliforms are a subset of total coliforms; they are more specific to feces but not necessarily fecal in origin. They can originate from textile, pulp, and paper mill wastes (Behar, 1997). *E. Coli* is a fecal coliform specific to fecal material from humans and other warm-blooded animals. It is an indicator of health risk from water contact. (See appendix V for NYS DEC standards)

The Micro Laboratories Coliscan Membrane method was used to determine total coliforms and E. Coli.

Water Chemistry Values for sites 1 – 5 & Comparison of 2003 and 2006 Water Chemistry for Sites 1 – 3.

Indicator	Site 1 10/22/06	Site 2 10/22/06	Site 3 10/22/06	Site 4 10/22/06	Site 5 11/25/06	Site 1 6/8/03	Site 2 8/9/03	Site 3 8/9/03
Temperature (˚C)			12˚C	9˚C	12˚C	15˚C	25˚C	25˚C
PH	7.1	8.3	8.4	8.4	10.7	8.0		8.6
Alkalinity (mg/L CaCO3)	88 mg/L	256 mg/L	84 mg/L	100 mg/L	36 mg/L	104 mg/L		100 mg/L
Dissolved Oxygen (mg/L)				8 mg/L	11.4 mg/L	6.3 mg/L		10 mg/L
Nitrate (mg/L)	.4 mg/L	20.1 mg/L	1 mg/L	0.3 mg/L	0.6 mg/L	0.7 mg/L	1.0 mg/L	0.9 mg/L
Orthophosphate As PO4 (mg/L)	.02 mg/L	3.9 mg/L	.04 mg/L	0.09 mg/L	.04 mg/L	0.19 mg/L	1.48 mg/L	0.01 mg/L
Conductivity (uS/cm)	173 uS/cm	1263 uS/cm	248 uS/cm	273 uS/cm	83 uS/cm	160 uS/cm		950 uS/cm
Turbidity (FAU)	10 FAU	6 FAU	6 FAU	72 FAU	1 FAU	8 FAU	47 FAU	9 FAU

Incubated Coliforms Using 10 CC Sub-Sample from a 100 cc Sample Plate count by 10 for total colonies/100ml

E.coli							
Site / Date	9/10/2006	10/10/2006	10/22/2006	11/10/2006	11/11/2006	11/24/2006	Geomean
Site 1	1260	1820	50	60	160	10	149
Site 2	> 10,000	>17,980	>10,000	80	zero	zero	80
Site 3	80	70	370	350	------	70	138
Site 4	60	80	750	220	------	------	168

Total Coliforms							
Site / Date	9/10/2006	10/10/2006	10/22/2006	11/10/2006	11/11/2006	11/24/2006	Geomean
Site 1	>3260	160	------	60	160	90	108
Site 2	> 10,000	>17980	>10,000	3080	60	zero	430
Site 3	2080	2670	9370	5350	------	410	2,579
Site 4	1500	1480	11,750	4220	------	zero	3,239

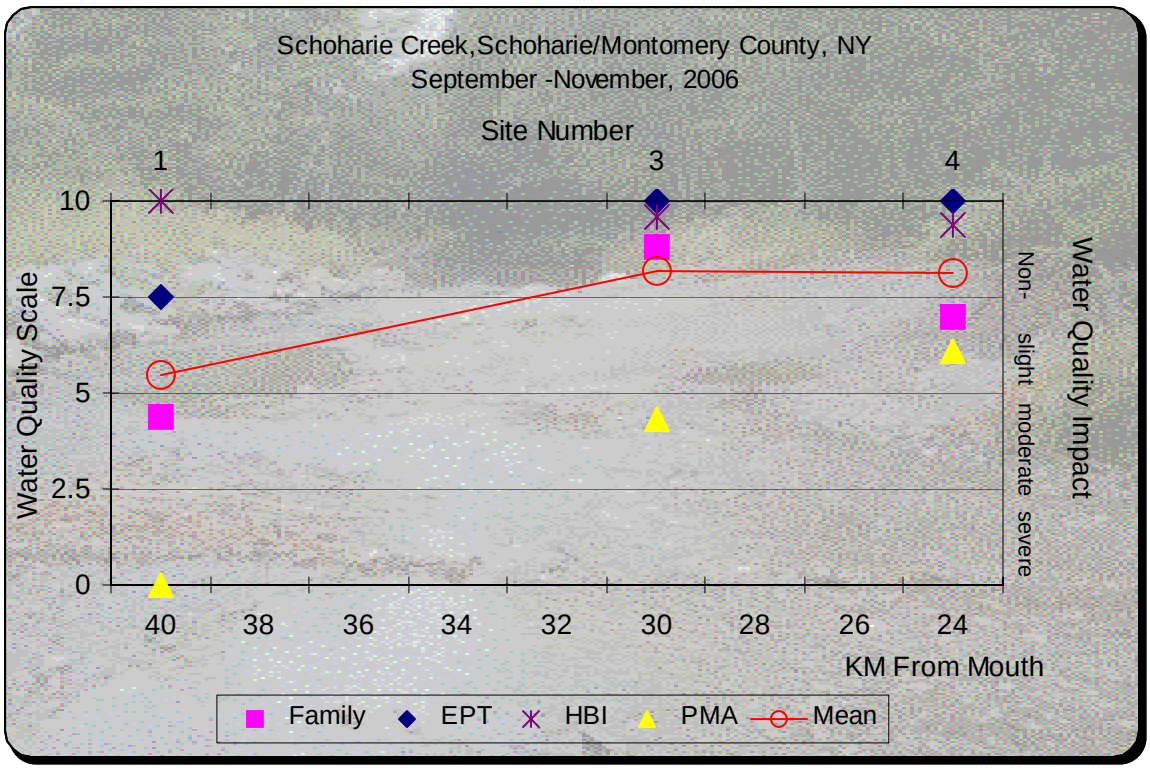


Fig 1-2006 Biological assessment profile

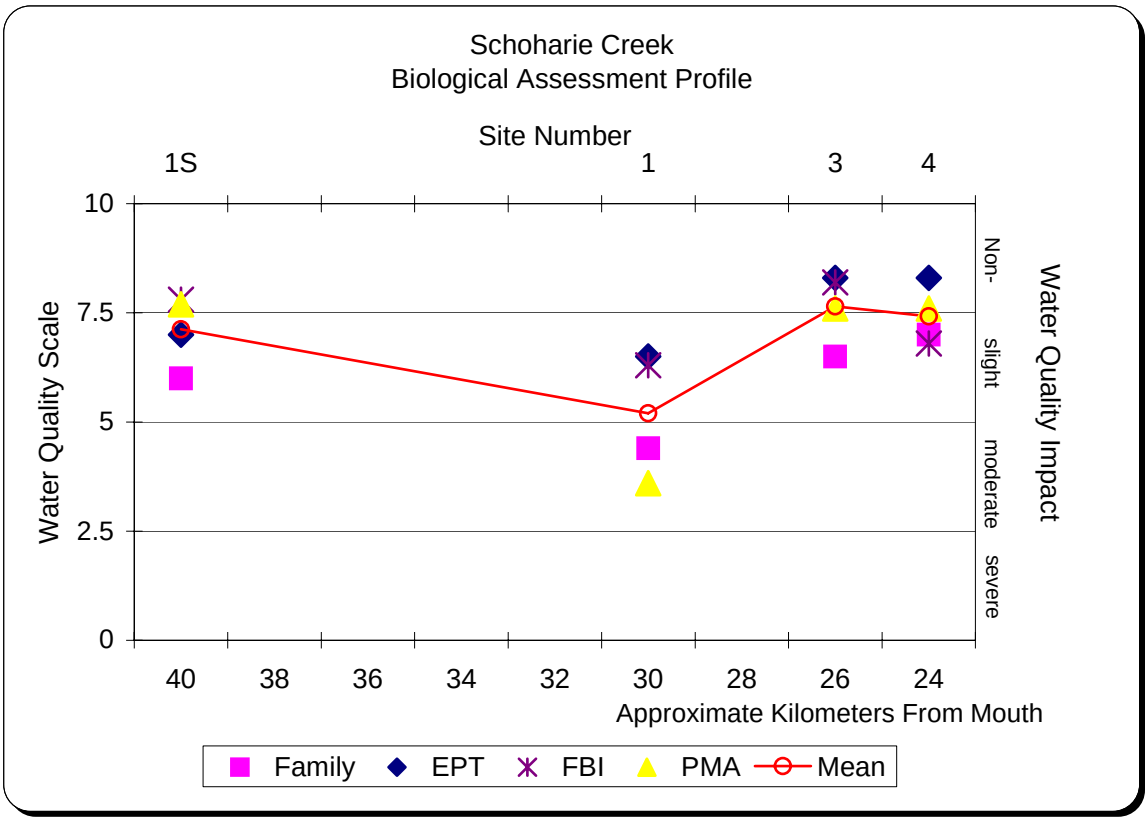
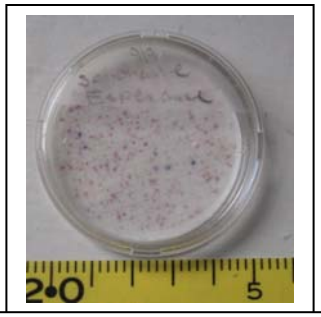


Fig 2-2003 Biological assessment profile: 1S on 2003 = 1 on 2006, 1 on 2003 = 3 on 2006, 4=4.

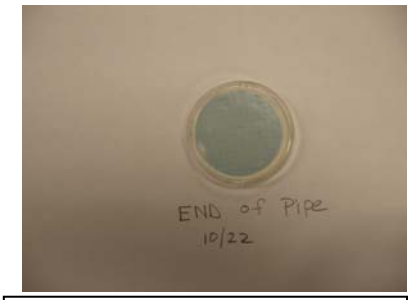
Comparison of Bacteria plates at point source site 2 and down stream test site 3

9/10/06 Plate of End of Pipe

Direction of Flow



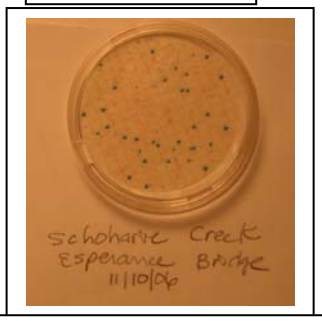
9/10 Plate of Esperance Bridge



10/22 Plate of End of Pipe

10/22 Plate of Esperance Bridge

11/11 Plate of End of Pipe

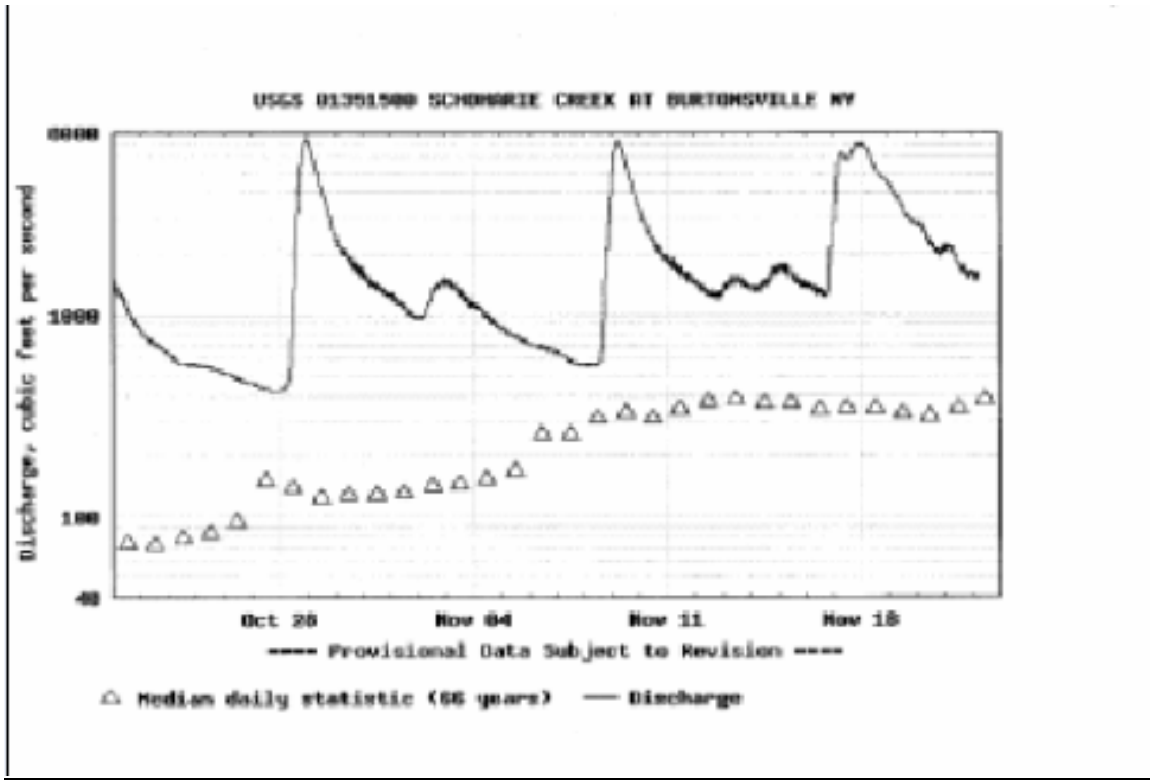


11/11/06 Plate of Esperance Bridge

11/24 Plate of end of Pipe

11/24 plate of Esperance Bridge

United State Geological Survey Flow Discharge Graph
The Schoharie Creek at Burtonsville
Cubic Feet / Second of water flowing at Burtonsville October 22 – November 22, 2006



NYS DEC FAMILY-LEVEL MACROINVERTIBRATE INDICIES

1. *Family richness:* This is the total number of Macroinvertebrate families found in a riffle kick sample. Expected ranges for 100-organism sub samples of kick samples in most streams in New York State are: greater than 12, non-impacted; 9-12, slightly impacted; 6-8, moderately impacted; less than 6, severely impacted
2. *Family EPT richness:* EPT denotes the orders of mayflies (Ephemeroptera), stoneflies (Plecoptera), and caddisflies (Tricoptera). These are considered to be mostly clean-water organisms, and their presence generally is correlated with good water quality (Lenat, 1987). The number of EPT families found in a 100-organism sub sample is used for this index. Expected ranges from most streams in New York State are: greater than 7, non-impacted: 4-7 slightly impacted; 1-3, moderately impacted; and 0, severely impacted.
3. *Family biotic index:* The family-level Hilsenhoff Biotic Index is a measure of the tolerance of the organisms in the sample to organic pollution (sewage inputs, animal wastes) and low dissolved oxygen levels. It is calculated by multiplying the number of individuals in each family by their assigned tolerance values, summing these products, and dividing by the total number of individuals. On a 1-10 scale, tolerant values range from intolerant (0), to tolerant (10). Values are listed in Hilsenhoff (1988); additional values are listed in the Quality Assurance document (Bode et al., 1996). Ranges for the levels of impact are: 0-4.50, non-impacted; 4.51-6.50, slightly impacted; 6.51-8.50, moderately impacted; and 8.51-10.00, severely impacted
4. *Percent Model Affinity:* This is a measure of similarity to a model non-impacted community based on percent abundance in 7 major groups (Novak and Bode, 1992). Percentage similarity is used to measure similarity to a community of 40% Ephemeroptera, 5% Plecoptera, 10% Tricoptera, 10% coleopteran, 20% Chironomidae, 5% Oligochaeta, and 10% Other. Ranges for the level of impact are: >64, non-impacted; 50-64, slightly impacted; 35-49, moderately impacted; and >35, severely impacted.

Non-impacted: Indices reflect very good water quality. The Macroinvertebrate community is diverse, usually with at least 12 families in riffle habitats. Mayflies, stoneflies, and Caddiflies are well represented; EPT family richness is greater than 7. The biotic index values 4.50 or less. Percent model affinity is greater than 64. Water quality should not be limited 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 food water quality. The Macroinvertebrate community is slightly but significantly altered from the pristine state. Family richness usually is 6-8. Mayflies and stoneflies may be restricted, with EPT values of 4-7. The biotic index value is 4.51-6.50. Percent model affinity is 50-64. Water quality is usually not limited to fish survival, but may limiting to fish propagation.

Moderately Impacted: Indices reflect poor water quality. The Macroinvertebrate community is altered to a large degree from the pristine state. Family richness usually is 6-8. Mayflies and stoneflies are rare or absent, caddisflies are often restricted; EPT richness is 1-3. The biotic index value is 6.51-8.50. The percent model affinity value is 35 –49. 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 families. Family richness is less then 6. Mayflies, Stoneflies, and caddisflies are rare or absent; EPT richness is 0. The biotic index value is greater than 8.51. Percent Model affinity is less than 35. 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.

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