ASSESSMENT OF INTERSTATE STREAMS IN THE SUSQUEHANNA RIVER BASIN

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Introduction

The Susquehanna River Basin is the largest river basin on the Atlantic Coast of the United States, draining 27,510 square miles. The Susquehanna River originates at the outlet of Otsego Lake, Cooperstown, N.Y., and flows 444 miles through New York, Pennsylvania, and Maryland to the Chesapeake Bay at Havre de Grace, Md. Eighty-three streams cross state lines in the basin. Several streams traverse the state lines at multiple points, contributing to 91 total crossings. Of those 91 crossings, 45 streams flow from New York into Pennsylvania, 22 from Pennsylvania into New York, 15 from Pennsylvania into Maryland, and 9 from Maryland into Pennsylvania. Many streams are small and 32 are unnamed.

The Susquehanna River Basin Commission (SRBC) reviews projects that may have interstate impacts on water resources in the Susquehanna River Basin. SRBC established a monitoring program in 1986 to collect data that were not available from monitoring programs implemented by state agencies in New York, Pennsylvania, and Maryland. The state agencies do not assess all of the interstate streams and do not produce comparable data needed to determine potential impacts on the water quality of interstate streams. SRBC's ongoing interstate monitoring program is partially funded through a grant from the U.S. Environmental Protection Agency (USEPA).

The interstate water quality monitoring program includes periodic collection of water and biological samples from interstate streams, as well as assessments of their physical habitat. Water quality data are used to: (1) assess compliance with water quality standards; (2) characterize stream quality and seasonal variations; (3) build a database for assessment of water quality trends; (4) identify streams for reporting to USEPA under Section 305(b) of the Clean Water Act; (5) provide information to signatory states for Integrated List purposes and possible Total Maximum Daily Load (TMDL) development; and (6) identify areas for restoration and protection. Biological conditions are assessed using benthic macroinvertebrate and fish populations, which provide an indication of the biological health of a stream and serve as indicators of water quality. Habitat assessments provide information concerning potential stream impairment from erosion and sedimentation, as well as an indication of the stream's ability to support a healthy biological community. Additionally, this report includes analysis of trends in water quality for all Group 1 stations.

SRBC's interstate monitoring program began in April 1986. For the first five years, results were reported for water-years that ran from October to September. In 1991, SRBC changed the reporting periods to correspond with its fiscal year that covers the period from July to June. In 2008, SRBC transitioned to a calendar year reporting period. Therefore, this report includes data collected between January 1 and December 31, 2009. Reports are typically completed during the following summer for the data from the previous calendar year. In 2007, a web-based format was initiated to provide a more user-friendly product that is easily accessible to not only government agencies but also to anyone who is interested in the condition of these streams and rivers. Recent reports are available on the SBRC web site at http://www.srbc.net/docs/Publications/techreports.htm.

Methods

Field and Laboratory Methods

Sampling frequency

In 1989, the interstate streams were divided into three groups according to the degree of water quality impairment, historical water quality impacts, and potential for degradation. These groupings were determined based on historical water quality and land use. To date, these groups remain consistent and are described below.

Streams with impaired water quality or judged to have a high potential for degradation due to large drainage areas or historical pollution have been assigned to Group 1. Each year, Group 1 streams are sampled in February, May, July or August, and October. Benthic macroinvertebrates are collected and habitat assessments are performed at all Group 1 streams during the summer sampling period. Beginning in 2009, fish sampling will occur at Group 1 stations in alternating years. Electrofishing will be conducted during the May sampling quarter. The river sites CHEM 12.0, COWN 1.0, COWN 2.2, SUSQ 10.0, SUSQ 44.5, SUSQ 289.1, SUSQ 340.0, SUSQ 365.0, and TIOG 10.8 will be excluded from fish sampling due to difficulties associated with large size.

Streams judged to have a moderate potential for impacts have been assigned to Group 2. Water quality samples, benthic macroinvertebrate samples, and physical habitat information were obtained from Group 2 stations once a year, during base flow conditions in the summer months of July or August. Fish sampling will occur at all Group 2 streams in alternating years, beginning in 2009.

Streams judged to have a low potential for impacts have been assigned to Group 3 and are sampled each May for macroinvertebrates, and habitat conditions are assessed. Field chemistry parameters also are measured on Group 3 streams at the time of biological sampling.

Stream discharge

Stream discharge is measured at all stations unless high stream flows makes access impossible. Several stations are located near U.S. Geological Survey (USGS) stream gages. These stations include the following: the Susquehanna River at Windsor, N.Y., Kirkwood, N.Y., Sayre, Pa., Marietta, Pa., and Conowingo, Md.; the Chemung River at Chemung, N.Y.; the Tioga River at Lindley, N.Y.; the Cowanesque River at Lawrenceville, Pa.; and Octoraro Creek near Richardsmere, Md. Recorded stages from USGS gaging stations and rating curves were used to determine instantaneous discharges in cubic feet per second (cfs). Instantaneous discharges for stations not located near USGS gaging stations were measured at the time of sampling, using standard USGS procedures (Buchanan and Somers, 1969).

Water samples

Water samples are collected at each of the Group 1 and Group 2 streams to measure nutrient and metal concentrations. Water samples are collected using a depth-integrated sampler. Composite samples are obtained by collecting several depth-integrated samples across the stream channel and combining them in a churn splitter that was previously rinsed with stream water. Water samples are mixed thoroughly in the churn splitter and collected in a 500-ml bottle, two 250-ml bottles, and two 40 ml vials. The 500-ml bottle is for a raw sample. Each of the 250-ml bottles consists of a whole water sample, one fixed with concentrated nitric acid (HNO_3) for metal analysis and one fixed with concentrated sulfuric acid (H_2SO_4) for nutrient analysis. The two 40 ml vials are pre-cleaned and fixed with sulfuric acid (H_2SO_4). The vials are filled with sample water and are used to measure total organic carbon (TOC). The samples are chilled on ice and sent to the Pennsylvania Department of Environmental Protection (PADEP), Bureau of Laboratories in Harrisburg, Pa., within 24 hours of collection.

Field chemistry

Temperature, dissolved oxygen, conductivity, and pH are measured in the field for Group 1 and 2 stations. In addition to the same parameters listed above, alkalinity and acidity are also measured in the field for Group 3 stations. Temperature, dissolved oxygen, conductivity, and pH are measured using a YSI model 6820 V2 multiparameter water quality sonde. Dissolved oxygen and pH probes are calibrated each day, prior to sampling. The conductivity probe is calibrated at the beginning of each week. When alkalinity and acidity are to be measured at Group 3 stations, pH is first determined using a Cole-Parmer Model 5996 meter that is calibrated at the beginning of each day. Alkalinity is then determined by titrating a known volume of water to pH 4.5 with 0.02N sulfuric acid (H_2SO_4). Acidity is measured by titrating a known volume of sample water to pH 8.3 with 0.02N sodium hydroxide (NaOH). Total chlorine is measured at Cayuta Creek, Ebaughs Creek, Scott Creek, and the Cowanesque River since CAYT 1.7, EBAU 1.5, SCTT 3.0, and COWN 1.0 are located downstream of wastewater treatment plants. A HACH Datalogging Colorimeter model DR/890 is used with the DPD Test and Tube method (10101) to measure chlorine concentrations.

Macroinvertebrate and physical habitat sampling

SRBC staff collects benthic macroinvertebrate samples from Group 1 and Group 2 stations in July and August and from Group 3 streams in May. The benthic macroinvertebrate community is sampled to provide an indication of the biological condition of the stream. Macroinvertebrates are defined as aquatic insects and other invertebrates too large to pass through a No. 30 sieve.

Benthic macroinvertebrate samples are analyzed using field and laboratory methods described in Rapid Bioassessment Protocol for Use in Streams and Rivers by Barbour and others (1999). Sampling is performed using a 1-meter-square kick screen with size No. 30 mesh. The kick screen is stretched across the current to collect organisms dislodged from riffle/run areas by physical agitation of the stream substrate. Two kick screen samples are collected from a representative riffle/run at each station. The two samples are composited and preserved in denatured ethyl alcohol for later laboratory analysis.

In the laboratory, composite samples are sorted into 200-organism subsamples using a gridded pan and a random numbers table. The organisms contained in the subsamples are identified to genus (except Chironomidae and Oligochaeta) and enumerated using keys developed by Merrit and Cummins (1996), Peckarsky and others (1990), and Pennak (1989). Each taxon is assigned an organic pollution tolerance value and a functional feeding category.

Physical habitat conditions at each station are assessed using a slightly modified version of the habitat assessment procedure outlined by Barbour and others (1999). Eleven habitat parameters are field-evaluated at each site and used to calculate a site-specific habitat assessment score. Habitat parameters are evaluated on a scale of 0 to 20 and are based on instream composition, channel morphology, and riparian zone and bank conditions. Some of the parameters to be evaluated vary based on whether the stream was characterized by riffles and runs or by glides and pools.

Fish sampling

Fish community assessments will be adapted from the RBP manual (Barbour and others, 1999) and from the Maryland Biological Stream Survey (Roth and others, 1998). Electrofishing at 25 wadeable Group 1 and 2 interstate stream stations will occur in alternate years, beginning in 2009. Specifically, fish community will be gathered at 18 stations in 2009 and the remaining seven stations will be sampled in 2010. Conditions at the time of sampling must be conducive to electrofishing operations. Specifically, flows must be manageable and allow the electrofishing team to traverse the entire width of the stream. Water clarity also must be suitable to allow visual detection of immobilized fish at all depths. Every possible effort will be made prior to departure for sampling activities to ensure that ideal conditions are realized.

Electrofishing at each site will consist of two passes on a 75-meter segment containing best available habitat. The downstream point should be a natural cutoff (e.g., impassable riffles, falls, head of a pool) that could deter fish from migrating out of the sample reach. If a natural cutoff is not present, then block nets will be deployed to keep fish within the reach. After placing a piece of flagging tape in a visible location at the downstream point, staff will measure five wetted channel widths, in meters, with a tape or rangefinder while walking to the upstream limit of the reach. Sample reach distance may be adjusted if a natural cutoff occurs within ± 5 meter of the 75 meter mark. If there is no natural cutoff at the upstream margin of the reach, block nets will be used.

GPS coordinates for the upstream and downstream limits of the sample reach will be recorded on the data sheet (Figure 6). Sampling teams will consist of three or four members. Backpack electrofishing units (battery-powered or electrical-generated) with two handheld probes will be used. Electrofishing will consist of a two-pass coverage of the entire width and length of the stream segment selected. Beginning at the downstream limit of the sample reach, the sampling team will proceed upstream covering the entire stream width, using a sinuous pattern when necessary. A concerted effort will be made by each team member to capture every fish sighted over 25mm in length, so that a representative sample is collected. Start and stop times, as well as accumulated electrofishing time (shock time), will be recorded on the data sheet.

Nets and holding cages with 0.25 inch mesh netting will be used to prevent escape. All fish will be collected and identified to species in the field, when possible. The first 50 individuals of game fish species will be measured to the nearest millimeter and weighed to the nearest tenth of a gram. Fish that cannot be identified in the field will be preserved in formalin and returned to the laboratory for identification. Digital photographs will be taken of all unknown specimens, as well as voucher (reference) photographs of each species. After processing fish from the first pass, all individuals will be returned to the stream at a point downstream of the reach, where fish cannot travel back into the sample reach. All data will be entered into SRBC's Access database.

Data Synthesis Methods

Chemical water quality

Results of laboratory analysis for chemical parameters are compared to New York, Pennsylvania, and Maryland state water quality standards. In addition, a simple water quality index (WQI) is calculated, using procedures established by McMorran and Bollinger (1990). The WQI is used to make comparisons between sampling periods and stations within the same geographical region; therefore, the water quality data are divided into three groups. One group contains stations along the New York-Pennsylvania border, another contains stations along the Pennsylvania-Maryland border, and the remaining group compares large river stations. The data in each group are sorted by parameter and ranked by increasing order of magnitude, with several exceptions. Dissolved oxygen is ranked by decreasing order of magnitude, while pH, alkalinity, acidity, calcium, and magnesium are not included in the WQI analysis. The values of each chemical analysis are divided by the highest ranking value in the group to obtain a percentile. The WQI score is calculated by averaging all percentile ranks for each sample. WQI scores range from 1 to 100, with high WQI scores indicating poor water quality.

Biological and physical habitat conditions

Benthic macroinvertebrate samples are assessed using procedures described by Barbour and others (1999), Klemm and others (1990), and Plafkin and others (1989). Using these methods, staff calculates a series of biological indexes for a stream and compares them to a reference station in the same region to determine the degree of impairment. The metrics used in this survey are summarized below. Metric 2 (Shannon Diversity Index) followed the methods described in Klemm and others (1990), and all other metrics were taken from Barbour and others (1999).

The 200-organism subsample data are used to generate scores for each of the seven metrics. Scores for metrics 1-4 are converted to a biological condition score, based on the percent similarity of the metric score, relative to the metric score of the reference site. Scores for metrics 5-7 are based on set scoring criteria developed for the percentages (Plafkin and others, 1989; Ohio Environmental Protection Agency, 1987b). The sum of the biological condition scores constituted the total biological score for the sample site, and total biological scores are used to assign each site to a biological condition category. Habitat assessment scores of sample sites are compared to those of reference sites to classify each sample site into a habitat condition category.

Fish data are analyzed using an adapted version of the Maryland Biological Stream Survey (MBSS) fish Index of Biotic Integrity (IBI) (Roth and others, 1998; Roth and others, 2000; Southerland and others, 2005). The IBI contains five metrics: number of native species, number of benthic species, percent abundance of dominant species, percentage of tolerant species, and number of individuals per square meter. The percentage of tolerant species metric uses USEPA northeast region tolerance values. The number of individuals per square meter metric was modified from the biomass per square meter metric that is used in the MBSS fish IBI. Instead of using predetermined values for scoring purposes, as used by the MBSS fish IBI, fish metric scores are determined by comparing to reference condition. Fish metric scores for all sites within the same group are compared with the highest scoring station. Fish metrics falling within the 100th and 50th percentile received a metric score of 5; metrics falling within the 50th and 10th percentile received a metric score of 3; and metrics falling below the 10th percentile received a metric score of 1. Fish metric scores are added together for each station, and then divided by five to give the average metric score, which is the assessment value.

Narrative Descriptions of Stream Biological Integrity Associated with Each of the IBI Categories (Roth and others, 2000)

Good	IBI score 4.0 – 5.0	Comparable to reference streams considered to be minimally impacted. On average, biological metrics fall within the upper 50% of reference site conditions.
Fair	IBI score 3.0 – 3.9	Comparable to reference conditions, but some aspects of biological integrity may not resemble the qualities of these minimally impacted streams. On average, biological metrics are within the lower portion of the range of reference sites (10th to 50th percentile).
Poor	IBI score 2.0 – 2.9	Significant deviation from reference conditions, with many aspects of biological integrity not resembling the qualities of minimally impacted streams, indicating some degradation. On average, biological metrics fall below the 10th percentile of reference site values.
Very Poor	IBI score 1.0 – 1.9	Strong deviation from reference conditions, with most aspects of biological integrity not resembling the qualities of minimally impacted streams, indicating severe degradation. On average, biological metrics fall below the 10th percentile of reference site values; most or all metrics are below this level.

Trend analysis

Long-term trend analysis has been performed on Group 1 streams that have been sampled since April 1986 to identify increases and decreases over time in total suspended solids, total ammonia, total nitrogen, total phosphorus, total chloride, total sulfate, total iron, total manganese, total aluminum, and the WQI. Overall, these long-term trends do not change very much from year to year. Therefore, SRBC has decided to analyze for trends every five years. The next trend analysis will be in the CY-2014 Interstate Report.

The nonparametric trend test used in previous reports was the Seasonal Kendall Test, which is described by Bauer and others (1984), and Smith and others (1982). For more information on this test and how it was used to assess trends in the data see Nutrients and Suspended Sediment Transported in the Susquehanna River Basin (McGonigal 2008), LeFevre (2003), and other previous Interstate reports.

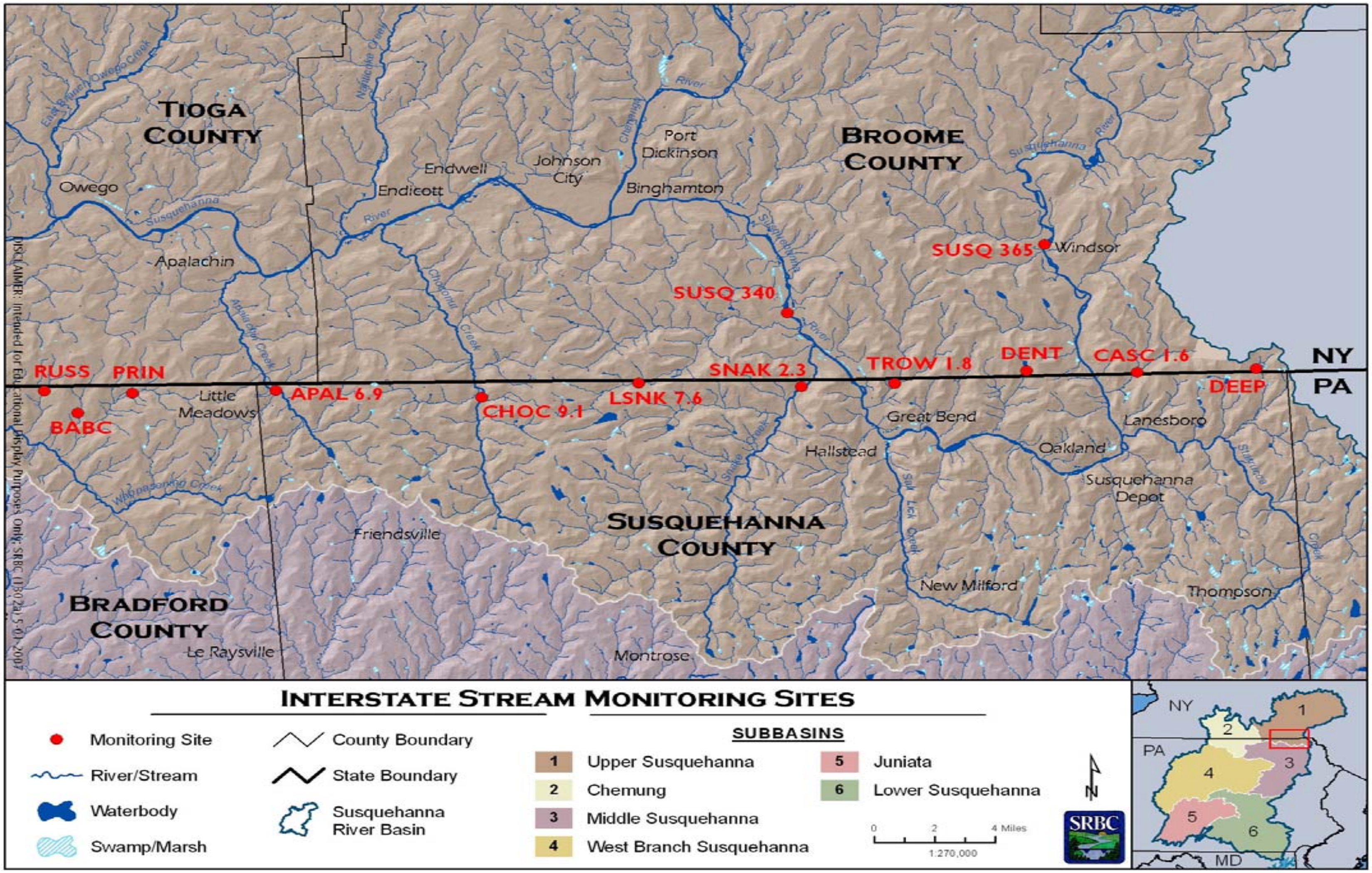
List of New York- Pennsylvania Interstate Streams

Station	Stream and Location	Monitoring Group	Rationale
APAL 6.9	Apalachin Creek, Little Meadows, PA	2	Monitor for potential water quality impacts
BABC	Babcock Run, Cadis, PA	3	Monitor for potential impacts
BILL	Bill Hess Creek, Nelson, PA	3	Monitor for potential impacts
BIRD	Bird Creek, Webb Mills, NY	3	Monitor for potential impacts
BISC	Biscuit Hollow, Austinburg, PA	3	Monitor for potential impacts
BNTY 0.9	Bentley Creek, Wellsburg, NY	1	Monitor for potential water quality impacts
BRIG	Briggs Hollow, Nichols, NY	3	Monitor for potential impacts
BULK	Bulkley Brook, Knoxville, PA	3	Monitor for potential impacts
CAMP	Camp Brook, Osceola, PA	3	Monitor for potential impacts
CASC 1.6	Cascade Creek, Lanesboro, PA	1	Monitor for potential water quality impacts
CAYT 1.7	Cayuta Creek, Waverly, NY	1	Municipal discharge from Waverly, NY
CHEM 12.0	Chemung River, Chemung, NY	1	Municipal and industrial discharges from Elmira, NY
CHOC 9.1	Choconut Creek, Vestal Center, NY	2	Monitor for potential water quality impacts
COOK	Cook Hollow, Austinburg, PA	3	Monitor for potential impacts
COWN 2.2	Cowanesque River, Lawrenceville, PA	1	Impacts from flood control reservoir
COWN 1.0	Cowanesque River, Lawrenceville, PA	1	Recovery zone from upstream flood control reservoir
DEEP	Deep Hollow Brook, Danville, NY	3	Monitor for potential impacts
DENT	Denton Creek, Hickory Grove, PA	3	Monitor for potential impacts
DRYB	Dry Brook, Waverly, NY	3	Monitor for potential impacts
HLDN 3.5	Holden Creek, Woodhull, NY	2	Monitor for potential water quality impacts
LSNK 7.6	Little Snake Creek, Brackney, PA	1	Monitor for potential water quality impacts
LWAP	Little Wappasening Creek, Nichols, NY	3	Monitor for potential impacts
NFCR 7.6*	North Fork Cowanesque River, North Fork, PA	2	Monitor for potential water quality impacts
PARK	Parks Creek, Litchfield, NY	3	Monitor for potential impacts
PRIN	Prince Hollow Run Cadis, PA	3	Monitor for potential impacts
PRIN	Prince Hollow Run Cadis, PA	3	Monitor for potential impacts
REDH	Redhouse Run, Osceola, PA (formerly Beagle Hollow Run)	3	Monitor for potential impacts
RUSS	Russell Run, Windham, PA	3	Monitor for potential impacts
SACK	Sackett Creek, Nichols, NY	3	Monitor for potential impacts
SEEL 10.3	Seeley Creek, Seeley Creek, NY	1	Monitor for potential water quality impacts
SMIT	Unnamed tributary to Smith Creek, East Lawrence, PA	3	Monitor for potential impacts
SNAK 2.3	Snake Creek, Brookdale, PA	2	Monitor for potential water quality impacts
SOUT 7.8	South Creek, Fassett, PA	2	Monitor for potential water quality impacts
STRA	Strait Creek, Nelson, PA	3	Monitor for potential impacts
SUSQ 365.0	Susquehanna River, Windsor, NY	1	Large drainage area (1,882 sq. mi.); municipal discharges from Cooperstown, Sidney, Bainbridge, and Oneonta
SUSQ 340.0	Susquehanna River, Kirkwood, NY	1	Large drainage area (2,232 sq. mi.); historical pollution due to sewage from Lanesboro, Oakland, Susquehanna, Great Bend, and Hallstead
SUSQ 289.1	Susquehanna River, Sayre, PA	1	Large drainage area (4,933 sq. mi.); municipal and industrial discharges
TIOG 10.8	Tioga River, Lindley, NY	1	Pollution from acid mine discharges and impacts from flood control reservoirs
TRUP 4.5	Troups Creek, Austinburg, PA	1	High turbidity and moderately impaired macroinvertebrate populations
TROW 1.8	Trowbridge Creek, Great Bend, PA	2	Monitor for potential water quality impacts
WAPP 2.6	Wappasening Creek, Nichols, NY	2	Monitor for potential water quality impacts
WBCO	White Branch Cowanesque River, North Fork, PA	3	Monitor for potential impacts
WHIT	White Hollow, Wellsburg, NY	3	Monitor for potential impacts

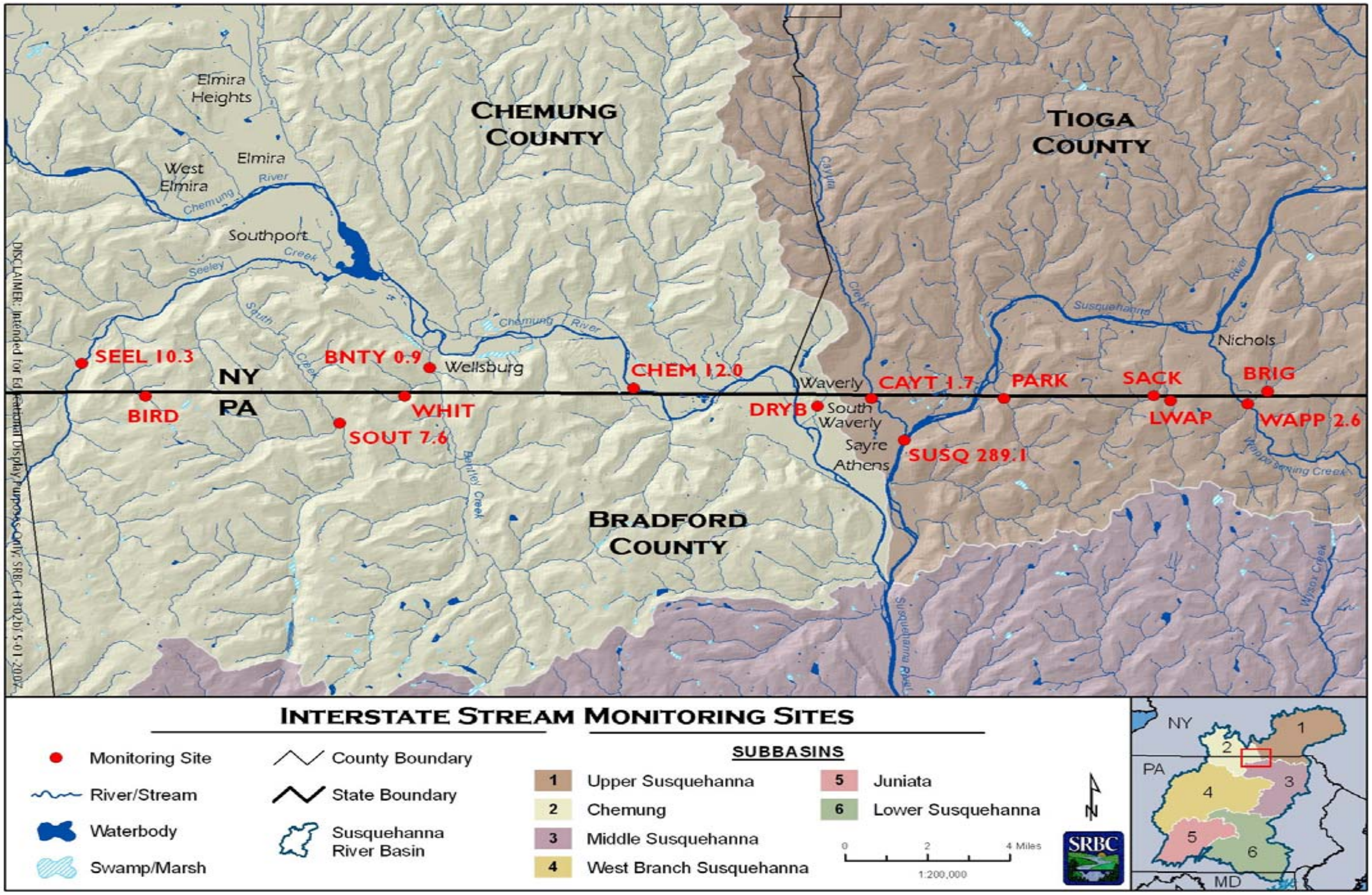
List of Pennsylvania-Maryland Interstate Streams

Station	Stream and Location	Monitoring Group	Rationale
BBDC 4.1	Big Branch Deer Creek, Fawn Grove, PA	2	Monitor for potential water quality impacts
CNWG 4.4	Conowingo Creek, Pleasant Grove, PA	1	High nutrient loads and other agricultural runoff; nonpoint runoff to Chesapeake Bay
DEER 44.2	Deer Creek, Gorsuch Mills, MD	1	Past pollution from Gorsuch Mills, MD, Stewartstown, PA; nonpoint runoff to Chesapeake Bay
EBAU 1.5	Ebaughs Creek, Stewartstown, PA	1	Municipal discharge from Stewartstown, PA; nonpoint runoff to Chesapeake Bay
FBDC 4.1	Falling Branch Deer Creek, Fawn Grove, PA	2	Monitor for potential water quality impacts
LNGA 2.5	Long Arm Creek, Bandanna, PA	1	Monitor for potential water quality impacts
OCTO 6.6	Octoraro Creek, Rising Sun, MD	1	High nutrient loads due to agricultural runoff from New Bridge, MD; water quality impacts from Octoraro Lake; nonpoint runoff to Chesapeake Bay
SBCC 20.4	South Branch Conewago Creek, Bandanna, PA	2	Monitor for potential water quality impacts
SCTT 3.0	Scott Creek, Delta, PA	1	Historical pollution due to untreated sewage
SUSQ 44.5	Susquehanna River, Marietta, PA	1	Bracket hydroelectric dams near the state line
SUSQ 10.0*	Susquehanna River, Conowingo, MD	1	Bracket hydroelectric dams near the state line

*denotes no macroinvertebrates were collected in 2009

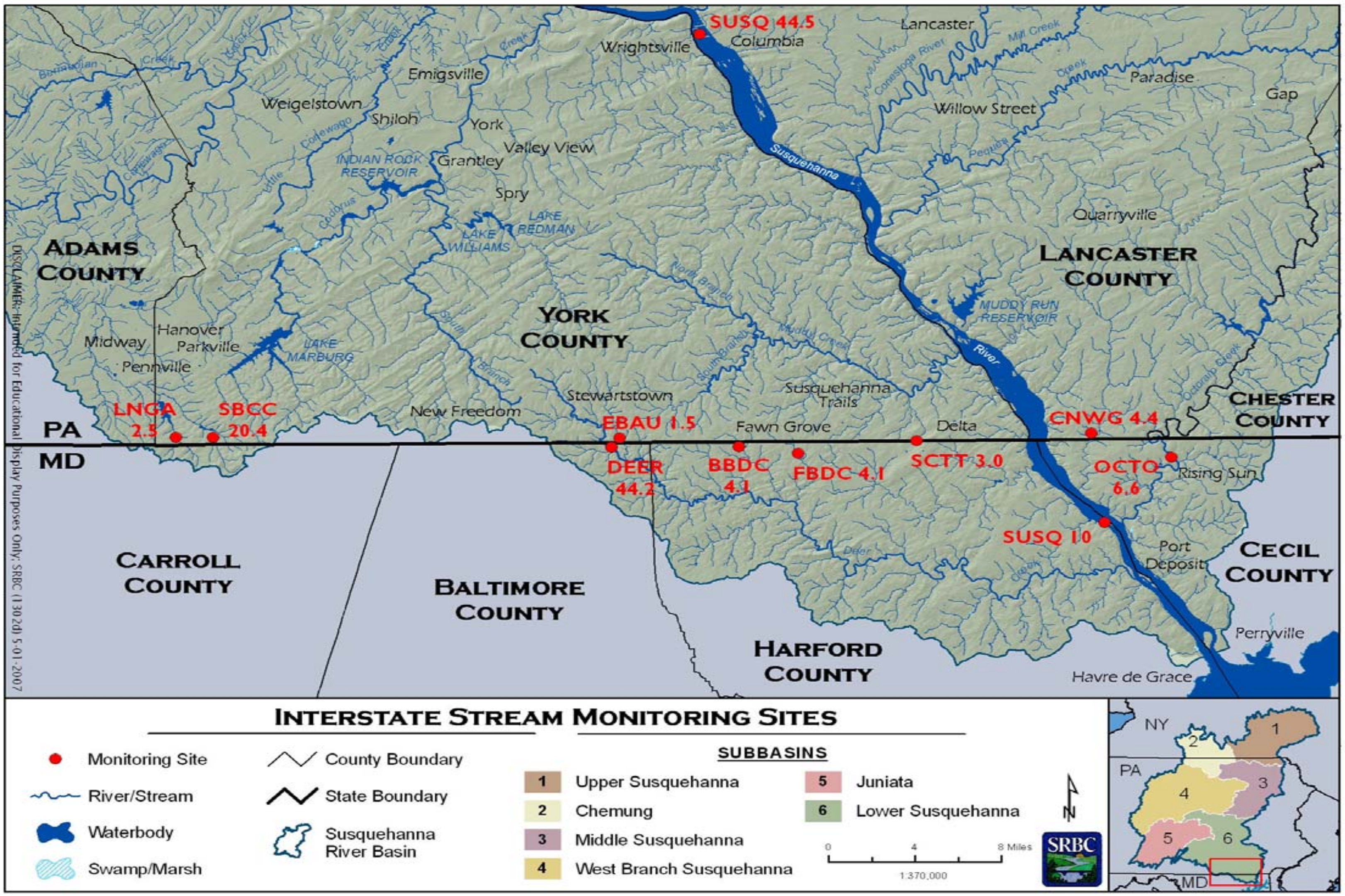


Map of New York-Pennsylvania Interstate Streams (eastern section)



Map of New York-Pennsylvania Interstate Streams (central section)

Map of New York-Pennsylvania Interstate Streams (western section)



Map of Pennsylvania-Maryland Interstate Streams

Criteria Used to Evaluate Physical Habitat

Habitat Parameter	OPTIMAL (20-16)	SUBOPTIMAL (15-11)	MARGINAL (10-6)	POOR (5-0)
1. Epifaunal Substrate (R/R)[1]	Well-developed riffle/run; riffle is as wide as stream and length extends 2 times the width of stream; abundance of cobble.	Riffle is as wide as stream but length is less than 2 times width; abundance of cobble; boulders and gravel common.	Run area may be lacking; riffle not as wide as stream and its length is less than 2 times the width; some cobble present.	Riffle or run virtually nonexistent; large boulders and bedrock prevalent; cobble lacking.
1. Epifaunal Substrate (G/P)[2]	Preferred benthic substrate abundant throughout stream site and at stage to allow full colonization (i.e. log/snags that are not new fall and not transient).	Substrate common but not prevalent or well suited for full colonization potential.	Substrate frequently disturbed or removed.	Substrate unstable or lacking.
2. Instream Cover (R/R)	> 50% mix of boulders, cobble, submerged logs, undercut banks or other stable habitat.	30-50% mix of boulder, cobble, or other stable habitat; adequate habitat.	10-30% mix of boulder, cobble, or other stable habitat; habitat availability less than desirable.	< 10% mix of boulder, cobble, or other stable habitat; lack of habitat is obvious.
2. Instream Cover (G/P)	> 50% mix of snags, submerged logs, undercut banks or other stable habitat; rubble, gravel may be present.	30-50% mix of stable habitat; adequate habitat for maintenance of populations.	10-30% mix of stable habitat; habitat availability less than desirable.	Less than 10% stable habitat; lack of habitat obvious.
3. Embeddedness [a] (R/R)	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediments.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediments.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediments.	Gravel, cobble, and boulder particles are >75% surrounded by fine sediments.
3. Pool Substrate Characterization (G/P)	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
4. Velocity/Depth Regimes [b] (R/R)	All 4 velocity/depth regimes present (slow/deep, slow/shallow, fast/deep, fast/shallow).	Only 3 of 4 regimes present (if fast/shallow is missing, score lower than if missing other regimes).	Only 2 of 4 regimes present (if fast/shallow or slow/shallow are missing, score low).	Dominated by 1 velocity/depth regime.
4. Pool Variability [c] (G/P)	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.

Criteria Used to Evaluate Physical Habitat—Continued

Habitat Parameter	OPTIMAL (20-16)	SUBOPTIMAL (15-11)	MARGINAL (10-6)	POOR (5-0)
5. Sediment Deposition (R/R)	Little or no enlargement of islands or point bars and <5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from coarse gravel; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, coarse sand on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; >50% of the bottom changing frequently; pools almost absent due to sediment deposition.
5. Sediment Deposition (G/P)	Less than 20% of bottom affected; minor accumulation of fine and coarse material at snags and submerged vegetation; little or no enlargement of island of point bars.	20-50% affected; moderate accumulation; substantial sediment movement only during major storm event; some new increase in bar formation.	50-80% affected; major deposition; pools shallow, heavily silted; embankments may be present on both banks; frequent and substantial movement during storm events.	Channelized; mud, silt, and/or sand in braided or non-braided channels; pools almost absent due to substantial sediment deposition.
6. Channel Flow Status (R/R) (G/P)	Water reaches base of both lower banks and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate exposed.	Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
7. Channel Alteration [d] (R/R) (G/P)	No channelization or dredging present.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization (>20 yr) may be present, but not recent.	New embankments present on both banks; and 40-80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; >80% of the reach channelized and disrupted.
8. Frequency of Riffles (R/R)	Occurrence of riffles relatively frequent; distance between riffles divided by the width of the stream equals 5 to 7; variety of habitat.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream equals 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the stream width is between 15-25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is >25.
8. Channel Sinuosity (G/P)	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line.	The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line.	The bend in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long time.
9. Condition of Banks [e] (R/R) (G/P)	Banks stable; no evidence of erosion or bank failure, little potential for future problems; <5% of bank affected; on Glide/Pool streams side slopes generally <30%.	Moderately stable; infrequent, small areas of erosion mostly healed over; 5-30% of bank in reach has areas of erosion; on Glide/Pool streams side slopes up to 40% on one bank; slight erosion potential in extreme floods.	Moderately unstable, 30-60% of banks in reach have areas of erosion; high erosion potential during floods; on Glide/Pool streams side slopes up to 60% on some banks.	Unstable; many eroded areas; “raw” areas frequent along straight sections and bends; on side slopes, 60-100% of bank has erosional scars; on Glide/Pool streams side slopes > 60% common.
(score each bank 0-10)	**(9-10)**	**(6-8)**	**(3-5)**	**(0-2)**

Criteria Used to Evaluate Physical Habitat—Continued

Habitat Parameter	OPTIMAL (20-16)	SUBOPTIMAL (15-11)	MARGINAL (10-6)	POOR (5-0)
10. Vegetative Protective Cover (R/R) (G/P)	>90% of the streambank surfaces covered by vegetation; vegetative disruption through grazing or mowing minimal.	70-90% of the streambank surfaces covered by vegetation; disruption evident but not affecting full plant growth potential to any great extent.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation.	<50% of the streambank surfaces covered by vegetation; disruption is very high; vegetation removed to 5 cm or less.
(score each bank 0-10)	**(9-10)**	**(6-8)**	**(3-5)**	**(0-2)**
11. Riparian Vegetative Zone Width (R/R) (G/P)	Width of riparian zone >18 meters; human activities (i.e. parking lots, roadbeds, clearcuts, lawns, or crops) have not impacted zone.	Width or riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone only minimally.	Width of riparian zone <6 meters; little or no riparian vegetation due to human activities.
(score each bank 0-10)	**(9-10)**	**(6-8)**	**(3-5)**	**(0-2)**

[1] R/R – Riffle/Run — Habitat assessment parameters used for streams characterized by riffles and runs.

[2] G/P – Glide/Pool — Habitat assessment parameters used for streams characterized by glides and pools.

[a] Embeddedness — The degree to which the substrate materials that serve as habitat for benthic macroinvertebrates and for fish spawning and egg incubation (predominantly cobble and/or gravel) are surrounded by fine sediment. Embeddedness is evaluated with respect to the suitability of these substrate materials as habitat for macroinvertebrates and fish by providing shelter from the current and predators and by providing egg deposition and incubation sites.

[b] Velocity/Depth Regimes — The general guidelines are 0.5 m depth to separate shallow from deep, and 0.3 m/sec to separate fast from slow.

[c] Pool Variability — Rated based on the variety and spatial complexity of slow- or still-water habitat within the sample segment. It should be noted that even in high-gradient segments, functionally important slow-water habitat may exist in the form of plunge-pools and/or larger eddies. General guidelines are any pool dimension (i.e., length, width, oblique) greater than half the cross-section of the stream for separating large from small and 1 m depth separating shallow and deep.

[d] Channel Alteration — A measure of large-scale changes in the shape of the stream channel. Channel alteration includes: concrete channels, artificial embankments, obvious straightening of the natural channel, rip-rap, or other structures.

[e] Condition of Banks — Steep banks are more likely to collapse and suffer from erosion than are gently sloping banks and are therefore considered to be unstable. Left and right bank orientation is determined by facing downstream.

Source: Modified from Barbour and others, 1999.

Summary of Metrics Used to Evaluate the Overall Biological Integrity of Stream and River Benthic Macroinvertebrate Communities

Metric	Description
1. Taxonomic Richness (a)	The total number of taxa present in the 200-organism subsample. Number decreases with increasing stress.
2. Shannon Diversity Index (b)	A measure of biological community complexity based on the number of equally or nearly equally abundant taxa in the community. Index value decreases with increasing stress.
3. Modified Hilsenhoff Biotic Index (a)	A measure of the organic pollution tolerance of a benthic macroinvertebrate community. Index value increases with increasing stress.
4. EPT Index (a)	The total number of Ephemeroptera (mayfly), Plecoptera (stonefly), and Trichoptera (caddisfly) taxa present in the 200-organism subsample. Number decreases with increasing stress.
5. Percent Ephemeroptera (a)	The percentage of Ephemeroptera in the 200-organism subsample. Ratio decreases with increasing stress.
6. Percent Dominant Taxa (a)	Percentage of the taxon with the largest number of individuals out of the total number of macroinvertebrates in the sample. Percentage increases with increasing stress.
7. Percent Chironomidae (a)	The percentage of Chironomidae in a 200-organism subsample. Ratio increases with increasing stress.

Sources: (a) Barbour and others, 1999 (b) Klemm and others, 1990

Summary of Criteria Used to Classify the Biological Conditions of Sample Sites

SAMPLING AND ANALYSIS

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TOTAL BIOLOGICAL SCORE DETERMINATION

Metric	Biological Condition Scoring Criteria 6	4	2	0
1. Taxonomic Richness (a)	>80 %	79 – 60 %	59 – 40 %	<40 %
2. Shannon Diversity Index (a)	>75 %	74 – 50 %	49 – 25 %	<25 %
3. Modified Hilsenhoff Biotic Index (b)	>85 %	84 – 70 %	69 – 50 %	<50 %
4. EPT Index (a)	>90 %	89 – 80 %	79 – 70 %	<70 %
5. Percent Ephemeroptera (c)	>25 %	10 – 25 %	1 – 9 %	<1 %
6. Percent Chironomidae (c)	<5 %	5 – 20 %	21 – 35 %	>36 %
7. Percent Dominant Taxa (c)	<20 %	20 – 30 %	31 – 40 %	>40 %
Total Biological Score (d)				

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BIOASSESSMENT

Percent Comparability of Study and Reference Site Total Biological Scores (e)	Biological Condition Category
>83	Nonimpaired
79 - 54	Slightly Impaired
50 - 21	Moderately Impaired
<17	Severely Impaired

(a) Score is study site value/reference site value X 100.

(b) Score is reference site value/study site value X 100.

(c) Scoring criteria evaluate actual percent contribution, not percent comparability to the reference station.

(d) Total Biological Score = the sum of Biological Condition Scores assigned to each metric.

(e) Values obtained that are intermediate to the indicated ranges will require subjective judgment as to the correct placement into a biological condition category.

Summary of Criteria Used to Classify the Habitat Conditions of Sample Sites

DETERMINATION OF HABITAT ASSESSMENT SCORES				
	Habitat Parameter Scoring Criteria			
Parameter	Excellent	Good	Fair	Poor
Epifaunal Substrate	20-16	15-11	10-6	5-0
Instream Cover	20-16	15-11	10-6	5-0
Embeddedness/Pool Substrate	20-16	15-11	10-6	5-0
Velocity/Depth Regimes/Pool Variability	20-16	15-11	10-6	5-0
Sediment Deposition	20-16	15-11	10-6	5-0
Channel Flow Status	20-16	15-11	10-6	5-0
Channel Alteration	20-16	15-11	10-6	5-0
Frequency of Riffles/Channel Sinuosity	20-16	15-11	10-6	5-0
Condition of Banks (a)	20-16	15-11	10-6	5-0
Vegetative Protective Cover (a)	20-16	15-11	10-6	5-0
Riparian Vegetative Zone Width (a)	20-16	15-11	10-6	5-0
Habitat Assessment Score (b)				

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HABITAT ASSESSMENT	
Percent Comparability of Study and Reference Site Habitat Assessment Scores	Habitat Condition Category
>90	Excellent (comparable to reference)
89-75	Supporting
74-60	Partially Supporting
<60	Nonsupporting

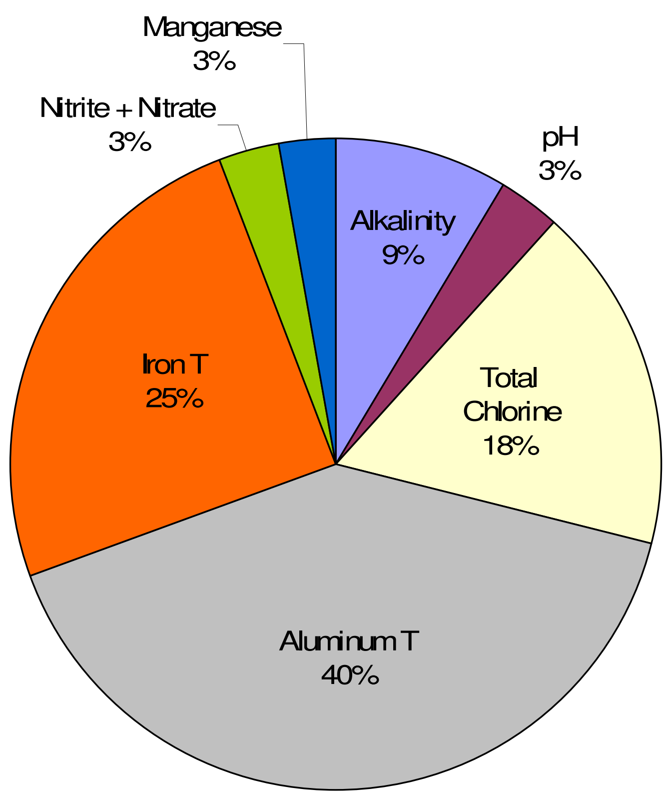
(a) Combined score of each bank
(b) Habitat Assessment Score = Sum of Habitat Parameter Scores

Results

Water Quality

The calendar year 2009 (CY-09) report included water quality data collected January 1 through December 31, 2009. The parameter that most often exceeded standards was total aluminum, followed closely by total iron. Approximately 39 percent of Group 1 and 2 streams met designated use classes, with no parameters exceeding water quality standards. Nineteen out of 31 sites had at least one parameter exceeding acceptable limits, with sixteen of those having more than one violation.

Parameters Exceeding Water Quality Standards



Parameter	Standard	Standard Value	Number of Observations	Number Exceeding Standards
Alkalinity	Pa. aquatic life	20 mg/l	112	6
Total Aluminum	N.Y. aquatic (chronic)	100 µg/l	60	28
Total Chlorine	N.Y. aquatic (acute) Md. aquatic life	0.019 mg/l 0.019 mg/l	7 6	7 5
Dissolved Oxygen	Pa. aquatic life	5.0 mg/l	112	0
Total Iron	N.Y. aquatic (chronic) Pa. aquatic life	300 µg/l 1500 µg/l	60 91	17 2
Nitrate plus Nitrate	Pa. public water supply	10 mg/l	91	2
pH	N.Y. general Md. aquatic life Pa. aquatic life	6.5-8.5 6.5-8.5 6.0-9.0	81 31	2 0
Turbidity	Md. aquatic life	150 NTU	31	0
Total Manganese	N.Y. aquatic (chronic)	300 ug/l	60	2

Water Quality Trends

Trends in water quality for the entire period of record (1986–2009) were analyzed using a Seasonal Kendall Test. Concentrations of each constituent were flow-adjusted. In order for a trend to be considered increasing or decreasing, the p value must be less than 0.05. A p value of greater than 0.05 indicated that no trend was observed. Trends analysis was completed for stations that are sampled quarterly, meaning that only Group 1 stations are included. The constituents with the highest number of stations showing a decreasing trend included total sulfate, phosphorus, ammonia, and iron, respectively. Only total chlorides and total solids were shown to be increasing in flow adjusted concentration. Detailed results of trends analysis are available in Appendix A.

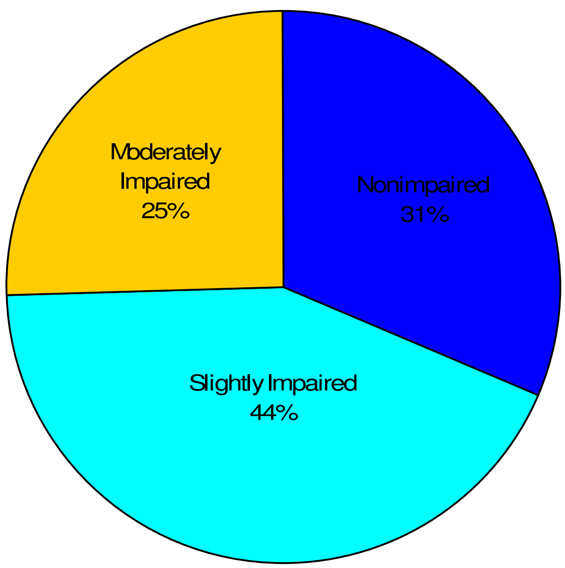
Number of stations that were increasing, decreasing, or showed no trend for constituents of concern

Constituent	Increasing	None	Decreasing	NA
Total Solids	3	14	3	1
Total Nitrogen		5	1	15
Total Ammonia		7	11	3
Total Phosphorus		8	13	
Total Chlorides	11	9		1
Total Sulfate		2	18	1
Total Iron		11	9	1
Total Manganese		11	9	1
Total Aluminum		18	2	1

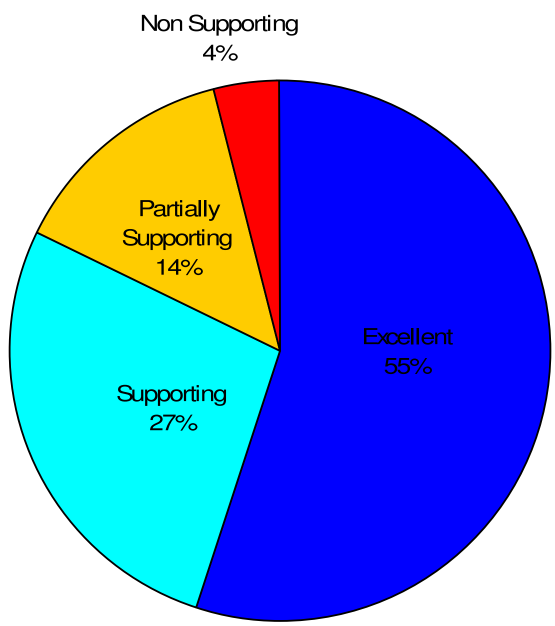
Macroinvertebrates and Habitat

In 2009, 16 of the 51 interstate streams sites at which macroinvertebrate samples were collected contained nonimpaired IBI scores. Biological conditions at another 22 sites were slightly impaired, while 13 sites were moderately impaired. SUSQ 10.0 and NFCR 7.6 were not sampled using RBP III techniques due to deep waters and access issues, respectively. Consequently, these sites were not averaged into final scores. Twenty-eight sites had excellent habitats, 14 sites had supporting habitats, seven sites had partially supporting habitats, and two sites were designated as having nonsupporting habitat. Habitat was not assessed at SUSQ 10.0 and NFCR 7.6.

CY-09 Macroinvertebrate IBI rating



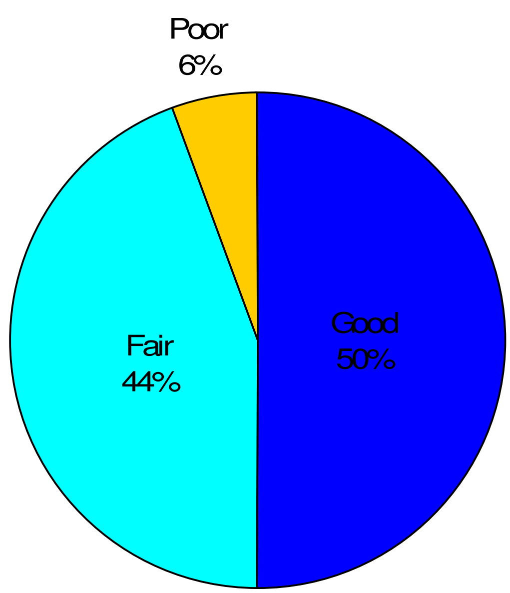
CY-09 Habitat Rating



Fish

In 2009, fish sampling occurred at 18 Group 1 and 2 interstate stream stations. Large river sites, including all interstate stations on the Chemung, Cowanesque, Susquehanna, and Tioga Rivers were not sampled for fish because of size restrictions. Fish sampling will occur in 2010 at LNGA 3.5, SCTT 3.0, HLDN 3.5, NFCR 7.6, and TROW 1.8. Of the 18 stations where fish community data were collected, nine sites earned a good fish IBI score, while eight were rated fair and one was rated poor. Detailed fish community and analysis data for all stations is available in Appendix B.

CY-09 Fish IBI rating



Results for 2009 New York – Pennsylvania Stream Assessments

Sites that represent the best available suite of conditions, in terms of biological community, water quality, and physical habitat for each group of stream sites are designated as reference sites. All other locations within that grouping are compared to the reference site. In 2009, Little Snake Creek (LSNK 7.6) was the reference site to which all other Group 1 and 2 New York – Pennsylvania interstate streams were compared. Located near Brackney, Pa., LSNK 7.6 represented the best combination of biological, water quality, and habitat conditions in the Northern Appalachian Plateau and Uplands Ecoregion. New York – Pennsylvania sampling stations consisted of 13 sites located near or on the border of these states. Of these 13 sites, the macroinvertebrate communities of four sites (31 percent) were nonimpaired. Five stations (38 percent) were slightly impaired, and four sites (31 percent) were designated as moderately impaired. The metrics that most often scored poorly were percent Chironomidae and percent dominant taxa. Macroinvertebrate sampling did not occur at NFCR 7.6 in 2009 due to access issues, but will resume in 2010, if possible.

Fish community data were collected and analyzed at 11 Group 1 and 2 stations in 2009. Staff will collect fish data at HLDN 3.5, NFCR 7.6, and TROW 1.8 during 2010. A narrative description of fish IBI scoring categories is presented in Appendix B, Table B1. Of the 11 sites where fish sampling took place, five sites received good fish IBI scores, five sites scored fair, and one site scored poor (Appendix B, Table B2).

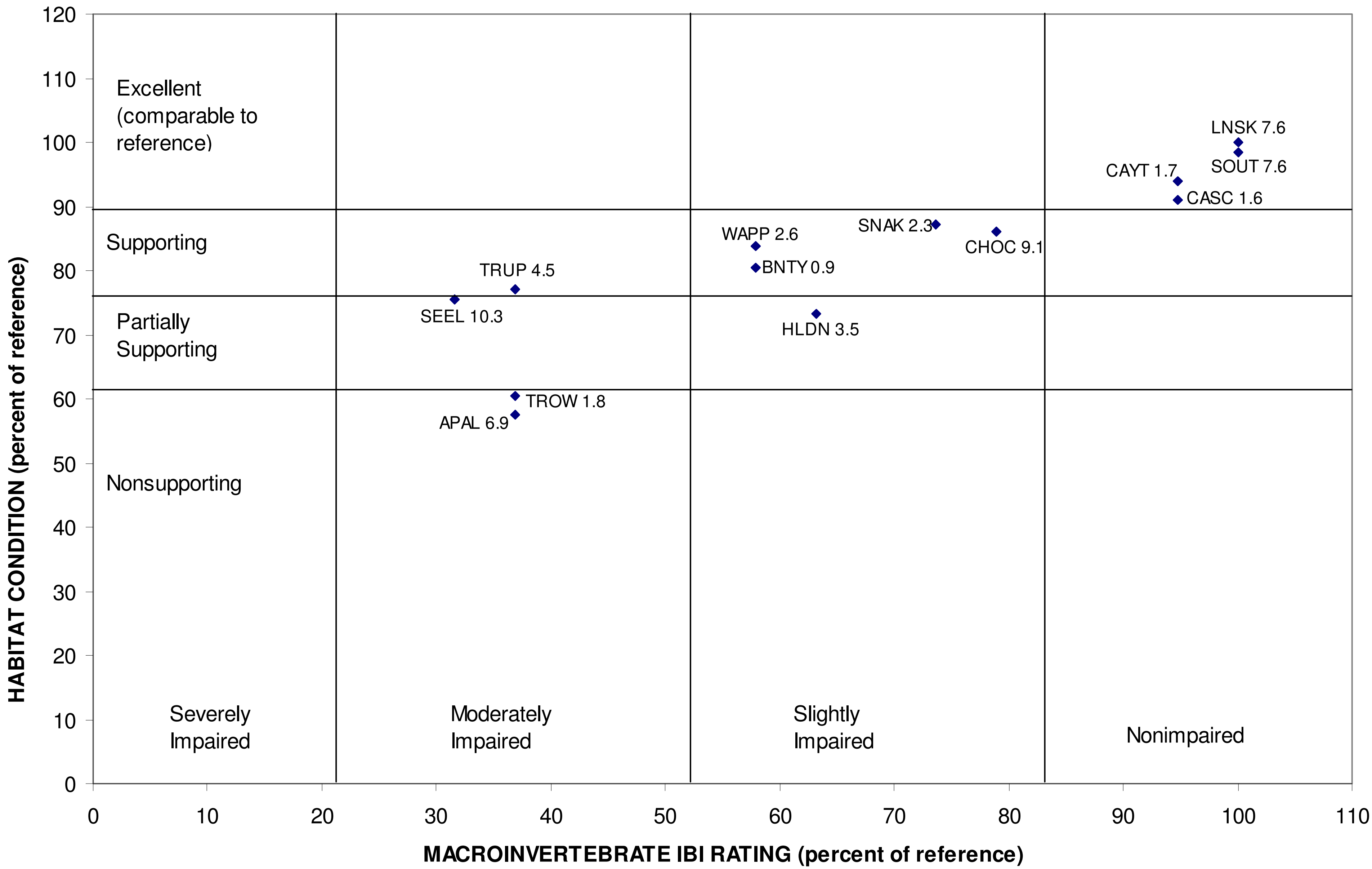
The fishes caught in the highest abundance in the stations along the New York – Pennsylvania border included central stonerollers (*Campostoma anomalum*), sculpins (*Cottus spp.*), and blacknose dace (*Rhinichthys atratulus*). The most widespread fishes encountered were white suckers (*Catostomus commersonii*), sculpins (*Cottus spp.*), and cutlips minnows (*Exoglossum maxillingua*), which were captured at ten, nine, and nine sites respectively. Of the 29 species of fishes encountered in the New York – Pennsylvania stations, eight were considered introduced species (28 percent). TRUP 4.5 had the highest catch per unit effort, with 8.30 individuals captured per minute.

Highest scoring site and respective value for each metric (for PA-NY streams)

Metrics	Highest Scoring Site	Value
Number of native species	TRUP 4.5	12
Number of benthic species	SEEL 10.3	5
Percent abundance of dominant species	SOUT 7.6	26%
Percentage of tolerant species (EPA)	CAYT 1.7	20%
Number of individuals per square meter	LSNK 7.6	0.36

Habitat was not evaluated at NFCR 7.6 in 2009 due to access issues. Out of the 13 remaining habitat classifications, four sites (31 percent) were rated excellent, and five sites (38 percent) were rated supporting. Two sites (15 percent) received partially supporting ratings and two sites were rated nonsupporting.

The chart below summarizes the macroinvertebrate community and habitat data for the New York – Pennsylvania interstate streams sites.


HABITAT CONDITION (percent of reference)
MACROINVERTEBRATE IBI RATING (percent of reference)
Excellent (comparable to reference)
Supporting
Partially Supporting
Nonsupporting
Severely Impaired
Moderately Impaired
Slightly Impaired
Nonimpaired
LNSK 7.6
SOUT 7.6
CAYT 1.7
CASC 1.6
SNAK 2.3
CHOC 9.1
WAPP 2.6
BNTY 0.9
HLDN 3.5
TRUP 4.5
SEEL 10.3
TROW 1.8
APAL 6.9

Results for 2009 Pennsylvania – Maryland Stream Assessments

Sites that represent the best available suite of conditions, in terms of biological community, water quality, and physical habitat for each group of stream sites are designated as reference sites. All other locations within that grouping are compared to the reference site. In 2009, Falling Branch Deer Creek (FBDC 4.1) was the reference site to which all other Group 1 and 2 Pennsylvania – Maryland interstate streams were compared. Located in Harford County, Md., FBDC 4.1 represented the best combination of biological, water quality, and habitat conditions in the Northern Piedmont Ecoregion (Omernik, 1987). Pennsylvania – Maryland sampling stations consisted of nine sites located on or near the border of these states. Of these nine sites, the macroinvertebrate communities of four sites (44 percent) were designated nonimpaired, using RBP III protocol designations. Four additional stations were slightly impaired, and one site (11 percent) was designated moderately impaired. The metrics that most often scored poorly were the Hilsenhoff Biotic Index and EPT Index, indicating that organic pollution may be the largest source of impairment within the Pennsylvania – Maryland region.

Fish community data were collected and analyzed at seven Group 1 and 2 stations in 2009. LNGA 2.5 and SCTT 3.0 will be electrofished in 2010. Of the seven sites where fish sampling took place, four sites (57 percent) received good fish IBI scores and three sites (43 percent) scored fair (Appendix B, Table B3).

The fishes caught in the highest abundance in the stations along the Pennsylvania – Maryland border included blacknose dace (*Rhinichthys atratulus*), American eels (*Anguilla rostrata*), and creek chubs (*Semotilus atromaculatus*). The most widespread fishes encountered were white suckers (*Catostomus commersonii*) and tessellated darters (*Etheostoma olmstedi*), which were captured at seven and six sites, respectively. Of the 31 species of fishes encountered in the Pennsylvania-Maryland stations, five were considered introduced species (16 percent). FBDC 4.1 had the highest catch per unit effort, with 10.77 individuals captured per minute.

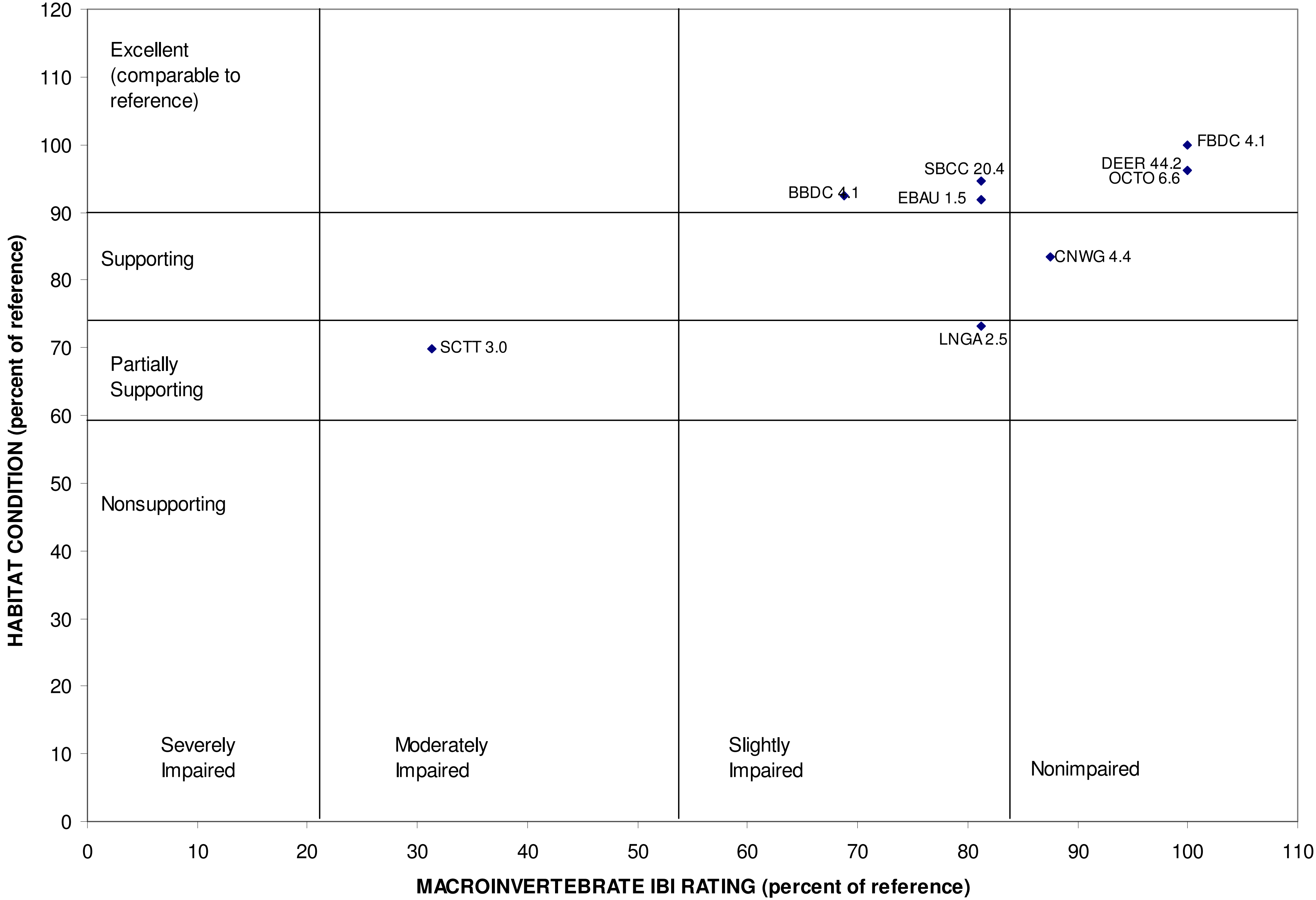
Highest scoring site and respective value for each metric (for PA-MD streams)

Metrics	Highest Scoring Site	Value
Number of native species	DEER 44.2	15
Number of benthic species	OCTO 6.6	4
Percent abundance of dominant species	DEER 44.2	13%
Percentage of tolerant species (EPA)	EBAU 1.5	25%
Number of individuals per square meter	FBDC 4.1	1.77

Six (67 percent) of the Pennsylvania – Maryland border sites had excellent habitats, while one (11 percent) had supporting habitat, and two (22 percent) had partially supporting habitat ratings.

As noted above, the reference site for this group of streams was Falling Branch Deer Creek (FBDC 4.1). DEER 44.2 also earned a good fish IBI score, nonimpaired macroinvertebrate IBI rating, and an excellent habitat assessment.

The chart below summarizes the biological and habitat data for the Pennsylvania - Maryland interstate streams sites.

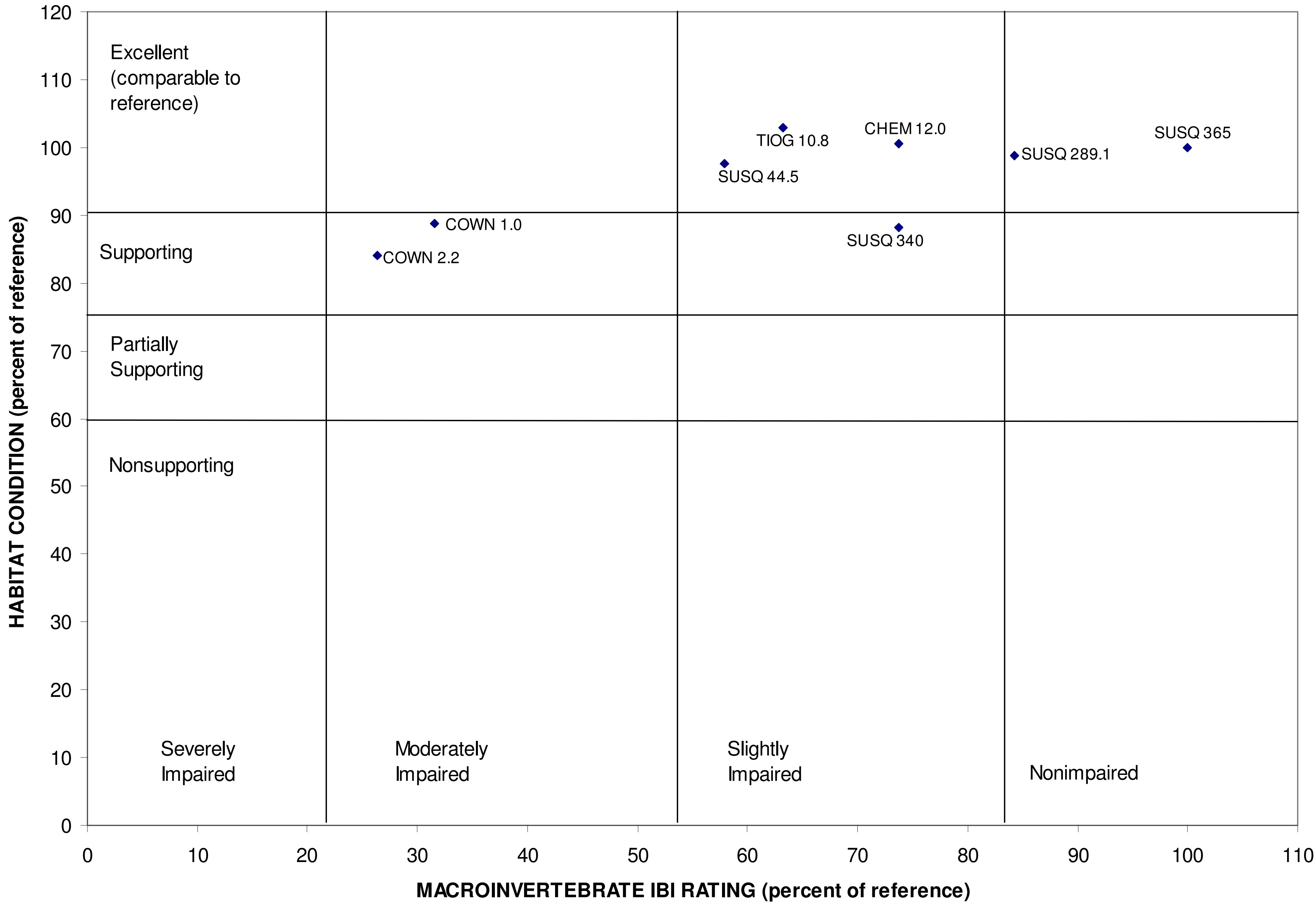

HABITAT CONDITION (percent of reference)
MACROINVERTEBRATE IBI RATING (percent of reference)
Excellent (comparable to reference)
Supporting
Partially Supporting
Nonsupporting
Severely Impaired
Moderately Impaired
Slightly Impaired
Nonimpaired
FBDC 4.1
DEER 44.2
OCTO 6.6
SBCC 20.4
BBDC 4.1
EBAU 1.5
CNWG 4.4
LNGA 2.5
SCTT 3.0

Results for 2009 River Site Assessments

Sites that represent the best available suite of conditions, in terms of biological community, water quality, and physical habitat for each group of stream sites are designated as reference sites. All other locations within that grouping are compared to the reference site. Specifically, in the large river classification, the Susquehanna, Chemung, Cowanesque, and Tioga Rivers at seven sites on the New York – Pennsylvania border and one site in southern Pennsylvania are examined as a reference group. In 2009, the Susquehanna River in Windsor, N.Y., (SUSQ 365) was the reference site to which all other large river sites were compared. This site on the Susquehanna River represented the best combination of biological, water quality, and habitat conditions of the eight sites sampled. The Susquehanna River downstream of the Conowingo Dam (SUSQ 10) was not included in this analysis because conditions prevented adequate macroinvertebrate collection and habitat assessment. The macroinvertebrate communities at two river sites (25 percent) received nonimpaired IBI ratings. Four river sites (50 percent) were slightly impaired, and two sites were designated as moderately impaired. Physical habitat at five river sites (63 percent) was excellent, while three sites (37 percent) were supporting.

The Susquehanna River at Windsor, N.Y., (SUSQ 365) possessed the best macroinvertebrate IBI rating and physical habitat was rated excellent. The Susquehanna River at Sayre, Pa., also received a nonimpaired macroinvertebrate IBI rating and excellent habitat assessment. The other two sites on the Susquehanna River (SUSQ 44.5 and SUSQ 340) received slightly impaired macroinvertebrate IBI ratings. The lowest macroinvertebrate IBI ratings of all interstate large river stations were located at the two sites on the Cowanesque River. Sampling on the Cowanesque River takes place directly downstream of the Cowanesque Reservoir in the river's primary recovery zone. COWN 2.2 is located directly below the outflow of the reservoir. This site received the lowest macroinvertebrate IBI rating and physical habitat assessment. Concerns with water quality also were observed. However, approximately one mile downstream on the Cowanesque River (COWN 1.0), minor improvements in the macroinvertebrate community and physical habitat were observed, indicating that this waterway shows recovery over a short distance after being impounded. The Tioga River is sampled near Lindley, N.Y. Water quality at TIOG 10.8 shows evidence of the abandoned mine drainage that influences the headwaters of this river, as total aluminum and manganese exceeded water quality standards in multiple sampling quarters. However, excellent physical habitat is present at this site and the macroinvertebrate community received a slightly impaired IBI rating. The Chemung River near Chemung, N.Y., also had metals concentrations exceeding water quality standards. However, the macroinvertebrate community at CHEM 12.0 received a slightly impaired macroinvertebrate IBI rating and physical habitat was rated excellent. Overall, the lowest scoring macroinvertebrate IBI metrics among large river interstate stations were Hilsenhoff Biotic Index, percent dominant taxa, and EPT taxa. For more in depth information regarding the Chemung and Susquehanna Rivers, refer to the Large River Assessment Project on the SRBC web site (www.srbc.net).

The chart below summarizes the biological and habitat data for the river interstate streams sites stations.


HABITAT CONDITION (percent of reference)
MACROINVERTEBRATE IBI RATING (percent of reference)
Excellent (comparable to reference)
Supporting
Partially Supporting
Nonsupporting
Severely Impaired
Moderately Impaired
Slightly Impaired
Nonimpaired
COWN 1.0
COWN 2.2
TIOG 10.8
SUSQ 44.5
CHEM 12.0
SUSQ 340
SUSQ 289.1
SUSQ 365

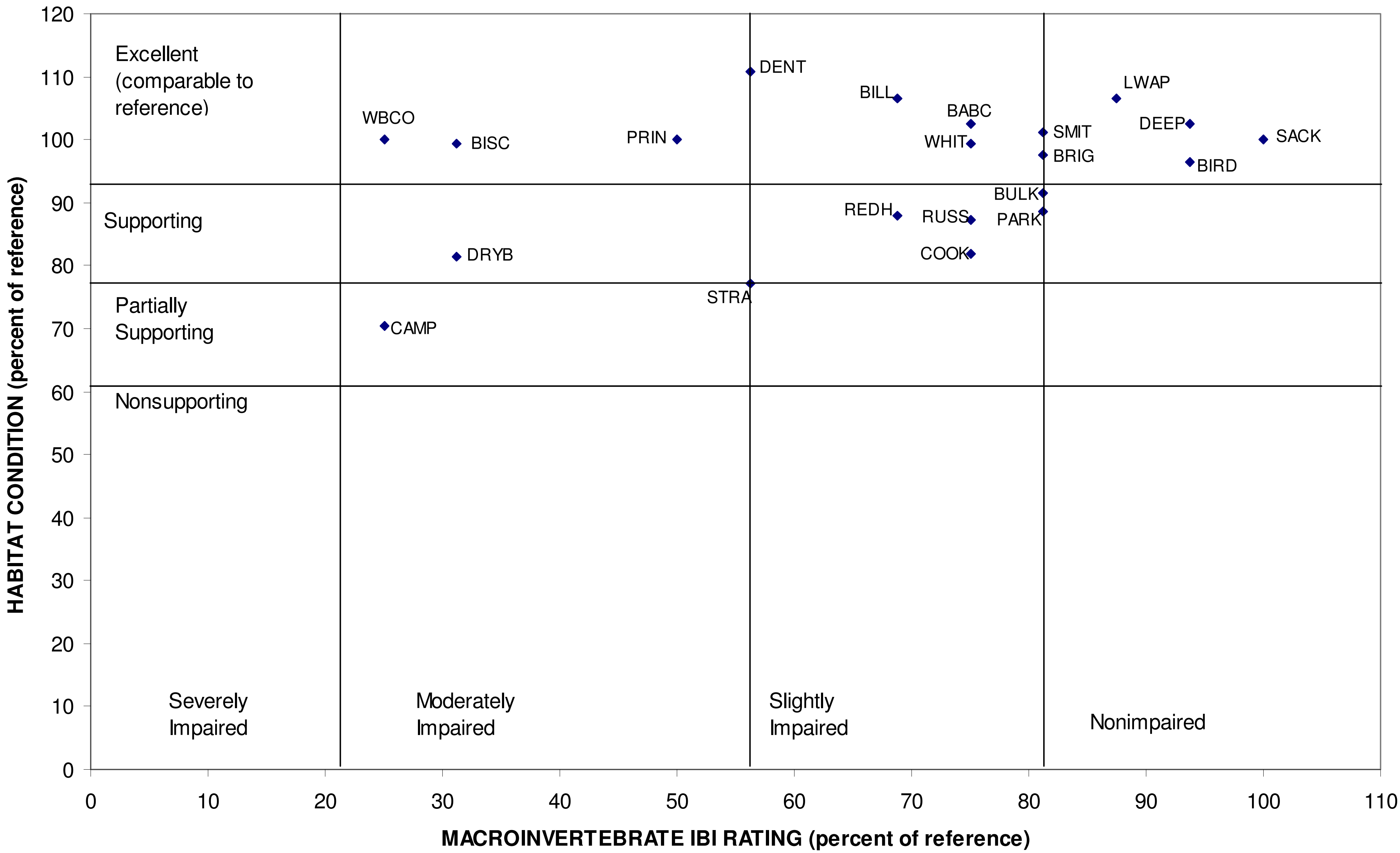
Results for 2009 Group 3 Site Assessments

Sites that represent the best available suite of conditions, in terms of biological community, water quality, and physical habitat for each group of stream sites are designated as reference sites. All other locations within that grouping are compared to the reference site. Specifically, in the Group 3 classification, many smaller streams along the New York – Pennsylvania border are examined. In 2009, Sackett Creek (SACK) in Tioga County, N.Y., was the reference site to which all other Group 3 streams were compared. SACK has shown a steady improvement in macroinvertebrate IBI ratings over the past five years, and scored the best among all 21 Group 3 stations in 2009. Physical habitat was excellent at SACK and no field chemistry parameters exceeded acceptable limits. Including SACK, six Group 3 stations (29 percent) received a nonimpaired macroinvertebrate IBI rating. Nonimpaired macroinvertebrate communities were found at Bird Creek (BIRD), Briggs Hollow (BRIG), Deep Hollow Brook (DEEP), Little Wappasening Creek (LWAP), and an unnamed tributary to Smith Creek (SMIT). Nine Group 3 stations (43 percent) received a slightly impaired macroinvertebrate IBI rating, while six additional stations were rated moderately impaired. Camp Brook and the White Branch Cowanesque River stations received the worst macroinvertebrate IBI ratings of all Group 3 stations. CAMP and WBCO scored poorly for percent dominant taxa, Hilsenhoff Biotic Index, EPT Index, and taxonomic richness metrics.

Physical habitat was rated excellent at 13 Group 3 stations (62 percent). Five stations (24 percent) received supporting physical habitat scores and habitat at three stations (14 percent) received partially supporting scores.

Alkalinity was the only field chemistry parameter to exceed acceptable limits at two (DEEP and DENT) out of 21 Group 3 stations.

The chart below summarizes the biological and habitat data for the Group 3 interstate streams sites.



HABITAT CONDITION (percent of reference)
MACROINVERTEBRATE IBI RATING (percent of reference)
Excellent (comparable to reference)
Supporting
Partially Supporting
Nonsupporting
Severely Impaired
Moderately Impaired
Slightly Impaired
Nonimpaired
WBCO
BISC
PRIN
DENT
BILL
BABC
WHIT
SMIT
BRIG
LWAP
DEEP
BIRD
SACK
DRYB
CAMP
STRA
REDH
RUSS
COOK
BULK
PARK
0
10
20
30
40
50
60
70
80
90
100
110
120

Water Quality Trends Analysis

Trends in water quality for the entire period of record (1986-2009) were analyzed using a Seasonal Kendall Test. Concentrations of each nine constituents were flow-adjusted. S-ESTREND, Version 1.2 software was used to analyze trends in water quality. Detailed results of trends analysis are presented in Appendix A, Tables A1-A9. Only total nitrogen and phosphorus concentration data were sufficient for trends analysis at Seeley Creek (SEEL 10.3). Seeley Creek was only sampled annually from 1988 to 1998, while other Group 1 sites were sampled quarterly.

Number of stations that were increasing, decreasing, or showed no trend for constituents of concern

Constituent	Increasing	None	Decreasing	NA
Total Solids	3	14	3	1
Total Nitrogen		5	1	15
Total Ammonia		7	11	3
Total Phosphorus		8	13	
Total Chlorides	11	9		1
Total Sulfate		2	18	1
Total Iron		11	9	1
Total Manganese		11	9	1
Total Aluminum		18	2	1

Total Suspended Solids

Trend analysis results for total suspended solids are presented in Appendix A, Table A1. Flow-adjusted concentration values at three stations (14 percent), BNTY 0.9, CAYT 1.7, and TIOG 10.8, showed significant, decreasing trends. Three additional stations (DEER 44.2, OCTO 6.6, and SUSQ 365) showed significant, increasing trends, while 14 sites (67 percent) showed no significant trends.

Total Nitrogen

Trends analysis results for total nitrogen are presented in Appendix A, Table A2. Laboratory analysis of total nitrogen has only been completed for the interstate streams project since 2000. Therefore, the nine year data-set was not sufficient for trends analysis in 15 of 21 stations. Flow-adjusted concentration values at one station (5 percent), EBAU 1.5, showed significant, decreasing trends. Five additional stations had sufficient data to perform trends analysis, but these stations did not show any significant trends.

Total ammonia

Trends analysis results for total ammonia are presented in Appendix A, Table A3. No stations showed increasing trends in flow-adjusted concentrations of ammonia. Eleven stations (52 percent), CAYT 1.7, CHEM 12.0, COWN 2.2, DEER 44.2, EBAU

1.5, OCTO 6.6, SCTT 3.0, SUSQ 289.1, SUSQ 340, SUSQ 365, and TIOG 10.8, showed significantly decreasing trends in flow-adjusted concentrations of total ammonia. Seven stations (33 percent) showed no significant trends.

Total phosphorus

Trends analysis results for total phosphorus are presented in Appendix A, Table A4. Flow-adjusted concentrations of total phosphorus at 13 stations (62 percent) showed significantly decreasing trends. These stations included CASC 1.6, CHEM 12.0, DEER 44.2, LSNK 7.6, OCTO 6.6, SCTT 3.0, SEEL 10.3, and TIOG 10.8, as well as all stations on the Susquehanna River. Trends in concentrations of phosphorus were not significant at eight stations (38 percent).

Total chloride

Trends analysis results for total chloride are presented in Appendix A, Table A5. Flow-adjusted concentrations of total chloride showed significant, increasing trends at 11 stations (52 percent). The stations with increasing trends included CHEM 12.0, CNWG 4.4, DEER 44.2, LNGA 2.5, OCTO 6.6, and TRUP 4.5, as well as all stations on the Susquehanna River. Trends in concentrations of chloride were not significant at nine stations (43 percent).

Total sulfate

Trends analysis results for total sulfate are presented in Appendix A, Table A6. Flow-adjusted concentrations of total sulfate showed significantly increasing trends at 18 stations (86 percent). No significant trends in concentrations of sulfate were observed at CASC 1.6 and SCTT 3.0 (10 percent of stations), while data at SEEL 10.3 were insufficient for trends analysis.

Total iron

Trends analysis results for total iron are presented in Appendix A, Table A7. Flow-adjusted concentrations of total iron showed significantly decreasing trends at nine stations (43 percent). Stations with decreasing trends of iron concentrations included CASC 1.6, CAYT 1.7, CNWG 4.4, DEER 44.2, LNGA 2.5, LSNK 7.6, OCTO 6.6, SUSQ 44.5, and SUSQ 340. No significant trends in concentrations of iron were observed at 11 stations (52 percent).

Total manganese

Trends analysis results for total manganese are presented in Appendix A, Table A8. Flow-adjusted concentrations of total manganese showed significantly decreasing trends at nine stations (43 percent). Stations with decreasing trends of manganese concentrations included CASC 1.6, CHEM 12.0, CNWG 4.4, DEER 44.2, LSNK 7.6, SCTT 3.0, SUSQ 10.0, SUSQ 44.5, and TIOG 10.8. No significant trends in concentrations of manganese were observed at 11 stations (52 percent).

Total aluminum

Trends analysis results for total aluminum are presented in Appendix A, Table A9. Flow-adjusted concentrations of total aluminum showed significantly decreasing trends at two stations (10 percent). No significant trends in concentrations of aluminum were observed at 18 stations (86 percent).

Bioassessment of Interstate Streams

Summaries of all stations that include WQI scores, parameters that exceeded water quality standards, and parameters that exceeded the 90^{th} percentile at each station are available at www.srbc.net/interstate_streams. RBP III biological and habitat data also are provided, along with graphs depicting historical water quality and biological conditions over the past five years. A white bar indicates calendar year 2008 WQI scores, and black bars in all WQI graphs indicate previous WQI scores. Abbreviations for water quality standards are provided below.

Abbreviation	Parameter	Abbreviation	Parameter
ALK	Alkalinity	TNO_3	Total Nitrate
COND	Conductivity	TN	Total Nitrogen
TAl	Total Aluminum	DO	Dissolved Oxygen
TCa	Total Calcium	TP	Total Phosphorus
TCl	Total Chloride	TPO_4	Total Orthophosphate
TFe	Total Iron	TS	Total Solids
TMg	Total Magnesium	TSO_4	Total Sulfate
TMn	Total Manganese	TOC	Total Organic Carbon
TNH_3	Total Ammonia	TURB	Turbidity
TNO_2	Total Nitrite	WQI	Water Quality Index
TCln	Total Chorine	RBP	Rapid Bioassessment Protocol
SS	Suspended Sediment	TEMP	Water Temperature