ASSESSMENT OF INTERSTATE STREAMS IN THE SUSQUEHANNA RIVER BASIN

Monitoring Report No. 22
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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 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.

One of the functions of the Susquehanna River Basin Commission (SRBC) is to review 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 303(d) listing and possible Total Maximum Daily Load (TMDL) development; and (6) identify areas for restoration and protection. Biological conditions are assessed using benthic macroinvertebrate 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.

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. Beginning this year, the interstate streams project changed from the traditional fiscal year approach to a new calendar year reporting period. In order to make this transition, the current report contains analyses on monitoring data from one and one half years, from July 1, 2007–December 31, 2008. The calendar year 2009 report will include data collected between January 1, 2009 and December 31, 2009. In addition to routine field sampling and data analysis, fish sampling will occur at selected Group 1 and 2 streams in May 2009. Reports typically are completed during the following summer for the data from the previous fiscal 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.

2007 data can be found in the fiscal year 2006 (FY-06) archive on the Interstate Streams web page. Recent reports are available online from 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.

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.

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, pH, alkalinity, and acidity are measured in the field. Dissolved oxygen is measured using a YSI model 55-dissolved oxygen meter that is calibrated at the beginning of each day when water samples are collected. Conductivity is measured with a Cole-Parmer Model 1481 meter. A Cole-Parmer Model 5996 meter is used to measure pH. The pH meter is calibrated at the beginning of the day and randomly checked throughout the day. Alkalinity is 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.

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.

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-2009 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 <u>Trends in Nitrogen, Phosphorus, and Suspended Sediment in the Susquehanna River Basin, 1974-93</u> (Edwards, 1995), LeFevre (2003), and other previous Interstate reports.

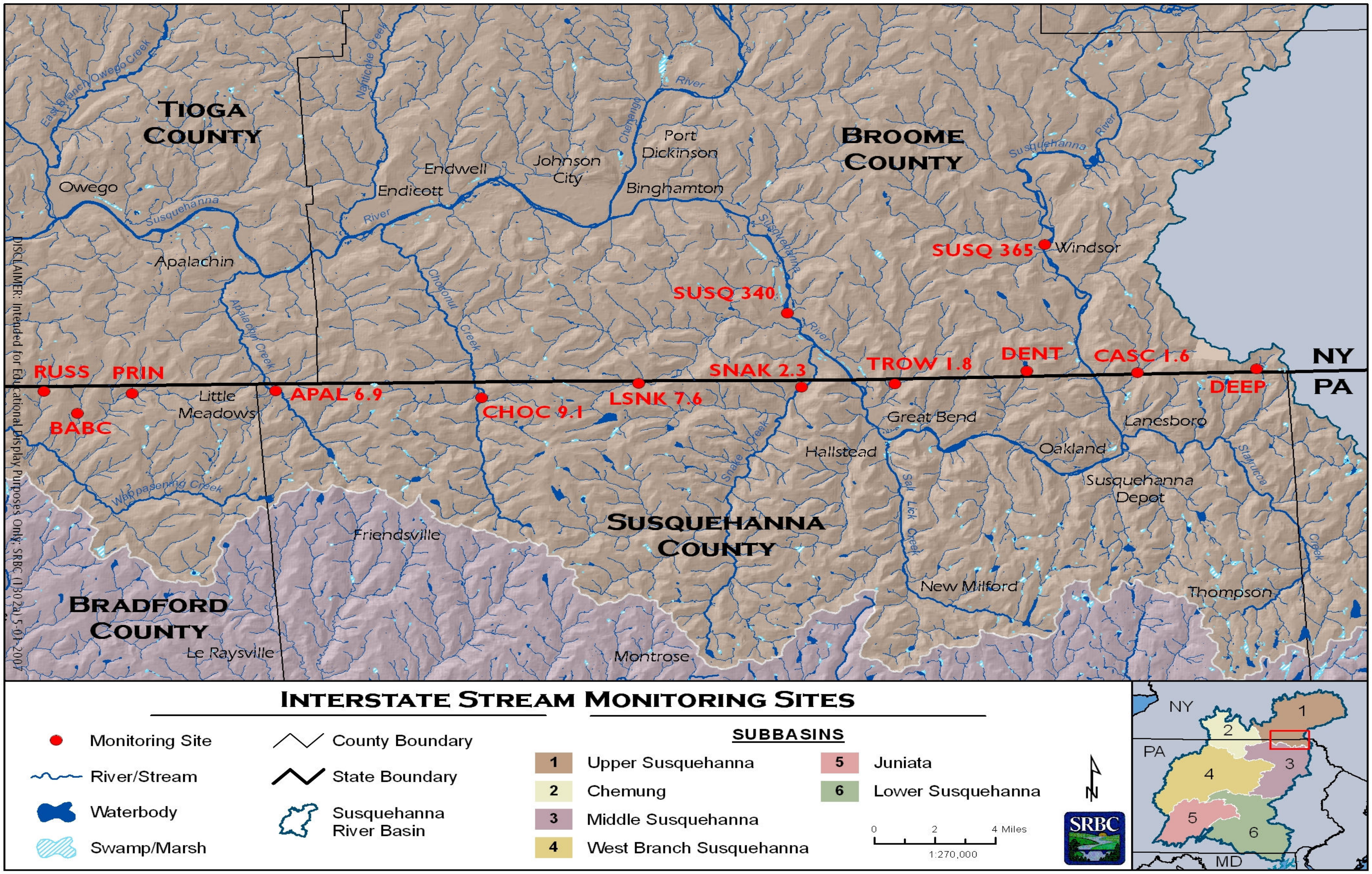
List of New York- Pennsylvania Interstate Streams

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

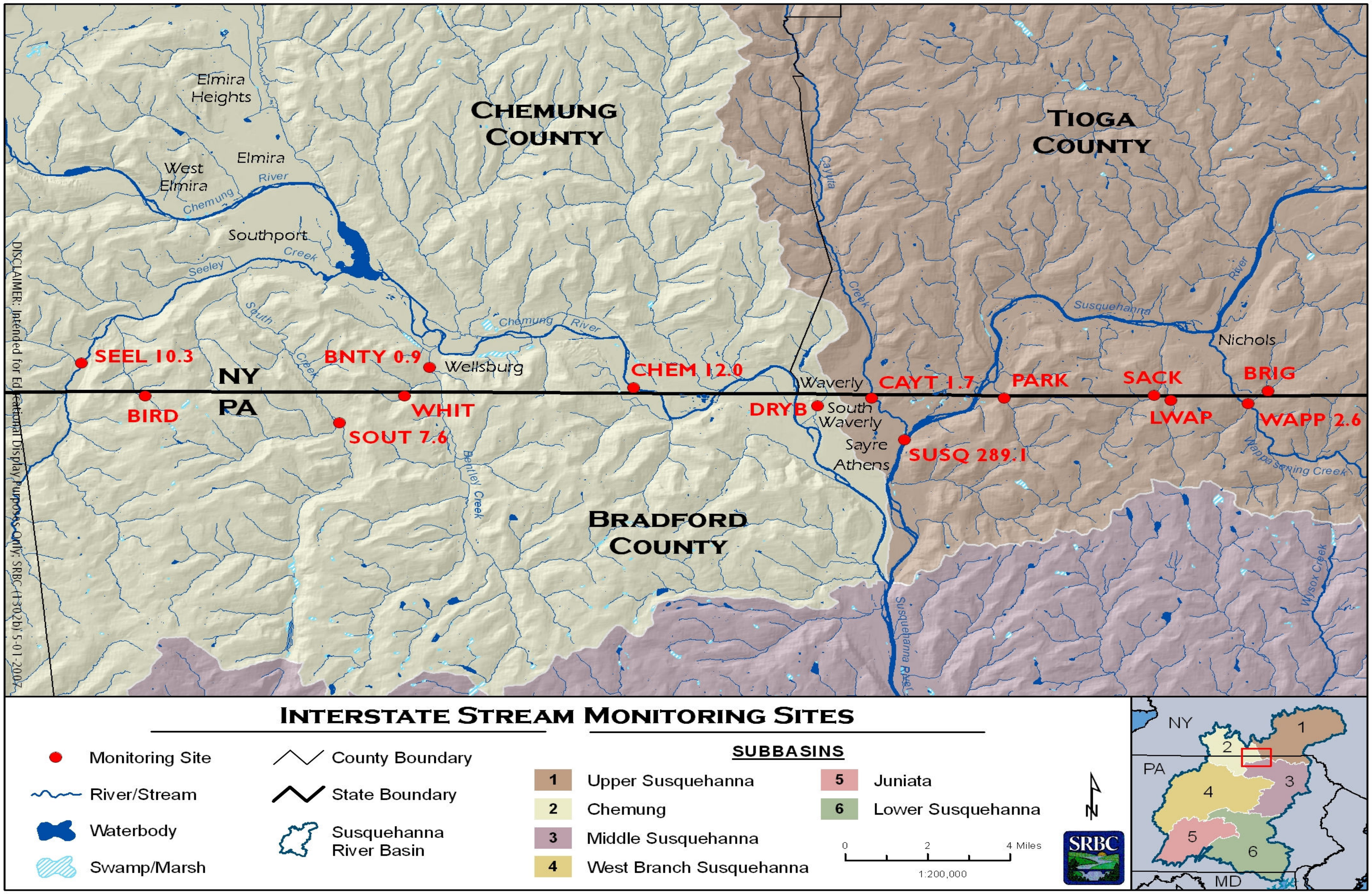
List of Pennsylvania-Maryland Interstate Streams

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

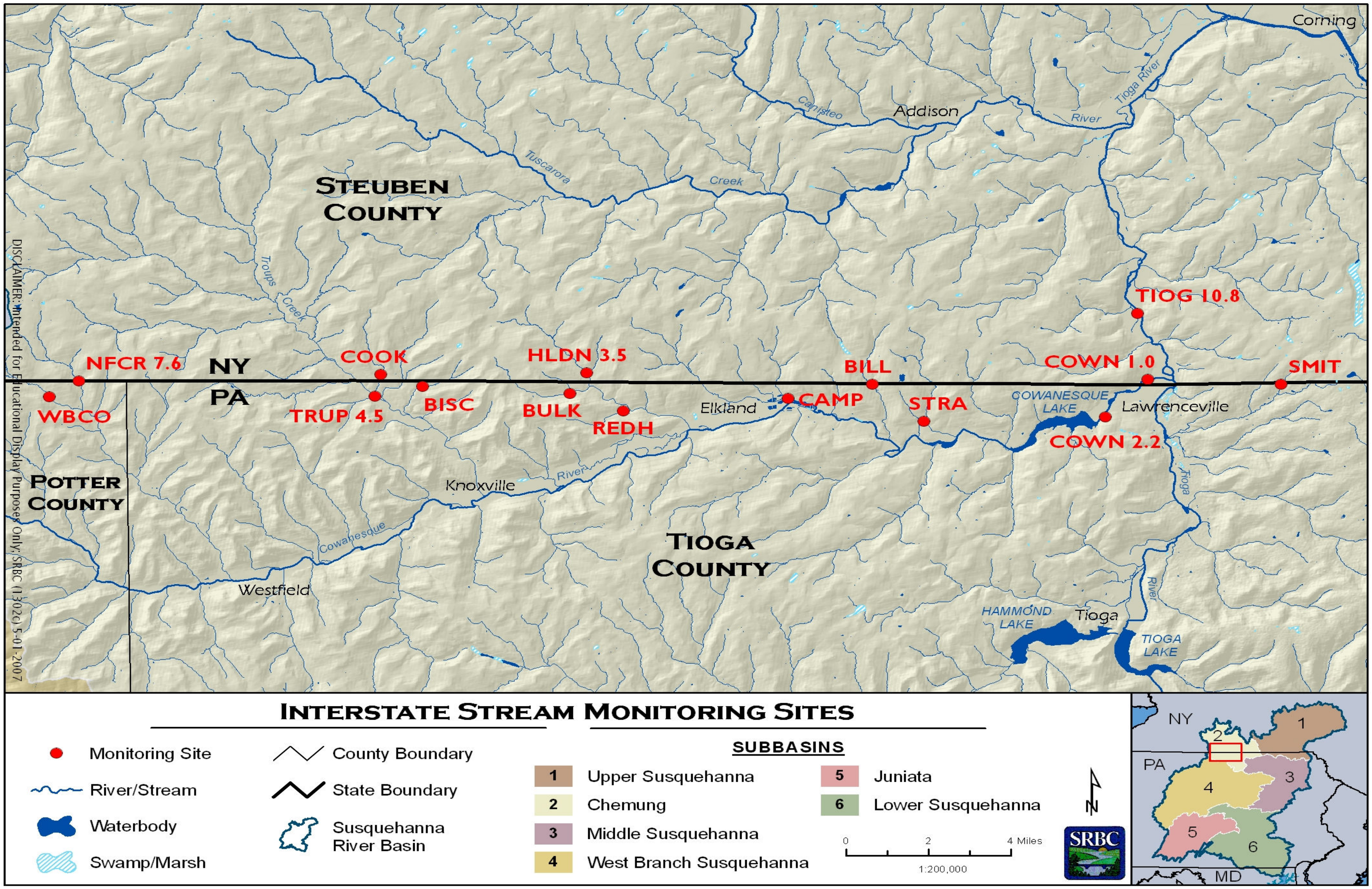
*denotes no macros were collected in 2007
+denotes no macros were collected in 2008



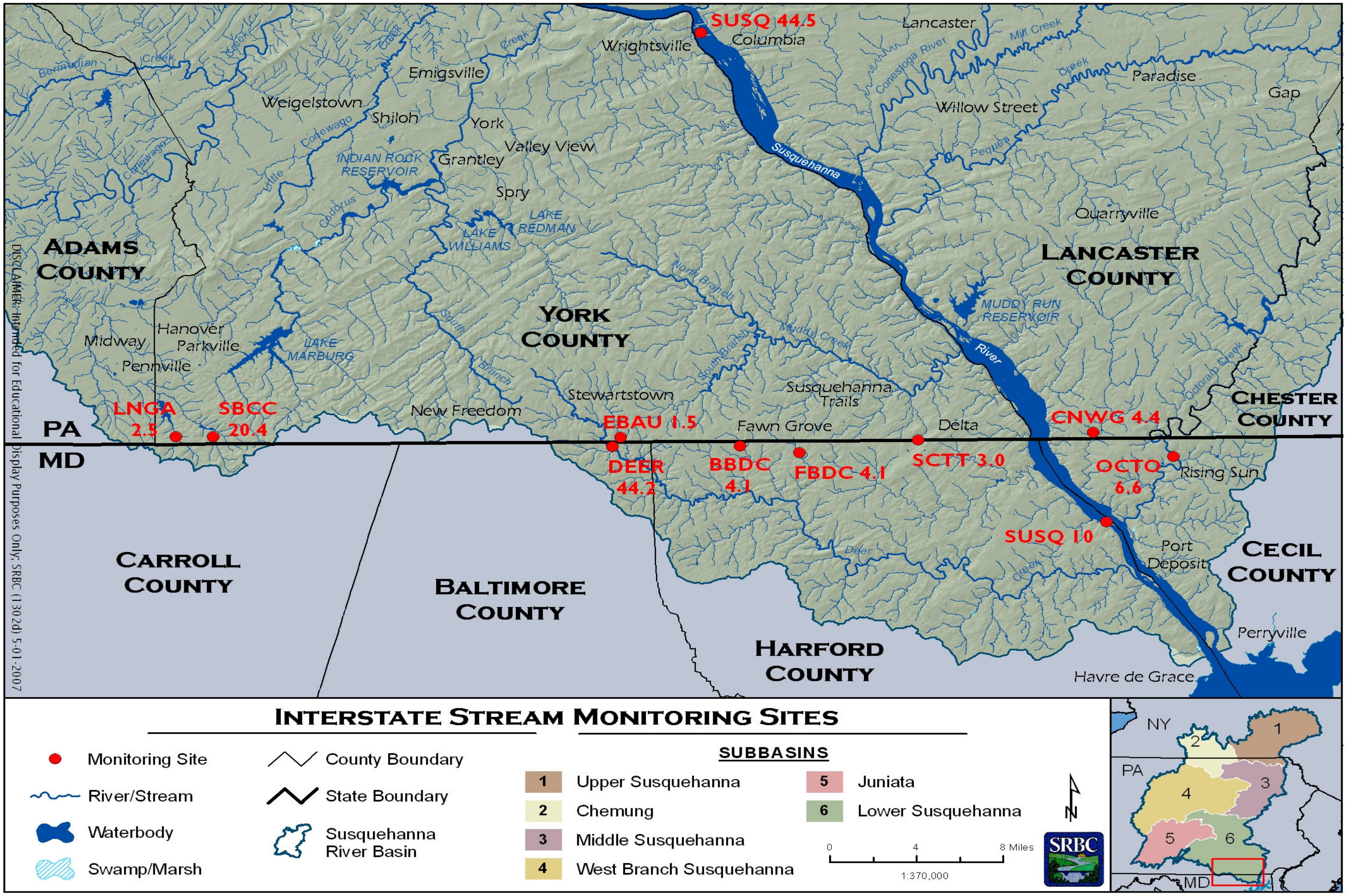
Map of New York-Pennsylvania Interstate Streams (eastern section)



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				
	Biological Condition Scoring Criteria			
Metric	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)				

↓
↓
↓

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)				

↓

↓

↓

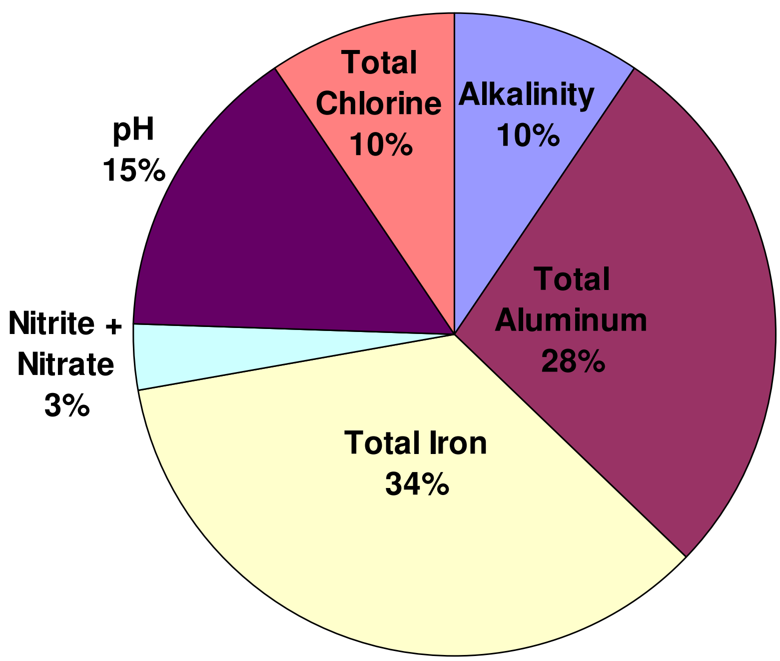
HABITAT ASSESSMENT	
Percent Comparability of Study and Reference Site Habitat Assessment Scores	Habitat Condition Category
>90	Excellent (comparable to reference)
89-75	Supporting
74-60	Partially Supporting
<60	Nonsupporting

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

Results

Water Quality

The calendar year 2008 (CY-08) report included water quality data collected from July 1, 2007 to December 31, 2008, encompassing six sampling quarters. Group 1 streams were sampled six times, Group 2 streams were sampled twice, and field chemistry was measured at Group 3 streams once. The parameter that most often exceeded standards was total iron, followed closely by total aluminum. Approximately 22 percent of the Group 1 and 2 Interstate streams continued to meet designated use classes and water quality standards. Twenty five out of the 32 sites had at least one parameter exceeding acceptable limits, with 18 of those having more than one violation. Water quality decreased in CY-08, compared to last year (FY-07). However, the CY-08 water quality analysis included six water quality samples, while FY-07 included only four samples. The larger number of samples could increase the likelihood of finding a parameter that exceeds water quality standards. Overall, 94 out of a possible 1285 observations (based on the number of applicable water quality standards for each state) exceeded water quality standards.

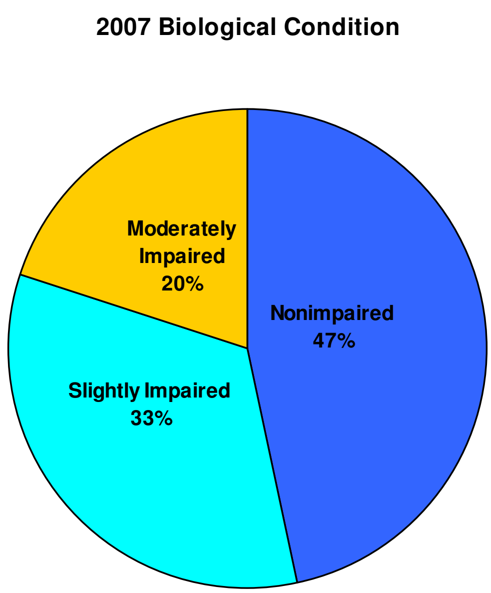


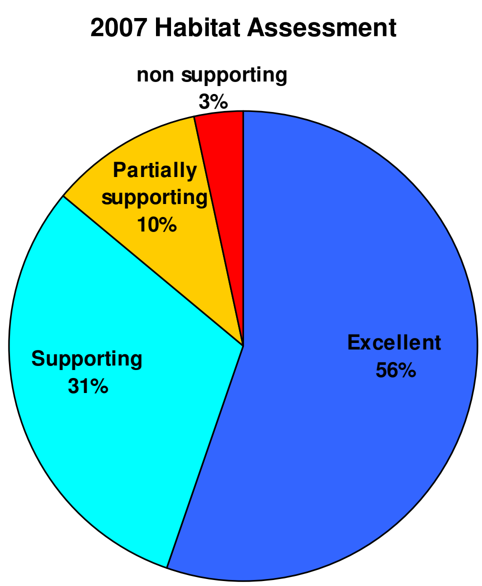
Parameters Exceeding Water Quality Standards

Parameter	Standard	Standard Value	Number of Observations	Number Exceeding Standards
Alkalinity	Pa. aquatic life	20 mg/l	148	9
Total Aluminum	N.Y. aquatic (chronic)	100 µg/l	88	26
Total Chlorine	N.Y. aquatic (acute) Md. aquatic life	0.019 mg/l 0.019 mg/l	4 5	4 5
Dissolved Oxygen	Pa. aquatic life	5.0 mg/l	148	0
Total Iron	N.Y. aquatic (chronic) Pa. aquatic life	300 µg/l 1500 µg/l	88 142	32 7
Nitrate plus Nitrate	Pa. public water supply	10 mg/l	142	3
pH	N.Y. general Md. aquatic life	6.5-8.5 6.5-8.5	94 54	5 9
Turbidity	Md. aquatic life	150 NTU	54	0

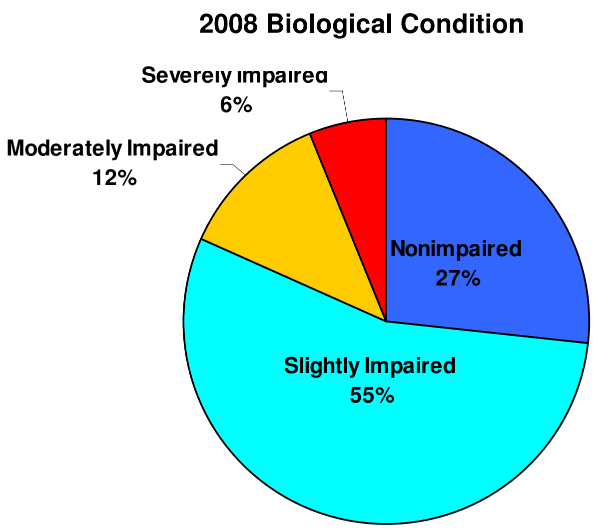
Macroinvertebrates and Habitat

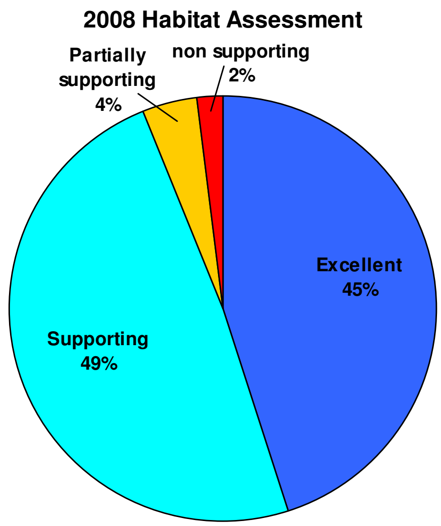
For the current report, Group 1 and 2 macroinvertebrate samples from 2007 and 2008 were analyzed, while the analysis for Group 3 streams encompassed only 2008 samples. In 2007, 14 of the 30 interstate streams sites at which macroinvertebrate samples were collected contained nonimpaired biological communities. Biological conditions at another 10 sites were slightly impaired, while six sites were moderately impaired. Sixteen sites had excellent habitats, nine sites had supporting habitats, three sites had partially supporting habitats, and one site was designated as having non supporting habitat.





Out of the 49 interstate streams sites where macroinvertebrates were sampled in 2008, 13 sites were nonimpaired, 27 sites were slightly impaired, six sites were moderately impaired, and three sites were severely impaired. Twenty-two sites had excellent habitats, 24 sites had supporting habitats, two sites had partially supporting habitats, and one site was designated as having non supporting habitat. It is important to note that Group 3 sites were absent from the 2007 analysis. Group 3 streams have historically had lower biological condition scores and habitat rankings, which may have affected the overall percentages shown above.



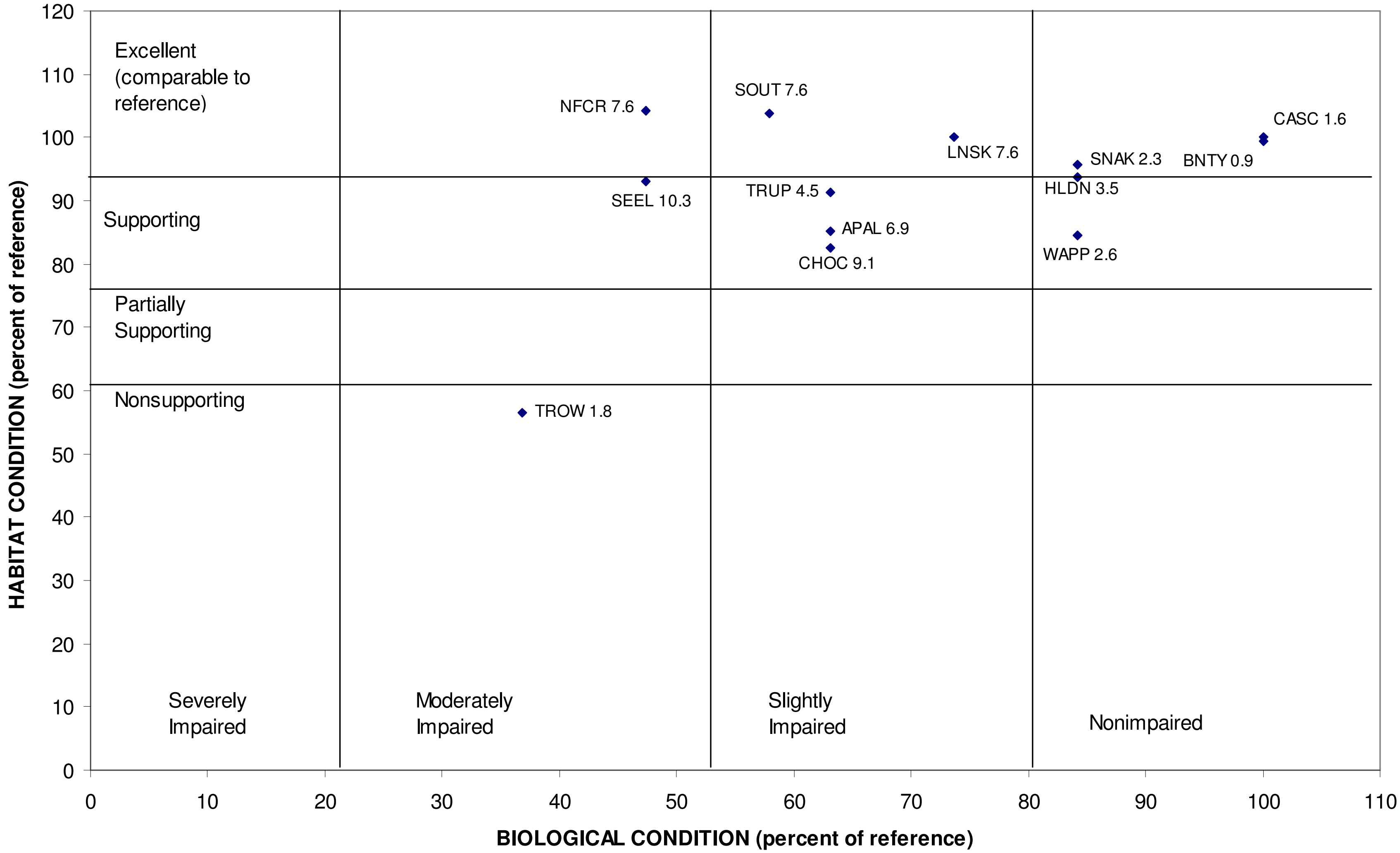


Results for 2007 New York–Pennsylvania Stream Assessments

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 2007, Cascade Creek (CASC 1.6) was the reference site to which all other Group 1 and 2 New York–Pennsylvania interstate streams were compared. Located near Cascade Valley, N.Y., CASC 1.6 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 14 sites located near or on the border of these states. Of these 14 sites, the biological communities of five sites (36 percent) were nonimpaired. Six stream sites (43 percent) were slightly impaired, and three sites (21 percent) were designated as moderately impaired. During the summer sampling quarter of 2007, habitat was not evaluated at Cayuta Creek (CAYT 1.7) due to high flows. Out of the 13 remaining habitat classifications, seven sites (54 percent) were rated excellent, and five sites (38 percent) were rated supporting. One site received a non supporting habitat classification in 2007.

The only site to receive a non supporting habitat classification was Trowbridge Creek (TROW 1.8), which appears to have a history of dredging. Possibly due to this disruption of habitat, TROW 1.8 received the lowest bioassessment score of its group and was classified as moderately impaired. However, it is interesting to note that TROW 1.8 had the lowest water quality index (WQI) value of all New York Group 1 and 2 streams in the summer of 2007, meaning that excellent water quality is found within this stream. CASC 1.6 served as the reference stream in 2007 with top ratings for biological condition and physical habitat. Water quality is a concern at CASC 1.6, where metals such as aluminum and iron often exceed water quality standards. However, throughout 20 years of interstate stream sampling, metals often have exceeded water quality standards, possibly due to local geology.

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



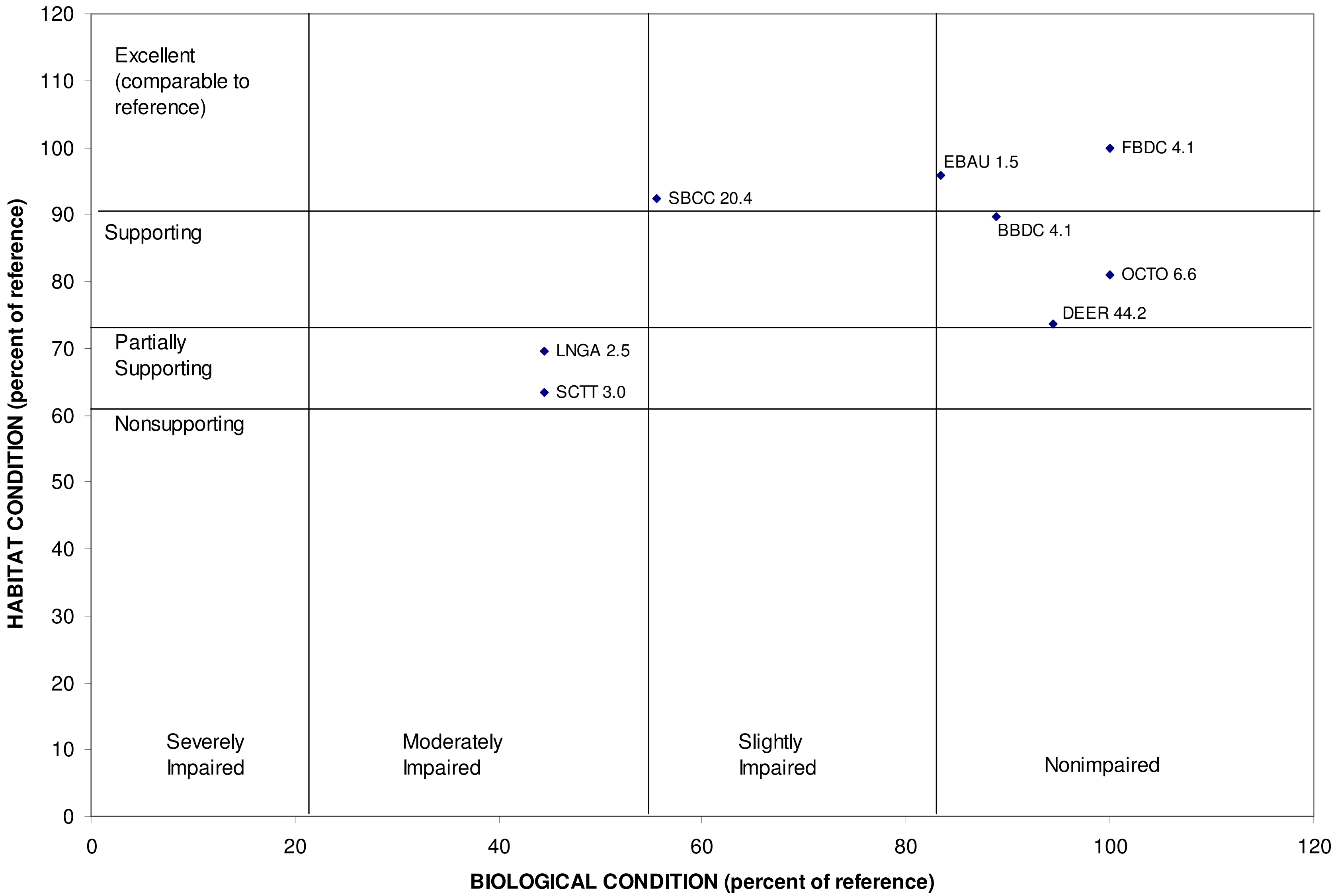
HABITAT CONDITION (percent of reference)
BIOLOGICAL CONDITION (percent of reference)
Excellent (comparable to reference)
Supporting
Partially Supporting
Nonsupporting
Severely Impaired
Moderately Impaired
Slightly Impaired
Nonimpaired
NFCR 7.6
SOUT 7.6
CASC 1.6
LNSK 7.6
SNAK 2.3
BNTY 0.9
HLDN 3.5
SEEL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

Results for 2007 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 2007, 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 eight sites located on or near the border of these states. Of these eight sites, the biological communities of five sites (63 percent) were designated nonimpaired, using RBP III protocol designations. One stream site (12 percent) was slightly impaired, and two sites (25 percent) were designated moderately impaired. Three (38 percent) of the Pennsylvania–Maryland border sites had excellent habitats, while three more had supporting habitats, and two (25 percent) had partially supporting habitats. During the summer sampling quarter of 2007, macroinvertebrates were not collected and habitat was not evaluated at the Conowingo Creek site (CNWG 4.4) due to access issues.

As noted above, the reference site for this group of streams was Falling Branch Deer Creek (FBDC 4.1). This site had the second best WQI value and the top biological and habitat scores. Six other streams along the Pennsylvania–Maryland border were comparable with FBDC 4.1, having either a nonimpaired biological condition, excellent habitat, or both. Long Arm Creek (LNGA 2.5) and Scott Creek (SCTT 3.0) were two of the worst scoring interstate streams in this group. Both stream sites received a moderately impaired biological condition and a partially supporting habitat rating. LNGA 2.5 suffers from poor habitat due to little flow, as it is located in a backwater area of the Long Arm Reservoir. SCTT 3.0 is downstream of the Delta Borough sewage treatment plant discharge and also has problems with nutrients, siltation, and flow variability.

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



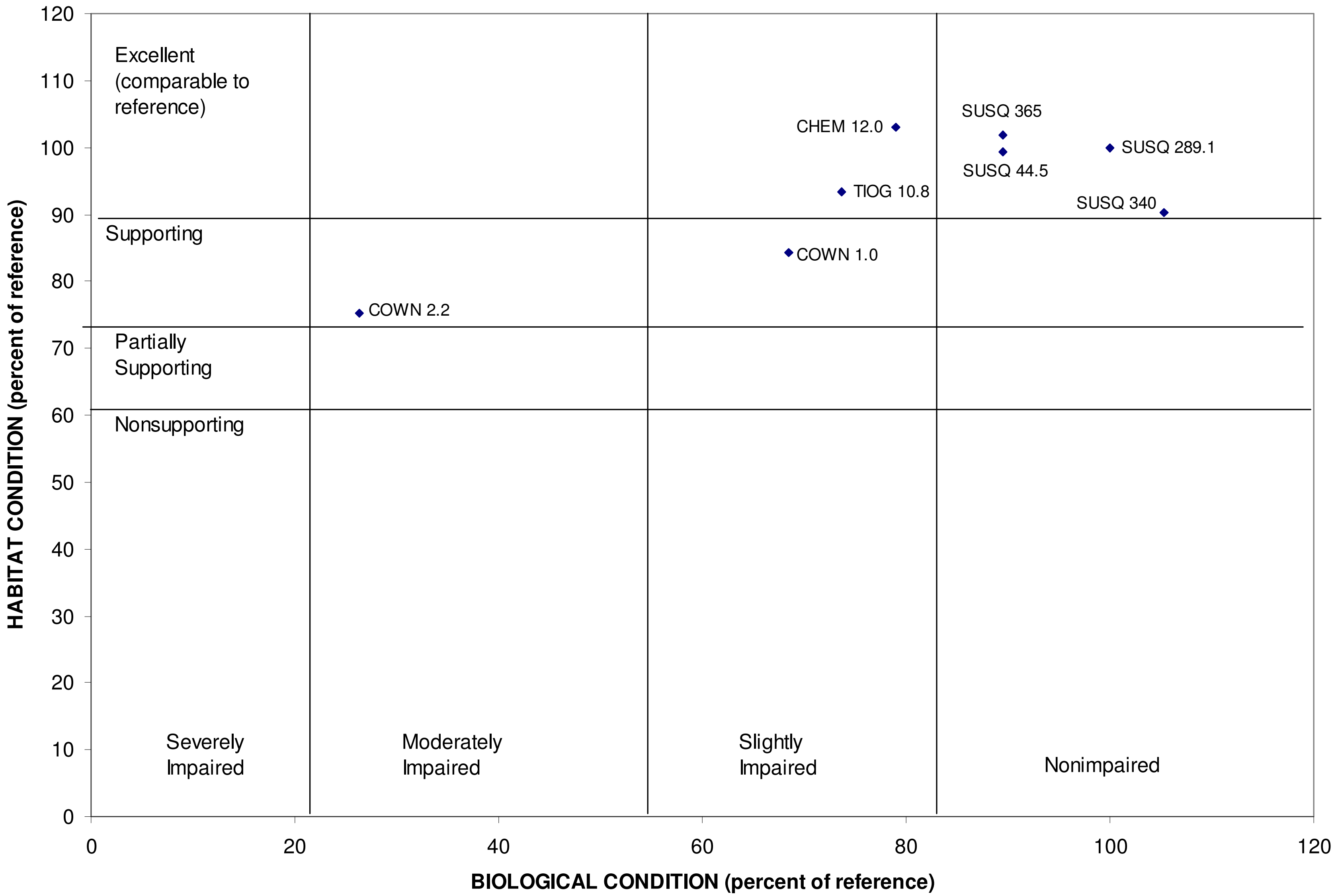
Excellent (comparable to reference)
Supporting
Partially Supporting
Nonsupporting
Severely Impaired
Moderately Impaired
Slightly Impaired
Nonimpaired
FBDC 4.1
EBAU 1.5
SBCC 20.4
BBDC 4.1
OCTO 6.6
DEER 44.2
LNGA 2.5
SCTT 3.0
HABITAT CONDITION (percent of reference)
BIOLOGICAL CONDITION (percent of reference)
0
10
20
30
40
50
60
70
80
90
100
110
120

Results for 2007 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 2007, the Susquehanna River in Sayre, Pa., (SUSQ 289.1) 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 prevent adequate macroinvertebrate collection and habitat assessment. The biological communities at four river sites (50 percent) were nonimpaired. Three river sites (38 percent) were slightly impaired, and one site (12 percent) was designated as moderately impaired. Physical habitat at six river sites (75 percent) was excellent, while one site (12 percent) was supporting, and the remaining site was partially supporting.

The Susquehanna River at Sayre, Pa., (SUSQ 289.1) did not possess the best biological condition score. This site ranked second to the Susquehanna River at Kirkwood, N.Y., (SUSQ 340.0). However, habitat at SUSQ 289.1 was far better than SUSQ 340. For this reason, SUSQ 289.1 served as the reference site in 2007. The four sites on the Susquehanna River (SUSQ 44.5, SUSQ 289.1, SUSQ 340, and SUSQ 365) were designated as having a nonimpaired biological condition and excellent habitat in 2007, which is an indication of relative river health for this large system. The lowest scores for biological condition and physical habitat were both located at the Cowanesque River, directly downstream of the Cowanesque Reservoir (COWN 2.2) in the river's primary recovery zone. This site was designated as having a moderately impaired biological community and partially supporting physical habitat. However, about one mile downstream on the Cowanesque River (COWN 1.0), conditions rebounded to slightly impaired biological and supporting habitat designations.

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



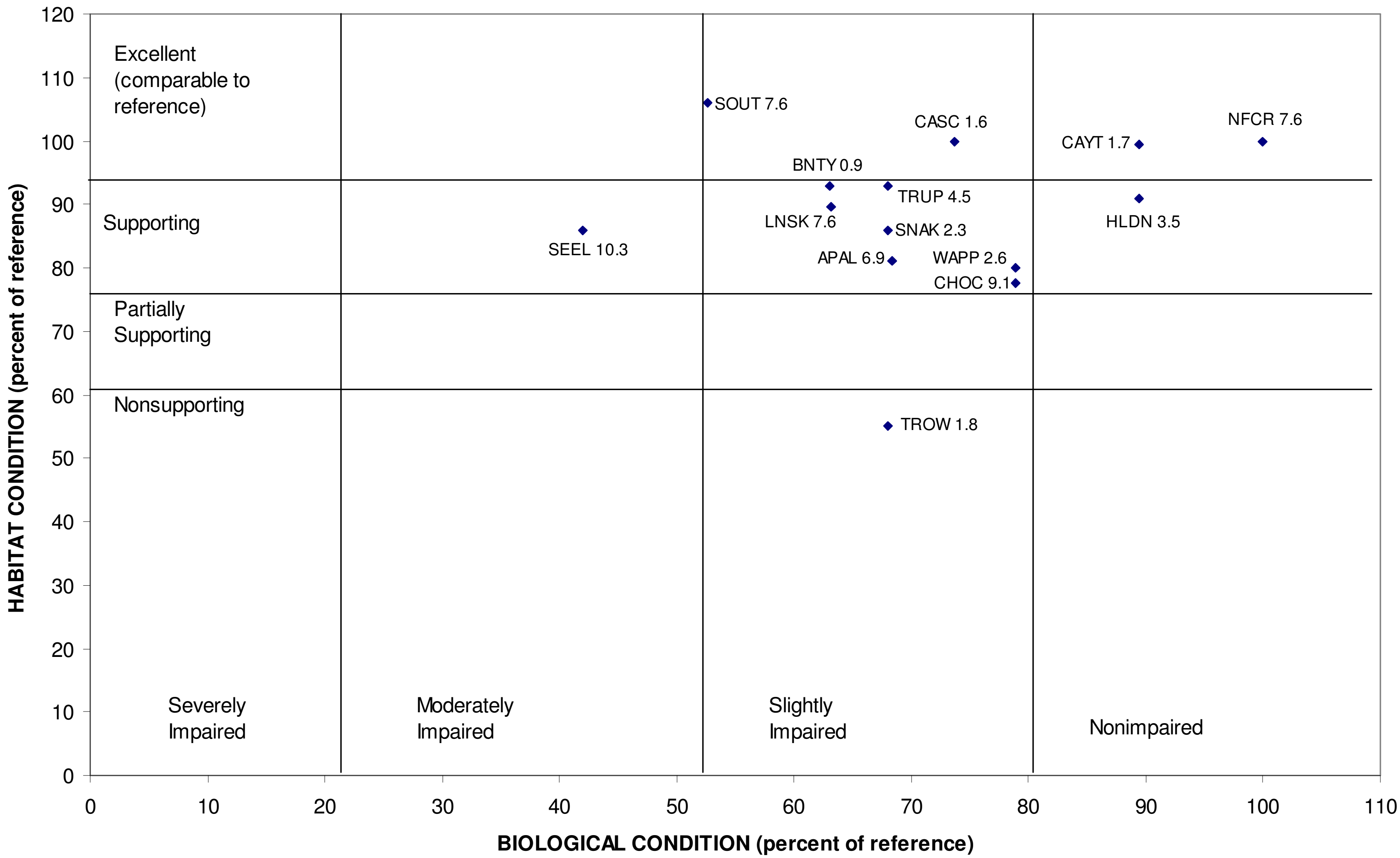
HABITAT CONDITION (percent of reference)
BIOLOGICAL CONDITION (percent of reference)
Excellent (comparable to reference)
Supporting
Partially Supporting
Nonsupporting
Severely Impaired
Moderately Impaired
Slightly Impaired
Nonimpaired
CHEM 12.0
SUSQ 365
SUSQ 289.1
SUSQ 44.5
TIOG 10.8
SUSQ 340
COWN 1.0
COWN 2.2
0
10
20
30
40
50
60
70
80
90
100
110
120
0
20
40
60
80
100
120

Results for 2008 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 2008, the North Fork Cowanesque River (NFCR 7.6) was the reference site to which all other Group 1 and 2 New York–Pennsylvania interstate streams were compared. Located near North Fork, Pa., NFCR 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 14 sites located near or on the border of these states. Of these 14 sites, the biological communities of three sites (21 percent) were nonimpaired. Ten stream sites (71 percent) were slightly impaired, and one site (7 percent) was designated as moderately impaired. Further, physical habitat at six sites (43 percent) was rated excellent, and seven sites (50 percent) were rated supporting. One site received a nonsupporting habitat classification in 2008.

Trowbridge Creek (TROW 1.8) was the only site that received a non supporting habitat classification for the second year in a row. However, TROW 1.8 improved biologically to slightly impaired and continued to possess the best water quality of the group, with the lowest water quality index value. Cascade Creek (CASC 1.6) retained its excellent habitat in 2008, but declined to a slightly impaired biological designation after serving as the reference site in 2007. The only site designated as having a moderately impaired biological condition in 2008 was Seeley Creek (SEEL 10.3). The North Fork Cowanesque River (NFCR 7.6) served as the reference stream in 2008 with top ratings for biological condition and physical habitat. NFCR 7.6 showed major improvement with regard to biological condition compared to 2007, when it received a moderately impaired biological condition.

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



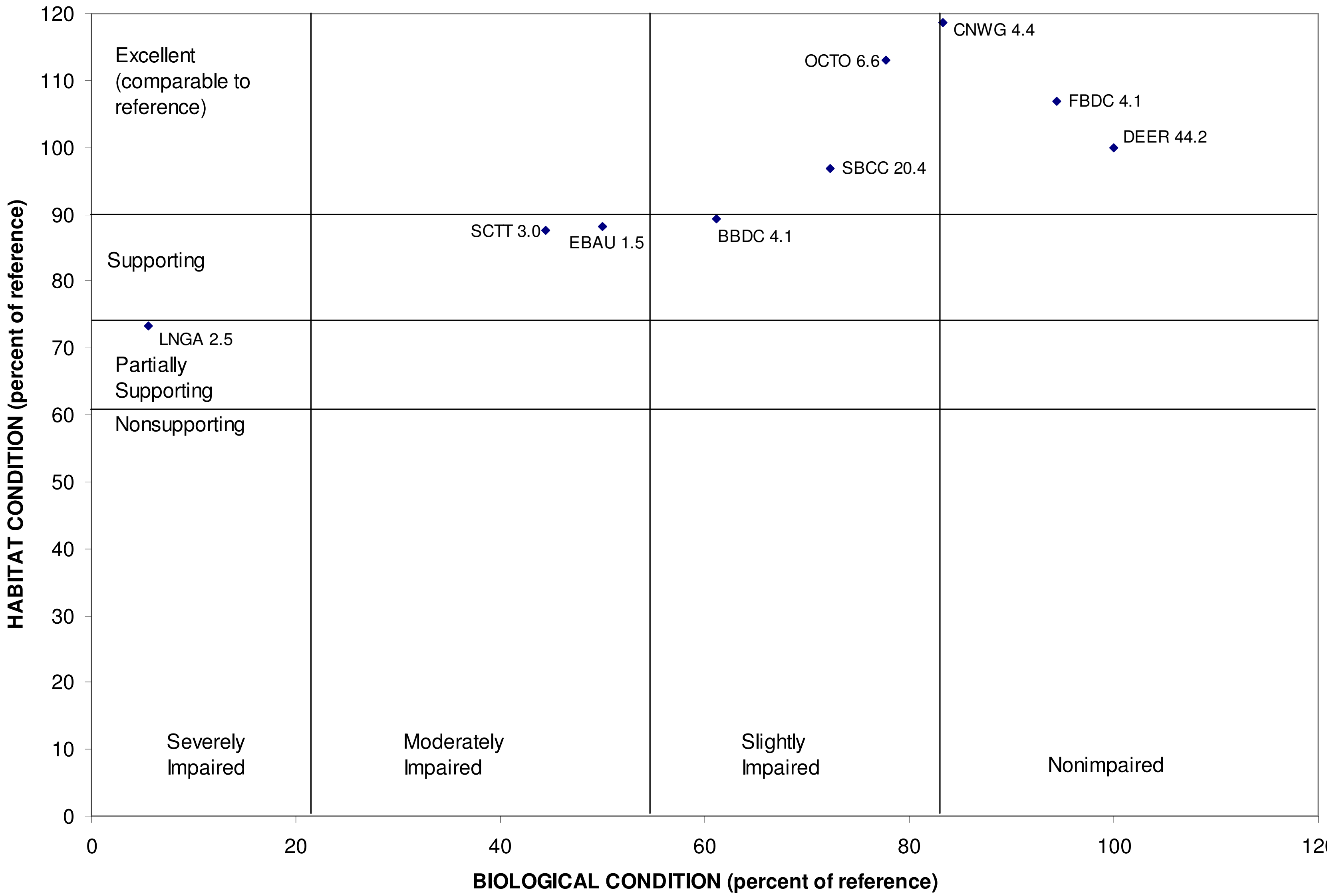
Excellent (comparable to reference)
Supporting
Partially Supporting
Nonsupporting
Severely Impaired
Moderately Impaired
Slightly Impaired
Nonimpaired
SOUT 7.6
CASC 1.6
NFCR 7.6
CAYT 1.7
BNTY 0.9
TRUP 4.5
LNSK 7.6
SNAK 2.3
HLDN 3.5
SEEL 10.3
APAL 6.9
WAPP 2.6
CHOC 9.1
TROW 1.8
HABITAT CONDITION (percent of reference)
BIOLOGICAL CONDITION (percent of reference)
0
10
20
30
40
50
60
70
80
90
100
110
120

Results for 2008 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 2008, Deer Creek (DEER 44.2) was the reference site to which all other Group 1 and 2 Pennsylvania–Maryland interstate streams were compared. Located near Gorsuch Mills, Md., DEER 44.2 represented the best combination of biological, water quality, and habitat conditions in the Northern Piedmont Ecoregion (Omernik, 1987). Pennsylvania–Maryland sampling consisted of nine sites located on or near the border of these states. Of these nine sites, the biological communities of three sites (33 percent) were designated nonimpaired, using RBP III protocol designations. Three stream sites (33 percent) were slightly impaired, two sites (22 percent) were moderately impaired, and one site (11 percent) was designated severely impaired. Five (56 percent) of the Pennsylvania–Maryland border sites had excellent habitat ratings, while three (33 percent) more had supporting habitats, and one (11 percent) had a partially supporting habitat

The reference site for this group of streams was Deer Creek (DEER 44.2). DEER 44.2 had excellent water quality and habitat and the top biological score. Three other stream sites received better scores for physical habitat conditions, but due to the superior biological community at DEER 44.2, this station served as the reference site for 2008. Two additional streams, Conowingo Creek (CNWG 4.4) and Falling Branch Deer Creek (FBDC 4.1) along the Pennsylvania–Maryland border were very comparable to DEER 44.2, receiving nonimpaired biological and excellent habitat designations. Long Arm Creek (LNGA 2.5) had the worst bioassessment score of any stream, most likely due to the very low number of macroinvertebrates collected. Few individuals were collected due to partially supporting habitat and little flow, as the station is located just upstream of the Long Arm Reservoir. Scott Creek (SCTT 3.0) remained moderately impaired biologically in 2008, but habitat at this station improved to supporting.

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



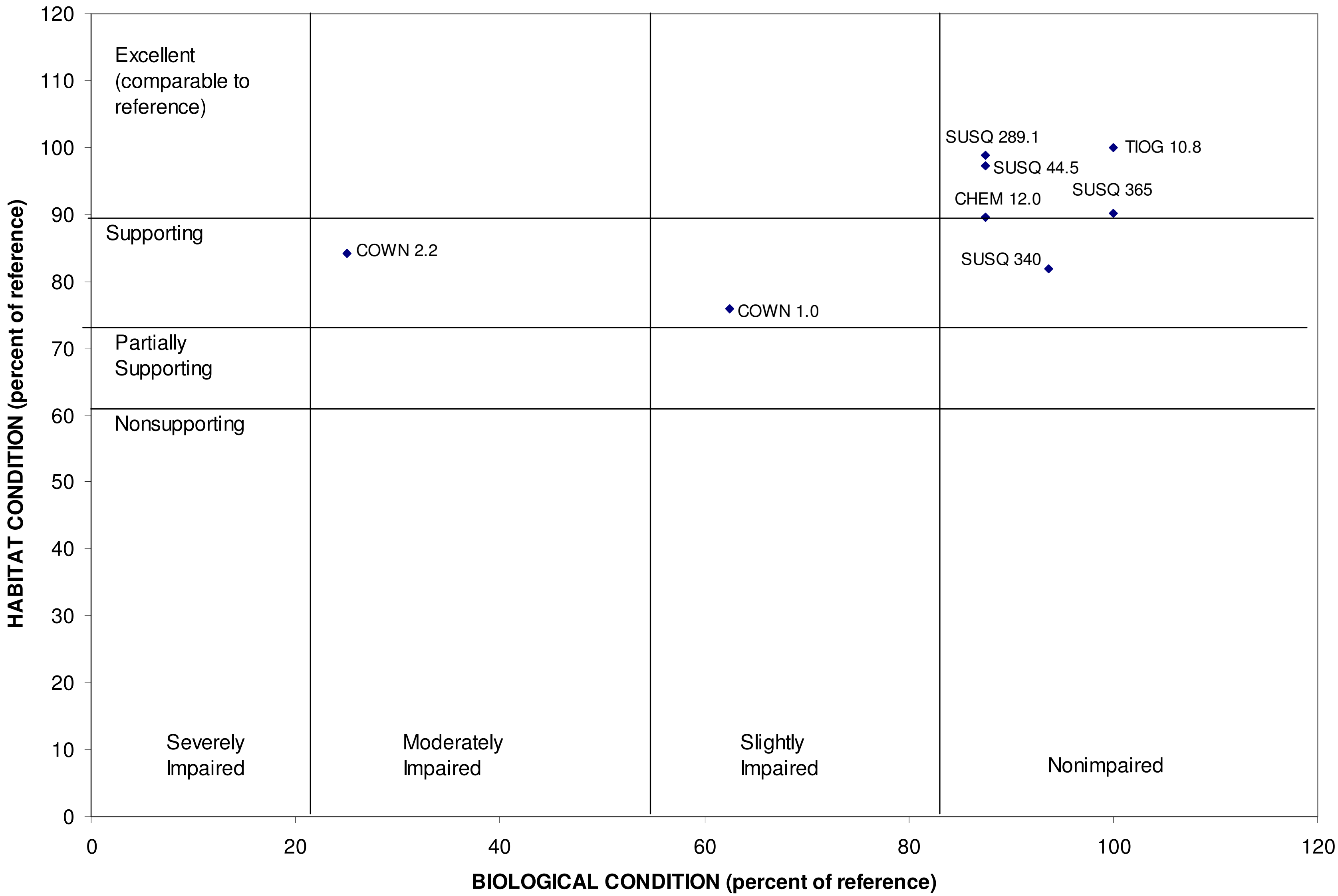
HABITAT CONDITION (percent of reference)
BIOLOGICAL CONDITION (percent of reference)
Excellent (comparable to reference)
Supporting
Partially Supporting
Nonsupporting
Severely Impaired
Moderately Impaired
Slightly Impaired
Nonimpaired
CNWG 4.4
OCTO 6.6
FBDC 4.1
DEER 44.2
SBCC 20.4
SCTT 3.0
EBAU 1.5
BBDC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

Results for 2008 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. 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 2008, the Tioga River in Lindley, N.Y., (TIOG 10.8) was the reference site to which all other large river sites were compared. This site on the Tioga 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 at this site prevent adequate macroinvertebrate collection and habitat assessment. The biological communities at six river sites (75 percent) were nonimpaired. One river site (12 percent) was slightly impaired, and one site was designated as moderately impaired. Physical habitat at five river sites (63 percent) was excellent, while three sites (37 percent) were rated supporting.

The Tioga River at Lindley, N.Y., (TIOG 10.8) possessed the highest bioassessment score as well as the highest physical habitat rating. The Susquehanna River at Sayre, Pa., (SUSQ 289.1) maintained its nonimpaired and excellent ratings in biological and habitat conditions, respectively, after serving as the reference site for the large river group in 2007. The Cowanesque River (COWN 2.2) directly downstream from the Cowanesque Reservoir had the worst biological condition in every metric and the lowest combined bioassessment score. However, about one mile downstream on the Cowanesque River (COWN 1.0), significant improvement was seen, as the biological condition was rated slightly impaired, while habitat remained stable with a supporting rating. In 2008, the trend continued with each of the four sites on the Susquehanna River (SUSQ 44.5, SUSQ 289.1, SUSQ 340, SUSQ 365) having nonimpaired biological conditions, indicating that the Susquehanna River is relatively healthy. The Chemung and Tioga River sites (CHEM 12.0 and TIOG 10.8) showed biological improvement over 2007 when they were rated slightly impaired, as they were designated nonimpaired in 2008.

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



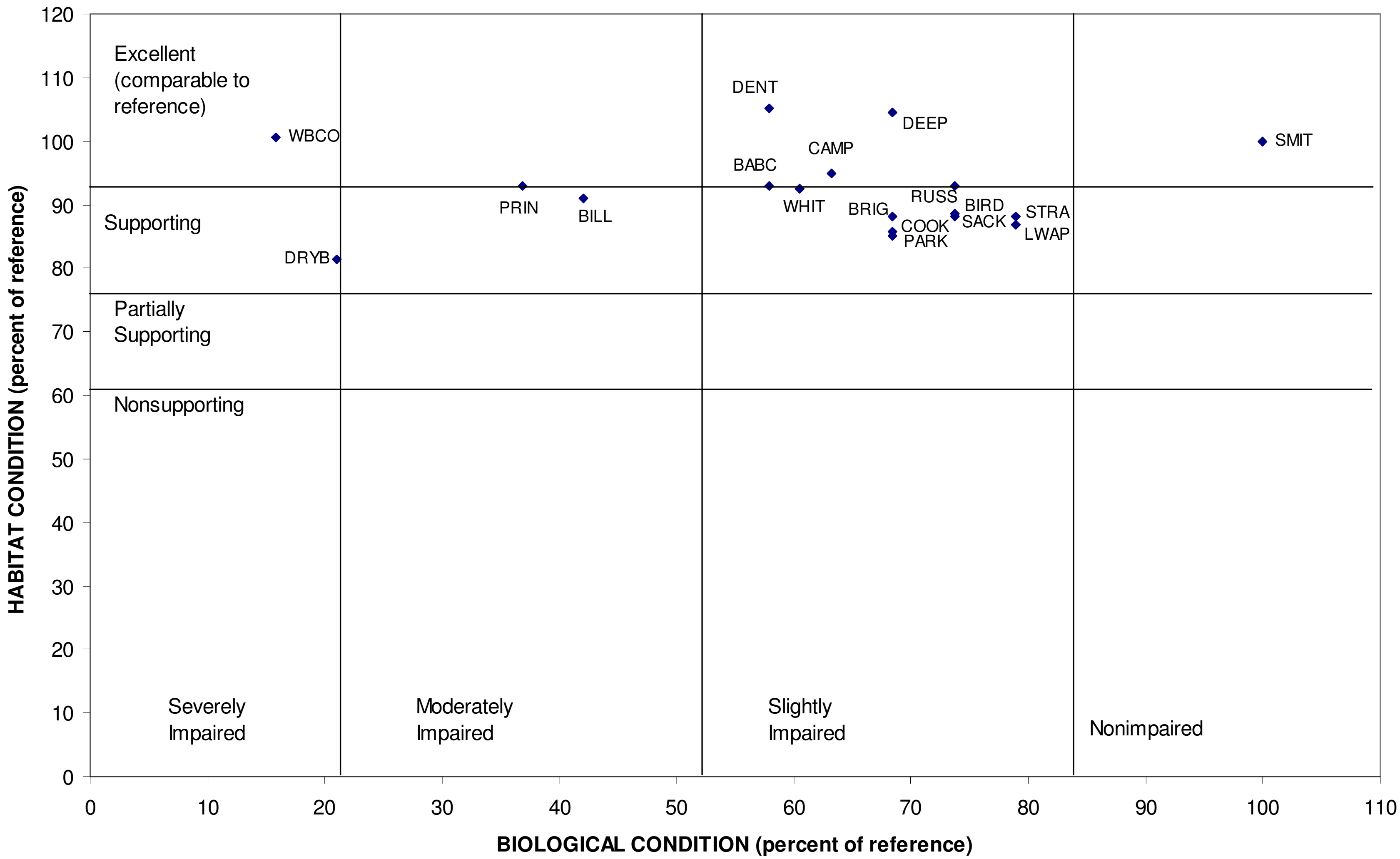
HABITAT CONDITION (percent of reference)
BIOLOGICAL CONDITION (percent of reference)
0
10
20
30
40
50
60
70
80
90
100
110
120
0
20
40
60
80
100
120
Excellent (comparable to reference)
Supporting
Partially Supporting
Nonsupporting
Severely Impaired
Moderately Impaired
Slightly Impaired
Nonimpaired
SUSQ 289.1
TIOG 10.8
SUSQ 44.5
SUSQ 365
CHEM 12.0
COWN 2.2
SUSQ 340
COWN 1.0

Results for 2008 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 2008, an unnamed tributary to Smith Creek (SMIT) in Tioga County, Pa. was the reference site to which all other Group 3 streams were compared. SMIT represented the best combination of biological, field water quality, and habitat conditions of the 18 sites sampled. Biscuit Hollow (BISC), Bulkley Brook (BULK), and Red House Run (REDH) were not sampled in 2008 due to near dry conditions. The only site designated as having a nonimpaired biological condition was the reference site, SMIT, in 2008. Thirteen Group 3 sites (72 percent) were slightly impaired, two sites (11 percent) were moderately impaired, and two sites were designated severely impaired. Physical habitat at six Group 3 sites (33 percent) was excellent, 11 sites (61 percent) were supporting, and one site (6 percent) was rated partially supporting.

An unnamed tributary to Smith Creek (SMIT) possessed the highest biological condition by a wide margin. Although other stations had superior habitat ratings, the biological conditions at SMIT were far better, and thus SMIT served as the reference stream for this group in 2008. Only Deep Hollow Brook (DEEP) and Denton Creek (DENT) had parameters that exceeded water quality standards. Field water quality samples at both streams exhibited low alkalinity and pH values. The biological condition at DEEP, which was the reference stream from 2005-2007, decreased to slightly impaired. Bill Hess Creek (BILL) and Prince Hollow Run (PRIN) had moderately impaired biological conditions in 2008. Biological conditions at Dry Brook (DRYB) and the White Branch Cowanesque River (WBCO) were severely impaired, as each stream had the worst bioassessment scores of all Group 3 streams. The only partially supporting habitat of all Group 3 streams was found at DRYB, which is located in a subdivision, receiving impacts from mowed lawns in its riparian zones, sediment input, and runoff from nearby roadways.

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


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

Conclusions

Overall, 79 interstate streams sites were sampled for macroinvertebrates in CY-08. Group 1 and 2 streams were sampled in July 2007 and 2008, while Group 3 streams were only sampled in May 2008. Twenty-seven sites (34 percent) had nonimpaired biological communities, 37 sites (47 percent) were slightly impaired, 12 sites (15 percent) were moderately impaired, and three sites (4 percent) were severely impaired. The most common reasons for impairment were low EPT Index and high percent dominant taxa.

Out of 78 sites where habitat was assessed in CY-08, 38 sites (49 percent) had excellent habitat. Thirty-three sites (42 percent) had supporting habitat, five sites (6 percent) had partially supporting habitat, and two sites (3 percent) had nonsupporting habitat. The most common causes of habitat impairment were riparian vegetative zone width, velocity/depth regimes, and channel flow status, respectively.

Elevated concentrations of total iron and total aluminum were the most common causes of water quality impairment for CY-08 interstate streams. Metal contaminants and depressed alkalinity most often affect New York–Pennsylvania interstate streams, possibly due to acid precipitation. High total dissolved solids, nitrogen, and phosphorus are persistent problems in Pennsylvania–Maryland interstate streams where agriculture comprises a large percentage of land use.

The current and historical data contained in this report provide a database that enables SRBC staff and others to better manage water quality, water quantity, and biological resources of interstate streams in the Susquehanna River Basin. The data can be used by SRBC's member states and local interest groups to better understand water quality in upstream and downstream areas outside of their jurisdiction. Information in this report also can serve as a starting point for more detailed assessments and remediation efforts that may be planned on these streams.

Future Study

Future study and remediation efforts should focus on those streams that had moderately or severely impaired macroinvertebrate communities or exceeded water quality standards. Moderately impaired biological conditions were found at Seeley Creek, Trowbridge Creek, North Fork Cowanesque River, Cowanesque River (COWN 2.2), Long Arm Creek, Scott Creek, Ebaughs Creek, Bill Hess Creek, and Prince Hollow Run in CY-08. Severely impaired biological conditions were found at Long Arm Creek, Dry Brook, and the White Branch Cowanesque River in CY-08. Additional study of stream water chemistry, biology, and habitat at varying stream discharge levels may help explain some impairment problems.

As previously mentioned, 25 out of 32 stations were found to have one or more water quality parameters exceeding acceptable limits. Specific data, such as number and type of parameters exceeding standards, can be found on the individual station pages. The water quality conditions of these streams should be monitored for future violations. Furthermore, the source of the pollutants should be identified. State water quality standards vary across state lines, and problems may arise when the source of these pollutants is located in an adjacent state.

Although chemical and physical data are useful in their own right, biological information has proven to be a more robust and comprehensive indication of the health of aquatic environments. Fish are indicator organisms that reveal details about aquatic system health when fish community data are analyzed. Specifically, fish provide a comprehensive picture of the state of stream environments because within a community of fishes, there is a large range of species that represents a variety of trophic levels and pollution tolerances (Karr, 1981). For these reasons, during CY-09 fish sampling will occur in May at selected Group 1 and 2 streams to add value to the existing biological assessments that have been conducted historically at interstate streams sites.

Bioassessment of Interstate Streams

Summaries of all stations that include WQI scores, parameters that exceeded water quality standards, and parameters that exceeded the 90th 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