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Juniata River Subbasin Survey

A Water Quality and Biological Assessment, June - November 2004

The Susquehanna River Basin Commission (SRBC) conducted a survey of the Juniata Subbasin from June to November 2004. This survey was part of SRBC's Subbasin Survey Program, which is funded in part through the United States Environmental Protection Agency (USEPA). This program consists of two-year assessments in each of the six major subbasins (Figure 1) on a rotating schedule. Included in this report are details of the Year-1 survey, which entailed point-in-time samples of the water quality, macroinvertebrate community, and habitat in the major tributaries and areas of interest throughout the Juniata River Subbasin. The Year-2 survey will be a more intensive study in the Morrison Cove area, which has been identified as a highly agricultural and potentially stressed groundwater area. Previous surveys of the Juniata Subbasin were conducted in 1985 (McMorran, 1986) and 1995 (McGarrell, 1997); a comparison of the 1995 data and the present results are included in this report.

Figure 1. *The Susquehanna River Subbasins*

Subbasin survey information is used by SRBC staff and others to:

- evaluate the chemical, biological, and habitat conditions of streams in the basin;
- identify major sources of pollution and lengths of stream impacted;
- identify high quality sections of streams that need to be protected;
- maintain a database that can be used to document changes in stream quality over time;
- review projects affecting water quality in the basin; and
- identify areas for more intensive study.


S. LeFevre
Juniata River near Thompsontown, Pa.

Description of the Juniata Subbasin

The Juniata Subbasin drains an area of approximately 3,400 square miles from west of Bedford to Duncannon, Pa., which includes significant portions of Bedford, Blair, Fulton, Huntingdon, Perry, Juniata, and Mifflin Counties. Two different ecoregions are found within this area:

- Central Appalachian Ridges and Valleys (Ecoregion 67)
- Central Appalachians (Ecoregion 69) (Omernik, 1987)

Ecoregion 67 is characterized by almost parallel ridges and valleys formed by folding and faulting events. The predominant geologic materials include sandstone, shale, limestone, dolomite, siltstone, chert, mudstone, and marble. Springs and caves are common in this ecoregion. Ecoregion 69 is mainly a plateau formation that is predominantly sandstone, shale, conglomerate, and coal. Mining for bituminous coal can occur in this ecoregion. Six different subecoregions are found in the Juniata Subbasin:

- 67a - Northern Limestone/ Dolomite Valleys
- 67b - Northern Shale Valleys
- 67c - Northern Sandstone Ridges
- 67d - Northern Dissected Ridges and Knobs
- 69a - Forested Hills and Mountains
- 69b - Uplands and Valleys of Mixed Land Use (Omernik and others, 1992) (Figure 2).

The mixed land use in the Juniata Subbasin primarily includes forested areas concentrated in the ridges, with agricultural and urban areas in the valleys (Figure 3). Many of the forested areas are state forest or state game lands. The largest urban center is Altoona; other notable developed areas include Bedford, Everett, Tyrone, Huntingdon, Mount Union, Lewistown, and Newport. Other important land uses in this subbasin are abandoned mine land (AML) and impounded water in Raystown Lake. Raystown Branch Juniata River was dammed in 1968 primarily for flood control, but the lake also is used as a recreational impoundment. Today, some hydroelectric power is generated at this dam.

Residents of the Juniata River Watershed and others are interested in protecting the river's resources and accounting its history. *Juniata River of Sorrows* by Dennis P. McIlnay (2003) details the fishing resources available from this river and gives accounts of the troubled history of this region through the struggle for its land and resources. Through numerous floating trips down the Juniata, McIlnay provides information on fishing hot spots, boating trouble spots, and the fish and other aquatic life that reside in the mainstem Juniata River. Fish mentioned in this book include walleye, brown trout, rainbow trout, Palomino trout, muskellunge, carp, rock bass, and smallmouth and largemouth bass.

The Juniata Subbasin is unique in that there is a nonprofit group organized to promote its environmental health and stability. In 1997, the Chesapeake Bay Foundation brought together concerned citizens and

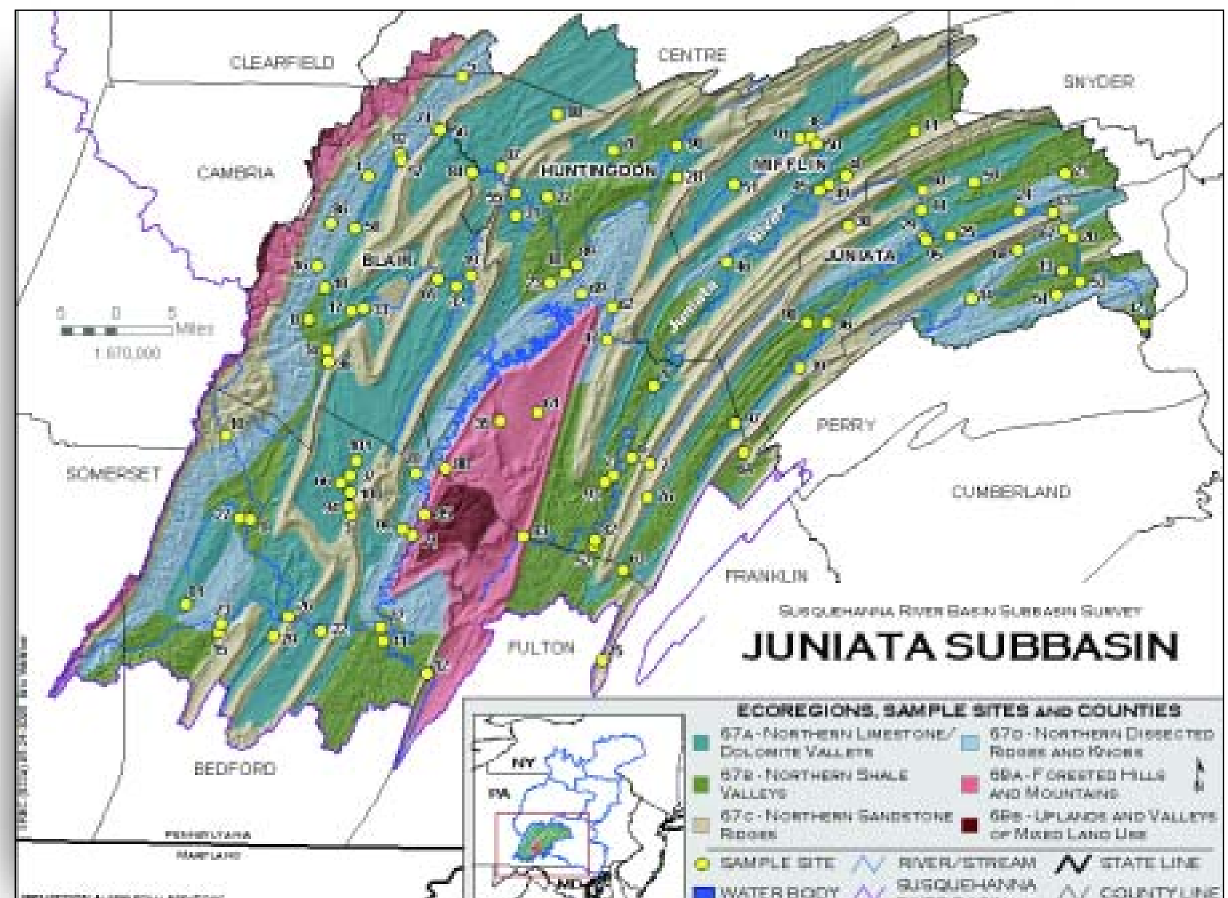

Figure 2. *Ecoregions, Subecoregions, and Counties in the Juniata Subbasin*

stakeholders from community groups, nonprofit conservation organizations, county planning offices, and county conservation districts to develop a Juniata Watershed Management Plan. This group eventually became the Juniata Clean Water Partnership (JCWP) whose mission statement is, "...building and sustaining local capacity through education, assistance, and advocacy in order to enhance, restore, and protect the natural resources of the Juniata watershed" (JCWP, 2005). Annually, JCWP holds a Juniata Watershed Summit to bring together the people and groups of the watershed to share information, provide training to implement the Juniata Watershed Management Plan, and highlight achievements in the watershed. Additionally, JCWP publishes a *Juniata Watershed Journal* newsletter seasonally that provides information on activities and projects going on at JCWP and in the watershed. Every year, JCWP organizes a Juniata Sojourn to explore the river, natural resources, and local communities by boat and promote stewardship of the land and water. Contact information for JCWP and other watershed groups within the Juniata Subbasin can be found in Table 1.

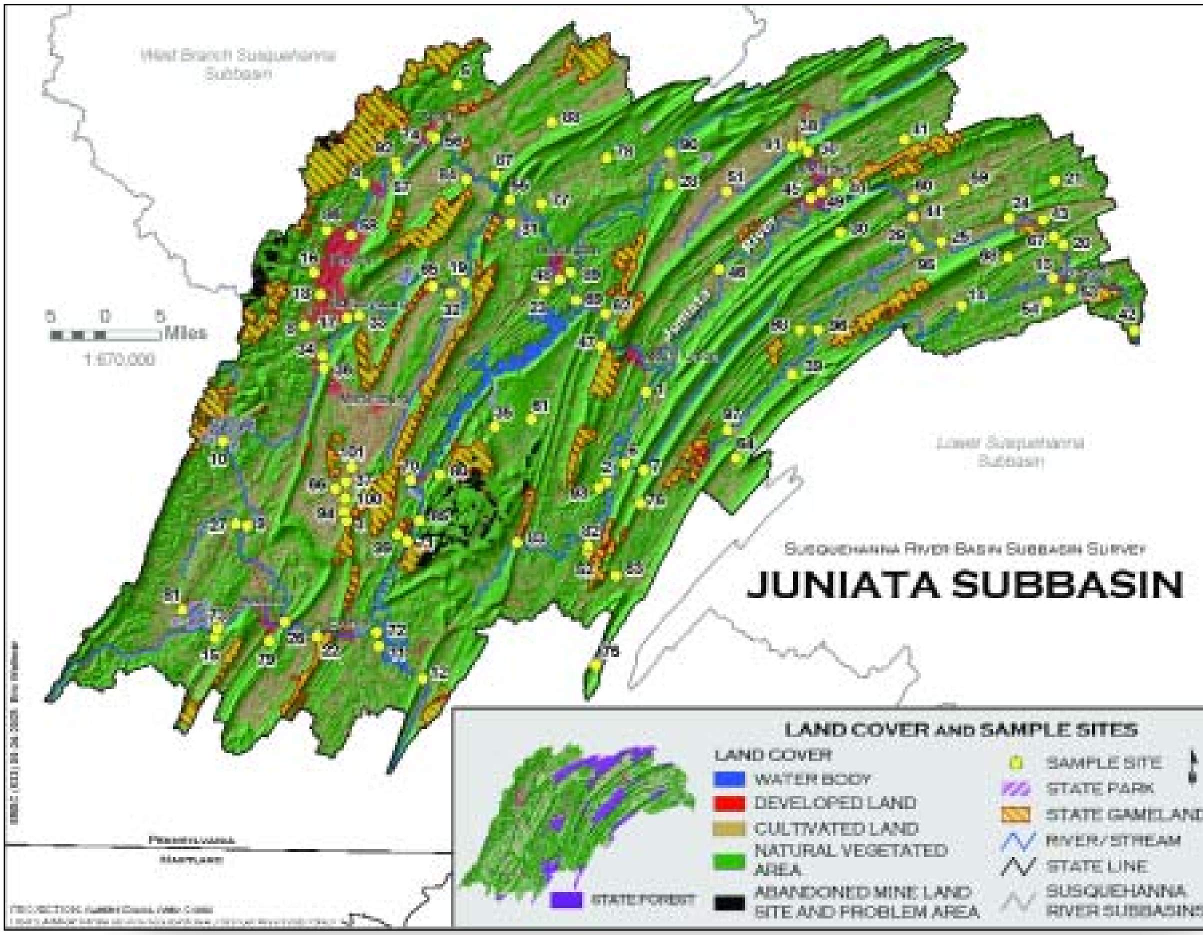

Figure 3. *Land Use in the Juniata Subbasin*

In 2004, the Juniata River experienced near-record flooding with streamflows near the mouth at Newport, Pa., being 74 percent above normal for the year (SRBC, 2004). Remnants of hurricanes Frances, Ivan, and Jeanne hit Pennsylvania from September 8-10, 17-19, and 27-28, respectively, dumping seven to ten or

Table 1. *Contact Information for Watershed Organizations and County Conservation Districts in the Juniata Subbasin*

Organization Name	County	Contact Person	Address	Phone	Email or Website
Beaverdam Branch Watershed Coalition	Blair	Ms. Mary Ann Elder	9 Grand View Court, Duncansville, PA 16635	(814) 695-8763	beaverdambranch@aol.com
Blair Senior Services (Blair Gap Run)	Blair	Ms. Cheryl Nolan	Blair County Senior Services 1320 12th Ave, Altoona, PA 16601	(814) 946-1235	
Bob's Creek Stream Guardians	Bedford	Mr. Tim Clingerman	1561 Tulls Hill Road, Bedford, PA 15522	(814) 733-2394	
Trough Creek Watershed Association	Huntingdon	Mr. Roy McCabe	P.O. Box 66, Wood, PA 16694	(814) 635-4120	ebtminer@nb.net
Juniata Clean Water Partnership (JCWP)	Huntingdon/Mifflin/ Juniata/Perry	Mr. Mike Makufka	416 Penn Street, Huntingdon, PA 16652	(814) 506-1190	mmakufka@jcwp.org / www.jcwp.org
Little Juniata Watershed Association	Huntingdon/Blair				http://www.littlejuniata.org
Shoups Run Watershed Association	Huntingdon	Ms. Gracie Angelo	RR 1 Box 258 A1A, Saxton, PA 16678	(814) 635-2600	beckydolte@adelphia.net
Six Mile Run Area Watershed Committee	Bedford				
Spruce Creek Watershed Association	Huntingdon	Ms. Sharon Dell	5269 Trout Run Lane, Spruce Creek, PA 16683		smd11@psu.edu
Yellow Creek Coalition	Bedford	Mr. Fred Sherlock	132 McElwee Drive, Hopewell, PA 16650	(814) 766-3176	
Bedford Conservation District	Bedford		702 West Pitt Street, Fairlawn Court Suite 4, Bedford, PA 15522	(814) 623-7900 ext 3	bedcocd@earthlink.net
Blair Conservation District	Blair		1407 Blair Street, Hollidaysburg, PA 16648	(814) 696-0877 ext. 5	dfisher@blairconservationdistrict.org
Fulton Conservation District	Fulton		216 N. Second St., Suite 15, McConnellsburg, PA 17233	(717) 485-3547	fultoncounty@state.pa.us
Huntingdon Conservation District	Huntingdon		RR #1, Box 7C, Huntingdon, PA 16652-9603	(814) 627-1627	c-apatters@state.pa.us
Juniata Conservation District	Juniata		RR#5, Box 35, Stoney Creek Drive, Mifflintown, PA 17059	(717) 436-8953 ext. 5	c-dlauver@state.pa.us
Mifflin Conservation District	Mifflin		20 Windmill Road, Suite 4, Burnham, PA 17009	(717) 248-4695	c-ddunmire@state.pa.us
Perry Conservation District	Perry		P.O. Box 36, New Bloomfield, PA 17068	(717) 582-8988 ext. 4	c-tbrajkov@state.pa.us
Western PA Coalition for Abandoned Mine Reclamation	Westmoreland	Coalition Regional Coordinator, Westmoreland Conservation District	Donohoe Center, RR 12 Box 202B, Greensburg, PA 15601	(412) 837-5271	Westmoreland.conservation@ dep.state.pa.us

more inches of rain, making this the second wettest month in the state's history (The Pennsylvania State Climatologist, 2004; National Weather Service, 2005). The flooding occurred during the sampling for this subbasin report. The streams were allowed to subside before sampling resumed; however, the streams were still above normal flow, and many of the stream channels had been changed dramatically from scour and deposition. This flooding may have impacted the biological and habitat scores of streams sampled after these flooding events.

S. LeFevre

Photo at left: September Flooding of Juniata River and Crooked Creek from remnants of Hurricane Frances, Huntingdon, Pa.

Photo below: Confluence of Crooked Creek and Juniata River at normal flow, Huntingdon, Pa.

S. LeFevre

Methods Used in the 2004 Subbasin Survey

DATA COLLECTION

During the summer and fall of 2004, SRBC staff visited and collected samples from 101 sites throughout the Juniata River Subbasin. Appendix A contains a list with the sample site number, station name (designated by approximate stream mile), description of the sampling location, latitude and longitude, drainage in square miles, and subecoregion and drainage size category. Sites that also were sampled in 1995 are listed in blue with an asterisk. Sites that were sampled after the flooding in September are in bold print. Macroinvertebrate samples were taken at 81 sites. Staff could not sample 20 sites due to high water conditions. Habitat was rated at the sites where a macroinvertebrate sample was collected.

The sites were sampled once during this Year-1 sampling effort to provide a point-in-time picture of stream characteristics throughout the whole subbasin. Samples were collected using a slightly modified version of the USEPA's Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers (RBP III) (Barbour and others, 1999).

Water Quality

A portion of the water sample from each collection site was separated for laboratory analysis, and the rest of the sample was used for field analysis. A list of the field and laboratory parameters and their units is found in Table 2. Measurements of flow, water temperature, dissolved oxygen, pH, conductivity, alkalinity, and acidity were taken in the field. Flow was measured using standard U.S. Geological Survey methodology (Buchanan and Somers, 1969). Temperature was measured in degrees Celsius with a field thermometer. A Cole-Parmer Model 5996 meter was used to measure pH. Dissolved oxygen was measured with a YSI 55 meter, and conductivity was measured with a Cole-Parmer Model 1481 meter. Alkalinity was determined by titration of a known volume of sample water to pH 4.5 with

Table 2. *Water Quality Parameters Sampled in the Juniata Subbasin*

FIELD PARAMETERS	
Flow, instantaneous cfs[a]	Conductivity, µmhos/cm[c]
Temperature, °C	Alkalinity, mg/l
pH	Acidity, mg/l
Dissolved Oxygen, mg/l[b]	
LABORATORY ANALYSIS	
Alkalinity, mg/l	Total Magnesium, mg/l
Total Suspended Solids, mg/l	Total Sodium, mg/l
Total Nitrogen, mg/l	Chloride, mg/l
Nitrite - N, mg/l	Sulfate - IC, mg/l
Nitrate - N, mg/l	Total Iron, µg/l[e]
Turbidity, NTU[d]	Total Manganese, µg/l
Total Organic Carbon, mg/l	Total Aluminum, µg/l
Total Hardness, mg/l	Total Phosphorus, mg/l
Total Calcium, mg/l	Total Orthophosphate, mg/l

[a] cfs = cubic feet per second
[b] mg/l = milligram per liter
[c] µmhos/cm = micromhos per centimeter
[d] NTU = nephelometric turbidity units
[e] µg/l = micrograms per liter

0.02N H_2SO_4. Acidity was determined by titration of a known volume of sample water to pH 8.3 with 0.02N NaOH.

One 500-ml bottle and two 250-ml bottles of water were collected for laboratory analyses. One of the 250-ml bottles was acidified with nitric acid for metal analyses. The other 250-ml bottle was acidified with sulfuric acid for nutrient analyses. Samples were iced and shipped to the Pennsylvania Department of Environmental Protection (PADEP), Bureau of Laboratories in Harrisburg, Pa.

Table 3. *Water Quality Levels of Concern and References*

PARAMETERS	LIMITS	REFERENCE CODES
Temperature	>25 °C	a,f
D.O.	<4 mg/l	a,g
Conductivity	>800 µmhos/cm	d
pH	<5.0	c,f
Acidity	>20 mg/l	m
Alkalinity	<20 mg/l	a,g
TSS	>25 mg/l	h
Nitrogen	>1.0 mg/l	j
Nitrite-N	>0.06 mg/l	f,n,i
Nitrate-N	>1.0 mg/l	e,j
Turbidity	>150 NTU	h
Phosphorus	>0.1 mg/l	e,k
TOC	>10 mg/l	b
Hardness	>300 mg/l	e
Calcium	>100 mg/l	m
Magnesium	>35 mg/l	i
Sodium	>20 mg/l	i
Chloride	>250 mg/l	a
Sulfate	>250 mg/l	a
Iron	>1,500 µg/l	a
Manganese	>1,000 µg/l	a
Aluminum	>200 µg/l	c
Phos T Ortho	>0.05 mg/l	l,f,j,k

REFERENCE CODES/REFERENCE

a http://www.pacode.com/secure/data/025/chapter93/s93.7.html
b Hem (1970) - http://water.usgs.gov/pubs/wsp/wsp2254/
c Gagen and Sharpe (1987) and Baker and Schofield (1982)
d http://www.uky.edu/WaterResources/Watershed/KRB_AR/wq_standards.htm
e http://www.uky.edu/WaterResources/Watershed/KRB_AR/krww_parameters.htm
f http://www.hach.com/h2ou/h2wtrqual.htm
g http://sites.state.pa.us/PA_Exec/Fish_Boat/education/catalog/pondstream.pdf
h http://www.epa.gov/waterscience/criteria/sediment/appendix3.pdf
i http://www.dec.state.ny.us/website/regs/part703.html
j* http://water.usgs.gov/pubs/circ/circ1225/images/table.html
k http://water.usgs.gov/nawqa/circ-1136/h6.html#NIT
l http://www.epa.gov/waterscience/criteria/goldbook.pdf
m based on archived data at SRBC
n http://srmwww.gov.bc.ca/risc/pubs/aquatic/interp/

** Background levels for natural streams*

Macroinvertebrates

Benthic macroinvertebrates (organisms that live on the stream bottom, including aquatic insects, crayfish, clams, snails, and worms) were collected using a modified version of RBP III (Barbour and others, 1999). Two kick-screen samples were obtained at each station by disturbing the substrate of representative riffle/run areas and collecting dislodged material with a one-meter-square 600-micron mesh screen. Each sample was preserved in 95 percent denatured ethyl alcohol and returned to SRBC's lab, where the sample was sorted into a subsample of at least 200 organisms. Organisms in the subsample were identified to genus, except for midges and aquatic worms, which were identified to family.

Habitat

Habitat conditions were evaluated using a modified version of RBP III (Plafkin and others, 1989; Barbour and others, 1999). Physical stream characteristics relating to substrate, pool and riffle composition, shape of the channel, conditions of the banks, and the riparian zone were rated on a scale of 0-20, with 20 being optimal. Other observations were noted regarding weather, substrate material composition, surrounding land use, and any other relevant features in the watershed.

DATA ANALYSIS

Water quality was assessed by examining field and laboratory parameters that included nutrients, major ions, and metals (Table 2). The data collected were compared to water chemistry values that were at a level of concern based on current state and federal regulations, background levels for uninfluenced streams, or references for approximate tolerances of aquatic life (Table 3). Laboratory values were used when field and laboratory data existed for the same parameter. The difference between each value and the level of concern value from Table 3 was calculated for each site, and if the value did not exceed the level of concern value, the site was given a score of zero. If the level of concern value was exceeded, the difference was listed, and an average of all the parameters for each site was calculated. All sites that received a score of zero (no parameters exceeded the limits) were classified as "higher" quality. Sites that had a percentage value between zero and one were classified as "middle" quality, and sites that had a percentage value greater than one were classified as "lower" quality.

Six reference categories were created for macroinvertebrate and habitat data analysis based on drainage size, ecoregions, and subecoregions (Omernik, 1987; Omernik, 1992). All the sites were divided into small (< 100 square miles), medium (100 to 500 square miles), and large drainage areas (> 500 square miles). The small drainage areas were then grouped according to ecoregions and subecoregions. Based on the location of the sampling sites, the six reference categories used were 67a, 67b, 67c, 67d, 69a, and medium size drainage. None of the large drainage size area sites were sampled for macroinvertebrates due to the high flows after flooding.

Benthic macroinvertebrate samples were analyzed using seven metrics mainly derived from RBP III (Plafkin and others, 1989; Barbour and others, 1999): (1) taxonomic richness; (2) modified Hilsenhoff Biotic Index; (3) percent

Ephemeroptera; (4) percent contribution of dominant taxon; (5) number of Ephemeroptera/Plecoptera/Trichoptera (EPT) taxa; (6) percent Chironomidae; and (7) Shannon-Wiener Diversity Index. Reference sites were determined for each reference category, primarily based on the results of the macroinvertebrate metrics and secondarily based on habitat and water quality scores, to represent the best combination of conditions. The metric scores were compared to the reference scores, and a biological condition category was assigned based on RBP III methods (Plafkin and others, 1989; Barbour and others, 1999). The same reference sites were used in the analysis for the habitat scores. The ratings for each habitat condition were totaled, and a percentage of the reference site was calculated. The percentages were used to assign a habitat condition category to each site (Plafkin and others, 1989; Barbour and others, 1999).

Taxonomic Richness: Total number of taxa in the sample. Number decreases with increasing stress.

Hilsenhoff Biotic Index: A measure of organic pollution tolerance. Index value increases with increasing stress.

Percent Ephemeroptera: Percentage of number of Ephemeroptera in the sample divided by the total number of macroinvertebrates in the sample. Percentage decreases with increasing stress.

Percent Contribution of Dominant Taxa: 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.

EPT Index: Total number of Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) taxa present in a sample. Number decreases with increasing stress.

Percent Chironomidae: Percentage of number of Chironomidae individuals out of total number of macroinvertebrates in the sample. Percentage increases with increasing stress.

Shannon-Wiener Diversity Index: A measure of the taxonomic diversity of the community. Index value decreases with increasing stress.

Results/Discussion

Water quality, macroinvertebrate, and habitat site conditions for each sampling site in the Juniata Subbasin in 2004 are depicted in Figures 4 - 6. Twelve sites demonstrated the best overall conditions in each category with nonimpaired macroinvertebrates, “higher” water quality, and excellent habitat. Twenty-three sites did not exceed water quality levels of concern and received a “higher” water quality designation. Sixty-four sites slightly exceeded levels of concern and received a “middle” quality designation, and 14 sites were considered “lower” quality. Nonimpaired biological conditions were found at 44 sites (54 percent), slightly impaired conditions were found at 26 sites (32 percent), moderately impaired conditions were found at eight sites (10 percent), and severely impaired conditions were found at three sites (four percent). Habitat conditions throughout the subbasin were rated highly. Habitat conditions were excellent at 66 sites (81.5 percent), supporting at 13 sites (16 percent), and partially supporting at two sites (2.5 percent).

Seventy-eight sites had at least one parameter that exceeded a level of concern (Table 4). The highest number of parameters exceeding levels of concern occurred at BURG 0.5 and HALT 0.6. Total nitrogen exceeded the level of concern at 66 sites while total nitrate-n exceeded the level of concern at 61 sites. The values set for nitrogen and nitrate-n (1.0 mg/l) are based on natural background concentrations; therefore, values higher than 1.0 mg/l indicate the potential presence of nitrogen sources such as agriculture in the watershed. This level is not based on aquatic life tolerances or levels of concern, as standards have not yet been developed for nutrients in Pennsylvania.

The third highest parameter to exceed levels of concern was total aluminum, which was exceeded 16 times. At seven of those 16 sites, abandoned mine drainage (AMD) conditions were the likely cause of the higher aluminum values, and atmospheric deposition was most likely the cause for at least one other site. The cause for high aluminum at the other eight sites needs further research. Since the sample is a one-time sample, duplication of these results at different times, flows, and seasons would be necessary. The land use in many of these watersheds contains agricultural activity, some of which includes farmland applications of biosolids from municipal wastewater treatment plants. In fact, farms that apply or in the past have applied biosolids are located in the area of at least six of those eight sites with higher aluminum values (PADEP, 2005). Some wastewater treatment plants use alum as a flocculent to settle out solids. Research suggests that chemicals, such as alum, added to waste during the treatment process can affect the chemical composition of the biosolids (USEPA, 1999).

Agricultural land use appeared to influence many of the Juniata Subbasin Survey sampling sites. Total nitrogen values were very high at some sites, with the highest value being 11.64 mg/l (Table 4). Total phosphorus and orthophosphate values were exceeded four and 11 times, respectively. Orthophosphate and phosphorus can be indicators of wastewater and septic systems,

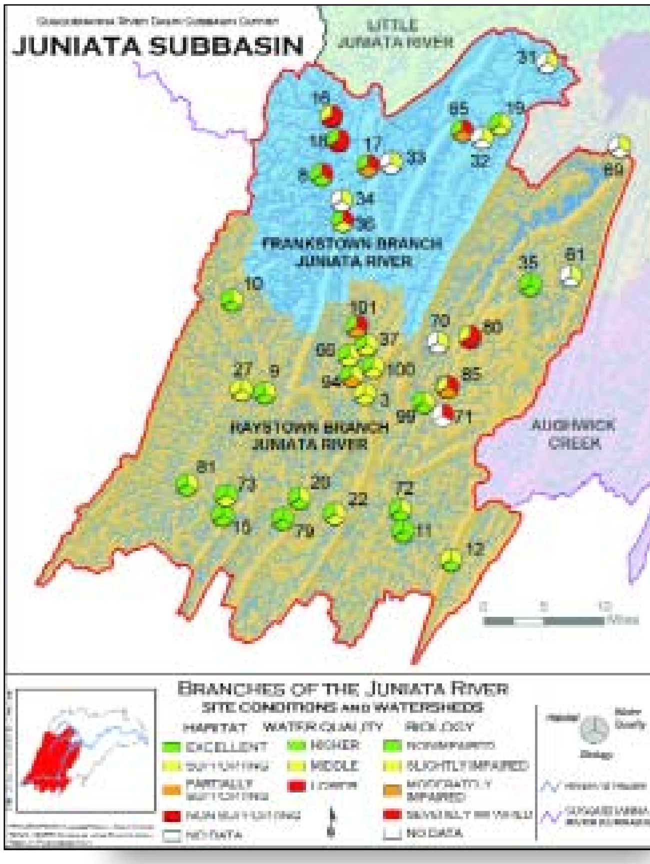

Figure 4. *Water Quality, Biological, and Habitat Conditions in the Frankstown and Raystown Branches*

detergents, chemical fertilizers, animal waste, some industrial discharges, and soil erosion. The highest value for total phosphorus was 0.471 mg/l, and the highest value for total orthophosphate was 0.463 mg/l (Table 4). Many areas in the subbasin are conducive to farming due to the limestone and dolomite geology in the valleys between the ridges (Figure 2).

AML are not as prevalent in this subbasin (Figure 3), since the geology that is conducive to mining (Ecoregion 69) is not as prevalent (Figure 2). Parameters indicative of AMD conditions such as iron, manganese, aluminum, pH, alkalinity, and acidity were not exceeded as often as the parameters indicative of agricultural conditions, such as total nitrogen. The AMD conditions of the sites sampled were not very severe, with the lowest pH being 4.0. The highest concentrations of metals consisted of iron at 5,570 µg/l, manganese at 3,670 µg/l, and aluminum at 3,080 µg/l. Approximately seven sites indicate at least some impact from AMD pollution.

Section 303(d) of the Clean Water Act requires a Total Maximum Daily Load (TMDL) to be developed for any waterbody designated as impaired, or not meeting the state water quality standards or its designated use. Streams in Pennsylvania are being assessed as part of the State Surface Waters Assessment Program, and, if they are found to be impaired, a TMDL is calculated for the watershed. Some of the watersheds in the Juniata Subbasin have been rated impaired, and subsequently, will require a TMDL. Table 5 identifies those watersheds that have been found to be impaired, their impairment causes and the date they were sampled, the proposed date for TMDL completion, and Juniata Subbasin Survey stations located in impaired sections. More information on the TMDL program is available at: http://www.dep.state.pa.us/watermanagement_apps/tmdl/default.asp.

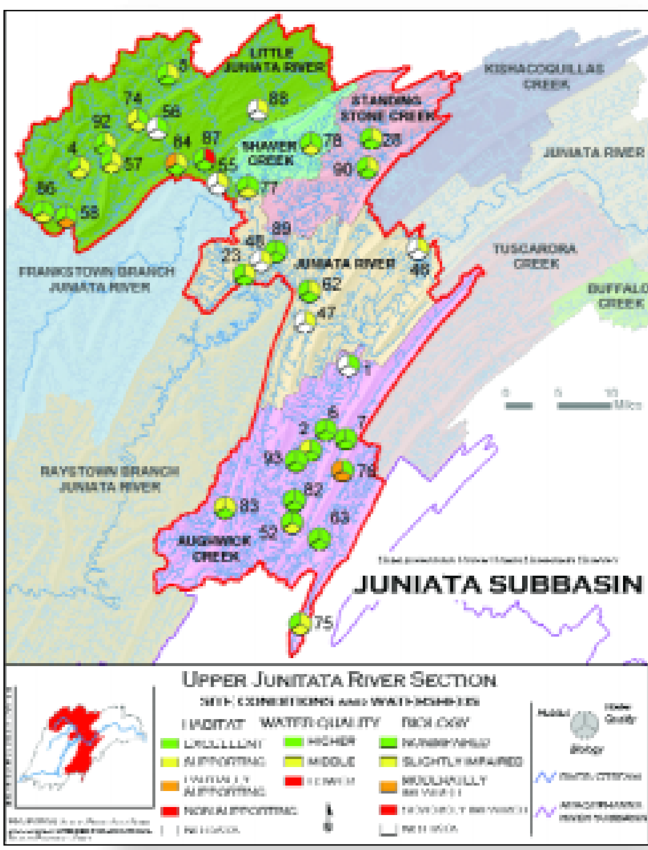

Figure 5. *Water Quality, Biological, and Habitat Conditions in the Upper Juniata River Section*

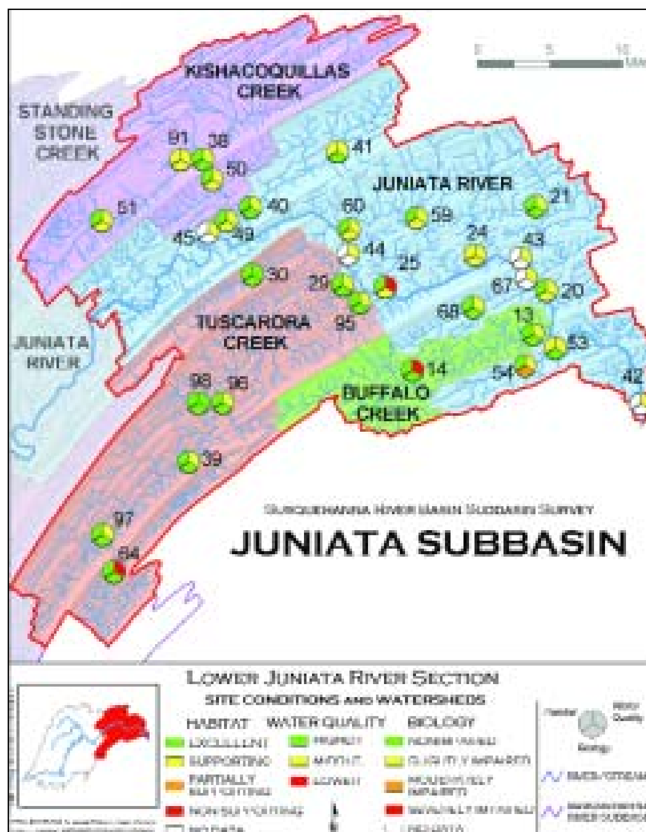

Figure 6. *Water Quality, Biological, and Habitat Conditions in the Lower Juniata River Section*

Table 4. *Juniata Subbasin Sites with Water Quality Values Exceeding Levels of Concern*

Stations	Hardness T >300 mg/l	Magnesium T >35 mg/l	Nitrate-N T >1.0 mg/l	Nitrogen T >1.0 mg/l	Orthophosphate T >0.05 mg/l	Phosphorus T >0.1 mg/l	Sodium T >20 mg/l	T Susp Solid >25 mg/l	Acidity >20 mg/l	pH < 5.0	Alkalinity <20 mg/l	Aluminum T >200 µg/l	Iron T >1,500 µg/l	Manganese T >1,000 µg/l	TOTAL
BEAV0.1			5.6	5.65											2
BELG2.4											13.6				1
BIGF1.0											17.6	213			2
BLRG2.5												281			1
BOBS0.9			1.65	1.8											2
BOBS11.4											15				1
BRUS14.1											17.4				1
BUFF0.4			1.78	2.2											2
BUFF14.6			1.72	1.92	0.194	0.207						227			5
BURG0.5				1.05					23	**4**	**0**	**3080**	**5570**	**3670**	7
BVDB0.1			1.39	1.66								275			3
BVDB5.0				1.27				**44**			18.6	2080	2060	1800	6
CLOV0.1			5.65	6.04											2
COCO0.2			3.08	3.04											2
COCO9.6			2.26	2.32	**0.463**	**0.471**									4
COVE7.7			5	5.09											2
CRKD0.3			1.28	1.47											2
DELA0.2			5.07	5.06											2
DOER0.3			4.98	5.01								359			3
DUNN0.1			1.14	1.3											2
DUNN9.9				1.2											1
EBSS0.5			1.26	1.29											2
ELKC0.1			1.26	1.46											2
FRNK1.6			3.06	3.6	0.054										3
FRNK18.9			2.59	3.13	0.064										3
FRNK32.5			2.17	2.66	0.073		21.3								4
FRNK38.1			3.09	3.67	0.056										3
HALT0.6	**382**	35.3	5.79	6.2	0.103	0.115	**21.8**								7
HKBC0.1			5	5.2											2
HONY0.2			1.07	1.15											2
HSVR0.5				1.06											1
JACK2.9			1.72	1.88											2
JACK11.7			2.55	2.84											2
JUNR2.0			1.75	2.5											2
JUNR17.3			1.68	2.32											2
JUNR34.0			1.89	2.08											2
JUNR47.0			1.61	2.18											2
JUNR63.6			1.58	2.07											2
JUNR84.6			1.61	2.14											2
JUNR94.0			2.55	3.06											2
KISH0.4			3.39	3.54											2
KISH5.5			3.54	3.66	0.059										3
KISH15.6			7.2	7.07											2
LBUF0.1			1.03	1.32											2
LBUF2.1			1.15	1.46	0.05										3
LJUN3.8			2.27	2.64											2
LJUN19.4			1.27	1.55	0.11	0.117									4
LLOS0.5			6.38	5.97	0.072										3
LOSC0.2			1.8	1.9											2
LTRO0.8												205			1
MILL0.3			1.59	1.98											2
NBTC3.1			2.96	3.32								245			3
PINY0.6			7.81	7.74								469			3
PTRC0.1			6.4	6.42											2
RACC0.2			1.86	2.1											2
RACC5.0			1.5	1.79											2
RAYS4.6			1.09	1.57											2
RAYS42.8			2.16	2.46											2
RAYS54.1			1.19	1.42								803			3
RAYS80.5			1.96	2.18											2
SBLA8.3											3.6				1
SHUP0.1											3.4	1460		1080	3
SHWN4.2			1.98	2.13											2
SIDE13.9											17.4				1
SINK0.3			1.75	1.88								203			3
SIXM0.3									**28**		2.2	1940	1550		4
SPRU1.0			3.32	3.67								370			3
SPRU10.6			3.5	3.51											2
STST26.8											19.6				1
TEAC0.1			3.59	3.65								209			3
TIPT1.3											15.2				1
TSPR0.1			9.25	9.26											2
TUSC0.6			1.13	1.48											2
TUSC22.5				1.33											1
TUSC39.3			1.26	1.56											2
YELL3.5			5.55	5.72											2
YELL9.1			7.98	8.07											2
YELL12.0	342	**39.6**	**11.7**	**11.64**											4
TOTAL	2	2	61	66	11	4	2	1	2	1	12	16	3	3	

**Highest or lowest values are in bold print.*

Table 5. *Juniata Subbasin Survey Streams Identified as Impaired Streams Requiring a TMDL on PADEP's 2004 Integrated List of All Waters*

WATERSHEDS	MAJOR SOURCES OF IMPAIRMENT	TMDL STATUS	STATIONS IN IMPAIRED SECTIONS
Aughwick Creek	Source Unknown/Mercury:2002	Proposed 2011	
Beaver Creek	Agriculture/Siltation:2004, Agriculture/Nutrients:2004	Proposed 2017	BEAV 0.1
Beaver Dam Branch	Abandoned Mine Drainage/Metals:1996, Combined Sewer Overflow/Organic Enrichment/Low D.O.:1996, Urban Runoff/Storm Sewers/Cause Unknown:1996	Proposed 2005	BVDB 0.1/ BVDB 5.0
Bells Gap Run	AMD/Siltation:2002, AMD/pH:2002, AMD/Metals:2002	Proposed 2017	
Brush Creek	Crop Related Agriculture/Siltation:2002, Crop Related Agriculture/ Nutrients:2002, Small Residential Runoff/Nutrients:2002	Proposed 2017	
Buffalo Creek	Crop Related Agriculture/Siltation:2002	Proposed 2015	
Burgoon Run	AMD/Metals:1996, AMD/Siltation:2002, AMD/pH:2002	Proposed 2005	BURG 0.5
Cocolamus Creek	Grazing Related Agriculture/Siltation:2002, Agriculture/ Siltation:2002, Animal Feeding Agriculture/Nutrients:2002	Proposed 2015	
Doe Run (Cedar Spring Run)	Agriculture/Siltation:2002	Proposed 2015	
Frankstown Branch	Industrial Point Source/Nonpriority Organics:1996, Industrial Point Source/ Priority Organics:1996, Industrial Point Source/Suspended Solids: 1998 and 2002, Road Runoff/Siltation:2002	Proposed 2005/2015	FRNK 32.5
Halter Creek	Urban Runoff/Storm Sewers/Suspended Solids:1998, Source Unknown/Cause Unknown:1998	Proposed 2005	HALT 0.6
Hickory Bottom Creek	Agriculture/Siltation:2004	Proposed 2015	HKBC 0.1
Honey Creek	Agriculture/Nutrients:2002, Agriculture/Siltation:2002, Crop Related Agriculture/Siltation:2002	Proposed 2015	
Jacks Creek	Source Unknown/PCB:1998	Proposed 2009	
Juniata River	Crop Related Agriculture/Siltation:2002	Proposed 2015	
Kishacoquillas Creek	Agriculture/Siltation:2002, Agriculture/Nutrients:2002, Hydromodifications/Siltation:2002, Construction/Siltation:2002	Proposed 2015/2017	KISH 15.6
Little Juniata River	Municipal Point Source/Organic Enrichment/Low D.O.:1996, Urban Runoff/Storm Sewers/Cause Unknown:1996	Proposed 2005	LJUN 29.6
Little Lost Creek	Crop Related Agriculture/Siltation:2002, Crop Related Agriculture/Nutrients:2002	Proposed 2015/2017	LLOS 0.5
Lost Creek	Crop Related Agriculture/Nutrients:2002, Crop Related Agriculture/Siltation:2002	Proposed 2015	
Narrows Branch Tuscarora Creek	Agriculture/Siltation:2002	Proposed 2015	
North Branch Little Aughwick Creek	Crop Related Agriculture/Nutrients:2002, Crop Related Agriculture/Siltation:2002	Proposed 2015/2017	
Piney Creek	Agriculture/Siltation:2002	Proposed 2017	
Potter Creek	Agriculture/Siltation:2004	Proposed 2017	PTRC 0.1
Raystown Branch Juniata	Agriculture/Siltation:2004, Small Residential Runoff/Siltation:2004, Industrial Point Source/Nutrients:2004	Proposed 2017	
Raystown Branch Juniata	Source Unknown/Mercury:2002	Proposed 2011	
Shoups Run	Abandoned Mine Drainage/pH:1996, Abandoned Mine Drainage/metals:1996	Completed TMDL 2001	SHUP 0.1
Sixmile Run	Abandoned Mine Drainage/pH:1996, Abandoned Mine Drainage/metals:1996	Proposed 2009	SIXM 0.3
South Bald Eagle Creek	Industrial Point Source/Thermal Modifications:1996	Proposed 2009	SBEC 1.4
Spruce Creek	Agriculture/Siltation:2002, Grazing Related Agriculture/Siltation:1998, 2002, Grazing Related Agriculture/Nutrients:2002, Agriculture/Suspended Solids:1998	Proposed 2017	
Three Springs Run	Agriculture/Siltation:2004	Proposed 2017	TSPR 0.1
Tuscarora Creek	Agriculture/Siltation:2002, Grazing Related Agriculture/Siltation:2002, Grazing Related Agriculture/Nutrients:2002	Proposed 2015	
Yellow Creek	Agriculture/Siltation:2004	Proposed 2017	YELL 9.1/YELL 12.0

FRANKSTOWN BRANCH AND RAYSTOWN BRANCH OF THE JUNIATA RIVER

Frankstown Branch Juniata River

Site conditions for the Frankstown Branch Juniata River and the Raystown Branch Juniata River are depicted in Figure 4. The Frankstown Branch drains the urban area of Altoona, Pa., some AML, agricultural lands, and forested areas with sections of state game lands. Of the streams sampled in the Frankstown Branch, none of the sites had "higher" water quality. Two sites (BURG 0.5 and HALT 0.6) had seven parameters exceeding levels of concern, and one (BVDB 5.0) had six parameters exceeding levels of concern (Table 4). Water quality impairment was due to agricultural practices, urban influences, and AMD conditions.

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Frankstown Branch Juniata River (FRNK 1.6) in Alexandria, Pa.

Only one site in the Frankstown Branch had nonimpaired macroinvertebrate conditions, two sites were slightly impaired, two sites were moderately impaired, and two sites were severely impaired. BLRG 2.5 had nonimpaired biology, but the water quality was rated "lower" due to slightly high aluminum. This site drained mostly state game lands; however, it also drained some AML, had an industrial discharge point, and was near a biosolids land application (PADEP, 2005). These are all potential sources for the slightly high aluminum value. The severely impaired sites, BURG 0.5 and BVDB 5.0, were impaired by AMD with iron precipitate coating the streambeds. BURG 0.5 had the most severe AMD conditions of the Juniata Subbasin sampling sites, with the highest levels of metals and the lowest pH and alkalinity. BVDB 0.1, downstream of BVDB 5.0, also was impacted by AMD; however, the biological conditions improved to moderately impaired. BVDB 0.1 also had lower levels of metals than BVDB 5.0; however, the total nitrogen and total nitrate-n values increased, possibly due to urban influences such as lawn fertilizers, stormwater runoff, and a wastewater treatment plant. BVDB 0.1 had the highest level of chloride (35.2 mg/l) of all the Juniata Subbasin sites, possibly caused by the wastewater treatment plant and urban runoff influences.

PINY 0.6 was the other moderately impaired site. This site also had "lower" water quality due to high nitrogen and aluminum. The reason for the high aluminum needs further research. No biosolids applications were identified (PADEP, 2005); however, the area is agricultural, and agricultural impairment was noted in one section of the watershed (PADEP, 2005). Piney Creek is being studied through a Coldwater Heritage Grant by the Blair County Conservation District and is part of SRBC's Year-2 Subbasin Survey study of Morrison Cove. Clover Creek and Halter Creek are other streams in the Year-2 Subbasin Survey study. CLOV 0.1 and HALT 0.6 were both slightly impaired. CLOV 0.1 had "middle" water quality due to high total nitrogen and nitrates, and HALT 0.6 had "lower" quality from high nitrogen, nitrates, hardness, magnesium, orthophosphate, phosphorus, and sodium. HALT 0.6 was located downstream of the urban area of Roaring Springs, industry, a wastewater treatment plant, and a quarry operation.

The sites on the mainstem Frankstown Branch were not sampled for macroinvertebrates due to high flow conditions following the September floods. The water quality was rated "middle" for all the Frankstown Branch mainstem sites on account of high total nitrogen, nitrate-n, and orthophosphate. Also, FRNK 32.5 had a high sodium value. The high sodium levels at FRNK 32.5 may have originated from Halter Creek, since high sodium also was noted at HALT 0.6.

Raystown Branch Juniata River

The Raystown Branch Juniata River drains the area west of Bedford to near Huntingdon, Pa., the lower section of which is dammed for approximately 28 miles. The Raystown Branch is similar to the Frankstown Branch in land use, with less urban land use in this watershed. The most agricultural area was Yellow Creek, located in the Morrison Cove area.

The sites sampled throughout the Raystown Branch were mostly nonimpaired (11 sites), with seven sites rated as slightly impaired, three sites being moderately impaired, and one site designated severely impaired. The water quality ratings were mostly "middle" (17 sites), with only five sites rated "higher" and four sites rated "lower" water quality. Most of the water quality impairment was attributed to agriculture though some of it was attributed to AMD. The habitat at all sites was rated either excellent or supporting.

Part of the headwaters of the Raystown Branch is the Dunning Creek Watershed, which includes Bobs Creek,

S. LeFevre

White rocks along the banks of Raystown Branch Juniata River (RAYS 4.6) downstream of the Raystown Dam and is located north of Bedford, Pa. This watershed was mostly nonimpaired, with only slight impairment in the headwaters of Dunning Creek (DUNN 9.9), probably due to slight degradation of the stream channel. Water quality was "middle" quality at all the sites in this watershed due to low alkalinity in the headwaters of Bobs Creek and slightly high total nitrogen on Dunning Creek (Table 4).

The other creeks in the headwaters of Raystown Branch (Shawnee Branch, Buffalo Run, Shobers Run, and Cove Creek) were mostly non-impaired with only slight impairment on Cove Creek due to agricultural land use and higher nitrogen values. Shawnee Branch also had "middle" water quality due to slightly high total nitrogen values (Table 4). The Raystown Branch main-stem site, RAYS 103.0, showed slight impairment, although the water quality at the time of sampling did not exceed levels of concern and the habitat was rated excellent.

The next downstream site on Raystown Branch mainstem, RAYS 80.5, was nonimpaired with total nitrogen and nitrate-n values only slightly exceeding levels of concern. Brush Creek enters Raystown Branch west of Breezewood, Pa., with nonimpaired biological conditions and "higher" water quality. The headwaters of Brush Creek were slightly low in alkalinity, and the habitat was rated supporting.

The next major input to the Raystown Branch is the Yellow Creek Watershed, which drains the Morrison Cove area. This area is highly agricultural, and the sites in this watershed all showed high total nitrogen values greater than 5.0 mg/l. The tributaries to Yellow Creek (Hickory Bottom Creek, Potter Creek, Three Springs Run, and Beaver Creek) were all slightly impaired with "middle" water quality, except for Three Springs Run, which had moderately impaired conditions. Three Springs Run also had the highest total nitrogen and nitrate-n values of these tributary streams (9.26 and 9.25, respectively) (Table 4).


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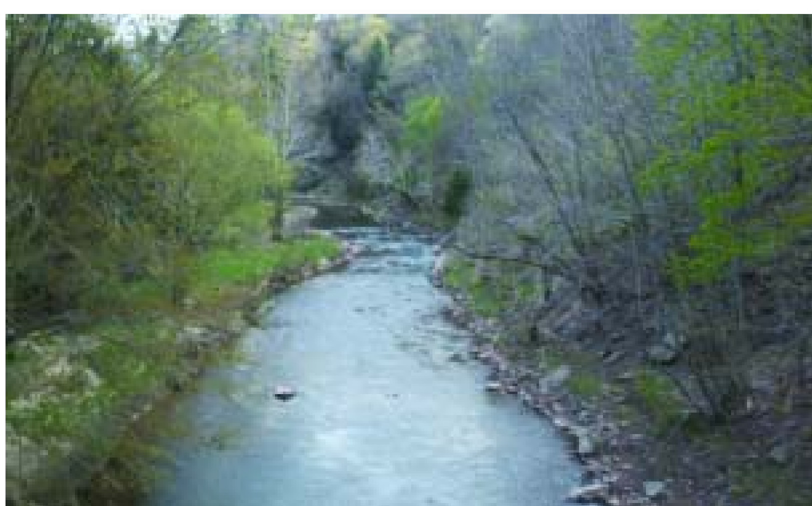
AMD conditions on Burgoon Run (BURG 0.5) at Leopold Park near Altoona, Pa.

None of these sites had stoneflies present in the macroinvertebrate samples. The most impaired site on Yellow Creek was the one closest to the headwaters, YELL 12.0. This site had "lower" water quality with total nitrogen and nitrate-n values of 11.64 mg/l and 11.7 mg/l, respectively, and also exceeded the levels of concern for hardness and magnesium (Table 4). These nitrogen and nitrate-n values were the highest of any site sampled in the Juniata Subbasin Survey. The macroinvertebrate population was moderately impaired. Downstream at YELL 9.1, biological conditions improved to slightly impaired, and the water quality rating was "middle" due to decreases in total nitrogen, nitrate-n, hardness, and magnesium. Conditions continued to improve downstream, and YELL 3.5, located outside of Morrison Cove near Eichelbergertown, Pa., had a nonimpaired macroinvertebrate community and further improved total nitrogen and nitrate-n values, although the values still exceeded levels of concern. The Yellow Creek Watershed will be studied as part of the Year-2 Subbasin Survey in Morrison Cove. Furthermore, a Yellow Creek Coalition has been working to improve the quality of this watershed through numerous projects (Table 1).

The Raystown Branch flows through an area of AML (Figure 3) from near Hopewell, Pa., to around Saxton, Pa., which also correlates to the section of Ecoregion 69 (Figure 2) and geology favorable to coal mining. The streams sampled in this area, Sixmile Run and Shoups Run, exhibited AMD conditions such as low alkalinity and high metals (Table 4) and had moderately and severely impaired biological conditions, respectively. The site on the mainstem Raystown Branch in Hopewell, Pa., RAYS 54.1, showed a high aluminum value, probably from other AMD streams upstream of this site. The site at Saxton, Pa., RAYS 42.8, did not show the influence of AMD conditions, which may have been due to time of sampling or dilution from Yellow Creek and other streams entering the Raystown Branch between these sites. RAYS 42.8 had higher nitrogen and nitrates, which indicated an impact from Yellow Creek.


S. LeFevre

Brush Creek (BRUS 0.1) west of Breezewood, Pa.

Another significant influence to the Raystown Branch is the Great Trough Creek Watershed that covers a large section of land east of Raystown Lake. This stream was aptly named as a "trough" because of sections of deep channel and slow-moving stream water. Although the headwaters drain some AML, the water quality of Great Trough Creek near the point it enters the lake was "higher" quality and had nonimpaired biological conditions. GTRC 2.9 was used as a reference site for subecoregion 69a. The Trough Creek State Park surrounds the stream for several miles near the mouth. The headwaters area, including Little Trough Creek, has more agricultural influence; however, nitrogen values were not high. A macroinvertebrate sample was not taken at this site due to lack of riffle habitat.

The sample at the mouth of Raystown Branch Juniata River, RAYS 4.6, was collected downstream of Raystown Lake. A macroinvertebrate sample was not collected due to the lack of riffle conditions at the time of sampling. The water chemistry indicated "middle" quality due to nitrogen and nitrate-n values that slightly exceed background concentrations.

UPPER JUNIATA RIVER SECTION

The Upper Juniata River section includes Little Juniata River, Shavers Creek, Crooked Creek, Standing Stone, Mill Creek, and Aughwick Creek Watersheds, most of which demonstrated "middle" or "higher" water quality, slightly impaired or nonimpaired biology, and supporting or excellent habitat (Figure 5). This section had 16 "higher," 16 "middle," and one "lower" water quality ratings. The biological conditions of 16 sites were nonimpaired, eight sites were slightly impaired, two sites were moderately impaired, and seven sites did not have a macroinvertebrate sample collected. Most habitat conditions were rated excellent (21 sites), with three sites rated supporting, two sites rated partially supporting, and seven sites with no habitat assessment.

The Little Juniata River Watershed is a beautiful watershed that has improved dramatically from a history of industrial and wastewater pollution prior to the 1970s to become a premier trout fishery today. The Little Juniata River begins in Altoona, Pa., where two sampling sites, SPRR 1.0 and LJUN 29.6, were located. SPRR 1.0 was located on the outskirts of Altoona just upstream of the Pennsylvania State University Altoona Campus, and had "higher" water quality at the time of sampling with slight impairment of the macroinvertebrate community, possibly from urban encroachment. LJUN 29.6 was located in a high traffic and industrial area; however, the stream was slightly buffered by vegetated areas. The water quality analysis did not detect any significant sources of pollution; however, the substrate was covered with sediment, and the macroinvertebrate population was moderately impaired. The macroinvertebrate community was dominated by pollution-tolerant midges, low in mayflies, and lacking stoneflies. Further study and a more extensive water quality analysis including industrial pollutants may be necessary to identify the source of biological impairment at this site.

> ***"The Little Juniata River Watershed is a beautiful watershed that has improved dramatically from a history of industrial and wastewater pollution prior to the 1970s to become a premier trout fishery today."***

Four sites were located on tributaries to Little Juniata River from Altoona, Pa., to Tyrone, Pa.: BELG 2.4, TIPT 1.3, BIGF 1.0, and SBEC 1.4. Bells Gap Run and Tipton Run both had "middle" water quality due to lower alkalinity values. Bells Gap Run had a slightly impaired biological condition; this impairment and the lower alkalinity values are probably caused by the AMD impairment (Table 5) in the headwaters of this stream (PADEP, 2005). Tipton Run had a nonimpaired macroinvertebrate population. The Little Juniata River mainstem site between Bells Gap Run and Tipton Run (LJUN 19.4) showed improvement from LJUN 29.6 in the macroinvertebrate community; however, the water quality analysis showed total nitrogen, nitrate-n, phosphorus, and orthophosphate values slightly exceeding levels of concern (Table 4).

Big Fill Run flows into South Bald Eagle Creek near Bald Eagle, Pa. BIGF 1.0 had nonimpaired biological conditions; however, the water quality showed slightly low alkalinity and slightly high aluminum. Part of this watershed drains Ecoregion 69, which has more acidic geology, and this watershed could be impacted by acidic atmospheric deposition. South Bald Eagle Creek, SBEC 1.4, did not exceed any levels of concern for the parameters tested; however, the macroinvertebrate population was slightly impaired. The impairment may be a consequence of habitat conditions, such as concrete channelization and buildings located adjacent to the stream channel. Industrial discharges also are located upstream, and more extensive water quality analysis may be necessary to detect other pollution sources. The Little Juniata River mainstem site downstream of Tyrone, Pa., LJUN 15.0, did not have any parameters that exceeded levels of concern, and biological conditions were not sampled due to high flow conditions.

Downstream from LJUN 15.0, Sinking Run and Spruce Creek enter the Little Juniata. Sinking Run had nonimpaired biological conditions and "middle" water quality due to slightly elevated total nitrogen, nitrate-n, and aluminum values. Biosolids land application was identified near SINK 0.3 around Arch Spring, Pa., (PADEP, 2005), which may be a reason for the slightly high aluminum value. Habitat conditions at SINK 0.3 were partially supporting due to lack of vegetation surrounding and covering the stream, algae-covered substrate, lack of variety of flow regimes, and low frequency of riffles. SPRU 1.0 at the Pennsylvania Fish and Boat Commission Special Regulations Area near Colerain was the only site in the Upper Juniata Section to receive a "lower" water quality rating. Spruce Creek was affected by high total nitrogen, nitrate-n, and aluminum. There are several farms located in this watershed, some of which are Concentrated Animal Feeding Operations (CAFOs) that apply biosolids to the land (PADEP, 2005), which is a potential source of the high aluminum. The macroinvertebrate community at SPRU 1.0 was rated nonimpaired, although sections of Spruce Creek and its tributaries Halfmoon Creek and Warriors Mark are impaired according to assessments done by PADEP (Table 5). The Pennsylvania State University Center for Watershed Stewardship (PSUCWS) is conducting an assessment of the Spruce Creek Watershed that started in the fall of 2003. Their project included activities such as public awareness meetings, streamside buffer plantings, water quality assessments, drinking water well monitoring and education, and preparation of a restoration plan. In particular, the PSUCWS was instrumental in the formation and support of a Spruce Creek Watershed Association (Table 1). LJUN 3.8, near the mouth in Barree, Pa., was sampled only for water quality and demonstrated "middle" quality due to total nitrogen and nitrate-n values exceeding background concentrations (Table 4).

Smaller watersheds within the Upper Juniata Section include Shaver Creek, Crooked Creek, Standing Stone Creek, and Mill Creek located between Petersburg and Mill Creek, Pa. These watersheds contributed high quality water and biological conditions to the Juniata River. "Middle" water quality was found only at CRKD 0.3, EBSS 0.5, STST 26.8, and MILL 0.3 due to slightly elevated nitrate-n and nitrogen values and, in the case of STST 26.8, an alkalinity value that was just under 20 mg/l. (Table 4). STST 26.8 and STST 1.0 served as reference sites for subecoregion 67a and medium size drainages, respectively, and MILL 0.3 served as the reference site for subecoregion 67d. All of the sites had nonimpaired macroinvertebrate communities, except for the sites on Shaver Creek, which had slightly impaired communities as a consequence of having a low number of stoneflies. Habitat conditions were excellent at all of these sites.


S. Rummel

Trout fishing on the Little Juniata River near Barree, Pa.

Downstream of Mill Creek Watershed, near Mount Union, Pa., Aughwick Creek enters the Juniata River. Aughwick Creek is a large watershed that drains approximately 320 square miles and contributes very good water quality and biological conditions to the Juniata River. A site on Blacklog Creek, BLLG 0.9, served as a reference site for subecoregion 67b. All the sites had "higher" water quality except for two headwater sites, SIDE 13.9 and SBLA 8.3, which had "middle" quality due to low alkalinity values. The alkalinity value at SBLA 8.3 was very low (3.6 mg/l); this site also had slightly impaired biological conditions. Of particular interest was a lack of mayflies at this site, which may be an indication of detrimental influence from acid deposition. Another site with slightly impaired biology was LAUG 0.1 due to lower taxa richness, diversity, and number of EPT taxa compared to other sites in this reference group; however, this site had numerous sensitive macroinvertebrate genera. Shade Creek in Shade Gap, Pa., was moderately impaired most likely due to partially supporting habitat conditions or water quality parameters not included in this analysis. SHAD 1.8 had rip-rap along its banks, lack of vegetated buffer and stream cover, excessive algae growth coating the substrate, trash along the banks, and also appeared to have been subject to recent high flows. SHAD 1.8 was sampled directly downstream of a discharge pipe from a mill and discharges from at least two lumber operations. All other habitat conditions in Aughwick Creek were either excellent or supporting. The mouth of Aughwick Creek, AUGH 0.4, was not sampled for macroinvertebrates due to high flow from the September floods.

LOWER JUNIATA RIVER SECTION

The watersheds sampled in the Lower Juniata River section were Kishacoquillas Creek, Jacks Creek, Lost Creek, Doe Run, Tuscarora Creek, Delaware Creek, Raccoon Creek, Cocolamus Creek, Buffalo Creek, and Little Buffalo Creek (Figure 6). These watersheds mostly contribute good water quality, with very good macroinvertebrate and water quality conditions in the Tuscarora Creek and Jacks Creek Watersheds. Overall, there were two "higher," 26 "middle," and three "lower" water quality sites in the Lower Juniata River section. Sixteen sites had nonimpaired, nine had slightly impaired, and one had moderately impaired biological conditions. One site (RACC 0.2) was not sampled for macroinvertebrates due to lack of riffle habitat and deep water and three Juniata River mainstem sites were not sampled on account of high water from the floods. Habitat conditions were excellent or supporting.

Kishacoquillas Creek drains an agricultural limestone valley between Jacks Mountain and Stone Mountain and maintains a popular trout fishery. The three sites on Kishacoquillas Creek and the two tributaries, Honey and Tea Creeks, had "middle" quality mostly due to total nitrogen and nitrate-n. KISH 5.5 also had an orthophosphate value slightly above the level of concern, and Tea Creek had slightly high aluminum. Tea Creek Watershed is another watershed that has documented land applications of biosolids (PADEP, 2005) as a possible source of the aluminum. The highest total nitrogen and nitrate-n values in Kishacoquillas Creek Watershed were found at KISH 15.6 (Table 4). These were the highest levels recorded in the Lower Juniata River section. The lowest levels of nitrogen and nitrate-n in the Kishacoquillas Creek Watershed were in Honey Creek, where levels slightly exceeded natural background concentrations. All sites had slightly impaired macroinvertebrate populations except Honey Creek, which had nonimpaired conditions.

S. LeFevre

Kishacoquillas Creek (KISH 15.6) in Bellville, Pa.

Jacks Creek enters the Juniata River just downstream of the Kishacoquillas Creek confluence in Lewistown, Pa. This watershed drains the more forested limestone valley between Jacks Mountain and Shade Mountain. This watershed had nonimpaired biological conditions and "middle" water quality due to nitrogen and nitrate-n values slightly greater than 1.0 mg/l.

Lost Creek and Doe Run Watersheds had slightly impaired biological conditions and "middle" and "lower" water quality mostly due to agricultural pollution. Little Lost Creek (LLOS 0.5) had high total nitrogen, nitrate-n, and slightly exceeding orthophosphate values. CAFOs and a wastewater treatment plant are located upstream of this site (PADEP, 2005). The nitrogen and orthophosphate values decreased near the mouth of Lost Creek (LOSC 0.2). Doe Run showed high nitrogen and nitrate-n values also (Table 4), and had tributary sections impaired due to agriculture (Table 5). DOER 0.3 also had a biosolids application near the mouth west of Mexico, Pa., (PADEP, 2005) that might be contributing to the elevated aluminum value of 359 µg/l (Table 4).

Entering the Juniata River from the other bank is the Tuscarora Creek Watershed, which had nonimpaired biological conditions and excellent habitat conditions at all the sites sampled in this survey. Two of the sites, ELKC 9.8 and WILL 0.4, had "higher" water quality, and ELKC 9.8 was the reference site for subecoregion 67c. The other sites in this watershed had "middle" water quality due to total nitrogen values slightly above background concentrations. One site, NBTC 3.1, had "lower" water quality due to higher aluminum. This stream, Narrows Branch Tuscarora Creek, had CAFOs located in the watershed and upstream tributaries that were impaired for agriculture (Table 5).

Delaware, Raccoon, and Cocolamus Creeks enter the Juniata River in the stretch from Thompsontown, Pa., to Millerstown, Pa. These watersheds had "middle" quality due to the nitrogen and nitrate-n contributed to the Juniata River. Raccoon Creek contributed nitrogen and nitrate-n slightly higher than background levels and had nonimpaired biological conditions at RACC 5.0. Total nitrogen and nitrate-n values were slightly higher at the mouth (RACC 0.2). Total nitrogen and nitrate-n were higher on Delaware and Cocolamus Creeks, with DELA 0.2 having the highest values around 5.0 mg/l. Cocolamus Creek had values ranging from 2-3 mg/l; however, COCO 9.6 also had high orthophosphate and phosphorus values. A CAFO and other agricultural activities exist upstream of this site. In fact, two tributaries upstream of COCO 9.6 were impaired for agricultural activities (Table 5). The water quality conditions normally may be better at this site, because the macroinvertebrate community was nonimpaired. COCO 0.2 and DELA 0.2 had slightly impaired macroinvertebrate conditions, and DELA 0.2 had a lower habitat rating due to concrete and rip-rap along the banks, sections of eroded banks, and lack of adequate protective riparian vegetative zone.

Buffalo and Little Buffalo Creeks join the Juniata River at Newport, Pa. Buffalo Creek had nonimpaired macroinvertebrate communities; however, the water quality in the headwaters was rated "lower" and at the mouth "middle." Both sites had slightly exceeding nitrogen and nitrate-n levels, but BUFF 14.6 also exceeded orthophosphate, phosphorus, and aluminum. BUFF 14.6 was located downstream of a wastewater treatment plant, which could be a possible source for the higher phosphorus and orthophosphate values. It also has land application of biosolids in the headwaters (PADEP, 2005), which may be a possible source for the aluminum. Little Buffalo Creek also had nitrogen and nitrate-n levels slightly above background concentrations. The site located in Little Buffalo State Park, LBUF 2.1, had moderately impaired macroinvertebrate conditions, possibly a result of disturbance in the well-used park and because the site was located downstream of the dam. Even though the site at the mouth was located downstream of a concrete plant and quarry, the macroinvertebrate community was nonimpaired. The habitat at LBUF 0.1 was rated supporting due to a more urbanized environment that affected channel alteration, condition of banks, and riparian vegetative zone width.

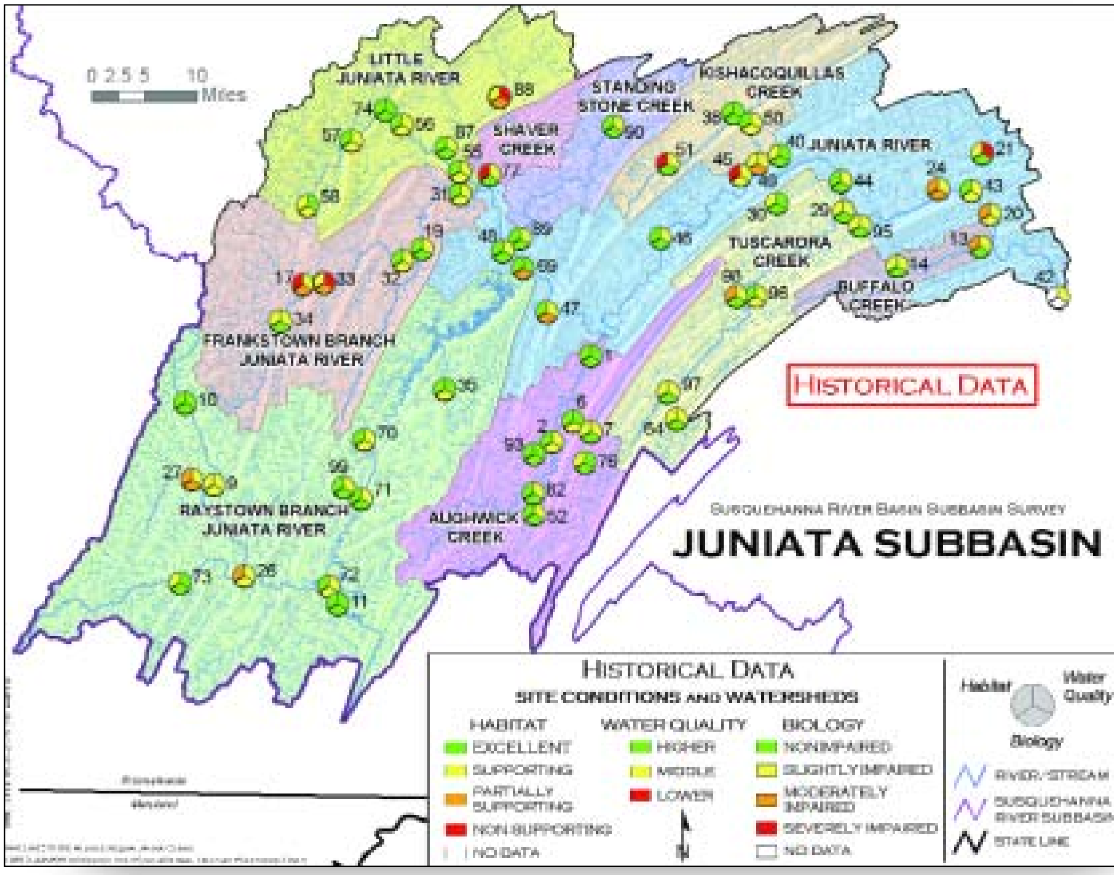


Figure 7. *Water Quality, Biological, and Habitat Conditions in 1995 Sample Sites in the Juniata Subbasin*

JUNIATA RIVER MAINSTEM

Water quality conditions for the Juniata River are depicted in Figures 5 and 6. The mainstem was not sampled for macroinvertebrates on account of high flows. The seven sites dispersed throughout the Juniata River were all rated "middle" quality, and all had nitrogen and nitrate-n values slightly greater than natural background concentrations.

Comparison of 1995 and 2004 Data

A comparison of historical Juniata Subbasin data from 1995 and the current survey data from 2004 indicated that the biological conditions have remained relatively the same. The results for water quality, biology, and habitat conditions in the 1995 Juniata Subbasin Survey are depicted in Figure 7, and the sites that were sampled in 1995 and 2004 are in blue print with an asterisk in Appendix A. The methods have changed slightly throughout the years, and the methods for the 1995 survey can be found in McGarrell, 1997. Specifically, the number of macroinvertebrates subsampled changed from 100 to 200 count, the habitat assessment form changed to assigning each parameter 20 points instead of weighting the parameters with different point ranges, and the water quality assessment analysis has changed. In the 1997 report, McGarrell assessed water quality using Principal Components Analysis and cluster analysis and did not assign rating categories for site conditions. For comparison purposes, the 1995 data was analyzed using current methodology to acquire water quality site condition ratings. In addition, the reference categories have changed for a couple of sites due to advances in GIS (Geographic Information Systems) technology, and in 1995, sites in subecoregions 67c and 67d were grouped together. Another difference was flow, which was much higher for most of the sites in 2004 than in 1995.

In 1995, 55 percent of the biological conditions were nonimpaired, 31 percent were slightly impaired, and 14 percent were moderately impaired (Figure 8). A summary of the biological conditions in 2004 yielded similar results with 54 percent being nonimpaired, 32 percent slightly impaired, 10 percent moderately impaired, and four percent severely impaired (Figure 9). A different number of samples was collected in each survey; however, overall it appears that conditions remained similar. Of the sites that were sampled in 1995 and 2004, 57 percent maintained the same site condition rating, 24 percent improved, and 19 percent degraded. The improvements and degradations were only by one step in category, except for SHAD 1.8, which degraded from nonimpaired conditions in 1995 to moderately impaired conditions in 2004.

The 1995 data were analyzed using current methods and levels of concern, and 23 percent of the sites were considered "higher," 72 percent were "middle" quality, and five percent were considered "lower" quality. In 2004, 23 percent were "higher" water quality, 63 percent were "middle" quality, and 14 percent were considered "lower" quality. The sites that were added in 2004 tended to be of poorer quality, and in particular more AMD streams were added. A site-to-site comparison indicated that 67 percent of the sites had the same water quality site condition category in 2004 as in 1995, 18 percent improved, and 15 percent degraded.

Table 6 shows a comparison of the total number of sites to exceed levels of concern for the sites that were sampled in both 1995 and 2004. Total nitrogen had a similar number of exceeding values, while nitrate-n exceedences increased in 2004. The range of nitrogen values differed from 1995 to 2004, with a high of 6.31 mg/l in 1995 and 11.64 mg/l in 2004. More sites exceeded orthophosphate and phosphorus levels of concern in 1995 than in 2004, which could be a consequence of upgrades in wastewater treatment plants and best management practices (BMPs) to prevent soil erosion. Streams that did not exceed the aluminum level of concern in 1995 exceeded this level in 2004. The largest difference in parameters from 1995 to 2004 was in temperature. Flow was lower at most of the sites sampled in 1995, and a majority of the sampling was conducted in July and August.

Although the habitat assessment form has changed from 1995 to 2004 and the assessments are subjective measures completed by different people, the process of assigning a comparative condition category using a reference site remained the same. A much higher percentage of stream sites was rated excellent in 2004. Forty-one percent of the habitat condition ratings remained the same, 52 percent improved from 1995 to 2004, and seven percent degraded from 1995 to 2004.

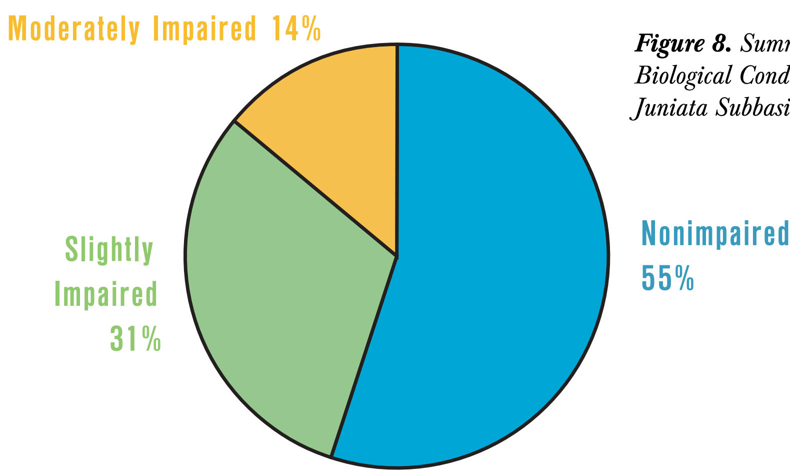


Figure 8. *Summary of the Biological Conditions in the Juniata Subbasin in 1995*

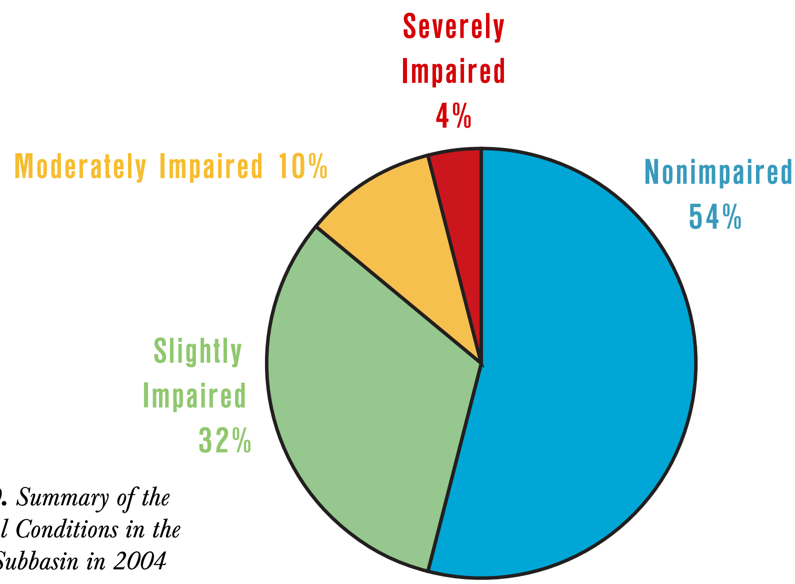


Figure 9. *Summary of the Biological Conditions in the Juniata Subbasin in 2004*

Conclusions

Overall, streams in this subbasin had very good water quality, macroinvertebrates, and habitat in 2004. Approximately half of the sites sampled in this subbasin had nonimpaired macroinvertebrate conditions. The largest source of impairment appeared to be from agricultural activities, although many streams exhibited only slight increases over background levels. Areas of AMD pollution were concentrated mostly in the area west of Altoona and in the area from Hopewell to Saxton, Pa. Urban pollution was not detected often in this survey, with the most urban influence found in the Altoona area.

Some of the highest quality watersheds within this subbasin were Aughwick Creek, Tuscarora Creek, Jacks Creek,

Table 6. *Number of Water Quality Values Exceeding Levels of Concern for the same sites in 2004 and 1995*

Year	Nitrite-N T	Nitrate-N T	Nitrogen T	Orthophosphate T	Phosphorus T	Sodium T	T Susp Solid	Acidity	Alkalinity	Aluminum T	Iron T	Temperature
1995	1	31	39	12	11	4	1	1	2	2	1	13
2004	0	38	40	8	3	1	0	0	2	5	0	0

Shobers Run, Great Trough Creek, Buffalo Run, Brush Creek, and Standing Stone Creek. Aughwick Creek Watershed had the most sites with the best possible site conditions in each category. Some of the most degraded watersheds were Burgoon Run, Beaverdam Branch, Shoups Run, Sixmile Run, and the Morrison Cove area. The Frankstown Branch was the section with the most impairment overall, with AMD, agriculture, and urban influences. The Raystown Branch had isolated sections of impairment (Ecoregion 69 and Morrison Cove), contributing AMD and agricultural pollution near the start of the impoundment of water from the dam. Unfortunately, numerous stations could not be sampled for macroinvertebrates due to high flow conditions, which reduced the information available in 2004 for many streams.

Efforts should be made to restore the most degraded watersheds within this subbasin and to protect the higher quality ones. Agriculture BMPs can be used to limit the impacts associated with farming operations. Information on these practices and other conservation methods can be gathered from the County Conservation District Offices (Table 1). Grant opportunities to cleanup AMD and more information on remediation technologies also are available in County Conservation District Offices and from the Western PA Coalition for Abandoned Mine Reclamation (Table 1). Urban stormwater problems can be minimized with low impact development and by allowing for groundwater recharge areas. More information on urban pollution remediation can be obtained from the Center for Watershed Protection in Ellicott City Md., through its Urban Subwatershed Restoration Manual Series (http://www.cwp.org/).

Further study and research would be needed to identify the source and cause of the higher aluminum values found in this survey. It appears that the higher aluminum concentrations were not adversely impacting macroinvertebrate communities. Aluminum is not toxic to aquatic life, such as fish, unless the pH of the stream is lower than approximately 5.2, when the aluminum is present in dissolved form (Gagen and Sharpe, 1987; Baker and Schofield, 1982).

A second year of more intensive sampling began in the Morrison Cove area in Spring 2005. The streams sampled in this Year-2 survey include Yellow, Beaver, Hickory Bottom, Potter, Three Springs, Halter, Cabbage, Plum, Clover, and Piney Creeks. The streams in the Yellow Creek Watershed (Beaver, Hickory Bottom, Potter, and Three Springs Creeks) have been impaired for agricultural pollution, and Halter Creek was impaired due to urban and industrial runoff and storm sewer problems (Table 5). Furthermore, the Morrison Cove area has been identified as a potentially stressed groundwater area. Quarterly water sampling of streams, springs, and seeps is being conducted to gather information on groundwater influence on stream quality. Macroinvertebrates were collected in spring 2005 in order to assess the biological health of these streams. More information on this project is available from SRBC.

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FOR MORE INFORMATION

For more information on a particular stream or more details on the methods used in this survey, contact Susan R. LeFevre, (717) 238-0426 ext. 104, e-mail: slefevre@srbc.net.

For additional copies of this subbasin survey, contact the Susquehanna River Basin Commission, 1721 N. Front Street, Harrisburg, PA 17102-2391, (717) 238-0423, fax: (717) 238-2436, e-mail: srbc@srbc.net.

For raw data from this survey or more information concerning SRBC, visit our website: www.srbc.net.

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APPENDIX

SAMPLE SITE #	STATION NAMES	LOCATION DESCRIPTION	LATITUDE	LONGITUDE	DRAINAGE (MILES^2)	DESIGNATION
1	***AUGH 0.4**	**Aughwick Creek at T403 bridge near Aughwick, Huntingdon Co.**	**40.334797073**	**-77.859967220**	**320.12**	**M**
2	***AUGH 17.2**	**Aughwick Creek downstream of Three Springs Creek and Rt. 994 near Pogue, Huntingdon Co.**	**40.215420999**	**-77.927165408**	**203.82**	**M**
3	**BEAV 0.1**	**Beaver Creek at mouth in Loysburg, Bedford Co.**	**40.160030000**	**-78.374584000**	**19.1**	**67a**
4	BELG 2.4	Bells Gap Run at Hunter Road near Reightown, Blair Co.	40.606503046	-78.352617446	21	67d
5	BIGF 1.0	Big Fill Run off Route 350, near Bald Eagle, Blair Co.	40.738076470	-78.193760183	12.1	67d
6	***BLLG 0.9**	**Blacklog Creek along T599 upstream of Rockhill and Orbisonia, Huntingdon Co.**	**40.240538345**	**-77.895020042**	**66.5**	**67b**
7	***BLLG 4.6**	**Blacklog Creek upstream of Peterson Road Bridge, upstream of Shade Creek, Huntingdon Co.**	**40.231717330**	**-77.863295945**	**34.12**	**67c**
8	BLRG 2.5	Blair Gap Run upstream of Mill Run Road, near Foot of Ten, Blair Co.	40.415904649	-78.451895830	16.7	67b
9	***BOBS 0.9**	**Bobs Creek at tractor crossing, near Reynoldsdale, Bedford Co.**	**40.150955127**	**-78.545316778**	**64.2**	**67b**
10	***BOBS 11.4**	**Bobs Creek at ball field, near Pavia, Bedford Co.**	**40.261872874**	**-78.589639005**	**22.1**	**67c**
11	***BRUS 0.1**	**Brush Creek upstream of SR2026, west of Breezewood, Bedford Co.**	**39.994160934**	**-78.315296422**	**85.1**	**67b**
12	**BRUS 14.1**	**Brush Creek upstream of SR3017 in Gapsville, Bedford Co.**	**39.952297628**	**-78.239835002**	**35.5**	**67c**
13	*BUFF 0.4	Buffalo Creek upstream of SR1007 (Fairground Road) covered bridge, near Newport, Perry Co.	40.489062973	-77.158074141	67.3	67b
14	*BUFF 14.6	Buffalo Creek off of Route 849, upstream of Eschol, Perry Co.	40.452291942	-77.315835315	43.8	67d
15	**BUFR 0.4**	**Buffalo Run upstream of Route 31/96 bridge in Manns Choice, Bedford Co.**	**40.002013639**	**-78.597352710**	**24.3**	**67a**
16	BURG 0.5	Burgoon Run at Leopold Park downstream of Lake Altoona, near Altoona, Blair Co.	40.487162309	-78.438011720	13.7	67d
17	*BVDB 0.1	Beaverdam Branch along T405, near Hollidaysburg, Blair Co.	40.428014514	-78.379371110	74.8	67a
18	BVDB 5.0	Beaverdam Branch upstream of Westerly Wastewater Treatment Facility, near Canan, Blair Co.	40.457877306	-78.426540700	37.7	67b
19	*CLOV 0.1	Clover Creek at church near mouth, in Cove Forge, Blair Co.	40.476754890	-78.175770626	50.1	67a
20	*COCO 0.2	Cocolamus Creek at old Route 22 bridge in Millerstown, Perry Co.	40.537870179	-77.145206535	64.11	67b
21	*COCO 9.6	Cocolamus Creek at T475 bridge, upstream of Dimmsville, Juniata Co.	40.617513570	-77.154635589	27.11	67b
22	**COVE 7.7**	**Cove Creek at SR 1004 bridge downstream of New Enterprise Stone and Lime, near Ashcom, Bedford Co.**	**40.005795263**	**-78.422355751**	**41.5**	**67a**
23	CRKD 0.3	Crooked Creek upstream of SR3033 bridge in Huntingdon, Huntingdon. Co.	40.480391295	-78.021433556	26.95	67b
24	*DELA 0.2	Delaware Creek along Route 333 downstream of Route 22/322 in Thompsontown, Juniata Co.	40.568170196	-77.234399142	11.18	67d
25	DOER 0.3	Doe Run near mouth in Mexico, Juniata Co.	40.535936288	-77.351888453	7.6	67b
26	***DUNN 0.1**	**Dunning Creek near mouth upstream SR1001, near Bedford, Bedford Co.**	**40.024334311**	**-78.477944508**	**196.3**	**M**
27	***DUNN 9.9**	**Dunning Creek at SR4032 bridge upstream of Reynoldsdale, Bedford Co.**	**40.152653016**	**-78.565447248**	**59.2**	**67b**
28	EBSS 0.5	East Branch Standing Stone Creek upstream of 2nd SR1019 (East Branch Road) bridge crossing from mouth, near Jackson Corner, Huntingdon Co.	40.609588175	-77.824145746	14.06	67a
29	*ELKC 0.1	East Licking Creek in park along Route 333, upstream of Port Royal, Juniata Co.	40.533814472	-77.397916656	45.46	67a
30	*ELKC 9.8	East Licking Creek upstream of Clearview Reservoir in Tuscarora State Forest, near Martins Crossroad, Juniata Co.	40.547563443	-77.526204559	21.78	67c
31	***FRNK 1.6**	**Frankstown Branch Juniata River upstream bridge in Alexandria, Huntingdon Co.**	**40.555670208**	**-78.098871250**	**378.7**	**M**
32	***FRNK 18.9**	**Frankstown Branch Juniata River at USGS gage upstream of SR2015 bridge in Williamsburg, Blair Co.**	**40.463085818**	**-78.200086245**	**289.3**	**M**
33	***FRNK 32.5**	**Frankstown Branch Juniata River upstream of Beaverdam Branch, upstream of SR2007 near Hollidaysburg, Blair Co.**	**40.431251054**	**-78.357935948**	**122.1**	**M**
34	***FRNK 38.1**	**Frankstown Branch Juniata River at Route 36 bridge near Brooks Mill, Blair Co.**	**40.377173310**	**-78.419832241**	**90.6**	**67b**
35	*GTRC 2.9	Great Trough Creek upstream of Trough Creek State Park, upstream of T370 (Trough Creek Drive) bridge near Newburg, Huntingdon Co.	40.286366000	-78.121036000	71.5	69a
36	HALT 0.6	Halter Creek at Route 36 bridge near McKee, Blair Co.	40.360518923	-78.417642395	32.7	67a
37	**HKBC 0.1**	**Hickory Bottom Creek upstream Route 36 bridge near Waterside, Bedford Co.**	**40.192456000**	**-78.375725000**	**7.3**	**67a**
38	*HONY 0.2	Honey Creek near mouth in Reedsville, Mifflin Co.	40.663472232	-77.592531771	93.71	67a
39	HSVR 0.5	Horse Valley Run along SR3002 downstream of Kansas Valley Run as exiting Tuscarora Mountain gap near East Waterford, Juniata Co.	40.359444400	-77.608055600	14.86	67c
40	*JACK 2.9	Jacks Creek upstream SR2004 east of Lewistown, Mifflin Co.	40.613050233	-77.532186737	57.02	67b
41	JACK 11.7	Jacks Creek upstream T707 in Shindle, Mifflin Co.	40.671731292	-77.415528134	27.25	67b
42	***JUNR 2.0**	**Juniata River mouth upstream of Route 11/15 bridge near Amity Hall, Perry Co.**	**40.419167000**	**-77.016944000**	**3402.5**	**L**
43	***JUNR 17.3**	**Juniata River upstream of Millerstown, Perry Co.**	**40.548286246**	**-77.158187741**	**3174.36**	**L**
44	***JUNR 34.0**	**Juniata River at Route 35 bridge in Mifflintown, Juniata Co.**	**40.568886191**	**-77.400671292**	**2842.19**	**L**
45	***JUNR 47.0**	**Juniata River at Route 103 bridge upstream of Kishacoquillas Creek in Lewistown, Mifflin Co.**	**40.593520126**	**-77.578415178**	**2518.07**	**L**
46	***JUNR 63.6**	**Juniata River on both sides of the island at bridge in McVeytown, Mifflin Co.**	**40.498165277**	**-77.736208218**	**2461.7**	**L**
47	***JUNR 84.6**	**Juniata River at bridge in Mapleton, Huntingdon Co.**	**40.394598353**	**-77.939792476**	**2026.76**	**L**
48	***JUNR 94.0**	**Juniata River at 4th Street bridge in Huntingdon, Huntingdon Co.**	**40.482582368**	**-78.011782181**	**846.2**	**L**
49	***KISH 0.4**	**Kishacoquillas Creek near mouth at the Kepler Bridge road off SR2004 in Lewistown, Mifflin Co.**	**40.601934233**	**-77.560294857**	**190.02**	**M**
50	***KISH 5.5**	**Kishacoquillas Creek in Jacks Mountain gap near Burnham, Mifflin Co.**	**40.654722200**	**-77.583333300**	**162.95**	**M**
51	*KISH 15.6	Kishacoquillas Creek at T350 bridge in Belleville, Mifflin Co.	40.600818739	-77.724270872	29.61	67a
52	***LAUG 0.1**	**Little Aughwick Creek at T309 bridge in Maddensville, Huntingdon Co.**	**40.123090914**	**-77.958958613**	**56.7**	**67b**
53	LBUF 0.1	Little Buffalo Creek near mouth in Newport, Perry Co.	40.475216532	-77.128753825	20.11	67b
54	LBUF 2.1	Little Buffalo Creek downstream of Little Buffalo State Park Road in Little Buffalo State Park, Perry Co.	40.457651690	-77.168216989	15.37	67d
55	***LJUN 3.8**	**Little Juniata River at SR4004 bridge in Barree, Huntingdon Co.**	**40.587027063**	**-78.100419633**	**335.32**	**M**
56	***LJUN 15.0**	**Little Juniata River along Route 453 near Tyrone Forge, Blair Co.**	**40.667754459**	**-78.230795871**	**160.8**	**M**
57	***LJUN 19.4**	**Little Juniata River along T502 between Tipton and Fostoria, Blair Co.**	**40.627389161**	**-78.296512228**	**75.8**	**67a**
58	***LJUN 29.6**	**Little Juniata River upstream Homer Gap Run in northeast section of Altoona, Blair Co.**	**40.536900277**	**-78.374536202**	**13.2**	**67a**
59	LLOS 0.5	Little Lost Creek at SR2007 bridge near Oakland Mills, Juniata Co.	40.605498712	-77.311317274	6.47	67a
60	LOSC 0.2	Lost Creek upstream SR1002 bridge near Cuba Mills, Juniata Co.	40.593871095	-77.399660754	39.6	67a
61	LTRO 0.8	Little Trough Creek upstream SR3008 bridge near Cherry Grove, Huntingdon Co.	40.297418000	-78.058096000	27.2	69a
62	MILL 0.3	Mill Creek near mouth upstream of Route 22 bridge at Lions Club Park at Mill Creek, Huntingdon Co.	40.437941456	-77.932206677	37.52	67d
63	**NBLA 1.4**	**North Branch Little Aughwick Creek upstream T457 bridge near Burnt Cabins, Fulton Co.**	**40.091925263**	**-77.909209640**	**18**	**67b**
64	*NBTC 3.1	Narrows Branch Tuscarora Creek upstream SR4007 bridge in Concord, Franklin Co.	40.248375860	-77.704353282	19.51	67b
65	PINY 0.6	Piney Creek near mouth at Franklin Forge, Blair Co.	40.472155516	-78.231991059	25.3	67a
66	**PTRC 0.1**	**Potter Creek upstream Route 36 bridge along Route 868 in Waterside, Bedford Co.**	**40.189067000**	**-78.376854000**	**13.3**	**67a**
67	RACC 0.2	Raccoon Creek upstream SR4006 bridge near Millerstown, Perry Co.	40.543208714	-77.156138046	21.67	67d
68	RACC 5.0	Raccoon Creek upstream of bridge in Donnally Mills, Perry Co.	40.515974200	-77.236311900	11.84	67a
69	***RAYS 4.6**	**Raystown Branch Juniata River near mouth downstream of Raystown Dam, Huntingdon Co.**	**40.454921748**	**-77.983475034**	**962.1**	**L**
70	***RAYS 42.8**	**Raystown Branch Juniata River upstream Route 913 bridge in Stonerstown, Bedford Co.**	**40.215016167**	**-78.265030988**	**753.7**	**L**
71	***RAYS 54.1**	**Raystown Branch Juniata River upstream of Yellow Creek in Hopewell, Bedford Co.**	**40.133446476**	**-78.269074083**	**626.9**	**L**
72	***RAYS 80.5**	**Raystown Branch Juniata River upstream of Greys Run east of Everett, Bedford Co.**	**40.004657986**	**-78.300172011**	**459.5**	**M**
73	***RAYS 103.0**	**Raystown Branch Juniata River upstream of covered bridge on SR4007 near Manns Choice, Bedford Co.**	**40.006541884**	**-78.597571412**	**77.3**	**67a**
74	*SBEC 1.4	South Bald Eagle Creek near mouth in Tyrone, Blair Co.	40.670317406	-78.237325644	52.6	67c
75	**SBLA 8.3**	**South Branch Little Aughwick Creek upstream SR1005 (Aughwick Road), upstream of Cowans Gap Lake in Cowans Gap State Park, Fulton Co.**	**39.972961044**	**-77.942323289**	**3.2**	**67c**
76	***SHAD 1.8**	**Shade Creek along Route 522 at Shade Gap, Huntingdon Co.**	**40.187503881**	**-77.868741685**	**20.06**	**67c**
77	*SHAV 1.4	Shaver Creek upstream SR4011 bridge near Petersburg, Huntingdon Co.	40.582643602	-78.045950113	56.24	67a
78	SHAV 10.0	Shaver Creek upstream T536 bridge downstream of dam in PSU Experimental Forest near Masseyburg, Huntingdon Co.	40.643728177	-77.932390790	10.54	67a
79	**SHOB 0.4**	**Shobers Run along Business Route 220 downstream of Bedford Springs, Bedford Co.**	**39.998889000**	**-78.503611000**	**16.3**	**67a**
80	SHUP 0.1	Shoups Run along Route 913 near Middletown, Huntingdon Co.	40.222336966	-78.214746194	18.1	69a
81	**SHWN 4.2**	**Shawnee Branch upstream of T443 bridge upstream of Shawnee Lake near Schellsburg, Bedford Co.**	**40.038188588**	**-78.654342645**	**18.1**	**67a**
82	***SIDE 0.1**	**Sideling Hill Creek at mouth near Maddensville, Huntingdon Co.**	**40.130570476**	**-77.957262519**	**96.7**	**67b**
83	**SIDE 13.9**	**Sideling Hill Creek in Sideling Hill gap along Route 913 between Waterfall and New Granada, Fulton Co.**	**40.133791939**	**-78.080049384**	**44.9**	**69a**
84	SINK 0.3	Sinking Run at SR1013 bridge near Union Furnace, Blair Co.	40.613595384	-78.175978454	28.6	67a
85	**SIXM 0.3**	**Sixmile Run along SR1036 in Riddlesburg, Bedford Co.**	**40.161475951**	**-78.248900214**	**14.7**	**69a**
86	SPRR 1.0	Spring Run upstream of Penn State Altoona Campus in Altoona, Blair Co.	40.543136070	-78.416848866	4.7	67d
87	*SPRU 1.0	Spruce Creek at Pa. Fish and Boat Commission Special Regulations Area, near Colerain, Huntingdon Co.	40.620153239	-78.125275509	106.06	M
88	*SPRU 10.6	Spruce Creek at Route 45 bridge in Graysville, Huntingdon Co.	40.690597665	-78.029233770	63.72	67a
89	*STST 1.0	Standing Stone Creek along Route 26 in Huntingdon, Huntingdon Co.	40.492552174	-77.993683468	131.62	M
90	*STST 26.8	Standing Stone Creek at SR1023 bridge near McAlevys Fort, Huntingdon Co.	40.651852107	-77.822778704	33.95	67a
91	TEAC 0.1	Tea Creek upstream of West Logan Street in Reedsville, Mifflin Co.	40.663102827	-77.597279727	10.86	67a
92	TIPT 1.3	Tipton Run upstream of SR4021 in Tipton, Blair Co.	40.635052751	-78.299386031	17.9	67a
93	***TSPC 0.1**	**Three Springs Creek upstream of T341 near Pogue, Huntingdon Co.**	**40.207939620**	**-77.940905799**	**30.94**	**67b**
94	**TSPR 0.1**	**Three Springs Run upstream of Route 36 along Route 869 north of Loysburg, Bedford Co.**	**40.171806000**	**-78.378509000**	**9.8**	**67a**
95	*TUSC 0.6	Tuscarora Creek near mouth at Route 75/Route 333 bridge in Port Royal, Juniata Co.	40.528162800	-77.391934200	259.96	M
96	*TUSC 22.5	Tuscarora Creek upstream of T322 bridge near McCullochs Mills, Juniata Co.	40.418955933	-77.563919051	129.48	M
97	*TUSC 39.3	Tuscarora Creek upstream of SR2010 bridge in Blairs Mills, Huntingdon Co.	40.285369289	-77.719629469	30.59	67b
98	*WILL 0.4	Willow Run near mouth at T305 bridge near McCullochs Mills, Juniata Co.	40.418518066	-77.596019333	10.64	67b
99	***YELL 3.5**	**Yellow Creek near mouth along Route 26 near Hopewell, Bedford Co.**	**40.142619415**	**-78.286272186**	**93.5**	**67d**
100	**YELL 9.1**	**Yellow Creek upstream of Potter Creek along Route 36 in Waterside, Bedford Co.**	**40.189713000**	**-78.375725000**	**17.6**	**67a**
101	**YELL 12.0**	**Yellow Creek upstream T638 bridge in Woodbury, Bedford Co.**	**40.230162328**	**-78.367647072**	**6.3**	**67a**

**Stations sampled in 1995 and 2004 in blue print.*

Bolded sites were sampled after September floods

Juniata River Sojourn 2005
Raystown Branch

SUSQUEHANNA RIVER BASIN COMMISSION

In 1971, the Susquehanna River Basin Commission was created as an independent agency by a federal-interstate compact among the states of Maryland, New York, and the Commonwealth of Pennsylvania, and the federal government. In creating the Commission, the Congress and state legislatures formally recognized the water resources of the Susquehanna River Basin as a regional asset vested with local, state, and national interests for which all the parties share responsibility. As the single federal-interstate water resources agency with basinwide authority, the Commission's goal is to coordinate the planning, conservation, management, utilization, development and control of the basin's water resources among the public and private sectors.

SUSQUEHANNA RIVER BASIN COMMISSION
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