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,

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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.

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).

> ***"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."***

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.

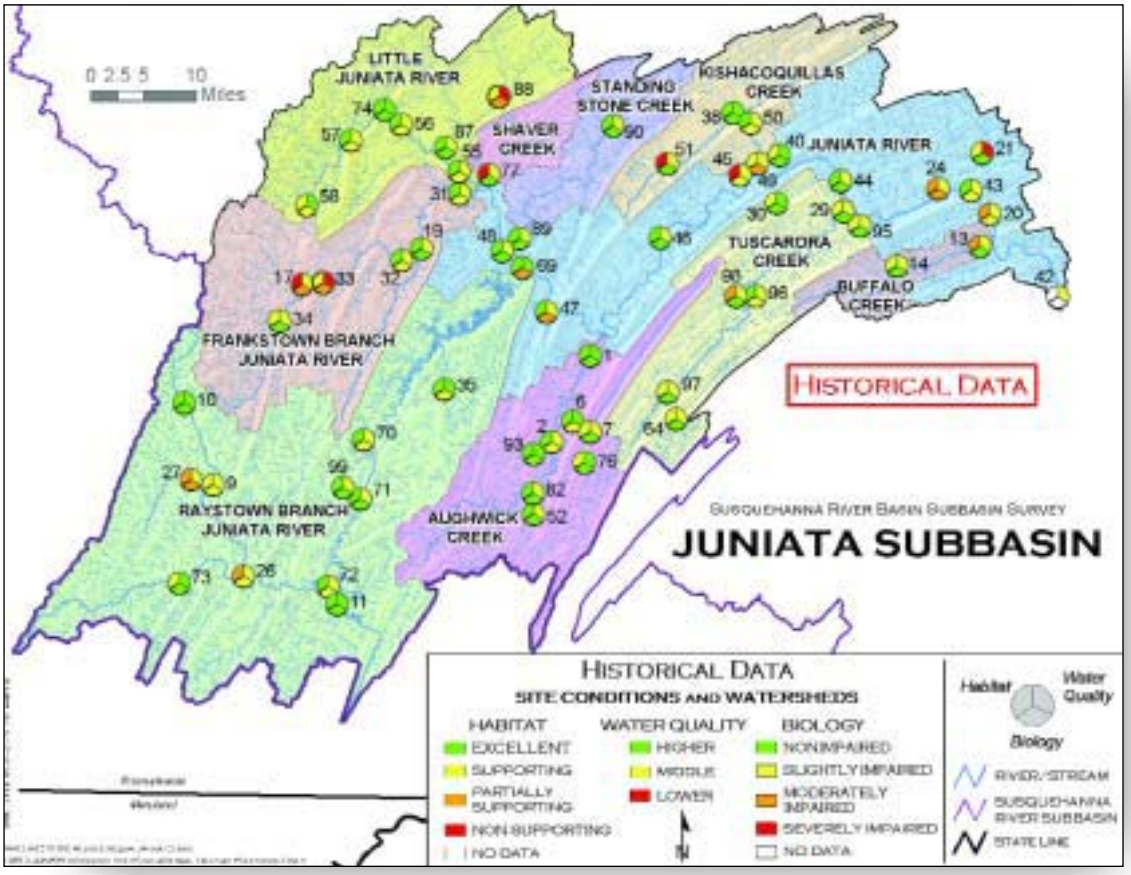

Figure 7. *Water Quality, Biological, and Habitat Conditions in 1995 Sample Sites in the Juniata Subbasin*

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