(TNK 11.3) still had a "middle" water quality rating, but the habitat was excellent, and the macroinvertebrate population was nonimpaired, similar to the East Branch. The South Branch also had excellent habitat, but the water quality was "lower" and the macroinvertebrate population at STNK 0.1 was slightly impaired. The site near the mouth of Tunkhannock Creek (TNK 0.3) contains a "higher" water quality, a nonimpaired biological community, and excellent habitat. Overall, this watershed was healthy.

BOWMANS CREEK WATERSHED (BOW)

The main branch of Bowmans Creek is designated as a HQ-CWF (Table 3), and this watershed appeared to be healthy. Both sites had "higher" water quality, slightly impaired macroinvertebrate communities, and excellent habitat.

Lower Half of the Middle Susquehanna Subbasin

LACKAWANNA RIVER WATERSHED (LWR)

This watershed was fairly healthy at the upstream sites. In fact, the East Branch Lackawanna River is designated as a HQ-CWF (Table 3). It was degraded downstream, however, due to abandoned mine land and urban influences (Figure 3). The East and West Branch Lackawanna River sites had "higher" water quality, excellent habitat, and slightly and moderately impaired macroinvertebrate populations, respectively. Despite signs of AMD starting to appear downstream on Lackawanna River at LWR 36.0 and LWR 15.0, these two sites on the main branch remained fairly healthy with "higher" water quality ratings, slightly impaired macroinvertebrate communities, and supporting and excellent habitats, respectively. Leggetts Creek (LGT 0.1) entered the Lackawanna River with "lower" water quality and a moderately impaired macroinvertebrate population. LGT 0.1 was located below joint sewage and wastewater treatment plants and is listed in Table 2 for high total nitrogen, high phosphorus, high total organic carbon, and high chloride. Roaring Brook also entered the Lackawanna River downstream of Leggetts Creek, but with "higher" water quality and slightly to moderately impaired macroinvertebrate populations despite strong urban influence. LWR 4.0 was characterized by "lower" water quality and a moderately impaired macroinvertebrate community. High total nitrogen was evident at this site (Table 2), and the stream sediments and water smelled of chlorine at the time of the sampling. Although a tributary to the main branch, Spring Brook (SPR 0.1), influenced the Lackawanna River with "higher" water quality and a slightly impaired macroinvertebrate population, the site at the mouth of the Lackawanna River (LWR 0.3) had "lower" water quality, severely impaired biological conditions, and supporting habitat. This site is listed in Table 2 for high iron and manganese (both indicators of AMD), and had yellow boy ($FeOH_2$) on the streambed.

SOLOMONS CREEK (SOL 0.9), NANTICOKE CREEK (NTK 0.4), and NEWPORT CREEK (NPT 0.1)

These streams were strongly impacted by AMD and urban influences (Figure 3). All the sites had "lower" water quality ratings and SOL 0.9 and NTK 0.4 had severely impaired macroinvertebrate communities. NPT 0.1 was not sampled for macroinvertebrates because

Nescopeck Creek outfall severly impacted by acid mine drainage.
(Left) Robert Hughes of EPCAMR helps remove litter during Streamside Cleanup 2001.

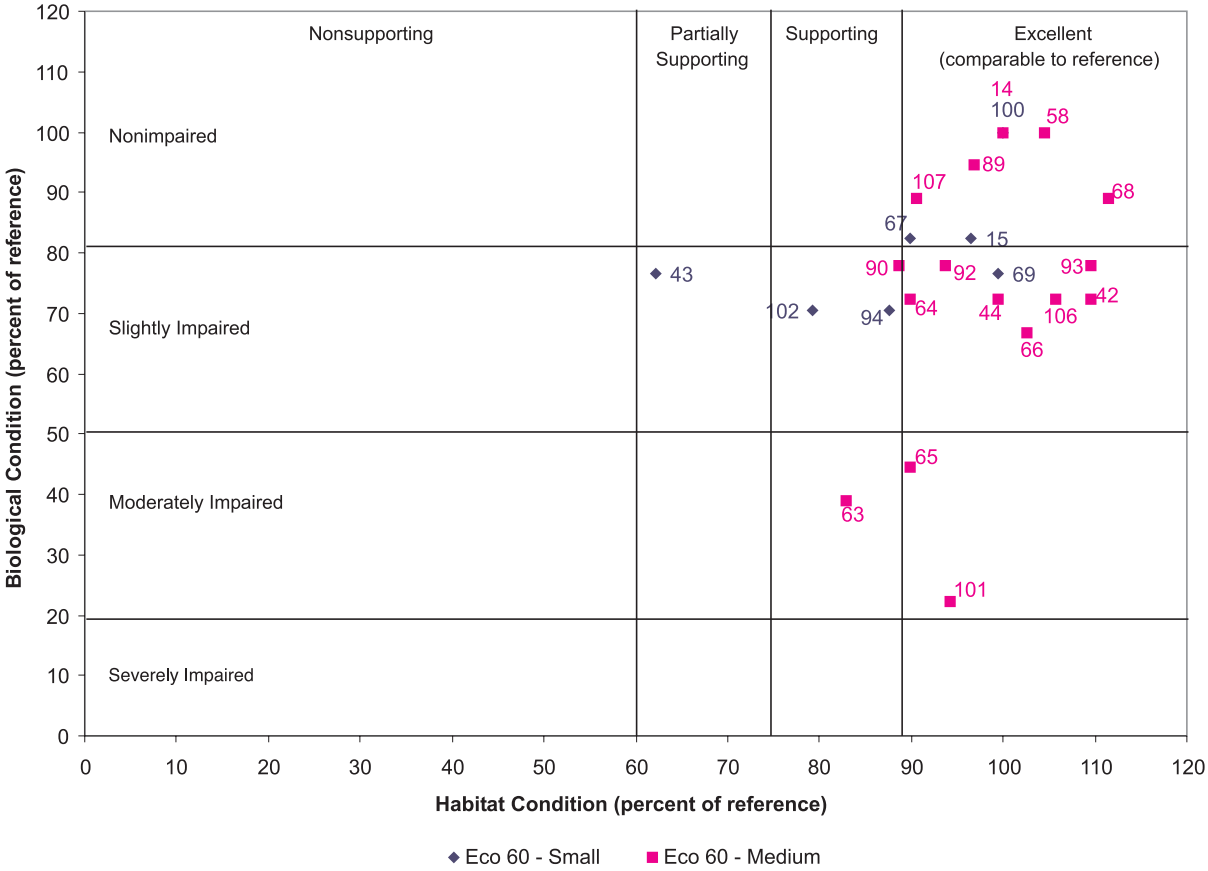

Figure 9. *Biological and Habitat Condition Scores at Ecoregion 60 Small and Medium Reference Category Sample Sites in the Middle Susquehanna Subbasin.*

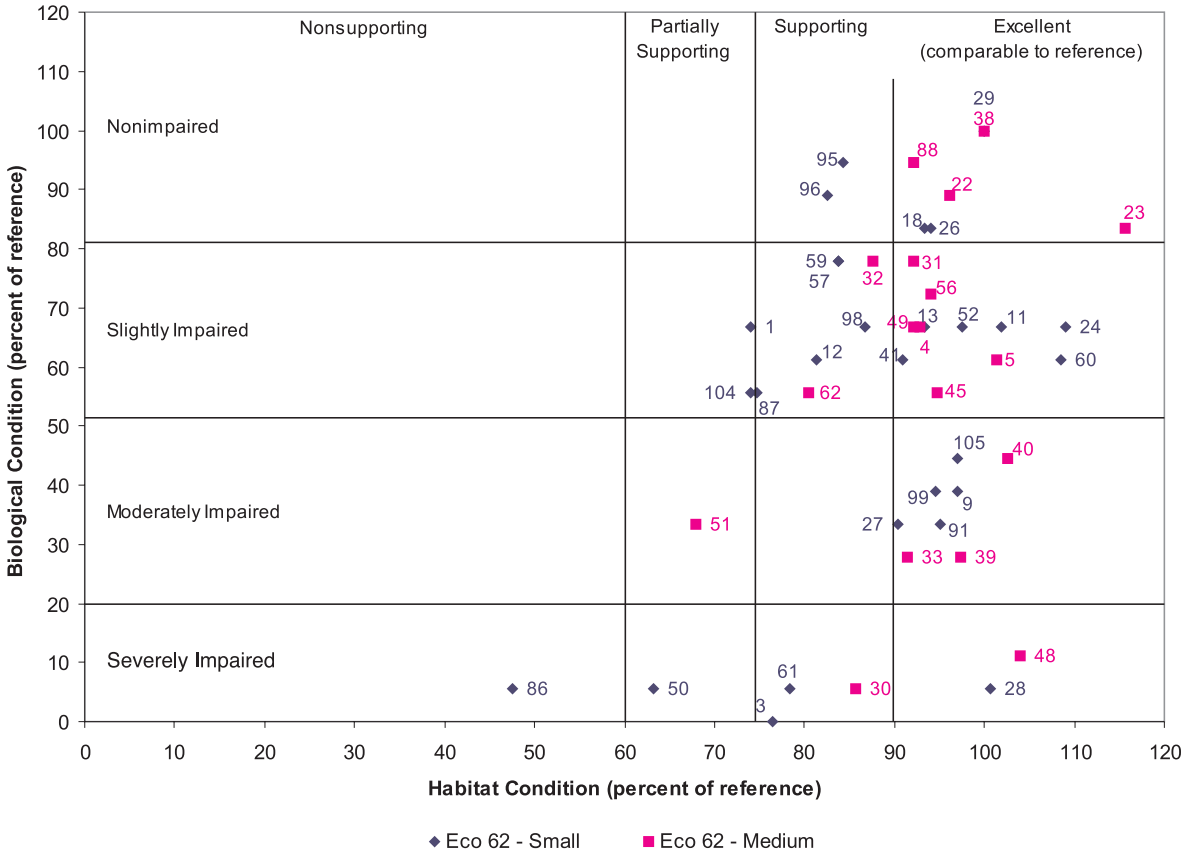

Figure 10. *Biological and Habitat Condition Scores at Ecoregion 62 Small and Medium Reference Category Sample Sites in the Middle Susquehanna Subbasin.*

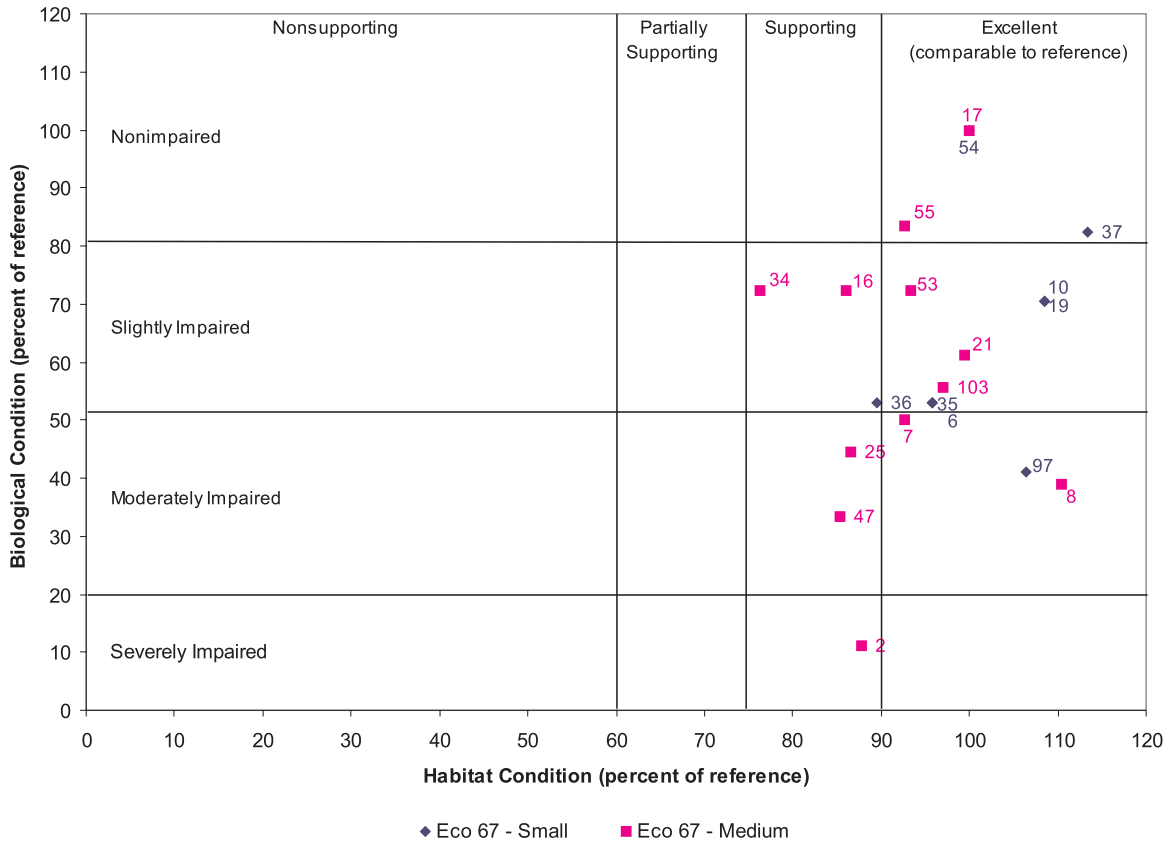

Figure 11. *Biological and Habitat Condition Scores at Ecoregion 67 Small and Medium Reference Category Sample Sites in the Middle Susquehanna Subbasin.*

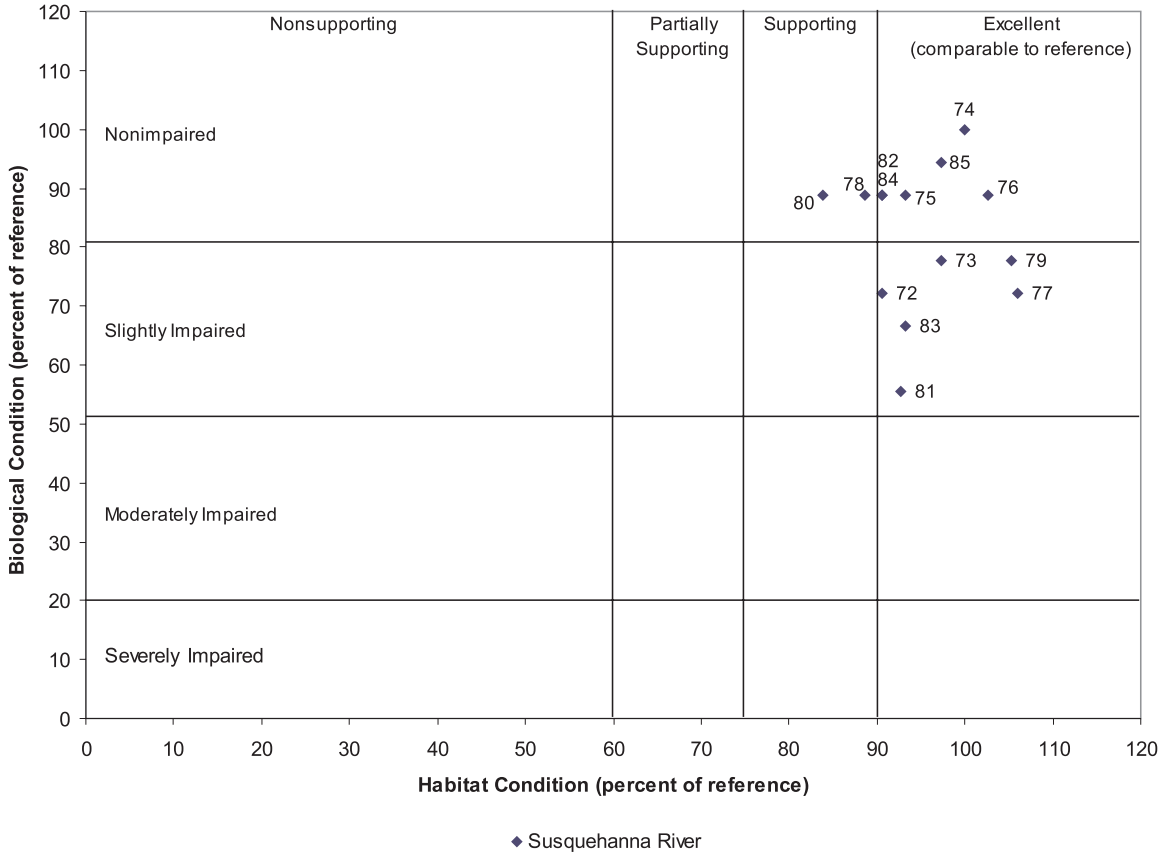

Figure 12. *Biological and Habitat Condition Scores at Susquehanna River Reference Category Sample Sites in the Middle Susquehanna Subbasin.*

the depth of iron deposits made entering the stream hazardous. All three sites were covered with a coating of yellow boy, and some of them smelled of sulfide. A sewage treatment smell, possibly from a local sanitary authority pumping station located adjacent to the site, was detected at NTK 0.4. All sites are listed in Table 2 for AMD characteristics.

NESCOPECK CREEK WATERSHED (NSK)

Most of the sites in this watershed had severely impaired macroinvertebrate populations, although the habitat ratings were excellent or supporting throughout the watershed. The upstream site in this watershed (NSK 13.9) was healthy with "higher" water quality and a slightly impaired macroinvertebrate population. Little Nescopeck Creek (LNSK 0.1), which had "lower" water quality and a severely impaired biological condition, joined Nescopeck Creek and degraded the stream causing "lower" water quality and a severely impacted macroinvertebrate population below the confluence (NSK 13.2). LNSK 0.1 and NSK 13.2 are listed in Table 2 for AMD characteristics. Black Creek also influenced the water quality in Nescopeck Creek Watershed. The macroinvertebrate population was severely impacted at both sites on Black Creek, even though the water quality was rated "higher" and "middle" quality. Black Creek was affected by aluminum (Table 2). At the downstream site in this watershed (NSK 0.7), the water quality remained "lower," and the site is listed in Table 2 for AMD characteristics. However, the macroinvertebrate population recovered slightly and received a moderately impaired rating.

FISHING CREEK WATERSHED (FSH)

All the sites in this watershed had "higher" water quality and nonimpaired or slightly impaired macroinvertebrate populations, except the site at the mouth of Little Fishing Creek (LFSH 0.1), which was rated moderately impaired. LFSH 0.1 also is listed on Table 2 for high total organic carbon. All habitat ratings in the Fishing Creek Watershed were excellent or supporting. Many areas of this watershed are designated HQ-CWF (Table 3). FSH 15.6 served as a reference site for Ecoregion 67 medium drainage size category.

CATAWISSA CREEK WATERSHED (CAT)

This watershed is affected by AMD. Even though the habitat was rated as excellent at all sites, the macroinvertebrate population was moderately impaired at all sites in this watershed, possibly due to very high aluminum concentrations (Table 2). CAT 25.0 also is listed in Table 2 for high manganese and low pH values.

ROARING CREEK WATERSHED (RRC)

The upstream site on Roaring Creek (RRC 10.7) was used as a reference site for the Ecoregion 67 small drainage size category. The macroinvertebrate population was nonimpaired at RRC 10.7 and SBRC 0.5, and was rated slightly impaired at RRC 1.1. The habitat at all sites was excellent.

SUSQUEHANNA RIVER SITES (SUSQ)

Water quality, macroinvertebrates, and habitat received the best quality ratings, for Susquehanna River sites, in the upper portion of the Middle Susquehanna Subbasin from below the Meshoppen Creek Watershed to upstream of the Lackawanna River Watershed (Figure 7). SUSQ 230, located below the confluence of Meshoppen Creek, was the only river site to have "higher" water quality, a nonimpaired macroinvertebrate community, and excellent habitat. The sites in the lower portion of the Middle Susquehanna Subbasin had either "middle" or "lower" water quality, although the macroinvertebrate populations were not largely impaired. The river site below Solomons, Nanticoke, and Newport Creeks, SUSQ 181, appeared to be impacted by the poor quality of the streams above it. SUSQ 181 had a "lower" water quality rating and a slightly impaired macroinvertebrate community. SUSQ 146.2 had the same ratings as SUSQ 181. This site was located below the borough of Berwick and the town of Bloomsburg.

G. Hirschel

Susquehanna River near Wilkes-Barre.

Table 2. Middle Susquehanna Subbasin Sites with Extreme Values in Parameters Characteristic of Abandoned Mine Drainage (AMD) or Agriculture/Wastewater Treatment Plants.

	pH		AMD				AGRICULTURE/WASTE WATER TREATMENT PLANT				
Sites	Field pH (<5.0)[a]	Lab pH (<5.0)[a]	Iron (>1,500 ug/l)[a]	Manganese (>1,000 ug/l)[a]	Aluminum (>200 ug/l)[b]	Sulfate (>250 mg/l)[a]	D.O. (<4.0mg/l)[a]	Nitrogen T (>5.0 mg/l)[a]	Phosphorus T (>1.0 mg/l)[a]	T. Org. Carbon (>4.0 mg/l)[a]	Chloride (>150mg/l)[a]
BLK 0.10	4.5	4.9		913							
CAT 0.20				254							
CAT 13.0	4.15	4.8		880							
CAT 25.0	3.4	4	2,060	5,850							
EBRR 4.7			5,370	221							
EFSH 0.50				220							
ETNK 0.10			1,610								
LFSH 0.10									4.1		
					13.52	2.78	5	179			
20	4,880	9,960									
0	1,510										
				5.92							
					4.5						
7											
6											
5											
3.8											
	4.2										
	4.2										

[a]Values based on Hem (1970) and The Commonwealth of Pennsylvania (2002). [b]Gagen and Sharpe (1987) and Baker and Schofield (1982).

Table 3. Values of Exceptional Value (EV)[a] and High Quality-Cold Water Fishes (HQ-CWF)[b] Middle Susquehanna Subbasin Sites based on Abandoned Mine Drainage (AMD), and Agriculture/Wastewater Treatment Plant Characteristics.

		pH		AMD					AGRICULTURE/WASTE WATER TREATMENT PLANT				
Sites	Designation	Field pH	Lab pH	Iron ug/l	Manganese ug/l	Aluminum ug/l	Sulfate mg/l	D.O. mg/l	Nitrogen T mg/l	Phosphorus T mg/l	T. Org. Carbon mg/l	Chloride mg/l
SCH 12.0	EV	6.85	5.8	31	<10	73.3	5.6	4.12	0.22	<0.01	1.2	<1
SCH 0.2	HQ-CWF	7.1	5.9	22	<10	69.5	17.9	3.8	0.13	<0.01	1.3	<1
MHO 15.0	HQ-CWF	5.65	5.7	80	22	129	4.3	4.45	0.26	<0.01	3	1
BOW 12.5	HQ-CWF	7.05	6.3	81	31	37.6	5.6	4.67	0.37	0.01	1.5	<1
BOW 0.1	HQ-CWF	7.3	6.5	20	<10	20.3	7.2	4.84	0.53	0.01	1.4	7
ELWR 0.1	HQ-CWF	7.15	6.8	201	36	38.1	6.5	6.5	0.38	0.02	2.6	6
RRB 10.0	HQ-CWF	7.15	6.7	84	25	27.6	7.1	6.65	0.54	0.02	2.4	15
SPR 0.1	HQ-CWF	7.2	6.6	23	<10	15.2	9.9	7.5	0.4	0.03	1.2	25
LSHK 0.1	HQ-CWF	7.05	6.7	282	34	82.2	5.2	4.93	0.62	0.02	3.5	5
WFSH 0.5	HQ-CWF	6.7	5.9	<20	<10	26.9	5.3	6.65	0.53	<0.01	1.2	<1
EFSH 0.5	HQ-CWF	6.3	5.3	40	45	220	6.4	8.3	0.62	<0.01	3.3	<1
LFSH 10.0	HQ-CWF	7.2	6.5	132	12	45.5	3.6	5.96	0.67	0.02	2.2	6
SBRC 0.5	HQ-CWF	6.95	6.5	95	11	34.4	8.7	8.43	0.75	0.07	2	9

[a] *Strongest special protection designated use for surface water that meets specific water chemistry and biological qualifiers (The Commonwealth of Pennsylvania, 2002)*

[b] *Special protection designated use for surface water that meets specific water chemistry and biological qualifiers (The Commonwealth of Pennsylvania, 2002)*

Conclusions

The watersheds in the upper portion of the Middle Susquehanna Subbasin appeared to be healthier than the ones in the lower portion. Assessments of Towanda Creek, Meshoppen Creek, Mehoopany Creek, Tunkhannock Creek, and Bowmans Creek indicated healthy watersheds. There were no watersheds in the upper portion that would be characterized as extremely degraded. In the lower portion of the Middle Susquehanna Subbasin, only some of the smaller watersheds and the Fishing Creek and Roaring Creek Watersheds are considered healthy. The Lackawanna River, Solomons Creek, Nanticoke Creek, Newport Creek, Nescopeck Creek, and Catawissa Creek were all degraded, mostly by abandoned mine lands and urban influence (Figure 3). The primary source of severe impairment in the Middle Susquehanna Subbasin was AMD. Urban influence was another source of impairment, while agricultural impairment was not significant in this subbasin.

The results of this report were similar to those found in the 1993 Middle Subbasin Survey (Water Quality & Monitoring Programs Division, 1997). It was difficult to directly compare these results since the present survey included more sampling points than the 1993 survey. However, two of the sampling sites in this report that were used as reference sites (RRC 10.7 and FSH 15.6) also were used as reference sites in the 1993 survey. Three of the reference sites in this report were not sampling sites in 1993. For the most part, the watersheds that were categorized as healthy in this report also scored well in the previous survey. The watersheds that were severely degraded also were severely degraded in 1993.

A second year of more intensive sampling will be conducted in the Middle Susquehanna Subbasin starting in the fall of 2002. SRBC will focus on a smaller watershed within the Middle Susquehanna Subbasin based on the survey results and input from watershed organizations and local government entities. The data collected will be provided to these local groups to support protection or remediation efforts in the watershed.