A BIOLOGICAL ASSESSMENT OF THE RUDOLPH RUN WATERSHED GREENE COUNTY, PENNSYLVANIA

prepared for

GREENE COUNTY CONSERVATION DISTRICT
and
THE FRIENDS OF RUDOLPH RUN

by

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Introduction

The Rudolph Run Watershed is located in south-central Greene County, Pennsylvania. Drainage from the watershed reports to Dunkard Creek, just across the state line in West Virginia. Topography of the watershed is steep hillsides and narrow valleys with limited flat bottomlands. The flat land that does exist in the floodplain has been used for agriculture, primarily pasturing and hay production with some animal concentration areas (barnyards and feed lots). Historically, homes and outbuildings have been located in the floodplain of the Rudolph Run Watershed.

Serious flooding resulting in damage to residences and other property has occurred in the past. Local residents concerned about flood related damage have asked the Greene County Conservation District (GCCD) for assistance in finding possible solutions to recurrent flooding problems. GCCD personnel felt there was a need for more information about the watershed, particularly the biological communities, before possible corrective actions could be considered. This study was undertaken to assess the existing water quality and biological conditions of the Rudolph Run Watershed.

A total of ten sampling stations were established in the watershed (Figure 1). Five stations were situated in the main stem of Rudolph Run and five in the downstream portions of major tributary channels. Other than STA 1, the main stem stations were located just downstream of the confluences of these tributaries.

Water quality and biological samples were collected in September 2001 and April 2002.

Methods

During each sampling period, water samples were collected and returned to H & H Water Controls of Carmichaels, Pennsylvania for analysis of 13 typical water quality parameters. When biological samples were collected field measurements of water temperature, pH,

conductivity and dissolved oxygen were made using an YSI Model 610-D Water Quality Meter.

Macroinvertebrates were qualitatively sampled with a D-frame kicknet and by handpicking of large rocks, leafpacks and other substrate materials not sampled by the D-frame net. All available habitats were sampled. The samples were preserved in a formaldehyde solution and returned to the lab for sorting of specimens from sample debris. Specimens were identified to the lowest practicable taxon with the aid of taxonomic keys in Merritt and Cummins (1996); Peckarsky, et al (1990); Pennak (1989); Stewart and Stark (1993) and Jezerinac, et al (1995).

Fish were collected using a Coffelt Mark X backpack electrofishing unit. Most fish were identified in the field and returned to the stream. Some questionable specimens were preserved and returned to the lab for positive identification with the aid of taxonomic keys in Cooper (1983). Nomenclature followed that used in Page and Burr (1991).

Results

Water quality samples were collected on September 24, 2001 and May 6, 2002. Analytical results for those samples are presented in Tables 1 through 4. For the types of human impacts (agricultural and residential) that exist in the Rudolph Run Watershed, the parameters analyzed for did not yield any unusual values. The only anomaly from the September samples, as compared to the other stations during that sampling period, appears to be the high total suspended solids (TSS) value reported for Station 1 (Table 1). The TSS value of 717 mg/l at Station 1 is nearly three times that recorded for any other station on the main stem of Rudolph Run. No unusual conditions were noted during sample collection that would explain this high TSS value.

In April field pH measurements were slightly higher than would be expected (Tables 3 and 4) at all stations. Dissolved oxygen levels were also high in April and can be explained by

the presence of an abundant algal community on most stream substrates. Photosynthetic activity of algae often results in higher stream pH levels and could be responsible for the higher than expected pH values found in April 2002.

Weather during the September 25, 2001 macroinvertebrate and fish sampling was rainy with temperatures in the mid-60 degree Fahrenheit range. Although intermittent rain or showers occurred most of the day, stream conditions were acceptable for sampling, i.e. the water was not too cloudy to prevent fish collection.

The spring of 2002 was extremely wet, with frequent, heavy storms making the scheduling of sample collection difficult. Originally plans were to collect samples in late March or early April 2002, but weather conditions prevented biological sampling until April 19, and water quality sampling could not be completed until May 6. For the April 2002 biological sampling morning temperatures were in the mid-50's with afternoon temperatures reaching 80 degrees. Water conditions were marginal for fish collection with flows rather high and water slightly cloudy.

Tables 5 through 8 show the macroinvertebrates collected from the Rudolph Run Watershed stations. If looked at separately, the total number of macroinvertebrate taxa collected during either the September or April sampling periods appear to be normal for small streams in this part of Pennsylvania. However, when considered together it can be seen that, with three exceptions, the total number of taxa collected from each station in April 2002 was lower than those collected in September 2001. The exceptions were at Station 1, the station in the main stem headwaters of Rudolph Run, where there was a
37.5 % increase in the number of taxa collected in April 2002; Station 2 on a small, unnamed tributary in the upper Rudolph Run Watershed, where there was a 17.6 % increase in total taxa collected; and at Station 7, on the lower main stem of Rudolph Run, where there was no difference in the total number of taxa collected in September 2001 verse April 2002. At all other stations there was a decrease in the total number of taxa collected in April 2002. Station 8, on the lower end of Sharp Run, had a decrease in total taxa collected in April 2002

of 34.8 %, and Station 10, the far downstream station on the main stem of Rudolph Run, had a 33.3 % decrease in total taxa.

Regardless of numbers, the macroinvertebrate taxa collected in both sampling periods were typical of those found in streams with moderate to low human impacts.

Fish species collected in September 2001 and April 2002 are presented in Tables 9 through 12. As with the macroinvertebrates, at eight of the ten sampling stations the total number of fish species collected in April 2002 were lower than the number of species collected in September 2001. Again, the species collected were typical of those found in small drainages in southwest Pennsylvania.

Discussion

Based on the parameters examined in this study, water quality in the Rudolph Run Watershed does not appear to be severely impacted. This was a little surprising since there are several barnyards or other animal concentration areas that the stream flows directly through. Other impacts that could potentially affect water quality are recently timbered properties and moderate to severe stream bank erosion throughout the watershed.

As noted above, there was a reduction in the number of macroinvertebrate taxa at most stations in April 2002 when compared to the numbers collected in September 2001. The most plausible explanation for this is the extremely wet weather and resultant high stream flows during early 2002. Movement and repositioning of substrate materials within the stream channel was quite evident during the April 2002 sampling. Disturbance of the substrate apparently was sufficient to dislodge and sweep away many aquatic macroinvertebrates. Although no measurements where made to verify this, visual observations confirmed that several of the sampling stations had physically changed since the September 2001 sampling. Pooled areas at some sampling stations had partially filled in or been otherwise altered. The riffle area at Station 10, below the road crossing, had been scoured to a bedrock substrate, which provides little usable habitat for aquatic macroinvertebrates. The author observed

similar reduced macroinvertebrate populations at several other streams in Greene and Washington counties during sampling in early 2002, all presumably due to higher than normal stream flows.

The slight reduction in the number of fish species collected in April 2002 is probably due to nothing more than normal sampling variability. Although sampling conditions were not ideal during April 2002, it did not appear than sampling efficiency was greatly reduced. Fish are more mobile than macroinvertebrates and thus not as subject to being swept out of a stream reach by high flows. They can position themselves in small eddies and back currents to stay relatively fixed within the stream where macroinvertebrates, once in the water column, are carried great distances downstream or destroyed.

Although not a major focus of this study, a visual survey of the watershed was conducted to identify potential sources for sediment loading and deposition sites. The most obvious source of sediment in Rudolph Run is from stream bank erosion. Greene County Conservation District personnel in the fall of 2001 placed pins in the banks of Rudolph Run to assess the rate of bank erosion at several points in the watershed. While touring the watershed with Lisa Bennett of GCCD it was evident that severe erosion is taking place. Other potential sediment sources are from animal disturbance to stream banks in barnyards and from logging operations in the watershed. Debris, such as brush and tree limbs from logging operations or other sources, can become jammed at stream culverts or other restricted points and cause damming of the stream. Sediments will be deposited in the slower waters behind such obstructions and can add to future flooding problems.

Conclusion

Water quality in the lightly populated Rudolph Run Watershed does not appear to be unduly affected by normal human impacts. The aquatic communities examined during this study appeared to be typical for small drainages in southwest Pennsylvania. Weather during the study period was unusually wet when compared to what has been the norm for this region during the past decade. High stream flows appear to have impacted the aquatic

macroinvertebrate community of Rudolph Run, and other streams, in the region, primarily from disturbance of substrates. Fish did not seem to be as affected by the high flows, although the number of species encountered was lower in April 2002 than in September 2001. In either case, the aquatic communities should not be permanently affected by the wet weather of early 2002 and would be expected to re-colonize the stream in a short time.

High stream flows, however, have contributed to additional erosion and deposition of materials within the watershed. Although no measurements were made, it was evident, from pools being partially filled to riffle areas altered, that substrate materials had been redistributed throughout the watershed.

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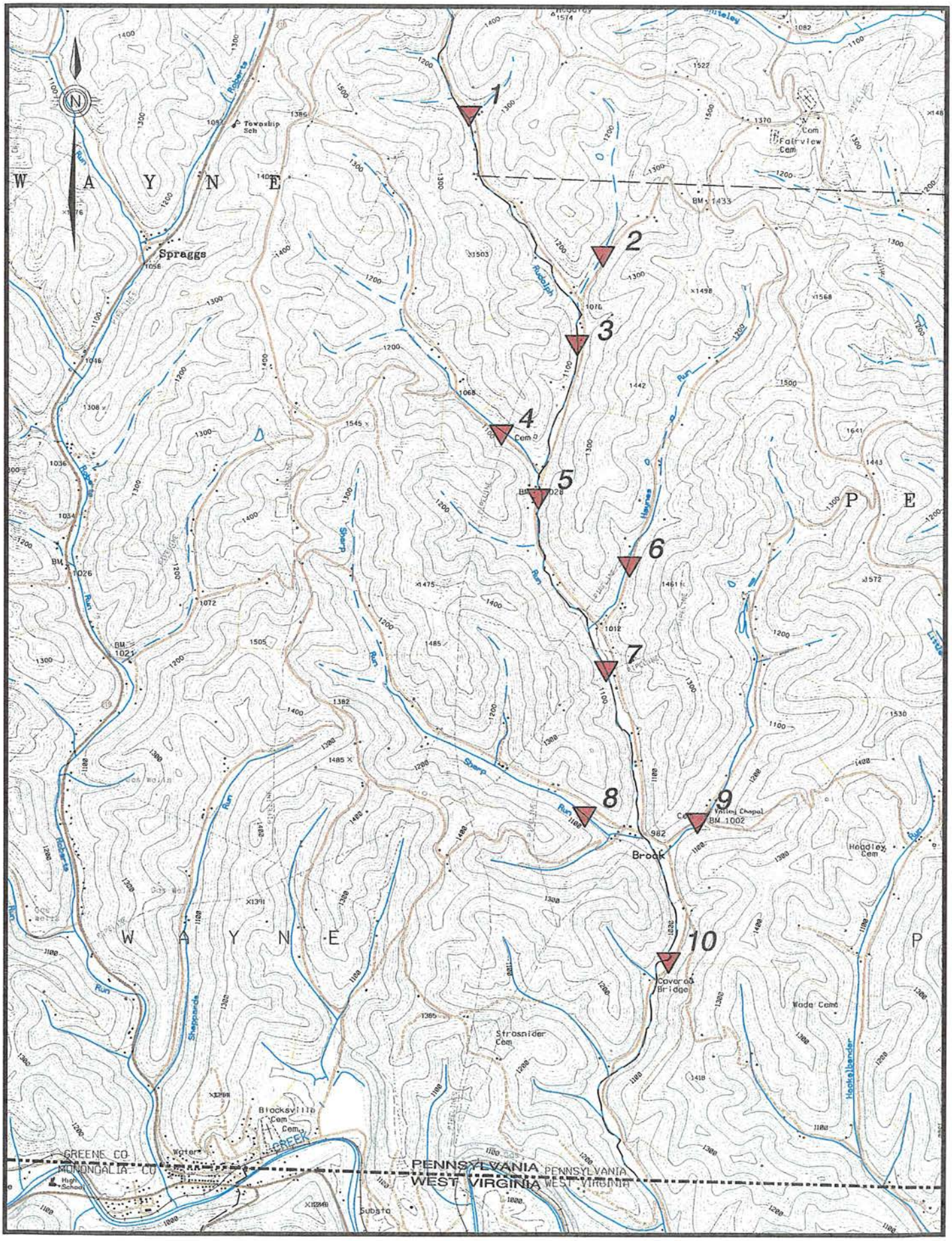

Scale: 1" = 3,000'

0 3,000' 6,000'

Figure 1
SAMPLING STATIONS ON RUDOLPH RUN

Table 1. Water Quality Parameters For Sampling Stations 1 Through 5 in the Rudolph Run Watershed, Greene County, Pennsylvania, September 2001 (units in mg/l unless otherwise noted) *

Parameter	STA 1	STA 2	STA 3	STA 4	STA 5
Water Temperature °C	14.6	17.2	16.4	14.8	16.0
Field pH (std units)	6.09	7.49	7.30	6.96	7.23
Conductivity (µmhos)	250	388	362	337	349
Dissolved Oxygen	7.98	9.69	5.65	9.27	7.65
D.O. % Saturation	77.1	99.7	55.3	91.2	77.4
Alkalinity	171	143	106	125	160
Total Suspended Solids	10.0	10.0	10.0	8.0	6.0
Total Dissolved Solids	717	262	230	191	199
Sulfate	30	38	26	29	24
Iron	0.2	0.4	1.2	0.3	0.1
Manganese	0.08	0.3	0.7	0.1	0.03
Aluminum	0.1	0.2	0.4	0.2	0.07
Sodium	27.2	18.9	21.1	30.3	27.3
Chloride	27.0	16.0	24.5	8.0	13.0
Calcium	74.0	59.0	53.0	51.0	55.0
Magnesium	14.4	12.6	9.0	7.5	8.2
Nitrate	0.18	<0.2	0.20	<0.2	<0.2
Phosphorus	**	0.191	0.181	0.171	0.104

*Field water quality measurements made on September 25, 2001.
Analytical samples collected September 24, 2001.

** No sample bottle.

Table 2. Water Quality Parameters For Sampling Stations 6 Through 10 in the Rudolph Run Watershed, Greene County, Pennsylvania, September 2001 (units in mg/l unless otherwise noted) *

Parameter	STA 6	STA 7	STA 8	STA 9	STA 10
Water Temperature °C	15.9	16.1	16.2	15.8	17.0
Field pH (std units)	7.67	7.61	7.19	7.55	7.38
Conductivity (µmhos)	594	285	402	398	386
Dissolved Oxygen	10.20	8.74	6.90	10.10	9.83
D.O. % Saturation	103.7	88.7	69.4	102.2	100.7
Alkalinity	273	197	154	172	160
Total Suspended Solids	21.0	5.0	5.0	14.0	<5.0
Total Dissolved Solids	360	255	234	223	248
Sulfate	48	34	60	34	41
Iron	0.2	0.1	<0.03	0.4	<0.03
Manganese	0.1	0.04	<0.01	0.03	0.01
Aluminum	0.2	0.07	<0.04	0.2	<0.04
Sodium	66.8	67.7	23.0	34.5	29.6
Chloride	8.5	12.5	4.5	8.5	9.0
Calcium	65.0	46.0	57.0	56.0	51.0
Magnesium	13.6	11.3	5.2	9.8	6.9
Nitrate	<0.2	<0.2	0.35	<0.2	<0.2
Phosphorus	0.090	0.120	0.034	0.125	0.060

*Field water quality measurements made on September 25, 2001.
Analytical samples collected September 24, 2001.

Table 3. Water Quality Parameters For Sampling Stations 1 Through 5 in the Rudolph Run Watershed, Greene County, Pennsylvania, April/May 2002 (units in mg/l unless otherwise noted)*

Parameter	STA 1	STA 2	STA 3	STA 4	STA 5
Water Temperature °C	19.1	19.2	19.0	17.2	17.2
Field pH (std units)	8.18	8.30	8.40	8.50	8.58
Conductivity (µmhos)	233	194	229	225	234
Dissolved Oxygen	9.70	10.70	11.10	10.36	11.04
D.O. % Saturation	104.5	116.0	123.7	107.1	115.0
Alkalinity	79	85	89	77	70
Total Suspended Solids	<5.0	8.0	<5.0	<5.0	<5.0
Total Dissolved Solids	123	102	126	122	124
Sulfate	44	53	51	49	42
Iron	0.4	0.5	0.3	0.2	0.2
Manganese	0.04	0.02	0.02	0.01	0.02
Aluminum	0.4	0.6	0.2	0.1	0.09
Sodium	10.8	6.2	10.2	9.7	11.0
Chloride	8.0	<3.0	3.0	<3.0	<3.0
Calcium	30.5	29.6	38.4	28.8	36.8
Magnesium	5.7	5.7	6.2	5.9	6.4
Nitrate	<0.2	<0.2	<0.2	<0.2	<0.2
Phosphorus	0.1	0.1	0.06	0.03	<0.03

*Field water quality measurements made on April 19, 2002.
Analytical samples collected May 6, 2002.

Table 4. Water Quality Parameters For Sampling Stations 6 Through 10 in the Rudolph Run Watershed, Greene County, Pennsylvania, April/May 2002 (units in mg/l unless otherwise noted) *

Parameter	STA 6	STA 7	STA 8	STA 9	STA 10
Water Temperature °C	17.0	16.9	15.1	14.6	14.4
Field pH (std units)	8.36	8.25	8.21	8.15	8.16
Conductivity (µmhos)	421	274	270	289	281
Dissolved Oxygen	11.18	10.91	10.72	10.03	10.04
D.O. % Saturation	117.5	112.7	100.6	99.7	98.5
Alkalinity	173	120	86	91	110
Total Suspended Solids	<5.0	<5.0	<5.0	6.0	<5.0
Total Dissolved Solids	229	164	154	148	148
Sulfate	80	56	85	54	56
Iron	0.3	0.2	0.3	0.2	0.2
Manganese	0.07	0.02	0.01	0.01	0.02
Aluminum	0.2	0.2	0.2	0.2	0.1
Sodium	33.9	14.9	11.2	18.4	14.4
Chloride	<3.0	<3.0	<3.0	<3.0	3.5
Calcium	56.1	32.1	37.6	30.4	28.8
Magnesium	11.4	7.0	8.5	6.7	7.3
Nitrate	<0.2	<0.2	<0.2	<0.2	<0.2
Phosphorus	<0.03	<0.03	<0.03	<0.03	<0.03

*Field water quality measurements made on April 19, 2002.
Analytical samples collected May 6, 2002.

Table 5. Macroinvertebrate Taxa Collected From Rudolph Run Watershed Stations 1 Through 5, Greene County, Pennsylvania, September 2001

Taxon	STA 1	STA 2	STA 3	STA 4	STA 5
Turbellaria					
Cura foremanii		X			
Oligochaeta					
Enchytraeidae			X		
Lumbriculidae	X				
Gastropoda					
Fossaria					X
Physella	X	X	X		X
Bivalvia					
Pisidium			X		X
Ephemeroptera					
Acerpenna			X		X
Caenis			X	X	X
Eurylophella	X				
Isonychia					X
Leptophlebia	X	X			
Procloeon			X		
Stenacron	X			X	X
Stenonema		X		X	X
Odonata					
Aeshna	X				
Argia	X	X	X		
Arigomphus				X	
Basiaeschna			X		
Boyeria					X
Calopteryx	X	X	X		X
Coenagrion	X	X	X		
Gomphus					X
Helocordulia	X				
Libellula		X			

Table 5. Macroinvertebrate Taxa Collected From Rudolph Run Watershed Stations 1 Through 5, Greene County, Pennsylvania, September 2001 (continued)

Taxon	STA 1	STA 2	STA 3	STA 4	STA 5
Plecoptera					
Acroneuria				X	X
Diploperla				X	
Hemiptera					
Aquarius	X			X	
Belostoma			X		
Microvelia	X	X	X	X	X
Rhagovelia				X	
Trepobates				X	
Trichoptera					
Cheumatopsyche	X	X	X	X	X
Chimarra	X	X	X	X	X
Goera	X				
Helicopsyche	X		X		X
Hydropsyche				X	X
Ptilostomis				X	
Lepidoptera					
Baetra				X	
Coleoptera					
Berosus	X		X		
Dubiraphia	X	X	X		
Hydroporus	X	X		X	X
Laccophilus		X			
Optioservus			X		X
Psephenus	X			X	X
Stenelmis	X	X	X		

Table 5. Macroinvertebrate Taxa Collected From Rudolph Run Watershed Stations 1 Through 5, Greene County, Pennsylvania, September 2001 (continued)

Taxon	STA 1	STA 2	STA 3	STA 4	STA 5
Megaloptera					
Nigronia				X	X
Sialis	X	X			
Diptera					
Anopheles	X				X
Chironomidae		X	X	X	X
Chrysops			X		
Dicranota				X	
Simuliidae				X	
Tipula				X	X
Decapoda					
Cambarus bartonii			X		
Orconectes obscurus	X		X	X	X
Total Taxa	24	17	23	23	25

Table 6. Macroinvertebrate Taxa Collected From Rudolph Run Watershed Stations 6 Through 10, Greene County, Pennsylvania, September 2001

Taxon	STA 6	STA 7	STA 8	STA 9	STA 10
Turbellaria					
Cura foremanii				X	
Oligochaeta					
Enchytraeidae		X			
Gastropoda					
Ferrissia		X			X
Fossaria			X		
Physella			X	X	X
Ephemeroptera					
Acerpenna			X		X
Caenis				X	X
Ephemera	X	X	X	X	X
Eurylophella			X	X	
Isonychia					X
Leptophlebia				X	
Stenacron	X	X		X	X
Stenonema	X	X	X	X	X
Odonata					
Aeshna	X				
Argia				X	
Arigomphus		X			
Basiaeschna		X			
Boyeria	X	X			X
Calopteryx	X	X	X	X	X
Coenagrion					X
Gomphus			X	X	X

Table 6. Macroinvertebrate Taxa Collected From Rudolph Run Watershed Stations 6 Through 10, Greene County, Pennsylvania, September 2001 (continued)

Taxon	STA 6	STA 7	STA 8	STA 9	STA 10
Plecoptera					
Acroneuria	X	X			X
Diploperla			X		
Hemiptera					
Aquarius			X		X
Gerris		X			
Microvelia	X	X	X	X	X
Rhagovelia				X	X
Trepobates		X			X
Trichocorixa			X		
Trichoptera					
Ceratopsyche	X		X	X	X
Cheumatopsyche	X	X		X	X
Chimarra	X				X
Helicopsyche		X		X	X
Hydropsyche	X		X	X	X
Lepidoptera					
Noctuidae				X	
Coleoptera					
Bledius			X		
Dubiraphia	X		X	X	
Helichus					X
Hydroporus	X	X	X		
Laccophilus			X		
Optioservus				X	
Psephenus	X		X	X	X
Stenelmis	X	X		X	X
Tropisternus			X		

Table 6. Macroinvertebrate Taxa Collected From Rudolph Run Watershed Stations 6 Through 10, Greene County, Pennsylvania, September 2001 (continued)

Taxon	STA 6	STA 7	STA 8	STA 9	STA 10
Megaloptera					
Corydales					X
Nigronia		X	X	X	
Diptera					
Anopheles		X			
Atherix					X
Chironomidae	X			X	X
Chrysops	X				
Hexatoma				X	
Tipula					X
Decapoda					
Cambarus bartonii			X		
Orconectes obscurus	X	X	X	X	X
Total Taxa	19	20	23	26	30

Table 7. Macroinvertebrate Taxa Collected From Rudolph Run Watershed Stations 1 Through 5, Greene County, Pennsylvania, April 2002

Taxon	STA 1	STA 2	STA 3	STA 4	STA 5
Hirudinea					
Placobdella parasitica					X
Oligochaeta					
Enchytraeidae	X				
Lumbriculidae		X	X		
Gastropoda					
Physella	X	X			
Bivalvia					
Pisidium	X				
Ephemeroptera					
Acerpenna					X
Caenis	X				X
Ephemera	X			X	X
Eurylophella	X		X		X
Paraleptophlebia					X
Procloeon	X		X		
Stenacron	X	X			X
Stenonema	X	X	X	X	
Odonata					
Argia					
Arigomphus	X			X	X
Boyeria	X				
Calopteryx	X		X		X
Cordulegaster	X	X			

Table 7. Macroinvertebrate Taxa Collected From Rudolph Run Watershed Stations 1 Through 5, Greene County, Pennsylvania, April 2002 (continued)

Taxon	STA 1	STA 2	STA 3	STA 4	STA 5
Plecoptera			X		
Amphinemura	X	X		X	X
Diploperla	X	X		X	
Haploperla				X	
Isoperla	X	X		X	X
Leuctra		X			X
Rasvena			X		
Hemiptera					
Microvelia	X	X	X		
Trichoptera					
Ceratopsyche				X	
Cheumatopsyche	X	X	X	X	
Chimarra				X	X
Diplectrona		X			
Goera	X				
Grammotaulius	X		X		
Helicopsyche				X	X
Hydropsyche			X		
Neophylax				X	X
Platycentropus	X		X		
Ptilostomis	X				
Rhyacophila	X	X		X	
Coleoptera					
Dubiraphia	X		X		X
Ectopria	X				
Hydroporus	X				
Optioservus		X			
Peltodytes				X	
Psephenus	X			X	
Stenelmis	X	X	X	X	X

Table 7. Macroinvertebrate Taxa Collected From Rudolph Run Watershed Stations 1 Through 5, Greene County, Pennsylvania, April 2002 (continued)

Taxon	STA 1	STA 2	STA 3	STA 4	STA 5
Megaloptera					
Nigronia				X	X
Diptera					
Chironomidae	X	X	X	X	X
Hexatoma					X
Pedicia	X				
Pseudolimnophila		X			
Simuliidae		X			
Tipula	X	X		X	
Decapoda					
Cambarus bartonii	X	X		X	X
Orconectes obscurus	X	X	X		X
Total Taxa	33	21	17	20	22

Table 8. Macroinvertebrate Taxa Collected From Rudolph Run Watershed Stations 6 Through 10, Greene County, Pennsylvania, April 2002

Taxon	STA 6	STA 7	STA 8	STA 9	STA 10
Oligochaeta					
Lumbriculidae	X				
Gastropoda					
Ferrissia		X		X	
Physella	X		X		
Pseudosuccinea columella	X				
Bivalvia					
Pisidium		X		X	
Ephemeroptera					
Acerpenna				X	
Ameletus			X		
Baetis				X	
Caenis	X				
Cloeon	X				
Epeorus			X		
Ephemera	X	X			
Eurylophella		X	X	X	
Isonychia		X			X
Leptophlebia			X	X	
Procloeon		X			
Stenacron		X		X	X
Stenonema	X	X	X	X	X
Odonata					
Argia	X				
Arigomphus					X
Calopteryx	X	X		X	X
Coenagrion					X
Cordulegaster	X				
Gomphus				X	

Table 8. Macroinvertebrate Taxa Collected From Rudolph Run Watershed Stations 6 Through 10, Greene County, Pennsylvania, April 2002 (continued)

Taxon	STA 6	STA 7	STA 8	STA 9	STA 10
Plecoptera					
Acroneuria		X			X
Amphinemura				X	X
Diploperla			X		X
Isoperla					X
Leuctra			X	X	
Sweltsa					X
Hemiptera					
Aquarius			X		
Microvelia	X			X	
Trichoptera					
Ceratopsyche			X		
Cheumatopsyche	X	X	X		X
Chimarra					X
Grammotaulius		X			
Ptilostomis		X			X
Rhyacophila					X
Coleoptera					
Dubiraphia	X		X	X	
Hydroporus			X		
Psephenus		X		X	
Stenelmis	X	X			X

Table 8. Macroinvertebrate Taxa Collected From Rudolph Run Watershed Stations 6 Through 10, Greene County, Pennsylvania, April 2002 (continued)

Taxon	STA 6	STA 7	STA 8	STA 9	STA 10
Megaloptera					
Nigronia		X		X	X
Diptera					
Chironomidae	X	X			X
Clinocera		X			
Simuliidae	X		X		X
Tipula		X			
Decapoda					
Cambarus bartonii			X		
Orconectes obscurus	X	X		X	X
Total Taxa	17	20	15	17	20

Table 9. Fish Species Collected From Rudolph Run Watershed, Greene County, Pennsylvania Stations 1 Through 5, September 2001

Species	STA 1	STA 2	STA 3	STA 4	STA 5
Campostoma anomalum Central stoneroller	X	X	X	X	X
Ericymba buccata Silverjaw minnow			X	X	
Luxilus chrysocephalus Striped shiner		X			X
Pimephales notatus Bluntnose minnow		X	X	X	X
Rhinichthys atratulus Blacknose dace	X		X	X	X
Semotilus atromaculatus Creek chub	X	X	X	X	X
Catostomus commersoni White sucker			X		
Hypentelium nigricans Northern hog sucker		X	X	X	
Lepomis macrochirus Bluegill	X	X	X	X	
Micropterus punctulatus Spotted bass		X			
Etheostoma blennioides Greenside darter					X
Etheostoma caeruleum Rainbow darter			X	X	X
Etheostoma flabellare Fantail darter	X			X	X
Etheostoma nigrum Johnny darter		X	X	X	X
Total Species	5	8	10	10	9

Table 10. Fish Species Collected From Rudolph Run Watershed, Greene County, Pennsylvania Stations 6 Through 10, September 2001

Species	STA 6	STA 7	STA 8	STA 9	STA 10
Campostoma anomalum Central stoneroller	X	X	X	X	X
Ericymba buccata Silverjaw minnow					X
Luxilus chrysocephalus Striped shiner		X		X	X
Pimephales notatus Bluntnose minnow		X		X	X
Rhinichthys atratulus Blacknose dace	X		X	X	X
Semotilus atromaculatus Creek chub	X	X	X	X	X
Catostomus commersoni White sucker		X			X
Hypentelium nigricans Northern hog sucker		X		X	X
Moxostoma duquesnei Black redhorse					X
Ambloplites rupestris Rock bass		X			X
Lepomis macrochirus Bluegill		X		X	X
Micropterus dolomieu Smallmouth bass					X
Etheostoma blennioides Greenside darter		X		X	X
Etheostoma caeruleum Rainbow darter		X		X	X
Etheostoma flabellare Fantail darter	X	X	X	X	X
Etheostoma nigrum Johnny darter		X	X	X	X
Total Species	4	12	5	11	16

Table 11. Fish Species Collected From Rudolph Run Watershed, Greene County, Pennsylvania Stations 1 Through 5, April 2002

Species	STA 1	STA 2	STA 3	STA 4	STA 5
Campostoma anomalum Central stoneroller	X	X	X	X	X
Luxilus chrysocephalus Striped shiner		X		X	X
Pimephales notatus Bluntnose minnow		X	X		X
Rhinichthys atratulus Blacknose dace	X		X	X	X
Semotilus atromaculatus Creek chub	X	X	X	X	X
Catostomus commersoni White sucker			X		
Hypentelium nigricans Northern hog sucker			X	X	
Lepomis macrochirus Bluegill		X			
Micropterus punctulatus Spotted bass			X		
Etheostoma blennioides Greenside darter					X
Etheostoma caeruleum Rainbow darter				X	X
Etheostoma flabellare Fantail darter		X	X	X	X
Etheostoma nigrum Johnny darter		X	X		
Total Species	3	7	9	7	8

Table 12. Fish Species Collected From Rudolph Run Watershed, Greene County, Pennsylvania Stations 6 Through 10, April 2002

Species	STA 6	STA 7	STA 8	STA 9	STA 10
Campostoma anomalum Central stoneroller	X		X	X	X
Ericymba buccata Silverjaw minnow					X
Luxilus chrysocephalus Striped shiner		X	X	X	X
Pimephales notatus Bluntnose minnow		X		X	X
Rhinichthys atratulus Blacknose dace	X		X	X	
Semotilus atromaculatus Creek chub	X	X	X	X	X
Catostomus commersoni White sucker		X		X	X
Hypentelium nigricans Northern hog sucker		X		X	X
Moxostoma duquesnei Black redhorse					X
Micropterus dolomieu Smallmouth bass		X			
Etheostoma blennioides Greenside darter					X
Etheostoma caeruleum Rainbow darter		X	X	X	X
Etheostoma flabellare Fantail darter	X	X	X	X	X
Etheostoma nigrum Johnny darter		X		X	X
Total Species	4	9	6	10	12

APPENDIX 1

PHOTOGRAPHS OF STREAM SAMPLING STATIONS ON RUDOLPH RUN, GREENE COUNTY, PENNSYLVANIA

Figure 1. Rudolph Run sampling station 1 looking downstream.

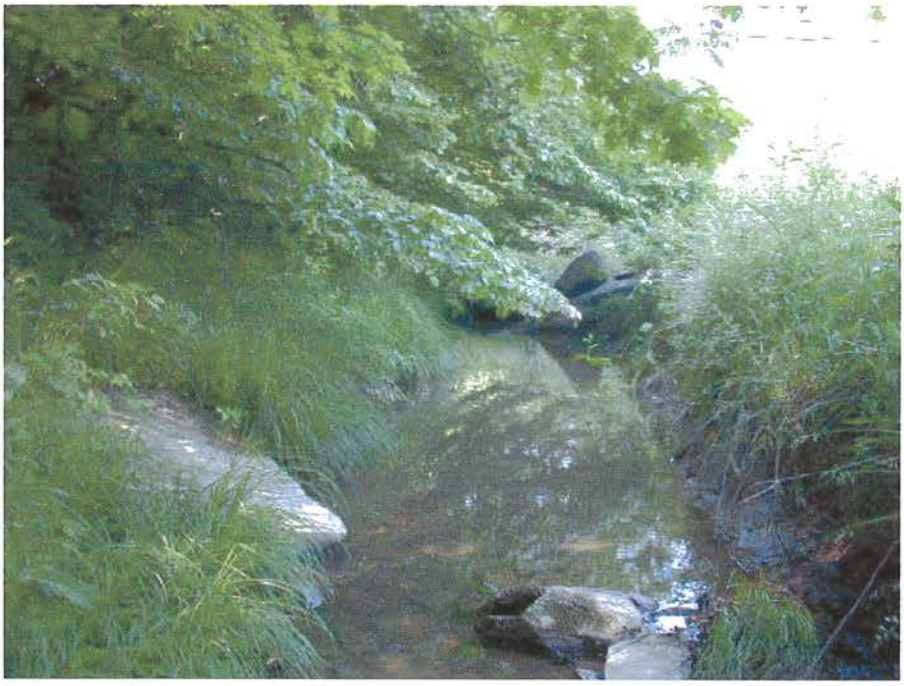

Figure 2. Rudolph Run sampling station 1 looking upstream.

Figure 3. Rudolph Run sampling station 2 looking downstream.

Figure 4. Rudolph Run sampling station 2 looking upstream.

Figure 5. Rudolph Run sampling station 3 looking upstream.

Figure 6. Rudolph Run sampling station 3 looking downstream.

Figure 7. Rudolph Run sampling station 4 looking downstream.

Figure 8. Rudolph Run sampling station 4 looking upstream.

Figure 9. Rudolph Run sampling station 5 looking downstream.

Figure 10. Rudolph Run sampling station 5 looking upstream.

Figure 11. Rudolph Run sampling station 6 looking upstream.

Figure 12. Rudolph Run sampling station 6 looking downstream.

Figure 13. Rudolph Run sampling station 7 looking upstream.

Figure 14. Rudolph Run sampling station 7 looking downstream.

Figure 15. Rudolph Run sampling station 8 looking upstream.

Figure 16. Rudolph Run sampling station 8 looking downstream.

Figure 17. Rudolph Run sampling Station 9 looking upstream.

Figure 18. Rudolph Run sampling station 9 looking downstream.

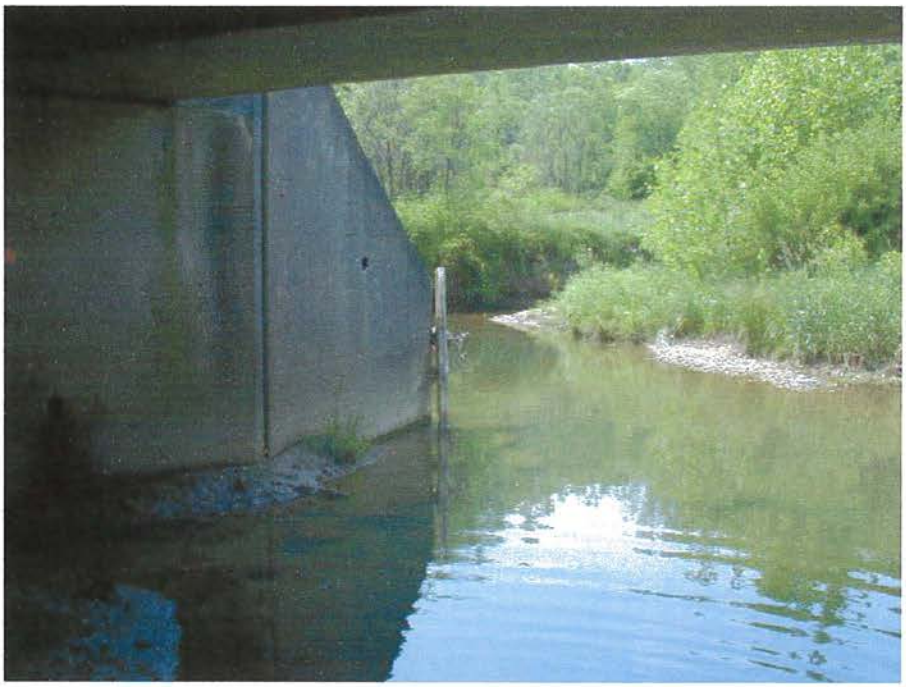

Figure 19. Rudolph Run sampling station 10 looking upstream.

Figure 20. Rudolph Run sampling station 10 looking downstream.

APPENDIX 2

PHOTOGRAPHS OF POTENTIAL PROBLEM AREAS IN THE RUDOLPH RUN, GREENE COUNTY, PENNSYLVANIA WATERSHED

Figure 1. Tree tops from a timbering operation left in a tributary to Rudolph Run could contribute to stream blockage and flooding.

Figure 2. Another view of debris from a timbering operation in a tributary stream channel.

Figure 3. An example of bank erosion in the upper Rudolph Run watershed.

Figure 4. Another view of bank erosion in the upper Rudolph Run watershed.

Figure 5. Bank erosion in the lower Rudolph Run watershed.

Figure 6. Another example of bank erosion in the lower Rudolph Run watershed.

Figure 7. Hillside erosion contributes sediment to the Rudolph Run watershed.

Figure 8. Obstructions in the Rudolph Run stream channel could cause flooding behind accumulated debris.

Figure 9. Bank erosion in a pasture along Rudolph Run.

Figure 10. Another example of bank erosion in a pastured area on Rudolph Run.