Final Report for FY Section 319(h) Funds
Bear Rock Run Habitat Improvement/Alkalinity Boosting Project
Washington Township, Cambria County

Summary

The Bear Rock Run Habitat Improvement / Alkalinity Producing Project was created out of the Stonycreek Conemaugh Rivers Improvement Project (SCRIP) Initiative. Through the mapping and monitoring under SCRIP, this project was identified as an excellent opportunity to begin the remediation of the Little Conemaugh Watershed at the headwaters.

The overall goal of this project was to restore some aquatic life to Christie Hollow Run and restore the full productivity of Bear Rock Run to its confluence with the Little Conemaugh River. There are two significant areas of acid mine drainage (AMD) pollution along Christie Hollow Run, a primary tributary to Bear Rock Run. A series of wetlands was constructed to treat two mine openings in one area. A semi-oxic limestone trench was placed in the stream to boost alkalinity immediately following a wetland polluted by several small AMD affected seeps. A walking trail has been constructed that leads from the Borough of Lilly and winds along the scenic Bear Rocks Run ending at the constructed wetlands.

This project has been a collaborative effort between the Cambria County Conservation District and the Cambria County Conservation and Recreation Authority. The cost for this project was greatly reduced by utilizing Cooney Brothers Coal Company and Washington Township to construct the wetlands and build the trail. Local volunteers were integral in the completion, assisting in seeding and planting as well as adding the final touches to the wetlands.

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Introduction

The Bear Rock Run Project originated from the *Report on the Water Quality and Acid Mine Drainage in the Little Conemaugh River Watershed*. This report was generated by the Cambria County Conservation District as part of the SCRIP Project. The purpose of this report was to identify and map all of the sources of mine pollution on the Little Conemaugh River in Cambria County. From this report, Bear Rock Run was identified as a excellent candidate for the Conservation and Recreation Authorities first remediation project. The cleanup of a few discharges would improve a naturally reproducing trout stream and improve aquatic habitat to a small tributary. It would be the first demonstration of a low cost and low maintenance solution in this area.

At the time when this project was developed there was very little information on passive treatment as a solution to AMD pollution. This was the first project in Cambria County to utilize passive treatment technology to remedy an acid mine discharge. The project served as a catalyst to bring municipalities, local conservation organizations and sportsmen groups together with the county agencies to begin the cleanup of the Little Conemaugh Watershed.

One of the main goals of this project was to create an awareness among local residents and organizations that there are viable low cost ways to cleanup our streams and rivers. Mine pollution in this area is so extensive and severe that nearly every tributary to the Little Conemaugh River is impacted to some degree. As a result of this project, there are several small sportsman groups in the area that have begun monitoring the streams and actively seeking funds for remediation projects. Support from the Bear Rock Run Sportsmen and the local communities of Lilly and Washington Township have made this project possible. Local residents have provided land for access roads and the treatment areas and donated their time to assist in putting the final touches on the project. As part of this project a recreational trail was constructed. In the summer, the trail is extensively used for hiking and biking by the residents of Lilly and the surrounding communities. In the winter months the trail is used by snowmobiles. The Conservation District has received a great deal of positive feedback from users of the trail. The Conservation and Recreation authority intends to join the Bear Rock Trail to the proposed Mainline Trail that will come directly through Lilly Borough. This will open the trail up to a much larger group of people that will be hiking and biking the historic Mainline Trail.

Site Location

Bear Rock Run is the first large tributary to enter the Little Conemaugh River. It begins on the top of the Allegheny Front in Cambria County and flows west toward the Borough of Lilly where it joins the Little Conemaugh River (**See Figure 1**). The Bear Rock watershed contains approximately 2,400 acres and is made up of the main stem Bear Rock Run and two tributaries; Christie Hollow Run and Burgoon Run. There are four reservoirs located along the stream. The two small reservoirs are owned by Lilly Borough and the two largest are owned by Highland Sewer and Water Authority. The extreme headwaters of Bear Rock Run are very high quality. Prior to enforcement of the filtration rule for surface water supplies, the reservoirs were maintained to provide a public water supply on Bear Rock Run.

Name: CRESSON
Date: 5/11/98
Scale: 1 inch equals 2000 feet

Location: 040° 25' 15.5" N 078° 35' 46.5" W
Caption: Bear Rock Run Habitat Improvement/Alkalinity Boosting Project

Figure 1

Burgoon Run is a relatively clean tributary with no significant sources of AMD pollution. It enters Bear Rock Run a few hundred feet east of Lilly Borough, in Washington Township.

Christie Hollow Run is the primary source of pollution in the Bear Rock Watershed. Christie Hollow Run is a small tributary that enters Bear Rock Run immediately above an abandoned mine complex. The stream is severely degraded by both deep and strip mine discharges. There are two significant areas of pollution along Christie Hollow Run: an acid, low metal discharge and two acid, moderate metal deep mine discharges. Untreated, these discharges kill approximately one mile of Christie Hollow Run and degrade two and three tenths miles of Bear Rock Run below the entrance of Christie Hollow Run.

Treatment System

The primary focus of this project was to remediate two deep mine discharges along Christie Hollow Run. These discharges are relatively small but severely impact Christie Hollow Run. The discharges consist of two abandoned clay mine openings. The largest of the two discharges is a mine shaft, the smaller is a drift mine opening to the same mine. A series of wetlands was constructed to remediate both of these discharges.

The larger shaft mine discharge is acidic with a moderate amount of metal content. Based on weir measurements, the average flow of this discharge ranges between 15 and 30 gallons per minute(gpm). However, flows as high as 65 gpm have been measured during periods of high rain fall.

A series of four ponds were constructed to treat this discharge. The ponds are linked together by shallow limestone channels. The channels serve to raise dissolved oxygen levels and encourage iron precipitation in the water as it flows over the limestone.

The first two basins are shallow oxidation ponds. Several rows of hay bale barriers were placed in both of these ponds to decrease the rate of flow through the ponds. The large surface area of these ponds allows for the absorption of oxygen by the water. By creating sufficient retention time, we have greatly reduced the amount of metals in the water. The iron oxide precipitate remains as the substrate of the ponds. These ponds have proved very effective at reducing the amount of iron and aluminum in the water.

The third pond is a reducing wetland. This pond is slightly deeper than the first two ponds. It is lined with approximately 12 inches of manure compost. The compost is an organic material necessary for reduction reactions. The removal of oxygen in the substrate of the wetland causes any metals to be precipitated as sulfides, reducing sulfate ions which in turn raise the pH. This pond is vegetated with several varieties of wetland plants including an abundance of cattails.

The fourth pond is a small basin that has been lined with 3-4 inch diameter chunks of limestone. The purpose of this pond is to boost the alkalinity prior to entering Christie Hollow Run. As the water flows over the limestone, the calcium carbonate slowly desolves, raising the pH. By the time the water reaches this basin almost all of the metals have been removed and there is virtually no metal precipitate coating the limestone. The average effluent pH is 5.9.

The smaller of the two discharges at this site is a drift mine opening. This discharge has a very low flow averaging 5-10gpm. This discharge is acidic but has significantly less iron than the mine shaft. A small shallow oxidizing basin has been constructed to precipitate metals. Following the settling basin is a small polishing pond to boost alkalinity before entering Christie Hollow Run.

The second treatment area for this project consists of a semi-oxic limestone trench. A limestone channel was placed directly into the stream channel in order to raise alkalinity in Christie Hollow Run. This area is located upstream of the two deep mine discharges. The stream is degraded in this area due to several polluted seeps that are located in a wetland area of Christie Hollow Run. These small discharges have low metal content but are acidic in nature. Because of the low amount of metals, there is no armoring of the limestone.

Construction of the wetlands was done by Cooney Brothers Coal Company and the Washington Township Supervisors. Cooney Brothers donated a D-7 bulldozer, fuel and an operator to clear the treatment site and rough out the ponds. Washington Township donated their equipment to finish the ponds. Washington Township completed the limestone trench, maintained the access road to the site and completed the trail. Volunteer labor was largely responsible for the finishing touches on both the treatment system and the trail. The University of Pittsburgh Environmental Club assisted on the placement of limestone channels and planting on two separate occasions. Local volunteers assisted with trail clearing and development.

Monitoring Results

A monitoring plan was established for this project in order to track water quality improvements to both Christie Hollow Run and Bear Rock Run. Water samples were collected over a period of two years, upon completion of the treatment system. These samples were analyzed by the DEP laboratory. Chemical parameters included: pH, conductivity, total alkalinity, total sulfates, total acidity, iron, dissolved iron, manganese, dissolved manganese, aluminum and dissolved aluminum. Field parameters including pH, conductivity and temperature were frequently collected. Volunteers from the University of Pittsburgh at Johnstown Geology Department have installed weirs at the larger of the two deep mine discharges, one at the source and one at the last treatment pond so that we can continue to monitor the rate of flow through the treatment system.

Water quality results indicate a substantial decrease in metal loading in the deep mine discharges that pass through the wetland systems. The average improvement of 5 tenths of a point in the pH from the large discharge. In the smaller discharge, pH has consistently increased one point. **(See Chart 1 and Schematic)**

Monitoring results indicate a slight increase in pH in Christie Hollow Run immediately below the in stream limestone trench. However, there is no measurable increase in water quality downstream in Christie Hollow Run.

In addition to the water sampling, an aquatic insect survey was done by Dr. Steve Keating from St. Francis University in Loretto, Pennsylvania. Dr. Keating completed three separate

Monitoring System Schematic

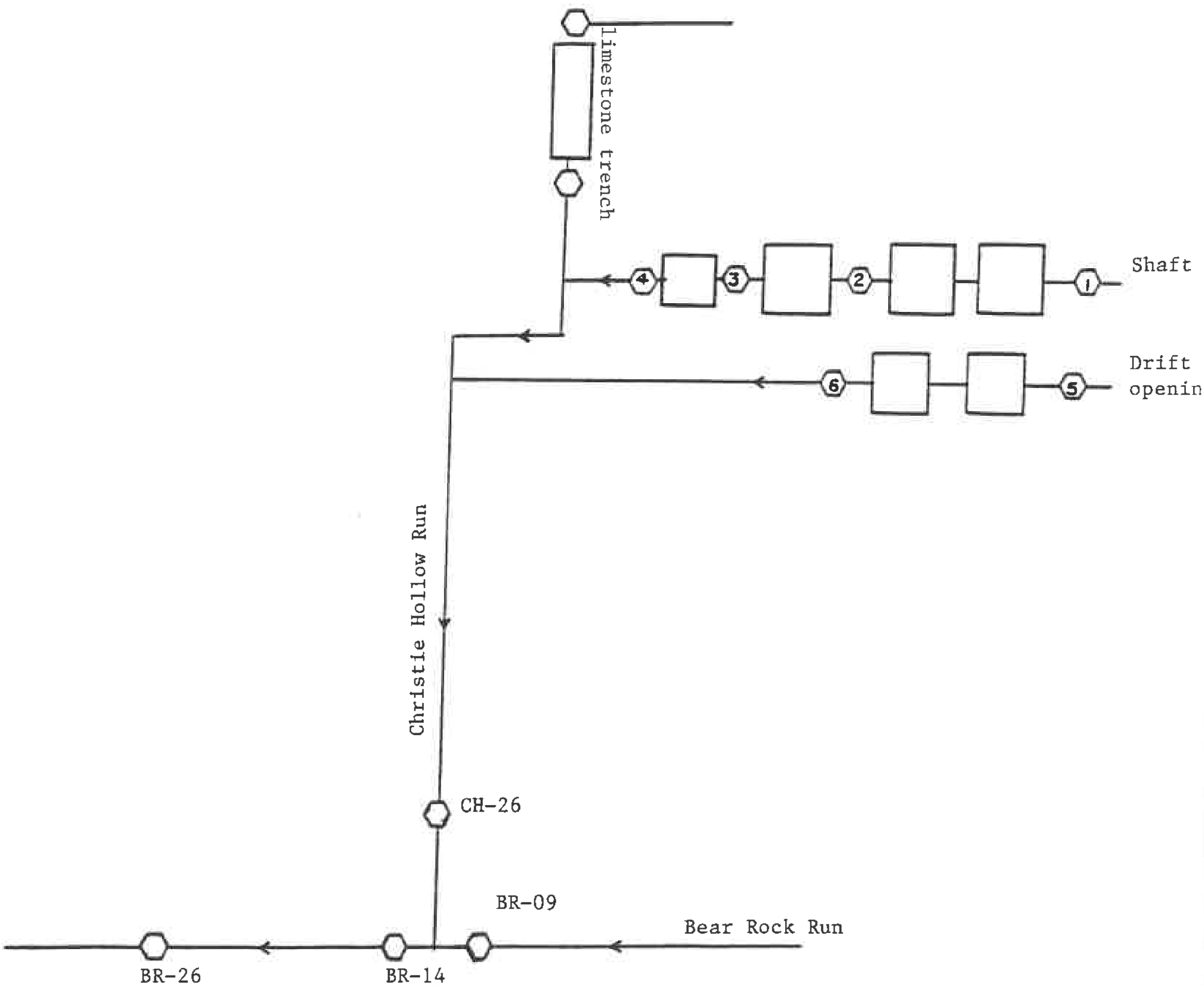

Chart 1

Monitoring Results from constructed wetlands (see schematic for locations)

Sampling point	Date	Flow gpm	Sp Cond umhos	pH	Tot Alk mg/l	Tot Acid mg/l	Tot SO4 mg/l	Tot Fe mg/l	Dis Fe mg/l	Tot Mn mg/l	Dis Mn mg/l	Tot Al mg/l	Dis Al mg/l
SL-1	11/1/94	7	44	5.3	5.4	72	17.5	32.9	6.28	0.663	0.657	4.76	0.135
SL-1	5/22/95	65	66	5.2	5.6	13	28.2	10.1	3.66	0.54	0.54	0.79	0.26
SL-1	9/23/95	10	58	5.8	14.8	34	17.4	11.9	8.88	0.703	0.703	0.608	0.135
SL-1	4/3/96	35	45	5.25	2.6	9.2	16.3	3.01	1.06	0.406	0.385	0.339	0.229
SL-1	8/6/96	18	59	5.5	5.4	0	18.9	4.74	4.07	0.599	0.599	0.432	0.265
SL-1	11/7/96	24	55	5.3	8	28	18.4	5.27	4.89	0.635	0.635	0.614	0.614
SL-2	11/1/94	37	78	6.1	5.4	42	17.1	11.4	1.43	0.914	0.804	5.98	0.683
SL-2	5/22/95	57	29	5	2.4	8.8	14.1	0.59	0.45	0.46	0.41	0.25	0.16
SL-2	9/23/95	9	64	6.2	7.2	2.8	18.7	0.76	0.17	0.33	0.21	0.4	0.14
SL-2	4/3/96	47	42	5.1	2.6	7	16.4	0.614	0.369	0.39	0.385	0.269	0.175
SL-2	8/6/96	13	49.6	5.2	2	4.6	18.1	0.177	0.074	0.538	0.533	0.172	0.135
SL-2	11/7/96	24	49	5.6	3.6	10.2	15.4	1.67	1.29	0.52	0.443	0.415	0.135
SL-3	11/1/94	37	69	6.1	5.6	40	16.5	2.73	0.574	0.719	0.676	2.32	0.135
SL-3	5/22/95	57	48	5.6	3.2	8.4	14	0.68	0.23	0.37	0.37	0.28	0.14
SL-3	9/23/95	8	66	6.2	7.4	0	18.6	0.336	0.102	0.103	0.096	0.135	0.135
SL-3	4/3/96	38	42	5.2	2.6	5.6	15.6	1.41	0.168	0.534	0.37	0.135	0.135
SL-3	8/9/96	8.6	52	5.6	3.2	0	17.1	0.317	0.061	0.31	0.31	0.135	0.135
SL-3	11/7/96	21	47	5.3	3	7	15.3	0.616	0.479	0.456	0.422	0.153	0.135
SL-4	9/23/95	8	66	6.3	7.8	0	46	0.271	0.108	0.116	0.109	0.135	0.135
SL-4	4/3/96	35	41	5.3	2.8	7.4	15.3	0.28	0.107	0.351	0.351	0.192	0.135
SL-4	8/9/96	7	64	6.1	7.6	6.2	17.9	0.261	0.039	0.28	0.28	0.166	0.135
SL-4	11/7/96	19.7	51	5.8	3.2	5.8	14.7	0.32	0.226	0.408	0.404	0.135	0.135
SL-5	9/23/95	4	52	4.8	1.8	7.4	18.7	0.19	0.19	0.449	0.433	0.353	0.208
SL-5	4/3/96	46	38	4.9	3	8.6	14.8	0.58	0.4	2.72	0.187	6.39	0.19
SL-5	8/9/96	7.5	38	5.1	2.4	8.6	11	3	0.14	0.255	0.243	0.607	0.135
SL-5	11/7/96	17	37	5	2.2	8.4	11.3	0.157	0.039	0.223	0.222	2.28	2.28
SL-6	9/23/95	3	73	6.4	11	0	18.7	1.79	0.099	0.334	0.203	2.16	0.135
SL-6	4/3/96	40	38	5.4	3.6	3.4	14	0.33	0.191	0.239	0.235	0.276	0.172
SL-6	8/9/96	6	64	6.1	7.6	6.2	17.9	0.261	0.039	0.28	0.28	0.166	0.135
SL-6	11/7/96	14	67	6.5	18	0	11.4	0.226	0.072	0.149	0.129	0.334	0.158

surveys on Christie Hollow Run and Bear Rock Run. One of the surveys was done in 1994, prior to construction of the treatment system. The next survey was completed in the summer of 1995, immediately following construction of the treatment ponds. The last survey was completed in 1996, one year after completion of the treatment system. Dr. Keatings findings for 1995 and for 1996 indicate only a slight improvement in the diversity and abundance of aquatic insects in Christie Hollow Run and Bear Rock Run. A comprehensive report on these surveys is included as **Appendix A**.

Dr. Keating has completed a survey for 1998. He is currently working on completing the report for 1996 and the 1998 report. These results will be available in the spring of 1999.

Overall, there has not been a substantial increase in water quality in Bear Rock Run (**See Chart 2 and Schematic**).

Habitat

The wetlands were largely completed in the summer of 1995. This area has provided habitat to variety of wildlife. Cattails and other wetland plants have become prevalent throughout all of the ponds. Tadpoles, salamanders and crayfish have all been found in the polishing ponds from both of the discharges and in the compost wetland. The Conservation District has installed wood duck boxes in the compost wetland. Deer, wood ducks, mallard ducks and turkeys have all been observed in and around the wetlands.

Conclusions

This project can be considered a success for many reasons. The wetlands are functioning well and there is a noticeable improvement in Christie Hollow Run. Any improvement to Christie Hollow Run will benefit Bear Rock Run and will further enhance the stream.

Chart 2

Data prior to treatment system

Sample Point	Date	Flow gpm	Sp Cond umhos	Temp deg C	pH	Tot. Acid mg/l	Tot. Alk. mg/l	Tot. SO4 mg/l	Tot. Fe mg/l	Dis Fe mg/l	Tot. Mn mg/l	Dis. Mn mg/l	Tot. Al mg/l	Dis. Al mg/l
CH-26	7/27/92	25	66	17.5	4.2	16.4	0	18.4	0.39	0.23	0.58	0.58	0.81	0.67
CH-26	8/3/93	63	63	17.4	4.3	12.2	0	24.8	0.43	0.33	0.56	0.56	0.57	0.44
CH-26	6/13/94	95	64	17.1	4.4	16.6	0	21.6	0.283	0.15	0.384	0.384	0.515	0.426
BR-09	6/13/94	444	37	17.9	5.2	12.4	2.6	11.4	0.13	0.09	0.16	0.16	0.2	0.17
BR-14	6/13/94	496	40	18	4.8	17.8	2	12.9	0.18	0.12	0.21	0.21	0.27	0.23
BR-26	7/27/92	254	90	19.6	6.2	1.8	12	22.9	0.22	0.03	0.03	0.02	0.29	0.14

Data following the placement of the wetlands and semi-oxic limestone trench

CH-26	9/3/95	58	60	17.3	4.7	11.6	0	19.4	0.235	0.137	0.37	0.37	0.89	0.645
CH-26	4/4/96	105	54	17.2	4.4	10.2	0	22	0.207	0.124	0.363	0.361	1.19	0.882
CH-26	8/9/96	76	48	17.4	4.6	10.3	0	18.3	0.201	0.103	0.352	0.103	0.83	0.643
BR-09	4/4/96	1265	35	17.7	4.89	6.4	2	12.5	0.074	0.063	0.146	0.146	0.632	0.445
BR-09	8/9/96	544	32	17.8	5.1	7	2	11.6	0.086	0.072	0.153	0.153	0.54	0.382
BR-14	4/4/96	1370	38	17.7	4.7	7.2	1.6	15.4	0.181	0.079	0.212	0.195	0.764	0.596
BR-14	8/9/96	620	36	17.8	4.9	7.5	2	12.3	0.17	0.081	0.234	0.225	0.636	0.403
BR-26	4/4/96	1370	39	17.8	4.7	8.4	1.4	15.4	0.104	0.062	0.197	0.195	0.539	0.564
BR-26	8/9/96	620	38	17.8	5	8.8	1.8	12.3	0.164	0.058	0.2	0.432	0.365	0.204

A thriving wetland community now provides habitat to a variety of waterfowl and wildlife. Public awareness to the AMD problem and passive treatment technologies has been created. Many local sportsman groups and municipalities are becoming interested in improving local streams. The Conservation District regularly receives calls from municipalities to inquire about funding possibilities and new ways of treatment.

This project has also been an important learning experience for the Conservation District and newly established Conservation and Recreation Authority. The Authority is currently involved in several other remediation projects. They are committed to maintaining the Bear Rock Run Project and further enhancing the water quality.

INSECT SURVEY OF CHRISTY HOLLOW/BEAR ROCK RUNS

Methods:

All sites were characterised by extensive riffle zones composed primarily of shale and sandstone slabs, cobbles and gravel. Surber samplers (0.09 m^2, 1.0 mm mesh) were used to take six samples within a 100 meter reach at each site during late May and early June, 1984. Samples were placed on stream bottoms within the riffle zones, stones within the sampler's boundries were removed and brushed into the opening of the collection net and the substrate was disturbed to a depth of 5 to 10 cm. Insects swept into the net were preserved in 75% alcohol, seperated from the collected substrate and sorted by orders. Insects in the orders Ephemeroptera (mayflies), Plecoptera (stoneflies), Trichoptera (caddisflies) and Megaloptera (hellgrammites) were further identified to family level; Chironomidae (midges) and Simuliidae (blackflies) were also identified and counted, but other dipterans were not identified to family level.

1994 survey:

Christy Hollow Run:

Plecoptera:

Only two families are found in Christy Hollow, Leuctridae and Nemouridae; a level of family diversity that is much lower than most other sites. Leuctridae densities are about the same at all sites (CH1 - CH5) along the stream, suggesting that these individuals are relatively unaffected by chemical differences among sites, and may be candidates for transfer to low pH sites. However, Nemouridae densities, which are very high at the most upstream site (CH5), decline dramatically at downstream sites, with very few individuals found at the most downstream sites (CH1 and CH2). Thus, Nemouridae numbers and the Nemouridae:Leuctridae ratio may be valuable bioindicators along Christy Hollow Run.

Emphemeroptera:

There are none. This is striking, given the abundance of mayflies outside the Christy Hollow-Bear Rock watershed. Since metal levels are no higher, and in some case lower, than metal levels at general survey sites where mayflies are common, it does not appear as though metals are responsible for the absence of mayflies. On the other hand, Christy Hollow pH levels are clearly lower than pH levels at other sites, so it may be that low pH levels are involved in preventing colonization of Christy Hollow by mayflies. A return mayfly populations would certainly be a good indication of improving water quality.

Trichoptera:

Caddisfly densities are clearly higher at the most upstream site (CH5), with Rhyacophilidae being the dominant family. Caddisfly densities at the downstream sites (CH1-CH4) are lower than at any general survey site and the two most upstream Bear Rock Run sites. An increase in caddisfly numbers at downstream sites would probably be a good indication of improving water quality.

Diptera:

There are very few Chironomids present at any of the six sites, but two sites (CH4 and CH5) had large populations of Simulidae (blackfly) larvae.

Bear Rock Run:

Plecoptera:

Above the confluence with Christy Hollow Run, stonefly densities are relatively high, and there are more families present than in Christy Hollow. Below the confluence, stonefly densities, especially Nemouridae densities, clearly decline.

Ephemeroptera:

Mayfly densities are unusually low. Unlike Christy Hollow, a few mayflies were present, but densities were much lower than densities at general survey sites outside of the Christy Hollow-Bear Rock watershed. This suggests that Bear Rock Run, even at sites above the Christy Hollow confluence, has some factor in common with Christy Hollow which restricts mayfly colonization. Periods of low pH may partially explain the low densities, but pH is probably not the full explanation.

Trichoptera:

At sites above Christy Hollow, caddisfly densities are intermediate, relative to general survey sites, with Rhyacophilidae and Hydropsychidae being the dominant families. Below the Christy Hollow confluence, caddisflies are rare.

Diptera:

Both chiromonid and simulids densities are low throughout Bear Rock Run.

Christy Hollow-Bear Rock summary:

While the two streams are similar with respect to low mayfly numbers, there are clearly difference in terms of stonefly densities and diversities and in caddisfly densities. Differences are greatest between lower Christy Hollow sites (CH1 and CH2) and Bear Rock sites (BR2) located above the Christy Hollow confluence. The waters of Christy Hollow reduce insect population in Bear Rock Run, but densities and diversities are still higher than in lower sites in Christy Hollow itself. Return of mayflies, increases in nemourid stoneflies and increases in caddisflies could probably all be used as indicators of improving water quality in Christy Hollow Run.

1995 survey:

Overall, little difference was observed between communities sampled in 1994 and 1995.

Ephemeroptera remain very rare; two were collected at site BR2 and none at any other site, including all Christy Hollow sites. Blacklight trapping for adult mayflies suggest that few adults were moving into the area at this time to mate and lay eggs. Thus, mayfly populations are expected to remain very low for another year, despite any improvement in water quality.

Plecoptera individuals remain the dominant EPT organisms, with all individuals belonging to the families Leuctridae and Nemouridae. As in 1994, the more acid-tolerant Leuctridae individuals were the majority at sites B3, C1 and C2, altough the Leuctridae/Nemouridae ratios were not quite as high as before at sites B3 and C1.

Tricoptera remain rare at all sites except B2 and C5. However, three families were found at site B3 in 1995, compared with only one family in 1994, and there was a slight increase in Rhyacophilidae density at site C1; the Rhyacophilidae remain more common in the Bear Rock-Christy Hollow drainage than at sites outside of this area. Chironomidae densities remained low at all sites, but far more Simulidae (black flies) larvae were found at site C1 in 1995.

In addition to continuing to sample Bear Rock-Christy Hollow sites, two new sites were added in the Burgoon Run drainage to provide control data from an adjacent drainage with good water quality. The insect densities were much greater in Burgoon Run and communities were far more diverse. Five different families of mayflies were collected, with the density of Heptageniidae being exceptional high at one of the two Burgoon Run sites. Thus, there should be plenty of adult mayflies in this adjacent drainage to colonize the Bear Rock-Christy Hollow drainage IF they are inclined to disperse. As in Bear Rock-Christy Hollow, the majority of Plecoptera individuals belonged to the families Leuctridae and Nemouridae, but three other families were also found. Tricoptera densities were not high, but five different families were collected; most individuals were in the family Uenoidae.

1996 survey:

Insects from from the 1996 survey have not yet been completely sorted and identified, but it is clear that little has changed in Christy Hollow Run since the the pre-wetlands survey (1994). The ratio of leuctriids to nemourids (Order Plecoptera) remains very high. There are a few more caddisflies (Order Tricoptera), but stoneflies (especially leuctriids) remain the dominant order. Mayflies (Order Trichoptera) have still not been found in Christy Hollow, despite their abundance in nearby Burgoon Run. Dipteran populations are also still low. Given that much of the iron is being removed by the wetlands, it seems likely that the absence of mayflies is due to ph levels that remain below 6.0 (?) and/or other factors left unchanged by the treatment of the AMD by wetlands.

We recently finished sampling Christy Hollow and Bear Rock sites for a fourth time (May, 1998). Results of this survey should be available in the spring of 1999.

Table 1: Summary of insect collections for 1994.

Order Family	Sites BR2	BR3	CH1	CH2	CH4	CH5	BG1	BG2
Ephemeroptera:	1	2	0	0	0	0		
Baetidae	0	0	0	0	0	0		
Caenidae	0	0	0	0	0	0		
Ephemerellidae	0	2	0	0	0	0		
Ephemeridae	0	0	0	0	0	0		
Heptageniidae	1	0	0	0	0	0		
Leptophlebiidae	0	0	0	0	0	0		
Oligoneuridae	0	0	0	0	0	0		
Sipholonuridae	0	0	0	0	0	0		
Plecoptera:	77	35	50	54	77	190		
Capniidae	0	0	0	0	0	0		
Chloroperlidae	0	0	0	0	0	0		
Leuctridae	29	27	48	53	33	55		
Nemouridae	47	7	2	1	34	135		
Peltoperlidae	1	1	0	0	0	0		
Perlidae	0	0	0	0	0	0		
Perlodidae	0	0	0	0	0	0		
Trichoptera:	12	1	2	1	5	20		
Hydropsychidae	7	0	0	0	0	0		
Hydroptilidae	0	0	0	0	0	0		
Lepidostomatidae	2	1	1	1	1	3		
Limnephilidae	0	0	0	0	0	0		
Molannidae	0	0	0	0	0	0		
Polycentropodidae	0	0	0	0	0	0		
Psychomyiidae	0	0	0	0	0	0		
Odontoceridae	0	0	0	0	0	0		
Philopotamidae	0	0	0	0	0	0		
Rhyacophilidae	3	0	1	0	4	6		
Uenoidae	0	0	0	0	0	11		
Diptera:	3	5	7	7	87	76		
Chironomidae	1	4	2	3	0	2		
Simuliidae	2	1	5	4	87	74		

Table 2: Summary of insect collections for 1995.

Order Family	Sites BR2	BR3	CH1	CH2	CH4	CH5	BG1	BG2
Ephemeroptera:	2	0	0	0	0	0	315	36
Baetidae	0	0	0	0	0	0	9	0
Caenidae	0	0	0	0	0	0	0	0
Ephemerellidae	1	0	0	0	0	0	4	6
Ephemeridae	0	0	0	0	0	0	0	0
Heptageniidae	1	0	0	0	0	0	222	13
Leptophlebiidae	0	0	0	0	0	0	75	17
Oligoneuridae	0	0	0	0	0	0	0	0
Sipholonuridae	0	0	0	0	0	0	50	0
Plecoptera:	30	31	36	49	58	451	56	34
Capniidae	0	0	0	0	0	0	0	0
Chloroperlidae	0	0	0	0	0	0	4	1
Leuctridae	12	24	30	48	29	178	10	20
Nemouridae	18	7	6	1	29	273	39	12
Peltoperlidae	0	0	0	0	0	0	0	0
Perlidae	0	0	0	0	0	0	0	1
Perlodidae	0	0	0	0	0	0	3	0
Trichoptera:	16	11	8	2	1	49	19	9
Hydropsychidae	10	2	0	0	0	0	0	0
Hydroptilidae	0	0	0	0	0	0	0	0
Lepidostomatidae	0	6	1	0	0	2	3	1
Limnephilidae	0	0	0	0	0	0	0	1
Molannidae	0	0	0	0	0	0	0	0
Polycentropodidae	0	0	0	0	0	0	1	6
Psychomyiidae	0	0	0	0	0	0	0	0
Odontoceridae	0	0	0	0	0	0	0	0
Philopotamidae	0	0	0	0	0	0	0	0
Rhyacophilidae	4	3	7	2	1	30	1	1
Uenoidae	2	0	0	0	0	17	14	0
Diptera:	5	2	30	5	159	131	20	13
Chironomidae	4	2	3	0	2	11	17	10
Simuliidae	1	0	27	5	157	120	3	3

Table 3: Summary of insect collections for 1996 (IDENTIFICATION INCOMPLETE).

Order Family	Sites BR2	BR3	CH1	CH2	CH4	CH5	BG1	BG2
Ephemeroptera:	3	0	0	0	0	0		
Plecoptera:	164	86	19	66	107	105		
Capniidae	0	0	0	0	0	0		
Chloroperlidae	0	0	0	0	0	0		
Leuctridae	54	27	18	66	37	65		
Nemouridae	110	59	1	0	70	40		
Peltoperlidae	0	0	0	0	0	0		
Perlidae	0	0	0	0	0	0		
Perlodidae	0	0	0	0	0	0		
Trichoptera:	13	7	6	7	29	42		
Diptera:	5	18	4	13	73	9		