Western Pennsylvania
Conservancy

water, land, life.

Mill Creek and Little Mill Creek of Clarion & Jefferson Counties Macroinvertebrate Assessment, October 2012 Along With an Overview of Water Quality and Fisheries Improvements Over the Past 25 Years of the Mill Creek Coalition

A 25th Anniversary Report

Prepared by:

Eric Chapman, Director of Aquatic Science
Western Pennsylvania Conservancy, Watershed Conservation Program
1067 Philadelphia Street, Indiana, PA 15701
Phone (724) 471-7202   Fax (724)-471-7036

With collaborative narrative provided by the
Mill Creek Coalition of Clarion & Jefferson Counties (MCC).
and
with project funding administered by the

Headwaters Charitable Trust
434 State Street-Suite 1, Curwensville, PA 16833
Phone (814) 236-4333   Fax (814) 236-4334

Printed October 2015   2/18/16

Mill Creek Coalition
of
Clarion and Jefferson Counties

Alliance for Wetlands and Wildlife

Conservation District Clarion County

Conservation District Jefferson County

Federation of Sportsmen Clarion County

Federation of Sportsmen Jefferson County

Iron Furnace Chapter of Trout Unlimited

League of Women Voters of Clarion County

Mill Creek Chapter Nat'l Wild Turkey Fed.

Natural Resources Conservation Services

Northwest Pennsylvania's Great Outdoors Tourist Promotion Agency

Seneca Rocks Audubon Society

INTRODUCTION

As with many acid mine drainage (AMD) affected streams in Pennsylvania and elsewhere, the Mill Creek watershed was actively strip-mined prior to the passage and implementation of the Surface Mining Control and Reclamation Act (SMCRA) in 1977. This federal legislation, along with significantly improved state regulations, has substantially reduced the incidence of AMD in present-day strip-mining activities. By 1990, the year the Mill Creek Coalition (MCC) of Clarion and Jefferson Counties was formed, strip-mining on the watershed was close to non-existent due to increased knowledge of overburden geology and hydrology and their role in the creation of AMD-associated problems. Concurrent with these advances, knowledge of how to treat AMD problems was also progressing rapidly. One of the main reasons why MCC formed was to promote the use of developing technologies and to encourage the use of new ones to restore the coldwater fishery in those parts of the Mill Creek watershed that were negatively impacted by AMD.

The Mill Creek Coalition has actively worked to improve the water quality and coldwater fishery of the 60-square-mile Mill Creek watershed (Figure 1). Formed in the fall of 1990, the MCC is celebrating its 25th year. Since its inception, about 40 projects have occurred that in some way have resulted in a positive change to the watershed; these include:

- the construction of passive treatment systems (24 sites);
- continuation of active treatment systems originally constructed by a defunct mining company with its present operation supported through a Pennsylvania Department of Environmental Protection (DEP)-negotiated trust (6 sites);
- DEP Bureau of Abandoned Mine Reclamation (BAMR) treatment of more recent mine sites (3 sites) and re-mining of 4 sites;
- the re-contouring and adding of alkalinity to disturbed overburden, followed by re-vegetation (1 site);
- incorporating heavy applications of lime to the surface of previously mined sites (2 sites);
- plugging of abandoned gas wells (2 sites).

Roughly $12 million has been invested in the Mill Creek watershed since the early 1990s, excluding about $100,000/year by the aforementioned trust to maintain active chemical treatment on the six sites formerly treated by a coal company. It is likely that nearly several thousand gallons per minute (gpm) of AMD water has been substantially improved through these efforts.

The Pennsylvania Fish and Boat Commission (PFBC) has maintained a long-term trout stocking commitment on Mill Creek in the vicinity of McCanna Run (i.e., Old State Road Bridge; Figure 1). In 1991, MCC's first efforts to improve the main stem of Mill Creek with a passive treatment system occurred at a site (Howe Road Bridge) located at the upstream boundary of Game Lands 74 (Figure 1).

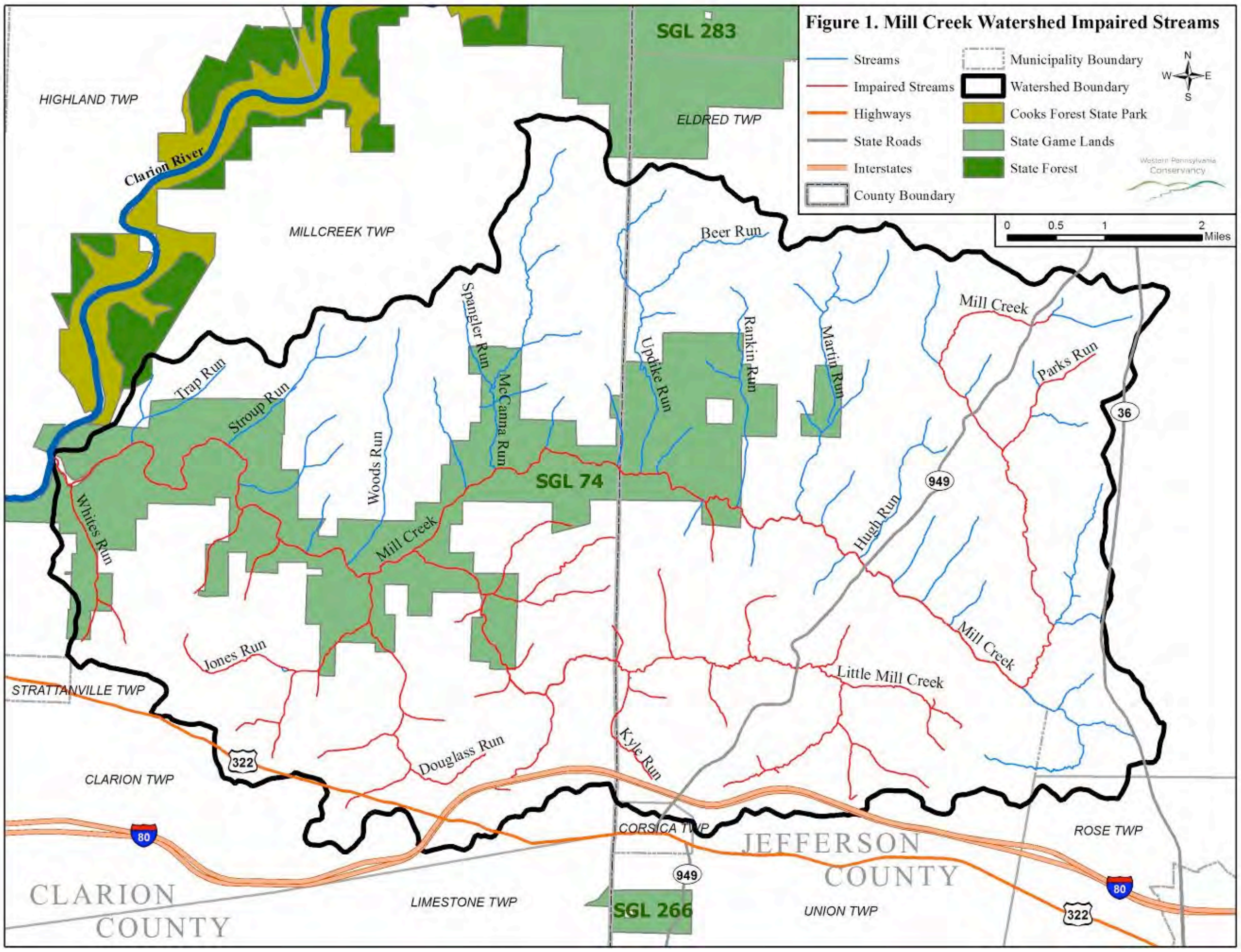


Figure 1. Overview map of the Mill Creek watershed with all named streams and un-named tributaries in the 60-square-mile watershed. In addition, the impaired streams according to DEP are highlighted in red.

In 1995, the PFBC committed to its second trout stocking location at the Howe Bridge site due to the improved water quality. Since both sites are on State Game Lands 74, they encompass approximately the lower one-half of the watershed, where there is ample accessibility to the public for fishing, hunting and other appropriate outdoor opportunities. The PFBC has approximately doubled the trout stocking effort since then, when money and trout allocations have allowed. About 4,500 Brook Trout are presently stocked each year. Over the past 25 years, thousands of water samples have been taken by DEP and the MCC; both groups have documented improving water quality as treatment sites and other corrective measures were added.

Based on these data in 2011 and again in 2013, the PFBC initiated a comprehensive electrofishing study of the entire Mill Creek watershed and its tributaries. This was to document the presence or absence of native Brook Trout and other coldwater species. Through the efforts of the PFBC as well as fishery studies by Clarion University biologists and students, the MCC's knowledge of Brook Trout and several other fish species have been documented throughout much of the entire watershed, with the exception of the last six miles of Mill Creek, which remains moderately affected by AMD.

With the ongoing and extensive field studies on the fisheries, it was also apparent that the MCC's knowledge of the macroinvertebrates of the watershed similarly needed to be updated and expanded. Therefore, the Western Pennsylvania Conservancy's Watershed Conservation Program was contacted, resulting in this present study to provide a macroinvertebrate assessment focusing on both Mill Creek and Little Mill Creek (Figure 2). The macroinvertebrate data collected will better represent a consistent (or lack thereof) environment capable of sustaining a coldwater fishery.

With the recent compilation of the PFBC's fisheries assessment as well as WPC's macroinvertebrate report, MCC and its funding partners are now able to better judge the effectiveness of time, energy, and money invested on ameliorating the AMD sources in the watershed. This will also help determine future restoration priorities and potential project locations in the watershed.

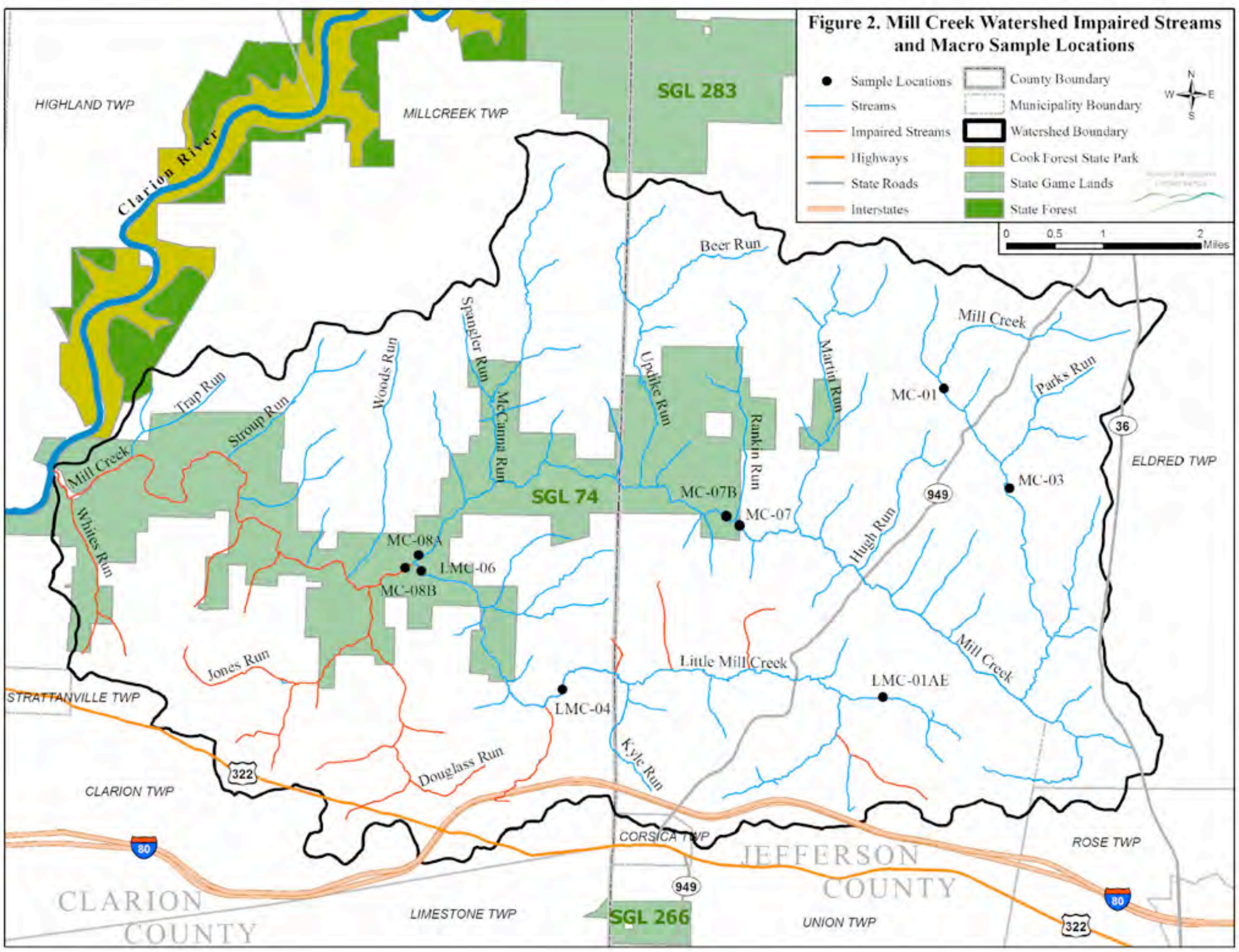


Figure 2. Water quality and macroinvertebrate sample locations in the Mill Creek watershed (Clarion and Jefferson Counties). Nine sample sites were selected by representatives of the Mill Creek Coalition.

METHODOLOGY

General Description of Sample Site Locations

The macroinvertebrate samples were taken at nine locations along Mill and Little Mill Creeks in October 2012 (Figure 2). These locations represented headwater, mid-length, and downstream sites, which are all important for documenting the current biological condition of the whole watershed. The site numbering system used herein was developed by the MCC; DEP's Knox District Mining Office uses a slightly different system. The pH and other parameters taken at each site are shown in Table 2.

1. Headwater sites were chosen to represent segments of Little Mill and Mill Creek where poor water quality has historically not been a problem. The headwaters of Little Mill Creek (LMC-01AE) and Mill Creek (MC-01), where summer flows are several hundred gpm, should be inhabited by macroinvertebrates that rather closely represent the natural communities indicative of headwater freestone streams not affected by AMD. Both Headwaters lower boundaries coincide with Rt. 949 bridges. Below the bridges are the beginnings of the Mid-length segments.

2. Mid-length sites, including LMC-04 on Little Mill, along with MC-03, MC-07 and MC-07B on Mill Creek, are segments which are in the 1,000–3,000 gpm range. LMC-04 on Little Mill Creek was heavily affected by upstream AMD (circum pH 3.5 with metals) prior to the treatment of numerous AMD sites, but over the past half dozen years has a circum pH in the 6s, with low metal concentrations presently detected. On Mill Creek itself, MC-03 was slightly affected by AMD well over a decade ago and the residual AMD effects are minimal. Further downstream from MC-03 on Mill Creek, MC-07 and adjacent MC-07B represent a site where above them a number of significant AMD locations below MC-03 were found and largely addressed. MC-07 is located immediately upstream of the AMD treatment site at Howe Bridge. MC-07B is located below the treated water. It is also the last site for about a 3.5 mile stretch before the confluence with Little Mill Creek that is not affected by any appreciable AMD. With much of the same AMD treatments occurring during the same approximate time as above Little Mill's LMC-04, MC-07 and MC-07B have also recovered to nearly the same water quality as its LMC-04 counterpart. The junction between the Mid-length and Downstream segments on Mill is the bridge immediately below the McCanna Run. For Little Mill, the junction between the Mid-length and Downstream is below LMC-04 and just above a bridge and the red tributary, referred to as the Asbury Rd. tributary, which flows under I-80 (Figure 1).

3. Downstream areas are characterized by sites LMC-06, MC-08A, and MC-08B. LMC-06, located just above the confluence with Mill Creek, is the last sample site on Little Mill Creek. The flow at this location is about 4,000 gpm, with a pH of circum 6, iron levels at 5.0–10.0 mg/l and manganese at 4.0–6.0 mg/l, due primarily to one untreated AMD affected tributary (referred to the Asbury Rd. tributary) with its mouth draining adjacent to a significant AMD site

(Markle/Kotchey) approximately 2.5 miles upstream from LMC-06 and where only partial treatment is presently occurring. These two adjacent AMD sites serve as the boundary between the upper Mid-length and lower Downstream segments. This lower stream segment has a noticeable iron oxide coating and staining on the substrate with some effects occurring in the mixing zone with Mill Creek. The MC-08A site on Mill Creek is just above the confluence with Little Mill Creek and provides an opportunity to assess the macroinvertebrate community prior to mixing with Little Mill Creek. Mill Creek at MC-08A has a flow approximately twice that of Little Mill Creek and a pH of about mid-6 with a nominal metal load. However, below the confluence with Little Mill Creek at site MC-08B, the pH of Mill Creek drops nearly a half pH with metals running 10–50% or more than MC-08A levels, depending on flow conditions of both streams.

Macroinvertebrate Sampling Overview

Sampling was conducted along the nine selected sites of both streams, covering the entire length of Little Mill Creek (9 miles) and the upper 15 miles of Mill Creek to the point where Little Mill Creek confluences with Mill Creek (Figure 2). Mill Creek continues to flow in a westerly direction for approximately 6 miles before flowing into the Clarion River north of Strattanville, Pennsylvania. Headwater samples were taken from both streams (LMC-01AE, MC-01), at Mid-length locations (LMC-04, MC-03, MC-07, MC-07B), and the Downstream site of Little Mill Creek (LMC-06) and for Mill Creek (MC-08A, MC-08B) just above and below the confluence with Little Mill Creek.

This survey was conducted following the benthic macroinvertebrate protocol for single habitat streams, as described in *EPA's Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers*. Benthic macroinvertebrates were sampled utilizing triplicate Surber samples that covered $0.09m^2$ in water depths of 0.3m or less. Once the substrate is moved, the macroinvertebrates drift into the net to be collected (Figure 3).

Figure 3. Shows an example of the Surber Sampling Method.

Following each sample collected, all specimens and sediment were transferred into sample bottles and preserved with 70% ethanol. Preserved samples were delivered to the Western Pennsylvania Conservancy's (WPC) Watershed Conservation Program laboratory for processing and identification. Laboratory procedures followed DEP Invertebrate Comparative Evaluation (ICE) protocols. Macroinvertebrate samples were carefully examined and organisms were separated from the debris in the laboratory. The goal was to gather a 200-count (plus or minus 50 macroinvertebrates) from each sample. The identified organisms were transferred to collection bottles and preserved with 70% ethanol. Organisms were identified to the genus taxonomic level under a dissecting microscope. All samples were sorted completely, which resulted in a total ranging from 23–233 individuals per sample. Samples that had more than 200 individuals were completely picked, re-distributed and then the resulting organisms found within grids were composited to meet the necessary sample number. A random number generator and grid system were used to remove bias from selecting grids with conspicuous or large taxa. Quality control procedures included a qualified staff member sorting through a sub-section of the completely sorted sample to check for missed and misidentified organisms. Water samples were also taken and tested for standard chemistry parameters that can be seen in the RESULTS section.

Data Analyses

The following metrics were used to analyze the macroinvertebrate data for this study: (1) total number of individuals, (2) Richness, (3) Evenness, (4) number of EPT taxa, (5) percent EPT, (6) percent Chironomidae, (7) Shannon Diversity Index (H), (8) Pollution Tolerance Index (PTI), (9) Hilsenhoff Index, and (10) Hilsenhoff Rank. The Richness indicates the number of families present in the sample. Evenness measures how close the numbers of species are in the environment. The number of EPT taxa indicates the number of families of mayflies (Ephemeroptera), stoneflies (Plecoptera), and caddisflies (Trichoptera) present in the sample. The percent of EPT refers to the number of families for each group divided by the total number of families. The best coldwater streams are noted for having rich and abundant representation of these three insect orders, and are also sensitive to changes in water quality. An abundance (higher percent) of Chironomidae (midges) indicates poorer water quality. Diversity indices are mathematical measures of species or family level diversity in a community. The Shannon Diversity Index provides information about species or family richness and also takes into account the relative abundances of different species or families collected. The higher the index value, the more diverse the macroinvertebrate community will be at a particular location. The Pollution Tolerance Index (PTI) Score is based on the concept of indicator organisms and tolerance levels. Indicator organisms are those organisms sensitive to water quality changes and their presence or absence indicates the condition of the water in which they live. Pollution-intolerant organisms include the mayflies (Ephemeroptera), stoneflies (Plecoptera), caddisflies (Trichoptera), riffle beetles, and water pennies. Pollution-tolerant organisms include tubifex worms, midges, pouch snails, and leeches. PTI Rank is the same number as the score but it is assigned either an Excellent (>23), Good (17-22), Fair (11-16), and Poor (<10) ranking. The Hilsenhoff Index is a measure of organic pollution sources which often impair streams in Pennsylvania. Hilsenhoff Rank is based on the number from the Hilsenhoff Index, where it is assigned an Excellent (0.00-3.50), Very Good (3.51-4.50), etc., category. All macroinvertebrate results identified to an appropriate taxonomic level are attached as Appendix 1.

RESULTS

Water Quality

In northwestern Pennsylvania, freestone streams are the most common stream type. Derived from the geologic history of the region, these streams have a number of physio-chemical characteristics, such as moderate acidity, low calcium concentrations, with a slightly acid or circum neutral pH. The Mill Creek watershed is a classic example of this stream type. Before macroinvertebrate sampling began, routine water quality parameters were collected at all sites utilizing hand-held electronic probes (Table 1). Results showed that all nine sites are within the parameter standards for pH and dissolved oxygen for wadeable streams. Two sites, LMC-04 and LMC-06, had slightly elevated conductivities (due to past mining in those areas) whereas MC-01 had a slightly lower conductivity than all the other sites, but all sites were within the conductivity levels associated with Pennsylvania streams during the time of year when sampling occurred. The Total Dissolved Solids (TDS) are slightly elevated at the LMC-04 and LMC-06 sites which could be a result of local geologic formations or anthropogenic sources, potentially from acid mine drainage, which is commonly found in this stream section. Due to the efforts of DEP and the Mill Creek Coalition, a huge water quality dataset pinpoints the chemical and physical effects of AMD along different reaches of Little Mill and Mill Creek but that dataset was not necessary for this project. All data reported in this document were the result of sampling during the 2012 field season, with an initial report provided in 2013.

Table 1. Water quality results from sampling the Mill Creek watershed at the time of the October 2012 study. Low numbered sites are highest in the watershed (headwater locations) and increasing site numbers are lower in the watershed.

	Little Mill Creek Sites			Mill Creek Sites					
	LMC-01AE	LMC-04	LMC-06	MC-01	MC-03	MC-07	MC-07B	MC-08A	MC-08B
pH	7.28	6.45	5.90	6.32	6.18	5.96	6.19	6.81	6.43
H_2O Temp. °C	10.01	10.60	11.10	12.10	12.50	11.60	11.70	10.80	11.00
TDS (ppm)	112	350	275	56.4	104	178	171	122	140
Cond (µs)	195.3	593.0	630.0	92.3	171.8	295	285	203.0	230.0
Diss. O_2 (mg/l)	9.25	9.28	9.36	8.31	8.46	9.09	9.01	9.2	10.03

Habitat Conditions

The majority of the nine sites sampled for this project had average to above average habitat for macroinvertebrates. All sections surveyed on Little Mill Creek were less than 5 m in width, and had a good distribution of riffle, run, and pool habitat. LMC-01AE and LMC-04 had a nice cobble substrate which is an important habitat type for macroinvertebrate populations. Mill Creek sites MC-01 and MC-03 were beautiful reaches that contained a similar cobble substrate as well as other excellent habitat features, including large woody debris, undercut banks, and slow deep pools. While conducting macroinvertebrate surveys at these sites, native Brook Trout were observed developing redds in preparation for spawning activities. All the Brook Trout observed were small (< 180 mm) which is a good indication that they were native fish and not stocked by either the PFBC, individuals, or a local fishing or sportsman's group. Unfortunately, there are still indications at a few sites of AMD impacts from years past such as iron staining at LMC-04, LMC-06, MC-07, MC-07B, MC-08A, and MC-08B. However, by and large, the habitat found during this assessment was average to above average for aquatic organisms with the potential for all locations to have ample macroinvertebrate populations, given stable water quality conditions.

Macroinvertebrate Assessment

The nine sites analyzed were tabulated in Table 2. The total individuals in Little Mill were highest in the Headwaters and dropped to a tenth of that in the Mid-length and Downstream sites. For Mill Creek, the similar high numbers were found in the Headwaters and first Mid-length site (MC-03), then dropped to one-third of the original before attaining high numbers in the Downstream site (MC-08A) before plummeting after the confluence with Little Mill (MC-08B).

Table 2. Various metrics utilized in the macroinvertebrate assessment for Little Mill and Mill Creek.

	Little Mill Creek			Mill Creek					
Parameter	LMC-01AE	LMC-04	LMC-06	MC-01	MC-03	MC-07	MC-07B	MC-08A	MC0-8B
Total Individuals (N)	227	37	23	177	233	67	83	211	29
Richness	17	12	6	18	15	8	8	22	8
Evenness (E)	0.6671	0.7606	0.8360	0.7670	0.7431	0.7084	0.5472	0.6785	0.8187
Shannon Diversity (H)	1.89	1.89	1.50	2.22	2.01	1.47	1.14	2.10	1.70
Hilsenhoff Index	2.987	4.027	3.696	3.644	4.034	3.507	3.976	4.146	4.448
Hilsenhoff Rank	Excellent	Very Good	Very Good	Very Good	Very Good	Excellent	Very Good	Very Good	Very Good
% Ephemeroptera	1.76	2.70	34.78	4.52	2.57	0.00	0.00	30.66	3.44
% Plecoptera	37.00	16.00	0.00	33.00	23.00	30.00	12.00	3.00	0.00
% Trichoptera	43.00	43.00	48.00	8.00	29.00	51.00	66.00	35.00	34.00
% EPT	82.00	62.00	83.00	45.00	55.00	81.00	78.00	69.00	38.00
% Chironomidae	5.00	22.00	0.00	29.00	35.00	16.00	19.00	19.00	28.00
# Intolerant Taxa ,1,2)	9	3	1	7	5	4	3	8	0
PTI Index Score	28	28	10	31	28	16	21	29	15
PTI Rank	Excellent	Excellent	Poor	Excellent	Excellent	Fair	Good	Excellent	Fair

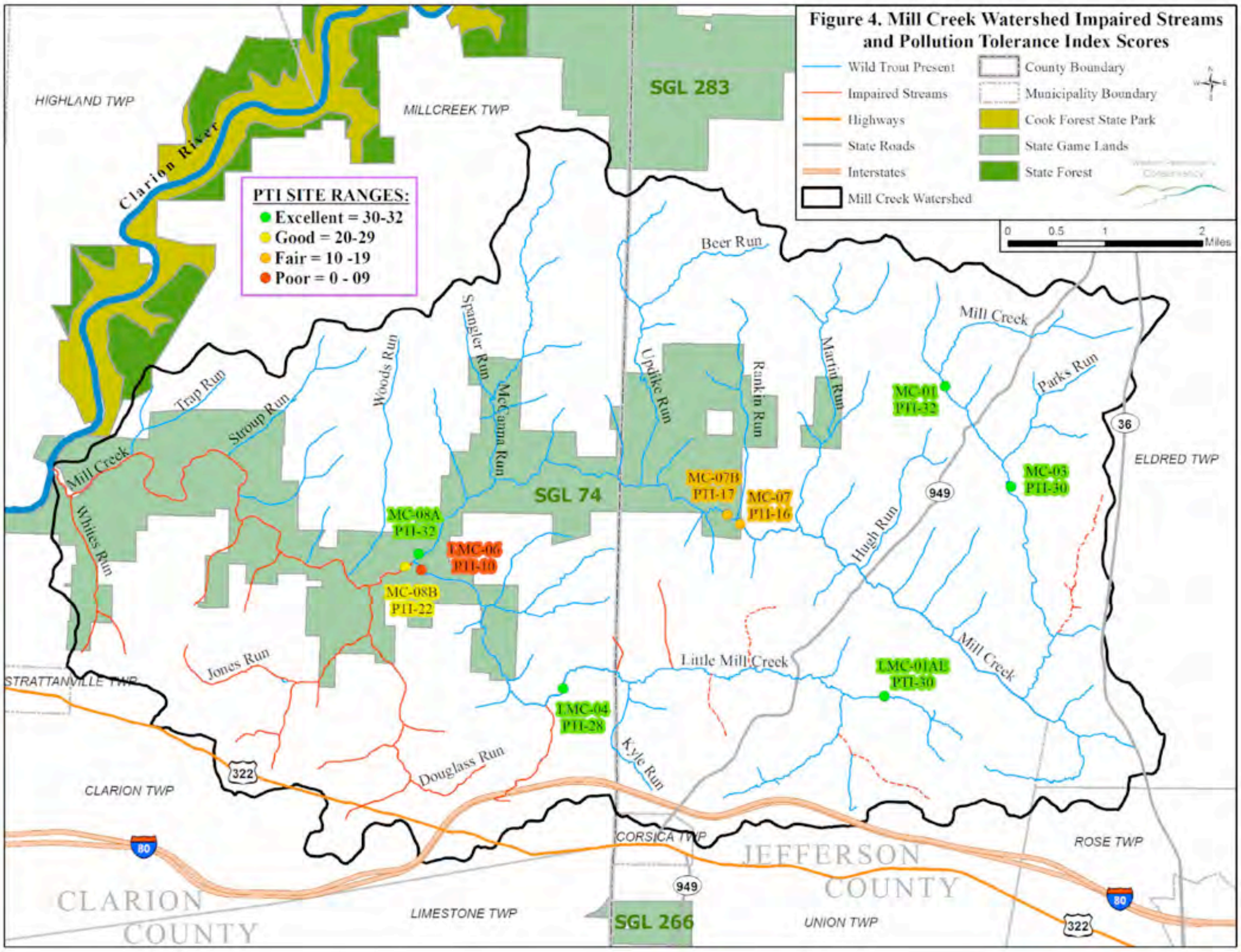
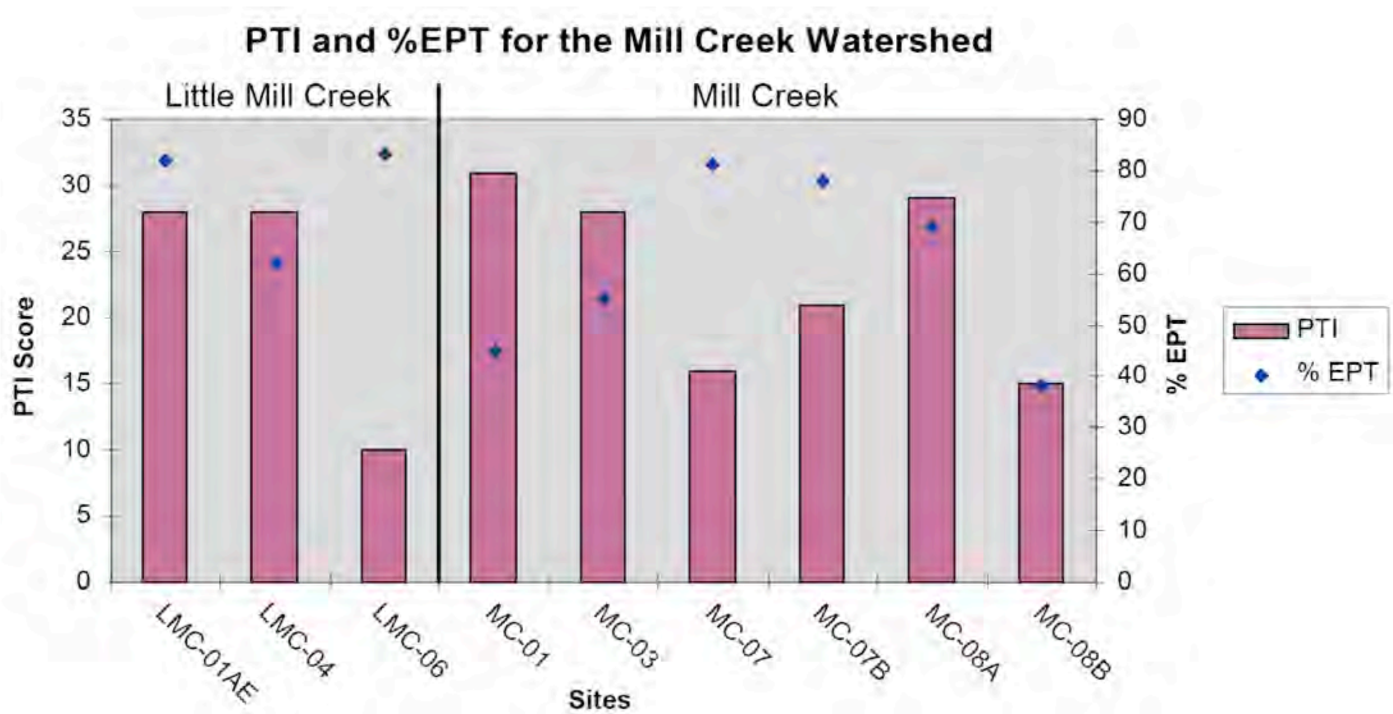


Figure 4. Pollution Tolerance (PTI) rank and score overlaid on the macroinvertebrate sample locations in the Mill Creek watershed. Note that Figure 4 also shows the presence of wild trout (Brook Trout) as documented by the PA Fish & Boat Commission during the 25-year period of the MCC's restoration efforts. The four dashed red streams need to be assessed.

There are wide ranging diversity values based on taxa richness and PTI scores. Only one site, LMC-06, scored in the poor range based on our Fall 2012 macroinvertebrate survey (Table 2 and Figure 4). MC-07 and MC-07B both scored in the fair range. The other six sites, some of which are found on "impaired" sections of Little Mill and Mill Creek, scored in the good to excellent range. Evenness values were slightly skewed at MC-07B and MC-08A due to a couple of dominant taxa (mostly *Hydropsyche* and *Chematopsyche* caddisflies, and Chironomidae (flies and midges). Shannon Diversity (H´) values were average for streams of this size and geologic type for western Pennsylvania. Hilsenhoff Rank values, which are important measures of organic contamination were all low, which is to be expected because there was little agriculture or anthropogenic sources found near any of the sample sites. Closer examination of %EPT values are of good quality for all sites except MC-08B which has a value (38%) much lower than the mean of 65.8% (Table 2 and 3). This site is a mixing zone for all water draining from impaired Little Mill into Mill Creek, so a slightly depressed community at this location is expected, due to the poorer water quality in Little Mill. Chironomidae levels ranged from 0% to as high as 35% which is normal for a healthy stream. As a group, caddisflies (Trichoptera) were the most abundant taxa recovered from eight of the nine sites, and were represented by numerous genera, a finding commonly found in freestone streams.

Overall, in the Mill Creek watershed, the higher sites are most often represented by a thriving macroinvertebrate community due to unimpaired water quality. The observed PTI scores show that in the watershed there are still lingering problems with AMD due to its deleterious effects on macroinvertebrates. For example, on Little Mill, LMC-06 is a site that is clearly being impacted by some untreated mine water because upstream from that location, the PTI scores are in the excellent range (LMC-01AE and LMC-04). But partially treated AMD water downstream of LMC-04 is causing a dramatic negative effect on the macroinvertebrate community, lowering the PTI scores from 28 down to 10 at LMC-06 (Figure 4; Table 2). On Mill Creek, a fine example of this effect can be seen in the differences in PTI scores between MC-08A (above Little Mill Creek confluence) and MC-08B (below the confluence with Little Mill Creek). Little Mill Creek is impacting the mainstem of Mill Creek, which can be seen in the resulting PTI scores from above and below the mixing area where above, the PTI score is 29 and below, has dropped to 15 (Figure 4, Table 3). Once more of the AMD issues are remediated in this watershed, the fair and poor PTI scores will better mirror what the Headwater locations are currently exhibiting in terms of biodiversity.

Table 3. Pollution tolerance index (PTI) values and percent Ephemeroptera, Plecoptera, and Trichoptera (% EPT) found within the Mill Creek watershed.



DISCUSSION

Macroinvertebrates

In a 2011 Masters thesis in Biology by Amy Beth Myers from Clarion University of Pennsylvania titled “Analysis of Changes in Macroinvertebrate Communities on the Mill Creek Watershed Resulting from Passive Treatment of Acid Mine Drainage”, she tallied from DEP reports about 60 mine sites from 1974-2006, peaking in the 1970s and tailing off in the 1980s to some smaller mining/remining activities in the past decade or two.

The mining that occurred in the Mill Creek watershed generally started in the southerly 9 mile in length Little Mill watershed and moved northward. Over 20 AMD treatment sites (some treatment sites captured more than one discharge) and two plugged gas wells are present on Little Mill. As shown in Figures 1 and 2, essentially all of Little Mill was seriously impaired except for a few of the smaller terminal clean stretches of headwater streams (such as LMC-01AE). Below the Headwaters segment, the fish community was almost totally absent in Little Mill by the time the MCC was formed in 1990.

On the other hand, the more northerly Mill Creek stem was substantially less impacted by mining, due to the AMD potential from hydrological factors and the acidic overburden, resulting in the macroinvertebrates inhabiting nearly all of the main stem and its tributaries largely spared from mining activities (Figures 1 and 2). About twice as long as Little Mill, it has about one-half as many AMD sources. The main stream was only mildly AMD affected (impaired) and while somewhat depauperate in species richness and numbers, it still maintains a small but viable Brook Trout population. Unlike the many abandoned mine sites along Little Mill, about one-half of the dozen or so AMD sources on Mill Creek are treated by a mining trust and most of the remainder were addressed by the MCC in its first five years (1991-1995). As a result, the present macroinvertebrates communities found at the Mill Creek study sites have probably been rather stable for the past several decades to the present time.

The MCC transitioned from early efforts to address AMD treatment on Mill Creek to Little Mill. From 1992-2002 was a period of constructing new passive treatment systems on Little Mill (only four new ones since then) with emphasis after that and to the present time gradually shifting to upgrading the older or failed systems. The 2012 macroinvertebrates report for Little Mill shows one benchmark of success from these long term and continuing efforts which should improve the water quality even more with the continual upgrades being pursued.

A major part of Myers’ thesis was to report on a faculty supported, seven year sampling effort by students (including Myers) of the macroinvertebrates life on Little Mill from 1997-2006. The objective was to measure the colonization and general changes to the macroinvertebrates community during the multi-year efforts to ameliorate the AMD problems on the watershed. Over a half-dozen new passive treatment systems were completed or under construction during this period. Sampling occurred at eleven sites during the summer using the same general protocol as the present report. Macroinvertebrate individual numbers, generic richness, and relative abundance were assessed.

Analyses of these metrics showed overall improvement between 1997-2004 for the entire stream, followed by a decline to 2006 (when the study ended) as upgrading old treatment systems and construction of new ones did not keep up with the deteriorating ones. In Appendix II, Tables 1 and 2, show just the three data sets that are the same as in the present study, namely LMC-01AE, LMC-04 and LMC-06.

LMC-01AE, not impaired by AMD, shows the natural vagaries of the macroinvertebrates community over the period of the Myers study. Secondly, the improvements at other sites occurred rather rapidly in the number of individuals and richness, generally in agreement with the 2012 study. Notably, the colonization of the Ephemeroptera (mayflies), Plecoptera (stone flies) and Trichoptera (caddisflies) were much slower in response to the better water conditions, with the Trichoptera being the most successful/tolerant of the EPT group, an important food resource in high quality streams.

Past and present studies demonstrate that macroinvertebrate diversity is often correlated with a variety of positive and negative variables, each having different effects on the community. Diversity typically decreases in an area when water quality is negatively affected by anthropogenic disturbances, such as mining, lumbering, or agricultural operations that occur in close proximity to a stream in this 2012 study. In the Mill Creek watershed the total number of individuals and taxa are greatest at the relatively undisturbed Headwater sites on Little Mill Creek (LMC-01AE) and Mill Creek (MC-01, MC-03), which is not surprising. The fish community also is relatively undisturbed at these headwaters.

At the Mid-length sites on Little Mill Creek (LMC-04) and Mill Creek (MC-07 and MC-07B), the most obvious differences in this somewhat impaired zone of both streams are the influences of a low concentration of metals and some iron coating/staining. Accordingly, a significant drop in the number of total individuals and richness, as well as a dip in the number of intolerant taxa were observed. For example, at MC-07 (above the Howe Bridge treatment site) and MC-07B (below the Howe Bridge treatment site), the Ephemeroptera (mayflies) were entirely lacking. The positive point here is through the successful treatment of a significant AMD problem at Howe Bridge, MC-07B is no worse and actually slightly better than MC-07. Since there is very little impact due to AMD influences for the next 5 miles (to the confluence with the AMD affected Douglass/Jones tributary), the PFBC established its second trout stocking site in 1995 at Howe Bridge, located at the uppermost boundary of Game Lands 74. The long standing trout stocking point (Old State Road Bridge, adjacent to McCanna Run (Figure 2), is approximately 3.5 miles downstream from the newer Howe Bridge stocking site. With the exception of the Howe Bridge AMD site, the downstream stretch has remained relatively stable for several decades, thus providing years of trout fishing for native and stocked Brook Trout.

With respect to the Downstream sites, the sampling site on Little Mill is LMC-06, just above the confluence with Mill Creek (Figure 2). LMC-06 has a more variable pH (circum 5.5–6.5) with a moderate iron coating/stain, which is negatively impacting the macroinvertebrate community. It has the fewest number of individuals, the lowest richness, no Plecoptera (stoneflies), and a poor PTI ranking (Tables 2, 3). Between LMC-04 and LMC-06 there are a number of untreated AMD sites. However, the most significant problem is the Markle/Kotchey passive treatment site located about one mile below LMC-04. This treatment system is presently undersized and cannot adequately treat all the AMD the way it is currently designed. In addition, an AMD affected tributary (the Asbury Rd. tributary) enters Little Mill adjacent to this treatment site and needs to be addressed in order to increase the macroinvertebrate community which can then support a significant coldwater fishery throughout this lower portion of Little Mill, a goal of MCC's AMD restoration projects.

There are two Downstream sites on Mill Creek. The first is MC-08A, located about one mile downstream from the Old State Road Bridge/McCanna Run trout stocking site and located just above the confluence with Little Mill Creek. At this site the macroinvertebrate community is thriving even better than the Mid-length sample points (MC-07 and MC-07B). A large number of individuals, with a high Shannon Diversity score, the greatest richness, many intolerant taxa, and a solid PTI score and rank (Excellent) make this site one of the best in the Mill Creek watershed. The water quality is a marked improvement from the MC-07 and MC-07B sampling station, the location of the Howe Bridge AMD passive treatment site, where 30–50 gpm results in 125–150 lbs per day of iron and 200–225 lbs per day of acidity are largely removed, resulting in the continued improvement of Mill Creek to the confluence with Little Mill Creek 3.5 miles downstream. Of importance to note, is the fact that Little Mill Creek, with about one-half the flow of Mill Creek, has a decidedly negative effect on Mill Creek (see MC-08B). Located downstream from the Little Mill confluence, the lower water quality here is primarily because of the treatment inadequacies of the Markle/Kotchey site and the Asbury Rd. tributary adjacent to the treatment site. When compared to MC-08A, the MC-08B site has the total number of individuals drastically reduced, it has lost some richness, lacks Plecoptera, has no intolerant taxa, and has a low PTI score and ranking (Good). However, a Brook Trout fishery in Mill Creek downstream of MC-08B persists for another one-half mile until the badly AMD affected Douglass/Jones tributary makes Mill Creek largely unhabitable for the last 6 miles to its confluence with the Clarion River.

Fisheries

Obviously, it is important and of great interest to the MCC and its financial supporters to determine if the watershed's fish community was benefitting from the improvements in water quality and the macrobenthic community. One of the Pennsylvania Fish and Boat Commission's responsibilities is to regularly monitor the lakes, dams and waterways in order to assess the fisheries, and develop an appropriate management practice if necessary for protecting and enhancing this valuable resource.

As a result, the PFBC was a contributor at the conference held 25 years ago that ultimately led to the formation of the MCC. While DEP, another contributor, shared its knowledge of mining in the Mill Creek watershed as well as its regulatory responsibilities, it was the

PFBC that provided the initial information about the fisheries in the watershed. As a result, the PFBC initiated an extensive electrofishing survey at some of the MCC's monitoring points starting in 1991, just before the completion of the Coalition's first passive treatment system, located at the Howe Bridge site on Mill Creek. Based on improvements to the water chemistry and electrofishing activities at that site, Brook Trout stocking began in 1995. In 2011 and 2013, the PFBC surveyed nearly all the tributaries in the watershed (Figure 4), documenting the presence of wild Brook Trout in most.

Starting in 1992, Andrew Turner of Clarion University initiated an electrofishing survey on a number of sites on both Mill Creek and Little Mill Creek. Primarily using his fisheries course students, most of the selected sites were surveyed numerous times in the years between 1992-2015. In Appendix III, Tables 1 and 2 show the data from the same sites as those of the 2012 macroinvertebrate study. Table 3 in Appendix III shows the fish species found in the watershed, most of which are commonly found in a freestone stream such as the Mill Creek watershed.

For Mill Creek (Table 1), MC-01 represents the Headwaters area. All the significant AMD sites in the Mid-length segment were addressed by 1996. The multi-year data show the natural vagaries in terms of the number of individuals for each recorded fish species. Due to the treatment of the AMD sites, the Mid-length and Downstream stretches appeared to show a recolonization or at least an increase in numbers of fish by 1997 and beyond due to better water quality and associated macroinvertebrate response.

For Little Mill (Table 2), the AMD problems were more severe, extending throughout the Mid-length and Downstream segments LMC-01AE represents the Headwaters area. Below LMC-01AE and above Rt. 949, about 18 AMD sites were treated/upgraded and one abandoned gas well plugged between 1994-2008 in the upper Mid-length segment. From 2002-2011, three very significant AMD sites were addressed, along with lesser improvements in the lower Mid-length segment. Nearly two dozen generally small AMD sites continue untreated in the Downstream segment, where water and macroinvertebrate improvements are the result of the upstream efforts.

There are only three species (Blacknose Dace, Creek Chub, Mottled Sculpin) shown in significant numbers in the LMC-01AE Headwaters segment and they show, like Mill Creek, annual variations in the numbers of each species. Interestingly, while the Headwaters LMC-01AE lacked Brook Trout, a southerly tributary flowing into the headwaters east of Rt. 949 is inhabited by the species, but has not appeared to have recolonized to any of the fish sampling stations. In Little Mill's Mid-length stretch (LMC-04), the Mottled Sculpin has not yet appeared. The Creek Chub first appeared in 2010 and the Blacknose Dace in 2015 in Turner's electrofishing study. While the water chemistry at LMC-04 was in the pH 5 range by 2004 and mostly pH 6 or better by 2005, pH variations may have occurred, impeding the rate of colonization. In addition, there is "flat" water for several miles starting just above Rt. 949 and continuing to above LMC-04 before pool/riffle waters reappear. There is also considerable beaver activity with dams throughout this segment. Turner and his students did not sample the Downstream segment because of the lack of easy access.

While MCC individuals were visiting the watershed, there was usually a casual watch for fish recolonization in Little Mill from the undisturbed Headwaters area. Finally, in July 2004, "minnows" (Creek Chubs and/or Blacknose Dace) were observed at the Rt. 949 bridge and in August, another half mile downstream at another bridge crossing. This is a period of 10 years from the completion of the first AMD passive treatment site above Rt. 949. During that decade most of the 18 AMD sites above the Rt. 949 bridge were treated. By 2006, minnows were occasionally observed further downstream. By that time, passive treatment systems were functioning at nearly all the AMD sites and two abandoned gas wells were plugged in the Headwaters and most of the Mid-length segments of Little Mill.

During the 2007 fall semester, to officially determine their presence/absence and the species involved, Clarion University biology faculty member Peter Dalby and students Jordan Blair and Shanna Bowersox placed overnight at 13 sites two baited minnow traps, moving from the headwaters over successive weeks to Little Mill’s confluence with Mill Creek. This study, entitled “Restoration of a Coldwater Fishery on Mill Creek, an Acid Mine Drainage (AMD) Affected Stream, Clarion and Jefferson Counties, Pennsylvania was reported at the annual spring meeting of the Pennsylvania Academy of Science. Creek Chubs were present throughout most of Little Mill with the highest numbers (typically 3-7 per trap) in the Headwaters locations where water quality showed the greatest improvement. In the Mid-Length segment, only Creek Chubs were captured but in lesser amounts (1-3 per trap). Only Blacknose Dace were captured at Downstream LMC-06 (near the confluence of Mill Creek). Also, a single Common Sucker as well as one Creek Chub were captured at a Downstream site near where the Game Lands 74 boundary crosses Little Mill. This study confirms the presence of the Blacknose Dace and Creek Chub recolonization by 2007 in Little Mill Creek, earlier than found in Turner’s surveys. The occurrence of the Blacknose Dace only at LMC-06 suggests that it had moved from Mill into Little Mill. The Blacknose Dace that Turner reported at the Mid-length site in 2015 undoubtedly came from the Headwaters population.

As noted previously over the past 25 years of MCC’s restoration activities, numerous electrofishing events occurred by the PFBC and the fisheries classes at Clarion University. Thirteen species of fish are documented in the watershed (Appendix III, Table 3). Blacknose Dace and Creek Chubs are the most common and numerous species. Brook Trout are found throughout the study area at the time of this report albeit in much smaller numbers. Mottled Sculpin are less common and found in the riffles of the tributaries and higher quality waters. In Little Mill, the species has not been found downstream of Rt. 949, in part probably because of a lot of “flat” beaver inhabiting water and no riffles for a several mile length.

White Suckers, Redside Dace and Johnny Darters are generally not in large numbers but are found throughout the studied portion of Mill Creek. A few White Suckers are scattered throughout Little Mill. Johnny Darters and Redside Dace are presently absent from Little Mill. The last five species in Table 3: Brown Trout, Pumpkinseed, Bluegill, Green Sunfish and Brown Bullhead represent incidental captures of only one to several individuals captured over the past 25 years. The Common Shiner was last documented in

1978 in Mill Creek near the Old State Road bridge/McCanna Run, but was rediscovered in 1994 by Turner at the LMC-01 site on Little Mill.

Below the LMC-04 site approximately one-quarter mile are two significant AMD sites: an unnamed stream referred to as the Asbury Rd. tributary and the Markle/Kotchey site. Because of their impact on Little Mill (high iron), it is doubtful that upper stream fish have passed through this stretch to colonize the Downstream length. More likely, the few Blacknose Dace, Creek Chubs, White Suckers and Brook Trout in this affected stream section have moved upstream from Mill Creek, inhabiting the lower portion where the iron sediments are less.

A Review of the Coalition's Stream Restoration Strategy

It was early in the Coalition's formation before it acquired an actual "hands on" understanding of the AMD challenges in the 60 mi^2 Mill Creek watershed.

It was readily evident that Mill Creek itself had fewer AMD problems than Little Mill, and that they were scattered throughout its 20 mile length from the headwaters to near its drainage into the Clarion River. A number were the responsibility of several coal companies to address. Most of those problems were resolved in the early years of the Coalition by DEP approving the establishment of a trust with the primary company to provide long-term treatment of AMD in the Headwaters and Mid-length portion of the stream. Through primarily DEP financial support, and assistance from the National Guard, the Mid-length Howe Bridge site and several other smaller AMD problems just east of Hugh Run/Rt. 949 (Figure 1) were addressed by the MCC. Further downstream, DEP addressed one significant AMD site on Whites Run.

Because Mill was not heavily mined, most of the tributaries were not adversely affected by AMD. Also, in general the AMD treatment at the mining locations at this time was rather good, minimizing the AMD entering the stream. Therefore, the macroinvertebrate and fisheries data noted in this report show that Mill Creek, other than its last half-dozen miles, is in a good to excellent condition. As noted earlier in this report, the AMD treatment system at the Howe Bridge site was very effective in addressing this significant AMD source, and as a result received a lot of attention when the PFBC soon designated the Howe Bridge as a new trout stocking location on the stream, therefore doubling the number of stocked trout in this Mid-length section of Mill Creek. This 4-5 mile stretch is open to fishing since it is located entirely on Game Lands 74. Strategically, as the MCC's first project, the Howe Bridge site was a spectacular success and resulted in the MCC receiving a lot of credibility from the local community, environmental agencies and NGOs.

Strategy-wise, the fact that about two-thirds of Mill Creek is in Game Lands 74 and available for public use played a role in the decision to address Mill Creek first, along with the fact it was less impacted by AMD than Little Mill, and the fact that DEP and the coal companies were resolving the AMD issues made Mill Creek a priority to address.

For Little Mill with so many AMD sites, large and small, with varied metal concentrations and with some on affected tributaries, a definite but flexible treatment strategy was necessary. It was determined that the Headwaters was inhabited by fish in two slightly separated and isolated streams with little or no movement back and forth between the two. The strategy on Little Mill was to start at the Headwaters, that part east of Rt. 949 (Figure 1). While a few AMD sites on Mill Creek were still being addressed through 1995, the MCC completed its first passive treatment system on Little Mill in 1992. That was the first of about 18 AMD sites and a plugged well that dominated the MCC efforts for the next 15 years. Finally, by 2007, minnows were found recolonizing the Mid-length segment of the stream west of the Rt. 949 bridge while upgrading some of the older treatment systems continued.

While maintaining its primary focus on the Headwaters of Little Mill, an important component of MCC's strategy is to routinely acquire water chemistry at a number of AMD sites throughout the watershed. First, this allows the coalition to stay up to date on the performance of the passive treatment systems. Secondly, it also is invaluable for establishing passive treatment priorities based on location, AMD severity, costs and funding options. These criteria allow some flexibility from a strict headwaters strategy. Three significant AMD sites in the Mid-length segment benefitted from this flexibility which allowed them to be addressed while the primary focus remained in the Headwaters of Little Mill.

The upper one (Orcutt/Smail, also known as the REM site), located on a tributary about one-half mile west of Rt. 949, consists of two nearby AMD locations with high metal concentrations. It was first addressed in 2003 due to funding from the NRCS PL83-566 program and DEP's Landowner Reclamation Funds, and provided sufficient improvement to Little Mill's water quality to allow macroinvertebrate and fish colonization, including Brook Trout, for another three miles downstream to the Markle/Kotchey and Asbury Rd. sites. The Orcutt/Smail (REM) site was vastly improved by DEP in 2014 by the construction of an active lime slurry treatment plant, resulting in a very positive response downstream throughout the remaining Mid-length segment, particularly by the Creek Chubs and Blacknose Dace in the 2015 electrofishing survey (Appendix III, Table 1). Total costs for Orcutt/Smail (REM) surpasses $1.5 million.

About two miles downstream from the Orcutt/Smail (REM) site is the Mid-length Kyle Run (Figure 1), an AMD affected tributary. Several AMD sources located along its length were occasionally sampled over the years. It was even discovered that there was a modest Brook Trout/Creek Chub population in its headwaters. In 2009, a sudden opportunity arose to apply for funding through the NRCS PL83-566 program which had received monies from the American Recovery and Reinvestment Act of 2009. The MCC was able to continue working on its Headwaters projects while readily identifying two significant AMD sites on Kyle Run along with gathering updated water chemistry data, followed by treatment design and construction. At a cost of about $750,000, both passive treatment systems known as the Glenn sites, were completed and operating in 2011. The treatment systems substantially improved the water quality in the tributary which also had a positive effect on Little Mill.

The third critical site for continued recolonization into the Downstream segment is actually two adjacent sites, the Markle/Kotchey AMD site and the Asbury Rd. tributary, both located about one mile downstream fro Kyle Run. DEP agreed to address both sites near the end of MCC's first decade and completed both in 2002. The Asbury Rd. tributary received attention because of a high wall on a strip mine site south of I-80 (Figure 1). DEP was able to eliminate the highwall, add lime to the overburden, establish divergent ditches to remove surface water and then lime, fertilize, mulch, and seed the surface, thus reducing some of the tributary's volume and improving the water quality slightly. The primary AMD source, known as the Shofestall/Zerbe site, is in the headwaters of the tributary which accepts other AMD affected seeps along its length to Little Mill. One of the larger AMD sources, the Brown/Hanlon site, was also constructed by DEP. At the mouth of the tributary, the acidic flow is low in metals with highly variable flows of several gpm to several hundred gpm (Table 4). Table 4 shows the water chemistry and loading from one recent sampling period for the Asbury Rd. tributary and the Markle/Kotchey sites.

Table 4. General water chemistry and loading parameters for the outflow of the Markle/Kotchey treatment site and Asbury Rd. tributary. In addition, the effects on Little Mill and Mill Creek are noted. The water samples were taken on September 17-18, 2015, by Hedin Environmental.

Sample ID	gpm	Lab pH	Acid mg/L	Fe mg/L	Al mg/L	Mn mg/L	SO4 mg/L	Acid #/day	Fe #/day	Al #/day	Mn #/day
Asbury Rd. Trib	344	3.99	17	1.1	1.8	3.60	169	70.6	4.5	7.5	14.9
Markle/Kotchey Out	370	5.76	57	80.6	0.1	21.09	916	252.7	357.7	0.4	93.8
Little Mill Upstream	3714	6.99	0	0.5	0.1	2.31	190	-17.8	24.1	4.5	103.1
Little Mill Bridge	3978	6.35	3	6.8	0.2	3.81	234	133.2	325.1	9.1	182.1
Little Mill Mouth	6330	6.02	10	6.1	0.5	3.12	190	725.4	464.9	35.7	237.3
Mill Upstream	12800	6.47	4	0.4	0.3	0.55	35	549.9	63.0	41.5	84.6
Mill Downstream	19130	6.20	5	4.0	0.5	2.11	140	1097.3	920.5	107.9	485.0

Literally a few meters from where the Asbury Rd. tributary enters Little Mill is the Markle/Kotchey site. The water emanates from the toe of a hill, a suspected bore hole and fractured bedrock. It is high volume (several hundred gps), steady in its flow, moderate in pH and high in iron (Table 4). A large ALD (anoxic limestone drain) and a baffled settling pond partially treat the water. Figures 5 and 6 show the difference in appearance in Little Mill above and below the Markle/Kotchey and Asbury Rd. sites. The pH of Little Mill above the two sites is near a pH 7.0, drops to just below 6.5 due to the two AMD outflows, followed by a gradual drop in pH to 6.0 as it flows into Mill Creek. Mill Creek is about pH 6.5 above Little Mill, but falls to 6.2 under Little Mill's influence. Little Mill is about .5-1.0 mg/l of iron above Markle/Kotchey, but rises about 10 times to 7-10 mg/l after the 60-80 mg/l effect of Markle/Kotchey, dropping slightly during Little Mill's flow to Mill Creek. As observed in Figure 6, there is considerable iron deposition and staining in this Downstream segment of the stream.

Figure 5. Little Mill above the Markle/Kotchey treatment system. Iron levels are about 0.5-1.0 mg/l. Photo compliments of Hedin Environmental.

Figure 6. Little Mill below the treatment system discharge (looking downstream from the bridge). The 60-80 mg/l of iron from the Markle/Kotchey site is diluted by Little Mill to 7-10 mg/l of iron. Photo compliments of Hedin Environmental.

While there are about 18 AMD sites on Little Mill below the Asbury Rd. and Markle/Kotchey sites, they are generally small flows ranging from 1-35 gpm and vary widely in pH and metals. One tripartite stream (Figure 4) is unaffected by AMD and is used by Brook Trout for reproduction. The Markle/Kotchey site accounts for about 85 percent of the iron loading into Little Mill. The effects of a slightly lower pH and a higher iron concentration results in a diminished macroinvertebrate community in this Downstream portion of Little Mill (LMC-06) and Mill (compare MC-08A to MC-08B, Tables 2, 3). While a substantial upgrade of the Markle/Kotchey and Asbury Rd. sites will not be 100 percent successful because of flow rates and spatial constraints, nevertheless there is the potential to greatly decrease the untreated/partially untreated AMD entering Little Mill.

Presently, with about $1.1 million already invested in the past, both sites are receiving additional attention as to how/when to proceed with their upgrading which will lead to a considerable improvement in the last 2.5 miles of Little Mill's journey to Mill Creek. The upgrading of the Markle/Kotchey and Asbury Rd. AMD sites is also important for continued improvement of Mill Creek.

At the Crossroads

With the current data on the macroinvertebrate and fish communities, it is obvious that the treatment strategies employed on Mill and Little Mill are effective. These successes led to another crossroads in decision-making as to how to maintain and update each treated AMD site over the long term. To ensure that the present successes continue, the Mill Creek Coalition established in 2006 an OM&R (Operation, Maintenance & Replacement) plan for its passive treatment systems to maintain/improve the water quality of the receiving stream. In the area of the watershed covered in this study, Little Mill Creek has the most treated AMD sites. Presently, the older treatment sites (10–15 years) have been receiving attention in the Headwaters (east of Rt. 949) segment. Several systems were upgraded in the 2010–2012 period, but obviously there is a lag time before the macroinvertebrate community can respond and likely had little effect on the 2012 macroinvertebrate study. In addition, three older systems not on the Filson property were upgraded in the 2014-2015 summers. Two new systems (Glenn sites) on Kyle Run (Figure 1), a tributary of Little Mill, became operational one year before the 2012 study was completed. An entirely different operational system (lime slurry plant) replaced the previous passive treatment system at the Orcutt/Smail (REM) site in late 2014. This site is located on a tributary that enters Little Mill about one-half mile downstream of the intersection of Rt. 949 with Little Mill. All of these project sites are upstream of LMC-04 and are presently making an incredible improvement at the present time in the water quality for sites downstream, including the Mill Creek mainstem. Two small AMD systems on Mill and one on Little Mill are candidates for upgrading in the near future. In addition, it is anticipated that the Howe Bridge site will be upgraded in the 2016 summer.

Two very important treatment sites on Little Mill Creek with continued AMD challenges are the aforementioned Markle/Kotchey site (Figures 5, 6) along with the adjacent AMD affected Asbury Rd. tributary. Both were recognized by DEP about 15 years ago as significant sources of AMD, and a substantial initial effort was made to reduce their effects. As noted in the text, the water chemistry and its loading effects on Little Mill are well substantiated. Both DEP, environmental consultants and the MCC have suggested a number of options to improve their efficiency. The delay in doing anything since then was to wait until now when considerable water quality, macroinvertebrate and fish community improvements were demonstrated for Little Mill.

While the OM&R plan maintains our current standard of excellence in our present systems, it also aids in setting priorities for the road ahead. As a result, it is time to move ahead with the upgrading of the Markle/Kotchey site and the Asbury Rd. tributary. They should receive immediate attention because of their proximity to each other and the dual impact they have on the last 2.5 miles of Little Mill and remaining six miles of Mill Creek. Approximately $1.1 million have been invested in these two AMD areas due to their initial construction costs.

Approximately one-half mile downstream from the confluence of Little Mill with Mill Creek is the seriously AMD affected Douglass/Jones tributary (Table 1). With about one-half the flow of Little Mill, it discharges about the same iron loading as the Markle/Kotchey and Asbury Rd. sites, 2-3 times the acidity, about the same amount of aluminum, and 1.5 times the amount of manganese (Table 4). As expected, it has about the same effect on Mill Creek as the Markle/Kotchey and Asbury Rd. sites have on Little Mill, resulting in this last six miles of Mill Creek having a pH above Douglass/Jones in the low 6s, then dropping to the low 5s below, along with a significant precipitation of metals onto Mill's steam bottom. As previously noted, the macroinvertebrate and fish communities are seriously imperiled on this Downstream segment of Mill Creek.

The crossroads decision to pursue AMD problems on Douglass/Jones while still addressing Little Mill sites was initiated in 2010 and later by updating and identifying the different AMD sources and their chemistry and loading characteristics. Based upon those results, it was found that the Douglass Run tributary to Jones was the least affected by AMD. Based on that knowledge, the MCC identified a headwaters site just south of Rt. 322 (Figure 1) in which several AMD sources were identified in close proximity to each other. Several years ago, a passive treatment construction plan was developed and is presently awaiting a funding opportunity. If the treatment system is successful, it is believed that Douglass Run could once again be restored to a viable stream as well as having a slightly positive effect on Mill Creek.

Jones, on the other hand, is more complicated, with a number of AMD sites some of which would be difficult to treat due to chemistry, flow and topographical features. As a result, it could be 5-10 years before the crossroads on how to address Jones is reached and a treatment strategy is developed for the whole Jones tributary.

SUMMARY

Over the past 25 years of the MCC's existence, with the aid of state and federal agencies, non-government organizations and other supporters, a significant improvement has been made on the water quality found in the upper two-thirds (approximately 15 miles) of Mill Creek. The macroinvertebrate population currently found in this primarily mid-length reach of Mill Creek is sufficient to sustain a coldwater fishery. Strategically, instead of first treating upper-stream AMD problems, the MCC focused instead on a lower Mid-length significant AMD site, the Howe Bridge site. In response to the MCC's success, the PFBC, in addition to its long-term stocking on Mill Creek at Old State Road Bridge/McCanna Run, added the Howe Bridge site (MC-07) in 1995, with both being in State Game Lands 74 and open to public access. As a result, this 3.5 mile length between these two sites and extending another 1.8 miles to the degraded Douglass/Jones tributary, is a popular fishing area that has been helped dramatically by the first AMD treatment remediation implemented by MCC and its partners.

Although the MCC and its partners have been effective at restoring most of the AMD sites on Mill Creek, there are still some locations that need additional improvement.
The Schnepp Road area, a stretch of largely treated and some untreated AMD, ranges from the southernmost intersection of Rt. 949 with Mill Creek and continues upstream for approximately one mile (Figure 4). This area is primarily responsible for residual iron and manganese levels, resulting in some iron coating/staining on the substrate, which in turn depresses the macroinvertebrate and fishery community. This feature remains somewhat evident at MC-07 and MC-07B (Howe Bridge), but essentially disappears over the 3.5 miles to the Old State Road Bridge/McCanna Run location and beyond to MC-08A (at the confluence with Little Mill), where sampling demonstrates a substantial rebounding of the macroinvertebrate community and fishery. The joining of Little Mill Creek (LMC-06) with its elevated metals depresses these Mill Creek communities somewhat, which are then impacted with the serious AMD effects of Douglass/Jones 0.5 miles downstream. This tributary is responsible for the lack of sustainable macroinvertebrate and fish communities for the remaining one-third (approximately 6 miles) of Mill Creek to its confluence with the Clarion River.

As noted earlier, the PFBC and its extensive electrofishing of the Mill Creek watershed in 2011 and 2013 was the first to document that native Brook Trout can be found throughout most of the 9 mile length of Little Mill Creek, as well as its tributaries. The Brook Trout is often used as an indicator species and its presence in Little Mill Creek along with the results of the 2012 macroinvertebrate study, is a cause for renewed vigilance and perseverance in the continued attempts of MCC to mitigate the impacts of AMD in the remaining affected areas of the Mill Creek watershed. For years, the last six-mile segment of Mill Creek to the Clarion River has had a pH of 3-4 and iron concentrations of 2-7 mg/l due to the flow of Little Mill and Douglass/Jones. With the improvement of Little Mill’s water quality in recent years, it is common to find this last segment nearer a pH circum 5 at low flows and in the pH 6s at higher flows. Recently there have been several sightings of minnows during this low flow period in Mill Creek, suggesting that additional improvements at the Markle/Kotchey and Asbury Rd. AMD sites on Little Mill may soon make the last six miles of Mill Creek once again habitable for fish. Stocked Brook Trout also occur when Mill Creek has high flows and a more favorable pH.

RECOMMENDATIONS

Based on the macroinvertebrate survey work from Little Mill Creek and Mill Creek, the Western Pennsylvania Conservancy makes the following recommendations for the Mill Creek Coalition:

- Continue to implement AMD projects in the Mill Creek watershed. The MCC is making a measureable difference in the water quality, as well as in the recovery of the macroinvertebrate and fishery communities. Also, the continued recovery of this watershed is particularly important and locally appreciated in this heavily AMD impacted area of the Commonwealth. Clarion County is #1 (Jefferson Co. #10) in respect to the number of AMD affected stream miles compared to the square miles in each county. Also, Clarion County is #4 (Jefferson Co. #7) in the amount of strip-mined acres compared to the total acres of each county.

- Petition the Department of Environmental Protection (DEP) to complete a re-assessment of certain sections of Mill Creek and Little Mill Creek to take them off the Impaired Waters list.
- Continue to partner with the Pennsylvania Fish and Boat Commission to identify potential headwater streams in the watershed that could be periodically surveyed for native Brook Trout and other trout (and other fish species) as part of the Unassessed Waters Program.
- Explore options for continuous data logger installation(s) to monitor potential Marcellus/Utica shale gas drilling activity in the area, if the Mill Creek Coalition sees it as a concern.

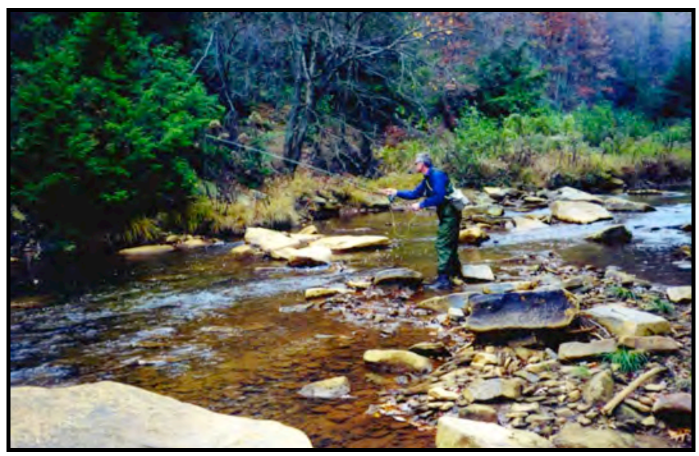
ACKNOWLEDGEMENTS

The macroinvertebrate study conducted in 2012 would not have been possible without the generous support of the Colcom Foundation to the WPC. Alysha Trexler (WPC) and Stephanie Jellison (WPC) were helpful in completing the identification of the macroinvertebrate samples collected. The 2011 and 2013 electrofishing on the watershed as well as in the earlier years was conducted by PFBC Al Woomer and Brian Ensign from the Fisheries Management Area 2 Office (Tionesta) with MCC assistance. Clarion University faculty member Andy Turner and his fisheries students have regularly sampled sites on the watershed from 1992-2015. Peter Dalby (MCC) and Terry Morrow (MCC) were of great assistance with determining where to sample Mill Creek and Little Mill Creek. Officers of the MCC also assisted with their editing expertise on drafts of this report. The MCC acknowledges the impeccable assistance of Jen and David Moore for their typing services in earlier drafts. Tye Desiderio (WPC) completed the mapping component of this project which allows for good visualization of the macroinvertebrate data. Kylie Maland (WPC) completed all of the necessary editing to make the macroinvertebrate component of this report shine; her assistance is most appreciated. Appreciation is also extended to Barb Dalby for her typing assistance and patience as this report expanded to more than a significant macroinvertebrate study. Thanks is especially extended to Clarion University’s Printing and Graphics Express Services (PAGES) for final formatting and printing. Printing costs were provided through the proceeds of the first two Rubber Ducky races (2014, 2015) on Mill Creek, thanks to the local individuals and businesses, supporters of the MCC.

PHOTOS

The Ducky Race on Mill Creek, started in 2014, provides an opportunity for local citizens to become engaged in the rebirth of the stream.

Clarion County fisherman John Street tests the waters for brookies on Mill Creek in the vicinity of McCanna Run and Old State Road Bridge in the early 1990s. The pH in this stream section is in the 6s with iron about 0.5 mg/l.



A local family enjoys a respite from the afternoon heat of a hot September 2015 day by relaxing on the shoreline and cool waters of Mill Creek in the vicinity of McCanna Run and Old State Road Bridge.

APPENDIX I

<u>Appendix I.</u> Lab identifications of the total individuals collected in the Surber samples, identified to order, family, and genus levels for each sample site.

LMC-01AE:
Total Count = 227
Quadrants Used: Not determined

N	Order- Family Genus
2	Ephemeroptera- Heptageniidae- Stenacron
1	Ephemeroptera-Ephemerellidae- Serratella
1	Ephemeroptera-Ephemerellidae- Attenella
5	Plecoptera- Perlidae- Acroneuria
1	Plecoptera- Perlodidae- Hydroperla
12	Plecoptera- Leuctridae-Leuctra
2	Plecoptera- Nemouridae- Paranemoura
62	Plecoptera- Taeniopterygidae- Taeniopteryx
1	Plecoptera- Chloroperlidae- Sweltsa
1	Plecoptera- Chloroperlidae- Utaperla
20	Trichoptera- Hydropsychidae- Diplectrona
5	Trichoptera- Hydropsychidae- Hydropsyche
62	Trichoptera- Hydropsychidae- Cheumatopsyche
1	Trichoptera- Hydropsychidae- Macrostemum
10	Trichoptera- Philoptamidae- Dolophilodes
1	Odonata- Gomphidae-Gomphus
15	Coleoptera- Elmidae -Stenelmis
1	Diptera- Tipulidae- Prioncera
3	Diptera- Tipulidae- Tipula
1	Diptera- Tipulidae- Hexatoma
2	Diptera- Tipulidae- Antocha
4	Diptera- Chironomidae
1	Diptera- Tabanidae- Chrysops
2	Megaloptera- Corydalidae- Nigronia
8	Megaloptera- Corydalidae- Neohermes
3	Decapoda- Cambaridae-Orconectes

<u>Appendix I, cont.</u> Lab identifications of the total individuals collected in the Surber samples, identified to order, family, and genus levels for each sample site.

LMC-04:
Total Count: 37
Quadrants Used: Whole Sample

N	Order- Family-Genus
1	Ephemeroptera- Heptageniidae- Macdunnoa
1	Plecoptera- Perlodidae-Hydroperla
5	Plecoptera- Taeniopterygidae- Taeniopteryx
7	Trichoptera- Hydropsychidae-Hydropsyche
1	Trichoptera- Hydropsychidae- Cheumatopsyche
7	Trichoptera- Hydropsychidae- Diplectrona
1	Trichoptera- Limnephilidae-Madeophylax
2	Coleoptera- Elmidae (riffle beetles)
1	Diptera- Tipulidae-Prionocera
1	Diptera - Certopogonidae
7	Diptera- Chironomidae
1	Megaloptera- Corydalidae - Nigronia
1	Megaloptera- Sialidae- Sialis
1	Collembola - Isotomidae - Agrenia

LMC-06
Total Count: 23
Quadrants Sampled: Whole Sample

N	Order-Family-Genus
5	Ephemeroptera- Heptageniidae-Macdunnoa
2	Ephemeroptera- Ephemerellidae- Ephemerella
1	Ephemeroptera- Ephemerellidae- Drunella
3	Trichoptera- Hydropsychidae- Hydropsyche
6	Trichoptera- Hydropsychidae- Diplectrona
1	Trichoptera- Hydropsychidae-Homoplectra
1	Trichoptera- Limnephilidae- Madeophylax
1	Diptera- Simuliidae-Prosimulium
3	Megaloptera- Sialidae - Sialis

<u>Appendix I, cont.</u> Lab identifications of the total individuals collected in the Surber samples, identified to order, family, and genus levels for each sample site.

MC-01
Total Count: 177
Quadrants Sampled: Whole Sample

N	Order-Family- Genus
6	Ephemeroptera- Ephemerellidae- Attenella
2	Ephemeroptera- Leptophelbiidae- Leptophelbia
4	Plecoptera- Perlidae-Acroneuria
11	Plecoptera -Capniidae-Allocapnia
43	Plecoptera - Nemouridae-Nemoura
1	Trichoptera -Hydropsychidae- Hydropsyche
2	Trichoptera -Hydropsychidae-Diplectrona
8	Trichoptera- Polycentropodidae-Neuroclipsis
2	Trichoptera- Limnephelidae-Pycnopsyche
1	Trichoptera- Rhyacophilidae-Rhycophila
2	Odonata -Gomphidae-Gomphus
34	Coleoptera -Elmidae - Stenelmis
1	Coleoptera- Psephenidae-Ectopria
4	Diptera- Tipulidae-Limnophilia
4	Diptera- Tipulidae-Tipula
10	Diptera- Tipulidae-Prinocera
33	Diptera -Chironomidae
2	Diptera -Simuliidae-Simulium
1	Diptera -Simuliidae-Prosimulium
1	Diptera-Empipidae- Hemerodromia
2	Decapoda -Cambaridae-Orconectes
3	Oligochaeta (annelid worms)

Appendix I, cont. Lab identifications of the total individuals collected in the Surber samples, identified to order, family, and genus levels for each sample site.

MC-03
Total Count: 233
Quadrants Sampled: Not determined

N	Order- Family- Genus
6	Ephemeroptera – Ephemerellidae - Attenella
4	Plecoptera - Perlidae - Acroneuria
5	Plecoptera - Capniidae - Allocapnia
44	Plecoptera - Nemouridae - Nemoura
57	Trichoptera - Hydropsychidae - Hyrdropsyche
8	Trichoptera - Philoptamidae - Dolophilodes
2	Trichoptera - Polycentropodidae - Polycentropus
1	Trichoptera - Polycentropodidae - Neureclipsis
1	Odonata - Gomphidae - Gomphus
13	Coleoptera - Elmidae - Stenelmis
4	Diptera - Tipulidae - Tipula
7	Diptera - Tipulidae - Prioncera
5	Diptera - Tipulidae - Hexatoma
2	Diptera - Tipulidae - Antocha
63	Diptera - Chironomidae
4	Diptera - Simuliidae - Simulium
2	Diptera - Empididae - Hemerodromis
2	Decapoda - Cambaridae - Orconectes
2	Hirudinea (leeches)

Appendix I, cont. Lab identifications of the total individuals collected in the Surber samples, identified to order, family, and genus levels for each sample site.

MC-07
Total Count: 67
Quadrants Used: Whole Sample

N	Order- Family- Genus
2	Plecoptera - Perlidae - Acroneuria
6	Plecoptera - Capniidae - Allocapnia
12	Plecoptera - Nemouridae - Nemoura
34	Trichoptera - Hydropsychidae - Hydropsyche
1	Odonata - Gomphidae - Gomphus
2	Diptera - Tipulidae - Tipula
1	Diptera - Empididae - Hemerodromia
9	Diptera - Chironomidae

MC-07B
Total Count: 83
Quadrants Used: Whole Sample Identified

N	Order- Family- Genus
4	Plecoptera - Leuctridae - Leuctra
6	Plecoptera - Taeniopterygidae - Taeniopteryx
35	Trichoptera - Hydropsychidae - Hydropsyche
1	Trichoptera - Hydropsychidae - Macrostemum
3	Trichoptera - Hydropsychidae - Cheumatopsyche
15	Trichoptera - Hydropsychidae - Diplectrona
1	Trichoptera - Limnephilidae - Madeophylax
1	Coleoptera - Elmidae - Stenelmis
1	Megaloptera - Corydalidae - Corydalus
1	Diptera - Tipulidae - Tipula
15	Diptera - Chironomidae

Appendix I, cont. Lab identifications of the total individuals collected in the Surber samples, identified to order, family, and genus levels for each sample site.

MC-08A
Total Count: 211
Quadrants Used: Not-determined

N	Order- Family- Genus
14	Ephemeroptera - Heptageniidae - Maccaffertium
1	Ephemeroptera - Heptageniidae - Stenecron
3	Ephemeroptera - Heptageniidae - Heptagenia
30	Ephemeroptera - Heptageniidae - Stenonema
2	Ephemeroptera - Heptageniidae - Epeorus
1	Ephemeroptera - Neoephemeridae - Neoephemera
6	Ephemeroptera - Ephemerellidae - Attenella
2	Ephemeroptera - Baetiscidae - Baetisca
1	Ephemeroptera - Baetidae - Baetis
1	Ephemeroptera - Caenidae - Caenis
4	Ephemeroptera - Oligoneuriidae - Isonychia
2	Plecoptera - Perlidae - Acroneuria
1	Plecoptera - Leuctridae - Leuctra
1	Plecoptera - Capniidae - Allocapnia
2	Plecoptera - Taeniopterygidae
10	Trichoptera - Hydropsychidae - Hydropsyche
1	Trichoptera - Hydropsychidae - Macrostemum
36	Trichoptera - Hydropsychidae - Cheumatopsyche
14	Trichoptera - Hydropsychidae - Diplectrona
13	Trichoptera - Philoptamidae - Dolophilodes
4	Odonata - Gomphidae - Gomphus
5	Coleoptera - Elmidae - Stenelmis
6	Diptera - Empididae - Hemerodromia
41	Diptera - Chironomidae
2	Diptera - Ceratopogonidae
2	Diptera - Simuliidae - Prosimulium
2	Megaloptera - Corydalidae - Corydalus
3	Megaloptera - Sialidae - Sialis
1	Hirudinea (leeches)

<u>Appendix I, cont.</u> Lab identifications of the total individuals collected in the Surber samples, identified to order, family, and genus levels for each sample site.

MC-08B
Total Count: 29
Quadrants Used: Whole Sample Identified

N	Order - Family - Genus
1	Ephemeroptera- Heptageniidae- Mecaffertium
2	Trichoptera -Hydropsychidae- Hydropsyche
5	Trichoptera- Hydropsychidae- Cheumatopsyche
1	Trichoptera-Hydropsychidae- Diplectrona
2	Trichoptera- Philopotamidae- Dolophilodes
1	Coleoptera- Elmidae-Stenelmis
1	Diptera- Empididae- Hemerodromia
8	Diptera- Chironomidae
7	Megaloptera- Sialidae- Sialis
1	Oligochaeta (annelid worms)

APPENDIX II

Appendix II. Macroinvertebrate data from the Myers 1997-2006 study.

Table 1. Generic richness and number of individuals found for sampling sites LMC-01AE, LMC-04, and LMC-06.

Site	Year	General Richness	# of Individuals
LMC-01AE	1997	15	87
	1999	22	208
	2000	43	454
	2001	46	587
	2004	57	1139
	2005	37	205
LMC-04	1997	2	21
	1999	8	109
	2004	14	62
	2005	12	37
	2006	7	19
LMC-06	1999	5	13
	2004	5	8
	2006	7	28

<u>Appendix II, cont.</u> Macroinvertebrate data from the Myers1997-2006 study.

Table 2. Community composition properties including EPT sensitivity index values for Little Mill Creek sampling sites LMC-01AE, LMC-04 and LMC-06 from 1997-2006.

Site	Year	% Ephemeroptera	% Plecoptera	% Trichoptera	% EPT	% Chironomidae	% Diptera
LMC-01AE	1997	2.30	3.45	11.49	17.24	0.00	3.45
	1999	2.01	14.16	11.24	27.41	53.31	62.95
	2000	9.47	27.97	19.38	56.83	22.47	37.89
	2001	3.92	17.89	5.79	27.6	60.99	63.54
	2004	20.02	25.99	28.62	74.63	15.19	18.35
	2005	12.68	12.20	33.17	58.05	24.88	29.27
	2006	13.56	7.63	15.25	36.44	54.24	55.93
LMC-04	1997	0.00	0.00	0.00	0.00	0.00	0.00
	1999	0.00	0.00	5.61	5.60	78.21	78.21
	2002	0.00	0.00	6.45	6.45	54.84	54.84
	2004	0.00	1.61	58.06	59.67	29.03	30.65
	2005	0.00	0.00	13.52	13.51	48.65	51.35
	2006	0.00	0.00	0.00	0.00	89.47	89.47
LMC-06	1999	0.00	0.00	7.89	7.89	59.40	59.40
	2004	0.00	0.00	5.00	5.00	25.00	25.00
	2006	0.00	0.00	3.57	3.57	53.57	53.57

Appendix III

<u>Appendix III.</u> Electrofishing Survey

Table 1. Mill Creek electrofishing data collected primarily by Clarion University fall fisheries classes from 1992-2015; number per 100 meters of stream, single pass sampling. Dashes indicate non-sampling events. * See note below.

Taxa	**Station**	**1992**	**1993**	**1994**	**1997**	**1998**	**1999**	**2000**	**2004**	**2008**	**2015**
Brook Trout	MC-01	6	21	6	10	8	11	9	4	------	------
	MC-03	28	37	29	28	18	12	15	------	5	------
	MC-07	0	0	1	0	1	2	7	------	0	------
	MC-07B	1	7	1	11	7	1	------	------	------	------
	MC-08A	3	1	4	2	8	0	1	2	0	2
Blacknose Dace	MC-01	19	41	18	14	21	36	46	21	------	------
	MC-03	24	71	76	67	54	56	116	------	35	------
	MC-07	8	7	16	16	142	50	110	------	23	------
	MC-07B	4	36	24	22	54	59	------	------	------	------
	MC-08A	28	166	38	64	83	85	159	31	79	87
Creek Chub	MC-01	2	19	15	18	6	5	58	11	------	------
	MC-03	12	40	47	42	17	19	76	------	14	------
	MC-07	3	3	11	21	33	17	7	------	16	------
	MC-07B	1	8	23	24	12	14	------	------	------	------
	MC-08A	49	63	19	59	53	7	4	3	19	11
White Sucker	MC-01	2	2	6	4	10	5	24	14	------	------
	MC-03	1	7	18	20	11	8	35	------	5	------
	MC-07	1	0	2	3	1	1	0	------	1	------
	MC-07B	1	2	1	2	2	1	------	------	------	------
	MC-08A	2	11	0	1	5	0	0	1	4	4
Redside Dace	MC-01	0	0	0	4	1	0	6	1	------	------
	MC-03	0	0	0	19	8	5	33	------	9	------
	MC-07	0	0	0	1	0	3	0	------	9	------
	MC-07B	0	0	0	0	0	4	------	------	------	------
	MC-08A	0	0	0	0	0	1	0	0	38	2
Johnny Darter	MC-01	0	0	0	0	0	0	0	0	------	------
	MC-03	0	0	0	1	2	1	15	------	3	------
	MC-07	1	0	4	0	3	1	0	------	6	------
	MC-07B	1	2	2	0	4	1	------	------	------	------
	MC-08A	0	0	0	2	3	0	1	2	3	3
Mottled Sculpin	MC-01	1	12	22	8	22	45	47	11	------	------
	MC-03	0	5	28	31	18	20	36	------	7	------
	MC-07	0	1	0	0	2	1	1	------	1	------
	MC-07B	0	5	5	3	0	0	------	------	------	------
	MC-08A	0	2	7	2	2	4	12	2	7	26

<u>Other fish captured in these censuses:</u>

Pumpkinseed Sunfish: MC-03, 1997:4, 1999:1
Brown Trout: MC-03, 1992:1 (105mm TL)
Bluegill: MC-01, 1999:3 (187, 97,65 mm TL)

*Note:
MC-08, located at the Old State Road Bridge; McCanna Run Point was sampled instead of MC-08A because of its accessibility for a class event. However, the water chemistry is virtually the same as MC-08A.

<u>Appendix III, cont.</u> Electrofishing survey.

Table 2. Little Mill Creek electrofishing data collected primarily by Clarion University fall fisheries classes from 1992-2015; number per 100 meters of stream, single pass sampling. Dashes indicate non-sampling events.

Taxa	Station	1994 June	1994 Nov	1995 June	1997	1998	1999	2000	2004	2008	2010	2015
Blacknose Dace	LMC-01AE	100	92	89	60	81	140	64	73	47	----	----
	LMC-04	0	0	0	----	----	0	0	0	0	0	29
Creek Chub	LMC-01AE	1	16	4	23	57	40	32	89	37	----	----
	LMC-04	0	0	0	----	----	0	0	0	0	5	19
Mottled Sculpin	LMC-01AE	48	117	52	36	15	18	25	2	4	----	----
	LMC-04	0	0	0	----	----	0	0	0	0	0	0

<u>Other fish captured in these censuses:</u>

Common Shiner: LMC-01, June, 1994:3
White Sucker: LMC-06, 2015:4

Table 3. A list of fish from the Mill Creek watershed based on electrofishing from the PFBC and the fisheries classes at Clarion University.

1.	Blacknose Dace
2.	Creek Chub
3.	Brook Trout
4.	Mottled Sculpin
5.	White Sucker
6.	Johnny Darters
7.	Redside Dace
8.	Common Shiner
9.	Brown Trout
10.	Punpkinseed
11.	Bluegill
12.	Green Sunfish
13.	Brown Bullhead

Appendix IV

<u>Appendix IV.</u> The Five-Year Plan: 2016-2020

In a MCC September 2011 report entitled “A 20-Year (1990-2010) Review of the Accomplishments of the Mill Creek Coalition of Clarion and Jefferson Counties, with a Five-Year Plan for 2011-2015,” the MCC provided a list of priorities which would guide the group for the following five years. After a review of that plan, following are a number of important strategic priorities on which the Coalition will focus its efforts for the next five years, 2016-2020:

- The Coalition has been successful in the past five years in acquiring funding to improve and upgrade the older passive treatment systems on the watershed, notably those in the headwaters of Little Mill. It is estimated that 85 percent are in very good to excellent condition and the remainder will be addressed over the next five years or less. Funding is primarily dependent upon DEP’s 319 Program and OSM’s matching monies.

- DEP in 2008 accepted responsibility for the Orcutt/Smail (REM) Site. The MCC and DEP worked together to ensure that both short and long term treatment goals were met. A treatment design for a lime slurry treatment plant was approved in 2011, with construction finished in late 2014. There has been a remarkable improvement in water quality to the receiving tributary and Little Mill. Its performance will continue to be monitored. Since a component of the systems performance is monitored by computer at DEP’s Knox office, it also has the potential to be utilized for educational purposes in the classroom.

- Funding through the PL83-566 program provided for the construction of two passive treatment systems on the Corsica tributary, known as Kyle Run, which flows into the lower half of Little Mill Creek. Construction was completed in 2011. With their successful completion, only a few remaining AMD sites amenable to passive treatment remain on Little Mill Creek and are being pursued.

- At about the junction of the mid-length and downstream segments are two adjacent AMD flows into the stream, one from an unnamed tributary referred to here as the Asbury Rd. tributary, and the second known as the Markel/Kotchey site. Both sites were recognized some 15 years ago by DEP because of their high volumes, acidity and metals. DEP invested about $1.1 million in the sites while partially addressing these problems. The delay in doing anything since then was to wait until considerable water quality, macroinvertebrate and fish community improvements were demonstrated in this lower section of Little Mill. Recently demonstrated, it is time to work with DEP to develop a plan to simultaneously make a dramatic improvement to both AMD sites.

- The Douglass/Jones tributary will receive substantial attention during the next five years and beyond. It is the second largest tributary to the Mill Creek Watershed. It is about five miles in length, and includes approximately 11% of the watershed area (compared to 25% for Little Mill Creek). DEP completed a TMDL report on the watershed in 2009. Based on low flow conditions in the fall, Douglass/Jones contributes approximately 15% of the flow into Mill Creek, but is responsible for about 50% of the acidity, iron and manganese and 85% of the aluminum to Mill Creek. Numerous AMD discharges are on the Douglass/Jones tributary, some of which due to location, are difficult to treat via a passive treatment system. While the Douglass fork has AMD problems, they are slight compared to the much larger contribution provided by Jones Run. A Technical Assistance Grant (TAG) was awarded in 2009 and again in 2010 to Hedin Environmental to field visit the watershed, take water samples, examine past data on the watershed, then ultimately provide treatment recommendations. A final comprehensive report was provided in late 2011. A design and construction phase will follow, which will likely go beyond 2020. Final reports resulted in most of MCC's immediate attention to focus on the less impacted Douglass Run. An application for funding to address several contiguous AMD sources in the headwaters south of Rt. 322 was submitted to DEP but was not funded in 2014 due to technical issues. Since then, several other projects have been pursued resulting in a delay in resubmitting an application.

- Because of Mill Creek's general lack of alkalinity and the presence of acidity, discussions have ensued between the Coalition, BAMR and selected environmental consultants about the potential construction of other lime dosing/slurry plants on the Mill Creek watershed. For lime dosing, it is desirable to have reasonably fast current conditions, multiple riffles, a significant elevation drop and accessibility: several locations on Little Mill Creek and Douglass/Jones do exist. Lime slurry plants, because of faster oxidation reactions, can be associated with passive treatment systems or direct input to a stream. Initial cost, yearly operation costs and applicability of dosing/slurry systems within the watershed all need to be critically ascertained.

- The Coalition intends to continue its cooperative relationship with the PA Fish and Boat Commission, including the identification of other stocking possibilities as water quality continues to improve in the watershed, thus providing additional fishing opportunities for the public. Also, between the PFBC, Clarion University fisheries classes and MCC, recolonization progress will be documented.

- The MCC intends to continue participating with DEP and others in water sampling throughout the watershed. It will also continue to monitor on a periodic basis the macroinvertebrate and associated fish communities.

- The commitment of financial and personnel resources over the past 25 years by MCC and such a diverse group of NGOs, state, and federal agencies is truly impressive. To maintain this level of success and to guarantee a sustainable level of improvement and maintenance, the MCC will actively pursue having the Mill Creek Watershed become a Qualified Hydrological Unit within BAMR's Acid Mine Drainage Set-

Aside Program. In addition, it would be advantageous to complete DEP's 319 Watershed Implementation Plan.

- The MCC looks forward to maintaining its academic/research/educational relationship with Clarion University and the surrounding community. The MCC will encourage the PA Fish and Boat Commission to locate a site on the watershed for a "Trout in the Classroom" educational program and fish release activity.

- The MCC initiated a "Rubber Ducky Race" on Mill Creek in April 2015 and 2016 and is looking forward to this as an annual event. It raises some funds for the MCC and provides an outdoor educational opportunity to the local public.

- The Coalition will continue having its members contributing to the WPCAMR, state and federal AMD related meetings and conferences, and providing press releases to the newspapers servicing this area.

MILL CREEK COALITION OFFICERS

President Peter Dalby Date 14 Oct. 2015

Vice President Janice Horn Date Oct. 14, 2015

Secretary Terry O. Morrow Date Oct 14, 2015

Treasurer Jack Williams Date 10/14/15

HEADWATERS CHARITABLE TRUST

Executive Director Janie French Date Oct 14, 2015