Moshannon Creek Headwaters Coldwater Conservation Plan

Prepared by:
Clearfield County Conservation District

Conducted under a Coldwater Heritage Partnership (CHP) grant

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MCWC
Moshannon Creek Watershed Coalition

COLDWATER HERITAGE PARTNERSHIP

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SECTION 1.0 ACKNOWLEDGEMENTS

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The landowners, who were instrumental in allowing this project to be completed. Without their cooperation valuable data would have been unattainable.

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SECTION 2.0 INTRODUCTION

Moshannon Creek is a 269- square mile watershed that forms the boundary between Clearfield County and Centre County, Pennsylvania. The headwaters begin in Blair County and flow northeast until the stream enters the West Branch of the Susquehanna River near Karthaus. Unfortunately, Moshannon Creek is also known as the "Red Mo" due to the iron precipitate that coats the stream bottom for most of its length. Although mining has impacted the stream in this way, most people do not realize that the headwaters of Moshannon Creek above Roup Run have good water quality and populations of fish and macroinvertebrates. Mining does not seriously affect the Moshannon Creek watershed until Roup Run enters, which is over 5.5 miles downstream of the origin. There are many efforts occurring to restore Moshannon Creek. The portion of the watershed that this Coldwater Heritage Plan focuses on will need to be protected to aid with this restoration.

There are several concerns that need to be addressed in order to protect and enhance this watershed. First are the Abandoned Mine Drainage (AMD) problems that affect the watershed. Even though the headwaters are classified as high quality there have been some mining activities that have degraded the stream. Also, Pennsylvania Rural Water has installed wells in the watershed to be used by the Houtzdale Water Authority. The final concern is the possible effect of acid precipitation on the watershed.

2.1 Project Goals

- Identify current and potential pollution sources within the watershed
- Report baseline water quality and macroinvertebrate data
- Identify next steps for the Moshannon Creek Watershed Coalition (MCWC) to protect and restore the headwaters of Moshannon Creek

2.2 Description of Study

The main part of this study was designed to identify and present the potential pollution problems in the watershed. This was accomplished by completing a stream reconnaissance of the entire watershed. Two interns were hired to complete the study. They were trained on how to identify pollution sources in the watershed. Some of the concerns they were looking for were erosion from dirt roads or All Terrain Vehicle (ATV) trails; improper logging practices; agriculture issues; abandoned mine drainage and gas wells. Acid precipitation was also a possible concern; however, this was determined through water sample analysis instead of field reconnaissance.

Before walking the stream every property owner was sent a letter explaining the study (Appendix E). Landowners were asked to contact the Conservation District if they did not wish to grant access to their property. If no responses were received, the assumption was made that permission was granted.

After training, the interns walked the main stem and every tributary in the watershed looking for the potential pollution sources listed above. When a potential problem was encountered the coordinates were found by using a Global Positioning System (GPS) unit, a photograph was taken and a description was noted in a fieldbook. If a new source of water was encountered pH, conductivity and temperature readings were taken. The pH was taken with an Oakton Waterproof pH Testr 20 which takes the temperature in account when giving a reading. Conductivity was measured using an Oakton Waterproof ECTestr low (umhos). Temperature was taken using an Enviro-Safe Armor Case Pocket Thermometer (° C). The area was then walked to identify the source. This was especially important when trying to identify any possible abandoned mine drainage problems. A pH less than 4.5 and/or conductivity greater than 400 uS were cause for concern. Measurements in these ranges usually indicate possible AMD issues.

Water samples were taken twice during this project. At each sample point field pH, conductivity and temperature was measured. All chemical samples were collected as grab samples to limit the possibility of cross contamination. Water samples were collected using new polyethylene bottles provided by Mahaffey Laboratory. Bottles were rinsed with the sample water before the actual final sample was collected. The sample was collected at mid-stream and at mid-depth when safe to do so with the sampler facing upstream. The smaller bottle had 5 drops of nitric acid added to acidify the metals. The bottles were placed on ice until delivery to Mahaffey Laboratory. All water quality samples were tested at the laboratory for pH, conductivity, alkalinity, acidity, iron, aluminum, sulfates and manganese. The results can be found in Appendix A.

Data from other samples that were taken from previous studies were also used to identify possible problems in the watershed. The results from both were compared to water quality parameters listed in Table 1, Appendix A. Most of the parameters looked at are the ones that are the most affected by abandoned mine drainage (AMD) and/or acid deposition.

Macroinvertebrates were sampled using a kick net. Two kicks were used and the organisms were preserved in Kahle’s fluid and identified to Family level when possible. Each different family was considered different taxa. If the macroinvertebrate could only be identified to order (ie. watermites or crayfish), it was also counted as a separate taxa. The results can be found in Appendix B. Macroinvertebrates are the best indicator for identifying pollution in a watershed. They are the least mobile and are a great indicator of the degree of pollution based on presence and absence. The diversity was calculated using the Shannon Index.

$$\text{Diversity} = -\sum_{i=0}^{n} p_i \ln p_i$$

$$p_i = \frac{\text{individual of species}}{\text{total of individuals}}$$

A higher number indicates a diverse population due to the presence of many different taxa with an even distribution of organisms present in each one. Low diversity can occur when there is a dominance of one certain taxa or very few different taxa due to pollution. Another benthic metric used was total number of taxa. This measures the overall variety of the macroinvertebrates and will decrease with increasing pollution. The last metric used was the EPT taxa. This is the number of taxa in the orders Ephmeroptera (mayflies), Plecoptera (stoneflies) and Tricoptera (caddisflies). This number will also decrease with increasing pollution. The results were not compared to a reference stream, just to each other. The headwaters were considered the best condition with which to compare the rest of the samples in Moshannon Creek. It had the best habitat, water quality and riparian area in the watershed. Most disturbances occur downstream of this point.

Finally, Stream Habitat Assessment forms were completed at the same points that water samples were collected. The methods used were those approved for the Pennsylvania Senior Environment Corps protocol and can be found in Appendix C. The habitat assessment results can be found in Appendix D. The closer the number is to 200, then the better the habitat is. This assessment also helped to determine if sediment was an issue in the watershed. It was also used to gauge the suitability of habitat for macroinvertebrates and to determine the quality of the riparian zone.

The watershed was broken into four sections in order to simplify the explanations in this particular study. Please see the color-coded map in Appendix F to clarify the location of the sections and sample points.

- Headwater Section (brown): All of the area above and including MC #1.
- Middle Section (purple): All of the watershed from MC #3 upstream to the headwater section. This includes MC #2 and MCFORE water sample points. This section is above the mouth of Wilson Run.
- Wilson Run (red): The Wilson Run tributary only. This includes MC #4 at the mouth of Wilson Run.
- Lower Section (green): This section is from the mouth of Wilson Run downstream to the end of the study just above the mouth of Roup Run. This includes the sample points MC #5 which is downstream of Wilson Run and MC #6 which is the point above Roup Run.

SECTION 3.0 WATERSHED DESCRIPTION

3.1 Classification

The headwaters of Moshannon Creek above Roup Run are classified as a High Quality Coldwater Fishery (HQ-CWF). High quality water is a classification of a stream that has excellent quality waters that require special water quality protection under Chapter 93 of the Pennsylvania Code. To protect this designated use, changes must not occur in the water quality unless there is social and economic justification. The PA Fish and Boat Commission (PFBC) have classified the stream as Class A Wild Trout Waters. These are streams that support a population of naturally produced trout. The trout must be abundant and of sufficient size to support a long-term sport fishery. They are managed to allow natural reproduction; therefore, no stocking occurs.

Wilson Run is a tributary located in this section of Moshannon Creek. It is protected as a Coldwater Fishery (CWF). Wilson Run supports a wild trout population and is managed by the PFBC as a Class C trout fishery.

3.2 Land Use

Within this study area, 75% of the land is forested and relatively undisturbed. There are a few roads that lead to water supply wells and logging operations. The remaining 25% is mined lands. This mining consisted of both deep and strip mining. Most of these are concentrated downstream of Wilson Run.

3.3 Geography and Physiography

The headwaters of the Moshannon Creek watershed are located in the Appalachian Plateau Province. This area is northwest of the Allegheny Front, which separates that area from the Valley and Ridge Province. The topography is influenced by the nature of the Mississippian and Pennsylvania age sedimentary units present, and represents approximately 100 million years of erosion. In the area represented in this study, stream gradients are steep and are located within the Allegheny Mountain section of the Appalachian Plateau province (Scarlift Study, 1972).

Total relief in the study area is from 1560 feet near Roup Run to 2400 feet at the headwaters. The highest elevation is at 2630 feet located east of the corner of Clearfield, Blair and Centre Counties. The stream runs in a northward path and is largely controlled by rock type, folding and faulting. Portions of the stream run along the trending axis of the Houtzdale-Snow Shoe Syncline, which is reflected in the northwest-southeast drainage patterns (Scarlift Study, 1972).

3.4 Geology

The Moshannon Creek Watershed is located on the northeast end of the Main Bituminous Coal Fields of Appalachia that extend west into Ohio and south as far as Alabama. The rocks in this area are from the Mississippian and Pennsylvanian time and consist of interbedded shales, siltstones, sandstones, clays and bituminous coals seams. These coal seams vary in thickness and are mined wherever it is economical to do so.

The surface formations range from the upper part of the Mississippian Pocono Formation, through the Pennsylvanian, Pottsville, Allegheny and lower part of the Conemaugh Group. The Allegheny Group contains the rocks that are most important to the coal economy. This sequence of Allegheny Group Coals, otherwise known as the coal measures, begins with the Clarion-Brookville coal at the base, up through Lower, Middle and Upper Kittanning coals to the Lower and Upper Freeport coals. The Clarion-Brookville, Lower and Middle Kittanning were coals that were formed in a reducing environment and are high in pyrite and other sulfuric compounds. These produce acid when exposed to oxygen and water (Scarlift Study, 1972).

The majority of the mining occurs on the Clearfield County side of the watershed. Mining does not occur on the Centre County side until the Roup Run watershed. Most of Roup Run has good water quality until near the mouth where AMD impairs the stream. Once Roup Run enters Moshannon Creek, the fish and other aquatic life virtually disappear. This is where this particular study ends.

3.5 Soils

The soils in this area of Moshannon Creek belong to the Rayne-Gilpin-Ernest and the Cookport-Hazelton Clymer associations. The Rayne-Gilpin-Ernest soils are distinguished by well to moderately well-drained, deep, gently sloping to steep soils, on hilltops, ridges and slopes. The Cookport-Hazelton-Clymer association is deep, moderately well-drained soils found on ridges, uplands, and hillsides. Another association, the Udorthents-Gilpin-Rayne association, is also present in small amounts. These soils vary from shallow to deep, well to poorly-drained, and have level to steep slopes. The Udorthents-Gilpin-Rayne association is the one that has been disturbed the most by surface mining (Merrow, 1996).

SECTION 4.0 HISTORICAL BACKGROUND

4.1 Fish and Boat Commission Information

Past studies have been done on the headwaters in 1932 and 1946. The 1932 study determined that Roup Run was the first major source of pollution, while the 1946 study determined that the first major source was approximately one mile downstream from the headwaters in a wetland (PFBC).

In 1997 the Fish and Boat Commission took another look at the headwaters of Moshannon Creek from Roup Run upstream. According to the biologists this section could be characterized as a small, infertile stream. A site 3 km upstream from Wilson Run was electrofished. An abundance of naturally reproducing brook trout was found representing several age classes along with slimy sculpins. The study also indicated that the water was lightly buffered with a total alkalinity of 6 mg/L and a pH of 6.6 SU. One recommendation from the study was to manage Moshannon Creek from the source to Roup Run as a Class A wild brook trout fishery with no stocking. The second recommendation was to upgrade the stream to HQ-CWF (PFBC).

Also in 1997 the Fish and Boat Commission sampled Wilson Run. According to the biologists this watershed is classified as a small, infertile coldwater stream. A site about .5 km upstream from the mouth was electrofished. Slimy sculpins and brook trout were the only two species of fish found. Several age classes were found but few adults. The population of the brook trout is probably limited by lack of pools and extensive riffle habitat. The water quality also showed a slightly buffered stream with a total alkalinity of only 2 mg/L and a pH of 6.5 SU. It was also stated in the report that the low alkalinity makes Wilson Run sensitive to acidification. It was recommended that this stream be managed as a Class C wild brook trout fishery with no stocking in order to protect this resource.

4.2 Mining

Coal mining was very important in the social and economic development of the Moshannon Creek Valley. Both lumber and coal came to the region in the early 19th century. Towns were built in areas where jobs in mining were plentiful. The earliest mining method for coal at this time was deep mining. This required miners to tunnel underground to the coal seams. This coal was shipped by railroad, roadways and by boats down the West Branch of the Susquehanna River. By the late 19th century, numerous small deep mines were scattered throughout the Moshannon Creek watershed, especially downstream of Wilson Run, which is part of this particular study. In the 1950’s strip mining became the more preferred method to remove the coal. The problem is that most of this mining was accomplished without any concern for the environment and the effect it was having on Moshannon Creek and its tributaries. Now laws regulate the proper way to remove the coal in the area without adding to the pollution problem (Merrow, 1996).

4.3 Drinking Water Supply

Moshannon Creek and some of its tributaries are sources of water for the Houtzdale Municipal Authority. The main intake is on Mountain Branch, which is downstream of the particular study. There are wells along Moshannon Creek near the headwaters between MC #1 and MC #3. These wells are used as back-ups.

There have been concerns raised in the past about drinking water wells drawing too much of the flow away from the streams. In 1994 the US Supreme Court decision stated that the antidegradation policy of the Clean Water Act applies not only to water quality but also water quantity. As a result of that the Oley Decision (October 24, 1996) by the Environmental Hearing Board stated that Pennsylvania Department of Environmental Protection (DEP) must consider whether well construction and operation will violate the Pennsylvania Clean Stream Law that beneficial resources must be preserved. Prior to this appeal DEP interpreted that their responsibilities in the Public Water Supply permit review was only to ensure the water quality was safe for domestic use. No thought was given to the interrelationship of well pumping to surface water quantity. Now DEP must evaluate what will happen to surface waters with well operation and pumping.

Measuring Flow on Moshannon Creek

This situation was highlighted in the Spring 2002 issue of the Pennsylvania Trout (Coulton, 2002). Mountain Branch, a tributary of Moshannon Creek downstream of this particular study area, was the source of water for 8,000 customers in the Houtzdale area. With the building of the Houtzdale State Correctional Institution the usage had to increase to an additional 400,000 gallons per day. Therefore new wells were drilled in the Trim Root Watershed, a tributary to Mountain Branch. Trout Unlimited members were concerned that the excess water being drawn from the wells was taking away baseflow from Trim Root Run. The Pennsylvania Fish and Boat Commission was contacted to complete various studies on the stream. Flows are measured in Trim Root Run. Any pumping from the shallow well must cease whenever the flow drops too low (Young, 2002). This is true of the wells on Moshannon Creek. There is a weir constructed on Moshannon Creek that is believed to be used to monitor the flow to ensure it doesn’t drop below the level that would damage the stream.

SECTION 5.0 CONCERNS IN THE WATERSHED

5.1 Abandoned Mine Drainage (AMD)

Abandoned Mine Drainage is a type of non-point pollution that occurs due to past mining practices. It is formed when water and oxygen are exposed to pyrite that is found in coal, refuse or the overburden of a coal operation. This reaction results in water with high acidity and dissolved metals. These metals will remain in solution until the pH rises to a level that causes them to precipitate as a solid. The most common metals found are iron, aluminum and manganese. As a solid, iron will be red in color; aluminum will be white and manganese, black. Iron and aluminum are the most lethal metals to aquatic life. While in solution, these metals can make streams with a low pH even more lethal. As solids, the metals can coat gills of fish, bury substrate used for spawning and macroinvertebrate habitat, and increase turbidity that can interrupt feeding.

Abandoned Mine Drainage is one of the largest pollution problems in Clearfield County. Mining in some form has been occurring in Clearfield County for over 100 years. The effects from this mining still haunt the county today. According to “Abandoned Mine Watershed Fact Pack” produced by Pennsylvania Organization for Watersheds and Rivers (POWR), Clearfield County leads the state in number of unreclaimed features (3,374) and acres of unreclaimed mine lands (23,715) in the state. These features include strip mines, spoil piles, mine entries, mine shafts and subsidence openings. Many watersheds in Clearfield County show the effects of AMD. Many, if not most, of the streams are devoid of any aquatic life.

Most of these abandoned mine sites are also very unsightly. Very little vegetation grows on the barren land. This increases erosion that adds excess sediment into the streams (See Sediment below). These areas attract all-terrain vehicles that can accelerate erosion. Also, numerous people lose their lives in these areas due to careless riding by trying to climb up very steep spoil piles. Some people ride or fall over highwalls that they did not know were present. In many cases, the pits left by mining are used as swimming holes. People can perish after jumping into these very deep bodies of water because of extreme temperature changes. These barren lands also attract illegal dumping. Many people dump their trash, which only increases unsightliness of the area.

5.2 Sediment

Excess sediment in the stream is another form of non-point source pollution. There are a couple of different terms to understand when talking about the effect of sediment: suspended load, also called turbidity, and siltation. The turbidity is the sediment in the water column. This is what causes the cloudy water after a rainstorm. Siltation is the settling of the fine, suspended sediment. Both forms of sediment can affect fish and macroinvertebrates. If the stream is turbid there is decreased light penetration. This affects fish abilities to see prey when feeding. Decreased light also affects the algae that grow on rocks. This alga is important food source for the macroinvertebrates, which in turn feed the fish that live in the stream. Also, the sediment in the water can cause an abrasive effect. This is a problem for both fish and macroinvertebrates. Excess sediment can have an abrasive action on the gills. This makes the fish more susceptible to disease and suffocation. This abrasive action of sediment along with light reduction can cause invertebrate drift. This is a term to describe the macroinvertebrates as they release their hold on the substrate and float downstream.

Siltation is when the water in the stream slows down to the point that sediment settles on the bottom. Stream substrate is then coated with fine particles. This affects the habitat for macroinvertebrates. Spaces between the larger rocks are attachment sites for macroinvertebrates. Sediment fills up these spaces and takes away areas for the macroinvertebrates to live. This change in habitat also alters the type of macroinvertebrate communities that are present. Siltation also affects fish, especially the brook trout that reside in these streams. Reproduction success will be decreased because sediment will bury the redds that contain the eggs and recently hatched trout. This siltation can take oxygen away from the trout in the redds. After the trout use all the egg sac they must exit the redd to find food. If buried due to sediment, the trout can't exit and die. Then the redd becomes a "tomb". Also, excess sediment can fill in deep holes that are used by fish as resting places or for hiding from predators.

Excess sediment can also affect waters supplies. Reservoirs used as a source for drinking water can fill up with sediment causing less capacity. This is especially a problem during droughts. Also, turbid water is more expensive to treat in order for it to be drinkable.

5.3 Acid deposition

Acid precipitation is another form of pollution that can have devastating effects on fish and macroinvertebrates. It is the result of human-made emissions from fossil fuel burning (coal), automotive exhausts and other industrial sources that produce sulfur dioxide (SO_2) and nitrogen oxide (NO_x) gases. These gases move through the atmosphere and are deposited back to earth in the form of sulfuric and nitric acids by rain, sleet or snow. Pennsylvania is at high risk for this type of pollution due to many factors. First is that the state is a high producer of the sulfuric dioxide and nitrogen oxide gases. Also, Pennsylvania is downwind of other high producing states of these gases in the Midwest (Wilderman, PFC 7/89).

Different areas of the state are more susceptible than others. The degree of which acid deposition affects a watershed depends on the ability of the land to "buffer" or neutralize the acidity. This "acid neutralizing capacity" hinges on the dissolved mineral content of the water. The local geology controls the types of minerals in any given watershed. Especially vulnerable are areas underlain by sandstones. This type of geology will have low acid neutralizing capacity, therefore, decreasing the ability of the area to buffer the acid deposition (Wilderman, PFC 7/89).

Increased acidity lowers the pH in streams with no acid neutralizing capacity. This high acidity affects algae and aquatic plants that are a food source to the aquatic macroinvertebrates and smaller fish that live in a stream. Also, macroinvertebrates found in the orders Ephemeroptera, Plecopetera and Tricoptera are more susceptible to acidity and begin to die, leaving more acid tolerant forms that may not be as abundant a supply of food for the fish. Also, higher acidity will affect the ability of a fish to regulate its blood chemistry. Aluminum is a metal that is increased in watersheds affected by acid deposition. Over 0.7 mg/L will kill fish by damaging their gills and decreasing sodium in their bloodstream. Fish eggs and fry are very susceptible to low pH and high acidity (Wilderman, PFC 7/89). Brook trout are the most abundant fish in this part of the watershed. Despite being one of the more tolerable species of trout, if the pH drops below 5.0 the fish become seriously stressed and mortality increases.

5.4 Logging

Harvesting of lumber can cause numerous problems with sedimentation. Skid roads used to pull out logs will not have any vegetation needed to keep soil in place. Therefore, during rain events, water runs down these areas with no vegetation forming gullies and little streams that are full of sediment. The dirt roads and landings that are built also expose soil to erosion. This is especially true in areas of steep terrain. Also some loggers do not install the temporary bridges that are required by law whenever a stream crossing is necessary.

Another concern with the industry is timbering in the riparian zone. Removing trees that would be shading the stream causes an increase in the temperature of the water. This will change community composition in that watershed.

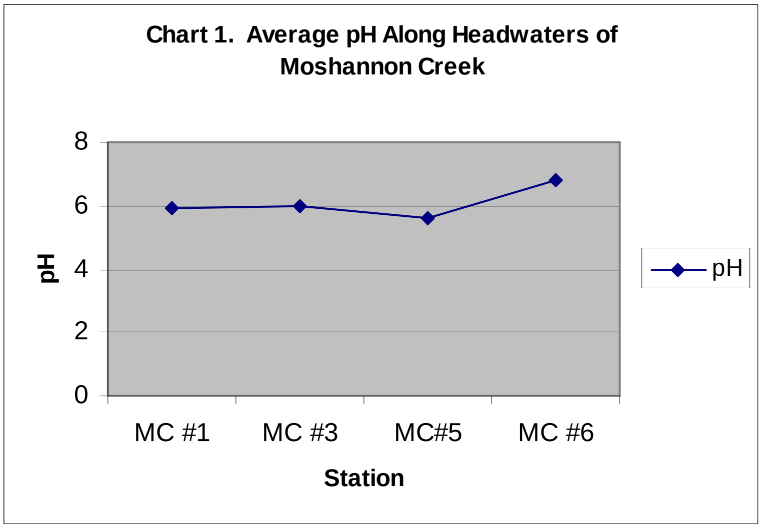
5.5 All Terrain Vehicles (ATVs)

ATV use can cause damage to streams. Improperly established trails destroy vegetation that keeps soil in place. Thus, during rain events, water runs down these areas with no vegetation, forming gullies and little streams that are full of sediment. This is especially dramatic in areas with very steep trails. Topsoil is removed permanently making it nearly impossible for vegetation to grow there. ATV crossings can erode stream banks when used for extended periods of time. As the bank becomes too steep, due to continuous use, some ATV users will move the trail further upstream or downstream of original crossing, thus increasing the area affected by erosion. Also, some ATV users are attracted to wetlands because they enjoy driving through the mud. This can destroy critical habitat and the high diversity of life found in these fragile areas.

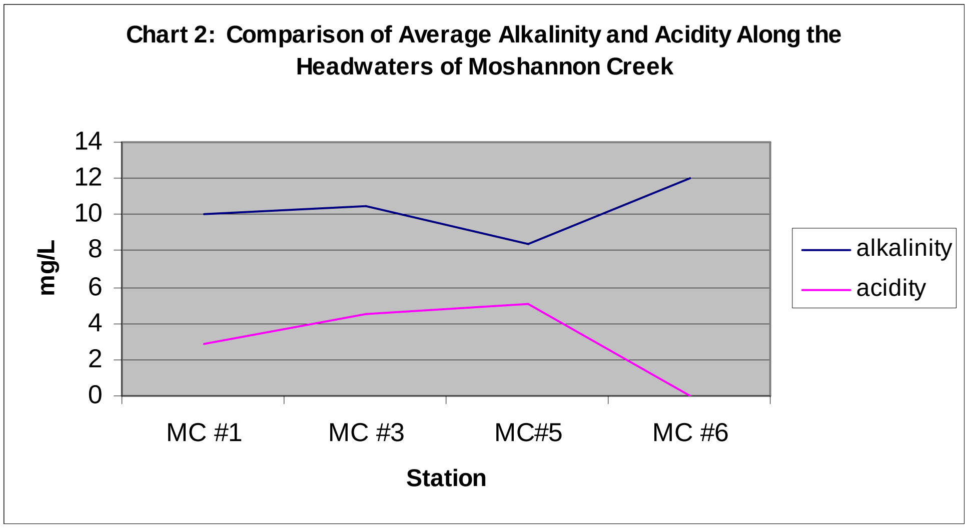
SECTION 6.0 RESULTS OF THE STUDY

6.1 Overall Study Results

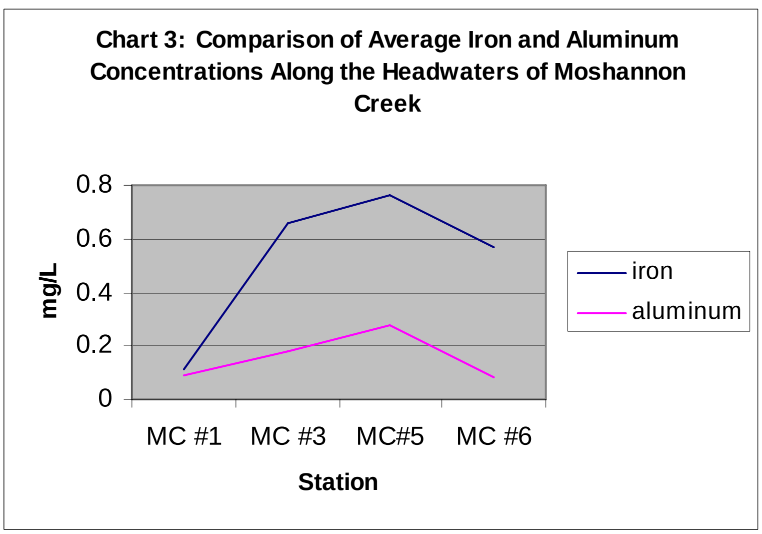
Findings in each section of stream are provided in more detail on the following pages. In general overall average water quality meets the Pennsylvania standards along the main stem in the Headwaters of Moshannon Creek but some issues arise when looking at the macroinvertebrates and habitat assessment. As shown in Chart 1, the average pH hovers just below the ideal range except for the most downstream station (MC #6).



In a watershed it is important that alkalinity is always more than acidity. That way the water body can buffer any changes in pH. On average as shown in Chart 2, all stations show alkalinity is higher than acidity throughout the section studied. Unfortunately there were instances during the spring when acidity was the same or higher than alkalinity at individual stations. This will be elaborated further when each section is discussed in detail separately.



AMD is definitely present within the watershed. As shown in Chart 3, both iron and aluminum show an increase after AMD enters the stream upstream and downstream of MC#3. Iron shows the biggest increase, most likely due to MCFORE, an AMD site that contains a large amount of the metal. Fortunately the average of both iron and aluminum (See Table 1, Appendix A) are below state standards.



Another part of the study was looking at the macroinvertebrates. There is definitely a decrease in the number of taxa as shown in Chart 4. The decrease corresponds not only to the influence of the AMD but also other disturbances such as excess sediment from exposed spoil piles and dirt roads. These instances begin to occur downstream of MC#1. Macroinvertebrates appear to rebound at the most downstream point, MC #6. Wilson Run is shown for comparison because it is a relatively undisturbed watershed.

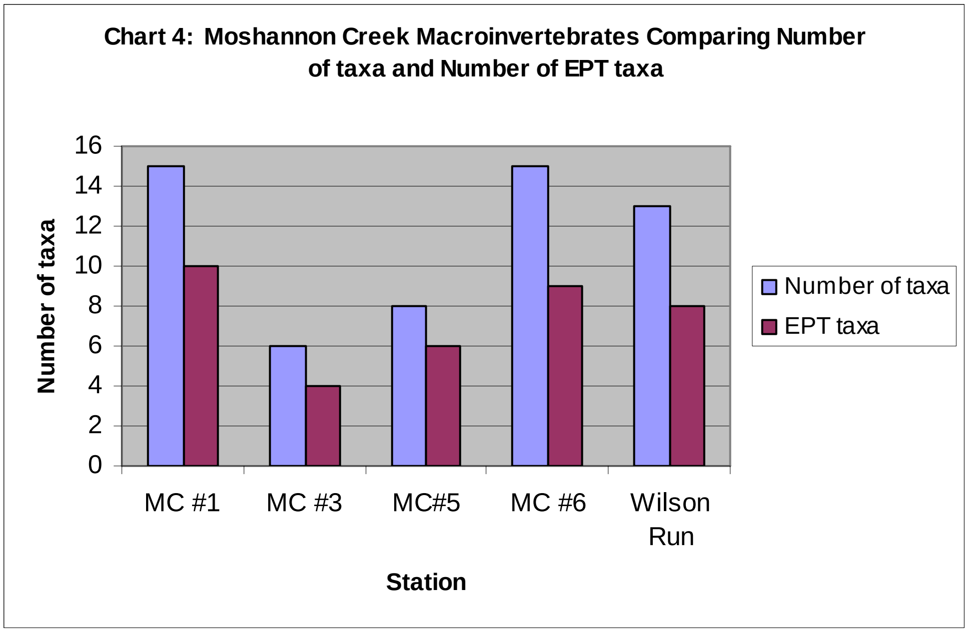
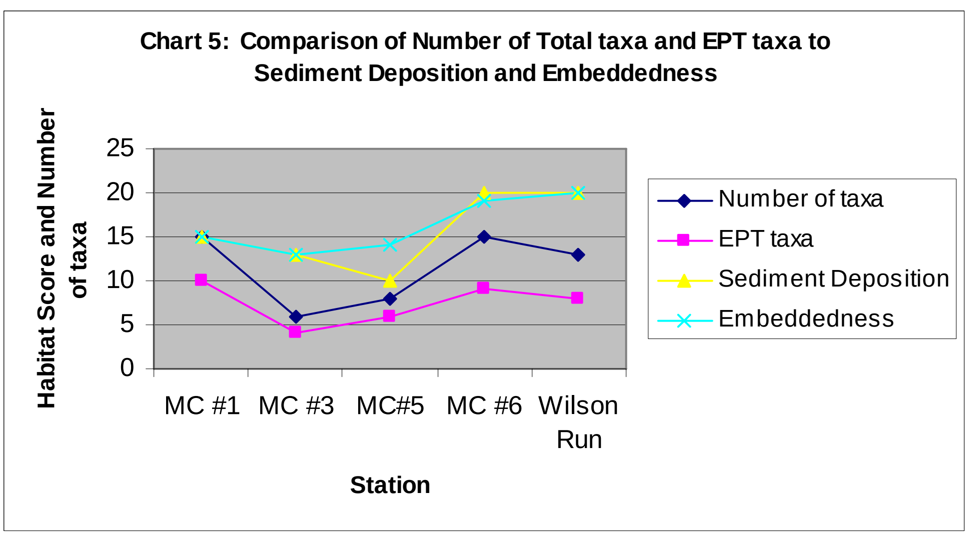


Chart 5 shows the effect of the sediment. The habitat score is from the visual assessment looking specifically at sediment deposition and embeddedness. The closer the score is to 20 the better. The drop in habitat score for deposition and embeddedness indicates there is more sediment present in the stream at these locations. The macroinvertebrate data drops in response to the increase in sediment. It begins to recover at MC #6 due to less sediment deposition and embeddedness. Wilson Run is shown for comparison because it is a relatively undisturbed watershed.



6.2 Headwaters Section

Headwaters of Moshannon Creek

6.2.1 Water quality

The headwater portion of the watershed has excellent water quality when compared to many other streams in the area. (See Appendix A for detailed water quality). The values for pH ranged from 5.4 to 6.4. Even though alkalinity was low (7-12 mg/L) it was always more than acidity (0-7 mg/L) except in Spring 2007 at high flows. At that time both acidity and alkalinity were the same, which may indicate a concern for acid precipitation. Conductivity ranged from 64-92 umhos. Iron (.05-.26 mg/L), aluminum (.05-.2 mg/L) and manganese (.02-.07 mg/L) concentrations were all below state standards. There were also little to no sulfates (6-12 mg/L), which is a good indication that no mining has occurred upstream from this sampling point. Even though there is some concern for acid deposition the overall water quality in this section of Moshannon Creek is excellent for aquatic life.

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6.2.2 Macroinvertebrates

This section of stream had a diversity that ranged from 1.81-2.21 the two times it was sampled. Besides Wilson Run it had the highest diversity of all the sample points. The number of taxa went from 13 to 16 and the number of EPT taxa from 9 to 11. This section was the least disturbed besides Wilson Run.

6.2.3 Stream Habitat

This portion of the watershed has very good habitat. It is favorable for both fish and aquatic macroinvertebrates. The area is heavily forested with little land disturbance. The Stream Habitat Assessment showed a score of 181 out of a possible 200, the third highest habitat score in this study. The assessment showed suboptimal conditions for embeddedness and sediment deposition. This would indicate that there is a source of excess sediment somewhere above this point.

6.2.4 Stream Reconnaissance

The headwaters of Moshannon Creek are heavily forested. The stream is very intact. There were a couple of disturbances noted. First was an ATV trail that travels down the hill and crosses the stream. There are areas of erosion along the trail that would be an issue during rain events. The stream crossing is actually quite stable. It would appear that the trail is an access for hunters who are not intent on tearing up the stream.

Also there is a dirt road that runs parallel to the stream that leads to some drilled water wells. The groundwater wells spread through approximately one mile of the stream in both the headwater section and downstream into the second section of the study. They are owned by the Houtzdale Municipal Water Authority. There would definitely be a concern of drawing too much water from the wells and lowering the baseflow of the stream in low flow conditions. At the time of the study they were used as back-up only and the Authority's main source of water was from Mountain Branch, a tributary of Moshannon Creek downstream of this study area.

6.2.5 Explanation of Headwaters

Water quality, macroinvertebrates and stream habitat help demonstrate why this section of Moshannon Creek is considered a high quality fishery and a Class A Wild Trout Waters. There is some concern for acid deposition. During spring flows the acidity and alkalinity were the same. The stream is definitely on the edge during rain and snow events. A more thorough study would need to be completed to verify if acid deposition is a valid concern. The metals and sulfates are both very low which indicates no mining has occurred in the headwaters above this point. The habitat assessment did indicate there was some sedimentation occurring in the stream. This could be due to the ATV trail or the road that leads to the source water wells. There could be some old logging roads that were not found during the stream reconnaissance that could be adding excess sediment to the watershed. Other than the slightly elevated sediment levels, the stream had excellent habitat for both macroinvertebrates and fish.

ATV Trail in headwaters of Moshannon Creek

6.3 Middle Section

6.3.1 Water Quality

The section of the watershed begins to show very slight changes due to the influences of past mining. The values for pH ranged from 5.7 to 6.3. Alkalinity was fairly low (7-14 mg/L) and in one sample was less than acidity (0-9 mg/L). Conductivity was slightly elevated from the upstream sample point (MC#1). Although slightly more elevated, the main metals in AMD, iron (.35 - .97 mg/L), aluminum (.13 - .22 mg/L) and manganese (.41-.51 mg/L) are well below state standards. Sulfates also increase slightly from the upstream sample point (MC#1) indicating possible effects from mining although at 21-27 mg/L are still below state standards that would be harmful to the aquatic life present.

These changes are all due to a few abandoned mine areas entering the watershed between MC#1 and MC#3. The largest contributor is MCFORE, a discharge that originates in an area that was backfilled and reclaimed by the Bureau of Abandoned Mine Reclamation (BAMR). In one sample taken, the pH was 4.7 and conductivity 2480 umhos. This high conductivity would indicate possible metals in the water, which is found to be the case. Iron is at 253 mg/L and manganese at 66.2 mg/L in the MCFORE discharge, which is grossly over the standards for aquatic life to survive. Aluminum is below state standards at .36 mg/L. Sulfates are also above standards at 1211 mg/L in this discharge, which is a prime indicator of AMD. Even though there is some alkalinity found in the water (12 mg/L) at MCFORE, acidity is much higher (508 mg/L).

MCFORE Discharge

The second source of impairment is sample point MC #2, a small tributary affected by AMD entering from the Clearfield County side of Moshannon Creek. The mouth of this trib had a pH of 3.7 and a conductivity of 409 umhos. There is no alkalinity in the water and acidity was found to be 32 mg/L. Iron at 7.1 mg/L and manganese at 7.08 mg/L are well beyond state standards for aquatic life to survive, although aluminum at .44 mg/L and sulfates at 133 mg/L are below the standards.

6.3.2 Macroinvertebrates

Diversity drops in this section of the stream to a 1.38. The number of taxa decrease to 6 and the number of EPT taxa to 4. The decrease in the indices indicates an increase in pollution. Mayflies, the most sensitive order to pollution, were not found during this sample.

6.3.3 Stream Habitat

The Stream Habitat Assessment showed a score of 162 out of a possible 200, the lowest habitat score in this study. There are suboptimal conditions for attachment sites for macroinvertebrates, embeddedness, channel alteration and sediment deposition. The left bank is also showing a marginal riparian zone. This is beginning to show some changes occurring in this watershed.

6.3.4 Stream Reconnaissance

Changes are beginning to occur in the watershed from MC #1 and MC #3. The first noticeable issue is the groundwater wells that were mentioned in the headwaters section. There are three wells located in this section of stream used by Houtzdale Municipal Authority. They are used as a back-up supply only.

Groundwater wells

The effects of mining are beginning to occur. The MCFORE discharge is a pond that had been backfilled about 2 years ago and is located in this section of the watershed. The pond was an AMD discharge that just trickled into the stream, but once backfilled the discharge flowed into the stream at a higher rate. The water from the discharge travels through a limestone channel that is covered with an iron precipitate. The water then enters a beaver pond that slows the flow of the AMD. However during high flow conditions like in the summer of 2004, it could be seen where the water had flowed due to the path of iron and dead trees on its way to the wetland. In speaking with the landowner after the summer of 2004, the backfilled pond had greatly affected the stream quality and rocks downstream now had an orange precipitate.

The first tributary enters below the MCFORE discharge from the Clearfield County side of the stream. This would be sampling point MC #2. The area where the tributary enters

Moshannon Creek is swampy due to its relatively flat elevation and the many ponds created by beavers. Determining specific sources of pollution in the area was difficult due to low flow conditions. It was assumed that more water was seeping into the wetland area from the groundwater since the tributary didn't appear to be the only source.

Further downstream, an area was noted where the streambed was altered. There was a dugout channel with pipes going to a large concrete box. It was thought that water was being pumped from a tributary where the concrete box was located to a logging operation nearby, although this was not confirmed. There was also a large road running to this area that was causing erosion and sediment pollution in the stream.

There is also evidence from past mining located throughout this portion of the watershed. There are areas of spoil that have not been revegetated. There are also old dirt roads that cross the stream. Both of these are examples of sources for excess sediment in the stream.

Culvert from dirt road crossing

Cobbles and sediment below culvert shown above.

It should be noted that the majority of this section and downstream is posted. Therefore the public is unable to access this stream. For this study, special permission was obtained in order to complete the stream reconnaissance and the needed water and macroinvertebrate sampling. The landowners were very cooperative in allowing this study and others to be completed. Hopefully, MCWC can work with the landowners to allow the stream to be accessible to the public for fishing.

6.3.5 Explanation of Middle Section

Water quality is definitely beginning to show that mining has occurred in this section of the watershed. The mining areas are on the Clearfield County side of the stream. Even though the metals and sulfates show an increase, the numbers are still below state standards. The biggest problem that seems to be affecting the macroinvertebrates would be the sedimentation. Run-off from roads for logging, old strip roads and access to groundwater wells is the most likely culprit for the excess sediment. Also the MCFORE discharge and the AMD affected tributary contain high elevations of iron. Above a pH of 3.5, iron begins to precipitate out and coat the streambed. Some of this precipitated iron could be having the same effect on the macrinvertebrates as the sediment.

6.4 Wilson Run

Wilson Run at mouth. A logging road can be seen on the left

6.4.1 Water Quality

Wilson Run is a tributary that enters from the Centre County side. It is undisturbed by mining which is confirmed by the water quality. The pH of 5.9-6.0 and conductivity from 23-25 umhos is an indication of good water quality. Alkalinity ranged from 6-8 mg/L but unfortunately acidity is also in that range from 2-8 mg/L and was higher during one sample. This indicates the stream could be subject to acid deposition. Iron (.05-.15 mg/L), manganese (.02 mg/L) and aluminum (.05-.1 mg/L) were below state standards. Sulfates were also very low, in the range of 7-10 mg/L, which indicates no mining has occurred in the watershed. The only concern with water quality in Wilson Run would be its possible vulnerability to acid deposition.

6.4.2 Macroinvertebrates

The diversity in Wilson Run is 1.82. The only other point higher than this in the study is MC #1, located in the headwaters. Wilson Run was only sampled once but had 13 different taxa and 8 EPT taxa. This is comparable to the headwaters of Moshannon Creek.

6.4.3 Stream Habitat

The Stream Habitat Assessment showed a score of 184 out of a possible 200, the second highest habitat score in this study. All habitat parameters showed optimal conditions except the riparian vegetative zone width. This was due to the logging road that ran along Wilson Run.

6.4.4 Stream Reconnaissance

A logging operation was occurring during the time this study was completed. A logging road crossed Moshannon Creek below the mouth of Wilson Run then ran along side of this tributary. Even so there was no evidence of excess sedimentation in Wilson Run due to this road or the logging occurring in the watershed. The riparian zone was narrow due to the road but there were still trees shading the stream.

Logging road crossing Moshannon Creek below the mouth of Wilson Run

6.4.5 Explanation of Wilson Run

This tributary helps to improve the water quality in Moshannon Creek. The water quality, especially the low conductivity, metal concentrations and sulfates, indicate that this stream has not been affected by abandoned mine drainage. Therefore it is a good source of water to help buffer Moshannon Creek as it travels past AMD sites. There seems to be a concern for acid deposition, as the water samples did indicate during certain times that acidity was more than alkalinity. A more thorough study would need to be completed to verify if acid deposition is a valid concern. Macroinvertebrate populations coincided with the good water quality. Diversity and number of taxa were close to the standards set at the headwaters. The habitat was also optimal for macroinvertebrates. Past studies completed by the PFBC indicated the stream might not be large enough to provide habitat for the bigger trout to survive. The biggest concern was the logging operation occurring. The width of the riparian zone was decreased because a dirt road runs along the stream. There still is a good, but small, riparian buffer zone between the road and Wilson Run. This will still help in keeping the sun from warming the stream too much. At the time of the study it appeared that the logging was not increasing the sediment load in the stream, although observations made after heavy rain events have indicated that runoff from the logging road does enter Moshannon Creek at certain times, causing sediment to enter the stream.

6.5 Lower Section

6.5.1 Water Quality

The next section covers two main stream points MC #5 and MC #6. Sample point MC #5 is located downstream with the confluence of Wilson Run and below main stream point MC #3. The pH fluctuated from poor water quality unable to support aquatic life (pH 5.1) to excellent (pH 6.6). Metals such as iron (.35-1.48 mg/L) and manganese (.32 – 1.51 mg/L) had ranges from excellent to close to exceeding standards. This usually occurred in relation to low pH values. Aluminum (.14-.47 mg/L) and sulfates (13-28 mg/L) remained below state standards. Alkalinity ranged from 6-14 mg/L and acidity from –2-10 mg/L. On one sampling date when the metals were high so too was acidity greater than alkalinity.

The sample point MC #6 is most downstream point in this study. It is located above Roup Run, the tributary that erases most aquatic life in Moshannon Creek. Between MC #5 and MC #6 the stream flows past spoil piles and other small AMD influences occurring on the Clearfield County side. Even so the water quality at this point is excellent. The pH was 6.4 and conductivity was 91 omhos. Alkalinity was at 12 mg/L and there was no acidity. Iron (.57 mg/L), manganese (.08 mg/L), aluminum (.08 mg/L) and sulfates (20 mg/L) were all below state standards and would support aquatic life. It should be noted however that the stream sample from MC #5 taken the same day also showed excellent water quality. Unfortunately there is no water quality taken at MC #6 at the same time poor water quality was occurring upstream at MC #5.

6.5.2 Macroinvertebrates

This last section includes two sample points, MC #5 and MC #6. Downstream of Wilson Run (MC #5) ranges from 1.27-1.49, which is not a huge improvement from the site above Wilson Run. In the May sample the number of taxa is only 4 although the number of EPT taxa is 3, which is indicating some of the sensitive taxa of macroinvertebrates are present. In the July sample a year later the number of taxa increase to 12 and number of EPT taxa to 8, including mayflies which were now found again.

The macroinvertebrate sampling at the site above Roup Run (MC #6) shows a diversity of 1.69, which is lower than the headwaters. The number of taxa at 15 and the number of EPT taxa at 9 is close to the headwater figures.

6.5.3 Stream Habitat

Downstream of Wilson Run at MC #5 the habitat score was 176 out of a possible 200, ranking it fourth out of the five sites. Suboptimal conditions were found for embeddedness and sediment deposition. The parameters for the riparian zone were optimal. This indicates that the banks are very stable with an excellent riparian zone.

Sediment coating substrate below Wilson Run

The last station for the study is MC #6, located upstream of Roup Run. The habitat score for this section was 191 out of 200, the highest score of all the sites. The habitat for macroinvertebrates and fish were optimal. Sediment deposition is not as visible. All banks are stable with excellent riparian zones. The only parameter in the suboptimal range was the stream velocity and depth combinations.

6.5.4 Stream Reconnaissance

The first problem located in this section of the study was an iron mat that runs into the stream and a large spoil pile adjacent to the streambed. The iron mat is approximately 40 feet long and visibly disturbs the streambed. The spoil pile has deep channels where runoff reacts with the pyrite and enters the stream. There are also two small tributaries that receive runoff from the spoil. The area is approximately 3 acres and forms the left bank of Moshannon Creek.

Spoil pile forming the left bank (facing downstream) of Moshannon Creek

Leftovers from mining are prevalent in this section of stream. All the land on the Clearfield side of the watershed has been affected by mining. There is also one more AMD tributary that enters from the Clearfield County side, which runs across an used road and into a man-made channel adjacent to spoil piles. This could be having a small affect on Moshannon Creek.

Tributary affected by AMD receiving excess sediment from logging road

6.5.5 Explanation of MC #5 and MC #6

Downstream of Wilson Run, Moshannon Creek appears to be showing the effects from AMD. During certain times of the year the pH dropped and iron and manganese increased. Although manganese is not a concern for aquatic life, iron is, and it was very close to exceeding state standards set forth in Chapter 93. Also corresponding with this increase in metals, acidity exceeded alkalinity. This is the only sample where this occurred. Most likely the increase of metals and acidity and decrease of pH and alkalinity occurred during low flow times when Wilson Run, a stream with excellent water quality, did not have as much flow to buffer the AMD discharges.

The macroinvertebrate population continues to show a decline when compared to the headwaters. The number of taxa increased when compared to the section upstream of Wilson Run but is still not as desirable as it is in the headwaters. The sensitive EPT taxa are still present indicating that the water quality is still at the level they can survive. This shows again that Wilson Run is an important tributary in the overall quality of Moshannon Creek especially with the beginning influx of AMD problems.

At MC #6, the bottom end of the study area, Moshannon Creek appears to be improved. Water quality is excellent and all metals are below state standards. This is somewhat hard to believe due to the mining that has occurred in this section from MC #5 downstream. Even though diversity of the macrinvertebrates is lower than the headwaters the number of taxa and EPT taxa has increased. This is an indication that water quality has improved. Most importantly the habitat has improved. The stream assessment showed optimal conditions except for one category. This goes to show that good habitat is needed along with good water quality in order to have a healthy macroinvertebrate population.

This part of the stream can be very fragile. Abandoned Mine Drainage discharges can remain fairly constant during low flow situations especially if the water is from a deep mine as in MCFORE. Unfortunately base flow of tributaries such as Wilson Run will decrease during times of low precipitation. When this happens a source of water that can buffer AMD is slowly diminished. Then the stream may start showing the effects of low pH and high metals, which can be detrimental to aquatic life. Also, as it is in most sections of the upper section of Moshannon Creek, acid deposition may also play a role in water quality. A more thorough study would need to be completed to verify if acid deposition is a valid concern.

An explanation of this section would not be complete without mentioning Roup Run. This particular study ended at the mouth of this tributary because once it enters, Moshannon Creek is dramatically altered. Roup Run was the first source of water that kills all life downstream on Moshannon Creek. This tributary enters from Centre County. The pollution of this tributary occurs only 100 yards above the mouth of the stream. This discharge comes from a large 2 acre pond which was surrounded by reclaimed mines. Approximately 10% of Roup Run's water comes from this tributary, which has a pH of 2.9 and a conductivity of 2060 umhos. The water has very high levels of acidity, iron, manganese, aluminum, and sulfates. Above this bad tributary, Roup Run has good water quality.

Mouth of Roup Run

SECTION 7.0 NEXT STEPS FOR THE WATERSHED

1. An assessment needs to be completed concentrating on the AMD pollution problems. At this time, the Moshannon Creek Watershed Coalition (MCWC) is completing this study. A restoration plan will be developed prioritizing the sites that need to be addressed. The MCFORE discharge and the spoil pile that is along the creek are issues that need to be addressed in order to help this stream in the future.
2. The majority of the land in this study is posted. This natural resource is not open for the public to enjoy. This is unfortunate because there are not many streams in the area that have water quality to support trout and fishing. The landowners were extremely cooperative during this study. MCWC would need to explore ideas to work with the landowners so the stream is more accessible to the public. Trout Unlimited and Department of Conservation and Natural Resources (DCNR) may be a good starting point to gain an easement to the stream.
3. A partnership with Houtzdale Water Authority should be established. The Authority will be monitoring the amount of flow when drawing from the wells in the watershed. A relationship with them will show that people do care for the watershed and the amount of baseflow. Also MCWC could help monitor any changes that could affect the water supply and to notify the authority when there is a concern. Also a Source Water Protection Plan has not been established. This might be something the watershed group could partner with the Houtzdale Water Authority to complete.
4. MCWC needs to work with the landowners with the concerns of the various sources of sediment. The main culprits of the excess sediment could be the logging, bare areas due to past mining and roads and ATV trails. First, proper logging practices will help protect the stream from extra sedimentation. An educational component that concentrates on this issue is needed.
5. Another source of excess sediment is exposed soil from past mining practices. There are many areas of spoil and exposed ground where grasses and trees have a difficult time growing. There are many ways to mix in an alkaline soil amendment to make the area more viable for vegetation to grow. If these areas are not identified in the AMD study being completed on the headwaters, a survey should be completed identifying the areas that would benefit with more vegetation.
6. Sedimentation from roads should also be addressed. Roads that are no longer used could be re-seeded. MCWC could work with the Houtzdale Water Authority to install proper BMP's to help prevent excess runoff from the road. Also culverts should be examined to make sure they are sized correctly in reference to the size of the watershed.
7. ATV use was not identified as a huge problem. Even so, MCWC could help educate ATV riders and landowners on environmental damage that can occur to streams with irresponsible riding.
8. Acid deposition may be a concern in certain parts of the watershed. Once the AMD problems enter, this may be masked. A study could be completed to

identify is acid deposition is a problem above AMD influences. This would be a lower priority project until AMD issues are taken care of.

SECTION 8.0 REFERENCES

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Appendix A

Parameters	Ranges looked at to make determinations of water quality in this study
pH	6.0-9.0
Conductivity	Above 400 umhos indicates possible AMD problems
Alkalinity	More than acidity
Acidity	Lower than alkalinity
Iron	Must be less than 1.5 mg/L
Manganese	Must be less than 1.0 mg/L
Aluminum	Must be less than .75 mg/L
Sulfate	Not to succeed 250 mg/L
Suspended Solids	Less than 25 mg/L is clear water
Total Dissolved Solids (TDS)	More than 400 mg/L is considered polluted

MC#1 Headwaters of Moshannon Creek								
	10/23/03	12/22/03	3/10/04	5/18/04	9/29/04	12/10/04	8/8/05 *	3/20/07
Field pH	5.5	6.6	5.0	6.4	5.4	5.6	6.2	6.2
Lab pH	6.1	6.2	6.4	5.4	6.0	6.4	3.9	6.2
Conductivity (umhos)	92	83	84	64	72	69	96	72
Temperature (°C)	8	6	7	13	13	8	16	5
Alkalinity (mg/L)	11	12	8	12	10	10	0	7
Acidity (mg/L)	5	0	2	0	0	6	58	7
Iron (mg/L)	<.05	<.05	.21	.26	.09	.05	.14	<.05
Manganese (mg/L)	<.02	.02	.05	.07	.04	.02	.03	.02
Aluminum (mg/L)	<.05	<.05	.08	.2	.07	.06	.1	.09
Sulfate (mg/L)	6	7	7	6	12	12	<10	8
Susp. Solids (mg/L)	<5.7	17.1	5.7	<5.7	<5.7	5.7	<6.2	<5.0
TDS	56	53	57	53	23	24	69	34

* Indicates water quality data appears to be quite different from rest of sampling

MC #2 -AMD affected trib entering from Clearfield County side of Moshannon Creek between MC #1 and MC # 3	
	7/28/05
Field pH	4.0
Lab pH	3.7
Conductivity (umhos)	409
Temperature (°C)	22
Alkalinity (mg/L)	0
Acidity (mg/L)	32
Iron (mg/L)	7.1
Manganese (mg/L)	7.08
Aluminum (mg/L)	.44
Sulfate (mg/L)	133
Susp. Solids (mg/L)	7.1
TDS	264
MCFORE Discharge (enters Moshannon creek from left side)	
	9/29/04
Field pH	5.2
Lab pH	4.7
Conductivity (umhos)	2480
Temperature (°C)	13
Alkalinity (mg/L)	12
Acidity (mg/L)	508
Iron (mg/L)	253.0
Manganese (mg/L)	66.2
Aluminum (mg/L)	.36
Sulfate (mg/L)	1211
Susp. Solids (mg/L)	14.3
TDS	2453

MC#3 Moshannon Creek above Wilson Run		
	7/28/05	3/13/07
Field pH	6.3	5.7
Lab pH	6.6	6.0
Conductivity (umhos)	110	83
Temperature (°C)	19	6
Alkalinity (mg/L)	14	7
Acidity (mg/L)	0	9
Iron (mg/L)	.97	.34
Manganese (mg/L)	.41	.51
Aluminum (mg/L)	.13	.22
Sulfate (mg/L)	27	21
Susp. Solids (mg/L)	<6.2	<5.0
TDS	71	53

MC #4 Wilson Run			
	5/18/04	7/28/05	3/13/07
Field pH	5.4	6.0	5.9
Lab pH	6.1	5.9	6.1
Conductivity (umhos)	23	25	24
Temperature (°C)	14	16	6
Alkalinity (mg/L)	6	8	7
Acidity (mg/L)	4	2	8
Iron (mg/L)	.06	.15	<.05
Manganese (mg/L)	.02	.02	<.02
Aluminum (mg/L)	<.05	.1	<.05
Sulfate (mg/L)	7	<10	7
Susp. Solids (mg/L)	<5.7	<6.2	<5.0
TDS	20	24	11

MC#5 Headwaters of Moshannon Creek (below Wilson Run)								
	10/23/03	12/22/03	3/10/04	5/18/04	9/29/04	12/10/04	7/28/05 *	3/13/07
Field pH	5.5	5.9	4.9	5.1	5.5	5.7	6.3	5.8
Lab pH	5.9	6.0	6.1	5.1	5.2	6.0	6.6	6.1
Conductivity (umhos)	111	101	79	122	99	93	84	75
Temperature (°C)	8	5	7	15	14	7	19	6
Alkalinity (mg/L)	10	8	8	6	6	8	14	7
Acidity (mg/L)	8	2	2	10	6	5	-2	8
Iron (mg/L)	.68	.57	.36	1.48	1.39	.42	.85	.35
Manganese (mg/L)	.65	.75	.34	1.51	.86	.74	.32	.4
Aluminum (mg/L)	.22	.35	.28	.47	.39	.22	.14	.19
Sulfate (mg/L)	20	21	13	28	27	25	14	19
Susp. Solids (mg/L)	<5.7	15.7	5.7	11.4	<5.7	5.7	<6.2	<5.0
TDS	50	47	51	83	44	39	57	42

MC #6 –Above Roup Run	
	7/28/05
Field pH	6.8
Lab pH	6.4
Conductivity (umhos)	91
Temperature (°C)	17
Alkalinity (mg/L)	12
Acidity (mg/L)	0
Iron (mg/L)	.57
Manganese (mg/L)	.12
Aluminum (mg/L)	.08
Sulfate (mg/L)	20
Susp. Solids (mg/L)	<6.2
TDS	51

Appendix B

Macroinvertebrate Sampling at MC 1 – Headwaters of Moshannon Creek		
Date sampled	5/18/04	6/22/05
Ephmeroptera		
Baetidae	132	19
Caenidae		1
Heptagennidae	26	7
Oligoneuriidae	6	
Plecoptera		
Nemouridae	20	
Perlidae	16	
Perlodidae		32
Peltoperlidae	2	2
Pteronarcyidae	1	3
Tricoptera		
Hydropsychidae	2	5
Lepidostomatidae		1
Leptoceridae		6
Limnephilidae	3	
Polycentropodidae		33
Rhyacophilidae		2
Odonata		
Gomphidae	13	4
Diptera		
Ceratopogonidae		4
Dixidae		2
Tipulidae	14	
Coleoptera		
Elmidae		37
Gyrinidae	18	
Megaloptera		
Corydalidae	23	
Watermite		1
Crayfish		4
Total number of organisms	276	163
Diversity (Based on Family)	1.81	2.21
Number of taxa	13	16
Number of EPT taxa	9	11

Macroinvertebrate Sampling at MC 3 – Above Wilson Run Confluence	
Date sampled	7/12/05
Plecoptera	
Perlodidae	2
Leuctridae	44
Tricoptera	
Hydropsychidae	29
Polycentropodidae	9
Diptera	
Ceratopogonidae	1
Simuliidae	37
Total number of organisms	122
Diversity (based on Family)	1.38
Number of taxa	6
Number of EPT taxa	4

Macroinvertebrate Sampling at MC #4 - Wilson Run	
Date sampled	7/12/05
Ephmeroptera	
Baetidae	34
Ephemerellidae	2
Plecoptera	
Perlodidae	73
Peltoperlidae	8
Leuctridae	7
Tricoptera	
Hydropsychidae	17
Polycentropodidae	26
Unknown	2
Odonata	
Gomphidae	6
Diptera	
Ceratopogonidae	3
Dixidae	5
Simuliidae	5
Watermite	1
Total number of organisms	189
Diversity (based on Family)	1.82
Number of taxa	13
Number of EPT taxa	8

Macroinvertebrate Sampling at MC 5 – Below Wilson Run		
Date sampled	5/18/04	7/12/05
Ephmeroptera		
Baetidae		10
Ameletidae		2
Plecoptera		
Nemouridae	15	
Perlidae	7	
Perlodidae		30
Peltoperlidae		2
Pteronarcyidae		1
Leuctridae		100
Tricoptera		
Hydropsychidae	15	30
Polycentropodidae		6
Odonata		
Gomphidae		1
Diptera		
Ceratopogonidae		1
Dixidae		2
Simuliidae	3	4
Total number of organisms	40	189
Diversity (based on Family)	1.27	1.49
Number of taxa	4	12
Number of EPT taxa	3	8

Macroinvertebrate Sampling at MC #6 – Above Roup Run	
Date sampled	7/14/05
Ephmeroptera	
Baetidae	39
Leptophlebidae	1
Plecoptera	
Nemouridae	1
Perlidae	1
Perlodidae	14
Peltoperlidae	1
Leuctridae	54
Tricoptera	
Hydropsychidae	28
Polycentropodidae	9
Odonata	
Gomphidae	1
Diptera	
Ceratopogonidae	3
Dixidae	1
Simulidae	18
Coleoptera	
Elmidae	2
Watermite	2
Total number of organisms	175
Diversity (based on Family)	1.69
Number of taxa	15
Number of EPT Taxa	9

Appendix C

Stream Habitat Assessment Procedure

*(Adapted from Volunteer Stream Monitoring: A Methods Manual, United States Environmental Protection Agency, Office of Water, Draft Document #EPA 841-B-97-003, November 1997.)*Each time you conduct macroinvertebrate sampling you will also assess the stream habitat for fish, macroinvertebrates, and plants. Just as with macroinvertebrate sampling the type of stream habitat - rocky bottom versus muddy bottom - affects your assessment procedures.**Rocky Bottom Habitats****Conduct the habitat assessment twice a year, in the spring and in the fall, at the site that you used for your macroinvertebrate sampling.**

1. **Attachment sites for macroinvertebrates** are essentially the amount of living space or hard substrates (rocks, snags, etc.) available for aquatic insects and snails. Many insects begin their life underwater in streams and need to attach themselves to rocks, logs, branches, or other sub-merged substrates. In streams unimpaired by pollution, the greater the variety and number of available living spaces or attachment sites, the greater the variety of insects the stream habitat could support. Optimally, cobble should predominate and boulders and gravel should be common. The availability of suitable living spaces for macroinvertebrates decreases as cobble becomes less abundant and boulders, gravel, or bedrock become more prevalent.

2. **Embeddedness** refers to the extent that rocks (gravel, cobble, and boulders) are surrounded by, covered, or sunken into the silt, sand, or mud of the stream bottom. As rocks become embedded, fewer living spaces are available to macroinvertebrates and fish for shelter, spawning and egg incubation. To estimate the percent of embeddedness, observe the amount of silt or finer sediments overlying and surrounding the rocks. If kicking does not dislodge the rocks or cobbles, they might be greatly embedded.

3. **Shelter for fish** and macroinvertebrates includes the relative quantity and variety of natural structures in the stream, such as fallen trees, logs, and branches; root wads; large cobble and boulders; and undercut banks that are available to fish for hiding, sleeping, or feeding. A wide variety of submerged structures means more living spaces in a stream and the more types of fish and other aquatic life the stream can support. ***Assess the stream as far as you can see.***

4. **Channel alteration** is a measure of large-scale changes in the shape of the stream channel. Many streams in urban and agricultural areas have been straightened, deepened, dredged, or diverted into concrete channels, often for flood control purposes. Such streams have far fewer natural habitats for fish, macroinvertebrates, and plants than do naturally meandering streams. Channel alteration is present when the stream runs through a concrete channel; when artificial embankments, riprap, and other forms of artificial bank stabilization or structures are present; when the stream is very straight for significant distances;

when dams, bridges, and flow-altering structures such as stormwater pipes are present; when the stream is of uniform depth due to dredging; and when other such changes have occurred. Signs that indicate the occurrence of dredging include straightened, deepened, and otherwise uniform stream channels, as well as the removal of streamside vegetation to provide dredging equipment access to the stream. ***Assess channel alteration up and down the stream as far as you can see.***

5. **Sediment deposition** is a measure of the amount of sediment that has been deposited in the stream channel and the changes to the stream bottom that have occurred as a result of the deposition. High levels of sediment deposition create an unstable and continually changing environment that is unsuitable for many aquatic organisms. Sediments are naturally deposited in areas where the stream flow is reduced, such as pools and bends, or where flow is obstructed. These deposits can lead to the formation of islands, shoals, or point bars (sediments that build up in the stream, usually at the beginning of a meander) or can result in the complete filling of pools. To determine whether sediment deposits are new, look for vegetation growing on them: new sediments will not yet have been colonized by vegetation.

6. **Stream velocity and depth combinations** are important to the maintenance of healthy aquatic communities. Fast water increases the amount of dissolved oxygen in the water, keeps pools from being filled with sediment, and helps food items like leaves, twigs, and algae move more quickly through the aquatic system. Slow water provides spawning areas for fish and shelters macroinvertebrates that might be washed downstream in high stream velocities. Similarly, shallow water tends to be more easily aerated (i.e. holds more oxygen), but deeper water stays cooler longer. Thus the best stream habitat includes all of the following velocity/depth combinations and can maintain a wide variety of organisms.

   * slow (<1 ft/sec or <0.3048 m/sec), shallow (0.4572 m or <1.5 ft);* fast, deep;
   * slow, deep; * fast, shallow

7. **Channel flow status** is the percentage of the existing channel that is filled with water. The flow status changes as the channel enlarges or as flow decreases as a result of dams and other obstructions, diversions for irrigation, or drought. When water does not cover much of the streambed, the living area for aquatic organisms is limited.

For the next three parameters, evaluate the condition of the right and left stream banks separately. Define the "left" and "right" banks by standing at the downstream end of your study stretch and looking upstream. Each bank is evaluated on a scale of 0-10.

8. **Bank vegetative protection** measures the amount of the stream bank that is covered by vegetation. The root systems of plants growing on stream banks help hold soil in place, reducing erosion. Vegetation on banks provides shade for fish and macroinvertebrates and serves as a food source by dropping leaves and other organic matter into the stream. Ideally, a variety of vegetation should be present, including trees, shrubs, and grasses. Vegetative disruption can occur when the grasses and plants on the stream banks are mowed or grazed, or when the trees and shrubs are cut back or cleared.

9. **Condition of banks** measures erosion potential and whether the stream banks are eroded. Steep banks are more likely to collapse and suffer from erosion than are gently sloping banks and are therefore considered to have a high erosion potential. Signs of erosion include crumbling, unvegetated banks, exposed tree roots, and exposed soils.

10. **The riparian vegetative zone width** is defined as the width of vegetation from the edge of the stream bank. The riparian vegetative zone is a buffer to prevent pollutants from entering a stream. It also controls erosion and provides stream habitat and nutrient input to the stream. A wide, relatively undisturbed riparian vegetative zone helps maintain a healthy stream system; narrow, far less useful riparian zones occur when roads, parking lots, fields, lawns, and other cultivated areas, bare soil, rocks or buildings are near the stream bank. The presence of “old fields” (i.e. previously developed agricultural fields allowed to revert to natural conditions) should be rated higher than fields in continuous or periodic use. In arid areas, the riparian vegetative zone can be measured by observing the width of the area dominated by riparian or water-loving plants, such as willows, marsh grasses, and cotton wood trees.

Stream Habitat Assessment Field Data Sheet – Rocky Bottom Sampling

(p 1 of 3)

ALL of the following data sheets MUST be completed for the web host.

Date: Year _______ Month ________ Day________ Time: Hour ________ Minute ________

Site ID #________________ Volunteer(s) ID #(s) ________________ Recorder ID # _________

Habitat	Category			
Parameter	Optimal	Suboptimal	Marginal	Poor
1. Attachment Sites for Macro-invertebrates	Well-developed riffle and run; riffle is as wide as stream and length extends 2 times the width of stream; cobble predominates; boulders and gravel common.	Riffle is as wide as stream but length is less than 2 times width; cobble less abundant; boulders and gravel common.	Run area may be lacking; riffle not as wide as stream and length is less than 2 times the stream width; gravel or large boulders and bedrock prevalent; some cobble present.	Riffles or run virtually nonexistent; large boulders and bedrock prevalent; cobble lacking.
Score:	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
2. Embedded-ness	Fine sediment surrounds and fills in 0-25% of the living spaces around and in between the gravel, cobble, and boulders.	Fine sediment surrounds and fills in 25-50% of the living spaces around and in between the gravel, cobble, and boulders.	Fine sediment surrounds and fills in 50-75% of the living spaces around and in between the gravel, cobble, and boulders.	Fine sediment surrounds and fills in more than 75% of the living spaces around and in between the gravel, cobble, and boulders.
Score:	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
3. Shelter for Fish & Macro-invertebrates	Snags, submerged logs, undercut banks, cobble and large rocks, or other stable habitat are found in over 50% of the site.	Snags, submerged logs, undercut banks, cobble and large rocks or other stable habitat are found in over 30-50% of the site.	Snags, submerged logs, undercut banks, cobble and large rocks or other stable habitat are found in over 10-30% of the site.	Snags, submerged logs, undercut banks, cobble and large rocks, or other stable habitat are found in less than 10% of the site.
Score:	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1

Total ______________ (1-3)

Stream Habitat Assessment Field Data Sheet – Rocky Bottom Sampling ***(p 2 of 3)***

Habitat	Category			
Parameter	Optimal	Suboptimal	Marginal	Poor
4. Channel Alteration	Stream straightening, dredging, artificial embankments, dams or bridge abutments absent or minimal; stream with meandering pattern.	Some stream straightening, dredging, artificial embankments or dams usually in areas of bridge abutments; no evidence of recent channel alteration activity.	Artificial embankments present to some extent on both banks; at 40 to 80% of stream site straightened, dredging, or otherwise altered.	Banks shored with gabion or cement; over 80% of the stream site straightened and disrupted.
Score:	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from coarse gravel; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel coarse sand on old and new bars; 30-50% of the bottom affected; sediment deposits at stream obstructions and bends; moderate deposition in pools.	Heavy deposits of fine material, increased bar development; more bottom affected; pools almost absent due to substantial sediment deposition.
Score:	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. Stream Velocity & Depth Combinations	Slow (<1 ft/s)/deep (>1.5 ft); slow/shallow; fast/deep; fast/shallow combinations all present.	3 of the 4 velocity/depth combinations are present; fast current areas generally dominate.	Only 2 or the 4 velocity/depth combinations present. Score lower if fast current areas missing.	Dominate by 1 velocity/depth category (usually slow/shallow areas).
Score:	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Flow Status	Water reaches base of both lower banks and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; <25% of channel substrate is exposed.	Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
Score:	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Total_______________ (4-7)

Date

________/________/________

Site ID # ______________________

Stream Habitat Assessment Field Data Sheet – Rocky Bottom Sampling *(p 3 of 3)*

Habitat Parameter	Category: Optimal	Suboptimal	Marginal	Poor
8. Bank Vegetative Protection Note: determine left or right side by facing upstream (score each bank)	More than 90% of streambank surfaces covered by natural vegetation, including trees, shrubs, or other plants; vegetative disruption, through grazing or mowing, minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by natural vegetation, but one class of plant is not well-represented; some vegetative disruption evident; more than one-half of the potential plant stubble remaining.	50-70% of the streambank surfaces covered by vegetation; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation is very high; vegetation has been removed to 2 inches or less in average stubble height.
Score:	Left Bank 10 9	8 7 6	5 4 3	2 1 0
Score:	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Condition of Banks (score each bank)	Banks stable; no evidence of erosion or bank failure; little potential for future problems.	Moderately stable; infrequent, small areas of erosion mostly healed over.	Moderately unstable; up to 60% of banks in site have areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank collapse or failure; 60-100% of bank has erosional scars
Score:	Left Bank 10 9	8 7 6	5 4 3	2 1 0
Score:	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >50 feet; no evidence of human activities (i.e. parking lots, roadbeds, clear-cuts, mowed areas, or crops) within the riparian zone.	Width of riparian zone 35-40 feet; little evidence of human activities (i.e. parking lots, roadbeds, clear-cuts, mowed areas, or crops) within the riparian zone.	Width of riparian zone 20-35 feet; moderate evidence of human activities (i.e. parking lots, roadbeds, clear-cuts, mowed areas, or crops) within the riparian zone.	Width of riparian zone <20 feet; much evidence of human activities (i.e. parking lots, roadbeds, clear-cuts, mowed areas, or crops) within the riparian zone.
Score:	Left Bank 10 9	8 7 6	5 4 3	2 1 0
Score:	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total _______________ (8-10)
Total _______________ (1-3)
Total _______________ (4-7)
_________________ **Total (out of possible 200)**

Date

Summary Table - Stream Habitat Assessment Field Data Sheet – Rocky Bottom Sampling (Senior Environment Corps protocol)

Appendix D

Site	Habitat Score (Highest score is 200)
MC #1 Headwaters	181
MC #3 Above Wilson Run	162
MC #4 Wilson Run	184
MC #5 Below Wilson Run	176
MC #6 Above Roup Run	191

Stream Habitat Assessment Field Data Sheet – Rocky Bottom Sampling (Senior Environment Corps protocol) – MC #1 Headwaters

Category				
Habitat Parameter	Optimal 16-20	Suboptimal 11-15	Marginal 6-10	Poor 1-5
Attachment Sites for Macroinvertebrates	19			
Embeddedness		15		
Shelter for Fish and Macroinvertebrates	19			
Channel Alteration	20			
Sediment Deposition		15		
Stream Velocity and Depth Combinations	18			
Channel Flow Status	19			
Category				
Habitat Parameter	Optimal 9-10	Suboptimal 6-8	Marginal 3-5	Poor 0-2
Bank Vegetative Protection (face upstream to determine side)	Left bank – 10 Right bank – 10			
Conditions of banks		Left bank – 8 Right bank – 8		
Riparian Vegetative Zone Width	Left bank – 10 Right bank – 10			
Total	181 out of a possible 200			

Stream Habitat Assessment Field Data Sheet – Rocky Bottom Sampling (Senior Environment Corps protocol) - MC #3 Above Wilson

Category				
Habitat Parameter	Optimal 16-20	Suboptimal 11-15	Marginal 6-10	Poor 1-5
Attachment Sites for Macroinvertebrates		15		
Embeddedness		13		
Shelter for Fish and Macroinvertebrates	19			
Channel Alteration		15		
Sediment Deposition		13		
Stream Velocity and Depth Combinations	18			
Channel Flow Status	19			
Category				
Habitat Parameter	Optimal 9-10	Suboptimal 6-8	Marginal 3-5	Poor 0-2
Bank Vegetative Protection (face upstream to determine side)	Right bank – 10	Left bank – 7		
Conditions of banks	Left bank 10 Right bank 10			
Riparian Vegetative Zone Width	Right bank – 10		Left bank – 3	
Total	162 out of a possible 200			

Stream Habitat Assessment Field Data Sheet – Rocky Bottom Sampling (Senior Environment Corps protocol) - MC #4 Wilson Run

Category				
Habitat Parameter	Optimal 16-20	Suboptimal 11-15	Marginal 6-10	Poor 1-5
Attachment Sites for Macroinvertebrates	20			
Embeddedness	20			
Shelter for Fish and Macroinvertebrates	20			
Channel Alteration	18			
Sediment Deposition	20			
Stream Velocity and Depth Combinations	13			
Channel Flow Status	19			
Category				
Habitat Parameter	Optimal 9-10	Suboptimal 6-8	Marginal 3-5	Poor 0-2
Bank Vegetative Protection (face upstream to determine side)	Left bank – 10 Right bank – 10			
Conditions of banks	Left bank 10 Right bank 10			
Riparian Vegetative Zone Width	Right bank – 10		Left bank – 4	
Total	184 out of a possible 200			

Stream Habitat Assessment Field Data Sheet – Rocky Bottom Sampling (Senior Environment Corps protocol) - MC #5 Below Wilson Run

Category				
Habitat Parameter	Optimal 16-20	Suboptimal 11-15	Marginal 6-10	Poor 1-5
Attachment Sites for Macroinvertebrates	18			
Embeddedness		14		
Shelter for Fish and Macroinvertebrates	17			
Channel Alteration	20			
Sediment Deposition			10	
Stream Velocity and Depth Combinations	18			
Channel Flow Status	19			
Category				
Habitat Parameter	Optimal 9-10	Suboptimal 6-8	Marginal 3-5	Poor 0-2
Bank Vegetative Protection (face upstream to determine side)	Left bank – 10 Right bank – 10			
Conditions of banks	Left bank 10 Right bank 10			
Riparian Vegetative Zone Width	Left bank – 10 Right bank – 10			
Total	176 out of a possible 200			

Stream Habitat Assessment Field Data Sheet – Rocky Bottom Sampling (Senior Environment Corps protocol) – MC #6 Above Roup Run

Category				
Habitat Parameter	Optimal 16-20	Suboptimal 11-15	Marginal 6-10	Poor 1-5
Attachment Sites for Macroinvertebrates	20			
Embeddedness	19			
Shelter for Fish and Macroinvertebrates	19			
Channel Alteration	20			
Sediment Deposition	20			
Stream Velocity and Depth Combinations		15		
Channel Flow Status	18			
Category				
Habitat Parameter	Optimal 9-10	Suboptimal 6-8	Marginal 3-5	Poor 0-2
Bank Vegetative Protection (face upstream to determine side)	Left bank – 10 Right bank – 10			
Conditions of banks	Left bank 10 Right bank 10			
Riparian Vegetative Zone Width	Left bank – 10 Right bank – 10			
Total	191 out of a possible 200			

Appendix E

Watershed Assessment of Moshannon Creek Headwaters

Organization Name: Clearfield County Conservation District
Donna Carnahan- Watershed Specialist
(814) 765-8130

The Moshannon Creek Headwaters Assessment is:

- An 18-month effort to determine the ecological condition of the water from the headwaters of Moshannon Creek to Roup Run.
- A project conducted by the Clearfield County Conservation District and funded by a grant from the Coldwater Heritage Partnership on behalf of the PA Department of Conservation and Natural Resources, the PA Fish and Boat Commission, the Western PA Watershed Program, and PA Trout Unlimited.

Objectives of the Assessment:

- To study the environmental condition of the headwaters of Moshannon Creek;
- To study the water quality and biological indicators of the headwaters of Moshannon Creek;
- To describe the physical characteristics of the watershed;
- To develop a plan for conserving and protecting the headwaters of Moshannon Creek.

What will ***NOT*** happen on your property:

- The study is *not* done to regulate or enforce any laws.
- The study will *not* associate any finding with property owners.
- The study will *not* degrade your property value or destroy wildlife habitat.

Watershed Facts:

- The Moshannon Creek watershed covers 269 square miles that forms the boundary between Clearfield and Centre Counties.
- The headwaters begin in Blair County and flow northeast to the West Branch of the Susquehanna near the town of Karthaus.
- The creek is commonly referred to as the "Red Moshannon" due to iron precipitate due to poor mining practices.

- The Headwaters preceding Roup Run are classified as a high quality fishery and a Wild Brook Trout Fishery.

How research will be conducted:

- During the 18-month period, team members will designate sites to collect water samples.
- The site will be left in the same condition as found.
- All access will be done by foot only.
- The Clearfield County Conservation District will complete a detailed analysis of the field data and generate a final report which will be available to the public
- There will be a public meeting held to review concerns and to inform the public on the research conducted on the Headwaters of the Moshannon Creek.

The end result will be:

- A report that describes the overall condition of the headwaters of Moshannon Creek to Roup Run. The information gained will be used to develop a plan to preserve and protect the watershed, the water quality, and the wildlife in the stream.

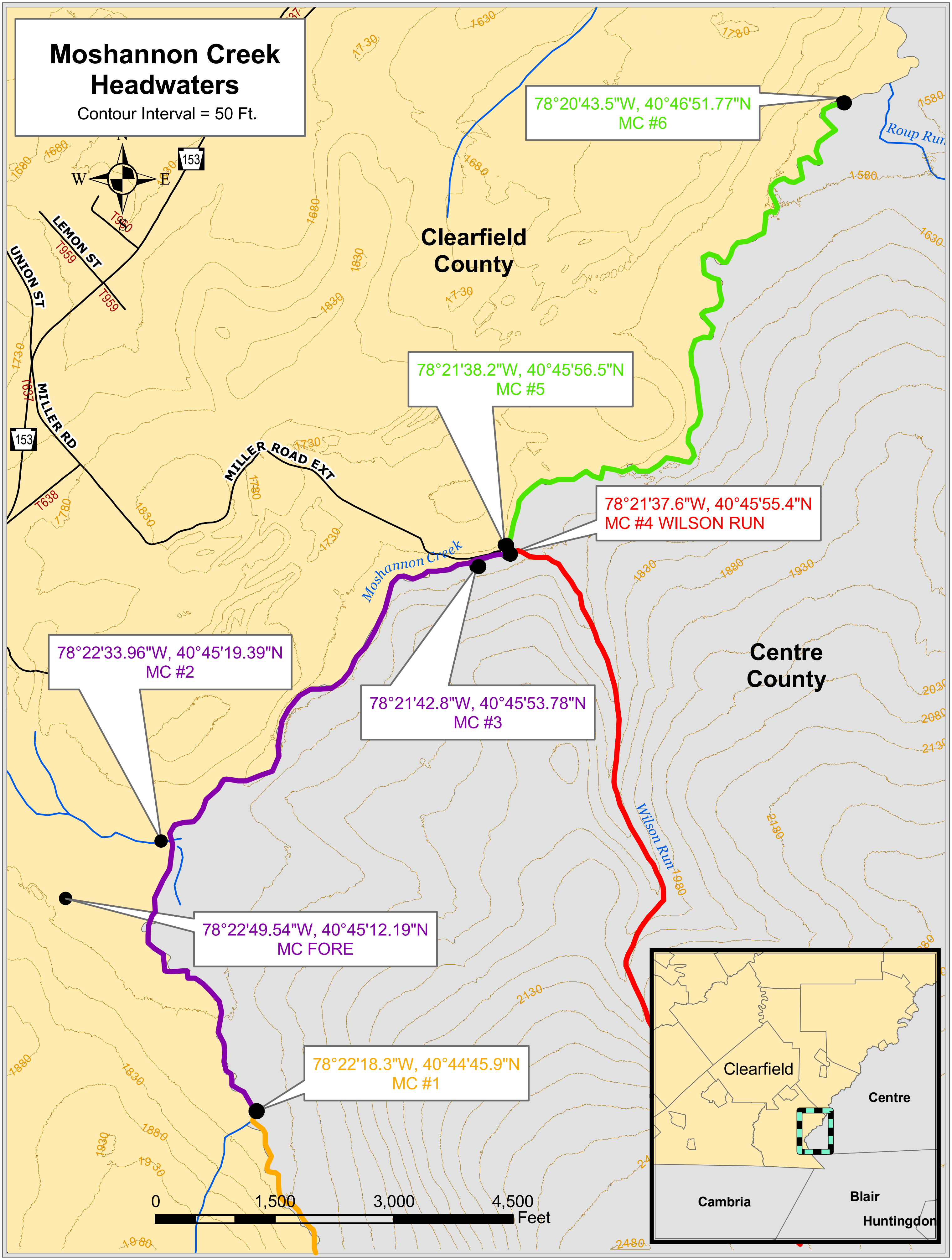
IF YOU HAVE ANY PROBLEMS, COMMENTS OR CONCERNS WITH EMPOYEES OF THE CLEARFIELD COUNTY CONSERVATION DISTRICT ACCESSING MOSHANNON CREEK AND ITS TRIBUTARIES ON YOUR PROPERTY,
Please contact Donna Carnahan at (814) 765-8130.

Thanks for your support in helping clean Pennsylvania's waterways.

Date: ___________

Map # ________
Parcel# ________

Appendix F Map



Moshannon Creek Headwaters
Contour Interval = 50 Ft.
78°20'43.5"W, 40°46'51.77"N
MC #6
78°21'38.2"W, 40°45'56.5"N
MC #5
78°21'37.6"W, 40°45'55.4"N
MC #4 WILSON RUN
78°21'42.8"W, 40°45'53.78"N
MC #3
78°22'33.96"W, 40°45'19.39"N
MC #2
78°22'49.54"W, 40°45'12.19"N
MC FORE
78°22'18.3"W, 40°44'45.9"N
MC #1
Clearfield County
Centre County
Moshannon Creek
Wilson Run
Roup Run
LEMON ST
UNION ST
MILLER RD
MILLER ROAD EXT
153
T959
T638
0
1,500
3,000
4,500
Feet
Clearfield
Centre
Cambria
Blair
Huntingdon