Future AMD Restoration Costs and Economic Benefits in the Stonycreek River Watershed

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Introduction

The Stonycreek River watershed is one of two major watersheds that form the Conemaugh River, with the other watershed being the Little Conemaugh River. The Stonycreek River watershed has a drainage area of 468 square miles. The drainage area lies mostly in Somerset County, but a small portion is located in Cambria County on the outskirts of the City of Johnstown. Like the Little Conemaugh River, the Stonycreek River was severely impacted by abandoned mine drainage (AMD). In 1994 the United States Geological Survey (USGS) conducted a survey of mine drainages within the Stonycreek River basin. The study located a total of 270 mine discharges in the watershed, with 193 of these discharges exceeding United States Environmental Protection Agency (USEPA) effluent standards (Williams et al. 1996). In 1994, according to Pennsylvania Fish and Boat Commission (PFBC) electrofishing surveys, the majority of the Stonycreek River watershed was severely degraded by AMD.

Since 1994 $10 million has been invested in the watershed for AMD abatement projects. One of the lead groups behind the remediation efforts has been the Stonycreek-Conemaugh River Improvement Project (SCRIP), which was created to address environmental problems in the Upper Conemaugh Basin that includes the Stonycreek and Little Conemaugh Rivers. SCRIP is a coalition of grass roots groups and local resource agencies drawing in sportsmen, environmental groups, municipalities, businesses, coal operators, schools, etc. SCRIP was created in part through the support of Congressman John Murtha and has enjoyed strong support from virtually all elected officials. With the grassroots and political support, SCRIP has succeeded in creating partnerships with many agencies such as the PA Department of Environmental Protection, USDA Natural Resources Conservation Service, USGS, US Office of Surface Mining and the Army Corps of Engineers, who funded most of this restoration.

In 2007, the Somerset Conservation District conducted a watershed reassessment to identify the impacts that treatment systems and conservation efforts have had in the Stonycreek River watershed. The results of this reassessment showed the success of implemented projects. Fish populations have improved or been restored to the majority of the watershed. A year-round put and grow trout fishery has been established from the borough of Shanksville to the borough of Benson (Hollsopple). Macroinvertebrate life was also on the rebound throughout the watershed.

Even with all the restorative success in the watershed, the reassessment also determined that the major tributaries and headwater reaches of the Stonycreek were still severely degraded from AMD and agricultural runoff. These areas can be reclamated but due to the high cost of building and maintaining treatment systems not much remediation has been accomplished. If these subwatersheds are fully restored they would then become destination points for eco-tourism and secure the water quality future of the Stonycreek and Conemaugh River watersheds. Restoration of these areas would produce a large economically viable fishery, along with expansive premier white water sporting opportunities. Increased water available for drinking water sources would spur business development in the Stonycreek River watershed and increase the property values.

This summary of the full restoration will discuss the locations, treatment needed, cost of treatment, and economic benefits of restoration for the Stonycreek River watershed. This summary utilized various reports and restoration plans from throughout the Stonycreek River watershed to compile an estimate of treatment and economic benefit for the watershed (Table 1).

The treatment system costs were calculated using AMD Treat Software 2002. Inflation of construction materials was also added to the total cost of treatment systems and maintenance. For the purpose of this report the watershed was divided into five focus areas each of which has its own unique qualities and benefits of being restored. The five segments are the Upper Stonycreek, Middle Stonycreek, Quemahoning Creek, Shade Creek, and Paint Creek (Figure 1).

This document summarizes the more specific discharge site details that are recommended in the Quemahoning Creek Restoration Plan, Shade Creek Watershed Restoration Plan and the Paint Creek Restoration Plan that were all developed by locally-driven watershed restoration efforts. This document assigns cost of design and construction for each AMD discharge location that is recommended in these plans as essential for effective AMD abatement. An assessment of a sustainable restorative economic dollar amount that captures the natural capitol value that AMD restoration will create within the Stonycreek River watershed has also been derived.

Table 1. Watershed plans used in report.

Plan	Completed by	Author(s)	Year
Stonycreek River Watershed Reassessment	Somerset Conservation District	Deal, Null and Lichvar	2008
Quemahoning Creek Watershed Restoration Plan	Southern Alleghenies Conservancy	Diehl and Lichvar	2002
Position Paper for Stonycreek Whitewater Releases from Quemahoning Dam	American Whitewater and Benscreek Canoe Club	Cuppett and Tuscano	1999
Wildlife Habitat in Pennsylvania: Past, Present and Future		Goodrich, Brittingham, Bishop and Barber	2000
Rapid Watershed Assessment: Conemaugh Watershed	USDA NRCS		2007
Paint Creek Restoration Plan	Paint Creek Regional Watershed Association and PA DEP	Clark	2003
Aquatic Survey of Quemahoning Creek Watershed	PA DEP, Bureau of Abandoned Mine Reclamation	Spyker	2008
Shade Creek Watershed Restoration Plan	Dark Shade Brownfields Project, Shade Creek Watershed Association, and Somerset Conservation District		2000
Justification for Heinemyer and Artesian Discharge Treatment systems on Lamberts Run	Somerset Conservation District	Deal and Lichvar	2008

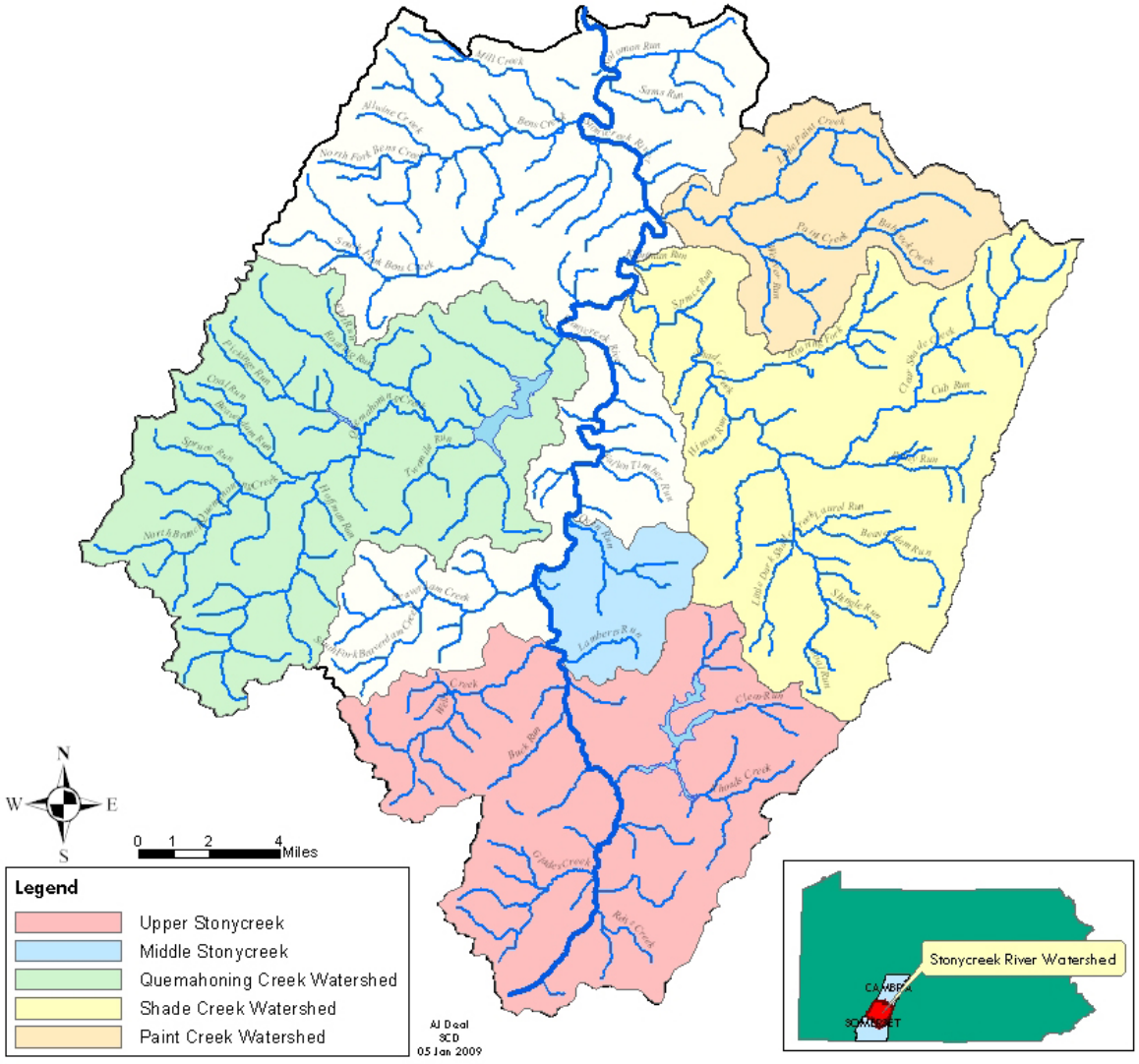
The Somerset Conservation District (SCD) has provided administrative, grant writing, GIS and other technical support to all the watershed groups and other volunteer and professional organizations in the Stonycreek River watershed. Through these services, the SCD has empowered these groups to achieve their on the ground project goals and create visionary plans for the future. The SCD has also utilized its own in-house capacity to secure funding for design and implementation of its own water quality improvement projects in the watershed.

The Stonycreek Quemahoning Initiative (SQI) has already utilized the improving water quality to create and fund eco-tourism infrastructure in the watershed. Efforts of the SQI clearly

demonstrate that dollar investments in green initiatives are a direct result of resource conservation projects.

The Stonycreek River watershed is strategically positioned within the PA DCNR Laurel Highlands Conservation Landscape Initiative (Laurel Highlands 2008). This initiative, just underway, focuses on long-term sustainable development and conservation efforts within a specific region of southwestern Pennsylvania. This initiative is dependent on past, current and future resource conservation projects. The improved water quality in the Stonycreek River watershed is one of the primary improvements that have spurred opportunities such as the Laurel Highlands Initiative. If this initiative is to succeed in meeting its sustainable economic goals, then water quality must be maintained and improved and the Stonycreek River is a cornerstone component of that requirement.

Figure 1. Focus areas of restoration in the Stonycreek River watershed.



Upper Stonycreek River Restoration

The upper portion of the Stonycreek River, from its headwaters in Berlin to the confluence with Wells Creek, (14 main stem miles) is classified as a cold water fishery by the state of Pennsylvania. This section has been the least studied portion of the watershed, and the 2007 reassessment gave special attention to this region due to the lack of data available from this area. Results showed that this section was suffering from severe physical habitat impairment mostly due to the absence of a substantial riparian buffer. Water chemistry showed a spike in nitrate levels, which was likely the result of nutrient runoff (Deal et al. 2008). The lack of a riparian buffer also contributes to increased siltation in the river and severe bank erosion causing the benthic substrate to be covered with sediment. Without a riparian buffer the water in the river has no canopy to shade the water from sun, therefore increasing the water's temperature above the levels that are tolerated by trout. Riparian buffers also act as a filtering mechanism that prevents nutrient-laden agriculture runoff from entering the river. The majority of the impacts in this section are caused by poor farming practices. Farmers have removed the buffers in the area to allow for more cattle grazing and crop growing area, while not realizing that they are loosing part of their farm every year to erosion.

This region of the watershed has a large percentage of non-traditional farmers. A partnership must be established with both traditional and non-traditional farmers to improve the headwaters of the Stonycreek. If this area is reclaimed and fishing access can be acquired, there will be 10 miles (from Glades to the confluence with Wells Creek) of the Stonycreek River available to trout fishing that was not available before reclamation. The cold water that would be restored could allow for the establishment of one of the longest delayed harvest trout fishing areas in Pennsylvania. One of the closest and most famous delayed harvest areas is located on the Casselman River in Grantsville, Maryland. This three mile delayed harvest area on the Casselman River has reportedly brought $750,000 per year to the Grantsville/Garrett County region. The Casselman is worth roughly one quarter of a million dollars per mile a year (Klotz et al 2002). Using those numbers, this area of the Stonycreek River would be worth $2.5 million per year to Somerset County just in angling tourism. When comparing the Casselman River in Grantsville and the Upper Stonycreek, the watersheds have approximately the same size, topography and demographics.

Rapid Riparian Replacement Initiative

The Somerset Conservation District has been working with hybrid poplar trees for the past four years as source for cellulosic biofuel production. While not native, these trees can be propagated easily under the proper conditions. They develop large root masses quickly and provide ample shade. The trees reach usable size in 4-5 years (8-10 in dbh). The notion that these trees can be planted with native species to anchor the ground while native riparian trees develop is a proposal that the SCD has been researching. The beginning of the research would involve the collection of poplar leaves to be weighed and placed in leaf packs. These leaf packs would be placed in a stream of known high shredder macroinvertebrate taxa populations. The leaf packs would be randomly removed at weekly intervals in the fall of the year. The leaves would be dried and weighed to assess if the poplar leaves contributed to the aquatic food web in a positive way. If these hybrids were found to contribute energy to the food web in a positive manner, then trial riparian plots would be planted with one third of the trees being comprised of

hybrid poplar saplings. The remaining trees would be native species that grow much slower. The poplars would help to stabilize the bank while the native trees developed large root wads.

The overall goal of this project is to establish forested areas on lands that are nonproductive or abandoned mine lands that can be put back into productive use by growing biomass which can be utilized for wood production or energy development.

The major component to the restoration of these areas is public education for the local farmers and to provide possible public access to future public access to streams. The permitting, land purchasing, and legal fee are costly necessities for this area to benefit the public.

The Somerset Conservation District is involved with a project called the "One Million Trees Program" which is a multifaceted program that will use poplar trees as a rotational crop for woody biomass. This project will also utilize nutrients from the Chesapeake Bay that will be incorporated into poorly reclaimed mine lands to add additional nutrients to these nutrient depleted soils. The ultimate goal is to develop an infrastructure for a local sustainable renewable energy source.

Cost of Restoration of the Upper Stonycreek (Table 2)

The upper Stonycreek and its tributaries require eight miles of riparian buffer restoration while the largest tributary Wells Creek needs approximately three miles of riparian restoration on its mainstem and tributaries. In-stream structures such as K-dams and log deflectors will be used to aid the stream in cleaning itself from silt and sediment. The cost for the complete riparian buffer restoration including trees, fencing, and labor is $128,000. The cost for the rapid riparian buffer initiative is $23,000. In-stream structures for this area of the watershed will cost approximately $100,000 for the materials and labor. The cost for permitting, legal fees, and land access is approximately $170,000. The total cost for the restoration of the upper Stonycreek River is $583,000. The total revenue generated by restoring the fishery in this area far exceeds the total cost for the project (Rapid Watershed Assessment 2007).

Table 2. Upper Stonycreek improvement needs and costs.

Restoration Component	Cost
Wells Creek Riparian Buffer Reestablishment	$16,000
Upper Stonycreek Riparian Buffer Reestablishment	$94,000
Upper Stonycreek In-stream structures	$100,000
Rapid Riparian Stabilization Initiative	$3,000
Farmer Incentive/Angler Access/ Legal Fees	$120,000
Project Labor	$200,000
Public Education	$50,000
Total Cost	**$583,000**

Middle Stonycreek Restoration

The middle reaches of the Stonycreek River watershed are comprised of smaller subwatersheds than the upper and lower reaches. The small sub-watersheds include Lamberts Run, Pokeytown Run, and Oven Run. The Oven Run watershed has been extensively remediated with six treatment systems at an initial cost of $5 million, but due to the severity of the discharges on Oven Run, the treatment systems cannot remove all of the metals from the stream before entering the Stonycreek. A large aluminum discharge from an abandoned mine outside of the village of Lambertsville is currently discharging large amounts of aluminum into Oven Run. The downstream treatment systems are taxed by this new discharge and cannot remove all the aluminum. This discharge needs to be addressed with its own treatment system. Oven Run's existing treatment systems are in desperate need of maintenance and upgrades. When these systems were built in the late 1990's there were insufficient funds set aside for maintenance of the systems beyond ten years. Now the systems are in need of work and if maintenance is not performed on a yearly basis, these systems will fail, resulting in the surge of untreated hot acidic water with a pH of 2.5 into the Stonycreek River.

The Lamberts Run sub-watershed also has active and passive treatment systems already installed. This stream originates in the proposed historic Flight 93 National Memorial and is discussed in length in multiple publications by state and federal agencies in conjunction with the memorial (Flight 93 2006). Lamberts Run has been a limiting factor to the trout fishery in the middle section of the Stonycreek River. The current active treatment system has been upgraded and modified. Through a trust fund settlement through PA DEP, the system should continue to function and be maintained into the future. The current passive treatment has been funded through PA DEP's Growing Greener Program for upgrades and improvements that should restore its effectiveness.

A new project to reduce the impairments of the Heinemyer and Artesian discharges along Lamberts Run must be constructed in order to complement the current active and passive treatment sites, as well as address the remaining significant AMD pollution entering Lamberts Run. The total project cost of treating Heinemyer and Artesian discharges as calculated by the PA DEP is $361,000 (PA DEP 2008).

This reclamation project will resurrect three miles of fishery on Lamberts Run and improve the fishery on six miles of the Stonycreek River. The economic impact of this nine mile restoration is $665,872.92 in angling tourism (Deal and Lichvar 2008).

The last of the severely degraded small subwatersheds is Pokeytown Run. Pokeytown Run is severely degraded by acidic mine drainage to the point that the average pH in the mainstem of the creek is 3.67. This small tributary degrades the water that is treated by the upstream facility at Oven Run. The seeps on this tributary are small but run very hot with acidity.

All of these middle reach sites degrade water quality downstream to the Quemahoning Creek, potentially harming future economic and conservation opportunities.

Cost of Treatment (Table 3)

The Oven Run treatment systems need an additional $1.2 million to treat the large aluminum discharge in the upper Oven Run watershed. The treatment of this large discharge

would ease the burden of metal accumulation in the Oven Run Site A treatment system, which was not designed to handle this discharge. The Pokeytown Run watershed will be a relative inexpensive site to treat due to the low volume of water in the discharges. The Pokeytown Run area would be able to be treated with a vertical flow wetland for approximately $78,000 and $3,000 per year for maintenance.

Table 3. Middle Stonycreek improvements and costs.

Restoration Component	Initial Cost	Yearly Maintenance Cost
AMD Treatment System	$78,000	$3,000
Oven Run Aluminum Treatment	$1,200,000	$8,000
Oven Run Existing Treatment Sites	0	$51,000
Lamberts Run Treatment Upgrade	$125,000	$12,000
Heinemyer and Artesian Treatment Systems	$361,000	$20,000
Total Cost	**$1,764,000**	**$94,000**

Quemahoning Creek Restoration

The Quemahoning Creek sub-watershed is a 98 square mile watershed and has long been impacted by AMD. But with the dedicated efforts of organizations such and SCD, SCRIP, MLTU, PA DEP and OSM, the Quemahoning now supports a year-round trout stocked fishery in its lower reaches. A complete Quemahoning Creek Watershed Restoration Plan was completed by the Southern Alleghenies Conservancy in 2002 (Diehl and Lichvar 2002). Quemahoning Creek is impounded by the Quemahoning Reservoir. This 364 acre impoundment has a capacity of 92 billion gallons of water, which will soon be used to supply multiple townships with potable water through the completion of the Quemahoning Pipeline. In Somerset County large drinking water reserves are rare, and even with the relatively small population of 69,000, Somerset is running out of large areas of water to tap. The public acquisition of the Quemahoning Reservoir helped to solve this problem. With the AMD abatement projects in place, water quality in the Quemahoning Reseroir is greatly improved. However, Quemahoning Creek is still impacted by large alkaline mine drainages that taint the creek with iron. The watershed also contains small acidic seeps that generate large amounts of toxic metals that are discharged into the stream. These discharges must be addressed to maintain the stability of this important water supply.

In the near future, the permit mandated conservation release of 10.8 million gallons a day will be released from the Quemahoning Reservoir. This water release will restore the historic flow of water into the last mile of Quemahoning Creek and the Stonycreek River, which has been absent for nearly 100 years. As a result, downstream reaches will be able to sustain a seasonal coldwater and year-round coolwater fishery.

The main problem that plagues the Quemahoning Creek watershed is the same problem that all the other remediated portions of the Stonycreek have, ongoing maintenance costs for its treatment systems. The other untreated discharges in the watershed are constantly adding iron and other metals to the creek and staining the stream bottom downstream to the reservoir. These metals are accumulating in the reservoir, thus harming the potable and industrial water supply potential. If the existing treatment systems fail and untreated discharges enter the reservoir, the county will have no choice but to install a more advanced treatment system to filter the metals from the water. This would cost the individuals serviced by this system millions of dollars to

install. The increased cost of water would make the houses and property in this area unattractive for development and housing sale, thus the county objective of smart development would be greatly jeopardized.

Full remediation the Quemahoning Creek watershed would also enhance the fisheries in the stream and reservoir and ensure their long-term survival. The PFBC, SCD and other conservation groups have already installed fish habitat structures in the lake to enhance the fishery. The popularity of the reservoir as a fishery and source of regulated in-stream flows for rafting is growing fast. The fishery in the lower reaches of the stream is maintained by stocking trout. Reservoir trout migrate into Quemahoning Creek to spawn, but their efforts are in vain because the metal precipitates onto the stream bottom smothering their eggs. Restoring this watershed would protect this valuable drinking water source and as well as promote the sustainability of the coldwater and warmwater fisheries in the reservoir. The restoration will also create five more miles of TSF on the upper areas of the creek. This new fishery would be worth $369,930 per year to the local economy (Recreational Use Loss Values 2008).

Cost of Reclamation (Table 4)

The discharges in the Quemahoning Creek watershed are divided into three categories based on treatment type; active, passive for acid drainage, and passive for alkaline discharges. The treatment systems were chosen based on the Southern Alleghenies Conservancy's feasibility study of treatment system designs that could be used for these discharges. The active treatments will be used to remove acidity and precipitate metals out of the water before it enters Quemahoning Creek. The passive acid systems will be installed is areas where land availability allows, and will remove all metals and add alkalinity to Quemahoning Creek. The passive alkaline systems will be constructed to remove large quantities of iron from the discharges before they enter the mainstem.

Table 4. Quemahoning Creek AMD abatement systems and costs.

Active Treatment Sites	**Type of System**	**Initial Cost**	**Yearly Maintenance**
USGS 183	Limestone Doser	$75,933	$3,356
USGS 92	Limestone Doser	$68,076	$3,259
USGS 47	Limestone Doser	$75,859	$3.360
USGS 258	Limestone Doser	$125,162	$3,459
Passive Alkaline Systems			
USGS 54	Aerobic Wetland	$27,456	$8,493
USGS 174	Aerobic Wetland	$39,134	$7,788
Passive Acid Systems			
USGS 48	Anaerobic Wetland	$30,385	$4,384
USGS 209	Anaerobic Wetland	$29,863	$4,740
USGS 208	Anaerobic Wetland	$1,365,393	$295,633
USGS 175	Anaerobic Wetland	$25,742	$,526
USGS 172	Vertical Flow	$36,288	$12,326
Total Costs		**$1,899,291**	**$351,324**

Shade Creek Restoration

The Shade Creek watershed is home to one of the most pristine areas in the Stonycreek River basin, Clear Shade Creek. Clear Shade Creek has the only special regulation trout water in the Stonycreek watershed. This heavily forested, freestone stream has little or no development within its watershed. Clear Shade Creek confluences with Dark Shade Creek outside of the borough of Central City. This is where water quality becomes degraded and excellent trout fishing ends in the Shade Creek watershed. As depicted in the Shade Creek Watershed Restoration Plan of 2002, Shade Creek's headwaters (Dark Shade Creek) encounter very acidic AMD (Shade Creek 2000). These discharges are all stream killing discharges and some have treatment systems already installed to treat the acidity. Unfortunately all discharges are dwarfed by the USGS 16 (Reitz #4), which has flow rates up to 5.4 million gallons a day (MGD) with an average pH of 3.20. This discharge effectively destroys any treatment attempt in the watershed to reclamate the mainstem of Shade Creek. The USGS 16 site is very difficult to treat because of limited land availability for a massive treatment system. Research is still being compiled to assess how to treat this mega discharge, but funding has run short.

At the confluence of Shade Creek with the Stonycreek River a defined line of precipitated heavy metals can be seen. The pH of Shade Creek at the confluence is 3.5. This discharge does not kill the Stonycreek because of the alkalinity supplied to the river by upstream treatment systems and alkaline geology. Shade Creek does, however, eliminate the Stonycreek's buffering capacity, which allows the downstream input of Paint Creek to severely impair the lower Stonycreek River. Another problem that arises with Shade's effluent into the Stonycreek is the presence of large quantities of heavy metals which limit aquatic life. Shade Creek's confluence with the Stonycreek River is located downstream of the upcoming conservation release from the Quemahoning Reservoir. Metal precipitate in Shade Creek continually reduces the potential for more stable water quality to sustain a year-round coldwater and coolwater fishery.

Economic Value of Restoration

While the number of lethal discharges is less in the Shade Creek watershed when compared to the Paint Creek watershed, all discharges in the Shade Creek watershed are large and able to kill Shade Creek. Restoration of this watershed would create a viable trout fishery as well as a rafting destination. The reclamation of 25 miles of trout stocked fishery (TSF) fishery would generate $1,849,650 to the local economy per year. Five miles of intermediate whitewater rafting area would be available without pollution; this would be worth $1.2 million to the local economy per year (Cuppett and Tuscano 1999). Jobs created by the rafting and fishing would emerge in Central City as well as local businesses to accommodate the tourism.

Cost of Reclamation (Table 5)

All discharges in the Shade Creek Watershed are acidic. The treatment systems have been divided into passive and active treatments. The active treatments will be used in areas where insufficient land is available for a passive treatment system. These systems will utilize a limestone dosing silo to treat each discharge. There are two sites where active systems must be used, Roaring Run and Whispering Pines. The total cost of these two systems is approximately $193,389 with a yearly maintenance fee of $18,697. Passive treatment systems are located on

large discharge sites. The passive systems should remove all metals and add alkalinity to the mainstem of Shade Creek. The total cost of these systems is $877,482 with a yearly maintenance cost of $126,121.

The massive USGS 16 will require funding for alternative treatment methods due to its large size and location. The USGS 16 is the largest discharge in the entire Stonycreek River watershed. As mentioned before the specific technology to treat and maintain the USGS 16 is not available. With future funding reinstated, the development of a treatment method can occur. The estimates of a treatment method were calculated by using the targeted water quality, existing water quality, and maintenance fees of treating the water. The estimate for the treatment of this facility with research included is $4.8 million with an annual maintenance of $285,000. It is important to note that without the reclamation of this discharge all other discharges that can be treated will still not be able to combat the effects of this single discharge on Shade Creek. When the USGS 16 is compared to the other mentioned discharges, the true size of the discharge can be appreciated. The USGS 16 produces 241 tons of iron, 77 tons of aluminum, and 34 tons of manganese per year. The other mentioned discharges added together produce 17 tons of iron, 17 tons of aluminum, and 8 tons of manganese per year.

Table 5. Shade Creek watershed AMD abatement systems and costs.

Active Treatment Sites	Type of System	Initial Cost	Yearly Maintenance
Roaring Run	Limestone Silo	$68,389	$8,175
Whispering Pines	Limestone Silo	$125,000	$10,522
Passive Treatment Sites			
Reitz #2	Anoxic Limestone Drain	$34,698	$14,306
USGS 14	Anoxic Limestone Drain	$61,579	$11,155
Sand Plant	Anaerobic Wetland	$92,110	$12,512
USGS 15	Anoxic Limestone Drain	$79,764	$18,480
Huskin Run	Anaerobic Wetland	$584,731	$63,668
USGS 214	Vertical Flow	$24,600	$6,000
USGS 16 (Reitz #4)	Based on anoxic limestone drain**	$4,450,000	$285,000
Refuse Pile Removal		$750,000	0
Total Cost		**$6,270,871**	**$429,818**
			**technology in development

Paint Creek Restoration

Paint Creek is the most degraded of the subwatersheds with AMD. The Paint Creek watershed is located in the northeast area of the Stonycreek watershed. Paint Creek is a 38 square mile watershed comprised of 61.3 stream miles. While the headwater reaches of the watershed support brook trout populations the majority of the watershed is severely degraded by AMD. This watershed has the potential to support trout populations due to its steep gradient, cold water and canopy cover, but the severity of the acidy and heavy metals make fish life in the

stream impossible. This tributary of the Stonycreek River is largest limiting factor to the health of the lower Stonycreek River. Paint Creek is surrounded by forests and is located is some of Somerset County's most wild areas. There is an established watershed group within Paint Creek watershed, but due to the severity of the AMD drainages and lack of funding the group has had only marginal progress in reclaiming these large sites.

Treatment systems for the most inhibiting drainages have already been analyzed in detail by Thomas Clark, the watershed's consultant, in his Paint Creek Restoration Plan (Clark 2003). Treatment options are well defined for each of the severe discharges in the watershed's restoration plan. While treatment options have been determined, the amount of acidity and heavy metals in these discharges prevent treatment systems from being constructed due to the expensive systems needed to abate most of the discharges. Acquisition of funds to treat these discharges would result in approximately sixteen miles of reclamated water. The stream could support a stocked trout fishery and in time after metals were naturally removed from the stream bottom the area could support a thriving wild trout fishery. With the removal of the metals the stream would have more appeal as a whitewater destination. Paint Creek is already a Class V whitewater stream according to the American Whitewater Association. The reclamation of this stream would stimulate more whitewater recreation.

Economic Value of Reclamation

If the most severely impacted 11 miles of Paint Creek were reclaimed a TSF could be established in the watershed. The value of a TSF according to the Pennsylvania Fish and Boat Commission is $73,986.00 per mile a year, figuring that each mile of stream would receive 1,100 trips per year and the average angler would spend $67.26 every trip. This would add $813,846 to the local economy per year from angling tourism. The attractive white water qualities could bring as many as 1,500 rafters per mile per year generating $2.5 million per year, given that the average rafter spends $150 per weekend (Cuppett and Tuscano 1999). The Paint Creek watershed's scenic views, forests and state land attract hikers and wildlife viewers. According to the Pennsylvania Department of Conservation of Natural Resources (DCNR) the average bird watcher spends $350 a year to view birds in wild settings. This use of the reclamated resource is difficult to estimate, but with the abundance of AMD wetland treatment ponds this should attract diverse bird life.

Cost of Reclamation (Table 6)

There are 27 sites in the Paint Creek watershed that need to be addressed in order to reclaim the watershed. Some of these sites are located close enough to each other that one treatment system can treat multiple discharges. Treatment systems that will be employed are a combination of active and passive systems. These sites' pH range from 2.7 to 5.0 and all violate Pennsylvania Water quality criteria for at least one of the three AMD metals: aluminum, iron, and manganese (Pennsylvania Code 2001). The reclamation strategy for these sites is the standard protocol, begin reclamation in the headwaters and work downstream.

Treatment sites and methods were derived from the Paint Creek Restoration Plan (Clark 2003). Active lime silo dosing will be used at Upper Paint Creek Discharge 07 and Upper Paint Creek 06. The cost for treating these two sites is approximately $1.2 million with a yearly maintenance fee of $54,190. Babcock Creek Discharges 1-4 and Seese Run Discharge 01 will

utilize limestone sand dosing. The limestone sand will be placed on the stream banks to neutralize acidic impacts caused by precipitation. The cost to treat these four sites is approximately $223,359 with a yearly maintenance fee of $2,000. Upper Paint Creek Discharge 08, Upper Paint Creek Discharge 15, Lower Paint Creek Discharge 04 will utilize large scale vertical flow wetlands with sedimentation ponds. The total cost of these three systems is $1.7 million with a yearly maintenance fee of $20,000. Oxic limestone drains with settling ponds will be installed to remediate 17 sites within the watershed. The total cost to treat these sites is $2.6 million with a yearly maintenance fee of $30,525. The total cost for restoring the Paint Creek Watershed is approximately $7,569,036 with yearly maintenance costs being $104,743.

Table 6. Paint Creek watershed AMD abatement systems and costs.

Active Treatment Sites	Type of System	Initial Cost	Yearly Maintenance
Upper Paint Creek 07 & 06	Limestone Silo	$1,212,396	$54,190
Babcock Creek Sites 1-4	Limestone Sand Dosing	$223,359	$2,000
Seese Run Site 1	Limestone Sand Dosing	$36,000	$2,000
Passive Treatment Sites			
Upper Paint Creek 08	Vertical Flow Wetland with Sedimentation Ponds	$880,800	$10,808
Upper Paint Creek 15	Vertical Flow Wetland with Sedimentation Ponds	$512,700	$5,220
Lower Paint Creek 04	Vertical Flow Wetland with Sedimentation Ponds	$313,200	$3,133
Seese Run Site 02	Oxic Limestone Drain with Settling Ponds	$326,400	$3,265
Seese Run Site 03	Oxic Limestone Drain with Settling Ponds	$547,920	$5,479
Seese Run Site 04	Oxic Limestone Drain with Settling Ponds	$406,800	$4,104
Seese Run Site 07	Oxic Limestone Drain with Settling Ponds	$385,800	$3,856
Middle Paint Creek Sites 1-11	Oxic Limestone Drain with Settling Ponds	$54,661	$2,000
Middle Paint Creek Sites 12 & 13	Oxic Limestone Drain with Settling Ponds	$869,000	$8,688
Refuse Pile Removal		$1,800,000	0
Total Cost		**$7,569,036**	**$104,743**

Economic Benefits

AMD remediation will benefit both local communities and the entire commonwealth. For every dollar of external funds spent on local AMD abatement projects, the local economy will actually receive $1.36 to $1.87 in local economic activity, depending on the availability of local goods and services (Hansen et al. 2008). Employers and employees benefit through clean water and a better environment, but also from receiving wages and purchases from regional businesses. Project implementation creates green-collar jobs through the direct construction and

maintenance of treatment systems and also indirectly through jobs based on the cycled wages and secondary purchases.

AMD abatement will also create additional tax revenue for the local economy. Each business or worker that receives wages from remediation work will pay taxes as their investment dollars circulate through the local economy. The boost in local tax revenue can then boost funding for parks, greenways or other recreational outlets that can help people appreciate the newly restored watersheds.

Other Restoration Benefits

Cooperative Trout Nursery

The total restoration of the Stonycreek River watershed would result in many miles of sustainable and stocked trout fisheries. The PFBC is already maximizing its trout production and because of effluent limits cannot increase its production levels. A fishery of this size would require more stockings to take full advantage of the increased angling potential. A cooperative fish nursery between the conservation organizations of the Stonycreek River watershed and the PFBC would result in an ample supply of fish for these newly reclaimed streams and ensure the economic viability of this area as a fishery. A nursery with the ability to raise 20,000 trout annually would be needed. According to the PFBC Bureau of Engineering, a nursery that would harbor 10,000 fish would cost approximately $100,000 to build. Two of these nurseries would be needed. The idea of a cooperative nursery is not new. Sites have been located for these nurseries but funding and local support will be needed to build and maintain these facilities.

Property Value Increase

Another economic value of AMD remediation is the direct property value increase associated with clean streams. Trout Unlimited's West Branch of the Susquehanna Restoration Initiative economic benefit analysis for the Susquehanna in Pennsylvania projects that AMD riverfront and streamfront property will increase by an average of five percent per acre after reclamation is completed. Twenty-five percent of the total land area in the watershed would benefit from this increase. Taking into account the average cost of land in the watershed the increase would be $7.5 million. This would increase resale value and promote business and tourism development in the area.

Conclusion

Construction of all the necessary treatment systems within the Stonycreek River watershed would cost approximately $17.9 million. The most important factor in constructing these systems is their necessary maintenance. If these systems are not properly maintained then all the systems will fail resulting in the water quality of the Stonycreek returning to is pre-1994 status. The maintenance fees for the entire watershed to ensure the treatment systems can operate beyond ten years will be $10.9 million. At least a $2 million trust fund with a 0.5% interest rate should be established to maintain the $100,000 yearly maintenance costs. The total cost for the restoration of the Stonycreek River watershed will be $30.7 million (Table 7).

Table 7. Complete reclamation costs in the Stonycreek River watershed.

Watershed Region	Construction Cost	Yearly Maintenance Cost
Upper Stonycreek	$583,000	$0
Middle Stonycreek	$1,403,000	$74,000
Quemahoning Creek	$1,899,291	$351,324
Shade Creek	$6,270,871	$429,818
Paint Creek	$7,569,036	$104,743
Cooperative Fish Nursery	$200,000	$35,000
	Total Construction Cost $17,925,198	Total Yearly Maintenance $994,885
Administrative Costs (10%)	($1,792,519)	($99,488)
Total Cost for Complete Restoration of the Stonycreek River Watershed (construction, administration and maintenance for 10 years)		**$30,661,453**

The economic value of the fishery, white water rafting, and eco-tourism of the watershed can exceed $21 million in economic revenue a year for Somerset County and the state of Pennsylvania (Table 8). The property value increase is estimated at 5% (Hansen et al. 2008), totaling $26,006,000 and the influx of tourism could draw investors and businesses to the area making this reclamated resource worth far more than just the additional $21 million in recreation. The exceptional water quality that would result from the total restoration of the watershed would make potable water readily available in the county allowing all residents to have access to public water at a low cost. The economic viability of the land within the watershed would promote the restoration of other brownfield areas in the watershed as well as in the county.

It should be noted that $17 million in design/construction of AMD abatement projects would realistically occur over a period of years. Subsequently, the economic revenue of $21 million a year would incrementally follow suit as impacts of that reclamation occur over time. This documents attempts to depict what a healthy watershed can create economically and spur the commitment required to achieve that goal.

Table 8. Recreational economic value of fully reclaimed Stonycreek River watershed.

Recreational Benefit	Economic Value
Restored Fisheries	$8,105,443
Whitewater Sports	$11,745,000
Non-consumptive wildlife viewing	$1,800,000
Total Recreational Benefit	**$21,650,443**

Most traditional economic indicators take into account “growth” or “development” that lead to the use or degrading of our natural resources without any cost associated with those losses. Consequently the cost/benefit of perceived economic growth is never accurately accounted for. This document seeks to not merely right this wrong but attempts to put a dollar

value on the conservation of resources through restoration that impact vitality in the Stonycreek River watershed. This has never been fully calculated or assigned a value in the past.

Viewing the restoration and sustainable use of our natural resources as an economic benefit has never been properly understood or utilized by our decision makers. The time has come for that to change and the Stonycreek River watershed is the place to start.

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