Tubmill Creek Coldwater Conservation Plan

December 2009

Kiski-Conemaugh Stream Team

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water, land, life.

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Cover photo by Melissa Reckner.

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Executive Summary

In 2007, the Coldwater Heritage Partnership awarded the Conemaugh Valley Conservancy's Kiski-Conemaugh Stream Team a Coldwater Conservation Grant for Tubmill Creek in Westmoreland County. The Stream Team utilized this grant to collect and review previous studies and data and develop a strategy to protect and conserve Tubmill Creek, a coldwater fishery of exceptional value. The Partnership supports the evaluation, conservation and protection of Pennsylvania's coldwater streams. Coldwater conservation plans serve as a tool for local and state organizations as they plan and implement projects that enhance and protect coldwater resources. They also generate support of such projects through public education and awareness (Coldwater Heritage Partnership 2009).

Tubmill Creek is an Exceptional Value (EV) stream as classified by the Pennsylvania Department of Environmental Protection (PA DEP) from its headwaters downstream to the Tubmill Reservoir. This indicates the water quality is of the highest standard according to the PA DEP and supports an abundant aquatic community. The EV section of Tubmill Creek is privately owned, as is the reservoir, and boasts some of the best wild rainbow and native brook trout populations in the region. Below the reservoir, the stream is classified as a Trout-Stocked Fishery, due to warmer water temperatures and some abandoned mine discharge (AMD) seeps that degrade water quality. Still, some sections contain diverse and abundant aquatic life, including Eastern Hellbenders, the largest salamanders in the United States and demand clear, high quality water.

The Tubmill Creek watershed is vulnerable to pollution and habitat loss from agriculture, development, and resource extraction. Several organizations are working to protect and preserve it. The Western Pennsylvania Conservancy (WPC) deemed it one of four priority watersheds in the Laurel Highlands. This indicates that WPC is investing human and financial resources to protect its forests and waterways through restoration efforts and conservation easements. The Conemaugh Valley Conservancy, through a Growing Greener II grant, is constructing a limestone doser that will actively treat an AMD discharge degrading the final two miles of Tubmill Creek. The limestone doser will counteract the acidity produced by the discharge and improve the water quality of Tubmill Creek and ultimately the Conemaugh River as well. Additionally, work continues with the High Ridge Water Authority to make bottom releases from Tubmill Reservoir possible, which will support coldwater fishes further downstream and make establishing a wild trout population below the dam a possibility. Through these and similar efforts, as well as a vigilant community, Tubmill Creek should remain an exceptional waterway for years to come.

Stream Team Background

The Kiski-Conemaugh River Basin Alliance formed the Kiski-Conemaugh Stream Team (Stream Team) in 1999 because of recommendations made in the *Kiski-Conemaugh River Basin Conservation Plan* (The Kiski-Conemaugh River Basin Alliance 1999). The Stream Team concentrates on water monitoring and environmental education with a focus on conservation and AMD. The mission of the Stream Team is to educate and engage citizen stewards in maintaining, enhancing and restoring the natural resources of the Kiski-Conemaugh River basin. The Conemaugh Valley Conservancy, Inc. oversees the Stream Team.

The Stream Team relies heavily on a network of volunteers who monitor 150 sites, collecting 548 water samples in 2008 within the five sub-watersheds of the 1,887 square mile Kiski-Conemaugh River basin. Volunteers are trained to collect water samples from select sites according to Pennsylvania Department of Environmental Protection (PA DEP) protocols, and the PA DEP Bureau of Laboratories analyzes the samples. For these reasons and because of the strong partnership between the Stream Team and the PA DEP, Stream Team's data are used by over 20 local, state, and federal agencies for multiple purposes, including grasping the extent of water quality problems; prioritizing restoration and treatment systems; evaluating restoration and treatment systems; improving treatment technology; gauging the overall health of waterways; and performing case studies for educational purposes.

Recognizing that children are spending increasingly less time outdoors exploring nature, investigating their curiosity and discovering the many wonders of our Earth, the Stream Team is involved with numerous environmental education initiatives. Most notable are Trout in the Classroom and Outdoor Heritage.

Figure 1. Exhibitors at Outdoor Adventures assist students with an environmental activity. Photo by Melissa Reckner.

Trout in the Classroom is a national and global program that, together with local financial support, provides the basic equipment necessary to operate a large classroom aquarium and raise trout fingerlings from eggs. Throughout the school year, students maintain the aquarium system, care for and study the fish, and learn the importance of coldwater ecosystems and conservation. Most importantly, they experience a real, tangible connection to nature

that lays the foundation for good conservation practices and a lifelong commitment to stewardship. Plus, community support and involvement is fantastic!

Each April, the Stream Team and its many partners organize Outdoor Heritage Month, which is designed to promote global, national, and local conservation events and encourage active conservation and stewardship. Outdoor Heritage Month culminates with Outdoor Adventures, a two-day education event for 1,100 students. Children participate in over three dozen interactive exhibits, where they can see and identify live stream bugs, test out a solar cooker, take a nature walk, witness the power of solar panels and windmills, go fishing, and much, much more! The Pennsylvania Association for Environmental Educators endorses Outdoor Adventures, and teachers, parents, and exhibitors praise the event.

Introduction

Conservation Plan Objectives

The objectives of this conservation plan are to identify and inventory the quality of and threats to the Tubmill Creek watershed and recommend enhancement and protection measures to secure this special resource. This plan will be shared with other conservation partners and municipalities as a reference tool to maintain or improve stream quality in the watershed.

Figure 2. Tubmill Creek 1.5km below Stanton Bridge on Creek Road. Photo by Melissa Reckner.

The compilation of this plan includes many studies done by the Western Pennsylvania Conservancy (WPC), including visual assessments, fish surveys, macroinvertebrate studies, water quality tests, and Hellbender studies. The Pennsylvania Fish and Boat Commission (PFBC) has completed multiple fish surveys in the watershed that were also incorporated into this plan. Additionally, the Westmoreland Conservation District and the *Kiski-Conemaugh River Basin Conservation Plan* was of help in the completion of this plan.

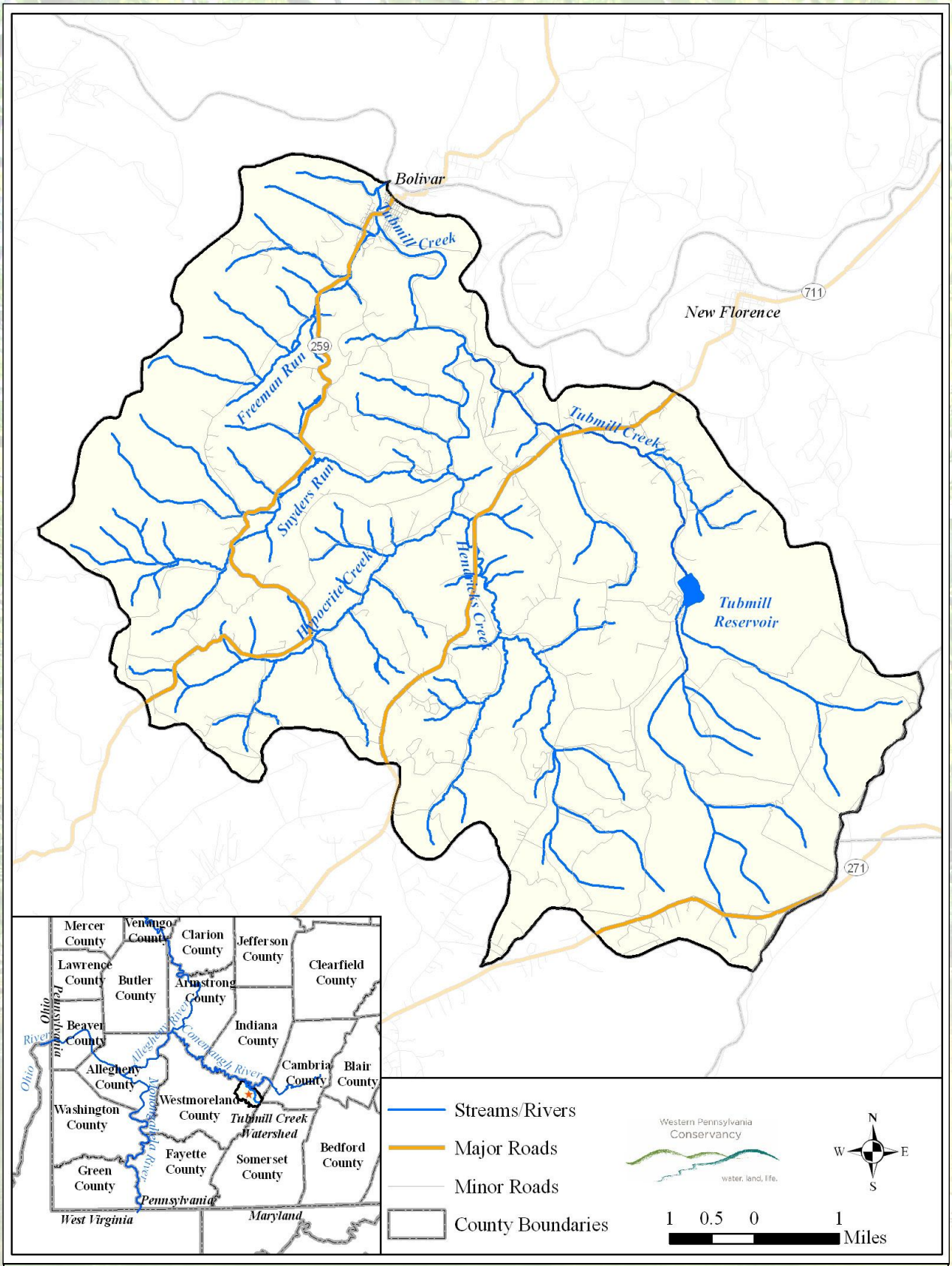

Figure 3. Map of Tubmill Creek watershed.

Watershed Characteristics

The Tubmill Creek watershed encompasses 54 square-miles on Pennsylvania's Appalachian Plateau and is located primarily in Fairfield Township in northern Westmoreland County, Pennsylvania. Its headwaters originate in the Rachaelwood area owned by the Mellon family and public access to this area is restricted. Tubmill Creek flows northwest near the Westmoreland-Indiana County border for approximately 12.6 miles through coniferous and deciduous forests and a small portion of agricultural land until it discharges into the Conemaugh River just west of Bolivar Borough. The entire watershed contains 84 perennial stream miles and 5 main tributaries including Hendricks Creek (8.88 mi), Hypocrite Creek (4.07 mi), Snyders Run (3.79 mi), Lick Run (3.16 mi), and Freeman Run (2.97 mi).

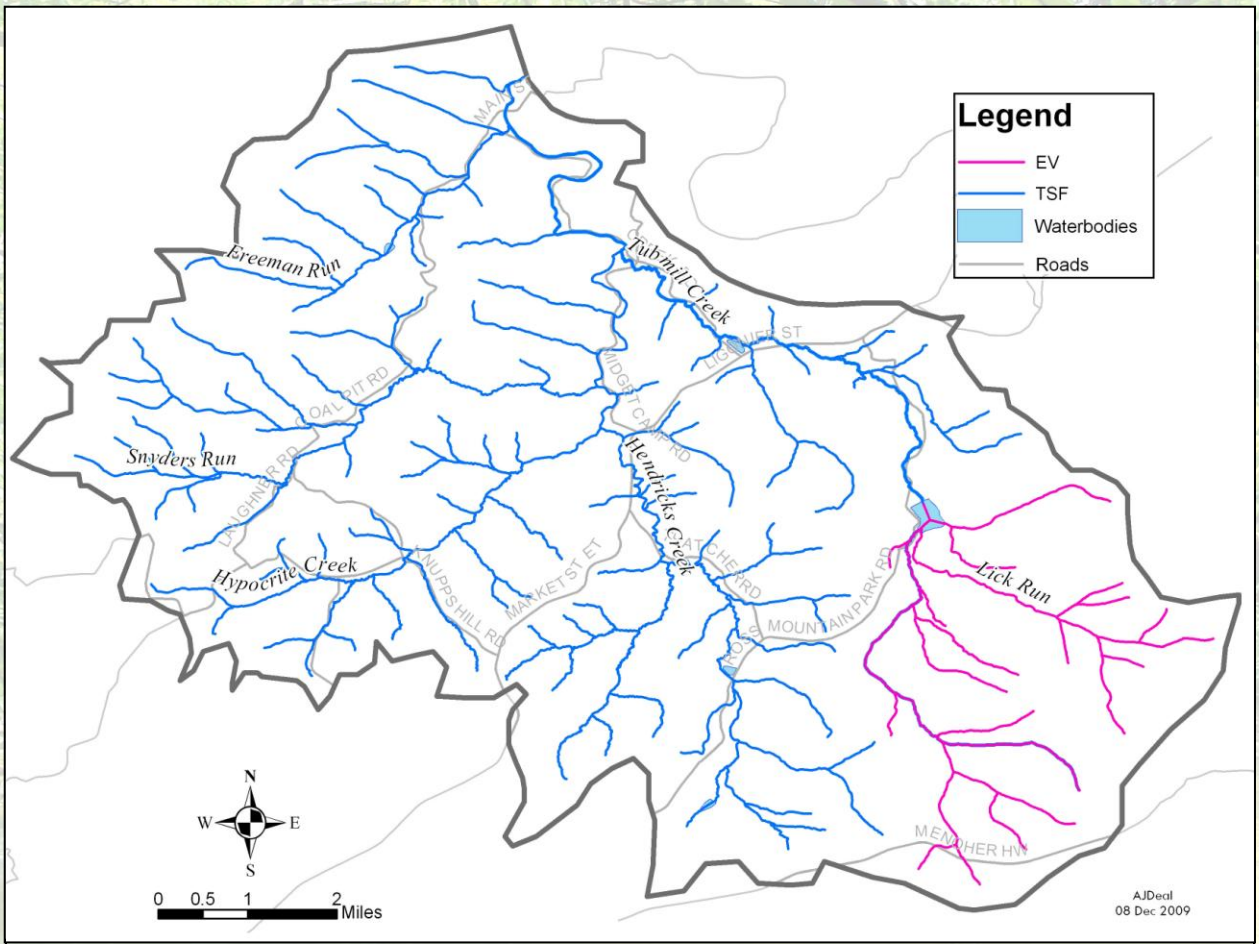

Figure 4. PA DEP designated stream use in Tubmill Creek watershed (Corradini 2004).

In its upper reaches, Tubmill Creek is classified as Exceptional Value (Figure 4), according to PA DEP Chapter 93 Water Quality Standards, because of its excellent water quality, which is preserved largely because 100% of that area is privately owned and 85% is completely restricted to public access. The remainder of Tubmill Creek and all other tributaries are classified as Trout Stocked Fisheries (Pennsylvania Code 2009).

The PFBC classifies Tubmill Creek itself as Class A Wild Trout Waters for Rainbow Trout from its headwaters downstream to the Tubmill Reservoir, a distance of 4 miles. Class A Wild Trout Waters are those that support a population of wild, naturally reproducing trout of sufficient size and abundance to support a long-term sport fishery. These streams are not stocked by the PFBC.

General History

The Tubmill Creek watershed stretches over Fairfield Township and a small portion of St. Clair Township in Westmoreland County and includes the towns of New Florence, Bolivar and West Fairfield. Westmoreland County was formed by an Act of Assembly, approved by Governor Richard Penn, on February 26, 1773. Fairfield Township was the name of a division of the county while it was still a part of Bedford County and was made an official township of Westmoreland County by a court at Hannastown on March 6, 1773. St. Clair Township was formed from Fairfield Township in 1856 and named in honor of Major General Arthur St. Clair.

The only incorporated borough in Fairfield Township is Bolivar. In May 1863, the town of Bolivar petitioned to become an incorporated borough and the final order of court was made on November 25, 1863 incorporating the borough (Zipfel 2009).

Archeological Features

There have been several archeological surveys conducted in Fairfield and St. Clair Townships (Chiarulli et al. 2001). Three of the sites were located within the Tubmill Creek watershed and did not reveal any significant archeological artifacts. One site covering 60 acres in Fairfield and Wheatfield (Indiana County) Townships identified 12 archeological sites. Of these, 11 were identified as prehistoric, and 8 could potentially be added to the National Register of Historic Places. This survey was conducted in 1997 as part of the Bolivar Bridge Replacement Project.

Ross Furnace (Figure 5), built in 1825, is on the National Register of Historic Places. It is located on the golf course at Ross Mountain Park. The furnace was originally owned by Jacob D. Mathiot, an ironmaster, militia colonel and state legislator. The furnace was one of the first iron furnaces in the county and remained in operation from the time it was built until 1874 (Mid-Atlantic Karst Conservancy 2004).

Figure 5. Ross Furnace
Photo courtesy of J. Markiel.

Another site of interest is the Squirrel Hill

site in New Florence, also on the National Register of Historic Places. The site is listed as significant during the period of 1000AD-1499AD. The site was first used as a domestic dwelling, and is now used as part of an agricultural operation (National Register of Historic Places 2009).

Topographic & Geologic features

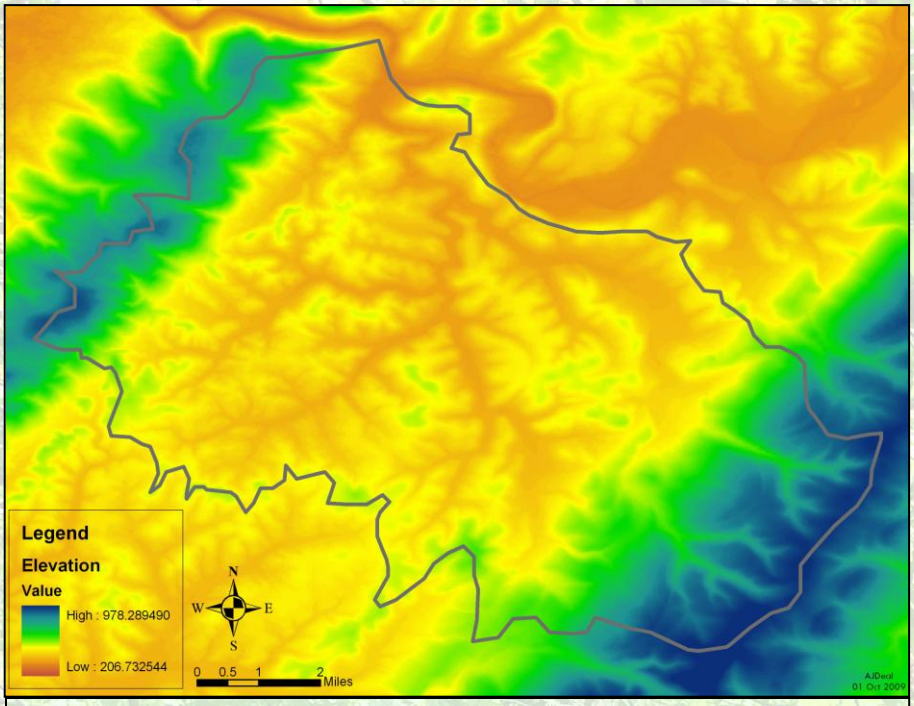

Figure 6. Elevation in Tubmill Creek watershed.

The elevation in Tubmill Creek watershed ranges from 810m (2,658ft) in the headwaters to approximately 300m (985ft) at its mouth (Figure 6). The middle reaches and tributaries lie in the 300-400m elevation range and make up the majority of the watershed. In addition to the headwaters, high elevations are also found along the northwestern watershed boundary.

The highest elevations in the watershed are underlain by Burgoon Sandstone, Shenango and Mauch Chunk Formations (Figure 7). These bedrock classes are composed of sandstone and contain conglomerates at their bases. They also contain many plant fossils, but generally contain few economically beneficial substances. Nonetheless, a small amount of uranium was mined from the Mauch Chunk formation near Jim Thorpe, PA in 1953 (Klemic and Baker 1954).

Geologic features in the middle reaches are comprised mainly of Casselman and Glenshaw Formations. These bedrock layers are dominated by siltstone, claystone, shale, and sandstone. Coal can be found in the Casselman Formation, but it has no real regional economic importance due to widespread discontinuity (PA Bureau of Topologic and Geologic Survey 2001). However, with the use of modern technology, coal has been mined in this area and its impacts have been detrimental to the health of the watershed.

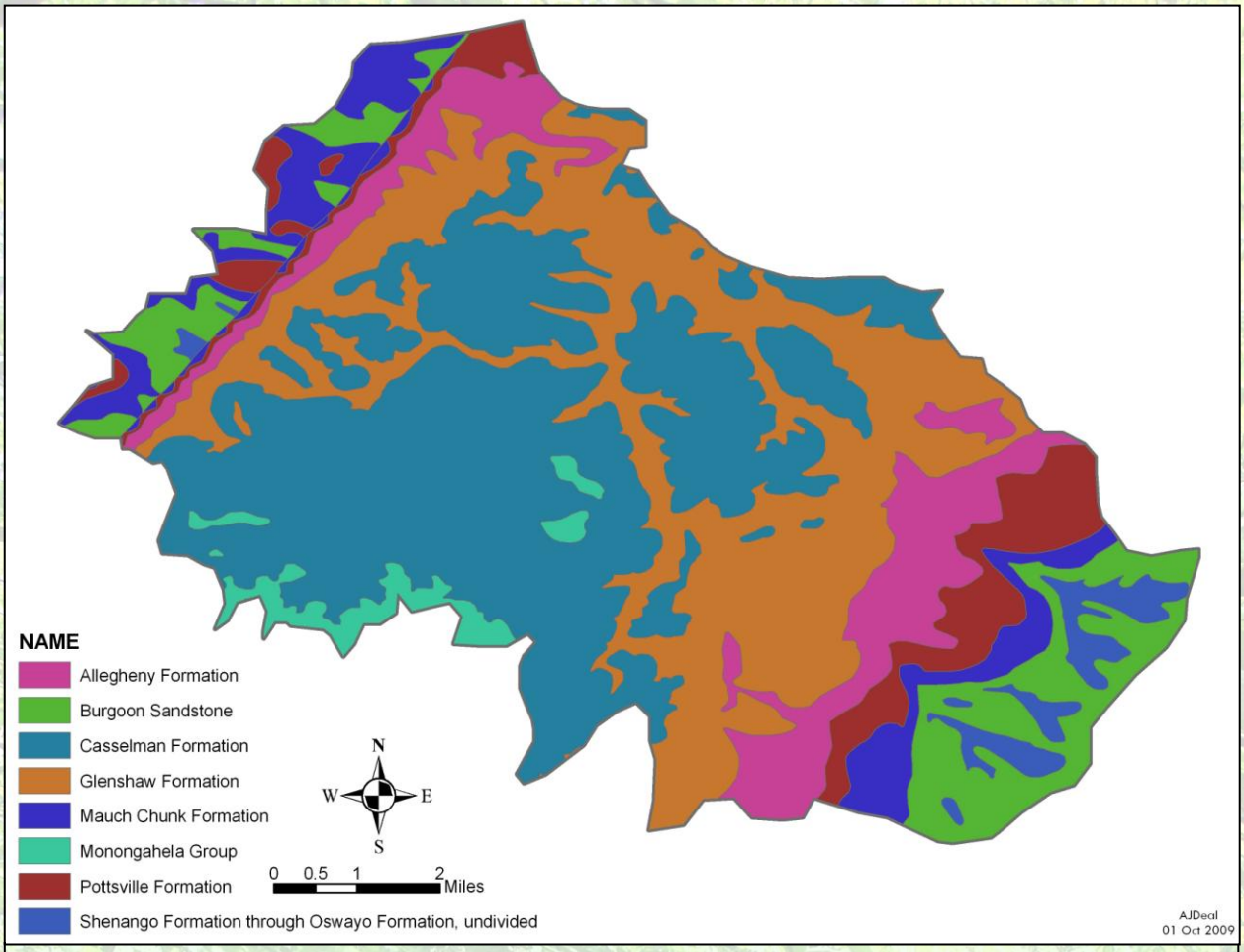

Figure 7. Underlying geology in Tubmill Creek watershed.

Marcellus Shale Drilling

Approximately 2/3 of Pennsylvania, including the Tubmill Creek watershed, is underlain by Marcellus shale at a depth of 5,000 to 8,000 ft (Figure 8). This formation is thought to hold trillions of cubic feet of natural gas, but until recently has been cost prohibitive to access. Recent advances in drilling technology and rising gas prices have garnered new interest in the formation.

Both vertical and horizontal drilling are generally required to extract natural gas from the Marcellus Shale along with a process called hydraulic fracturing, or "fracking." After the well is drilled, large amounts of water mixed with sand and other substances are pumped into the shale formation under high pressure to fracture the shale around the well, allowing the natural gas to glow freely to the well bore. The amount of water typically required for fracking ranges from one million to five million gallons per well. After the fracking process the used water, "frack water," must be reused in the next well or treated at an approved facility (Pennsylvania Department of Environmental Protection 2009).

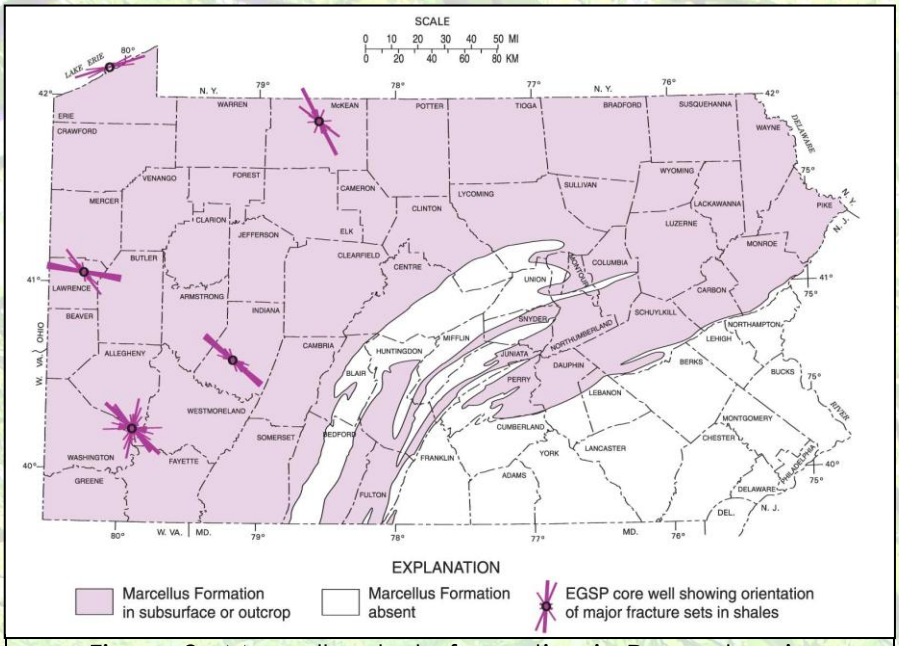

Figure 8. Marcellus shale formation in Pennsylvania (PA DCNR 2008.)

Fairfield Township, which encompasses the large majority of the Tubmill Creek watershed, has some of the thickest Marcellus shale in the formation. As a result, the area is highly predisposed to gas drilling. Five Marcellus shale gas wells are already present in the watershed (Figure 9), and more are likely to be proposed and drilled (PA DCNR 2008).

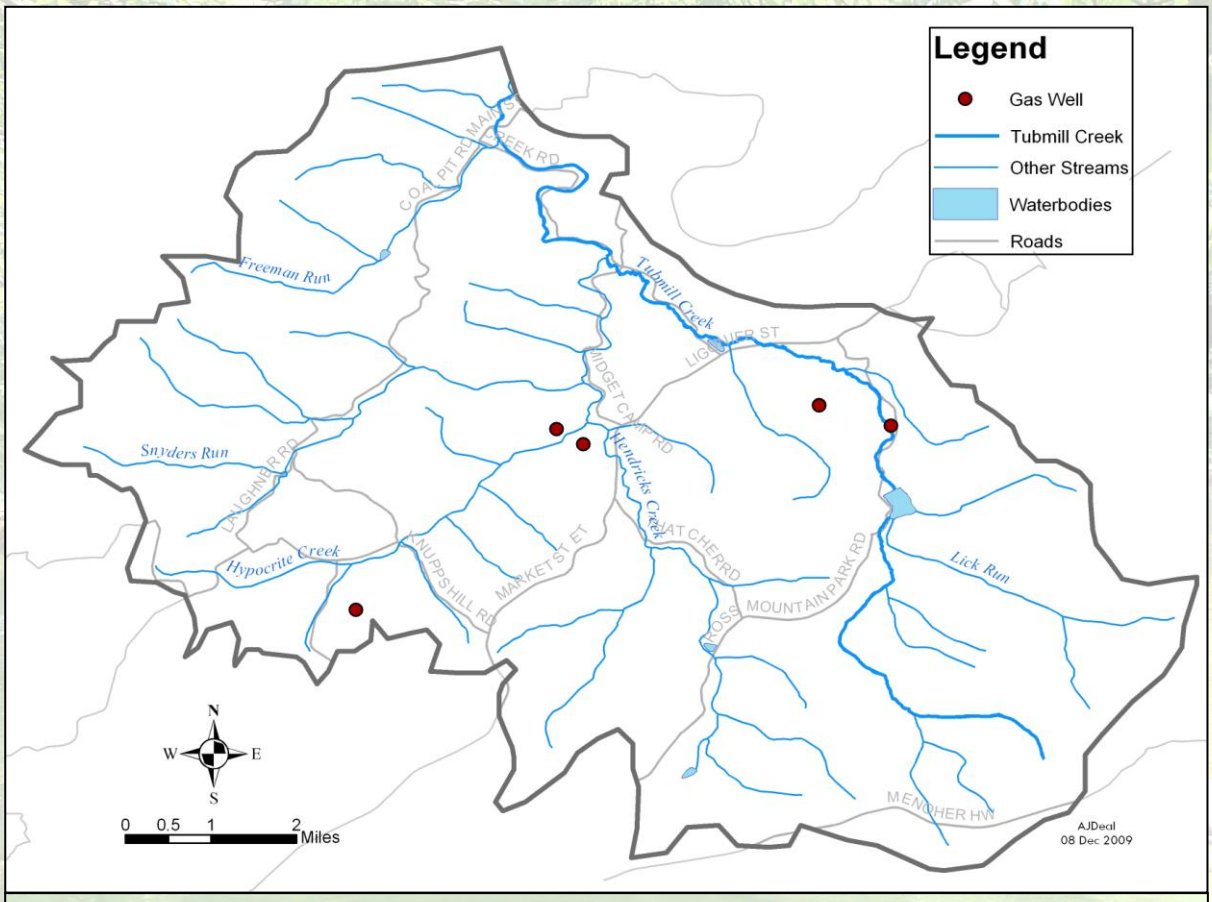

Figure 9. Marcellus shale wells in Tubmill Creek watershed (PA DEP 2009)

Coal-bed Methane

Although not yet present in the Tubmill Creek watershed, coal-bed methane production is occurring in nearby municipalities and could potentially become a concern. During the process of forming coal, surprisingly large quantities of methane are generated and stored within the coal; a coal-bed methane reservoir can store six or seven times as much gas as a conventional natural gas reservoir of equal rock volume. Coal-bed methane generally exists at shallow depths compared to conventional natural gas reservoirs, making it easier and less expensive to pursue.

Production of coal-bed methane may seem somewhat simple compared to other methods of resource extraction, but it still carries with it environmental and economic concerns. In order to produce methane from coal beds, water must first be drawn off to lower the pressure allowing methane to flow out of the coal and to the well bore. The contaminated water must be disposed of or properly treated. The water is frequently reinjected back into subsurface rock formations. Because of the shallow nature of these formations, contamination of drinking water supplies is a concern. The migration of methane as a result of new wells can also contaminate groundwater sources for entire neighborhoods and the controls and regulations of methane migration are unclear (United States Geologic Survey 2000).

While some may claim that production of methane from coal beds will create jobs and bolster the local economy, it may also cause economic hardship because there are no royalties or severance taxes on the gas produced. The local economy will not see an influence in its tax dollars even though their valuable natural resources are being removed and generating a profit for other parties. Coal-bed methane production is also an economic concern because, in the event of environmental contamination, the production company may not be found responsible and the financial burden may be passed on to the local community.

State Lands

Although the Tubmill Creek watershed does not completely encompass any state lands, portions of several state lands are found on its perimeter. The eastern tip of Forbes State Forest is located in the northwestern portion of the Tubmill Creek watershed. Laurel Ridge State Park extends to the highest elevations of the watershed in the headwaters of Tubmill Creek. State Gamelands 42 and 153 also have portions overlapping the watershed boundaries.

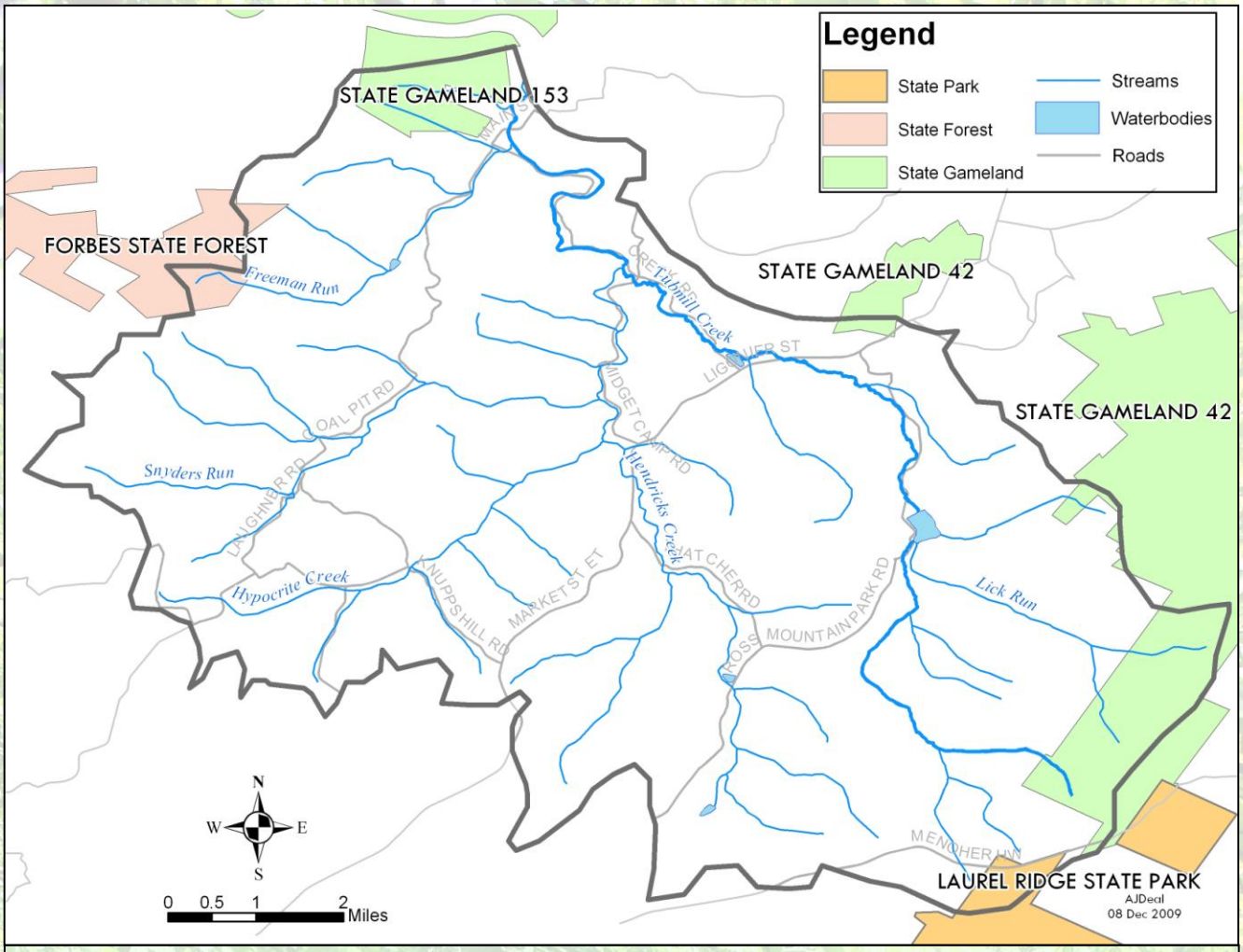

Figure 10. Public lands in Tubmill Creek watershed.

Land use

A visual assessment survey conducted by the WPC in 2006-2007 suggested that 63% of the Tubmill Creek watershed is forested, 13% residential, 9% grazing/pasture, 9% open field, 2% other and less than 1% each of industry, row crops, and conservation reserve.

Data analysis of the 2001 USGS Land Use/Land Cover database shows results similar to the visual assessment (Figure 12). The major land cover in the watershed is forest, which makes up 81.7% of the watershed. The second highest land use is agriculture (12%), followed by 6.3% residential. All other land use types account for less than 1% of the land cover in the watershed.

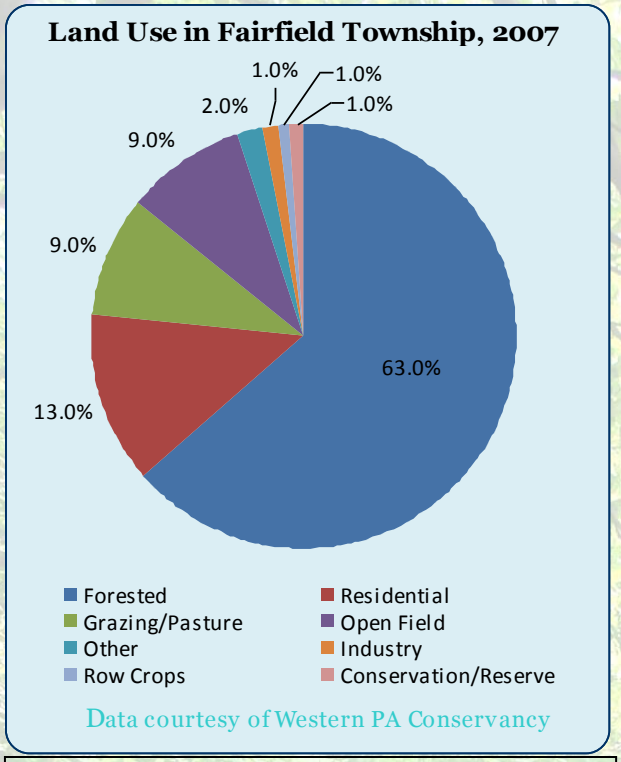

Figure 11. Land use as determined by visual assessment, 2006-2007.

The summit of Laurel Ridge near the headwaters of Tubmill Creek has land uses that may be detrimental to stream health. Numerous off-road vehicle trails and dirt roads are present, as well as a portion of the highly traveled State Route 271. This combination can lead to erosion, causing sedimentation of Tubmill Creek.

Agriculture

Agriculture in the watershed makes up 12% of the total land cover, but its effects are concentrated and have detrimental effects on water quality. Approximately 40% of all agriculture in the watershed is found in the Hypocrite Creek sub-watershed. As a result, Hypocrite Creek and all of its minor tributaries are impaired and classified by the PA DEP as non-attaining streams for aquatic life due to siltation from agricultural runoff.

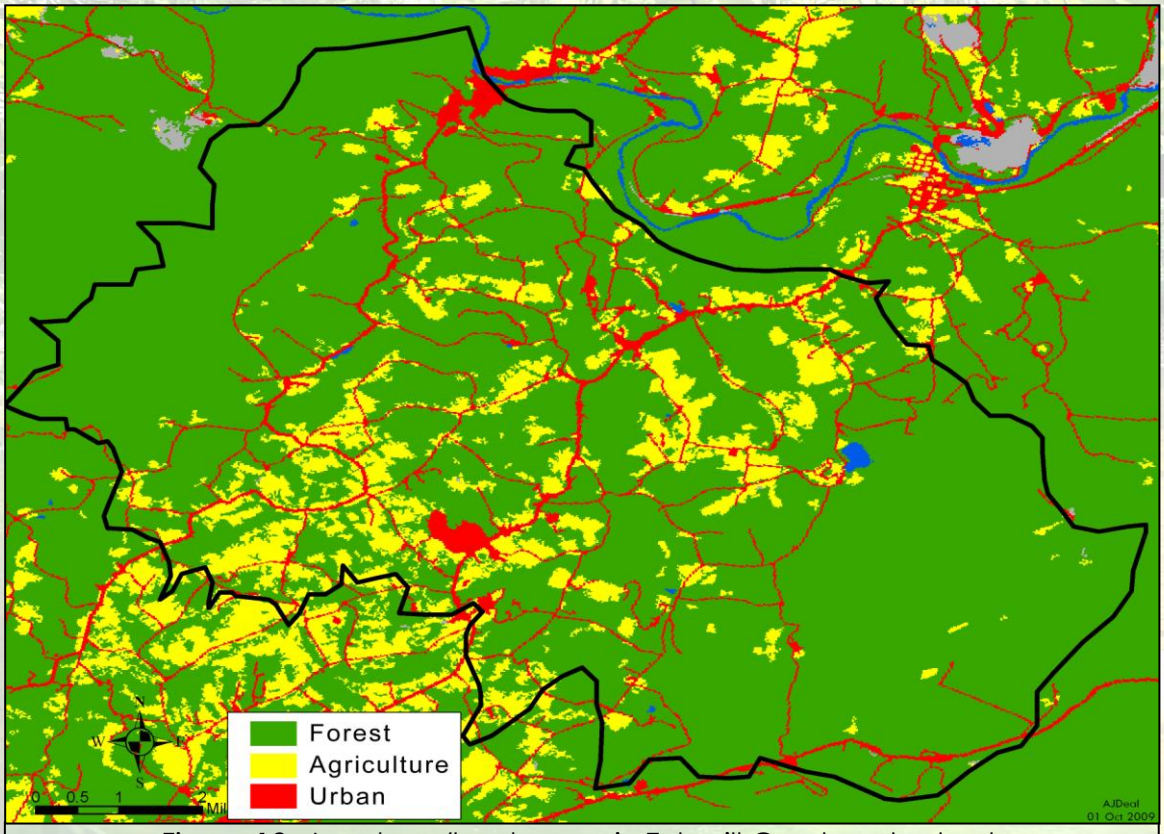

Figure 12. Land use/land cover in Tubmill Creek watershed.

Populous

Political Boundaries

Most of the Tubmill Creek watershed lies within Fairfield Township in Westmoreland County. The township covers over 6,000 acres in the northeast part of the county, bordered by the Conemaugh River to the north and Derry Township and the Chestnut Ridge mountains to the west. Cambria and Somerset counties are to the east, while Ligonier Township is to the south (Figure 13).

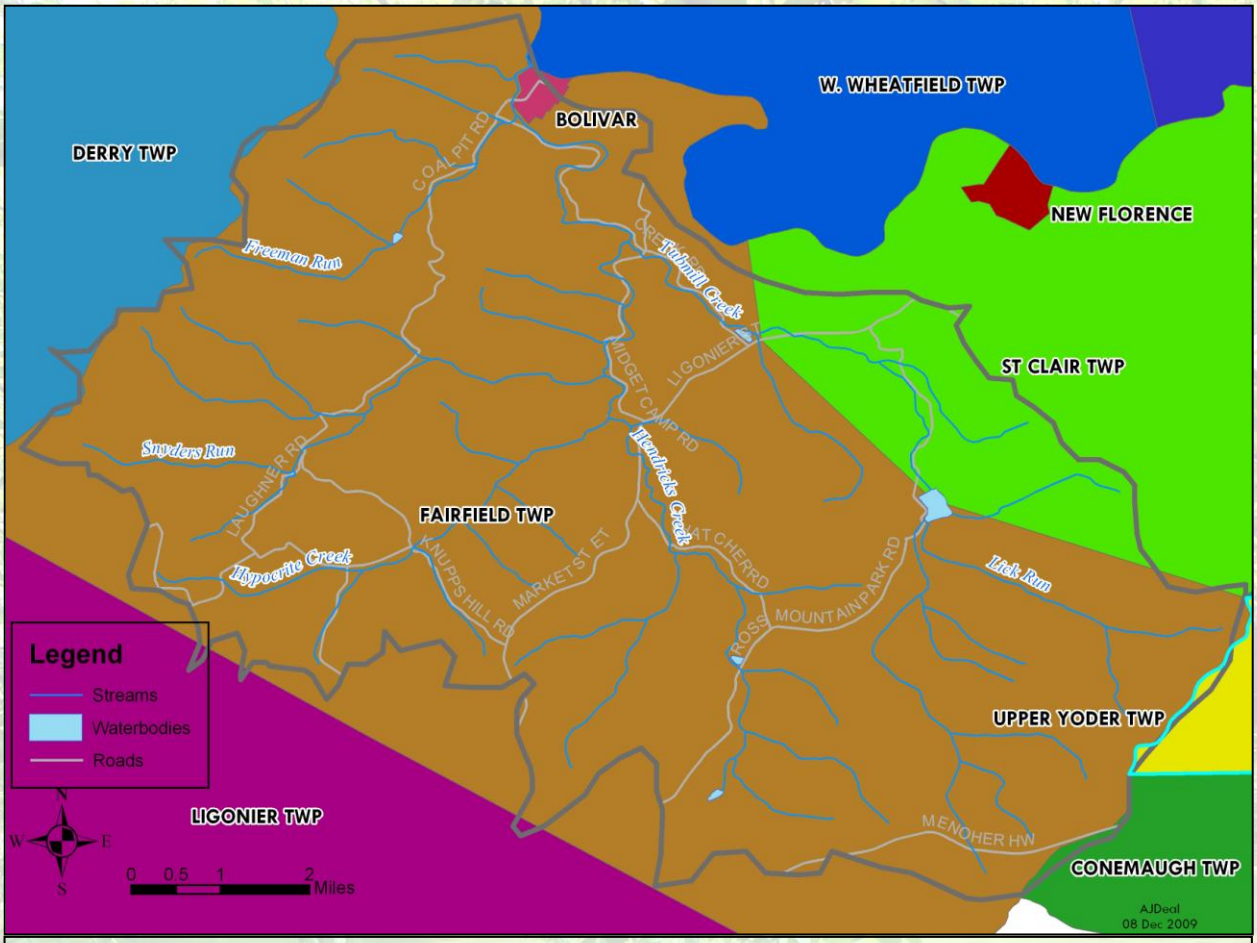

Figure 13. Political boundaries in Tubmill Creek watershed.

Demographics /Economics

The population in the Tubmill Creek watershed is 2,536, with a median age of 39.3 years old. There are 1,141 housing units with an average household size of 2.6 occupants (includes non-relatives), and an average family size of 3 (related family members only) (U.S. Census 2000).

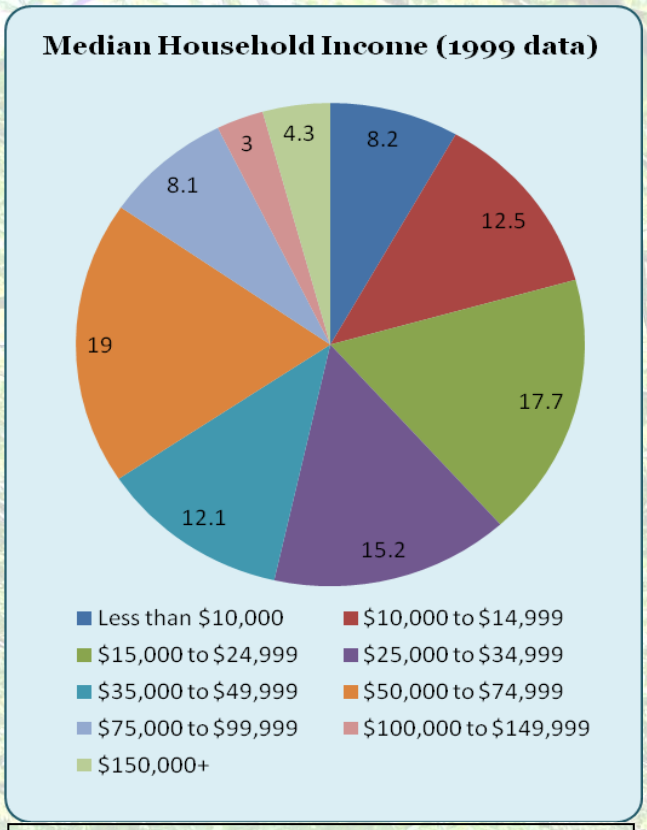

Figure 14. Median household income in Fairfield Township, 1999.

The number of high school graduates or higher is 1,405, 80% of the population, which mirrors the national average at the time of census. The number of those with a bachelor's degree or higher is 297, or 16.9%, lower than the national average of 24.4%. The number of those over age 16 that are employed is 1,057, with the majority employed in management or professional occupations. Second highest in the occupancy field are service-based positions, followed by sales and office jobs, production and transportation, then construction and maintenance, and finally farming, fishing, and forestry as the least occupied category. The average commute time to work for those in Fairfield Township is a little over 33 minutes each way (U.S. Census 2000).

Median household income (Figure 14) for the township was much lower than the national average based on 1999 data; $32,927 for Fairfield Township versus $41,994 for the nation. Median family income had an even bigger gap, with $37,177 average for the township and $50,046 for the nation. This is most likely due to the fact that the percent of families living under the poverty level was 12.1% compared to the nation at 9.2%, and individuals under the poverty level was 15.5% versus 12.4% for the national average (U.S. Census 2000).

Recreation

Many recreational opportunities exist in the Laurel Highlands region that encompasses Tubmill Creek. Though most of the adjoining land is privately owned above Tubmill Reservoir, south of Ross Mountain Park is open to the public and used extensively for fishing. The PFBC and the Tubmill Trout Club stock both Tubmill Creek

and Hendricks Creek. The PFBC stocks Tubmill Creek section 02 from Tubmill Reservoir downstream to Keiper Road, a private lane off of T470, with brook trout, rainbow trout and brown trout twice in the spring. They also stock Hendricks Creek from the SR 711 bridge to the mouth twice in the spring with brook trout, rainbow trout and brown trout. The Tubmill Trout Club has 169 members and stocks streams in the watershed four times a year with palomino trout, brown trout, brook trout and rainbow trout. Over the course of the year, the Tubmill Trout Club stocks over 4,800 adult trout at 28 different locations and "big fish" at 10 sites.

With its rich history and abundant natural resources, the Laurel Highlands offer much in the way of interactive experiences in a technology-saturated world. The nearby town of Ligonier is the site of Fort Ligonier (Figure 15), the Southern Alleghenies Museum of Art, and many shops along its diamond center square. Numerous state parks are near the area, including Linn Run and Laurel Mountain, operated by the Pennsylvania Department of Conservation and Natural Resources (DCNR). Within an hour's drive is Ohiopyle State Park, Frank Lloyd Wright's Fallingwater and Kentuck Knob, Bear Run Nature Reserve, and whitewater opportunities on the Youghiogheny and Stonycreek Rivers.

Figure 15. Fort Ligonier in the nearby, historic community of Ligonier. Photo courtesy Penny West.

Also close by is the historic town of Johnstown. This city is famous for the flood of 1889 that killed over 2,200 people and almost wiped out the entire city. A flood museum is located downtown, and a flood memorial is located at the site where the dam was located that caused the flood. Johnstown is also home to the world's steepest incline and a minor league hockey team.

Reservoirs

Tubmill Creek is not a very large watershed, but it has several large lakes within its boundaries including Mirror Lake, Echo Lake and Tubmill Reservoir. Mirror Lake and Echo Lake are not used for water supply. The largest of these, Tubmill Reservoir, is a privately owned water supply located at Ross Mountain Park. Below the reservoir, Tubmill Creek loses its Exceptional Value status because of the increase in water temperature. The large area of mostly stagnant, unshaded water has more exposure to

the warming effects of the sun, thus increasing its temperature and making it uninhabitable for some aquatic species. The High Ridge Water Authority, who is responsible for management of the reservoir, is agreeable to bottom releases, but a valve must be replaced to make bottom releases possible.

Conservation Efforts

Over the past few years, the Tubmill Creek watershed has benefitted from the work of conservation groups, especially the WPC. In 2007, the WPC held public meetings and outreach events to educate the public on the importance of Tubmill Creek and the implementation of sound conservation practices. Because of the programs that year, nine landowners were enrolled who agreed to adopt sound conservation practices on their properties. The WPC designed agricultural stream crossings, streambank erosion control devices, installed three miles of streambank fencing and two alternative watering systems. In 2007, the WPC also gained protection of 150 acres along Tubmill Creek through conservation easements. Over 80 of these acres have stream frontage on Tubmill Creek itself and through cooperation with other conservation partners, WPC will implement measures to reduce erosion and sediment runoff into the stream.

In 2008, the WPC assisted in implementation of 23 road stabilization projects on dirt and gravel roads to help reduce the harmful effects of runoff. The WPC also worked directly in the stream by installing 23 fish habitat structures, removing an unnecessary dam and stabilizing 500 ft of streambank.

The Tubmill Creek watershed also falls within the Pennsylvania Department of Conservation of Natural Resource's Laurel Highlands Conservation Landscape Initiative. A Conservation Landscape Initiative is a place-based strategy for natural resource stewardship and advocacy in key landscapes across Pennsylvania where there are strong natural assets and local support for conservation, planning and economic revitalization efforts. The Initiative is a partnership that strives to raise the region's quality of life while maintaining sustainable development tied to the natural and cultural assets of the region. The Initiative seeks to conserve, restore and improve the ecological, cultural, historic and recreational resources of the region. Another major component of the initiative is to revitalize core communities and expand local and regional economies through sustainable resource use and development. Finally, the partnership is also focused on building capacity and constituency in the region in order to implement and maintain the community revitalization and sustainability efforts of the ecological, cultural, historic and recreational resources.

Water Chemistry

The Exceptional Value stream section's water chemistry was evaluated by the PFBC in 1984 and by the PA DEP from 2005-2007. Despite the 22-year gap in data collection, water chemistry remains relatively constant for this stream section. Water chemistry is typical of a pristine, coldwater stream with an average temperature of 13.8 ^{o}C, conductivity values averaging 80 µS, and pH values ranging from 6.9 to 7.4. Alkalinity values were low, even in the Exceptional Value upper reaches, leaving the stream vulnerable to possible acidification.

The PA DEP conducted water chemistry tests on Tubmill Creek at 6 points from 2005 to 2007. Two points were abandoned mine discharges (AMD) and 4 were stream sites. (Appendix 1). Both discharge points show high aluminum and iron content and very low pH values ranging from 2.4 to 3.2. Above the AMD discharges stream chemistry shows an average pH of 7.1 with low levels of aluminum and iron. Stream chemistry deteriorates as it flows downstream with alkalinity being constantly reduced and metals gradually increasing.

Figure 16. The Stanton Bridge AMD discharge. Photo by Melissa Reckner.

One of the sites sampled by the PA DEP was the Stanton Bridge discharge, the AMD discharge that the Conemaugh Valley Conservancy will actively treat through the addition of limestone. The discharge itself consistently has a pH around 3.0 with total hot acidity values ranging from 125 to 413 mg/L with an average of 181 mg/L. The discharge also has high concentrations of metals with iron levels ranging from 9.5 to 15.9 mg/L and aluminum ranging from 6.2 to 9.3 mg/L. Upstream of the Stanton Bridge discharge, the water chemistry of Tubmill Creek is quite good. The average pH over the two-year period was 7.1, 0 net acidity, net alkalinity 41.87 ppm, total iron 0.40 ppm, and total aluminum less than 0.5 ppm. After the Stanton Bridge discharge, the average stream pH falls to 6.7 and iron and aluminum values also increase. This stream section is classified as non-attaining by the PA DEP due to AMD-metals.

Biology

Pennsylvania Natural Heritage Program

The Pennsylvania Natural Heritage Program (PNHP) is a program designed to inventory important species and ecological areas throughout the state. It is a joint effort between the DCNR, the PFBC, the Pennsylvania Game Commission (PGC) and WPC.

In 1998, the County Natural Heritage Inventory for Westmoreland County was completed (Western Pennsylvania Conservancy 1998). The assessment for the county is broken down by municipality, with any sensitive or endangered species noted and any important biological ecosystems assessed.

For the Tubmill Creek watershed, the PNHP identified the Upper Tubmill Creek Biological Diversity Area (BDA), Laurel Ridge Landscape Conservation Area (LCA), and State Game Lands #42. A BDA is defined an area that contains one or more occurrences of plants, animals or natural communities recognized as a state or federal species of special concern and/or high quality examples of natural communities or areas supporting exceptional native diversity. A LCA is defined as a large contiguous area that is important because of its size, open space, habitats, and/or inclusion of one or more BDAs, and although including a variety of land uses, has not been heavily disturbed and thus retains much of its natural character.

According to the PNHP, the Upper Tubmill Creek BDA is of high significance. Its state rank is S3 and is defined as, "rare and uncommon, or found only in a restricted range or because of other factors making it vulnerable to extirpation." There is no legal status for this area at the state or federal level.

The PNHP makes note of the exceptional value (EV) stream designation and the fact that the majority of the headwaters is privately owned. Threats noted are fragmentation, sedimentation, thermal pollution, and potential for invasive species introduction. Recommendations include an erosion and sedimentation plan to protect the EV designation and to further reduce the risk of fragmentation and ensure good water quality.

Laurel Ridge LCA is of exceptional significance to Westmoreland County. Laurel Ridge as a whole extends from the southern border of Fayette County north to Cambria County. In Westmoreland County, the ridge extends from the Conemaugh River Gorge to County Line Road. The Laurel Ridge LCA is given highest conservation priority and contains numerous natural communities, species of special concern, and a minimally developed forested landscape.

Activities that result in fragmented forests or water quality or quantity impairments are of greatest concern in the Laurel Ridge LCA. New house development is becoming common on private land on Laurel Ridge, especially in areas closest to Seven Springs and Hidden Valley Resorts. Although these large commercial areas are outside of the Tubmill Creek watershed, they are close enough that unplanned

development is a concern and could deplete or degrade the ecological resources associated with the mountain (Western Pennsylvania Conservancy 1998).

Visual Assessment/Riparian Assessment

The WPC conducted a visual assessment of the Tubmill Creek watershed on various dates from December 2006 to August 2007. WPC assessed 123 sites throughout the Tubmill Creek watershed.

The map below (Figure 18) summarizes their findings for the stream segments. Each point was given a score on a scale of 1-10, with 10 being the best quality. Scores were based on stream cover, riparian zone, fish barriers, macroinvertebrate habitat, bank stability, water appearance, nutrient enrichment, embeddedness and the presence of AMD, sewage or manure. During the visual assessment, land use was also noted and recorded. A score summary is shown to the right (Figure 17).

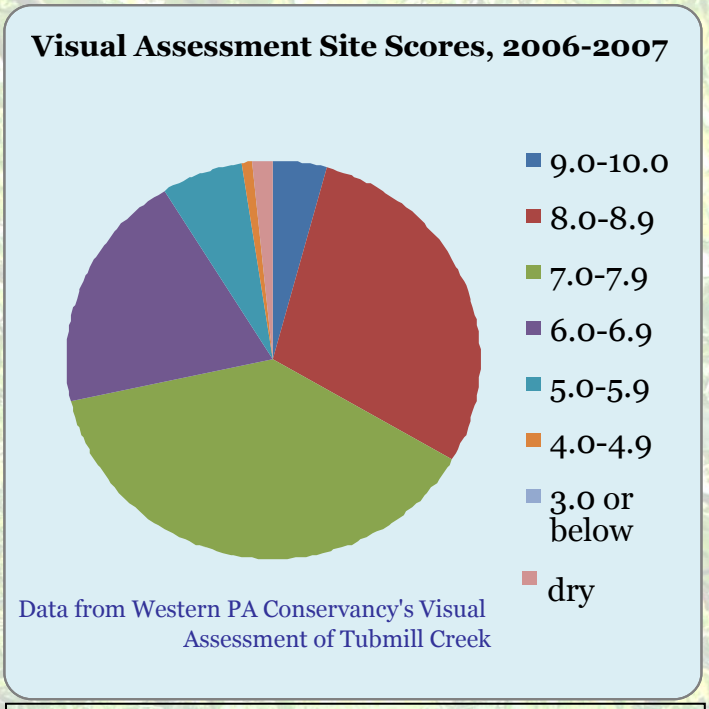

Figure 17. WPC visual assessment scores.

Of all the sites assessed, the site with the highest score, 9.8, was a site on Hendricks Creek. The site had a wide riparian area, mixed deciduous forest, and ample fish cover. There were only 4 other sites that scored a 9.0 or better. Thirty-six scored 8.0-8.9, 47 scored 7.0-7.9, 24 scored 6.0-6.9, 7 5.0-5.9, only 1 4.0-4.9, no sites below 3.0, and 2 sites were dry. Overall, 88% scored a 7.0 or higher in terms of stream health and quality.

The lowest score recorded was 4.0 on an unnamed tributary to Hypocrite Creek. This site was next to a cattle farm, with no riparian area and heavy erosion present. One other tributary to Hypocrite Creek only received a score of 5, and two sites on the mainstem of Hypocrite Creek received a score of 5 as well.

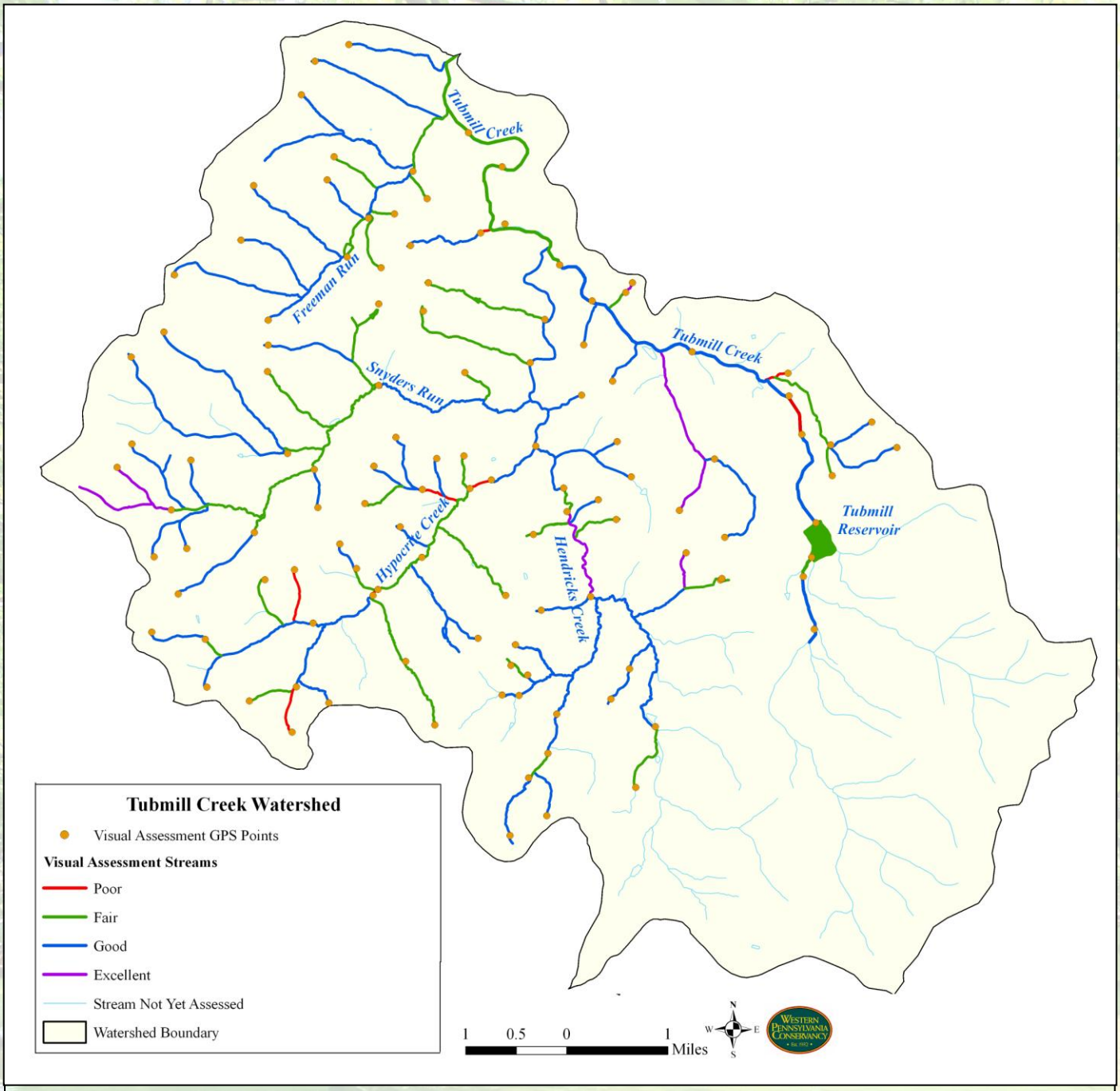

Figure 18. Visual assessment results in Tubmill Creek watershed.

Invasive Species

Invasive species were assessed in 2006 and 2007 during the visual assessment completed by WPC. Even though portions of Tubmill Creek are classified as EV, it is still susceptible to plant and animal invaders.

Based on WPC's findings, Multiflora rose and Japanese knotweed were the only invasive plant species present. Multiflora rose was present at 66 of 123 sites, while Japanese knotweed was present at 8.

Figure 19. Multiflora rose. Photo courtesy Natural Biodiversity.

Multiflora rose (*Rosa multiflora*) (Figure 19) is a common plant invader in western Pennsylvania. The Pennsylvania State Department of Agriculture considers the plant a noxious weed and it is illegal to willfully plant or transport it into the state. Multiflora rose was introduced to the United States from Japan in the 1800s as a rootstock for ornamental roses. Citizens planted it purposely for bank stabilization, living fences for livestock, and in highway median strips. Multiflora rose is a perennial shrub that grows easily in disturbed areas, spreading by seed, roots, and through animal droppings. Because it can live in a wide range of soils, it forms dense impenetrable areas of vegetation that crowd out native species, even in forested areas. (Natural Biodiversity 2009)

Figure 20. Japanese knotweed. Photo by Melissa Reckner.

Japanese knotweed (*Fallopia japonica*) is the other invasive plant identified during the visual assessment (Figure 20). Even though the commonwealth of Pennsylvania does not officially recognize it as a noxious weed, it still threatens ecosystems throughout western Pennsylvania. Japanese knotweed is a bamboo-like plant that thrives in disturbed open areas. It spreads by seed or roots and forms a dense stand of vegetation that crowds out everything below. (Natural Biodiversity 2009)

Japanese knotweed, or 'knotweed' for short, was introduced to the United States in the late 1800s from Japan for bank stabilization and erosion control. The plant is tolerant of a wide range of soil types and can live in wet or

dry areas, but is intolerant of shade. Riparian areas along stream banks are the most at risk of invasion because the plant is tolerant of flooding and can easily overtake shorelines. (Natural Biodiversity 2009)

Since WPC's assessment, it is possible that more invasive plant species have found their way into the Tubmill Creek watershed. Through education and identification, these species can be managed to keep the spread of the species to a minimum. It is important to educate the public about the dangers of purposely introducing non-native plant species and to research plant species before planting or transplanting.

Terrestrial Wildlife

Two terrestrial animal species of interest have been found in the Tubmill Creek watershed. One is the Allegheny Woodrat (*Neotoma magister*), which is a state threatened species that is currently found in the southwestern portion of Pennsylvania's mountains. The reason for decline of the species is not well understood, but likely attributed to habitat fragmentation, road building, increased susceptibility to parasitic infestations and the loss of primary food sources, such as the American Chestnut. Small, localized populations of woodrats disappear through time and are not re-populated because other woodrats are unable to cross barriers such as multi-lane roads, large clearcuts and other large-scale forest openings (Pennsylvania Game Commission 2006).

Figure 21. A fisher. Photo courtesy of PGC, Hal Korber.

A second species of special interest in the Tubmill Creek watershed is the fisher (*Martes pennanti*) (Figure 21). Fishers were once widely distributed throughout forested regions across the state. However, large-scale deforestation and alterations in forest composition caused a drastic decline in fisher populations. Fisher populations are once again established and increasing in Pennsylvania due to the large-scale reintroduction program in Pennsylvania and expansion from reintroduced populations in West Virginia and New York. Management of the fisher population is of interest to hunters, trappers and non-consumptive users alike (Lovallo 2008).

Macroinvertebrates

WPC sampled macroinvertebrates on the main stem of Tubmill Creek in the spring of 2008 and the fall of 2007 and 2008. Sampling locations are shown in the map below (Figure 22). Macroinvertebrate samples were collected in riffle sections of Tubmill Creek at 10 sample locations. Macroinvertebrates were sampled per EPA protocol, with three Surber samples being collected per site, and then compiled into a single composite sample. Surber samplers are used for macroinvertebrate population monitoring because they provide a quantitative sampling technique that yields extrapolative results about the health of a given reach of a stream. Samples were preserved in a 70% ethanol solution until identification. Samples were sorted completely, and then randomly selected for identification until the sample reached a count of 300 individuals. Samples were identified to the family level and analyzed (Chapman and Viazanko 2009).

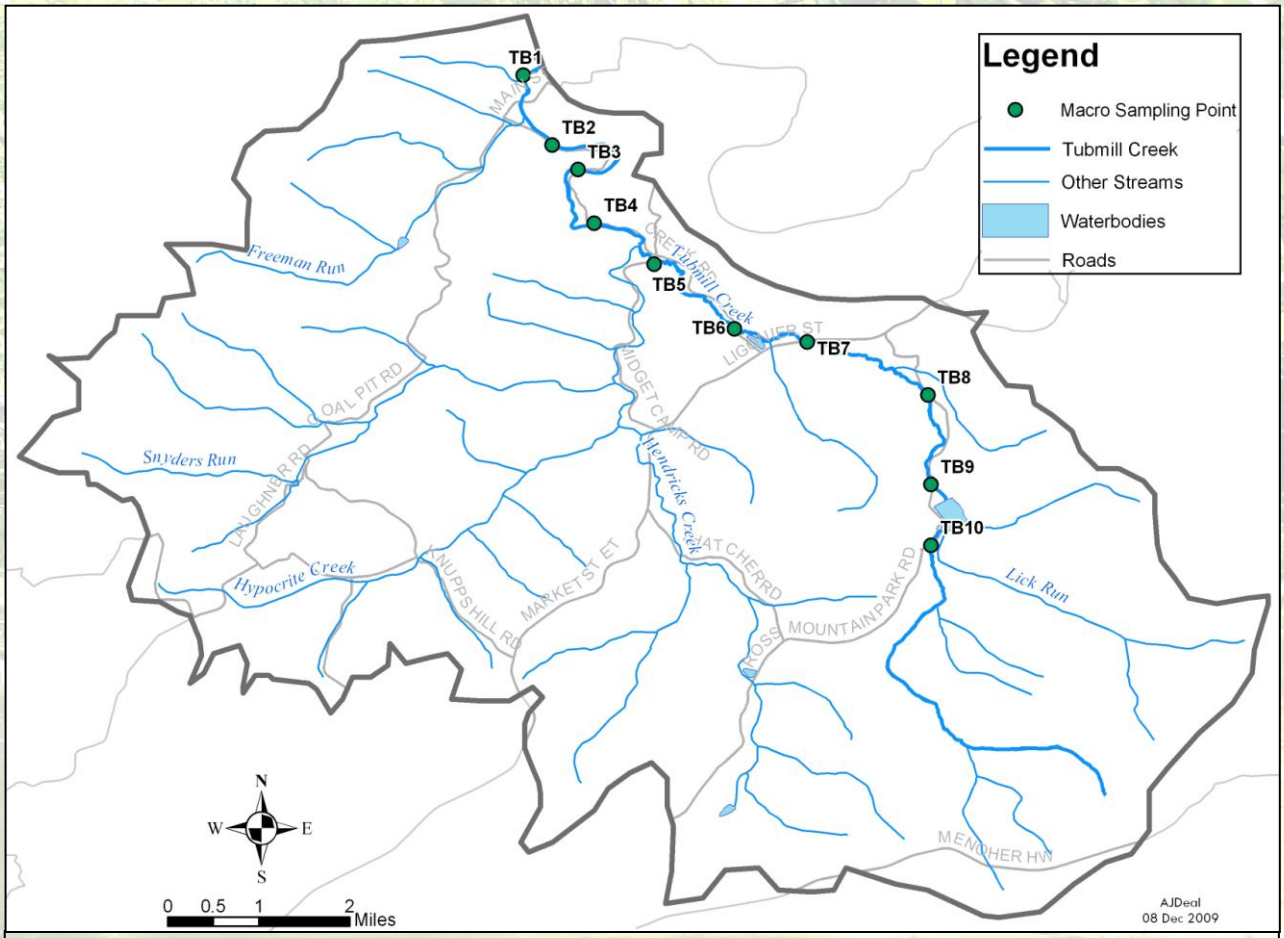

Figure 22. Macroinvertebrate sampling locations.

Several statistical indices were used to analyze the macroinvertebrate data including richness, evenness, Shannon Weiner Diversity Index (H`), pollution tolerant index (PTI), percentage Ephemeroptera, Plecoptera and Trichoptera (% EPT), and the Hilsenhoff Index (B). Descriptions of the macroinvertebrate metrics can be found in Appendix 2. All calculated metric scores can be found in Tables 1, 2 and 3.

Macroinvertebrate diversity was measured for the first time by WPC in Tubmill Creek in the fall of 2007. Overall, the communities appear to have significant differences in family level diversity. TB2 had only 8 families present and TB7 had the highest diversity with 23 families identified (Appendix 3). The least even sample was from TB1, with an evenness value of 0.286 due to over 89% of the sample consisting of one caddisfly family. The site with the highest evenness value is TB4, with 0.781, which also had the highest Shannon-Wiener Diversity Index of 2.299 and the highest PTI score of 36. Site TB7 had the highest richness value of 23, a high evenness score of 0.7274, and excellent PTI score of 35. All ten sites contained important members of the EPT taxa, demonstrating that Tubmill Creek has had stable water quality for the last few years.

Table 1. Tubmill Creek macroinvertebrate metrics, Fall 2007.

	TB1	TB2	TB3	TB4	TB5	TB6	TB7	TB8	TB9	TB10
Richness	9	8	11	19	15	14	23	15	10	19
Evenness	0.286	0.442	0.667	0.781	0.651	0.718	0.727	0.709	0.548	0.653
Total Individuals	228	79	209	196	300	73	103	114	283	121
Shannon Diversity (H')	0.629	0.920	1.599	2.299	1.763	1.894	2.281	1.921	1.263	1.922
% EPT	90.35	75.95	82.78	48.47	72.67	68.49	67.96	66.67	96.47	81.82
Hilsenhoff Index (B)	4.868	4.886	3.804	4.561	4.483	4.123	3.942	4.500	4.505	4.570
# Intolerant Taxa	0	0	1	1	3	1	4	3	2	2
PTI	19	19	20	36	27	26	35	32	14	34

Unlike the fall 2007 data, TB1 scored better than expected in the spring sampling period (Table 4). TB1 evenness, richness, and PTI scores are similar to sites much further upstream. For instance, TB1's richness value is the same as TB4, TB5, and TB9. The PTI score of 34 for site TB1 is the second highest PTI value of all sites sampled. Sites TB2 and TB3 have low values for evenness and richness. The two sites' values for PTI are the same at 27, the lowest of all the sites sampled; however, this score still falls into the "excellent" category. TB10 has the highest Shannon-Wiener Diversity Index score of 2.450. Site TB8 has the lowest Hilsenhoff Biotic Index score of 3.597, indicating that this site is minimally affected by organic pollution. TB8 also has the highest evenness score of 0.85, demonstrating that this site has a diverse macroinvertebrate community. An increase in the number of intolerant taxa was

common among all sites in the spring sampling season, with TB10 having 6 intolerant taxa.

Table 2. Tubmill Creek macroinvertebrate metrics, Spring 2008.

	TB1	TB2	TB3	TB4	TB5	TB6	TB7	TB8	TB9	TB10
Richness	10	11	10	17	17	21	14	16	17	19
Evenness	0.462	0.170	0.638	0.463	0.647	0.637	0.657	0.846	0.542	0.832
Total Individuals	242	296	65	158	106	284	113	114	285	122
Shannon Diversity (H')	1.065	0.407	1.470	1.312	1.833	1.941	1.734	2.347	1.536	2.450
% EPT	33.47	3.38	12.31	18.35	18.87	33.1	14.16	68.42	31.23	62.3
Hilsenhoff Index (B)	4.375	5.862	5.631	5.279	5.283	5.433	5.204	3.597	4.375	4.303
# Intolerant Taxa	2	2	2	3	4	4	2	4	3	6
PTI	24	27	27	31	29	34	27	29	33	31

Macroinvertebrate diversity levels and trends in Fall 2008 were similar to samples from Fall 2007 with diversity being lower overall as compared to spring samples.

Table 3. Tubmill Creek macroinvertebrate metrics, Fall 2008.

	TB1	TB2	TB3	TB4	TB5	TB6	TB7	TB8	TB9	TB10
Richness	7	6	9	18	16	20	9	5	12	17
Evenness	0.546	0.839	0.809	0.549	0.695	0.725	0.713	0.656	0.632	0.885
Total Individuals	191	31	89	96	300	213	260	68	295	256
Shannon Diversity (H')	1.063	1.504	1.777	1.586	1.926	2.172	1.567	1.056	1.571	2.508
% EPT	68.06	12.9	32.58	20.83	57.33	50.7	91.92	91.18	94.58	69.92
Hilsenhoff Index (B)	5.052	4.484	4.787	5.333	4.787	4.516	3.485	4.397	4.159	4.332
# Intolerant Taxa	0	0	0	1	1	3	2	1	1	3
PTI	21	18	18	26	32	36	24	19	24	29

To summarize macroinvertebrate sampling results, headwater sites above Tubmill Reservoir generally had the highest quality macroinvertebrate communities and the most downstream sampling sites had the poorest macroinvertebrate communities. As expected, diversity was lowest in the fall of each year. With regard to pollution tolerance, all sites scored good or excellent except for TB9 in Fall 2007. Results of the Hilsenhoff Index suggest that most sites have elevated amounts of organic pollution that is higher in the spring than fall.

Fishes

The PFBC conducted electrofishing surveys on Tubmill Creek in 1977, 1984, 1999, and 2006. The PFBC also conducted another study in 2007 in conjunction with the Stream Team, WPC, Westmoreland Conservation District, and PA DEP. The PFBC has also conducted electrofishing surveys on Tubmill Creek tributaries Lick Run, Hendricks Creek, Hypocrite Creek and Snyders Run. All fish data and water quality data collected by the PFBC can be found in Appendix 5.

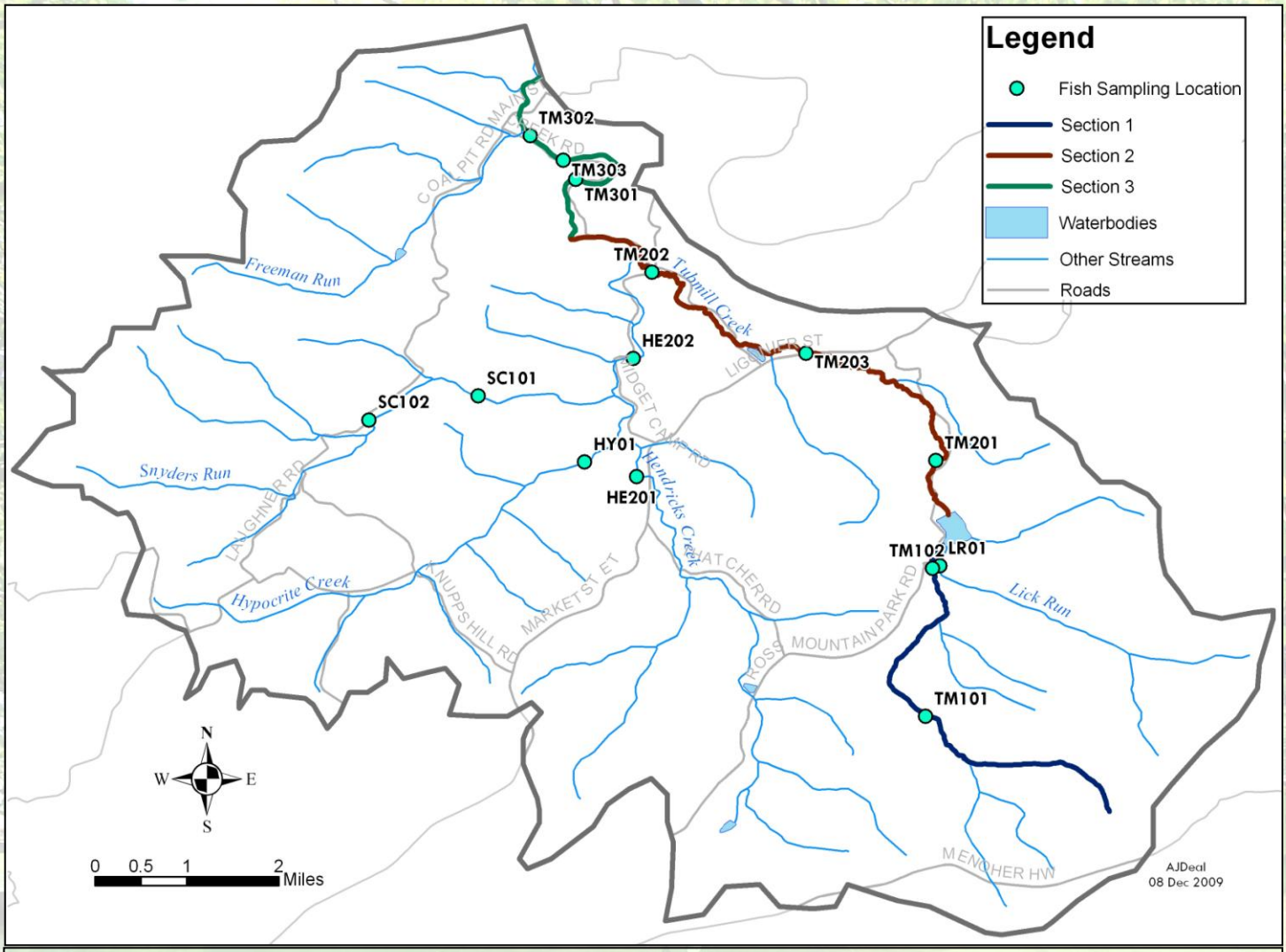

Figure 23. Fish sampling locations and PFBC sections of Tubmill Creek.

Section 01 of Tubmill Creek is characterized by a dense overhead canopy of mature hardwoods and conifers, providing nearly total shade and is described as optimum brook trout habitat. The PFBC manages section 01 for wild trout. In 1984, the PFBC sampled Tubmill Creek above the reservoir in the Rachaelwood area (Weirich 1987). This headwater section of stream is considered Section 01 of Tubmill Creek. This portion above the reservoir is completely privately owned, with 15% open to public fishing access from a local road near the reservoir. Section 01 had not been sampled for fish prior the 1984 survey and no fish studies have been conducted since.

During the study, 4 fish species were collected. Brook trout, brown trout and rainbow trout were collected and the only non-salmonid species present was mottled sculpin (*Cottus bairdi*). 81% of rainbow trout collected were determined to be wild, representing one of the best wild rainbow trout fisheries in the area. In fact, only six streams in the southwestern PA have documented wild rainbow trout populations. The lower portion of section 01 near the reservoir is dominated by wild rainbow trout and is an area of concern because of public accessibility in this section. The upper portion of section 01 is completely inaccessible to the public and is dominated by a healthy and increasing wild brook trout population.

Figure 24. A native brook trout. Photo by Len Lichvar.

Tubmill Creek section 02 begins at river mile 7.85 at the outflow of Tubmill Reservoir and continues to river mile 3.84. Section 02 is managed by the PFBC as a stocked trout fishery. The section was surveyed by the PFBC in 1977, 1999 and 2006. The 1999 study replicated the 1977 survey and used the same sampling locations (sites TM201 and TM202). In 2006, fish sampling took place at river miles 5.92 (site TM203) and site TM202.

Site TM201 had 14 species present 1999 and 11 species present in 1977. Eight species were present in both sampling years. Six different species, including hatchery rainbow trout, were present in 1999 but not in 1977. Three species were also present in 1977 but not in 1999.

Seven more species were collected at site TM202 in 1999 than in 1977, including one wild brown trout. The entire length of section 02 is privately owned, but open to public fishing. 99% of section 02 is within 300m of a road, ensuring that the public has adequate access to this portion of Tubmill Creek. The reason for low numbers of wild fish populations below the reservoir is due to increased water temperatures from the reservoir itself. The PFBC recommended coldwater releases from the reservoir to help establish a strong wild trout population.

Figure 25. Least brook lamprey collected upstream of AMD discharge on Tubmill Creek, 2007. Photo by Melissa Reckner.

One species, the mountain brook lamprey, was collected in 1977 but not 1999 and is currently considered threatened in the state of Pennsylvania (under the PA Code Chapter 75 and Wild Resource Conservation Plan). This species requires clean streams with gravel, rubble and unconsolidated rock substrate mixed with sand and clean detritus. Siltation, along with various types of pollution have made habitat unsuitable for the mountain brook lamprey and as a result, its range and population numbers have been reduced (Wild Resource Conservation Plan 2009).

In 2006 a total of 20 species were found at the two sites combined. Site TM203 had 16 species recorded while TM202 had 15 species present. All of the brook trout, brown trout, and rainbow trout found were hatchery-raised, unlike the trout above the reservoir that were mostly wild.

Section 03 begins upstream of the Stanton Bridge at river mile 2.06 and extends to the mouth (Figure 23). This section was surveyed in 1977, 1999 and 2007. The PFBC manages this stream reach as a coolwater/warmwater fishery.

Site 0301 is upstream of the Stanton Bridge abandoned mine discharge. Some small seeps are present above the main discharge and have deposited iron oxide on the streambed, thus increasing conductivity. Sixteen fish species were collected at this site, including one wild brown trout.

Site 0302 is near the mouth of Tubmill Creek before it enters the Conemaugh River in Bolivar. Several more mine seeps enter Tubmill Creek along this last stretch of the stream, coating the rocks and stream bottom with iron oxide. Despite the pollution, 15 species of fish were collected in 1999, compared to only 6 species in 1977.

The most recent fish survey performed on Tubmill Creek section 03 was on August 14, 2007. This was a joint effort between the PFBC, PA DEP, WPC, Westmoreland Conservation District and Stream Team. This survey included two sites; one at river mile 1.13 (site TM303), 1.5 km below the Stanton Bridge discharge, and the second at site TM301, 95 m upstream of the discharge (Table 5).

Twenty-three total species were collected, with 20 of those species present at both sites. Interestingly, the site downstream of the discharge had one more species than upstream. However, total numbers are quite different between the two sites. The upstream survey (site TM301) produced 833 fish, while the downstream site TM303 had

only 396 fish present. Blacknose dace (*R. atratulus*) and blackside darters (*Percina maculate*) were present downstream but not upstream, while Least brook lamprey (*Lampetra aepyptera*) were present upstream but not downstream. There were also no trout present at the downstream or immediately upstream sites, even though both sections are stocked by the Tubmill Trout Club. Trout are the dominant species upstream of the reservoir.

Hendricks Creek, a tributary to Tubmill Creek, is managed by the PFBC in two sections. The lower section, section 2, was sampled in 1977, 1988 and 2005. Section 2 begins at the SR 0711 bridge and extends 5.51 km to its mouth. The PFBC stocks this section with brook trout and brown trout in preseason and brown trout and rainbow trout during the season (Smith and Lorson 2006).

Figure 26. Electrofishing Tubmill Creek, August 2007. Photo by Melissa Reckner

Species richness was highest among the three sampling periods in 2005 with 20 species collected versus 17 in 1988 and 14 in 1977. Nine species were present in all three sampling years and 5 species were collected for the first time in 2005. Two species, smallmouth bass (*Micropterus dolomieui*) and common shiner (*Luxilus cornutus*), were collected in 1977 and 1988 but not in 2005, likely due to increased sedimentation.

The fish composition in Hendricks Creek section 02 indicates marginal water for wild trout. Summer water temperatures approach or exceed thermal tolerance for trout and siltation may also be a limiting factor.

The PFBC conducted an electrofishing survey on Lick Run in June 1998. Lick Run is a tributary to Tubmill Reservoir and is located primarily on privately owned land. Survey results showed the presence of crayfish but no fish. Habitat quality is suitable for trout, but acid precipitation is the likely culprit of poor water quality and the absence of fish. The 1998 PFBC report recommended limestone sand treatment to remedy pH and alkalinity problems and promote the presence of reproducing trout populations (Lorson and Smith 1999).

Snyders Run was sampled by the PFBC at two sites in 1983, SR102 and SR101 (river miles 1.34 and 2.51 respectively) and again at site SR101 in 2006. Site SR101 had the greatest species richness with 19 species. Site SR102 had 12 species in 1983 and 8 in 2006. Six species were present in 1983 but not in 2006 and two species were present in 2006 but not 1983. In addition, the upstream site (SR102) had trout present in 1983 but not in the 2006 sample. The 2006 survey indicated that the high silt load was a likely impairment factor. Both the 1983 and 2006 surveys indicated that summer water temperatures might also be a critical limiting factor for trout.

Hypocrite Creek was sampled at one location (site HY01) by the PFBC in 2006. The site was located 100 m downstream of a private bridge and runs through agricultural land and rural housing. The fish community was composed of coolwater/warmwater species. Based on the fish composition at this site, water temperatures and sedimentation are likely limiting factors for trout.

Hellbenders

An interesting species found in Tubmill Creek is Eastern Hellbender (*Cryptobranchus alleganiensis*) (Figure 27). The hellbender is the largest salamander in the United States, with populations historically throughout the Mid-Atlantic States. Recorded populations are currently known to exist in Pennsylvania, Ohio, West Virginia, Virginia, North and South Carolina, and Georgia. Hellbenders live in clear, cool mountain streams. These large salamanders respire through their skin, and feed on crayfish, small fish, and macroinvertebrates.

Figure 27. A hellbender being processed during a stream survey. Photo by Nicholas Sly.

Historically, fishermen have regarded hellbenders, believed to consume all of the fish from good streams, as a nuisance. Actually, because hellbenders are very sensitive to water pollution, they are good indicators of stream quality.

The population of hellbenders has been on the decline for many decades. In Pennsylvania, hellbenders are not given any kind of protection status nor are any restrictions placed on the capture or killing of the species. One of the greatest threats to hellbenders is the sedimentation of rivers and streams. Runoff from dirt and gravel roads, farms, and erosion generally decreases oxygen in the water. Since hellbenders breathe through their skin, increased stream sedimentation is a serious detriment to hellbender health. Sediment also inhibits hellbenders access to nest rock and smothers young hellbenders. Additionally, the Nature Conservancy has found that predation of young hellbenders is occurring by trout, primarily stocked trout (Gall 2008). Therefore, hellbender populations might be diminishing because of trout stocking and its frequency. Other threats to hellbenders include dams, overcollection for the pet industry, killing by fishermen, and endocrine disruptors from toxic chemicals in the water.

Hellbenders are present in Tubmill Creek giving testament to its great water quality; however, sedimentation remains a concern. The WPC has been conducting hellbender studies on various sections of Tubmill Creek since 2007. To date 47 hellbenders have been captured; of those 12 have been captured over consecutive years and 10 have been captured in 2 of the 3 years. The animals ranged in mass from 100 g (0.22 lbs) to 1,290 g (2.48 lbs) and lengths from 26 cm (10.24 in) to 60.5 cm (23.8 in).

The WPC is working to protect hellbenders in Tubmill Creek through the reduction of sediment by the installation of various best management practices. The WPC is also acquiring land and conservation easements, placing an emphasis of no disturbance on riparian corridors.

Areas of Concern

Non-attaining Streams

Three stream segments in the Tubmill Creek watershed are classified by the PA DEP as non-attaining on the integrated stream list based on aquatic life (Figure 28). This list represents stream assessments in an integrated format for the Clean Water Act Section 305(b) reporting and Section 303(d) listing. The PA DEP aims to protect four types of water use including aquatic life, fish consumption, potable water supply and recreation. All non-attaining segments in the Tubmill Creek watershed suffer from impairment of aquatic life due to agricultural siltation or AMD metals.

The longest section of non-attaining stream is in the Hypocrite Creek sub-watershed. The entire upper section and its tributaries are listed as non-attaining due to siltation from agriculture. As described earlier, approximately 40% of all agriculture in the watershed is located in the Hypocrite Creek sub-watershed. With such a high concentration of agriculture, poor management practices can easily accumulate and have serious detrimental effects on stream health.

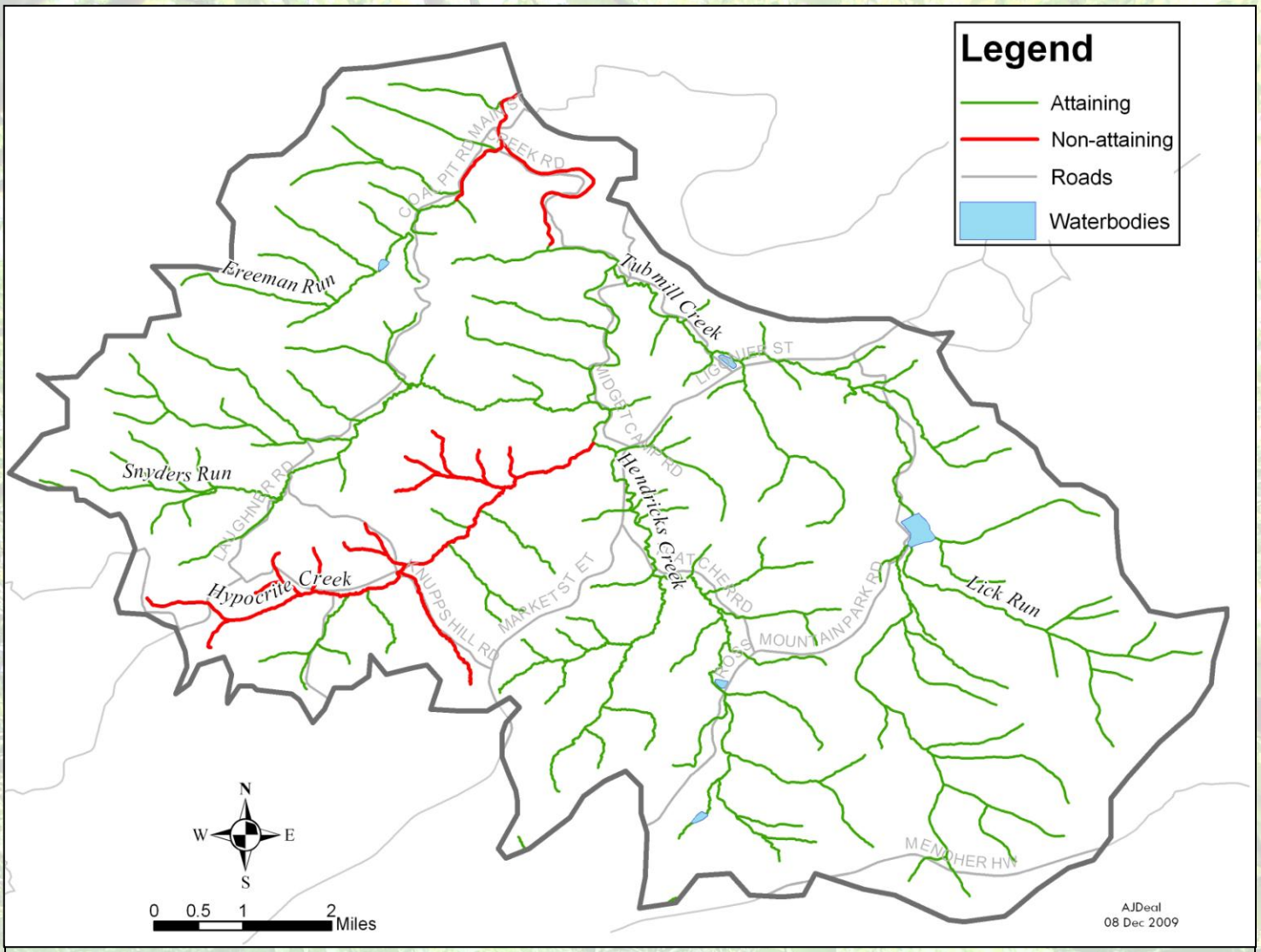

Figure 28. Attaining and non-attaining stream segments in Tubmill Creek watershed.

The lowest portions of Tubmill Creek and Freeman Run are classified as non-attaining due to AMD metals pollution. The majority of the AMD points identified on the Office of Surface Mining Abandoned Mine Land Inventory are located near these stream reaches. The types of AMD problems in this section include open shafts, mine entries, AMD discharge areas, vertical mine shafts, abandoned structures or untreated discharges.

The Stanton Bridge AMD discharge is primarily responsible for degrading Tubmill Creek to its mouth, a distance of 2 miles. Sampling, both chemical and biological, has shown the negative impacts of this discharge on stream quality. Upstream of the discharge, the stream is an excellent coldwater fishery. Below the discharge, trout as well as other aquatic species, can not exist in the degraded conditions.

Sedimentation

Sediment enters a stream through many different processes both natural and anthropogenic. Stream bank erosion is a common source of stream sedimentation that often appears to be natural. However, the degree of bank erosion can be drastically influenced by human activities. For example, removal of streambank vegetation can reduce the soil stability and increase the degree of streambank erosion. Activities throughout the watershed can also increase streambank erosion. High percentages of impervious landcover can cause increased streambank erosion because of the disruption in natural precipitation infiltration. High levels of impervious surface area cause stormwater runoff to accumulate overland quickly and enter the stream in higher volumes and at a faster rate than in a natural setting where precipitation slowly infiltrates into the ground and enters the stream gradually through groundwater. The increased quantity of water that enters a stream in a watershed with high impervious areas provides more energy to do work on the stream bank, thus increasing the degree of streambank erosion and sedimentation entering the stream.

Another major contributor of sediment to streams is poor agricultural practices. The removal of natural riparian vegetation to increase crop planting area causes banks to be less stable and increase the amount of sediment that enters a stream. Livestock can also add to sedimentation through heavy use on unstabilized areas or direct access to the stream. Both decrease soil stability and increase sedimentation.

Sediment may also enter a stream as a result of poorly designed or maintained dirt and gravel roads. Dirt and gravel roads increase stream sedimentation through erosion or dust pollution. Various programs are available to help reduce the negative impacts of dirt and gravel roads on streams.

Thermal Pollution

Certain stream organisms have a narrow range of temperatures at which they can survive. In a coldwater setting, a constant low temperature must be maintained to support the associated biotic communities. When a stream or body of water is exposed to direct sunlight the temperature increases. The Tubmill Reservoir is an open body of water and is heated throughout the entire day by the sun. When water is released from the top of the dam, the heated water enters the stream, often making thermal conditions unsuitable for coldwater organisms. Lack of or removal of riparian vegetation that provides canopy cover can also cause harmful increases in stream temperature.

Acidification

In addition to AMD pollution, acidification can also occur as a result of acid deposition. The upper reaches of Tubmill Creek and its tributaries including Lick Run have very low alkalinities, which mean that they have very little buffering capacity making them very susceptible to acidic events. Fish, especially wild trout, and macroinvertebrate populations can be greatly impaired due to acidification.

Illegal Dumps

PA Cleanways has identified 4 illegal dumpsites in the Tubmill Creek watershed as of March 2009. The dumps range in size from .75 tons to 2 tons of mostly household trash, tires and construction and debris waste. All 4 sites are considered active with dumping occurring more than twice a year. The largest illegal dumpsite is located off of Loughner Road, and in addition to bagged household trash, tires and construction waste, also contained at least 6 dumped white goods (major kitchen appliances). Illegal dumps pose a direct threat to the environment and humans alike. Illegal dumps attract disease-spreading rodents and mosquitoes by giving them a place to live and breed. Because of the presence of broken glass, rusty metals and toxic substances, illegal dumps can also be a source of physical injury for humans and animals. Moreover, the threat of extremely toxic methamphetamine lab byproducts being dumped illegally is becoming increasingly common and dangerous.

Figure 29. An illegal dump such as this could cost over $1,000 to clean up. Photo by Len Lichvar.

Illegal dumps also have negative economic effects. They are expensive to clean up, with costs of removal and disposal of trash from a site ranging from $600 to over $1,000 per ton. If not cleaned up illegal dumpsites can reduce property values, be a liability for property owners and affect property purchases and transfers. Tourism revenue may also be affected by the site of illegal dumps.

Marcellus Shale Drilling

Production of natural gas can certainly be a boon to the local economy, but Marcellus shale drilling may lead to environmental consequences that could outweigh the benefits in the long-term. Besides the on-the ground footprint of drilling the wells including roads, pipelines, drilling pads and wastewater storage pits, Marcellus shale drilling requires extremely large volumes of water for their specialized hydraulic fracturing process. Drilling a single well can require over 5 million gallons of water. Water quantity concerns arise over where the enormous volumes of water used in the process may come from. If water is pumped from one watershed then used and disposed of in another, problems may arise with water quantity issues. In an interbasin transfer, water is removed from its natural system and is not replenished, potentially causing a lack of water or drought conditions in the watershed where the water is being taken. But, perhaps an even greater concern is the disposal of frack water after the process is complete. After water is used, it becomes a slurry of water, salt, sand, and toxic chemicals. This water cannot be treated at an ordinary water treatment facility because of its toxic composition and huge volume. Frack water must be treated at specialized, approved facilities, which are currently scarce in Pennsylvania.

Regulations for permitting and monitoring Marcellus shale drilling are still being formed, while the industry is poised to quickly advance drilling with only limited regulations and procedures in place. Water resources of the Tubmill Creek could be in jeopardy if precautions are not taken to prevent damage from Marcellus shale drilling. All parties with a local interest in maintaining environmental integrity must be proactive in assuring that drilling companies do not decimate natural resources in the area.

Other Studies

Tubmill Creek First Day of Trout Surveys

On the first day of trout season, April 12, 2008, 21 anglers were surveyed on Tubmill Creek to determine how many people come to Tubmill Creek to fish or recreate. The survey also aimed to gauge how far people are willing to travel, how much money they are spending in the area and how frequently they visit the region. Amanda Love and Andrea Viazanko, with the Stream Team, and Jeff Rininger administered the surveys. Detailed survey results are located in Appendix 6.

Survey results showed that the average angler age was 45.6 years with an average of 30.5 years fishing experience and an average of 3 people per group or vehicle. Most people surveyed were from the neighboring towns of New Florence and Bolivar, with the furthest location being Irwin, PA—a distance of 37.5 miles.

When asked what species of trout they would like to see the most, brook trout

was the favorite, followed by brown, rainbow, golden, and tiger. Eighteen of the 21 said they would like to see more trout stocking. Most did not choose to answer the demographical questions such as education level and income. Nine people surveyed ranked their experience as "above average" and 8 stated their experience as "excellent."

In terms of economics, there was an estimated total of $2,268 spent within 25 miles of Tubmill Creek by these 21 people. This includes money spent on gasoline, food, supplies and lodging. This figure may seem somewhat low, but most people surveyed were from the area and did not spend much money on fuel or food. In addition, rising fuel costs have likely deterred individuals from other outlying areas to travel long distances for fishing.

Most people suggested that they would not spend more money to come to the area. Of the 10 people who said no, 7 said they would not spend an additional $25 to come to the area, 2 said no to $50 more, and 1 said they would not spend another $75 more. Of those who said they would spend more money, 2 stated they would spend $25 more, 2 $50 more, and 2 said they would spend more than $100 to come to the area.

All of those who stated they would not spend an additional $25 to come to the area live within 30 miles of Tubmill Creek.

Public Comments/ Concerns/ Suggestions

Tubmill Trout Club Public Survey

A public survey was administered at the Tubmill Trout Club meeting on March 12, 2008. There were a total of 9 questions and a copy of the survey and the results can be found in Appendix 7.

Most of those surveyed (78%) were from the area with an average of 37.5 years residency in the Tubmill Creek watershed. Every respondent considered Tubmill Creek to be a healthy stream but most did not know that the stream is classified as Exceptional Value by the DEP. Every respondent was also in favor of upgrading the portion of Tubmill Creek below the reservoir from its current status as a Trout-Stocked Fishery (TSF) to High-Quality TSF ranking.

Concerns in regards to the health of Tubmill Creek were focused on runoff and pollution. In terms of participation in recreational activities in the watershed, everyone who replied listed fishing, and 78% also listed hunting as an activity in which they participate. Camping, hiking, wildlife viewing, canoeing/kayaking, and boating each received 3 responses each.

Figure 30. Melissa Reckner, Stream Team, speaks to the public at a Tubmill Trout Club meeting in 2008. Photo courtesy of Tubmill Trout Club.

When asked why they participate in such activities within the watershed, most replied it is because it is within close proximity to their home. Two stated they wanted to see more ATV and 4-wheeler trails, while others expressed they wanted stream improvement, erosion control, and sewage cleanup.

Potential threats to the Tubmill Creek watershed were listed in chart form, and respondents were asked to rank each of the concerns on a scale of 1 to 5, with 5 being of extreme concern. Coal bed methane was of most concern, with an average ranking of 4.38 out of 5, followed by AMD with an average ranking of 4.22 out of 5. Sedimentation and erosion was third on the list of concerns with a score of 3.89 out of 5. Gas well drilling was another concern expressed by 1 respondent with a ranking of 5, though at the time of the survey little was known about Marcellus shale drilling.

Overall, the responses show that the majority of the group is concerned about the health of Tubmill Creek. Everyone believes that Tubmill Creek is a healthy stream, but major concerns identified are coal bed methane and AMD. These issues are of concern because of the amount of recreation that takes place within the watershed and the need to keep Tubmill Creek healthy.

Recommendations

Preserve EV

Since the upper portion of the Tubmill Creek watershed consists of an EV stream segment, it is important to maintain that status by limiting fragmentation and maintaining water quality. The EV designation provides some protection through the antidegradation policy, where the status of the stream must be maintained and protected. An erosion and sedimentation plan must be in place for all earth-moving projects and must show no degradation of water quality. However, many activities, such as agriculture, small-scale building projects and timber harvesting, receive no review or guidance under the EV designation. In order to assure that these activities do not

degrade water quality, conservation groups must work with landowners to develop comprehensive management agreements to complement and bolster the protection already provided by the EV status.

Laurel Ridge LCA is recognized as an area of exceptional significance by the PNHP and protection of this region, including Tubmill Creek headwaters, is essential. Careful planning within the LCA would benefit both ecological resources and people living and recreating on the land. In order to protect and maintain the area, municipalities, public agencies and private landowners must work together to develop a common vision and consider planning that considers ecologically sustainable land practices.

AMD Treatment

The Stanton Bridge AMD discharge degrades the last two stream miles of Tubmill Creek. The treatment of this discharge will provide benefits, not only ecologically, but also for the local community. Upstream of the discharge, the watershed exhibits some of the best ecological resources in the area. Treating the Stanton Bridge AMD discharge will restore water quality and biotic integrity to the currently degraded final two miles of Tubmill Creek.

Figure 31. Limestone doser like the one that will be installed on Tubmill Creek to treat the Stanton Bridge AMD discharge. Photo by Melissa Reckner.

Funding has been awarded to the Conemaugh Valley Conservancy (CVC) through Growing Greener II to treat the Stanton Bridge AMD discharge. The goal of the project is to neutralize the acidity entering Tubmill Creek, thus restoring the fishery and water quality to the lower stream reaches. The preferred treatment method for this discharge is to neutralize the acidity and produce alkalinity by adding limestone to the discharge. The water chemistry, flow rates and location make this site a candidate for installation of an active limestone doser. The doser used for this project will be a silo-type apparatus that is powered and regulated by the flow of the discharge (Figure 31). This will be one of the first limestone dosers installed in Pennsylvania and will help to showcase another option for AMD abatement. This treatment system will eliminate 19 tons of acidity entering the stream each year. Stream improvements will be monitored through regular stream water chemistry sampling. The CVC will be purchasing lime to

fill the doser and will continue to seek grants and donations and are in the process of establishing an endowment to provide funds needed to supply and maintain the silo after the Growing Greener funds are depleted. After the silo is installed, the stream will also be monitored biologically through electrofishing surveys below the discharge.

Included as an integral portion of this AMD treatment project is a community outreach and education component. Signage will be installed at the site to inform visitors of all aspects of the project and brochures will be developed and distributed as well.

Agricultural Best Management Practices

The Hypocrite Creek sub-watershed is degraded due to the effects of agriculture. Visual assessments in the sub-watershed identified direct animal access to streams, lack of riparian buffers, and severe erosion. All of these contribute to the severe sediment pollution of Hypocrite Creek.

Agricultural best management practices (BMPs) must be implemented in order to improve the stream quality of this important tributary to Tubmill Creek. The implementation of individual conservation and nutrient management plans for agricultural operations within the watershed would go a long way to reducing sediment and nutrient impact currently associated with agriculture. For example, stream bank fencing, properly installed stream crossings, and stabilized feeding and heavy use areas would all help to reduce sediment pollution. Farmers and landowners in this sub-watershed should be approached and educated on the importance and benefits of BMPs and should be provided assistance in implementation.

Watershed Goals, Tasks and Potential Funding Sources

Goal 1: Neutralize acidity.		
Milestones		*Possible Partners or Funding Sources*
Task 1	Install limestone doser to treat the Stanton Bridge discharge.	GG secured by CVC Businesses TTC
Task 2	Limestone sand additions.	PA DEP PFBC

Goal 2: Enhance and maintain riparian zones.		
Milestones		*Possible Partners or Funding Sources*
Task 1	Obtain conservation easements with landowners.	WPC
Task 2	Educate adjacent landowners on stream friendly landscaping.	LWV—WREN
Task 3	Streambank fencing.	NRCS

Goal 3: Reduce nutrient loading.		
Milestones		*Possible Partners or Funding Sources*
Task 1	Develop nutrient management plans.	NRCS Technical Assistance Grant CSAW
Task 2	Increase riparian buffer zones.	WPC
Task 3	Educate and partner with farmers.	WCD

Goal 4: Increase fishery.		
Milestones		*Possible Partners or Funding Sources*
Task 1	Replace valve and conduct bottom releases from Tubmill Reservoir.	HRWA PA DEP
Task 2	Monitor temperature above and below Tubmill Reservoir through use of temperature loggers.	PFBC
Task 3	Sample Hendricks Creek headwaters to evaluate presence or absence of wild trout.	PFBC
Task 4	Sample Freeman Run above AMD to determine fish community.	PFBC
Task 5	Reevaluate status of wild rainbow and brook trout populations in Tubmill Creek Section 01.	PFBC
Task 6	Reevaluate stocking locations and frequencies once HRWA starts bottom releases from Tubmill Reservoir.	PFBC TTC

Goal 5: Decrease stormwater runoff.		
Milestones		*Possible Partners or Funding Sources*
Task 1	Evaluate existing stormwater controls.	Municipalities
Task 2	Develop stormwater management plans.	Municipalities WCD
Task 3	Educate residents on BMPs (ie. Rain barrels, rain gardens, etc.).	WCD

Goal 6: Decrease erosion and sedimentation.		
Milestones		*Possible Partners or Funding Sources*
Task 1	Create a land development and preservation plan.	LHCLI
Task 2	Stream bank stabilization.	PFBC
Task 3	Dirt and gravel roads improvements.	WPC
Task 4	Implement agricultural BMPs to reduce erosion.	WCD WPC

Goal 7. Reduce thermal pollution.		
Milestones		*Possible Partners or Funding Sources*
Task 1	Work with HRWA to maintain bottom releases.	PFBC
Task 2	Plant vegetation to provide canopy cover in riparian areas.	WCD WPC Natural Biodiversity

Goal 8. Protect species diversity.		
Milestones		*Possible Partners or Funding Sources*
Task 1	Study hellbender populations over time.	WPC Pittsburgh Zoo
Task 2	Reevaluate trout stocking locations and frequencies.	PFBC TTC WPC Nature Conservancy
Task 3	Restore mountain brook lamprey.	PFBC

Goal 9. Clean-up illegal dump sites.		
Milestones		*Possible Partners or Funding Sources*
Task 1	Remove illegal dump sites.	PA Cleanways CVC WPC WCD Municipalities
Task 2	Maintain natural beauty.	Municipalities Residents

Key to Possible Funding Sources

CSAW – Consortium for Scientific Assistance to Watersheds
CVC – Conemaugh Valley Conservancy
GG – Growing Greener
HRWA – High Ridge Water Authority
LHCLI – Laurel Highlands Conservation Landscape Initiative
LWV-WREN – League of Women Voters – Water Resources Education Network
NRCS – Natural Resources Conservation Service
PA DEP – PA Department of Environmental Protection
PFBC – PA Fish and Boat Commission
TTC – Tubmill Trout Club
WCD – Westmoreland Conservation District
WPC – Western Pennsylvania Conservancy

Listed funding sources are not meant to be comprehensive and all efforts should be make to explore other public and private sources.

Conclusions

The Tubmill Creek watershed is home to some of the best coldwater resources in the area. The EV status of its headwaters and excellent wild trout fishery are exceptional resources not to be taken for granted. Protection of these reaches should be a priority and proactive measures should be taken to ensure that they remain unspoiled. Careful planning and public education can help maintain the pristine nature of Tubmill Creek's headwaters.

Although parts of Tubmill Creek are excellent resources, downstream reaches are in need of restorative action. The bottom stream section suffers from AMD pollution, causing impairment of water quality and stream life. Plans are already underway to construct an active limestone doser to abate one of the most damaging AMD discharges. Installation of the doser will help restore stream integrity, both chemically and biologically. Hypocrite Creek, a major tributary to Tubmill Creek, suffers horribly from the effects of poor agricultural practices, which in turn also pollutes Tubmill Creek itself. If Hypocrite Creek is to return to a healthy stream, work must be done to educate farmers of the importance and benefits of implementing agricultural BMPs.

Many partnerships exist and more within reach to bring back the abundant diversity of life that is known to inhabit the Tubmill Creek watershed and to protect what is there. With education, active conservation and good stewardship practices, Tubmill Creek has a promising future.

Photo by Melissa Reckner.

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APPENDIX 1.
PA DEP Water Chemistry on Tubmill Creek, 2005-2007.

(Note: values in blue indicate values less than that of the lowest detectable limit.)

Site	Description	Date	pH	Total "Hot" acidity (mg/L)	Total alkalinity (mg/L)	Total Iron (mg/L)	Total Aluminum (mg/L)
TMCUS	Tubmill Creek upstream	8/1/05	6.9	-8.20	38.60	0.93	0.50
		9/27/05	6.9	-10.40	41.20	0.37	0.50
		12/16/05	6.6	27.20	28.20	0.30	0.50
		2/10/06	7.2	16.20	25.20	0.30	0.50
		3/15/06	6.9	-6.80	23.80	0.30	0.50
		5/18/06	6.8	-7.20	26.20	0.41	0.50
		8/31/06	7.7	-45.40	57.00	0.38	0.50
		1/25/07	7.4	-16.40	28.60	0.30	0.50
		2/21/07	7.4	-21.20	35.80	0.32	0.50
STANTON	Mine discharge beside Stanton Bridge	7/27/05	3.0	147.20		10.80	7.37
		8/1/05	2.9	256.40		11.70	8.19
		9/27/05	3.0	151.20		15.20	9.04
		12/16/05	3.2	124.80		13.60	6.16
		2/10/06	3.0	139.40		12.05	8.20
		3/15/06	3.0	135.40		9.48	7.09
		5/18/06	3.0	133.40		10.00	7.47
		8/31/06	3.0	152.20		15.15	9.31
		1/25/07	3.0	412.80		15.90	8.52
		2/21/07	2.9	157.20		10.70	8.24
TMCDSSTAN	Tubmill Creek downstream of Stanton	8/1/05	6.6	25.00	28.80	0.91	0.50
		9/27/05	6.6	16.00	28.20	1.05	0.64
		12/16/05	6.4	19.20	21.40	0.80	0.50
		2/10/06	6.2	27.60	15.00	1.04	0.66
		3/15/06	6.8	12.20	20.40	0.57	0.50
		5/18/06	6.6	17.80	22.00	0.74	0.50
		8/31/06	7.2	-35.60	47.60	0.98	0.50
		1/25/07	6.6	-5.20	18.60	1.16	0.63
		2/21/07	7.2	-17.00	32.40	0.69	0.50
TMCUSTUSC	Tubmill Creek upstream of Tuscano	8/1/05	6.7	17.00	23.40	0.40	0.50

APPENDIX 1. Continued.

Site	Description	Date	pH	Total "Hot" acidity (mg/L)	Total alkalinity (mg/L)	Total Iron (mg/L)	Total Aluminum (mg/L)
TUSCANO	Discharge from Tuscano property	7/27/05	2.6	852.40		129.00	52.60
		8/1/05	2.6	846.60		114.00	54.10
		12/16/05	2.6	1220.80		182.00	91.90
		2/10/06	2.4	1000.80		159.80	62.35
		3/15/06	2.5	917.00		134.00	51.10
		5/18/06	2.5	835.80		124.00	47.70
		8/31/06	2.6	884.80		161.40	64.97
		1/25/07	2.4	1090.00		208.00	51.90
		2/21/07	2.5	898.40		145.00	48.70
TMCDS	Tubmill Creek downstream at RT 259 in Bolivar	8/1/05	6.5	4.20	13.20	0.30	0.50
		9/27/05	6.8	4.00	25.00	0.03	0.50
		12/16/05	6.3	24.60	25.20	0.45	0.50
		2/10/06	6.9	34.00	19.40	0.73	0.63
		3/15/06	6.9	4.00	22.00	0.32	0.50
		5/18/06	6.8	5.60	24.80	0.55	0.50
		8/31/06	7.6	-35.20	46.60	0.52	0.50
		1/25/07	7.0	249.80	20.20	0.97	0.59

APPENDIX 2.
PFBC Water Chemistry on Tubmill Creek, 1977-2006.

River Mile	Site – LatLon	Section	Site Date	Air Temp	Water Temp	pH	Sp Conductance	Total Alkalinity	Total Hardness
11.2	401756 790532	1	7/9/1984	20	12.5	7	72	4	14
9.3	401920 790528	1	6/29/1984	23	14.5	7	59	7	15
7.85	402021 790526	2	6/21/2006		19	7	61	8	14
7.85	402021 790526	2	6/16/1999		17	7	88	8	20
7.85	402021 790526	2	8/30/1977	23	22.8	7	65	9	27
5.92	402122 790640	2	6/21/2006		19	7	76	10	20
3.84	402208 790808	2	6/16/1999		17.5	7	110	16	34
3.84	402208 790808	2	8/31/1977	28	21.7	7	95	18	43
2.06	402300 790849	3	6/15/1999		19	7	179	32	48
0.82	402322 790915	3	6/15/1999		18	7	206	12	56
0.82	402322 790915	3	8/31/1977	26	21.7	7	210	11	165

APPENDIX 3.
Description of macroinvertebrate metrics.

	Metric	Definition	Description
R	Richness	Number of species present in each sample	Higher the number of species present, the higher the richness
E	Evenness	Measure of how evenly distributed the numbers of each taxon are within a sample.	Example: A sample may have 100 individuals, with species abundances of 25, 25, 25 and 25. Another sample may have abundances of 97, 1, 1 and 1. The former is distributed completely evenly, while the latter is heavily dominated by one species. Higher numbers, close to 1 indicate a more even distribution.
H'	Shannon Weiner Diversity Index	Considers the abundance of each species relative to the number of species present in the sample.	Scores range from 0 – 3 in freshwater macroinvertebrate surveys. A lower score indicates low diversity whereas a score closer to 3 means high diversity and abundance of taxa.
PTI	Pollution Tolerance Index	Percentage of interolerant versus tolerant taxa	Scores 23 and higher are classified as Excellent, 17-22 are good, 11-16 are considered fair and 10 or less are classified as poor with relation to pollution tolerance.
%EPT	Percentage Ephemeroptera, Plecoptera and Trichoptera	Percentage mayflies, stoneflies and caddisflies in a sample.	A higher EPT score means that more of the sample is comprised of these three orders, which are generally more sensitive to pollution, and less of the sample is comprised of the more tolerant taxa such as Diptera.
B	Hilsenhoff Index	Assesses the level of organic pollution.	Measured values range from 0 – 10, with a score of 0 having no organic impact and 10 being severely impacted by organic pollution.

APPENDIX 4.
Macroinvertebrates collected on Tubmill Creek, Fall 2007.

Taxa	TB 1	TB 2	TB 3	TB 4	TB 5	TB 6	TB 7	TB 8	TB 9	TB 10
EPHEMERPOTERA										
heptangeniidae	2		75	16	19	25	35	31	42	11
oligonueriidae			26	17	57	1	5	2	1	
ephemeridae				5						
baetidae					1					9
baetiscidae							1			
leptophlebiidae										1
PLECOPTERA										
perlodidae			1				1			3
chloroperlidae				1	3			1		
perlidae					3	1	1	1	19	2
capniidae		1				1				1
TRICHOPTERA										
hydropsychidae	194	59	69	54	134	17	20	37	180	63
philopotamidae	10		2	1	1	3			16	1
limnephelidae				1		1	3			
polycentropodidae						1	2	2	13	4
heliopsychidae							1			
psychomiidae							1	2	2	1
brachycentridae										3
DIPTERA										
chironomidae				24	2		1	17		1
tipulidae		1		16	4	3	6	6		6
simulidae					1				6	1
ceratopogonidae										
tabanidae										
empididae			1				2		2	
athericidae					4		1			
unknown						1				
COLEOPTERA										
elmidae	17	11	7	18	33	14	5	2		6
psephenidae				1		2	1	2		2
MEGALOPTERA										
corydalidae	1	4	12	3	5		7	1		2
sialidae						1	1			
ODONATA										
calopterygidae	1						1			
gomphidae				1		1	1	2		2
HEMIPTERA										
mesoveliidae	1		1							
veliidae				2						

APPENDIX 4. Continued.

Taxa	TB 1	TB 2	TB 3	TB 4	TB 5	TB 6	TB 7	TB 8	TB 9	TB 10
DECAPODA										
cambaridae		1	1			2	2	1	2	2
PULMONATA										
ancylidae	1	1		6	25		4	7		
VENEROIDA										
sphaeriidae				9						
corbiculidae	1	1	14	17	8					
OLIGACHAETA				2						
LEPIDOPTERA										
pyralidae				2			1			
TOTAL INDIVIDUALS	228	79	209	196	300	74	103	114	283	121
TOTAL TAXA	9	8	11	19	15	15	23	15	10	19

APPENDIX 5.
Macroinvertebrates collected on Tubmill Creek, Spring 2008.

TAXA	TB1	TB2	TB3	TB4	TB5	TB7	TB8	TB9	TB10
EPHEMEROPTERA									
Heptageniidae					1		3		1
Ephemerellidae	3	6	2	17	2		13	1	10
Baetidae	67						19	3	31
Oligoneuriidae						1			
Ephemeridae						2			
Baetiscidae				2					
PLECOPTERA									
Perlidae		1		2	1		8	7	
Perlodidae	4		2						1
Capniidae					1				
Leuctridae							19	61	5
Nemouridae		1						7	3
Chloroperlidae					1	1	1		11
TRICHOPTERA									
Hydropsychidae	7	1	4	1	13	7	11	6	8
Philoptamidae							3		
Glossosomatidae						2			
Hydroptilidae		1			1				
Limnephilidae				1					1
Lepidostomatidae				4					
Polycentropodidae				1		3	1	4	4
Psychomyiidae									1
Heliopsychidae				1					
ODONATA	0								
Gomphidae							2	3	
Aeshnidae						1			
COLEOPTERA									
Elmidae (riffle beetle)	2	2	3	2	18	3	3	5	15
Psephenidae									1
Hydrophilidae				1					
DECAPODA									
Cambaridae			2	2	1	2	3	1	4
DIPTERA									
Tipulidae	3	1		2	1	20	19	1	9
Chironomidae	150	274	39	112	45	57	7	156	11
Empididae		7	8	7	15	2		19	1
Athericidae					1				
Simuliidae	3	1	3	1	1	8		2	4
MEGALOPTERA									
Corydalidae		1	1	1	2	4		7	1
Tubiferae	2								
pyralidae	1							1	
Water Mite					1		1		

APPENDIX 5. Continued.

TAXA	TB1	TB2	TB3	TB4	TB5	TB7	TB8	TB9	TB10
Clam (sphaeriidae)			1				1		
corbiculidae					1				
Isopoda (asellidae)				1				1	
TOTAL INDIVIDUALS	242	296	65	158	106	113	114	285	122
TOTAL TAXA	11	11	10	17	17	14	16	17	19

APPENDIX 6.
Fish data collected in the Tubmill Creek watershed.

1977 PFBC Tubmill Creek Survey				
Common Name	**Scientific Name**	**TM201**	**TM202**	**TM302**
Blacknose dace	*Rhinichthys atratulus*		X	X
Brown trout	*Salmo trutta*	X	X	
Central stoneroller	*Campostoma anomalum*		X	X
Common shiner	*Luxilus cornutus*	X	X	
Creek chub	*Semotilus atromaculatus*	X	X	X
Greenside darter	*Etheostoma blennioides*	X	X	
Johnny darter	*Etheostoma nigrum*	X		
Longnose dace	*Rhinichthys cataractae*		X	
Mottled sculpin	*Cottus bairdi*	X	X	X
Mountain brook lamprey	*Ichthyomyzon greeleyi*	X		
Northern hog sucker	*Hypentelium nigricans*	X	X	X
Pumpkinseed	*Lepomis gibbosus*	X		
River chub	*Nocomis micropogon*	X		X
Rock bass	*Ambloplites rupestris*	X		
Smallmouth bass	*Micropterus dolomieui*	X	X	
White sucker	*Catostomus commersoni*	X	X	
Yellow perch	*Perca flavescens*	X		

1984 PFBC Tubmill Creek Survey			
Common Name	**Scientific Name**	**TM101**	**TM102**
Brook trout	*Salvelinus fontinalis*	X	X
Brown trout	*Salmo trutta*	X	
Mottled sculpin	*Cottus bairdi*	X	X
Rainbow trout	*Oncorhynchus mykiss*	X	X

APPENDIX 6. Continued.

1999 PFBC Tubmill Creek Survey					
Common Name	**Scientific Name**	**TM201**	**TM202**	**TM301**	**TM302**
Blacknose dace	*Rhinichthys atratulus*	X	X	X	X
Bluegill	*Lepomis macrochirus*		X		
Bluntnose minnow	*Pimephales notatus*	X	X	X	X
Brown trout	*Salmo trutta*		X		X
Brown trout- hatchery	*Salmo trutta*	X	X		X
Central stoneroller	*Campostoma anomalum*	X	X	X	X
Common shiner	*Luxilus cornutus*	X	X	X	X
Creek chub	*Semotilus atromaculatus*	X	X	X	X
Fantail darter	*Etheostoma flabellare*	X	X		
Greenside darter	*Etheostoma blennioides*		X	X	X
Johnny darter	*Etheostoma nigrum*	X	X	X	X
Mottled sculpin	*Cottus bairdi*	X	X	X	X
Northern hog sucker	*Hypentelium nigricans*	X	X	X	X
Pumpkinseed	*Lepomis gibbosus*			X	
Rainbow darter	*Etheostoma caeruleum*		X		X
Rainbow trout- hatchery	*Oncorhynchus mykisss*	X	X		
River chub	*Nocomis micropogon*	X	X	X	X
Rock bass	*Ambloplites repestris*		X		X
Rosyface shiner	*Notropis rubellus*	X	X	X	X
Silverjaw minnow	*Ericymba buccata*		X	X	
Smallmouth bass	*Micropterus dolomieui*		X	X	X
White sucker	*Catosotmus commersoni*	X	X	X	X

APPENDIX 6. Continued.

2006 PFBC Tubmill Creek Survey			
Common Name	**Scientific Name**	**TM201**	**TM203**
Blacknose Dace	*Rhinichthys atratulus*	X	
Bluegill	*Lepomis macrochirus*	X	
Bluntnose minnow	*Pimephales notatus*	X	X
Brook trout- hatchery	*Salvelinus fontinalis*	X	
Brown trout- hatchery	*Salmo trutta*	X	X
Central Stoneroller	*Campostoma anomalum*	X	X
Creek chub	*Semotilus atromaculatus*	X	X
Fantail Darter	*Etheostoma flabellare*	X	
Greenside darter	*Etheostoma blennioides*		X
Johnny darter	*Etheostoma nigrum*		X
Mottled sculpin	*Cottus bairdi*	X	X
Northern hog sucker	*Hypentelium nigricans*	X	X
Rainbow darter	*Etheostoma caeruleum*		X
Rainbow trout- hatchery	*Oncorhynchus mykiss*	X	X
River chub	*Nocomis micropogon*	X	X
Rock bass	*Ambloplites rupestris*		X
Rosyface shiner	*Notropis rubellus*	X	X
Smallmouth bass	*Micropterus dolomieui*		X
Striped shiner	*Luxilus chrysocephalus*	X	X
White sucker	*Catostomus commersoni*	X	X

APPENDIX 6. Continued.

2007 Fish survey conducted by PFBC, PA DEP, WPC, WCD, Stream Team.			
Common Name	**Scientific Name**	**TM301**	**TM303**
Least Brook Lamprey	*Lempetra aepyptera*	1	0
Banded Darter	*Etheostoma zonale*	10	27
Blacknose Dace	*Rhinichthys atratulus*	0	3
Blackside Darter	*Percina maculata*	0	2
Bluntnose Minnow	*Pimephales notatus*	103	15
Central Stoneroller	*Campostoma anomalum*	56	51
Creek Chub	*Semotilus atromaculatus*	3	1
Emerald Shiner	*Notropis atherinoides*	49	26
Fantail Darter	*Etheostoma flabellare*	10	2
Greenside Darter	*Etheostoma blennioides*	54	29
Johnny Darter	*Etheostoma nigrum*	16	2
Logperch	*Percina caprodes*	11	2
Longnose Dace	*Rhinichthys cataractae*	3	6
Mottled Sculpin	*Cottus bairdi*	95	12
Northern Hog Sucker	*Hypentelium nigricans*	89	51
Rainbow Darter	*Etheostoma caeruleum*	11	2
River Chub	*Nocomis micropogon*	19	9
Rock Bass	*Ambloplites rupestris*	20	7
Rosyface Shiner	*Notropis rubellus*	100	105
Silverjaw Minnow	*Ericymba buccata*	3	1
Smallmouth Bass	*Micropterus dolomieui*	9	4
Striped Shiner	*Luxilus chrysocephalus*	160	28
White Sucker	*Catostomus commersoni*	11	11
Species Total:		21	22
Total number of fish:		833	396

APPENDIX 6. Continued.

PFBC Hendricks Creek fish survey results. (Site HE201)				
Common Name	**Scientific Name**	**1977**	**1988**	**2005**
banded darter	*Etheostoma zonale*		X	
blacknose dace	*Rhinichthys atratulus*		X	X
bluegill	*Lepomis macrochirus*		X	
bluntnose minnow	*Pimephales notatus*	X		X
brook trout -- unknown	*Salvelinus fontinalis*	X		
brook trout --hatchery	*Salvelinus fontinalis*			X
brown trout	*Salmo trutta*		X	X
brown trout --hatchery	*Salmo trutta*			X
central stoneroller	*Campostoma anomalum*	X	X	X
common shiner	*Luxilus cornutus*	X	X	
creek chub	*Semotilus atromaculatus*		X	X
fantail darter	*Etheostoma flabellare*			X
greenside darter	*Etheostoma blennioides*	X	X	X
johnny darter	*Etheostoma nigrum*	X	X	X
largemouth bass	*Micropterus salmoides*		X	
least brook lamprey	*Lampetra aepyptera*			X
mottled sculpin	*Cottus bairdi*	X	X	X
mountain brook lamprey	*Ichthyomyzon greelei*	X		
northern hog sucker	*Hypemtelium nigricans*	X	X	X
rainbow darter	*Etheostoma caeruleum*	X		X
rainbow trout -- hatchery	*Oncorhynchus mykiss*			X
redside dace	*Clinostomus elongatus*			X
river chub	*Nocomis micropogon*	X	X	X
rock bass	*Ambloplites repestris*	X	X	X
rosyface shiner	*Notropis rubellus*			X
smallmouth bass	*Micropterus dolomieui*	X	X	
striped shiner	*Luxilus chrysocephalus*			X
white sucker	*Catostomus commersoni*	X	X	X

APPENDIX 6. Continued.

PFBC Hendricks Creek fish survey results. (Site HE202)				
Common Name	**Scientific Name**	**1977**	**1988**	**2005**
banded darter	*Etheostoma zonale*		X	
blacknose dace	*Rhinichthys atratulus*		X	X
bluegill	*Lepomis macrochirus*		X	
bluntnose minnow	*Pimephales notatus*		X	X
brown trout-hatchery	*Salmo trutta*			X
central stoneroller	*Campostoma anomalum*	X	X	X
common shiner	*Luxilus cornutus*	X	X	
creek chub	*Semotilus atromaculatus*	X	X	X
fantail darter	*Etheostoma flabellare*		X	X
fathead minnow	*Pimephales promelas*			X
green sunfish	*Lepomis cyanellus*		X	
greenside darter	*Etheostoma blennioides*	X	X	X
Johnny darter	*Etheostoma nigrum*	X	X	X
lamprey (unid)	Lamprey		X	
largemouth bass	*Micropterus salmoides*		X	X
least brook lamprey	*Lampetra aepyptera*			X
mottled sculpin	*Cottus bairdi*	X	X	X
northern hog sucker	*Hypentelium nigricans*	X	X	X
pumpkinseed	*Lepomis gibbosus*		X	
rainbow darter	*Etheostoma caeruleum*	X	X	X
river chub	*Nocomis micropogon*	X	X	X
rock bass	*Ambloplites rupestris*	X	X	X
roshyface shiner	*Notropis rubellus*		X	X
silverjaw minnow	*Ericymba buccata*		X	X
smallmouth bass	*Micropterus dolomieui*	X	X	X
striped shiner	*Luxilus chrysocephalus*			X
white sucker	*Catostomus commersoni*		X	X

APPENDIX 6. Continued.

PFBC Hypocrite Creek fish survey results. (Site HY01)	
Common Name	**Scientific Name**
Blacknose Dace	*Rhinichthys atratulus*
Bluegill	*Lepomis macrochirus*
Bluntnose Minnow	*Pimephales notatus*
Central Stoneroller	*Campostoma anomalum*
Creek Chub	*Semotilus atromaculatus*
Fantail Darter	*Etheostoma flabellare*
Greenside Darter	*Etheostoma blennioides*
Johnny Darter	*Etheostoma nigrum*
Largemouth Bass	*Micropterus salmoides*
Logperch	*Percina caprodes*
Mottled Sculpin	*Cottus bairdii*
Northern Hog Sucker	*Hypentelium nigricans*
Pumpkinseed	*Lepomis gibbosus*
Redside Dace	*Clinostomus elongatus*
Rock Bass	*Ambloplites rupestris*
Rosyface Shiner	*Notropis rubellus*
Striped Shiner	*Luxilus chrysocephalus*
White Sucker	*Catostomus commersonii*

PFBC Snyders Run survey data.				
Common Name	**Scientific Name**	1983 Site SR102	1983 Site SR101	2006 Site SR101
Black Crappie	*Pomoxis nigromaculatus*	X		
Blacknose Dace	*Rhinichthys atratulus*	X	X	
Bluegill	*Lepomis macrochirus*	X	X	
Bluntnose Minnow	*Pimephales notatus*	X		
Brook Trout	*Salvelinus fontinalis*	X		
Brown Trout	*Salmo trutta*	X	X	
Central Stoneroller	*Campostoma anomalum*	X	X	X
Common Shiner	*Luxilus cornutus*	X	X	
Creek Chub	*Semotilus atromaculatus*	X	X	X
Fantail Darter	*Etheostoma flabellare*	X		
Greenside Darter	*Etheostoma blennioides*	X		
Johnny Darter	*Etheostoma nigrum*			X
Largemouth Bass	*Micropterus salmoides*	X	X	
Mottled Sculpin	*Cottus bairdii*	X	X	X
Northern Hog Sucker	*Hypentelium nigricans*	X	X	X
Pumpkinseed	*Lepomis gibbosus*	X		
Rainbow Darter	*Etheostoma caeruleum*	X	X	
Redside Dace	*Clinostomus elongatus*		X	X
Rock Bass	*Ambloplites rupestris*	X		
Rosyface Shiner	*Notropis rubellus*	X		
Striped Shiner	*Luxilus chrysocephalus*			X
White Sucker	*Catostomus commersonii*	X	X	X

APPENDIX 7.
First Day of Trout Season Angler Survey Results, 2008.

(SURVEY RESULTS ARE SHOWN IN ***RED***)

Section I. Activities

1. What was the primary reason for making the trip to this area?

a. To participate in outdoor activities ***21***
b. To visit other attractions in the area ***0***
Which one(s)? _____
c. Visiting friends or relatives in the area ***0***
d. Business ***0***
e. Other _____ ***0***

2. Please, check the activities you participated in during this trip. Also, please check the activities you participate in this area throughout the year. Please, leave blank those that do not apply.

	Today	Spring	Summer	Fall	Winter
Hunting	***1***	***11***		***14***	***11***
Fishing	***21***	***18***	***15***	***8***	
Biking			***5***	***2***	
Camping	***1***	***3***	***4***	***1***	
Picnicking	***1***	***1***	***5***		
Sightseeing/Photography		***1***	***2***	***3***	***2***
Hiking		***3***			
Running		***1***	***1***	***1***	***1***
Bird watching		***1***	***1***		
Wildlife viewing	***1***	***4***	***5***	***3***	***2***
Rock climbing					
Canoeing/Kayaking		***3***	***3***		
Boating		***4***	***5***		
Fruit gathering			***3***		
Botanical observation			***1***		
Cross country skiing					
Snow mobiling					***1***
Visit a heritage area		***1***	***1***		
Visit a Museum	***1***	***5***	***6***	***5***	***5***
Other:					

2.1 If you checked more than one activity for this trip, which <u>one</u> of these activities was the <u>most</u> important reason for your trip to this area?

Fishing (20)

2.2 For how long have you been practicing this activity? ***7-55 yrs, 31 yrs avg***

3. How far did you drive, ONE WAY, to come to this area? (one way)

1-37.5 mi, 11.5 mi avg

4. Including yourself, how many people came with you in this trip today?

1-10 people, 3.3 avg

5. Please, complete the following table with some details about the people that are here with you today.

Trips = How many trips has each person in your vehicle made to this area this calendar year?
Zip Code = What is the Zip Code of residence for each person in your vehicle?
Age = What is the age of each person in your vehicle?

# Trips	***3-200, 31 AVG***
Zip Code	***MULTIPLE***
Age	***3-68, 31 AVG***

6. The people that are here with you today are:

16 Relatives
10 Friends
1 Members of a club
Other: _____

7. Who do you most frequently do this activity with?

18 Relatives
14 Friends
5 Members of a club
4 Alone
Other: _____

Section II: Trip Expenditures

8. Did your group, or will your group, purchase food, gasoline, clothing, etc., in communities surrounding the property during this trip (communities located within 25 miles of the property)?

Yes 19 No 2

8.1 If YES, please indicate the amount you and members of your group with whom you shared expenses (e.g., other family members, traveling companions) spent on each category on this trip.

Trip Expense	$ Amount Spent
Gas & Oil for Auto &/or Boat	***$5-100, $27.70 avg***
Food/drink:	***$5-150, $34.87 avg***
Supplies/fishing tackle/other retail	***$10-510, $64 avg***
Activities: admissions, entertainment fees, sporting goods	
Equipment rental	
Souvenirs	
Rental car	
Other; Please List:	

9. Is your group staying overnight in this area on this trip?

18 Yes
3 No

9.1. If YES, check one:

In a motel ***1***
In a B&B
Camping ***2***
Owned seasonal home
With friends

9.2. If Yes, for how many nights? ***1-2 nights, 1.7 nights avg***

9.3 If Yes, how much is your group spending for lodging each night?
$0-89, avg $30

10. Your fishing license is:

18 Resident Age 16-64
Senior Resident Age 65-up
2 Senior Resident - Lifetime Age 65-up
National Guard & Armed Forces Reserve (resident)
1-day Resident (not valid April 1-30) 16 & up
Non-Resident Age 16-up
Seven-Day Tourist Age 16-up
Three-Day Tourist Age 16-up
1-day Tourist (includes all stamps, license not valid in April)
Trout Salmon Stamp 16 & up

10.1 What type of fishing do you do most?

20 Bait
20 Spinners/spoons
2 Fly

10.2 Would you like to see?

18 More stocking
Less stocking
3 Stay the same

10.3 Do you keep the fish you catch?

13 Yes
8 No

10.4 If 10.3 is yes? How many fish in a year do you keep from this stream?
1-250, 33 avg

10.5 Would you like to see more <u>brook trout</u> in this waterway?

20 Yes
1 No

10.6 Which Trout Species would you like to see the most? You may mark more than one.

6 Brook
4 Brown
4 Rainbow
2 Golden (Palominos)
Tiger
12 All of the above

11. As you know, some of the costs of travel such as gasoline often increase. If the total cost of this most recent trip had been $_____ higher, would you have made this trip?

Higher cost	$25	$50	$75	$100	More
YES	*2*	*50*		*2*	
NO	*8*	*2*	*1*		

Section III. Demographics

12. Finally, please, tell us a little about yourself.

Gender
18 Male
1 Female

Income Level
Less than $10,000
1 $10,000 to $19,999
$20,000 to $29,999
1 $30,000 to $39,000
2 $40,000 to $49,000
3 $50,000 to $74,999
$75,000 to $99,999
$100,000 to $149,999

Education Level
Some High School
5 High School Graduate
2 Vocational/Technical
2 Some College
1 College Graduate
Graduate Study

13. How will you rate you overall experience in this area?
8 Excellent
9 Above average
3 Average
Less than average
1 Poor

14. Other comments or suggestions to help us improve your next visit:
More fish/stocking (7)
Garbage cans needed (1)
Need float stocking by state (1)
Better late season stocking (1)

APPENDIX 8.
Tubmill Trout Club Survey and Results.

Tubmill Trout Club Meeting
March 12, 2008

1. Do you live in the Tubmill Creek watershed? ***YES 7*** ***NO 2***
   If so, for how many years? ***24-51, 37.5 avg***
2. Do you consider Tubmill Creek a healthy stream? ***YES 9*** ***NO 0***
3. Did you know that a portion of Tubmill Creek is classified as Exceptional Value?
   YES 6 ***NO 3***
   Would you like to see the portion of Tubmill Creek below Tubmill reservoir raised from its current Trout-Stocked Fishery (TSF) status to a High-Quality TSF status?
   YES 9 ***NO 0***
4. What concerns do you have in regards to the health of Tubmill Creek?
   runoff (2), sewage (1), well drilling (1), pollution (1), lower portion (1), AMD (1), warm temperature/lack of trout habitat (1)
5. Please fill out the following chart and indicate the activities in which you participate in the **Tubmill Creek watershed**.

Activity	
Hunting	***8***
Fishing	***9***
Biking	***2***
Camping	***3***
Picnicking	***2***
Sightseeing/Photography	***2***
Hiking	***3***
Running	***2***
Bird watching	***1***
Wildlife viewing	***3***
Rock climbing	
Canoeing/Kayaking	***3***
Boating	***3***
Fruit gathering	***1***
Botanical observation	***1***
Cross country skiing	
Snow mobiling	***1***
Visit a heritage area	
Visit a Museum	

6. Why do you choose to fish/hunt/camp etc… in the Tubmill Creek watershed?
   local (5), nice area (2), scenic (1), good selection of game & fish (1), big fish (1), clean (1), easily accessible (1)

7. What kinds of conservation and/or recreational activities would you like to see more of in the area?

   ATV trails (2), erosion control (1), stream improvements (1), sewage cleanup (1), add delayed harvest section (1)

8. Please fill out the following chart with regards to your concern of threats to the Tubmill Creek watershed from 1-5. (1 not of concern, 5 extreme concern))

Potential Threat	
Sedimentation/Erosion	***3-5, 3.89 avg***
Agriculture	***1-5, 3.11 avg***
Industrial operations	***1-5, 3.0 avg***
Abandoned Mine Drainage (AMD)	***3-5, 4.22 avg***
Land Development	***1-5, 2.89 avg***
Stormwater/Flooding	***1-5, 3.22 avg***
Littering/Dumping	***1-5, 3.33 avg***
Coal Bed Methane	***3-5, 4.38 avg***
Other:	

9. Other comments/concerns/suggestions

   Gas or coal mining

Notes

Back page photos by Melissa Reckner.