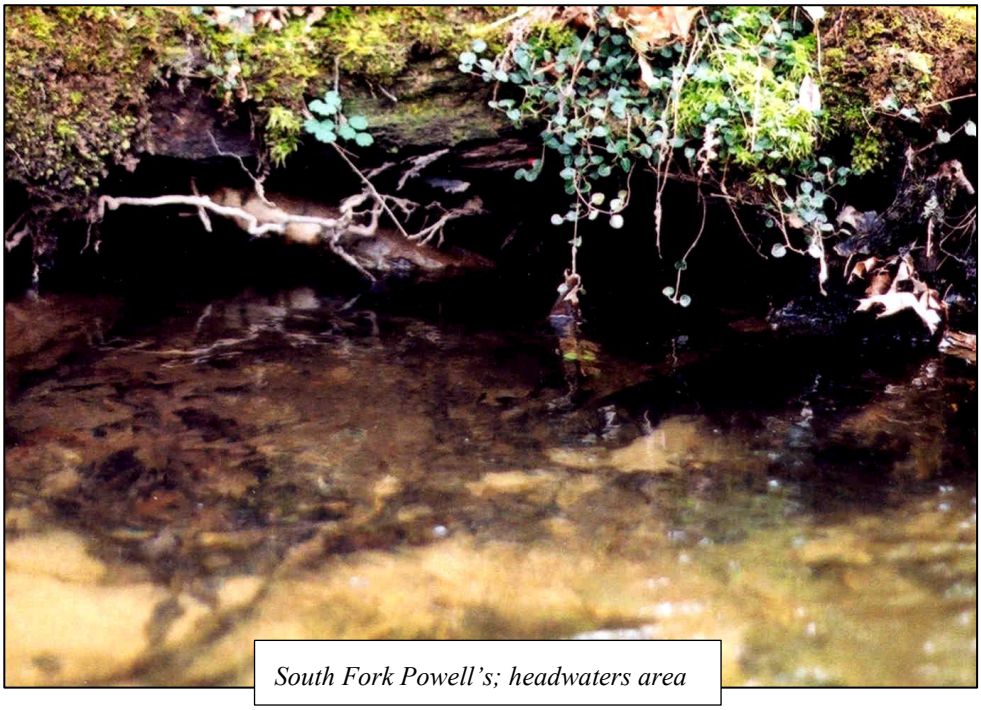
Introduction

A Conservation Plan for South Fork Powell's Creek:

What makes the stream special and how to keep it that way



South Fork Powell's; headwaters area

This document is intended as an educational tool and an informative guide to understanding and appreciating South Fork Powell's Creek as a community asset deserving of special protection. The conservation plan details the unique characteristics of the stream and the challenges to maintaining and enhancing it as important aquatic habitat.

The stream's greatest asset is its good water quality. An assessment by the PA Department of Environmental Protection in 1997 noted that the stream may be a candidate for a chapter 93 designation upgrade to "high quality". The stream supports sensitive aquatic species, including naturally reproducing brook trout - our only native trout and a species that thrives only in clean cool water. The SF Powell's watershed is also home to a rare plant.

The loss of the stream's protective forest by extensive logging in the late 1800's allowed rain storms to wash in excessive amounts of sandy soil and sediment, which smothers aquatic habitat. The stream's secluded location has enabled it to gradually recover as the forest regenerated. Catastrophic flooding from hurricane Agnes in 1972 also left some damage, but in general the

stream has remained relatively undisturbed for many years, allowing nature's restorative processes to renew water quality and aquatic habitat.

Heptageniidae
The flat headed mayfly

The stream's aquatic community, also in recovery from those earlier occurrences, now includes a quantity and variety of pollution sensitive aquatic insect species that are reliable indicators of a healthy stream. Data from the Dauphin County Conservation District shows that Powell's Creek is the only county stream in which every site examined scored "good" for these water quality indicators. These insects are an important food source for the stream's population of native brook trout.

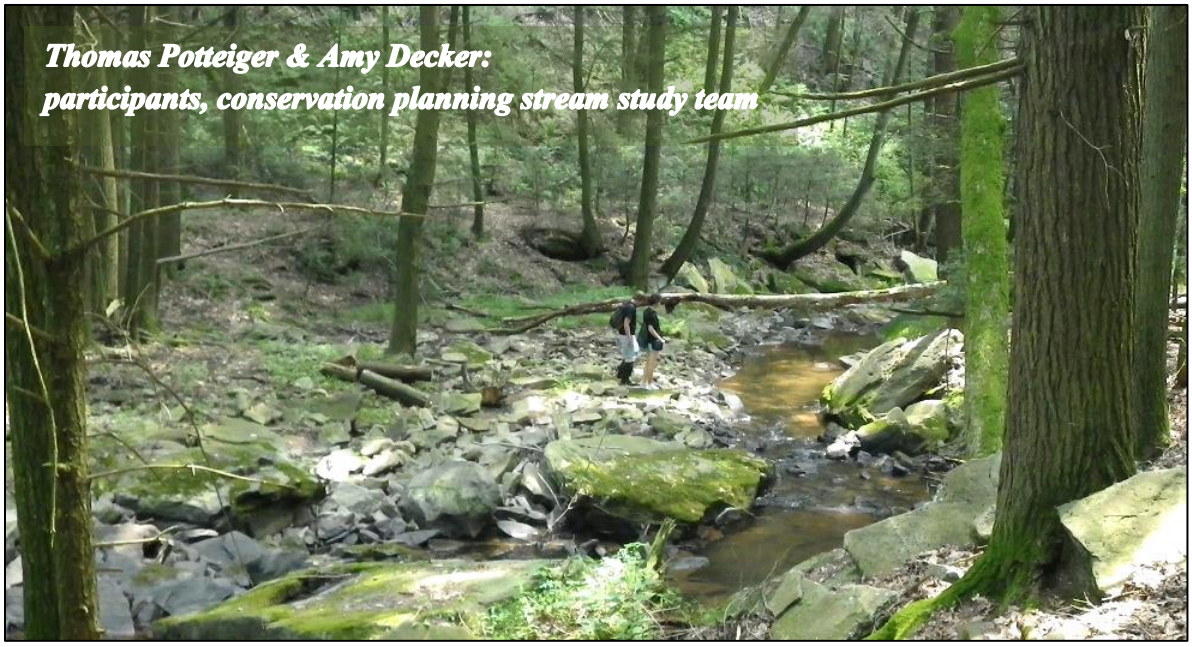
A study of the **status of brook trout** throughout their native range in the Appalachian region (Hurdy et al. 2005) found that 27% of the populations were considered severely reduced from historic levels. Among the North Atlantic States of New York, Pennsylvania and New Jersey, Pennsylvania had the greatest number of subwatersheds with brook trout populations classified as reduced (118), severely reduced (505), and extirpated (449).

Watershed investigations conducted as the conservation plan was developed show that, although the stream now has good water quality, its health and productivity are still somewhat limited by the effects of those historic impacts on aquatic habitat. Acid rain will also continue to stress aquatic populations, particularly during storm events, when the stream's ability to dilute it is overwhelmed.

Conservation plan recommendations discuss best management practices for the watershed that can protect and enhance water quality and aquatic habitat in the stream. Measures are included that apply to residents, stream side land owners and municipal officials. By making sure that the natural process of the stream are not disturbed, the community can ensure that its recovery will continue and its dependent flora and fauna will flourish.

Developing a Cold Water Conservation Plan

Purpose of Conservation Plans: To identify the values and threats that affect the health of the coldwater ecosystems that are home to naturally reproducing native trout. The collected information can be used as a catalyst for more comprehensive planning or for development of watershed improvements projects.



Goals of a conservation plan for SF Powell's:

- Promote local interest and appreciation of our cold water ecosystem as an important local asset to be preserved and protected
- Assist local officials in comprehensive planning efforts
- Conduct a watershed study that will identify actions and projects that will **protect, preserve and enhance SF Powell's as a cold water stream**, with habitat conducive to reproduction, population expansion & long term survival of native brook trout

Objectives of the Watershed Study:

- Field data collection to assess current conditions & trends
- Assemble all available existing related data and information to identify historic and contemporary watershed conditions and trends.
- Evaluate the data to assess the stream's potential as a candidate for a state designated use upgrade
- Include public participation as an education component

Public Participation/Education:

An invitation to join us

Twin Valley Conservation introduced the project at the annual Ned Smith Festival for Nature and Art. We believe that as a native trout stream, South Fork Powell's is interesting to people from the area in general, not just watershed residents. The festival draws thousands from the county and beyond, making it a great opportunity to reach people from a broad area.

The public awareness campaign began with a special program on Brook Trout at TVC's display booth at the festival in 2009. We used the program to entice people to visit and check out the display featuring the "in progress" Cold Water Conservation Plan.

BONUS PROGRAM

Ken Undercoffer
Past President,
PA Trout Unlimited

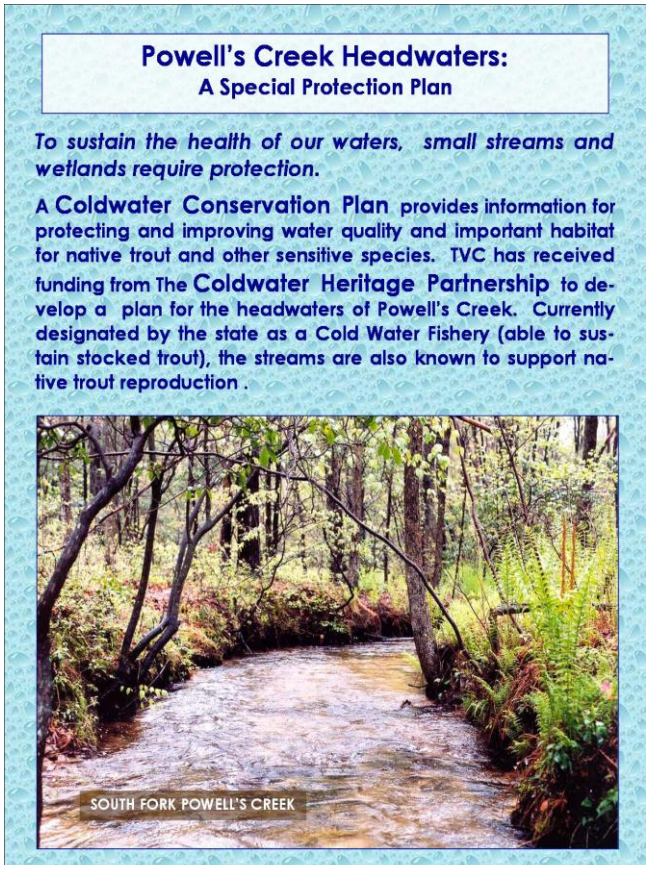
All About Brook Trout

1—1:30 PM
Twin Valley Conservation Tent
(Next to Pavilion #1)

Mr. Undercoffer will present a PowerPoint program about Eastern Brook Trout and the initiative to protect, restore and enhance their habitat.

In 2005, in recognition of the need to address regional and range-wide threats to brook trout, a group of public and private entities formed the **Eastern Brook Trout Joint Venture** to halt the decline of brook trout and restore fishable populations.

The EBTJV coordinates efforts that build private and public partnerships for brook trout conservation.

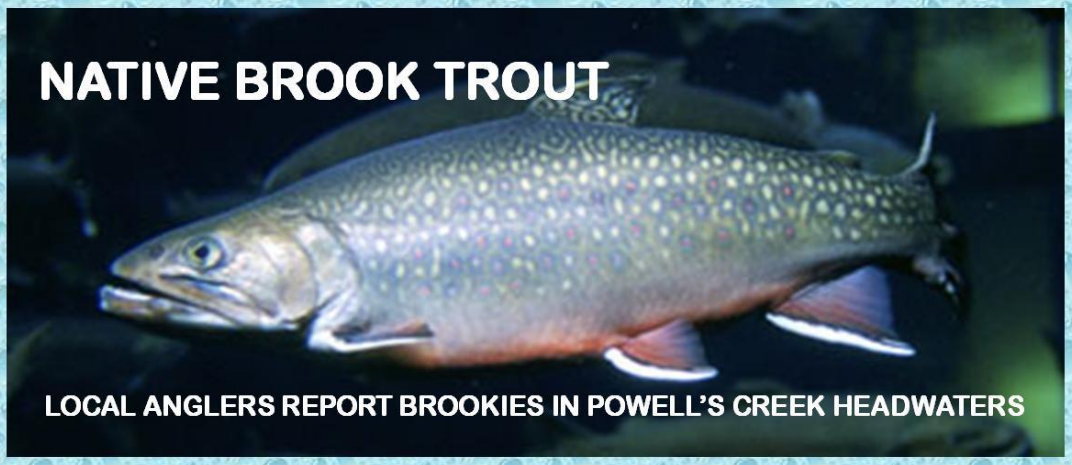


Display poster, CHP presentation program

Ongoing project activities, including student partner participation in the watershed study, were again presented at the 2010 NS Festival. A press release about the plan was printed in the local paper, and included an invitation to participate in the stream study. Project volunteers also presented a program on macro invertebrates and their relationship to clean water at the Ned Smith Center's 2010 Family Fun Day.

Watershed Tours: several tours were held to which the public was invited, including one with the Dauphin County Conservation District's watershed biologist for members of the Jefferson Township Planning Commission's "stream committee" – a group of local residents interested in obtaining a stream designation upgrade.

NATIVE BROOK TROUT



LOCAL ANGLERS REPORT BROOKIES IN POWELL'S CREEK HEADWATERS

THE NATIVE RANGE of brook trout (*Salvelinus fontinalis*) covers much of North America, from northern Georgia into northeastern Canada.

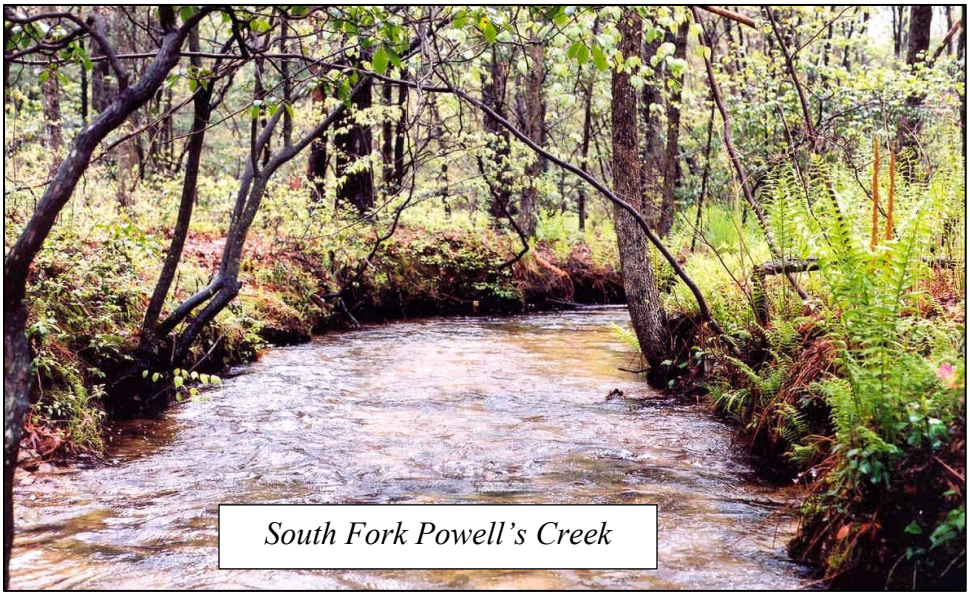
IN OUR REGION brook trout have largely been replaced by non-native brown trout and rainbow trout

SPECIES IN DECLINE: A recent assessment by the Eastern Brook Trout Joint Venture found that brook trout populations remain undisturbed in less than 5% of their historic subwatersheds and are extirpated from 21%. Population data are needed for 32% , particularly in New York, Pennsylvania and New England.

USUALLY FOUND IN COLD, CLEAR HEADWATER STREAMS, brook trout can also be found in lakes . They thrive in cool water with high oxygen content. Their short lifespan (about five years) and slow growth rates contribute to their generally small size

Another informative poster from TVC's public programs & displays

Part One: All About the Stream



South Fork Powell's Creek

Location: The South Fork of Powell's Creek flows from North East to South West through a long, narrow, upland valley. The ridges of Berry Mountain to the North and Peter's Mountain to the south run together at the eastern end of a wide, elevated depression known locally as Broad Mountain or "the flats". Pinched between its southern edge and the north slope of Peters Mountain is the head of Powell's Valley and the headwaters of SF Powell's. The stream proceeds through a perched valley between Peter's Mountain and a secondary ridge that parallels it, separating the South Fork from the North Fork Watershed below. Near its end the South Fork turns north and descends though a hollow in the ridge to join the North Fork near Carsonville.

Watershed description: Most of the headwaters area is encompassed by State Game Lands #210. Hardwoods dominate the almost completely forested watershed and occasional stands of hemlock are found in the lower reaches. The mid and lower reaches are privately owned. Most development is confined to the lower end of the watershed, near the Carsonville Road crossing and upstream of Back Road, where summer cottages, hunting cabins and some year round homes are located. A homeowner sewage module (Macky residence) has an outflow on the lower reach upstream of Back Road.

Now used primarily for hunting, fishing and outdoor recreation, historic land uses include lumbering and charcoal making. Deforestation during this period heavily impacted the watershed. Without protective cover, the very sandy soil at the higher elevations washed down into the upper perched valley. Evident throughout the entire Powell's Creek watershed, the sand is now continually moved downstream by storm events.

Smoke Hole Run is the only named tributary to the South Fork, and joins just below the headwater area. DEP biologist's assessment report noted that it has "lots of brookies". A few other small unnamed tributaries feed the stream, including a tributary that drains a wetland to the west of the point where the SF turns through a gap in the ridge and descends to Powell's Valley.

Approximate stream length: 12.2 miles; watershed area: 6.8 square miles

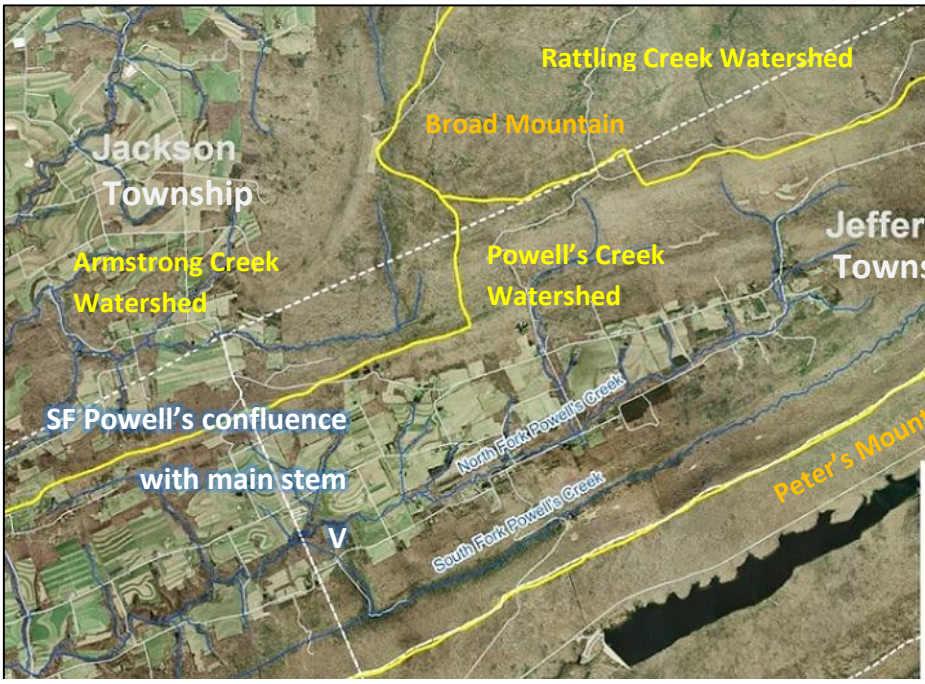
State Water Plan Subbasin: 06C; Pennsylvania code 93.9m - Drainage List M

Commonwealth Hydrologic Unit Code: HUC8 02050301.

Water quality standards protected designated water uses: CWF/MF.

CFS: *Cold Water Fishes*—Maintenance or propagation, or both, of fish species including the family Salmonidae and additional flora and fauna which are indigenous to a cold water habitat. (This means the stream is of sufficient quality to support native trout reproduction.)

MF: *Migratory Fishes*—Passage, maintenance and propagation of fishes which move to or from flowing waters to complete their life cycle in other waters.



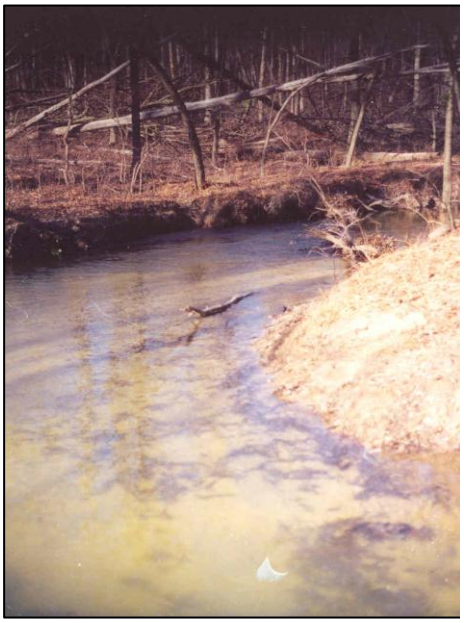
Land Use

Powell's Creek Watershed and Surrounding Area

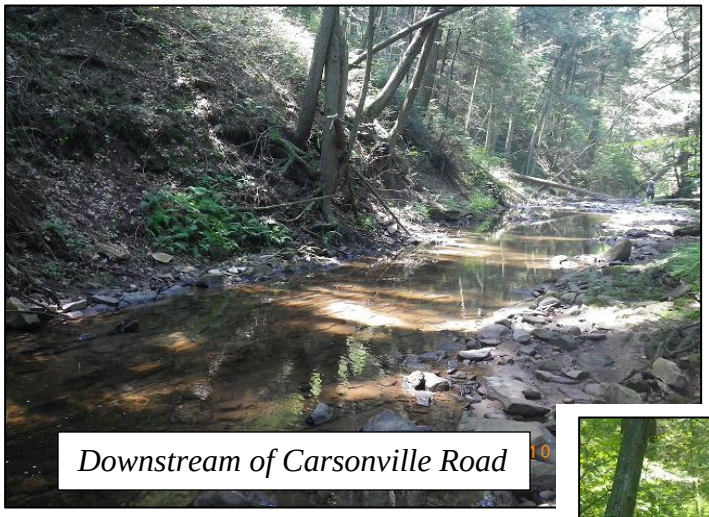
Jefferson Township
Dauphin County PA

SF Powell's headwaters, PA SGL 210

Stream geology: SF Powell's is a freestone stream, meaning in general that the surrounding geology is other than limestone. SF Powell's is primarily influenced by red, brown or gray shale in the lower areas and sandstone on the mountain ridges. Oddly, and due to its location in a perched valley up in the mountains, the upper reaches are very low gradient, almost flat, tortuously meandering with a sandy bottom – far more typical of lowland streams than of mountain streams. The sand, associated with a prehistoric inland sea, is a result of geological repositioning, when low areas are gradually forced upward into mountain tops.



Meandering, sandy bottom channel typical of upper reaches SF Powell's Creek

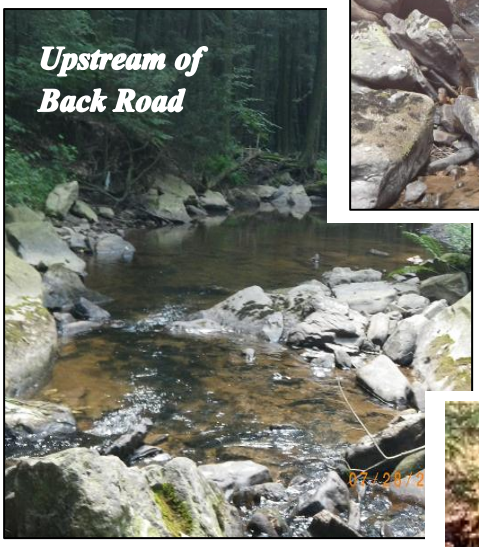


Downstream of Carsonville Road

At lower elevations (after the Carsonville Road crossing), the soil is less sandy and bedrock shale is near the surface. A steeper slope reduces meandering, and the added velocity boosts the streams ability to flush sand deposits from pools. More available trout habitat is evident.

Beginning the descent to the valley

The reach where the stream turns and drops down into the valley is steeper yet with numerous riffles and the rocky, step pool configuration more typically seen in the upper reaches of mountain streams.



Upstream of Back Road

After it's decent to Powell's Valley, the channel gradient is not quite as steep, but still retains enough slope to flush most sand from upstream on through the channel, maintaining a gravel bottom riffle/pool habitat appropriate for trout and sensitive macro invertebrates.

Downstream of Back Road:
Twin Valley Conservation volunteers collect samples for water quality data

About Freestone Streams: Freestone streams are born high in the mountains by precipitation - either snow melt or rain- that collects into streamlets that continue to combine until they become a stream. They tend to be more acidic due their dependency on (acid) rain and due to the surrounding foliage, which is often oak and hemlock trees – also acidic. They experience rapid changes in water level and temperatures because they are at the mercy of the rains. These streams that usually start high in the mountains often support fair populations of brook trout.

During dry periods they are fed by seeps and hard rock springs. The hard rock base offers little buffering capacity, making them much more vulnerable to acid rain than a limestone stream. (Limestone can neutralize acid, reducing its ability to negatively impact the stream. Freestones are distinguished by few rooted aquatic plants and by an abundance of gravel and rocks.

Mountaintop freestones generally have steep gradients characterized by areas of rapids and fast currents. They often have waterfalls and extensive pocket water (deeper pools), or a classic pool-and-riffle configuration. Riffles aerate the water, beneficial to the macro invertebrates that serve as a food source for fish. Although freestone streams can have a greater variety of aquatic insects as a food source, because of low alkalinity (acid buffering capacity) they are less fertile for trout populations than the limestone streams.

Because they rely upon precipitation, their volume is greatest in spring and early summer, and diminishes in the late summer and fall. There is often stark contrast between springtime and late summer flows. A stream with inviting pool habitat in spring may be nearly dry by fall. Springtime flows may be high and muddy yet run low and clear the rest of the season. High flows commonly scour stream channels. Rooted aquatic plants have difficulty surviving the seasonal heavy flows. Stream channels can change from one year to the next. Some scouring may be beneficial if it washes away excess silt accumulated in the rocky, gravelly, riffled sections.

As a general rule, the freestone stream's growing season is much shorter than that of a limestone creek. Freestone streams fluctuating water levels are more prone to wide variations in available habitat and in temperature. Low, shallow flows are more easily impacted by ambient temperature changes. Winter cold can cause a stream to run close to freezing while summer heat can cause it to exceed 70°F. This wide variation shortens a fish's growing season, which occurs when the water temperature is between 55-65 degrees. Summer die-offs can occur due to excessively warm temperatures, which reduce water's ability to hold sufficient oxygen.

Heavy rainfall has a greater impact on pH during periods of low flow. In times of excess acid, plants, insects, and fish are impacted. The snow pack at a stream's source can accumulate acidic precipitation. This is concentrated into the bottom layer of snow. As this bottom layer melts, the sudden release of acid can be devastating to its downstream environment.

Why the stream is important: *Native Brook Trout Habitat:* The South Fork Powell's watershed is important as a native trout nursery. The stream's clean cool water, essential to natives, supports numerous aquatic macro invertebrate species which are an important food source. A number of those are pollution sensitive species found only in streams with good water quality. Native trout reproduction has been observed for many years by local fisherman, who report sightings of Brook Trout well down the main stem. PA Fish & Boat Commission surveys document the presence of natives in the South Fork.

Aquifer Recharge, Storm Water Retention and Infiltration: The heavily forested area is conducive to infiltration of rain water, reducing damaging storm flows and re-charging the water table. The mountain formations of the upper elevations are apparently a factor in the additional rainfall observed in the SF Powell's watershed as compared to neighboring watersheds. During dry periods the extra rainfall captured and stored by the watershed can seep into the stream as ground water, maintaining stream flow in SF Powell's, which in turn contributes water to the main stem. The infiltration process can also remove excess nutrients and pollutants.

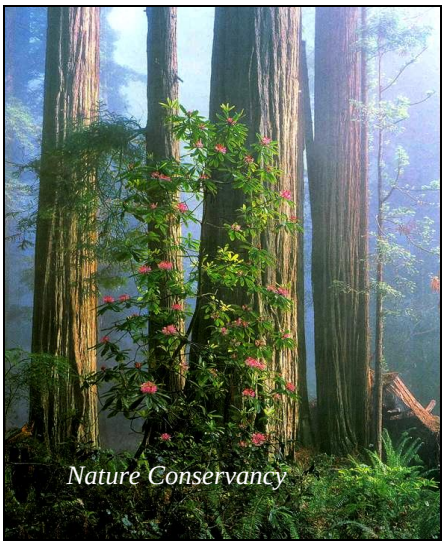
Wildlife Habitat: In addition to its importance to local water quality and quantity, the stream and watershed also support diverse wildlife with clean water and suitable habitat. Hunting, fishing & wildlife watching are very important to area residents. The watershed is home not only to the usual deer, bear & turkey, but also supports many less frequently seen species, such as beaver & the reclusive bobcat. It is also designated as an Audubon Important Bird Area.

Bobcat, photographed by trail camera
John Laskowski, Carsonville

Areas Significant to Natural Diversity: The Dauphin County Natural Diversity Inventory lists its major tributary, Smoke Hole Run, as a priority site for conservation. It is home to a plant species of concern, the Rough Leafed Aster. It also lists Powell's Creek Swamp as an area of significance. The swamp, in the headwaters area at the confluence of Smoke Hole Run and South Fork Powell's, is in a young forest that may have been logged in the past but is recovering. It's damp, sandy soil and dappled sunlight offers potential habitat for the rare plant species found nearby.

Part Two: Watershed Assets and Challenges

Factors Contributing to Watershed Health:



The most important contributor to the health of water quality in South Fork Powell's Creek is the forested watershed that almost completely encompasses it. Our cold water streams evolved over millions of years in an almost unbroken forest from the east coast to the Mississippi River. Their characteristics and the life dependent on them are uniquely suited to a forest environment. For thousands of years, massive chestnuts, sycamores and hemlocks created a deep shade that cooled the riffles and pools where our aquatic life evolved. Deep roots reinforced and protected stream channels from erosion, especially during high water events, and infiltrated it into the ground, storing it to feed the streams during dry periods.

Our native Brook Trout are dependent on shaded, cool, clear, oxygen rich water, and many of the aquatic insects that serve as their food need the same. The forest surrounding SF Powell's maintains the required cooler temperatures, but native species need more than just cool clean water to flourish. Roots, fallen leaves and branches provide food, shelter and habitat for all sorts of aquatic life. Without the protection of trees, streams are vulnerable to excessive runoff from storm water. They can become choked with sediment; the deeper pools that provide cover and cooler water in summer get filled in, as well as the spaces between the rocks and gravel that provide nesting habitat for brook trout and shelter for the aquatic insects they feed on.. The channel can become unstable as the banks erode, allowing the stream bed to shift across the flood plain.

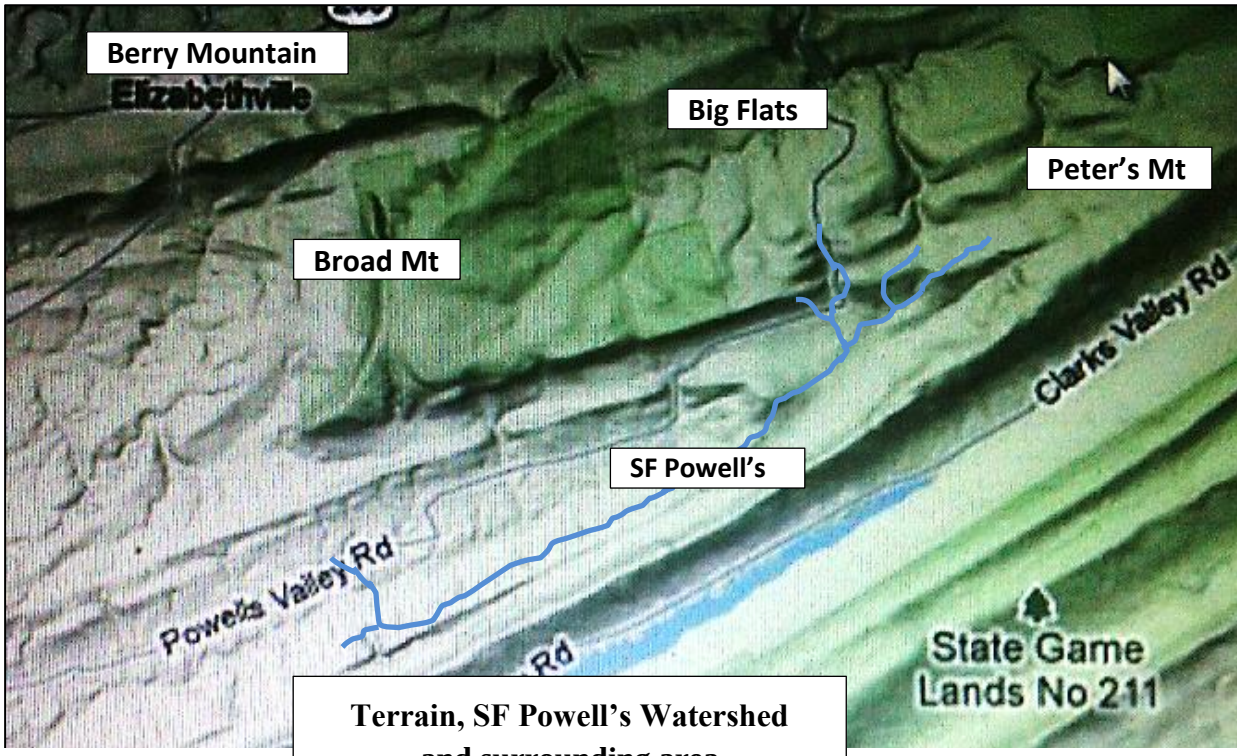
Conserved Land: Roughly half of the watershed is permanently protected as PA State Game Land #210. This area is managed for wild life habitat, and although some timber harvesting does take place, the forest will always be allowed to regenerate.

In addition to the forest protected by inclusion in state game lands, the Harrisburg Authority holds approximately 400 acres that encompass the stream. This land was purchased when the reservoir on neighboring Clarks Creek was built, as insurance in case Clarks Creek did not supply enough water for the authority's needs. The land was meant to provide access to withdrawals from SF Powell's by means of a pipe under Peters Mountain. That strategy has been proved unnecessary, and the land has remained in its natural state. At this point, due to the financial stress of the city of Harrisburg, the land may be available for purchase. This presents

an opportunity to work with a land conservancy to expand permanently protected land in the watershed by possibly adding it to the adjoining State Game Lands.

Minimal development: The current forest, like most in Pennsylvania, is not an old growth forest. It began regrowth about 80 to 140 years ago. Since then, most of the watershed has seen minimal disturbance. Development is limited to predominately hunting camps and vacation cottages. There are very few permanent residents in the watershed. Most privately owned land is used for recreational purposes and/or lumber harvesting.

Limited Accessibility: One of the most interesting aspects of the stream is that very few people have seen very much of it. For the most part the watershed is relatively inaccessible to motor vehicles. There are only a few dirt roads penetrating the watershed, and they are not open to the public. Only two paved roads transect the stream, a limiting factor for future development. Its remoteness has protected the stream from much of the development that could harm it.

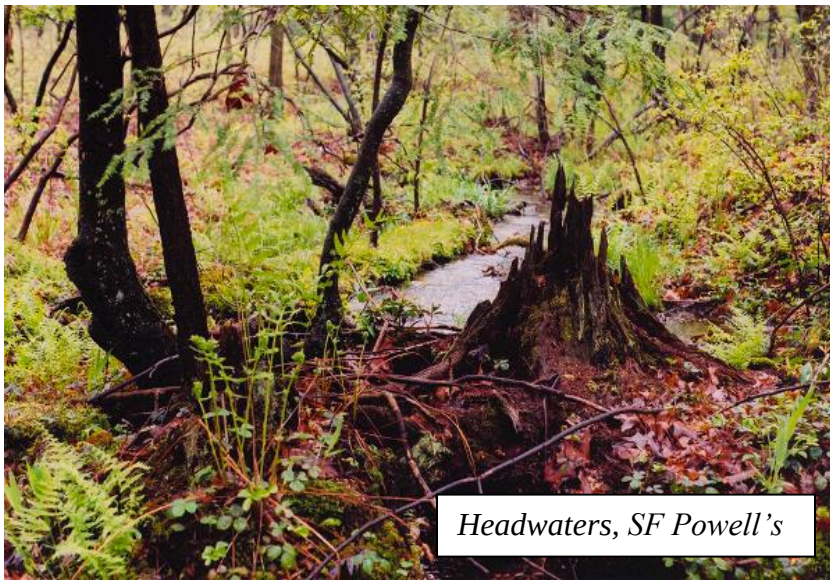


Terrain, SF Powell's Watershed and surrounding area

Factors that challenge the watershed:

Historic Impacts: The SF Powell's Creek was not always protected by the forest that surrounds it *now*. The current forest has regenerated from extensive clear cutting in the past. From early in the 1700s through the 1860s, timber was being cut for charcoal to fuel Pennsylvania's iron industry; pines were also useful for making tar. (Remnants of charcoal and tar pits can still be found on Broad Mountain.) Coal was being mined to the east of the watershed, and the railroads that transported the coal from the mines to the river needed railroad ties. Lumber was needed to build homes and towns.

It was a period of exploitation and, except for a few patches that were too hard to reach, most of the watershed, as well as most of the state, was clear cut more than once. A report on the conditions of the headwaters area of the watershed in 1855 *(see excerpts on page 16)* describes much of the once forested area as being sparsely timbered with patches of marshy fields and arable land, a few small farms, a couple of active sawmills and evidence of extensive previous charcoaling and tar making. Large scale deforestation in the headwater areas of the watershed allowed the very sandy soil in the upper ridges to wash down slope and accumulate in the upper valley where the headwaters form.



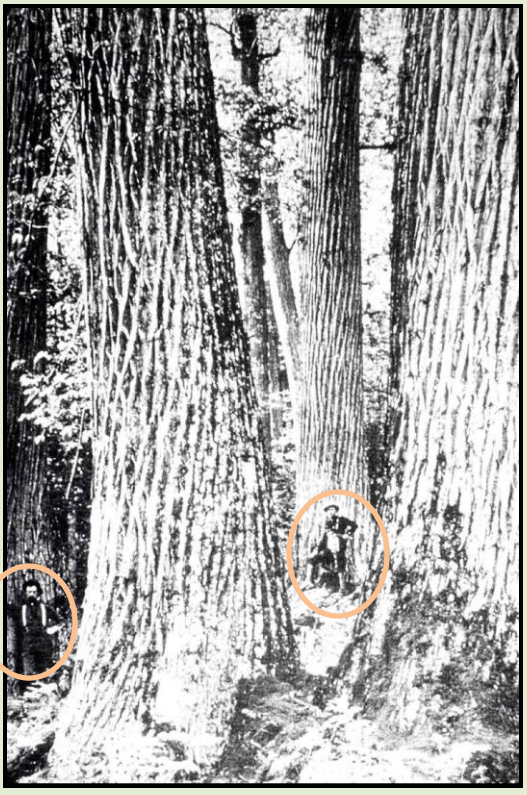
Headwaters, SF Powell's

These bowl-like valleys, pinched up between the ridges, were inundated with sand. (Channel erosion in South Fork Powell's Creek has exposed fallen trees buried under nearly three feet of sand). This sand is still migrating downstream today. The steeper, fast moving stretches, particularly where the headwaters drop to the valley, manage to carry the sand along. As the streams reach the more level terrain in the valley sections, the flow slows down and the sand drops out, accumulating in the channel and on the banks. Flooding carries very large amounts of sand to the lower valley, where it is deposited on the flood plains. Later, smaller rain storms wash the sand back into the creek. When the flow is too low and slow to move the sand and keep the channel clear, accumulations build up and smother aquatic habitat.

Excerpts: **Report on the Lands of the Susquehanna Coal Company. April 16, 1855:**

On top of the mountain there is a considerable quantity of young pine timber, too small to be cut into lumber, and a tar kiln with a young pine in the center indicating that it must have been about 25 years since the timber had been cut away and burned in the manufacture of tar and charcoal. Other old tar kilns are found in various places where there is no other mark of timber having ever existed. There are spots of arable land of 1 – 10 acres, but the only timber is sparsely scattered young pines and scrubby oaks.

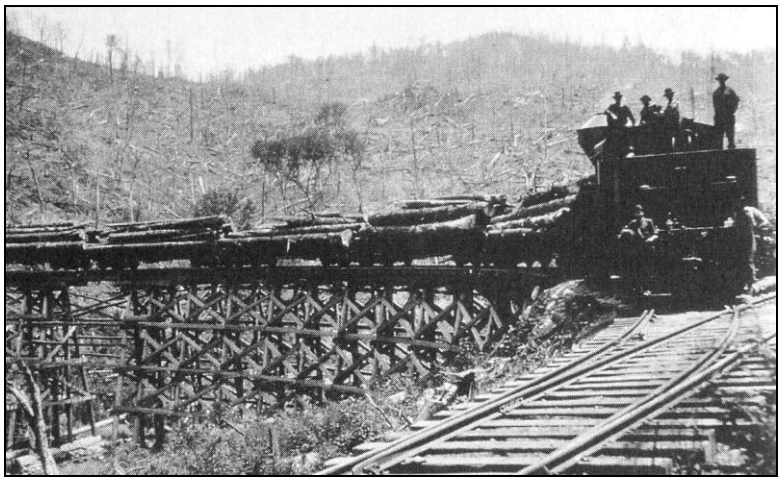
The existence of old tar kilns and the traces of a wagon road up the middle branch of Smoke Hole Run shows that many years ago an extensive business in the manufacture of tar and charcoal has been carried on; this requires a heavy growth of pine timber to supply and accounts satisfactorily for none being found at the present day. The names applied by the old hunters to the heads of this valley indicate the appearance of the ground - ***Woodpecker Knob, the Beggars Turnabout and Dutchman's Gap*** are steep and barren. Just south of Round Top Mountain the large and valuable white pines of White Pine Swamp have mysteriously disappeared, in the shape of shingles, the manufacture of which, I am told, has been stealthily carried on in this place for twenty years.



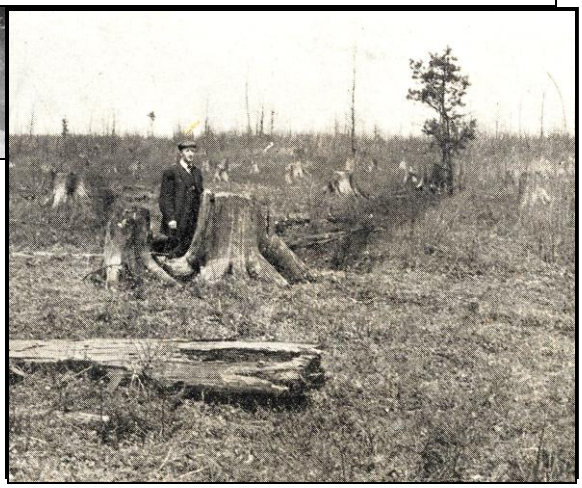
North of Round Top, the ***Big Flats*** is a marshy plain thick with brush, but large timber is scarce to be seen. One of the Galbraith's has built a saw mill and it is likely that some of the timber has gone in that direction. East of the Smoke Hole there are a few good pines but 12 or 15 fine ones have been hauled away. Logs having thickness and bark matching these stumps were seen afterwards at Frees (Ferree's) saw mill, and his refusal to account for logs coming to the mill from that direction makes it almost certain that his own hands had something to do with them. *Full report on the appendix CD.*

When Europeans first arrived, one in four trees was an American Chestnut, now decimated by blight. Some were hollow and large enough to use as a workshop or dwelling.

In 1880, Pennsylvania ranked number one in the nation for lumber production. By the end of the 1800's, nearly all of Pennsylvania's forests had been clear cut to make charcoal for iron foundries, railroad ties to transport coal or lumber for houses and towns.



Logs were dragged out with mules, floated out on streams and rivers, or hauled out by rail and later trucks.



Today only a few remnants of old growth forests remain only because they were in areas that were too difficult to reach. The nearest is Hemlocks Natural Area [Tuscarora State Forest] Perry County, southwest of Blain near Big Spring State Park.

Conservation begins: In the late 1800's the Pennsylvania Fish & Boat Commission, Game Commission and Bureau of Forestry were formed to protect our forests and wildlife. Forests regenerated, wildlife rebounded and hunting and fishing were revived as an important source of food and recreation. For the next 100 years the forests encompassing SF Powell's enjoyed a period of managed recovery. ***Pennsylvania today ranks number one in the nation in hardwood production.***

A collier build conical mounds of wood, then set them afire.

A controlled slow burning fire turned wood into charcoal

Making Charcoal

Controlling the burn was dangerous work. A collier who climbed the mound to add wood or inspect the fire could fall through if the outer walls had burned too thin to support the weight. The heat inside the mound was so intense that if a collier did fall in, rescue was considered futile and not attempted.

How streams work: Healthy stream channels are in equilibrium with the sediments washed in during rain storms, maintaining a velocity that is strong enough to efficiently flush sediment through the channel without either eroding the channel or allowing the sediment to accumulate. A slightly V shaped stream bed consolidates water in dry, low periods so that the channel's flow still has enough force to flush away sediment, maintaining the aerating riffles and deeper pools required for aquatic habitat.

Sandy soil near streams is highly erodible: *Composite photo view of both sides of creek shows impact of high water flows when protective forested buffers have been lost.* *Powell's Creek*

When things go wrong: Changes in surrounding vegetation, the amount of water entering the channel, or the materials lining the bed and banks can alter the balance and tip the stream into an unstable state. Deforestation; heavy flooding from unusual storm events; large water withdrawals for irrigation or drinking water; development that requires large paved areas that don't retain rain water; storm water piped directly into streams, or portions of stream channels lined with concrete or other hard surfaces are examples of changes that can alter the equilibrium of streams.

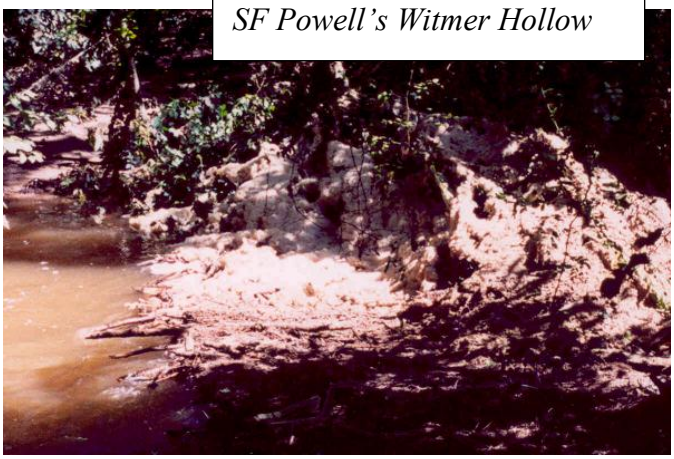
Evidence of channel instability*: eroded banks, falling trees, over widened channel, excess gravel & sediment deposits blocking flow.* *Powell's Creek*

When streams are out of equilibrium, excessive flow or diversion of water by mounds of accumulated sediment can cause channels to erode and migrate across the land. Soil and sediment wash into the channel as banks erode; stream bank vegetation is undercut and trees fall into the stream. Soil, sand and gravel smother the spaces between stones in riffle areas where aquatic insects live, removing an important food source for fish. Fish breeding areas are buried, and deep pools fill and become shallow, warmer and less able to hide fish

Fallen trees from many years ago which had been buried under nearly three feet of sand protrude from the bank, exposed by the stream channel as sand is carried downstream.

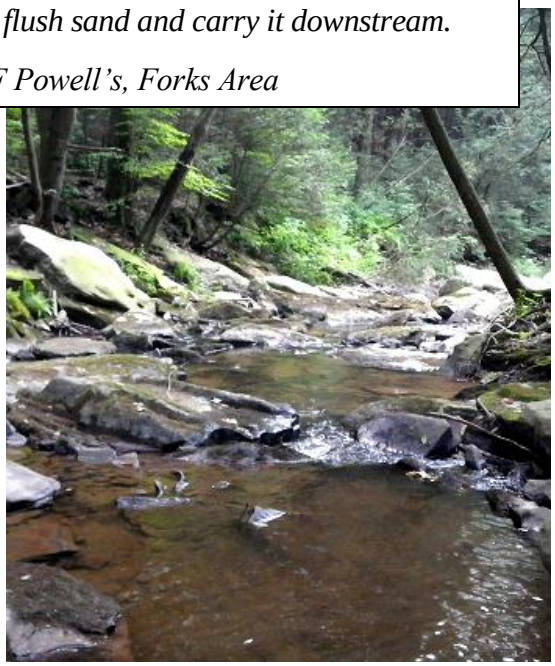
Looks like snow: Sand deposited on banks as flood waters recede

SF Powell's Witmer Hollow



Greater velocity in steeper areas is able to flush sand and carry it downstream.

SF Powell's, Forks Area



Downstream sediment accumulation after flood event

SF Powell's near confluence with NF Powell's.

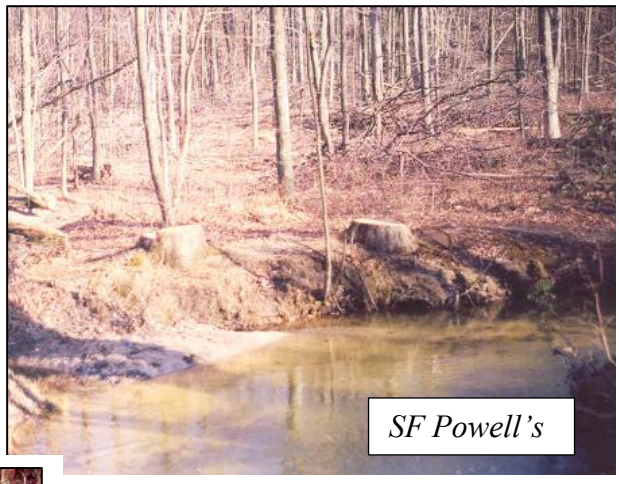
Other Factors of Concern in the Watershed:

Sandy soil: The very sandy soil engulfing the watershed presents the greatest challenge to maintaining healthy cold water species habitat in the stream. This sand is a result of geological weathering of the sandstone now found at the highest elevations. As the mountains slowly erode through rain water and freeze/thaw cycles, the sand is washed down hill and accumulates in valley bottoms. Storm events move the sand into stream channels, where it is carried farther downstream and re-deposited at even lower elevations until it eventually reaches the sea.

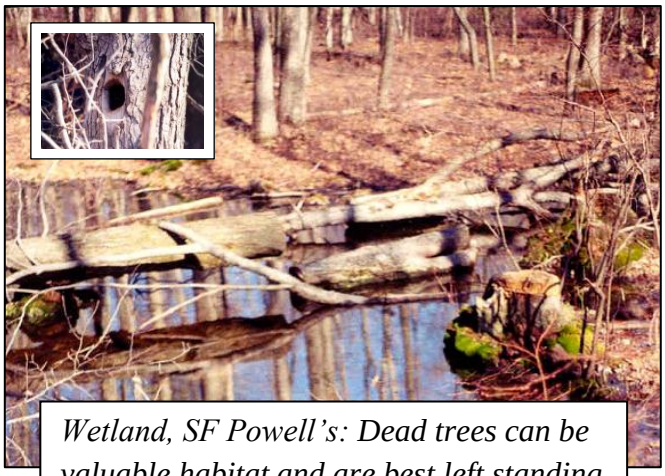
Nature is relentless in its pursuit of equilibrium, and will continue to move soil and stone particles downhill as it erodes higher elevations. Changes in environment can exacerbate the process beyond the stream's ability to transport the sediment contributed to its channel. Although SF Powell's is recovering from the damage incurred during historic periods of deforestation, it is still struggling with excess sand that fills pools and smothers habitat.

Logging Practices:

The very sandy soil will continue to be vulnerable to reductions in forest cover, particularly in areas near the stream channel. Removal of shade trees raises water temperature in warm seasons. Rutted logging trails and the loss of trees and brush allow storm events to wash greater amounts of sand into the channel. Heavy equipment driven across the channel damages the banks, making them more vulnerable to erosion.



SF Powell's



Wetland, SF Powell's: Dead trees can be valuable habitat and are best left standing

Both public and private land owners engage in logging. Due to the remoteness of the area, it is difficult for land owners to monitor methods and practices when logging is in progress. While no clear cutting has taken place recently, large trees, the roots of which are essential to bank stability, have been removed from the stream banks. Wetlands, important to storm water retention and as wildlife habitat, have

been used as place to dispose of trees that were in the way and have no economic value. In the absence of bridges, equipment is driven through the stream to access the opposite side.

Flooding: The propensity of the watershed for flooding complicates the already fragile relationship between its forest cover and sandy soil. The watershed's location on the edge of a high triangular area at the junction of two mountain ridges apparently positions it to receive a surplus of storm water. This site has been known to receive precipitation when the areas immediately adjoining it remain dry. The inverted V shaped folds in mountain ridge formation seems to capture and hold rain storms more frequently and longer than the surrounding areas.

Left and below: South Fork Powell's, Carsonville Road crossing, during and after a flood event. The watershed's frequent heavy flows make protective vegetative cover even more important as a defense against erosion and sedimentation.

These heavy rain and flood events mobilize the ever present sand, carrying it into the channel and down the stream. Habitat is transformed as older pools are filled in and new ones carved out. As the flood waters diminish and the flow slows down, sand drops out onto the channel's banks and bottom. Without enough vegetation to retain it, sand that falls onto the stream banks can re-enter the stream during future rain events.

Impacts to Brook Trout Habitat: Radical changes to the channel are a hardship for aquatic life. Fish need to be able to find deep pools for the cooler water and for cover from predators. Native brook trout require a very specific habitat for nesting and reproduction. They need clean gravel with the upwelling, cool, oxygen rich spring water that often feeds head water streams for spawning. This combination is usually found in the loose gravel associated with a riffle/pool habitat. Stream water flowing up and out of the pool and into the faster, shallower riffle water cleans and sorts sand and gravel. This process creates areas of loose, clean gravel through which cool, oxygenated water can move; and ideal location for survival of eggs.

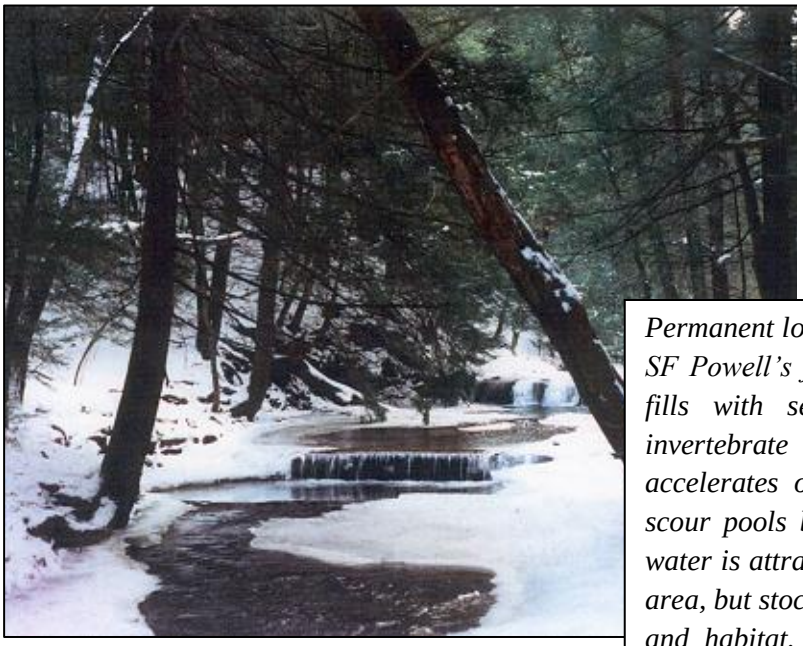
The continually shifting sand and gravel in the channel is an impediment to expanding populations of reproducing natives as it fills in deep pools and clogs nesting sites and smothers food sources.

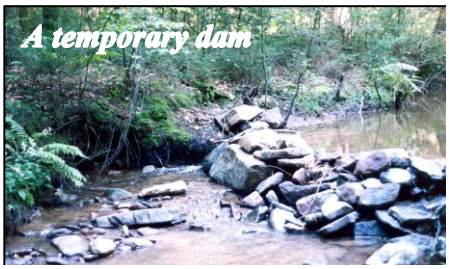
Acid Rain: Acid rain is a mild solution of sulfuric acid and nitric acid. Acid rain is formed from both natural sources, such as volcanoes and decaying vegetation, and man-made sources, primarily emissions of sulfur dioxide and nitrogen oxides from fossil fuel combustion. In the United States, much of these emissions come from burning fossil fuels, like coal, to generate electric power. Automobile emissions also contribute to acid rain. Prevailing winds blow these compounds across state and national borders, sometimes over hundreds of miles.

SF Powell's, as a freestone stream, has little buffering capacity to reduce acid rain's impact on pH, which tends to be rather acidic. Heavy rain during low flows has a greater impact, as there is less water already in the channel to dilute the input. Snow pack concentrates the acidity near the bottom, so the last of the pack to melt can also have a greater negative impact. Wetlands can slow the release of snow melt, reducing impact to the stream.

Dams, Water Impoundments and Bridges: All dams collect sediment upstream of the structure. As the water slows and pools behind the impoundment, the sediment it is carrying drops to the bottom. The sandy soil in the headwaters of SF Powell's Creek provides an unending supply. The slowing and warming of the water as it collects in ponds also reduces oxygen. The sediment accumulations and the changes in temperature and oxygen radically alter the habitat of the stream. Warm water fish like bass can adapt to pond conditions, but trout need cooler water with more oxygen. As the dam holds back water, the flow is pushed out towards the sides. This often causes bank erosion as storm water forces its way around and past the dam.

A number of low head dams traverse the SF Powell's. There are a couple permanent structures intended to improve trout habitat. One (picture, next page) is just north of Back Road. Another smaller concrete structure is located upstream near the cottages in the area known as the Forks. There are also a few other very small dams assembled of rocks collected from the surrounding area. These are more temporary, and storm flows will likely dismantle them in time.





Permanent low head dam at Lucky Dutchman camp, SF Powell's just north of Back Road. It routinely fills with sediment, which reduces the macro invertebrate food sources in the vicinity. Water accelerates over dams in normal flows to create scour pools beneath. Deeper, cooler and aerated water is attractive to trout, which are stocked in the area, but stocked trout compete with natives for food and habitat. Erosion induced channel widening evident in photo.

A number of beaver dams, some older and abandoned, and some showing recent activity, can be found in the central reaches of the stream, it's most remote area. Interestingly, while these areas have reduced density of forest cover and caused some ponding, a good bit of stream flow continues to travel through the lower part of the dams. Most have caused minimal channel erosion, but have reduced the flow of sediment downstream.

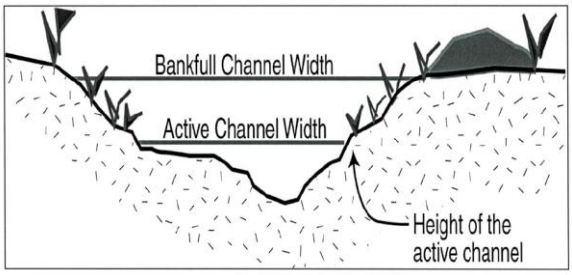
There is evidence of what was once a rather large dam near the lower end of the midsection, not far from Carsonville Road. The dam is no longer present, but there is an open area, thick with brush, adjoining the stream. The channel is quite wide, and the area nearby is very sandy. This colony has either been removed or may possibly account for the more recent, although less extensive, activity upstream.

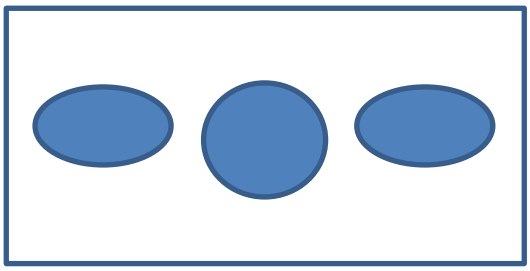
Bridges can also impound storm water if they are too small to manage heavy flows. Water squeezing under the bridge is accelerated, causing downstream channel erosion (the "fire hose" effect). Storm water overflows and circumvents the under sized bridge, causing more erosion. Sometimes bridges can make the channel too wide and flat, which slows down the stream water, allowing sediment to drop out and clog the channel, and sometimes block the bridge opening.

Carsonville Road after flood

Proper dimensions that accommodate both normal flows and storm flows are essential to protecting the stream channel. Bridges work best when they approximate the size and shape of the natural channel, which, over time, has evolved to manage the stream's water input.

Dr. Peggy A. Johnson of Maryland's Dept. of Environment, has studied the problem extensively. At her suggestion, Maryland is now using a relatively inexpensive solution for culvert type bridges, such as the one on Carsonville Road, by constructing a bridge opening with a culvert width adequate to retain the velocity of normal stream flow, and then adding squash pipes (oval shaped culvert pipes) on either side at a higher elevation to manage storm flows at a lower velocity. This mimics nature by allowing flood waters to spread out and slow down, while still maintaining a concentrated flow during dry periods.





In areas where multiple culverts are prone to blockage with branches and debris, the wider, longer, ***bottomless arch and box culverts*** *are an ideal way to accommodate stream flows, especially during high water events.*

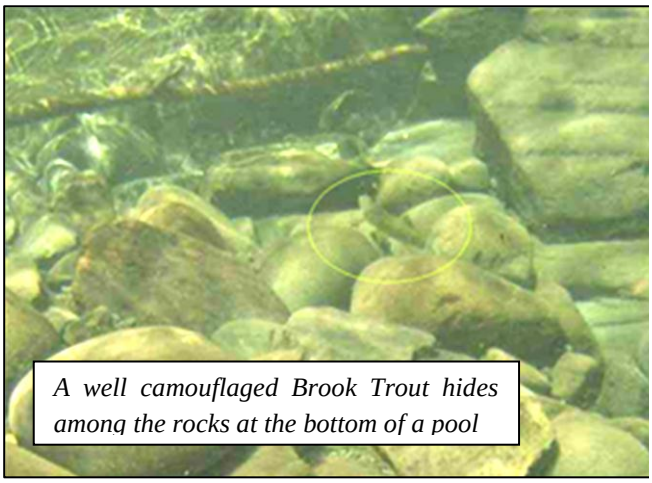
Land development: Any land uses which disturbs the soil or removes vegetation – roads and tracks, excavation, agriculture - all have the potential to negatively impact the stream through additional erosion and sedimentation.

Of the limited development in the SF Powell's watershed, the majority is residential or vacation cottages, most of which are very near paved roads. The major concern of residential development near the stream is the potential for sewage pollution. Poorly maintained on-lot sewage systems can leach contaminates through the very sandy soil and impact the stream. There is currently only one direct discharge sewage system, the Macky sewage module, now emptying directly into the stream. This system was installed due to the failure of the previous system. The discharge is upstream of Back Road in the Forks area.

There is a limited amount of agriculture in the watershed. Agriculture has the potential to contribute excess nutrients to the stream (fertilizers and/or manure). Excess nitrogen and phosphorus can cause algae blooms which deplete the oxygen when they die off. Herbicides and pesticides can also wash into the stream during storm events. Well forested buffers are the best defense against agricultural pollutants. Trees and shrubs can absorb and utilize some of the excess nutrients. They can slow down storm water entering the stream, giving it more time to leach into the soil where it can be filtered before seeping into the stream.

Other than timber harvesting, there is no appreciable amount of commercial development in the SF Powell's watershed. The Harrisburg Authority, a major land owner, has recently considered building a wind plant on the ridge. A test device was installed to monitor the wind velocity, but that idea is not being pursued at this time, as apparently the tests did not show enough wind for the location to be a productive site. Other alternatives for which they may use or sell the property are unknown.

Part Three: The Watershed Study



A well camouflaged Brook Trout hides among the rocks at the bottom of a pool

Historic Data: The study began in 2009 with the assembly of all available previously collected data. Included in the appendix are watershed assessment data from studies initiated by Twin Valley Conservation in partnership with the United States Geologic Survey, the Pennsylvania Department of Environmental Protection, and Rivers Unlimited hydrologic consultants; also data from the PA Fish & Boat Commission, the PA DEP and the Dauphin County Conservation District.

The field data collection component began with site selection, development of protocols, and assembly of a volunteer/local student team. Historic data indicated that habitat assessment and macro invertebrate collection and identification would be the best indicators of water quality, stream health and its ability to support native species.

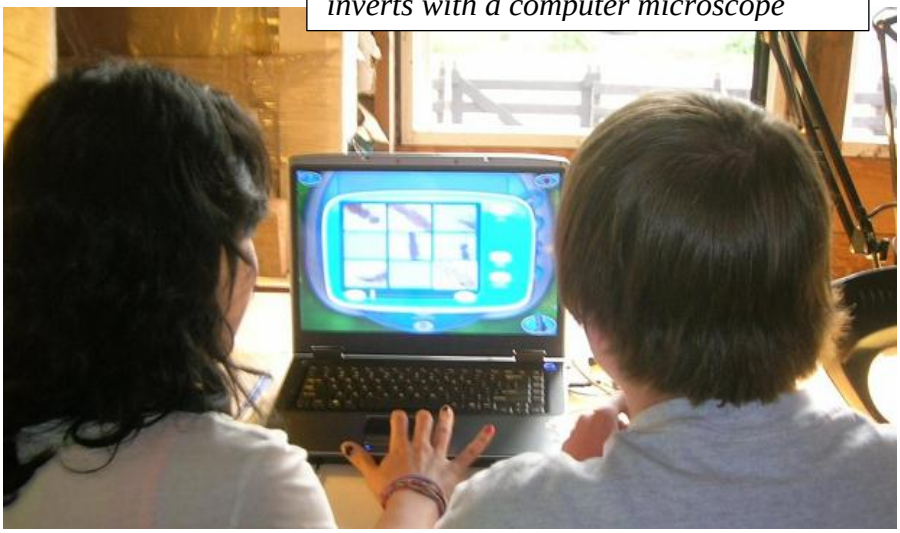
Water Quality and Habitat Assessment: Protocols for macro invertebrate sort and count were designed to be as close to those used by the DEP as possible, since that agency is responsible for collecting the data that will make the final determination as to whether the stream is a candidate for the additional protection benefits of a designated use upgrade. Bob Schott, biologist for the DEP, met with team advisors to provide guidance on how to use similar protocols, with the exception of doing the sort with live macros rather than the DEP method of identifying specimens which have been preserved in alcohol.

A live sort must be done immediately upon collection, as it is difficult to keep the sample water cool and oxygenated enough for long term survival of sensitive species, but being able to see them swim and the gill movement during respiration is more interesting and appealing to non-professionals. The movement and color of live insects (alcohol fades color) can also assist in correct identification. Using a specially designed, compartmentalized, aerated and cooled aquarium, the participants randomly selected a representative sample from the composite sample. They would then sort, identify and photograph each insect with a computer microscope, creating a digital record of the collection. Biologists from the Pennsylvania Senior Environment Corps and Stroud Water Research Center would review the data for correct identification of each specimen.

Two sites were selected at either end of the stream for the study. The sites were measured, photographed, and evaluated for habitat quality using the habitat assessment methods outlined in US Environmental Protection Agency's Rapid Bio Assessment Protocols, which are also used by the DEP. Macro invertebrate samples were obtained, sorted and recorded from each site. While interesting and educational for the participants, the field data is not considered to be of professional quality, but rather an indicator of what a professional biologist might find.

Wyatt Kenno & Amy Decker collect a macro invertebrate sample for identification as a water quality indicator

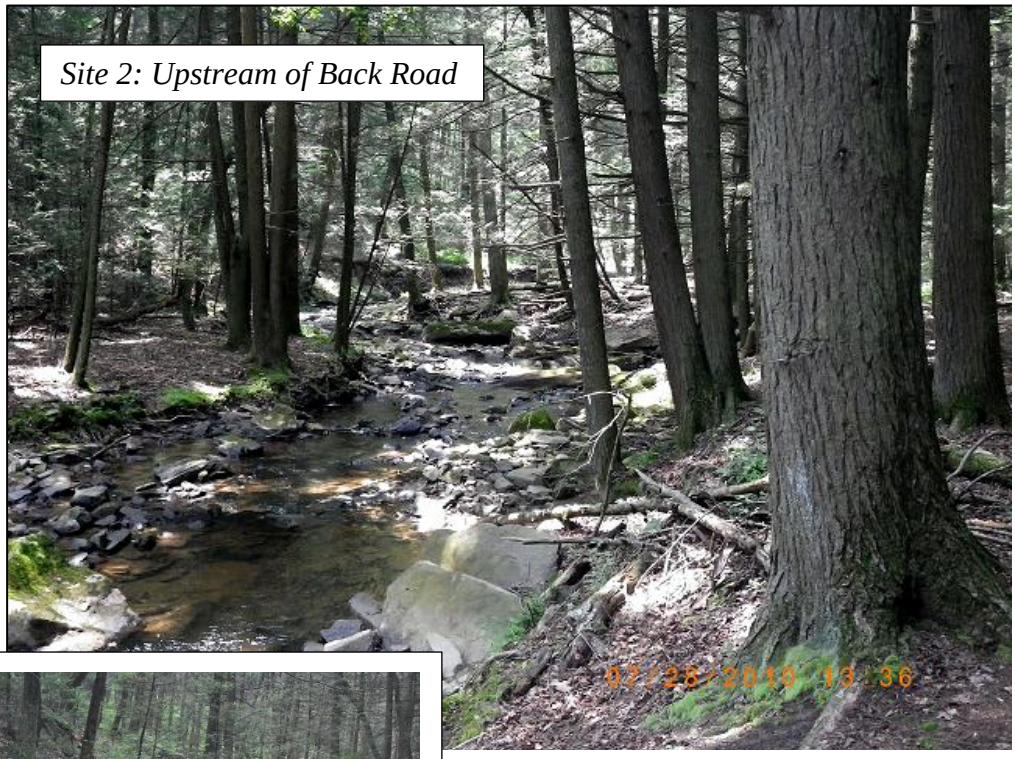
Amy and Thomas Potteier record macro inverts with a computer microscope



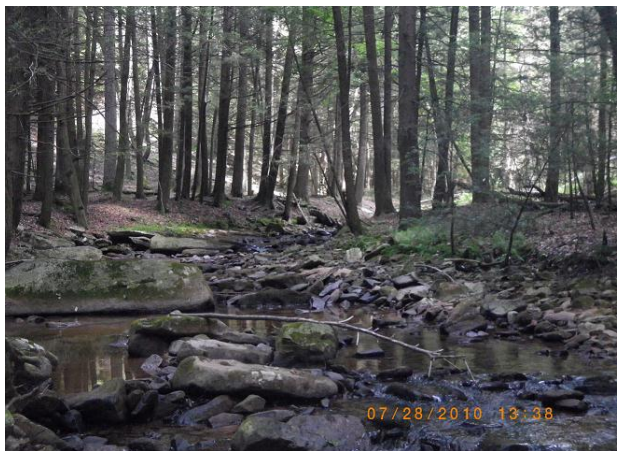
Site 1: SF Powell's Headwaters

Pool forms under tree root; fallen branches provide cover. Sand is evident in channel.

Site 2: Upstream of Back Road

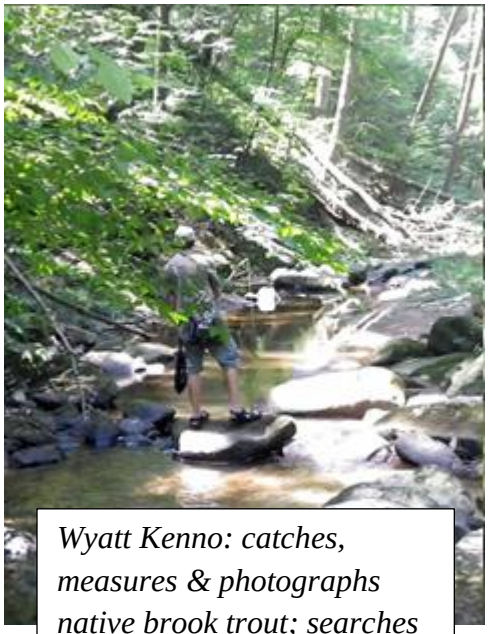


Bank erosion is evident just below site. Steeper gradients flush sediment out of rock, gravel and pools; flat areas collect sand and sediment, filling in pools and smothering rocks & gravel.



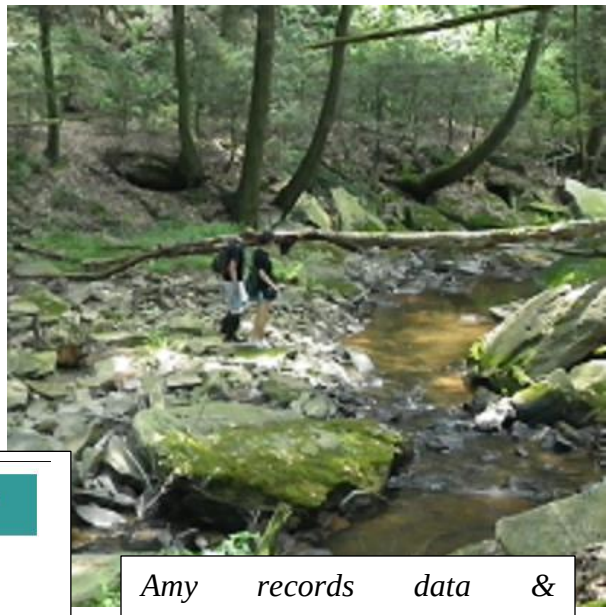
Trout Habitat Assessment: In addition to the information obtained at each of the individual sites, habitat and stream channel conditions were also assessed for the reach of the stream that appeared to be most conducive to native trout reproduction: from the Carsonville Road crossing downstream to the Back Road crossing. The student participants and the project coordinator hiked this reach to observe and record location and depth of pools and to look for potential nesting habitat. It was planned that the hike would be repeated the following year to observe storm flow impact (scouring and deposition) on the stream channel and available habit. However, unusually frequent flood events during the next two summers made the area often inaccessible. 2010 had three major floods, and 2011 was the wettest year on record. Weather conditions & their very busy job and school schedules prevented a follow up assessment by the students from taking place.

As an alternative, PA Fish & Boat Commission regional habitat manager Karl Lutz was asked to inspect the reach, particularly the area downstream of the Carsonville Road crossing and the area upstream of the Back Road crossing, where the stream channel is most stable.



Wyatt Kenno: catches, measures & photographs native brook trout; searches for good nesting habitat

Thomas obtains GPS data



Amy records data & photographs sites. Team members carried business cards as ID for land owner inquiries.

Part Four: Results of the Study

Water Quality: A surface water assessment conducted by the USGS in 2003 found no water-quality problems in the Powell's Creek sites. The biologist for PA DEP's 2000 assessment (303d list report) noted that ***SF Powell's may be a candidate for chapter 93 "high quality" designation***. Water quality is good, although pH often runs around 6.4, a little acidic for trout, which prefer the neutral pH of 7. Much of the soil in the watershed originates from acidic shale and sandstone, which lack the alkaline nutrients and minerals which can buffer (neutralize) acid, resulting in water pH readings sometimes as low as 5.5. The headwater mountain streams where trout live usually have the lowest acid-buffering capabilities. This poor buffering capacity makes the stream extremely sensitive to acid rain, and may limit the potential for aquatic productivity. Although some acid additions may come from natural sources, such as bogs, most of the stream's acidic water quality problems are caused by acid precipitation.

Most fishes, including trout, are generally not seriously affected by a pH between 6.0 and 7.0, but as values dip below 6.0, problems with all stream life become noticeable. As acidity increases, the macro invertebrate food base dwindles, and spawning success and egg survival of fishes decline. If the pH declines below 5.0, just about all species of aquatic plants and animals die. Our native brook trout has adapted to the natural infertile conditions, but even it cannot survive water conditions severely impacted by acid rain.

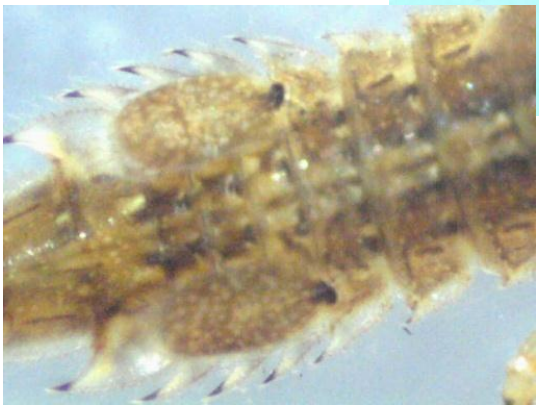
Macro Invertebrates: Macro Invertebrates are both a food source and an indicator of stream health. Because they reside in the stream, they are subject to stream conditions over a period of time. Unlike other stream monitoring methods, which can only describe the condition of the stream at the moment of inspection, the number and diversity of aquatic insects and other macro inverts reflect the conditions of the stream as a habitat over time.

In general, a diverse population, especially if it includes quantity and variety of the more pollution sensitive species, indicates clean and healthy the stream. Large numbers of pollution tolerant species indicates problems with water quality and/or habitat. The Dauphin County Stream Health Report in 2010 states that SF Powell's exhibited a high percentage of sensitive species. The student stream study participants recorded a similar result at both the headwaters site and the lower site near the confluence with the North Fork Powell's.

Student stream study *participants photographed aquatic insects with a computer microscope. Close ups revealed details used in identification.*

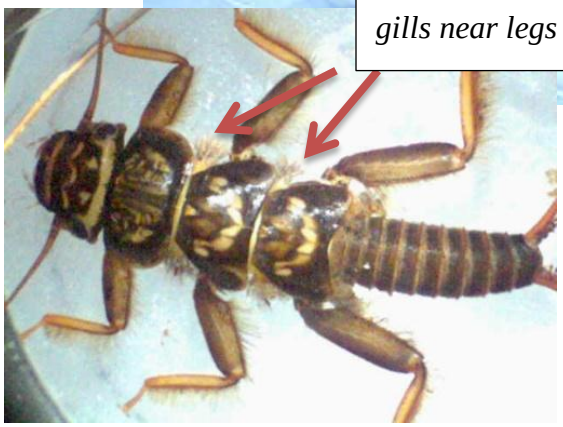
Several varieties of Mayflies

Mayflies have gills on the abdomen; most have three tails. Above, center, is Epeorus, the unusual two tailed mayfly – a sensitive species

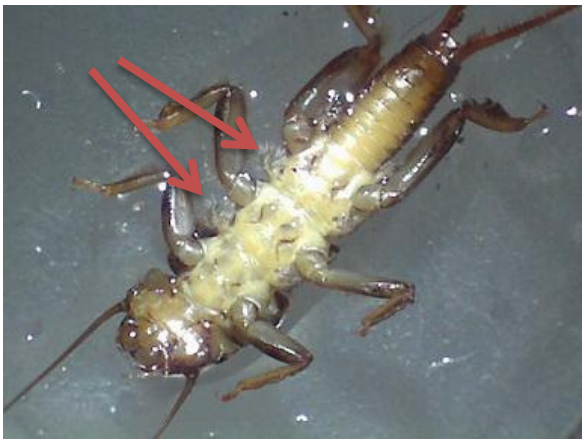


Gill type and movement patters help to identify different species

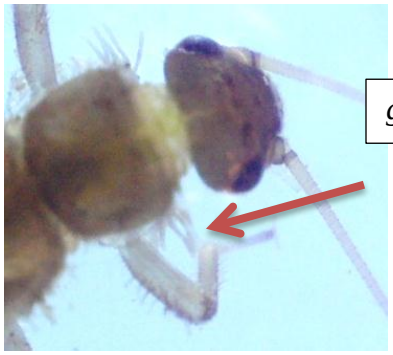
Stoneflies *are sensitive to pollution. Stonefly nymphs have two tails. They have two pairs of wing forming pads (Mayflies have only one) and their gills are on the thorax rather than the abdomen. Color patterns, head and abdomen shape, and gill placement are some of their identifying features.*



gills near legs



Some specimens were also photographed from the bottom to better view gill placement



gills at the neck

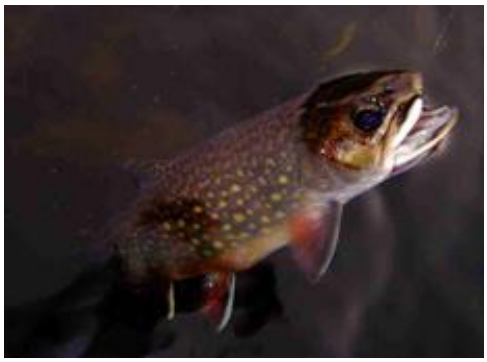
Physical Habitat: Karl Lutz, Regional Habitat Manager, PA Fish & Boat Commission, summed it up after inspecting the stream: "lots of good physical habitat and good riparian corridor, sand likely is restricting some spawning success (lots of surface gravel, but sand immediately underneath), water quality may be a slight issue (freestone streams are not always highly productive). It would be interesting to see fish data from other than traditional PFBC sites." The sites where fish data has been documented are stocked regularly with hatchery trout. Stocked fish compete with natives for food and shelter. Stocked sites must be accessible to recreational fishing and sometimes are not the best habitat available in the stream, which, as in SF Powell's, may be rather remote.

Karl is an authority on habitat restoration. He felt that habitat was pretty good in the headwaters despite the prevalence of sand in the stream bed. Fallen trees in the creek contributed to natural habitat, creating scour pools and supplying food for macro invertebrates. Although not plentiful, some gravel areas suitable for spawning were seen. Here the stream is very small, which limits the size of adult fish. At the lower end of the stream sand is less prevalent and boulders and gravel are more abundant, which can provide good habitat for spawning and for larger adult fish.

Karl's overall assessment is that Powell's Creek is a good quality stream, with good protective forest cover for much of its extent. However, the stream may be at the highest potential it can naturally sustain, and little can realistically be done to improve it. The best course of management may be to protect the stream and surrounding forest so that nature can continue to heal the stream from past abuse.

Stream Channel Stability: A fluvial geomorphic assessment was conducted on the stream in 2004. Fluvial geomorphology is the examination of the processes that operate in river systems and the landforms which they create or have created. It investigates stream flow, channel stability and sediment deposits. The results of that study concluded that regarding channel stability, the stream is doing as well as can be expected given the substrate in which it is formed. Although a remarkable amount of sand and sediment is endemic to the system, natural processes are at work to manage it. The channel has established relative equilibrium; excessive channel migration, bank or bed erosion is not evident. No artificial structures were recommended for channel stabilization purposes.

Native Trout Populations: Local fishermen remember SF Powell's as having "lots" of native trout around 50 years ago. Yet in the late 70's a PA Fish Commission survey found only four, and they may have been hatchery trout. Are those memories faulty, or did something happen?



There is little data from back then, but a possible explanation is damage from tropical storm Agnes in 1972. Besides the 30 straight days of acid rain, the influx of sand carried by the catastrophic amount of storm water must have caused severe scouring and erosion of the channel. If more recent storm events are any indicator, the receding storm water also must have deposited an enormous amount of sand in the channel and on the banks. The impacts to water quality and habitat could certainly explain a devastating drop in population. The good news is that native brook trout population appears to be on the rebound as the stream gradually recovers from the damage.

According to Kristopher M. Kuhn, Fisheries Manager, Area 7 of the PA Fish & Boat Commission: "We have limited data regarding the South Fork and it is from a survey conducted during 1979 where only four trout, potentially hatchery fish, were captured in a 230 meter electrofishing site. Based on this data the stream was determined to be a Class D fishery for PFBC management purposes…but things can change in 30 years."

"A single pass catch-per-unit-effort electrofishing survey was conducted (total length electrofished 605m) targeting stocked trout on March 11, 2010 as part of an Agency initiative to assess potential stocked trout movement. During those surveys we captured a total of 32 wild brook trout and one wild brown trout. This was not a population estimate (required for Class A designation), however, these numbers do not add up to a Class A population. But, these numbers also should be interpreted knowing that the survey was conducted at a time of the year not conducive to adequately assess the wild population."

A factor when considering native populations is that stocked trout compete with natives for food and habitat. The Fish Commission did surveys to collect data on stocked trout, so the area of their survey would not be optimal habitat for natives.

Class A wild trout water: A surface water classified by the Fish and Boat Commission, based on species-specific biomass standards, which supports a population of naturally produced trout of sufficient size and abundance to support a long-term and rewarding sport fishery.

A Class A designation by the Fish Commission would automatically give the stream the protection of a high quality trout stream. Given the current data, however, even if a survey were conducted at a more productive location and at a better time of year, it is unlikely that it would result in finding at least twice as many fish, which would be required for a Class A stream. Thus, obtaining a high quality designation upgrade through this method is very unlikely at this time.

Kris suggests that "if the status of the macroinvertebrate community is "good" perhaps you should petition PADEP for a Chapter 93 upgrade based on macros."

More from Kris about electro fish surveys for population estimates: When conducting population estimates electrofishing surveys we electrofish sites at least 300 meters in length and survey enough sites to comprise at least 10% of the management section to determine biomass. In doing so, if we capture 30 or more wild trout in the 300m site we conduct a mark-recapture survey to estimate biomass (kilograms/hectare) which entails marking all the fish (fin clip) on the first pass and coming back and electrofishing the site again within a few days. Based on the number of fish marked on the first day and the number of fish recaptured (marked fish) on the second day we can then estimate abundance. If we do not capture more than 30 fish on the first day we do not electrofish a second time and only use the single pass catch-per-unit-effort to describe the population. In these cases when we capture less than 30 fish these populations generally classify as a Class D (< 10kg/ha) or in some cases a Class C (between 10 & 20 kg/ha) population. We only captured 16 brook trout at both sites and one brown trout at one site this spring, so SF Powell would likely be a Class D population. In order for me to recommend that PADEP upgrade the Chapter 93 status to HQ-CWF, I must document a Class A wild trout population (40 kg/ha or greater for brown trout or greater than 30 kg/ha of brook trout).

The sites we surveyed at SF Powell Creek this spring were located at lat/lon 40.46646/76.77853 (surveyed 300m upstream from this point) and 40.47078/76.78148 (surveyed 305m upstream from this point).

Summary: Native trout numbers are improving, but it will take many, many years for the stream to return to the quality habitat that it likely was before the impacts of early deforestation. Water quality is good and aquatic diversity and population look promising, but natives are not rebounding as quickly as we would like during this slow healing process.

A Spotted Salamander explores the stream bottom in SF Powell's

The watershed's frequent high water events make the stream more prone to storm related impacts, which overwhelm the system with acid rain while the subsequent scouring continues to mobilize and re-deposit sand and sediment. When spaces between rocks and gravel are filled with sediment, food and shelter for stream inhabitants is limited. Reproduction is reduced as nesting

sites become unsuitable. The cooling and cover of deep pools during warm seasons is less unavailable; without adequate cover, juvenile and adult trout are exposed to predation.

The regrowth of forest cover is well under way and provides the shading required for maintaining cooler temperatures, but sedimentation and acid rain will continue to stress water quality and habitat. There is little that can be done to resolve these problems other than to let nature continue its healing and restorative work. Some habitat improvement structures may be of benefit in certain locations, but only if carefully designed to work with the natural processes of the stream. While no aggressive restoration efforts are indicated, supportive management will go a long way to help the stream recuperate naturally. It's a slow process, but it is in progress.

Flood damage, SF Powell's

Precipitation, Powell's Creek Watershed 2011 – The wettest year on record

Rain - 79.2"; Snow - 33.25"

(Average annual rainfall - 41.45")

Sept. 2011 - Total rain 21.8"
Rainiest string of days:
Sept. 4 - 2.0",
Sept. 5 - 1.65",
Sept. 6 - 3.4",
Sept. 7 - 3.4",
Sept. 8 - 2.5",
Sept. 9 - .05"

During this period Powell's Creek was out over its banks a couple times on Union Church Road and for a sustained period, too.

Sept. 8 & 9, 2011 Halifax Schools closed due to small stream and Susquehanna River flooding.

Here are the totals for 2009:

Jan.	0.00" - rain	7.75" - snow
Feb.	.40" -rain	4.00" -snow
Mar.	.80" -rain	1.00" -snow
Apr.	4.70" -rain	
May	7.45" -rain	
Jun.	4.65" -rain	
Jul.	7.00" -rain	
Aug.	5.65" -rain	
Sep.	3.65" -rain	
Oct.	6.65" -rain	
Nov.	2.30" -rain	
Dec.	2.40"- rain	11.00" -snow

Overall precipitation was average for the year (41.55" rain), although there was a shortfall of snow of over a foot. Jan., Feb., Mar., Nov. & Dec. were drier than normal. The other months were wetter than normal and Sept. the only month with an average amount.

And for 2010:

Jan.	5.00" - rain,	.5" – snow
Feb.	0.00" - rain	4.5" - snow
Mar.	3.70" - rain	
Apr.	2.10" - rain	
May	3.75" - rain	
Jun.	1.65" - rain	
Jul.	7.00" - rain	
Aug.	2.55" - rain	
Sep.	5.80" - rain	
Sept.	30th 3.3"	
Oct.	3.50" - rain	
Nov.	3.10" - rain	
Dec.	2.50" - rain	Dusting - snow

Overall precipitation was slightly above average but some months (April, June, & Dec) were shortfalls while others (Jan., Jul. & Sep.) were way above normal.

Precipitation data above provided by TVC Volunteer Rich Frantz, recorded from his personal rain gage located near main stem Powell's below the NF/SF confluence

Normal monthly precipitation for Harrisburg, PA (30 years)
National Oceanic and Atmospheric Administration

Jan	3.18	Feb	2.88	March	3.58
April	3.31	May	4.60	June	3.99
July	3.21	August	3.24	Sept	3.65
Oct	3.06	Nov	3.53	Jan	3.22

Annual 41.45

Part five: Recommendations

To Protect and Enhance South Fork Powell's Creek as a Resource

ABOUT: DEP's Statewide Surface Water Assessment Program and SF Powell's designated and protected uses:

The Department of Environmental Protection (DEP) develops water quality standards for all surface waters of the state. These standards, which are designed to safeguard Pennsylvania's streams, rivers and lakes, consist of both use designations and the criteria necessary to protect those uses. The *Integrated Water Quality Monitoring and Assessment Report* fulfills the water quality reporting requirements of Section 305(b) and 303(d) of the federal Clean Water Act.

Water quality standards are comprised of the uses that waters can support and goals established to protect those uses. Uses include, among other things, aquatic life, fish consumption, recreation, and potable water supply, and what must be achieved to support the uses. DEP has an ongoing program to assess the quality of waters in Pennsylvania, and to identify as "impaired" any streams and other bodies of water that are not attaining designated and existing uses.

DEP biologists use a combination of habitat and biological assessments as the primary mechanism to evaluate Pennsylvania streams. This method requires selecting stream sites that would reflect impacts from surrounding land uses that are representative of the stream segment being assessed. The biologist selects as many sites as necessary to establish an accurate assessment for a stream segment. The length of the stream segment assessed can vary between sites. Several factors are used to determine site location and how long a segment can be, including distinct changes in stream characteristics, surface geology, riparian land use, and the pollutant causing impairment.

Habitat surveys and a biological assessment are conducted at each site. Biological surveys include kick screen sampling of benthic macroinvertebrates, which are identified to family in the field, and an evaluation of their tolerances to pollution. Benthic macroinvertebrates are the organisms, mainly aquatic insects, which live on the stream bottom. Since they are short-lived (most have a one-year life cycle) and relatively immobile, their presence or absence reflects the chemical and physical characteristics of a stream and chronic pollution sources or stresses. Habitat assessments evaluate how deeply the stream substrate is embedded, degree of streambank erosion, condition of riparian vegetation, and amount of sedimentation.

All commonwealth waters are protected for a designated aquatic life use as well as a number of water supply and recreational uses. The use designation shown in the water quality standards is the aquatic life use. These uses are Warm Water Fishes (WWF), Trout Stocking (TSF), Cold Water Fishes (CWF) and Migratory Fishes (MF).

In addition, streams with excellent water quality may be designated High Quality Waters (HQ) or Exceptional Value Waters (EV). ***The water quality in an HQ stream can be lowered only if a discharge is the result of necessary social or economic development, the water quality criteria are met, and all existing uses of the stream are protected. EV waters are to be protected at their existing quality; water quality shall not be lowered.***

To change or upgrade a streams designated use, redesignation evaluations may be conducted at the request of the Pennsylvania Fish and Boat Commission (PFBC). In addition, any person, agency, group, organization, municipality or industry may submit a rulemaking petition to the Environmental Quality Board (EQB) to request a stream redesignation.

A DEP biologist assessed NF Powell's, SF Powell's & Powell's Creek main stem under the Unassessed Waters Program in 1997. He noted that brook trout were present and that it was a possible High Quality stream. He also commented that the degree of embeddedness and sedimentation was due to sand that appeared to be of natural causes, and that the two small dam near the Lucky Dutchman camp are barriers to upstream movement of fish under the flow conditions observed at the time.

Based on the data from 1997, SF Powell's is listed as a Category 2 water body in the 2012 Pennsylvania Integrated Water Quality Monitoring and Assessment Report. C2 streams are waters in which some, but not all, designated uses are confirmed as being met. Attainment status of some designated uses is unknown because data are insufficient to categorize a water body consistent with the state's listing methodology. Very few streams are C1, all uses confirmed.

SF Powell's supports the aquatic life of one of its designated use, cold water fishes (CWF). The other designated use of SF Powell's waters is migratory fishes (MF). Historically, Powell's Creek could have been used by lamprey eels and/or shad, entering from the Susquehanna River. There is insufficient data to confirm this use.

SF Powell's listings, 2012 Integrated Water Quality Monitoring and Assessment Report:

South Fork Powell Creek Miles = 0.84475467091
Aquatic Life (14474) – (numeric code for "attainment of aquatic life")
(Due to a computer error this segment was not included with the main stem shown below)

South Fork Powells Creek Miles = 9.09132979033
Aquatic Life (14474)

Tributaries: (Smoke Hole Run was assessed as a separate entity)
Smoke Hole Run Miles = 1.76 Aquatic Life (14474)

South Fork Powell Creek Unnamed Tributary (ID:54974611) Miles = 0.9410979018
Aquatic Life (14474)

South Fork Powells Creek Unnamed Tributary (ID:54973553) Miles = 0.57508183794
Aquatic Life (14474)

South Fork Powells Creek Unnamed Tributary (ID:54973665) Miles = 0.89509904738
Aquatic Life (14474)

South Fork Powells Creek Unnamed Tributary (ID:54973741) Miles = 0.20694374642
Aquatic Life (14474)

South Fork Powells Creek Unnamed Tributary (ID:54973815) Miles = 0.07765450369
Aquatic Life (14474)

Obtain a stream designation upgrade: A first priority action for protecting the South Fork Powell's is to petition the PA DEP for a stream upgrade designation. The stream is currently designated as a CWF (cold water fishery – trout and other species indigenous to a cold water habitat can survive and reproduce in the stream.) Data indicates that it may be a candidate for an upgrade to a High Quality (HQ) designation.

HQ or EV (exceptional value) designations are reserved for cleanest and most outstanding aquatic habitats in Pennsylvania. These streams have excellent diversity and plentiful populations of aquatic life, and are entitled to special protections to ensure that water quality is maintained. Data from the DCCD Stream Health Report shows that Powell's Creek is the only stream in Dauphin County in which every test site showed "good" macro invertebrate diversity and quantity. No other stream, even if already designated as HQ, was without an impaired site.

According to the Pennsylvania Campaign for Clean Water, there are two common ways that EV or HQ status may affect certain projects or activities in a watershed:

The first: ***an Antidegradation Review*** by the DEP is required for proposed new discharges.

- First, the applicant must evaluate **nondischarge alternatives** to the proposed discharge and use an alternative that is environmentally sound and cost-effective when compared with the cost of the proposed discharge.
- Second, if a nondischarge alternative is not environmentally sound and costeffective, the applicant must use the best available combination of cost-effective treatment, land disposal, pollution prevention and wastewater reuse technologies (referred to as **ABACT**).
- Third, if no environmentally sound and cost-effective nondischarge alternative exists, the applicant must demonstrate that the discharge will maintain and protect existing water quality (**non-degrading discharge**).
- Fourth, for HQ waters only, if after evaluating all of the above the applicant still proposes a discharge that lowers water quality, the discharge is only permitted if the applicant can demonstrate that allowing lower water quality is necessary to accommodate important economic or social development in the area in which the waters are located (**SEJ exception**). *This SEJ exception is only for HQ waters. Where discharges are proposed in EV waters, water quality must be maintained and protected without exception*.

From the **Pennsylvania Campaign for Clean Water**:

An HQ or EV designation means that "new or expanded activities do not degrade existing water quality. It does not mean development will stop, or that permits for most projects cannot be obtained. It does mean that projects like building a new commercial or residential development, a new or expanded concentrated animal feeding operation (CAFO), a new or expanded sewage treatment plant, or a new road will undergo more rigorous permit review by the Pennsylvania Department of Environmental Protection (DEP) and, in some cases, must meet more stringent requirements to protect water quality.

In many cases, HQ and EV status will have no impact on projects and activities in your watershed. Existing projects and activities are grandfathered. An upgrade to EV status does not mean you have to stop your discharge, install a more stringent water treatment technology, apply for a new permit, or remove your stream encroachment or facility. Moreover, HQ or EV status does not impose any liability on municipal governments to clean up the stream. Municipalities are further not required to amend any of their local ordinances or to change their practices and criteria for zoning and land development approvals as a result of an upgrade to HQ or EV status.

Some common activities are not impacted at all, even if they are proposed after a stream is re-designated HQ or EV. Road maintenance activities, including winter maintenance and bridge and culvert repairs may continue just as they did prior to HQ or EV designation. There is no impact on the siting, design and operation of on lot sewage systems. Pesticide use or plowing and tilling activities on farms are not impacted.

HQ and EV designation can also have beneficial impacts to your community. It can improve your community's chances of obtaining funding for new or upgraded wastewater treatment facilities or for dirt and gravel road maintenance. EV status also bars the siting of radioactive and hazardous waste disposal facilities in your watershed.

*For more information, see the Pennsylvania Campaign for Clean Water's brochure **"Effects of Special Protection"** in the appendix*

The second common way that EV or HQ status may affect certain projects or activities in a watershed is that ***individual permits instead of general permits*** are required in many cases.

The DEP usually authorizes discharges and other activities that may impact water quality by issuing either general permits or individual permits. General permits are used for certain similar discharges or activities that are lower impact and can be adequately regulated with standardized specifications and conditions. They are easier and faster to get than an individual permit.

When discharges or activities require a permit but do not qualify for a general permit, an individual permit is required. Discharges and activities in HQ or EV watersheds which would have otherwise been regulated through general permits require individual permits due to the designation. Individual permits are issued for specific projects on specific sites. The applications are reviewed by the DEP on a case-by-case basis, and usually take longer than general permits. The approved permit may include special conditions that may be more stringent than the requirements found in a general permit, to protect existing water quality and natural resources.

Other Protection/Enhancement Activities:

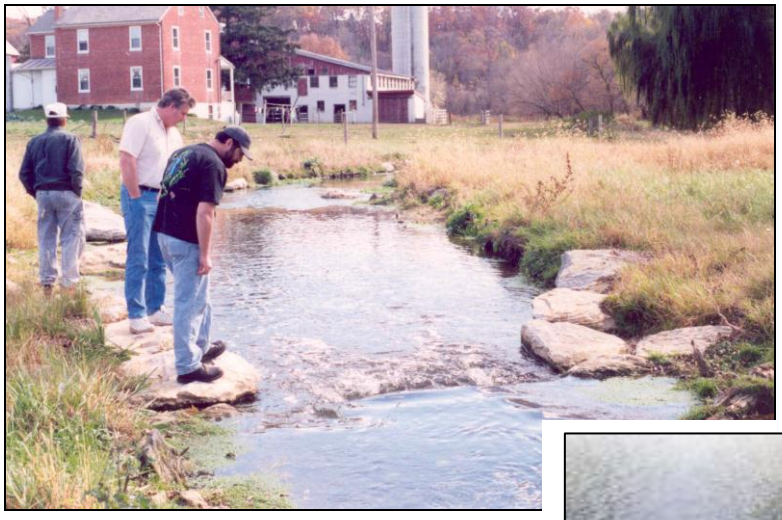
There are a number of actions that local municipalities and organizations can undertake that can have a lasting effect on the ability of the South Fork Powell's to become a more productive habitat for native species. Subjects that should be addressed include land owner education, forest cover and wetland conservation, logging practices, maintenance of roads & bridges, channel modifications and the impact of trout stocking.

Land Owner Education: Too often land owners are unaware of how activities within the watershed can impact water quality and dependent species. Information promoting the value of the resource, it's sensitive and fragile areas, the existence of native species and rare plants, and the fact that data indicates that SF Powell's has of some of the best water quality in the county, may encourage them to consider low impact alternatives when making land use decisions. Distributing information about the importance of forest buffers, and how to manage and use land to accomplish objectives with reduced negative impact could help land owners to make better choices about land management. Educational information suitable for distribution to stream side landowners is included in the appendix.

Address Channel Modifications: Stream side land owners tend to make modifications in the stream channel intended as habitat improvements, to reduce erosion or to make pools for fishing or swimming. These "homemade" structures can actually worsen the situation, especially in a stream system that has sediment accumulation problems. In general, attempts to interfere in natural processes of the stream should be discouraged; however, if stream side landowners feel compelled to do something, it would probably be in the best interest of the stream if they had a basic idea of what helps and what doesn't. Information on how to properly construct habitat improvements or bank protection structures is available from the PA Fish & Boat Commission. It offers general

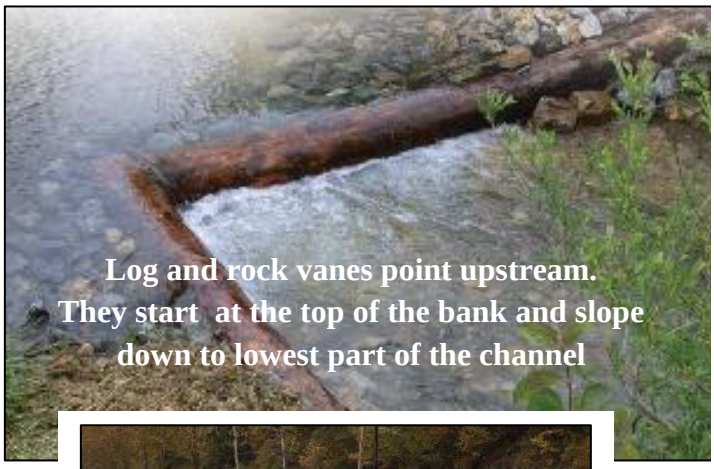
A mud sill reduces bank erosion and provides a hiding place for fish

guidance in determining which structure is appropriate for a situation and how to construct it. The guide also explains permit requirements for these designs, which are administered by the Department of Environmental Protection (DEP. The guide is included in the appendix.



TVC volunteers inspect a professionally constructed stream bank protection and habitat restoration structure on a stream in Lancaster County. These types of structure (this one is a cross vane) mimic the natural processes of the stream.

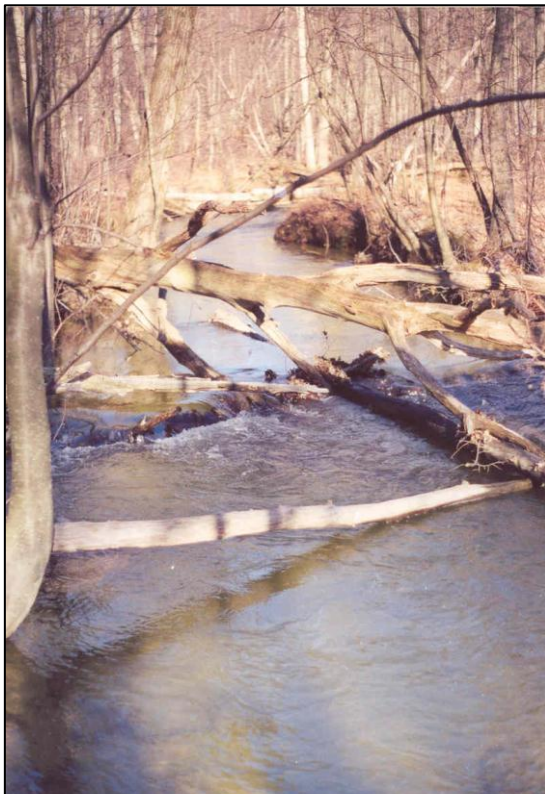
These carefully designed structures direct the flow toward the center of the channel and away from the banks. They consolidate the flow during dry periods so that the stream can continue to flush sediment out of the scour pools they create. Sand & sediment collects near the upstream banks where it can be vegetated and help to reduce stream bank erosion.



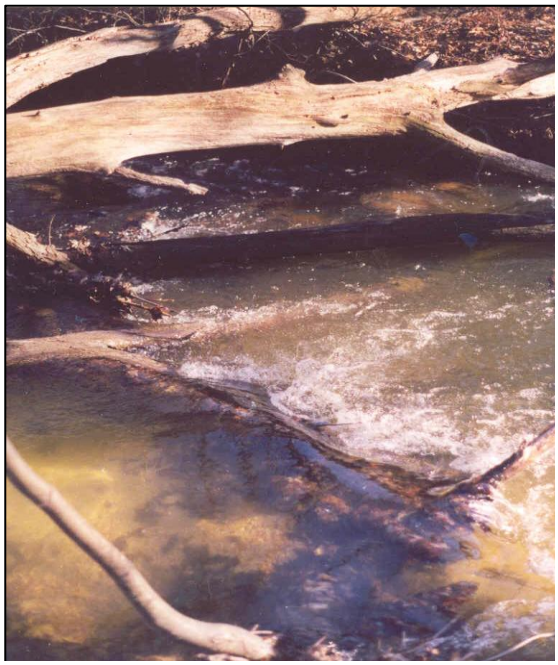
Log and rock vanes point upstream. They start at the top of the bank and slope down to lowest part of the channel

By keeping the channel clear of excess sand and gravel, the structures improve aquatic insect habitat, an important food source for fish. Oxygenation is improved and scour pools, important for cover and for cooling temperatures in warm seasons, are maintained.

Entering the channel to remove woody debris is another common land owner practice. Sometimes woody debris can accumulate, causing a log jam that completely blocks and divert the channel, threatening property and causing excessive stream bank erosion. Most times, however, woody debris improves to aquatic habitat by providing food (leaves) and cover.

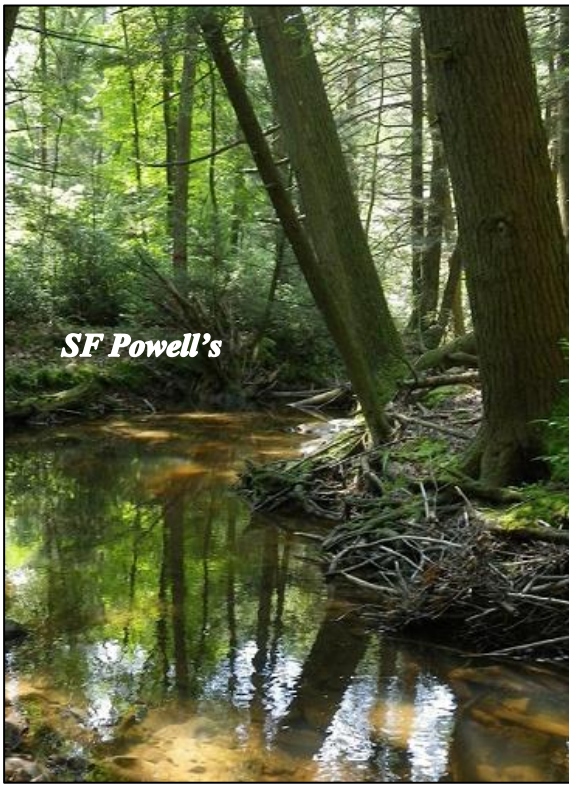


In a sandy bottom channel like the headwaters of SF Powell's, available habitat is scarce due to a shortage of deep pools and rocks for shelter. Fallen trees and branches may provide the only available cover, and the only available method of adding oxygen to the stream, aerating the water and creating scour pools as it cascades over. Without aquatic plants or algae covered rocks, food for small fish and macro invertebrates can also be in short supply. It is imperative that these habitats remain in place. Removing fallen trees and branches for "neatness" should be discouraged. Stream blockages should be removed only if a threat to safety or property.



Fallen branches create a riffle dam, aerating water and scouring out a pool as it cascades over the branch. Trapped leaves are habitat and food source for aquatic insects, and provide cover for fish.

Forest cover and wetland conservation: Forest cover is integral to protecting stream banks from erosion and reducing sediment carried by storm water into the channel. Wetlands capture storm water, filter it and leach water into the stream during dry periods. Permanently protecting forest and wetlands in the watershed could help to ensure that the stream has adequate cover and wetland recharge areas. The importance of adequate forested buffers in a watershed with loose, sandy soil cannot be overstated. Ideally, a forested buffer of 150 feet is desirable. At minimum, an undisturbed area of 35 feet from the bank should be maintained.



Forested buffers should include a brushy understory in addition to mature trees. Roots of mature trees re-enforce the channel and banks; their shade is important to maintaining cool temperatures during the warm season. Shrubs and brush also provide shade; they help slow down storm over-flows, filter sediment, and help to use up excess nitrogen during their growth periods. If the buffer is narrower than ideal due to nearby mowed or agricultural fields, a strip of uncut tall grass is also important to help filter soil and sediment being carried toward the stream by storm water.

Thick brushy forest protects the stream from channel erosion and reduces sediment input from storm water run-off.

Without adequate protection, the channel migrates during storm flows and sedimentation is increased.

Even a generous buffer doesn't protect the stream as well as contiguous forest. The many deep roots of a forest stabilize soil and reduce run-off by improving penetration of rain water into the water table, where it is stored to be slowly released to the stream during dry periods. Much of the headwaters area is permanently protected as state game lands, but the mid-section and the lower reaches (where the best native trout habitat is currently found) are privately owned.

Working with local land conservancies to purchase land or conservation easements could be invaluable in extending the stream's protection. The Harrisburg water authority currently holds hundreds of acres of unused land adjoining SF Powell's. In the head waters area near Smoke Hole Run is found a species of concern, the Rough Leafed Aster. Nearby is Powell's Creek Swamp, recognized by the PA Natural Diversity Inventory as a "locally significant site" with potential habitat for this rare plant. The swamp is an important ground water recharge area. Part of this site is within PA State Game Lands #211. Conservation easements prevent certain disturbances while allowing the land owner to retain ownership and use of the land. Sometimes land purchased for conservation is held in trust; due to its proximity to State Game Lands, land in the SF Powell's watershed could also be transferred to the PA Game Commission.

Rough-leaved Aster
Eurybia radula (Aster radula)

- Family: Aster (Asteraceae)
- Habitat: wet woods or swamps
- Height: 1 to 3 feet
- Flower size: flowerheads 1 to 1-1/2 inches across
- Flower color: pale violet rays around a yellow disk
- Flowering time: July to September
- Origin: native

Current State Status

The PA Biological Survey (PABS) considers rough-leaved aster to be a species of special concern, based on the few occurrences that have been recently confirmed and its wetland habitat. It does not have a PA legal rarity status, but has been assigned a suggested rarity status of Threatened by PABS. About 30 populations are currently known from the state

Conservation Considerations

The viability of known populations of rough-leaved aster and its habitat may be enhanced by creating buffers around wetlands, controlling invasive species, and protecting the natural hydrology surrounding wetlands. Excessive browsing by deer may be a threat in some

Promote best management practices for timber harvesting: There are two land owners in the watershed that control substantial acreage and conduct timber harvesting for different purposes. One is the PA Game Commission, which manages land for wildlife habitat, but may not be attuned to water quality and aquatic habitat issues. The other is the Harrisburg Water Authority, which manages land (predominately in the Clarks Creek watershed) for a public water supply. Although the water authority does not appear to use their holding of several hundred acres in the SF Powell's watershed, they have tested for wind turbines on Peter's Mountain ridge.

The PA GC has done considerable logging in the last several years and will probably continue. The Water Authority has recently harvested timber on its land near the Dehart reservoir. Private land owners have also conducted logging in the watershed. Land owner awareness of the sensitive nature of the watershed is important and should be established through outreach and education so that they can specify that low impact practices be utilized.

Due to the secluded location, land owners or their representatives are usually not present during timber harvesting activities in the SF Powell's watershed, and evidence of poor practices has been observed in the watershed. Avoiding stream crossings, disturbing wetlands and damaging trees that will be left standing for forest re-seeding is important, as well as leaving dead trees standing as wildlife habitat. Other best management practices include minimizing road width and the size of staging areas. Monitoring logging activities by land owners or their representatives should be encouraged to ensure best management practices are being followed.

Logging in South Fork Powell's Watershed

Ruts where equipment was driven across stream; protective forest buffer removed, exposing sandy soil to storm water erosion

Maintenance of roads & bridges:

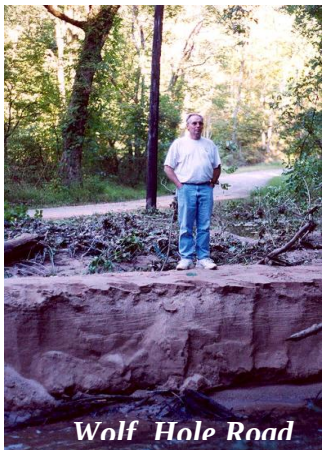
Dirt roads are notorious contributors of sediment to nearby streams. Run off from road salt in winter is also detrimental to water quality. Land owners should be encouraged to maintain dirt roads to reduce erosion and prevent run-off from directly entering the stream.

General practices (from the Center for Environmental Excellence) for pollution prevention from dirt and gravel roads include:

- Stabilize exposed soil areas to prevent soil from eroding during rain events. This is particularly important on steep slopes.
- For roadside areas with exposed soils, the most cost-effective choice is to vegetate the area, preferably with a mulch or binder that will hold the soils in place while the vegetation is establishing. Native vegetation should be used if possible.
- If vegetation cannot be established immediately, apply temporary erosion control mats/blankets, straw, or gravel as appropriate.
- If sediment is already eroded and mobilized in roadside areas, temporary controls should be installed. These may include: sediment control fences, fabric-covered triangular dikes, gravel-filled burlap bags, biobags, or hay bales staked in place.

Undersized ***bridges and culverts*** can impede storm flows and cause sedimentation upstream and erosion downstream. As the storm water backs up behind the obstruction, pressure builds up, increasing velocity as water is forced through the opening - the "water cannon" effect. As flow is forced around and through the obstruction, the banks and channel erode. The ponding that builds up behind an obstruction also leads to excess sediment accumulation upstream as the trapped water backs up. The pooling water loses velocity and no longer has the capacity to carry the sand and sediment that was washed in with the storm water. The sediment settles out along the banks and channel bottom as the flood waters recede.

Ideally a bridge should span the flood plain and allow storm flows to pass unrestricted. A wide bridge with a flat bottom channel under it, however, can allow sediment to accumulate in the opening during periods of low flow. These accumulations can reduce the size of the opening and impede storm flows. A natural stream channel has a V shaped bottom. During dry periods, low flows are consolidated by the V shape, retaining enough velocity to keep the channel flushed of sediment and reducing the likelihood of channel blockage.

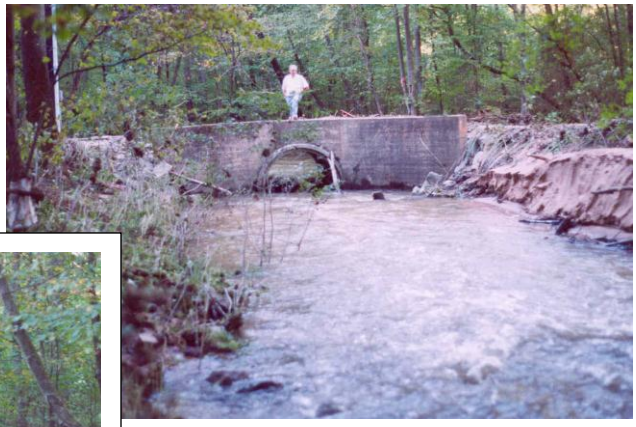


This photo, taken in neighboring Armstrong Valley, illustrates the amount of sand that can be deposited behind an undersized bridge following a storm event.

From TVC's photo collection:

Examples of problem bridges:

On Wolf Hole road: an undersized culvert and the sand that was deposited by backed up storm flow.

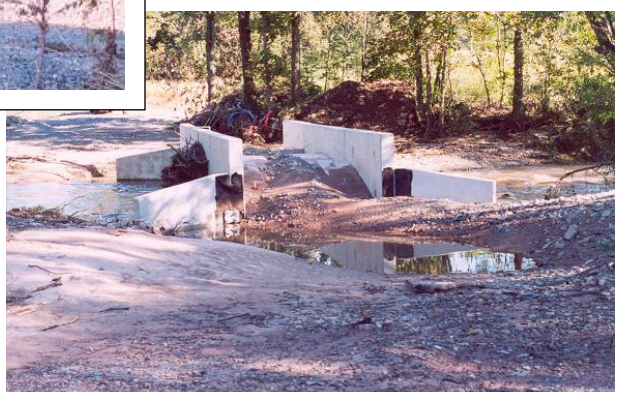


Left: "water cannon" effect – bank erosion and falling trees downstream

Right: on Armstrong Creek, a newly installed home owner access bridge after same flood

Above: this bridge obstructs even normal wet season flows.

Above and right: bank erosion and deposition left by storm flows



Land owners and municipal officials can reduce stream damage, storm damage, and bridge maintenance by insisting on bridge design shape and sizing that reflect natural stream processes. *(Note illustrations on page 24).*

The current crossing on Carsonville Road at Witmer Hollow has long been undersized and is now in need of rebuilding, presenting an opportunity to consider the stream as well as the road when the replacement is designed.

Carsonville Road crossing after a storm event: Ponding reduces velocity of backed up storm water, which will drop sediment up stream; increased velocity downstream scours out the channel bottom; erosion occurred where peak storm flow was forced over the road

Mattie Witmer of Carsonville, whose family lived near the Carsonville Road crossing when she was young, tells of how as children, she and her siblings and cousins would purposely block the culvert pipe during the summer. The ponding would make their swimming hole deeper, and when they released the blockage, they could jump in and shoot through the pipe!

A poorly maintained dirt road can become a conduit for soil and gravel entering the stream during rain storms. Photo: NF Powell's

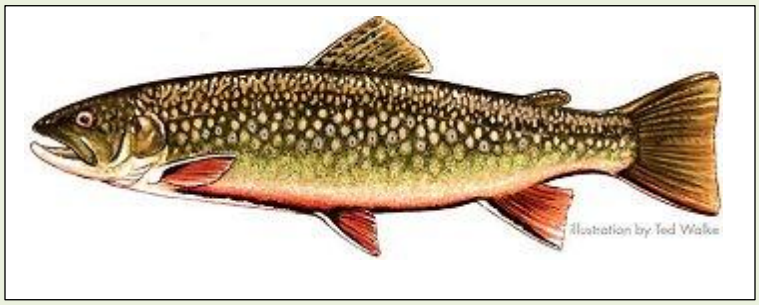
Consider impacts of trout stocking: Brook trout, the only trout species native to Pennsylvania, live and reproduce in only the coldest and purest of our mountain streams. These streams are generally less than 15 feet wide, well shaded, and have numerous pools. Native brook trout tend to be small fish that average five to six inches in length and seldom exceed 10 inches.

While trout stocking no doubt improves the experience for many fishing enthusiasts, stocked trout appear to compete with natives when resources are limited. Nonnative species such as rainbow, golden and brown trout have size and appearance that appeal to anglers, but when introduced to native brook trout waters they may have a negative impact on native populations. Some research suggests that brook trout are extremely vulnerable to the effects of predation and competition from other fishes, particularly in the first years of life (Bonney 2001) Brown trout, introduced from Europe in 1883, are larger and more tolerant of unfavorable conditions than brook trout. Brown trout are often the most predatory fish eating species in a stream. With their larger size, they may drive smaller natives from the best nesting sites and into less protected areas, resulting in less food and more exposure to other predators.

Even hatchery reared brook trout can put pressure on local natives. From Eastern Brook Trout Joint Venture: "The potential impact of stocking hatchery-reared trout on top of self-sustaining brook trout populations include ***genetic alteration*** due to interbreeding or altered selection pressures (Hindar et al. 1991; Kruger and May 1991; Allendorf et al. 2001); ***displacement*** (Waters 1983; Larson and Moore 1985; Hindar et al. 1991), and ***introduction of diseases*** (Goede 1986; Hindar et al. 1991; Kruger and May 1991; Stewart 1991)."

If native brook trout populations are to have their best chance to thrive and expand, reducing or eliminating stocking may be desirable.

The PA Fish & Boat Commission's policy on stocking: As part of the Commission's trout stocking program, we try to match the species with the habitat that is available for stocking or to the environment where a particular species would be expected to provide the best fishery. Therefore, brook trout are generally stocked in small to moderate size coldwater streams and often in combination with brown trout. Due to the fact that brook trout are the most acid tolerant trout species, we also utilize them for stocking in the more acid sensitive lakes and streams that are approved for stocking. In addition, to maintain species integrity, we plant only brook trout in the stocked stream sections that support good biomass Class B wild brook trout fisheries. Overall, brook trout compose approximately 22% of our total catchable trout production.



Generally, we do not stock brook trout in many of the larger waters or more marginal streams that have elevated seasonal water temperatures. This is primarily due to the fact that brook trout are more sensitive to water temperature elevations in comparison to either brown or rainbow trout. Aside from the waters where water chemistry or species integrity is an issue, we usually try to provide multi-species management as part of the stocking program.

This strategy allows us to manage the trout fishery for some variety. Therefore, you will notice that many of the waters are stocked with a combination of brook and brown trout, brown and rainbow trout or in some cases all three species.