The Reclamation of Babb Creek

1. Background

Babb Creek is a tributary of Pine Creek in Tioga County, Pa. It drains an area of approximately 130 square miles, in a roughly triangular area bounded on the northwest by the county seat, Wellsboro, on the northeast by the village of Arnot and by lines extending southwest from each of those towns to the village of Blackwell, where it joins Pine Creek, contributing about 13 percent of Pine Creek's flow. Main tributary streams of Babb Creek include Stony Fork and Wilson Creek, which drain the western half of the watershed, and Long Run and Lick Creek, which flow in from the east.

Much of the watershed is on State Forest Lands administered by the Tioga State Forest District, based at Wellsboro. State Game Lands 268, located about three miles northwest of Morris between the tributaries Stony Fork and Wilson Creek, contains about 3,600 acres. Pine Creek upstream from Blackwell is a state wild and scenic river. It flows through a steep-sided gorge known as the Pennsylvania Grand Canyon, a National Natural Landmark, almost entirely on publicly owned lands.

The Pine Creek Valley in Lycoming and Tioga counties is one of the state's wildest and most varied outdoor recreation areas. It contains two world-class trout streams, along with more than 100 miles of stocked trout water. A 1991 survey by the state Fish and Boat Commission showed the valley to be the most popular trout fishing destination in the state. Thousands more travel there annually for the superb hunting for deer, black bears and wild turkeys. In recent years, river otters, fishers, bald eagles and ospreys have returned or been reintroduced to the valley. Canoeing and rafting on Pine Creek are extremely popular in the spring. Hundreds of miles of trails in the surrounding mountains are maintained by the state Bureau of Forestry, providing opportunities for hikers, bicyclists, snowmobilers, cross-country skiers and all-terrain vehicle enthusiasts. The Pine Creek Rail Trail, through the gorge, has been named by USA Today newspaper as one of the 10 best in the world. Camping is available at state parks, state forest campgrounds and several private camping courts. Rooms and meals also are available at several small hotels.

2. The Ruin of Babb Creek

The mountains surrounding the Babb Creek watershed are underlain by several seams of bituminous coal. Beginning about 1853, these coal seams were mined and remined by a succession of companies. The early mines were underground, dug into the hillsides where the coal seams were exposed. In some areas, as many as three distinct coal seams, one beneath another, were mined. With the advent of heavy earth-moving equipment early in this century, large acreages also were strip mined. Some surface mines were dug above deep mines, penetrating into the upper tunnels and removing the remaining coal. While most deep mines were played out and abandoned by the 1930s, strip mining continued in sections of the watershed until 1990.

The Babb Creek watershed became a casualty of acid mine drainage soon after mining began. High sulfur content in the coal itself and in iron pyrite deposits associated with the seams provided abundant materials for production of acid mine drainage with toxic concentrations of dissolved metals, including iron, aluminum and manganese. Deep mines were dug without concern for the environment and were simply abandoned when the coal played out. Older strip mines were not reclaimed or even backfilled. Both activities left behind large piles of mine spoil. Most tributary streams of the watershed were biologically dead by the late 1800s. The accumulated contaminants killed the main creek as well. Only in the headwaters of Stony Fork, Long Run and Babb Creek itself -- upstream of the mining zones -- did water quality remain sufficiently good to sustain a healthy aquatic ecosystem.

Acid and dissolved metals flowing down Babb Creek severely affected Pine Creek below their confluence at Blackwell. As Babb Creek's flow mixed with the main creek's more alkaline waters, the rising pH caused dissolved metals to precipitate out as insoluble compounds. Deposition of these metal compounds -- mostly aluminum and manganese -- coated the bottom rocks along the eastern shore of Pine Creek below Blackwell for more than half a mile downstream. The deposition cemented in the rocks and coated the substrate, making it impossible for most stream-dwelling life to find shelter, food or reproduction sites, even if they could tolerate the acidic water.

Biological studies by the state Department of Environmental Protection, the Fish and Boat Commission and the Pine Creek Headwaters Protection Group all have demonstrated that Babb Creek's acid flows adversely affect stream-dwelling organisms of all kinds. Only minimal, acid-tolerant stream life was found in Babb Creek in a 1990 Fish Commission survey. A 1993 DEP survey documented reductions in invertebrate variety and population density in Pine Creek as far as four miles downstream from Blackwell.

Trout fishermen and longtime valley residents both have reported for years observations that hatches of mayflies are visibly less in variety, quantity and duration 10 miles and more below Blackwell than they are in the unpolluted sections of Pine Creek immediately upstream of the village. This problem was exacerbated in the 1970s and 1980s when Antrim Mining Co., stripping coal near the village of Antrim, "daylighted" abandoned deep mines. The daylighting increased surface water infiltration, the production of acid and the levels of dissolved metals in the discharges from the deep mines, which flowed into Wilson Creek and then into Babb Creek.

Although cause-and-effect proof is lacking, the increased discharge from the Antrim mines is suspected to be the chief cause of a precipitous decline in mayfly hatches on Pine Creek downstream of Blackwell during the 1970s and '80s. Over several years whole species, once abundant, vanished. These included the famous brown drakes and green drakes. Historically important hatches, including Hendricksons, Blue Quills, Quill Gordons and March Browns, became spotty and short-lived. Meanwhile, mayfly hatches in the gorge above Blackwell continued to be prolific in number, variety and duration.

3. The Comeback Begins

In 1989, at the request of board member Robert W. McCullough Jr. of South Williamsport, the Pennsylvania Environmental Defense Foundation (PEDF) filed suit in federal district court against Antrim Mining Co. The suit alleged the company had violated its National Pollution Discharge Elimination System (NPDES) permit by increasing the acidity and metals concentrations of the discharge from the abandoned Antrim #1 mine tunnels. The suit followed several attempts by McCullough, a longtime conservation activist, to get the state Department of Environmental Resources to enforce mining laws against Antrim. The agency was investigating, but its progress was too slow to satisfy McCullough.

After a series of pre-trial motions, Antrim owner Richard Mase proposed a negotiated settlement of the suit. PEDF accepted and in January 1990 a court order approving the settlement was signed by U.S. District Court Judge Malcolm Muir.

The main elements of the agreement included 1.) Antrim would cease strip mining, close out its strippings and reclaim them in compliance with state regulations; 2.) an account to be known as the Babb Creek Trust Fund would be established, into which Antrim would pay 25 cents per ton for each ton of waste deposited in the Phoenix Resources residual waste landfill, located on part of the mined area; 3.) the trust fund would be managed by a committee comprised of two representatives from PEDF and one from Antrim Mining; 4.) monies deposited in the trust fund would be used for the sole purpose of remediating acid mine drainage in the Babb Creek watershed; 5.) Antrim would make an initial payment of $25,000 into the fund, with no additional payments until sufficient tonnage was received at the landfill to account for the agreed-on 25-cents- per-ton, after which payments would be made on a monthly basis for the operating life of the landfill.

PEDF appointed McCullough and board member James P. Barr to be the organization's managers of the trust fund. The $25,000 was deposited in Jersey Shore State Bank in Williamsport until suitable projects could be identified and planned.

In February 1990, at the recommendation of Paul Swanson, North Central Region supervisor for the Fish and Boat Commission, Barr contacted Joseph Schueck, a hydrogeologist with DER's Bureau of Mining and Reclamation, who at the time was exploring new remediation technologies. Informed of the funding available through the trust fund, Schueck and colleague Michael Smith took it upon themselves to research the mining history and known conditions of the Babb Creek watershed to determine what could be done. A primary resource was the state's "Operation Scarlift" program, which documented abandoned mine problems throughout Pennsylvania.

Schueck and Smith, with zeal and energy far greater than could be expected, went far beyond their initial offer to examine Babb Creek and suggest potential projects. They made several visits to the watershed to learn the lay of the land and take water samples to determine the current acidity levels and chemical make-up in the tributaries and known mine discharges. They also recruited several experts to provide advice and assistance. These included Dr. Dean E. Arnold, an assistant professor at Penn State University and an aquatic ecologist for the U.S. Fish and Wildlife Service's Pennsylvania Cooperative Research Unit at the university, and Dr. Barry Sheetz, an expert in exotic uses of concrete with Penn State's Materials Research Laboratory. At the time, Dr. Arnold was exploring several technologies for countering the effects of acid precipitation in streams and lakes for a consortium of electric generating companies. Dr. Sheetz was working with Schueck to develop techniques for injecting fly-ash/concrete grout into abandoned strip and deep mines to seal off acid-producing pyrite concentrations.

An initial meeting to discuss potential projects in the Babb Creek watershed was held at Morris in early May 1990. Attending the meeting were McCullough and Barr of PEDF; Schueck and Smith of Mining and Reclamation; Drs. Arnold and Sheetz from Penn State; John K. Sherwood, Tioga District Forester for the state Bureau of Forestry; Paul Swanson and Steve Kepler of the Fish Commission; Dennis Bernhardy and David Brown of the state Game Commission's North Central Region staff; Dr. Robert Ross, an aquatic biologist with Fish and Wildlife's Asaph Fisheries Research and Development Laboratory; and Ronald Comstock of the Pine Creek Headwaters Protection Group, a Wellsboro-based nonprofit environmental organization primarily focused on stopping the then-proposed expansion of Phoenix Resources' residual waste landfill at Antrim.

Discussion at the meeting consisted of a review of the several abandoned mine discharges and possible technologies to remediate them. During the discussion a consensus was reached that the best initial project would be construction of a limestone diversion well on the Lick Creek headwaters tributary, which received discharges from several abandoned deep mines just south of the town of Arnot. Parties at the meeting agreed to accept specific roles in planning the project, with the goal of constructing one or more diversion wells in early autumn that year. Schueck, Smith and Arnold agreed to identify a location for the wells and do the necessary chemical, flow and engineering analyses. Swanson and Kepler agreed to do a preliminary biological survey of Babb Creek to provide baseline information on aquatic invertebrates and fish species. Sherwood agreed to cooperate in selection of the site and applying for needed stream encroachment permits. Barr and McCullough would serve as overall coordinators, with the additional responsibility of recruiting volunteer labor and finding suppliers for construction materials.

4. The First Diversion Wells

Dr. Dean Arnold, in his work on acid precipitation remediation, had discovered a technology used in Scandinavia to increase the alkalinity of acidified streams. The system, called a limestone diversion well, involved construction of a large concrete cylinder into which water from the stream was diverted by piping from an upstream dam. The water was directed vertically into the cistern through a central pipe, which discharged near the bottom of the well. The chamber was filled with limestone gravel. Gravitational force provided by the drop in elevation from the dam to the well produced hydraulic action which churned the gravel. Pieces colliding with each other chipped off tiny fragments of limestone, which provided greater surface contact for neutralizing acid as they dissolved. Slightly larger fragments were carried from the well with the discharge, coating the stream bottom below the outflow with a fine limestone sediment that continued to neutralize acid in the stream itself.

In 1986, Dr. Arnold, with cooperation of the Dauphin County Chapter of Trout Unlimited, constructed the first limestone diversion well in the United States on Rausch Creek, a tributary of Stony Creek in Lebanon County. The well, which treated the discharge from an abandoned coal mine, would serve as a test bed for diversion well technology, and at the same time help offset acid mine drainage in Stony Creek, a state scenic river and popular trout fishing stream that flows into the Susquehanna River at the borough of Dauphin, north of Harrisburg.

In the process of planning construction of a diversion well on Babb Creek, Dr. Arnold, Schueck and Barr solicited the cooperation of Dauphin County TU and the Pennsylvania National Guard, which had embarked on a program of using public recreation and environmental projects as training exercises for its engineer units. A primary force in this program was Capt. Chris Cleaver, the Guard's public affairs officer and TU member. Dale Schwalm, a civilian Guard employee, also was at the time president of Dauphin TU and coordinated maintenance of the Stony Creek diversion well.

In late August 1990, the project planning group had completed most of its tasks and another meeting was held to schedule and coordinate construction. Joining the growing list of cooperators were Neil Hedrick, Antrim Mining engineer and representative to the Babb Creek Trust Fund Committee; members of the Susquehanna Chapter of Trout Unlimited; the Pine Creek Preservation Association; and Thomas Finkbiner, proprietor of Wolfe's General Store and Slate Run Tackle Shop in Slate Run. Through consensus, it was decided that -- to handle as much of Lick Creek's flow as possible -- two diversion wells would be build adjacent to each other along the stream on State Forest Land about two miles south of the village of Arnot. Various parties agreed to perform specific tasks necessary for construction. The Babb Creek Trust Fund would pay for the materials, the National Guard would bring in heavy equipment to install the wells, the Bureau of Forestry would provide supervision, Schueck and Dr. Arnold would serve as project engineers, and the volunteer groups would provide labor for construction of the dam and pipeline.

In the course of the discussions, Robert McCullough cautioned participants to not be overly optimistic. The upcoming project would not be "the solution" to Babb Creek's acid mine drainage. "This watershed is like an innertube with 100 holes in it, and we're just putting a patch on one of those holes," he said. Reclamation of Babb Creek would take 10 or 15 years or more, even with steady progress.

Participants, McCullough suggested, should consider the immediate goal to be reducing the acid load Babb Creek delivers to Pine Creek. With Pine Creek's more alkaline waters neutralizing the acid and precipitating the dissolved metals, small reductions in contaminants entering Pine Creek should have greater discernible effect on its aquatic ecosystem than could be expected in Babb Creek, with its smaller flows and numerous acidic discharges. And with Babb Creek virtually biologically dead for a century or more, no one should expect it to revive because of one or two small treatment plants, McCullough concluded.

National Guard personnel, including Capt. Cleaver and Dale Schwalm, began construction on Oct. 8, 1990. Their mission was to install the two six-foot-diameter reinforced concrete cylinders during the work week. They accomplished their task, despite nearly constant heavy rains which began falling almost as soon as they arrived at the site. Antrim Mining Co. provided a heavy-lift crane to place the cylinder sections, which proved too heavy for the Guard's equipment.

On Saturday, Oct. 13, more than 40 volunteers from the cooperating nonprofits, along with state employees of bureaus of Forestry, Mining and Reclamation and Fish Commission converged on the site, intent on completing construction. A rock dam, lined with heavy plastic, was constructed approximately 350 feet upstream from the wells. Twin lines of 8-inch PVC pipe were laid on the ground surface from dam to the wells, spillways were installed to carry water from the wells back into the stream.

Despite the hard and enthusiastic work of all involved -- including four teenage boys from Morris, who showed up "because we read about it in the newspaper and thought it was a good thing to do" -- work could not be completed that day. Another work day was scheduled for the following Saturday. In the interim, Schueck and Hedrick reviewed progress made. Hedrick recommended several improvements to assure the integrity of the pipelines, which snaked down from the dam, making two 90-degree turns to go underneath a bridge and then on down to the wells. The insecurity of the lines was brought home during the week, when a large rain storm caused Lick Creek to flood. The rampaging waters tore sections of pipe apart and twisted the entire line into a jumble. They also knocked down much of the creek-stone dam.

With Hedrick's engineering expertise and more volunteer labor, the pipeline and dam were reconstructed and made secure enough to endure the coming winter. Plans were made to construct a more permanent dam and improve the pipeline the following spring.

The wells were placed into operation at that time. Testing done by DER and Pine Creek Headwaters volunteers over the next several months showed the water exiting the wells was between 1 and 1.5 pH units higher than that entering the system in the dam pool upstream. The increase from a pH of 4.5 to 5.5 or 6 was heartening, but less than the 2 to 2.5 pH boost observed in the Stony Creek well in Lebanon County. This was due to numerous problems resulting from inexperience and hasty construction, which compromised the system's efficiency. Fallen leaves clogged the intakes, turns and sags in the lines impeded water flow, air sucked into the pipelines created "vapor lock," and below-zero temperatures caused pipes and well surfaces to freeze.

In June 1991, extensive improvements were made to the systems. A new, timber and plank dam was constructed under supervision of Paul Swanson of the Fish Commission. District Forester Jack Sherwood, other district workers, Schueck and Mike DiMaddio from Mining and Reclamation provided most of the manual labor. Ed Signor of Signor Brothers Contraction, Arnot, provided heavy equipment. Pipe lines were disassembled and relaid in a nearly straight line from the dam to the wells, which required trenching through Landrus Road, an improved dirt forestry road that crosses Lick Run between the dam and wells. New nozzles were installed on the wells' inlet pipes to direct the water flow outward into the surrounding stone. Stand pipes were installed to reduce air blockage, and the entire pipeline was covered with fill dirt to prevent freezing and vandalism.

The results of these improvements were immediate. Neutralization increased to between 2 and 2.5 pH units. Alkalinity, although minimal, began to appear in the water samples. And pH was higher at a testing station 100 yards below the wells than in the outflows, indicating that further neutralization was occurring in the stream due to the limestone particles suspended in the discharge.

Bureau of Forestry personnel kept the wells filled with limestone, purchased through the Babb Creek Trust Fund. And District Forester Sherwood took a personal interest in seeing that the systems were maintained and functioning properly. Schueck and other DER personnel settled in to monitor the wells, testing to find ways to improve their operation and assess the treatment systems' downstream benefits. Dr. Arnold, working with Penn State graduate students under his proctorship, began a series of studies to increase understanding of diversion well operations and assess the effects of the improved water quality on the biology of Babb Creek. His work was aided by a $30,000 grant from national Trout Unlimited.

5. More Diversion Wells, Other Projects

After the improvements in the summer of 1991, the two diversion wells operated successfully and continuously for three years before any additional treatment systems were built. Meanwhile, Schueck and others involved in what had become known as the Babb Creek Reclamation Task Force explored methods of remediating other mine discharges and sources of acid mine drainage in the watershed.

With the assistance of Susquehanna TU members and other volunteers, Schueck began surface studies on a portion of Game Lands 268, known as the Rattler Mine Complex. The 100-plus-acre area had been both deep mined and strip mined, with the stripping causing widespread collapses into the deep mines below. Although the discharge from the site was relatively small, its pH ranged from 2.5 to 3 and it carried heavy concentrations of dissolved iron, aluminum and other metals.

The Rattler discharge flows into Paint Run, a tiny tributary of the Stony Fork branch of Babb Creek. The Fish Commission stocks trout in Stony Fork upstream from Paint Run but not below, because of the acid discharge's effect on water quality.

Attacking the Rattler discharge was attractive for three reasons: 1.) It was confined and manageable, and its elimination would further the overall goal of reducing the acid load on Pine Creek. 2.) It was on public lands, so reclamation would improve wildlife habitat and public recreation opportunities. 3.) By improving the water quality of Stony Fork below Paint Run, three or four miles of the stream from that point to its confluence with Babb Creek would be restored to conditions that could support fishable trout populations.

Another project examined during this period was the removal of an old railroad bed built out of mine spoil fill. The rail bed runs for about 3,000 feet along Babb Creek several miles upstream from Morris. Part of it has been cut away by stream erosion, with the spoil washing into the creek. Testing done by Schueck showed that the spoil contains high concentrations of pyrite, and as a result acid is produced as rain water percolates through the fill. The fill also contains a large percentage of waste coal, (Schueck estimated between 30,000 and 40,000 tons) making it usable fuel for some electric cogeneration plants.

Working with PEDF members McCullough and Barr and Forester Sherwood, Schueck proposed to have the rail bed material dug up and shipped to a cogeneration plant for burning. Its removal would eliminate one more source of acid in the watershed. Although necessary permits were obtained for the work, the inability to find a trucking company that would transport the material at a reasonable cost caused the project to languish.

One of the biggest steps forward in the reclamation of Babb Creek occurred in 1991. In a negotiated settlement with DER's bureau of Mining and Reclamation, Antrim Mining/Phoenix Resources constructed a large lime dosing system to treat the Antrim #1 discharge, the degrading of which had been the cause of PEDF's 1989 lawsuit. The system, which went into operation Dec. 31, 1991, treated nearly 50 percent of the acid load flowing down Wilson Creek into Babb Creek.

The treatment had an almost immediate effect on Pine Creek. Within two years after the system began operating, mayfly hatches began increasing markedly in the creek downstream from Blackwell. The company also continued making regular payments into the Babb Creek Trust Fund.

In the summer of 1994, Schueck decided that the next workable project in the watershed would be construction of a small diversion well to treat the Klondike deep mine discharge, which flows into Lick Creek about half a mile below the original diversion wells. Schueck's testing showed that the Klondike discharge, though small, almost completely counteracted the beneficial effects of the original diversion wells on Lick Creek's water chemistry.

Because of the small size of the Klondike discharge, Schueck had to design a downsized diversion well. Rather than using a six-foot-diameter well and eight-inch pipe, he used a four-foot well and four-inch pipe. This system was constructed using DER funds specifically designated to test diversion well technology. It went into operation in July 1994 and has worked almost continuously since.

Another important milestone occurred in 1994. Babb Creek was selected as one of eight watersheds in the state to test a new remediation strategy. The idea behind the "Comprehensive Mine Reclamation Strategy" was to eliminate all sources of acid mine drainage in entire watersheds, rather than spending state and federal funds correcting scattered, individual discharges with no apparent priority or benefit. The program was to be a cooperative effort of the U.S. Bureau of Mines, the Environmental Protection Agency and DER.

J. Corey Cram, a hydrogeologist with the Bureau of Mining and Reclamation's Hawk Run District Office, was named Babb Creek watershed coordinator under the CMRS program. Cram, one of Dr. Arnold's graduate students, had studied diversion wells for his master's degree thesis.

In April 1995, Tom Finkbiner of Slate Run Tackle Shop, reported sustained, prolific hatches of mayflies on Pine Creek downstream from Blackwell. In May that year, he reported seeing large hatches of Brown and Green Drake mayflies. It was the first Green Drake hatch on lower Pine Creek in at least 15 years, he said. They were back again in 1996.

Satisfied with the operations of the existing Lick Creek and Klondike diversion wells, Cram and Michael Smith, now manager of the Hawk Run District Office, recommended in 1995 that two more wells be constructed on Red Run, another small, acidified tributary of Lick Creek between the original wells and the Klondike. The new wells would treat Red Run's acid load, but more important, they would add more alkalinity to Lick Creek and Babb Creek below it. The wells were constructed in September 1995 with Babb Creek Trust Fund moneys.

With a much greater drop from dam to well, a new nozzle design and a smaller size gravel, these wells chew up limestone at more than twice the rate of the original wells, more than 2,000 pounds each per week. Assessment of their effect on watershed water quality has been hampered by the flooding of Jan.19-20, 1996, which clogged the intakes. Partial operation was restored in the spring of 1996, and full operation in December 1996, after installation of new nozzles.

Meanwhile, additional water analyses was being done by Cram and other Hawk Run District staff. Their testing indicated that the diversion wells had raised the water quality in Babb Creek below Lick Run from the category of "seriously impacted" to "marginal." Sampling done by Schueck, Arnold and his graduate students found evidence of increasing aquatic invertebrate life in Babb Creek all the way from the Lick Run confluence to the confluence of Wilson Creek, an distance of more than nine miles.

Ed Signor, a member of the Arnot Sportsman's Club who had become a cooperator in the task force, released trout from the club's cooperative nursery into Babb Creek during August 1995, when drought dried up the nursery's water supply. Those trout could still be seen swimming in the stream when the Red Run diversion wells were built two months later.

6. SAPS, Rattler and Beyond

In December 1995, PEDF working with Mining and Reclamation's Corey Cram, Joe Schueck and Michael Smith put together a grant application for funding under the Comprehensive Mine Reclamation Strategy initiative. The three reclamation experts proposed construction of a combination system, known as a Successive Alkalinity- Producing System (SAPS), to treat the Arnot #2 deep mine discharge in the Lick Creek headwaters about a mile upstream from the original diversion wells. The system, an artificial wetlands combined with an underground anoxic limestone drain, would treat the largest source of acid mine drainage above the diversion wells. It was hope this would allow the wells to add alkalinity to the stream rather than have their limestone used up neutralizing acid.

PEDF and DEP signed a no-bid contract for the Foundation to act as project manager for the SAPS construction. The procedure was used in an effort to save money, compared to the costs of the state contracting out the work itself. DEP committed $130,000 of the federal-state program funds, the Babb Creek Trust Fund committed $30,000. Another $10,000 was requested, and subsequently received, from the Howard Heinz Foundation through its Western Pennsylvania Watershed Improvement Program.

Tioga District Forester John Sherwood cooperated in the project by having several acres of woodlands adjacent to the Arnot #2 mine discharge clearcut in a contract timber sale. In August, Signor Brothers Contracting of Arnot was selected as the low bidder for the construction contract. Another contract was let to Eastern Industries Inc. of Winfield to supply some 4,500 tons of limestone needed for the systems. Other materials were purchased or ordered, and construction began in earnest in late September 1996. The project was expected to be substantially completed by the end of November, weather permitting.

Encouraged by the anecdotal reports of increasing stream life in Babb Creek, the Fish Commission's region supervisor Paul Swanson and Steve Kepler of the agency's Environmental Services Division decided to do a biological survey of the stream above Morris. The survey was conducted on June 18 and 19, 1996. Final results were not available as of this writing; however, a preliminary report documented the presence of numerous varieties of aquatic insects and -- although none were found during a 1990 baseline survey before construction of the first diversion wells -- small numbers of several fish species, including trout.

Bruce Hollender, the commission's area fisheries manager, said that depending on the outcome of Kepler's survey and the success of the SAPS system, he would schedule another survey for the summer of 1997. If that proves the water quality is being sustained at a high enough level to support trout, he said he might recommend adding the nine-mile section of Babb Creek above Morris to the state's approved trout waters list, probably for the 1998 season. The lower end of Babb Creek, where road access is good, might be stocked with trout, Hollender said. The remainder probably would be managed as a wild trout fishery.

In July 1996, Hawk Run's Cram and Smith, working with Penn State's Drs. Barry Sheetz and Michael Silsbee, of Penn State's Materials Research Laboratory, were successful in obtaining $50,000 through the federal-state program to begin work on the Rattler Mine Complex remediation on Game Lands 268. A planning meeting was held July 15, with representatives of the Game Commission assuring that agency's cooperation. Barr and McCullough agreed to explore possible additional funding through the Heinz Foundation, the Tioga County Conservation District and other sources. Preparatory work continued through the summer and an initial site visit was held Sept. 13 with Game Commission personnel.

Plans call for the injection of a concrete and fly-ash grout into the old deep mine voids to cut off the flow of water and-or seal off the iron pyrite in the surrounding rock to prevent acid production. It was estimated 1 million tons of grout would be needed. Fly- ash/concrete caps are planned on the strip-mined portion of the complex and for a large spoil pile. Sheetz and Silsbee estimated the entire project would take three years to complete.

The Rattler project will move the Babb Creek reclamation effort into a new phase, shifting from the eastern side of the watershed to the western, where the problem areas are larger and less amenable to simple, inexpensive solutions. However, with the continued cooperation of all the agencies and volunteer organizations who have made this effort the success it has been up until now, the eventual restoration of Babb Creek to a clean and

living stream ecosystem remains well within reach.

Project Update, February, 1997

Construction of the Arnot #2 SAPS was completed Dec. 19, 1996, and the mine discharge was channeled into the pond. Three days later, water began flowing out of the anoxic drain discharge. An inspection was conducted by DEP, Bureau of Forestry and PEDF personnel with the contractor on Dec. 30. Mine discharge flowing into the system field tested at a pH of 3.5; discharge from the system tested at a pH of 7, neutral. Flow was approximately 240 gallons per minute.

The outflow pH may be somewhat elevated due to fine particles of limestone in the system. Treatment effectiveness may decline somewhat as these fines are consumed or washed out; however, a pH elevation of 2.5 to 3 units is expected even afterward.

Costs of the project, due to a number of unforeseen circumstances, increased to more than $200,000. A main cause was EPA insistence that federal prevailing wage rates be used by the contractor. This resulted in an increase in the construction cost of $36,000 over the contractor's standard-wage bid. Other factors were additional work required to uncover the mine opening, construct a concrete dam to raise the mine discharge to allow gravity-feed to the SAPS and clearance of additional forested land to accommodate the project elements, which had to be reconfigured due to the location and elevation of the mine discharge.

DEP has provisionally approved a contract amendment to provide an additional $15,000 to help cover project cost overruns. The remainder of the excess costs will be paid out of BCTF funds.

In conjunction with the SAPS project, DCNR and Ducks Unlimited were prevailed upon to plan a rehabilitation project for the approximately 80 acres of wetlands through which the Arnot #2 discharge and the headwaters of Lick Creek flow before reaching the original diversion wells. Details of this project were not available at this writing.

In late December 1996, Antrim Mining completed construction of a new treatment system for the Antrim #1 discharge. The system uses gravity flow and lime kiln waste, making it cheaper to operate and, once start-up problems are worked out, more effective than the previous system. The new system should make it much more affordable for Antrim to treat the discharge on a sustained basis.

In late 1996, another important project was proposed for the Babb Creek watershed, partly due to the reclamation program's success. The Pennsylvania Task Force on Dirt and Gravel Roads succeeded in obtaining a grant to demonstrate erosion and sedimentation control methods for dirt roads, part of a continuing effort to develop construction and maintenance methods to reduce the negative impacts drainage from the state's 22,000 miles of dirt roads have on adjacent streams. The project is under the direction of Dr. Dean Arnold, Woodrow Colbert of the state Department of Transportation's Bureau of Environmental Quality, Bruce Vandegrift of DEP's Bureau of Air Quality, and Ken Murin of DEP's Bureau of Land and Water Conservation.

The $250,000, three-year project will involve construction of seven demonstration projects Rattler and Landrus roads in the watershed. Three of the projects will be in conjunction with the Rattler project, which with heavy trucks delivering some 4,0000 loads of materials to the site, should provide a torture test for the erosion and sedimentation controls.

Planning continues for the Rattler project, with an expected start date of April 21 or 22, 1997 -- Earth Day. The Pa. Air National Guard has agreed to do preliminary earthmoving for the project, to build a staging area and erosion control devices.

Additional projects being planned include a SAPS system to treat two abandoned mine discharges from the Anna S complex on Wilson Creek. Schueck has proposed new systems -- dubbed limestone upflow beds -- to replace the Klondike diversion well and treat another Anna S discharge, known as the Mitchell Drift.

-- JPB, 2/28/97 --

Four Years Later

Since the 1997 update, much has happened with efforts to reclaim Babb Creek and with the entire idea of citizens partnerships cleaning up their local environments. The following are highlights:

-- In late 1997, a second SAPS system was constructed to treat the Klondike Mine discharge. The discharge had been inadequately treated with a small diversion well. Funding was received from the Howard Heinz Endowments and Orvis Corp. Construction was done partly by the state's Bureau of Abandoned Mine Reclamation and the remainder by Signor Brothers under contract with PEDF's Babb Creek Committee. The diversion well was retained as a backup and to provide supplemental treatment during high-flow periods.

-- In 1998, a large spoil pile at the Klondike Mine was reclaimed. The steeply graded pile was bulldozed to gentler slopes, organic material from the Westfield Tannery was applied to the surface and a mixture of grass and clover was planted. The project resulted in a lush, green meadow of about seven acres in size, providing forage for deer, turkeys and other wildlife where a sterile, ugly black pile of spoil had marred the landscape for about 70 years.

-- In late 1998, the Babb Creek Watershed Association was formed as a nonprofit corporation. Its mission was to provide a successor to the PEDF committee and the informal partnership that had so far conducted the reclamation program, to assure organized, citizen involvement in maintaining the watershed into the indefinite future. The first task of BCWA Inc. was to prepare to take over management of the Antrim #1 Acid Mine Drainage Treatment Plant at the village of Antrim.

-- In March 1999, Antrim Mining Co., in preparation for dissolving as a business entity, deeded the Antrim Treatment Plant, built at a cost of nearly $2 million, and about 100 acres of land to the state of Pennsylvania and paid into a trust fund $1.5 million to pay for operating the plant for the next 50 years. On April 1, BCWA Inc. took over operation of the treatment plant under an agreement with the state Department of Environmental Protection. BCWA received payments from the Antrim Treatment Trust to pay costs associated with the operation of the treatment plant. The arrangement was made in order to save money, as compared to having state employees running the plant. BCWA was the first citizens' group accorded such a responsibility. In June 2001, after a long period of negotiation, DEP and BCWA executed a consent order and agreement delegating BCWA plant management for five years, with automatic renewals if all parties were satisfied.

-- A state Fish and Boat Commission survey done in August 1999 found large numbers of fish during an electroshocking survey of Babb Creek. The fish were from at least 12 species, including stream-born brook and brown trout. Insect variety and numbers also were found to be increasing.

-- In December 1999, DEP announced it was removing five miles of Pine Creek below its confluence with Babb Creek from the state's list of impaired streams. DEP biologists had determined that fish and aquatic insect life in the section had recovered to levels similar to those in unaffected sections of Pine Creek upstream of Blackwell. The recovery was credited to the reclamation program's successes in improving water quality on Babb Creek.

-- After years of difficulty in working out proper arrangements, Signor Brothers finally began work in early 2000 to remove the old railroad grade made of waste coal and mine spoil below the abandoned town of Landrus. PEDF's Babb Creek Trust Fund contributed more than $30,000 to the project, with the remaining costs being covered by Signors' sale of several thousand tons of coal recovered from the rail grade. The site, nearly half a mile long, was then leveled and planted with grasses and clover, producing a beautiful, green meadow.

-- In the summer of 2000, Stott Coal Co. of Ebensburg constructed two large SAPS systems to treat two discharges from the Bear Run mine complex. The work, costing upwards of $500,000 was done under DEP direction, as compensation for environmental harm done in Stott's mining operations elsewhere in the state. Those discharges were the last remaining on the main stem of Babb Creek upstream of Morris. Bringing them under treatment eliminated acid mine drainage impacts on more than 10 miles of the creek between Arnot and

Morris.

-- With the advent of Pennsylvania's Growing Greener program, BCWA applied for and received two grants during the first grant round in early 2000. It received $299,000 to pay for a variety of upgrades to the Antrim Treatment Plant and acted as sponsor for the Arnot Sportsmen Club's $376,000 grant to build a SAPS system on a second discharge from the Arnot #2 mine complex. That discharge drains into a pond that feeds both the Babb Creek headwaters and Johnson Run, a tributary to the Tioga River.

-- In the second Growing Greener grant round, BCWA was awarded $411,000 to pay for the long delayed Rattler Mine project on State Game Lands 269. The project had changed over time. A new technology would be tried -- injecting limestone sand into the underground mine tunnels to try to partially treat the acid mine drainage before it reached the surface. SAPS systems then could be used to further raise the pH and precipitate dissolved metals. Approximately 60 acres of partially reclaimed strip mines and spoil piles associated with the Rattler mines also would be revegetated by applying sewage treatment plant sludge and planting with grasses and trees.

-- In the third Growing Greener grant round, BCWA was awarded a $2.2 million grant to build systems to treat four discharges from the Anna S mine complex, on the mountain west of Route 287 between Morris and Wellsboro. The largest Growing Greener grant ever awarded, it will pay for construction of more than 7 acres of SAPS ponds, sediment basins and constructed wetlands to raise pH and remove dissolved metals from three of the discharges. A set of diversion wells would be constructed to treat the fourth discharge. Together they would form the largest passive AMD treatment complex in the state. They also would treat the last significant AMD sources in the watershed. Plans were being made to finish construction by the end of 2002.

Although work remains to repair stream banks, reclaim spoil piles and stop sources of erosion and sedimentation, the Anna S project will basically complete the reclamation of Babb Creek. After more than a decade of work and the investment of well over $10 million from dozens of sources, the program begun so naively and hopefully in early 1990 will have reached its ultimate, once seemingly unreachable goal.

In the process, the program inspired hundreds of other citizens to take an interest in reclaiming their local streams and proved that the concept of broad-based, public-private partnerships could achieve real environmental improvements. Babb Creek was one of just a handful of initiatives, launched by concerned citizens with little more than hopes and dreams, that perceptive state government leaders used as models to fashion the Growing Greener program and create a conservation revolution that has yet to see its brightest days.

-- JPB, 10/10/01 --