Lick Run Assessment and Conservation Plan

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For the Allegheny Mountain Chapter of Trout Unlimited

Conducted under a Coldwater Heritage Partnership (CHP) grant

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Carl Undercofler (Clearfield County Senior Environmental Corps) accompanied me on most of the trips to the stream. He drove his 4-wheel drive truck to get us into difficult access areas and we used his snowmobiles during the winter of 2004/2005 to get into areas that we simply could not have reached otherwise. He kicked rocks and sorted bugs and showed me how to do all the other things that were necessary in order to do this assessment.

Donna Carnahan (Clearfield County Conservation District) accompanied us on most of the trips to the stream. She was the driving force behind the benthic invertebrate study all the way from holding the net to identifying, counting and categorizing the invertebrates.

Without the help of Carl and Donna, this study would not have been possible.

There were many others who contributed as well:

Dr. William E. Sharpe (Penn State) graciously shared his extensive knowledge of the effects of acid deposition on freestone streams and provided many technical papers on the subject.

The Pennsylvania Fish and Boat Commission provided survey data and other records from its files which were invaluable in documenting the history of Lick Run.

The Sadoti family allowed us access to the area around the former site of the Crystal Spring Lodge and special thanks to **Nick Sadoti** who provided the history of the lodge.

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Colleen Shannon (Land Manager - PA Game Commission) arranged access to Lick Run at the SGL #90 gate, again saving us many added miles of walking.

Rudy Schrot accompanied me on the rod-and-reel survey and caught most of the beautiful brookies shown in this report.

Chuck Failing IV (Clearfield County GIS) created the maps of Lick Run.

Christy Thomas (Clearfield County Conservation District) put together the brochure for the startup notification meeting.

Susan Reed and the Clearfield County Conservation District supported this project from the very beginning.

INTRODUCTION

Scope

This was an 18-month effort to determine the ecological condition of Lick Run from the headwaters to Stone Run, a distance of about six miles.

Lick Run is a medium-sized freestone stream located in Clearfield County; see Figure 1. The headwaters are relatively inaccessible and heavily forested with maple, beech, oak and other hardwoods as well as significant stands of second-growth hemlock and white pine. The stream is well shaded and runs clear even after heavy rain events.

I have been fishing Lick Run for some 55 years. In my opinion, Lick Run is one of the best wild brook trout streams in Clearfield County. It is currently rated by the Pennsylvania Department of Environmental Protection as a High Quality Coldwater Fishery and holds a self-sustaining population of native brook trout. There is reason to believe that this population has been degraded in the upper reaches by chronic and periodic acid deposition.

Donna Carnahan, Watershed specialist for the Clearfield County Conservation District and Carl Undercofler head of the Clearfield County Senior Environmental Corps provided on-the-ground help for this assessment.

Project Objectives

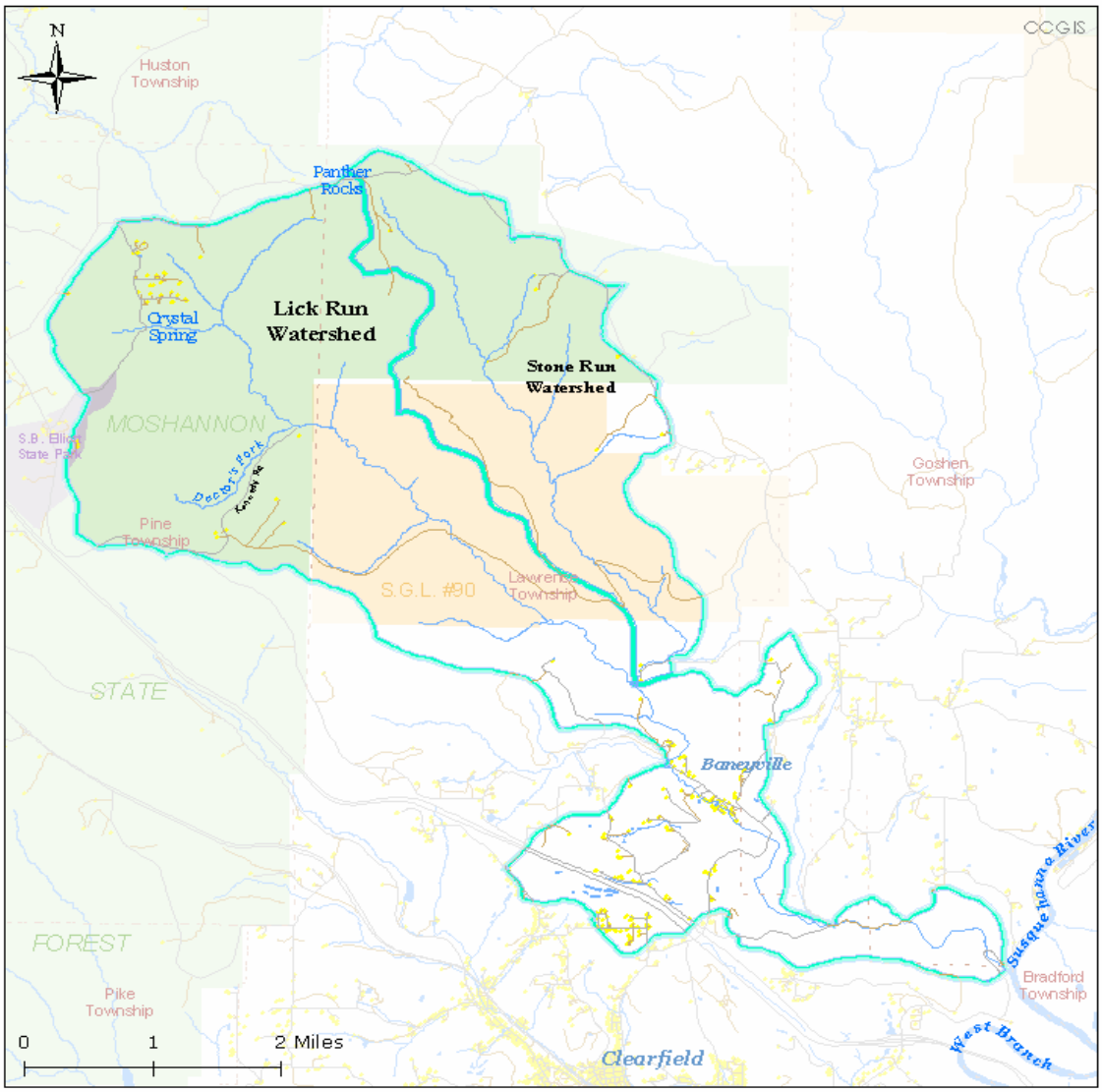
- Review the history of the Lick Run fishery.
- Describe the physical characteristics of the watershed.
- Determine the environmental condition of the upper Lick Run watershed.
- Determine the water quality and biological indicators in upper Lick Run.
- Determine the possible negative effects of acid precipitation in the headwaters of Lick Run.
- Develop a plan for conserving and protecting the upper Lick Run watershed.

History

The Lick Run watershed was heavily logged in the late part of the 19th and early part of the 20th centuries. Logging began in Clearfield County about 1820. [1] Essentially all the white pine was gone by 1895.Logging began to taper off throughout PA about 1915 as nearly all the old-growth forests had been clear cut. [2]

Since the end of the massive logging era, the forest along Lick Run has regenerated and the stream is now heavily forested throughout most of its length.

A survey conducted just below the confluence of Stone Run by the then Pennsylvania Fish Commission (PFC) on August 18, 1961 indicated natural reproduction of both brook



(Map by Chuck Failing IV, Clearfield County GIS)

Figure 1. Lick Run, Clearfield County, from the headwaters at Panther Rocks to the West Branch of the Susquehanna River.

trout and brown trout. Blacknose dace, white sucker and slimy sculpin were also recorded. [3]

Lick Run was heavily impacted by Hurricane Ivan in the fall of 2004 but seems to have suffered no long-term ill effects.

Acid Precipitation in Lick Run

After a heavy rain in March, 1980 a fish kill occurred from Doctors Fork all the way down to Fork Run at Baney Settlement. A chemical check of the water in March of 1980 showed the pH in Lick Run to be 5.6 and the surrounding snow 5.2. Surveys conducted from below the Doctors Fork confluence to the confluence of Fork Run revealed a low-level population of mostly sub-legal brook trout and only 1 brown trout. Only 34 brook trout were found in an electrofishing survey of 406 meters of Lick Run. No other fish species were found. During the survey, a few large, dead hatchery brook trout were observed. Many more dead hatchery trout had been reported just prior to the survey. PFC Area Manager Hollender's conclusion was: "Since there is no mining within or upstream of this section, the low pH and attendant fish kill must be attributed to natural acid/or acid rain." [4]

In the past, Lick Run was stocked with hatchery trout throughout most of its length. Stocking by the PFBC was halted in 1985 because of episodic acid precipitation events. Since stocking was halted, the native brook trout population appears to have rebounded substantially. The main stem of Lick Run was surveyed again by the PFBC in 1996. At Doctors Fork the brook trout biomass was 8.9 kg/h and at Stone Run it was 19.1 kg/h. [5]

No acid mine drainage (AMD) enters Lick Run above the confluence with Stone Run. Below normal pH of the water in Lick Run would therefore be attributable to acid precipitation and the low buffering capability of the surrounding watershed.

Acid Precipitation and Its Effects on Nearby Streams

Acid precipitation is the transfer of strong acids from the atmosphere to the earth's surface by rain and snow. The negative effects of acid deposition on terrestrial and aquatic systems have been known and much studied in the Northeastern United States since 1960. [6]

Acid precipitation has been causing a decline in pH of freestone streams in the Allegheny Plateau Region of central Pennsylvania for many years. Lick Run and other streams in the Clearfield County area originate in Pottsville bedrock, which is especially problematic. [7, 8, 9] Progressing downstream, higher pH seeps and springs from underlying and slightly better buffered strata add some alkalinity and pH increases. But, in general, these waters are of very low alkalinity and very infertile. In many, all or most of the fish species once present are now extirpated. [10, 11]

Nevertheless, brook trout are able to eke out a life in these waters and many still hold self-sustaining populations of Pennsylvania's only native, stream-dwelling salmonid and state fish. Brown trout no longer reproduce in many of these acidified headwater streams.

Mosquito Creek originates in the same general area of Clearfield County as Lick Run and joins the West Branch of the Susquehanna at Karthaus, about 33 miles downstream from Lick Run. It is the subject of an extensive Growing Greener project to reduce the effects of acid precipitation in the headwaters. Alkaline limestone is being added to the stream at several points in the headwaters using various methodologies. This project started in September of 2001 and is, at the time of this writing, still underway. [12]

Trout Run is a slightly larger freestone stream than Lick Run. It originates in the same area of Clearfield County and flows into the West Branch of the Susquehanna River, about 2 miles downstream from Lick Run, at Shawville. The headwaters of Trout Run have also been negatively impacted by acid deposition. Alex Branch, a major headwater tributary entering from the west, is devoid of brook trout except for the very lowest section near its confluence with Trout Run. The effects of acid precipitation in Roberts Run, a headwater tributary entering Trout Run from the east, just downstream from Alex Branch, have been studied extensively by DeWalle and Swistock [13] and Baker, et al. [14] These studies indicated that Roberts Run has also been much degraded by acid deposition.

Trout Run was taken off the stocking list at about the same time as Lick Run because hatchery trout could not survive in the periodically acidified water long enough to provide even a short-term fishery.

Stone Run is the largest tributary to Lick Run. It originates about a half–mile from the source of Lick Run, at the same geographic level, and flows more or less parallel to it in the adjacent watershed to the north, before joining Lick Run about a mile above Baney Settlement. The geology and conditions in the watersheds of both streams are similar.

Stone Run holds a sparse population of native brook trout. Their existence is perilous because of chronic and periodic atmospheric acidification.

A study of the brook trout population in Stone Run by Dolte [15] showed that the brook trout population was being negatively impacted by episodic acid rain events. Severe recruitment failures and a significant depression in the brook trout population were observed in the winter of 1996. Brook trout were able to take refuge in less acidic seeps and springs during this event and managed to maintain a population.

Stone Run once held a population of slimy sculpin, which are about as resistant to acidification as brook trout. A study conducted during 1999 and 1998 by Kaeser and Sharpe [16] indicated that the slimy sculpin population in Stone Run had collapsed because of atmospheric deposition events.

Description of Study Section

The section assessed begins at the source of the Lick Run main stem near Panther Rocks Camp and extends six miles downstream to the confluence of Stone Run. Stone Run enters Lick Run about five miles upstream from the confluence of Lick Run and the West Branch of the Susquehanna River.

A small tributary enters Lick Run from the west about 1.3-miles below the source at Panther Rocks Camp. A larger tributary and the outflow from Crystal Spring (referred to in this report as Crystal Spring Stream) mix in a boggy area at the abandoned site of the Crystal Spring Lodge. Crystal Spring Stream flows into Lick Run from the west about 1.5-miles below the Panther Rocks source. Both of these tributaries are significant contributors to the flow of Lick Run in the headwaters. Together, they appear to more than double the flow.

Doctor's Fork, another major tributary, enters Lick Run from the west about 2.6 miles below the source. From here to the end of the study section at Stone Run there are a few, small unnamed tributaries and many springs and seeps entering the Lick Run main stem.

In the headwaters above Doctors Fork, the Lick Run watershed is primarily in the Moshannon State Forest, with the exception of a few minor in-holdings that are open to the public. From just below Doctors Fork to about 1-mile above Stone Run the assessed section is on State Game Lands #90. The lower 1-mile of the study section is on privately owned property.

Currently, Lick Run from Doctors Fork to its confluence with the WB Susquehanna holds native brook trout. The middle section that runs through Baney settlement has been slightly degraded by human development. Its lower reaches, near the confluence with the WB Susquehanna, have been seriously degraded by AMD.

METHODOLOGY

Assessments of the chemical condition of the water in Lick Run were made in the spring, summer and fall of 2004, and the winter and spring of 2005. Measurements were taken in the field to determine pH (Oakton pH Tester 2, calibrated prior to each survey with pH-4.0 & 7.0 standard solutions), alkalinity (Hach Chemical Tester), temperature (stream thermometer) and conductivity (Oakton EC Tester).

The major assessment sites were: Panther Rocks Camp, Crystal Spring Stream at the Crystal Spring Road crossing, ~100 yards above Doctors Fork, ~100 yards below Doctors Fork, SGL #90 bridge, SGL #90 southern boundary, and ~100 yards above the Stone Run confluence. A number of other sites were assessed a single time during the spring 2005 stream walk from Panther Rocks Camp to the confluence of Stone Run

Two benthic invertebrate studies were conducted, one in the fall of 2004 and the other in the spring of 2005.

A stream walk of the entire study section was conducted in the spring of 2005. Along the way, measurements of water chemistry were taken for the Lick Run main stem and its tributaries, significant springs and seeps. Estimates of flow were made for springs, seeps and minor tributaries. Photographs were taken at various points along the way to document the character of the stream and its riparian area.

OBSERVATIONS

pH Readings

Table 1 is a summary of pH measurements taken at the major assessment sites throughout the four seasons.

Table 1. Summary Of pH Data For Lick Run Main Stem Sites During The Four Seasons

Site	Spr. 04	Sum. 04	Fall 04	Win. 05	Spr. 05
Panther Rocks Camp	4.5	4.7	4.1	5.4	4.4
Crystal Spring*	4.7	5.2	4.8	4.6	4.3
Above Dr. Fork	4.7	6.1	5.5	5.5	4.7
Below Dr. Fk.	4.7	6.0	6.1	5.8	5.0
SGL #90 Bridge	5.0	5.7	5.7	5.3	5.3
SGL #90 So. Boundary	5.1	5.9	-	5.6	5.6
Just above Stone Run	5.4	6.0	6.9	5.7	5.6

*The outflow from Crystal Spring and the stream flowing past is not considered to be part of the main stem by the mapmakers but contributes significantly to the flow of the Lick Run headwaters and was therefore considered in this study.

In the headwaters and above Doctors Fork, pH tended to be at its lowest in the spring, peaked in the summer and declined slightly in the fall and winter. The Panther Rocks reading for the winter of 2005 was an anomaly. Downstream of Doctors Fork, pH peaked in the fall and declined slightly in the winter.

The tendency for pH to be at a minimum in the early spring in acid precipitation impacted freestone streams is well known as melting snow and increased rainfall increase the acid load. The declines in pH observed in the headwaters in the fall, were probably because of decaying leaf litter which added tannin to the water.

A definite trend observed was that pH increased progressing downstream all the way to the confluence of Stone Run, regardless of the season. Dr. Bill Sharpe of Penn State [17] explains that the rock strata in the high elevations of the Appalachian Plateau in this area

have almost no buffering capacity. What little that was once present, is about gone. Deeper strata, exposed in the downstream sections, have better buffering capability and raise pH until at some point it is high enough to support brook trout.
There does appear to be a slight dip in pH at the SGL # 90 bridge site during the summer, fall and winter. Readings just below Doctors Fork ranged from pH-5.8 to pH-6.1 during this period. At the SGL #90 bridge, they were from pH-5.3 to pH-5.7. This may be due to the localized influence of a significant tributary that parallels the SGL #90 road and enters Lick Run from the west not far above the SGL #90 bridge. This tributary tends to be more acidic than the Lick Run main stem at this site.

Except in the uppermost reaches of Lick Run, pH values observed during the spring of 2005 were, on average, higher than those measured during the spring of 2004. Snow pack during the winter of 2003-2004 was much greater than that during the winter of 2004-2005. Melting snow would be expected to add additional acidity to the stream in the spring runoff. Additionally, rainfall during the spring of 2005 was less than that of the previous spring. As a result a greater proportion of the flow was from deeper springs which have greater buffering capacity.

Conductivity

Conductivity measurements give some indication of the amount of dissolved minerals in the water. Values above 400 µS/cm would indicate high concentrations of these minerals. Values of 40 to 50 µS/cm were typical at the Panther Rocks and Crystal Spring sites. Downstream Lick Run main stem sites were typically 30. No seasonal variation was observed. Concentrations of dissolved minerals in the water were, apparently, very low, and much lower than what one would expect in an AMD-impacted stream.

Alkalinity

Some alkalinity measurements were taken, but the values were below the limits of resolution (<5 mg/L).

Water Temperature

Temperatures recorded in the Lick Run study section during the seasonal surveys are shown in Table 2. The upper reaches of Lick Run are well shaded and temperatures recorded were well within the tolerable level for brook trout.

Spring 2005 main stem water temperatures through the middle of Lick Run were higher than those recorded during the spring of 2004. The snow pack during the winter of 2004/2005 and rainfall during the spring of 2005 were much lower than during the previous year. Lick Run flow was much reduced in the spring of 2005; consequently, average water temperatures were higher.

Table 2. Water Temperature Summary					
Measuring Point	**Spr/04**	**Sum/04**	**Fall/04**	**Win/05**	**Spr/05**
Panther Rocks Camp	**10 °C**	**15 °C**	**13 °C**	**3 °C**	**10 °C**
Above Doctors Fork	**10 °C**	**15 °C**	**10 °C**	**+0 °C**	**-**
Doctors Fork	**9 °C**	**15 °C**	**10 °C**	**+0 °C**	**14 °C**
Below Doctors Fork	**11 °C**	**15 °C**	**10 °C**	**+0 °C**	**14 °C**
SGL #90 Bridge	**10 °C**	**15 °C**	**10 °C**	**1 °C**	**16 °C**
Above Stone Run	**9 °C**	**14 °C**	**8 °C**	**2 °C**	**8 °C**

Water temperatures were also taken during other stream visits. The highest temperature recorded during the 18-month assessment period was 18°C (64°F), at 4:00 PM, on July 29, 2005, during the rod and reel survey. This was still well within the comfort level for brook trout. It was a warm sunny day and the stream was extremely low. The highest air temperature for the day was 27°C (81°F).

Silting

Because of the heavy forest cover, silting is almost non-existent in the upstream reaches of Lick Run. Some of the larger pools have silty or sandy areas along the sides and on the bottom, but these are not common. The stream bottom is comprised mostly of cobble, sand and gravel or bedrock. In many places bedrock has been exposed to form ledges and shelves both above and below the water. Areas where water velocity is especially high are often scoured down to bedrock.

CRYSTAL SPRING -The Other Lick Run Source

No study of the Lick Run headwaters would be complete without a discussion of Crystal Spring and the stream which originates above Crystal Spring. This stream and the outflow from Crystal Spring join at the now abandoned site of Crystal Spring Lodge, a once magnificent old restaurant built next to the outflow of its namesake spring. Its sylvan setting made it a popular eating place for area residents and their guests and a great place for hunters and anglers to get a meal. It burned to the ground on December 12, 1974 and was never rebuilt. It has now been taken back by nature, but is a reminder of ‘days-gone by’ to those who enjoyed a meal there and the peaceful surroundings that it once offered. The abandoned lodge and the surrounding area shown in the photos are privately owned.

Figure 2. Headwaters of Crystal Spring stream.

Figure 3. Ruins of Crystal Spring (upper center) and outflow (lower center/right)

Crystal Spring Stream, begins in a broad open area (Figure 2) north of Crystal Spring Road. It flows under Crystal Spring Road and down past the ruins of the Crystal Spring Lodge. Crystal Spring still flows strong and the ruins of the old spring house are still visible (Figure3).

Figure 4. The old pond is now occupied by beavers. Crystal Spring is visible just above the center of the photo.

Figure 5. All that remains of Crystal Spring Lodge is the water-filled foundation.

The outflow from Crystal Spring enters an old beaver dam (Figure 4) where a pond in front of the lodge once held trout for use in the restaurant. The area is now an open wetland. All that remains of the lodge is the cellar and foundation which are now filled with water (Figure 5).

The outflow from Crystal Spring joins Crystal Spring Stream just below the old lodge. Several smaller springs issue from the mountainside below the old lodge site and merge to form an extensive, thicketed wetland that adds significant water to the flow of Crystal Spring Stream. This all merges with Lick Run about a mile downstream from Crystal Spring road. By then Crystal Spring Stream is a significant source of water for the Lick Run main stem and about doubles the base flow. This stream is a potentially valuable monitoring site for the future.

THE STREAM AND ITS RIPARIAN AREA

The entire study section of the Lick Run main stem was walked, from the source just above Panthers Rocks Camp to the Stone Run confluence. The section from the source to

the SGL #90 bridge was surveyed on 4/20/05 and the section from the SGL #90 bridge to Stone Run on 4/26/05.

Survey data are shown in Table 3.

A map showing the assessment points of the study section is shown in Figure 6.
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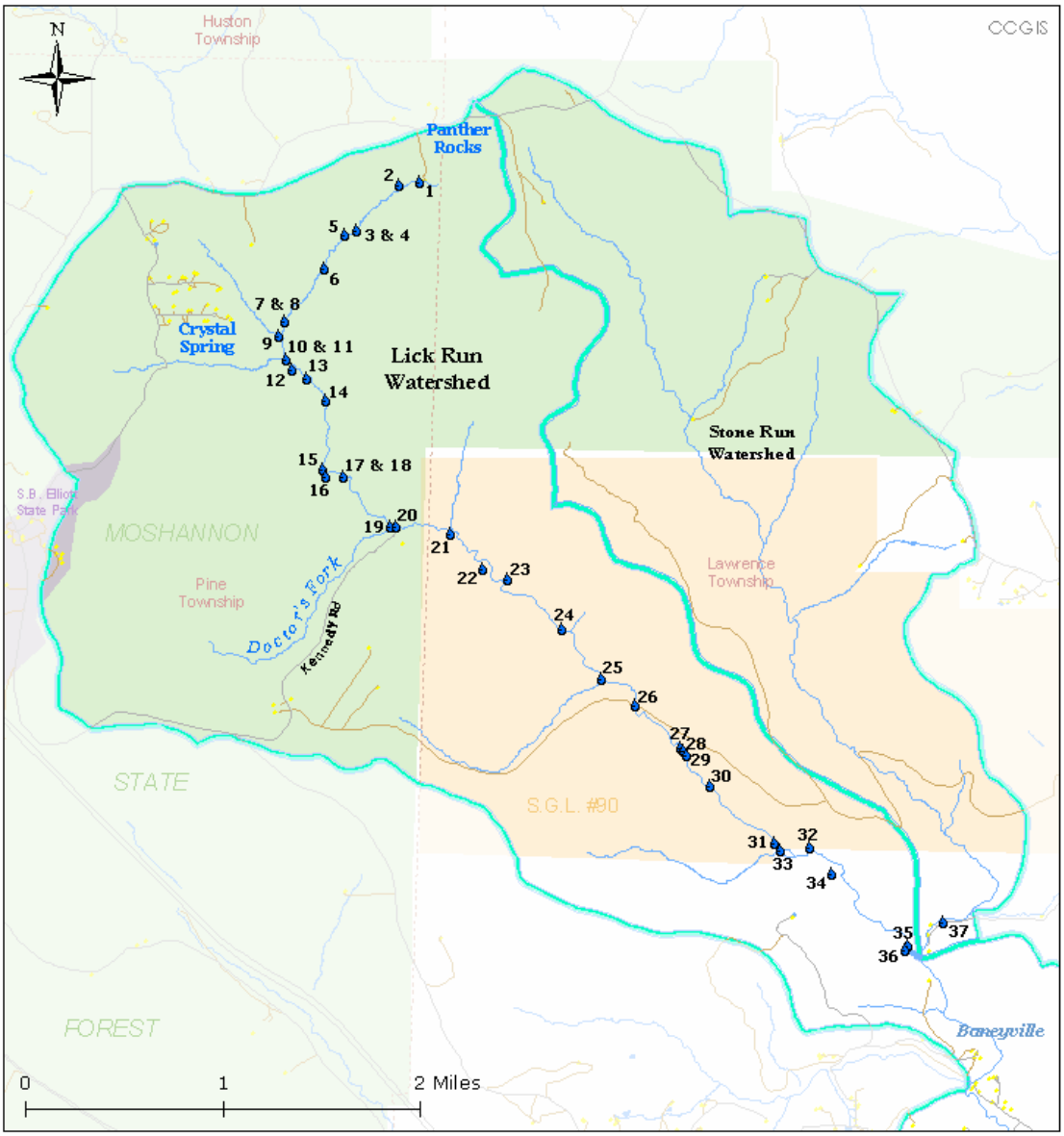
Table 3. Spring 2005 Stream-Walk Survey - Lick Run Main Stem, Tributaries, Springs And Seeps From Origin Above Panther Rocks Camp To Stone Run. (Points 1-25 were surveyed on 4/20/05; points 26 – 37 on 4/26/05.)

Point	*Description*	*Latitude*	*Longitude*	*pH*	*T (°C)*	*Observations*
1	**Lick Run at Panther Rocks Camp**	**41 08 21**	**78 29 15**	**4.4**	**10**	**Flow very low; no invertebrates**
2	Two Springs (east side)	41 08 20	78 29 22	4.2	9 & 12	Est. total 15 gpm
3	Small tributary (east side)	41 08 08	78 29 37	4.5	8	Est 50 gpm
4	**Lick Run ~ 0.44-mi below P.R. Camp**	**" " "**	**" " "**	**4.2**	**12**	**Few caddis & black fly larvae**
5	Tributary (west side)	41 08 07	78 29 41	4.1	15	~5 gpm; ½" slate gray stone flies
6	**Lick Run ~ 0.72-mi below P.R. Camp**	**41 07 58**	**78 29 48**	**4.3**	**13**	**Stone fly and caddis larvae**
7	Spring (west side)	41 07 44	78 30 02	5.4	10	
8	Spring (west side)	" " "	" " "	4.4	11	Perlid stone fly larva
9	Tributary above Crystal Spring stream	41 07 40	78 30 04	4.5	14	Caddis & stone fly larvae
10	**Lick Run just above Cry. Spr. stream**	**41 07 34**	**78 30 01**	**4.4**	**14**	
11	Crystal Springs stream at mouth	" " "	" " "	4.3	15	1.24-mi below Panther Rocks Camp
12	**Lick Run ~ 0.1-mi below Cry. Spr. Str.**	**41 07 31**	**78 29 59**	**4.3**	**14**	
13	Tributary/springs/seeps/spl. dam (east)	41 07 29	78 29 54	6.1	13	~ 100gpm
14	Tributary (east side)	41 07 23	78 29 97	4.4	12	~30 gpm
15	Significant Tributary (east side)	41 07 05	78 29 48	4.5	11	~150 gpm; s. fly & caddis larvae
16	Small tributary (west side)	41 07 03	78 29 47	5.1	10	Stone fly larvae
17	**Lick Run ~ 0.39-mi above Dr. Fork**	**41 07 03**	**78 29 41**	**4.7**	**15**	
18	Sm. Tributary to Dr. Fork. at mouth	" " "	" " "	5.8	15	
19	Dr. Fork at mouth	41 06 50	78 29 24	5.7	14	
20	**Lick Run below Dr. Fk & beaver dam**	**41 06 50**	**78 29 22**	**5.0**	**14**	
21	Tributary ~ 0.31-mi below Dr. Fk (east)	41 06 48	78 29 03	5.2	13	
22	Tributary ~ 0.59 -mi below Dr. Fk (west)	41 06 39	78 28 52	6.2	13	
23	Tributary/spr above SGL N. bndry (east)	41 06 36	78 28 43	5.7	12	Caddis and stone fly larvae
24	Tributary/spr above SGL brdg (west)	41 06 23	78 28 24	6.4	11	
25	Mouth trib parallel to SGL 90 road (west)	41 06 10	78 28 12	5.0	13	
26	**Lick Run at SGL 90 bridge**	**41 06 03**	**78 27 58**	**5.3**	**16**	
27	Spring at ATV trail crossing	41 05 52	78 27 42	6.3	10	~20 gpm
28	Spring below ATV trail crossing	41 05 51	78 27 41	6.1	10	~2 gpm
29	Small spring (west side)	41 05 50	78 27 40	6.3	10	~5 gpm
30	**Lick Run at big rocks**	**41 05 42**	**78 27 32**	**5.5**	**9**	
31	**Lick Run at SGL 90 So. boundary**	**41 05 27**	**78 27 09**	**5.6**	**10**	
32	Spring seep (east side)	41 05 26	78 26 57	6.3	12	
33	Tributary at SGL 90 So. Boundary	41 05 25	78 27 07	5.3	11	~400 gpm
34	Small tributary (west side)	41 05 19	78 26 49	5.8	9	~30 gpm
35	**Lick Run just above Stone Run**	**41 05 00**	**78 26 22**	**5.6**	**12**	
36	Spring just above Stone Run (west side)	41 04 59	78 26 23	5.2	10	~50 gpm
37	Stone Run just above confluence w/L.R.	41 04 58	78 26 10	5.5	11	

Photos, pH measurements of the main stem, tributaries, springs and seeps were taken, estimates of the flow rates of these various inflows were made, benthic invertebrates seen along the way were recorded and other observations were made along the way.



Map by Chuck Failing IV, Clearfield County GIS

Figure 6. The study section of Lick Run showing assessment points from the headwaters at Panther Rocks Camp to the confluence with Stone Run**.** (Points 1-25 were surveyed on 4/20/05; points 26 – 37 on 4/26/05.)

pH Observations

Considerable differences in pH of the various tributaries and especially springs and seeps entering the Lick Run main stem were observed. The first major deviation in pH from that of the main stem was seen in a small spring entering from the west side of Lick Run (P7) about 0.75-mile below Panther Rocks Camp. The main stem pH here was 4.3 and that of the spring 5.4. Another spring entering from the same side and just downstream (P8) had a pH of only 4.4. Both of these springs had very low flow rates, so even combined they had little effect on the main stem pH.

A significant flow of higher pH water enters the main stem from the east (P13) a short distance below where Crystal Spring Stream enters Lick Run from the east. What appears to be an old splash dam acts as a basin which gathers water from the outflow of several springs and seeps coming in from the east. This forms a modest stream with a total flow estimated to be about 100 gpm and a pH of 6.1.

Further down, a small tributary entering Lick Run from the west (P16) had a pH of 5.1, which also helped to boost the pH of the main stem. The main stem pH a short ways above Doctors Fork (P17) was 4.7.

A very interesting little tributary enters Doctors Fork at the mouth (P18). It issues from the mountain about a half mile above Doctors Fork and had a pH of 5.8. The pH of Doctors Fork just above this tributary (P19) was 5.7.

A short distance below Doctors Fork (P20) the Lick Run main stem pH was 5.0. The influence of the little tributary at the mouth of Doctors Fork and the flow from Doctors Fork apparently has a strong influence on the pH of the Lick Run main stem. This appears to be a critical point in the Lick Run watershed. This is where fish life finally seems to appear. No brook trout were seen much above where Doctors Fork enters Lick Run.

A few small tributaries, springs and seeps enter Lick Run between Doctors Fork (P20) and the SGL #90 bridge (P26) which had pH values ranging from 5.2-6.4. There is a fairly good sized tributary which flows down parallel to the SGL #90 road and enters Lick Run about a quarter-mile above the SGL #90 bridge (P25). It had a pH of 5.0. All of this together boosted the main stem pH of Lick Run to 5.4-5.5 at the SGL #90 bridge.

Below the SGL#90 bridge main stem pH rose steadily and peaked at 5.6 just above the Stone Run confluence (P36). The reason was obvious: many springs and seeps entered which had pH values in excess of 6. The pH of Stone Run was 5.5 just above its confluence with Lick Run (P38).

Rainfall in the spring of 2005 had been very light and therefore flow rates were very low. Many springs that were flowing heavily in the spring of 2004 were scarcely flowing in 2005. The main stem flow of Lick Run was more like one would expect in the early summer and almost certainly represented base flow conditions.

Panther Rocks Camp to Doctors Fork

Figure 7. The source of Lick Run. A small spring just above Panther Rocks camp

Figure 8. Donna Carnahan sampling water at Panther Rocks site..

A small spring just above Panther Rocks Camp marks the geographical source of the Lick Run main stem (Figure 7). This spring issues from the ground about a half-mile west of the source of Stone Run, the major tributary of Lick Run and lower end of the study section.

An old bridge below the Panther Rocks Camp (Figure 8) was the uppermost site where Lick Run main stem measurements where taken. The stream is very small in this area and nearly dries up most summers. Little life was observed here, neither during the stream walk nor during the fall 2004 and spring 2005 benthic invertebrate surveys.

Figure 9. Looking upstream toward Panther Rocks Camp.

Figure 10. Farther downstream the forest begins to close in.

As one progresses downstream stream, flow increases rapidly and significant pools begin to appear. A small tributary enters from the east and adds considerable flow to the main stem. The riparian area for the first half-mile below Panther Rocks Camp is very open (Figure 9). There is almost no shading of the stream in this section. A lot of boggy sphagnum seeps on either side of the stream add to the flow. A little farther downstream the riparian border becomes tree-covered (Figure 10).

Figure 11. As the trees crowd in, woody debris forms pools.

Figure 12. As slope increases, large rocks create waterfalls and plunge pools.

As trees crowd in toward the stream, major pools formed by woody debris appear (Figure 11). About half-way down to Crystal Spring Stream the slope increases and rocks form a series of falls and pools (Figure 12).

Figure 13. Confluence of Crystal Spring Stream (far left) and Lick Run (2 braids on right)

Figure 14. Remains of an old splash dam. Lick Run flows behind bank on left.

A small tributary enters the main stem about a quarter-mile above the confluence of Lick Run and Crystal Spring Stream. Below the confluence of Lick Run and Crystal Spring Stream (Figure 13) flow is about doubled by the inflow from these two tributaries.

A short way below the confluence with Crystal Spring Stream there is what appears to be an old splash dam along the east side of the Lick Run main stem (Figure 14). The main stem bypasses this old dam on the western side. The dam itself has long since washed out, but there is an approximately 2-acre basin where it once stood. Along the ridge side to the east (right side of photo) there is a series of seeps and springs with a pH of 6.1 and a total flow of about 100 gpm. This is the only significant flow of higher pH water that appears to enter the main stem of Lick Run between Crystal Spring Stream and Doctors Fork.

About half-way between the old splash dam and the confluence with Doctors Fork there is a tributary entering from the east with a pH of 4.5 and flow estimated to be about 150 gpm. There are also several springs and seeps.

Figure 15. Typical pool and riffles series between Crystal Spring stream & Dr. Fork

Figure 16. Big rocks and pool about a half-mile above Doctors Fork.

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The stream morphology from Crystal Spring Stream to Doctors Fork is mostly one of riffles and pools formed by large woody debris and large rocks (Figures 15 & 16). The quarter-mile section above Doctors Fork is flat and featureless, with shallow riffles and poor habitat.

Doctors Fork to SGL #90 Bridge

Brook trout begin to appear at the confluence of Lick Run and Doctors Fork. There is a broad basin at the confluence of the two streams and an abundance of springs and seeps. Apparently, they add just enough buffering to Lick Run so that brook trout can survive and reproduce from here downstream. From here to Stone Run, Lick Run is a beautiful wilderness stream with riffles and pools, magnificent scenery and enough brook trout to make fishing it a pleasurable way to spend the day.

Figure 17. Doctors Fork looking upstream from LickRun, Note how the grass is flattened from high water flows.

Figure 18. Tiny tributary flowing into Dr. Fork at the confluence with Lick Run. It has elevated pH and holds lots of brook trout.

Doctors Fork is a major tributary entering from the west (Figure 17). There is an interesting little tributary (Figure 18) that enters Doctors Fork at the confluence with Lick Run. It originates about a half mile above Doctors Fork at the base of the mountain that divides Doctors Fork and Lick Run. It maintains its flow throughout the year, has a pH averaging about 5.8 and it is full of brook trout. Brook trout were seen spawning here in the fall of 2004.

Figure 19. Abandoned beaver dam at confluence of Doctors Fork and Lick Run.

Figure 20. Abutment was to have been where Kennedy Road crossed Lick Run.

There is a recently abandoned beaver dam at the confluence of Lick Run and Doctors Fork (Figure 19). Except for the mid-winter survey, brook trout of several age classes were observed all through this area every time it was visited.

Just below Doctors Fork there is an old bridge abutment (Figure 20). The abutment was built by the CCC according to a plaque cemented into the stone and dated 1941. Kennedy road, which ends here at Lick Run, was to have crossed the stream at this point and continued on. The project was abandoned whenever the CCC was disbanded at the outbreak of WWII.

From Doctors Fork to the SGL #90 bridge, Lick Run has a shallow gradient. Hurricane Ivan carved out many nice pools, undercut tree roots and the bank, forming excellent

Figure 21. Undercut tree roots form a glide-pool between Doctors Fork and the SGL #90 bridge.

Figure 22. Overhanging rhododendron provides shade and cover in the summer and a beautiful setting in early-July.

cover for brookies in this section (Figure 21). New pools were formed by woody debris and rock bars were piled up by the massive flooding. Rhododendron along the banks helps to shade the stream during the summer and provides cover (Figure 22) in some places.

SGL #90 Bridge to SGL # 90 So. Border

Figure 23. The bridge where the SGL #90 road crosses Lick Run.

Figure 24. Carl Undercofler sampling water just below SGL #90 bridge.

From the SGL # 90 bridge (Figure 23) to the SGL #90 southern border is some of the prettiest water in the stream. Just below the SGL #90 bridge there is a flat sinuous section with several nice pools (Figure 24).

Figure 25. Very large pool below SGL #90 bridge marks the beginning of a high-gradient stretch of Lick Run.

Figure 26. Lower end of a long, boulder-strewn stretch with deep step pools on SGL #90.

Progressing downstream, the stream gradient increases significantly. The pool at the top of this stretch is perhaps the largest in the assessed section (Figure 25). It marks the beginning of a long, relatively pristine stretch extending all the way downstream to the southern boundary of SGL #90. A quarter-mile long rocky section lies within the middle of this wilderness. Here big boulders form deep pools and the stream is heavily shaded (Figure 26). This section ends about a half-mile above the SGL #90 southern boundary.

Figure 27. A long flat stretch near the Southern SGL #90 border.

Figure 28. Large woody debris forms a nice pool above and plunge pool below.

The stream flattens near the SGL # 90 southern boundary (Figure 27). Here some really nice pools are formed by large woody debris. The water backed up behind these pools and plunge pools formed below the jammed logs (Figure 28) provide excellent cover for brook trout and other aquatic life.

A small tributary enters from the west near the SGL #90 southern border. It does not appear to hold trout.

SGL #90 So. Border to Stone Run

Figure 29. An ATV trail (on private land) turns uphill to left. SGL #90 southern boundary is just beyond view at top right.

Figure 30. A large pool not far below the the SGL # 90 southern boundary

Lick Run is still relatively wild through the mile-long privately–owned section from SGL #90 to the Stone Run confluence. It has some nice pools and plenty of good habitat.

Signs of human disturbance begin to appear not far below the SGL #90 southern border. An ATV trail parallels Lick Run from below the confluence with Stone Run upstream to the SGL #90 southern border (Figure 29). Until a couple of years ago this trail extended upstream all the way to the SGL #90 bridge. Activity appears to have ceased on the SGL #90 section of the ATV trail during the last couple of years. Lick Run is still relatively unaffected by human activity, however, with plenty of good holding water (Figure 30).

Figure 31. An old hemlock stump is a reminder of the logging era that ended here some one-hundred years ago.

Figure 32. The confluence of Lick Run (center/left) and Stone Run (center/right), mark the downstream extent of the study section.

Here and there an old hemlock stump (Figure 31) still stands as a reminder of the logging era that absolutely devastated the forests of Pennsylvania a hundred years ago.

The bottom end of the study section ends at the confluence of Stone Run and Lick Run (Figure 32) about a mile below the SGL #90 southern border.

From its confluence with Stone Run, Lick Run flows another 5 miles before reaching the West Branch of the Susquehanna. Except for the short section that runs through Baney Settlement, it is relatively undeveloped. The author has fished this stretch of Lick Run since the early-1950s. From Stone Run to about a 0.37-mile below the SR 1006 bridge there has always been a substantial population of native brook trout. At this point a tributary comes in from the west that appears to be influenced by AMD and lifeless. It has been as long as I have been fishing Lick Run. Other small tributaries enter from the east and they too appear to be affected by AMD. However, an occasional brook trout can be caught in this AMD affected section all the way to the West Branch of the Susquehanna.

BENTHIC INVERTEBRATE SURVEYS

Two surveys were conducted, one in the fall of 2004 and the other in the spring of 2005 to determine the extent of benthic invertebrates in the study section of Lick Run. The protocol utilized for collecting, counting and classifying invertebrates was from the Pennsylvania Volunteer Water Quality Monitoring Field Manual used by the Pennsylvania Senior Environmental Corps.

Invertebrates were collected using a 1-meter square net. The stream section to be sampled was chosen and the net held to the bottom with rocks. Then the area above the net was thoroughly kicked in order to dislodge benthic invertebrates (Figure 33) which washed downstream and collected in the net. After the area was thoroughly scoured the net was removed from the water, the invertebrates sorted out (Figure 34) and collected in partitioned trays (Figure 35). Species and numbers present were counted and recorded. Two kick samples were collected at most sites.

Fall 2004

Benthic survey data collected from October 6 – 12, 2004 are shown in Table 4. The protocol used for macroinvertebrate sampling is from the Pennsylvania Senior Environment Corps manual approved by EPA. Macroinvertebrates were identified according to a chart adopted by the PA DEP for Watershed Snapshot from the University of Wisconsin-Extension. Macroinvertebrates are given a sensitive, facultative or tolerant ranking and counted. Sensitive taxa are multiplied by three; facultative by 2 and tolerant by one. These figures are then added up. If the sum is less than 11 and there are no sensitive taxa the stream is considered poor; if 11-16 and 1 sensitive taxa is present the stream is fair; if 17-21 and 2 or 3 sensitive taxa are present the stream is good; if 22-26 and 4 sensitive taxa are present the stream is very good and over 27 with 5 or more sensitive taxa present the stream is excellent.

Figure 33. Carl Undercofler kicks the bottom, dislodging benthic invertebrates which wash downstream and are collected in the net held by Donna Carnahan.

Figure 34. The collected organisms are separated from the debris and placed in trays.

Figure 35. Trays of collected benthic invertebrates ready for species identification and counting.

Hurricane Ivan had been through the area about three weeks before the fall survey was conducted. Its effects were obvious. Stream level had been two to three feet above normal. Massive movement of the streambed was evident. Trees and rocks had been washed downstream and deposited forming large bars and deep pools. In places banks and tree roots were undercut and uprooted forming excellent habitat for brook trout. By the time of the survey, Lick Run and its tributaries were back to base flow.

Lick Run at Panther Rocks Camp: Stream pH was 4.1 and flow was very low in spite of the recent heavy rains. Alderfly larvae (2) and Crayfish (1) were collected.

Crystal Spring: The pH of Crystal Spring where it issues from the hill was 4.7. Macros were collected further downstream, below the confluence of the Crystal Spring outflow and the stream that flows past the old lodge site. Stream pH was 4.8. A few dragonfly larvae and midge larvae were collected along with one alderfly and one free-living caddis fly larva.

Lick Run above Dr. Fork: Stream pH was 5.5. This is where, progressing downstream, brook trout first begin to appear. The predominant macro-invertebrate present was, by far, what appeared to be a single species of stonefly larvae (125). The next most predominant species was net-spinning caddis (52). Crane fly larvae (2), alderfly larvae (5) and crayfish (1), were also collected.

Lick Run Below Dr. Fork: Stream pH was 6.1. Stone fly larvae were still the predominant species (40). Net-spinning caddis fly larvae (22) were the next most

numerous. Alderfly larvae (2) were the only other species of macro-invertebrates collected at this site.

Lick Run at SGL #90 Bridge: Stream pH was 5.7. Stonefly larvae (44) and net-spinning caddis fly larvae (45) were present in about equal numbers. Also observed were aquatic worms (2) and midge larvae (3).

Lick Run above Stone Run: Stream pH was 6.9. Stonefly larvae (83) were still the predominant species. Net-spinning caddis larvae (53) were the next most common species. This site, located about a hundred yards above the confluence with Stone Run, was the first place that mayfly larvae (7) were observed in the fall 2004 survey. A free-living caddis was counted along with alderfly larvae (8) and an aquatic worm.

Table 4. Fall 2004 Benthic Invertebrate Survey

Survey Site (Date)	*Species*	*No.*	*pH*	*Cond.*	*T (ºC)*	*Water Quality Rating*
Lick Run at Panther Rocks (Oct. 6, 2004)	Alder Fly Larvae Crayfish	2 1	4.1	40	13	7.6 - Poor
Crystal Spring* (Oct. 12, 2004)	Dragonfly larvae Midge larvae Alderfly larvae Caddis (free)	3 2 1 1	4.8	30	10	Poor
Lick Run Above Dr. Fork (Oct. 6, 2004)	Stonefly nymphs Caddis (net) Cranefly larvae Alderfly larvae Crayfish	125 52 2 5 1	5.5	30	10	18.3 - poor
Lick Run Below Dr. Fork (Oct. 6, 2004)	Stonefly nymphs Caddis larvae (net) Alderfly larvae	40 22 2	6.1	30	10	14.6 - poor
Lick Run at SGL #90 Bridge (Oct. 12, 2004)	Stonefly nymphs Caddis larvae (net) Aquatic worms Midge larvae	44 45 2 3	5.7	30	10	10.2 - poor
Lick Run Above Stone Run (Oct. 6, 2004)	Stonefly nymphs Caddis larvae (net) Mayfly nymphs Caddis (non-net) Alderfly larvae Aquatic worms	83 53 7 1 8 1	6.9	30	8	23.4 - fair

* Taken in stream downstream from springs and old lodge and after mixing with stream that flows past Crystal Springs.

Spring 2005

Benthic survey data collected from May 5 - 11, 2005 are shown in Table 5. Stream levels were low for this time of year as the winter snow pack had been light and spring rains were light to moderate.

Lick Run at Panther Rocks Camp: Stream pH was 4.2. Stream level was extremely low. The stream was clogged with long, filamentous, green algae. No benthic invertebrates were collected.

Crystal Spring: Stream pH was 4.3 below the confluence of the Crystal Springs outflow and the stream that flows past the old lodge site. The stream was full of the same filamentous, green algae observed at the Panther Rocks site. Only 1 stonefly larva and 1 free-living caddis larva were collected.

Lick Run above Dr. Fork: Stream pH was 5.2. As in the fall 2004 survey, a single species of stonefly was, by far, the dominant species (200+). Net-spinning caddis larvae (50) and blackfly larvae (36) were also present in good numbers; midge larva (3) and crayfish (5) were also collected.

Dr. Fork at mouth: (This site was not sampled during the fall 2004 survey.) Stream pH was 5.0. Blackfly larvae (60) predominated; stonefly larvae were the next most predominant (40) and net spinning caddis (30) the third most predominant species. Midge larvae (3) and crayfish (3) were also observed, along with a single aquatic worm.

Lick Run Below Dr. Fork: Stream pH was 5.4. Stonefly larvae (100+ Leutridae and Peltoperlidea) were, by far, the predominant species observed. Net-spinning caddis (25, green Polycentropedidae and Hydropsyidae) and blackfly larvae (30) were present in significant numbers. A few free-living caddis larvae (2), fishfly larvae (3) and crayfish (2) were counted.

Lick Run at SGL #90 Bridge: Stream pH was 5.2. Stonefly larvae (100+) were again the predominant species. Net-spinning caddis (50) were also present in significant numbers. Midge (2), mayfly (2, Siphlonuridae and Ephemerellidae), stick-caddis (2, Limnephilidae and Glossosomalidae), fishfly (2), and blackfly (2) larvae and crayfish (6) were collected. This was the farthest upstream that mayfly nymphs were observed.

Lick Run above Stone Run: Stream pH 5.6. Stonefly (100+ Perlidae, Leutridae, Capnidae and Peltoperlidae) and caddis fly (100+, Hydropsychidae and Polycentropodidae) larvae were present in large and approximately equal numbers. Dobsonfly larvae (4), cranefly larvae (1), fishfly larvae (6) and blackfly larvae (5), and crayfish (9) were also collected.

Table 5. Spring 2005 Benthic Invertebrate Survey

Site (Date)	*Species*	*No.*	*pH*	*Cond.*	*T (ºC)*	*Water Quality Rating*
Lick Run at Panther Rocks (May 11, 2005)	None – green filamentous algae	0	4.2	40	13	<20 - Poor
Crystal Spring* (May 9, 2005)	Stonefly larvae Caddis (non-net)	1 1	4.3	40	13	10.0 - poor
Lick Run Above Dr. Fork (May 11, 2005)	Stonefly larvae Caddis (net) Blackfly larvae Midge larvae Crayfish	200+ 50 36 2 5	5.2	30	16	14.2 - poor
Dr. Fork at mouth (May 11, 2005)	Stonefly larvae Caddis larvae (net) Blackfly larvae Midge larvae Aquatic worms Crayfish	40 30 60 3 1 3	5.0	20	16	15.7 - poor
Lick Run Below Dr. Fork (May 11, 2005)	Stonefly larvae Caddis larvae (net) Blackfly larvae Caddis (non-net) Fishfly larvae Crayfish	100+ 24 30 2 3 2	5.4	30	15	21.2 - fair
Lick Run at SGL #90 Bridge (May 09, 2005)	Stonefly larvae Caddis larvae (net) Midge larvae Mayfly nymphs Caddis (stick) Fishfly larvae Blackfly larvae Crayfish	100+ 50 2 2 2 1 4 6	5.2	30	15	27.5 - fair
Lick Run Above Stone Run (May 5, 2005)	Stonefly larvae Caddis (net) Dobsonfly larvae Cranefly larvae Fishfly larvae Blackfly larvae Crayfish	100+ 100+ 4 1 6 5 9	5.6	-	-	24.1 - fair

***** Taken in stream downstream from springs and old lodge and after mixing with stream that flows past Crystal Spring.

BROOK TROUT

Native brook trout were observed in the main stem of Lick Run below Doctors Fork any time the stream was visited during the spring, summer and fall. The only time they were not seen was during the winter. Past angling experiences and a rod and reel survey

showed them to be present in good numbers from Stone Run to Doctors Fork. But Doctors Fork seems to be the upper end of their range in Lick Run

Reproduction

Most male brook trout are fertile by the end of the second summer of life and almost all will be fertile by the end of the third summer. Some females are capable of spawning by the second fall but most will not become sexually mature until the fall of the third year of life.

Smaller females lay smaller and considerably fewer eggs than larger females. The eggs of larger females, because they are larger, produce larger fry. Larger fry have a head start in the struggle for survival, especially when food is scarce and conditions are less than favorable.

First the female brook trout finds a suitable spot for her redd. Preferred are places where water wells up from the bottom, which keeps the redd free of silt and prevents freeze-out in the winter. Redds are often located at the tail-out of a pool where water is pushed up through the gravel by the current. Upwelling springs are also favored, and brook trout are exceptionally good at finding these places; they can detect the tiniest difference in water temperature.

The female brook trout excavates a redd by turning on her side and rapidly undulating her body. This sweeps silt and debris from the area so the eggs will be able to infiltrate down between the small rocks and gravel of the bottom. After the redd is completed the female squats down in the middle and the male moves in beside her. As she deposits her eggs he presses up against her and extrudes his milt. The eggs are fertilized as they fall to the bottom and filter down into the gravel. When done, the female moves upstream just above the redd and, using the same undulating movements she used to clear the redd, sweeps gravel down over the redd and covers the eggs a few inches deep. The eggs slowly develop through winter and hatch in late February or early March.

Upon hatching, each tiny brook trout has a yolk sac attached to its belly. They stay in the redd for a few weeks and are nourished by the egg sac. When it is gone, they wiggle up through the gravel and emerge as 0.8-inch long fry. They move into sheltered pockets along the shore and into small stream braids. Here they are out of the strong currents of the main stem and, more importantly, relatively safe from larger brook trout and other hungry creatures that will quickly make a meal of them if given the opportunity. These troutlings eat plankton and the tiniest of creatures and grow rapidly. As they grow, they will move into larger water and by the end of the summer are about 3 inches in length. But few, typically one or two percent, will survive the first 9 months of life.

Spawning in Lick Run

A pair of spawning brook trout was photographed in Lick Run in mid-October of 2004. The female, about 8 inches in length, had selected a site for her redd just below the SE

corner of the SGL #90 bridge, in about two-feet of water (Figures 36 and 37). The slightly larger male stayed just behind and to the side as she prepared the redd. This was the best vantage point for him to keep sight of her and to make sure no other males intruded in this process. Surprisingly, both took something from the surface during preparation of the redd.

It was obvious the following spring that brook trout in Lick Run had successfully reproduced during the fall and winter of 2004/2005. Many newly-hatched brook trout were visible in the shallows along the edges of the main stem and in small stream braids the spring of 2005 (Figure 38). Young–of-the-year brook trout were present from the confluence of Stone Run to Doctors Fork throughout the spring and summer of 2005. No young of the year brook trout were observed above Doctors Fork or in Doctors Fork. Adult brook trout were seen in Doctors Fork.

Figure 36. Brook trout on the redd. The male is the larger fish visible in the upper center above the smaller female. Both are hovering over a nearly finished redd that the female is in the process of completing in preparation to spawning.

Figure 37. The female (center/right) rapidly undulates her body in order to sweep the redd clear of silt and other debris before depositing her eggs. The male waits behind until the redd is ready.

Figure 38. A newly-hatched brook trout (circled). The hatchling brookie is on the left and his slightly larger shadow to the right. The edges of the stream and small braids were full of these newly hatched brookies during the spring of 2005.

Rod-and Reel Survey

This survey was not meant to be a measure of the total biomass of brook trout in the stream, nor is that claim made. Larger fish were targeted by fishing the better-appearing lies in the stream; consequently, smaller fish were less likely to be captured. Higher percentages of larger fish were therefore observed during the rod-and-reel survey than would be expected in an electroshocking survey. Biomass data observed during the 1996 survey of Lick Run by Hollender [5] and summarized on Page 3, are representative of the biomass of native brook trout in the study section at that time.

The rod-and-reel survey does, however, give one a good picture of what can be expected when fishing small, infertile mountain streams like Lick Run. The author fishes not only Lick Run, but several other similar freestone streams in Clearfield County. The size distribution and number of brook trout captured in this survey were typical.

Flies with the barbs crimped down to facilitate release were used. The total length of each fish was measured to the nearest millimeter and recorded. All were released.

No species of fish other than brook trout was caught or observed.

Evidence of Angling pressure in Lick Run has been observed in the past. Although none was taken during this survey, hook damaged fish have been encountered as far upstream as the SGL #90 bridge. There is also considerable anecdotal evidence of angling pressure in the Stone Run area and near the SGL#90 bridge. The access road is gated at the top of the hill at the SGL #90 parking lot and the stream is accessible to anglers willing to make the mile-long hike down and back up the hill. The stream is also accessible at the end of Kennedy Road by 4-wheel drive vehicles and ATVs.

Lick Run from the confluence of Crystal Spring stream to Doctors Fork (1.1 mile) was fished during the summer of 2004. Two brook trout were observed: one of 190mm, caught about ¼-mile above Doctors Fork, and another of similar size hooked and lost 100 feet farther upstream. From there to Crystal Spring Stream, no fish of any species was seen or captured.

Lick Run from Doctors Fork to Stone Run (3.6 miles) was fished during the summer of 2005. Brook trout of all age classes were caught throughout the entire reach. Photos were taken of typical specimens (Figures 39 - 42).

Figure 39. A Lick Run brookie in early August of the first year of life is about 66mm (2.6 inches) long. They grow fast at this age, but few survive the first year of life.

Figure 40. By the third summer of its life a Lick Run brookie would be about144mm (5.7 inches long).

Figure 41. By the fourth summer of life Lick Run brookies have grown to about 170mm (6.7 inches) like this one. Some brookies this old might be of legal size (7 inches).

Figure 42. A Lick Run brookie of 243mm (9.6 inches) like this one would be at least 5 and probably 6 or more years old. Growth is slow in these infertile mountain freestones...brookies 9 inches or longer are a rare prize.

Size Distribution of Brook Trout: The smallest brook trout caught during the rod-and-reel survey was 66mm and the largest 243mm in length.

The preponderance of larger specimens (>178mm) were caught in the more remote areas of the study section, between Doctors Fork and the SGL #90 southern boundary (~2.6 miles). Here, 46% of the brook trout caught (N=46) and measured exceeded the legal minimum size limit.

Only 17% of the brook trout caught (N=35) between the SGL #90 southern boundary and Stone Run (~1mile), exceeded 178mm. This is attributed to some degree of angling pressure in the more accessible water in the lower reaches of the study section.

CONCLUSIONS

The Study Section of Lick Run in General:

- Is a forested, picturesque wilderness with few signs of human disturbance from the sources at Crystal Spring and Panther Rocks Camp to the Southern boundary of SGL #90.
- Access by motor vehicles is limited to: Panther Rocks Camp, Crystal Spring, Doctors Fork (4-wheel drive), SGL #90 parking lot (walk-in) and Stone Run (privately owned).
- Water temperatures and habitat are suitable for brook trout throughout the entire year from about a half-mile below each of its primary sources at Crystal Spring and Panther Rocks Camp to Stone Run.
- Silting is almost non-existent.
- Benthic invertebrates present are primarily black flies, a few species of small stone flies and caddis; pollution intolerant mayfly species are scarce and only begin to appear downstream of Doctors Fork at the SGL #90 bridge.
- On average, pH of the Lick Run main stem increases progressing downstream all the way to the confluence of Stone Run; however, there are pockets of reduced pH where low-pH springs and tributaries enter the main stem.
- The pH of inflowing tributaries and springs is highly variable and, on average, increases progressing downstream

Lick Run Main Stem from Panther Rocks Camp to Doctors Fork:

- Starting about a half-mile below the source has excellent habitat comprised of riffles and pools formed by large rocks and large woody debris.
- Contains few brook trout and shows no signs of natural reproduction.
- Has been degraded by acid precipitation to the point where even the relatively acid-resistant brook trout cannot survive and reproduce.
- Has only a few species of benthic invertebrates: primarily black flies, small stone flies, caddis and no mayflies.

Lick Run Main Stem from Doctors Fork to the SGL # 90 bridge:

- Holds a low-level, but fishable, population of naturally reproducing native brook trout.
- Is fairly low-gradient with plenty of cover including undercut banks, large woody debris and a few pools formed by large rocks.
- Benthic life increases: mostly small stoneflies caddis and blackflies; a few mayflies are present at the SGL #90 bridge.

Lick Run from SGL # 90 bridge to Stone Run:

- Holds a good population of naturally reproducing native brook trout up to 243mm.
- Has some of the best habitat in the study section, which includes a high-gradient section in the middle with large rocks and deep pools.
- Becomes low-gradient at the southern SGL# 90 boundary with large woody debris and occasional large rocks that form deep pools and excellent holding water.
- Has an ATV trail on the privately-owned section between SGL #90 and Stone Run and there are some signs of human disturbance.
- It is, however, still relatively undisturbed between SGL #90 and Stone Run.

RECOMMENDATIONS

- An acid precipitation remediation plan for the headwaters of Lick Run above Doctors Fork should be developed.

- Any acid precipitation remediation plan should include provisions to minimize physical changes to the stream and its riparian border in order to preserve the wilderness nature of the area.

- The section of the Lick Run main stem from Doctors Fork to Stone Run should be preserved as a wild brook trout fishery.

- Hatchery trout, including hatchery brook trout, should not be reintroduced into Lick Run in order to protect the wild brook trout population from the well-known detrimental effects of stocking over wild trout populations and introgression of undesirable characteristics into the wild brook trout population.

- Lick Run, from the confluence of Doctors Fork to Stone Run, should be considered for addition to the Brook Trout Enhancement Program.

- If the upstream section of Lick Run main stem above Doctors Fork can be restored, it too should be added to the Brook Trout Enhancement Program.

- The upper reaches of Lick Run should be monitored for many years into the future in order to determine how the stream is responding to changes in the

amount of acid precipitation over time and the potential beneficial effects of acid precipitation remediation work that may be done in the headwaters.

- The landowners on the privately owned section between the SGL#90 southern boundary and Stone Run should be encouraged to protect the stream and its riparian border in its relatively unimpaired state.

- The lower reaches of Lick Run from Stone Run to the West Branch of the Susquehanna should be assessed and recommendations made as to how best restore and protect water quality and habitat there. This larger and potentially more fertile section, where native brook trout still exist, could be improved tremendously if the AMD problems below SR1006 were mitigated and the relatively undisturbed riparian zone is preserved in its current state.

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