Letort Spring Run

Coldwater Conservation Plan

Route 34 to Interstate-81

Photo credit: Neil Sunday

Plan Prepared by:

Cumberland Valley Trout Unlimited

&

Cumberland County Conservation District

CUMBERLAND VALLEY TROUT UNLIMITED

CUMBERLAND COUNTY CONSERVATION DISTRICT

COLDWATER HERITAGE PARTNERSHIP

Index

This Project was financed in part by a grant from the Coldwater Heritage Partnership on behalf of the PA Department of Conservation and Natural Resources (Environmental Stewardship Fund), the PA Fish and Boat Commission, the Foundation for Pennsylvania Watersheds, and the PA Council of Trout Unlimited.

Introduction and Background

Organization Backgrounds

Cumberland Valley Trout Unlimited (CVTU) is active in coldwater conservation efforts in the Cumberland Valley. Recently, CVTU has celebrated its 50th Anniversary and has grown to over 600 members. CVTU is dedicated to the preservation and enhancement of coldwater resources within the Cumberland Valley including the Letort Spring Run, Yellow Breeches, Big Spring Creek, and Cedar Run.

Past CVTU work in the Letort includes their Feet In The Stream (FITS) Team that looks after maintenance of the Letort, including raking weeds from the substrate to enhance spawning sites, raking the substrate to release sediment to enhance spawning habitat, cleaning up fishing line and other litter, as well as, constructing fish habitat structures.

Figure 1: CVTU's Feet In The Stream (FITS) crew working to expose gravel substrate and remove reed canary grass.

The Cumberland County Conservation District (CCCD) is active in advocating the stewardship and protection of the natural resources of Cumberland County to sustain and improve the quality of life for its citizens. Active programs include Nutrient Management; Chesapeake Bay Program; Dirt, Gravel, and Low Volume Roads; Watershed Program; Erosion and Sediment Control; and Post Construction Stormwater reviews. Active programs include the District's Annual Tree Sale, Annual Envirothon, and Golf Tournament. The District uses raised funds to promote Environmental Education through public events and scholarships.

Area of Study

The study area will focus on a 2.2 mile stretch of the headwaters, starting at State Route 34 to the overpass bridge of Interstate 81. Stream miles are measured from the confluence of the Letort and the Conodoguinet Creek upstream based on methods from U.S. Geological Survey. Our study area is located between stream mile 5.7 and mile 7.4. The Letort flows north east until an unnamed tributary joins from the east, known locally as the East Branch. The West Branch is locally known as Bonny Brook. The main branch then flows north towards Interstate 81 and the town of Carlisle.

This section of the Letort is designated as Exceptional Value (EV) and Migratory Fish (MF) under Title 25, Chapter 93 of the Pennsylvania Code, as Class A Wild Trout by the Pennsylvania Fish & Boat Commission and as a Pennsylvania Scenic River by the Department of Conservation of Natural Resources.

The Letort originates from limestone springs, which gives it unique qualities and characteristics. Temperature stays consistent due to the geology of the area. Stream level stays consistent as well due to water infiltrating through the porous bedrock in the surrounding areas. The stream is a low gradient stream that supports habitat for brown trout, blacknose dace, slimy sculpins, white suckers, pearl dace, mayflies, and aquatic sow bugs.

The Letort Spring Run has a rich history in the Cumberland Valley and Carlisle. Historically, it received its name from James Letort, who trapped and sold furs as part of the initial settlement to the area. Before that, it was an important trade location for local American Natives as a trade route between the Yellow Breeches and the Conodoguinet Creek.

The Letort Spring Run also became legendary among fly fisherman through Charlie Fox, Vince Marinaro, and Ed Shenk. Vince Marinaro discovered the importance of terrestrial insects on the diet of trout and created several flies and fishing techniques along with Charlie Fox and Ed Shenk.

Over the years, the Letort corridor has become witness to many different challenges. There have been several fish kills and vegetation kills along with siltation being trapped in the cobbles and creating too many vegetative patches. Urban sprawl has increased stormwater runoff and nonpoint source pollutant loads have increased. Limestone karst geology and sinkholes are a challenge both within the stream corridor and the surround landscapes. However, the Letort does persist as an exceptional resource and fishery.

Figure 2: View looking downstream from Bonny Brook parking area footbridge showing exposed gravel in the thalweg of the stream with watercress and elodea providing cover for fish.

Watershed/Protection Area Description

Location

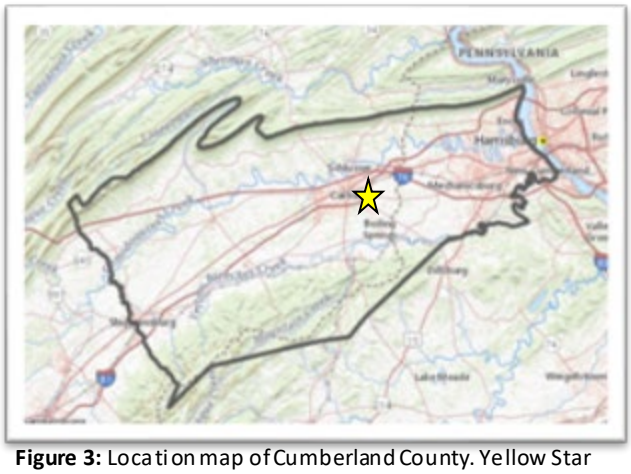


Figure 3: Location map of Cumberland County. Yellow Star located on the study area, near Carlisle, PA.

The Letort Spring Run is located in the center of Cumberland County and flows through the town of Carlisle. The main stem of the Letort is 6.5 miles long and has a watershed area of 21.8 square miles. The Letort flows into the Conodoguinet Creek, which then flows into the Susquehanna River, which flows into the Chesapeake Bay.

The Letort spans multiple municipalities, including Dickinson Township, South Middleton Township, Carlisle Borough, North Middleton Township and Middlesex Township. The municipalities that are included in the Letort partnered together to create the Letort Regional Authority.

The project study area will focus on the upper reach south of Carlisle from State Route 34 (Holly Pike) to Interstate 81, and includes an unnamed tributary that enters from the east and is locally known as the East Branch. The main stem of the Letort within the study area is a total of 1.6 miles and the tributary coming in from the east is 0.69 miles in length.

This section of stream is mostly located in South Middleton Township and a small portion of Carlisle Borough.

Main Stream Corridor:

Upstream latitude/longitude at State Route 34: (40.168498, -77.193592)

Downstream latitude/longitude at Interstate 81: (40.188140, -77.186058)

East Branch:

Upstream latitude/longitude near South Spring Garden St: (40.174015, -77.177183)

Downstream latitude/longitude confluence with main stem: (40.176748, -77.185414)

Size of watershed, drainage area, stream length or order

The watershed of the Letort is composed entirely of carbonate rock, which gives the Letort unique characteristics. The Letort is a low gradient stream, in the heart of the Cumberland Valley. Most of the stream's flow comes from a network of underground springs through limestone Karst geology. The temperature and level of the Letort stays consistent year round due to constant inflow of water from the springs.

Drainage area for the study area is calculated at 8.4 square miles (5,376 acres) via StreamStats mapping program by the US Geological Survey. Please see attached map in Appendix A. The

headwater of the watershed is dominated by agricultural and rural homesteads, with more urban development closer to Carlisle. The stream corridor has open meadows, wooded areas dominated by mature trees and rural homesteads.

The Letort is a first order stream at State Route 34 and becomes a second order stream at the confluence of the unnamed tributary. The unnamed tributary, locally known as the East Branch is a first order stream.

Figure 4: Young brown trout caught and then released.

Chapter 93 Stream Designation and Stream Classifications

This section of the Letort is designated as Exceptional Value (EV) and Migratory Fish (MF) under Title 25, Chapter 93 of the Pennsylvania Code, as a Class A Wild Trout by the Pennsylvania Fish & Boat Commission.

On March 30, 1998, the Letort Spring Run was designated as the seventh Pennsylvania Scenic River by Pennsylvania Department of Environmental Resources. Today, PA Department of Conservation and Natural Resources (DCNR) oversees the Pennsylvania Scenic Rivers program. The Letort is classified as Pastoral, with scenic views of grass fields and agriculture.

The Letort has a population of naturally reproducing brown trout. Historically, the Letort was stocked with brown trout, brook trout, and rainbow trout, but these have all faded out except the reproducing population of brown trout. Other fish species that are present include blacknose dace, pearl dace, white suckers, and slimy sculpins.

Land use (farming, residential, commercial/ industry, etc.)

Land use is dominated by agriculture. There are small pockets of woodland along the Bonny Brook section of the stream by State Route 34. The lower reach of the study area is Urban and has been classified as part of Carlisle Borough's Municipal Separate Stormwater Sewer (MS4) program. According to Stream Stats, 11 percent of the upper watershed is forest and 4 percent is urban. 6 percent of the watershed is industrial with Union Quarries.

Ownership (Public Access)

Public access is available to the Letort in several areas of the study reach. The Letort Nature Trail follows the old South Mountain Railroad bed along the Letort and is ADA handicap accessible. Several parking areas are available at the trail head in the Letort Park, Lamberton Middle School, and Spring Garden Street.

Cumberland Valley Trout Unlimited owns Vince's Meadow that is downstream from Union Quarries and has a parking area off of South Spring Garden Street. CVTU also owns the Frey/Tiley Tract, and Trego's Meadow that is upstream from Union Quarries on both sides of Bonny Brook Road.

Central Pennsylvania Conservancy purchased the B&W Quality Growers Watercress Farm in 2018, which is located on the East Branch and is accessible via the Letort Nature Trail's Spring Garden Street parking area.

Private property does abut both the Nature Trail and CVTU's properties. Please remember to be respectful of private property.

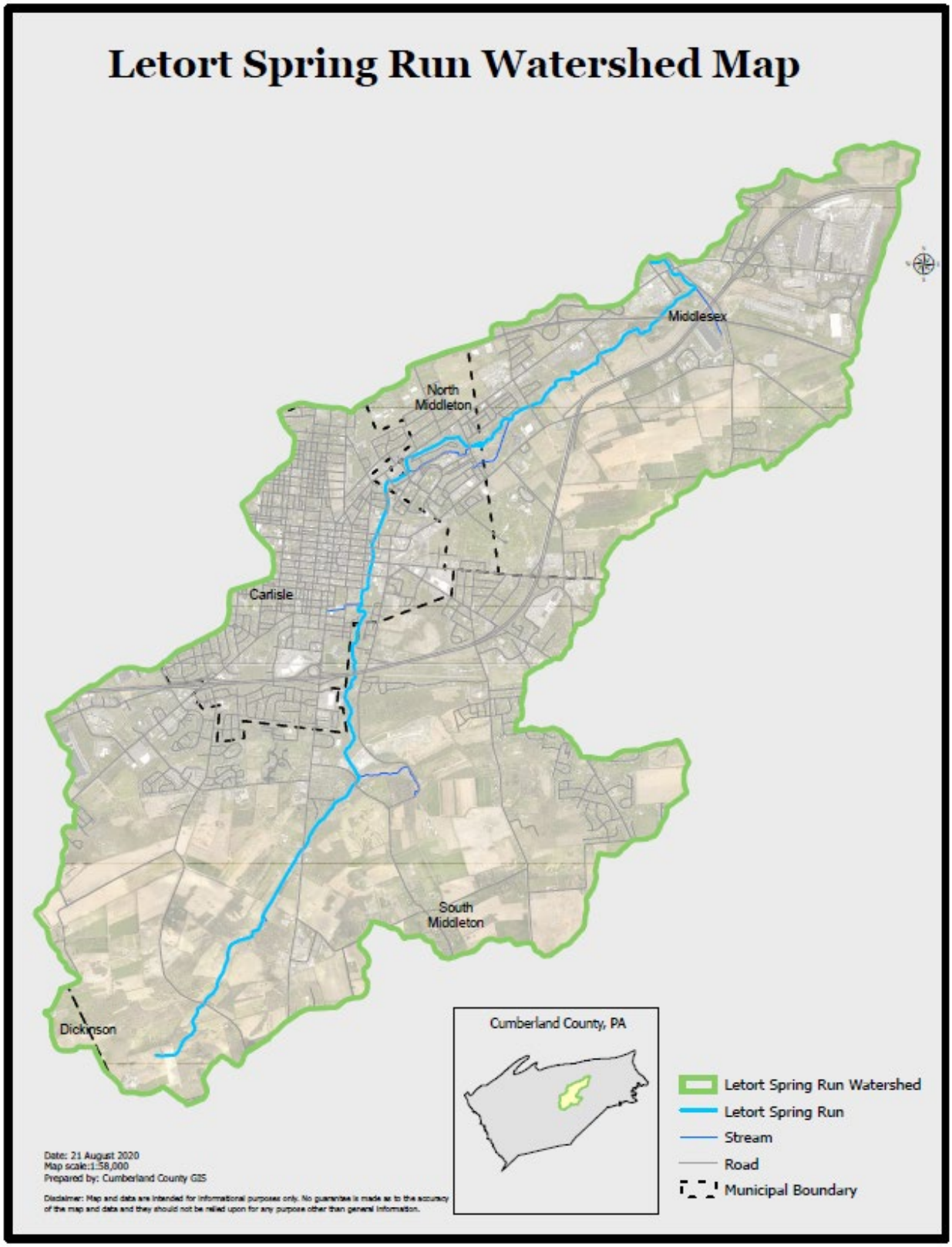
Figure 5: **View of the Letort from the footbridge near parking area looking upstream at Bonny Brook Road.**

Stream Impairment-303(d) list

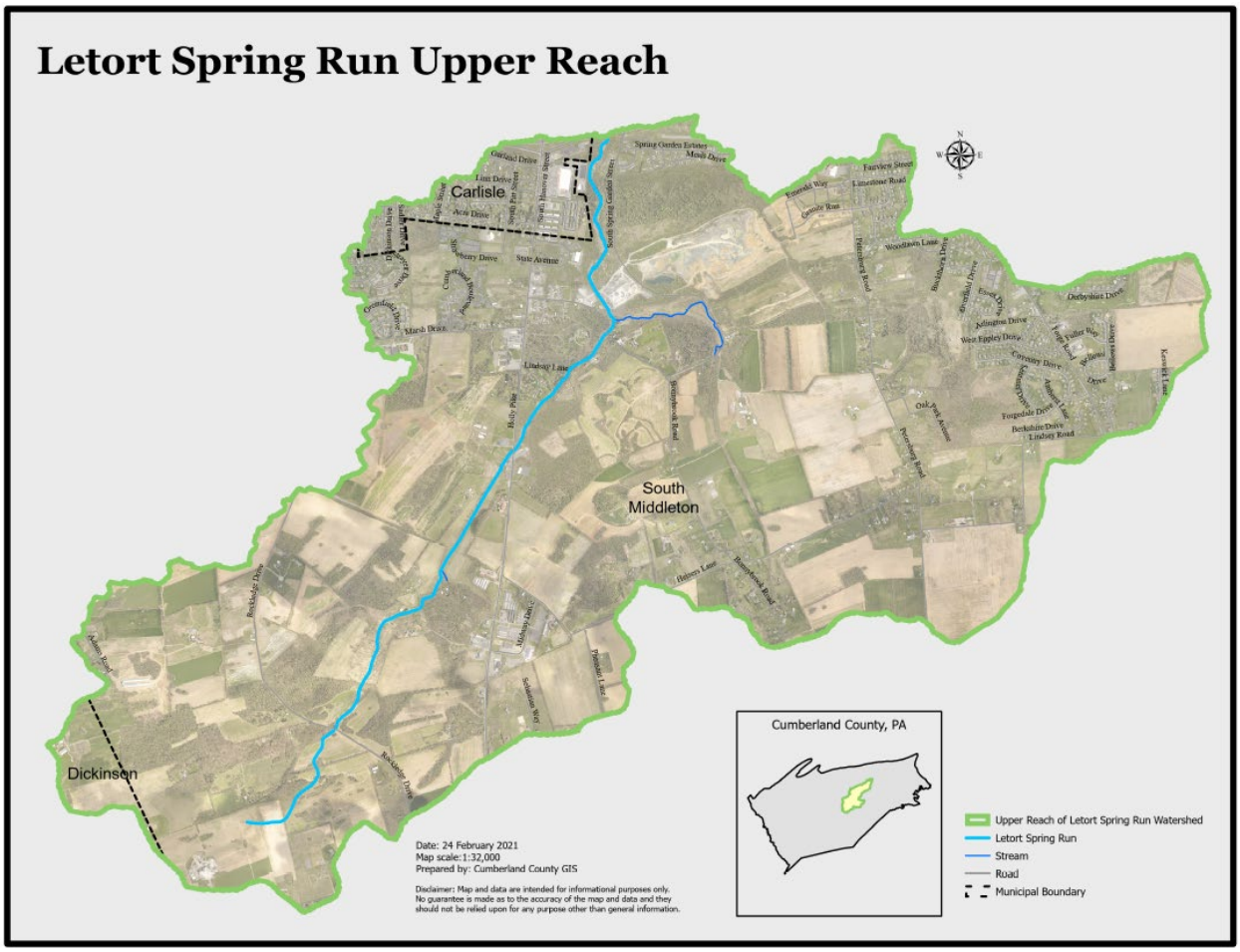
The project area of the Letort is not listed on the 303(d) list for impairment in this section. Even though it is not listed on the 303(d) list, this section of the Letort does have sediment and siltation problems. As sediment deposits it creates areas for aquatic vegetation to be able to take root. Elodea and other aquatic plants growing in the stream channel cause the water to slow, resulting in sediment deposition. This excessive plant growth blocks channel flow, which causes water levels to rise, which has started to change the hydrology of the meadow conditions to become more marsh like. Bank saturation has also caused soil instability and has made stream banks more prone to erosion.

Detailed Maps of Watershed

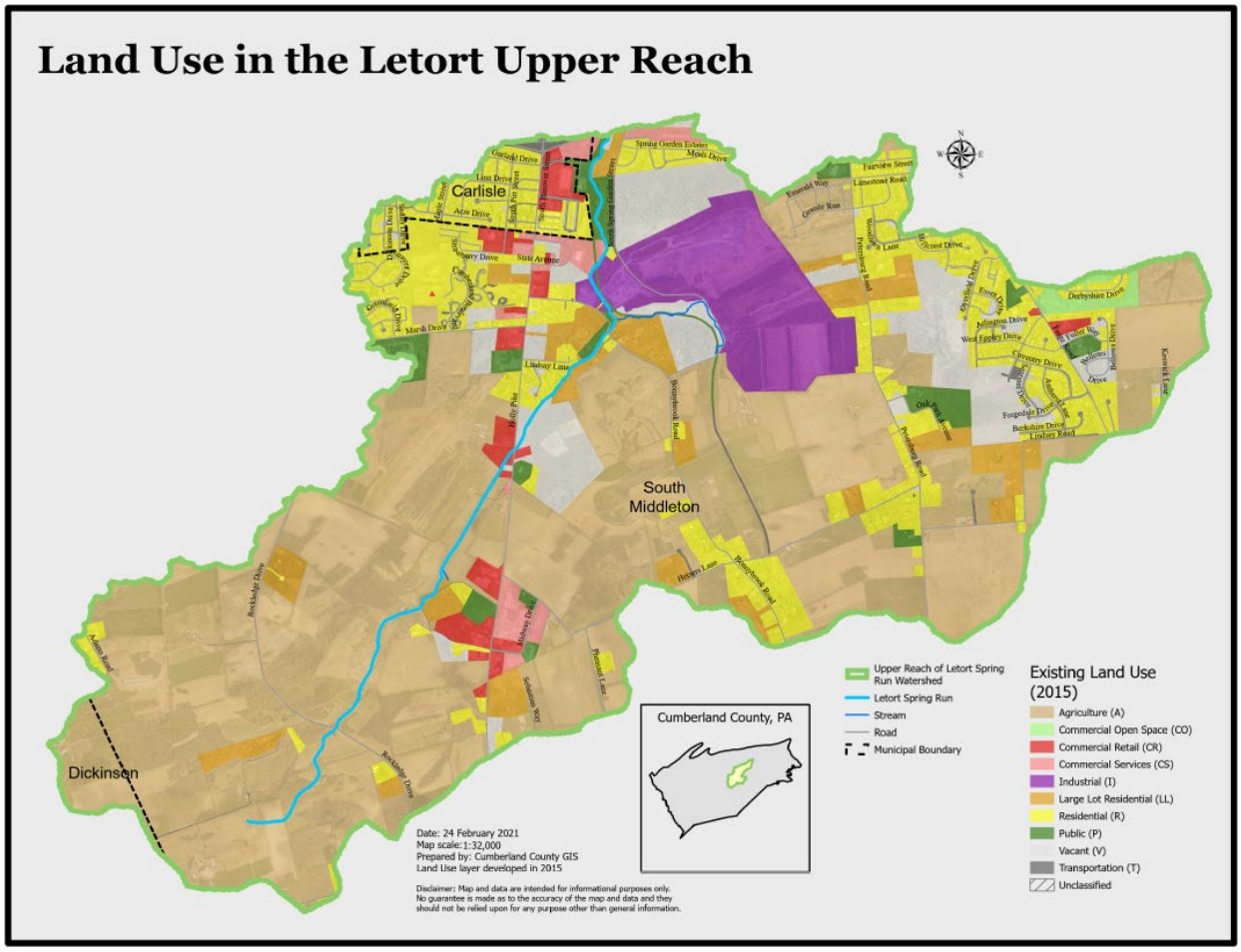
Map 1: Letort Spring Run Watershed Map



Map 2: Letort Spring Run Upper Reach

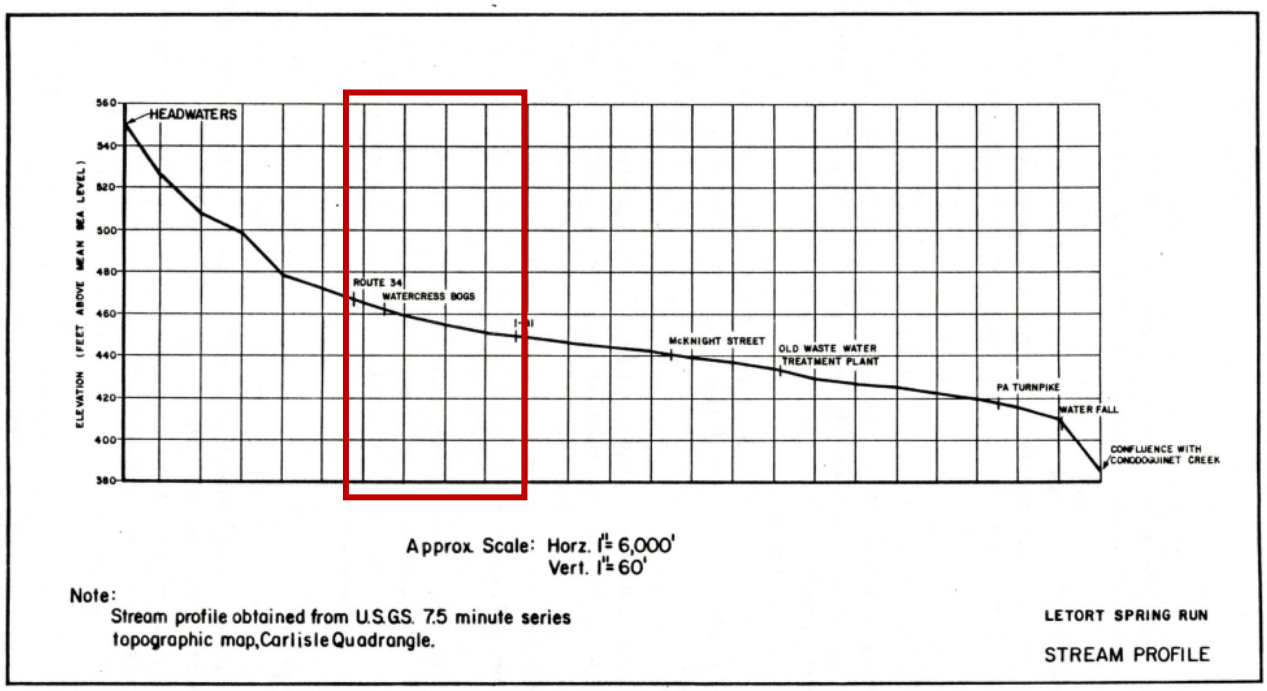


Map 3: Land Use in the Letort Upper Reach



Previously Existing Information and Current Data Analysis

The Letort Spring Run is a low-gradient limestone stream that receives most of its flow from spring seeps from limestone Karst geology. Water stays a consistent temperature year round, with cold water during the summer and ice-free flow during the winter. Water chemistry shows that it is alkaline (pH greater than 7) and is rich in dissolved nutrients like calcium.



Above: Stream Gradient Information: (Scenic Rivers study, page 16). Red box shows the area of study. Elevation at Route 34 is about 470 and elevation at I-81 is about 450, which is only 20 feet difference over 1.6 miles gives a slope of 0.24%.

Hydrology for this section of the Letort is shown as an 8.41 square mile watershed according to Stream Stats mapping program from the United States Geological Survey. Please see USGS Stream Stats map located in Appendix A. Shapefile from this application was used to make maps 2 and 3.

Hydraulic data from USGS 01569800 Letort Spring Run in Carlisle, PA near route 11 collect flow rate data from October 1, 1975 through September 30, 2009. The mean flow varies from 35 cubic feet per second in the drier months of August through December and then increases to 60 cubic feet per second during the wet spring months of April through May. Data chart is located in Appendix B.

Letort Spring Run Habitat Assessment Excerpt

An assessment of Letort Spring Run habitat was conducted on March 5 and March 9, 2021. The assessment protocol that was followed is utilized by the Pennsylvania Department of Environmental Protection (DEP).

Since the Letort is a low gradient stream a low gradient stream protocol was chosen for the assessment. It involves the assessment and scoring of nine parameters each with a possible score ranging from 1 to 20 with 20 being the best. The highest possible score would be 180.

The matrix of parameters that are looked at during the assessment is based on physical characteristics of the stream and the land surrounding the stream. Both instream and surrounding land conditions will have a limiting effect on quality and quantity of habitat available for aquatic biological communities. Even though the quality (chemical composition) of the water flowing through a reach may be good the quality of the habitat (aquatic and terrestrial) may be limiting the full potential of the community.
The resulting scores for the various reaches show how that particular reach compares to a "perfect" low gradient stream and where improvements can be made. It also shows how each reach scores relative to other reaches. It is also important to look at each individual parameter to understand how the total score was derived or what parameter(s) are limiting the reach from its full potential.

Figure 5: Photo of Robert Schott during habitat assessment at the Frey/Tiley Tract. Historically this area had two sink holes repairs in the last 15 years.

Figure 6: Upstream of Vince's Meadow. This area is loaded with sediment and has reed canary grass growing into the stream corridor.

The habitat assessment was conducted on the upper Letort from Rt. 81 upstream to Rt. 34 and also included the unnamed tributary or East Branch which flows through the property owned by the Central Pennsylvania Conservancy (CPC). Due to differing flow regimes and land use it was initially thought that the assessment should be broken down into 3 reaches: Rt. 81 to upstream to the confluence of the East Branch and Bonny Brook Branch, the East Branch, and the Bonny Brook Branch upstream to Rt. 34. Upon further discussion and conditions in the field the assessment was broken down into a total of 8 reaches. Habitat scores ranged from a low of 89 for Reach 1 (upper section) on the Bonny Brook Branch to a high of 144 for Reach 4 (lower section) on the East

Branch. The main stem had an average score of 138.
The major problems on the main branch are excessive sedimentation in the lower 80% of the section and channelization and bridge crossings in the upper reach through the Union Quarries property.

The upper reach of the Bonny Brook branch is completely anomalous to all the other reaches that were assessed due to excessive sediment, shallow water, sections of unstable banks, and overall lack of good habitat. After receiving abundant spring flow input the lower reach of the Bonny Brook branch is vastly improved although a large percentage of the reach is very wide and shallow providing poor habitat for larger fish.

Figure 7: Turtle basking in the sunlight during habitat assessment study.

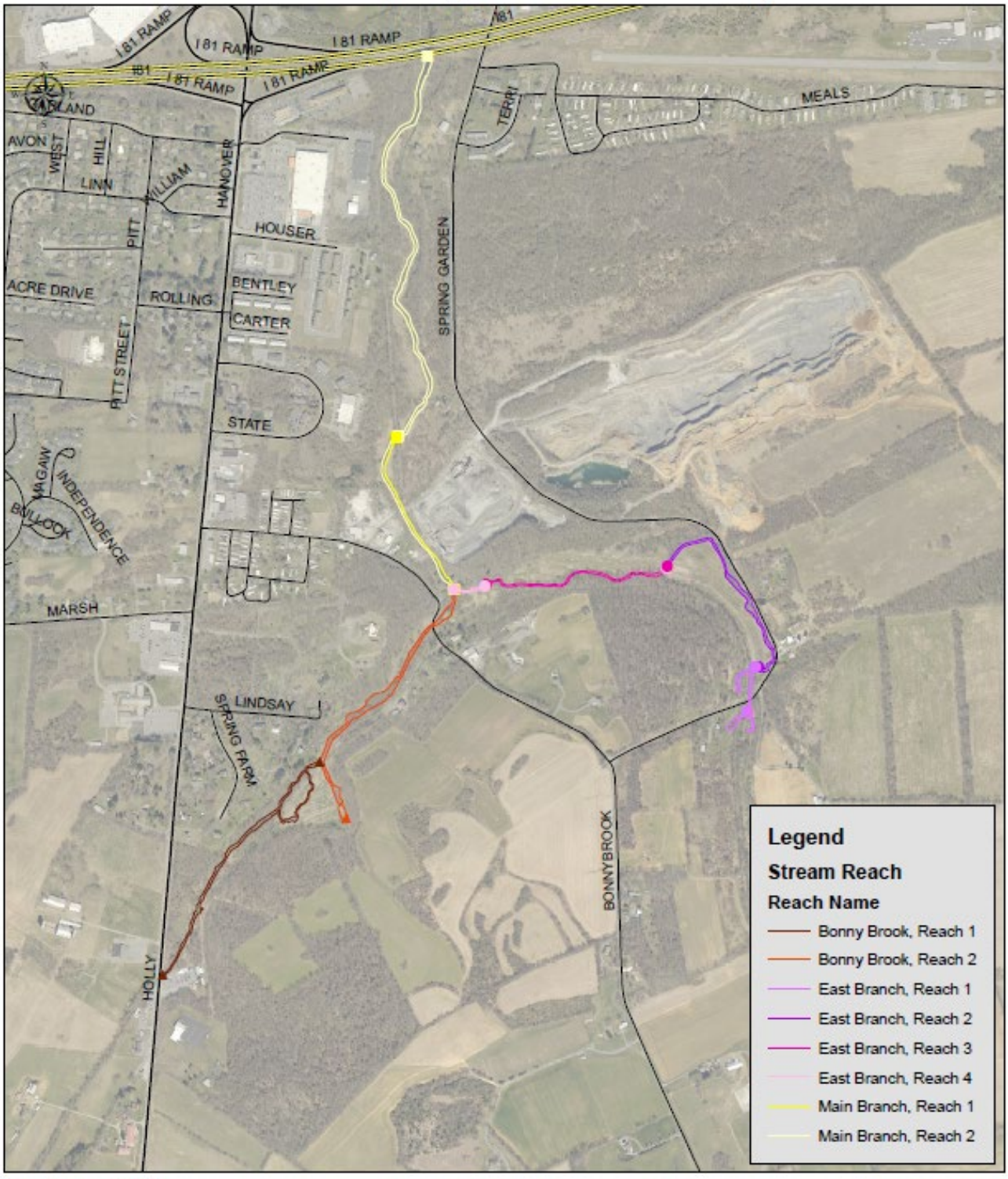
The East Branch which is now owned by the CPC flows through a former watercress farm. It is plagued by a number of issues. Much of the reach had been moved and channelized in the past to allow for flow around and diversion through the cress beds. Excessive sedimentation is present due to erosion from a steep bank along a bordering road and past operations on the cress farm. Stream bank vegetative protection is marginal along some sections and the overall riparian zone is narrow due to the presence of the old cress beds, bordering roads, and rail trail. The lower reach of the East Branch is downstream from the former cress farm and possesses a deep meandering channel with optimal habitat conditions.

Please see full Habitat Assessment Report and data sheets in Appendix C.

Table 1. Letort Spring Run habitat assessment reaches and habitat scores.

Reach	Habitat Score
Main Letort, Reach 1	141
Main Letort, Reach 2	135
Bonny Brook Branch, Reach 1	89
Bonny Brook Branch, Reach 2	138
East Branch, Reach 1	127
East Branch, Reach 2	100
East Branch, Reach 3	114
East Branch, Reach 4	144

Letort Spring Run Habitat Study



Map Scale: 1:12,000
Prepared by:
Cumberland County
Conservation District

0 500 1,000 2,000
Feet

Stream Reach Map
Letort Spring Run
Overview

Aquatic organism passage (stream crossings)

Aquatic organism passage is a term used to determine if there is stream continuity through structures that cross waterways such as culvert pipes and bridges. It is important that bank margins and substrate are present and stable throughout these structures.

When stream flow is constricted through structures that are smaller than bankfull width, the water velocity increases and creates hydraulic head pressure. This can create scour holes inside the structure and at the outfall of the structure. If the stream structure has a bottom, these flows can flush material out, creating a bare bottom for the pipe, which decreases habitat and bank margins through the culvert as well as decreases the lifespan of metal structures.

Evaluation methodology was used from trainings through the Center for Dirt and Gravel Roads training on stream culverts which uses the North American Aquatic Connectivity Collaborative methodology.

Stream crossings were evaluated during the habitat study. Structures include bridges and round pipe culverts on spring tributaries that come into the Letort. All of the bridges did allow for aquatic organism passage. The culvert pipes still allow for aquatic organism passage, but would be hard for wildlife to pass through due to increased flow velocities. No structures were found to be perched that would create a barrier for aquatic organism passage.

Figure 8: Bonny Brook Road bridge downstream of Trego's meadow. The bridge narrows the stream corridor here but still allows aquatic passage and cover for fish. The constricted flow increases velocity under the bridge which could be a benefit downstream by exposing stream bed gravel.

Aquatic life: Macroinvertebrates

The Pennsylvania Fish and Boat Commission and the Pennsylvania Department of Environmental Protection both collect data on aquatic life. PA DEP biologists collect macroinvertebrate samples at the Bonny Brook Road Bridge location. Below is a chart compiled from DEP's reports from 2000, 2005, 2006, 2007, 2008, and 2016. All reports used the Limestone testing protocol except for 2000 and 2005. Reports 2005-2016 all show that the macroinvertebrate community is classified as good condition. 2005 shows poor quality, but also used the Freestone protocols.

Macroinvertebrate Data:

Aquatic Macroinvertebrate Survey Results Pennsylvania Department of Environmental Protection								
Station ID	**20160330-1030-ablascovic**	**20080505-0270-WQN**	**20080331-0945-amywilli**	**20070312-1015-mbrickner**	**20060413-0270-WQN**	**20050427-0270-WQN**	**20000419-0270-WQN22**	
Method	**Limestone**	**Limestone**	**Limestone**	**Limestone**	**Limestone**	**Freestone**	**Freestone**	
Year	**2016**	**2008**	**2008**	**2007**	**2006**	**2005**	**2000**	
Condition	**Good**	**Good**	**Good**	**Good**	**Good**	**Good**	**Poor**	
Location	**Downstream Bonny Brook Rd**	**Downstream Bonny Brook Rd**	**Upstream Bonny Brook Rd**	**Downstream Bonny Brook Rd**	**Downstream Bonny Brook Rd**	**Downstream Bonny Brook Rd**	**Downstream Bonny Brook Rd**	
Taxa								**Common Name**
Antocha	0	0	2	0	0	0	0	cranefly
Baetis	1	10	2	14	4	9	1	mayfly
Caecidotea	2	0	0	0	0	0	0	aquatic sow bug (isopod)
Cambaridae	0	0	0	0	0	0	1	crayfish
Ceratopsyche	0	0	3	0	0	0	0	caddisfly
Chelifera	0	0	0	1	0	0	0	fly (Diptera)
Cheumatopsyche	2	0	2	0	0	0	0	caddisfly
Chironomidae	**53**	**86**	**47**	**47**	**70**	**30**	**5**	**midge (Diptera)**
Ephemerella	**41**	**4**	**17**	**11**	**11**	**17**	**0**	**mayfly**
Gammarus	**113**	**131**	**128**	**118**	**100**	**144**	**115**	**scud (amphipod crustacean**
Hemerodromia	**0**	**0**	**1**	**0**	**0**	**0**	**0**	dance fly
Hydracarina	0	7	8	2	30	7	0	water mites
Hydrobiidae	0	51	0	0	0	0	0	mud snails
Hydropsyche	2	0	0	0	0	0	0	caddisfly
Hydroptila	0	0	0	0	0	1	0	caddisfly
Lepidostoma	0	0	1	2	1	0	0	caddisfly
Lirceus	**10**	**0**	**20**	**39**	**27**	**7**	**26**	**aquatic sow bug (isopod)**
Lymnaeidae	0	0	0	0	1	1	0	mud snails
Nematoda	1	0	0	10	0	0	0	roundworm
Neophylax	2	0	1	0	0	0	0	caddisfly
Neoplasta	0	1	0	0	0	0	0	dance fly (Diptera)
Ochrotrichia	0	19	0	0	2	1	0	caddisfly
Oligochaeta	2	2	18	2	26	1	0	aquatic worm
Optioservus	9	0	42	8	16	9	34	**riffle beetle**
Oulimnius	0	6	0	0	0	0	14	riffle beetle
Oxyethira	0	0	0	1	0	0	0	caddisfly
Paraleptophlebia	2	0	0	0	3	0	0	mayfly
Physidae	0	5	0	1	0	3	4	bladder snail
Planorbidae	0	0	0	1	0	1	0	ramshorn snail
Polycentropus	2	0	0	0	0	0	0	caddisfly
Simulium	9	0	2	5	0	0	0	black fly (Diptera)
Sphaeriidae	0	0	0	0	3	0	0	bivalve mullusc
Tubificidae	0	0	0	0	10	1	0	aquatic worm
Turbellaria	0	7	2	3	3	5	0	flatworm
Viviparidae	0	0	0	1	0	0	0	snail

Figure 9: Data compiled from PA DEP, link: http://www.depgis.state.pa.us/macroviewer/index.html. Samples taken near the Bonny Brook Road bridge. See Figure 2 for mapped locations.

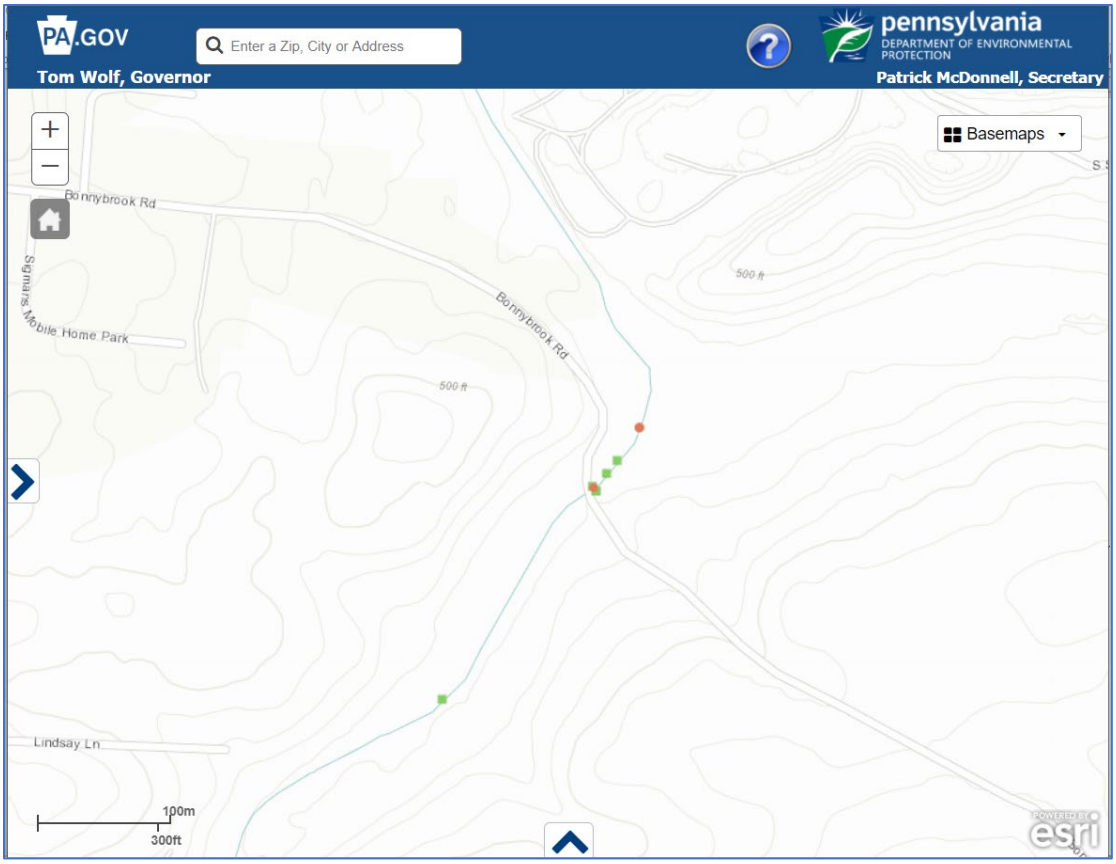


Figure 12.b.: PA DEP Macroinvertebrate Taxa Viewer, zoomed into data collection sites. http://www.depgis.state.pa.us/macroviewer/index.html

Aquatic Life: Fishes

PA Fish and Boat Commission biologists study the native trout populations and collect fish surveys. The last study was completed in 2019. Historical data is provided from 1995, 1997, and 2003. Fish species include American eel, blacknose dace, brown trout, pearl dace, and white sucker. American eel and blacknose dace were rare at this site and brown trout, pearl dace were abundant, and white suckers were common.

Historical data focused on trout populations of brown trout and rainbow trout. By 2003, most of the rainbow trout were no longer stocked and there is no longer a rainbow trout population, which has reduced competition for the brown trout. Today, brown trout have an established a natural reproducing population that has become known throughout the world.

Table n. Fish collected from Letort Spring Run at site rivermile 5.9 with Site Latitude 401044 Longitude 771112 DMS or 40.178923 -77.186745 DD using Electrotowboat gear. Site established 8/26/2019 by Fisheries Management Area 7. This site is currently located within section 2, 07B.

Common Name	Scientific Name	Coarse Abundance
American Eel	Anguilla rostrata	Rare(<3)
Blacknose Dace	Rhinichthys atratulus	Rare(<3)
Brown Trout	Salmo trutta	Abundant(>100)
Pearl Dace	Margariscus margarita	Abundant(>100)
White Sucker	Catostomus commersonii	Common(26-100)

TABLE 1. COMPARISON OF A TWO PASS MARK/RECAPTURE RUN (M+C-R) FOR LETORT SPRING RUN BY ELECTROFISHING THE 300 METER BONNYBROOK QUARRY STATION IN 1995, 1997 AND 2003. BROWN TROUT (BT) & RAINBOW TROUT (RT)

	1995		1997		2003	
SIZE (Inches)	BT	RT	BT	RT	BT	RT
1						
2					2	
3	15	12	10	2	99	11
4	70	22	101	29	159	9
5	27	5	92	3	22	
6	2		9		10	
7	3	2	6		25	
8	16	3	15		27	
9	16		16	6	18	
10	16		13	4	9	
11	10	2	13	1	7	
12	16		11	2	8	
13	9	1	9	3	6	
14	3		6		1	
15	2		5		2	
16	3		2		1	
17	1		1			
18	1					
19						
20						
21						
22	1					
23						
24						
25						
26						
TOTALS	211	47	309	50	396	20

Historical Bonnybrook Site (Union Quarry) captured brown trout from 2-16 inches. Good size distribution with multiple age classes. Very strong 2003 year class of brown trout. Some reduction from previous surveys in numbers of brown trout 10 inches and larger. A few rainbow trout at 3 - 5 inches. Site had water cress cover and areas of clean gravel.

Invasive Plant Species

Like many of our natural areas, this section of the Letort also has many invasive plant species. Invasive species thrive in the same environment as our native plant species and can out-compete most native species by growing densely and choking out native plants. Invasive species also leaf out early in the growing season, which gives them a head start over native plants. Invasive species also interrupt the food web of organisms that depend on ecosystems within the stream corridor.

An invasive species survey was completed on May 3, 2021, by John Schwartzer, Service Forester with the Department of Conservation and Natural Resources and Lori Glace of the Conservation District. Species reported below were found along the Letort Nature Trail and riparian area.

Invasive plants found in this area include:

Invasive Plant Species Present along Letort Nature Trail			
Common Name	**Scientific Name**	**Type**	**Threat Rank**
iris (yellow)	*Iris pseudacorus*	flower	2
chickweed (common)	*Stellaria media*	forb	3
Dames rocket	*Hesperis matronalis*	herb	2
deadnettle	*Lamium purpureum L.*	forb	n/a
garlic mustard	*Alliaria petiolata*	herb	1
greater celandine	*Chelidonium majus*	forb	2
wineberry	*Rubus phoenicolasius*	forb	n/a
reed canary grass	*Phalaris arundinacea*	grass	2
autumn olive	*Elaeagnus umbellata*	shrub	2
buckthorn (common)	*Rhamnus cathartica*	shrub	1
bush honeysuckle	*Lonicera spp.*	shrub	1
Japanese honeysuckle	*Lonicera spp.*	Shrub	1
multiflora rose	*Rosa multiflora*	shrub	1
privet	*Ligustrum spp.*	shrub	2
white mulberry	*Morus alba*	shrub	3
Norway maple	*Acer platanoides*	tree	2
tree of heaven	*Ailanthus altissima*	tree	1
English ivy	*Hedera helix*	vine	3
Oriental bittersweet vine	*Celastrus orbiculatus*	vine	1

Department of Conservation and Natural Resources Invasive Plant Threat Ranking
Rank 1- Severe Threat. Exotic plant species that possess characteristics of invasive species and spread easily into native plant communities and displace native vegetation. Includes species that are or could become widespread in Pennsylvania. **Rank 2**- Significant Threat. Exotic plant species that possess characteristics of invasive species but are not presently considered to spread as easily and aggressively into native plant communities as those species listed as Rank 1. **Rank 3**- Lesser Threat. Exotic plant species that spread in or near disturbed areas, and are not presently considered a major threat to undisturbed native plant communities. **Watch List**- Exotic plant species that are severe problems in surrounding states but have not been widely reported in Pennsylvania, OR may naturalize and become a problem in the future and require more monitoring.

The East Branch section owned by the Central Pennsylvania Conservancy has been very active at treating invasive species on their property in partnership with the Letort Stewards, which includes chemical

treatment, controlled burns, and then planting native plant forbs, shrubs, and trees over the last few years. Treatment can take multiple years to fully control invasive threats.

Between Otto's Meadow and the quarry were several mature Tree-of-Heaven trees that are a high priority to treat and remove due to their hosting capabilities for the Spotted Lantern Fly.

Cumberland Valley Trout Unlimited is also very active in removing reed canary grass (*Phalaris arundinacea*), which is present in both the riparian area and the waterways. It can choke the flow of water and will trap sediment. This contributes to the silty stream beds, which causes slowing water, more sediment to drop out, and promotes more grass growth in the stream corridor. During the survey, it was noted the abundance of Canada geese that have moved in between Otto's Meadow and I-81 and were eating the reed canary grass.

Figure 12: Oriental bittersweet damaging a native hackberry tree.

Figure 13: Reed canary grass growing into the main corridor of the Letort. View is downstream of the railroad bridge on the Letort Nature Trail by Otto's Meadow.

Letort Spring Run Water Quality Monitoring Program

The Alliance for Aquatic Resource Monitoring (ALLARM) at Dickinson College has been monitoring the water quality of the Letort since 1993. ALLARM has a partnership with the Letort Regional Authority (LRA) to monitor 10 sites in the Letort. Each month, ALLARM provides results from these testing locations to LRA.

Parameters include: water temperature, dissolved oxygen, conductivity, total dissolved solids, nitrate, orthophosphate, and turbidity. The below chart was pulled in October, 2020 and the box in red are located within the Coldwater Conservation Plan study area.

All data samples collected by ALLARM fall within the ideal values recommended by the United States Environmental Protection Agency water quality standards.

Water Quality Results

Letort Spring Run Monitoring Program

Monthly Results: October 13, 2020

Site #	Water Temp °C	Dissolved Oxygen mg/L	pH pH units	Conductivity µS/cm	Total Dissolved Solids mg/L	Nitrate mg/L NO_3-N	Ortho-phosphate mg/L PO_4	Turbidity NTU
1	11.5	9.66	7.6	591	420	2.7	<0.02	1.4
2	11.8	9.93	7.9	531	375	3.0	<0.02	1.1
3	11.9	9.86	7.7	570	406	2.8	0.04	0.8
5	12.0	10.57	7.8	576	410	2.8	<0.02	2.2
6	12.1	9.78	7.9	574	409	3.1	0.05	2.8
9	12.7	10.31	7.8	652	460	2.3	<0.02	1.3
10	12.8	10.17	8.0	630	448	1.9	0.03	2.2
Ideal Values		> 7.0	6 – 9	< 1100	< 750	< 5.0	< 0.10	< 10.0

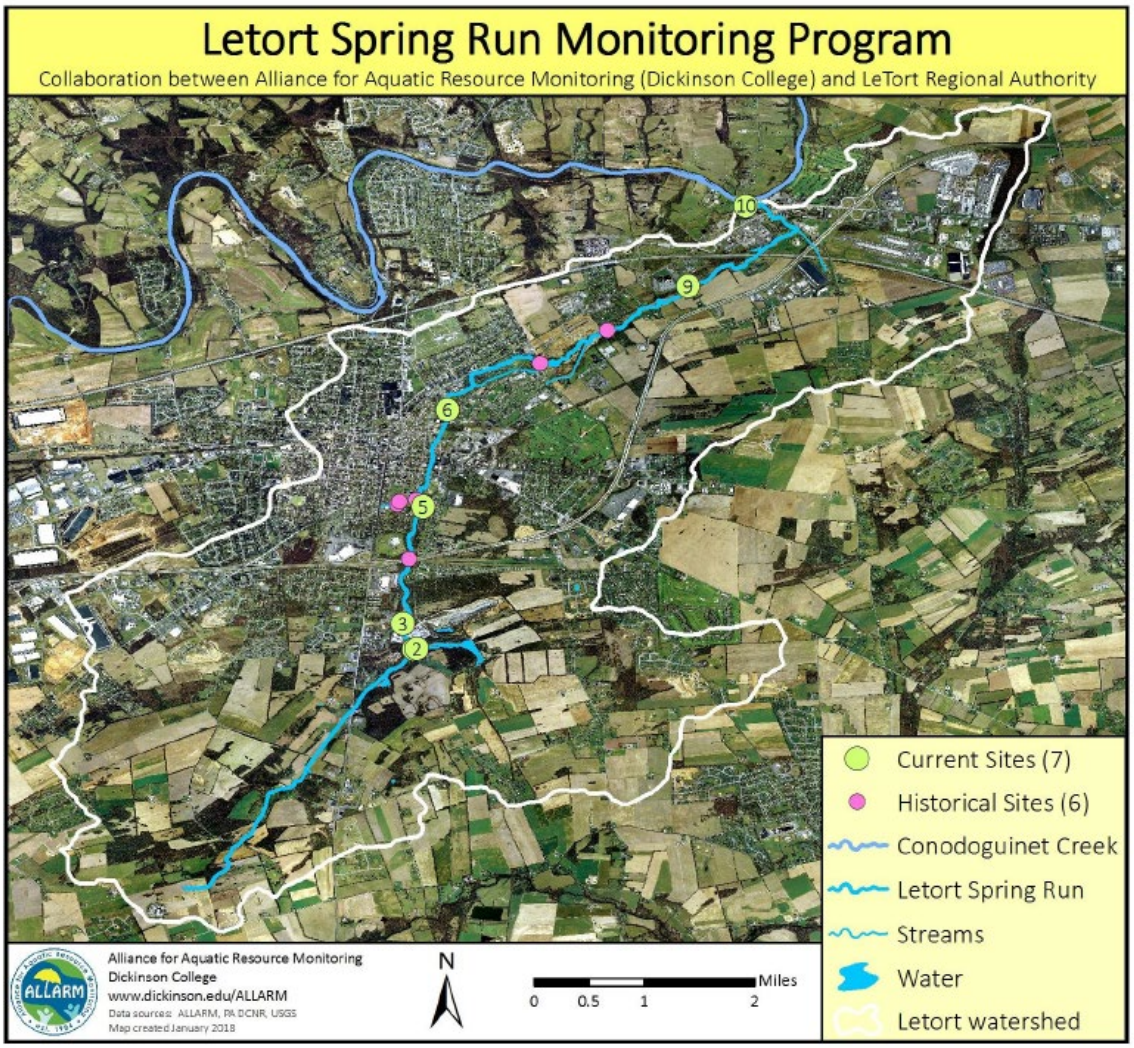
Site	Site Name	Site ID
1	LSRNT footbridge	LETSPRRUN 6.51
2	Trib - LSRNT footbridge	UNTLETSPRRUN 0.01
3	LSRNT RR bridge	LETSPRRUN 6.24
5	LeTort Park RR bridge	LETSPRRUN 5.05
6	Webster Street	LETSPRRUN 4.05
9	Shady Lane	LETSPRRUN 1.53
10	Mill Road	LETSPRRUN 0.04

Site Averages: 2015 – 2019

Site #	Water Temp °C	Dissolved Oxygen mg/L	pH pH units	Conductivity µS/cm	Total Dissolved Solids mg/L	Nitrate mg/L NO_3-N	Ortho-phosphate mg/L PO_4	Turbidity NTU
1	11.6	11.0	7.7	587	400	4.4	0.07	2.0
2	12.0	11.3	8.0	547	370	4.3	0.06	2.7
3	11.8	11.2	7.8	588	400	4.2	0.06	2.4
5	12.4	12.1	8.0	595	410	3.9	0.06	3.2
6	12.2	11.6	8.1	599	410	3.9	0.06	4.0
9	12.7	11.9	8.0	678	470	3.2	0.07	4.1
10	12.9	11.2	8.1	712	490	3.0	0.07	4.7

Monthly Averages: 2015 – 2019

Month	Water Temp °C	Dissolved Oxygen mg/L	pH pH units	Conductivity µS/cm	Total Dissolved Solids mg/L	Nitrate mg/L NO_3-N	Ortho-phosphate mg/L PO_4	Turbidity NTU
Feb	9.3	12.8	8.1	550	460	4.6	0.08	5.5
Apr	13.3	13.0	8.0	616	410	3.8	0.07	3.8
Jun	13.6	11.0	7.8	595	410	3.9	0.08	2.2
Aug	14.1	9.2	7.9	622	430	3.5	0.06	3.5
Oct	14.3	11.0	7.9	599	410	4.0	0.07	3.1
Dec	7.9	11.4	8.0	596	410	3.8	0.08	3.5


Letort Spring Run Monitoring Program
Collaboration between Alliance for Aquatic Resource Monitoring (Dickinson College) and LeTort Regional Authority
10
9
6
5
3
2
Current Sites (7)
Historical Sites (6)
Conodoguinet Creek
Letort Spring Run
Streams
Water
Letort watershed
Alliance for Aquatic Resource Monitoring
Dickinson College
www.dickinson.edu/ALLARM
Data sources: ALLARM, PA DCNR, USGS
Map created January 2018
N
0 0.5 1 2
Miles

The below chart was summarized historical data from samples collected by R. Schott while he worked for PA DEP and were analyzed by DEP's lab in 1990 and 2008. Historical samples are comparable to ALLARM's data. Please see the chart below:

Parameter	Letort Spring East Branch		Letort Spring Run West Branch	
	1990	2008	1990	2008
Alkalinity	200	210.6	220	231.6
Aluminum		<0.2		<0.2
Calcium		86.3		87.5
Copper**		<4.0		<4.0
Dissolved Oxygen	7.7		8.7	
Hardness	222	262	229	292
Iron**		20		<20.0
Lead**		<1.0		<1.0
Magnesium		11.3		17.8
Manganese**		<10.0		<10.0
Nickel**		<50.0		<50.0
Nitrogen (Total)		7.22		7.51
Nitrogen (Ammonia)	<0.02	<0.02	<0.02	<0.02
Nitrogen (Nitrate)	7.26	7.28	6.29	7.29
Nitrogen (Nitrite)	<0.04	<0.04	<0.04	<0.04
pH (Units)	7.1	7.8	7.17	7.6
Phosphorus (Total)	0.02	<0.010	<0.020	<0.010
Phosphorus (Orthophosphate)		<0.010		<0.010
Specific Conductivity (umhos/cm)	412	503	452	551
Sulfate		19.9		21.9
Temperature (c)	10.8		10.5	
Temperature (F)	51.4		50.9	
Total Organic Carbon	<1.0		<1.0	
Zinc**		<10.0		<10.0

Results expressed as parts per million unless indicated otherwise.
**Results expressed as parts per billion.

Figure 14: Letort Spring Run water quality data collected by PA DEP in 1990 and 2008.

Stream Soil Phosphorus Study

Collected by Cumberland Valley Trout Unlimited and analyzed by Analytical Laboratory Service (ALS) Environmental on July 6, 2018.

Please see Appendix D for full report.

Summary:

3 sample locations were taken on July 6, 2018. Site locations include Route 34 Bridge, Luciano's property, and Spring Garden Street. Samples were analyzed using standards set by the Environmental Protection Agency protocol 365.1 for Determination of Phosphorus by Semi-Automated Colorimetry.

Sediment Level Summary

Site	Parameter	Results	Unit	Method
RTE 34 Bridge	Phosphorus, Total	665	mg/kg	EPA 365.1
Luciano's	Phosphorus, Total	403	mg/kg	EPA 365.1
Spring Garden	Phosphorus, Total	674	mg/kg	EPA 365.1

Levels from this study are high. According to Penn State University's Soil Test Recommendations Handbook For Agronomic Crops, optimum phosphorus rates for agronomic crops range from 30-50 ppm (parts per million) for grain crops. Once phosphorus levels exceed optimum, it is not recommended to apply excess phosphorus to crops.

Excess phosphorus can lead to additional plant and algal growth in waterways. When algal blooms take over, it is called Eutrophication and can cause a severe lack of dissolved oxygen. The Letort does have an abundance of plant growth within its waterways.

As a side note, orthophosphate in the water column is within the recommended EPA guidelines (see page 22 for results from ALLARM's studies).

Additional research and study design is recommended to compare phosphorus levels in stream sediment. While doing research for this plan, similar studies and standards were incompatible or unavailable. Bringing additional partners on board are also recommended.

Areas of Concern and Opportunity

This section relates directly to the Habitat Study. Please refer to Appendix C for additional detail and photographs.

Several areas of concern were identified during the habitat study. Overall threats to the main stem of the Letort include excessive sedimentation, shallow water, sections of unstable banks, and overall lack of good habitat. Additional threats include sediment/nutrient load, threats of sink holes, lack of riparian areas, and invasive plant species in the riparian zone areas.

The Bonny Brook Branch (west branch) has a lot of the same problems as the main stem, with excessive sedimentation, unstable banks, some areas are over-widened and overall lack of habitat. However closer to Route 34 the water level is shallower, incised flow, unstable stream banks, and laden with sediment.

Figure 15: Upstream of Railroad Bridge on Letort Nature Trail.

The East Branch was formerly a watercress farm and most of this stream channel has been manipulated through the years through channelization and diversion into cress beds. This section has excessive sedimentation, overall riparian zone is narrow due to the former watercress beds, bordering roads, and rail trail.

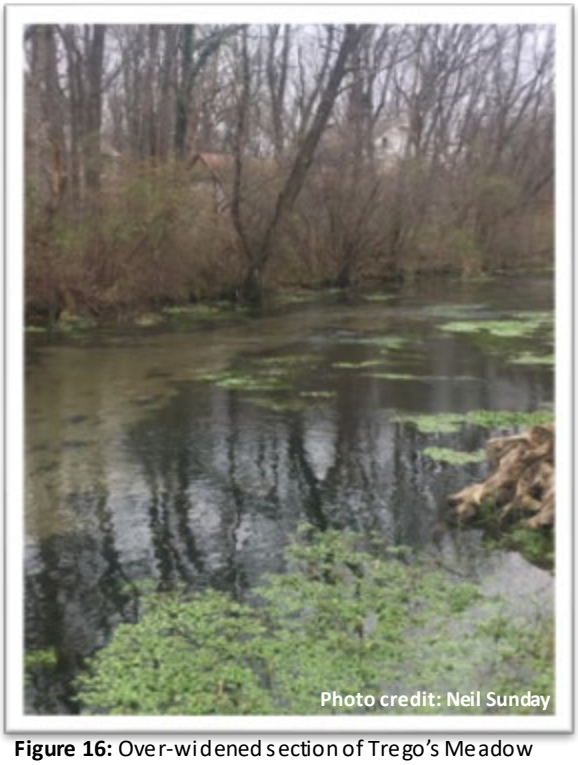


Figure 16: Over-widened section of Trego's Meadow upstream of Bonny Brook Road.

Sediment deposition chokes out gravel areas that are critical to the wild trout populations in the Letort. Trout require loose gravel to build redds. Redds are shallow gravel depressions in circular or oval shapes where females lay their eggs and then males fertilize the eggs. Without loose gravel available, this crucial life cycle stage cannot be completed. Lack of clean gravel is also detrimental to macroinvertebrates for their life cycles as well, which provides additional food to trout and other fishes in the Letort.

Over-widening of the channel causes water to spread out over a larger area. This causes the water velocity to slow down. As water flow slows down, sediment will drop out of the water column. Over time, sediment bars and wedges form, which will allow for plants to colonize the area. These plants will trap additional sediment and cause more water displacement into the riparian zones. Slowing water and encroachment into the bank margins will cause warmer temperatures which will deplete the available dissolved oxygen that is

required by aquatic organisms to thrive.

Sediment and reed canary grass growth will displace water by choking the channel. As water is pushed into bank margins, it can form wetland areas along the stream, which changes the riparian area from being meadow conditions to a wetland system and which changes the plants that grow along the stream. This section is classified as meadow conditions in the Scenic River study and if conditions change from meadow to wetland, the Scenic River designation will have to change.

Sediment and nutrient runoff are also concerns for the Letort. Since the Letort is mostly spring fed, these nutrients can come from many sources, not only surface flow during storm events. The land use around this section of the Letort includes agriculture, commercial, and has influence from Route 34, Bonny Brook Road, and South Spring Garden Street. Nonpoint source pollution includes sediment, nitrogen, phosphorus, and petroleum products.

Sink holes have been a problem in the section below the quarry discharge to the railroad bridge on the Letort Trail. Sink holes form in Karst systems due to water slowly dissolving carbonate rock until it weakens the rock that it collapses. Sink holes cause water levels in the stream to drop until repaired or blocked.

As invasive plants choke out their native counterparts, it can change the dynamics of terrestrial insects and aquatic macroinvertebrates which affects the food chain and ecosystem of the Letort. Invasive plants cause a disruption to native populations and can greatly influence the food chain. Research from Stroud Research Center has identified that aquatic macroinvertebrates shredders would rather starve to death than eat tree-of-heaven and autumn olive leaf material. Species that have specialized food sources are displaced when invasive plants start to take over their natural environment, which can cause holes in the food web and ecosystem, especially since the Letort was recognized for the importance that terrestrial insects play on the food web of brown trout.

Recommendation Opportunities

Downstream of Route 34 to Trego's Meadow (river mile: 7.05-7.55)

This section is entrenched with unstable banks and excess sediment. Remediation opportunities include bank stabilization through trout habitat structures, planting of live stakes (dogwoods/willows).

Trego's Meadow (river mile: 6.88-7.05)

Located upstream of Bonny Brook Road, this section is over-widened, bank failure, and stream banks are turning marshy. Remediation opportunities include fish habitat structures to stabilize the bank and direct water back into the center of the stream. This will also help to keep the gravel clear in this section. Random boulder placement will help to create diversity in the stream channel and will create pockets of water where trout can rest and hide.

Central Pennsylvania Conservancy Property (tributary East Branch)

Located on the east branch of the Letort, downstream of Bonny Brook Road, this section does have a restoration plan that is currently being pursued. Remediation opportunities include recovery of the original stream corridor, invasive species removal, and native plantings and expansion of riparian zone buffers where possible.

Union Quarries (discharge river mile: 6.44)

The quarry property is active and part of their operation has a constant drawdown of ground water that is returned to the Letort by large pumps. Dust is produced during stone crushing, mining of the limestone, and by truck traffic that goes into the quarry to be loaded. There is runoff from the access road onto the Letort Trail that is causing erosion that flows into the Letort. Remediation opportunities include planting native trees and shrubs to create a wind-break to collect dust from falling into the Letort. Remediation opportunities can include a water bar or broad-based dip to prevent water from flowing onto the Letort Trail and would then also allow for a buffer before runoff flows into the Letort.

Area below quarry discharge (river mile 6.35-6.44)

This section is located below the quarry's discharge point. In order for the quarry to harvest rock located below ground water, there is a continuous pump to remove water from where they are working to return it to the Letort. Below the discharge there were several sections that had sink holes that developed and were repaired. This area also has observation wells that are monitored. Currently there are no known sinkholes, but this is a section of concern to monitor for additional sinkholes. Remediation opportunities include immediate notification to state agency partners to obtain necessary emergency permits for immediate repair if a sink hole opens.

Otto's Meadow (6.27-6.24)

This section is located downstream of the railroad bridge on the rail trail between the Quarry and I-81. Historically, this area had cattle on pasture. Today it is still retaining meadow conditions, but has not had cattle for many years. The stream is over-widened here and does make a bend to go into the railroad bridge and then another bend downstream of the bridge. Reed canary grass is also encroaching on the stream corridor, which is causing stream banks to turn from meadow to wetland. Remediation opportunities include trout habitat structures to help direct the water back into the center of the stream and narrow the main channel. Random boulders would also help provide more cover and diversity for trout. Removal of reed canary grass is on-going and is recommended to continue.

Vince's Meadow (river mile 6.1-6.24)

Located between Otto's Meadow and I-81, this section of stream is choked with sediment which has allowed reed canary grass to encroach on the stream. This section of stream also has several Willow trees that are dying. Remediation opportunities include installation of trout habitat structures to help increase the flow of water to help reveal gravel substrate. Recommend to replant trees where large willow trees have died.

Invasive plants (Quarry intersection to I-81) (river mile 6.32-6.45)

There are several species of concern from the Invasive plant survey conducted in early May. Please refer to chart on page 21. Remediation Opportunities include removal of Tree-of-heaven (*Ailanthus altissima*), located south of the rail road bridge, is a high priority to treat and remove due to its hosting abilities for

the spotted lanternfly. Other high ranking common species include honeysuckle (*Lonicera spp.*), multiflora rose (*Rosa multiflora*), autumn olive (*Elaeagnus umbellate*), garlic mustard (*Alliaria petiolate*), and Oriental bittersweet (*Celastrus orbiculatus*). Other general recommendations: start with invasive tree removal, then shrubs, then undergrowth. Recommend planting native plants where invasive plants are removed. This treatment will take several years to fully become successful and will have to be spot treated continuously.

Challenges:

Remediation work will have several steps before projects become shovel-ready. Since most of this section of the Letort is both classified as an Exceptional Value for water quality by Chapter 93 and is a designated Scenic River, there are additional steps that will be need to be planned for during project design to ensure that work on the Letort will maintain the current water quality standards.

Potential project planning and permitting could include:

All projects that propose habitat improvements and in-stream work will have either Pennsylvania Fish and Boat Commission or Pennsylvania Trout Unlimited habitat specialists consult with work to be performed. Low gradient spring creeks need special considerations when trout habitat structures and remediation practices are designed.

Chapter 105 Water Obstruction and Encroachment Permits reviewed and issued by Pennsylvania Department of Environmental Protection. Since the Letort is an Exceptional Value stream through this section, a site meeting is recommended to discuss project parameters to verify which permitting pathway would be taken. Certain work is not allowed under the General Permit conditions but may be acceptable through Waiver 16 or could be permitted through a joint permit or small projects permit. This really depends on the scope of work and any direct impact to adjoining wetlands. All Chapter 105 permits would be submitted to PA DEP for review and approval since Cumberland County Conservation District is not delegated to review these plans. Depending on the project scope, the U.S. Army Corps of Engineers should also be included in pre-design site meetings.

The Pennsylvania Natural Diversity Index (PNDI) will need to be included in all permit work. The PNDI is an index compiled by the Pennsylvania Natural Heritage Program (PNHP) which is a partnership through the Pennsylvania Department of Conservation and Natural Resources (DCNR), the Pennsylvania Fish and Boat Commission (PFBC), the Pennsylvania Game Commission (PGC), and Western Pennsylvania Conservancy in partnership with the U.S. Fish and Wildlife Service. The PNDI compiles location and status of important ecological resources. If a species comes back as threatened or endangered, the respective agency will review information provided about the project and will provide additional guidance, depending on the species threat level and proposed work.

Future Funding Opportunities and/or Potential Partners

There are a variety of potential funding opportunities and potential project partners. Project partners can help the success of the Letort in several ways including technical assistance, permitting help, grant writing and administration, and funding opportunities.

Several key partners include but are not limited to:

Alliance for Aquatic Resource Monitoring

Carlisle Borough

Central Pennsylvania Conservancy

Chesapeake Bay Foundation

Clean Water Cumberland

Coldwater Heritage Partnership

Cumberland County

Cumberland County Conservation District

Cumberland Valley Trout Unlimited

Letort Regional Authority

Letort Stewards

Penn State Extension Watershed Stewards

Pennsylvania Council of Trout Unlimited

Pennsylvania Department of Environmental Protection

Pennsylvania Fish and Boat Commission

Pennsylvania Department of Conservation and Natural Resources

South Middleton Township

Funding opportunities:

Grant Resources				
Source	**Grant Program**	**Min Amt**	**Max Amt**	**Match Requirement**
Cold Water Heritage Partnership	Implementation Grants	n/a	$ 8,000.00	1:1 Match
Cumberland County	Land Partnership Grants	n/a	$ 50,000.00	1:1 Match
Izaak Walton League		n/a	n/a	n/a
National Fish & Wildlife Foundation	Small Watershed Grants	$ 20,000.00	$ 500,000.00	1:3 Match
National Fish & Wildlife Foundation	Local Government Implementation Grants	$ 20,000.00	$ 200,000.00	15%
PA American Water	Environmental Grants	n/a	$ 10,000.00	n/a
PA DEP	Growing Greener Plus	n/a	n/a	15%
PA Dept. of Community & Economic Development	Watershed Restoration and Protection Program	n/a	$ 300,000.00	15%
PA Dept. of Community & Economic Development	Greenways, Trails, and Recreation Program	n/a	$ 250,000.00	15%
PA Foundation of Watersheds	Project Grants	n/a	$ 2,000.00	n/a
PennDOT	Mitigation Funds	n/a	n/a	n/a
South Mountain Partnership	Mini-Grants	$ 2,500.00	$ 15,000.00	1:1 Match

Summary and Conclusions

In conclusion, the upper reach of the Letort is still an exceptional resource in Cumberland Valley but it does need some help to improve habitat conditions to ensure the legacy that its reputation boasts of. In general, remediation recommendations include narrowing of the stream channel where is has become over-widened through bank erosion, additional trout habitat structures to keep sediment from choking stream gravel, and removing invasive species along the stream corridor.

Next steps include design and implementation of projects sites identified in the plan, which will include pre-design meetings with landowners, partners, and state and federal agency personnel. Public updates will be given at Cumberland Valley Trout Unlimited meetings and will include educational outreach via their website and newsletter: Tight Lines.

We would like to thank the many partners that helped with their expertise, local knowledge, reviews, and data. Thank you to the Cumberland Valley Trout Unlimited Coldwater Conservation Plan Committee for their many hours of review, edits, and time. This was a little challenging doing everything remotely while complying with the pandemic restrictions, which did allow a time extension which was needed for the field work portion of this plan.

Special Thank You

CVTU Coldwater Conservation Plan Committee
Mark Albano, Eric Naguski, John Leonard, Robert Schott, Ken Okorn, Gerry Kerstetter, Neil Sunday, John Zazworsky, Tom Baltz, and Keith Tyler

Alliance for Aquatic Resource Monitoring
Julie Vastine & Jinnie Monismith

Central Pennsylvania Conservancy
Benjamin Mummert

Letort Regional Authority
Andy Parker

Landowners
Joe Luciano, Steven Capone, and Rocky Stump

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Appendices

Appendix A: Stream Stats

Streamflow Statistics and Spatial Analysis Tools for Water-Resources Applications
Letort Watershed Map and Data Summary

Appendix B: Historic Discharge

U.S. Geologic Survey Historic Stream Flow Data Chart

Appendix C: Habitat Assessment

Habitat Assessment, Data Sheets, and Map

Appendix D: Stream Soil Phosphorus Study

ALS Environmental results for Total Phosphorus in soil samples conducted July 2018

StreamStats Report Letort Spring Run

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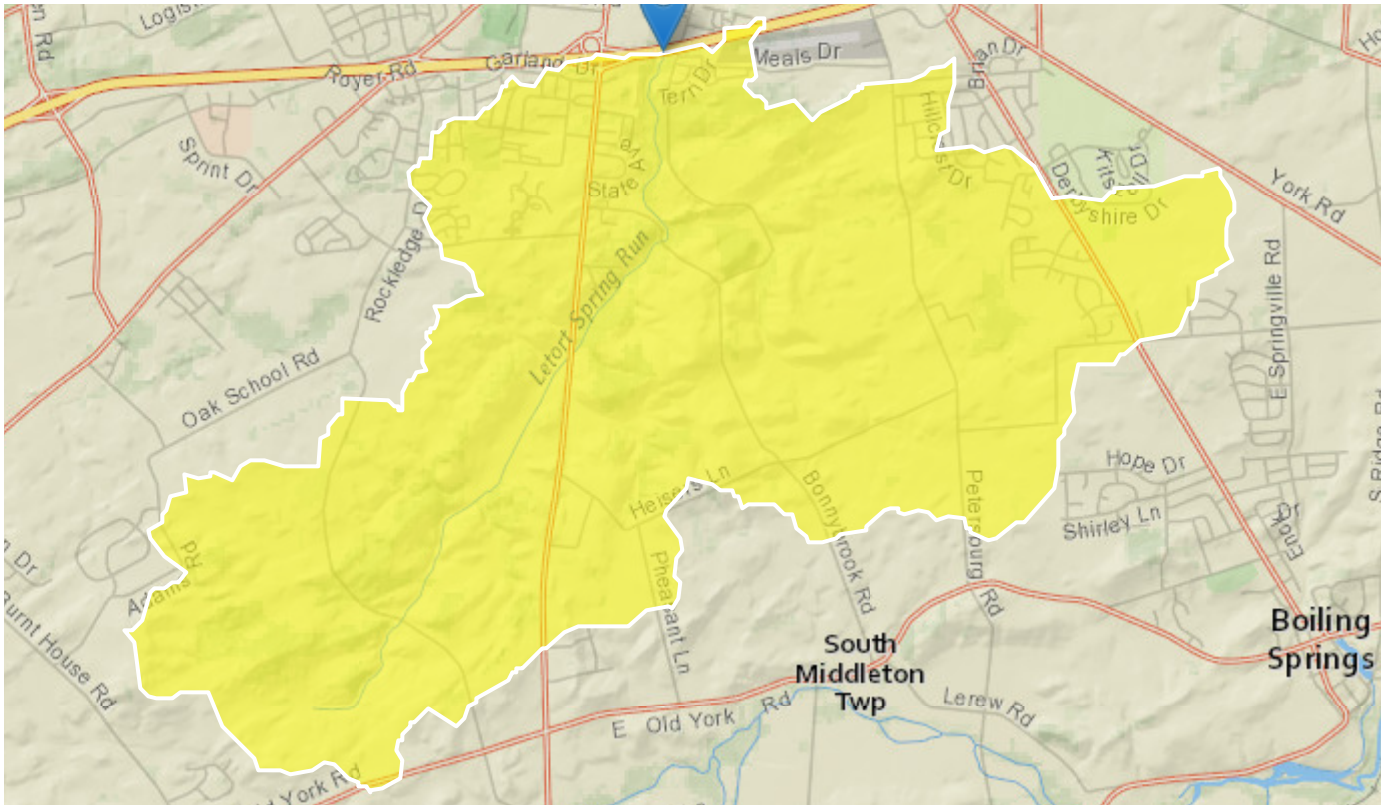


Headwaters to I-81

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	8.41	square miles
PRECIP	Mean Annual Precipitation	39	inches
CARBON	Percentage of area of carbonate rock	100	percent
FOREST	Percentage of area covered by forest	11	percent
URBAN	Percentage of basin with urban development	4	percent

Base Flow Statistics Parameters[Statewide Mean and Base Flow]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	8.41	square miles	2.26	1720
PRECIP	Mean Annual Precipitation	39	inches	33.1	50.4
CARBON	Percent Carbonate	100	percent	0	99
FOREST	Percent Forest	11	percent	5.1	100
URBAN	Percent Urban	4	percent	0	89

Base Flow Statistics Disclaimers[Statewide Mean and Base Flow]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Base Flow Statistics Flow Report[Statewide Mean and Base Flow]

Statistic	Value	Unit
Base Flow 10 Year Recurrence Interval	4.27	ft^3/s
Base Flow 25 Year Recurrence Interval	3.64	ft^3/s
Base Flow 50 Year Recurrence Interval	3.29	ft^3/s

Base Flow Statistics Citations

Stuckey, M.H.,2006, Low-flow, base-flow, and mean-flow regression equations for Pennsylvania streams: U.S. Geological Survey Scientific Investigations Report 2006-5130, 84 p. (http://pubs.usgs.gov/sir/2006/5130/)

USGS Product Names Disclaimer: Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

Application Version: 4.3.11

Station 01569800 Letort Spring Run Near Carlisle, PA

Historic Data

00060, Discharge, cubic feet per second

Mean of daily mean values for each day for water year of record in, ft^3/s (Calculation Period 1975-10-01->2009-09-30)

Day	January	February	March	April	May	June	July	August	September	October	November	December
1	42	47	50	64	53	46	45	37	32	35	34	40
2	43	48	53	66	53	46	44	36	35	34	35	41
3	43	47	52	66	53	48	44	37	32	34	35	41
4	42	47	54	63	53	47	43	38	33	34	34	40
5	43	48	59	63	54	47	44	37	32	34	35	43
6	42	46	56	61	55	47	43	36	34	35	34	41
7	42	45	55	60	53	47	43	35	36	34	34	40
8	45	45	54	58	54	46	45	35	34	34	39	39
9	46	44	54	60	53	45	42	35	33	43	37	39
10	44	44	55	61	53	44	40	36	34	36	36	40
11	44	46	54	59	54	43	39	37	37	36	35	45
12	42	49	54	59	55	45	40	35	36	34	36	44
13	41	47	54	59	54	46	42	36	40	37	35	50
14	42	47	57	58	53	44	40	34	34	36	34	48
15	42	46	59	63	53	45	41	33	33	35	34	45
16	43	46	57	63	56	44	41	34	36	34	36	47
17	42	46	56	62	53	45	40	35	35	34	35	47
18	43	47	56	59	53	44	38	35	41	35	35	45
19	48	46	56	59	52	45	38	37	37	38	35	45
20	50	47	58	59	52	47	38	39	35	37	36	45
21	49	49	65	61	51	46	38	39	35	38	37	44
22	46	49	65	62	50	45	39	37	36	36	37	44
23	47	52	64	59	50	44	44	35	36	36	36	44
24	61	56	64	61	50	44	41	35	34	36	37	45
25	57	57	62	57	50	43	39	34	35	37	36	46
26	50	60	62	59	49	45	38	35	36	36	37	44
27	52	53	65	58	47	47	38	33	38	37	36	42
28	50	51	66	56	47	49	36	34	40	37	42	42
29	48	59	66	55	51	45	36	33	37	35	41	42
30	48		64	53	47	45	37	32	36	35	39	41
31	46		62		48		37	33		34		41

STATION.--01569800 LETORT SPRING RUN NEAR CARLISLE, PA

LOCATION.--Lat 40`14'05", long 77`08'23", Cumberland County, Hydrologic Unit 02050305, on right bank 320 ft downstream from bridge on U.S. Highway 11, 0.2 mi upstream from mouth, 3.1 mi west of New Kingstown, and 3.7 mi east of Carlisle.

DRAINAGE AREA.--21.6 square miles.

PERIOD OF RECORD.--June 1976 to September 2009. (Discontinued)

GAGE.--Water-stage recorder and crest-stage gage. Elevation of gage is 410 ft above sea level, from topographic map.

EXTREMES OUTSIDE PERIOD OF RECORD.--Flood in March 1936 reached a stage of 8.8 ft, discharge not determined, and flood in June 1972 reached a stage of 8.4 ft, from information by local resident, discharge not determined.

Averages (from above chart)

Mean of daily mean values for each day for water year of record in, ft^3/s (Calculation Period 1975-10-01->2009-09-30)

	January	February	March	April	May	June	July	August	September	October	November	December
Monthly Totals	1423	1414	1808	1803	1609	1364	1253	1097	1062	1106	1082	1340
Monthly Averages	46	49	58	60	52	45	40	35	35	36	36	43
Yearly Average	44.71922198											

Appendix C
Letort Spring Run Habitat Assessment
Robert Schott

An assessment of Letort Spring Run habitat was conducted on March 5 and March 9, 2021. The assessment protocol that was followed is utilized by the Pennsylvania Department of Environmental Protection (DEP) (Lookenbill and Shull, 2018) and is a modification of USEPA's Rapid Bioassessment Protocols (Barbour et al. 1999).

DEP utilizes two separate protocols. One is for streams with riffle/run habitat and the other is for low gradient streams with pool/glide habitat. Since the Letort is a low gradient stream the low gradient stream protocol was chosen for this assessment. It involves the assessment and scoring of nine parameters each with a possible score ranging from 1 to 20 with 20 being the best. The highest possible score is 180.

The matrix of parameters that are looked at during the assessment is based on physical characteristics of the stream and the land surrounding the stream. Both instream and surrounding land conditions will have a limiting effect on quality and quantity of habitat available for aquatic biological communities. Even though the quality (chemical composition) of the water flowing through a reach may be good the quality of the habitat (aquatic and terrestrial) may be limiting the full potential of the community.
The resulting scores for the various reaches show how that particular reach compares to optimal stream conditions and indicates where improvements can be made. It also shows how each reach scores relative to other reaches. It is also important to look at each individual parameter to understand how the total score was derived or what parameter(s) are limiting the reach from its full potential.

An explanation of the matrix of parameters used to assess the Letort is listed here:

• **Epifaunal Substrate/Available Cover**. Evaluates the percent makeup of the substrate (boulders, cobble, other rock material) and submerged objects (logs, undercut banks) that provide refuge for a variety of fish including both large bodied pelagic species as well as smaller benthic specialists.

• **Pool Substrate Characterization.** Evaluates the type and condition of bottom substrates found in pools. Firmer sediment types (e.g., gravel, sand) and rooted aquatic plants support a wider variety of organisms and are scored higher than a pool substrate dominated by mud or bedrock and no plants.

• **Pool Variability.** Evaluates the overall mixture of pool types found in streams, according to size and depth (large-shallow, large-deep, small-shallow, and small-deep.

Note: Since the Letort consists primarily of runs with few pools this parameter would more correctly be considered run variability. The protocol differentiates deep from shallow as greater than 0.5 meter (approximately 20 inches).

• **Sediment Deposition.** Estimates the extent of sediment effects in the formation of islands, point bars, and pool deposition. Deposition is typically evident in areas that are obstructed by natural or man-made debris and areas where the stream flow decreases, such as bends.

• **Channel Flow Status.** Estimates the areal extent of exposed substrates due to water level or flow conditions. The flow status will change as the channel enlarges (e.g., aggrading stream beds with actively widening channels) or as flow decreases as a result of dams and other obstructions, diversions for irrigation, or drought. In riffle/run prevalent streams, riffles and cobble substrate are exposed; in low gradient streams, the decrease in water level exposes logs and snags, thereby reducing the areas of good habitat.

• **Channel Alteration.** Evaluates the extent of channelization or dredging, but can include any other large-scale changes in the shape of the stream channel that would be detrimental to the habitat. Channel alteration is present when artificial embankments, rip-rap, and other forms of artificial bank stabilization or structures are present; when the stream is very straight for significant distances; when dams and bridges are present; and when other such changes have occurred.

• **Condition of Banks.** Evaluates the extent of bank failure, signs of erosion, or the potential for erosion. The stream bank is defined as the area from the water's surface to the bankfull delineation. Steep banks are more likely to collapse and suffer from erosion than are gently sloping banks, and are therefore considered to be unstable. Signs of erosion include crumbling, unvegetated banks, exposed tree roots, and exposed soil.

• **Bank Vegetative Protection.** Estimates the extent of stream bank that is covered by plant growth providing stability through well-developed root systems. The stream bank is defined as the area from the water's surface to the bankfull delineation. This parameter supplies information on the ability of the bank to resist erosion as well as some additional information on the uptake of nutrients by the plants, the control of instream scouring, and stream shading. This parameter is made more effective by defining the native vegetation for the region and stream type (i.e., shrubs, trees, etc.). In some regions, the introduction of exotics has virtually replaced all native vegetation. The value of exotic vegetation to the quality of the habitat structure and contribution to the stream ecosystem must be considered in this parameter. In areas of high grazing pressure from livestock or where residential and urban development activities disrupt the riparian zone, the growth of a natural plant community is impeded and can extend to the bank vegetative protection zone.

• **Riparian Vegetative Zone Width.** Estimates the width of natural vegetation from the edge of the stream bank out through the riparian zone. Narrow riparian zones occur when roads, parking lots, fields, lawns, bare soil, rocks, or buildings are near the stream bank. Residential developments, urban centers, golf courses, and range land are the common causes of anthropogenic degradation of the riparian zone. Conversely, the presence of "old field" (i.e., a previously developed field not currently in use), paths, and walkways in an otherwise undisturbed riparian zone may be judged to be inconsequential to altering the riparian zone and may be given relatively high scores.

The habitat assessment was conducted on the upper Letort from Rt. 81 upstream to Rt. 34 and also included the unnamed tributary or East Branch which flows through the property owned by the Central Pennsylvania Conservancy (CPC). Due to differing flow regimes and land use it was initially thought that the assessment should be broken down into 3 reaches: Rt. 81 to upstream to the confluence of the East Branch and Bonny Brook Branch, the East Branch, and the Bonny Brook Branch upstream to Rt. 34. Upon further discussion and conditions in the field the assessment was broken down into a total of 8 reaches (Appendix 1). Habitat scores ranged from a low of 89 for Reach 1 on the Bonny Brook Branch to a high of 144 for Reach 4 on the East Branch (Table 1). Score sheets for the various reaches are included in Appendix 2.

Table 1. Letort Spring Run habitat assessment reaches and habitat scores.

Reach	Habitat Score
Main Letort, Reach 1	141
Main Letort, Reach 2	135
Bonny Brook Branch, Reach 1	89
Bonny Brook Branch, Reach 2	138
East Branch, Reach 1	127
East Branch, Reach 2	100
East Branch, Reach 3	114
East Branch, Reach 4	144

Results

Main Letort, Reach 1, Score 141

This reach starts at the confluence of both branches and continues to the Letort Rail Trail bridge downstream from the Union Quarry property (Figure 1). In spite of the quarry activity and narrowed riparian corridor through the quarry property the upper and lower sections of this reach contain numerous deep channels through the vegetated beds. Bank stability is good even through the quarry stretch where vegetation and tree roots prevent erosion and keep the stream banks in place. Evidence of erosion is minimal and limited to small areas at bridge crossings.

Figure 1. Main Letort Spring Run, Reach 1, looking downstream from the confluence of the East Branch on the right and the Bonny Brook Branch on the left.

Pool or run variability is fairly optimal due to the good mix of deep and shallow areas of various sizes. This diversity in habitat promotes a more diverse, stable aquatic community. Also, the input of a fairly constant flow from numerous springs throughout the Letort watershed results in an optimal channel flow status.

The substrate is a good mix of sediment, vegetated beds, and an extensive stretch of gravel which provides good spawning habitat (Figure 2). Apparently the gravel was dumped in the stream years ago to provide spawning habitat for trout.

Figure 2. Main Letort Spring Run, Reach 1, looking downstream from the most upstream Union Quarries bridge.

Overall, this section contains excellent fish habitat and cover provided by the deep channels that have been cut through the submerged vegetation. The mix of gravel substrate and vegetation also provides optimal substrate for macroinvertebrate colonization.

Main Letort, Reach 2, Score 135

This reach begins at the Letort Rail Trail bridge and continues downstream to the I-81 bridge (Figure 3). It is a meandering stretch of stream with optimal stream-side habitat. For the vast majority of the reach the stream banks are well vegetated and stable. The riparian zone is wide and fairly diverse providing the stream good buffering from overland runoff. Just downstream from the Letort Rail Trail bridge sections of gravel substrate can be seen in deeper runs cut between the vegetation providing deep water and overhead cover for fish. The vegetation and gravel provide good habitat and substrate for insects and crustaceans. Unfortunately, in-stream habitat for fish and macroinvertebrates is sub-optimal for the reach overall due to sediment deposition.

Figure 3. Main Letort Spring Run, Reach 2, looking downstream from the Letort Rail Trail bridge which is located downstream from Union Quarries.

Further downstream a couple hundred meters the stream is virtually devoid of all submerged vegetation (Figure 4). The substrate consists of a thick layer of silt from bank to bank rendering this section mostly uninhabitable for a good fish and macroinvertebrate community. The exact upstream and downstream extent of this non-vegetated reach should be further documented. The cause of the condition is presently unknown.

Figure 4. Main Letort Spring Run, Reach 2, looking downstream. Location is approximately 200 meters downstream from Letort Rail Trail bridge.

Further downstream (Figure 5) where the Letort flows past the Cumberland Valley Chapter of Trout Unlimited's property (Vince's Meadow) pockets of vegetation are present allowing for the formation of deeper, scoured channels between the vegetated areas. The vegetation provides cover for fish and substrate for macroinvertebrate colonization.

As with the condition in Reach 1 upstream, channel flow status was optimal due to a high ground water table and large spring flow.

Figure 5. Main Letort Spring Run, Reach 2, looking upstream at the reach bordering the property owned by the Cumberland Valley Chapter of Trout Unlimited (Vince's Meadow).

Bonny Brook branch, Reach 1, Score 89

The upper limit of this reach starts at the Rt. 34 bridge and ends at the confluence with the large spring-fed flow on the east side of the Capone property. This area was formerly known as the Spott's Dam portion of the B&W Quality Growers watercress farm. Over half of this reach is bordered on both sides by property owned by Hempt Brothers, Inc. which is wooded. The lower portion is bordered on the northwest side by residential land that for the most part is partially wooded along the stream corridor. The southeast side of the lower portion is the former watercress farm property which is wooded along the stream corridor. There were no signs of significant overland sediment input along the entire reach. Nonetheless, the entire streambed is laden with a thick layer of sediment and minimal vegetation (Figure 6).

Figure 6. Bonny Brook Branch of Letort Spring Run, Reach 1, looking upstream. Location is approximately 250 meters downstream from Rt. 34.

The lower portion of this reach receives some spring input from a smaller spring on the Capone property and allows for the establishment of some vegetated areas (Figure 7). Overall though, the entire reach lacks depth, clean substrate, and favorable habitat precluding the establishment of a healthy fish and macroinvertebrate community.

Figure 7. Bonny Brook Branch of Letort Spring Run, Reach 1, looking downstream.

Due to dry weather conditions prior to this survey channel flow status was low since this portion of the Letort lacks input from larger springs. The eroded stream banks indicate that the stream level through this reach is at least a foot higher during major storm events. It appears that the high sediment load is due to erosion from agricultural areas upstream from Rt. 34 and eroding stream banks along this reach.
The sediment inputs from the agricultural areas upstream from Rt. 34 need to be investigated with subsequent reduction or elimination. This additional sediment loading along with the existing in-stream load and eroding stream banks will continue to be flushed downstream into the lower Letort exacerbating problems in an already sediment-laden stream.

Bonny Brook branch, Reach 2, Score 138

This reach begins with two large spring outflows (Figure 8) along the east border of the Capone property (former B&W Quality Growers watercress farm) and ends downstream from Bonnybrook Road at the confluence with the unnamed tributary (East Branch). Most notable about the stretch of stream immediately below the springs is the clean gravel substrate. This is most likely what most of the Letort looked like prior to development and farming in the watershed.

Figure 8. Bonny Brook Branch, Letort Spring Run, Reach 2, showing one of the two major spring outflows located on the eastern border of the Capone property. Note the clean gravel substrate.

The large volume of flow from those springs provides this section of the Letort with optimal channel flow although at least half of the reach is shallow due to the width of the stream (Figure 9).

Figure 9. Bonny Brook Branch, Letort Spring Run, Reach 2, looking upstream. Location is immediately below the confluence of Reach 1 and major spring outflows located on the Capone property.

Habitat and depth improve in those areas where the stream is narrower. Such is the case along the Luciano property (Figure 10) where the narrowing of the channel has led to increased water velocity which in turn allows for the flushing of sediment and reduced plant growth. Clean gravel areas are also prevalent which provides excellent habitat for fish spawning and macroinvertebrate colonization.

Figure 10. Bonny Brook Branch, Letort Spring Run, Reach 2, looking downstream towards Luciano property.

Further downstream the stream widens (Figure 11). This is especially significant along the stretch owned by the Cumberland Valley Chapter of Trout Unlimited. This area is known as Trego's Meadow.

Figure 11. Bonny Brook Branch, Letort Spring Run, Reach 2, looking downstream. The left side of the frame is the property owned by the Cumberland Valley Chapter of Trout Unlimited.

The wider channel and slower water velocity promotes sediment deposition along with increased plant growth which in turn tends to widen the channel. A narrowing of the channel or addition of structure to move the flow to the center of the stream would allow for deeper habitat and a flush of accumulated sediment and excessive plant growth. Exposed gravel would allow for additional spawning habitat and clean substrate for macroinvertebrate colonization.

The lower end of Reach 2 between Bonnybrook Road and the confluence with the East Branch is narrower (Figure 12). Deeper channels are prevalent between the vegetated beds providing excellent fish habitat.

Figure 12. Bonny Brook Branch, Letort Spring Run, Reach 2, looking upstream towards Bonnybrook Road.

In summation, Reach 2 of the Bonny Book branch has fairly good fish habitat overall except for wider stretches of the stream. Sediment deposition tends to be more prevalent in those areas which promotes plant growth and further widening of the channel. Overall though, sediment deposition is not nearly as severe as upstream in Reach 1. Substantial areas of exposed gravel allow for fish spawning and macroinvertebrate colonization.

Out-of-stream habitat is optimal to sub-optimal. Most of the stream banks are moderately stable with well established vegetative protection. Except for a small section of residential land-use the majority of the reach has a wide, protective riparian zone preventing the introduction of additional sediment.

East Branch, Reach 1, Score 127

This reach starts on the southeast side of Spring Garden Street where the stream emerges from two large spring areas (Figure 13). From there it flows under Spring Garden Street and on to the property

Figure 13. East Branch, Letort Spring Run, Reach , looking upstream from Spring Garden Street.

owned by the Central Pennsylvania Conservancy (CPC) which was the former B&W Quality Growers watercress farm. This reach ends at the road culvert at the upstream border of the former watercress farm (Figure 14). Major stream channel modifications and land use changes have occurred below that location due to activities at the former watercress growing facility.

Channel flow status for the reach was optimal due to the spring flow which is fairly consistent. Throughout the reach the substrate is mostly gravel with interspersed areas of sedimentation. Watercress beds are found over a major portion of the stream channel. The majority of the reach is shallow and appears to be good spawning habitat and refuge for juvenile trout and small fish. The areas of clean gravel substrate also promote colonization by aquatic macroinvertebrates. The lower end of this reach formerly served as an upstream macroinvertebrate sampling location for studies performed by DEP to determine the effects of the watercress farm operations on the stream.

The habitat along this reach is fairly stable. The stream borders the Letort Rail Trail which is evidence of past channelization which narrows the riparian vegetative zone. The stream banks are mostly stable with only small acres of exposed soil. Potential for erosion and sediment-laden runoff is minimal.

Figure 14. East Branch, Letort Spring Run, Reach 1, looking upstream from the upper end of former watercress beds on property owned by Central Pennsylvania Conservancy.

East Branch, Reach 2, Score 100

The reach begins at the road culvert at the upstream end of the former watercress farm and continues downstream to the next road culvert separating the upper and lower sections of the former farm. B&W Quality Growers named the upper section of the farm as the Meadows beds. The lower section was known as the Bonny Brook beds.

Evidently the original stream channel ran through the present location of the Meadows beds but was diverted east and then along Spring Garden Street (Figure 15) where it flows north-northwest as a channelized stretch between Spring Garden Street and a shale-filled road between the stream and the cress beds. It flows along Spring Garden Street for approximately 350 meters (1148 feet) and then makes an unnatural 90-degree turn to the southwest and flows under the next road culvert separating the upper and lower farm areas which is the lower border of Reach 2.

Figure 15. East Branch, Letort Spring Run, Reach 2, looking downstream from road culvert at upper end of former watercress beds. Spring Garden Street is in the background.

As the stream flows along Spring Garden Street (Figure 16) it picks up additional flow from two springs. Channel flow status along this reach is optimal and the majority of the reach is deep. The deeper water, vegetation, and occasional large woody debris all combine to create good fish habitat. Substrate composition is fairly good with numerous areas of clean gravel for macroinvertebrate colonization but sediment deposition is present over 50% of the reach. It appears that the major source of sediment along this reach is coming from erosion off the steep stream bank bordering Spring Garden Street. Overall, the condition of the stream banks is marginal along both sides of the stream. The riparian vegetative zone rated poorly due to the short distance between the stream and Spring Garden Street on one side and the shale-fill road and cress beds on the opposite side.

Figure 16. East Branch,Letort Spring Run, Reach 2, looking upstream from property owned by Central Pennsylvania Conservancy. Spring Garden Street is above the steep bank on the left.

After the stream makes the 90-degree turn it flows along the lower end of the Meadows cressbeds where the former discharges from the cressbeds are located (Figure 17). These discharge pipes were a source of sediment when the cress farm was in operation. When the farm was active the workers would walk through the beds stirring up sediment while harvesting the watercress by cutting the tops off the plants. This would typically occur 4 to 5 times a growing season. The Pennsylvania Department of Environmental Resources (now DEP) began regulating the farm after the May, 1981 fish kill due to their extensive use of pesticides. B&W Quality Growers was further instructed to install filter fabric above the discharge pipes at the lower end of the beds. This resulted in a reduction in sediment leaving the beds but did not eliminate it. The water that was discharged from the beds were also a source of nutrient and pesticide contamination.

Figure 17. East Branch, Letort Spring Run, Reach 2, looking upstream from road culvert separating the former upper (Meadows) and lower (Bonny Brook) cressbeds.

Overall, fish and macroinvertebrate habitat in Reach 2 would be characterized as fairly good mostly due to a deep narrow channel through the lower half, presence of vegetation and large woody-debris, and areas of gravel substrate. The reach received its lower score due to the fact that it is channelized and has poor stream-side habitat.

East Branch, Reach 3, Score 114

This reach begins at the road culvert separating the upper and lower sections of the former watercress farm and ends at Letort Rail Trail bridge. Most of the reach flows between the Letort Rail trail and a earthen roadbed separating it from the former Bonny Brook section of the old cress farm (Figure 18).

Figure 18. East Branch, Letort Spring Run, Reach 3, looking downstream from road culvert separating the former upper (Meadows) and lower (Bonny Brook) cressbeds. PVC pipe was formerly used to divert water from cressbed to a block trout holding area in order to observe the potential effects of the discharge on the fish.

The reach tends to be shallower overall compared to Reach 2. This is mostly due to increased sedimentation that has occurred over the years from the discharge exiting the cressbeds. The retention of sediment in this reach was further exacerbated by the presence of two small dams that were installed to raise the water level for diversion into the Bonny Brook cressbeds. This has led to the widening and filling in of a large section of this reach (Figure 19). Overall, sediment deposition affects upwards to 80 percent of this section. Thick beds of vegetation are also present. During the summer thick growths of filamentous algae also plague this section of the stream. While in operation the farm would drip-feed fertilizer into the cressbeds possibly leaving a high nutrient residual in the accumulated sediment.

Figure 19. East Branch, Letort Spring Run, Reach 3, looking upstream from former dam structure utilized to raise water level and divert flow into former cressbeds.

Downstream from the lower impounded stretch the stream narrows and the flow velocity increases which has led to the flushing of some of the sediment and exposing of some areas of gravel. This section is mostly shallow with good habitat for smaller fish and macroinvertebrates (Figure 20).

Figure 20. East Branch, Letort Spring Run, Reach 3, looking downstream. Letort Rail Trail is on the left side of the stream.

On the date of this investigation the lower section of Reach 3 was flowing over its banks into a wetland area below the former watercress beds (Figure 21). Bare stream banks and numerous downed trees give the stretch a poor appearance although the large woody-debris in the stream and deep channel provides excellent cover for fish.

Figure 21. East Branch, Letort Spring Run, Reach 3, looking upstream from Letort Rail Trail bridge towards former watercress farm.

Overall, this reach of the East Branch has a diversity of issues and habitat types which makes for a difficult overall evaluation. Fish cover is slightly suboptimal for the reach. Numerous shallow areas are available for small fish and scattered reaches with gravel offer spawning habitat. The deeper areas with overhead cover in the lower section provide cover for larger fish. Macroinvertebrate colonization is favorable in those areas where increased velocity has exposed gravel substrate. Sediment deposition is a problem in the upper section of the reach due to the presence of small diversion dams.

Stream-side habitat is marginal to suboptimal. For the most part the stream is channelized with the rail trail on one side and the former cress farm road on the other. At least 25% of the reach had exposed stream banks which are susceptible to erosion. The riparian zone was narrow along the trail side of the stream and basically non-existent on the former cress farm side.

East Branch, Reach 4, Score 144

This reach begins at the Letort Rail Trail bridge and ends at the confluence with the main Letort or the Bonny Brook branch. The reach was not included as part of Reach 3 because of the major differences that exist upstream and downstream from the bridge. Below the bridge the stream meanders through a marsh/meadow type of habitat at least to the next downstream bridge (Figure 22). The channel is narrow and deep with areas of exposed gravel. The deep water and beds of vegetation provide excellent habitat for fish. The presence of exposed gravel and rocks provides better habitat for macroinvertebrates. The condition of the banks and bank vegetative protection is optimal with no signs of erosion. The only channel alteration is at the location of the two bridge crossings. The two parameters that lowered the score for this reach were sediment deposition and riparian zone width caused by the thick beds of watercress that trap sediment and the presence of a gravel roadway that infringes on the riparian zone.

Figure 22. East Branch, Letort Spring Run, Reach 4, looking downstream from Letort Rail Trail bridge.

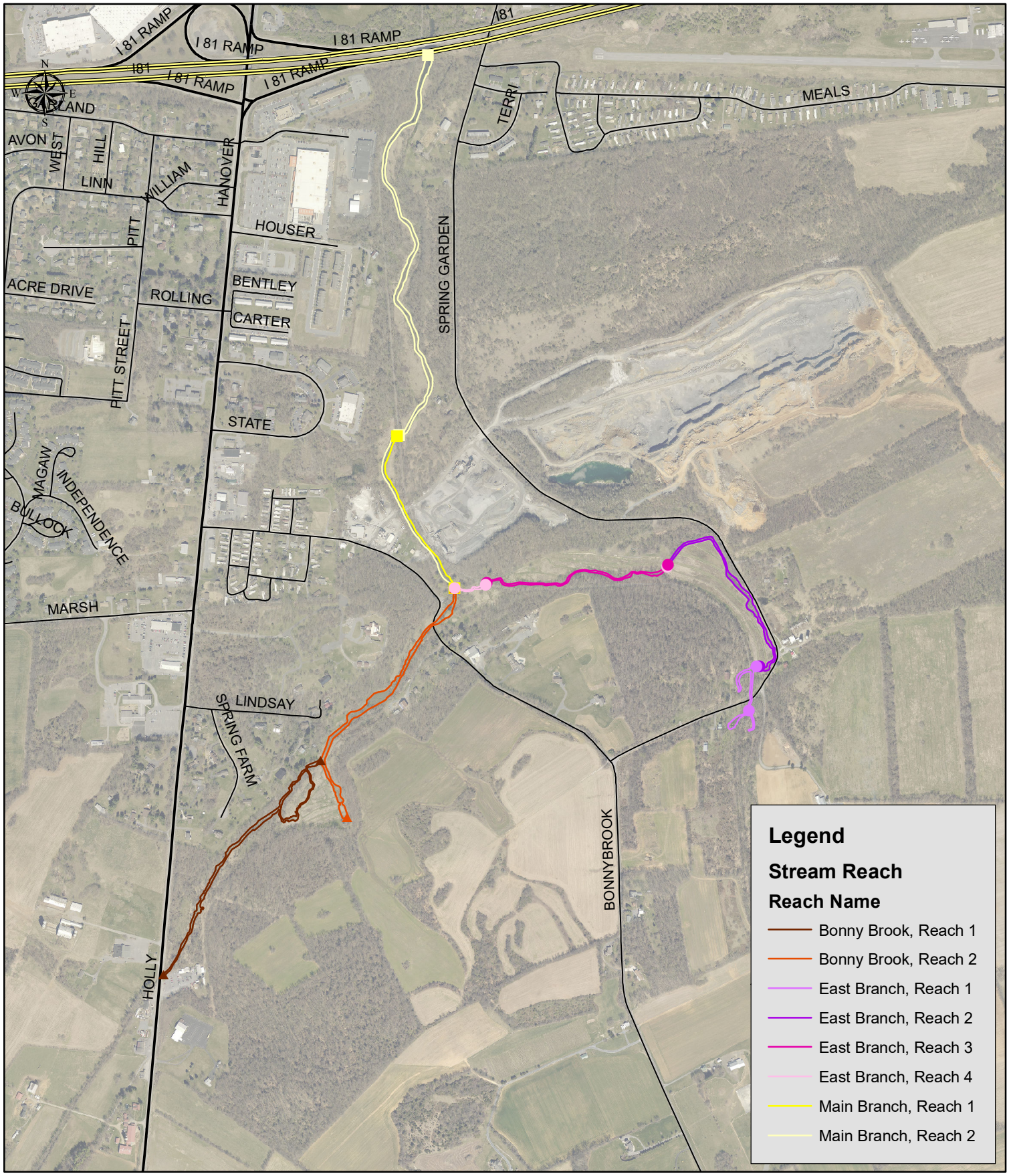
As a side note, a sampling of macroinvertebrates was conducted on the date of this habitat study. The sampling revealed numerous mayfly nymphs of the genus *Ephemerella.* This was notable due to the fact that back when the watercress farm was in operation there were virtually no mayflies to be found in the stretch downstream from the cress bed discharges.

Literature cited

Shull, D. R., and J. Lookenbill (editors). 2018. Water Quality Monitoring Protocols for Streams and Rivers. Pennsylvania Department of Environmental Protection, Harrisburg, Pennsylvania.

Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. Rapid bioassessment protocols for use in streams and wadeable rivers: periphyton, benthic macroinvertebrates and fish, second edition. EPA 841-B-99-002. United States Environmental Protection Agency; Office of Water. Washington, D.C.

Letort Spring Run Habitat Study



Map Scale: 1:12,000
Prepared by: Cumberland County Conservation District

0 500 1,000 2,000
Feet

Stream Reach Map
Letort Spring Run
Overview

Physical Habitat Evaluation Form for Low Gradient (Pool/Glide) Streams

Waterbody Name: LETORT SPRING RUN | GIS Key (YYYYMMDD-hhmm-User): 3-5-2021

Location: MAIN LETORT, TRAIL BRIDGE UPSTREAM TO CONFLUENCE W/EAST BRANCH REACH 1

Investigators: SCHOTT, NAGUSKI, GLACE | Completed By: R. SCHOTT

Parameter	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/Available Cover 19	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale)	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 (19) 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
2. Pool Substrate Characterization 16	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
	20 19 18 17 (16)	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
3. Pool Variability 16	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
	20 19 18 17 (16)	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
4. Sediment Deposition 13	Little or no enlargement of islands or point bars and less than 20% of the bottom affected by sediment deposition	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
	20 19 18 17 16	15 14 (13) 12 11	10 9 8 7 6	5 4 3 2 1
5. Channel Flow Status 20	Water reaches base of both lower banks and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
	(20) 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1

MAIN LETORT. REACH 1

Parameter	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration 12	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely
	20 19 18 17 16	15 14 13 **(12)** 11	10 9 8 7 6	5 4 3 2 1
7. Condition of Banks 15	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly sealed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
	20 19 18 17 16	**(15)** 14 13 12 11	10 9 8 7 6	5 4 3 2 1
8. Bank Vegetative Protection 15	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in stubble height.
	20 19 18 17 16	**(15)** 14 13 12 11	10 9 8 7 6	5 4 3 2 1
9. Riparian Vegetative Zone 15	Width or riparian zone >18 meters; human activities (i.e. parking lots, roadbeds, clear-cuts, lawns or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters; little or no riparian vegetation due to human activities.
	20 19 18 17 16	**(15)** 14 13 12 11	10 9 8 7 6	5 4 3 2 1

TOTAL 141

Physical Habitat Evaluation Form for Low Gradient (Pool/Glide) Streams

Waterbody Name: LETORT SPRING RUN | GIS Key (YYYYMMDD-hhmm-User): 3-5-2021

Location: MAIN LETORT, RT. 81 UPSTREAM TO TRAIL BRIDGE. REACH 2

Investigators: SCHOTT, NAGUSKI, GLACE | Completed By: R. SCHOTT

Parameter	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/Available Cover 13	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale)	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16	15 14 **(13)** 12 11	10 9 8 7 6	5 4 3 2 1
2. Pool Substrate Characterization 13	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
	20 19 18 17 16	15 14 **(13)** 12 11	10 9 8 7 6	5 4 3 2 1
3. Pool Variability 13	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
	20 19 18 17 16	15 14 **(13)** 12 11	10 9 8 7 6	5 4 3 2 1
4. Sediment Deposition 7	Little or no enlargement of islands or point bars and less than 20% of the bottom affected by sediment deposition	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
	20 19 18 17 16	15 14 13 12 11	10 9 8 **(7)** 6	5 4 3 2 1
5. Channel Flow Status 20	Water reaches base of both lower banks and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
	(20) 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1

Parameter	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration 15	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely
	20 19 18 17 16 **(15)** 14 13 12 11	10 9 8 7 6	5 4 3 2 1	
7. Condition of Banks 16	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly sealed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
	20 19 18 17 **(16)** 15 14 13 12 11	10 9 8 7 6	5 4 3 2 1	
8. Bank Vegetative Protection 19	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in stubble height.
	20 **(19)** 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
9. Riparian Vegetative Zone 19	Width or riparian zone >18 meters; human activities (i.e. parking lots, roadbeds, clear-cuts, lawns or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters; little or no riparian vegetation due to human activities.
	20 **(19)** 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1

TOTAL 135

Physical Habitat Evaluation Form for Low Gradient (Pool/Glide) Streams

Waterbody Name: LETORT SPRING RUN | GIS Key (YYYYMMDD-hhmm-User): 3-9-2021

Location: BONNY BROOK (WEST) BRANCH, FROM CONFLUENCE WITH MAIN SPRING FLOW ON CAPONE PROPERTY UPSTREAM TO RT. 34 REACH 1

Investigators: SCHOTT, CAPONE | Completed By: R. SCHOTT

Parameter	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/Available Cover 5	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale)	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	(5) 4 3 2 1
2. Pool Substrate Characterization 11	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
	20 19 18 17 16	15 14 13 12 (11)	10 9 8 7 6	5 4 3 2 1
3. Pool Variability 5	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	(5) 4 3 2 1
4. Sediment Deposition 5	Little or no enlargement of islands or point bars and less than 20% of the bottom affected by sediment deposition	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	(5) 4 3 2 1
5. Channel Flow Status 8	Water reaches base of both lower banks and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
	20 19 18 17 16	15 14 13 12 11	10 9 (8) 7 6	5 4 3 2 1

BONNY BROOK BRANCH REACH 1

Parameter	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration 15	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely
	20 19 18 17 16	(15) 14 13 12 11	10 9 8 7 6	5 4 3 2 1
7. Condition of Banks 10	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly sealed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
	20 19 18 17 16	15 14 13 12 11	(10) 9 8 7 6	5 4 3 2 1
8. Bank Vegetative Protection 15	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in stubble height.
	20 19 18 17 16	(15) 14 13 12 11	10 9 8 7 6	5 4 3 2 1
9. Riparian Vegetative Zone 15	Width or riparian zone >18 meters; human activities (i.e. parking lots, roadbeds, clear-cuts, lawns or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters; little or no riparian vegetation due to human activities.
	20 19 18 17 16	(15) 14 13 12 11	10 9 8 7 6	5 4 3 2 1

TOTAL 89

Physical Habitat Evaluation Form for Low Gradient (Pool/Glide) Streams

Waterbody Name: LETORT SPRING RUN | GIS Key (YYYYMMDD-hhmm-User): 3-5-2021

Location: BONNY BROOK (WEST) BRANCH UPSTREAM TO SPRING ON EAST SIDE OF CAPONE PROPERTY. REACH 2

Investigators: SCHOTT, NAGUSKI, GLACE | Completed By: R. SCHOTT

Parameter	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/Available Cover 15	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale)	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16 **(15)** 14 13 12 11		10 9 8 7 6	5 4 3 2 1
2. Pool Substrate Characterization 16	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
	20 19 18 17 **(16)** 15 14 13 12 11		10 9 8 7 6	5 4 3 2 1
3. Pool Variability 10	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
	20 19 18 17 16 15 14 13 12 11		**(10)** 9 8 7 6	5 4 3 2 1
4. Sediment Deposition 15	Little or no enlargement of islands or point bars and less than 20% of the bottom affected by sediment deposition	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
	20 19 18 17 16 **(15)** 14 13 12 11		10 9 8 7 6	5 4 3 2 1
5. Channel Flow Status 20	Water reaches base of both lower banks and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
	(20) 19 18 17 16 15 14 13 12 11		10 9 8 7 6	5 4 3 2 1

BONNY BROOK BRANCH REACH 2

Parameter	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration 15	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely
	20 19 18 17 16 **(15)** 14 13 12 11		10 9 8 7 6	5 4 3 2 1
7. Condition of Banks 15	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly sealed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
	20 19 18 17 16 **(15)** 14 13 12 11		10 9 8 7 6	5 4 3 2 1
8. Bank Vegetative Protection 18	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in stubble height.
	20 19 **(18)** 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
9. Riparian Vegetative Zone 14	Width or riparian zone >18 meters; human activities (i.e. parking lots, roadbeds, clear-cuts, lawns or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters; little or no riparian vegetation due to human activities.
	20 19 18 17 16 15 **(14)** 13 12 11		10 9 8 7 6	5 4 3 2 1

TOTAL 138

Physical Habitat Evaluation Form for Low Gradient (Pool/Glide) Streams

Waterbody Name: UNT LETORT SPRING RUN | GIS Key (YYYYMMDD-hhmm-User): 3-5-2021

Location: EAST BRANCH FROM CULVERT ON UPSTREAM END OF FORMER CRESS FARM UPSTREAM TO MAIN SPRING SOURCE. REACH 1

Investigators: SCHOTT, OKORN, NUMMERT, HARTLEY | Completed By: R. SCHOTT

Parameter	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/Available Cover 13	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale)	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16	15 14 (13) 12 11	10 9 8 7 6	5 4 3 2 1
2. Pool Substrate Characterization 18	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
	20 19 (18) 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
3. Pool Variability 10	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
	20 19 18 17 16	15 14 13 12 11	(10) 9 8 7 6	5 4 3 2 1
4. Sediment Deposition 16	Little or no enlargement of islands or point bars and less than 20% of the bottom affected by sediment deposition	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
	20 19 18 17 (16)	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
5. Channel Flow Status 20	Water reaches base of both lower banks and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
	(20) 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1

EAST BRANCH, REACH 1

Parameter	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration 13	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely
	20 19 18 17 16	15 14 (13) 12 11	10 9 8 7 6	5 4 3 2 1
7. Condition of Banks 16	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly sealed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
	20 19 18 17 (16)	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
8. Bank Vegetative Protection 13	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in stubble height.
	20 19 18 17 16	15 14 (13) 12 11	10 9 8 7 6	5 4 3 2 1
9. Riparian Vegetative Zone 8	Width or riparian zone >18 meters; human activities (i.e. parking lots, roadbeds, clear-cuts, lawns or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters; little or no riparian vegetation due to human activities.
	20 19 18 17 16	15 14 13 12 11	10 9 (8) 7 6	5 4 3 2 1

TOTAL 127

Physical Habitat Evaluation Form for Low Gradient (Pool/Glide) Streams

Waterbody Name: UNT LETORT SPRING RUN | GIS Key (YYYYMMDD-hhmm-User): 3-5-2021

Location: EAST BRANCH ROAD CULVERT SEPARATING LOWER AND UPPER CRESS BEDS UPSTREAM TO ROAD CULVERT ON UPSTREAM END OF FORMER CRESS FARM. REACH 2

Investigators: SCHOTT, OKORN, NUMMERT, HARTLEY | Completed By: R. SCHOTT

Parameter	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/Available Cover 15	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale)	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16	(15) 14 13 12 11	10 9 8 7 6	5 4 3 2 1
2. Pool Substrate Characterization 15	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
	20 19 18 17 16	(15) 14 13 12 11	10 9 8 7 6	5 4 3 2 1
3. Pool Variability 13	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
	20 19 18 17 16	15 14 (13) 12 11	10 9 8 7 6	5 4 3 2 1
4. Sediment Deposition 8	Little or no enlargement of islands or point bars and less than 20% of the bottom affected by sediment deposition	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
	20 19 18 17 16	15 14 13 12 11	10 9 (8) 7 6	5 4 3 2 1
5. Channel Flow Status 20	Water reaches base of both lower banks and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
	(20) 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1

Parameter	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration 10	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely
	20 19 18 17 16	15 14 13 12 11	(10) 9 8 7 6	5 4 3 2 1
7. Condition of Banks 8	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly sealed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
	20 19 18 17 16	15 14 13 12 11	10 9 (8) 7 6	5 4 3 2 1
8. Bank Vegetative Protection 6	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in stubble height.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 (6)	5 4 3 2 1
9. Riparian Vegetative Zone 5	Width or riparian zone >18 meters; human activities (i.e. parking lots, roadbeds, clear-cuts, lawns or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters; little or no riparian vegetation due to human activities.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	(5) 4 3 2 1

TOTAL 100

Physical Habitat Evaluation Form for Low Gradient (Pool/Glide) Streams

Waterbody Name: UNT LETORT SPRING RUN | GIS Key (YYYYMMDD-hhmm-User): 3-5-2021

Location: EAST BRANCH TRAIL BRIDGE UPSTREAM TO ROAD CULVERT SEPARATING LOWER AND UPPER CRESS BEDS. REACH 3

Investigators: SCHOTT, OKORN, MUMMERT, HARTLEY | Completed By: R. SCHOTT

Parameter	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/Available Cover 15	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale)	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16 **(15)** 14 13 12 11		10 9 8 7 6	5 4 3 2 1
2. Pool Substrate Characterization 16	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
	20 19 18 17 **(16)** 15 14 13 12 11		10 9 8 7 6	5 4 3 2 1
3. Pool Variability 7	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
	20 19 18 17 16 15 14 13 12 11		10 9 8 **(7)** 6	5 4 3 2 1
4. Sediment Deposition 9	Little or no enlargement of islands or point bars and less than 20% of the bottom affected by sediment deposition	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
	20 19 18 17 16 15 14 13 12 11		10 **(9)** 8 7 6	5 4 3 2 1
5. Channel Flow Status 20	Water reaches base of both lower banks and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
	(20) 19 18 17 16 15 14 13 12 11		10 9 8 7 6	5 4 3 2 1

EAST BRANCH REACH 3

Parameter	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration 10	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely
	20 19 18 17 16	15 14 13 12 11	(10) 9 8 7 6	5 4 3 2 1
7. Condition of Banks 13	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly sealed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
	20 19 18 17 16	15 14 (13) 12 11	10 9 8 7 6	5 4 3 2 1
8. Bank Vegetative Protection 14	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in stubble height.
	20 19 18 17 16	15 (14) 13 12 11	10 9 8 7 6	5 4 3 2 1
9. Riparian Vegetative Zone 10	Width or riparian zone >18 meters; human activities (i.e. parking lots, roadbeds, clear-cuts, lawns or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters; little or no riparian vegetation due to human activities.
	20 19 18 17 16	15 14 13 12 11	(10) 9 8 7 6	5 4 3 2 1

TOTAL 114

Physical Habitat Evaluation Form for Low Gradient (Pool/Glide) Streams

Waterbody Name: UNT. LETORT SPRING RUN | GIS Key (YYYYMMDD-hhmm-User): 3-5-2021

Location: EAST BRANCH FROM MOUTH UPSTREAM TO TRAIL BRIDGE REACH 4

Investigators: SCHOTT, OKORN, NUMMERT, HARTLEY | Completed By: R. SCHOTT

Parameter	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/Available Cover 19	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale)	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 (19) 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
2. Pool Substrate Characterization 17	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
	20 19 18 (17) 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
3. Pool Variability 15	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
	20 19 18 17 16	(15) 14 13 12 11	10 9 8 7 6	5 4 3 2 1
4. Sediment Deposition 10	Little or no enlargement of islands or point bars and less than 20% of the bottom affected by sediment deposition	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
	20 19 18 17 16	15 14 13 12 11	(10) 9 8 7 6	5 4 3 2 1
5. Channel Flow Status 20	Water reaches base of both lower banks and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
	(20) 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1

EAST BRANCH REACH 4

Parameter	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration 15	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely
	20 19 18 17 16 **(15)** 14 13 12 11		10 9 8 7 6	5 4 3 2 1
7. Condition of Banks 19	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly sealed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
	20 **(19)** 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
8. Bank Vegetative Protection 19	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in stubble height.
	20 **(19)** 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
9. Riparian Vegetative Zone 10	Width or riparian zone >18 meters; human activities (i.e. parking lots, roadbeds, clear-cuts, lawns or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters; little or no riparian vegetation due to human activities.
	20 19 18 17 16	15 14 13 12 11	**(10)** 9 8 7 6	5 4 3 2 1

TOTAL 144

ALS Environmental

34 Dogwood Lane ▪ Middletown, PA 17057 ▪ Phone: 717-944-5541 ▪ Fax: 717-944-1430 ▪ www.alsglobal.com

NELAP Certifications: NJ PA010 , NY 11759 , PA 22-293 DoD ELAP: A2LA 0818.01
State Certifications: DE ID 11 , MA PA0102 , MD 128 , VA 460157 , WV 343

July 26, 2018

Mr. Chet Halenborth
Cumberland County Trout Unlimited
PO Box 520
Carlisle, PA 17013

Certificate of Analysis

Project Name:	**Cumberland Co. Trout Unlimited**	Workorder:	**2324727**
Purchase Order:	**Paid $135 CC**	Workorder ID:	**Cumberland Co. Trout Unlimited**

Dear Mr. Halenborth:

Enclosed are the analytical results for samples received by the laboratory on Friday, July 6, 2018.

The ALS Environmental laboratory in Middletown, Pennsylvania is a National Environmental Laboratory Accreditation Program (NELAP) accredited laboratory and as such, certifies that all applicable test results meet the requirements of NELAP.

If you have any questions regarding this certificate of analysis, please contact Kelli A Snow (Project Coordinator) at (717) 944-5541.

Analyses were performed according to our laboratory's NELAP-approved quality assurance program and any applicable state requirements. The test results meet requirements of the current NELAP standards or state requirements, where applicable. For a specific list of accredited analytes, refer to the certifications section of the ALS website at www.alsglobal.com/en/Our-Services/Life-Sciences/Environmental/Downloads.

ALS Spring City: 10 Riverside Drive, Spring City, PA 19475 610-948-4903

This page is included as part of the Analytical Report and must be retained as a permanent record thereof.

Kelli A Snow
Project Coordinator

ALS Environmental

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NELAP Certifications: NJ PA010 , NY 11759 , PA 22-293 DoD ELAP: A2LA 0818.01
State Certifications: DE ID 11 , MA PA0102 , MD 128 , VA 460157 , WV 343

SAMPLE SUMMARY

Workorder: 2324727 Cumberland Co. Trout Unlimited

Lab ID	Sample ID	Matrix	Date Collected	Date Received	Collected By
2324727001	RTE 34 Bridge	Solid	7/6/2018 09:15	7/6/2018 11:47	Collected by Client
2324727002	Luciano's	Solid	7/6/2018 09:15	7/6/2018 11:47	Collected by Client
2324727003	Spring Garden	Solid	7/6/2018 09:15	7/6/2018 11:47	Collected by Client

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State Certifications: DE ID 11 , MA PA0102 , MD 128 , VA 460157 , WV 343

SAMPLE SUMMARY

Workorder: 2324727 Cumberland Co. Trout Unlimited

Notes

-- Samples collected by ALS personnel are done so in accordance with the procedures set forth in the ALS Field Sampling Plan (20 - Field Services Sampling Plan).
-- All Waste Water analyses comply with methodology requirements of 40 CFR Part 136.
-- All Drinking Water analyses comply with methodology requirements of 40 CFR Part 141.
-- Unless otherwise noted, all quantitative results for soils are reported on a dry weight basis.
-- The Chain of Custody document is included as part of this report.
-- All Library Search analytes should be regarded as tentative identifications based on the presumptive evidence of the mass spectra. Concentrations reported are estimated values.
-- Parameters identified as "analyze immediately" require analysis within 15 minutes of collection. Any "analyze immediately" parameters not listed under the header "Field Parameters" are preformed in the laboratory and are therefore analyzed out of hold time.
-- Method references listed on this report beginning with the prefix “S” followed by a method number (such as S2310B-97) refer to methods from “Standard Methods for the Examination of Water and Wastewater”.
-- For microbiological analyses, the "Prepared" value is the date/time into the incurbator and the "Analyzed" value is the date/time out the incubator.

Standard Acronyms/Flags

J	Indicates an estimated value between the Method Detection Limit (MDL) and the Practical Quantitation Limit (PQL) for the analyte
U	Indicates that the analyte was Not Detected (ND)
N	Indicates presumptive evidence of the presence of a compound
MDL	Method Detection Limit
PQL	Practical Quantitation Limit
RDL	Reporting Detection Limit
ND	Not Detected - indicates that the analyte was Not Detected at the RDL
Cntr	Analysis was performed using this container
RegLmt	Regulatory Limit
LCS	Laboratory Control Sample
MS	Matrix Spike
MSD	Matrix Spike Duplicate
DUP	Sample Duplicate
%Rec	Percent Recovery
RPD	Relative Percent Difference
LOD	DoD Limit of Detection
LOQ	DoD Limit of Quantitation
DL	DoD Detection Limit
I	Indicates reported value is greater than or equal to the Method Detection Limit (MDL) but less than the Report Detection Limit (RDL)
(S)	Surrogate Compound
NC	Not Calculated
*	Result outside of QC limits

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State Certifications: DE ID 11 , MA PA0102 , MD 128 , VA 460157 , WV 343

ANALYTICAL RESULTS

Workorder: 2324727 Cumberland Co. Trout Unlimited

Lab ID: **2324727001** Date Collected: 7/6/2018 09:15 Matrix: Solid

Sample ID: **RTE 34 Bridge** Date Received: 7/6/2018 11:47

Parameters	Results	Flag	Units	RDL	Method	Prepared	By	Analyzed	By	*Cntr*
WET CHEMISTRY										
Moisture	54.3		%	0.1	S2540G-11			7/13/18 09:38	AXD	A
Phosphorus, Total	665		mg/kg	223	EPA 365.1	7/13/18 10:36	CTD	7/18/18 08:50	KXK	A
Total Solids	45.7		%	0.1	S2540G-11			7/13/18 09:38	AXD	A

Kelli A Snow
Project Coordinator

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ANALYTICAL RESULTS

Workorder: 2324727 Cumberland Co. Trout Unlimited

Lab ID: **2324727002** Date Collected: 7/6/2018 09:15 Matrix: Solid

Sample ID: **Luciano's** Date Received: 7/6/2018 11:47

Parameters	Results	Flag	Units	RDL	Method	Prepared	By	Analyzed	By	*Cntr*
WET CHEMISTRY										
Moisture	42.2		%	0.1	S2540G-11			7/13/18 09:38	AXD	A
Phosphorus, Total	403		mg/kg	173	EPA 365.1	7/13/18 10:36	CTD	7/18/18 08:50	KXK	A
Total Solids	57.8		%	0.1	S2540G-11			7/13/18 09:38	AXD	A

Kelli A Snow
Project Coordinator

ALS Environmental

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NELAP Certifications: NJ PA010 , NY 11759 , PA 22-293 DoD ELAP: A2LA 0818.01
State Certifications: DE ID 11 , MA PA0102 , MD 128 , VA 460157 , WV 343

ANALYTICAL RESULTS

Workorder: 2324727 Cumberland Co. Trout Unlimited

Lab ID: **2324727003** Date Collected: 7/6/2018 09:15 Matrix: Solid

Sample ID: **Spring Garden** Date Received: 7/6/2018 11:47

Parameters	Results	Flag	Units	RDL	Method	Prepared	By	Analyzed	By	*Cntr*
WET CHEMISTRY										
Moisture	35.5		%	0.1	S2540G-11			7/13/18 09:38	AXD	A
Phosphorus, Total	674		mg/kg	146	EPA 365.1	7/13/18 10:36	CTD	7/18/18 08:50	KXK	A
Total Solids	64.5		%	0.1	S2540G-11			7/13/18 09:38	AXD	A

Kelli A Snow
Project Coordinator

ALS Environmental

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NELAP Certifications: NJ PA010 , NY 11759 , PA 22-293 DoD ELAP: A2LA 0818.01
State Certifications: DE ID 11 , MA PA0102 , MD 128 , VA 460157 , WV 343

ANALYSIS - PREP METHOD CROSS REFERENCE TABLE

Workorder: 2324727 Cumberland Co. Trout Unlimited

Lab ID	Sample ID	Analysis Method	Prep Method
2324727001	RTE 34 Bridge	EPA 365.1	EPA 365.1
2324727001	RTE 34 Bridge	S2540G-11	
2324727002	Luciano's	EPA 365.1	EPA 365.1
2324727002	Luciano's	S2540G-11	
2324727003	Spring Garden	EPA 365.1	EPA 365.1
2324727003	Spring Garden	S2540G-11	

ALS Environmental
34 Dogwood Lane
Middletown, PA 17057
P. 717-944-5541
F. 717-944-1430

CHAIN OF CUSTODY/ REQUEST FOR ANALYSIS

ALL SHADED AREAS MUST BE COMPLETED BY THE CLIENT / SAMPLER. INSTRUCTIONS ON THE BACK.

Page ___ of ___
Courier:
Tracking #:

* 2 3 2 4 7 2 7 *

Co. Name: CUMBERLAND COUNTY TROUT UNLIMITED
Contact (Report to): CHET HAGENBUCH Phone: 77-2263347
Address: P.O. BOX 520
CARLISLE PA 17013

Bill to (if different than Report to): SAME PO#:
Project Name/#: LETORT HEADWATERS STUDY ALS Quote #:
TAT: [X] Normal-Standard TAT is 10-12 business days. Date Required:
[ ] Rush-Subject to ALS approval and surcharges. Approved By:
Email? [ ] Y KCJK5410@Comcast.net
Fax? [ ] Y No.:

SPRING BOARD

Sample Description/Location (as it will appear on the lab report)	COC Comments	Sample Date	Military Time	*G or C	**Matrix	***Container Type	***Container Size	*** Preservative	Total Phos.	* Please analyze the solids.	Total Solids
						G	32oz	—			
1 RTE 34 BRIDGE		7/6/19	9:15	G	SW	1	*		1		
2 LUCIANO'S		↓	↓	G	SW	1	*		1		
3 ~~CUNNINGHAM BRIDGE~~				G	SW	1	*		1		
4 ~~VINCE'S MEADOW~~				~~G~~	~~SW~~	~~1~~	~~*~~		~~1~~		
5											
6											
7											
8											

Enter Number of Containers Per Analysis

(completed by Sample Receiving)
Performed by: DN
Cooler Temp: 21°C
Therm. ID: 402
No. of Coolers:
Notes:

Correct containers?	Correct sample volume?	Correct preservation?	Headspace/Volatiles?	Circle appropriate Y or N.
Y	Y	Y	Y	
N	N	N	N	N

Custody seals Present?	(if present) Seals intact?	Received on ice?	COC/Labels complete/accurate?	Container in good condition?
Y	Y	Y	Y	Y
N	N	N	N	N

SAMPLED BY (Please Print):

Project Comments: Paid W/ credit card. $135 DN 7/6/19

Relinquished By / Company Name	Date	Time	Received By / Company Name	Date	Time
1 [signature]	7/6/19	11:47	2 [signature]	7/6/19	1147
3			4		
5			6		
7			8		
9			10		

Data Deliverables: [ ] Standard [ ] CLP-like [ ] NJ-Reduced [ ] NJ-Full [ ] SDWA
EDDs Required? [ ] If yes, format type:
SDWA Forms? ⇨ yes [ ] yes [ ] yes [ ] yes [ ]
State Samples Collected In? MD [ ] NJ [ ] NY [ ] PA [ ]
Other
Enter PWSID No.
DOD Criteria Required?

ALS FIELD SERVICES
[ ] Pickup
[ ] Labor
[ ] Composite Sampling
[ ] Rental Equipment
[ ] Other:

* G=Grab; C=Composite
**Matrix: AI=Air; DW=Drinking Water; GW=Groundwater; OI=Oil; OL=Other Liquid; SL=Sludge; SO=Soil; WP=Wipe; WW=Wastewater
Copies: WHITE - ORIGINAL CANARY - CUSTOMER COPY
***Container Type: AG-Amber Glass; CG-Clear Glass, PL-Plastic. Container Size: 250ml, 500ml, 1L, 8oz., etc. Preservative: HCl, HNO3, NaOH, etc.
Rev 01-2013