

Manada Creek Coldwater Conservation Plan

Dauphin County Conservation District

November 2014



Table of Contents

I. Watershed Background	3
Conservation Work and Watershed Groups.....	7
II. Coldwater Conservation Plan.....	8
III. Water Quality.....	9
Temperature	10
Field Chemistry and Nutrient Sampling	11
Macroinvertebrate Sampling.....	14
Manada Creek Macroinvertebrate Sampling	15
Habitat Assessments	16
Fish Survey	17
IV. Future Priorities for Restoration	20
Attachment I. PA Fish and Boat Commission Stocked Trout Movement Study, 3/12/2012.....	25
Attachment II. Data from USGS’s Surface-water quantity and quality, aquatic biology, stream geomorphology, and groundwater-flow simulation for National Guard Training Center at Fort Indiantown Gap, PA, 2002-2005	38
Attachment III. DCCD Macroinvertebrate Data, Coldwater Conservation Plan.....	64
Attachment IV. Data sheets from the Fish Surveys led by DEP, 7/23/2014.....	70
Attachment V. Macroinvertebrate Sampling Photos, Compiled by the Doc Fritchey Chapter of Trout Unlimited	73

I. Watershed Background

Manada Creek, located in Lebanon and Dauphin Counties, is a tributary of the Swatara Creek in the Susquehanna River Basin. The Manada Creek Watershed is 32.09 square miles in all, and is located between the Second and Blue Mountains in western Lebanon County and eastern Dauphin County.

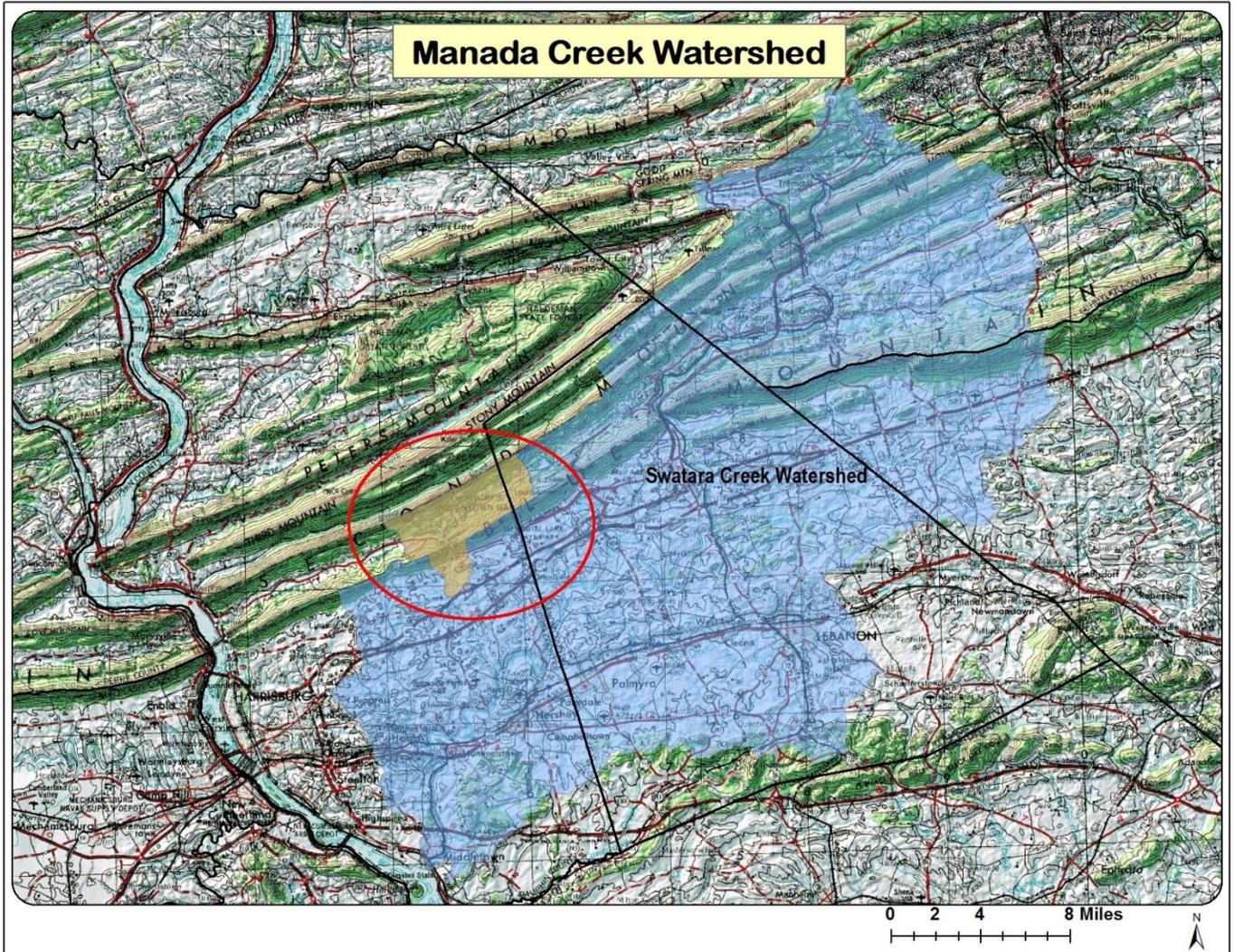


Figure 1. Location of the Manada Creek Watershed

Manada Creek is designated by the PA Fish and Boat Commission as supporting wild trout for seven miles, from its headwaters down to Furnace Rd., and is designated as a coldwater fishery in Chapter 93 of the Pennsylvania Code for the upper 10.5 miles, or until it reaches Interstate 81. There is also a 1.5 mile stretch, from Furnace Rd. to Fogarty Rd. that is designated as Delayed Harvest Artificial Lures Only by the PA Fish and Boat Commission. There are several medium sized, unnamed tributaries to Manada Creek. Figure 2, below, shows the stream designations.

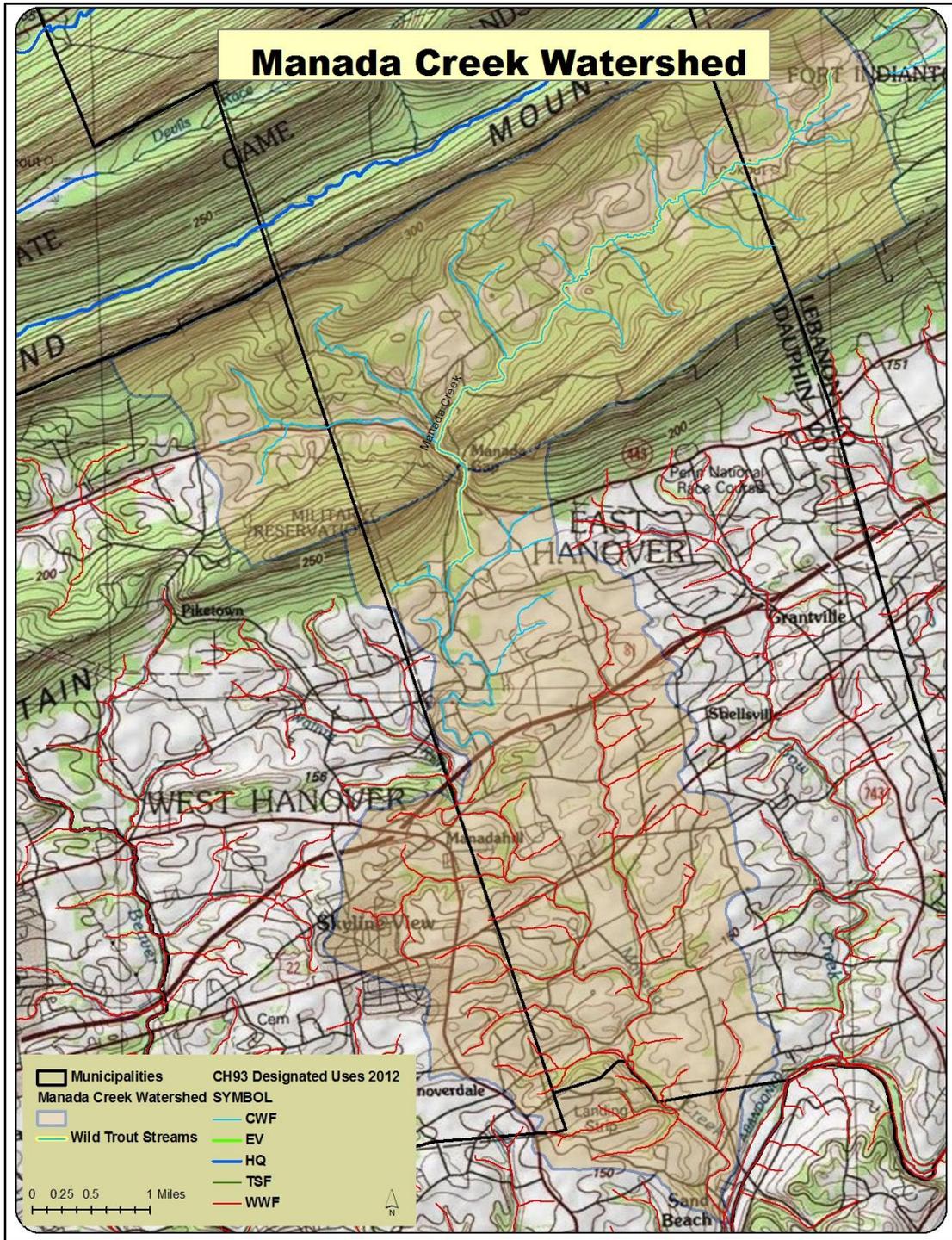


Figure 2. Stream Designations in the Manada Creek Watershed

This Coldwater Conservation Plan focuses on the upper, coldwater section of the watershed, located north of Instate 81, as depicted in Figure 3. This section of the watershed encompasses approximately 17 square miles and includes 29 stream miles.

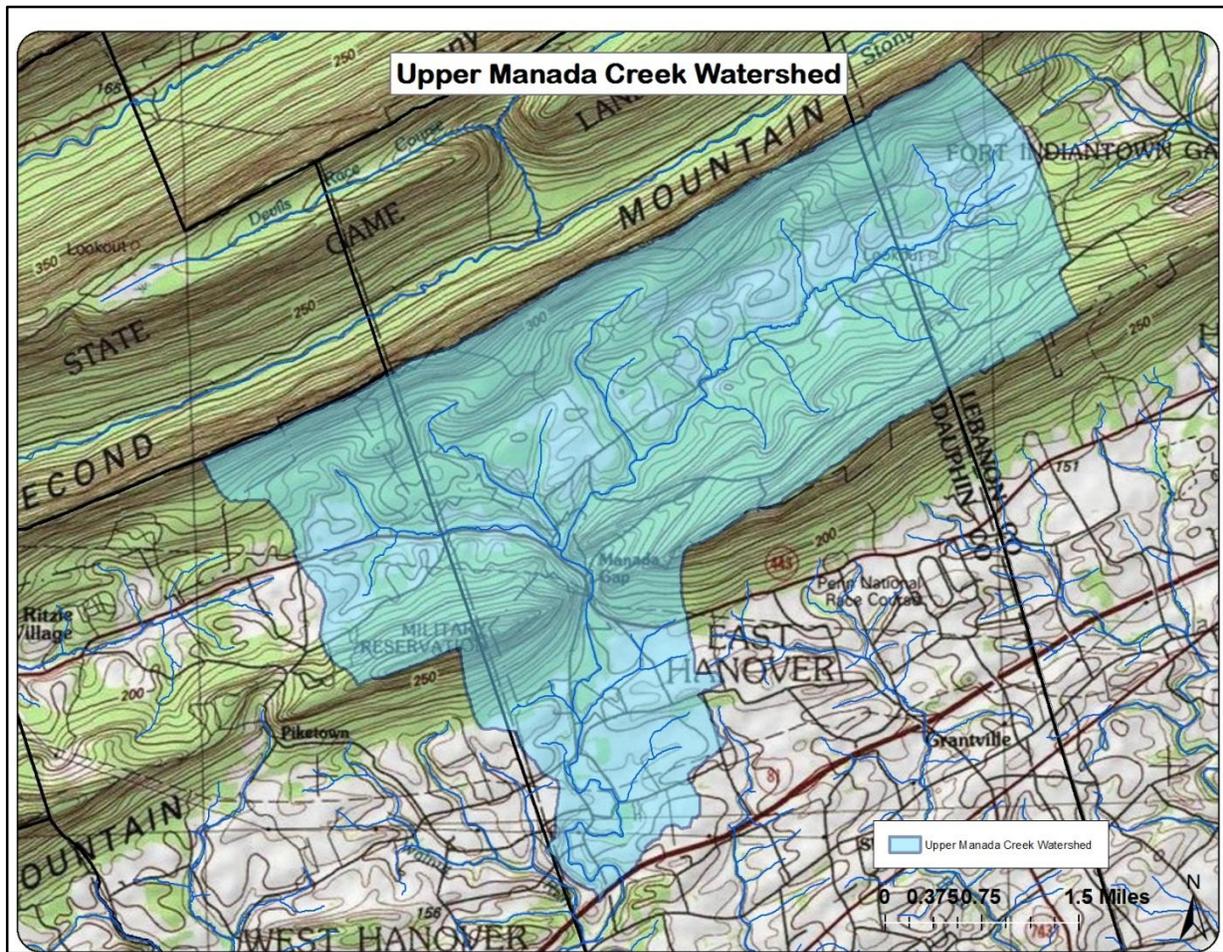


Figure 3. The Upper, Coldwater section of the Manada Creek Watershed

The landuse in the Upper Manada Creek Watershed is predominantly forest, with some agriculture and low density housing. Much of the watershed is owned by Fort Indiantown Gap Military Reservation, which uses vast expanses of land for tank roads and artillery ranges, which are open fields with shrubs and some bare earth. There has been an increase in sedimentation and streambank erosion due to land use and flooding in recent years. This is a concern for the aquatic habitat of macroinvertebrates and wild trout, as well as other fish.

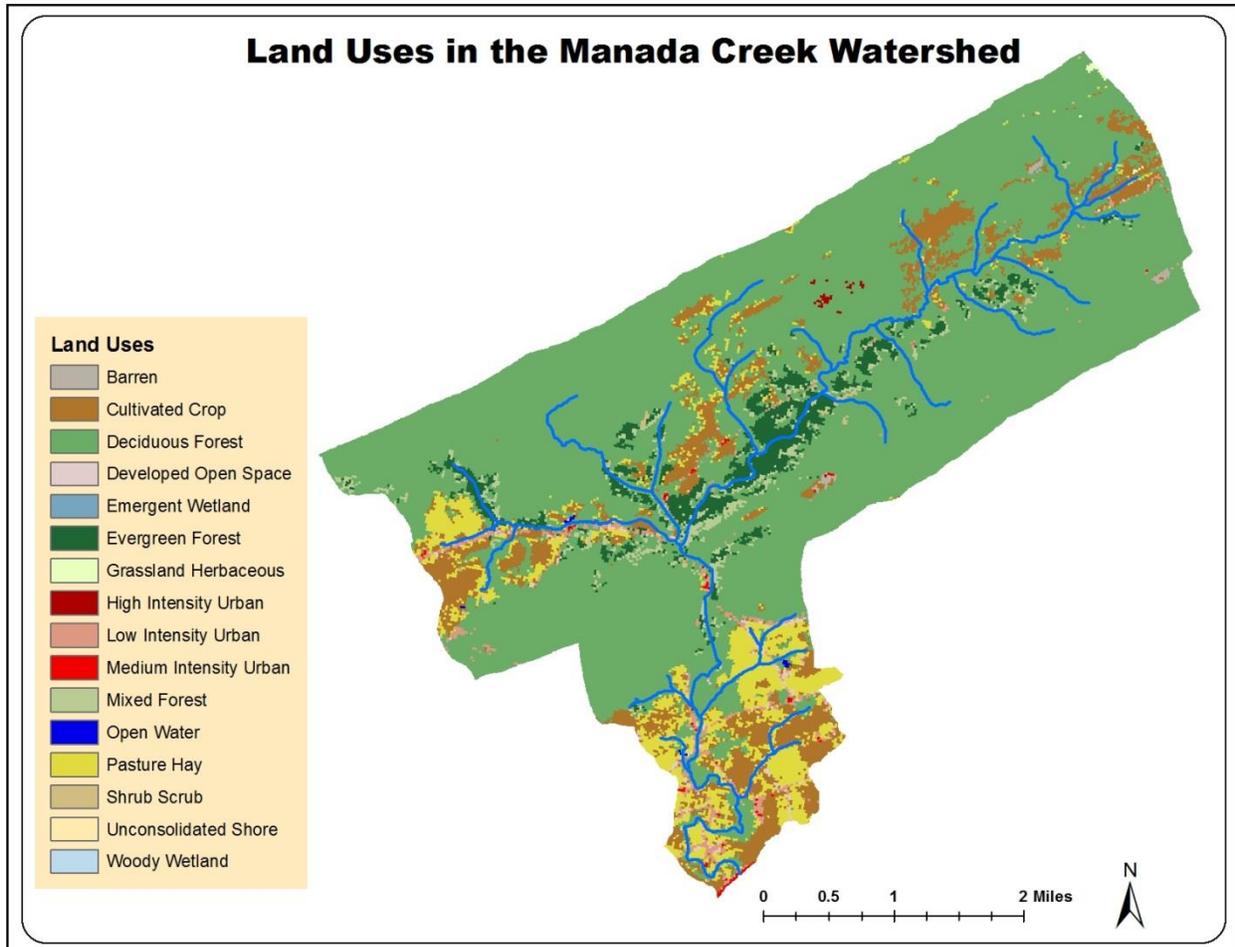


Figure 4. Land Use in the Upper Manada Creek Watershed. The land use layer is from the 2006 Chesapeake Bay Land Cover Dataset Series by the U.S. Geological Survey (PASDA)

In the headwaters of the watershed, 3.2 miles of stream are listed as non-attaining, or impaired, on Pennsylvania’s 2014 Integrated List. DEP cites the impairment as “road runoff-siltation.” As shown in Figure 5, the 3.2 stream miles that are listed as impaired because of siltation include the first 1.47 miles of the mainstem of the Manada Creek as well as three small unnamed tributaries.

In the 2104 Integrated List, 5 miles of the mainstem of Manada Creek were added as impaired because of pathogens from an unknown source. Additionally, all the tributaries of Manada Creek below Manada Gap, totaling over 4 stream miles, are also listed as impaired for pathogens. The majority of the watershed below I-81 is also listed as impaired on the 2014 Integrated List.

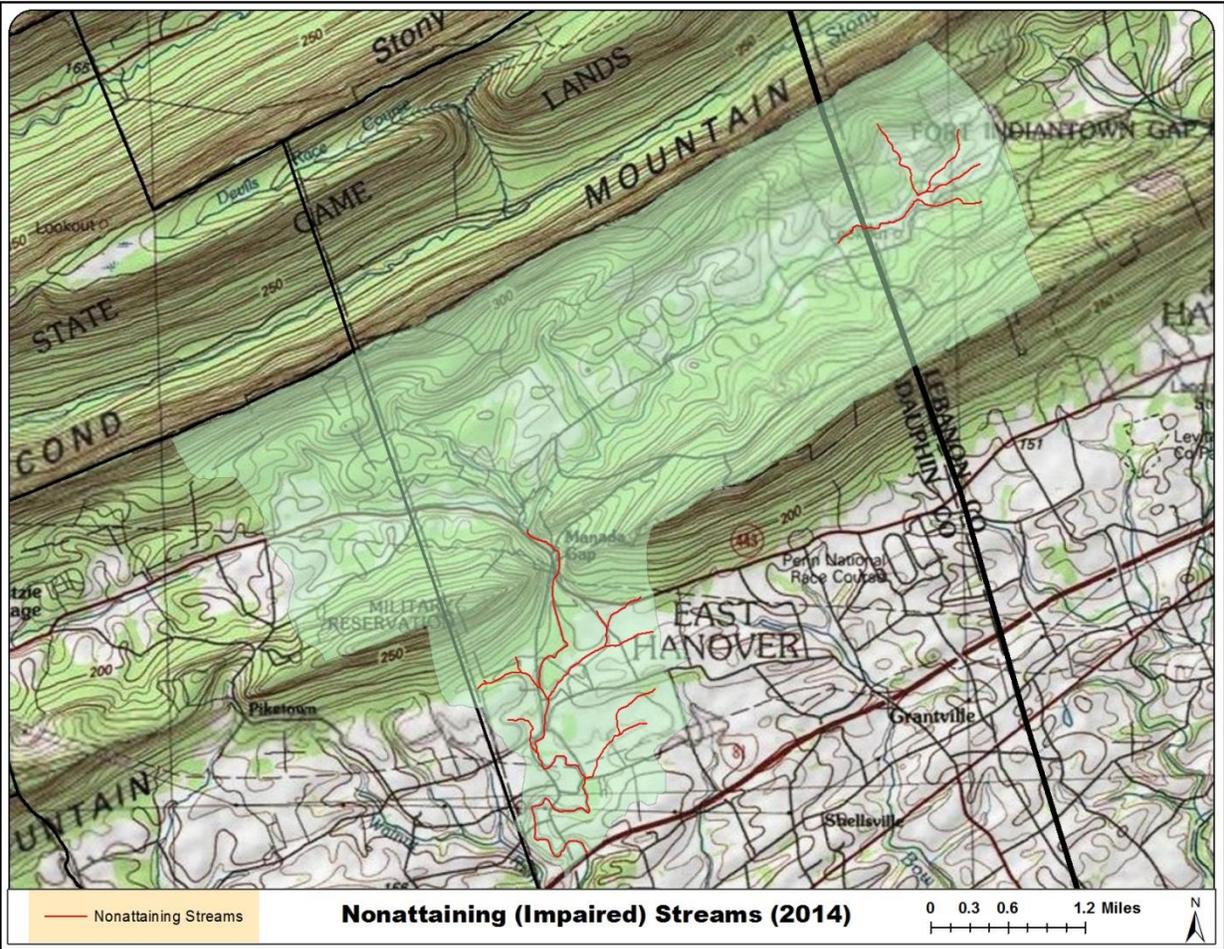


Figure 5. Map of the non-attaining, or impaired, streams in the Upper Manada Creek Watershed, as listed on Pennsylvania’s 2014 Integrated List.

Conservation Work and Watershed Groups

Manada Creek watershed, as a subwatershed of the Swatara Creek, is served by the Swatara Creek Watershed Association. However, the Swatara Creek Watershed is quite vast, and local leadership would be needed to coordinate with the watershed group to lead projects in the area.

The Doc Fritchey Chapter of Trout Unlimited has been active in the Manada Creek Watershed. They have been working with the Fish and Boat Commission to install fish habitat structures, which often serve a dual purpose of stabilizing streambanks. These structures, including log vanes and root wads, have been installed on a yearly basis in the Delayed Harvest area of Manada Creek.

II. Coldwater Conservation Plan

In early 2013, the Dauphin County Conservation District (DCCD) was awarded a Coldwater Heritage Grant to conduct a water quality assessment and draft the Coldwater Conservation Plan for the upper, coldwater section of Manada Creek. DCCD started the planning process by meeting with members of Doc Fritchey Chapter of Trout Unlimited and Joe Hovis, Wildlife Program Manager at Fort Indiantown Gap. They are familiar with the Manada Creek Watershed and are aware of past and present water quality issues and restoration efforts. The Fort Indiantown Gap Wildlife Office also conducts sampling in the watershed, both on and off of their property. With their input, DCCD planned where monitoring sites would be located in order to get a complete picture of the current water quality in the upper Manada Creek watershed.

On March 28th, 2013, DCCD held a public meeting at the East Hanover Township Building. A mailing was sent out to those who own land near the creek or its tributaries, the flyer was posted on DCCD's website, and was distributed further by the Doc Fritchey Chapter of Trout Unlimited. About 12 people attended the public meeting, where the watershed and planned monitoring was discussed. The main concerns raised by those in attendance were regarding erosion and debris from storm events. Erosion, and loss of land has occurred over the past few years as large storms have come through the area. The aftermath has sent large woody debris downstream, which can obstruct bridge culverts.

DCCD commenced water sampling in April by measuring flow rates, nutrients, and field chemistry throughout the year. Macroinvertebrates were sampled in April of 2014 and a fish survey was conducted in August of 2014.

III. Water Quality

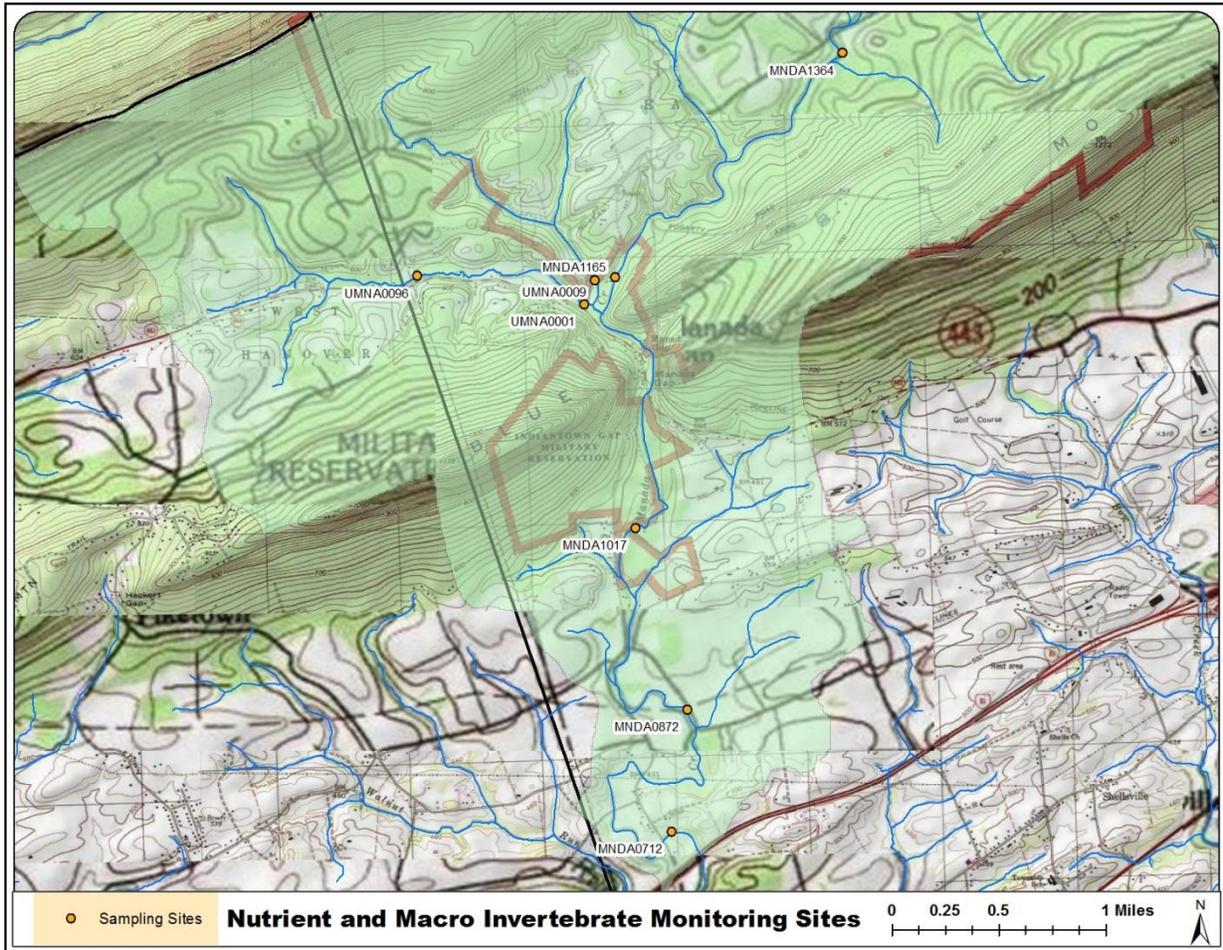


Figure 6. Map of monitoring sites where nutrient and macroinvertebrate was conducted for the Manada Creek Coldwater Conservation Plan.

Temperature

Manada Creek is designated as a Cold Water Fishery upstream of I-81. As defined in Chapter 93, a Cold Water Fishery (CWF) is a stream or a section of a stream that supports life of fish, flora, and fauna of a cold water habitat. Some waterways are protected by canopy, providing shade in the summer months, thus helping to keep the water temperature cooler for trout, among other organisms that can only survive in cool temperatures. The temperature requirements for a Cold Water Fishery are listed in Chapter 93 of the Pennsylvania Code. They are shown in Table 1, below.

All temperature data obtained during the assessment is displayed in Table 2, below. All temperatures in red exceed the temperature limits for a coldwater fishery, as outline in Chapter 93 of the PA Code.

Table 1: Temperature Standards Cold Water Fisheries. (25 Pa. Code § 93.4b).

<i>SYMBOL: CRITICAL USE: PERIOD</i>	<i>TEMP₁ CWF</i>
January 1-31	38
February 1-29	38
March 1-31	42
April 1-15	48
April 16-30	52
May 1-15	54
May 16-31	58
June 1-15	60
June 16-30	64
July 1-31	66
August 1-15	66
August 16-30	66
September 1-15	64
September 16-30	60
October 1-15	54
October 16-31	50
November 1-15	46
November 16-30	42
December 1-31	40

Table 2: Observed temperatures in the Manada Creek Watershed

Site	Date	Temperature (°F)
MNDA 07.12	4/24/2013	51.4
MNDA 08.72	4/24/2013	49.6
MNDA 10.17	4/24/2013	50.0
UMNA 00.01	4/24/2013	52.5
UMNA 00.01	6/27/2013	66.2
MNDA 10.17	7/11/2013	70.9
MNDA0872	7/11/2013	71.8
MNDA0712	7/11/2013	73.2
UMNA0096	9/5/2013	62.6
MNDA1017	9/5/2013	65.3
MNDA0872	9/5/2013	67.5
MNDA0712	9/5/2013	68.4
MNDA1364	9/20/2013	56.8
MNDA0712	11/6/2013	48.7
MNDA0872	11/6/2013	47.1
MNDA1017	11/6/2013	47.1
UMNA0001	11/6/2013	48.4
UMNA0096	1/13/2014	40.6
UMNA0001	1/13/2014	39.2
MNDA1017	1/13/2014	39.0
MNDA0872	1/13/2014	39.0
MNDA0712	1/13/2014	39.0
UMNA0009	1/13/2014	41.5
MNDA1364	2/25/2014	37.4
UMNA0096	3/21/2014	41.2
UMNA0009	3/21/2014	44.1
UMNA0001	3/21/2014	43.9

MNDA1017	4/14/2014	51.8
MNDA0872	4/14/2014	53.2
MNDA0712	4/14/2014	55.0
MNDA1364	4/22/2014	49.5
MNDA0712	4/23/2014	48.4
MNDA0872	4/23/2014	47.8
MNDA1017	4/23/2014	47.5
UMNA0001	4/23/2014	48.2
MNDA1165	4/23/2014	47.7
UMNA0096	6/4/2014	56.8
UMNA0001	6/4/2014	57.9
MNDA1017	6/4/2014	57.0
MNDA0872	6/4/2014	60.1
MNDA0712	6/4/2014	61.7
UMNA0009	6/4/2014	64.6

Field Chemistry and Nutrient Sampling

DCCD conducted regular flow, field chemistry, and nutrient sampling throughout the year. Flow was measured using a rod to measure water depth, measuring tape, and pygmy wheel with Swoffer retrofit that calculates flow based upon depth and space between measurements (manually entered) and wheel rotations that are counted by the meter. YSI handheld meters were used to measure pH, dissolved oxygen, conductivity, and temperature. Nutrients samples, as well as one iron sample, were analyzed in-house by DCCD, using a colorimeter. Funding was available to send nutrient samples to ALS, a lab accredited by DEP, in April and June 2014.

All of the pH values were in the normal range - between 6 and 8. There was a low level of iron present in the unnamed tributary that runs along State Route 443. Some iron is common in the area due to the geology.

For the most part, dissolved oxygen (DO), was above 9.0 mg/L. DO is very important for the survival of fish and all aquatic organisms. As water temperature rises, DO decreases. DO is higher in riffle areas. The lowest DO during the assessment was recorded at the most downstream sampling site, MNDA 07.12 on July 11, 2013. The water temperature was very high, 73°F.

Conductivity, or the measure of ions in the water, was all well below 200 $\mu\text{S}/\text{cm}^3$, the level at which it can be cause for concern. Conductivity can spike when road salts are washed into the road following winter application.

The samples were all analyzed for nutrients, nitrogen and phosphorus. All of the nutrient concentrations were well below the drinking water limits of 10 mg/L. Even in the higher flows,

the nutrient levels stayed low. Although all nutrient concentrations measured during the study were relatively low, there were a couple of things to note. One sample at UMNA 00.95 had a total Nitrogen concentration of 3.5 mg/L, and an Orthophosphate concentration of 0.12 mg/L was found in one sample at MNDA 08.72. While these concentrations would be considered low compared to nearby impaired watersheds, they are high for a mostly forested watershed that should have few impairments. The USGS Report, compiled from a water quality analysis completed during 2002-2005, found that nutrient concentrations in the Manada Creek were less than those in other Lower Susquehanna streams¹.

High nutrient concentrations can cause algae and eventually lead to eutrophication, or the depletion of oxygen in the water when algae and other aquatic plants die. Although eutrophication is the extreme, algae is prevalent in Manada Creek during the summer. It coats the bottom, similar to sediment, and fills up habitat for macroinvertebrates and areas where fish could spawn. Any nutrient loading will contribute to nutrient levels downstream, in the Swatara Creek and eventually the Susquehanna River.

Table 3: Nutrient and Field Chemistry Data Collected for the Manada Coldwater Conservation Plan

Date	Nutrient Analysis	Flow (cfs)	pH	Conductivity ($\mu\text{S}/\text{cm}^3$)	DO (mg/L)	Nitrate N (mg/L)	Ortho Phosphate (mg/L)	Iron (mg/L)	Total Nitrogen (mg/L)	TKN (mg/L)	Total Phosphorus (mg/L)
MNDA 07.12											
4/24/2013	DCCD in-house	22.77	7.46	64.5	10.86	0.32	0				
7/11/2013	DCCD in-house	9.75		70.8	5.91	0.2	0.02				
9/5/2013	DCCD in-house	4.88	7.66	73.4	8.85	0.03	0.01				
11/6/2013	DCCD in-house	6.29	7.54	78.1	9.60	0.18	0				
1/13/2014	DCCD in-house	52.04	6.75	83.3	13.30	0.56	0				
4/14/2014	ALS	43.78	7.92	58.5	10.82	0.54	0		0	0	0
6/4/2014	ALS	27.60	7.37	54.4	9.75	0.49	0		0	0	0
MNDA 08.72											
4/24/2013	DCCD in-house	19.11	7.31	58.6	9.86	0.32	0.12				
7/11/2013	DCCD in-house	11.64	7.64	61.0	8.41	0.16	0.02				
9/5/2013	DCCD in-house	3.10	7.65	63.5	7.83	0.05	0.03				
11/6/2013	DCCD in-house	5.06	7.37	64.0	9.40	0.1	0.01				
1/13/2014	DCCD in-house		6.44	73.1	13.58	0.47	0				
4/14/2014	ALS	38.02	7.55	53.4	10.69	0.53	0		0	0	0

6/4/2014	ALS	18.48	7.17	47.2	9.90	0.45	0		0	0	0
MNDA 10.17											
4/24/2013	DCCD in-house	20.18	7.28	49.1	11.36	0.37	0				
7/11/2013	DCCD in-house	9.77	7.35	53.4	9.11	0.19	0.05				
9/5/2013	DCCD in-house		7.48	54.7	9.05	0	0				
11/6/2013	DCCD in-house	5.88	7.16	51.8	10.62	0.1	0.01				
1/13/2014	DCCD in-house	51.68	6.53	60.8	13.25	0.47	0				
4/14/2014	ALS	50.18	7.03	46.0	10.76	0.54	0		0	0	0
6/4/2014	ALS	28.84	6.94	40.4	10.70	0.44	0		0	0	0
MNDA 13.64											
9/20/2013	DCCD in-house	1.06	7.22	39.4	10.06	0	0.05				
2/25/2014	DCCD in-house	19.82	6.49	33.0	12.77	0.15	0.03				
4/22/2014	ALS/mac roinvert e brate sampling	14.46	6.81	30.2	12.05	0.17	0		0	0	0
UMNA 00.01											
4/24/2013	DCCD in-house	17.36	7.31	55.6	11.10	0.50	0				
6/27/2013	DCCD in-house	1.65		74.2	8.10	0.52	0.02				
11/6/2013	DCCD in-house	1.59	7.35	87.0	9.77	0.68	0.07				
1/13/2014	DCCD in-house	9.56	6.47	118.5	13.08	1.19	0.01				
3/21/2014	ALS	6.54	7.06	102.5	11.90	1.80	0		1.8	0	0
6/4/2014	ALS	4.13	7.05	70.8	9.90	1.10	0		1.1	0	0
UMNA 00.09											
1/13/2014	DCCD in-house	6.78	6.28	43.3	13.63	0.48	0.03				
3/21/2014	ALS	2.49	6.79	28.8	11.44	0.70	0		0	0	0
6/4/2014	ALS	2.92	7.58	60.4	10.10	0.61	0		0	0	0
UMNA 00.95											
6/27/2013	DCCD in-house					0.52	0.05				
9/5/2013	DCCD in-house	1.61	7.23	67.2	8.75	0.1	0	0.07			
1/13/2014	DCCD in-house	7.67	6.50	115.1	12.97	1.25	0.01				
3/21/2014	ALS	3.79	6.57	94.5	11.94	1.80	0		3.5	1.7	0
6/4/2014	ALS	3.07	6.86	67.8	10.44	1.10	0		1.1	0	0

Macroinvertebrate Sampling

DCCD follows DEP's Instream Comprehensive Evaluation (ICE) protocol for macroinvertebrate sampling. At each site, a D-net is used for six kicks, working downstream to upstream over a 100 meter section. A "kick" entails kicking up all rocks and debris on the bottom of the stream, while standing upstream of the net, over a square meter. All large debris is removed and rinsed in the net, and all the debris collected is preserved for lab analysis.

The samples are then subsampled in-house. Subsampling involves sorting all collected debris and macroinvertebrates using a pan that is marked off in quadrants. Quadrants are randomly selected and all macroinvertebrates are picked out of them until 200 are selected. These randomly selected macroinvertebrates are then identified down to the genus level when possible and if not, the family level.

Six different biological metrics are calculated for each sample. The metrics measure various factors and indicators, including the number of pollution tolerant and sensitive macroinvertebrates, diversity, and the percentage of the samples that are found to be sensitive of pollution. A description of the metrics used is below:

- Modified Beck's Index: Weighted count of taxa with pollution tolerance values (PTVs) of 0, 1, and 2 (pollution tolerant taxa) – decreases in value with increasing stress
- EPT Taxa Richness: Count of Ephemeroptera (Mayfly) + Plecoptera (Stonefly) + (Trichoptera) Caddisfly
- Total Taxa Richness: Number of taxa in sample
- Shannon Diversity Index: Formula for measuring diversity of the sample, decreases in value with increasing stress
- Hilsenhoff Biotic Index: Average of pollution tolerance values weighted by number of individuals in each taxa; increases in value with increasing stress
- %PTI (Pollution Intolerant Individuals): $(\# \text{ of PTV } 0-3) / \text{sample size} \times 100$

The only metric that increases in value with stress is the Hilsenhoff Biotic Index, all of the other decrease in value as anthropogenic stress increases. The metric values are then standardized and averaged to compute the overall Index of Biological Integrity (IBI). IBI scores range from 0 to 100, with a higher score indicating better stream health. For DEP assessment purposes, an IBI score of equal to or greater than 83 is a benchmark for High Quality and Exceptional Value streams. Other IBI ranges are below:

- Good (63-100): Optimal site with a balanced community of pollution sensitive and tolerant organisms.
- Fair (50-62): Significant decrease in pollution-sensitive species, unbalanced site with sub-optimal habitat.
- Poor (0-49): Degraded site dominated by tolerant organisms. Site is not attaining aquatic life use.

Manada Creek Macroinvertebrate Sampling

Volunteers from the Doc Fritchey Chapter of Trout Unlimited assisted in the collection of the macroinvertebrates at six sites. Pictures of the collection are included in Attachment V. The macroinvertebrates were sampled in-house by DCCD and then were sent off to Water Assessment Associates, LLC to be identified. Most were identified to family, while some were identified to genus. The taxa list was sent back to DCCD and then the metrics and IBI scores were calculated. Table 4 shows the resulting IBI scores at the six macroinvertebrate sampling sites in the Manada Creek watershed. Sites are depicted on Figure 6.

<i>Table 4: Manada Creek macroinvertebrate samples, Index of Biological Integrity (IBI) scores</i>		
Site	Date	IBI
MNDA 07.12	4/23/2014	58.37
MNDA 08.72	4/23/2014	58.95
MNDA 10.17	4/23/2014	71.45
MNDA 11.65	4/23/2014	75.99
MNDA 13.64	4/22/2014	79.87
UMNA 00.01	4/23/2014	55.35

The two downstream sampling sites, as well as the one on the unnamed tributary (the west branch), all had IBI scores in the 50s, which indicate fair water quality. The rest are between 70-80, which is good. Below, Table 5 has all of the metrics calculated for each of the six sites. Again, most of the metrics, with the exception of the Hilsenhoff Biotic Index (HBI), decrease as anthropogenic increase. In other words, the lower the score, the more pollution (and the opposite is true for the HBI score). Sites MNDA 07.12, MNDA 08.72, and UMNA 00.01 all had lower Becks Index, EPT Taxa Richness, and % Intolerant Individuals. This shows that those samples had more pollution tolerant macroinvertebrates.

Table 5: Metric Calculations for the Manada Creek Macroinvertebrate Samples

MNDA 07.12	HBI=	2.23	MNDA 11.65	HBI=	2.06
	Total Taxa =	20		Total Taxa =	27
	Becks 3=	10		Becks 3=	19
	Shannon Div=	1.99		Shannon Div=	2.64
	EPT Taxa (0-4)=	10		EPT Taxa (0-4)=	12
	%PTV (0-3)=	38.18		%PTV (0-3)=	59.62
MNDA 08.72	HBI=	2.67	MNDA 13.64	HBI=	1.80
	Total Taxa =	20		Total Taxa =	31
	Becks 3=	12		Becks 3=	17
	Shannon Div=	2.30		Shannon Div=	2.42
	EPT Taxa (0-4)=	9		EPT Taxa (0-4)=	17
	%PTV (0-3)=	36.63		%PTV (0-3)=	55.05
MNDA 10.17	HBI=	2.32	UMNA 00.01	HBI=	3.13
	Total Taxa =	24		Total Taxa =	22
	Becks 3=	16		Becks 3=	10
	Shannon Div=	2.48		Shannon Div=	2.46
	EPT Taxa (0-4)=	13		EPT Taxa (0-4)=	8
	%PTV (0-3)=	54.11		%PTV (0-3)=	22.29

Table 6: IBI scores at CSAP sites in the Manada Creek Watershed

Site	Date	IBI
MNDA 10.17	3/30/2007	65.92
MNDA 10.17	2/7/2012	61.97
MNDA 10.17	4/23/2014	71.45
MNDA 13.64	3/30/2007	73.85
MNDA 13.64	5/16/2012	58.96
MNDA 13.64	4/22/2014	79.87

DCCD conducts macroinvertebrate sampling in streams throughout Dauphin County on a five year rotation under the Countywide Stream Assessment Program (CSAP). Two sites, MNDA 10.17 (at Furnace Rd.) and MNDA 13.64 (at McLean Rd. in Fort Indiantown Gap) are also CSAP sites that were previously sampled by DCCD in 2007 and 2012. Table 6 shows the current IBI scores, compared to those in previous sampling rounds. The scores of site MNDA 13.64 fluctuated quite a bit. 2012 samples may have been affected by large storm events that occurred in the fall of 2011.

Habitat Assessments

Qualitative habitat assessments were performed on 100 meter stretches at each of the six macroinvertebrate sites. These assessments take into account twelve parameters including the quality of streambanks, streambeds, and the surrounding land use. Each parameter is rated 0-20, with the scores of 16-20 indicating an optimal stream and 11-15 indicating a suboptimal stream. Table 8, below, displays the scores of each parameter for every site. The sites with the three lowest scores; MNDA 07.12, MNDA 08.72, and UMNA 00.01; are also the sites that had the lowest IBI values. The most common problems were lack of instream cover, embeddedness, and bank erosion.

Table 7: Habitat Assessment Scores in the Manada Creek Watershed

Habitat Parameter	MNDA 07.12	MNDA 08.72	MNDA 10.17	UMNA 00.01	MNDA 11.65	MNDA 13.64
Instream Cover	13	14	18	10	15	16
Epifaunal Substrate	18	18	18	18	18	17
Embeddedness	14	11	11	13	18	12
Velocity/Depth Regimes	18	13	18	13	18	18
Channel Alteration	18	15	18	11	18	18
Sediment Deposition	18	18	12	14	11	11
Frequency of Riffles	18	18	18	15	18	18
Channel Flow Status	16	18	15	15	16	16
Condition of Banks	9	16	15	16	11	11
Bank Vegetative Protection	13	18	14	17	16	13
Grazing or Other Disruptive Pressure	16	12	16	18	16	18
Riparian Vegetative Zone Width	16	10	16	12	11	18
Total	187	181	189	172	186	186

Fish Survey

On July 23rd, staff from DCCD worked with biologists from the PA Department of Environmental Protection (PA DEP) and two volunteers from the Doc Fritchey Chapter of Trout Unlimited to conduct a fish survey. The purpose of the survey was to see if there was a wild trout population outside of the existing section of Manada Creek that is designated as supporting wild brown trout, as well as noting other species found. For that reason, the section of Manada Creek from Furnace Rd. upstream, which is designated as a wild trout stream, was not surveyed since it is known to have a viable population of wild trout.

A total of four sites were surveyed – two on Manada Creek below Furnace Road, and two small unnamed tributaries that enter at Manada Gap. The four sites are shown on the map below. PA DEP biologists used two electrofishing backpack units to create a current in the water. All species of fish netted were noted, and all trout found were placed in buckets and measured.

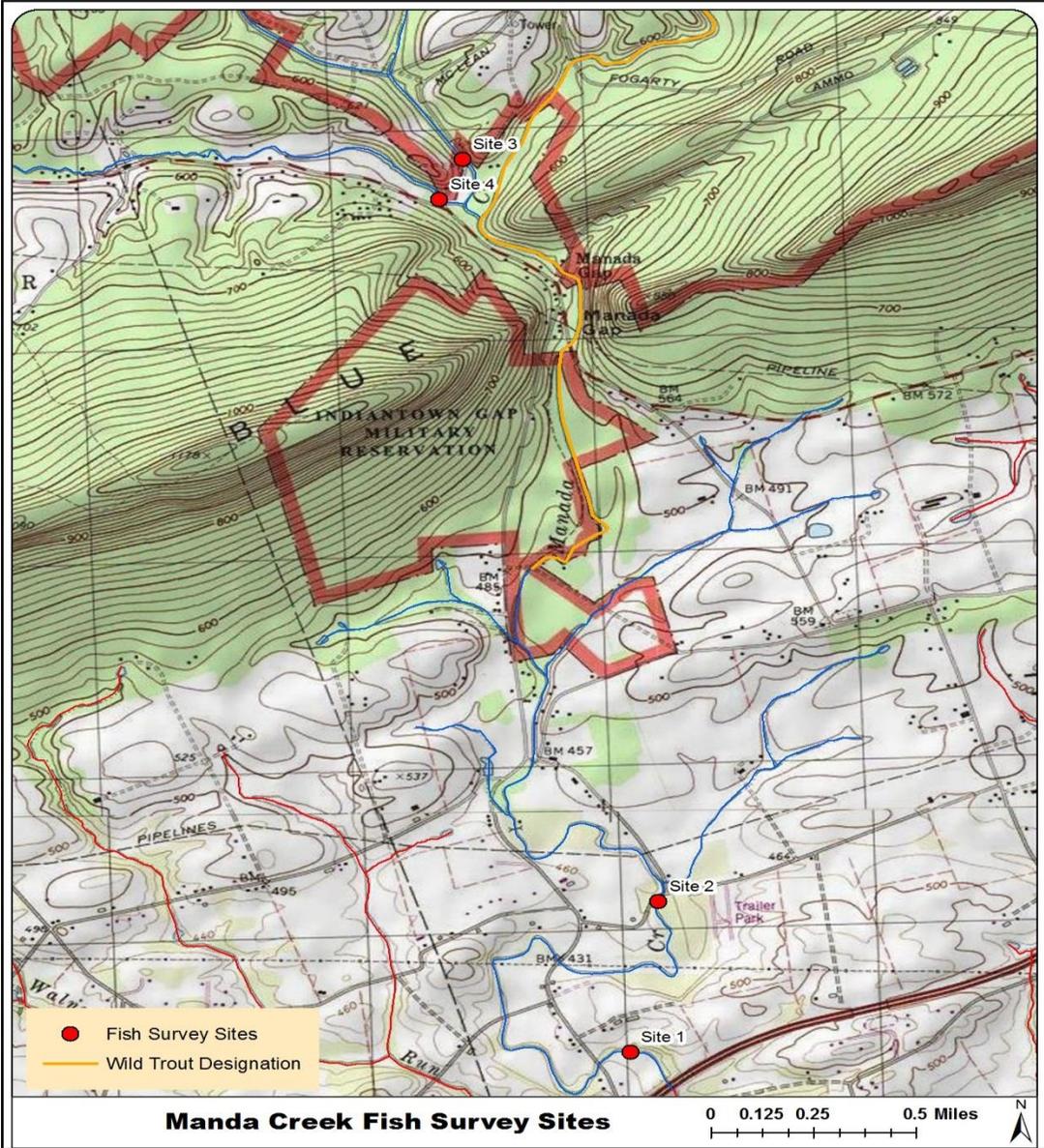


Figure 7. Manada Creek Fish Survey Sites



DCCD and DEP staff, along with Doc Fritchey Chapter of TU (DFTU) volunteers conduct a fish survey (photos from DFTU)

Table 8: Fish Survey Results

Site 1

<u>Species</u>	<u>Prevalence</u>
White Sucker	Common
Smallmouth Bass	Present
Fallfish	Common
Rock Bass	Present
Northern Hog Sucker	Present
Margined Madtom	Present
Greenside Darter	Rare
Cutlips Minnow	Present
Longnose Dace	Common
Blacknose Dace	Abundant

Site 2

<u>Species</u>	<u>Prevalence</u>	<u>Size Range (trout)</u>
Blacknose Dace	Common	
Cutlips Minnow	Present	
Brown Trout	Rare (1)	150-174 mm
Rock Bass	Present	
River Chub	Present	
Margined Madtom	Present	
Longnose Dace	Present	
Central Stoneroller	Present	
Bluegill	Present	

Site 3

<u>Species</u>	<u>Prevalence</u>	<u>Size Range (trout)</u>
Tesselated Darter	Present	
Creek Chub	Common	
Blacknose Dace	Abundant	
White Sucker	Common	
Brown Trout	Present (3)	60-74 mm
Brook Trout	Rare (1)	175-199 mm

Site 4

<u>Species</u>	<u>Prevalence</u>	<u>Size Range (trout)</u>
Blacknose Dace	Abundant	
Creek Chub	Common	
Northern Hog Sucker	Present	
Brown Trout	Rare (1)	150-174 mm
Longnose Dace	Present	
White Sucker	Common	

Sedimentation was noted during the fish survey, especially at sites 2 and 4. The fish found at Sites 1 and 2, on the mainstem of Manada Creek, were comprised of a good diversity and were both warm and coldwater fish. The tributaries further upstream held a fish population indicative of coldwater streams. Trout were present, in low numbers, at sites 2, 3, and 4. A single brook trout was present at Site 3, the unnamed tributary that flows down from Fort Indiantown Gap.

IV. Future Priorities for Restoration

Sediment is a problem throughout most of the stream sections that were monitored. Sediment causes many problems in streams. It can alter stream flow and fill up crevices in the stream bottom that serve as habitat for macroinvertebrates and other aquatic organisms. Not only is sediment a pollutant itself, but nutrients, both phosphorus and nitrogen, adhere to sediment. Streambank erosion is evident throughout the watershed and is an obvious source of some sedimentation. Large storm events, which are occurring more frequently, exasperate the problem.

The sites that had lower habitat assessment scores and IBI values were downstream of the development in the watershed. Although erosion is natural and storm events can cause major damage, some actions can be taken to reduce erosion. Throughout the watershed, any timber cutting and earth disturbances, if they must be done, should be carried out with careful planning to incorporate erosion and sedimentation control practices. Trees should be left near waterways to create a buffer to slow, or mitigate, runoff. High temperatures were a problem, especially in

the lower portion of the study area. Tree cover will also help to shade the stream and keep temperatures lower.

The stream corridor, including both the stream channel and areas directly along the stream should be the first priority for restoration projects. Best management practices (BMPs) in this area will result in the greatest water quality benefits. Planting of riparian buffers in areas that have little vegetation along the stream would be a beneficial BMP for the Manada Creek in order to establish tree cover, as well as root systems to hold the soil in place and filter runoff. DFTU, with the assistance of the PA Fish and Boat Commission, has been undertaking fish habitat improvement projects along the special regulation area of Manada Creek. These efforts should continue to restore habitat. Streambank stabilization structures, such as log vanes and mounds, are needed in other areas of the watershed as well. The photo below shows one highly eroded section of streambank near the downstream limits of the sampling area.



Eroded Streambank near site MNDA 07.12, downstream of Manada Bottom Rd.

Although most of the watershed is forested, there are several kinds of land use within the watershed – military training ranges and tank trails, other trails for off-road vehicles, agriculture, and residential (including cabins). There are many practices that can be followed in every land use to minimize water quality impacts. Off-road vehicles and the trails where they are used can be a source of a lot of sediment if they are not managed correctly. Stream and wetland areas should be avoided. It is important for there to be infiltration areas, or essentially areas of vegetation where runoff and sediment can soak into the ground, between trails where off-road use is heavy and nearby streams and wetlands.



The pictures above are of both banks of an unnamed tributary to Manada Creek where an off-road vehicle has been driven through the creek.

There have been reports of sewage and/or grey water straight-piping in the watershed. These are obvious sources of pollution, that if they are occurring, should be stopped immediately. Pathogens and nutrients would result from sewage contamination. DEP and the municipalities are responsible for enforcing regulations concerning sewage. Proper septic system maintenance is also necessary to prevent impacting water quality.

Agriculture, if not managed correctly, can be a source of sediment and nutrients. There are a wide range of agricultural BMPs that can be incorporated into farms including fencing animals out of streams, runoff controls from animal concentration areas, installation of gutters on barns, and no-till or reduced tillage. If a farm has any animals, they should have a manure management or nutrient management plan that is followed. All farms should also have a Conservation Plan, outlining practices in place and BMPs planned. If assistance is needed, DCCD's Agricultural Technicians are available to help.

There are also numerous BMPs that can be carried out in residential settings to mitigate runoff and other pollutants. Some examples include the use of native plants in landscaping and establishing riparian buffers; minimal pesticide, herbicide, and salt applications; installation of rain gardens; using rain barrels; and washing cars on grass instead of driveways or other impervious services.

Although a broad range of actions can be taken to improve water quality in the watershed, below are priorities for projects and BMPs from stream conditions found during the assessment for this Coldwater Conservation Plan:

- Establishment and expansion of riparian buffer; specifically, between sites MNDA 08.72 and MNDA 07.12. There are sections of Manada Creek that have narrow or no buffers through that stretch.
- Streambank stabilization and fish habitat projects that not only create habitat, but also address eroding streambanks. Bank erosion was noted as a problem in the entire Manada Creek watershed; therefore projects along any stretch or tributary would result in benefits to water quality. The site pictured above, downstream of site MNDA 07.12, is one such example where streambank stabilization would be beneficial.
- Agricultural BMPs. The main area of agricultural land use in the upper Manada Creek Watershed, where the assessment was done, is along the “West Branch,” or the unnamed tributary that flows parallel to State Route 443. Agricultural BMPs implemented on farms in the headwaters of the tributaries will help to reduce nutrients and sediment in the stream.
- Education and enforcement about septic tank maintenance. Most of the houses are located in Manada Gap or along the “West Branch.” Any sewage or grey water issues should be addressed immediately.
- Continued coordination with Fort Indiantown Gap (FIG). As one of the largest, if not the largest, landowner in the watershed, land use practices by Fort Indiantown Gap can help far-reaching ramifications for water quality in Manada Creek. DCCD and FIG should continue to work together to ensure that erosion controls are in place during any earth disturbance and that proper maintenance practices are followed on FIG’s tank trails and dirt roads.

Trout populations, and some of the macroinvertebrate scores and habitat assessments, were lower than preferred. With a concentrated effort by landowners to address sources of pollution in the watershed, as well as restoration projects to stabilize eroding streambanks and establish fish habitat, Manada Creek can be a better, more abundant coldwater fishery.

Sources

1. Langland, M. J., Cinotta, P. J., Chichester, D. C., Bilger, M. D., and Brightbill, R. A.. 2010. *Surface-water quantity and quality, aquatic biology, stream geomorphology, and groundwater-flow simulation for National Guard Training Center at Fort Indiantown Gap, PA, 2002-2005*: U.S. Geological Survey Scientific Investigations Report 2010-5155, 180 p.
2. United States Environmental Protection Agency. 2001. *Ambient water quality criteria recommendations: information supporting the development of state and tribal nutrient criteria, rivers and streams in nutrient ecoregion IX*. Office of Water. EPA 822-B-00-020. Accessed at <http://www2.epa.gov/sites/production/files/documents/rivers11.pdf>.
3. United States Geological Survey. 2006. *Chesapeake Bay Watershed Land Cover Data Series*. Accessed at http://www.pasda.psu.edu/uci/MetadataDisplay.aspx?entry=PASDA&file=CBWLCD_2006.xml&dataset=1333.

Table n. 764237 DMS or 402226764237. Site established 3/13/2012 by Fisheries Management Area 7. This site is currently located within Section Number 3, 07D.

Air Temperature (°C): 18
 General Chemistries Sample Time of Day: 1100
 Site Secchi Disk Depth Reading: Not Collected
 Secchi Disk Sample Time of Day: Not Collected
 Dissolved Oxygen Test: Dissolved Oxygen Field Electrometric
 Alkalinity Test: Total Alkalinity Field Mixed Indicator
 Hardness Test: Total Hardness Field EDTA
 pH Test: pH Field Colorimetric

Depth (m)	Temp (°C)	D.O. (mg/l)	Alk. (mg/l)	Hard. (mg/l)	Sp Cond. (umhos/cm@25°C)	pH (su)
0.2	9.3	11.96	22	20	53	6.8

No Additional Chemistries Collected

Table n. Length/frequency distribution and biomass statistics for all species enumerated from Manada Creek (0707D). Site located at River Mile 9.12 with a site Lat/Lon of 402226/764237 DMS or 40.373970 -76.710230 DD. Site currently located within section 3. Survey Date: 3/13/2012. Collection gear Electrobackpack.

Site Area (Ha): 0.2640 Site Length (m): 330

Length Group (mm)	Mean Catch Weight (g)	Weight Used From	Estimated Kg/Ha	Estimated Number/Ha	Estimated Number/Km
Brown Trout - Hatchery	1111	27	StateMeanWt	102	82

Total	27	0	Total Kg	102	82
-------	----	---	----------	-----	----

Rainbow Trout
- Hatchery

1111	18		StateMeanWt	68	55
Total	18	0	Total Kg	68	55

This form is designed to accept data "SCORE" from : Form 2 - Appendix A-1, Rapid Bioassessment Protocols For Use In Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish, Second Edition.

You are currently retrieving data from the following established site:

Water: Manada Creek **SubSubbasin** - 07D **Water LatLon** = 401818 / 764006

Site Lat/Lon: 402226 / 764237 **Site** 3/13/2012
Date:

Site Survey Stocked Trout Movement Study
Purpose:

Site River Mile: 9.12

Time of Day Assessment Conducted 11:00
(2400hrs):

Habitat Parameter Reported	Score	Habitat Parameter Reported	Score
1. Epifaunal Substrate / Available Cover:	10	8. (LB) Left Bank Stability (LB):	5
2. Embeddedness:	12	8. (RB) Right Bank Stability (RB):	4
3. Velocity / Depth Regime:	16	9. (LB) Left Bank Vegetative Protection:	8
4. Sediment Deposition:	14	9. (RB) Right Bank Vegetative Protection:	8
5. Channel Flow Status:	18	10. (LB) Left Bank Riparian Vegetative Width:	5
6. Channel Alteration:	17	10. (RB) Right Bank Riparian Vegetative Width:	6
7. Frequency of Riffles (or bends):	17	Entered Comments:	
Total Score:		No Comments Entered	
140			

Table n. Collection site information from Manada Creek at site rivermile 9.12 with Site Latitude 402226 Longitude 764237 DMS or 40.373970 -76.710230 DD using Electrobackpack gear. Site established 3/13/2012 by Fisheries Management Area 7. This site is currently located within Section Number 3 within sub-subbasin 07D.

Site Parameter	Parameter Value
Survey Purpose	Stocked Trout Movement Study

Site USGS 7.5 min Quad(s)	Site USGS Quad(s) Location: P32-Hershey
Site Sub-SubBasin	7D
Site Length (m)	330
Mean Site Width (m)	8
Site Area Hectares	0.26
Site Area Acres	0.65
County of Site	Dauphin
Law Enforcement Region	SC
Law Enforcement District	6085
WCO	Sweppenhiser, Mark A.
Site Erosion	Not Recorded
Site Water Flow	Normal (water close to normal water line)
Site Shade Assessment	Not Recorded
Site Terrestrial Vegetation Assessment	Not Recorded
Database Site Collector Code	07
Database Site Number	4815
Site Comment	220 M DNS Pipeline Crossing

Additional data recorded for Electro Fishing sampling from Manada Creek (0707D). Site located at River Mile 9.12 with a site Lat/Lon of 402226/764237 DMS or 40.373970 -76.710230 DD. Site currently located within section 3. Survey Date: 3/13/2012.

Number of netters	2
Average Voltage	250
Average Watts	100
Current Description	AC-Alternating Current (generator w/shock box)
Electrode Description	Two Fiberglass Poles / (Booms)
Electrode Configuration	8 Inch Diameter Ring
Anode Mobility Status	Movable
Average Pulse Width	0.00
Pulses Per Second	0.0

Table n. Fish collected from Manada Creek at site rivermile 9.12 with Site Latitude 402226 Longitude 764237 DMS or 40.373970 -76.710230 DD using Electrobackpack gear. Site established 3/13/2012 by Fisheries Management Area 7. This site is currently located within section 3, 07D.

Common Name	Scientific Name	Coarse Abundance
Blacknose Dace	Rhinichthys atratulus	Rare (<3)
Brown Trout - Hatchery	Salmo trutta	Common (26-100)

Central Stoneroller	Campostoma anomalum	Present (3-25)
Creek Chub	Semotilus atromaculatus	Rare (<3)
Fallfish	Semotilus corporalis	Present (3-25)
Longnose Dace	Rhinichthys cataractae	Common (26-100)
Margined Madtom	Noturus insignis	Rare (<3)
Northern Hog Sucker	Hypentelium nigricans	Present (3-25)
Rainbow Trout - Hatchery	Oncorhynchus mykiss	Present (3-25)
River Chub	Nocomis micropogon	Common (26-100)
Rosyface Shiner	Notropis rubellus	Present (3-25)
Shield Darter	Percina peltata	Rare (<3)
Tessellated Darter	Etheostoma olmstedi	Rare (<3)
White Sucker	Catostomus commersonii	Rare (<3)

Data for Site 09.51

Table n. Chemistries collected from Manada Creek at site rivermile 9.51 with Site Latitude 402235 Longitude 764243 DMS or 402235764243. Site established 3/13/2012 by Fisheries Management Area 7. This site is currently located within Section Number 3, 07D.

Air Temperature (°C): 17
 General Chemistries Sample Time of Day: 1100
 Site Secchi Disk Depth Reading: Not Collected
 Secchi Disk Sample Time of Day: Not Collected
 Dissolved Oxygen Test: Dissolved Oxygen Field Electrometric
 Alkalinity Test: Total Alkalinity Field Mixed Indicator
 Hardness Test: Total Hardness Field EDTA
 pH Test: pH Field Colorimetric

Depth (m)	Temp (°C)	D.O. (mg/l)	Alk. (mg/l)	Hard. (mg/l)	Sp Cond. (umhos/cm@25°C)	pH (su)
0.2	10.3	11.43	14	22	50	6.8

No Additional Chemistries Collected

Table n. Length/frequency distribution and biomass statistics for all species enumerated from Manada Creek (0707D). Site located at River Mile 9.51 with a site Lat/Lon of 402235/764243 DMS or 40.376350 -76.711970 DD. Site currently located within section 3. Survey Date: 3/13/2012. Collection gear Electrobackpack.

Site Area (Ha): 0.3012 Site Length (m): 317

Length Group (mm)	Mean Catch Weight (g)	Weight Used From	Estimated Kg/Ha	Estimated Number/Ha	Estimated Number/Km
Brown Trout - Hatchery					
1111	37	StateMeanWt		123	117
Total	37 0	Total Kg		123	117

Rainbow Trout
- Hatchery

1111	11		StateMeanWt	37	35
Total	11	0	Total Kg	37	35

This form is designed to accept data "SCORE" from : Form 2 - Appendix A-1, Rapid Bioassessment Protocols For Use In Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish, Second Edition.

You are currently retrieving data from the following established site:

Water: Manada Creek **SubSubbasin** - 07D **Water LatLon** = 401818 / 764006

Site Lat/Lon: 402235 / 764243 **Site** 3/13/2012
Date:

Site Survey Stocked Trout Movement Study
Purpose:

Site River Mile: 9.51

Time of Day Assessment Conducted 11:00
(2400hrs):

Habitat Parameter Reported	Score	Habitat Parameter Reported	Score
1. Epifaunal Substrate / Available Cover:	9	8. (LB) Left Bank Stability (LB):	6
2. Embeddedness:	14	8. (RB) Right Bank Stability (RB):	6
3. Velocity / Depth Regime:	17	9. (LB) Left Bank Vegetative Protection:	7
4. Sediment Deposition:	3	9. (RB) Right Bank Vegetative Protection:	8
5. Channel Flow Status:	18	10. (LB) Left Bank Riparian Vegetative Width:	4
6. Channel Alteration:	15	10. (RB) Right Bank Riparian Vegetative Width:	5
7. Frequency of Riffles (or bends):	10	Entered Comments:	
Total Score: 122		No Comments Entered	

Table n. Collection site information from Manada Creek at site rivermile 9.51 with Site Latitude 402235 Longitude 764243 DMS or 40.376350 -76.711970 DD using Electrobackpack gear. Site established 3/13/2012 by Fisheries Management Area 7. This site is currently located within Section Number 3 within sub-subbasin 07D.

Site Parameter	Parameter Value
Survey Purpose	Stocked Trout Movement Study

Site USGS 7.5 min Quad(s)	Site USGS Quad(s) Location: P32-Hershey
Site Sub-SubBasin	7D
Site Length (m)	317
Mean Site Width (m)	9.5
Site Area Hectares	0.3
Site Area Acres	0.74
County of Site	Dauphin
Law Enforcement Region	SC
Law Enforcement District	6085
WCO	Sweppenhiser, Mark A.
Site Erosion	Not Recorded
Site Water Flow	Normal (water close to normal water line)
Site Shade Assessment	Not Recorded
Site Terrestrial Vegetation Assessment	Not Recorded
Database Site Collector Code	07
Database Site Number	4816
Site Comment	200 M DNS BRDG Intersection Manada Bottom/Cliff Road

Table n. Additional data recorded for Electro Fishing sampling from Manada Creek (0707D). Site located at River Mile 9.51 with a site Lat/Lon of 402235/764243 DMS or 40.376350 -76.711970 DD. Site currently located within section 3. Survey Date: 3/13/2012.

Number of netters	2
Average Voltage	250
Average Watts	125
Current Description	AC-Alternating Current (generator w/shock box)
Electrode Description	Two Fiberglass Poles / (Booms)
Electrode Configuration	8 Inch Diameter Ring
Anode Mobility Status	Movable
Average Pulse Width	0.00
Pulses Per Second	0.0

Table n. Fish collected from Manada Creek at site rivermile 9.51 with Site Latitude 402235 Longitude 764243 DMS or 40.376350 -76.711970 DD using Electrobackpack gear. Site established 3/13/2012 by Fisheries Management Area 7. This site is currently located within section 3, 07D.

Common Name	Scientific Name	Coarse Abundance
Blacknose Dace	Rhinichthys atratulus	Rare (<3)
Brown Trout - Hatchery	Salmo trutta	Common (26-100)

Common Shiner	<i>Luxilus cornutus</i>	Present (3-25)
Cutlips Minnow	<i>Exoglossum maxillingua</i>	Rare (<3)
Fallfish	<i>Semotilus corporalis</i>	Common (26-100)
Longnose Dace	<i>Rhinichthys cataractae</i>	Present (3-25)
Northern Hog Sucker	<i>Hypentelium nigricans</i>	Present (3-25)
Rainbow Trout - Hatchery	<i>Oncorhynchus mykiss</i>	Present (3-25)
River Chub	<i>Nocomis micropogon</i>	Present (3-25)
Rosyface Shiner	<i>Notropis rubellus</i>	Rare (<3)
Smallmouth Bass	<i>Micropterus dolomieu</i>	
White Sucker	<i>Catostomus commersonii</i>	Common (26-100)

Attachment II. Data from USGS's Surface-water quantity and quality, aquatic biology, stream geomorphology, and groundwater-flow simulation for National Guard Training Center at Fort Indiantown Gap, PA, 2002-2005

Stream site name and USGS identification number	Drainage area (mi²)	Total annual flow (ft³/s)	Annual yield [(ft³/s)/mi²]	Annual mean daily flow (ft³/s)	Maximum mean daily flow (ft³/s)	Minimum mean daily flow (ft³/s)
Indiantown Run (01572950)						
WY 2003	5.48	5,056	923	13.9	90	1.8
WY 2004		5,292	966	14.5	384	2.8
WY 2005		4,730	863	13.0	139	1.2
Manada Creek (01573482)						
WY 2003	8.59	7,589	883	20.8	201	1.7
WY 2004		7,848	913	21.5	819	4.0
WY 2005		6,010	700	16.5	215	1.7

Pg. 13 Average load of the study period was 3.98 ton/square mile

Table 6. Monthly and annual estimated sediment loads for the two continuous-record long-term sites at the Fort Indiantown Gap facility based on suspended sediment concentrations and turbidity values. Loads for September 2004 and total loads for 2004 are shown with and (without) the remnants of Hurricane Ivan.

Month	Indiantown Run loads (tons)			Manada Creek loads (tons)		
	2003	2004	2005	2003	2004	2005
October	9.1	41	4	12	69	12
November	12	11	31	11	27	30
December	15	62	63	29	69	57
January	11	7.1	59	19	17	66
February	4.8	4.9	6.9	3	16	13
March	68	7.1	81	94	18	98
April	11	37	79	10	85	79
May	9.8	20	4	15	23	7.3
June	33	9.1	15	46	26	3.6
July	12	16	21	12	22	24
August	51	32	1.5	63	34	3.6
September	61	931 (46)	.59	62	2,020 (55)	2.3
Totals	298	1,178 (293)	366	376	2,426 (461)	396

Table 7. Monthly and annual estimated sediment yields for the two long-term sites at the Fort Indiantown Gap facility, Lebanon and Dauphin Counties, Pa.

Month	Indiantown Run yields (tons per square mile)			Manada Creek yields (tons per square mile)		
	2003	2004	2005	2003	2004	2005
October	1.66	7.48	0.73	1.40	8.03	1.40
November	2.19	2.01	5.66	1.28	3.14	3.49
December	2.74	11.31	11.50	3.38	8.03	6.64
January	2.01	1.30	10.77	2.21	1.98	7.68
February	.88	.89	1.26	.35	1.86	1.51
March	12.41	1.30	14.78	10.94	2.10	11.41
April	2.01	6.75	14.42	1.16	9.90	9.20
May	1.79	3.65	.73	1.75	2.68	.85
June	6.02	1.66	2.74	5.36	3.03	.42
July	2.19	2.92	3.83	1.40	2.56	2.79
August	9.31	5.84	.27	7.33	3.96	.42
September	11.13	170 (8.39)	.11	7.22	235 (6.40)	.27
Totals	54.36	214.8 (53.52)	66.79	43.80	282.0 (53.64)	46.08
Average monthly	4.53	17.9 (4.46)	5.57	3.65	23.5 (4.47)	3.84

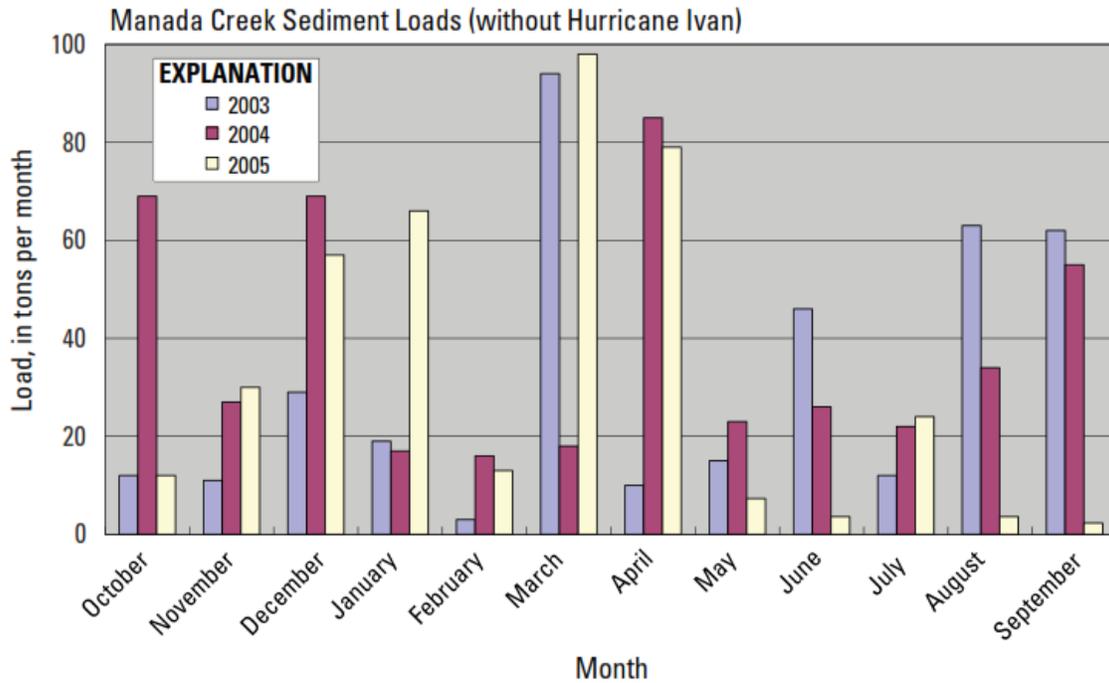


Figure 7. Sediment loads (tons) by month for years 2003 through 2005 at Manada Creek (01573482) with (top) and without (bottom) the remnants of Hurricane Ivan (note scales are not the same).

Pg. 15

Pg. 20

Drainage area (square miles)	Map number (fig. 9)	Station name	Site name	Latitude	Longitude
6.19	13	Manada Creek along McLean Road near Manada Gap, Pa.	mc-1	402506	764136
1.08	23	Unnamed tributary to Manada Creek near Manada Gap, Pa.	utmcm-1	402448	764216
8.59	14	Manada Creek near Manada Gap, Pa.	mc-1.5	402424	764234
1.64	24	Tributary along Horseshoe Trail to Manada Creek at Manada Gap, Pa.	utmcm-2	402409	764252
2.55	25	Unnamed tributary to Manada Creek at Rt 443 near Manada Gap, Pa.	utmcm-3	402410	764345
14.3	15	Manada Creek below Manada Gap at Manada Gap, Pa.	mc-2	402332	764238
2.57	26	Unnamed tributary to Manada Creek near Sand Beach, Pa.	utmcvRef-1	402036	764102

Pg. 21

Map number	Site name	Habitat scores				Mean	Classification
		2002	2003	2004	2005		
13	mc-1	167	160	166	143	159	Optimal
14	mc-1.5	176	171	186	130	166	Optimal
15	mc-2	157	174	183	144	165	Optimal

23	utmcm-1	175	173	168	142	165	Optimal
24	utmcm-2	164	170	168	144	162	Optimal
25	utmcm-3	144	156	152	158	153	Suboptimal
26	utmcvRef-1	147	148	151	111	139	Suboptimal

Pg. 27

Site name	Map number (fig. 9)	Catch-per-unit effort	Fish metrics				
			Percent native species ¹	Percent intolerant species	Percent dominant species	Total number of individuals	Total number of taxa
Manada Creek above McLean Road (mc-1)	13	5.0	93	1	39	211	9
Manada Creek near Manada Gap (mc-1.5)	14	2.3	89	1	59	167	10
Manada Creek below Manada Gap (mc-2)	15	3.9	94	3	45	141	13
Unnamed tributary to Manada Creek (utmcm-1)	23	3.4	81	4	64	181	5
Unnamed tributary to Manada Creek (utmcm-2)	24			No fish data collected			
Unnamed tributary to Manada Creek (utmcm-3)	25	1.0	94	0	53	34	7
Unnamed tributary to Manada Creek (utmcvRef-1)	26	4.0	99	0	43	260	9

Pg.29

Table 16. Number and type of trout found at Fort Indiantown Gap and nearby off-facility sites, Lebanon and Dauphin Counties, Pa.

[shaded, off-facility site; mm,millimeters]

Site name	Map number (fig. 9)	Trout species	Size class		
			Small (1–100 mm)	Medium (101–180 mm)	Large (181–500 mm)
Manada Creek above McLean Road (mc-1)	13	Brook	0	1	1
		Brown	5	7	2
Manada Creek near Manada Gap (mc-1.5)	14	Brook	0	1	0
		Brown	14	3	2
Manada Creek below Manada Gap (mc-2)	15	Brown	5	0	1
		Rainbow	0	0	2
Unnamed tributary to Manada Creek (utmcm-1)	23	Brook	5	2	0
		Brown	29	4	1
Unnamed tributary to Manada Creek (utmcm-3)	25	Brown	0	0	1
		Rainbow	0	0	1

Pg. 34

Table 18. Site-specific geomorphic data for Manada Creek and Indiantown Run, Fort Indiantown Gap, Lebanon and Dauphin Counties, Pa.

[XS, cross section; ft³/s, cubic feet per second; ft², feet squared; ft, feet; ft/ft, feet per foot; mm, millimeter; >, greater than; D84, particle size of which 84 percent of total sample is finer; D50, particle size which is 50 percent of particle size; D100, largest particle size from core sample]

Parameter	Manada Creek geomorphic study site			Indiantown Run geomorphic study site		
	Reach	XS 761	XS 1218	Reach	XS 347	XS 767
Bankfull discharge (ft ³ /s)	340			195		
Bankfull area (ft ²)		95.6	91.3		43.6	40.4
Mean bankfull depth (ft)		2.4	1.9		1.4	1.0
Maximum bankfull depth (ft)		3.5	3.1		1.9	
Bankfull width (ft)		40.3	47.0		31.0	40.5
Entrenchment ratio		>2.2	>2.2		>2.2	>2.2
Hydraulic radius (ft)		2.1	1.8		1.4	1.0
Bankfull slope (ft/ft)	.004	.004	.004	.004	.012	.028
Sinuosity	1.1			1.1		
Stream class ¹		C4	C4		C4	C3b
Valley type ²		II	II		II	III
D84 (mm)		110	118		136	147
D50 (mm)		50	35		52	69
D100 (mm)		229	76		457	305

¹C-class streams are characterized by Rosgen (1996) as located in narrow to wide valleys, constructed from alluvial deposition, with well-developed flood plains.

²Valley Type II is characterized by moderate slope with gentle sloping sides in colluvial valleys while Valley Type III is characterized by alluvial fans and debris cones (Rosgen, 1996)

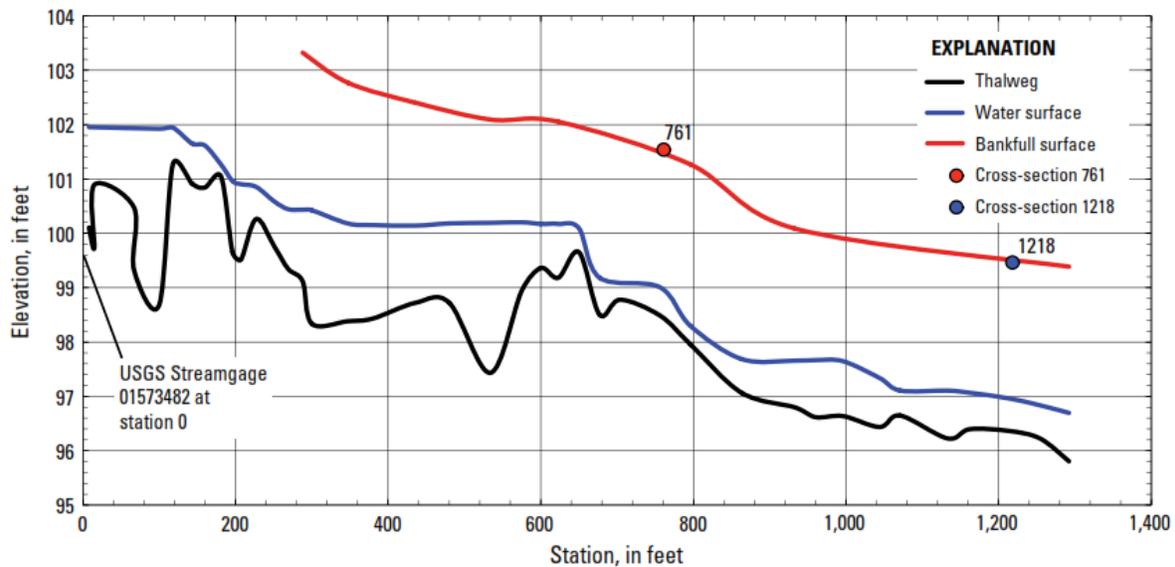


Figure 16. Longitudinal profile at Manada Creek showing locations of two surveyed cross sections, Fort Indiantown Gap facility, Lebanon and Dauphin Counties, Pa.

Left off on pg. 45

Summary of Site Assessment Results (pg. 84-86)

Manada Creek along McLean Road near Manada Gap, Pa. (mc-1)

Manada Creek along McLean Road site is within a forested area. The stream width was about 5 meters, and the depth was 0.5 meter. During the 4 years of study, a beaver was active in the area. The taxa richness ranged from 33 to 36, EPT values from 12 to 16, and the HBI scores from 3.64 to 4.96. It appears some of the increase in biotic index score was due to the presence of oligochaetes and chironomids such as *Micropsectra*. Over time, the percentage of chironomids decreased and the numbers of mayflies increased, lowering the HBI score and reflecting better water quality over time. The invertebrate community was indicative of a non-impacted water-quality condition.

Manada Creek near Manada Gap, Pa. (mc-1.5)

Manada Creek near Manada Gap was of a forested land use within a delayed harvest trout area. The stream width was about 10 meters, and the depth was 0.3 meter. The reach included a good mix of riffle-run-pool habitat. The taxa richness ranged from 25 to 36, EPT values from 8 to 12, and HBI scores from 3.10 to 4.13. The dominant taxon was the stonefly *Leuctra* for the first 3 years of collection; the fourth year was dominated by the hydropsychid caddisfly, *Cheumatopsyche*, which raised the HBI score. The invertebrate community was indicative of non-impacted water-quality conditions.

Manada Creek below Manada Gap at Manada Gap, Pa. (mc-2)

Manada Creek below Manada Gap was the widest and deepest stream sampled. The stream width was 15 meters, and the depth was 1 meter. The area was mostly forested, with a few residences in sight; the reach contained a delayed harvest trout designation. The dominant taxon was the hydropsychid caddisfly *Cheumatopsyche* in 2002 and 2004. Taxa richness ranged from 27 to 35, EPT values from 9 to 13, and HBI scores from 3.31 to 4.27. The invertebrate community was indicative of a non-impacted water-quality condition as the EPT numbers increased over time.

UNT Manada Creek near Manada Gap, Pa. (utmcm-1)

Unnamed Tributary near Manada Gap was in a mixed forested, low-brush area heavily canopied with shrubs. Stream width was about 1 meter, and the depth was 0.1 meter. The pH was around 6, specific conductance around 20 $\mu\text{S}/\text{cm}$, and water temperatures near 16.5°C. Taxa richness ranged from 22 to 46, EPT values from 9 to 17, and HBI scores from 3.15 to 4.55. The stream was not visible from the access road and exhibited a variety of habitats. The beetle *Promoresia* and mayfly *Maccaffertium* were dominant. This reach also yielded the highest number of taxa richness collected at all 27 sites over 4 years. The HBI for 2002 and 2004 was likely because of the more tolerant chironomid abundance. The invertebrate community was indicative of a non-impacted to slightly impacted water-quality condition.

Unnamed Tributary along Horseshoe Trail to Manada Creek at Manada Gap, Pa. (utmcm-2)

Unnamed Tributary along Horseshoe Trail was in a nearly impassable forested area with much overhanging vegetation. The stream width was around 1.5 meters, and the depth was 0.2 meter. The substrate was high in silt composition. The taxa richness ranged from 26 to 43, EPT values from 11 to 15, and HBI scores from 2.64 to 4.44. The dominant taxa were the stonefly *Leuctra* and pollution-sensitive caddisfly *Diplectrona* until 2005 when chironomids became the dominant animal showing the beginnings of impact. The invertebrate community was indicative of a non-impacted water-quality condition until 2005 and was then indicative of a slightly impacted condition.

Unnamed Tributary to Manada Creek at Route 443 near Manada Gap, Pa. (utmcm-3)

This unnamed tributary to Manada Creek directly paralleled Route 443 and flowed within a narrow band of thick shrubs and trees. Stream width was around 2 meters, and the depth was 0.3 meter. Taxa richness ranged from 26 to 34, EPT values from 9 to 14, and HBI scores from 3.22 to 5.40. A large number of naidid worms in 2004 raised the biotic index. In 2003, the midge *Rheotanytarsus* was dominant. The water-quality condition varied from a non-impacted to a slightly impacted condition.

Unnamed Tributary to Manada Creek near Sand Beach, Pa. (utmcvRef-1)

This unnamed tributary to Manada Creek near Sand Beach was in a narrow forested riparian buffer zone, below a large diameter culvert pipe and near a housing development. The stream width was around 3 meters, and the depth was 0.3 meter. A pH about 7 was recorded and a specific conductance near 300 $\mu\text{S}/\text{cm}$. Taxa richness ranged from 17 to 24, EPT values from 4 to 9, and HBI scores from 4.56 to 4.95. The dominant taxa were the elmid beetle *Stenelmis* and the caddisfly *Chimarra*. The site was heavily influenced by the suburban land use with part of the reach stabilized by rip-rap and showed definite effects of siltation. The water-quality condition was slightly impacted.

Station name: Manada Creek below Manada Gap at Manada Gap, Pa. **Date of collection:** 08/25/2004
Station identifier: mc-2 **Station number:** 01573501
Lat/Long: 40°23'32"/76°42'38" **Number of species at site:** 13
Sampling gear code: backpack electroshocker **Time/Pass (min.):** 36
Water temperature (°C): 17.00 **pH (units):** 5.92
Conductance (µS/cm @ 25°C): 45.4 **Discharge (cubic feet per second):** 13.14
Investigators: Bilger, Brightbill, Eggleston, O'Brien, Schreffler, Schott, Botts

Species name	Total number per species	Percent of total number	Total weight of species (grams)	Average weight (grams)	Range of weights (grams)	Percent total weight	Average total length (milli-meters)	Range of total lengths (milli-meters)
Cutlips minnow <i>Exoglossum maxillingua</i>	7	5	73	10	1-21	5	85	61-116
River chub <i>Nocomis micropogon</i>	2	1	77	38	6-71	5	130	85-176
Spottail shiner <i>Notropis hudsonius</i>	4	3	7	2	1-4	1	56	44-78
Blacknose dace <i>Rhinichthys atratulus</i>	64	45	123	2	1-4	8	53	40-65
Longnose dace <i>Rhinichthys cataractae</i>	12	9	105	8	1-17	7	82	30-107
Creek chub <i>Semotilus atromaculatus</i>	26	18	152	6	1-29	9	69	30-134
White sucker <i>Catostomus commersoni</i>	9	6	347	38	1-113	22	118	40-216
Northern hog sucker <i>Hypentelium nigricans</i>	4	3	97	24	8-63	6	115	85-177
Margined madtom <i>Noturus insignis</i>	2	1	32	16	16	2	112	110-113
Rainbow trout <i>Oncorhynchus mykiss</i>	2	1	441	220	211-230	27	292	180-303
Brown trout <i>Salmo trutta</i>	6	4	105	17.5	8-57	7	106	86-186
Rock bass <i>Ambloplites rupestris</i>	1	1	46	46	46	3	120	120
Tessellated darter <i>Etheostoma olmstedti</i>	2	1	4	2	2	1	46	45-47
Totals	141		1,609					

Anomalies: none

Station name: Manada Gap near Manada Gap, Pa.

Date of collection: 08/23/2004

Station identifier: mc-1.5

Station number: 01573482

Lat/Long: 40°24'24"/76°42'34"

Number of species at site: 10

Sampling gear code: backpack electroshocker

Time/Pass (min.): 72

Water temperature (°C): 14.85

pH (units): 7.35

Conductance (µS/cm @ 25°C): 33.2

Discharge (cubic feet per second): 11.23

Investigators: Bilger, Brightbill, Eggleston, Schreffler, O'Brien, Botts, Hepp

Species name	Total number per species	Percent of total number	Total weight of species (grams)	Average weight (grams)	Range of weights (grams)	Percent total weight	Average total length (milli-meters)	Range of total lengths (milli-meters)
Cutlips minnow <i>Exoglossum maxillingua</i>	3	2	11	4	3-4	1	66	62-70
Blacknose dace <i>Rhinichthys atratulus</i>	99	59	183	2	1-3	15	52	36-62
Longnose dace <i>Rhinichthys cataractae</i>	9	5	95	11	4-16	8	92	71-111
Creek chub <i>Semotilus atromaculatus</i>	29	17	146	5	1-15	12	70	33-102
White sucker <i>Catostomus commersoni</i>	3	2	127	42	18-78	10	149	114-197
Northern hog sucker <i>Hypentelium nigricans</i>	1	1	25	25	25	2	127	127
Brown trout <i>Salmo trutta</i>	19	11	573	30	2-217	47	104	51-279
Brook trout <i>Salvelinus fontinalis</i>	1	1	53	53	53	4	175	175
Bluegill <i>Lepomis macrochirus</i>	1	1	3	3	3	1	51	51
Tessellated darter <i>Etheostoma olmstedi</i>	2	1	3	2	1-2	1	50	49-50
Total	167		1,219					

Anomalies: none

Station name: Manada Creek above McLean Road near Manada Gap, Pa.

Date of collection: 08/23/2004

Station identifier: mc-1

Station number: 01573472

Lat/Long: 40°25'06"/76°41'36"

Number of species at site: 9

Sampling gear code: backpack electroshocker

Time/Pass (min.): 42

Water temperature (°C): 16.74

pH (units): 6.57

Conductance (µS/cm @ 25°C): 30.2

Discharge (cubic feet per second): 7.35

Investigators: Bilger, Brightbill, Eggleston, Schreffler, O'Brien, Botts, Hepp

Species name	Total number per species	Percent of total number	Total weight of species (grams)	Average weight (grams)	Range of weights (grams)	Percent total weight	Average total length (milli-meters)	Range of total lengths (milli-meters)
Cutlips minnow <i>Exoglossum maxilingua</i>	4	2	37	9	4–22	1	83	68–119
Spottail shiner <i>Notropis hudsonius</i>	3	1	11	4	3–4	1	70	70–71
Blacknose dace <i>Rhinichthys atratulus</i>	82	39	155	2	1–4	6	50	26–67
Creek chub <i>Semotilus atromaculatus</i>	75	36	588	8	1–327	21	74	26–190
White sucker <i>Catostomus commersoni</i>	16	8	1,041	65	5–177	37	158	77–257
Brown trout <i>Salmo trutta</i>	14	7	527	38	3–121	19	139	68–235
Brook trout <i>Salvelinus fontinalis</i>	2	1	243	122	23–220	9	206	132–280
Smallmouth bass <i>Micropterus dolomieu</i>	1	1	153	153	153	5	228	228
Tessellated darter <i>Etheostoma olmstedii</i>	14	7	36	3	1–4	1	53	45–65
Total	211		2,791					

Anomalies: Creek chub—7 percent with blackspot, Smallmouth bass—100 percent with leeches

Station name: Unnamed Tributary to Manada Creek at Route 443 near Manada Gap, Pa. **Date of collection:** 09/07/2004
Station identifier: utmcm-3 **Station number:** 01573496
Lat/Long: 40°24'10"/76°43'45" **Number of species at site:** 7
Sampling gear code: backpack electroshocker **Time/Pass (min.):** 33
Water temperature (°C): 19.35 **pH (units):** 7.09
Conductance (µS/cm @ 25°C): 61.1 **Discharge (cubic feet per second):** 1.16
Investigators: Bilger, Brightbill, Eggleston, Hainly

Species name	Total number per species	Percent of total number	Total weight of species (grams)	Average weight (grams)	Range of weights (grams)	Percent total weight	Average total length (milli-meters)	Range of total lengths (milli-meters)
Cutlips minnow <i>Exoglossum maxillingua</i>	2	6	8	4	4	1	68	66–70
Blacknose dace <i>Rhinichthys atratulus</i>	18	53	46	3	1–4	3	58	36–70
Creek chub <i>Semotilus atromaculatus</i>	7	21	54	8	1–14	3	86	50–114
White sucker <i>Catostomus commersoni</i>	4	12	248	62	1–140	15	157	47–244
Rainbow trout <i>Oncorhynchus mykiss</i>	1	3	236	236	236	15	302	302
Brown trout <i>Salmo trutta</i>	1	3	1,027	1,027	1,027	63	445	445
Tessellated darter <i>Etheostoma olmstedti</i>	1	3	1	1	1	1	48	48
Total	34		1,620					

Anomalies: none.

Station name: Unnamed Tributary to Manada Creek near Manada Gap, Pa. **Date of collection:** 09/15/2004
Station identifier: utmcm-1 **Station number:** 01573480
Lat/Long: 40°24'48"/76°42'16" **Number of species at site:** 5
Sampling gear code: backpack electroshocker **Time/Pass (min.):** 53
Water temperature (°C): 21.40 **pH (units):** 7.68
Conductance (µS/cm @ 25 °C): 199 **Discharge (cubic feet per second):** 1.16
Investigators: Bilger, Brightbill, Eggleston, Hainly

Species name	Total number per species	Percent of total number	Total weight of species (grams)	Average weight (grams)	Range of weights (grams)	Percent total weight	Average total length (milli-meters)	Range of total lengths (milli-meters)
Blacknose dace <i>Rhinichthys atratulus</i>	116	64	188	2	1–4	27	50	38–66
Creek chub <i>Semotilus atromaculatus</i>	23	13	175	8	1–34	25	80	40–150
Brown trout <i>Salmo trutta</i>	34	19	267	8	1–98	38	72	47–216
Brook trout <i>Salvelinus fontinalis</i>	7	4	67	10	4–22	10	90	64–136
Tessellated darter <i>Etheostoma olmstedti</i>	1	1	6	6	6	1	58	58
Total	181		703					

Anomalies: none

Taxonomy	Tolerance score	Manada Creek along McLean Road near Manada Gap, Pa.				Manada Creek near Manada Gap, Pa.				Manada Creek below Manada Gap at Manada Gap, Pa.			
		8/12/02	8/15/03	7/28/04	8/15/05	8/1/02	8/5/03	7/28/04	8/9/05	8/1/02	8/13/03	8/6/04	8/6/05
HYDRACHNIDIA	8	2	—	—	—	1	—	1	—	2	1	—	—
Hygrobatidae													
Atractidae	8	—	—	—	—	—	—	—	—	—	—	—	—
Hygrobatas	8	—	—	—	—	—	—	—	—	—	—	—	—
Sperchomidae													
Sperchon	6	—	—	—	1	—	—	—	—	—	—	—	1
Torrenticolidae													
Tetradacarus	6	—	—	—	—	—	—	—	—	—	—	—	—
Torrenticola	6	—	—	—	—	—	—	—	—	—	—	—	—
Hydryphantidae													
Protzia	8	—	—	—	—	—	—	—	—	—	—	—	—
Lebertidae													
Lebertia	6	—	—	—	—	—	—	—	—	—	—	—	—
Rhyrachydracaridae													
Clathrosperchon	6	—	—	—	—	—	—	—	—	—	—	—	—
ARTHROPODA													
CRUSTACEA													
MALACOSTRACA													
ISOPODA													
Asellidae													
Cascidotea	8	—	—	—	—	—	—	—	—	—	—	—	—
Lirceus	8	—	—	—	—	—	—	—	—	—	—	—	—
AMPHIPODA													
Crangonyctidae													
Crangonyx	6	—	—	—	—	—	—	—	—	—	—	—	—
Gammaridae													
Gammarus	6	—	—	—	—	—	—	—	—	—	—	—	—
DECAPODA													
Cambaridae	6	—	—	—	—	1	—	—	—	—	—	—	—
Cambarus	6	—	—	—	—	—	1	1	—	—	—	—	—
Orconectes	6	—	—	—	—	—	—	—	—	—	—	—	—
INSECTA													
COLLEMBOLA	10	—	—	—	—	—	—	—	—	—	—	—	—
Entomobryidae	10	—	—	—	—	—	—	—	—	—	1	—	—
Isotomidae	5	—	—	—	—	—	—	—	—	—	—	—	—
Isotomurus	5	—	—	—	—	—	—	—	—	—	—	—	—
EPHEMEROPTERA													
Leptophlebiidae	4	—	—	—	—	—	—	—	—	—	—	—	—
Habrophlebia	4	—	—	—	—	—	—	—	—	—	—	—	—
Habrophlebiodes	6	—	—	—	—	—	—	—	—	—	—	—	—
Paraleptophlebia	1	—	—	—	—	—	—	—	—	—	—	—	—
Ephemeridae	4	—	—	—	—	—	—	—	—	—	—	—	—
Ephamera	2	—	—	—	—	—	—	—	—	—	—	—	—
Litobrancha recurvata	2	—	—	—	—	—	—	—	—	—	—	—	—
Caenidae													
Caenis	6	—	—	—	—	—	—	—	—	—	—	—	—
Ephemerellidae	1	2	2	6	7	—	—	—	1	—	1	—	1
Attenella	1	—	—	—	—	—	—	—	—	—	—	—	—

Taxonomy	Tolerance score	Manada Creek along McLean Road near Manada Gap, Pa.				Manada Creek near Manada Gap, Pa.				Manada Creek below Manada Gap at Manada Gap, Pa.			
		8/12/02	8/15/03	7/28/04	8/15/05	8/1/02	8/5/03	7/28/04	8/9/05	8/1/02	8/13/03	8/6/04	8/6/05
Drumella	0	—	—	—	—	—	—	1	—	—	—	—	—
Ephemeraella	1	—	—	—	—	—	—	—	—	—	—	3	—
Eurylophella	2	—	—	—	—	—	—	1	—	—	—	—	—
Serratella	2	—	—	—	—	—	—	—	—	—	1	—	—
Baetidae	5	—	—	—	—	—	—	—	—	—	—	—	—
Acentrella	4	—	—	—	1	—	—	1	7	—	—	1	10
Acerpenna	5	—	—	—	—	—	—	—	—	—	—	—	—
Baetis	6	19	23	4	4	2	9	10	3	6	9	4	10
Baetis flavistriga	4	—	—	—	1	—	—	—	—	—	—	—	—
Placiditus	4	1	—	—	—	—	—	—	—	—	—	—	—
Isonychiidae	2	—	—	—	—	—	—	—	—	—	—	—	—
Isonychia	2	2	6	13	20	15	3	7	18	4	3	7	9
Hepptegeniidae	4	—	—	—	2	—	—	—	—	—	—	—	1
Epeorus	0	—	—	—	—	1	—	—	—	—	—	—	—
Leucrocota	1	1	—	—	—	—	—	—	—	1	1	—	—
Stenacron	7	—	—	—	—	—	—	—	—	—	—	—	—
Maccaffertium	3	4	—	—	—	—	—	—	—	—	—	—	—
Maccaffertium modestum	1	—	—	—	—	—	—	—	—	—	—	—	—
ODONATA	3	—	—	—	—	—	—	—	1	—	—	—	—
ANISOPTERA													
Aeschniidae													
Boyeria	2	—	—	—	—	—	2	2	—	—	—	—	—
Cordulegastridae													
Cordulegaster	3	—	—	—	—	—	—	—	—	—	—	—	—
Gomphidae	4	—	—	—	—	—	—	—	—	—	—	—	—
Lanflus	5	2	—	1	—	1	5	—	—	—	1	1	—
Stylogomphus	1	—	—	—	—	—	—	—	—	—	—	—	—
Libellulidae	2	—	—	—	—	—	—	—	—	—	—	—	—
ZYGOPTERA													
Calopterygidae	6	—	—	—	—	—	—	—	—	—	—	—	—
Calopteryx	6	—	—	—	—	—	—	—	—	—	—	—	—
Heteracina	6	—	—	—	—	—	—	—	—	—	—	—	—
Coenagrionidae	8	—	—	—	1	—	—	—	2	—	—	—	—
Argia	6	—	—	—	—	—	—	—	—	—	—	—	—
HEMIPTERA	6	—	—	—	—	—	—	—	—	—	—	—	—
Veliidae													
Microvelia	6	—	—	—	—	—	—	—	—	—	—	—	—
Rhagovelia	6	—	—	—	1	—	—	—	—	—	—	—	—
PLECOPTERA	1	—	—	—	—	—	—	—	—	—	—	—	—
Capniidae	3	—	—	—	—	—	—	—	—	—	—	—	—
Paracapnia	1	—	—	—	—	—	—	—	—	—	—	—	—
Leuctridae	0	—	—	—	—	—	—	—	—	—	—	—	—
Leuctra	0	1	3	9	2	18	13	34	3	2	18	7	2
Nemouridae	2	—	—	—	—	—	—	—	—	—	—	—	—
Amphimamura	3	—	—	—	—	—	—	—	—	—	—	—	—
Thaeniopterygidae	2	—	—	—	—	—	—	—	—	—	—	—	—
Chloroperlidae	0	—	—	—	1	—	—	—	—	—	—	—	1
Alloperla	0	—	—	—	—	—	—	—	—	—	—	—	—

Taxonomy	Tolerance score	Manada Creek along McLean Road near Manada Gap, Pa.				Manada Creek near Manada Gap, Pa.				Manada Creek below Manada Gap at Manada Gap, Pa.			
		8/12/02	8/15/03	7/28/04	8/15/05	8/1/02	8/5/03	7/28/04	8/5/05	8/1/02	8/13/03	8/6/04	8/6/05
Swelta	0	2	3	—	—	—	—	—	—	—	1	1	—
Peltoperlidae	0	—	—	—	—	—	—	—	—	—	—	—	—
Tallaperla	0	1	1	2	—	—	—	—	—	1	—	—	—
Perlidae	3	—	—	—	2	—	—	—	6	—	—	—	2
Acroneuria	0	—	1	4	—	7	6	10	1	11	4	11	—
A. carolinensis	0	—	—	—	—	—	—	—	—	—	—	—	—
Agmetina	2	—	—	—	—	—	—	—	—	—	—	—	—
Eccoptura xanthenes	3	—	—	—	—	—	—	—	—	—	—	—	—
Neoperla	3	—	—	—	—	—	—	—	—	—	—	—	—
Perlenta	4	—	—	1	—	—	—	—	—	—	—	—	—
Periodidae	2	—	—	—	—	—	—	—	—	—	—	—	—
Isoperla	2	—	—	—	—	—	—	—	—	—	—	—	—
Pteronarcyidae													
Pteronarcys	0	—	—	—	—	—	—	—	—	—	—	—	—
COLEOPTERA													
ADEPHAGA													
Gyrinidae													
Dinetus	4	—	—	—	—	—	—	—	—	—	—	—	—
POLYPHAGA													
Hydrophilidae													
Enochrus	5	—	—	—	—	—	—	—	—	—	—	—	—
Hydrobius	5	—	—	—	—	—	—	—	—	—	—	—	—
Psephenidae													
Ectopria	5	—	—	—	1	—	—	—	—	1	—	—	—
Psephenus	4	1	1	1	3	—	1	—	1	4	2	1	1
Lampyridae	5	—	—	—	—	—	—	—	—	—	—	—	—
Elmidae	5	—	—	—	9	—	—	—	7	—	—	—	3
Ancyronyx variegata	5	—	—	—	—	—	—	—	—	—	—	—	—
Dubiraphia	6	—	—	—	—	—	2	—	—	—	—	—	—
Macronychus glabratus	5	—	—	—	—	—	—	—	—	—	—	—	—
Macronychus	5	—	—	—	—	—	—	—	—	—	—	—	—
Microcyloepus	3	—	—	—	—	—	—	—	—	—	—	—	—
Optioservus	4	3	5	1	4	1	5	1	2	3	4	4	5
Oulimnius	4	13	4	1	—	1	5	4	—	5	1	6	—
Promoresia	2	4	—	1	—	—	3	19	7	—	1	2	—
Stenelmis	5	6	1	10	7	—	—	—	1	—	—	2	—
Ptilodactylidae													
Anchytarus	5	—	1	—	—	—	—	—	—	—	—	—	—
Curculionidae	5	—	—	—	—	—	—	—	—	—	—	—	—
MEGALOPTERA	4	—	—	—	—	—	—	—	—	—	—	—	1
Corydalidae													
Corydalis	4	—	—	—	—	—	—	—	—	—	—	—	—
Nigronia	4	—	1	2	—	—	—	—	—	—	8	3	—
Sialidae													
Sialis	4	—	—	—	—	—	—	—	—	—	—	—	—
TRICHOPTERA	4	—	—	—	2	—	—	—	—	—	—	—	—
Rhyacophilidae													
Rhyacophila	1	—	1	—	1	—	2	4	2	—	6	5	2

Taxonomy	Tolerance score	Manada Creek along McLean Road near Manada Gap, Pa.				Manada Creek near Manada Gap, Pa.				Manada Creek below Manada Gap at Manada Gap, Pa.			
		8/12/02	8/15/03	7/28/04	8/15/05	8/1/02	8/5/03	7/28/04	8/9/05	8/1/02	8/13/03	8/6/04	8/6/05
Hydroptilidae	6	—	—	—	—	—	—	—	—	—	—	—	—
Hydroptila	6	—	—	—	—	—	—	—	—	—	—	—	—
Leucotrichia	6	—	—	—	—	—	—	—	—	—	—	—	—
Ochrotrichia	6	—	—	—	—	—	—	—	—	—	—	—	—
Glossosomatidae	1	—	—	—	—	—	—	—	—	—	—	—	2
Glossosoma	0	—	1	—	2	—	—	—	—	—	—	—	—
Philopotamidae	4	—	—	—	—	—	—	—	—	—	—	—	—
Chimarra	4	—	—	—	—	—	—	—	—	—	—	—	—
C. sternina	4	—	—	—	—	—	—	—	—	—	—	—	—
C. obscura	4	—	—	—	—	—	—	—	—	—	—	—	—
Dolophilodes	4	—	10	—	6	3	11	1	16	12	5	11	15
Wormaldia	2	—	—	—	—	—	—	—	—	—	—	—	—
Psychomyiidae	2	—	—	—	—	—	—	—	—	—	—	—	—
Lype	2	—	—	1	—	—	—	—	—	—	3	—	—
Psychomyia	2	—	—	—	—	—	—	—	—	—	—	—	—
Dipseudopsidae													
Phyllocentropus	5	—	—	—	—	—	—	—	—	—	—	—	—
Polycentropodidae	6	—	—	—	—	—	—	—	—	—	—	—	—
Cymellus	8	—	—	—	—	—	—	—	—	—	—	—	—
Neuroclipsis	7	—	—	—	—	—	—	—	—	—	—	—	—
Polycentropus	6	—	—	—	—	—	—	—	—	—	—	—	—
Hydropsychidae	5	—	—	—	18	—	—	—	11	—	—	—	3
Chumatopsyche	5	63	28	32	7	9	3	8	65	18	8	9	—
Diplectrona	5	—	—	—	—	—	—	—	—	—	—	1	—
Hydropsyche	4	9	17	12	19	3	1	24	11	4	—	31	30
Hydropsyche morosa gr.	6	—	—	—	—	—	—	—	—	—	—	—	—
Phryganeidae													
Oligostomis	2	—	—	—	—	—	—	—	—	—	—	—	—
Brachycentridae													
Micrasema	2	—	—	—	—	—	—	—	—	—	—	—	—
Lepidostomatidae													
Lepidostoma	1	—	1	—	—	—	—	—	—	—	—	—	—
Limnephilidae													
Hydatophylax	2	—	—	—	—	—	—	—	—	—	—	—	—
Pycnopsyche	4	—	—	—	—	—	—	—	—	—	—	—	—
Uenoidae													
Neophylax	3	—	—	—	—	—	—	—	—	—	—	—	—
Gosidae	3	—	—	—	—	—	—	—	—	—	—	—	—
Gosia	3	1	—	1	—	—	—	—	—	—	1	—	—
Leptoceridae	4	—	—	—	—	—	—	—	—	—	—	—	—
Oecetis	5	—	—	—	—	—	—	—	—	—	—	—	—
Molannidae													
Molanna	6	—	—	—	—	—	3	—	—	—	—	—	—
Calamoceratidae													
Heteroplectron	3	—	—	1	—	—	—	—	—	—	—	—	—
Odontoceridae													
Pallotwa	0	—	1	—	—	—	—	—	—	—	—	—	—
LEPIDOPTERA	5	—	—	—	1	—	—	—	—	—	—	—	—

Taxonomy	Tolerance score	Manada Creek along McLean Road near Manada Gap, Pa.				Manada Creek near Manada Gap, Pa.				Manada Creek below Manada Gap at Manada Gap, Pa.			
		8/12/02	8/15/03	7/28/04	8/15/05	8/1/02	8/5/03	7/28/04	8/9/05	8/1/02	8/13/03	8/6/04	8/6/05
Tortricidae													
Archips	5	—	—	—	—	—	—	—	—	—	—	—	—
DIPTERA (red non-midges, purple midges)	6	—	—	—	—	—	—	—	—	—	—	—	—
Ceratopogonidae	6	—	—	—	—	—	—	—	—	—	—	—	—
Atrichopogon	6	—	—	—	—	—	—	—	—	—	—	—	—
Probezzia	6	—	—	—	—	—	—	—	—	—	—	—	—
Bezzia/Palpuszia	6	—	—	—	—	—	—	—	—	—	—	—	—
Chironomidae													
Tanypodinae	7	1	—	1	1	—	—	—	—	1	—	—	—
Macropelopiini	6	—	—	—	—	—	—	—	—	—	—	—	—
Brundiniella	6	—	—	—	—	—	—	—	—	—	—	—	—
Macropelopia	6	—	—	—	—	—	—	—	—	—	—	—	—
Natarviini													
Natarvia	8	—	—	—	—	—	—	—	—	—	—	—	—
Pantaneurini													
Ablabeomyia	8	—	—	—	—	—	—	—	—	—	—	—	—
Conchapelopia	6	—	—	—	—	—	—	—	—	—	—	—	5
Nilotanytus	6	—	—	—	—	—	—	—	—	—	—	—	—
Paramerina	6	—	—	—	—	—	—	—	—	—	—	—	—
Rheopelopia	4	—	—	—	—	—	—	—	1	—	—	—	—
Thienemannimyia gr.	6	4	—	—	—	12	7	—	—	7	3	3	—
Zavrelimyia	8	—	—	—	—	—	—	—	—	—	1	—	—
Diamosini													
Diamosa	5	—	—	—	—	—	—	—	—	—	—	—	—
Pagastia	1	—	—	—	—	—	—	—	—	—	1	—	1
Pottastia longimana	2	—	—	—	—	—	—	—	—	—	—	—	—
Orthocladinae	5	—	—	—	—	—	—	—	—	—	—	—	1
Corynoeurini													
Corynoeura	4	—	1	—	—	—	—	—	—	1	—	—	—
Thienemannella	6	—	—	—	—	—	—	—	—	—	—	—	—
Orthocladini	5	—	—	—	—	—	—	—	—	—	—	—	—
Brillia	5	—	—	—	—	—	2	—	—	—	—	—	—
Brillia flaviformis	5	—	—	—	—	—	—	—	—	—	—	—	—
Cricotopus	7	—	—	1	—	—	—	—	1	—	—	—	1
Cricotopus/Orthocladus	7	—	—	—	—	—	—	—	—	—	—	—	—
Cricotopus bicinctus	7	—	—	—	—	—	—	—	—	—	—	—	—
Cricotopus viernensis	7	—	—	—	—	—	—	—	—	—	—	—	—
Diplocladus	8	—	—	—	—	—	—	—	—	—	—	—	—
Eukiefferiella	4	—	—	—	—	—	—	—	—	—	1	—	—
Eukiefferiella brehmi gr.	4	—	—	—	—	—	—	—	—	—	—	—	—
Eukiefferiella claripennis	8	—	—	—	—	—	—	—	—	—	—	—	—
Eukiefferiella devonica gr.	4	—	—	—	—	—	—	—	—	—	—	—	—
Eukiefferiella pseudomontana gr.	8	—	—	—	—	—	—	—	—	—	—	—	4
Heleniella	3	—	—	—	—	—	—	—	—	—	—	—	—
Heterotrissocladus marcidus gr.	4	—	—	—	—	—	—	—	—	—	—	—	—
Kraussmittia	1	—	—	—	—	—	—	—	—	—	—	—	—
Limnophyes	8	—	—	—	—	—	—	—	—	—	—	—	—
Nanocladus	7	—	—	—	—	—	—	—	—	—	—	—	—

Taxonomy	Tolerance score	Manada Creek along McLean Road near Manada Gap, Pa.				Manada Creek near Manada Gap, Pa.				Manada Creek below Manada Gap at Manada Gap, Pa.			
		8/12/02	8/15/03	7/28/04	8/15/05	8/1/02	8/5/03	7/28/04	8/9/05	8/1/02	8/13/03	8/6/04	8/6/05
<i>Orthocladus lignicola</i>	6	—	—	—	—	—	—	—	—	—	—	—	—
<i>Parachaetocladus</i>	2	—	—	—	—	—	1	1	—	—	—	—	—
<i>Paracricotopus</i>	4	—	—	—	—	—	—	—	—	—	—	—	—
<i>Parametriconeus</i>	3	2	—	1	1	4	7	3	—	—	1	—	—
<i>Rheocricotopus</i>	6	—	—	—	—	—	—	—	—	—	—	—	—
<i>Rheocricotopus robacki</i>	3	—	—	—	—	—	—	—	—	—	—	—	—
<i>Tvetania bavaria gr.</i>	4	2	3	—	1	—	5	—	—	—	—	4	—
<i>Xylotopus par</i>	2	—	—	—	—	—	—	—	—	—	—	—	—
Chironominae	5	—	—	—	1	—	—	—	—	—	—	—	—
Chironomini													
<i>Chironomus</i>	10	—	—	—	—	1	—	—	—	—	—	—	—
<i>Cryptochironomus</i>	8	—	1	—	—	—	—	—	—	—	—	—	—
<i>Glyptotendipes</i>	10	—	—	—	—	—	—	—	—	—	—	—	—
<i>Microtendipes pedellus gr.</i>	6	—	1	—	—	2	1	—	—	—	—	—	—
<i>Microtendipes rydalsensis gr.</i>	4	—	—	—	—	—	—	—	—	—	—	—	—
<i>Paralutetobornella</i>	8	—	—	—	—	—	—	—	—	—	—	—	—
<i>Paratendipes albimanus</i>	6	—	—	—	—	—	2	—	—	—	—	—	—
<i>Phaenopsectra</i>	7	—	—	—	—	—	—	—	—	—	—	—	—
<i>Polypedilum</i>	6	4	1	—	—	2	—	—	—	4	—	—	—
<i>Polypedilum avicaps</i>	4	—	1	—	2	1	2	1	4	2	2	4	—
<i>Polypedilum fallax</i>	6	—	—	—	—	—	—	—	—	—	—	—	—
<i>Polypedilum flavum</i>	6	—	—	—	—	—	—	—	—	—	—	—	—
<i>Polypedilum illinoense</i>	7	—	—	—	—	—	—	—	—	—	2	—	—
<i>Polypedilum laetum</i>	6	1	—	—	—	—	—	—	—	—	—	—	—
<i>Polypedilum scalaeorum</i>	6	—	—	—	—	—	—	—	—	—	—	—	—
<i>Polypedilum tritum</i>	6	—	—	—	—	—	—	—	—	—	—	—	—
<i>Stenochironomus</i>	5	—	—	—	—	—	—	—	—	—	—	—	—
<i>Stictochironomus</i>	9	—	—	—	—	—	—	—	—	—	—	—	—
<i>Tribelos</i>	7	—	—	—	—	—	1	—	—	—	—	—	—
Tanytarsini	3	—	—	—	—	—	—	—	—	—	—	—	—
<i>Cladotanytarsus</i>	3	6	1	3	1	—	3	1	1	—	—	—	—
<i>Micropectra</i>	7	3	—	2	—	2	—	4	—	—	—	—	—
<i>Micropectra sp. A</i>	7	—	—	—	—	—	—	—	—	—	—	—	—
<i>Paratanytarsus</i>	6	—	—	—	—	—	—	—	—	—	—	—	—
<i>Rheotanytarsus</i>	6	15	—	—	—	1	—	—	1	2	—	—	—
<i>Rheotanytarsus exiguus gr.</i>	6	11	11	1	—	2	2	2	—	—	—	2	—
<i>Rheotanytarsus pellucidus</i>	4	—	—	—	—	—	—	—	—	—	—	—	—
<i>Stempellina</i>	2	—	—	—	—	—	2	—	—	—	—	—	—
<i>Stempellina sp. C</i>	4	—	—	—	—	—	—	—	—	—	—	—	—
<i>Stempellinella</i>	4	1	—	10	1	1	1	1	1	—	—	—	—
<i>Sublettea coffmanni</i>	4	—	—	—	—	—	—	—	—	—	—	—	—
<i>Tanytarsus</i>	6	2	2	1	4	2	3	—	10	2	3	—	1
<i>Zavrelia</i>	4	—	—	—	—	—	—	—	—	—	—	—	—
Dixidae													
<i>Dixa</i>	1	—	—	—	—	—	—	—	—	—	—	—	—
Simuliidae													
<i>Simulium</i>	5	3	2	—	1	—	1	—	1	—	2	—	—
Tipulidae	4	—	—	—	—	—	—	—	1	—	—	—	—

Taxonomy	Tolerance score	Manada Creek along McLean Road near Manada Gap, Pa.				Manada Creek near Manada Gap, Pa.				Manada Creek below Manada Gap at Manada Gap, Pa.			
		8/12/02	8/15/03	7/28/04	8/15/05	8/1/02	8/5/03	7/28/04	8/9/05	8/1/02	8/13/03	8/6/04	8/6/05
Tipula	6	—	—	—	—	—	—	—	—	—	—	—	—
Antocha	3	—	2	1	—	—	—	2	—	1	—	1	2
Dicranota	3	—	—	—	—	—	1	—	—	1	—	—	—
Hexatoma	2	—	2	3	—	1	—	3	1	—	—	—	—
Limnophila	3	—	—	—	—	—	—	—	—	—	—	—	—
Limonia	6	—	—	—	—	—	—	—	—	—	—	—	—
Molophilus	4	—	—	—	—	—	—	—	—	—	—	—	—
Pilaria	7	—	—	—	—	—	—	—	—	—	—	—	—
Athericidae													
Atherix	4	—	—	—	—	—	—	—	—	—	—	—	1
Empididae	6	—	—	—	—	—	—	—	—	—	—	—	—
Chelifera	6	—	6	—	—	—	—	—	—	—	—	—	—
Clinocera	6	—	—	—	—	—	—	—	—	—	—	1	—
Hemerodromia	6	—	—	3	8	—	2	1	3	—	—	3	—
Stratiomyidae	7	—	—	—	—	—	—	—	—	—	—	—	—
Tabanidae													
Chrysops	5	—	—	—	—	—	—	—	—	—	—	—	—
Ephydriidae	6	—	—	—	—	—	—	—	—	—	—	—	—
Psychodidae	10	—	—	—	—	—	—	—	—	—	—	—	—
Total taxa		33	36	33	35	25	36	30	30	27	35	31	30
Total number		196	148	139	144	94	125	164	190	112	122	159	124
Percent dominant taxa (single)		32	19	23	15	19	10	21	38	16	15	20	27
Total EPT Taxa		12	14	12	16	8	9	11	12	9	13	12	13
Total EPT		106	98	86	94	58	51	101	144	59	61	91	88
Percent EPT		54.08	66.22	61.87	65.28	61.70	40.80	61.59	76.32	52.68	50.00	57.23	70.97
HBI		4.96	4.13	3.93	3.64	3.25	3.12	3.1	4.13	3.82	3.31	3.48	4.27
Number Chironomidae taxa		12	9	8	8	11	14	7	7	7	8	4	6
Percent Chironomidae		26.53	14.86	14.39	8.33	31.91	31.20	7.93	10.00	16.96	11.48	8.18	10.48

Taxonomy	Tolerance score	Unnamed Tributary to Manada Creek near Manada Gap, Pa.				Tributary along Horseshoe Trail to Manada Creek at Manada Gap, Pa.				Unnamed Tributary to Manada Creek at Rt 443 near Manada Gap, Pa.			
		8/12/02	8/5/03	7/28/04	8/9/05	8/1/02	8/13/03	8/6/04	8/9/05	8/14/02	8/6/03	8/6/04	8/16/05
PLATYHELMINTHES													
TURBELLARIA													
TRICLADIDA													
Planariidae	1	—	—	1	—	—	—	—	—	—	—	1	—
NEMERTEA													
ENOPLA													
HOPLONEMERTEA													
Tetrastemmatidae													
Prostoma	8	—	—	—	—	—	—	—	—	—	—	—	—
NEMATODA													
	5	—	—	—	—	—	—	1	—	—	—	—	—
ANNELIDA													
BRANCHIOBELLAE													
OLIGOCHAETA													
LUBRICULIDA													
Lumbriculidae	5	1	—	1	—	—	—	1	—	—	16	7	—
Eclipidrilus	5	—	—	—	—	—	—	—	—	—	—	—	—
Lumbriculus	5	—	—	—	—	—	—	—	—	—	—	—	6
TUBIFICIDA													
Enchytraeidae	10	—	—	—	—	—	1	—	—	—	—	—	—
Naididae	8	—	5	2	—	4	1	4	—	2	4	120	3
Nais	8	—	—	—	1	—	—	—	—	—	—	—	1
N. behningi	6	—	—	—	—	—	—	—	3	—	—	—	4
Pristina	8	—	—	—	—	—	—	—	—	—	—	—	—
Tubificidae	10	—	—	—	—	—	—	—	1	—	—	—	—
Tubificidae w/ capilliform setae	10	1	—	—	—	—	—	—	—	1	—	—	—
Tubificidae w/o capilliform setae	10	—	—	1	—	—	—	—	—	2	—	—	—
LUMBRICINA													
MOLLUSCA													
GASTROPODA													
MESOGASTROPODA													
Viviparidae													
Campelema decivum	6	—	—	—	—	—	—	—	—	—	—	—	—
BASOMMATOPHORA													
Ancyliidae													
Ferrisia	6	—	—	—	—	—	—	—	—	1	—	—	—
Physidae													
Physa	8	—	—	—	—	—	—	—	—	—	—	—	—
Planorbidae													
Planorbella	6	—	—	—	—	—	—	—	—	—	—	—	—
BIVALVIA													
VENEROIDA													
Corbiculidae													
Corbicula fluminea	6	—	—	—	—	—	—	—	—	—	—	—	—
Pisidiidae	6	—	2	—	1	—	9	—	3	1	1	—	1
Pisidium	6	—	—	—	—	—	—	12	—	—	—	—	—
Sphaerium	6	—	—	3	—	—	—	—	—	—	—	—	—
CHELICERATA													
ORIBATEI													
	8	—	—	—	—	—	—	—	1	—	—	—	—

Taxonomy	Tolerance score	Unnamed Tributary to Manada Creek near Manada Gap, Pa.				Tributary along Horseshoe Trail to Manada Creek at Manada Gap, Pa.				Unnamed Tributary to Manada Creek at Rt 443 near Manada Gap, Pa.			
		8/12/02	8/5/03	7/28/04	8/9/05	8/1/02	8/13/03	8/6/04	8/9/05	8/14/02	8/6/03	8/6/04	8/16/05
HYDRACHNIDIA	8	—	—	—	5	2	—	1	—	1	—	8	—
Hygrobatidae													
Atractides	8	—	—	—	—	—	—	—	—	—	—	—	—
Hygrobates	8	—	—	—	—	—	—	—	—	—	—	—	—
Sperchonidae													
Sperchon	6	—	—	—	—	—	—	—	—	—	—	—	1
Torrenticolidae													
Tetradacarus	6	—	—	—	—	—	—	—	—	—	—	—	—
Torrenticola	6	—	—	—	—	—	—	—	—	—	—	—	—
Hydryphantidae													
Protzia	8	—	—	—	—	—	—	—	—	—	—	—	—
Lebertiidae													
Lebertia	6	—	—	—	—	—	—	—	—	—	—	—	—
Rhynchohydracaridae													
Clathrosperchon	6	—	—	—	1	—	—	—	—	—	—	—	—
ARTHROPODA													
CRUSTACEA													
MALACOSTRACA													
ISOPODA													
Asellidae													
Caecidotea	8	—	—	—	—	—	—	—	—	—	—	—	—
Lirceus	8	—	—	—	—	—	—	—	—	—	—	—	—
AMPHIPODA													
Crangonyctidae													
Crangonyx	6	—	—	—	—	—	—	—	—	—	—	—	—
Gammaridae													
Gammarus	6	—	—	—	—	—	—	—	—	—	—	—	—
DECAPODA													
Cambaridae	6	—	—	—	—	—	—	—	—	—	—	—	—
Cambarus	6	—	—	—	—	—	—	—	—	—	—	—	—
Orconectes	6	—	—	—	—	—	—	—	—	—	—	—	—
INSECTA													
COLLEMBOLA	10	—	—	—	—	—	—	—	—	—	—	—	—
Entomobryidae	10	—	—	—	—	—	1	—	—	—	—	—	—
Isotomidae	5	—	—	—	—	—	—	—	—	—	—	—	—
Isotomurus	5	—	—	—	—	—	—	—	—	—	—	—	—
EPHEMEROPTERA													
Leptophlebiidae	4	—	—	—	—	—	—	—	—	—	—	—	—
Habroplebia	4	—	—	—	—	—	—	—	—	—	—	—	—
Habroplebiodes	6	—	—	—	—	—	—	—	—	—	—	—	—
Paraleptophlebia	1	1	—	3	—	—	—	2	—	—	—	—	—
Ephemeridae	4	—	—	—	—	—	—	—	—	—	—	—	—
Ephemera	2	—	—	—	—	—	—	—	—	—	—	—	—
Litobranchia recurvata	2	—	—	—	—	—	—	—	—	—	—	—	—
Caesidae													
Caenis	6	6	—	—	—	—	—	—	—	—	—	—	—
Ephemerellidae	1	—	—	3	3	1	—	—	4	—	—	1	4
Amenella	1	—	—	—	—	—	—	—	—	—	—	—	—

Taxonomy	Tolerance score	Unnamed Tributary to Manada Creek near Manada Gap, Pa.				Tributary along Horseshoe Trail to Manada Creek at Manada Gap, Pa.				Unnamed Tributary to Manada Creek at Rt 443 near Manada Gap, Pa.			
		8/12/02	8/5/03	7/28/04	8/9/05	8/1/02	8/13/03	8/6/04	8/9/05	8/14/02	8/6/03	8/6/04	8/16/05
Drumella	0	—	—	—	—	—	—	—	—	—	—	—	—
Ephemera	1	—	—	—	—	—	—	—	—	—	—	—	—
Eurylophella	2	1	1	6	—	—	—	1	—	—	—	—	—
Serratella	2	1	—	—	—	—	—	—	—	—	—	—	—
Baetidae	5	—	—	—	3	1	—	—	—	—	—	—	—
Acentrella	4	—	—	—	—	—	—	—	—	—	—	—	1
Acerpenna	5	—	—	—	1	—	—	—	—	—	—	—	—
Baetis	6	8	6	3	—	12	2	—	—	2	7	14	10
Baetis flavistriga	4	—	—	—	—	—	—	—	—	—	—	—	—
Plautius	4	—	—	1	—	—	—	—	—	—	—	—	—
Isonychiidae	2	—	—	—	1	—	—	—	—	—	—	—	—
Isonychia	2	1	—	3	—	—	—	—	4	8	2	—	1
Heptageniidae	4	—	—	—	—	—	—	—	—	—	—	—	—
Epeorus	0	—	—	—	—	—	—	—	1	—	—	—	—
Leucrocota	1	1	1	—	—	—	—	—	—	—	—	—	—
Stenacron	7	—	—	—	—	—	—	—	—	1	—	1	—
Maccaffertium	3	16	2	16	2	10	14	10	15	34	5	6	22
Maccaffertium modestum	1	—	—	—	—	—	—	—	—	—	—	—	—
ODONATA	3	—	—	—	—	—	—	—	—	—	—	—	—
ANISOPTERA													
Aeschnidae													
Boyeria	2	—	—	—	—	—	—	—	1	—	—	—	—
Cordulegastridae													
Cordulegaster	3	—	—	—	—	1	—	—	—	—	—	—	—
Gomphidae	4	1	—	—	1	—	—	—	—	—	—	—	—
Lanflus	5	—	—	—	—	—	—	2	—	1	—	—	—
Stylogomphus	1	—	—	—	—	—	—	—	—	—	—	—	—
Libellulidae	2	—	—	—	—	—	—	—	—	—	—	—	—
ZYGOPTERA													
Calopterygidae	6	—	—	—	—	—	—	—	—	—	—	—	—
Calopteryx	6	11	—	—	—	—	—	—	—	—	—	—	—
Heterina	6	—	—	—	—	—	—	—	—	—	—	—	—
Coenagrionidae	8	—	—	6	5	—	—	—	—	—	—	—	1
Argia	6	1	1	—	—	—	—	—	—	—	—	—	—
HEMIPTERA	6	—	—	—	—	—	—	—	—	—	—	—	—
Veliidae													
Microvelia	6	—	—	—	—	—	—	—	—	—	—	—	—
Rhagovelia	6	—	—	—	—	—	—	—	—	—	—	—	—
PLECOPTERA	1	—	—	—	—	—	—	—	2	—	—	—	—
Capniidae	3	—	—	—	1	—	—	—	—	—	—	—	—
Paracapnia	1	—	—	—	—	—	—	—	—	—	—	—	—
Leuctridae	0	—	—	—	—	—	—	—	—	—	—	—	—
Leuctra	0	7	6	16	—	17	14	17	1	6	—	2	—
Nemouridae	2	—	—	—	—	—	—	—	—	—	—	—	—
Anopisamura	3	—	—	—	—	—	—	—	—	—	—	—	—
Taeniopterygidae	2	—	—	—	—	—	—	—	—	—	—	—	—
Chloroperlidae	0	—	—	—	—	—	—	—	—	—	—	—	—
Alloperla	0	—	—	—	—	—	—	1	—	—	—	—	—

Taxonomy	Tolerance score	Unnamed Tributary to Manada Creek near Manada Gap, Pa.				Tributary along Horseshoe Trail to Manada Creek at Manada Gap, Pa.				Unnamed Tributary to Manada Creek at Rt 443 near Manada Gap, Pa.			
		8/12/02	8/5/03	7/28/04	8/9/05	8/1/02	8/13/03	8/6/04	8/9/05	8/14/02	8/6/03	8/6/04	8/16/05
		Swelna	0	—	—	—	—	—	—	—	—	—	—
Peltepelidae	0	—	—	—	—	—	—	1	—	—	—	—	
Tallaperia	0	—	—	—	1	7	1	—	—	—	—	—	
Perlidae	3	—	—	—	—	—	—	—	2	—	—	2	
Acronesia	0	1	—	1	—	4	8	2	—	2	1	1	
A. carolinensis	0	—	—	—	—	—	—	—	—	—	—	—	
Agrestina	2	—	—	—	—	—	—	—	—	—	—	—	
Eccopectra xanthenes	3	—	—	—	—	—	—	—	1	—	—	—	
Neoperla	3	—	—	—	—	—	—	—	—	—	—	—	
Perlesta	4	—	—	—	—	—	—	—	—	—	—	—	
Perlodidae	2	—	—	—	2	—	—	—	1	—	—	1	
Isoperla	2	—	—	—	—	—	—	—	—	—	—	—	
Pteronarcyidae													
Pteronarcys	0	—	1	—	—	—	—	—	—	—	—	—	
COLEOPTERA													
ADEPHAGA													
Gyrinidae													
Dineutus	4	—	—	—	—	—	—	—	—	—	—	—	
POLYPHAGA													
Hydrophilidae													
Enochrus	5	—	—	—	—	—	—	—	—	—	—	—	
Hydrobius	5	—	—	—	—	—	—	—	—	—	—	—	
Psephenidae													
Ectopria	5	—	—	1	—	—	—	—	—	1	—	—	
Psephenus	4	—	—	1	—	—	—	—	—	1	—	—	
Lampyridae	5	—	—	—	—	—	—	—	—	—	—	—	
Elmidae	5	—	—	—	1	—	—	—	1	—	—	—	
Ancyronaxy variegata	5	—	—	—	—	—	—	—	—	—	—	2	
Dubiraphia	6	—	2	1	—	—	—	—	—	—	—	—	
Macronychus glabratus	5	—	—	—	—	—	—	—	—	—	—	—	
Macronychus	5	—	—	—	—	—	—	—	—	—	—	—	
Microcyloopus	3	—	—	—	—	—	—	—	—	1	—	—	
Optioarvus	4	4	—	—	2	—	1	—	2	4	3	1	
Oulimnius	4	—	1	5	—	5	3	6	—	—	1	1	
Promorexia	2	1	22	79	36	—	1	5	—	9	8	29	
Stenelmis	5	—	—	—	—	—	1	1	1	—	—	2	
Ptilodactylidae													
Anchytarvus	5	—	—	—	—	—	—	—	—	—	1	—	
Curculionidae	5	—	—	—	—	—	—	—	—	—	—	—	
MEGALOPTERA	4	—	—	—	—	—	—	—	—	—	—	—	
Corydalidae													
Corydalis	4	—	—	—	—	—	—	—	—	—	—	—	
Nigronia	4	1	—	1	—	—	4	1	1	5	7	10	
Sialidae													
Sialis	4	—	1	—	—	—	1	—	—	—	—	—	
TRICHOPTERA	4	—	—	—	—	—	—	—	—	—	—	—	
Rhyacophilidae													
Rhyacophila	1	—	—	1	—	—	1	3	—	—	—	2	

Taxonomy	Tolerance score	Unnamed Tributary to Manada Creek near Manada Gap, Pa.				Tributary along Horseshoe Trail to Manada Creek at Manada Gap, Pa.				Unnamed Tributary to Manada Creek at Rt 443 near Manada Gap, Pa.			
		8/12/02	8/5/03	7/28/04	8/9/05	8/1/02	8/13/03	8/6/04	8/9/05	8/14/02	8/6/03	8/6/04	8/16/05
		Hydroptilidae	6	—	—	—	1	—	—	—	—	—	—
Hydroptila	6	2	—	—	—	—	—	—	—	—	—	—	
Leucotrichia	6	—	—	—	—	—	—	—	—	—	—	—	
Ochrotrichia	6	—	—	—	—	—	—	—	—	—	—	—	
Glossosomatidae	1	—	—	—	—	—	—	—	—	—	—	1	
Glossosoma	0	—	—	—	—	—	2	—	—	3	1	—	
Philopotamidae	4	—	—	—	—	—	—	—	—	—	—	—	
Chimarra	4	—	—	—	—	—	—	—	—	2	—	—	
C. aterrima	4	—	—	—	—	—	—	—	—	—	—	—	
C. obscura	4	—	—	—	—	—	—	—	—	—	—	—	
Dolophilodes	4	—	—	—	—	4	4	1	3	6	13	6	
Wormaldia	2	—	—	—	—	—	—	—	—	—	—	—	
Psychomyiidae	2	—	—	—	—	—	—	—	2	—	—	—	
Lype	2	—	—	—	—	—	—	—	—	—	—	—	
Psychomyia	2	—	—	—	—	—	—	—	—	—	—	—	
Dipseudopsidae													
Phyloctenopus	5	—	—	—	—	—	—	—	—	—	—	—	
Polycentropodidae	6	1	—	—	—	—	—	—	—	—	—	—	
Cymellus	8	—	—	—	—	—	—	—	—	—	—	—	
Neureclipsis	7	—	—	—	—	—	—	—	—	—	—	—	
Polycentropus	6	—	—	—	—	—	—	—	—	—	—	—	
Hydropsychidae	5	—	1	—	7	—	—	—	10	—	—	10	
Chaumatopsyche	5	—	1	7	—	6	2	—	8	11	15	12	
Diplectrona	5	—	—	3	—	4	10	18	—	—	4	—	
Hydropsyche	4	—	—	1	—	2	—	15	2	2	23	15	
Hydropsyche morosa gr.	6	—	—	—	—	—	—	—	—	—	—	—	
Phryganeidae													
Oligotomis	2	—	1	2	—	—	—	—	—	—	—	—	
Brachycentridae													
Micrasema	2	—	—	2	—	—	—	—	—	1	4	—	
Lepidostomatidae													
Lepidostoma	1	—	—	—	—	1	—	—	—	—	—	—	
Limnephilidae													
Hydatophylax	2	—	—	—	—	—	1	—	—	—	—	—	
Pycnopsyche	4	—	—	—	—	—	—	—	—	—	—	—	
Uenoidae													
Neophylax	3	—	—	—	—	—	—	—	—	—	—	—	
Goatidae	3	—	—	—	1	—	—	—	—	—	—	—	
Goara	3	—	—	—	—	—	—	—	—	—	—	—	
Leptoceridae	4	—	—	—	—	—	—	—	—	—	—	—	
Oecetis	5	—	—	1	—	—	—	—	—	—	—	—	
Molannidae													
Molana	6	—	—	—	—	—	—	—	—	—	—	—	
Calamoceratidae													
Heteroplectron	3	—	—	—	—	—	—	—	—	—	—	—	
Odontoceridae													
Pulotren	0	—	—	2	—	—	2	2	—	—	—	—	
LEPIDOPTERA	5	—	—	—	—	—	—	—	—	—	—	—	

Taxonomy	Tolerance score	Unnamed Tributary to Manada Creek near Manada Gap, Pa.				Tributary along Horseshoe Trail to Manada Creek at Manada Gap, Pa.				Unnamed Tributary to Manada Creek at Rt 443 near Manada Gap, Pa.			
		8/12/02	8/5/03	7/28/04	8/9/05	8/1/02	8/13/03	8/6/04	8/9/05	8/14/02	8/6/03	8/6/04	8/16/05
Tortricidae													
Archips	5	—	—	—	—	—	—	—	—	—	—	—	—
DIPTERA (red non-midges, purple midges)	6	—	—	—	—	—	—	—	—	—	—	—	—
Caratopogonidae	6	—	—	—	—	—	—	—	—	—	—	—	—
Atrichopogon	6	—	—	—	—	—	—	—	—	—	—	—	—
Probenzia	6	—	—	—	—	—	1	—	—	—	—	—	—
Bezzia/Palponyia	6	—	—	—	—	—	—	—	—	—	—	—	—
Chironomidae													
Tanyptodinae	7	—	—	—	1	—	—	—	—	—	—	—	1
Macropelopiini	6	—	—	1	—	—	—	—	—	—	—	—	—
Brundiniella	6	—	—	—	—	—	—	—	—	—	—	—	—
Macropelopia	6	—	—	—	—	—	—	—	—	—	—	—	—
Natarini													
Nataria	8	—	—	—	—	—	—	—	1	—	—	—	—
Psittacurini													
Ablabomyia	8	—	—	—	—	—	—	—	—	—	—	—	—
Conchapelopia	6	—	—	—	—	—	—	—	1	—	—	—	—
Nilotanyptus	6	—	—	—	—	—	—	—	—	—	—	—	—
Paramerina	6	—	—	—	—	—	—	—	—	—	—	—	—
Rheopelopia	4	—	—	—	1	—	—	—	1	1	—	3	—
Thienemannimyia gr.	6	5	2	6	1	—	1	—	3	—	2	—	—
Zavrelimyia	8	—	—	—	—	—	—	—	—	—	—	—	—
Diamocini													
Diamocia	5	—	—	—	—	—	—	—	—	—	6	—	1
Pagastia	1	—	1	—	—	—	1	—	—	—	3	—	—
Porthastia longimana	2	—	—	—	—	—	—	—	—	—	—	—	—
Orthocladinae	5	—	—	—	1	—	—	1	1	—	—	—	—
Corynoneurini													
Corynoneura	4	—	1	—	—	—	—	—	—	—	—	—	—
Thienemannella	6	—	—	—	—	—	—	—	—	—	—	—	—
Orthocladini	5	—	—	—	—	—	—	—	—	—	—	—	—
Brillia	5	—	—	—	—	—	—	—	—	—	—	—	—
Brillia flaviformis	5	—	—	—	—	—	—	—	—	—	—	—	—
Cricotopus	7	—	—	—	2	—	—	—	—	—	—	—	—
Cricotopus/Orthocladus	7	—	—	—	—	—	—	—	—	—	—	—	—
Cricotopus bicinctus	7	—	1	2	—	—	—	—	—	—	—	—	—
Cricotopus vierniensis	7	—	—	—	—	—	—	1	—	—	—	—	—
Diplocladus	8	—	—	—	—	—	—	—	—	—	—	—	—
Eukiefferiella	4	—	1	—	31	—	—	—	1	—	—	4	—
Eukiefferiella brahmi gr.	4	—	2	—	—	—	—	—	—	—	—	—	—
Eukiefferiella claripennis	8	—	—	—	—	—	—	—	—	—	—	—	—
Eukiefferiella devonica gr.	4	—	—	—	—	—	—	1	—	—	—	—	—
Eukiefferiella pseudomontana gr.	8	—	—	—	1	—	—	—	—	—	—	—	—
Heleniella	3	—	1	—	—	—	—	—	—	—	—	—	—
Heterotrissocladus marcidus gr.	4	—	—	—	—	—	—	—	—	—	—	—	—
Kwanosmia	1	—	—	1	—	—	—	—	—	—	—	—	—
Limnophyes	8	—	—	—	—	—	—	—	—	—	—	—	—
Nanocladus	7	1	—	—	—	1	—	—	—	—	—	—	1

Taxonomy	Tolerance score	Unnamed Tributary to Manada Creek near Manada Gap, Pa.				Tributary along Horseshoe Trail to Manada Creek at Manada Gap, Pa.				Unnamed Tributary to Manada Creek at Rt 443 near Manada Gap, Pa.			
		8/12/02	8/5/03	7/28/04	8/9/05	8/1/02	8/13/03	8/6/04	8/9/05	8/14/02	8/6/03	8/6/04	8/16/05
<i>Orthocladus lignicola</i>	6	—	—	—	—	—	—	2	5	—	—	1	—
<i>Parachaetocladus</i>	2	—	—	—	2	—	—	—	—	—	—	—	—
<i>Paracricotopus</i>	4	—	—	—	—	—	—	—	—	—	—	—	—
<i>Parametriconeus</i>	5	2	1	9	—	—	1	1	2	—	1	2	—
<i>Rheocricotopus</i>	6	—	—	—	—	—	—	—	—	—	—	—	—
<i>Rheocricotopus robacki</i>	5	—	—	—	—	—	—	—	—	—	—	—	—
<i>Tvstania bavaria</i> gr.	4	—	—	8	1	2	1	2	—	1	4	3	—
<i>Xylotopus</i> par	2	—	—	—	—	—	—	—	—	—	—	—	—
Chironominae	5	—	—	—	1	—	—	—	—	—	—	—	—
Chironomini													
<i>Chironomus</i>	10	—	—	—	—	—	—	—	—	—	—	—	—
<i>Cryptochironomus</i>	8	—	—	—	—	—	—	—	—	—	—	—	—
<i>Glyptotendipes</i>	10	—	—	—	—	—	—	—	—	—	—	—	—
<i>Microtendipes pedellus</i> gr.	6	—	—	—	—	—	—	—	1	—	—	—	—
<i>Microtendipes rydalsensis</i> gr.	4	—	—	—	—	—	—	—	—	—	—	—	1
<i>Paralautschornella</i>	8	—	—	—	—	—	—	—	—	—	—	—	—
<i>Paratendipes albimanus</i>	6	—	—	—	—	—	—	—	—	—	—	—	—
<i>Phaenopsectra</i>	7	—	—	—	—	—	—	—	—	—	—	—	1
<i>Polypedihum</i>	6	—	—	—	1	4	—	1	1	—	—	—	—
<i>Polypedihum aviceps</i>	4	—	3	3	6	—	1	2	13	—	5	—	—
<i>Polypedihum fallax</i>	6	—	—	1	—	—	—	—	—	—	—	—	—
<i>Polypedihum flavum</i>	6	—	—	—	—	—	—	—	—	—	—	—	—
<i>Polypedihum illinoense</i>	7	—	—	—	—	—	—	—	—	—	—	—	—
<i>Polypedihum laetum</i>	6	—	—	—	—	—	—	—	—	—	—	—	—
<i>Polypedihum scalaeorum</i>	6	—	—	—	—	—	—	—	—	—	—	—	—
<i>Polypedihum tritum</i>	6	—	—	1	—	—	—	—	—	—	—	—	—
<i>Stenochironomus</i>	5	—	—	—	—	—	—	—	—	—	—	—	—
<i>Stictochironomus</i>	9	—	—	—	—	—	1	—	—	—	—	—	—
<i>Tribelos</i>	7	—	—	—	—	—	—	—	—	—	—	—	—
Tanytarini	5	—	—	—	—	—	—	—	—	—	—	—	—
<i>Cladotanytarus</i>	5	1	—	1	5	—	—	—	1	—	—	—	1
<i>Micropsectra</i>	7	5	3	—	—	2	6	—	—	1	—	3	17
<i>Micropsectra</i> sp. A	7	—	—	—	—	—	—	—	—	—	—	—	—
<i>Paratanytarus</i>	6	—	—	1	—	—	—	—	—	—	—	—	—
<i>Rheotanytarus</i>	6	9	—	—	14	5	—	—	5	2	—	—	—
<i>Rheotanytarus exiguus</i> gr.	6	5	3	2	—	3	8	1	—	—	18	2	—
<i>Rheotanytarus pallidus</i>	4	—	—	—	—	—	—	—	—	—	1	1	—
<i>Stempellina</i>	2	—	—	—	—	—	—	—	—	—	—	—	—
<i>Stempellina</i> sp. C	4	—	1	—	—	—	—	—	—	—	—	—	—
<i>Stempellinella</i>	4	5	13	10	10	1	—	—	5	—	2	—	1
<i>Subletta coffinani</i>	4	—	3	—	—	—	—	—	—	—	—	—	—
<i>Tanytarus</i>	6	—	—	2	28	1	1	1	18	—	1	—	2
<i>Zavrelia</i>	4	—	—	—	—	—	—	—	—	—	—	—	—
Dixidae													
<i>Dixa</i>	1	—	—	—	—	—	—	—	—	—	—	—	—
Simuliidae													
<i>Simulium</i>	5	—	1	3	—	—	1	—	—	—	—	2	—
Tipulidae	4	—	—	—	—	—	—	—	—	—	—	—	—

Taxonomy	Tolerance score	Unnamed Tributary to Manada Creek near Manada Gap, Pa.				Tributary along Horseshoe Trail to Manada Creek at Manada Gap, Pa.				Unnamed Tributary to Manada Creek at Rt 443 near Manada Gap, Pa.			
		8/12/02	8/5/03	7/28/04	8/9/05	8/1/02	8/13/03	8/6/04	8/9/05	8/14/02	8/6/03	8/6/04	8/16/05
Tipula	6	—	—	—	—	—	—	—	—	1	—	—	—
Antocha	3	1	—	1	1	1	—	1	—	—	2	2	5
Dicranota	3	1	—	—	—	—	3	—	—	—	—	—	—
Hexatoma	2	—	1	—	—	—	—	2	1	—	—	—	—
Limnophila	3	—	—	—	—	—	—	—	—	—	—	—	—
Limonia	6	—	—	—	—	—	—	—	—	—	—	—	—
Molophilus	4	—	—	—	—	—	—	—	—	—	—	—	—
Pilaria	7	—	—	—	—	—	1	—	—	—	—	—	—
Athericidae													
Atherix	4	—	—	—	—	—	—	—	—	—	—	—	—
Empididae	6	—	—	—	—	—	—	1	—	—	—	—	—
Chelifera	6	—	—	—	—	1	2	1	—	—	3	2	—
Climocera	6	—	—	—	—	—	—	—	1	—	—	—	—
Hemerodromia	6	—	—	—	1	—	—	—	1	—	—	—	1
Stratiomyidae	7	—	—	—	—	—	—	—	1	—	—	—	—
Tabanidae													
Chrysops	5	1	1	1	—	—	—	—	—	—	—	—	—
Ephydriidae	6	—	—	—	—	—	—	1	—	—	—	—	—
Psychodidae	10	—	—	—	—	—	—	—	—	—	—	—	—
Total taxa		31	33	46	38	26	35	37	43	26	31	34	33
Total number		103	93	226	184	102	111	127	134	107	141	282	145
Percent dominant taxa (single)		15	24	35	45	17	13	14	20	32	13	43	18
Total EPT Taxa		12	9	17	11	12	11	12	15	9	10	14	11
Total EPT		46	20	71	23	69	59	74	55	72	51	78	72
Percent EPT		44.66	21.51	31.42	11.96	67.65	53.15	58.27	41.04	67.29	36.17	27.66	49.66
HBI		4.55	3.82	3.15	4.39	3.27	2.64	2.8	4.44	3.22	3.89	5.4	4.44
Number Chironomidae taxa		8	14	14	16	8	9	10	15	4	10	8	9
Percent Chironomidae		32.04	38.71	21.24	57.61	18.63	18.92	10.24	44.03	4.67	30.50	6.74	17.93

Attachment III. DCCD Macroinvertebrate Data, Coldwater Conservation Plan

Project:	Manada Coldwater Heritage Plan				
Sample ID:	MNDA 07.12	Metrics	OB (observed value)	SV (Standardized value)	CorrectSV
		HBI=	2.231818182	0.957852259	95.78522587
Collection Date:	4/23/2014	Total Taxa =	20	0.606060606	60.60606061
Collector(s):	MWB	Becks 3=	10	0.263157895	26.31578947
Subsample					
Target:	200+/-20%	Shannon Div=	1.993825228	0.697141688	69.7141688
Subsample Size:	220	EPT Taxa (0-4)=	10	0.526315789	52.63157895
		%PTV (0-3)=	38.18181818	0.451855836	45.18558365
			IBI		58.37306789
Order (or higher)	Family	Genus	Lifestage	Count	
Coleoptera	Elmidae	Stenelmis	L	1	
Coleoptera	Elmidae		A	1	
Coleoptera	Psephenidae	Psephenus	L	32	
Diptera	Chironomidae		L	7	
Diptera	Empididae			1	
Diptera	Simuliidae			1	
Ephemeroptera	Baetidae	Acentrella	L	1	
Ephemeroptera	Ephemerellidae	Drunella	L	4	
Ephemeroptera	Ephemerellidae	Ephemerella	L	18	
Ephemeroptera	Ephemeridae	Ephemera		2	
Ephemeroptera	Heptageniidae	Maccaffertium		66	
Ephemeroptera	Heptageniidae	Stenacron	L	1	
Ephemeroptera	Isonychiidae	Isonychia	L	54	
Megaloptera	Corydalidae	Corydalus		1	
Odonata	Zygoptera			1	
Plecoptera	Perlidae	Acroneuria	L	2	
Trichoptera	Hydropsychidae	Cheumatopsyche	L	13	
Trichoptera	Hydropsychidae	Hydropsyche	L	5	
Trichoptera	Philopotamidae	Chimarra	L	5	
Trichoptera	Rhyacophilidae	Rhyacophila	L	4	
				Total:	220

Project:	Manada Coldwater Heritage Plan				
Sample ID:	MNDA 08.72	Metrics	OB (observed value)	SV (Standardized value)	CorrectSV
		HBI=	2.668604651	0.903994494	90.39944943
Collection Date:	4/23/2014	Total Taxa =	20	0.606060606	60.60606061
Collector(s):	MWB	Becks 3=	12	0.315789474	31.57894737
Subsample Target:	200+/-20%	Shannon Div=	2.29875605	0.803760857	80.37608565
Subsample Size:	172	EPT Taxa (0-4)=	9	0.473684211	47.36842105
% of Sample Picked:		%PTV (0-3)=	36.62790698	0.433466355	43.34663548
		IBI			58.94593326
Order (or higher)	Family	Genus	Lifestage	Count	
Coleoptera	Elmidae	Stenelmis	L	14	
Coleoptera	Psephenidae	Psephenus	L	39	
Diptera	Chironomidae		L	3	
Diptera	Simuliidae			2	
Diptera	Tipulidae	Antocha	L	2	
Diptera	Tipulidae	Dicranota	L	4	
Diptera			P	5	
Ephemeroptera	Baetidae		L	1	
Ephemeroptera	Ephemerellidae	Drunella	L	18	
Ephemeroptera	Ephemerellidae	Ephemerella	L	23	
Ephemeroptera	Heptageniidae	Maccaffertium		16	
Ephemeroptera	Isonychiidae	Isonychia	L	6	
Odonata	Gomphidae			1	
Plecoptera	Chloroperlidae			5	
Plecoptera	Perlidae	Acroneuria	L	3	
Trichoptera	Hydropsychidae	Cheumatopsyche	L	14	
Trichoptera	Hydropsychidae	Hydropsyche	L	12	
Trichoptera	Philopotamidae	Chimarra	L	2	
Trichoptera	Psychomyiidae	Psychomyia		1	
Cambaridae				1	
			Total:		172

Project:	Manada Coldwater Heritage Plan				
	MNDA				
Sample ID:	10.17(2014)				
		Metrics	OB (observed value)	SV (Standardized value)	CorrectSV
Collection Date:	4/23/2014	HBI=	2.31884058	0.947122	94.7122
					72.7272727
Collector(s):	MWB	Total Taxa =	24	0.727272727	3
Subsample Target:	200+/-20%	Becks 3=	16	0.421052632	42.1052631
					6
Subsample Size:	207	Shannon Div=	2.47957484	0.86698421	86.6984209
					7

% of Sample Picked:	EPT Taxa (0-4)=	13	0.684210526	68.4210526
Subsample Date:	%PTV (0-3)=	54.10628019	0.640311008	64.0311008
				71.4492183
		IBI		9
Order (or higher)	Family	Genus	Lifestage	Count
Coleoptera	Elmidae	<i>Optioservus</i>	A	3
Coleoptera	Elmidae	<i>Stenelmis</i>	L	1
Coleoptera	Psephenidae	<i>Psephenus</i>	L	13
Diptera	Chironomidae		L	12
Diptera	Empididae			5
Diptera	Simuliidae			10
Diptera	Tipulidae	<i>Antocha</i>	L	18
Diptera			P	9
Ephemeroptera	Baetidae	<i>Acentrella</i>	L	1
Ephemeroptera	Ephemerellidae	<i>Drunella</i>	L	37
Ephemeroptera	Ephemerellidae	<i>Ephemerella</i>	L	14
Ephemeroptera	Heptageniidae	<i>Epeorus</i>	L	1
Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>		11
Ephemeroptera	Isonychiidae	<i>Isonychia</i>	L	6
Ephemeroptera	Leptophlebiidae		L	1
Megaloptera	Corydalidae	<i>Nigronia</i>	L	4
Plecoptera	Perlidae	<i>Acroneuria</i>	L	7
Plecoptera	Perlodidae	<i>Isoperla</i>	L	5
Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	L	20
Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	L	9
Trichoptera	Philopotamidae	<i>Chimarra</i>	L	1
Trichoptera	Psychomyiidae	<i>Psychomyia</i>		1
Trichoptera	Rhyacophilidae	<i>Rhyacophila</i>	L	17
Trichoptera	Uenoidae	<i>Neophylax</i>	L	1
			Total:	207

Project:	Manada Coldwater Heritage Plan				
Sample ID:	MNDA 11.65				
Collection Date:	4/23/2014	Metrics	OB (observed value)	SV (Standardized value)	CorrectSV
Collector(s):	MWB	HBI=	2.056338028	0.979489762	97.94897622
Subsample Target:	200+/-20%	Total Taxa =	27	0.818181818	81.81818182
		Becks 3=	19	0.5	50

Subsample						
Size:	213	Shannon Div=	2.644087221	0.924506021	92.45060213	
		EPT Taxa (0-4)=	12	0.631578947	63.15789474	
		%PTV (0-3)=	59.62441315	0.705614357	70.56143568	
			IBI			75.9895151
Order (or higher)	Family	Genus	Lifestage	Count		
Coleoptera	Elmidae	<i>Optioservus</i>	A		3	
Coleoptera	Elmidae	<i>Stenelmis</i>	L		5	
Coleoptera	Psephenidae	<i>Psephenus</i>	L		13	
Coleoptera	Ptilodactylidae	<i>Anchytarsus</i>	L		1	
Diptera	Chironomidae		L		12	
Diptera	Simuliidae				1	
Diptera	Tipulidae	<i>Antocha</i>	L		1	
Diptera	Tipulidae	<i>Hexatoma</i>	L		2	
Ephemeroptera	Baetidae		L		2	
Ephemeroptera	Ephemerellidae	<i>Drunella</i>	L		22	
Ephemeroptera	Ephemerellidae	<i>Ephemerella</i>	L		15	
Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>			27	
Ephemeroptera	Heptageniidae	<i>Stenacron</i>	L		1	
Ephemeroptera	Isonychiidae	<i>Isonychia</i>	L		10	
Megaloptera	Corydalidae	<i>Nigronia</i>	L		9	
Megaloptera	Sialidae	<i>Sialis</i>			1	
Odonata	Gomphidae				2	
Plecoptera	Chloroperlidae				1	
Plecoptera	Perlidae	<i>Acroneuria</i>	L		18	
Plecoptera	Perlodidae	<i>Isoperla</i>	L		40	
Plecoptera	Pteronarcyidae	<i>Pteronarcys</i>	L		1	
Plecoptera					1	
Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	L		8	
Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	L		8	
Trichoptera	Philopotamidae	<i>Chimarra</i>	L		1	
Trichoptera	Rhyacophilidae	<i>Rhyacophila</i>	L		6	
Cambaridae					1	
Oligochaeta			A		1	
				Total:		213

Project:	Manada Coldwater Heritage Plan				
Sample ID:	MNDA 13.64	Metrics	OB (observed value)	SV (Standardized value)	CorrectSV
		HBI=	1.797979798	1.011346511	101.1346511
Collection					
Date:	4/22/2014	Total Taxa =	31	0.939393939	93.93939394

Collector(s):	MWB	Becks 3=	17	0.447368421	44.73684211
Subsample					
Target:	200+/-20%	Shannon Div=	2.424388044	0.847688127	84.76881272
Subsample					
Size:	198	EPT Taxa (0-4)=	17	0.894736842	89.47368421
		%PTV (0-3)=	55.05050505	0.651485267	65.14852669
		IBI			79.86698512
Order (or higher)	Family	Genus	Lifestage		
Insects					
Coleoptera	Elmidae	<i>Optioservus</i>	L		2
Coleoptera	Elmidae	<i>Stenelmis</i>	L		11
Coleoptera	Elmidae		A		21
Coleoptera	Psephenidae	<i>Psephenus</i>	L		21
Diptera	Chironomidae		L		4
Diptera	Simuliidae				7
Diptera	Tipulidae	<i>Antocha</i>	L		3
Diptera	Tipulidae	<i>Dicranota</i>	L		2
Ephemeroptera	Baetidae	<i>Acerpenna</i>			1
Ephemeroptera	Baetidae		L		1
Ephemeroptera	Ephemerellidae	<i>Drunella</i>	L		29
Ephemeroptera	Ephemerellidae	<i>Ephemerella</i>	L		30
Ephemeroptera	Ephemerellidae	<i>Eurylophella</i>	L		1
Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>			8
Ephemeroptera	Isonychiidae	<i>Isonychia</i>	L		1
Ephemeroptera	Leptophlebiidae		L		2
Megaloptera	Corydalidae	<i>Nigronia</i>	L		3
Megaloptera	Sialidae	<i>Sialis</i>			1
Odonata	Gomphidae				1
Plecoptera	Chloroperlidae				9
Plecoptera	Nemouridae	<i>Amphinemura</i>	L		2
Plecoptera	Perlidae	<i>Acroneuria</i>	L		16
Plecoptera	Perlodidae	<i>Isoperla</i>	L		7
Plecoptera					1
Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	L		4
Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	L		3
Trichoptera	Hydropsychidae		L		1
Trichoptera	Philopotamidae	<i>Chimarra</i>	L		2
	Psychomyiidae				2
Trichoptera	Rhyacophilidae	<i>Rhyacophila</i>	L		1
Trichoptera	Uenoidae	<i>Neophylax</i>	L		1
Total:					
198					

Project:	Manada Coldwater Heritage Plan				
Sample ID:	UMNA 00.01				
		Metrics	OB (observed value)	SV (Standardized value)	CorrectSV
Collection Date:	4/23/2014	HBI=	3.126506024	0.847533166	84.7533166
Collector(s):	MWB	Total Taxa =	22	0.666666667	66.66666667
Subsample Target:	200+/-20%	Becks 3=	10	0.263157895	26.31578947
Subsample Size:	166	Shannon Div=	2.457270619	0.859185531	85.91855311
		EPT Taxa (0-4)=	8	0.421052632	42.10526316
		%PTV (0-3)=	22.28915663	0.263777001	26.37770015
			IBI		55.35621486
Order (or higher)	Family	Genus	Lifestage	Count	
Insects					
Coleoptera	Elmidae	Optioservus	L	1	
Coleoptera	Elmidae	Stenelmis	L	1	
Coleoptera	Psephenidae	Psephenus	L	34	
Coleoptera	Ptilodactylidae	Anchytarsus	L	3	
Diptera	Chironomidae		L	10	
Diptera	Empididae			2	
Diptera	Tipulidae	Antocha	L	2	
Diptera	Tipulidae	Tipula	L	2	
Diptera	Tipulidae		L	1	
Ephemeroptera	Ephemerellidae	Ephemerella	L	3	
Ephemeroptera	Ephemerellidae	Eurylophella	L	1	
Ephemeroptera	Ephemeridae	Ephemera		4	
Ephemeroptera	Heptageniidae	Maccaffertium		24	
Lepidoptera				1	
Megaloptera	Corydalidae	Nigronia	L	15	
Plecoptera	Perlidae	Acroneuria	L	2	
Plecoptera	Perlodidae	Isoperla	L	4	
Trichoptera	Hydropsychidae	Cheumatopsyche	L	22	
Trichoptera	Hydropsychidae	Hydropsyche	L	18	
Trichoptera	Philopotamidae	Chimarra	L	8	
Trichoptera	Rhyacophilidae	Rhyacophila	L	6	
Cambaridae				1	
Oligochaeta			A	1	
				Total:	166

Attachment IV. Data sheets from the Fish Surveys led by DEP, 7/23/2014

Unassessed Waters Surveys - 2014

Survey Leader: Miller Sci Collector Permit # 0470 Sample Date 7/23/14
 Water Name: Manada Creek Mouth Latitude: N40.30479
 Tributary to: Swatara Creek Mouth Longitude: W -76.66817

Site Latitude: N 40.36458 Site Longitude: W -76.70849

Site Length: 100 m Widths: _____
 (meters) (meters)
 Site Location: DWS Manada Bottom Rd above Intersite 81 Avg 10 m

Gear Used: Pulsed DC: 250 volts
 Straight DC: _____ volts
 Other (specify): _____ Sampling Effort (min): 21:30

Size Group	Species: Number Caught:			Species: Number Caught:			Species Occurrence:
	Pass 1	Pass 2	Pass 3	Pass 1	Pass 2	Pass 3	
25 - 49 mm							Rock Bass - P
50 - 74 mm							Fall fish - C
75 - 99 mm							Cutlips - P
100 - 124 mm							Smallmouth - P
125 - 149 mm							Marginal madtom - P
150 - 174 mm							White Sucker - C
175 - 199 mm							No. Hognose Sucker - P
200 - 224 mm							Longnose dace - C
225 - 249 mm							Btk nose dace - A
250 - 274 mm							
275 - 299 mm							
300 - 324 mm							

Time of Day: 0900 Water Temp: 18 °C pH: _____
Electrometric
Colorimetric

Tot Alk: _____ mg/l Tot Hard: _____ mg/l Spec Cond: _____ umhos
Electrometric Electrometric Colorimetric

Comments: No meter available for water quality parameter measurements.

Unassessed Waters Surveys - 2014

Survey Leader: Miller Sci Collector Permit # 0470 Sample Date 7/23/14
 Water Name: Magrada Creek Mouth Latitude: N. 40.30479
 Tributary to: Swatura Creek Mouth Longitude: W -76.66817

Site Latitude: 40°22'17.1" Site Longitude: -76°42'20.7"
40.371417 -76.70575

Site Length: 100m Widths: _____
 (meters) (meters)
 Site Location: DWS from Cliff Rd + Rabbit Ln (TS17) Avg 7m
DWS from pipeline

Gear Used: Pulsed DC: 250 volts
 Straight DC: _____ volts
 Other (specify): _____ Sampling Effort (min): 29:31

Size Group	Species: <u>BNT</u> Number Caught:			Species: Number Caught:			Species Occurrence:
	Pass 1	Pass 2	Pass 3	Pass 1	Pass 2	Pass 3	
25 - 49 mm							Blk Dace - C Cottlip Minnow - P Brown Trout - R Rock Bass - P River Chub - P Madtom - P Long Nose Dace - P Stoneroller - P Blue Gill - P
50 - 74 mm							
75 - 99 mm							
100 - 124 mm							
125 - 149 mm							
150 - 174 mm	1						
175 - 199 mm							
200 - 224 mm							
225 - 249 mm							
250 - 274 mm							
275 - 299 mm							
300 - 324 mm							

Time of Day: 10:15 Water Temp: 18 °C pH: _____
Electrometric
Colometric
 Tot Alk: _____ mg/l Tot Hard: _____ mg/l Spec Cond: _____ umhos
Electrometric
Colometric Electrometric
Colometric

Comments: Water Flow: low water clarity - clear
silt covering most of rocks
No meter available for water chemistry measurements

Unassessed Waters Surveys - 2014

Survey Leader: Miller Scl Collector Permit #: 0470 Sample Date: 7/23/14
 Water Name: UNT Manada Mouth Latitude: 40.40071 N
 Tributary to: Manada Creek Mouth Longitude: -76.71435 W

Site Latitude: 40°24'09.4" Site Longitude: -76°42'51.6"
40.402611 -76.714333

Site Length: 100M Widths: _____ Avg: 2M
 (meters) (meters)
 Site Location: _____

Gear Used: Pulsed DC: 300 volts
 Straight DC: _____ volts
 Other (specify): _____ Sampling Effort (min): 21:39

Size Group	Species: <u>BNT</u> Number Caught:			Species: <u>BKT</u> Number Caught:		
	Pass 1	Pass 2	Pass 3	Pass 1	Pass 2	Pass 3
	25 - 49 mm					
50 - 74 mm	111					
75 - 99 mm						
100 - 124 mm						
125 - 149 mm						
150 - 174 mm						
175 - 199 mm				1		
200 - 224 mm						
225 - 249 mm						
250 - 274 mm						
275 - 299 mm						
300 - 324 mm						

Species Occurrence:
 Blk nose Dace - A
 Creek Chub - C
 Brown Trout - P
 Brook Trout - R
 Tesselated Darter - P
 White Sucker - C

Time of Day: 11:15 Water Temp: 17 °C pH: _____
 Electrometric
 Colorimetric
 Tot Alk: _____ mg/l Tot Hard: _____ mg/l Spec Cond: _____ umhos
 Electrometric
 Colorimetric

Comments: Sampled UPS McClam Bridge. water cloudy & clear, light sedimentation on bottom

Unassessed Waters Surveys - 2014

Survey Leader: Miller Sci Collector: 0470 Sample Date: 7/23/14
 Permit # 0470
 Water Name: West Manada Mouth Latitude: N40.40010
 Tributary to: Manada Creek Mouth Longitude: W-76.71366

Site Latitude: 40° 24' 3.3" Site Longitude: 76° 42' 56.0"
40.400917 -76.715556
 Site Length: 100m Widths: _____
 (meters) (meters)
 Site Location: Intersection MTN Rd + McLean Rd. Avg 4m

Gear Used: Pulsed DC: 300 volts
 Straight DC: _____ volts
 Other (specify): _____
 Sampling Effort (min): 14:53

Size Group	Species: <u>BNT</u> Number Caught:			Species: Number Caught:			Species Occurrence:
	Pass 1	Pass 2	Pass 3	Pass 1	Pass 2	Pass 3	
25 - 49 mm							Northern Hogsucker - P Creek Chub - C Blknose Dace - A Brown Trout - R Longnose Dace - P White Sucker - C
50 - 74 mm							
75 - 99 mm							
100 - 124 mm							
125 - 149 mm							
150 - 174 mm	<u>1</u>						
175 - 199 mm							
200 - 224 mm							
225 - 249 mm							
250 - 274 mm							
275 - 299 mm							
300 - 324 mm							

Time of Day: 1200 Water Temp: 17 °C pH: _____
 Electrometric
 Colorimetric
 Tol Alk: _____ mg/l Tol Hard: _____ mg/l Spec Cond: _____ umhos
 Electrometric
 Colorimetric
 Electrometric
 Colorimetric

Comments:

Attachment V. Macroinvertebrate Sampling Photos, Compiled by the Doc Fritchey Chapter of Trout Unlimited

Manada Creek Macroinvertebrate Survey – April 23, 2014

Doc Fritchey volunteers Doug Gray, Joe Notarangelo, Dennis Coffman and Bob Pennell assisted Megan Blackmon in the survey which is part of the Manada Creek watershed assessment project being conducted by the Dauphin County Conservation District.



Photos courtesy of Dennis Coffman